

# TEST REPORT

**Application No.:** KSCR2208001383AT  
**FCC ID:** SVN-HMC5100X  
**Applicant:** ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD.  
**Address of Applicant:** No.1199, Bin'an Road, Binjiang District, Hangzhou, P.R. China  
**Manufacturer:** ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD.  
**Address of Manufacturer:** No.1199, Bin'an Road, Binjiang District, Hangzhou, P.R. China  
**Equipment Under Test (EUT):**  
**EUT Name:** HIGH-PERFORMANCE MODULE COMPUTER  
**Model No.:** DHI-HMC5100X-H-708C2-W10A-BW, DHI-HMC5100X,  
 DH-HMC5100X#####,  
 OEM-HMC5100X#####,  
 DHI-HMC5100X#####,  
 HMC5100X#####

(The “#” symbols might consist of numbers from 0 to 9, letters from A to Z or a to z, “/”, “-”, space, and null, which indicates different sales regions, client codes, or software functions, and the product reliability and electromagnetic compatibility remain the same.)

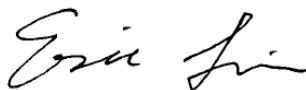
✱

Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.

**Standard(s) :** 47 CFR Part 15, Subpart C 15.247  
**Date of Receipt:** 2022-08-09  
**Date of Test:** 2022-08-15 to 2022-09-22  
**Date of Issue:** 2022-10-02

<b>Test Result:</b>	<b>Pass*</b>
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\* In the configuration tested, the EUT complied with the standards specified above.



Eric Lin  
Laboratory Manager



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Revision Record			
Version	Description	Date	Remark
00	Original	2022-10-02	/

Authorized for issue by:			
		<i>Pawn. Liu</i>	
		_____	
		<b>Pawn.Liu/Project Engineer</b>	
		<i>Eric Lin</i>	
		_____	
		<b>Eric Lin /Reviewer</b>	



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## 2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence		N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Conducted Peak Output Power		ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
20dB Bandwidth		ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Carrier Frequencies Separation		ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
Hopping Channel Number		ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Dwell Time		ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Below 1GHz		ANSI C63.10 (2013) Section 6.4,6.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Above 1GHz		ANSI C63.10 (2013) Section 6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass

There are series models mentioned in this report and they are the similar in electrical and electronic characters. Only the model DHI-HMC5100X-H-708C2-W10A-BW was tested since their differences are model number and The “#” symbols might consist of numbers from 0 to 9, letters from A to Z or a to z, “/”, “-”, space, and null, which indicates different sales regions, client codes, or software functions.



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## 4 General Information

### 4.1 Details of E.U.T.

Power supply:	DC 12V,7.5A or DC 19V,4.74A Adapter model:DPS-90AB-3 Input:100-240V,1-2A,50/60Hz Output:12V,7.5A,90W Adapter model:FSP090-DIEBN2 Input:100-240V,1.5A,50/60Hz Output:12V,4.74A
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.0 Dual mode
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	Antenna1:Dipole Antenna with RP-SMA connector
Antenna Gain:	Antenna1:4.43dBi (Provided by the manufacturer)
Test Voltage:	AC 120V/60Hz

### 4.2 Power level setting using in test:

Channel	DH	2DH	3DH
	Ant 1	Ant 1	Ant 1
1	Default	Default	Default
3	Default	Default	Default
5	Default	Default	Default

### 4.3 Environment Parameter

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Value	Temperature(°C)	Voltage(V)
NTNV	25	AC 120

Note:

NV:Normal Voltage	LV:Low Extreme Test Voltage	HV:High Extreme Test Voltage
NT:Normal Temperature	LT:Low Extreme Test Temperature	HT:High Extreme Test Temperature



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**4.4 Description of Support Units**

Description	Manufacturer	Model No.	Serial No.
Displayer	LENOVO	T2054pC	VNA246PX
Mouse	LENOVO	MS-370	512000000
Keyboard	LENOVO	SK-8827	8SSD50L80031AVLCO 5Y08DG

**4.5 Measurement Uncertainty**

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4 x 10 <sup>-8</sup>
2	Timeout	2s
3	Duty Cycle	0.37%
4	Occupied Bandwidth	3%
5	RF Conducted Power	0.6dB
6	RF Power Density	2.9dB
7	Conducted Spurious Emissions	0.75dB
8	RF Radiated Power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious Emission Test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-18GHz)
		5.4dB (Above 18GHz)
10	Temperature Test	1°C
11	Humidity Test	3%
12	Supply Voltages	1.5%
13	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



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### 4.6 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working frequency, antenna gain, cable loss, etc) is provided by the applicant. (If applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (If applicable).

### 4.7 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

#### • CNAS

Compliance Certification Services (Kunshan) Inc. is accredited by the China National Accreditation Service for Conformity Assessment (CNAS). Registration No. CNAS L4354

#### • A2LA

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

#### • FCC

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

#### • ISED

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

#### • VCCI

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

### 4.8 Deviation from Standards

None

### 4.9 Abnormalities from Standard Conditions

None



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## 5 Equipment List

Item	Equipment	Manufacturer	Model	Inventory No	Cal Date	Cal. Due Date
<b>Conducted Emission at Mains Terminals (150kHz-30MHz)</b>						
1	EMI Test Receive	R&S	ESCI	KS301101	01/22/2022	01/21/2023
2	LISN	R&S	ENV216	KS301197	01/22/2022	01/21/2023
3	LISN	Schwarzbeck	NNLK 8129	KS301091	01/22/2022	01/21/2023
4	Pulse Limiter	R&S	ESH3-Z2	KUS1902E001	01/22/2022	01/21/2023
5	CE test Cable	Thermax	/	CZ301102	11/14/2021	11/13/2022
6	Test Software	Farad	EZ-EMC	/	N.C.R	N.C.R
<b>RF Conducted Test</b>						
1	Spectrum Analyzer	Keysight	N9020A	KUS1911E004-2	08/22/2022	08/21/2023
2	Spectrum Analyzer	Keysight	N9020A	KUS2001M001-2	08/22/2022	08/21/2023
3	Spectrum Analyzer	Keysight	N9030B	KSEM021-1	01/22/2022	01/21/2023
4	Signal Generator	R&S	SMW200A	KSEM020-1	08/22/2022	08/21/2023
5	Signal Generator	Agilent	N5182A	KUS2001M001-1	08/22/2022	08/21/2023
6	Radio Communication Test Station	Anritsu	MT8000A	KSEM001-1	08/22/2022	08/21/2023
7	Radio Communication Analyzer	Anritsu	MT8821C	KSEM002-1	04/01/2022	03/31/2023
8	Universal Radio Communication Tester	R&S	CMW500	KUS1911E004-1	08/22/2022	08/21/2023
9	Switcher	CCSRF	FY562	KUS2001M001-3	08/22/2022	08/21/2023
10	AC Power Source	EXTECH	6605	KS301178	N.C.R	N.C.R
11	DC Power Supply	Aglient	E3632A	KS301180	N.C.R	N.C.R
12	Conducted Test Cable	Thermax	RF01-RF04	CZ301111-CZ301120	01/16/2022	01/15/2023
13	Temp. / Humidity Chamber	TERCHY	MHK-120AK	KS301190	04/01/2021	03/31/2023
14	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-5	04/14/2022	04/13/2023
15	Software	BST	TST-PASS	/	N/A	N/A
<b>RF Radiated Test</b>						
1	Spectrum Analyzer	R&S	FSV40	KUS1806E003	08/22/2022	08/21/2023
2	Universal Radio Communication Tester	R&S	CMW500	KSEM009-1	04/01/2022	03/31/2023
3	Signal Generator	Agilent	E8257C	KS301066	08/22/2022	08/21/2023
4	Loop Antenna	COM-POWER	AL-130R	KUS1806E001	04/13/2021	04/12/2023
5	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E005	06/29/2021	06/28/2023
6	Bilog Antenna	SCHWARZBECK	VULB9160	CZ301016	04/13/2021	04/12/2024
7	Horn-antenna(1-18GHz)	Schwarzbeck	BBHA9120D	KS301079	04/02/2022	04/01/2024
8	Horn-antenna(1-18GHz)	ETS-LINDGREN	3117	KS301186	02/22/2021	02/21/2023
9	Horn Antenna(18-40GHz)	Schwarzbeck	BBHA9170	CZ301058	03/17/2022	03/16/2023
10	Amplifier(30MHz~18GHz)	PANSHAN TECHNOLOGY	LNA:1~18G	KSEM010-1	01/22/2022	01/21/2023
11	Amplifier(18~40GHz)	COM-POWER	PAM-840A	KUS1710E001	01/22/2022	01/21/2023
12	RE Test Cable	REBES MICROWAVE	/	CZ301097	11/14/2021	11/13/2022
13	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-4	01/04/2022	31/03/2023
14	Software	Faratronic	EZ_EM-C-v 3A1	/	N/A	N/A



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## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

#### 6.1.2 Conclusion

Standard Requirement:

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, 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.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is Dipole Antenna and no consideration of replacement. The best case gain of the antenna is 4.43dBi.

Antenna location: Refer to internal photo.



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**6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence**

**6.2.1 Test Requirement:**

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

**6.2.2 Conclusion**

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom 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.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

- > Number of shift register stages: 9
- > Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits
- > Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping



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Report No.: KSCR220800138302

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frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



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## 7 Radio Spectrum Matter Test Results

### 7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207

Test Method: ANSI C63.10 (2013) Section 6.2

Limit:

Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.  
 Detector: Peak for pre-scan (9kHz resolution bandwidth) 0.15M to 30MHz

#### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C Humidity: 41.1 % RH Atmospheric Pressure: 1010 mbar

#### 7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

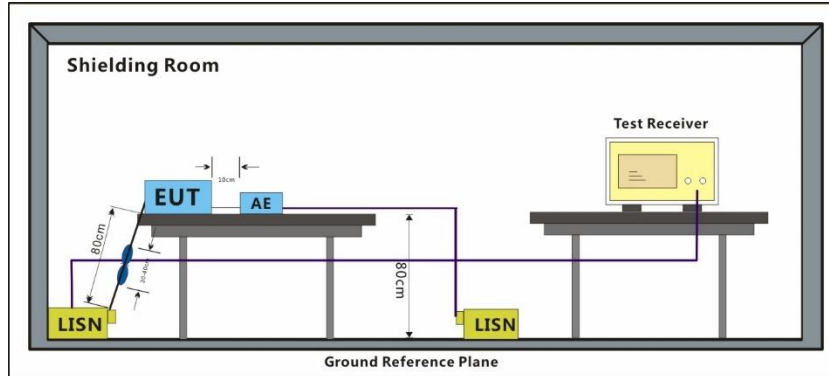


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### 7.1.3 Test Setup Diagram



### 7.1.4 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: Level=Read Level+ Cable Loss+ LISN Factor



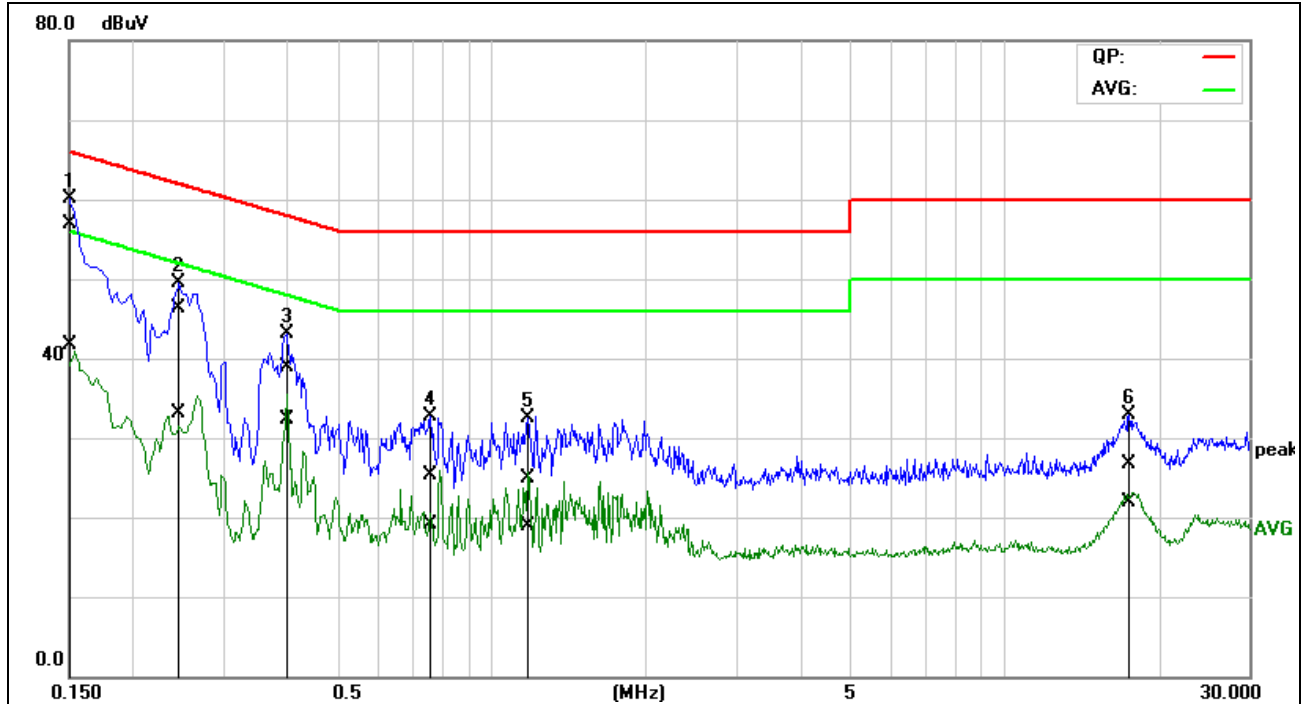
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Test Mode: 00; Line: Live line



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1*	0.1505	37.37	22.25	19.50	56.87	41.75	65.97	55.97	-9.10	-14.22	Pass
2	0.2447	26.87	13.55	19.50	46.37	33.05	61.94	51.94	-15.57	-18.89	Pass
3	0.3999	19.43	12.85	19.53	38.96	32.38	57.86	47.86	-18.90	-15.48	Pass
4	0.7622	5.81	-0.47	19.58	25.39	19.11	56.00	46.00	-30.61	-26.89	Pass
5	1.1715	5.39	-0.71	19.61	25.00	18.90	56.00	46.00	-31.00	-27.10	Pass
6	17.4867	6.48	1.66	20.29	26.77	21.95	60.00	50.00	-33.23	-28.05	Pass

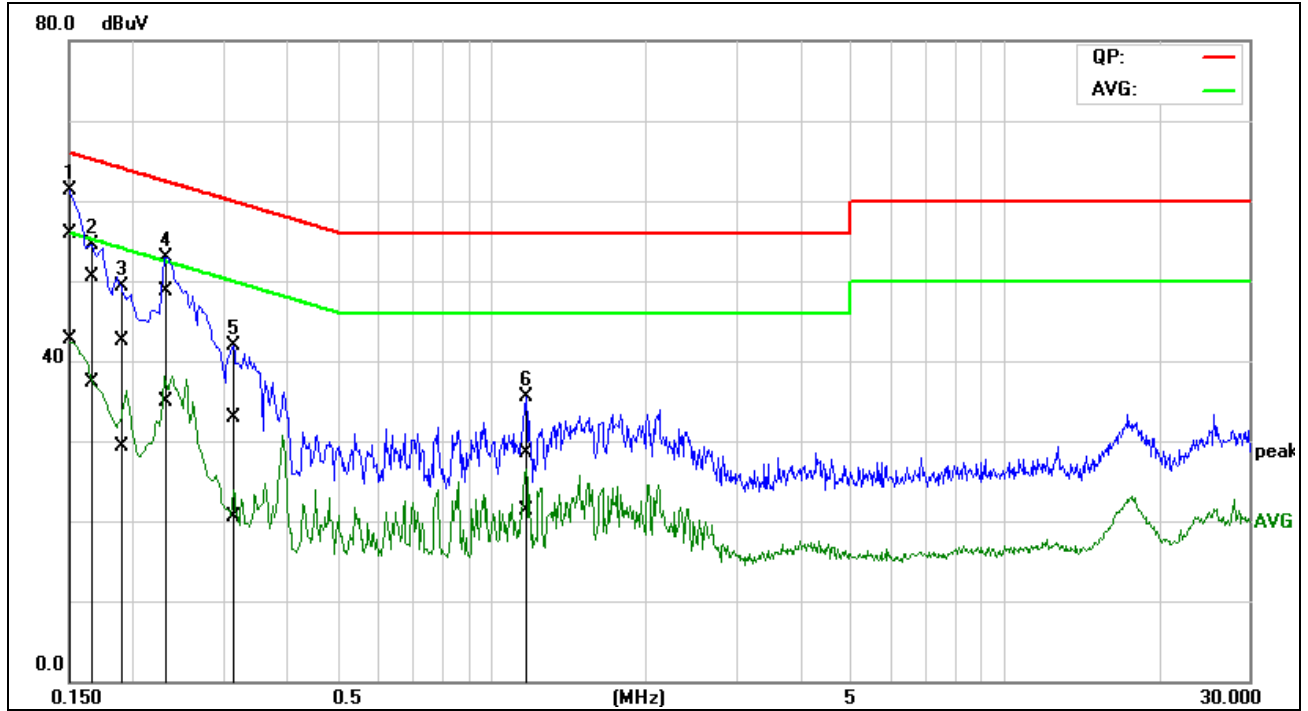


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Test Mode: 00; Line: Neutral Line



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1*	0.1500	36.47	23.16	19.48	55.95	42.64	66.00	56.00	-10.05	-13.36	Pass
2	0.1632	30.97	17.91	19.48	50.45	37.39	65.30	55.30	-14.85	-17.91	Pass
3	0.1907	22.97	9.74	19.49	42.46	29.23	64.01	54.01	-21.55	-24.78	Pass
4	0.2333	29.28	15.46	19.49	48.77	34.95	62.33	52.33	-13.56	-17.38	Pass
5	0.3134	13.41	0.98	19.50	32.91	20.48	59.88	49.88	-26.97	-29.40	Pass
6	1.1599	8.98	1.65	19.61	28.59	21.26	56.00	46.00	-27.41	-24.74	Pass



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### 7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.5

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for $\geq 50$ hopping channels
	0.25 for $25 \leq$ hopping channels $< 50$
	1 for digital modulation
2400-2483.5	1 for $\geq 75$ non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

#### 7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C

Humidity: 41.0 % RH

Atmospheric Pressure: 1010 mbar

#### 7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

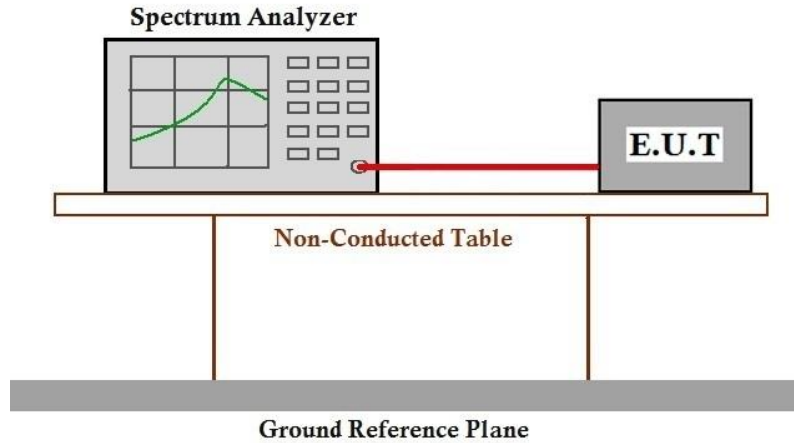


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### 7.2.3 Test Setup Diagram



### 7.2.4 Measurement Procedure and Data

Note: Since the verify power the same operating range bandwidth and smaller power can be covered by the higher power.

Please Refer to Appendix for Details



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### 7.3 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.7

#### 7.3.1 E.U.T. Operation

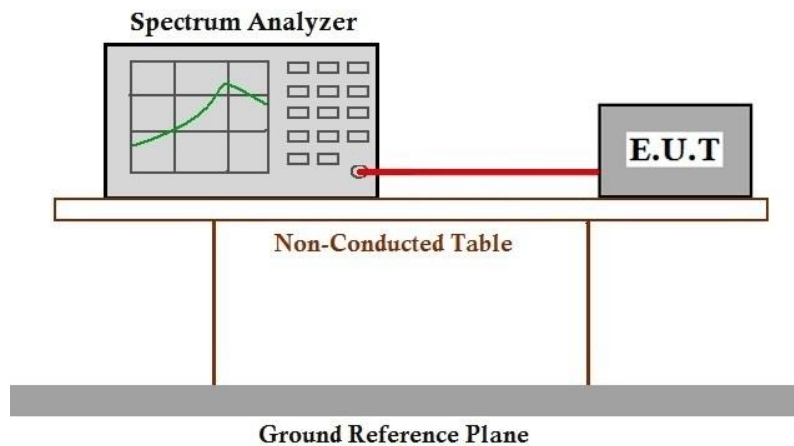
Operating Environment:

Temperature: 23.6 °C Humidity: 41.0 % RH Atmospheric Pressure: 1010 mbar

#### 7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.3.3 Test Setup Diagram



#### 7.3.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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### 7.4 Carrier Frequencies Separation

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)

Test Method: ANSI C63.10 (2013) Section 7.8.2

Limit:

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.

#### 7.4.1 E.U.T. Operation

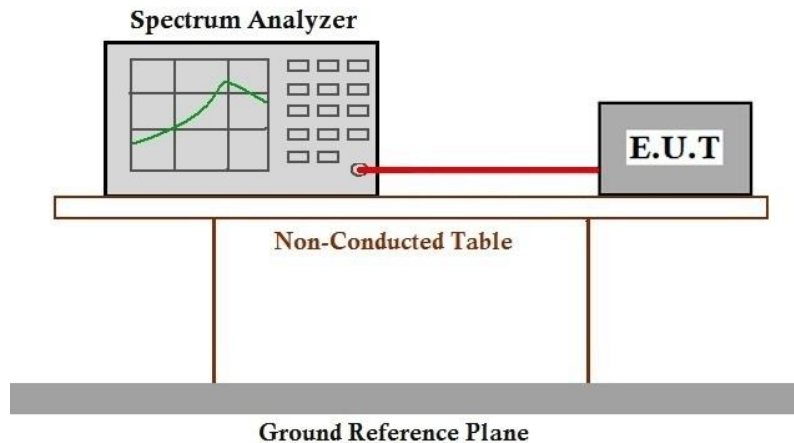
Operating Environment:

Temperature: 23.6 °C Humidity: 41.1 % RH Atmospheric Pressure: 1010 mbar

#### 7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_ Power by adapter DPS-90AB-3 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	12	TX_Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report

#### 7.4.3 Test Setup Diagram



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Report No.: KSCR220800138302

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### 7.4.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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## Compliance Certification Services (Kunshan) Inc.

Report No.: KSCR220800138302

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### 7.5 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

#### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C Humidity: 41.0 % RH Atmospheric Pressure: 1010 mbar

#### 7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_ Power by adapter DPS-90AB-3 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	12	TX_Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

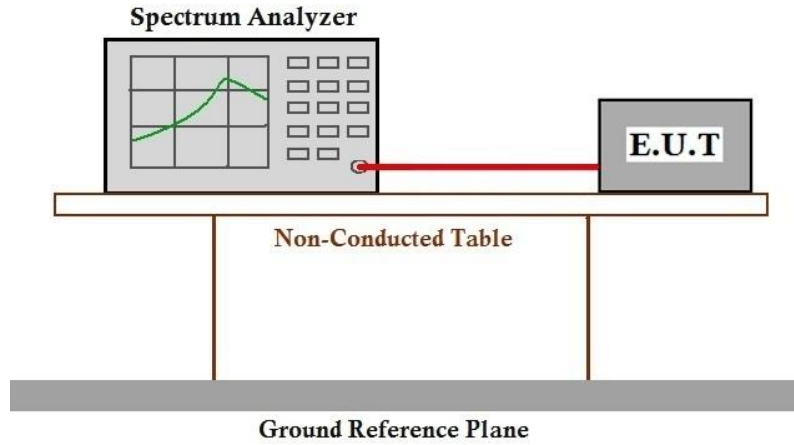


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### 7.5.3 Test Setup Diagram



### 7.5.4 Measurement Procedure and Data

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### 7.6 Dwell Time

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.4

Limit:

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period

#### 7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C Humidity: 41.0 % RH Atmospheric Pressure: 1010 mbar

#### 7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_ Power by adapter DPS-90AB-3 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	12	TX_Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report



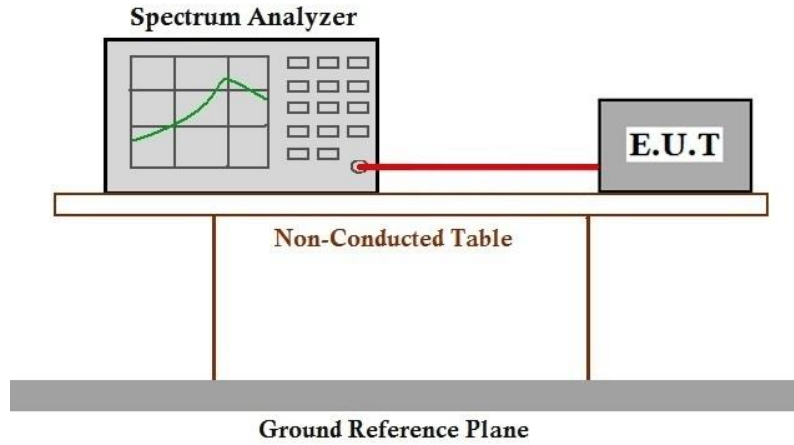
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### 7.6.3 Test Setup Diagram



### 7.6.4 Measurement Procedure and Data

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**7.7 Conducted Band Edges Measurement**

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.6

Limit:

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)).

**7.7.1 E.U.T. Operation**

Operating Environment:

Temperature: 23.6 °C Humidity: 41.0 % RH Atmospheric Pressure: 1010 mbar

**7.7.2 Test Mode Description**

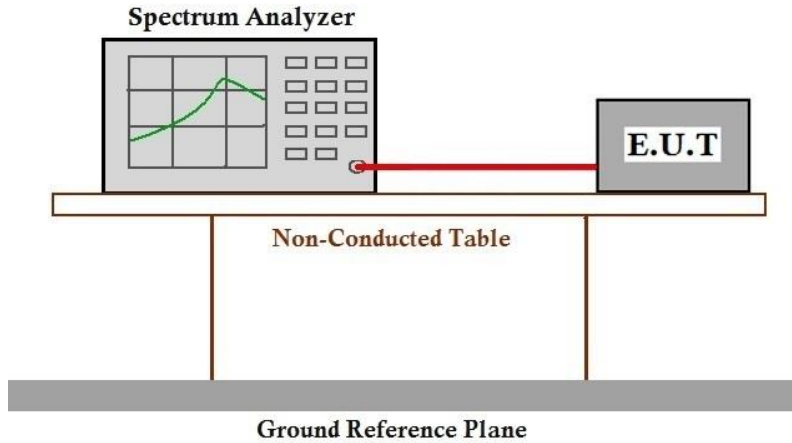
Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Final test	01	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	12	TX_Hop mode_ Power by adapter FSP090-DIEBN2 and Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.



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### 7.7.3 Test Setup Diagram



### 7.7.4 Measurement Procedure and Data

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### 7.8 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.8

Limit:

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)).

#### 7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C Humidity: 41.1 % RH Atmospheric Pressure: 1010 mbar

#### 7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.



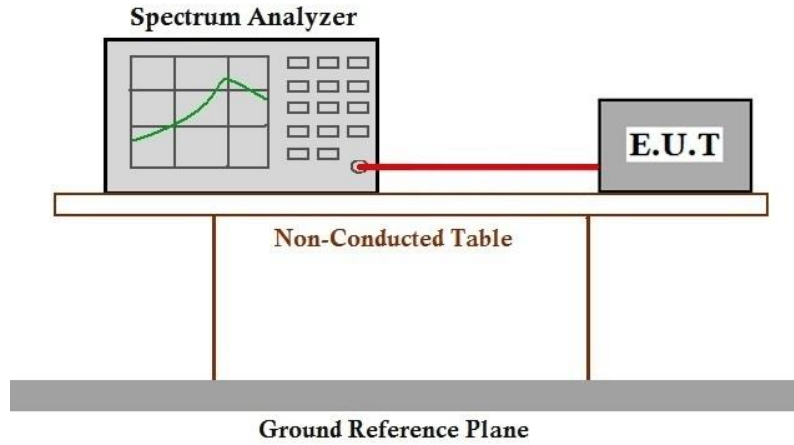
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### 7.8.3 Test Setup Diagram



### 7.8.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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 EMC Laboratory

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**7.9 Radiated Emissions which fall in the restricted bands**

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

**7.9.1 E.U.T. Operation**

Operating Environment:

Temperature: 22.8 °C Humidity: 58.3 % RH Atmospheric Pressure: 1010 mbar

**7.9.2 Test Mode Description**

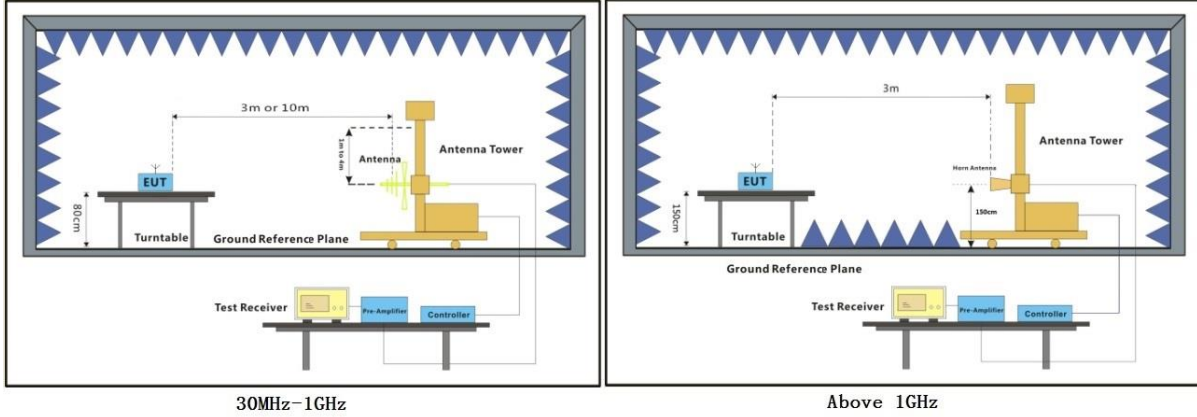
Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.



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### 7.9.3 Test Setup Diagram



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### 7.9.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



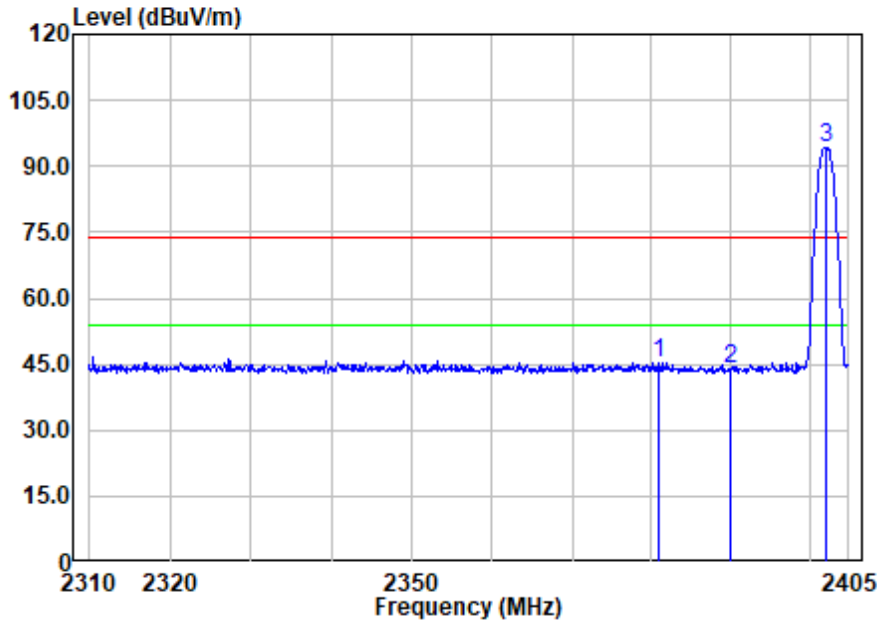
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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2380.965	0.00	42.92	56.02	45.50	74.00	-28.50	Peak
2	2390.000	0.00	42.92	54.45	43.95	74.00	-30.05	Peak
3	2402.055	0.00	42.93	104.71	94.24	74.00	20.24	Peak

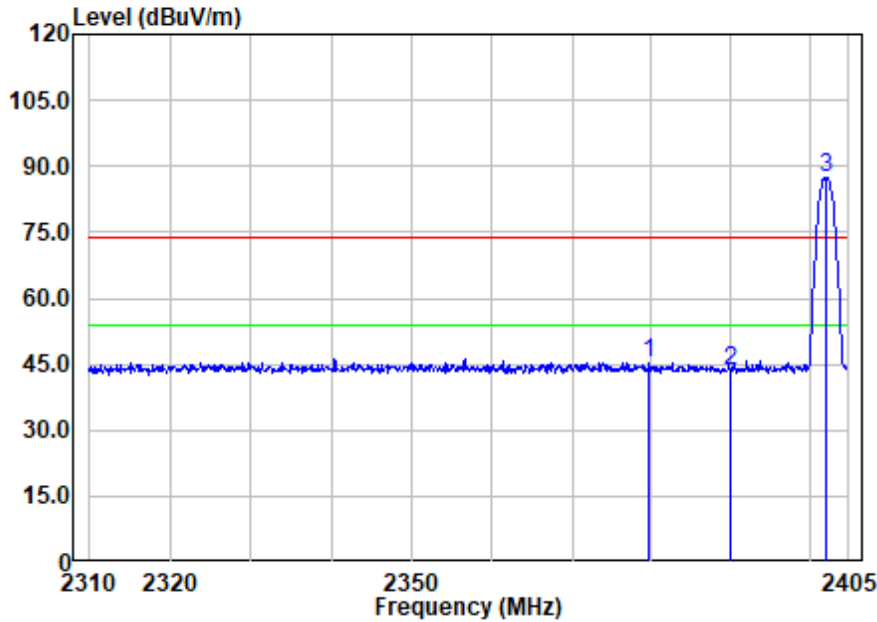


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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



	Aux Freq	Preamp Factor	Read Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	2379.730	0.00	55.92	45.39	74.00	-28.61 Peak
2	2390.000	0.00	54.19	43.69	74.00	-30.31 Peak
3	2402.150	0.00	97.77	87.30	74.00	13.30 Peak

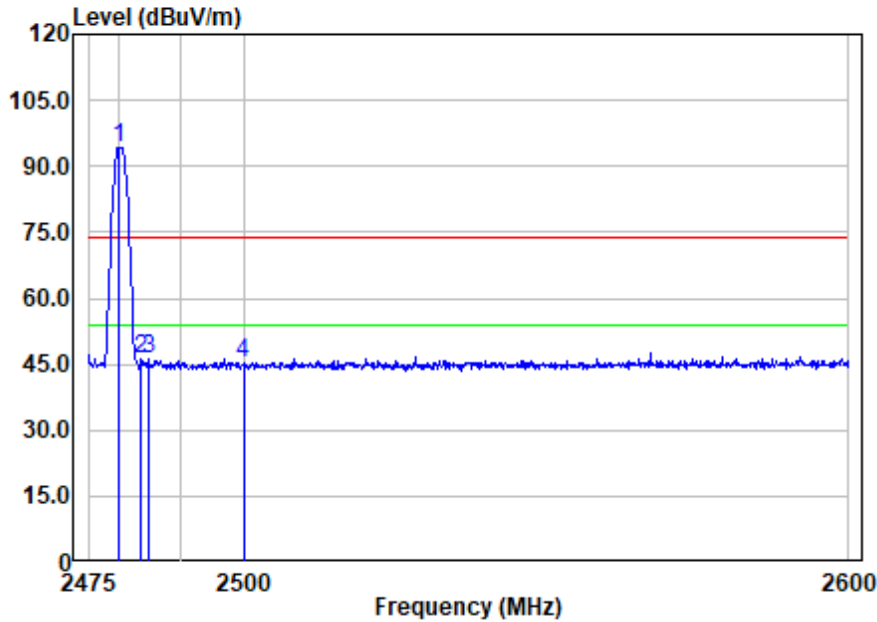


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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



	Freq	Aux Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.000	0.00	42.94	104.45	94.36	74.00	20.36	Peak
2	2483.500	0.00	42.94	56.11	46.04	74.00	-27.96	Peak
3	2484.750	0.00	42.94	56.43	46.37	74.00	-27.63	Peak
4	2500.000	0.00	42.94	55.31	45.32	74.00	-28.68	Peak

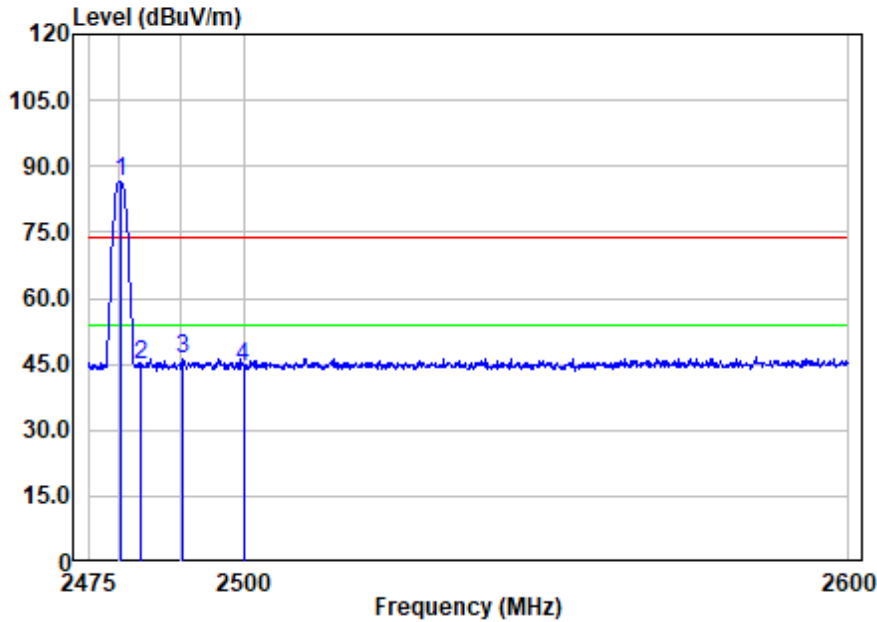


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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



	Freq	Aux Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.250	0.00	42.94	96.60	86.51	74.00	12.51	Peak
2	2483.500	0.00	42.94	54.91	44.84	74.00	-29.16	Peak
3	2490.125	0.00	42.94	56.40	46.35	74.00	-27.65	Peak
4	2500.000	0.00	42.94	54.57	44.58	74.00	-29.42	Peak



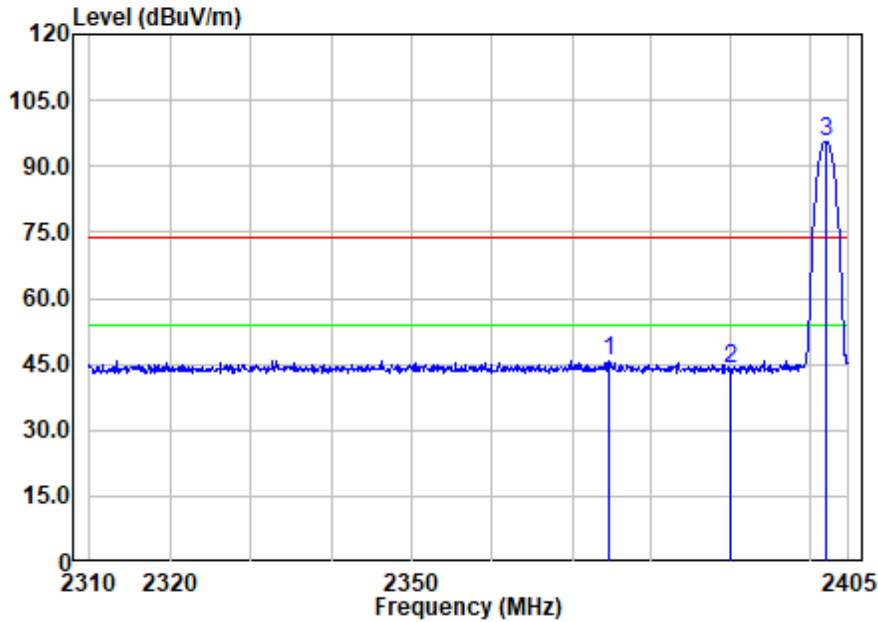
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Test Mode: 00; Polarity: Horizontal; Modulation:  $\pi/4$  DQPSK; Channel: Low



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2374.600	0.00	42.92	56.12	45.58	74.00	-28.42	Peak
2	2390.000	0.00	42.92	54.23	43.73	74.00	-30.27	Peak
3	2402.150	0.00	42.93	106.12	95.65	74.00	21.65	Peak

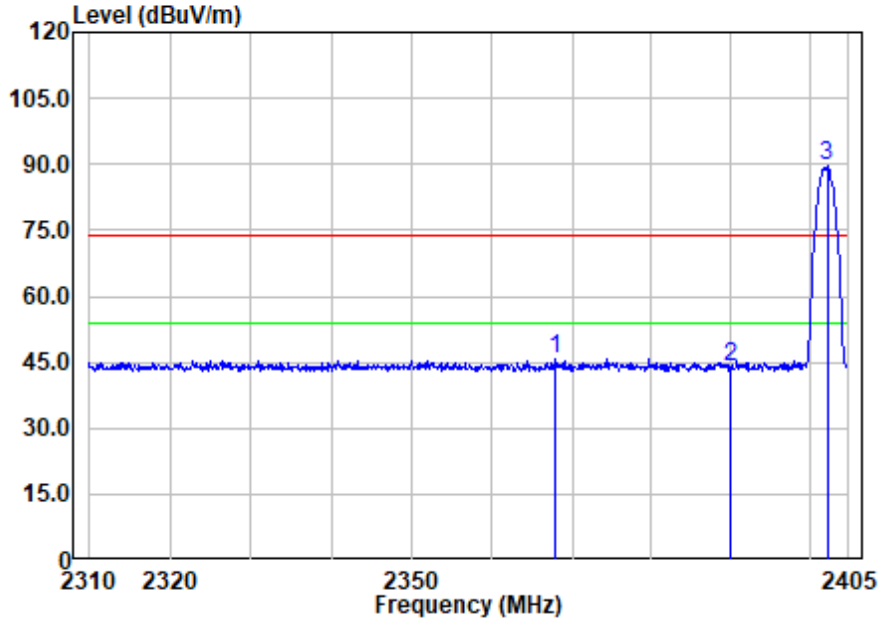


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Test Mode: 00; Polarity: Vertical; Modulation:  $\pi/4$  DQPSK; Channel: Low



	Aux Freq	Preamp Factor	Read Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	2367.855	0.00	56.30	45.75	74.00	-28.25 Peak
2	2390.000	0.00	54.46	43.96	74.00	-30.04 Peak
3	2402.245	0.00	99.96	89.49	74.00	15.49 Peak

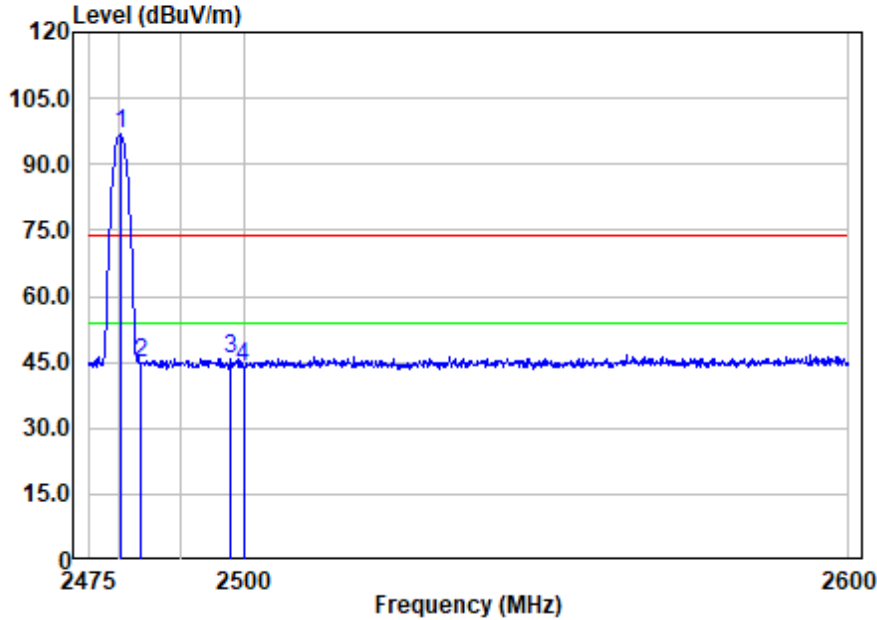


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 t(86-512)57355888 f(86-512)57370818 sgs.china@sgs.com

Test Mode: 00; Polarity: Horizontal; Modulation:  $\pi/4$  DQPSK; Channel: High



	Freq	Aux Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.125	0.00	42.94	106.78	96.69	74.00	22.69	Peak
2	2483.500	0.00	42.94	54.83	44.76	74.00	-29.24	Peak
3	2498.000	0.00	42.94	55.74	45.74	74.00	-28.26	Peak
4	2500.000	0.00	42.94	54.01	44.02	74.00	-29.98	Peak

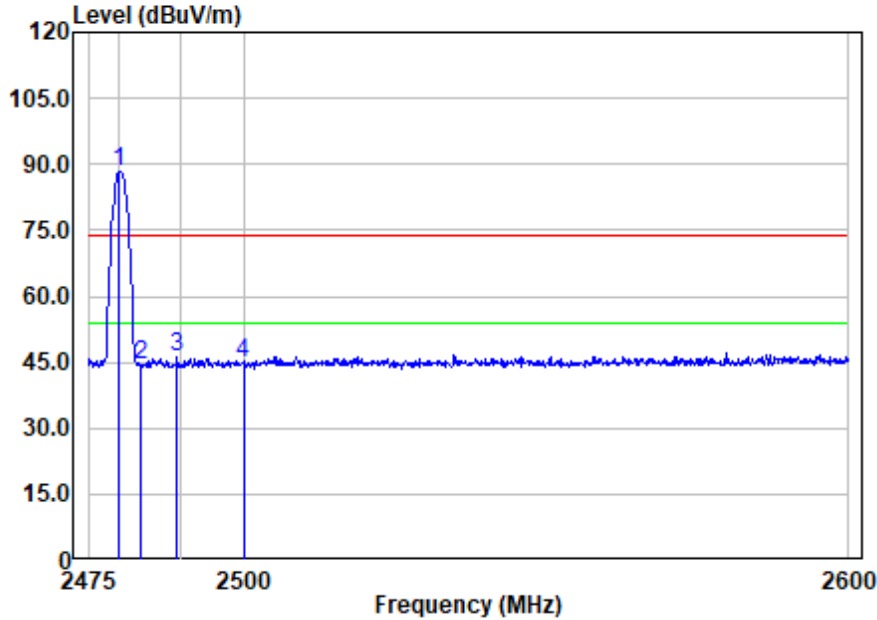


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 t(86-512)57355888 f(86-512)57370818 sgs.china@sgs.com

Test Mode: 00; Polarity: Vertical; Modulation:  $\pi/4$  DQPSK; Channel: High



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.000	0.00	42.94	98.39	88.30	74.00	14.30	Peak
2	2483.500	0.00	42.94	54.40	44.33	74.00	-29.67	Peak
3	2489.250	0.00	42.94	56.34	46.29	74.00	-27.71	Peak
4	2500.000	0.00	42.94	54.65	44.66	74.00	-29.34	Peak



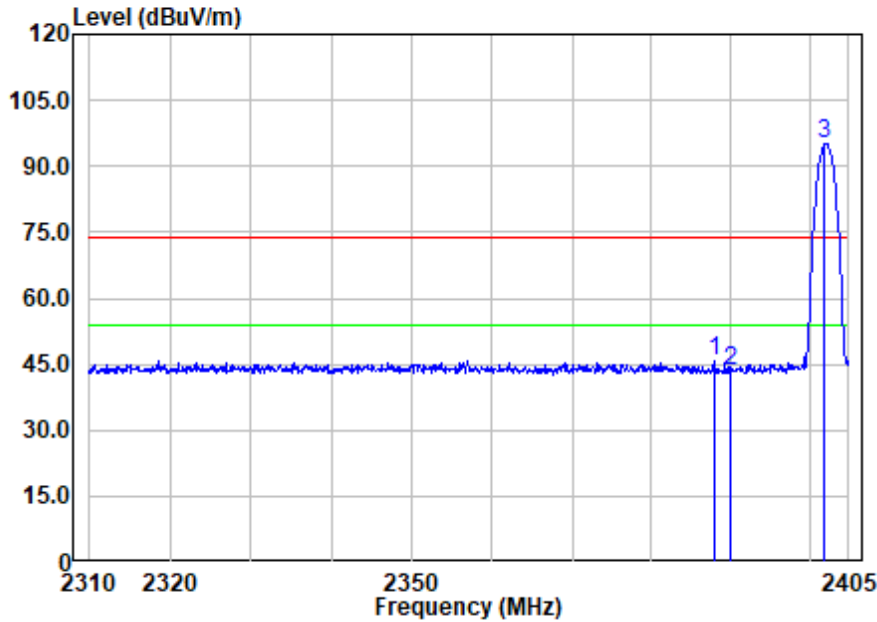
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Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:Low



	Aux Freq	Preamp Factor	Read Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	2387.900	0.00	56.05	74.00	-28.46	Peak
2	2390.000	0.00	53.81	74.00	-30.69	Peak
3	2401.960	0.00	105.78	74.00	21.31	Peak

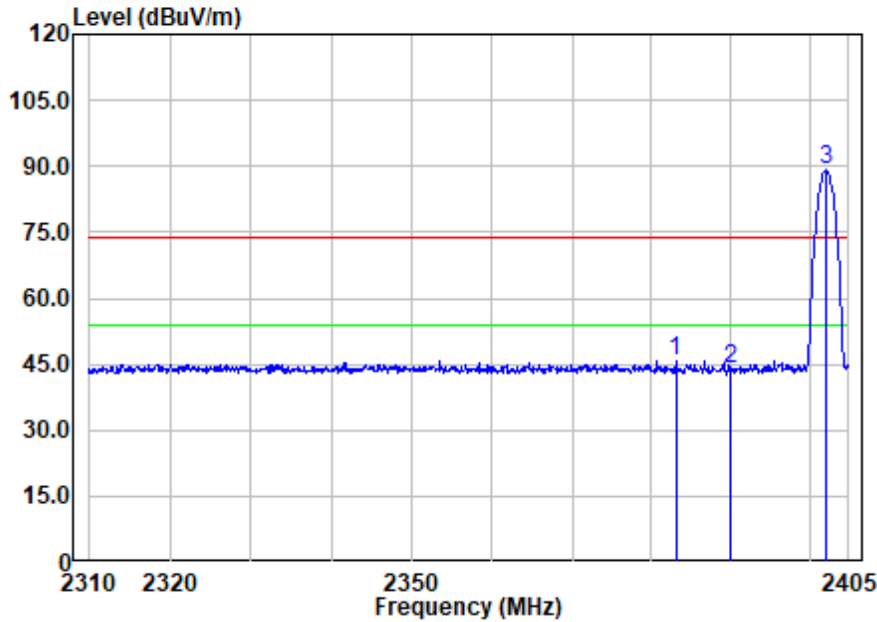


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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:Low



	Aux Freq	Preamp Factor	Read Level	Limit Line	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2383.055	0.00	42.92	56.15	45.64	74.00	-28.36 Peak
2	2390.000	0.00	42.92	54.35	43.85	74.00	-30.15 Peak
3	2402.150	0.00	42.93	99.46	88.99	74.00	14.99 Peak

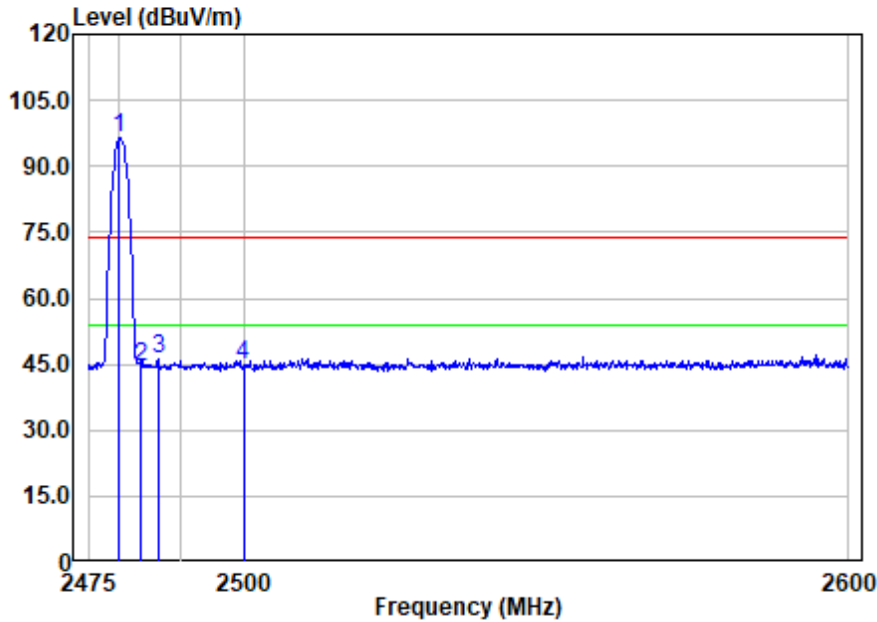


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Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:High



	Freq	Aux Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.000	0.00	42.94	106.50	96.41	74.00	22.41	Peak
2	2483.500	0.00	42.94	54.61	44.54	74.00	-29.46	Peak
3	2486.250	0.00	42.94	56.05	45.99	74.00	-28.01	Peak
4	2500.000	0.00	42.94	54.74	44.75	74.00	-29.25	Peak

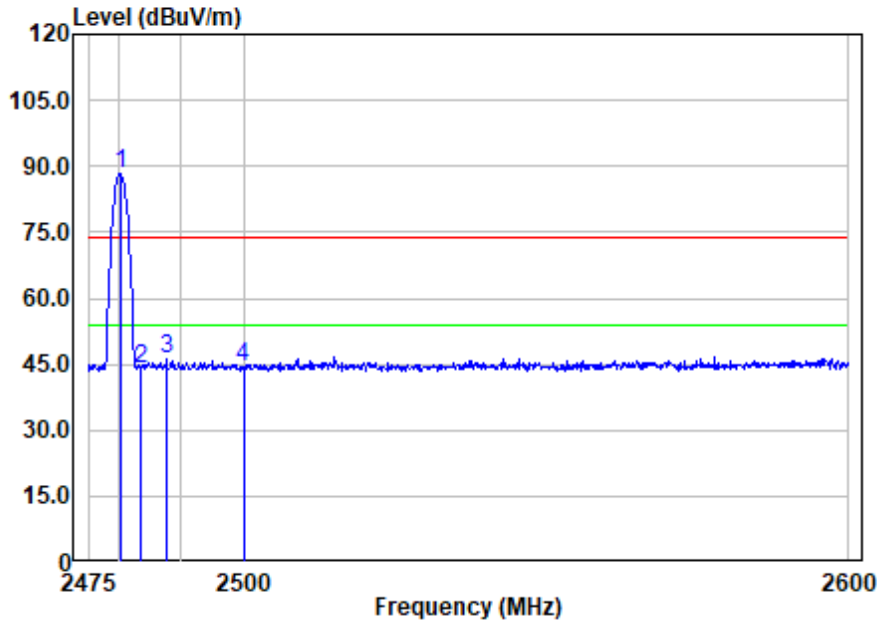


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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:High



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
1	2480.250	0.00	42.94	98.44	88.35	74.00	14.35	Peak
2	2483.500	0.00	42.94	53.88	43.81	74.00	-30.19	Peak
3	2487.625	0.00	42.94	56.12	46.07	74.00	-27.93	Peak
4	2500.000	0.00	42.94	54.22	44.23	74.00	-29.77	Peak



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### 7.10 Radiated Spurious Emissions Below 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
960-1000	500	3

#### 7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 21.0 °C Humidity: 51.4 % RH Atmospheric Pressure: 1010 mbar

#### 7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

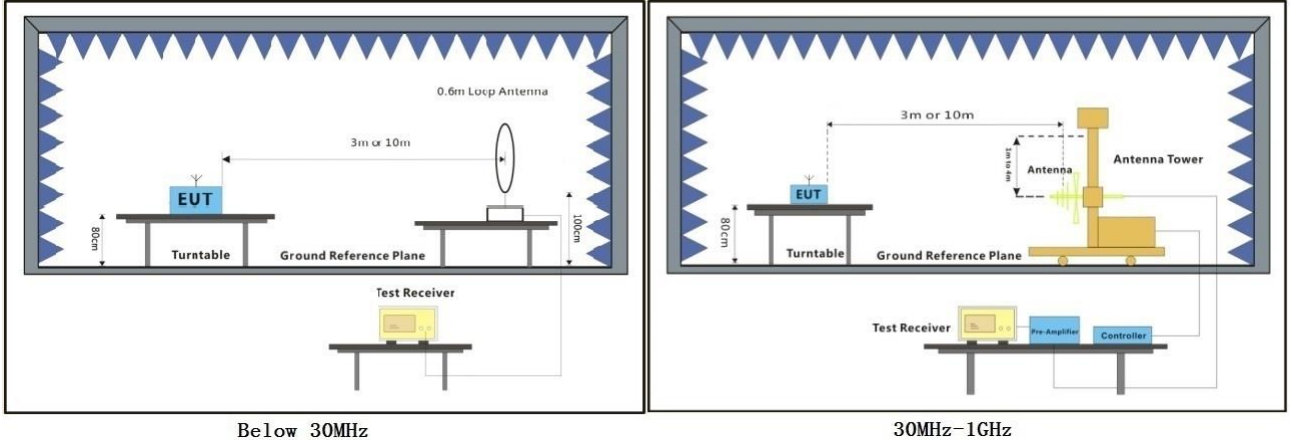


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### 7.10.3 Test Setup Diagram



Below 30MHz

30MHz-1GHz



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**7.10.4 Measurement Procedure and Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using quasi-peak method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
- 2. Scan from 9kHz to 30MHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 3. The disturbance below 1GHz was very low and the harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

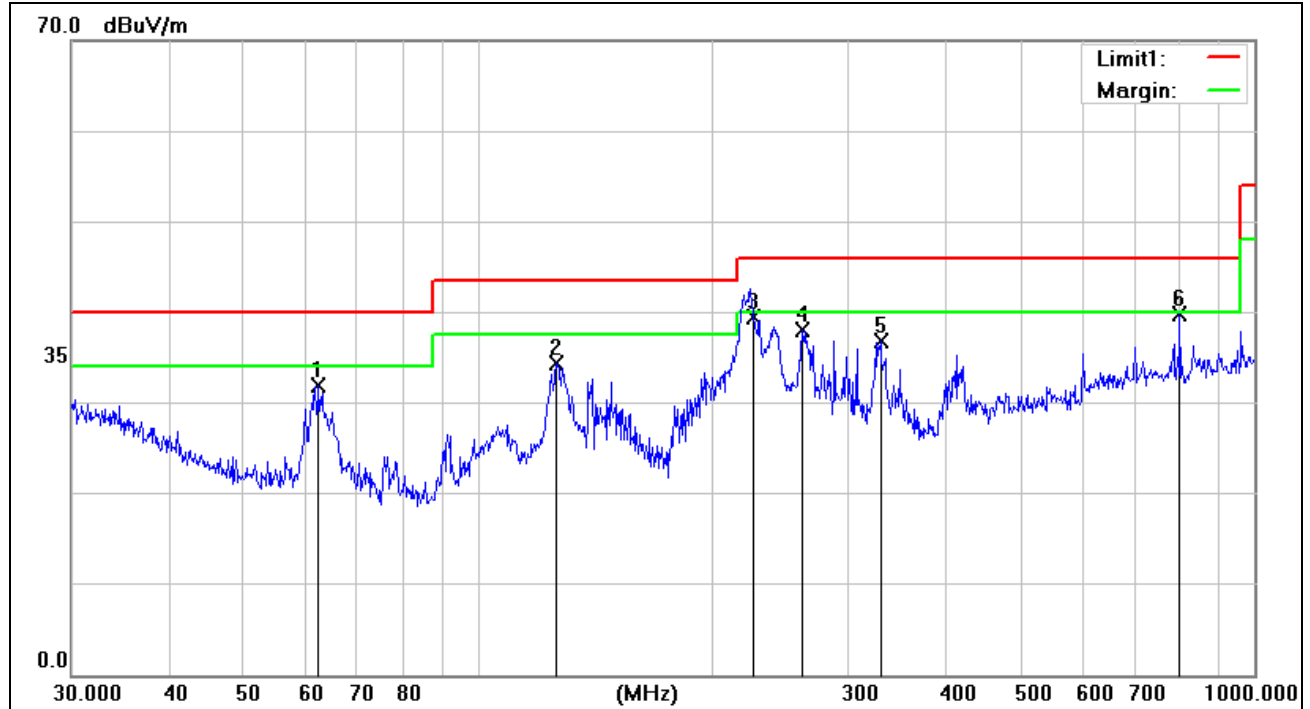


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Test Mode: 00; Polarity: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	62.4314	17.30	14.68	31.98	40.00	-8.02	100	298	QP
2	126.3286	15.00	19.45	34.45	43.50	-9.05	100	64	QP
3	227.5100	22.22	17.32	39.54	46.00	-6.46	100	360	QP
4	261.9753	16.95	21.04	37.99	46.00	-8.01	100	110	QP
5	330.1950	15.61	21.22	36.83	46.00	-9.17	100	84	QP
6	801.7863	37.50	2.25	39.75	46.00	-6.25	100	323	QP

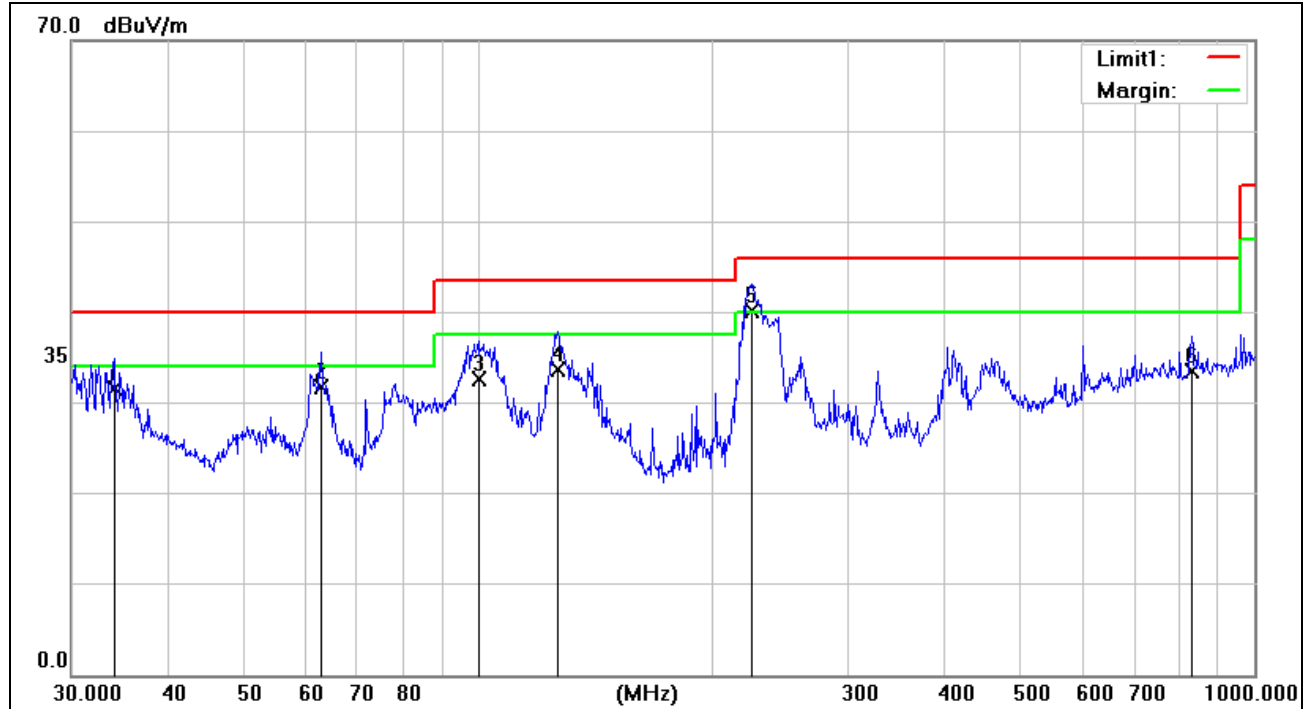


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Test Mode: 00; Polarity: Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	34.0365	6.62	24.90	31.52	40.00	-8.48	100	155	QP
2	62.8708	17.00	14.69	31.69	40.00	-8.31	100	357	QP
3	100.2286	15.60	17.11	32.71	43.50	-10.79	101	0	QP
4	126.7723	14.30	19.46	33.76	43.50	-9.74	101	0	QP
5	225.3080	23.06	17.07	40.13	46.00	-5.87	100	180	QP
6	830.4002	31.26	2.18	33.44	46.00	-12.56	100	226	QP



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### 7.11 Radiated Spurious Emissions Above 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
Above 1000	500	3

#### 7.11.1 E.U.T. Operation

Operating Environment:

Temperature: 22.8 °C

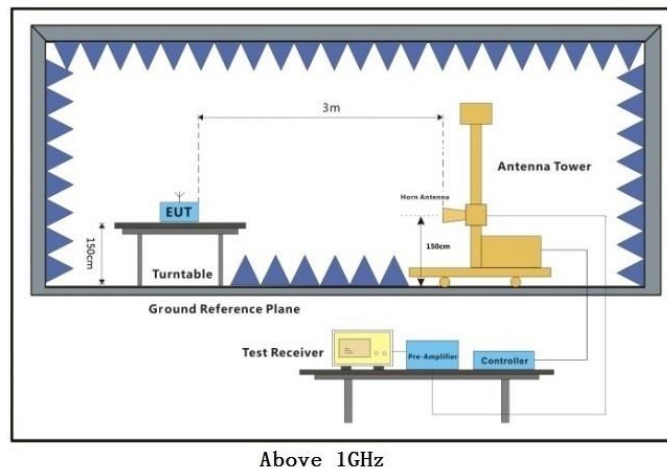
Humidity: 60.0 % RH

Atmospheric Pressure: 1010 mbar

#### 7.11.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Power by adapter DPS-90AB-3 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Pre-scan	11	TX_non-Hop mode_Power by adapter FSP090-DIEBN2 and Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.11.3 Test Setup Diagram



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**7.11.4 Measurement Procedure and Data**

- a. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
- 2. Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 3. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

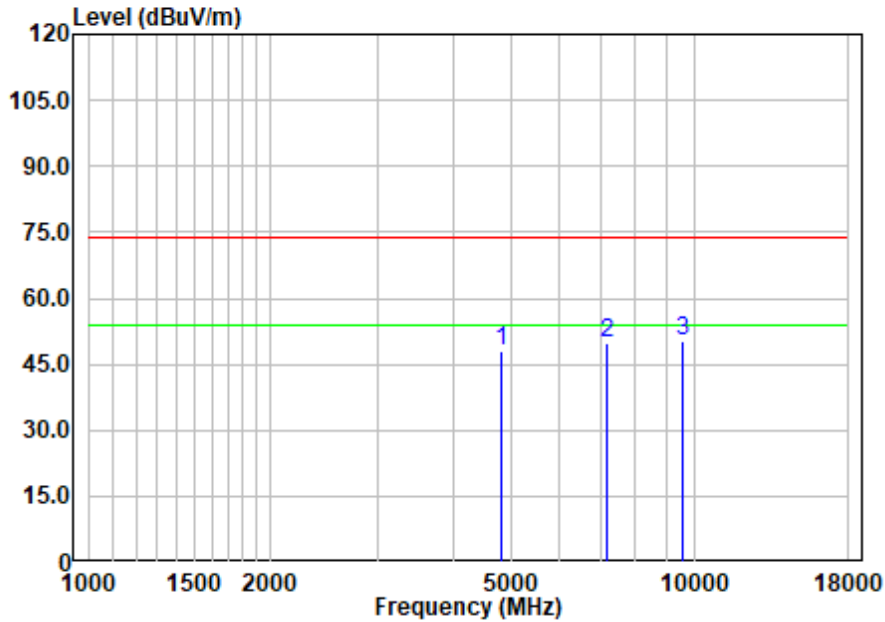


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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4804.000	0.00	48.26	48.19	74.00	-25.81 Peak
2	7206.000	0.00	46.75	49.88	74.00	-24.12 Peak
3	9608.000	0.00	41.99	50.09	74.00	-23.91 Peak



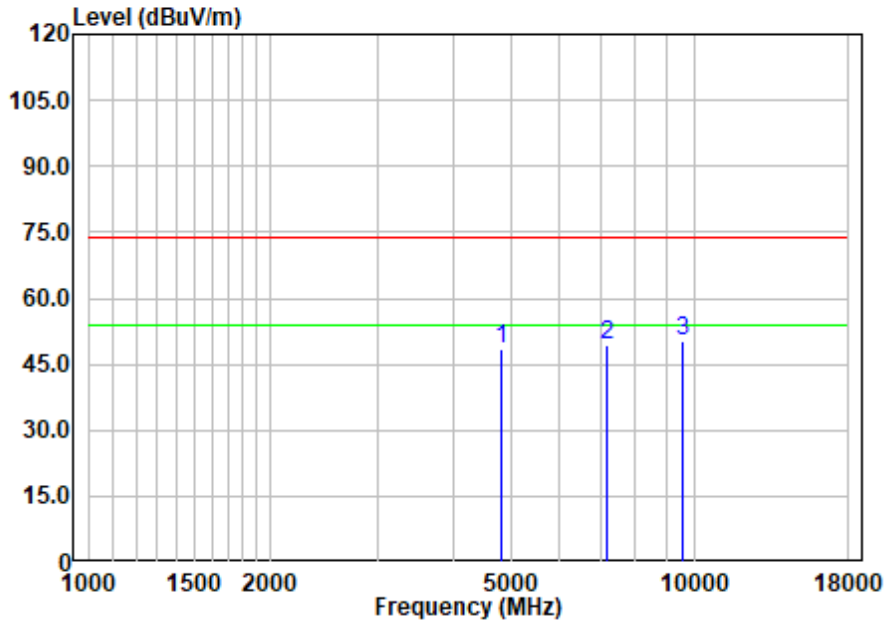
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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4804.000	0.00	48.43	48.36	74.00	-25.64 Peak
2	7206.000	0.00	46.37	49.50	74.00	-24.50 Peak
3	9608.000	0.00	41.99	50.13	74.00	-23.87 Peak

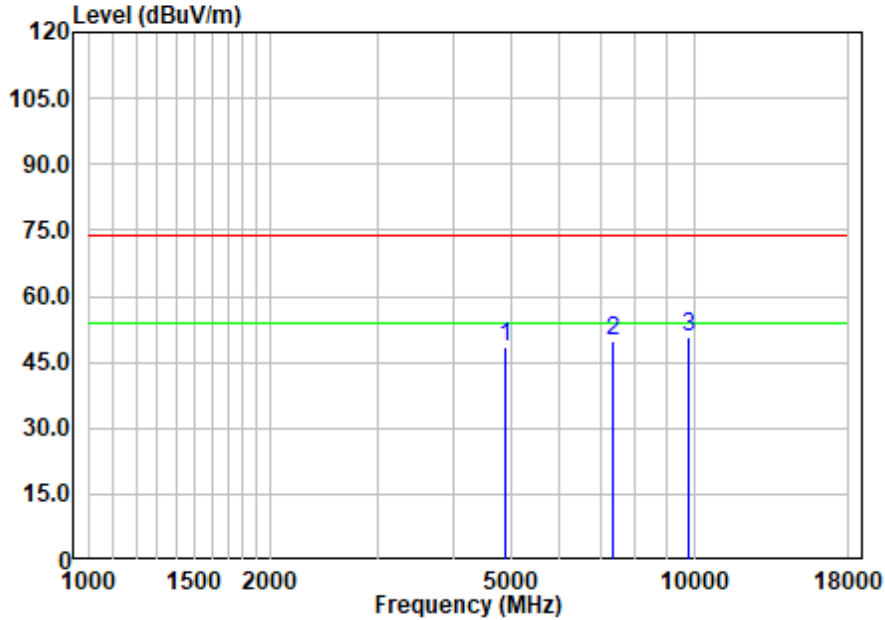


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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:middle



	Aux Freq	Preamp Factor	Read Level	Limit	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4882.000	0.00	41.87	47.79	48.27	74.00	-25.73 Peak
2	7323.000	0.00	42.49	46.39	49.82	74.00	-24.18 Peak
3	9764.000	0.00	42.56	43.89	50.80	74.00	-23.20 Peak

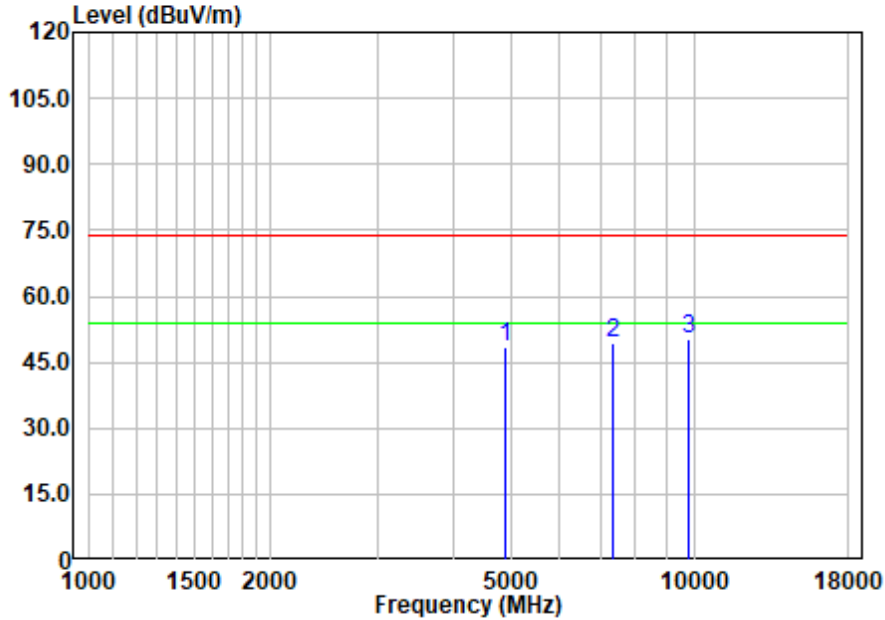


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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:middle



	Aux Freq	Preamp Factor	Read Level	Limit Line	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4882.000	0.00	41.87	48.16	48.64	74.00	-25.36 Peak
2	7323.000	0.00	42.49	45.97	49.40	74.00	-24.60 Peak
3	9764.000	0.00	42.56	43.18	50.09	74.00	-23.91 Peak

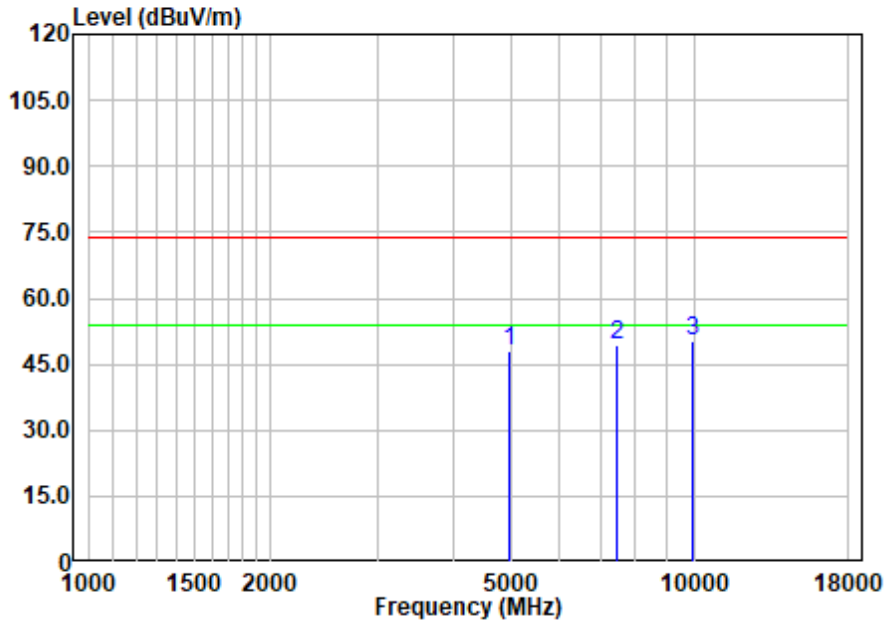


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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



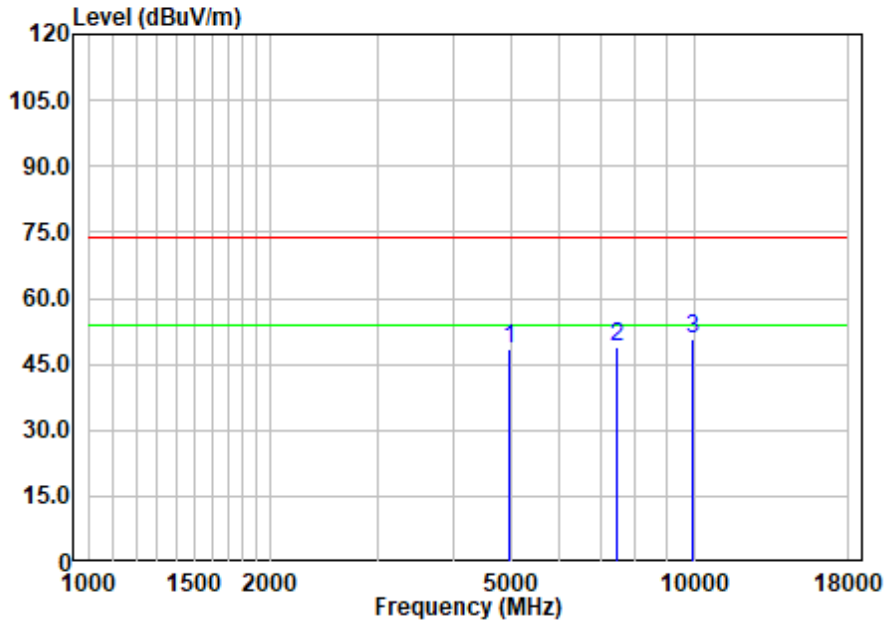
	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4960.000	0.00	47.36	48.15	74.00	-25.85 Peak
2	7440.000	0.00	45.53	49.14	74.00	-24.86 Peak
3	9920.000	0.00	42.27	50.46	74.00	-23.54 Peak



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	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4960.000	0.00	47.86	48.65	74.00	-25.35 Peak
2	7440.000	0.00	42.47	49.09	74.00	-24.91 Peak
3	9920.000	0.00	42.27	50.85	74.00	-23.15 Peak



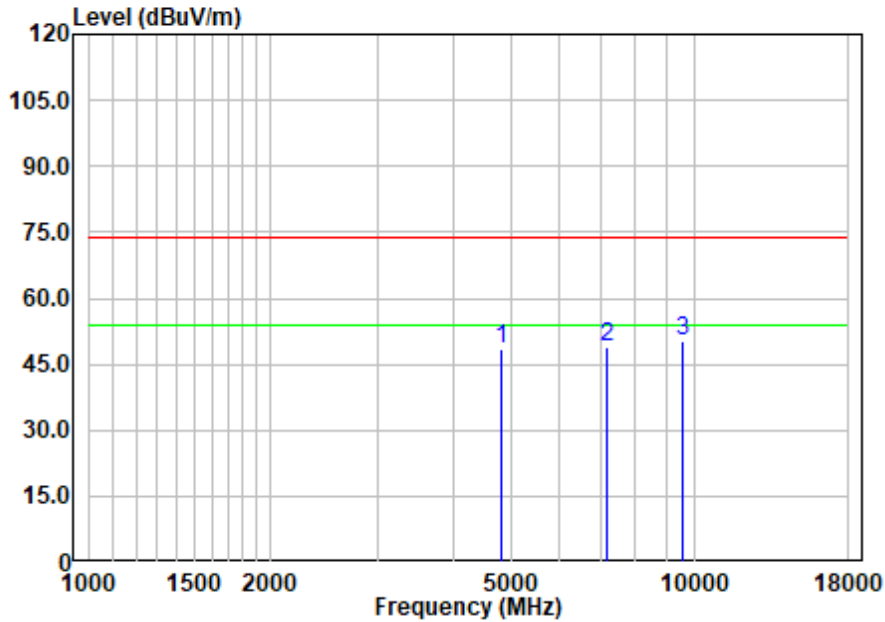
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Test Mode: 00; Polarity: Horizontal; Modulation:  $\pi/4$  DQPSK; Channel: Low



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4804.000	0.00	42.37	48.41	48.34	74.00	-25.66	Peak
2	7206.000	0.00	42.65	45.94	49.07	74.00	-24.93	Peak
3	9608.000	0.00	41.99	43.14	50.36	74.00	-23.64	Peak

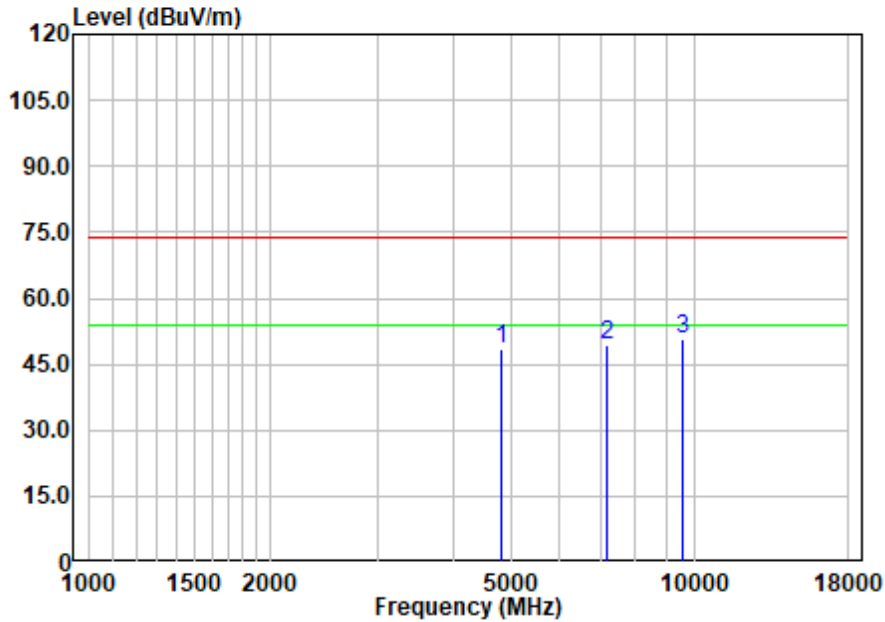


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Test Mode: 00; Polarity: Vertical; Modulation:  $\pi/4$  DQPSK; Channel: Low



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Limit	Over	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB
1	4804.000	0.00	42.37	48.55	48.48	74.00	-25.52 Peak
2	7206.000	0.00	42.65	46.01	49.14	74.00	-24.86 Peak
3	9608.000	0.00	41.99	43.65	50.87	74.00	-23.13 Peak

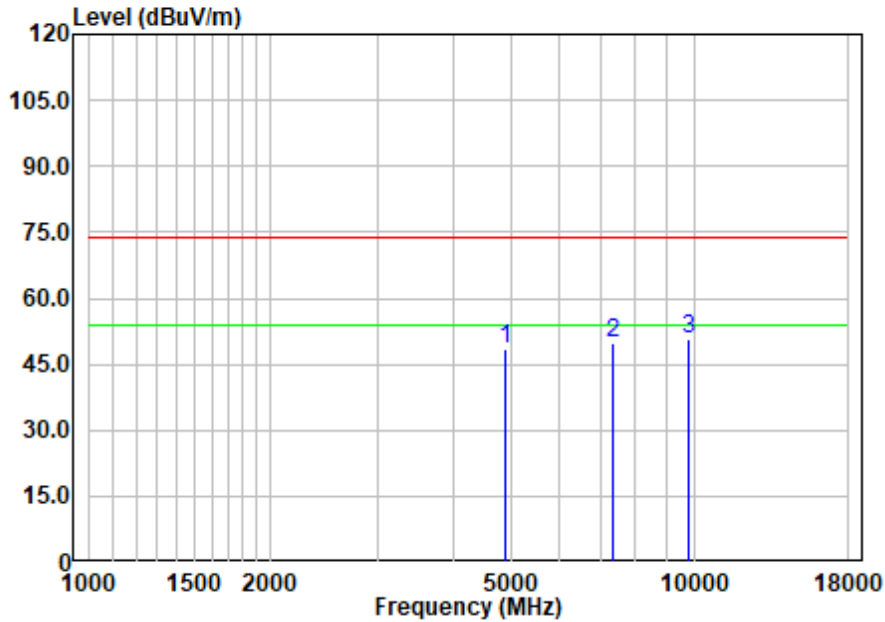


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Test Mode: 00; Polarity: Horizontal; Modulation:  $\pi/4$  DQPSK; Channel: middle



	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4882.000	0.00	41.87	48.14	48.62	74.00 -25.38	Peak
2	7323.000	0.00	42.49	46.41	49.84	74.00 -24.16	Peak
3	9764.000	0.00	42.56	43.98	50.89	74.00 -23.11	Peak

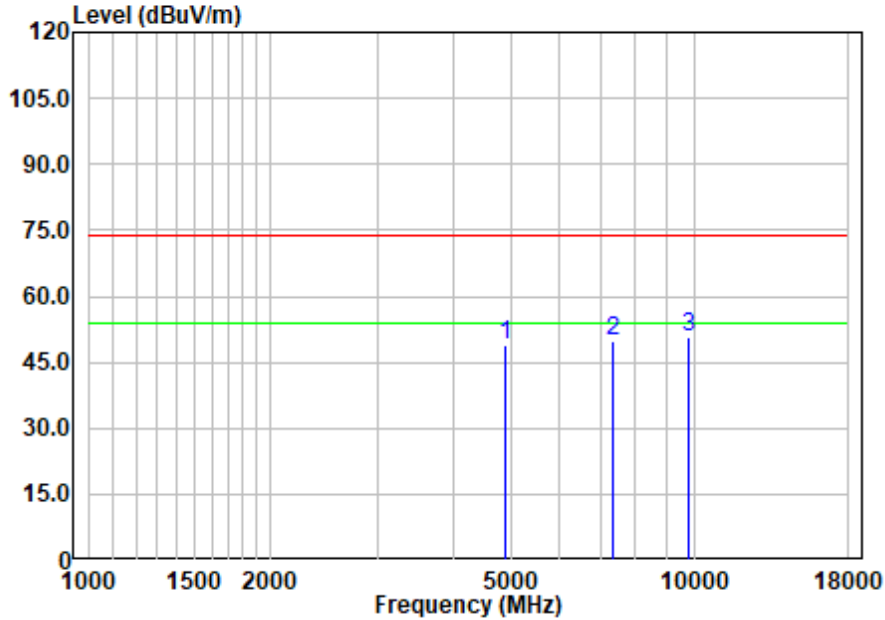


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Test Mode: 00; Polarity: Vertical; Modulation:  $\pi/4$  DQPSK; Channel: middle



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4882.000	0.00	41.87	48.30	48.78	74.00	-25.22	Peak
2	7323.000	0.00	42.49	46.40	49.83	74.00	-24.17	Peak
3	9764.000	0.00	42.56	43.88	50.79	74.00	-23.21	Peak

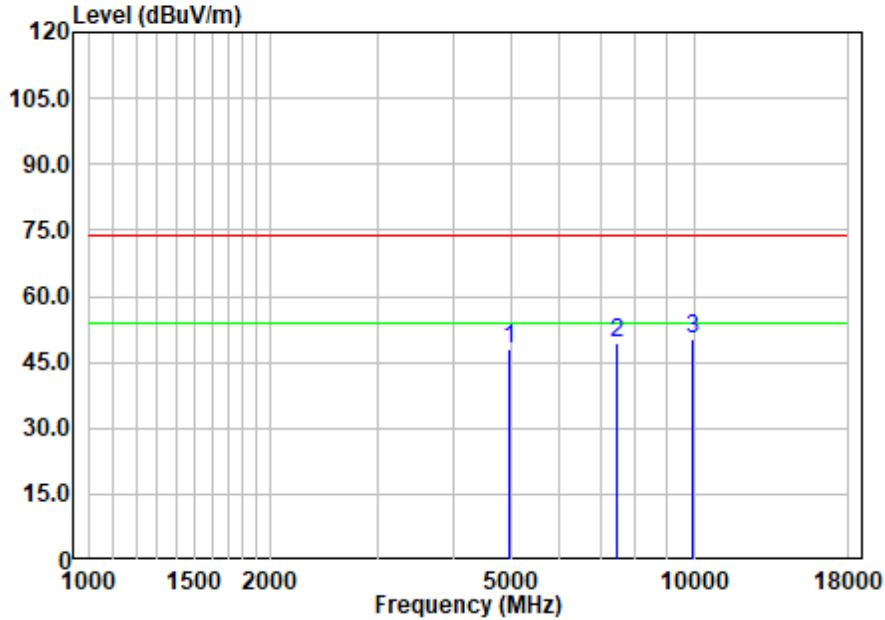


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Test Mode: 00; Polarity: Horizontal; Modulation:  $\pi/4$  DQPSK; Channel: High



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	0.00	41.59	47.35	48.14	74.00	-25.86	Peak
2	7440.000	0.00	42.47	45.73	49.34	74.00	-24.66	Peak
3	9920.000	0.00	42.27	42.71	50.12	74.00	-23.88	Peak



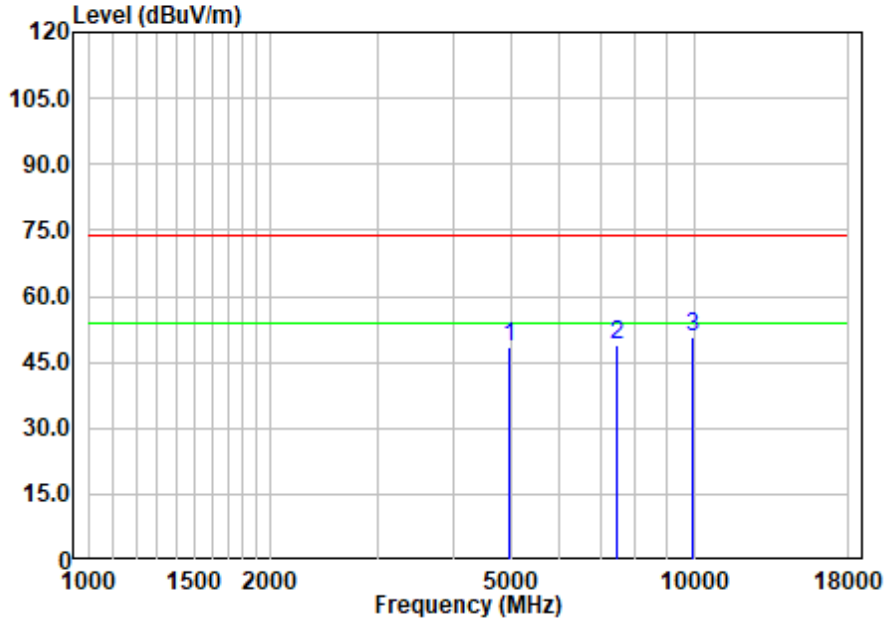
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 t(86-512)57355888 f(86-512)57370818 sgs.china@sgs.com



Test Mode: 00; Polarity: Vertical; Modulation:  $\pi/4$  DQPSK; Channel: High



	Aux Freq	Preamplifier Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	0.00	41.59	47.51	48.30	74.00	-25.70	Peak
2	7440.000	0.00	42.47	45.52	49.13	74.00	-24.87	Peak
3	9920.000	0.00	42.27	43.40	50.81	74.00	-23.19	Peak

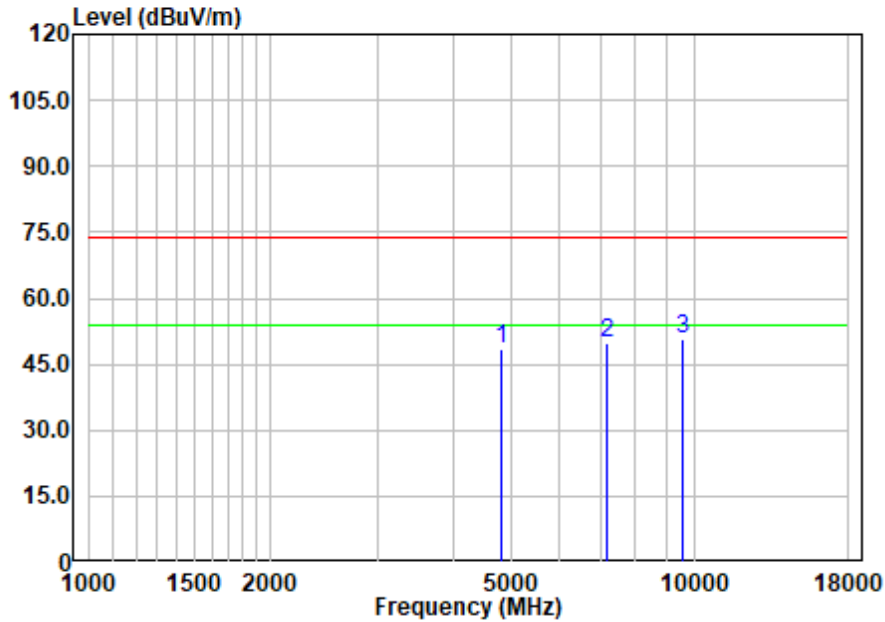


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Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:Low



	Aux Freq	Preamp Factor	Read Level	Limit	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4804.000	0.00	42.37	48.72	48.65	74.00 -25.35	Peak
2	7206.000	0.00	42.65	46.60	49.73	74.00 -24.27	Peak
3	9608.000	0.00	41.99	43.59	50.81	74.00 -23.19	Peak

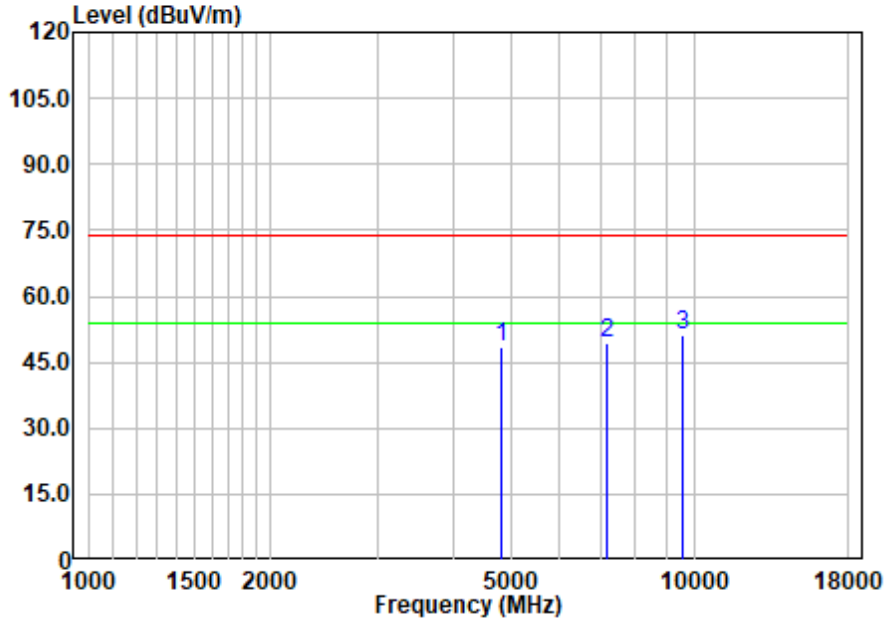


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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:Low



	Aux Freq	Preamp Factor	Read Level	Limit	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4804.000	0.00	42.37	48.54	48.47	74.00	-25.53 Peak
2	7206.000	0.00	42.65	46.42	49.55	74.00	-24.45 Peak
3	9608.000	0.00	41.99	43.77	50.99	74.00	-23.01 Peak

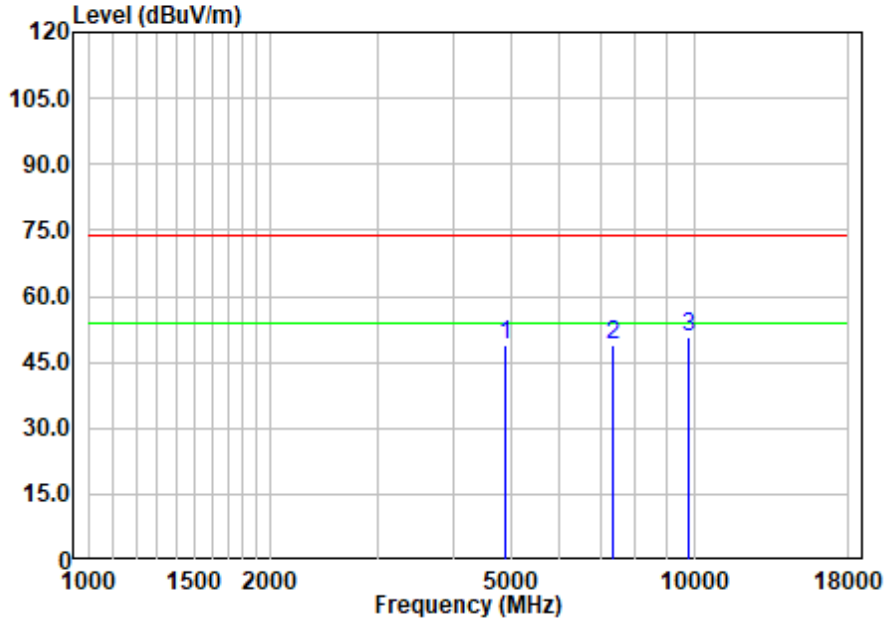


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Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:middle



	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4882.000	0.00	48.36	48.84	74.00	-25.16 Peak
2	7323.000	0.00	45.58	49.01	74.00	-24.99 Peak
3	9764.000	0.00	42.56	50.66	74.00	-23.34 Peak

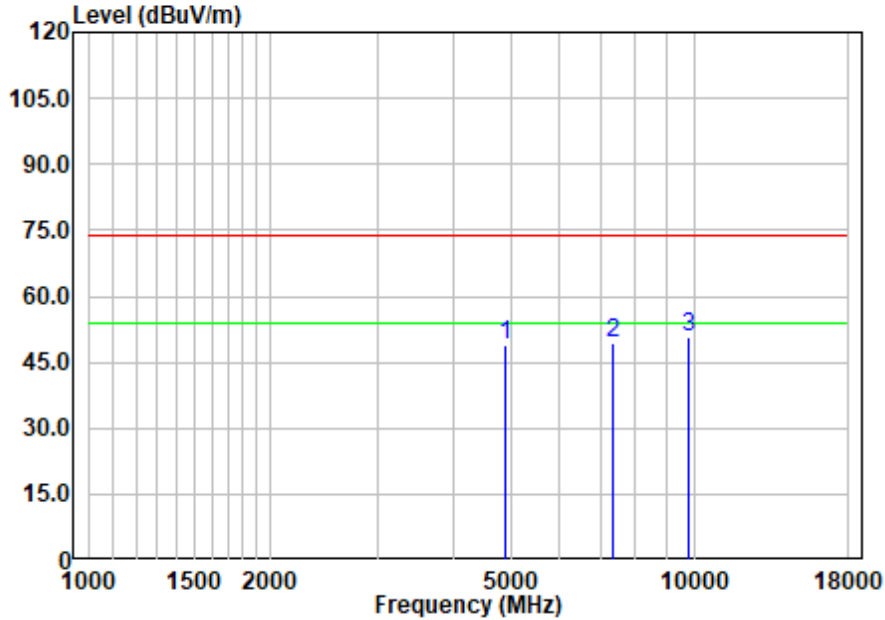


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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:middle



	Aux Freq	Preamp Factor	Read Level	Limit	Over Limit	Remark	
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB	
1	4882.000	0.00	41.87	48.37	48.85	74.00	-25.15 Peak
2	7323.000	0.00	42.49	45.71	49.14	74.00	-24.86 Peak
3	9764.000	0.00	42.56	43.72	50.63	74.00	-23.37 Peak



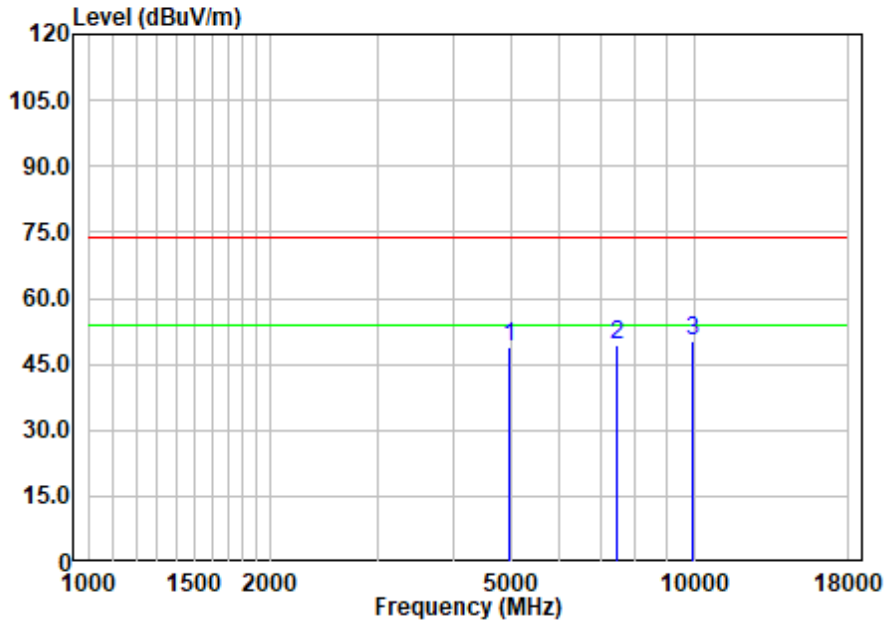
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Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:High



	Aux Freq	Preamp Factor	Read Level	Limit	Over	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4960.000	0.00	47.93	48.72	74.00	-25.28 Peak
2	7440.000	0.00	45.88	49.49	74.00	-24.51 Peak
3	9920.000	0.00	42.27	50.14	74.00	-23.86 Peak

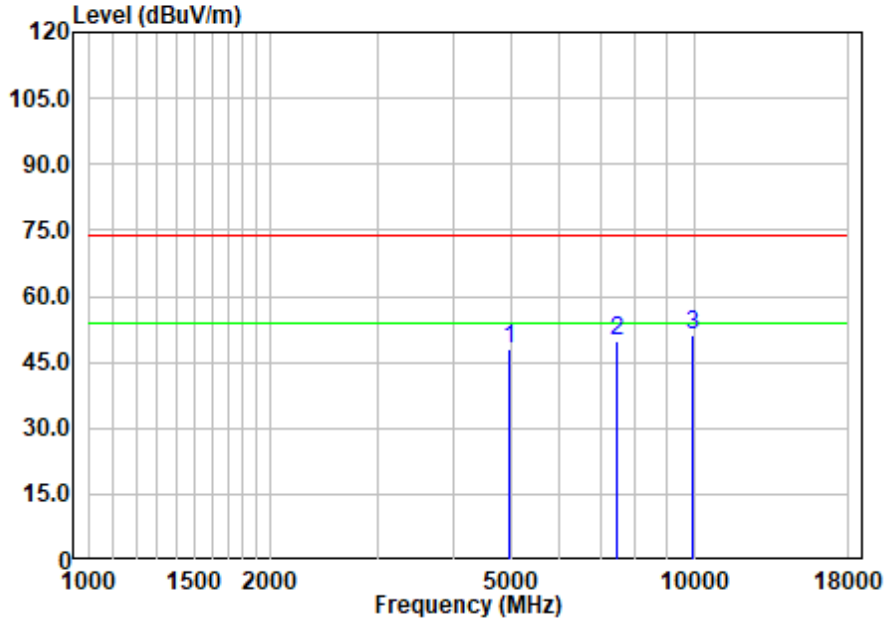


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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:High



	Aux Freq	Preamplifier Factor	Read Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV/m	dBuV/m	dB
1	4960.000	0.00	47.24	48.03	74.00	-25.97 Peak
2	7440.000	0.00	45.99	49.60	74.00	-24.40 Peak
3	9920.000	0.00	42.27	50.98	74.00	-23.02 Peak



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## Compliance Certification Services (Kunshan) Inc.

Report No.: KSCR220800138302

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### 8 Test Setup Photo

Refer to Appendix - Test Setup Photo for KSCR2208001383AT

### 9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for KSCR2208001383AT



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## 10 Appendix

### Appendix for KSCR2208001383AT

#### 1. Bandwidth

##### 1.1 OBW

##### 1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	99% Occupied Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	0.884	Pass
		2441	DH5	1	0.884	Pass
		2480	DH5	1	0.884	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.194	Pass
		2441	2DH5	1	1.194	Pass
		2480	2DH5	1	1.195	Pass
8DPSK	SISO	2402	3DH5	1	1.200	Pass
		2441	3DH5	1	1.199	Pass
		2480	3DH5	1	1.199	Pass



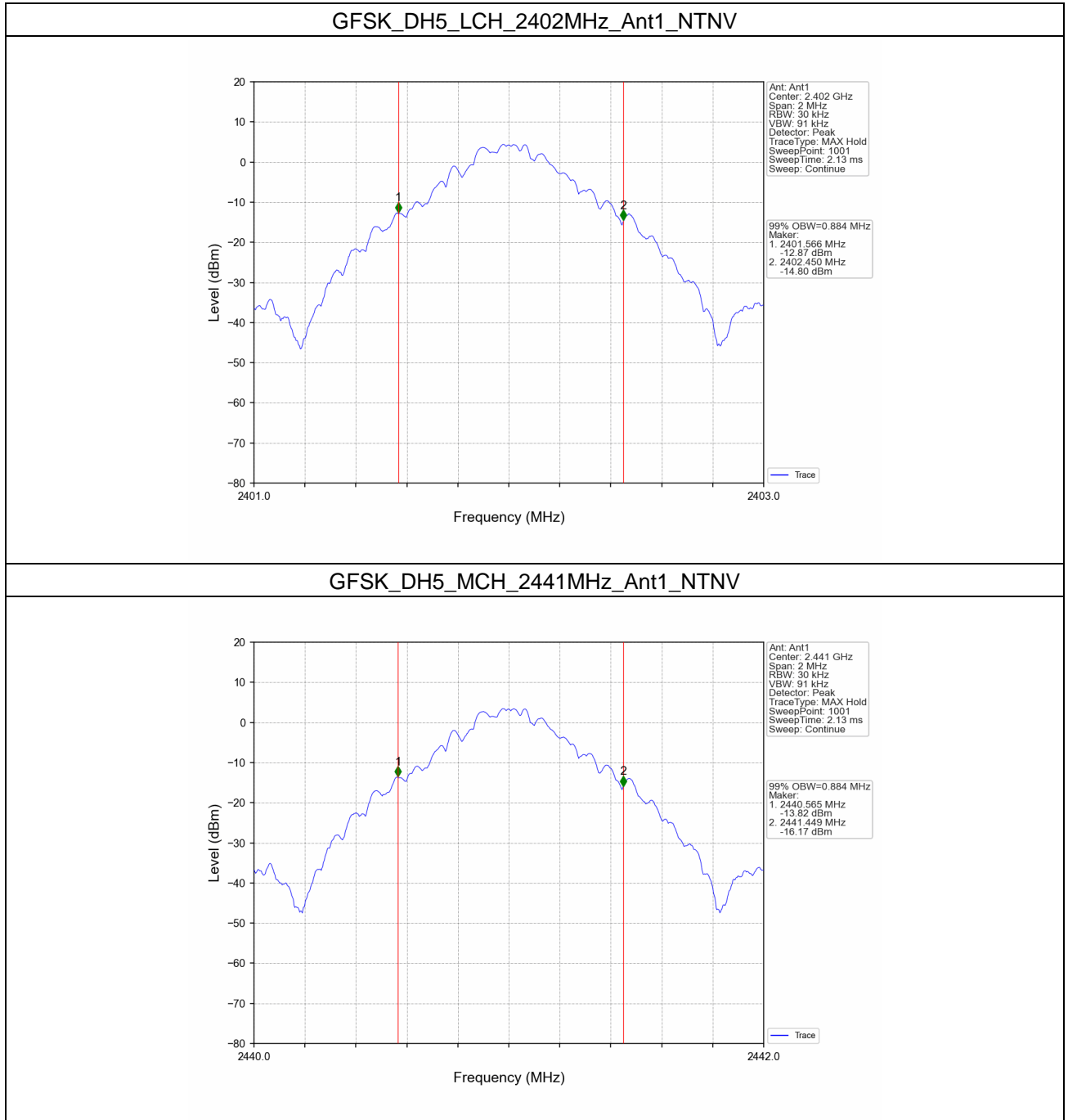
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### 1.1.2 Test Graph



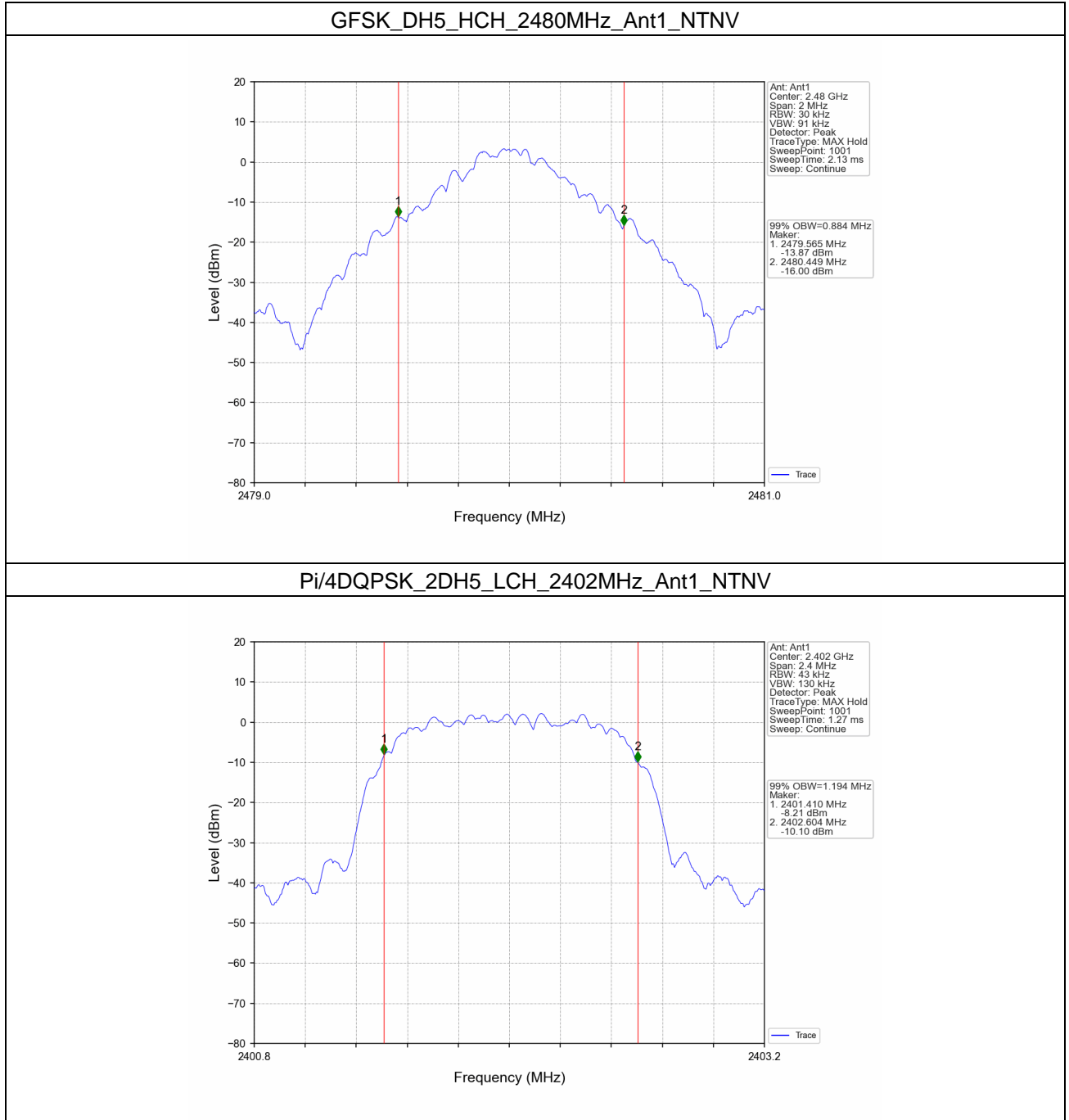
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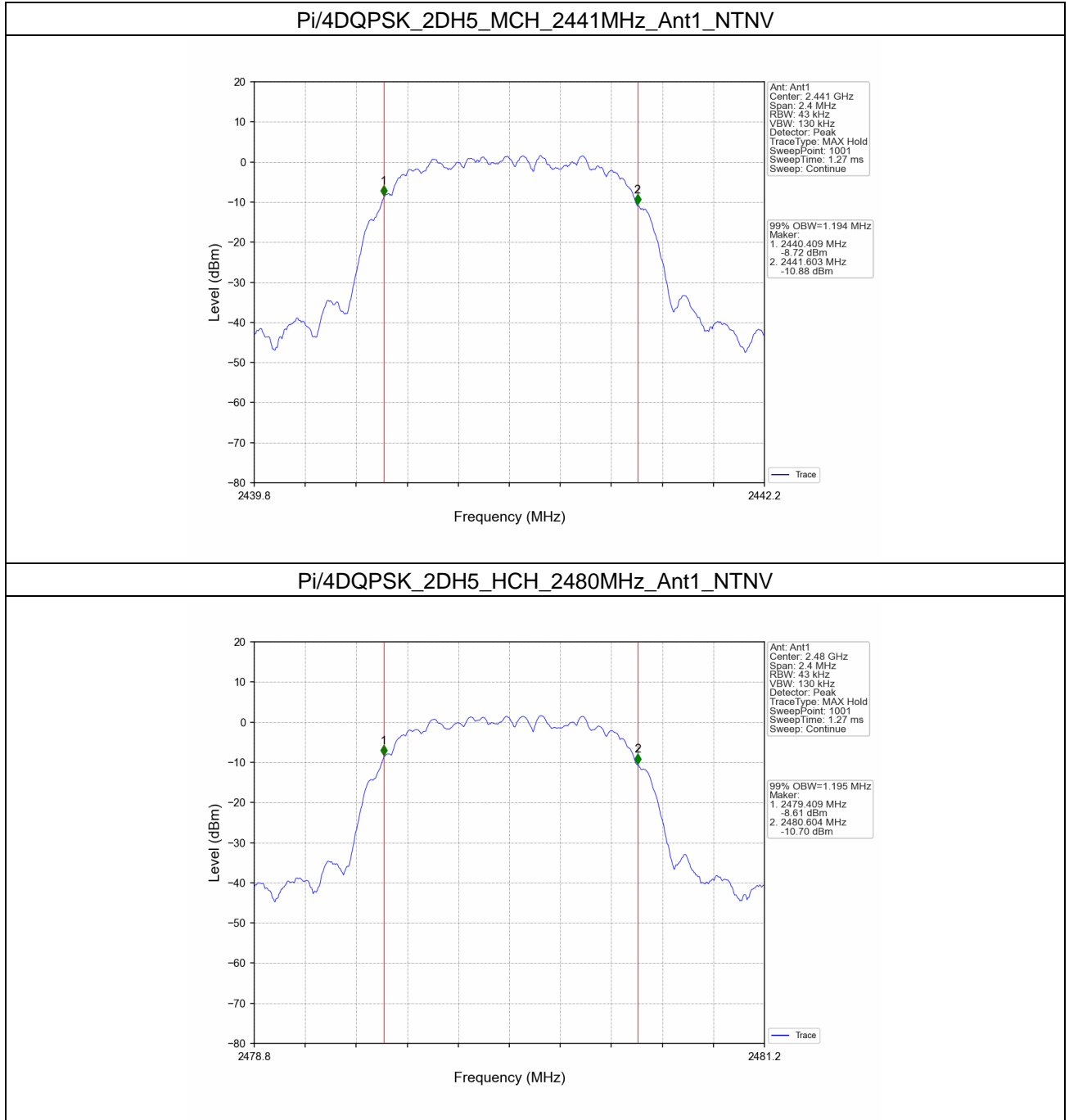


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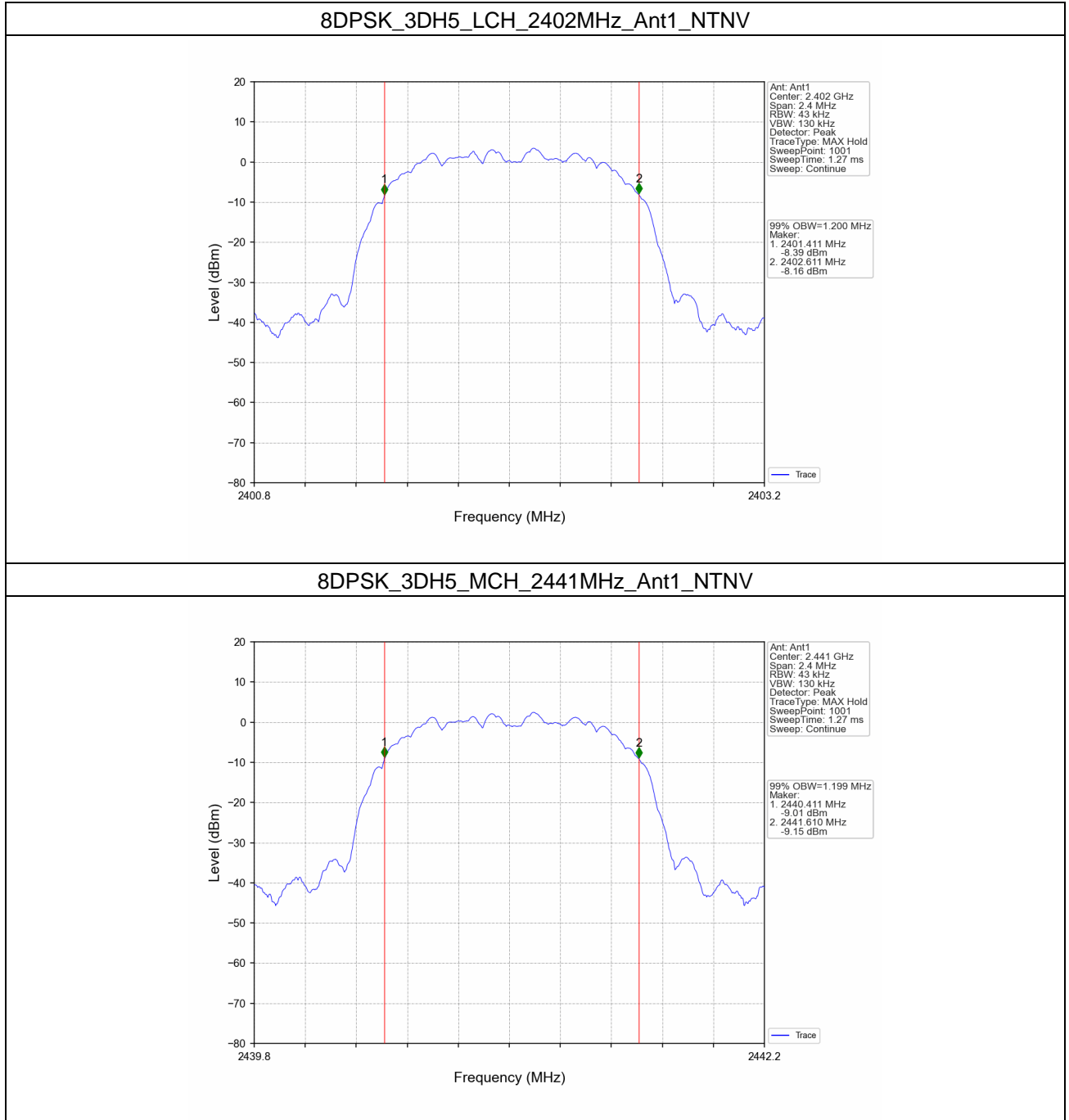


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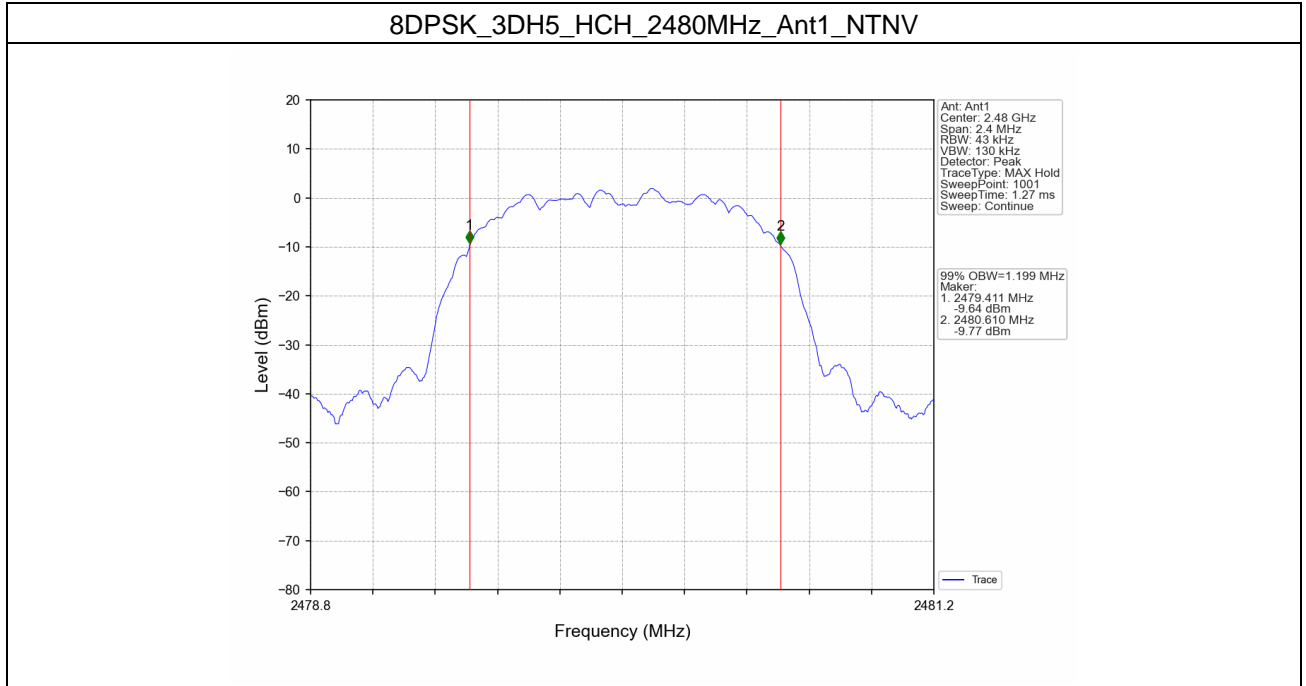
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### 1.2 20dB BW

#### 1.2.1 Test Result

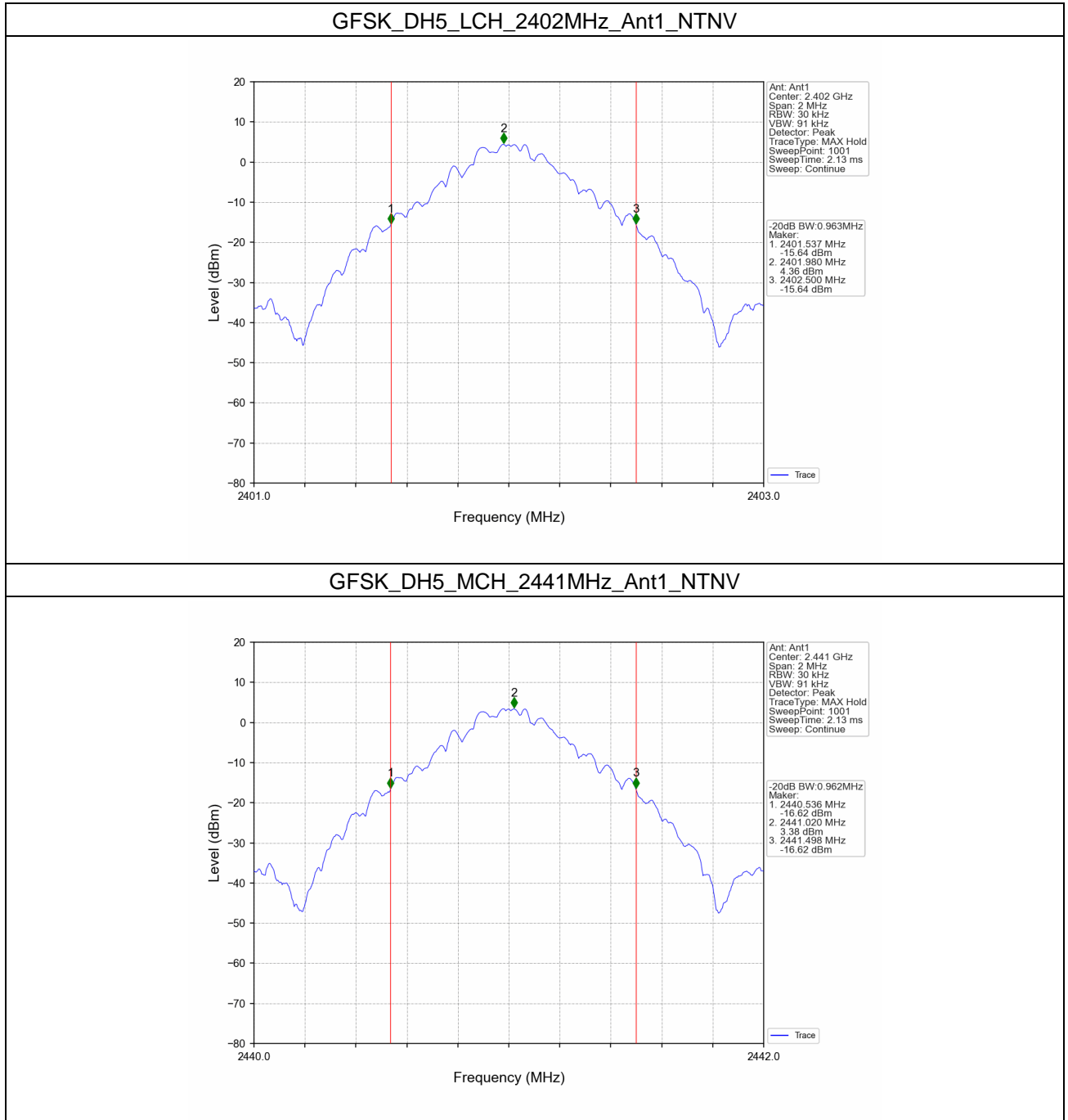
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	0.963	Pass
		2441	DH5	1	0.962	Pass
		2480	DH5	1	0.962	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.374	Pass
		2441	2DH5	1	1.375	Pass
		2480	2DH5	1	1.375	Pass
8DPSK	SISO	2402	3DH5	1	1.353	Pass
		2441	3DH5	1	1.351	Pass
		2480	3DH5	1	1.352	Pass



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### 1.2.2 Test Graph

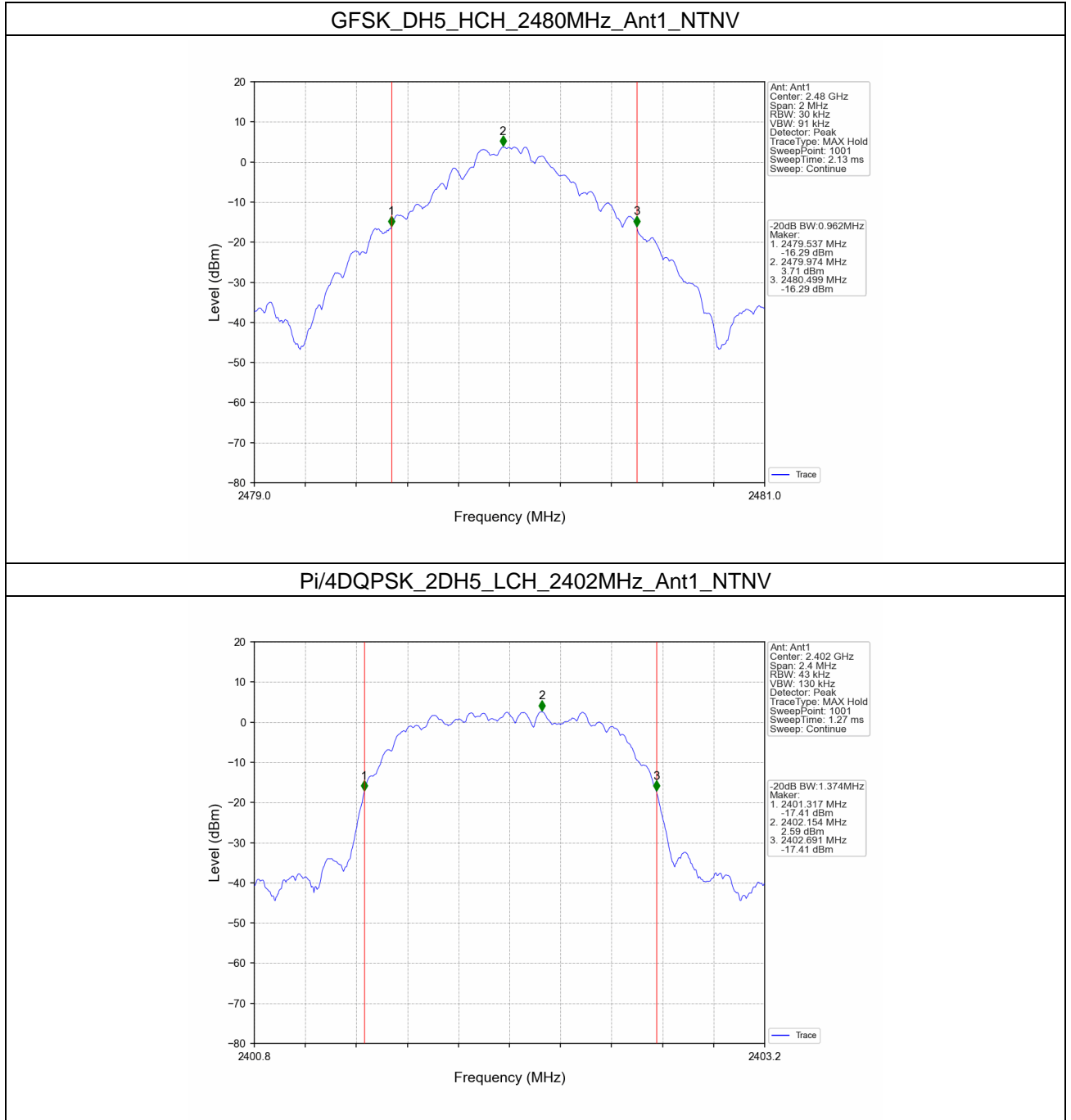


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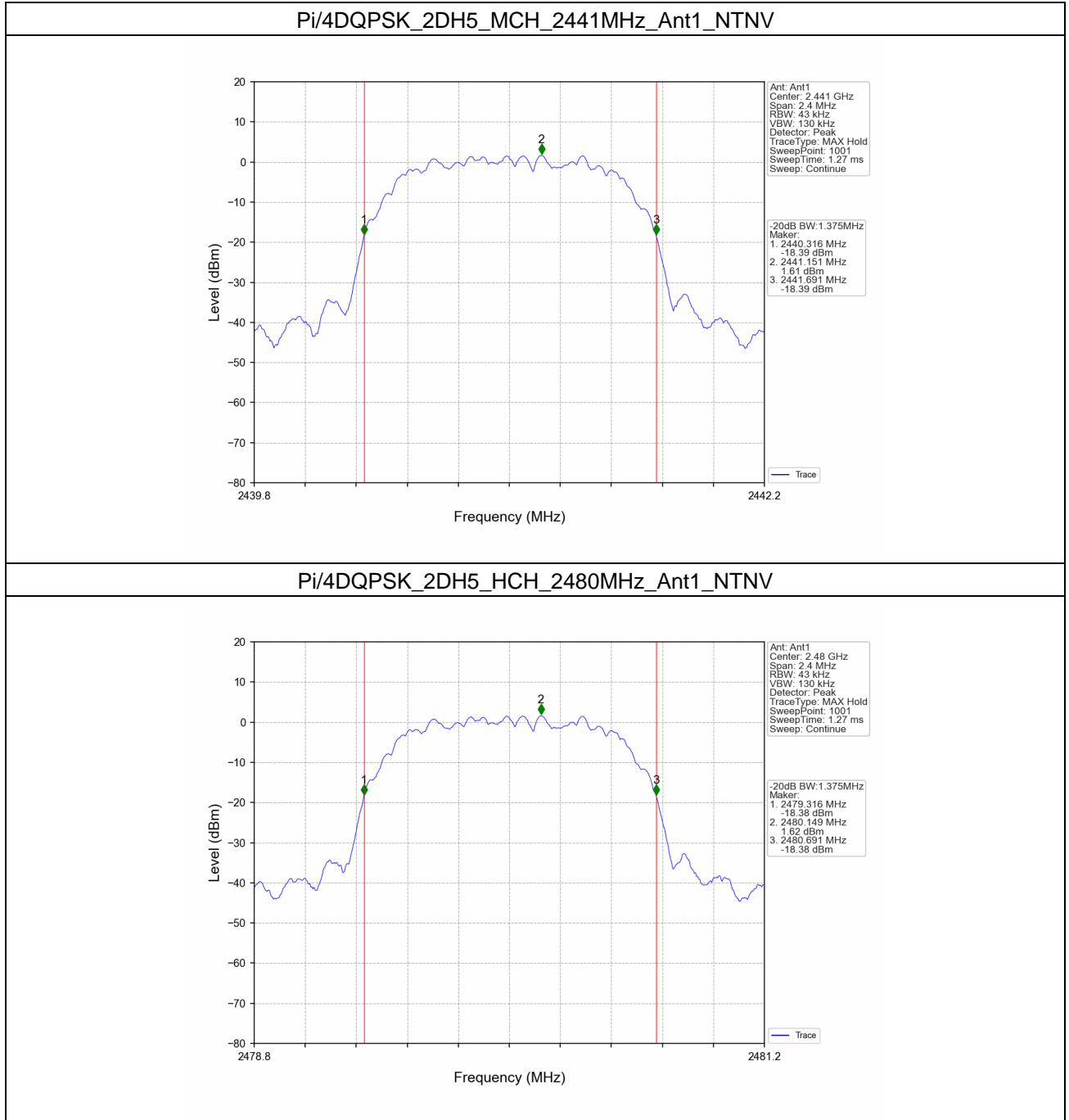


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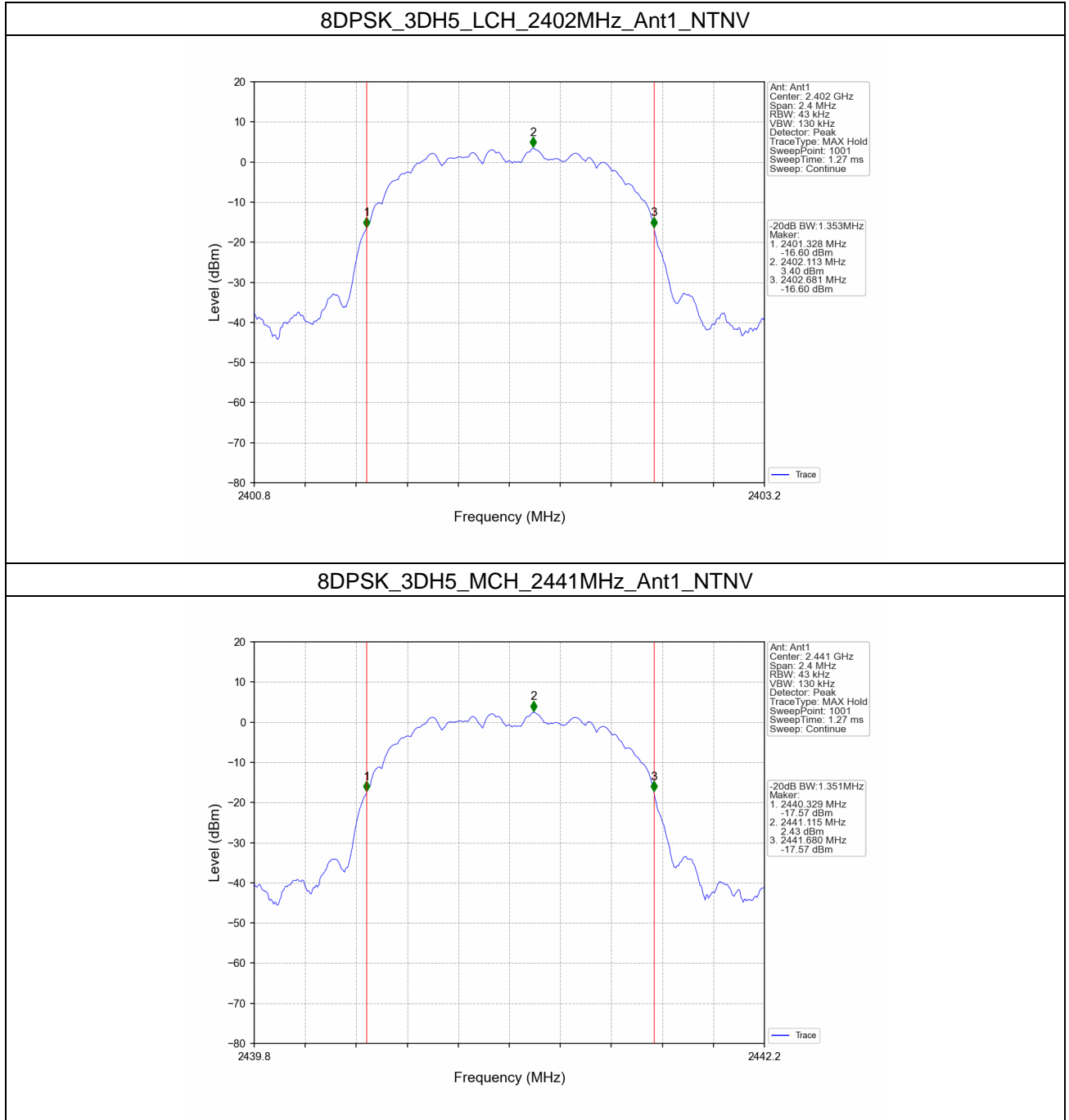


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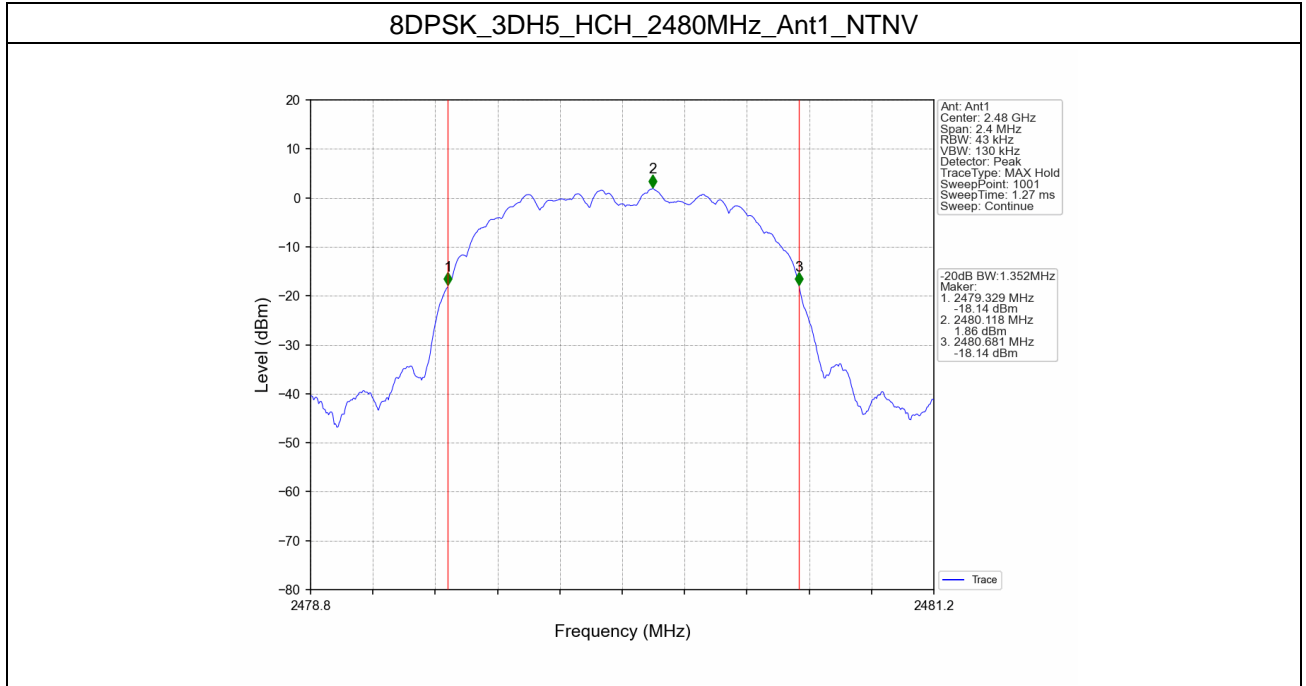


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## 2. Maximum Conducted Output Power

### 2.1 Power

#### 2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	7.01	<=30	Pass
		2441	DH5	6.05	<=30	Pass
		2480	DH5	6.39	<=30	Pass
Pi/4DQPSK	SISO	2402	2DH5	9.84	<=20.97	Pass
		2441	2DH5	8.93	<=20.97	Pass
		2480	2DH5	8.82	<=20.97	Pass
8DPSK	SISO	2402	3DH5	10.33	<=20.97	Pass
		2441	3DH5	9.41	<=20.97	Pass
		2480	3DH5	8.86	<=20.97	Pass

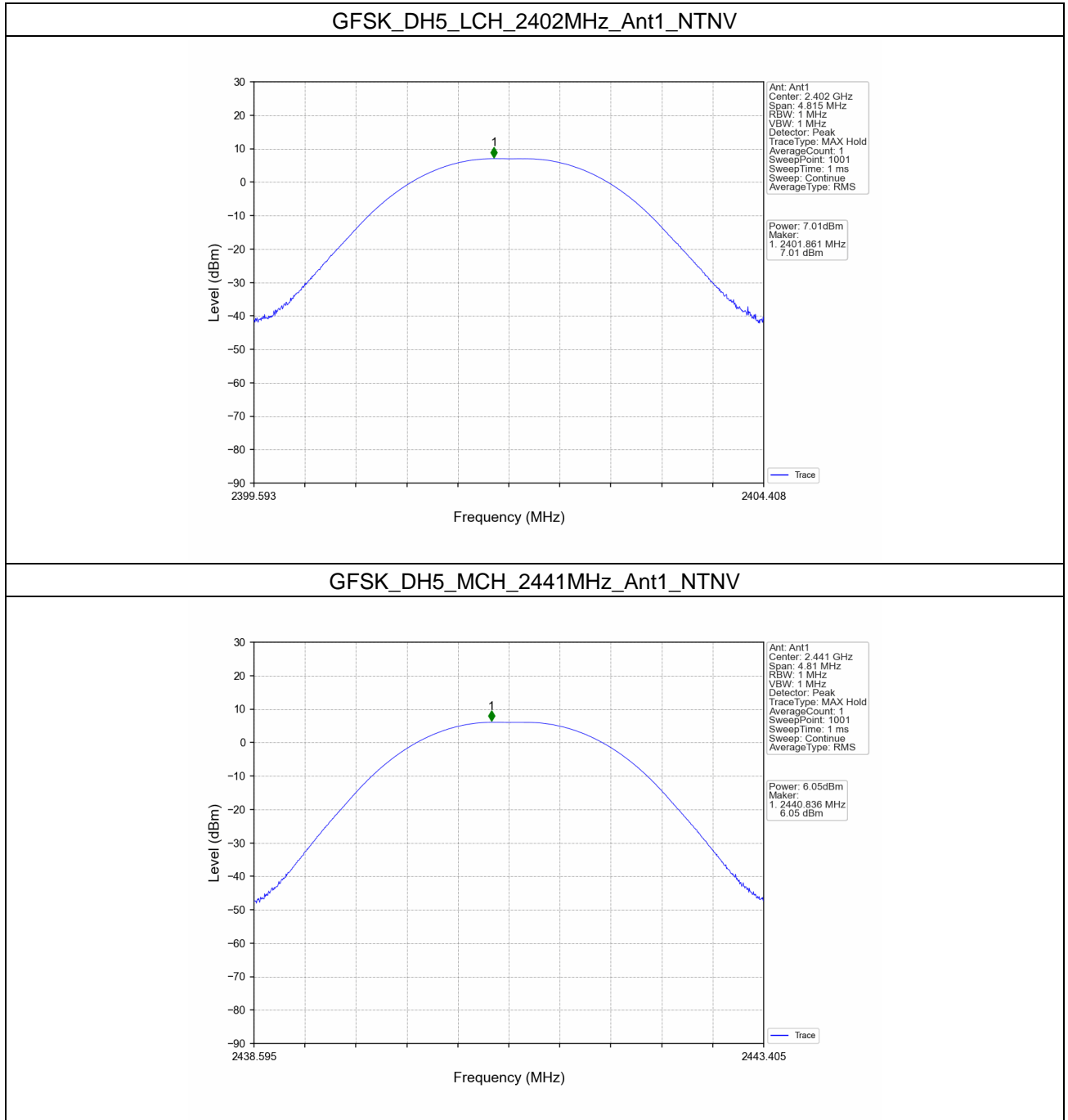
Note1: Antenna Gain: Ant1: 4.43dBi;



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### 2.1.2 Test Graph



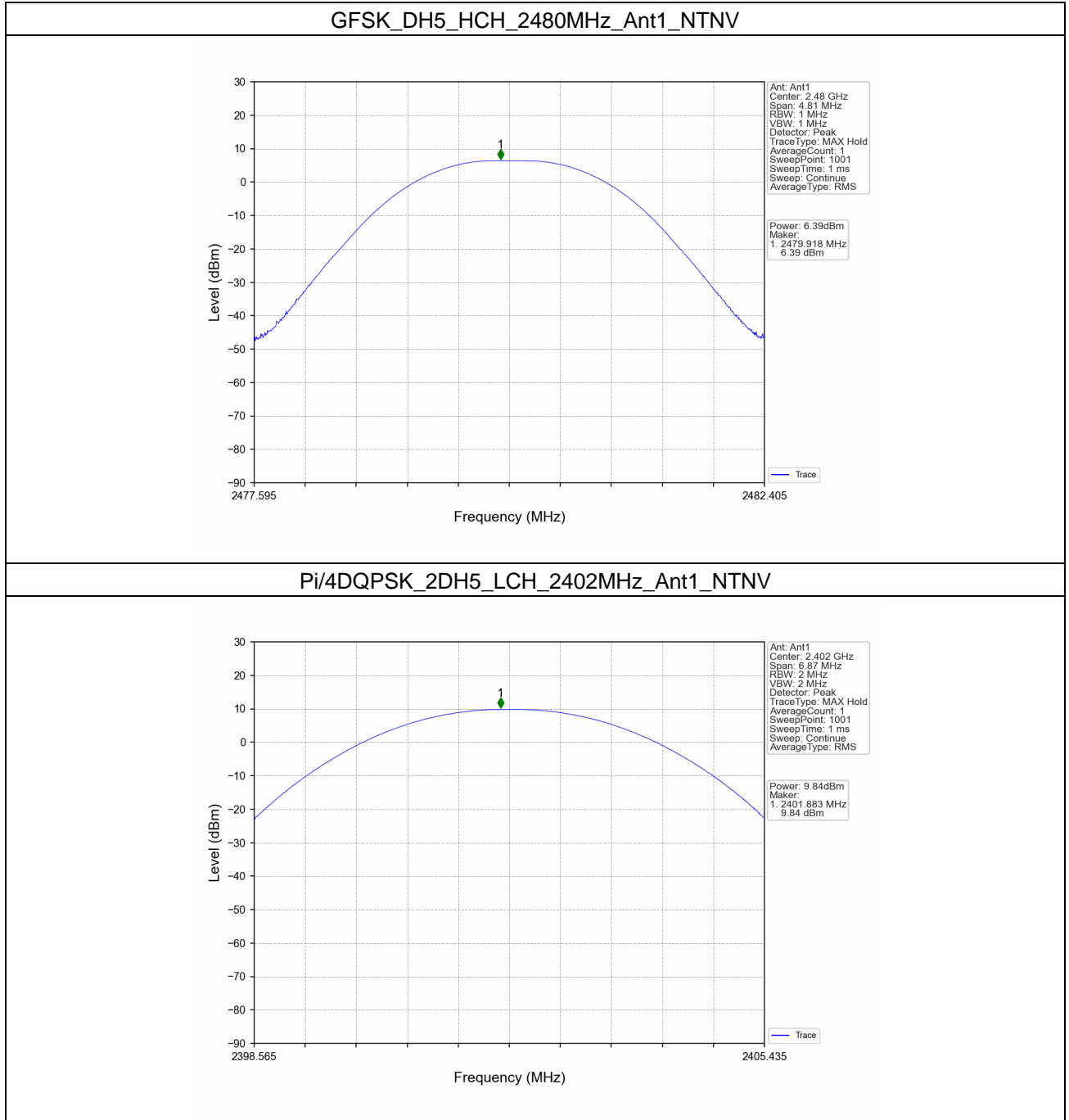
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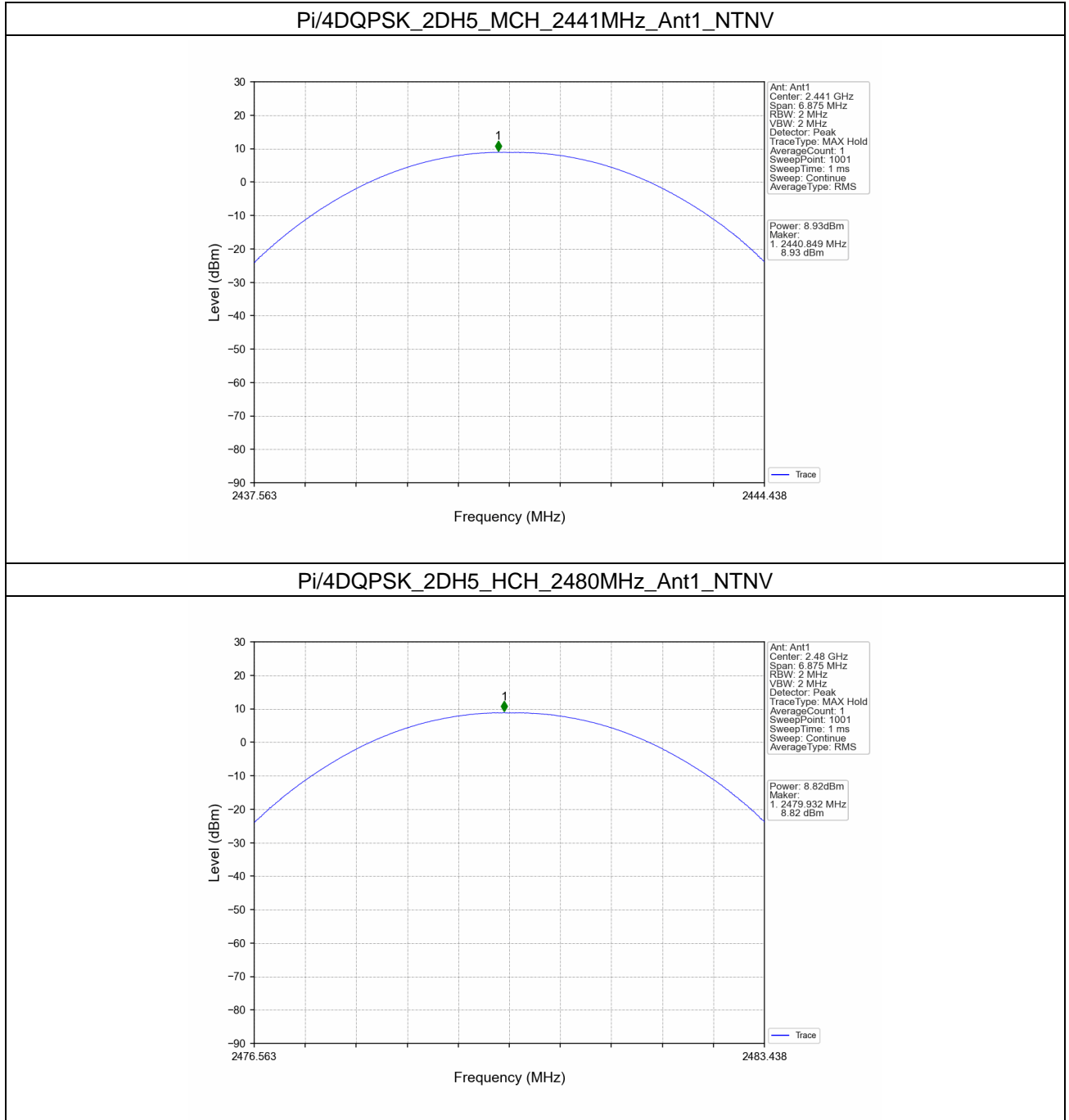




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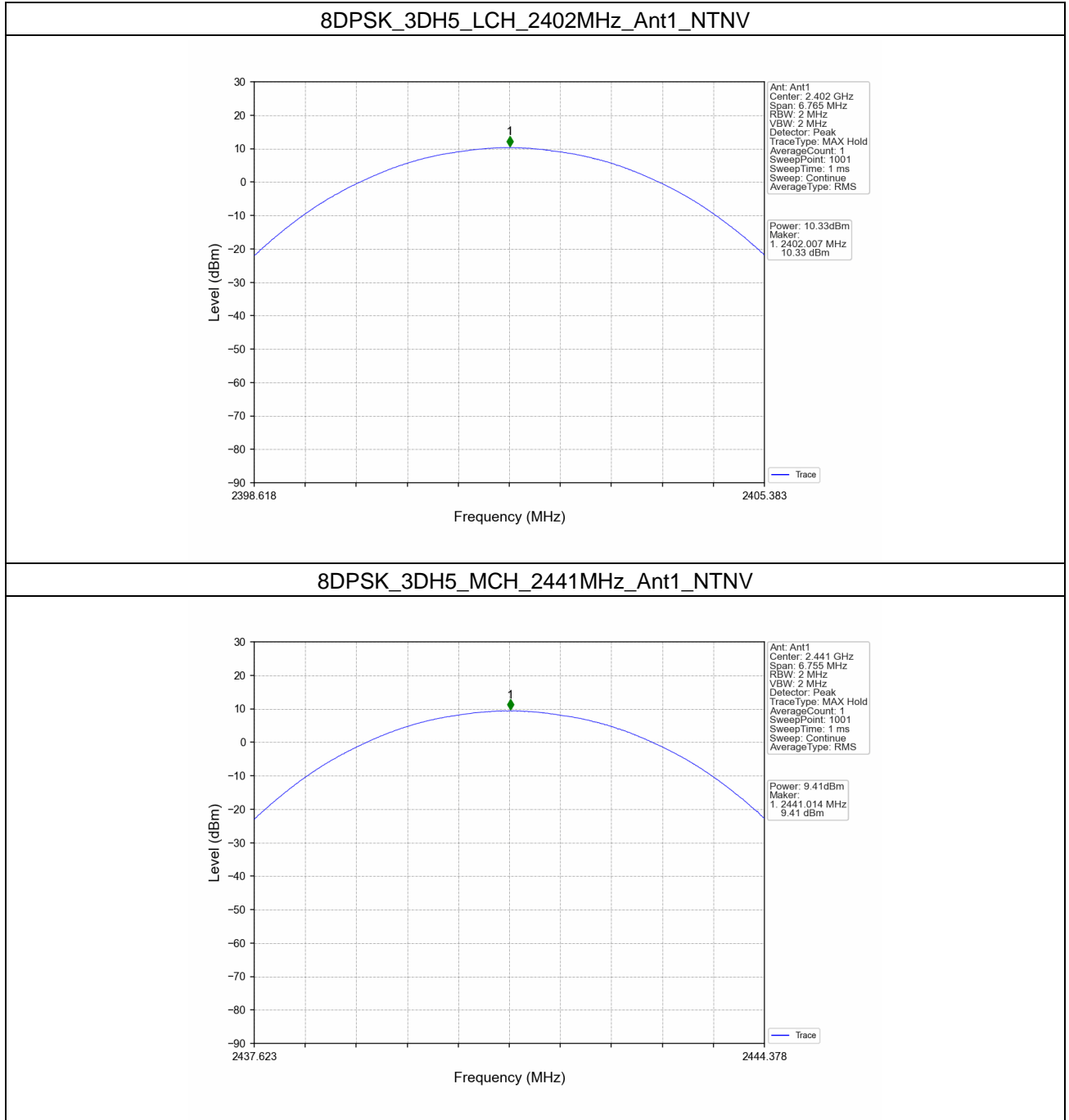
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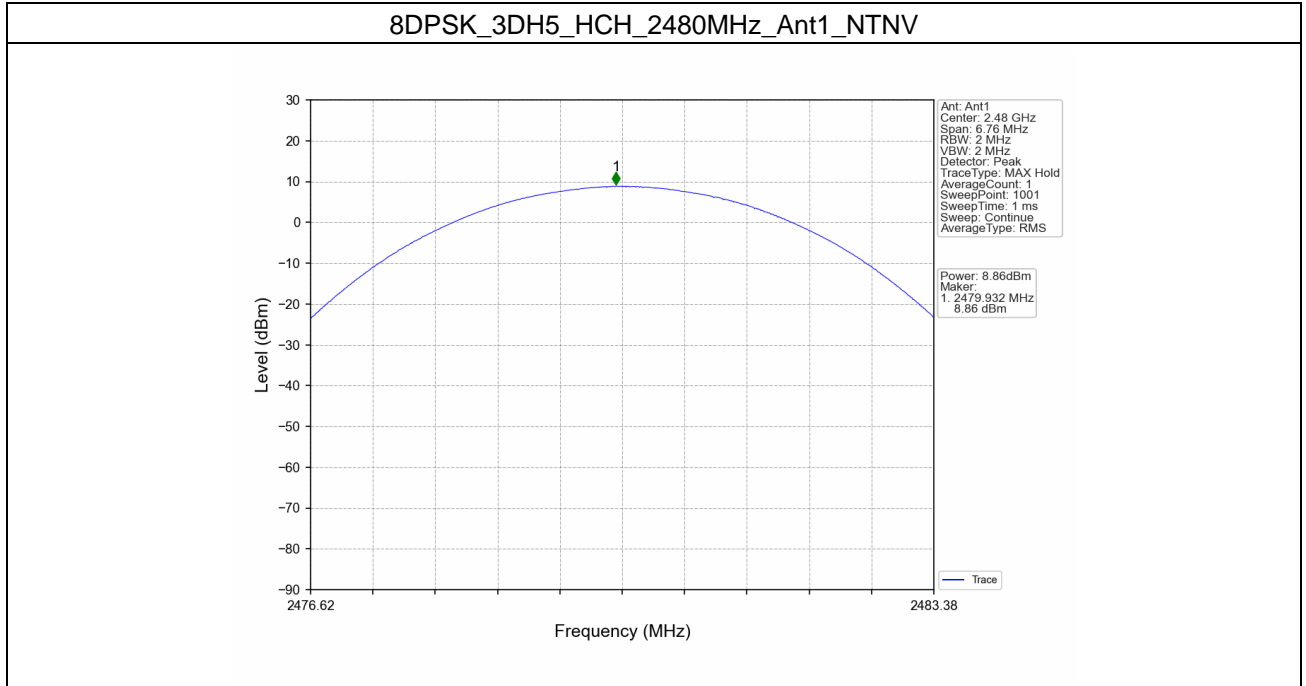
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### 3. Carrier Frequency Separation

#### 3.1 Ant1

##### 3.1.1 Test Result

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	0.992	0.963	$\geq 0.963$	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.001	1.375	$\geq 0.917$	Pass
8DPSK	SISO	HOPP	3DH5	1.003	1.353	$\geq 0.902$	Pass



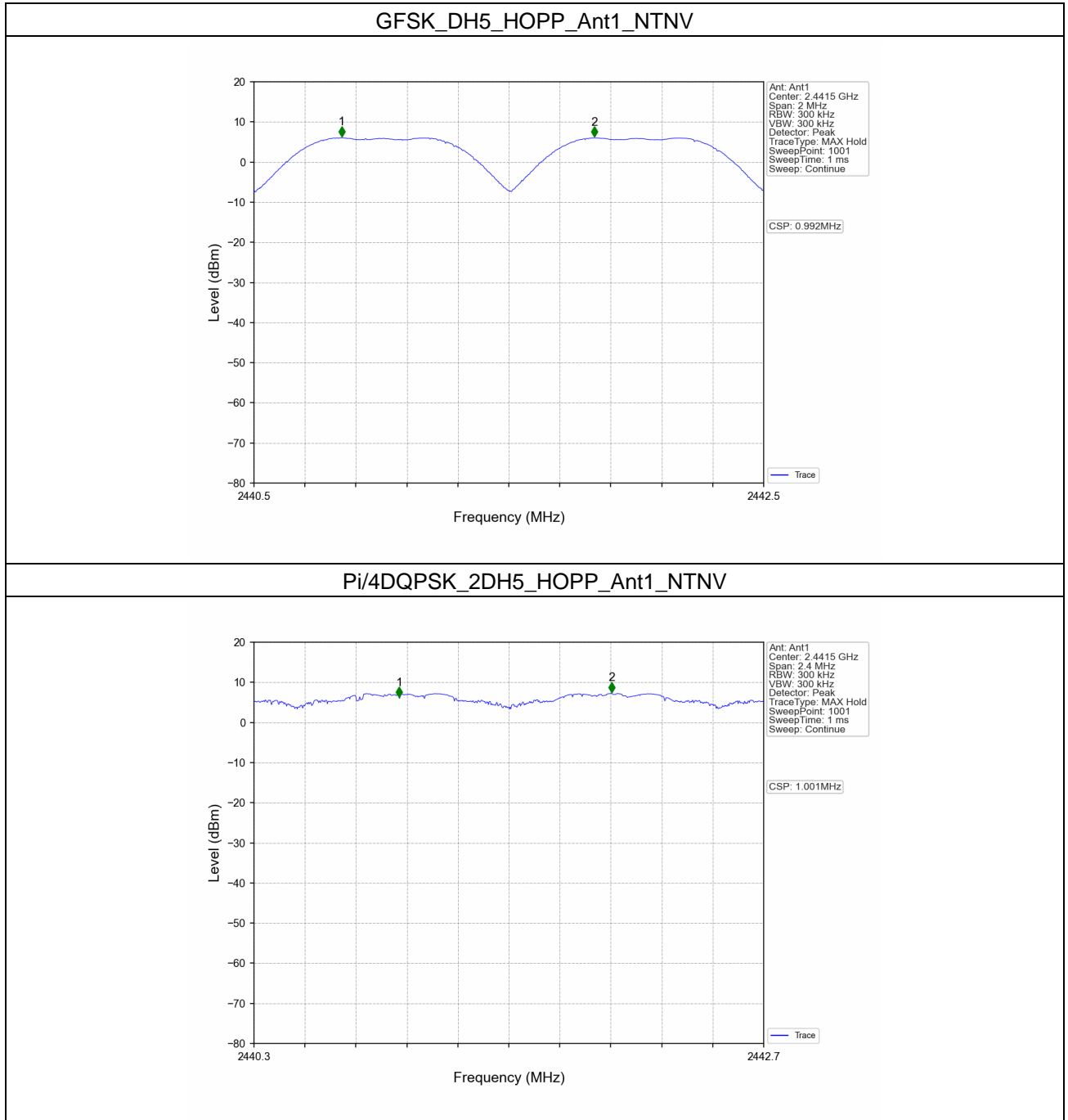
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### 3.1.2 Test Graph



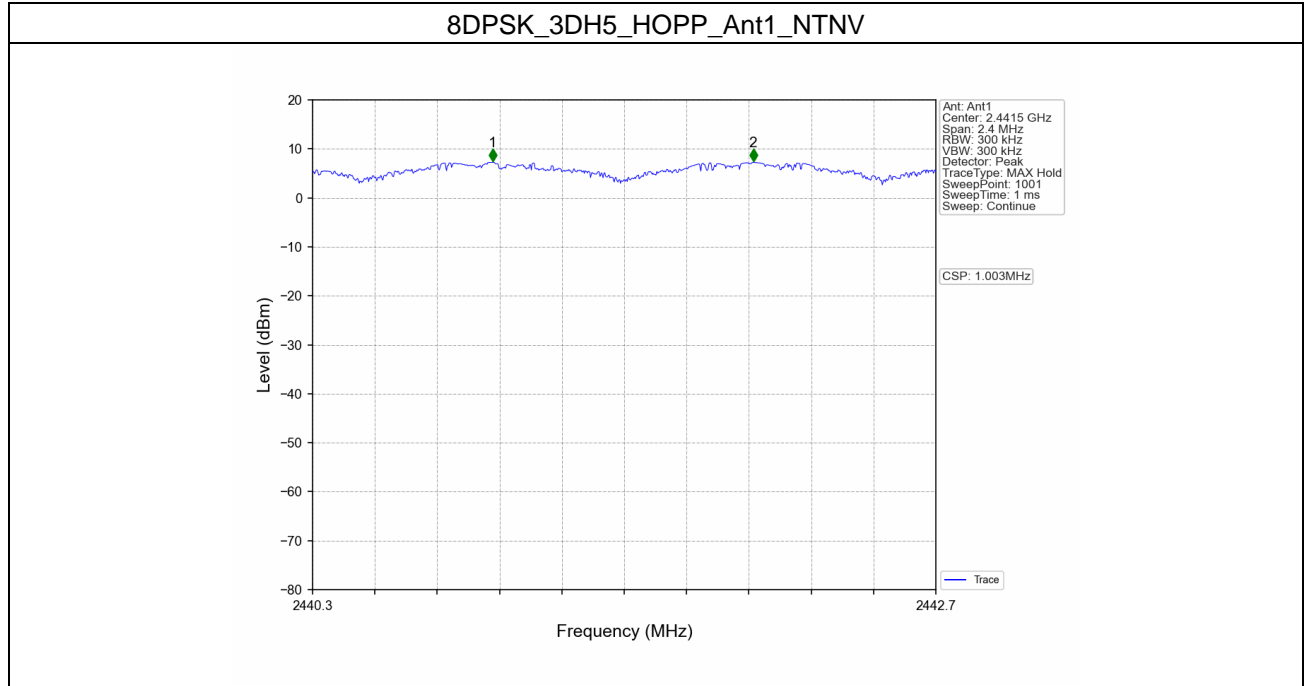
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### 4. Number of Hopping Frequencies

#### 4.1 HoppNum

##### 4.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	>=15	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	79	>=15	Pass
8DPSK	SISO	HOPP	3DH5	79	>=15	Pass

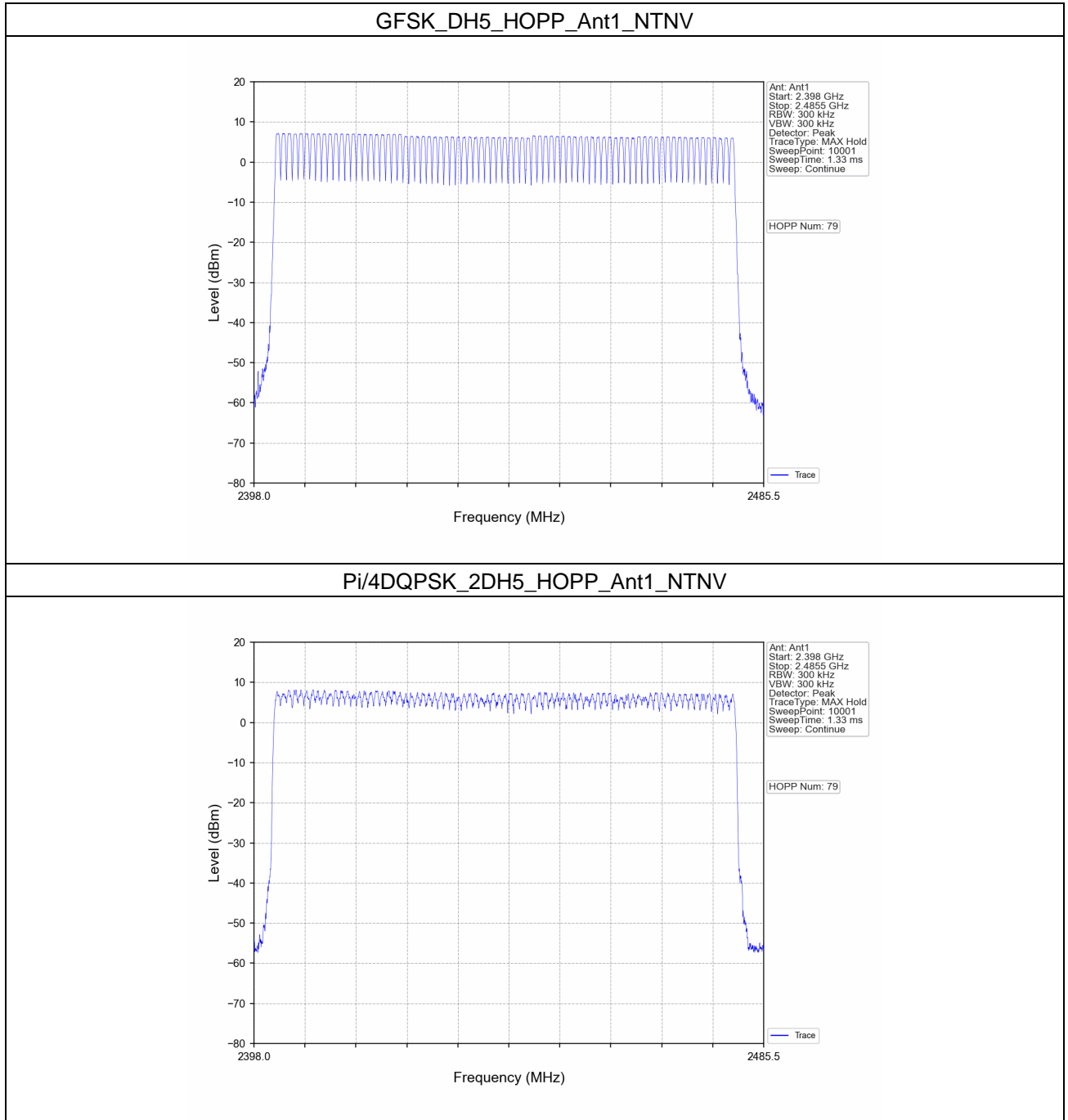


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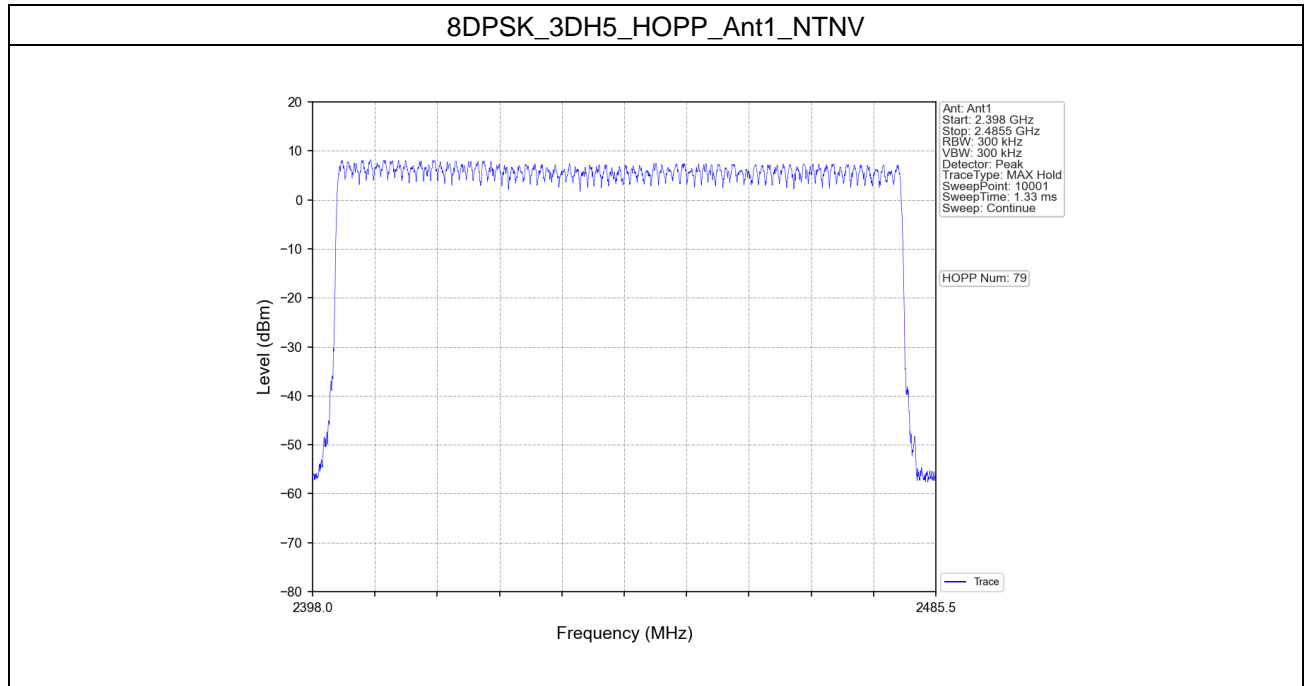
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### 4.1.2 Test Graph



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### 5. Time of Occupancy (Dwell Time)

#### 5.1 Ant1

##### 5.1.1 Test Result

Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.394	31.600	320	126.080	<=400	Pass
			DH3	1.648	31.600	153	252.144	<=400	Pass
			DH5	2.890	31.600	121	349.690	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.396	31.600	320	126.720	<=400	Pass
			2DH3	1.658	31.600	167	276.886	<=400	Pass
			2DH5	2.904	31.600	117	339.768	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.396	31.600	320	126.720	<=400	Pass
			3DH3	1.656	31.600	164	271.584	<=400	Pass
			3DH5	2.908	31.600	116	337.328	<=400	Pass



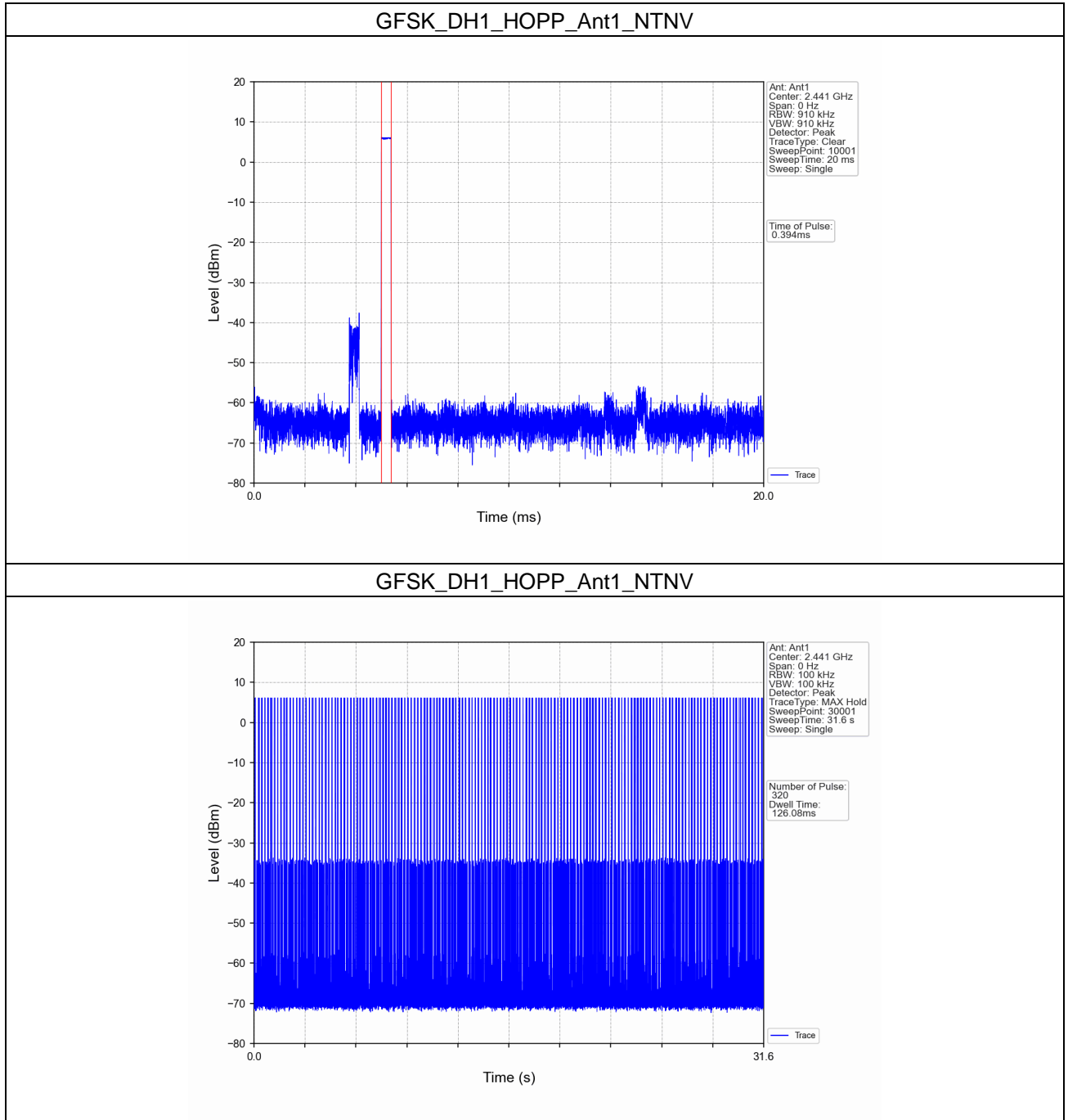
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### 5.1.2 Test Graph



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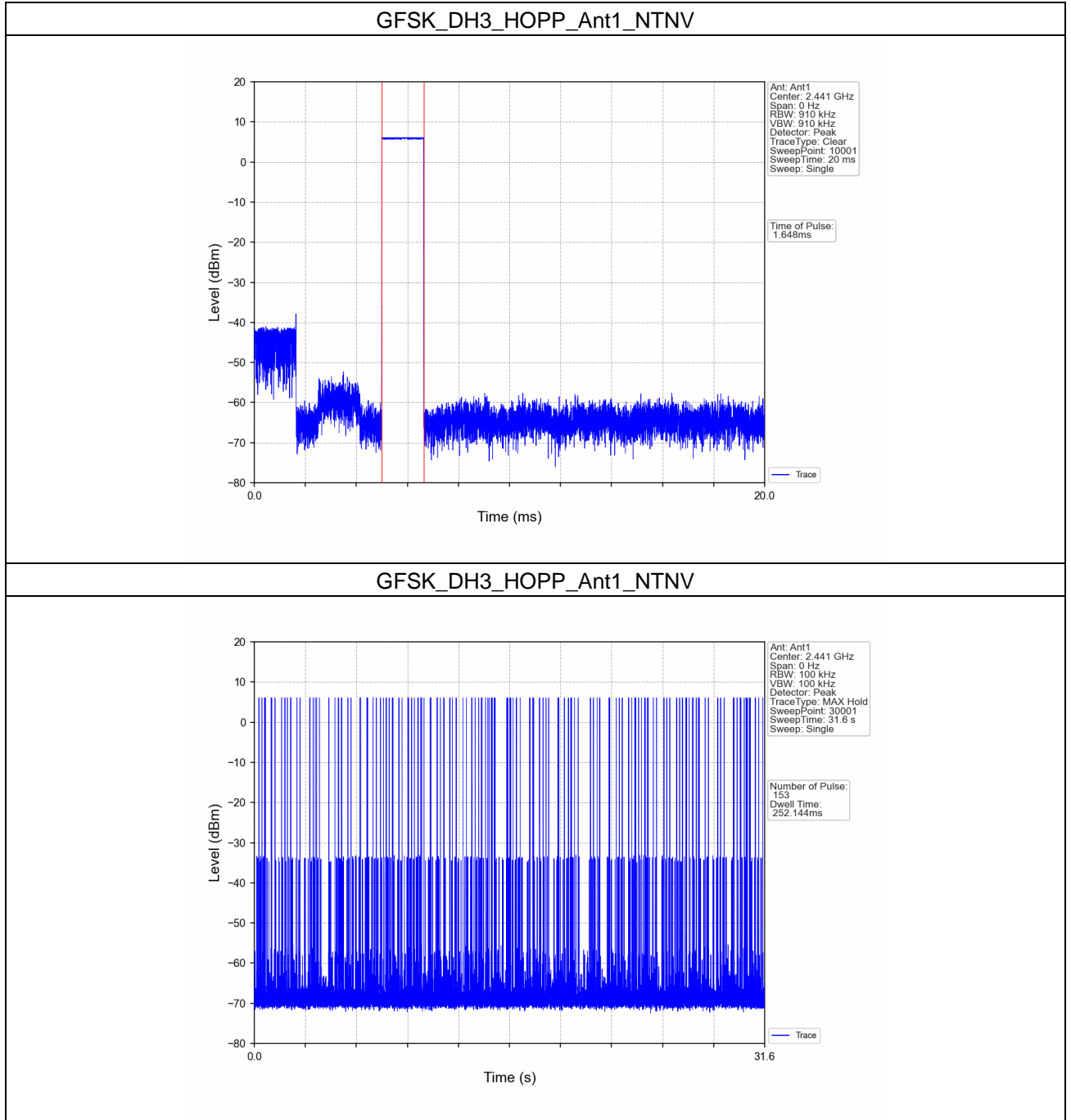
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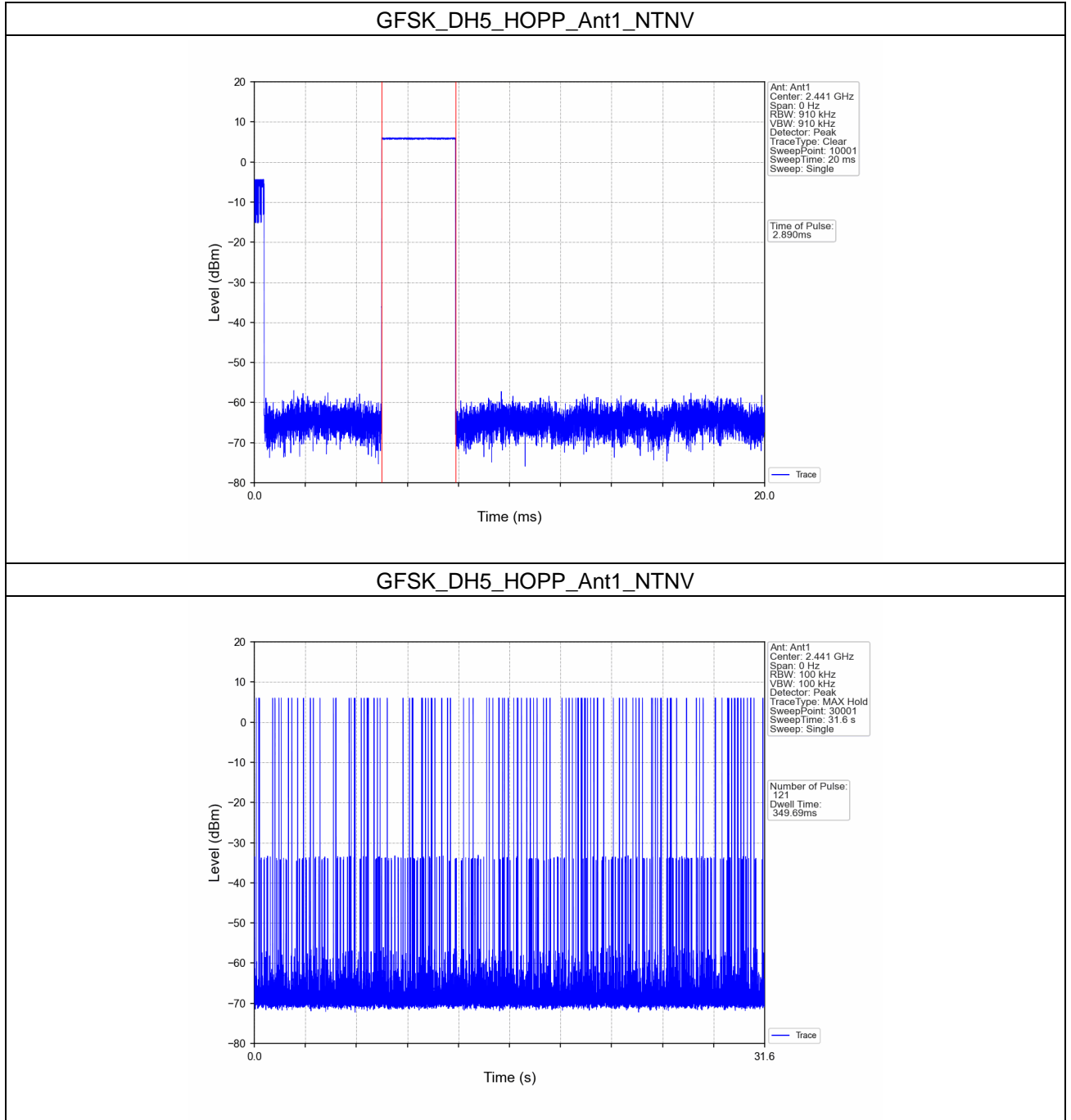
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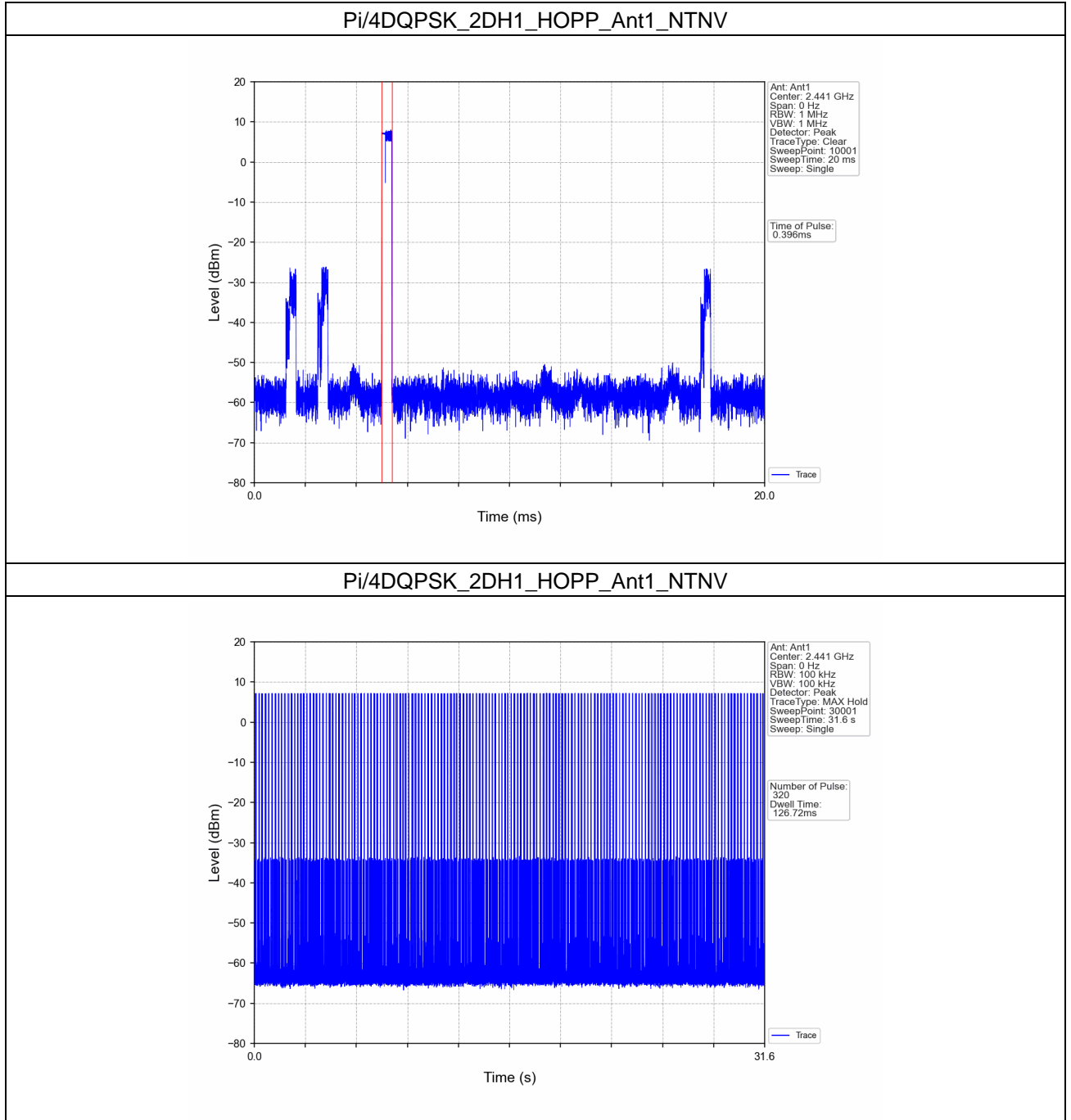


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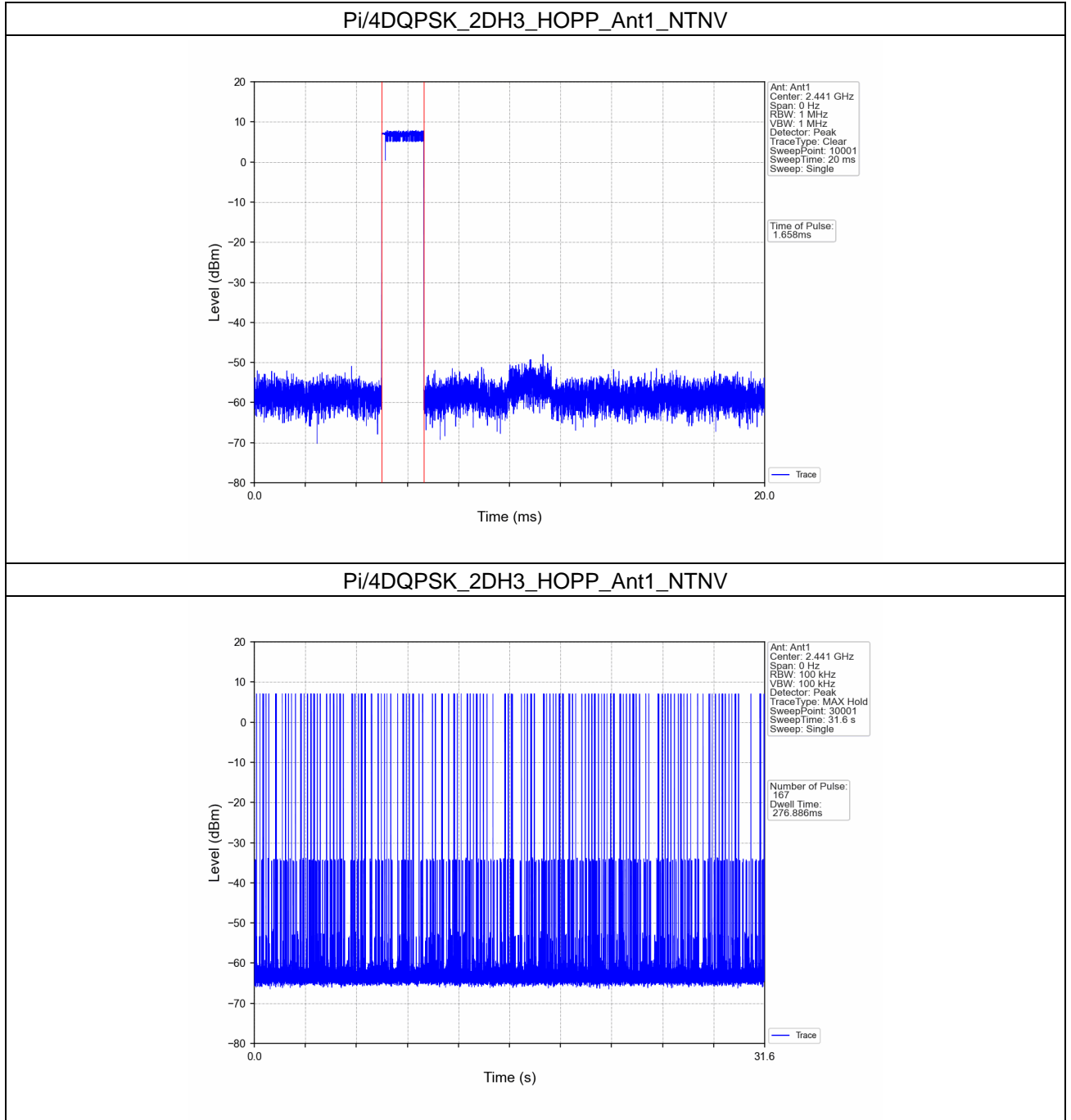


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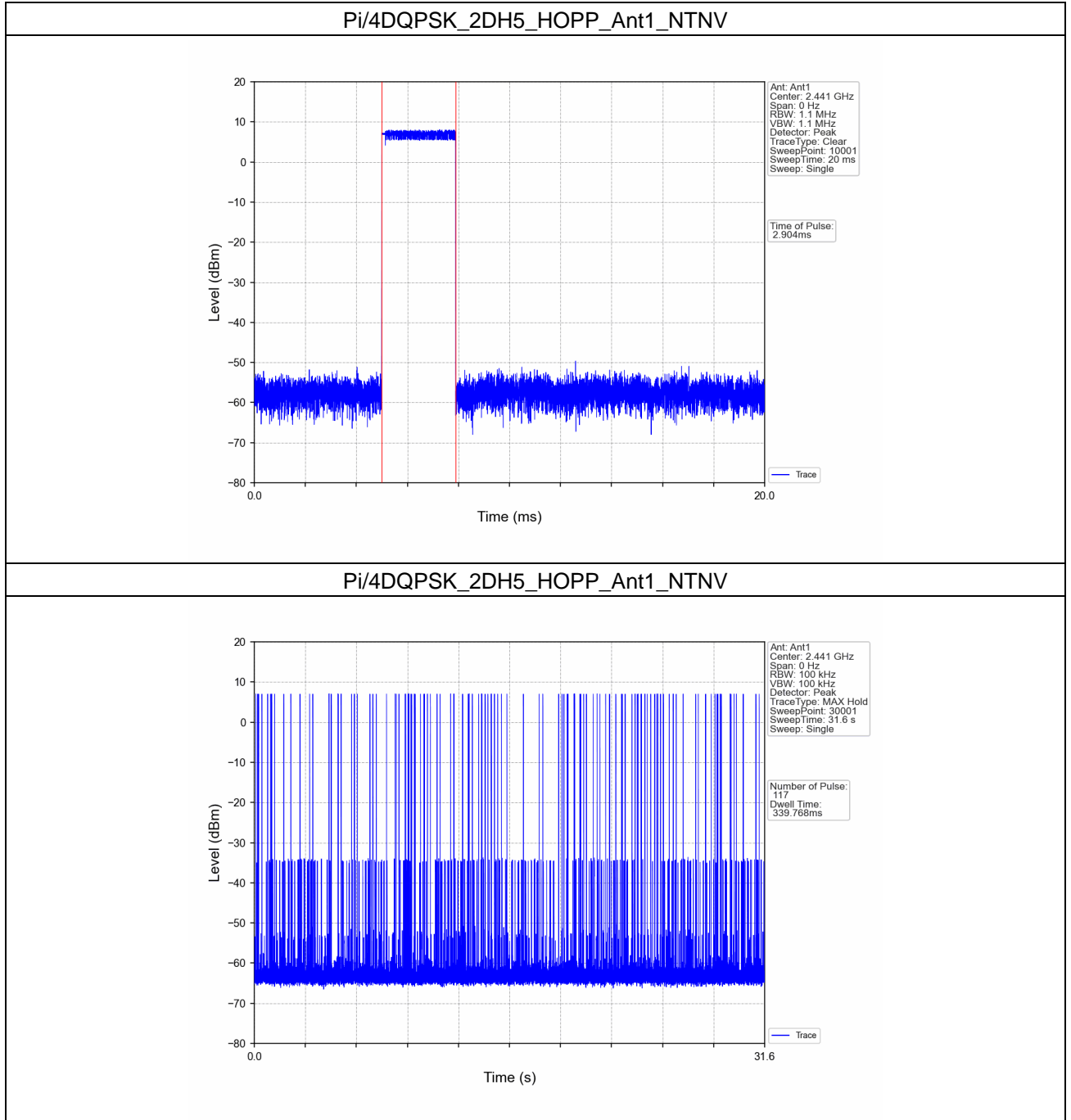


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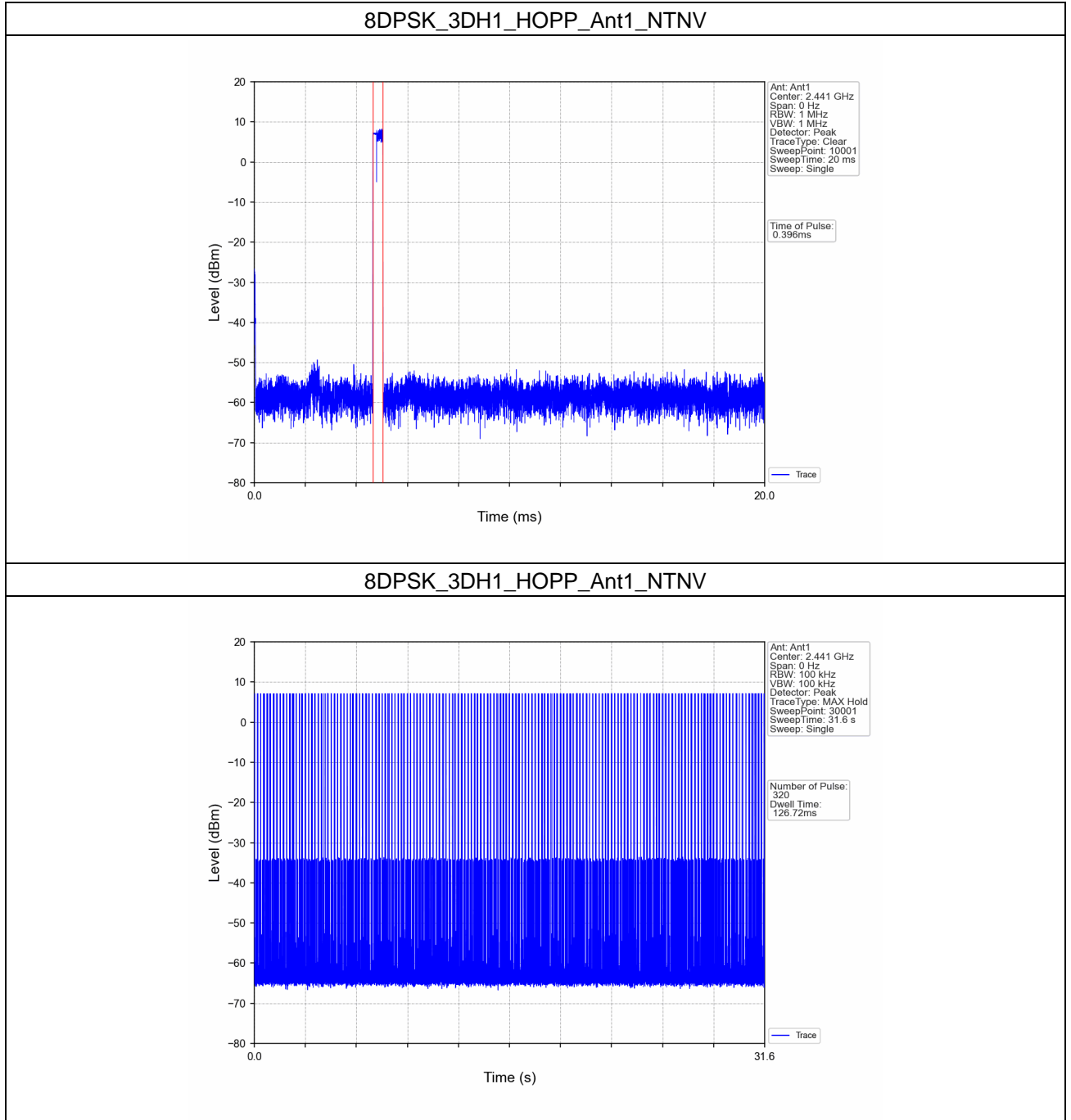


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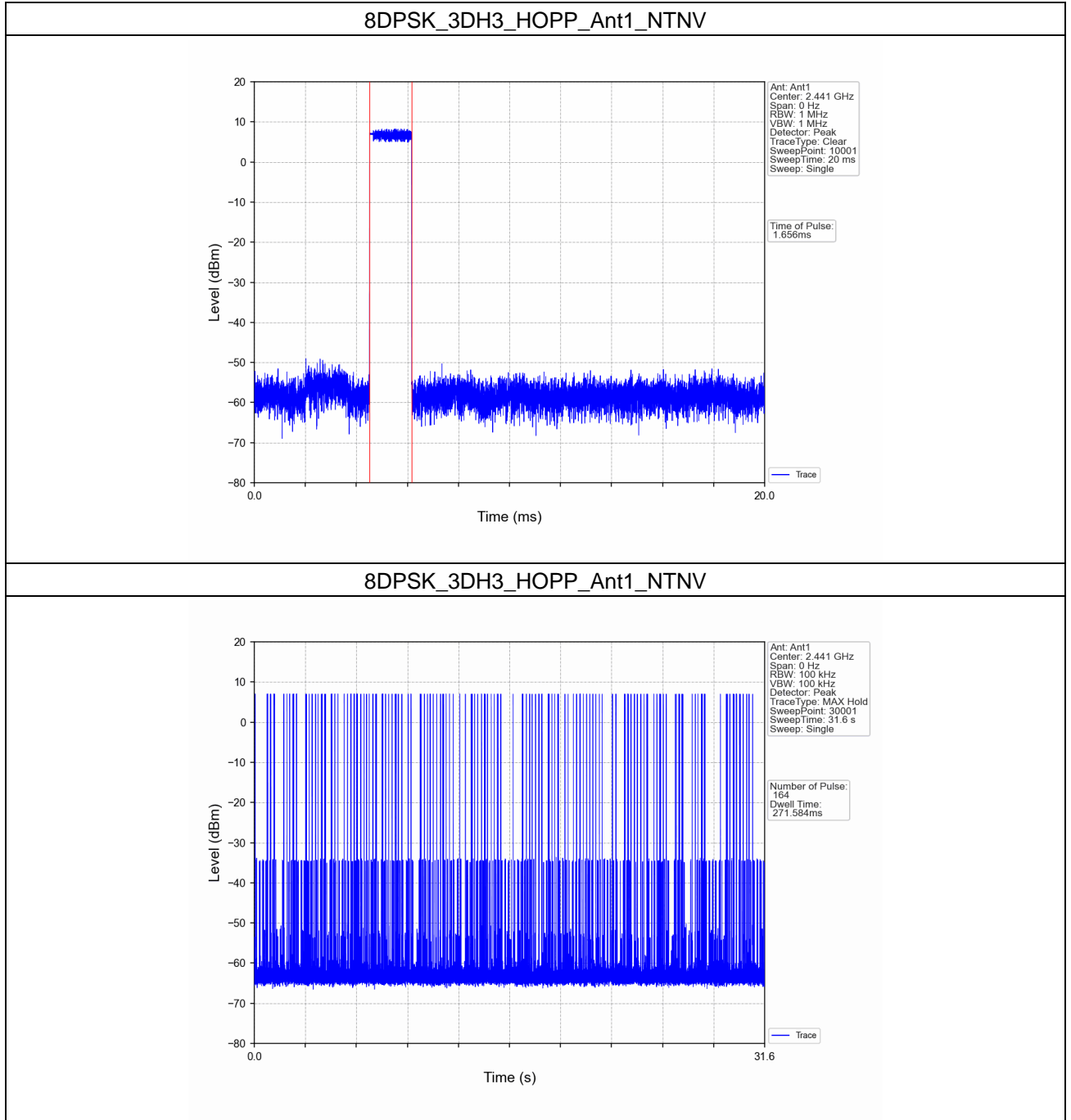
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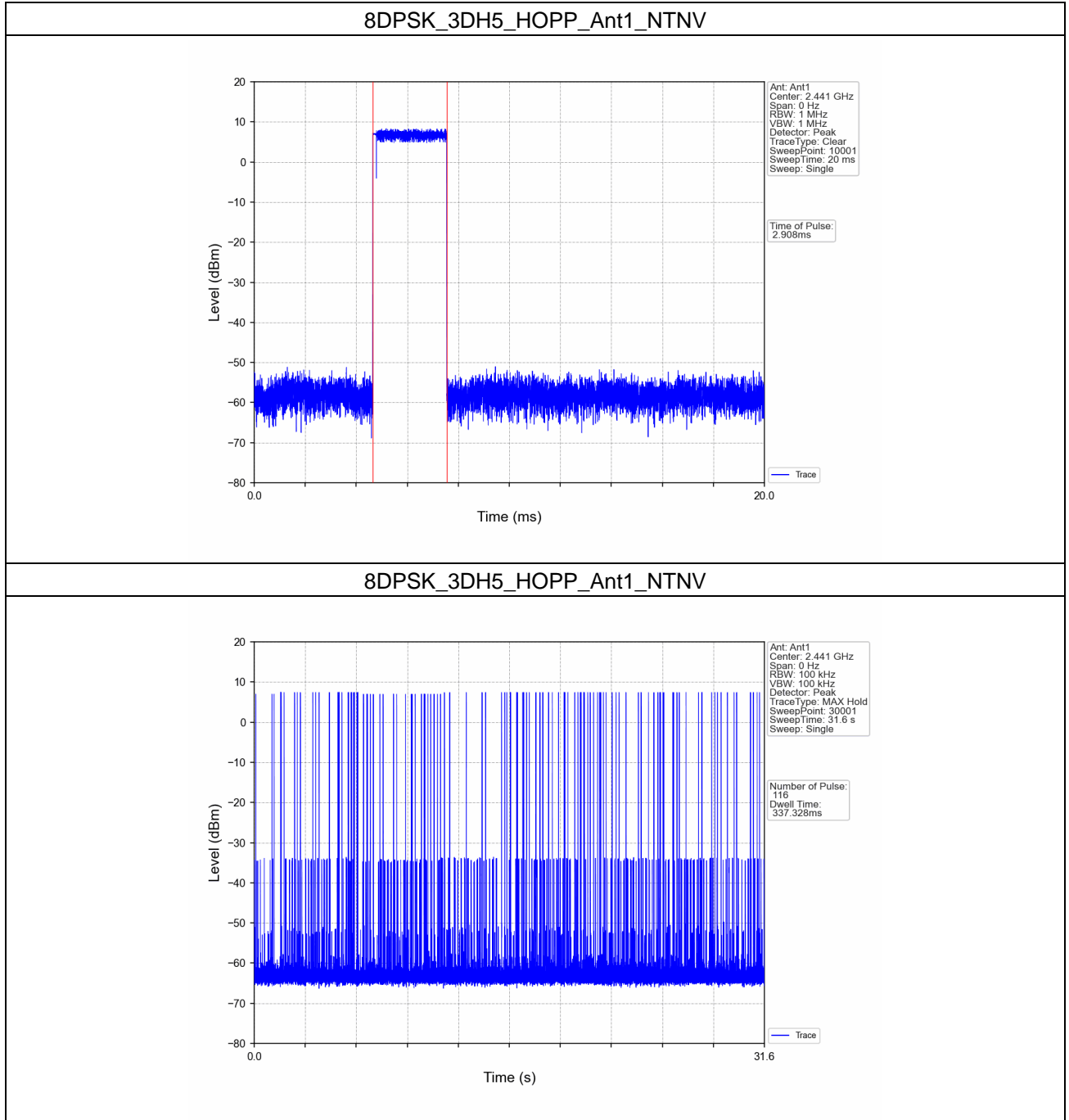


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## 6. Unwanted Emissions InStandard Non-restricted Frequency Bands

### 6.1 Ref

#### 6.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	6.36
		2441	DH5	1	5.41
		2480	DH5	1	5.76
Pi/4DQPSK	SISO	2402	2DH5	1	5.84
		2441	2DH5	1	4.85
		2480	2DH5	1	4.79
8DPSK	SISO	2402	3DH5	1	5.73
		2441	3DH5	1	4.78
		2480	3DH5	1	4.25

Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.

#### 6.1.2 Test Graph

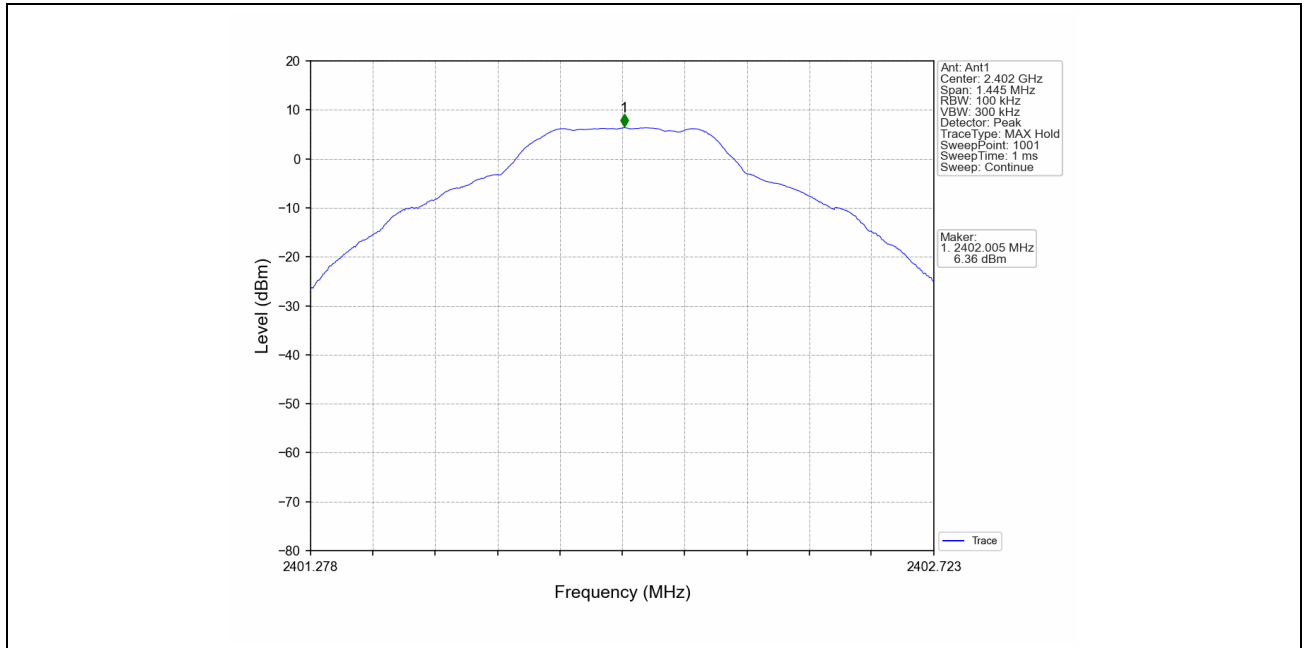
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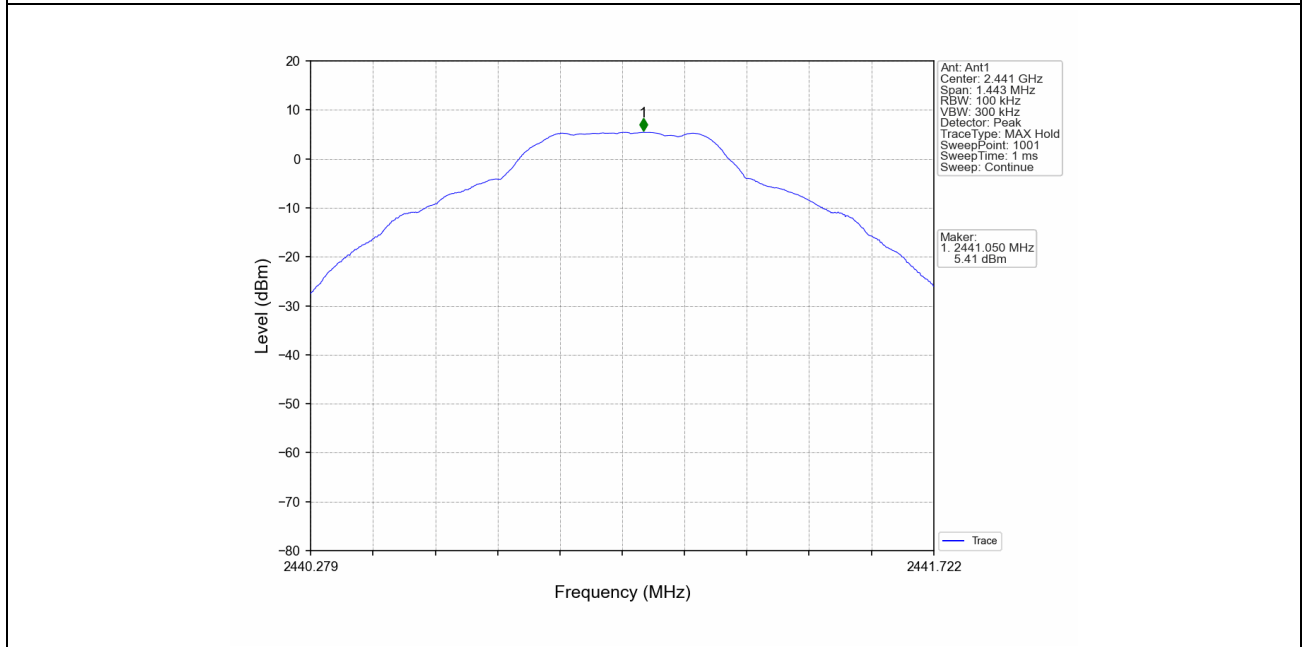
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GFSK\_DH5\_MCH\_2441MHz\_Ant1\_NTNV



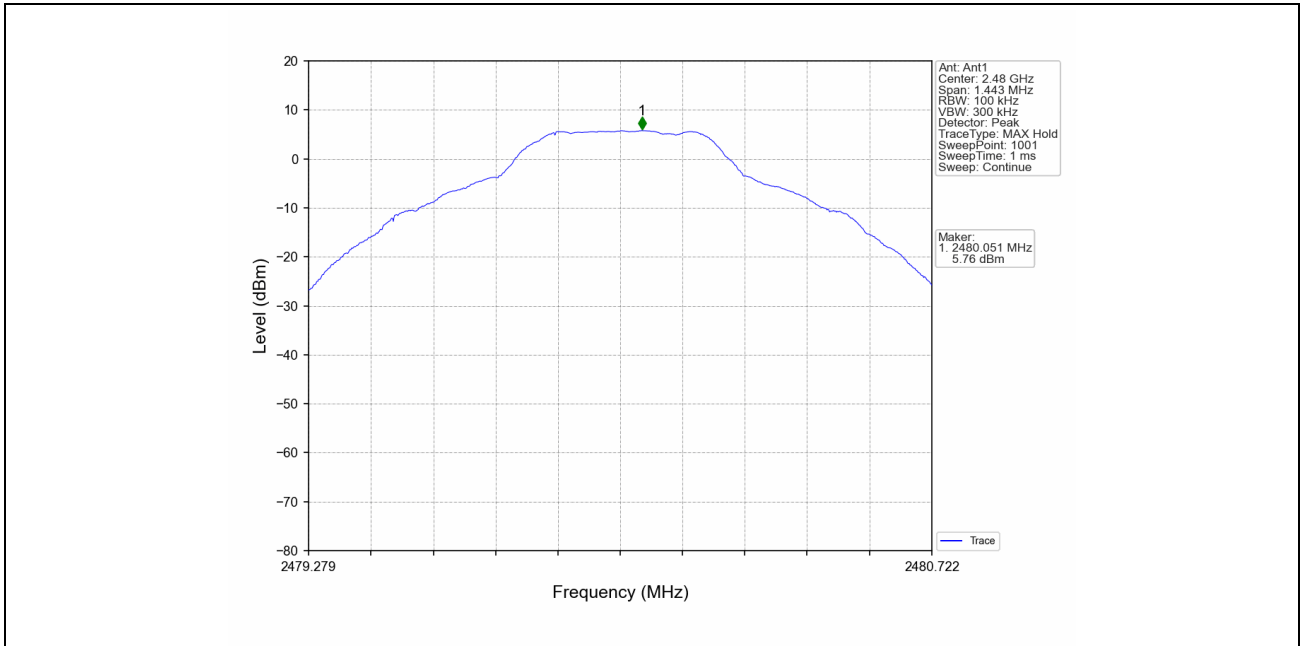
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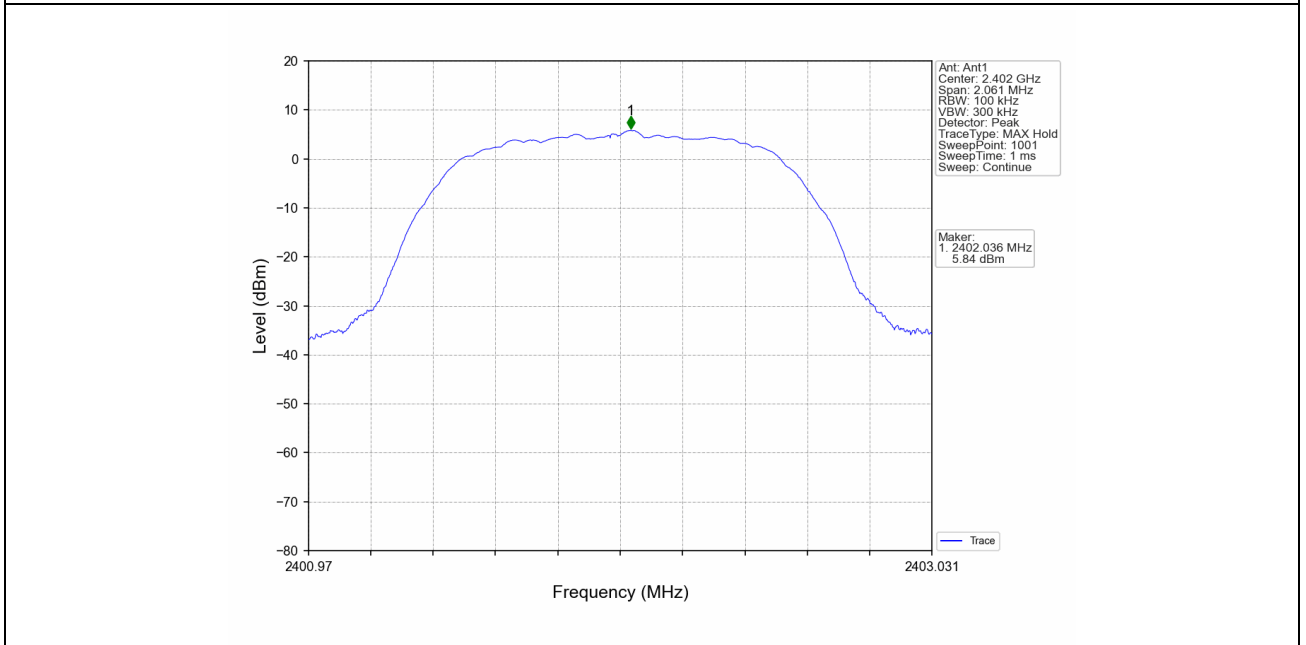
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Pi/4DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV



Pi/4DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV



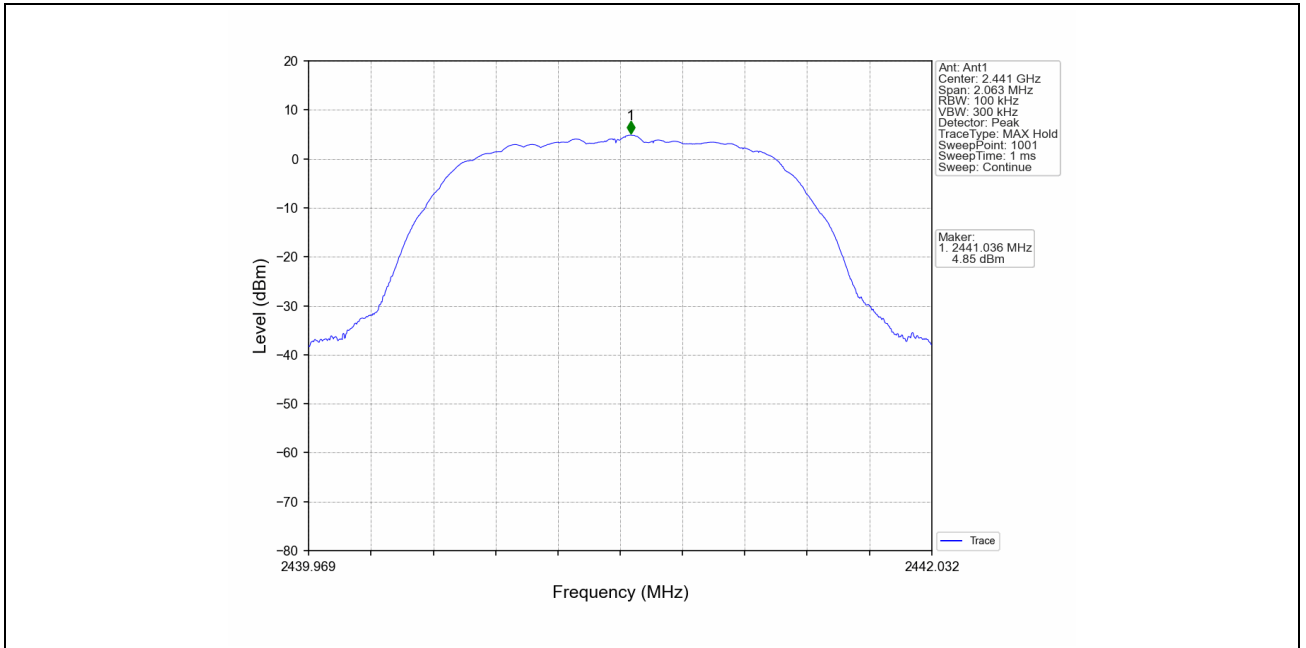
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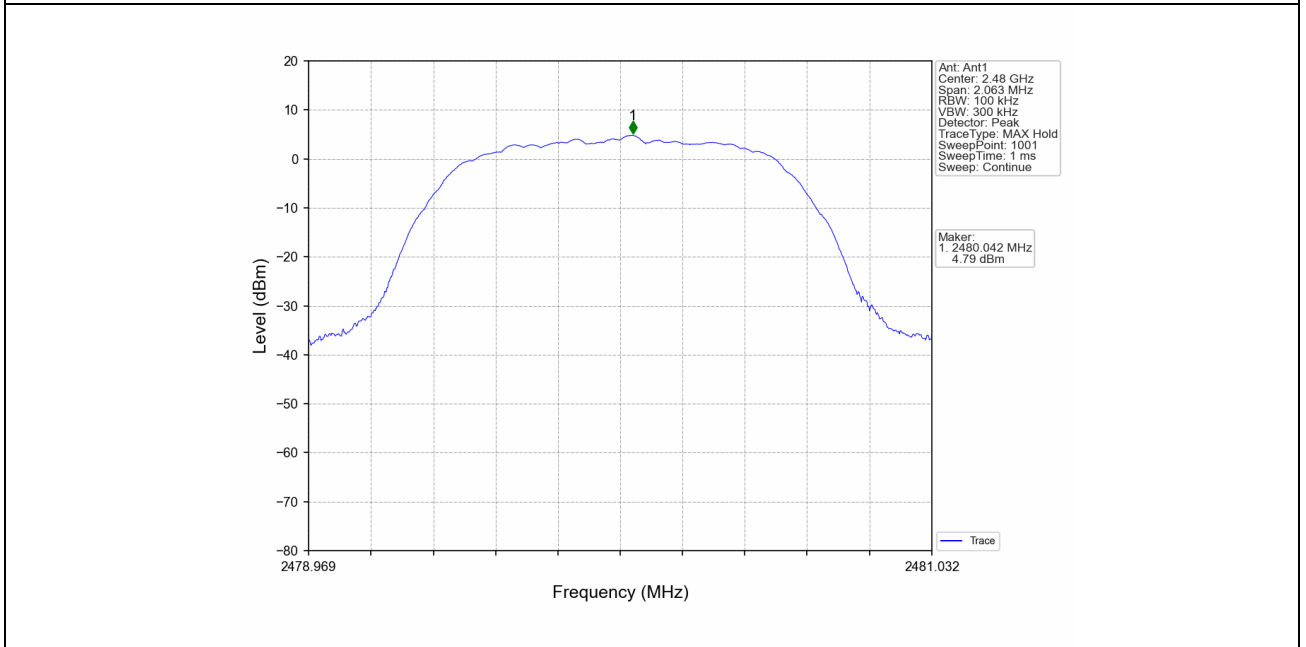
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Pi/4DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV



8DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV

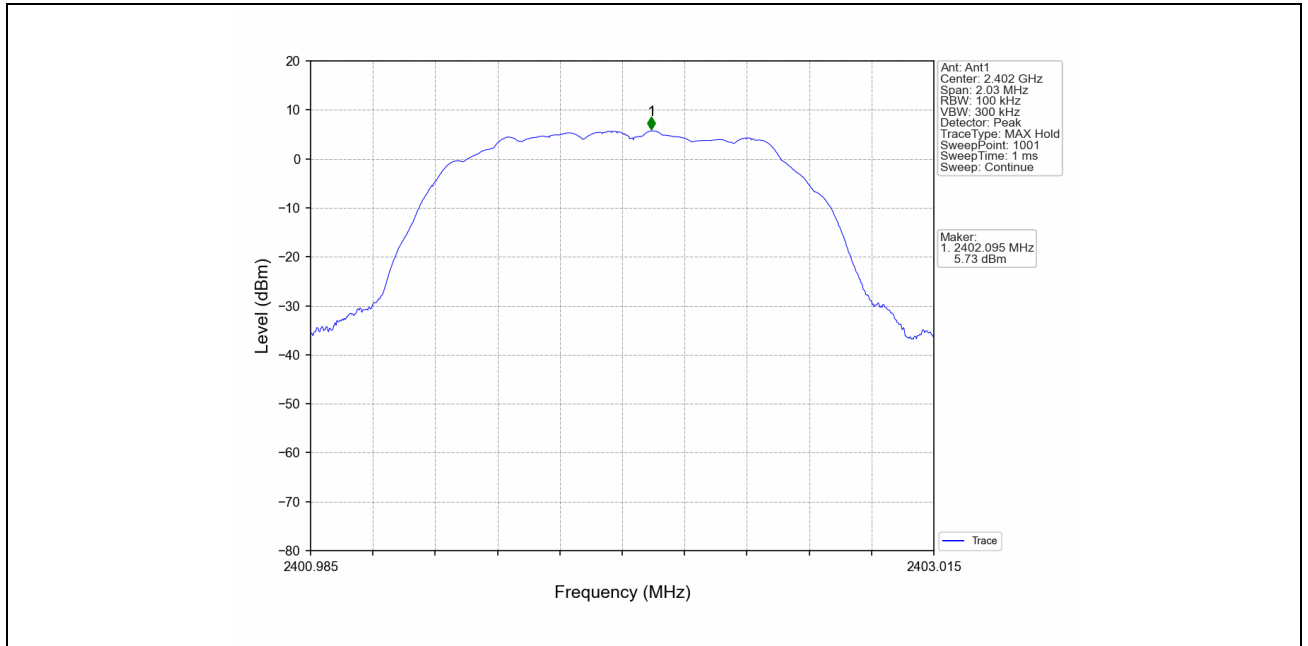


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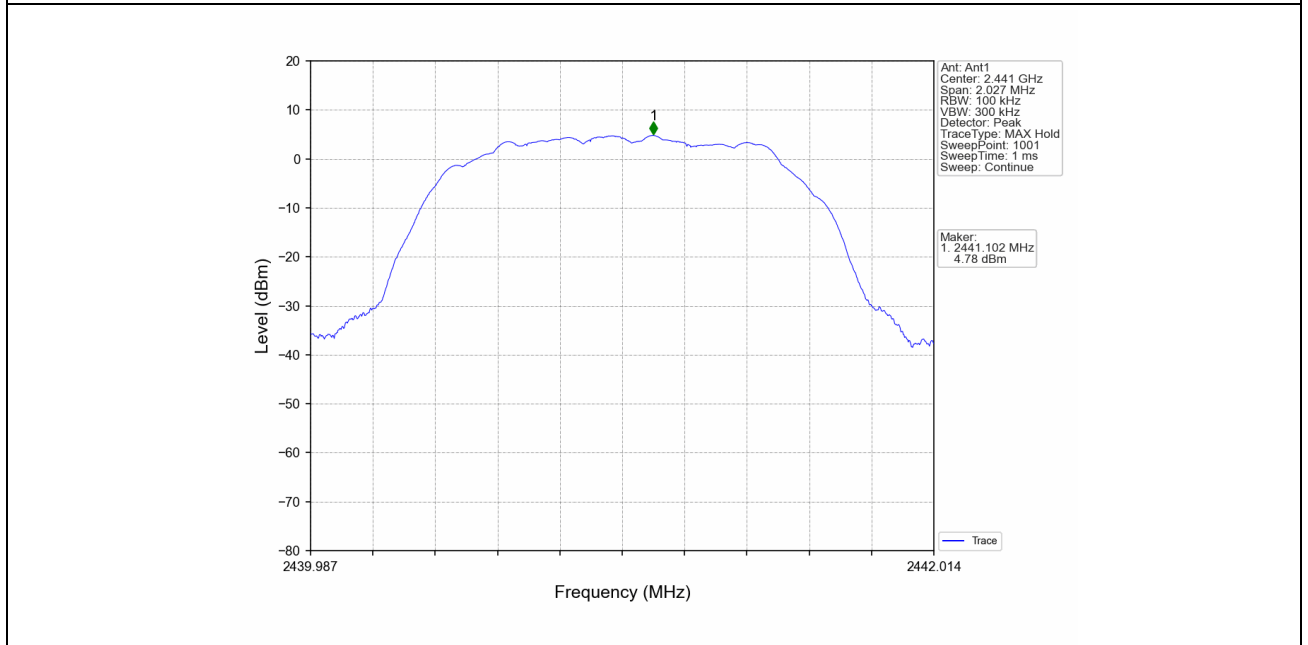
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8DPSK\_3DH5\_MCH\_2441MHz\_Ant1\_NTNV



8DPSK\_3DH5\_HCH\_2480MHz\_Ant1\_NTNV



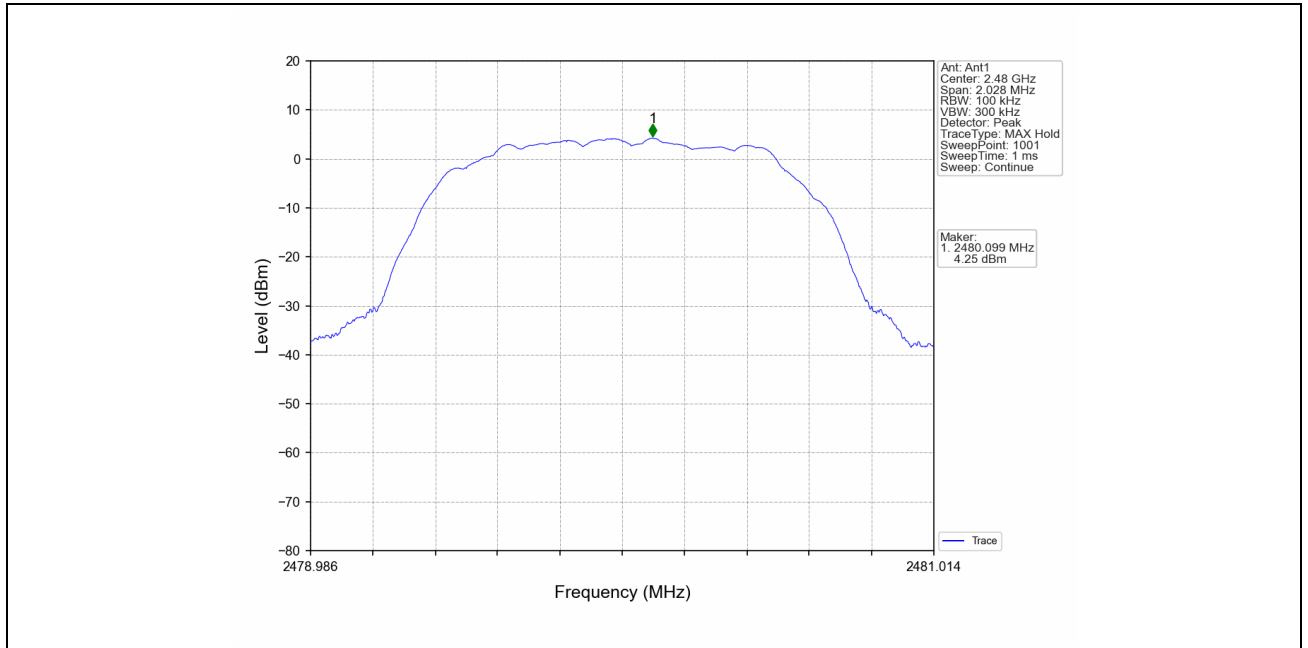
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### 6.2 CSE

#### 6.2.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	6.36	-13.64	Pass
		2441	DH5	1	6.36	-13.64	Pass
		2480	DH5	1	6.36	-13.64	Pass
		HOPP	DH5	1	6.36	-13.64	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	5.84	-14.16	Pass
		2441	2DH5	1	5.84	-14.16	Pass
		2480	2DH5	1	5.84	-14.16	Pass
		HOPP	2DH5	1	5.84	-14.16	Pass
8DPSK	SISO	2402	3DH5	1	5.73	-14.27	Pass
		2441	3DH5	1	5.73	-14.27	Pass
		2480	3DH5	1	5.73	-14.27	Pass
		HOPP	3DH5	1	5.73	-14.27	Pass

Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.

#### 6.2.2 Test Graph

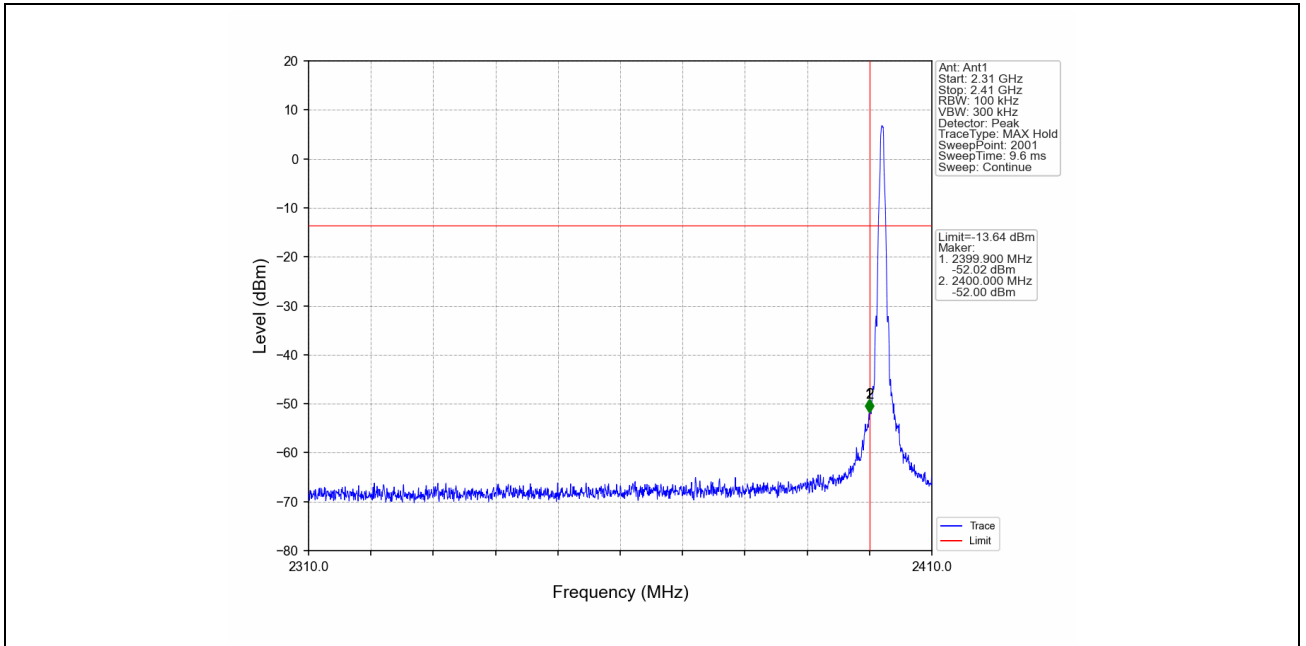
GFSK\_DH5\_LCH\_2402MHz\_Ant1\_NTNV



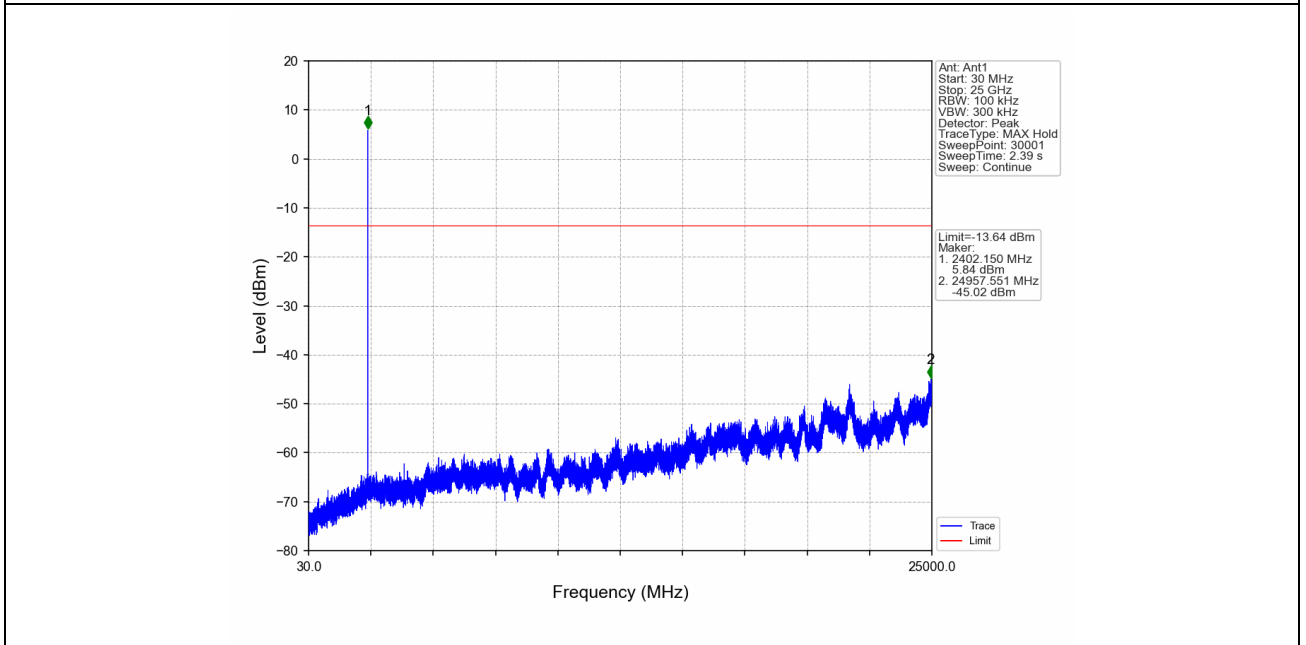
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GFSK\_DH5\_MCH\_2441MHz\_Ant1\_NTNV



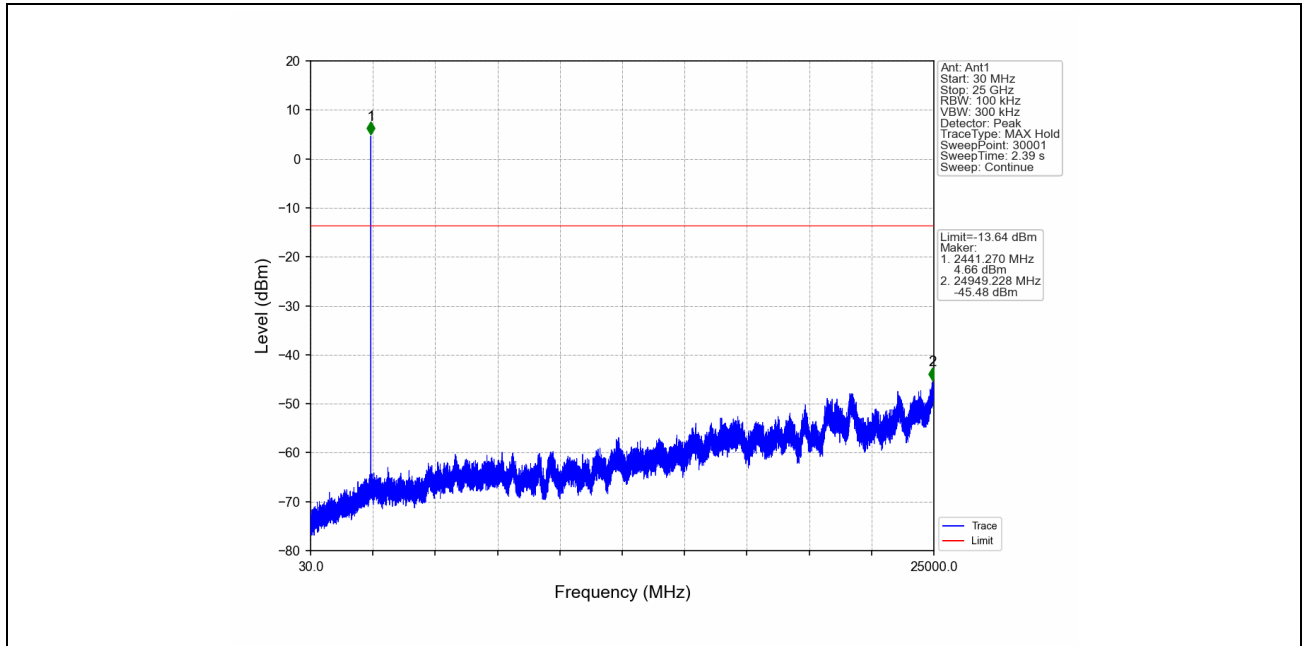
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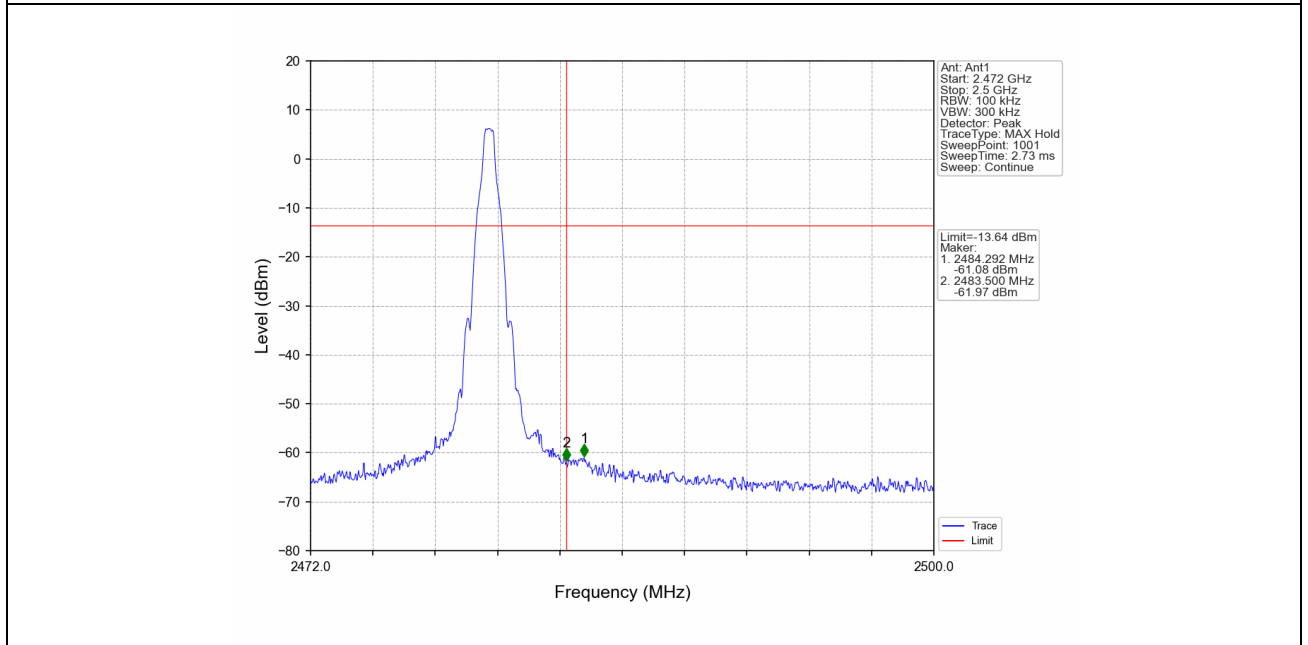
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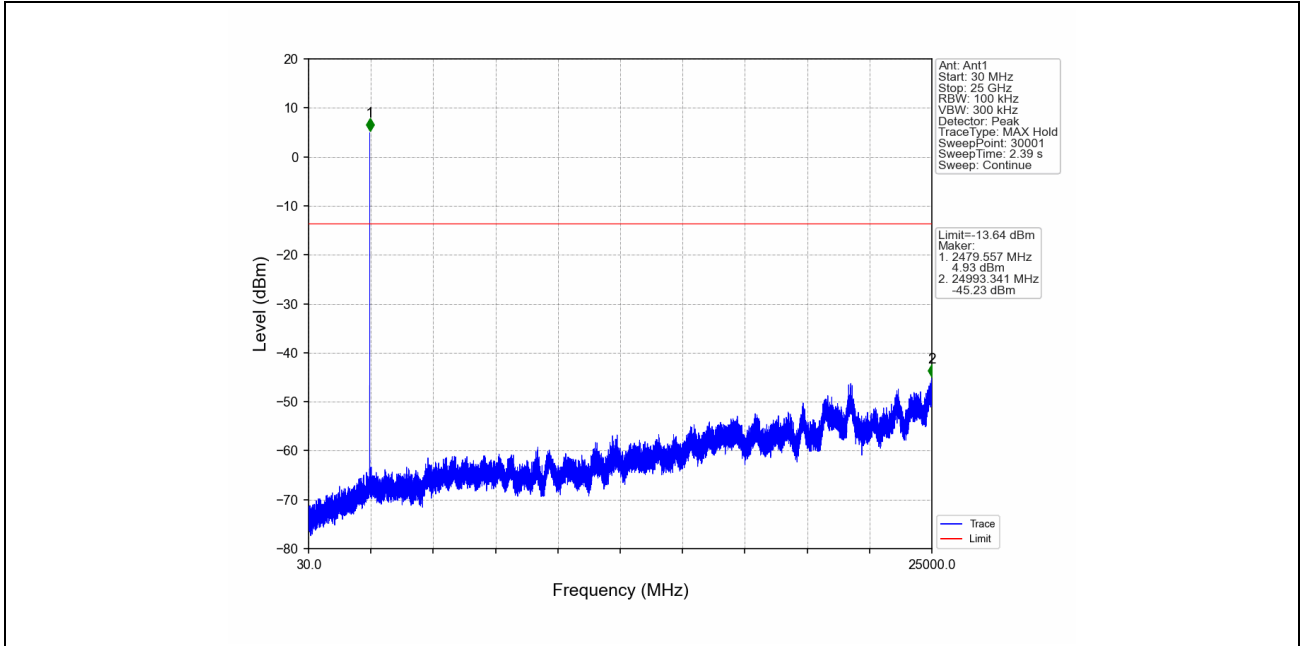
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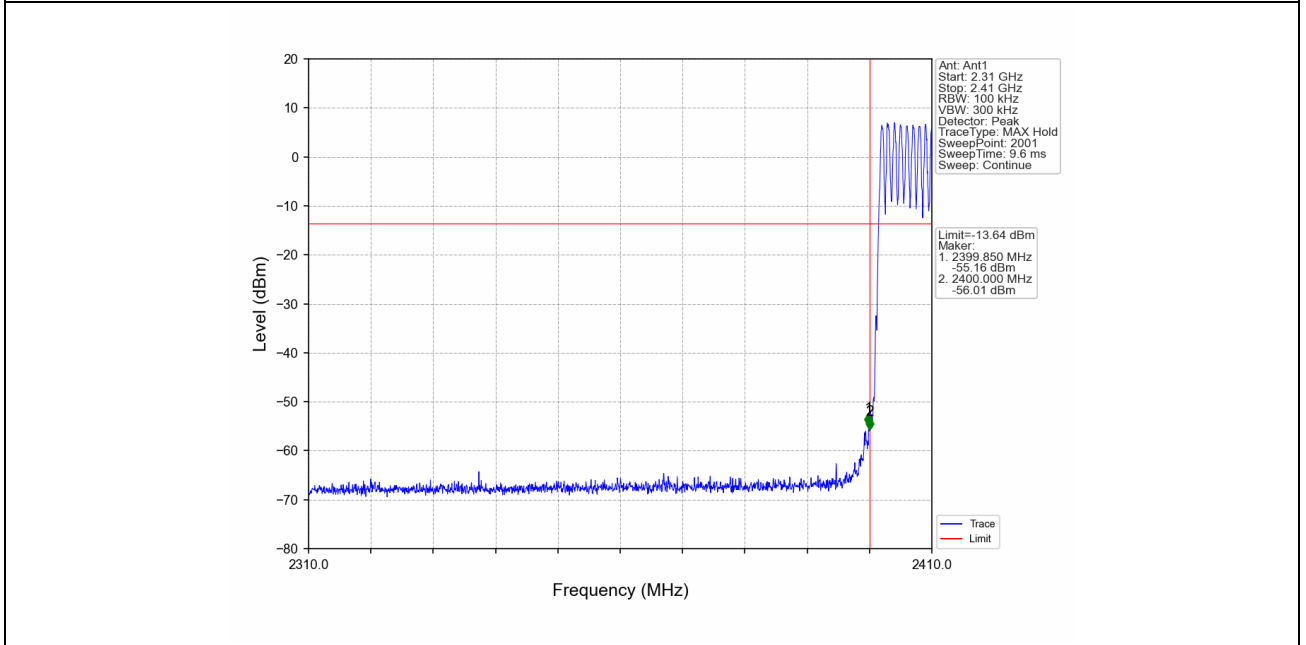
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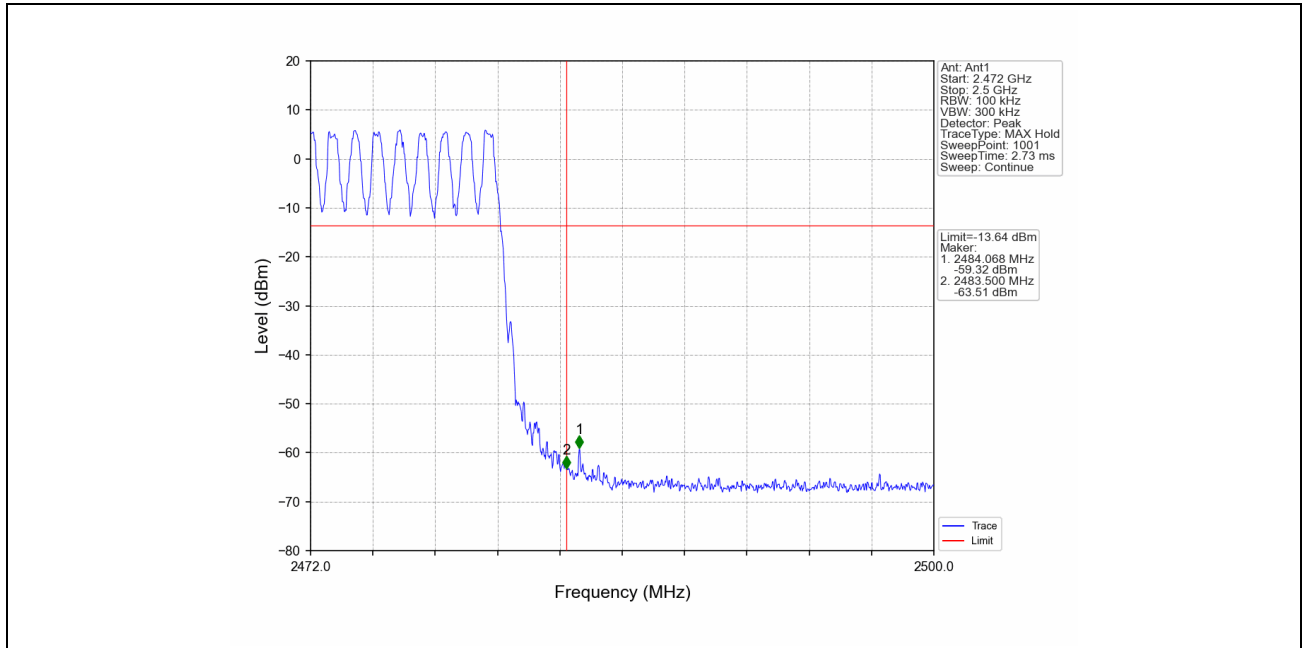


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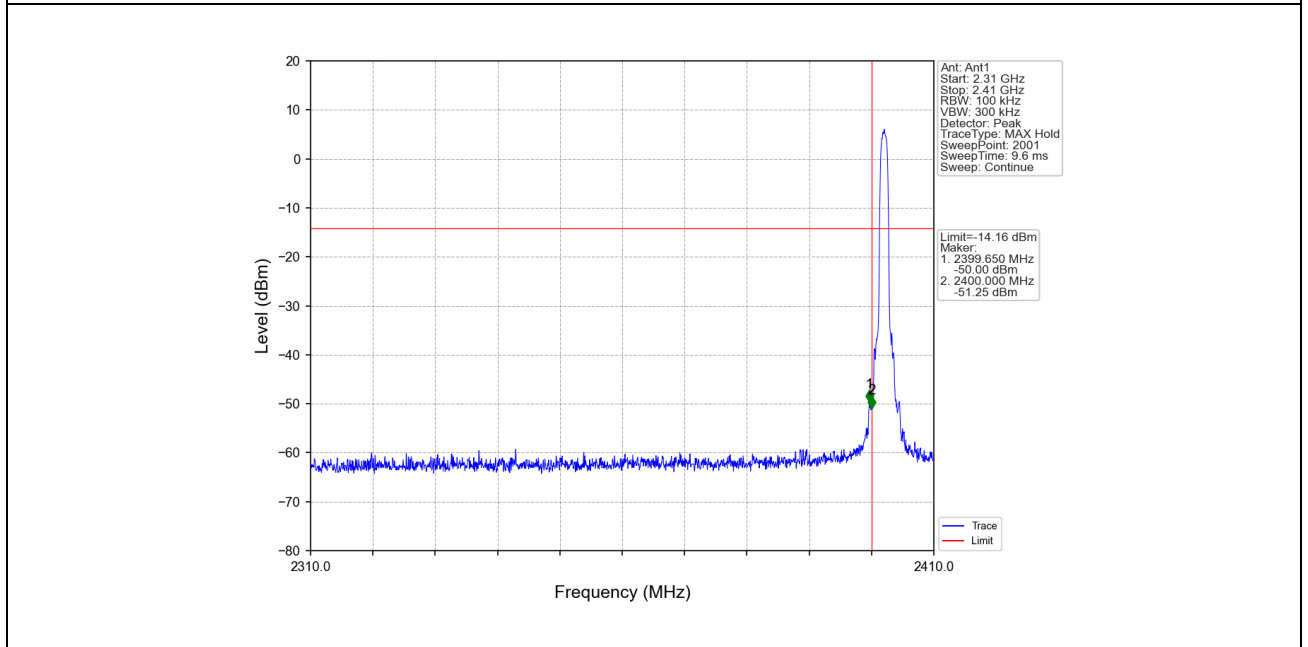
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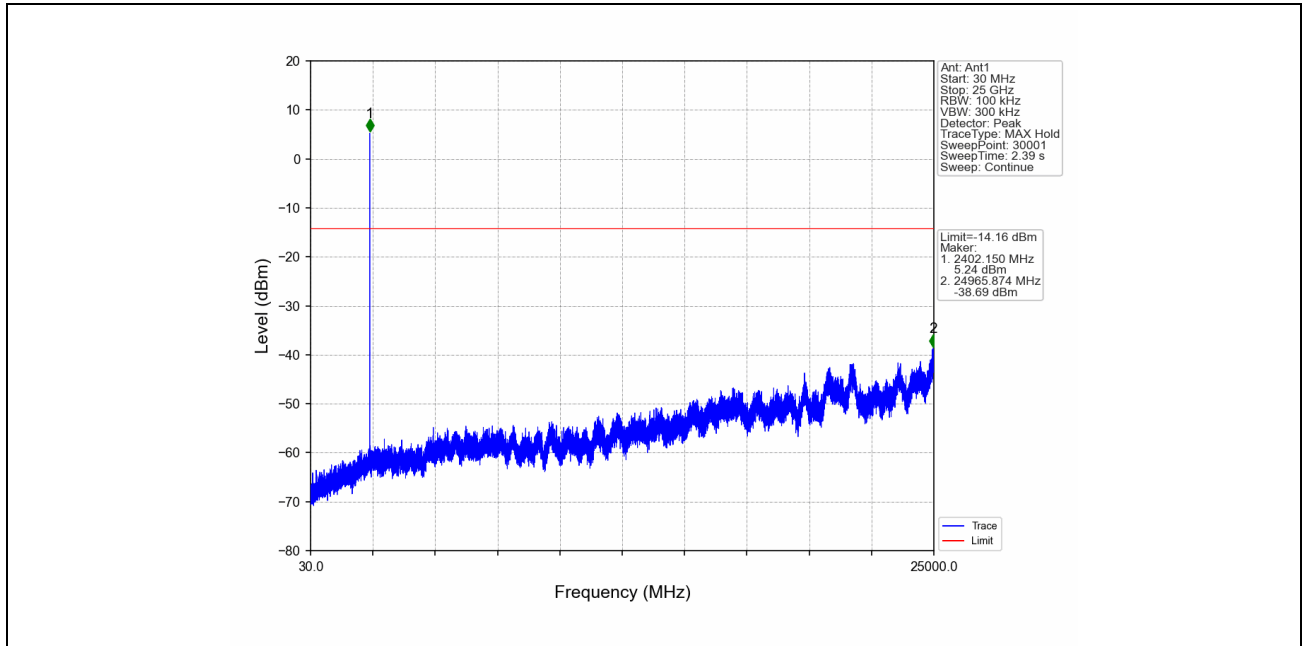


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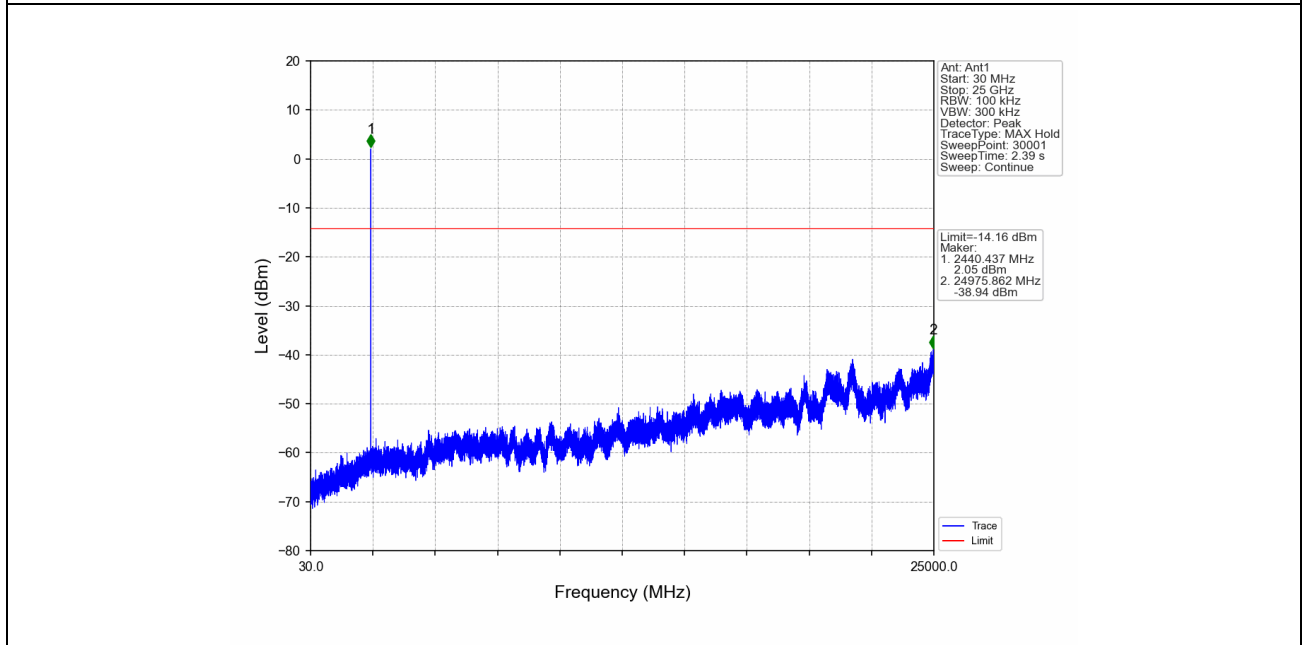
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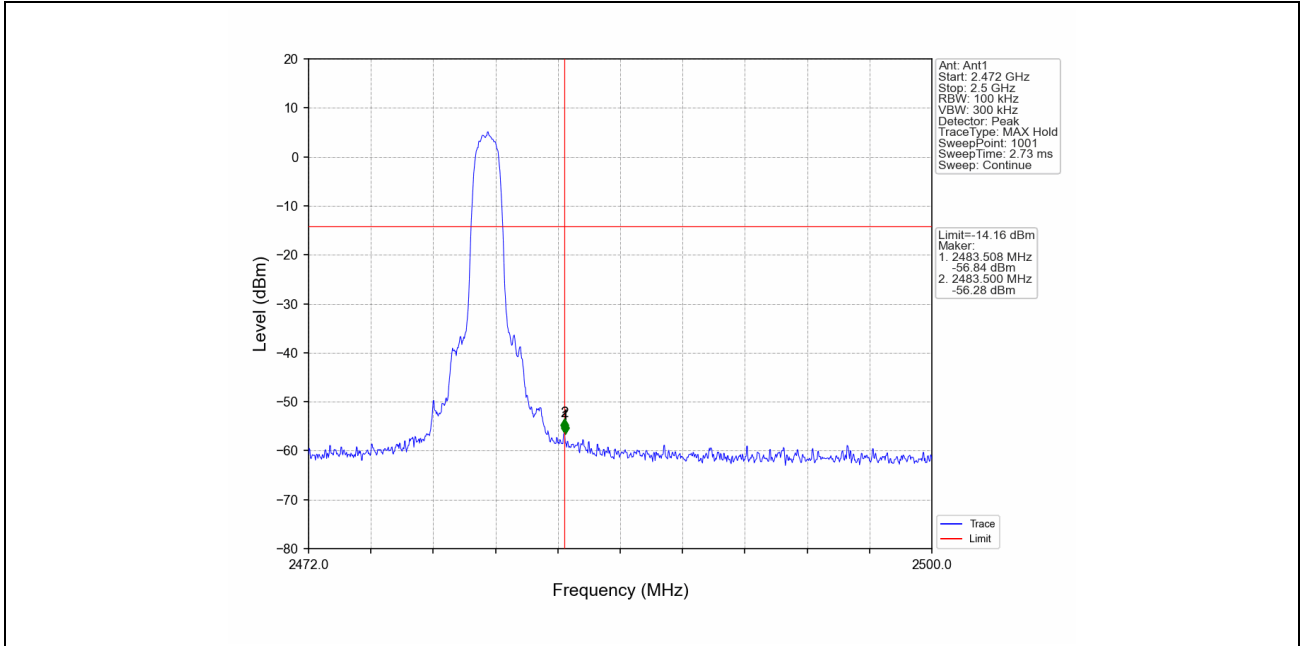
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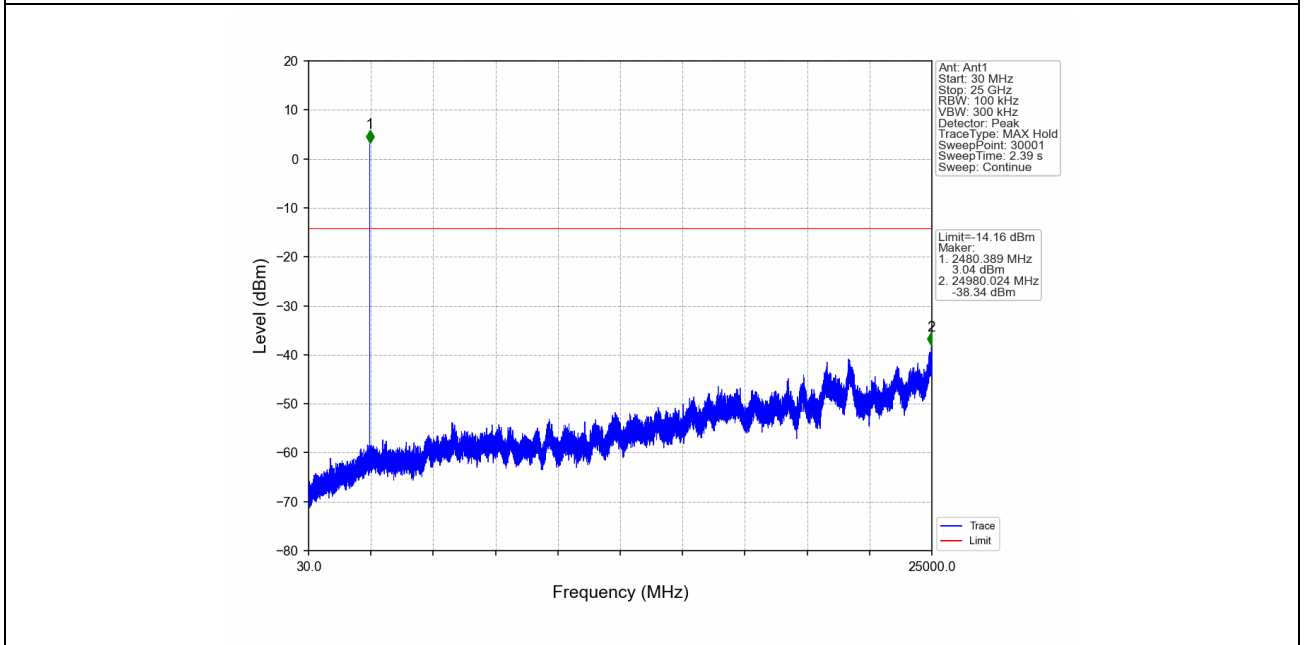
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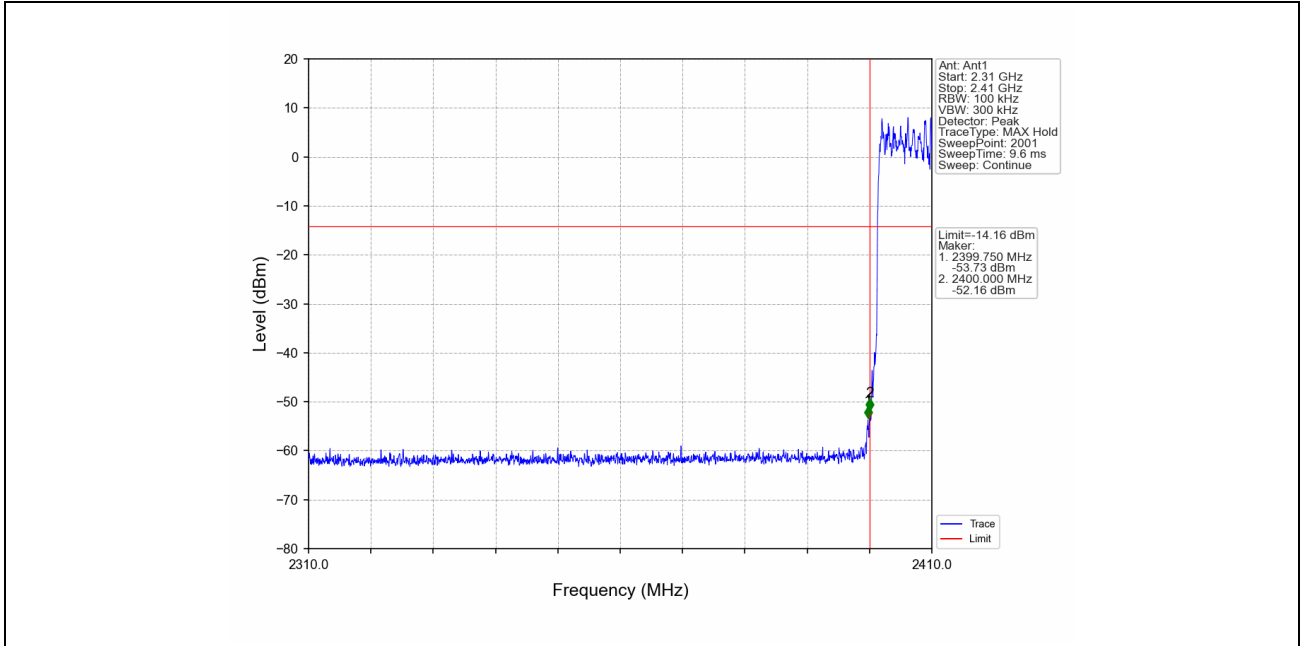
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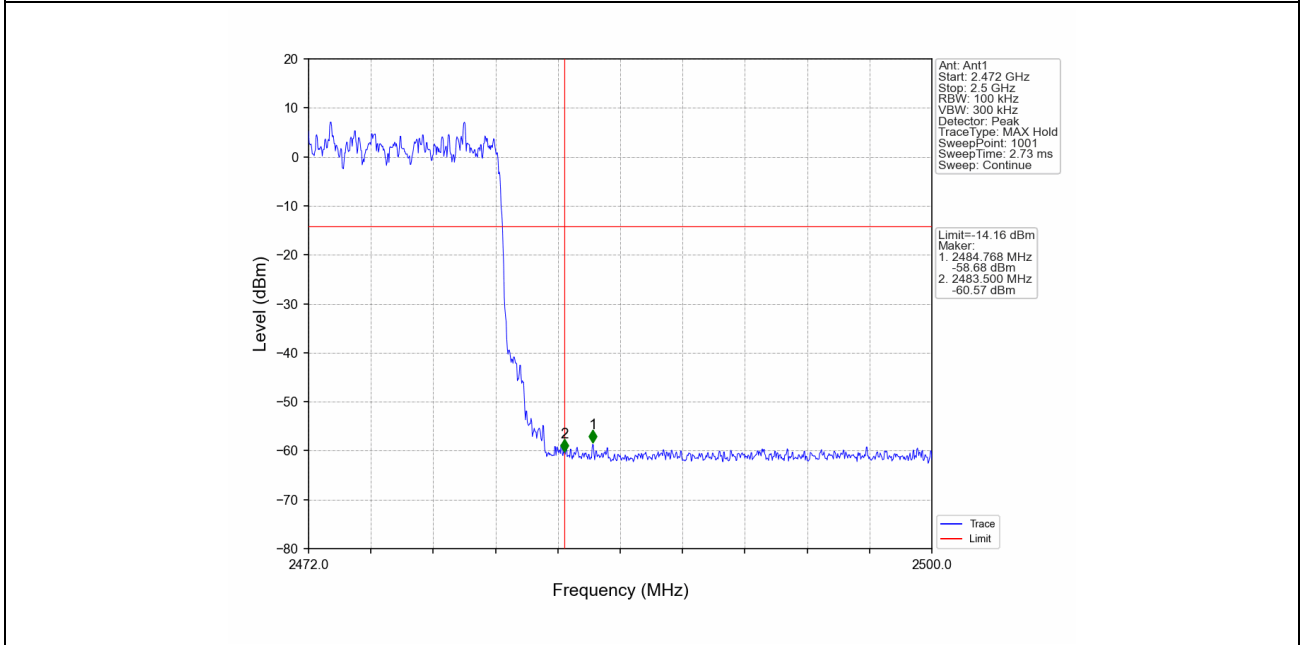
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Pi/4DQPSK\_2DH5\_HOPP\_Ant1\_NTNV



8DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV

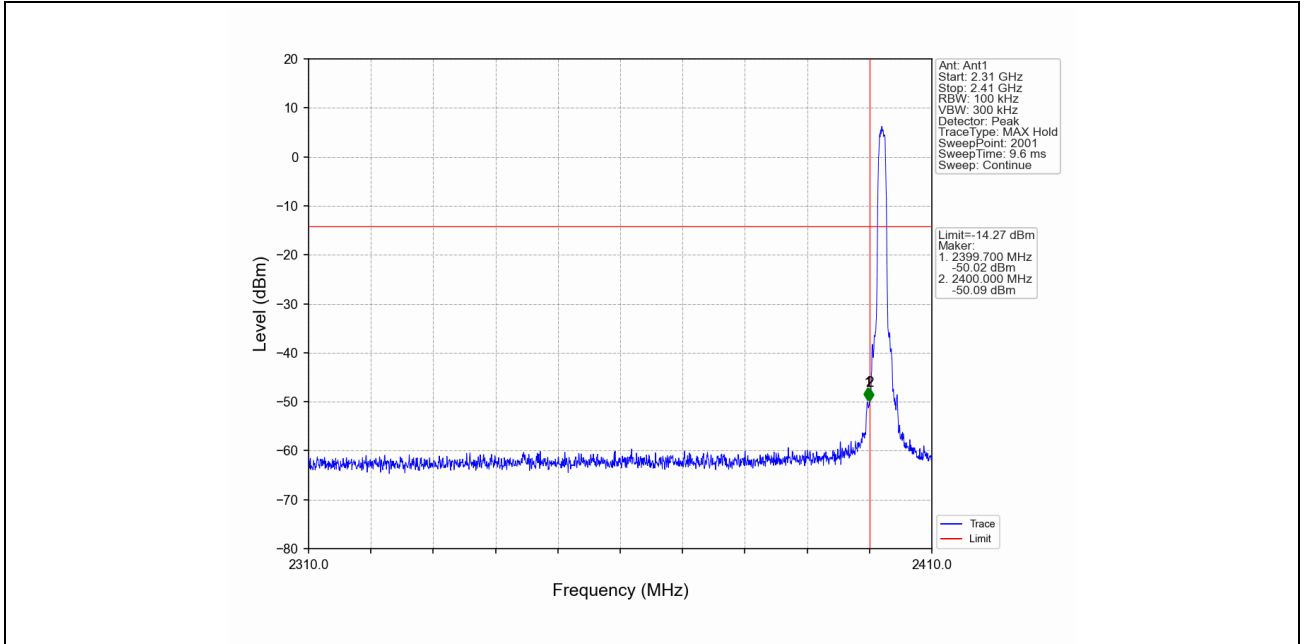


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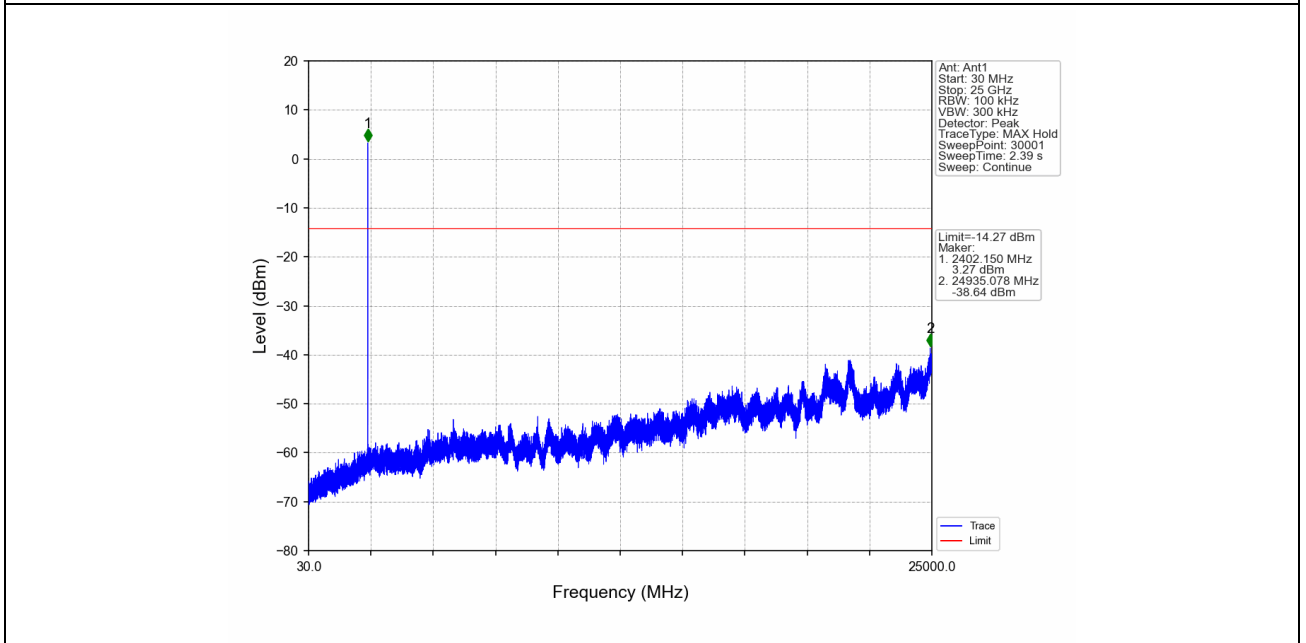
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8DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV



8DPSK\_3DH5\_MCH\_2441MHz\_Ant1\_NTNV



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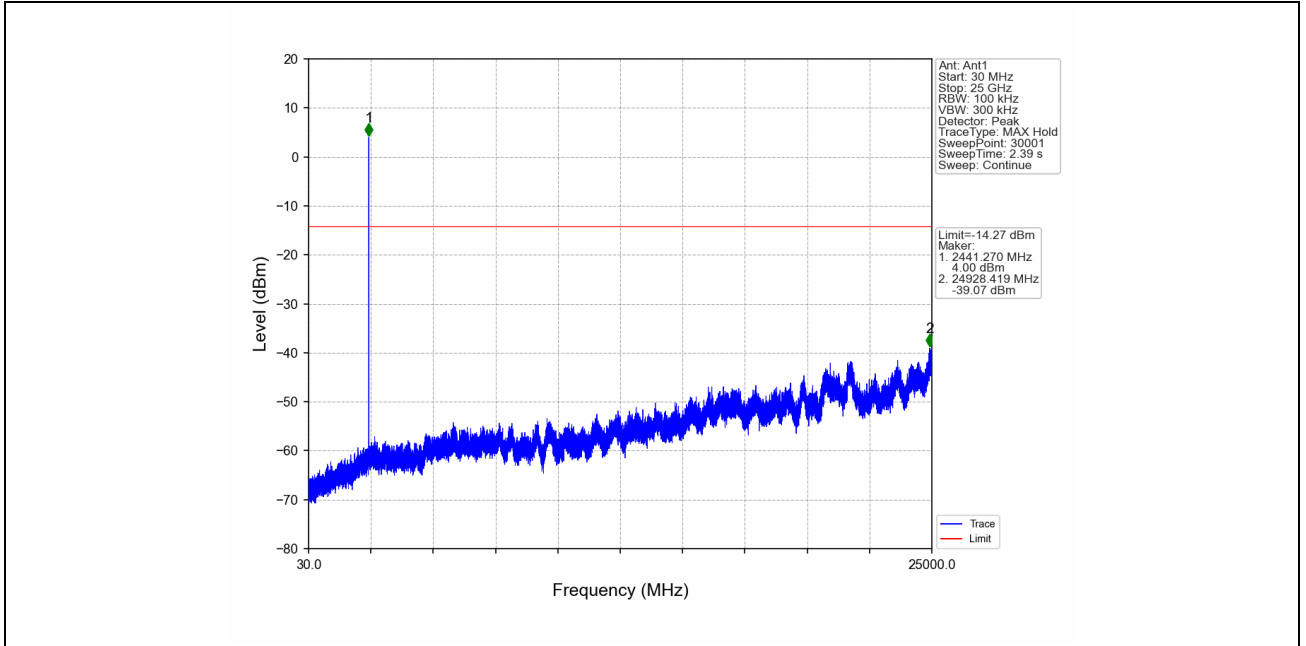
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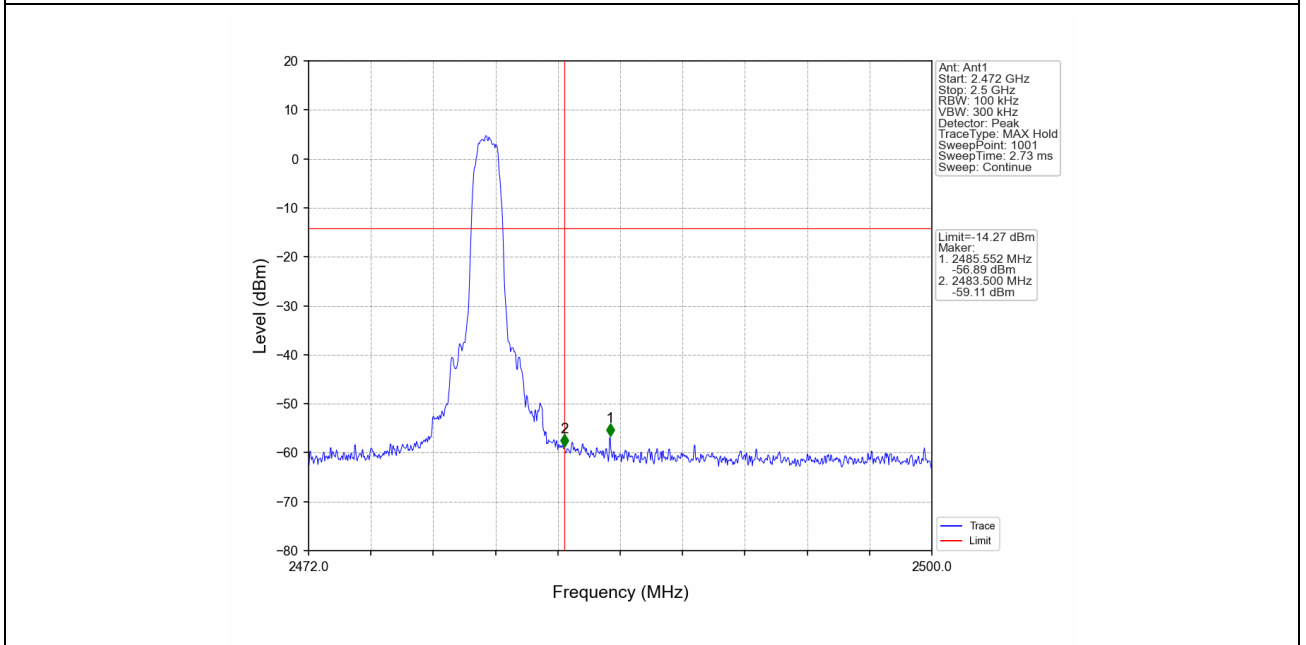
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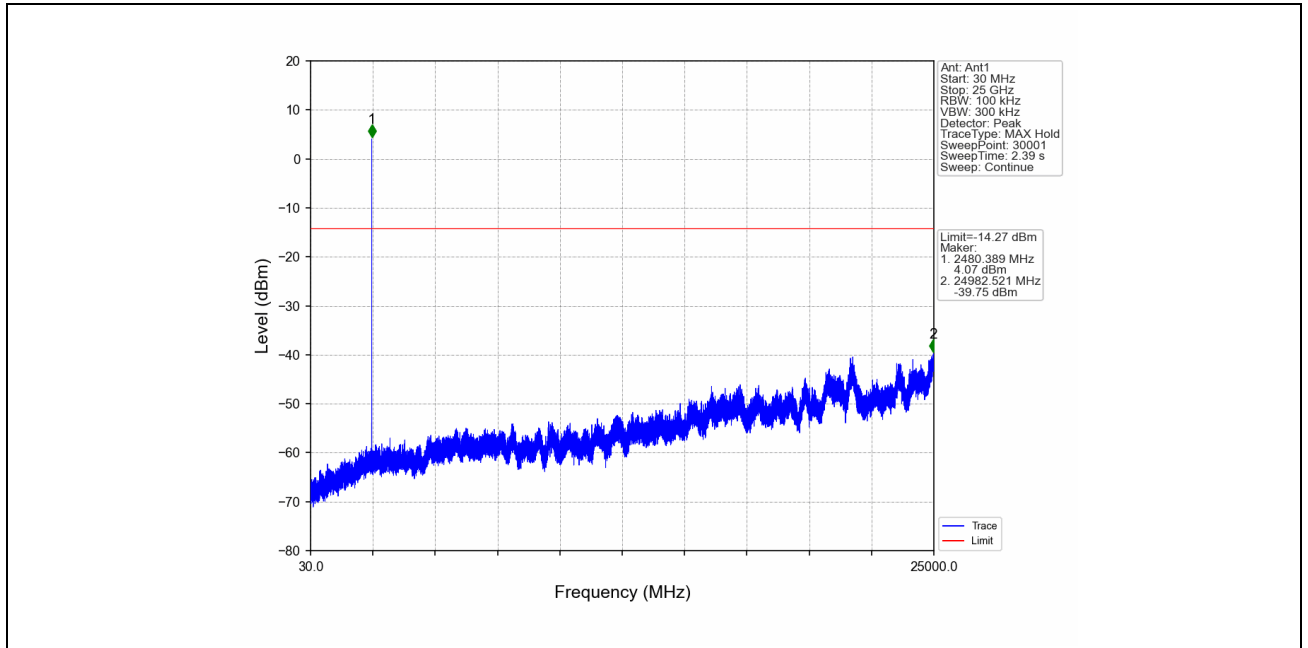
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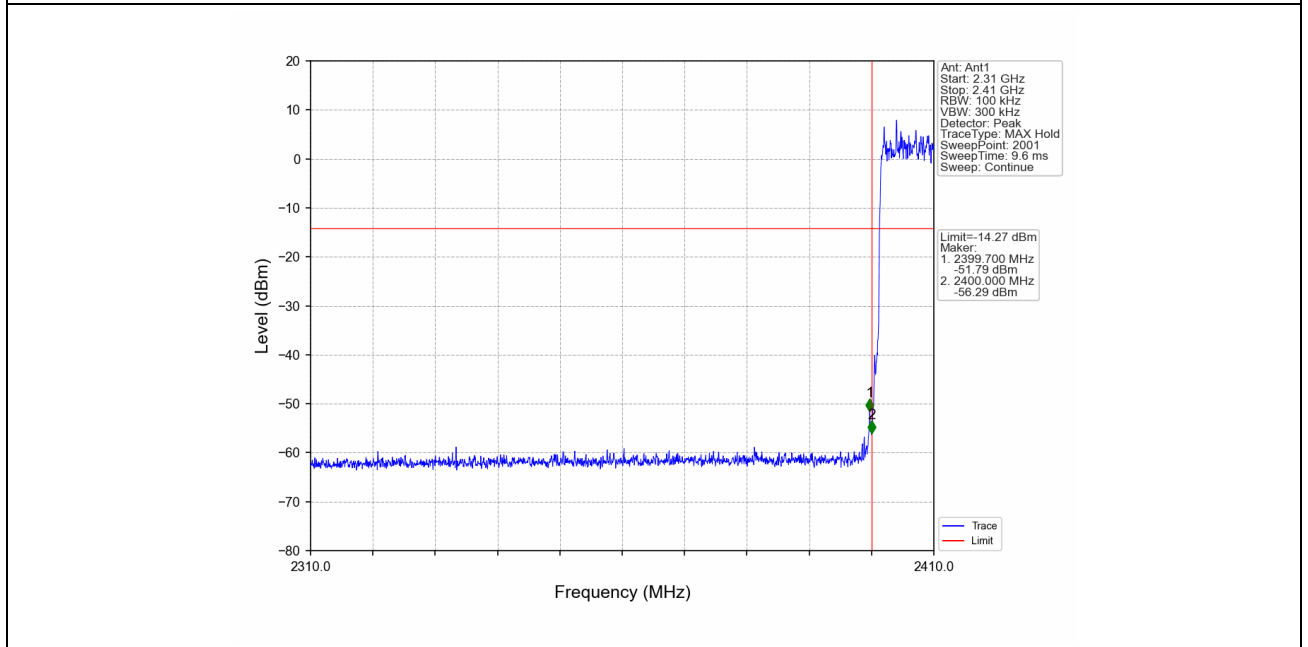
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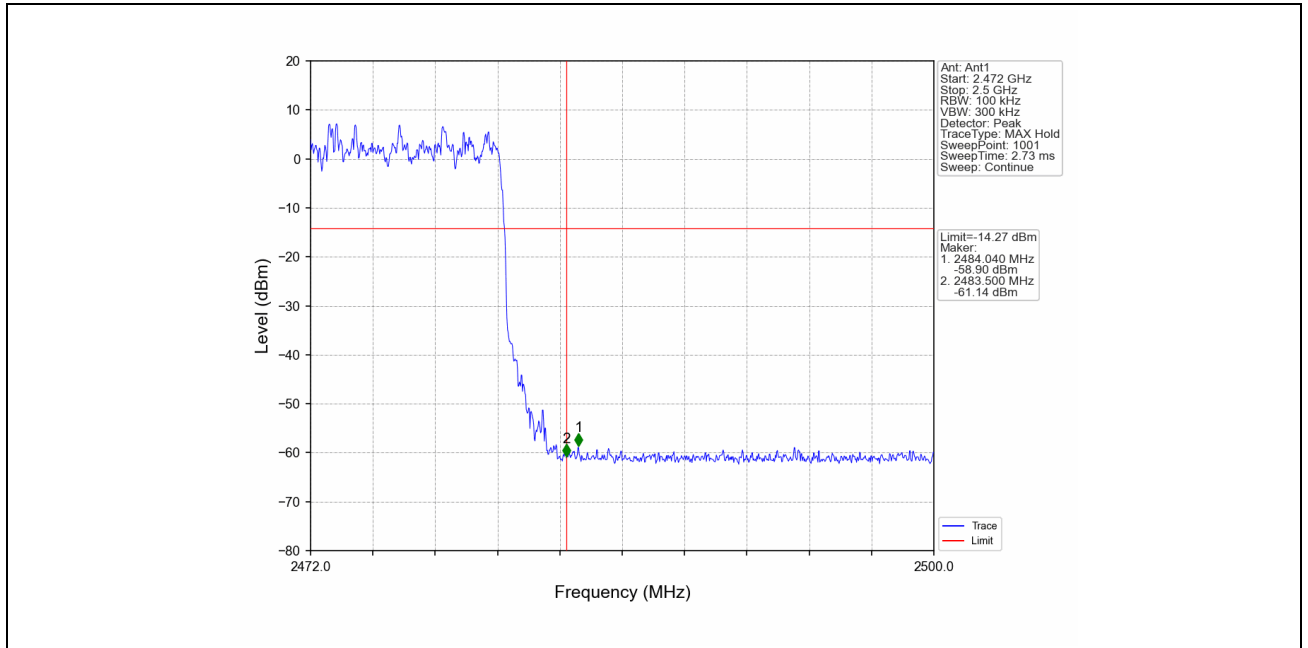


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