

Between 1GHz – 25GHz

Polar (H/V)	Frequency	Reading Level	Correct Factor	Measure- ment	Limits	Over	Detector Type
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dBuV/ m)	(dB)	
GFSK Low channel							
V	4804.00	53.19	-0.43	52.76	74.00	-21.24	PK
V	4804.00	44.54	-0.43	44.11	54.00	-9.89	AV
V	7206.00	43.73	8.31	52.04	74.00	-21.96	PK
V	7206.00	34.69	8.31	43.00	54.00	-11.00	AV
H	4804.00	51.86	-0.43	51.43	74.00	-22.57	PK
H	4804.00	41.48	-0.43	41.05	54.00	-12.95	AV
H	7206.00	42.42	8.31	50.73	74.00	-23.27	PK
H	7206.00	34.17	8.31	42.48	54.00	-11.52	AV
GFSK Middle channel							
V	4882.00	50.38	-0.38	50.00	74.00	-24.00	PK
V	4882.00	42.64	-0.38	42.26	54.00	-11.74	AV
V	7323.00	39.43	8.83	48.26	74.00	-25.74	PK
V	7323.00	30.43	8.83	39.26	54.00	-14.74	AV
H	4882.00	45.52	-0.38	45.14	74.00	-28.86	PK
H	4882.00	36.26	-0.38	35.88	54.00	-18.12	AV
H	7323.00	38.03	8.83	46.86	74.00	-27.14	PK
H	7323.00	29.23	8.83	38.06	54.00	-15.94	AV
GFSK High channel							
V	4960.00	52.73	-0.32	52.41	74.00	-21.59	PK
V	4960.00	43.91	-0.32	43.59	54.00	-10.41	AV
V	7440.00	44.04	9.35	53.39	74.00	-20.61	PK
V	7440.00	34.20	9.35	43.55	54.00	-10.45	AV
H	4960.00	50.44	-0.32	50.12	74.00	-23.88	PK
H	4960.00	39.51	-0.32	39.19	54.00	-14.81	AV
H	7440.00	42.50	9.35	51.85	74.00	-22.15	PK
H	7440.00	34.75	9.35	44.10	54.00	-9.90	AV

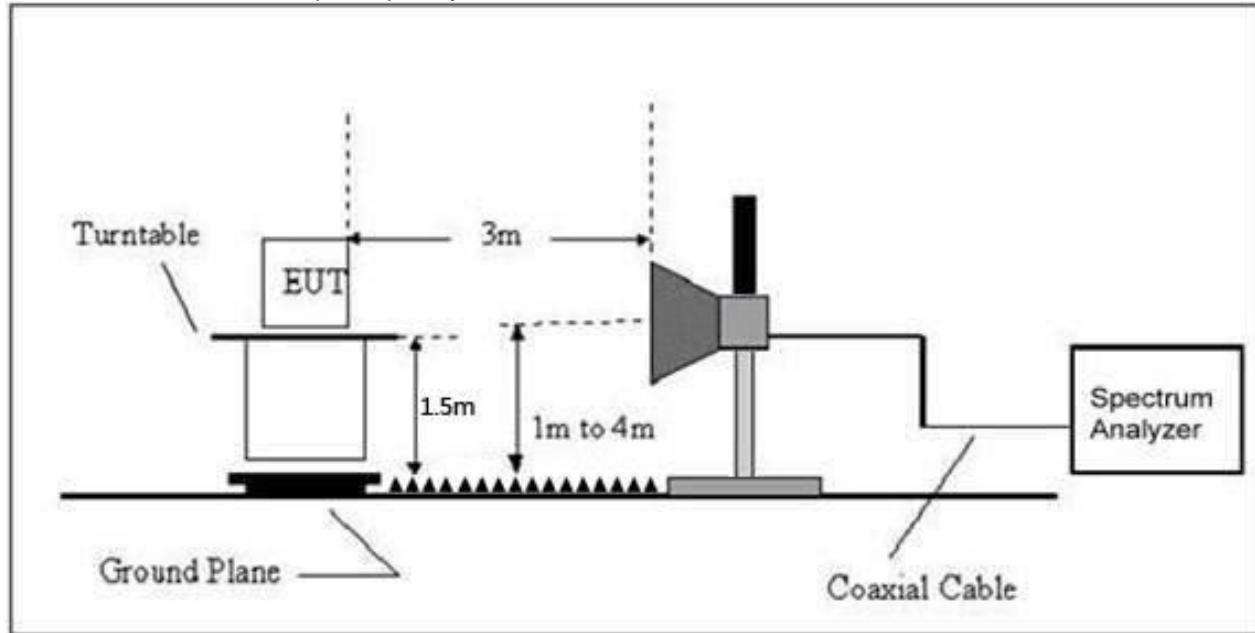
Remark:

1. Emission Level = Meter Reading + Factor,
Factor = Antenna Factor + Cable Loss – Pre-amplifier.
- Over= Emission Level - Limit
2. If peak below the average limit, the average emission was no test.
3. In restricted bands of operation, The spurious emissions below the permissible value more than 20dB
4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
5. All the Modulation are test, the worst mode is GFSK, the data recording in the report.

8. Radiated Band Emission Measurement And Restricted Bands Of Operation

8.1 Block Diagram Of Test Setup

Radiated Emission Test-Up Frequency Above 1GHz



8.2 Limit

FCC Part15 C Section 15.209 and 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1)The limit for radiated test was performed according to FCC PART 15C.
- (2)The tighter limit applies at the band edges.
- (3)Emission level (dBuV/m)=20log Emission level (uV/m).

8.3 Test Procedure

Receiver Parameter	Setting
Attenuation	Auto
Start Frequency	2300MHz
Stop Frequency	2520
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 1/T Hz for Average

Above 1GHz test procedure as below:

- a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

8.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

8.5 Test Result

	Polar (H/V)	Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measure- ment (dBuV/m)	Limits (dBuV/m)		Result
						PK	PK	
Low Channel 2402MHz								
GFSK	H	2390.00	53.94	-6.70	47.24	74.00	54.00	PASS
	H	2400.00	57.61	-6.71	50.90	74.00	54.00	PASS
	V	2390.00	54.08	-6.70	47.38	74.00	54.00	PASS
	V	2400.00	58.06	-6.71	51.35	74.00	54.00	PASS
	High Channel 2480MHz							
	H	2483.50	58.42	-6.79	51.63	74.00	54.00	PASS
	H	2500.00	52.05	-6.81	45.24	74.00	54.00	PASS
	V	2483.50	56.55	-6.79	49.76	74.00	54.00	PASS
$\pi/4$ DQPSK	V	2500.00	53.37	-6.81	46.56	74.00	54.00	PASS
	Low Channel 2402MHz							
	H	2390.00	53.90	-6.70	47.20	74.00	54.00	PASS
	H	2400.00	58.81	-6.71	52.10	74.00	54.00	PASS
	V	2390.00	53.46	-6.70	46.76	74.00	54.00	PASS
	V	2400.00	58.14	-6.71	51.43	74.00	54.00	PASS
	High Channel 2480MHz							
	H	2483.50	57.84	-6.79	51.05	74.00	54.00	PASS
	H	2500.00	52.03	-6.81	45.22	74.00	54.00	PASS
	V	2483.50	55.72	-6.79	48.93	74.00	54.00	PASS
	V	2500.00	52.76	-6.81	45.95	74.00	54.00	PASS
Remark: 1. Emission Level = Meter Reading + Factor, Factor = Antenna Factor + Cable Loss – Pre-amplifier. Over= Emission Level – Limit 2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit. 3 In restricted bands of operation, The spurious emissions below the permissible value more than 20dB 4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.								

9. Conducted Emission

9.1 Block Diagram Of Test Setup



9.2 Limit

Regulation 15.247 (d), 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))

9.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer:

Below 1GHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 1GHz:

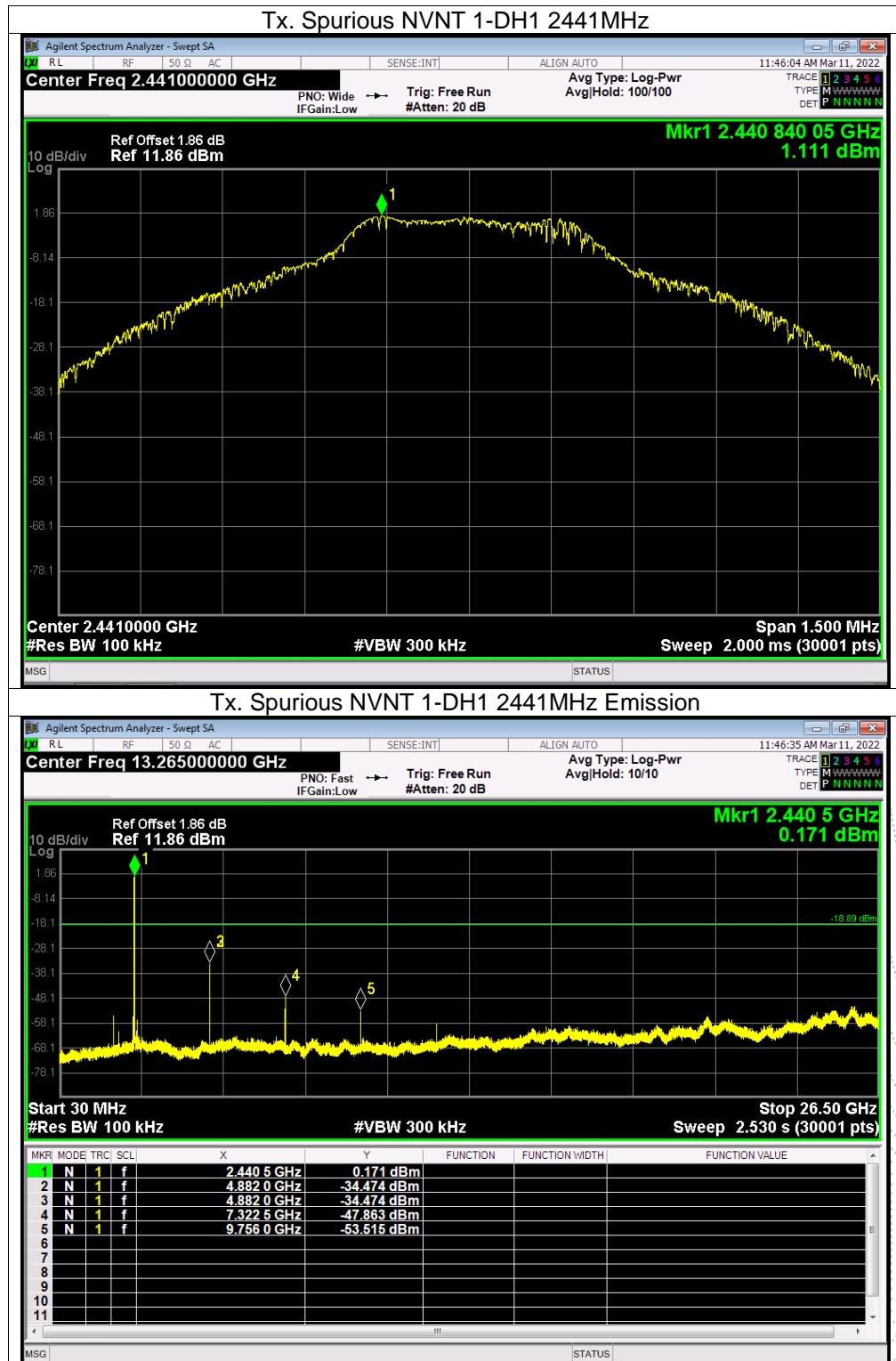
RBW = 100kHz, VBW = 300kHz, Sweep = auto

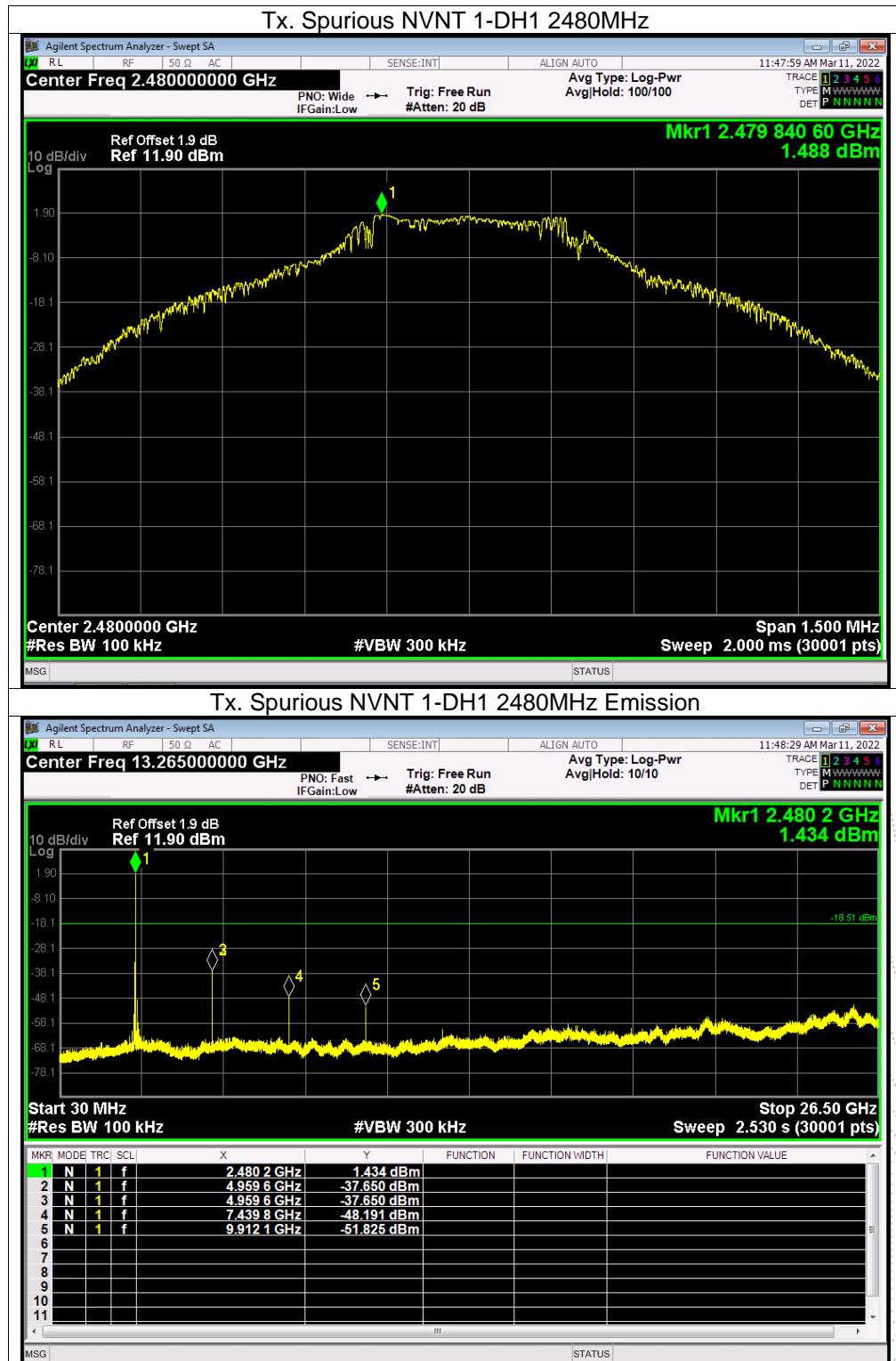
Detector function = peak, Trace = max hold

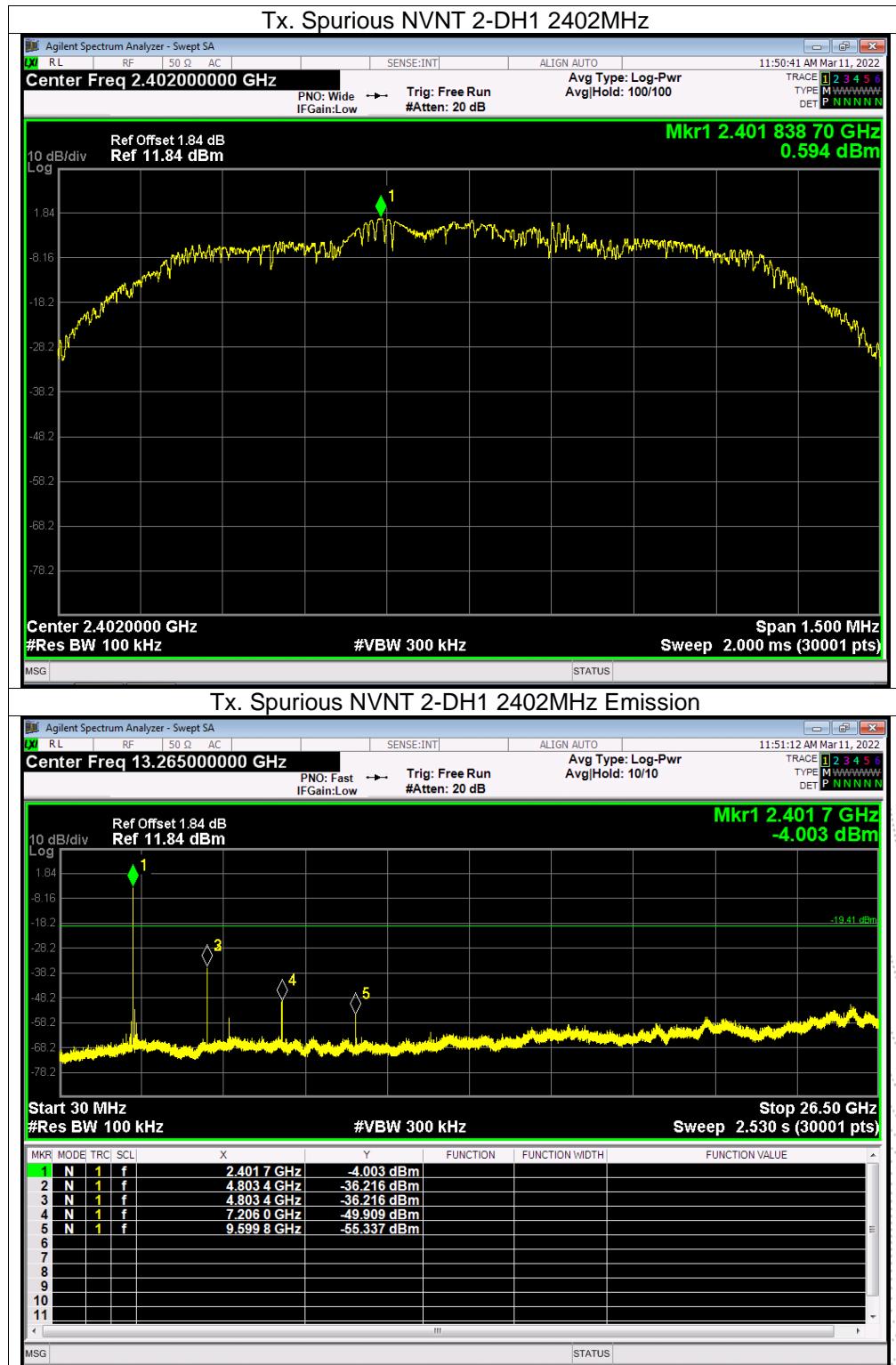
9.4 Test Result

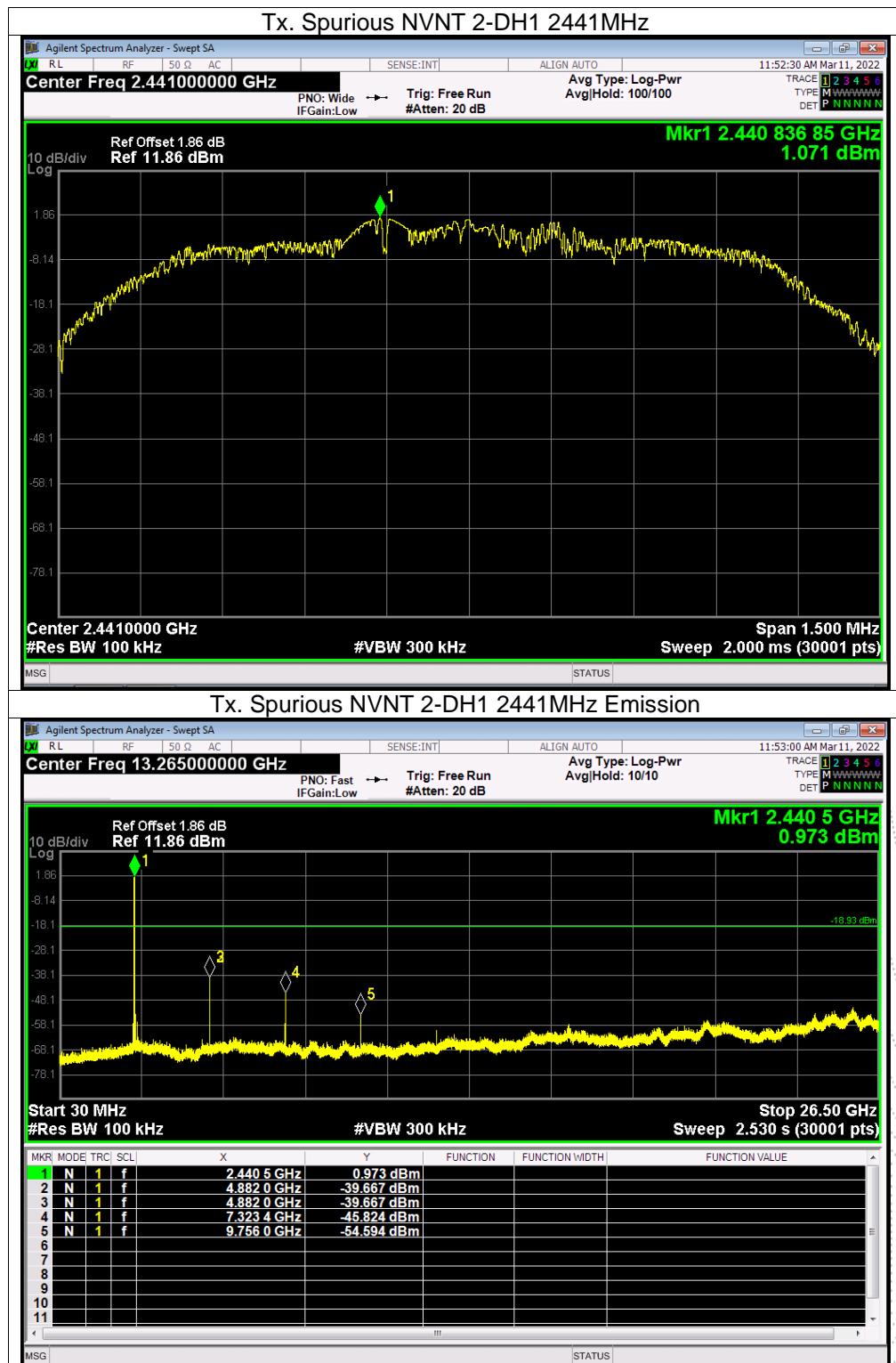
Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	AC 120V/60Hz	Remark:	N/A

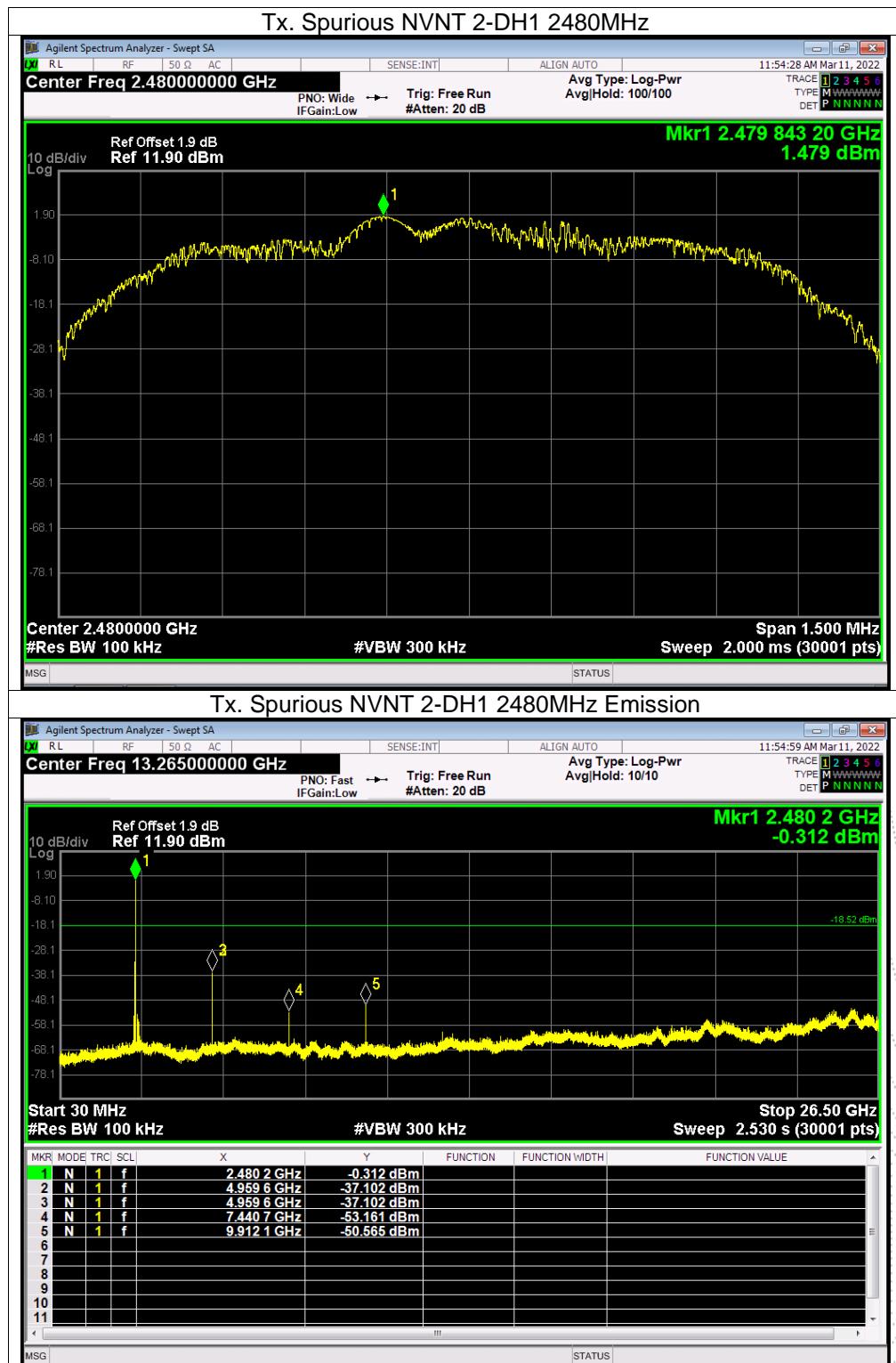


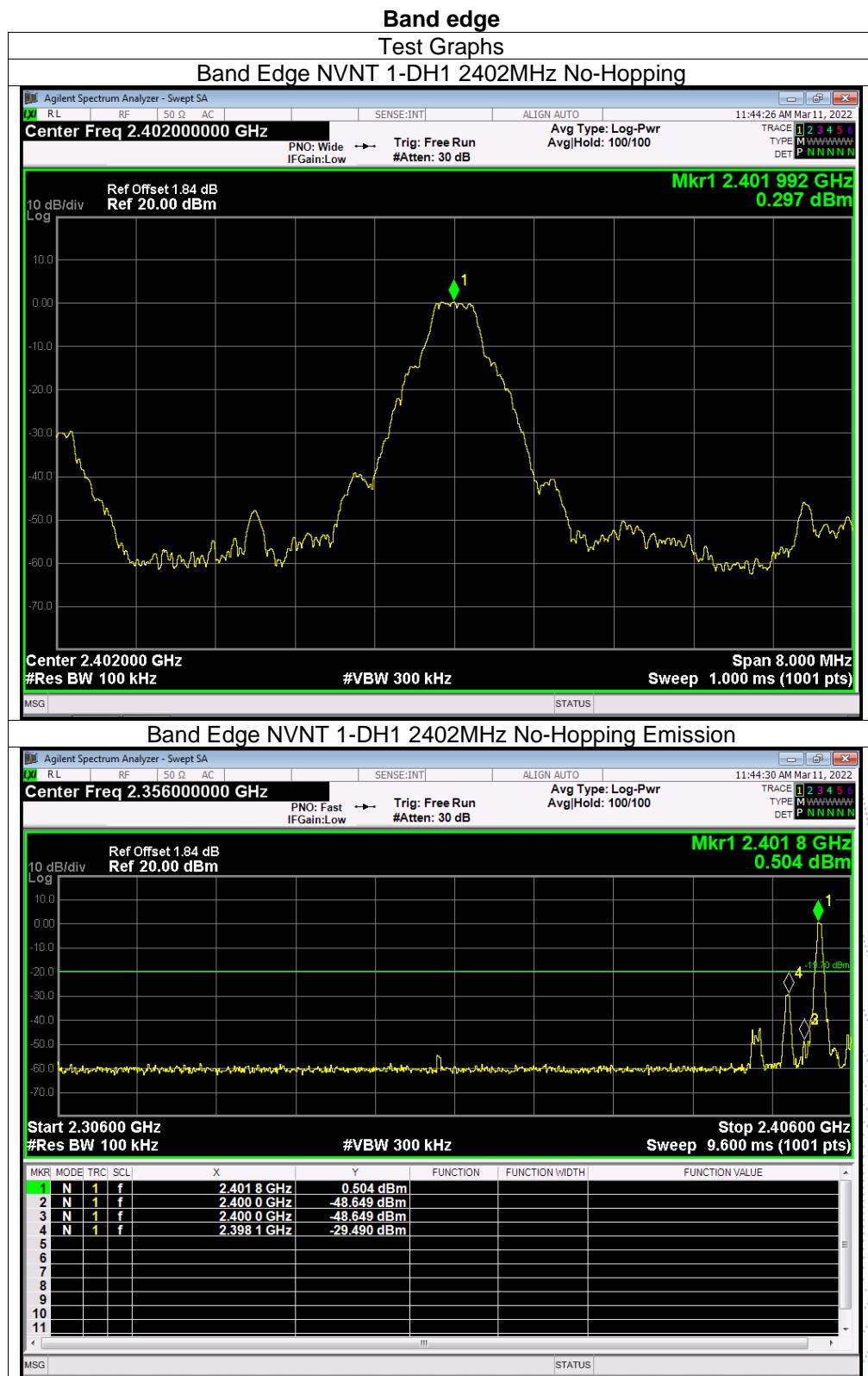


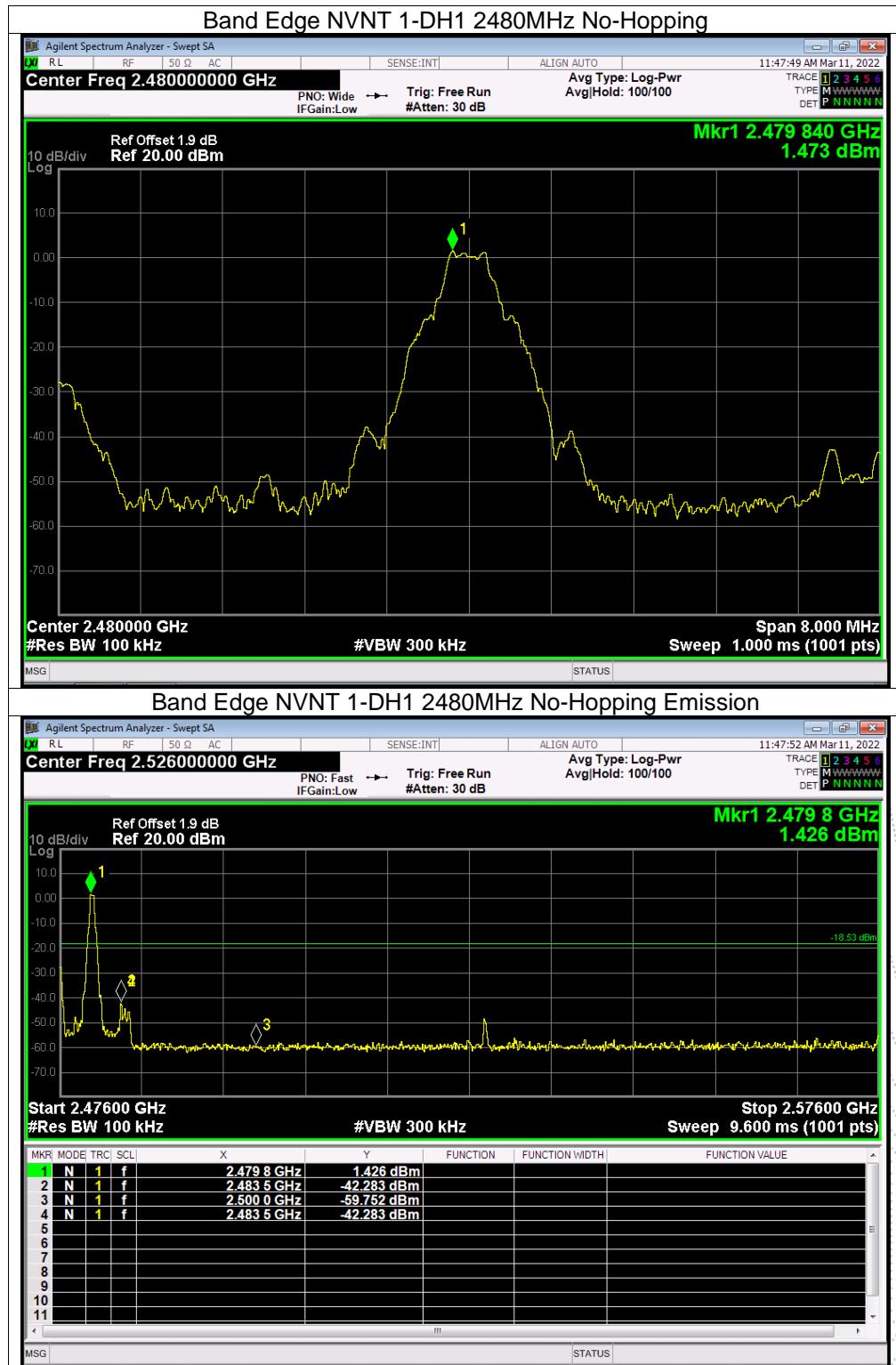


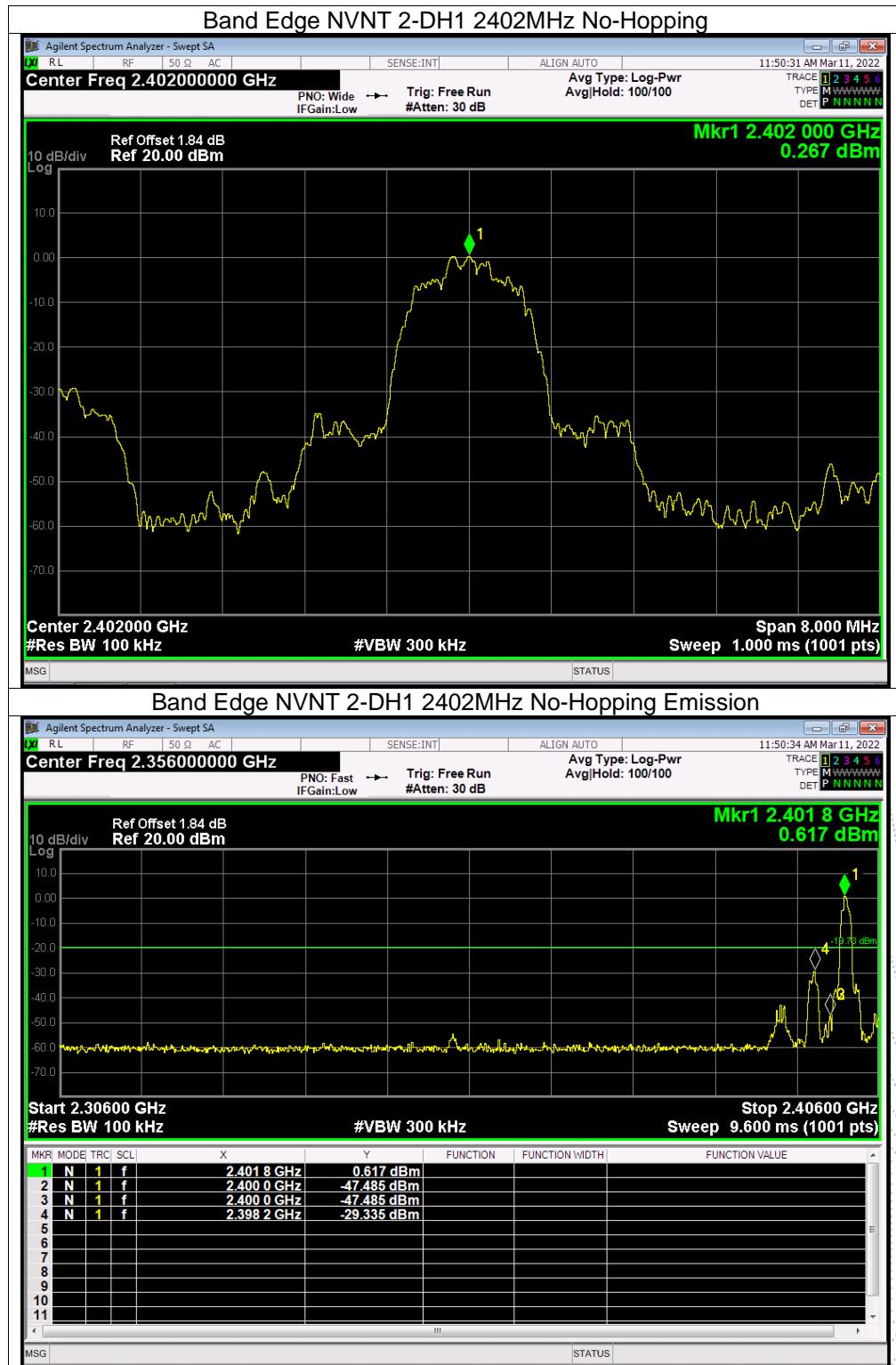


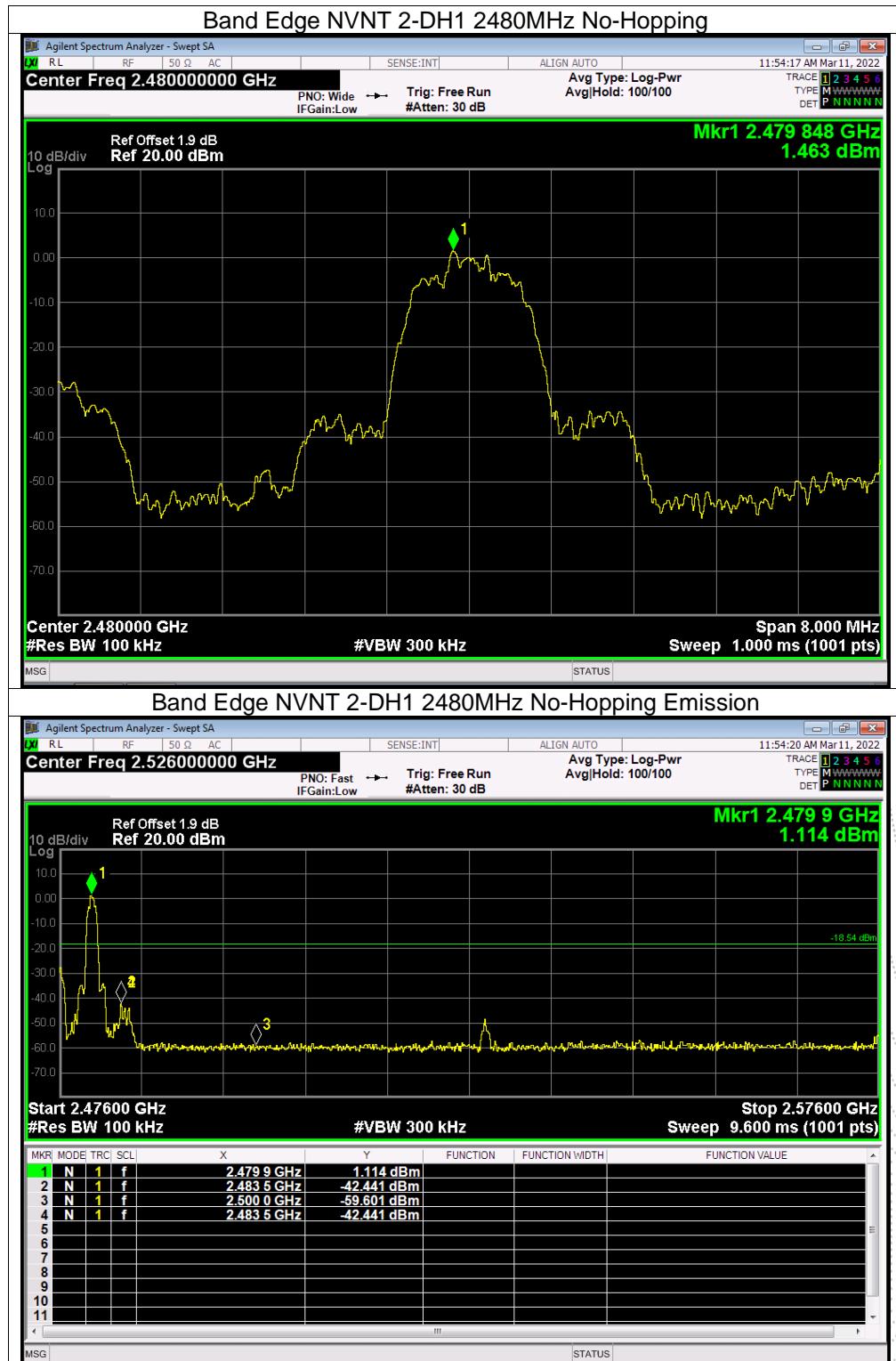








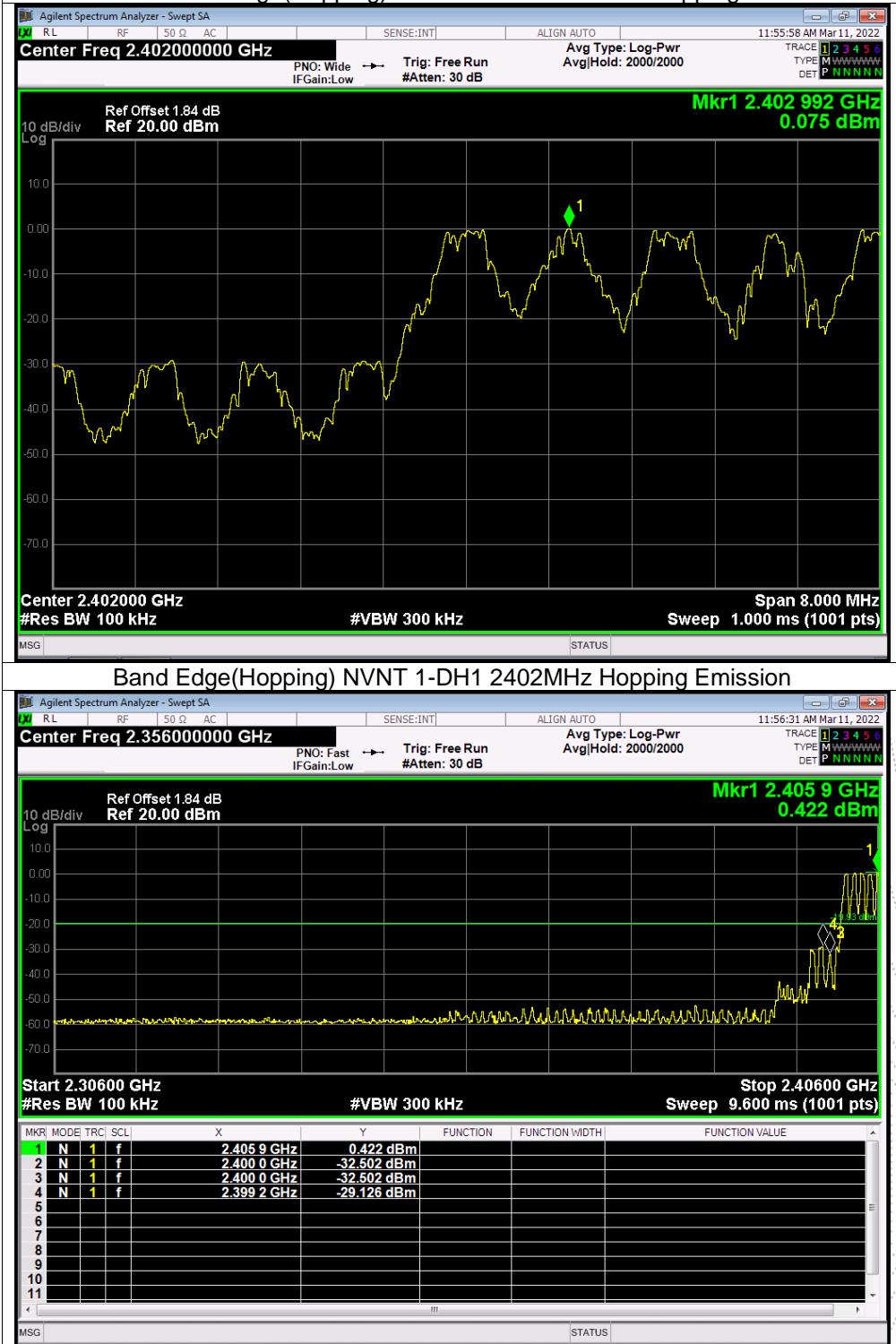


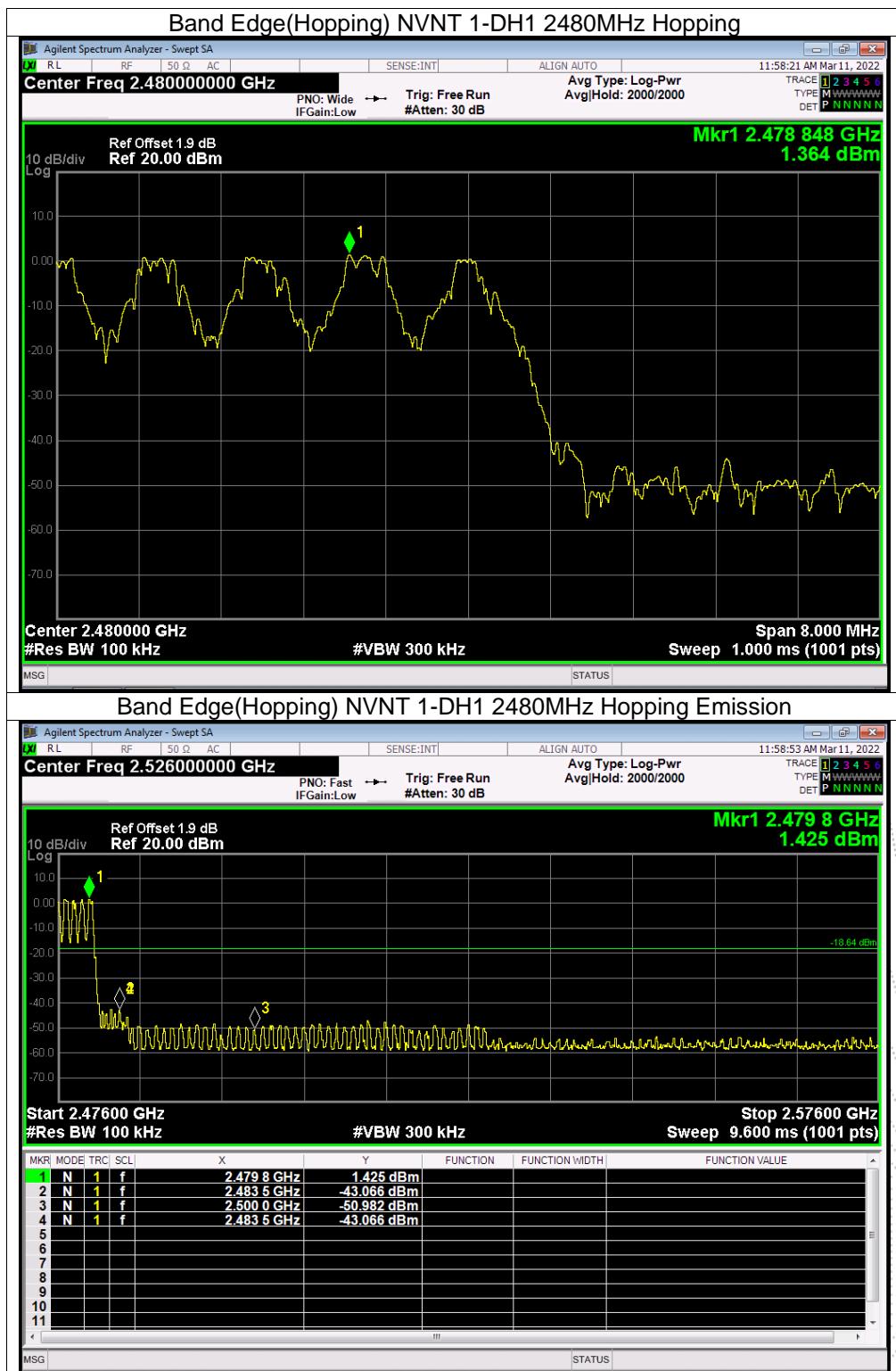


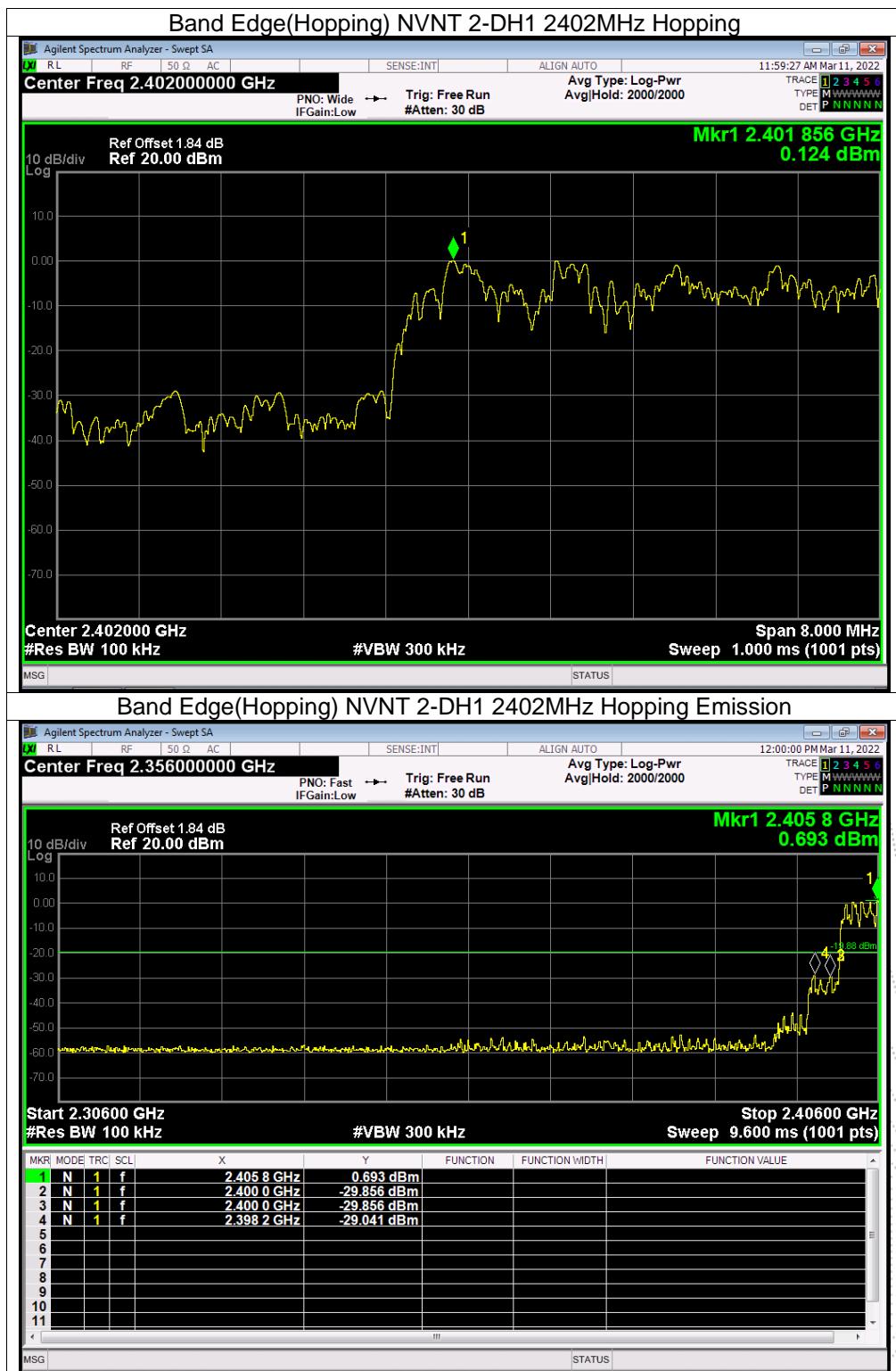
Band Edge(Hopping)

Test Graphs

Band Edge(Hopping) NVNT 1-DH1 2402MHz Hopping









10. 20 dB Bandwidth

10.1 Block Diagram Of Test Setup



10.2 Limit

N/A

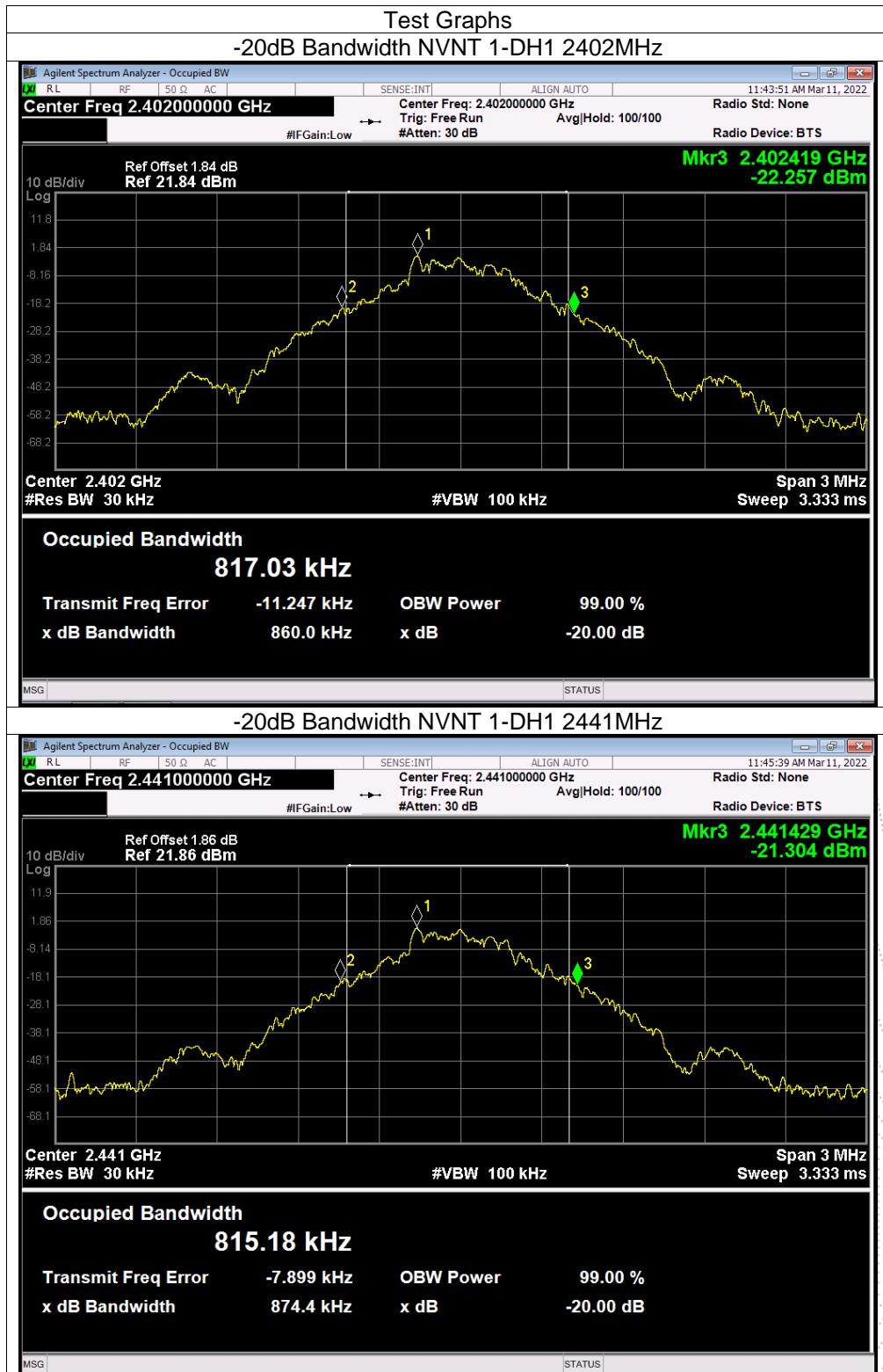
10.3 Test Procedure

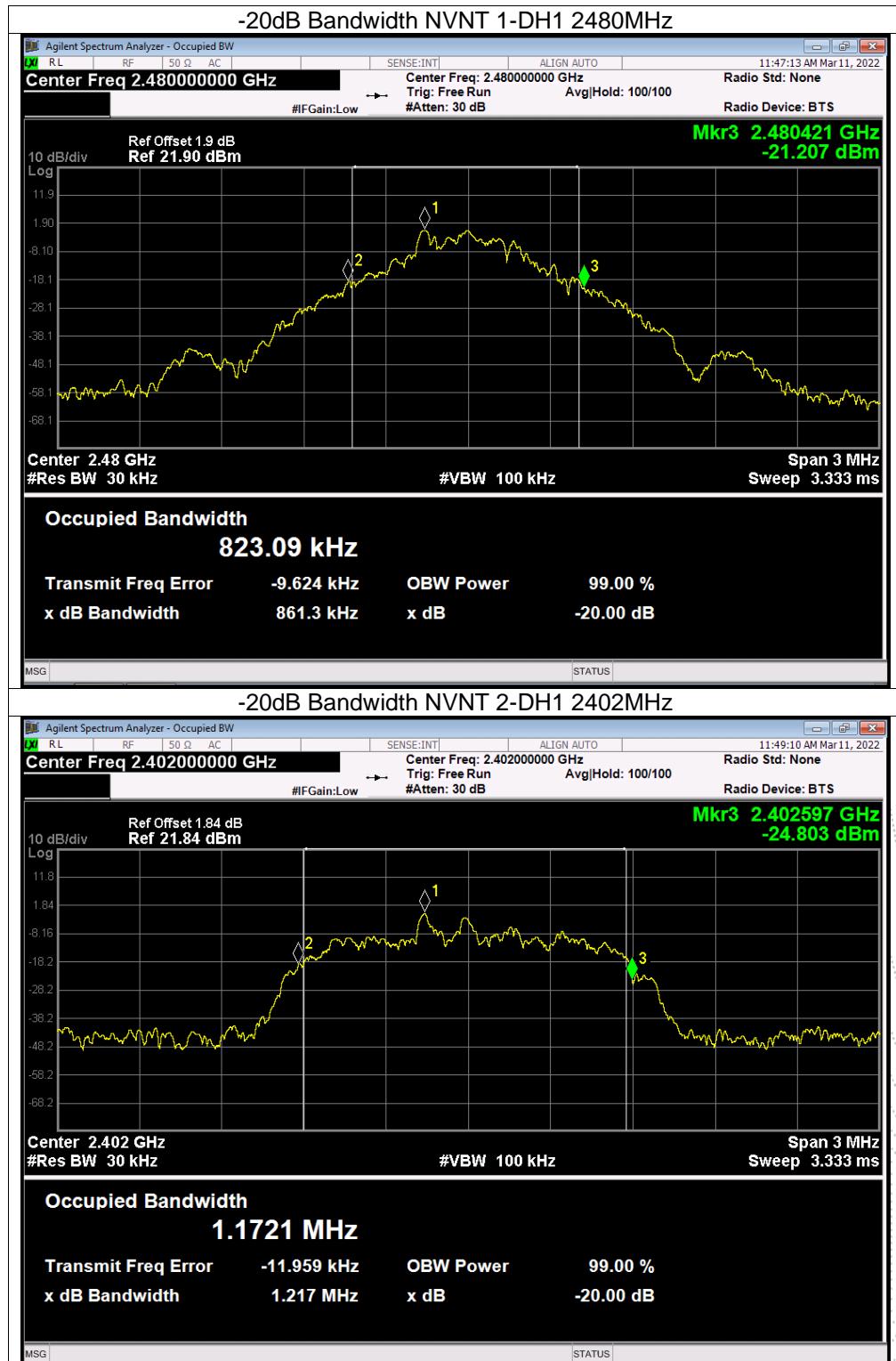
1. Set RBW = 30kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission. .

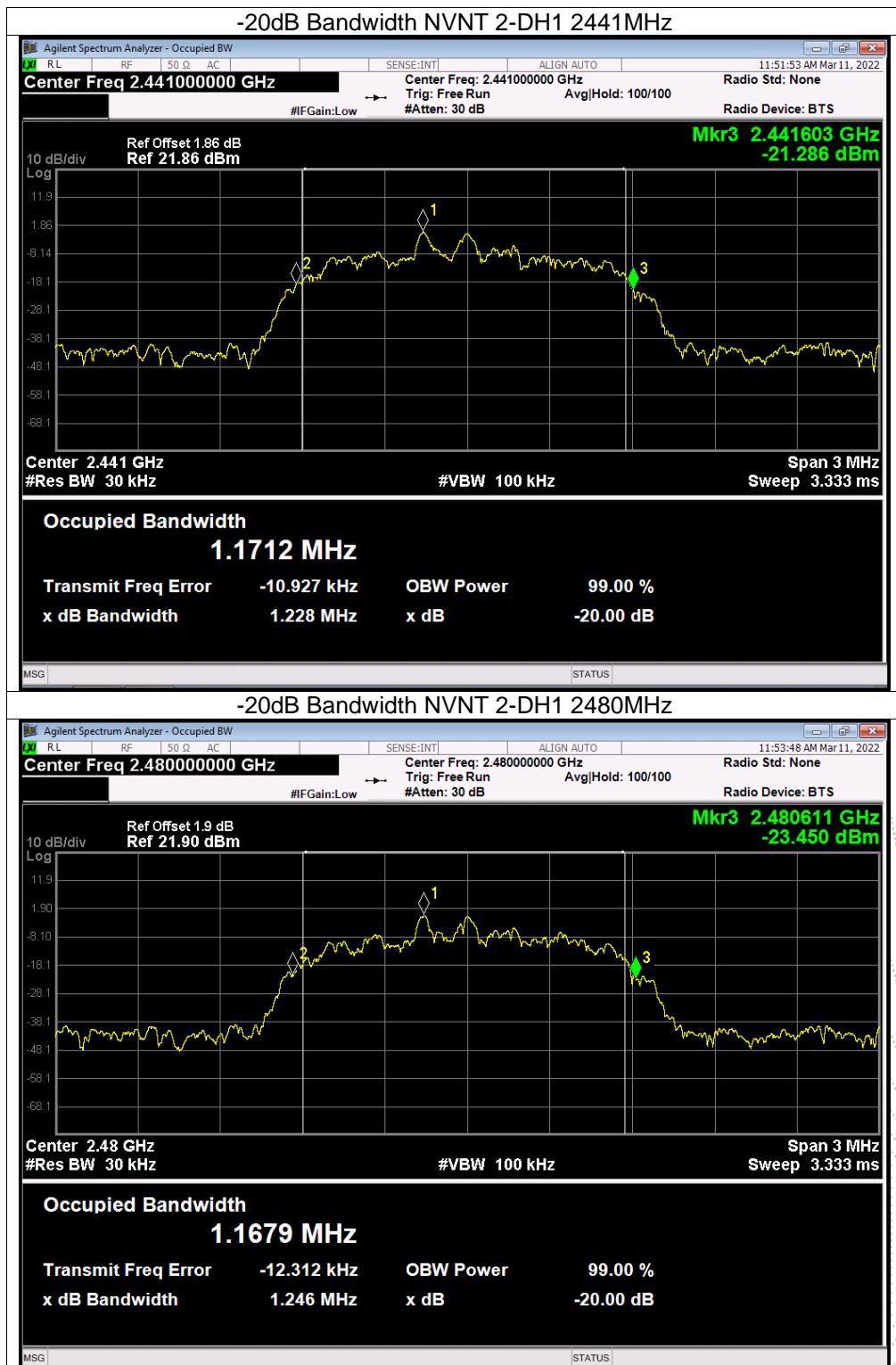
10.4 Test Result

Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	AC 120V/60Hz	Remark:	N/A

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	0.86
GFSK	Middle	0.874
GFSK	High	0.861
$\pi/4$ DQPSK	Low	1.217
$\pi/4$ DQPSK	Middle	1.228
$\pi/4$ DQPSK	High	1.246







11. Maximum Peak Output Power

11.1 Block Diagram Of Test Setup



11.2 Limit

FCC Part15 (15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(1)	Peak Output Power	0.125 watt or 21dBm	2400-2483.5	PASS

11.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

11.4 Test Result

Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	AC 120V/60Hz	Remark:	N/A

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	0.59	21
GFSK	Middle	1.15	21
GFSK	High	1.5	21
$\pi/4$ DQPSK	Low	1.32	21
$\pi/4$ DQPSK	Middle	1.81	21
$\pi/4$ DQPSK	High	2.17	21



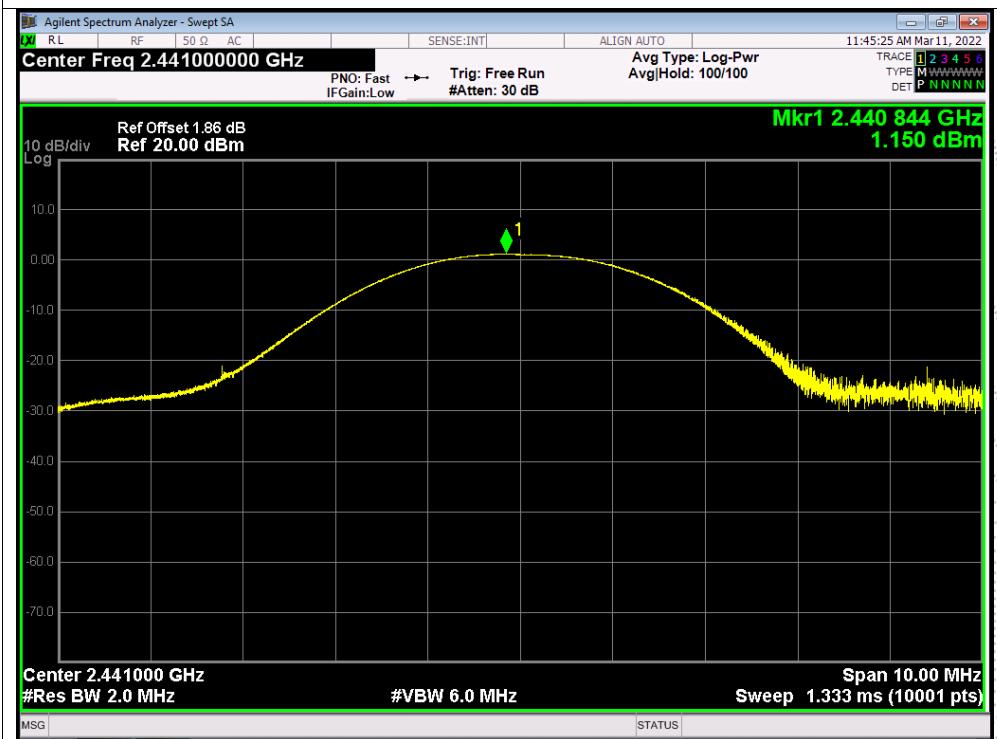
Test Graphs



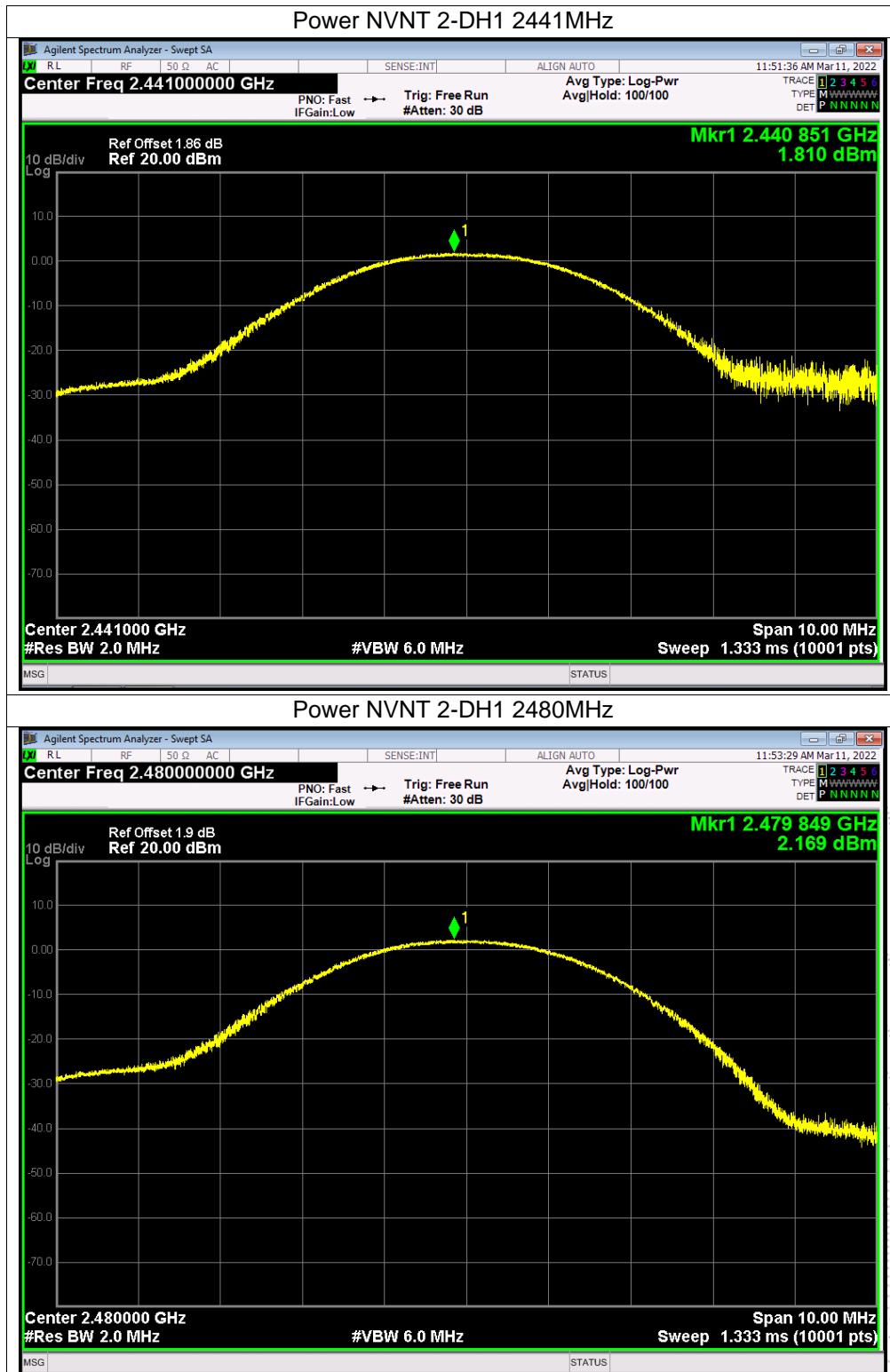
Power NVNT 1-DH1 2402MHz



Power NVNT 1-DH1 2441MHz







12. Hopping Channel Separation

12.1 Block Diagram Of Test Setup



12.2 Limit

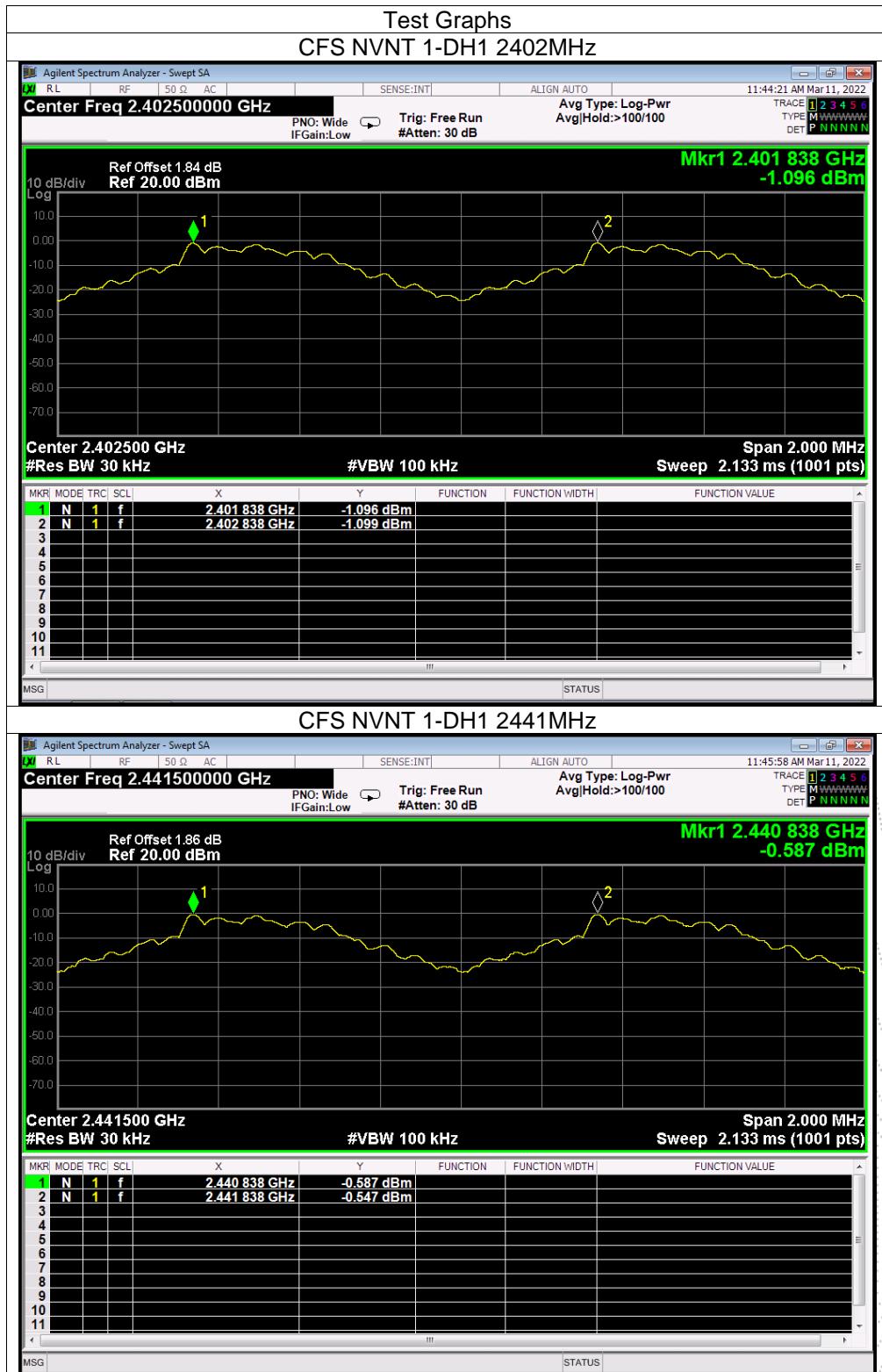
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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 0.125W.

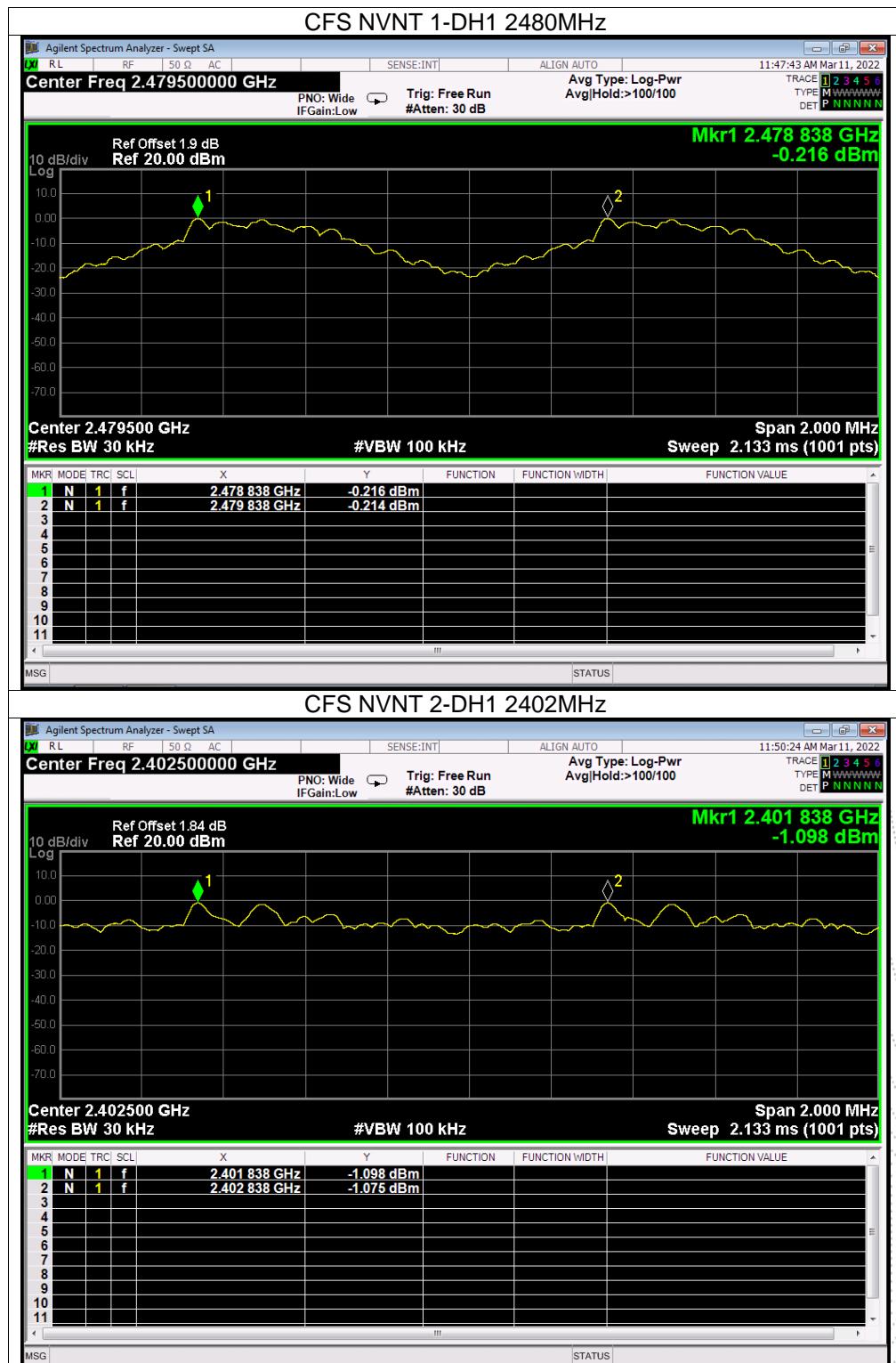
12.3 Test Procedure

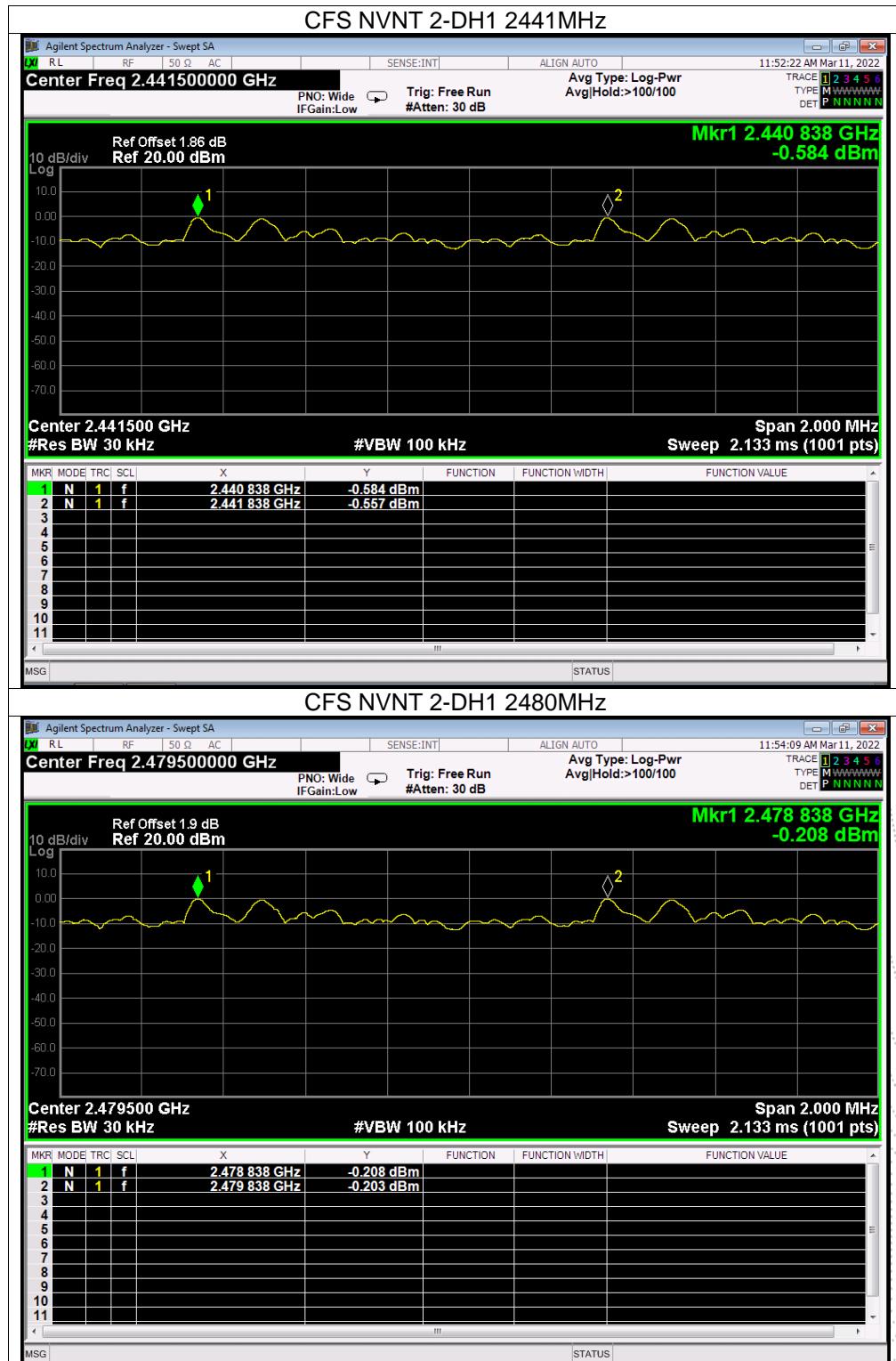
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 2.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

12.4 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1	0.860	PASS
GFSK	Middle	1	0.874	PASS
GFSK	High	1	0.861	PASS
$\pi/4$ DQPSK	Low	1	0.811	PASS
$\pi/4$ DQPSK	Middle	1	0.819	PASS
$\pi/4$ DQPSK	High	1	0.831	PASS







13. Number Of Hopping Frequency

13.1 Block Diagram Of Test Setup



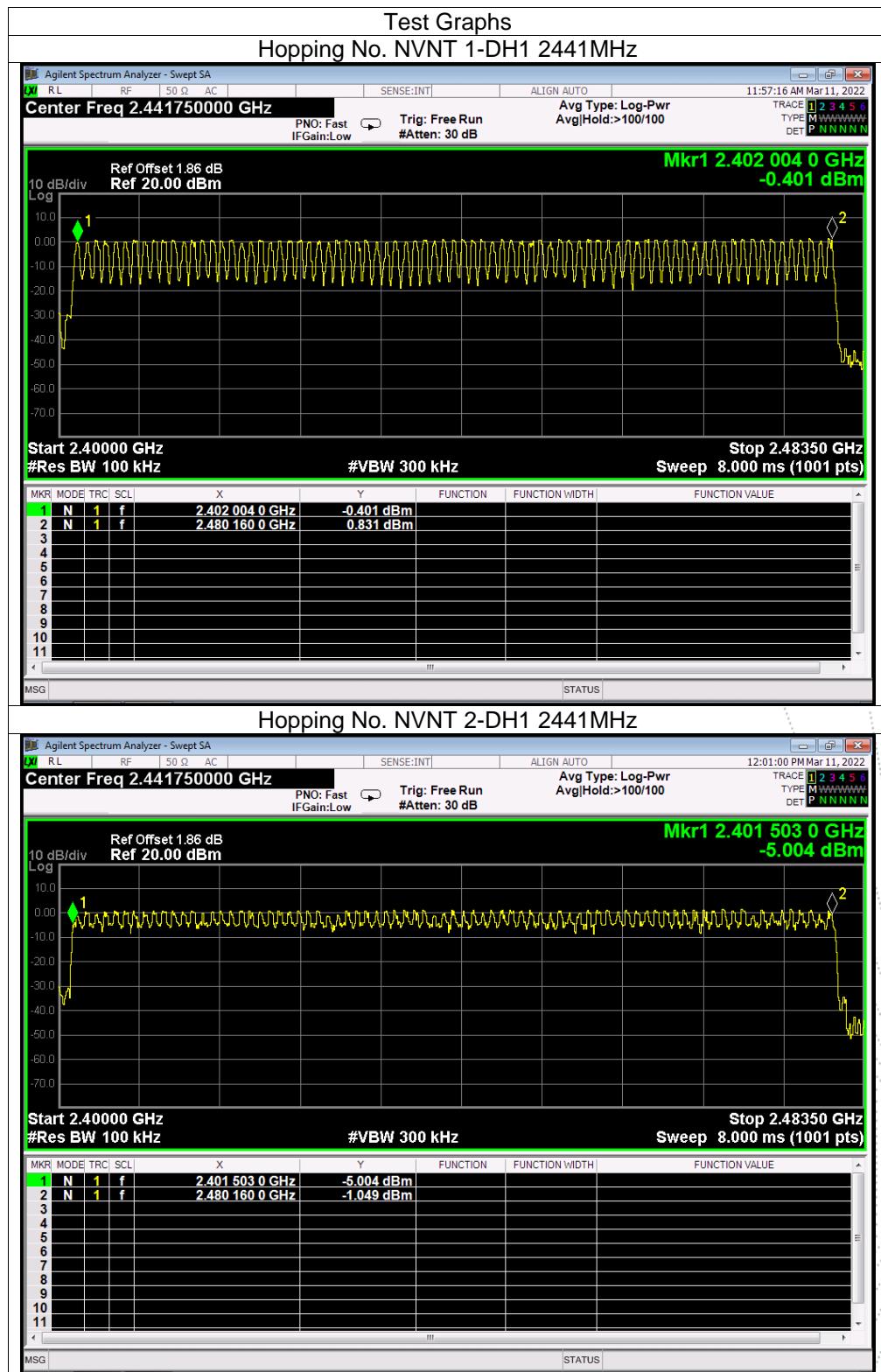
13.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

13.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

13.4 Test Result



14. Dwell Time

14.1 Block Diagram Of Test Setup



14.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

14.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

14.4 Test Result

Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH1	2441	0.375	120	320	31600	400	Pass
NVNT	1-DH3	2441	1.632	179.52	110	31600	400	Pass
NVNT	1-DH5	2441	2.88	201.6	70	31600	400	Pass
NVNT	2-DH1	2441	0.385	121.275	315	31600	400	Pass
NVNT	2-DH3	2441	1.633	168.199	103	31600	400	Pass
NVNT	2-DH5	2441	2.879	172.74	60	31600	400	Pass

