

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 1 of 93

# TEST REPORT

<b>Application No.:</b>	KSCR2409001732AT
<b>FCC ID:</b>	2BHG-0211C6U4
<b>IC:</b>	32743-0211C6U4
<b>Name of Testing Laboratory preparing the Report:</b>	Compliance Certification Services (Kunshan) Inc.
<b>Address of Testing Laboratory preparing the Report:</b>	No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.
<b>Applicant:</b>	KeyLife International Technology Limited
<b>Address of Applicant:</b>	27th Floor, Alexandra House, 18 Chater Road, Central, Hong Kong
<b>Manufacturer:</b>	KeyLife International Technology Limited
<b>Address of Manufacturer:</b>	27th Floor, Alexandra House, 18 Chater Road, Central, Hong Kong
<b>Factory:</b>	Zhejiang Uniview Systems Technology Co., Ltd.
<b>Address of Factory:</b>	No.1277 South Qingfeng South Road, Tongxiang City, Jiaxing City, Zhejiang Province, China
<b>Equipment Under Test (EUT):</b>	
<b>EUT Name:</b>	Dual-cam Doorbell (battery)
<b>Model No.:</b>	DB312, DB312 XXX XXX (where X may be 0-9 A-Z a-z or blank. The differences no impact safety related constructions and EMC) ♣
♣	Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
<b>For IC Model No.:</b>	DB312
<b>Standard(s) :</b>	47 CFR Part 15, Subpart C 15.247 RSS-247 Issue 3, August 2023 RSS-Gen Issue 5 Amendment 2 (February 2021)
<b>Date of Receipt:</b>	2024-09-04
<b>Date of Test:</b>	2024-09-13 to 2024-10-22
<b>Date of Issue:</b>	2024-10-22
<b>Test Result:</b>	<b>Pass*</b>

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

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.



# Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 2 of 93

<b>Revision Record</b>			
<b>Version</b>	<b>Description</b>	<b>Date</b>	<b>Remark</b>
00	Original	2024-10-22	/

Authorized for issue by:			
Tested By		<u>Maker_Qi</u>	
		<u>Maker_Qi/Project Engineer</u>	
Approved By		<u>Terry Hou</u>	
		<u>Terry Hou /Reviewer</u>	

## 2 Test Summary

<b>Radio Spectrum Technical Requirement</b>					
<b>Item</b>	<b>FCC Requirement</b>	<b>IC Requirement</b>	<b>Method</b>	<b>Result</b>	<b>Test Lab*</b>
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration	N/A
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	RSS-247 Section 5.1(a)	N/A	Pass	N/A

N/A: Not applicable

<b>Radio Spectrum Matter Part</b>					
<b>Item</b>	<b>FCC Requirement</b>	<b>IC Requirement</b>	<b>Method</b>	<b>Result</b>	<b>Test Lab*</b>
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.207	RSS-Gen Section 8.8	ANSI C63.10 (2013) Section 6.2	Pass	B
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(1)	RSS-247 Section 5.4(b)	ANSI C63.10 (2013) Section 7.8.5	Pass	A
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247(a)(1)	RSS-247 Section 5.1(a)	ANSI C63.10 (2013) Section 7.8.7	Pass	A
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247a(1)	RSS-247 Section 5.1(b)	ANSI C63.10 (2013) Section 7.8.2	Pass	A
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.3	Pass	A
Dwell Time	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.4	Pass	A
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.6	Pass	A
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.8	Pass	A
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.205 & 15.209	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass	B
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.205 & 15.209	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass	B
99% Bandwidth	-	RSS-Gen Section 6.7	ANSI C63.10 Section 6.9.3	Pass	A

Model No.: DB312,DB312 XXX XXX (where X may be 0-9 A-Z a-z or blank. The differences no impact safety related constructions and EMC)

Only the model DB312 was tested.

There are series models mentioned in this report, and they are identical in electrical and electronic characters. Only the model DB312 was tested since their differences were the model number and appearance.

### 3 Contents

	Page
<b>1 COVER PAGE</b>	<b>1</b>
<b>2 Test Summary</b>	<b>3</b>
<b>3 Contents</b>	<b>4</b>
<b>4 General Information</b>	<b>5</b>
4.1 Details of E.U.T.	5
4.2 Power level setting using in test:	5
4.3 Description of Support Units	5
4.4 Measurement Uncertainty	6
4.5 Test Location	7
4.6 Test Facility	8
4.7 Deviation from Standards	8
4.8 Abnormalities from Standard Conditions	8
<b>5 Equipment List</b>	<b>9</b>
<b>6 Radio Spectrum Technical Requirement</b>	<b>11</b>
6.1 Antenna Requirement	11
6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	12
<b>7 Radio Spectrum Matter Test Results</b>	<b>13</b>
7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)	13
7.2 Radiated Emissions which fall in the restricted bands	17
7.3 Radiated Spurious Emissions Below 1GHz	23
7.4 Radiated Spurious Emissions Above 1GHz	27
7.5 Conducted Peak Output Power	35
7.6 20dB Bandwidth	37
7.7 Carrier Frequencies Separation	38
7.8 Hopping Channel Number	39
7.9 Dwell Time	40
7.10 Conducted Band Edges Measurement	41
7.11 Conducted Spurious Emissions	42
<b>8 Test Setup Photo</b>	<b>43</b>
<b>9 EUT Constructional Details (EUT Photos)</b>	<b>43</b>
<b>10 Appendix</b>	<b>44</b>

## 4 General Information

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

Power supply:	~12-24V,50/60Hz,1.0A DC 5V/2A DC 3.6V by battery
Test voltage:	AC 120V/60Hz
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	Internal antenna
Antenna Gain:	3.9dBi (Provided by the manufacturer)

### 4.2 Power level setting using in test:

Channel	DH	2DH	3DH
	Ant 1	Ant 1	Ant 1
1	0x0	0x0	0x0
3	0x0	0x0	0x0
5	0x0	0x0	0x0

### 4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Notebook	LENOVO	K27	EB24537645

**4.4 Measurement Uncertainty**

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

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

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 7 of 93

### 4.5 Test Location

#### Lab A:

Compliance Certification Services (Kunshan) Inc.

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

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

#### Lab B:

Conducted Emissions at AC Power Line (150kHz-30MHz); Radiated Emissions; Radiated Emissions which fall in the restricted bands test at:

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.

South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone

Note:

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

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 8 of 93

### 4.6 Test Facility

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

#### Lab A:

- **A2LA**

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

- **FCC**

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

- **ISED**

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

- **VCCI**

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

#### Lab B:

- **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

- **FCC –Designation Number: CN1312**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory.

Designation Number: CN1312.

Test Firm Registration Number: 717327

### 4.7 Deviation from Standards

None

### 4.8 Abnormalities from Standard Conditions

None

# Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 9 of 93

## 5 Equipment List

### Lab A:

Item	Equipment	Manufacturer	Model	Inventory No	Cal Date	Cal. Due Date
<b>RF Radiated Test</b>						
1	Spectrum Analyzer	R&S	FSV40	KUS1806E003	08/06/2024	08/05/2025
2	Universal Radio Communication Tester	R&S	CMW500	KSEM009-1	03/19/2024	03/18/2025
4	Loop Antenna	COM-POWER	AL-130R	KUS1806E001	03/18/2023	03/17/2025
5	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E005	06/29/2023	06/28/2025
6	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E006	03/19/2024	03/18/2025
7	Horn-antenna(1-18GHz)	Schwarzbeck	BBHA9120D	KS301079	03/23/2024	08/22/2026
8	Horn-antenna(1-18GHz)	ETS-LINDGREN	3117	KS301186	04/07/2023	04/06/2025
9	Horn Antenna(18-40GHz)	Schwarzbeck	BBHA9170	CZ301058	01/07/2024	01/06/2026
10	Amplifier(30MHz~18GHz)	PANSHAN TECHNOLOGY	LNA:1~18G	KSEM010-1	01/15/2024	01/14/2025
11	Amplifier(18~40GHz)	PANSHAN TECHNOLOGY	LNA180400G40	KSEM038	08/12/2024	08/11/2025
12	RE Test Cable	REBES MICROWAVE	/	CZ301097	08/12/2024	08/11/2025
13	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-4	03/21/2024	03/20/2025
14	Software	Faratronic	EZ_EMCA-3A1	/	NCR	NCR
15	Software	ESE	E3_V 6.111221a	/	NCR	NCR



## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 10 of 93

### Lab B:

Item	Equipment	Manufacturer	Model	Inventory No	Cal Date	Cal. Due Date
<b>Conducted Emission at Mains Terminals</b>						
1	Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2/1/2024	1/31/2025
2	Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-06	2/8/2024	2/7/2025
3	Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-03	2/4/2024	2/3/2025
4	Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-04	2/4/2024	2/3/2025
5	Measurement Software	Tonscend	JS32-CE	SUWI-02-09-05	NCR	NCR
<b>RF Radiated Test</b>						
1	Semi-Anechoic Chamber	Brilliant-emc	N/A	SUWI-04-02-02	6/3/2023	6/2/2026
2	Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-13	2/8/2024	2/7/2025
3	Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	5/8/2024	5/7/2025
4	Signal Analyzer	KEYSIGHT	N9020A	SUWI-01-02-06	11/21/2023	11/20/2024
5	Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2/1/2024	1/31/2025
6	Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	VULB 9168	SUWI-01-11-04	11/25/2023	11/24/2024
7	Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9120D	SUWI-01-11-05	11/25/2023	11/24/2024
8	Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9170	SUWI-01-11-03	5/12/2023	5/11/2025
9	Active Loop Antenna	SCHWRZBECK MESS-ELEKTRONIK	FMZB 1519B	SUWI-01-21-01	5/13/2023	5/12/2025
10	Amplifier	Tonscend	TAP9K3G40	SUWI-01-14-01	2/1/2024	1/31/2025
11	Amplifier	Tonscend	TAP01018050	SUWI-01-14-02	2/1/2024	1/31/2025
12	Amplifier	Tonscend	TAP18040048	SUWI-01-14-03	2/1/2024	1/31/2025
13	Measurement Software	Tonscend	JS32-RE	SUWI-02-09-04	NCR	NCR
14	Measurement Software	Tonscend	JS32-RSE	SUWI-02-09-06	NCR	NCR

## 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 Internal antenna on the main PCB and no consideration of replacement. The best case gain of the antenna is 3.9 dBi.

Antenna location: Refer to internal photo.

## **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.

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 coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

## 7 Radio Spectrum Matter Test Results

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

Test Requirement 47 CFR Part 15, Subpart C 15.207

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

Limit:

Frequency of emission(MHz)	Conducted limit(dB $\mu$ 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.

Detector: Peak for pre-scan (9kHz resolution bandwidth) 0.15M to 30MHz

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

Operating Environment:

Temperature: 23 °C

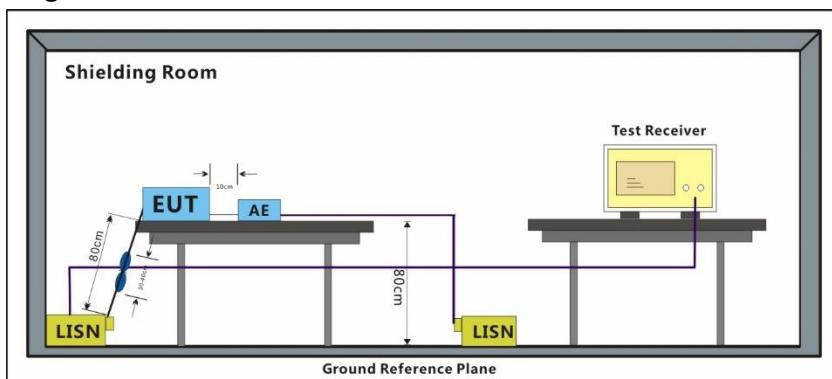
Humidity: 46 % RH

Atmospheric Pressure: 1010 mbar

#### 7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

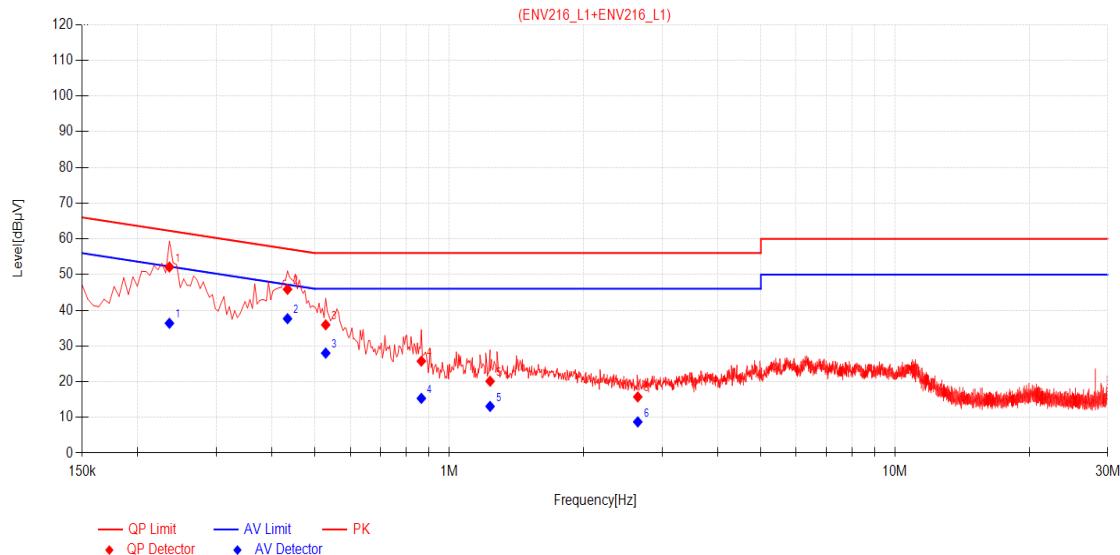
#### 7.1.3 Test Setup Diagram



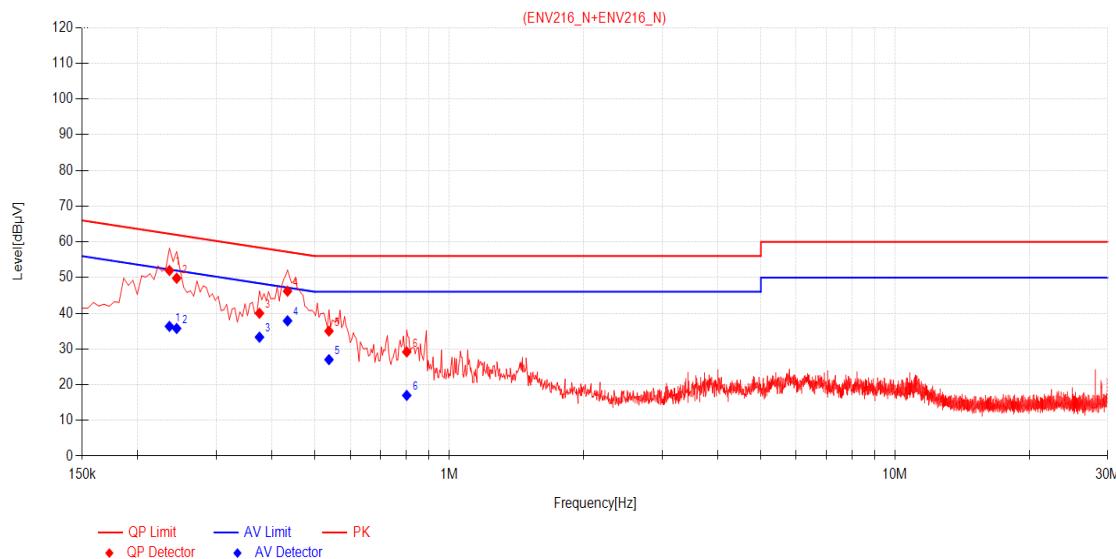
**7.1.4 Measurement Procedure and Data**

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

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



Final Data List											
NO.	Frequency [MHz]	Factor [dB]	QP Reading [dB $\mu$ V]	QP Value [dB $\mu$ V]	QP Limit [dB $\mu$ V]	QP Margin [dB]	AV Reading [dB $\mu$ V]	AV Value [dB $\mu$ V]	AV Limit [dB $\mu$ V]	AV Margin [dB]	Verdict
1	0.2355	10.16	41.95	52.11	62.25	10.14	26.20	36.36	52.25	15.89	PASS
2	0.4335	10.17	35.70	45.87	57.19	11.32	27.47	37.64	47.19	9.55	PASS
3	0.5280	10.18	25.74	35.92	56.00	20.08	17.82	28.00	46.00	18.00	PASS
4	0.8655	10.13	15.62	25.75	56.00	30.25	5.20	15.33	46.00	30.67	PASS
5	1.2345	10.08	10.04	20.12	56.00	35.88	3.00	13.08	46.00	32.92	PASS
6	2.6475	10.08	5.66	15.74	56.00	40.26	-1.34	8.74	46.00	37.26	PASS

**Final Data List**

NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.2355	10.16	41.81	51.97	62.25	10.28	26.16	36.32	52.25	15.93	PASS
	0.2445	10.16	39.64	49.80	61.94	12.14	25.58	35.74	51.94	16.20	PASS
3	0.3750	10.16	29.84	40.00	58.39	18.39	23.15	33.31	48.39	15.08	PASS
4	0.4335	10.16	36.01	46.17	57.19	11.02	27.72	37.88	47.19	9.31	PASS
5	0.5370	10.17	24.84	35.01	56.00	20.99	16.85	27.02	46.00	18.98	PASS
6	0.8025	10.16	19.01	29.17	56.00	26.83	6.83	16.99	46.00	29.01	PASS

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

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

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

Measurement Distance: 3m

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.

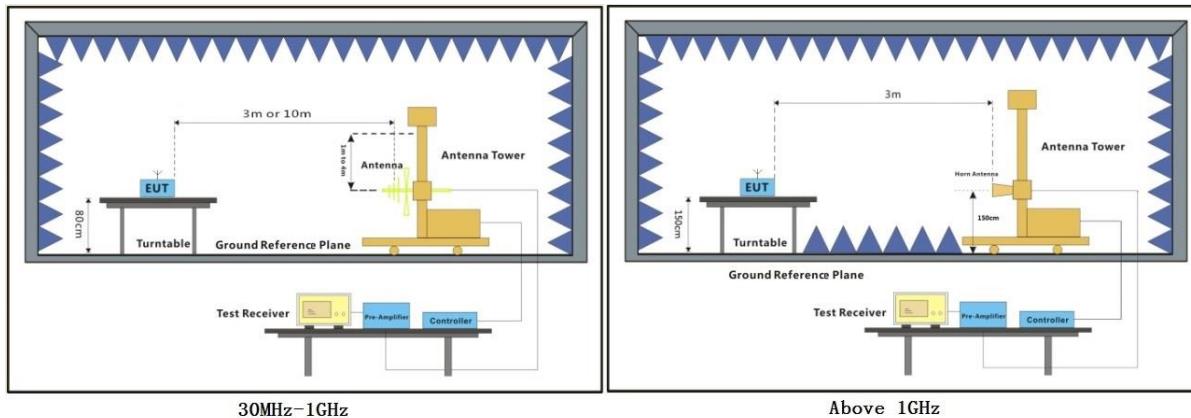
**7.2.1 E.U.T. Operation**

Operating Environment:

Temperature: 23 °C      Humidity: 46 % RH      Atmospheric Pressure: 1010 mbar

**7.2.2 Test Mode Description**

Pre-scan / Final test	Mode Code	Description
Final test	06	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.

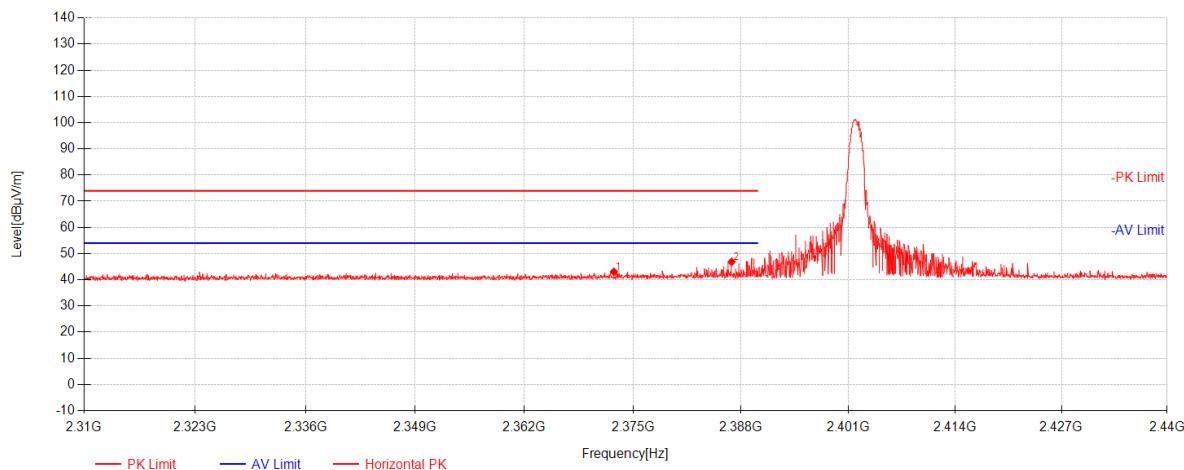
**7.2.3 Test Setup Diagram****7.2.4 Measurement Procedure and Data**

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

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

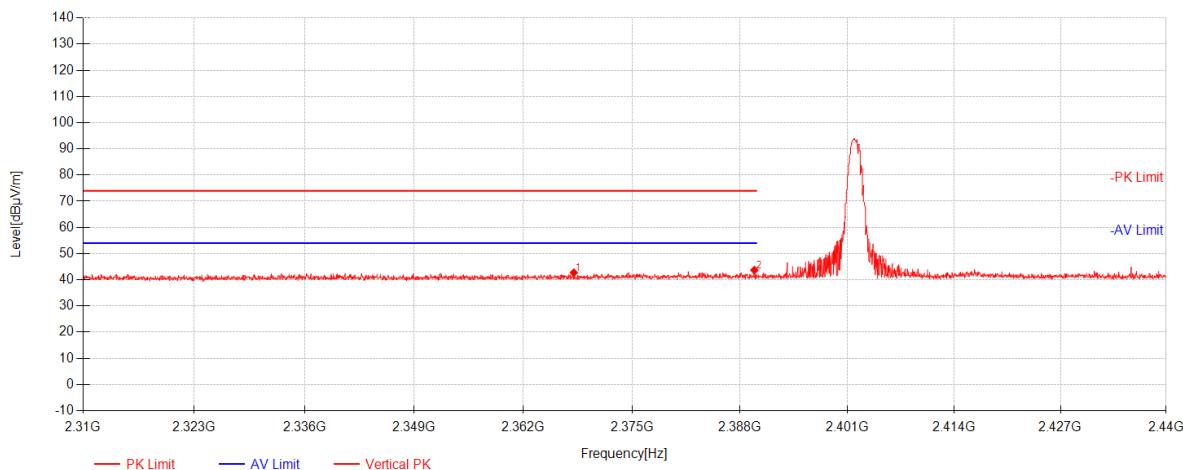
Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level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

## GFSK\_Channel 00



Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	2372.7033	39.68	26.95	-23.57	43.05	74.00	30.95	Horizontal
2	2386.8733	43.45	26.97	-23.57	46.85	74.00	27.15	Horizontal

## GFSK\_Channel 00



Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	2368.0233	39.35	26.94	-23.57	42.71	74.00	31.29	Vertical
2	2389.7333	40.27	26.98	-23.57	43.68	74.00	30.32	Vertical

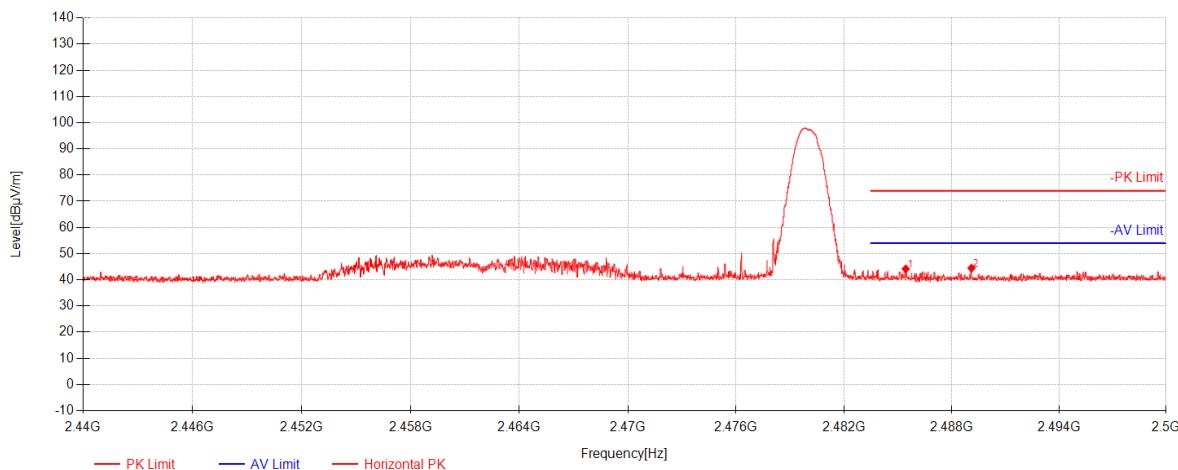
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 21 of 93

GFSK\_Channel 78



Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	2485.4425	40.54	27.17	-23.54	44.17	74.00	29.83	Horizontal
2	2489.11	40.84	27.18	-23.54	44.47	74.00	29.53	Horizontal

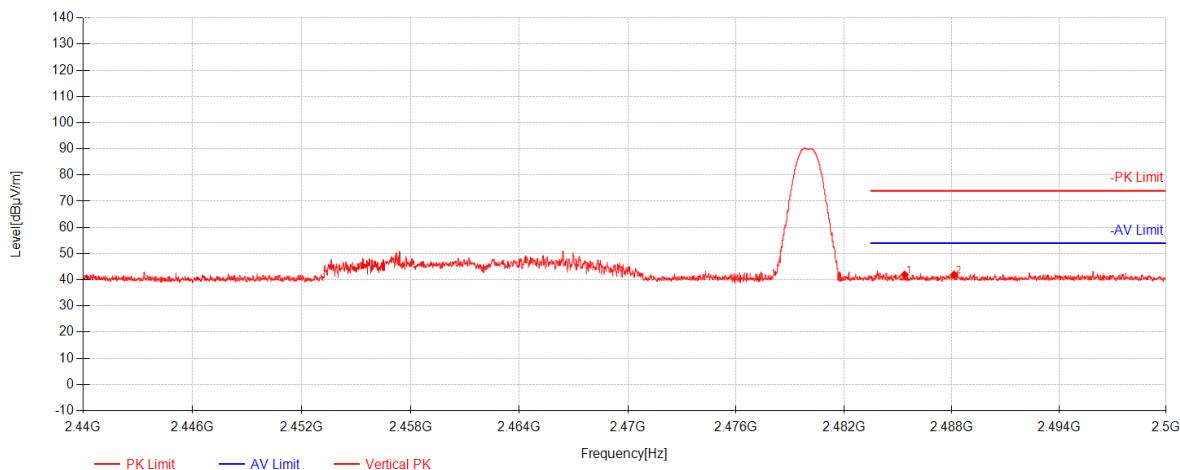
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 22 of 93

GFSK\_Channel 78



Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	2485.3825	38.27	27.17	-23.54	41.90	74.00	32.10	Vertical
2	2488.1425	38.30	27.18	-23.54	41.93	74.00	32.07	Vertical

### 7.3 Radiated Spurious Emissions Below 1GHz

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

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

Measurement Distance: 3m

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

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

Operating Environment:

Temperature: 23 °C

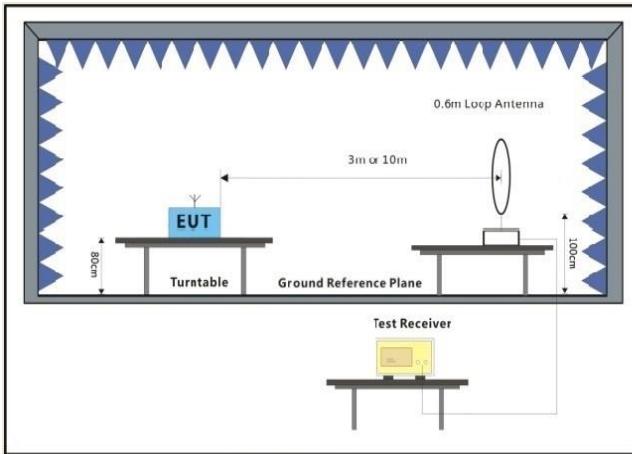
Humidity: 46 % RH

Atmospheric Pressure: 1010 mbar

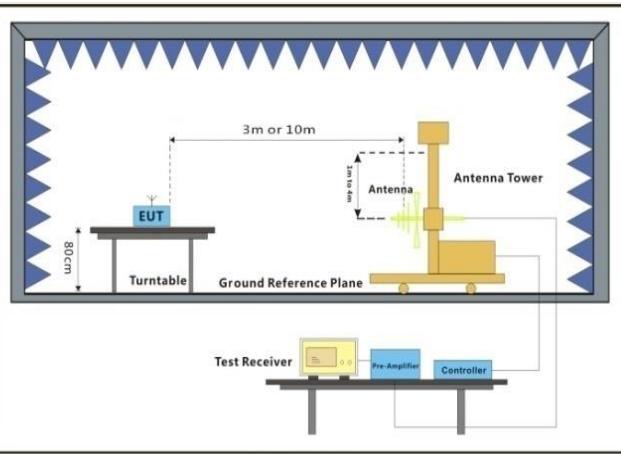
#### 7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.3.3 Test Setup Diagram



Below 30MHz



30MHz-1GHz

**7.3.4 Measurement Procedure and Data**

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

Remark:

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

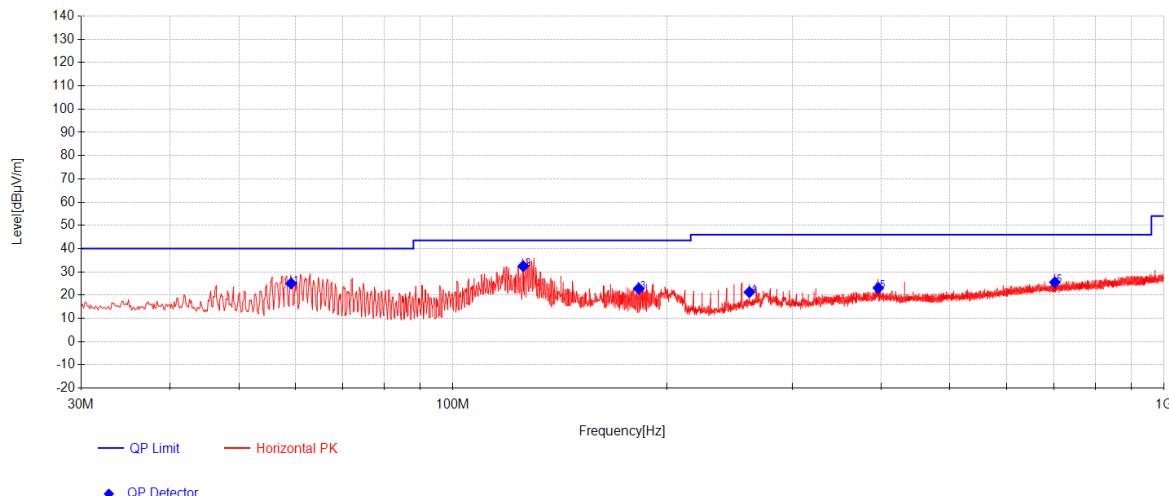
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

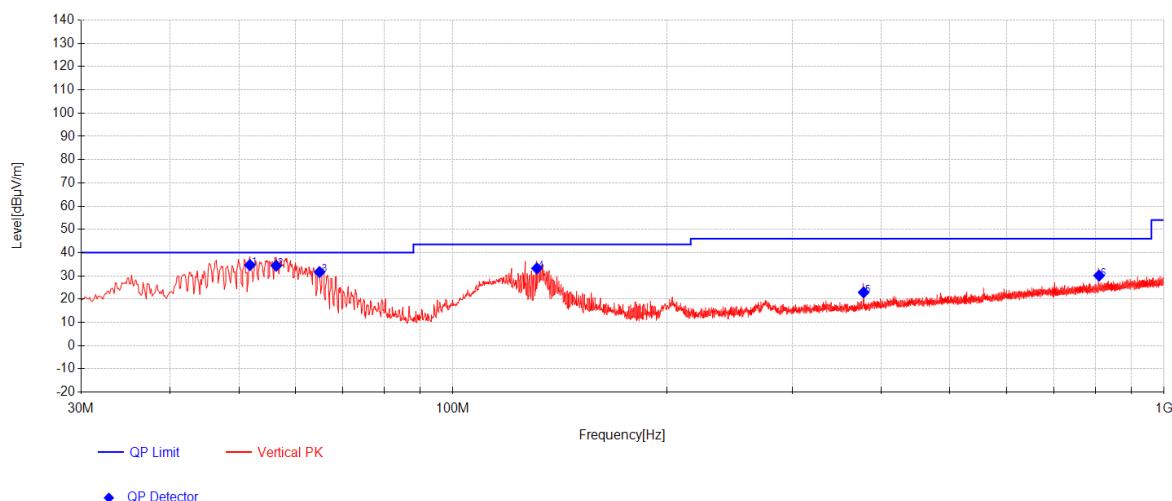
Page: 25 of 93

GFSK\_Channel 00



<b>Final Data List</b>								
NO.	Frequency [MHz]]	Reading [dB $\mu$ V]	Factor [dB]	AF [dB/m]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Polarity
1	59.2212	41.32	-33.87	17.58	25.03	40.00	14.97	Horizontal
2	125.545	48.22	-33.31	17.55	32.46	43.50	11.04	Horizontal
3	182.5325	39.54	-32.86	16.15	22.82	43.50	20.68	Horizontal
4	261.1025	36.55	-32.39	17.12	21.28	46.00	24.72	Horizontal
5	396.4175	34.33	-31.55	20.33	23.10	46.00	22.90	Horizontal
6	702.0888	30.21	-30.02	25.32	25.51	46.00	20.49	Horizontal

## GFSK\_Channel 00



Final Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	Factor [dB]	AF [dB/m]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Polarity
1	51.825	50.21	-33.96	18.42	34.67	40.00	5.33	Vertical
2	56.4325	50.11	-33.90	18.16	34.36	40.00	5.64	Vertical
3	64.92	48.22	-33.80	17.22	31.64	40.00	8.36	Vertical
4	131.2438	48.64	-33.28	17.87	33.23	43.50	10.27	Vertical
5	377.9875	34.68	-31.62	19.84	22.90	46.00	23.10	Vertical
6	810.1225	32.63	-29.71	27.20	30.12	46.00	15.88	Vertical

## 7.4 Radiated Spurious Emissions Above 1GHz

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

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

Measurement Distance: 3m

Limit:

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

### 7.4.1 E.U.T. Operation

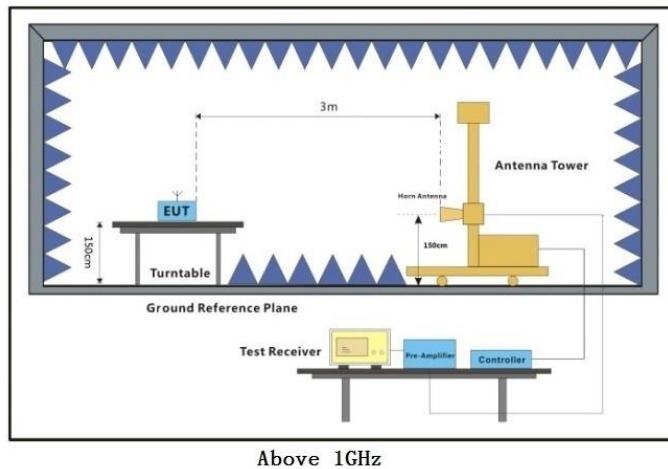
Operating Environment:

Temperature: 23 °C      Humidity: 46 % RH      Atmospheric Pressure: 1010 mbar

### 7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.4.3 Test Setup Diagram



**7.4.4 Measurement Procedure and Data**

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

**Remark:**

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

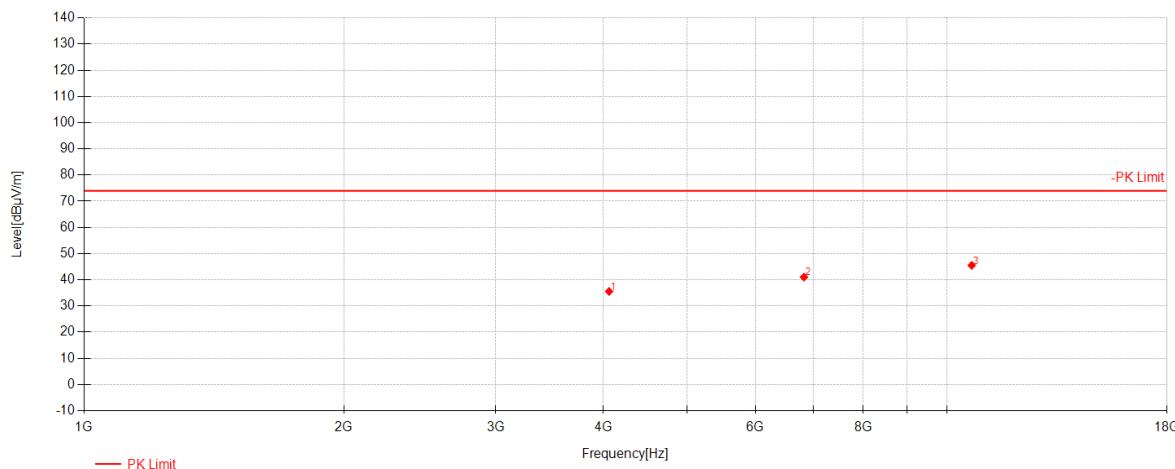
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 29 of 93

GFSK\_Channel 00



Data List								
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4060	51.88	29.54	-45.87	35.55	74.00	38.45	Horizontal
2	6829.5	50.49	34.69	-44.15	41.03	74.00	32.97	Horizontal
3	10686	44.90	38.57	-37.96	45.51	74.00	28.49	Horizontal

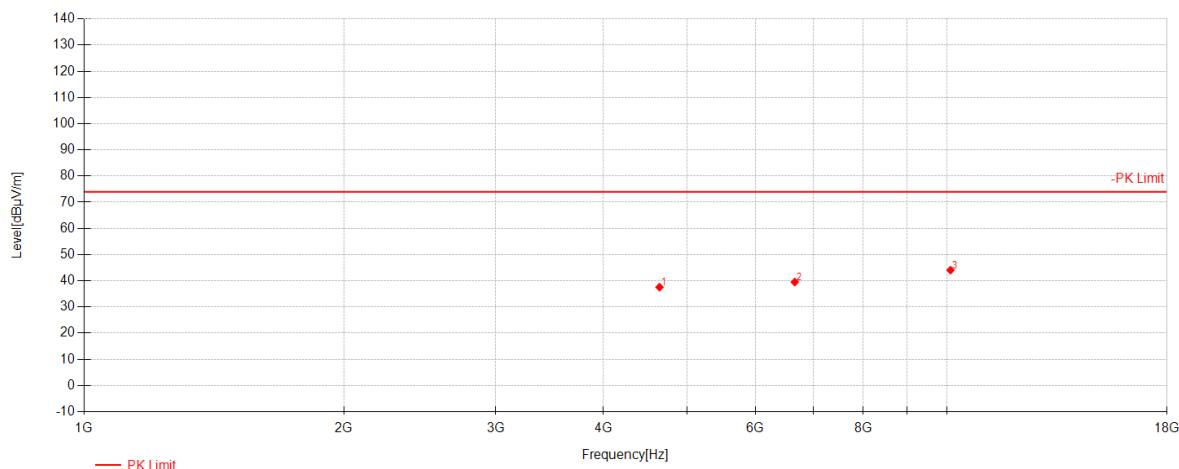
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 30 of 93

GFSK\_Channel 00

**Data List**

NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4644.5	52.37	30.83	-45.64	37.56	74.00	36.44	Vertical
2	6664	49.13	34.40	-44.00	39.52	74.00	34.48	Vertical
3	10098	44.65	38.51	-39.12	44.04	74.00	29.96	Vertical

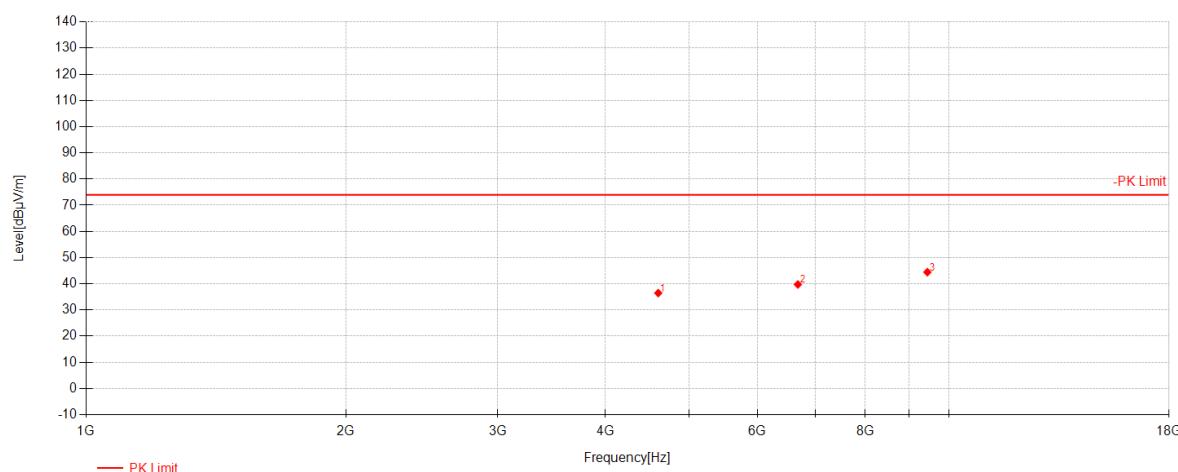
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

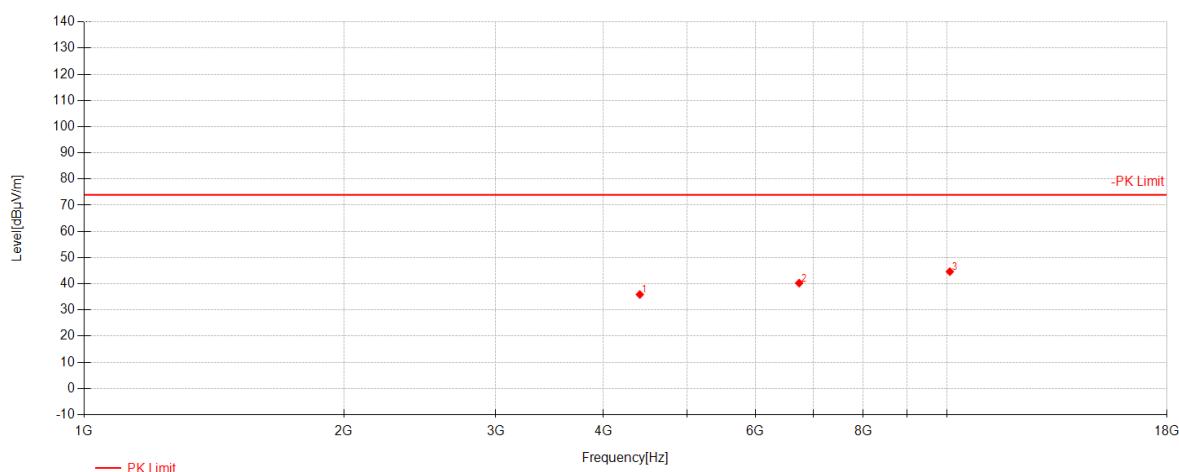
Page: 31 of 93

GFSK\_Channel 39

**Data List**

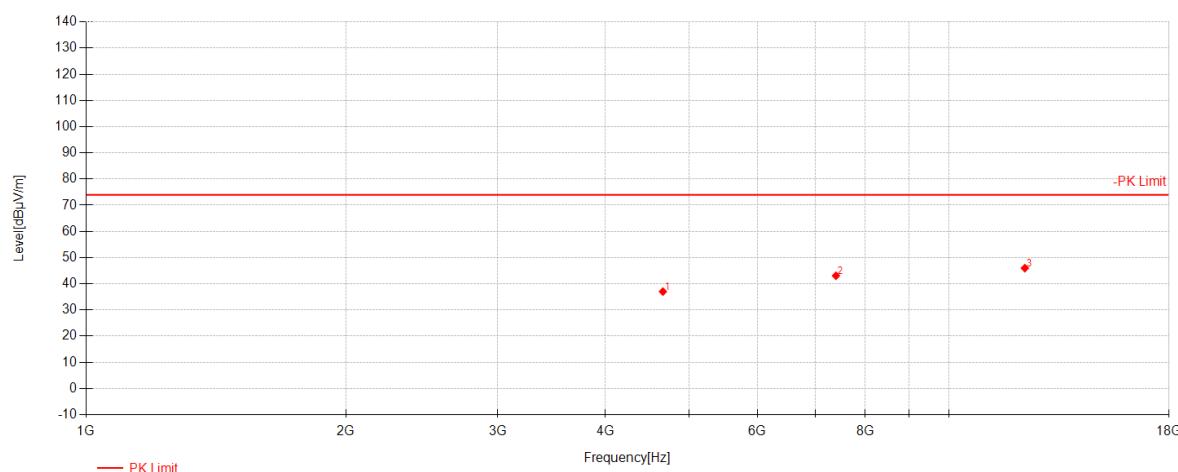
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4604.5	51.35	30.77	-45.67	36.45	74.00	37.55	Horizontal
2	6683.5	49.21	34.43	-43.90	39.74	74.00	34.26	Horizontal
3	9443	47.06	37.39	-40.00	44.44	74.00	29.56	Horizontal

## GFSK\_Channel 39

**Data List**

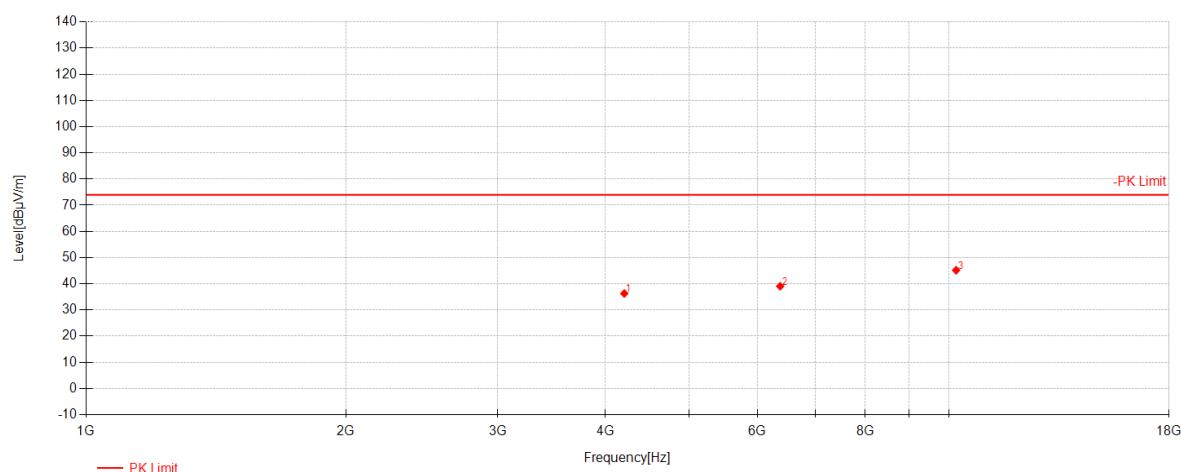
NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4407	51.34	30.38	-45.81	35.90	74.00	38.10	Vertical
2	6743	49.69	34.54	-43.96	40.26	74.00	33.74	Vertical
3	10079.5	45.28	38.51	-39.14	44.64	74.00	29.36	Vertical

## GFSK\_Channel 78

**Data List**

NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4662	51.79	30.86	-45.63	37.02	74.00	36.98	Horizontal
2	7398.5	50.37	36.12	-43.42	43.07	74.00	30.93	Horizontal
3	12250	44.25	39.18	-37.45	45.97	74.00	28.03	Horizontal

## GFSK\_Channel 78

**Data List**

NO.	Frequency [MHz]	Reading [dB $\mu$ V]	AF [dB/m]	Factor [dB]	Level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Polarity
1	4205.5	52.15	29.89	-45.76	36.29	74.00	37.71	Vertical
2	6375.5	49.84	33.68	-44.44	39.07	74.00	34.93	Vertical
3	10195.5	46.13	38.52	-39.48	45.17	74.00	28.83	Vertical

## 7.5 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.5

Limit:

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

### 7.5.1 E.U.T. Operation

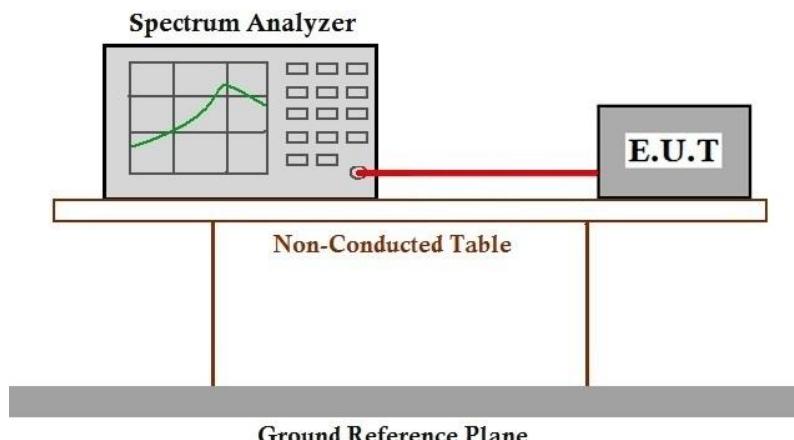
Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

### 7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	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.

### 7.5.3 Test Setup Diagram





## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 36 of 93

### 7.5.4 Measurement Procedure and Data

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

Please Refer to Appendix for Details

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 37 of 93

### 7.6 20dB Bandwidth

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

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

Measurement Distance: 3m

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

Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

#### 7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.6.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## 7.7 Carrier Frequencies Separation

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

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

Limit:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

### 7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	07	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.7.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## 7.8 Hopping Channel Number

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

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

Limit:

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

### 7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

### 7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	07	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.8.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 40 of 93

### 7.9 Dwell Time

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

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

Limit:

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

#### 7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 22.5 °C

Humidity: 48.2 % RH

Atmospheric Pressure: 1010 mbar

#### 7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	07	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.9.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## 7.10 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)  
Test Method: ANSI C63.10 (2013) Section 7.8.6

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

### 7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	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	07	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.

### 7.10.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## 7.11 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)  
Test Method: ANSI C63.10 (2013) Section 7.8.8

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 7.11.1 E.U.T. Operation

Operating Environment:

Temperature: 22.5 °C      Humidity: 48.2 % RH      Atmospheric Pressure: 1010 mbar

### 7.11.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	06	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.11.3 Measurement Procedure and Data

Please Refer to Appendix for Details

## Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 43 of 93

## 8 Test Setup Photo

Refer to Appendix - Test Setup Photo for KSCR2409001732AT

## 9 EUT Constructional Details (EUT Photos)

Refer to External and Internal Photos for KSCR2409001732AT

## 10 Appendix

### 1. Bandwidth

#### 1.1 Test Result

##### 1.1.1 OBW

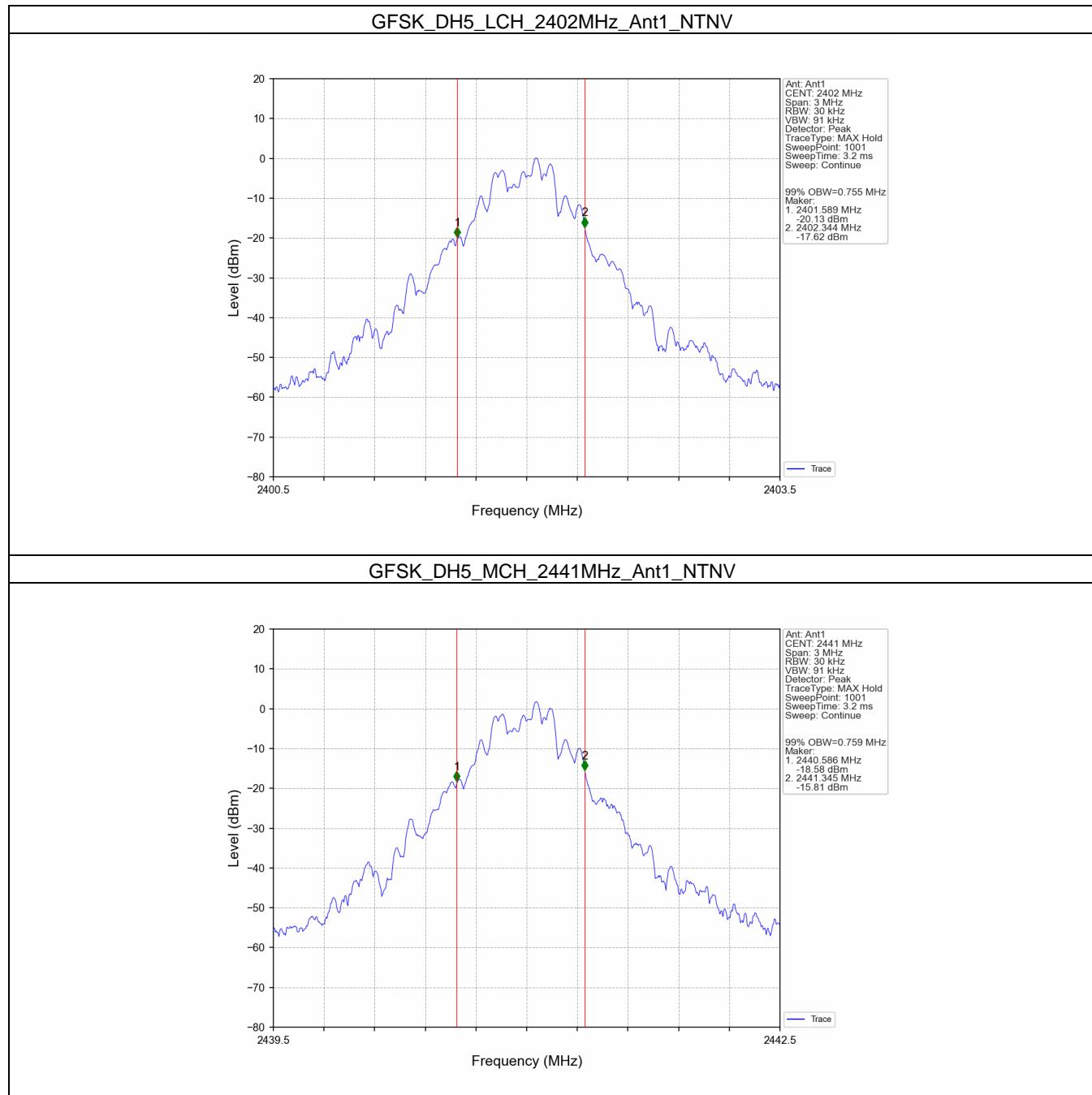
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	99% Occupied Bandwidth (MHz)		Verdict
					Result	Limit	
GFSK	SISO	2402	DH5	1	0.755	/	Pass
		2441	DH5	1	0.759	/	Pass
		2480	DH5	1	0.761	/	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.205	/	Pass
		2441	2DH5	1	1.201	/	Pass
		2480	2DH5	1	1.201	/	Pass
8DPSK	SISO	2402	3DH5	1	1.121	/	Pass
		2441	3DH5	1	1.119	/	Pass
		2480	3DH5	1	1.121	/	Pass

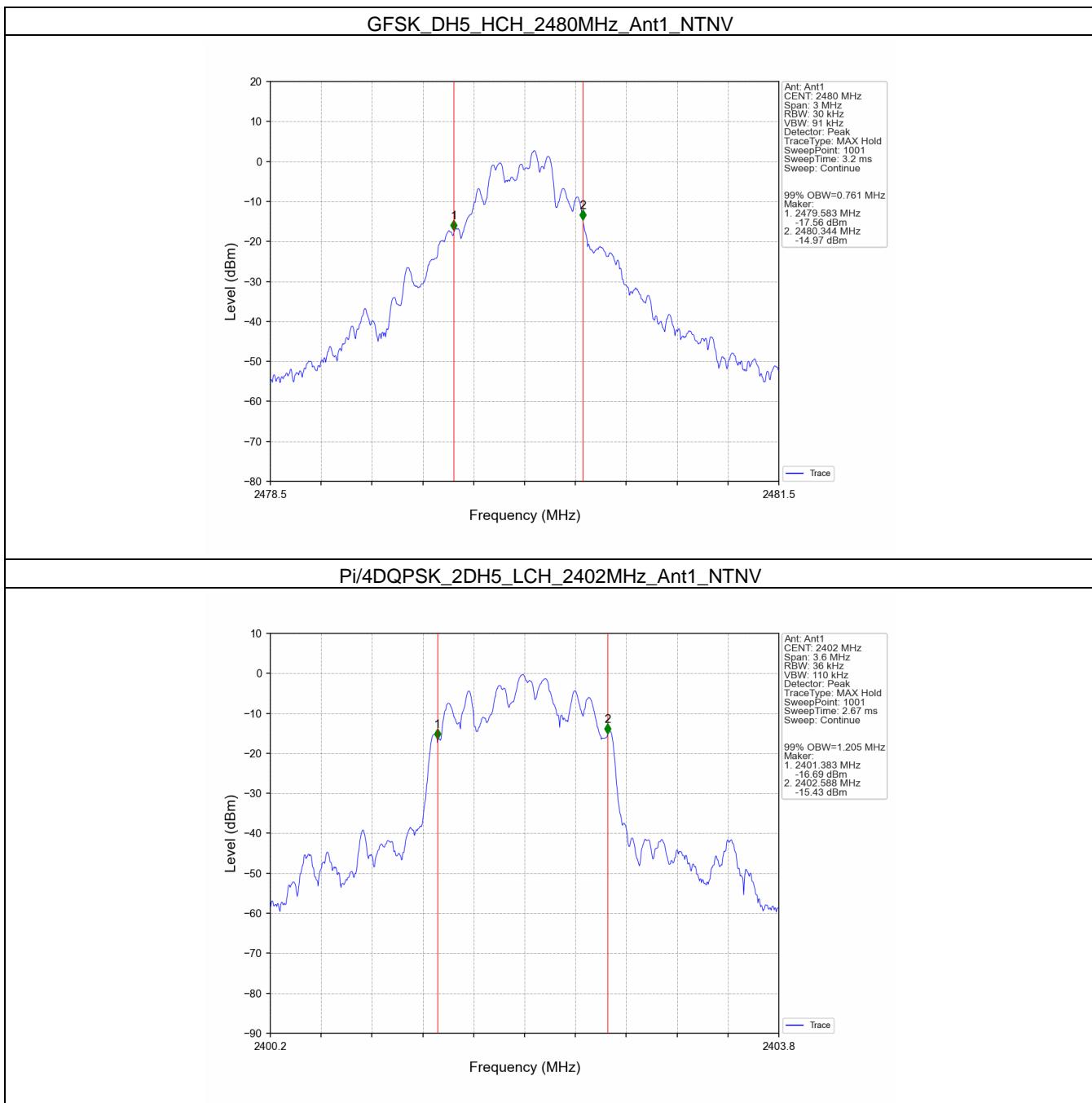
##### 1.1.2 20dB BW

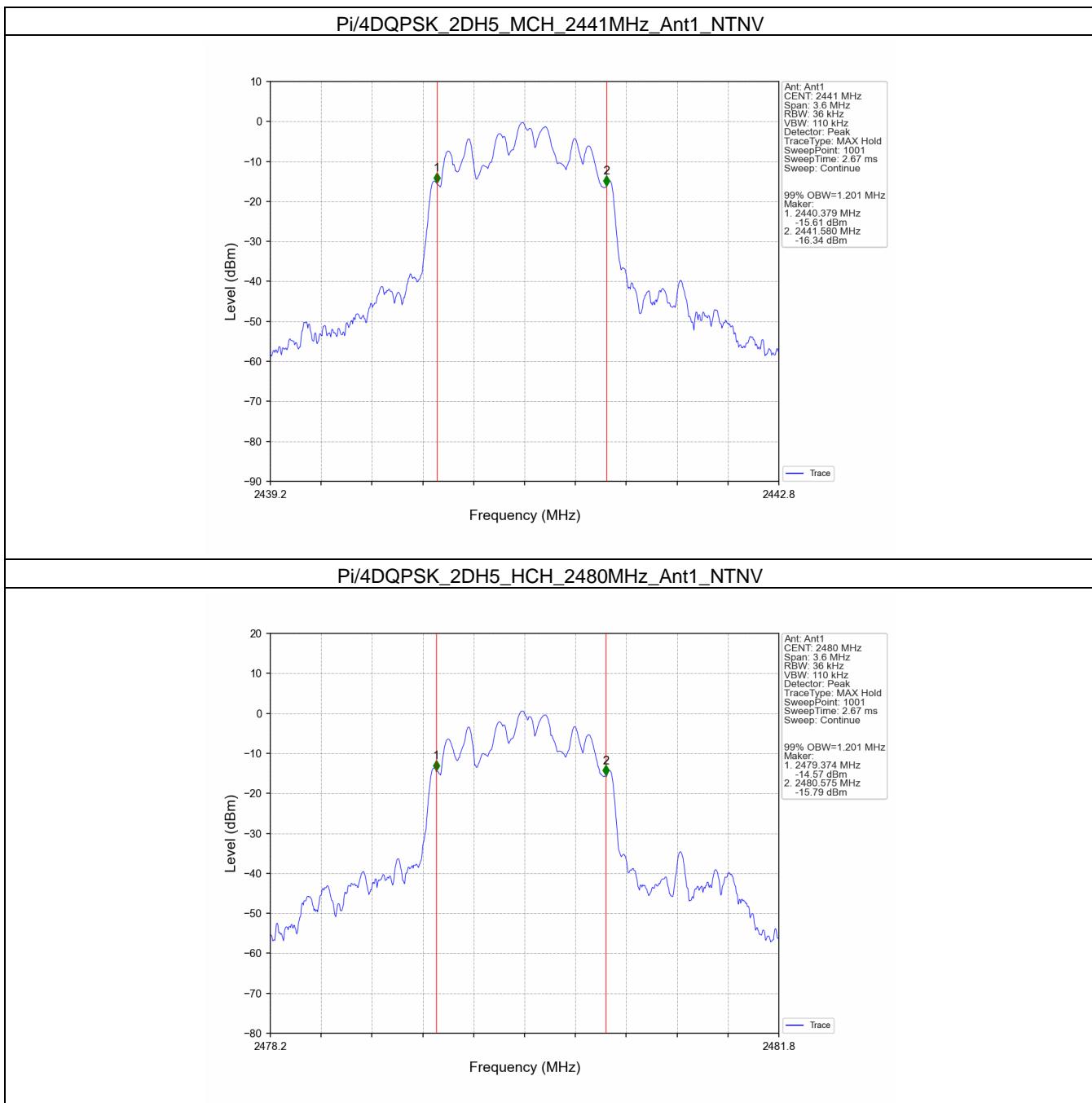
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)		Verdict
					Result	Limit	
GFSK	SISO	2402	DH5	1	0.762	/	Pass
		2441	DH5	1	0.765	/	Pass
		2480	DH5	1	0.768	/	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.307	/	Pass
		2441	2DH5	1	1.308	/	Pass
		2480	2DH5	1	1.307	/	Pass
8DPSK	SISO	2402	3DH5	1	1.215	/	Pass
		2441	3DH5	1	1.214	/	Pass
		2480	3DH5	1	1.215	/	Pass

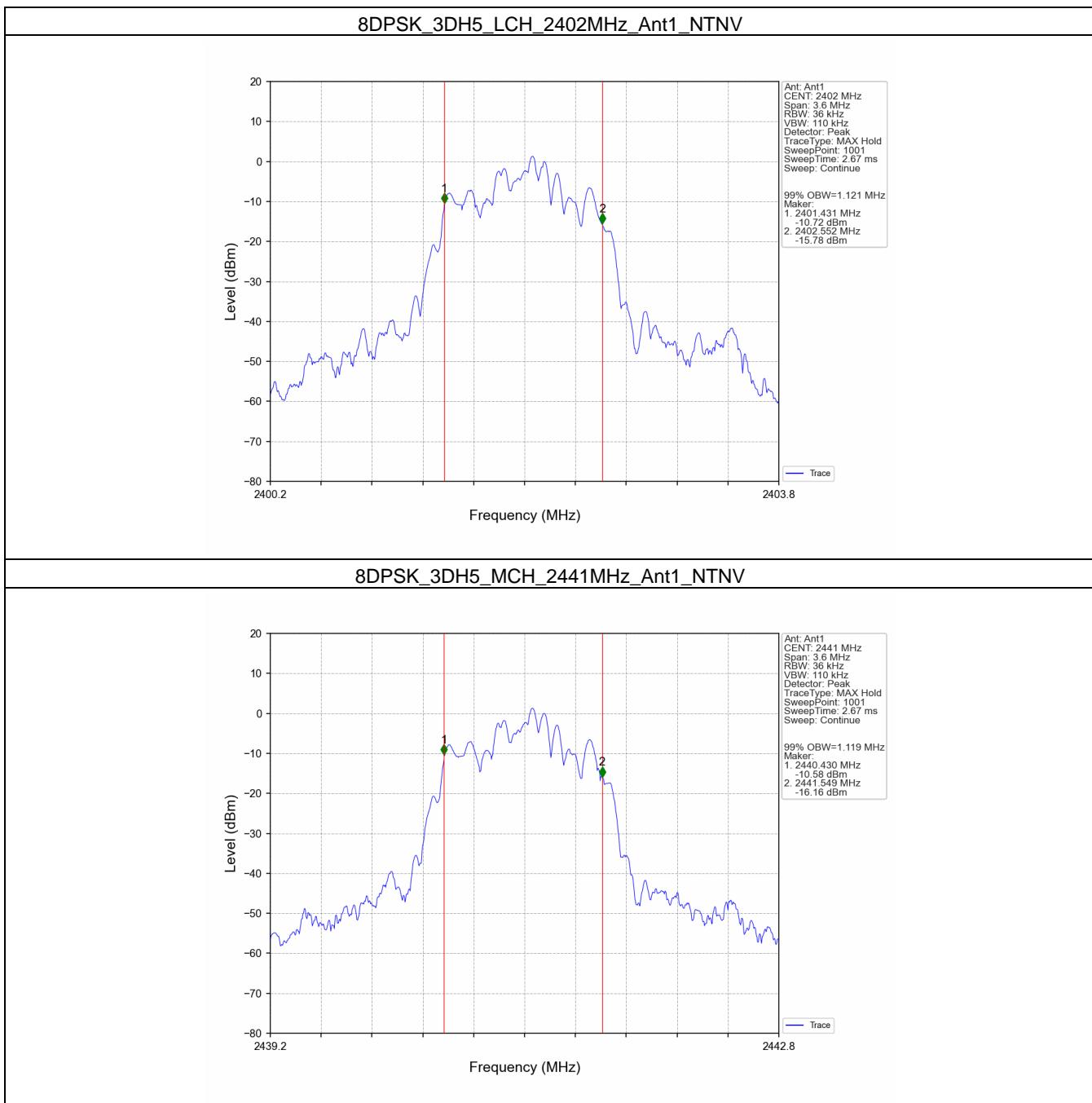
## 1.2 Test Graph

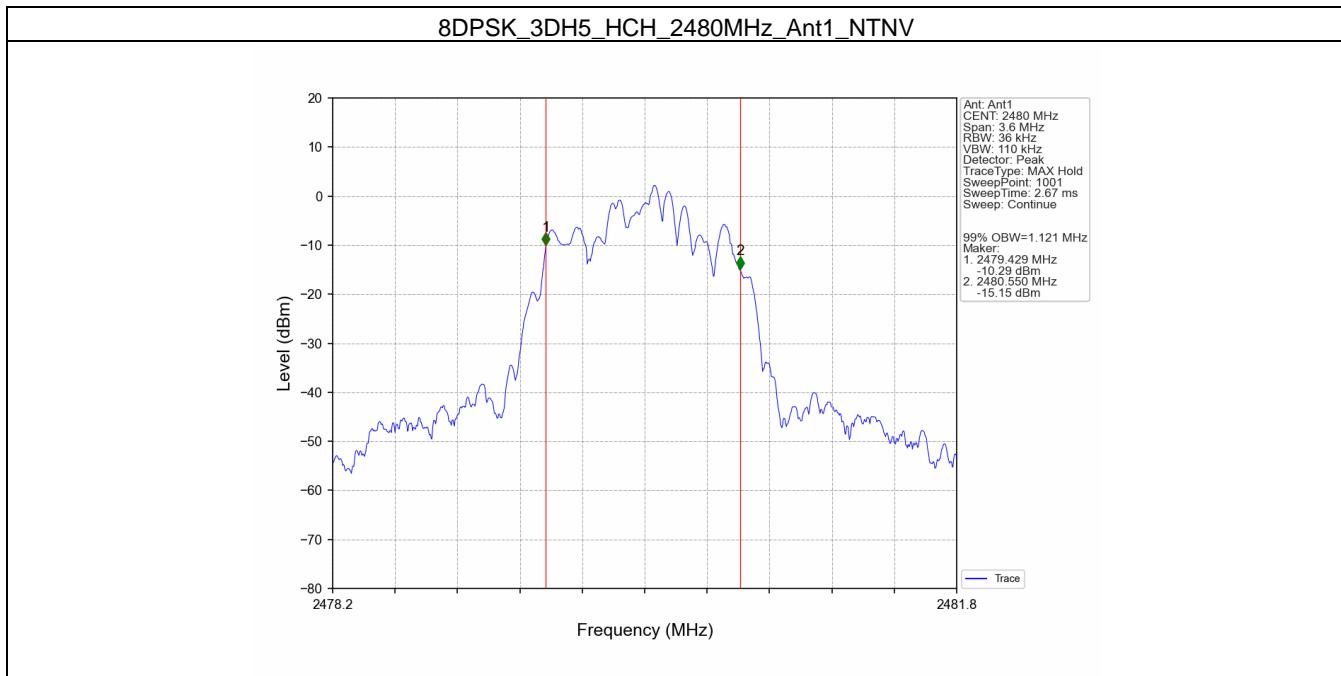
### 1.2.1 OBW



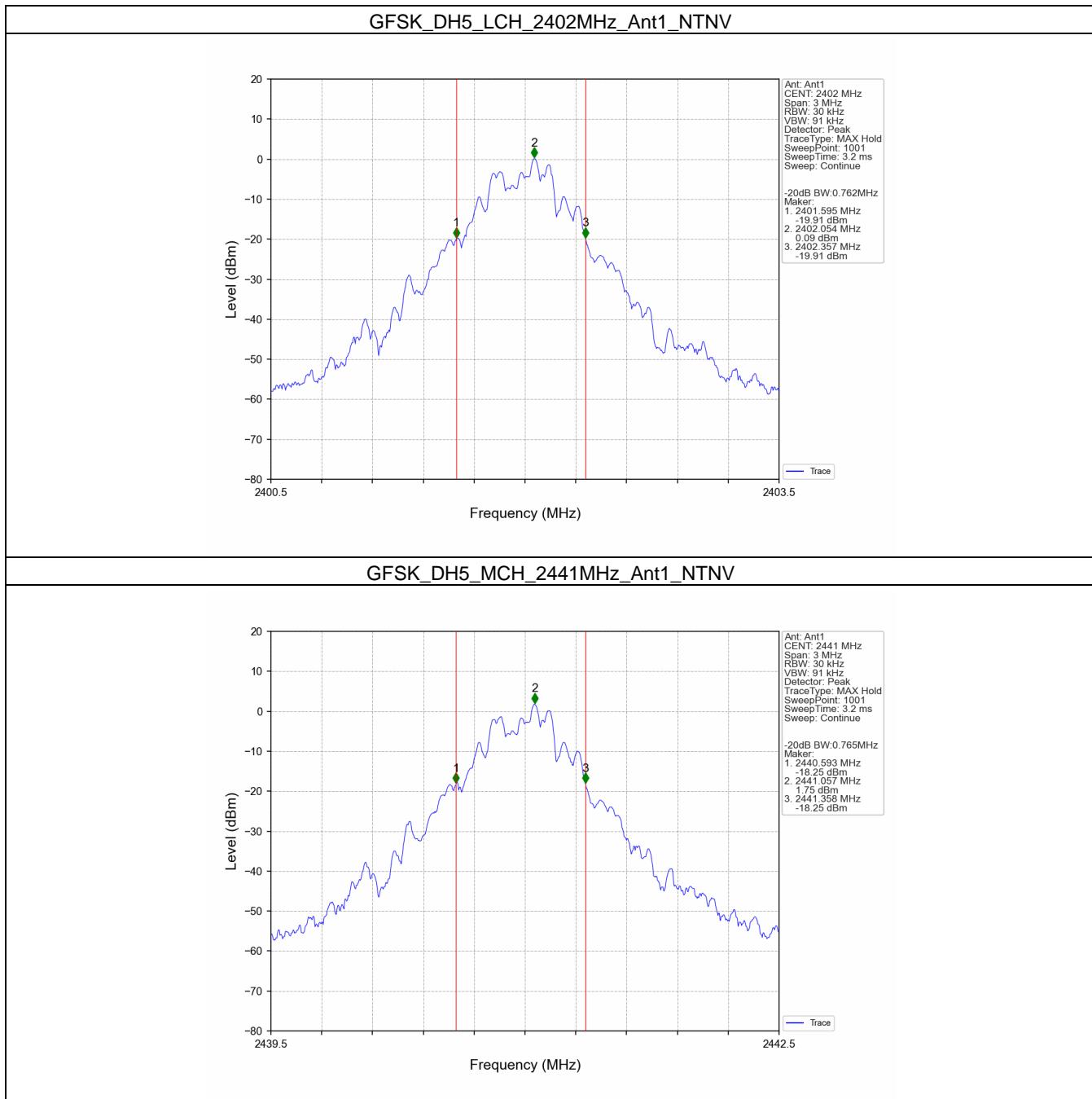


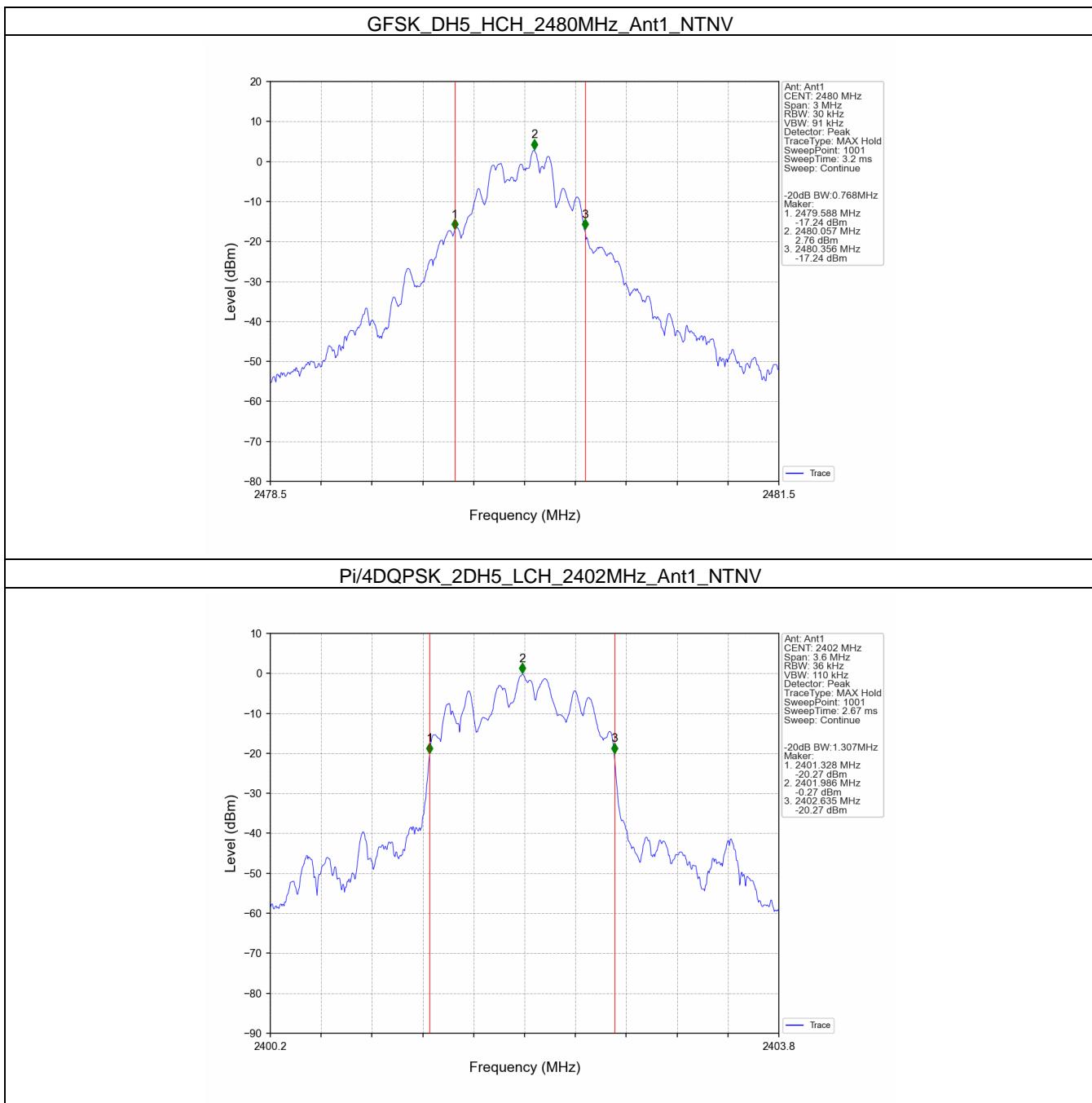


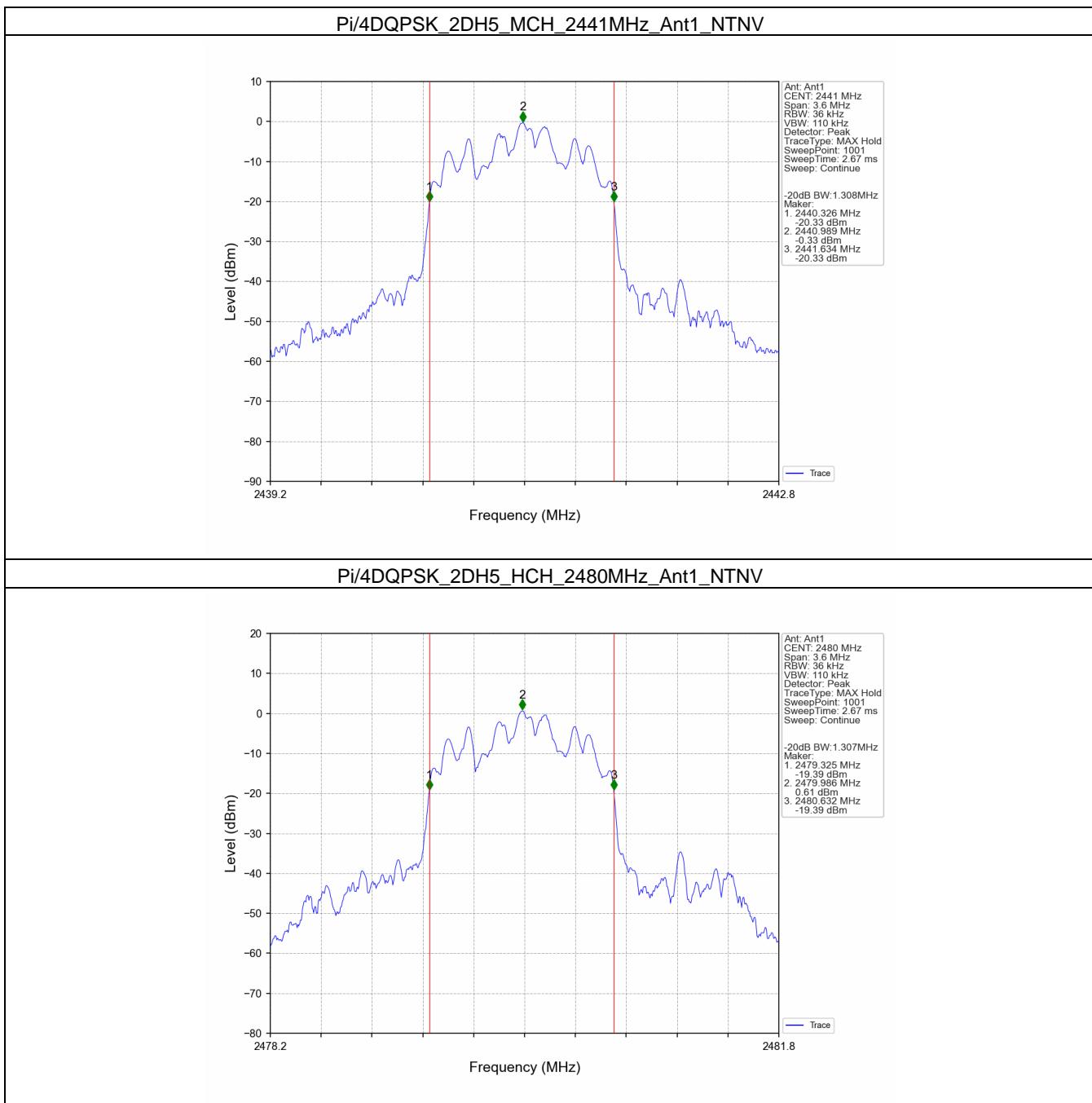


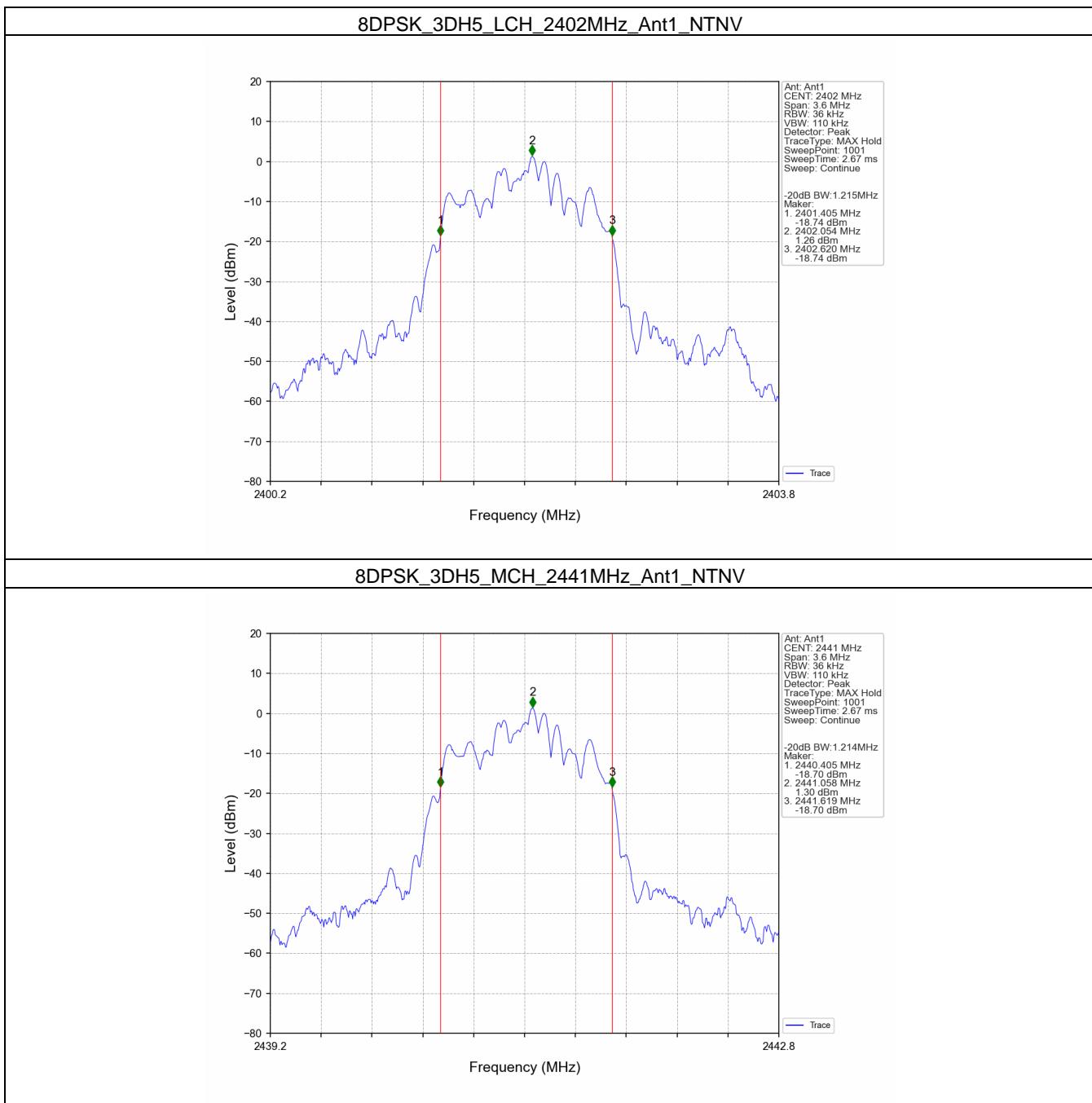


## 1.2.2 20dB BW







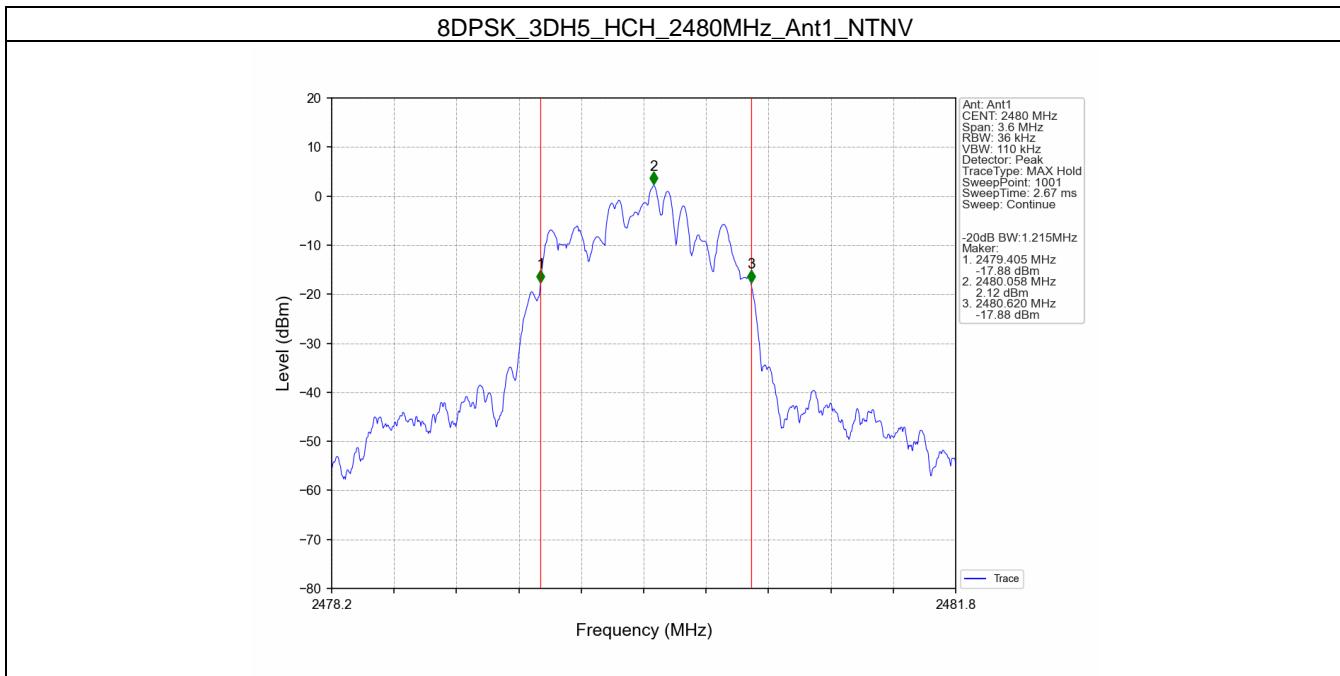


**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 54 of 93



## 2. Maximum Conducted Output Power

### 2.1 Test Result

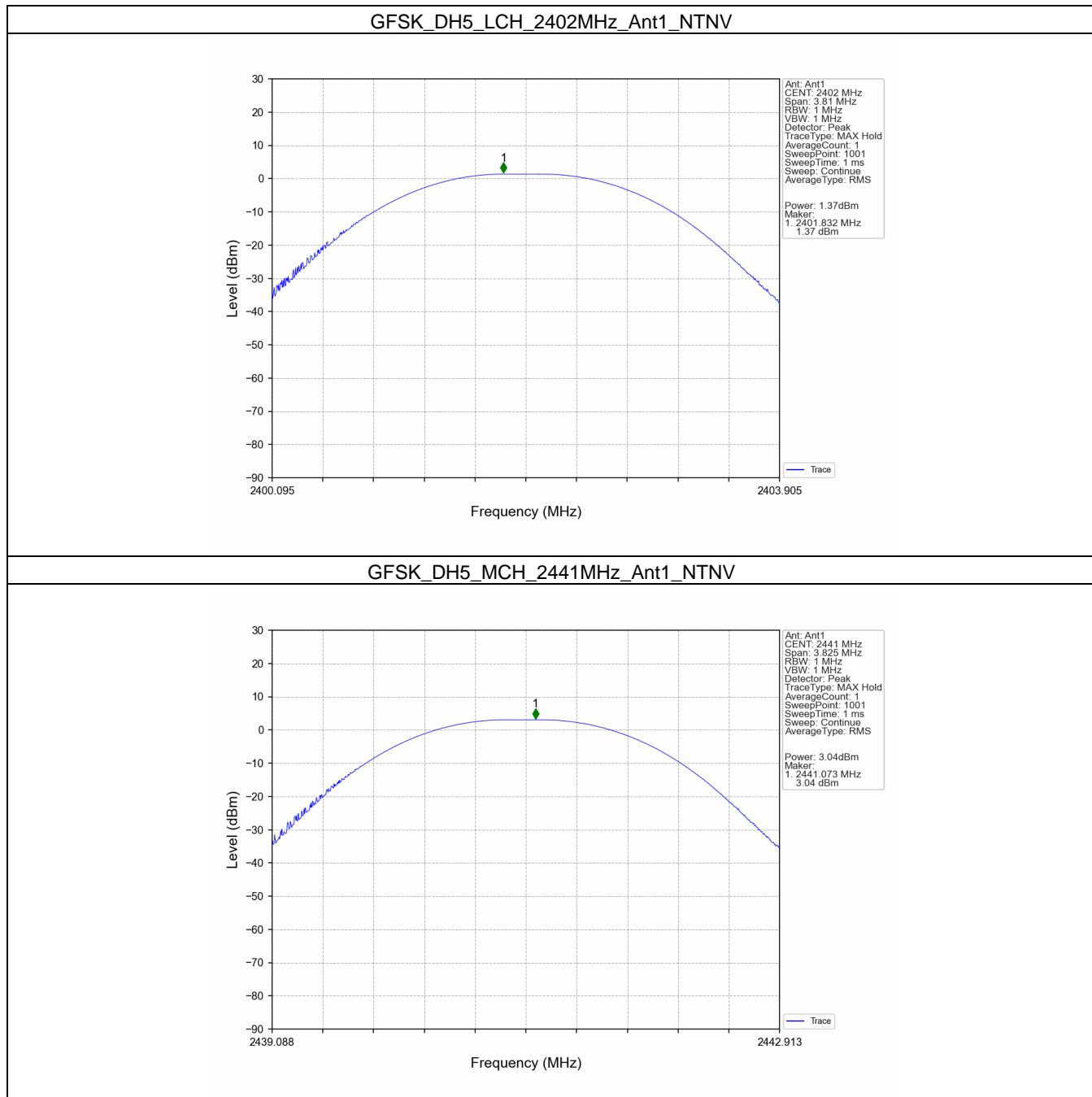
#### 2.1.1 Power

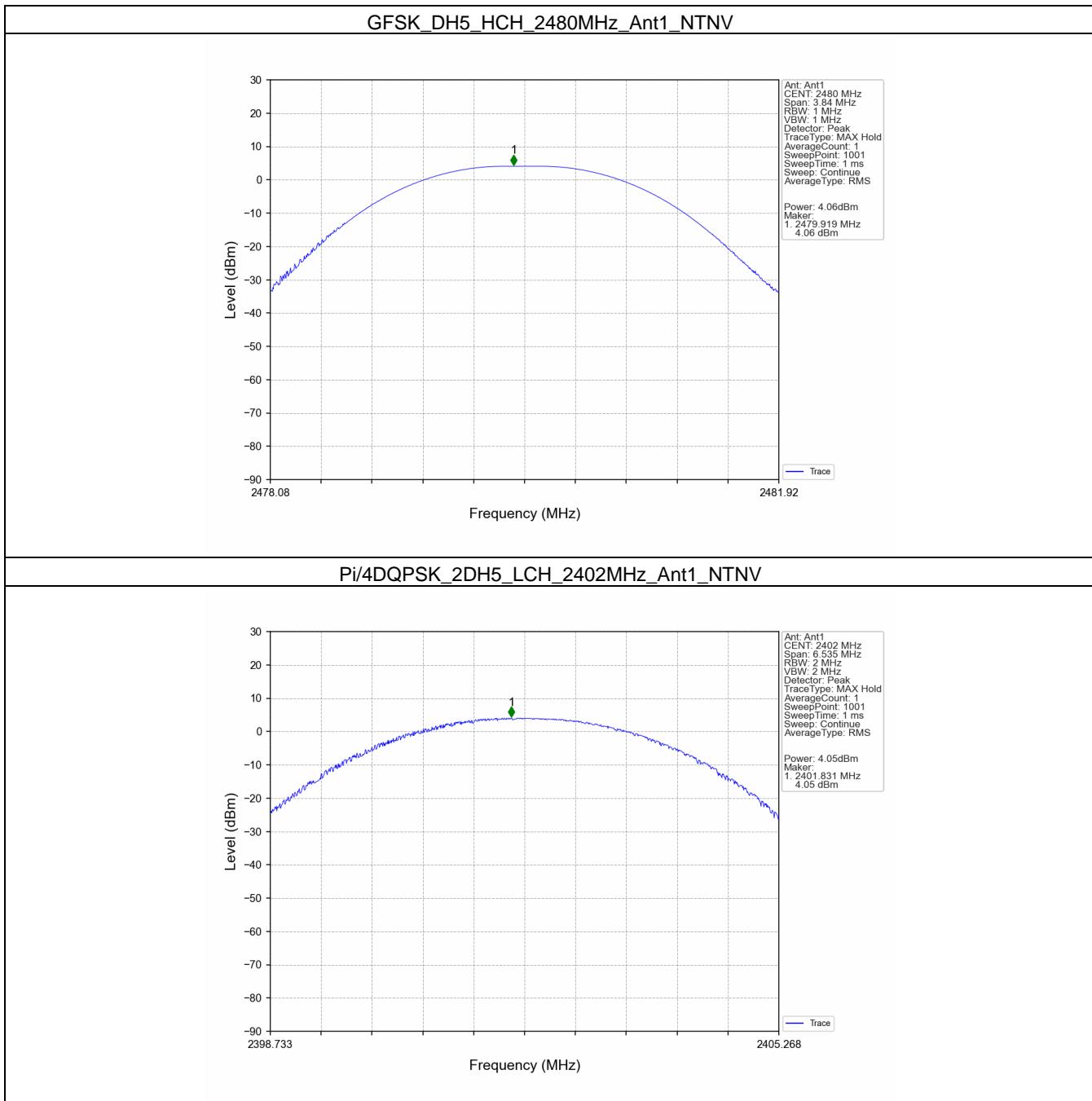
Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	1.37	<=30	Pass
		2441	DH5	3.04	<=30	Pass
		2480	DH5	4.06	<=30	Pass
Pi/4DQPSK	SISO	2402	2DH5	4.05	<=20.97	Pass
		2441	2DH5	4.06	<=20.97	Pass
		2480	2DH5	4.91	<=20.97	Pass
8DPSK	SISO	2402	3DH5	4.95	<=20.97	Pass
		2441	3DH5	4.90	<=20.97	Pass
		2480	3DH5	5.66	<=20.97	Pass

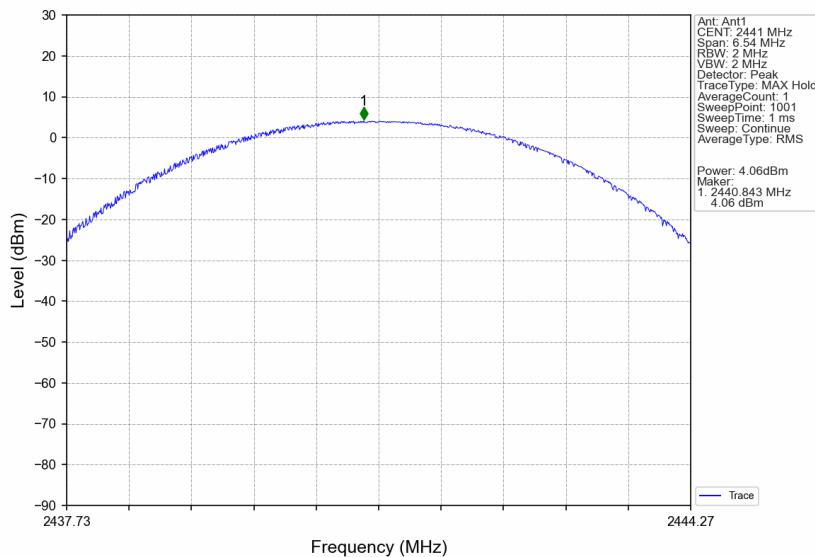
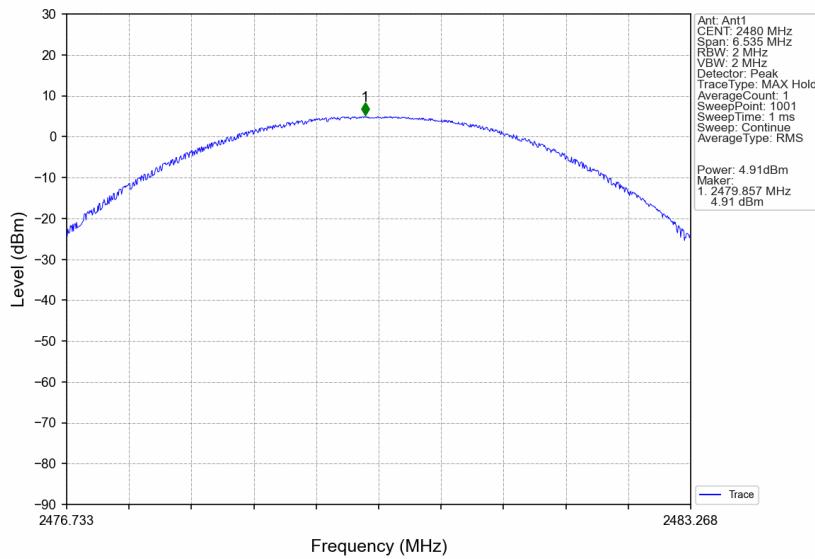
Note1: Antenna Gain: Ant1: 3.90dBi;

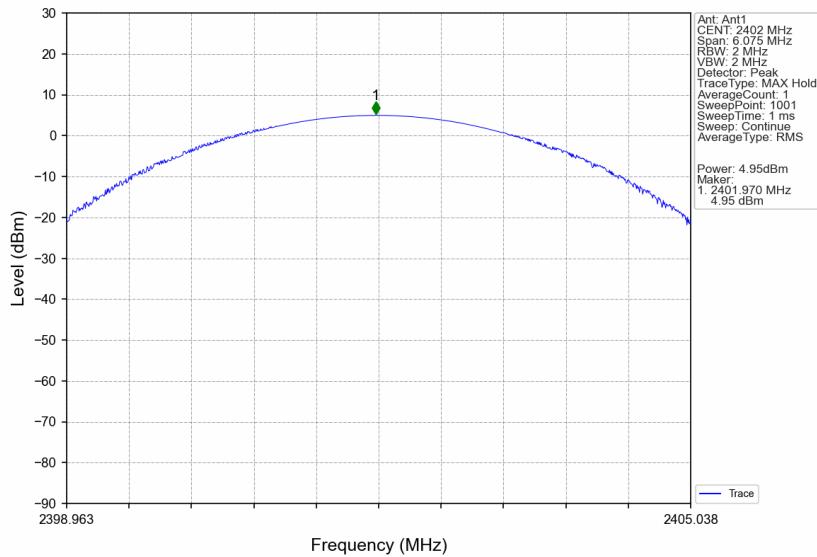
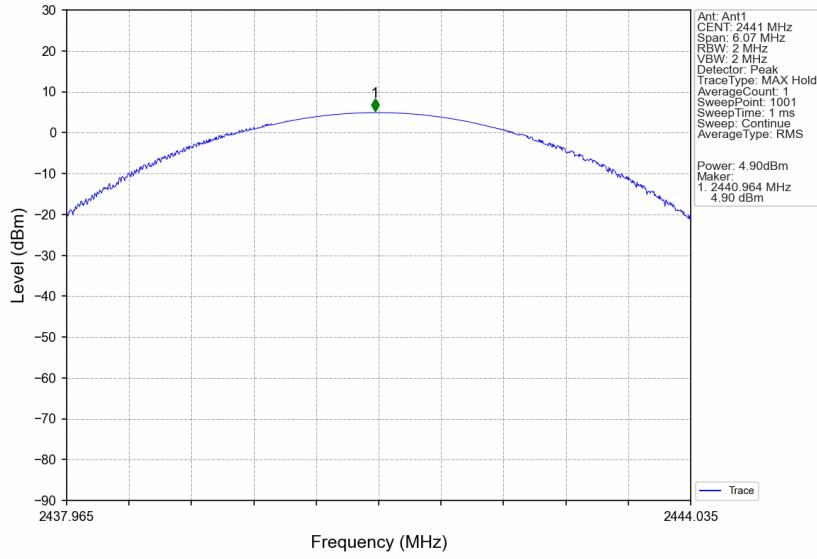
## 2.2 Test Graph

### 2.2.1 Power





**Pi/4DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV****Pi/4DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV**

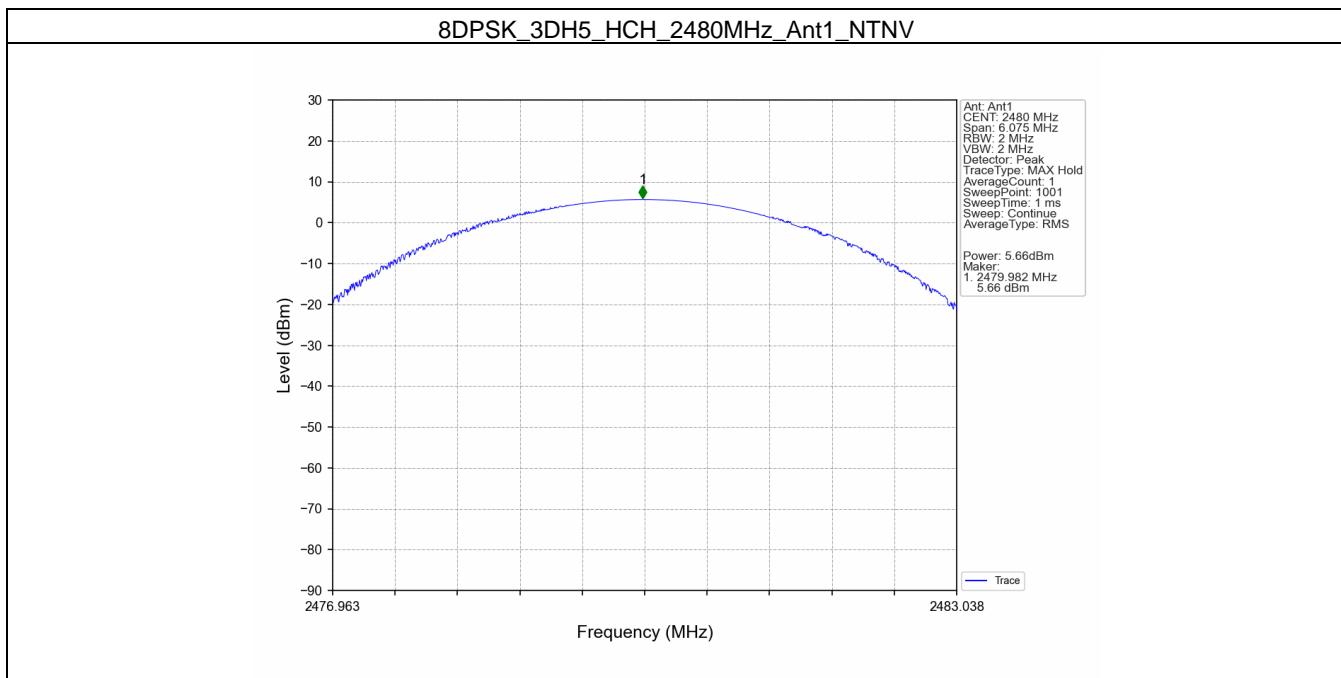
**8DPSK\_3DH5\_LCH\_2402MHz\_Ant1\_NTNV****8DPSK\_3DH5\_MCH\_2441MHz\_Ant1\_NTNV**

**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 60 of 93



### 3. Carrier Frequency Separation

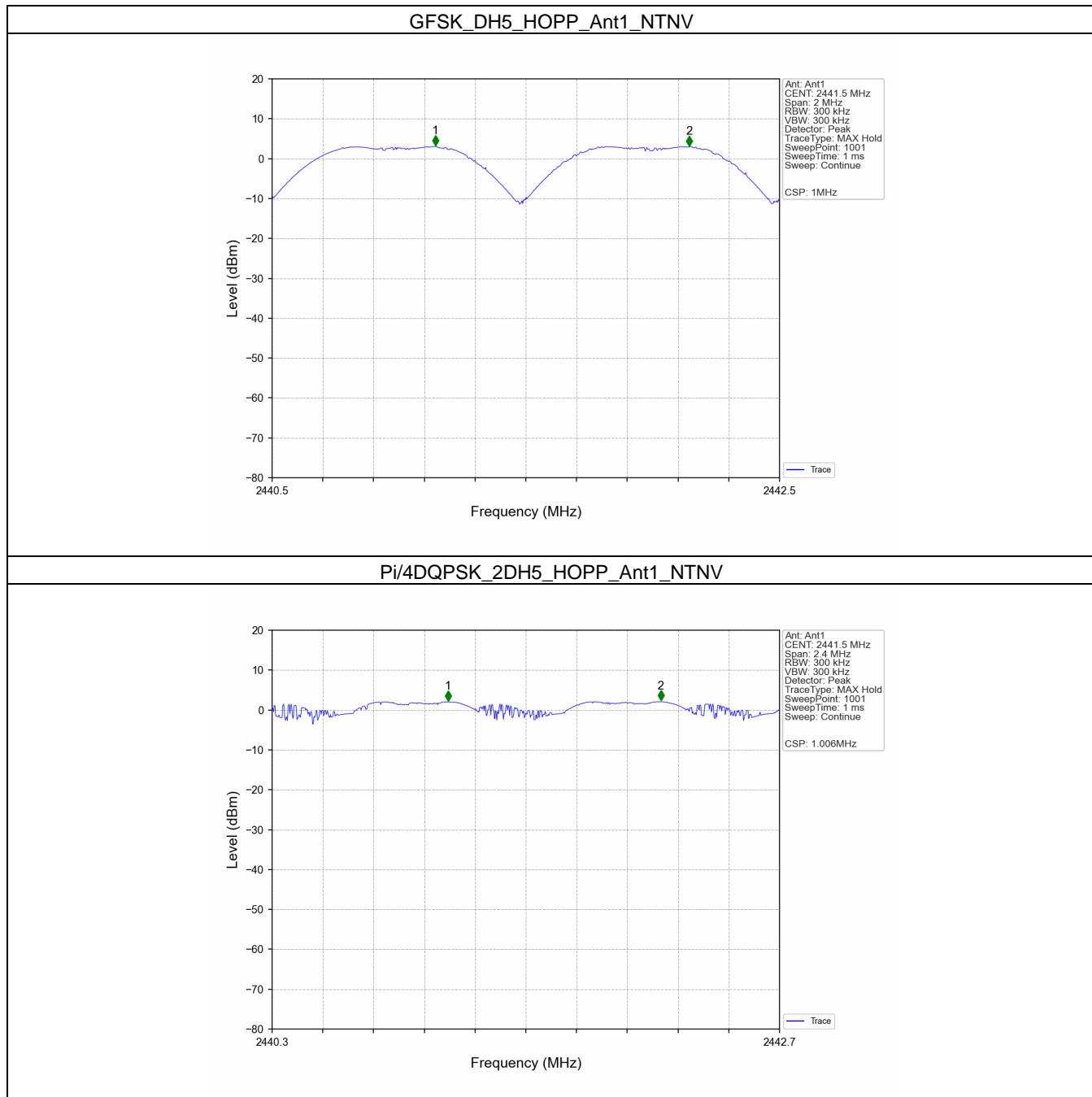
#### 3.1 Test Result

##### 3.1.1 Ant1

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.000	0.768	>=0.768	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.006	1.308	>=0.872	Pass
8DPSK	SISO	HOPP	3DH5	1.003	1.215	>=0.81	Pass

## 3.2 Test Graph

### 3.2.1 Ant1

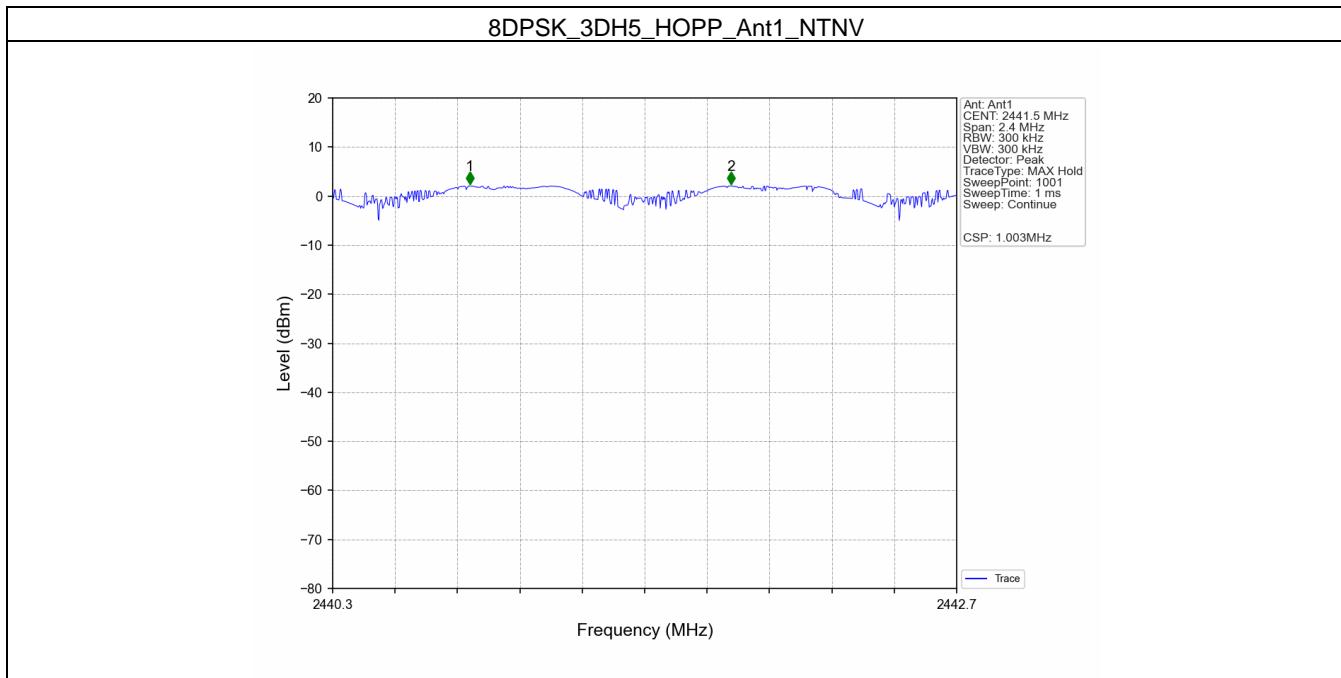


**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 63 of 93



## 4. Number of Hopping Frequencies

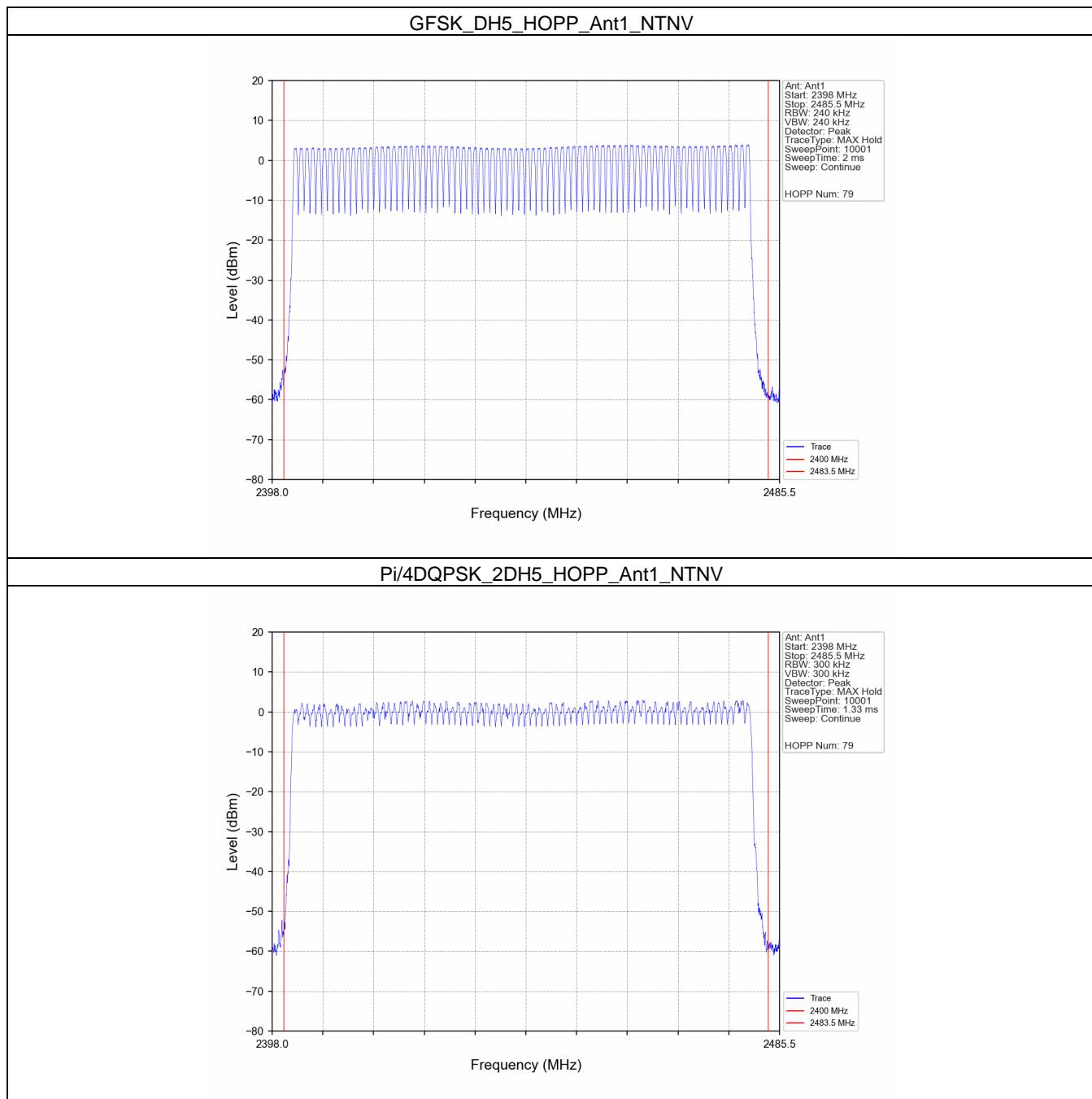
### 4.1 Test Result

#### 4.1.1 HoppNum

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

## 4.2 Test Graph

### 4.2.1 HoppNum

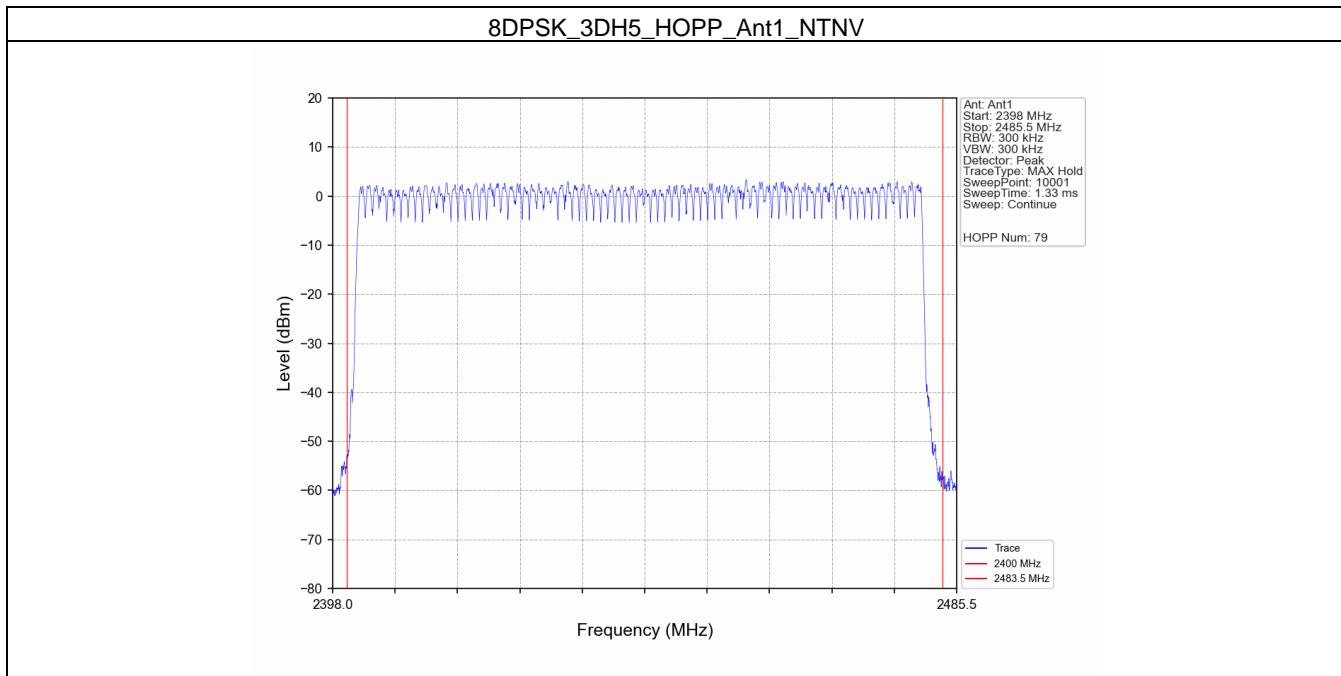


**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240900173202

Page: 66 of 93



## 5. Time of Occupancy (Dwell Time)

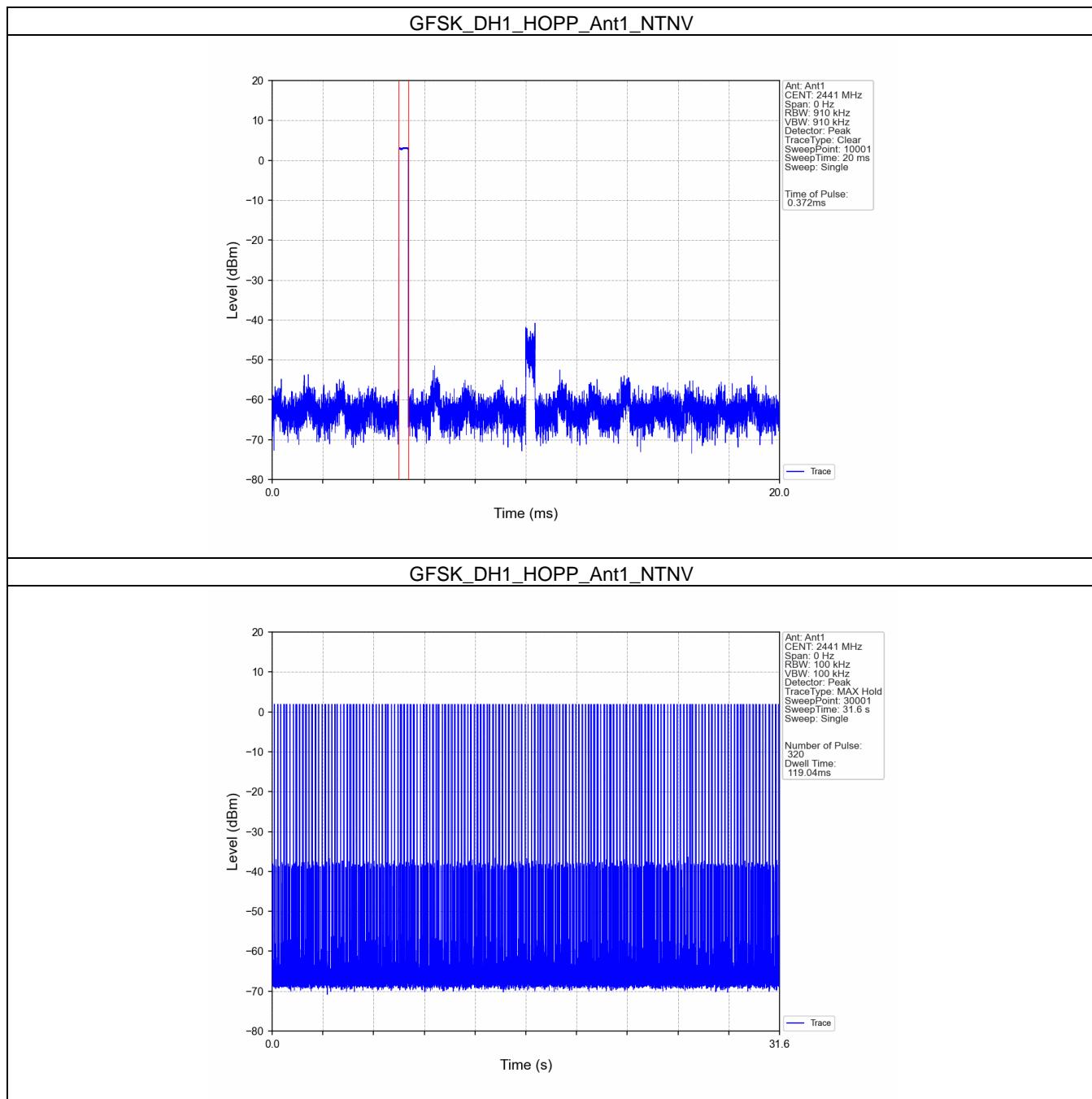
### 5.1 Test Result

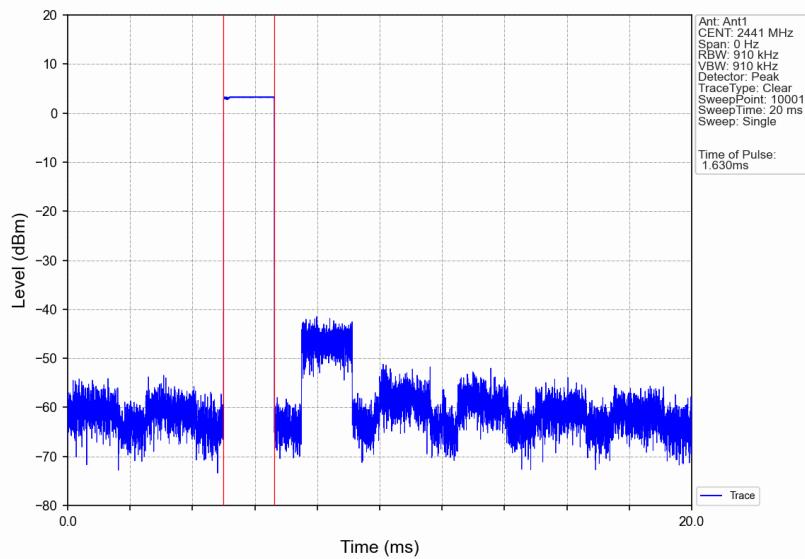
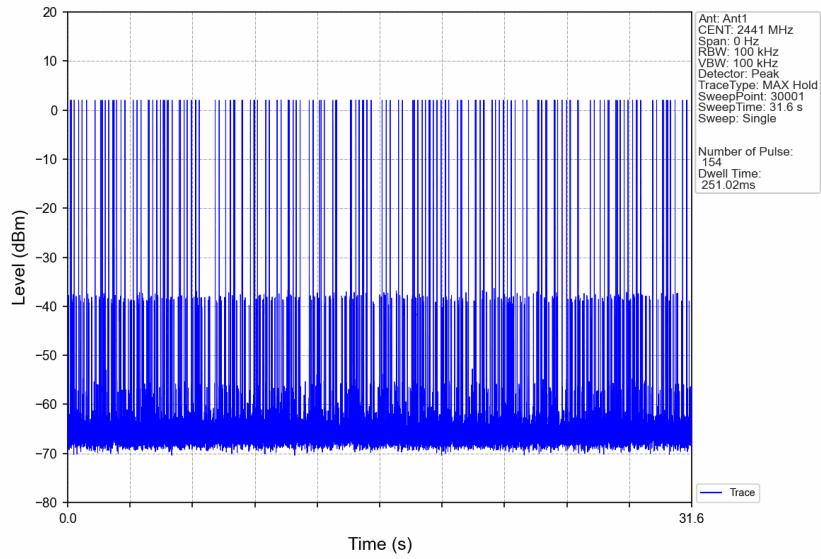
#### 5.1.1 Ant1

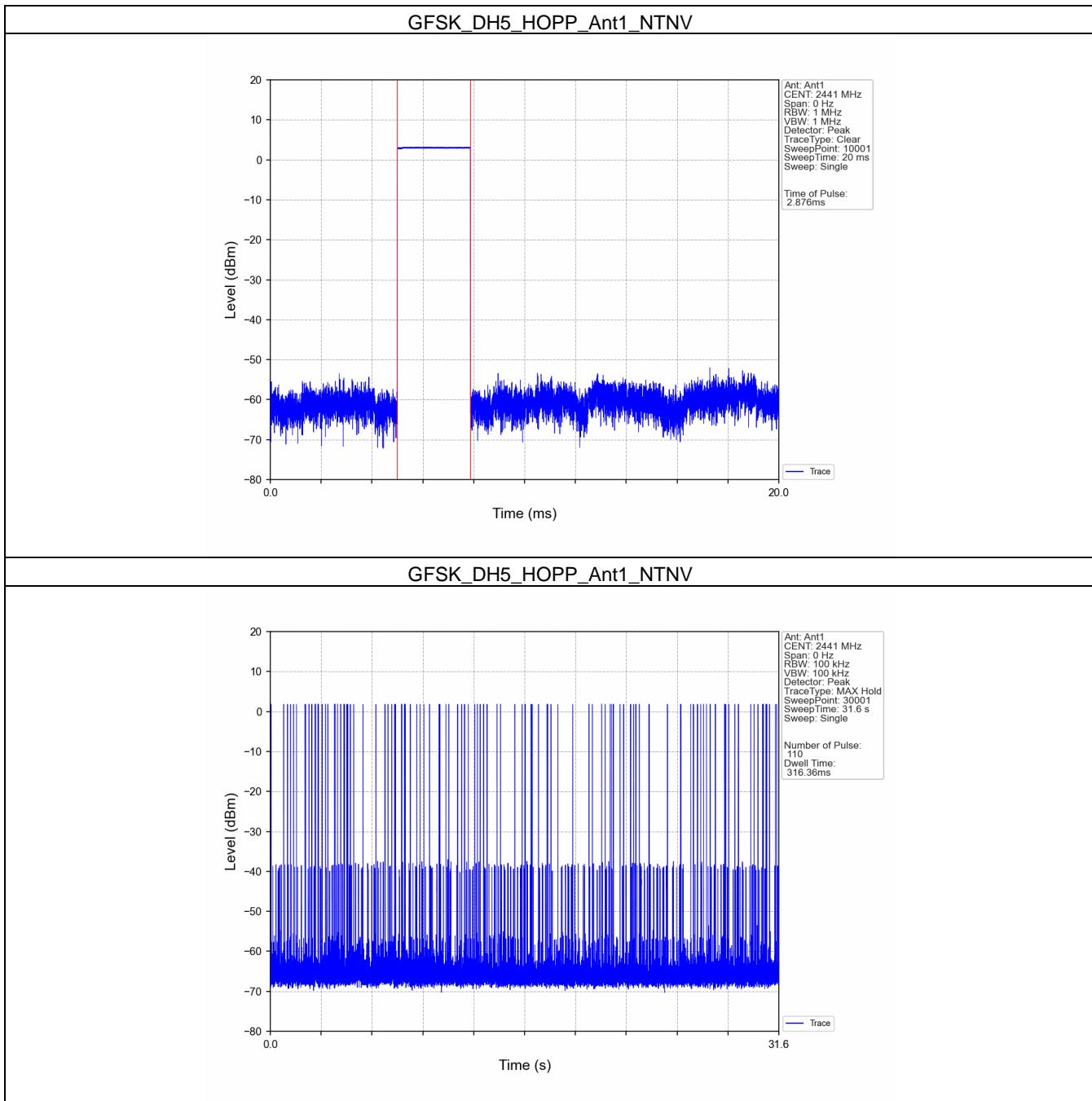
Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.372	31.600	320	119.040	<=400	Pass
			DH3	1.630	31.600	154	251.020	<=400	Pass
			DH5	2.876	31.600	110	316.360	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.380	31.600	321	121.980	<=400	Pass
			2DH3	1.634	31.600	160	261.440	<=400	Pass
			2DH5	2.884	31.600	113	325.892	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.380	31.600	320	121.600	<=400	Pass
			3DH3	1.634	31.600	159	259.806	<=400	Pass
			3DH5	2.886	31.600	101	291.486	<=400	Pass

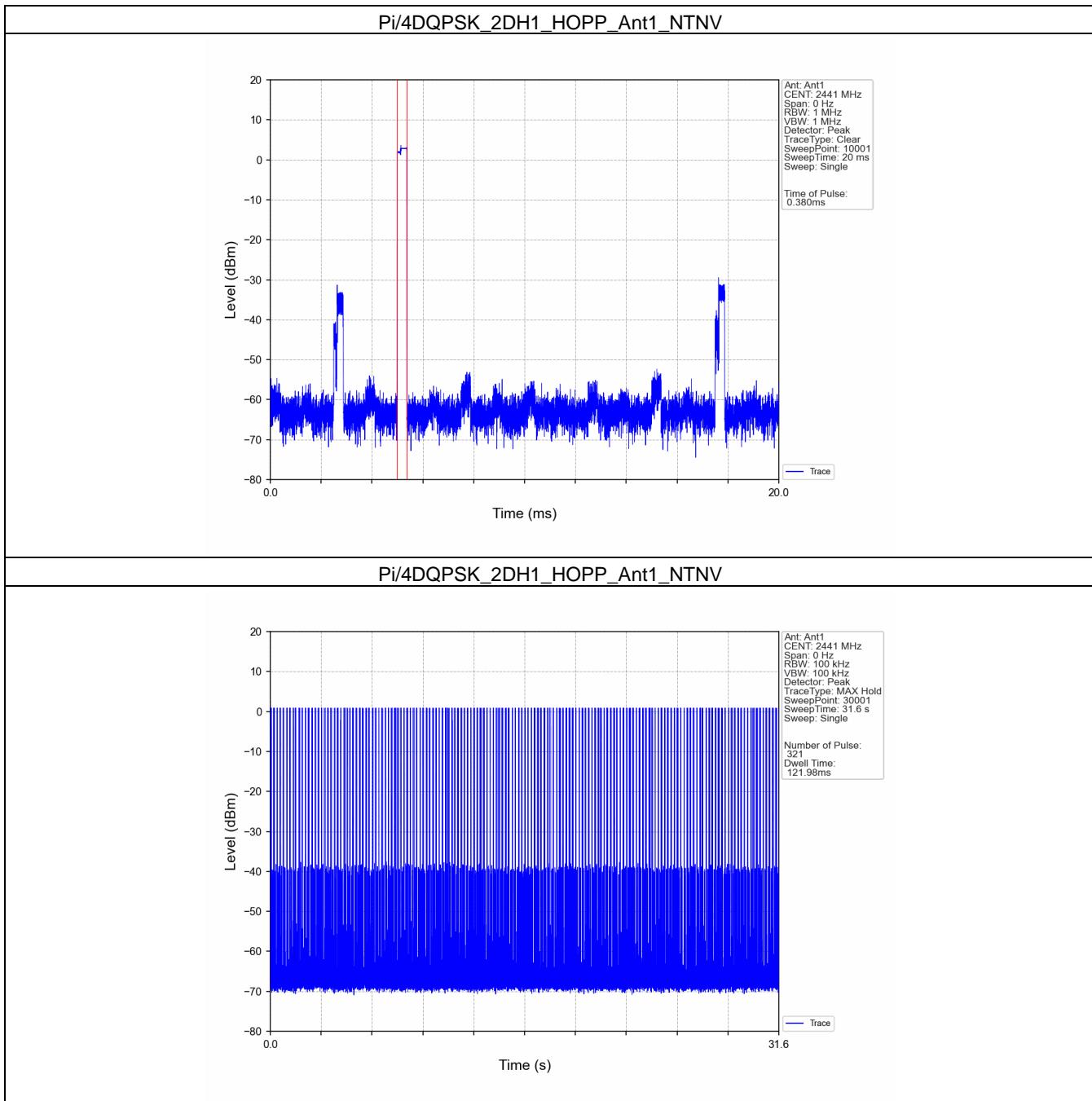
## 5.2 Test Graph

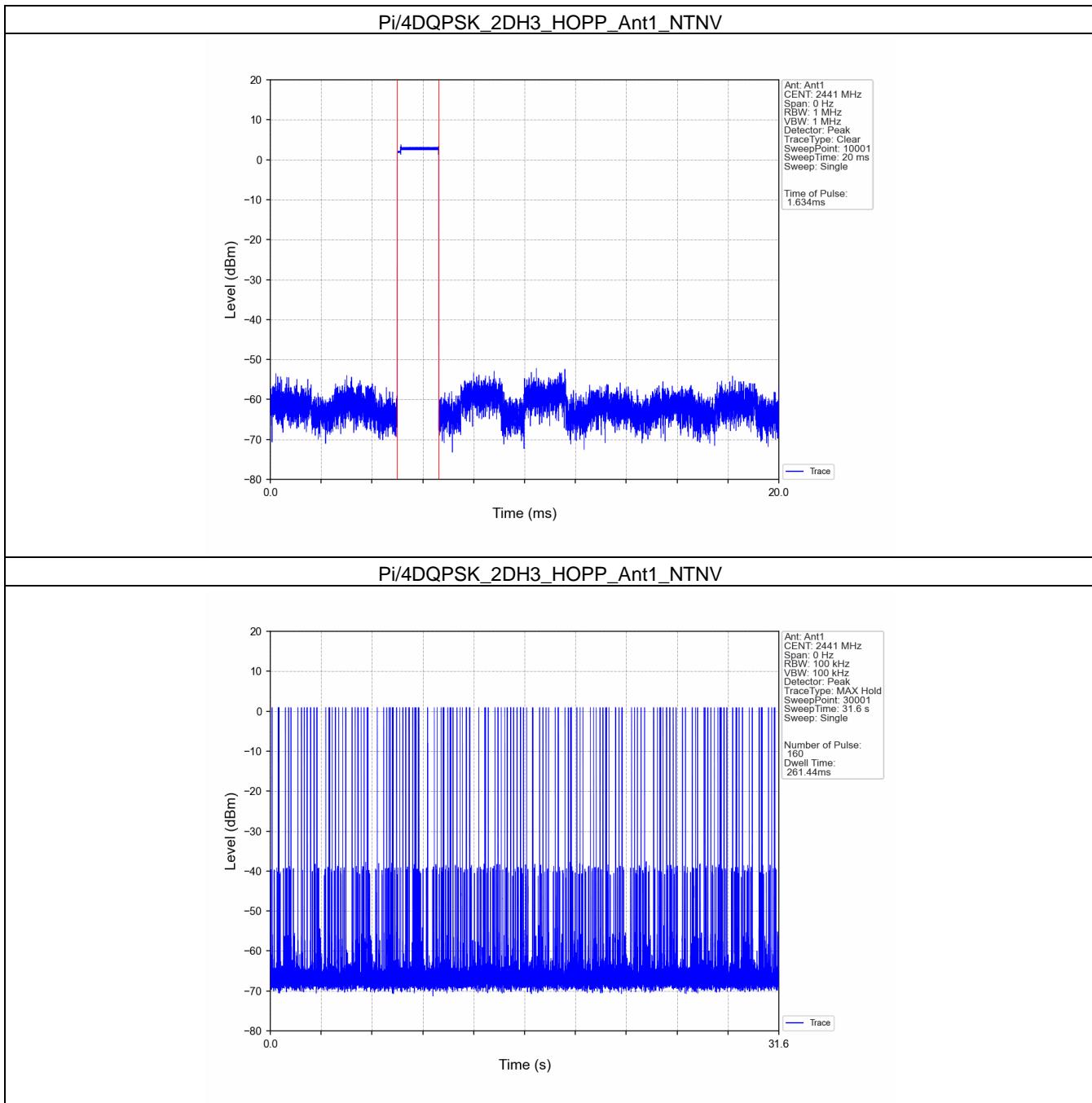
### 5.2.1 Ant1

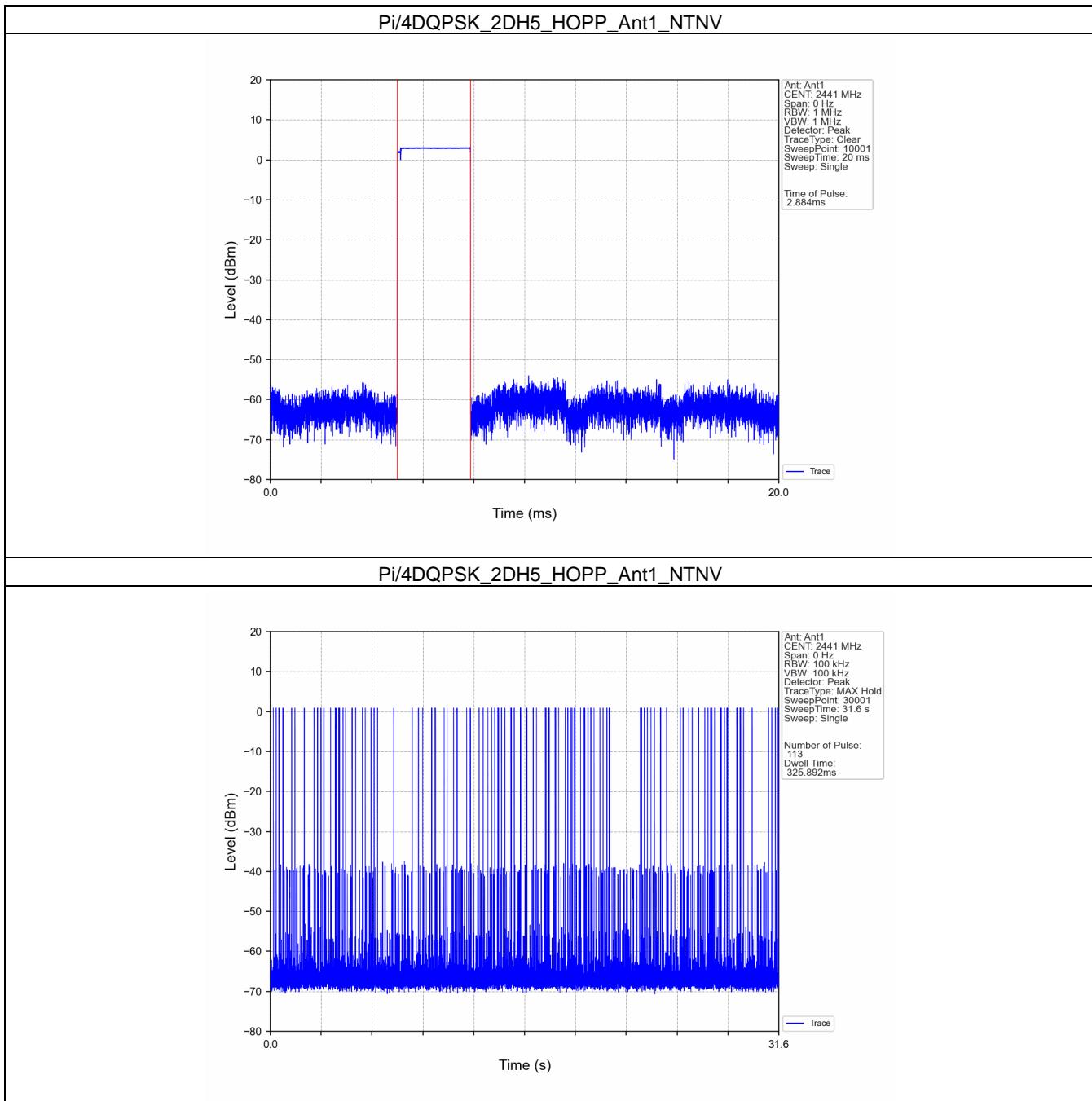


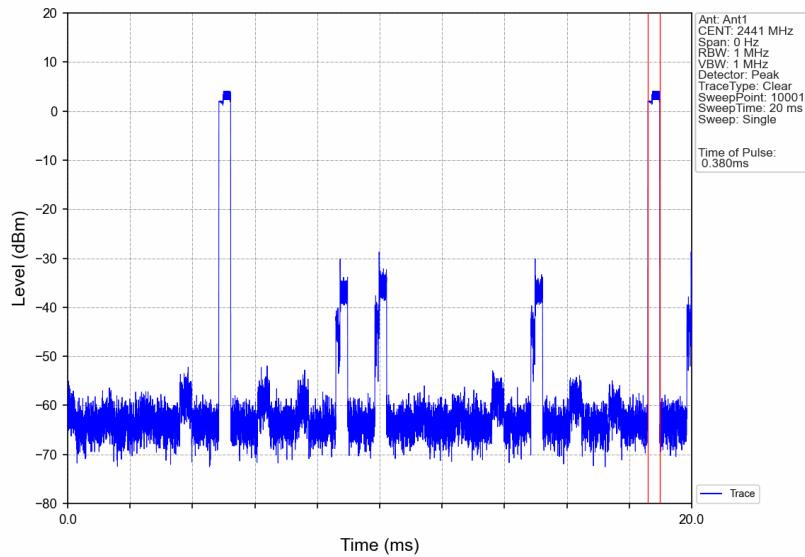
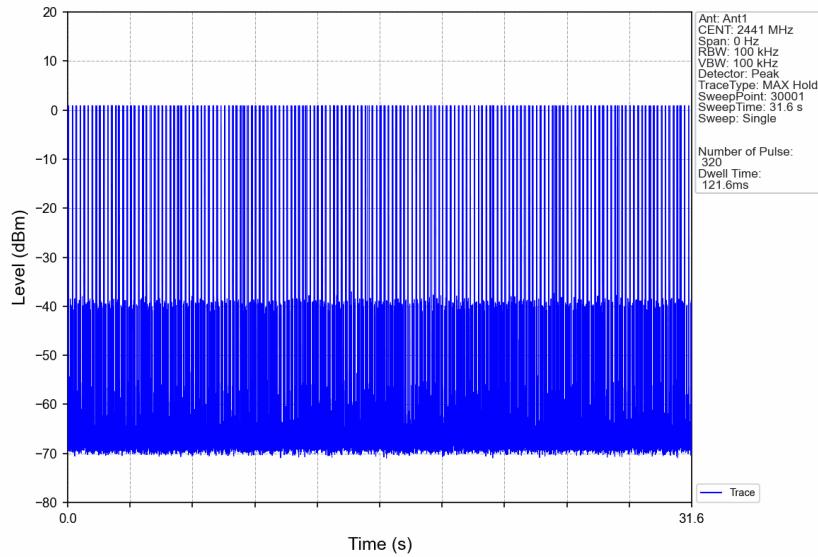
**GFSK\_DH3\_HOPP\_Ant1\_NTNV****GFSK\_DH3\_HOPP\_Ant1\_NTNV**

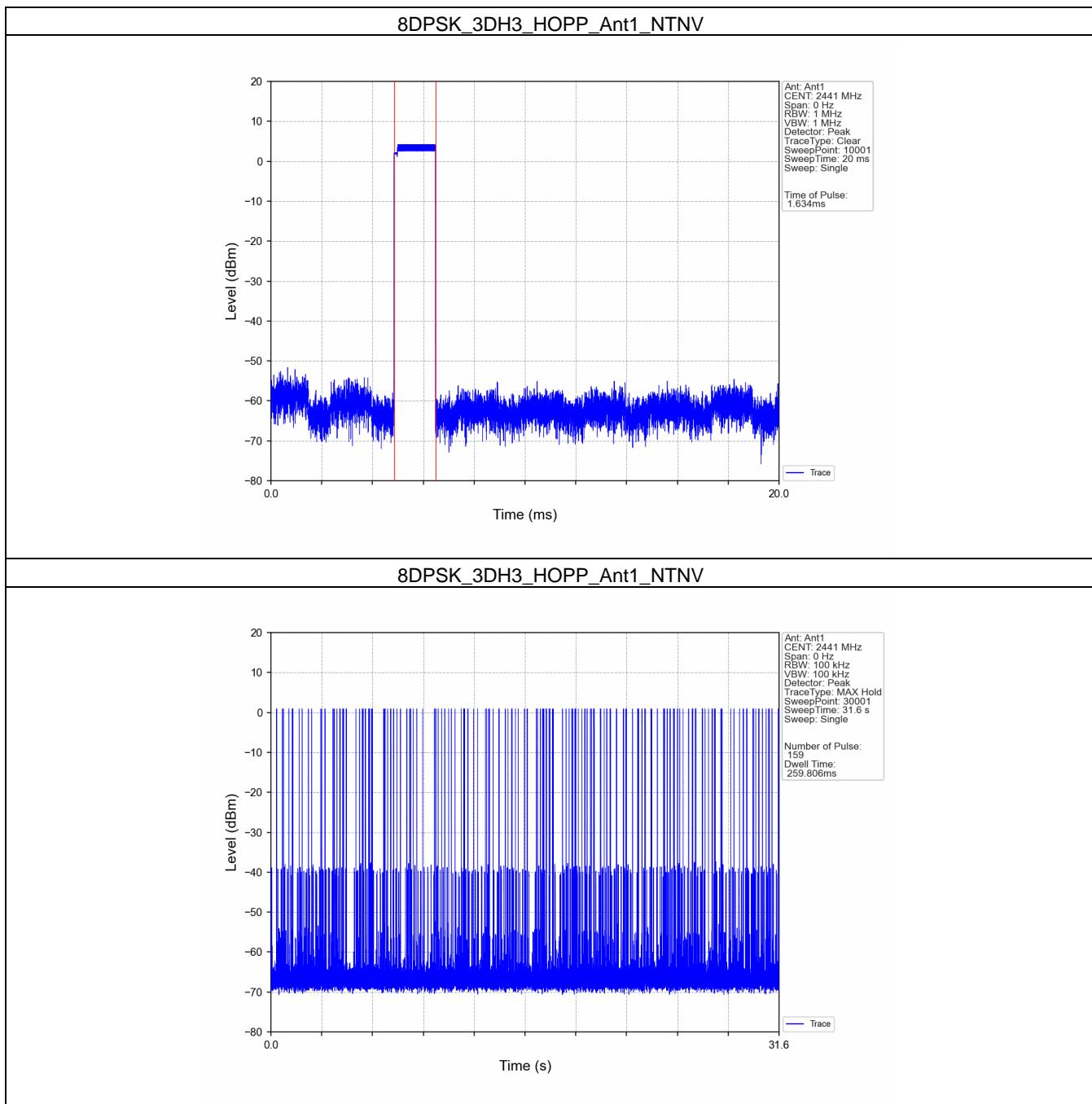


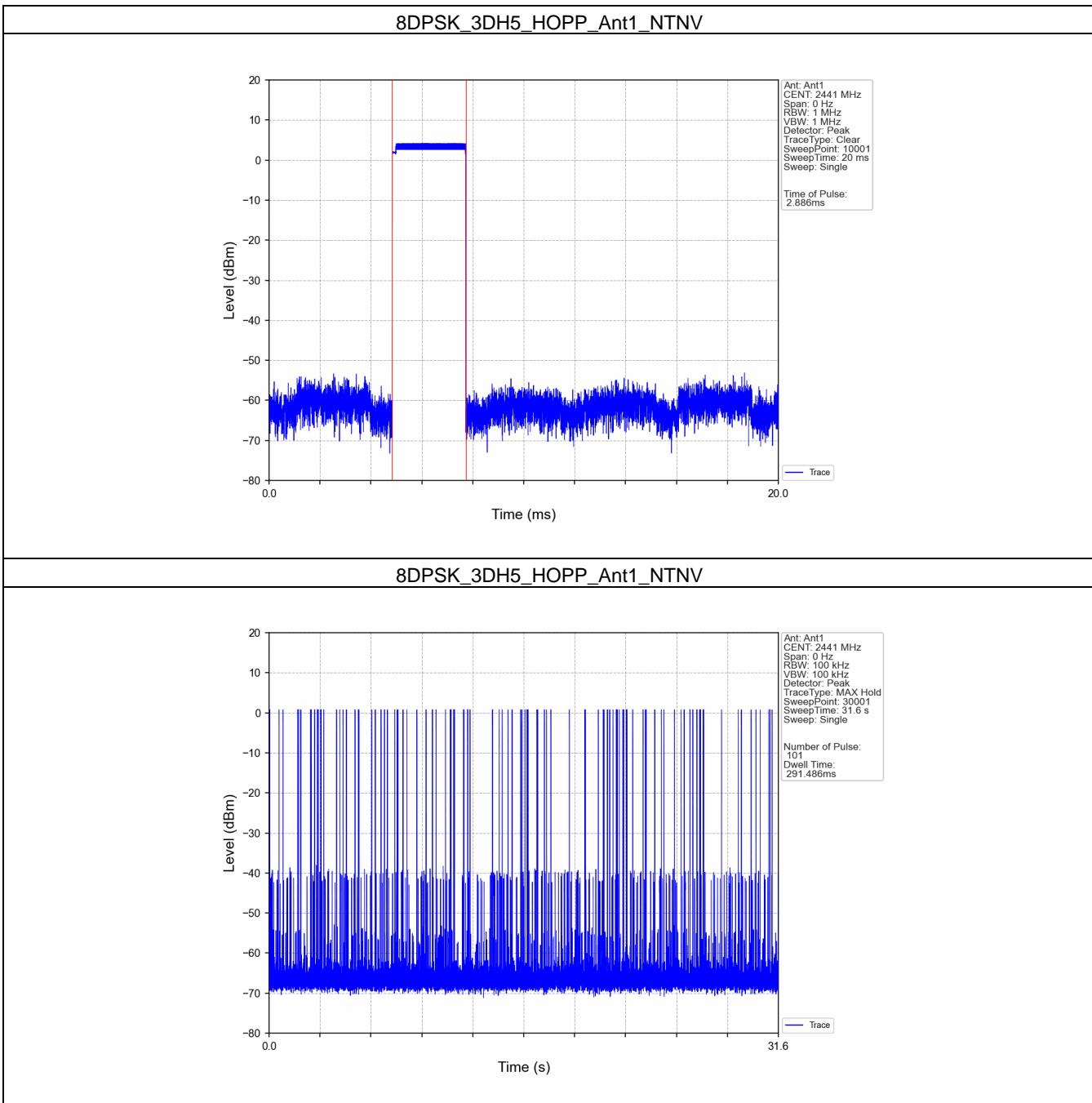






**8DPSK\_3DH1\_HOPP\_Ant1\_NTNV****8DPSK\_3DH1\_HOPP\_Ant1\_NTNV**





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

### 6.1 Test Result

#### 6.1.1 Ref

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	1.18
		2441	DH5	1	2.89
		2480	DH5	1	3.92
Pi/4DQPSK	SISO	2402	2DH5	1	1.87
		2441	2DH5	1	1.95
		2480	2DH5	1	2.93
8DPSK	SISO	2402	3DH5	1	2.00
		2441	3DH5	1	1.52
		2480	3DH5	1	2.94

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

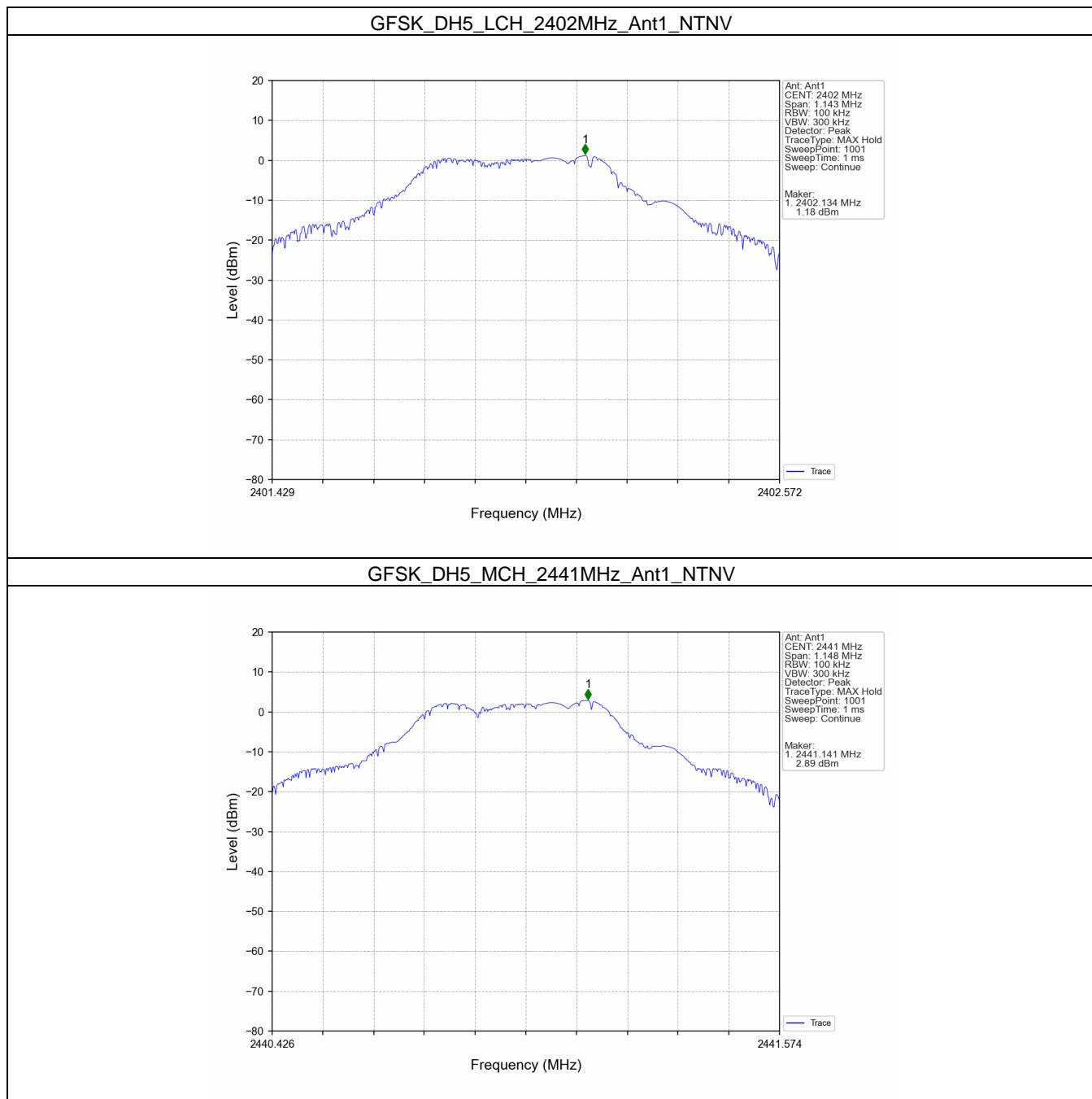
#### 6.1.2 CSE

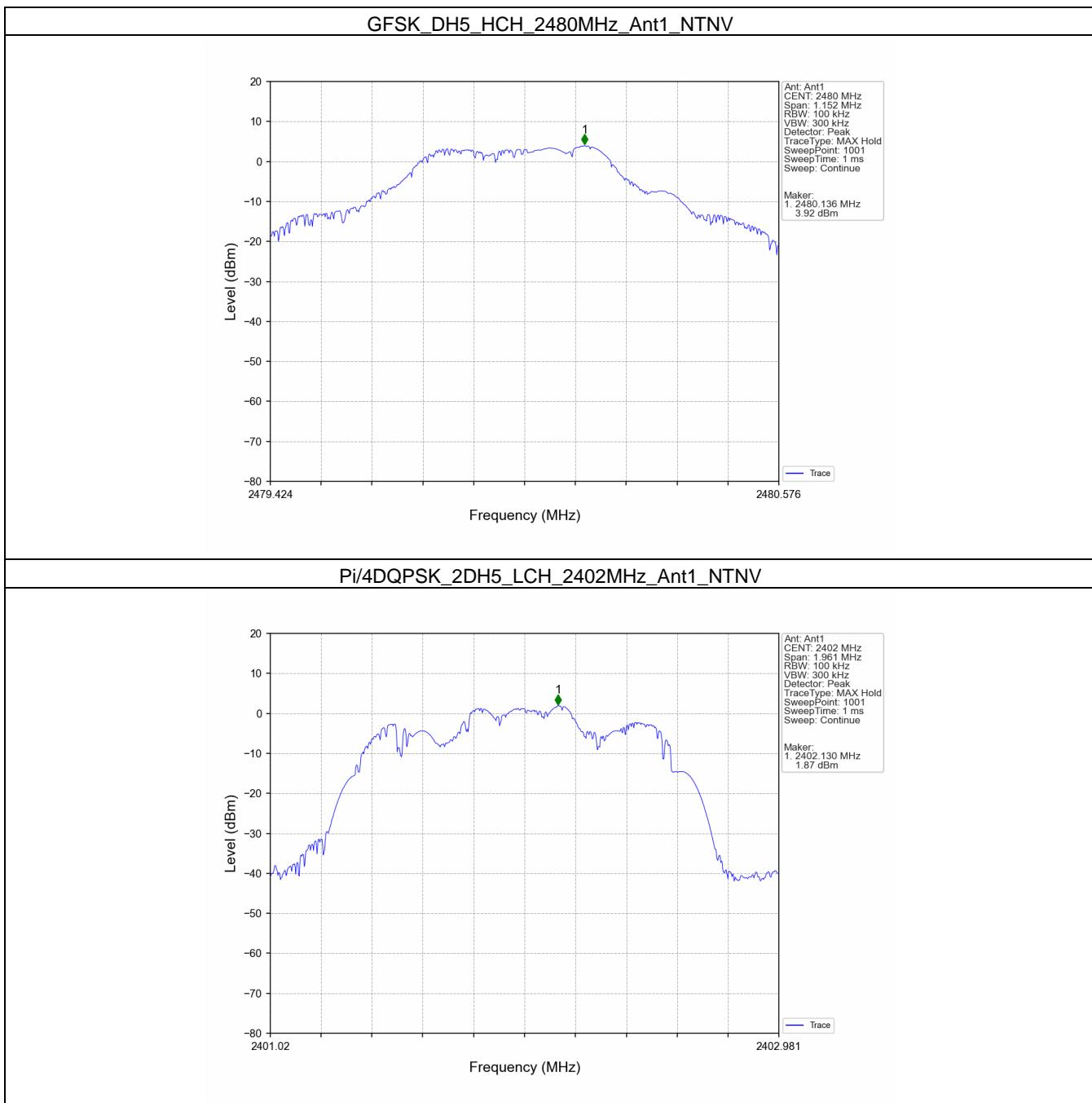
Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	3.92	-16.08	Pass
		2441	DH5	1	3.92	-16.08	Pass
		2480	DH5	1	3.92	-16.08	Pass
		HOPP	DH5	1	3.92	-16.08	Pass
					3.92	-16.08	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	2.93	-17.07	Pass
		2441	2DH5	1	2.93	-17.07	Pass
		2480	2DH5	1	2.93	-17.07	Pass
		HOPP	2DH5	1	2.93	-17.07	Pass
					2.93	-17.07	Pass
8DPSK	SISO	2402	3DH5	1	2.94	-17.06	Pass
		2441	3DH5	1	2.94	-17.06	Pass
		2480	3DH5	1	2.94	-17.06	Pass
		HOPP	3DH5	1	2.94	-17.06	Pass
					2.94	-17.06	Pass

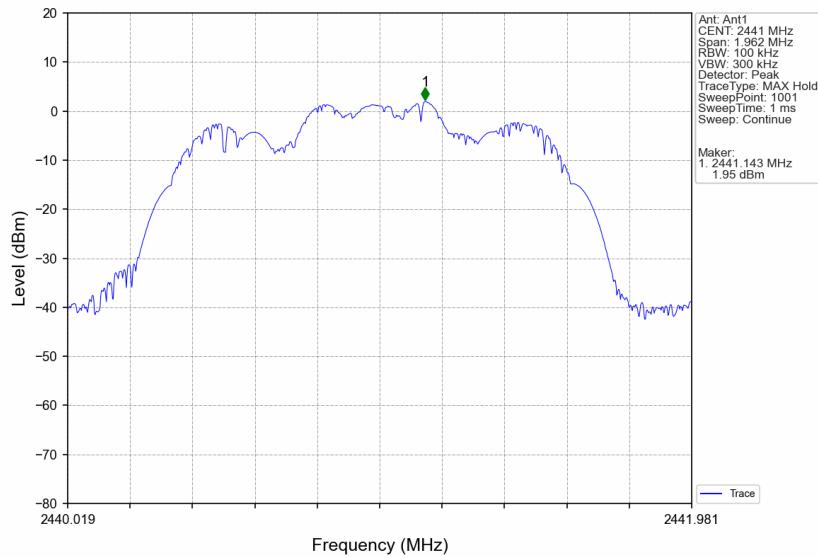
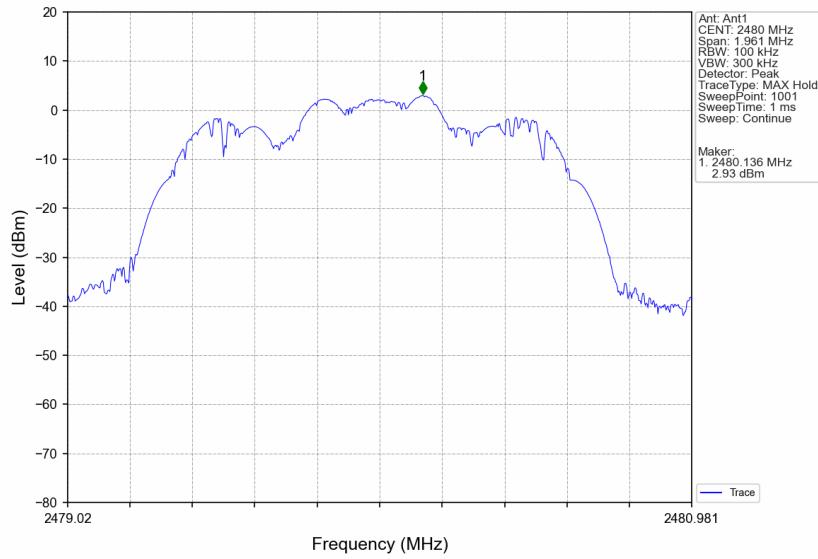
Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.

## 6.2 Test Graph

### 6.2.1 Ref





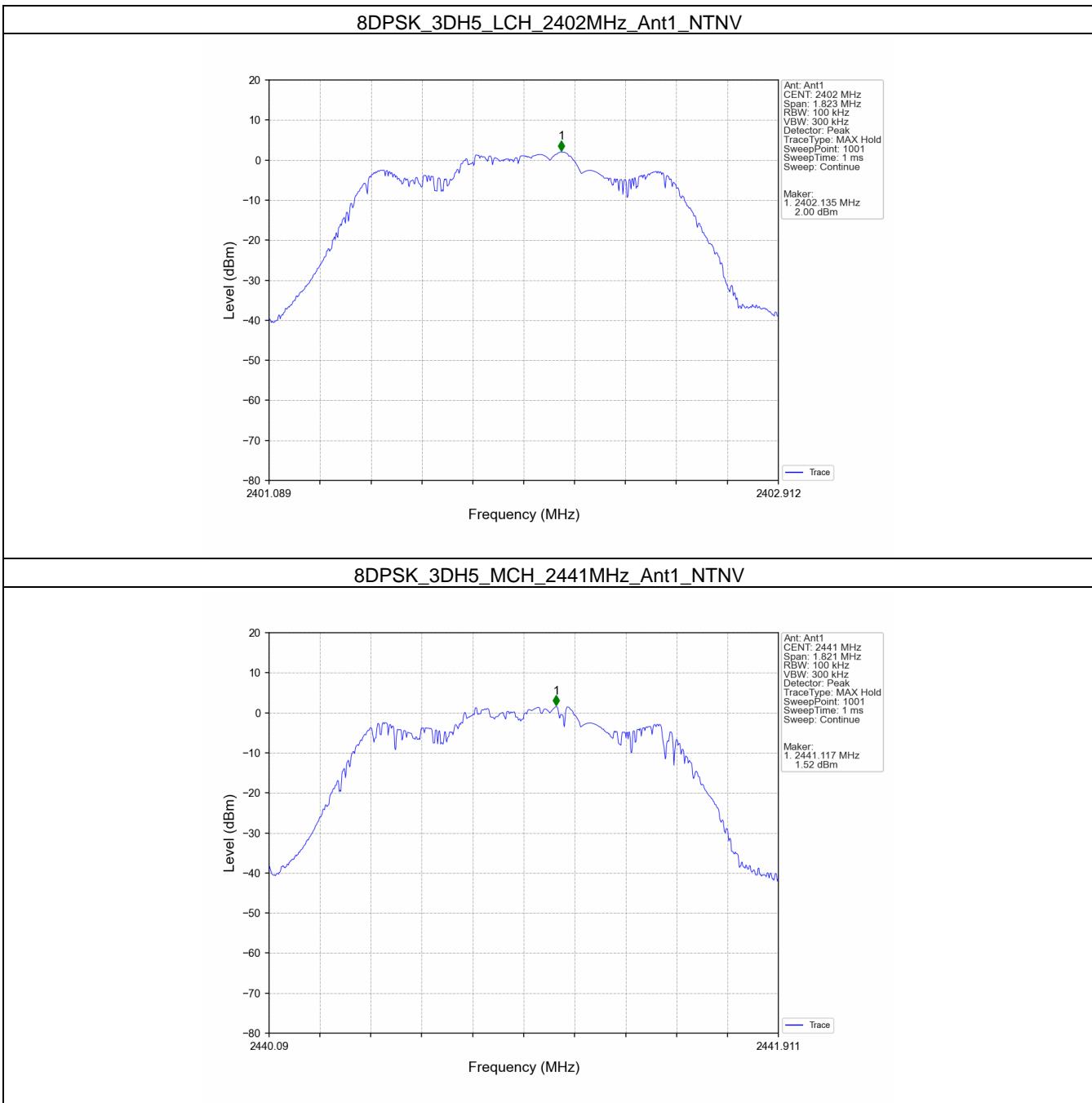
**Pi/4DQPSK\_2DH5\_MCH\_2441MHz\_Ant1\_NTNV****Pi/4DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV**

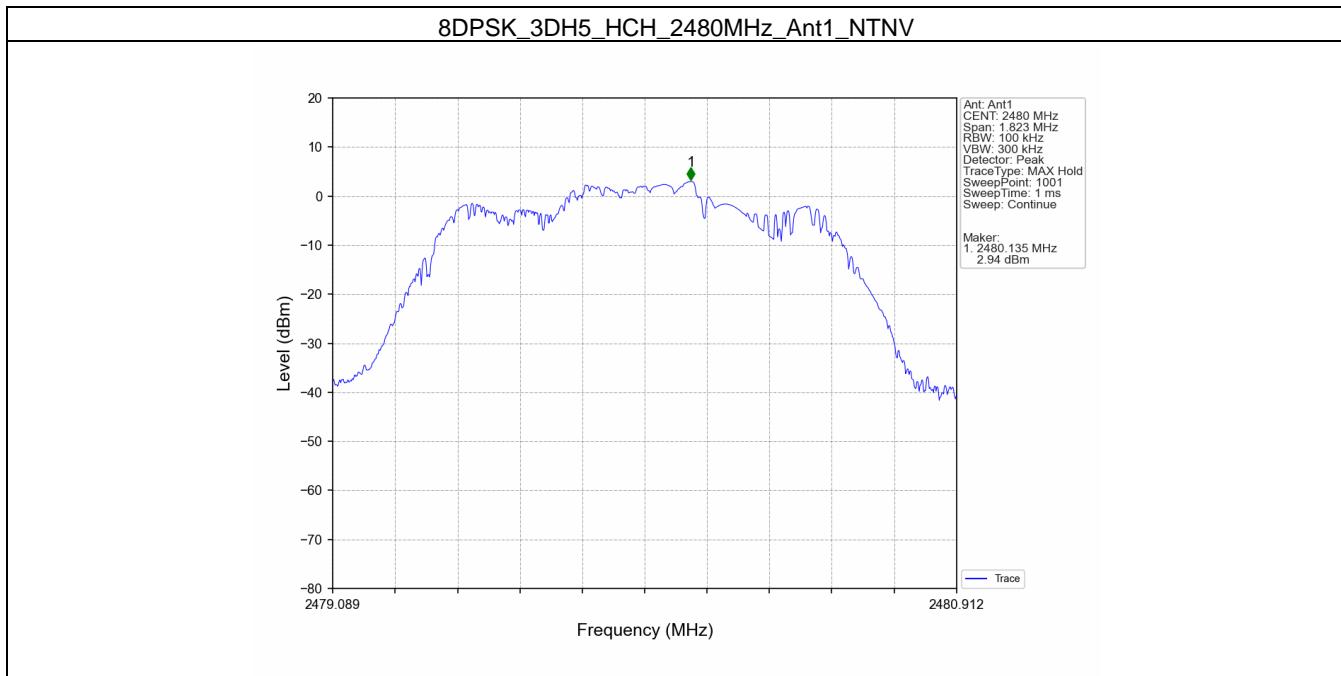
**Compliance Certification Services (Kunshan) Inc.**

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

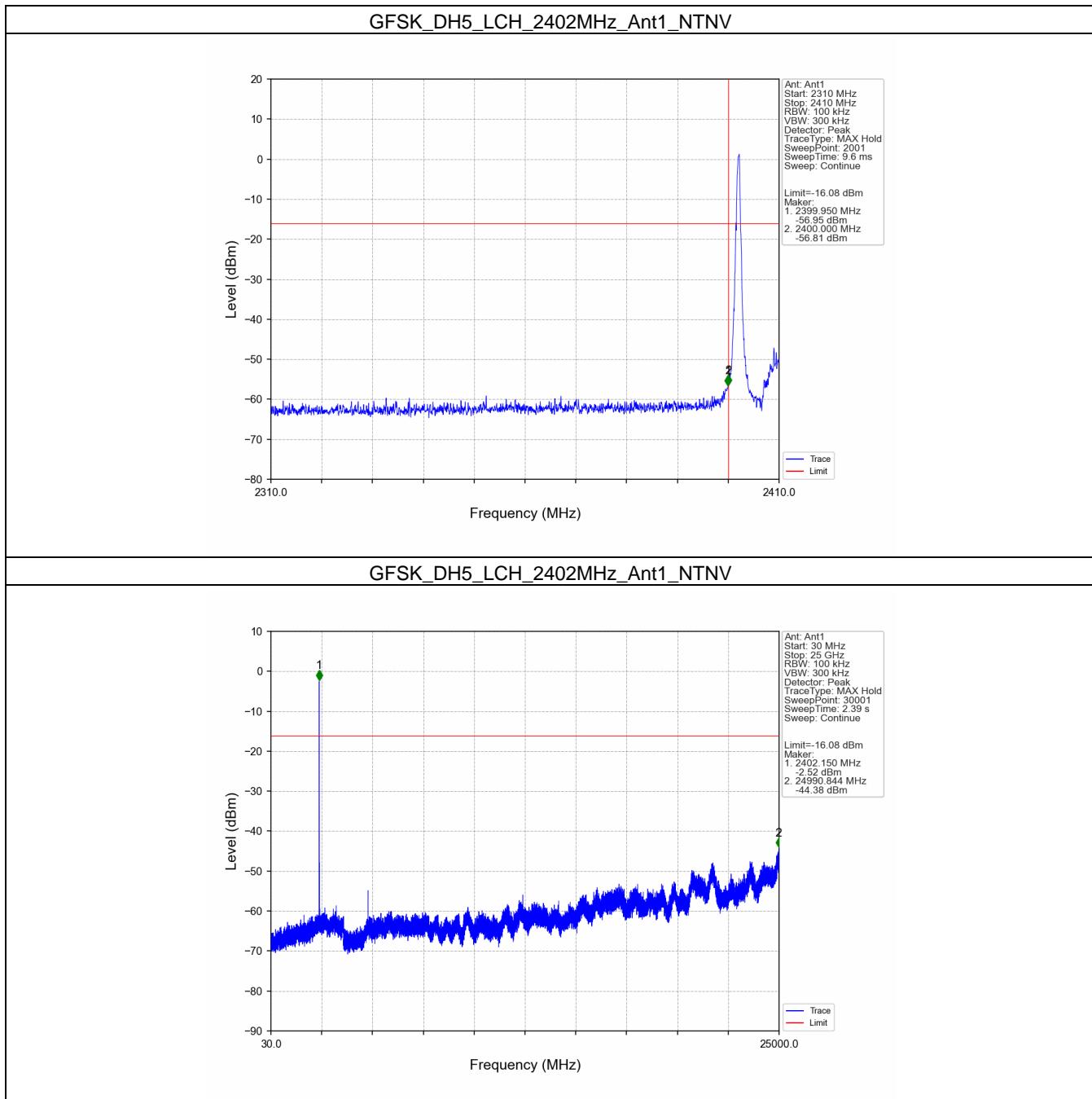
Report No.: KSCR240900173202

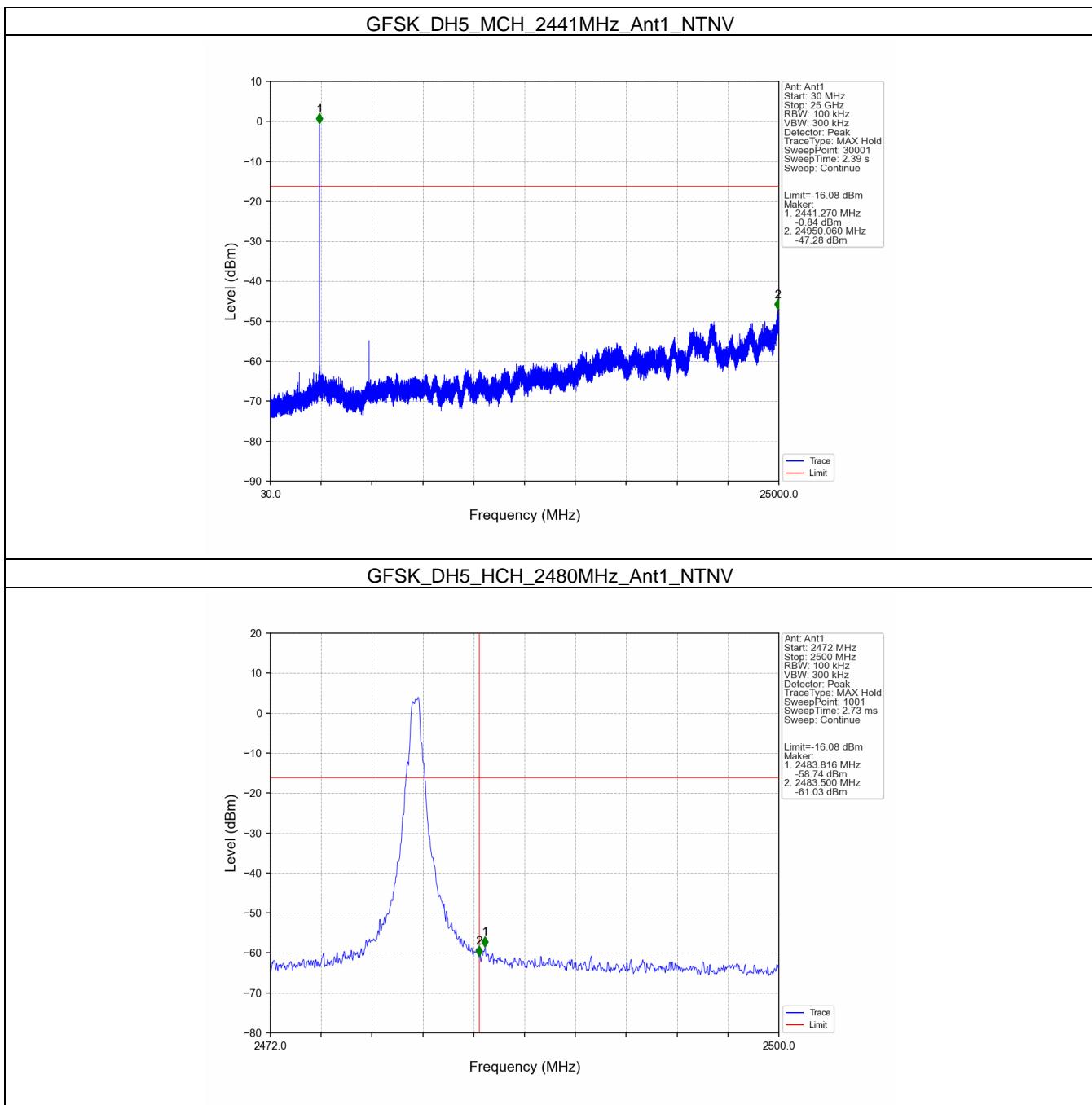
Page: 81 of 93

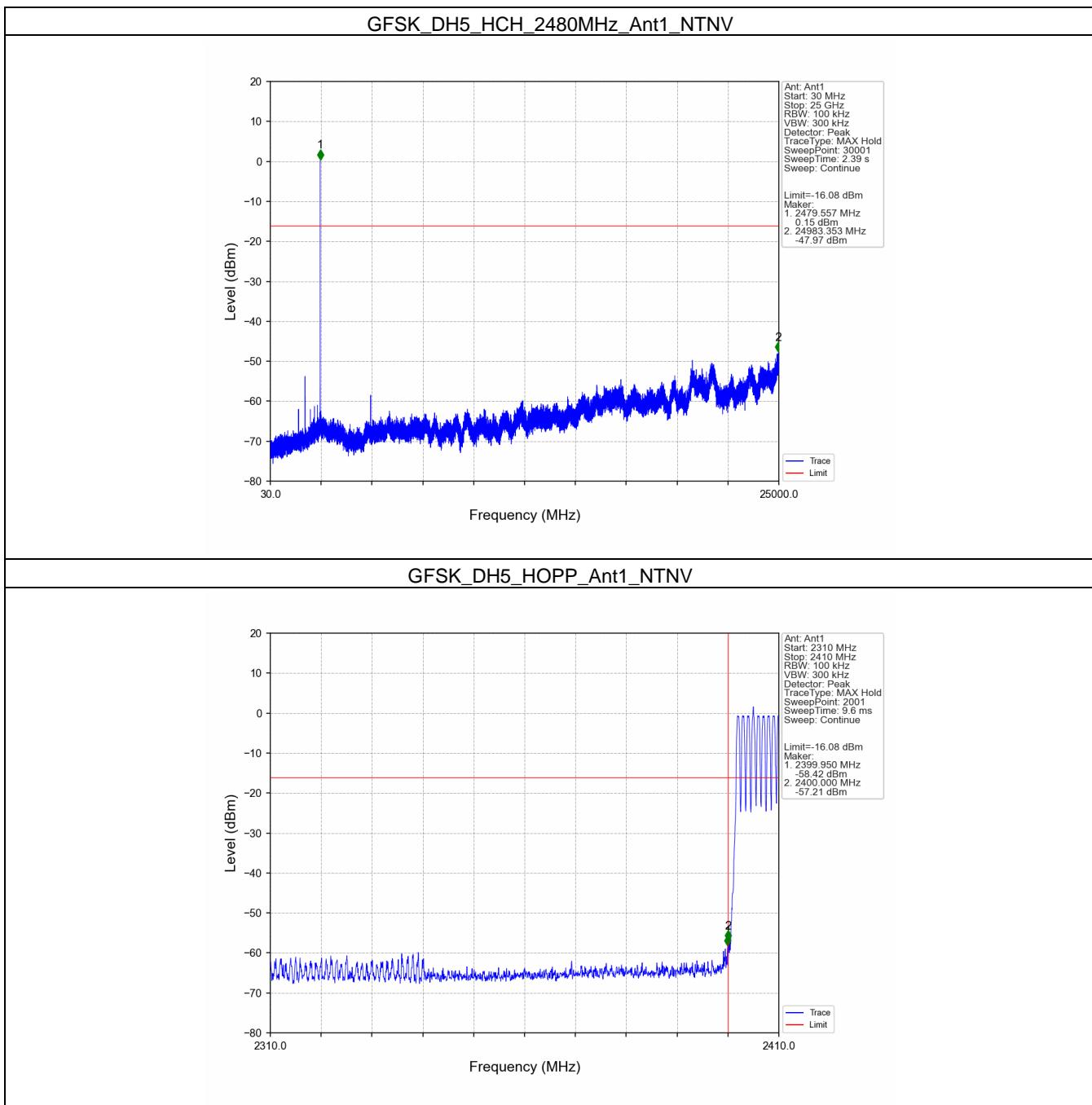


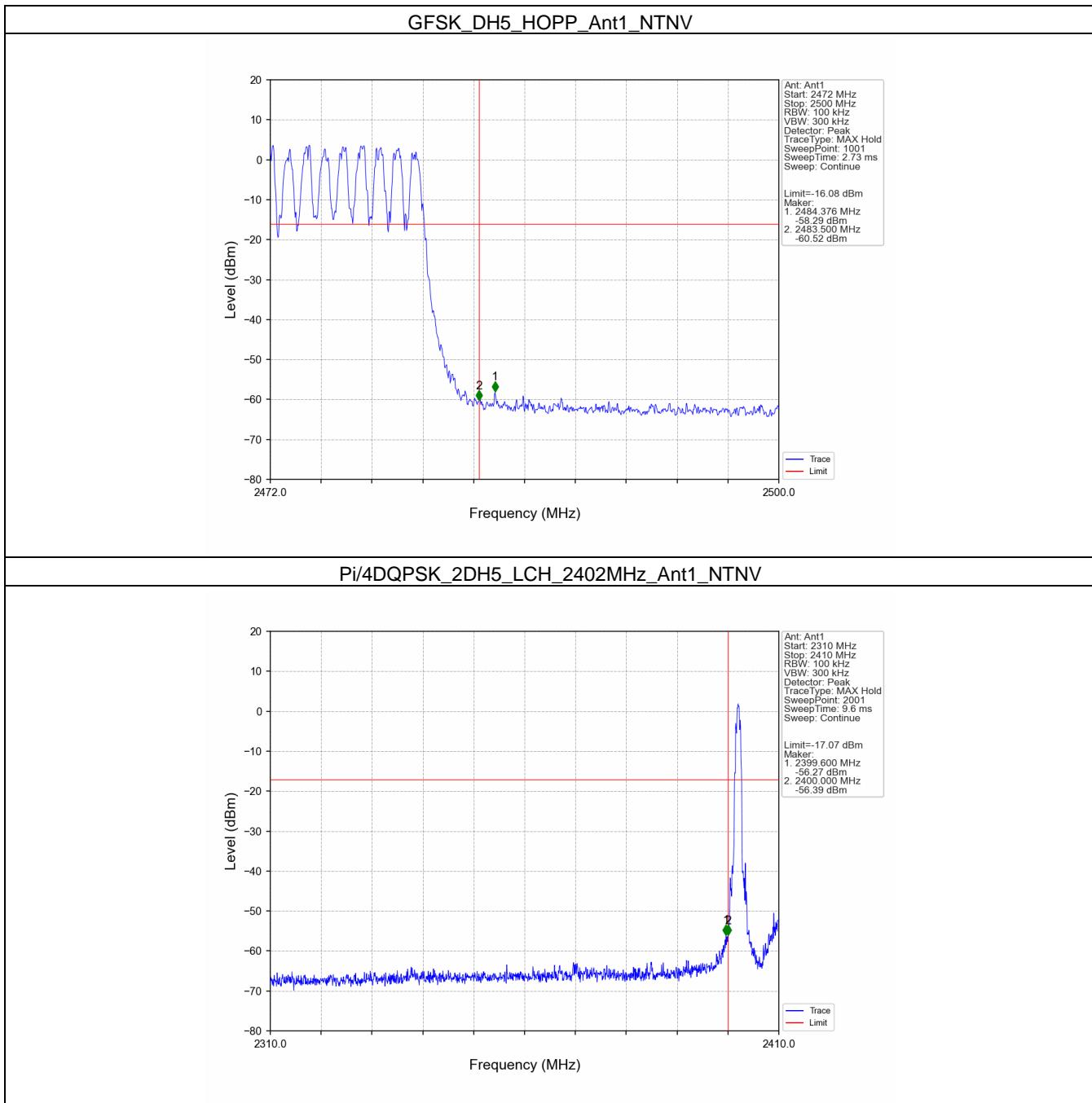


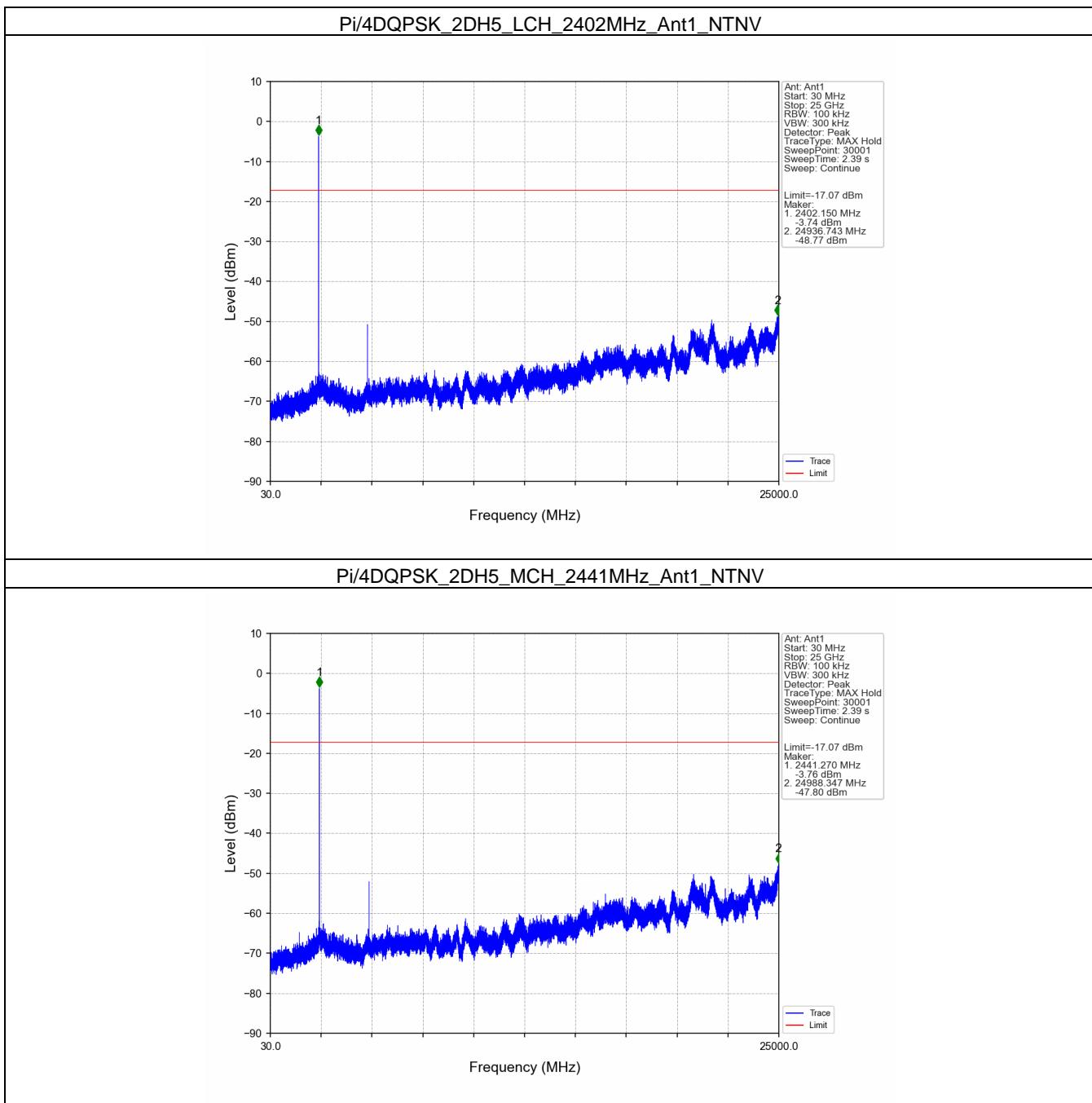
## 6.2.2 CSE

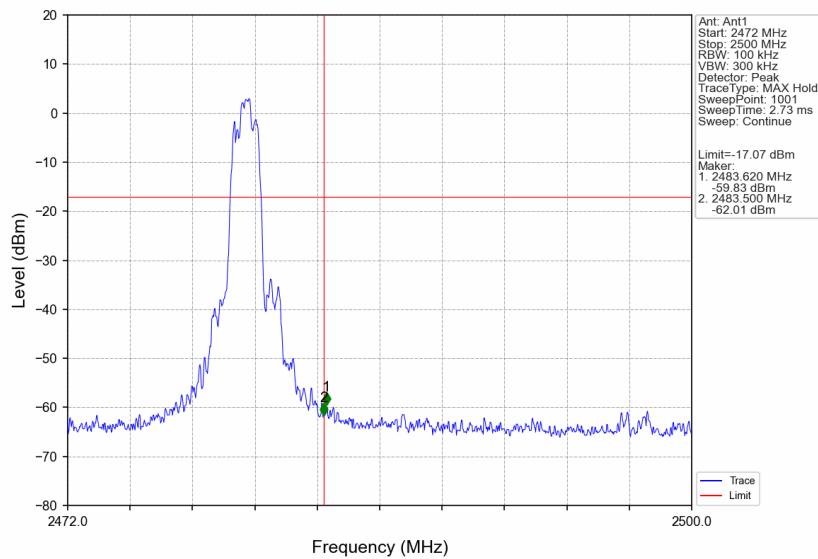
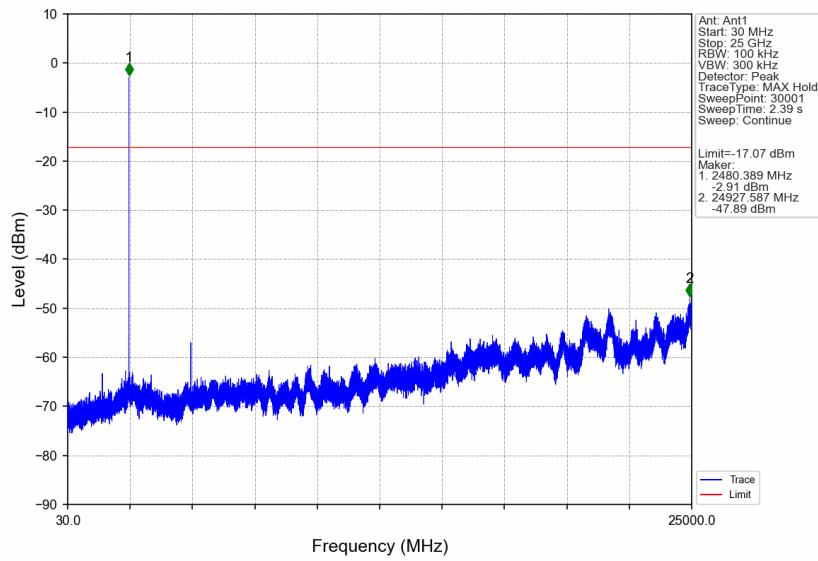


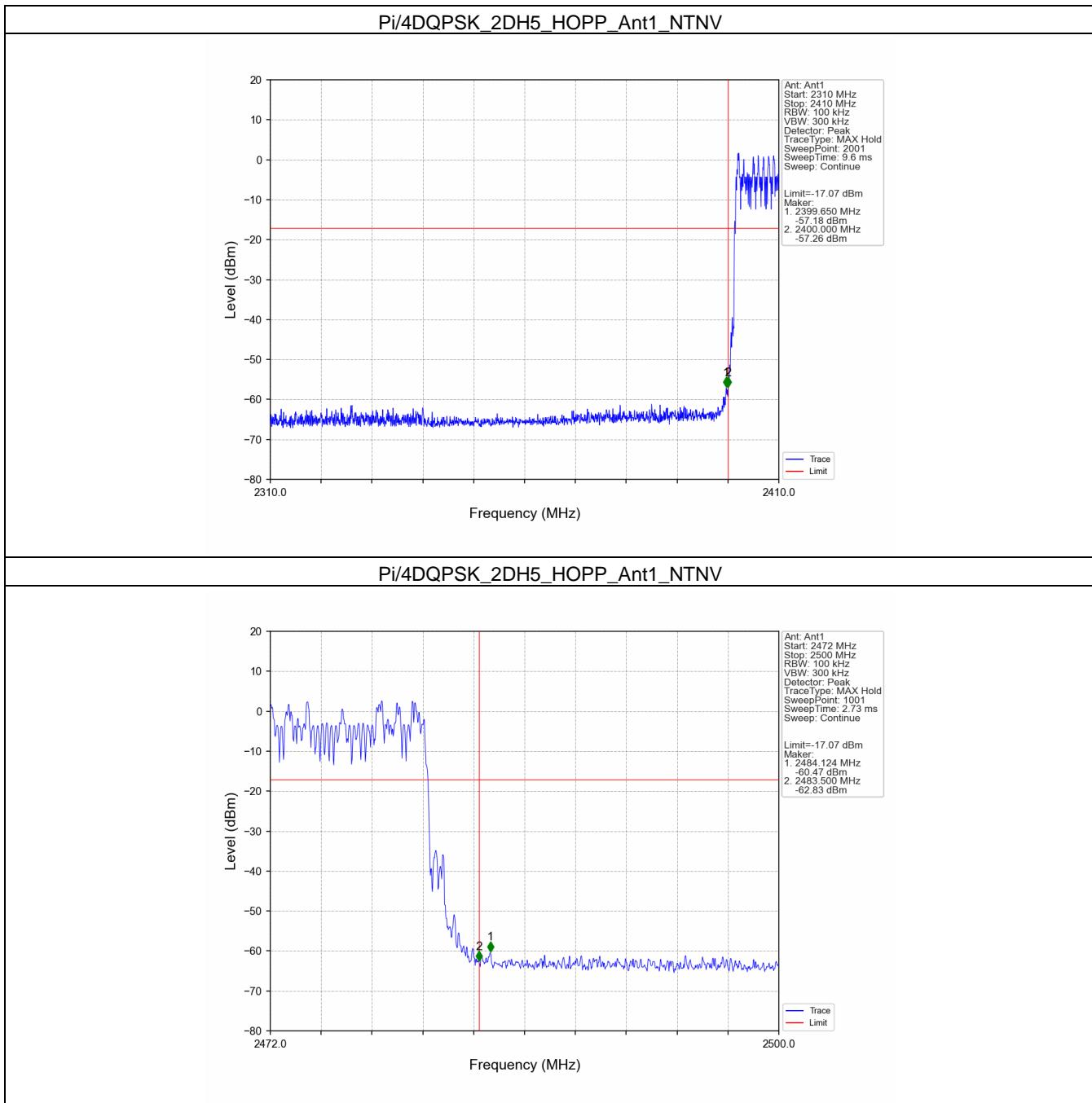


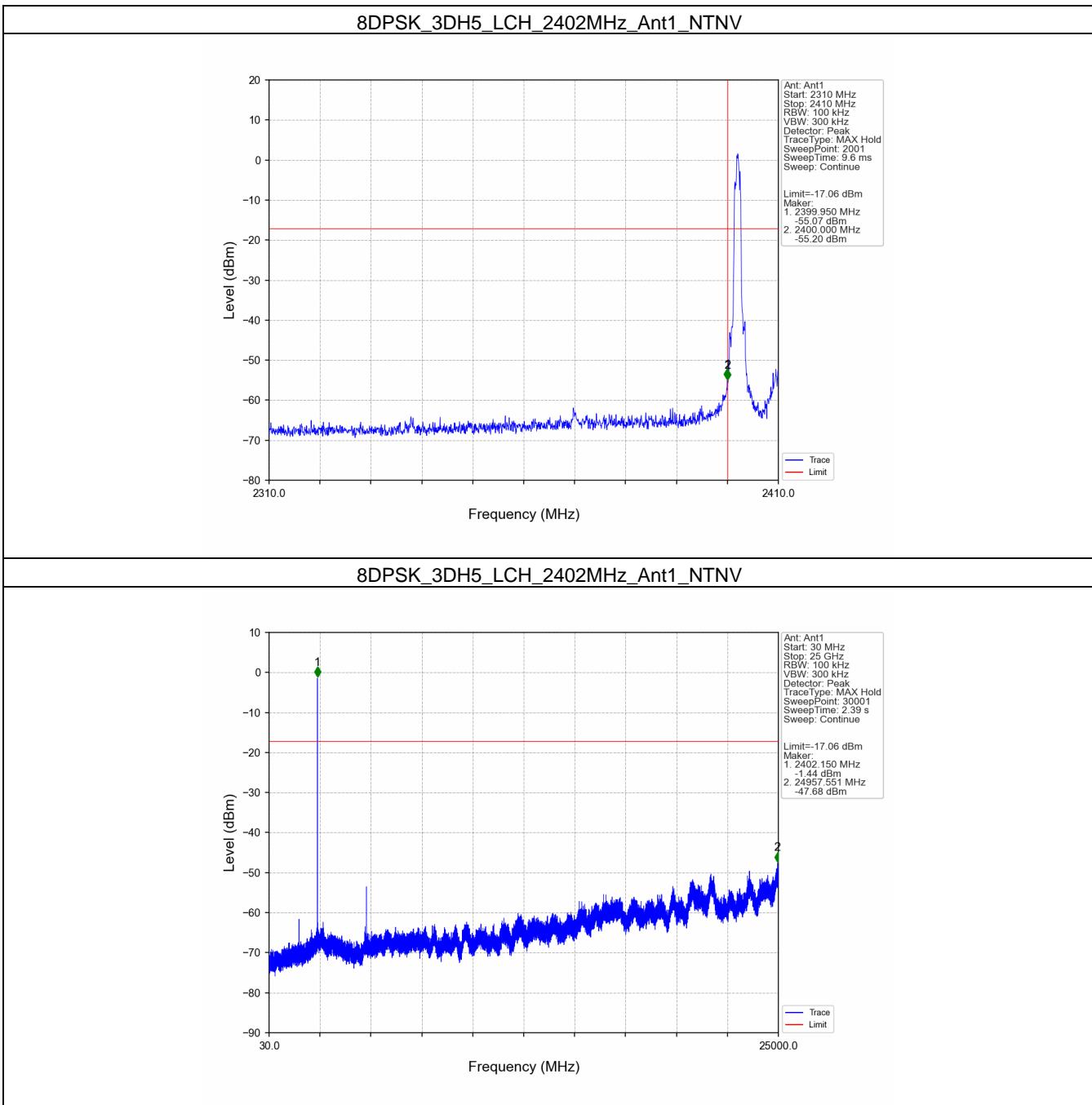


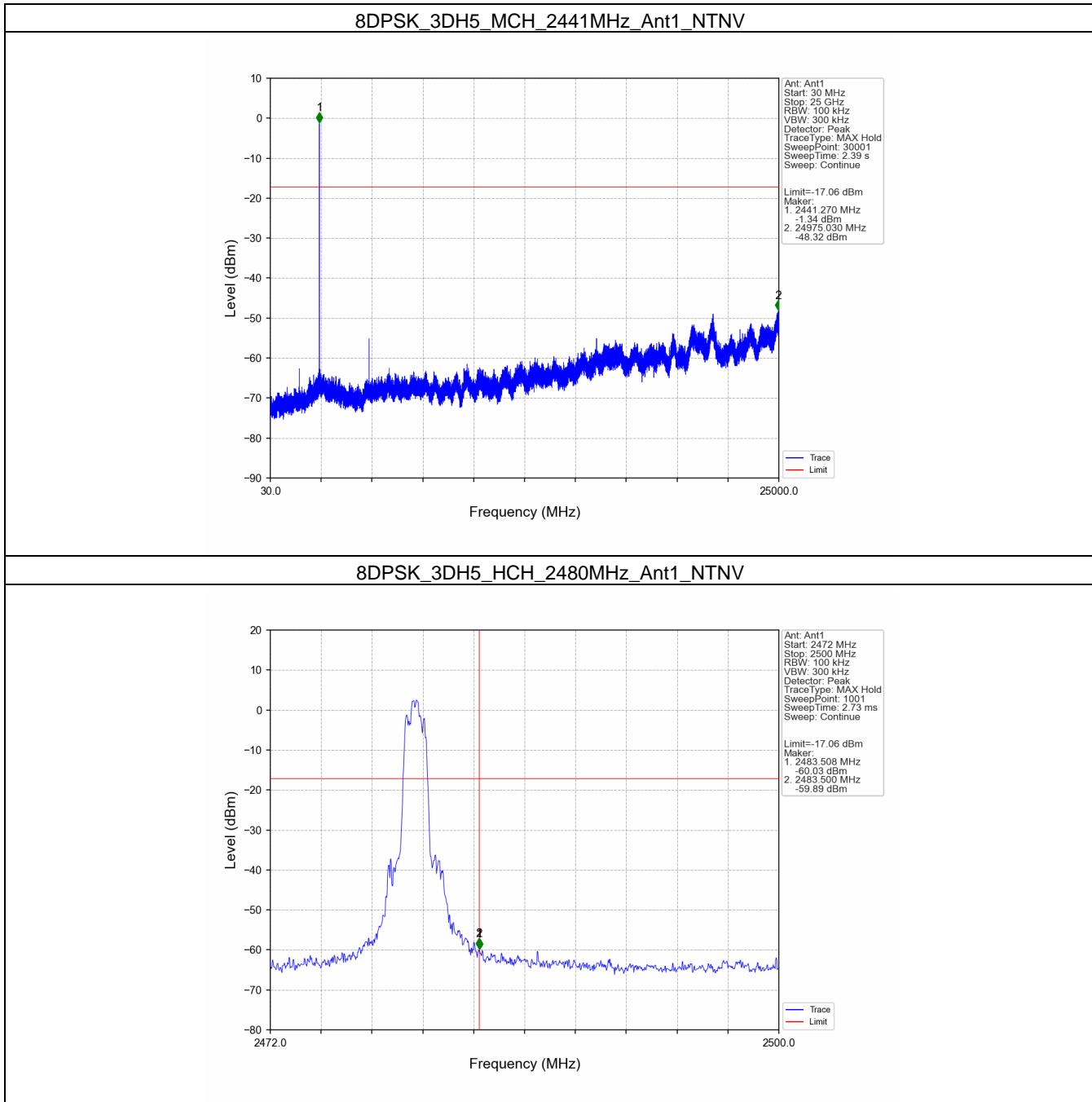


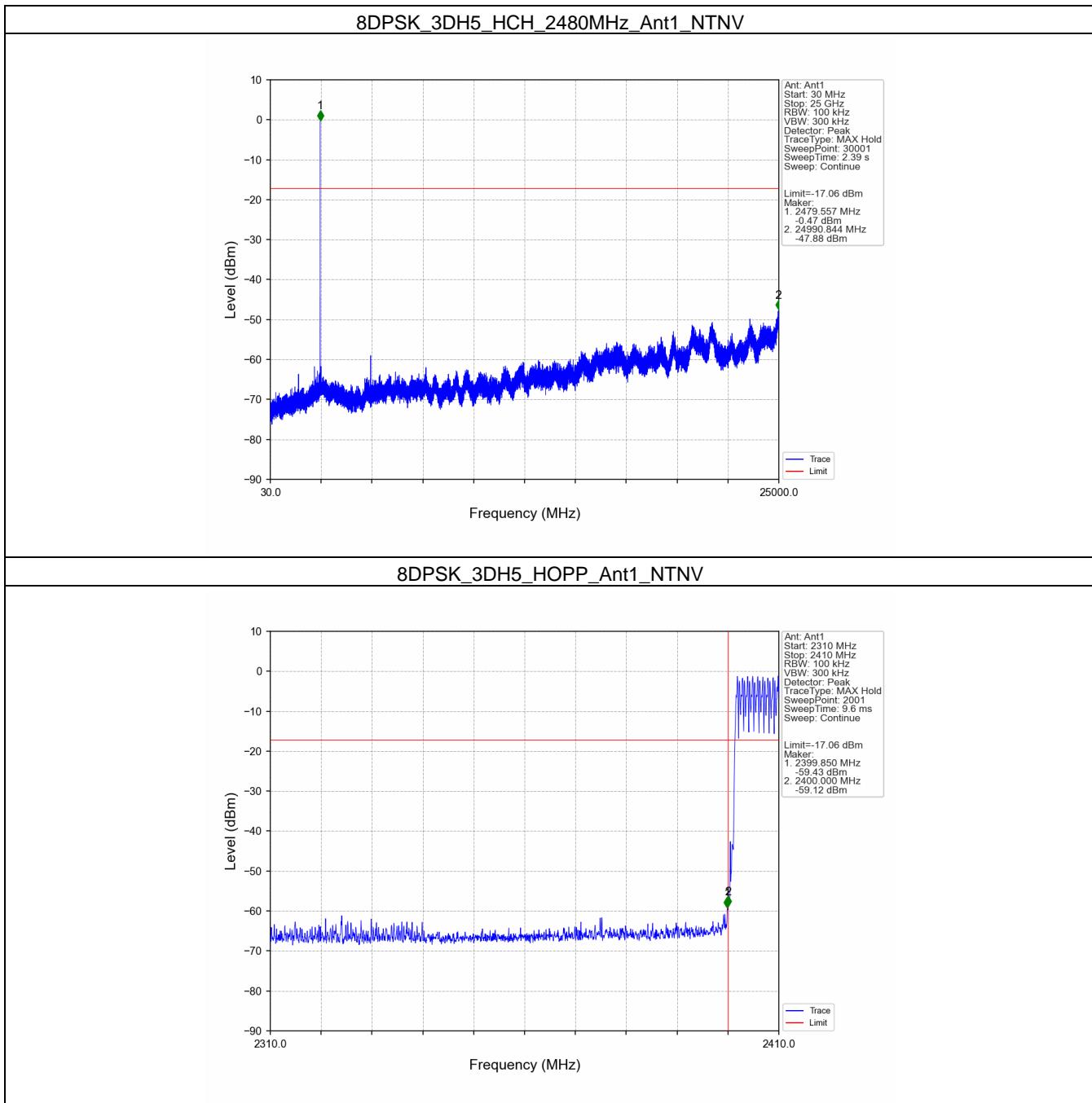


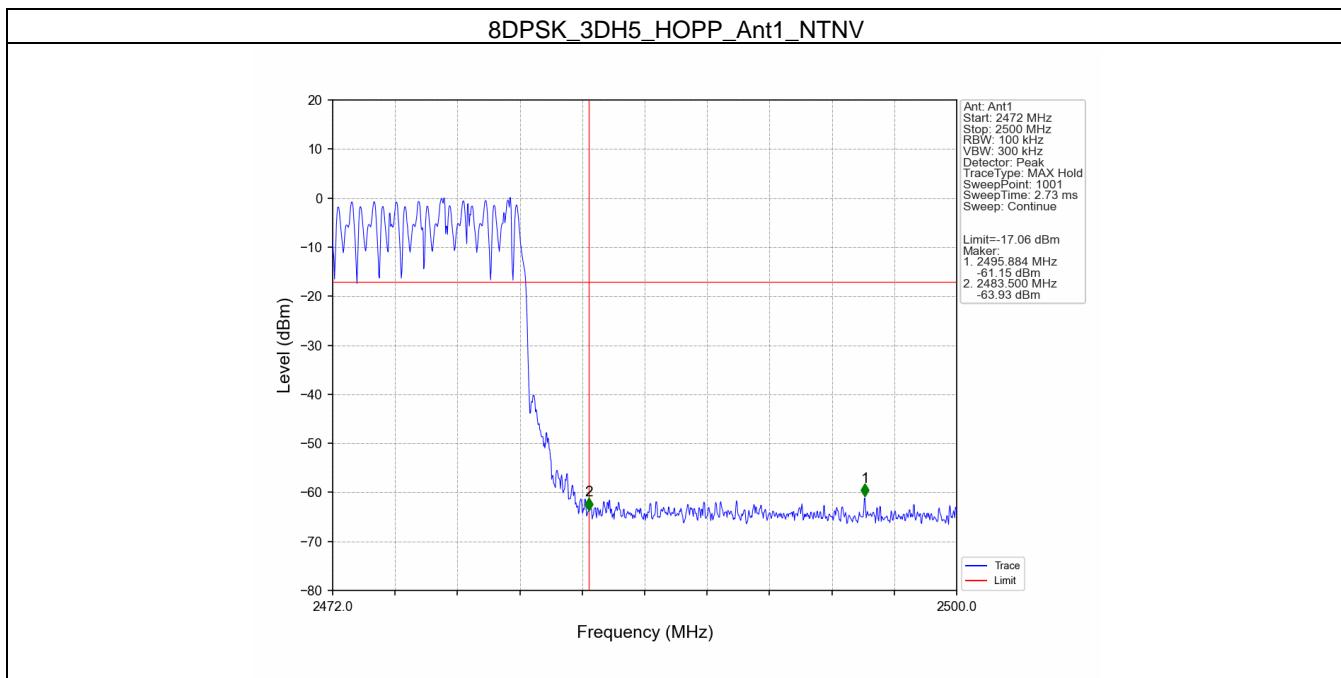
**Pi/4DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV****Pi/4DQPSK\_2DH5\_HCH\_2480MHz\_Ant1\_NTNV**











- End of the Report -