



TEST REPORT

Application No.: GZCR2108020809AT
Applicant: Razer Inc.
Address of Applicant: 9 Pasteur, Suite 100 Irvine California 92618 United States
Manufacturer: Razer (Asia-Pacific) Pte., Ltd.
Address of Manufacturer: 1 one-north Crescent, #02-01, Singapore 138538
Factory: Zhao Yang Electronic (Shenzhen) Co., Ltd.
Address of Factory: Building 2, De Yong Jia Industrial Park, Guang Qiao Road, Yu Lv Community, Gong Ming Street, Guang Ming New District, Shenzhen, China

Equipment Under Test (EUT):

EUT Name: Gaming & Music Soundbar
Model No.: RC30-039201
Trade Mark: RAZER
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2021-08-23
Date of Test: 2021-09-03 to 2021-09-08
Date of Issue: 2021-09-10

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

Kobe Jian

Kobe Jian

EMC Laboratory Manager



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EMC-TRF-01 Rev 1.0

SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZCR210802080901

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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2021-09-10		Original

Authorized for issue by				
				
		Curry Wu/Project Engineer		
				
		Ricky Liu/Reviewer		



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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 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions (Above 1GHz)		ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	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: Powered by DC 22.0V, 2.95A from Adapter
Model: DYS865-220295W
INPUT: AC 100-240V, 50/60Hz, 1.5A MAX
Output: DC 22.0V, 2.95A, 64.9W

Cable(s): AC cable 102cm unshielded
DC cable from adapter 146cm unshielded with one core
Type-C cable 186cm unshielded
Subwoofer output cable 210cm unshielded

Operation Frequency: 2402MHz to 2480MHz

Bluetooth Version: V5.1 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: PIFA Antenna

Antenna Gain: 1.94dBi

Hardware version: Ver: A

Software version: LPC_1.5.4.0_20210910

Firmware version: BT_FW 1.0.9.2_20210910

Serial number: 332138B03000001

Test software and version: AWRDLABV2(1.0.9.7)

Software Power Setting: For BDR/EDR, Low/ Middle/ High channel set to 0x0F43 for the RF test.
For BLE, Low/ Middle/ High channel set to 0x0F44 for the RF test.

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
--	--	--	--
The EUT has been tested as an independent unit.			



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4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Emissions at AC Power Line (150kHz-30MHz)	$\pm 3.12\text{dB}$
Conducted Peak Output Power	$\pm 0.75\text{dB}$
20dB Bandwidth	$\pm 3\%$
Carrier Frequencies Separation	$\pm 7.25 \times 10^{-8}$
Hopping Channel Number	$\pm 7.25 \times 10^{-8}$
Dwell Time	$\pm 0.37\%$
Conducted Band Edges Measurement	$\pm 0.75\text{dB}$
Conducted Spurious Emissions	$\pm 0.75\text{dB}$
Radiated Emissions which fall in the restricted bands	$\pm 5.08\text{dB}$ (1GHz-6GHz); $\pm 5.14\text{dB}$ (above 6GHz)
Radiated Spurious Emissions (Below 1GHz)	$\pm 5.06\text{dB}$ (3m); $\pm 4.46\text{dB}$ (10m)
Radiated Spurious Emissions (Above 1GHz)	$\pm 5.08\text{dB}$ (1GHz-6GHz); $\pm 5.14\text{dB}$ (above 6GHz)



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4.4 Test Location

All tests were performed at:

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198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

4.5 Test Facility

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

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

- **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.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2018 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of Testing Laboratories.

- **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, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.



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4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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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
Shielding Room	ChangZhou ZhongYu	8m x 3m x 3.8m	EMC0306	N/A	N/A
Two-Line V-Network	Rohde & Schwarz	ENV216	EMC0118	2021-01-08	2022-01-06
Two-Line V-Network-GZ	Rohde & Schwarz	ENV216	EMC2135	2020-09-25	2021-09-24
Coaxial Cable	HangTianXing	2m	EMC0107	2020-09-09	2022-09-08
Test Software E3c	Audix	Ver. 5.4.1221b	GZE100-62	N/A	N/A
EMI Test Receiver(9kHz-3.6GHz)	Rohde & Schwarz	ESR4	EMC2221	2021-06-01	2022-05-31

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Power Meter (U2021XA_Ch2)	Agilent Technologies	U2021XA_Ch2	SEM009-02	2021-05-19	2022-05-18
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Carrier Frequencies Separation					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Hopping Channel Number					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14



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Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Dwell Time

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Conducted Band Edges Measurement

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Conducted Spurious Emissions

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Radiated Emissions which fall in the restricted bands

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver(20Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2021-01-08	2022-01-07
Chamber cable(Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2020-09-17	2021-09-16



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Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Notch Filter (5150-5880)	Mico-Tronics	BRM50716	EMC2168	2021-07-29	2022-07-28
Horn Antenna(14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2020-06-28	2023-06-27
Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	EMC2172	2020-09-09	2021-09-08

Radiated Spurious Emissions (Below 1GHz)

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Chamber cable	HangTianXing	N/A	EMC0542	2020-09-09	2022-09-08
Trilog Broadband Antenna(25MHz-1GHz)-Lab	SCHWARZBECK MESS-ELEKTRONIK	VULB 9168	SEM003-18	2019-02-22	2022-02-22
Amplifier(9kHz-1.3GHz)	HP	8447F	EMC2065	2021-05-19	2022-05-18
Active Loop Antenna-RED	ETS-Lindgren	6502	EMC2190	2019-12-27	2021-12-26
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2019-10-20	2022-10-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
EMI Test Receiver(1Hz-8GHz)	Rohde & Schwarz	ESW8	EMC2220	2021-05-26	2022-05-25

Radiated Spurious Emissions (Above 1GHz)

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver(20Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2021-01-08	2022-01-07
Chamber cable(Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2020-09-17	2021-09-16
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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Horn Antenna(14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2020-06-28	2023-06-27
Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	EMC2172	2020-09-09	2021-09-08

General used equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DMM	Fluke	73	EMC0006	2021-07-05	2022-07-05
DMM	Fluke	73	EMC0007	2021-07-05	2022-07-05



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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

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 1.94 dBi.

Please refer to internal photos.

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)

Limit:

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)

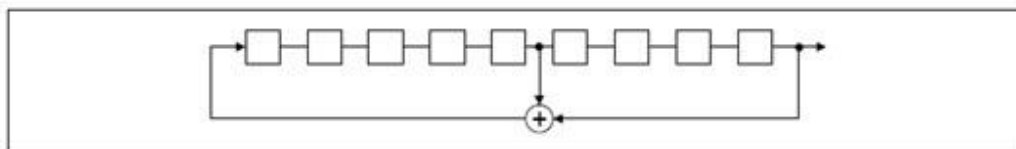
Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



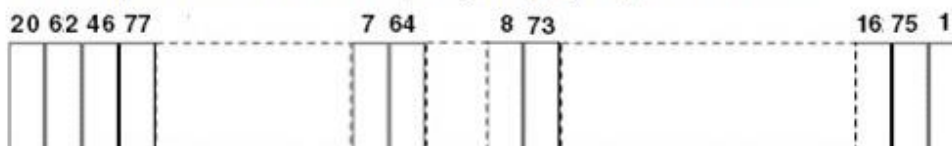
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Linear Feedback Shift Register for Generation of the PRBS sequence

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.

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



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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

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.



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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: 24.3 °C

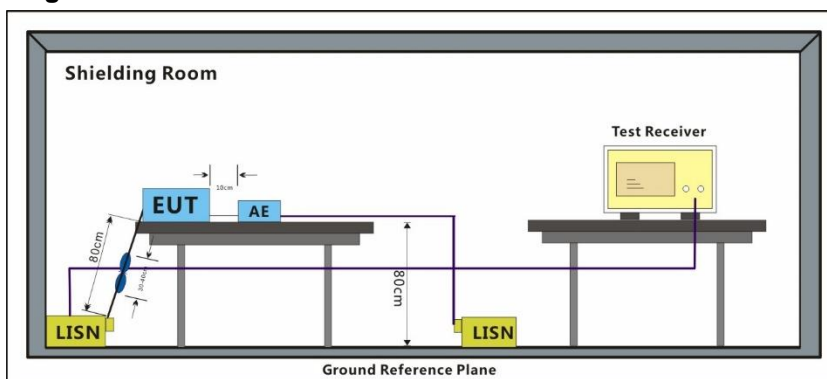
Humidity: 58.8 % RH

Atmospheric Pressure: 1010 mbar

7.1.2 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.

7.1.3 Test Setup Diagram



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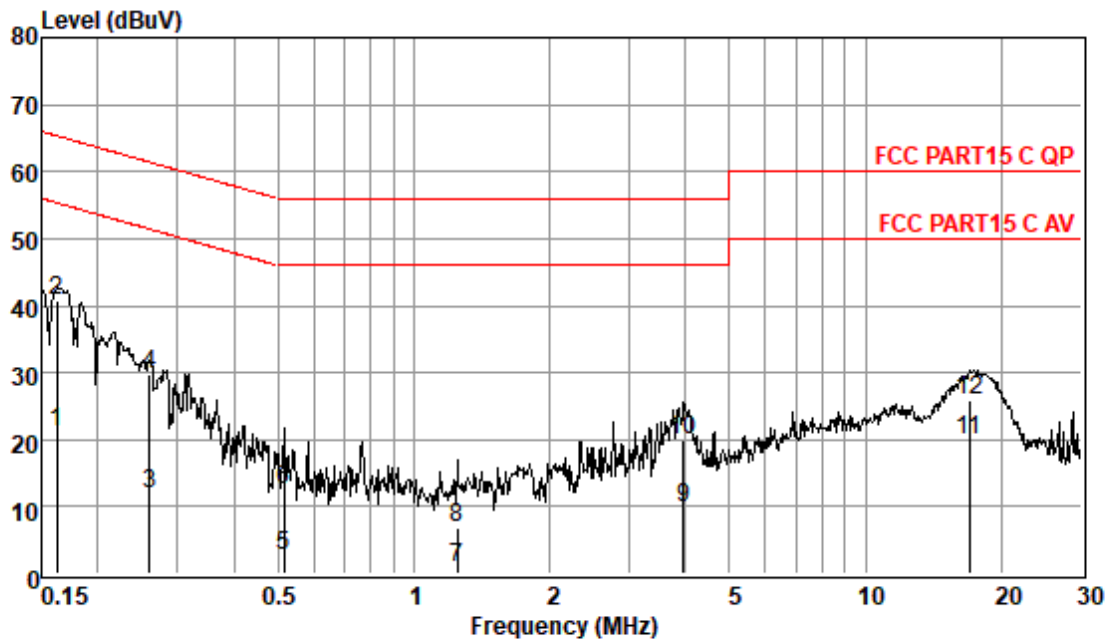
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7.1.4 Measurement Procedure and Data

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

Test Mode: 00; Line: Live line



Pol : LINE
Mode :
Model :

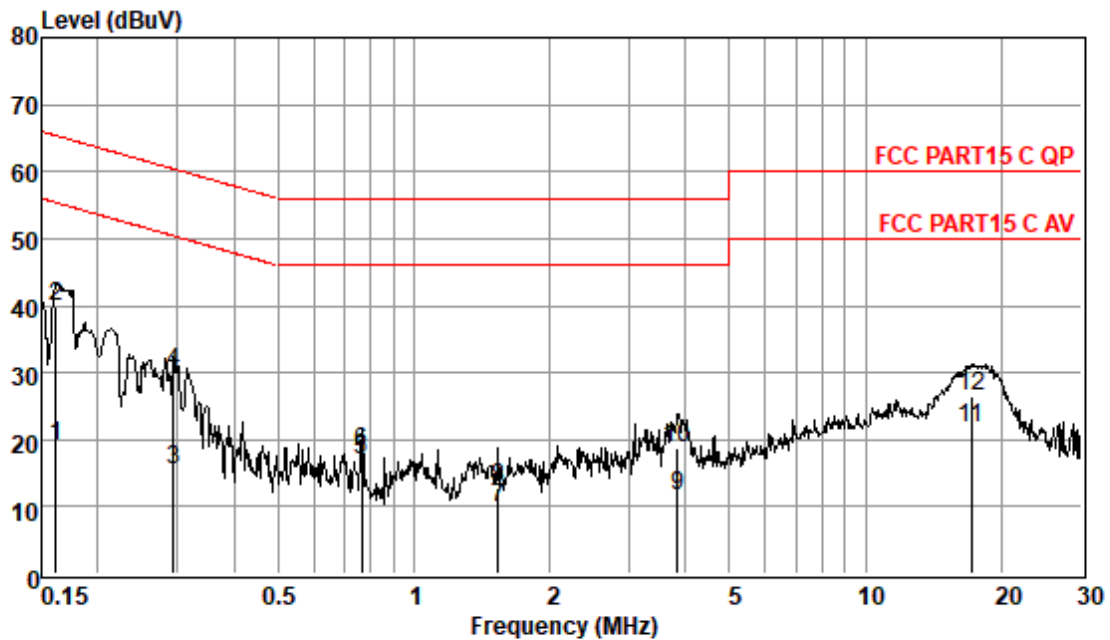
Frequency MHz	Read Level dBuV	Cable Loss dB	LISN Factor dB	Measured Level dBuV	Limit Line dBuV	Over Limit dB	Remark
0.16	11.48	0.06	9.62	21.16	55.34	-34.18	Average
0.16	31.04	0.06	9.62	40.72	65.34	-24.62	QP
0.26	2.07	0.06	9.62	11.75	51.42	-39.67	Average
0.26	20.19	0.06	9.62	29.87	61.42	-31.55	QP
0.52	-7.15	0.07	9.63	2.55	46.00	-43.45	Average
0.52	2.93	0.07	9.63	12.63	56.00	-43.37	QP
1.25	-8.86	0.09	9.61	0.84	46.00	-45.16	Average
1.25	-2.81	0.09	9.61	6.89	56.00	-49.11	QP
3.94	0.04	0.17	9.62	9.83	46.00	-36.17	Average
3.94	10.21	0.17	9.62	20.00	56.00	-36.00	QP
16.93	9.86	0.33	9.75	19.94	50.00	-30.06	Average
16.93	15.72	0.33	9.75	25.80	60.00	-34.20	QP



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Test Mode: 00; Line: Neutral Line



Pol : NEUTRAL
Mode :
Model :

Frequency MHz	Read Level dBuV	Cable Loss dB	LISN Factor dB	Measured Level dBuV	Limit Line dBuV	Over Limit dB	Remark
0.16	9.43	0.06	9.55	19.04	55.38	-36.34	Average
0.16	30.28	0.06	9.55	39.89	65.38	-25.49	QP
0.29	5.95	0.06	9.54	15.55	50.41	-34.86	Average
0.29	20.48	0.06	9.54	30.08	60.41	-30.33	QP
0.77	7.29	0.07	9.55	16.91	46.00	-29.09	Average
0.77	8.50	0.07	9.55	18.12	56.00	-37.88	QP
1.54	0.07	0.10	9.55	9.72	46.00	-36.28	Average
1.54	2.99	0.10	9.55	12.64	56.00	-43.36	QP
3.84	1.74	0.16	9.56	11.46	46.00	-34.54	Average
3.84	9.00	0.16	9.56	18.72	56.00	-37.28	QP
17.11	11.58	0.33	9.65	21.56	50.00	-28.44	Average
17.11	16.45	0.33	9.65	26.43	60.00	-33.57	QP



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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 ≥ 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

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.6 °C

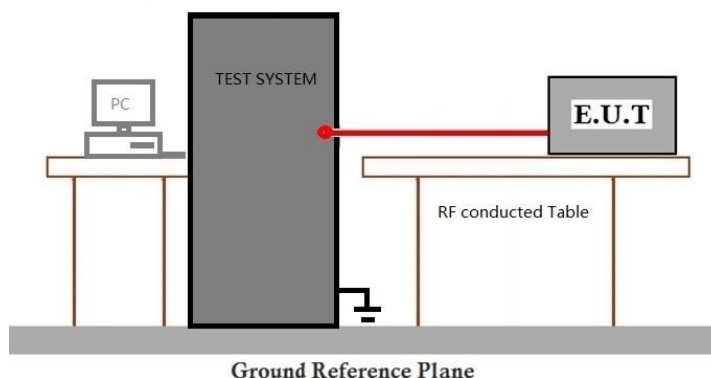
Humidity: 53.5 % RH

Atmospheric Pressure: 1010 mbar

7.2.2 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.

7.2.3 Test Setup Diagram



7.2.4 Measurement Procedure and Data

cable loss=0.9dB

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

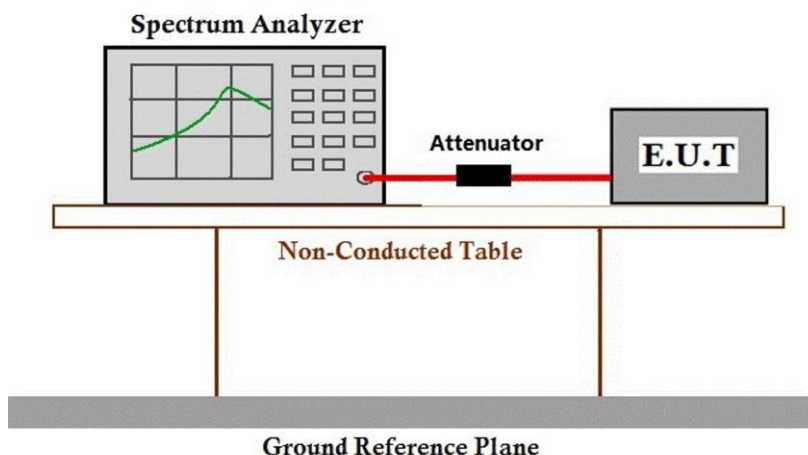
Operating Environment:

Temperature: 23.6 °C Humidity: 53.5 % 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_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

cable loss=0.9dB

Please Refer to Appendix for Details

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:

2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W.

7.4.1 E.U.T. Operation

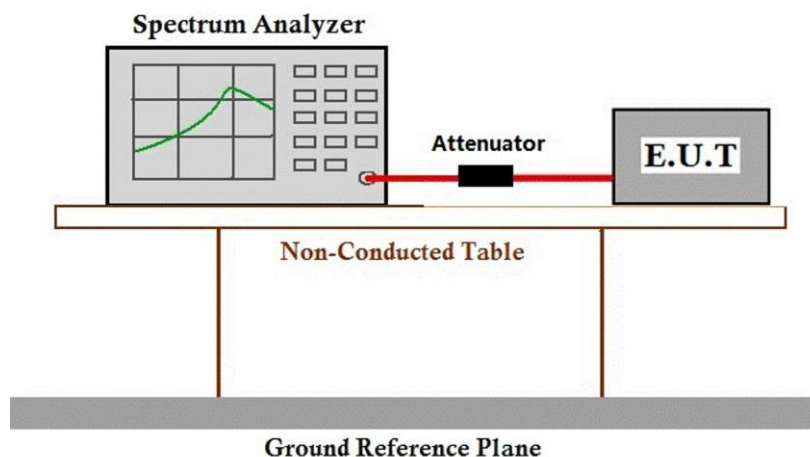
Operating Environment:

Temperature: 23.6 °C Humidity: 53.5 % RH Atmospheric Pressure: 1010 mbar

7.4.2 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.

7.4.3 Test Setup Diagram



7.4.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details

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

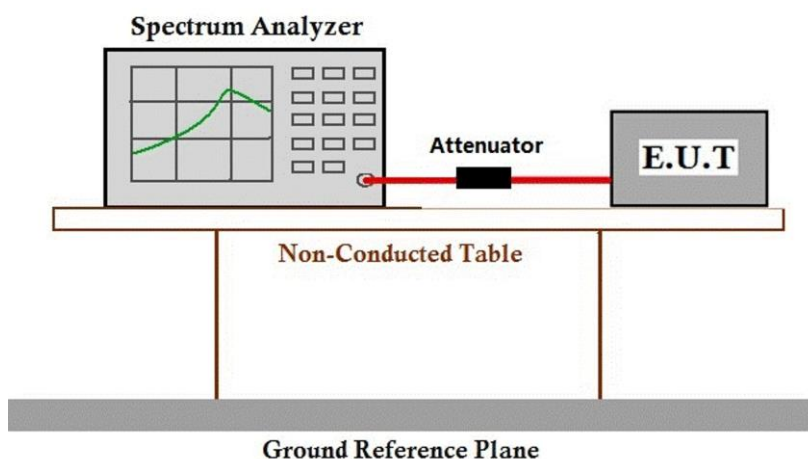
Humidity: 53.5 % RH

Atmospheric Pressure: 1010 mbar

7.5.2 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.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



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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: 53.5 % RH

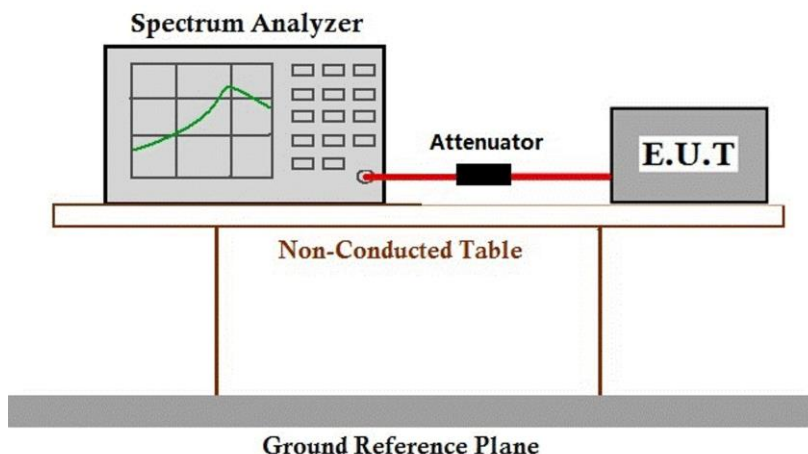
Atmospheric Pressure: 1010 mbar

7.6.2 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.
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7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



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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

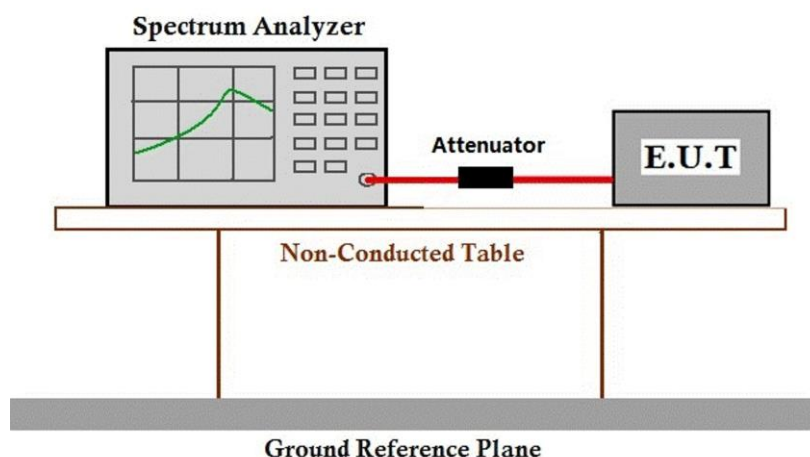
Humidity: 53.5 % RH

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.

7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



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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: 53.5 % RH

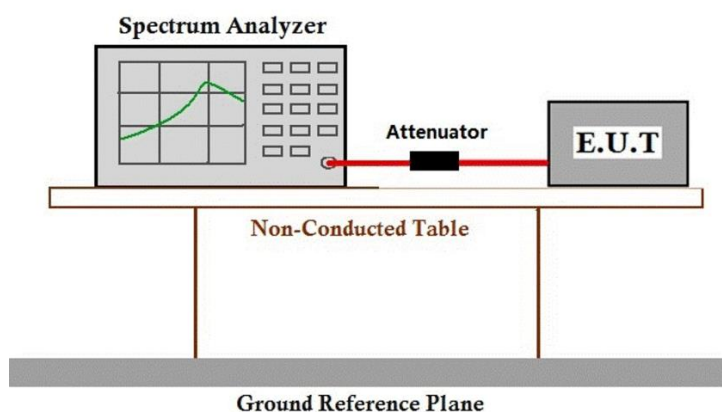
Atmospheric Pressure: 1010 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
--------------------------	--------------	-------------

Final test	00	TX_non-Hop mode_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

cable loss=0.9dB

Please Refer to Appendix for Details

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: 23.5 °C

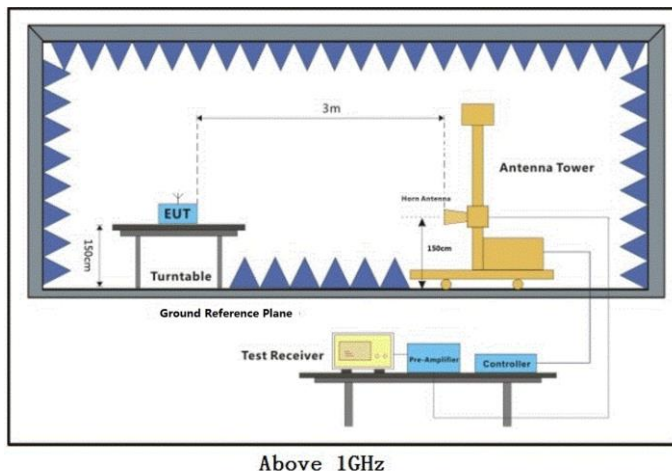
Humidity: 53.6 % RH

Atmospheric Pressure: 1010 mbar

7.9.2 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.

7.9.3 Test Setup Diagram



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 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

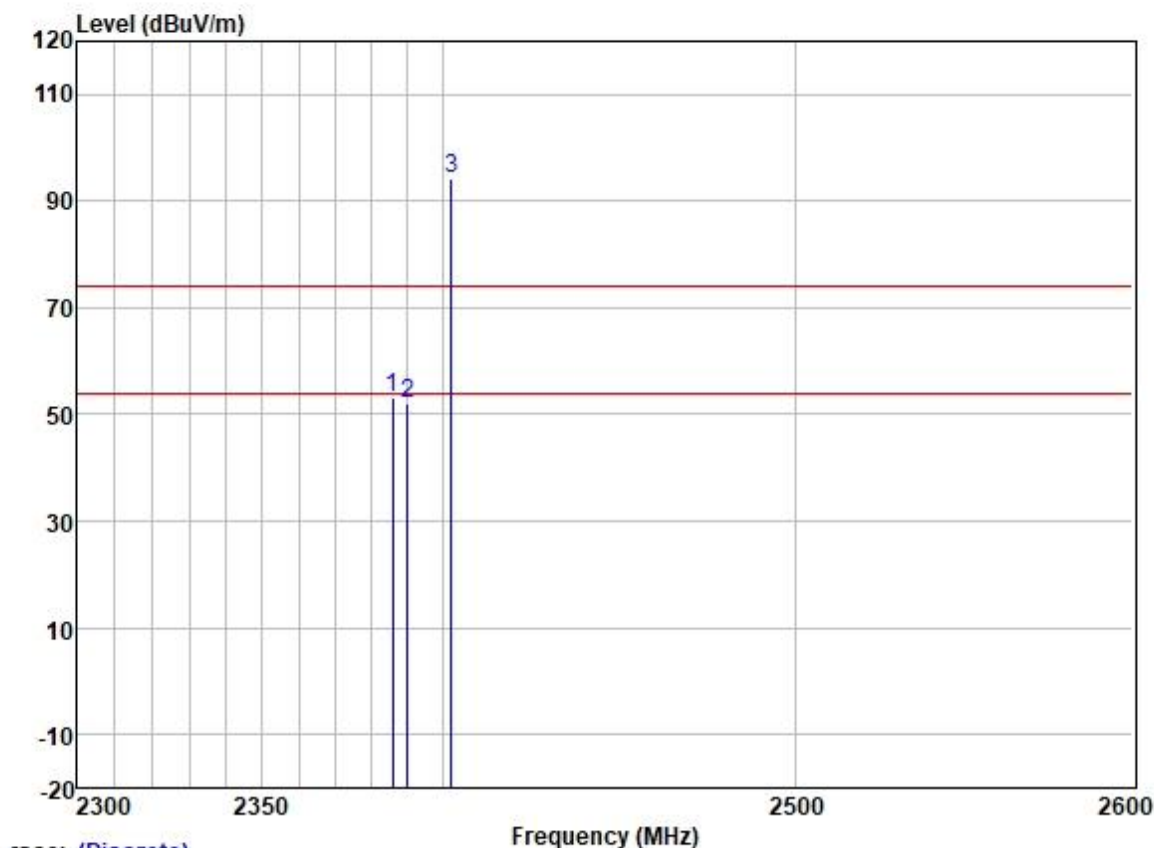
Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level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



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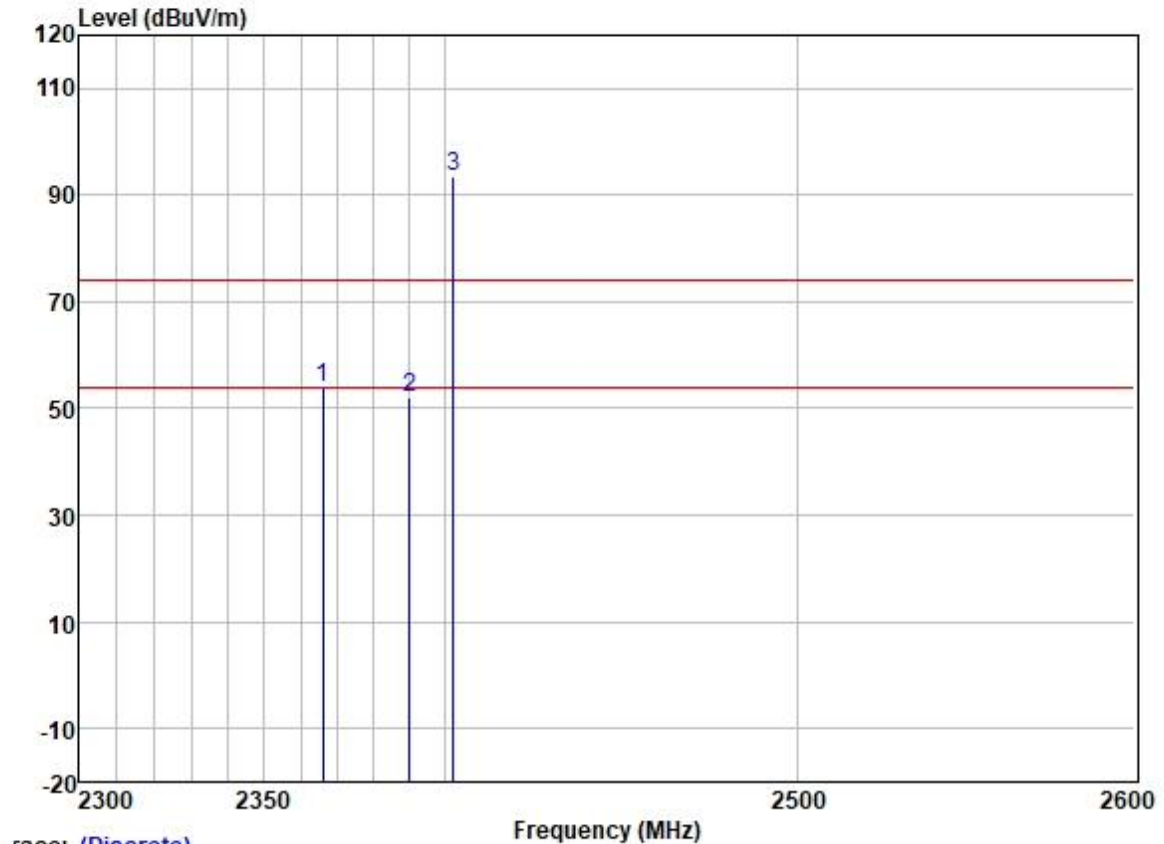
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:Low



Trace: (Discrete)

	Read	Antenna	Cable	Preamp		Limit	Over		
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2385.814	60.00	27.33	3.48	37.60	53.21	74.00	-20.79	HORIZONTAL Peak
2	2390.000	58.79	27.33	3.48	37.59	52.01	74.00	-21.99	HORIZONTAL Peak
3 *	2402.000	100.97	27.35	3.50	37.59	94.23	74.00	20.23	HORIZONTAL Peak

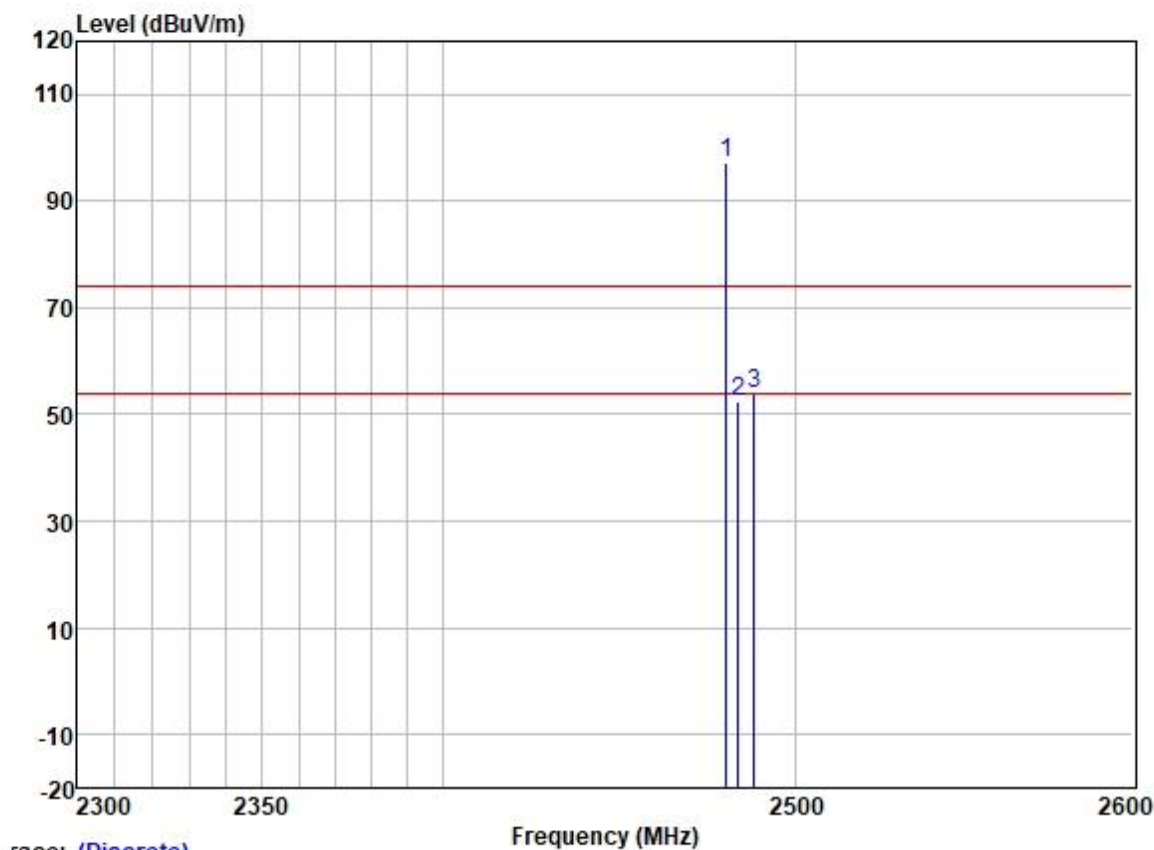
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; ; Channel:Low



Trace: (Discrete)

	Read	Antenna	Cable	Preamp		Limit	Over		
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2365.878	60.78	27.28	3.43	37.60	53.89	74.00	-20.11	VERTICAL Peak
2	2390.000	58.65	27.33	3.48	37.59	51.87	74.00	-22.13	VERTICAL Peak
3 *	2402.000	100.21	27.35	3.50	37.59	93.47	74.00	19.47	VERTICAL Peak

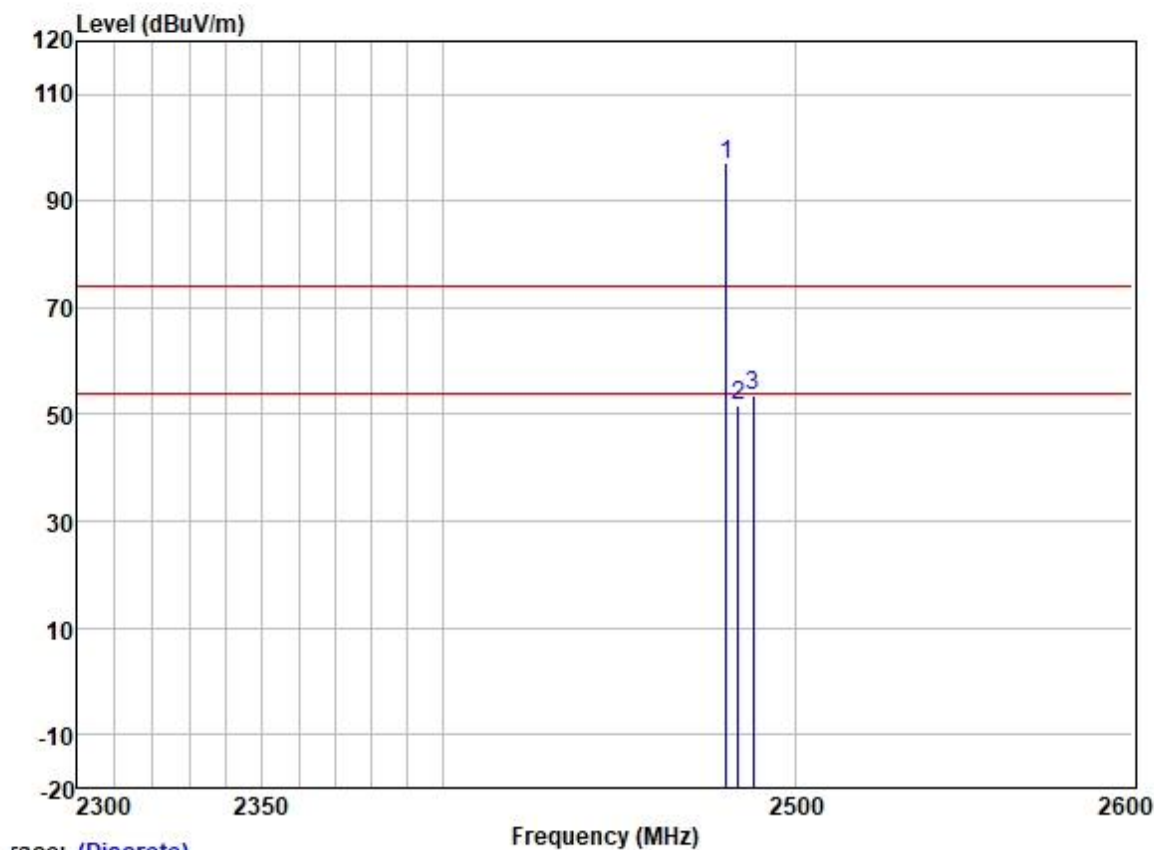
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

	Read	Antenna	Cable	Preamp		Limit	Over		
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1 *	2480.000	103.85	27.47	3.60	37.57	97.35	74.00	23.35	HORIZONTAL Peak
2	2483.500	58.81	27.48	3.53	37.57	52.25	74.00	-21.75	HORIZONTAL Peak
3	2488.094	60.31	27.48	3.53	37.56	53.76	74.00	-20.24	HORIZONTAL Peak

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



Trace: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1 *	2480.000	103.54	27.47	3.60	37.57	97.04	74.00	23.04	VERTICAL	Peak
2	2483.500	58.30	27.48	3.53	37.57	51.74	74.00	-22.26	VERTICAL	Peak
3	2487.794	60.01	27.48	3.53	37.56	53.46	74.00	-20.54	VERTICAL	Peak

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 6.4,6.5,6.6

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.

7.10.1 E.U.T. Operation

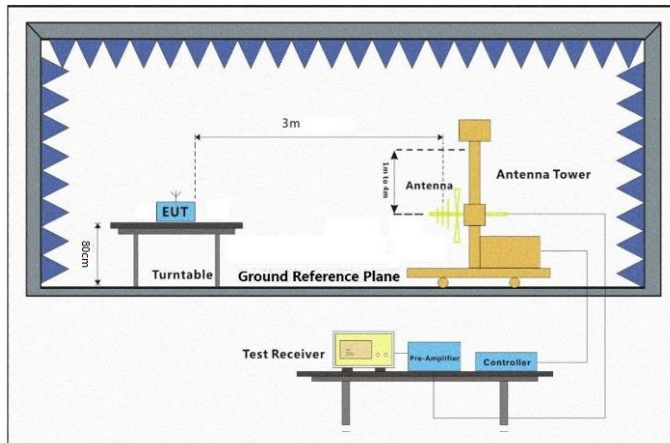
Operating Environment:

Temperature 23.5 °C Humidity: 53.2 % 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_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.

7.10.3 Test Setup Diagram



7.10.4 Measurement Procedure and Data

- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.
- Test the EUT in the lowest channel, the middle channel, the Highest channel.
- 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.
- Repeat above procedures until all frequencies measured was complete.

Remark:

1) Through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

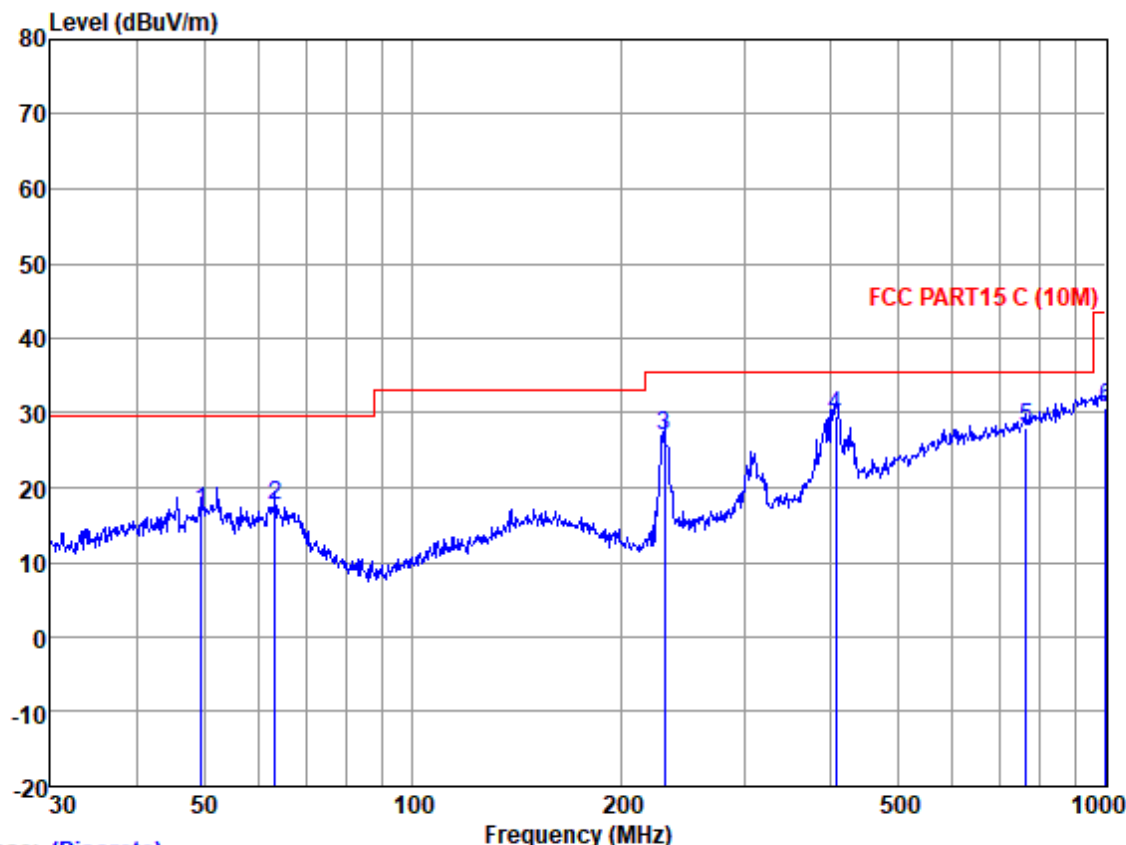
3) Scan from 9kHz to 1 GHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



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



Trace: (Discrete)

Site : SGS

Condition: FCC PART15 C (10M) 10m HORIZONTAL

Job :

Model :

Power :

Test Mode:

	Freq	ReadAntenna	Cable	Preamp		Limit	Over		
	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	49.53	28.99	13.92	1.14	27.17	16.88	29.50	-12.62	HORIZONTAL QP
2	63.31	30.59	12.97	1.31	27.15	17.72	29.50	-11.78	HORIZONTAL QP
3	230.91	40.22	10.64	2.73	26.69	26.90	35.60	-8.70	HORIZONTAL QP
4	407.51	37.06	15.85	3.97	27.36	29.52	35.60	-6.08	HORIZONTAL QP
5	766.06	27.77	22.20	6.05	28.06	27.96	35.60	-7.64	HORIZONTAL QP
6	1000.00	26.65	24.30	7.43	27.66	30.72	43.50	-12.78	HORIZONTAL QP

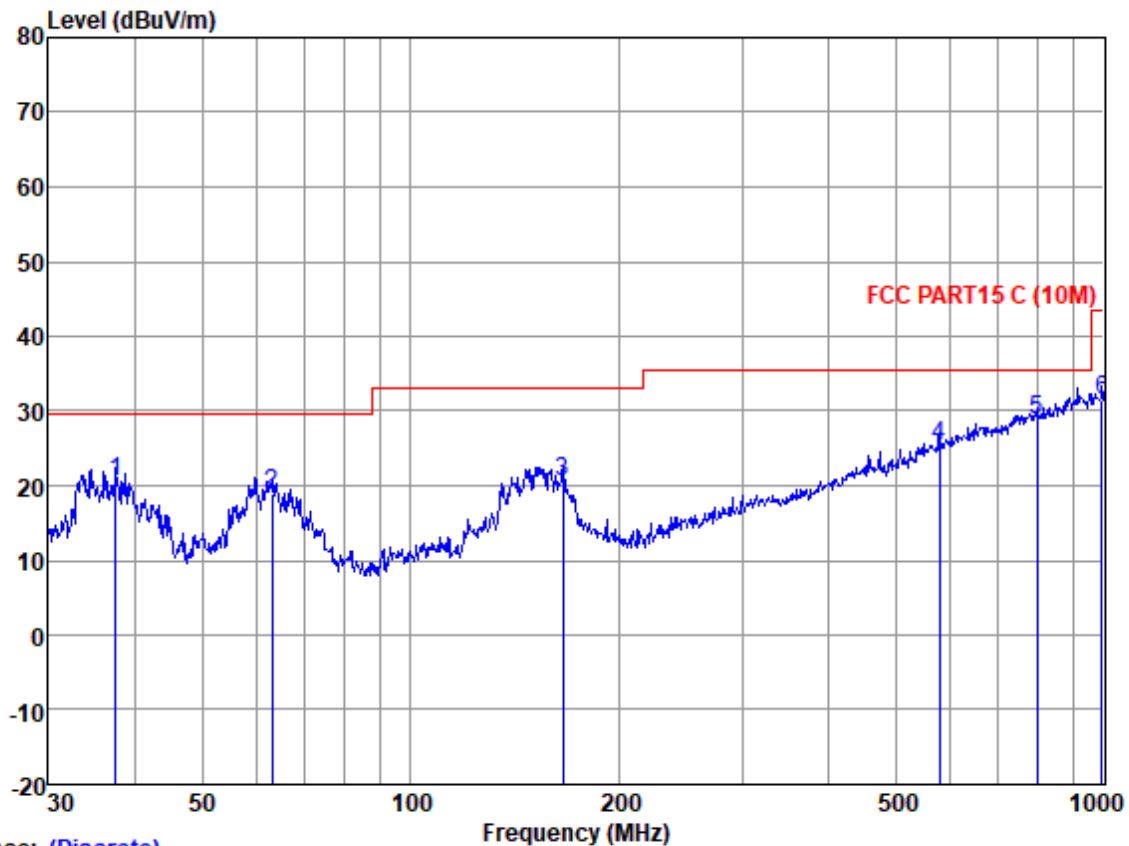


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Test Mode: 00; Polarity: Vertical; Modulation: GFSK; Channel: Low



Trace: (Discrete)

Site : SGS

Condition: FCC PART15 C (10M) 10m VERTICAL

Job :

Model :

Power :

Test Mode:

	Freq	ReadAntenna	Cable Preamp	Limit	Over				
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	37.55	33.34	13.25	1.09	27.18	20.50	29.50	-9.00	VERTICAL
2	63.09	31.78	13.00	1.31	27.15	18.94	29.50	-10.56	VERTICAL
3	165.49	31.64	13.42	2.37	26.78	20.65	33.10	-12.45	VERTICAL
4	578.67	29.40	19.15	5.02	28.18	25.39	35.60	-10.21	VERTICAL
5	798.98	27.93	22.60	6.17	28.03	28.67	35.60	-6.93	VERTICAL
6	993.01	27.64	24.23	7.37	27.67	31.57	43.50	-11.93	VERTICAL



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The test was performed at a 10m test site. According to below formulate and the test data at 10m test distance,

$$L_3 / L_{10} = D_{10} / D_3$$

Note:

L₃: Level @ 3m distance. Unit: uV/m;

L₁₀: Level @ 10m distance. Unit: uV/m;

D₃: 3m distance. Unit: m

D₁₀: 10m distance. Unit: m

The level at 3m test distance is below:

Mode 00:

Frequency (MHz)	Level 10m (dBuV/m)	Level @ 10m (uV/m)	Level @ 3m (uV/m)	Level @ 3m (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Ant. Polarization
49.53	16.88	6.98	23.27	27.34	40.00	-12.66	H
63.31	17.72	7.69	25.64	28.18	40.00	-11.82	H
230.91	26.9	22.13	73.77	37.36	46.00	-8.64	H
407.51	29.52	29.92	99.74	39.98	46.00	-6.02	H
766.06	27.96	25.00	83.34	38.42	46.00	-7.58	H
1000	30.72	34.36	114.52	41.18	54.00	-12.82	H
37.55	20.5	10.59	35.31	30.96	40.00	-9.04	V
63.09	18.94	8.85	29.50	29.40	40.00	-10.60	V
165.49	20.65	10.78	35.92	31.11	43.50	-12.39	V
578.67	25.39	18.60	62.00	35.85	46.00	-10.15	V
798.98	28.67	27.13	90.44	39.13	46.00	-6.87	V
993.01	31.57	37.89	126.29	42.03	54.00	-11.97	V



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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 6.4,6.5,6.6

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.

7.11.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

Humidity: 53.6 % RH

Atmospheric Pressure: 1010 mbar



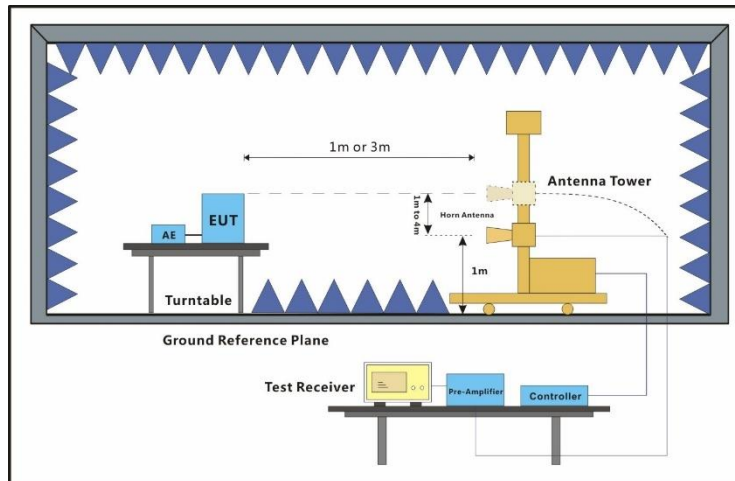
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7.11.2 Test Mode Description

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

- 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 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, quasi-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) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier 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) 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.



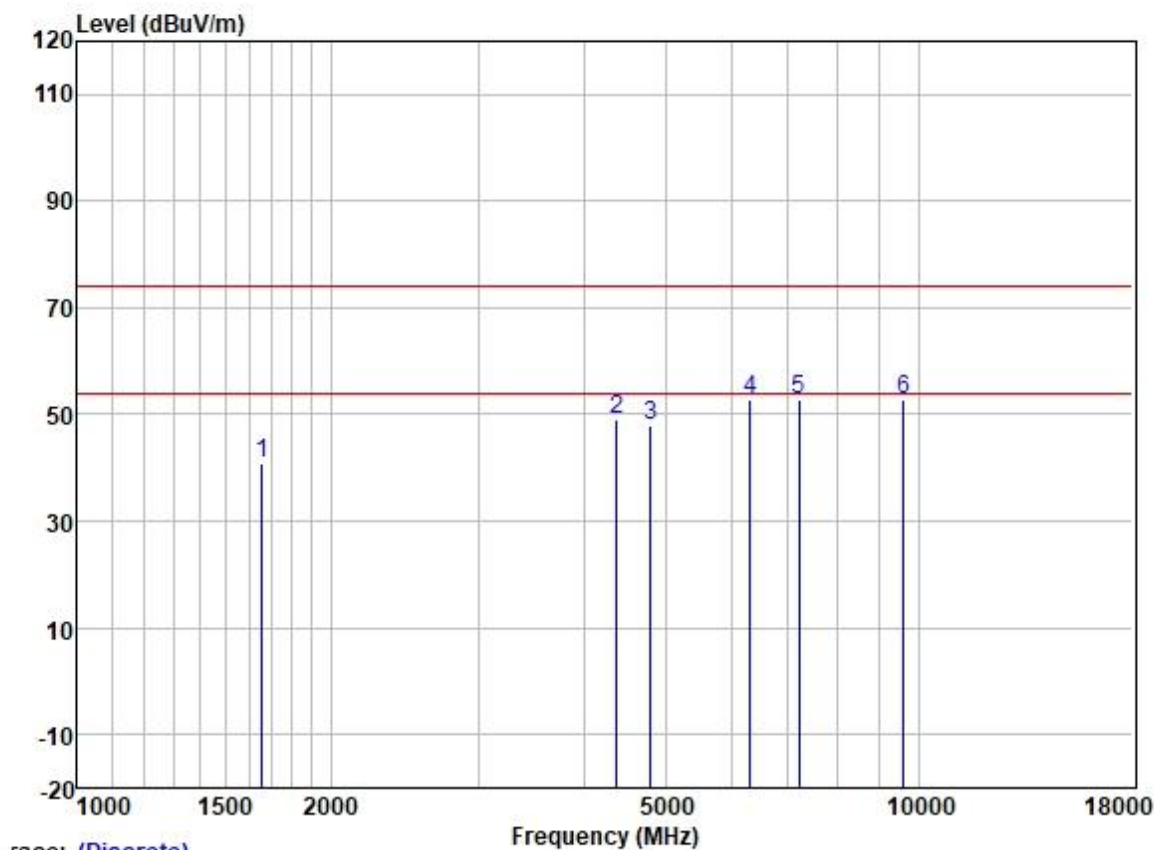
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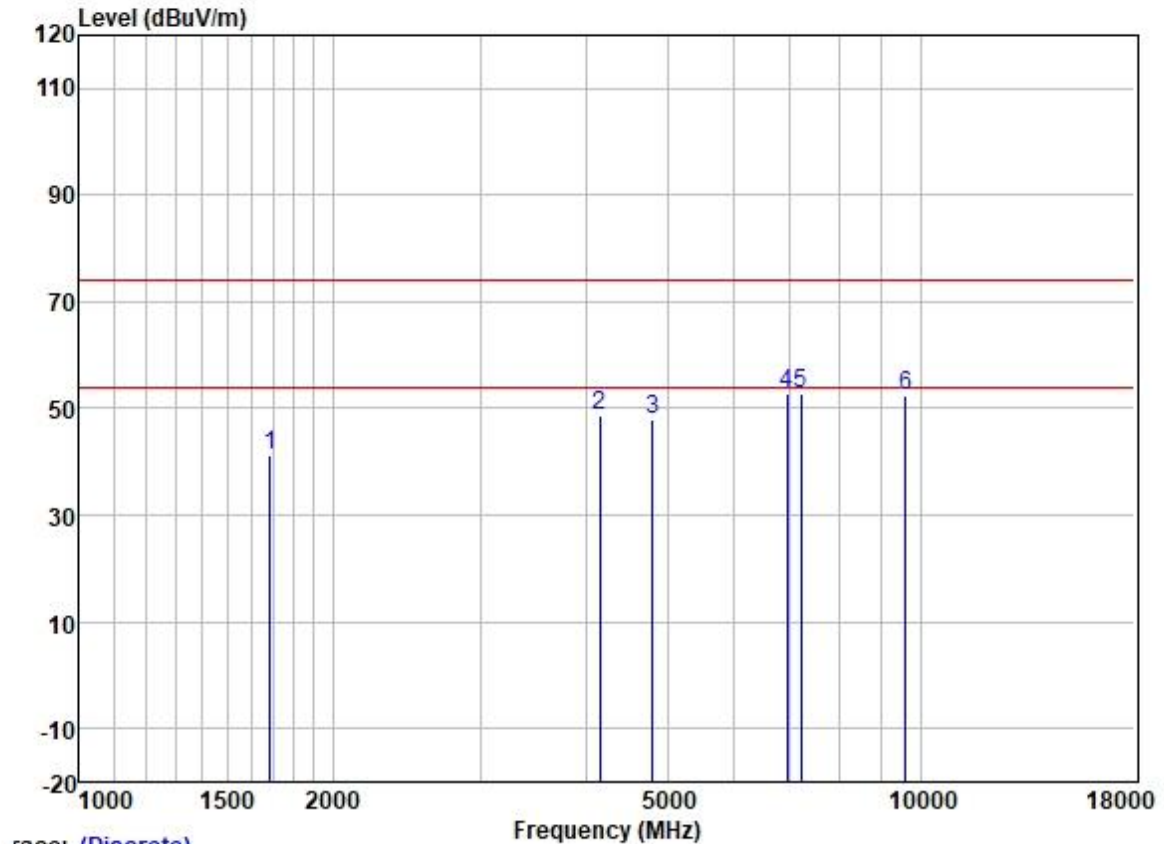
Test Mode: 00; Polarity: Horizontal; Modulation: GFSK; ; Channel: Low



Trace: (Discrete)

	Freq	Read	Antenna	Cable	Preamp	Limit	Over		
	MHz	Level	Factor	Loss	Factor	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	1658.337	50.20	25.65	2.80	37.93	40.72	74.00	-33.28	HORIZONTAL Peak
2	4379.699	50.51	30.64	4.69	36.81	49.03	74.00	-24.97	HORIZONTAL Peak
3	4804.000	48.07	31.42	5.40	36.83	48.06	74.00	-25.94	HORIZONTAL Peak
4	6303.890	50.34	33.44	5.97	36.96	52.79	74.00	-21.21	HORIZONTAL Peak
5	7206.000	48.81	35.54	5.98	37.38	52.95	74.00	-21.05	HORIZONTAL Peak
6	9608.000	44.82	38.37	7.07	37.42	52.84	74.00	-21.16	HORIZONTAL Peak

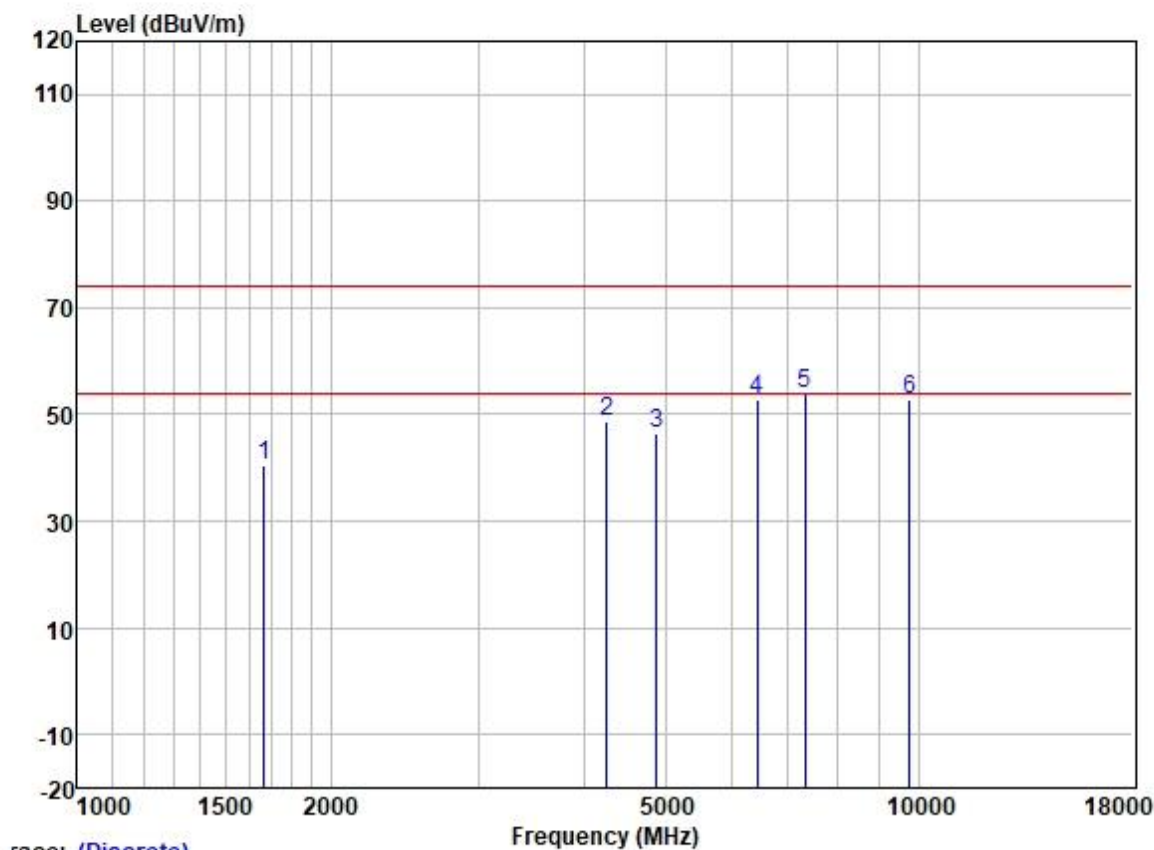
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; ; Channel:Low



Trace: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1687.347	50.69	25.69	2.80	37.91	41.27	74.00	-32.73	VERTICAL	Peak
2	4157.664	50.95	30.06	4.60	36.80	48.81	74.00	-25.19	VERTICAL	Peak
3	4804.000	47.95	31.42	5.40	36.83	47.94	74.00	-26.06	VERTICAL	Peak
4	6934.778	49.28	34.92	5.81	37.19	52.82	74.00	-21.18	VERTICAL	Peak
5	7206.000	48.68	35.54	5.98	37.38	52.82	74.00	-21.18	VERTICAL	Peak
6	9608.000	44.51	38.37	7.07	37.42	52.53	74.00	-21.47	VERTICAL	Peak

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



Trace: (Discrete)

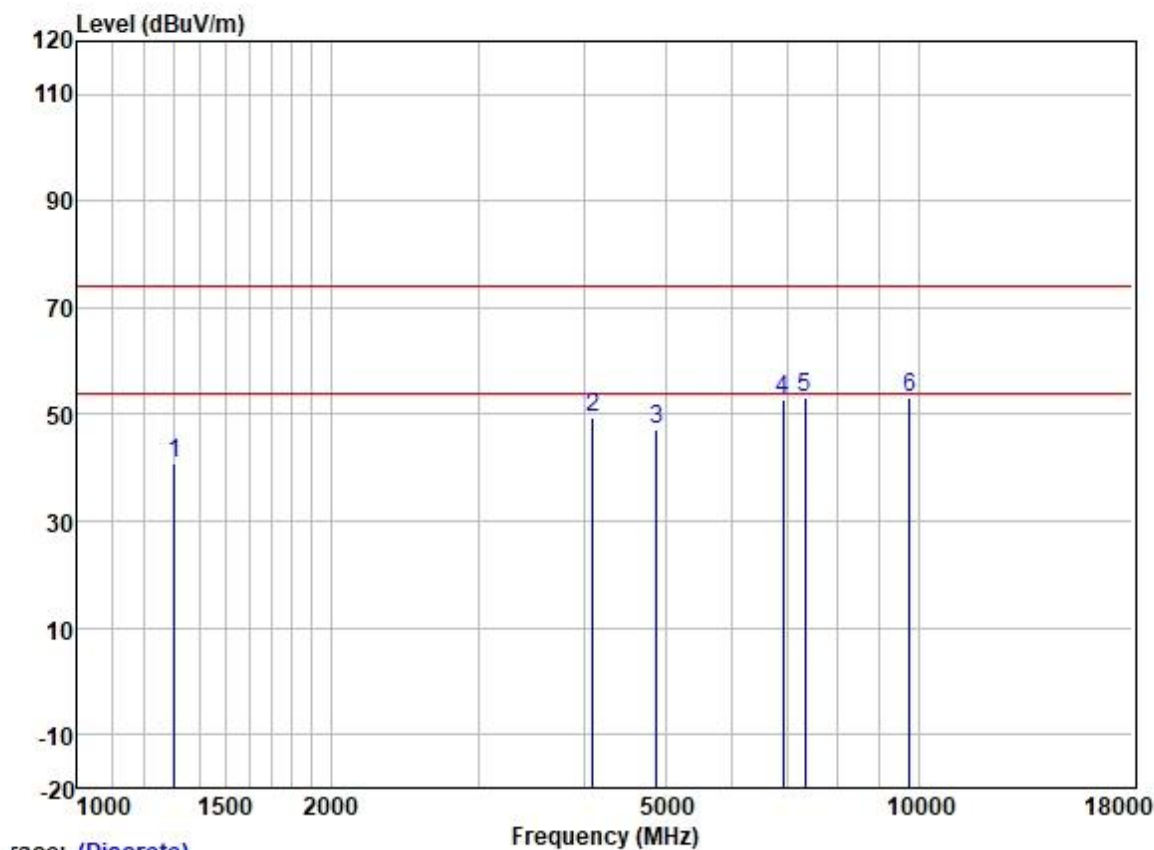
	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Limit Level	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dB		
1	1667.951	50.02	25.66	2.80	37.91	40.57	74.00	-33.43	HORIZONTAL Peak
2	4254.921	50.45	30.34	4.62	36.81	48.60	74.00	-25.40	HORIZONTAL Peak
3	4882.000	46.26	31.56	5.52	36.84	46.50	74.00	-27.50	HORIZONTAL Peak
4	6432.732	49.94	33.83	5.88	36.99	52.66	74.00	-21.34	HORIZONTAL Peak
5	7323.000	49.20	36.00	6.13	37.43	53.90	74.00	-20.10	HORIZONTAL Peak
6	9764.000	44.52	38.50	7.02	37.41	52.63	74.00	-21.37	HORIZONTAL Peak



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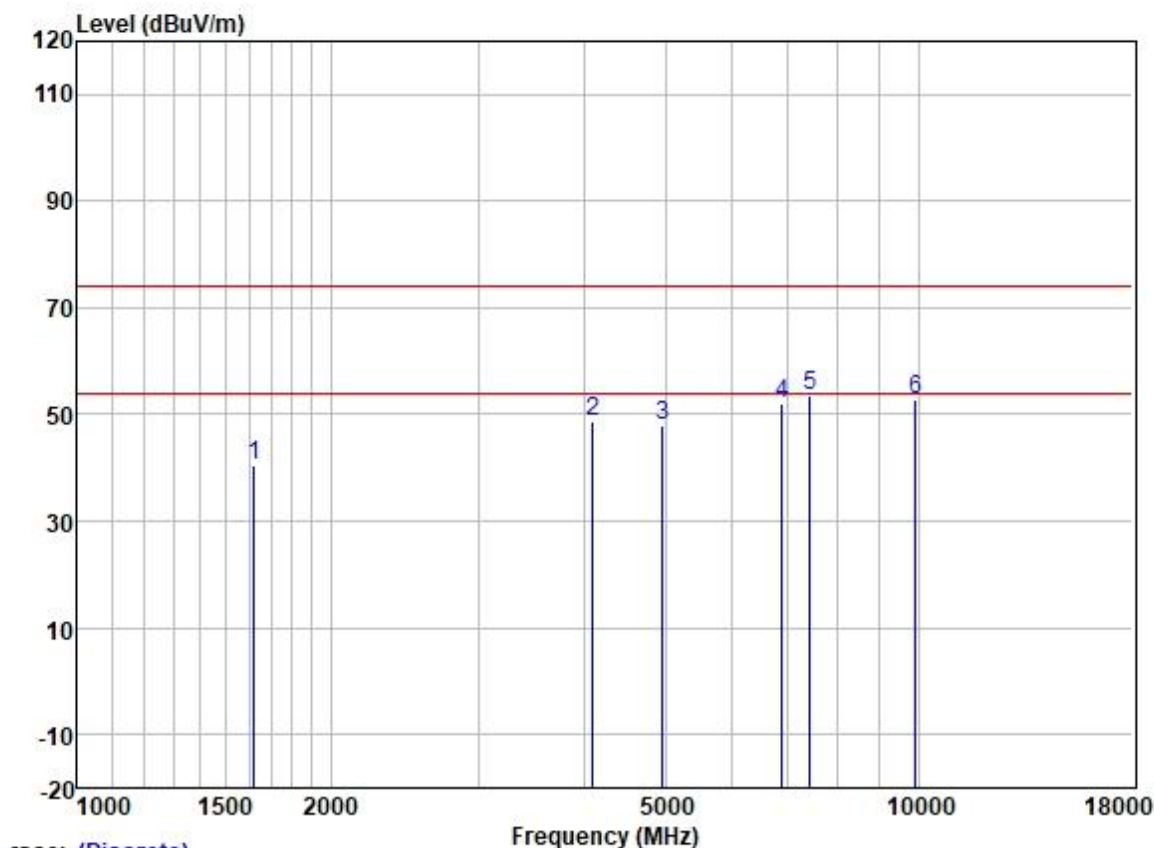
Test Mode: 00; Polarity: Vertical; Modulation: GFSK; ; Channel: middle



Trace: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1304.623	51.52	25.21	2.60	38.31	41.02	74.00	-32.98	VERTICAL	Peak
2	4098.010	51.76	29.94	4.60	36.80	49.50	74.00	-24.50	VERTICAL	Peak
3	4882.000	47.08	31.56	5.52	36.84	47.32	74.00	-26.68	VERTICAL	Peak
4	6894.806	49.35	34.85	5.81	37.18	52.83	74.00	-21.17	VERTICAL	Peak
5	7323.000	48.49	36.00	6.13	37.43	53.19	74.00	-20.81	VERTICAL	Peak
6	9764.000	45.21	38.50	7.02	37.41	53.32	74.00	-20.68	VERTICAL	Peak

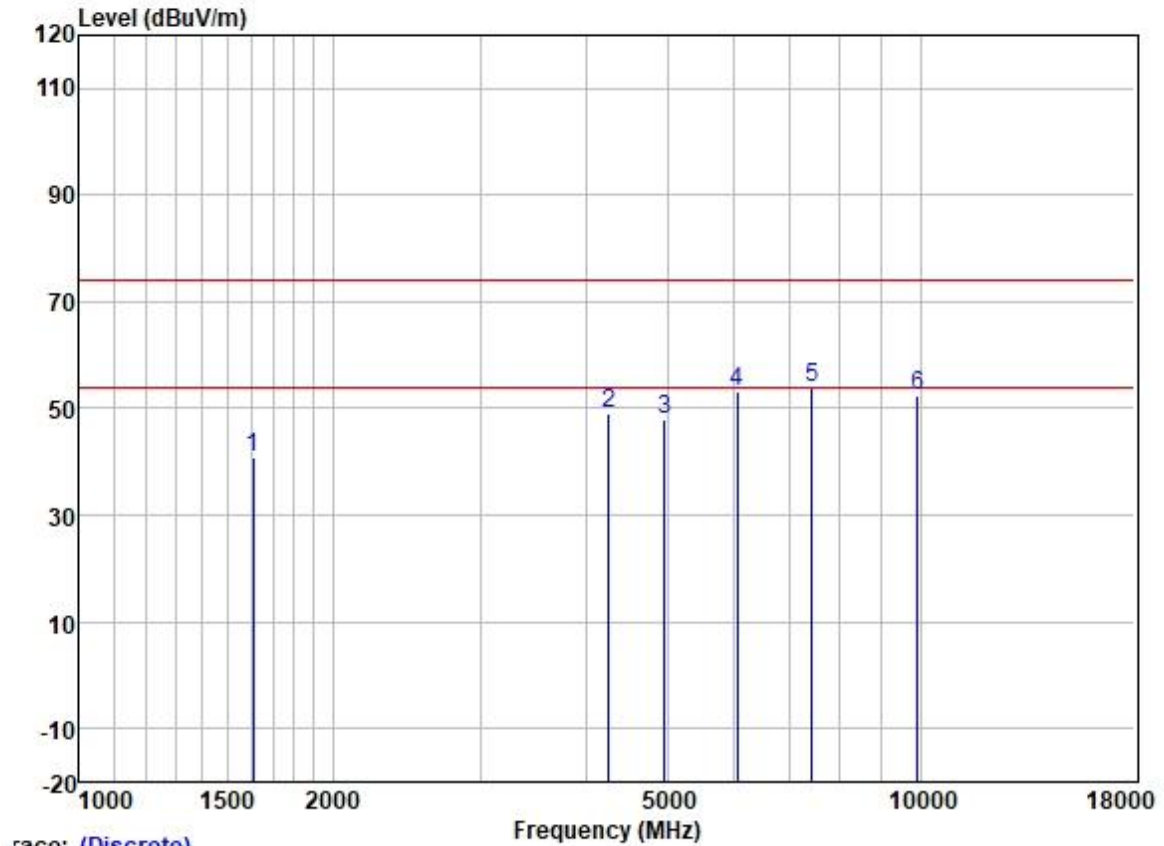
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Limit Level	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dB		
1	1620.431	49.89	25.60	2.80	37.95	40.34	74.00	-33.66	HORIZONTAL Peak
2	4098.010	51.05	29.94	4.60	36.80	48.79	74.00	-25.21	HORIZONTAL Peak
3	4960.000	47.41	31.65	5.65	36.84	47.87	74.00	-26.13	HORIZONTAL Peak
4	6874.906	48.71	34.82	5.82	37.16	52.19	74.00	-21.81	HORIZONTAL Peak
5	7440.000	48.69	36.27	6.22	37.47	53.71	74.00	-20.29	HORIZONTAL Peak
6	9920.000	44.51	38.65	6.96	37.40	52.72	74.00	-21.28	HORIZONTAL Peak

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



Trace: (Discrete)

	Freq	Read	Antenna	Cable	Preamp	Limit	Over		
	MHz	Level	Factor	Loss	Factor	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	1611.091	50.26	25.59	2.80	37.98	40.67	74.00	-33.33	VERTICAL Peak
2	4254.921	50.78	30.34	4.62	36.81	48.93	74.00	-25.07	VERTICAL Peak
3	4960.000	47.33	31.65	5.65	36.84	47.79	74.00	-26.21	VERTICAL Peak
4	6053.894	51.35	32.52	6.17	36.91	53.13	74.00	-20.87	VERTICAL Peak
5	7440.000	48.81	36.27	6.22	37.47	53.83	74.00	-20.17	VERTICAL Peak
6	9920.000	44.05	38.65	6.96	37.40	52.26	74.00	-21.74	VERTICAL Peak

8 Test Setup Photo

Refer to Appendix-Setup Photo for GZCR2108020809AT.

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - External and Internal Photos for GZCR2108020809AT.

10 Appendix

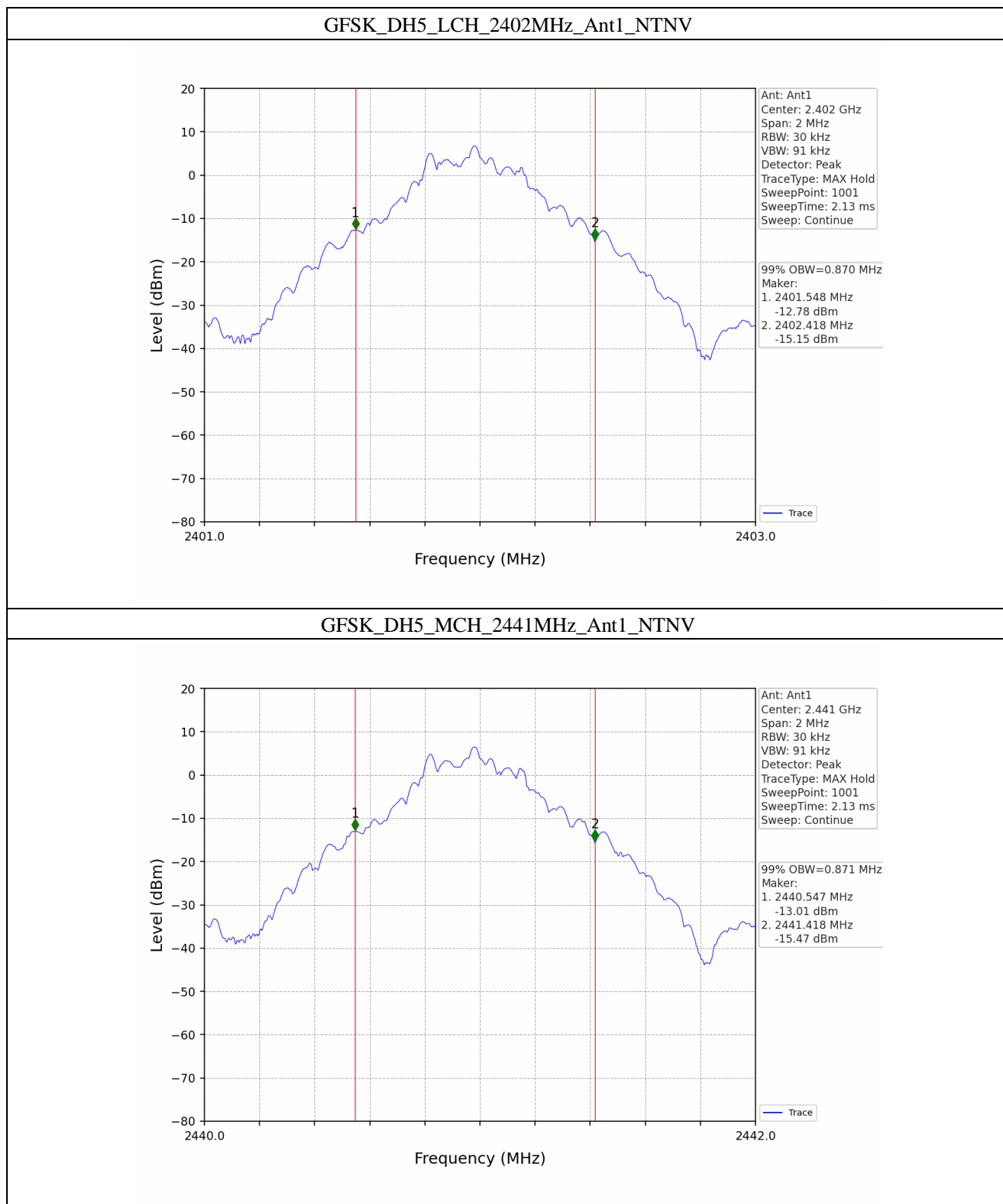
1. Bandwidth

1.1 OBW

1.1.1 Test Result

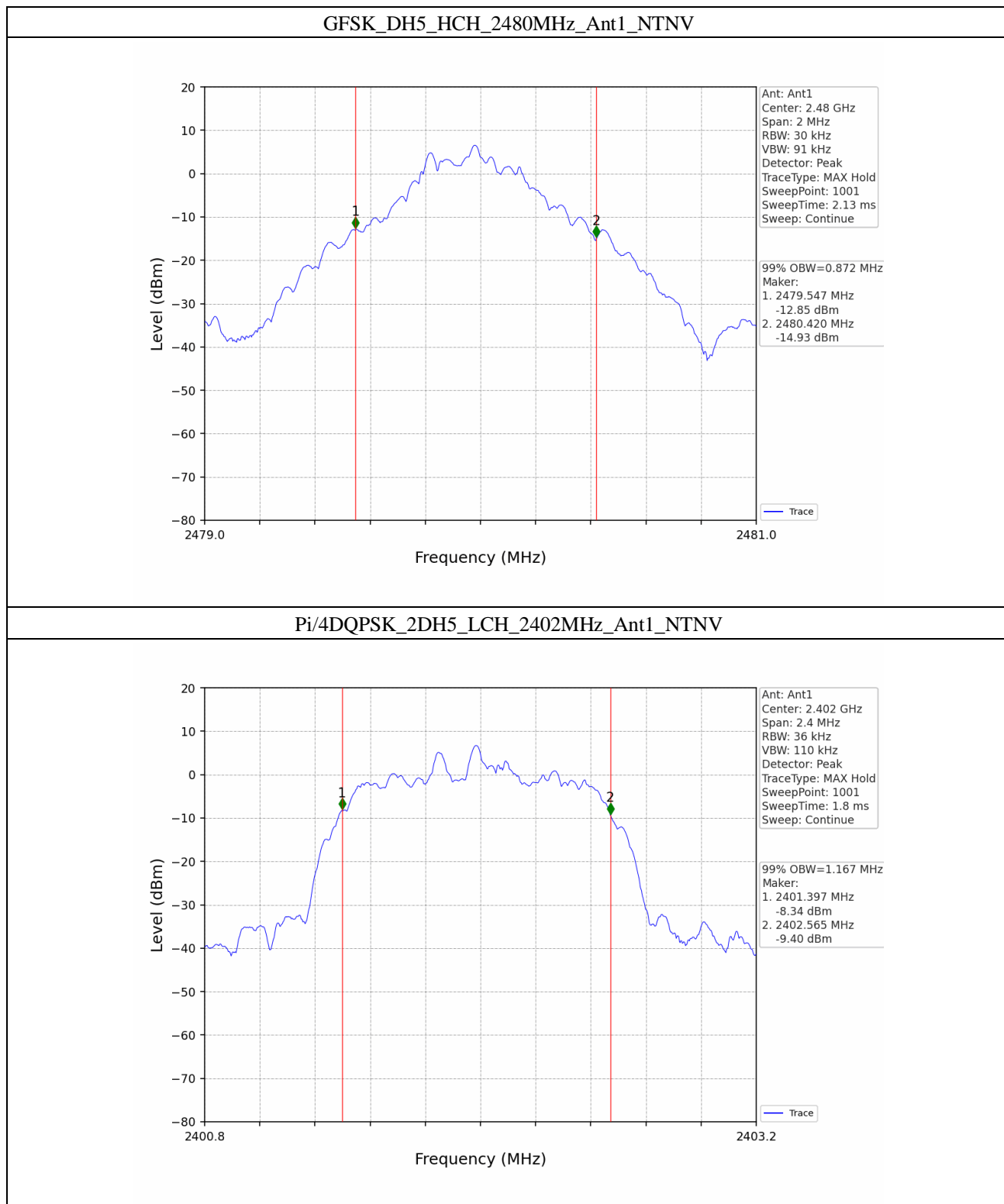
Mode	TX Type	Frequency (MHz)	Packet Type	Ant	99% Occupied Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	0.870	Pass
		2441	DH5	1	0.871	Pass
		2480	DH5	1	0.872	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.167	Pass
		2441	2DH5	1	1.166	Pass
		2480	2DH5	1	1.167	Pass
8DPSK	SISO	2402	3DH5	1	1.179	Pass
		2441	3DH5	1	1.178	Pass
		2480	3DH5	1	1.177	Pass

1.1.2 Test Graph



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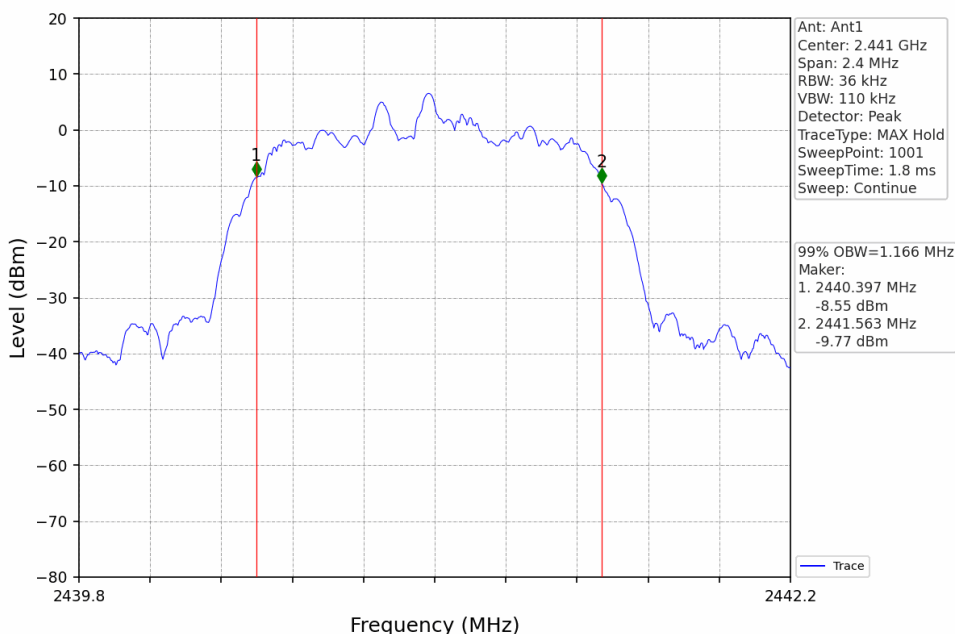
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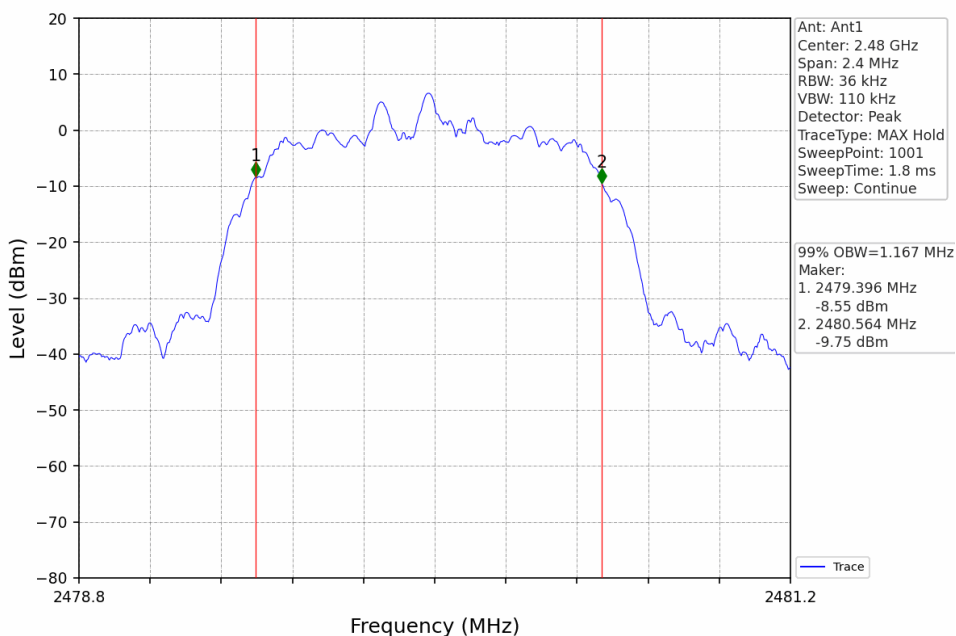
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV

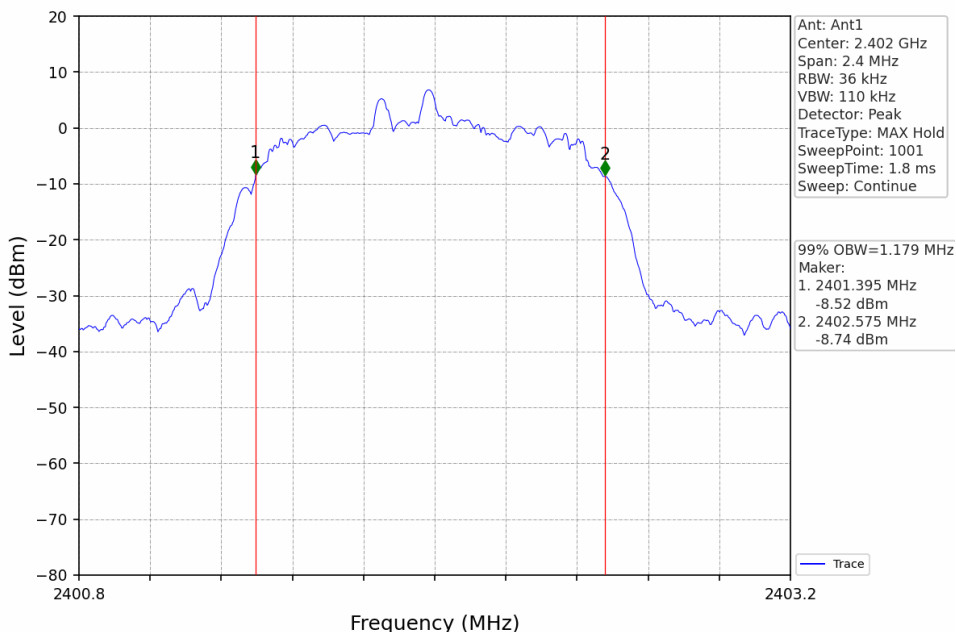


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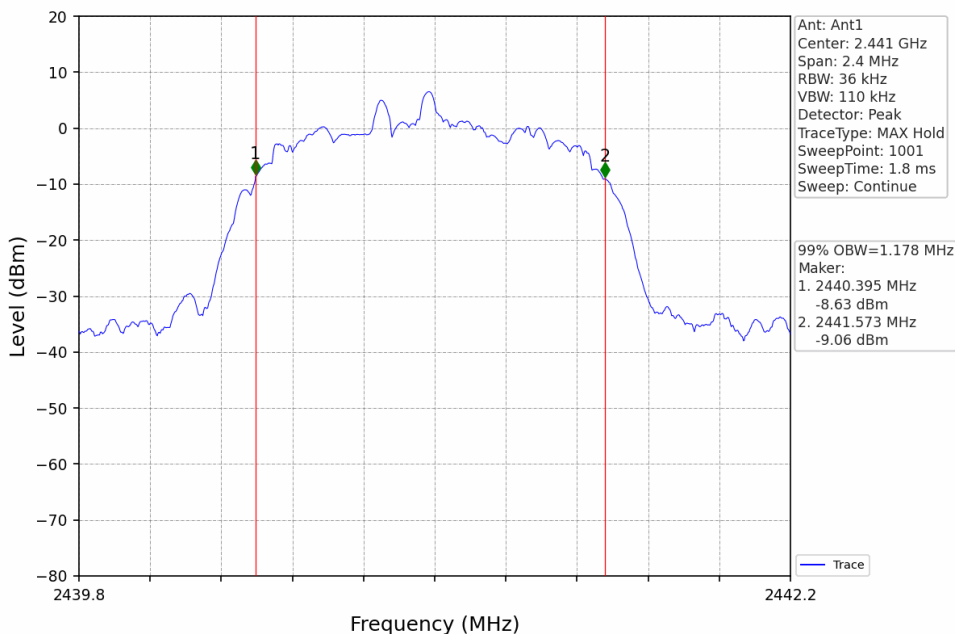
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



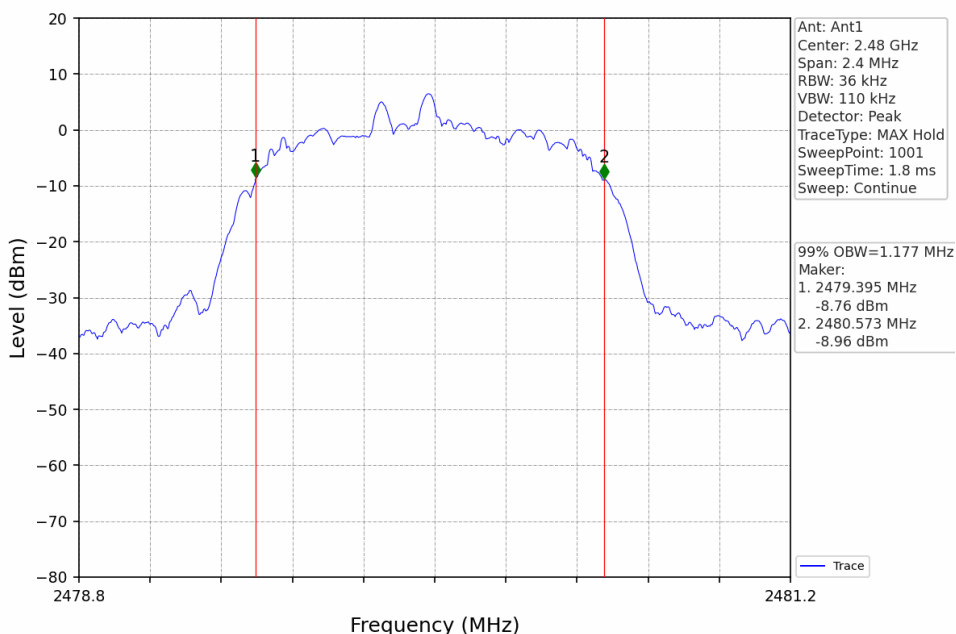
8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



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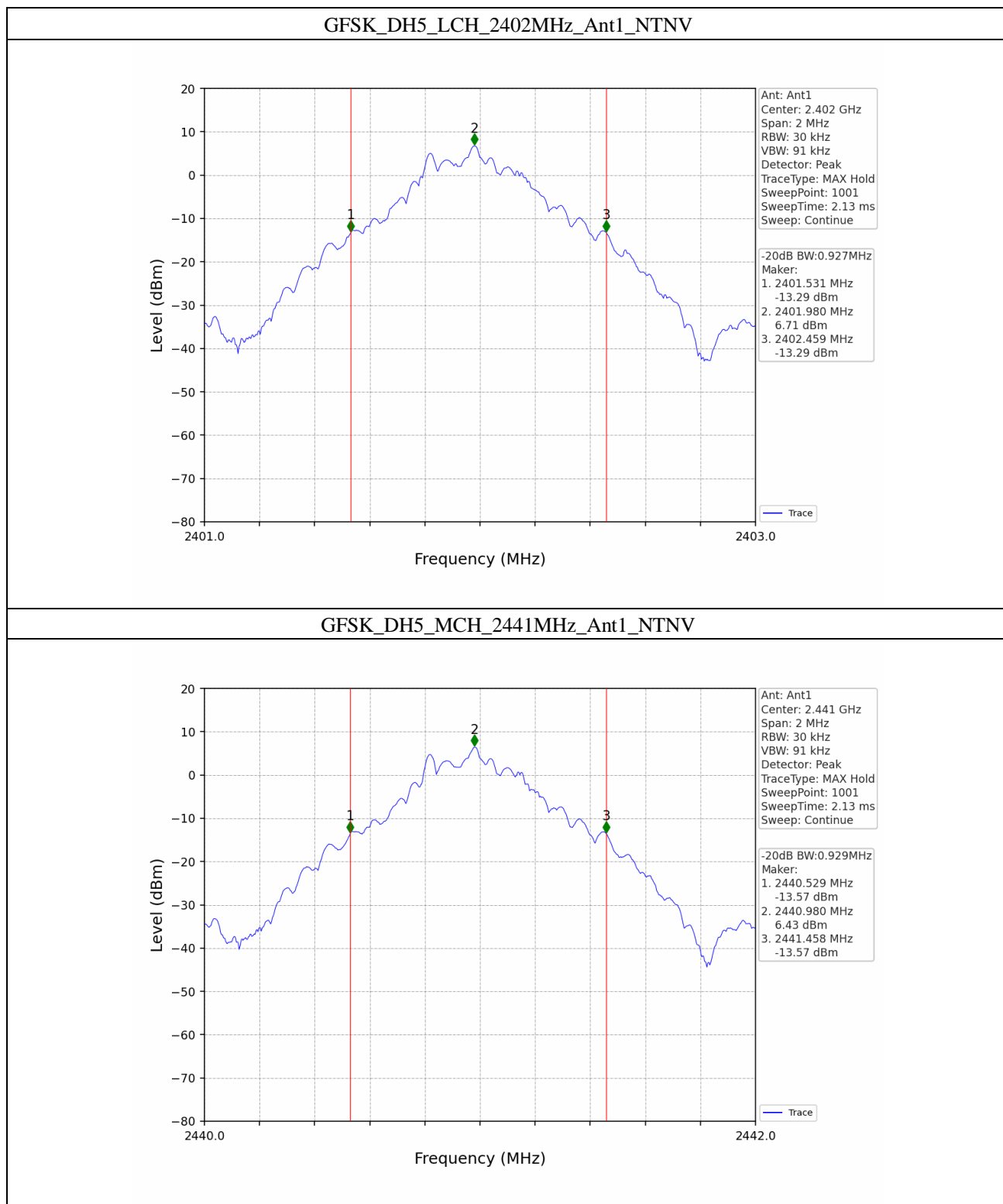
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1.2 20dB BW

1.2.1 Test Result

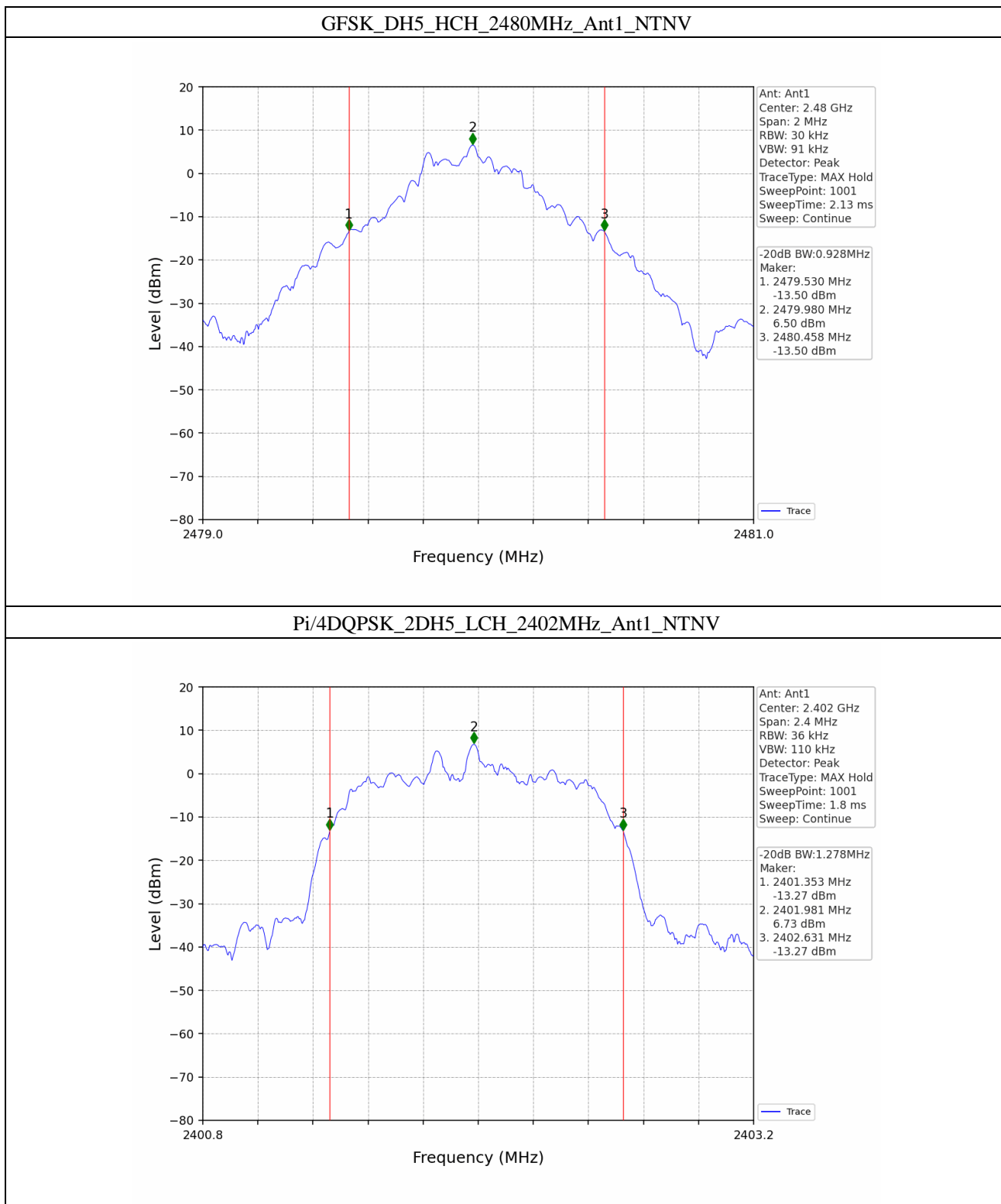
Mode	TX Type	Frequency (MHz)	Packet Type	Ant	20dB Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	0.927	Pass
		2441	DH5	1	0.929	Pass
		2480	DH5	1	0.928	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.278	Pass
		2441	2DH5	1	1.278	Pass
		2480	2DH5	1	1.277	Pass
8DPSK	SISO	2402	3DH5	1	1.295	Pass
		2441	3DH5	1	1.294	Pass
		2480	3DH5	1	1.292	Pass

1.2.2 Test Graph



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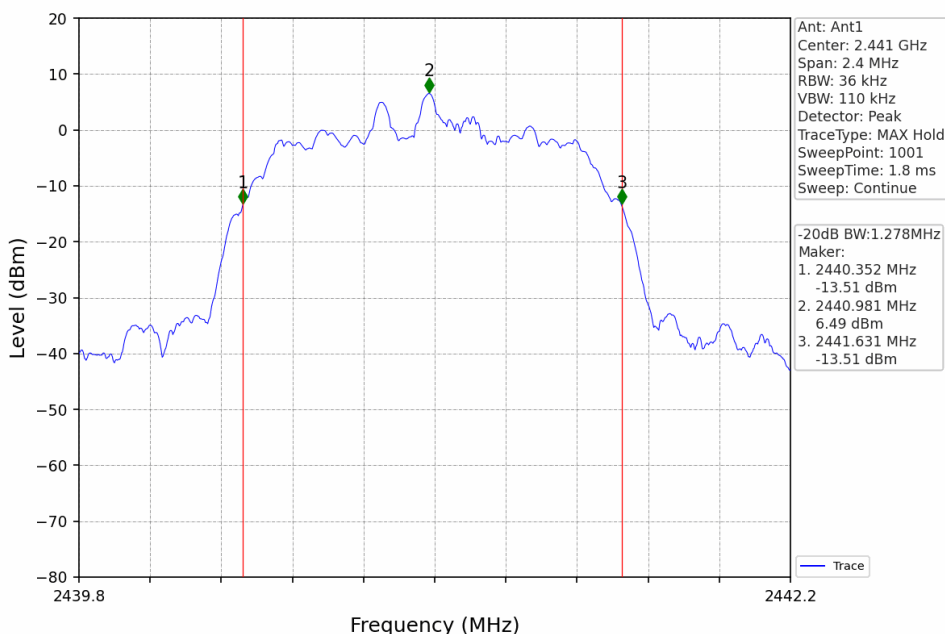
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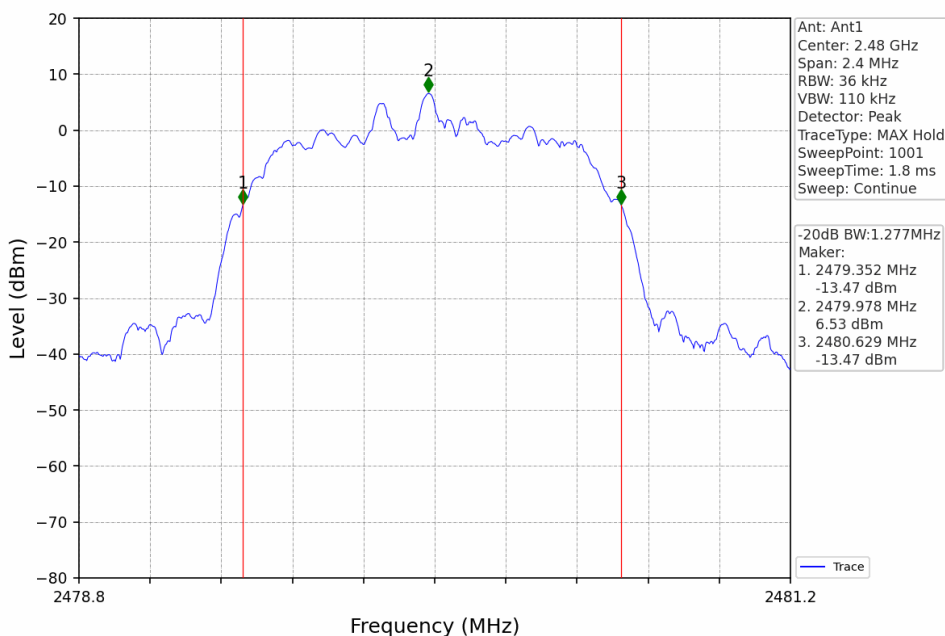
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



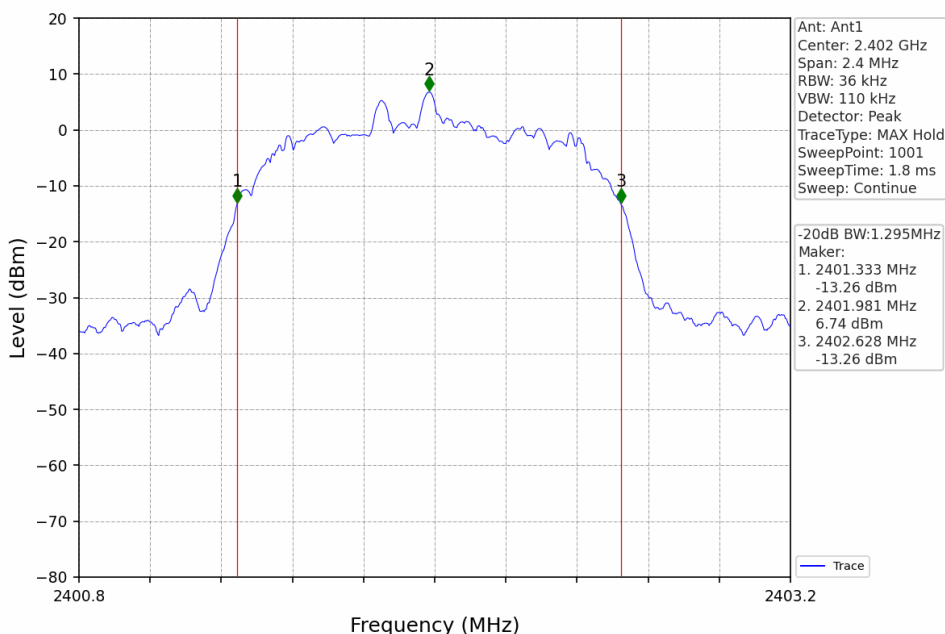
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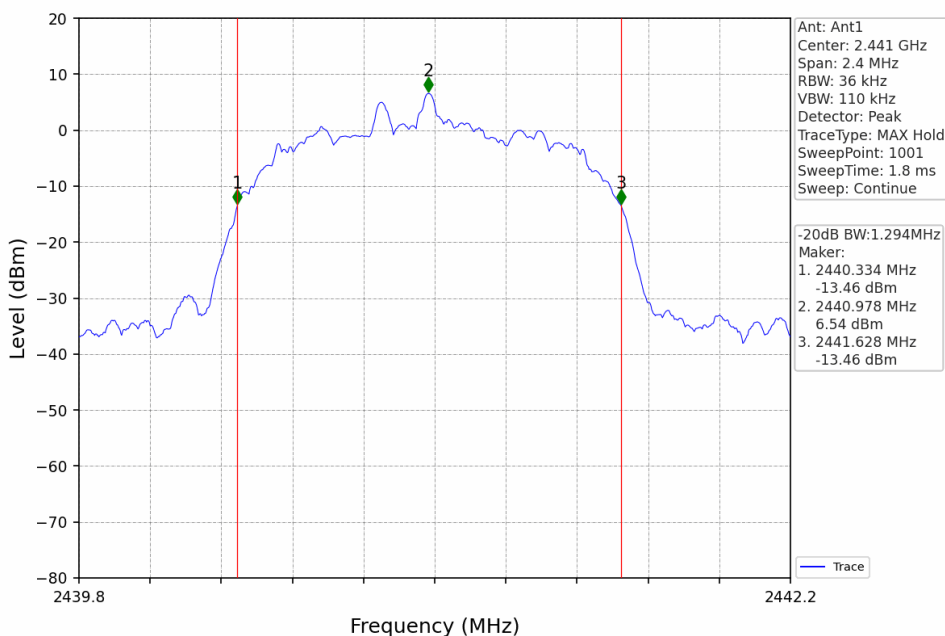
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV

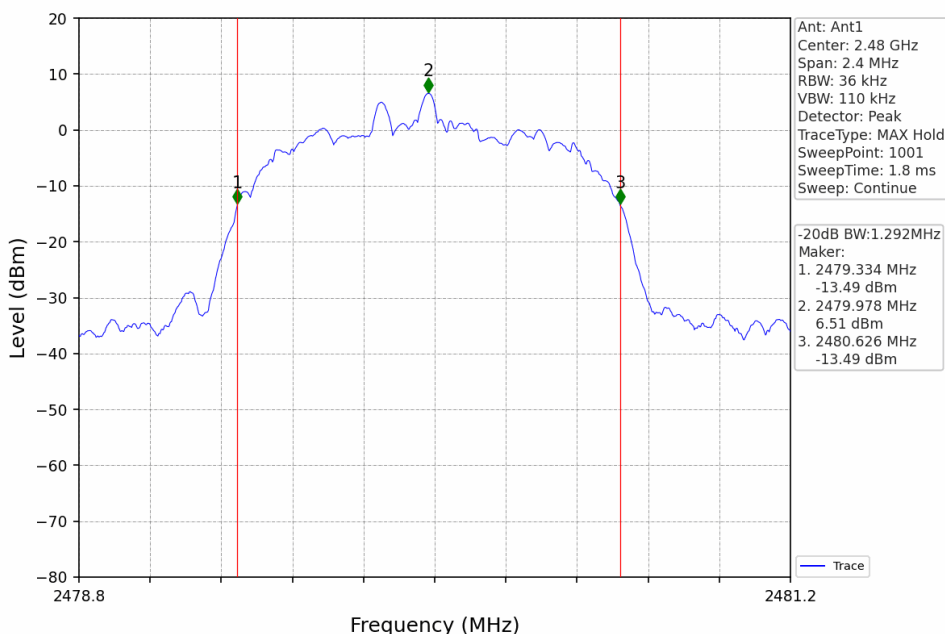


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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



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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	6.67	<=30	Pass
		2441	DH5	6.45	<=30	Pass
		2480	DH5	6.47	<=30	Pass
Pi/4DQPSK	SISO	2402	2DH5	8.97	<=20.97	Pass
		2441	2DH5	8.76	<=20.97	Pass
		2480	2DH5	8.81	<=20.97	Pass
8DPSK	SISO	2402	3DH5	9.51	<=20.97	Pass
		2441	3DH5	9.28	<=20.97	Pass
		2480	3DH5	9.30	<=20.97	Pass

Note1: Antenna Gain: Ant1: 1.94dBi;



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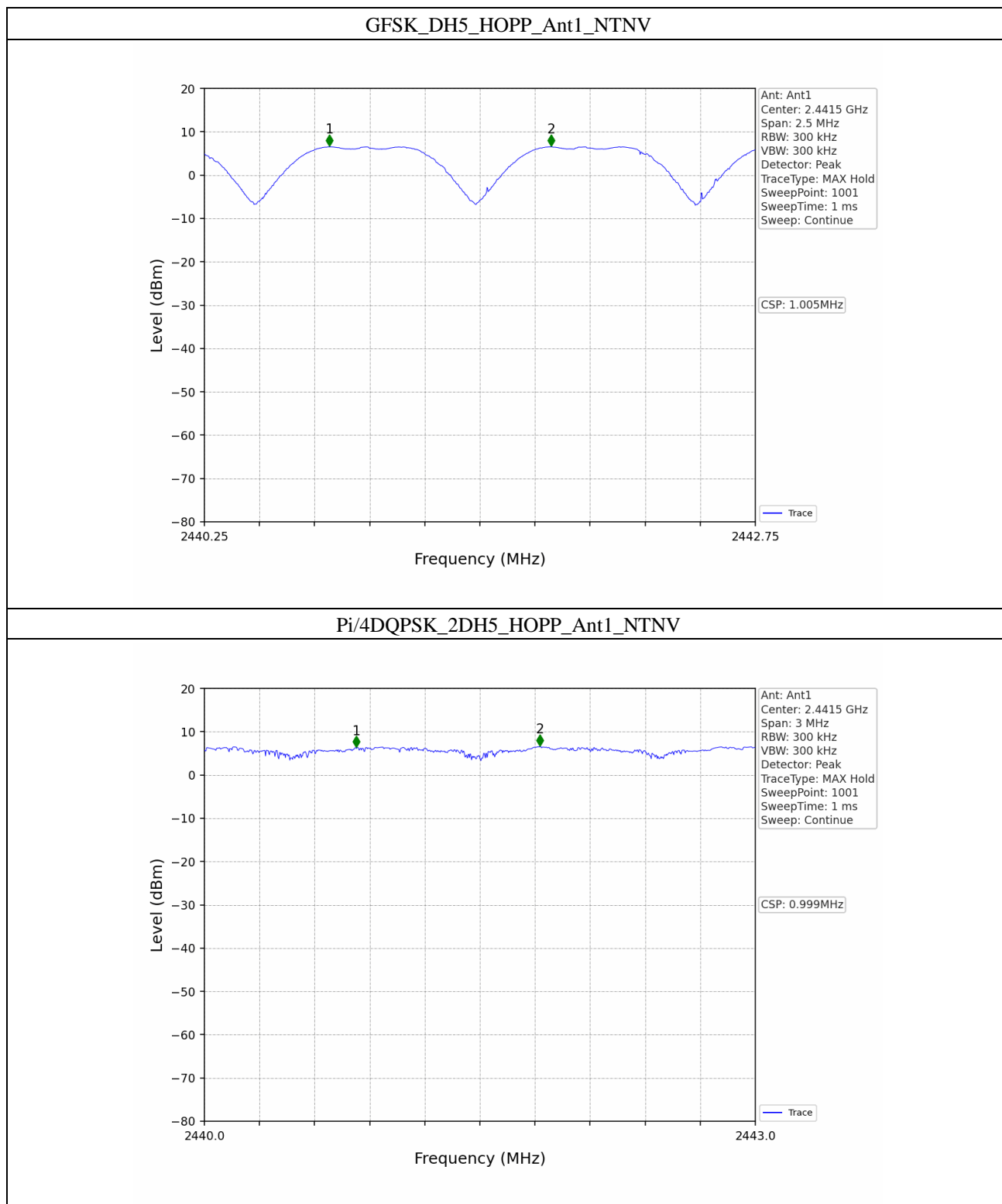
3. Carrier Frequency Separation

3.1 Ant1

3.1.1 Test Result

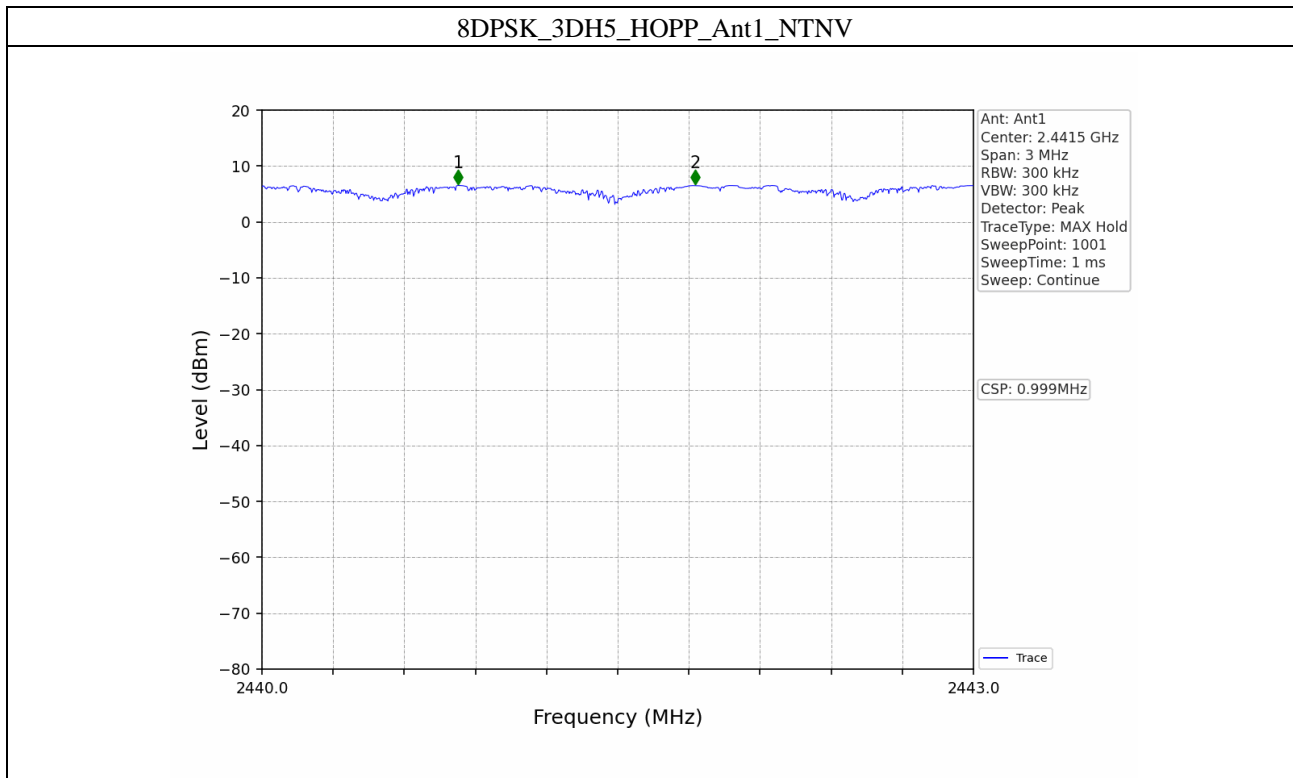
Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.005	0.929	≥ 0.929	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	0.999	1.278	≥ 0.852	Pass
8DPSK	SISO	HOPP	3DH5	0.999	1.295	≥ 0.863	Pass

3.1.2 Test Graph



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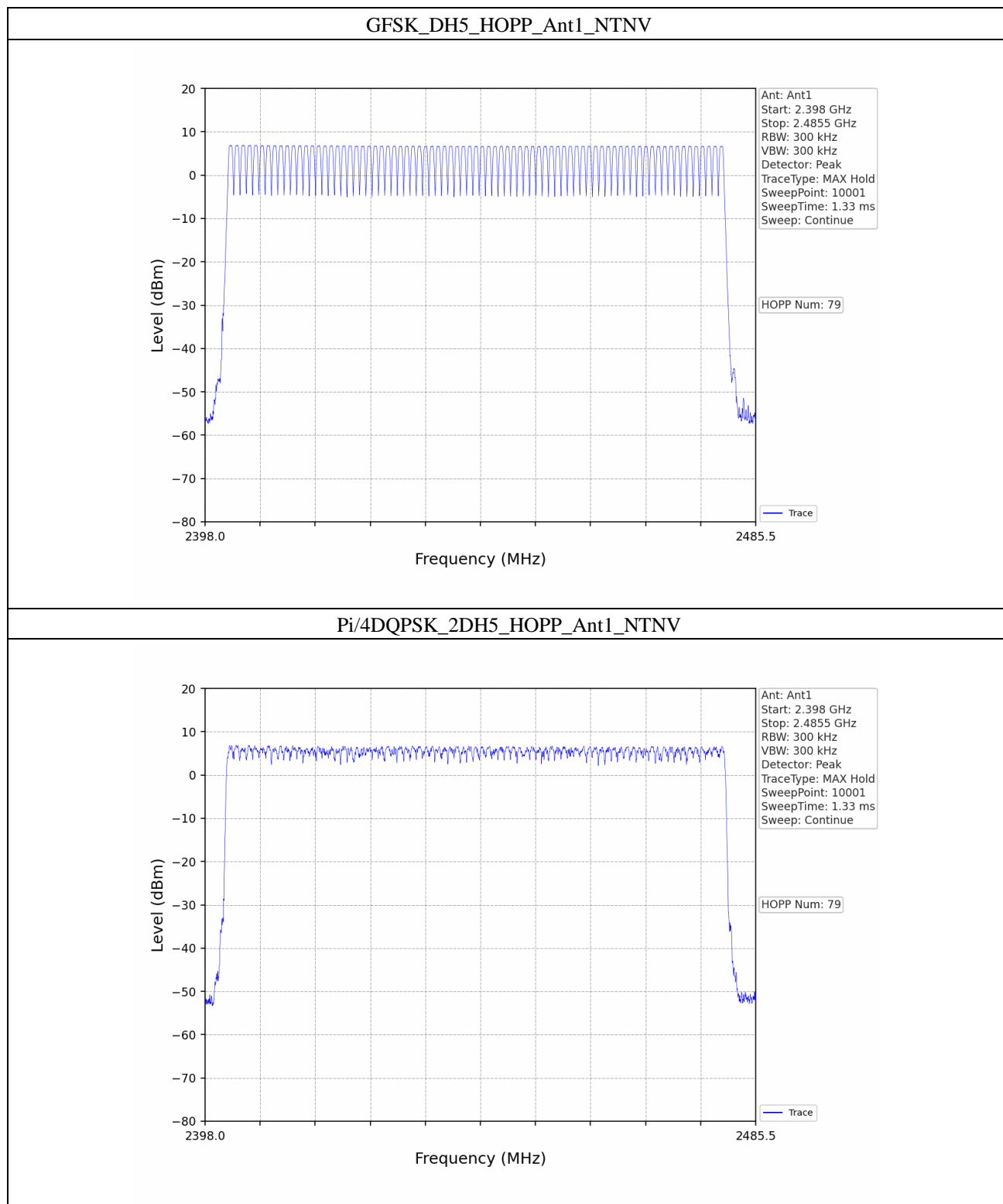
4. Number of Hopping Frequencies

4.1 HoppNum

4.1.1 Test Result

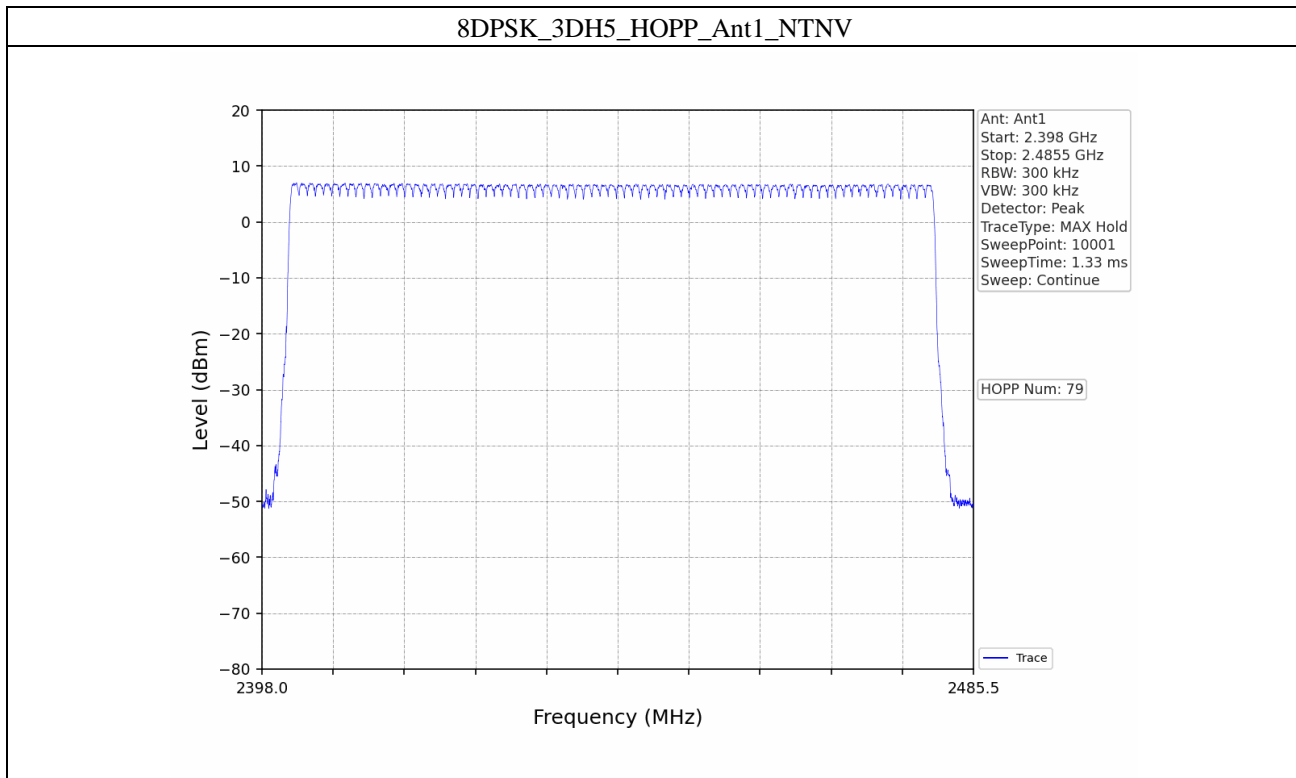
Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				Ant 1	Limit	
GFSK	SISO	HOPP	DH5	79	≥ 15	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	79	≥ 15	Pass
8DPSK	SISO	HOPP	3DH5	79	≥ 15	Pass

4.1.2 Test Graph



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5. Time of Occupancy (Dwell Time)

5.1 Ant1

5.1.1 Test Result

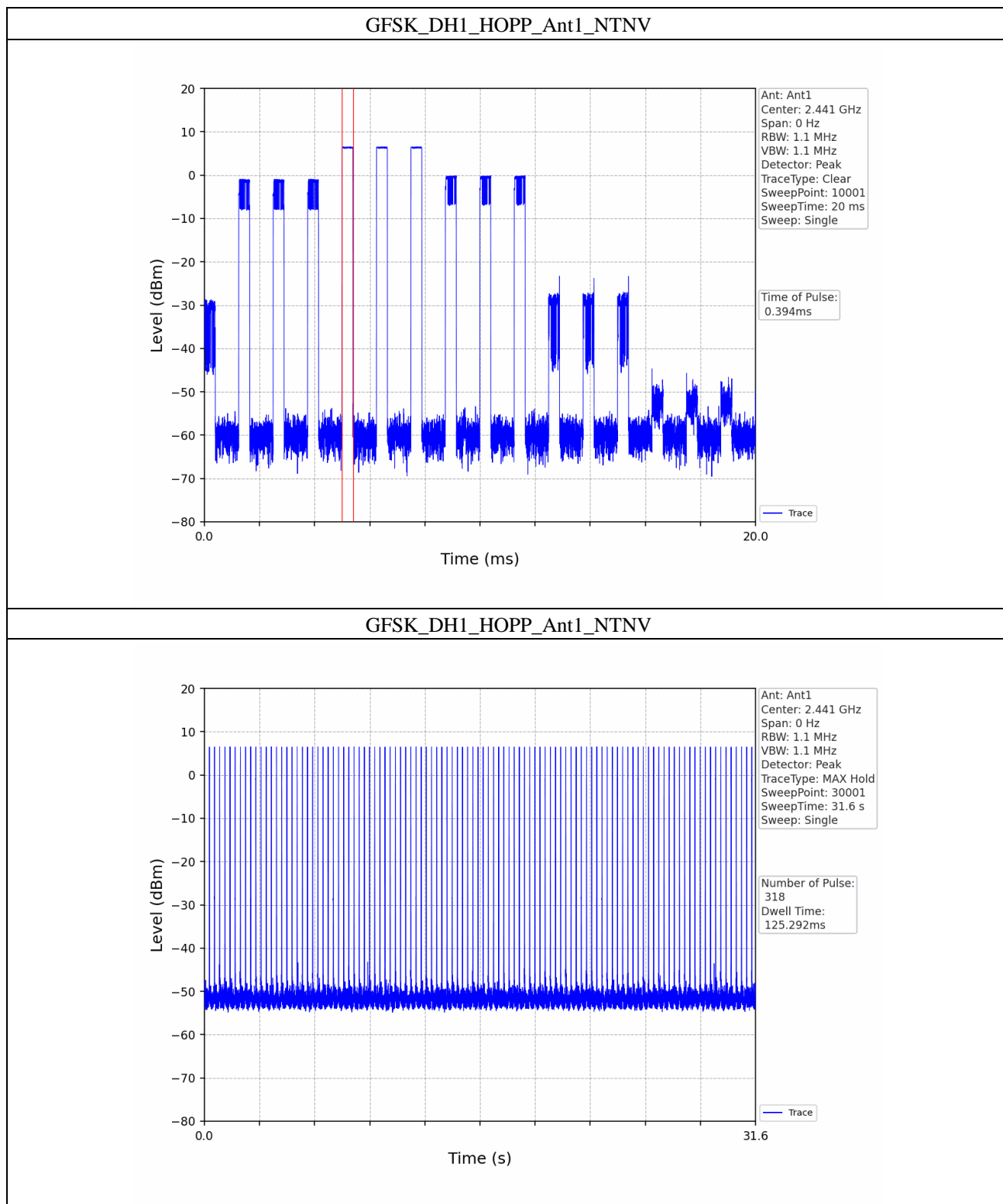
Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.394	31.600	318	125.292	<=400	Pass
			DH3	1.650	31.600	107	176.550	<=400	Pass
			DH5	2.900	31.600	106	307.400	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.404	31.600	318	128.472	<=400	Pass
			2DH3	1.654	31.600	107	176.978	<=400	Pass
			2DH5	2.902	31.600	107	310.514	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.402	31.600	321	129.042	<=400	Pass
			3DH3	1.654	31.600	106	175.324	<=400	Pass
			3DH5	2.904	31.600	107	310.728	<=400	Pass



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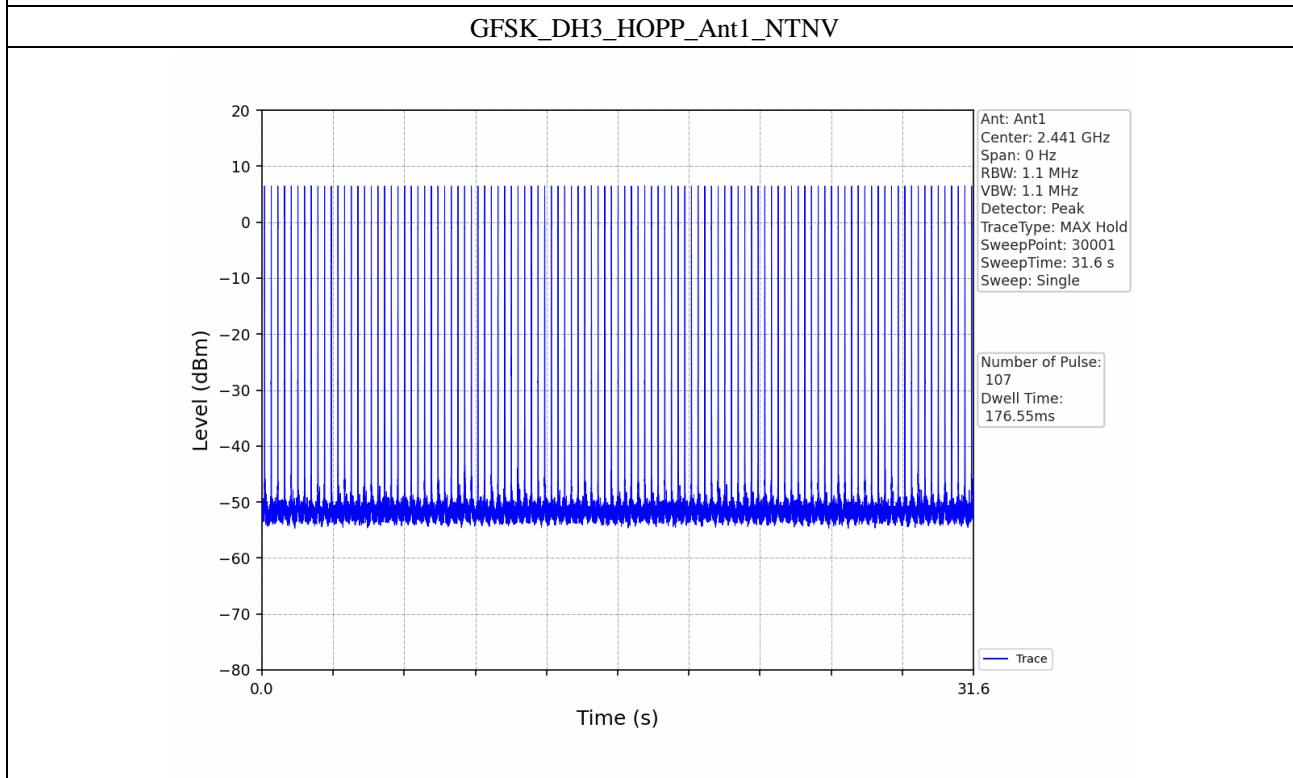
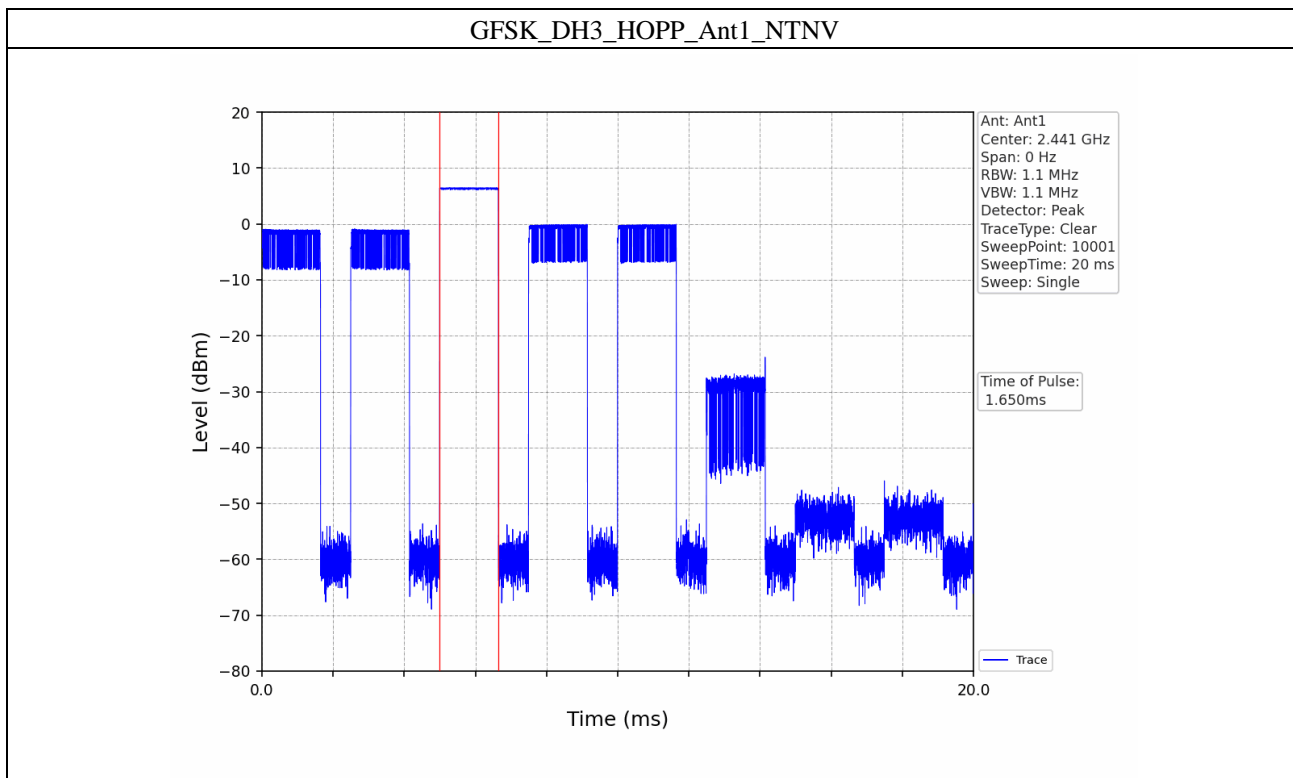
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5.1.2 Test Graph



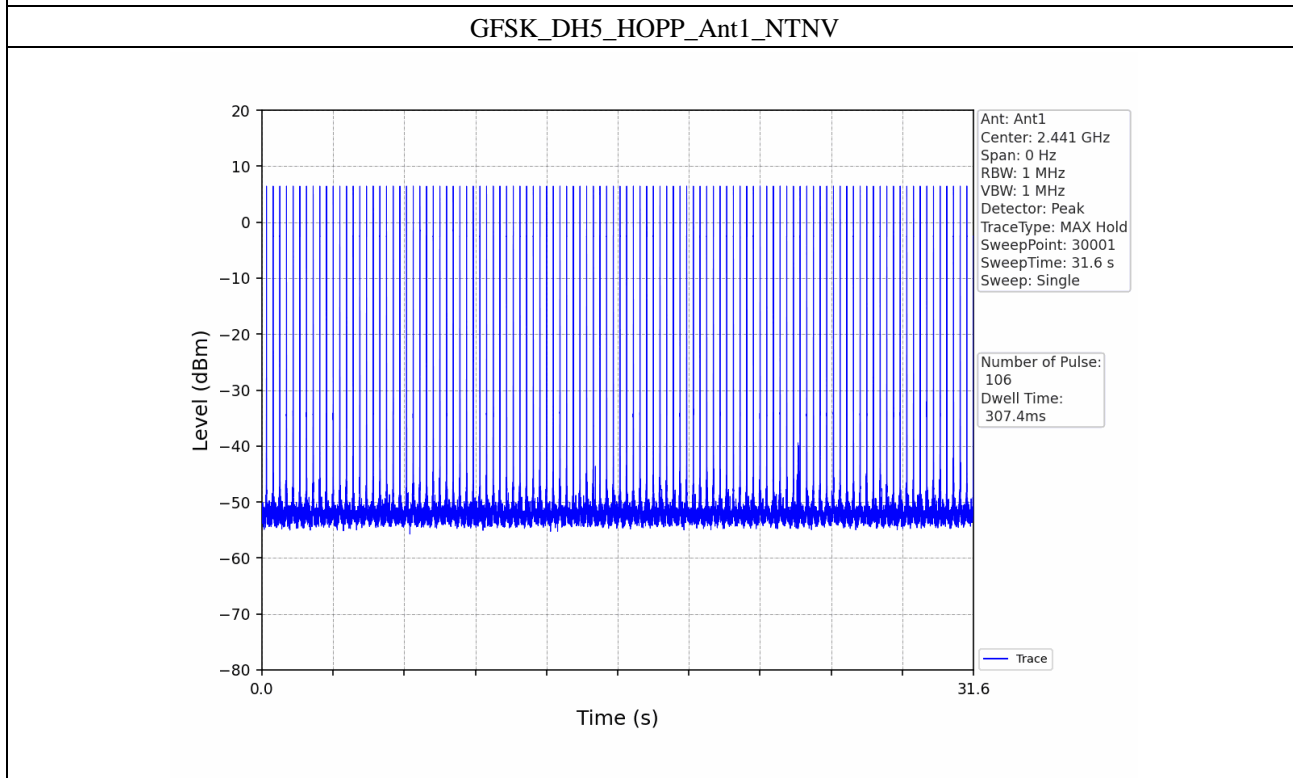
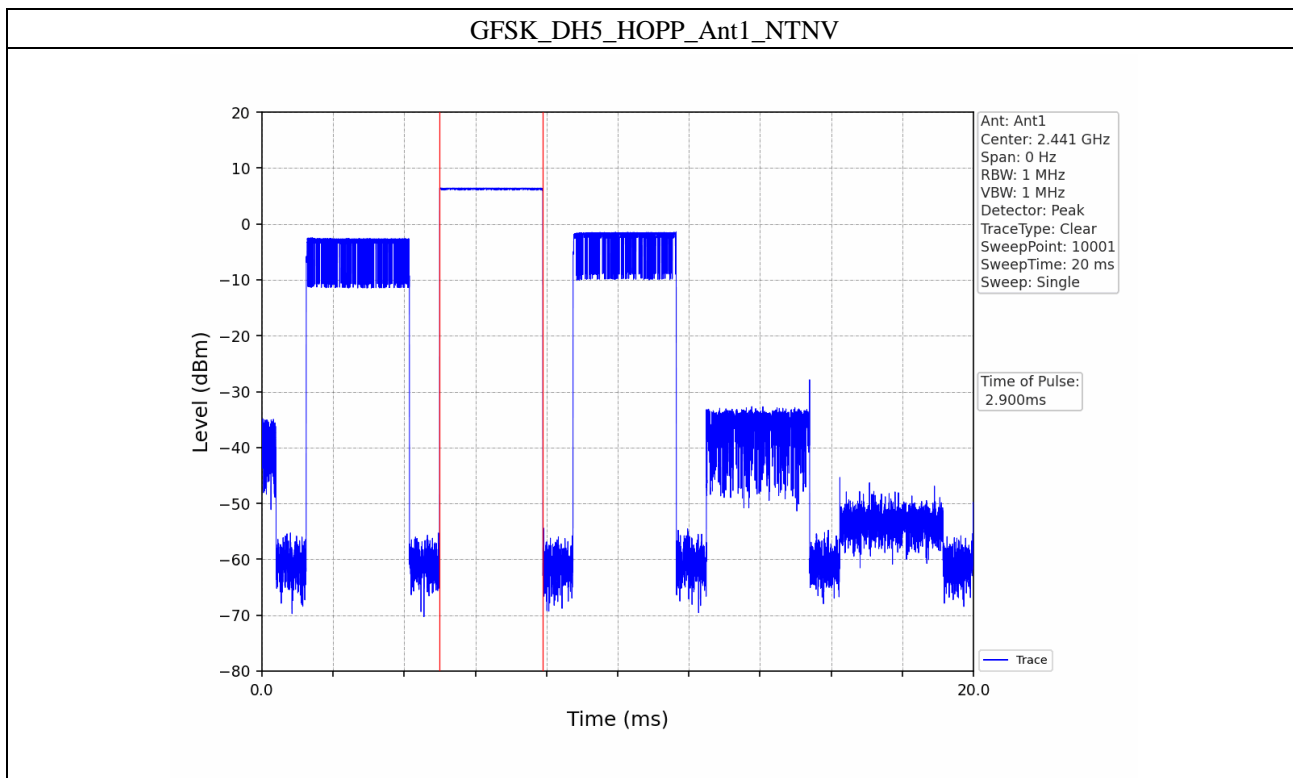
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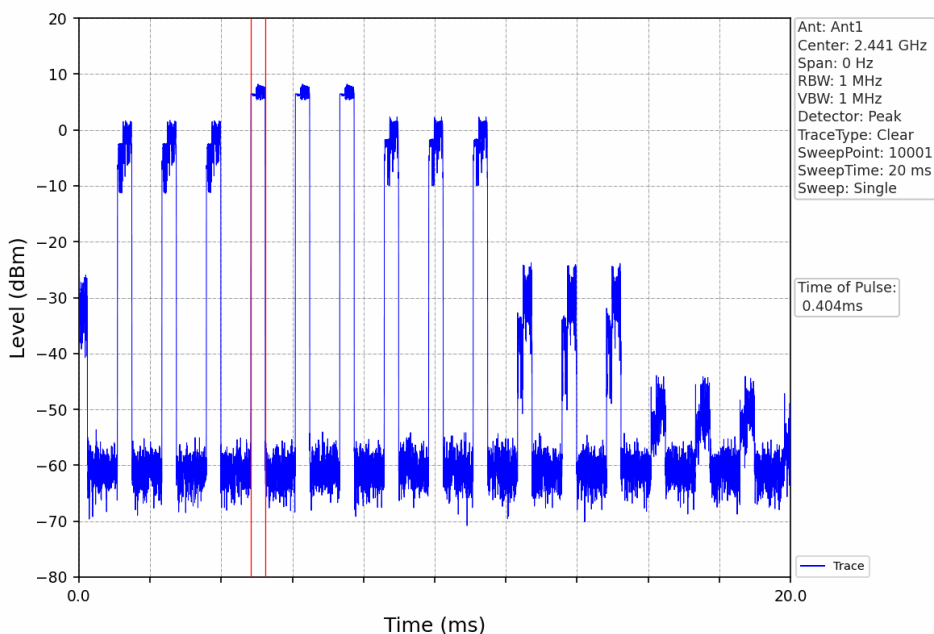
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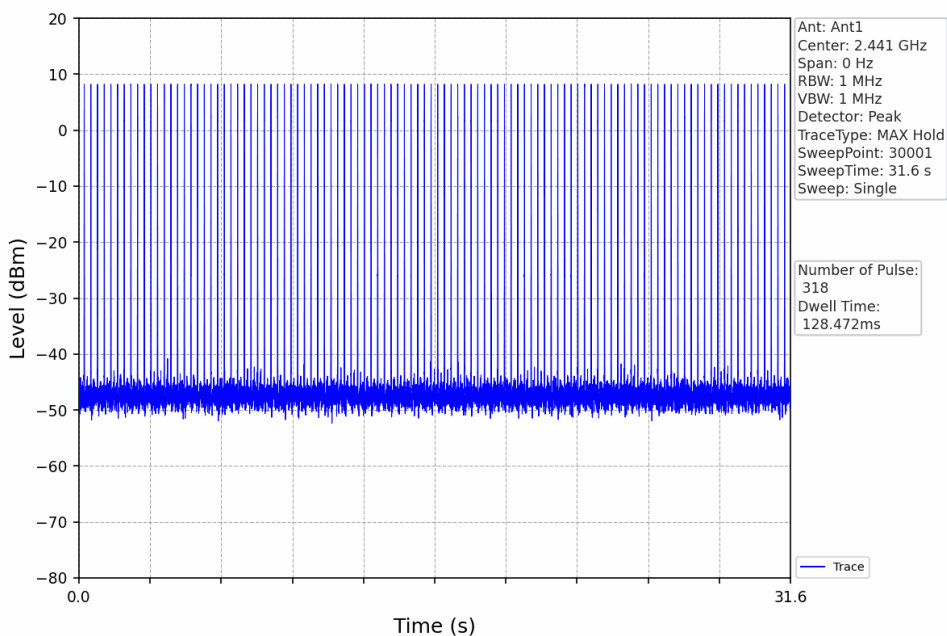
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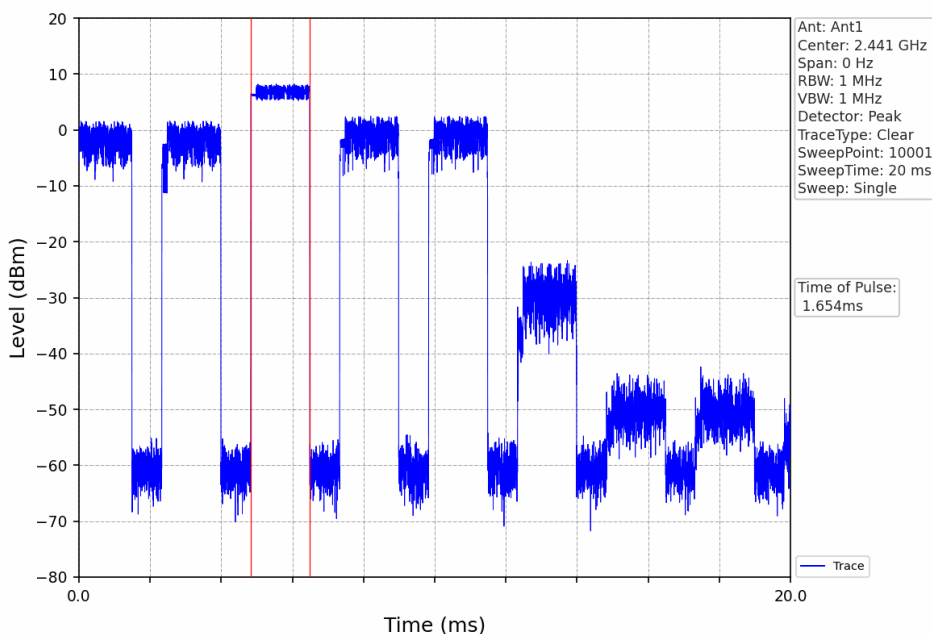
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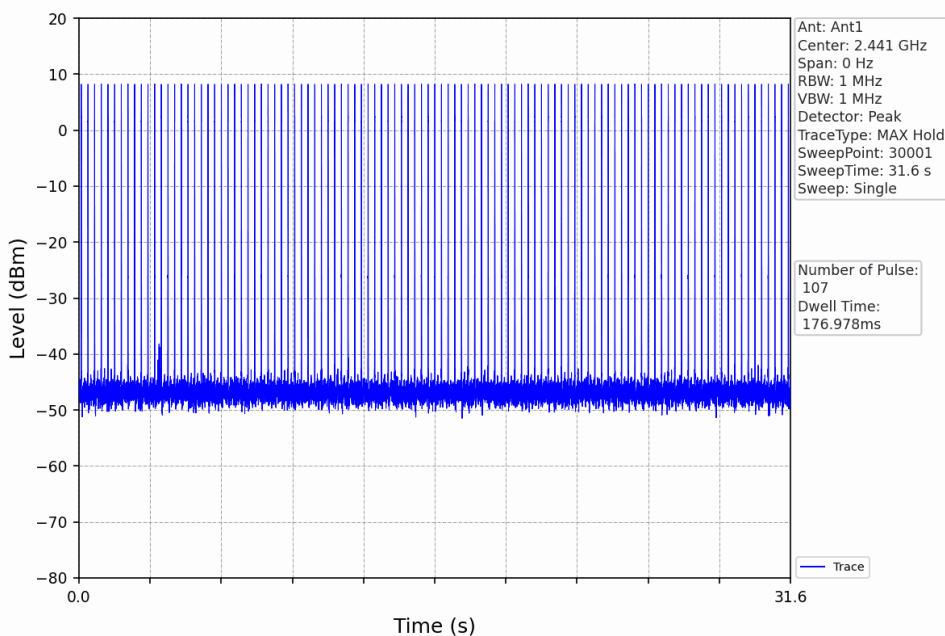
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Pi/4DQPSK_2DH3_HOPP_Ant1_NTNV



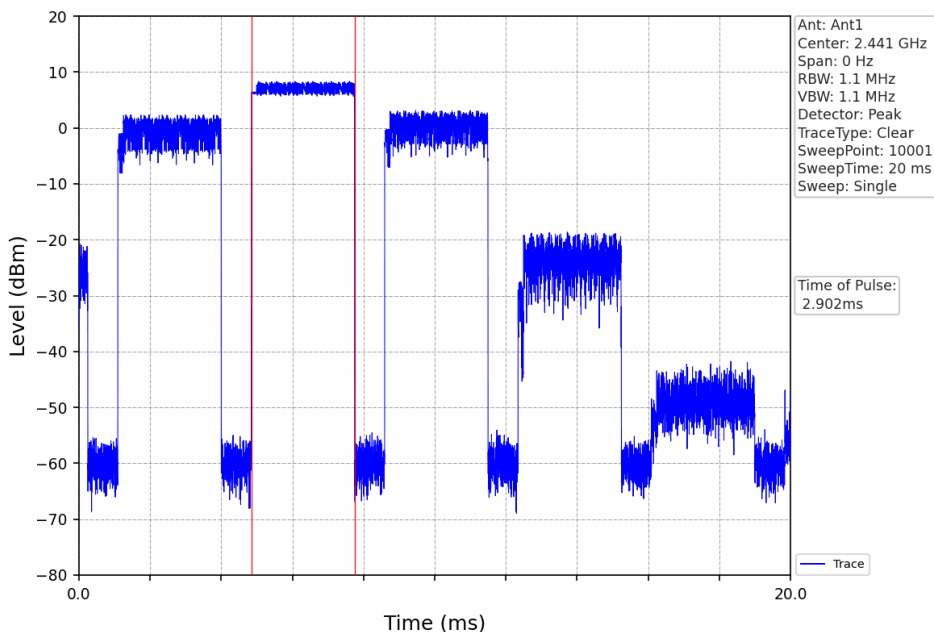
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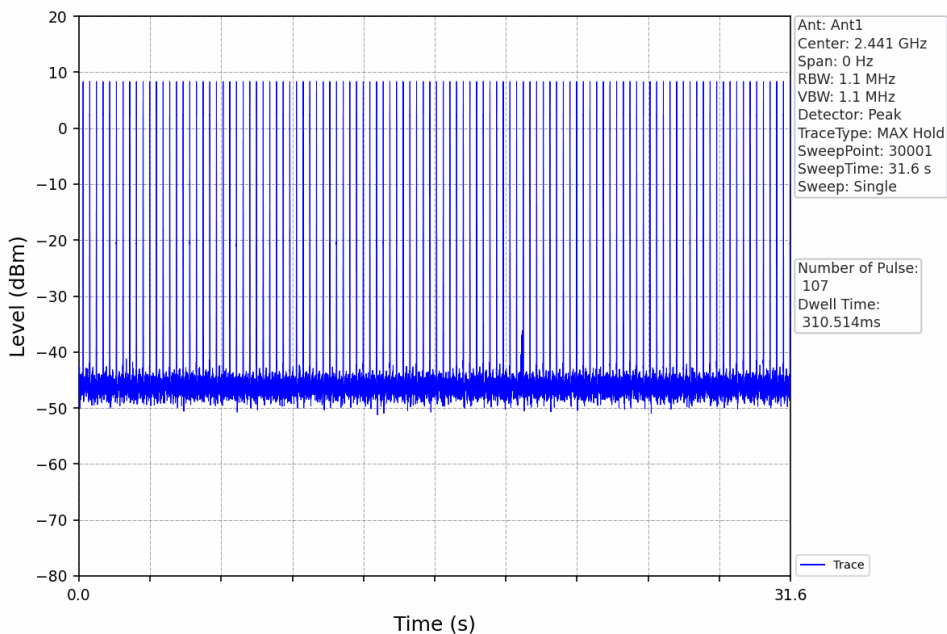
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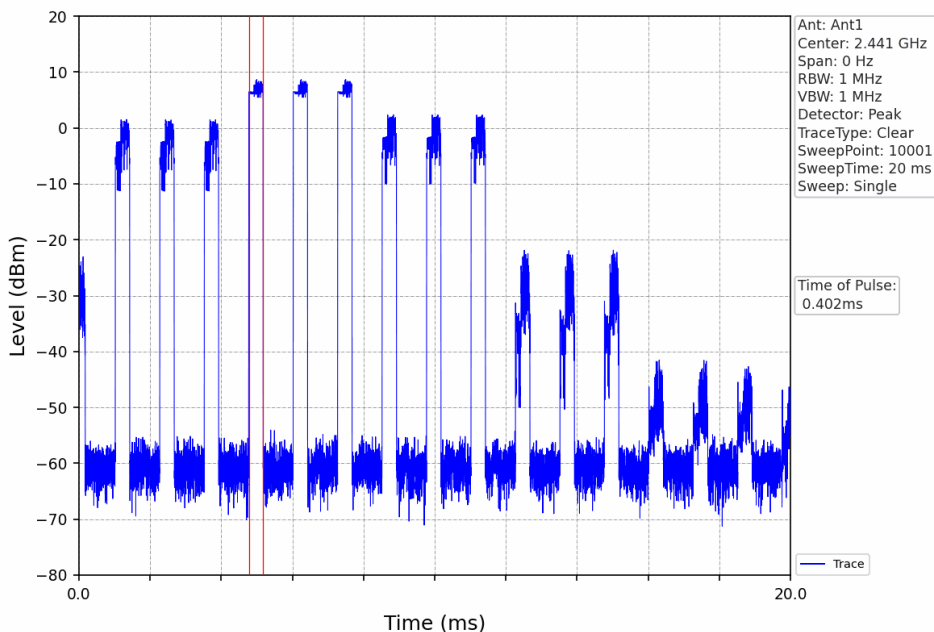
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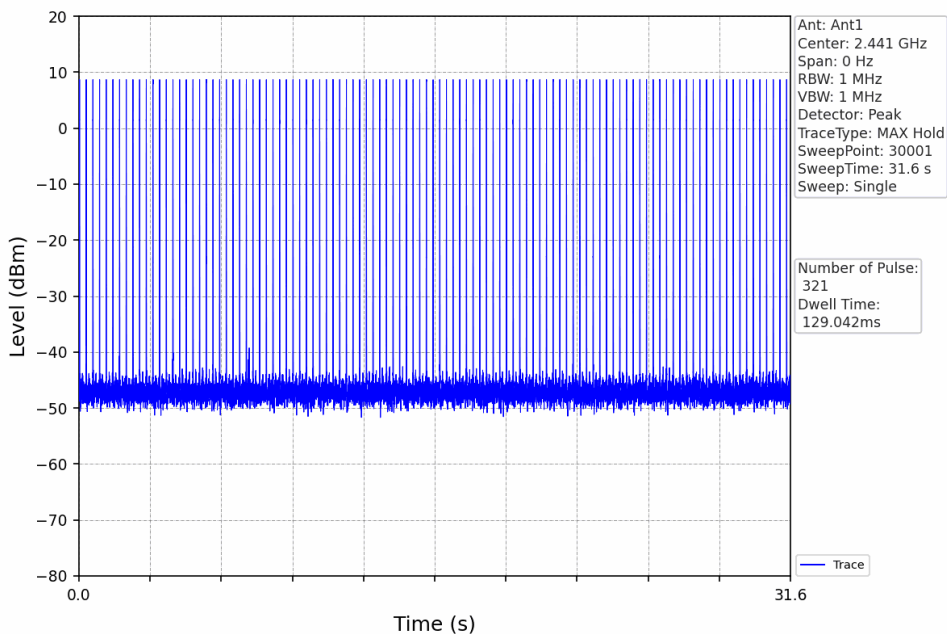
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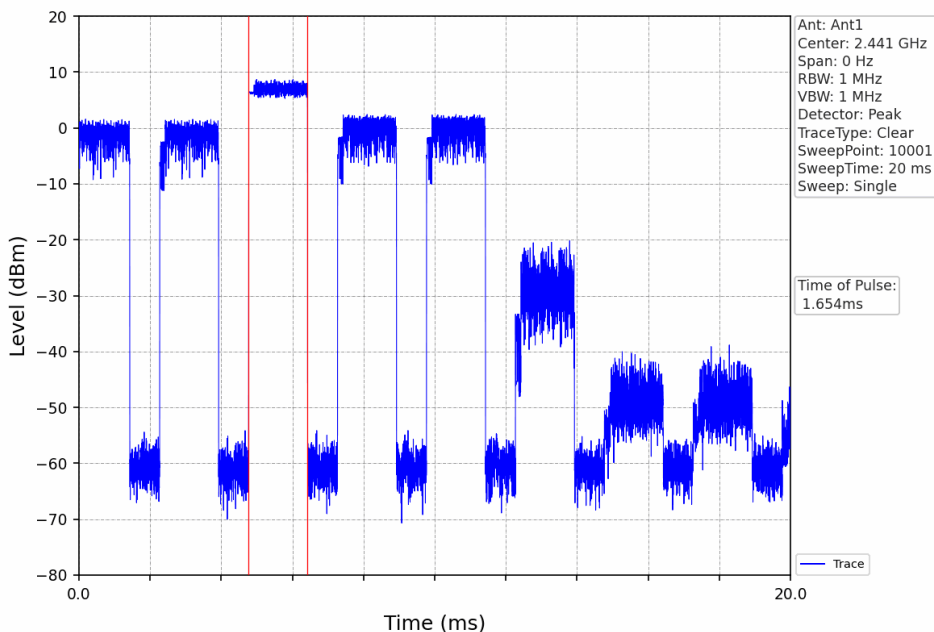
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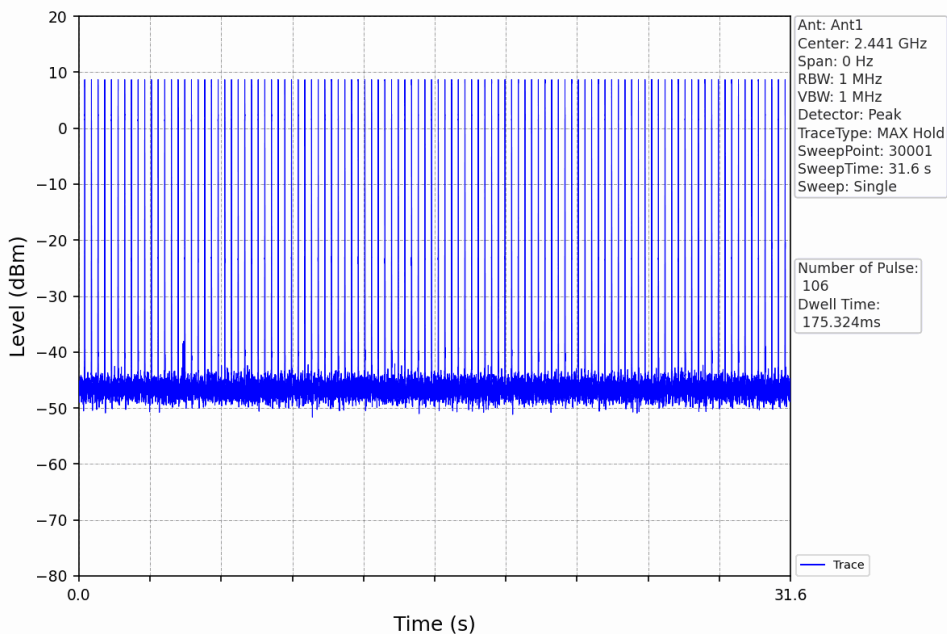
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8DPSK_3DH3_HOPP_Ant1_NTNV



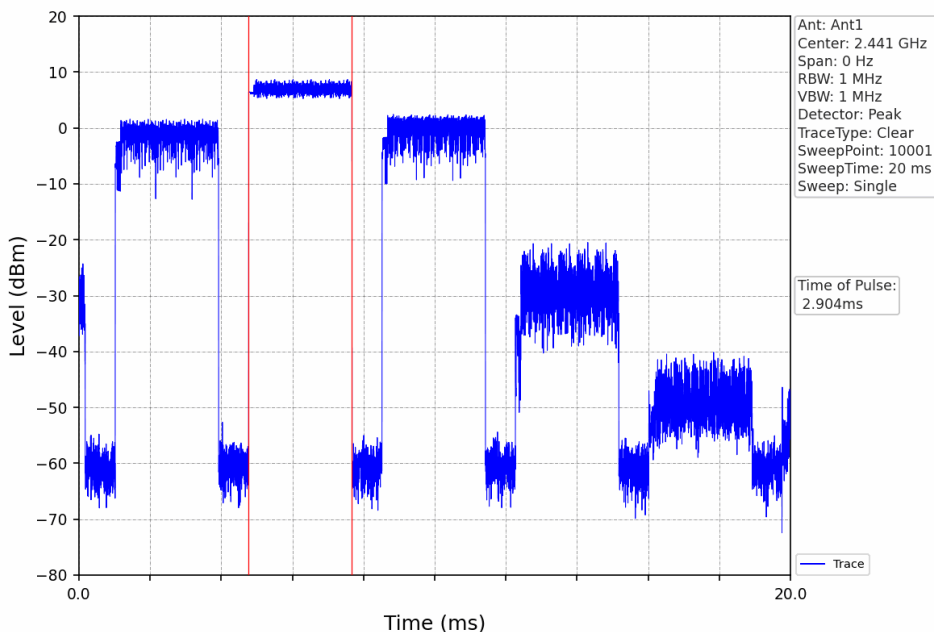
8DPSK_3DH3_HOPP_Ant1_NTNV



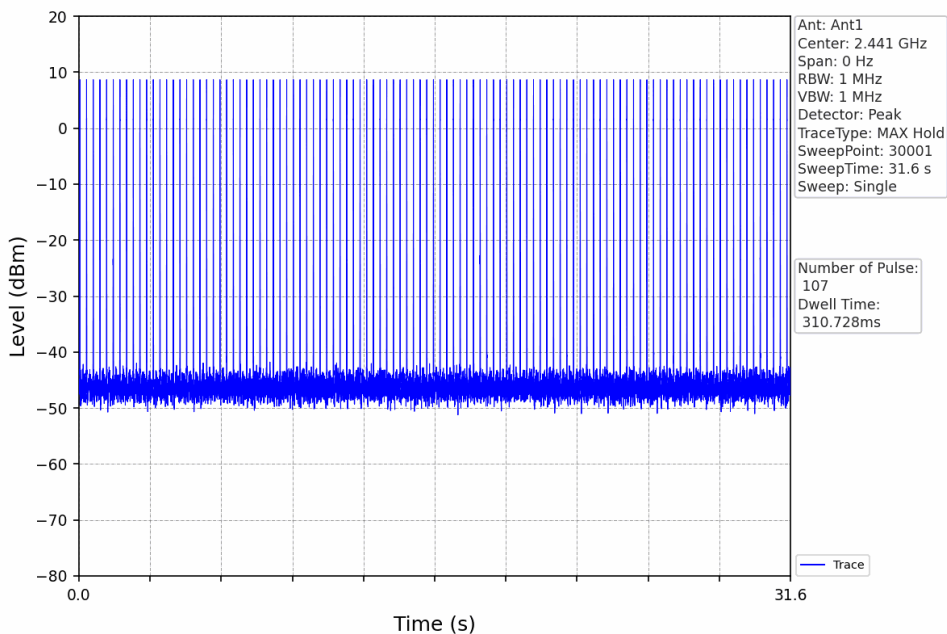
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8DPSK_3DH5_HOPP_Ant1_NTNV



8DPSK_3DH5_HOPP_Ant1_NTNV



6. Unwanted Emissions In Non-restricted Frequency Bands

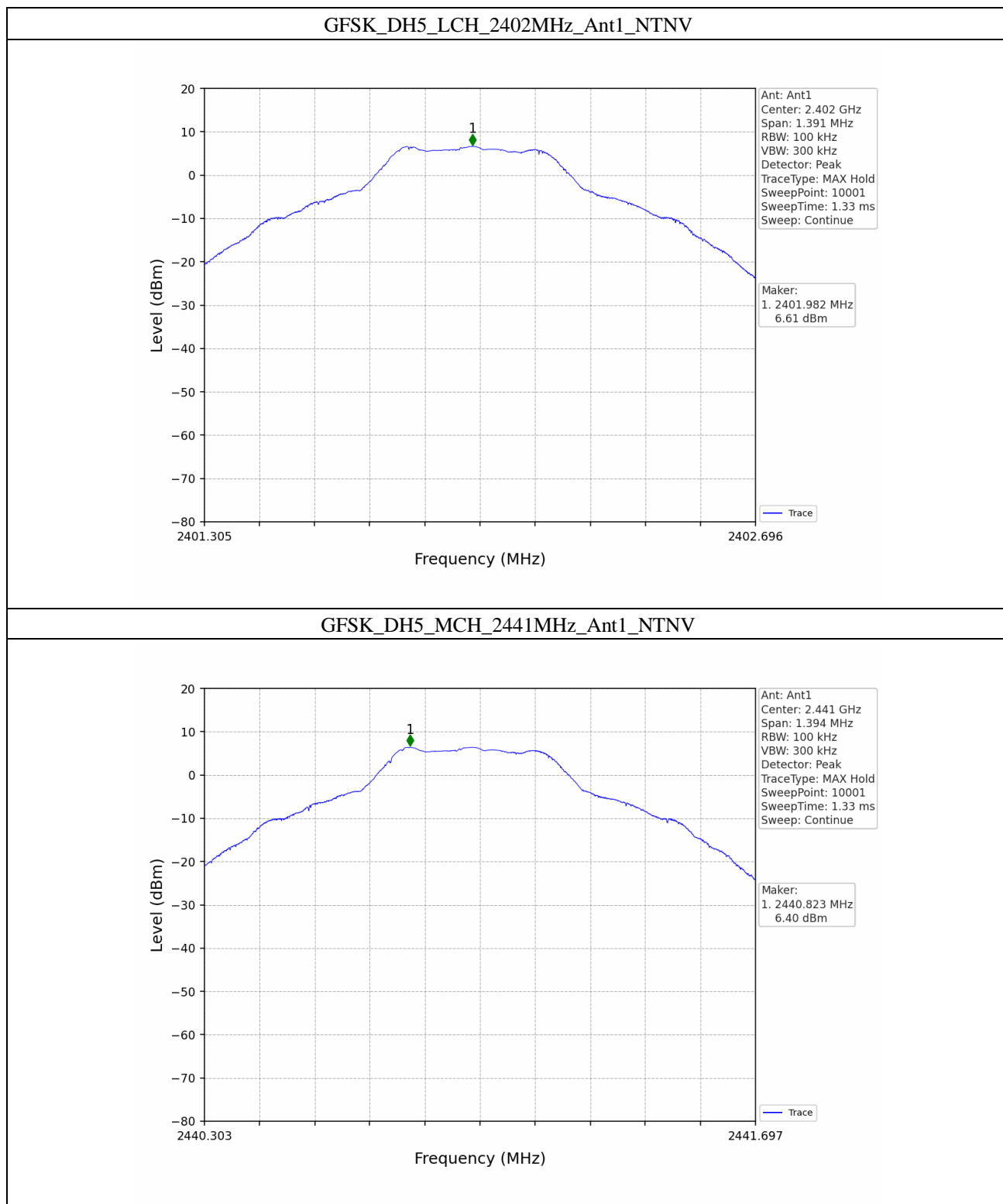
6.1 Ref

6.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Ant	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	6.61
		2441	DH5	1	6.40
		2480	DH5	1	6.42
Pi/4DQPSK	SISO	2402	2DH5	1	6.64
		2441	2DH5	1	6.41
		2480	2DH5	1	6.44
8DPSK	SISO	2402	3DH5	1	6.65
		2441	3DH5	1	6.40
		2480	3DH5	1	6.39

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.

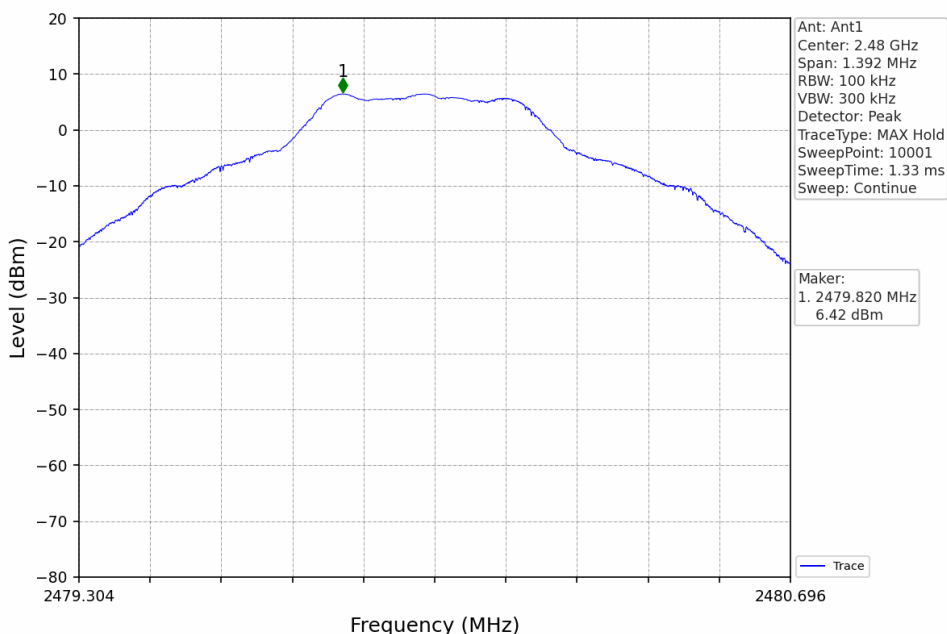
6.1.2 Test Graph



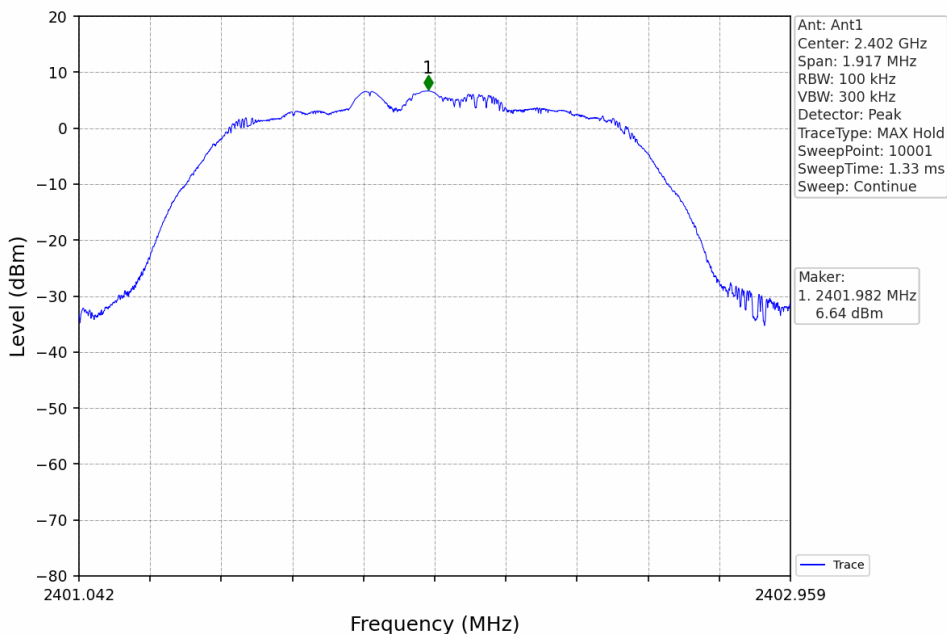
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GFSK_DH5_HCH_2480MHz_Ant1_NTNV



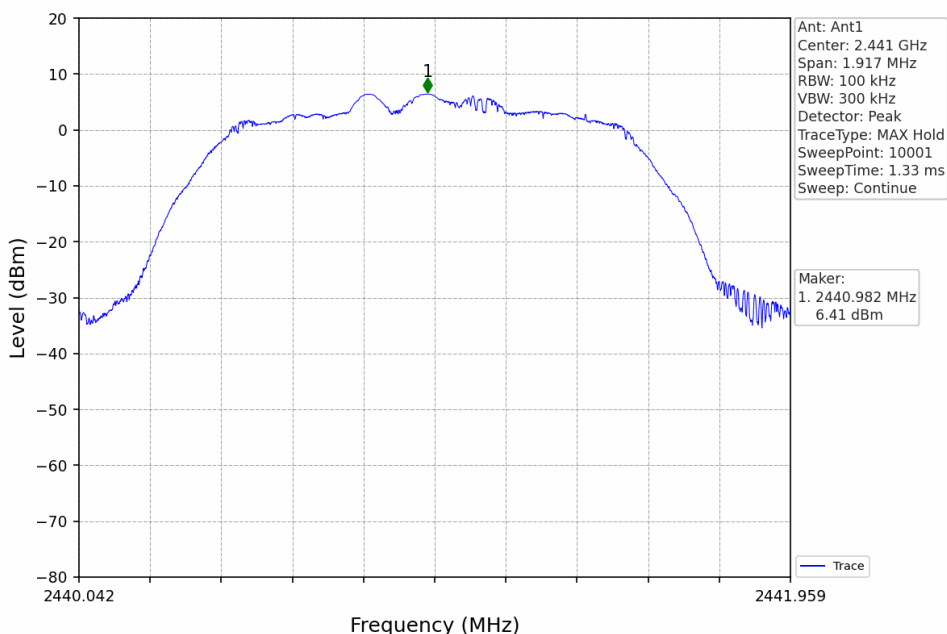
Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



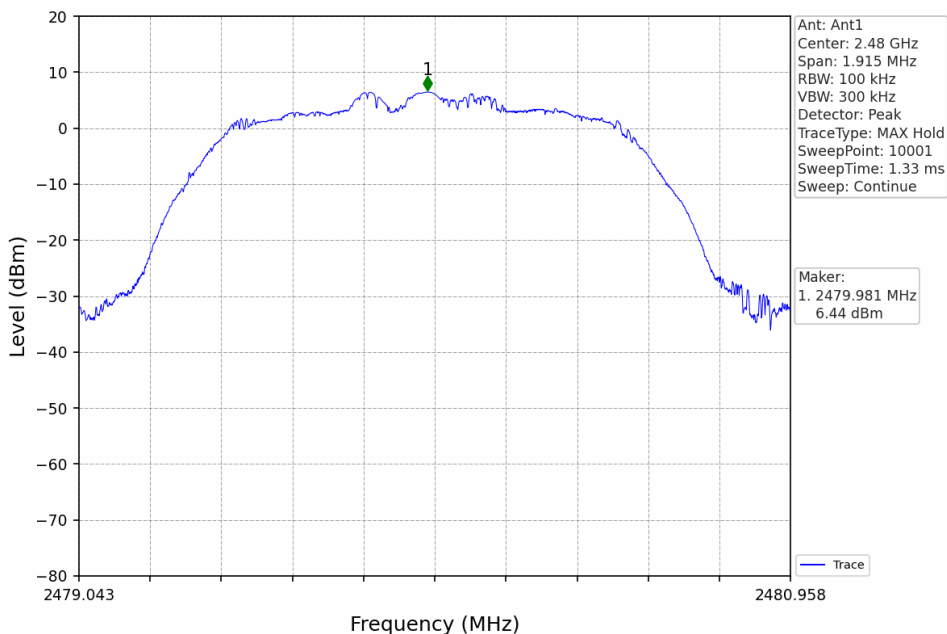
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV

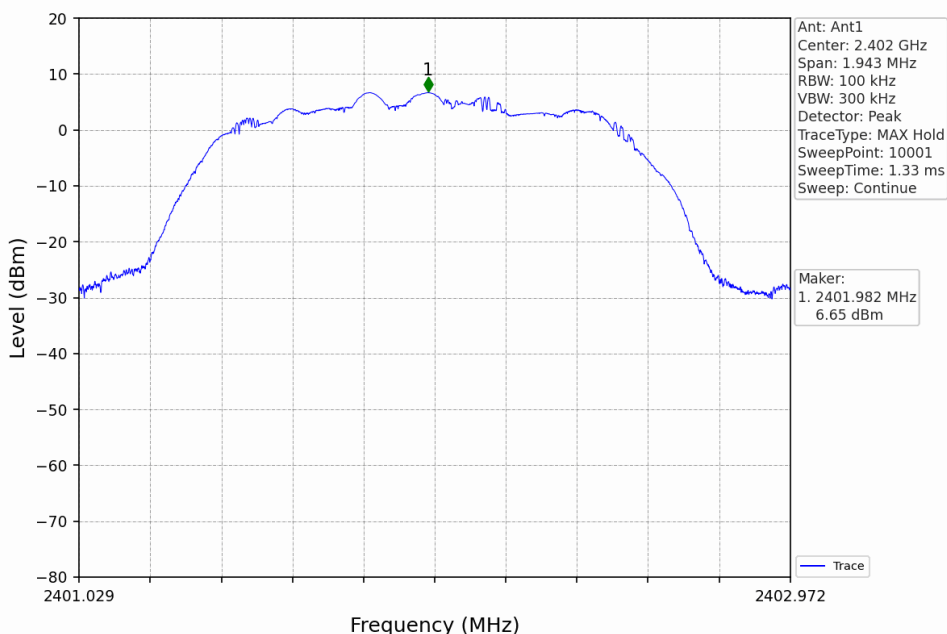


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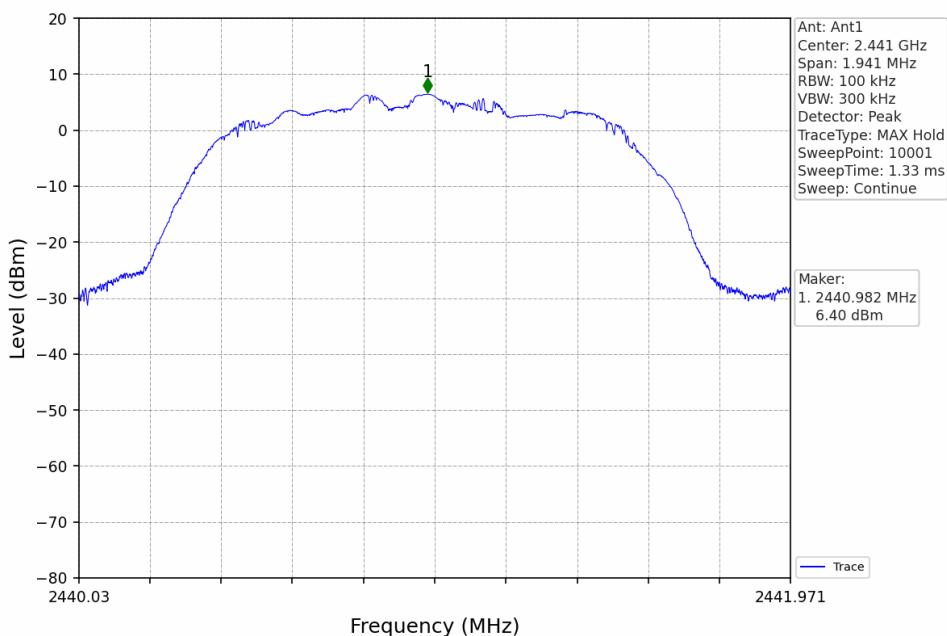
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



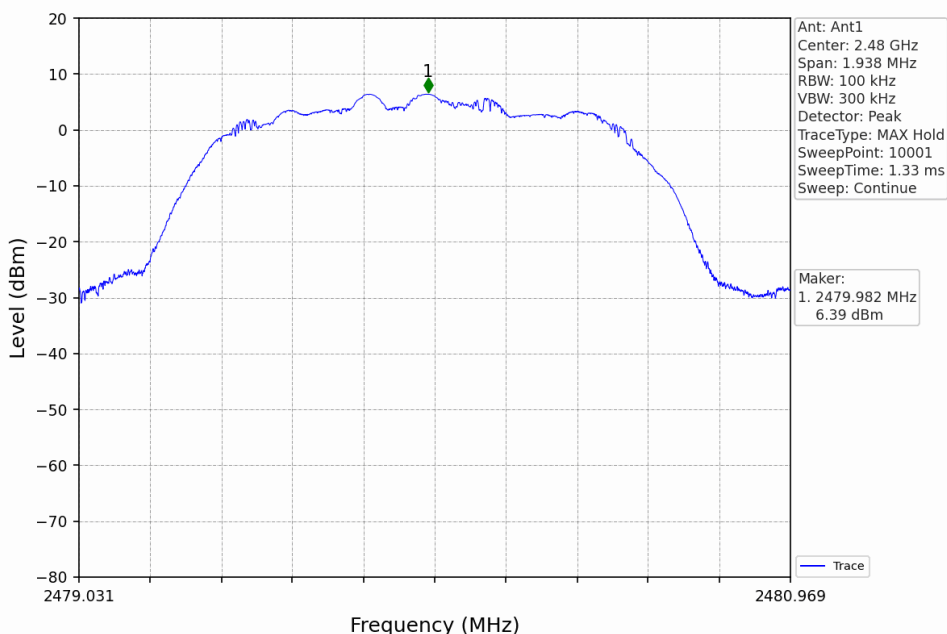
8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



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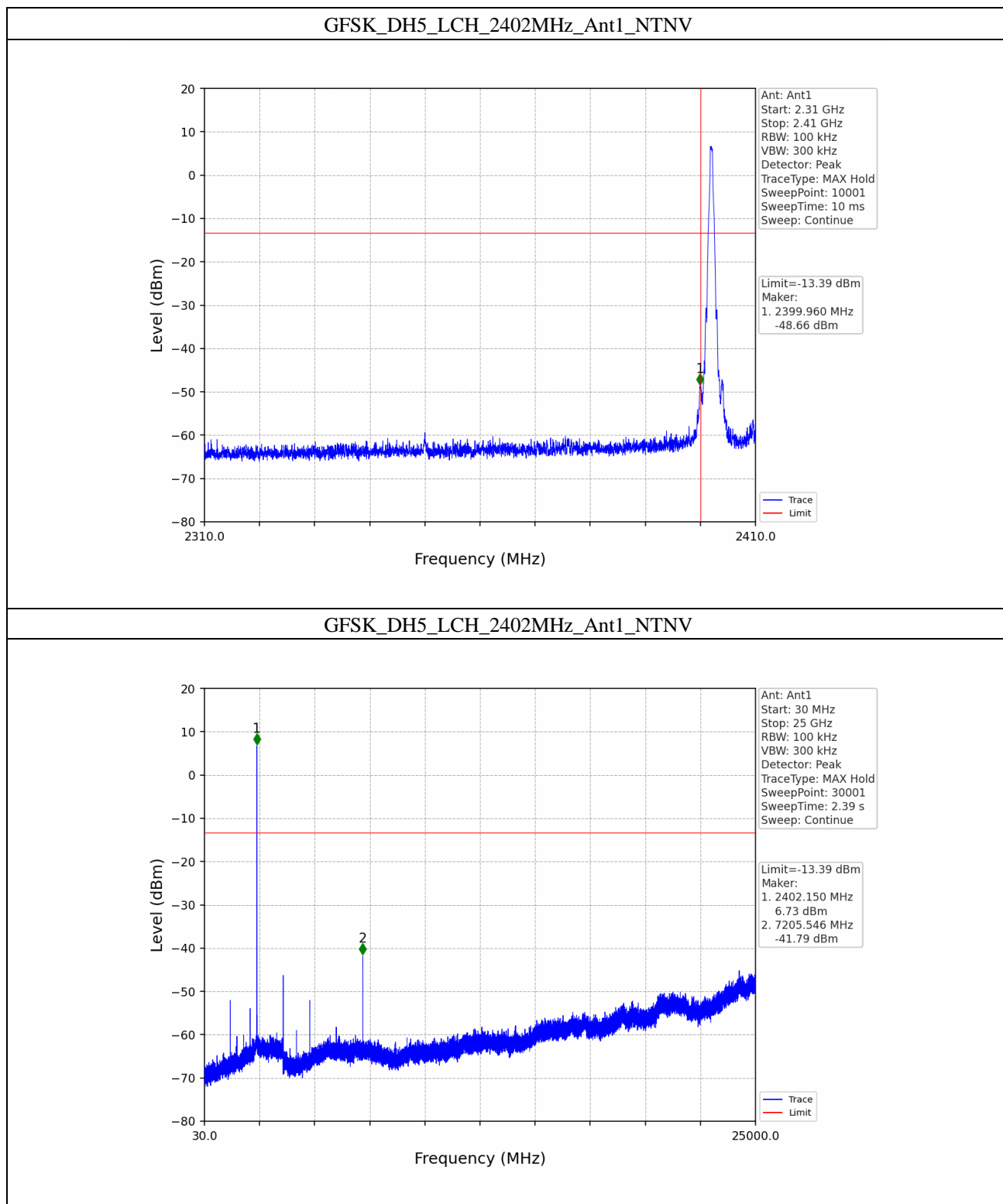
6.2 CSE

6.2.1 Test Result

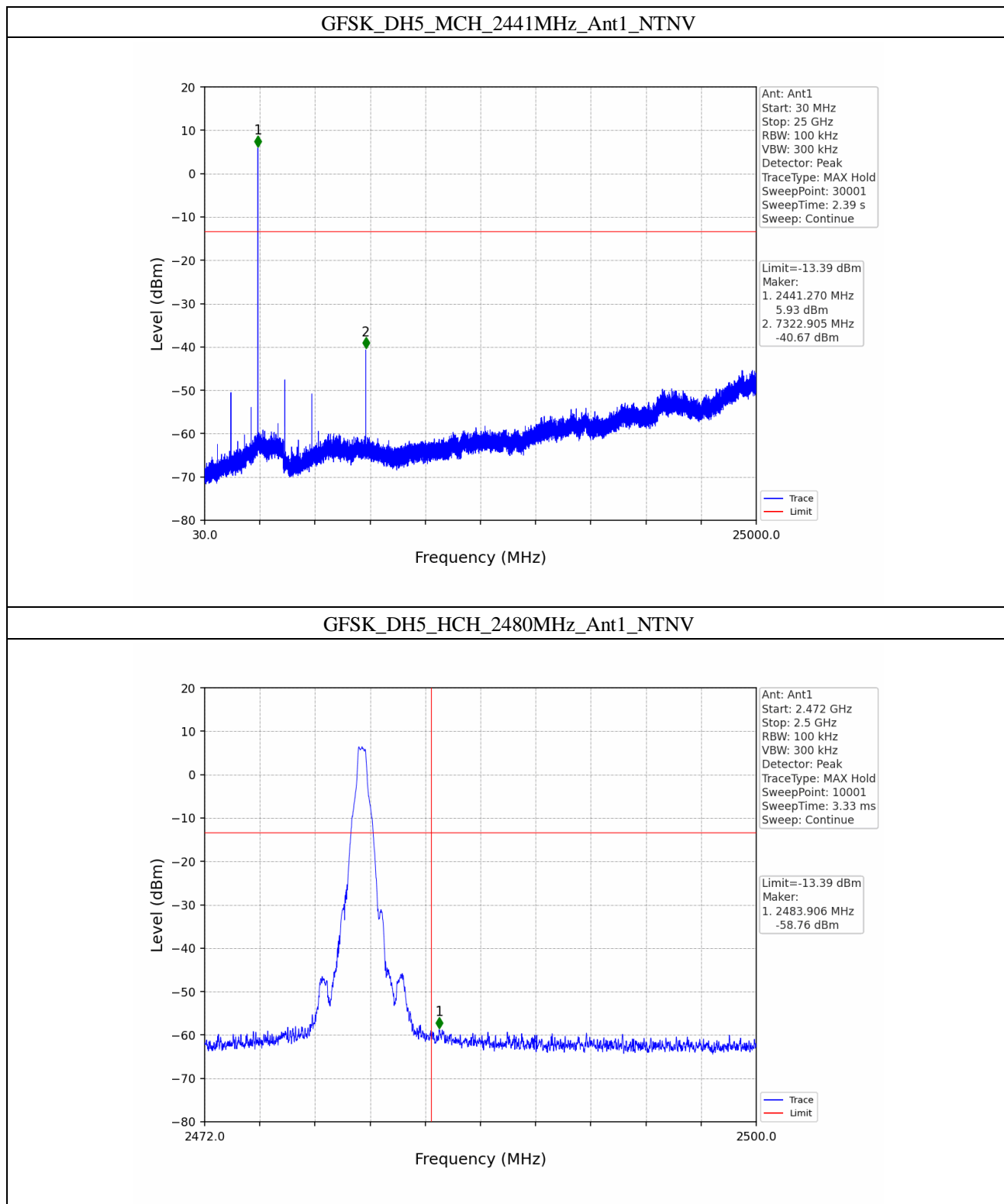
Mode	TX Type	Frequency (MHz)	Packet Type	Ant	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	6.61	-13.39	Pass
		2441	DH5	1	6.61	-13.39	Pass
		2480	DH5	1	6.61	-13.39	Pass
		HOPP	DH5	1	6.61	-13.39	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	6.64	-13.36	Pass
		2441	2DH5	1	6.64	-13.36	Pass
		2480	2DH5	1	6.64	-13.36	Pass
		HOPP	2DH5	1	6.64	-13.36	Pass
8DPSK	SISO	2402	3DH5	1	6.65	-13.35	Pass
		2441	3DH5	1	6.65	-13.35	Pass
		2480	3DH5	1	6.65	-13.35	Pass
		HOPP	3DH5	1	6.65	-13.35	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

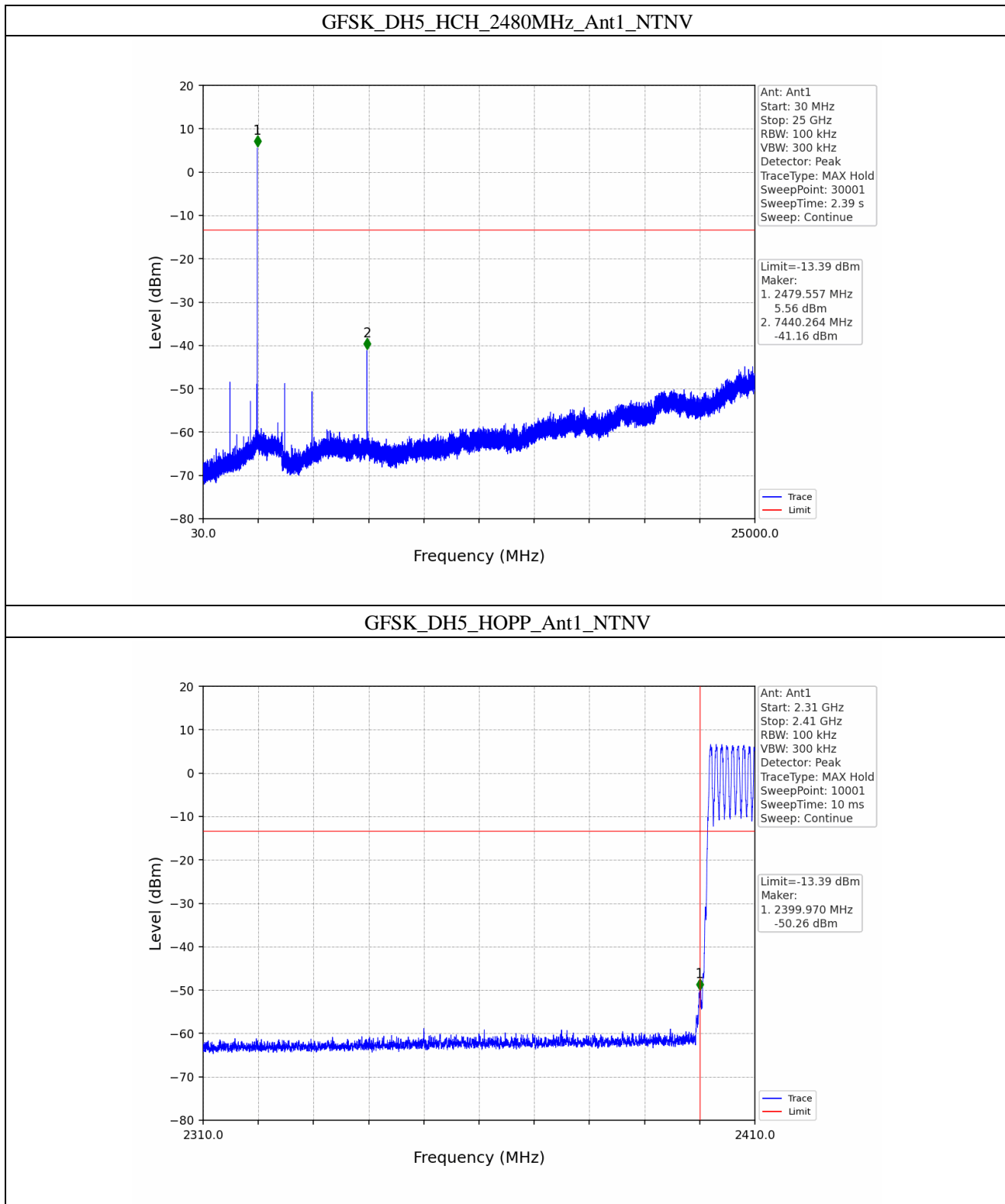


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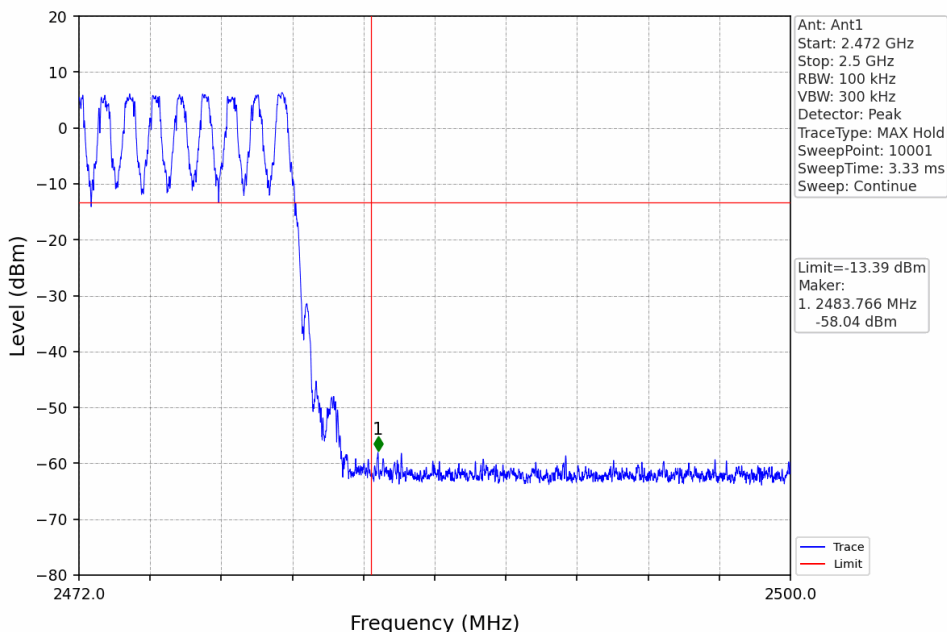
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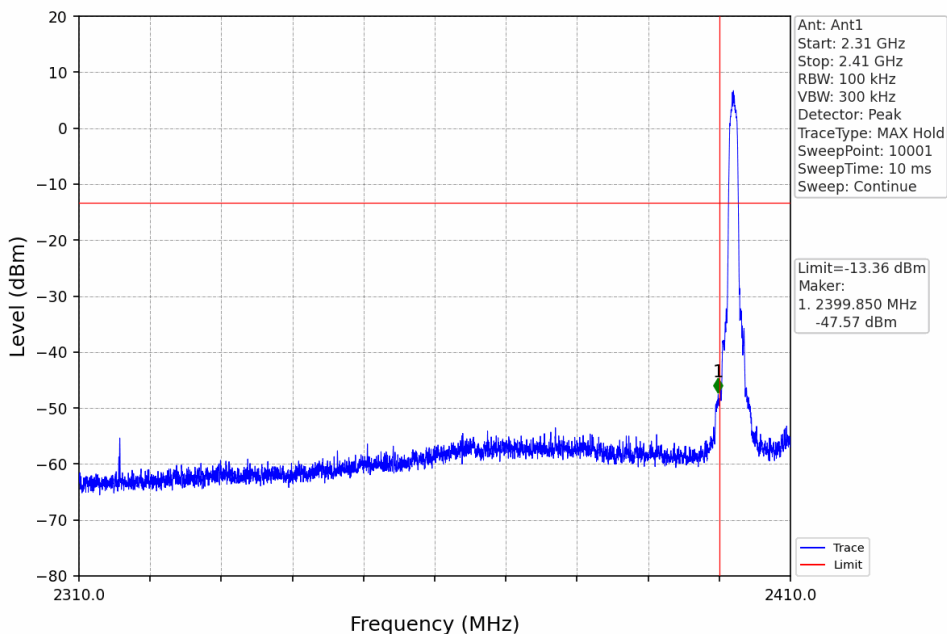
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GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV

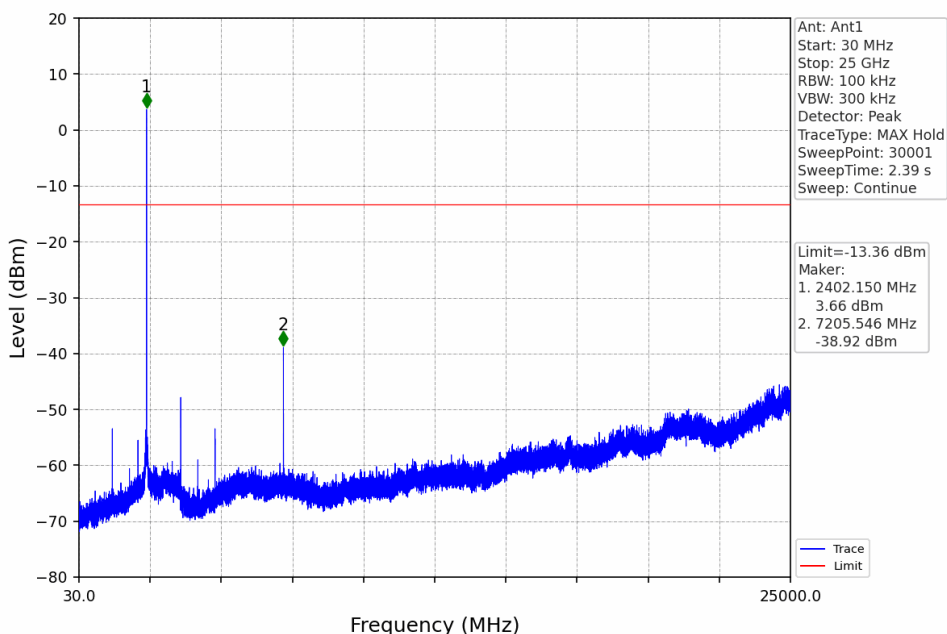


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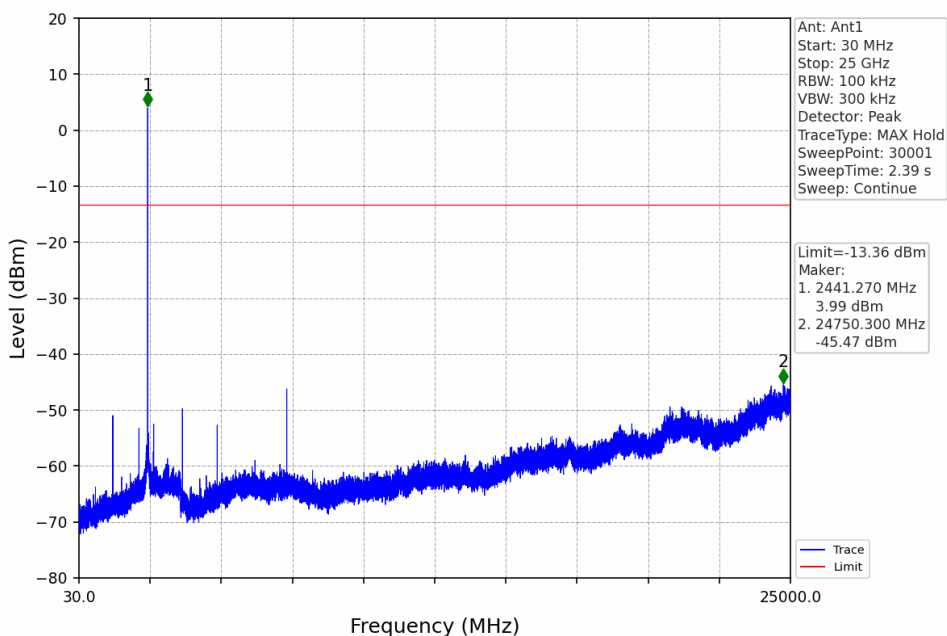
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Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



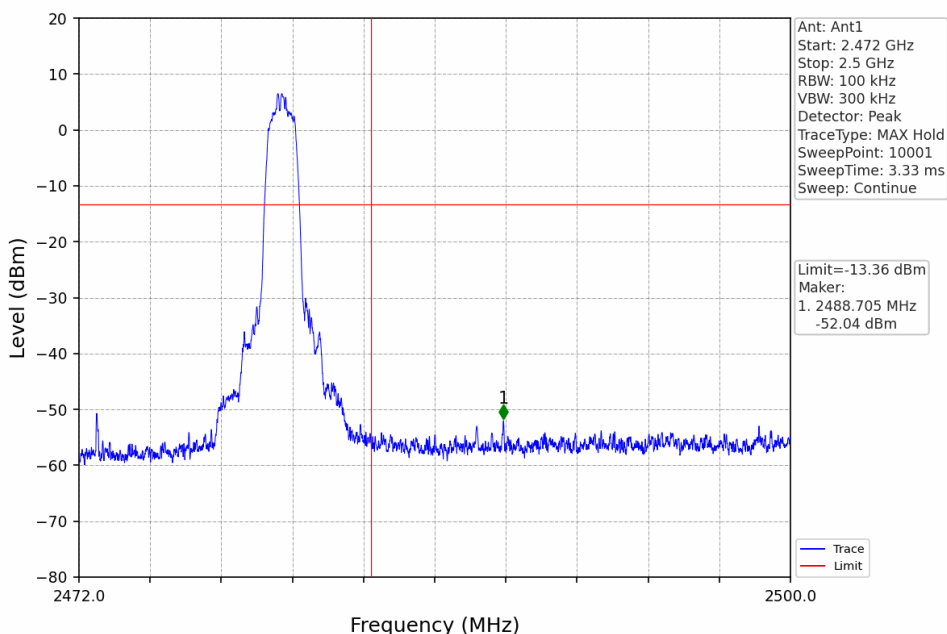
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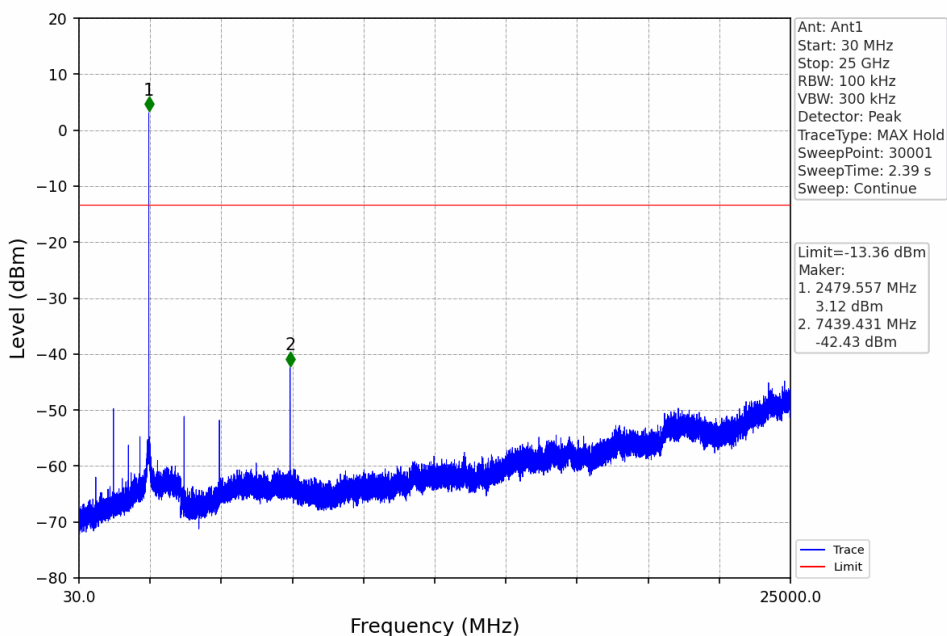
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Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



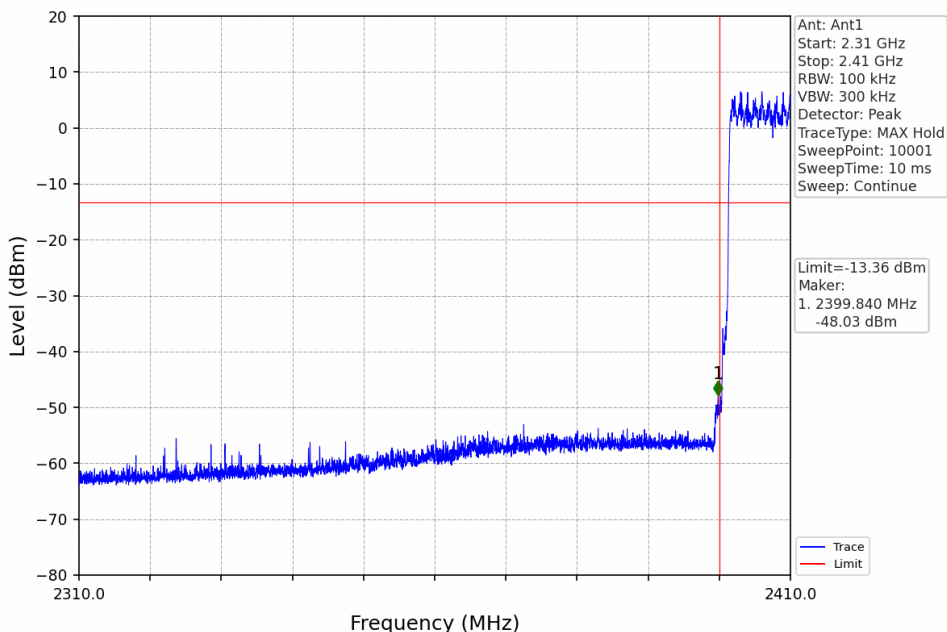
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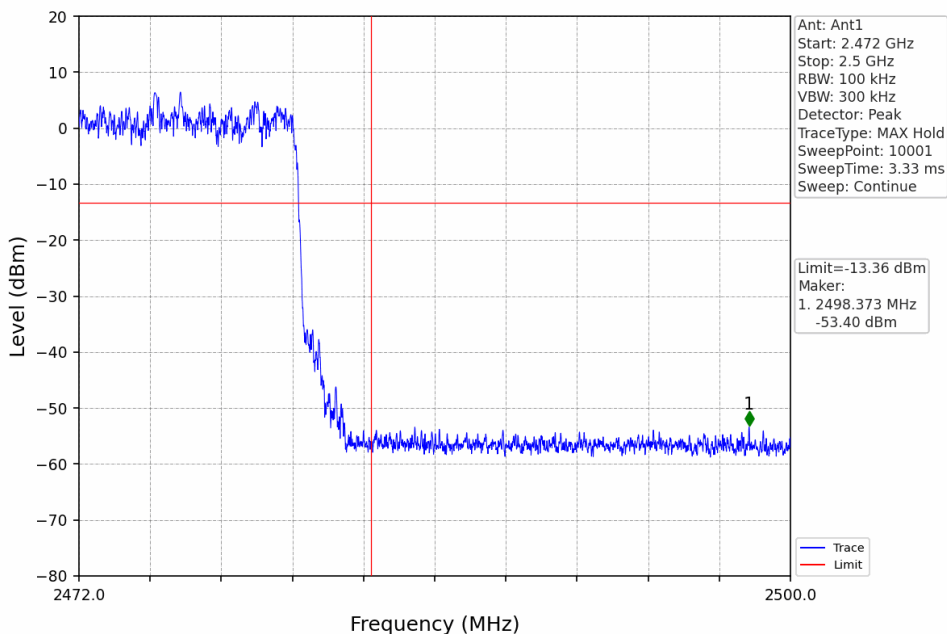
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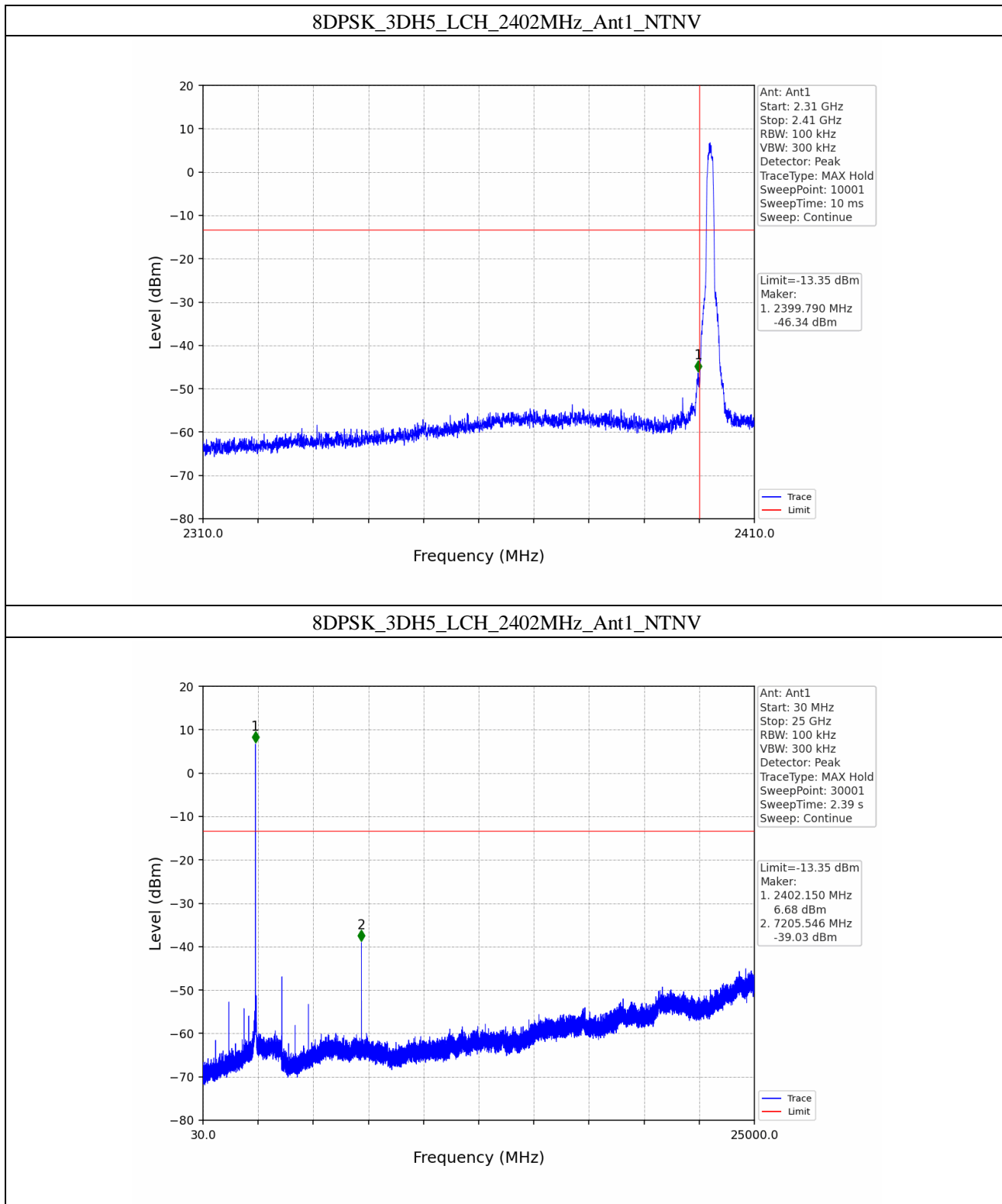
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Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



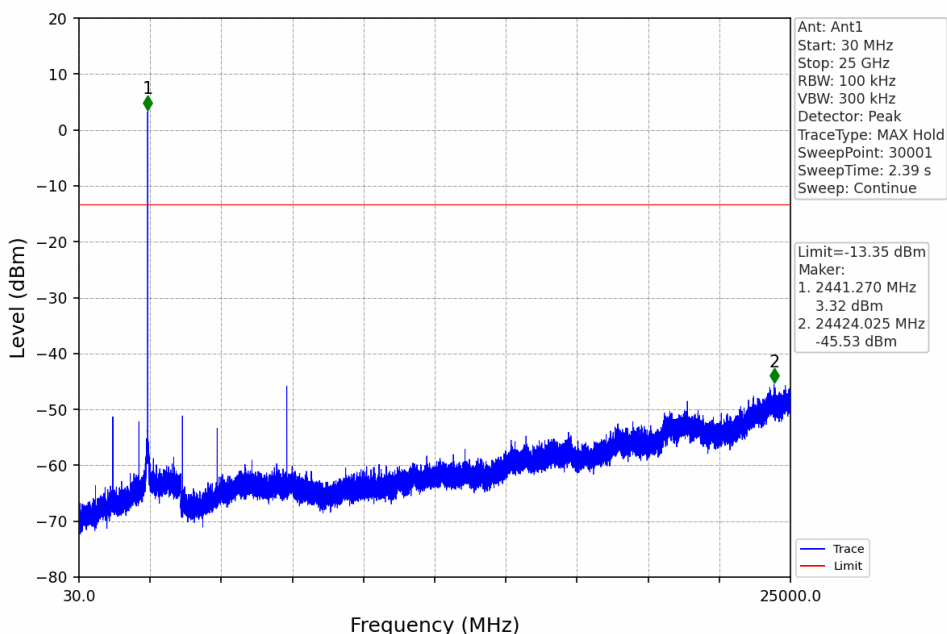
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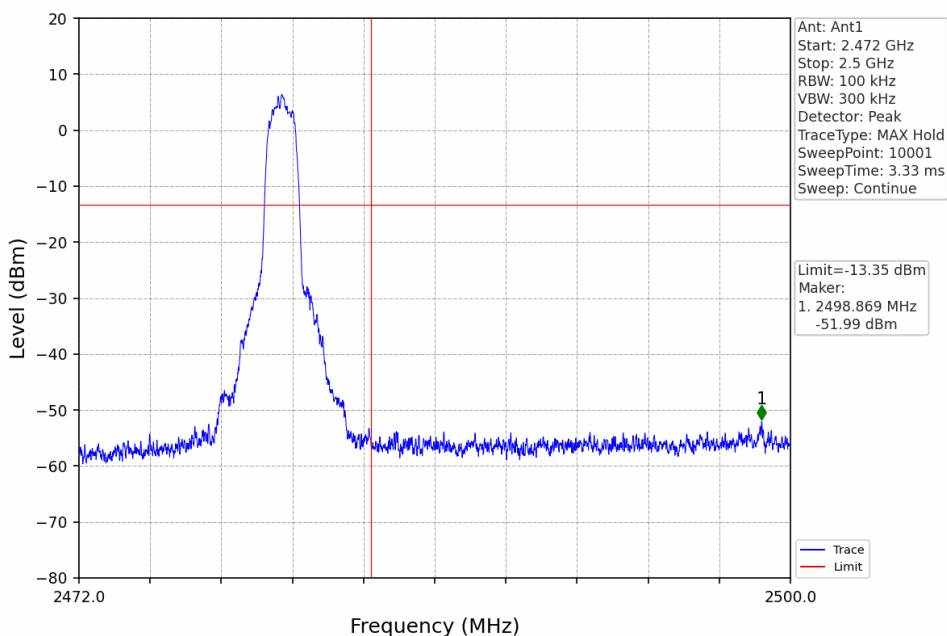
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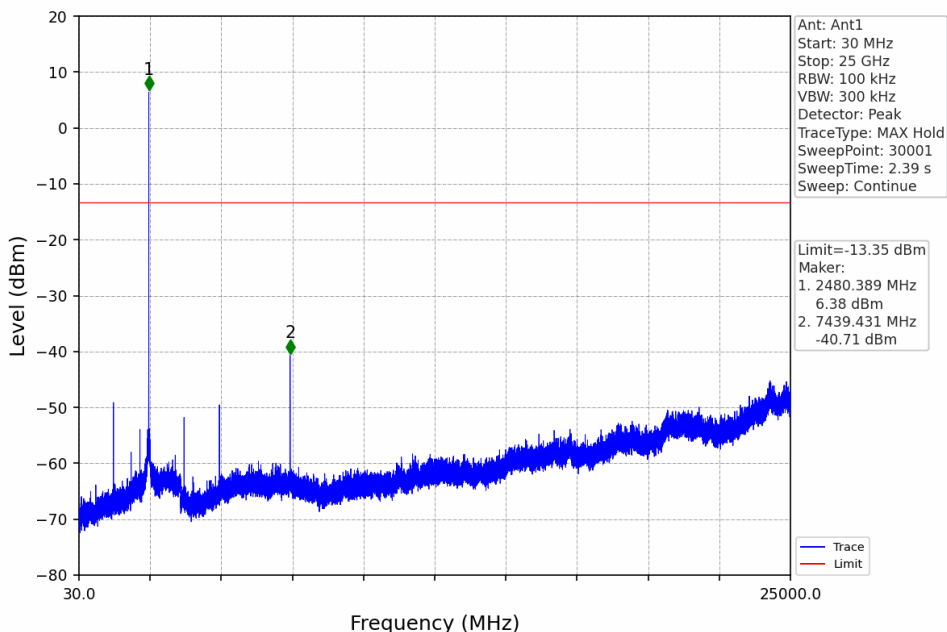
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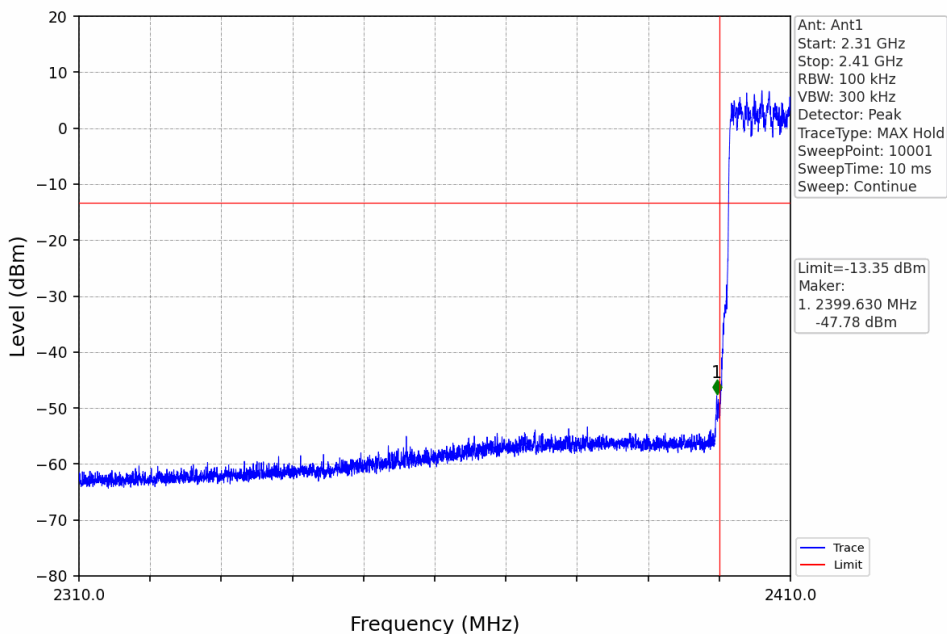
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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



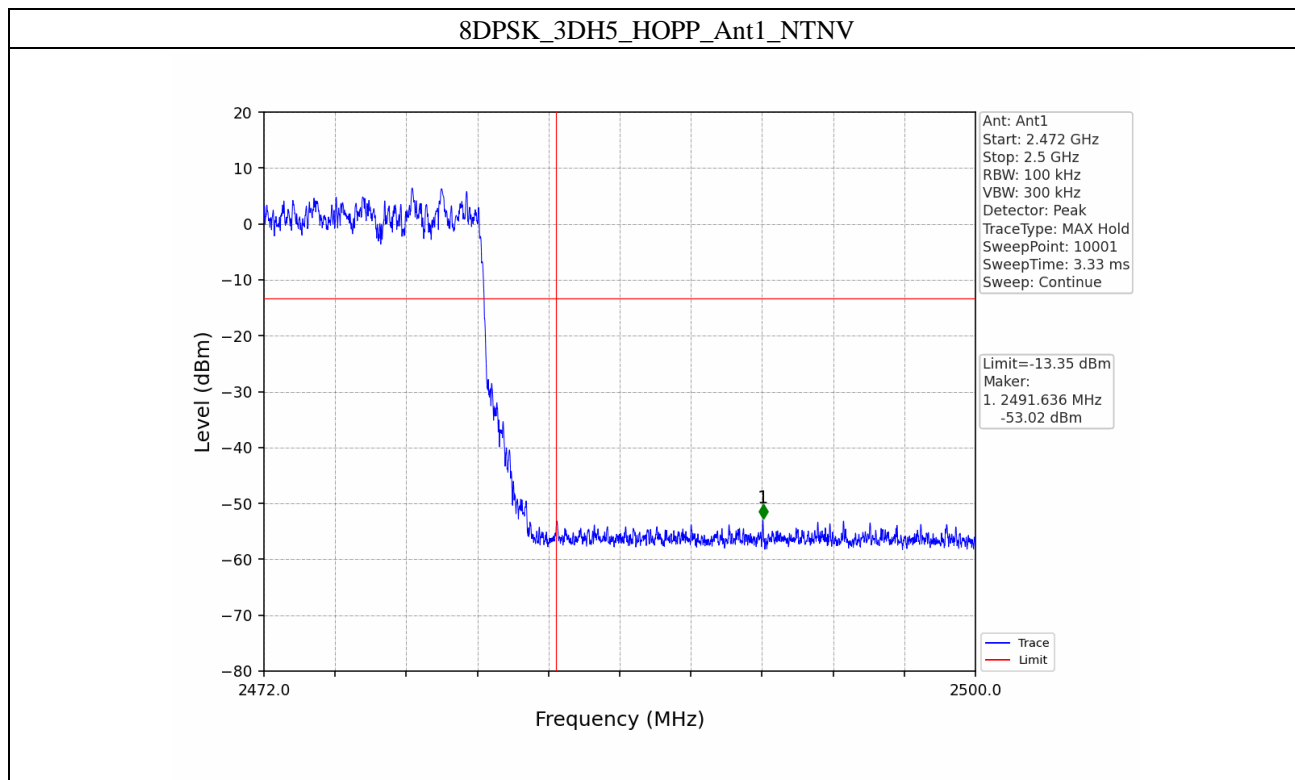
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