

# Test Report

**Report No.:** MTi220830006-01E1

**Date of issue:** 2022-10-10

**Applicant:** Hong Kong Etech Groups Ltd.

**Product:** TWS Earbuds

**Model(s):** EBT6-22152, EB5575-BKA

**FCC ID:** 2A3ZO-EBT6-21152

Shenzhen Microtest Co., Ltd.

<http://www.mtitest.com>

## Instructions

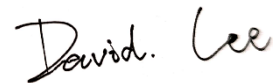
1. This test report shall not be partially reproduced without the written consent of the laboratory.
2. The test results in this test report are only responsible for the samples submitted
3. This test report is invalid without the seal and signature of the laboratory.
4. This test report is invalid if transferred, altered, or tampered with in any form without authorization.
5. Any objection to this test report shall be submitted to the laboratory within 15 days from the date of receipt of the report.

# Contents

<b>1</b>	<b>General Description .....</b>	<b>5</b>
1.1	Description of the EUT .....	5
1.2	Description of test modes .....	5
1.3	Measurement uncertainty .....	6
<b>2</b>	<b>Summary of Test Result.....</b>	<b>7</b>
<b>3</b>	<b>Test Facilities and Accreditations .....</b>	<b>8</b>
3.1	Test laboratory .....	8
<b>4</b>	<b>Equipment List .....</b>	<b>9</b>
<b>5</b>	<b>Test Result .....</b>	<b>10</b>
5.1	Antenna requirement .....	10
5.2	AC power line conducted emissions.....	11
5.3	Radiated spurious emission .....	12
5.4	20dB emission bandwidth .....	21
5.5	Maximum conducted output power .....	22
5.6	Carrier frequency separation .....	23
5.7	Time of occupancy.....	24
5.8	Number of hopping channels .....	25
5.9	Conducted emissions at the band edge .....	26
5.10	Conducted spurious emissions .....	27
	<b>Appendix A: 20dB Emission Bandwidth .....</b>	<b>28</b>
	<b>Appendix B: Maximum conducted output power .....</b>	<b>32</b>
	<b>Appendix C: Carrier frequency separation .....</b>	<b>36</b>
	<b>Appendix D: Time of occupancy .....</b>	<b>38</b>
	<b>Appendix E: Number of hopping channels.....</b>	<b>45</b>
	<b>Appendix F: Band edge measurements.....</b>	<b>47</b>
	<b>Appendix G: Conducted Spurious Emission.....</b>	<b>52</b>
	<b>Photographs of the Test Setup.....</b>	<b>62</b>
	<b>Photographs of the EUT.....</b>	<b>63</b>

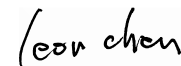
<b>Test Result Certification</b>	
<b>Applicant:</b>	<b>Hong Kong Etech Groups Ltd.</b>
Address:	16/F, Block C, 2nd Phase of Central Avenue, Haihong Industrial Area, Xixiang, Baoan, Shenzhen, China
<b>Manufacturer:</b>	<b>Hong Kong Etech Groups Ltd.</b>
Address:	16/F, Block C, 2nd Phase of Central Avenue, Haihong Industrial Area, Xixiang, Baoan, Shenzhen, China
<b>Factory:</b>	<b>DONGGUAN QIAOSIKE DIGITAL TECHNOLOGY CO., LTD.</b>
Address:	Room501, Room401, Building6, No.2. Hongjin Road, Hongmei Town, Dongguan City, Guangdong Province
<b>Product description</b>	
Product name:	TWS Earbuds
Trademark:	N/A
Model name:	EBT6-22152
Serial Model:	EB5575-BKA
Standards:	FCC 47 CFR Part 15 Subpart C
Test method:	ANSI C63.10-2013
<b>Date of Test</b>	
Date of test:	2022-09-14 ~ 2022-09-27
Test result:	Pass

Test Engineer :



(David Lee)

Reviewed By :



(Leon Chen)

Approved By :



(Tom Xue)

## 1 General Description

### 1.1 Description of the EUT

Product name:	TWS Earbuds
Model name:	EBT6-22152
Series Model:	EB5575-BKA
Model difference:	All the models are the same circuit and module, except the model name.
Electrical rating:	Input: DC 5V/0.5A Charging box: DC 3.7V 300mAh Bluetooth earphone: DC 3.7V 30mAh
Hardware version:	d031 v12
Software version:	E5EE1808_0818E042
Accessories:	N/A
EUT serial number:	MTi220830006-01-S0001
<b>RF specification:</b>	
Bluetooth version:	V5.0
Operation frequency:	2402 MHz ~ 2480 MHz
Modulation type:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna designation:	PCB antenna, antenna Gain: 0 dBi
Max. peak conducted output power:	6.82 dBm

### 1.2 Description of test modes

#### 1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	-	-

### 1.2.2 Test channels

Channel	Frequency
Lowest (CH0)	2402MHz
Middle (CH39)	2441MHz
Highest (CH78)	2480MHz

Note: The test software has been used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

### 1.2.3 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
Mobile phone	Mate 30	/	HUAWEI

### 1.3 Measurement uncertainty

Parameter	Measurement uncertainty
AC power line conducted emission (9 kHz~30 MHz)	±2.5 dB
Occupied Bandwidth	±3 %
Conducted RF output power	±0.16 dB
Conducted spurious emissions	±0.21 dB
Radiated emission (9 kHz ~ 30 MHz)	±4.0 dB
Radiated emission (30 MHz~1 GHz)	±4.2 dB
Radiated emission (above 1 GHz)	±4.3 dB

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

## 2 Summary of Test Result

No.	FCC reference	Description of test	Result
1	§ 15.203	Antenna requirement	Pass
2	§ 15.207	AC power line conducted emissions	N/A
3	15.247(a)(1)	20dB occupied bandwidth	Pass
4	15.247(b)(1)	Conducted peak output power	Pass
5	15.247(a)(1)	Carrier Frequencies Separation	Pass
6	15.247(a)(1)	Average time of occupancy (Dwell time)	Pass
7	15.247(a)(1)	Number of hopping channels	Pass
8	15.247(d)	Conducted emission at the band edge	Pass
9	15.247(d)	Conducted spurious emissions	Pass
10	15.247(d)	Radiated spurious emissions	Pass

**Note:** N/A means not applicable.

### 3 Test Facilities and Accreditations

#### 3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573



## 4 Equipment List

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTi-E002	EMI Test Receiver	R&S	ESCI3	101368	2022/05/05	2023/05/04
MTi-E023	Artificial power network	Schwarzbeck	NSLK8127	NSLK8127# 841	2022/05/05	2023/05/04
MTi-E025	Artificial power network	Schwarzbeck	NSLK8127	8127183	2022/05/05	2023/05/04
MTi-E043	EMI test receiver	R&S	ESCI7	101166	2022/05/05	2023/05/04
MTi-E046	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00044	2021/05/30	2023/05/29
MTi-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTi-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTi-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2022/05/05	2023/05/04
MTi-E048	Pre-amplifier	Agilent	8449B	3008A01120	2022/05/05	2023/05/04
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2022/04/15	2023/04/14
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2022/05/05	2023/05/04
MTi-E135	Horn antenna	Schwarzbeck	BBHA 9170	00987	2021/05/30	2023/05/29
MTi-E136	Pre-amplifier	Space-Dtronics	EVLAN1840G -G45	210405001	2022/05/05	2023/05/04
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2022/05/05	2023/05/04
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2022/05/05	2023/05/04
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2022/05/05	2023/05/04
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2022/05/05	2023/05/04
MTi-E010S	EMI Measurement Software	Farad	EZ-EMC Ver. EMEC-3A1	/	/	/
MTi-E014S	RF Test System	Tonscend	TS@JS1120 V2.6.88.0330	/	/	/

## 5 Test Result

### 5.1 Antenna requirement

#### 15.203 requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

#### Description of the antenna of EUT

The antenna of EUT is PCB antenna (Antenna Gain: 0 dBi). which is no consideration of replacement.

## 5.2 AC power line conducted emissions

### 5.2.1 Limits

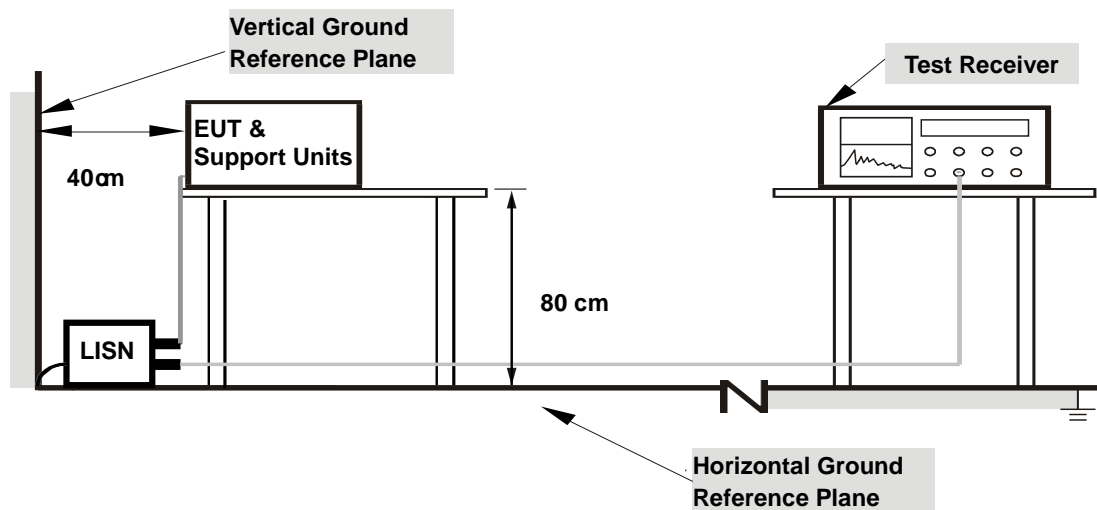
Frequency (MHz)	Detector type / Bandwidth	Limit-Quasi-peak dB $\mu$ V	Limit-Average dB $\mu$ V
0.15 -0.5	Average / 9 kHz	66 to 56	56 to 46
0.5 -5		56	46
5 -30		60	50

**Note 1:** the limit decreases with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz.

### 5.2.2 Test Procedures

- The test setup is refer to the standard ANSI C63.10-2013.
- The EUT is connected to the main power through a line impedance stabilization network (LISN). All support equipment is powered from additional LISN(s).
- Emissions were measured on each current carrying line of the EUT using an EMI test receiver connected to the LISN powering the EUT.
- The test receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes described in Item 1.2.
- The test data of the worst-case condition(s) was recorded.

### 5.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the test setup.

### 5.2.4 Test Result

**Note:** Not applicable. Because the product does not TX when it is charged, so this item not applicable.

### 5.3 Radiated spurious emission

#### 5.3.1 Limits

§ 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)).

§ 15.209 Radiated emission limits; general requirements.

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

**Note 1:** the tighter limit applies at the band edges.

**Note 2:** the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector

§ 15.35 (b) requirements:

When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

According to ANSI C63.10-2013, the tests shall be performed in the frequency range shown in the following table:

**Frequency range of measurements for unlicensed wireless device**

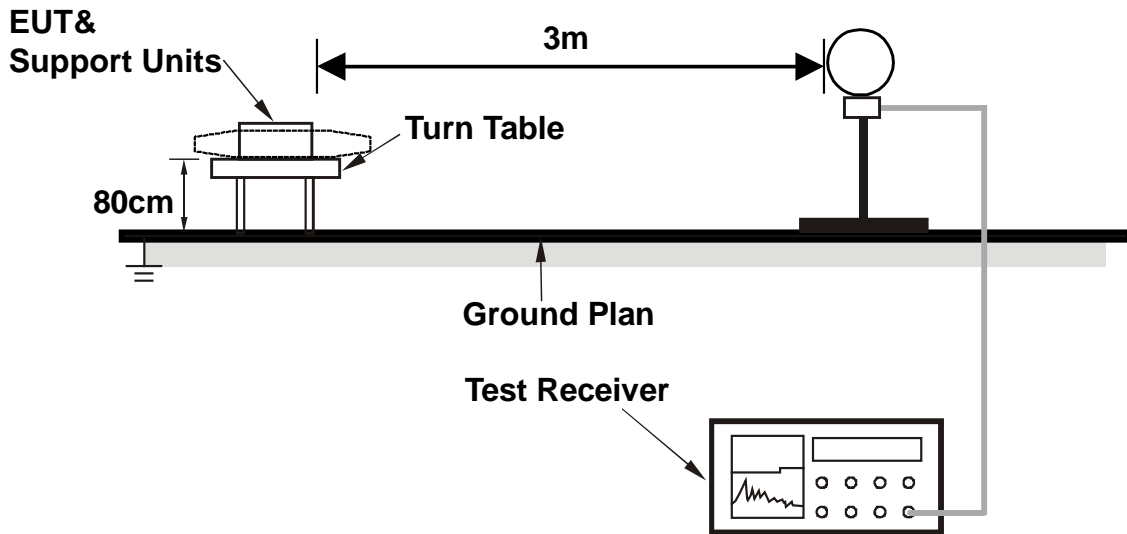
Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

**Frequency range of measurements for unlicensed wireless device with digital device**

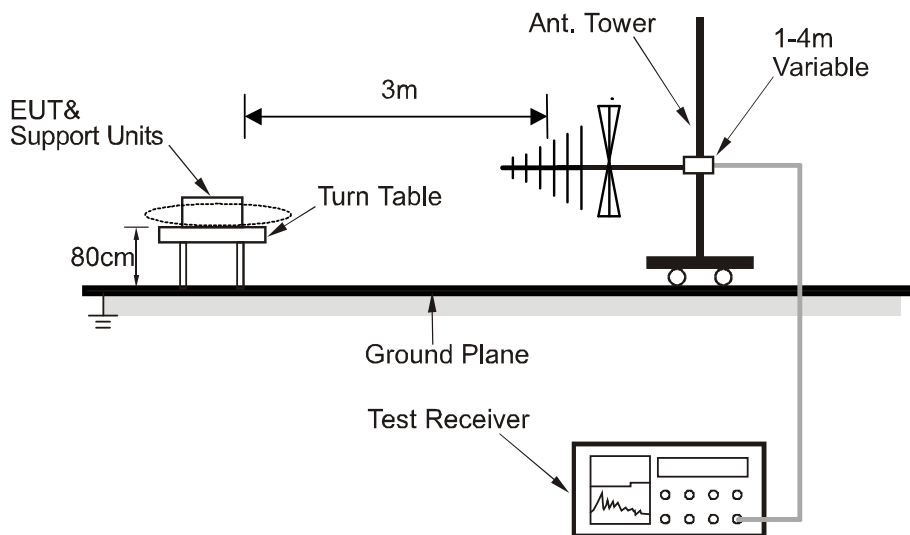
Highest frequency generated or used in the device or on which the device operates or tunes	Upper frequency range of measurement
Below 1.705 MHz	30 MHz
1.705 MHz to 108 MHz	1000 MHz
108 MHz to 500 MHz	2000 MHz
500 MHz to 1000 MHz	5000 MHz
Above 1000 MHz	5th harmonic of the highest frequency or 40 GHz, whichever is lower

**5.3.2 Test setup**

Below 30MHz



30MHz~1GHz



Above 1GHz



For the actual test configuration, please refer to the related item – Photographs of the test setup.

### 5.3.3 Test procedure

- a) Test method: ANSI C63.10-2013 Section 6.3, 6.4, 6.5, 6.6, 6.10.
- b) The EUT is placed on an on-conducting table 0.8 meters above the ground plane for measurement below 1GHz, 1.5 meters above the ground plane for measurement above 1GHz.
- c) Emission below 18 GHz were measured at a 3 meters test distance, above 18 GHz were measured at 1.5-meter test distance with the application of a distance correction factor
- d) The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

KDB 558074 D01 15.247 Meas Guidance v05r02

The use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

### Test instrument setup

Frequency	Test receiver / Spectrum analyzer setting
9 kHz ~ 150 kHz	Quasi Peak / RBW: 200 Hz
150 kHz ~ 30 MHz	Quasi Peak / RBW: 9 kHz
30 MHz ~ 1 GHz	Quasi Peak / RBW: 120 kHz
Above 1 GHz	Peak / RBW: 1 MHz, VBW: 3MHz, Peak detector AVG / RBW: 1 MHz, VBW: 1/T, Peak detector

### 5.3.4 Test results

#### Notes:

The amplitude of spurious emissions which are attenuated more than 20 dB below the limits are not reported.

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

There were no emissions found below 30MHz within 20dB of the limit.

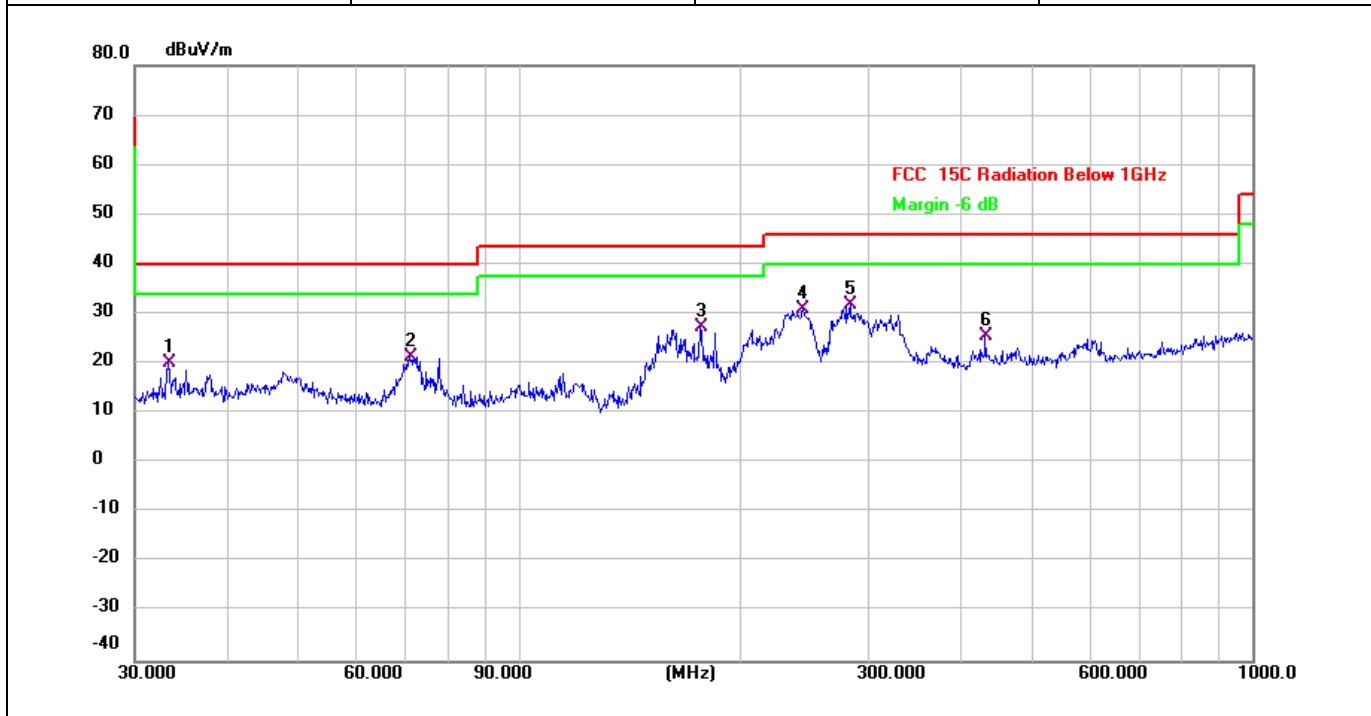
#### Calculation formula:

Measurement (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Correct Factor (dB/m)

Over (dB) = Measurement (dB $\mu$ V/m) – Limit (dB $\mu$ V/m)

**Radiated emissions between 30MHz – 1GHz**

Test mode:	TX 2DH5-2480	Polarization:	Horizontal
Power supply:	DC 3.7V	Test site:	RE chamber 2

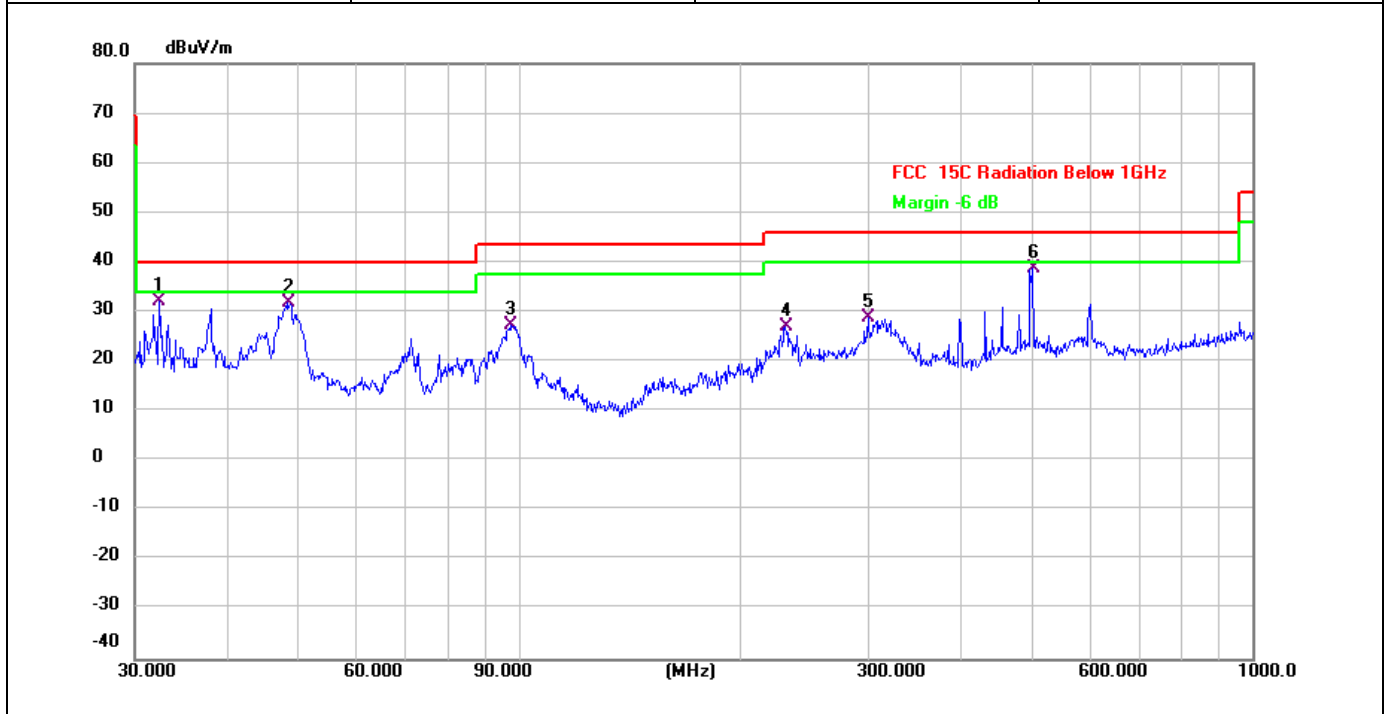


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1		33.3279	30.31	-10.22	20.09	40.00	-19.91	QP
2		71.0803	32.86	-11.57	21.29	40.00	-18.71	QP
3		176.8878	38.64	-11.17	27.47	43.50	-16.03	QP
4		244.2321	39.34	-8.32	31.02	46.00	-14.98	QP
5	*	282.9852	39.93	-8.02	31.91	46.00	-14.09	QP
6		432.5457	31.46	-5.92	25.54	46.00	-20.46	QP



**Radiated emissions between 30MHz – 1GHz**

Test mode:	TX 2DH5-2480	Polarization:	Vertical
Power supply:	DC 3.7V	Test site:	RE chamber 2



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		32.4059	42.61	-10.37	32.24	40.00	-7.76	QP
2		48.5016	40.97	-9.26	31.71	40.00	-8.29	QP
3		97.4560	37.86	-10.45	27.41	43.50	-16.09	QP
4		230.9068	35.87	-8.92	26.95	46.00	-19.05	QP
5		299.3158	37.20	-8.22	28.98	46.00	-17.02	QP
6	*	501.1790	43.75	-4.90	38.85	46.00	-7.15	QP

**Radiated emissions 1 GHz ~ 25 GHz**

Frequency (MHz)	Reading Level (dB $\mu$ V)	Correct Factor (dB/m)	Measuremen t (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Over (dB)	Detector Peak/AVG	Polarization H/V
<b><math>\pi/4</math>-DQPSK - 2402 MHz TX mode</b>							
4804	44.43	0.81	45.24	74.00	-28.76	Peak	V
4804	40.34	0.81	41.15	54.00	-12.85	AVG	V
7206	40.94	5.86	46.80	74.00	-27.20	Peak	V
7206	34.50	5.86	40.36	54.00	-13.64	AVG	V
9608	40.79	6.32	47.11	74.00	-26.89	Peak	V
9608	34.80	6.32	41.12	54.00	-12.88	AVG	V
4804	50.39	0.81	51.20	74.00	-22.80	Peak	H
4804	46.45	0.81	47.26	54.00	-6.74	AVG	H
7206	39.79	5.86	45.65	74.00	-28.35	Peak	H
7206	33.48	5.86	39.34	54.00	-14.66	AVG	H
9608	40.34	6.32	46.66	74.00	-27.34	Peak	H
9608	33.93	6.32	40.25	54.00	-13.75	AVG	H
<b><math>\pi/4</math>-DQPSK - 2441 MHz TX mode</b>							
4882	45.14	1.18	46.32	74.00	-27.68	Peak	V
4882	41.05	1.18	42.23	54.00	-11.77	AVG	V
7323	40.32	5.52	45.84	74.00	-28.16	Peak	V
7323	33.85	5.52	39.37	54.00	-14.63	AVG	V
9764	40.77	6.21	46.98	74.00	-27.02	Peak	V
9764	34.38	6.21	40.59	54.00	-13.41	AVG	V
4882	52.92	1.18	54.10	74.00	-19.90	Peak	H
4882	47.88	1.18	49.06	54.00	-4.94	AVG	H
7323	40.25	5.52	45.77	74.00	-28.23	Peak	H
7323	33.82	5.52	39.34	54.00	-14.66	AVG	H
9764	43.12	6.21	49.33	74.00	-24.67	Peak	H
9764	36.94	6.21	43.15	54.00	-10.85	AVG	H

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dB $\mu$ V)	(dB/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	Peak/AVG	H/V
<b><math>\pi/4</math>-DQPSK - 2480 MHz TX mode</b>							
4960	47.04	1.53	48.57	74.00	-25.43	Peak	V
4960	41.79	1.53	43.32	54.00	-10.68	AVG	V
7440	41.67	5.16	46.83	74.00	-27.17	Peak	V
7440	35.13	5.16	40.29	54.00	-13.71	AVG	V
9920	42.32	6.09	48.41	74.00	-25.59	Peak	V
9920	36.10	6.09	42.19	54.00	-11.81	AVG	V
4960	54.13	1.53	55.66	74.00	-18.34	Peak	H
4960	49.04	1.53	50.57	54.00	-3.43	AVG	H
7440	40.71	5.16	45.87	74.00	-28.13	Peak	H
7440	34.18	5.16	39.34	54.00	-14.66	AVG	H
9920	46.25	6.09	52.34	74.00	-21.66	Peak	H
9920	42.06	6.09	48.15	54.00	-5.85	AVG	H

**Radiated emissions at band edge**

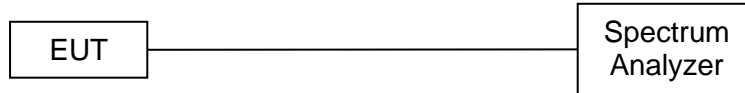
Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dB $\mu$ V)	(dB/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	Peak/AVG	H/V
<b><math>\pi/4</math>-DQPSK – Low band-edge</b>							
(MHz)	(dB $\mu$ V)	(dB/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	Peak/AVG	H/V
2310	46.89	-8.20	38.69	74.00	-35.31	Peak	V
2310	37.23	-8.20	29.03	54.00	-24.97	AVG	V
2390	48.11	-7.83	40.28	74.00	-33.72	Peak	V
2390	37.62	-7.83	29.79	54.00	-24.21	AVG	V
2310	47.10	-8.20	38.90	74.00	-35.10	Peak	H
2310	37.11	-8.20	28.91	54.00	-25.09	AVG	H
2390	46.97	-7.83	39.14	74.00	-34.86	Peak	H
2390	37.49	-7.83	29.66	54.00	-24.34	AVG	H
<b><math>\pi/4</math>-DQPSK – High band-edge</b>							
2483.5	47.44	-7.39	40.05	74.00	-33.95	Peak	V
2483.5	37.83	-7.39	30.44	54.00	-23.56	AVG	V
2500	46.47	-7.32	39.15	74.00	-34.85	Peak	V
2500	37.84	-7.32	30.52	54.00	-23.48	AVG	V
2483.5	55.34	-7.39	47.95	74.00	-26.05	Peak	H
2483.5	40.00	-7.39	32.61	54.00	-21.39	AVG	H
2500	47.87	-7.32	40.55	74.00	-33.45	Peak	H
2500	37.97	-7.32	30.65	54.00	-23.35	AVG	H

## 5.4 20dB emission bandwidth

### 5.4.1 Limits

None, for reporting purposes only.

### 5.4.2 Test setup



### 5.4.3 Test procedures

Test method: ANSI C63.10-2013 Section 6.9.2

### 5.4.4 Test results

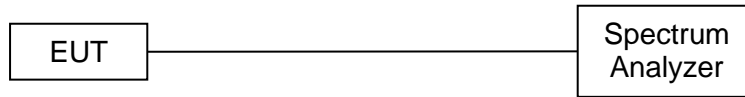
**Note: See the Appendix A**

## 5.5 Maximum conducted output power

### 5.5.1 Limits

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

### 5.5.2 Test setup



### 5.5.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.5

### 5.5.4 Test results

**Note: see the Appendix B**

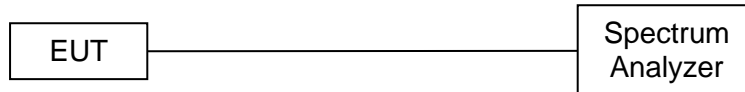
## 5.6 Carrier frequency separation

### 5.6.1 Limits

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

### 5.6.2 Test setup



### 5.6.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.2

### 5.6.4 Test results

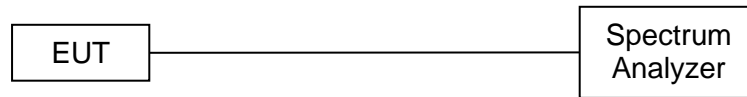
**Note: see the Appendix C**

## 5.7 Time of occupancy

### 5.7.1 Limits

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.

### 5.7.2 Test setup



### 5.7.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.4

### 5.7.4 Test results

**Note: see the Appendix D**

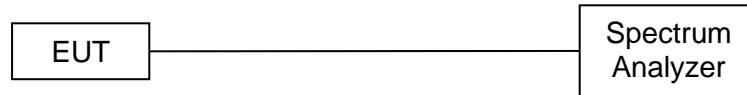


## 5.8 Number of hopping channels

### 5.8.1 Limit

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

### 5.8.2 Test setup



### 5.8.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.3

### 5.8.4 Test results

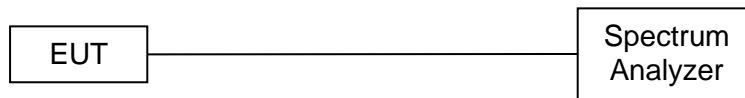
**Note: see the Appendix E**

## 5.9 Conducted emissions at the band edge

### 5.9.1 Limits

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)).

### 5.9.2 Test setup



### 5.9.3 Test procedure

Test method: ANSI C63.10-2013 Section 6.10.4

### 5.9.4 Test results

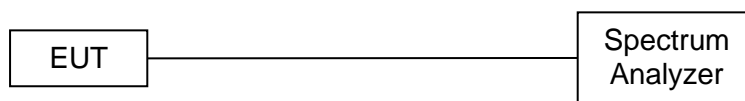
**Note: see the Appendix F**

## 5.10 Conducted spurious emissions

### 5.10.1 Limits

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)).

### 5.10.2 Test setup



### 5.10.3 Test procedure

Test method: ANSI C63.10-2013 Section 6.10.4

### 5.10.4 Test results

**Note: See the Appendix G**

**APPENDIX A: 20DB EMISSION BANDWIDTH**

## Test Result

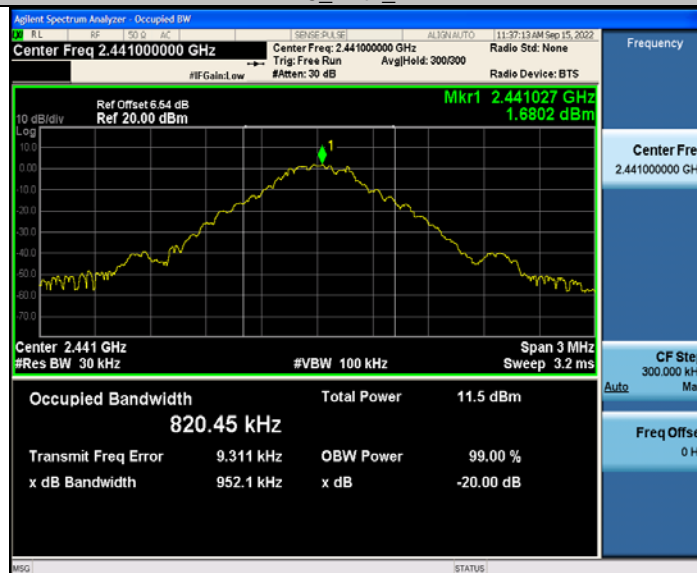
Test Mode	Antenna	Frequency [MHz]	20db EBW [MHz]
DH5	Ant1	2402	0.948
		2441	0.952
		2480	0.948
2DH5	Ant1	2402	1.288
		2441	1.286
		2480	1.283
3DH5	Ant1	2402	1.304
		2441	1.301
		2480	1.296

## Test Graphs

DH5\_Ant1\_2402



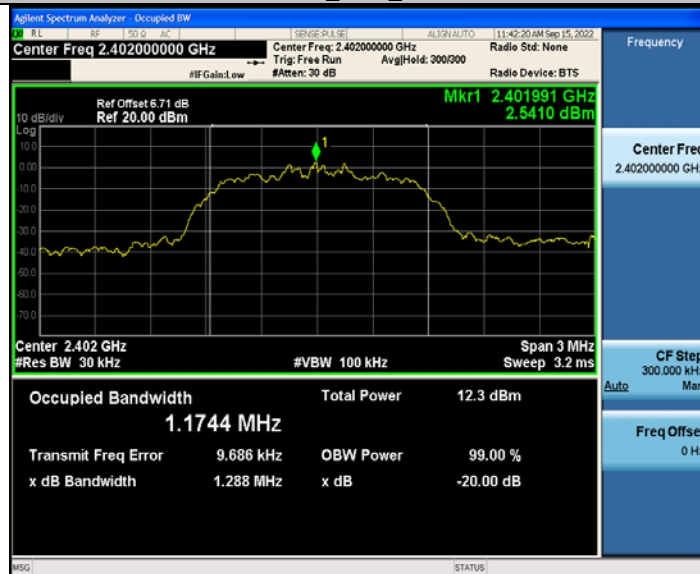
DH5\_Ant1\_2441



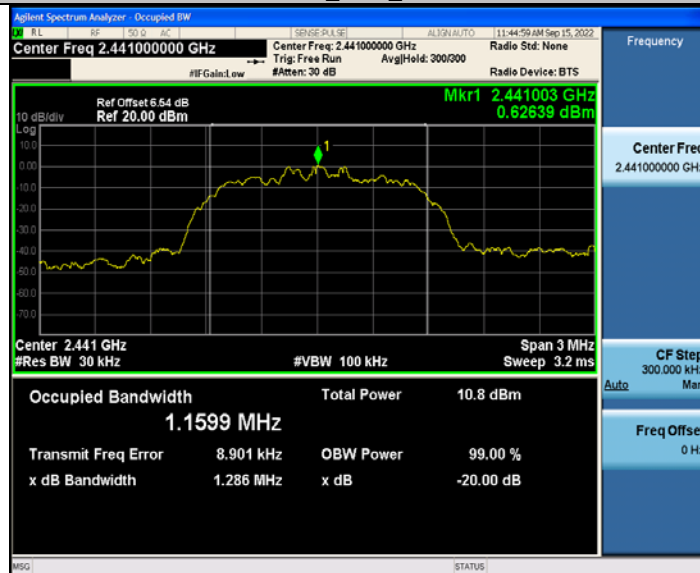
DH5\_Ant1\_2480



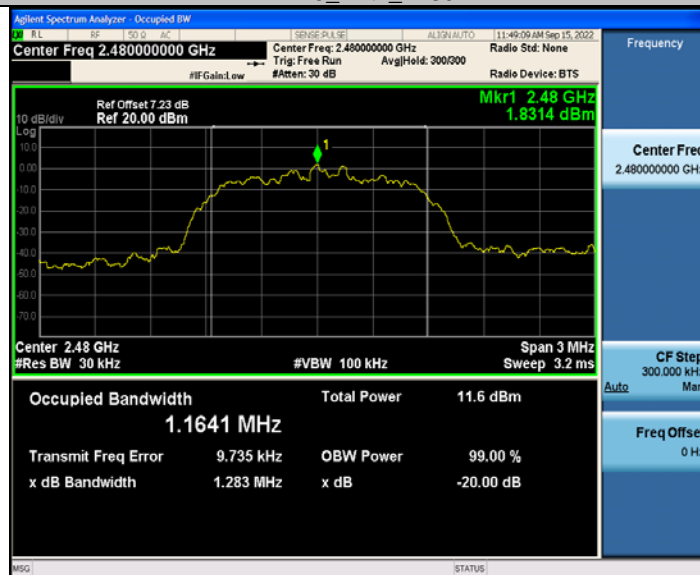
## 2DH5\_Ant1\_2402



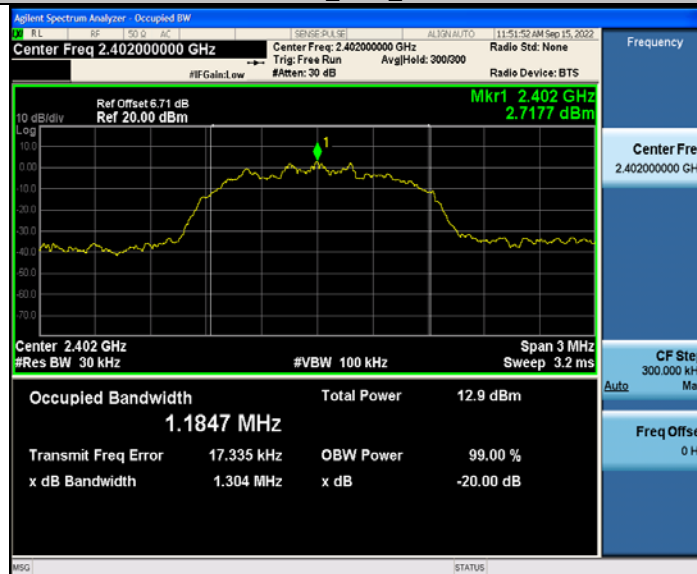
## 2DH5\_Ant1\_2441



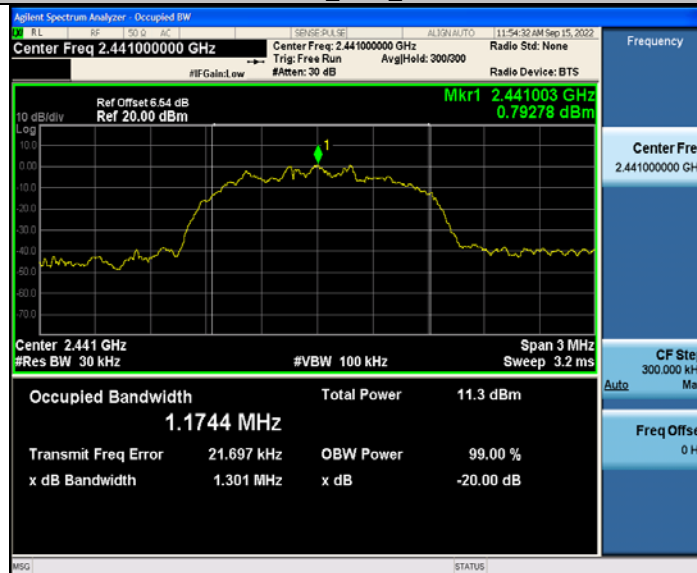
## 2DH5\_Ant1\_2480



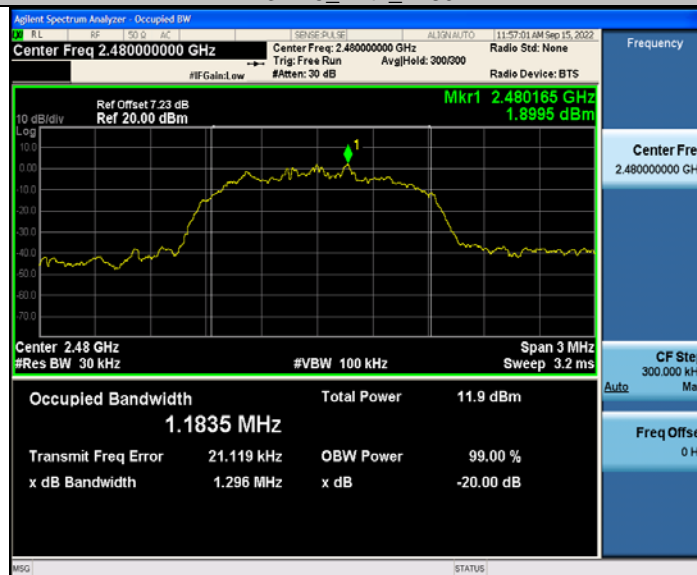
## 3DH5\_Ant1\_2402



## 3DH5\_Ant1\_2441



## 3DH5\_Ant1\_2480



## APPENDIX B: MAXIMUM CONDUCTED OUTPUT POWER

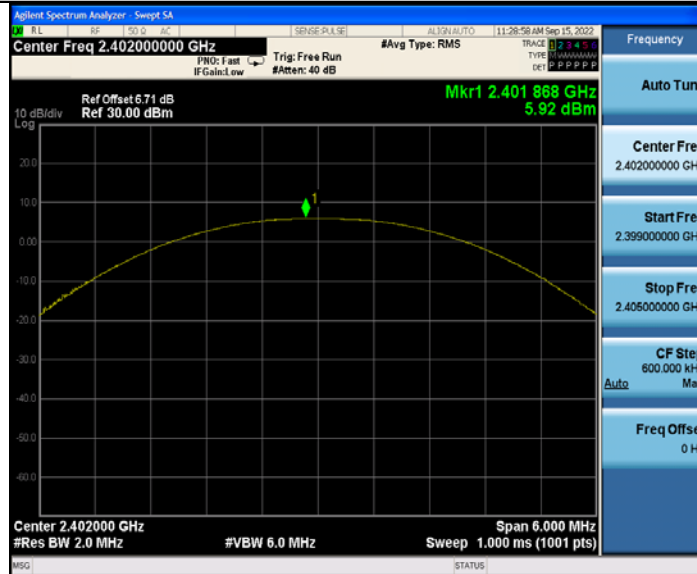
### Test Result Peak

Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	5.92	≤30	PASS
		2441	4.34	≤30	PASS
		2480	5.24	≤30	PASS
2DH5	Ant1	2402	6.46	≤30	PASS
		2441	4.95	≤30	PASS
		2480	5.76	≤30	PASS
3DH5	Ant1	2402	6.82	≤30	PASS
		2441	5.38	≤30	PASS
		2480	6.19	≤30	PASS

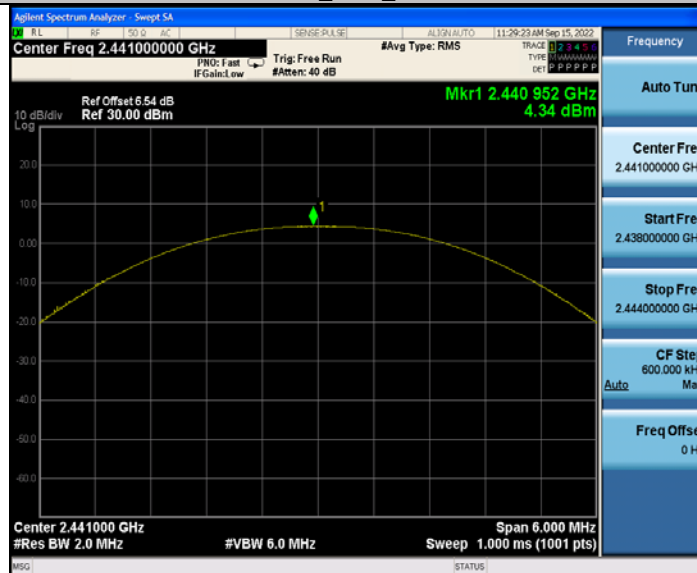


## Test Graphs

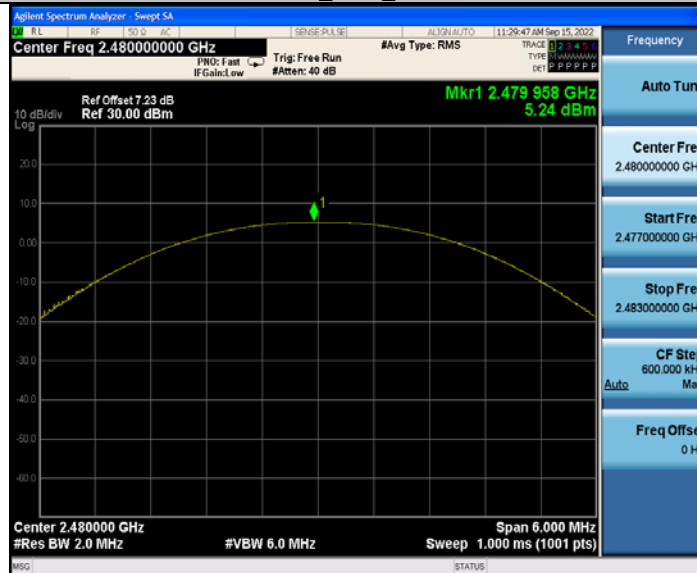
DH5\_Ant1\_2402



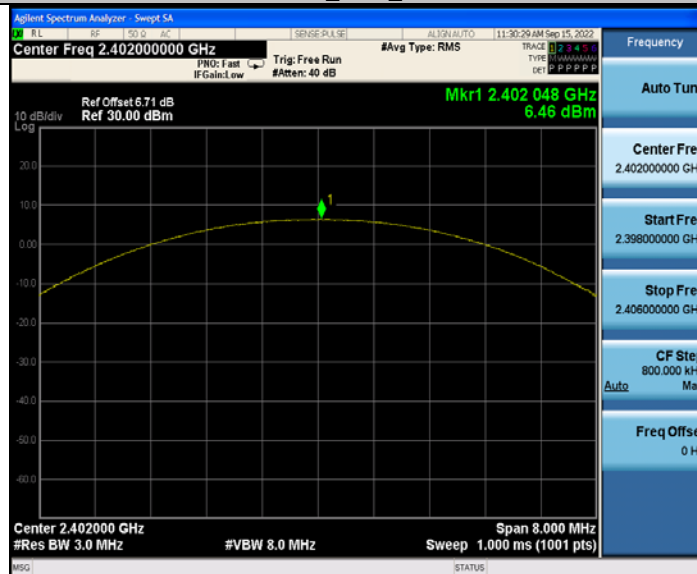
DH5\_Ant1\_2441



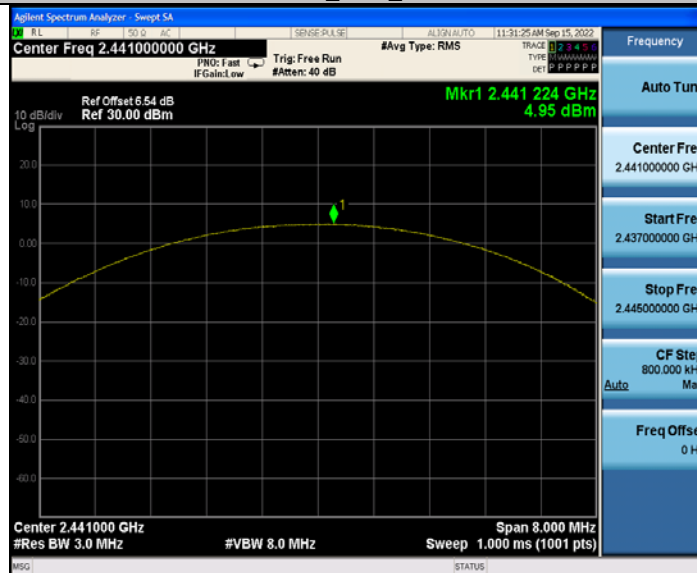
DH5\_Ant1\_2480



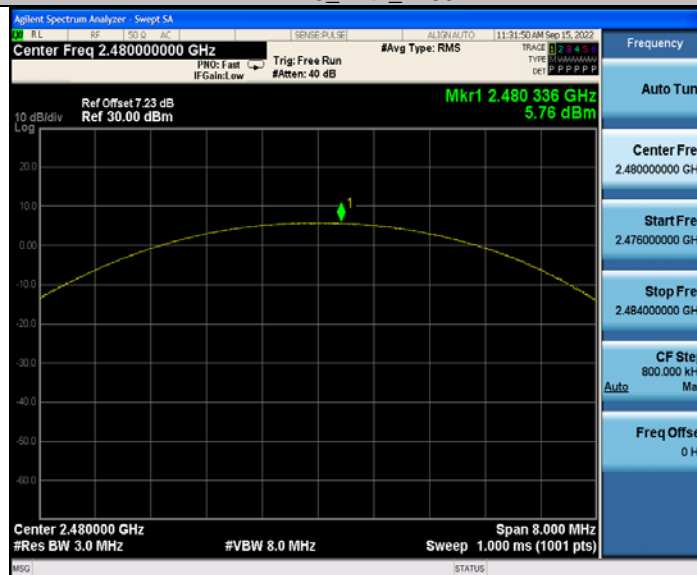
## 2DH5\_Ant1\_2402



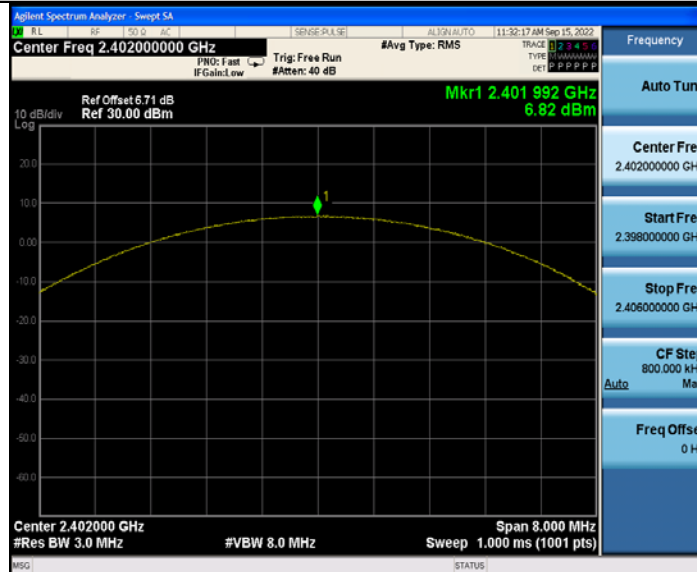
## 2DH5\_Ant1\_2441



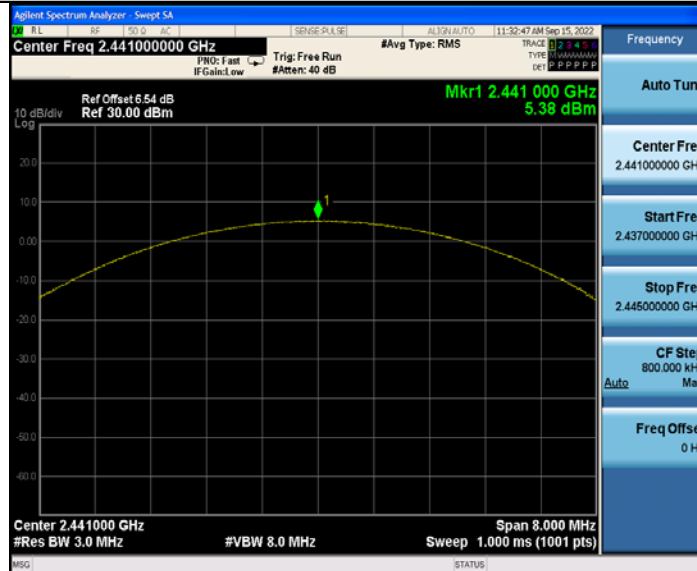
## 2DH5\_Ant1\_2480



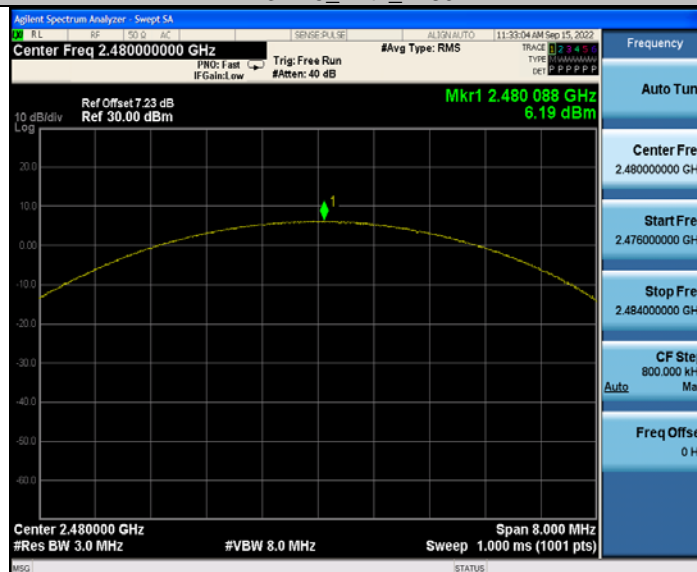
## 3DH5\_Ant1\_2402



## 3DH5\_Ant1\_2441



## 3DH5\_Ant1\_2480



## APPENDIX C: CARRIER FREQUENCY SEPARATION

### Test Result

Test Mode	Antenna	Frequency [MHz]	Result [MHz]	Limit [MHz]	Verdict
DH5	Ant1	Hop	1	$\geq 0.025$	PASS
2DH5	Ant1	Hop	1.002	$\geq 0.025$	PASS
3DH5	Ant1	Hop	1.004	$\geq 0.025$	PASS

## Test Graphs

DH5\_Ant1\_Hop



2DH5\_Ant1\_Hop



3DH5\_Ant1\_Hop



## APPENDIX D: TIME OF OCCUPANCY

### Test Result

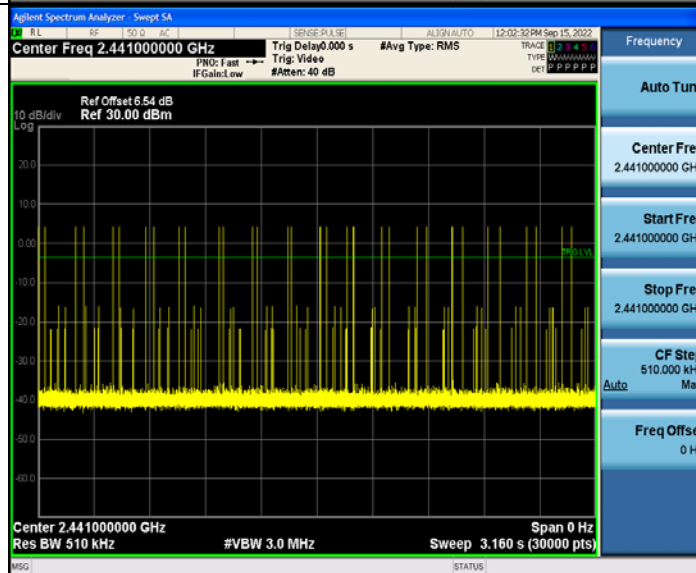
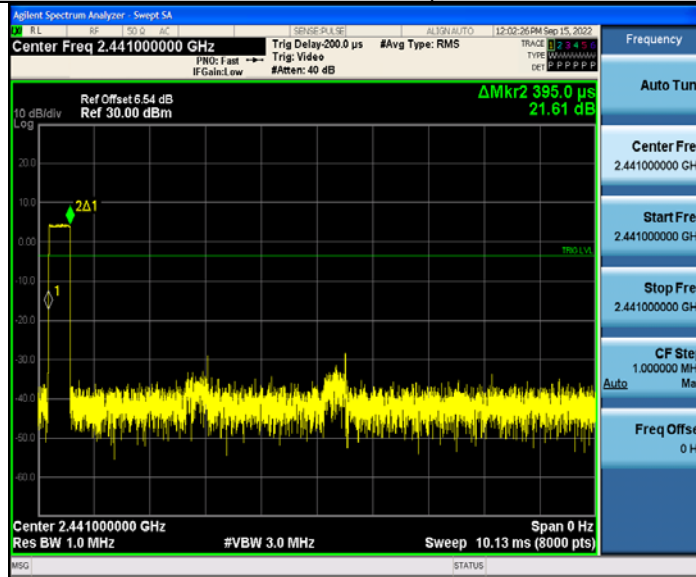
Test Mode	Antenna	Frequency [MHz]	BurstWidth [ms]	TotalHops [Num]	Result [s]	Limit [s]	Verdict
DH1	Ant1	Hop	0.395	320	0.126	≤0.4	PASS
DH3	Ant1	Hop	1.652	150	0.248	≤0.4	PASS
DH5	Ant1	Hop	2.898	90	0.261	≤0.4	PASS
2DH1	Ant1	Hop	0.405	330	0.134	≤0.4	PASS
2DH3	Ant1	Hop	1.657	190	0.315	≤0.4	PASS
2DH5	Ant1	Hop	2.906	110	0.32	≤0.4	PASS
3DH1	Ant1	Hop	0.408	330	0.135	≤0.4	PASS
3DH3	Ant1	Hop	1.658	180	0.299	≤0.4	PASS
3DH5	Ant1	Hop	2.907	120	0.349	≤0.4	PASS

### Notes:

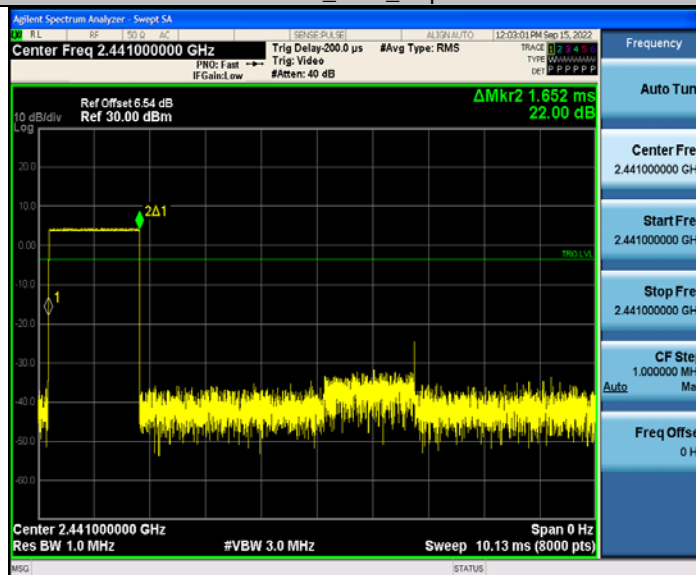
1. Period time = 0.4 (s) \* 79 = 31.6(s)
2. TotalHops [Num] = Number of pulses in 3.16s \* 10
2. Average time of occupancy = Pulse width \* TotalHops [Num]

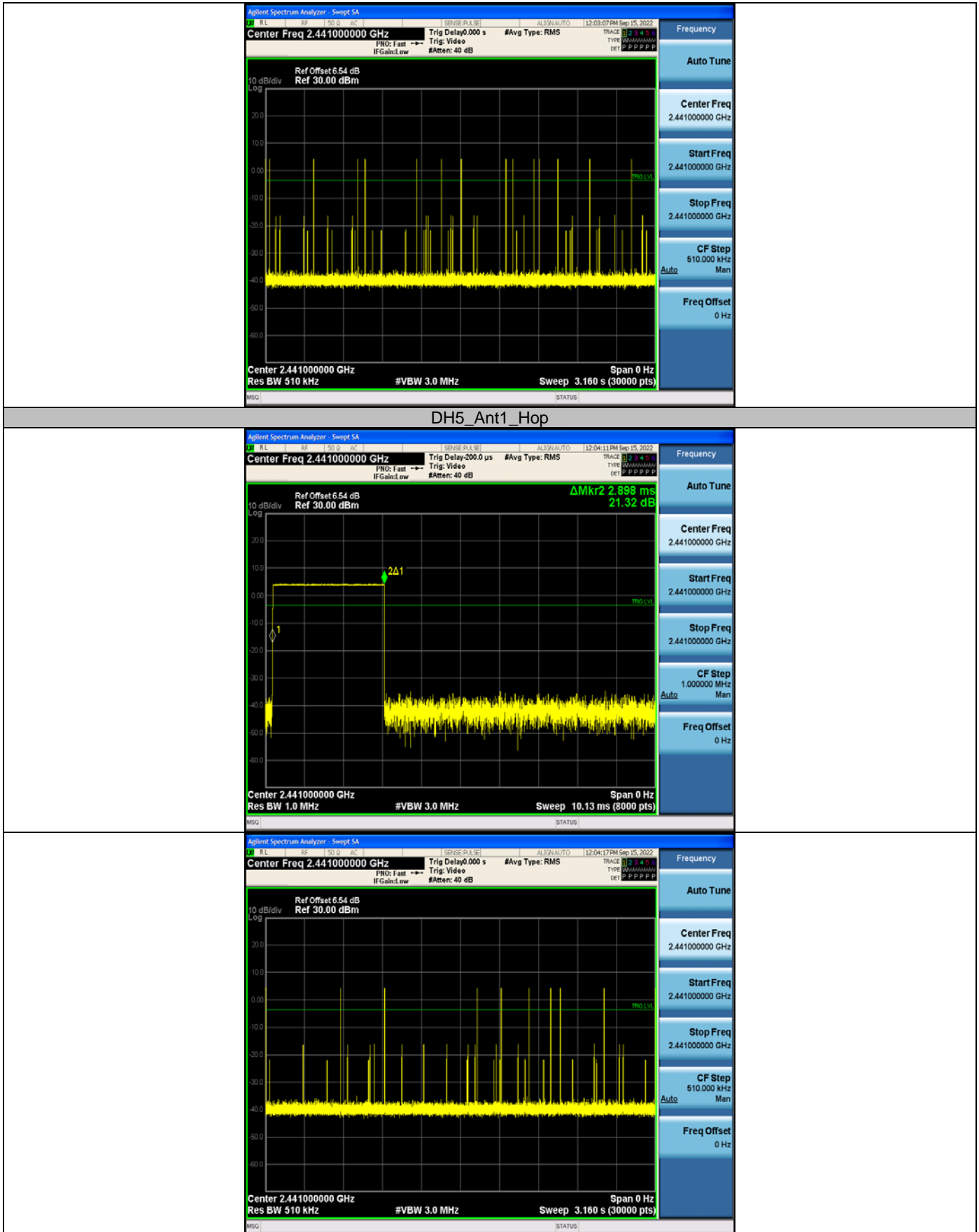
## Test Graphs

## DH1\_Ant1\_Hop



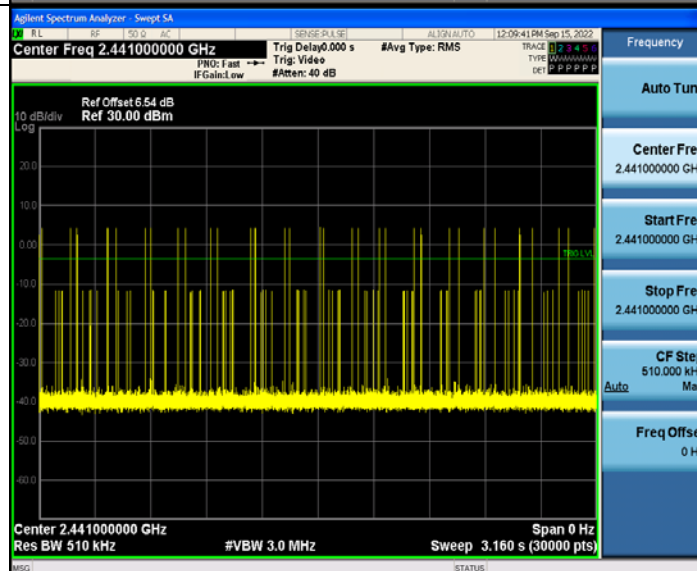
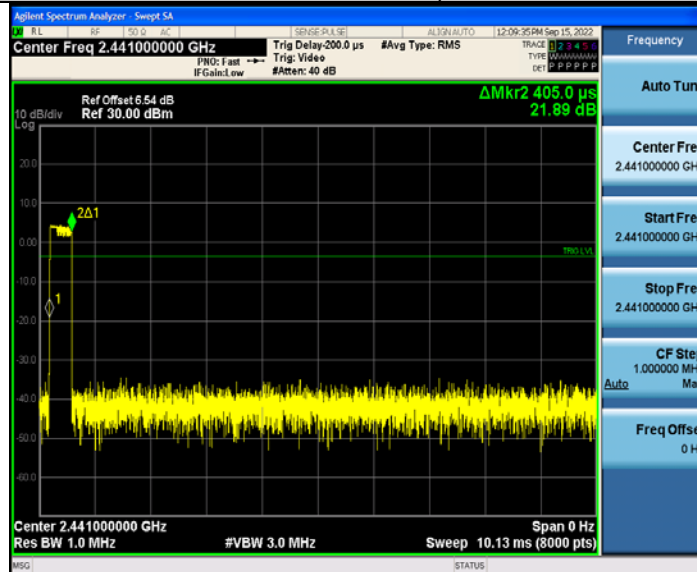
## DH3\_Ant1\_Hop



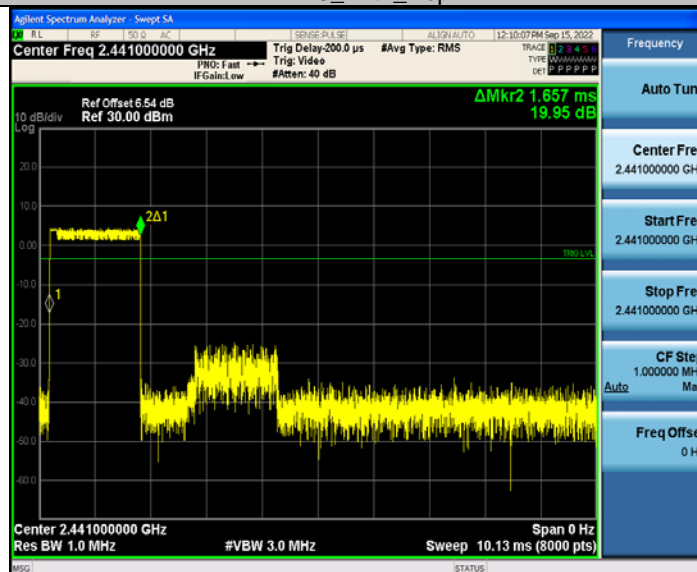


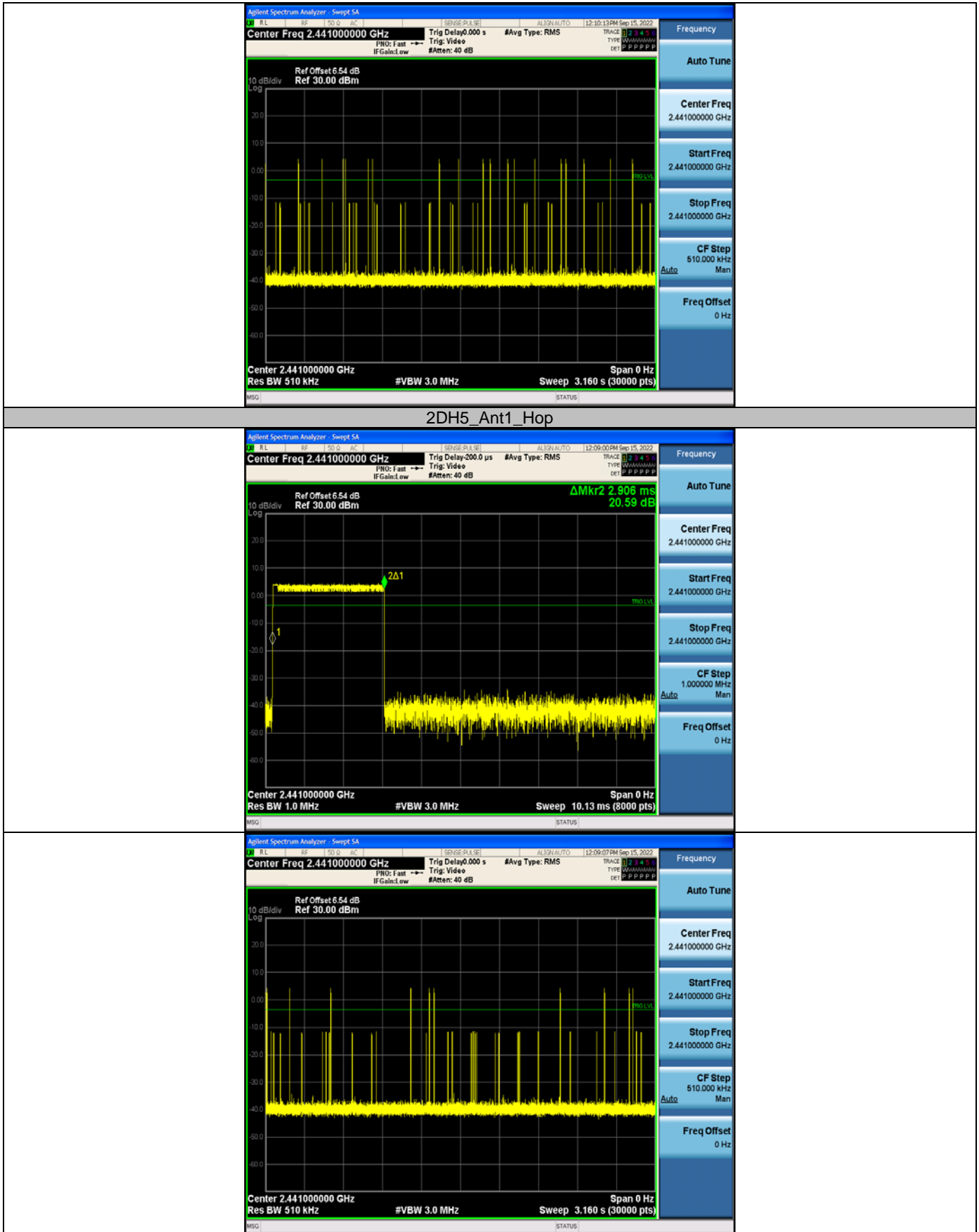


## 2DH1\_Ant1\_Hop

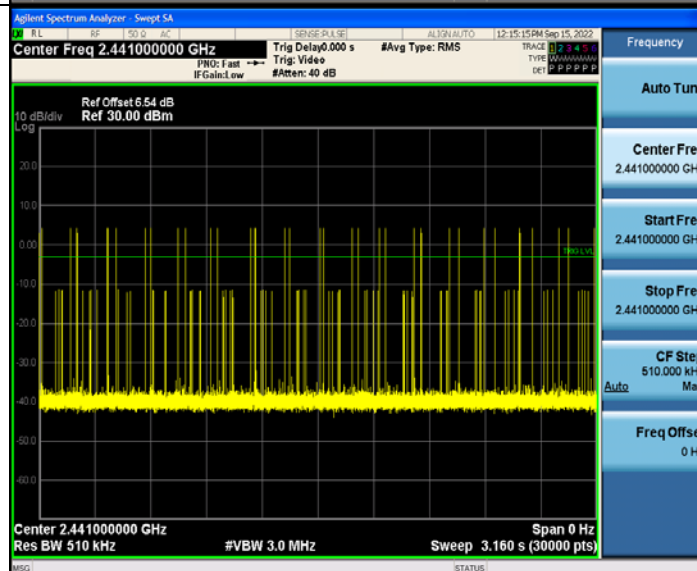
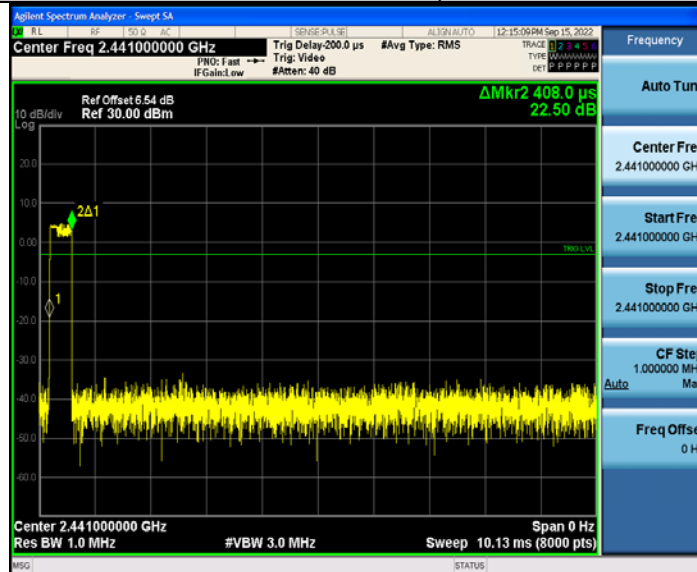


## 2DH3\_Ant1\_Hop

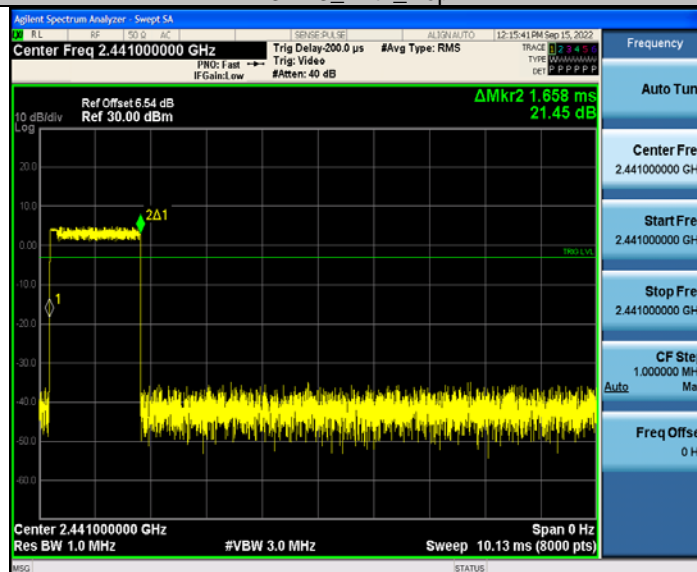


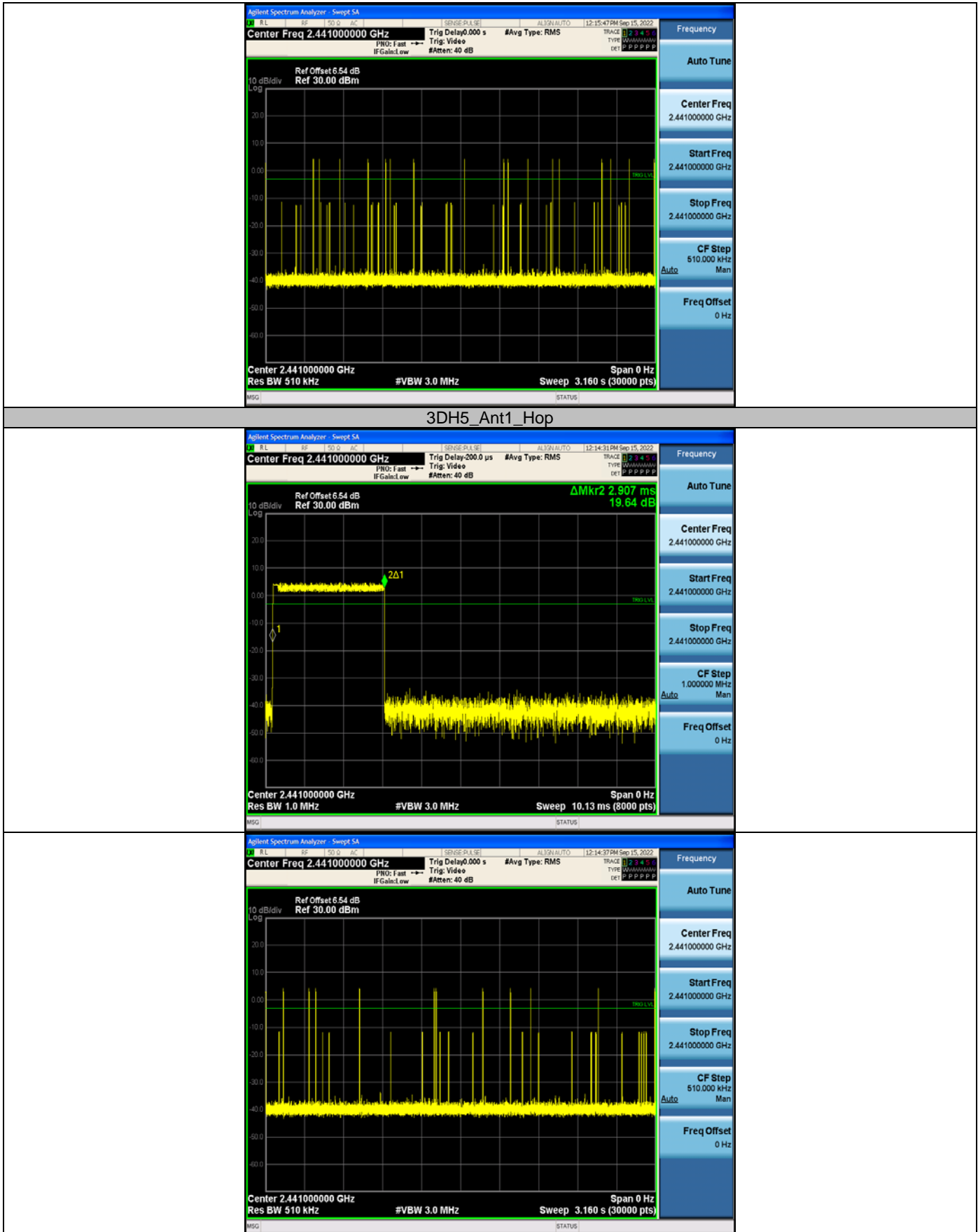


## 3DH1\_Ant1\_Hop



## 3DH3\_Ant1\_Hop





## APPENDIX E: NUMBER OF HOPPING CHANNELS

### Test Result

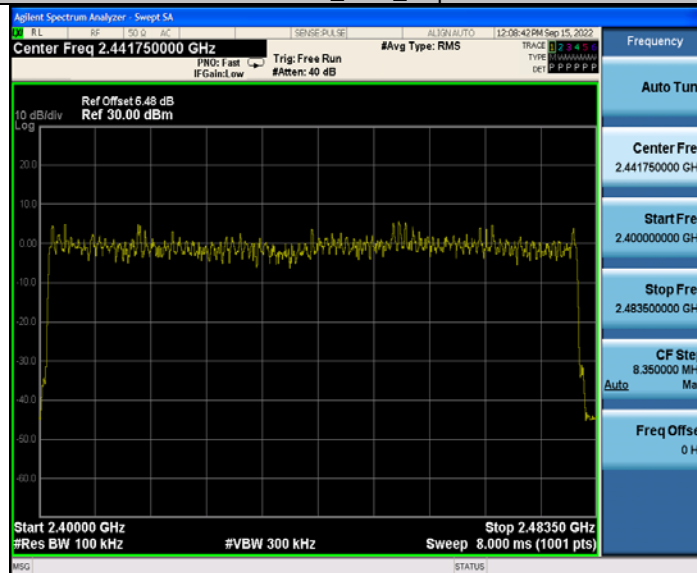
Test Mode	Antenna	Frequency [MHz]	Result [Num]	Limit [Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

## Test Graphs

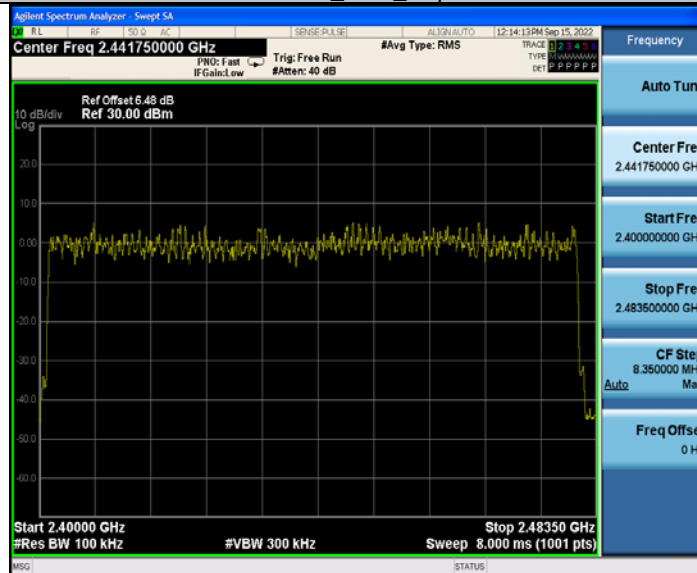
DH5\_Ant1\_Hop



2DH5\_Ant1\_Hop

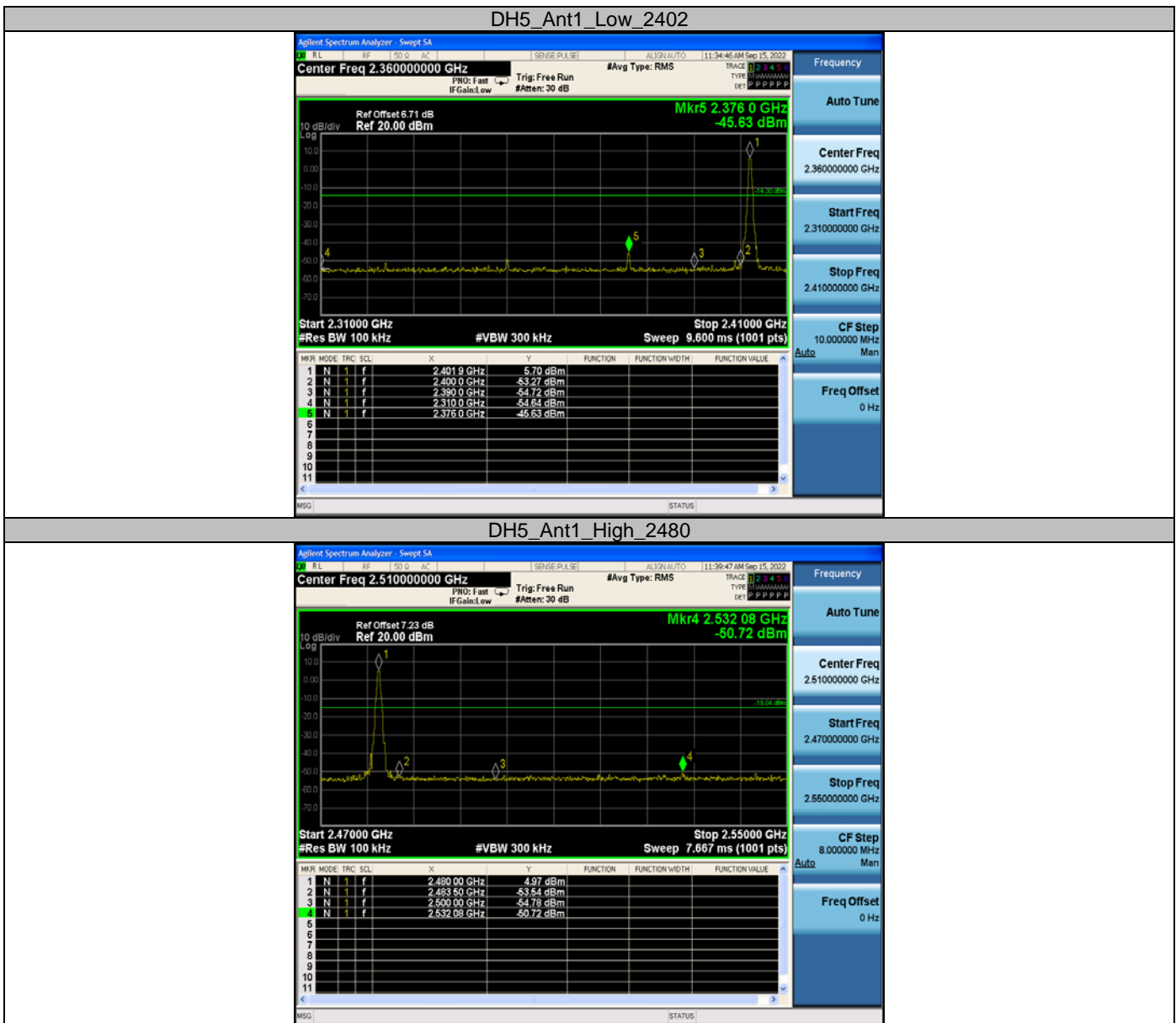


3DH5\_Ant1\_Hop

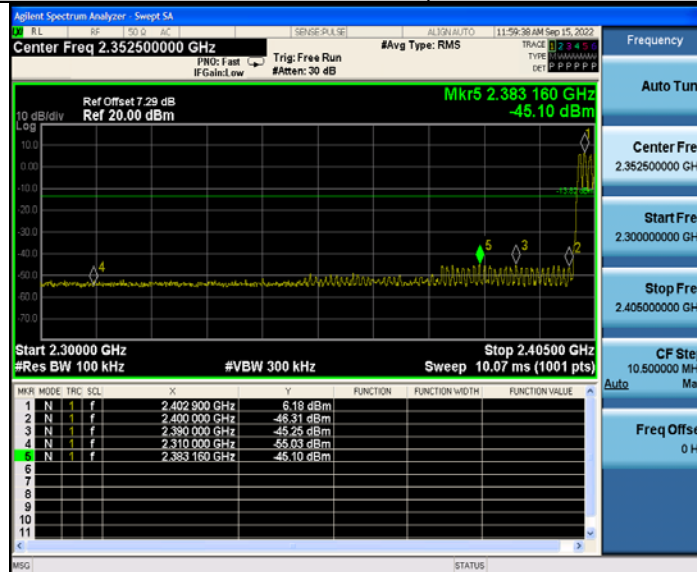


## APPENDIX F: BAND EDGE MEASUREMENTS

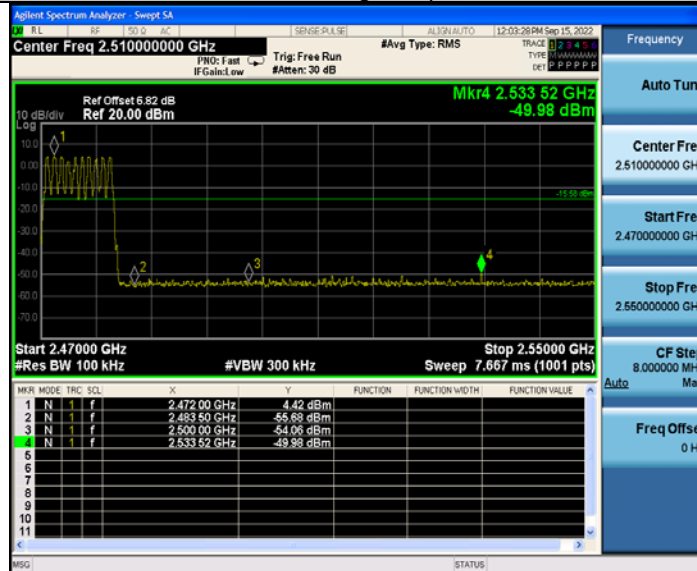
### Test Graphs



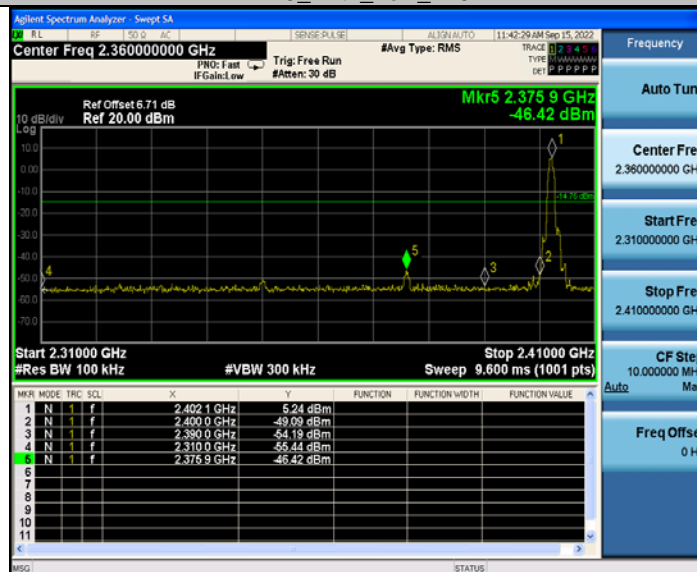
## DH5\_Ant1\_Low\_Hop\_2402



## DH5\_Ant1\_High\_Hop\_2480

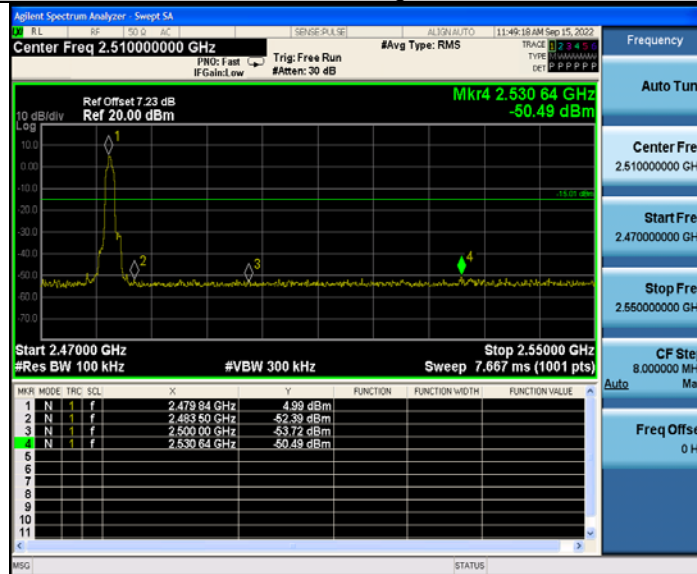


## 2DH5\_Ant1\_Low\_2402

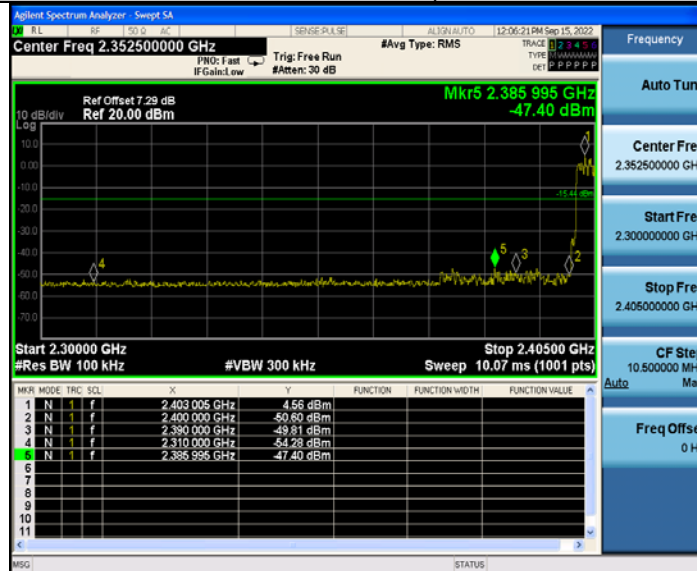




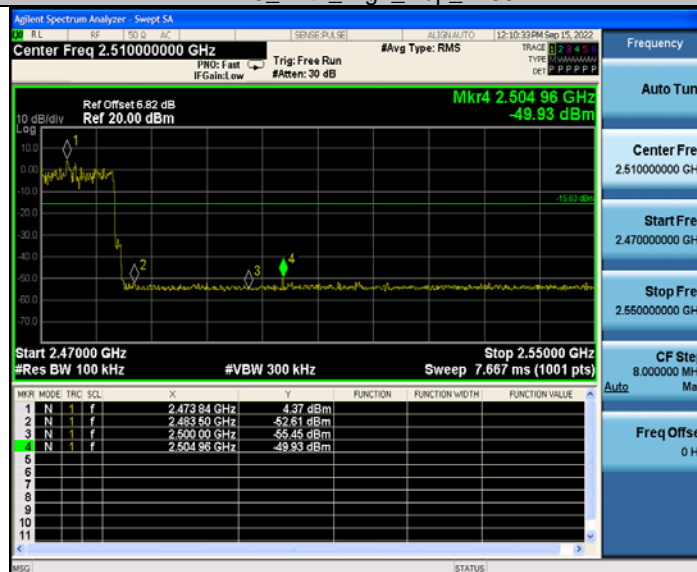
## 2DH5\_Ant1\_High\_2480



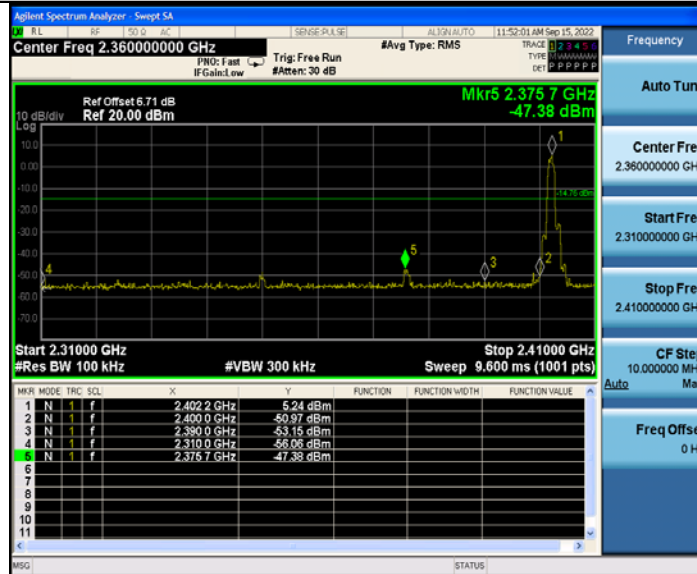
## 2DH5\_Ant1\_Low\_Hop\_2402



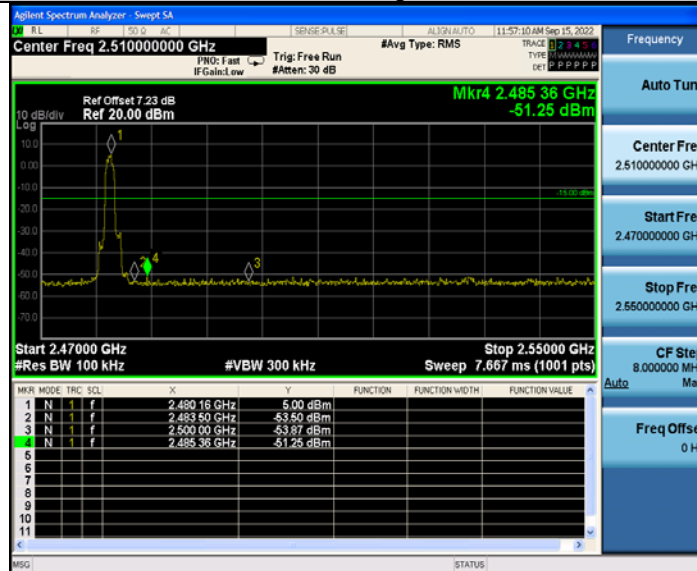
## 2DH5\_Ant1\_High\_Hop\_2480



## 3DH5\_Ant1\_Low\_2402



## 3DH5\_Ant1\_High\_2480



## 3DH5\_Ant1\_Low\_Hop\_2402

