FCC PART 15 SUBPART C
TEST REPORT

Issued By: Dongguan New Testing Centre Co., Ltd

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TEST REPORT DECLARE

FCC ID	:	2AFAX-HEADPODSPRO
Applicant	:	BOOMPODS (HK) LTD.
Address	:	RM 303-304 Hankow Centre 5-15,Hankow Road T.S.T. Kowloon, HONG KONG.
Equipment under Test	:	wireless headphones
Model No	:	headpods pro
Trade Mark	:	N/A
Manufacturer	:	Dongguan Linyar Technology Co., Ltd.
Address	:	No.2,PujiangRoad,DaningCommunity,Humen, Dongguan, Guangdong, China.

Test Standard Used:

FCC Rules and Regulations Part 15 Subpart C: 2017, ANSI C63.10:2013.

We Declare:

The equipment described above is tested by Dongguan New Testing Centre Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Dongguan New Testing Centre Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.

Report No.:	NTCER2004010		
Date of Test:	Apr.01,2019 to Apr.08,2019	**Date of Report**:	Apr.09,2019

Prepared By: ***Approved By:***

Jeffrey Zhang

Jeffrey Zhang/Engineer ***Dave Gao/LAB Manager***

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan New Testing Centre Co., Ltd

1. Summary of test results

Description of Test Item	Standard	Results
Antenna Requirement	Section 15.247(c)	PASS
Conduction Emissions	Section 15.207(a)	PASS
Radiated Emissions	Section 15.247(d)	PASS
Carrier Frequencies Separated	Section 15.247(a)(1)	PASS
Hopping Channel Number	Section 15.247(a)(1) (iii)	PASS
Dwell Time	Section 15.247(a)(1) (iii)	PASS
Maximum Peak Output Power	Section 15.247(b)	PASS
Band edge	Section 15.247(d)	PASS
Conducted Spurious Emissions	Section 15.247(d)	PASS

2. General test information

2.1. Description of EUT

EUT* Name	:	wireless headphones
Test model	:	headpods pro
EUT function description	:	Please reference user manual of this device
Power supply	:	5Vdc from micro-USB or 3.7Vdc from battery
Trade mark	:	N/A
Operation frequency	:	2402-2480MHz
Number of channel	:	79
Modulation Technology	:	GFSK, π/4-DQPSK, 8DPSK(1/2/3Mbps)
Bluetooth version	:	5.0
H/W No.	:	V 3.0
S/W No.	:	V 1.1
Antenna Type	:	PCB antenna
Antenna Gain	:	-0.58 dBi

Note: 1,EUT is the ab. of equipment under test.

2.2. Detail models

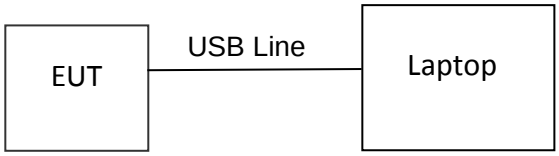
Model	Rating	Note
headpods pro	5Vdc from micro-USB or 3.7Vdc from battery	N/A

2.3. Detail models

No.	Equipment	Manufacturer	Model No.	Serial No.	Note
1	Notebook	Lenovo	ThinkPadE450	PF-0LRXDH	--
2	Charger	Xintong	XT0502000	--	--

2.4. Block diagram EUT configuration for test

1. Block diagram of EUT configuration(TX Mode)



Note:
1.Connect the EUT as above block diagram of configuration, Run the software, set the transmit serial port/power/channel/packet type/data type/hopping or not, send configuration, than EUT enter the TX mode.
2.Set EUT in continuous transmission signal mode.
3.Using the laptop and the transform board to control the fixed transmitting frequency and other test mode. After finishing the test setting, the notebook and the transform board will be removed during measurements.

2.5. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

(1) E.U.T. test conditions:

15.31(e): For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(2) Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. If required reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

(3) Frequency range of radiated measurements:

According to the 15.33, the test range will be up to the tenth harmonic of the highest fundamental frequency.

(4) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode,

The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.

2.6. Measurement uncertainty

Test Item	Uncertainty
Uncertainty for Conduction emission test	2.44dB
Uncertainty for Radiation Emission test (30MHz – 1GHz)	3.14 dB (Polarize: V)
	3.16 dB (Polarize: H)
Uncertainty for Radiation Emission test (1GHz – 18GHz)	4.27 dB (Polarize: V)
	4.51 dB (Polarize: H)
Uncertainty for conducted RF Power	0.63dB
Stop Transmitting Time Test	±0.5%
Uncertainty for frequency error	5.8 x 10-8

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

2.7. Test Peripheral List

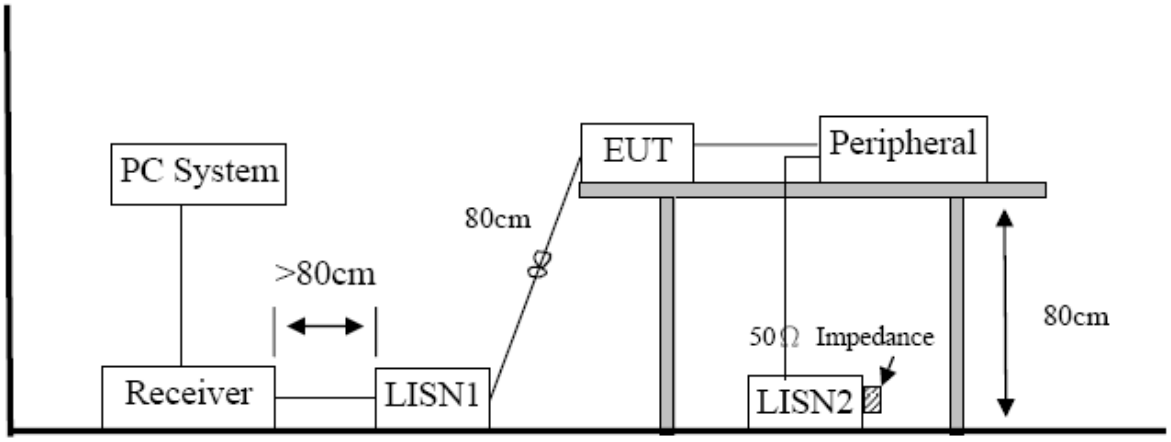
No.	Equipment	Manufacturer	FCC approved	Model No.	Serial No.	signal cable
1	Lap top	lenovo	DOC	ThinkPe dE450	2014ap5917	N/A

3. Power Line Conducted Emission Test

3.1. Test equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Test Receiver	R&S	ESCS30	8341151006	2019-05-23	1 Year
2	LISN	R&S	ENV216	3650.6550.06	2019-05-13	1 Year
3	Pulse Limiter	R&S	ESH3-Z2	0357-8810.54	2019-05-13	1 Year
4	RF Cable	HUBER	SUCOFLEX100	30722/4E	2019-05-13	1 Year
5	MEASUREMENT SOFTWARE	FARAD	EZ-EMC(VER:1.1.4.2)	N/A	N/A	N/A

3.2. BLOCK DIAGRAM OF TEST SETUP



3.3. Power Line Conducted Emission Limits (Class B)

Frequency	Quasi-Peak Level dB(μV)	Average Level dB(μV)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Note 1: * Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies.

3.4. Test Procedure

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.3 and test equipment as described in clause 3.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.3 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

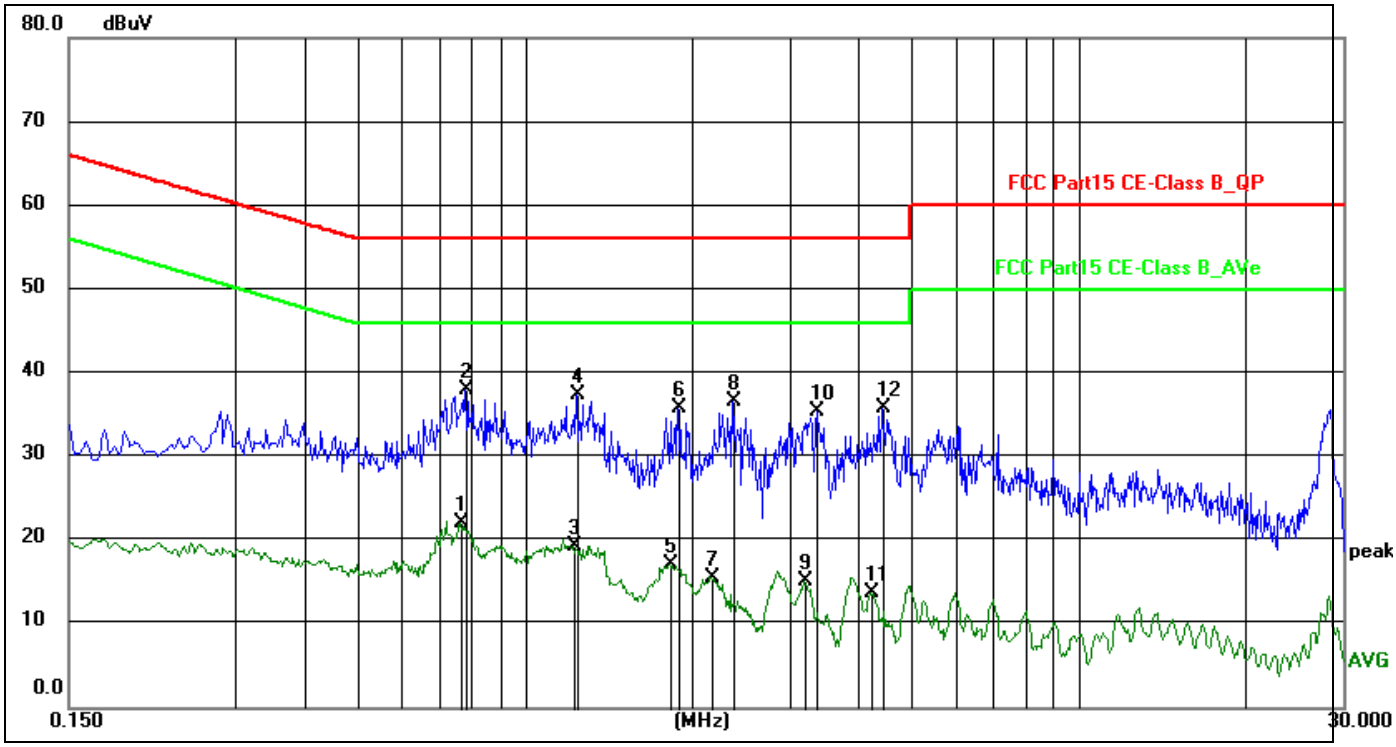
The bandwidth of test receiver is set at 9 KHz.

3.5. Test Result

PASS. (See below detailed test result)

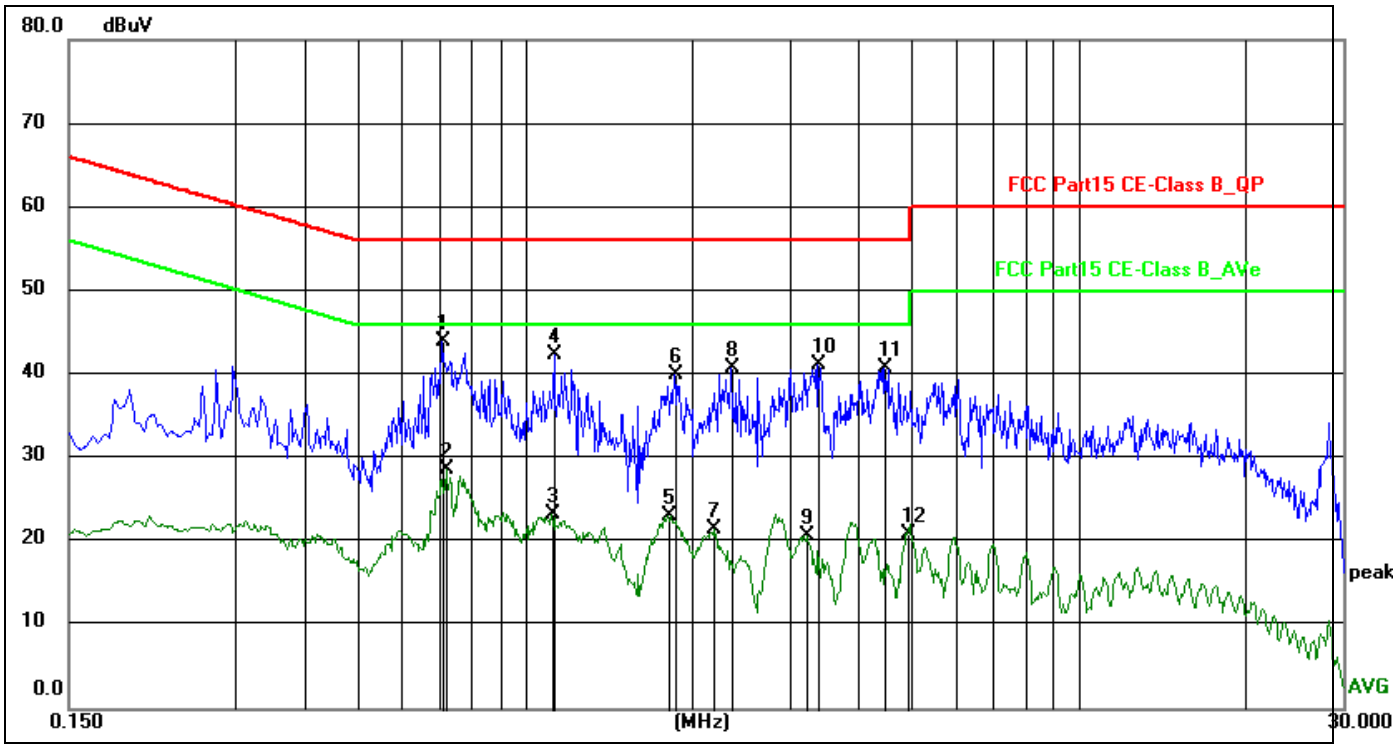
Note1: All emissions not reported below are too low against the prescribed limits.
Note2: “-----” means Peak detection; “-----” means Average detection
Note3: Measurement = Reading Level + Factor, Margin= Measurement-Limit

Conducted Emission Test Result



Site:		**Phase:L1**	**Temperature(C):24(C)**
Limit:	**FCC Part15 CE-Class B_QP**		**Humidity(%):63%**
EUT:	**wireless headphones**	**Test Time:**	**2020/4/1 16:58:32**
M/N.:	**headpods pro**	**Power Rating:**	**DC 5V by adapter input 120V/60Hz**
Mode:	**Tx mode (2402MHz-Worst cast)**	**Test Engineer:**	
Note:			

No.	Frequency (MHz)	Reading Level(dBuV)	Factor (dB)	Measure-ment(dBuV)	Limit (dBuV)	Margin (dB)	Detector	Comment
1	0.7660	12.36	9.80	22.16	46.00	-23.84	AVG	
2 *	0.7820	28.25	9.80	38.05	56.00	-17.95	peak	
3	1.2260	9.49	9.88	19.37	46.00	-26.63	AVG	
4	1.2420	27.58	9.88	37.46	56.00	-18.54	peak	
5	1.8220	7.22	9.87	17.09	46.00	-28.91	AVG	
6	1.8940	25.90	9.86	35.76	56.00	-20.24	peak	
7	2.1780	5.75	9.86	15.61	46.00	-30.39	AVG	
8	2.3820	26.85	9.87	36.72	56.00	-19.28	peak	
9	3.1940	5.28	9.87	15.15	46.00	-30.85	AVG	
10	3.3780	25.59	9.87	35.46	56.00	-20.54	peak	
11	4.2180	3.91	9.90	13.81	46.00	-32.19	AVG	
12	4.4140	26.00	9.90	35.90	56.00	-20.10	peak	



Site:		**Phase:N**	**Temperature(C):24(C)**
Limit:	**FCC Part15 CE-Class B_QP**		**Humidity(%):63%**
EUT:	**wireless headphones**	**Test Time:**	**2020/4/1 17:03:44**
M/N.:	**headpods pro**	**Power Rating:**	**DC 5V by adapter input 120V/60Hz**
Mode:	**Tx mode (2402MHz-Worst cast)**	**Test Engineer:**	
Note:			

No.	Frequency (MHz)	Reading Level(dBuV)	Factor (dB)	Measure-ment(dBuV)	Limit (dBuV)	Margin (dB)	Detector	Comment
1 *	0.7100	34.30	9.68	43.98	56.00	-12.02	peak	
2	0.7220	19.06	9.68	28.74	46.00	-17.26	AVG	
3	1.1180	13.61	9.72	23.33	46.00	-22.67	AVG	
4	1.1300	32.67	9.73	42.40	56.00	-13.60	peak	
5	1.8100	13.16	9.98	23.14	46.00	-22.86	AVG	
6	1.8620	29.94	10.00	39.94	56.00	-16.06	peak	
7	2.1940	11.52	10.05	21.57	46.00	-24.43	AVG	
8	2.3699	30.66	10.05	40.71	56.00	-15.29	peak	
9	3.2340	10.70	10.05	20.75	46.00	-25.25	AVG	
10	3.3860	31.16	10.05	41.21	56.00	-14.79	peak	
11	4.4660	30.67	10.05	40.72	56.00	-15.28	peak	
12	4.9220	10.96	10.05	21.01	46.00	-24.99	AVG	

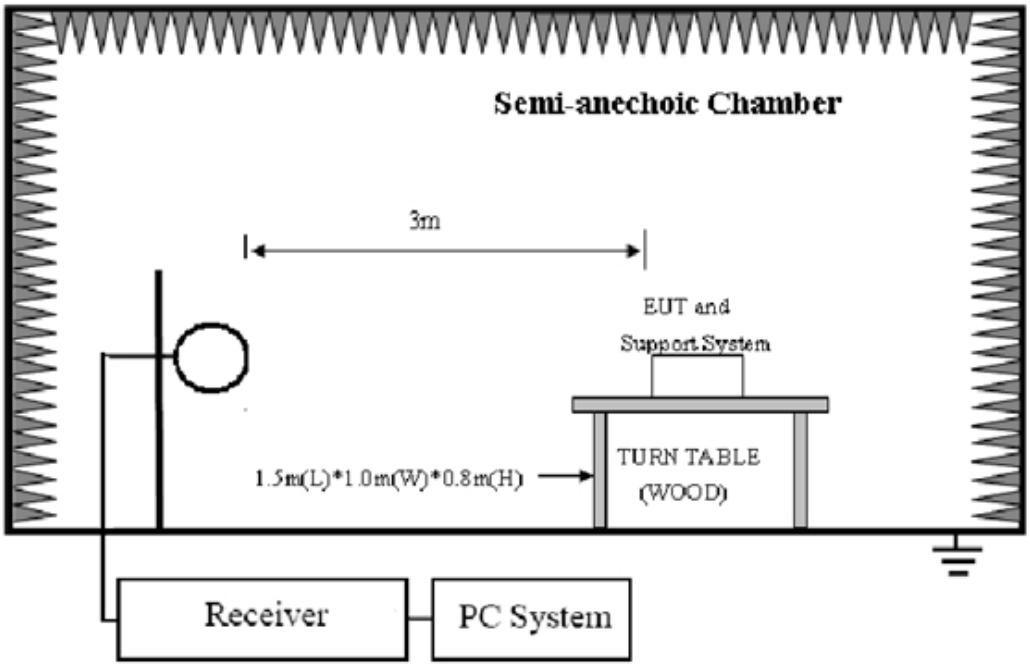
4. Radiated emission test

4.1. Test equipment

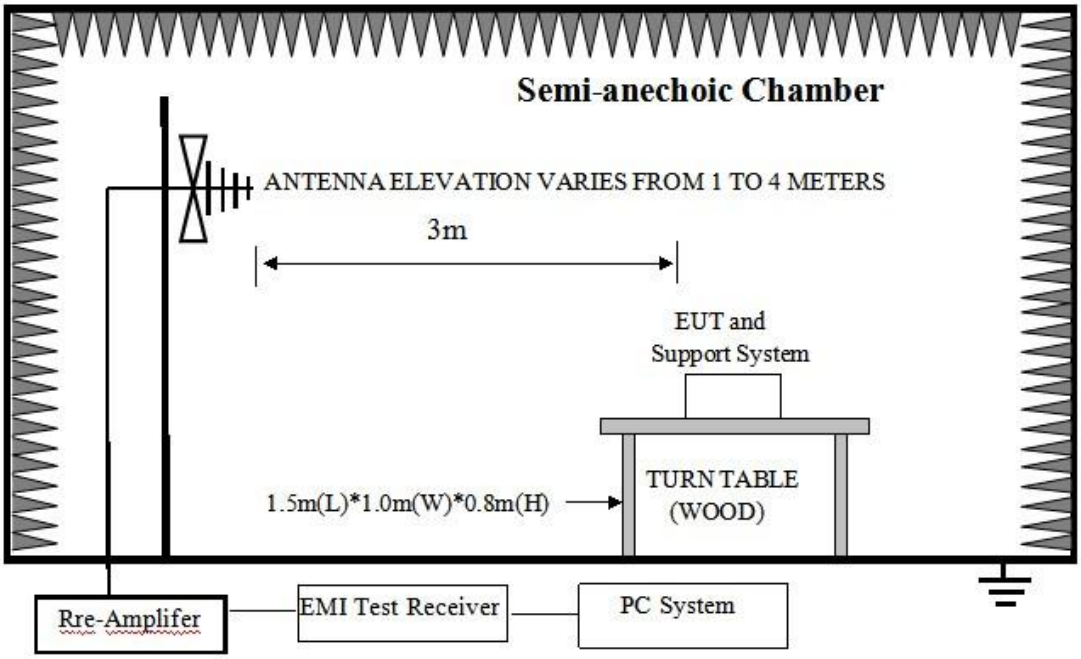
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	EMI Test Receiver	R&S	ESR	7250-304067528	2019-04-30	1Year
2	Trilog Broadband Antenna	Schwarzbeck	VULB9168	00969	2019-06-14	2 Year
3	Pre-amplifier	R&S	8447F	3113A04553	2019-05-13	1Year
4	Active Loop antenna	Schwarzbeck	FMZB-1519	1519-038	2019-05-23	1Year
5	Horn antenna	Schwarzbeck	BBHA9120D	453	2019-05-23	2Year
6	Double Ridged Horn Antenna	A.H. System	SAS-574	584	2019-05-23	1Year
7	Pre-amplifier	R&S	SCU18	105326	2019-05-23	1Year
8	RF Cable	GORE	OSQ01Q01078.7	SN15458473	2019-05-23	1Year
9	RF Cable	GORE	OSQ01Q01078.7	SN15458474	2019/5/14	1Year
10	RF Cable	ESCO	ETS-LINGREN	RFC-SMS-100-SMS-340-IN	2019-05-23	1Year
11	Measurement software	Farad	EZ-EMC(VER:1.1.4.2)	N/A	N/A	N/A

4.2. Block diagram of test setup

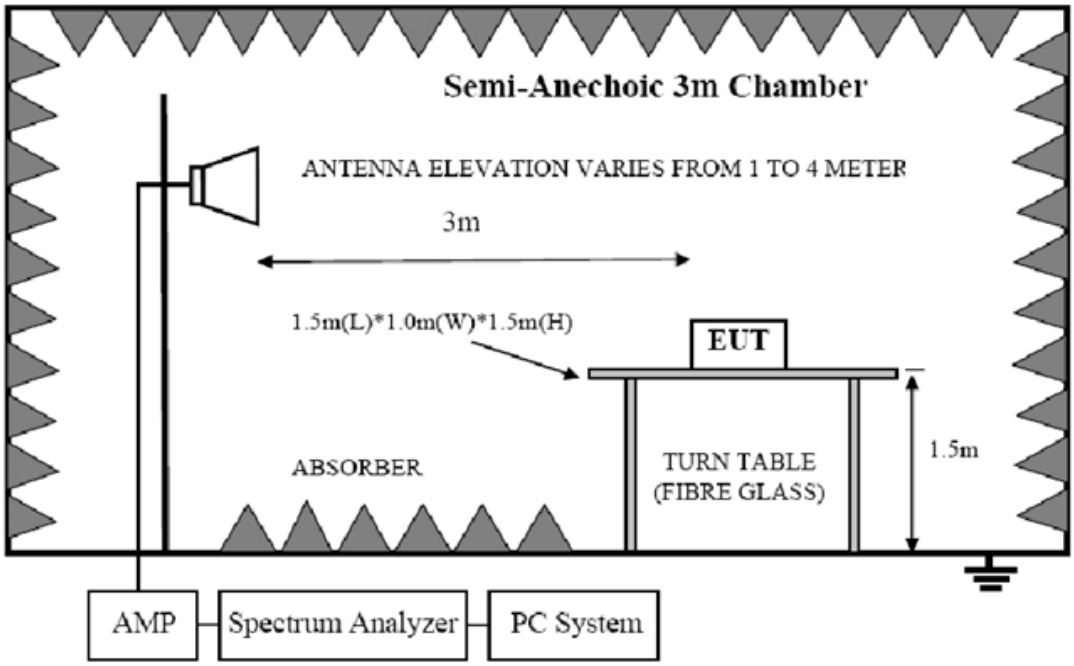
In 3m Anechoic Chamber Test Setup Diagram for 9KHz to 30MHz:



In 3m Anechoic Chamber Test Setup Diagram for 30MHz to 1GHz:



In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz:



4.3. Limit

FCC 15.205 Restricted frequency band:

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])

FCC 15.109 Limit

Frequency (MHz)	Distance (Meters)	Field Strengths Limits dB(μV)/m
30--88	3	40.0
88--216	3	43.5
216--960	3	46.0
960--1000	3	54.0
Above 1GHz	3	Peak: 74.0
	3	Average:54.0

Note: (1) The smaller limit shall apply at the cross point between two frequency bands.

(2)Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.

(3)The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz.Radiated emissions limits in these three bands are based on measurements employing an average detector.

(4) At frequencies below 30MHz, measurement may be performed at a distance closer then that specified, and the limit at closer measurement distance can be extrapolated by below formula:

Limit3m(dBuV/m)= Limit30m(dBuV/m) + 40Log(30m/3m)

(5)All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.109, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.109 limits.

4.4. Test Procedure

Procedure of Preliminary Test

Configuration EUT to simulate typical usage as described in clause 2.3 and test equipment as described in clause 4.2 of this report.

Mains cables, telephone lines or other connections to auxiliary equipment located outside the test are shall drape to the floor, be fitted with ferrite clamps or ferrite tubes placed on the floor at the point where the cable reaches the floor and then routed to the place where they leave the turntable. No extension cords shall be used to mains receptacle.

EUT height should be 0.8m for below 1GHz and 1.5m for above 1GHz at ground with absorbers.

The antenna was placed at 3 meter away from the EUT as stated in ANSI C63.10. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.

The Analyzer / Receiver quickly scanned from 30MHz to 18GHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

The X, Y, Z three axial are tested and the report only the worst case.

The emissions from 9KHz to 1GHz, QP or average values were measured with EMI receiver with below RBW:

Frequency band	RBW
9KHz-150KHz	200Hz
150KHz-30MHz	9KHz
30MHz-1GHz	120KHz

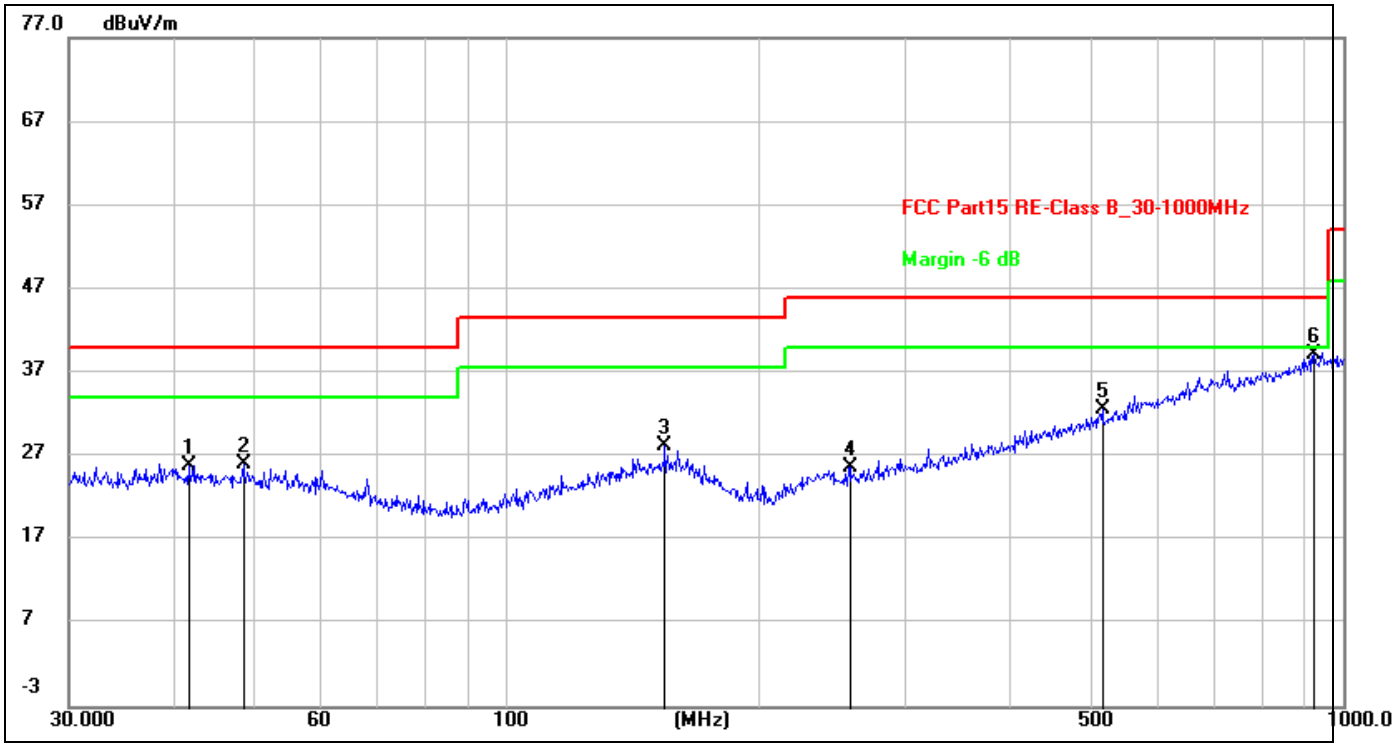
For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RMS detector RBW 1MHz VBW 3MHz for Average measure.

4.5. Test result

PASS. (See below detailed test result)

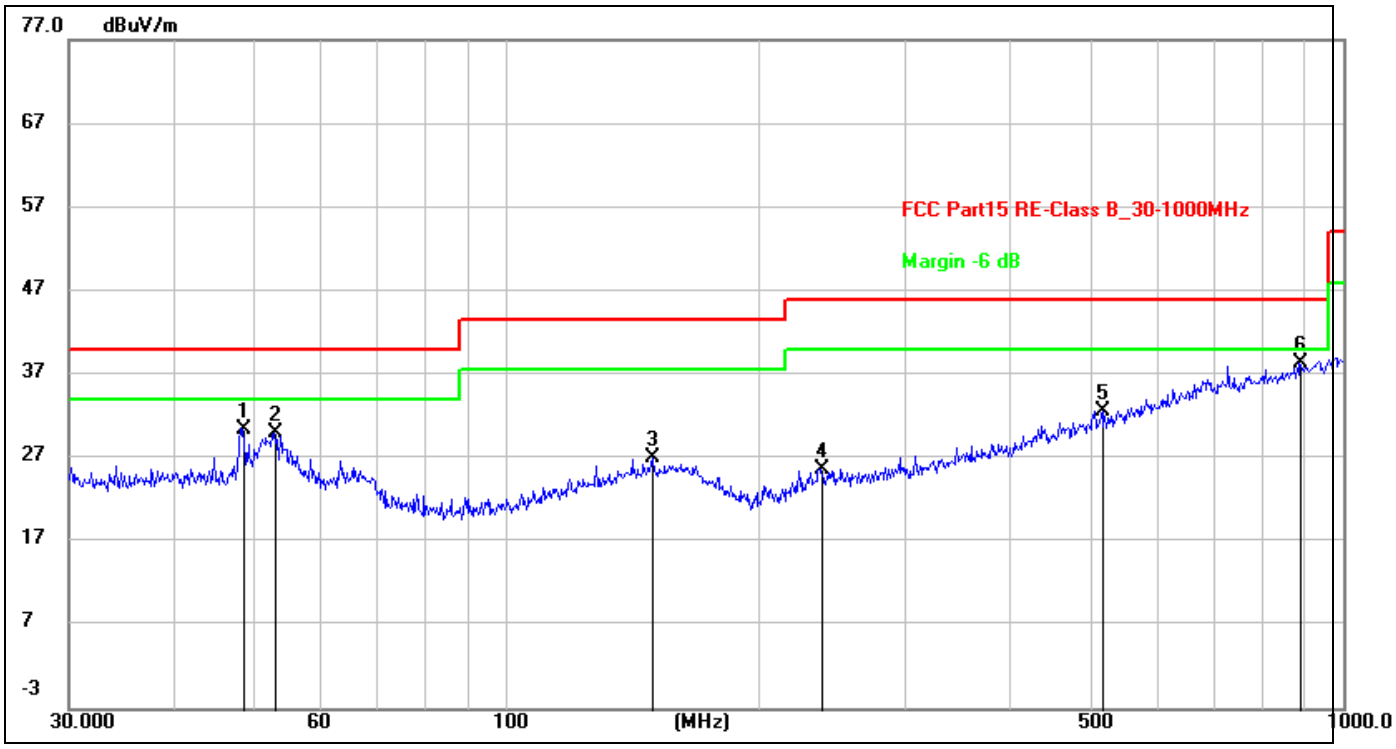
All the emissions except fundamental emission from 9 KHz to 40GHz were comply with FCC PART 15.109 limits limit.
Note1: According exploratory test no any obvious emission were detected from 9KHz to 30MHz and
18GHz to 40GHz, so the final test was performed with frequency range from 30MHz to 18GHz and recorded in below.
Note2: For emissions above 1GHz. If peak results comply with AV limit, AV Result is deemed to comply
with AV limit.
Note3: Level = Reading Level + Factor, Margin= Level-Limit

Radiated Emission Test Result



Site:		**Antenna::Horizontal**	**Temperature(C):24(C)**
Limit:	**FCC Part15 RE-Class B_30-1000MHz**		**Humidity(%):60%**
EUT:	**wireless headphones**	**Test Time:**	**2020/4/3 13:47:04**
M/N.:	**headpods pro**	**Power Rating:**	**DC 3.7V**
Mode:	**Tx mode (2402MHz-Worst cast)**	**Test Engineer:**	
Note:			

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	41.7129	11.25	14.70	25.95	40.00	-14.05	peak	100	51	
2	48.5015	11.63	14.36	25.99	40.00	-14.01	peak	200	187	
3	154.8204	12.73	15.45	28.18	43.50	-15.32	peak	200	218	
4	257.4221	12.39	13.35	25.74	46.00	-20.26	peak	100	62	
5	515.4373	13.57	19.14	32.71	46.00	-13.29	peak	200	218	
6 *	922.5157	14.12	25.15	39.27	46.00	-6.73	peak	200	72	



Site:		**Antenna::Vertical**	**Temperature(C):24(C)**
Limit:	**FCC Part15 RE-Class B_30-1000MHz**		**Humidity(%):60%**
EUT:	**wireless headphones**	**Test Time:**	**2020/4/3 13:49:37**
M/N.:	**headpods pro**	**Power Rating:**	**DC 3.7V**
Mode:	**Tx mode (2402MHz-Worst cast)**	**Test Engineer:**	
Note:			

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	48.3318	16.17	14.37	30.54	40.00	-9.46	peak	200	39	
2	52.7600	15.90	14.14	30.04	40.00	-9.96	peak	100	155	
3	149.4857	11.58	15.42	27.00	43.50	-16.50	peak	200	13	
4	237.4760	12.71	12.96	25.67	46.00	-20.33	peak	100	355	
5	515.4374	13.48	19.14	32.62	46.00	-13.38	peak	200	89	
6 *	887.6099	13.76	24.61	38.37	46.00	-7.63	peak	200	191	

EUT：	wireless headphones	Model Name ：	headpods pro
Temperature：	25 ℃	Test Engineer	Jack
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	3Mbps (worst)	Test Voltage ：	DC 3.7V
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/3MHz for Peak, 1MHz/10Hz for Average, PK detector is for them all.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
2390.00	50.57	4.68	55.25	74.00	-18.75	peak
2390.00	35.40	4.68	40.08	54.00	-13.92	AVG
4804.00	46.29	5.06	51.35	74.00	-22.65	peak
4804.00	36.64	5.06	41.70	54.00	-12.30	AVG
7206.00	43.82	7.03	50.85	74.00	-23.15	peak
7206.00	32.57	7.03	39.60	54.00	-14.40	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
2390.00	47.97	4.68	52.65	74.00	-21.35	peak
2390.00	35.70	4.68	40.38	54.00	-13.62	AVG
4804.00	46.33	5.06	51.39	74.00	-22.61	peak
4804.00	37.59	5.06	42.65	54.00	-11.35	AVG
7206.00	44.30	7.03	51.33	74.00	-22.67	peak
7206.00	31.11	7.03	38.14	54.00	-15.86	AVG

Note:

8~25GHz at least have 20dB margin. No recording in the test report.
Measurement Level = Reading Level + Factor
Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier
Lowest Channel: 2402 MHz
Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
4882.00	50.86	5.14	56.00	74.00	-18.00	peak
4882.00	36.18	5.14	41.32	54.00	-12.68	AVG
7323.00	49.94	7.54	57.48	74.00	-16.52	peak
7323.00	35.81	7.54	43.35	54.00	-10.65	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
4882.00	49.17	5.14	54.31	74.00	-19.69	peak
4882.00	39.27	5.14	44.41	54.00	-9.59	AVG
7323.00	42.45	7.54	49.99	74.00	-24.01	peak
7323.00	32.18	7.54	39.72	54.00	-14.28	AVG

Note:

8~25GHz at least have 20dB margin. No recording in the test report.
Measurement Level = Reading Level + Factor
Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier
Middle Channel: 2441 MHz
Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
2483.50	46.67	4.71	51.38	74.00	-22.62	peak
2483.50	36.09	4.71	40.80	54.00	-13.20	AVG
4960.00	48.82	5.22	54.04	74.00	-19.96	peak
4960.00	38.16	5.22	43.38	54.00	-10.62	AVG
7440.00	48.27	8.06	56.33	74.00	-17.67	peak
7440.00	38.72	8.06	46.78	54.00	-7.22	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Detector Type
2483.50	50.15	4.71	54.86	74.00	-19.14	peak
2483.50	37.10	4.71	41.81	54.00	-12.19	AVG
4960.00	47.58	5.22	52.80	74.00	-21.20	peak
4960.00	37.63	5.22	42.85	54.00	-11.15	AVG
7440.00	43.22	8.06	51.28	74.00	-22.72	peak
7440.00	37.38	8.06	45.44	54.00	-8.56	AVG

Note:

8~25GHz at least have 20dB margin. No recording in the test report.
Measurement Level = Reading Level + Factor
Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier
Highest channel: 2480 MHz
Data rate: 3Mbps

5. Maximum Peak Output Power

5.1. Applied procedures / Limit

15.247(a) (1) 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.
15.247(b) (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

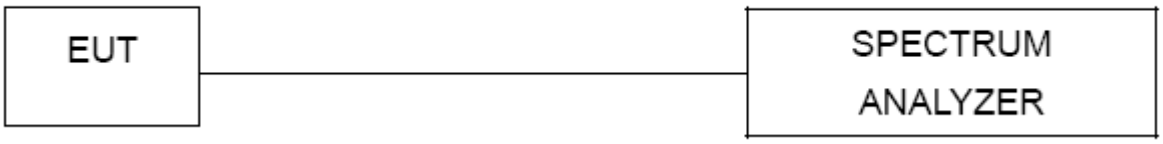
5.2. Test procedure

(1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW, Sweep = auto Detector function = peak, Trace = max hold
(2) The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.
(3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. Also shall be performed at different modes of operation.

5.3. Deviation from standard

No deviation.

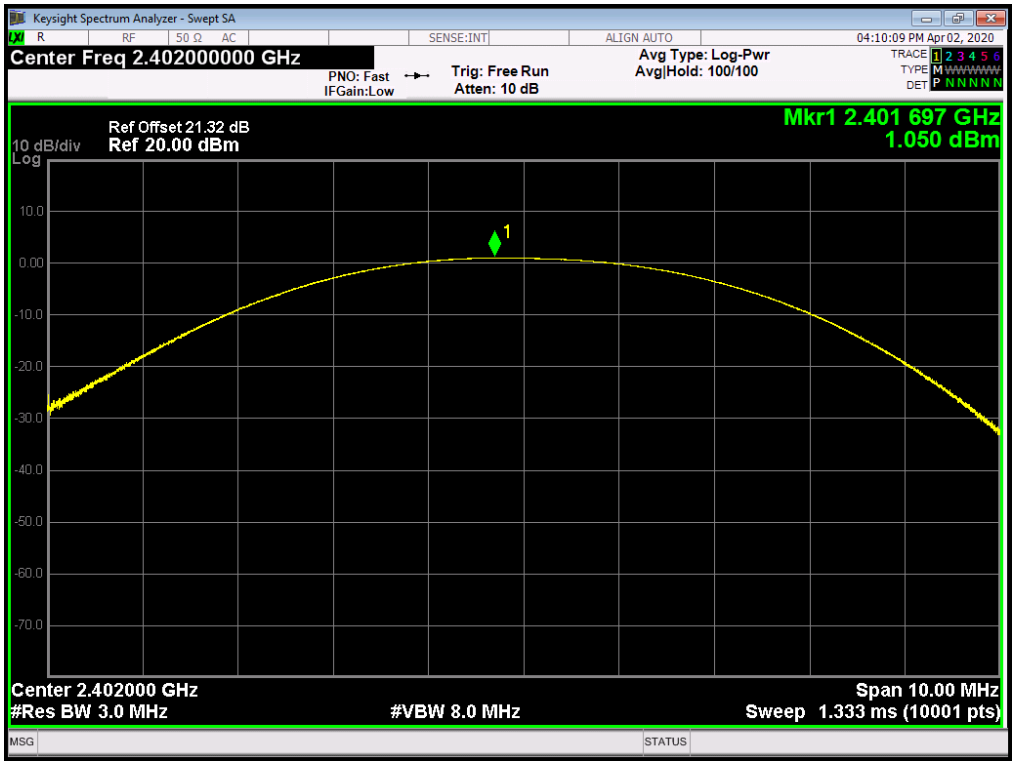
5.4. Test setup



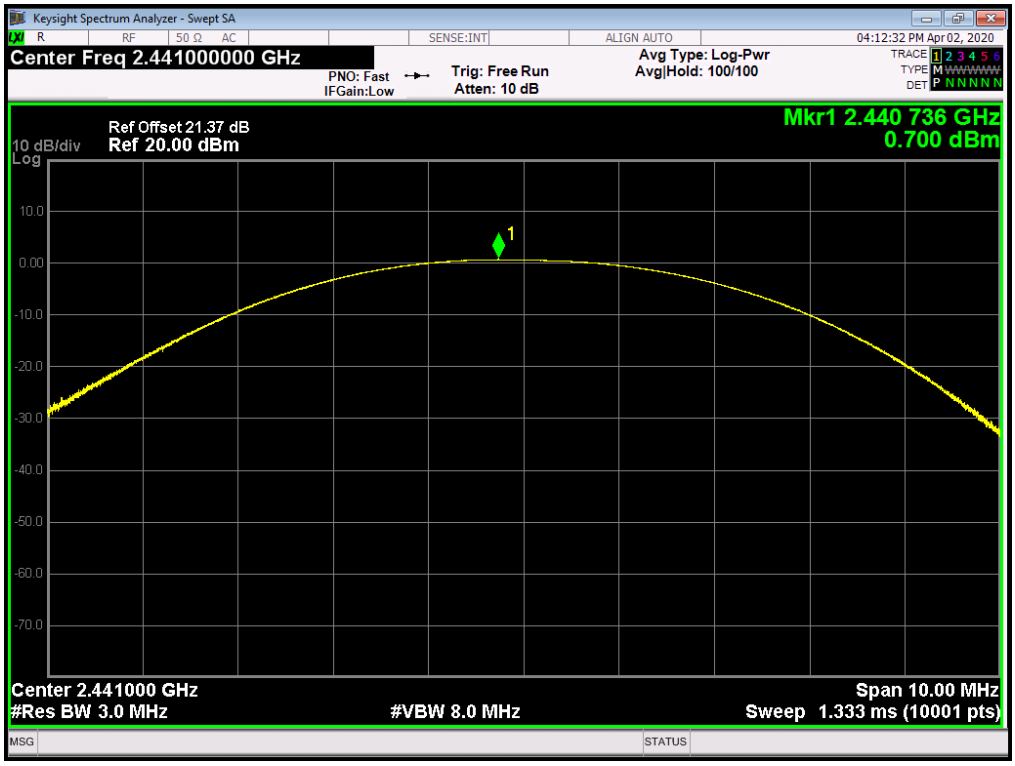
5.5. TEST RESULTS

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	1-DH1	2402	Ant 1	1.05	0	1.05	21	Pass
NVNT	1-DH1	2441	Ant 1	0.70	0	0.70	21	Pass
NVNT	1-DH1	2480	Ant 1	1.169	0	1.169	21	Pass

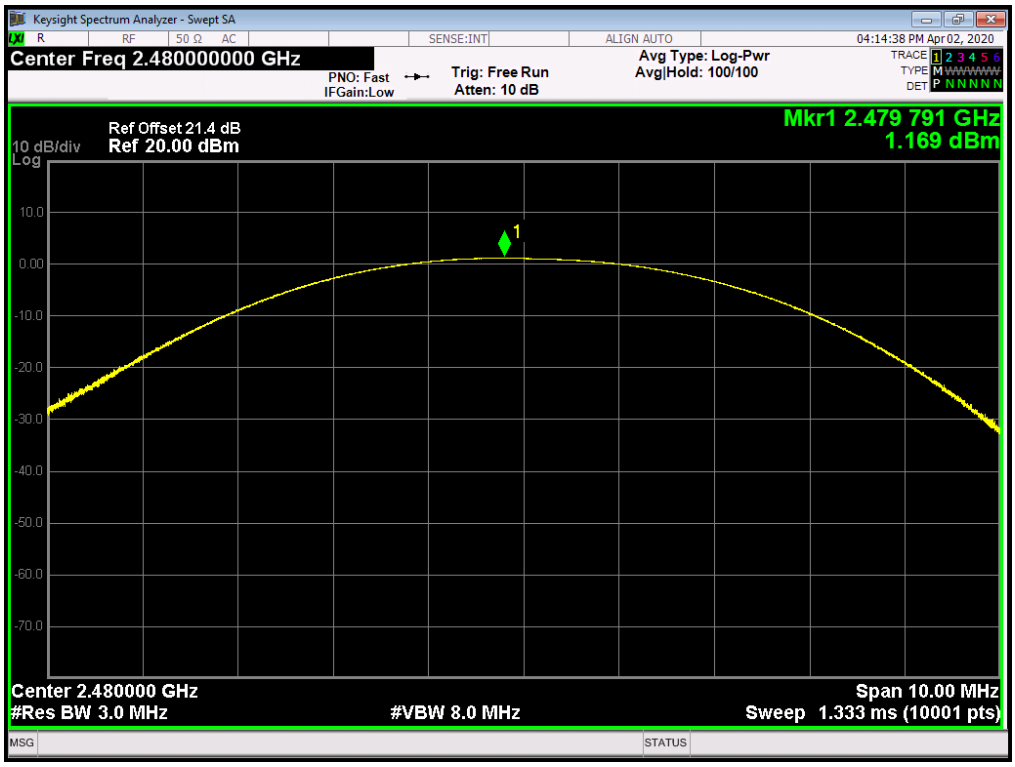
Power NVNT 1-DH1 2402MHz Ant1



Power NVNT 1-DH1 2441MHz Ant1

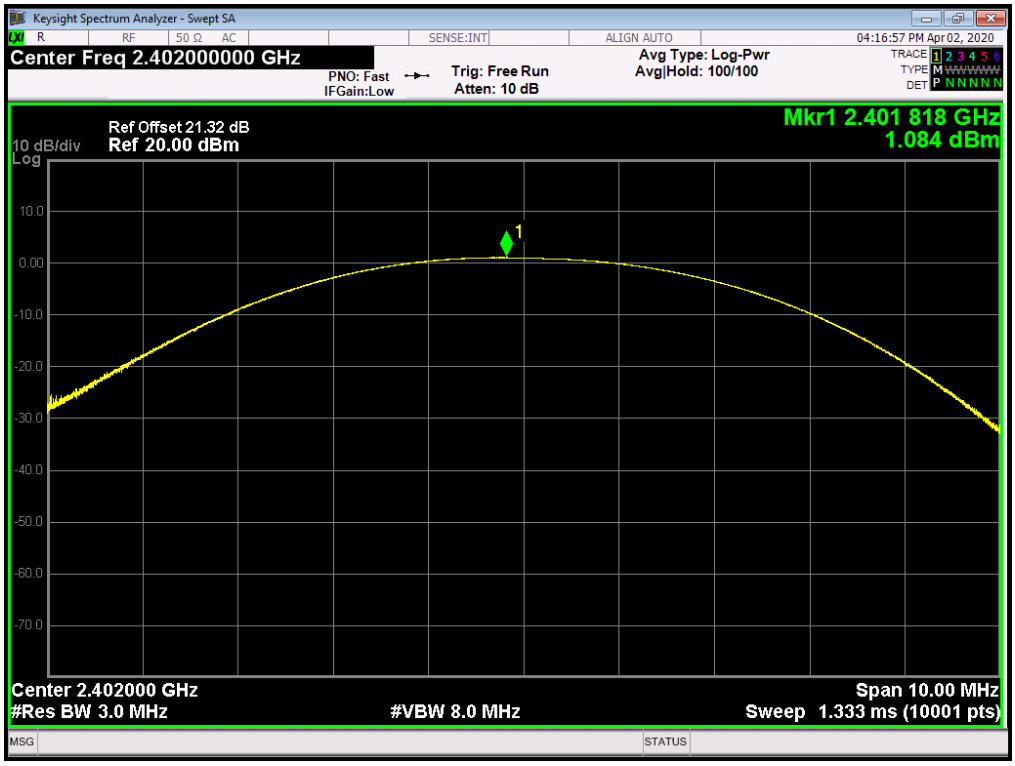


Power NVNT 1-DH1 2480MHz Ant1

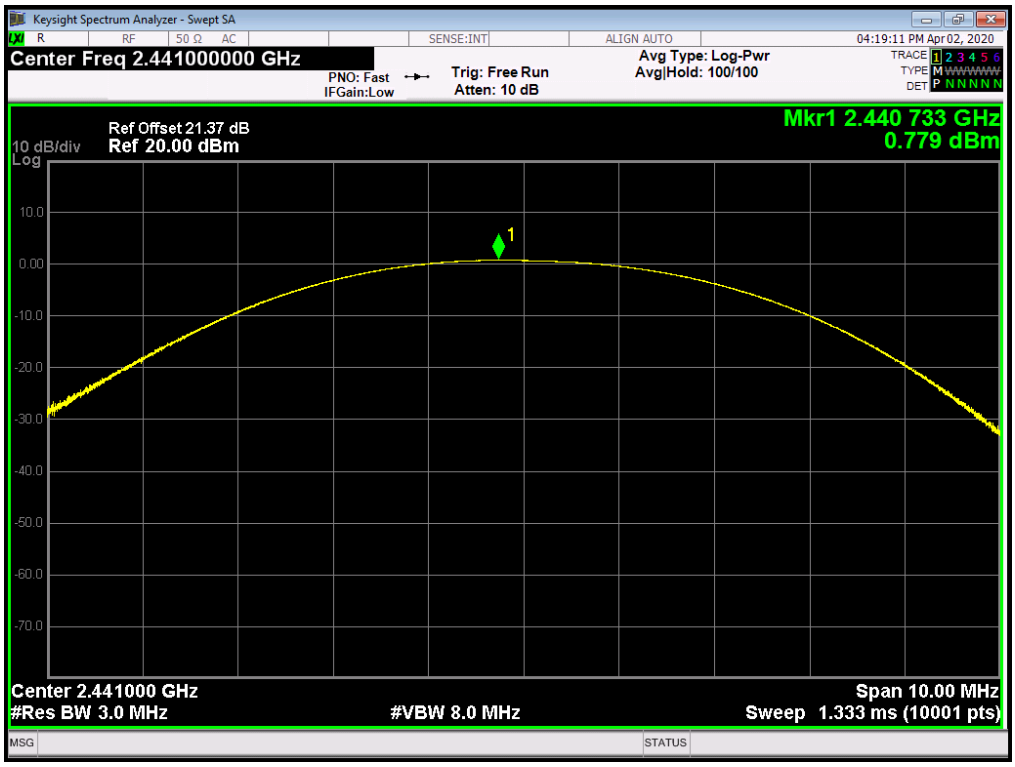


Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	1-DH3	2402	Ant 1	1.084	0	1.084	21	Pass
NVNT	1-DH3	2441	Ant 1	0.779	0	0.779	21	Pass
NVNT	1-DH3	2480	Ant 1	1.942	0	1.942	21	Pass

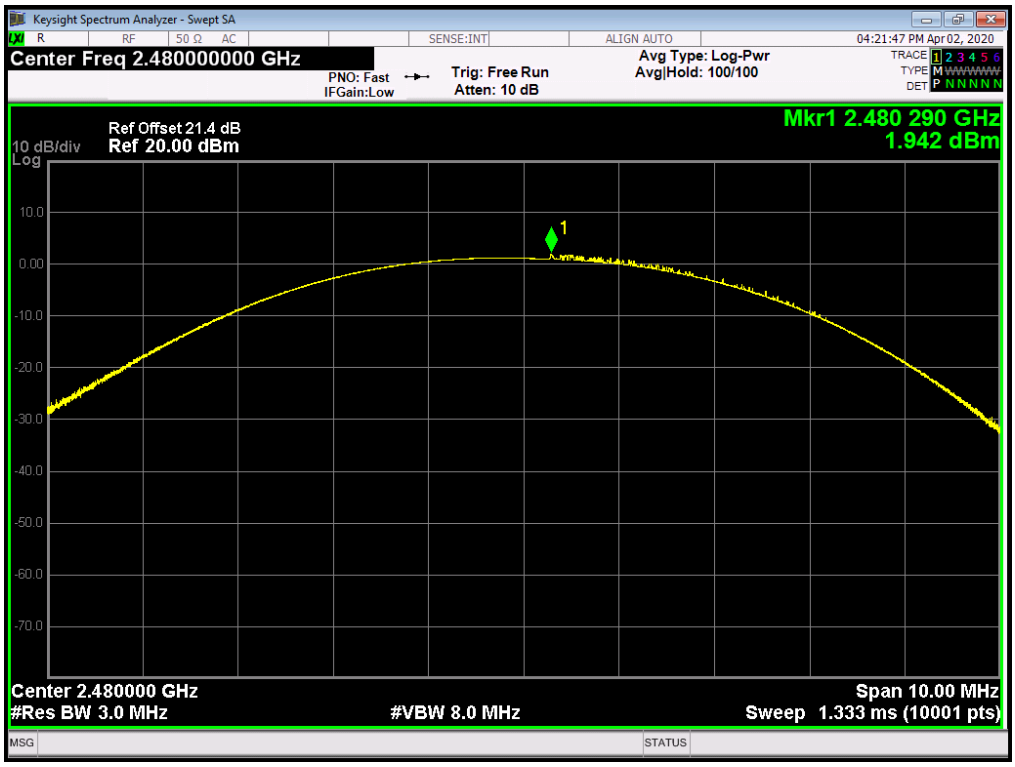
Power NVNT 1-DH3 2402MHz Ant1



Power NVNT 1-DH3 2441MHz Ant1

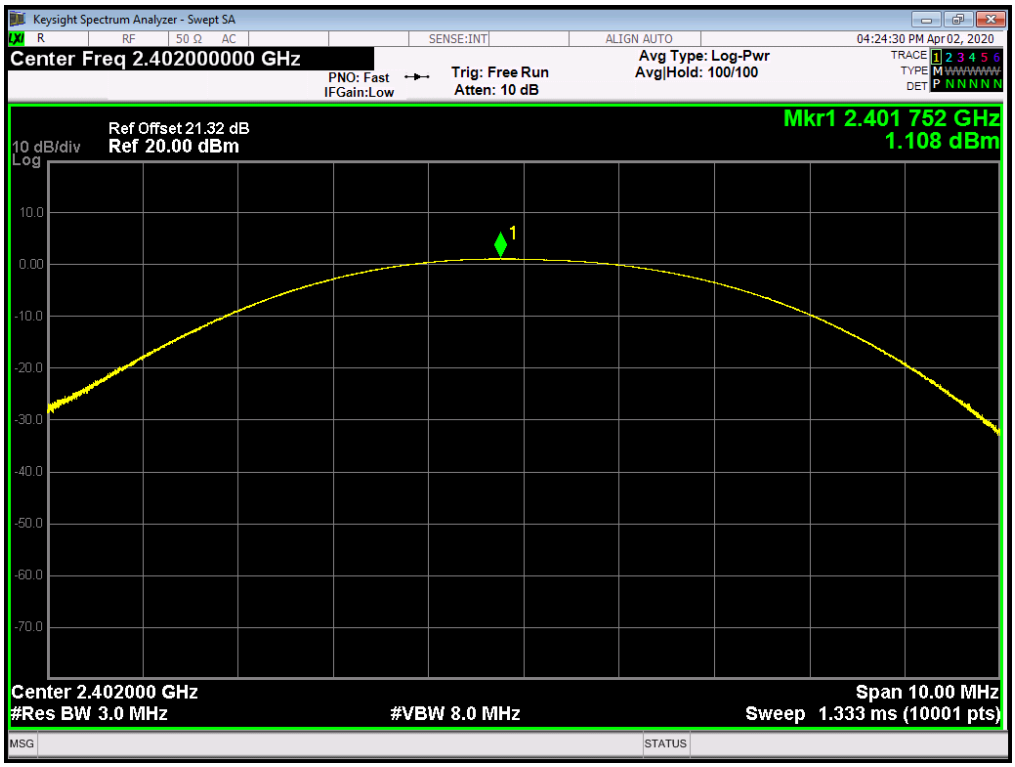


Power NVNT 1-DH3 2480MHz Ant1

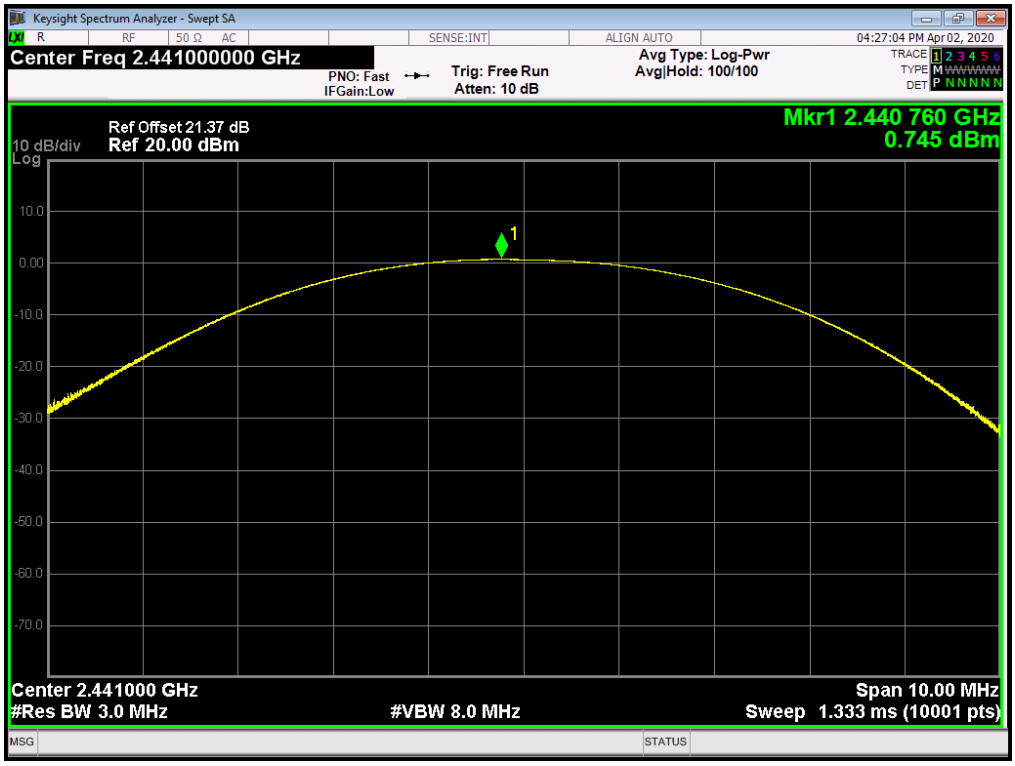


Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	1-DH5	2402	Ant 1	1.108	0	1.108	21	Pass
NVNT	1-DH5	2441	Ant 1	0.745	0	0.745	21	Pass
NVNT	1-DH5	2480	Ant 1	1.188	0	1.188	21	Pass

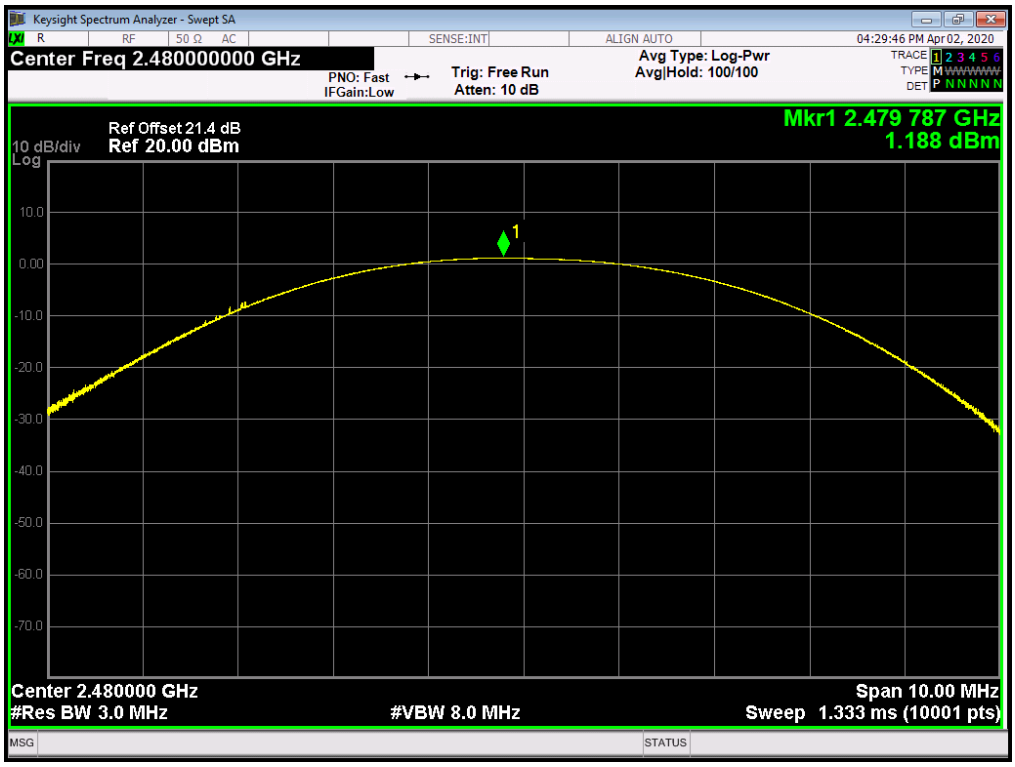
Power NVNT 1-DH5 2402MHz Ant1



Power NVNT 1-DH5 2441MHz Ant1



Power NVNT 1-DH5 2480MHz Ant1



Note: All the modes (1-DH1, 1-DH3,1-DH5,2-DH1,2-DH3,2-DH5,3-DH1,3-DH3,3-DH5) had been test, but only the worst data (1-DH1,2-DH3,3-DH5) record in the report.

6. BANDWIDTH TEST

6.1. Applied procedures / Limit

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dBbandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

6.2. Test procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW, Sweep = auto, Detector function = peak
Trace = max hold

6.3. Deviation from standard

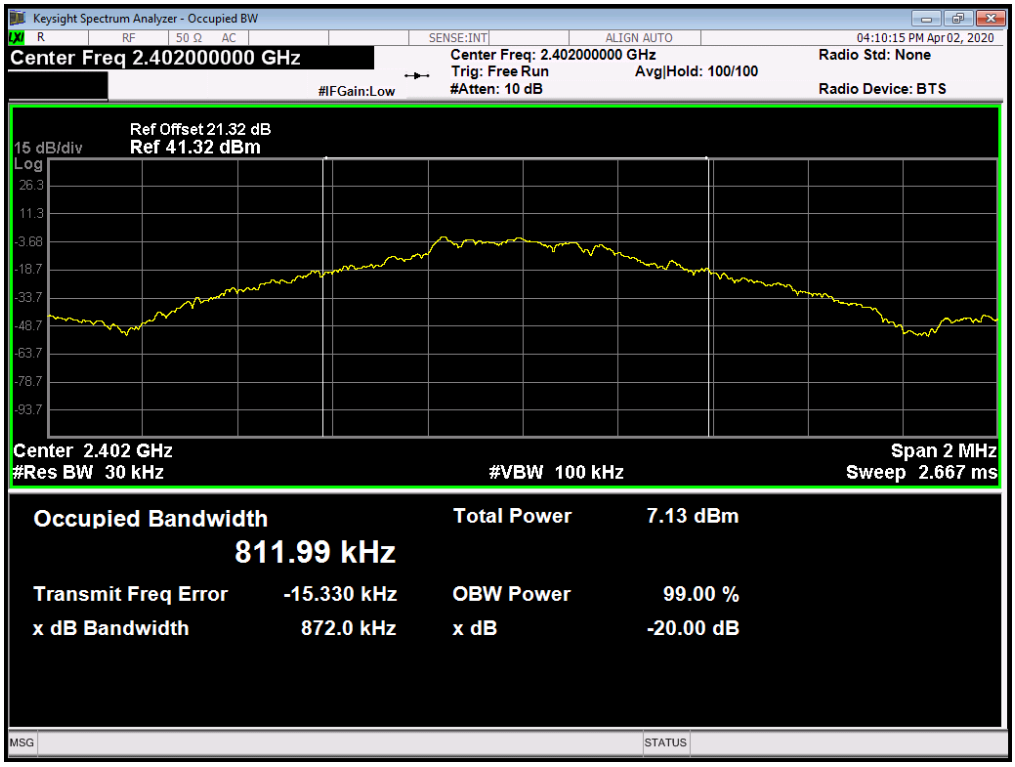
No deviation.

6.4. Test setup

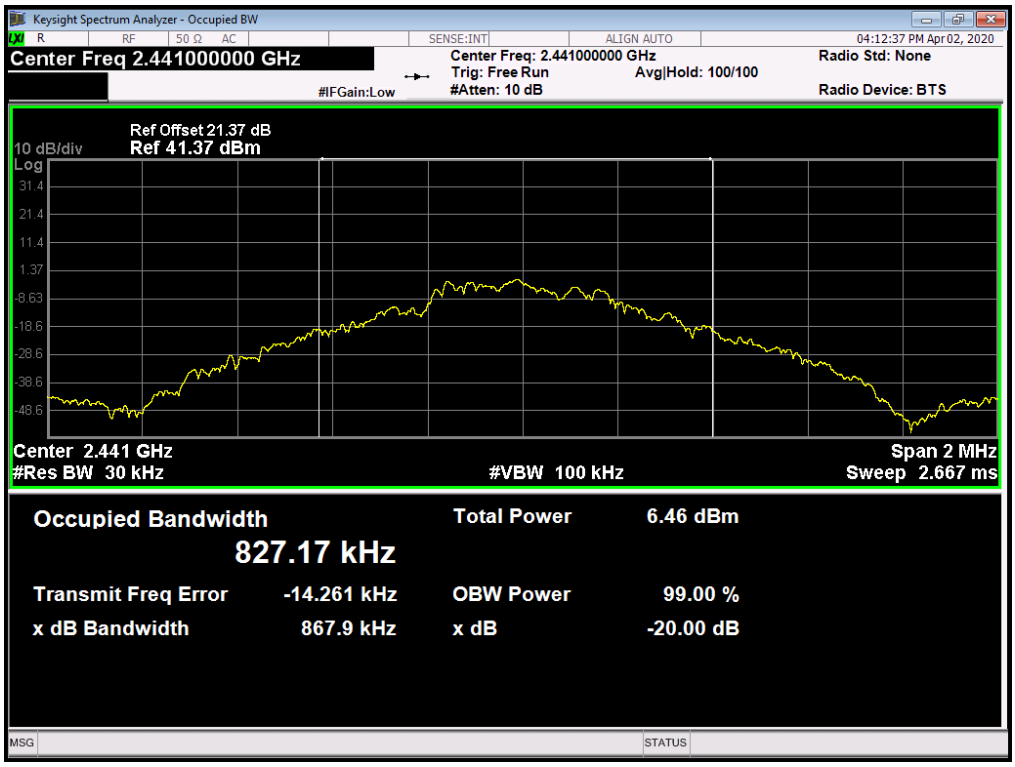
6.5. Test results

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Verdict
NVNT	1-DH1	2402	Ant 1	0.812	0.872	Pass
NVNT	1-DH1	2441	Ant 1	0.8272	0.8679	Pass
NVNT	1-DH1	2480	Ant 1	0.8166	0.8679	Pass

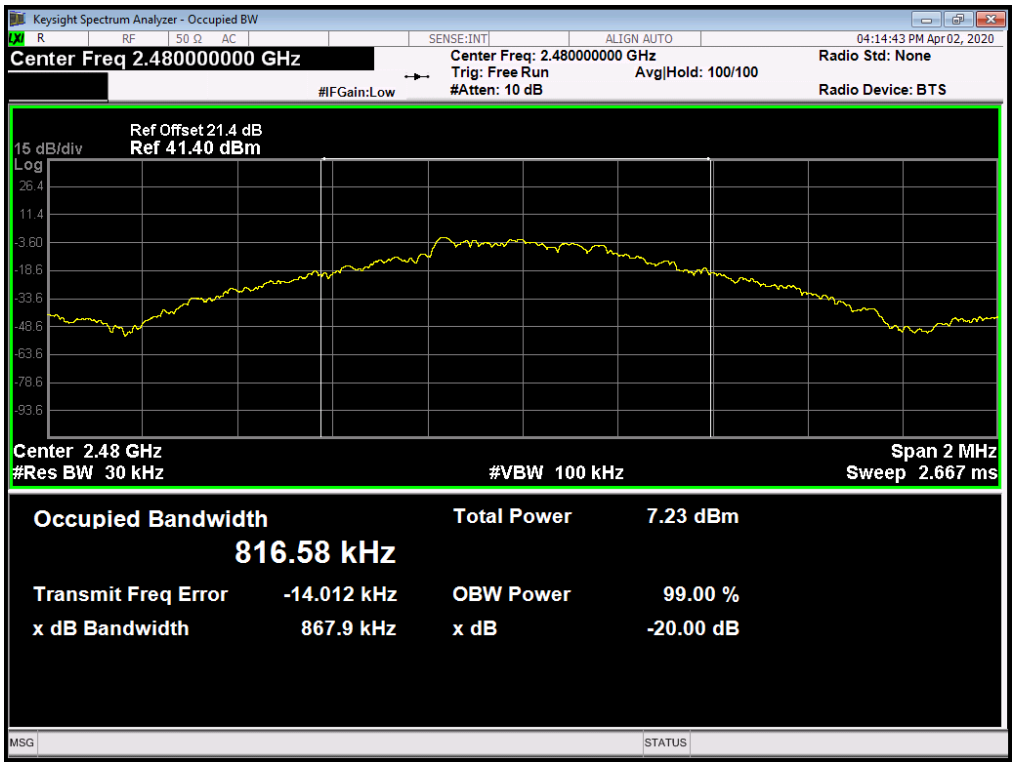
OBW NVNT 1-DH1 2402MHz Ant1



OBW NVNT 1-DH1 2441MHz Ant1

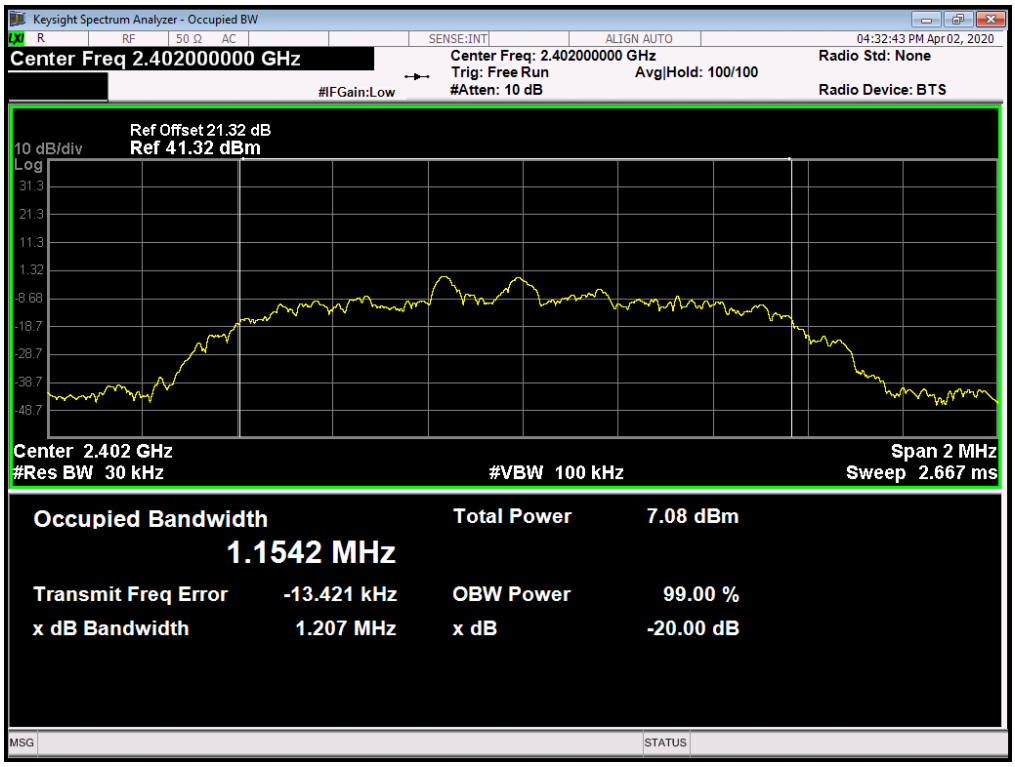


OBW NVNT 1-DH1 2480MHz Ant1

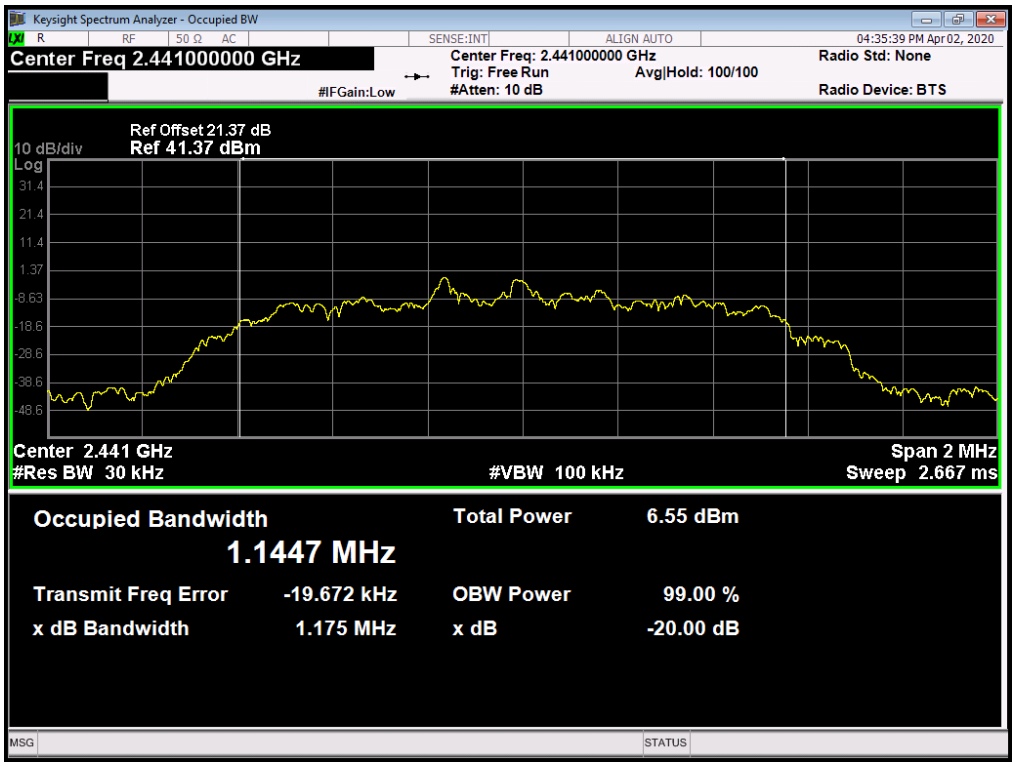


Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Verdict
NVNT	2-DH3	2402	Ant 1	1.1542	1.2073	Pass
NVNT	2-DH3	2441	Ant 1	1.1447	1.1746	Pass
NVNT	2-DH3	2480	Ant 1	1.1648	1.2128	Pass

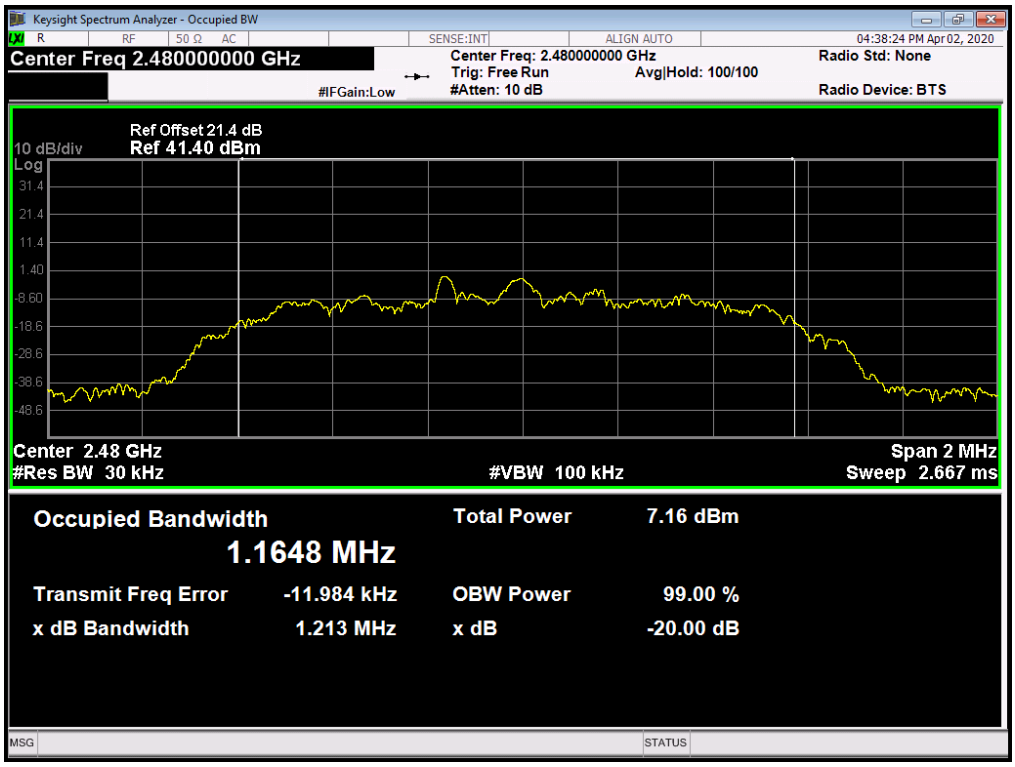
OBW NVNT 2-DH3 2402MHz Ant1



OBW NVNT 2-DH3 2441MHz Ant1

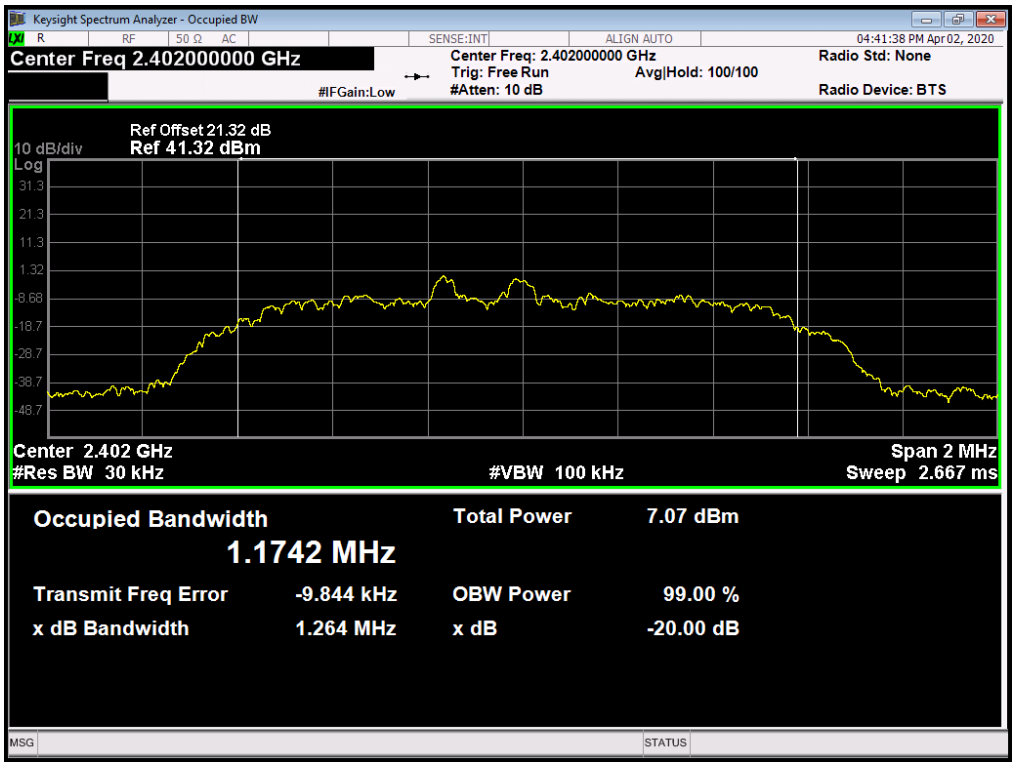


OBW NVNT 2-DH3 2480MHz Ant1

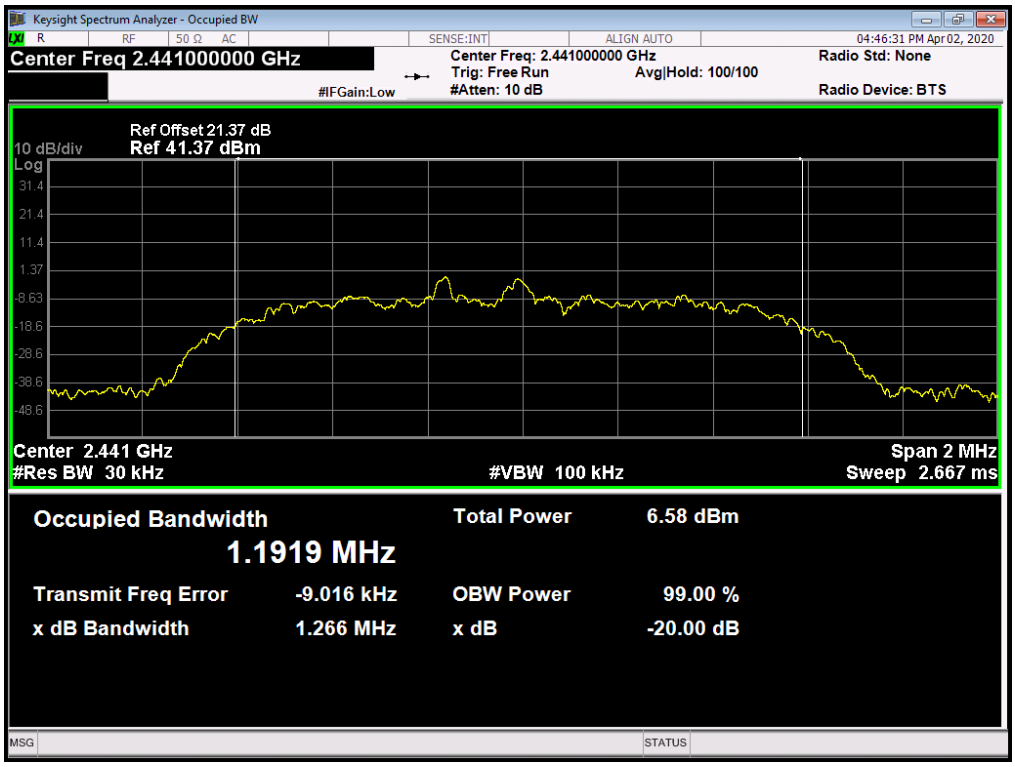


Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Verdict
NVNT	3-DH5	2402	Ant 1	1.1742	1.2637	Pass
NVNT	3-DH5	2441	Ant 1	1.1919	1.2662	Pass
NVNT	3-DH5	2480	Ant 1	1.198	1.3094	Pass

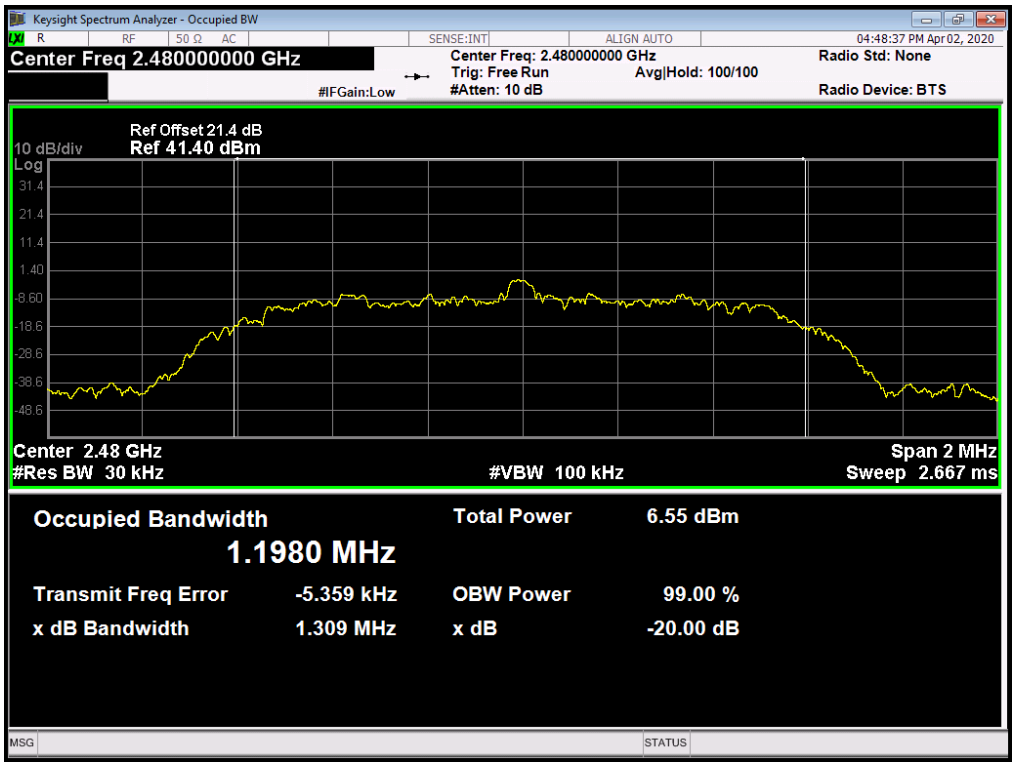
OBW NVNT 3-DH5 2402MHz Ant1



OBW NVNT 3-DH5 2441MHz Ant1



OBW NVNT 3-DH5 2480MHz Ant1



7. Carrier Frequencies Separated

7.1. Applied procedures / Limit

15.247(a) (1) 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.

7.2. Test procedure

(1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as Span = wide enough to capture the peaks of two adjacent channels, Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span, Video (or Average) Bandwidth (VBW) ≥ RBW Sweep = auto, Detector function = peak, Trace = max hold

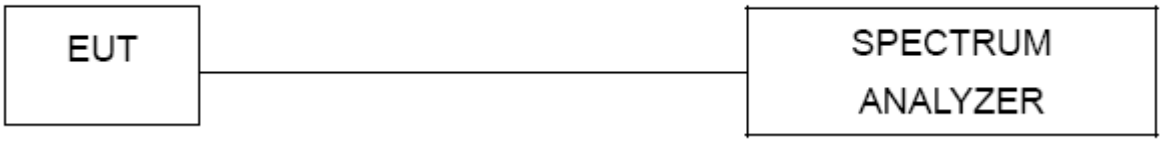
(2) The EUT should be transmitting at its maximum data rate. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

(3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. also shall be performed at different modes of operation.

7.3. Deviation from standard

No deviation.

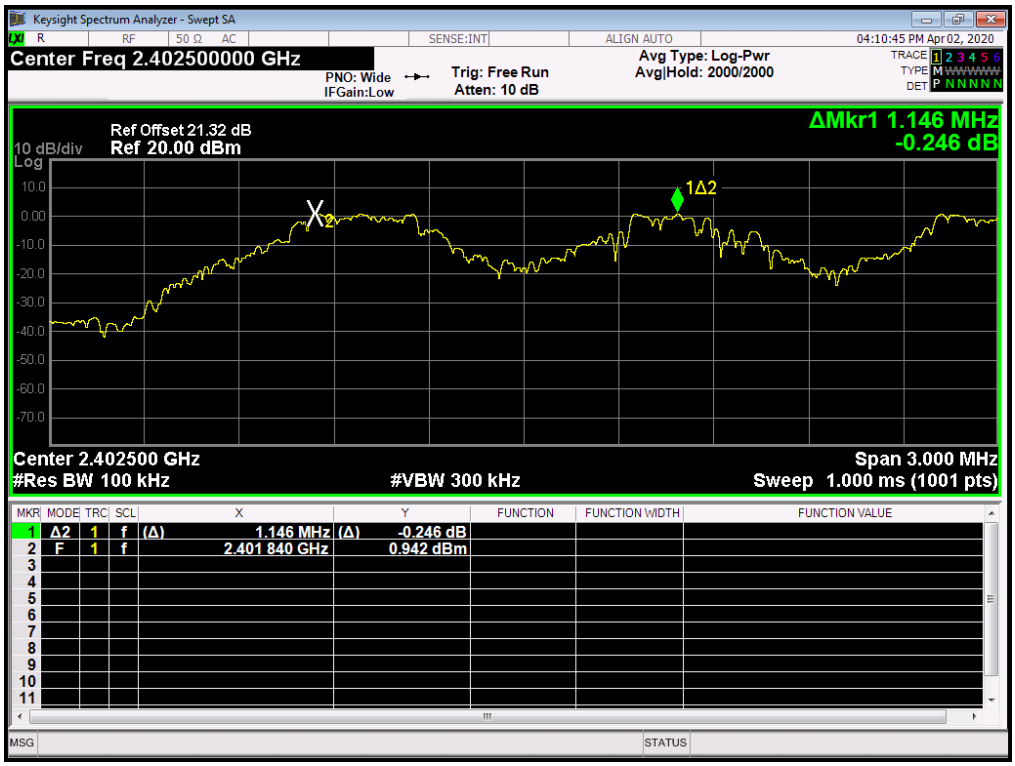
7.4. Test setup



7.5. Test results

Condition	Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Verdict
NVNT	1-DH1	2401.840	2402.986	1.146	Pass
NVNT	1-DH1	2440.825	2441.839	1.014	Pass
NVNT	1-DH1	2478.969	2479.806	0.837	Pass

CFS NVNT 1-DH1 2402MHz

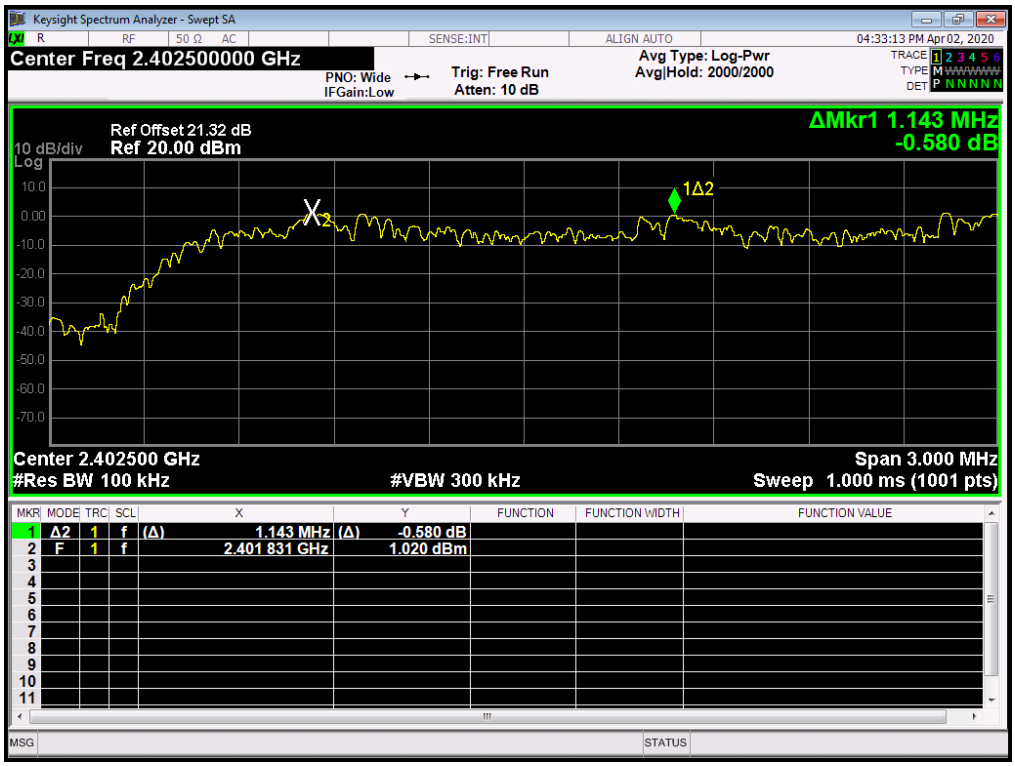


CFS NVNT 1-DH1 2441MHz

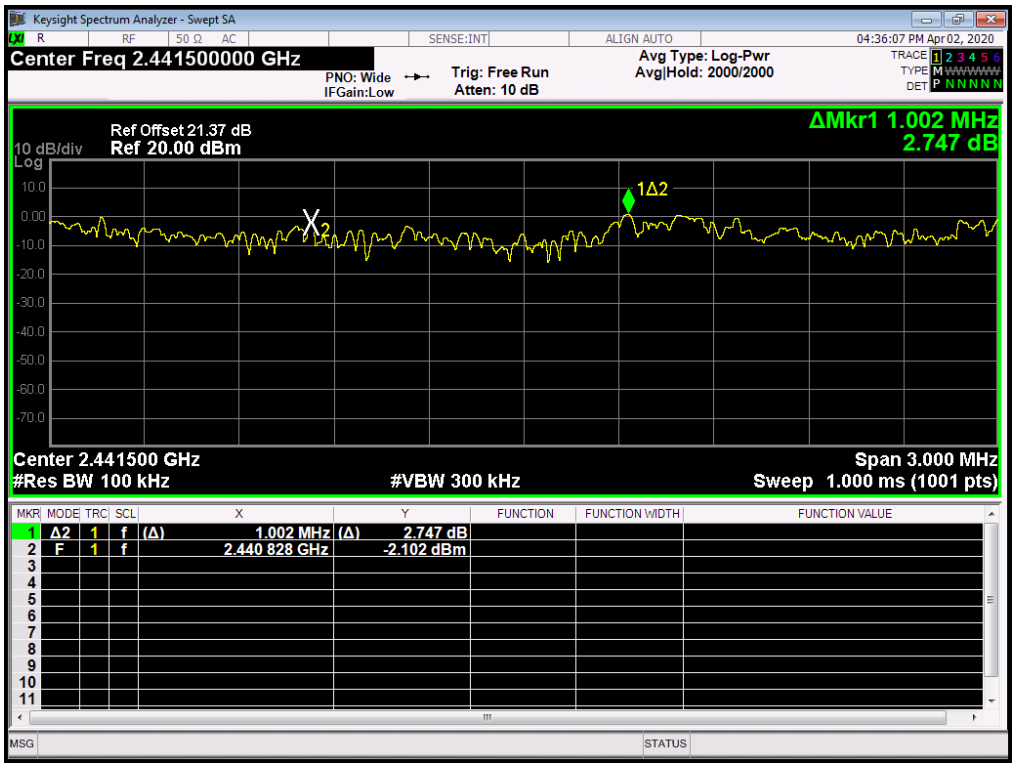
CFS NVNT 1-DH1 2480MHz

Condition	Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Verdict
NVNT	2-DH3	2401.831	2402.974	1.143	Pass
NVNT	2-DH3	2440.828	2441.83	1.002	Pass
NVNT	2-DH3	2478.834	2479.824	0.99	Pass

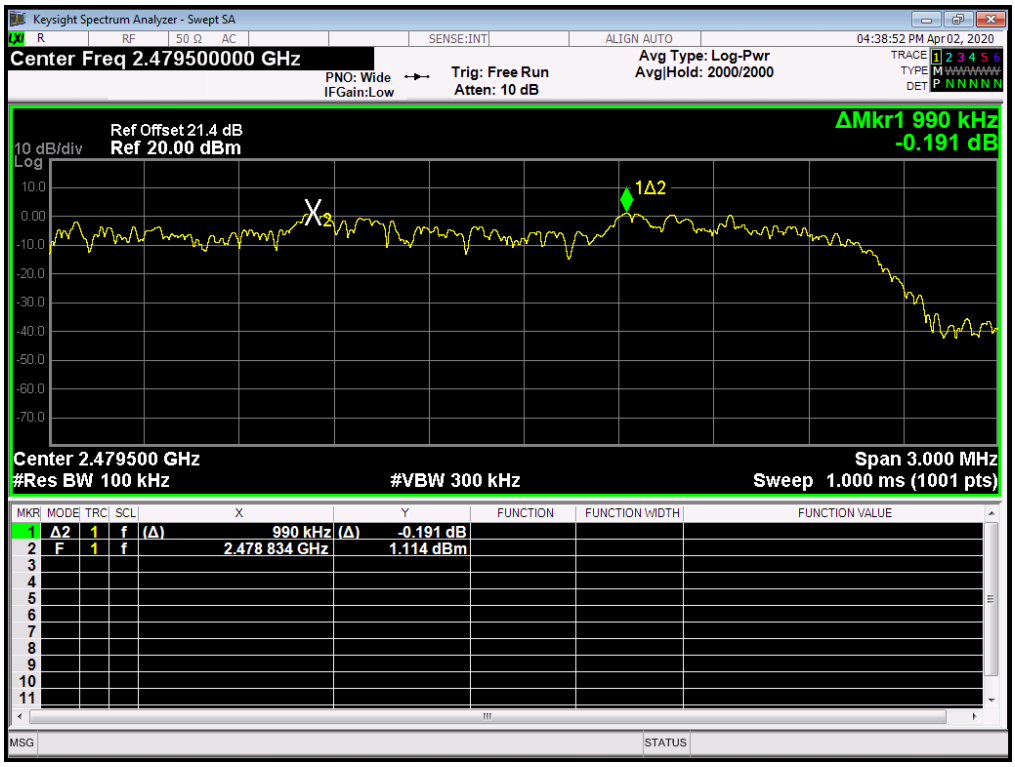
CFS NVNT 2-DH3 2402MHz



CFS NVNT 2-DH3 2441MHz

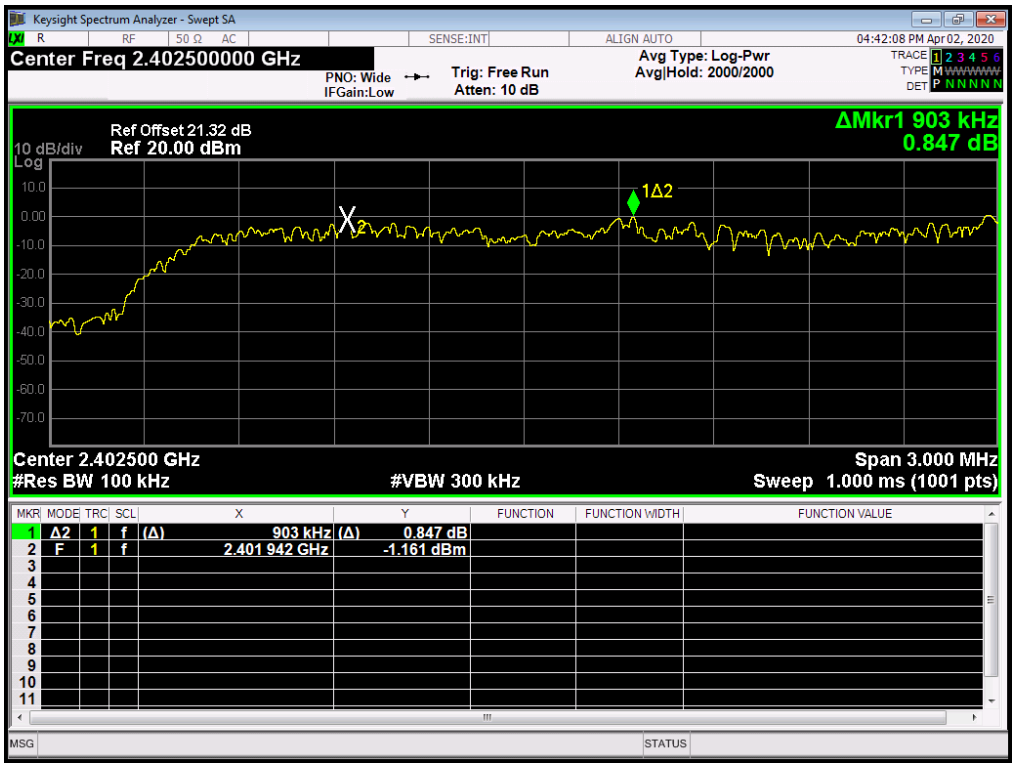


CFS NVNT 2-DH3 2480MHz

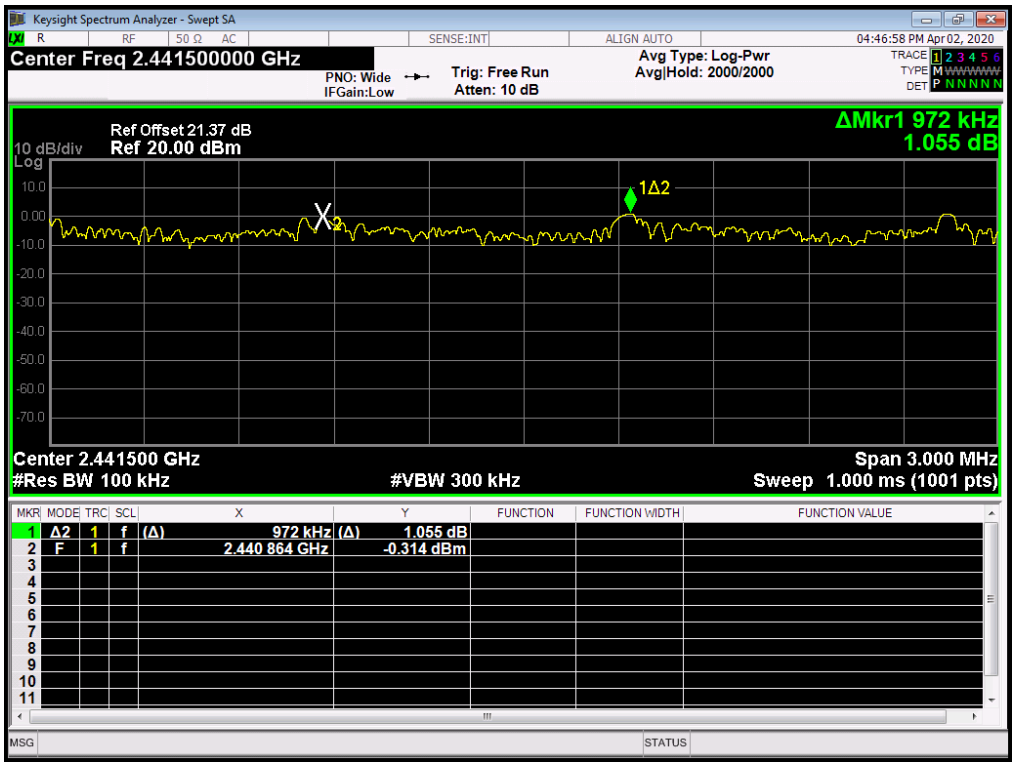


Condition	Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Verdict
NVNT	3-DH5	2401.942	2402.845	0.903	Pass
NVNT	3-DH5	2440.864	2441.836	0.972	Pass
NVNT	3-DH5	2478.96	2480.016	1.056	Pass

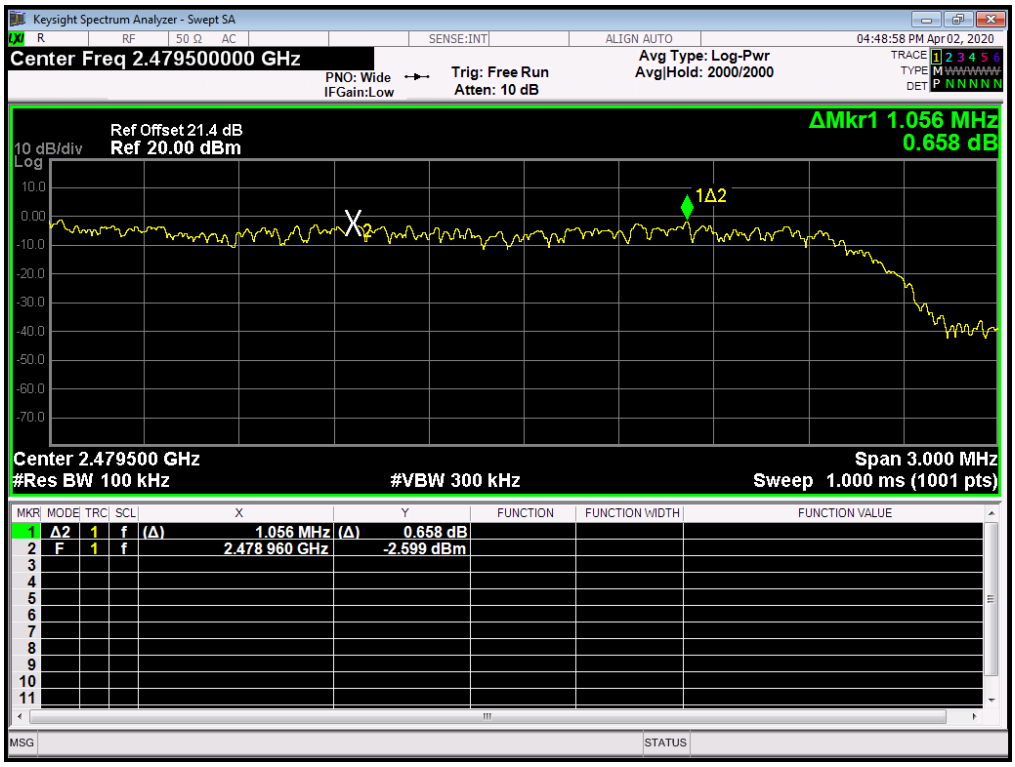
CFS NVNT 3-DH5 2402MHz



CFS NVNT 3-DH5 2441MHz



CFS NVNT 3-DH5 2480MHz



8. Hopping Channel Number

8.1. Applied procedures / Limit

15.247(a) (1) (iii) 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.

8.2. Test procedure

(1) Connected the antenna port to the Spectrum Analyzer , set the Spectrum Analyzer as Span = the frequency band of operation, RBW ≥ 1% of the span, VBW ≥ RBW Sweep = auto Detector function = peak, Trace = max hold

(2) The EUT should be have its hopping function enabled. Maxhold and record hopping channels It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

8.3. Deviation from standard

No deviation.

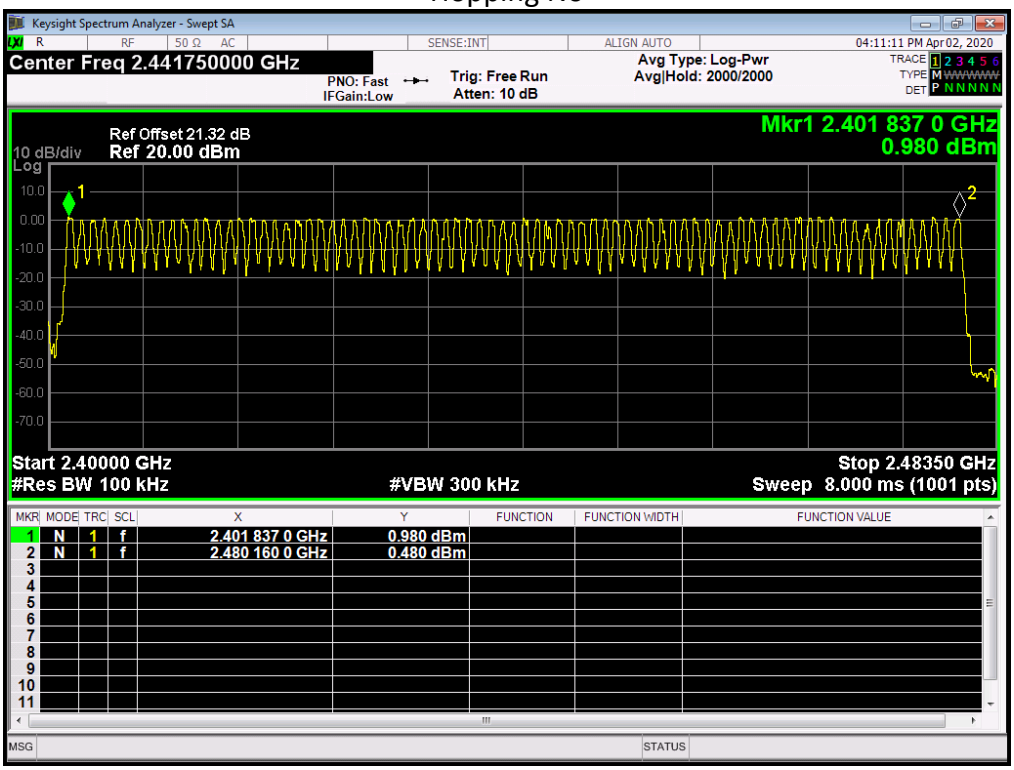
8.4. Test setup

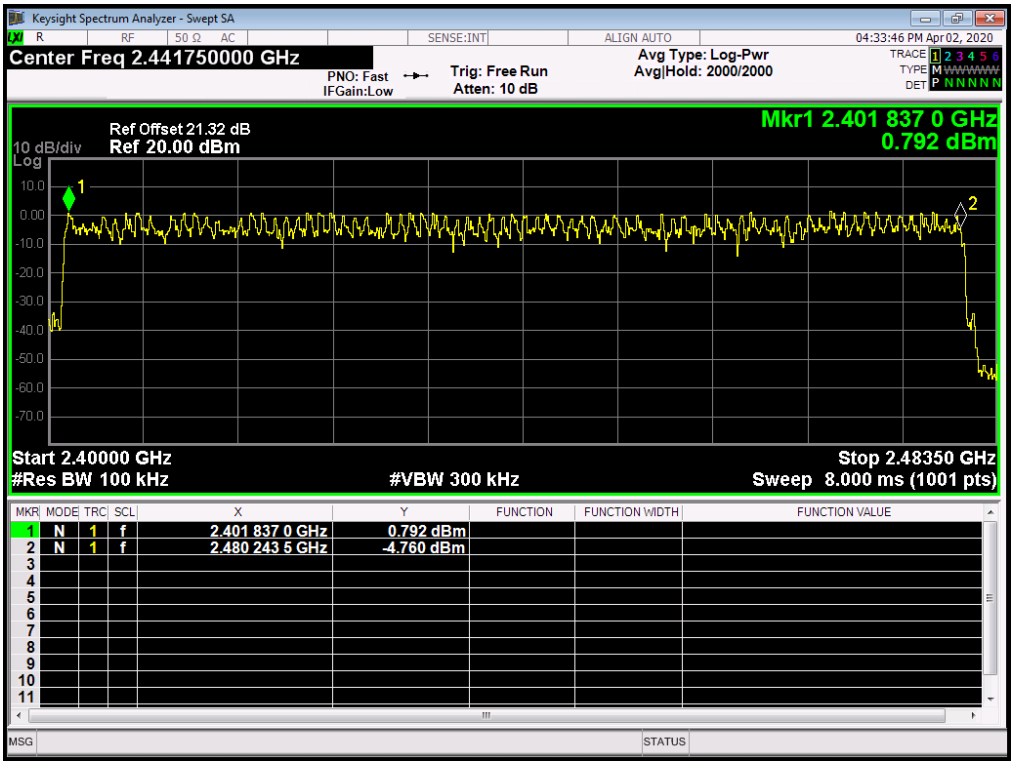
8.5. Test result

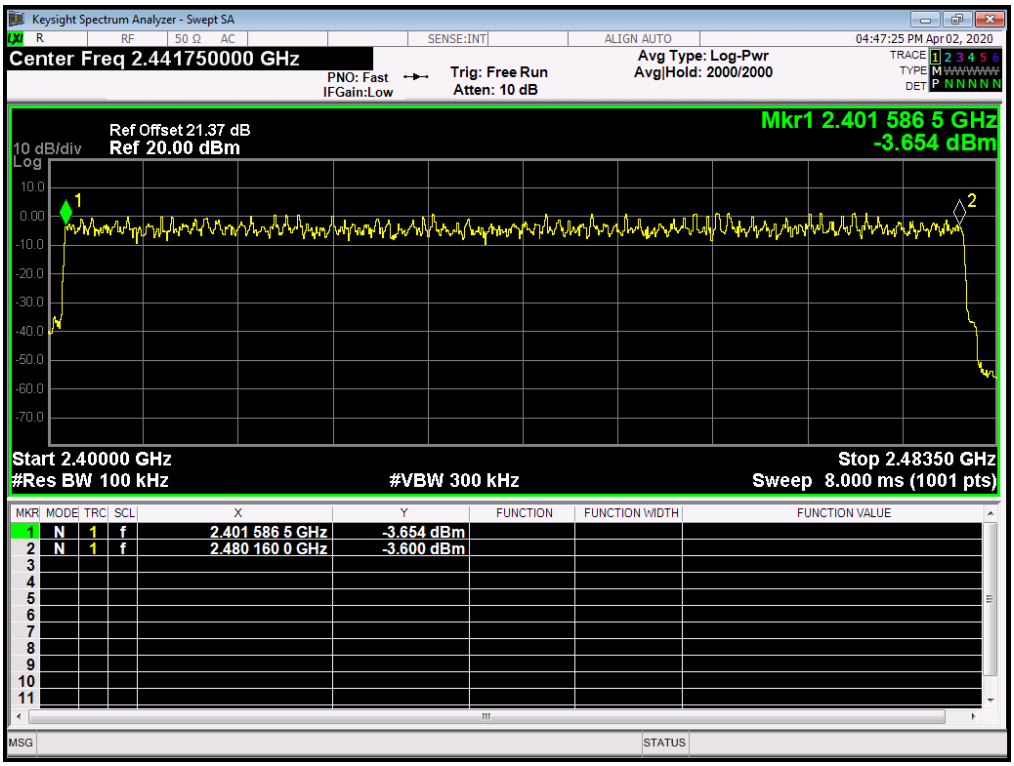
Number of Hopping Channel

Description of Channel:					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

Hopping No


Keysight Spectrum Analyzer - Swept SA
R RF 50 Ω AC SENSE:INT ALIGN AUTO 04:11:11 PM Apr 02, 2020
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold: 2000/2000
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 21.32 dB
10 dB/div Ref 20.00 dBm
Log
Mkr1 2.401 837 0 GHz
0.980 dBm
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.401 837 0 GHz 0.980 dBm
2 N 1 f 2.480 160 0 GHz 0.480 dBm
MSG STATUS


Keysight Spectrum Analyzer - Swept SA
R RF 50 Ω AC SENSE:INT ALIGN AUTO 04:33:46 PM Apr 02, 2020
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold: 2000/2000
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 21.32 dB
10 dB/div Ref 20.00 dBm
Log
Mkr1 2.401 837 0 GHz
0.792 dBm
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.401 837 0 GHz 0.792 dBm
2 N 1 f 2.480 243 5 GHz -4.760 dBm
MSG STATUS


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold: 2000/2000
04:47:25 PM Apr 02, 2020
Ref Offset 21.37 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.401 586 5 GHz
-3.654 dBm
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
1 N 1 f 2.401 586 5 GHz -3.654 dBm
2 N 1 f 2.480 160 0 GHz -3.600 dBm

9. Dwell time

9.1. Applied procedures / Limit

15.247(a) (1) (iii) 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.

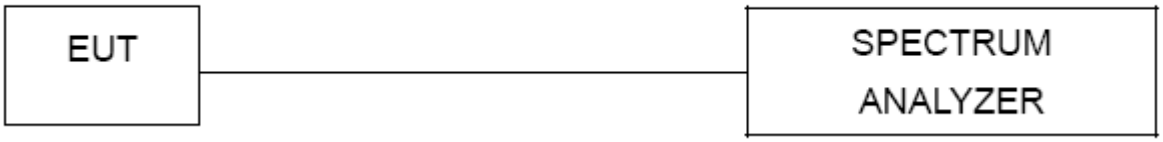
9.2. Test procedure

(1) Place the EUT on the table in the chamber or connect the antenna port of the EUT to spectrum analyzer and set it in transmitting mode.
(2) Set RBW of spectrum analyzer to 1MHz, VBW ≥ RBW
(3) Use a video trigger with the trigger level set to enable triggering only on full pulses.
(4) Sweep Time is more than once pulse time.
(5) Set the center frequency on any frequency would be measure and set the frequency span to zero span.
(6) Measure the maximum time duration of one single pulse.
(7) Set the EUT for DH5, DH3 and DH1 packet transmitting.
(8) Measure the maximum time duration of one single pulse.
(9) A Period Time = 79*0.4=31.6 S
DH1 Time Slot: Reading * (1600/2)*31.6/79
DH3 Time Slot: Reading * (1600/4)*31.6/79
DH5 Time Slot: Reading * (1600/6)*31.6/79

9.3. Deviation from standard

No deviation.

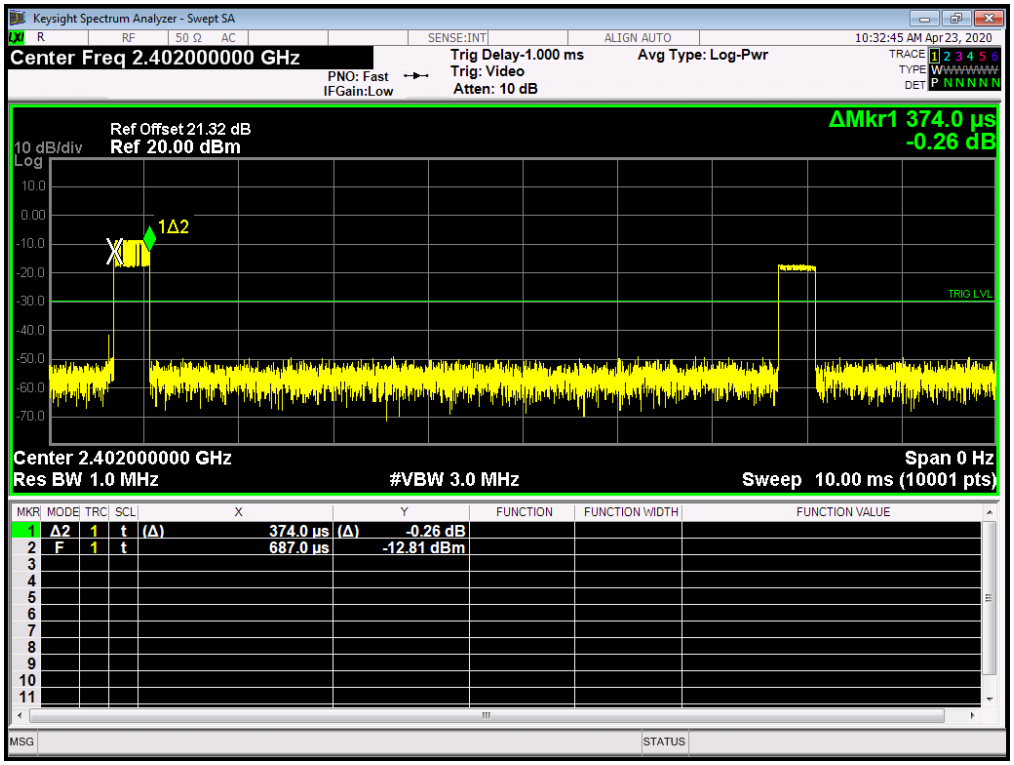
9.4. Test setup



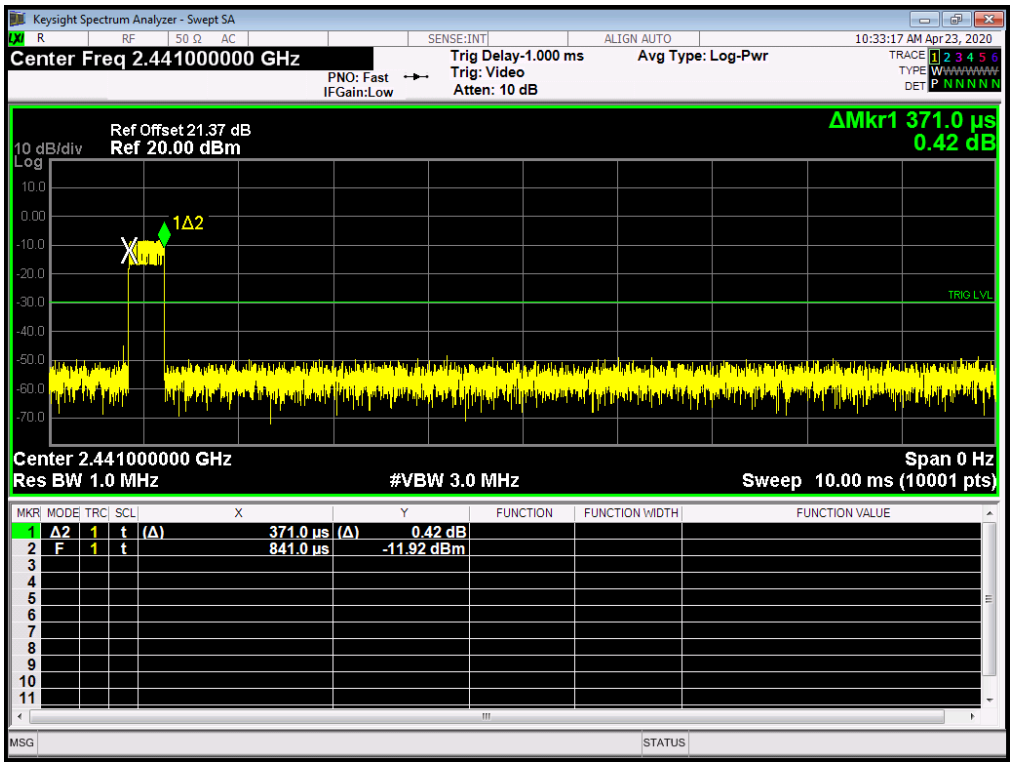
9.5. Test result

Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH1	2402	0.374	118.184	31600	400	Pass
NVNT	1-DH1	2441	0.371	117.236	31600	400	Pass
NVNT	1-DH1	2480	0.375	118.5	31600	400	Pass

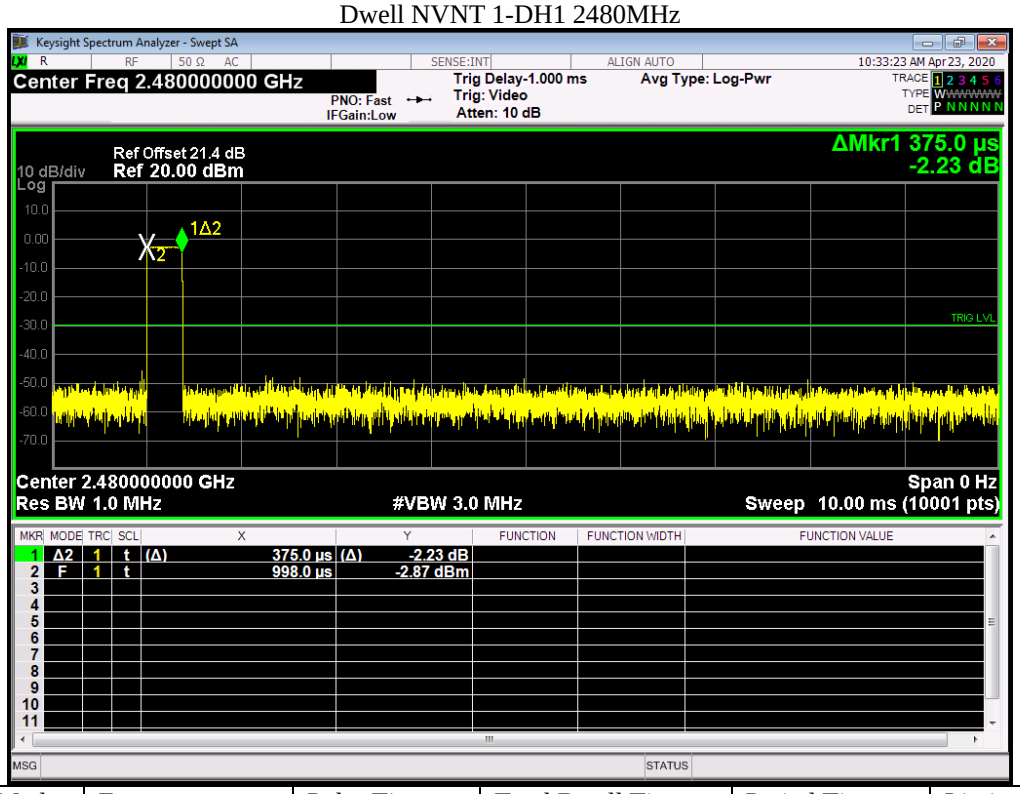
Dwell NVNT 1-DH1 2402MHz



Dwell NVNT 1-DH1 2441MHz

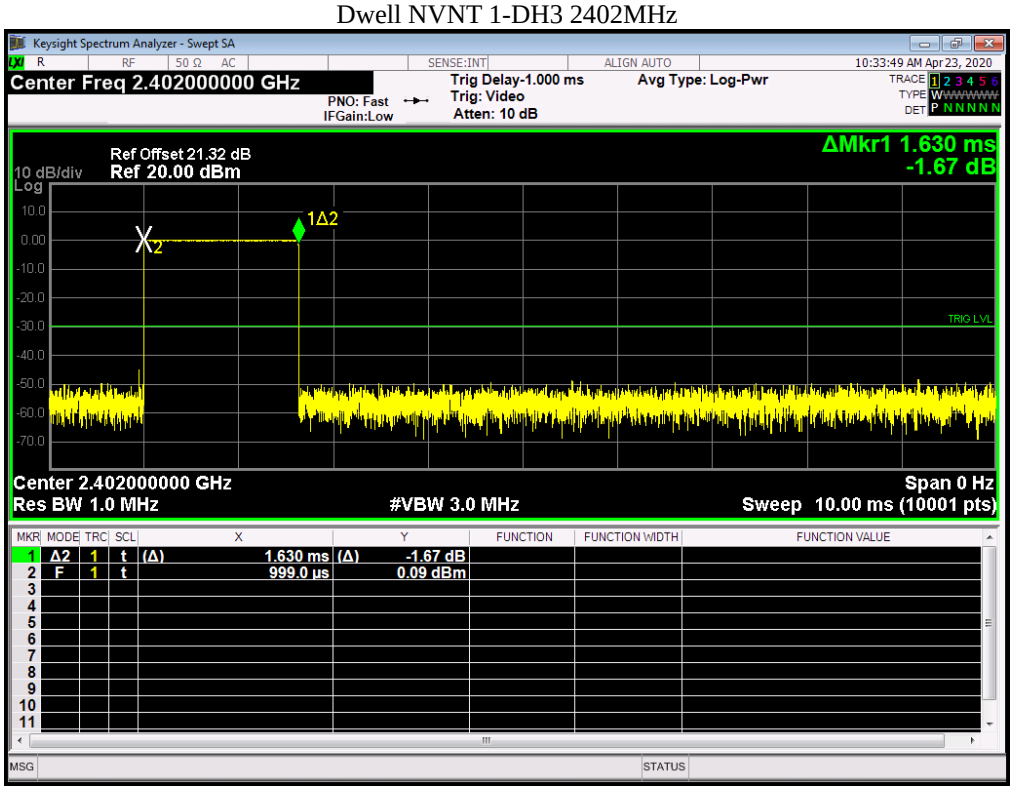


Dwell NVNT 1-DH1 2480MHz

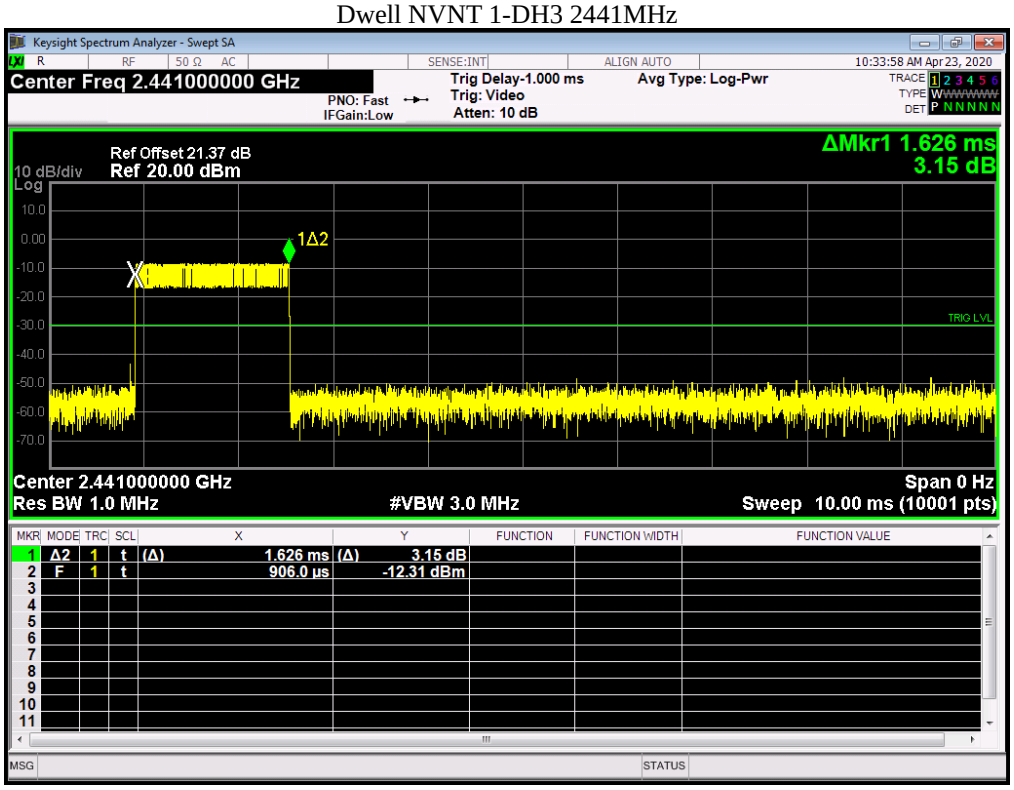


Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH3	2402	1.63	257.54	31600	400	Pass
NVNT	1-DH3	2441	1.626	256.908	31600	400	Pass
NVNT	1-DH3	2480	1.63	257.54	31600	400	Pass

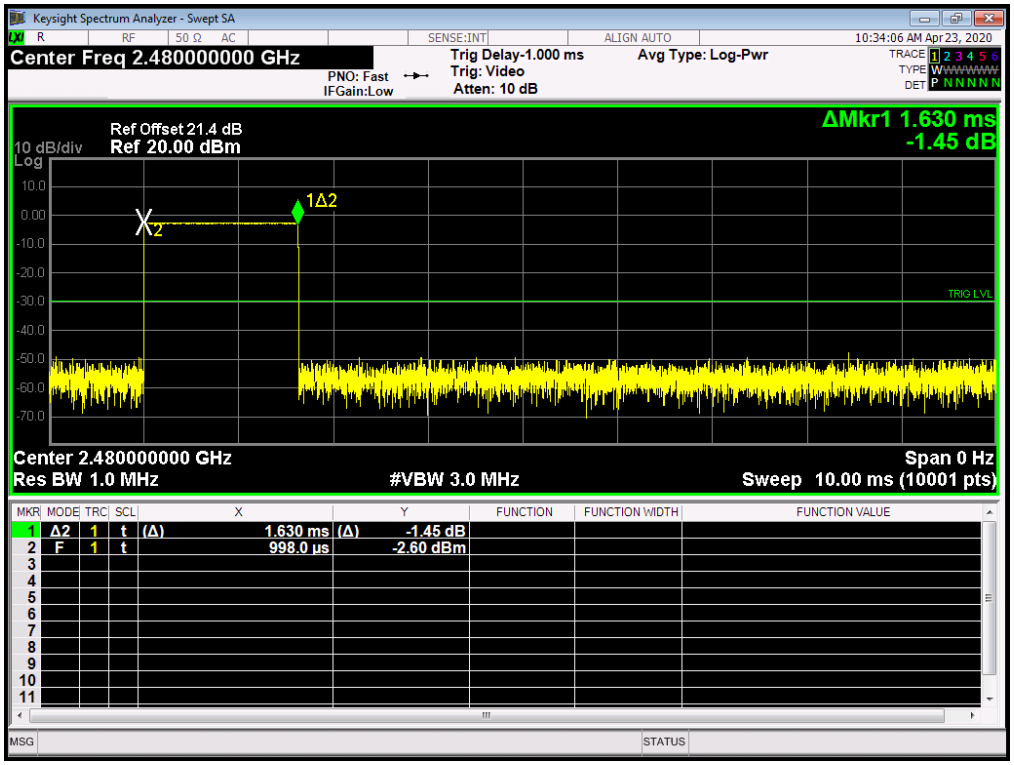
Dwell NVNT 1-DH3 2402MHz



Dwell NVNT 1-DH3 2441MHz

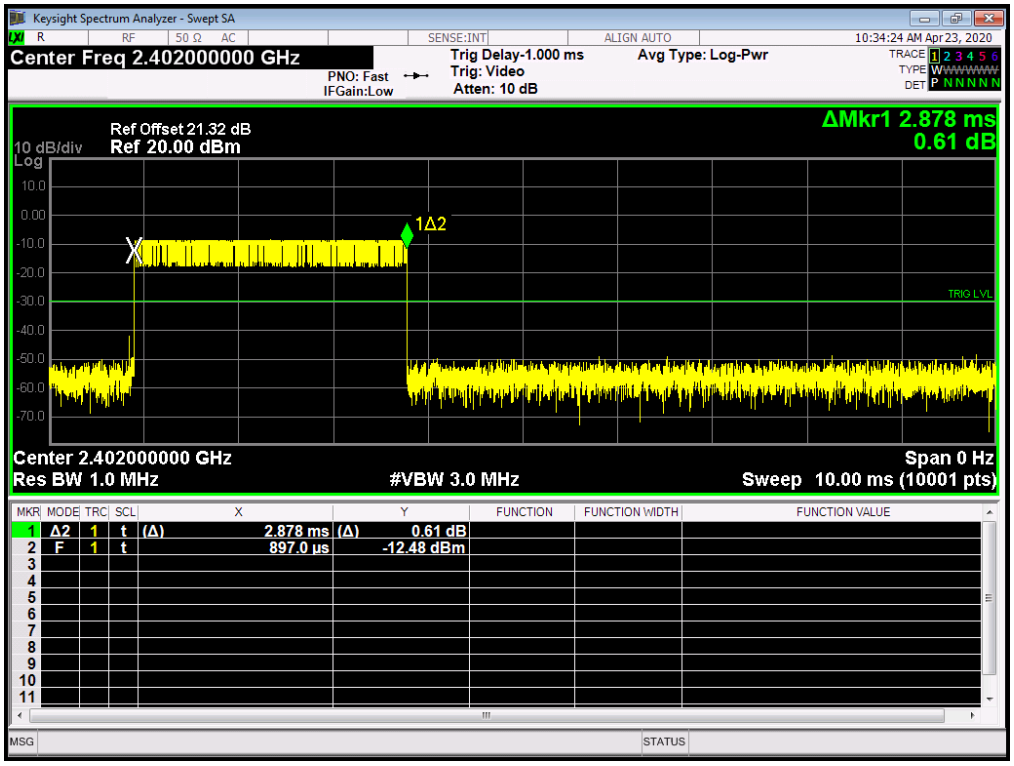


Dwell NVNT 1-DH3 2480MHz

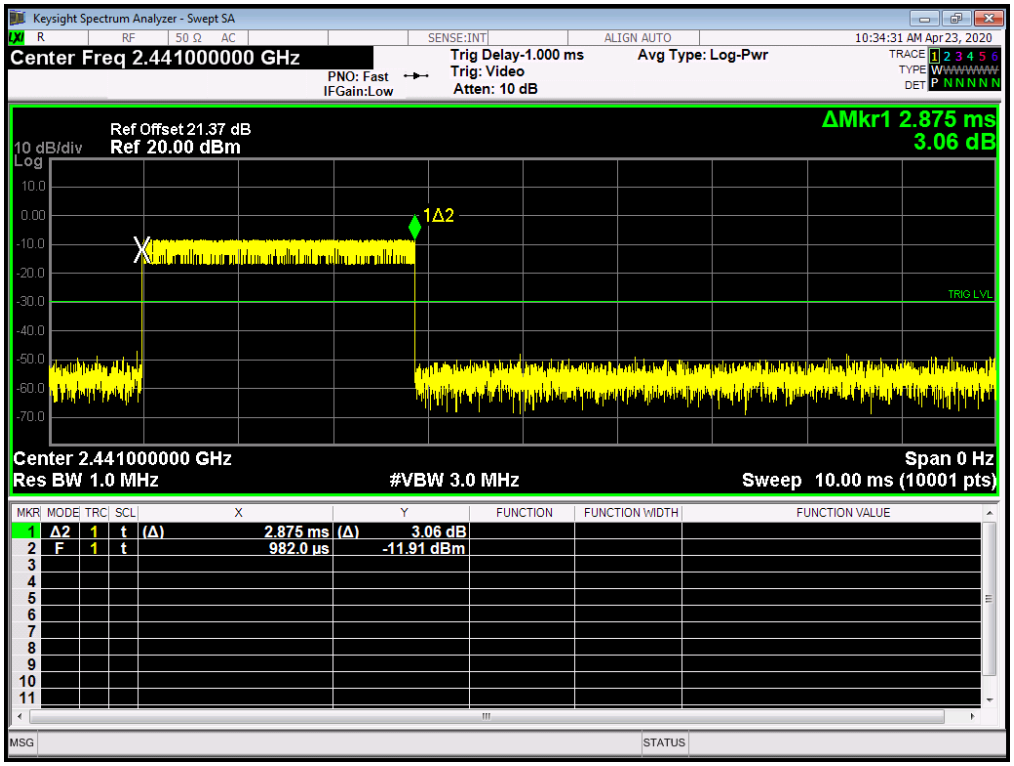


Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH5	2402	2.878	272.834	31600	400	Pass
NVNT	1-DH5	2441	2.875	272.55	31600	400	Pass
NVNT	1-DH5	2480	2.878	272.834	31600	400	Pass

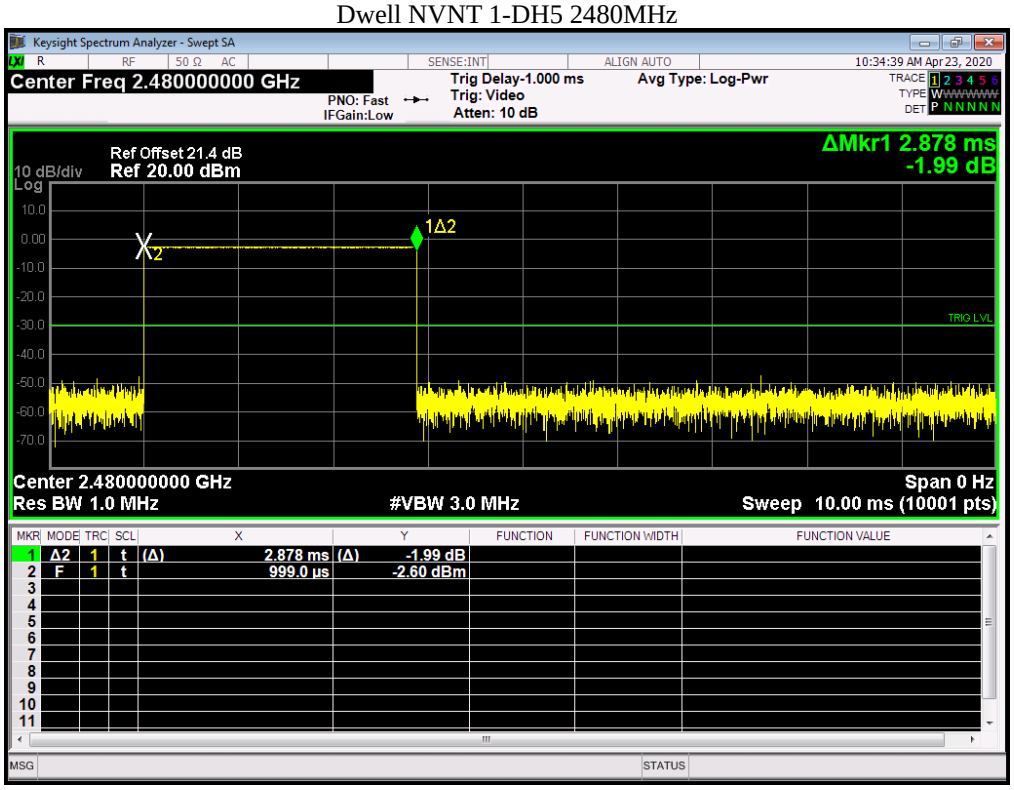
Dwell NVNT 1-DH5 2402MHz

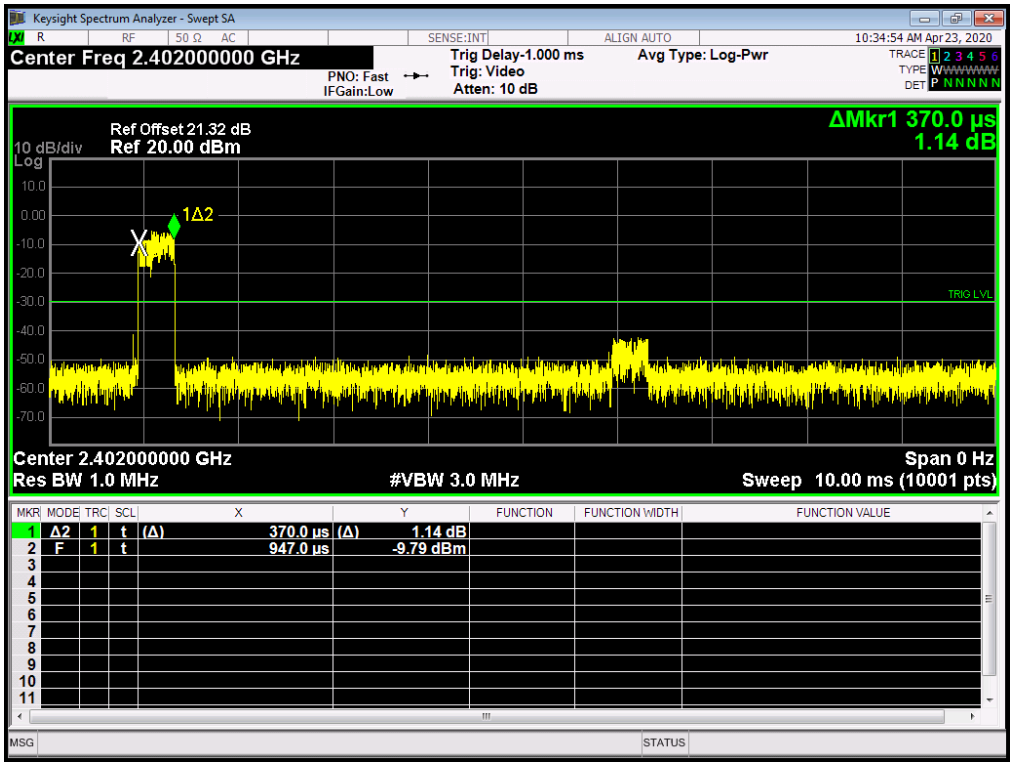


Dwell NVNT 1-DH5 2441MHz



Dwell NVNT 1-DH5 2480MHz



Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Period Time (ms)	Limit (ms)	Verdict
NVNT	2-DH1	2402	0.37	116.92	31600	400	Pass
NVNT	2-DH1	2441	0.37	116.92	31600	400	Pass
NVNT	2-DH1	2480	0.375	118.5	31600	400	Pass

Dwell NVNT 2-DH1 2402MHz