




# RF Test Report

## For

**Applicant Name:** **SKG Health Technologies Co., Ltd.**  
23A Floor, Building 3, Zhongke R&D Park, No.009 Gaoxin South 1st  
**Address:** Rd, High-tech Zone Community Yuehai Street, Nanshan District,  
Shenzhen, China  
**EUT Name:** Eye Massager  
**Brand Name:** N/A  
**Model Number:** E3 Pro  
**Series Model Number:** Refer to section 2

## Issued By

**Company Name:** **BTF Testing Lab (Shenzhen) Co., Ltd.**  
F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park,  
**Address:** Tantou Community, Songgang Street, Bao'an District, Shenzhen,  
China  
**Report Number:** BTF230911R00101  
**Test Standards:** 47 CFR Part 15.247  
**FCC ID:** 2AYVT-E3PRO  
**Test Conclusion:** Pass  
**Test Date:** 2023-08-29 to 2023-09-14  
**Date of Issue:** 2023-10-24

**Prepared By:**   
Chris Liu / Project Engineer  
**Date:** 2023-10-24

**Approved By:**   
Ryan.CJ / EMC Manager  
**Date:** 2023-10-24

*Note: All the test results in this report only related to the testing samples. Which can be duplicated completely for the legal use with approval of applicant; it shall not be reproduced except in full without the written approval of BTF Testing Lab (Shenzhen) Co., Ltd., All the objections should be raised within thirty days from the date of issue. To validate the report, you can contact us.*



Test Report Number: BTF230911R00101

Revision History		
Version	Issue Date	Revisions Content
R_V0	2023-10-24	Original
<i>Note: Once the revision has been made, then previous versions reports are invalid.</i>		

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## 1 Introduction

### 1.1 Identification of Testing Laboratory

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130

### 1.2 Identification of the Responsible Testing Location

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130
FCC Registration Number:	518915
Designation Number:	CN1330

### 1.3 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

## 2 Product Information

### 2.1 Application Information

Company Name:	SKG Health Technologies Co., Ltd.
Address:	23A Floor, Building 3, Zhongke R&D Park, No.009 Gaoxin South 1st Rd, High-tech Zone Community Yuehai Street, Nanshan District, Shenzhen, China

### 2.2 Manufacturer Information

Company Name:	SKG Health Technologies Co., Ltd.
Address:	23A Floor, Building 3, Zhongke R&D Park, No.009 Gaoxin South 1st Rd, High-tech Zone Community Yuehai Street, Nanshan District, Shenzhen, China

### 2.3 Factory Information

Company Name:	SKG Health Technologies Co., Ltd.
Address:	23A Floor, Building 3, Zhongke R&D Park, No.009 Gaoxin South 1st Rd, High-tech Zone Community Yuehai Street, Nanshan District, Shenzhen, China

### 2.4 General Description of Equipment under Test (EUT)

EUT Name:	Eye Massager
Test Model Number:	E3 Pro
Series Model Number:	N/A
Description of Model name differentiation:	N/A
Hardware Version	0.00.00.01
Software and Firmware Version	0.00.00.01

### 2.5 Technical Information

Power Supply:	3.7V from battery
Tested Sample ID.:	S01, S02
Operation Frequency:	2402MHz to 2480MHz
Number of Channels:	79
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8-DPSK
Antenna Type:	PCB antenna
Antenna Gain#:	-0.68dBi

Note:

#: The antenna gain provided by the applicant, and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.

### 3 Summary of Test Results

#### 3.1 Test Standards

The tests were performed according to following standards:

**47 CFR Part 15.247:** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

#### 3.2 Uncertainty of Test

Item	Measurement Uncertainty
Conducted Emission (150 kHz-30 MHz)	±2.64dB
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

#### 3.3 Summary of Test Result

Item	Standard	Requirement	Result
Antenna requirement	47 CFR Part 15.247	Part 15.203	Pass
Conducted Emission at AC power line	47 CFR Part 15.247	47 CFR 15.207(a)	Pass
Occupied Bandwidth	47 CFR Part 15.247	47 CFR 15.215(c)	Pass
Maximum Conducted Output Power	47 CFR Part 15.247	47 CFR 15.247(b)(1)	Pass
Channel Separation	47 CFR Part 15.247	47 CFR 15.247(a)(1)	Pass
Number of Hopping Frequencies	47 CFR Part 15.247	47 CFR 15.247(a)(1)(iii)	Pass
Dwell Time	47 CFR Part 15.247	47 CFR 15.247(a)(1)(iii)	Pass
Emissions in non-restricted frequency bands	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Band edge emissions (Radiated)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Emissions in restricted frequency bands (below 1GHz)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Emissions in restricted frequency bands (above 1GHz)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass

## 4 Test Configuration

### 4.1 Test Equipment List

Conducted Emission at AC power line					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	00953	2022-11-24	2023-11-23
Coaxial Switcher	SCHWARZBECK	CX210	CX210	2022-11-24	2023-11-23
V-LISN	SCHWARZBECK	NSLK 8127	01073	2022-11-24	2023-11-23
LISN	AFJ	LS16/110VAC	16010020076	2023-02-23	2024-02-22
EMI Receiver	ROHDE&SCHWARZ	ESCI3	101422	2022-11-24	2023-11-23

Occupied Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

Maximum Conducted Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

Channel Separation					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/



RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

#### Number of Hopping Frequencies

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

#### Dwell Time

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

Emissions in non-restricted frequency bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

Band edge emissions (Radiated)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Coaxial cable Multiflex 141	Schwarzbeck	N/SMA 0.5m	517386	2023-03-24	2024-03-23
Preamplifier	SCHWARZBECK	BBV9744	00246	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMAM-10m	21101566	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMAM-1m	21101568	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-1m	21101576	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-2.5m	21101573	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Horn Antenna	SCHWARZBECK	BBHA9170	01157	2021-11-28	2023-11-27
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI7	101032	2022-11-24	2023-11-23
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Broadband Preamplifier	SCHWARZBECK	BBV9718D	00008	2023-03-24	2024-03-23
Horn Antenna	SCHWARZBECK	BBHA9120D	2597	2022-05-22	2024-05-21
EZ EMC	Frad	FA-03A2 RE+	/	/	/
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Log periodic antenna	SCHWARZBECK	VULB 9168	01328	2021-11-28	2023-11-27

Emissions in restricted frequency bands (below 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Coaxial cable Multiflex 141	Schwarzbeck	N/SMA 0.5m	517386	2023-03-24	2024-03-23

Preamplifier	SCHWARZBECK	BBV9744	00246	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-10m	21101566	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-1m	21101568	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-1m	21101576	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-2.5m	21101573	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Horn Antenna	SCHWARZBECK	BBHA9170	01157	2021-11-28	2023-11-27
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI7	101032	2022-11-24	2023-11-23
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Broadband Preamplifier	SCHWARZBECK	BBV9718D	00008	2023-03-24	2024-03-23
Horn Antenna	SCHWARZBECK	BBHA9120D	2597	2022-05-22	2024-05-21
EZ EMC	Frad	FA-03A2 RE+	/	/	/
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Log periodic antenna	SCHWARZBECK	VULB 9168	01328	2021-11-28	2023-11-27

Emissions in restricted frequency bands (above 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Coaxial cable Multiflex 141	Schwarzbeck	N/SMA 0.5m	517386	2023-03-24	2024-03-23
Preamplifier	SCHWARZBECK	BBV9744	00246	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-10m	21101566	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-1m	21101568	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-1m	21101576	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-2.5m	21101573	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Horn Antenna	SCHWARZBECK	BBHA9170	01157	2021-11-28	2023-11-27
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI7	101032	2022-11-24	2023-11-23
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Broadband Preamplifier	SCHWARZBECK	BBV9718D	00008	2023-03-24	2024-03-23
Horn Antenna	SCHWARZBECK	BBHA9120D	2597	2022-05-22	2024-05-21
EZ EMC	Frad	FA-03A2 RE+	/	/	/
POSITIONAL	SKET	PCI-GPIB	/	/	/



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CONTROLLER					
Log periodic antenna	SCHWARZBECK	VULB 9168	01328	2021-11-28	2023-11-27

## 4.2 Test Auxiliary Equipment

Title	Manufacturer	Model No.	Serial No.
Adapter	HUAWEI	HW-100400C00	/
/	/	/	/

## 4.3 Test Modes

No.	Test Modes	Description
TM1	TX-GFSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with GFSK modulation.
TM2	TX- $\pi/4$ -DQPSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with $\pi/4$ -DQPSK modulation.
TM3	TX-8-DPSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with 8-DPSK modulation.
TM4	TX-GFSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with GFSK modulation.
TM5	TX- $\pi/4$ -DQPSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with $\pi/4$ -DQPSK modulation.
TM6	TX-8-DPSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with 8-DPSK modulation.

All channel was listed on the following table:

Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)
0	2402	21	2423	42	2444	63	2465
1	2403	22	2424	43	2445	64	2466
2	2404	23	2425	44	2446	65	2467
3	2405	24	2426	45	2447	66	2468
4	2406	25	2427	46	2448	67	2469
5	2407	26	2428	47	2449	68	2470
6	2408	27	2429	48	2450	69	2471
7	2409	28	2430	49	2451	70	2472
8	2410	29	2431	50	2452	71	2473
9	2411	30	2432	51	2453	72	2474
10	2412	31	2433	52	2454	73	2475
11	2413	32	2434	53	2455	74	2476
12	2414	33	2435	54	2456	75	2477
13	2415	34	2436	55	2457	76	2478
14	2416	35	2437	56	2458	77	2479
15	2417	36	2438	57	2459	78	2480
16	2418	37	2439	58	2460	-	-
17	2419	38	2440	59	2461	-	-
18	2420	39	2441	60	2462	-	-
19	2421	40	2442	61	2463	-	-
20	2422	41	2443	62	2464	-	-



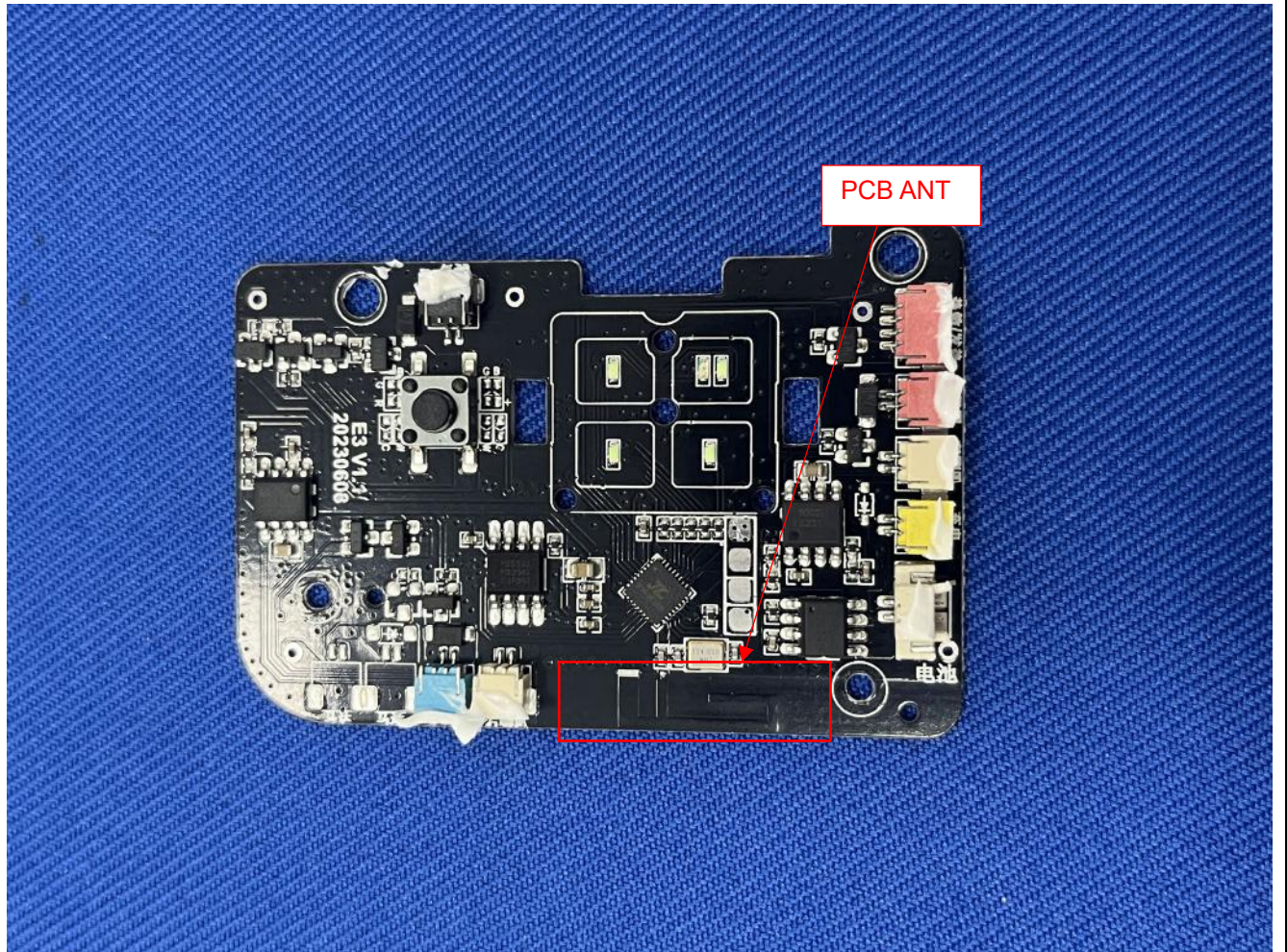
## 5 Evaluation Results (Evaluation)

### 5.1 Antenna requirement

Test 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 shall be considered sufficient to comply with the provisions of this section.

#### 5.1.1 Conclusion:



## 6 Radio Spectrum Matter Test Results (RF)

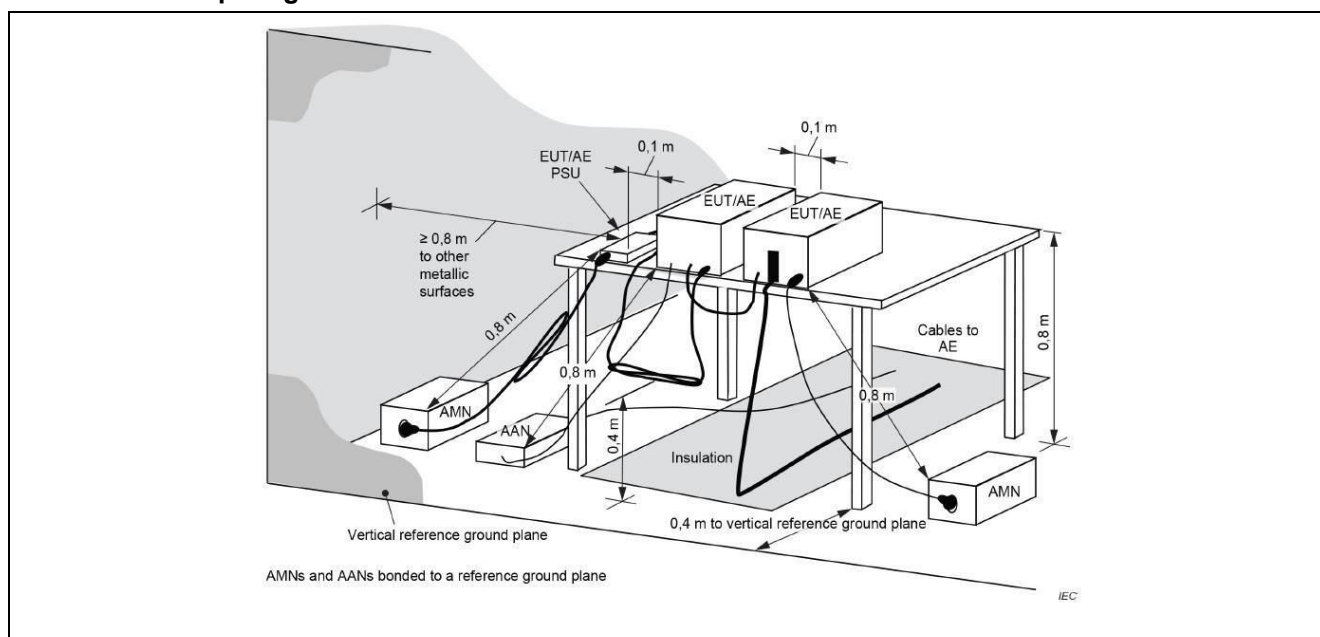
## 6.1 Conducted Emission at AC power line

Test Requirement:	Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 ohms line impedance stabilization network (LISN).		
Test Method:	Refer to ANSI C63.10-2013 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices		
Test Limit:	Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
*Decreases with the logarithm of the frequency.			

### 6.1.1 E.U.T. Operation:

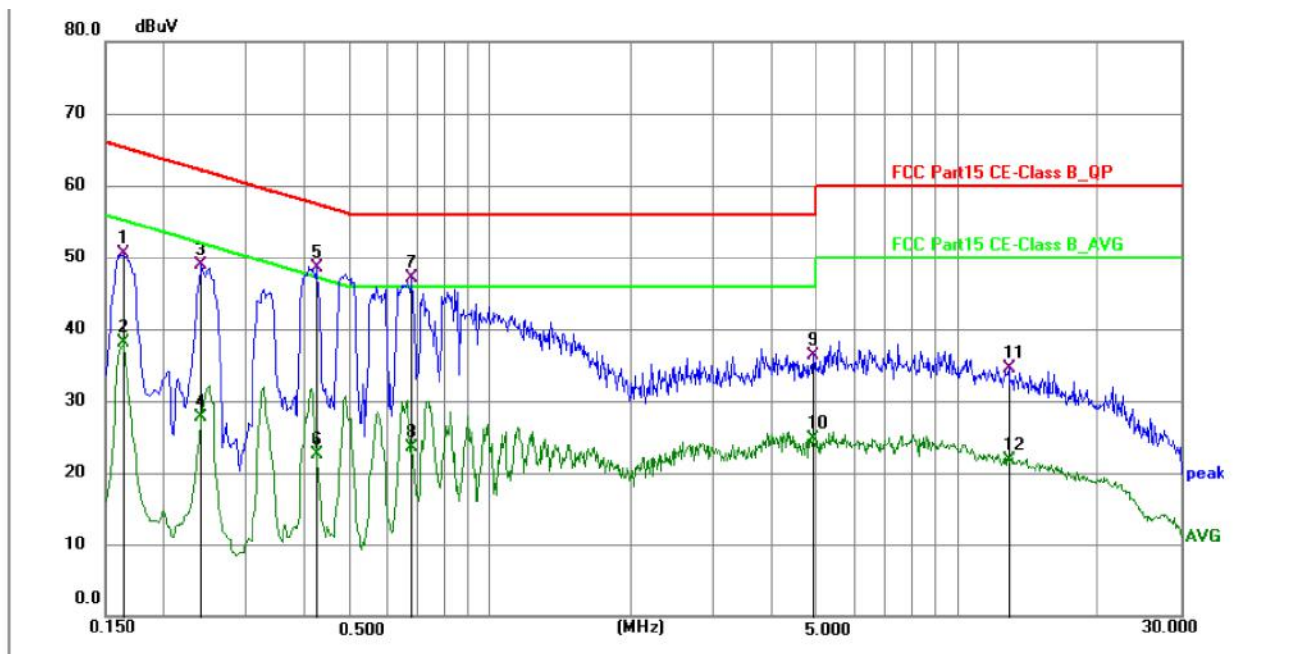
Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

### 6.1.2 Test Setup Diagram:



### 6.1.3 Test Data:

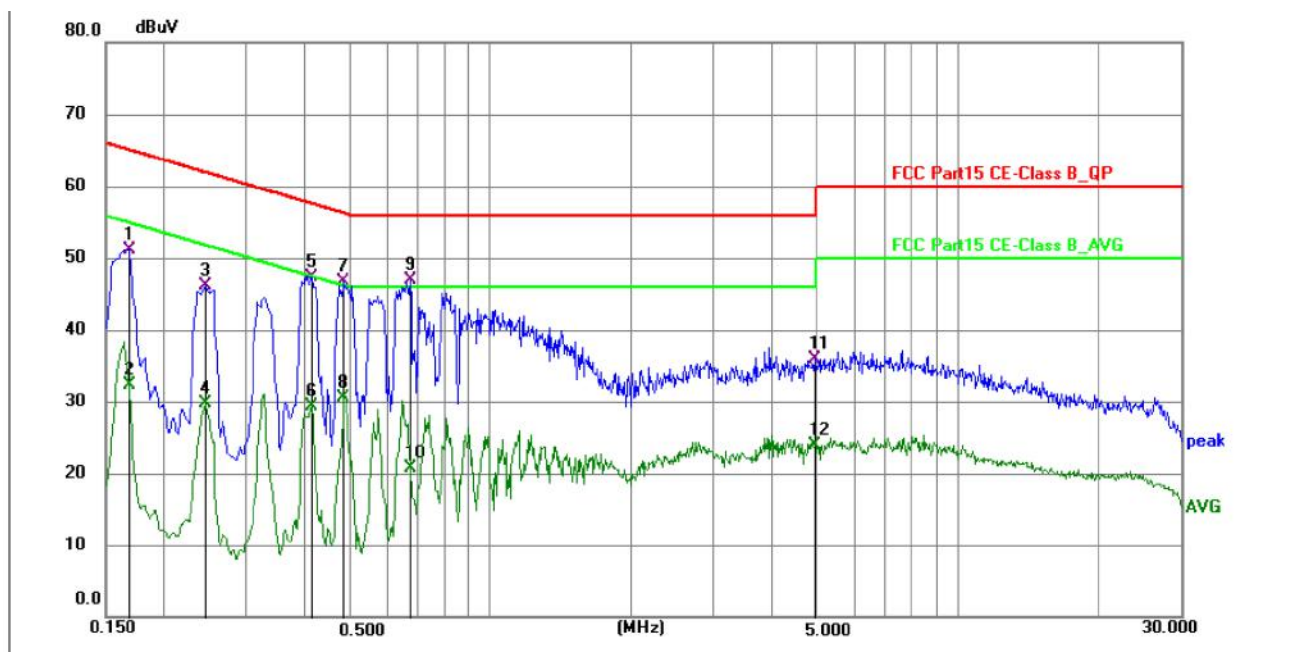
TM1 / Line: Line / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1635	40.55	9.91	50.46	65.28	-14.82	QP	P	
2	0.1635	28.14	9.91	38.05	55.28	-17.23	AVG	P	
3	0.2400	39.00	9.92	48.92	62.10	-13.18	QP	P	
4	0.2400	17.79	9.92	27.71	52.10	-24.39	AVG	P	
5	0.4245	38.49	9.96	48.45	57.36	-8.91	QP	P	
6	0.4245	12.59	9.96	22.55	47.36	-24.81	AVG	P	
7 *	0.6809	37.15	9.99	47.14	56.00	-8.86	QP	P	
8	0.6809	13.44	9.99	23.43	46.00	-22.57	AVG	P	
9	4.9155	26.35	10.00	36.35	56.00	-19.65	QP	P	
10	4.9155	14.70	10.00	24.70	46.00	-21.30	AVG	P	
11	12.8895	24.51	10.02	34.53	60.00	-25.47	QP	P	
12	12.8895	11.60	10.02	21.62	50.00	-28.38	AVG	P	



TM1 / Line: Neutral / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1680	41.09	9.93	51.02	65.06	-14.04	QP	P	
2	0.1680	22.41	9.93	32.34	55.06	-22.72	AVG	P	
3	0.2445	36.15	9.95	46.10	61.94	-15.84	QP	P	
4	0.2445	19.71	9.95	29.66	51.94	-22.28	AVG	P	
5	0.4110	37.39	9.98	47.37	57.63	-10.26	QP	P	
6	0.4110	19.25	9.98	29.23	47.63	-18.40	AVG	P	
7	0.4830	36.66	10.00	46.66	56.29	-9.63	QP	P	
8	0.4830	20.55	10.00	30.55	46.29	-15.74	AVG	P	
9 *	0.6720	36.80	10.01	46.81	56.00	-9.19	QP	P	
10	0.6720	10.77	10.01	20.78	46.00	-25.22	AVG	P	
11	4.9290	25.91	10.01	35.92	56.00	-20.08	QP	P	
12	4.9290	13.85	10.01	23.86	46.00	-22.14	AVG	P	

Note:

1. Level = Reading + Factor, Margin = Level – Limit;
2. Pre-scan all test modes, found worst case at GFSK 2441MHz, and so only show the test result of GFSK 2441MHz.

## 6.2 Occupied Bandwidth

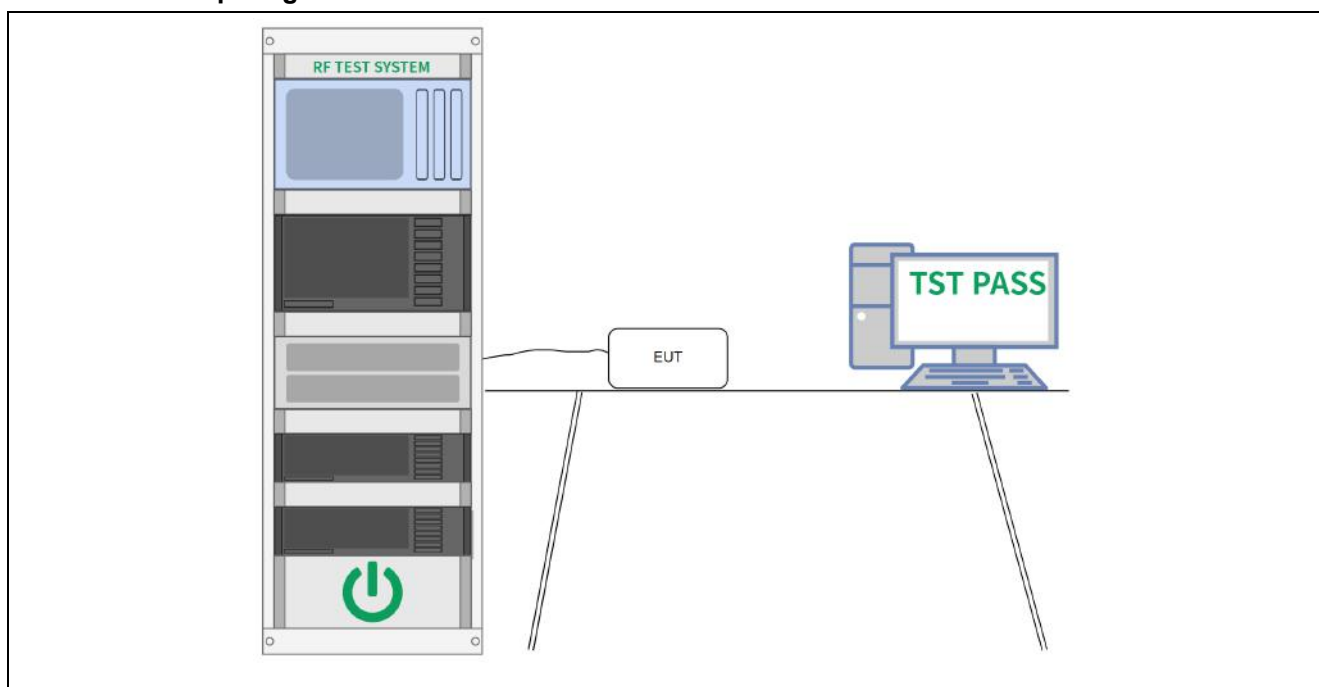
Test Requirement:	Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.
Test Method:	Occupied bandwidth—relative measurement procedure
Test Limit:	Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.
Procedure:	<p>a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.</p> <p>b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.</p> <p>c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than <math>[10 \log (OBW/RBW)]</math> below the reference level. Specific guidance is given in 4.1.5.2.</p> <p>d) Steps a) through c) might require iteration to adjust within the specified tolerances.</p> <p>e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.</p> <p>f) Set detection mode to peak and trace mode to max hold.</p> <p>g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).</p> <p>h) Determine the “-xx dB down amplitude” using <math>[(\text{reference value}) - xx]</math>. Alternatively, this calculation may be made by using the marker-delta function of the instrument.</p> <p>i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).</p> <p>j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.</p>

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

#### 6.2.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

#### 6.2.2 Test Setup Diagram:



#### 6.2.3 Test Data:

Please Refer to Appendix for Details.

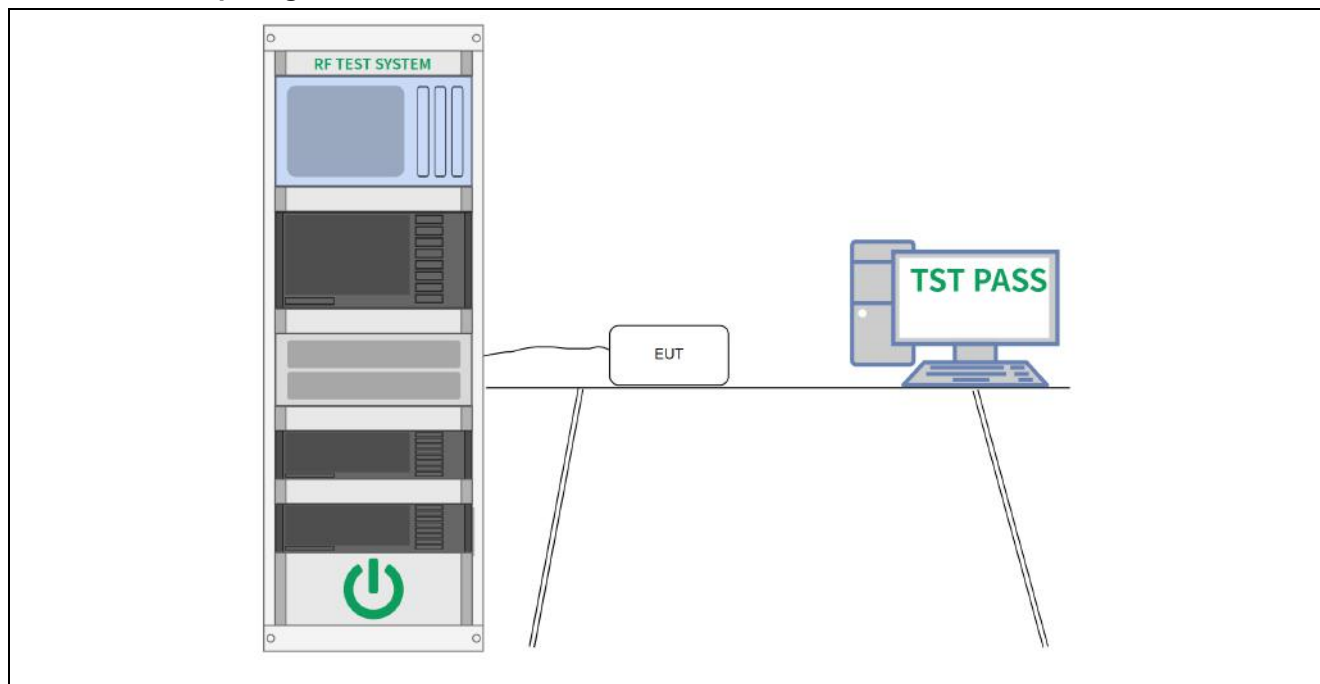
### 6.3 Maximum Conducted Output Power

Test Requirement:	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
Test Method:	Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices
Test Limit:	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
Procedure:	<p>This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:</p> <p>a) Use the following spectrum analyzer settings:</p> <ol style="list-style-type: none"> <li>1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.</li> <li>2) RBW &gt; 20 dB bandwidth of the emission being measured.</li> <li>3) VBW &gt;= RBW.</li> <li>4) Sweep: Auto.</li> <li>5) Detector function: Peak.</li> <li>6) Trace: Max hold.</li> </ol> <p>b) Allow trace to stabilize.</p> <p>c) Use the marker-to-peak function to set the marker to the peak of the emission.</p> <p>d) The indicated level is the peak output power, after any corrections for external attenuators and cables.</p> <p>e) A plot of the test results and setup description shall be included in the test report.</p> <p>NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.</p>

#### 6.3.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

### 6.3.2 Test Setup Diagram:



### 6.3.3 Test Data:

Please Refer to Appendix for Details.

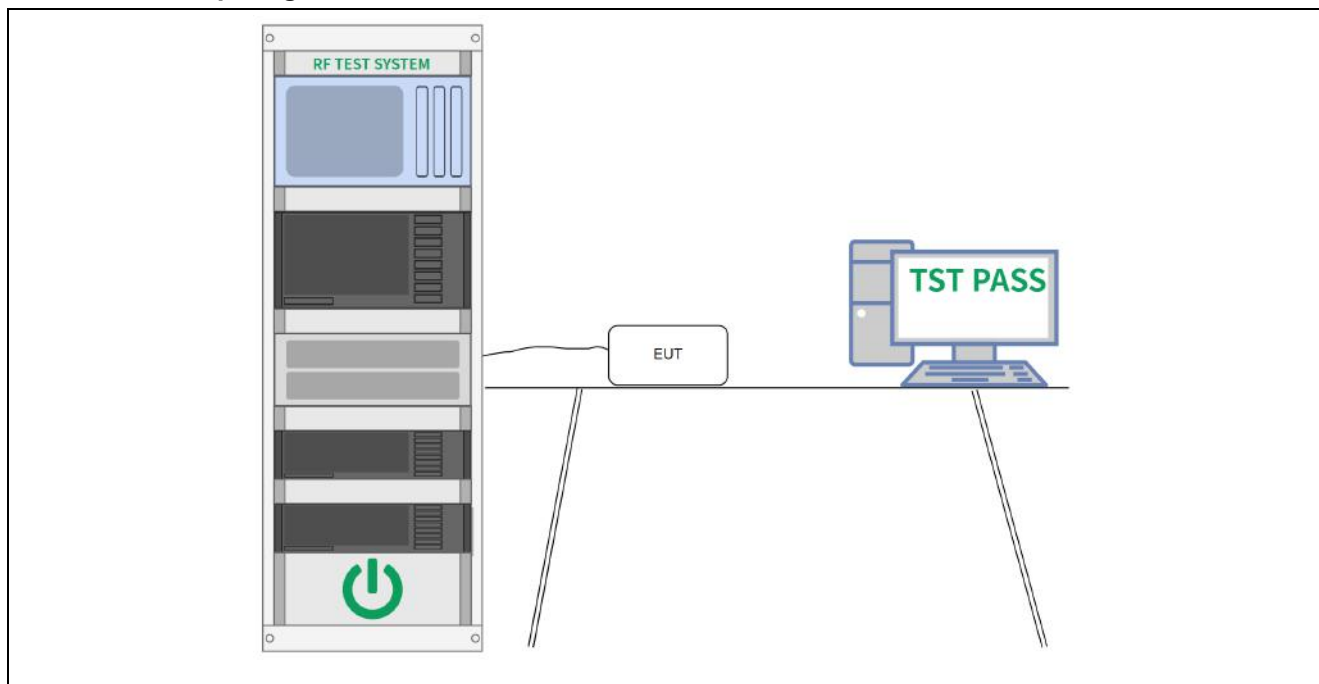
## 6.4 Channel Separation

Test Requirement:	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.
Test Method:	Carrier frequency separation
Test 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.
Procedure:	<p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> <li>a) Span: Wide enough to capture the peaks of two adjacent channels.</li> <li>b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.</li> <li>c) Video (or average) bandwidth (VBW) <math>\geq</math> RBW.</li> <li>d) Sweep: Auto.</li> <li>e) Detector function: Peak.</li> <li>f) Trace: Max hold.</li> <li>g) Allow the trace to stabilize.</li> </ul> <p>Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.</p>

### 6.4.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

#### 6.4.2 Test Setup Diagram:



#### 6.4.3 Test Data:

Please Refer to Appendix for Details.

## 6.5 Number of Hopping Frequencies

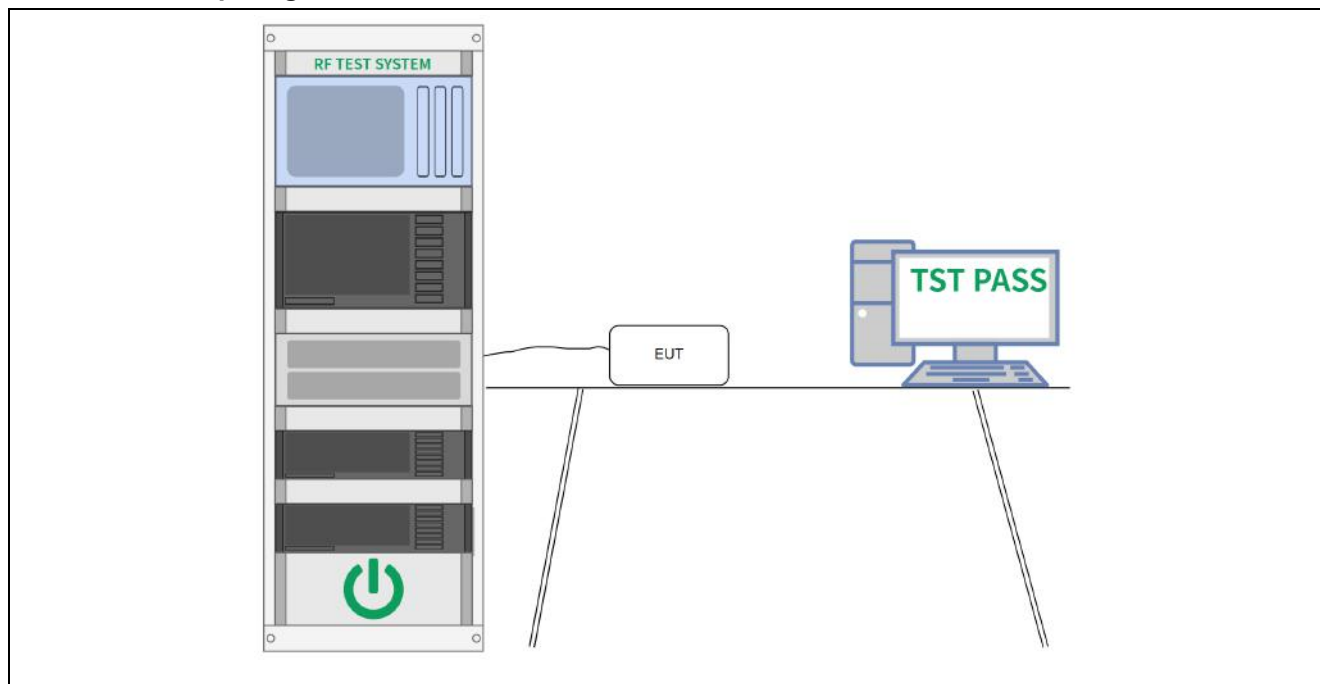
Test Requirement:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Method:	Number of hopping frequencies
Test Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Procedure:	<p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> <li>a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.</li> <li>b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.</li> <li>c) VBW <math>\geq</math> RBW.</li> <li>d) Sweep: Auto.</li> <li>e) Detector function: Peak.</li> <li>f) Trace: Max hold.</li> <li>g) Allow the trace to stabilize.</li> </ul> <p>It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.</p>

### 6.5.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar



### 6.5.2 Test Setup Diagram:



### 6.5.3 Test Data:

Please Refer to Appendix for Details.

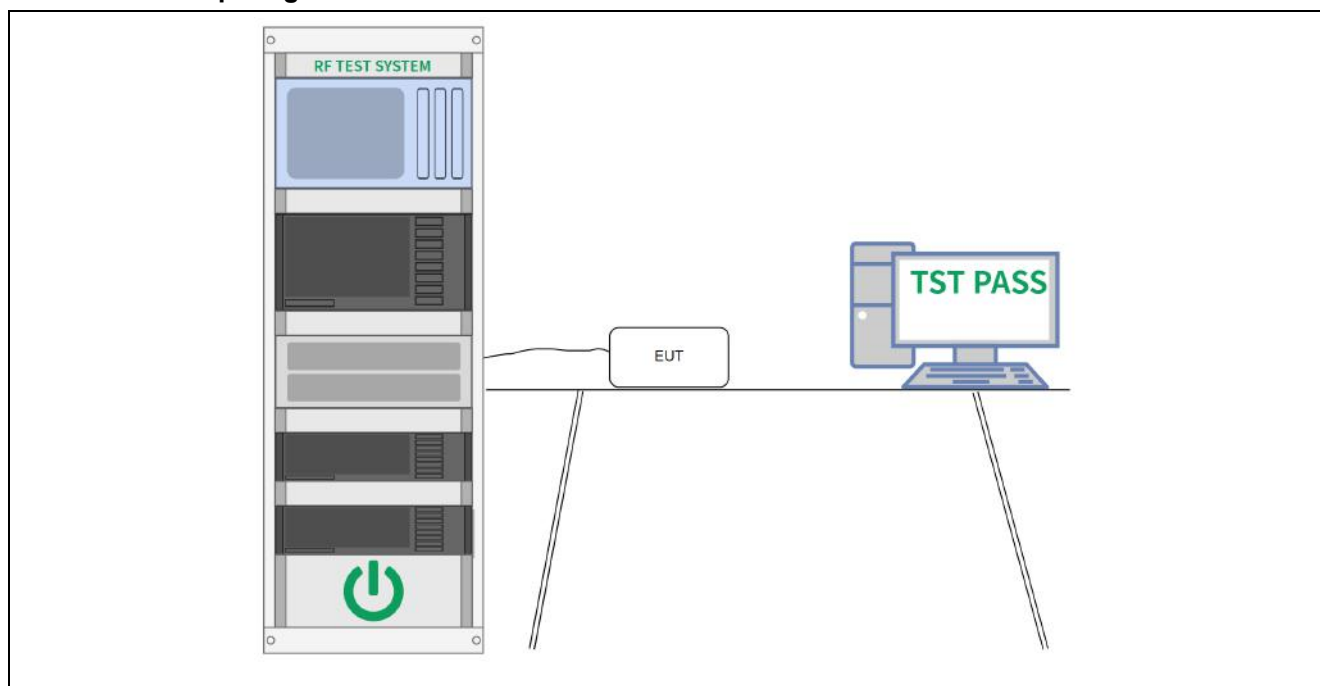
## 6.6 Dwell Time

Test Requirement:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Method:	Time of occupancy (dwell time)
Test Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Procedure:	<p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> <li>a) Span: Zero span, centered on a hopping channel.</li> <li>b) RBW shall be <math>\leq</math> channel spacing and where possible RBW should be set <math>\gg 1 / T</math>, where T is the expected dwell time per channel.</li> <li>c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.</li> <li>d) Detector function: Peak.</li> <li>e) Trace: Max hold.</li> </ul> <p>Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.</p> <p>Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:</p> $(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$ <p>The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.</p> <p>The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.</p>

### 6.6.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

### 6.6.2 Test Setup Diagram:



### 6.6.3 Test Data:

Please Refer to Appendix for Details.

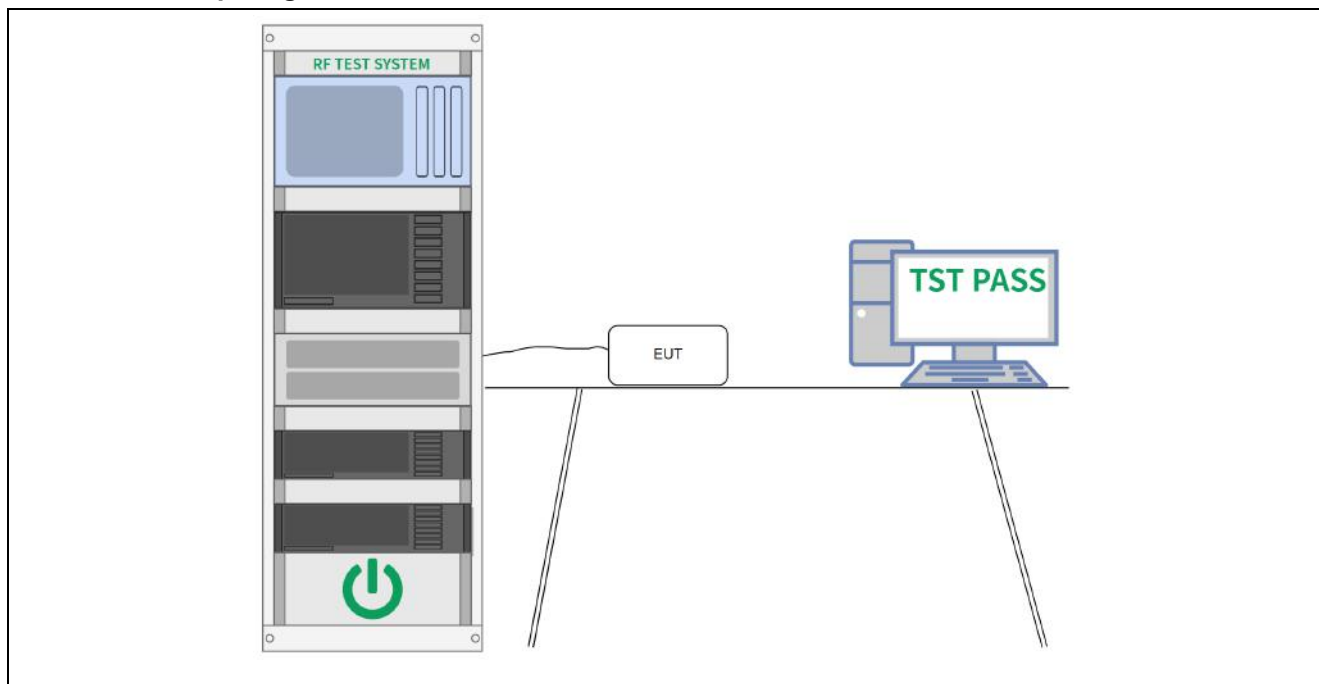
## 6.7 Emissions in non-restricted frequency bands

Test Requirement:	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.
Test Method:	Conducted spurious emissions test methodology
Test 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.
Procedure:	Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers. Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

### 6.7.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.2 °C
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

### 6.7.2 Test Setup Diagram:



### 6.7.3 Test Data:

Please Refer to Appendix for Details.

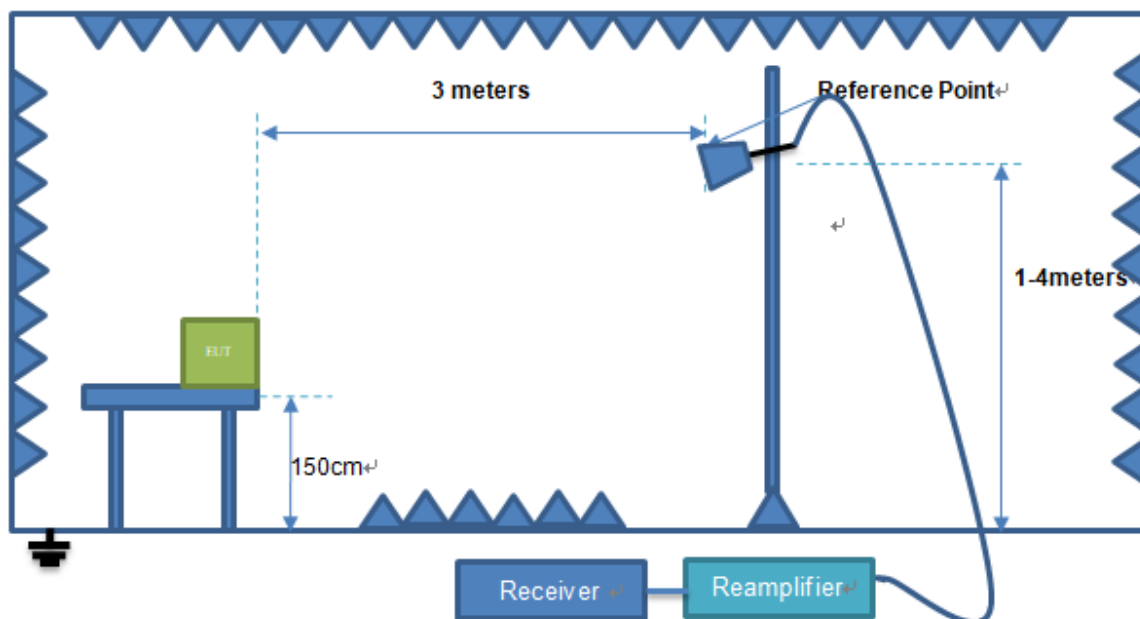
## 6.8 Band edge emissions (Radiated)

Test Requirement:	In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`		
Test Method:	Radiated emissions tests		
Test 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
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.			
Procedure:	ANSI C63.10-2013 section 6.6.4		

### 6.8.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.6 °C
Humidity:	45.5 %
Atmospheric Pressure:	1010 mbar

### 6.8.2 Test Setup Diagram:



### 6.8.3 Test Data:

Test Mode: GFSK										
Pol.	Frequen cy (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/ m)	Margin (dB)	Detect or Type	Result
Low Channel: 2402MHz										
H	2390.00	45.78	29.15	3.41	34.01	44.33	74.00	-29.67	PK	PASS
H	2400.00	62.98	29.16	3.43	34.01	61.56	74.00	-12.44	PK	PASS
H	2390.00	46.60	29.15	3.41	34.01	45.15	74.00	-28.85	PK	PASS
H	2400.00	65.33	29.16	3.43	34.01	63.91	74.00	-10.09	PK	PASS
V	2390.00	35.67	29.15	3.41	34.01	34.22	54.00	-19.78	AV	PASS
V	2400.00	47.08	29.16	3.43	34.01	45.66	54.00	-8.34	AV	PASS
V	2390.00	35.82	29.15	3.41	34.01	34.37	54.00	-19.63	AV	PASS
V	2400.00	49.01	29.16	3.43	34.01	47.59	54.00	-6.41	AV	PASS
High Channel: 2480MHz										
H	2483.50	48.23	29.28	3.53	34.03	47.01	74.00	-26.99	PK	PASS
H	2500.00	46.85	29.30	3.56	34.03	45.68	74.00	-28.32	PK	PASS
H	2483.50	49.56	29.28	3.53	34.03	48.34	74.00	-25.66	PK	PASS
H	2500.00	48.12	29.30	3.56	34.03	46.95	74.00	-27.05	PK	PASS
V	2483.50	38.54	29.28	3.53	34.03	37.32	54.00	-16.68	AV	PASS
V	2500.00	36.12	29.30	3.56	34.03	34.95	54.00	-19.05	AV	PASS
V	2483.50	39.99	29.28	3.53	34.03	38.77	54.00	-15.23	AV	PASS
V	2500.00	36.29	29.30	3.56	34.03	35.12	54.00	-18.88	AV	PASS

Test Mode: $\pi/4$ -DQPSK										
Pol.	Frequen cy (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/ m)	Margin (dB)	Detect or Type	Result
Low Channel: 2402MHz										
H	2390.00	45.85	29.15	3.41	34.01	44.40	74.00	-29.60	PK	PASS
H	2400.00	63.06	29.16	3.43	34.01	61.64	74.00	-12.36	PK	PASS
H	2390.00	46.68	29.15	3.41	34.01	45.23	74.00	-28.77	PK	PASS
H	2400.00	65.41	29.16	3.43	34.01	63.99	74.00	-10.01	PK	PASS
V	2390.00	35.73	29.15	3.41	34.01	34.28	54.00	-19.72	AV	PASS
V	2400.00	47.14	29.16	3.43	34.01	45.72	54.00	-8.28	AV	PASS
V	2390.00	35.88	29.15	3.41	34.01	34.43	54.00	-19.57	AV	PASS
V	2400.00	49.07	29.16	3.43	34.01	47.65	54.00	-6.35	AV	PASS
High Channel: 2480MHz										
H	2483.50	48.30	29.28	3.53	34.03	47.08	74.00	-26.92	PK	PASS
H	2500.00	46.91	29.30	3.56	34.03	45.74	74.00	-28.26	PK	PASS
H	2483.50	49.64	29.28	3.53	34.03	48.42	74.00	-25.58	PK	PASS
H	2500.00	48.19	29.30	3.56	34.03	47.02	74.00	-26.98	PK	PASS
V	2483.50	38.59	29.28	3.53	34.03	37.37	54.00	-16.63	AV	PASS
V	2500.00	36.17	29.30	3.56	34.03	35.00	54.00	-19.00	AV	PASS
V	2483.50	40.05	29.28	3.53	34.03	38.83	54.00	-15.17	AV	PASS
V	2500.00	36.33	29.30	3.56	34.03	35.16	54.00	-18.84	AV	PASS

Test Mode: 8-DPSK										
Pol.	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detect or Type	Result
Low Channel: 2402MHz										
H	2390.00	45.89	29.15	3.41	34.01	44.44	74.00	-29.56	PK	PASS
H	2400.00	63.11	29.16	3.43	34.01	61.69	74.00	-12.31	PK	PASS
H	2390.00	46.72	29.15	3.41	34.01	45.27	74.00	-28.73	PK	PASS
H	2400.00	65.47	29.16	3.43	34.01	64.05	74.00	-9.95	PK	PASS
V	2390.00	35.76	29.15	3.41	34.01	34.31	54.00	-19.69	AV	PASS
V	2400.00	47.17	29.16	3.43	34.01	45.75	54.00	-8.25	AV	PASS
V	2390.00	35.92	29.15	3.41	34.01	34.47	54.00	-19.53	AV	PASS
V	2400.00	49.11	29.16	3.43	34.01	47.69	54.00	-6.31	AV	PASS
High Channel: 2480MHz										
H	2483.50	48.35	29.28	3.53	34.03	47.13	74.00	-26.87	PK	PASS
H	2500.00	46.95	29.30	3.56	34.03	45.78	74.00	-28.22	PK	PASS
H	2483.50	49.70	29.28	3.53	34.03	48.48	74.00	-25.52	PK	PASS
H	2500.00	48.24	29.30	3.56	34.03	47.07	74.00	-26.93	PK	PASS
V	2483.50	38.62	29.28	3.53	34.03	37.40	54.00	-16.60	AV	PASS
V	2500.00	36.19	29.30	3.56	34.03	35.02	54.00	-18.98	AV	PASS
V	2483.50	40.08	29.28	3.53	34.03	38.86	54.00	-15.14	AV	PASS
V	2500.00	36.37	29.30	3.56	34.03	35.20	54.00	-18.80	AV	PASS

#### Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit



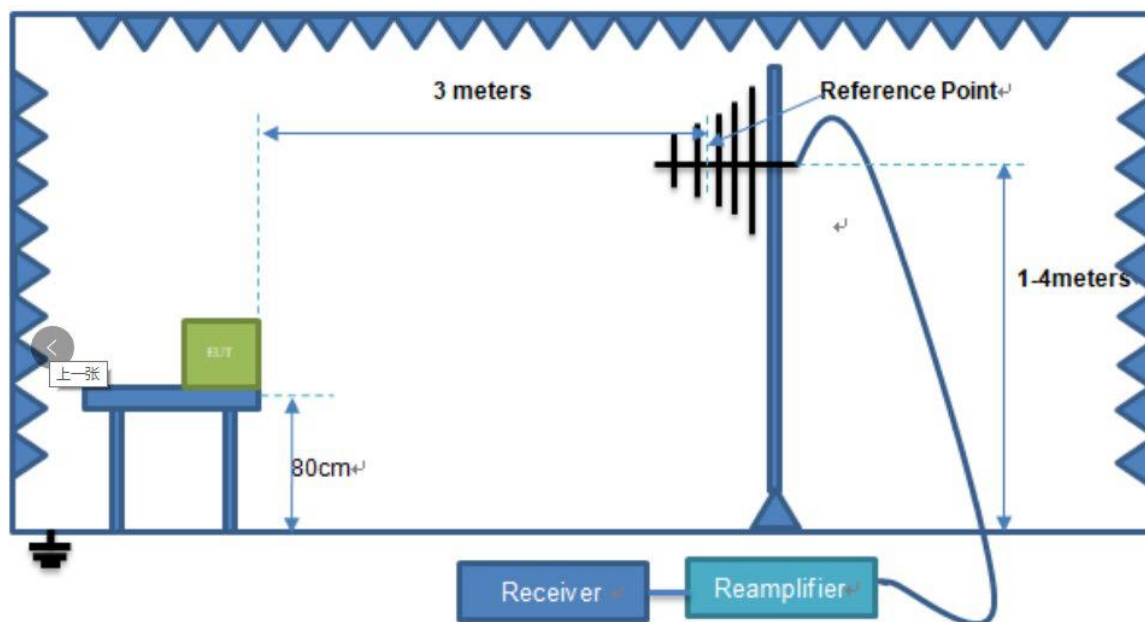
## 6.9 Emissions in restricted frequency bands (below 1GHz)

Test Requirement:	In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`		
Test Method:	Radiated emissions tests		
Test 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
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.			
Procedure:	ANSI C63.10-2013 section 6.6.4		

### 6.9.1 E.U.T. Operation:

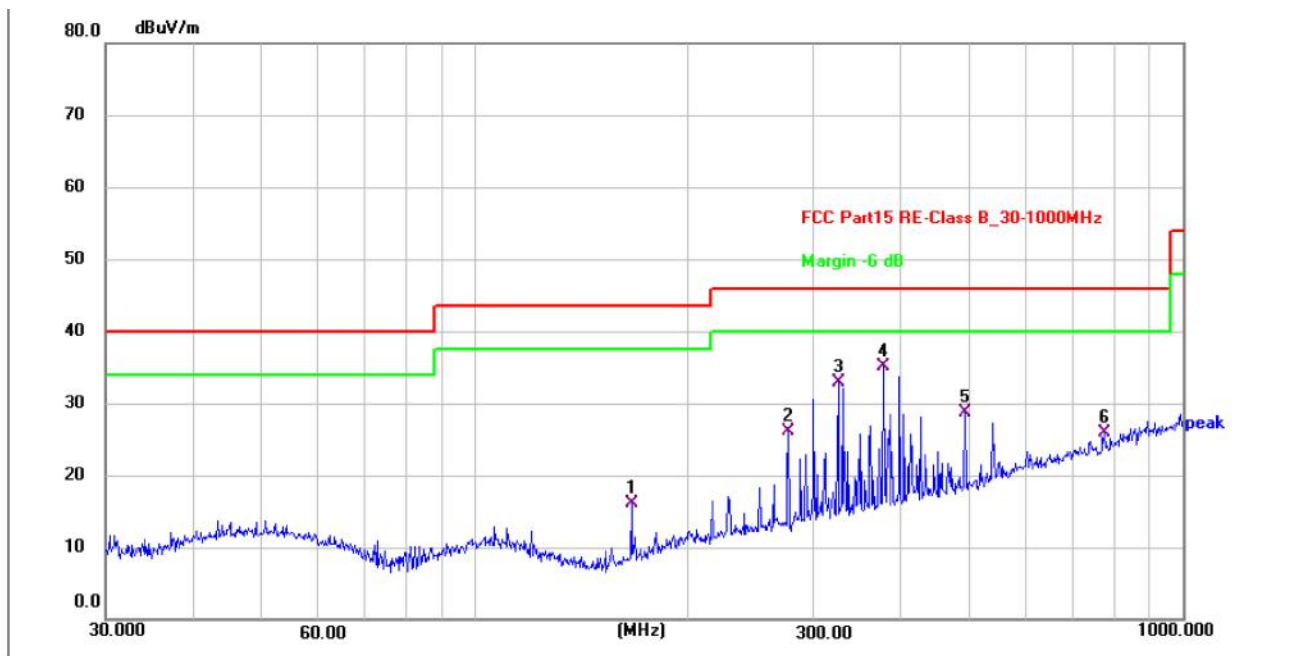
Operating Environment:	
Temperature:	25.6 °C
Humidity:	45.5 %
Atmospheric Pressure:	1010 mbar

### 6.9.2 Test Setup Diagram:



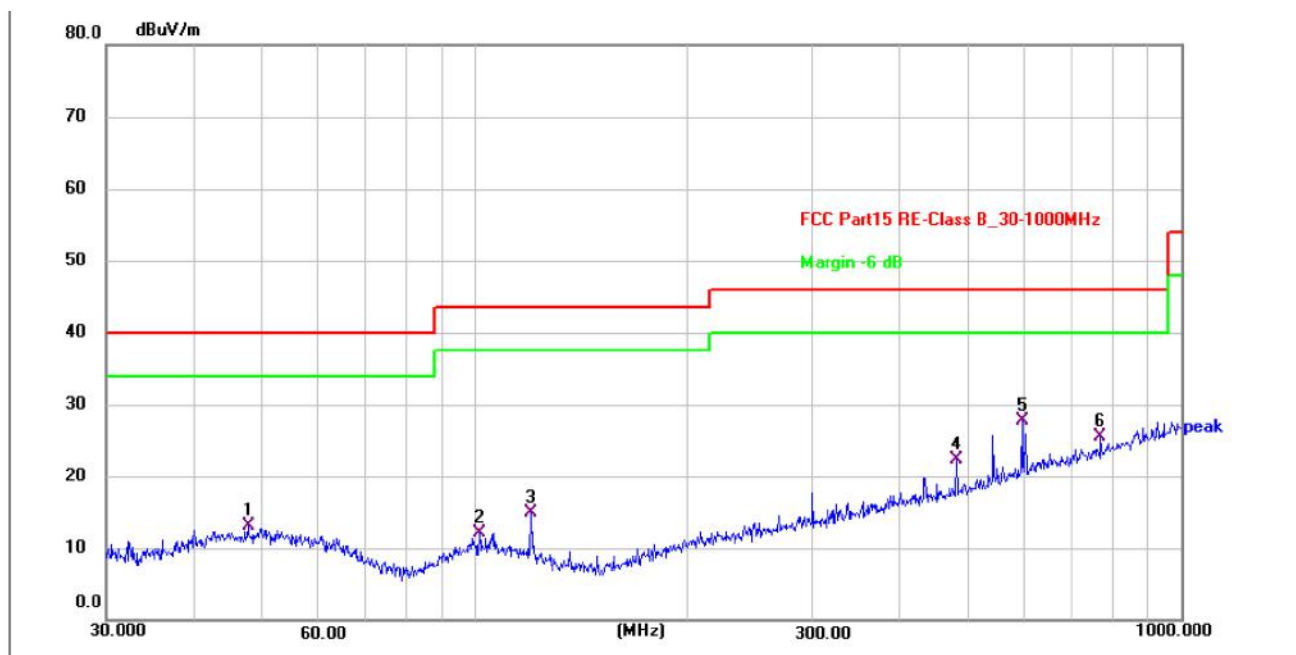
### 6.9.3 Test Data:

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	166.0680	33.26	-17.10	16.16	43.50	-27.34	QP	P	
2	277.0935	38.42	-12.28	26.14	46.00	-19.86	QP	P	
3	325.5958	44.04	-11.17	32.87	46.00	-13.13	QP	P	
4 *	377.2591	45.28	-10.15	35.13	46.00	-10.87	QP	P	
5	492.4685	37.24	-8.46	28.78	46.00	-17.22	QP	P	
6	774.1584	28.88	-2.94	25.94	46.00	-20.06	QP	P	

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	47.6586	26.85	-13.68	13.17	40.00	-26.83	QP	P	
2	101.2885	27.36	-15.31	12.05	43.50	-31.45	QP	P	
3	119.8556	31.25	-16.43	14.82	43.50	-28.68	QP	P	
4	480.5276	30.81	-8.54	22.27	46.00	-23.73	QP	P	
5 *	595.1329	33.68	-5.91	27.77	46.00	-18.23	QP	P	
6	768.7481	28.48	-2.98	25.50	46.00	-20.50	QP	P	

Note:

1. Level = Reading + Factor, Margin = Level – Limit;
2. Pre-scan all test modes, found worst case at GFSK 2441MHz, and so only show the test result of GFSK 2441MHz;
3. The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and the permissible value has no need to be reported.

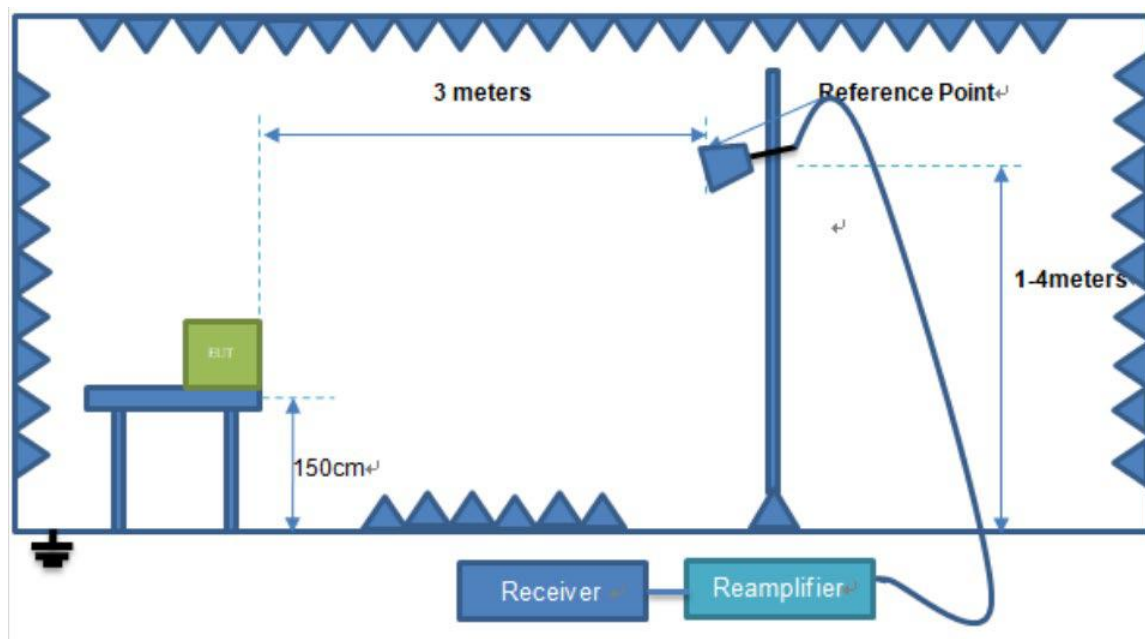
## 6.10 Emissions in restricted frequency bands (above 1GHz)

Test Requirement:	In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`		
Test Method:	Radiated emissions tests		
Test 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
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.			
Procedure:	ANSI C63.10-2013 section 6.6.4		

### 6.10.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.6 °C
Humidity:	45.5 %
Atmospheric Pressure:	1010 mbar

### 6.10.2 Test Setup Diagram:



### 6.10.3 Test Data:

Test Mode: CH00					Test channel: Lowest			
Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4804.00	38.72	34.04	6.58	34.09	45.25	74.00	-28.75	V
7206.00	32.77	37.11	7.73	34.50	43.11	74.00	-30.89	V
9608.00	32.30	39.31	9.23	34.79	46.05	74.00	-27.95	V
12010.00	*					74.00		V
14412.00	*					74.00		V
4804.00	43.29	34.04	6.58	34.09	49.82	74.00	-24.18	H
7206.00	34.65	37.11	7.73	34.50	44.99	74.00	-29.01	H
9608.00	31.86	39.31	9.23	34.79	45.61	74.00	-28.39	H
12010.00	*					74.00		H
14412.00	*					74.00		H
Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4804.00	27.26	34.04	6.58	34.09	33.79	54.00	-20.21	V
7206.00	21.29	37.11	7.73	34.50	31.63	54.00	-22.37	V
9608.00	20.28	39.31	9.23	34.79	34.03	54.00	-19.97	V
12010.00	*					54.00		V
14412.00	*					54.00		V
4804.00	31.65	34.04	6.58	34.09	38.18	54.00	-15.82	H
7206.00	23.56	37.11	7.73	34.50	33.90	54.00	-20.10	H
9608.00	20.13	39.31	9.23	34.79	33.88	54.00	-20.12	H
12010.00	*					54.00		H
14412.00	*					54.00		H

## 1GHz-25GHz

Test Mode: CH39					Test channel: Middle			
Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4882.00	37.66	34.38	6.69	34.09	44.64	74.00	-29.37	V
7323.00	32.06	37.22	7.78	34.53	42.53	74.00	-31.47	V
9764.00	31.68	39.46	9.35	34.80	45.69	74.00	-28.31	V
12205.00	*					74.00		V
14646.00	*					74.00		V
4882.00	42.01	34.38	6.69	34.09	48.99	74.00	-25.01	H
7323.00	33.85	37.22	7.78	34.53	44.32	74.00	-29.68	H
9764.00	31.13	39.46	9.35	34.80	45.14	74.00	-28.86	H
12205.00	*					74.00		H
14646.00	*					74.00		H
Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4882.00	26.42	34.38	6.69	34.09	33.40	54.00	-20.60	V
7323.00	20.72	37.22	7.78	34.53	31.19	54.00	-22.81	V
9764.00	19.77	39.46	9.35	34.80	33.78	54.00	-20.22	V
12205.00	*					54.00		V
14646.00	*					54.00		V
4882.00	30.69	34.38	6.69	34.09	37.67	54.00	-16.33	H
7323.00	22.92	37.22	7.78	34.53	33.39	54.00	-20.61	H
9764.00	19.53	39.46	9.35	34.80	33.54	54.00	-20.46	H
12205.00	*					54.00		H
14646.00	*					54.00		H

# 1GHz-25GHz

CH2 200MHz

Test Mode: CH78					Test channel: Highest			
Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4960.00	36.77	34.72	6.79	34.09	44.19	74.00	-29.81	V
7440.00	31.47	37.34	7.82	34.57	42.06	74.00	-31.94	V
9920.00	31.15	39.62	9.46	34.81	45.42	74.00	-28.58	V
12400.00	*					74.00		V
14880.00	*					74.00		V
4960.00	40.94	34.72	6.79	34.09	48.36	74.00	-25.64	H
7440.00	33.18	37.34	7.82	34.57	43.77	74.00	-30.23	H
9920.00	30.52	39.62	9.46	34.81	44.79	74.00	-29.21	H
12400.00	*					74.00		H
14880.00	*					74.00		H
Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4960.00	25.75	34.72	6.79	34.09	33.17	54.00	-20.83	V
7440.00	20.27	37.34	7.82	34.57	30.86	54.00	-23.14	V
9920.00	19.37	39.62	9.46	34.81	33.64	54.00	-20.36	V
12400.00	*					54.00		V
14880.00	*					54.00		V
4960.00	29.93	34.72	6.79	34.09	37.35	54.00	-16.65	H
7440.00	22.41	37.34	7.82	34.57	33.00	54.00	-21.00	H
9920.00	19.07	39.62	9.46	34.81	33.34	54.00	-20.66	H
12400.00	*					54.00		H
14880.00	*					54.00		H

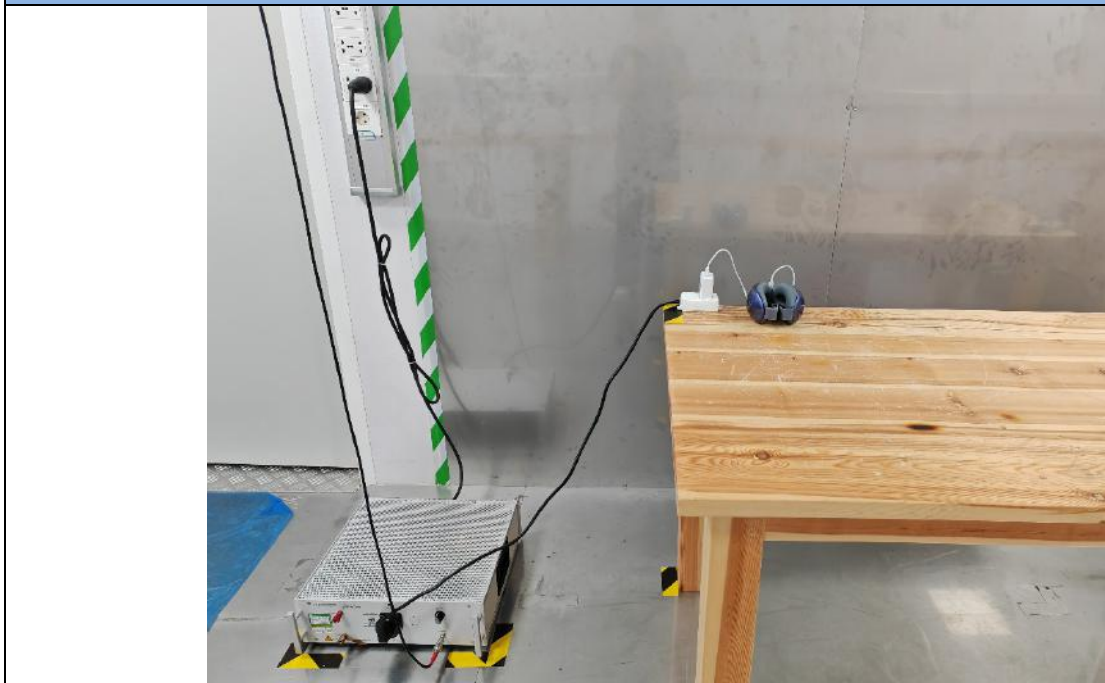
## Remark:

- During the test, pre-scan the GFSK,  $\pi/4$ QPSK, 8-DPSK modulation, and found the GFSK modulation is worse case, the report only record this mode.
- Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- “\*” means the test results were attenuated more than 20dB below the permissible limits, so the results don't record in the report.



## 7 Test Setup Photos

Conducted Emission at AC power line



Emissions in restricted frequency bands (below 1GHz)



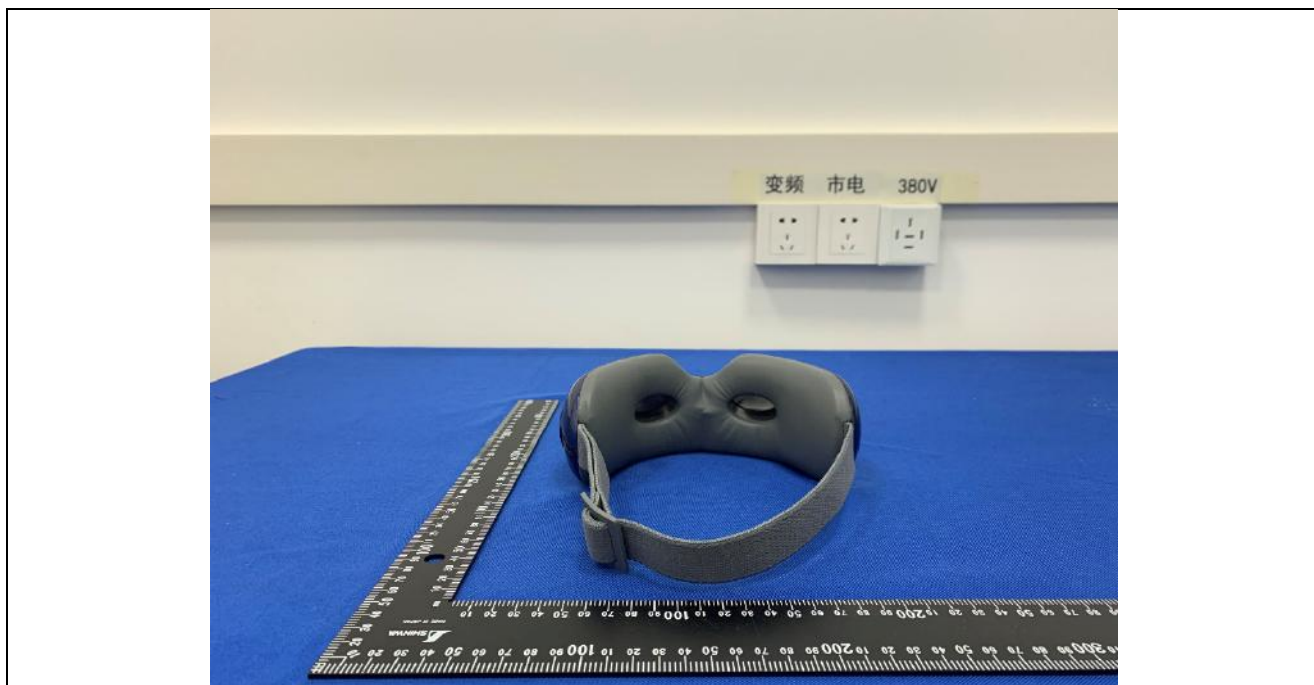


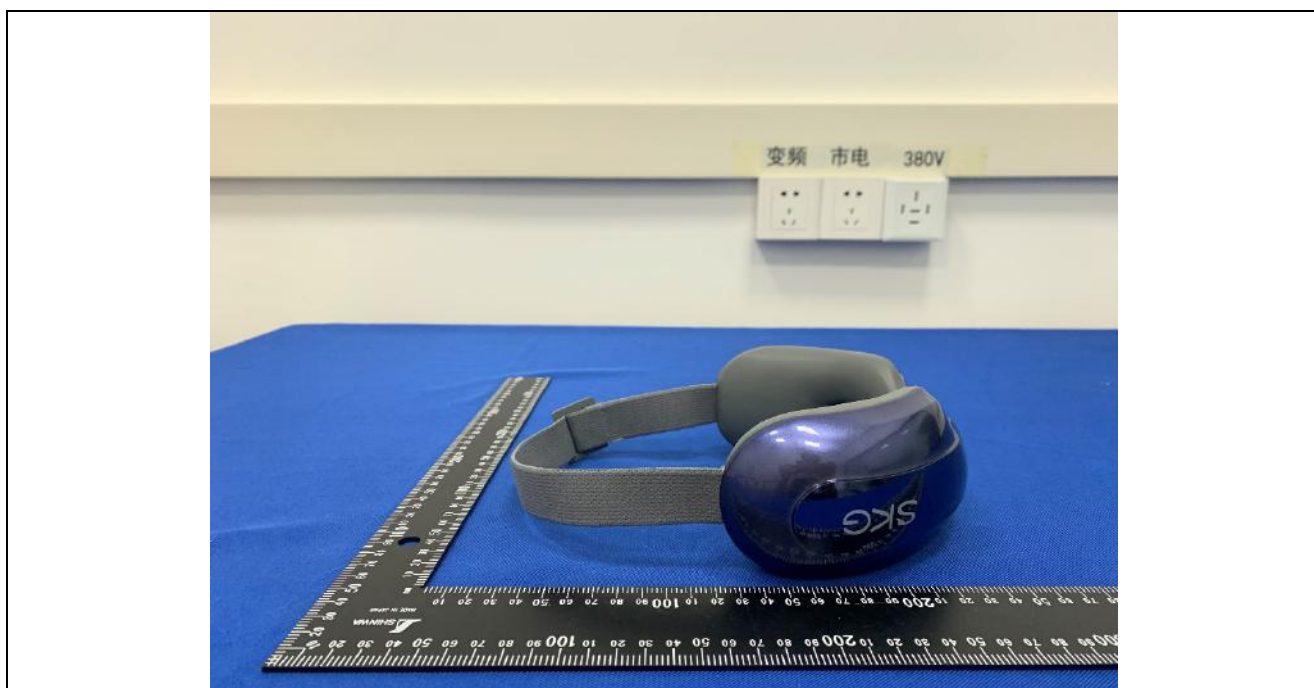
Emissions in restricted frequency bands (above 1GHz)

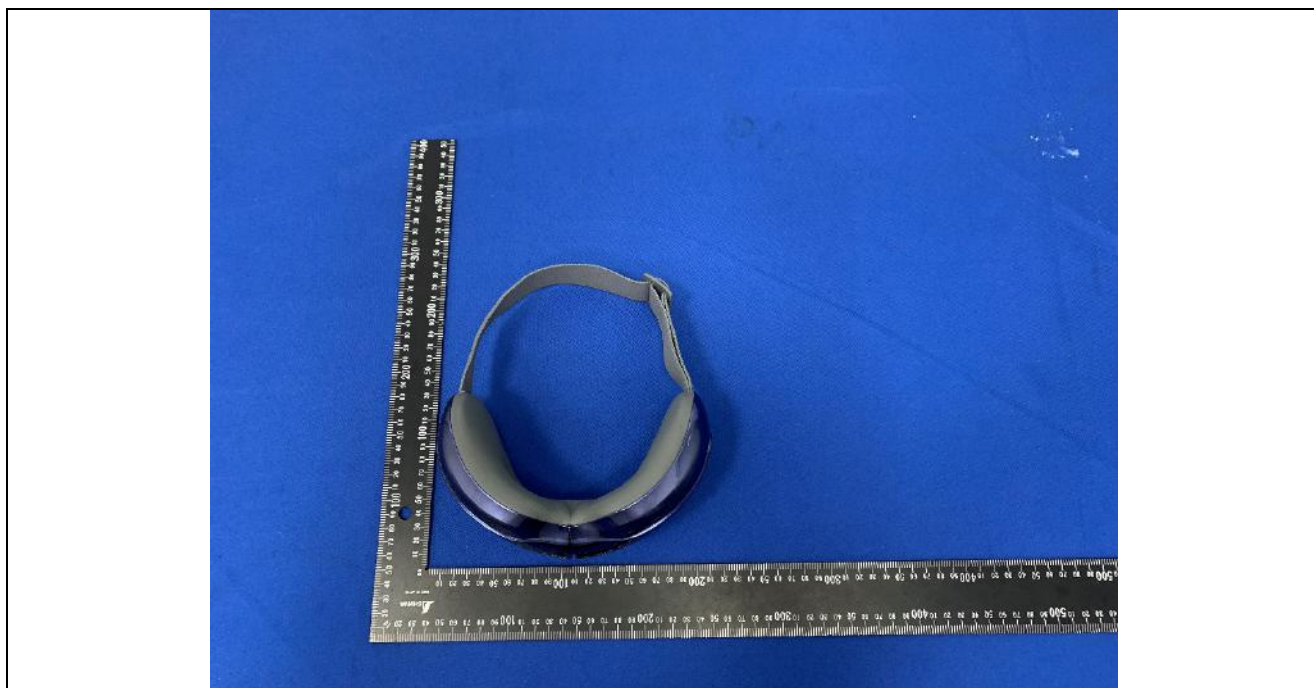
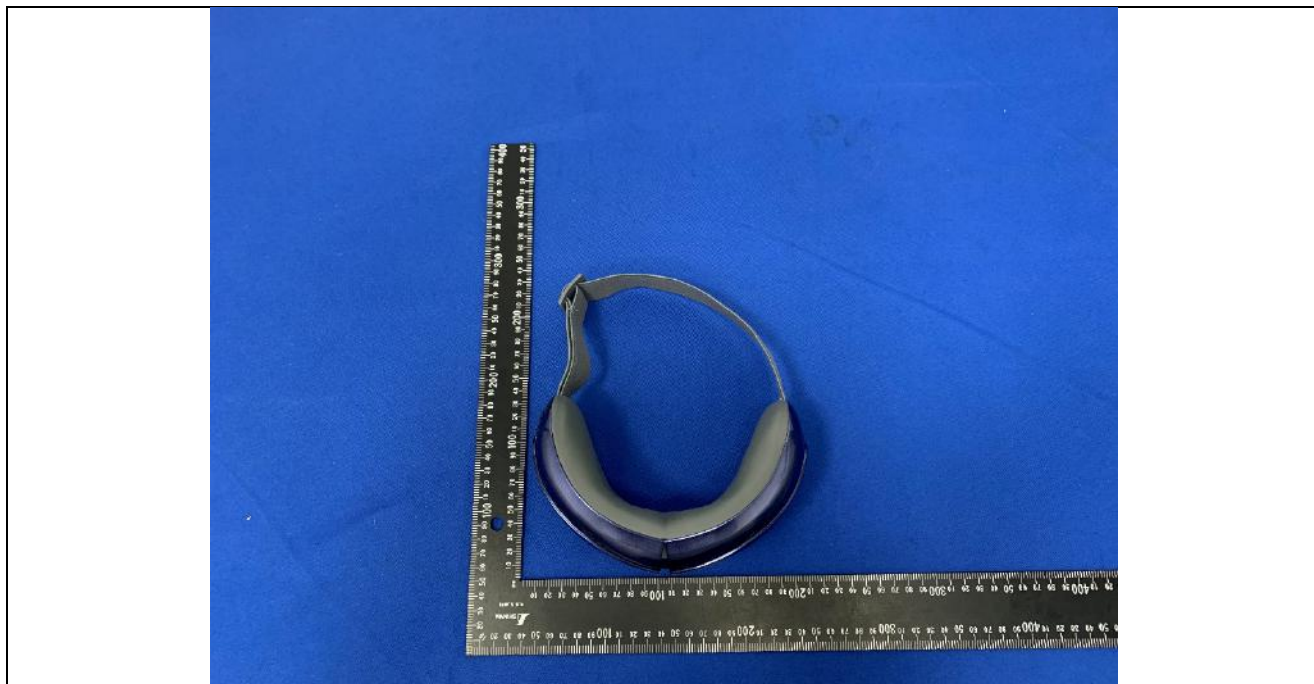


## 8 EUT Constructional Details (EUT Photos)

External



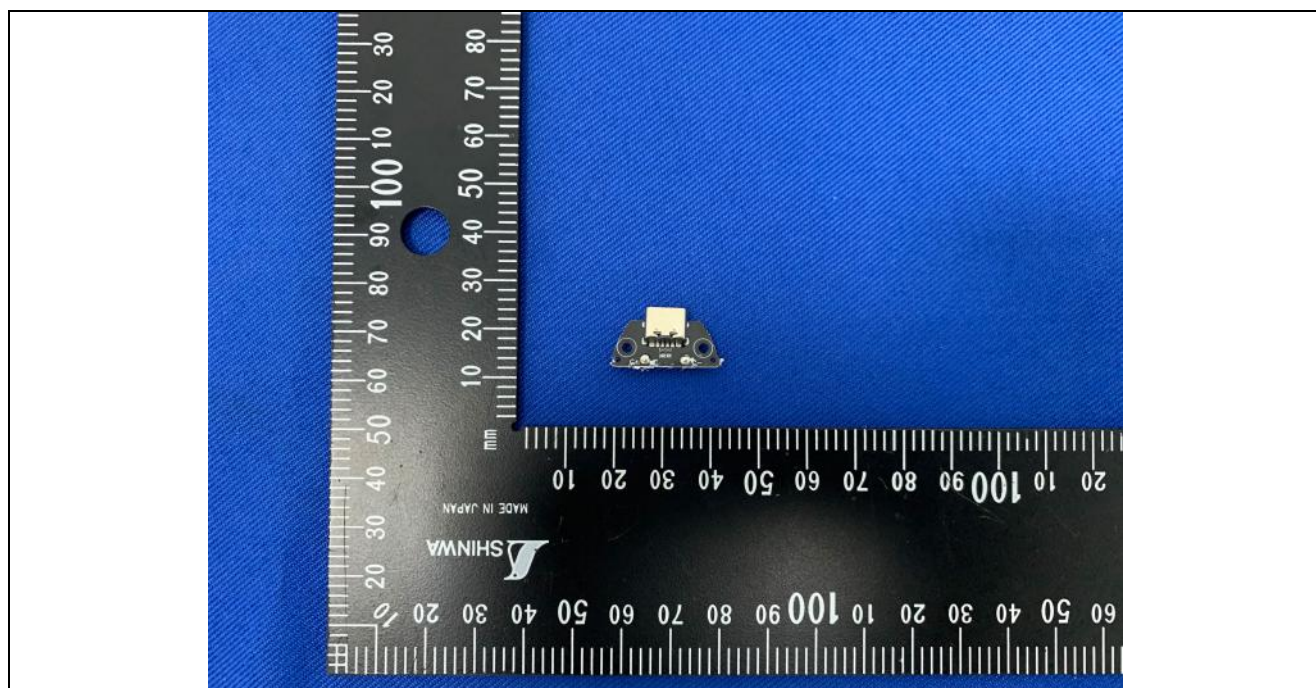
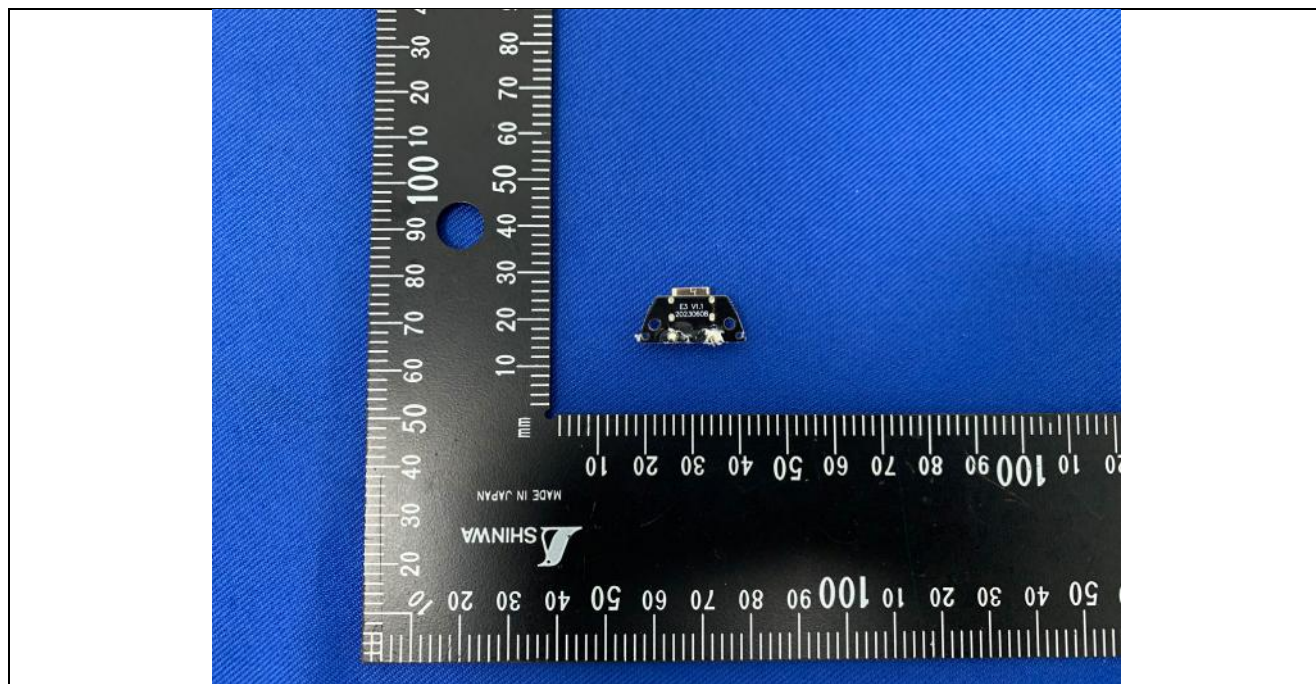




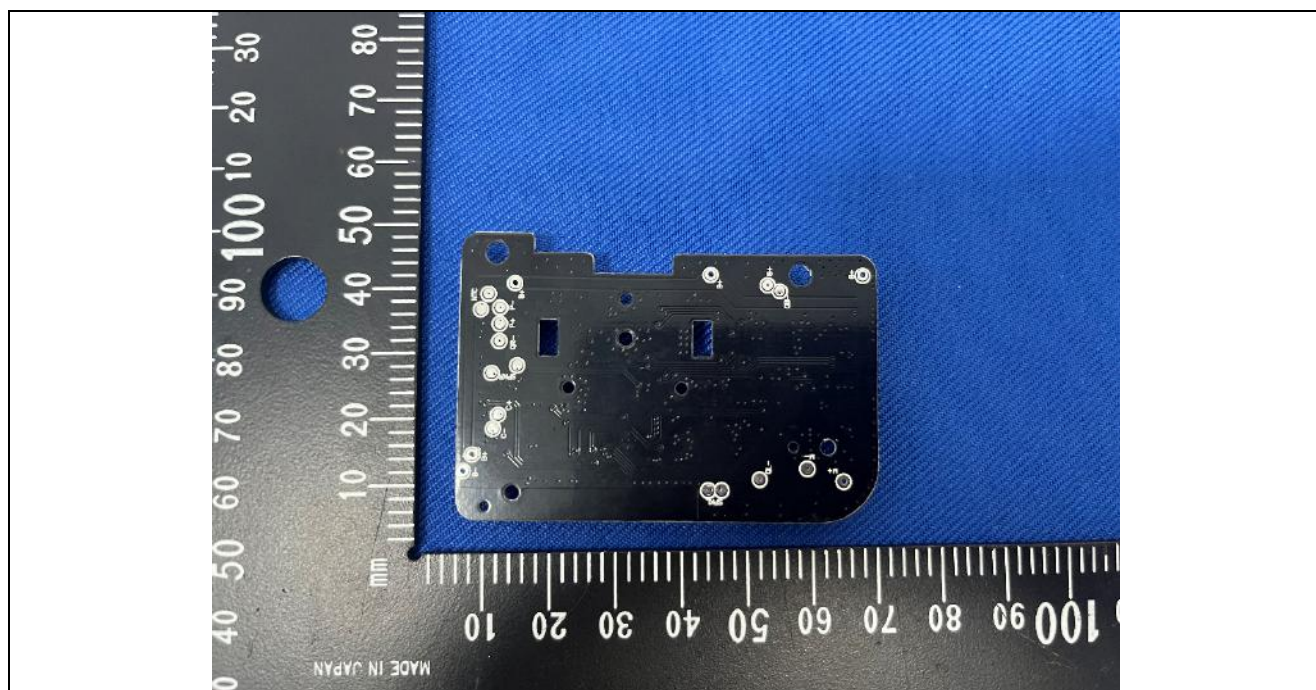
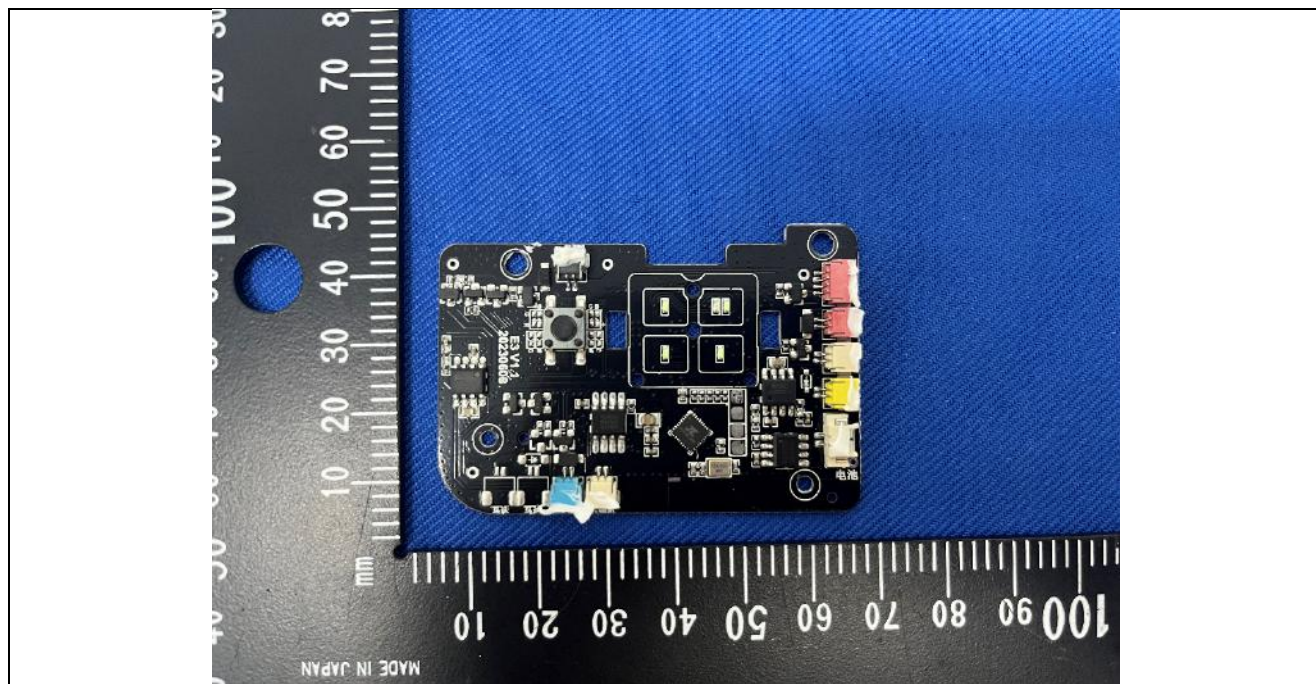


Internal

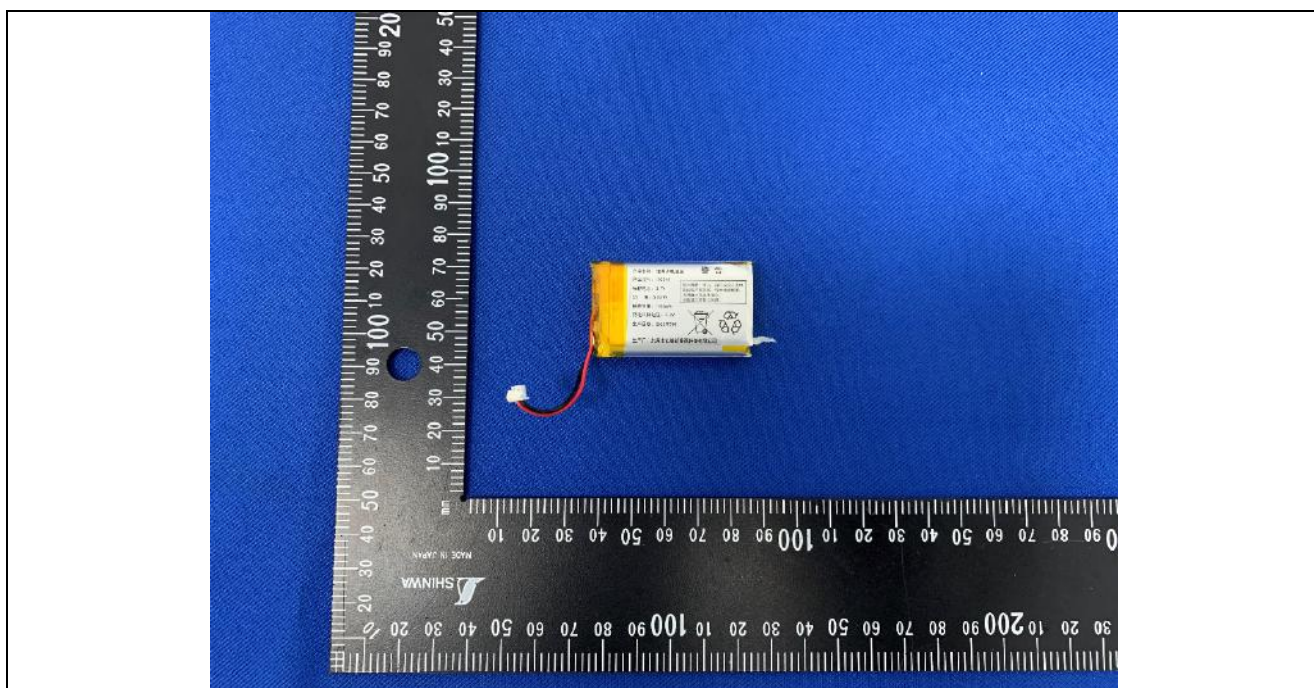
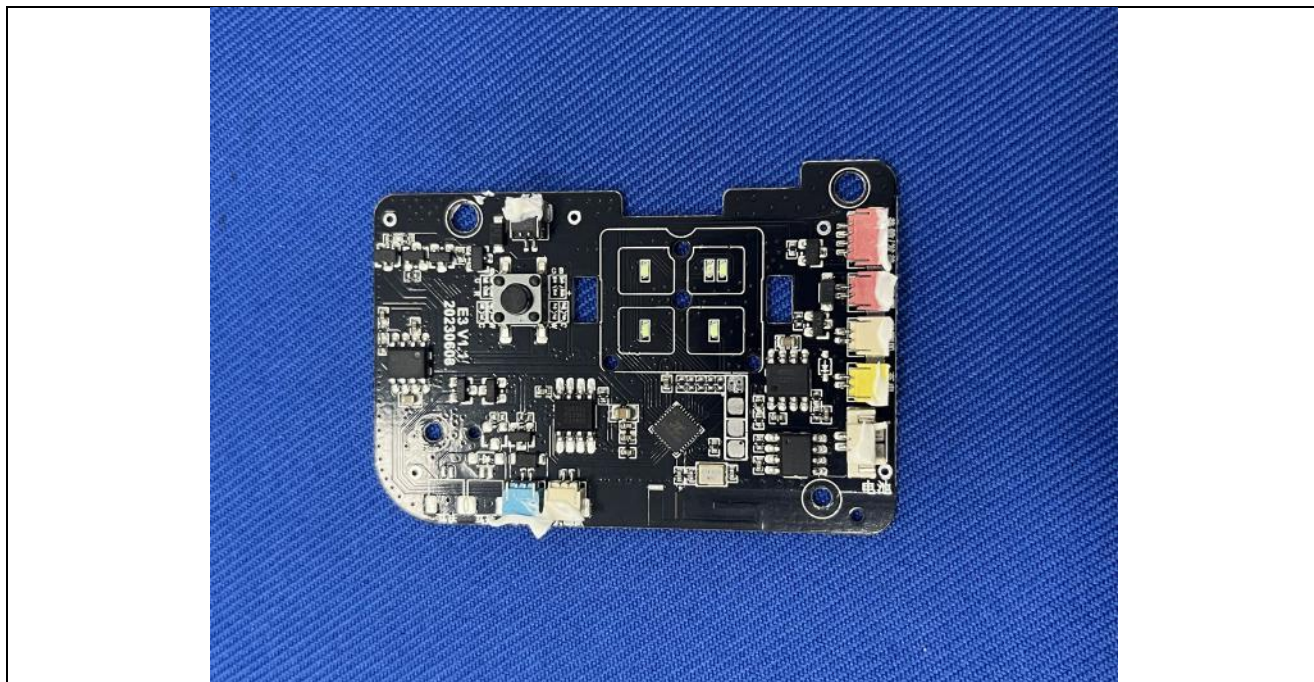




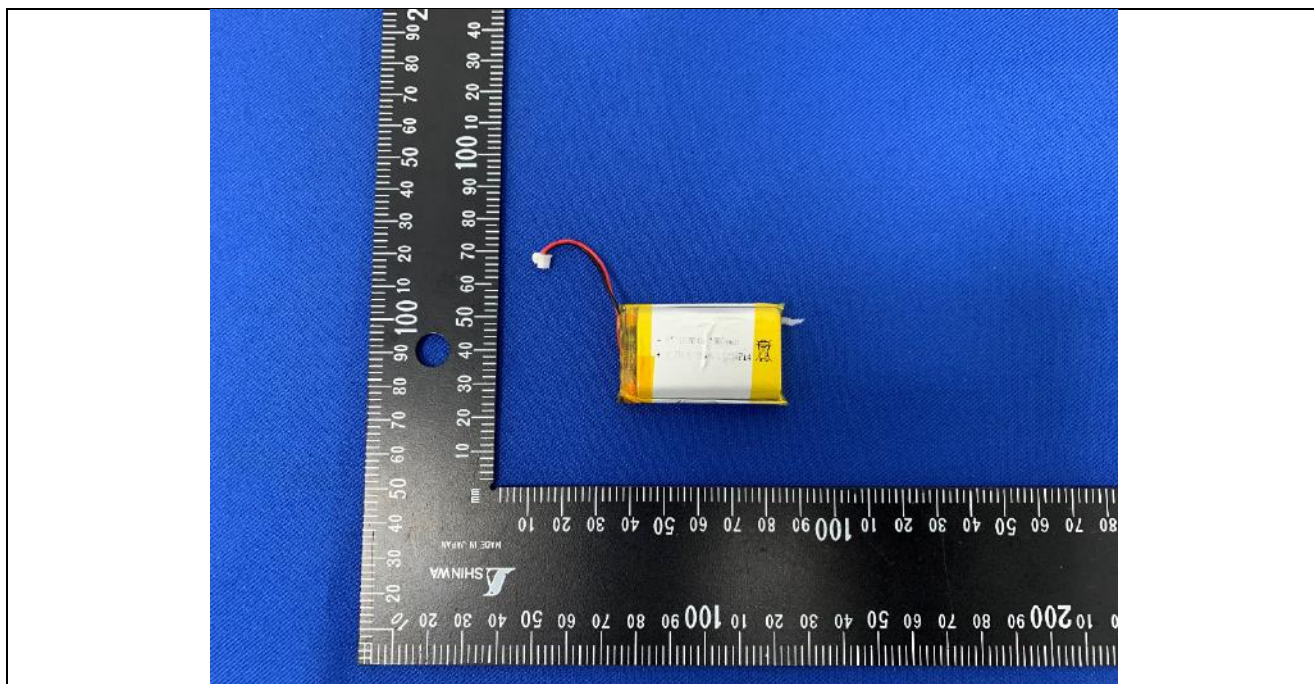












# Appendix

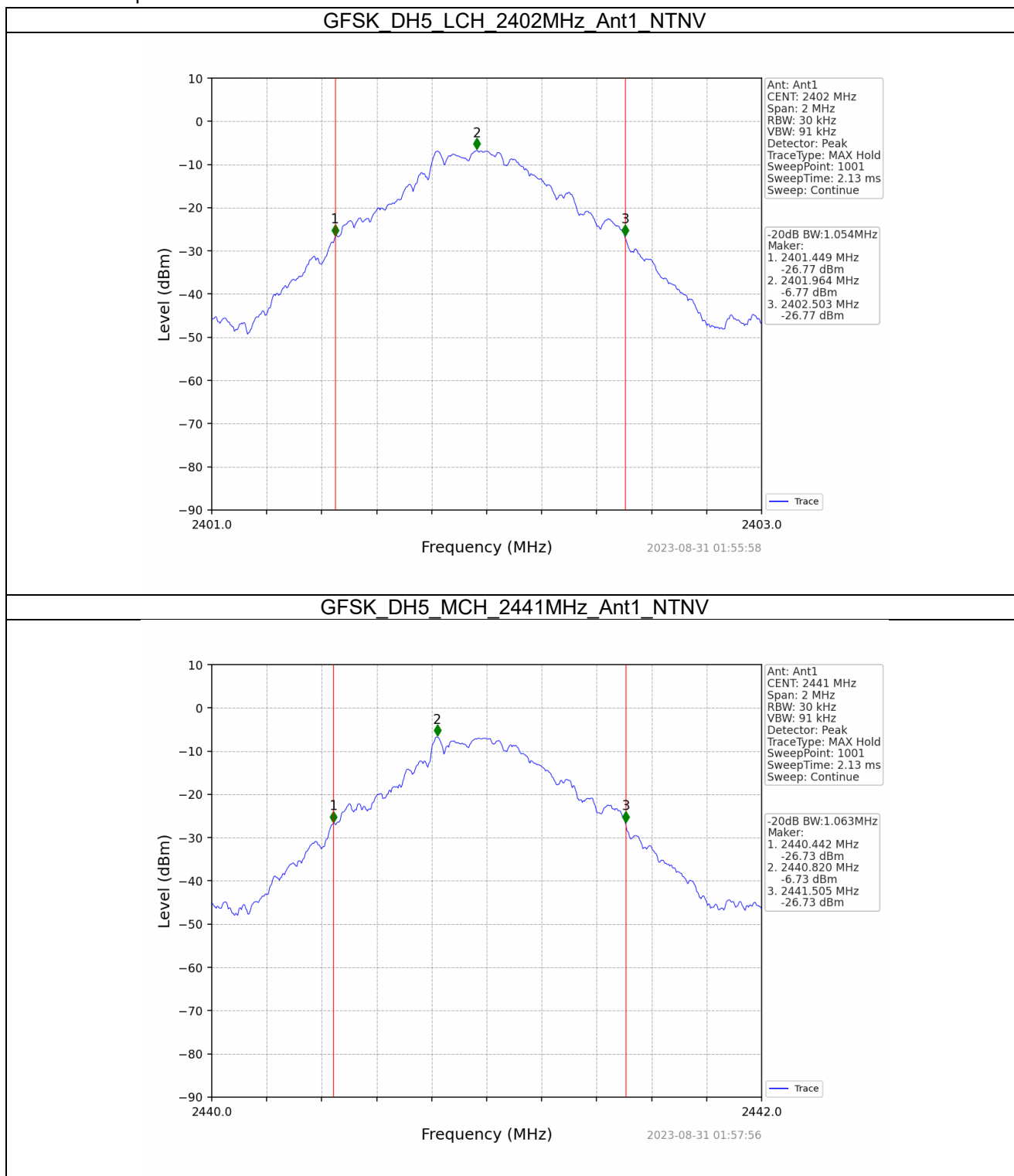
## 1. Bandwidth

## 1.1 20dB BW

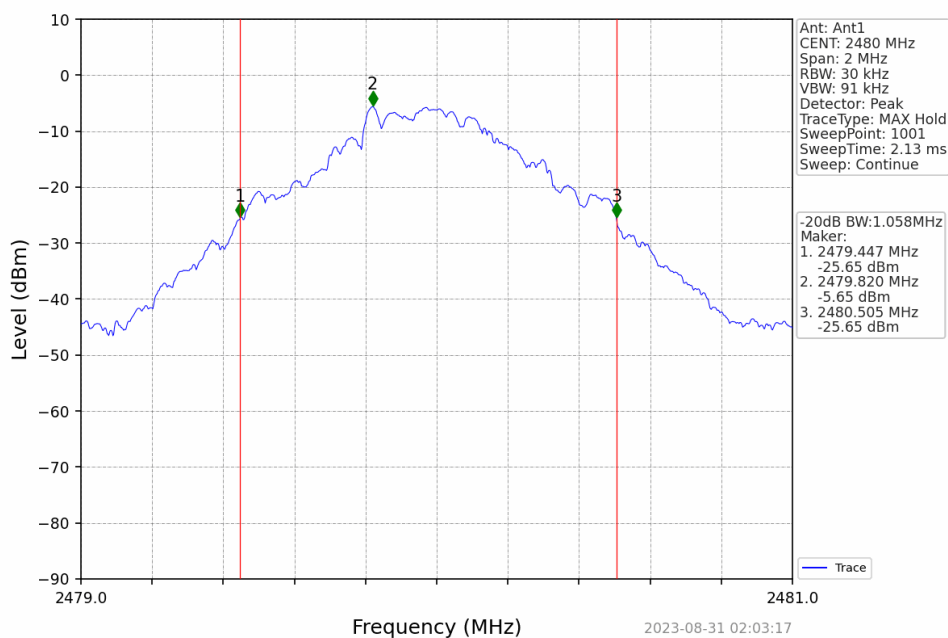
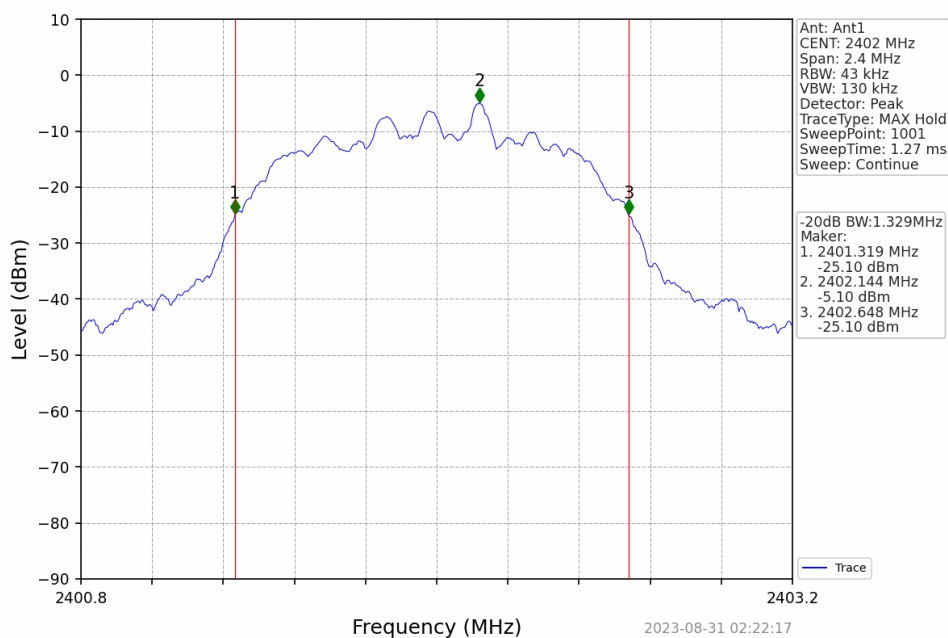
## 1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	1.054	Pass
		2441	DH5	1	1.063	Pass
		2480	DH5	1	1.058	Pass
$\pi/4$ -DQPSK	SISO	2402	2DH5	1	1.329	Pass
		2441	2DH5	1	1.348	Pass
		2480	2DH5	1	1.348	Pass
8-DPSK	SISO	2402	3DH5	1	1.325	Pass
		2441	3DH5	1	1.324	Pass
		2480	3DH5	1	1.319	Pass

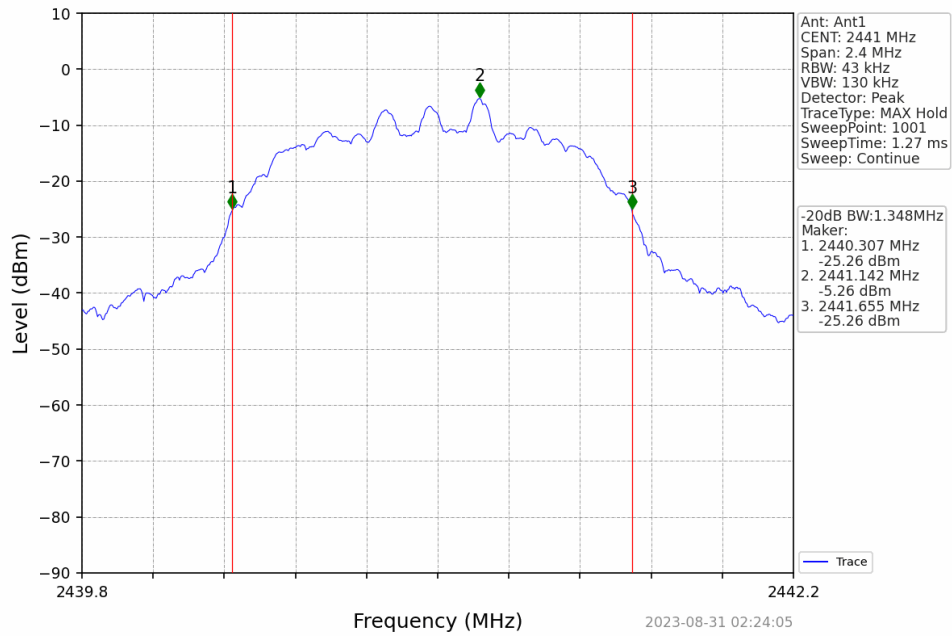
## 1.1.2 Test Graph



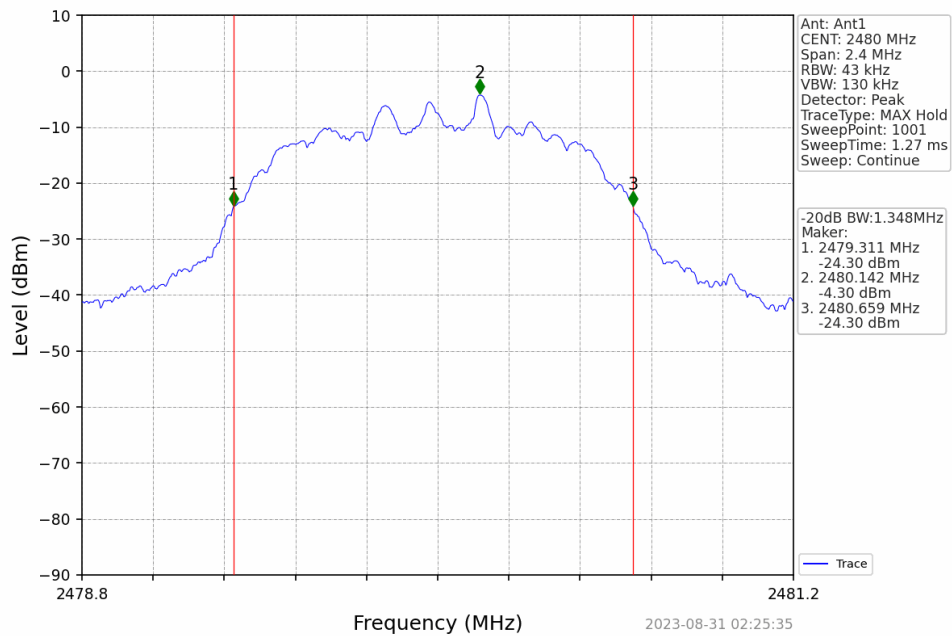
## GFSK\_DH5\_HCH\_2480MHz\_Ant1\_NTNV


 $\pi/4$ -DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV


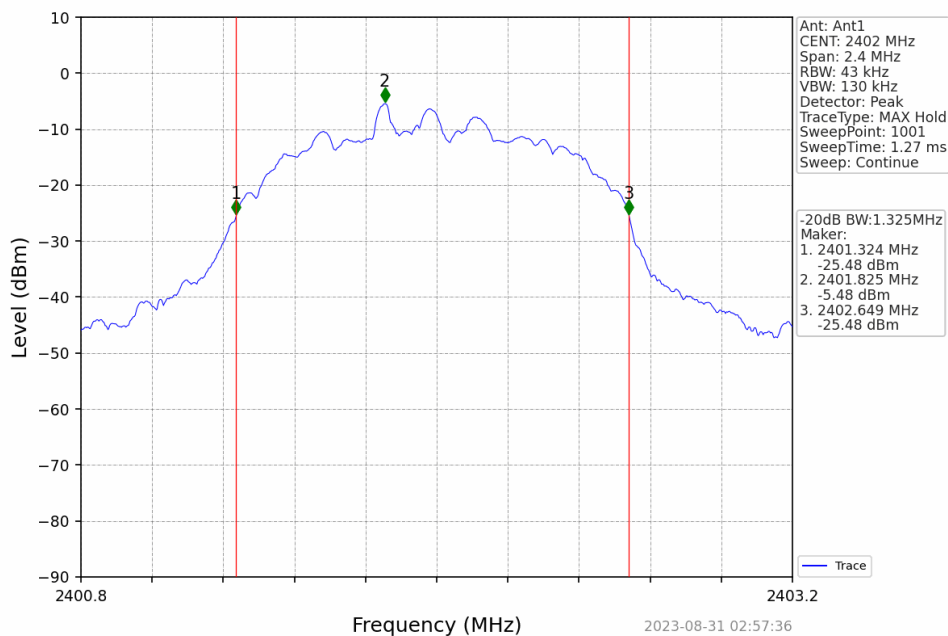
### $\pi/4$ -DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV



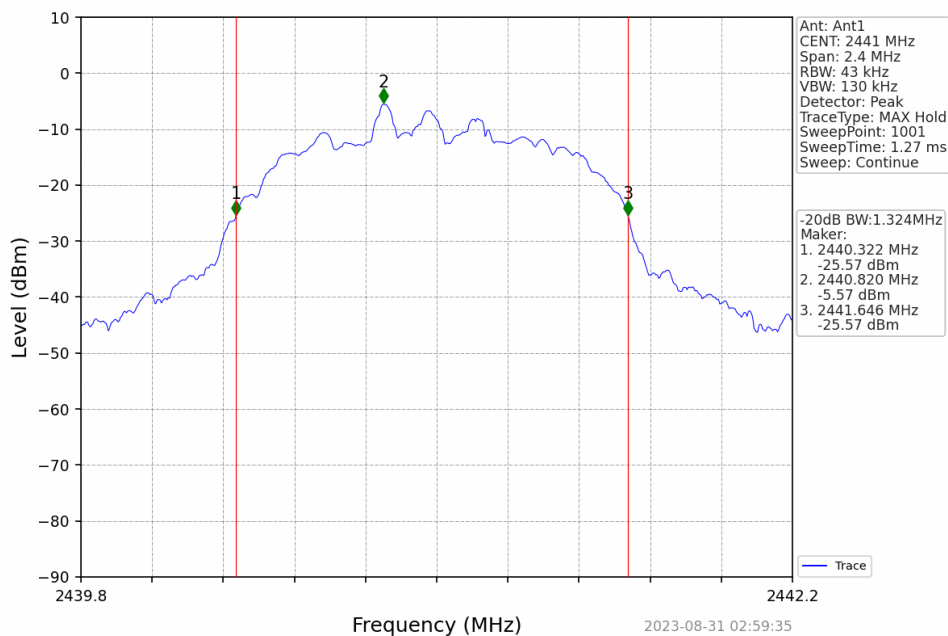
### $\pi/4$ -DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV



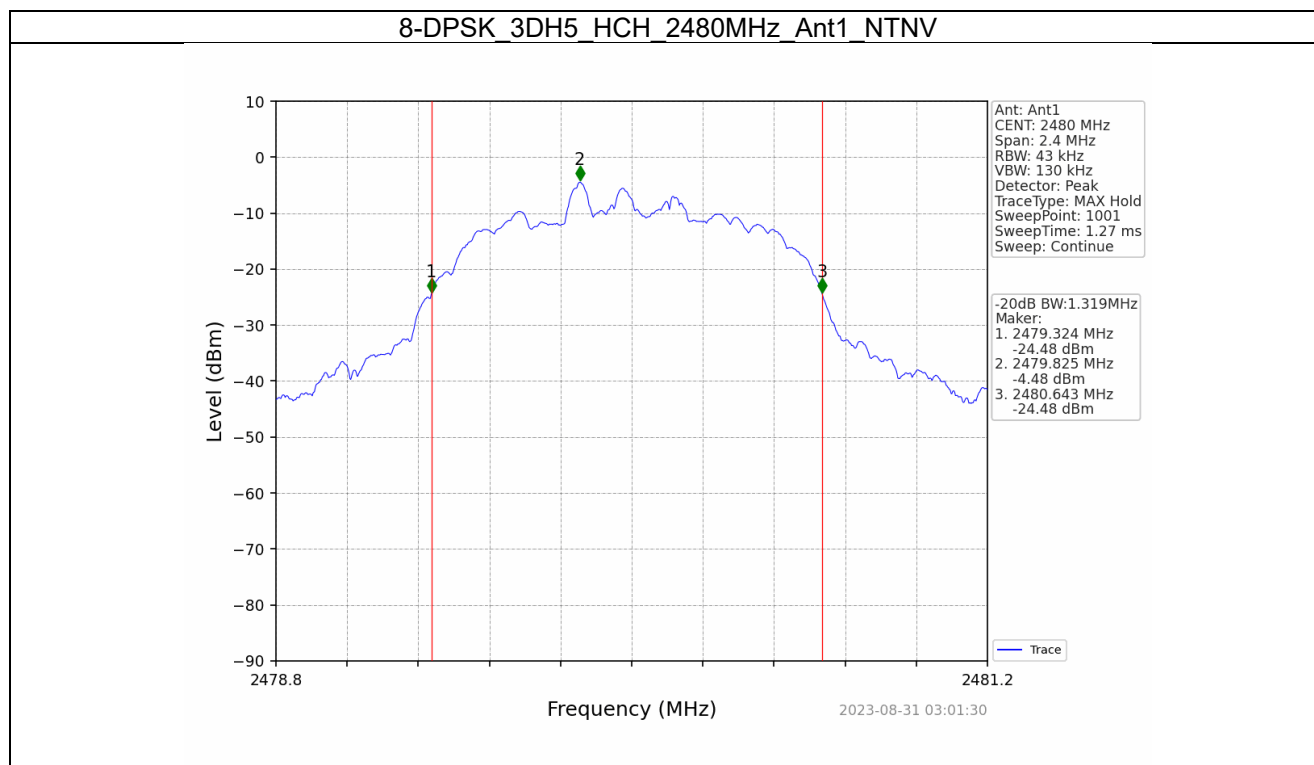
## 8-DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV



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







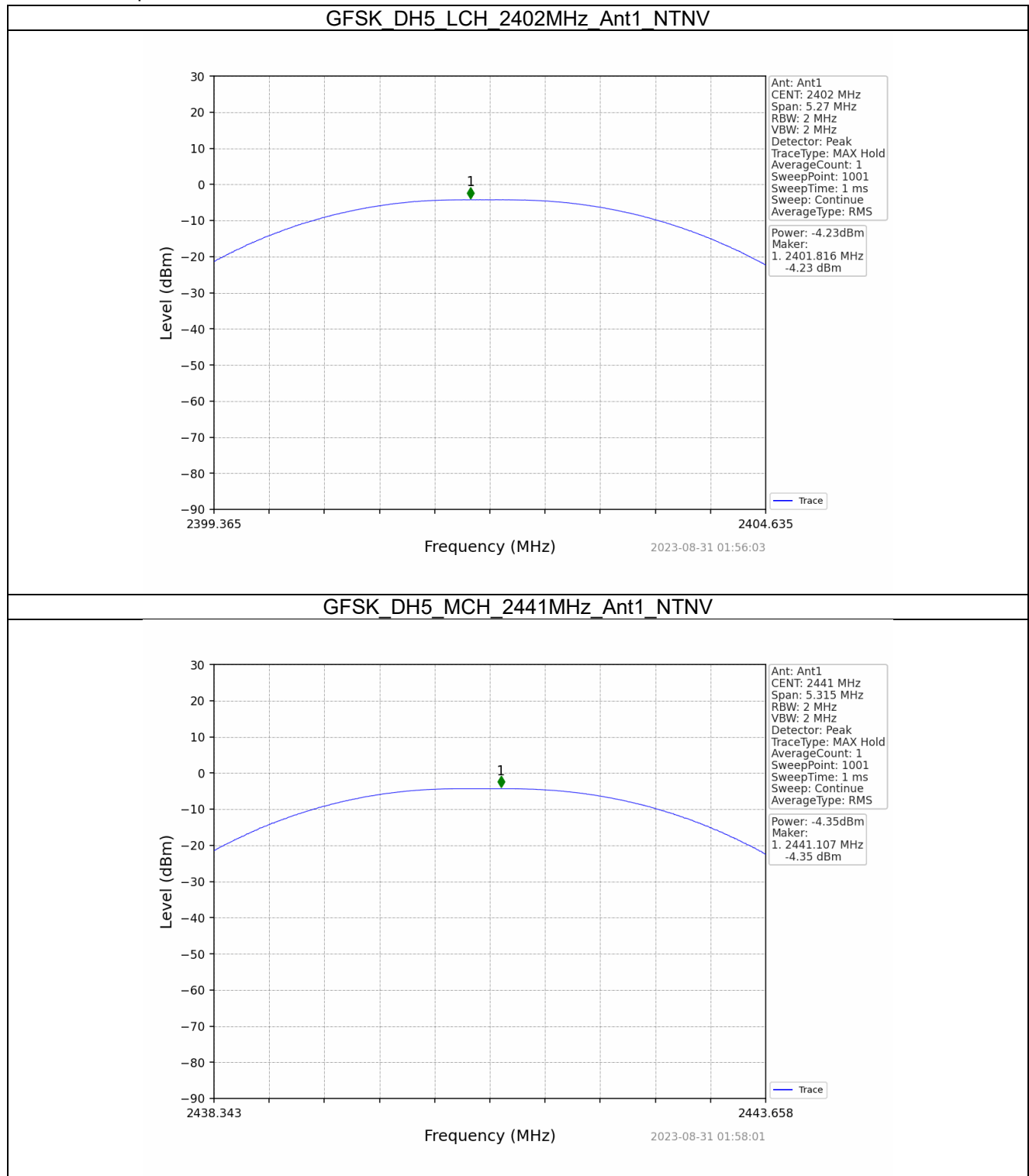
## 2. Maximum Conducted Output Power

### 2.1 Power

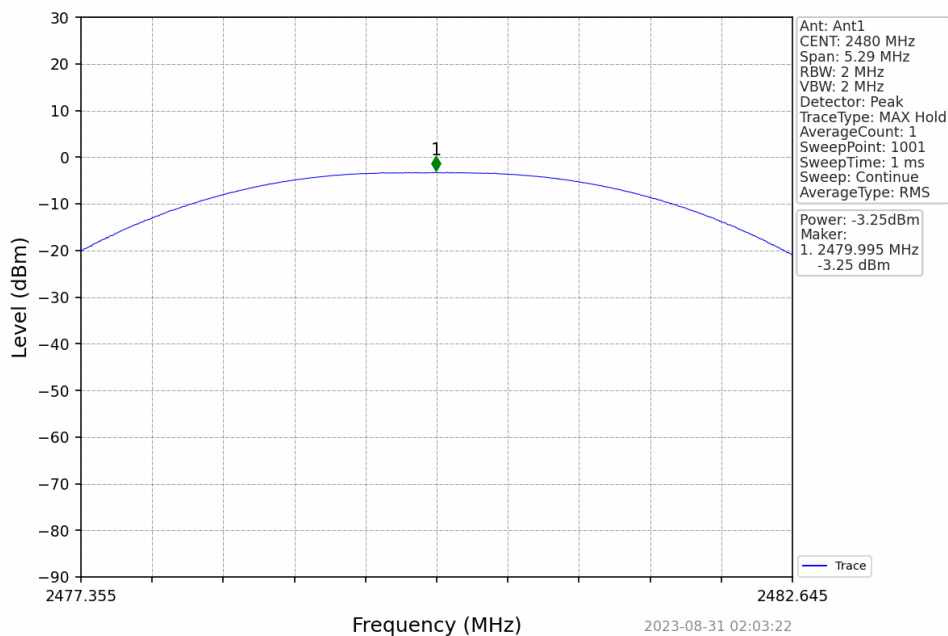
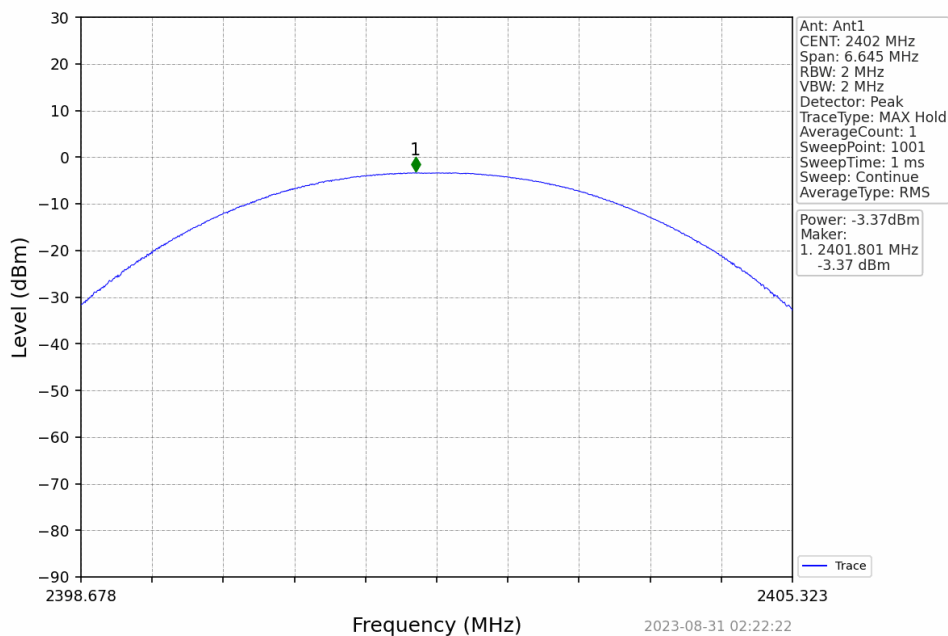
#### 2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-4.23	$\leq 20.97$	Pass
		2441	DH5	-4.35	$\leq 20.97$	Pass
		2480	DH5	-3.25	$\leq 20.97$	Pass
$\pi/4$ -DQPSK	SISO	2402	2DH5	-3.37	$\leq 20.97$	Pass
		2441	2DH5	-3.47	$\leq 20.97$	Pass
		2480	2DH5	-2.41	$\leq 20.97$	Pass
8-DPSK	SISO	2402	3DH5	-2.98	$\leq 20.97$	Pass
		2441	3DH5	-3.10	$\leq 20.97$	Pass
		2480	3DH5	-2.07	$\leq 20.97$	Pass

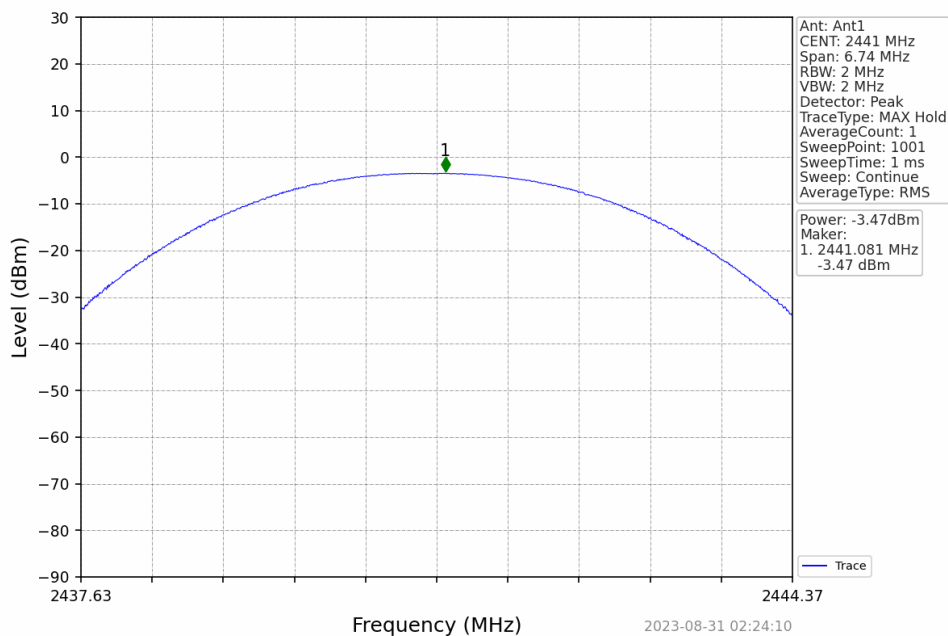
## 2.1.2 Test Graph



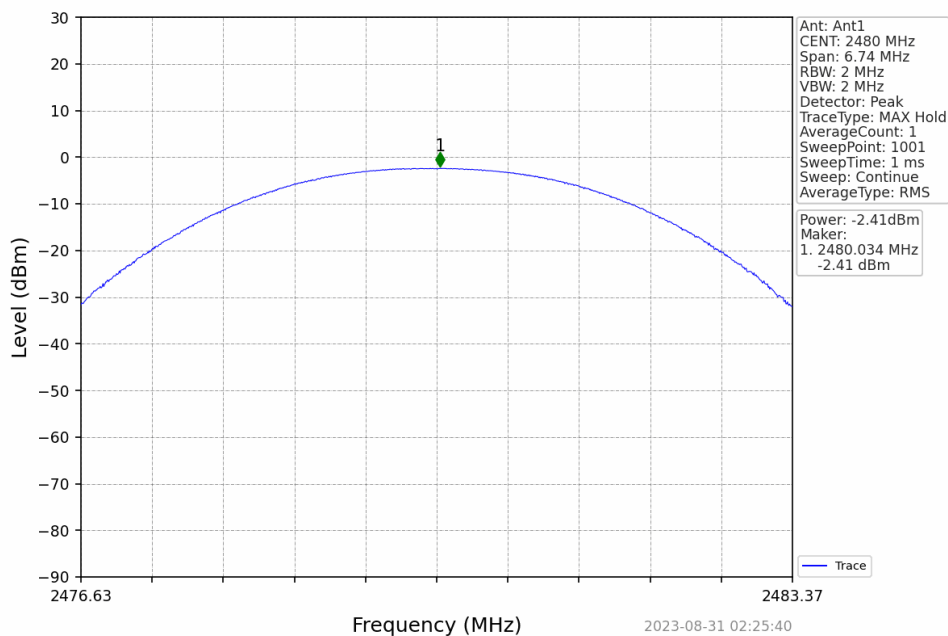
## GFSK\_DH5\_HCH\_2480MHz\_Ant1\_NTNV


 $\pi/4$ -DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV


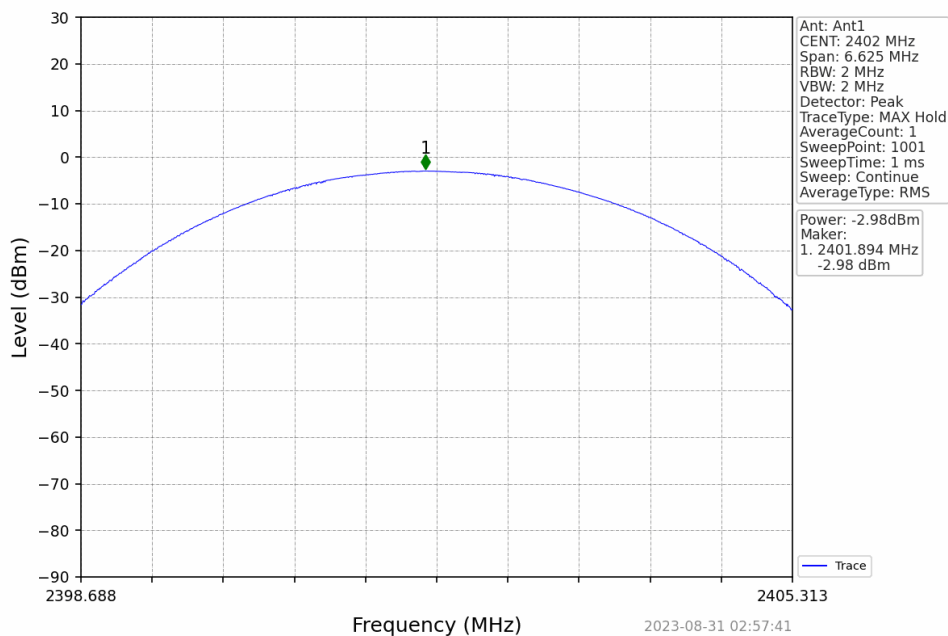
### $\pi/4$ -DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV



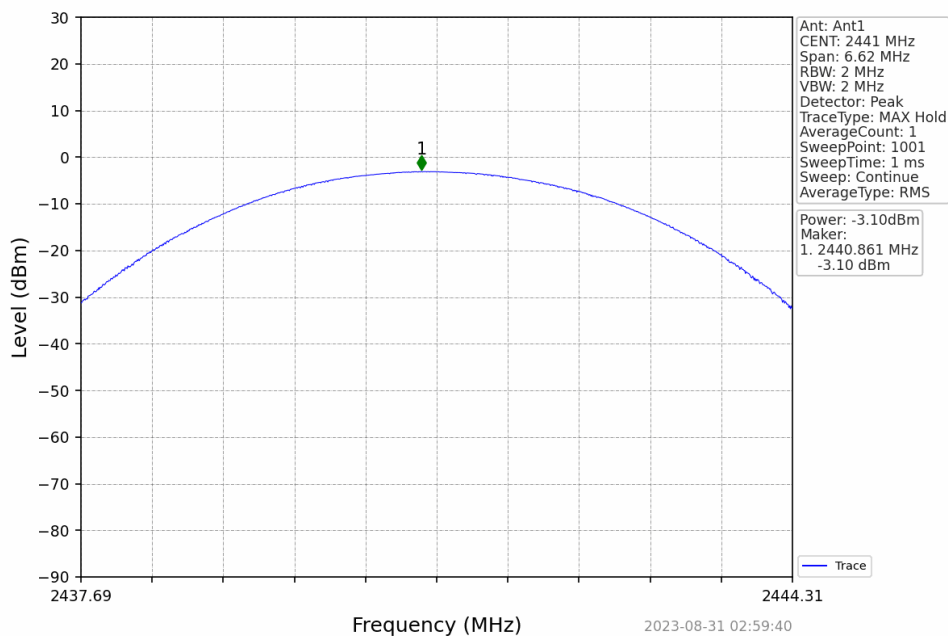
### $\pi/4$ -DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV

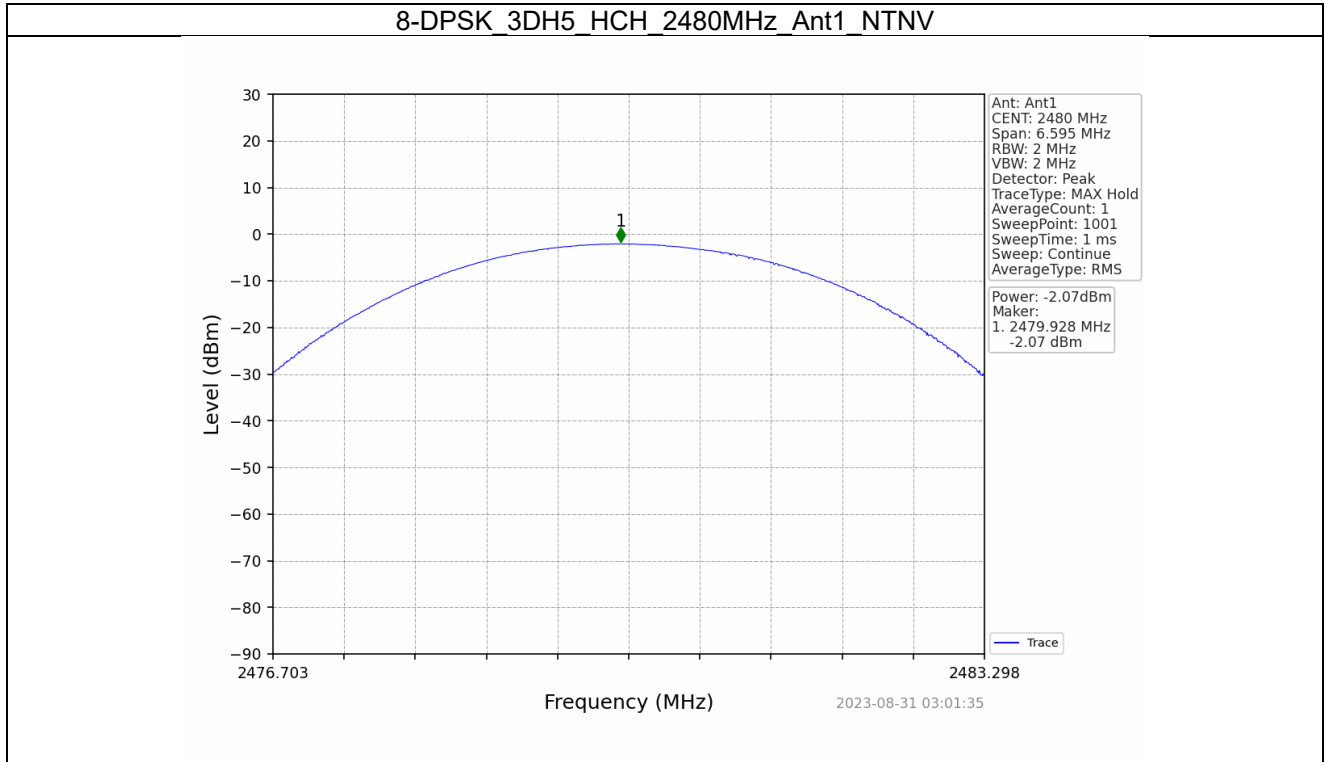


## 8-DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV



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







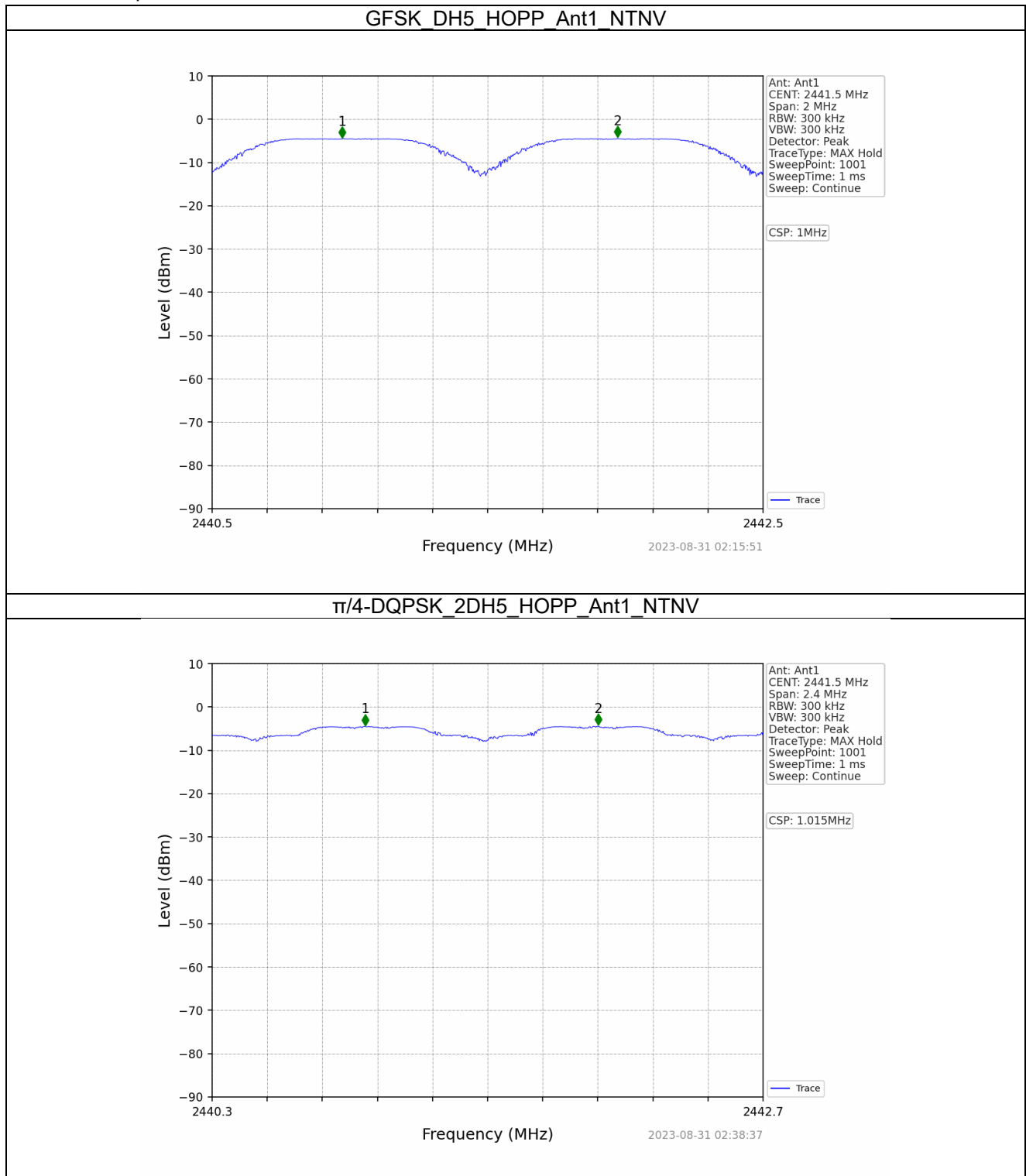
### 3. Carrier Frequency Separation

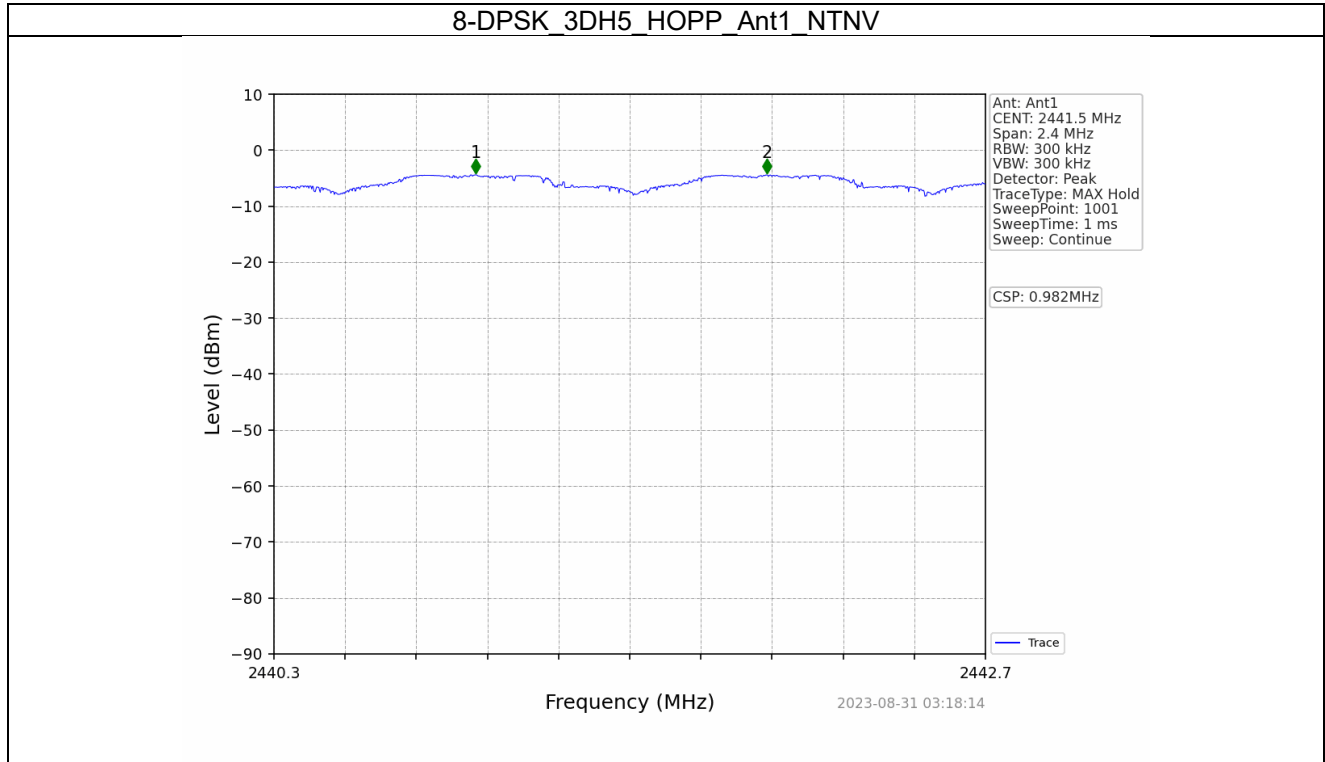
#### 3.1 Ant1

##### 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	1.000	1.063	$\geq 0.709$	Pass
$\pi/4$ -DQPSK	SISO	HOPP	2DH5	1.015	1.348	$\geq 0.899$	Pass
8-DPSK	SISO	HOPP	3DH5	0.982	1.325	$\geq 0.883$	Pass

## 3.1.2 Test Graph





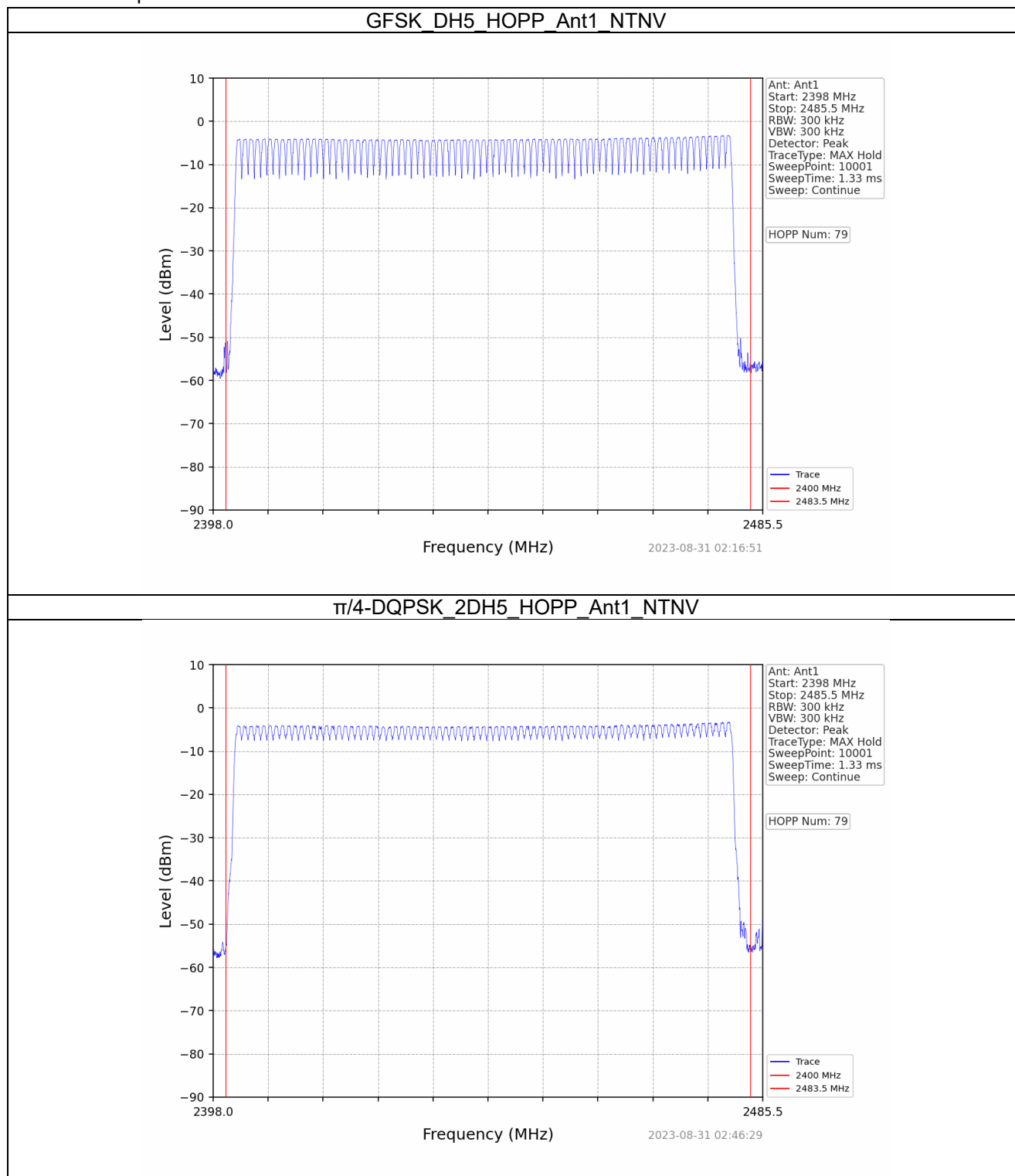
## 4. Number of Hopping Frequencies

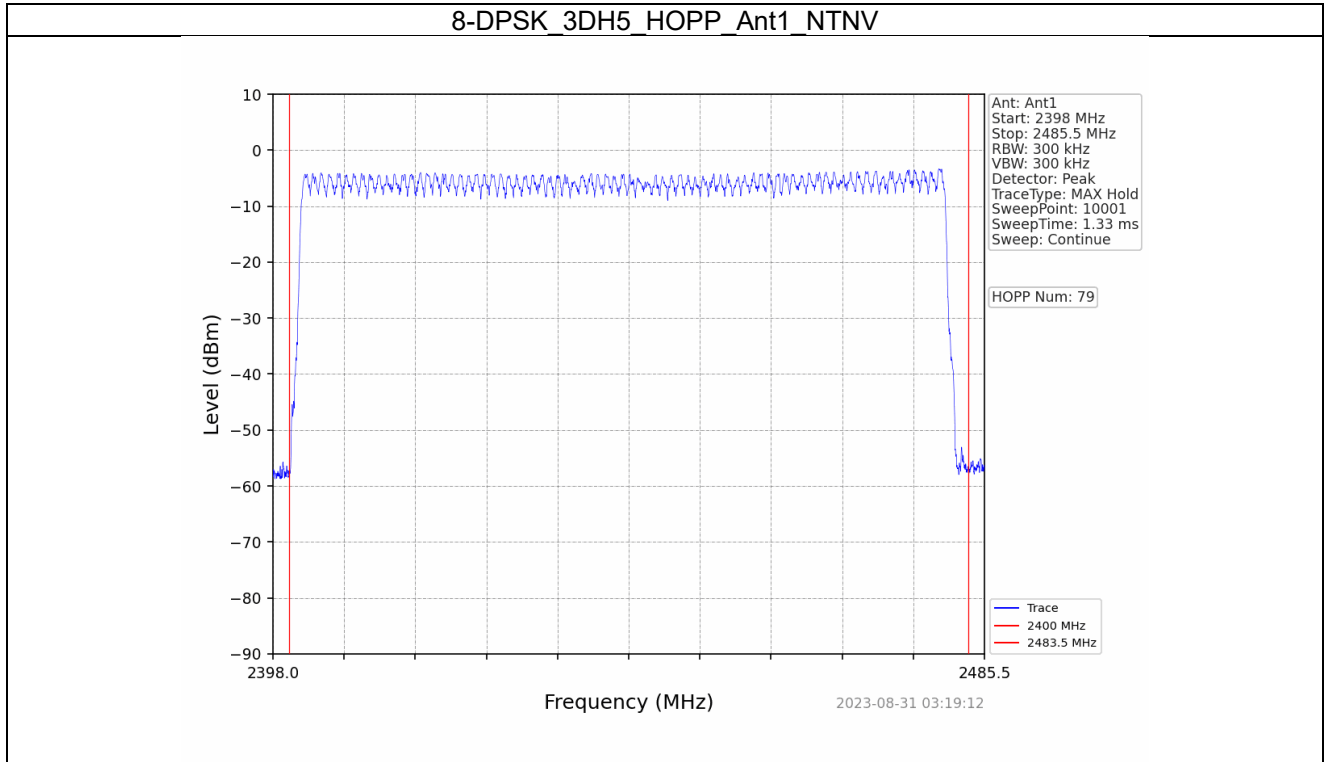
## 4.1 HoppNum

## 4.1.1 Test Result

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

#### 4.1.2 Test Graph





## 5. Time of Occupancy (Dwell Time)

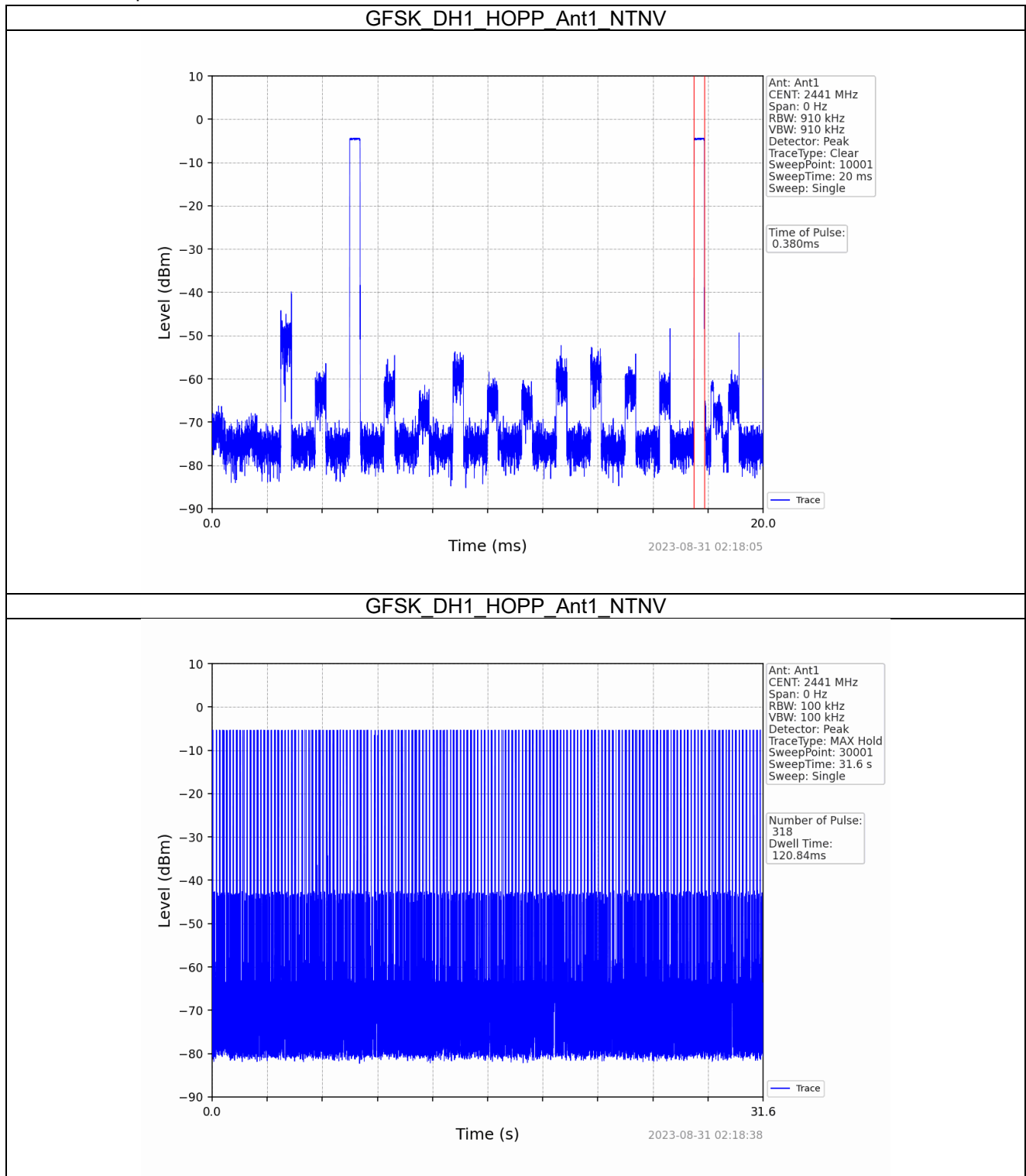
## 5.1 Ant1

## 5.1.1 Test Result

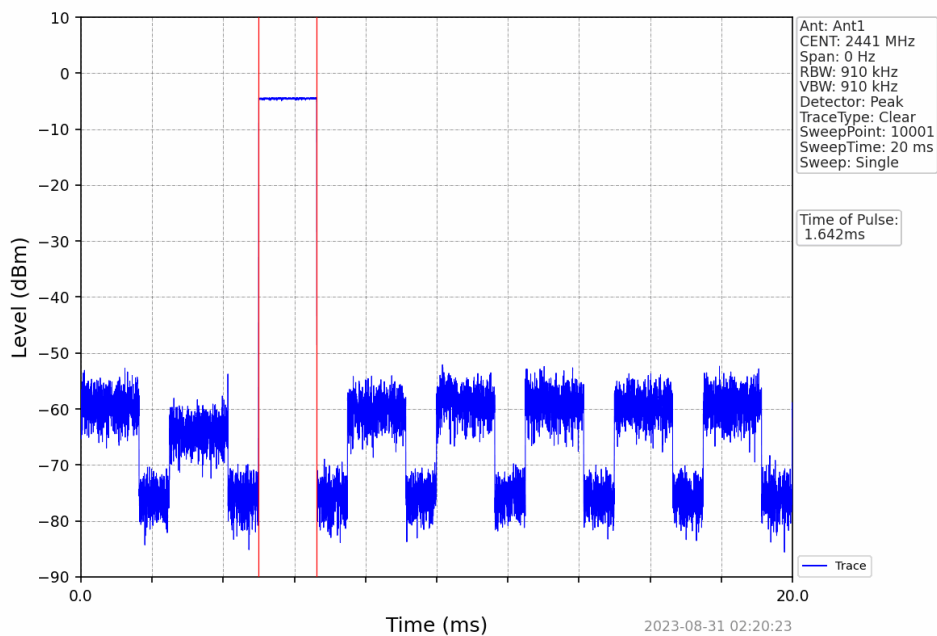
Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.380	31.600	318	120.840	<=400	Pass
			DH3	1.642	31.600	158	259.436	<=400	Pass
			DH5	2.890	31.600	102	294.780	<=400	Pass
$\pi/4$ -DQPSK	SISO	HOPP	2DH1	0.390	31.600	320	124.800	<=400	Pass
			2DH3	1.646	31.600	165	271.590	<=400	Pass
			2DH5	2.890	31.600	111	320.790	<=400	Pass
8-DPSK	SISO	HOPP	3DH1	0.392	31.600	320	125.440	<=400	Pass
			3DH3	1.640	31.600	153	250.920	<=400	Pass
			3DH5	2.898	31.600	122	353.556	<=400	Pass



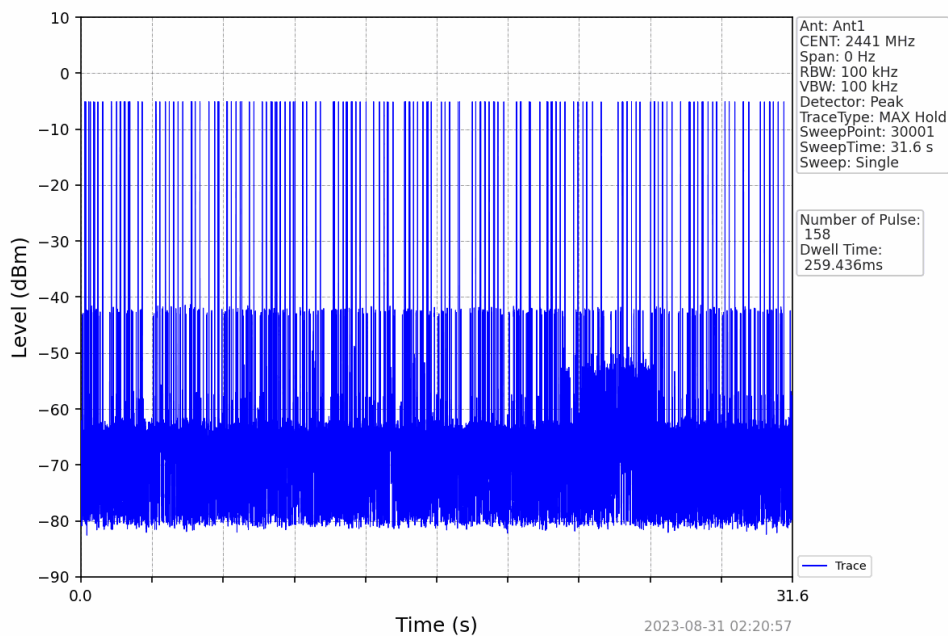
## 5.1.2 Test Graph



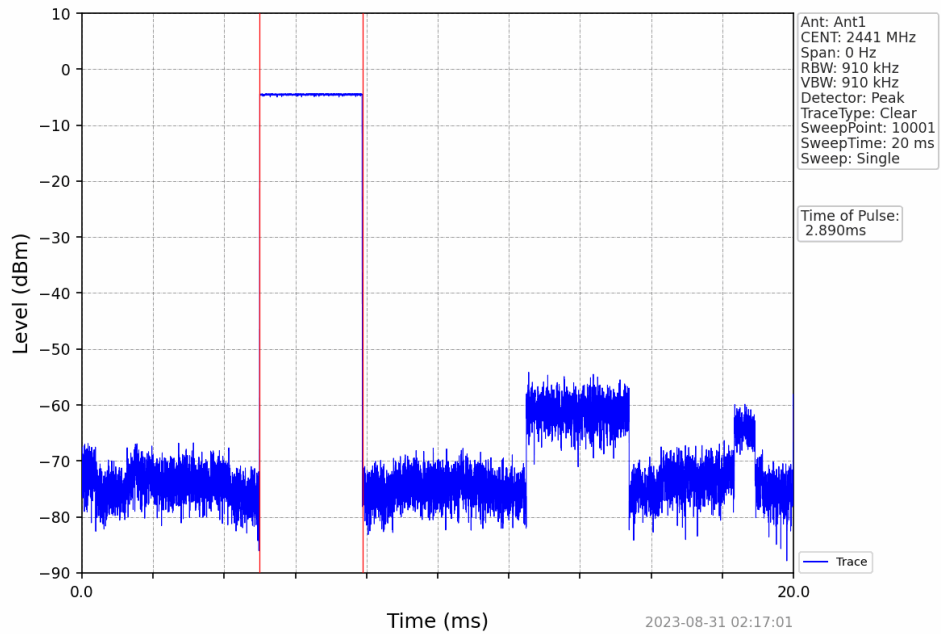
## GFSK\_DH3\_HOPP\_Ant1\_NTNV



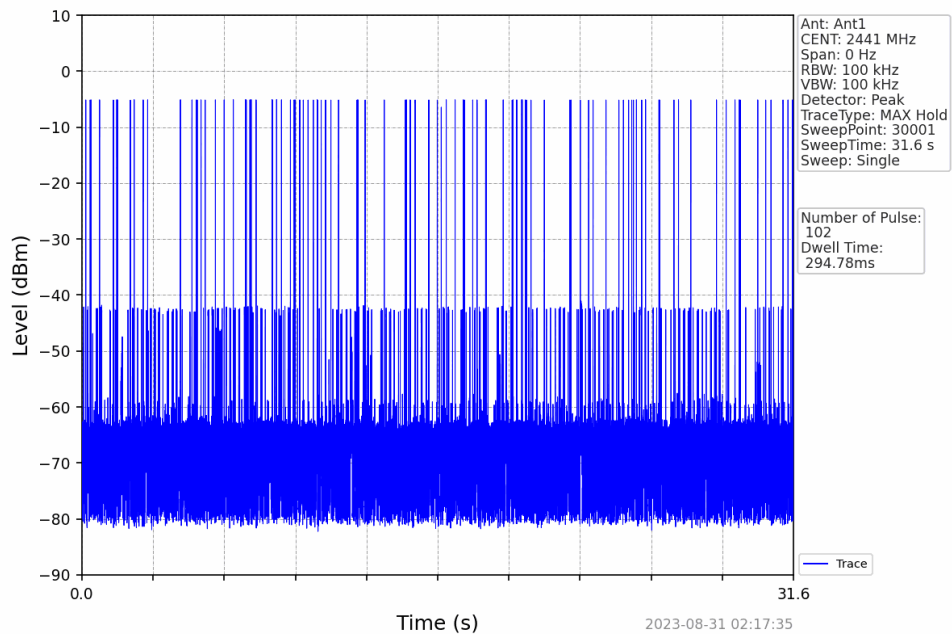
## GFSK\_DH3\_HOPP\_Ant1\_NTNV



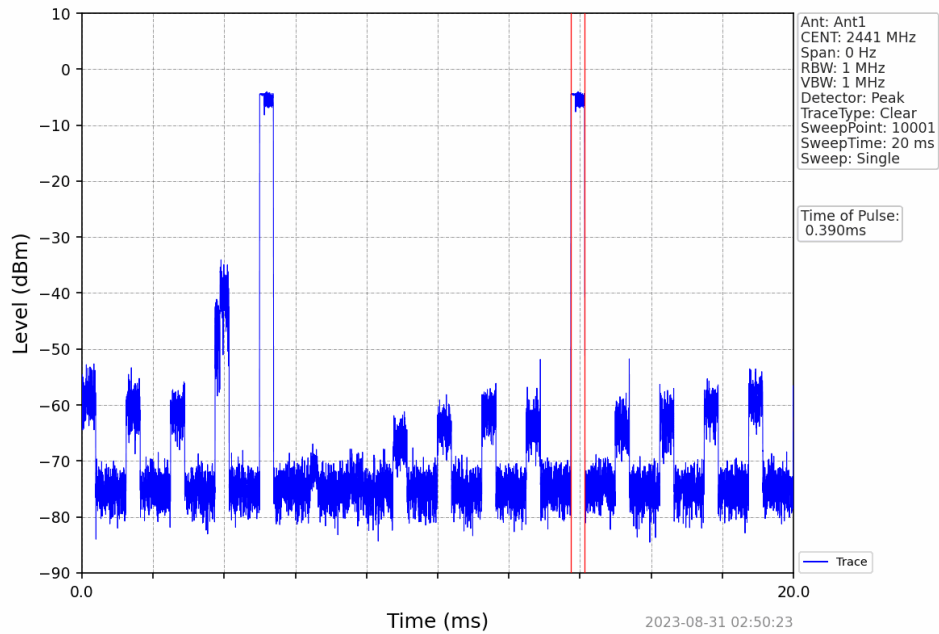
## GFSK\_DH5\_HOPP\_Ant1\_NTNV



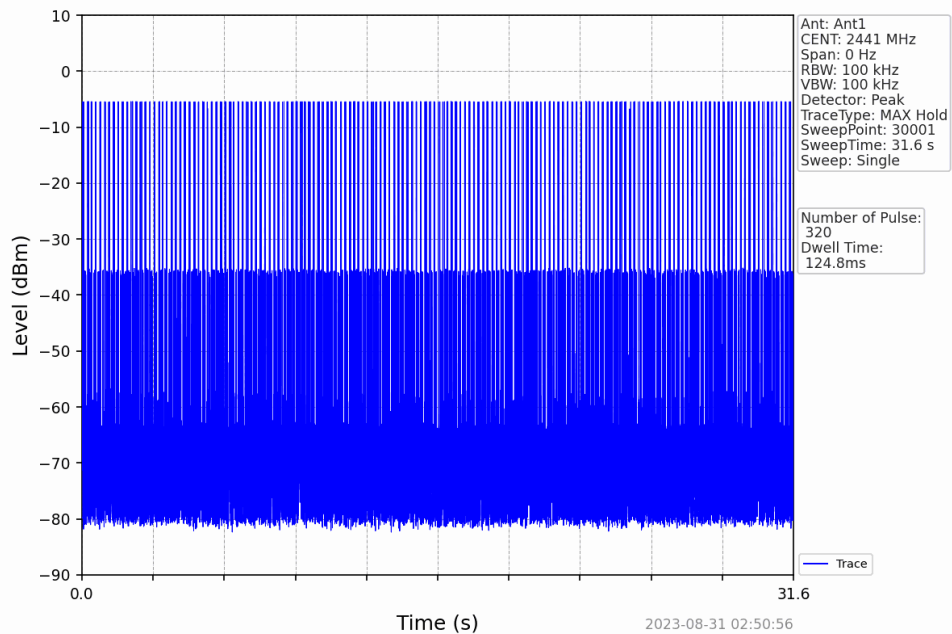
## GFSK\_DH5\_HOPP\_Ant1\_NTNV



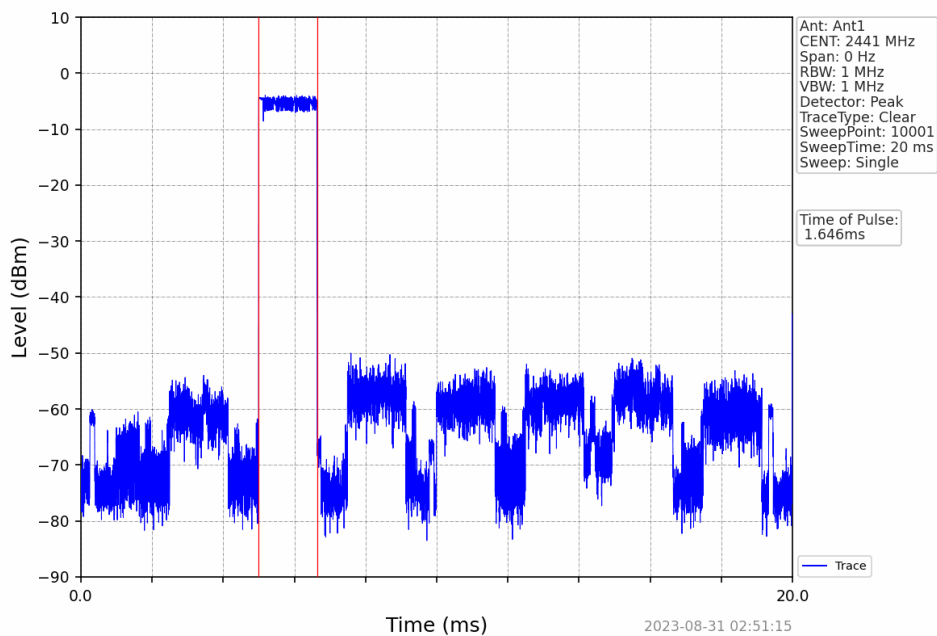
### $\pi/4$ -DQPSK 2DH1\_HOPP\_Ant1\_NTNV



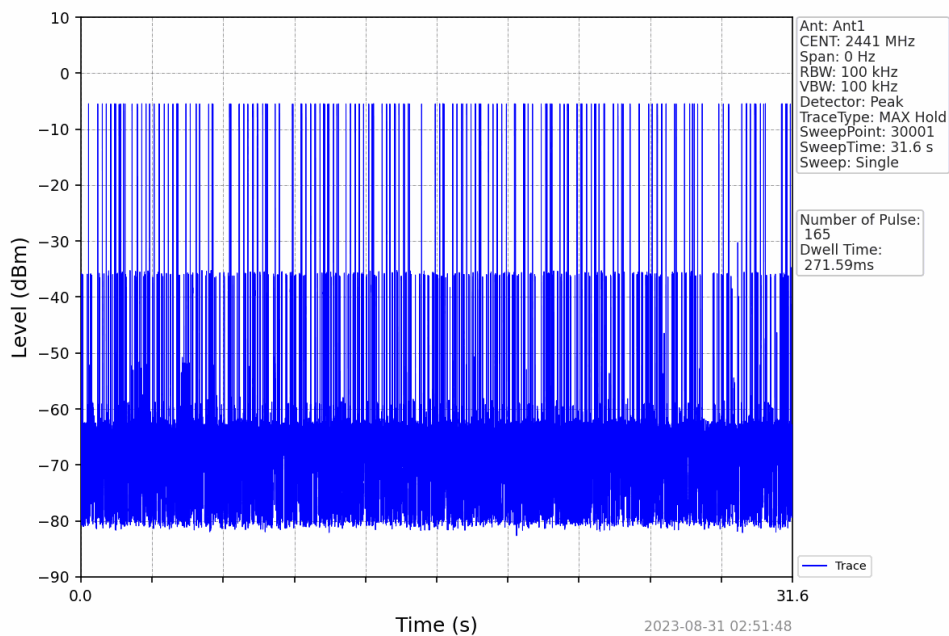
### $\pi/4$ -DQPSK 2DH1\_HOPP\_Ant1\_NTNV



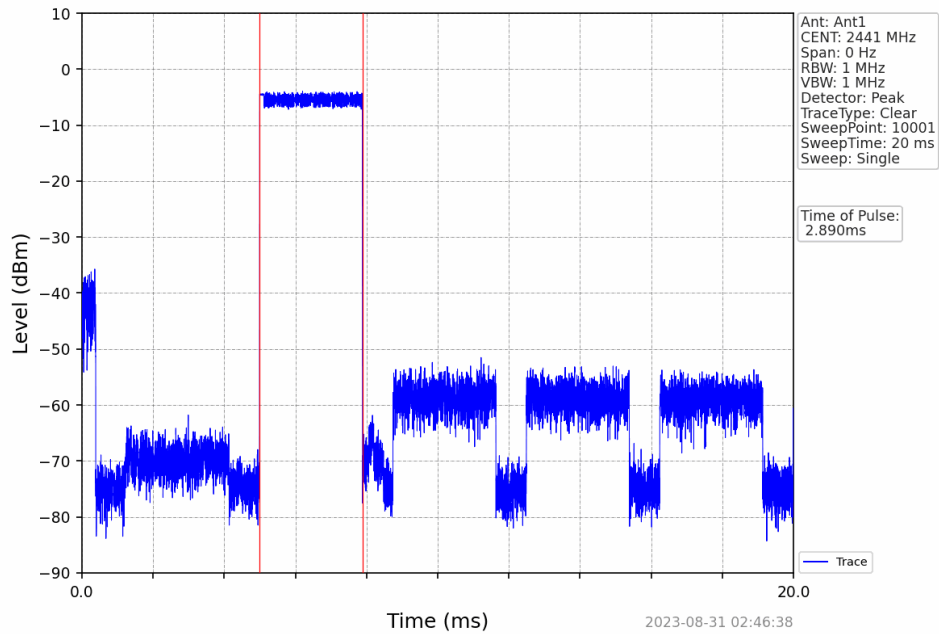
$\pi/4$ -DQPSK 2DH3\_HOPP\_Ant1\_NTNV



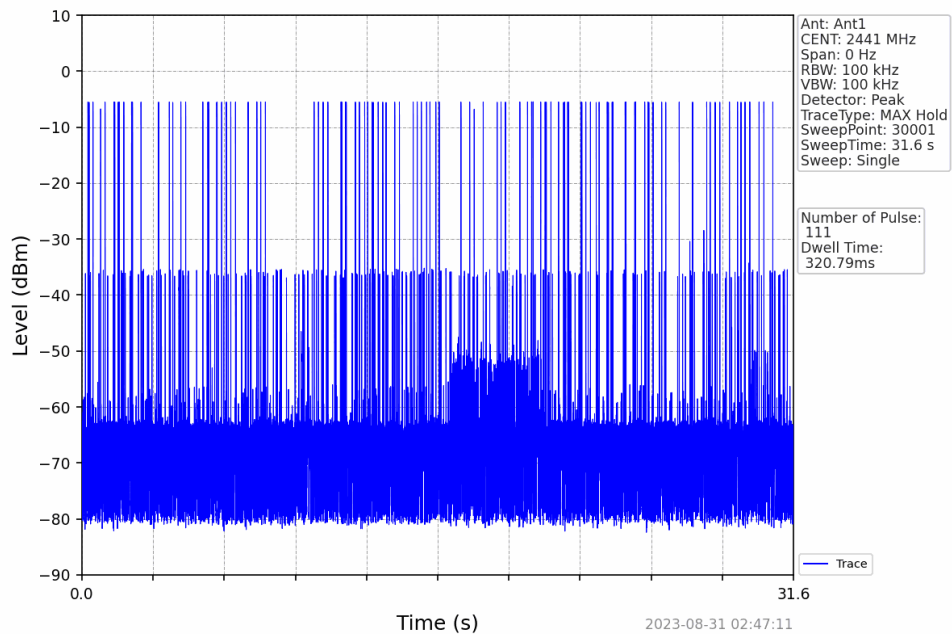
$\pi/4$ -DQPSK 2DH3\_HOPP\_Ant1\_NTNV



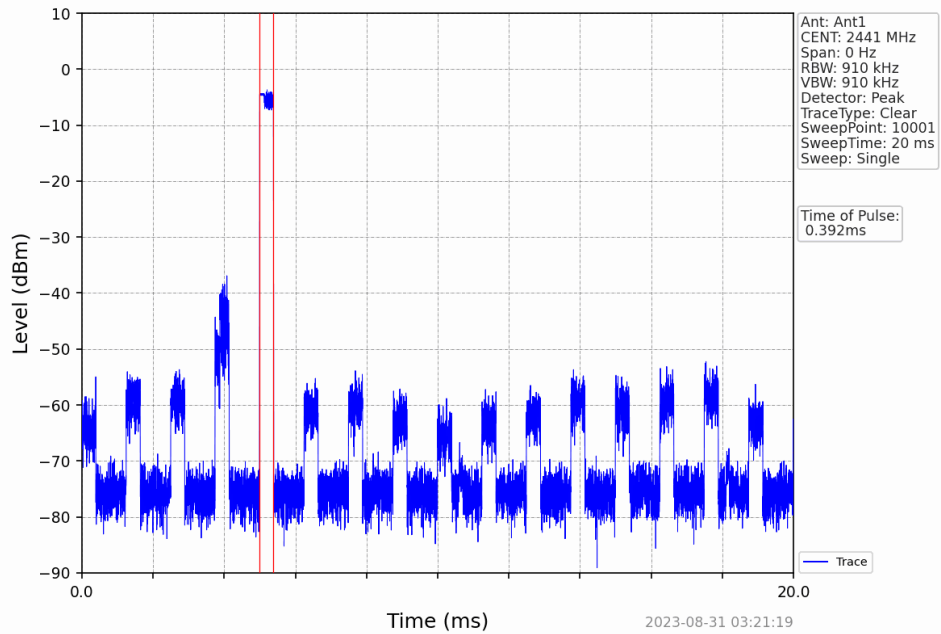
$\pi/4$ -DQPSK 2DH5\_HOPP\_Ant1\_NTNV



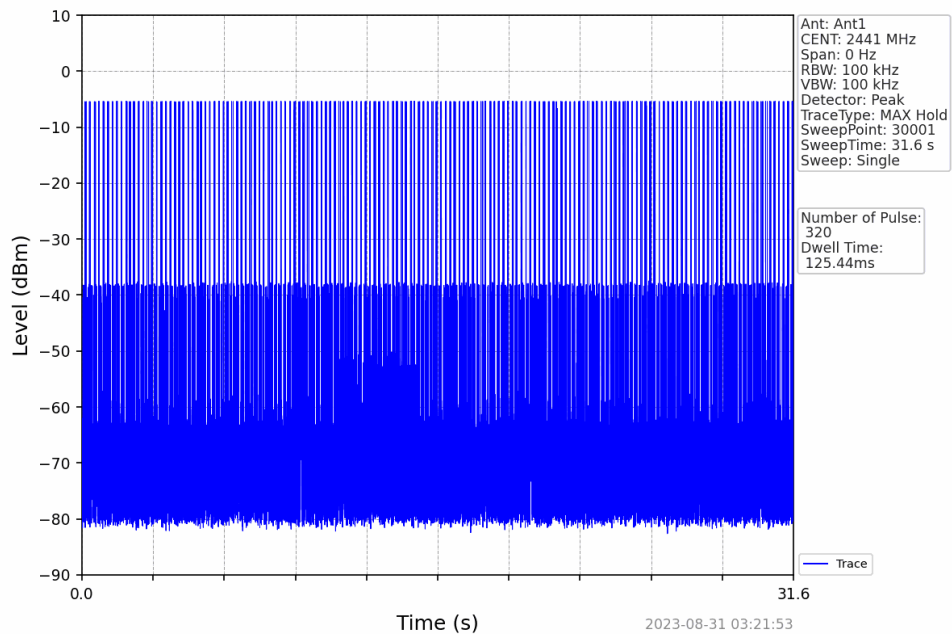
$\pi/4$ -DQPSK 2DH5\_HOPP\_Ant1\_NTNV



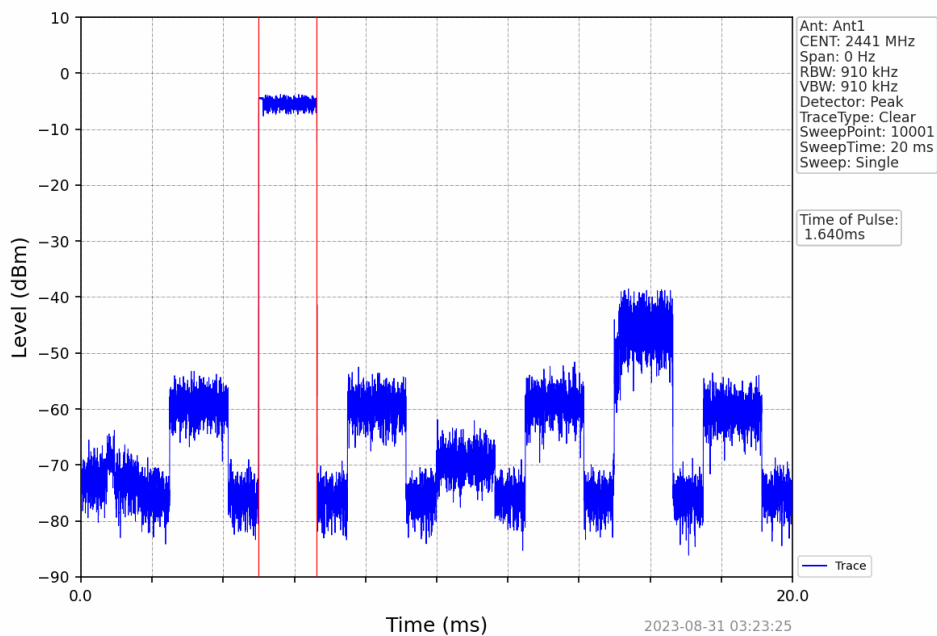
## 8-DPSK\_3DH1\_HOPP\_Ant1\_NTNV



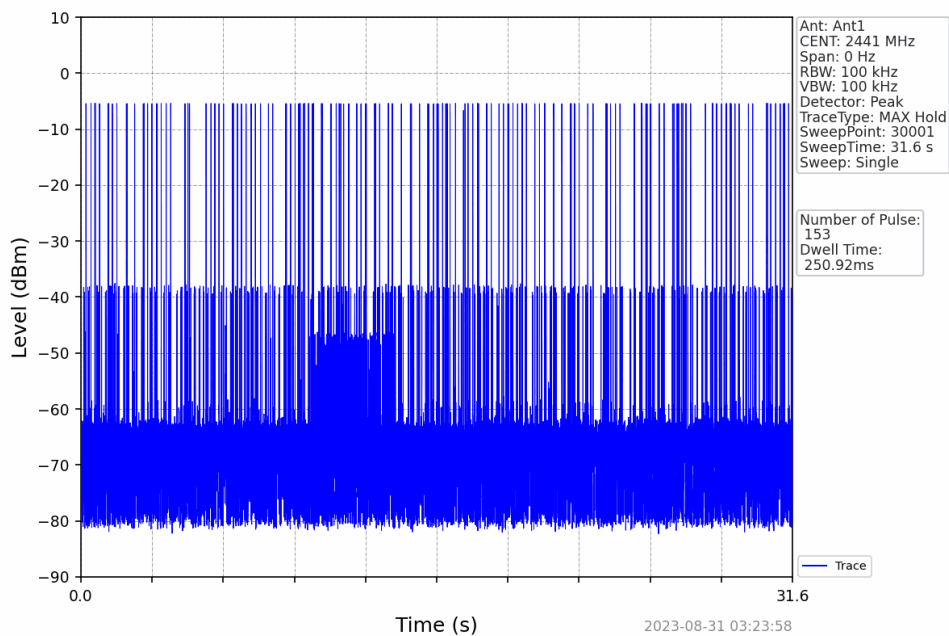
## 8-DPSK\_3DH1\_HOPP\_Ant1\_NTNV



## 8-DPSK\_3DH3\_HOPP\_Ant1\_NTNV

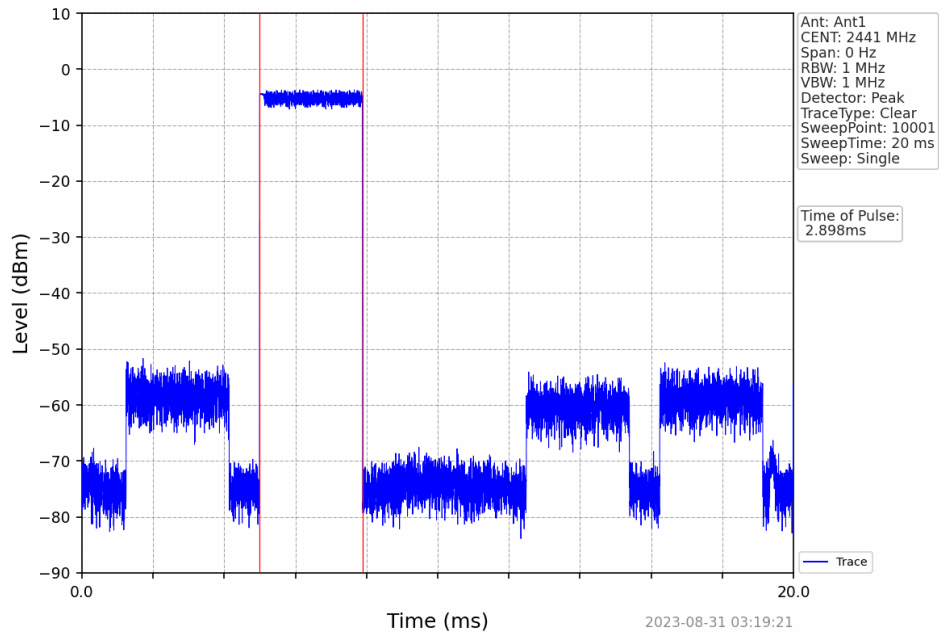


## 8-DPSK\_3DH3\_HOPP\_Ant1\_NTNV

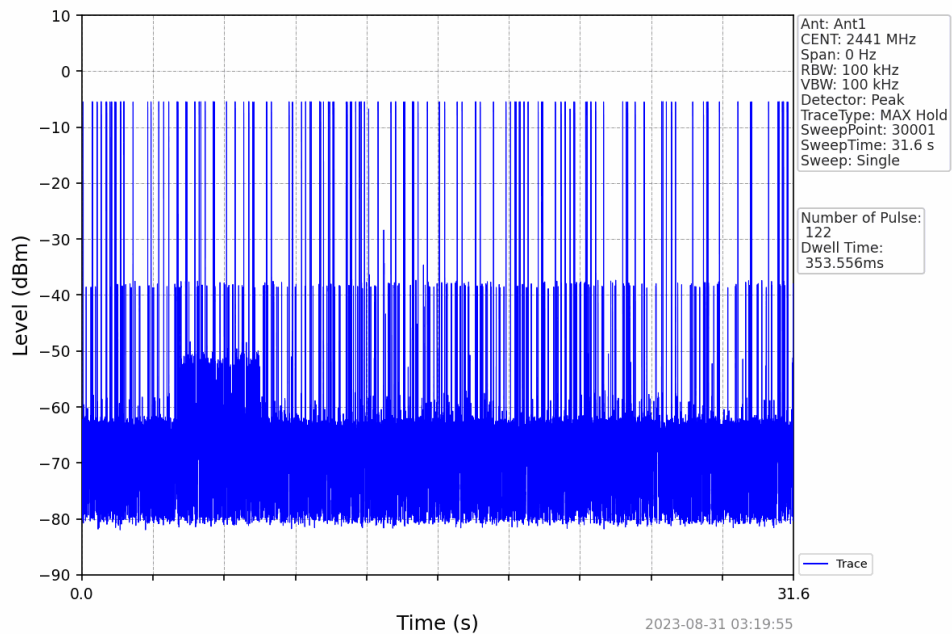




## 8-DPSK\_3DH5\_HOPP\_Ant1\_NTNV



## 8-DPSK\_3DH5\_HOPP\_Ant1\_NTNV



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

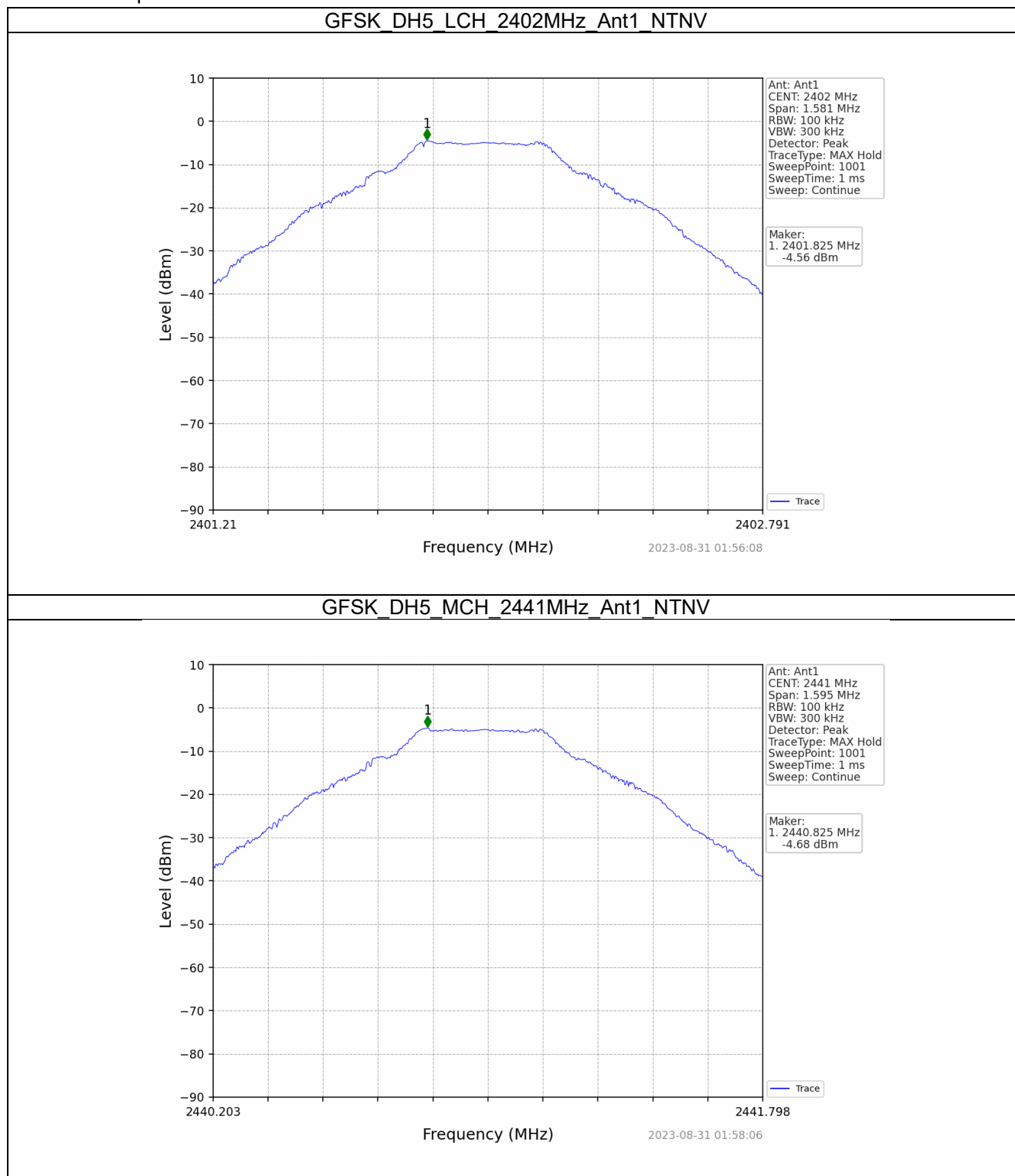
### 6.1 Ref

#### 6.1.1 Test Result

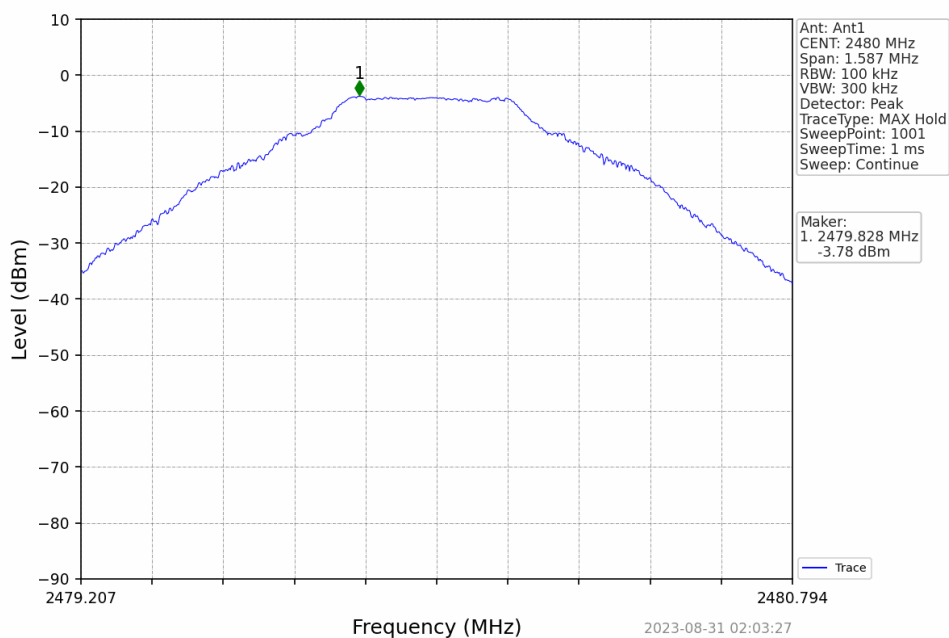
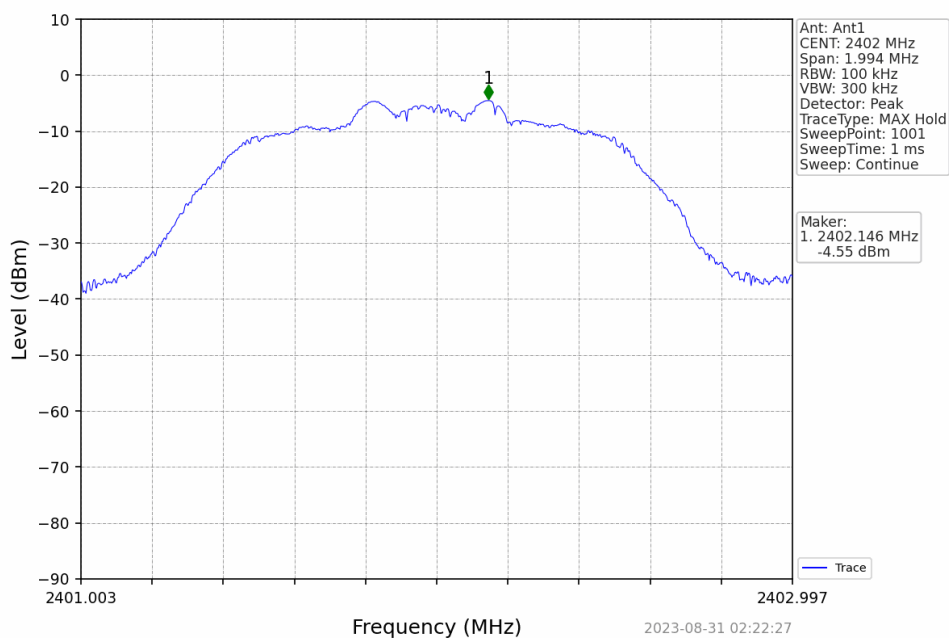
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	-4.56
		2441	DH5	1	-4.68
		2480	DH5	1	-3.78
$\pi/4$ -DQPSK	SISO	2402	2DH5	1	-4.55
		2441	2DH5	1	-4.68
		2480	2DH5	1	-3.69
8-DPSK	SISO	2402	3DH5	1	-4.51
		2441	3DH5	1	-4.74
		2480	3DH5	1	-3.67

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.

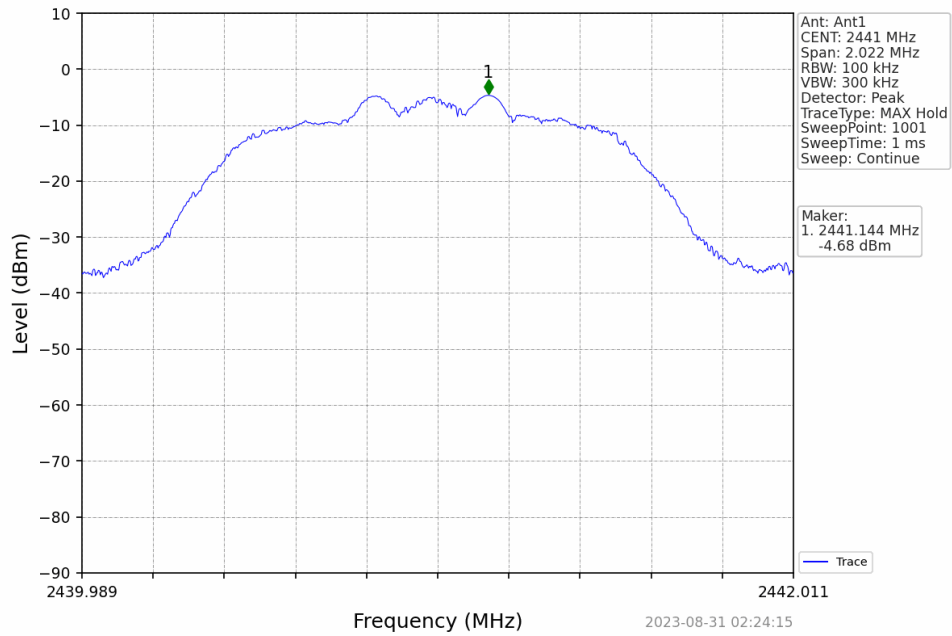
## 6.1.2 Test Graph



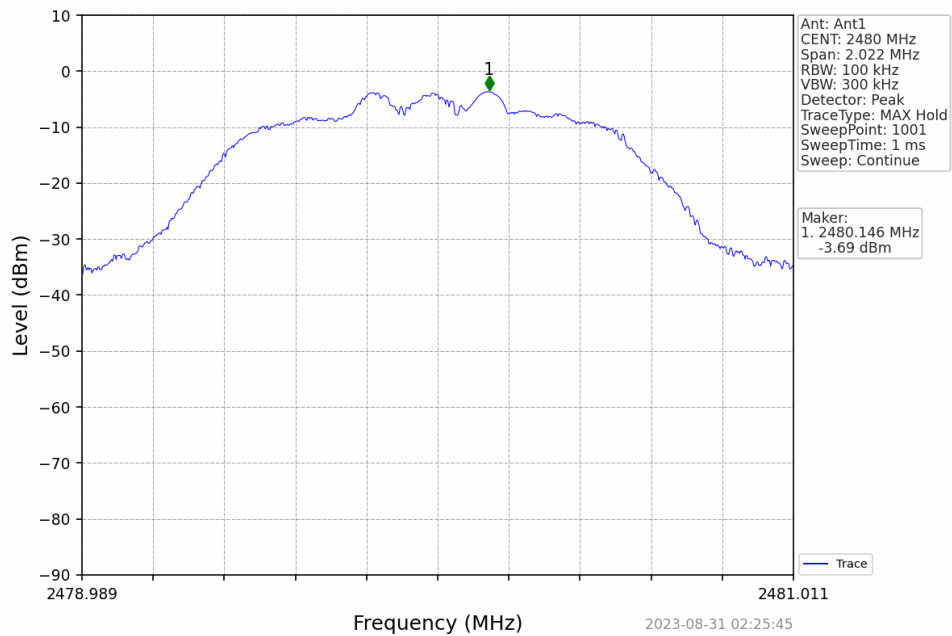
## GFSK\_DH5\_HCH\_2480MHz\_Ant1\_NTNV


 $\pi/4$ -DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV


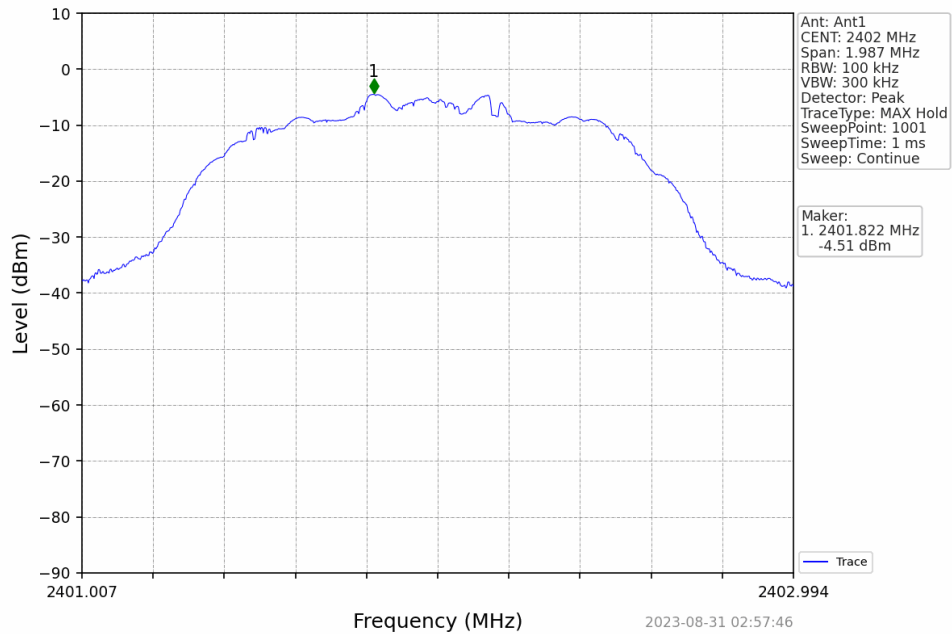
### $\pi/4$ -DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV



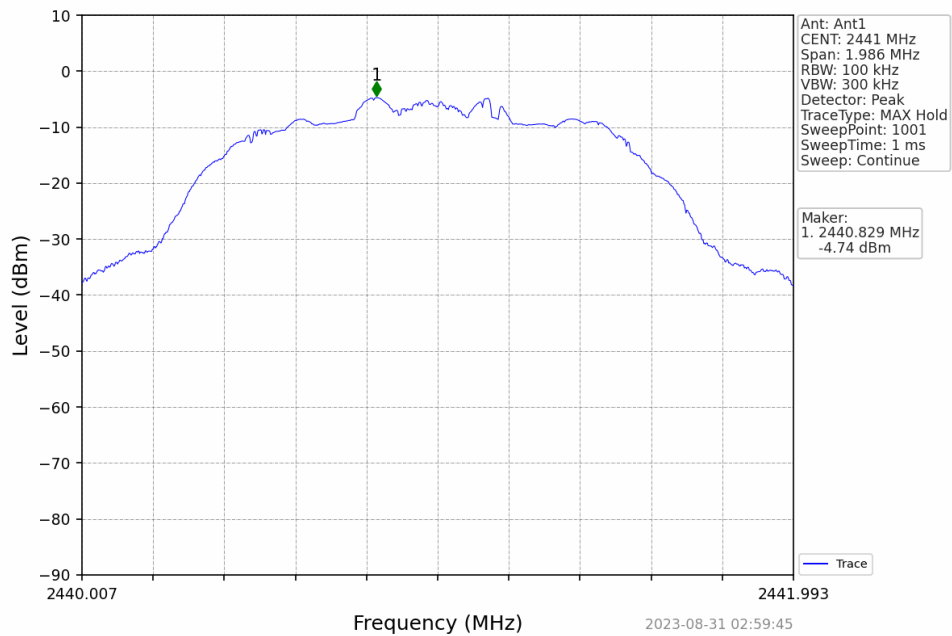
### $\pi/4$ -DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV

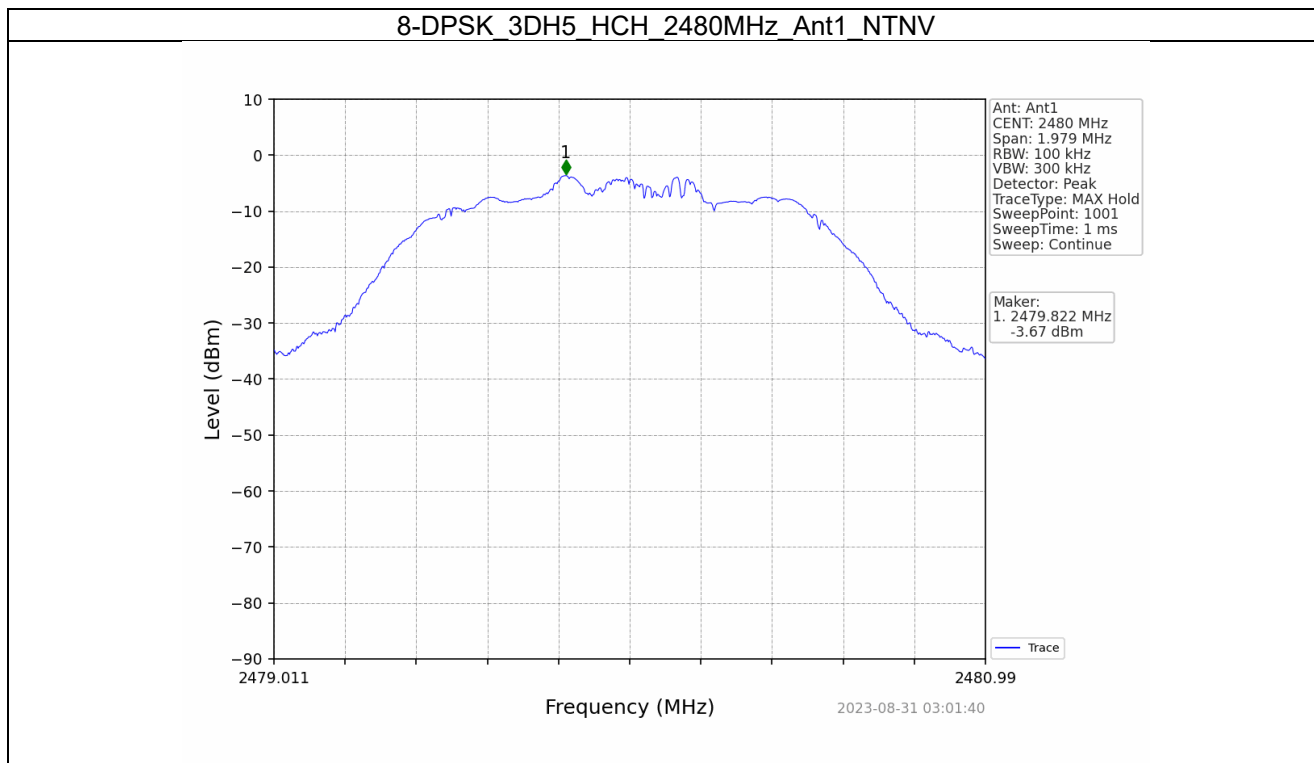


## 8-DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV



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





## 6.2 CSE

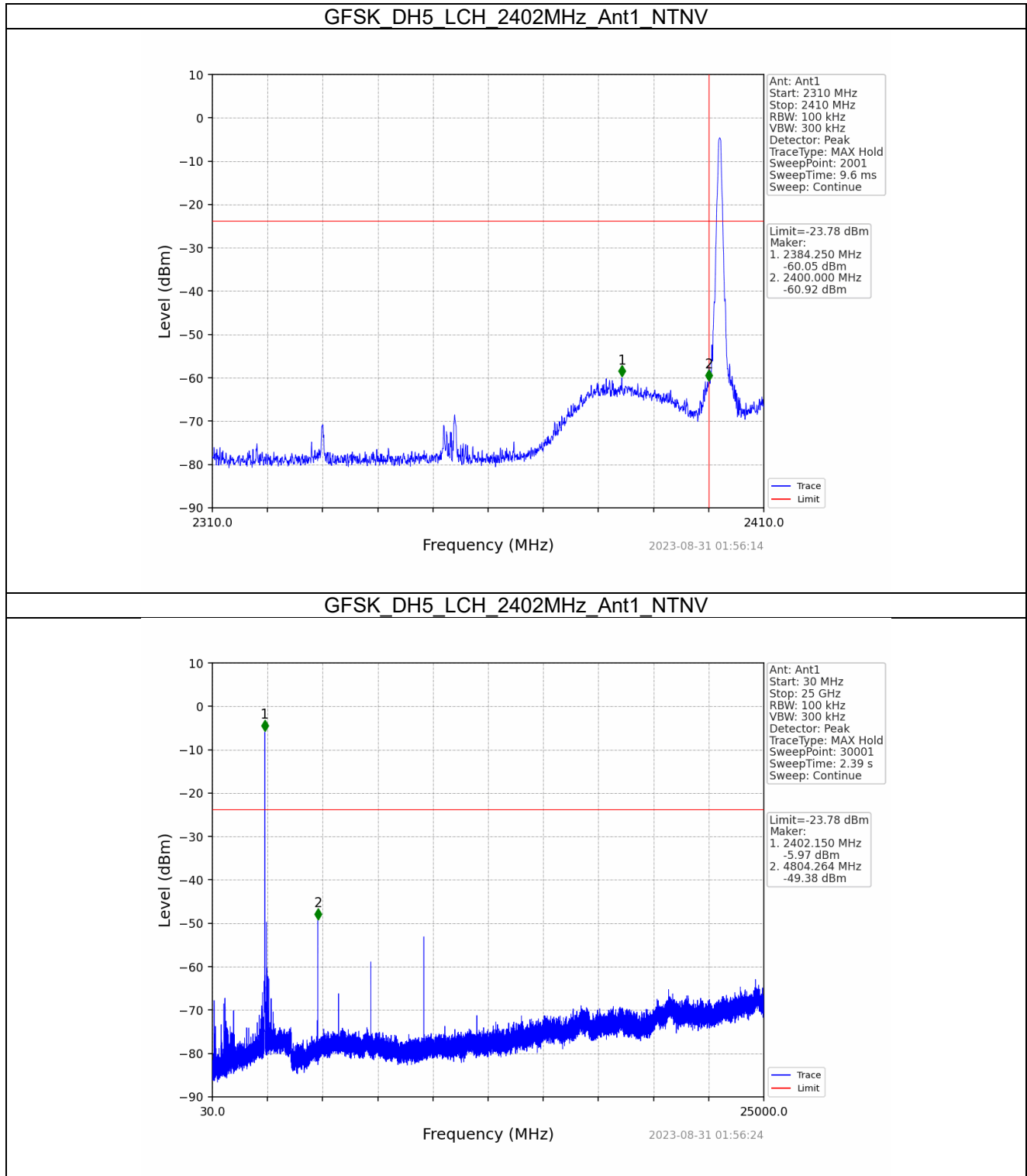
## 6.2.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	-3.78	-23.78	Pass
		2441	DH5	1	-3.78	-23.78	Pass
		2480	DH5	1	-3.78	-23.78	Pass
		HOPP	DH5	1	-3.78	-23.78	Pass
$\pi/4$ -DQPSK	SISO	2402	2DH5	1	-3.69	-23.69	Pass
		2441	2DH5	1	-3.69	-23.69	Pass
		2480	2DH5	1	-3.69	-23.69	Pass
		HOPP	2DH5	1	-3.69	-23.69	Pass
8-DPSK	SISO	2402	3DH5	1	-3.67	-23.67	Pass
		2441	3DH5	1	-3.67	-23.67	Pass
		2480	3DH5	1	-3.67	-23.67	Pass
		HOPP	3DH5	1	-3.67	-23.67	Pass

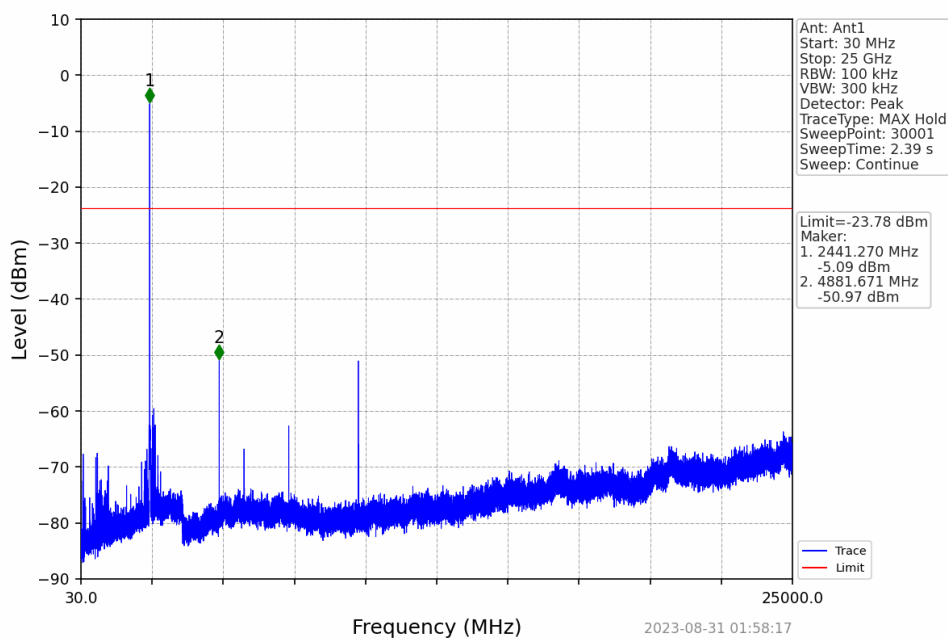
Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.



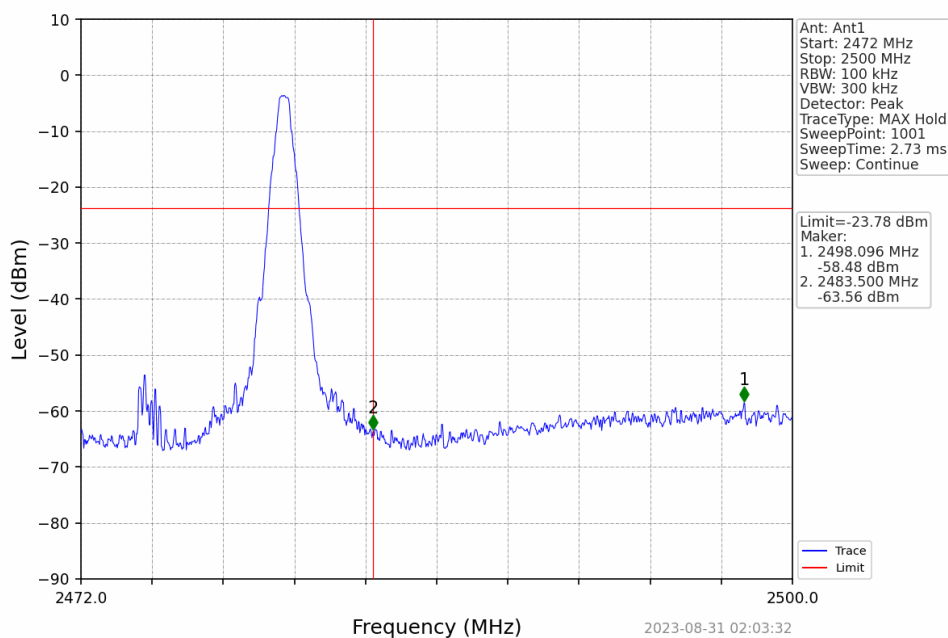
## 6.2.2 Test Graph



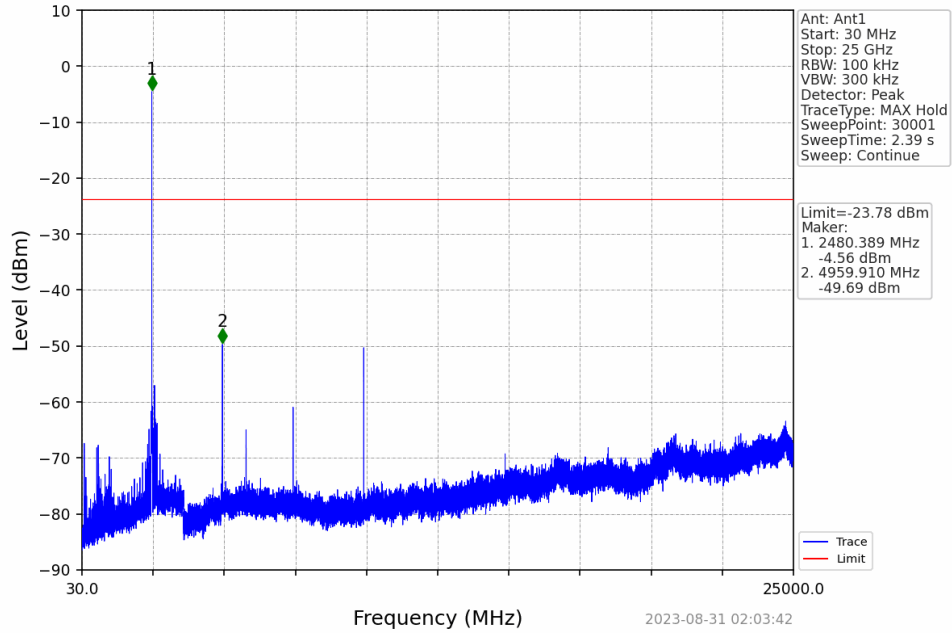
## GFSK\_DH5\_MCH\_2441MHz\_Ant1\_NTNV



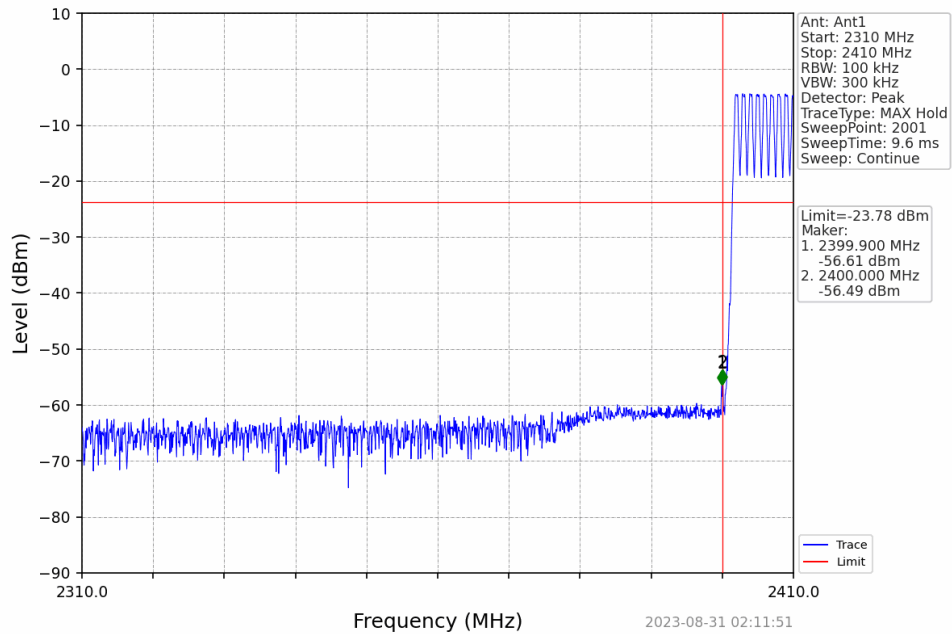
## GFSK\_DH5\_HCH\_2480MHz\_Ant1\_NTNV



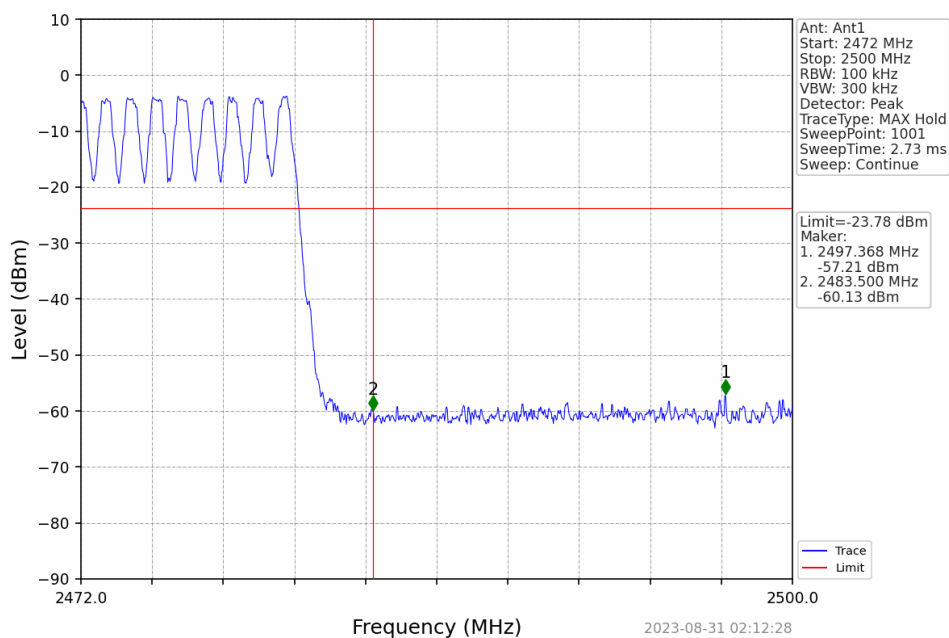
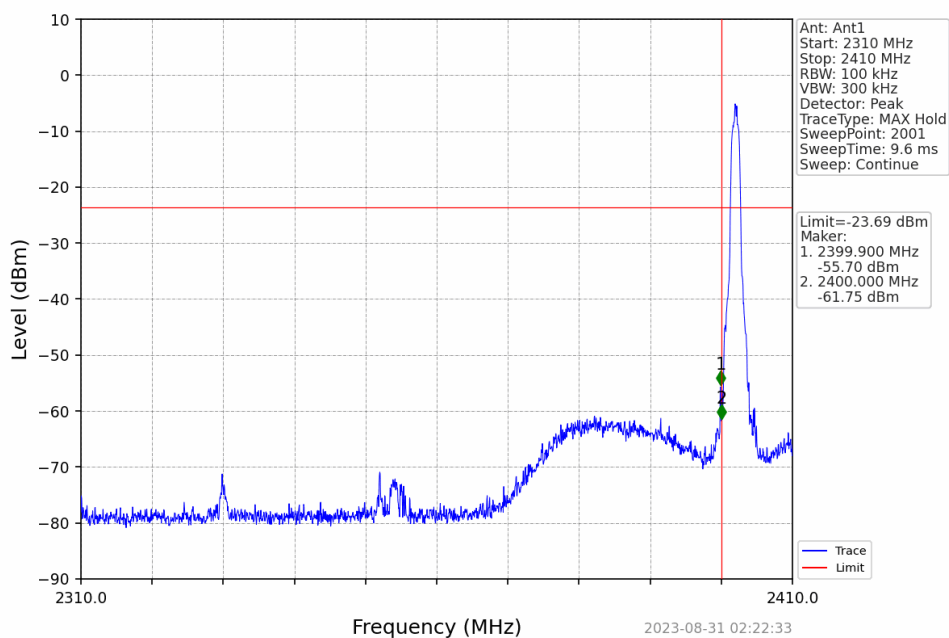
GFSK\_DH5\_HCH\_2480MHz\_Ant1\_NTNV



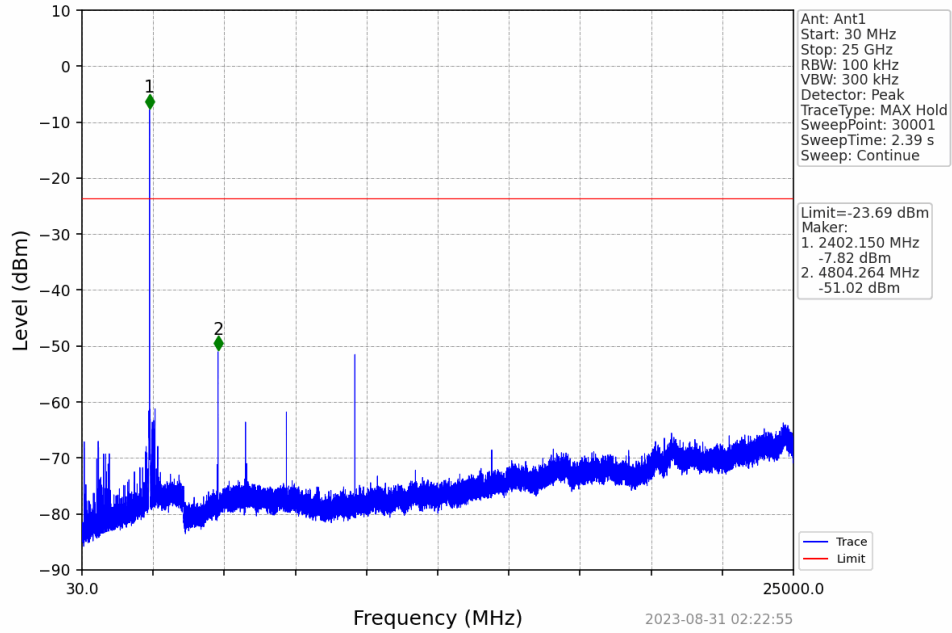
GFSK\_DH5\_HOPP\_Ant1\_NTNV



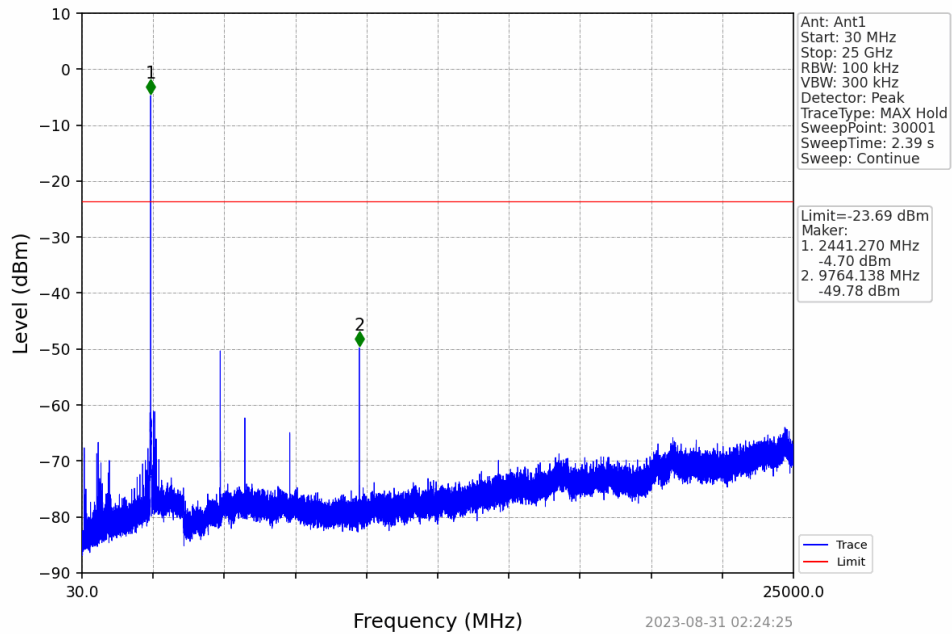
## GFSK\_DH5\_HOPP\_Ant1\_NTNV


 $\pi/4$ -DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV


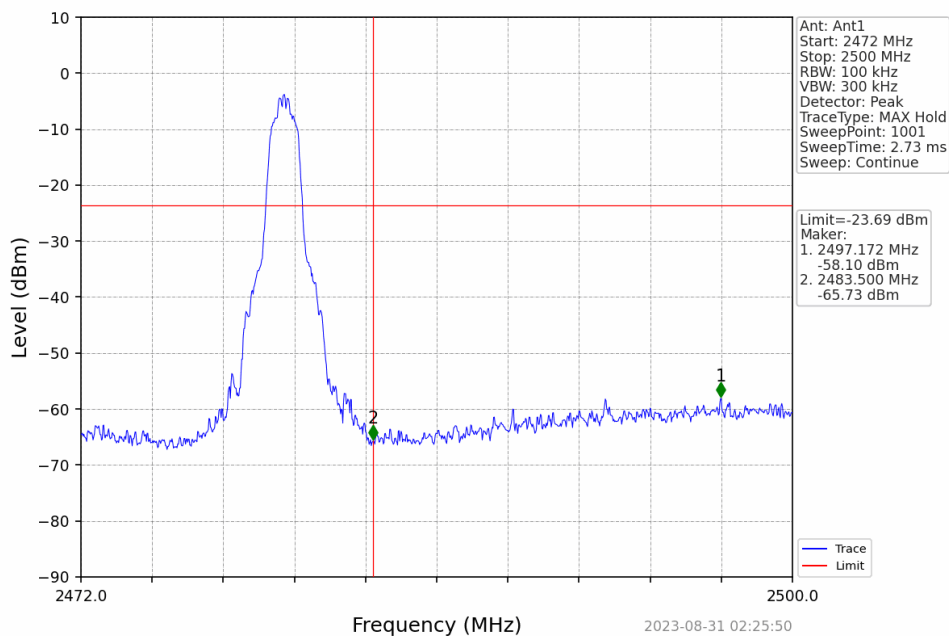
$\pi/4$ -DQPSK\_2DH5\_LCH\_2402MHz\_Ant1\_NTNV



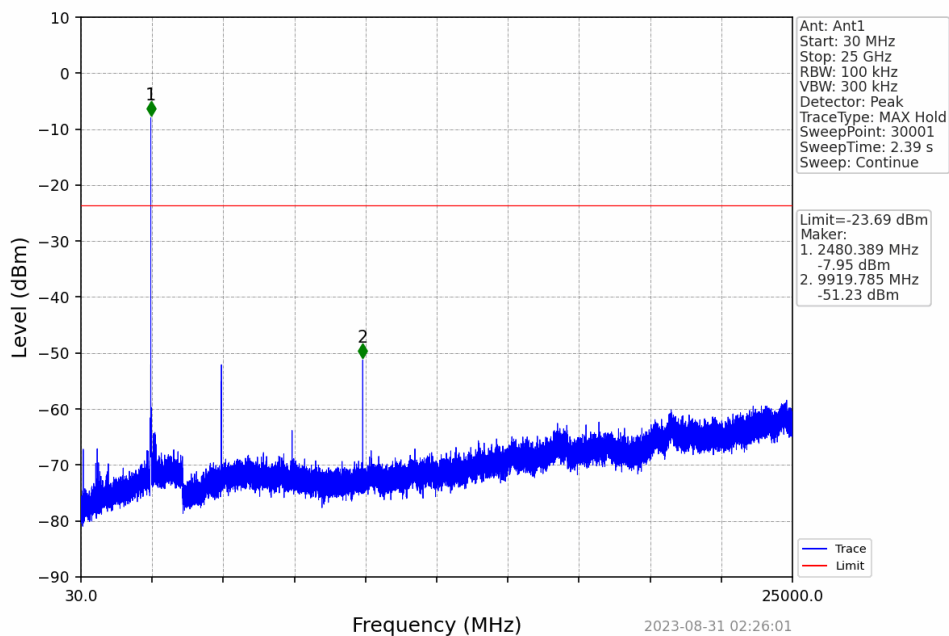
$\pi/4$ -DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV



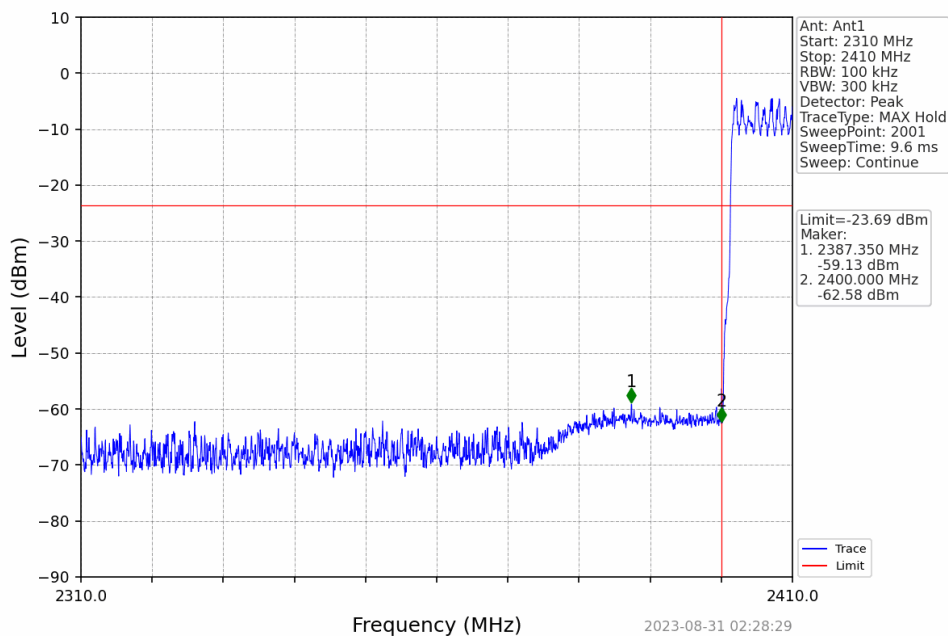
$\pi/4$ -DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV



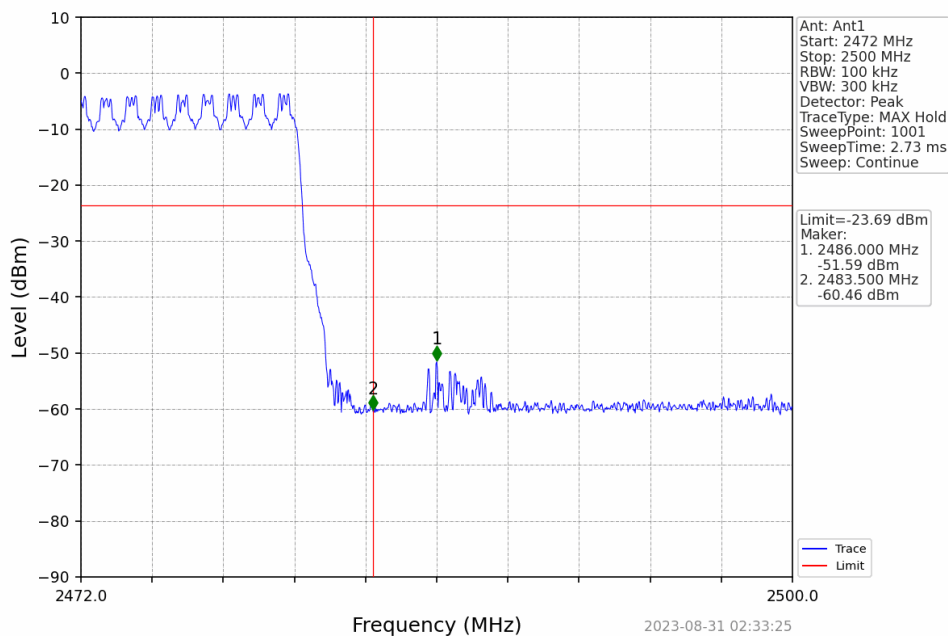
$\pi/4$ -DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV



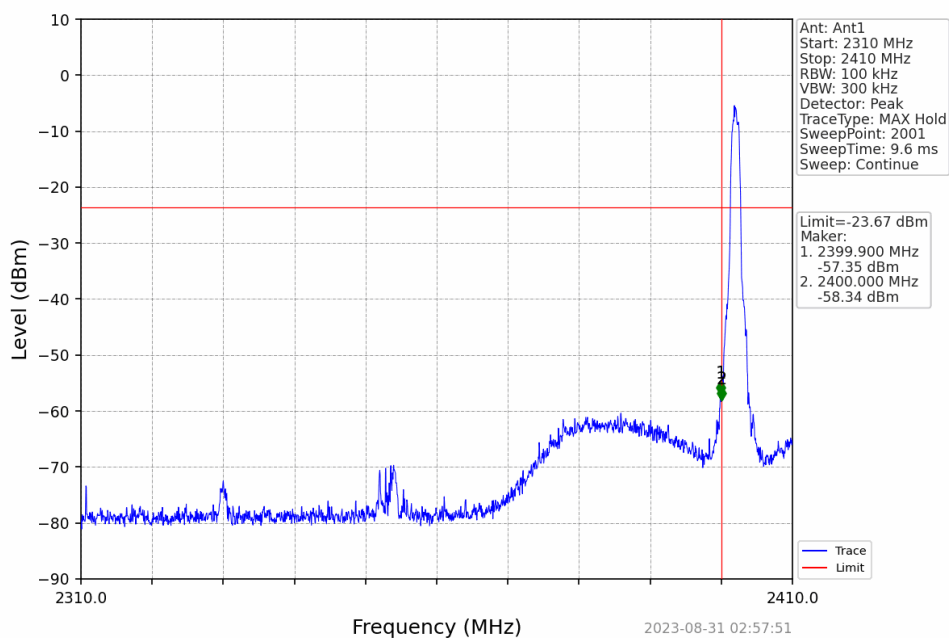
$\pi/4$ -DQPSK 2DH5\_HOPP\_Ant1\_NTNV



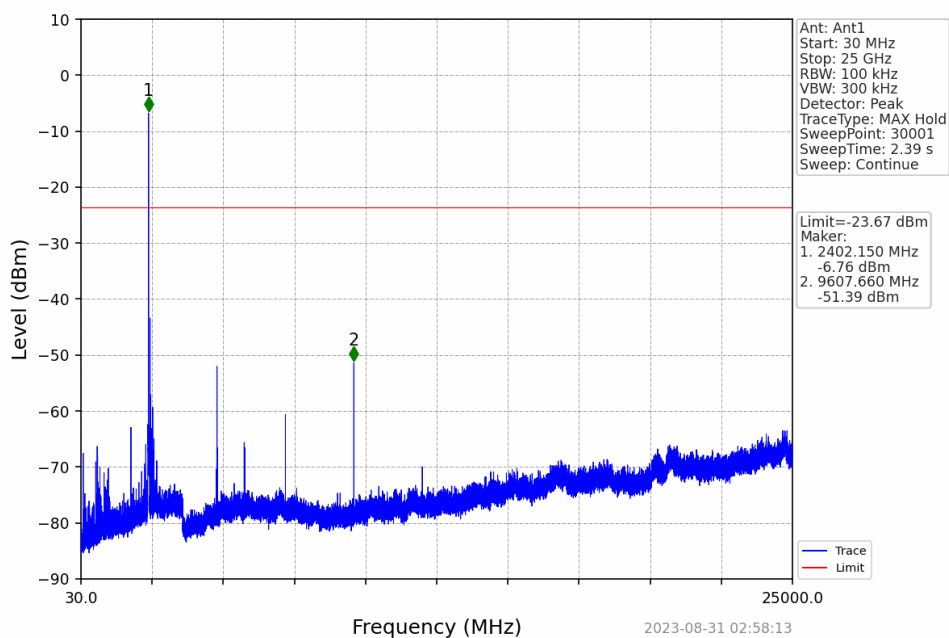
$\pi/4$ -DQPSK 2DH5\_HOPP\_Ant1\_NTNV



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

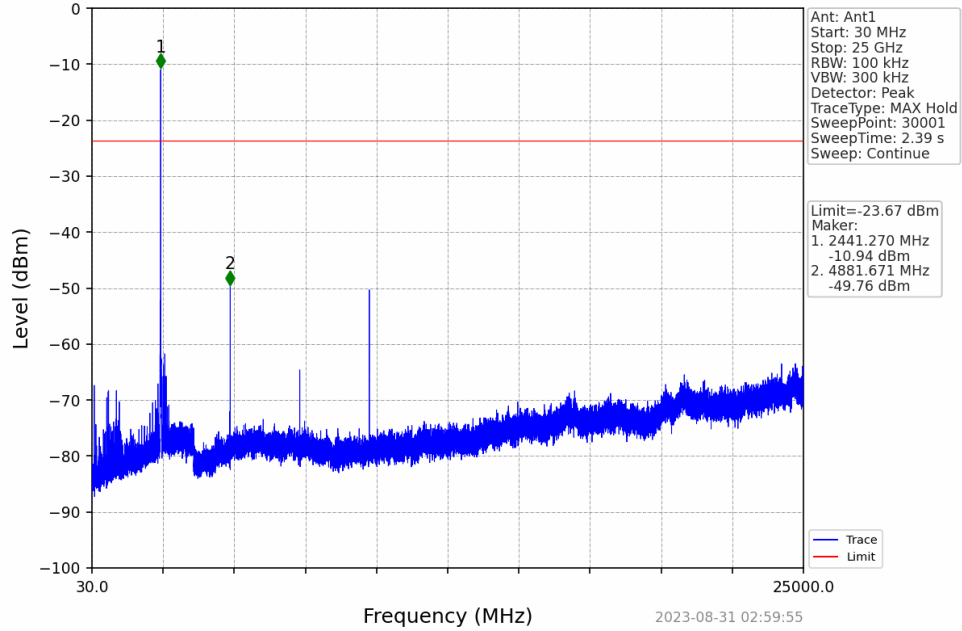


## 8-DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV

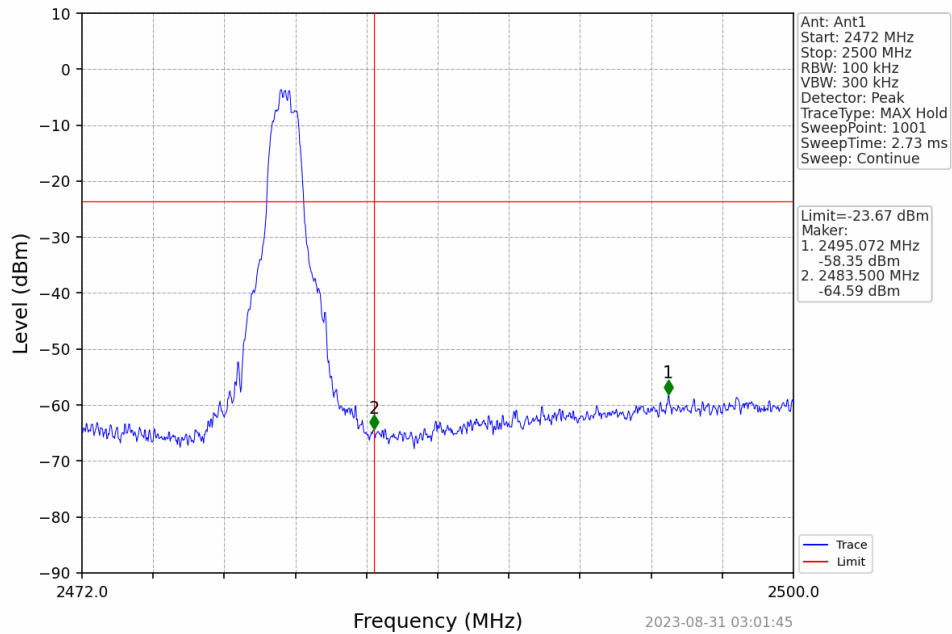




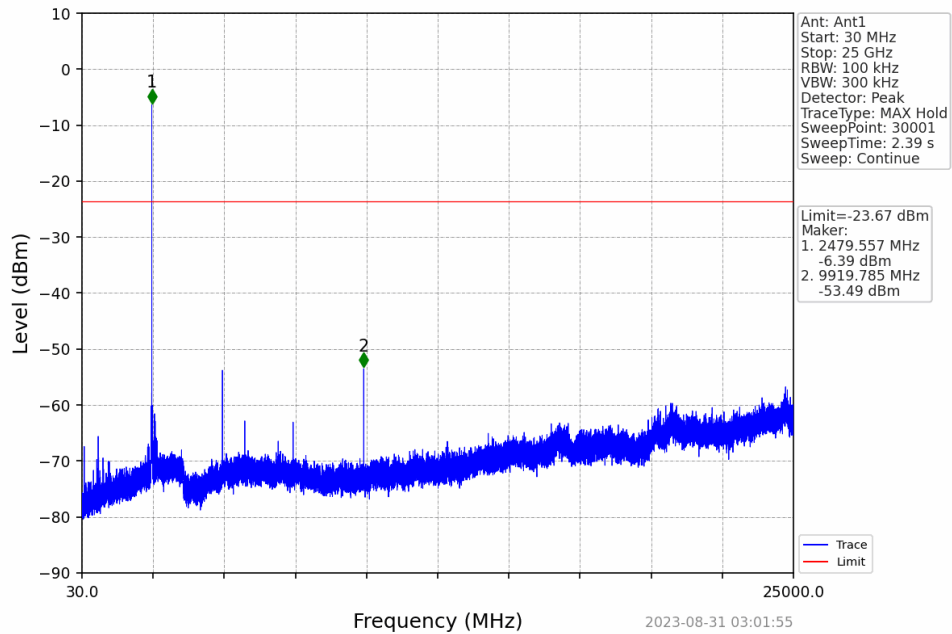
## 8-DPSK 3DH5\_MCH 2441MHz\_Ant1\_NTNV



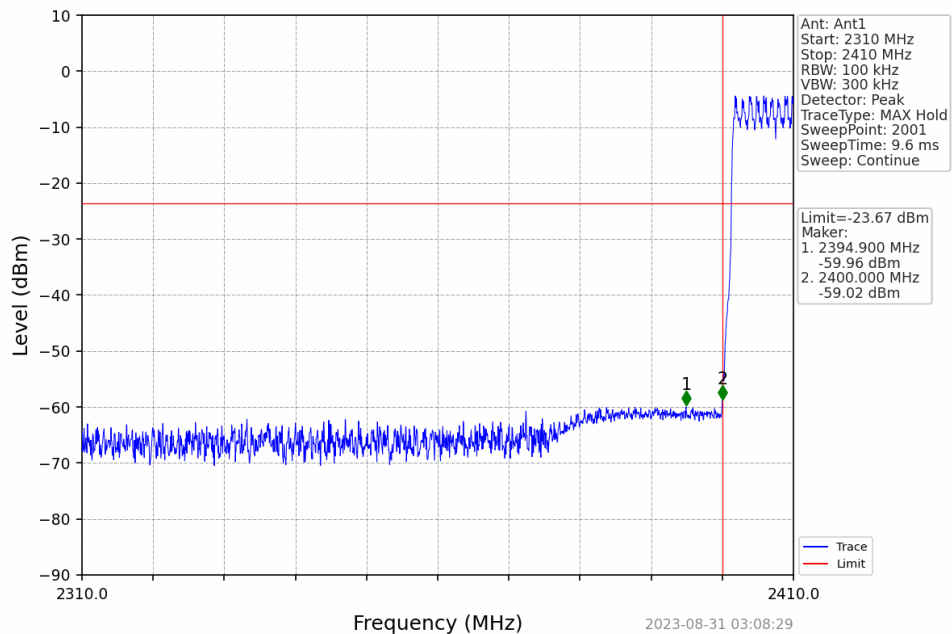
## 8-DPSK 3DH5\_HCH 2480MHz\_Ant1\_NTNV

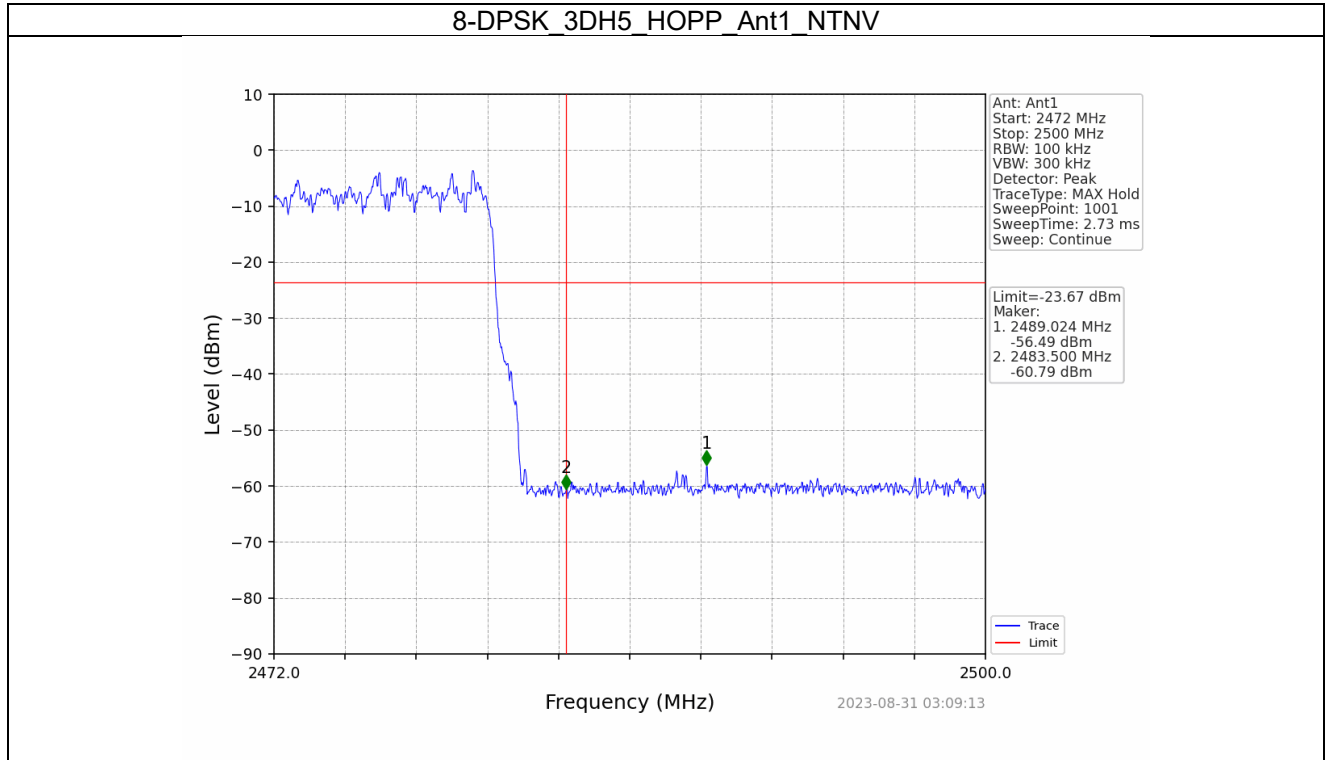


## 8-DPSK\_3DH5\_HCH\_2480MHz\_Ant1\_NTNV



## 8-DPSK\_3DH5\_HOPP\_Ant1\_NTNV







Test Report Number: BTF230911R00101



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**-- END OF REPORT --**