

TEST REPORT

Application No.:	GZCR2501000043AT
Applicant:	The House of Marley. LLC
Address of Applicant:	3000 Pontiac Trail, Commerce Township, Michigan 48390 United States
Manufacturer:	The House of Marley. LLC
Address of Manufacturer:	3000 Pontiac Trail, Commerce Township, Michigan 48390 United States
Factory:	1. Dongguan Ruihe Electronic Technology Co., Ltd. 2. Rocker Technology Co., Ltd 3. Dongguan Roker Intelligent Technology Co., Ltd.
Address of Factory:	1. Shatang Street 12, Puxin Industrial Zone, Shipai Town, Dongguan, Guangdong, China 2. Building S3, 2nd Floor, Area A, Star Maiya Innovation Science and Technology Park, Prey Roka Village, Chok Chheu Neang Commune, Ang Snoul, National Road 4, Kandal, Phnom Penh, Cambodia 3. Building 3, No. 35, Dongping Road Changping Section, Changping Town, Dongguan, Guangdong, China
Product Name:	Positive Vibration Frequency
Model No.:	EM-JH143R
Trade Mark:	MARLEY
Standard(s) :	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2025-01-08
Date of Test:	2025-02-07 to 2025-02-17
Date of Issue:	2025-06-20

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



Ricky Liu
Manager



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Revision Record			
Version	Report No.	Date	Remark
01	GZCR250100004303	2025-06-20	Original

Authorized for issue by:			
	 Pank Feng/Project Engineer		
	 Vico Cui/Reviewer		



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
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
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

Note:

E.U.T./EUT means Equipment Under Test.

Pass means the test result passed the test standard requirement, please find the detailed decision rule in the report relative section.

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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 5V for charging
	Battery operation: DC 3.7V internal rechargeable battery as below:
Model:	502535
	Rated: DC 3.7 V, 400mAh, 1.48Wh
Cable(s):	USB cable: about 1.0m unshielded
Test voltage:	AC 120V 60Hz
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Number:	1
Antenna Type:	FPC Antenna
Antenna Gain:	1.97 dBi according to antenna specification

Remark: The information in this section is provided by the applicant or manufacturer, SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Note Book Computer	LENOVO	ThinkPad T490	PF1D1MVJ
AC/DC Adapter	HUAWEI	Model:HW-110600C02; Input:AC 100-240V, 1.8A Max.50/60Hz; Output:DC 5V/2A, 10V/4A, 11V/6A Max.	JL28L4NBM03275



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4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Emissions at AC Power Line (150kHz-30MHz)	±3.22dB
Radiated Emissions which fall in the restricted bands	±5.14dB (3m); ±4.90dB (10m); ±4.88dB (1GHz-6GHz); ±5.06dB (6GHz-18GHz); ±5.30dB (18GHz-40GHz)
Radiated Spurious Emissions Below 1GHz	±3.08dB (9kHz to 150kHz); ±3.19dB (150kHz to 30MHz); ±5.14dB (30MHz-1GHz) (3m); ±4.90dB (30MHz-1GHz) (10m)
Radiated Spurious Emissions Above 1GHz	±4.88dB (1GHz-6GHz); ±5.06dB (6GHz-18GHz); ±5.30dB (18GHz-40GHz)
Conducted Peak Output Power	± 0.75dB
20dB Bandwidth	± 0.274%
Carrier Frequencies Separation	± 7.25 x 10 ⁻⁸
Hopping Channel Number	± 7.25 x 10 ⁻⁸
Dwell Time	± 0.029%
Conducted Band Edges Measurement	± 0.75dB
Conducted Spurious Emissions	± 0.75dB
Remark:	
The U_{lab} (lab Uncertainty) is less than U_{cisp} (CISPR Uncertainty) or U_{ETSI} (ETSI Uncertainty).	
Emission decision rule:	
<ul style="list-style-type: none"> – Compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit, marked as Pass in the report. – Non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit, marked as Fail in the report. 	

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
 No.198, Kezhu Road, Science City, Economic & Technological Development Area, Guangzhou,
 Guangdong, China 510663

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No tests were sub-contracted.



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4.5 Test Facility

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

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian/New Zealand Regulatory Compliance Mark (RCM).

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818.

- **ISED (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-20107 and T-11179)**

The 10m Semi-anechoic chamber, 966 Anechoic Chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-20107 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2017, the Basic Rules, IEC60061 and Rules of procedure IEC60062, and the relevant IEC60065 CB-Scheme Operational documents.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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Guangzhou Branch, Testing & EEC Laboratory

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5 Equipment List

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Coaxial Cable	HangTianXing	2m	EMC0107	2023-08-24	2025-08-23
Shielding Room	ChangZhou ZhongYu	8m x 3m x 3.8m	EMC0306	2022-10-16	2025-10-15
Two-Line V-Network-GZ	Rohde & Schwarz	ENV216	EMC2135	2024-09-02	2025-09-01
EMI Test Receiver (9kHz-3.6GHz)	Rohde & Schwarz	ESR3	EMC2221	2024-12-04	2025-12-03
Test Software E3r	Audix	Ver.6.191211	GZE100-77	N/A	N/A

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2024-10-14	2025-10-13
EMI Test Receiver (10Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2024-09-02	2025-09-01
Chamber cable (Above 1GHz)	Scoflex	KMKG-8.0m	EMC0545	2024-08-19	2026-08-18
Horn Antenna (1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2022-09-23	2025-09-22
Horn Antenna (14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2023-06-18	2026-06-17
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2024-08-19	2025-08-18
MXE EMI Receiver (10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2024-10-14	2025-10-13
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2023-12-20	2026-12-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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Radiated Spurious Emissions Below 1GHz

Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2022-10-16	2025-10-15
Coaxial cable	Mirco-COAX UTIFLEX	311A	EMC0540	2024-08-19	2026-08-18
Amplifier (9kHz-1.3GHz)	HP	8447F	EMC2065	2024-12-04	2025-12-03
Active Loop Antenna-RED	ETS-Lindgren	6502	EMC2190	2024-04-08	2026-04-07
EMI Test Receiver (9kHz-7GHz)	Rohde & Schwarz	ESR7	EMC2220	2024-12-04	2025-12-03
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Trilog Broadband Antenna (25MHz-2GHz)	Schwarzbeck Mess-Elektronik	VULB 9168	EMC2174	2022-06-19	2025-06-18

Radiated Spurious Emissions Above 1GHz

Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2024-10-14	2025-10-13
EMI Test Receiver (10Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2024-09-02	2025-09-01
Chamber cable (Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2024-08-19	2026-08-18
Horn Antenna (1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2022-09-23	2025-09-22
Horn Antenna (14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2023-06-18	2026-06-17
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2024-10-14	2025-10-13
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2024-08-19	2025-08-18
MXE EMI Receiver (10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2024-10-14	2025-10-13
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2023-12-20	2026-12-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

RF Conducted Test

Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
MI CABLE	SGS-EMC	0.8M	EMC2136	2023-11-02	2025-11-01
4X4 Power sensor Unit	TST	TSPS2023R	EMC2257	2024-08-19	2025-08-18
Test Software	TST	V2.0	GZE100-82	N/A	N/A
EXA Signal Analyzer	Agilent Technologies	N9010A	EMC2222	2024-12-03	2025-12-02

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General used equipment

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DMM	Fluke	73	EMC0006	2024-06-13	2025-06-12



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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 integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 1.97 dBi.

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: 29 -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 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.



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 (dB μ V)	
	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

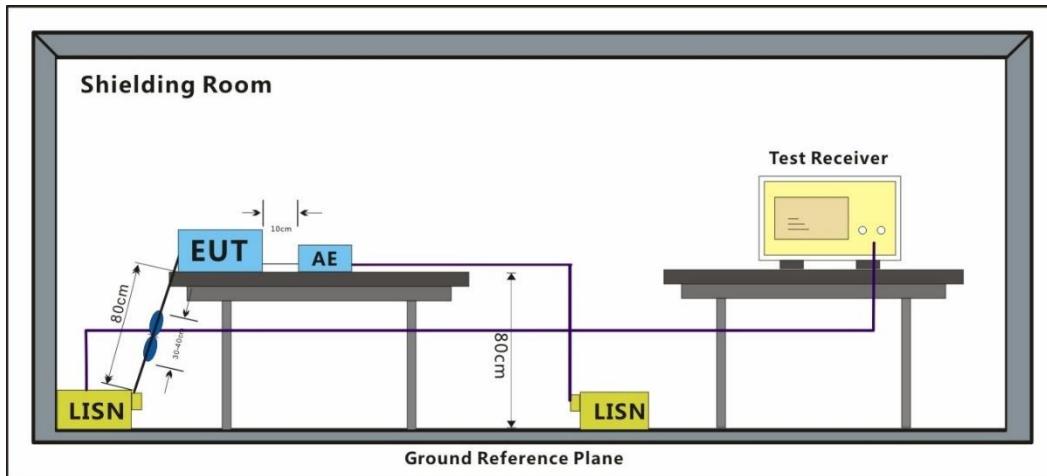
Operating Environment:

Temperature: 22.7 °C Humidity: 53.2 % RH Atmospheric Pressure: 1020 mbar

7.1.2 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.

7.1.3 Test Setup Diagram



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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.

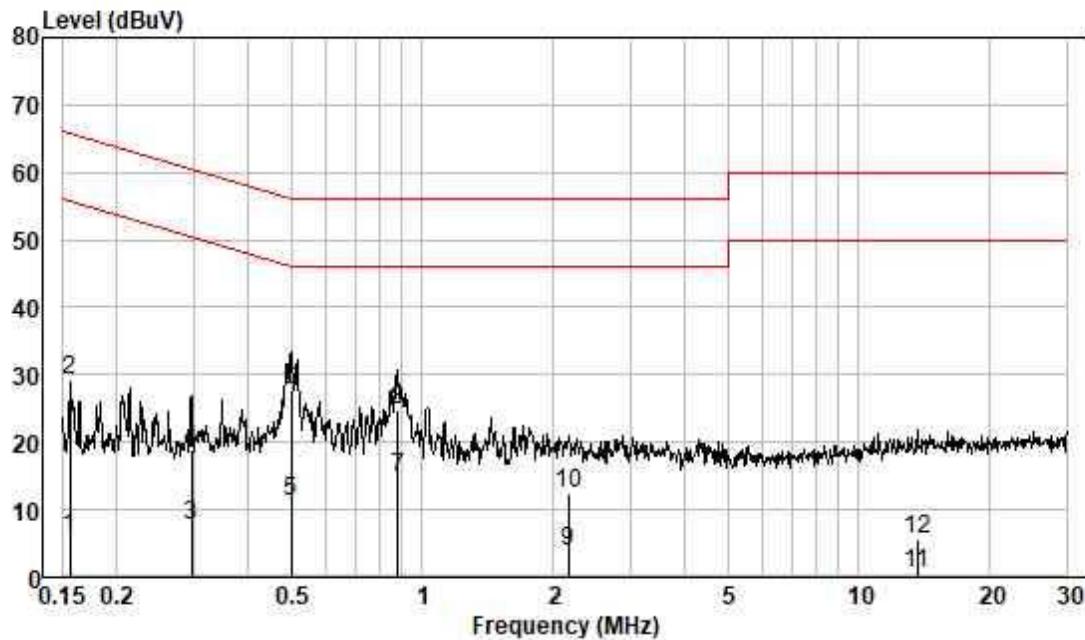
Remark: Level=Read Level+ Cable Loss+ LISN Factor



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Test Mode: 00; Line: Live line



Pol :LINE

Mode :

Model :

Power :

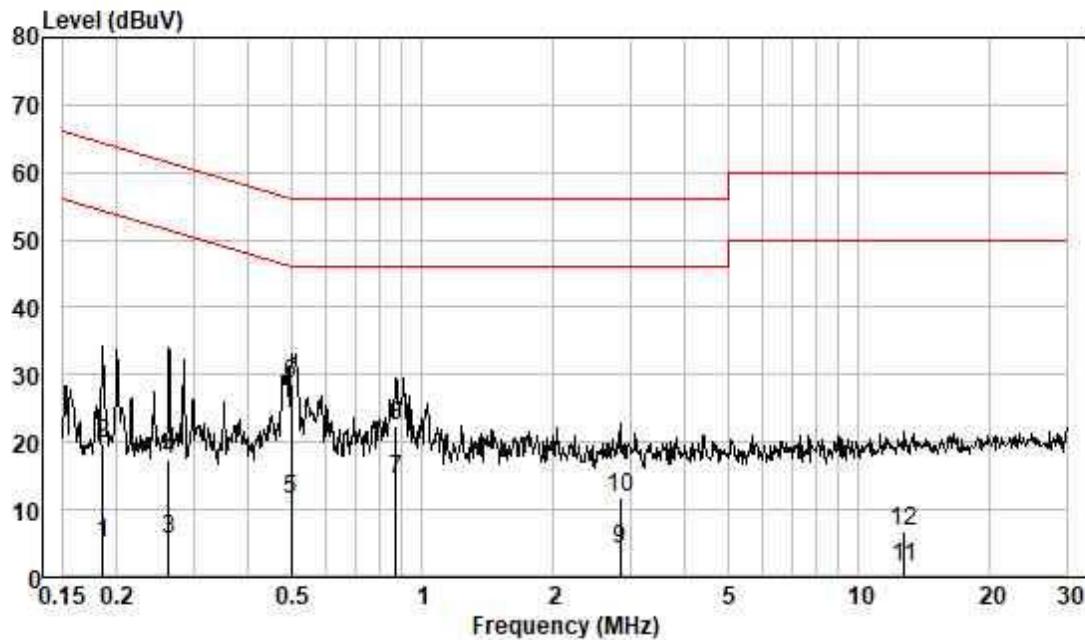
	Frequenc	Read Level	Cable Loss	LISN Factor	Measured Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.156	-3.65	0.04	9.56	5.95	55.69	-49.74	Average
2	0.156	19.57	0.04	9.56	29.17	65.69	-36.52	QP
3	0.296	-1.91	0.04	9.55	7.68	50.37	-42.69	Average
4	0.296	9.28	0.04	9.55	18.87	60.37	-41.50	QP
5	0.502	1.60	0.05	9.59	11.24	46.00	-34.76	Average
6	0.502	18.16	0.05	9.59	27.80	56.00	-28.20	QP
7	0.880	5.06	0.07	9.61	14.74	46.00	-31.26	Average
8	0.880	15.06	0.07	9.61	24.74	56.00	-31.26	QP
9	2.155	-5.91	0.13	9.59	3.81	46.00	-42.19	Average
10	2.155	2.62	0.13	9.59	12.34	56.00	-43.66	QP
11	13.623	-9.58	0.31	9.82	0.55	50.00	-49.45	Average
12	13.623	-4.45	0.31	9.82	5.68	60.00	-54.32	QP



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Test Mode: 00; Line: Neutral Line



Pol : NEUTRAL

Mode :

Model :

Power :

Frequency MHz	Read Level dBuV	Cable Loss dB	LISN Factor dB	Measured Level dBuV	Limit Line dBuV	Over Limit dB	Remark
							Measured Level dBuV
1 0.185	-4.63	0.04	9.55	4.96	54.24	-49.28	Average
2 0.185	10.31	0.04	9.55	19.90	64.24	-44.34	QP
3 0.263	-3.91	0.04	9.53	5.66	51.34	-45.68	Average
4 0.263	7.75	0.04	9.53	17.32	61.34	-44.02	QP
5 0.502	1.96	0.05	9.58	11.59	46.00	-34.41	Average
6 0.502	19.03	0.05	9.58	28.66	56.00	-27.34	QP
7 0.871	4.87	0.07	9.53	14.47	46.00	-31.53	Average
8 0.871	12.87	0.07	9.53	22.47	56.00	-33.53	QP
9 2.839	-5.46	0.15	9.57	4.26	46.00	-41.74	Average
10 2.839	2.17	0.15	9.57	11.89	56.00	-44.11	QP
11 12.716	-8.75	0.29	9.85	1.39	50.00	-48.61	Average
12 12.716	-3.24	0.29	9.85	6.90	60.00	-53.10	QP



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7.2 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:

Test Distance: 3 m

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.

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 21.3 °C Humidity: 48.3 % RH Atmospheric Pressure: 1020 mbar

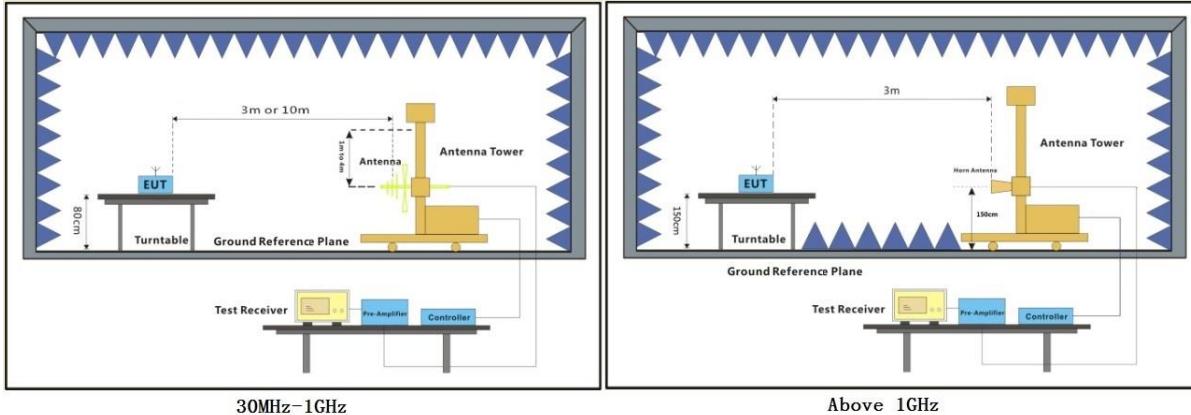
7.2.2 Test Mode Description

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.



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7.2.3 Test Setup Diagram

30MHz-1GHz

Above 1GHz

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7.2.4 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 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.

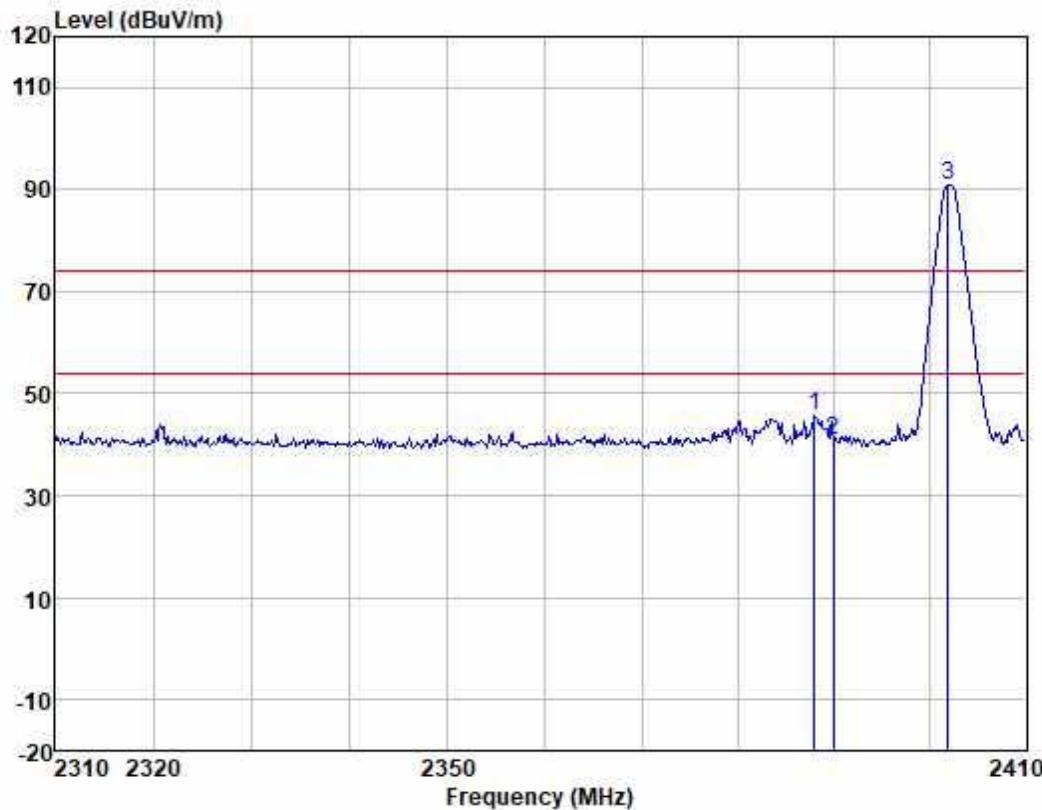
However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Remark 3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for Peak detection (PK) and Average detection (AV) at frequency above 1GHz.

Remark 4: For fundamental and harmonic signal measurement, the resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $\leq 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.



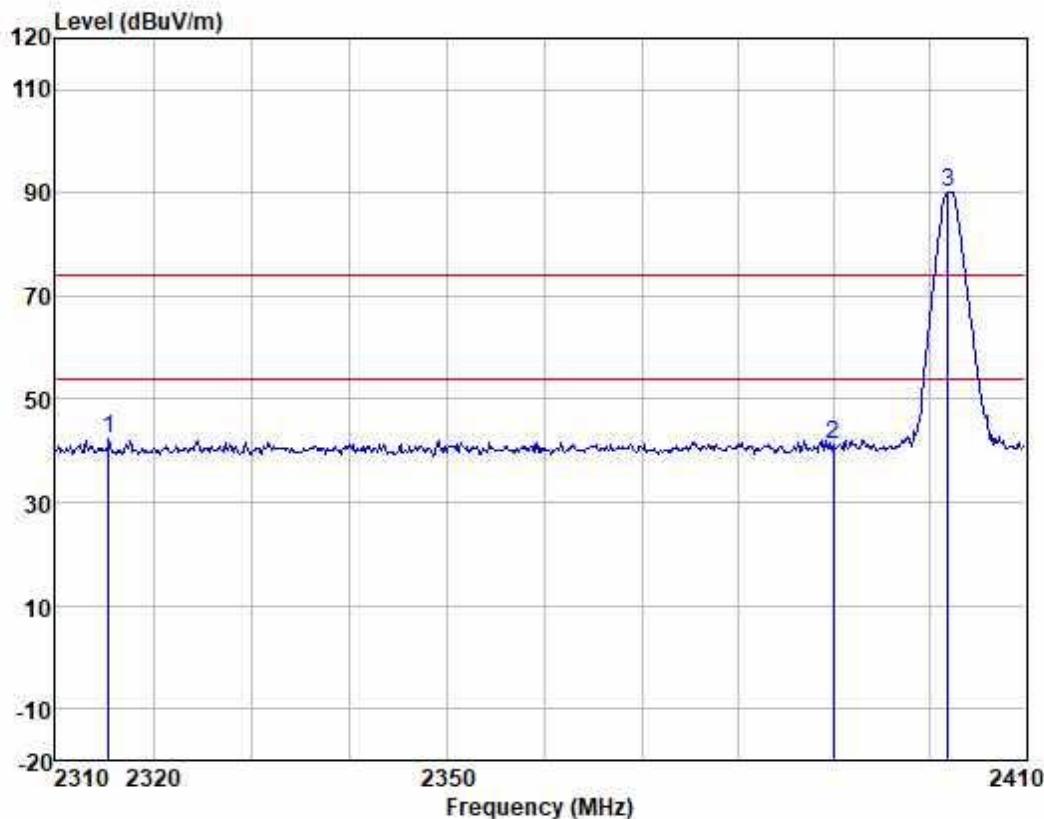
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



Freq	ReadAntenna	Cable		Preamp	Limit	Over	Over	Over	Remark
		Level	Factor						
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	dB	
1 2387.938	52.25	27.68	3.44	37.77	45.60	74.00	-28.40	VERTICAL	peak
2 2390.000	47.64	27.68	3.44	37.77	40.99	74.00	-33.01	VERTICAL	peak
3 * 2402.000	97.35	27.71	3.45	37.77	90.74	74.00	16.74	VERTICAL	peak



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



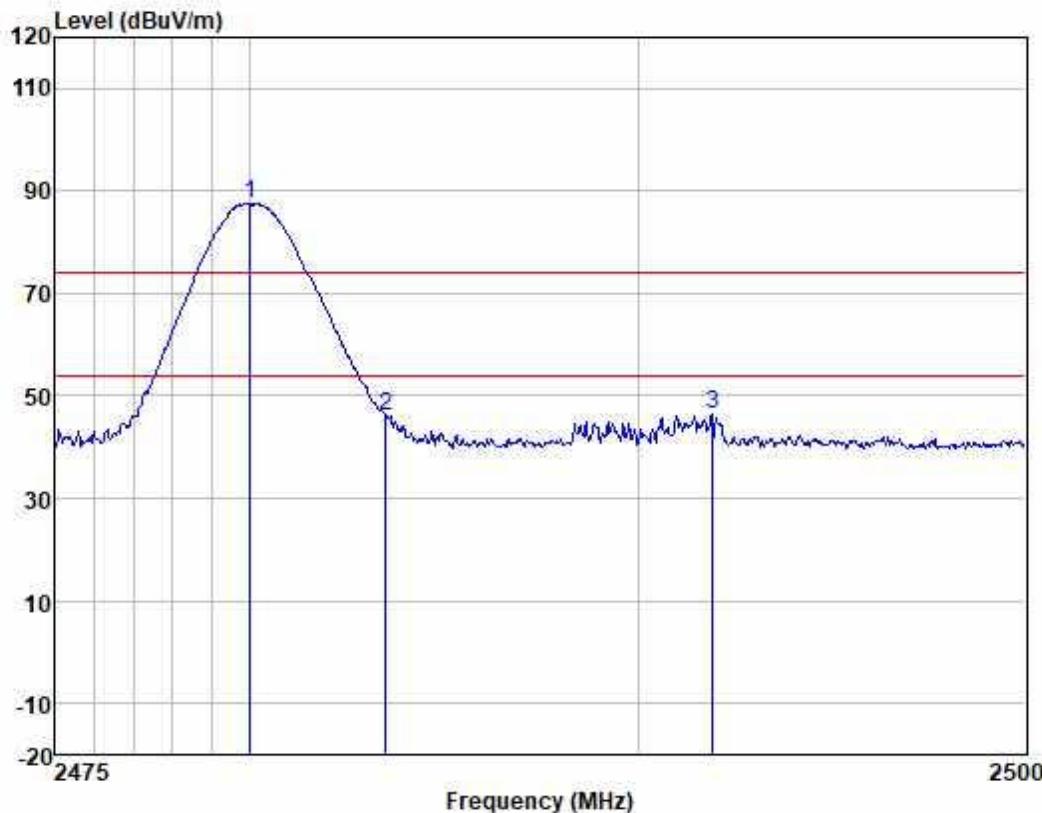
Freq	ReadAntenna		Cable		Preamp Loss Factor	Level	Limit Line	Over Limit	Over Line Pol/Phase	Remark
	MHz	Level Factor	dBuV	dB/m						
1	2315.391	49.21	27.49	3.40	37.78	42.32	74.00	-31.68	HORIZONTAL	peak
2	2390.000	47.85	27.68	3.44	37.77	41.20	74.00	-32.80	HORIZONTAL	peak
3 *	2402.000	96.66	27.71	3.45	37.77	90.05	74.00	16.05	HORIZONTAL	peak



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



Freq	ReadAntenna		Cable		Preamp	Limit	Over	Pol/Phase	Remark
	MHz	Level	Factor	Loss					
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1 *	2480.000	93.85	27.84	3.48	37.76	87.41	74.00	13.41	VERTICAL peak
2	2483.500	52.59	27.85	3.49	37.76	46.17	74.00	-27.83	VERTICAL peak
3	2491.923	52.87	27.86	3.49	37.76	46.46	74.00	-27.54	VERTICAL peak

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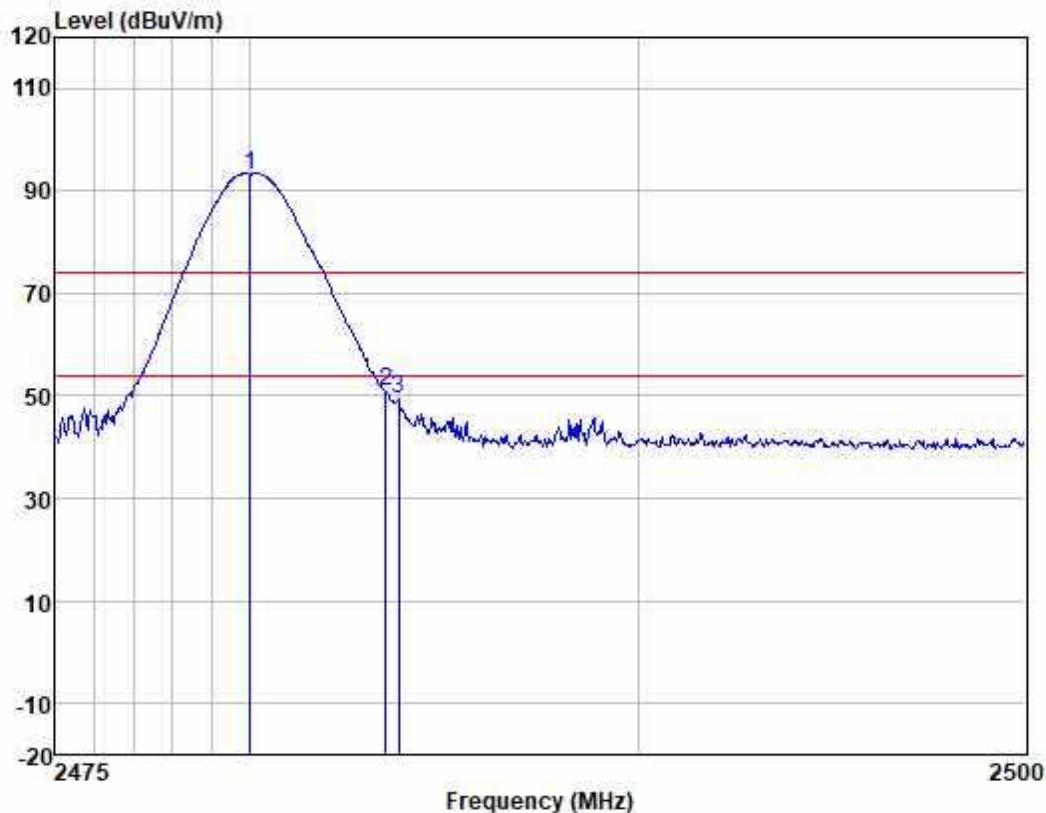
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中国·广东·广州高新技术产业开发区科学城科珠路198号 邮编: 510663 t (86-20) 82155555 sgs.china@sgs.com

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



Freq	ReadAntenna		Cable		Preamp	Limit	Over	Pol/Phase	Remark
	MHz	Level	Factor	Loss					
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1 *	2480.000	99.70	27.84	3.48	37.76	93.26	74.00	19.26	HORIZONTAL peak
2	2483.500	57.26	27.85	3.49	37.76	50.84	74.00	-23.16	HORIZONTAL peak
3	2483.821	55.70	27.85	3.49	37.76	49.28	74.00	-24.72	HORIZONTAL peak



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7.3 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:

Test Distance: 10 m above 30MHz, 3 m below 30MHz

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

7.3.1 E.U.T. Operation

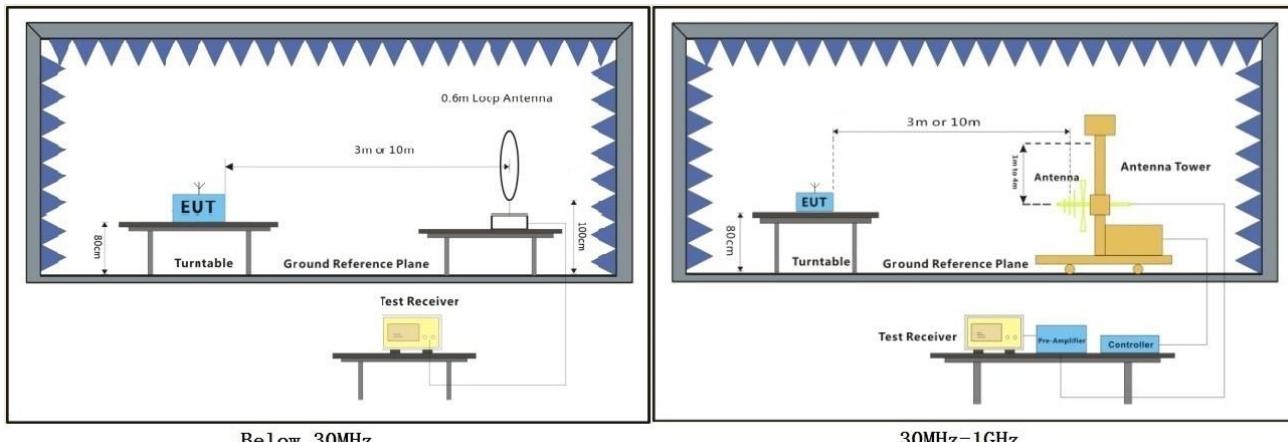
Operating Environment:

Temperature: 20.8 °C Humidity: 53.3 % RH Atmospheric Pressure: 1020 mbar

7.3.2 Test Mode Description

Pre-scan / Mode 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.

7.3.3 Test Setup Diagram



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7.3.4 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:

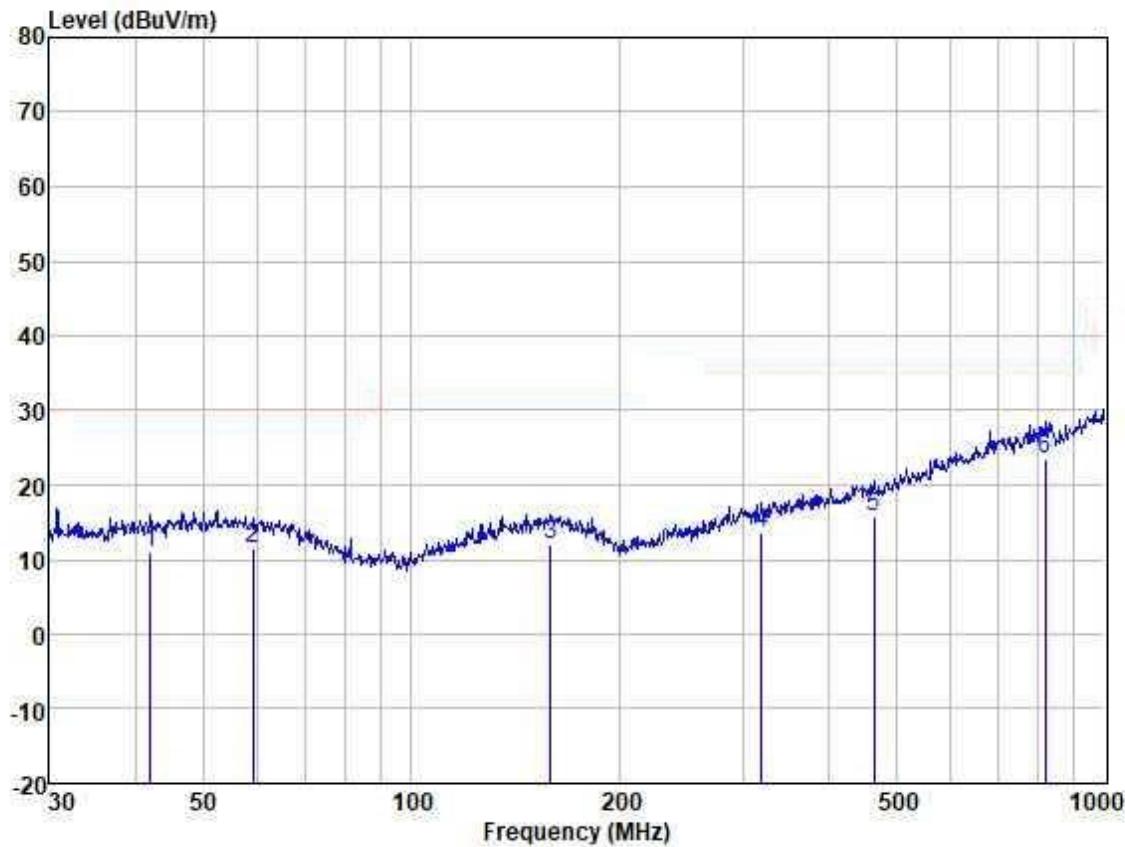
1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
2. Scan from 9kHz to 30MHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from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



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Test Mode: 00; Polarity: Horizontal



Site : SGS
Job :
Model :
Power :
Test Mode : TX

Freq	Read	Antena	Cable	Preamp	Measured	Limit	Over	Pol/	Remark
	Level	Factor	Loss	Factor	Level	Line	Limit	Phase	
1	42.007	24.59	13.66	0.70	27.98	10.97		HORIZONTAL	QP
2	59.025	25.26	13.45	0.77	27.93	11.55		HORIZONTAL	QP
3	158.668	25.08	13.67	1.02	27.70	12.07		HORIZONTAL	QP
4	319.937	25.11	14.03	1.72	27.25	13.61		HORIZONTAL	QP
5	465.599	24.94	17.19	1.87	28.40	15.60		HORIZONTAL	QP
6	821.710	25.83	23.38	2.55	28.27	23.49		HORIZONTAL	QP



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Frequency (MHz)	Level @10m (dBuV/m)	Convert Factor (dB)*	Level @ 3m (dBuV/m)	Limit @3m (dBuV/m)	Over limit (dB)	Remark
42.007	10.97	10.46	21.43	40.00	-18.57	QP
59.025	11.55	10.46	22.01	40.00	-17.99	QP
158.668	12.07	10.46	22.53	43.52	-20.99	QP
319.937	13.61	10.46	24.07	46.02	-21.95	QP
465.599	15.60	10.46	26.06	46.02	-19.96	QP
821.710	23.49	10.46	33.95	46.02	-12.07	QP

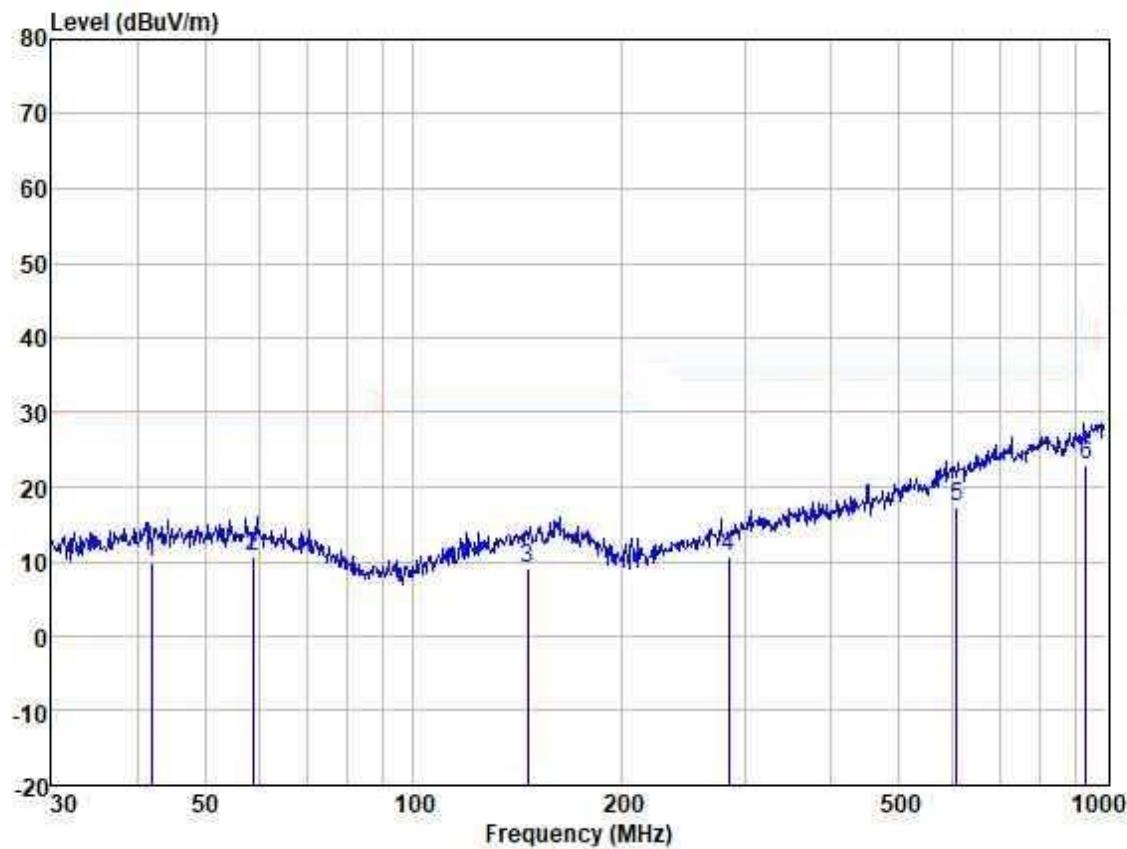
*Remark:

Level (dBuV/m) @3m = Level (dBuV/m) @10m + Convert Factor (dB)

Convert Factor (dB) = $20 \cdot \log(\text{Measurement Distance}/\text{Specified Distance}) = 20 \cdot \log(10/3) = 10.46 \text{ dB}$ according to 15.31 (f) (1)



Test Mode: 00; Polarity: Vertical



Site : SGS
Job :
Model :
Power :
Test Mode : TX

Freq	Read	Antena	Cable	Preamp	Measured	Limit	Over	Pol/	Remark
	Level	Factor	Loss	Factor	Level	Line	Limit	Phase	
1	41.860	23.53	13.66	0.70	27.98	9.91		VERTICAL	QP
2	58.613	24.37	13.56	0.77	27.93	10.77		VERTICAL	QP
3	145.861	22.47	13.31	0.97	27.73	9.02		VERTICAL	QP
4	284.977	23.18	13.06	1.65	27.22	10.67		VERTICAL	QP
5	607.787	23.70	20.15	2.06	28.46	17.45		VERTICAL	QP
6	935.546	24.25	23.78	2.67	27.81	22.89		VERTICAL	QP



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Frequency (MHz)	Level @10m (dBuV/m)	Convert Factor (dB)*	Level @ 3m (dBuV/m)	Limit @3m (dBuV/m)	Over limit (dB)	Remark
41.860	9.91	10.46	20.37	40.00	-19.63	QP
58.613	10.77	10.46	21.23	40.00	-18.77	QP
145.861	9.02	10.46	19.48	43.52	-24.04	QP
284.977	10.67	10.46	21.13	46.02	-24.89	QP
607.787	17.45	10.46	27.91	46.02	-18.11	QP
935.546	22.89	10.46	33.35	46.02	-12.67	QP

*Remark:

Level (dBuV/m) @3m = Level (dBuV/m) @10m + Convert Factor (dB)

Convert Factor (dB) = $20 \cdot \log(\text{Measurement Distance}/\text{Specified Distance}) = 20 \cdot \log(10/3) = 10.46 \text{ dB}$ according to 15.31 (f) (1)



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7.4 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

7.4.1 E.U.T. Operation

Operating Environment:

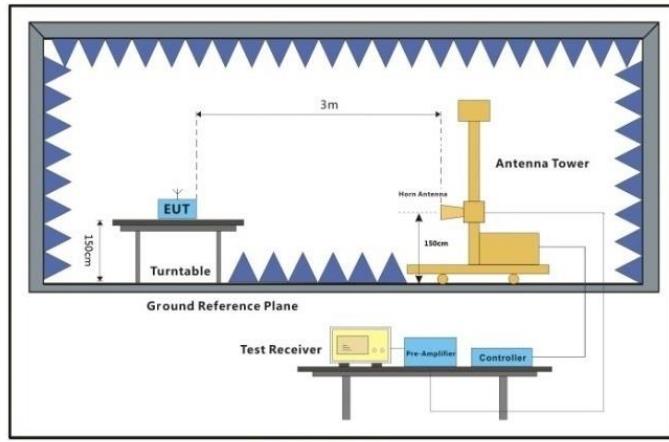
Temperature: 21.3 °C Humidity: 48.3 % RH Atmospheric Pressure: 1020 mbar

7.4.2 Test Mode Description

Pre-scan / Mode	Description
Final test	Code
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.

7.4.3 Test Setup Diagram



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7.4.4 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:

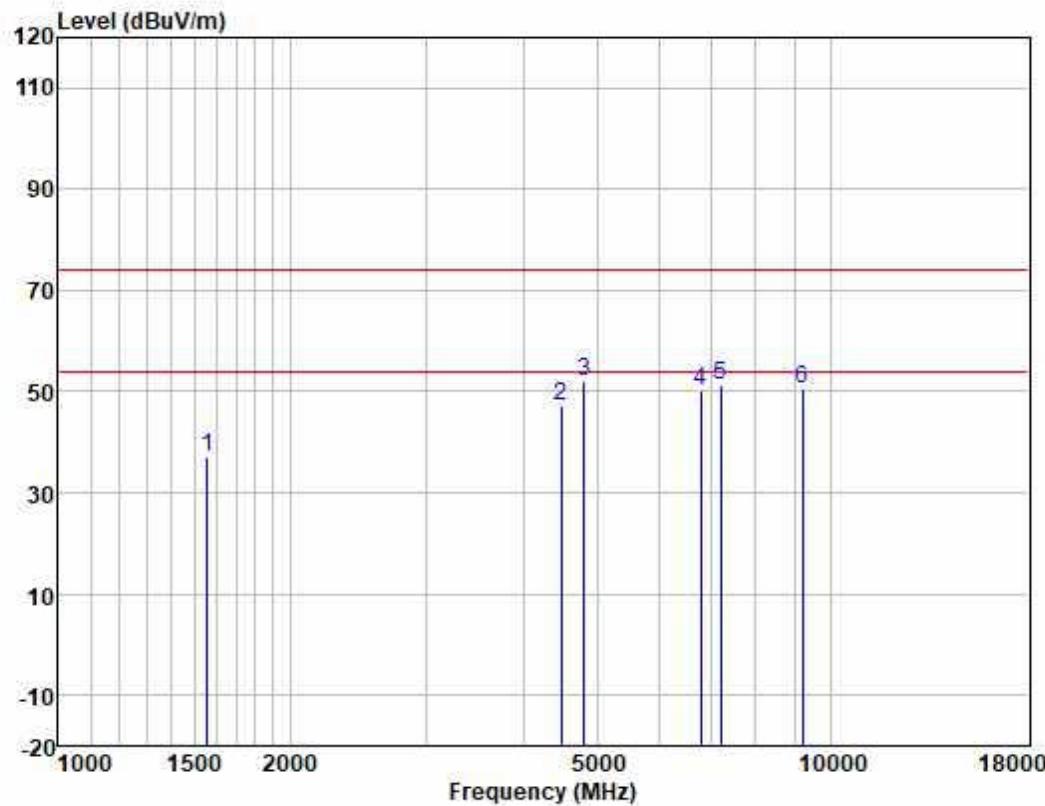
1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
2. Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from 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.
- 4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for Peak detection (PK) and Average detection (AV) at frequency above 1GHz.
- 5:For fundamental and harmonic signal measurement, the resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.



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



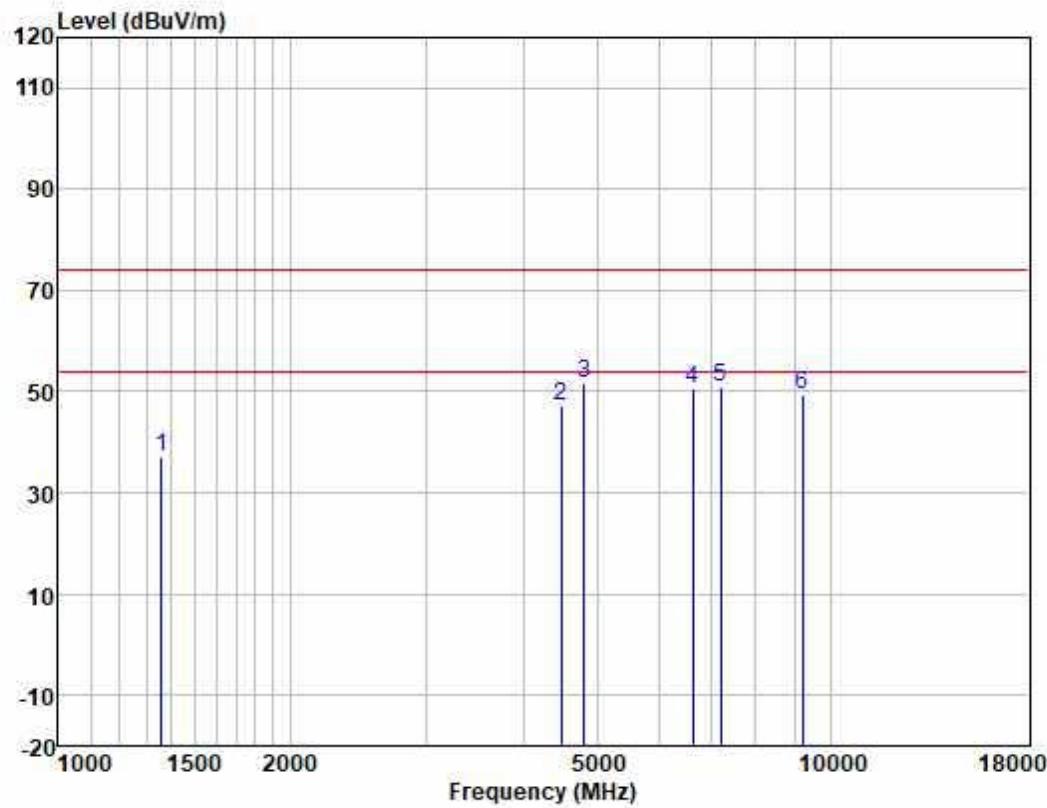
Freq	ReadAntenna		Cable		Preamp	Limit	Over	Over	Remark
	Level	Factor	Loss	Factor	Level				
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	dB	
1 1560.673	47.86	24.57	2.73	38.20	36.96	74.00	-37.04	VERTICAL	peak
2 4482.150	45.86	34.12	4.62	37.44	47.16	74.00	-26.84	VERTICAL	peak
3 4804.000	50.36	34.16	4.81	37.38	51.95	74.00	-22.05	VERTICAL	peak
4 6795.879	46.82	34.69	5.79	37.13	50.17	74.00	-23.83	VERTICAL	peak
5 7206.000	46.74	35.63	5.93	37.17	51.13	74.00	-22.87	VERTICAL	peak
6 9205.540	42.82	37.97	6.73	37.13	50.39	74.00	-23.61	VERTICAL	peak

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



Freq	ReadAntenna		Cable		Preamp		Limit	Over	Over	Remark
	Level	Factor	Loss	Factor	Level	Line				
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB			
1	1358.498	48.70	24.16	2.63	38.53	36.96	74.00	-37.04	HORIZONTAL	peak
2	4482.150	45.82	34.12	4.62	37.44	47.12	74.00	-26.88	HORIZONTAL	peak
3	4804.000	50.13	34.16	4.81	37.38	51.72	74.00	-22.28	HORIZONTAL	peak
4	6640.542	47.72	34.17	5.70	37.12	50.47	74.00	-23.53	HORIZONTAL	peak
5	7206.000	46.37	35.63	5.93	37.17	50.76	74.00	-23.24	HORIZONTAL	peak
6	9205.540	42.05	37.97	6.73	37.13	49.62	74.00	-24.38	HORIZONTAL	peak

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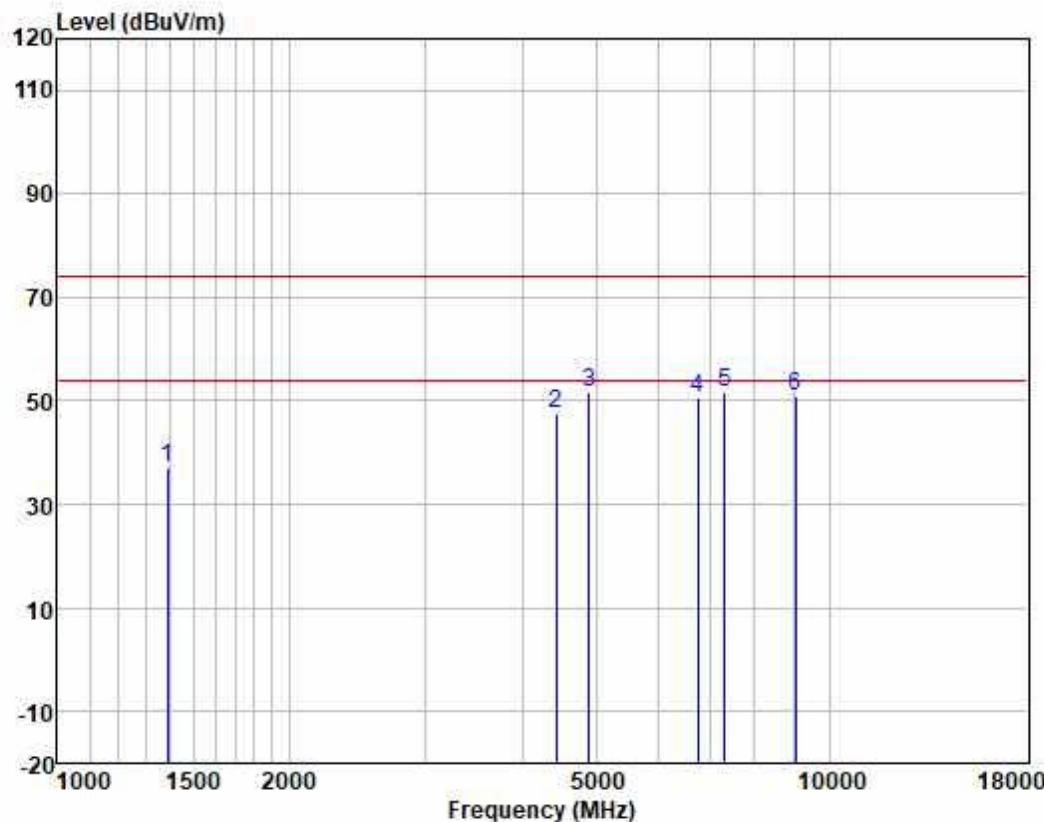
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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:middle



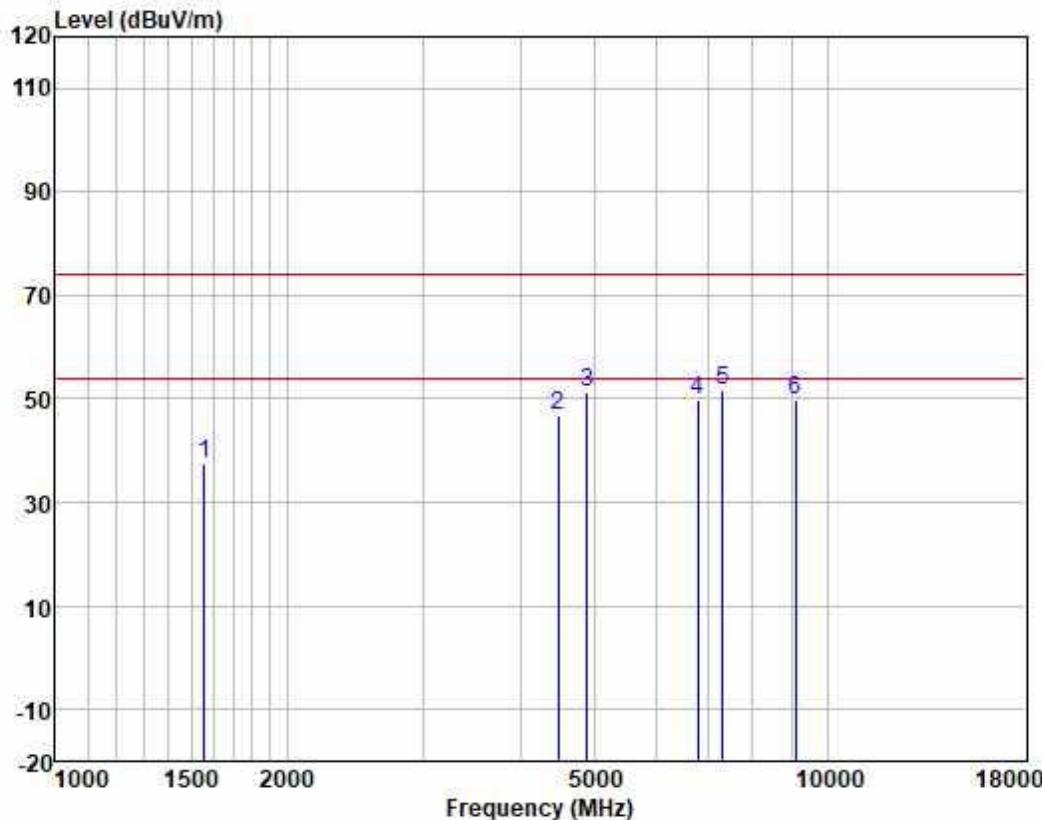
Freq	Read	Antenna	Cable	Preamp	Limit	Over	Limit	Over	Pol/Phase	Remark
	Level	Factor	Loss	Factor						
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	dB		
1 1390.276	48.87	24.24	2.65	38.49	37.27	74.00	-36.73	VERTICAL	peak	
2 4430.628	46.54	33.87	4.61	37.45	47.57	74.00	-26.43	VERTICAL	peak	
3 4882.000	49.86	34.15	4.86	37.35	51.52	74.00	-22.48	VERTICAL	peak	
4 6756.708	47.44	34.56	5.77	37.13	50.64	74.00	-23.36	VERTICAL	peak	
5 7323.000	46.96	36.07	5.98	37.18	51.83	74.00	-22.17	VERTICAL	peak	
6 9047.272	43.67	37.67	6.60	37.14	50.80	74.00	-23.20	VERTICAL	peak	

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



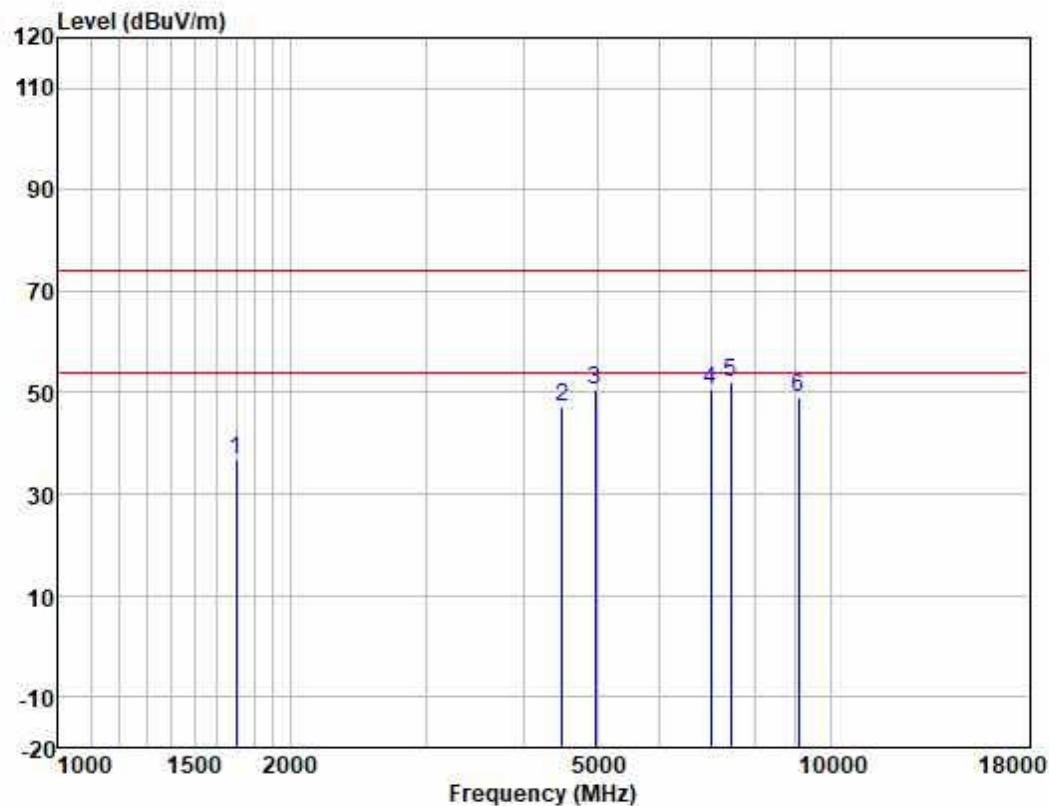
Freq	Read	Antenna	Cable	Preamp	Limit	Over	Limit	Over	Pol/Phase	Remark
	Level	Factor	Loss	Factor						
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	dB		
1 1560.673	48.29	24.57	2.73	38.20	37.39	74.00	-36.61	74.00	HORIZONTAL	peak
2 4482.150	45.45	34.12	4.62	37.44	46.75	74.00	-27.25	74.00	HORIZONTAL	peak
3 4882.000	49.82	34.15	4.86	37.35	51.48	74.00	-22.52	74.00	HORIZONTAL	peak
4 6795.879	46.55	34.69	5.79	37.13	49.90	74.00	-24.10	74.00	HORIZONTAL	peak
5 7323.000	46.68	36.07	5.98	37.18	51.55	74.00	-22.45	74.00	HORIZONTAL	peak
6 9099.724	42.63	37.75	6.64	37.14	49.88	74.00	-24.12	74.00	HORIZONTAL	peak



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



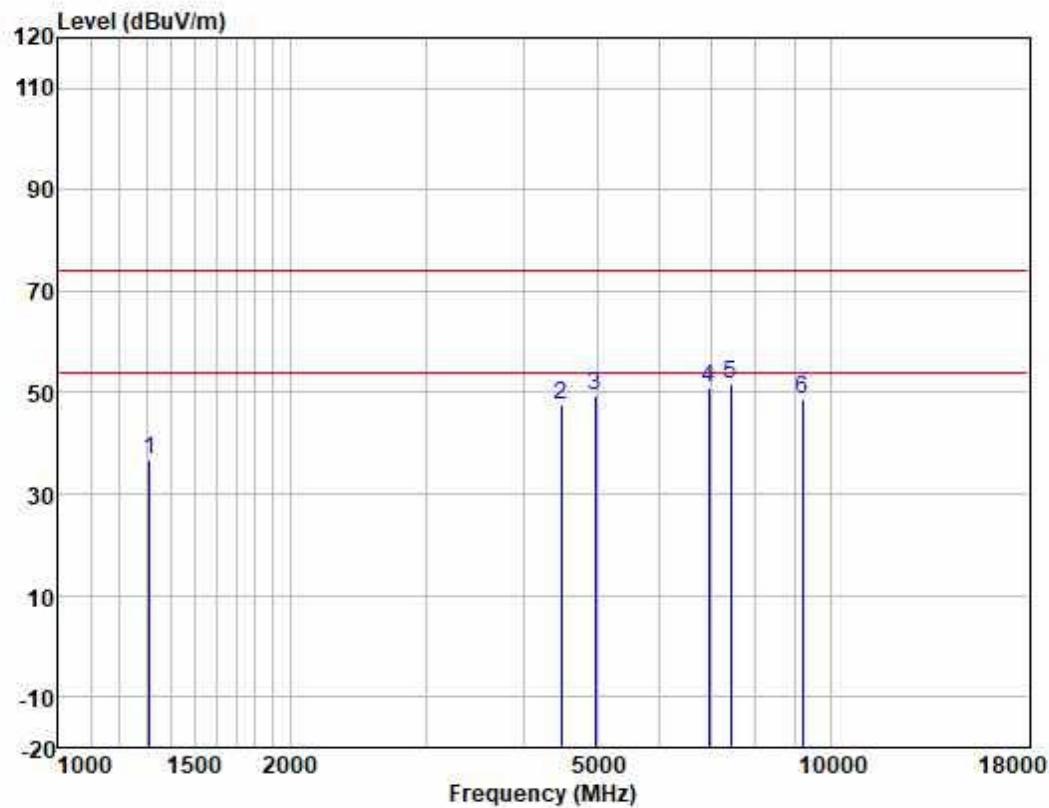
Freq	ReadAntenna	Cable	Preamp	Limit	Over	Over	Remark
	Level	Factor	Loss				
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1 1702.042	46.90	25.15	2.85	38.03	36.87	74.00	-37.13 VERTICAL peak
2 4495.125	45.97	34.17	4.62	37.44	47.32	74.00	-26.68 VERTICAL peak
3 4960.000	48.96	34.15	4.89	37.32	50.68	74.00	-23.32 VERTICAL peak
4 6995.172	46.87	35.11	5.87	37.15	50.70	74.00	-23.30 VERTICAL peak
5 7440.000	46.80	36.33	6.02	37.18	51.97	74.00	-22.03 VERTICAL peak
6 9099.724	41.84	37.75	6.64	37.14	49.09	74.00	-24.91 VERTICAL peak



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



Freq	ReadAntenna	Cable	Preamp	Limit	Over	Over	Remark
	Level	Factor	Loss				
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1 1312.187	48.53	24.02	2.60	38.58	36.57	74.00	-37.43 HORIZONTAL peak
2 4482.150	46.10	34.12	4.62	37.44	47.40	74.00	-26.60 HORIZONTAL peak
3 4960.000	47.90	34.15	4.89	37.32	49.62	74.00	-24.38 HORIZONTAL peak
4 6954.852	47.27	35.04	5.86	37.14	51.03	74.00	-22.97 HORIZONTAL peak
5 7440.000	46.58	36.33	6.02	37.18	51.75	74.00	-22.25 HORIZONTAL peak
6 9205.540	41.15	37.97	6.73	37.13	48.72	74.00	-25.28 HORIZONTAL peak

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7.5 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 ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 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

7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

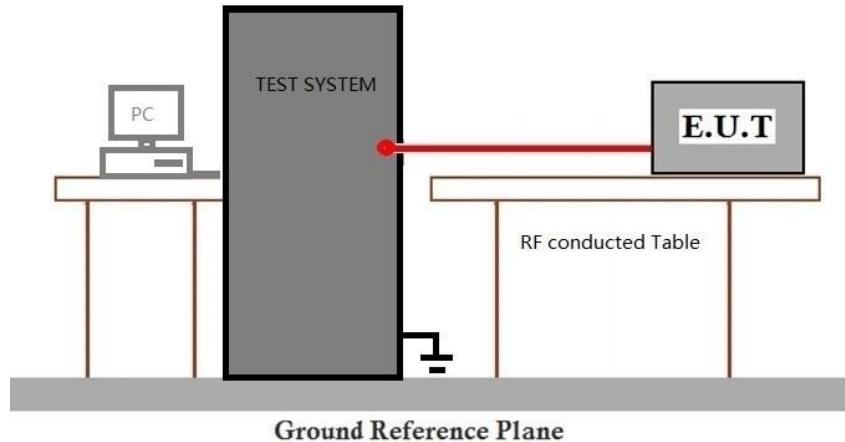
7.5.2 Test Mode Description

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.



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7.5.3 Test Setup Diagram**7.5.4 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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7.6 20dB Bandwidth

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

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

Limit:

20 dB bandwidth of the hopping channel	Hopping frequencies	Average time of occupancy
less than 250 kHz	least 50 hopping frequencies	shall not be greater than 0.4 seconds within a 20 second period
250 kHz to 500kHz	least 25 hopping frequencies	shall not be greater than 0.4 seconds within a 10 second period

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.0 °C

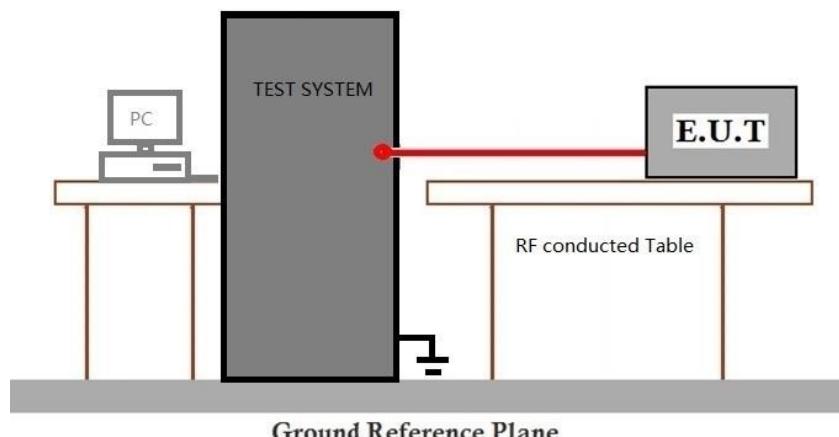
Humidity: 58.8 % RH

Atmospheric Pressure: 1020 mbar

7.6.2 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.

7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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7.7 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.

7.7.1 E.U.T. Operation

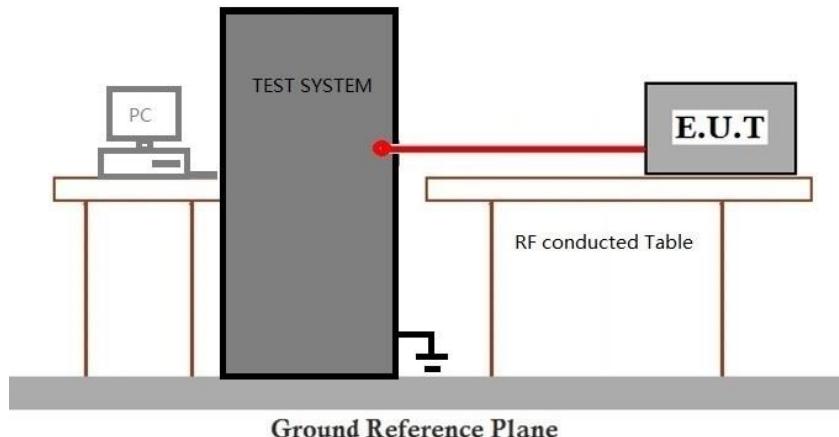
Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
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.

7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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7.8 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

7.8.1 E.U.T. Operation

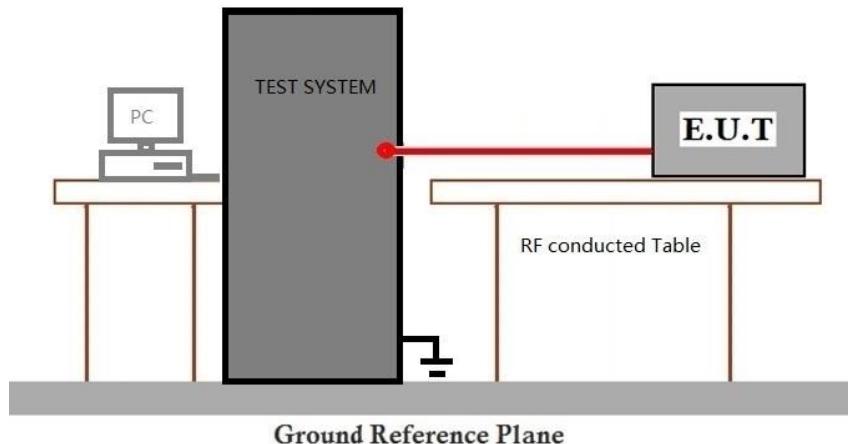
Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
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.

7.8.3 Test Setup Diagram



7.8.4 Measurement Procedure and Data

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7.9 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

7.9.1 E.U.T. Operation

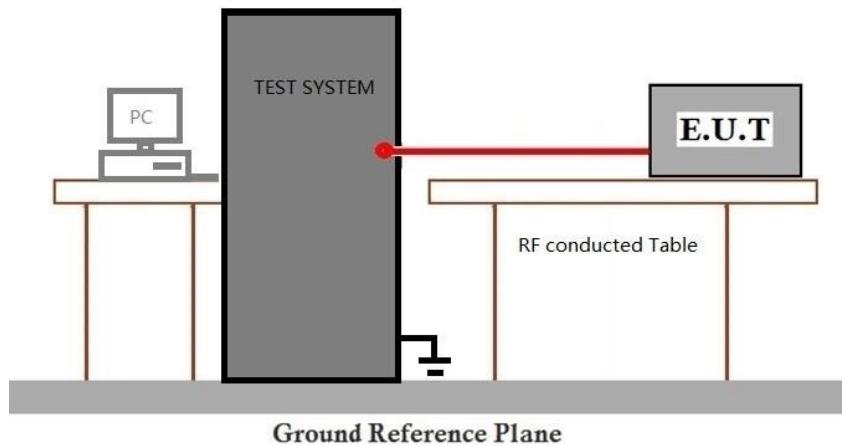
Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
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.

7.9.3 Test Setup Diagram



7.9.4 Measurement Procedure and Data

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7.10 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)).

7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

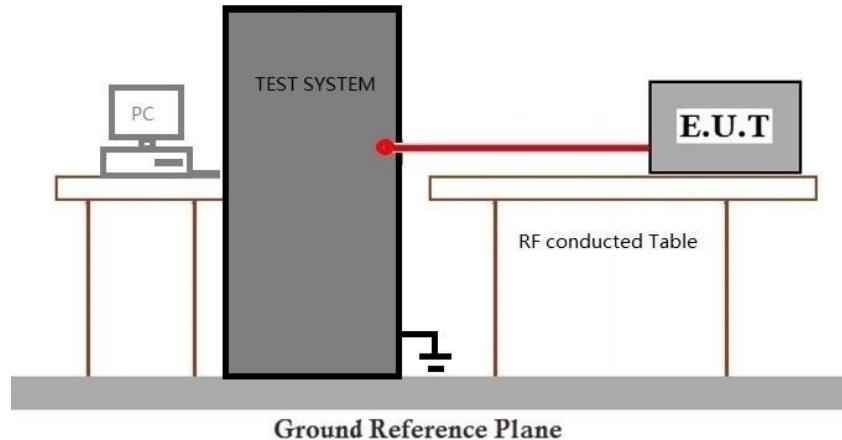
7.10.2 Test Mode Description

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.



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7.10.3 Test Setup Diagram**7.10.4 Measurement Procedure and Data**

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7.11 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)).

7.11.1 E.U.T. Operation

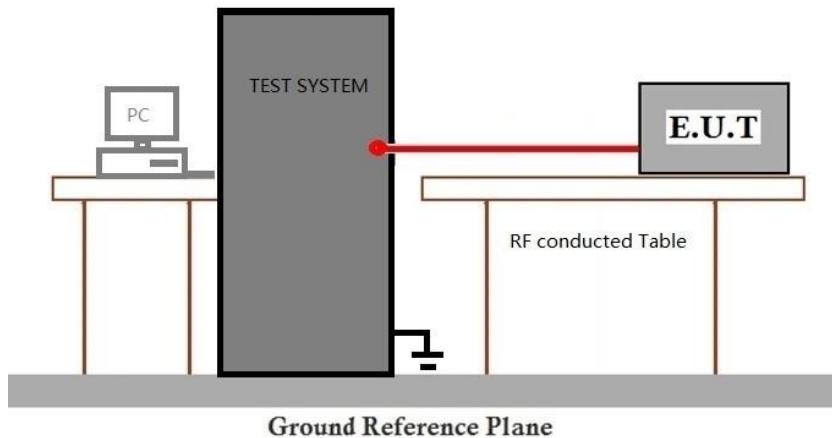
Operating Environment:

Temperature: 23.0 °C Humidity: 58.8 % RH Atmospheric Pressure: 1020 mbar

7.11.2 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.

7.11.3 Test Setup Diagram



7.11.4 Measurement Procedure and Data

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8 Test Setup Photo

Refer to Appendix - Test Setup Photo for GZCR250100004303



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9 EUT Constructional Details (EUT Photos)

Refer to Appendix - External and Internal Photos for GZCR2501000043AT



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10 Appendix

1. Bandwidth

1.1 Test Result

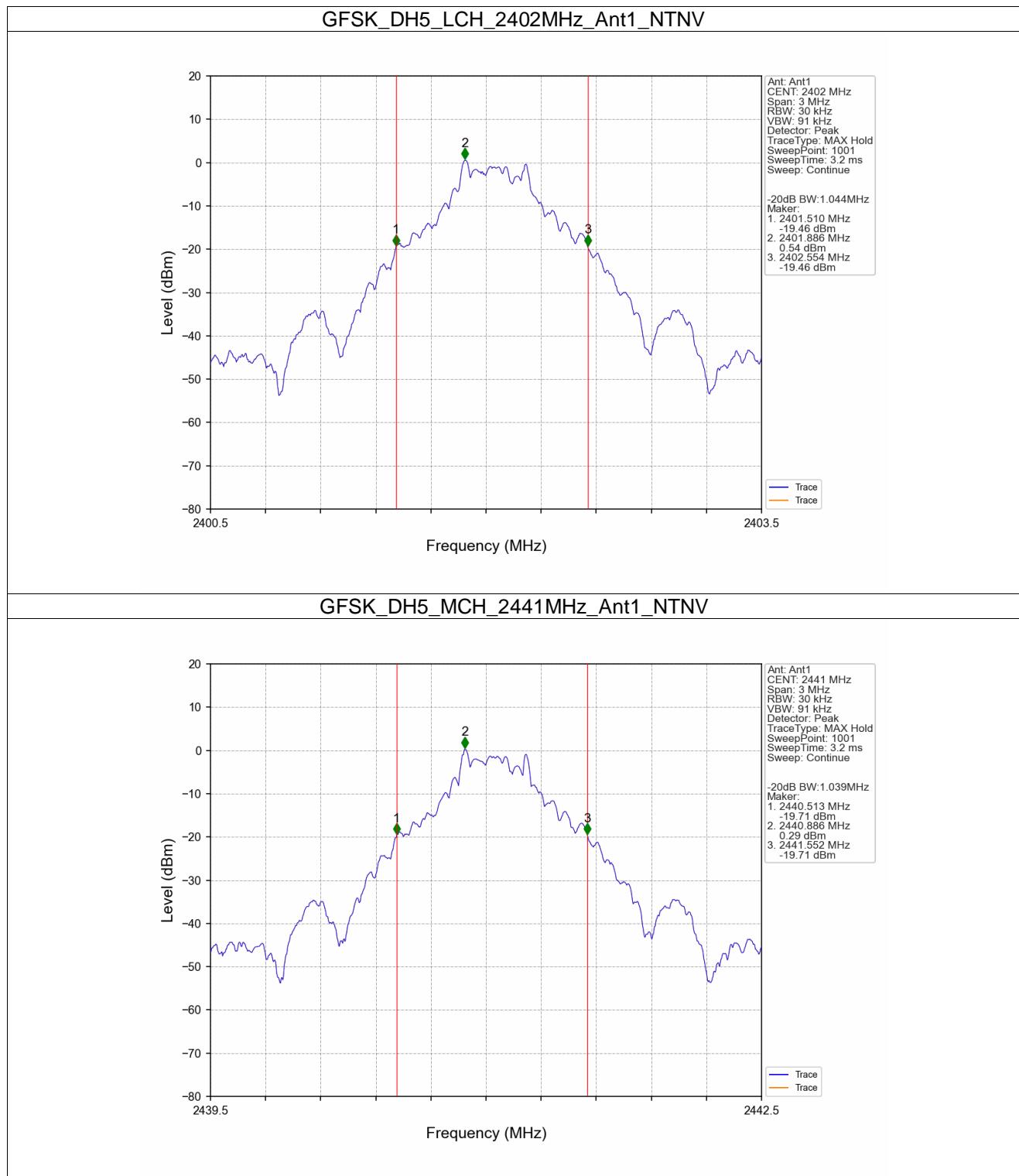
1.1.1 20dB BW

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)		Verdict
					Result	Limit	
GFSK	SISO	2402	DH5	1	1.044	/	Pass
		2441	DH5	1	1.039	/	Pass
		2480	DH5	1	1.053	/	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.043	/	Pass
		2441	2DH5	1	1.040	/	Pass
		2480	2DH5	1	1.044	/	Pass
8DPSK	SISO	2402	3DH5	1	1.277	/	Pass
		2441	3DH5	1	1.281	/	Pass
		2480	3DH5	1	1.284	/	Pass



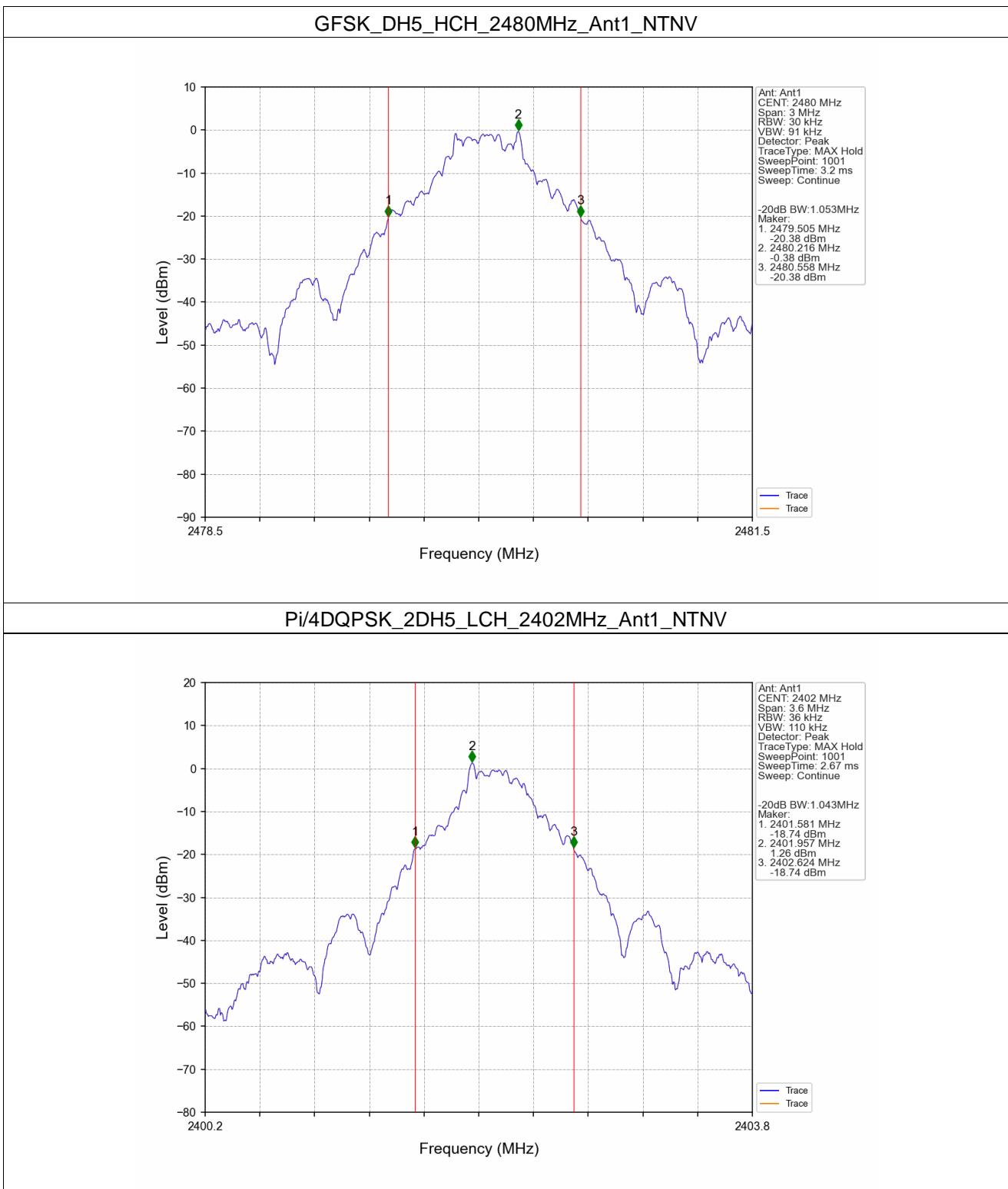
1.2 Test Graph

1.2.1 20dB BW



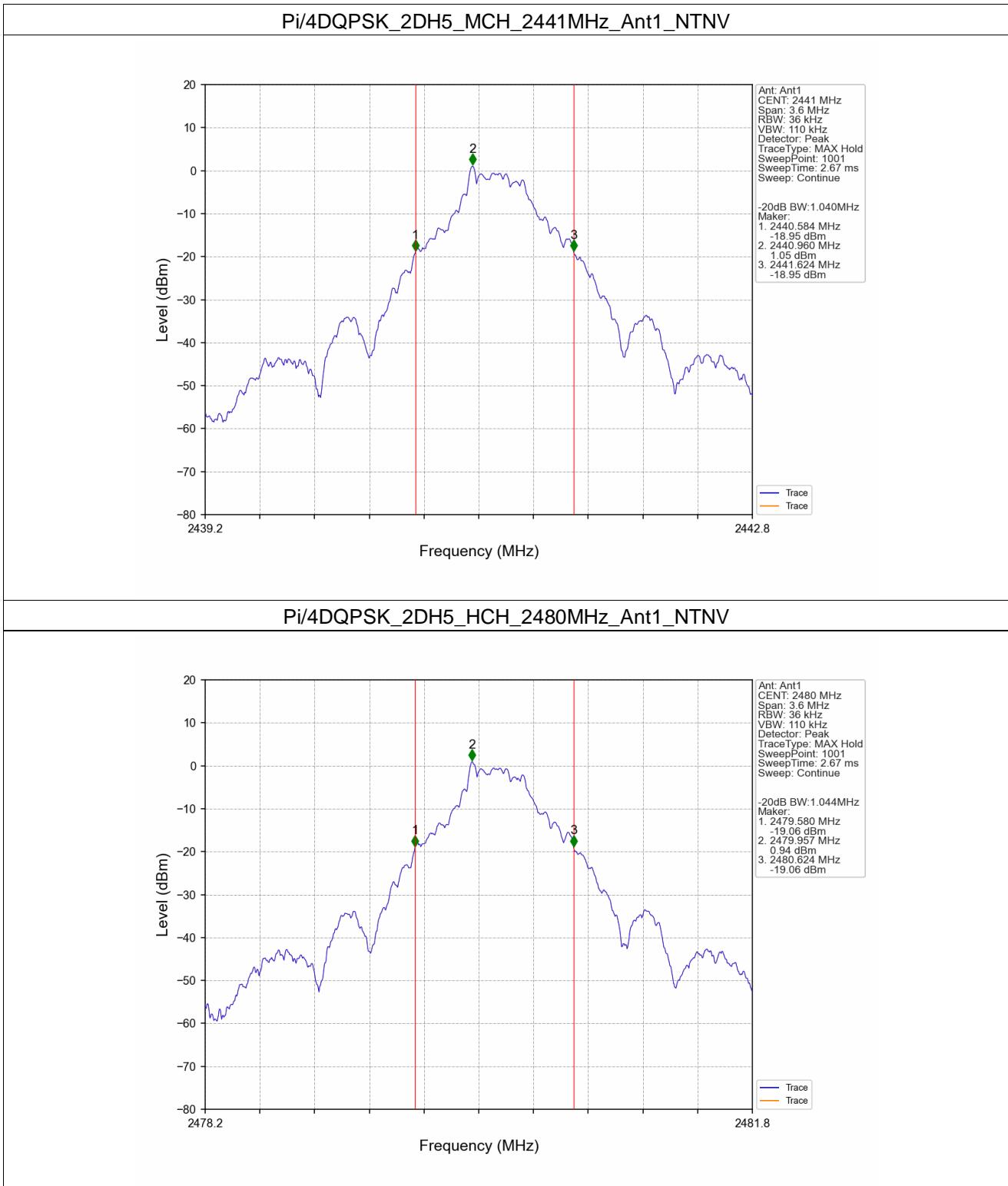
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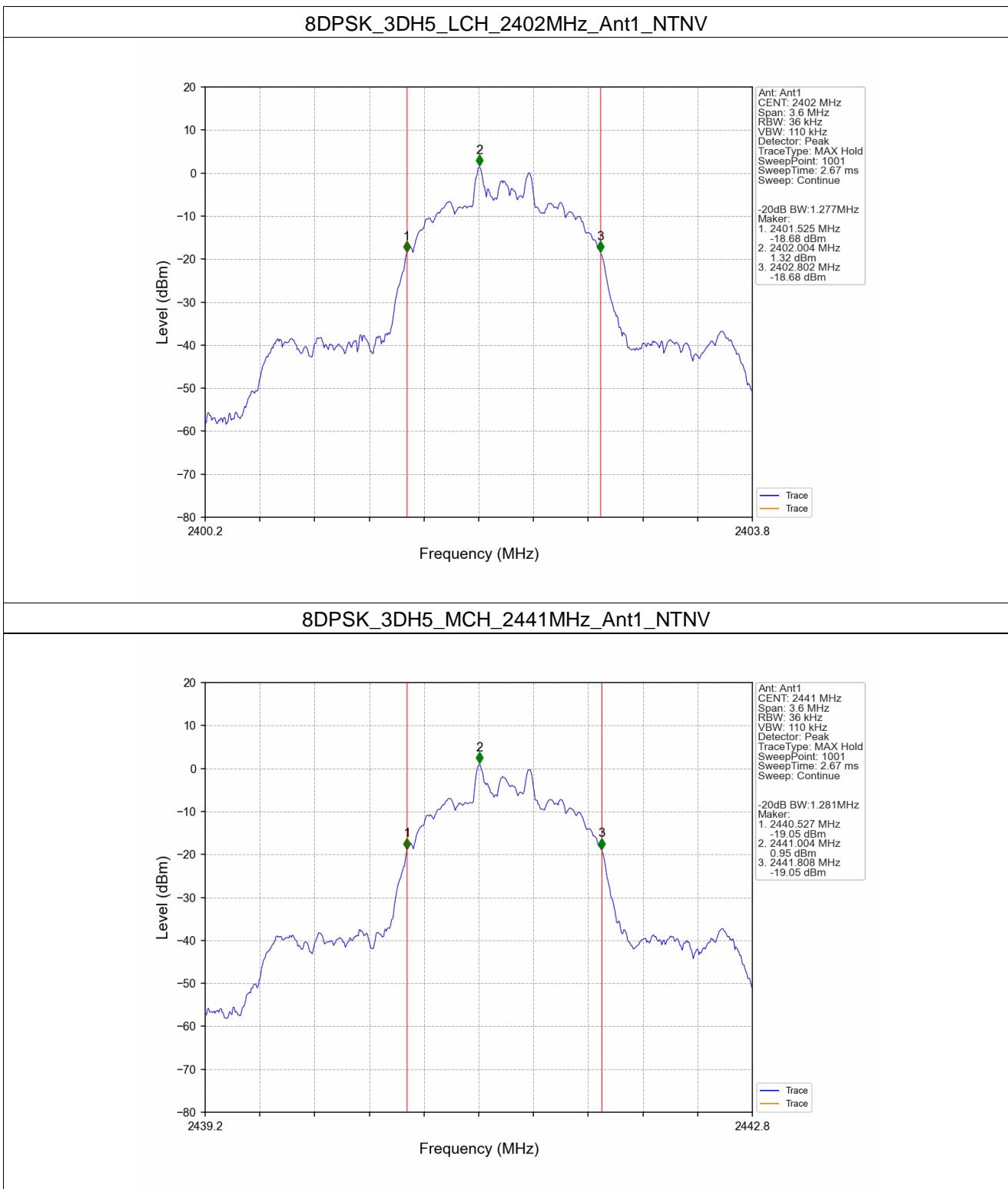
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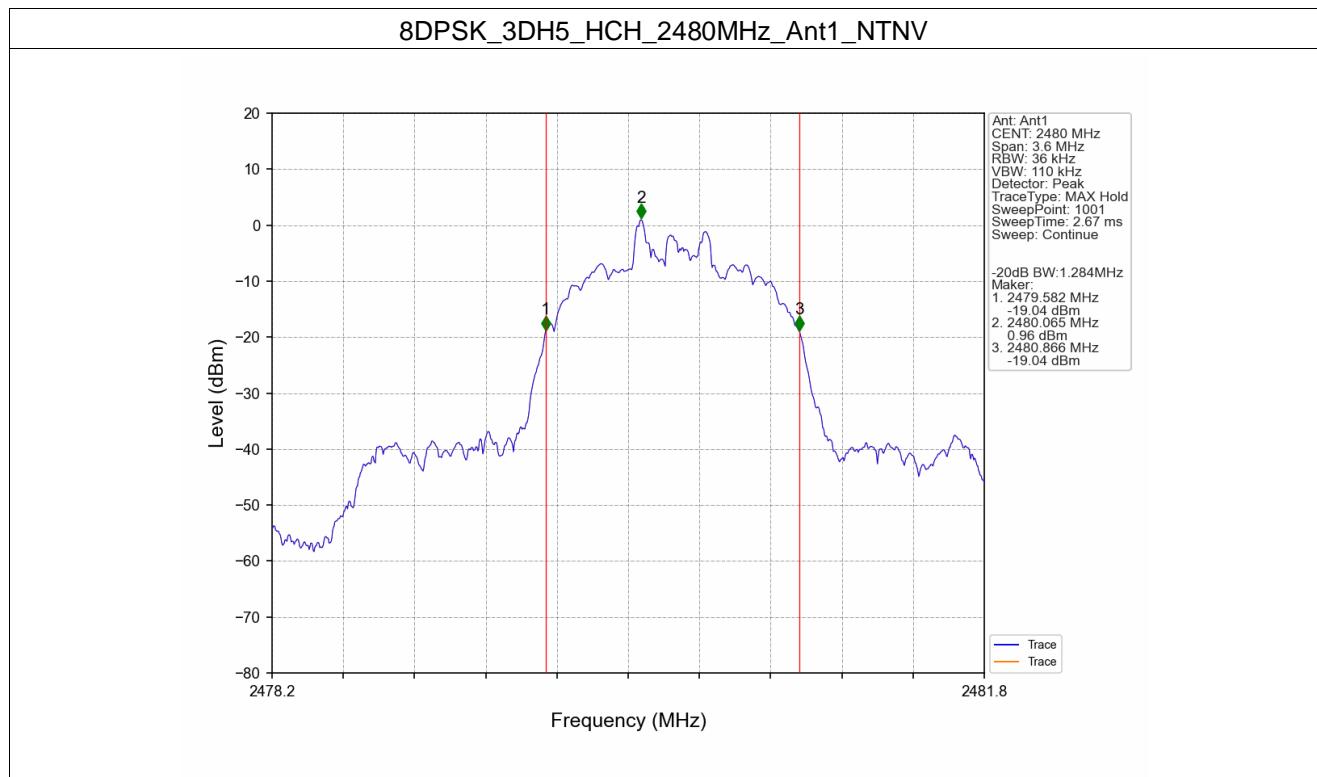


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2. Maximum Conducted Output Power

2.1 Test Result

2.1.1 Power

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	2.12	<=20.97	Pass
		2441	DH5	1.71	<=20.97	Pass
		2480	DH5	2.06	<=20.97	Pass
Pi/4DQPSK	SISO	2402	2DH5	2.19	<=20.97	Pass
		2441	2DH5	1.92	<=20.97	Pass
		2480	2DH5	1.95	<=20.97	Pass
8DPSK	SISO	2402	3DH5	2.17	<=20.97	Pass
		2441	3DH5	1.90	<=20.97	Pass
		2480	3DH5	1.93	<=20.97	Pass



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3. Carrier Frequency Separation

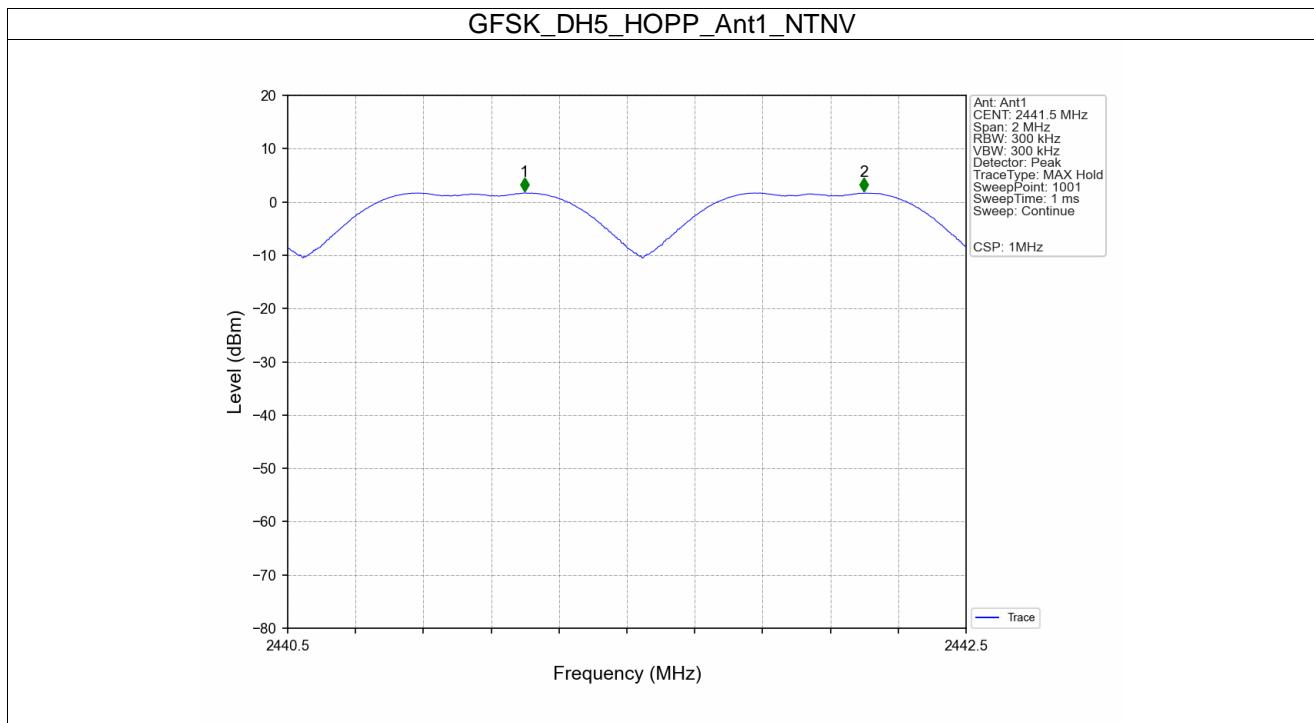
3.1 Test Result

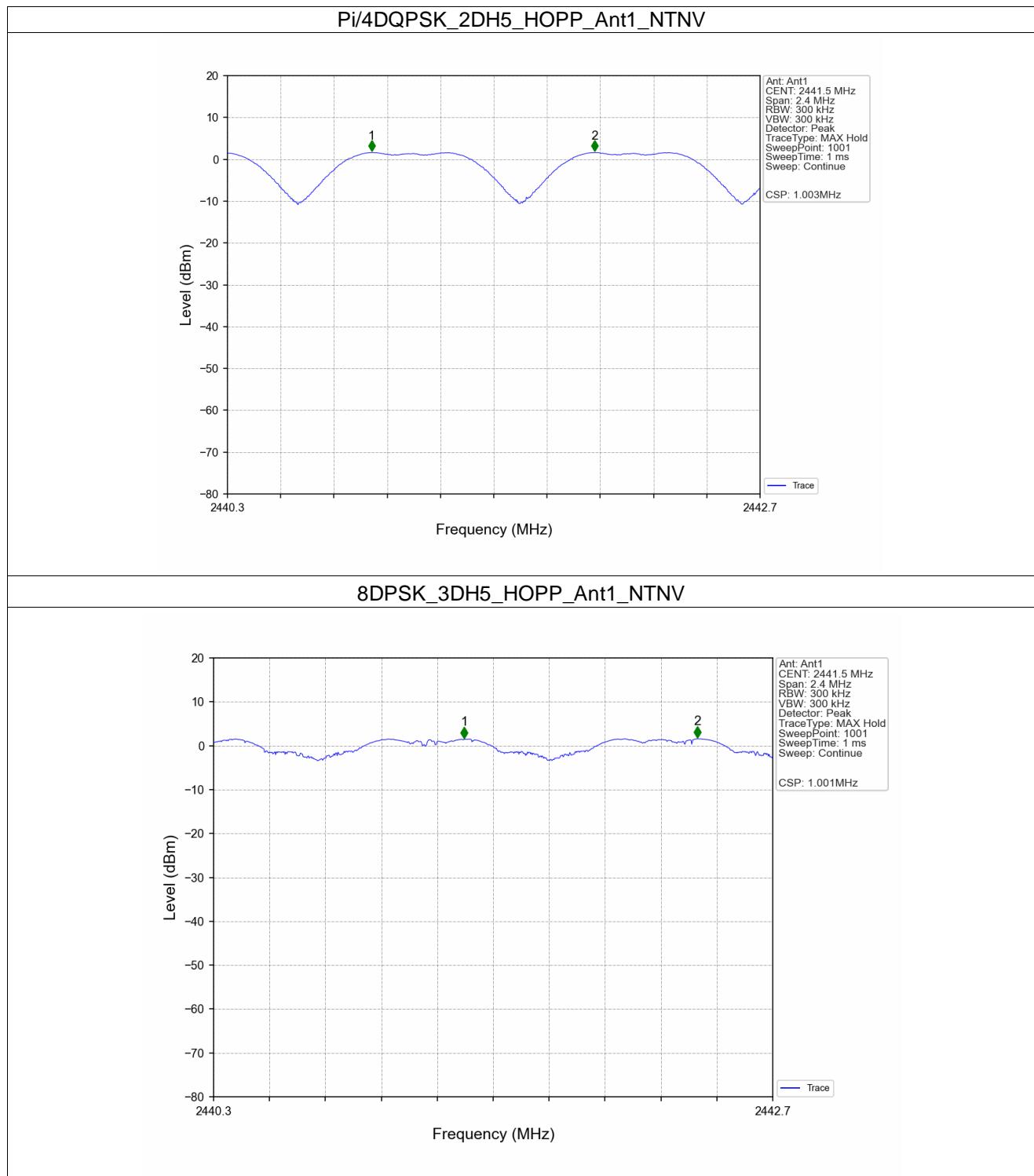
3.1.1 Ant1

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.000	1.053	>=0.702	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.003	1.044	>=0.696	Pass
8DPSK	SISO	HOPP	3DH5	1.001	1.284	>=0.856	Pass

3.2 Test Graph

3.2.1 Ant1





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4. Number of Hopping Frequencies

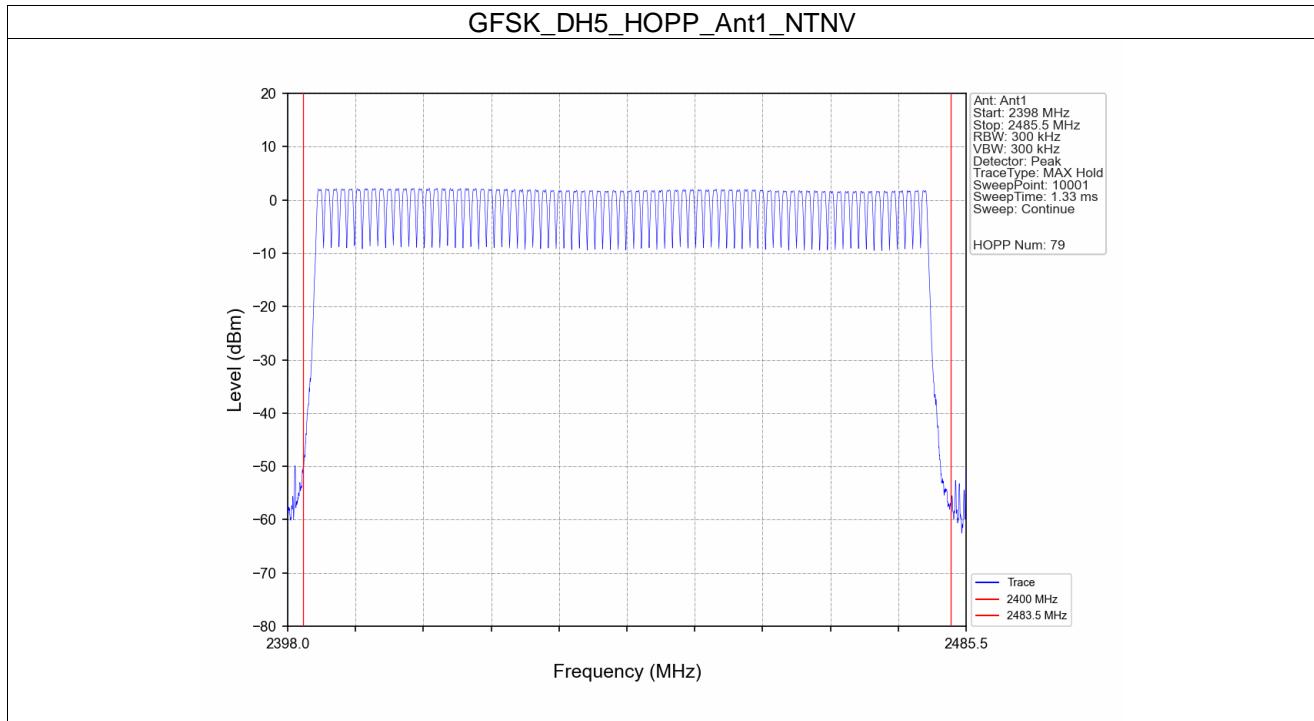
4.1 Test Result

4.1.1 HoppNum

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

4.2 Test Graph

4.2.1 HoppNum



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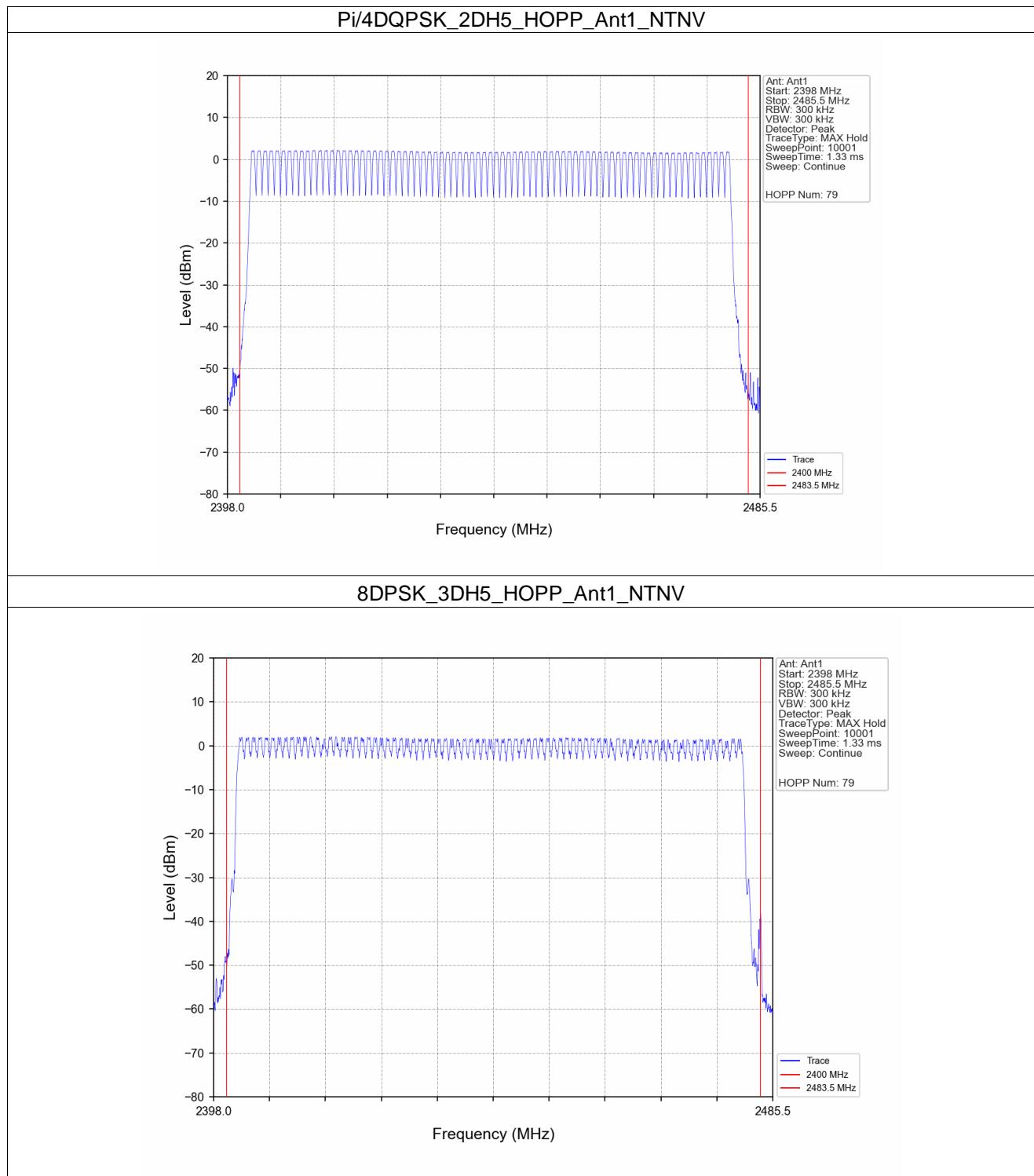
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5. Time of Occupancy (Dwell Time)

5.1 Test Result

5.1.1 Ant1

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	0.404	31.600	340	137.360	<=400	Pass
			DH3	1.660	31.600	153	253.980	<=400	Pass
			DH5	2.908	31.600	75	218.100	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.402	31.600	332	133.464	<=400	Pass
			2DH3	1.652	31.600	107	176.764	<=400	Pass
			2DH5	2.908	31.600	110	319.880	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.400	31.600	183	73.200	<=400	Pass
			3DH3	1.652	31.600	158	261.016	<=400	Pass
			3DH5	2.902	31.600	104	301.808	<=400	Pass

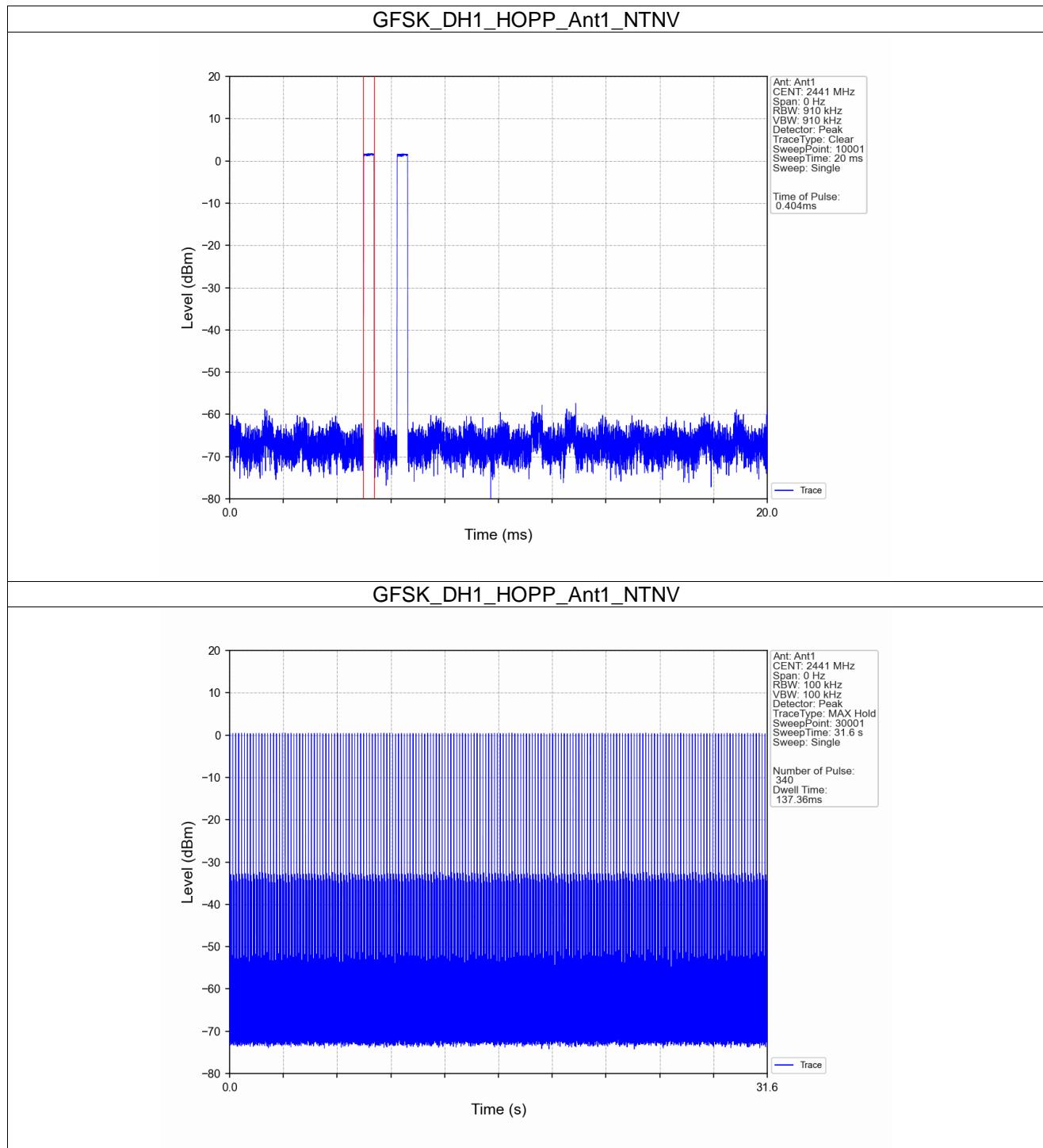


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5.2 Test Graph

5.2.1 Ant1



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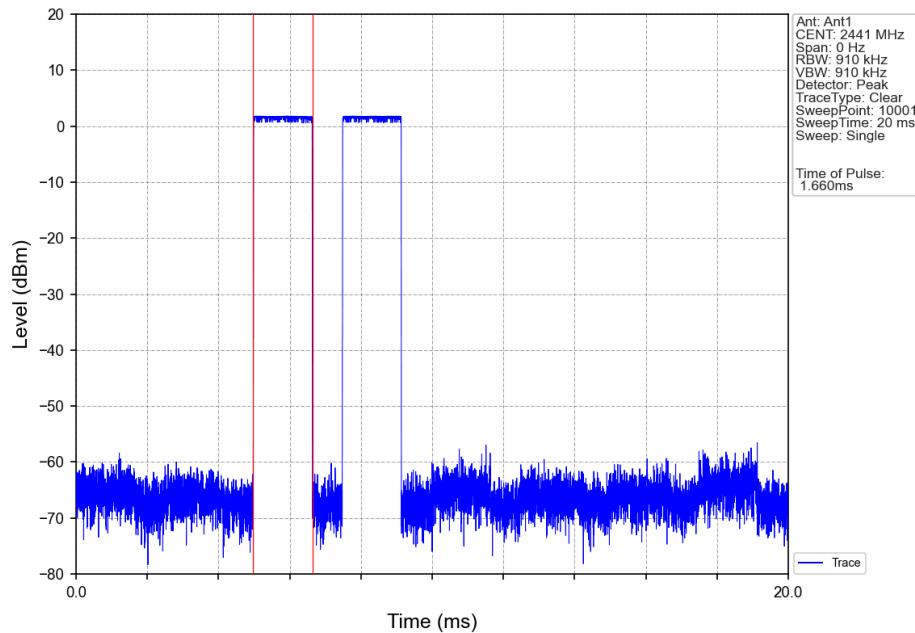
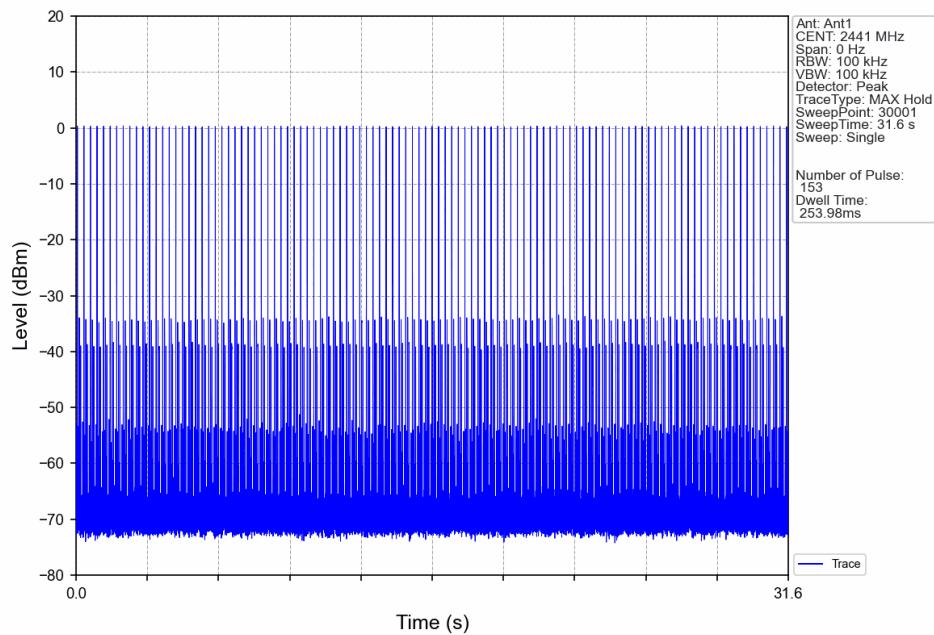
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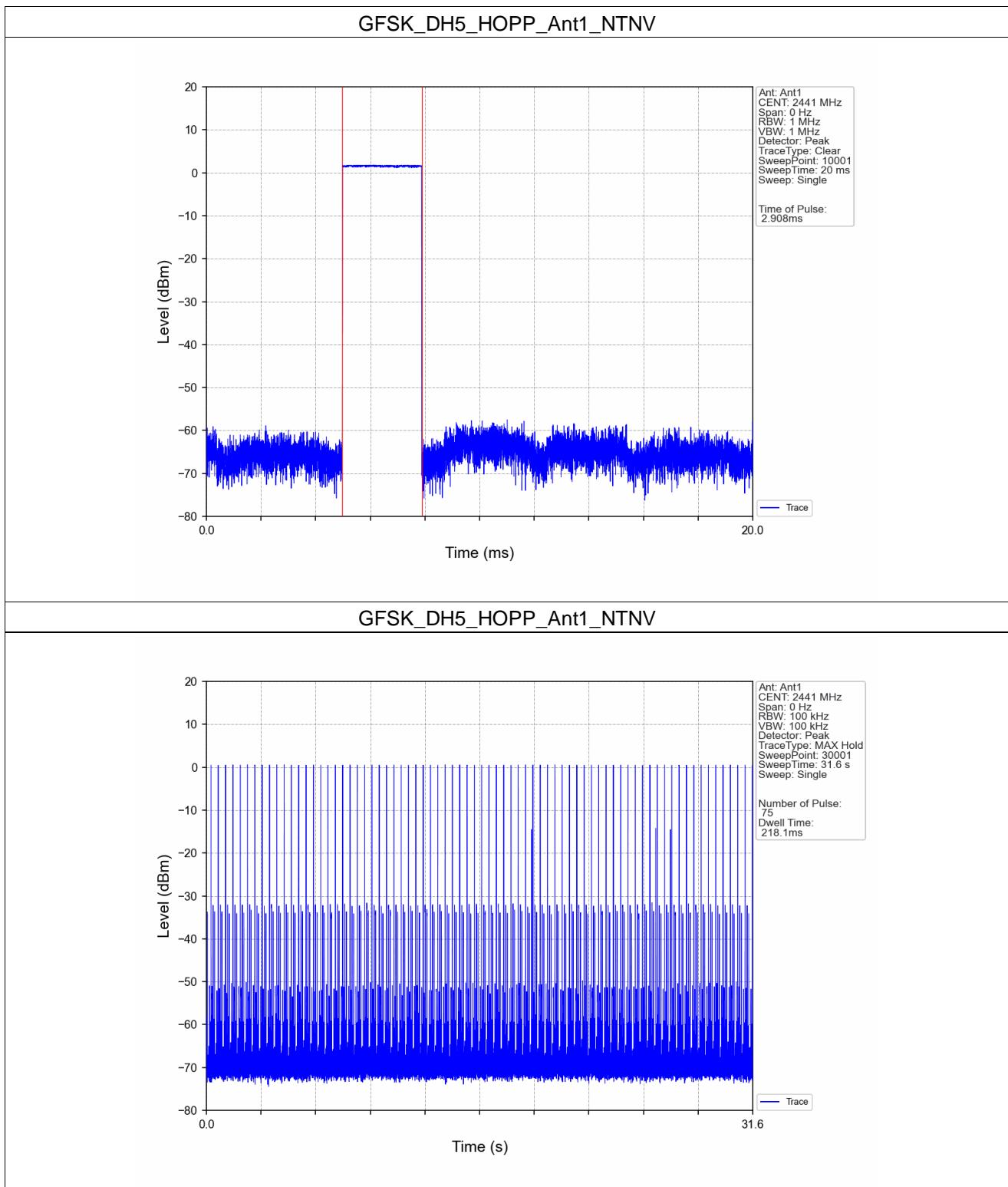
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GFSK_DH3_HOPP_Ant1_NTNV**GFSK_DH3_HOPP_Ant1_NTNV**

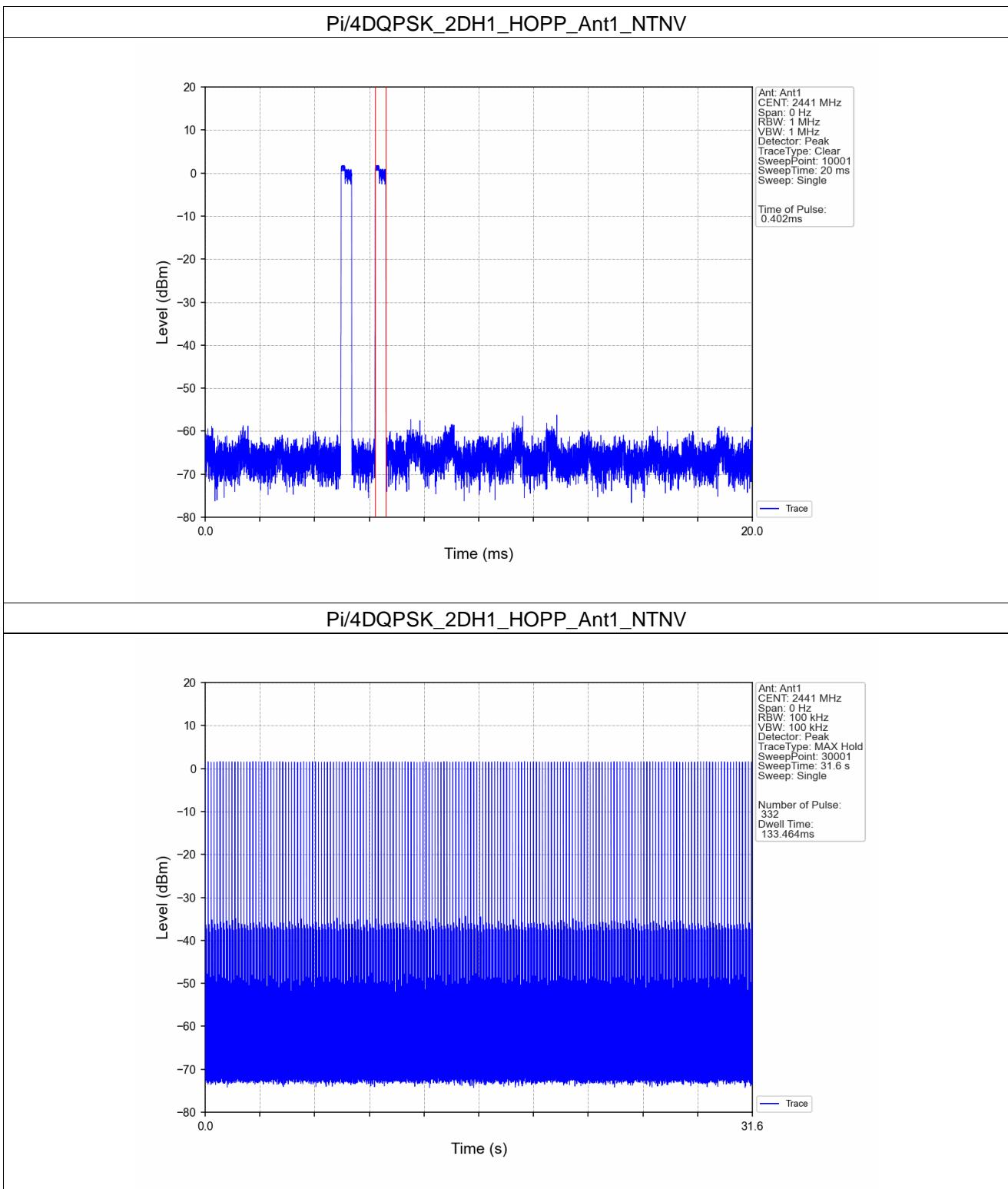
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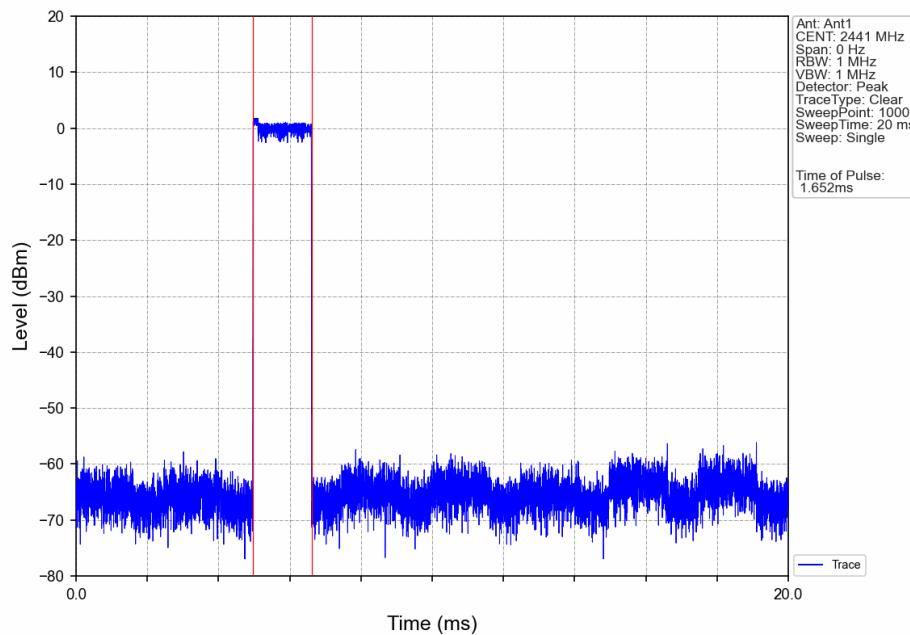
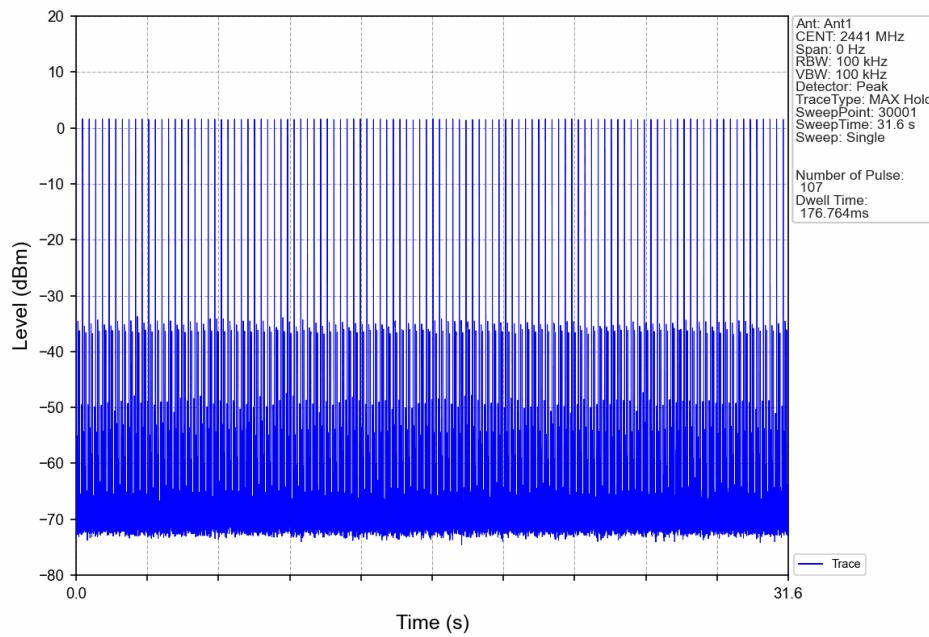
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Pi/4DQPSK_2DH3_HOPP_Ant1_NTNV**Pi/4DQPSK_2DH3_HOPP_Ant1_NTNV**

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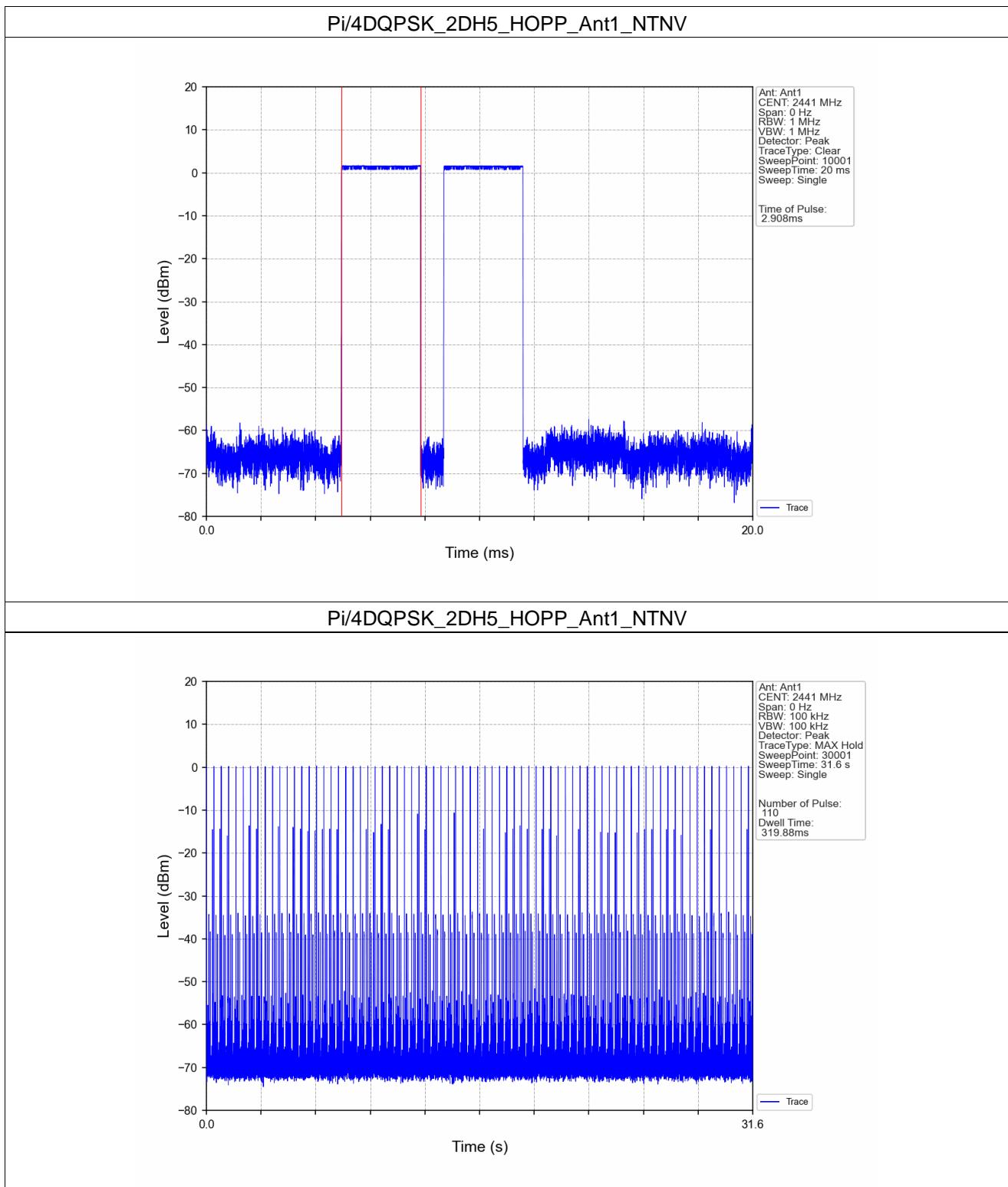
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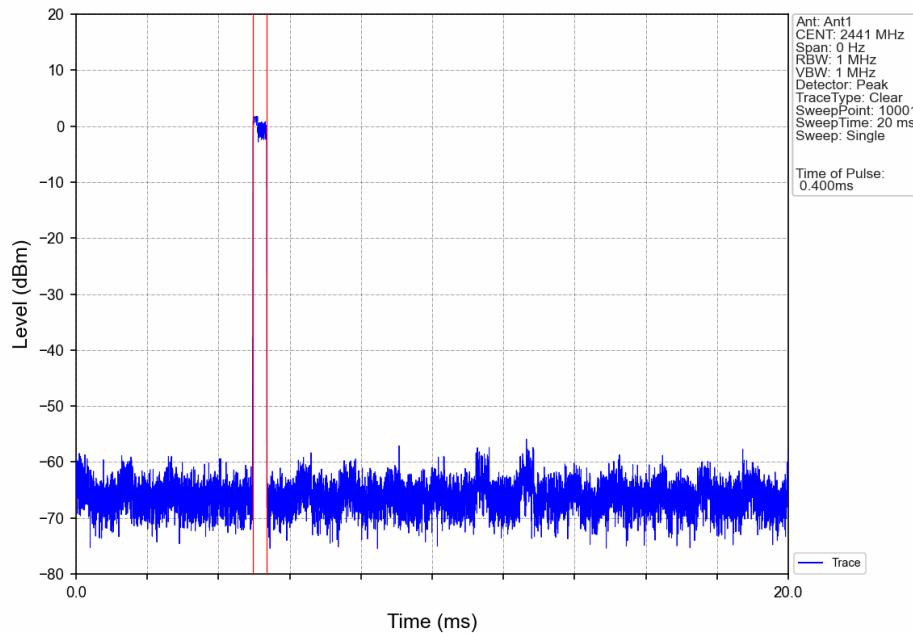
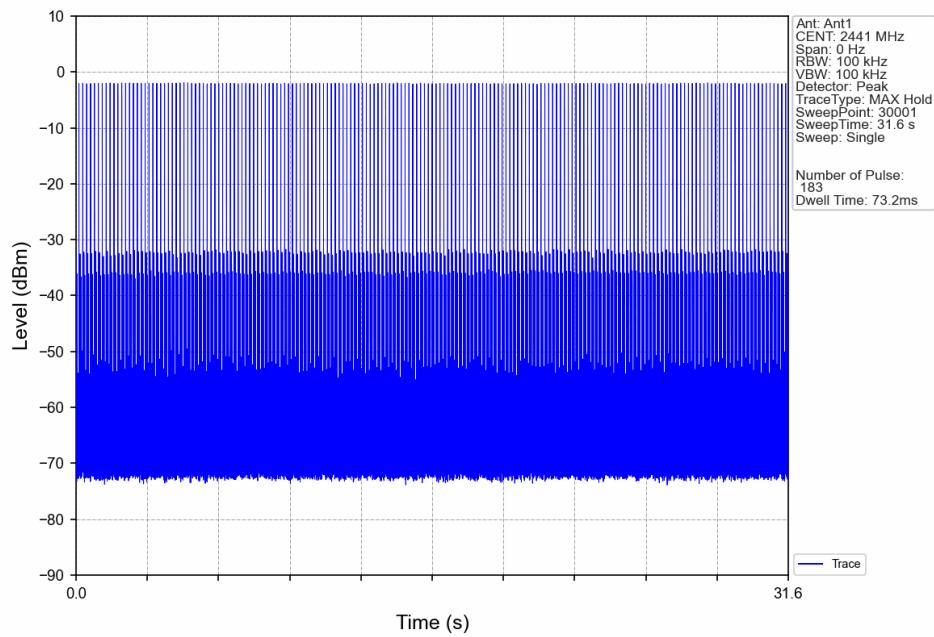
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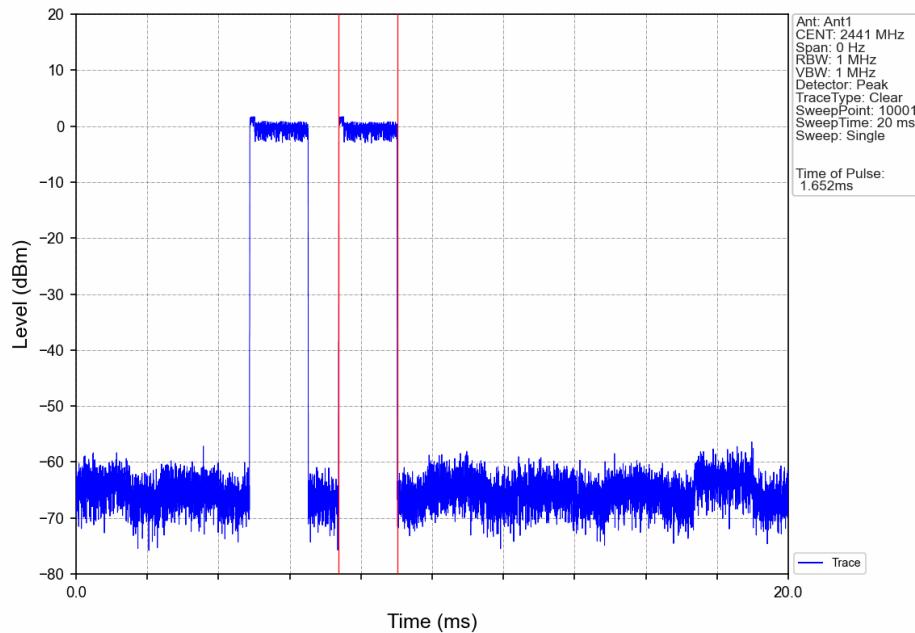
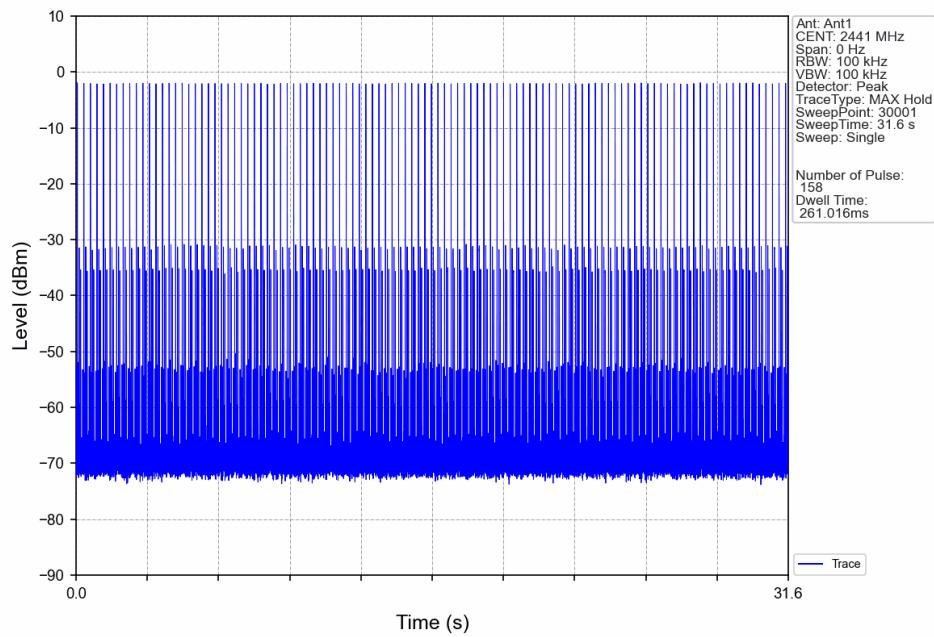
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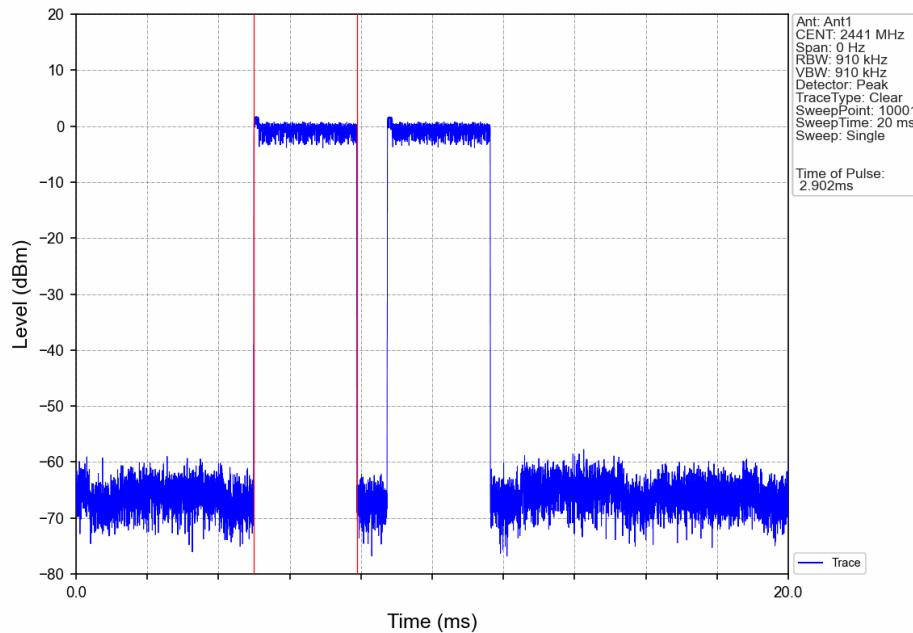
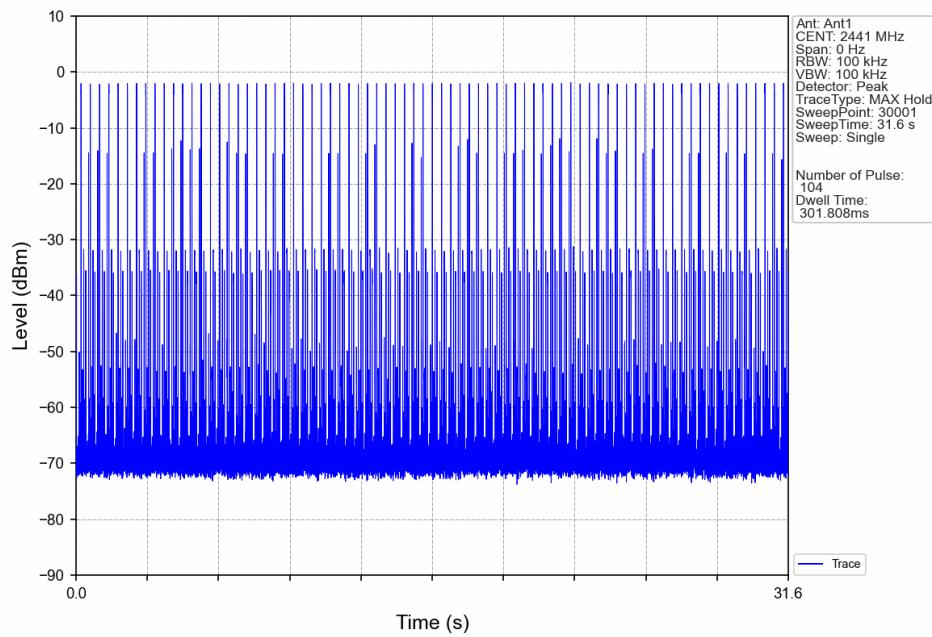
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8DPSK_3DH1_HOPP_Ant1_NTNV**8DPSK_3DH1_HOPP_Ant1_NTNV**

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8DPSK_3DH3_HOPP_Ant1_NTNV**8DPSK_3DH3_HOPP_Ant1_NTNV**

8DPSK_3DH5_HOPP_Ant1_NTNV**8DPSK_3DH5_HOPP_Ant1_NTNV**

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6. Unwanted Emissions In Non-restricted Frequency Bands

6.1 Test Result

6.1.1 Ref

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	1.70
		2441	DH5	1	1.37
		2480	DH5	1	1.73
Pi/4DQPSK	SISO	2402	2DH5	1	1.87
		2441	2DH5	1	1.63
		2480	2DH5	1	1.57
8DPSK	SISO	2402	3DH5	1	1.92
		2441	3DH5	1	1.54
		2480	3DH5	1	1.60

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 CSE and Band Edges

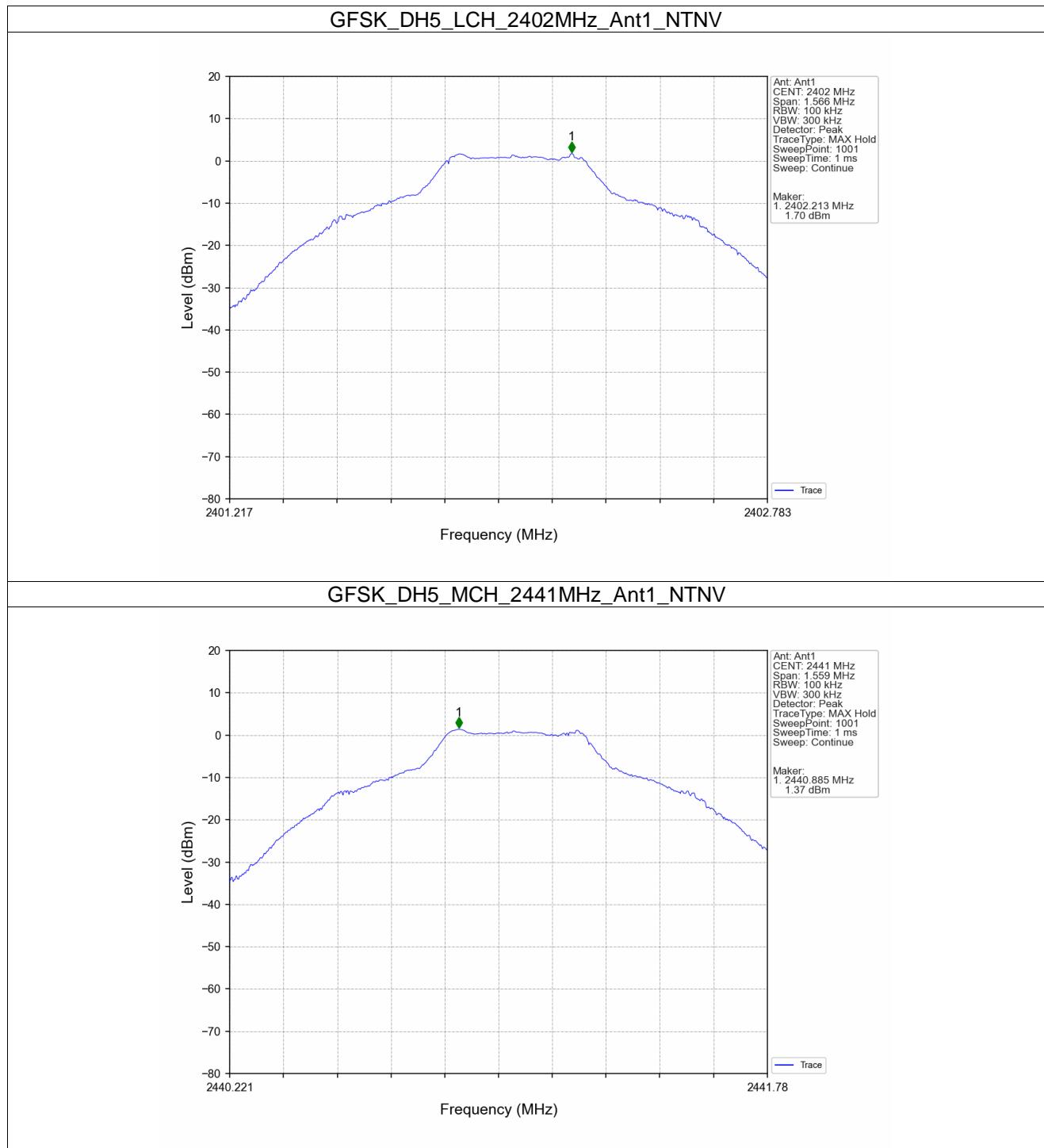
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	1.73	-18.27	Pass
		2441	DH5	1	1.73	-18.27	Pass
		2480	DH5	1	1.73	-18.27	Pass
		HOPP	DH5	1	1.73	-18.27	Pass
					1.73	-18.27	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.87	-18.13	Pass
		2441	2DH5	1	1.87	-18.13	Pass
		2480	2DH5	1	1.87	-18.13	Pass
		HOPP	2DH5	1	1.87	-18.13	Pass
					1.87	-18.13	Pass
8DPSK	SISO	2402	3DH5	1	1.92	-18.08	Pass
		2441	3DH5	1	1.92	-18.08	Pass
		2480	3DH5	1	1.92	-18.08	Pass
		HOPP	3DH5	1	1.92	-18.08	Pass
					1.92	-18.08	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 Test Graph

6.2.1 Ref



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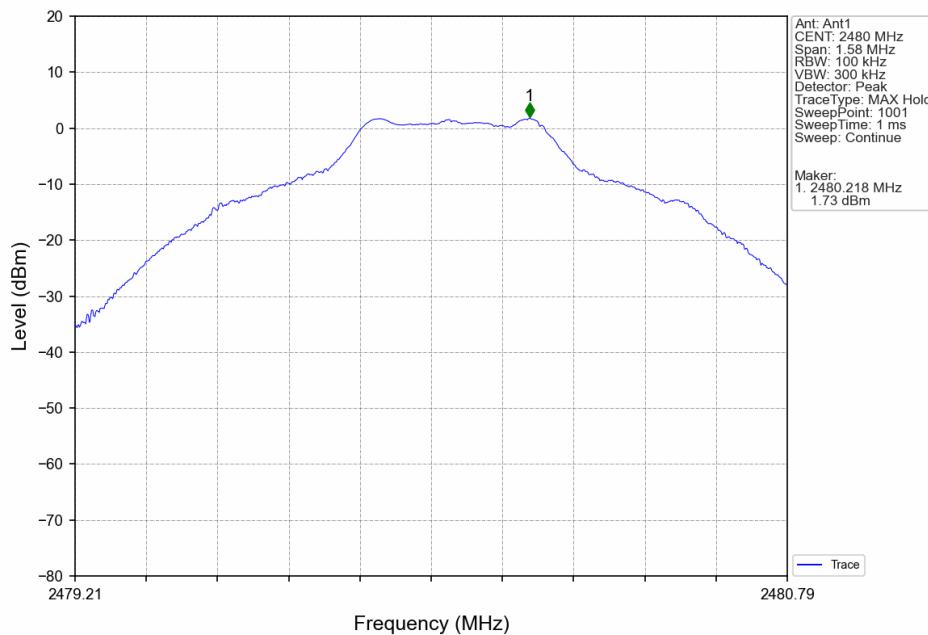
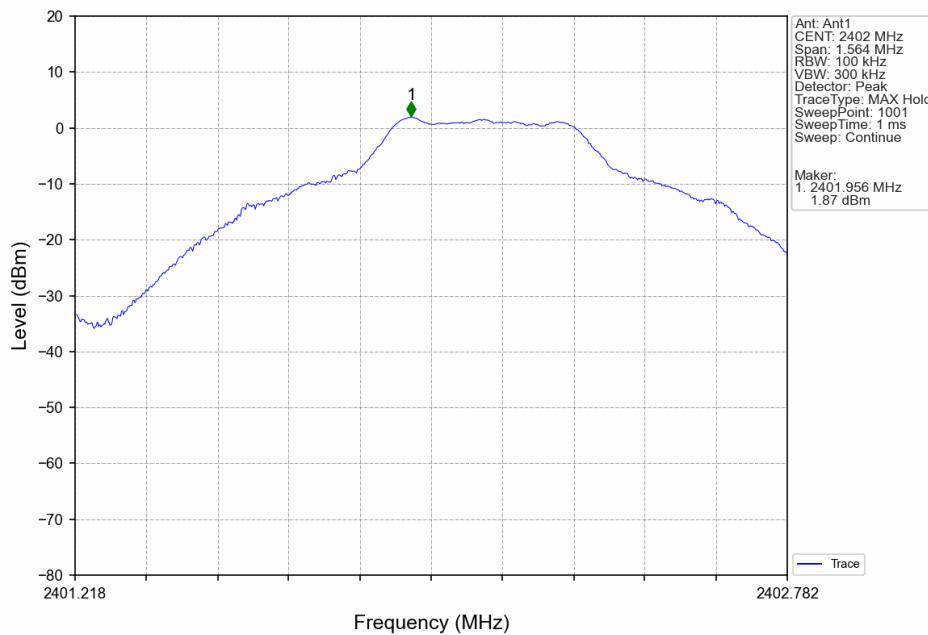
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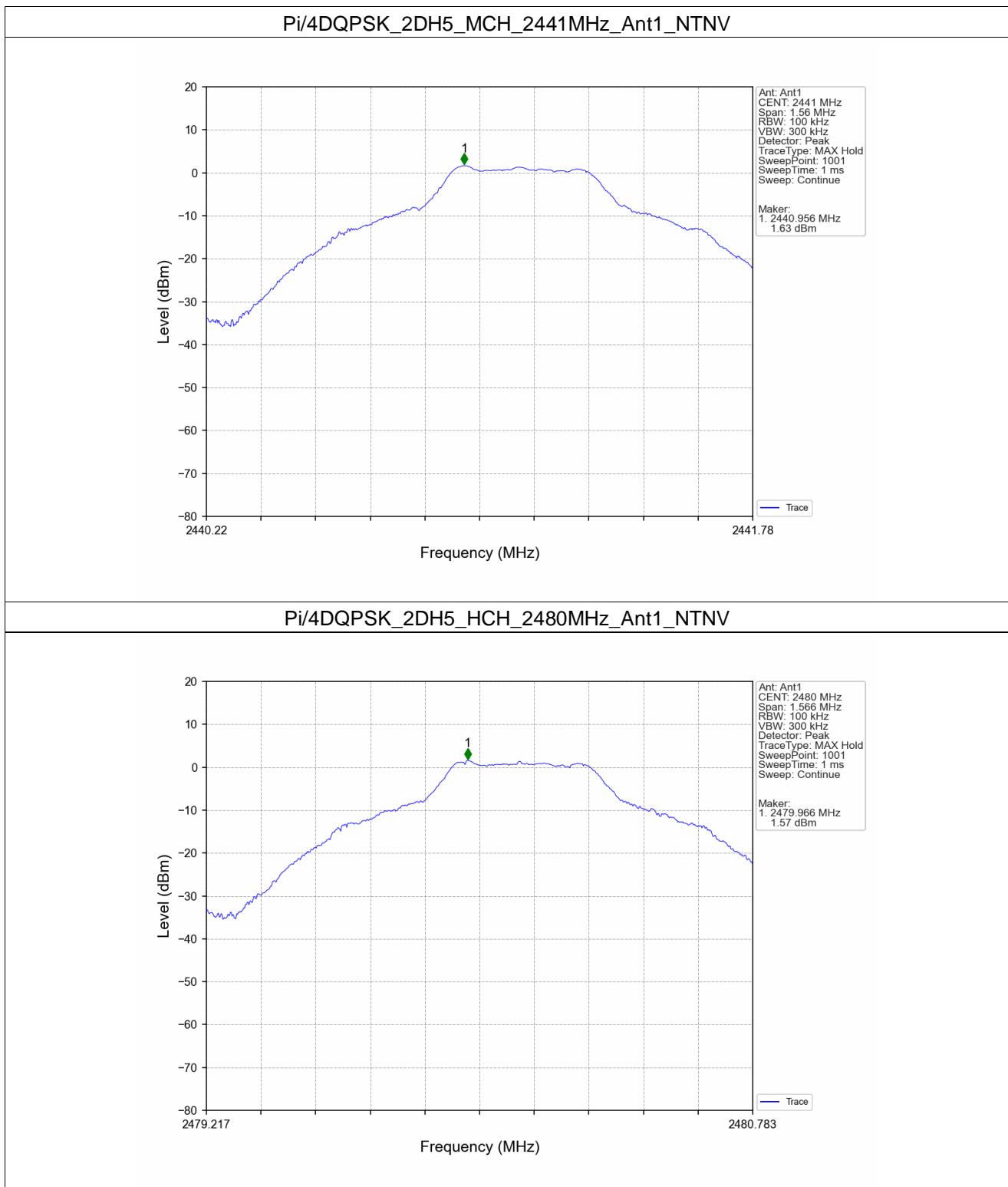
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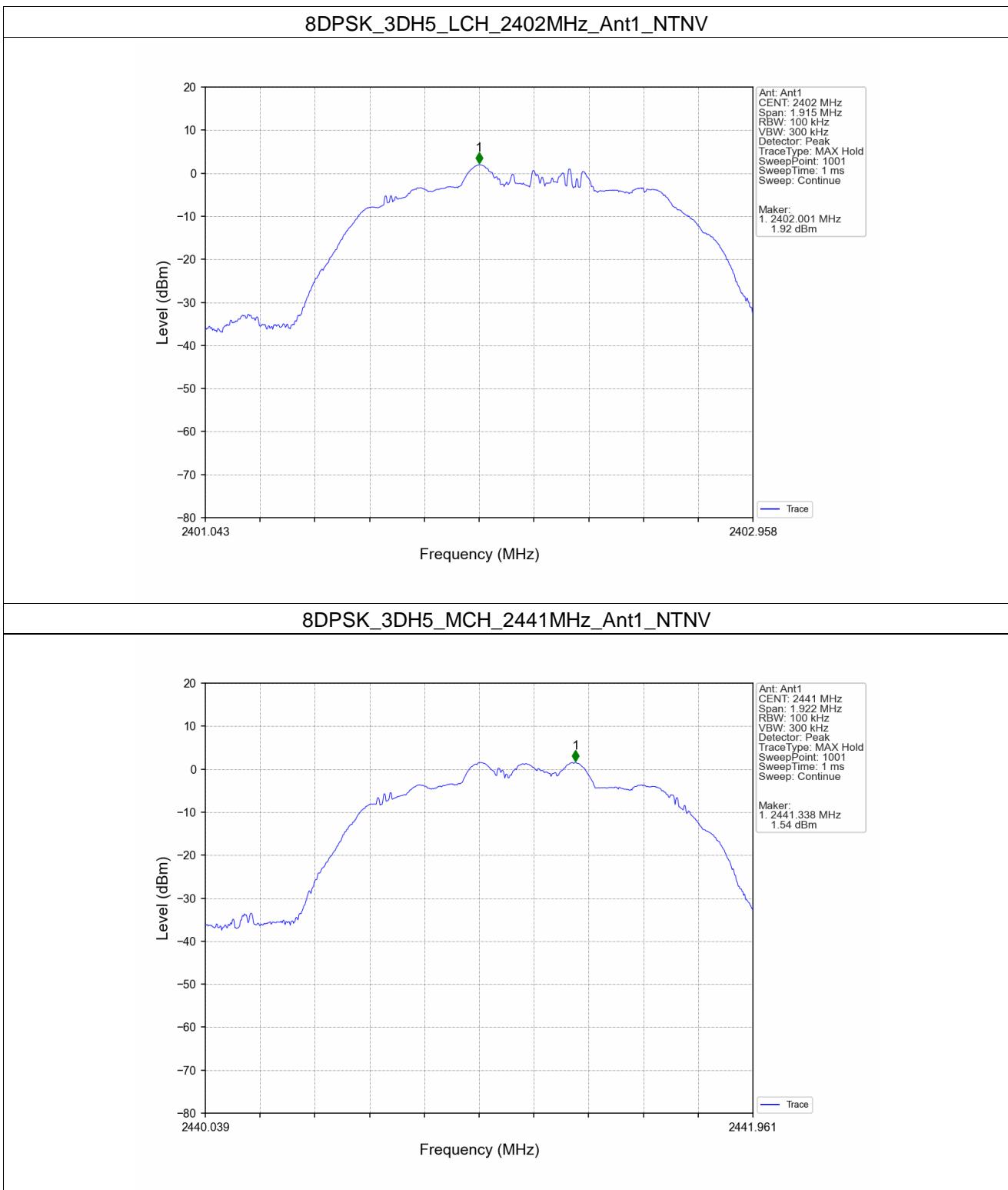
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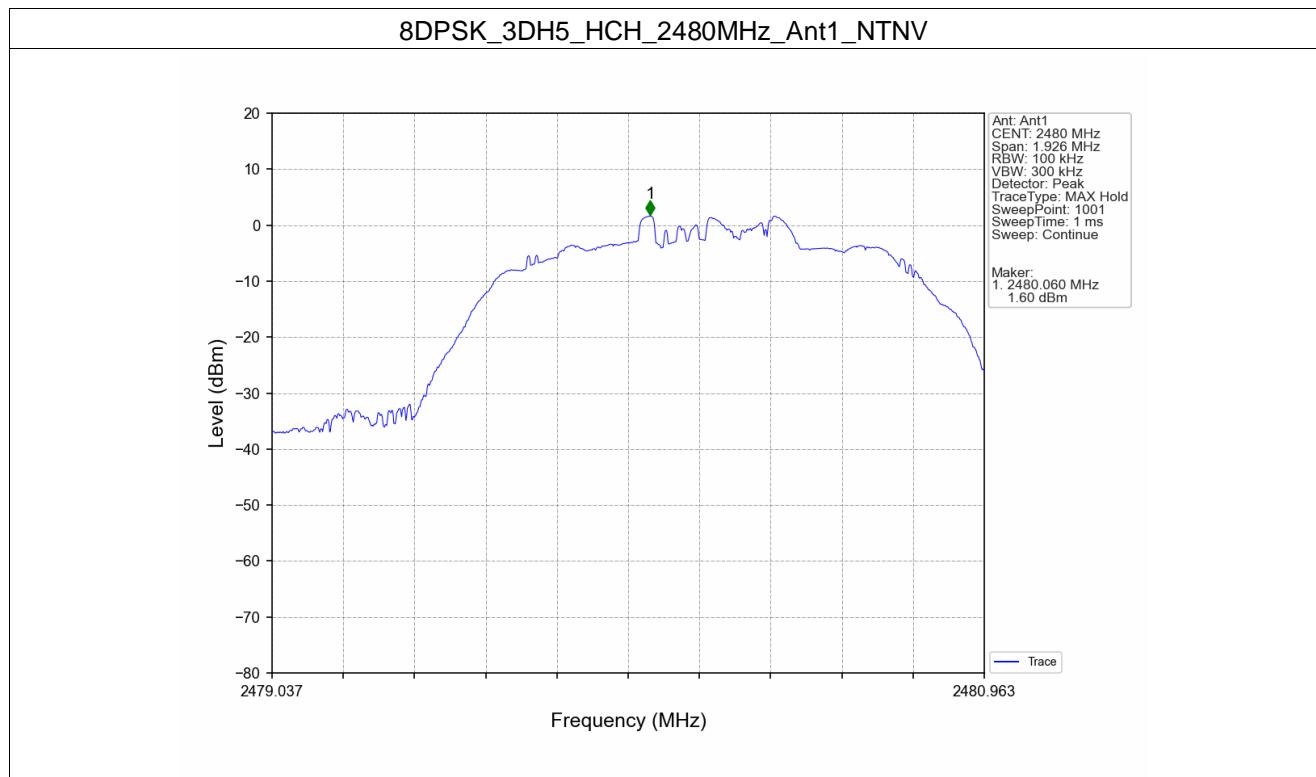
GFSK_DH5_HCH_2480MHz_Ant1_NTNV**Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV**

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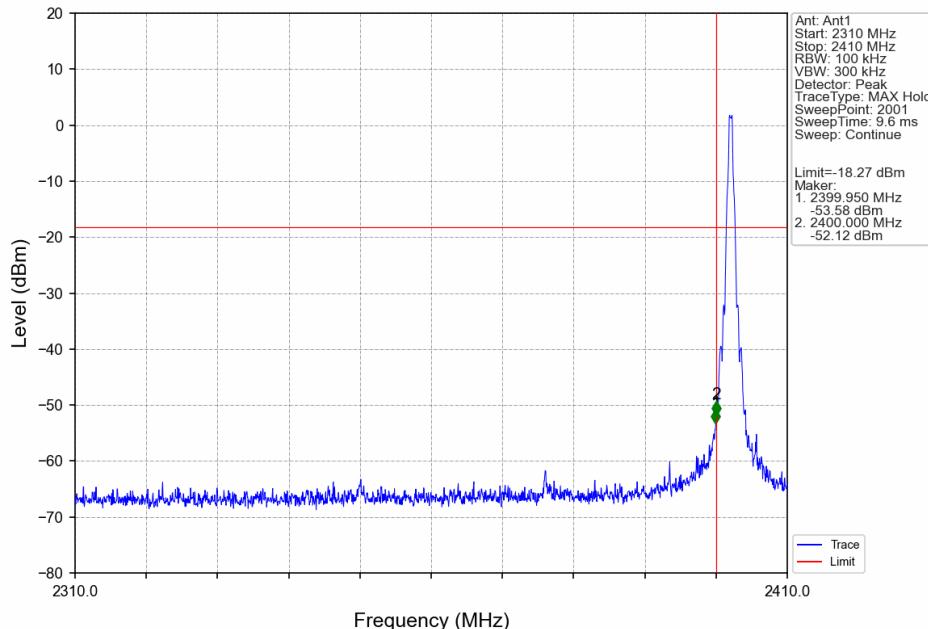
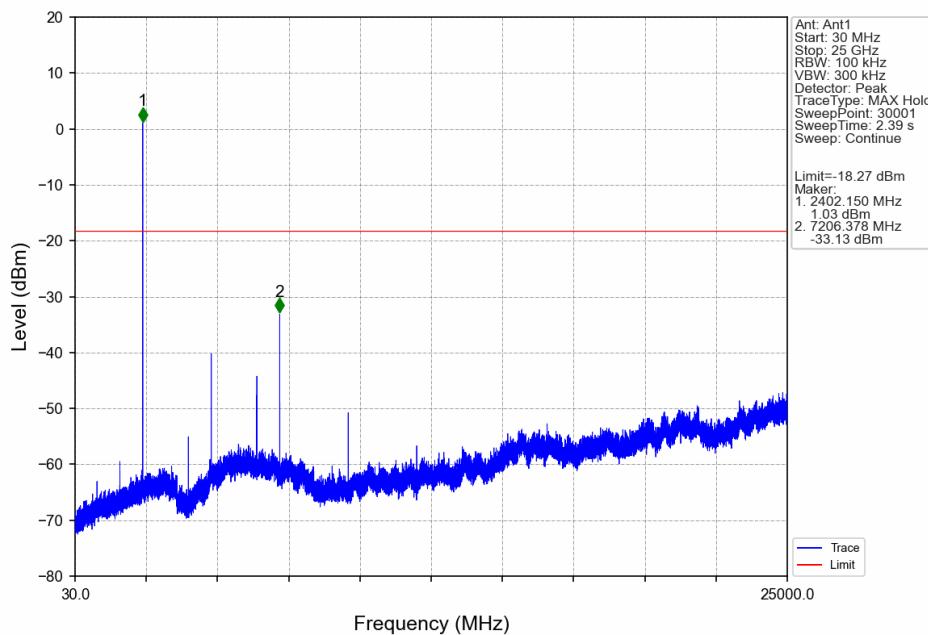




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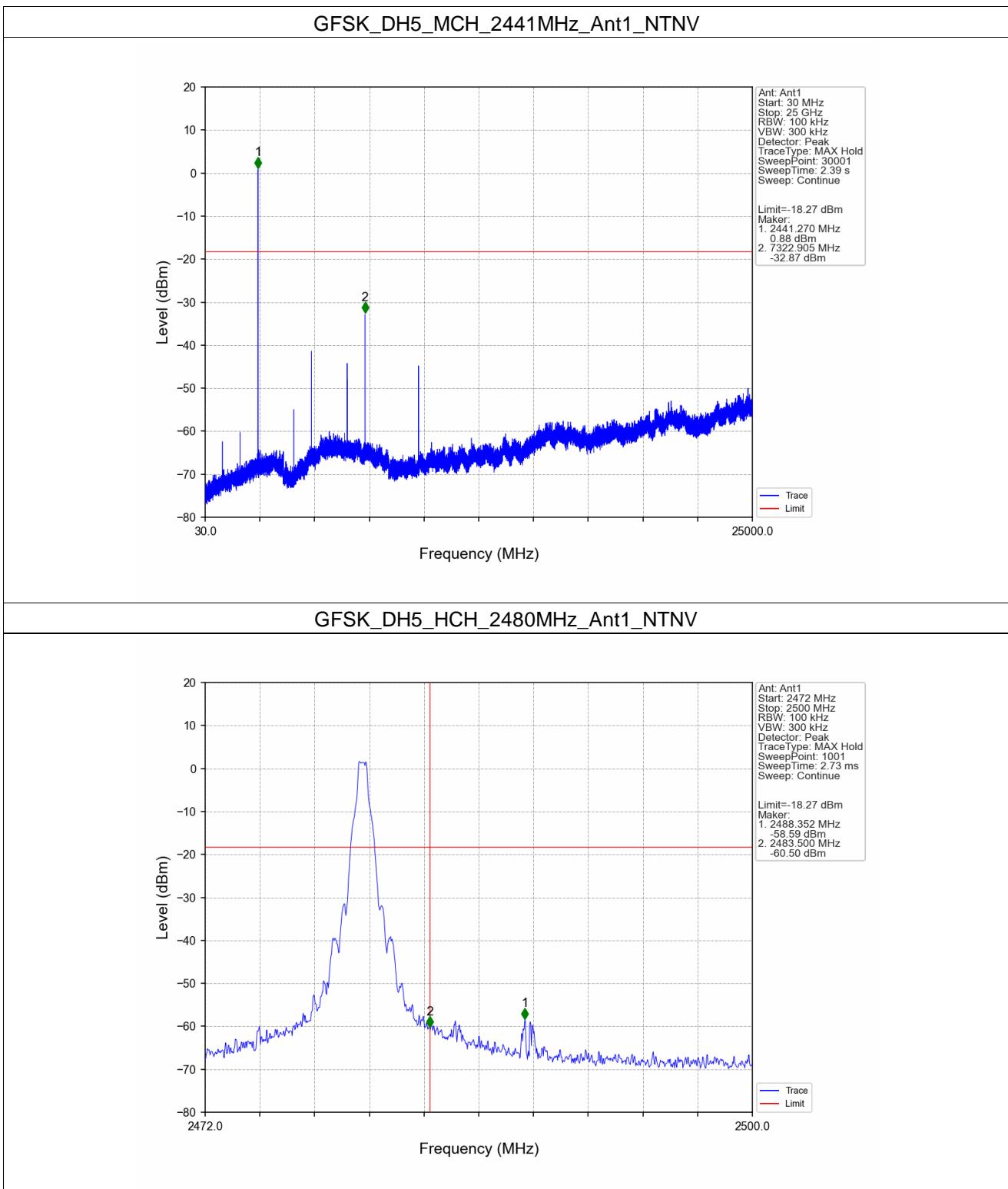
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6.2.2 CSE and Band Edges

GFSK_DH5_LCH_2402MHz_Ant1_NTNV**GFSK_DH5_LCH_2402MHz_Ant1_NTNV**

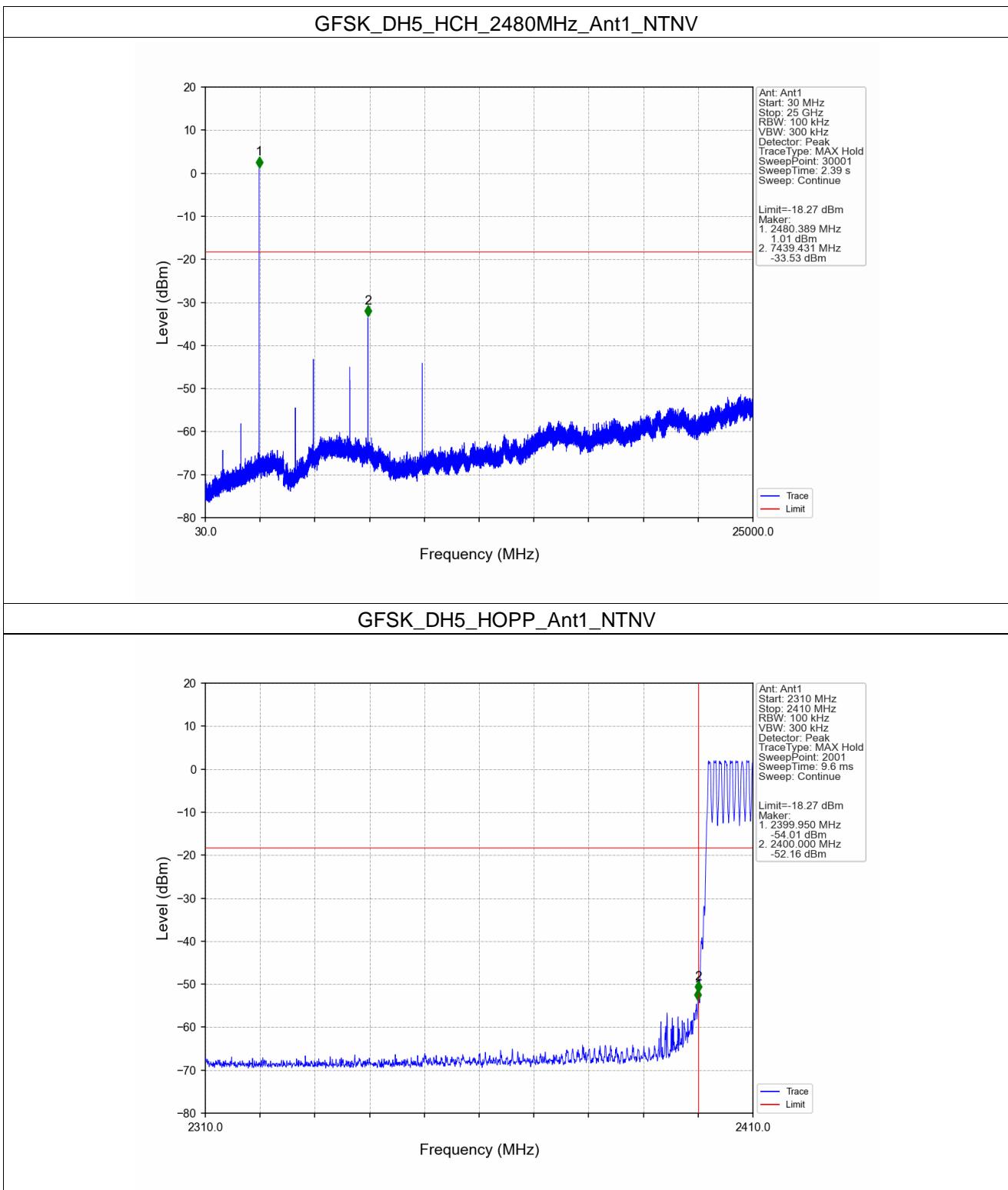
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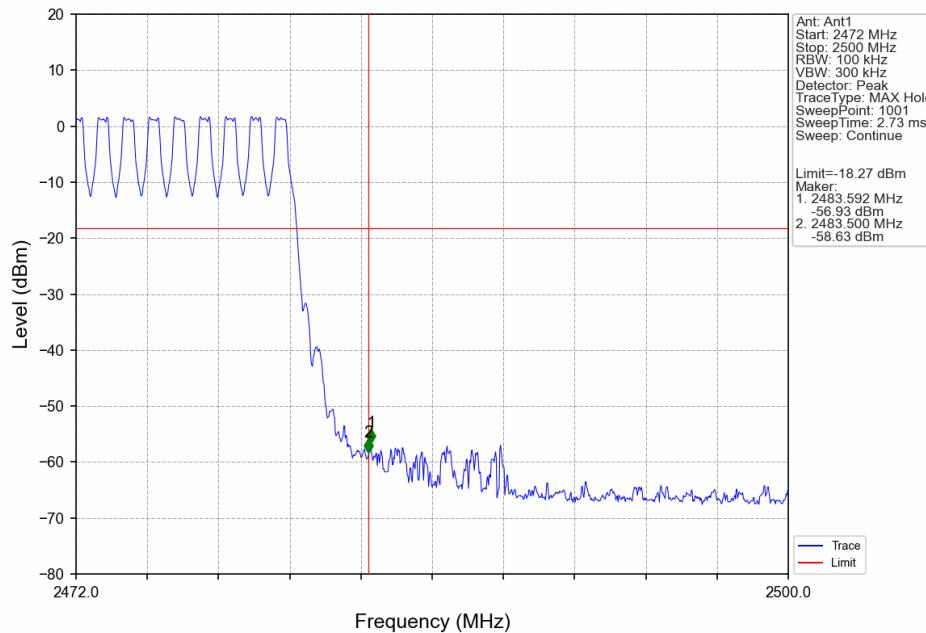
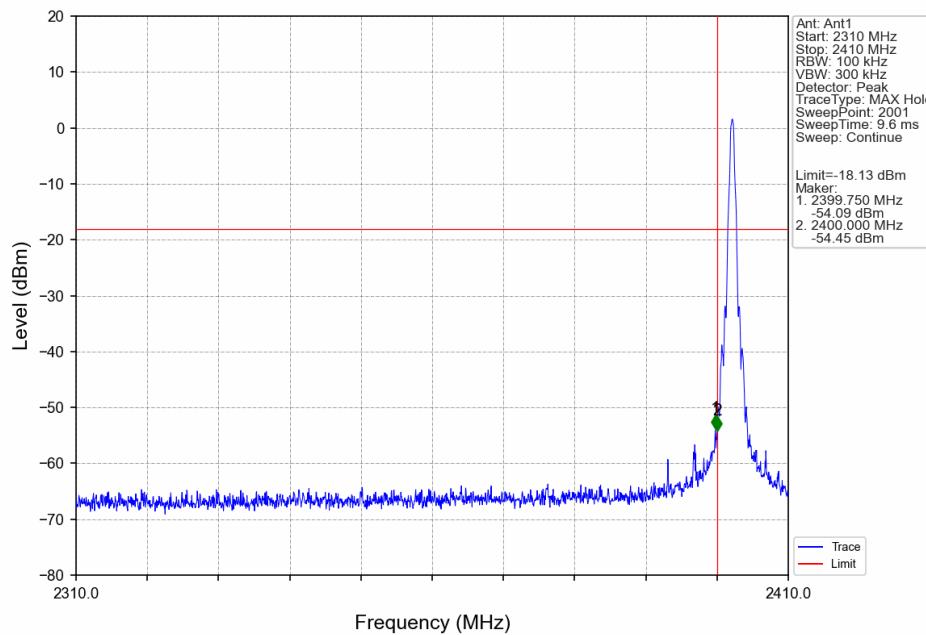
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GFSK_DH5_HOPP_Ant1_NTNV**Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV**

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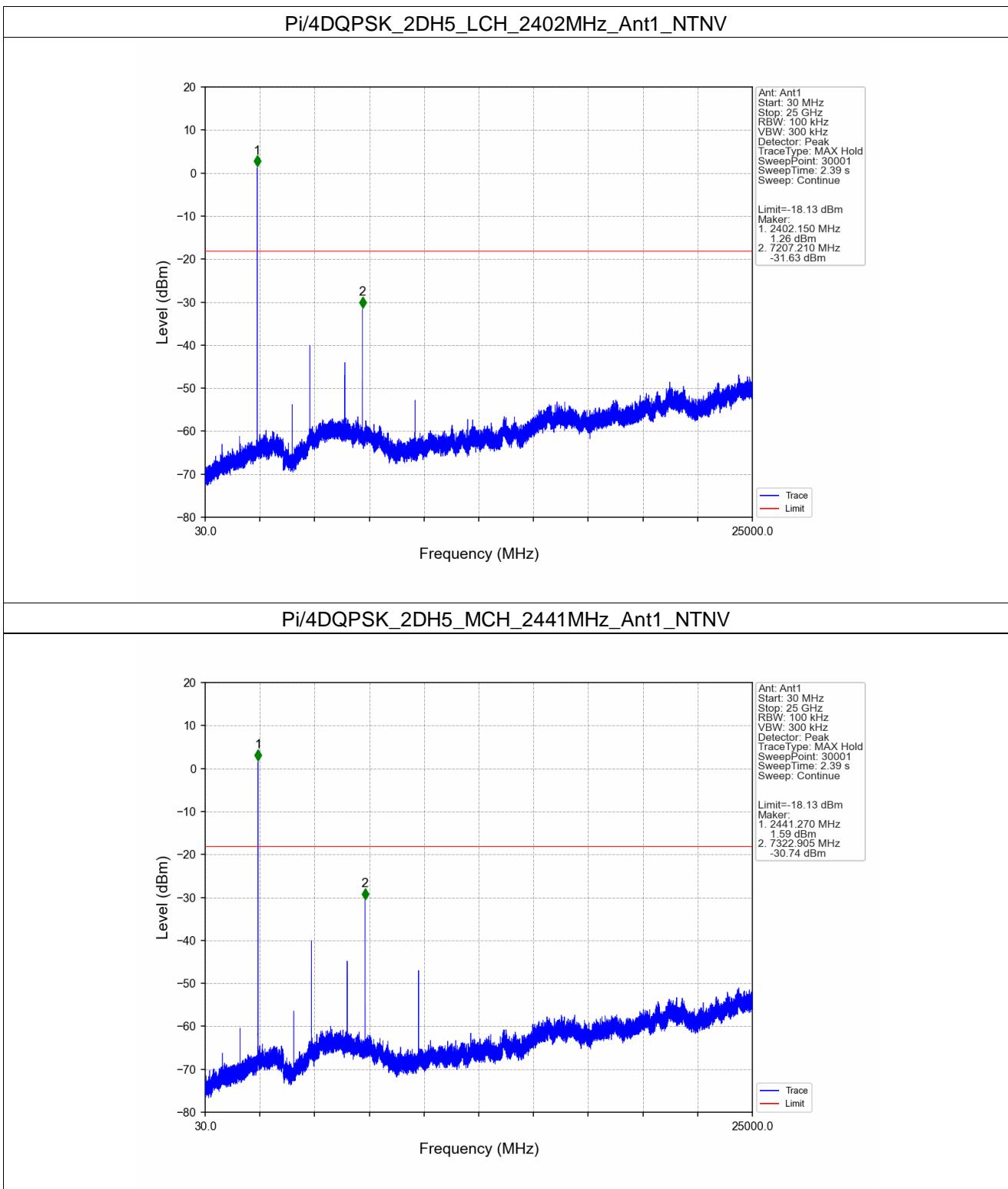
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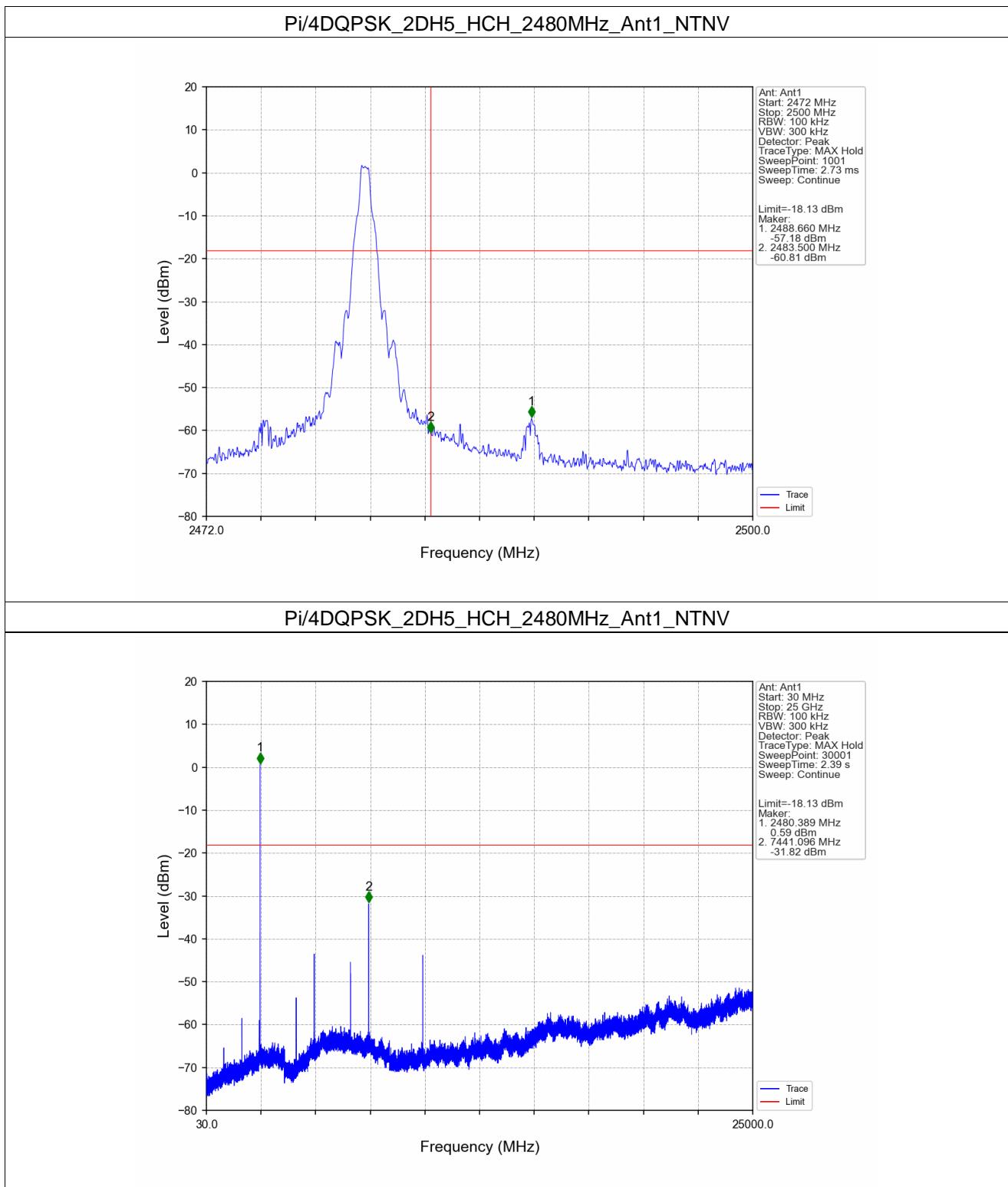
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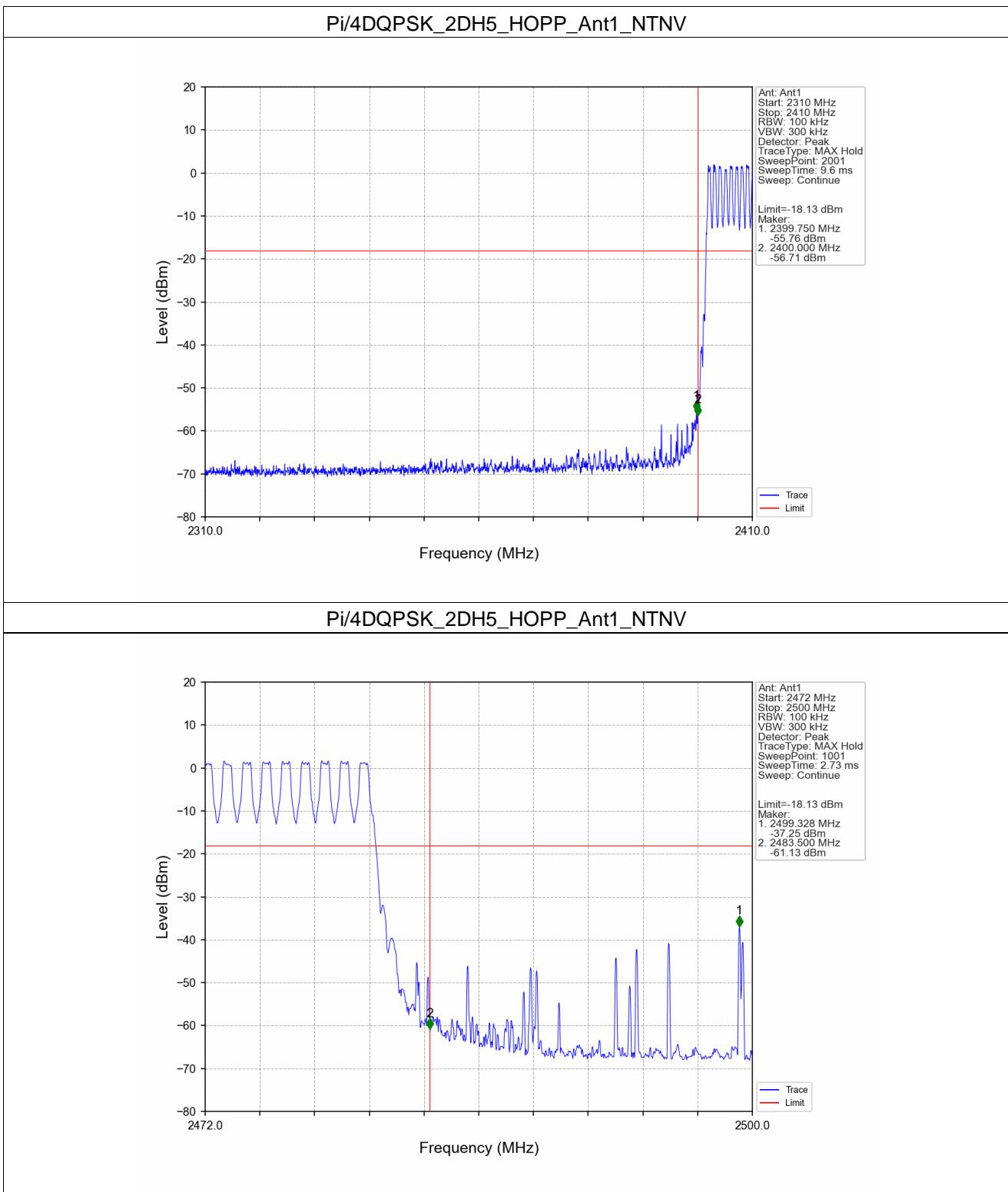
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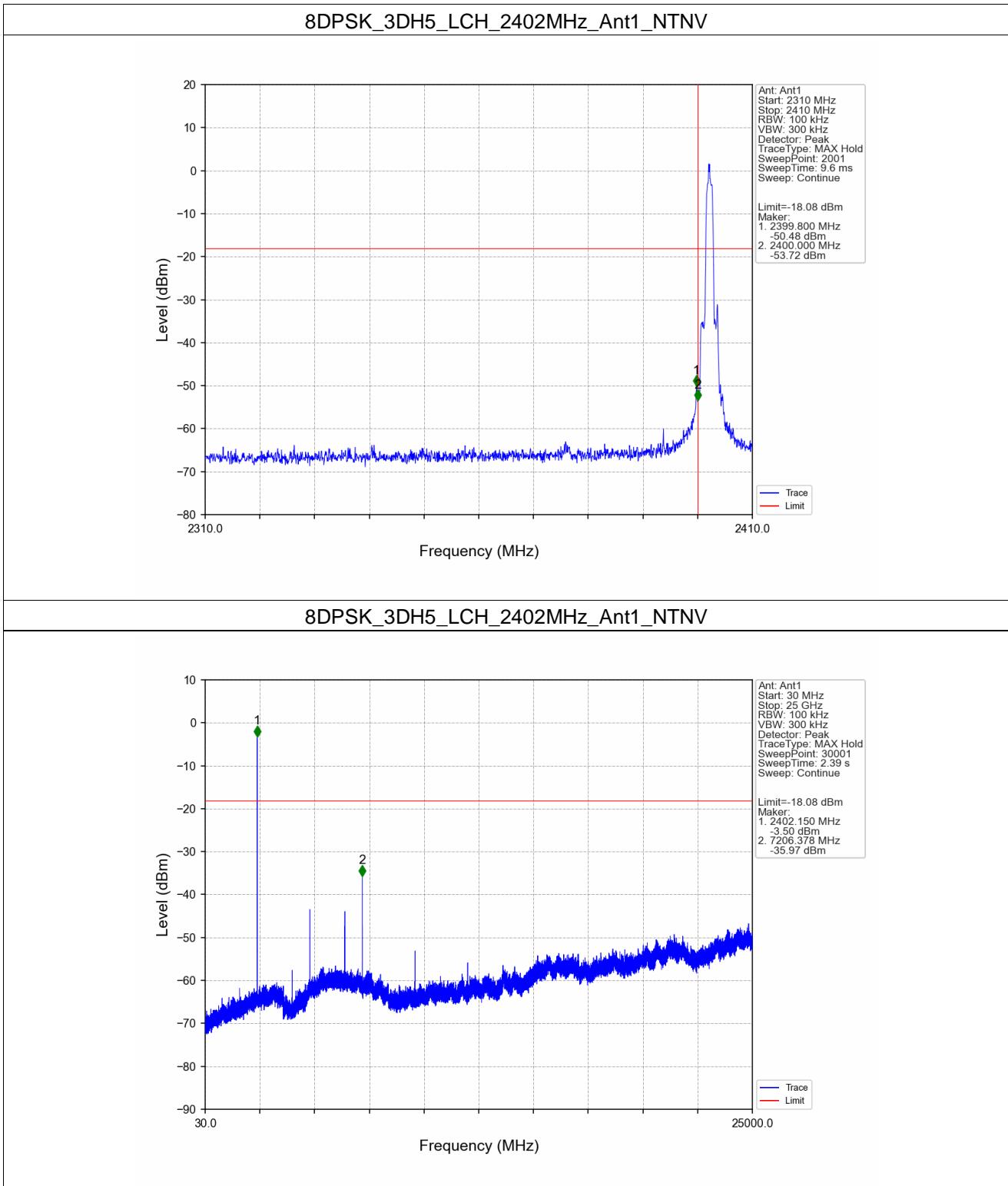
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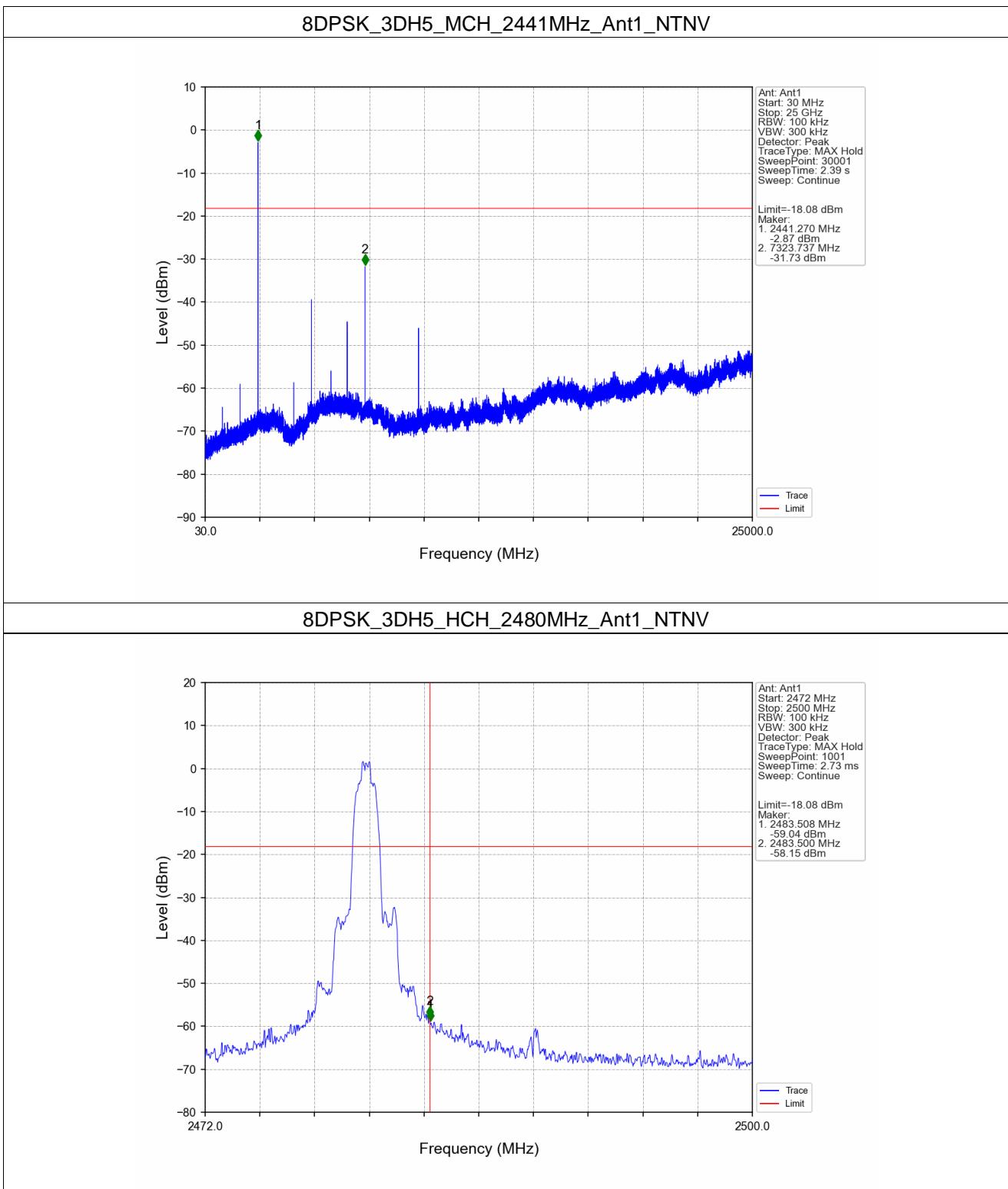
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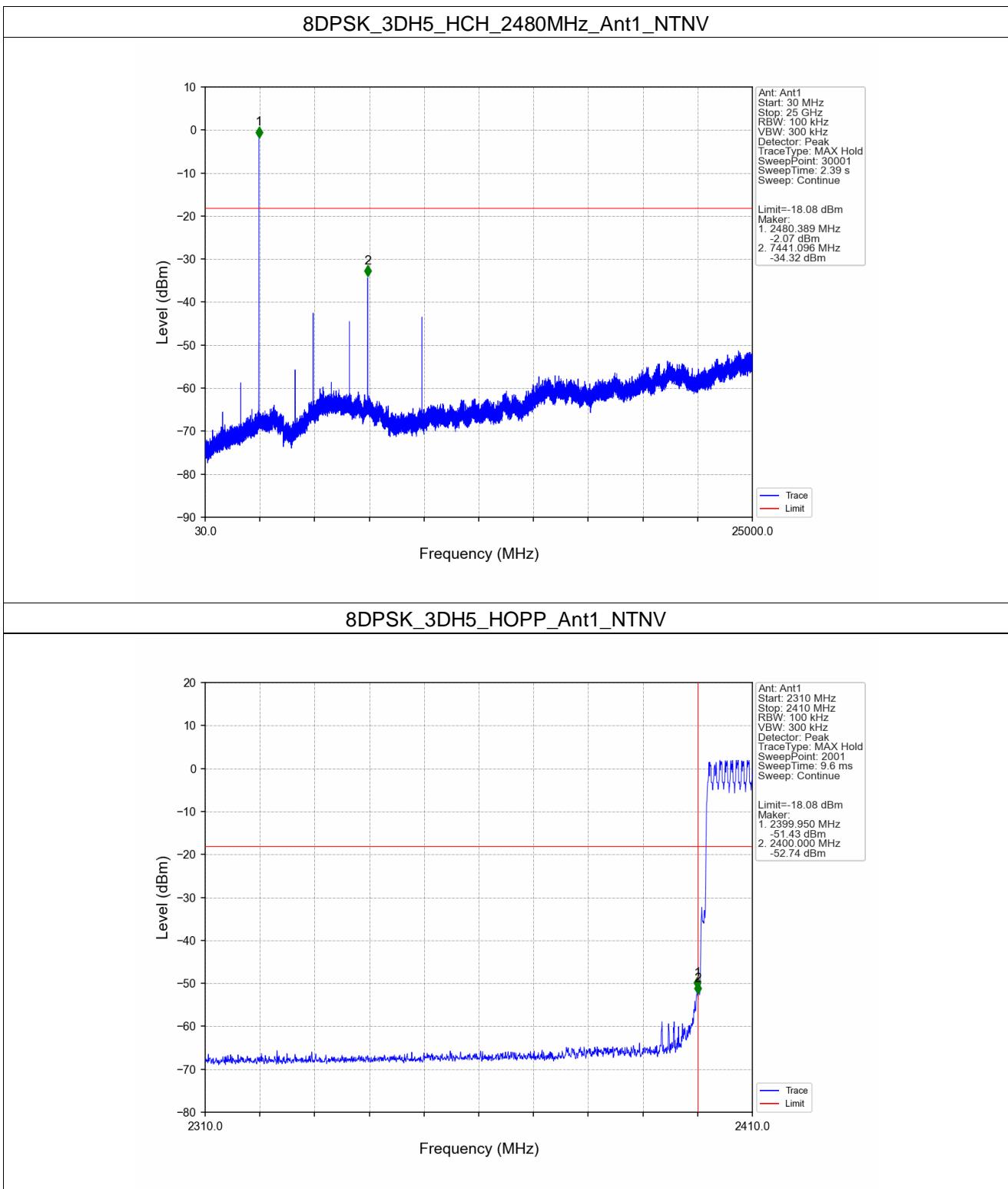
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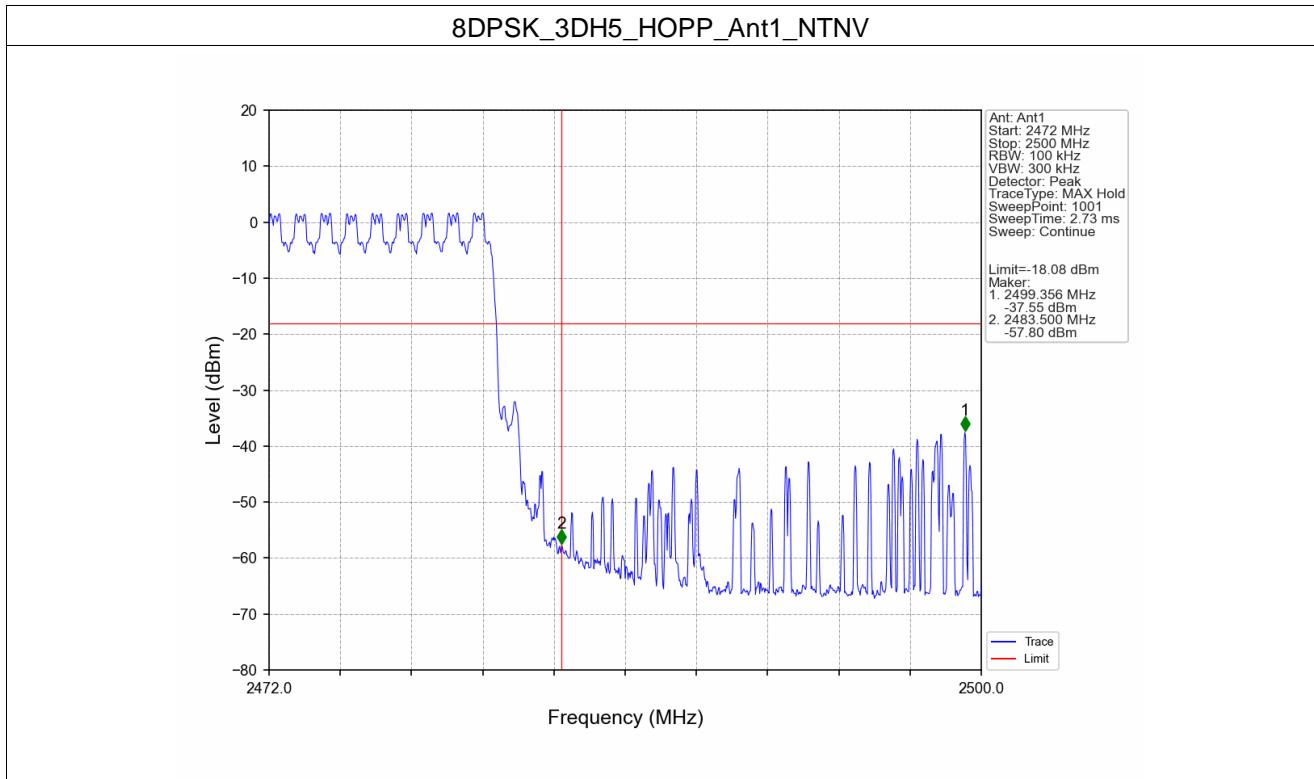
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