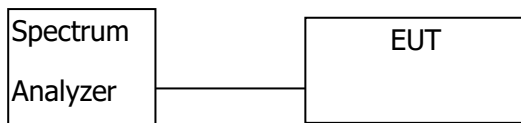# 9 20 dB Bandwidth Measurement

Test Requirement   :   FCC CFR47 Part 15 Section 15.247

Test Method   :   ANSI C63.10:2013

9.1 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

3.Set up:

```
┌──────────┐          ┌──────────┐
│Spectrum  │          │   EUT    │
│          │──────────│          │
│Analyzer  │          │          │
└──────────┘          └──────────┘
```

9.2 Test Result

TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.951	2401.553	2402.504	---	---
DH5	Ant1	2441	0.939	2440.553	2441.492	---	---
DH5	Ant1	2480	0.951	2479.553	2480.504	---	---
2DH5	Ant1	2402	1.320	2401.352	2402.672	---	---
2DH5	Ant1	2441	1.347	2440.340	2441.687	---	---
2DH5	Ant1	2480	1.329	2479.352	2480.681	---	---
3DH5	Ant1	2402	1.293	2401.367	2402.660	---	---
3DH5	Ant1	2441	1.329	2440.352	2441.681	---	---
3DH5	Ant1	2480	1.320	2479.361	2480.681	---	---

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

10 Maximum Peak Output Power

Test Requirement   :   FCC CFR47 Part 15 Section 15.247

Test Method   :   ANSI C63.10:2013

Test Limit   :

Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band eploying at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.
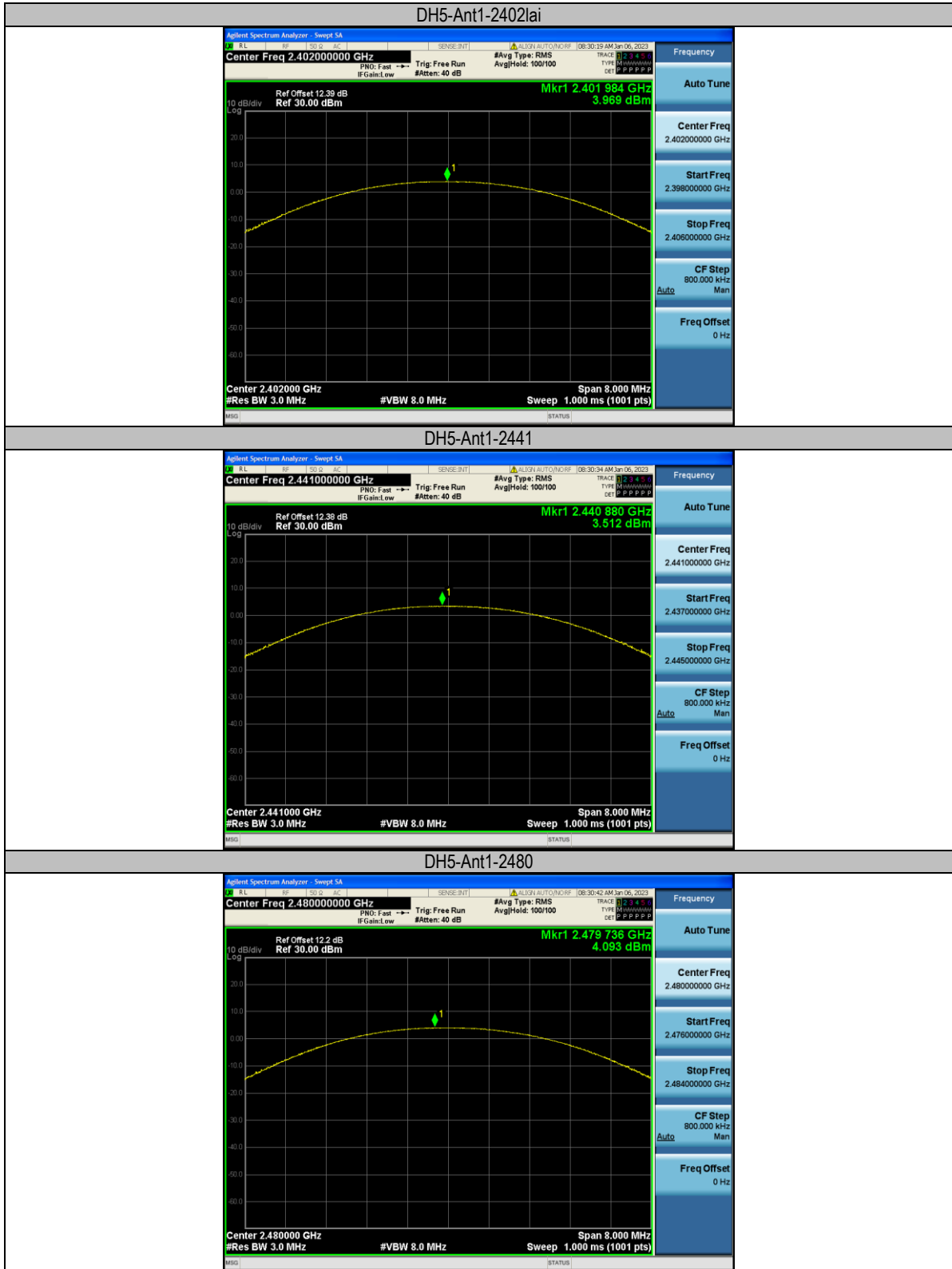
10.1 Test Procedure

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 analyser: RBW = 3MHz. VBW =8MHz. Sweep = auto; Detector Function = Peak.

3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.
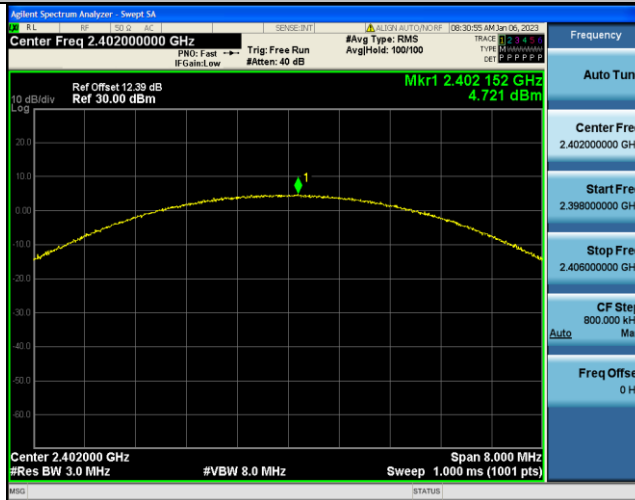
4. Set up:

```
┌──────────────┐          ┌──────────────┐
│ Spectrum     │          │              │
│ Analyzer     │──────────│     EUT      │
│              │          │              │
└──────────────┘          └──────────────┘
```

10.2 Test Result

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	3.97	≤30	PASS
DH5	Ant1	2441	3.51	≤30	PASS
DH5	Ant1	2480	4.09	≤30	PASS
2DH5	Ant1	2402	4.72	≤20.97	PASS
2DH5	Ant1	2441	4.31	≤20.97	PASS
2DH5	Ant1	2480	4.88	≤20.97	PASS
3DH5	Ant1	2402	5.37	≤20.97	PASS
3DH5	Ant1	2441	4.73	≤20.97	PASS
3DH5	Ant1	2480	5.39	≤20.97	PASS

DH5-Ant1-2402lai
DH5-Ant1-2441
DH5-Ant1-2480

2DH5-Ant1-2402

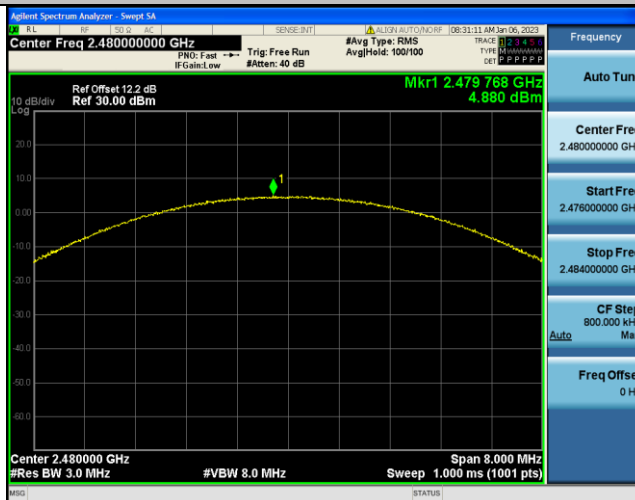| 2DH5-Ant1-2441 |
|---|
| |

2DH5-Ant1-2480

3DH5-Ant1-2402

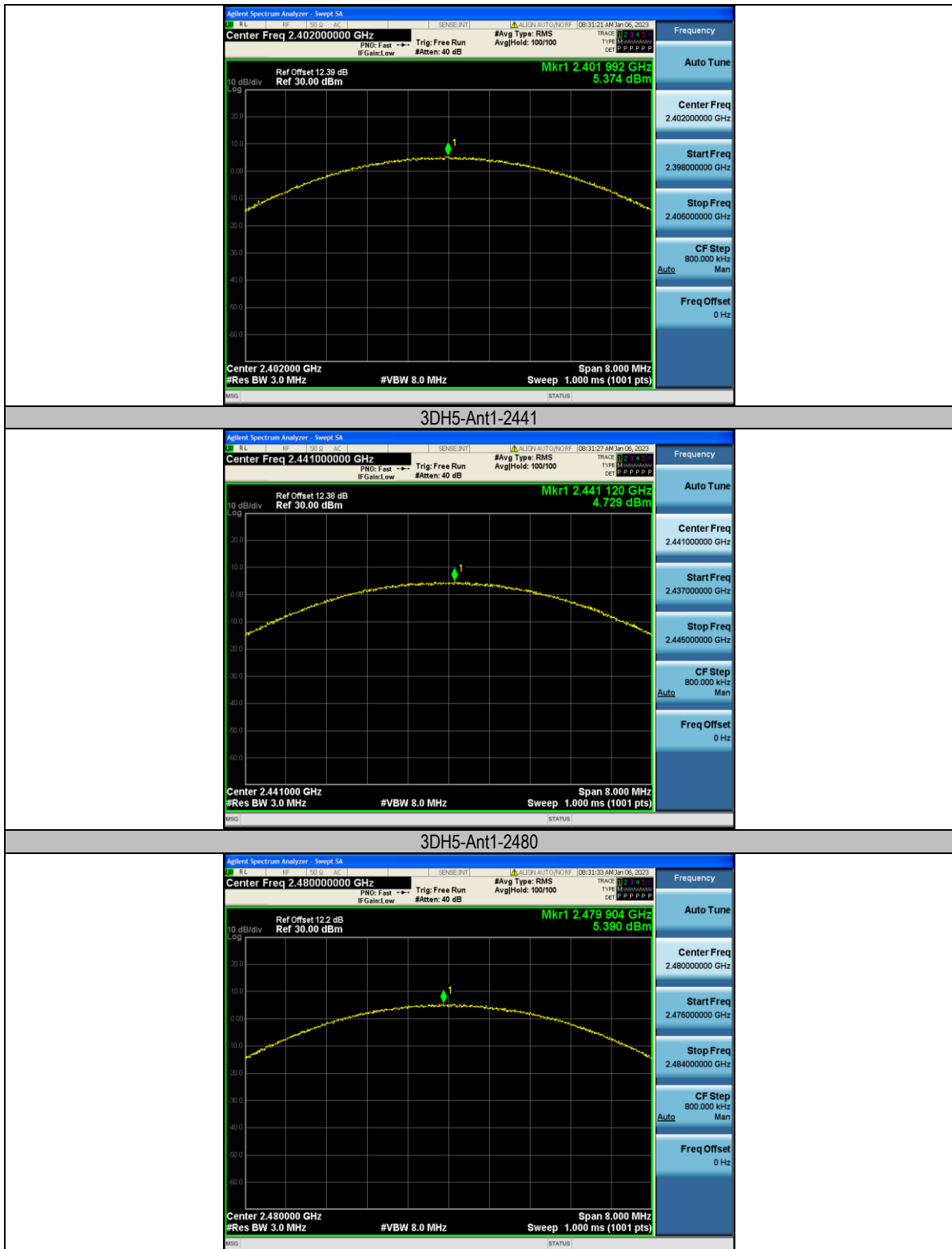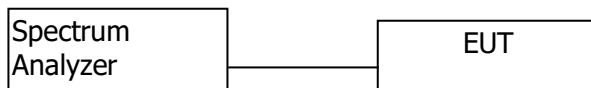3DH5-Ant1-2441

3DH5-Ant1-2480

11 Hopping Channel Separation

Test Requirement   :   FCC CFR47 Part 15 Section 15.247

Test Method   :   ANSI C63.10:2013

Test Limit   :   Regulation 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 2400-2483.5MHz 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 1W.

Test Mode   :   Hopping

11.1 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.
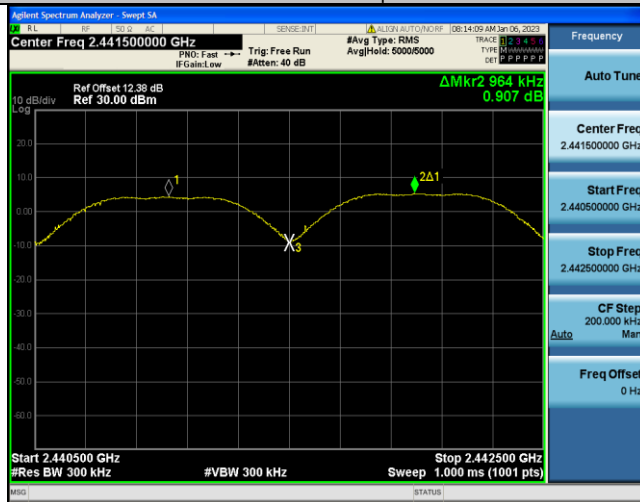
4. Set up:

```
┌──────────────┐              ┌──────────────┐
│ Spectrum     │              │              │
│ Analyzer     │──────────────│     EUT      │
│              │              │              │
└──────────────┘              └──────────────┘
```

11.2 Test Result

TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.964	≥0.951	PASS
2DH5	Ant1	Hop	1.138	≥0.898	PASS
3DH5	Ant1	Hop	1.144	≥0.886	PASS

DH5-Ant1-Hop

2DH5-Ant1-Hop

3DH5-Ant1-Hop

12 Number of Hopping Frequency

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Mode : Hopping(GFSK)

12.1 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 = 2.483GHz. Sweep=auto;
5. Set up:
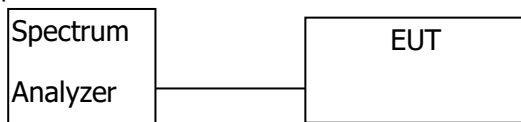
12.2 Test Result

TestMode	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

DH5-Ant1-Hop

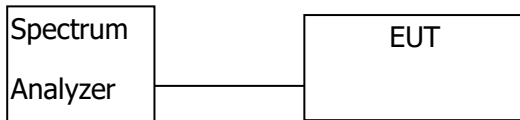| 2DH5-Ant1-Hop |
|---|
| |

3DH5-Ant1-Hop
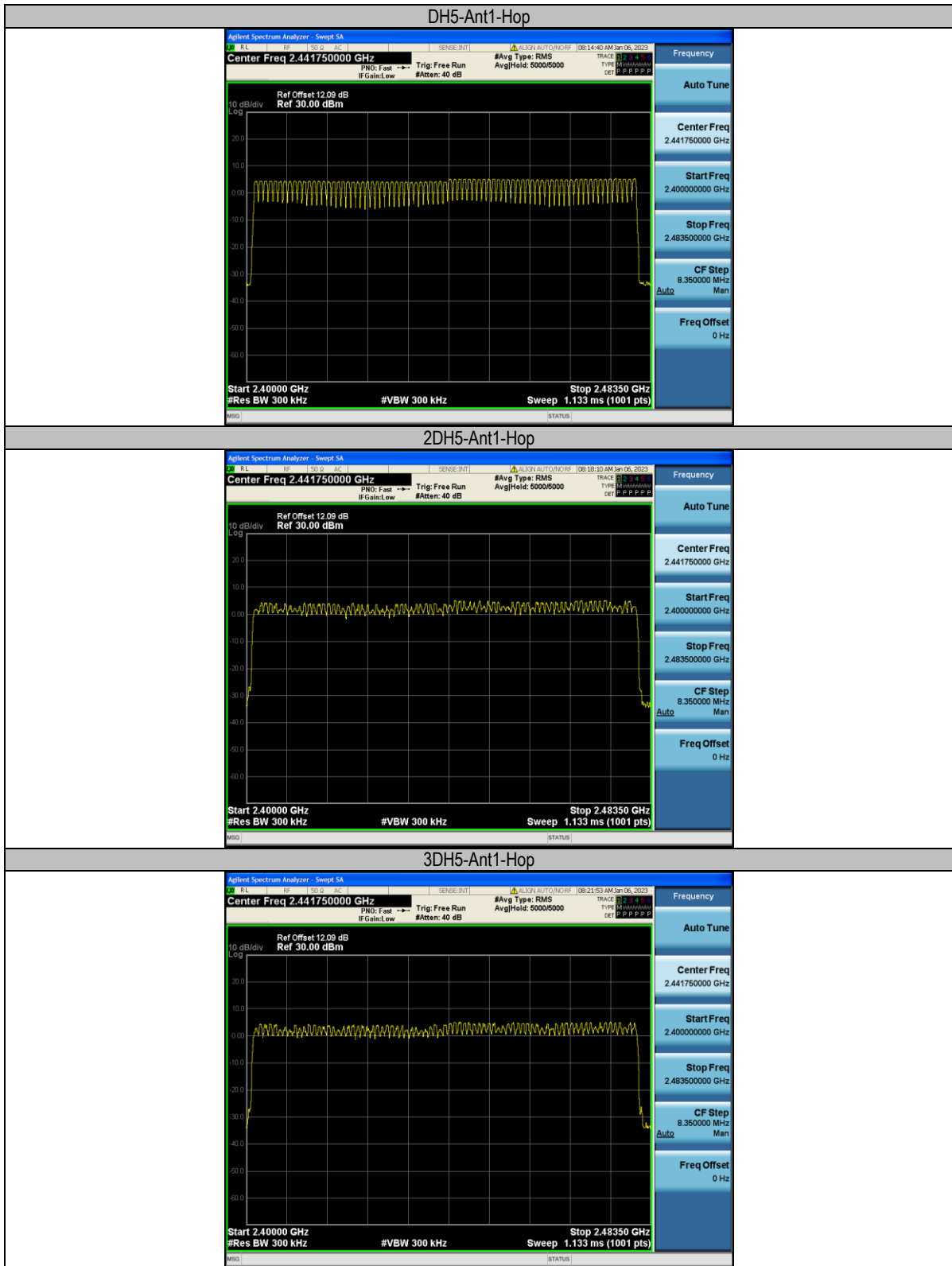
13 Dwell Time

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 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.

Test Mode : The worst case(π/4-DQPSK) was recorded

13.1 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).

5. Set up:

```
┌─────────────┐        ┌─────────────┐
│ Spectrum    │        │             │
│             │────────│    EUT      │
│ Analyzer    │        │             │
└─────────────┘        └─────────────┘
```

13.2 Test Result

TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH5	Ant1	Hop	2.899	106.67	0.309	≤0.4	PASS
DH1	Ant1	Hop	0.395	320	0.126	≤0.4	PASS
DH3	Ant1	Hop	1.652	160	0.264	≤0.4	PASS
2DH5	Ant1	Hop	2.904	106.67	0.31	≤0.4	PASS
2DH1	Ant1	Hop	0.405	320	0.13	≤0.4	PASS
2DH3	Ant1	Hop	1.657	160	0.265	≤0.4	PASS

3DH5	Ant1	Hop	2.907	106.67	0.31	≤0.4	PASS
3DH1	Ant1	Hop	0.407	320	0.13	≤0.4	PASS
3DH3	Ant1	Hop	1.657	160	0.265	≤0.4	PASS
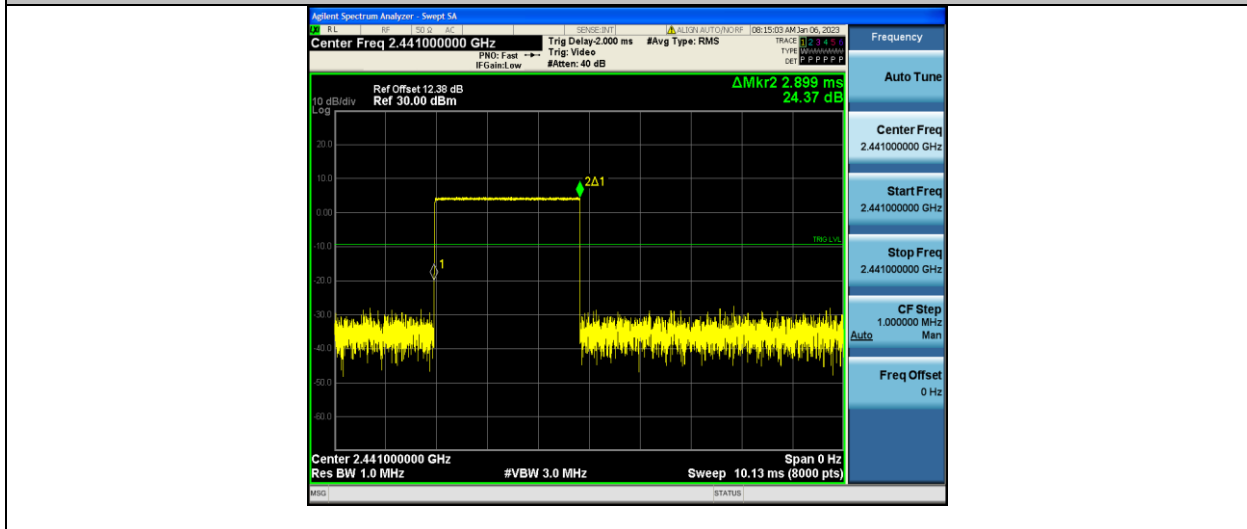
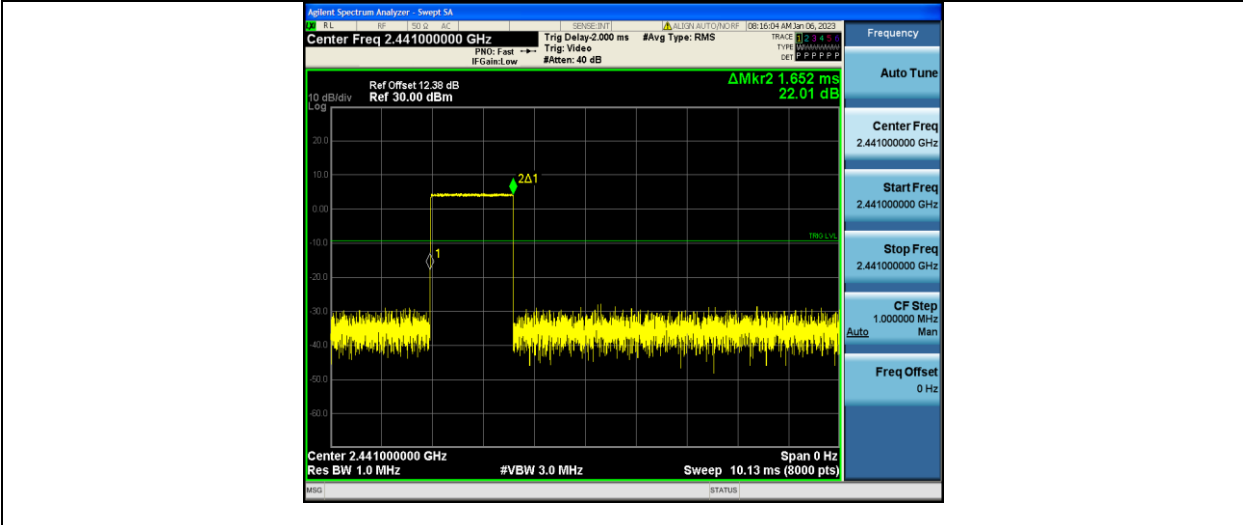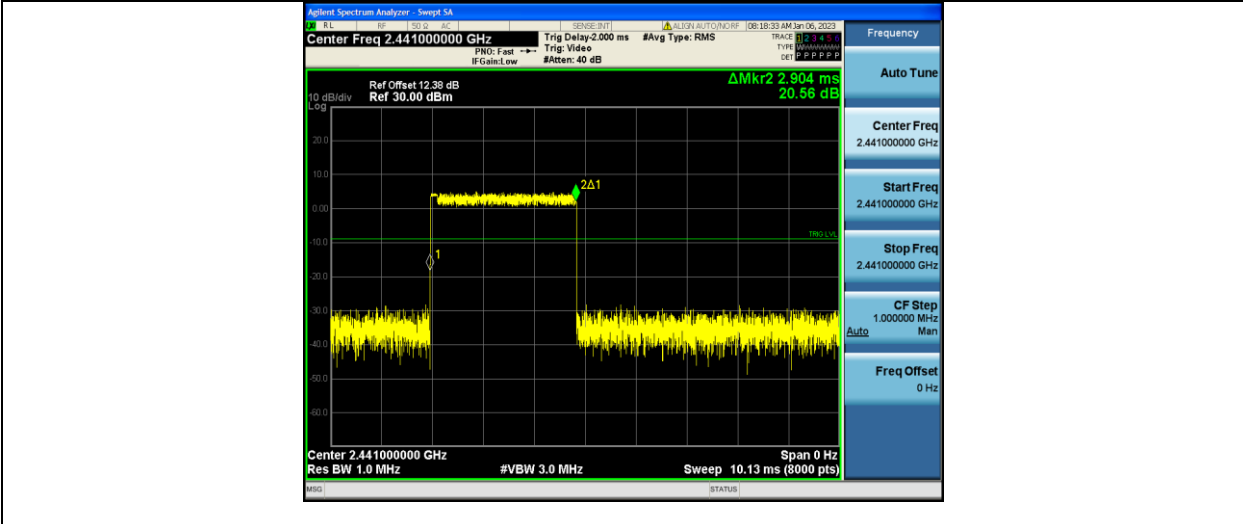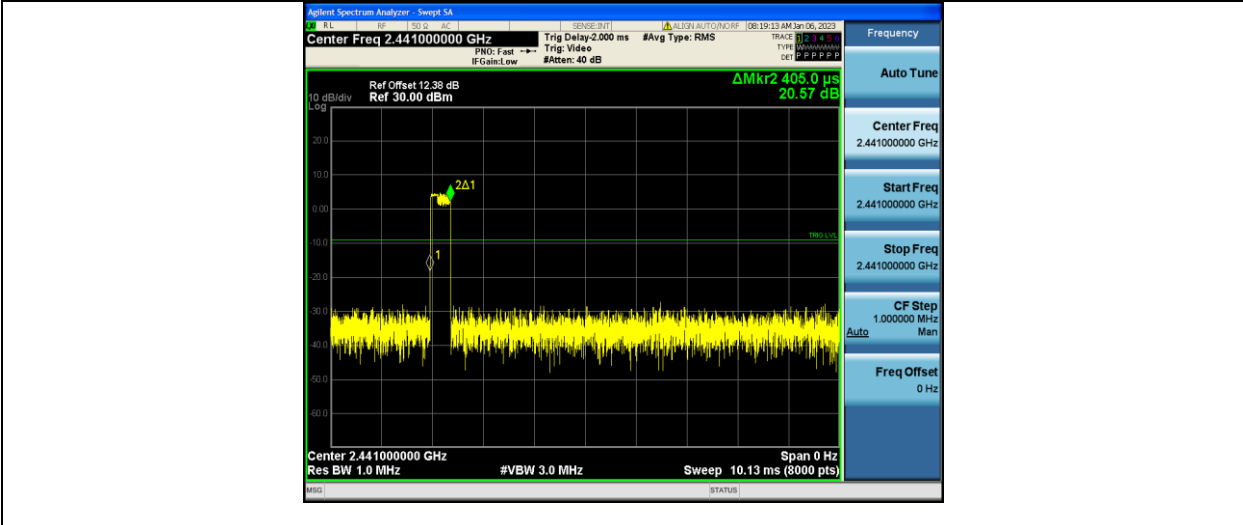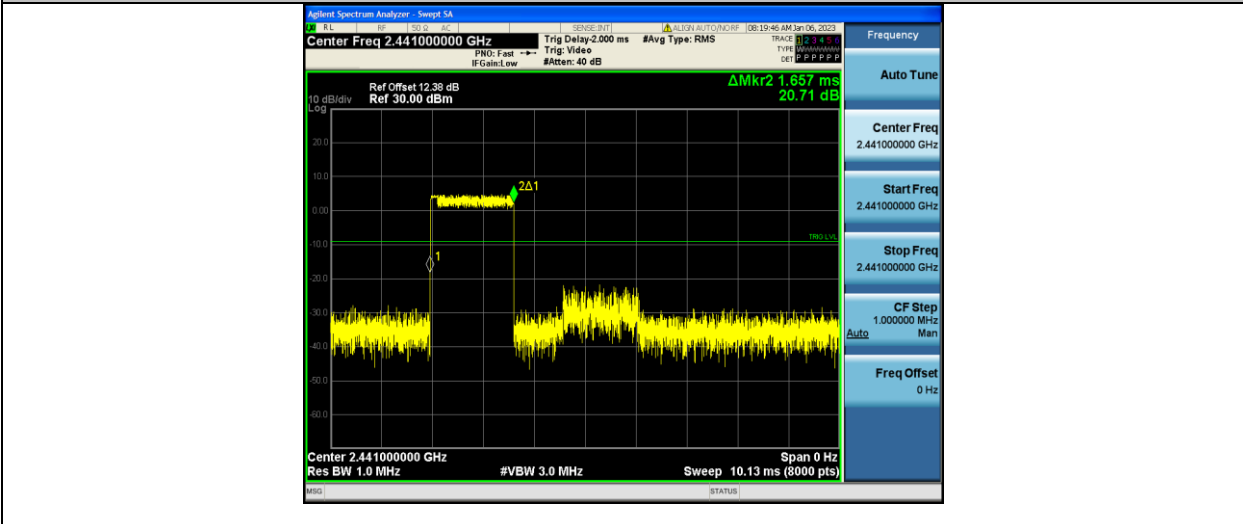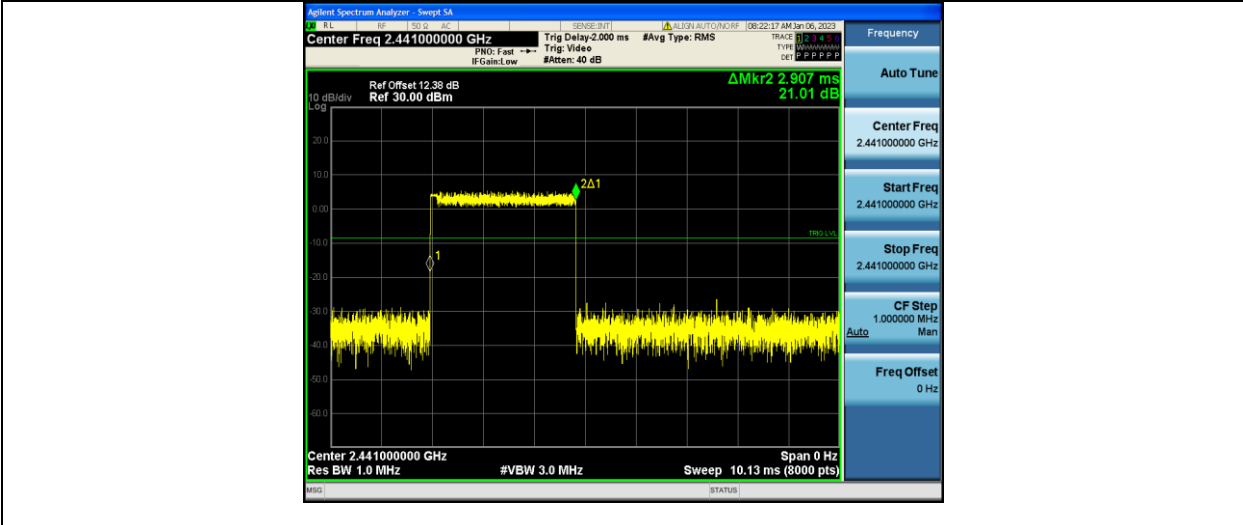| DH5-Ant1-Hop-2.899-106.67 |
| --- |
| |
| DH1-Ant1-Hop-0.395-320 |
| |
| DH3-Ant1-Hop-1.652-160 |
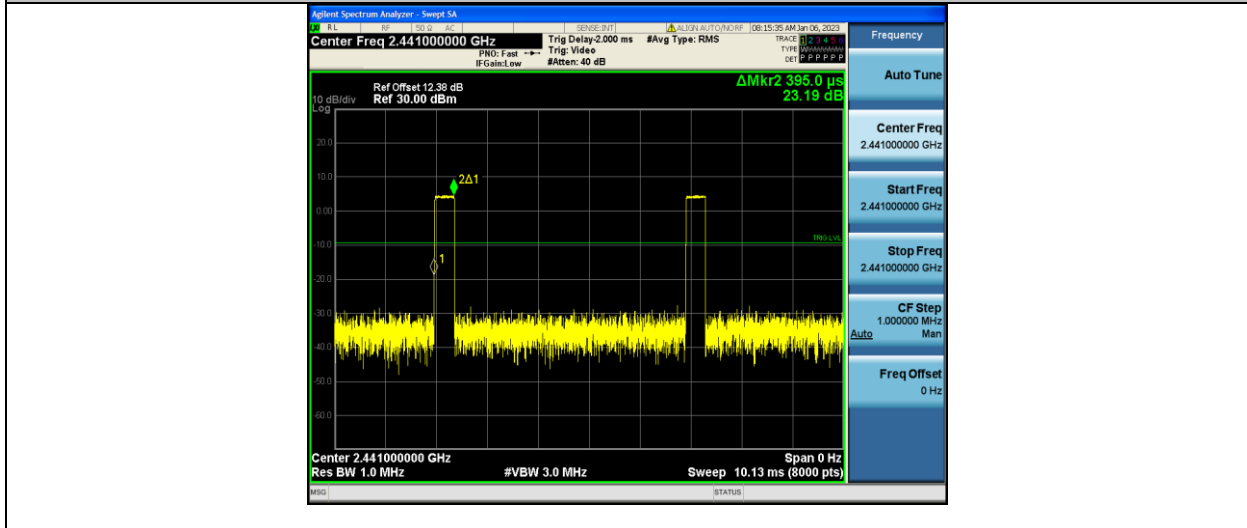
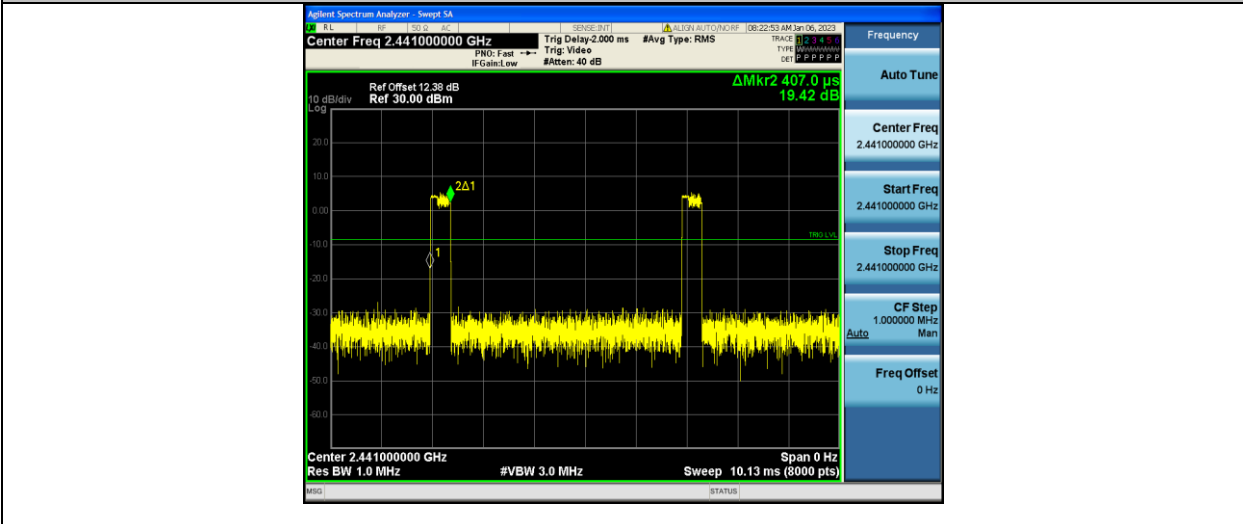2DH5-Ant1-Hop-2.904-106.67
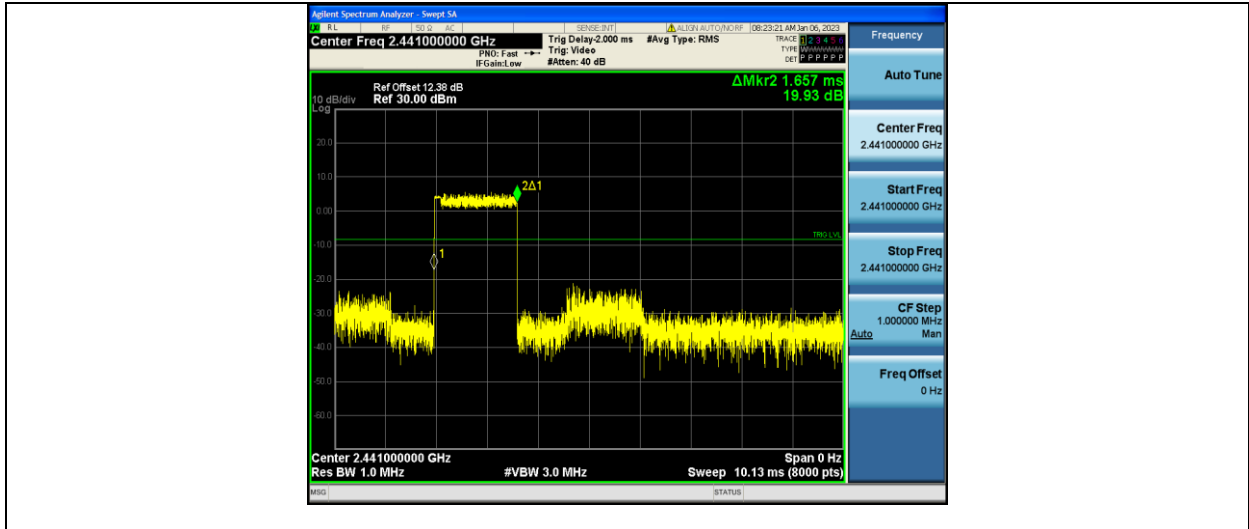

2DH1-Ant1-Hop-0.405-320

2DH3-Ant1-Hop-1.657-160

3DH5-Ant1-Hop-2.907-106.67

3DH1-Ant1-Hop-0.407-320

3DH3-Ant1-Hop-1.657-160

14   Antenna Requirement

14.1 Antenna Requirement

For intentional device, according to FCC 47 CFR Section 15.203, 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
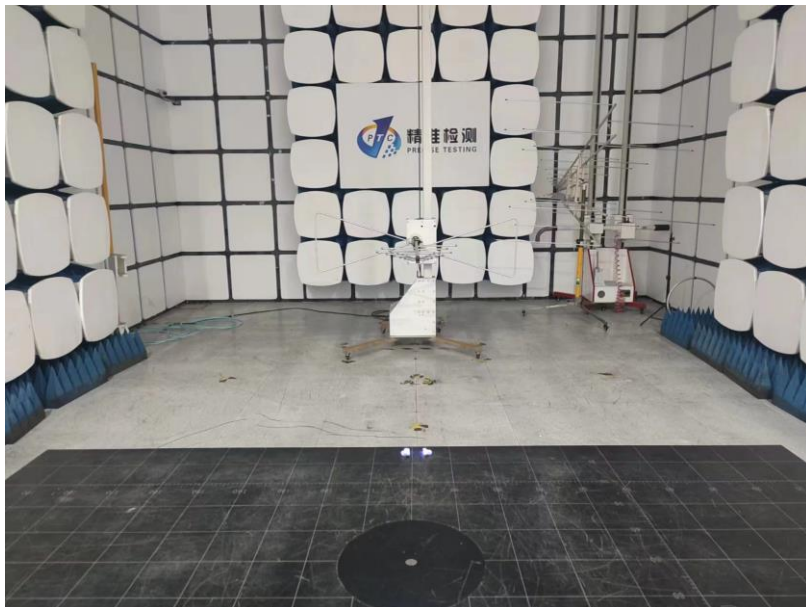
14.2 Result

The EUT'S antenna, permanent attached antenna, is Pcb Antenna. The antenna's gain is -0.58dBi and meets the requirement.
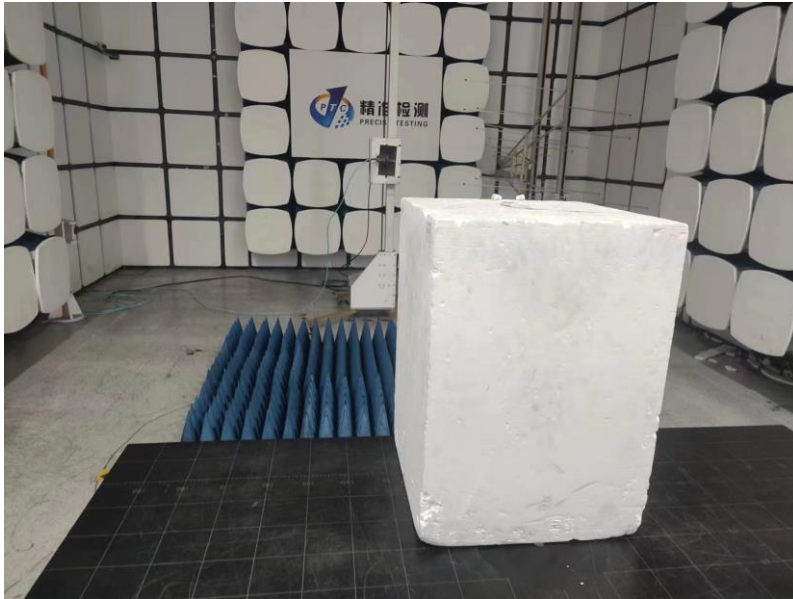
15 TEST PHOTOS

Conduction Emissions

Radiated Spurious Emissions
Test Frequency From 30MHz-1000MHz

Test Frequency above 1G

16 EUT PHOTOS

Reference EUT Photos

******THE END REPORT******