

TEST REPORT

Application No.: SZCR2104020508AT
Applicant: Dongguan Tunno Electronics Technology Co., Ltd
Address of Applicant: Room 201, 2nd Building, No. 153 Wenzhou Road, Dongcheng Street
Dongguan, China
Manufacturer: Dongguan Tunno Electronics Technology Co., Ltd
Factory: Room 201, 2nd Building, No. 153 Wenzhou Road, Dongcheng Street,
Dongguan, China
Equipment Under Test (EUT):
EUT Name: True Wireless Earphones
Model No.: 1212
FCC ID: 2AZUU-1212
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2021-04-14
Date of Test: 2021-04-17 to 2021-04-26
Date of Issue: 2021-05-08

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


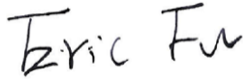
Keny Xu

Keny Xu
EMC Laboratory Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2021-05-08		Original

Authorized for issue by:				
				
		Bill Chen/Project Engineer		
				
		Eric Fu/Reviewer		



2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence		N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
20dB Bandwidth		ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Carrier Frequencies Separation		ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
Hopping Channel Number		ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Dwell Time		ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Below 1GHz		ANSI C63.10 (2013) Section 6.4,6.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Above 1GHz		ANSI C63.10 (2013) Section 6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 5V from adapter input AC 230V/50Hz Lithium Ion Battery: DC 3.7V 40mAh rechargeable battery which charged by charging case for left earbud and right earbud Lithium Ion Battery: DC 3.7V 400mAh 1.48Wh rechargeable battery which charged by USB port for charging case
Cable(s):	Type C cable:61cm unshielded
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.0
Modulation Type:	GFSK, Pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	PCB Antenna
Antenna Gain:	0.8dBi

Operation Frequency each of channel

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



Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Selected Test Channel	
Channel	Frequency
The lowest channel (CH0)	2402MHz
The middle channel (C39)	2441MHz
The highest channel (CH78)	2480MHz

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
--	--	--	--

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Peak Output Power	$\pm 0.75\text{dB}$
20dB Bandwidth	$\pm 3\%$
Carrier Frequencies Separation	$\pm 7.25 \times 10^{-8}$
Hopping Channel Number	$\pm 7.25 \times 10^{-8}$
Dwell Time	$\pm 0.37\%$
Conducted Band Edges Measurement	$\pm 0.75\text{dB}$
Conducted Spurious Emissions	$\pm 0.75\text{dB}$
Radiated Emissions which fall in the restricted bands	$\pm 4.5\text{dB}$ (Below 1GHz); $\pm 4.8\text{dB}$ (Above 1GHz)
Radiated Spurious Emissions Below 1GHz	$\pm 4.5\text{dB}$
Radiated Spurious Emissions Above 1GHz	$\pm 4.8\text{dB}$

Remark:

The U_{lab} (lab Uncertainty) is less than U_{CISPR} (CISPR Uncertainty), so the test results

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

4.4 Test Location

All tests were performed at:

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

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

4.5 Test Facility

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

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

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

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

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IC#: 4620C.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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5 Equipment List

RF Conducted					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2022-06-12
DC Power Supply	Rohde & Schwarz	NGSM 32/10	SEM011-04	2021-03-23	2022-03-22
MXA Signal Analyzer	KEYSIGHT	N9020A	SEM004-17	2021-04-08	2022-04-07
Measurement Software	TST	TST PASS V1.0.5	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-01	2020-07-10	2021-07-09
Attenuator	Huber+Suhner	6620_SMA-50-1	SEM021-09	2021-04-08	2022-04-07

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2021-03-26	2024-03-25
EXA Signal Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2021-02-01	2022-01-31
Horn Antenna	Rohde&Schwarz	HF907	SEM003-07	2021-04-14	2024-04-13
Pre-Amplifier	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2020-09-23	2021-09-22
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2020-07-10	2021-07-09
Horn Antenna	Schwarzbeck	BBHA 9170	SEM003-15	2020-11-14	2023-11-13
Pre-Amplifier	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2021-03-24	2022-03-23

Radiated Spurious Emissions Below 1GHz					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
10m Semi-Anechoic Chamber	SAEMC	FSAC1018	SEM001-03	2021-03-27	2024-03-26
MXE EMI receiver	KEYSIGHT	N9038A	SEM004-16	2020-11-02	2021-11-01
Trilog-Broadband Antenna	Schwarzbeck	VULB9168	SEM003-18	2019-08-08	2022-08-07
Pre-amplifier	Sonoma Instrument Co	310N	SEM005-04	2021-04-08	2022-04-07
Loop Antenna	ETS-Lindgren	6502	SEM003-08	2020-08-14	2023-08-13
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A



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Coaxial Cable	SGS	N/A	SEM029-01	2020-07-10	2021-07-09
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Radiated Spurious Emissions Above 1GHz

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2021-03-26	2024-03-25
EXA Signal Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2021-02-01	2022-01-31
Horn Antenna	Rohde&Schwarz	HF907	SEM003-07	2021-04-14	2024-04-13
Pre-Amplifier	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2020-09-23	2021-09-22
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2020-07-10	2021-07-09
Horn Antenna	Schwarzbeck	BBHA 9170	SEM003-15	2020-11-14	2023-11-13
Pre-Amplifier	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2021-03-24	2022-03-23

General used equipment

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2020-09-15	2021-09-14
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2020-09-15	2021-09-14
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2021-03-30	2022-03-29



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)

Limit:

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0.8dBi.

Antenna location: Refer to Internal photos.



6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

Limit:

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

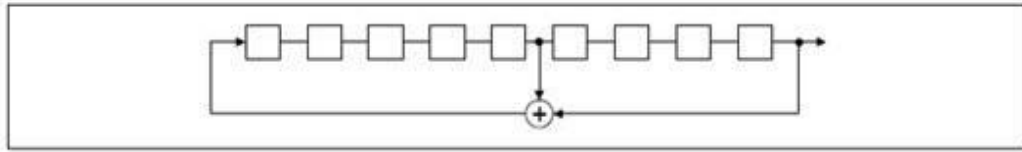
According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

- > Number of shift register stages: 9
- > Length of pseudo-random sequence: $2^9 - 1 = 511$ bits
- > Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

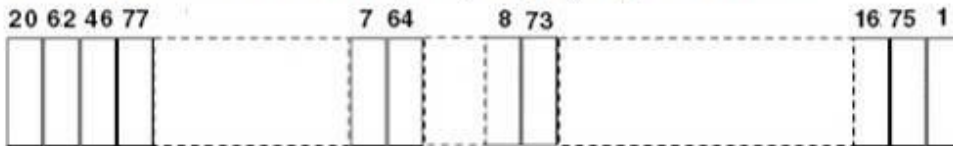
An example of Pseudorandom Frequency Hopping Sequence as follow:





Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

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

Compliance for section 15.247(g):

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

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



7 Radio Spectrum Matter Test Results

7.1 Conducted 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: $\leq 20.97\text{dBm}$

7.1.1 E.U.T. Operation

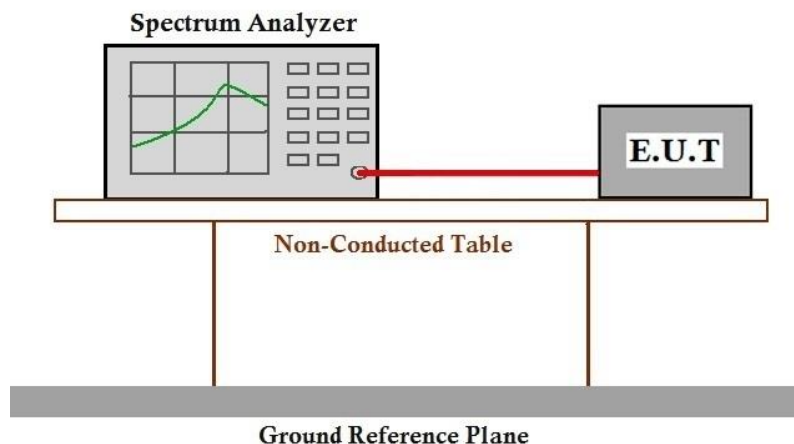
Operating Environment:

Temperature: 25.3 °C Humidity: 41.7 % RH Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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	02	TX_non-Hop mode(right earbud)_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

Please Refer to Appendix for Details

7.2 20dB Bandwidth

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

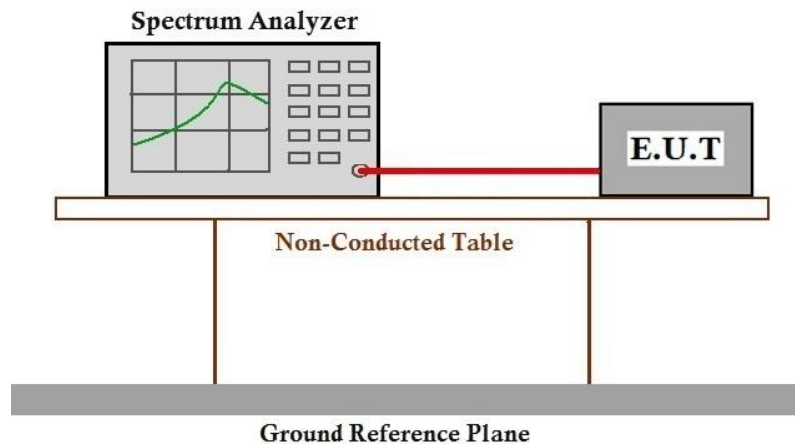
7.2.1 E.U.T. Operation

Operating Environment:
Temperature: 25.3 °C Humidity: 41.7 % RH Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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	02	TX_non-Hop mode(right earbud)_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

Please Refer to Appendix for Details

7.3 Carrier Frequencies Separation

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

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

Limit:

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

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C

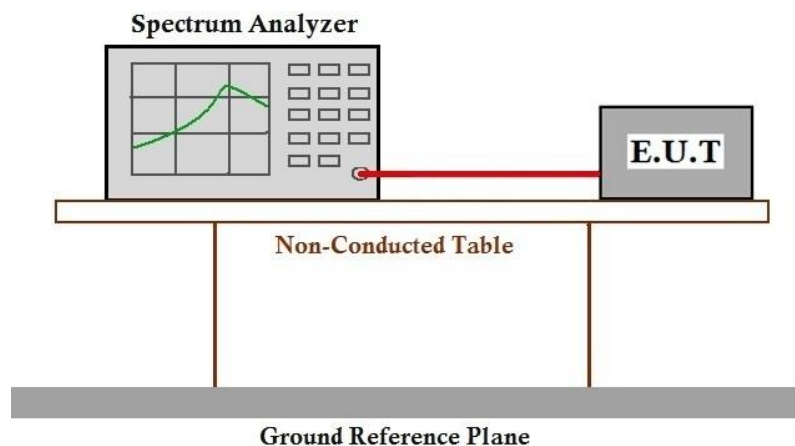
Humidity: 41.7 % RH

Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode(left earbud)_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.
Final test	03	TX_Hop mode(right earbud)_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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7.4 Hopping Channel Number

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

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

Limit:

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

7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C

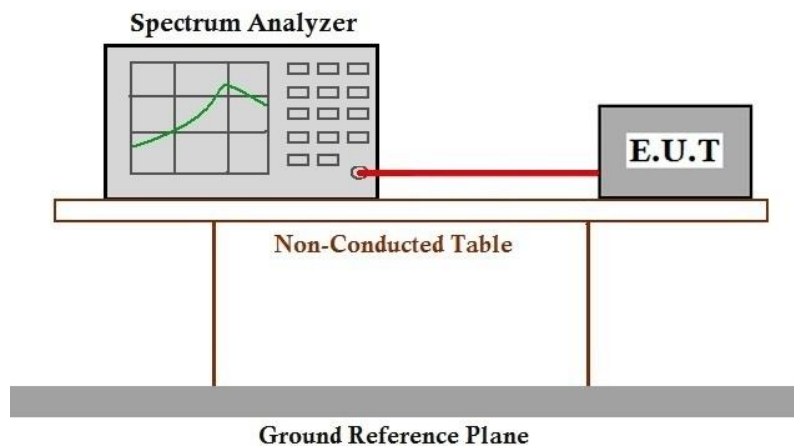
Humidity: 41.7 % RH

Atmospheric Pressure: 1010 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode(left earbud)_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.
Final test	03	TX_Hop mode(right earbud)_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.4.3 Test Setup Diagram



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7.4.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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7.5 Dwell Time

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

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

Limit:

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

7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C

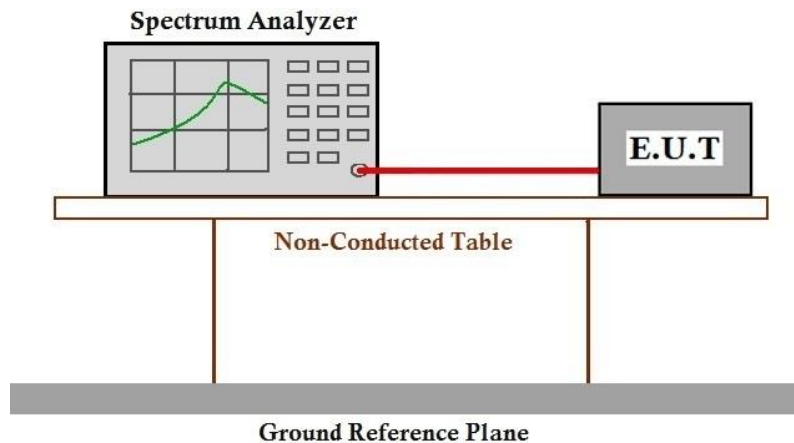
Humidity: 41.7 % RH

Atmospheric Pressure: 1010 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode(left earbud)_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.
Final test	03	TX_Hop mode(right earbud)_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

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7.6 Conducted Band Edges Measurement

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

Test Method: ANSI C63.10 (2013) Section 7.8.6

Limit:

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

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C

Humidity: 41.7 % RH

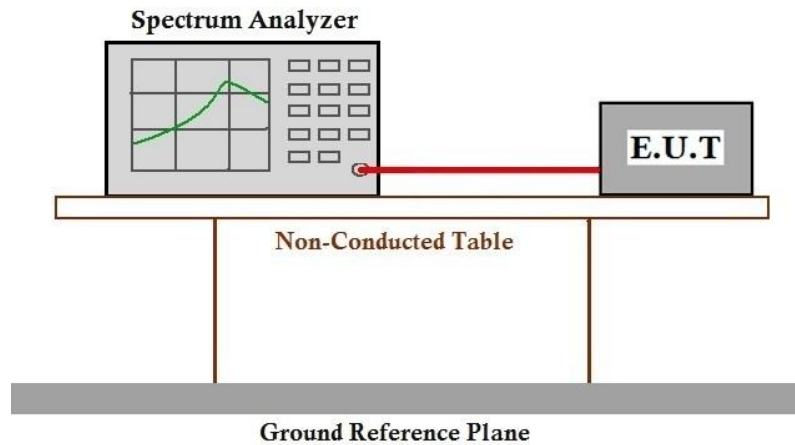
Atmospheric Pressure: 1010 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Final test	01	TX_Hop mode(left earbud)_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.
Final test	02	TX_non-Hop mode(right earbud)_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	03	TX_Hop mode(right earbud)_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.



7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

Please Refer to Appendix for Details



7.7 Conducted Spurious Emissions

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

Test Method: ANSI C63.10 (2013) Section 7.8.8

Limit:

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

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C

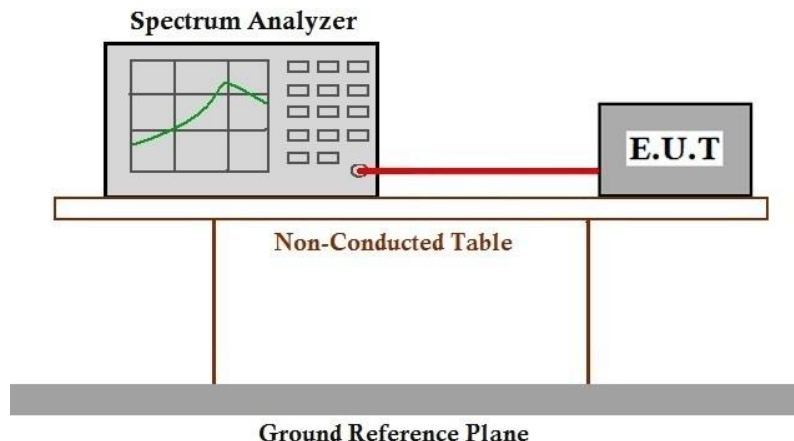
Humidity: 41.7 % RH

Atmospheric Pressure: 1010 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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	02	TX_non-Hop mode(right earbud)_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

Please Refer to Appendix for Details



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7.8 Radiated Emissions which fall in the restricted bands

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

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

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.8.1 E.U.T. Operation

Operating Environment:

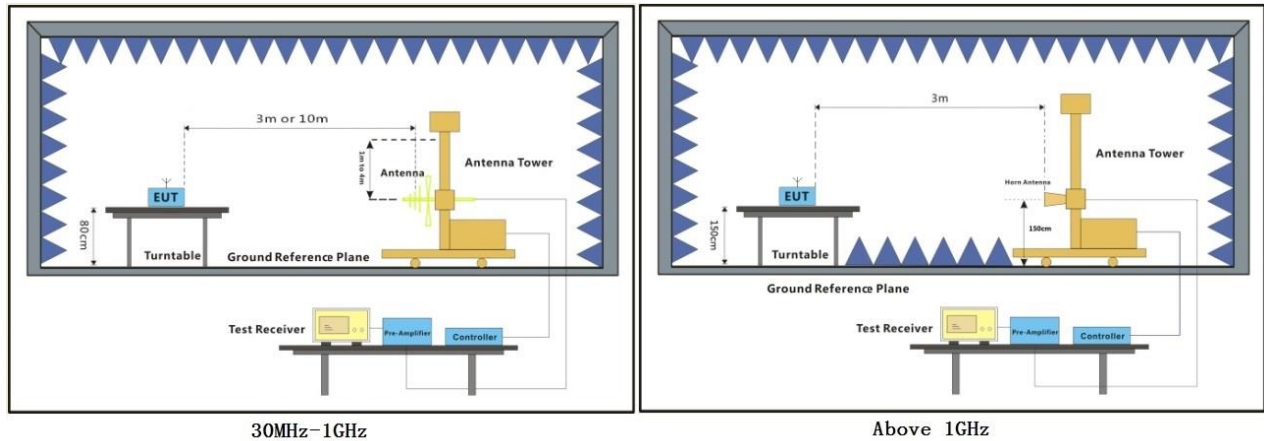
Temperature: 23.5 °C Humidity: 56.3 % RH Atmospheric Pressure: 1010 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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	02	TX_non-Hop mode(right earbud)_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.



7.8.3 Test Setup Diagram



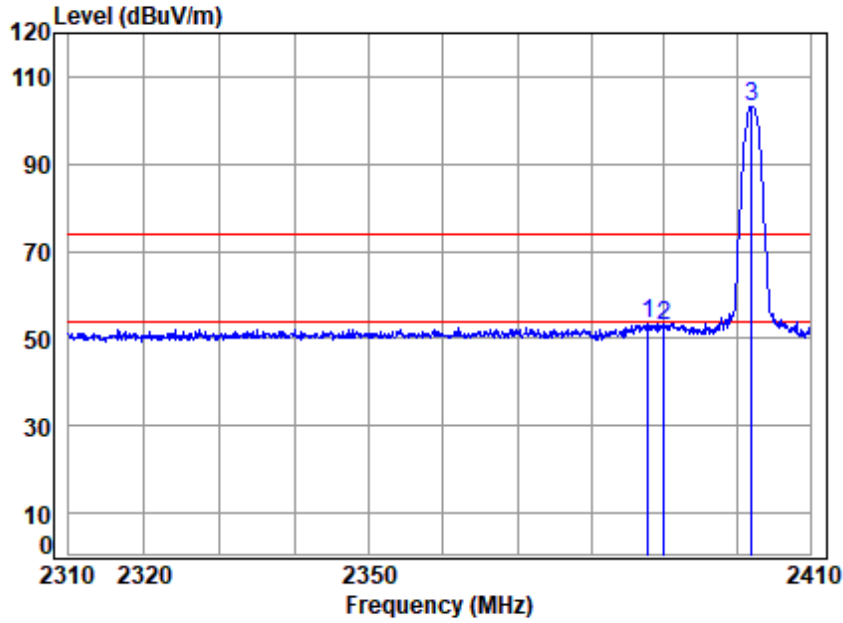
7.8.4 Measurement Procedure and Data

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

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

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

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

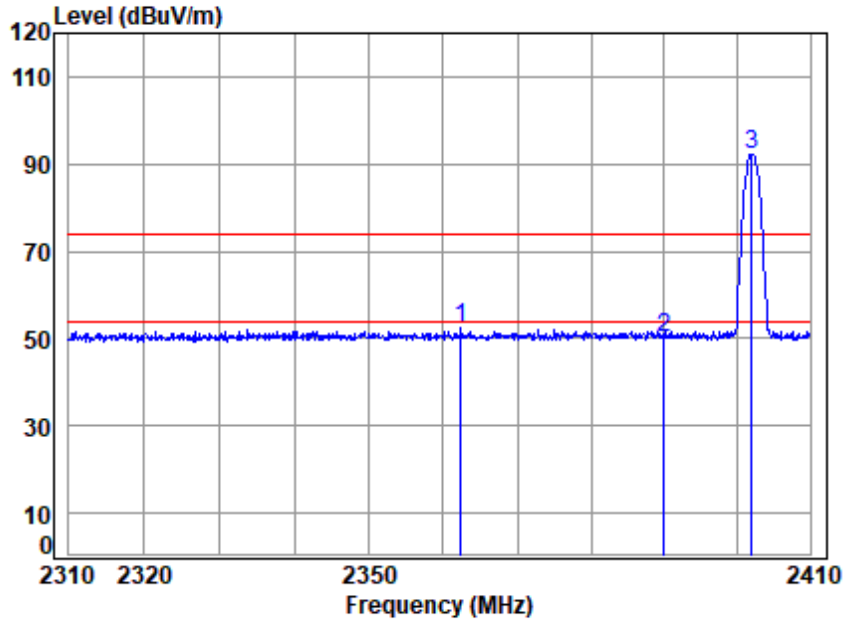


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2402 Band edge
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2387.837	4.34	28.87	40.42	60.71	53.50	74.00	-20.50	peak
2	2390.000	4.34	28.88	40.42	60.12	52.92	74.00	-21.08	peak
3 *	2402.000	4.36	28.90	40.43	110.27	103.10	74.00	29.10	peak



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

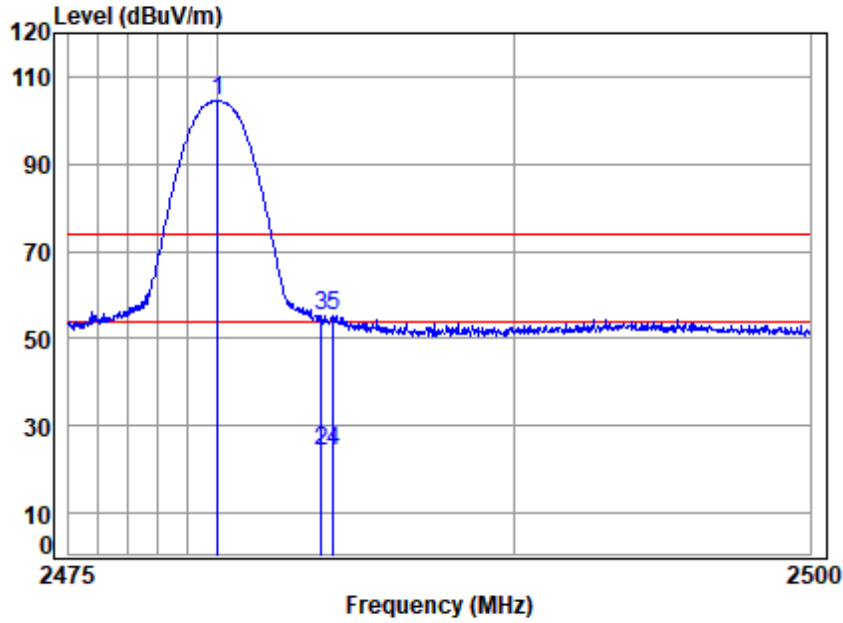


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2402 Band edge
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2362.372	4.30	28.82	40.41	59.76	52.47	74.00	-21.53	peak
2	2390.000	4.34	28.88	40.42	57.41	50.21	74.00	-23.79	peak
3 *	2402.000	4.36	28.90	40.43	99.38	92.21	74.00	18.21	peak



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



Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2480 Band edge
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 *	2480.000	4.49	29.06	40.47	111.34	104.42	74.00	30.42	peak
2	2483.500	4.49	29.07	40.47	31.19	24.28	54.00	-29.72	Average
3	2483.500	4.49	29.07	40.47	62.05	55.14	74.00	-18.86	peak
4	2483.896	4.49	29.07	40.47	31.12	24.21	54.00	-29.79	Average
5	2483.896	4.49	29.07	40.47	61.98	55.07	74.00	-18.93	peak



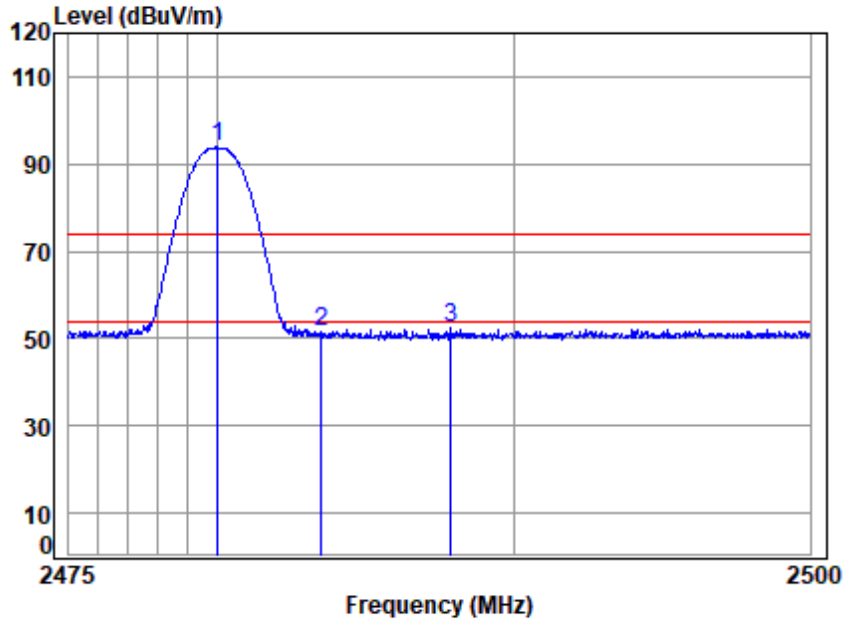
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Test Mode: 00; Polarity: Vertical; Modulation: GFSK; Channel: High

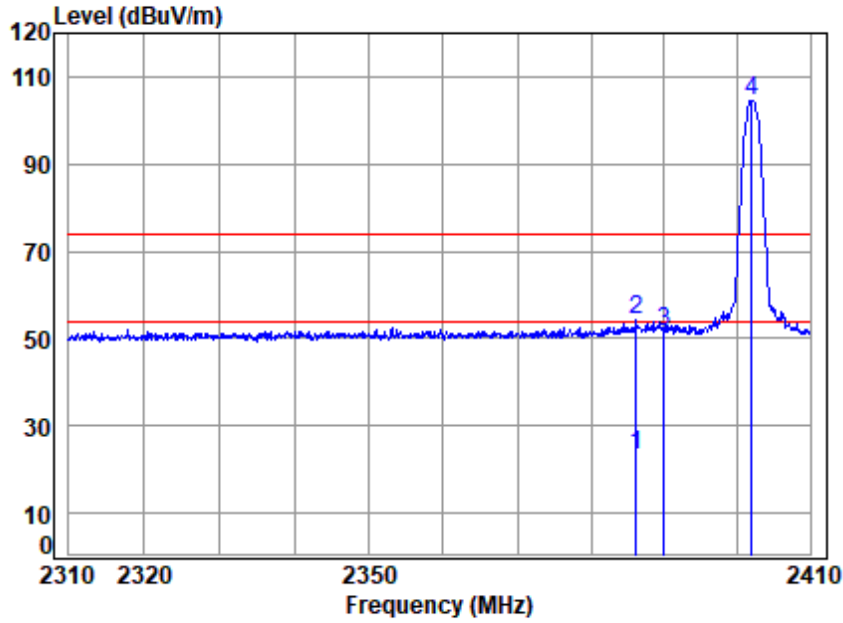


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2480 Band edge
Note : BT-L

	Cable	Ant	Preamp	Read		Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 * 2480.000	4.49	29.06	40.47	100.74	93.82	74.00	19.82	peak
2 2483.500	4.49	29.07	40.47	58.28	51.37	74.00	-22.63	peak
3 2487.869	4.50	29.08	40.47	59.24	52.35	74.00	-21.65	peak



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:Low

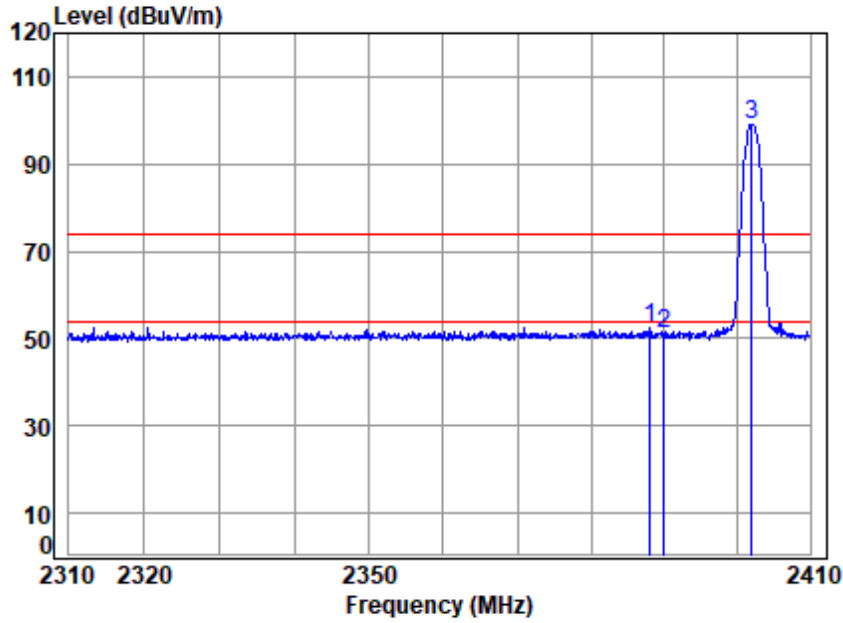


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2402 Band edge
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2386.118	4.34	28.87	40.42	30.43	23.22	54.00	-30.78	Average
2	2386.118	4.34	28.87	40.42	61.29	54.08	74.00	-19.92	peak
3	2390.000	4.34	28.88	40.42	58.98	51.78	74.00	-22.22	peak
4 *	2402.000	4.36	28.90	40.43	111.61	104.44	74.00	30.44	peak



Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: Low

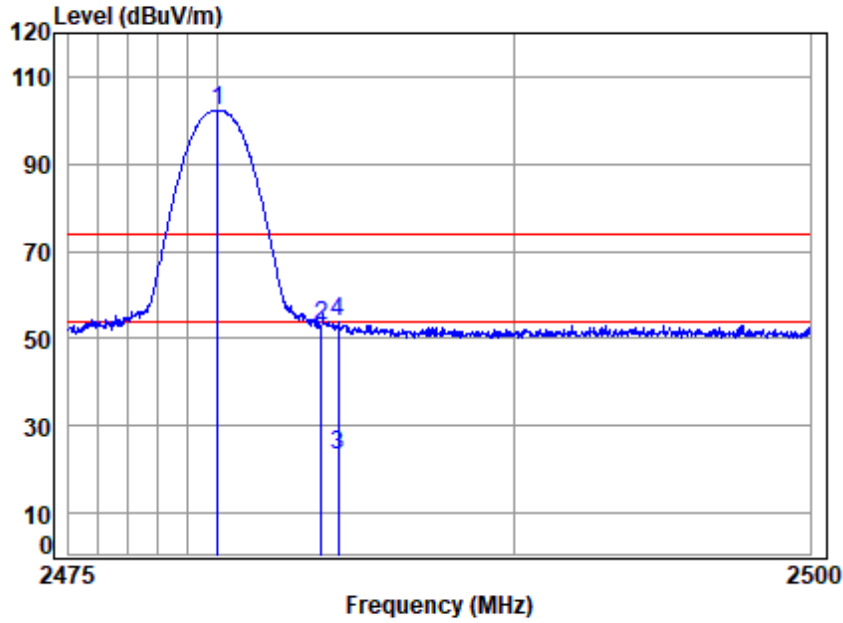


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2402 Band edge
Note : BT-R

		Cable	Ant	Preamp	Read	Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2388.040	4.34	28.87	40.42	59.73	52.52	74.00	-21.48 peak
2	2390.000	4.34	28.88	40.42	58.23	51.03	74.00	-22.97 peak
3 *	2402.000	4.36	28.90	40.43	106.22	99.05	74.00	25.05 peak



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:High

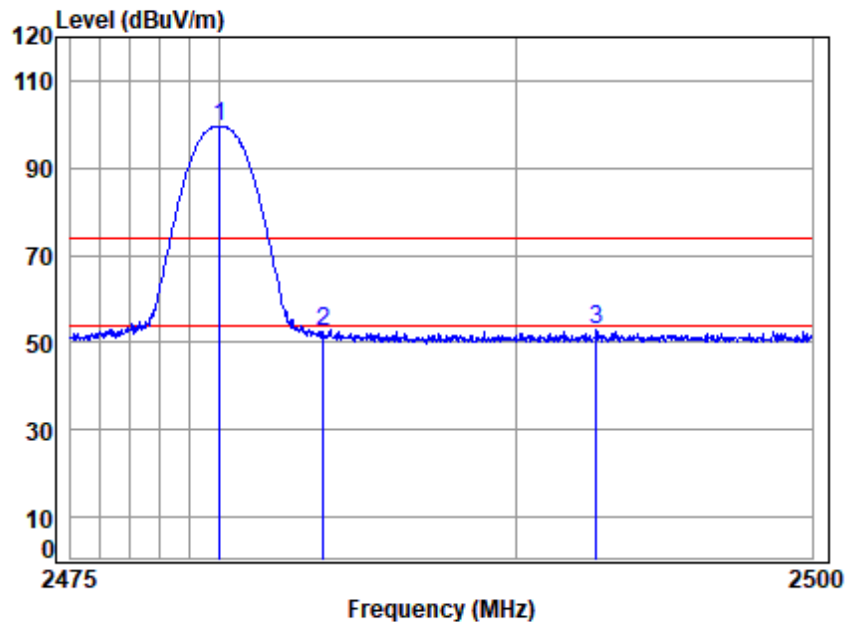


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2480 Band edge
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 *	2480.000	4.49	29.06	40.47	109.07	102.15	74.00	28.15	peak
2	2483.500	4.49	29.07	40.47	59.72	52.81	74.00	-21.19	peak
3	2484.071	4.50	29.07	40.47	30.05	23.15	54.00	-30.85	Average
4	2484.071	4.50	29.07	40.47	60.91	54.01	74.00	-19.99	peak



Test Mode: 02; Polarity: Vertical; Modulation:GFSK; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2480 Band edge
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 *	2480.000	4.49	29.06	40.47	106.39	99.47	74.00	25.47	peak
2	2483.500	4.49	29.07	40.47	59.58	52.67	74.00	-21.33	peak
3	2492.699	4.51	29.09	40.47	59.65	52.78	74.00	-21.22	peak



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Shenzhen Branch

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7.9 Radiated Spurious Emissions Below 1GHz

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

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

Measurement Distance: 10m

Limit:

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

7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 23.2 °C

Humidity: 49 % RH

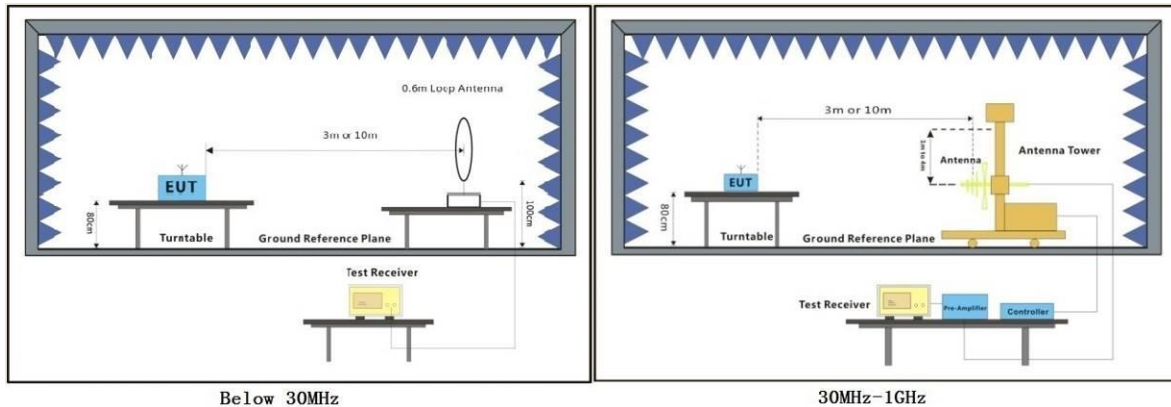
Atmospheric Pressure: 1010 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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.
Pre-scan	02	TX_non-Hop mode(right earbud)_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.



7.9.3 Test Setup Diagram



7.9.4 Measurement Procedure and Data

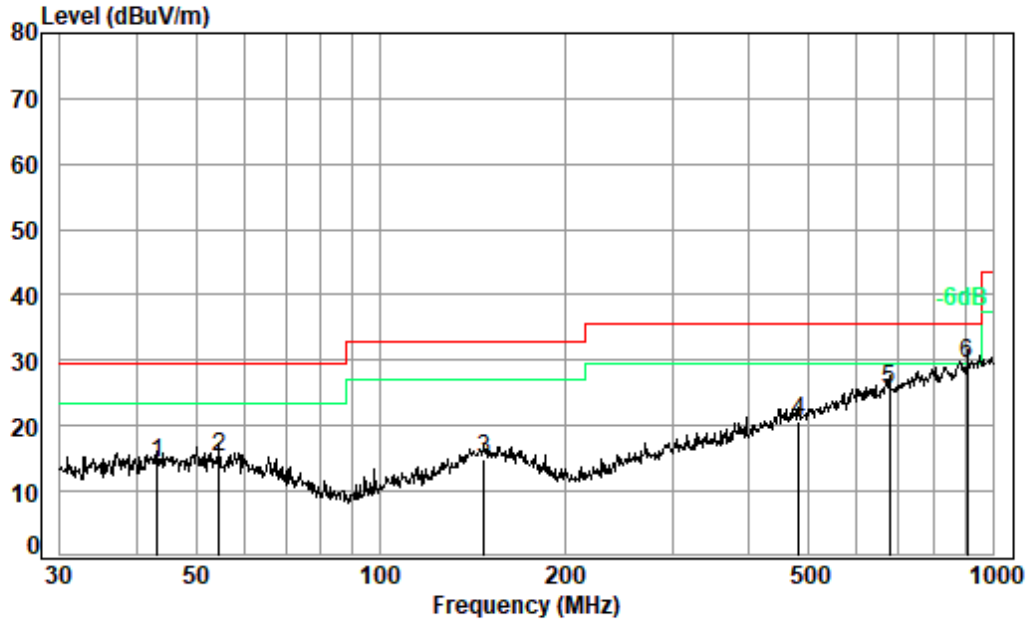
- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which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

Remark:

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



Test Mode: 00; Polarity: Horizontal



Condition: 10m HORIZONTAL

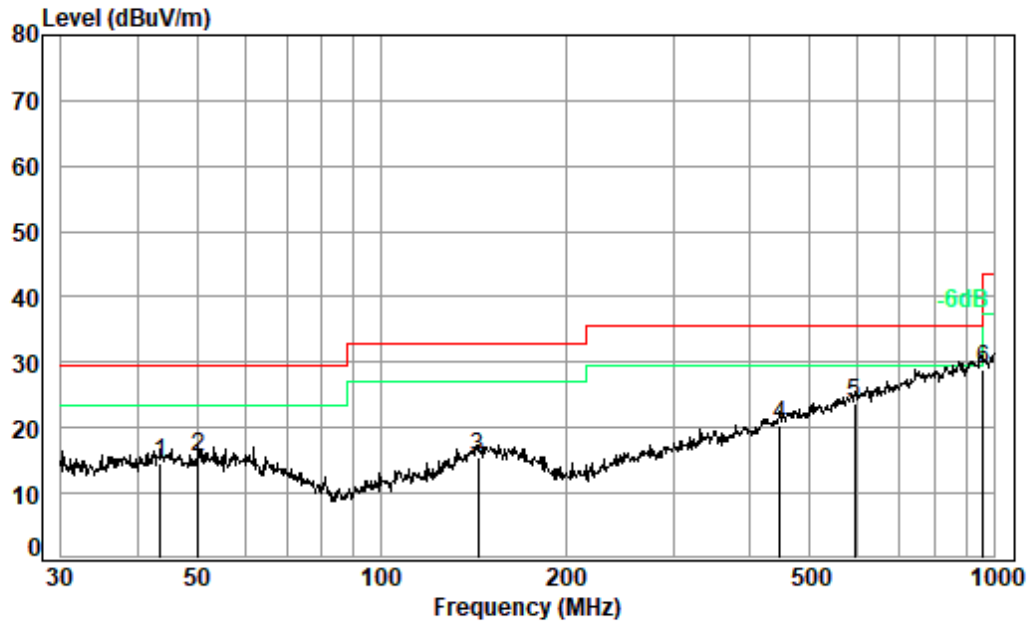
Job No. : 20508AT

Test Mode: 00

	Freq	Read Level	Ant Factor	Cable Loss	Preamplifier Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	43.202	25.43	20.34	0.94	32.50	14.21	29.50	-15.29	QP
2	54.643	26.93	19.90	1.00	32.49	15.34	29.50	-14.16	QP
3	147.921	25.89	20.10	1.48	32.42	15.05	33.00	-17.95	QP
4	482.216	26.61	23.74	2.73	32.30	20.78	35.60	-14.82	QP
5	677.580	27.84	26.78	3.24	32.30	25.56	35.60	-10.04	QP
6 pp	909.667	27.99	29.54	3.47	31.51	29.49	35.60	-6.11	QP



Test Mode: 00; Polarity: Vertical



Condition: 10m VERTICAL

Job No. : 20508AT

Test Mode: 00

	Freq	Read Level	Ant Factor	Cable Loss	Preamplifier Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	43.506	25.90	20.32	0.94	32.50	14.66	29.50	-14.84	QP
2	50.232	26.70	20.25	0.96	32.50	15.41	29.50	-14.09	QP
3	143.830	26.54	19.90	1.46	32.42	15.48	33.00	-17.52	QP
4	447.982	26.80	23.40	2.60	32.30	20.50	35.60	-15.10	QP
5	593.050	27.09	25.82	3.08	32.30	23.69	35.60	-11.91	QP
6 pp	958.794	26.59	29.89	3.58	31.06	29.00	35.60	-6.60	QP



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

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

Note:

L₃: Level @ 3m distance. Unit: uV/m;

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

D₃: 3m distance. Unit: m

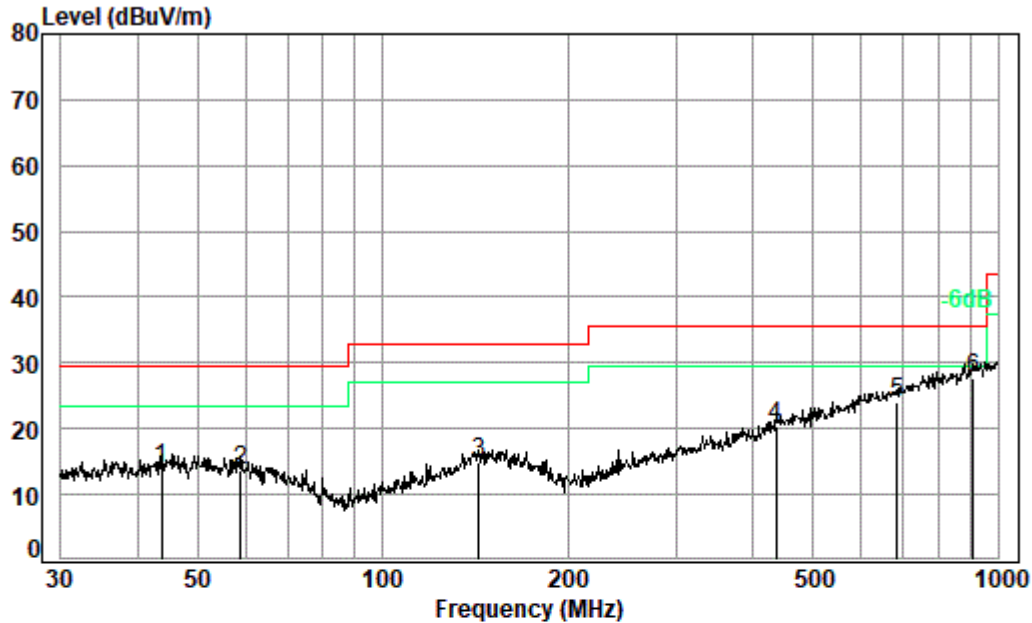
D₁₀: 10m distance. Unit: m

The level at 3m test distance is below:

Frequency (MHz)	Level @ 10m (dBuV/m)	Level @ 10m (uV/m)	Level @ 3m (uV/m)	Level @ 3m (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Ant. Polarization
43.51	14.66	5.41	18.03	25.12	40.00	-14.88	V
50.23	15.41	5.90	19.65	25.87	40.00	-14.13	V
143.83	15.48	5.94	19.81	25.94	43.50	-17.56	V
447.98	20.50	10.59	35.31	30.96	46.00	-15.04	V
593.05	23.69	15.29	50.98	34.15	46.00	-11.85	V
958.79	29.00	28.18	93.95	39.46	46.00	-6.54	V
43.20	14.21	5.13	17.12	24.67	40.00	-15.33	H
54.64	15.34	5.85	19.49	25.80	40.00	-14.20	H
147.92	15.05	5.66	18.85	25.51	43.50	-17.99	H
482.22	20.78	10.94	36.47	31.24	46.00	-14.76	H
677.58	25.56	18.97	63.22	36.02	46.00	-9.98	H
909.67	29.49	29.82	99.40	39.95	46.00	-6.05	H



Test Mode: 02; Polarity: Horizontal



Condition: 10m HORIZONTAL

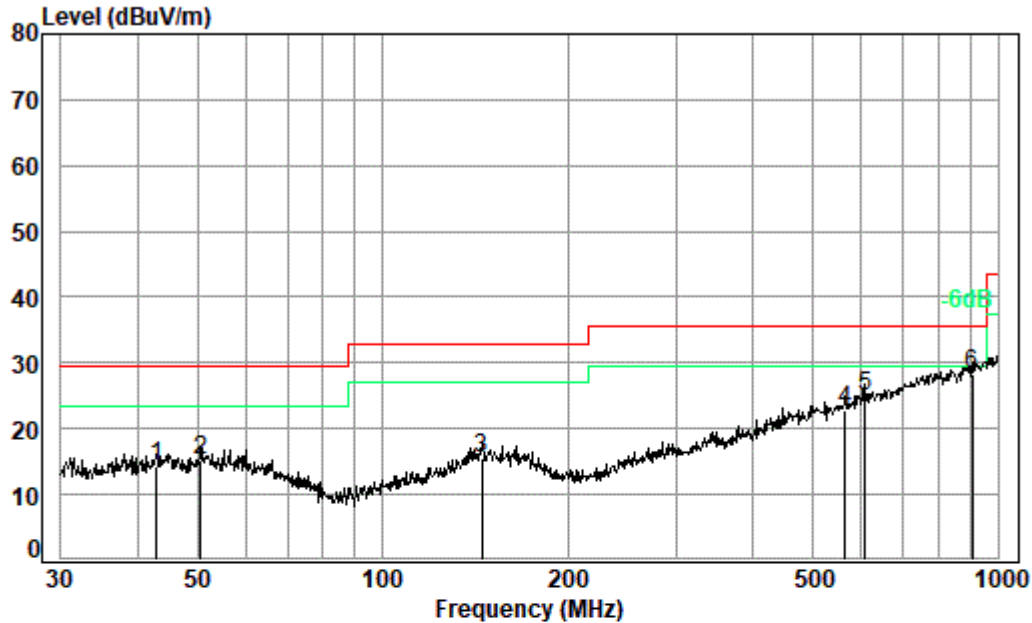
Job No. : 20508AT

Test Mode: 02

		Read	Ant	Cable	Preamp		Limit	Over	
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	43.812	25.34	20.31	0.94	32.50	14.09	29.50	-15.41	QP
2	58.819	25.72	19.45	1.04	32.49	13.72	29.50	-15.78	QP
3	143.326	25.92	19.87	1.46	32.42	14.83	33.00	-18.17	QP
4	435.590	27.32	22.87	2.54	32.30	20.43	35.60	-15.17	QP
5	684.745	26.04	26.90	3.26	32.30	23.90	35.60	-11.70	QP
6 pp	912.862	26.13	29.62	3.48	31.48	27.75	35.60	-7.85	QP



Test Mode: 02; Polarity: Vertical



Condition: 10m VERTICAL

Job No. : 20508AT

Test Mode: 02

	Freq	Read Level	Ant Factor	Cable Loss	Preamp Factor	Level	Limit	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	42.900	25.36	20.35	0.94	32.50	14.15	29.50	-15.35	QP
2	50.586	26.55	20.18	0.97	32.50	15.20	29.50	-14.30	QP
3	144.842	26.59	19.95	1.47	32.42	15.59	33.00	-17.41	QP
4	564.639	27.10	25.05	3.06	32.30	22.91	35.60	-12.69	QP
5	607.787	27.63	26.41	3.10	32.30	24.84	35.60	-10.76	QP
6 pp	906.482	26.89	29.46	3.46	31.54	28.27	35.60	-7.33	QP



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

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

Note:

L₃: Level @ 3m distance. Unit: uV/m;

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

D₃: 3m distance. Unit: m

D₁₀: 10m distance. Unit: m

The level at 3m test distance is below:

Frequency (MHz)	Level 10m (dBuV/m)	Level @ 10m (uV/m)	Level @ 3m (uV/m)	Level @ 3m (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Ant. Polarization
42.90	14.15	5.10	17.00	24.61	40.00	-15.39	V
50.59	15.20	5.75	19.18	25.66	40.00	-14.34	V
144.84	15.59	6.02	20.06	26.05	43.50	-17.45	V
564.64	22.91	13.98	46.60	33.37	46.00	-12.63	V
607.79	24.84	17.46	58.19	35.30	46.00	-10.70	V
906.48	28.27	25.91	86.37	38.73	46.00	-7.27	V
43.81	14.09	5.06	16.88	24.55	40.00	-15.45	H
58.38	13.72	4.85	16.18	24.18	40.00	-15.82	H
143.33	14.83	5.51	18.38	25.29	43.50	-18.21	H
435.59	20.43	10.51	35.03	30.89	46.00	-15.11	H
684.75	23.90	15.67	52.23	34.36	46.00	-11.64	H
912.86	27.75	24.41	81.35	38.21	46.00	-7.79	H



7.10 Radiated Spurious Emissions Above 1GHz

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

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

Limit:

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

7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

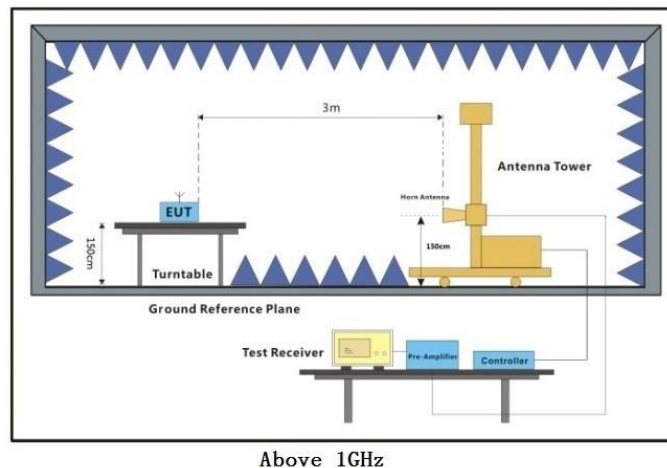
Humidity: 56.3 % RH

Atmospheric Pressure: 1010 mbar

7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode(left earbud)_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	02	TX_non-Hop mode(right earbud)_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.10.3 Test Setup Diagram



7.10.4 Measurement Procedure and Data

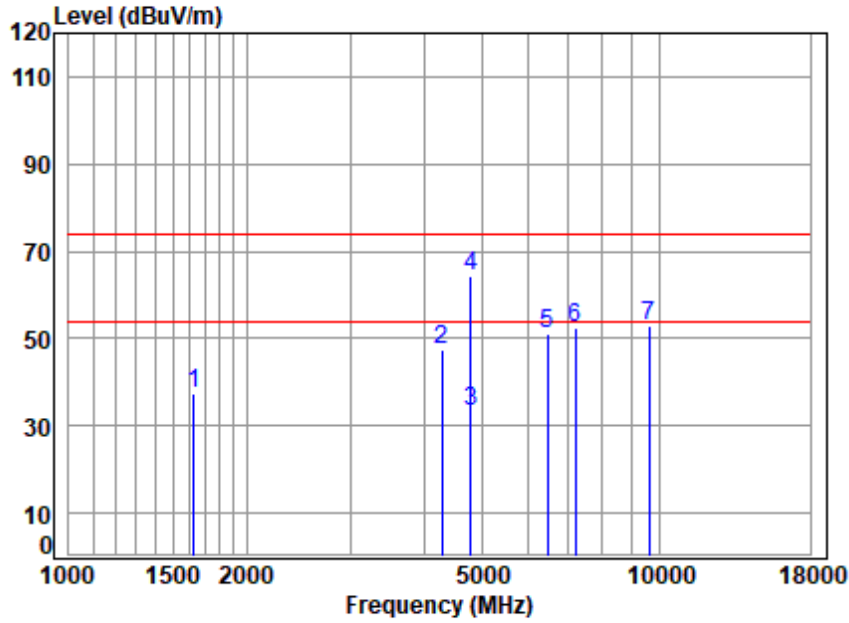
- a. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which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

Remark:

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



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

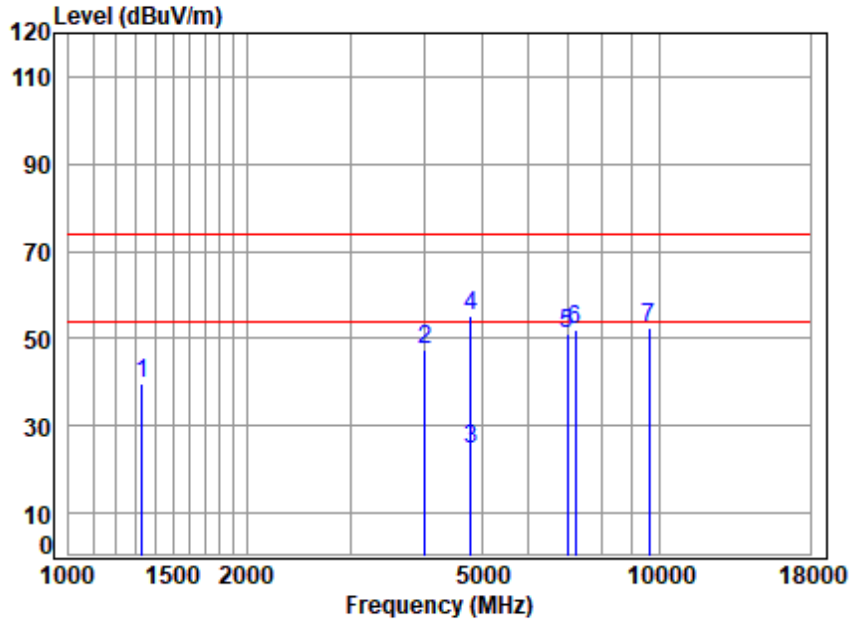


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2402 TX SE
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1629.825	3.37	26.36	40.02	47.82	37.53	74.00	-36.47	peak
2	4279.589	6.56	32.83	41.67	49.74	47.46	74.00	-26.54	peak
3	4804.000	7.10	33.62	42.14	34.72	33.30	54.00	-20.70	Average
4	4804.000	7.10	33.62	42.14	65.58	64.16	74.00	-9.84	peak
5	6470.026	8.28	34.60	42.06	50.40	51.22	74.00	-22.78	peak
6	7206.000	8.74	35.67	41.50	49.65	52.56	74.00	-21.44	peak
7	9608.000	10.81	37.34	37.76	42.60	52.99	74.00	-21.01	peak



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



Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2402 TX SE
Note : BT-L

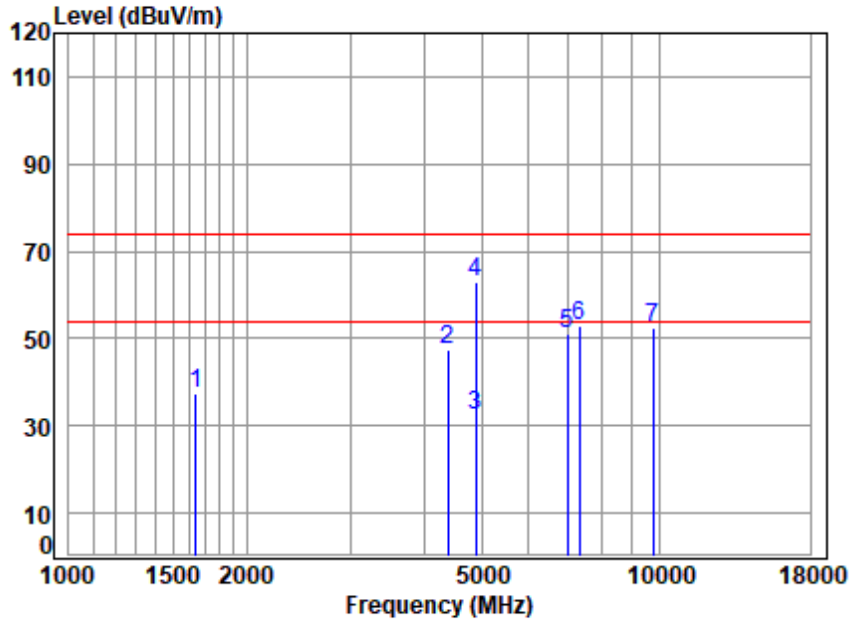
		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1331.288	3.00	25.38	39.85	51.03	39.56	74.00	-34.44	peak
2	4004.339	6.28	32.60	41.40	49.77	47.25	74.00	-26.75	peak
3	4804.000	7.10	33.62	42.14	25.90	24.48	54.00	-29.52	Average
4	4804.000	7.10	33.62	42.14	56.76	55.34	74.00	-18.66	peak
5	6995.172	8.54	35.49	41.70	48.89	51.22	74.00	-22.78	peak
6	7206.000	8.74	35.67	41.50	49.12	52.03	74.00	-21.97	peak
7	9608.000	10.81	37.34	37.76	42.15	52.54	74.00	-21.46	peak



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

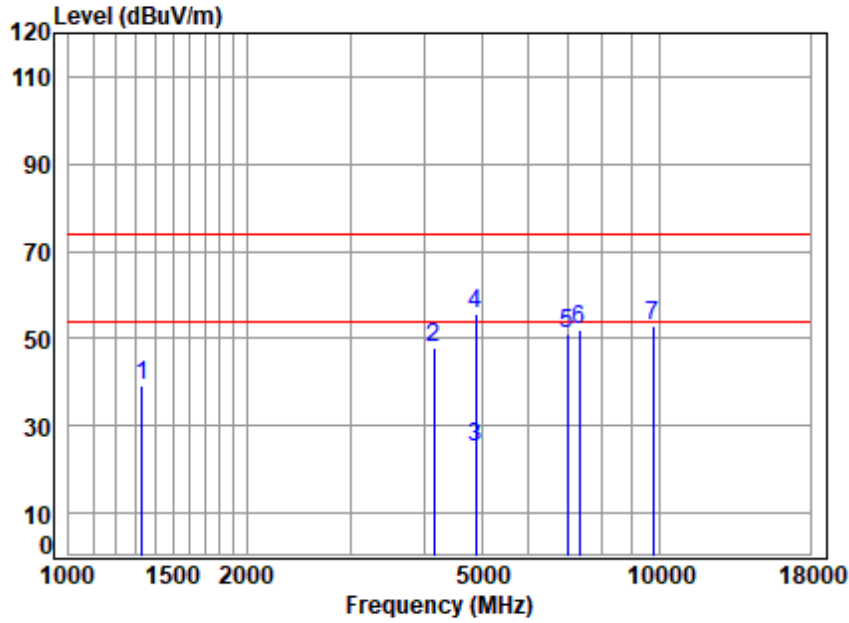


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2441 TX SE
Note : BT-L

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1639.274	3.38	26.41	40.03	47.82	37.58	74.00	-36.42	peak
2	4379.699	6.65	32.91	41.77	49.61	47.40	74.00	-26.60	peak
3	4882.000	7.18	33.77	42.20	33.51	32.26	54.00	-21.74	Average
4	4882.000	7.18	33.77	42.20	64.37	63.12	74.00	-10.88	peak
5	6995.172	8.54	35.49	41.70	48.85	51.18	74.00	-22.82	peak
6	7323.000	8.85	35.76	41.40	49.95	53.16	74.00	-20.84	peak
7	9764.000	10.76	37.41	37.50	41.69	52.36	74.00	-21.64	peak



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

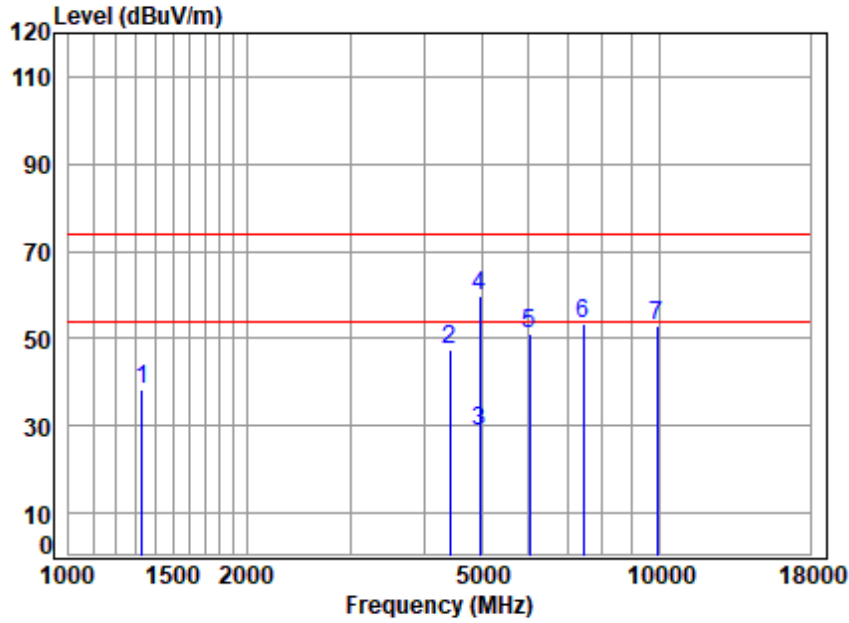


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2441 TX SE
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1331.288	3.00	25.38	39.85	50.93	39.46	74.00	-34.54	peak
2	4157.664	6.44	32.73	41.56	50.13	47.74	74.00	-26.26	peak
3	4882.000	7.18	33.77	42.20	26.23	24.98	54.00	-29.02	Average
4	4882.000	7.18	33.77	42.20	57.09	55.84	74.00	-18.16	peak
5	6974.982	8.53	35.46	41.72	48.75	51.02	74.00	-22.98	peak
6	7323.000	8.85	35.76	41.40	48.62	51.83	74.00	-22.17	peak
7	9764.000	10.76	37.41	37.50	42.47	53.14	74.00	-20.86	peak



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

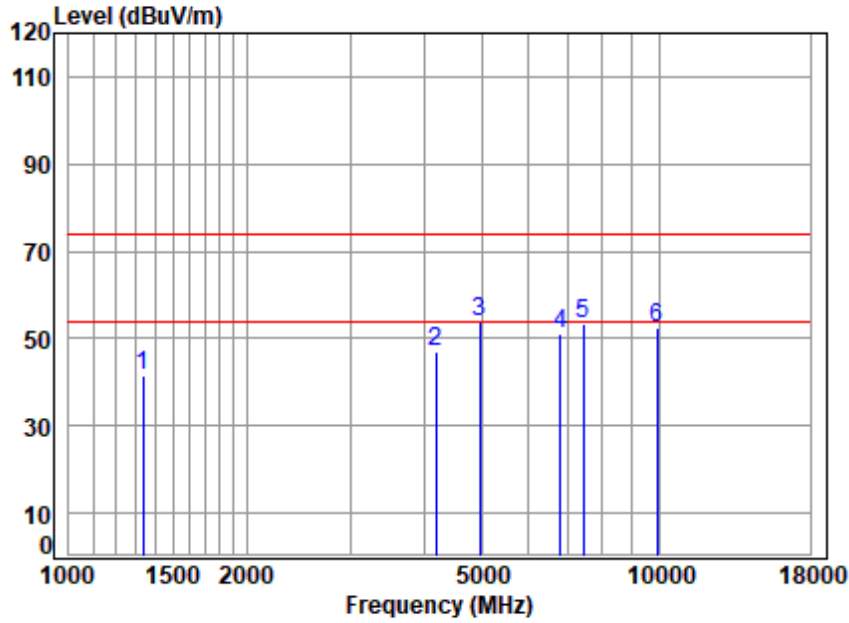


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2480 TX SE
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1331.288	3.00	25.38	39.85	49.94	38.47	74.00	-35.53	peak
2	4417.841	6.68	32.94	41.80	49.54	47.36	74.00	-26.64	peak
3	4960.000	7.26	33.92	42.27	29.89	28.80	54.00	-25.20	Average
4	4960.000	7.26	33.92	42.27	60.75	59.66	74.00	-14.34	peak
5	6018.999	8.26	34.60	42.39	50.43	50.90	74.00	-23.10	peak
6	7440.000	8.96	35.85	41.29	49.77	53.29	74.00	-20.71	peak
7	9920.000	10.71	37.47	37.23	41.89	52.84	74.00	-21.16	peak



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

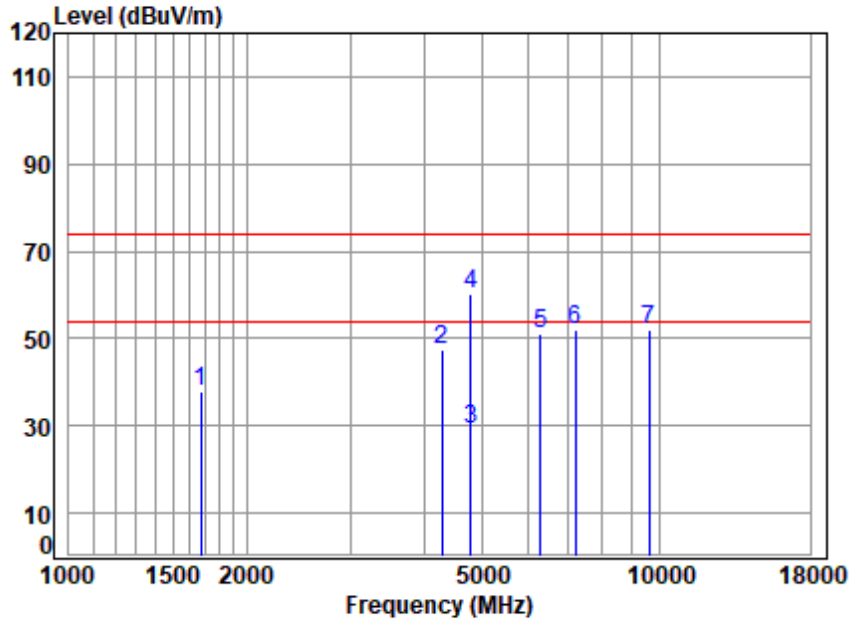


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2480 TX SE
Note : BT-L

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1335.141	3.00	25.38	39.85	52.82	41.35	74.00	-32.65	peak
2	4181.768	6.46	32.75	41.58	49.33	46.96	74.00	-27.04	peak
3	4960.000	7.26	33.92	42.27	54.82	53.73	74.00	-20.27	peak
4	6795.879	8.44	35.14	41.83	49.19	50.94	74.00	-23.06	peak
5	7440.000	8.96	35.85	41.29	49.70	53.22	74.00	-20.78	peak
6	9920.000	10.71	37.47	37.23	41.46	52.41	74.00	-21.59	peak



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:Low

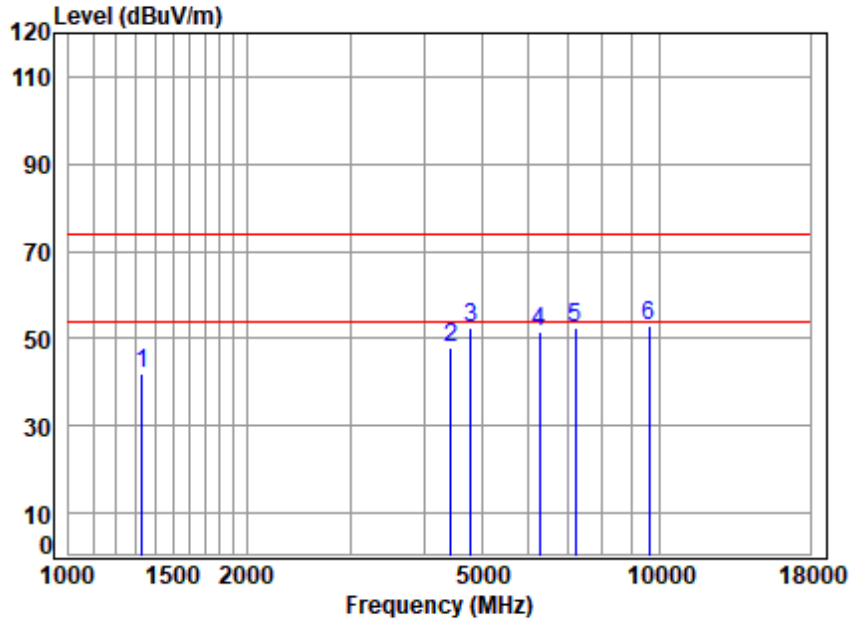


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2402 TX SE
Note : BT-R

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1672.779	3.41	26.57	40.05	48.05	37.98	74.00	-36.02	peak
2	4291.977	6.57	32.84	41.68	49.74	47.47	74.00	-26.53	peak
3	4804.000	7.10	33.62	42.14	30.67	29.25	54.00	-24.75	Average
4	4804.000	7.10	33.62	42.14	61.53	60.11	74.00	-13.89	peak
5	6285.695	8.27	34.60	42.19	50.23	50.91	74.00	-23.09	peak
6	7206.000	8.74	35.67	41.50	49.06	51.97	74.00	-22.03	peak
7	9608.000	10.81	37.34	37.76	41.71	52.10	74.00	-21.90	peak



Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: Low

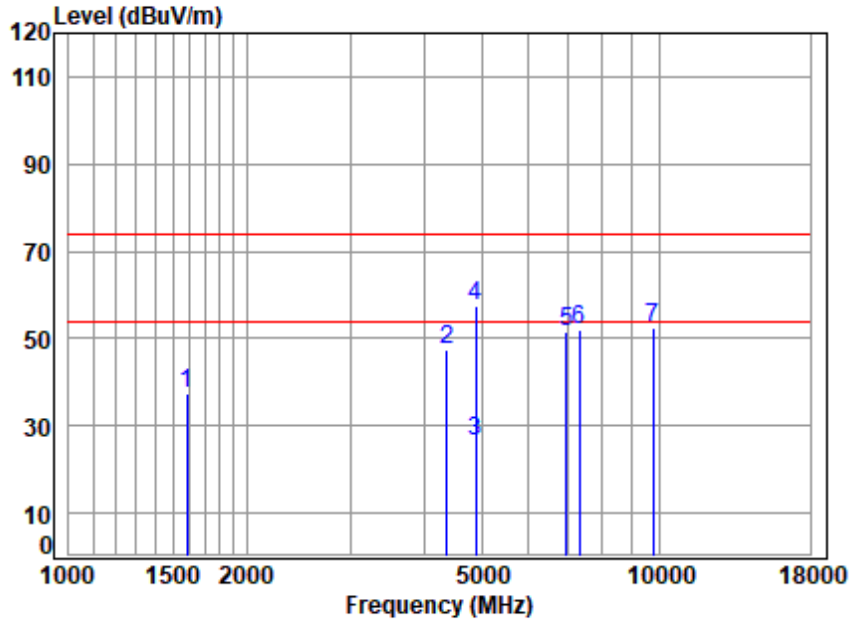


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2402 TX SE
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1331.288	3.00	25.38	39.85	53.66	42.19	74.00	-31.81	peak
2	4443.453	6.71	32.96	41.82	49.88	47.73	74.00	-26.27	peak
3	4804.000	7.10	33.62	42.14	53.74	52.32	74.00	-21.68	peak
4	6267.553	8.27	34.60	42.20	50.76	51.43	74.00	-22.57	peak
5	7206.000	8.74	35.67	41.50	49.37	52.28	74.00	-21.72	peak
6	9608.000	10.81	37.34	37.76	42.60	52.99	74.00	-21.01	peak



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:middle

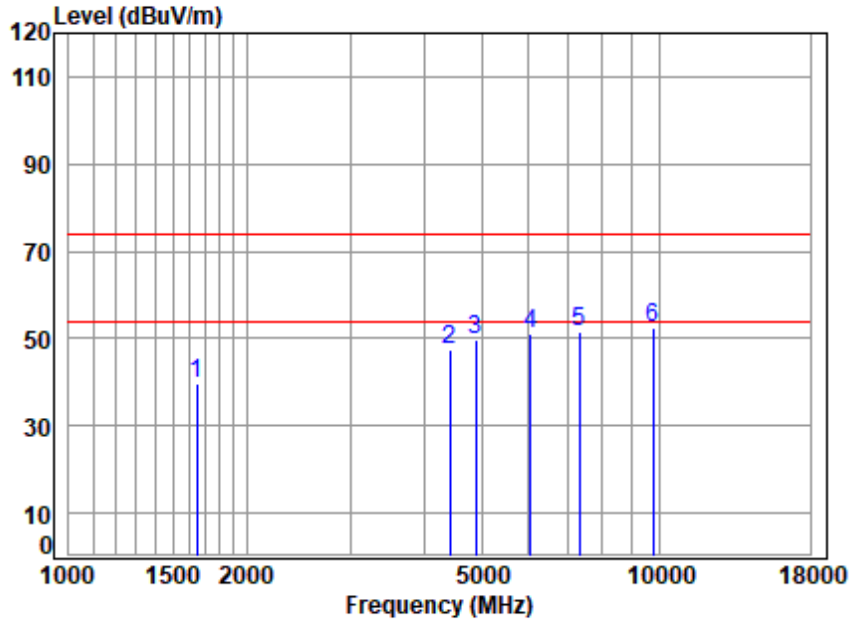


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2441 TX SE
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1587.975	3.34	26.16	40.00	48.12	37.62	74.00	-36.38	peak
2	4367.058	6.64	32.90	41.75	49.67	47.46	74.00	-26.54	peak
3	4882.000	7.18	33.77	42.20	27.77	26.52	54.00	-27.48	Average
4	4882.000	7.18	33.77	42.20	58.63	57.38	74.00	-16.62	peak
5	6954.852	8.52	35.42	41.73	49.43	51.64	74.00	-22.36	peak
6	7323.000	8.85	35.76	41.40	48.62	51.83	74.00	-22.17	peak
7	9764.000	10.76	37.41	37.50	41.75	52.42	74.00	-21.58	peak



Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: middle

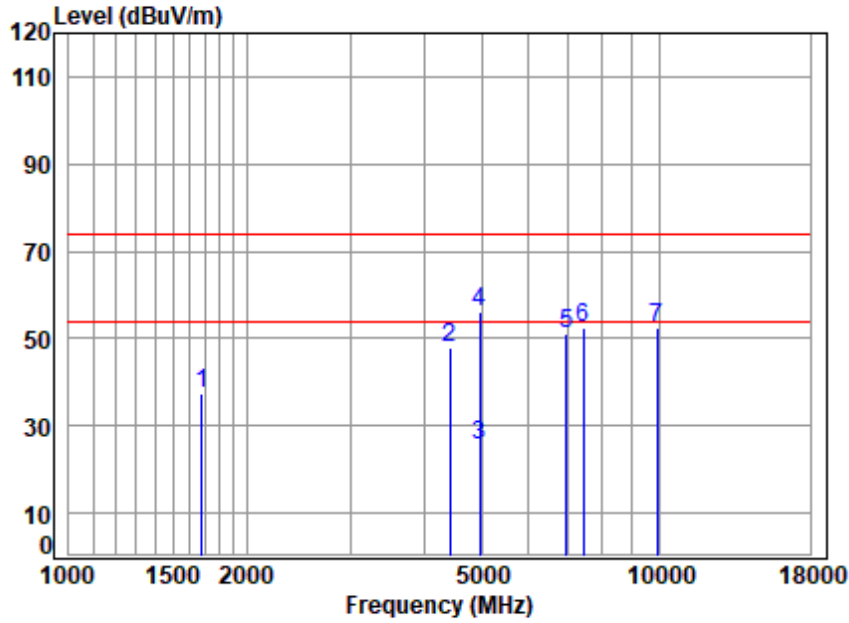


Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2441 TX SE
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1648.778	3.39	26.46	40.03	49.98	39.80	74.00	-34.20	peak
2	4417.841	6.68	32.94	41.80	49.44	47.26	74.00	-26.74	peak
3	4882.000	7.18	33.77	42.20	50.85	49.60	74.00	-24.40	peak
4	6053.894	8.26	34.60	42.36	50.51	51.01	74.00	-22.99	peak
5	7323.000	8.85	35.76	41.40	48.28	51.49	74.00	-22.51	peak
6	9764.000	10.76	37.41	37.50	41.69	52.36	74.00	-21.64	peak



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:High

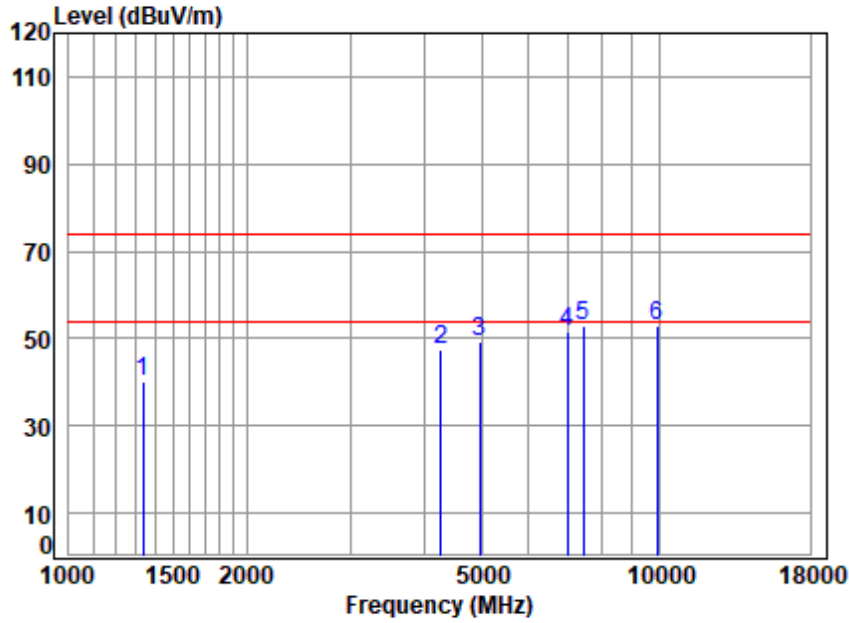


Site : chamber
Condition: 3m HORIZONTAL
Job No : 20508AT
Mode : 2480 TX SE
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1677.621	3.41	26.59	40.05	47.62	37.57	74.00	-36.43	peak
2	4417.841	6.68	32.94	41.80	49.98	47.80	74.00	-26.20	peak
3	4960.000	7.26	33.92	42.27	26.56	25.47	54.00	-28.53	Average
4	4960.000	7.26	33.92	42.27	57.42	56.33	74.00	-17.67	peak
5	6954.852	8.52	35.42	41.73	49.08	51.29	74.00	-22.71	peak
6	7440.000	8.96	35.85	41.29	48.91	52.43	74.00	-21.57	peak
7	9920.000	10.71	37.47	37.23	41.46	52.41	74.00	-21.59	peak



Test Mode: 02; Polarity: Vertical; Modulation:GFSK; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 20508AT
Mode : 2480 TX SE
Note : BT-R

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1335.141	3.00	25.38	39.85	51.57	40.10	74.00	-33.90	peak
2	4267.237	6.54	32.82	41.66	49.74	47.44	74.00	-26.56	peak
3	4960.000	7.26	33.92	42.27	50.41	49.32	74.00	-24.68	peak
4	6974.982	8.53	35.46	41.72	49.27	51.54	74.00	-22.46	peak
5	7440.000	8.96	35.85	41.29	49.43	52.95	74.00	-21.05	peak
6	9920.000	10.71	37.47	37.23	41.80	52.75	74.00	-21.25	peak



8 Test Setup Photo

Refer to setup photos for SZCR2104020508AT

9 EUT Constructional Details (EUT Photos)

Please Refer to external and internal photos for SZCR2104020508AT



10 Appendix

Appendix for 15.247-R

1. Bandwidth

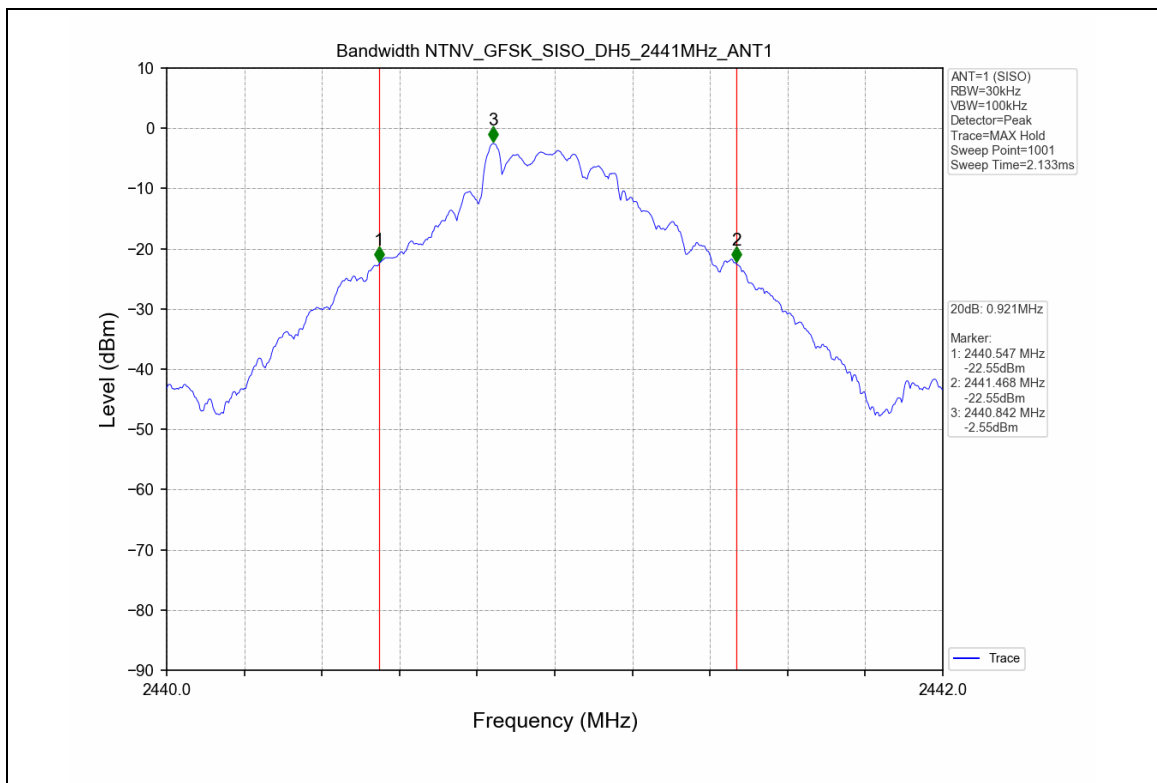
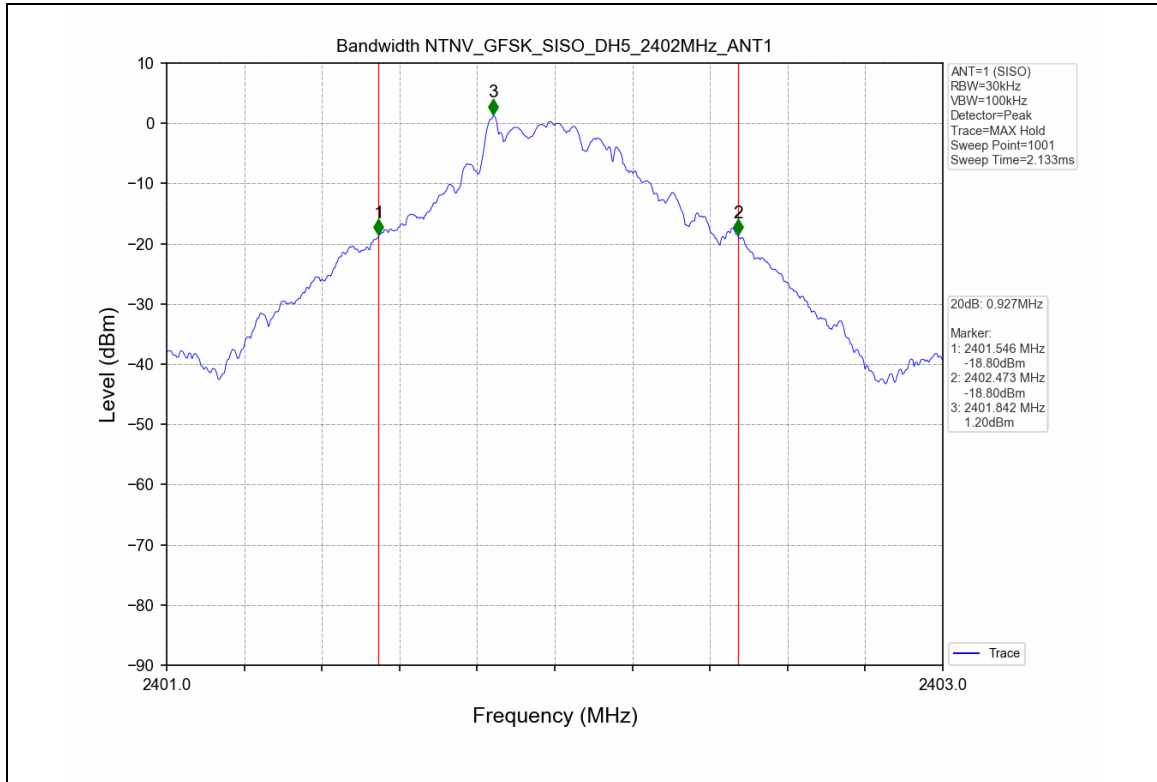
1.1 Test Result

Test Mode	Frequency (MHz)	TX Type	ANT No.	20dB Bandwidth	Verdict
				Test Result (MHz)	
GFSK	2402	SISO	1	0.927	PASS
	2441	SISO	1	0.921	PASS
	2480	SISO	1	0.926	PASS
Pi/4DQPSK	2402	SISO	1	1.257	PASS
	2441	SISO	1	1.238	PASS
	2480	SISO	1	1.230	PASS
8DPSK	2402	SISO	1	1.258	PASS
	2441	SISO	1	1.254	PASS
	2480	SISO	1	1.251	PASS

Test Mode	Frequency (MHz)	TX Type	ANT No.	99% Occupied Bandwidth	
				Test Result (MHz)	
GFSK	2402	SISO	1	0.881	Only for Report Use
	2441	SISO	1	0.868	Only for Report Use
	2480	SISO	1	0.858	Only for Report Use
Pi/4DQPSK	2402	SISO	1	1.174	Only for Report Use
	2441	SISO	1	1.170	Only for Report Use
	2480	SISO	1	1.163	Only for Report Use
8DPSK	2402	SISO	1	1.172	Only for Report Use
	2441	SISO	1	1.167	Only for Report Use
	2480	SISO	1	1.159	Only for Report Use

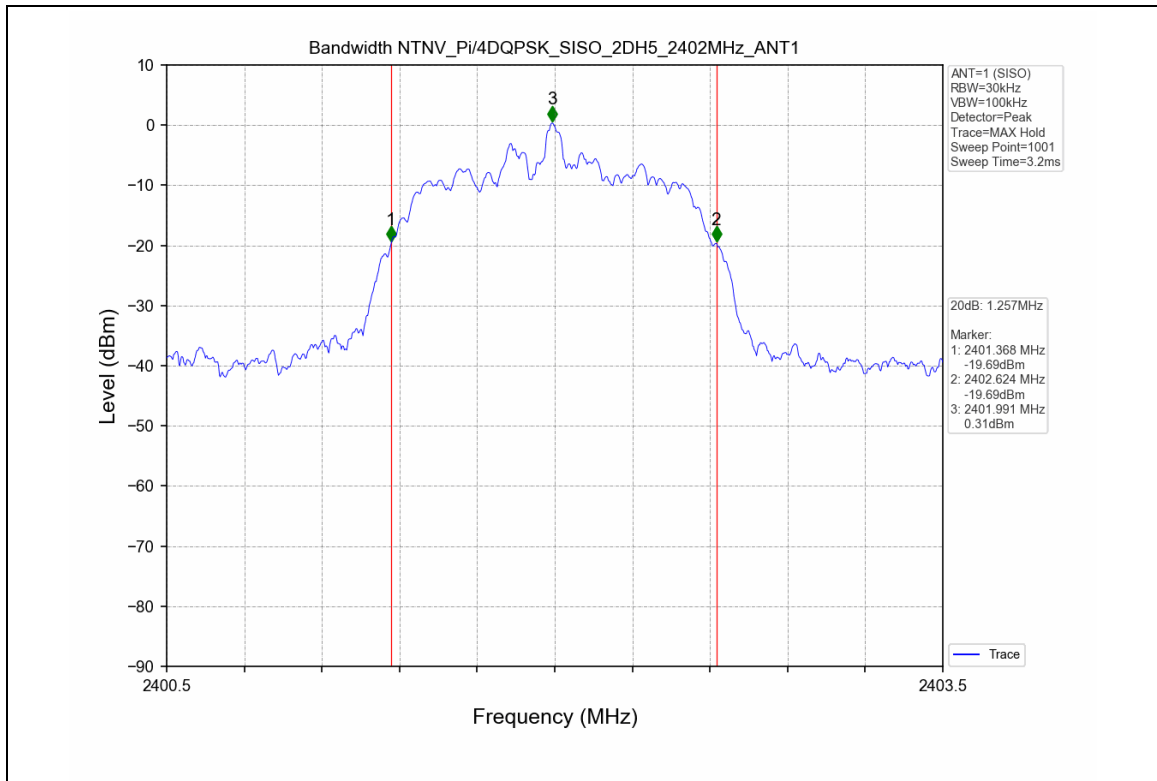
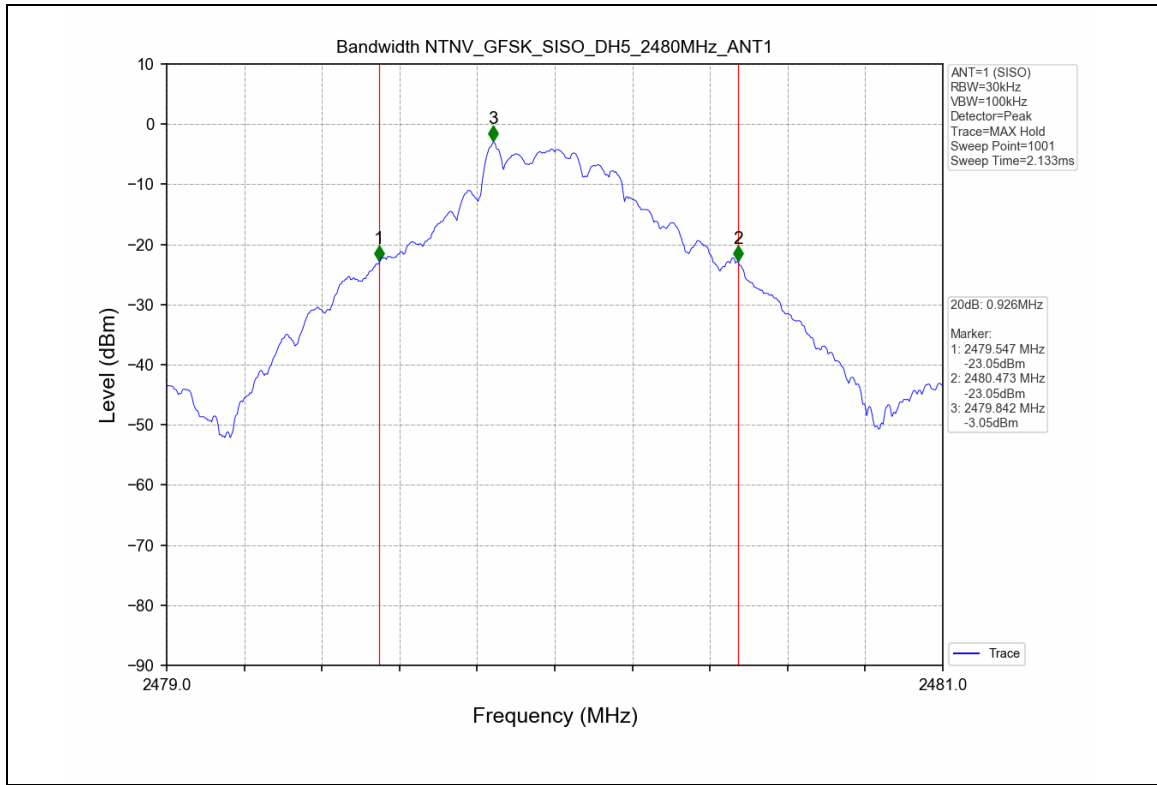


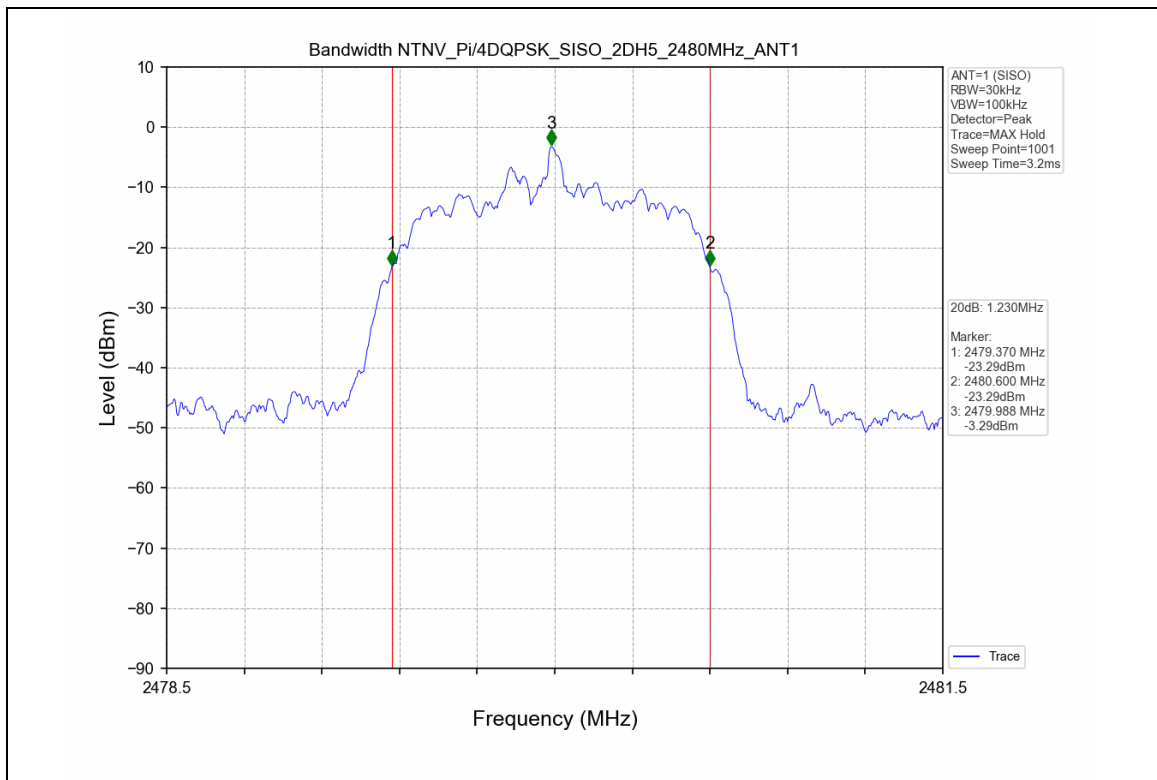
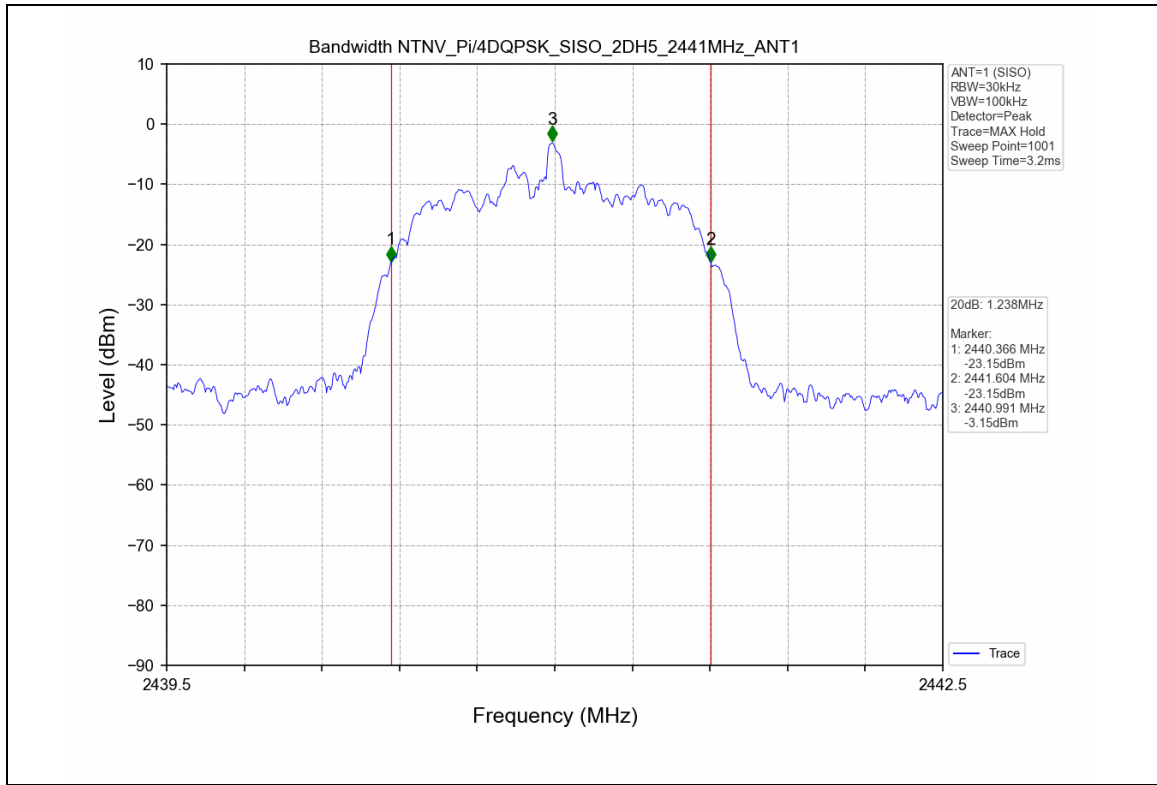
1.2 Test Graph - 20dB Bandwidth

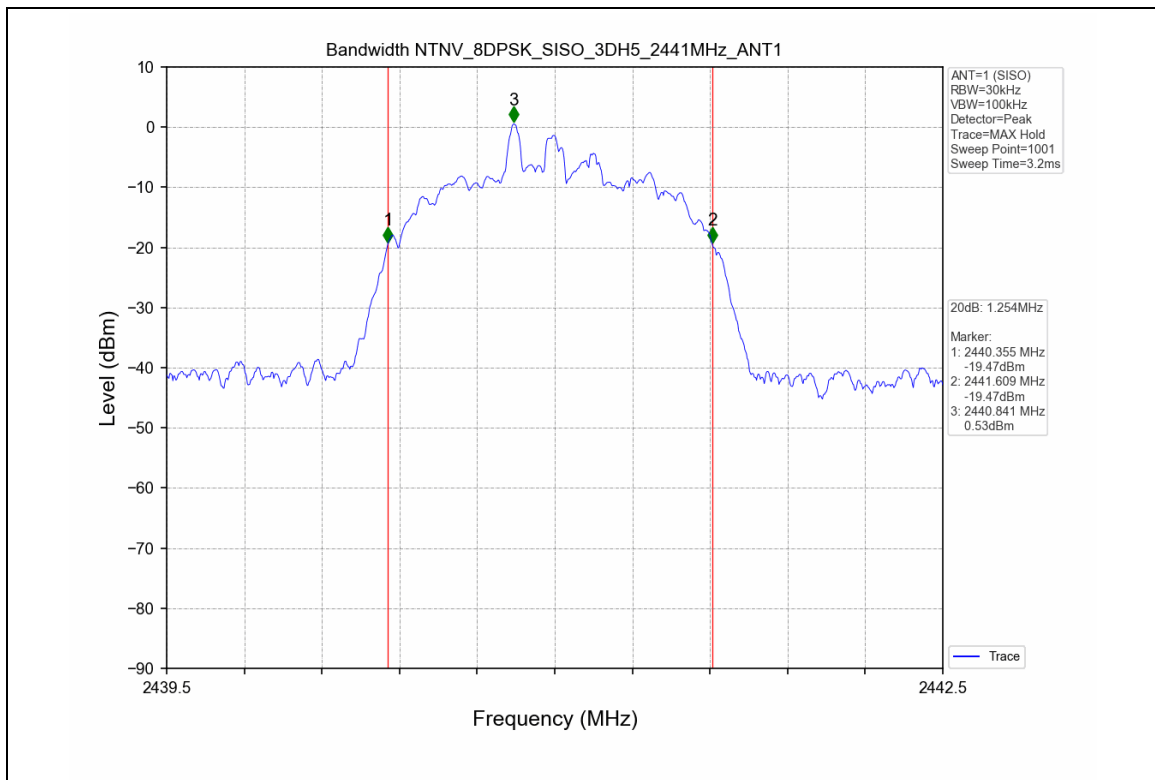
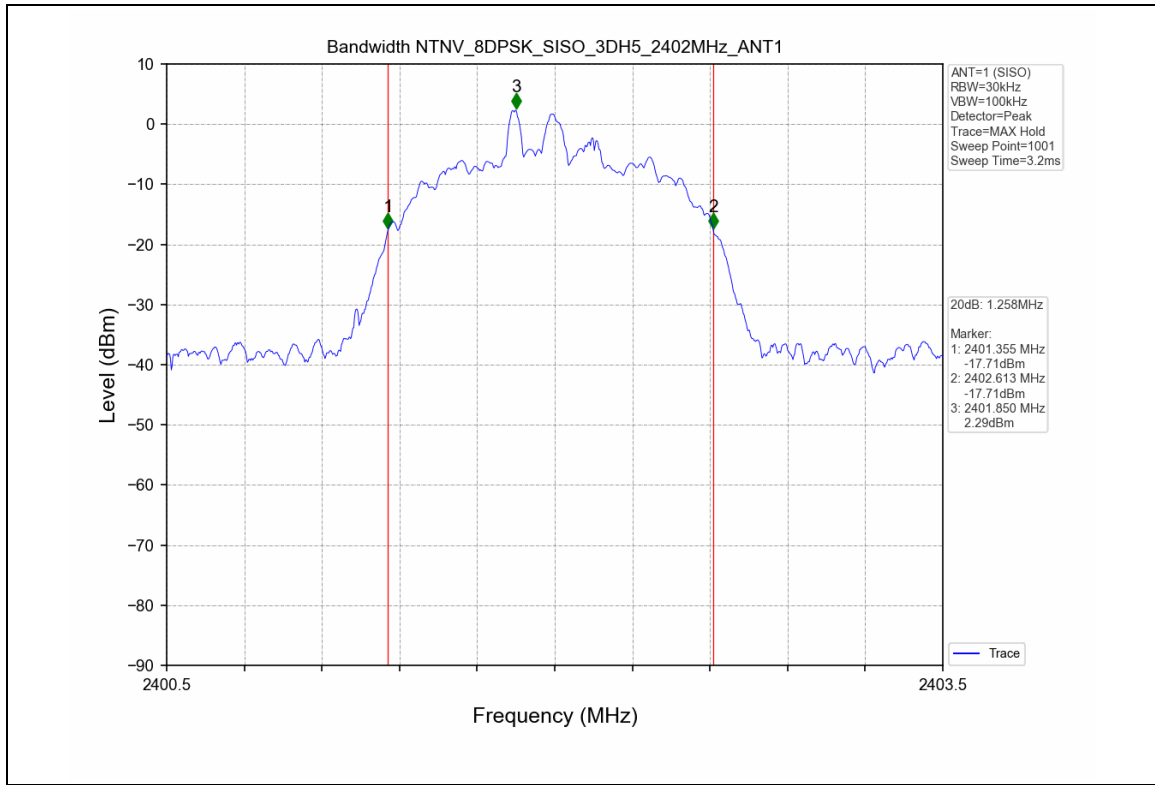


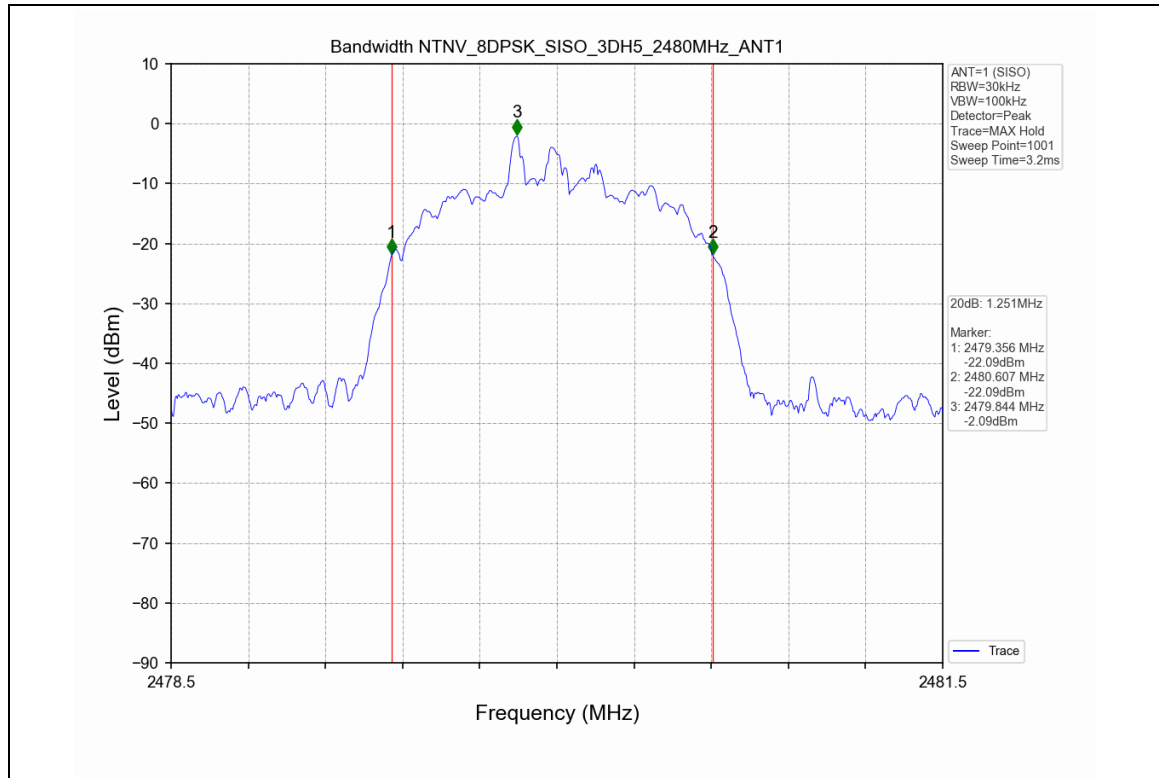
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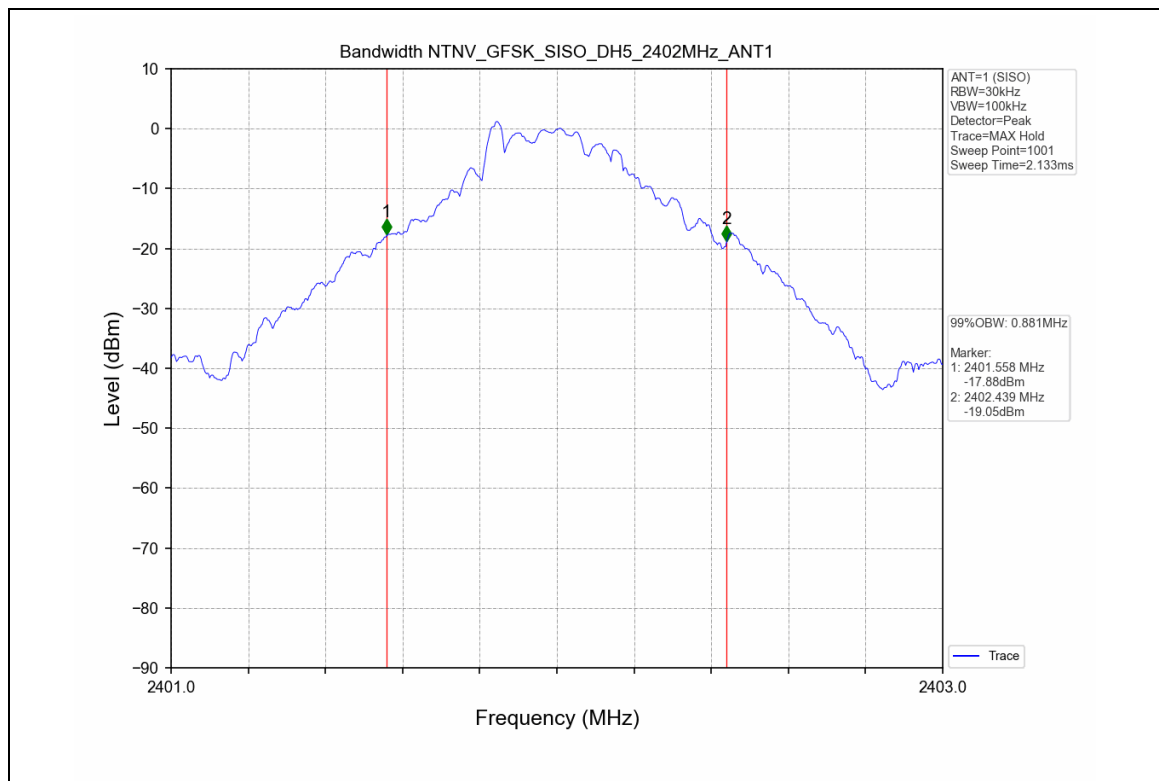






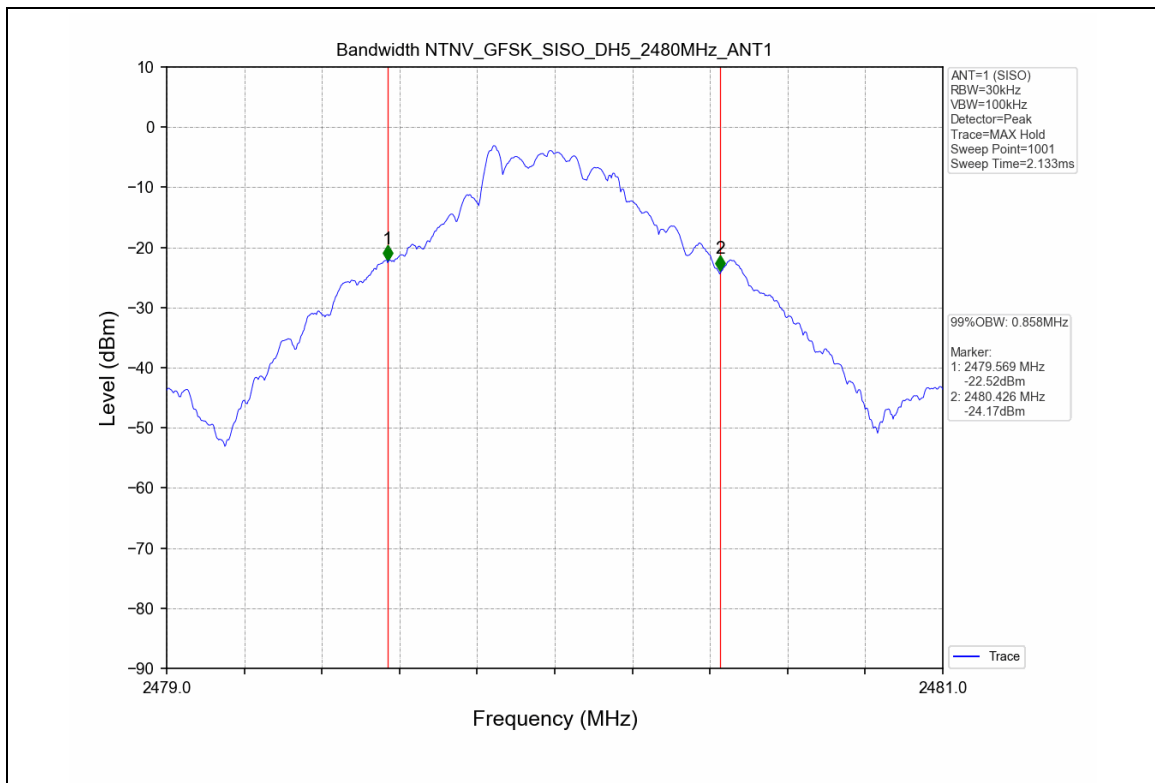
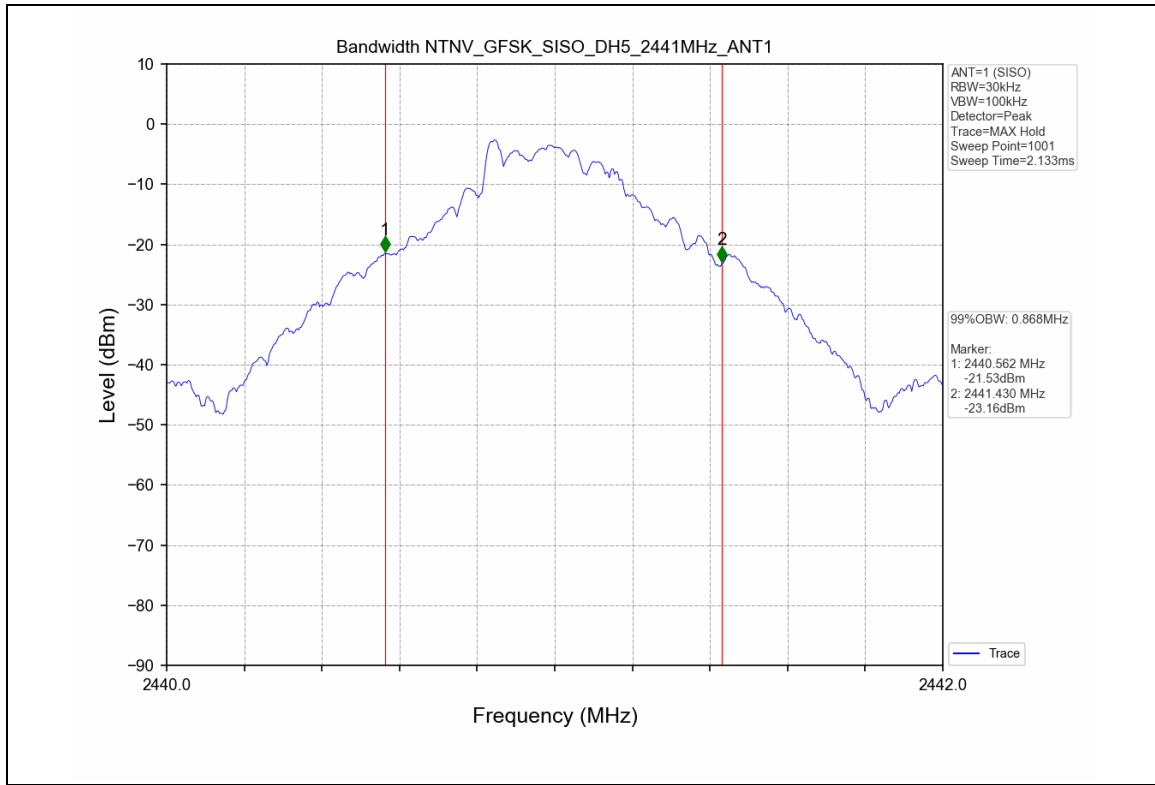


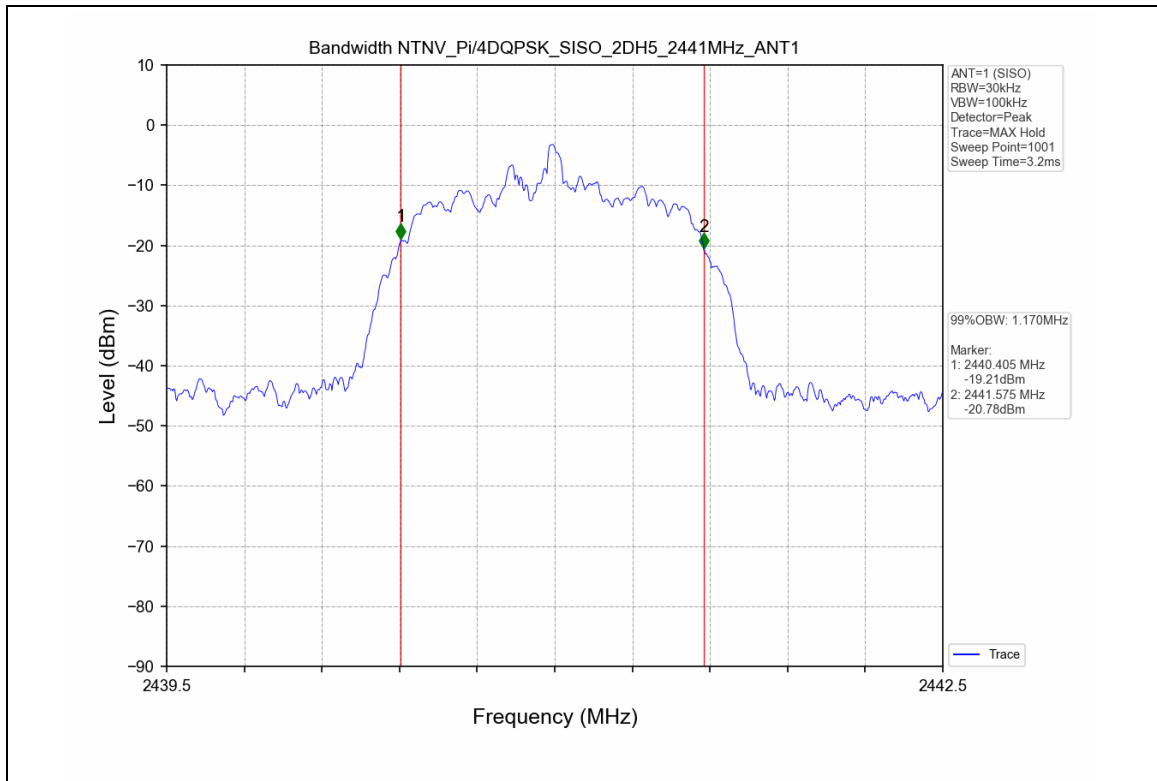
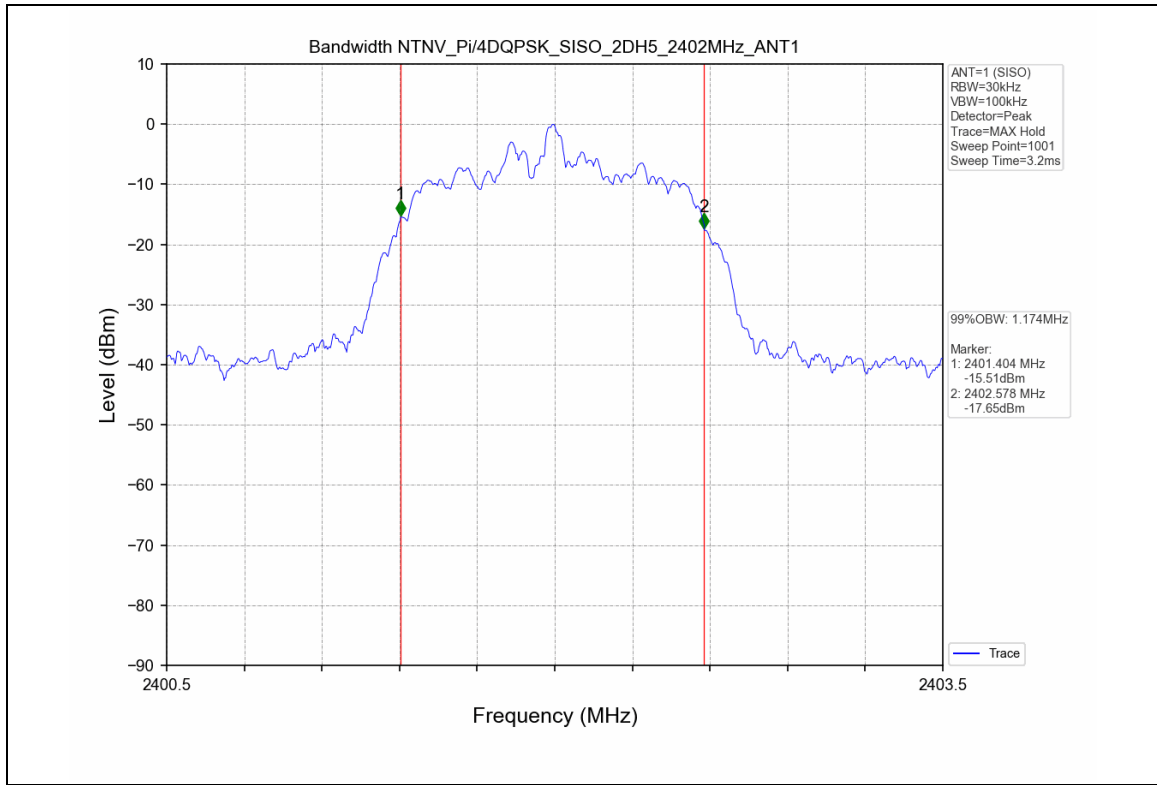
1.3 Test Graph - 99% Occupied Bandwidth

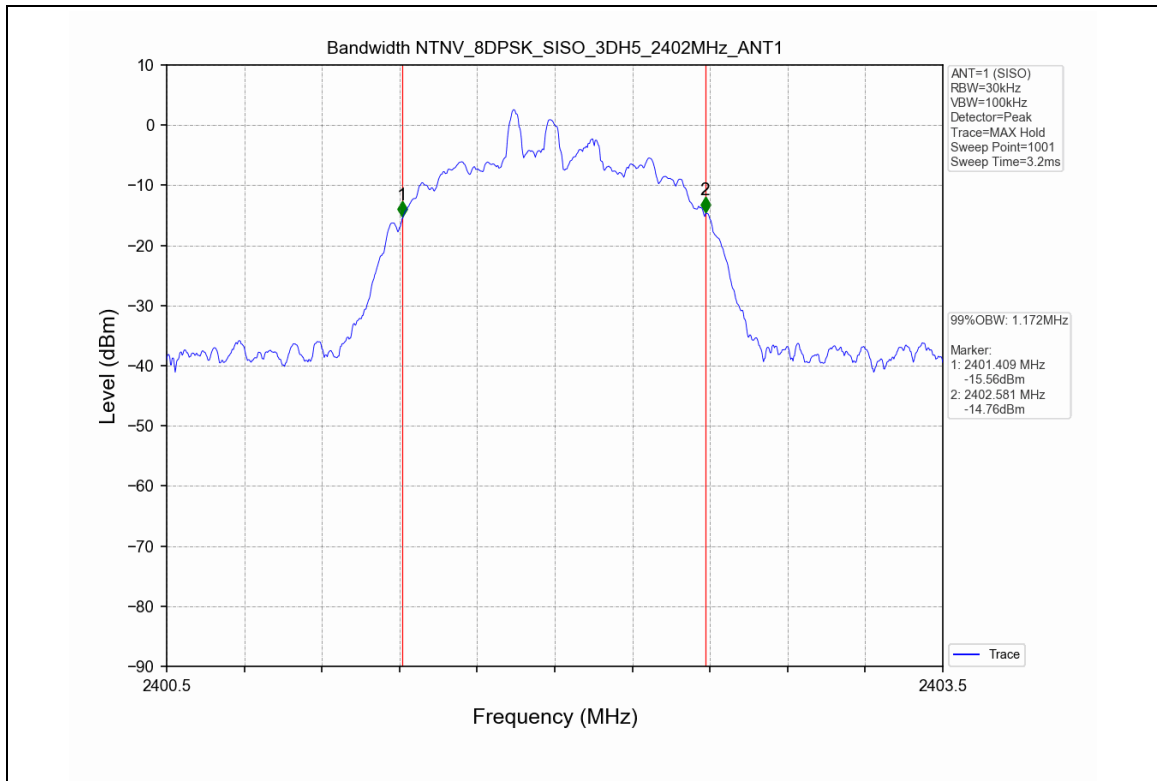
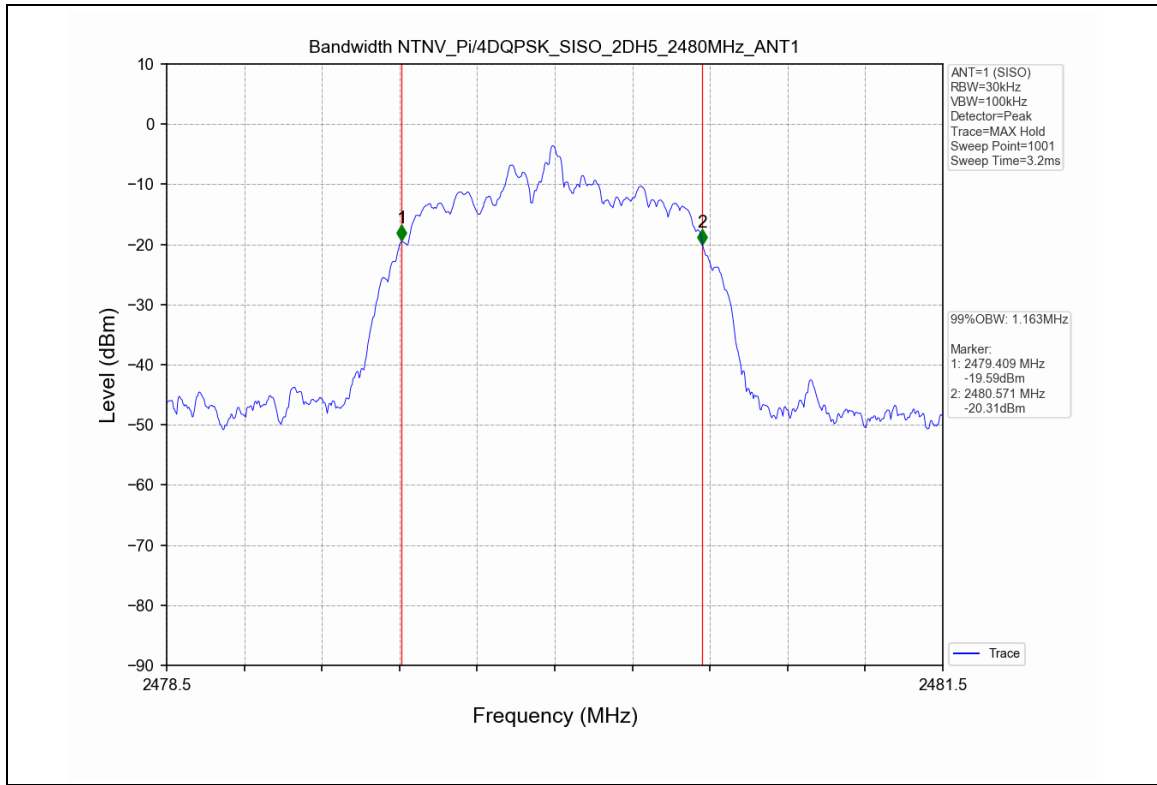


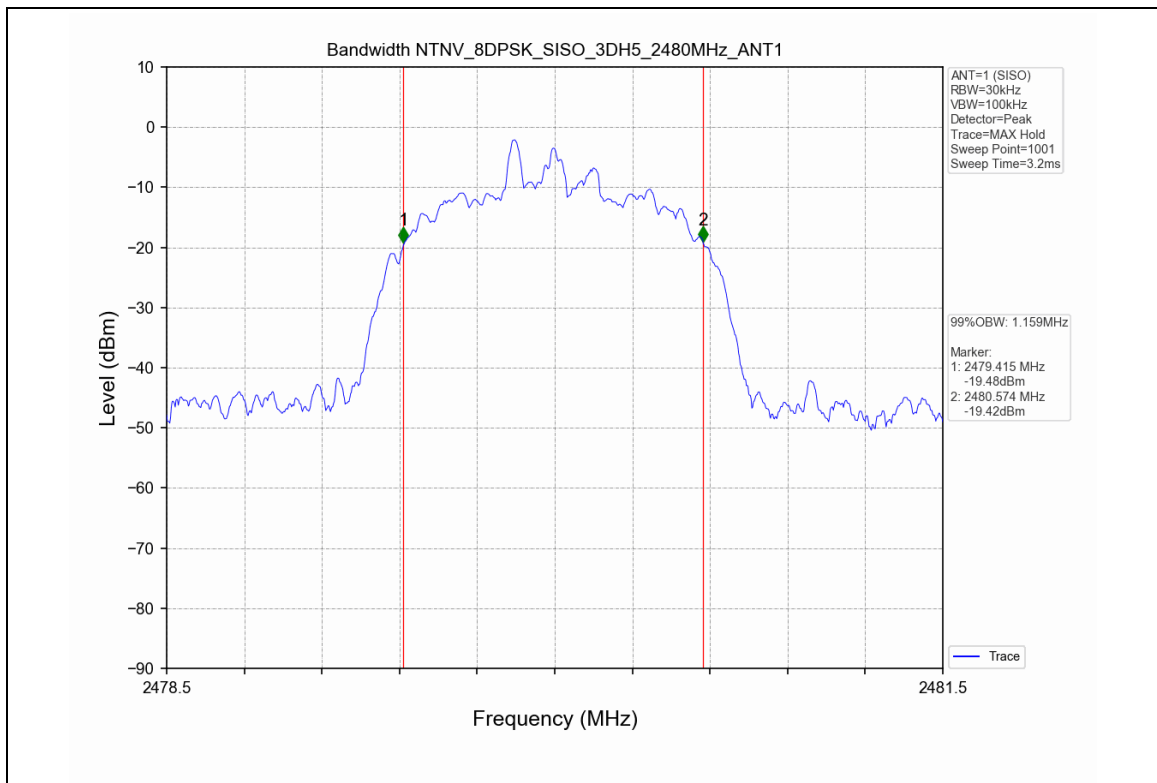
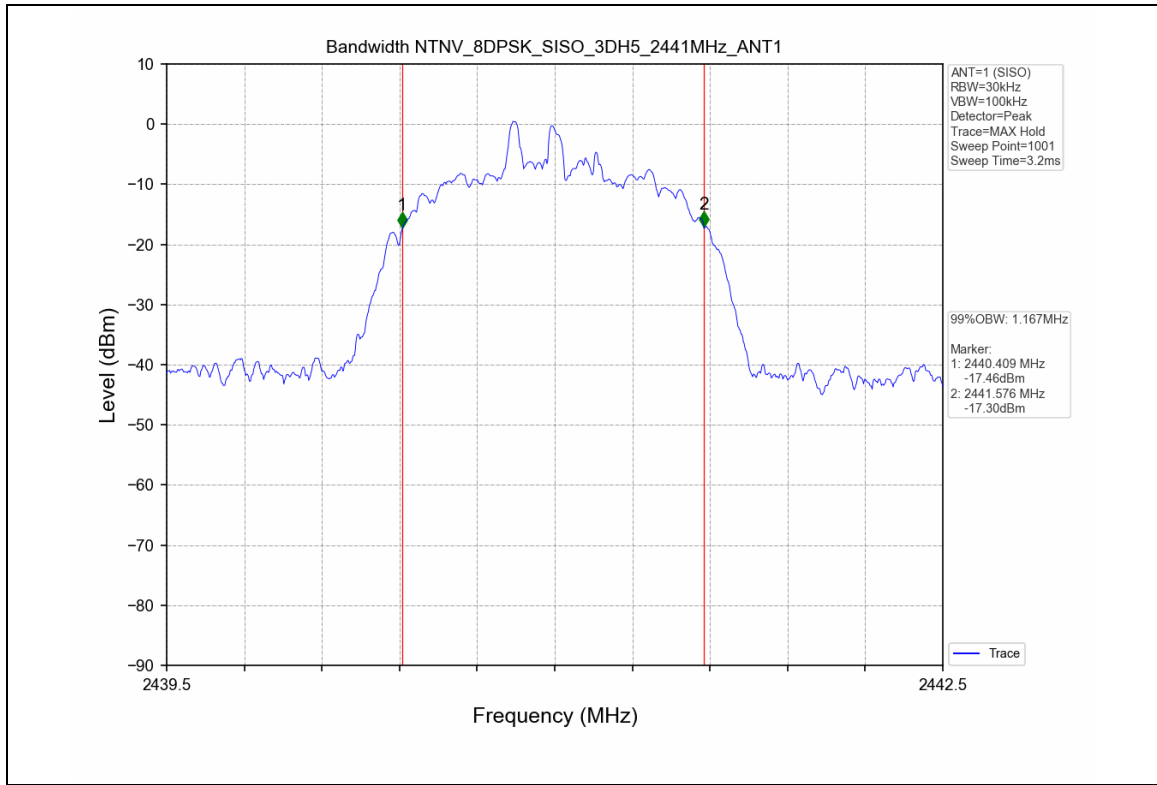
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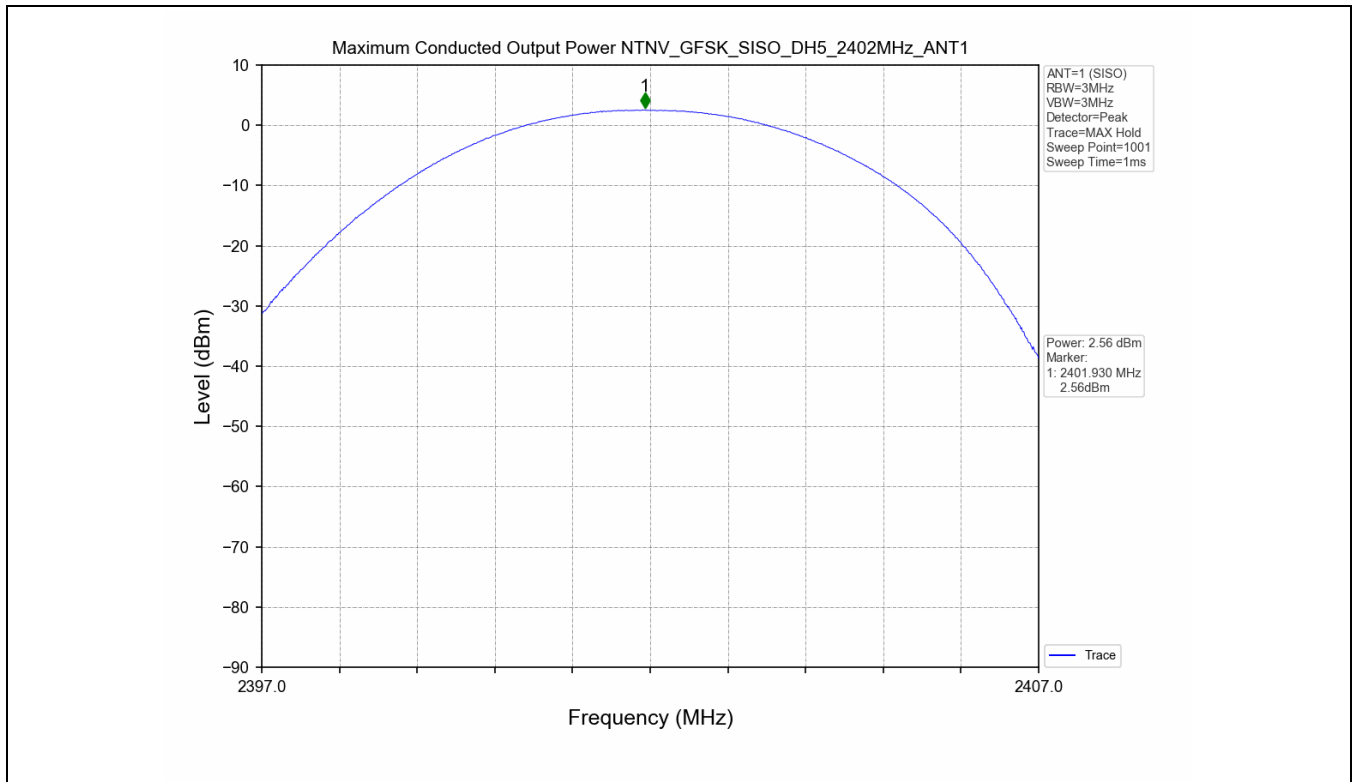


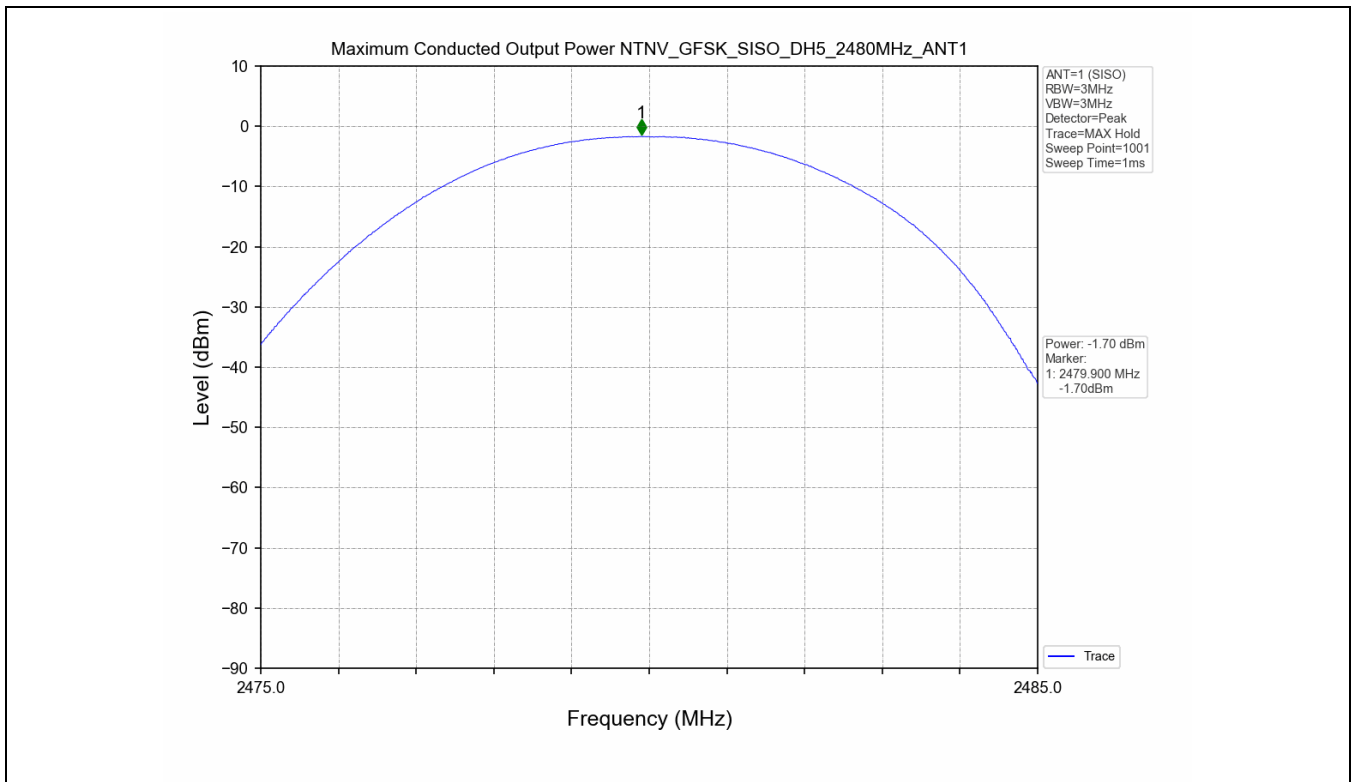
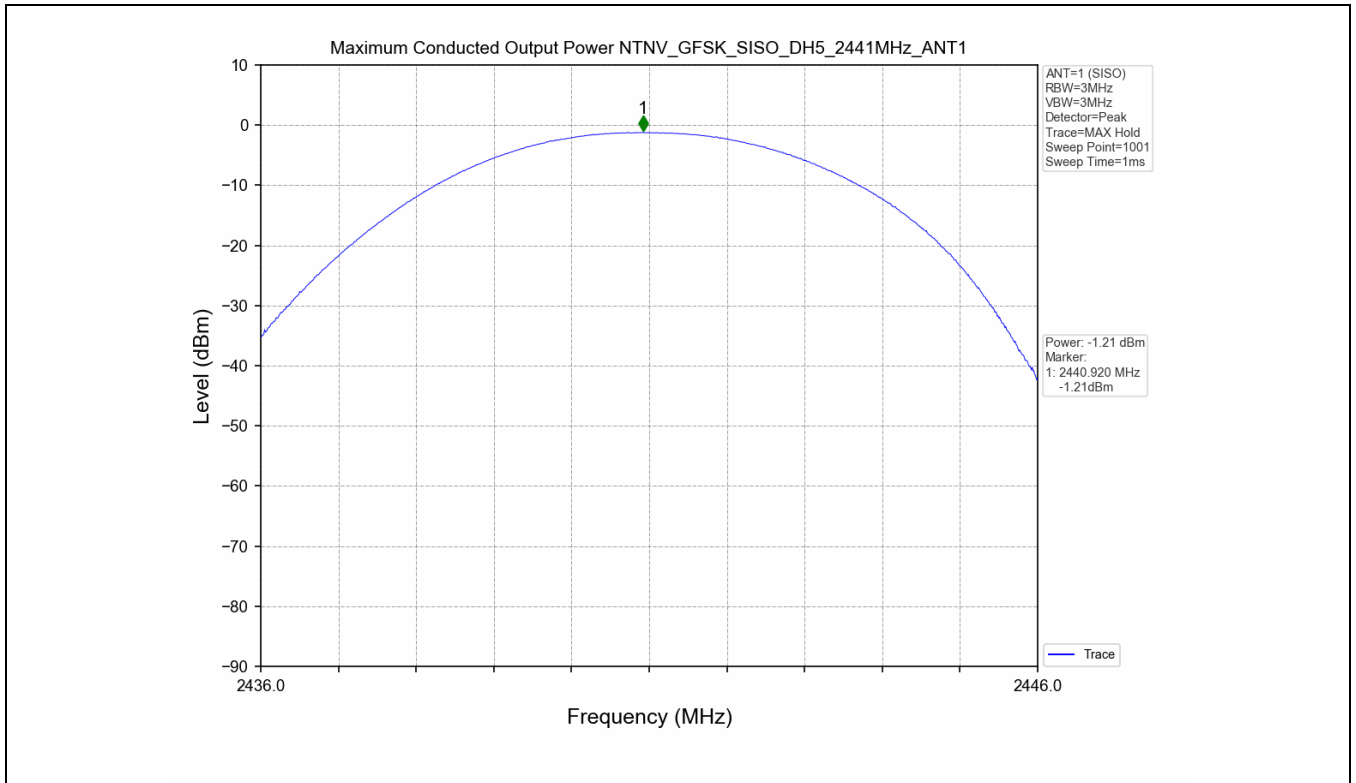
2. Maximum Conducted Output Power

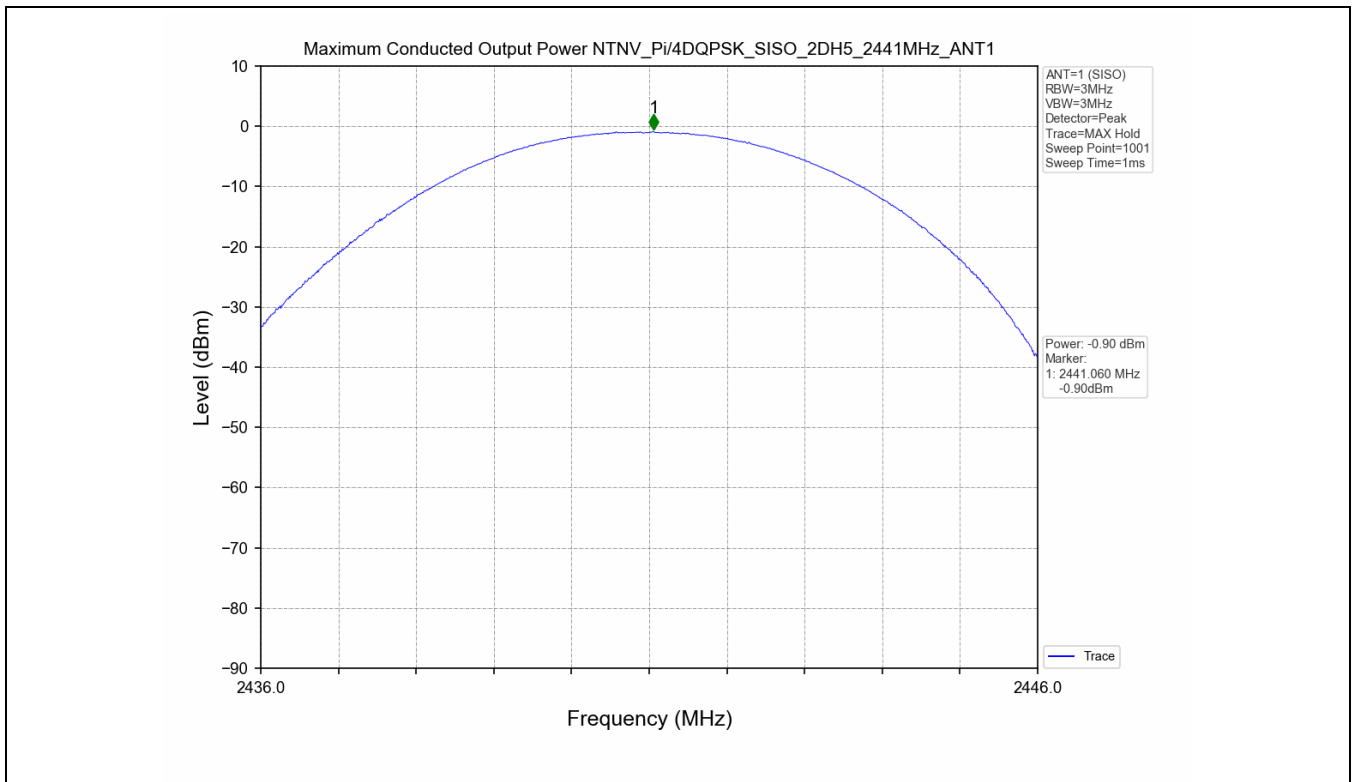
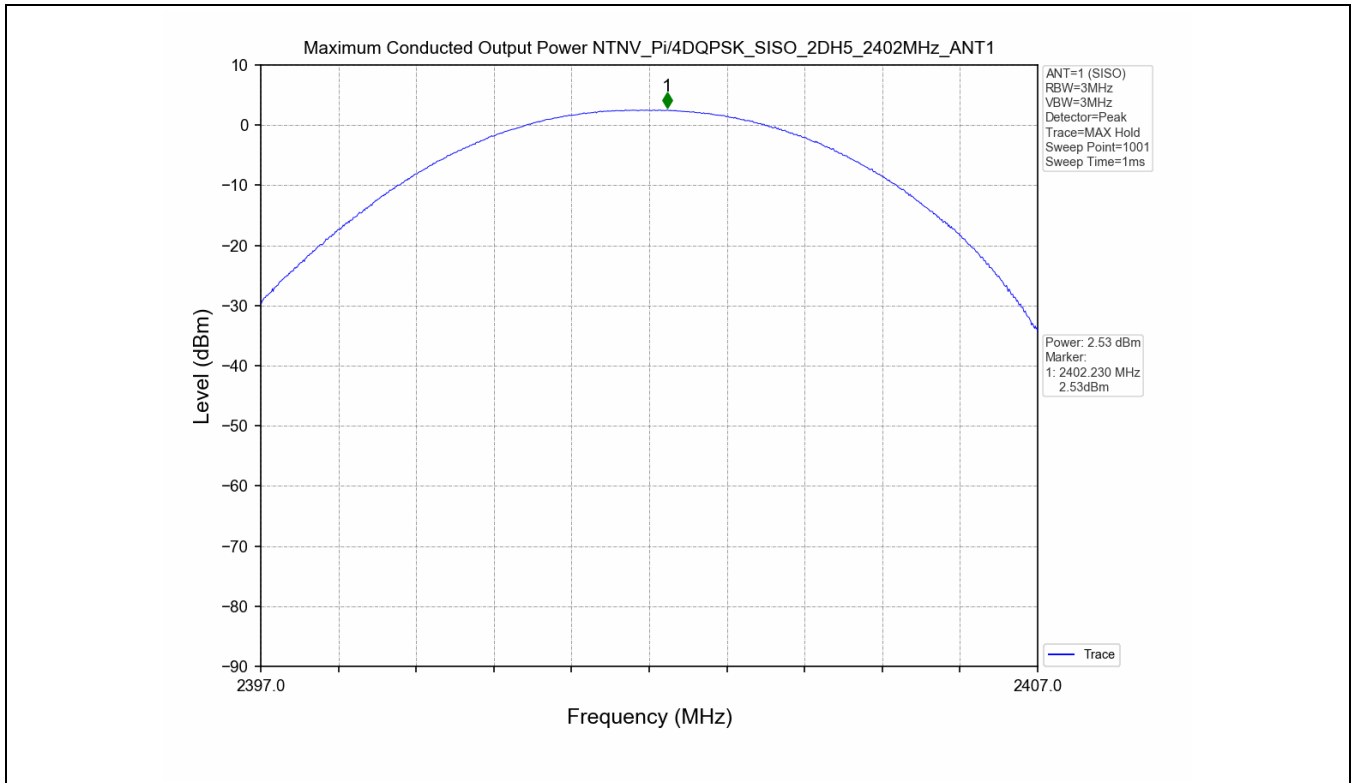
2.1 Test Result

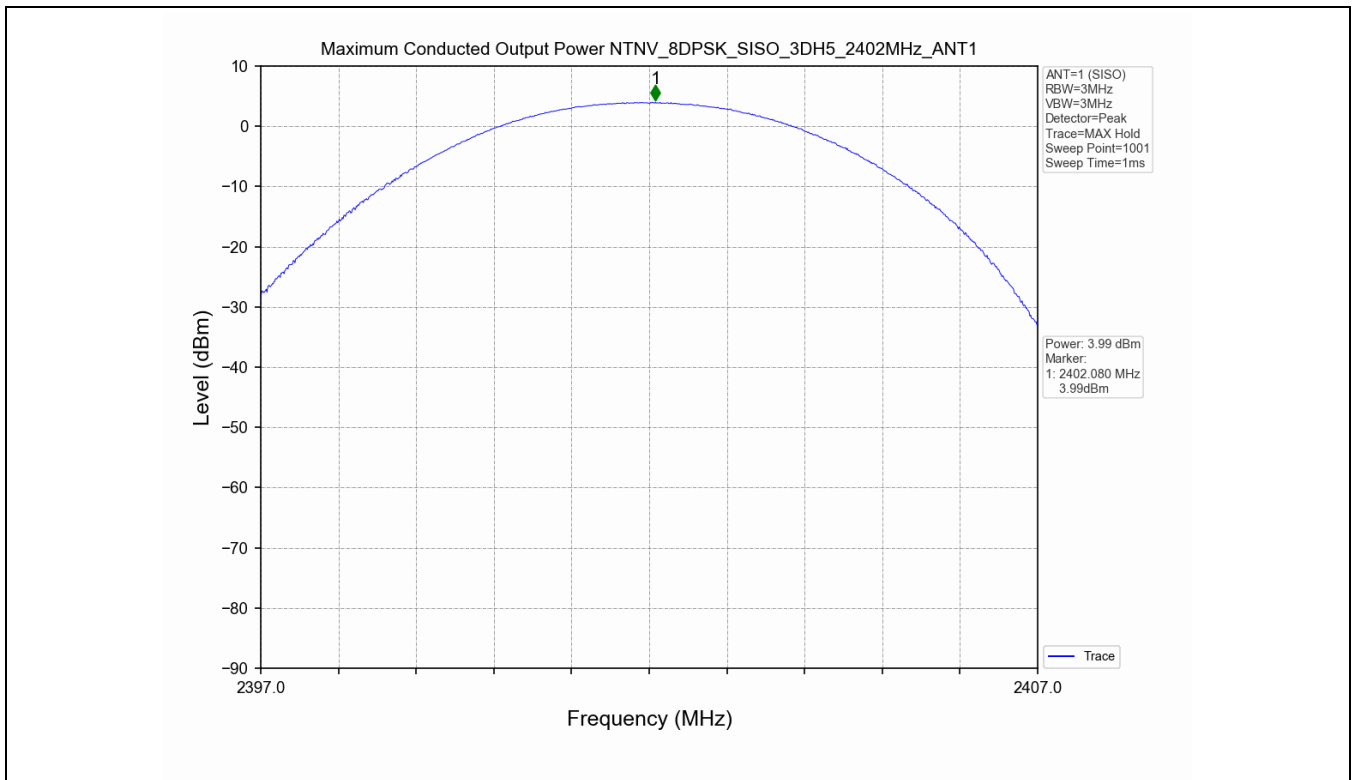
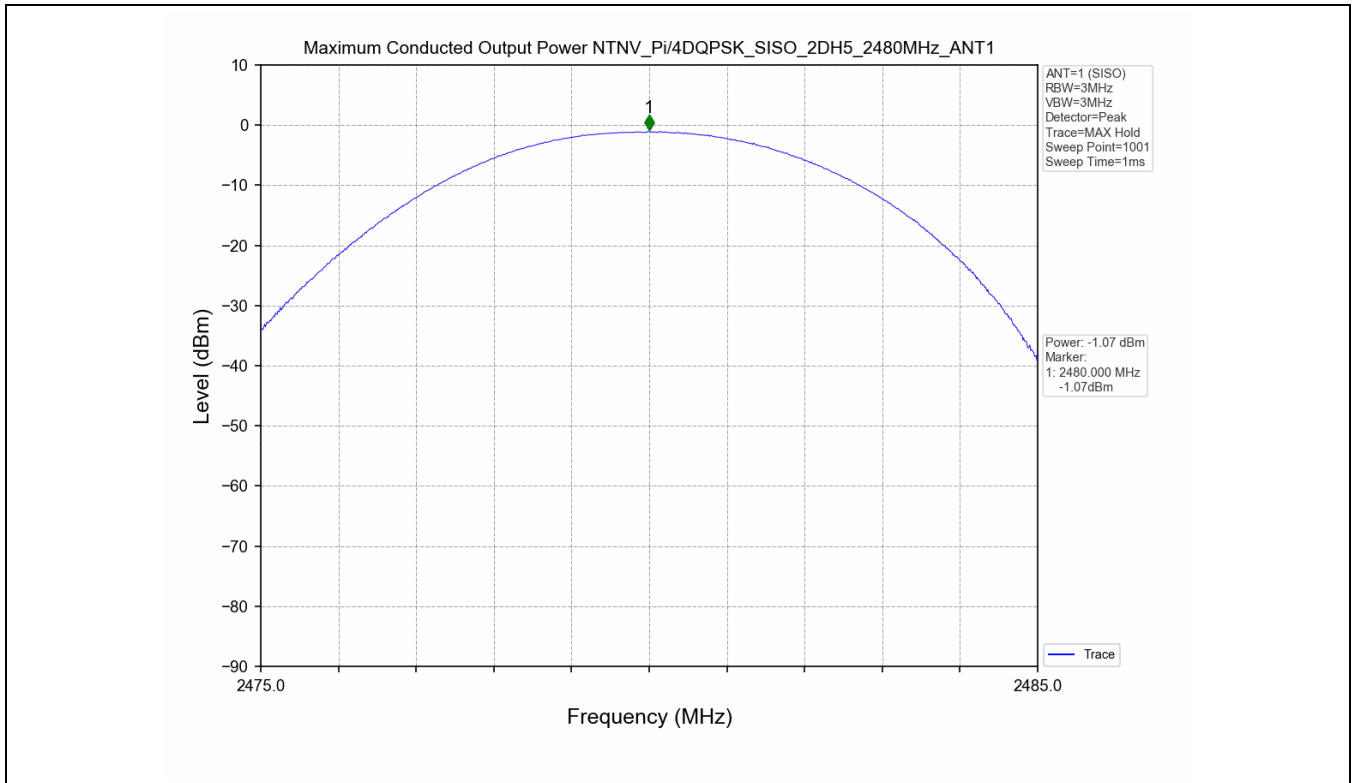
Test Mode	Frequency (MHz)	Tx Type	Measured Peak Output Power (dBm)	Limits (dBm)	Verdict
			Ant 1		
GFSK	2402	SISO	2.56	20.97	PASS
	2441	SISO	-1.21	20.97	PASS
	2480	SISO	-1.70	20.97	PASS
Pi/4DQPSK	2402	SISO	2.53	20.97	PASS
	2441	SISO	-0.90	20.97	PASS
	2480	SISO	-1.07	20.97	PASS
8DPSK	2402	SISO	3.99	20.97	PASS
	2441	SISO	1.93	20.97	PASS
	2480	SISO	-0.63	20.97	PASS

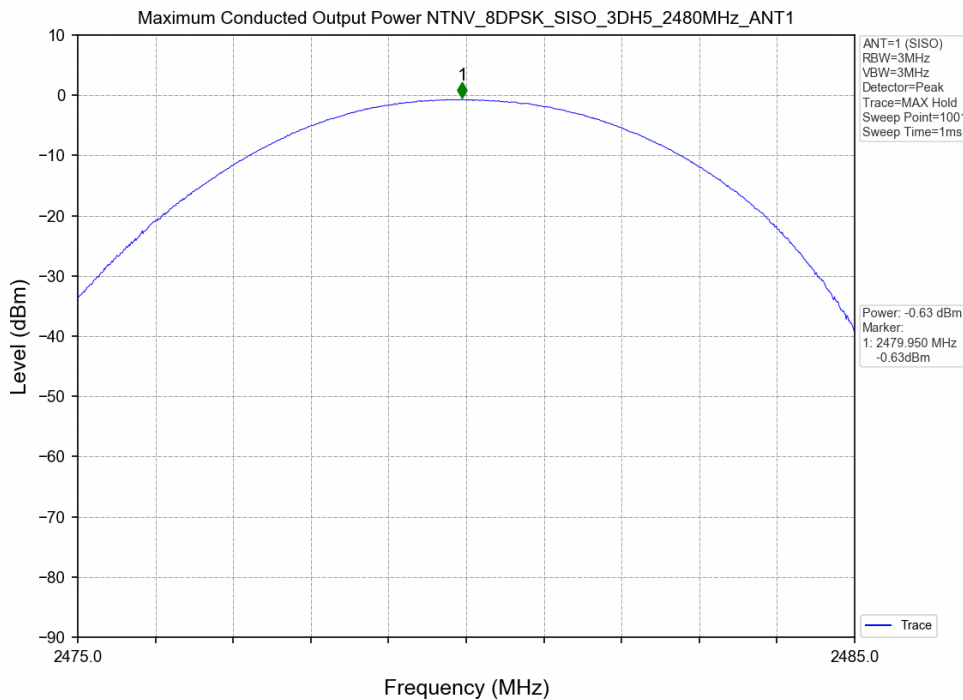
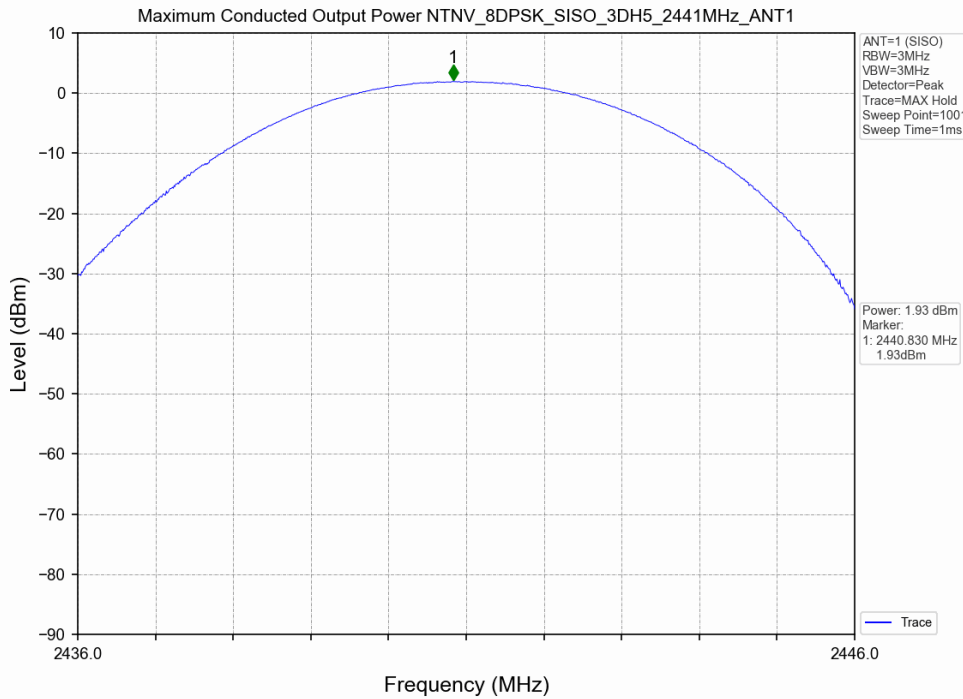
2.2 Test Graph









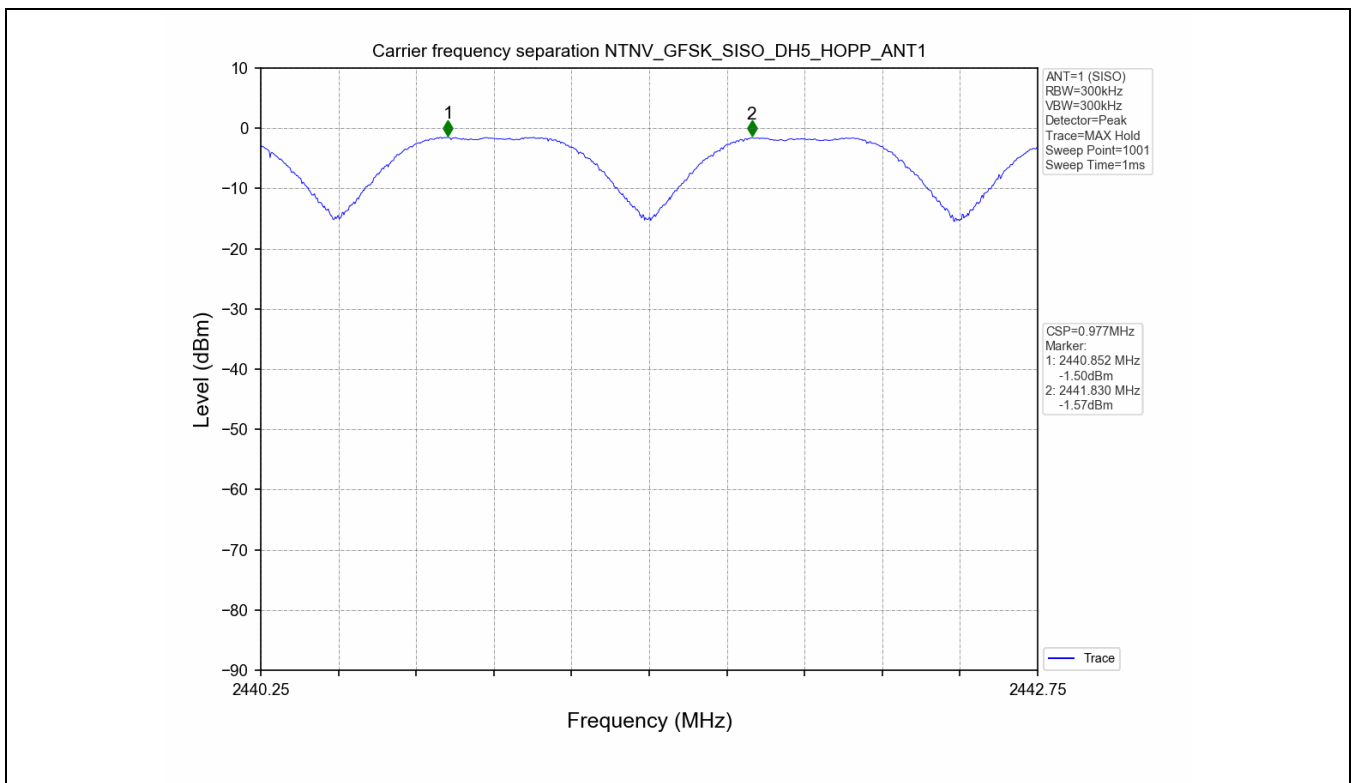


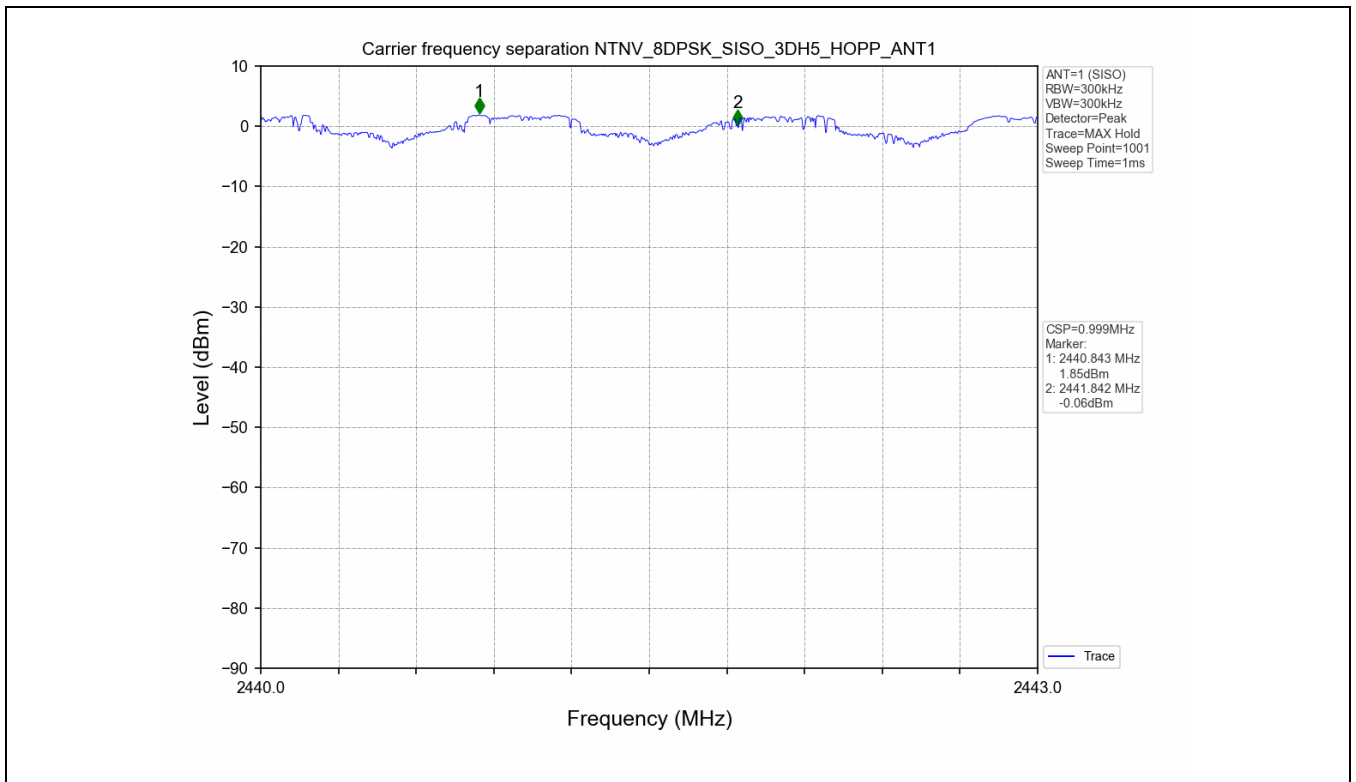
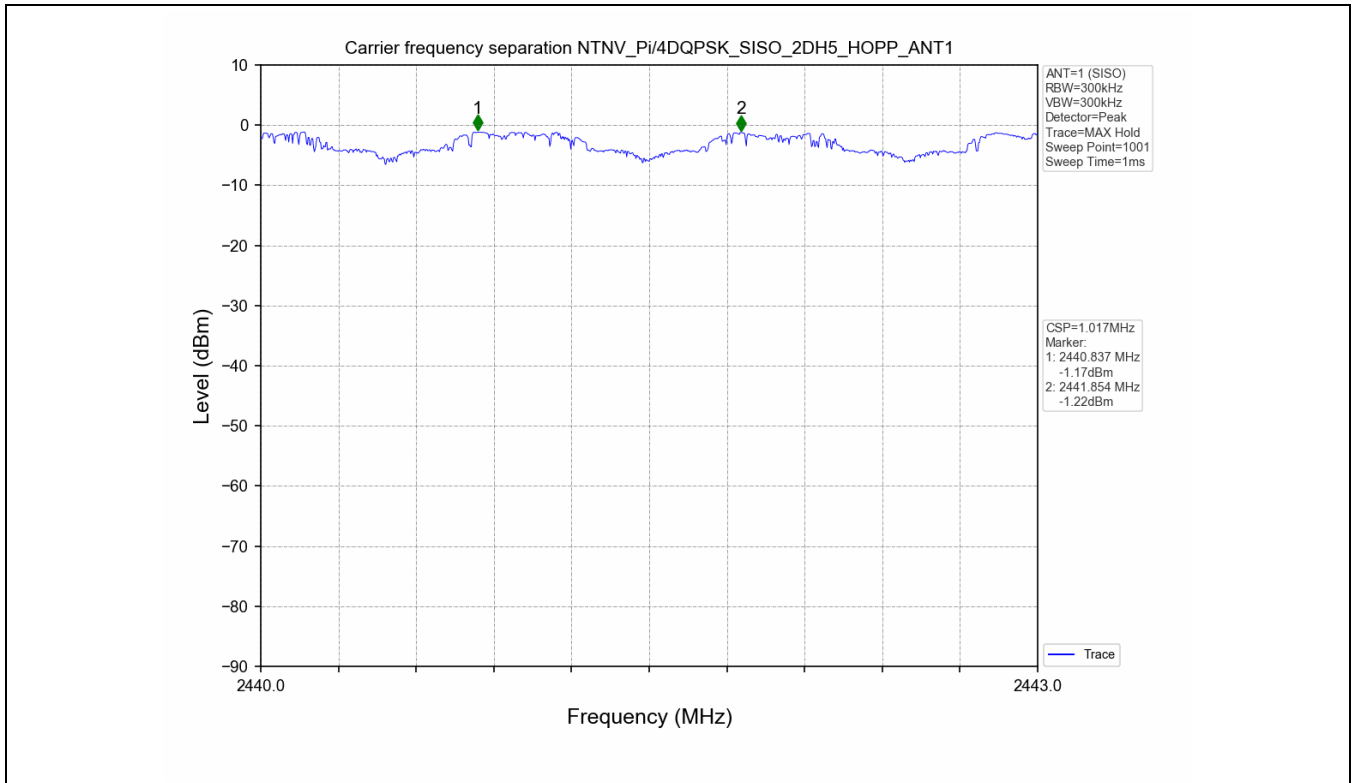
3. Carrier frequency separation

3.1 Test Result

Test Mode	TX Type	ANT No.	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limits (MHz)	Verdict
GFSK	SISO	1	0.977	0.927	≥ 0.927	PASS
Pi/4DQPSK	SISO	1	1.017	1.257	≥ 0.838	PASS
8DPSK	SISO	1	0.999	1.258	≥ 0.839	PASS

3.2 Test Graph



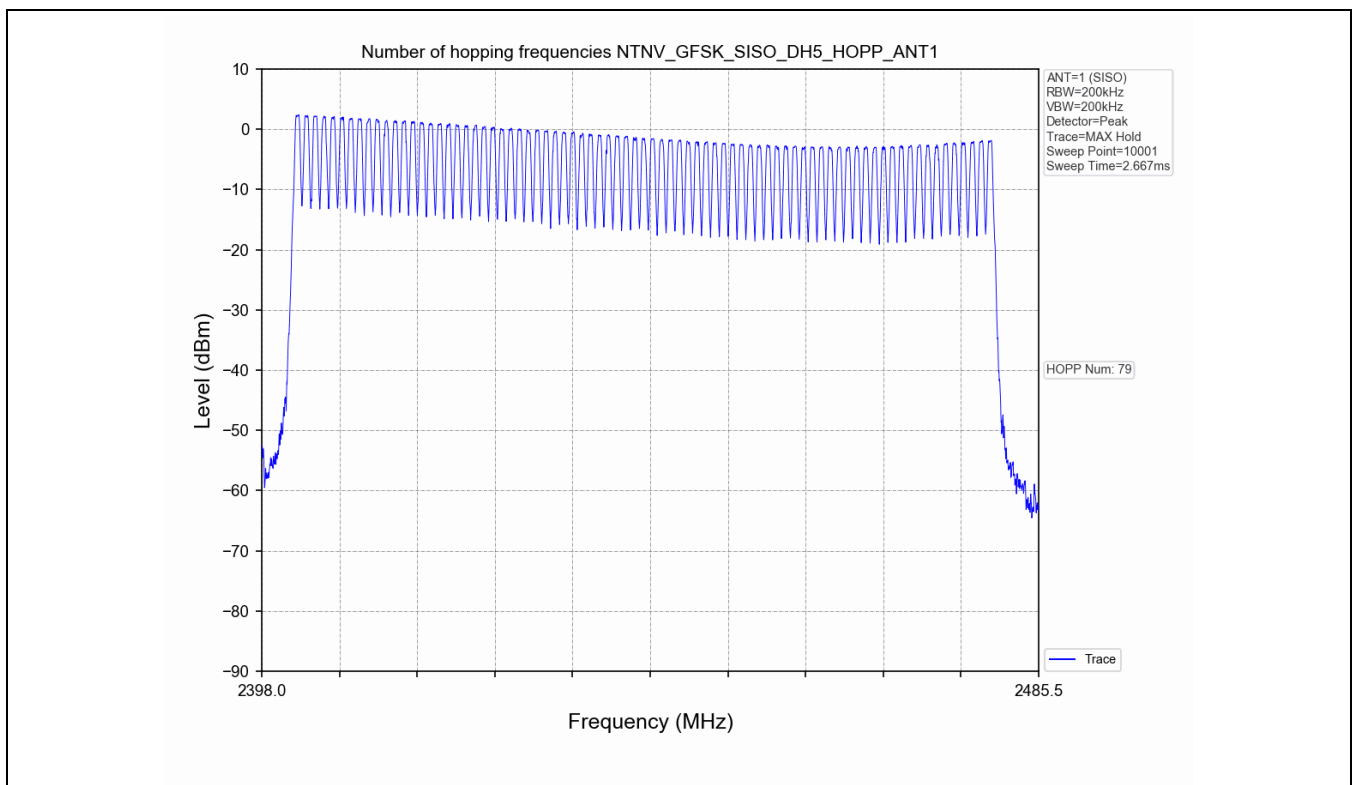


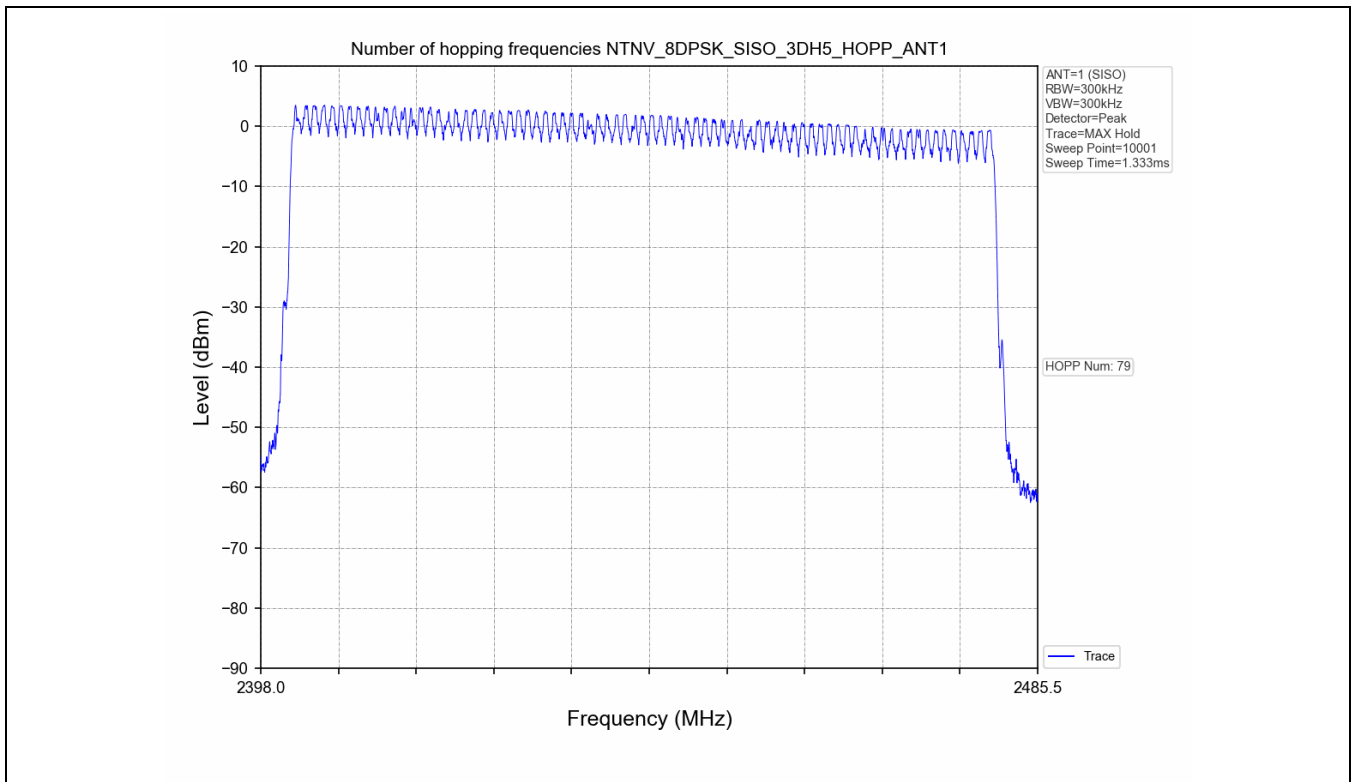
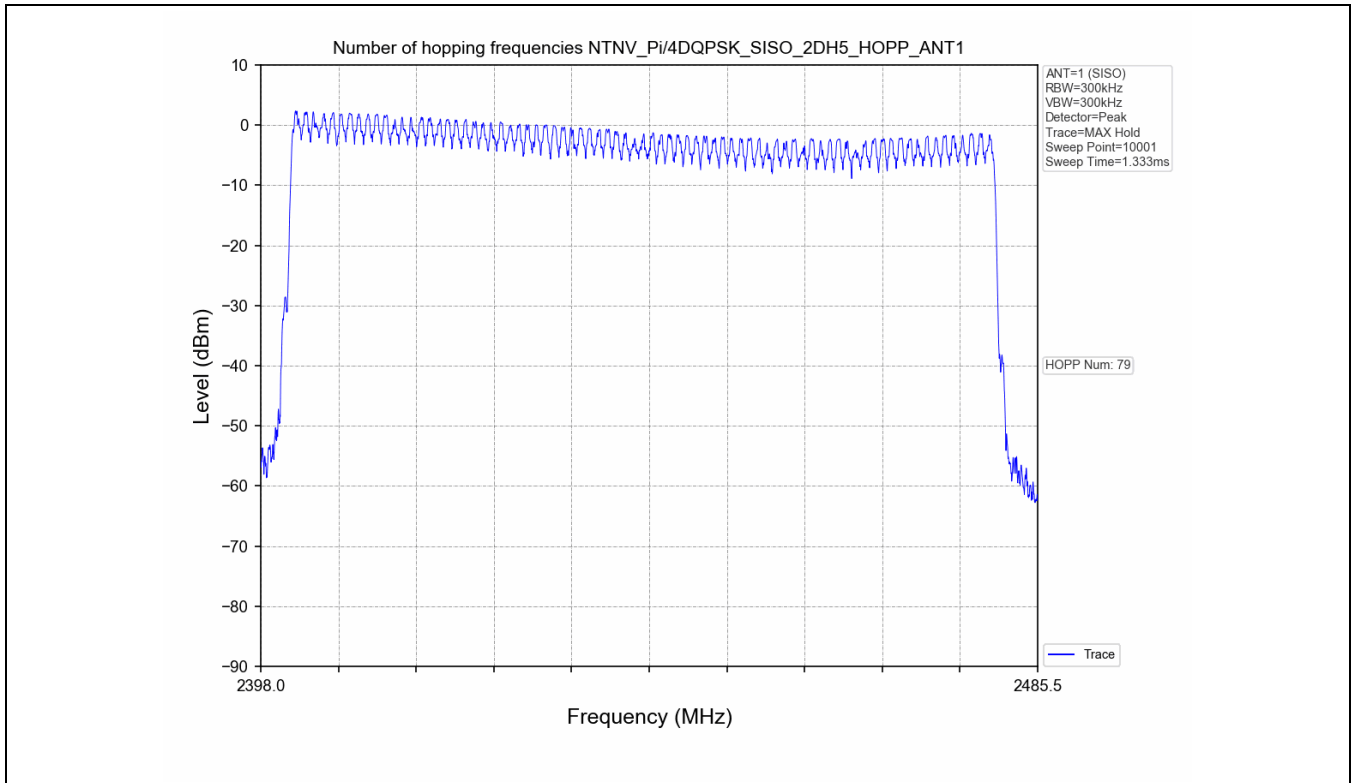
4. Number of hopping frequencies

4.1 Test Result

Test Mode	TX Type	ANT No.	Num of Hopping Frequencies	Limits	Verdict
GFSK	SISO	1	79	≥15	PASS
Pi/4DQPSK	SISO	1	79	≥15	PASS
8DPSK	SISO	1	79	≥15	PASS

4.2 Test Graph



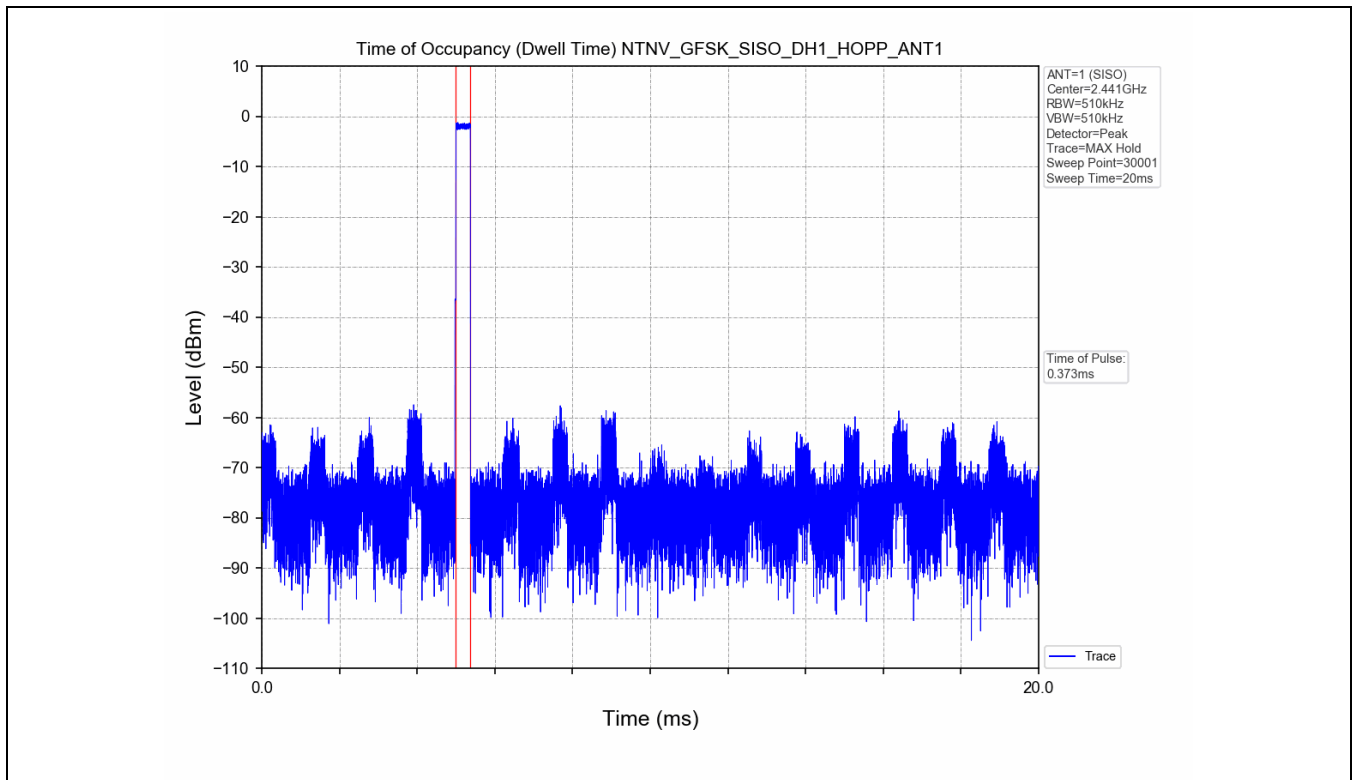


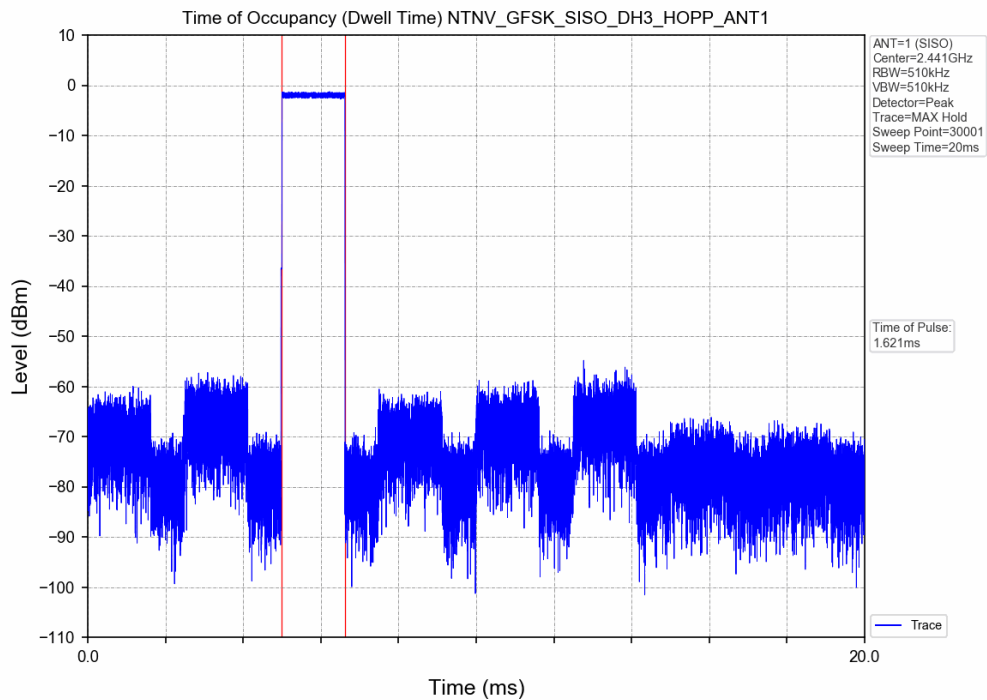
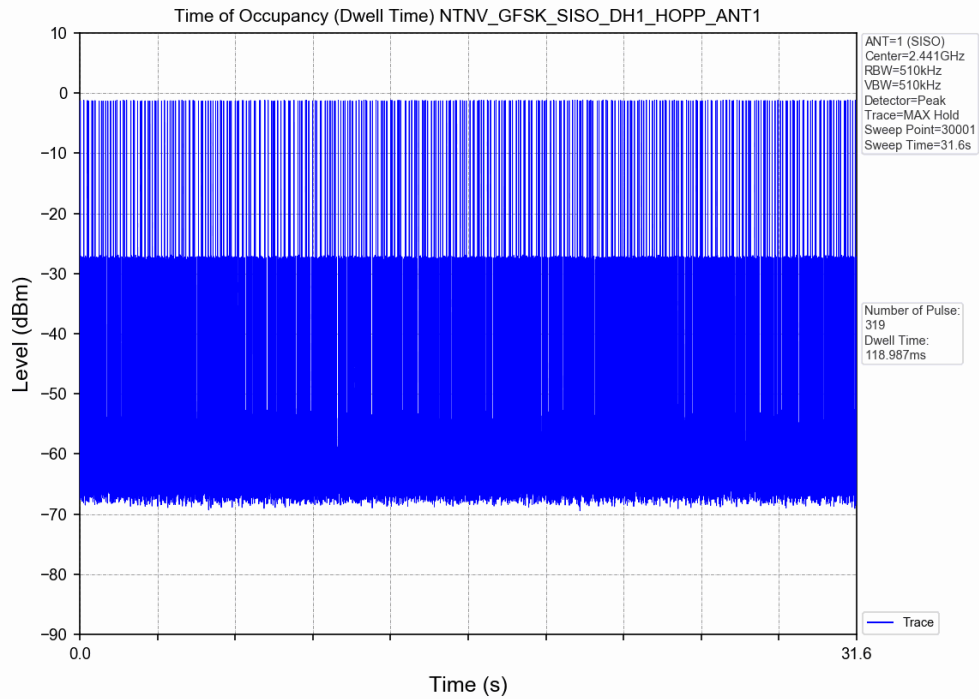
5. Time of Occupancy (Dwell Time)

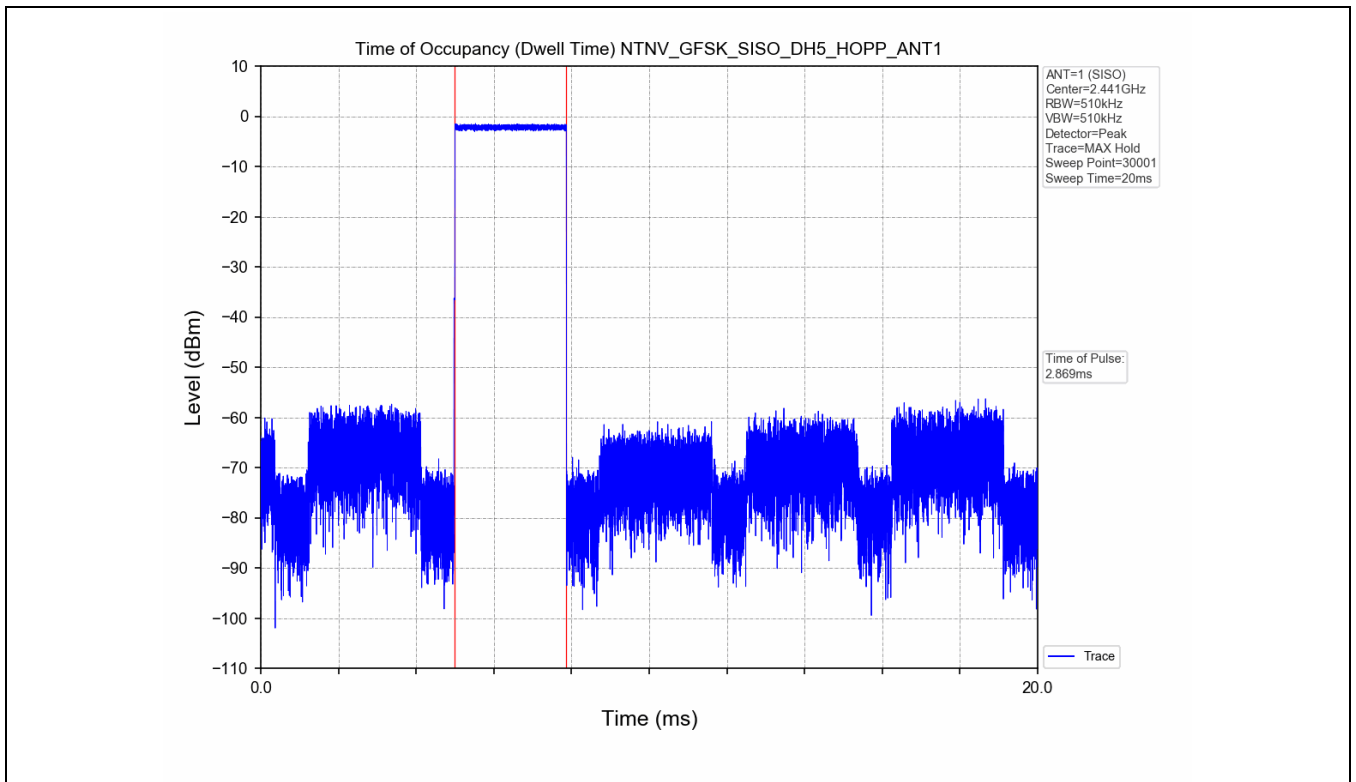
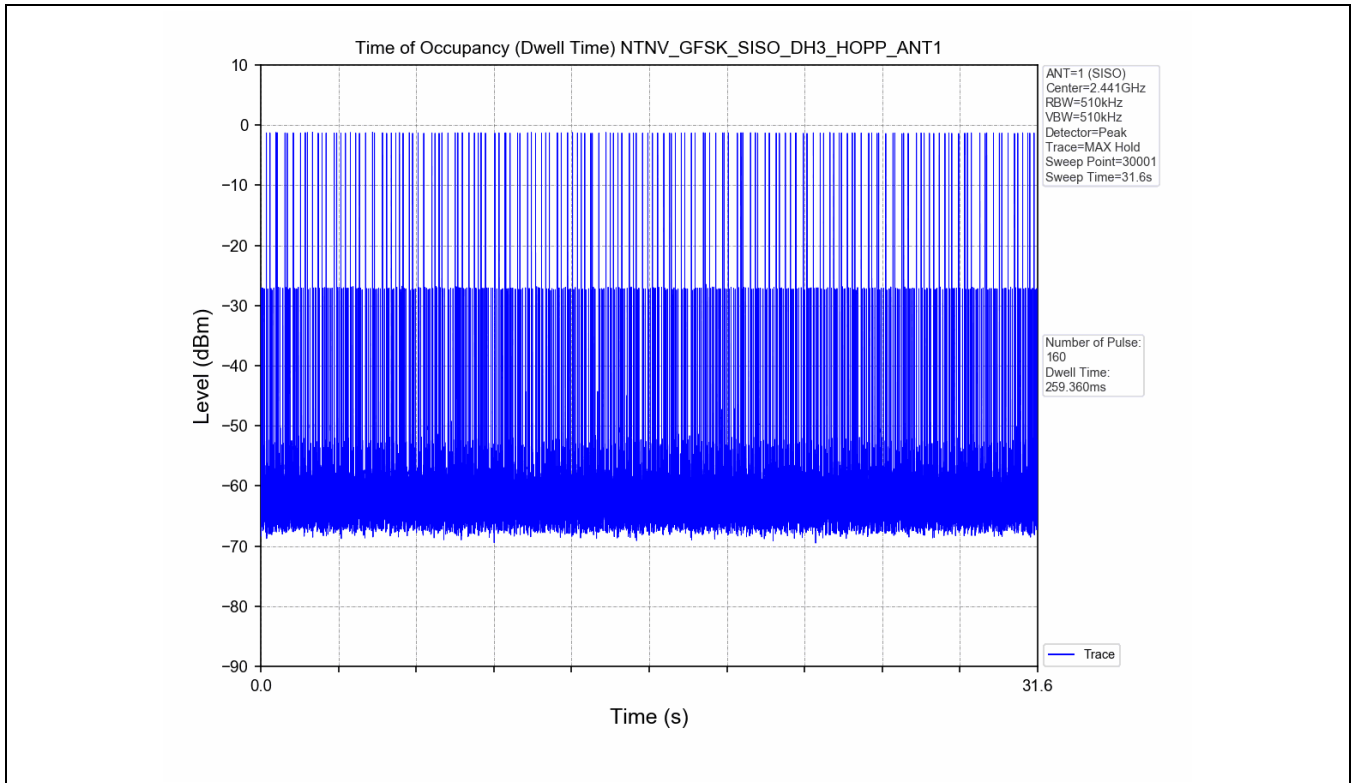
5.1 Test Result

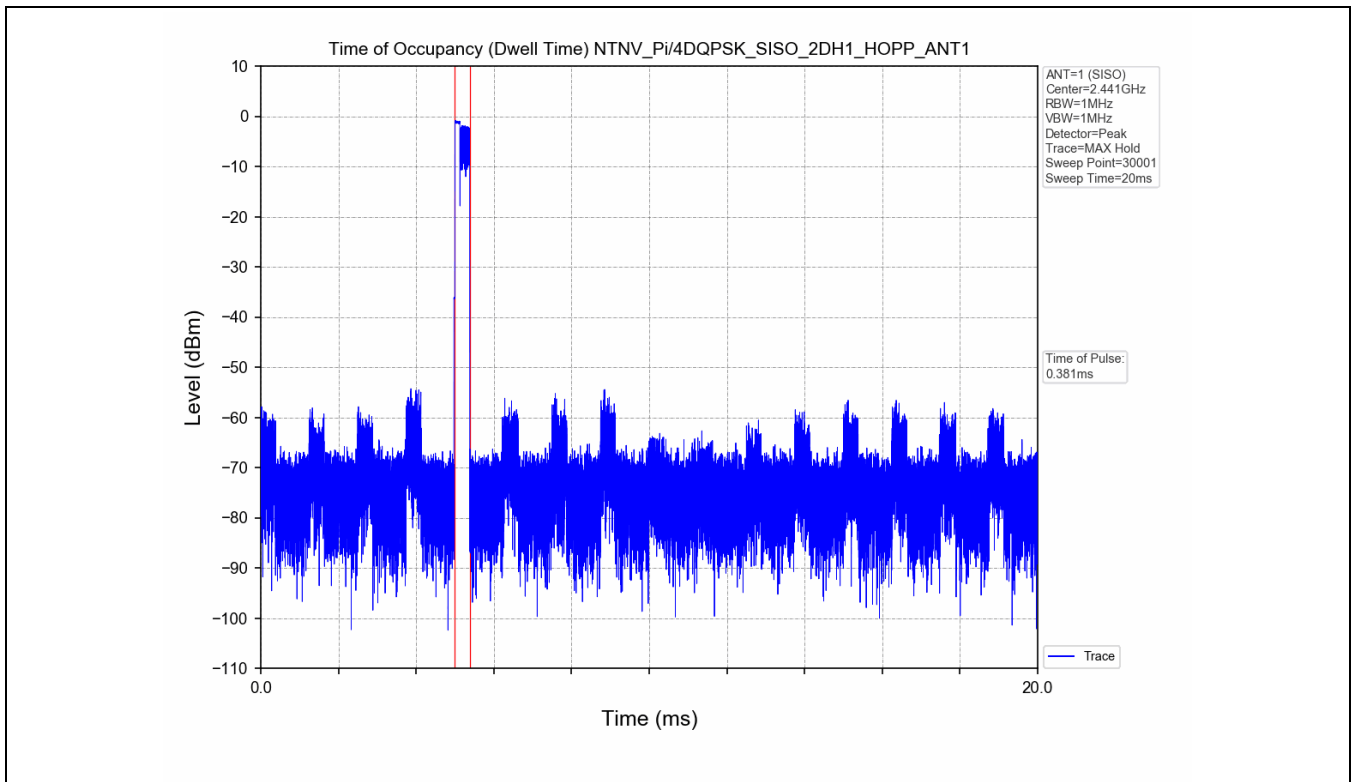
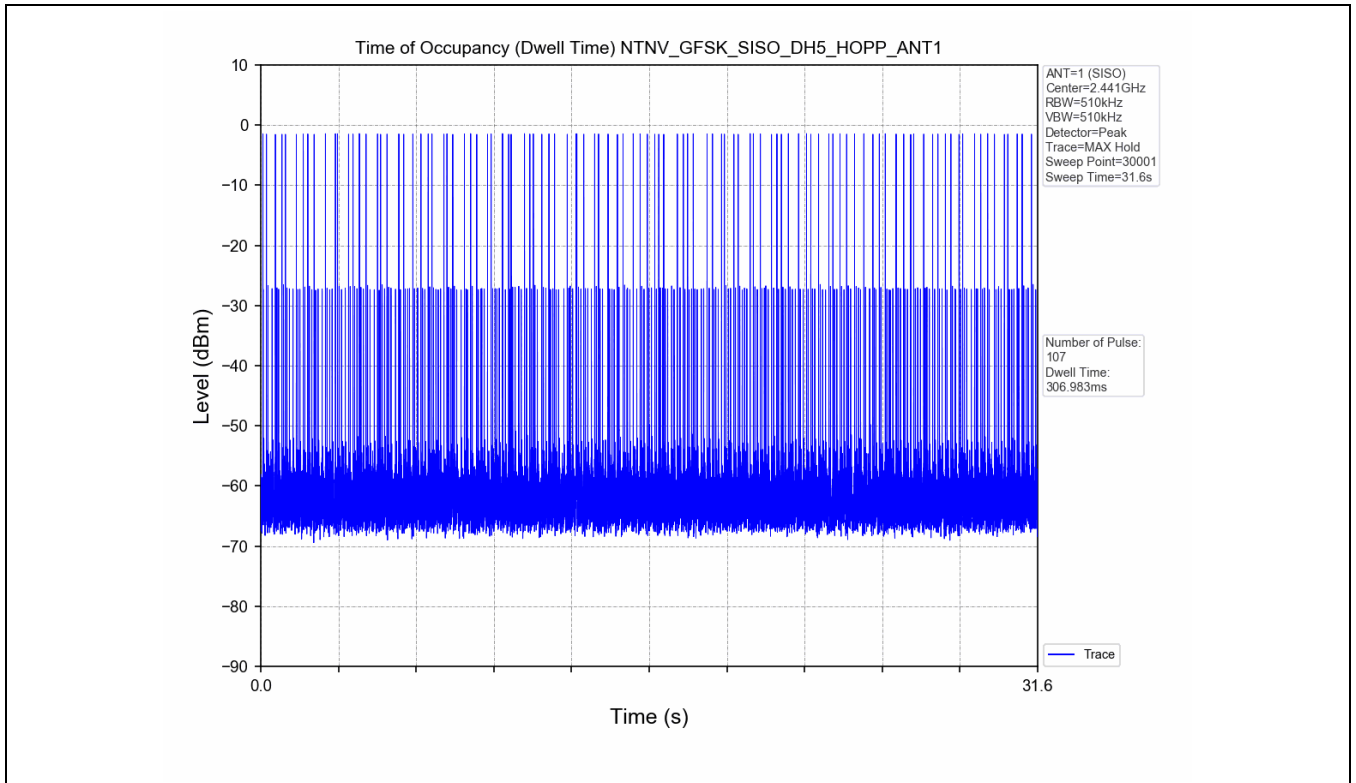
Test Mode	Packet Type	TX Type	ANT No.	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limits (ms)	Verdict
GFSK	DH1	SISO	1	0.373	31.6	319	118.987	≤400	PASS
	DH3	SISO	1	1.621	31.6	160	259.360	≤400	PASS
	DH5	SISO	1	2.869	31.6	107	306.983	≤400	PASS
Pi/4DQ PSK	2DH1	SISO	1	0.381	31.6	319	121.539	≤400	PASS
	2DH3	SISO	1	1.635	31.6	160	261.600	≤400	PASS
	2DH5	SISO	1	2.882	31.6	107	308.374	≤400	PASS
8DPSK	3DH1	SISO	1	0.383	31.6	321	122.943	≤400	PASS
	3DH3	SISO	1	1.633	31.6	160	261.280	≤400	PASS
	3DH5	SISO	1	2.885	31.6	106	305.810	≤400	PASS

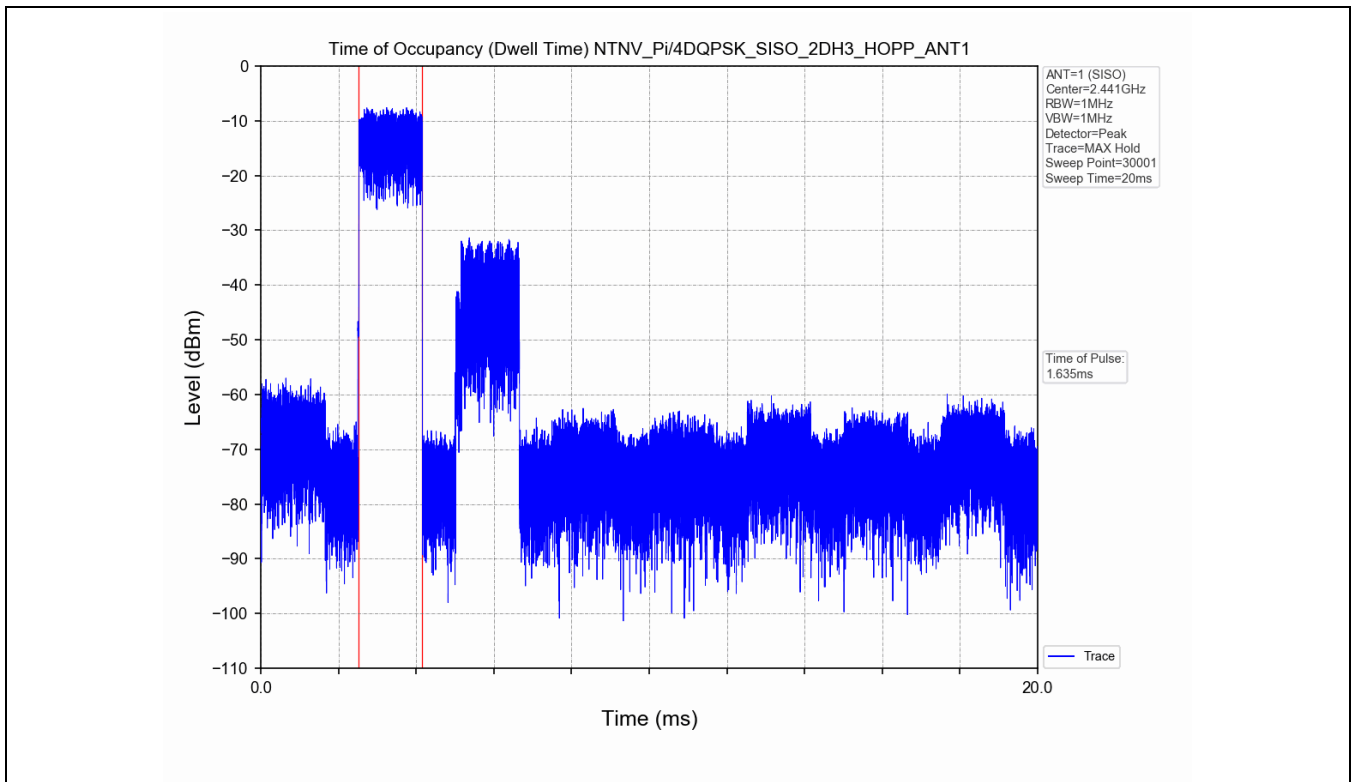
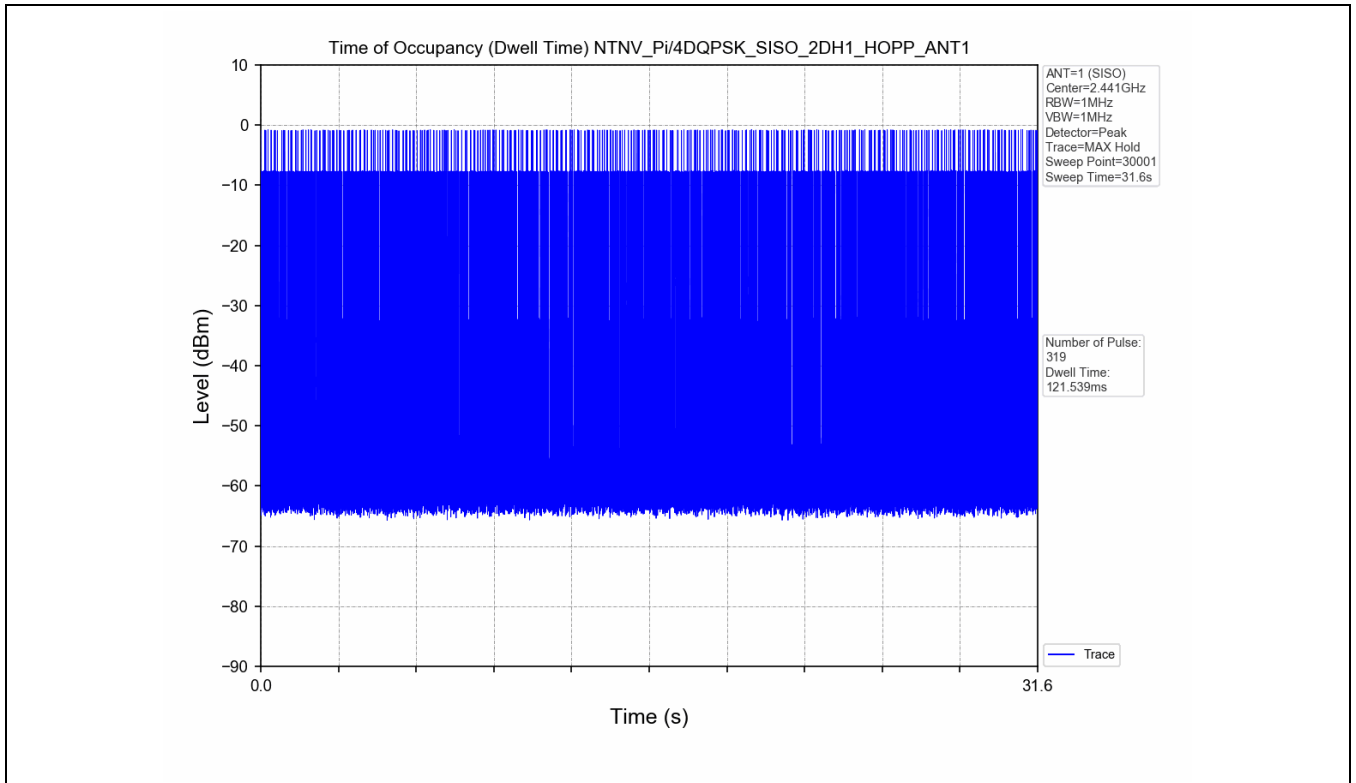
5.2 Test Graph

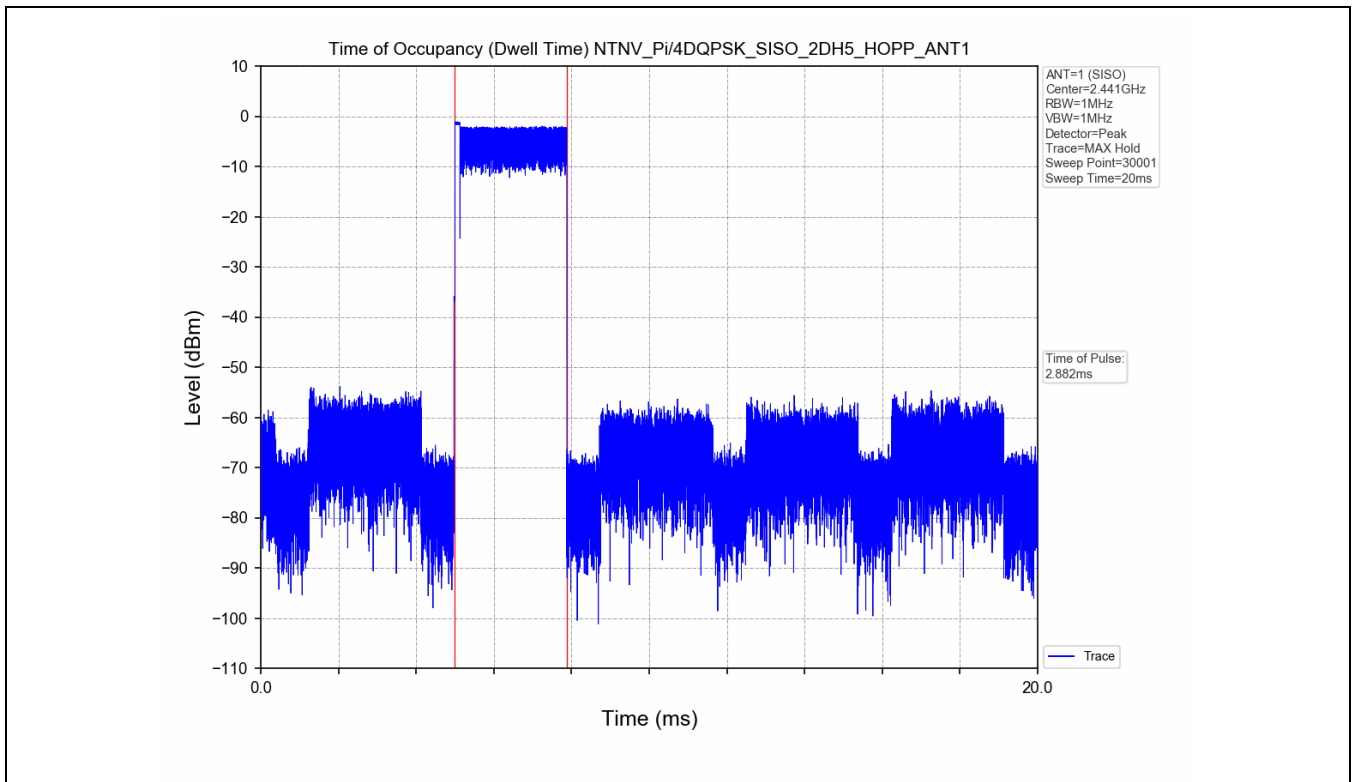
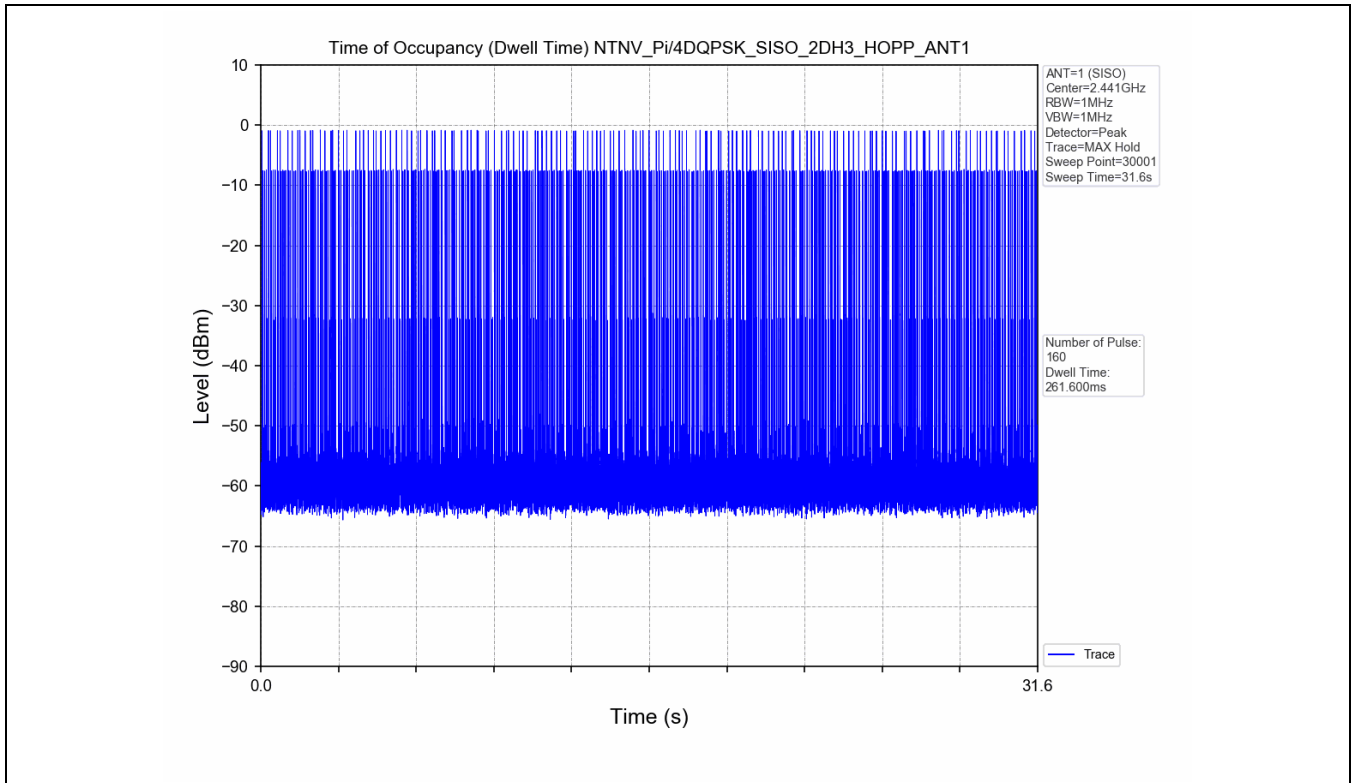


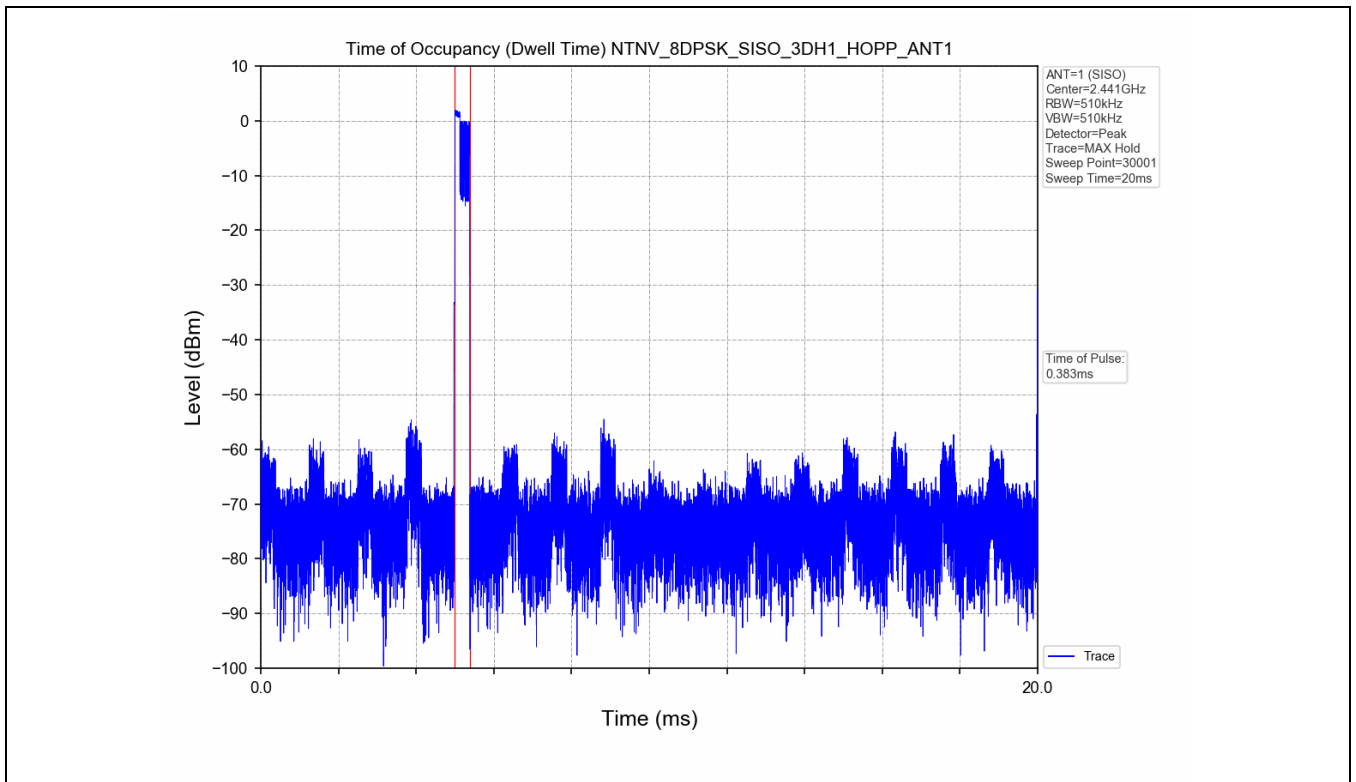
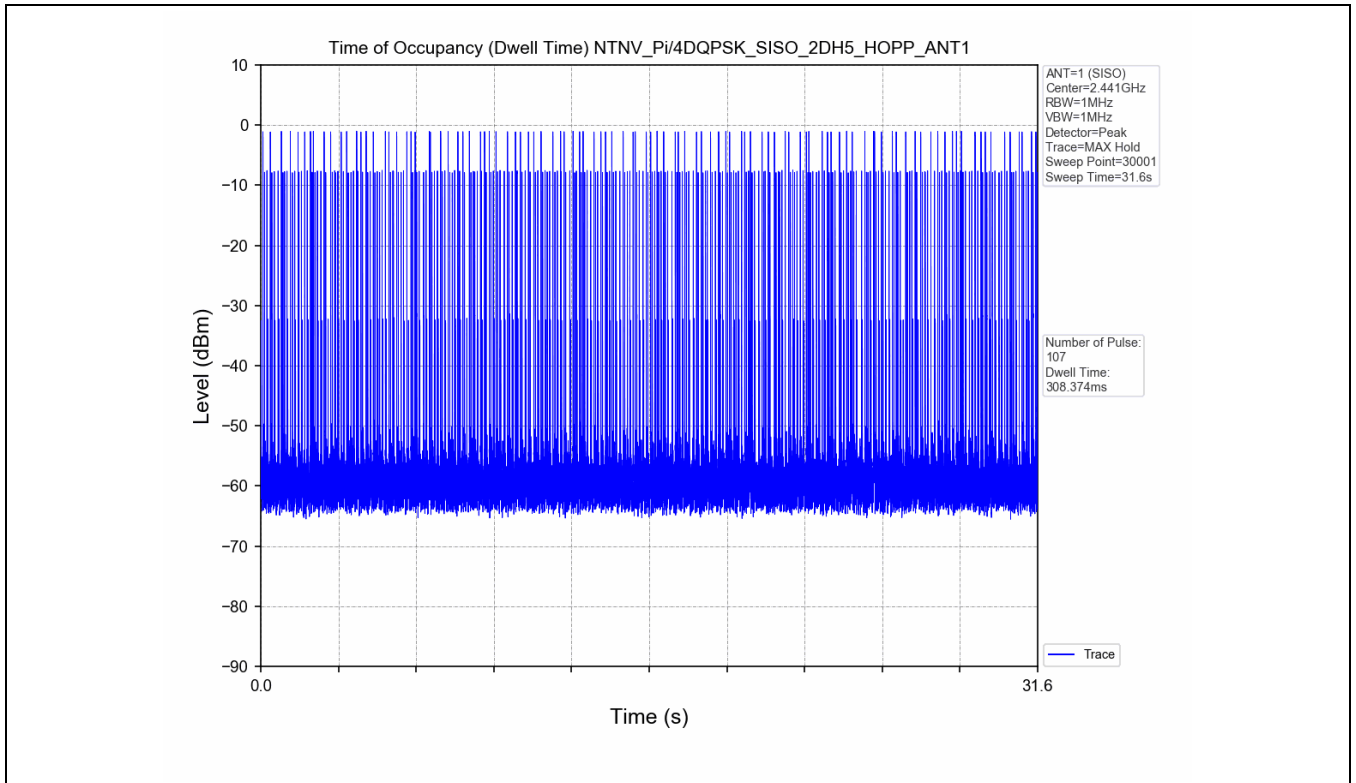


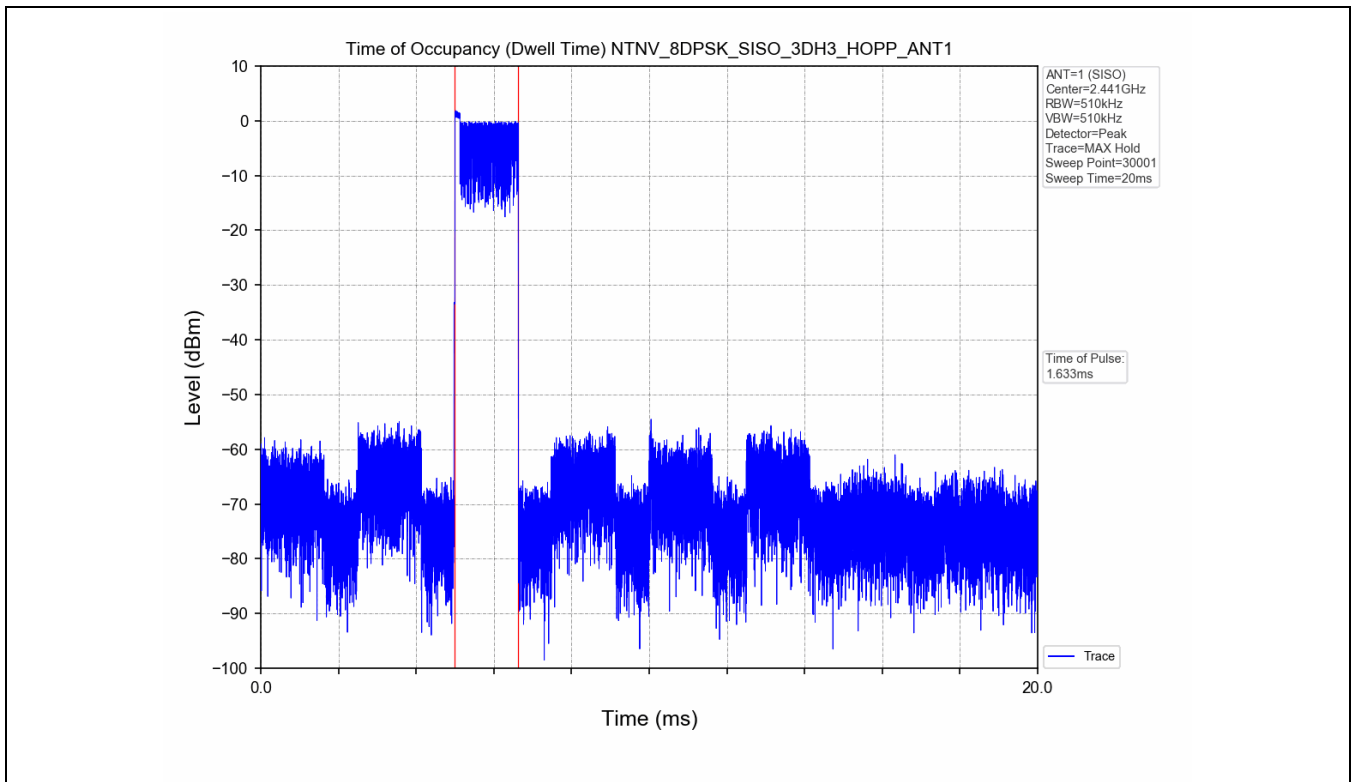
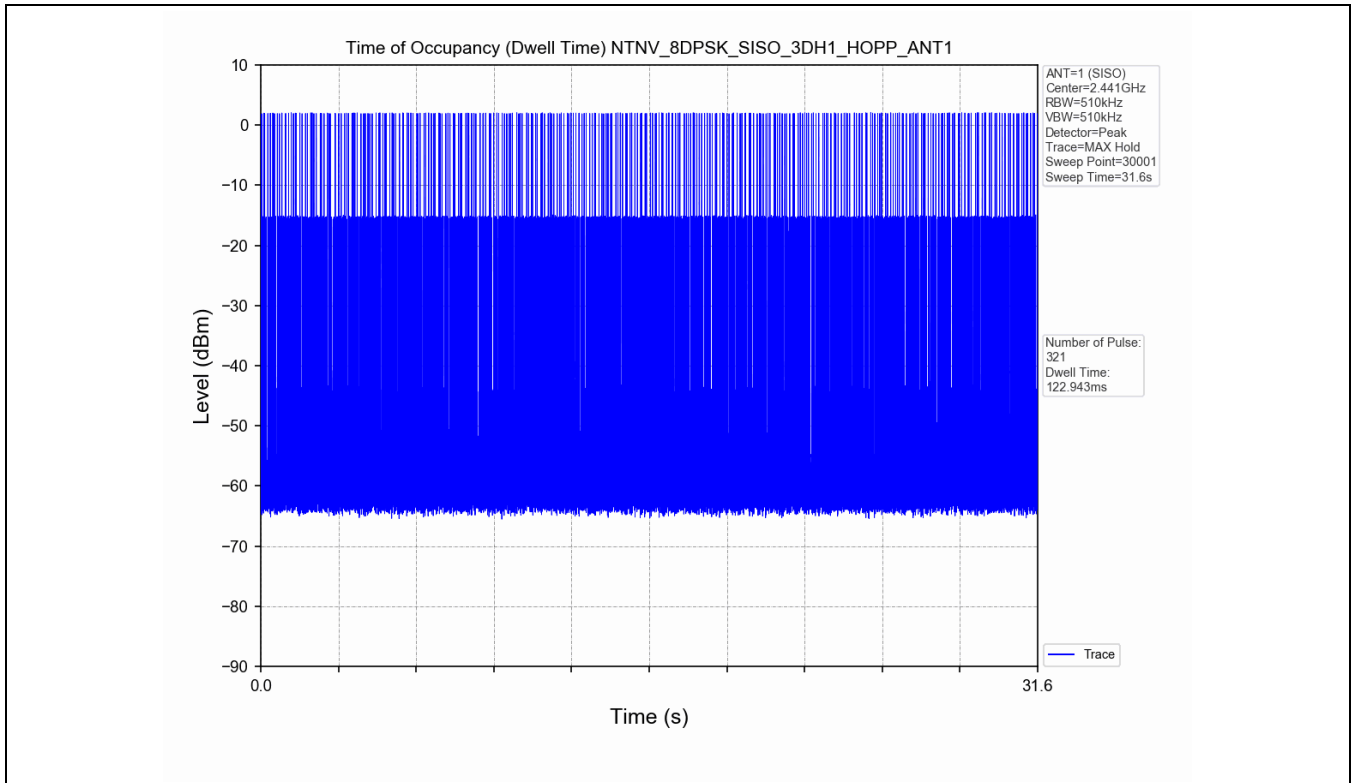


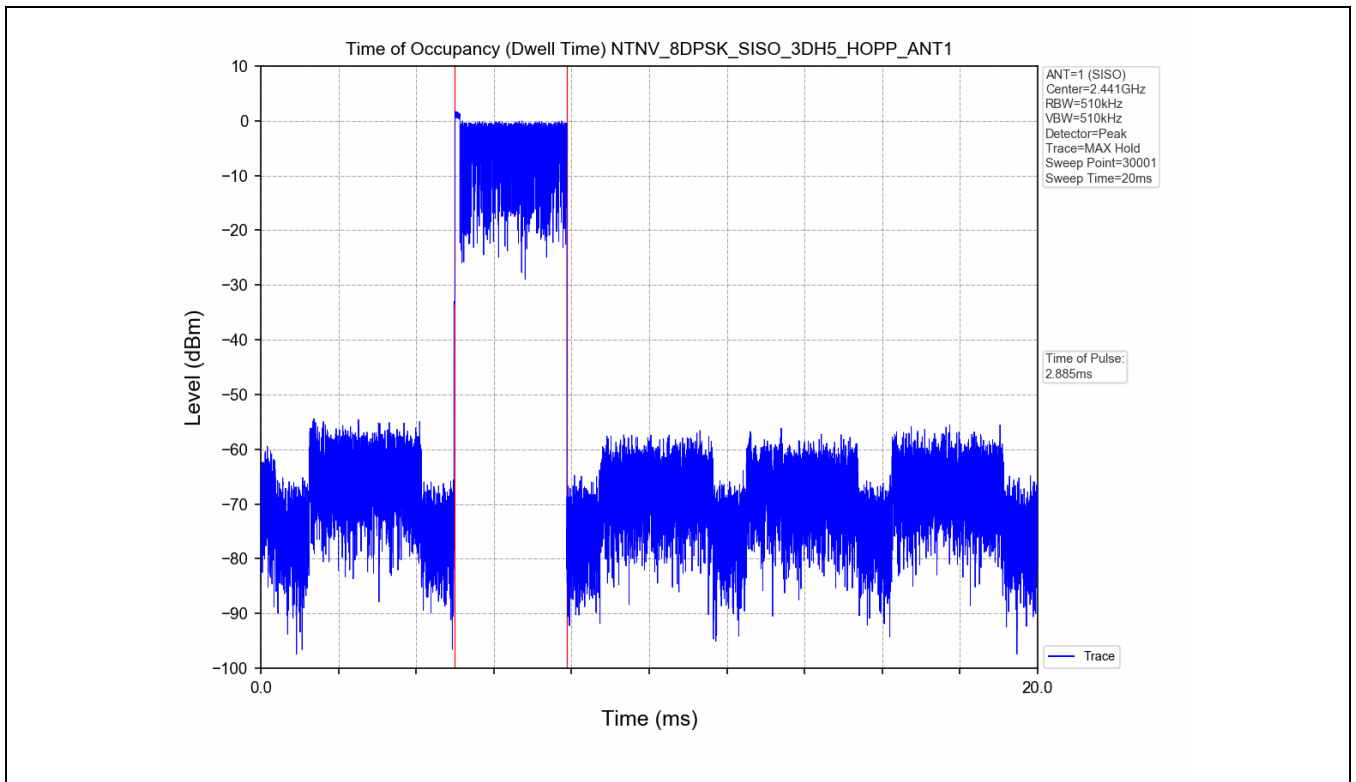
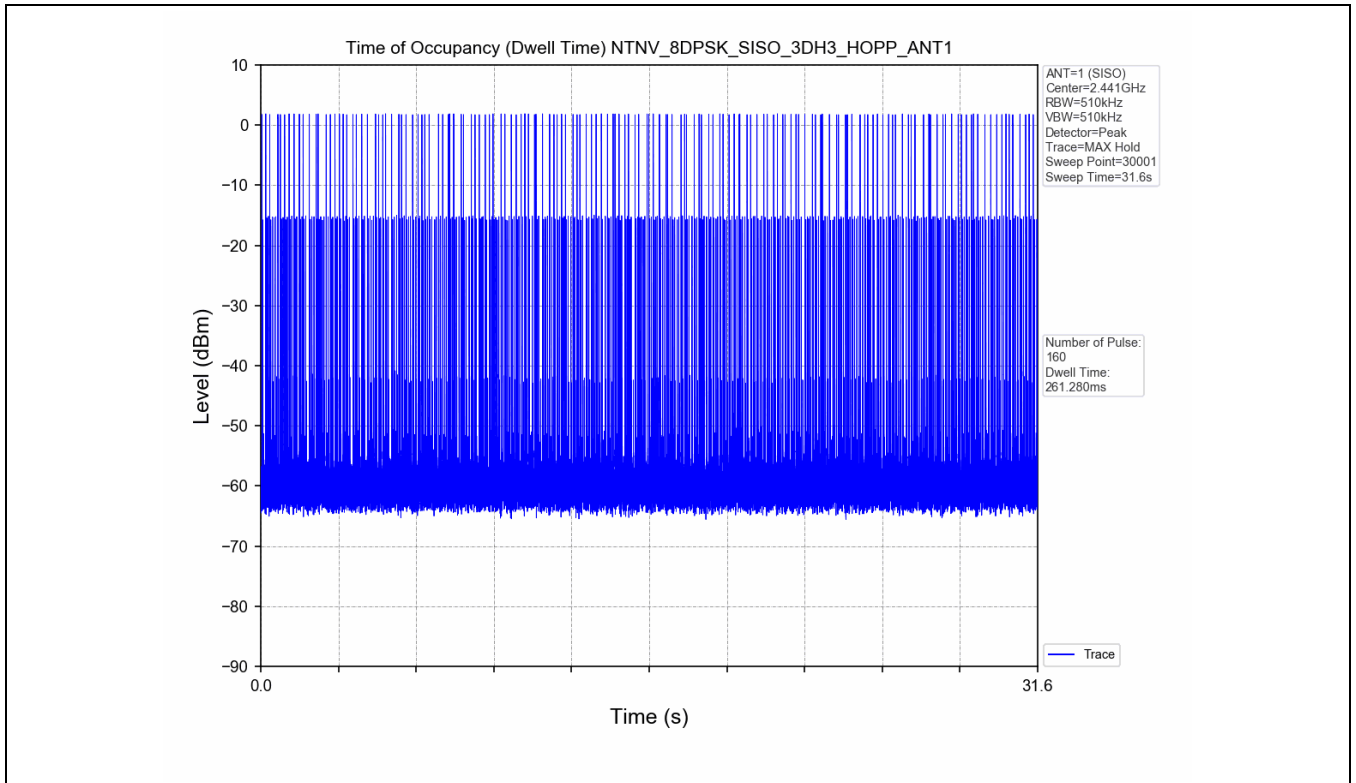


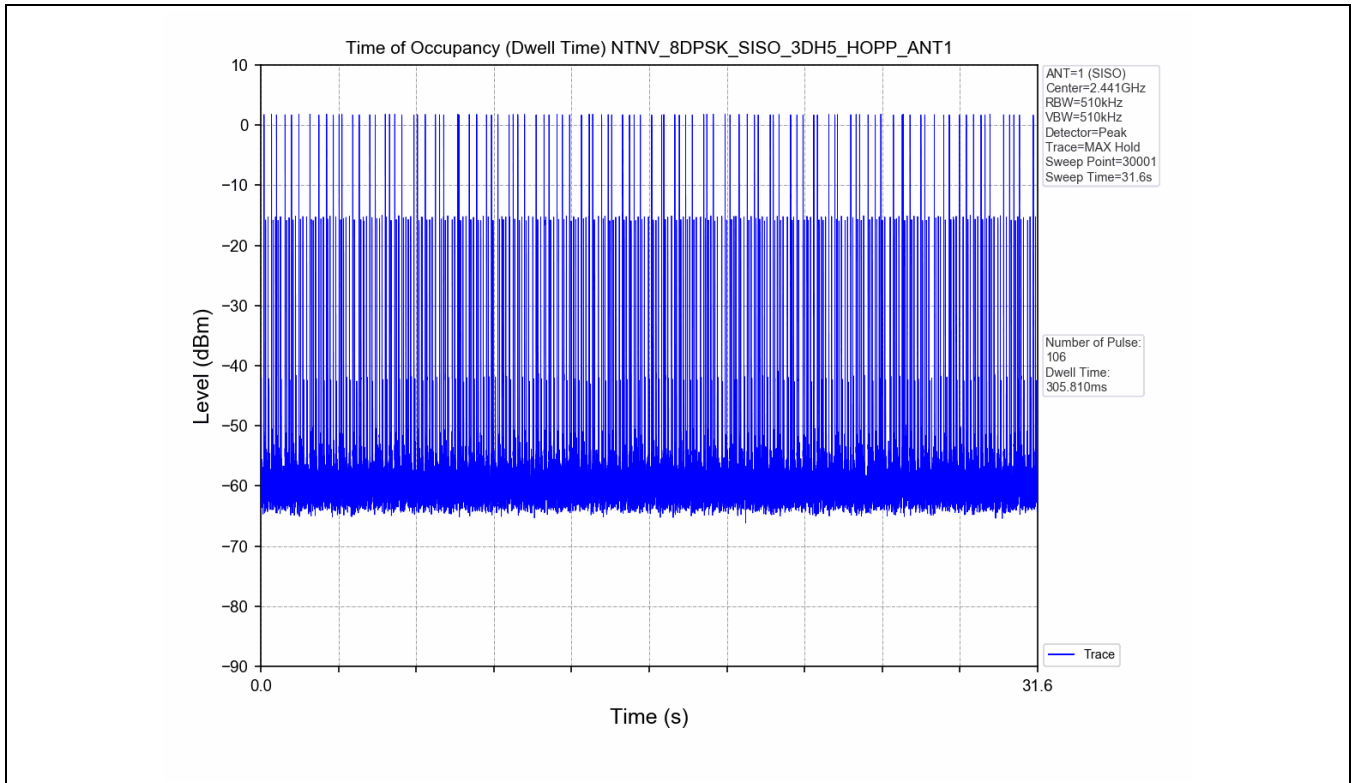












6. Unwanted Emissions in Non-restricted Frequency Bands

6.1 Test Result

Test Mode	Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limits (dBm)	Verdict
GFSK	2402	SISO	1	Refer to test graph	-17.89	PASS
	2441	SISO	1	Refer to test graph	-17.89	PASS
	2480	SISO	1	Refer to test graph	-17.89	PASS
	Hopping	SISO	1	Refer to test graph	-17.89	PASS
Pi/4DQPSK	2402	SISO	1	Refer to test graph	-18.03	PASS
	2441	SISO	1	Refer to test graph	-18.03	PASS
	2480	SISO	1	Refer to test graph	-18.03	PASS
	Hopping	SISO	1	Refer to test graph	-18.03	PASS
8DPSK	2402	SISO	1	Refer to test graph	-16.47	PASS
	2441	SISO	1	Refer to test graph	-16.47	PASS
	2480	SISO	1	Refer to test graph	-16.47	PASS
	Hopping	SISO	1	Refer to test graph	-16.47	PASS



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6.2 Test Graph

