

TEST REPORT

Application No.: SHCR2212002841AT
FCC ID: 2A994SPK01
Applicant: HANGZHOU CREATIVE LIVING CO., LTD.
Address of Applicant: 105 Binkang Road, Xixin Town, Binjiang Zone, Hangzhou, China
Manufacturer: Hangzhou VeloFox Intelligent Technology Co., Ltd.
Address of Manufacturer: No. 69 Yunjing Road, Zhuantang Street, Xihu District, Hangzhou, Zhejiang, China
Factory: Yuyao Shenghui Furniture Manufacturing Co., Ltd
Address of Factory: Huajia Village, Huangjiabu Town, Yuyao City, Ningbo, Zhejiang Province, China
Equipment Under Test (EUT):
EUT Name: Bluetooth Speaker
Model No.: SPK 01
Trade Mark: Wosaic
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2022-12-29
Date of Test: 2023-01-08 to 2023-03-06
Date of Issue: 2023-03-09

Test Result:**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Parlan Zhan

Parlan Zhan
Laboratory ManagerSGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
EEC EMC Lab

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Authorized for issue by:			
		Bill Wu	
		Bill Wu/Project Engineer	
		Parlam Zhan	
		Parlam Zhan/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 Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
20dB Bandwidth		ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Carrier Frequencies Separation		ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
Hopping Channel Number		ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Dwell Time		ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Below 1GHz		ANSI C63.10 (2013) Section 6.4,6.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Above 1GHz		ANSI C63.10 (2013) Section 6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 12V
Test voltage:	DC 12V
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	Bluetooth 5.0+EDR
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Gain:	-0.58dBi (Provided by manufacturer)
Antenna Type:	PCB Antenna

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	LENOVO	L460	-
Serial port adapter plate	-	Test Plate 3	-

4.3 Measurement Uncertainty & Decision Rule

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4×10^{-8}
2	Timeout	2s
3	Duty cycle	0.4%
4	Occupied Bandwidth	3%
5	RF conducted power	0.6dB
6	RF power density	2.9dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious emission test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-6GHz)
		5.4dB (6GHz-18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%



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



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4.4 Test Location

All tests were performed at:

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No tests were sub-contracted.

Note:

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

4.5 Test Facility

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

• **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

• **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.
Company Number: 8617A

• **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2022-12-20	2023-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2022-08-02	2023-08-01
Signal Generator	R&S	SMR20	SHEM006-1	2022-08-02	2023-08-01
Signal Generator	Agilent	N5182A	SHEM182-1	2022-08-02	2023-08-01
Communication Tester	R&S	CMW270	SHEM183-1	2022-07-25	2023-07-24
Communication Tester	R&S	CMW500	SHEM268-1	2022-07-25	2023-07-24
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2022-08-02	2023-08-01
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2022-11-08	2024-11-07
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2022-12-20	2023-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2022-12-20	2023-12-19
Conducted test Cable	/	RF01~RF04	/	2022-12-20	2023-12-19
Switcher	Tonscend	JS0806	SHEM184-1	2022-08-02	2023-08-01
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
Coaxial Cable	TST		SHEM263-1	2022-08-02	2023-08-01
Test software	TST	TST PASS	Version: 2.0	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2022-12-20	2023-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Communication Tester	R&S	CMW500	SHEM268-1	2022-07-25	2023-07-24
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2022-12-20	2023-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2021-09-11	2023-09-10
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2021-05-07	2023-05-06
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2022/8/11	2024-08-10
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2021-09-18	2023-09-17
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2021-09-18	2023-09-17
Pre-Amplifier	HP	8447D	SHEM236-1	2022-08-02	2023-08-01
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2022-12-20	2023-12-19
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2020-05-25	2023-05-24
RE test Cable	/	RE01, RE02, RE06	/	2023-01-07	2024-01-06
Test software	ESE	E3	Version: 6.111221a	/	/



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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 PCB antenna and no consideration of replacement. The best case gain of the antenna is -0.58 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: $2^9 - 1 = 511$ bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

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

Compliance for section 15.247(g):

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



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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 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

7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 20.6 °C Humidity: 37.7 % RH Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

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



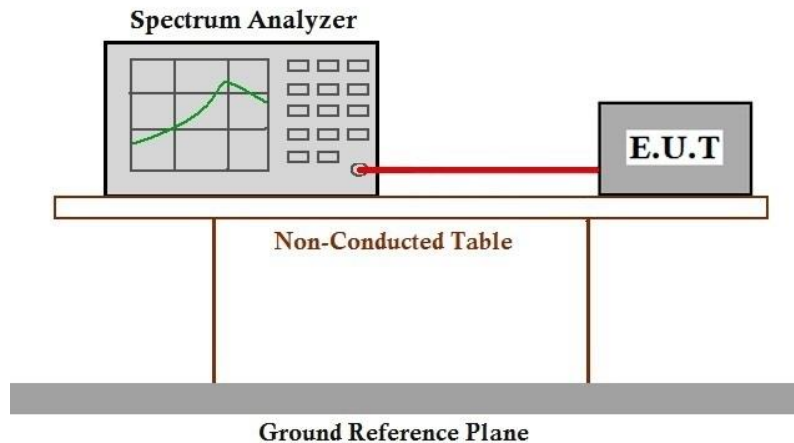
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7.1.3 Test Setup Diagram



7.1.4 Measurement Procedure and Data

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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7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)
Test Method: ANSI C63.10 (2013) Section 7.8.7

7.2.1 E.U.T. Operation

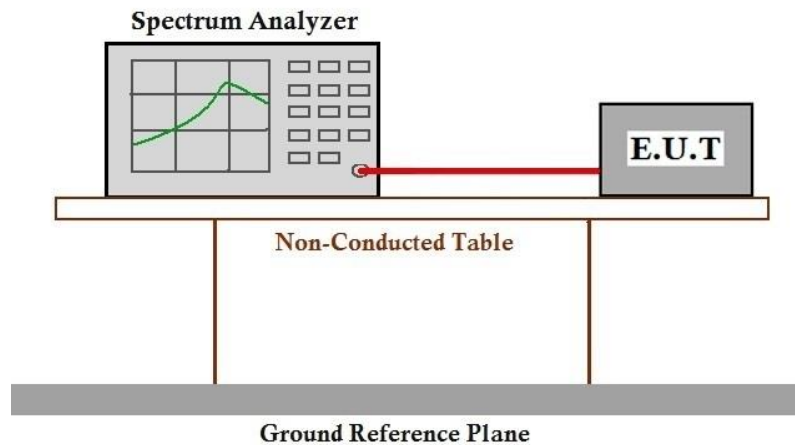
Operating Environment:

Temperature: 20.6 °C Humidity: 37.9 % RH Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_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

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7.3 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.

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 20.5 °C

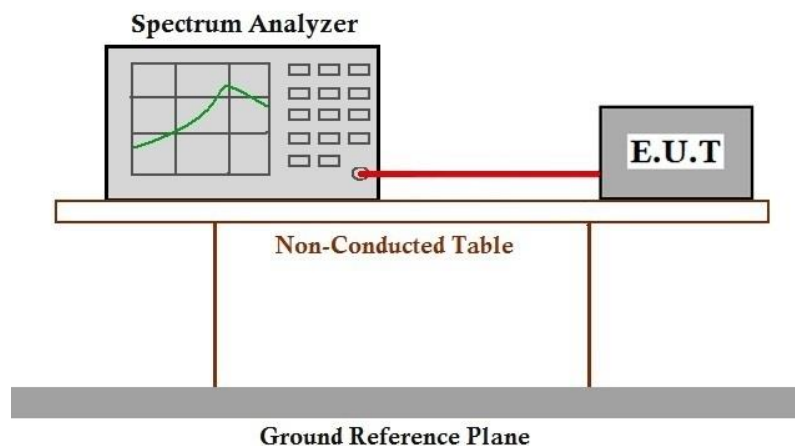
Humidity: 38.1 % RH

Atmospheric Pressure: 1010 mbar

7.3.2 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.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

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7.4 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

7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 20.5 °C

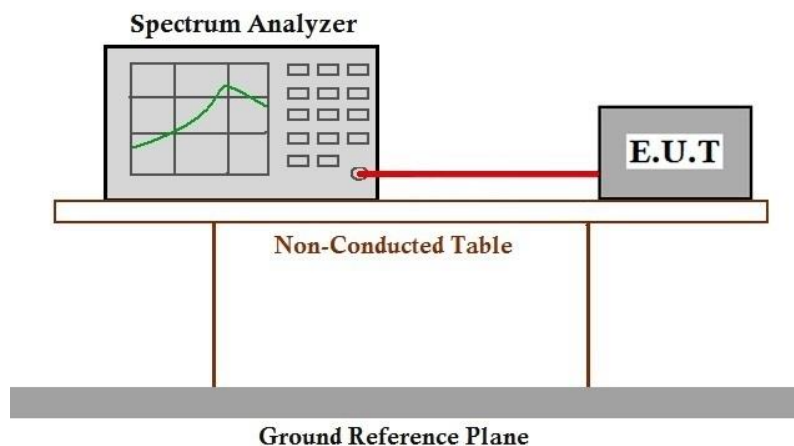
Humidity: 38.2 % RH

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

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7.5 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

7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 20.6 °C

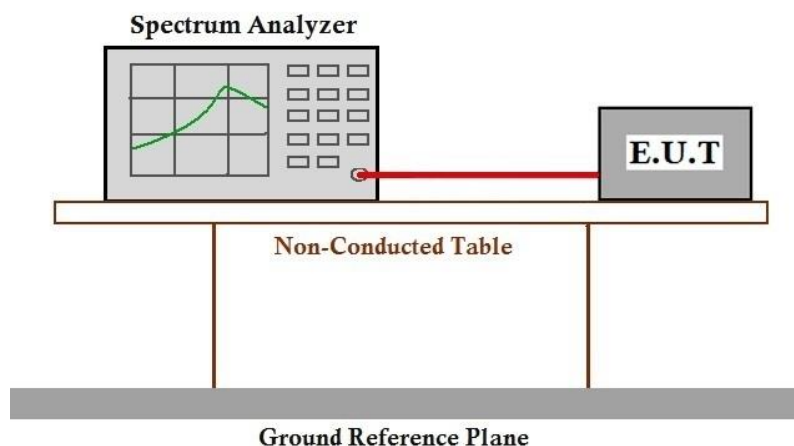
Humidity: 38.2 % RH

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

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7.6 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)).

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 20.6 °C Humidity: 38.3 % RH Atmospheric Pressure: 1010 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.
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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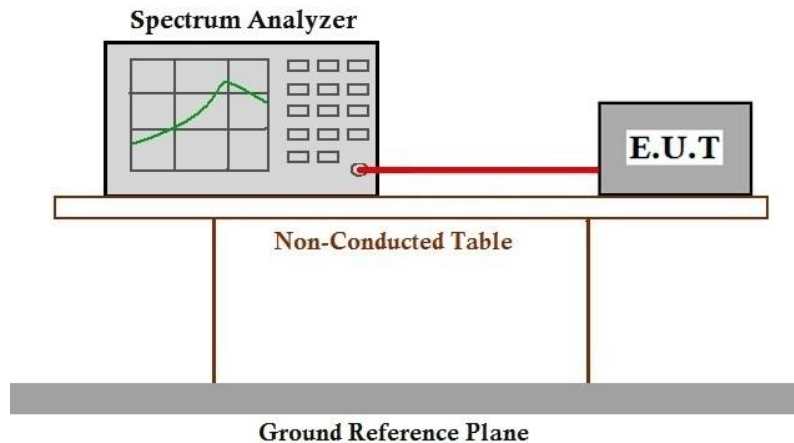
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7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

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7.7 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)).

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 20.6 °C

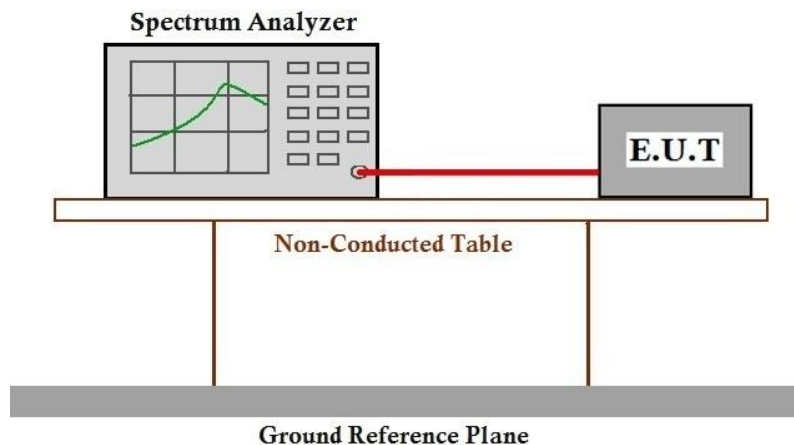
Humidity: 38.3 % RH

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.

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 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.

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 20.6 °C Humidity: 38.4 % 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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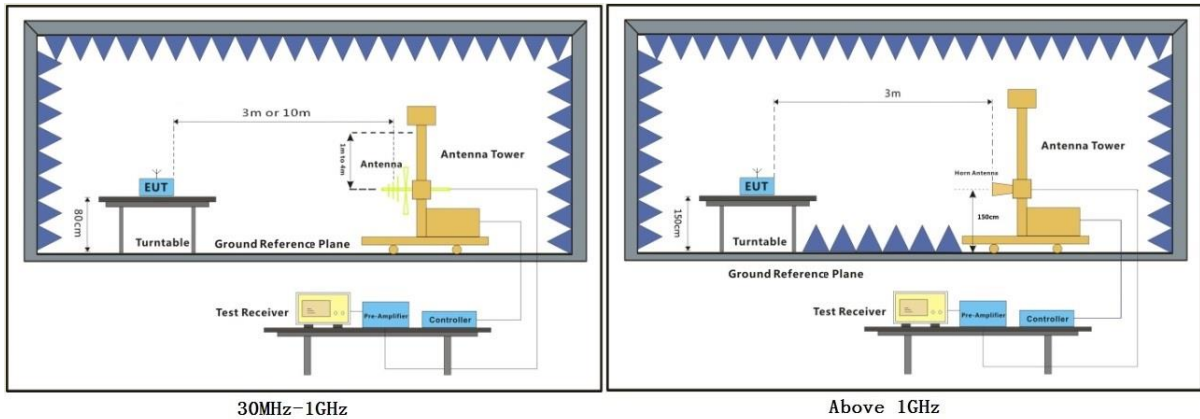
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7.8.3 Test Setup Diagram



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7.8.4 Measurement Procedure and Data

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

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

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



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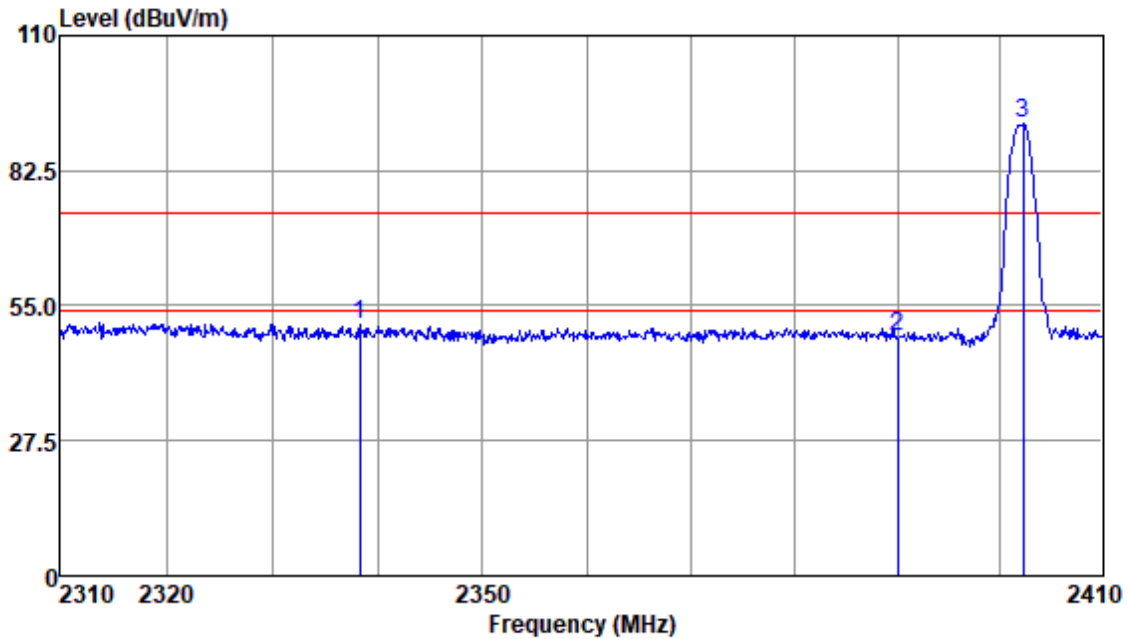
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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



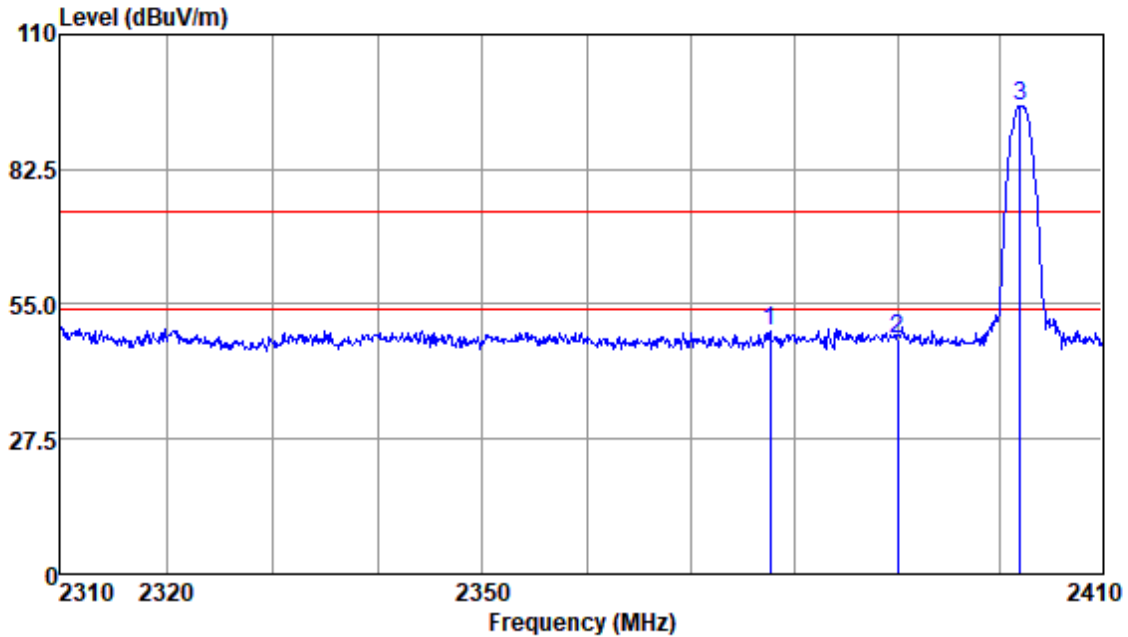
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2338.27	54.55	28.55	3.14	35.14	51.10	74.00	-22.90	Peak
2390.00	52.04	28.80	3.13	35.18	48.79	74.00	-25.21	Peak
2402.25	95.17	28.85	3.13	35.19	91.96	74.00	17.96	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



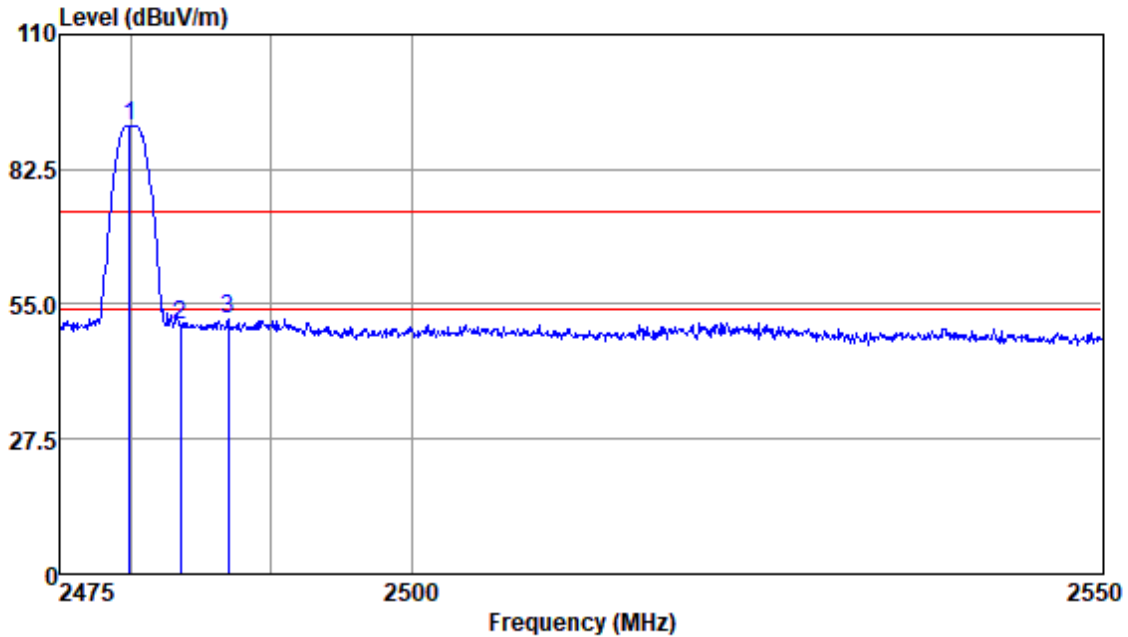
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2377.64	52.98	28.76	3.14	35.17	49.71	74.00	-24.29	Peak
2390.00	51.10	28.80	3.13	35.18	47.85	74.00	-26.15	Peak
2401.95	98.52	28.85	3.13	35.19	95.31	74.00	21.31	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



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



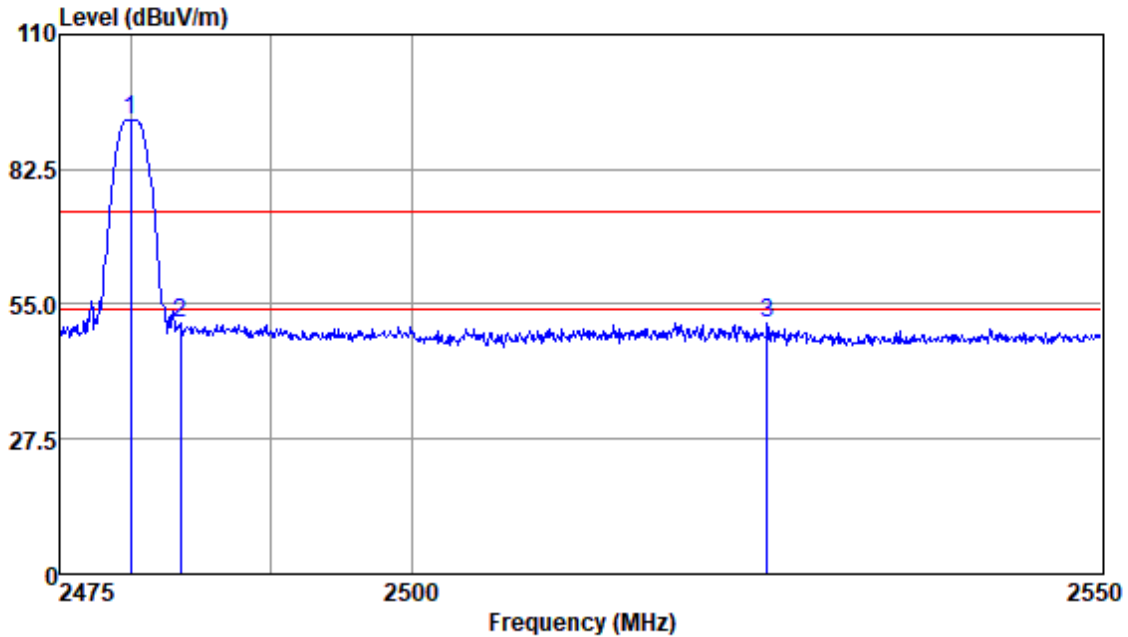
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.88	94.33	29.08	3.20	35.25	91.36	74.00	17.36	Peak
2483.50	53.52	29.09	3.20	35.26	50.55	74.00	-23.45	Peak
2486.92	54.87	29.09	3.20	35.26	51.90	74.00	-22.10	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



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



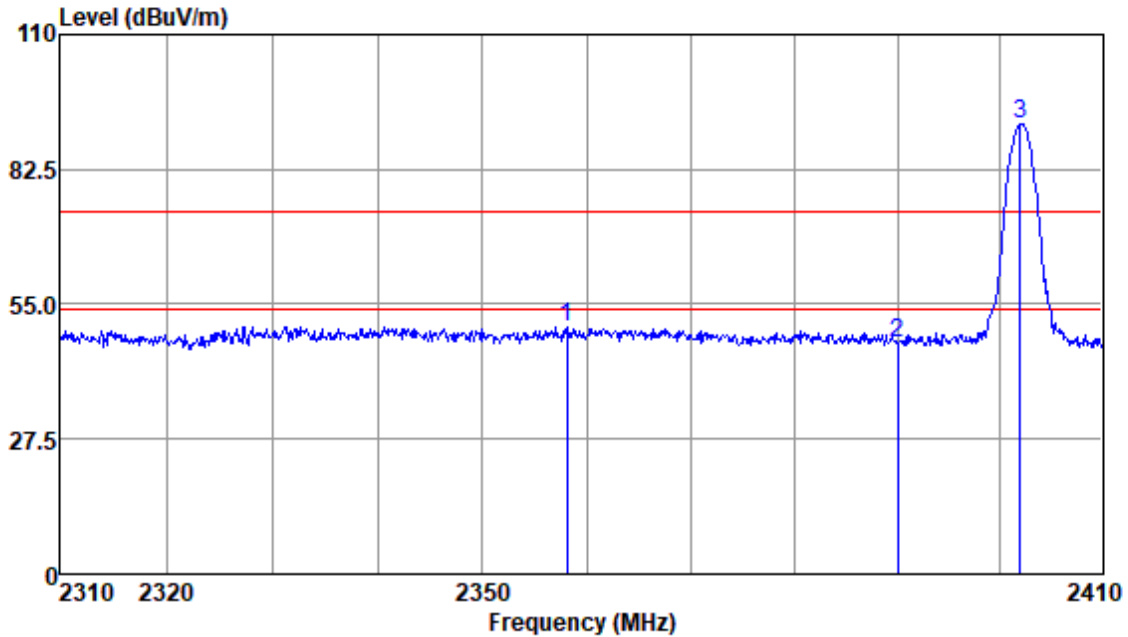
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.96	95.58	29.08	3.20	35.25	92.61	74.00	18.61	Peak
2483.50	54.17	29.09	3.20	35.26	51.20	74.00	-22.80	Peak
2525.61	54.10	29.13	3.30	35.31	51.22	74.00	-22.78	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



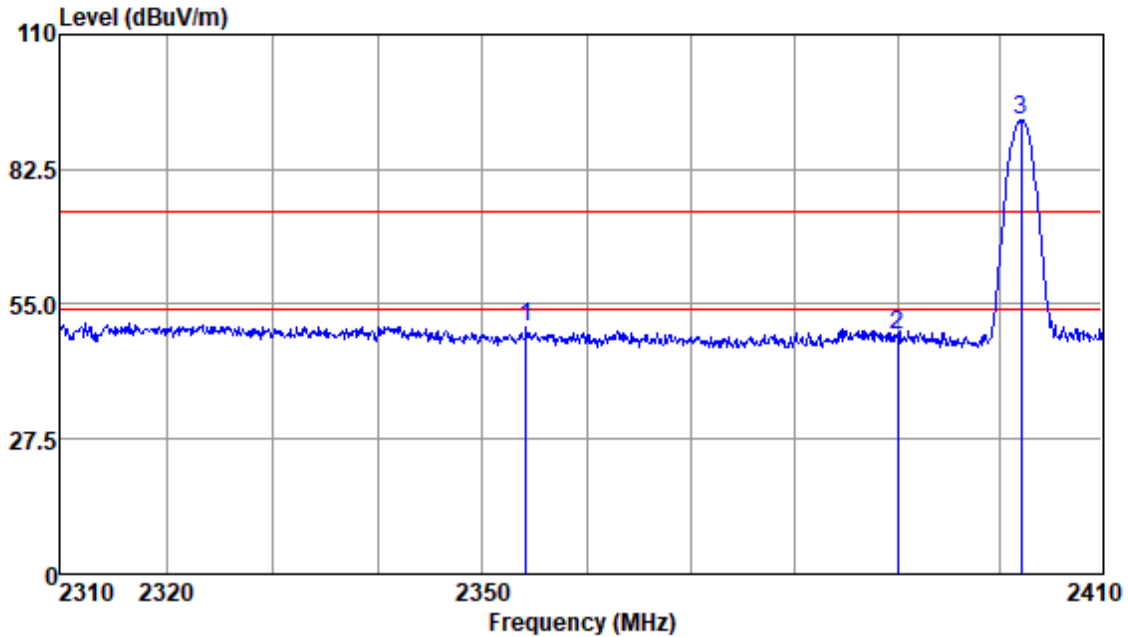
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2358.07	53.78	28.66	3.14	35.16	50.42	74.00	-23.58	Peak
2390.00	50.41	28.80	3.13	35.18	47.16	74.00	-26.84	Peak
2401.95	94.79	28.85	3.13	35.19	91.58	74.00	17.58	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



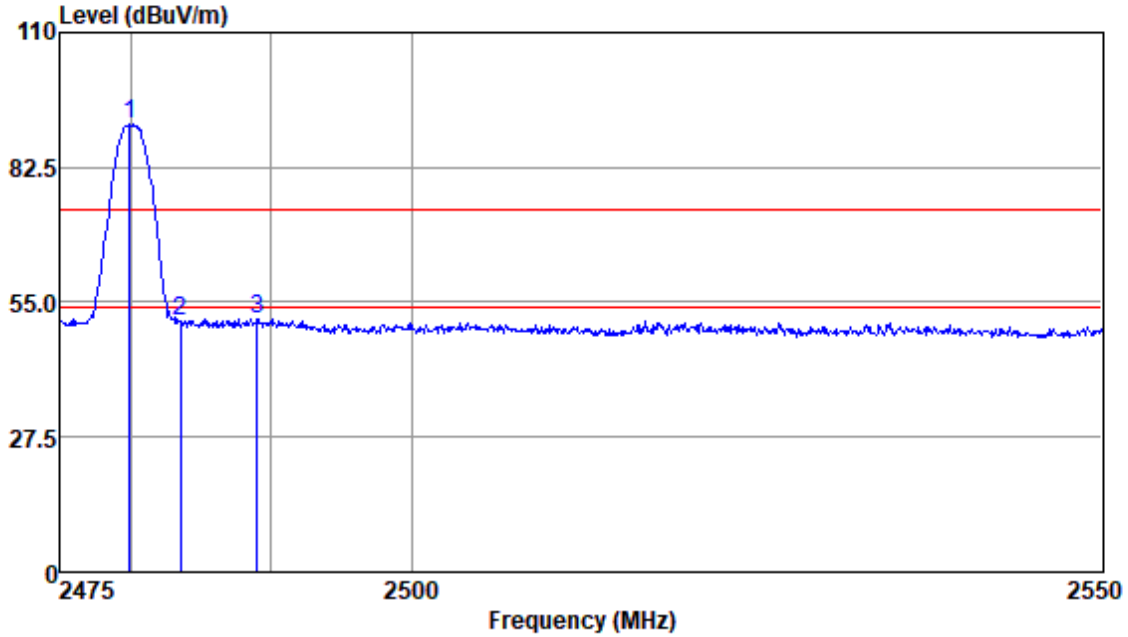
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2354.18	53.91	28.61	3.14	35.15	50.51	74.00	-23.49	Peak
2390.00	51.78	28.80	3.13	35.18	48.53	74.00	-25.47	Peak
2402.05	95.71	28.85	3.13	35.19	92.50	74.00	18.50	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamplifier Factor



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



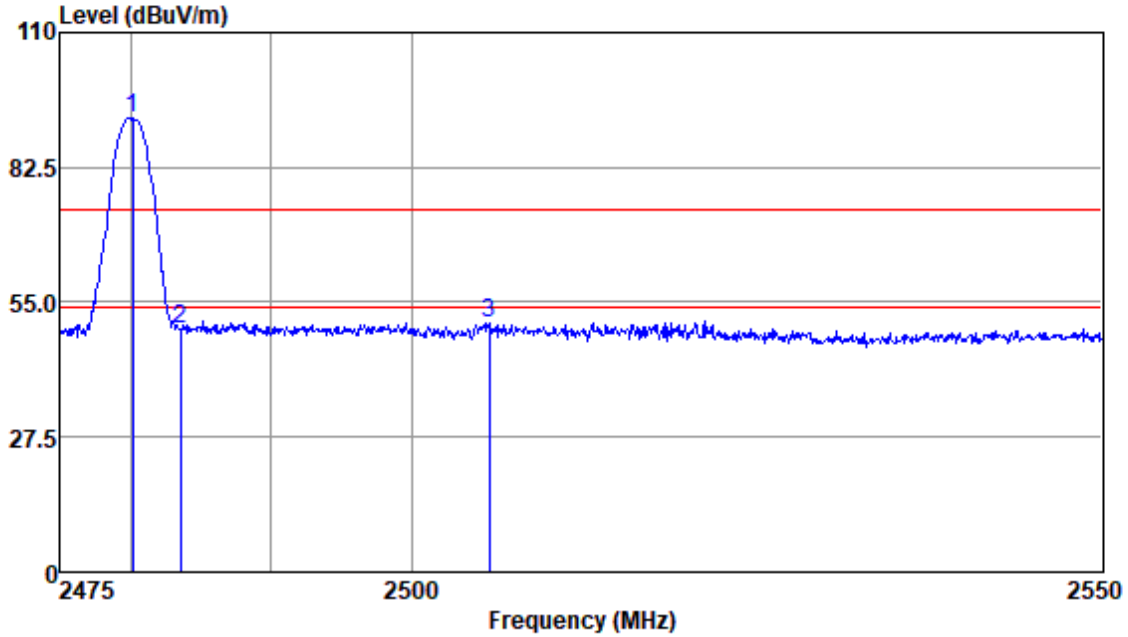
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.88	94.26	29.08	3.20	35.25	91.29	74.00	17.29	Peak
2483.50	54.05	29.09	3.20	35.26	51.08	74.00	-22.92	Peak
2489.00	54.46	29.09	3.23	35.26	51.52	74.00	-22.48	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamplifier Factor



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



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2480.10	95.58	29.08	3.20	35.25	92.61	74.00	18.61	Peak
2483.50	52.54	29.09	3.20	35.26	49.57	74.00	-24.43	Peak
2505.63	53.78	29.13	3.27	35.28	50.90	74.00	-23.10	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamplifier Factor



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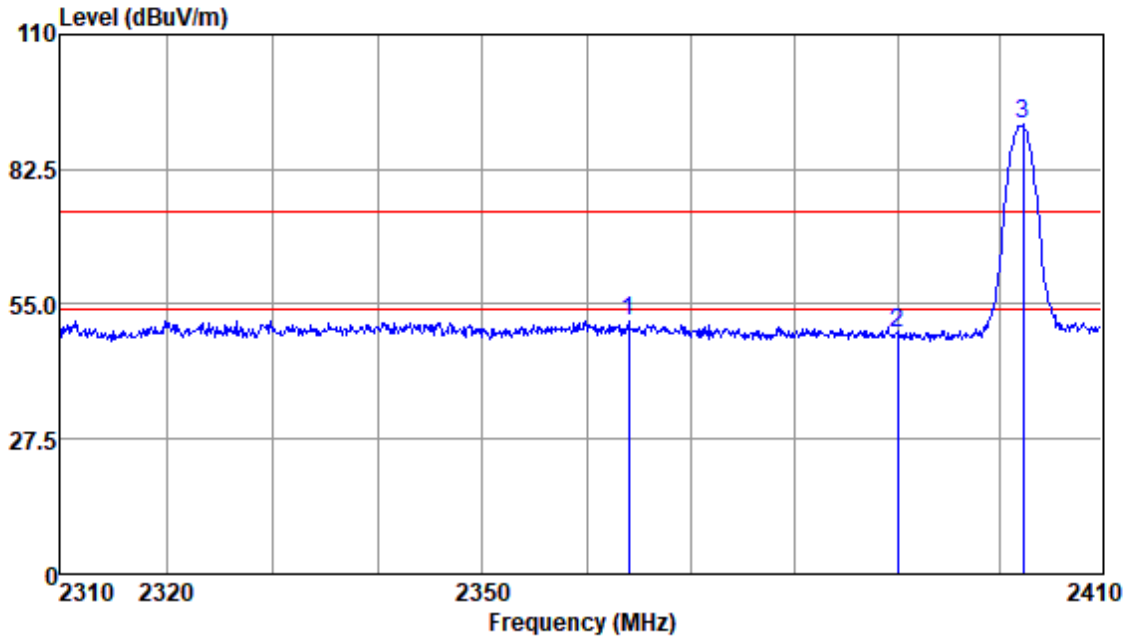
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Test Mode: 00; Polarity: Horizontal; Modulation: 8DPSK; Channel: Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2363.97	54.79	28.68	3.14	35.16	51.45	74.00	-22.55	Peak
2390.00	52.48	28.80	3.13	35.18	49.23	74.00	-24.77	Peak
2402.25	94.82	28.85	3.13	35.19	91.61	74.00	17.61	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

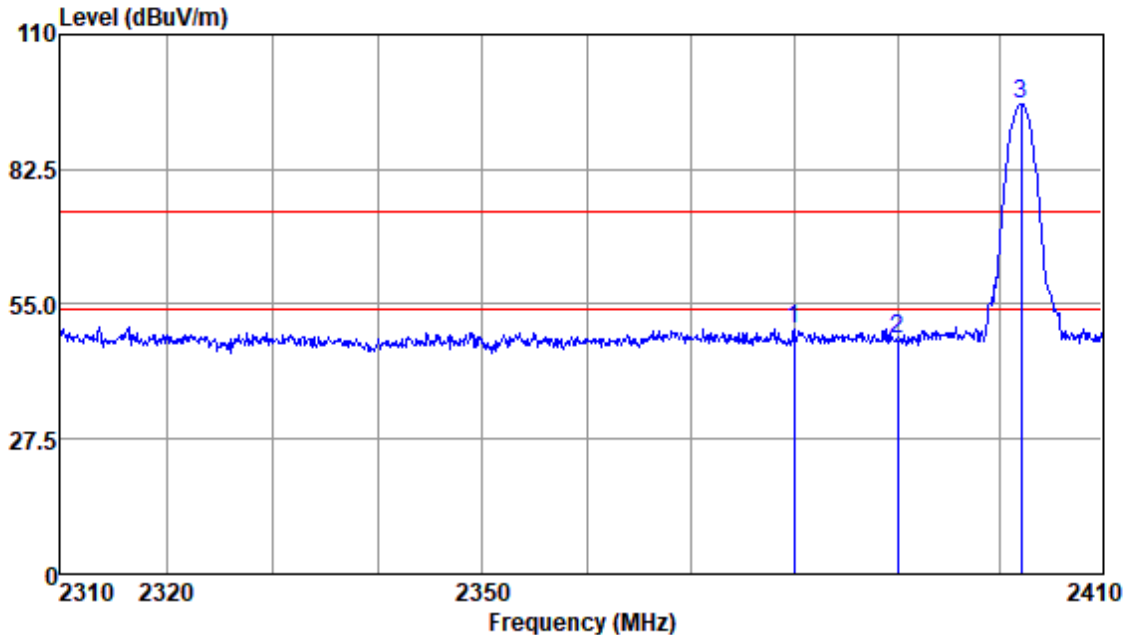


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Test Mode: 00; Polarity: Vertical; Modulation: 8DPSK; Channel: Low



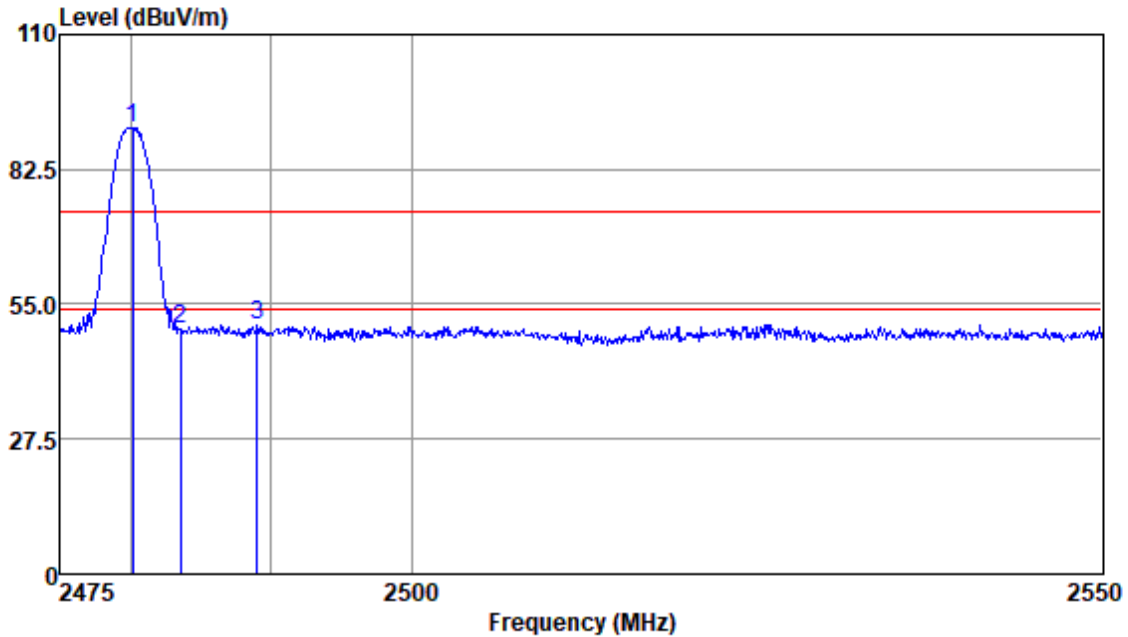
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2379.96	53.34	28.76	3.14	35.17	50.07	74.00	-23.93	Peak
2390.00	50.97	28.80	3.13	35.18	47.72	74.00	-26.28	Peak
2402.05	99.03	28.85	3.13	35.19	95.82	74.00	21.82	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



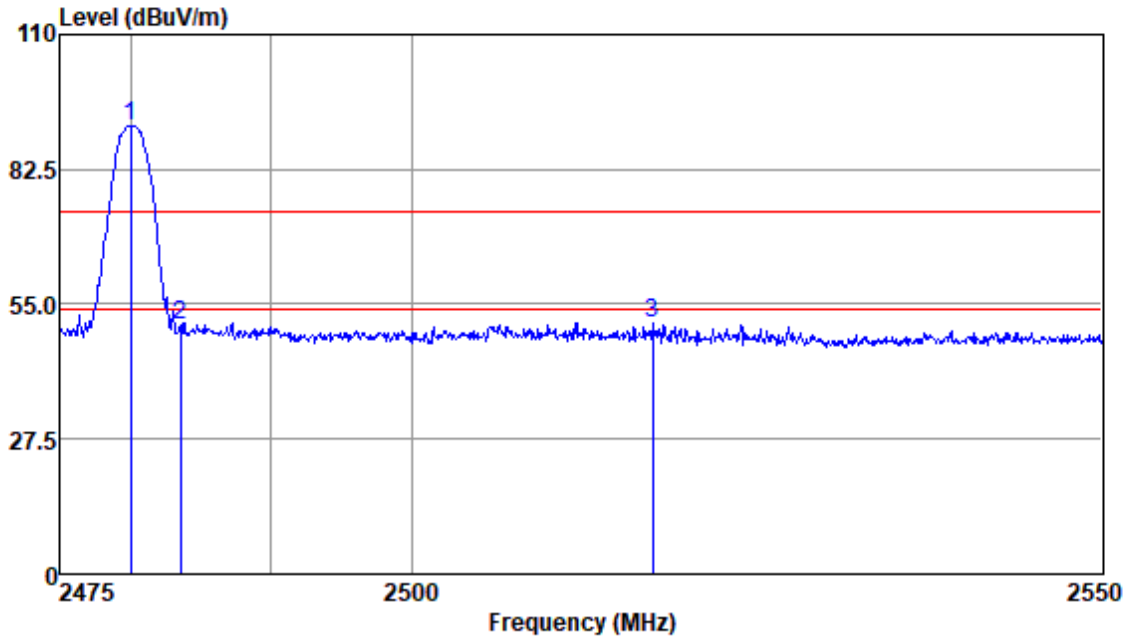
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2480.10	94.09	29.08	3.20	35.25	91.12	74.00	17.12	Peak
2483.50	52.78	29.09	3.20	35.26	49.81	74.00	-24.19	Peak
2489.00	53.65	29.09	3.23	35.26	50.71	74.00	-23.29	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamplifier Factor



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



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.96	94.50	29.08	3.20	35.25	91.53	74.00	17.53	Peak
2483.50	53.64	29.09	3.20	35.26	50.67	74.00	-23.33	Peak
2517.33	54.09	29.13	3.27	35.29	51.20	74.00	-22.80	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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7.9 Radiated Spurious Emissions Below 1GHz

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

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

Limit:

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

7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

7.9.2 Test Mode Description

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



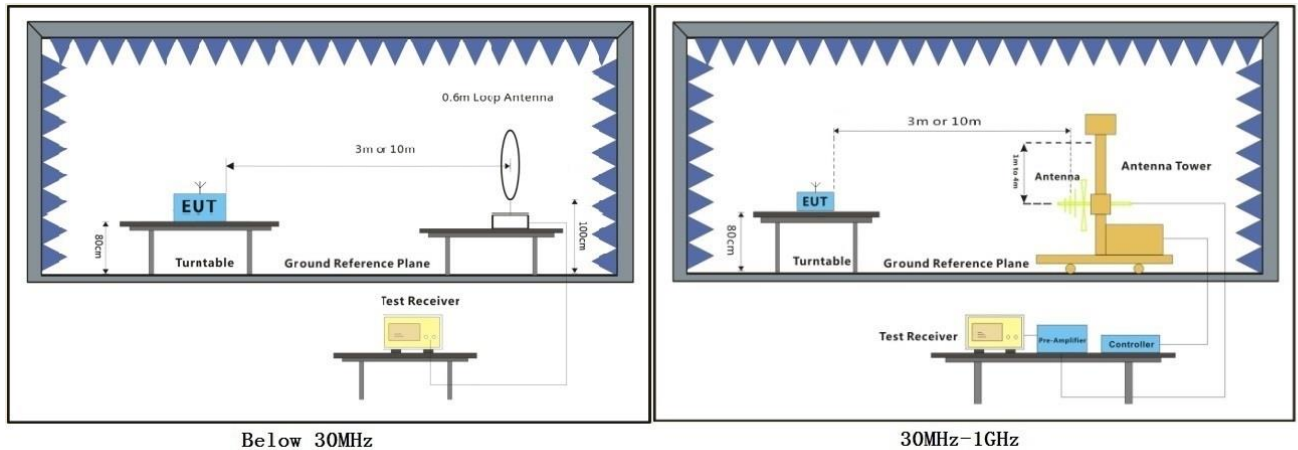
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7.9.3 Test Setup Diagram



7.9.4 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 quasi-peak 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:

- Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
- 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.
- The disturbance below 1GHz was very low and the harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.



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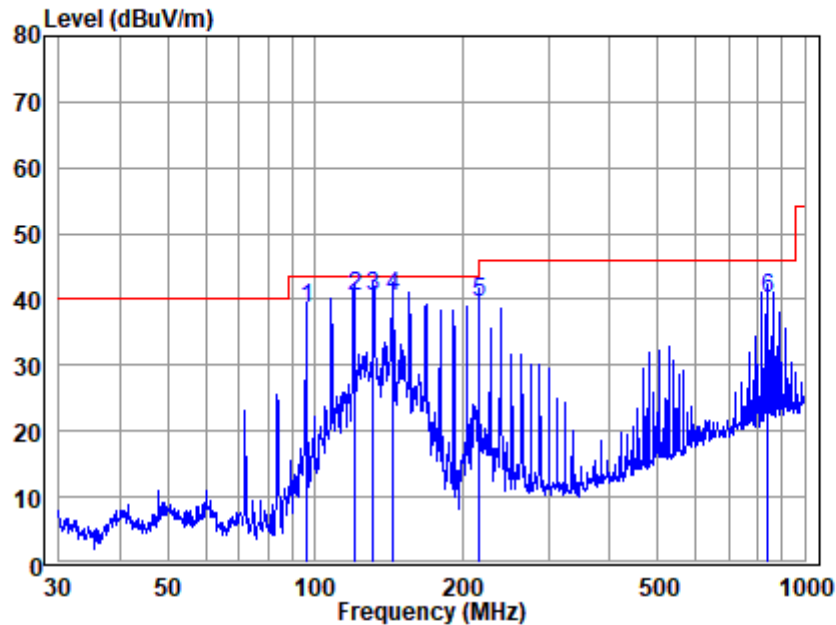
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Test Mode: 00; Polarity: Horizontal



Antenna Polarity :Horizontal
EUT/Project :2841AT
Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
1	96.10	61.88	8.48	1.85	33.60	38.61	43.50	-4.89	QP
2	120.28	60.85	11.06	2.06	33.56	40.41	43.50	-3.09	QP
3	131.76	59.70	12.12	2.28	33.54	40.56	43.50	-2.94	QP
4	143.83	58.39	13.11	2.46	33.51	40.45	43.50	-3.05	QP
5	216.02	59.70	9.90	3.22	33.24	39.58	46.00	-6.42	QP
6	842.13	43.26	22.72	6.67	32.42	40.23	46.00	-5.77	QP

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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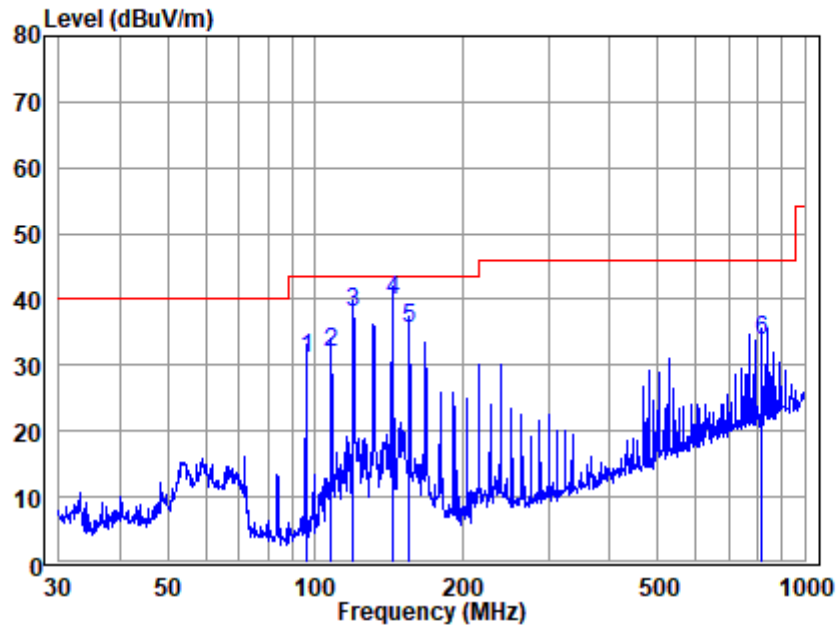
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Test Mode: 00; Polarity: Vertical



Antenna Polarity :Vertical
EUT/Project :2841AT
Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
1	96.10	54.36	8.48	1.85	33.60	31.09	43.50	-12.41	QP
2	107.89	53.58	10.04	1.98	33.58	32.02	43.50	-11.48	QP
3	119.86	58.48	11.02	2.06	33.56	38.00	43.50	-5.50	QP
4	143.83	57.94	13.11	2.46	33.51	40.00	43.50	-3.50	QP
5	155.91	53.07	13.42	2.47	33.48	35.48	43.50	-8.02	QP
6	815.97	37.23	22.45	6.47	32.47	33.68	46.00	-12.32	QP

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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7.10 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

7.10.1 E.U.T. Operation

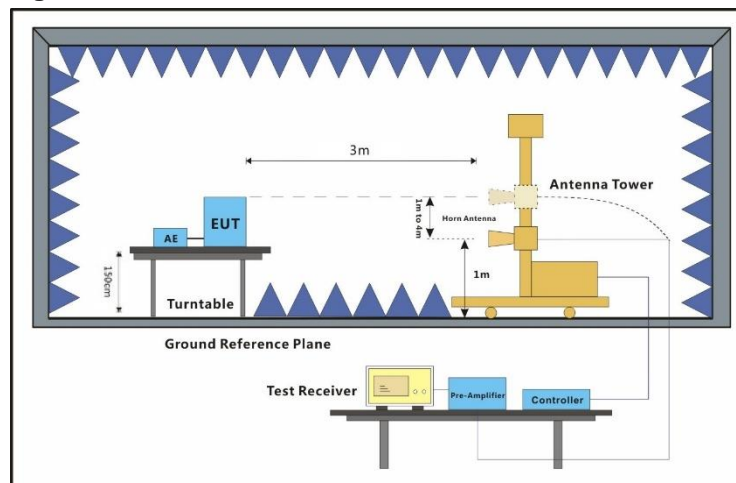
Operating Environment:

Temperature: 20.6 °C Humidity: 38.4 % RH Atmospheric Pressure: 1010 mbar

7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_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

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

Remark:

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



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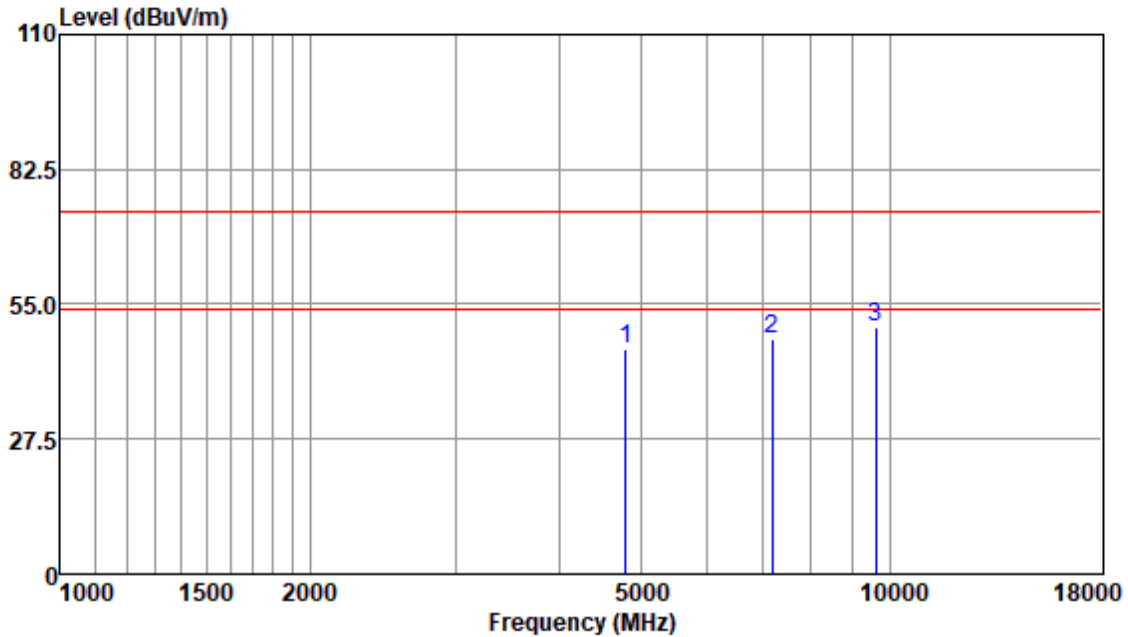
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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	44.36	33.57	4.53	36.79	45.67	74.00	-28.33	Peak
7206.00	40.58	36.24	6.66	35.53	47.95	74.00	-26.05	Peak
9608.00	37.41	37.75	8.56	33.58	50.14	74.00	-23.86	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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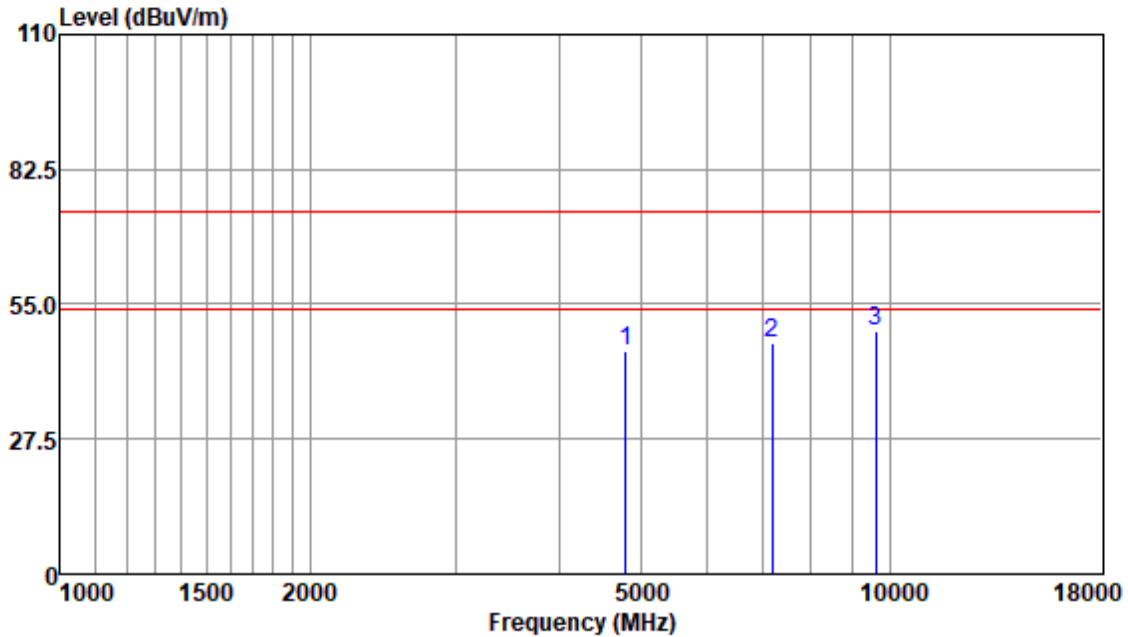
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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



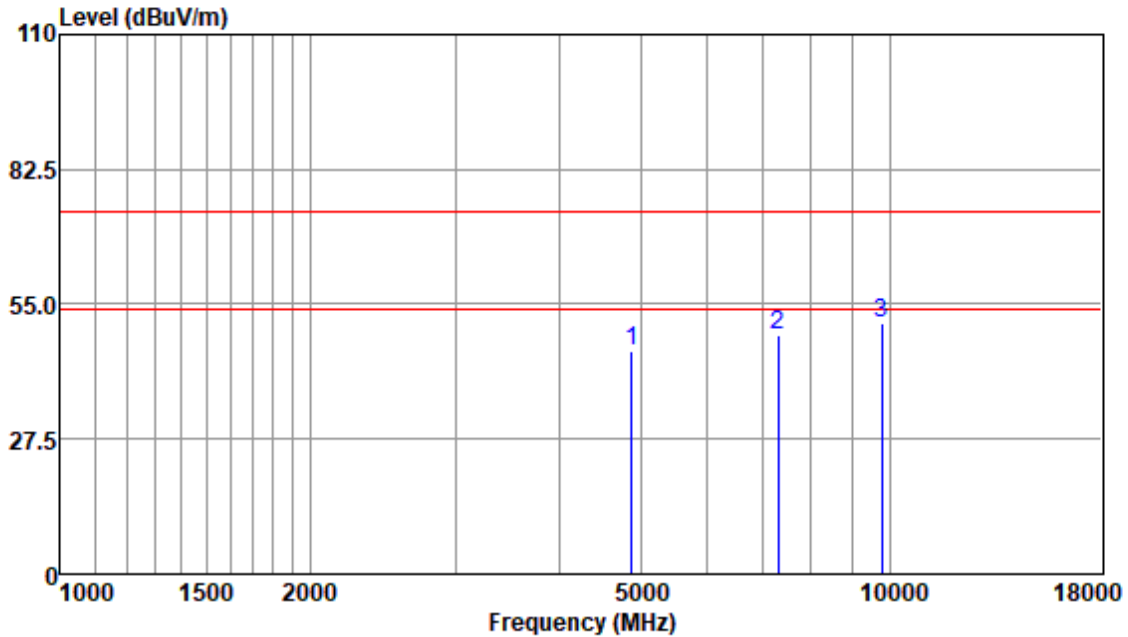
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	44.01	33.57	4.53	36.79	45.32	74.00	-28.68	Peak
7206.00	39.78	36.24	6.66	35.53	47.15	74.00	-26.85	Peak
9608.00	36.98	37.75	8.56	33.58	49.71	74.00	-24.29	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



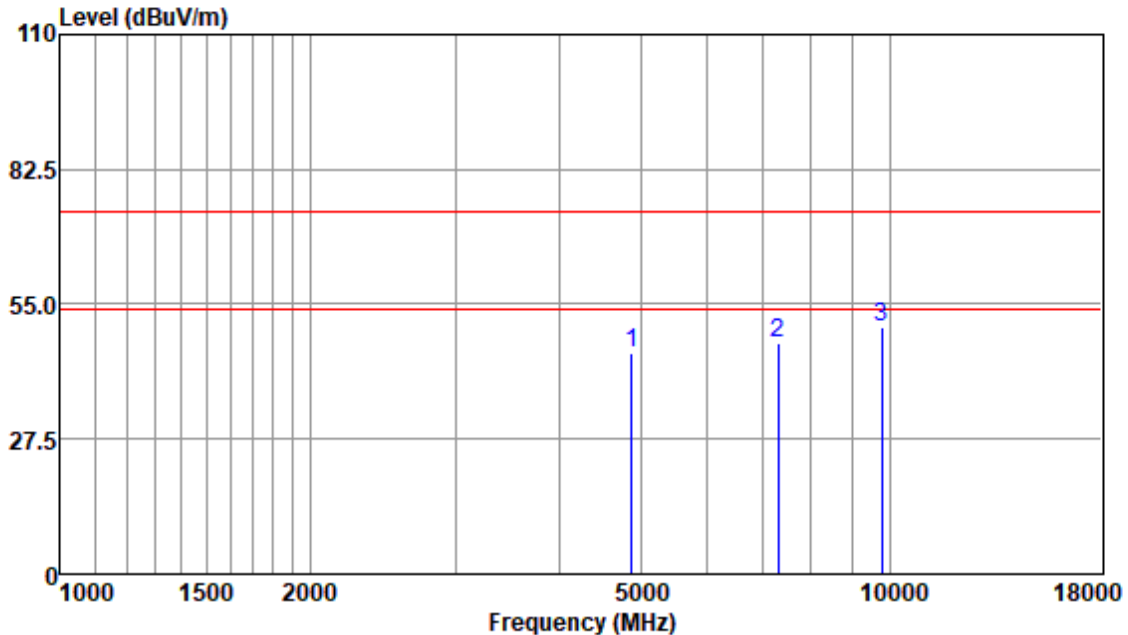
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	43.78	33.66	4.73	36.81	45.36	74.00	-28.64	Peak
7323.00	41.14	36.33	6.59	35.42	48.64	74.00	-25.36	Peak
9764.00	38.30	37.54	8.70	33.50	51.04	74.00	-22.96	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



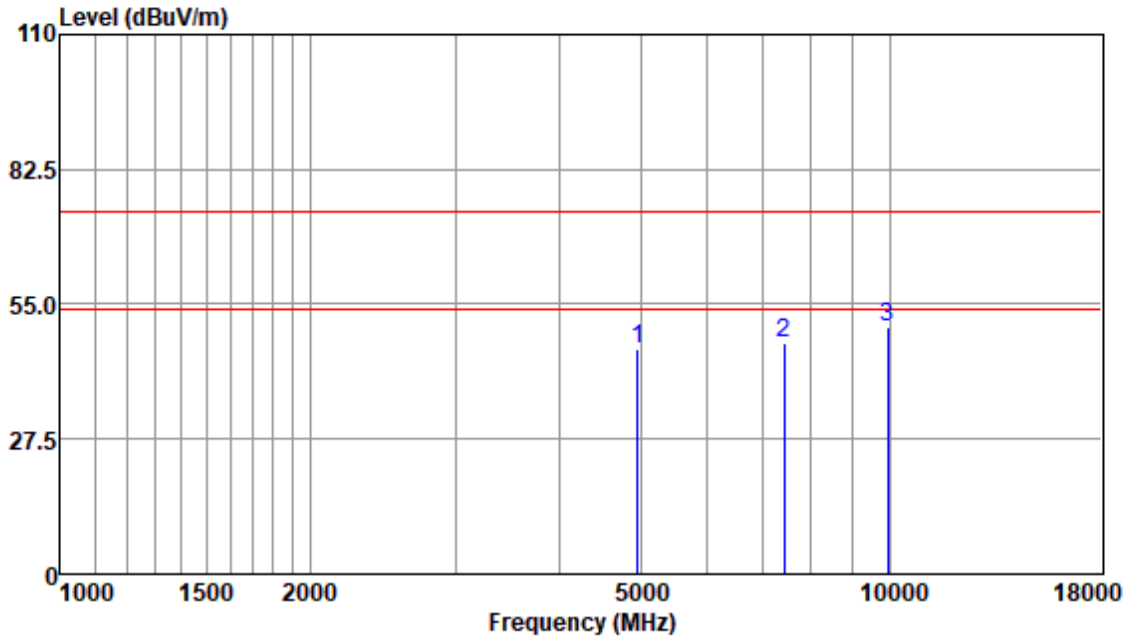
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	43.57	33.66	4.73	36.81	45.15	74.00	-28.85	Peak
7323.00	39.42	36.33	6.59	35.42	46.92	74.00	-27.08	Peak
9764.00	37.43	37.54	8.70	33.50	50.17	74.00	-23.83	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	43.97	33.98	4.92	36.83	46.04	74.00	-27.96	Peak
7440.00	39.59	36.40	6.61	35.34	47.26	74.00	-26.74	Peak
9920.00	37.01	37.81	8.87	33.41	50.28	74.00	-23.72	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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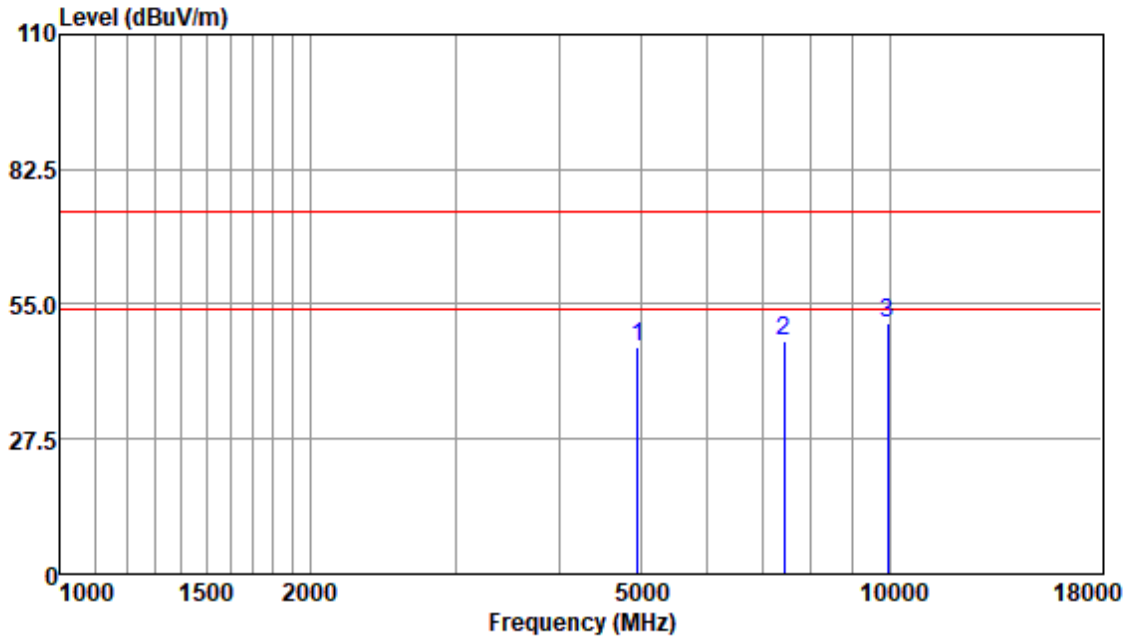
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Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	44.44	33.65	4.92	36.83	46.18	74.00	-27.82	Peak
7440.00	39.94	36.31	6.61	35.34	47.52	74.00	-26.48	Peak
9920.00	37.96	37.62	8.87	33.41	51.04	74.00	-22.96	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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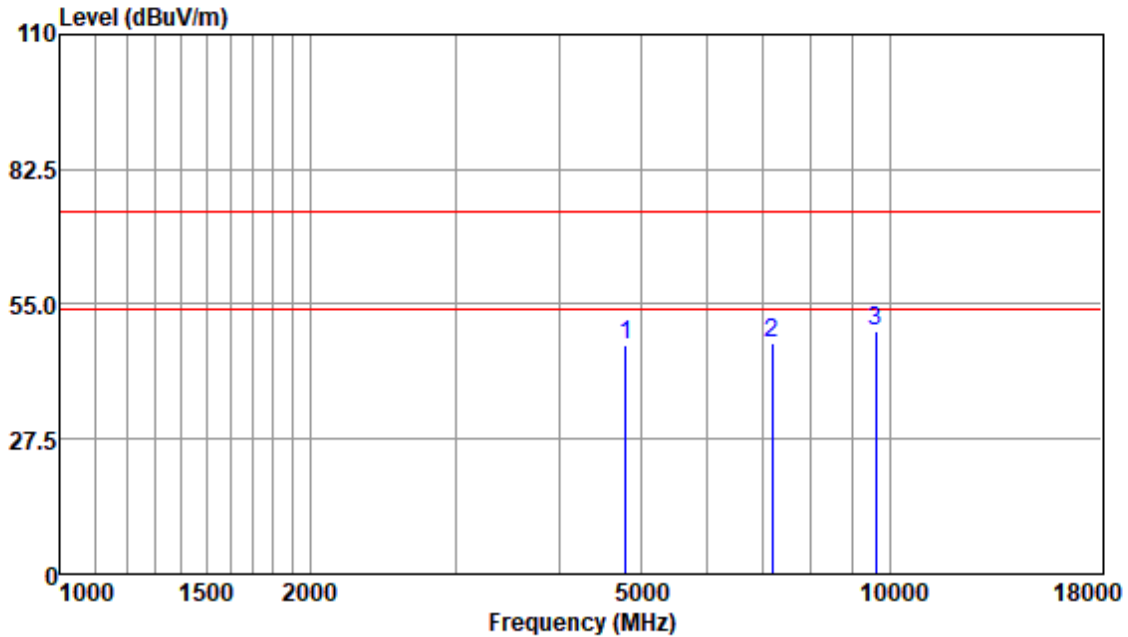
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Test Mode: 00; Polarity: Horizontal; Modulation: $\pi/4$ DQPSK; Channel: Low



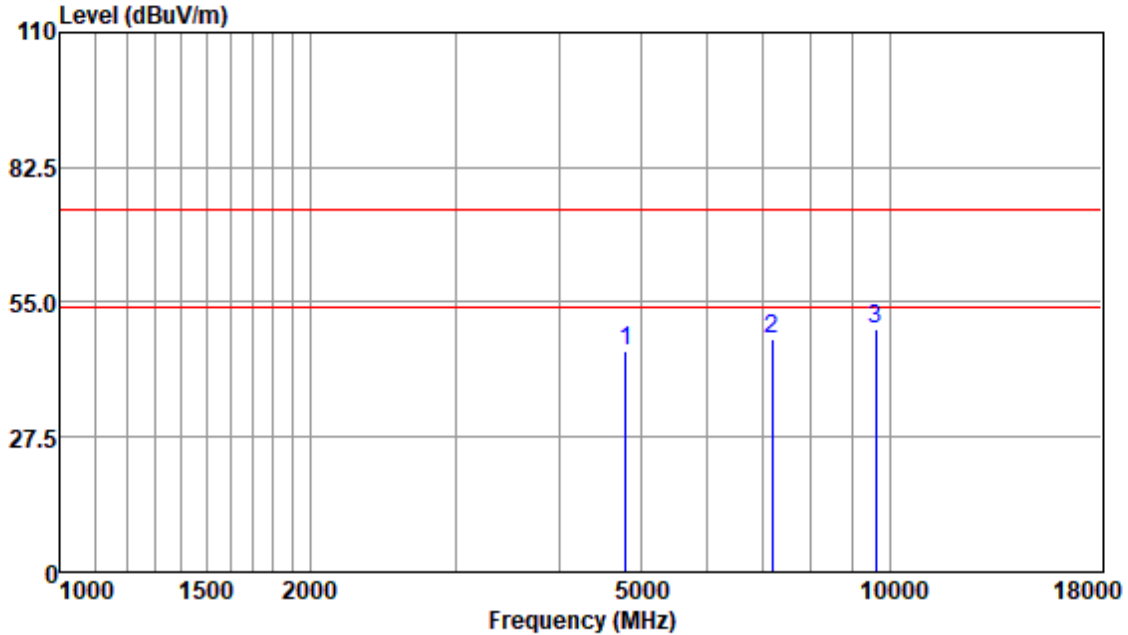
Antenna Polarity : HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4804.00	45.41	33.57	4.53	36.79	46.72	74.00	-27.28	Peak
7206.00	39.64	36.24	6.66	35.53	47.01	74.00	-26.99	Peak
9608.00	36.85	37.75	8.56	33.58	49.58	74.00	-24.42	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



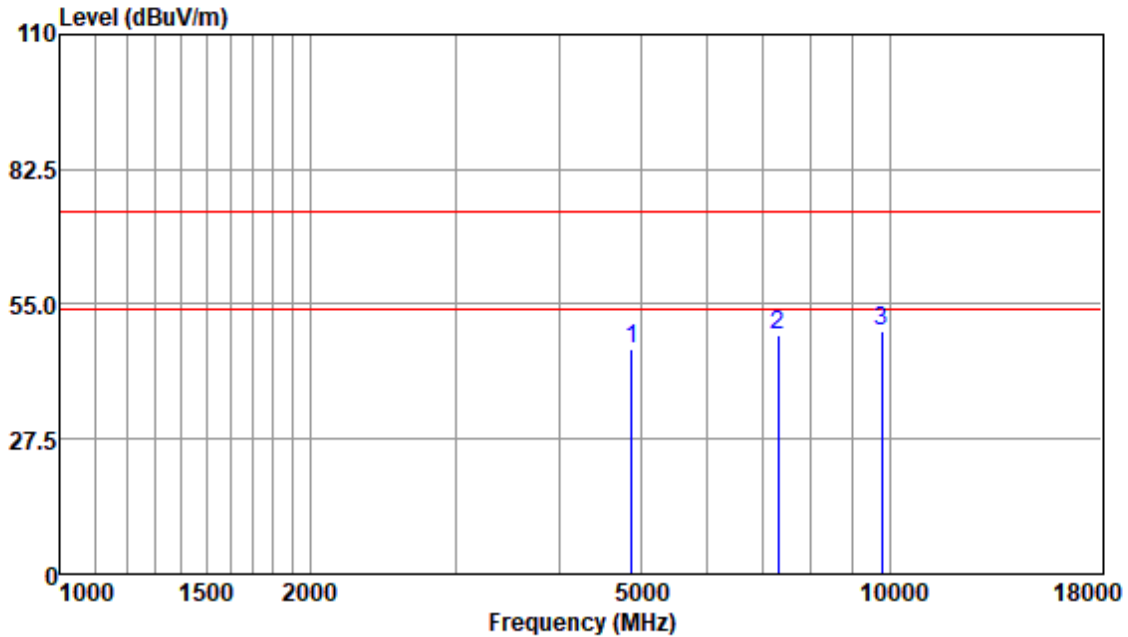
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	43.73	33.72	4.53	36.79	45.19	74.00	-28.81	Peak
7206.00	40.16	36.28	6.66	35.53	47.57	74.00	-26.43	Peak
9608.00	37.03	37.70	8.56	33.58	49.71	74.00	-24.29	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



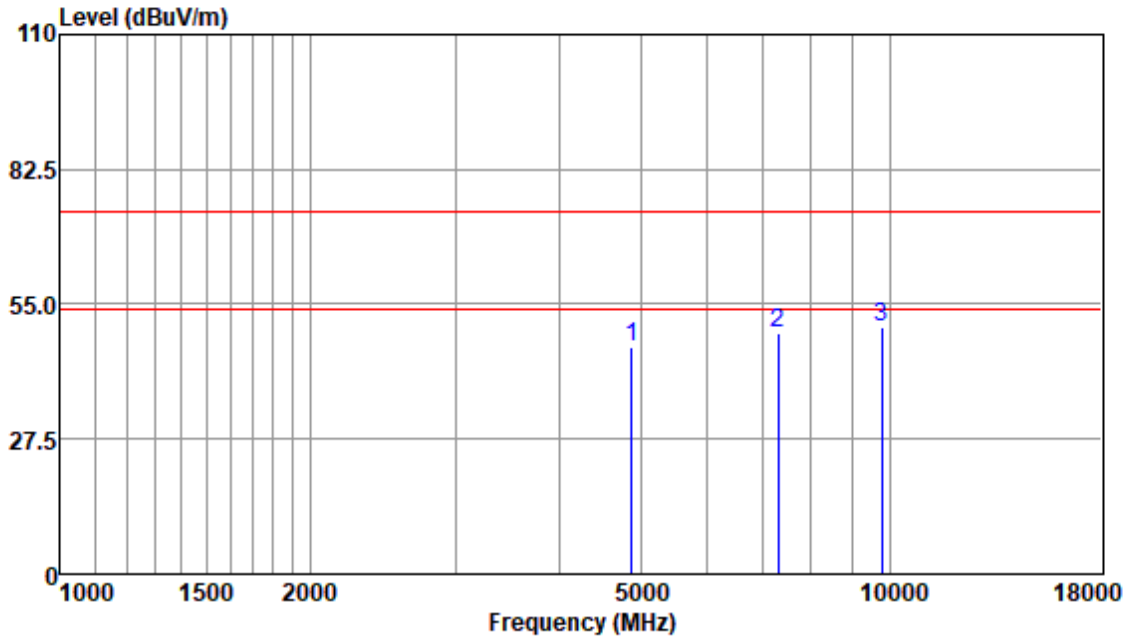
Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	44.38	33.66	4.73	36.81	45.96	74.00	-28.04	Peak
7323.00	41.21	36.33	6.59	35.42	48.71	74.00	-25.29	Peak
9764.00	36.78	37.54	8.70	33.50	49.52	74.00	-24.48	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	44.68	33.66	4.73	36.81	46.26	74.00	-27.74	Peak
7323.00	41.42	36.33	6.59	35.42	48.92	74.00	-25.08	Peak
9764.00	37.74	37.54	8.70	33.50	50.48	74.00	-23.52	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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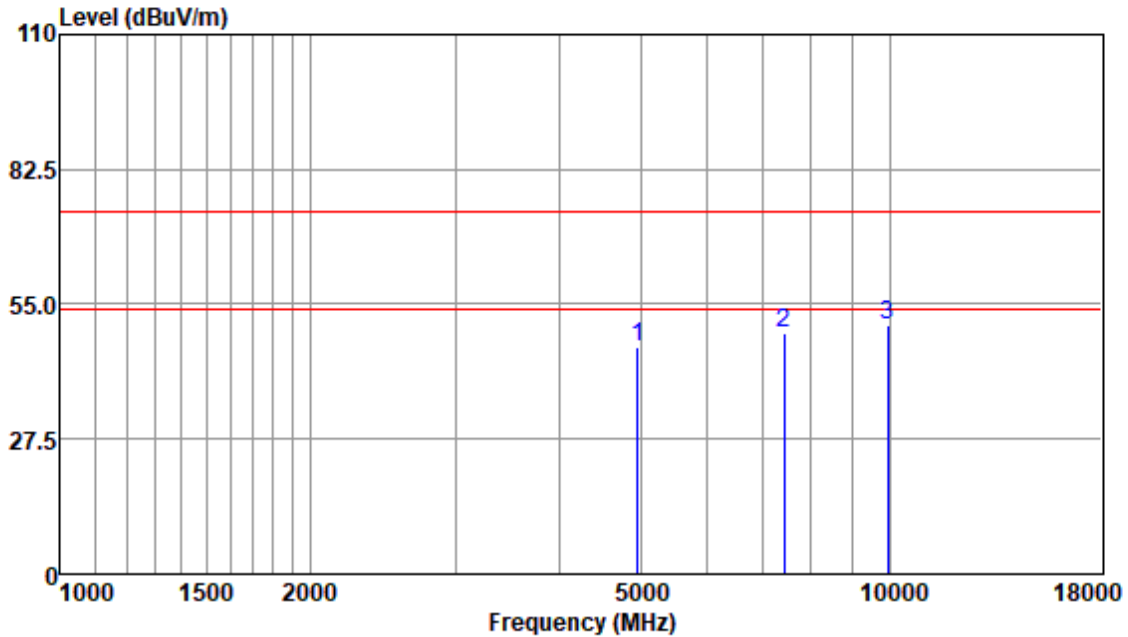
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Test Mode: 00; Polarity: Horizontal; Modulation: $\pi/4$ DQPSK; Channel: High



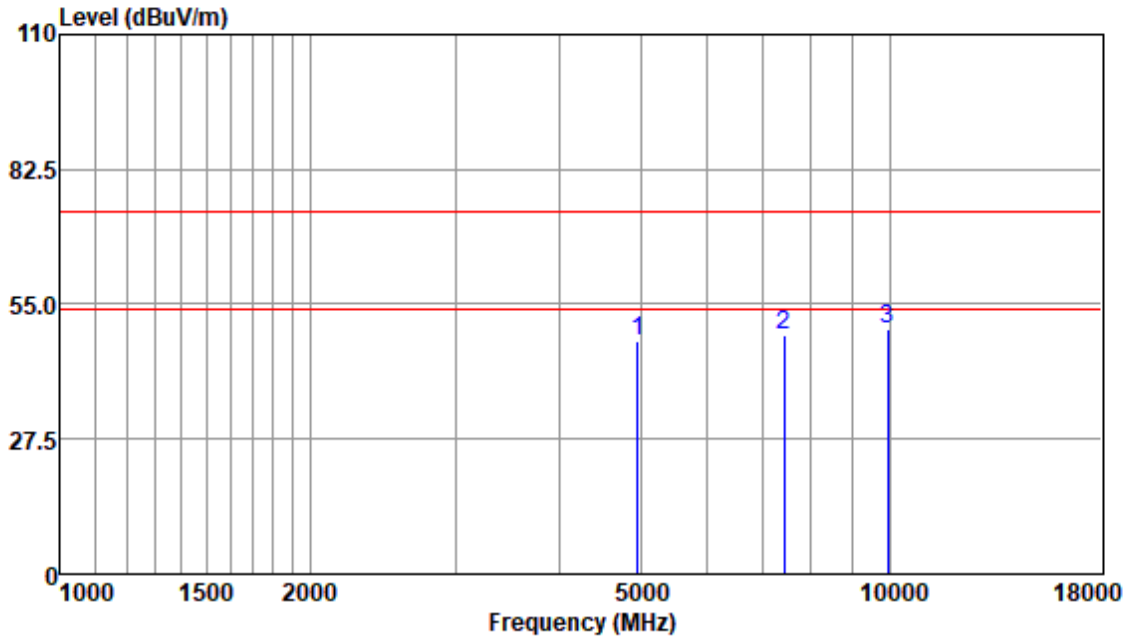
Antenna Polarity : HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4960.00	44.51	33.65	4.92	36.83	46.25	74.00	-27.75	Peak
7440.00	41.35	36.31	6.61	35.34	48.93	74.00	-25.07	Peak
9920.00	37.66	37.62	8.87	33.41	50.74	74.00	-23.26	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



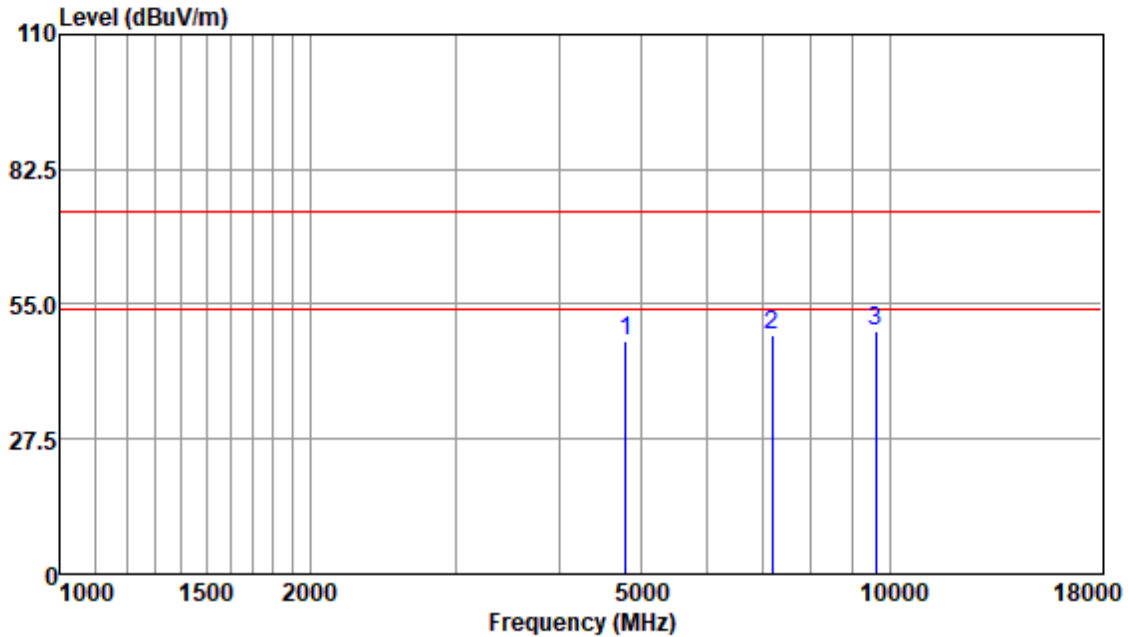
Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	45.85	33.65	4.92	36.83	47.59	74.00	-26.41	Peak
7440.00	41.05	36.31	6.61	35.34	48.63	74.00	-25.37	Peak
9920.00	36.79	37.62	8.87	33.41	49.87	74.00	-24.13	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



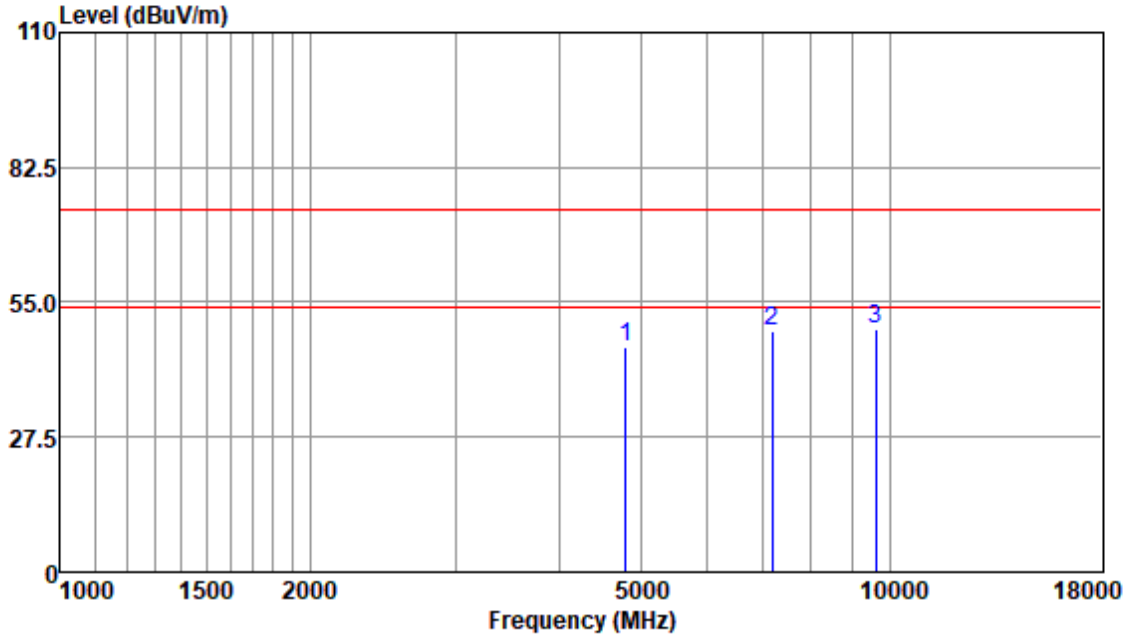
Antenna Polarity : HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	46.24	33.57	4.53	36.79	47.55	74.00	-26.45	Peak
7206.00	41.54	36.24	6.66	35.53	48.91	74.00	-25.09	Peak
9608.00	36.92	37.75	8.56	33.58	49.65	74.00	-24.35	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



Antenna Polarity : VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	44.56	33.57	4.53	36.79	45.87	74.00	-28.13	Peak
7206.00	41.59	36.24	6.66	35.53	48.96	74.00	-25.04	Peak
9608.00	36.82	37.75	8.56	33.58	49.55	74.00	-24.45	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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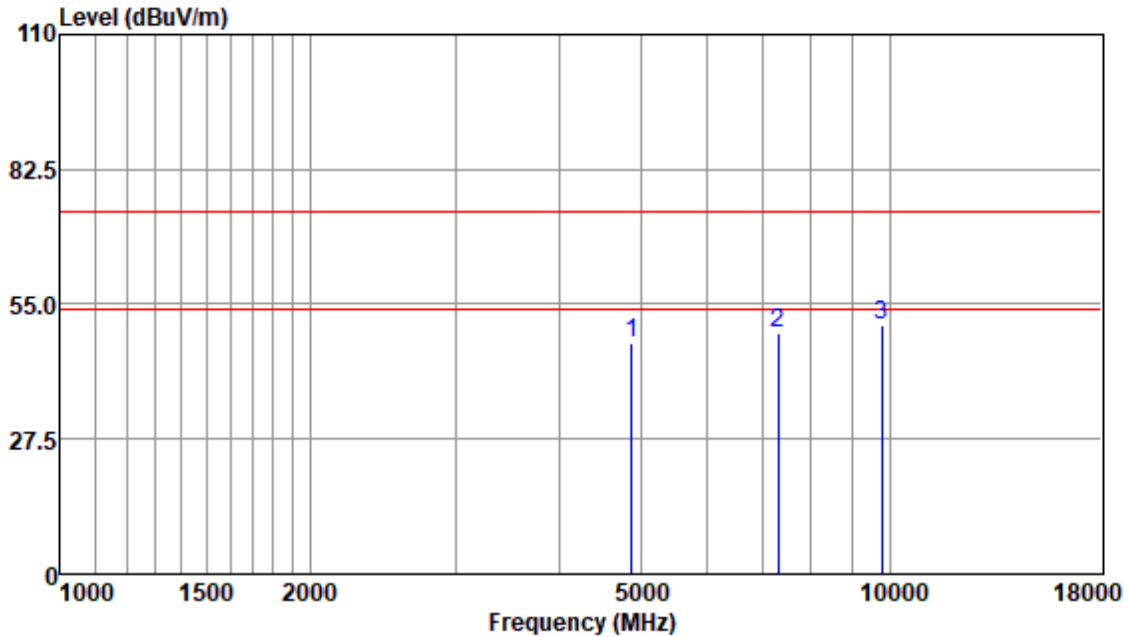
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Test Mode: 00; Polarity: Horizontal; Modulation: 8DPSK; Channel: middle



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	45.43	33.66	4.73	36.81	47.01	74.00	-26.99	Peak
7323.00	41.43	36.33	6.59	35.42	48.93	74.00	-25.07	Peak
9764.00	38.14	37.54	8.70	33.50	50.88	74.00	-23.12	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



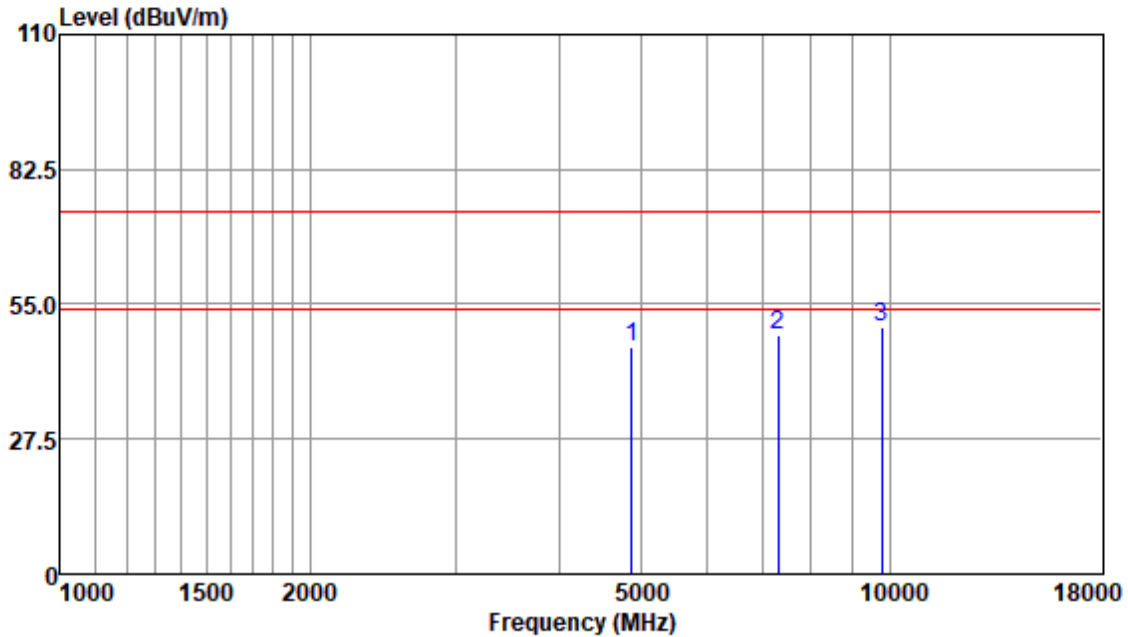
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Test Mode: 00; Polarity: Vertical; Modulation: 8DPSK; Channel: middle



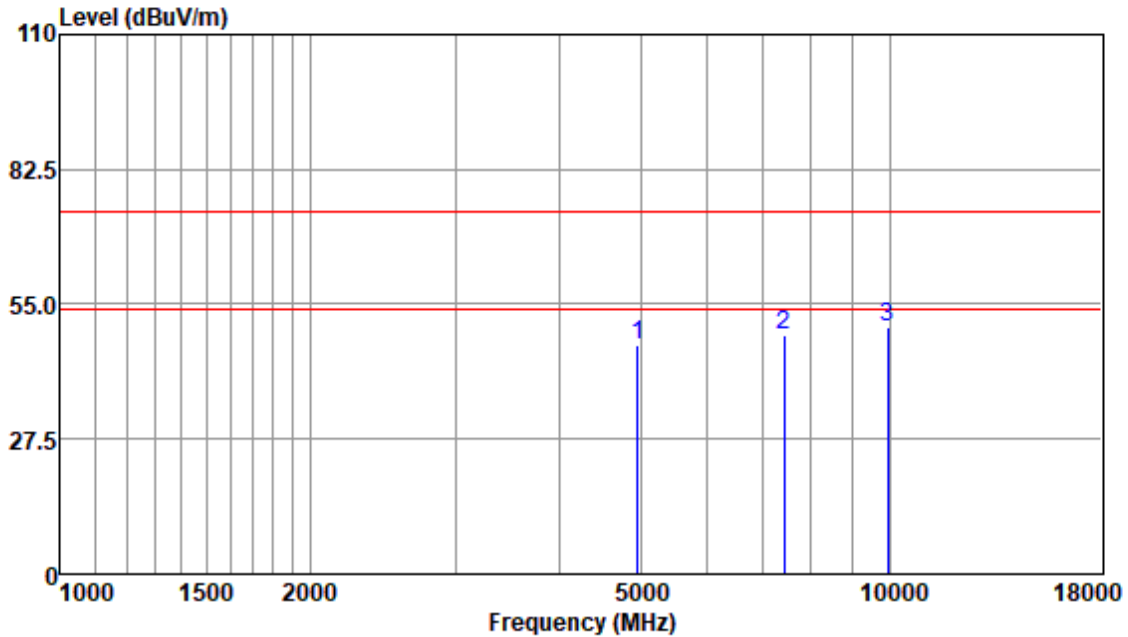
Antenna Polarity : VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	44.60	33.66	4.73	36.81	46.18	74.00	-27.82	Peak
7323.00	41.24	36.33	6.59	35.42	48.74	74.00	-25.26	Peak
9764.00	37.45	37.54	8.70	33.50	50.19	74.00	-23.81	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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



Antenna Polarity : HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4960.00	45.08	33.65	4.92	36.83	46.82	74.00	-27.18	Peak
7440.00	41.08	36.31	6.61	35.34	48.66	74.00	-25.34	Peak
9920.00	37.09	37.62	8.87	33.41	50.17	74.00	-23.83	Peak

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamp Factor



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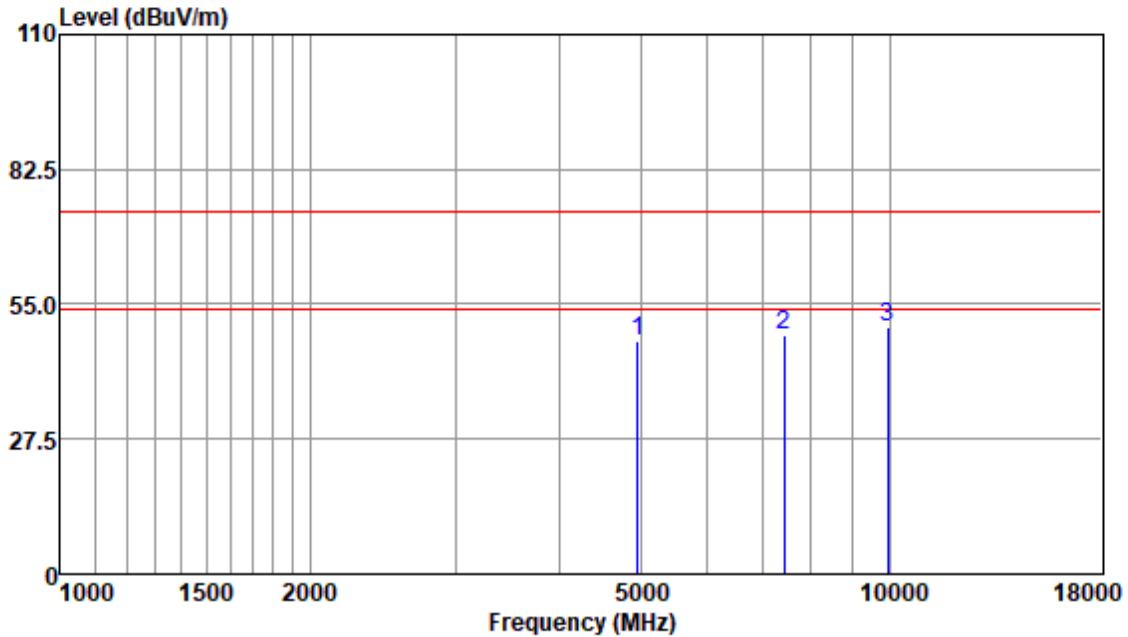
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Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	45.71	33.65	4.92	36.83	47.45	74.00	-26.55	Peak
7440.00	40.96	36.31	6.61	35.34	48.54	74.00	-25.46	Peak
9920.00	37.21	37.62	8.87	33.41	50.29	74.00	-23.71	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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8 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

9 EUT Constructional Details

Refer to the < External Photos > & <Internal Photos >.

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	0.929	Pass
		2441	DH5	1	0.956	Pass
		2480	DH5	1	0.970	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.202	Pass
		2441	2DH5	1	1.215	Pass
		2480	2DH5	1	1.236	Pass
8DPSK	SISO	2402	3DH5	1	1.201	Pass
		2441	3DH5	1	1.220	Pass
		2480	3DH5	1	1.232	Pass



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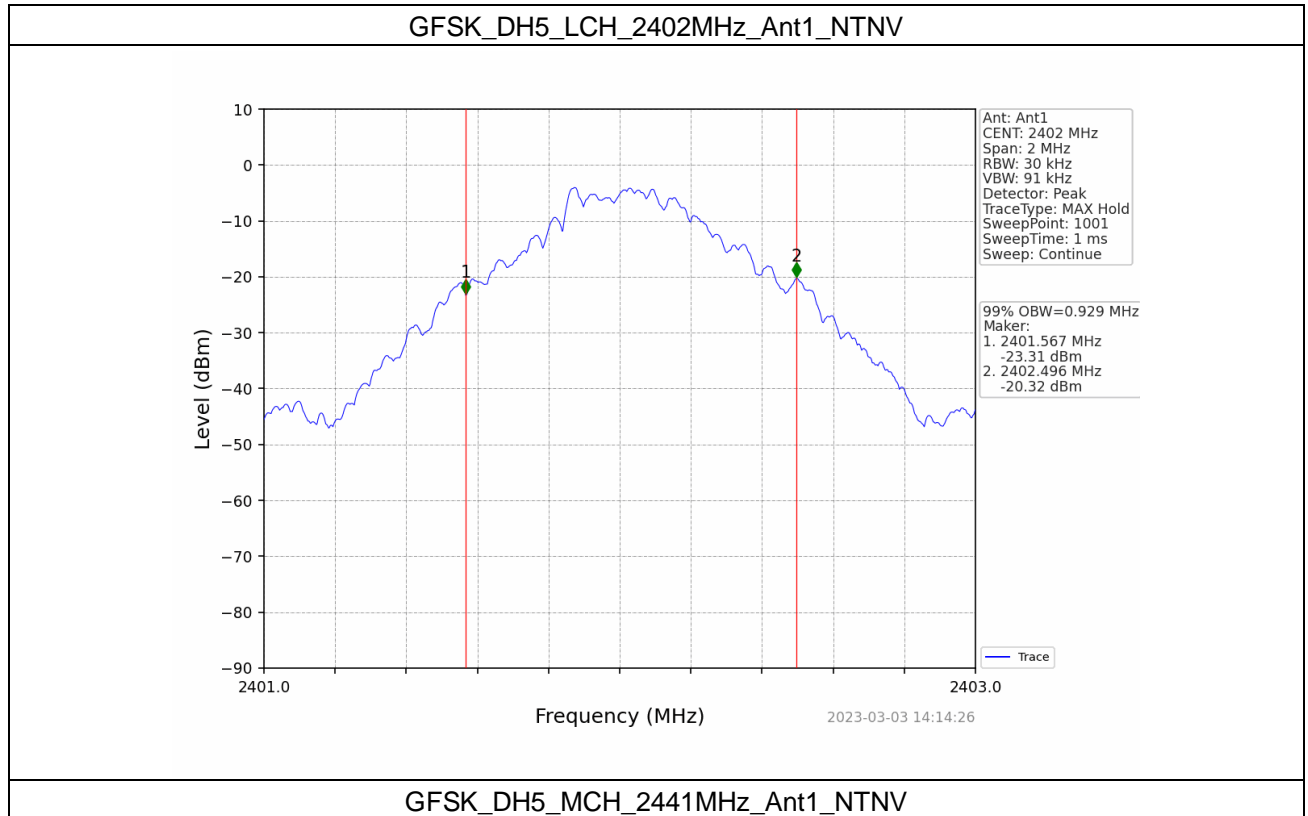
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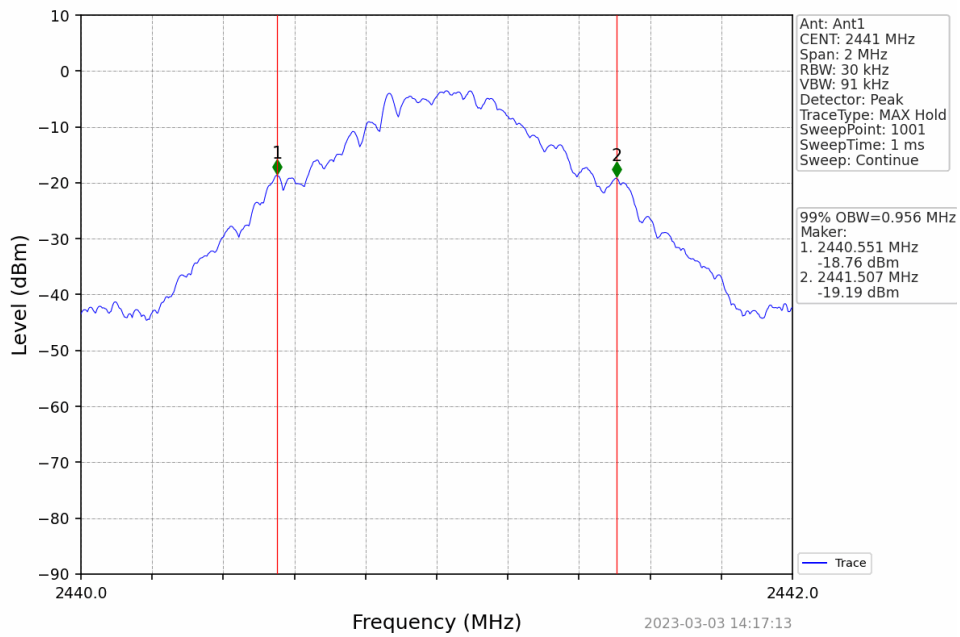
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1.1.2 Test Graph





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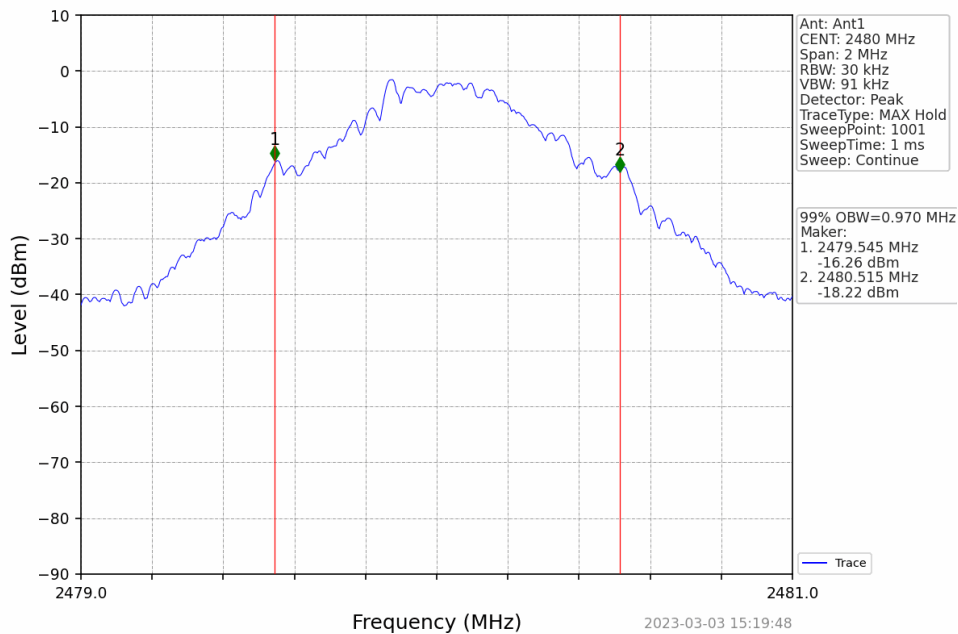
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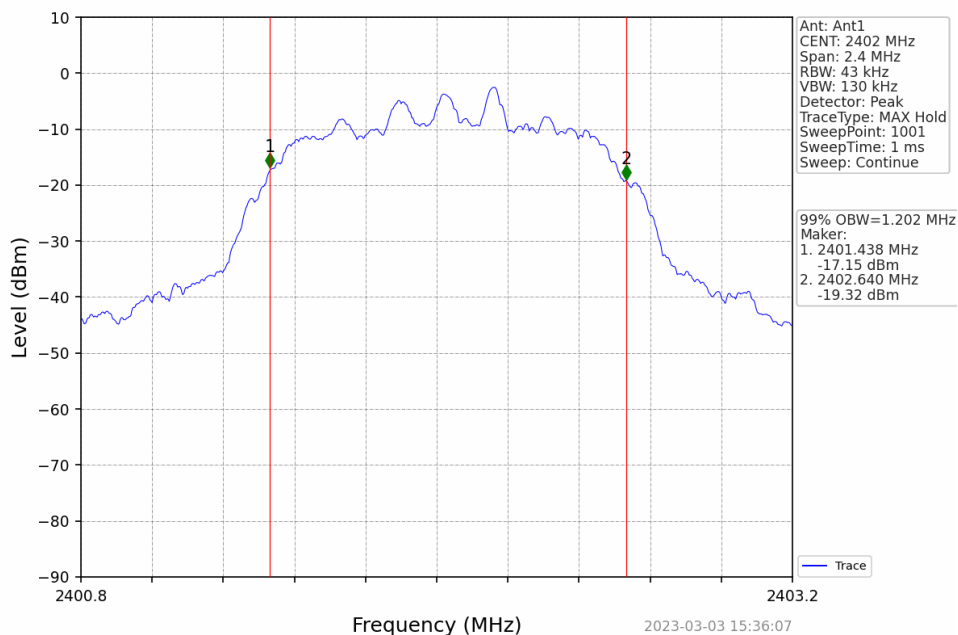
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GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4QPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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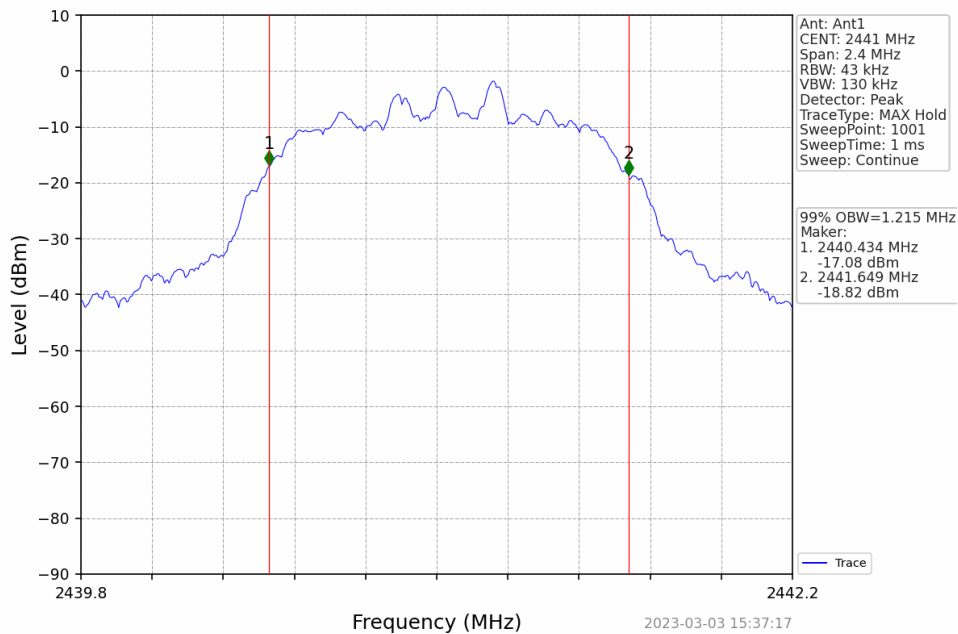
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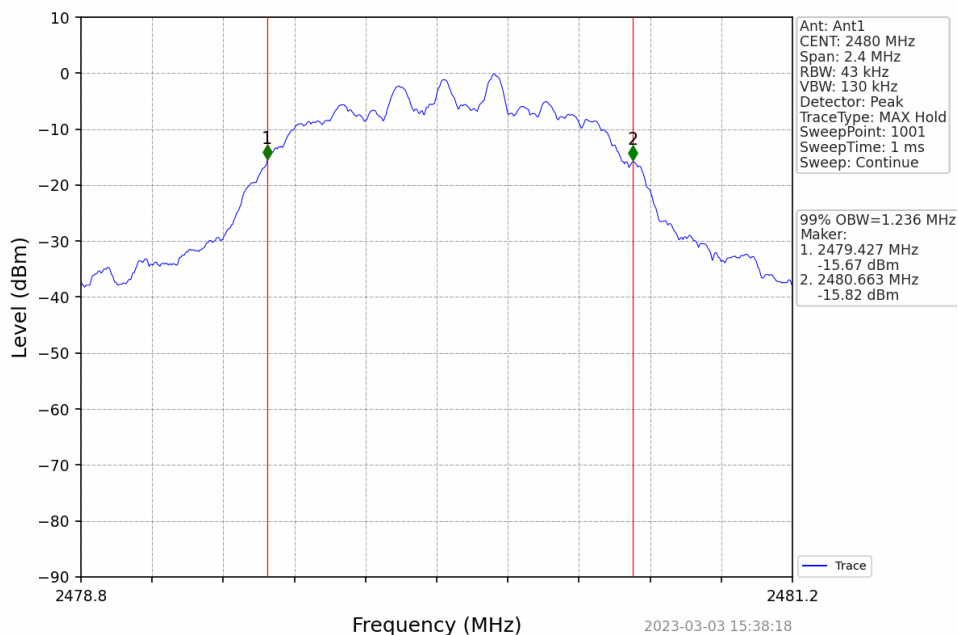
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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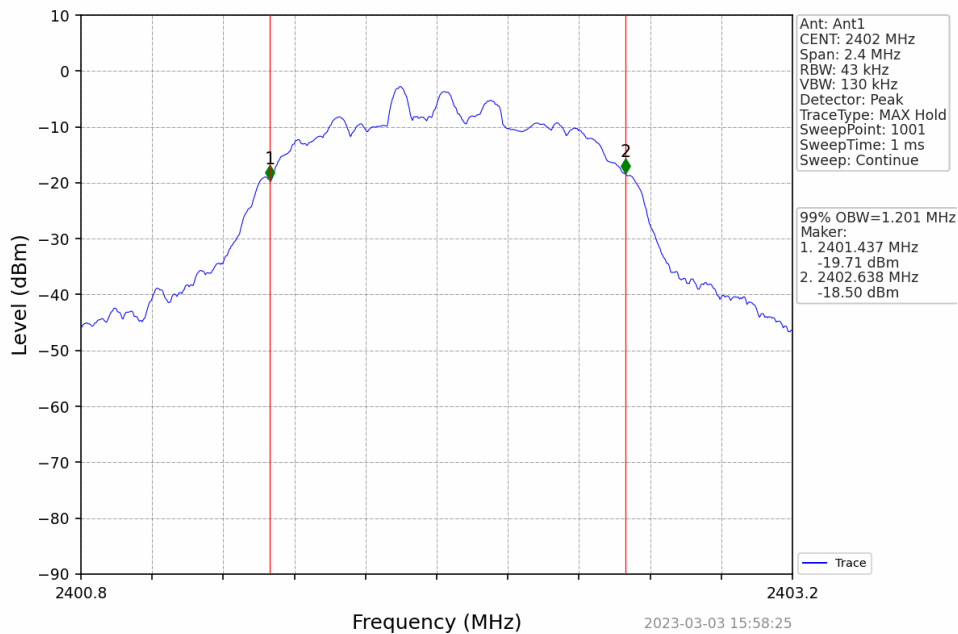
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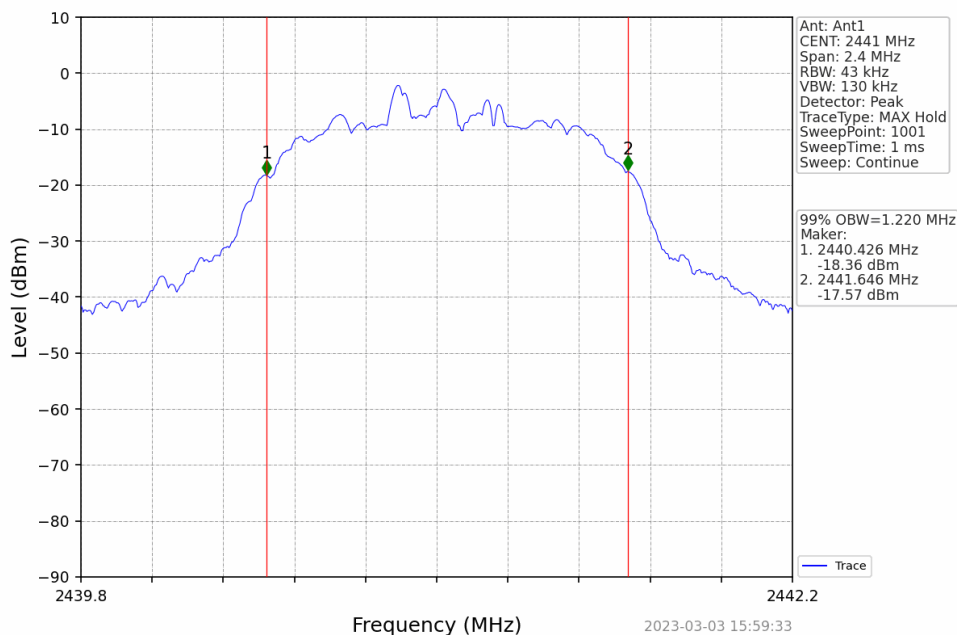
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



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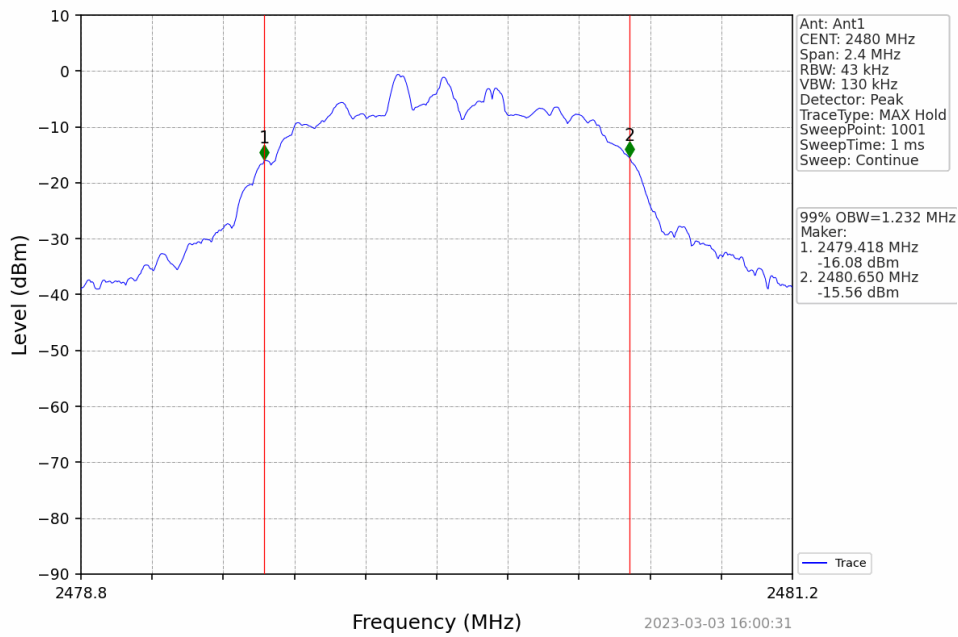
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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



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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	1.032	Pass
		2441	DH5	1	1.041	Pass
		2480	DH5	1	1.079	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.309	Pass
		2441	2DH5	1	1.334	Pass
		2480	2DH5	1	1.351	Pass
8DPSK	SISO	2402	3DH5	1	1.318	Pass
		2441	3DH5	1	1.320	Pass
		2480	3DH5	1	1.332	Pass



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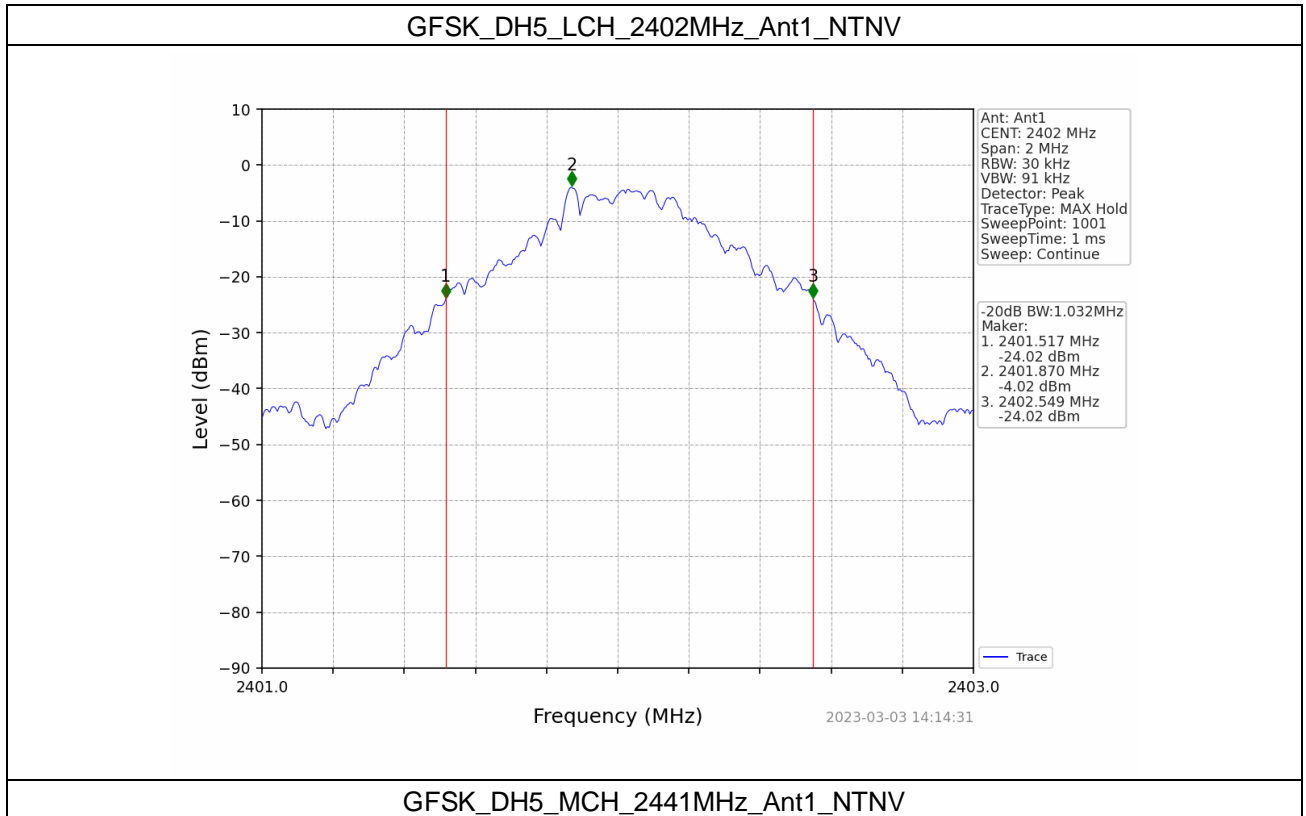
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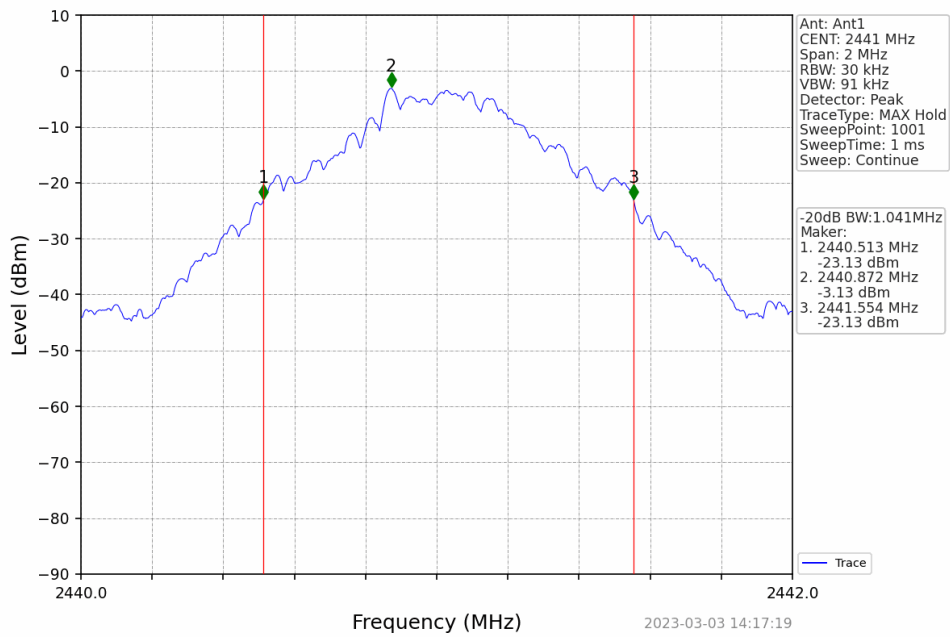
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1.2.2 Test Graph





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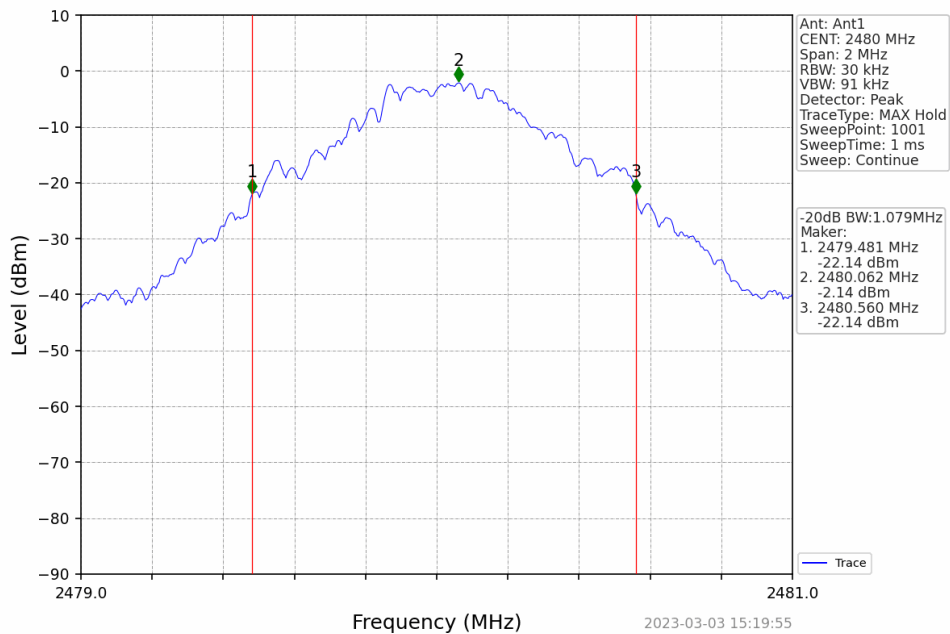
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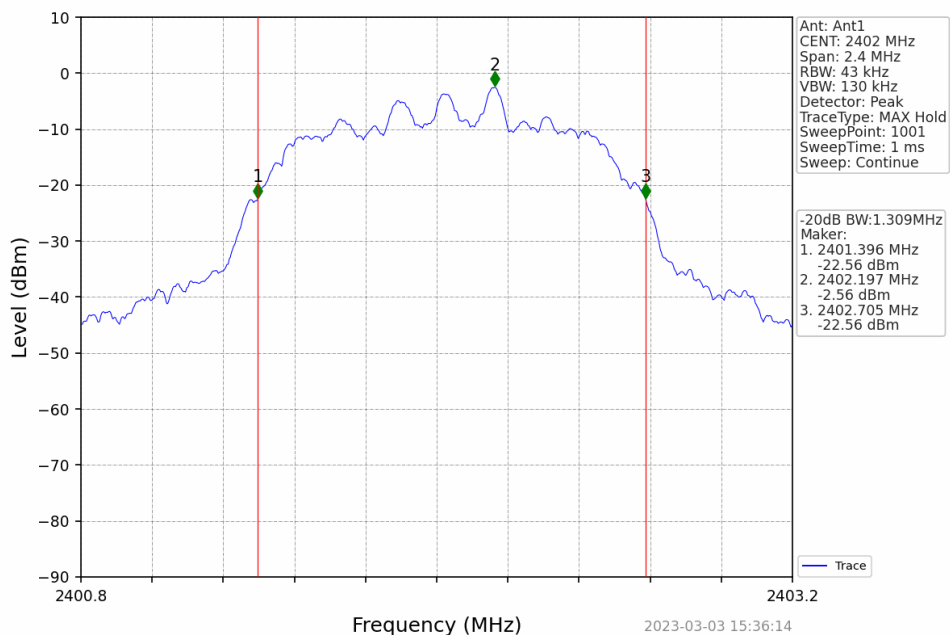
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GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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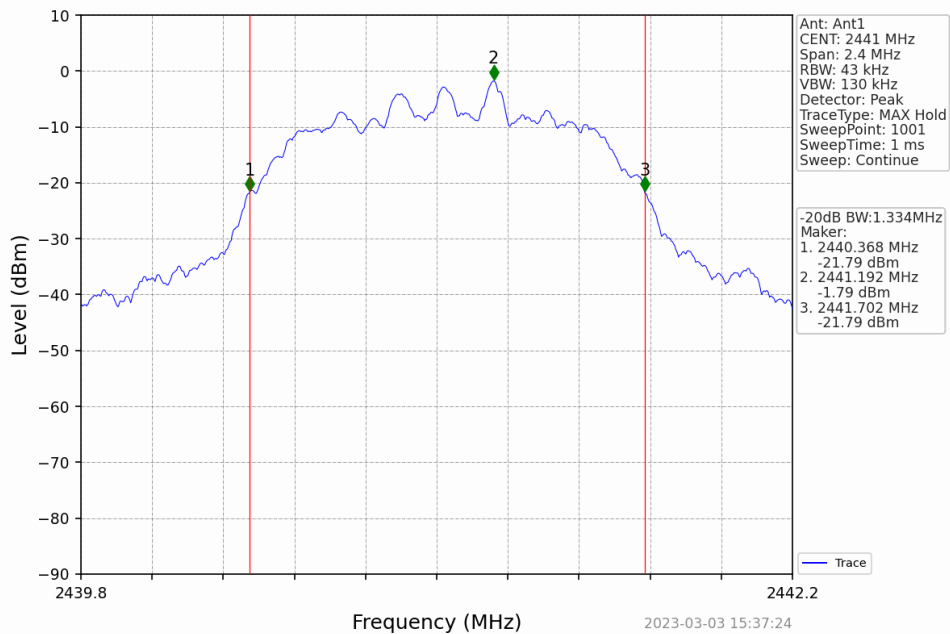
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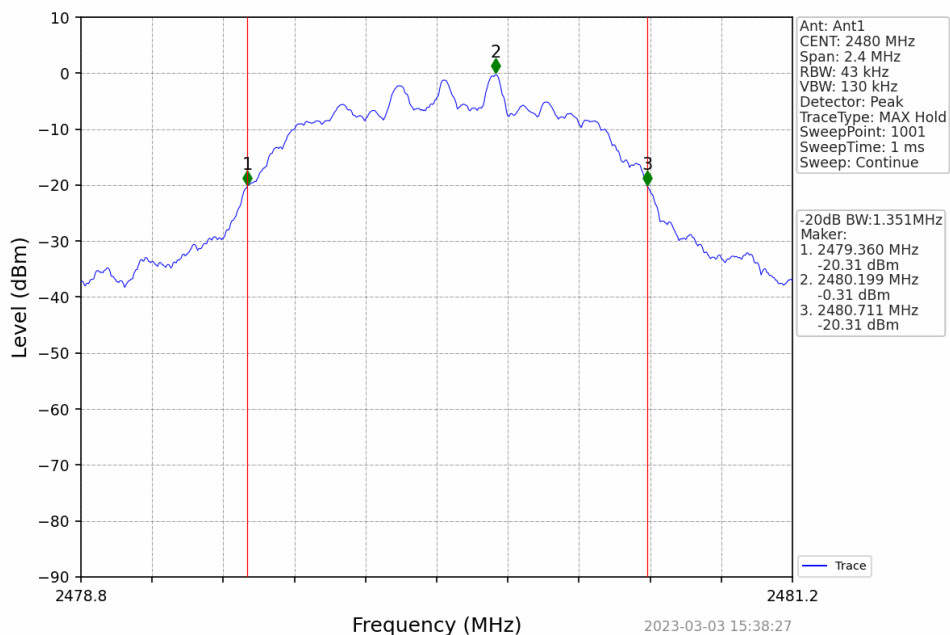
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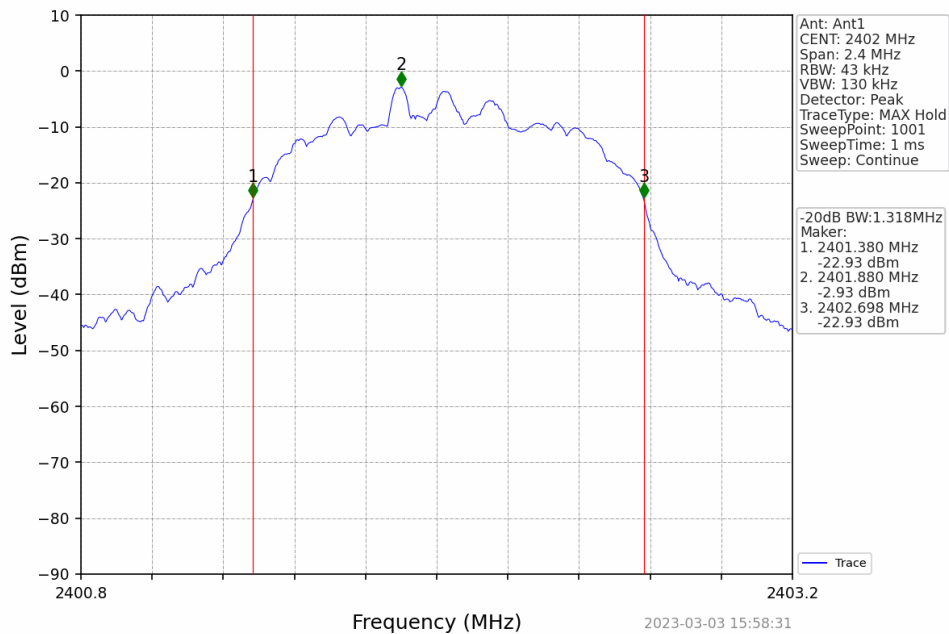
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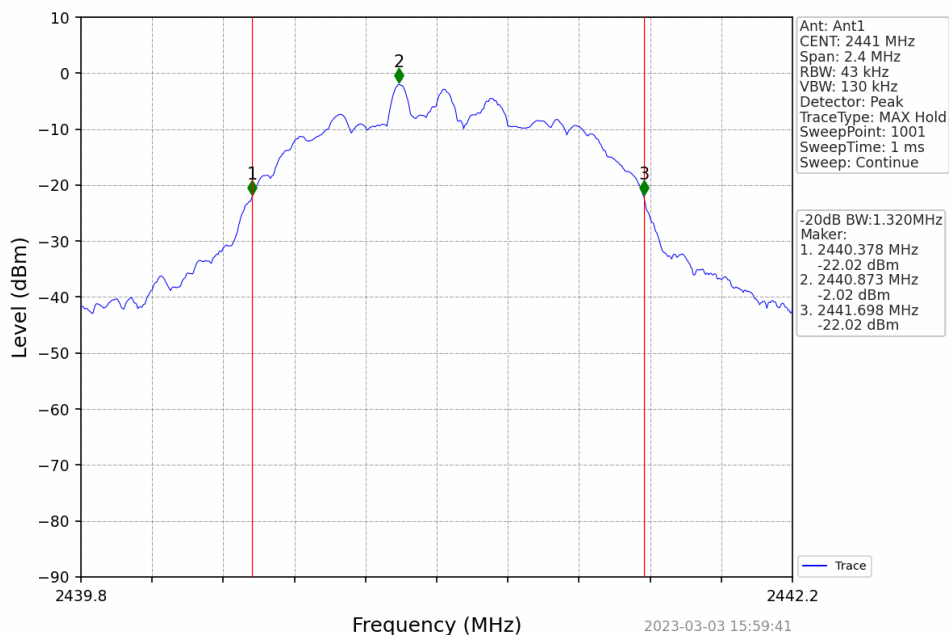
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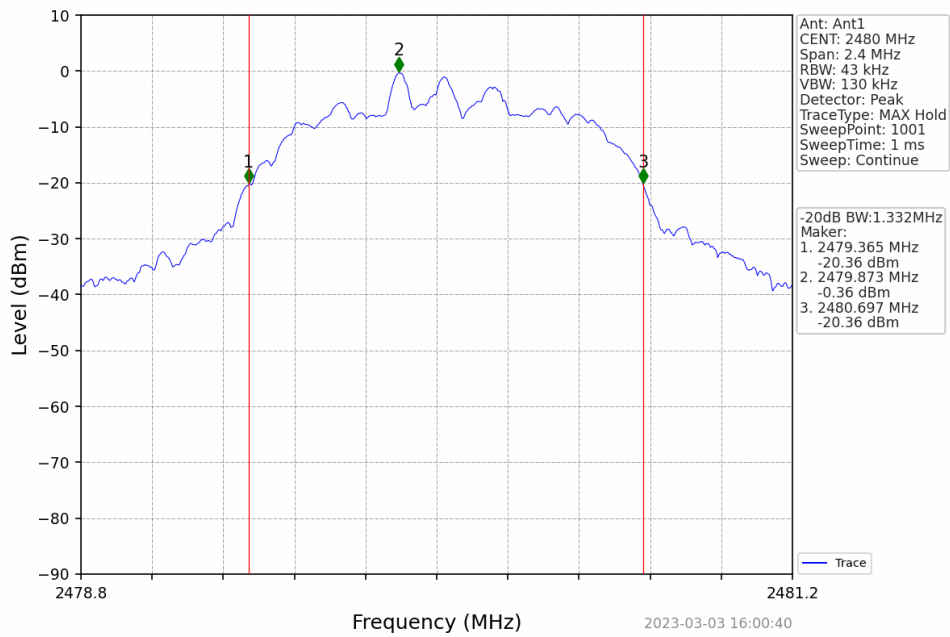
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2. Maximum Conducted Output Power

2.1 Power

2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-1.31	<=20.97	Pass
		2441	DH5	-0.52	<=20.97	Pass
		2480	DH5	1.08	<=20.97	Pass
Pi/4DQPSK	SISO	2402	2DH5	-0.46	<=20.97	Pass
		2441	2DH5	0.32	<=20.97	Pass
		2480	2DH5	1.92	<=20.97	Pass
8DPSK	SISO	2402	3DH5	-0.06	<=20.97	Pass
		2441	3DH5	0.69	<=20.97	Pass
		2480	3DH5	2.29	<=20.97	Pass



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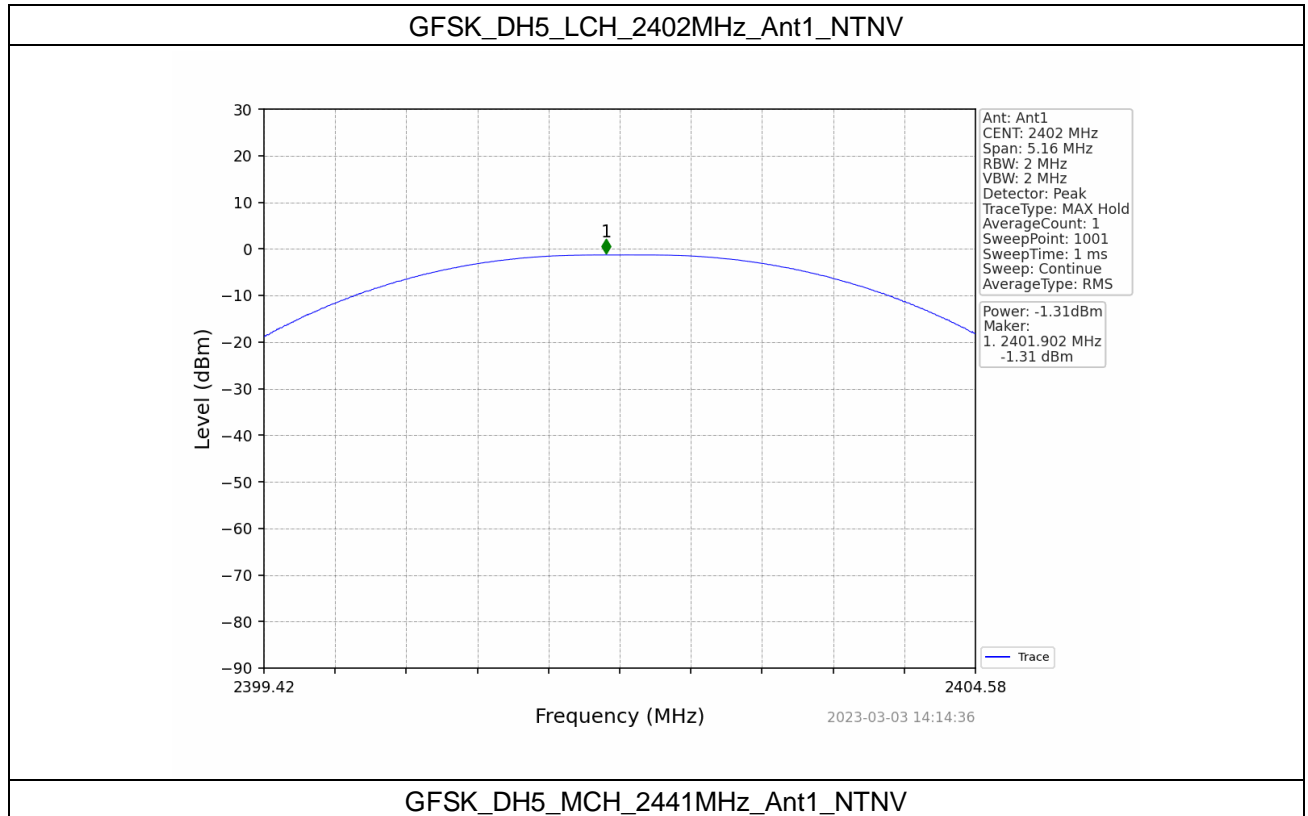
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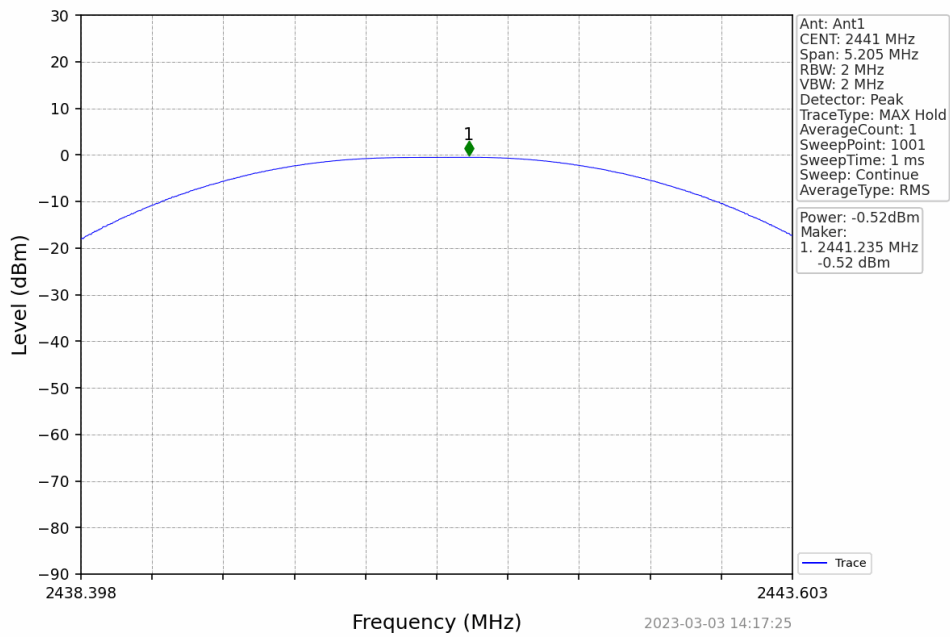
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2.1.2 Test Graph





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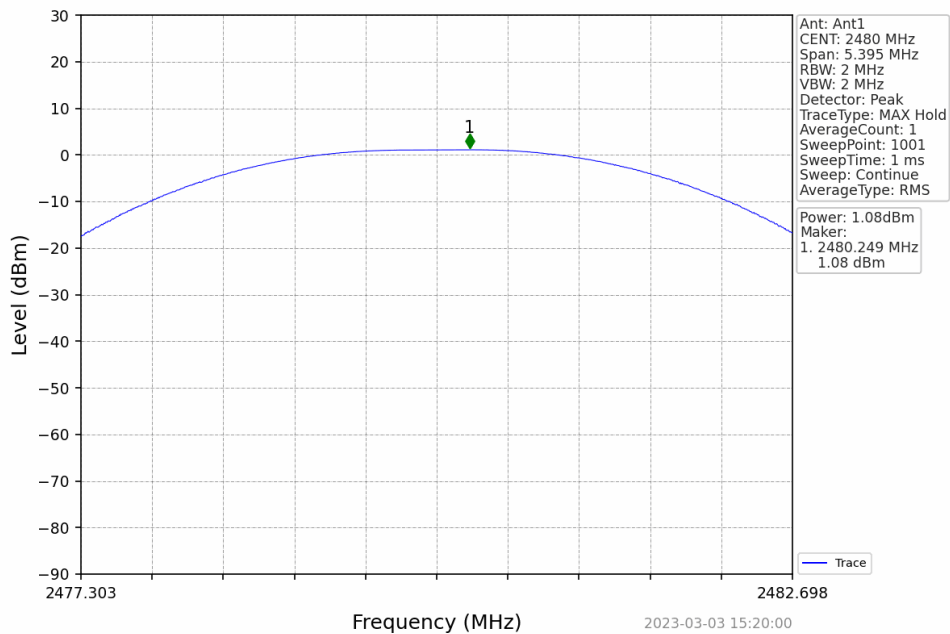
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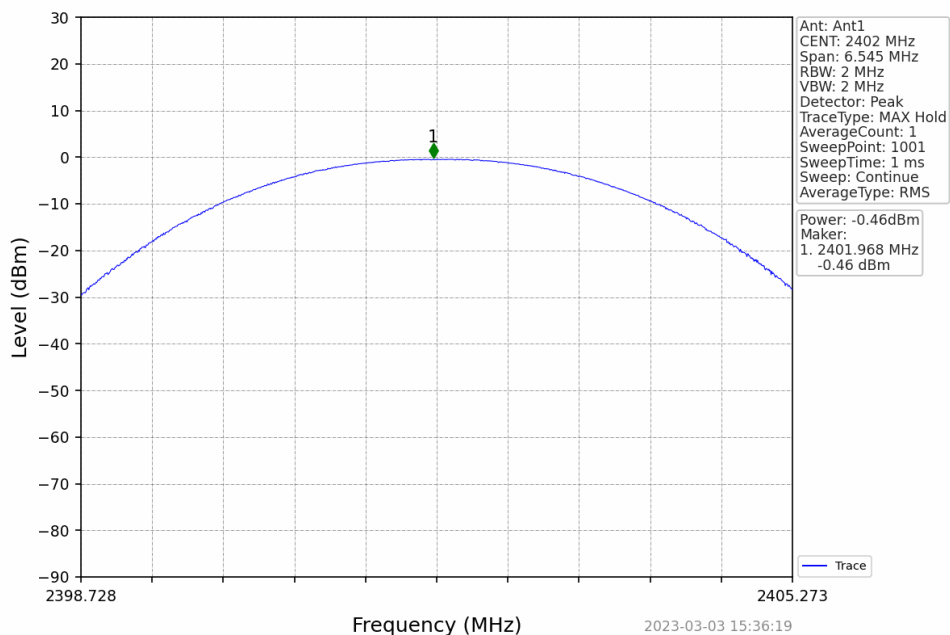
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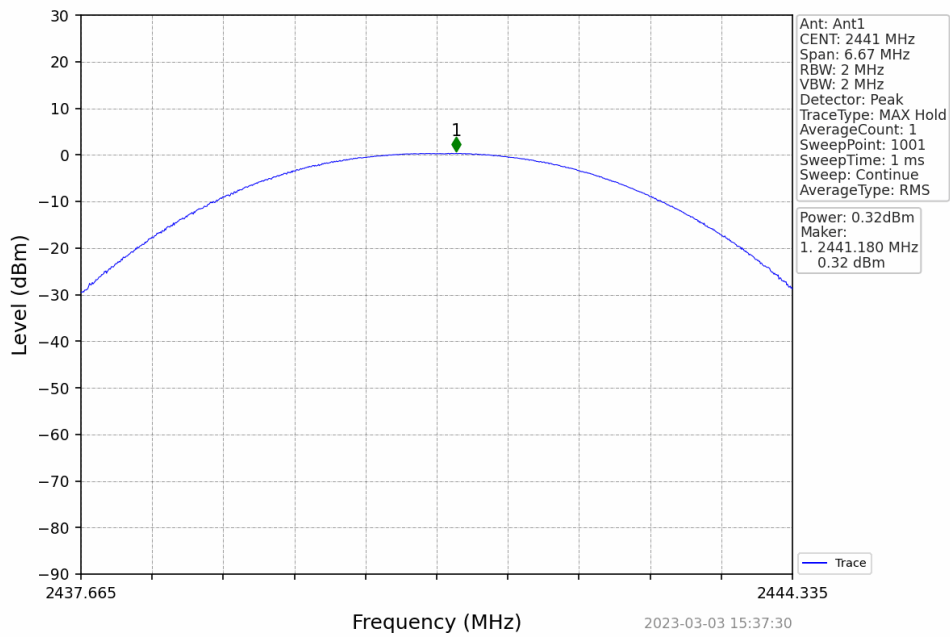
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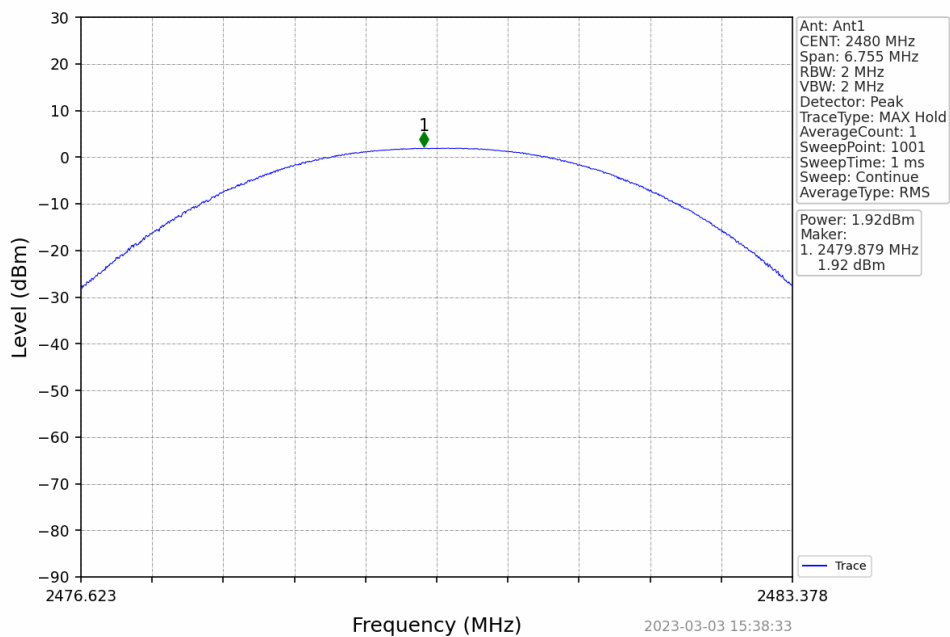
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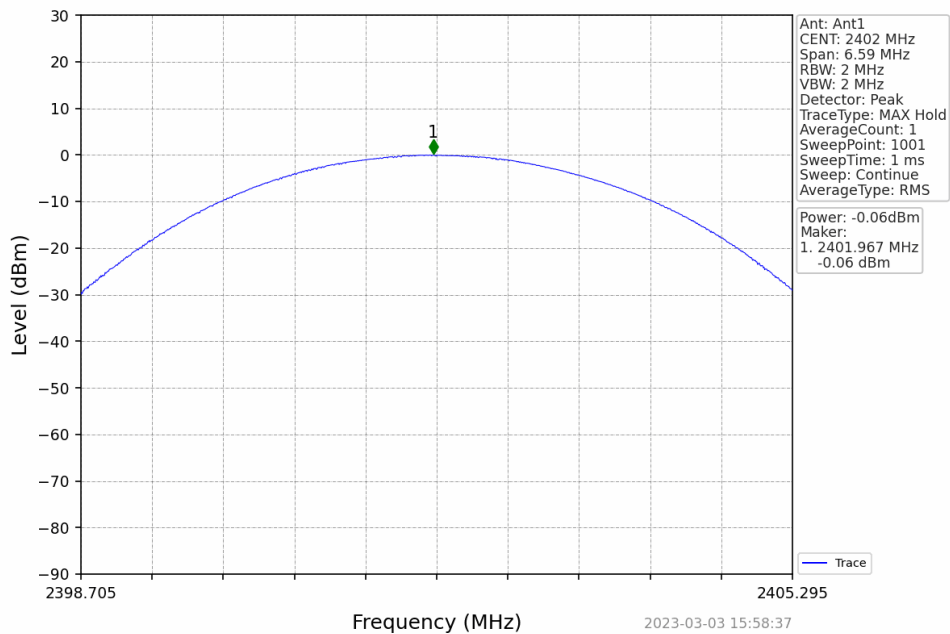
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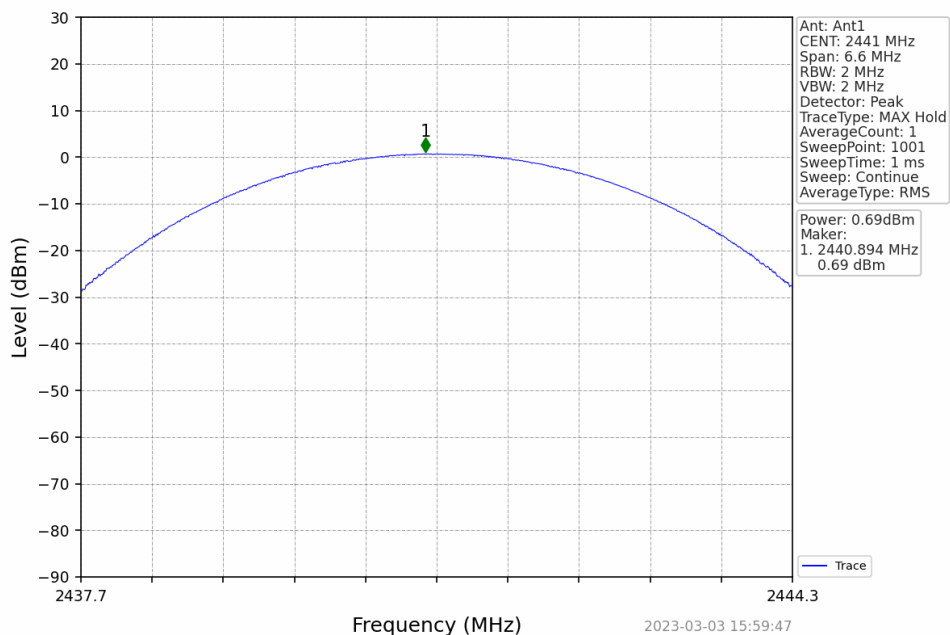
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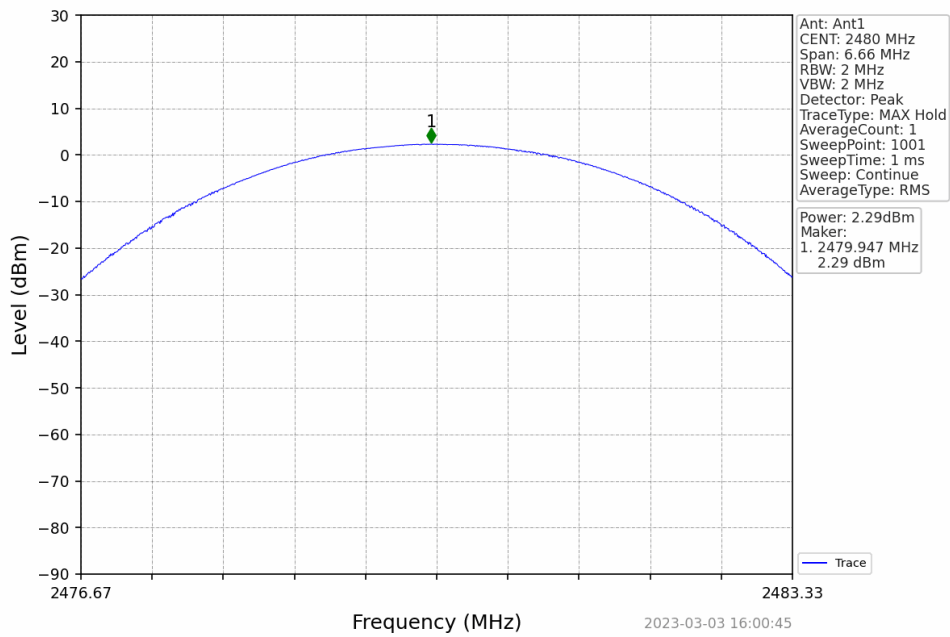
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3. Carrier Frequency Separation

3.1 Ant1

3.1.1 Test Result

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	0.994	1.079	≥ 0.719	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.001	1.351	≥ 0.901	Pass
8DPSK	SISO	HOPP	3DH5	1.001	1.332	≥ 0.888	Pass



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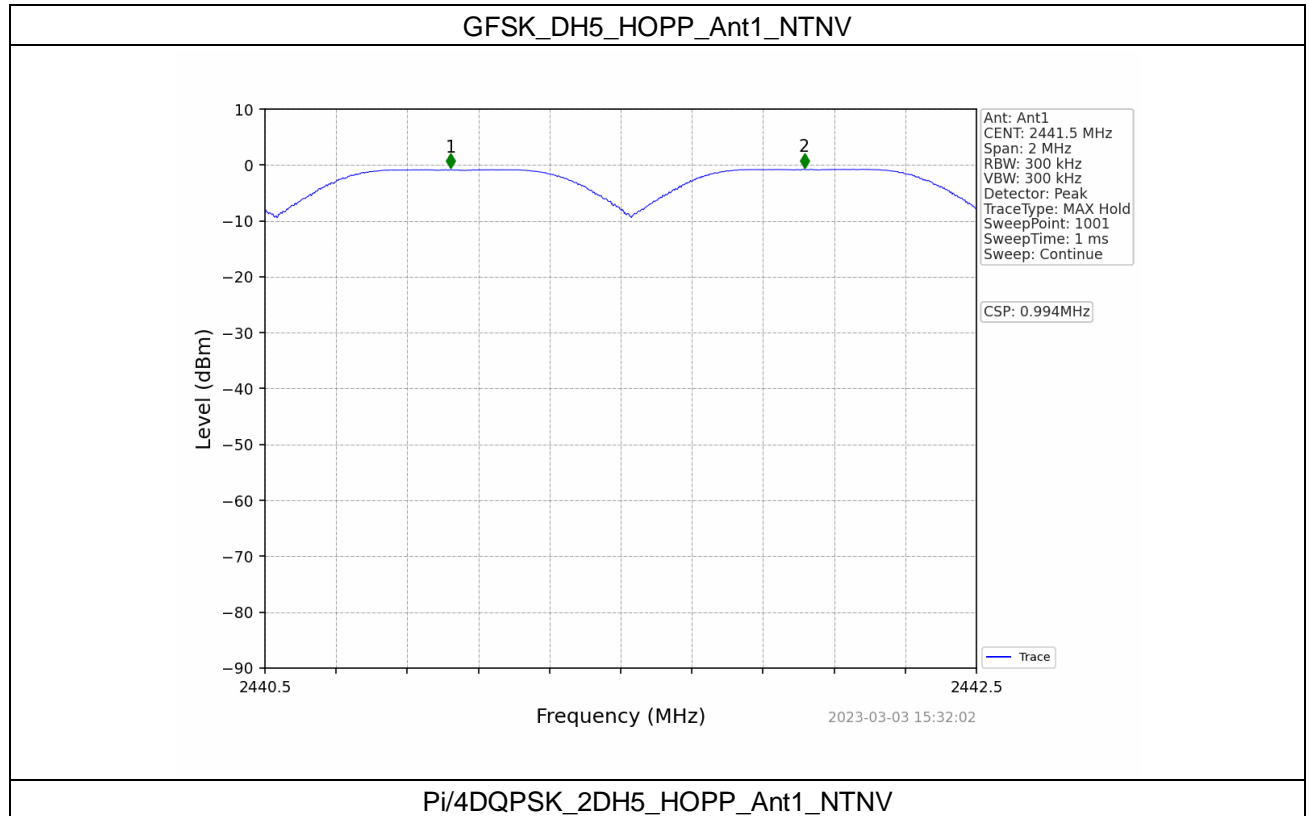
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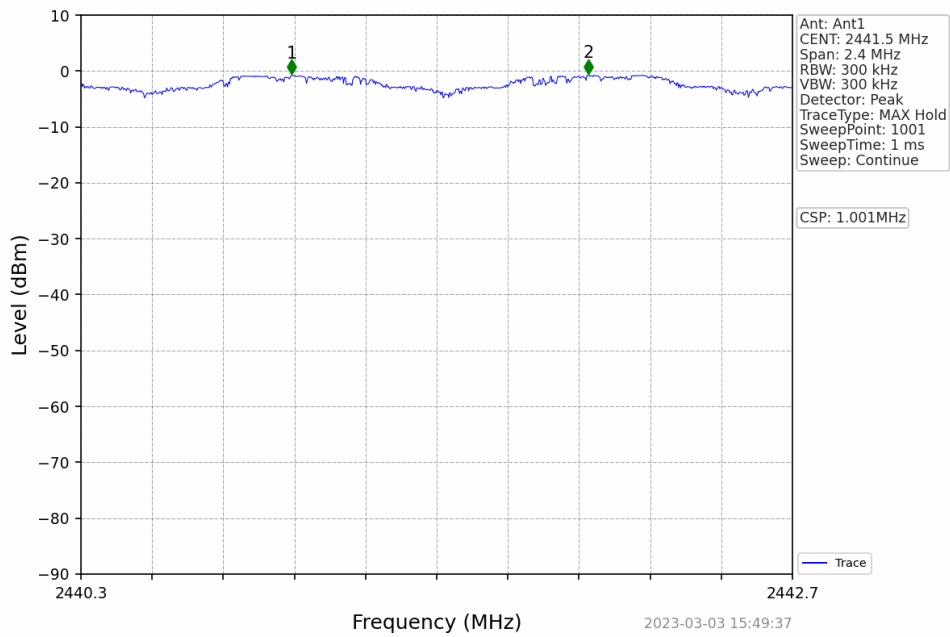
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3.1.2 Test Graph





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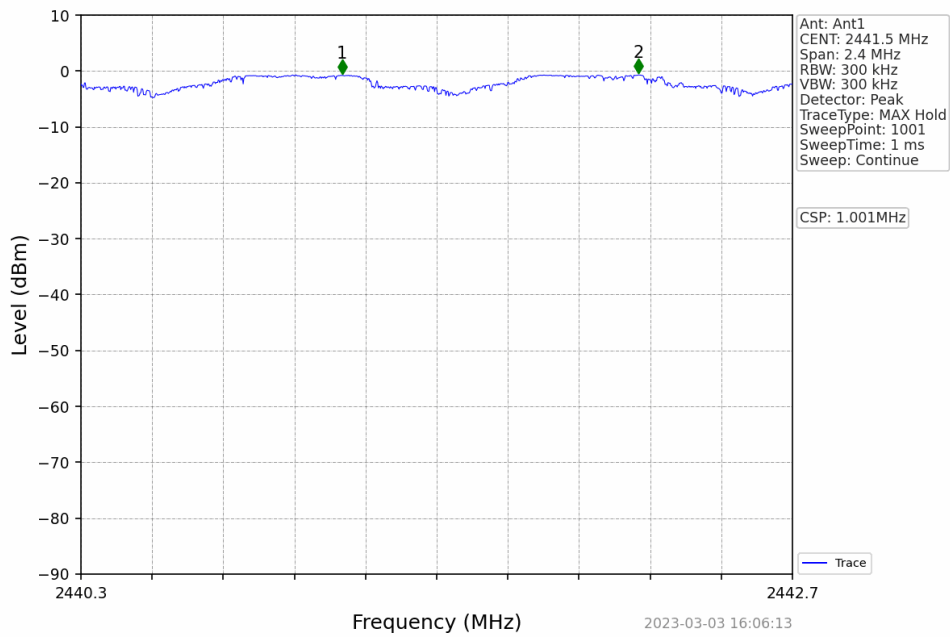
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8DPSK_3DH5_HOPP_Ant1_NTNV



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4. Number of Hopping Frequencies

4.1 HoppNum

4.1.1 Test Result

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



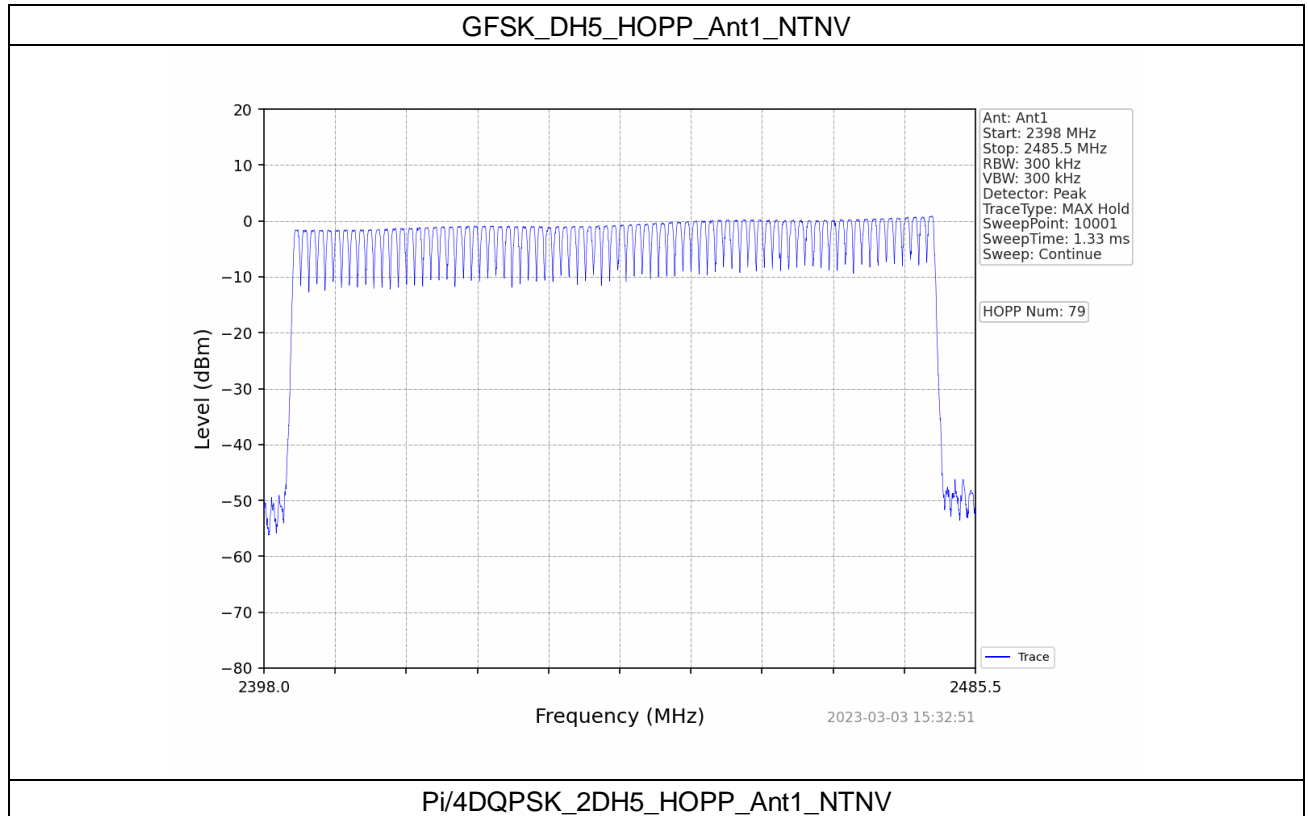
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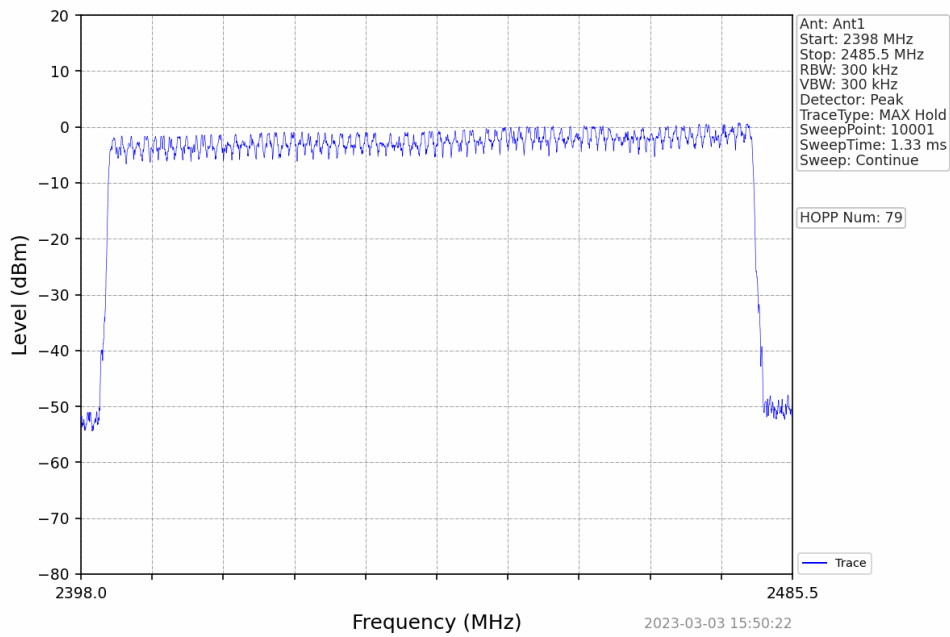
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4.1.2 Test Graph





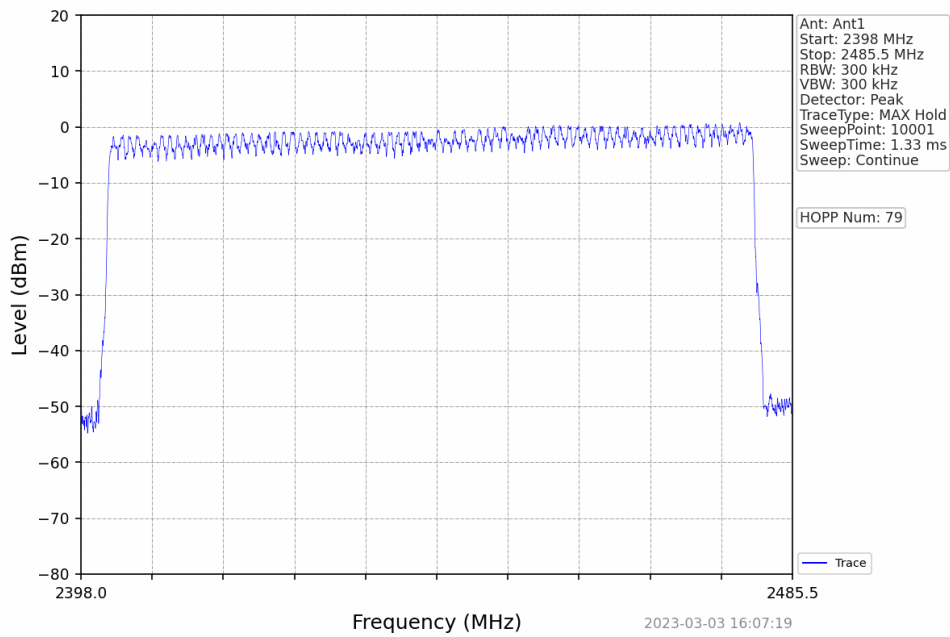
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8DPSK_3DH5_HOPP_Ant1_NTNV



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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	0.380	31.600	319	121.220	<=400	Pass
			DH3	1.640	31.600	166	272.240	<=400	Pass
			DH5	2.888	31.600	93	268.584	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.390	31.600	321	125.190	<=400	Pass
			2DH3	1.646	31.600	162	266.652	<=400	Pass
			2DH5	2.894	31.600	106	306.764	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.390	31.600	319	124.410	<=400	Pass
			3DH3	1.640	31.600	164	268.960	<=400	Pass
			3DH5	2.896	31.600	109	315.664	<=400	Pass



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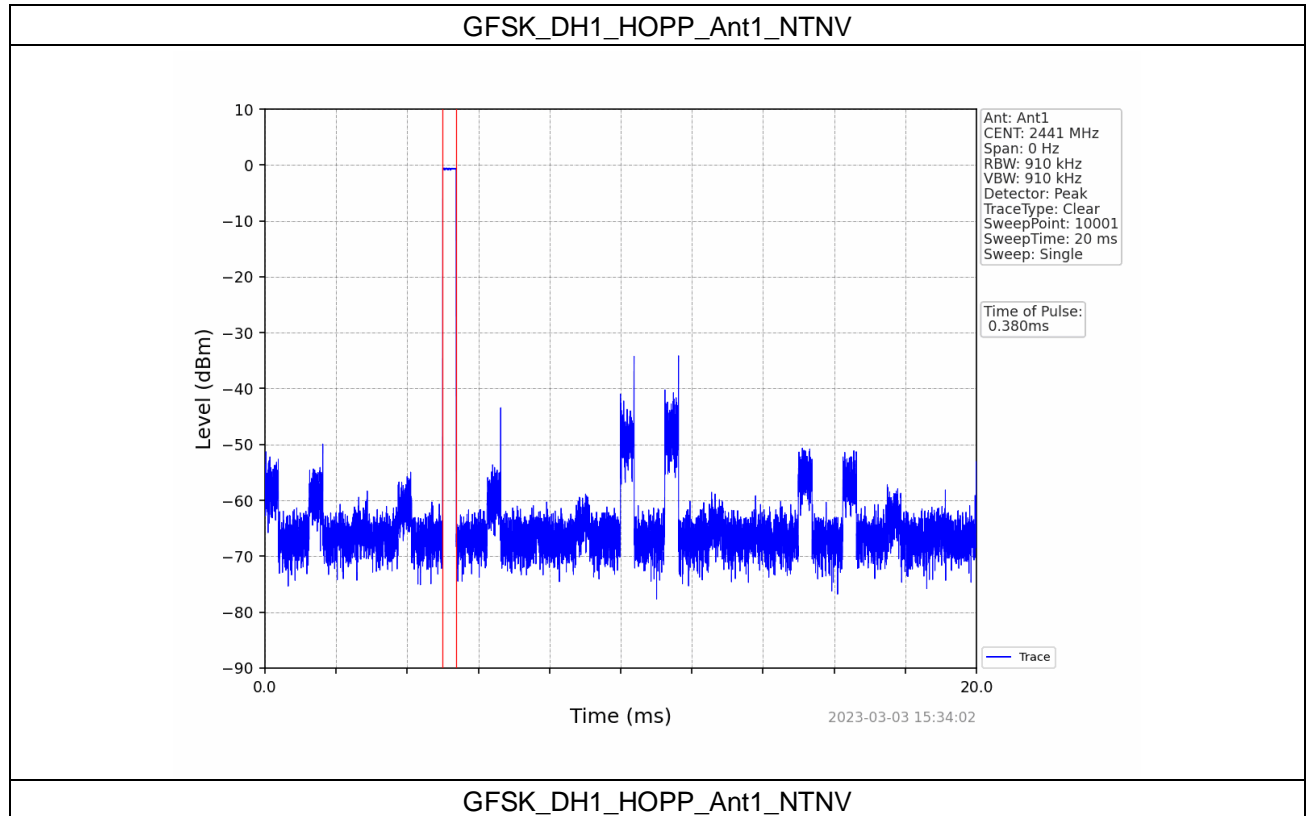
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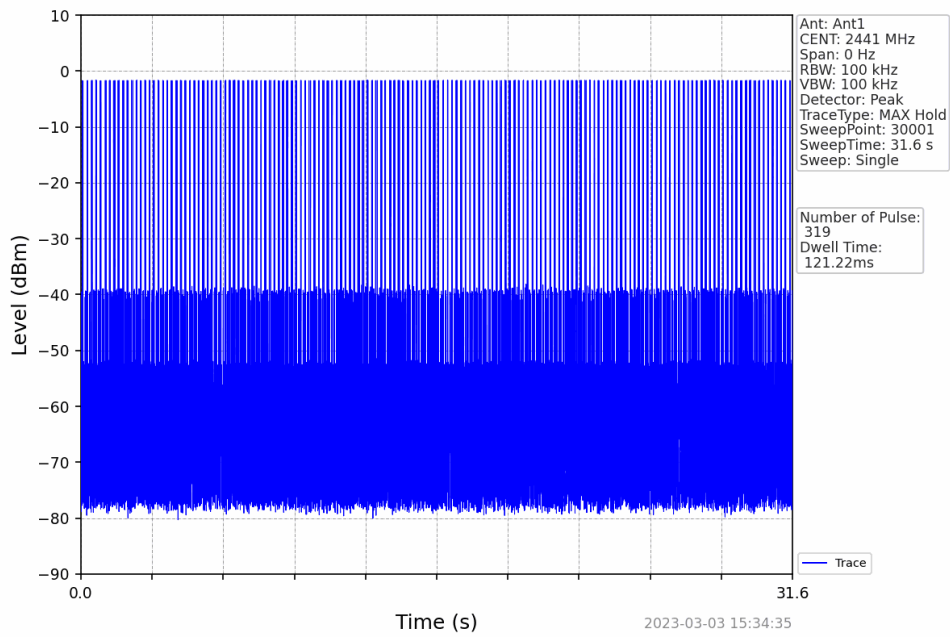
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5.1.2 Test Graph





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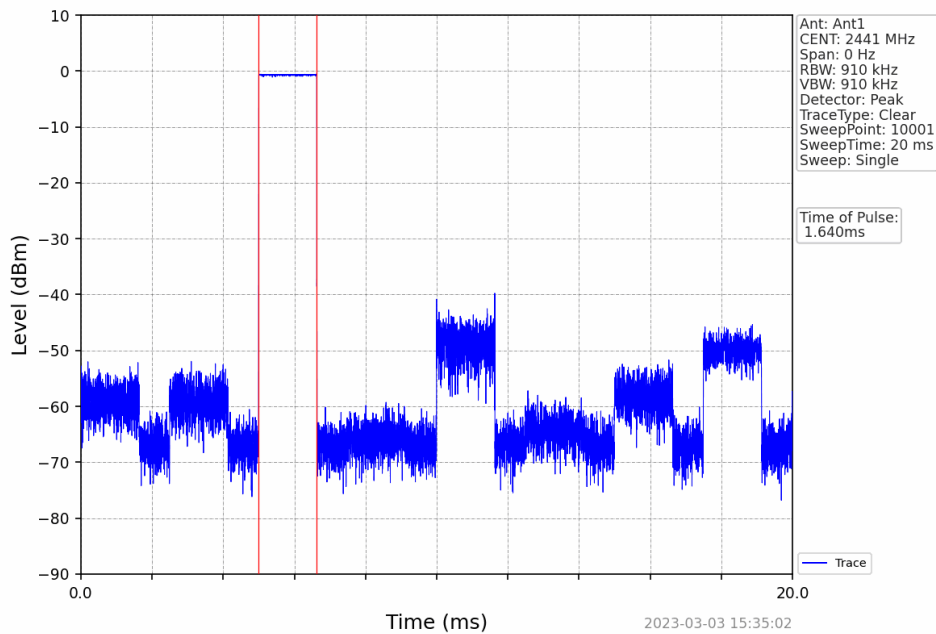
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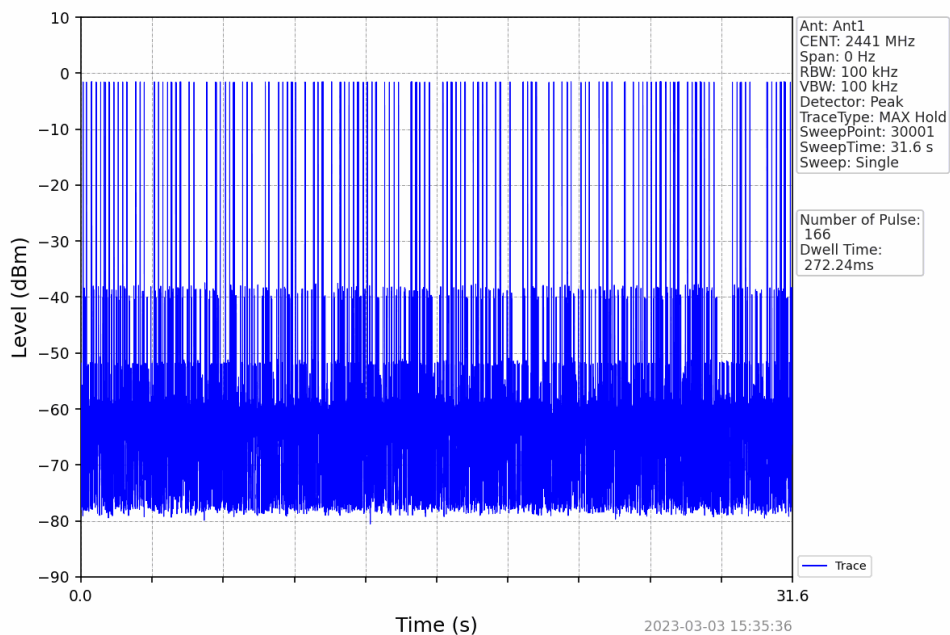
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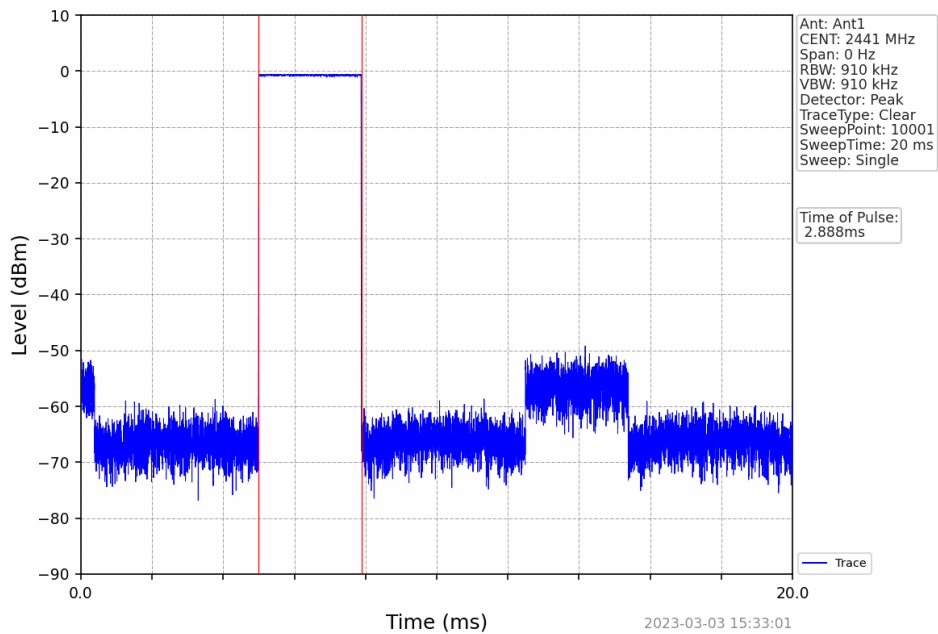


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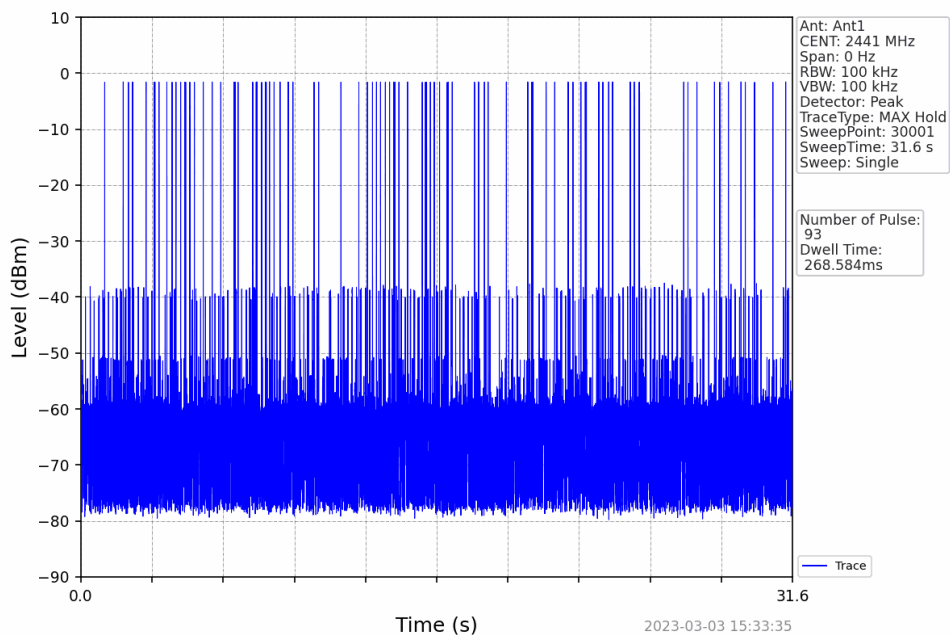
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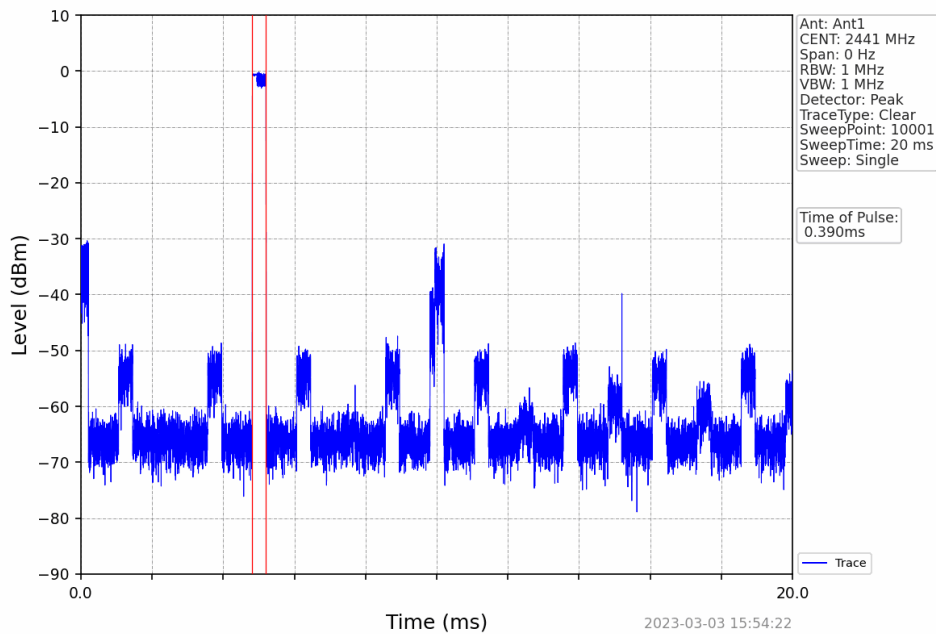
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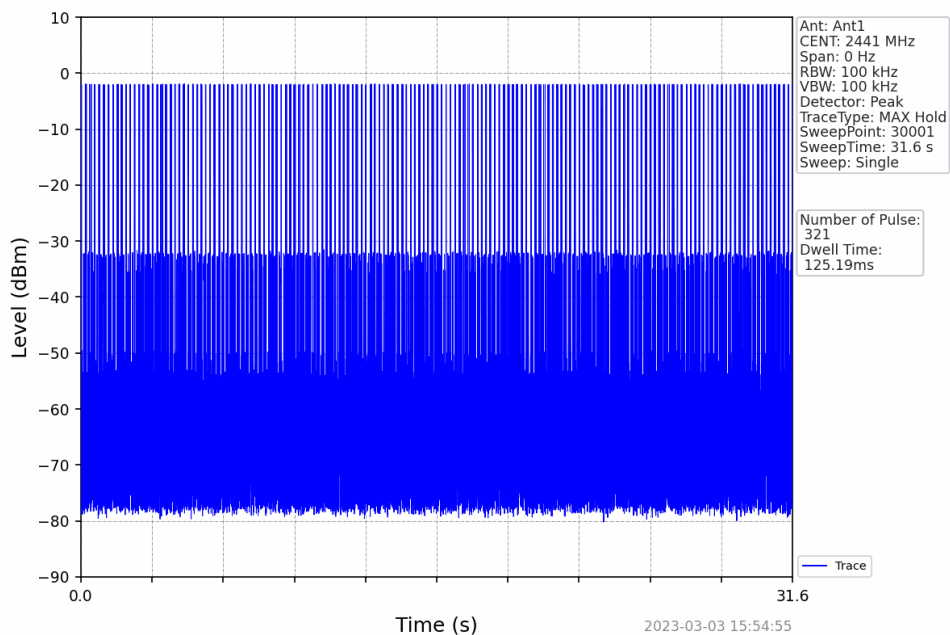
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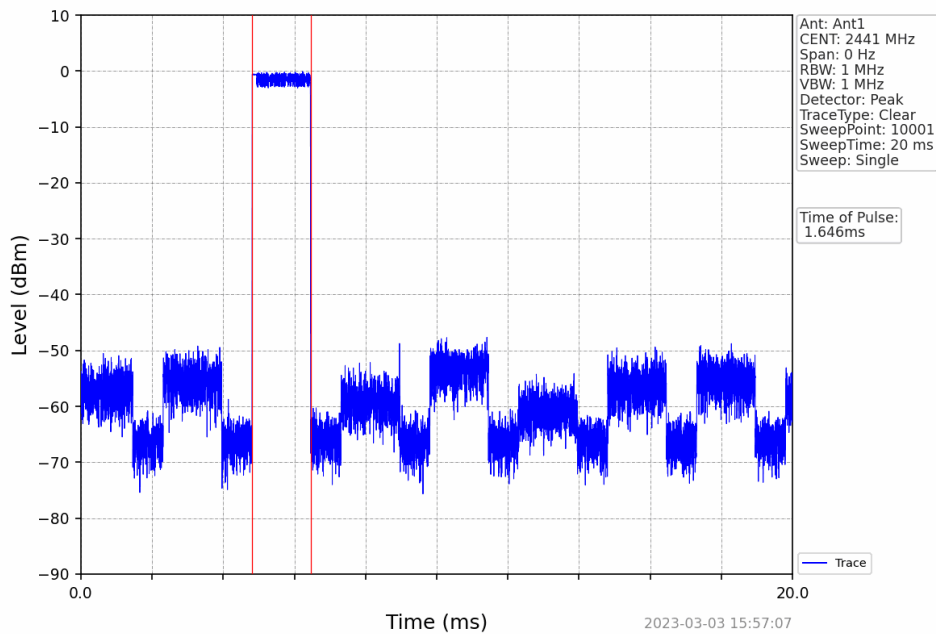
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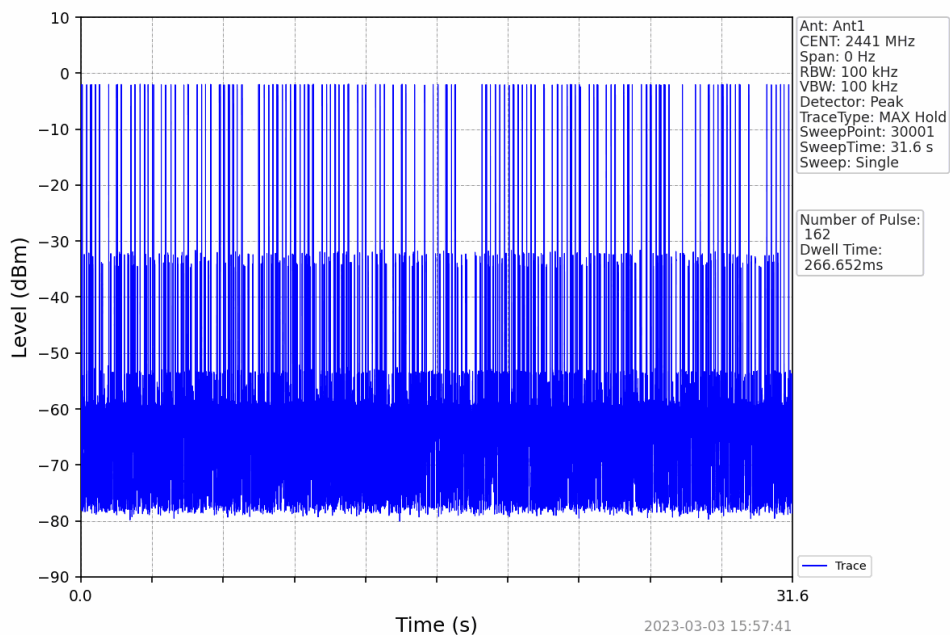
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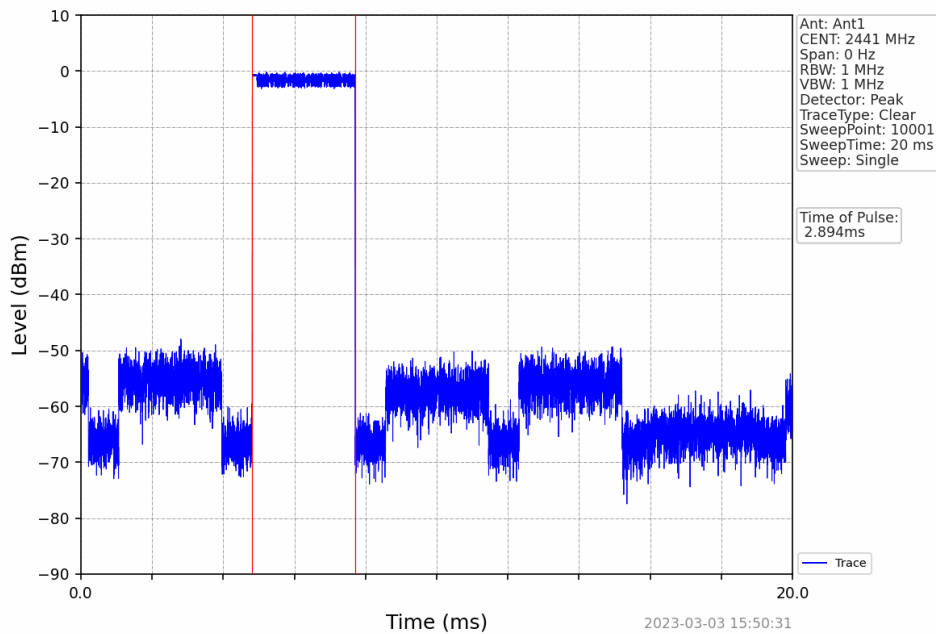
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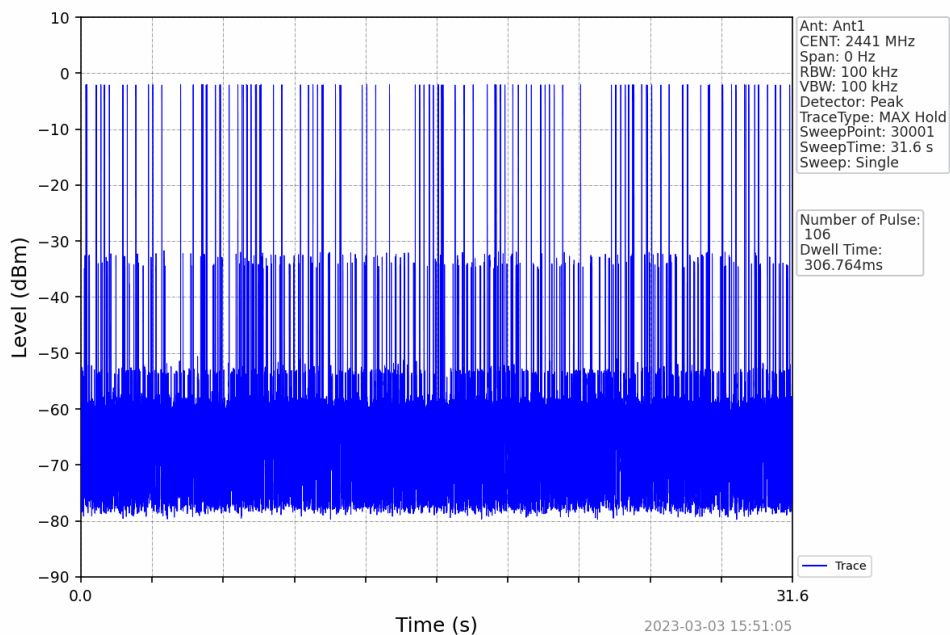
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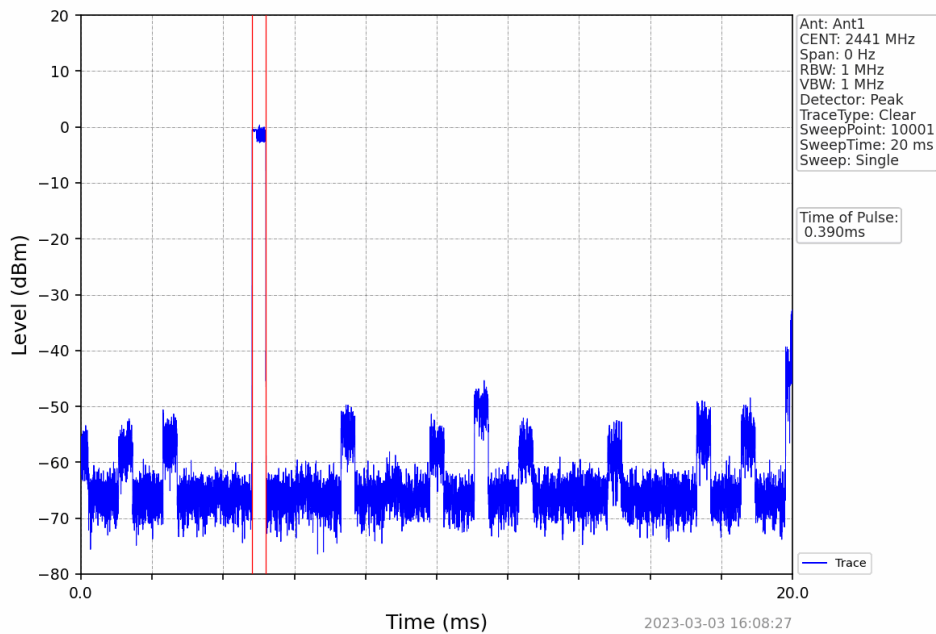
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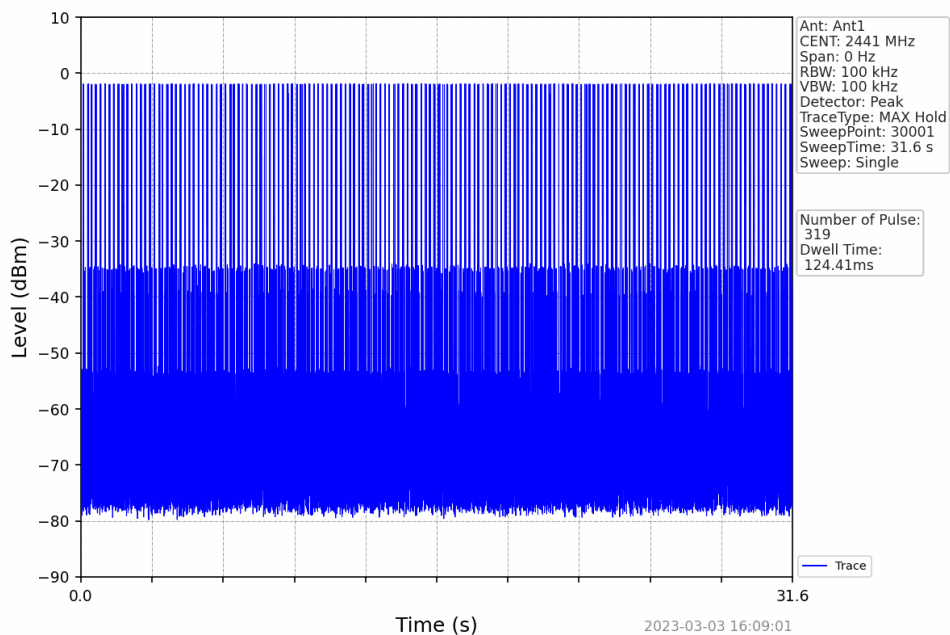
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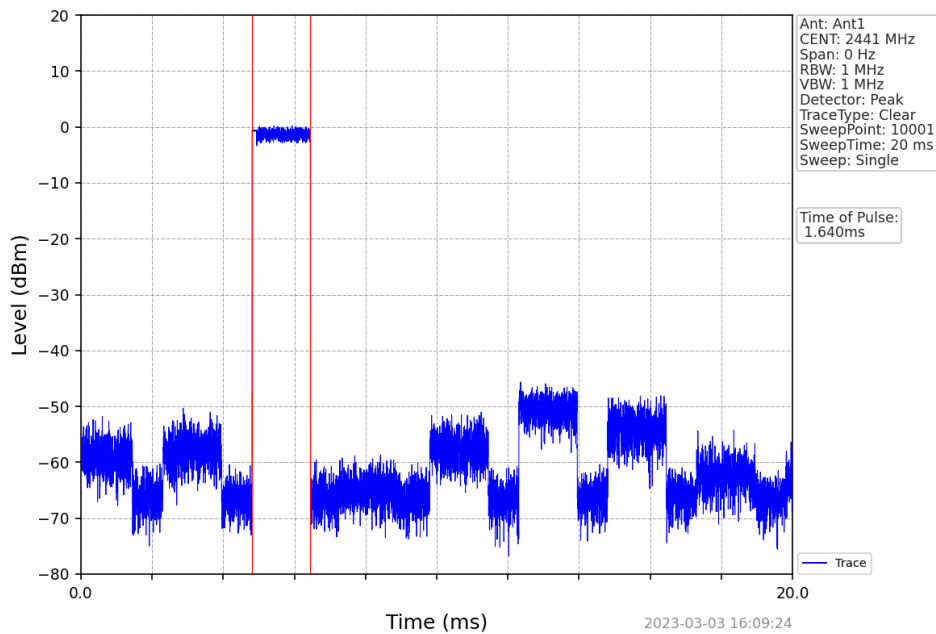


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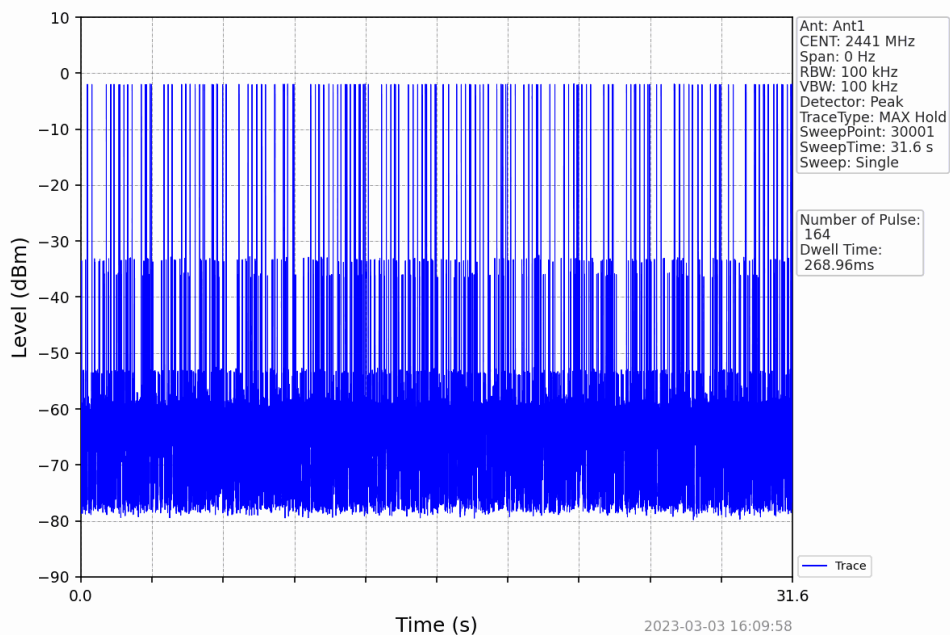
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8DPSK_3DH3_HOPP_Ant1_NTNV



8DPSK_3DH3_HOPP_Ant1_NTNV



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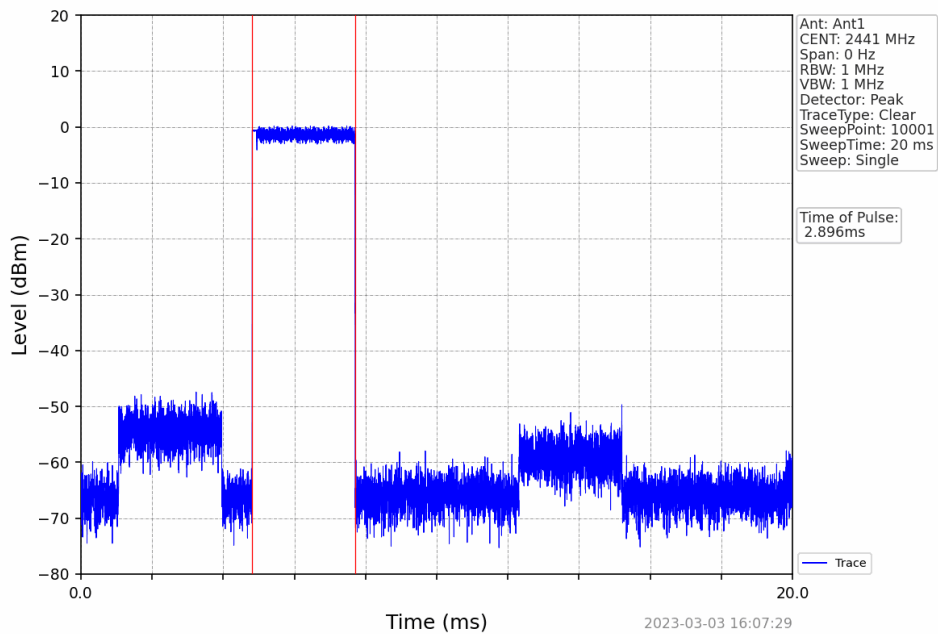
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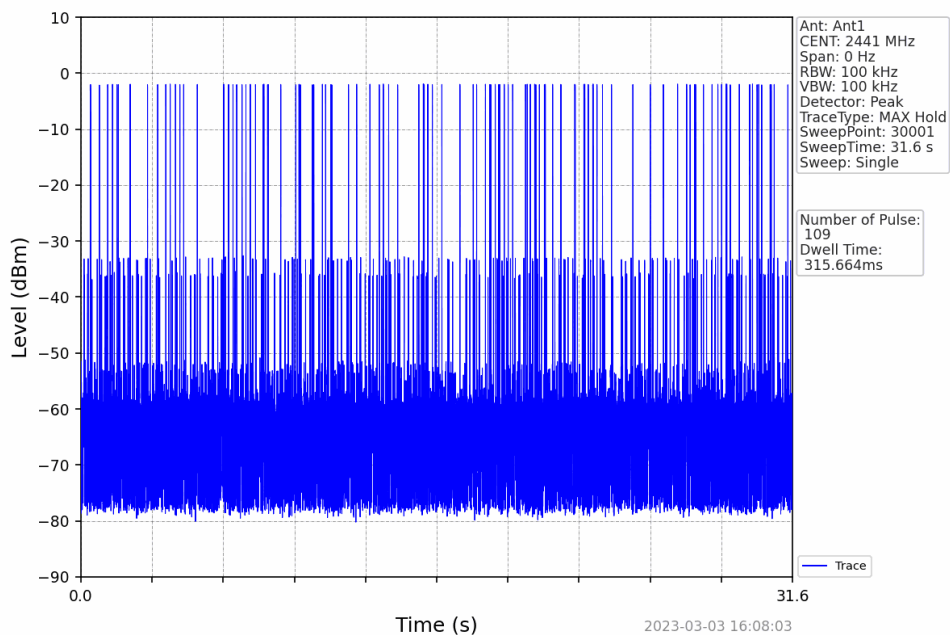
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8DPSK_3DH5_HOPP_Ant1_NTNV



8DPSK_3DH5_HOPP_Ant1_NTNV



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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	-1.59
		2441	DH5	1	-0.92
		2480	DH5	1	0.46
Pi/4DQPSK	SISO	2402	2DH5	1	-1.62
		2441	2DH5	1	-0.87
		2480	2DH5	1	0.72
8DPSK	SISO	2402	3DH5	1	-1.72
		2441	3DH5	1	-1.03
		2480	3DH5	1	0.72

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.



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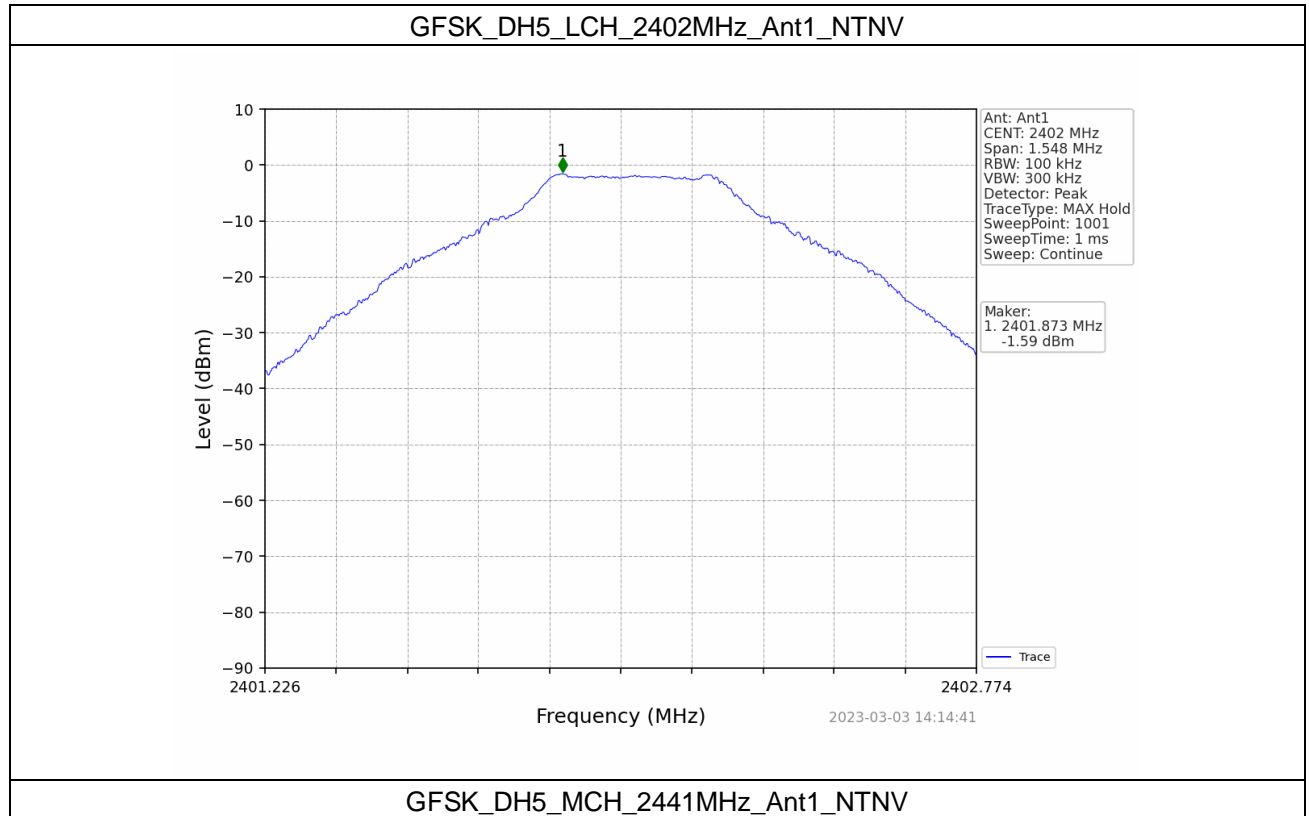
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6.1.2 Test Graph



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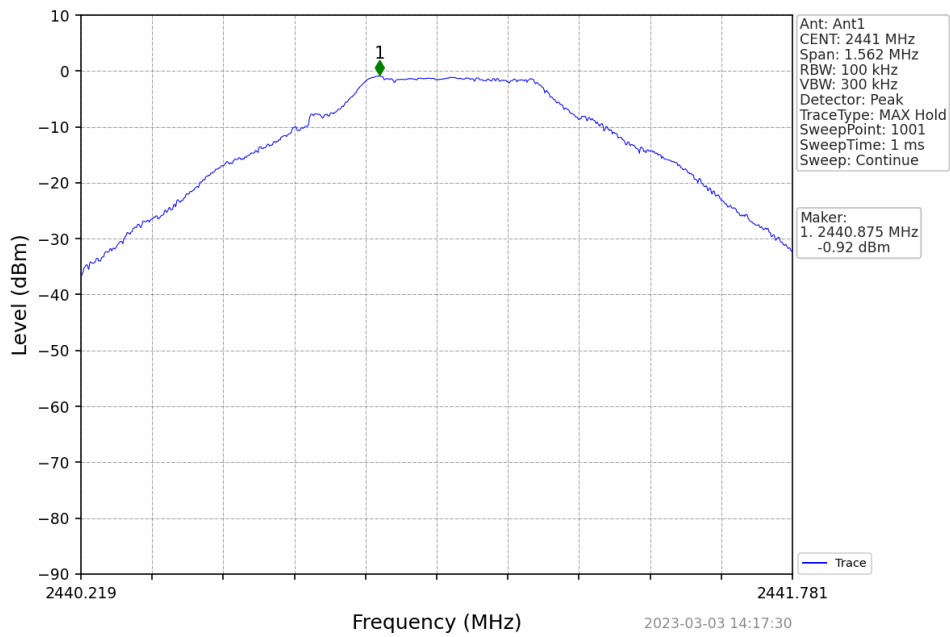
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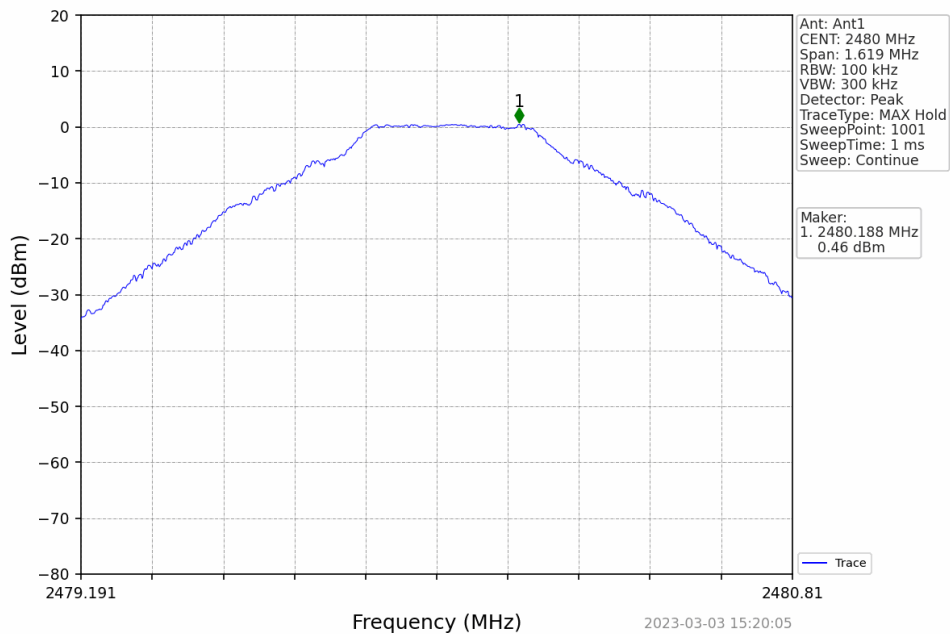
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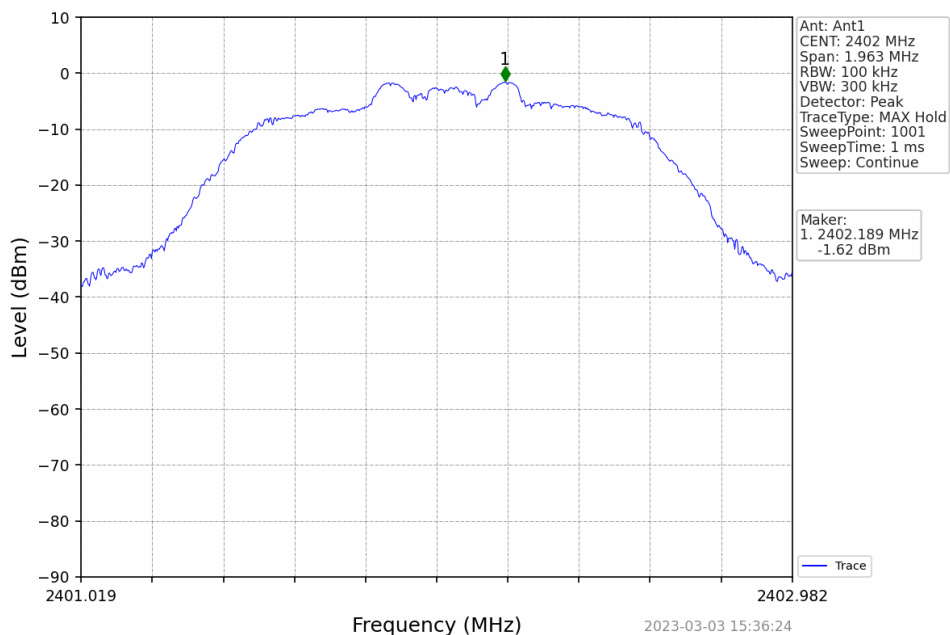
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GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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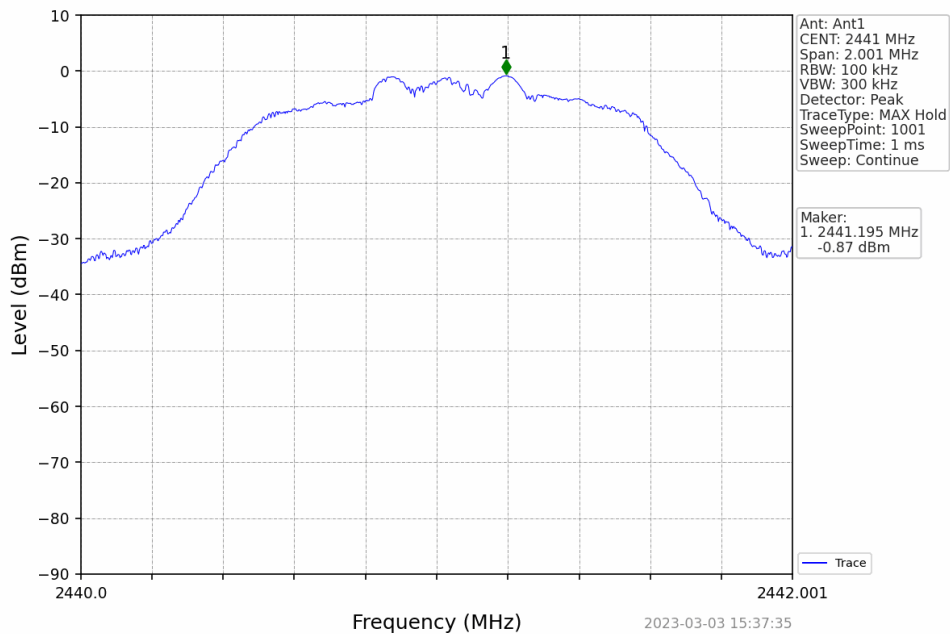
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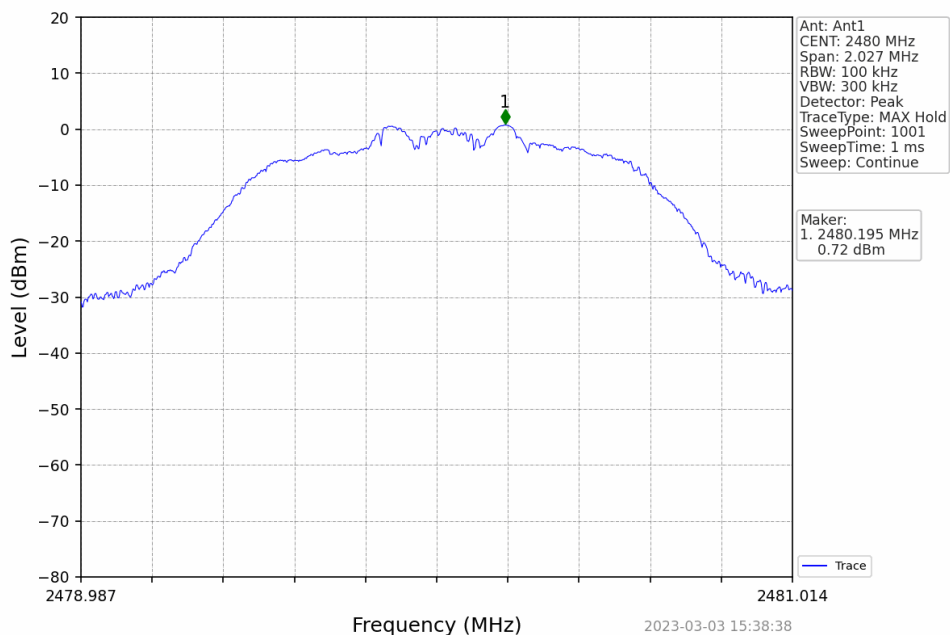
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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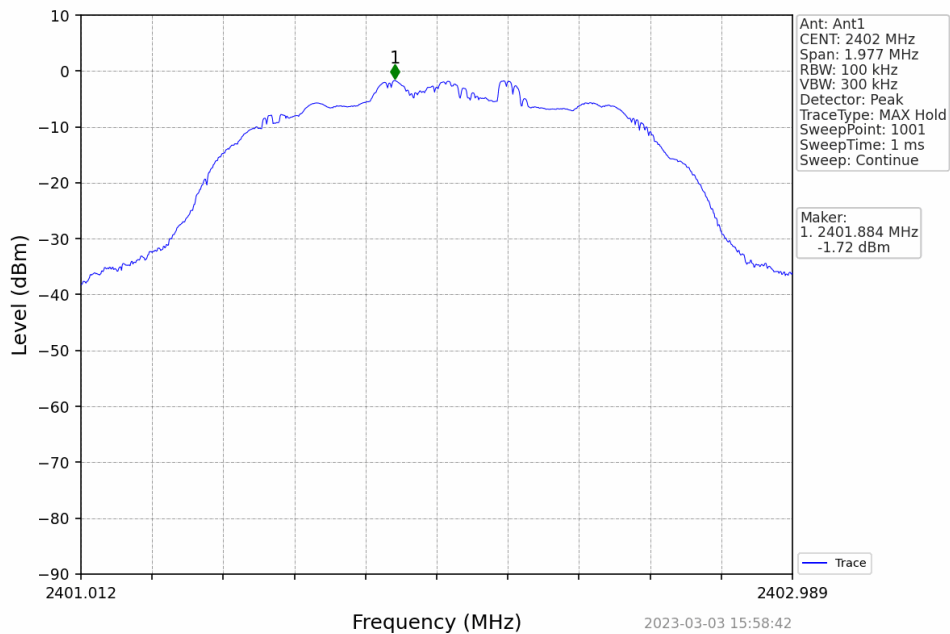
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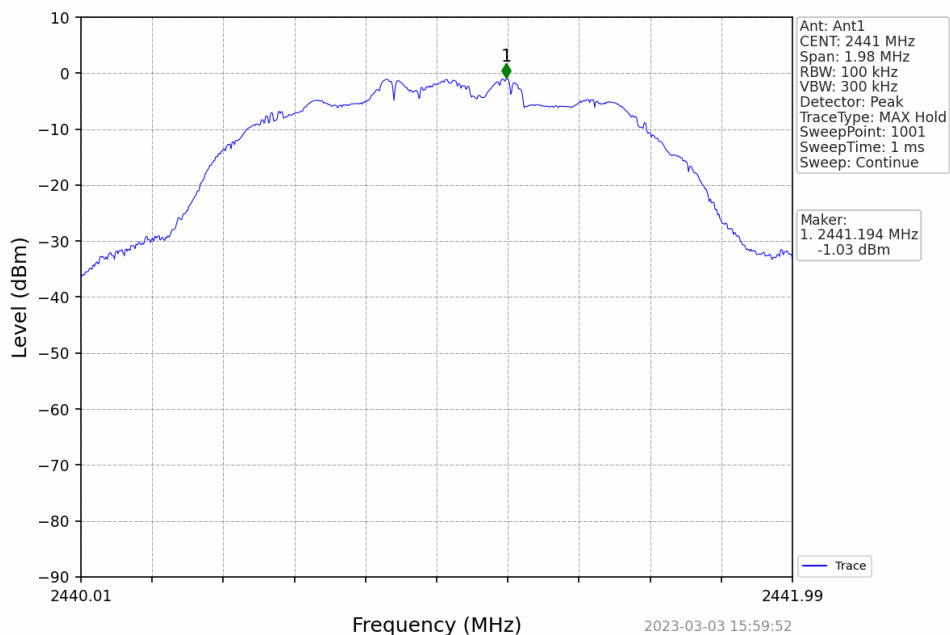
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



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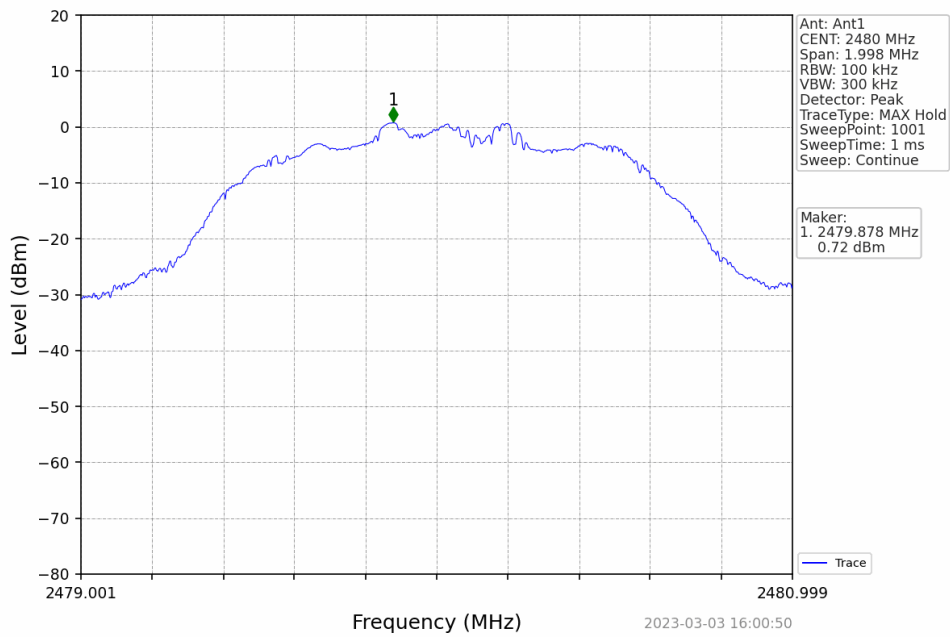
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8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



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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	0.46	-19.54	Pass
		2441	DH5	1	0.46	-19.54	Pass
		2480	DH5	1	0.46	-19.54	Pass
		HOPP	DH5	1	0.46	-19.54	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	0.72	-19.28	Pass
		2441	2DH5	1	0.72	-19.28	Pass
		2480	2DH5	1	0.72	-19.28	Pass
		HOPP	2DH5	1	0.72	-19.28	Pass
8DPSK	SISO	2402	3DH5	1	0.72	-19.28	Pass
		2441	3DH5	1	0.72	-19.28	Pass
		2480	3DH5	1	0.72	-19.28	Pass
		HOPP	3DH5	1	0.72	-19.28	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.



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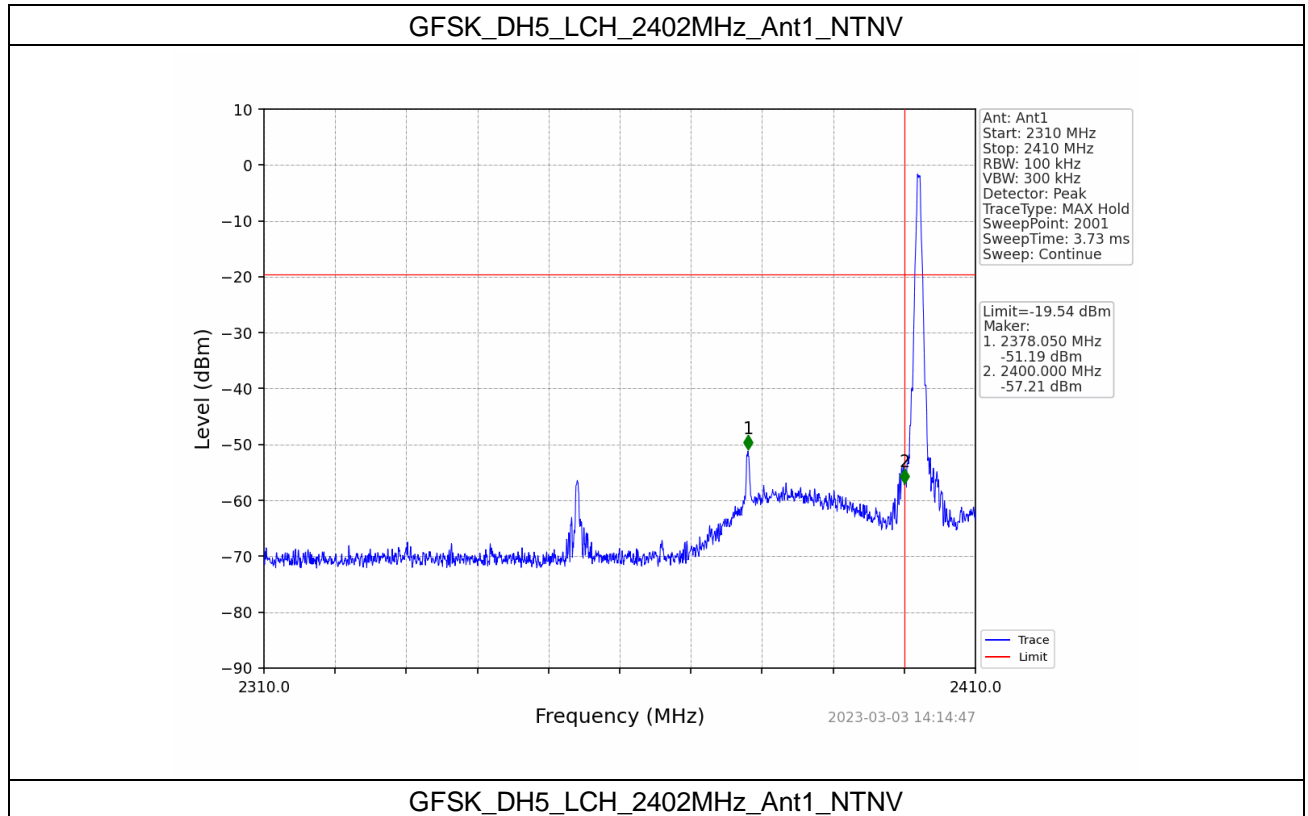
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6.2.2 Test Graph

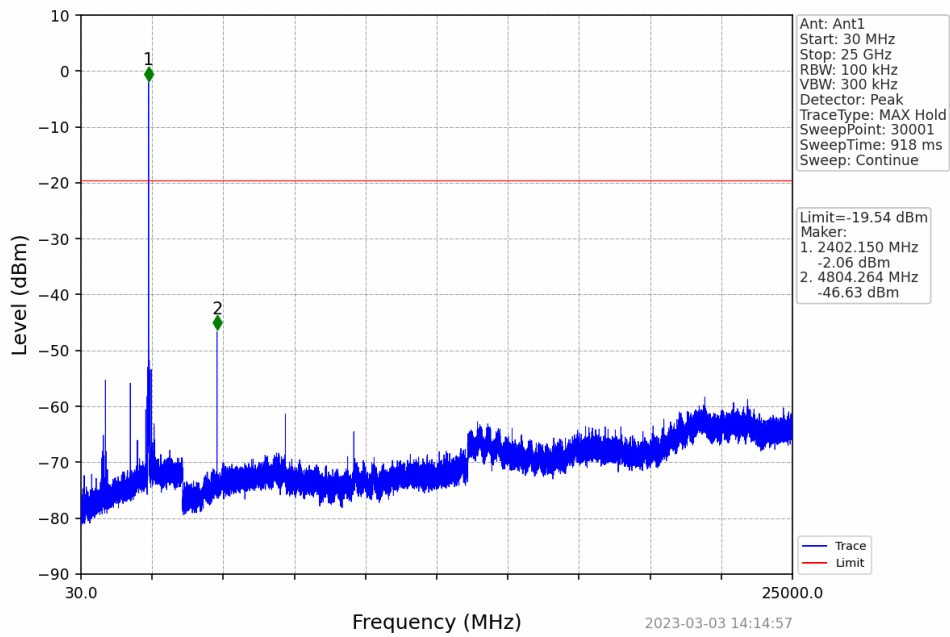


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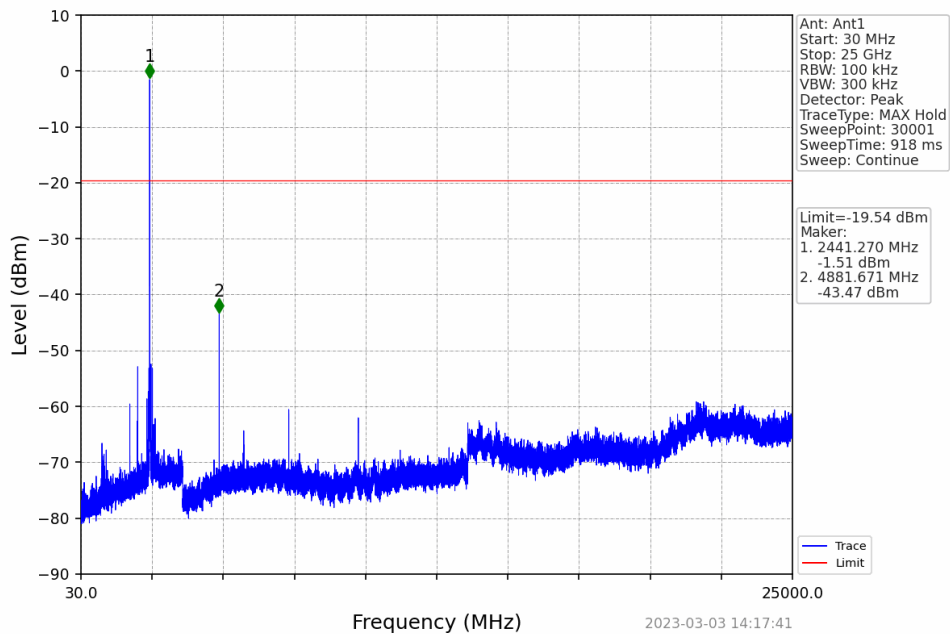
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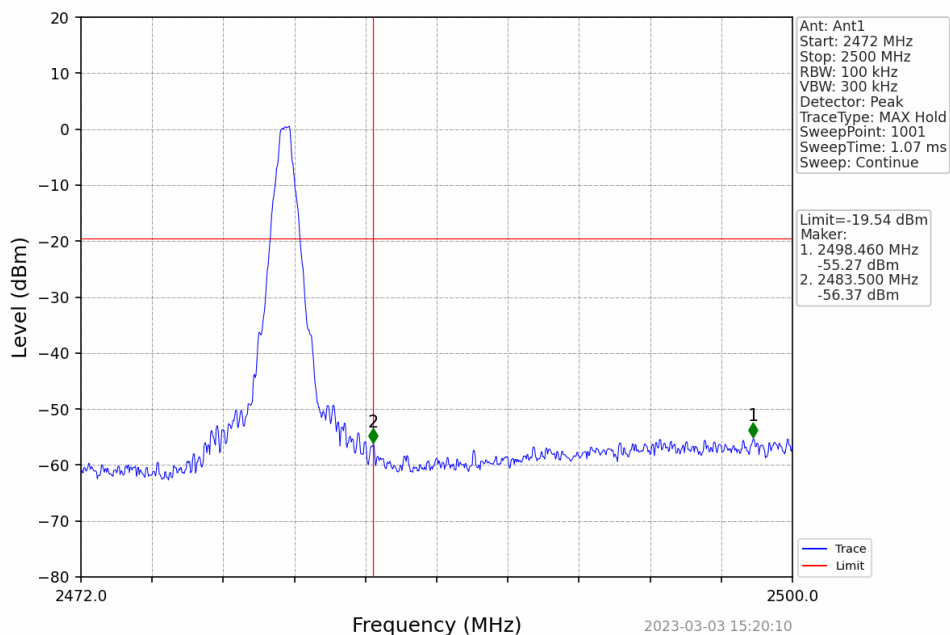
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GFSK_DH5_MCH_2441MHz_Ant1_NTNV



GFSK_DH5_HCH_2480MHz_Ant1_NTNV



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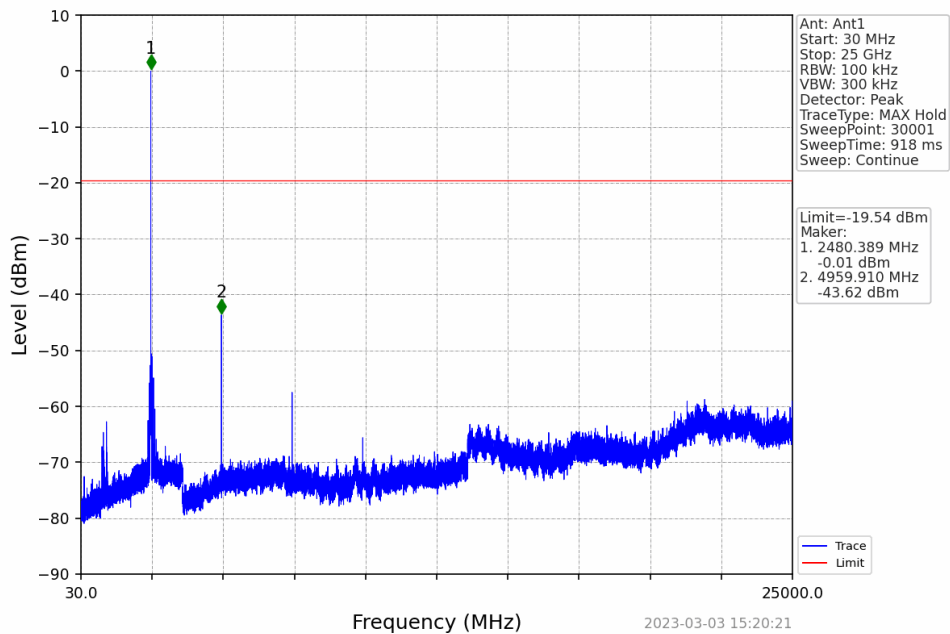
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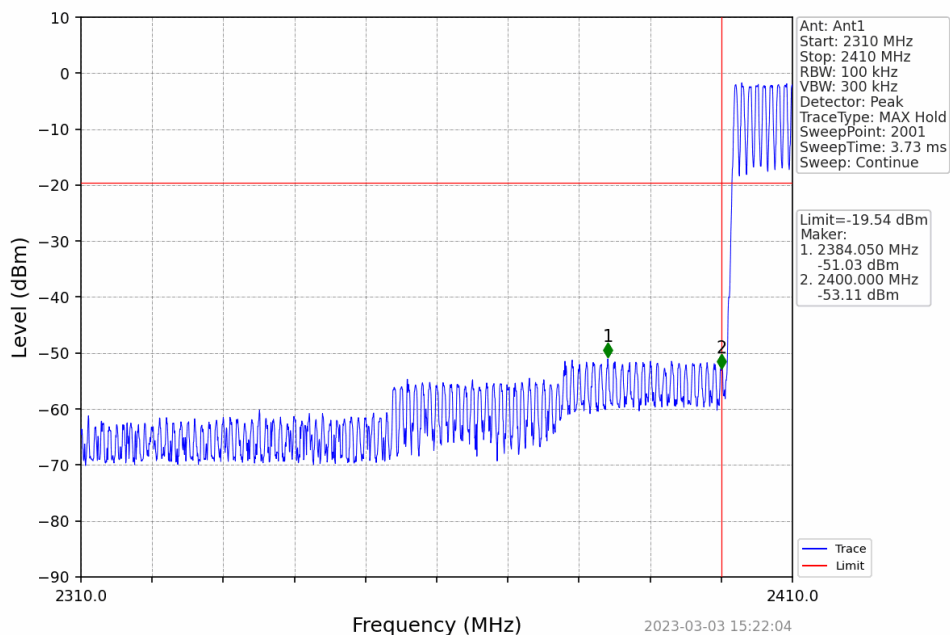
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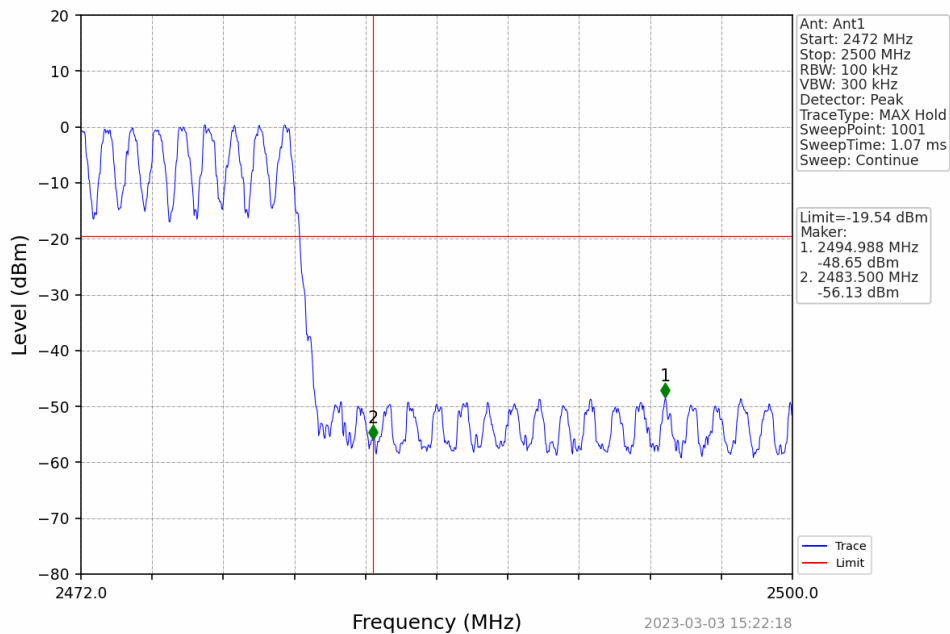
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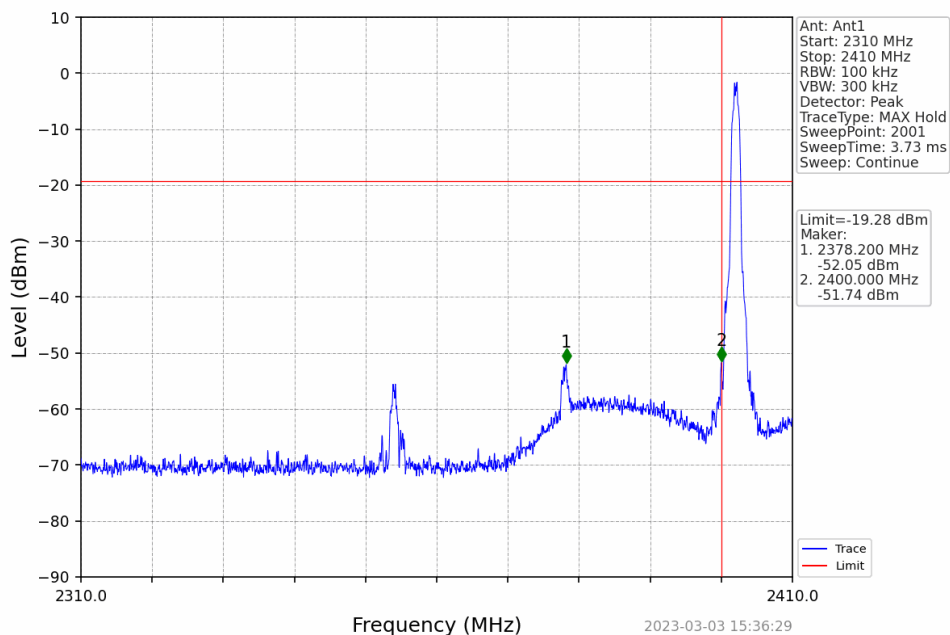
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GFSK_DH5_HOPP_Ant1_NTNV



Pi/4QPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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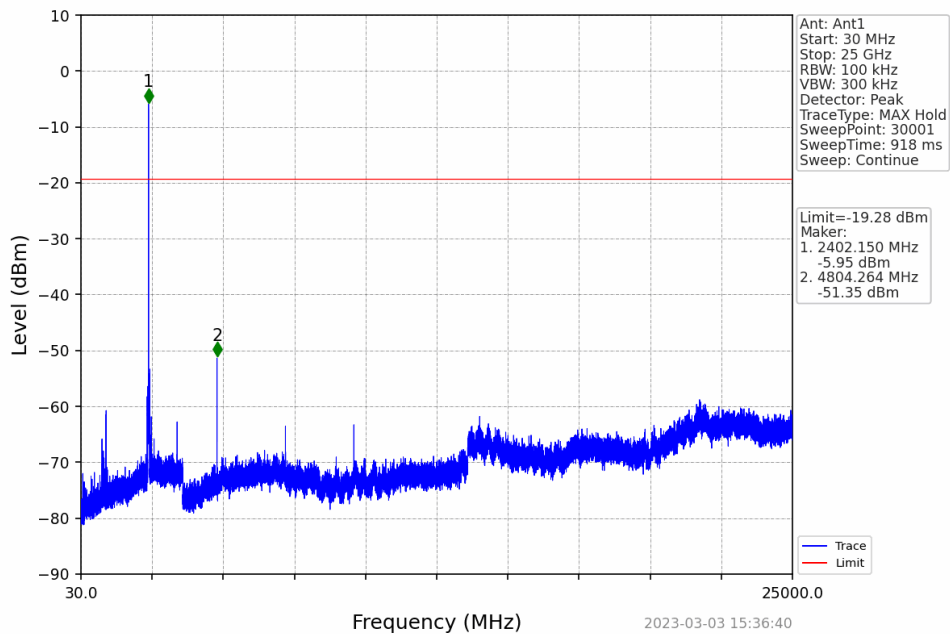
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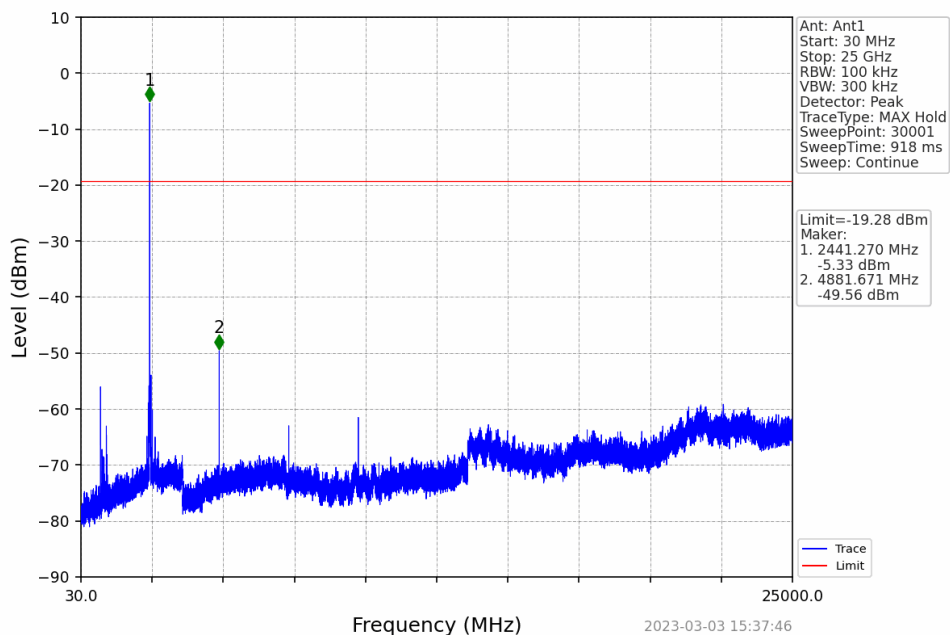
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Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



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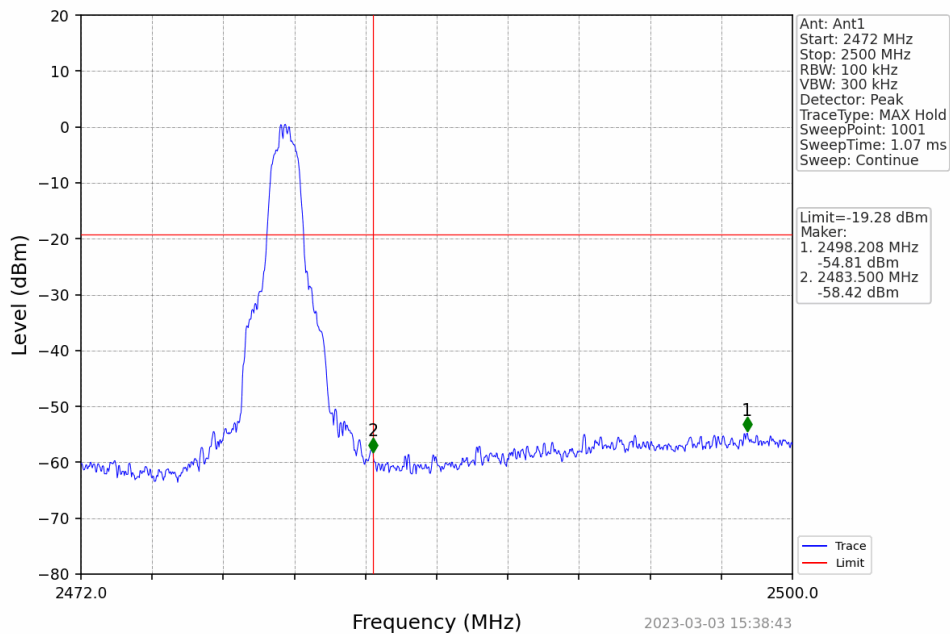
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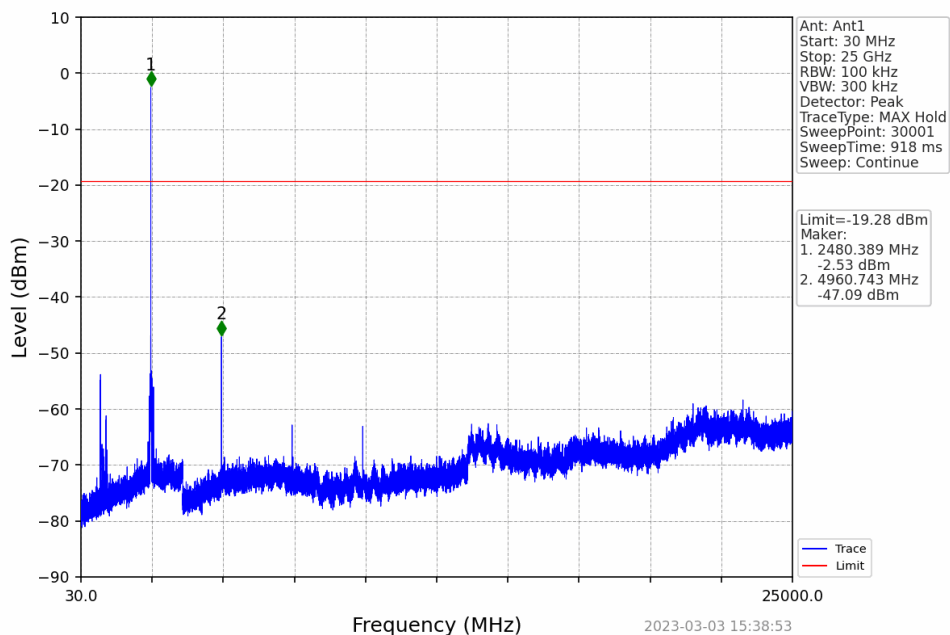
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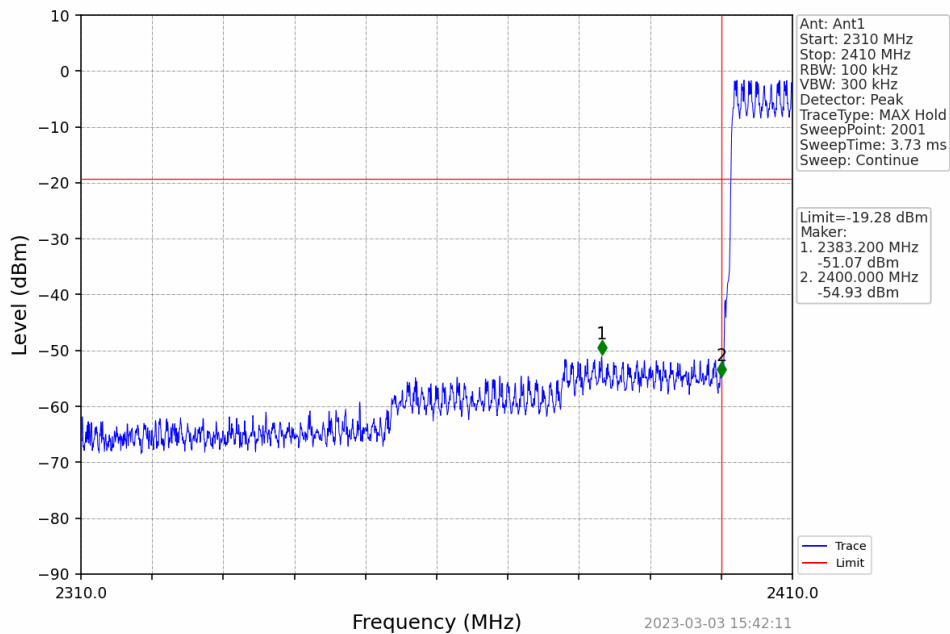


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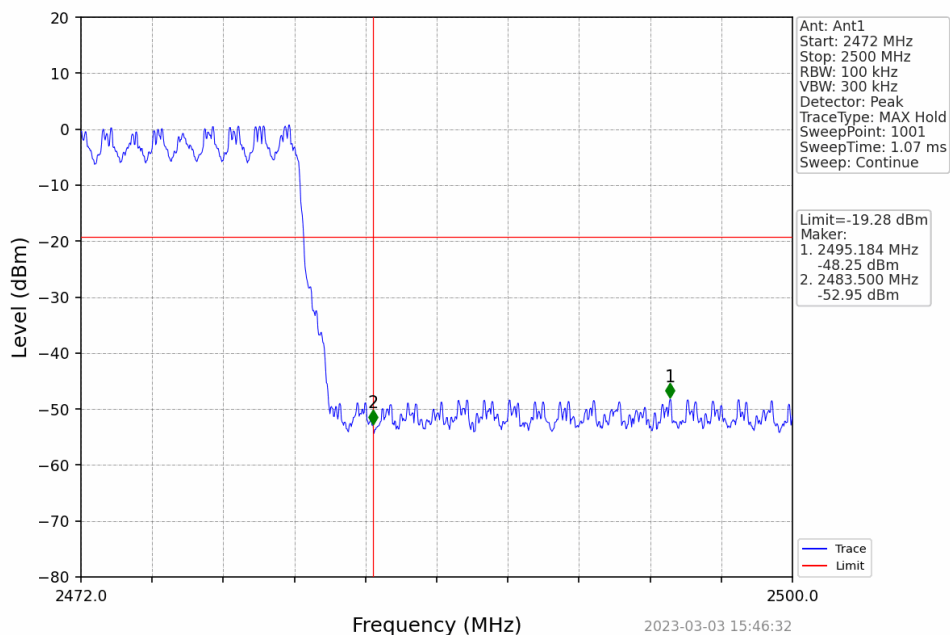
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Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



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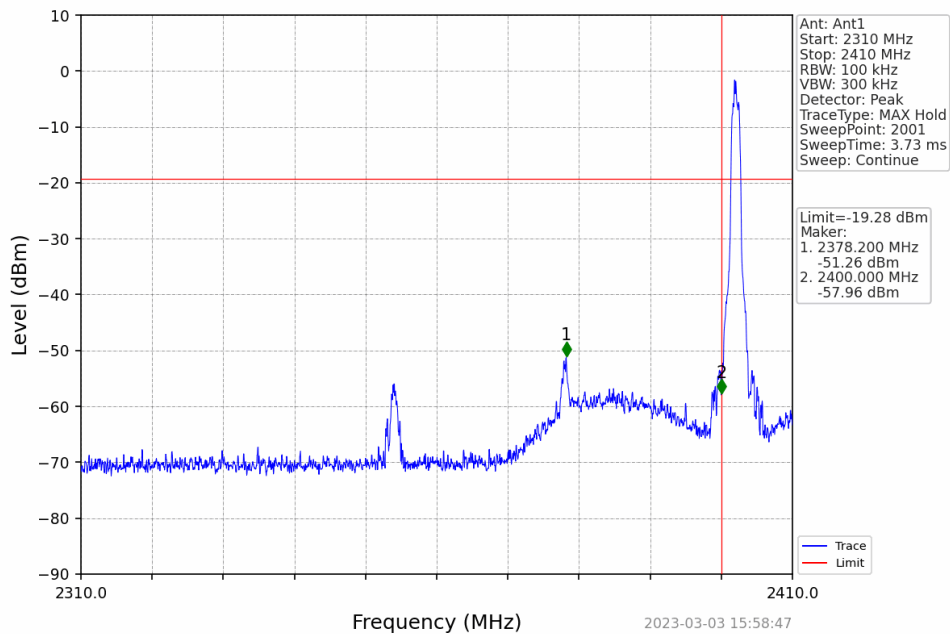


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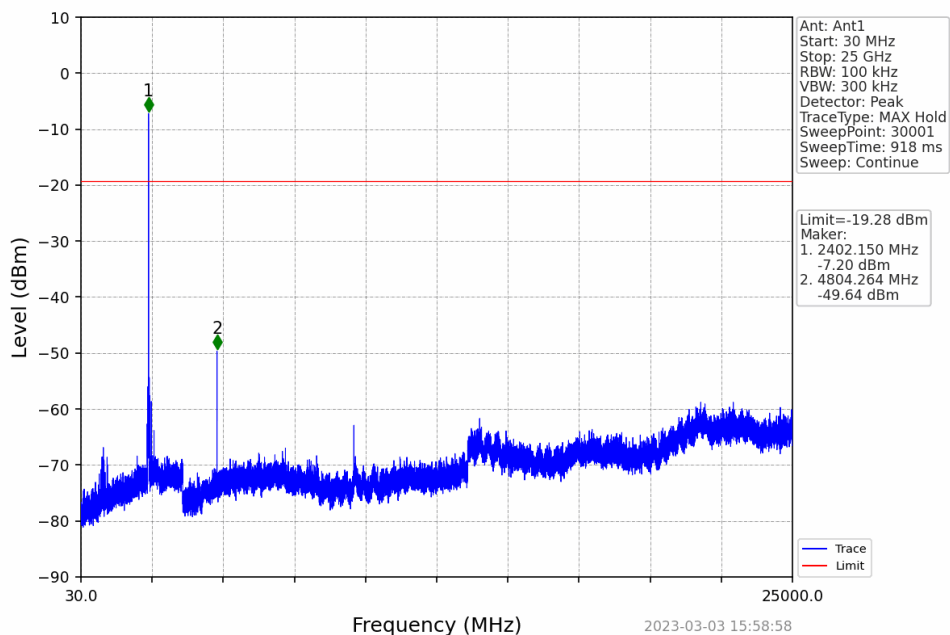
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8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



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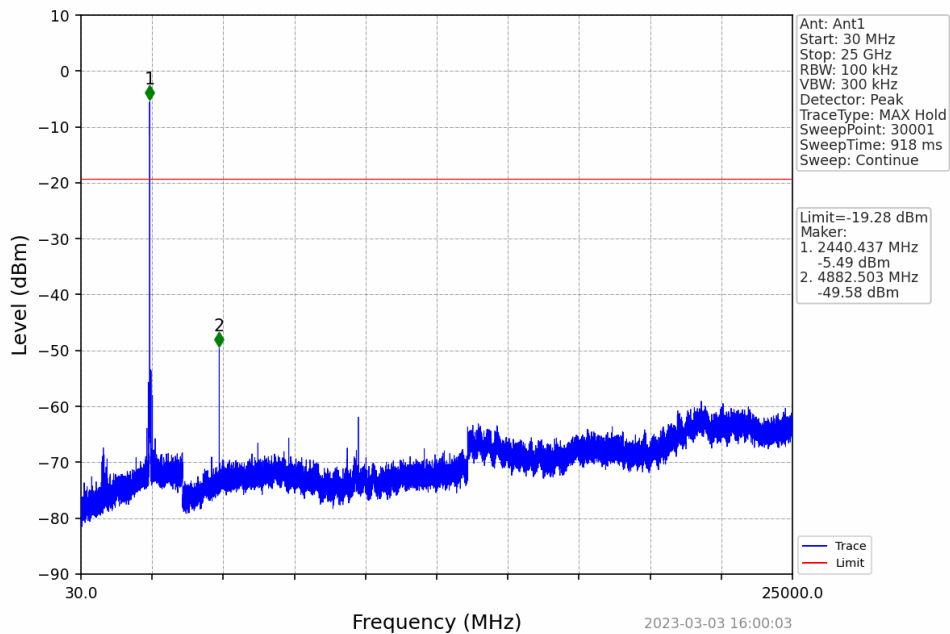
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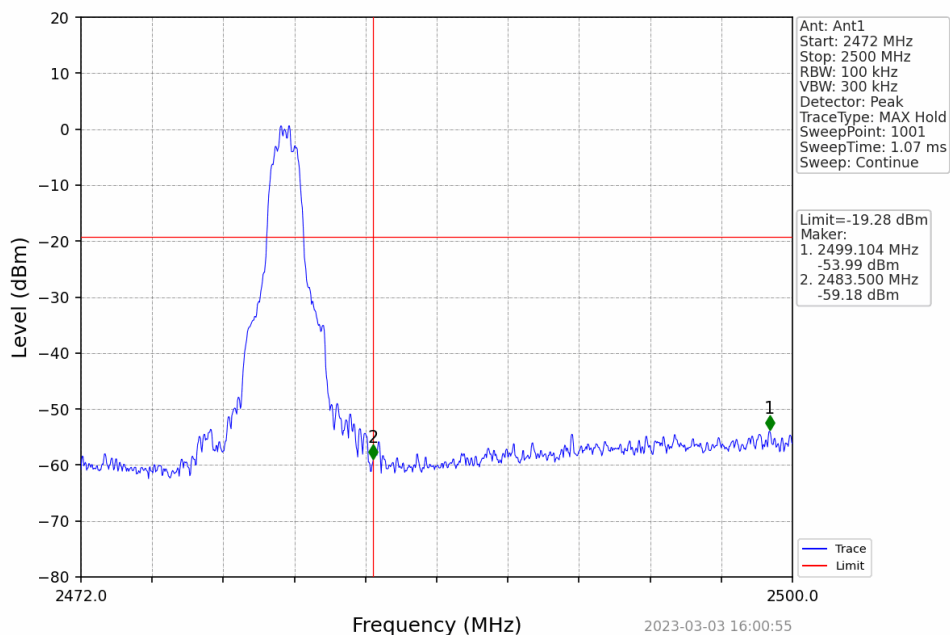
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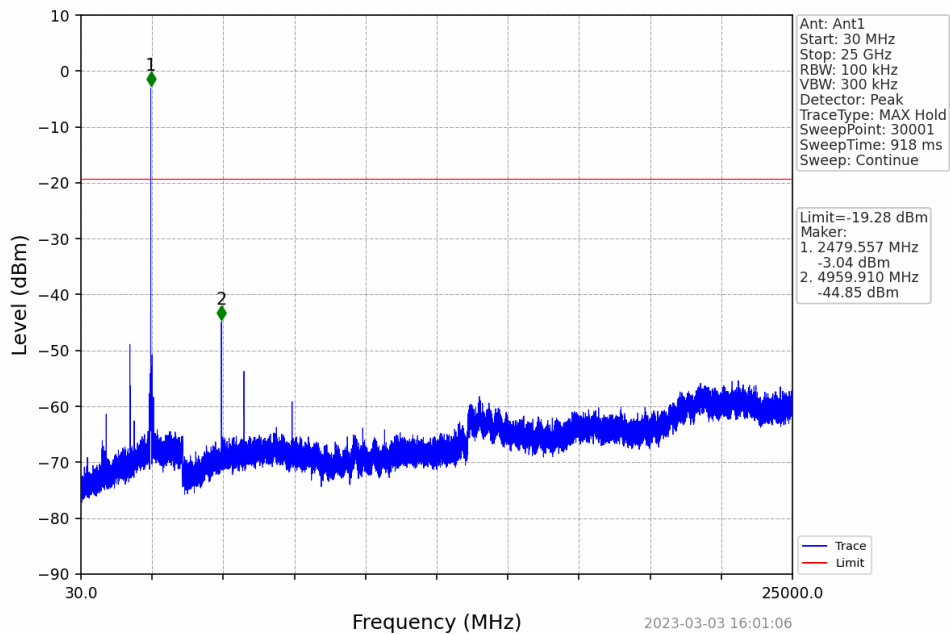
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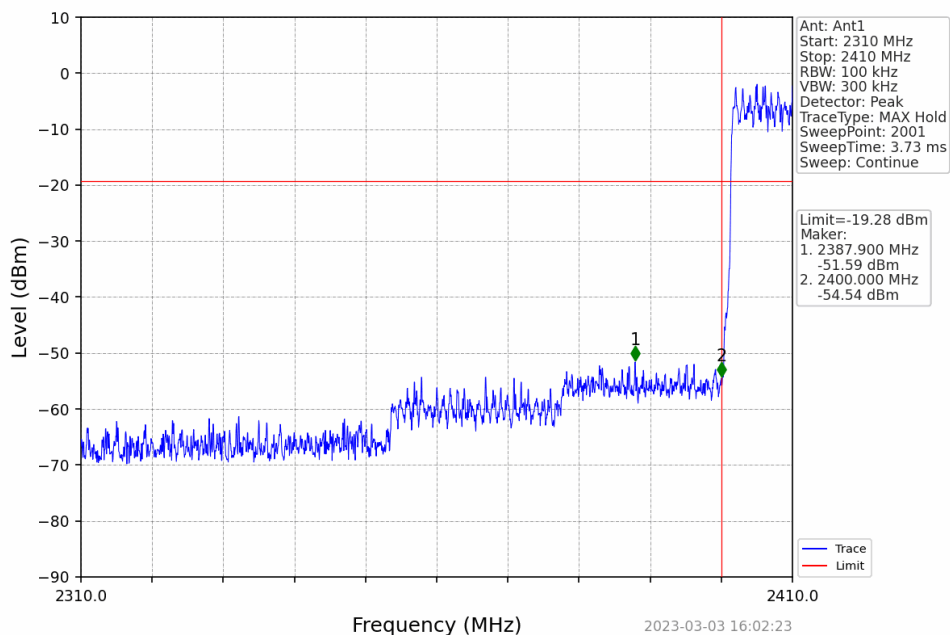
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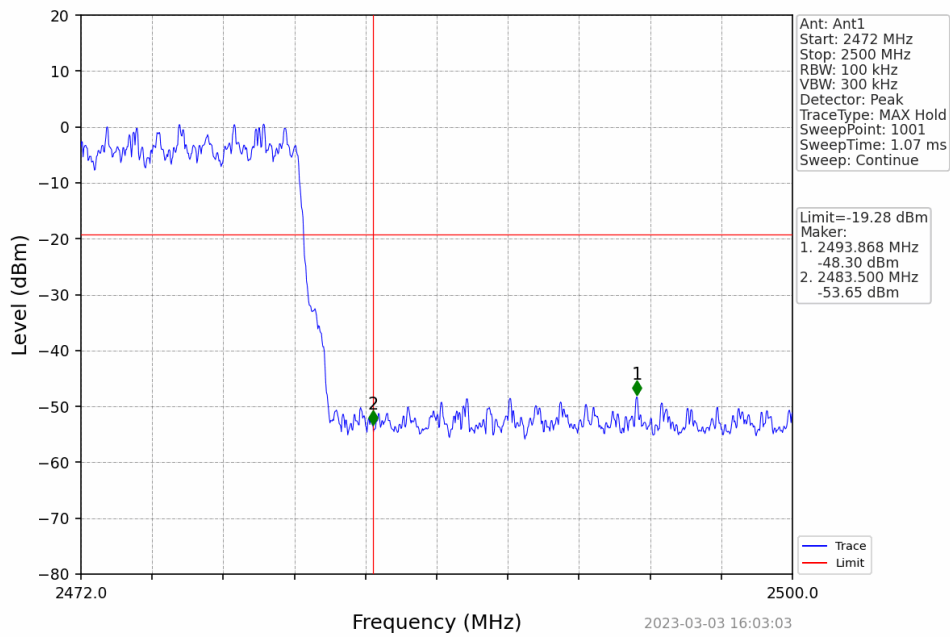


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