FCC §15.247(a) (1) (iii)-TIME OF OCCUPANCY (DWELL TIME)
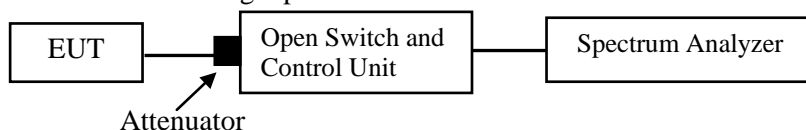
Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz 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.

Test Procedure

According to ANSI C63.10-2013, section 7.8.4

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

Test Data

Environmental Conditions

Temperature:	23-24 ℃
Relative Humidity:	50-53 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023.-04-25 and 2023-06-07.

EUT operation mode: Transmitting

Test Result: Compliant.
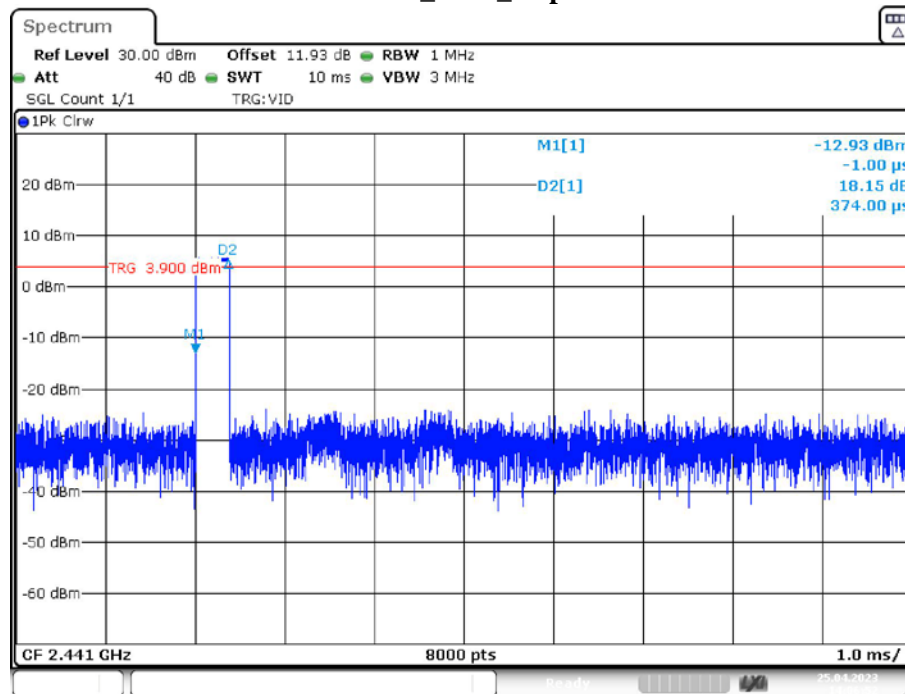
Test Mode	Antenna	Channel	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.374	320	0.12	<=0.4	PASS
DH3	Ant1	Hop	1.623	170	0.276	<=0.4	PASS
DH5	Ant1	Hop	2.862	110	0.315	<=0.4	PASS
2DH1	Ant1	Hop	0.385	330	0.127	<=0.4	PASS
2DH3	Ant1	Hop	1.629	150	0.244	<=0.4	PASS
2DH5	Ant1	Hop	2.870	110	0.316	<=0.4	PASS
3DH1	Ant1	Hop	0.385	320	0.123	<=0.4	PASS
3DH3	Ant1	Hop	1.629	160	0.261	<=0.4	PASS
3DH5	Ant1	Hop	2.872	130	0.373	<=0.4	PASS

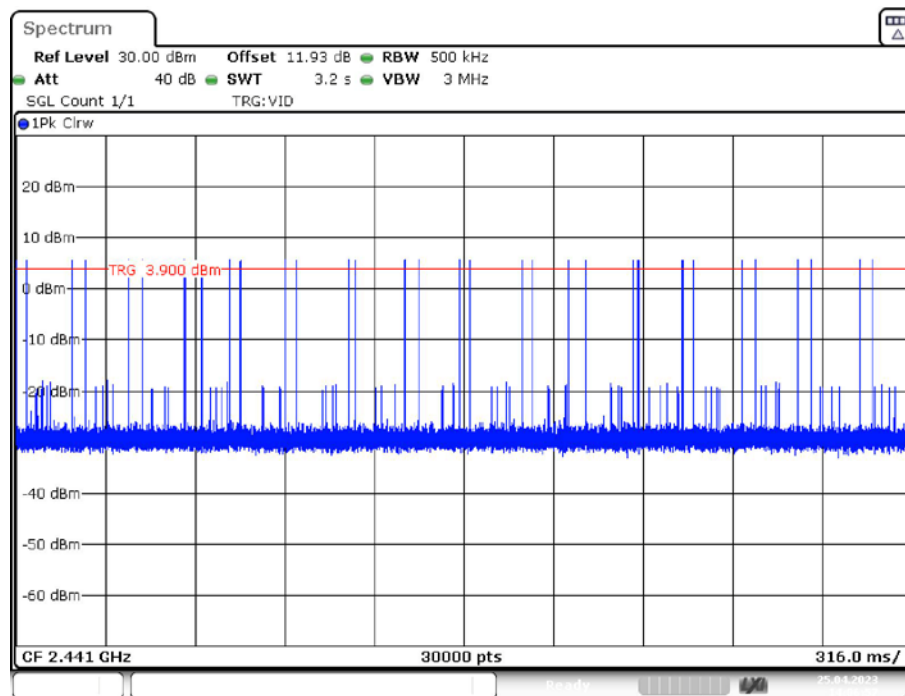Note 1: A period time=0.4*79=31.6(s), Result=Burst Width*Total Hops
Note 2: Total Hops =Hopping Number in 3.16s*10
Note 3: Hoping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)
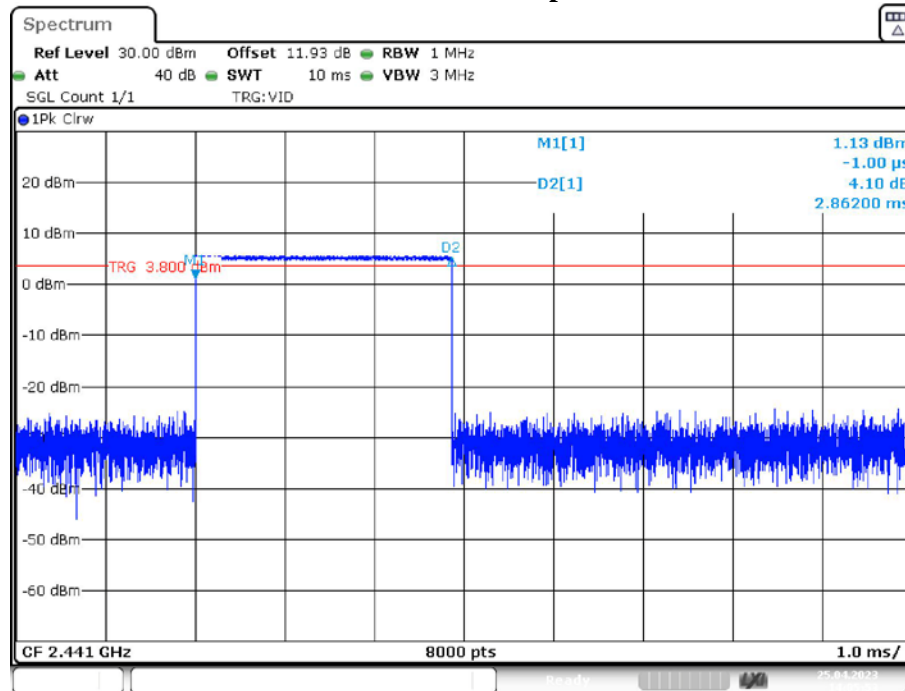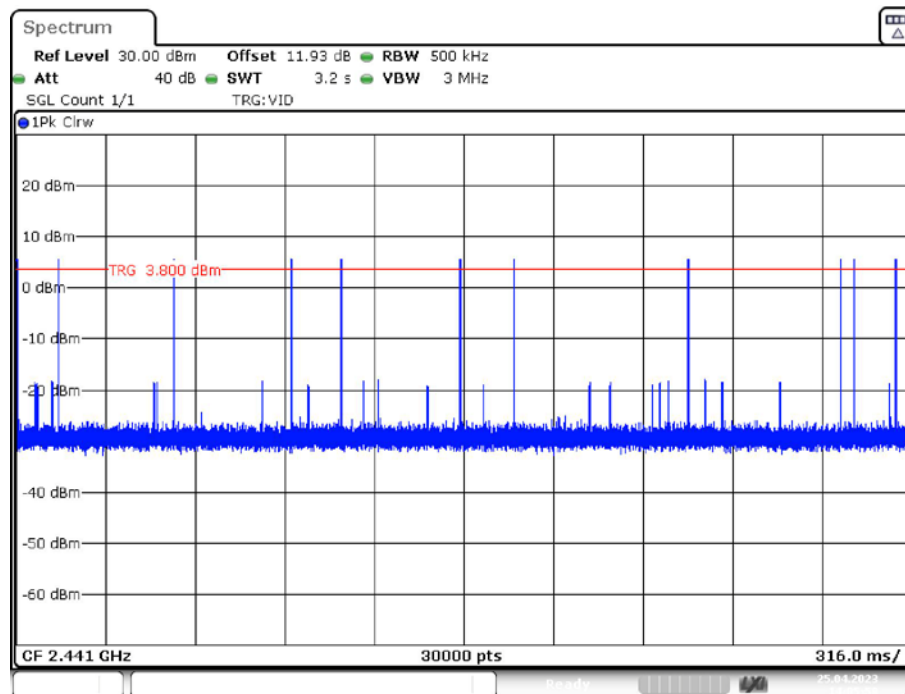
DH1_Ant1_Hop

Spectrum

Ref Level 30.00 dBm   Offset 11.93 dB ● RBW 1 MHz
● Att   40 dB ● SWT   10 ms ● VBW 3 MHz
SGL Count 1/1   TRG:VID

● 1Pk Clrw

	M1[1]	-12.93 dBm
		-1.00 µs
20 dBm		D2[1]	18.15 dB
		374.00 µs

10 dBm

TRG 3.900 dBm

0 dBm

-10 dBm

-20 dBm

-40 dBm

-50 dBm

-60 dBm

CF 2.441 GHz   8000 pts   1.0 ms/

Date: 25.APR.2023 14:06:52

Spectrum

Ref Level 30.00 dBm   Offset 11.93 dB ● RBW 500 kHz
● Att   40 dB ● SWT   3.2 s ● VBW 3 MHz
SGL Count 1/1   TRG:VID

● 1Pk Clrw

20 dBm

10 dBm

TRG 3.900 dBm

0 dBm

-10 dBm

-20 dBm

-40 dBm

-50 dBm

-60 dBm

CF 2.441 GHz   30000 pts   316.0 ms/

Date: 25.APR.2023 14:06:57

DH3_Ant1_Hop

Date: 25.APR.2023 14:07:28

Date: 25.APR.2023 14:07:33
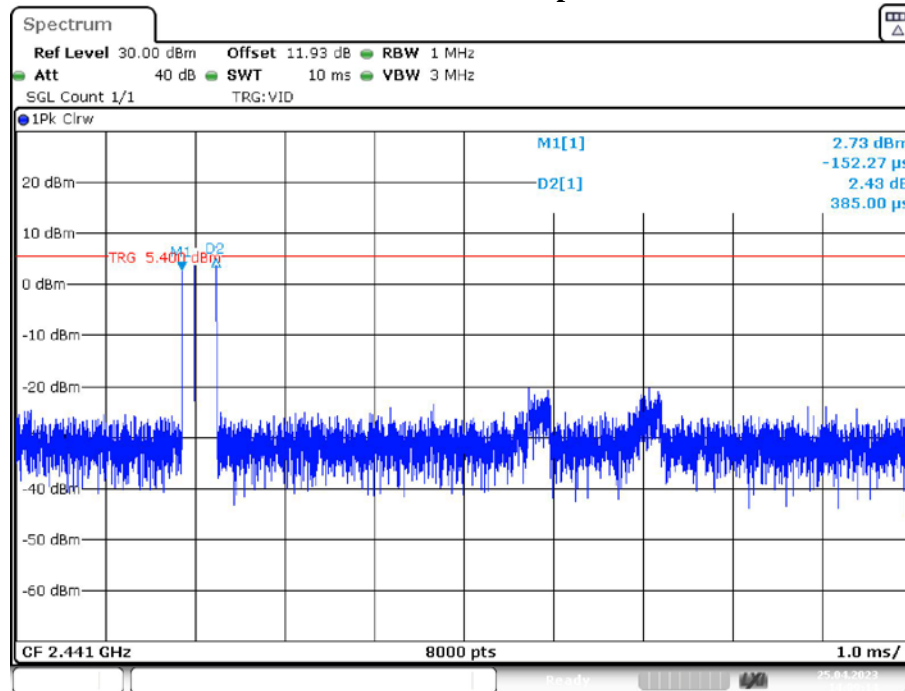
DH5_Ant1_Hop

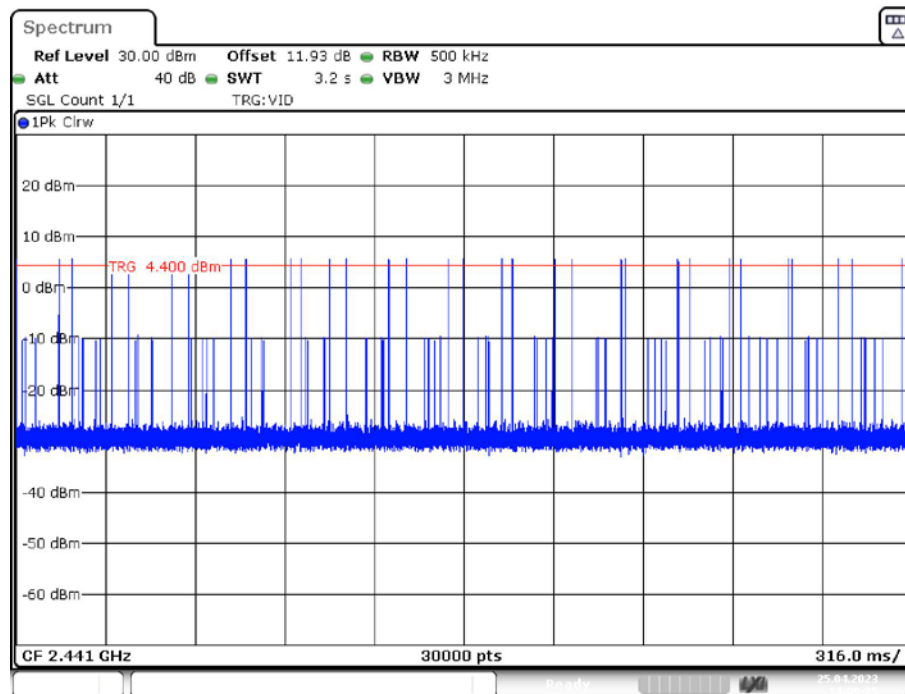Date: 25.APR.2023   14:05:53

Date: 25.APR.2023   14:05:58

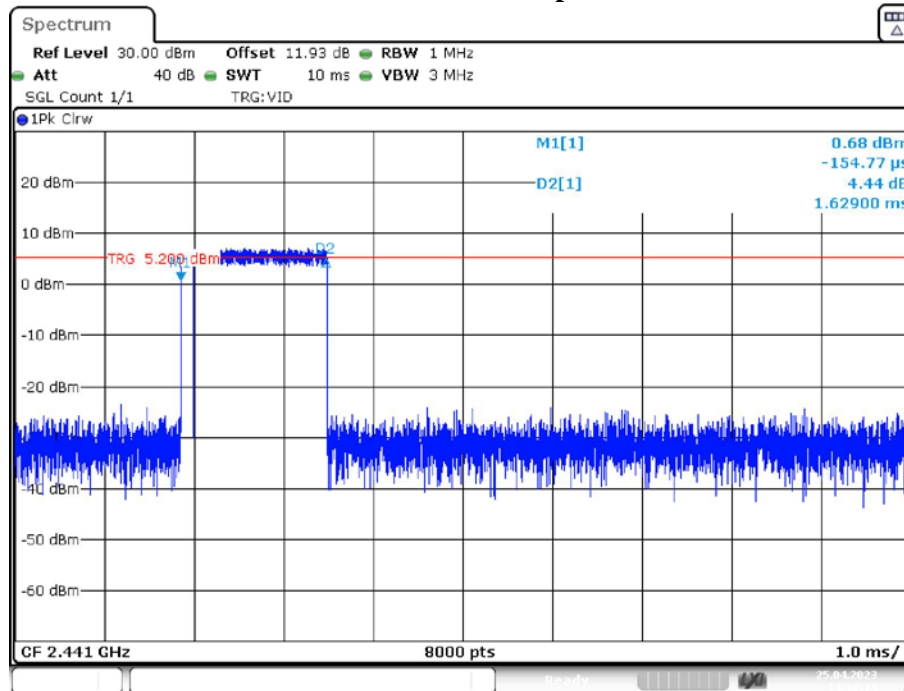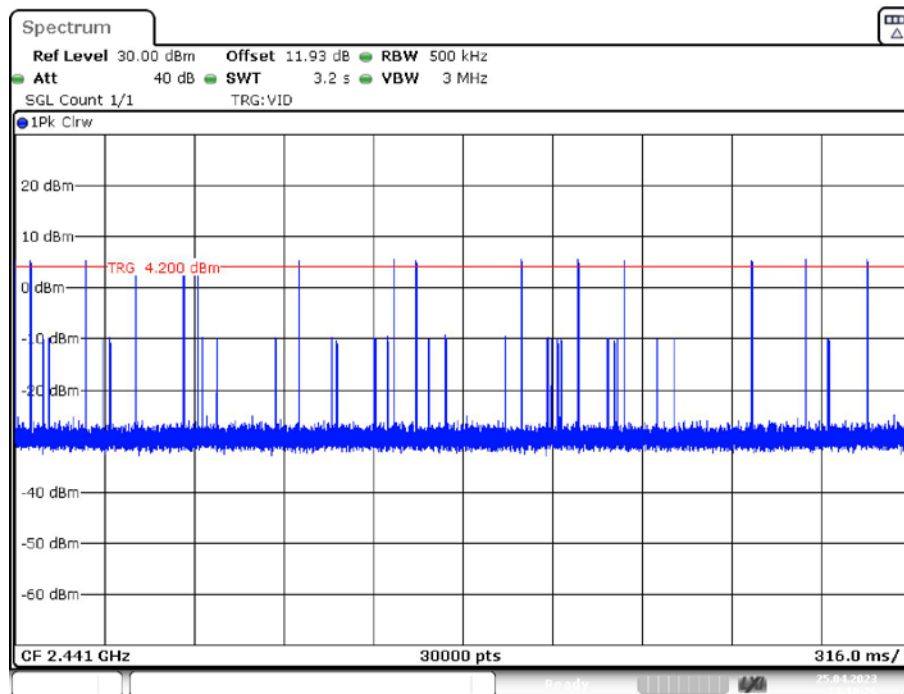**2DH1_Ant1_Hop**

Date: 25.APR.2023   14:09:14

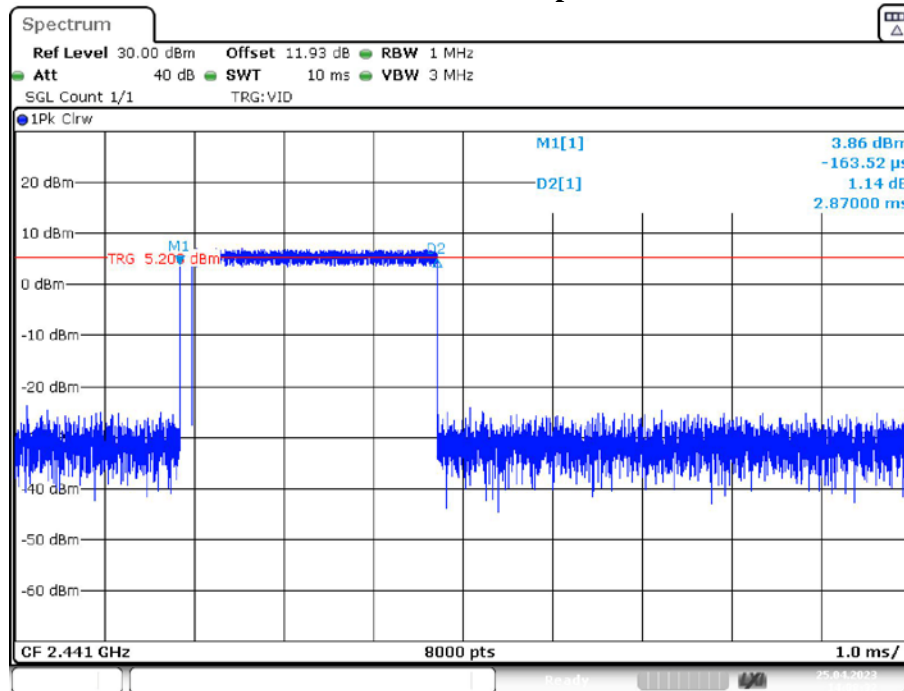Date: 25.APR.2023   14:09:26

2DH3_Ant1_Hop
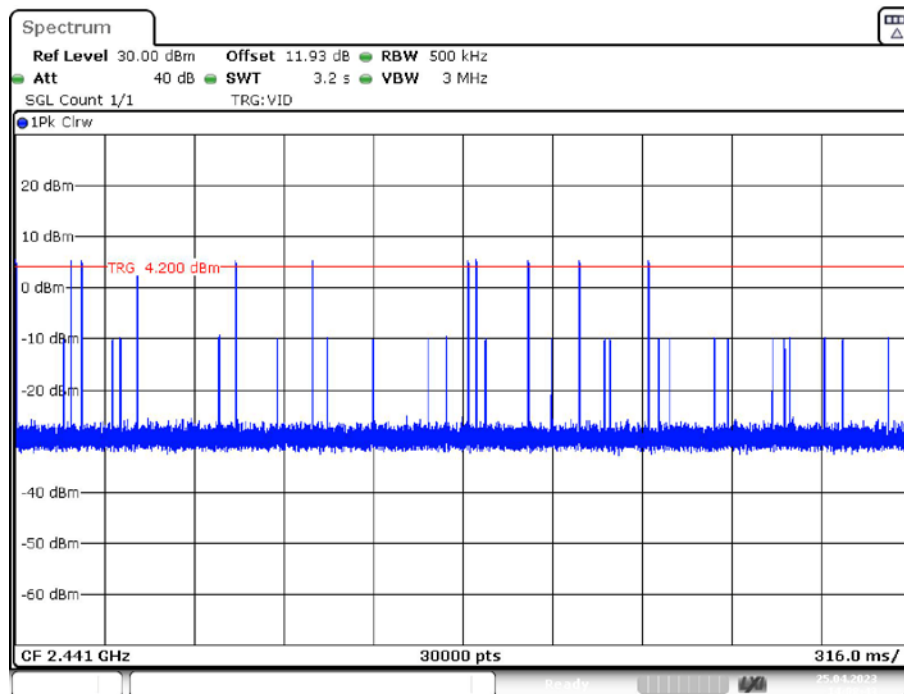

Date: 25.APR.2023 14:10:15

Date: 25.APR.2023 14:10:26
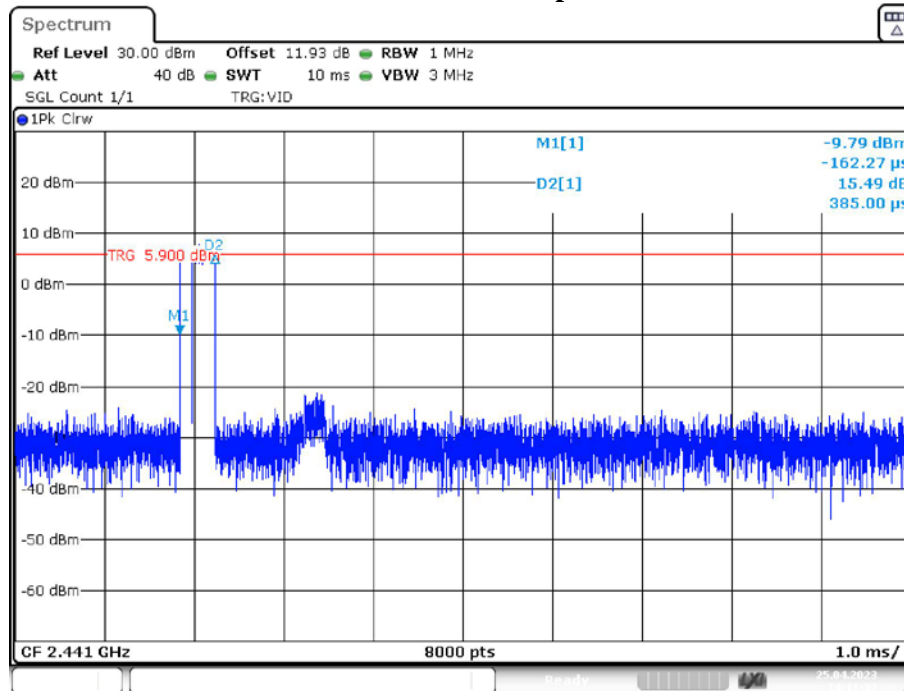
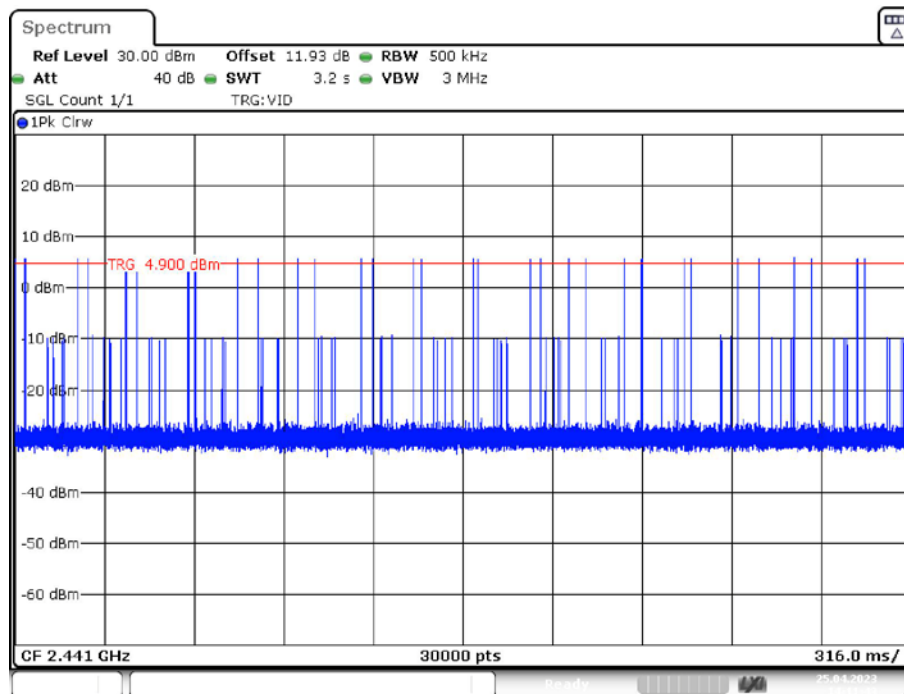**2DH5_Ant1_Hop**

Date: 25.APR.2023 14:08:32

Date: 25.APR.2023 14:08:43
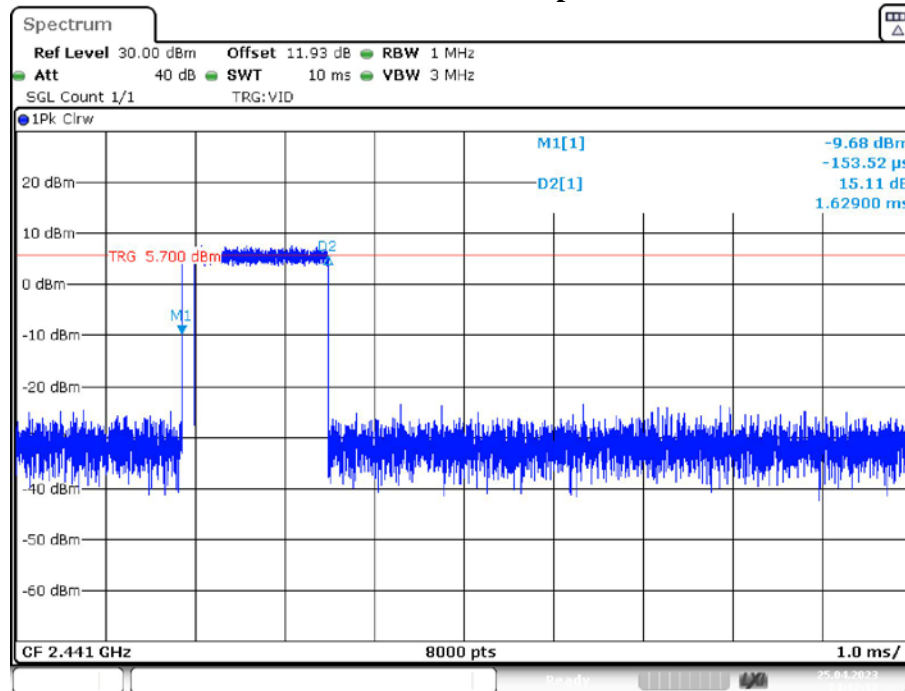
3DH1_Ant1_Hop
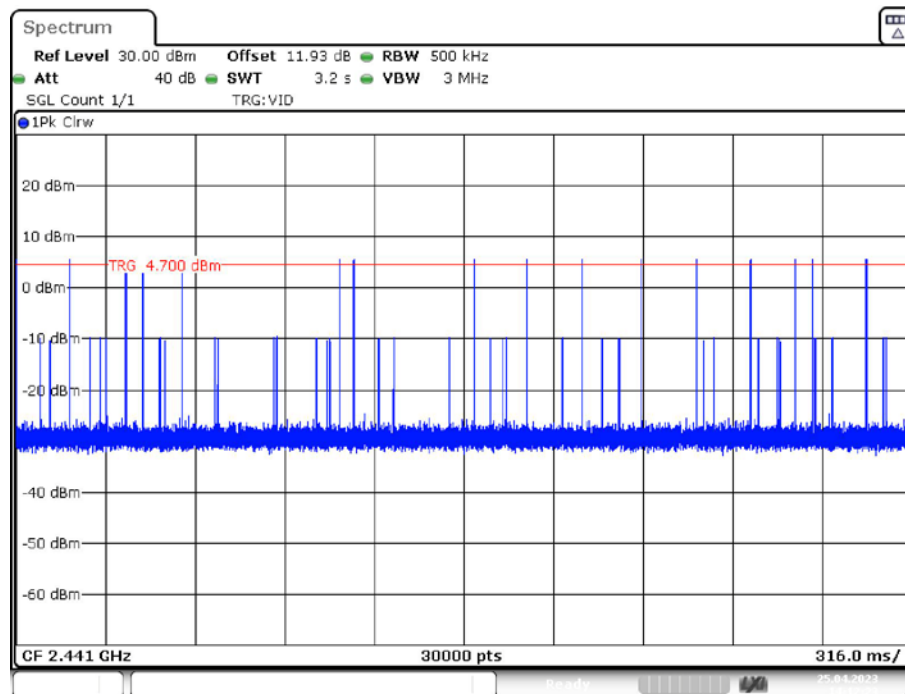

Date: 25.APR.2023   14:11:33

Date: 25.APR.2023   14:11:44

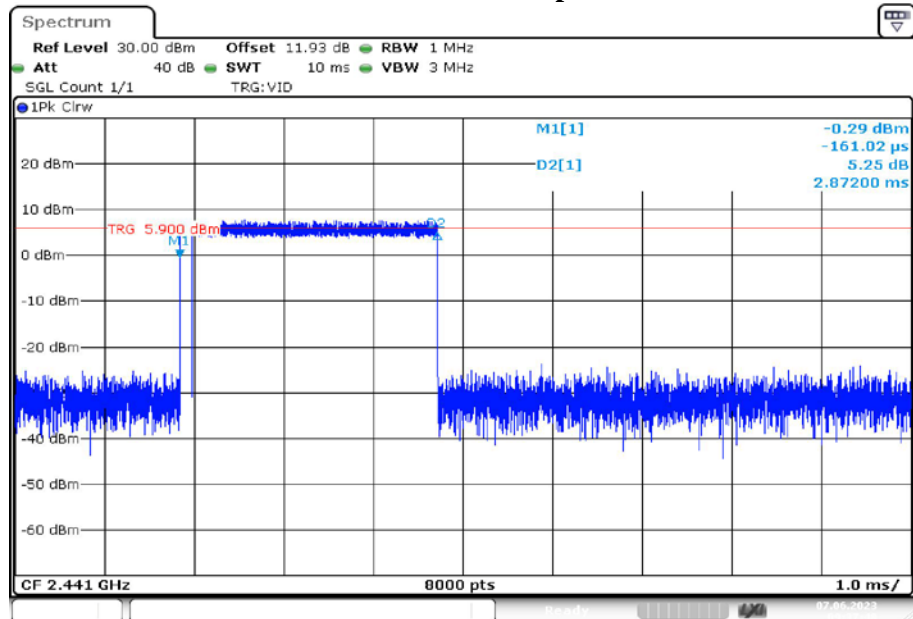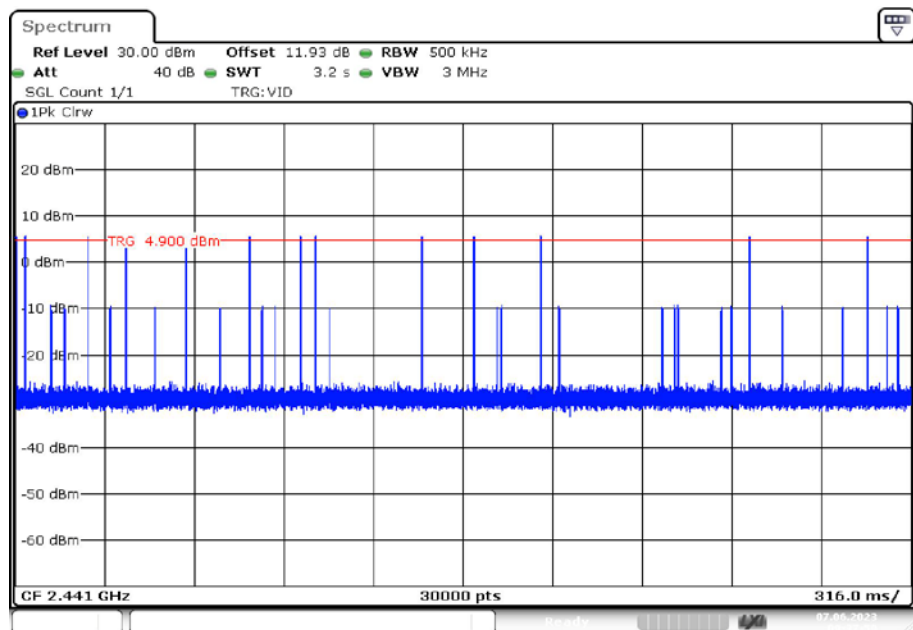**3DH3_Ant1_Hop**

Date: 25.APR.2023 14:12:12

Date: 25.APR.2023 14:12:23

3DH5_Ant1_Hop

Date: 7.JUN.2023 09:37:48

Date: 7.JUN.2023 09:37:59

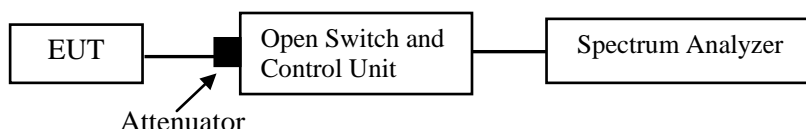# FCC §15.247(b) (1)-PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §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: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

According to ANSI C63.10-2013, section 7.8.5

1. Place the EUT on a bench and set in TX mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

```
┌─────────┐      ┌──────────────────┐      ┌──────────────────┐
│   EUT   │──────│ Open Switch and  │──────│ Spectrum Analyzer│
│         │   ▪  │ Control Unit     │      │                  │
└─────────┘   ↑  └──────────────────┘      └──────────────────┘
          Attenuator
```

Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	53%
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-04-25.
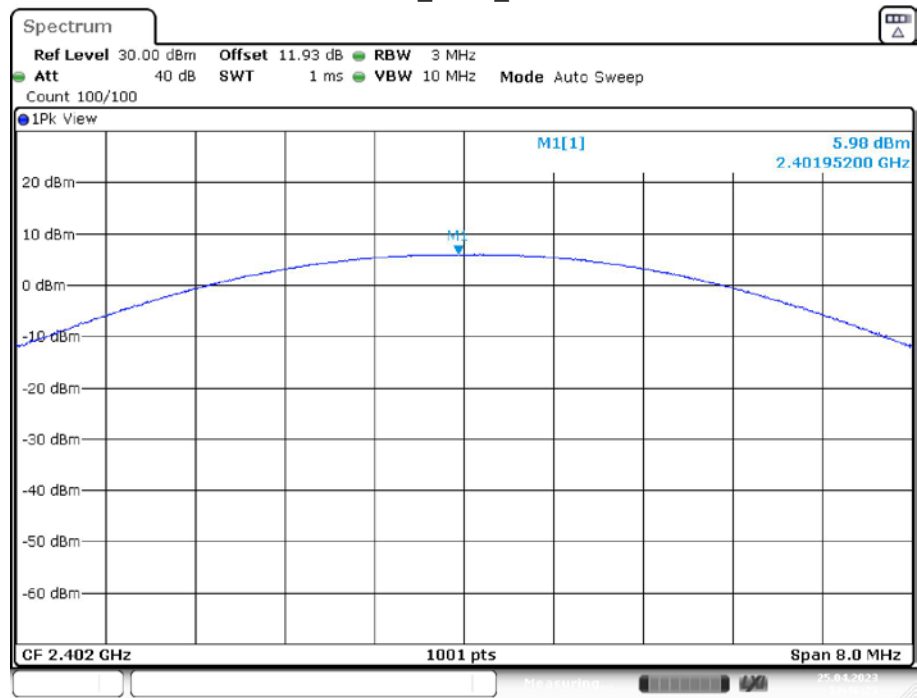
EUT operation mode: Transmitting

Test Result: Compliant.

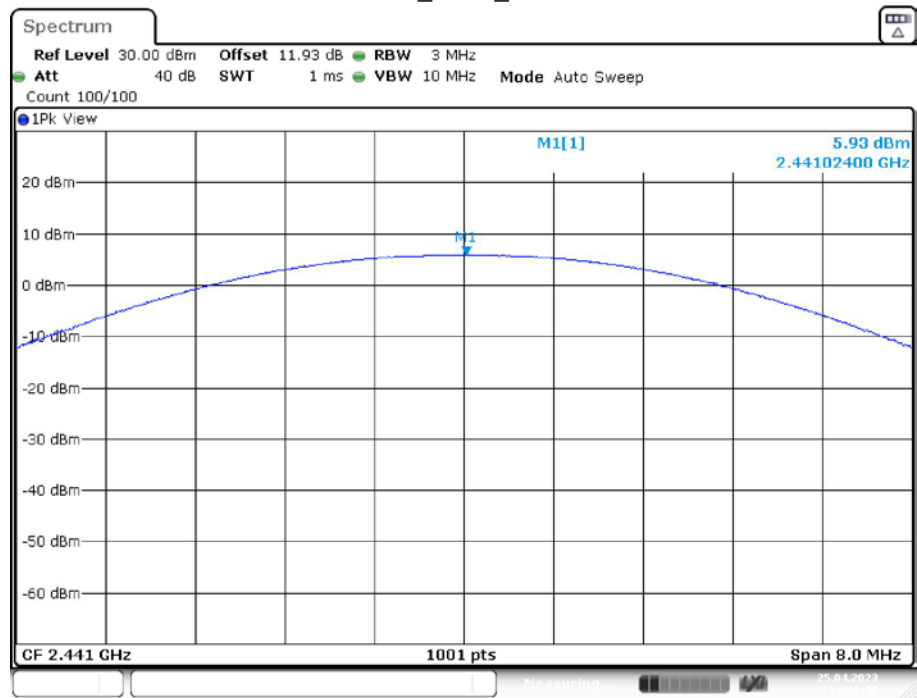| Test Mode	Antenna	Channel	Conducted Peak Output Power [dBm]	Limit[dBm]	Verdict
DH5	Ant1	2402	5.98	<=20.97	PASS
		2441	5.93	<=20.97	PASS
		2480	5.80	<=20.97	PASS
2DH5	Ant1	2402	8.27	<=20.97	PASS
		2441	8.16	<=20.97	PASS
		2480	8.07	<=20.97	PASS
3DH5	Ant1	2402	**8.66**	<=20.97	PASS
		2441	8.57	<=20.97	PASS
		2480	8.43	<=20.97	PASS

Please refer to the below plots:

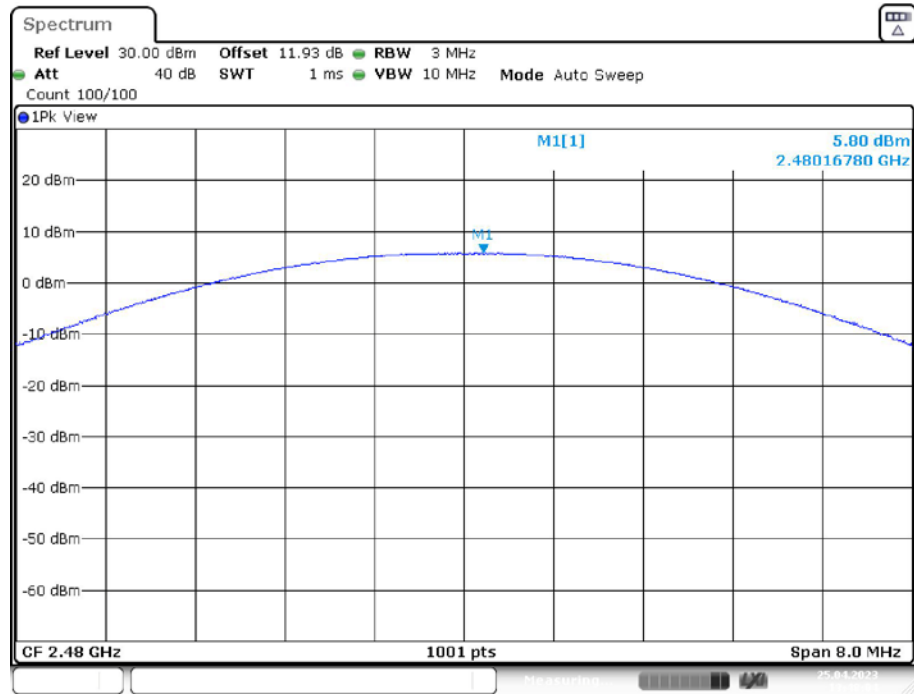**DH5_Ant1_2402**

Date: 25.APR.2023 13:46:24
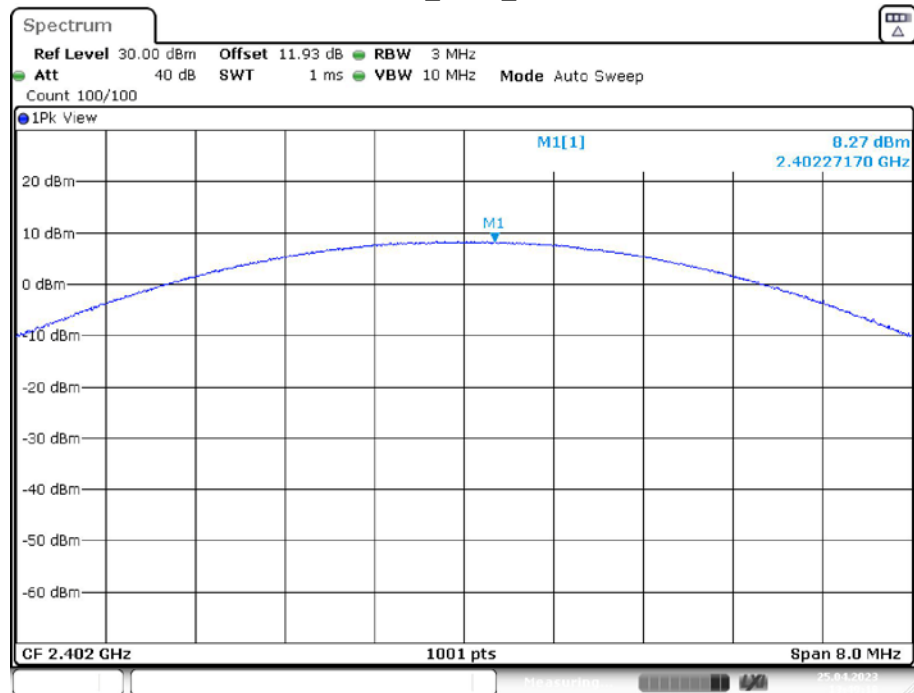
DH5_Ant1_2441

Date: 25.APR.2023 13:46:49
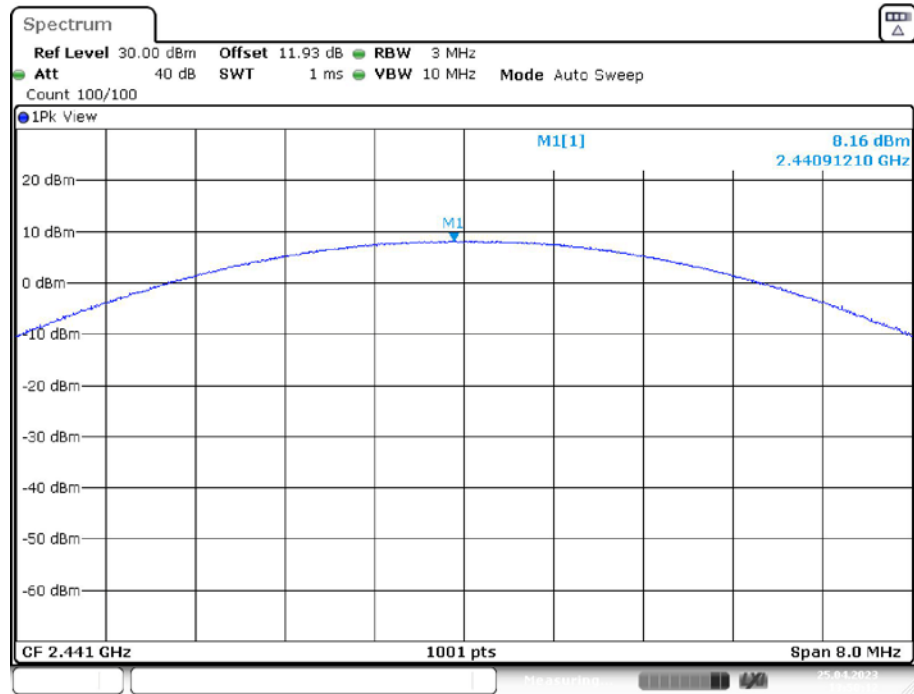
DH5_Ant1_2480

Date: 25.APR.2023 13:48:04

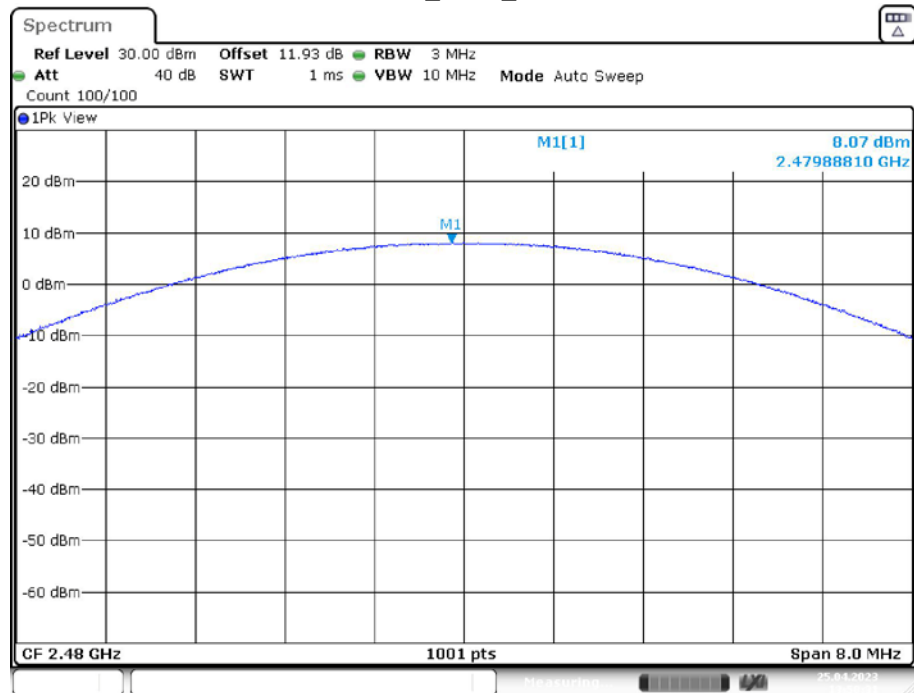**2DH5_Ant1_2402**

Date: 25.APR.2023 13:49:18

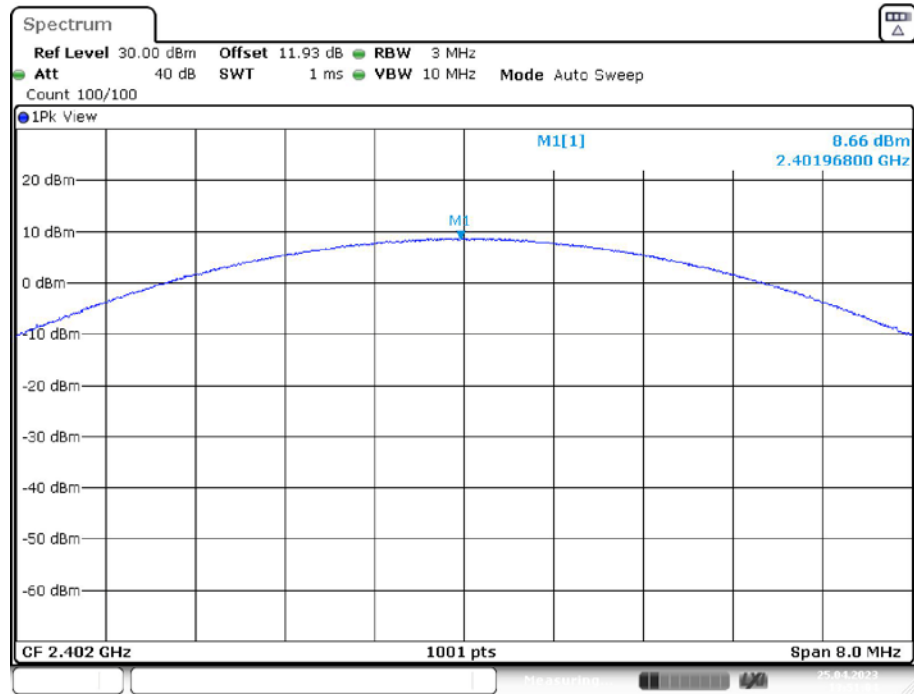**2DH5_Ant1_2441**

Date: 25.APR.2023   13:50:12
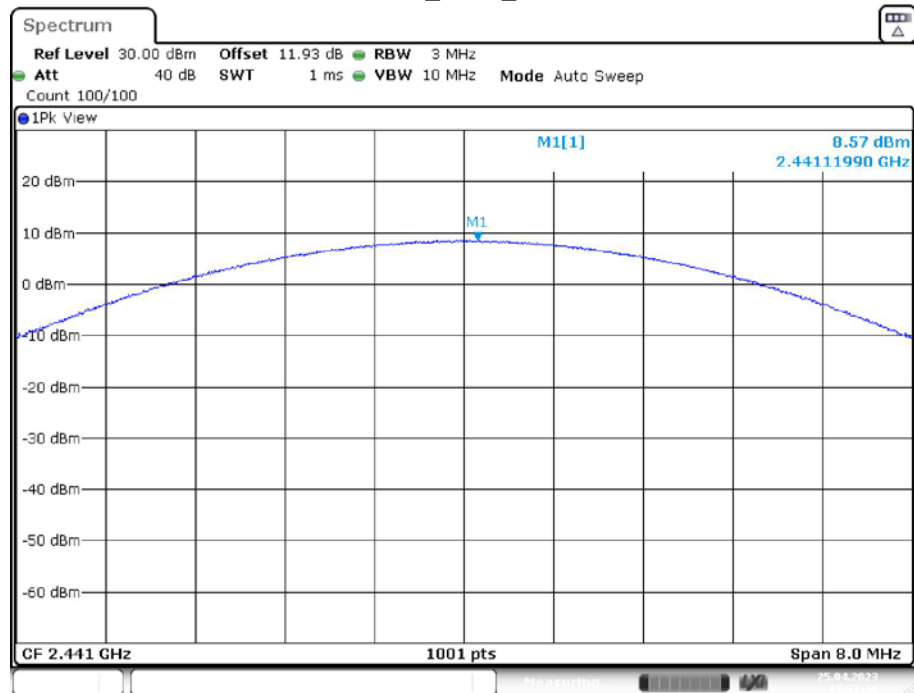
2DH5_Ant1_2480

Date: 25.APR.2023   13:50:31
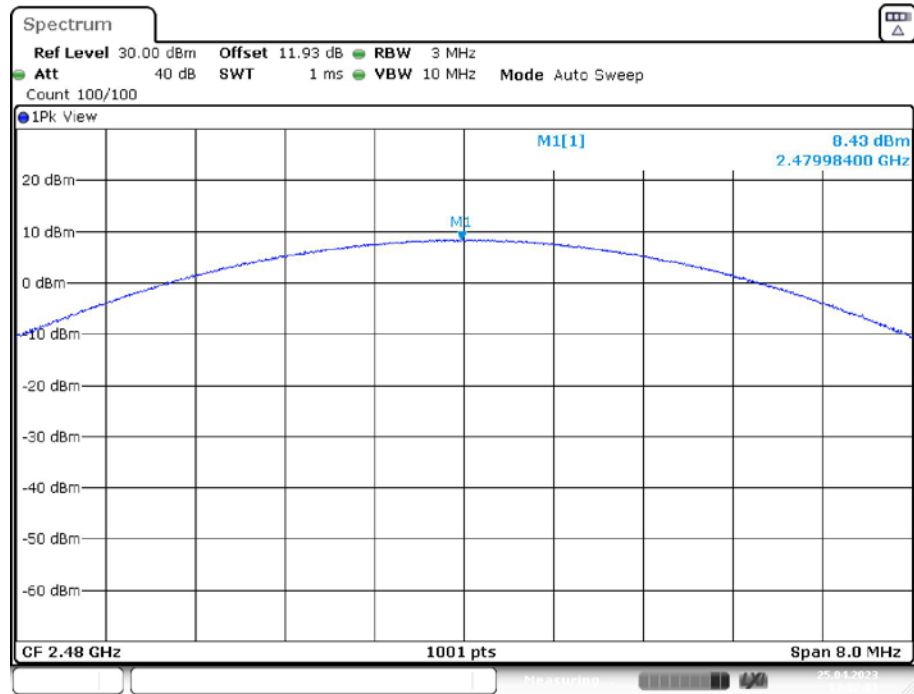
3DH5_Ant1_2402

Date: 25.APR.2023 13:51:05

3DH5_Ant1_2441

Date: 25.APR.2023 13:51:42

3DH5_Ant1_2480

Date: 25.APR.2023   13:52:02
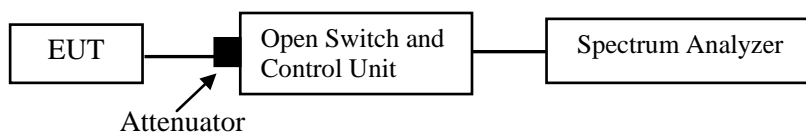
FCC §15.247(d)-BAND EDGES TESTING

Applicable Standard

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)).

Test Procedure

According to ANSI C63.10-2013, section 7.8.6 and section 6.10

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in TX mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

```
┌───────┐      ┌─────────────────┐      ┌────────────────────┐
│  EUT  │──────│ Open Switch and │──────│ Spectrum Analyzer  │
│       │    ■ │ Control Unit    │      │                    │
└───────┘   ↑  └─────────────────┘      └────────────────────┘
         Attenuator
```

Test Data

Environmental Conditions

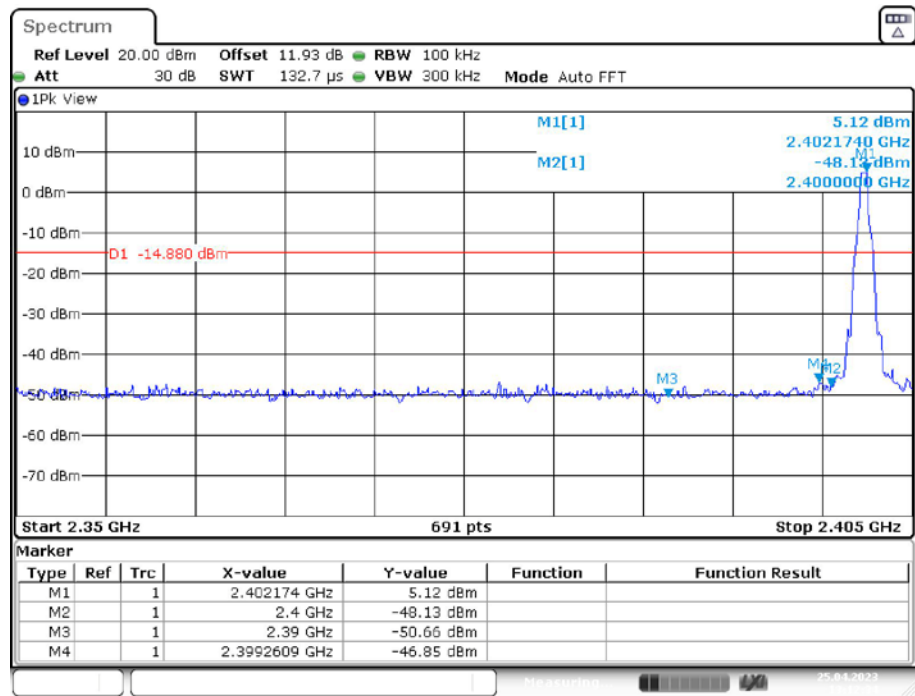|	
Temperature:	24℃
Relative Humidity:	53%
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-04-25.

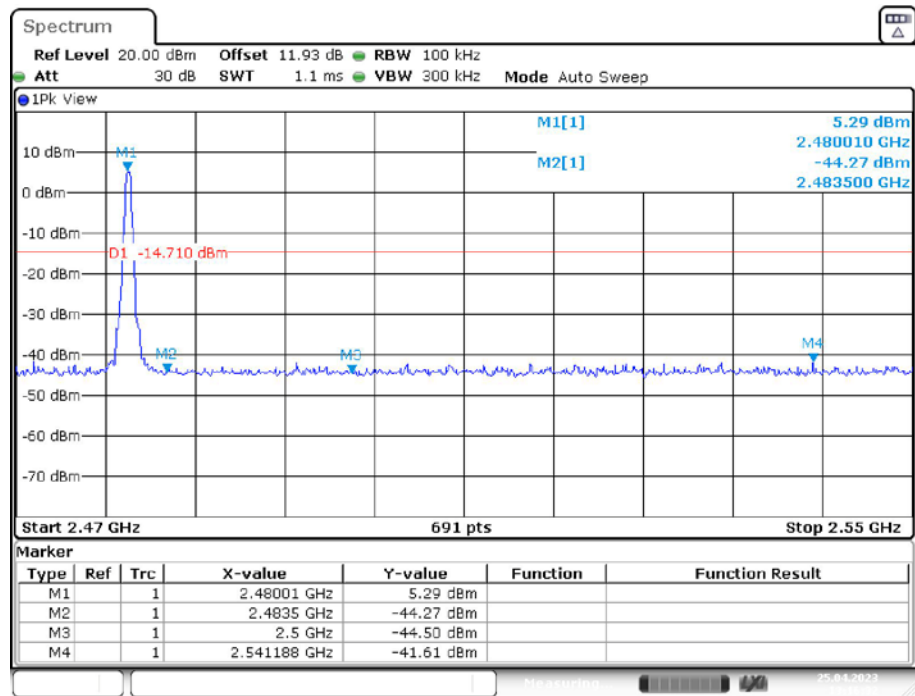*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the below plots:

DH5_Ant1_Low_2402
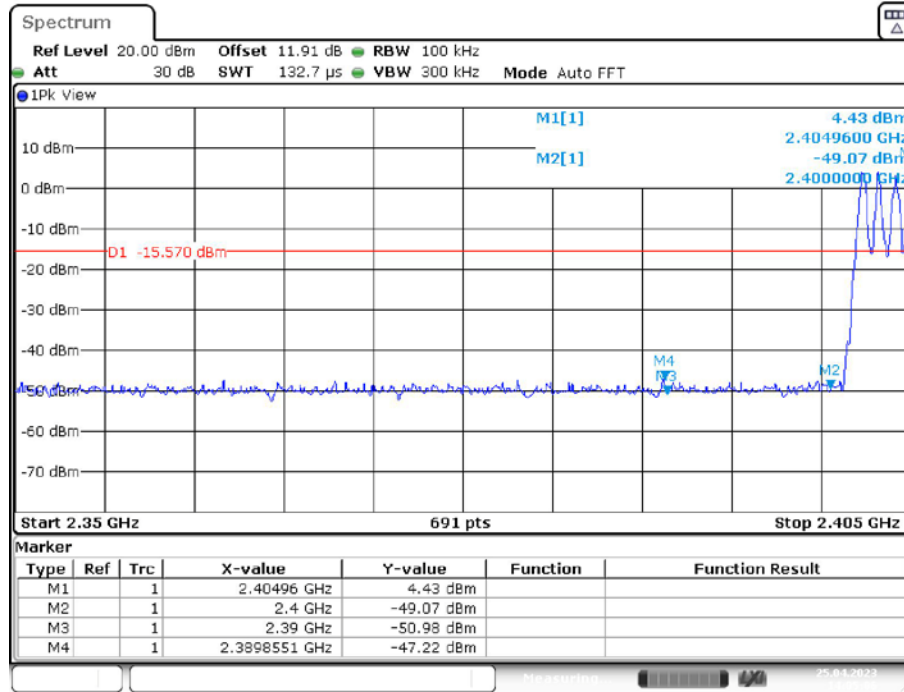

Date: 25.APR.2023 13:12:34

DH5_Ant1_High_2480

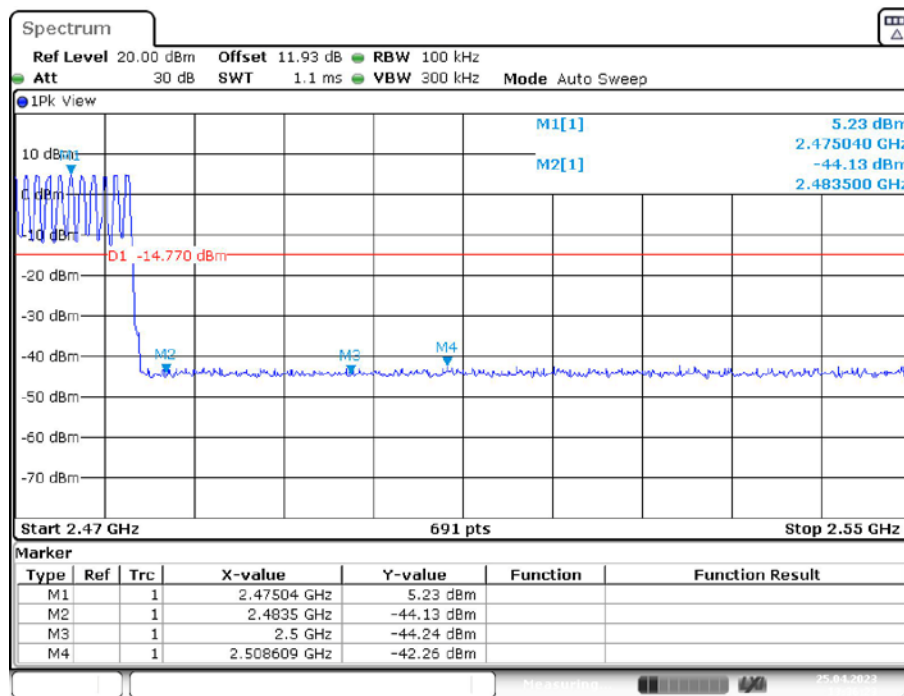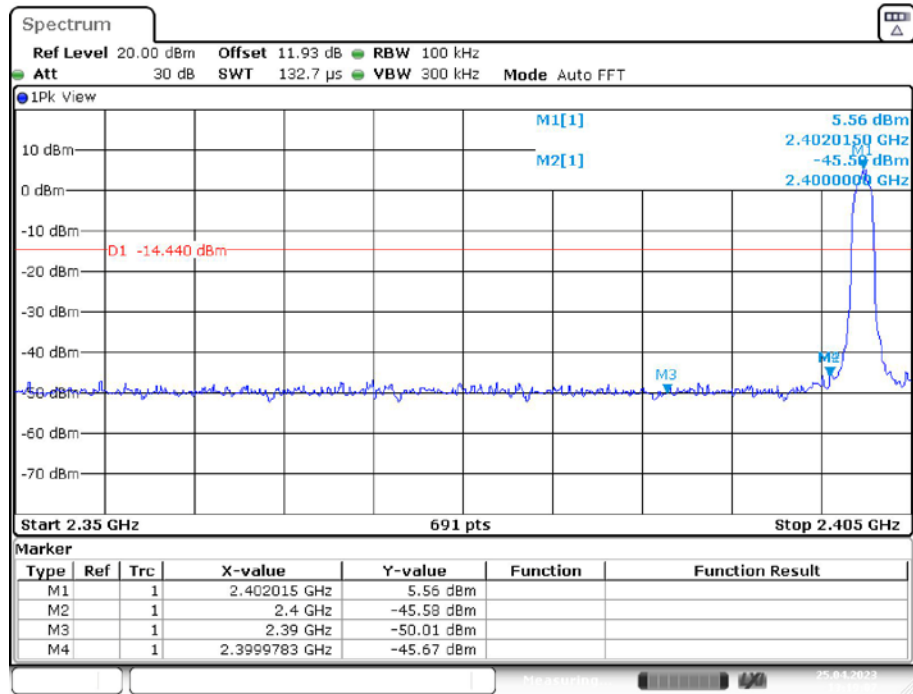Date: 25.APR.2023 13:16:32

DH5_Ant1_Low_Hop_2402

Date: 25.APR.2023   14:05:06

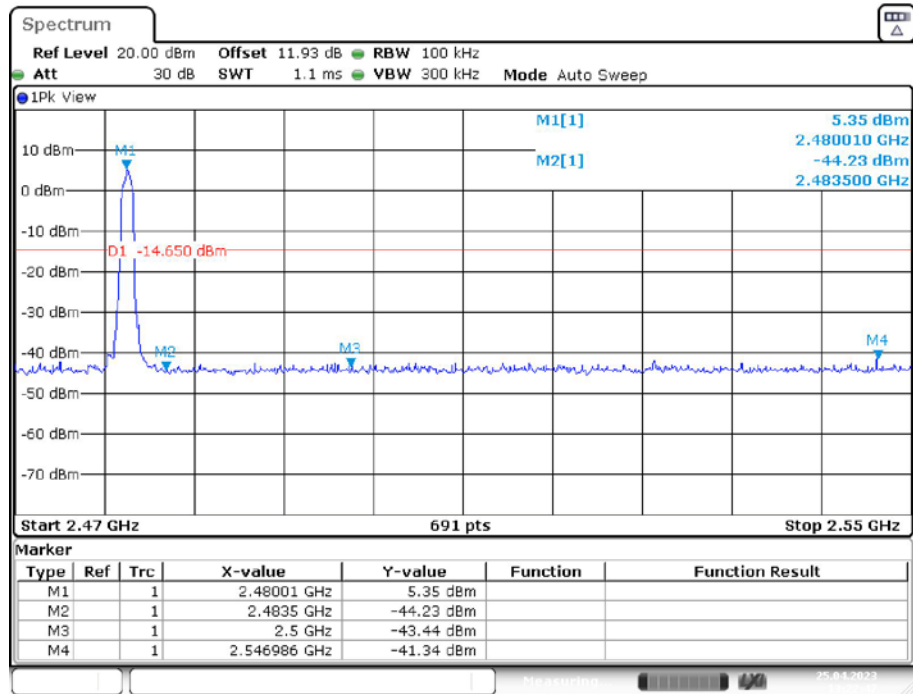## DH5_Ant1_High_Hop_2480

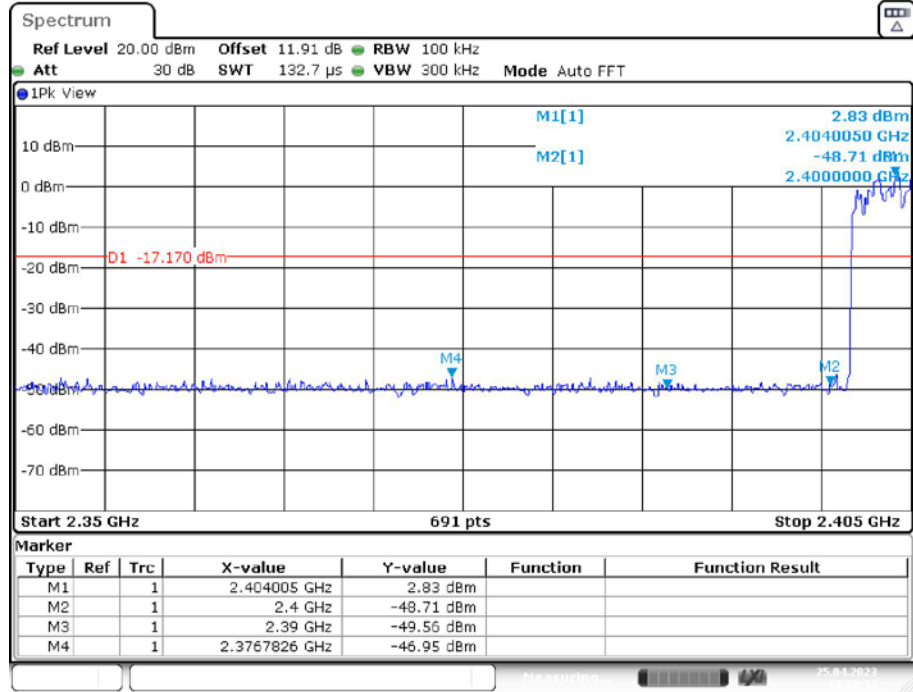Date: 25.APR.2023   13:36:23

2DH5_Ant1_Low_2402

Date: 25.APR.2023 13:19:07

2DH5_Ant1_High_2480

Date: 25.APR.2023 13:22:47

2DH5_Ant1_Low_Hop_2402

Spectrum						
Ref Level 20.00 dBm	Offset 11.91 dB	RBW 100 kHz				
Att 30 dB	SWT 132.7 µs	VBW 300 kHz	Mode Auto FFT			

1Pk View

M1[1]   2.83 dBm
                2.4040050 GHz
M2[1]   -48.71 dBm
                2.4000000 GHz

D1 -17.170 dBm

M4   M3   M2

Start 2.35 GHz   691 pts   Stop 2.405 GHz

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.404005 GHz	2.83 dBm		
M2		1	2.4 GHz	-48.71 dBm		
M3		1	2.39 GHz	-49.56 dBm		
M4		1	2.3767826 GHz	-46.95 dBm		

Date: 25.APR.2023   14:08:12

2DH5_Ant1_High_Hop_2480

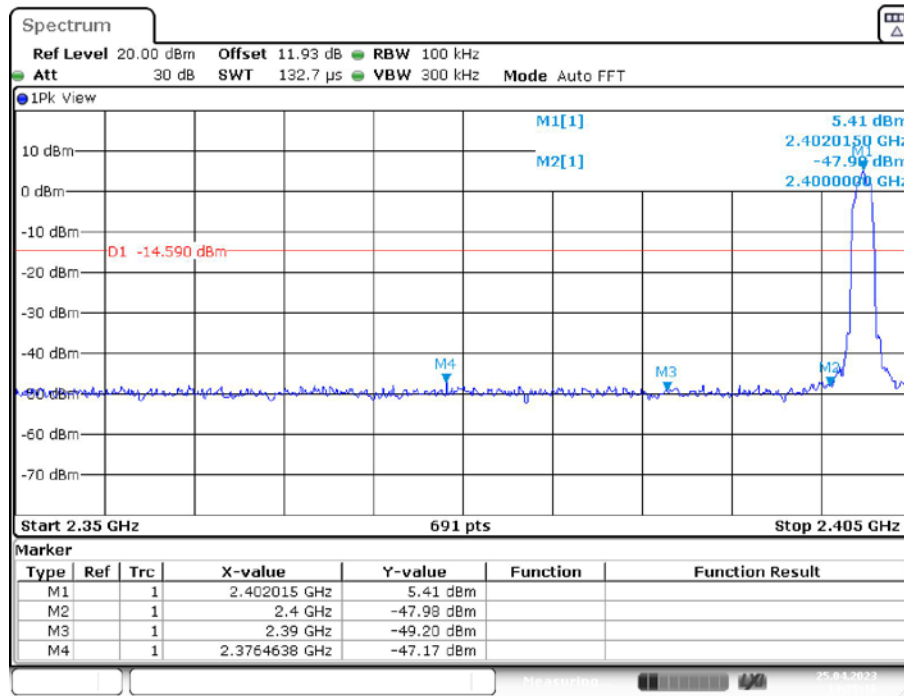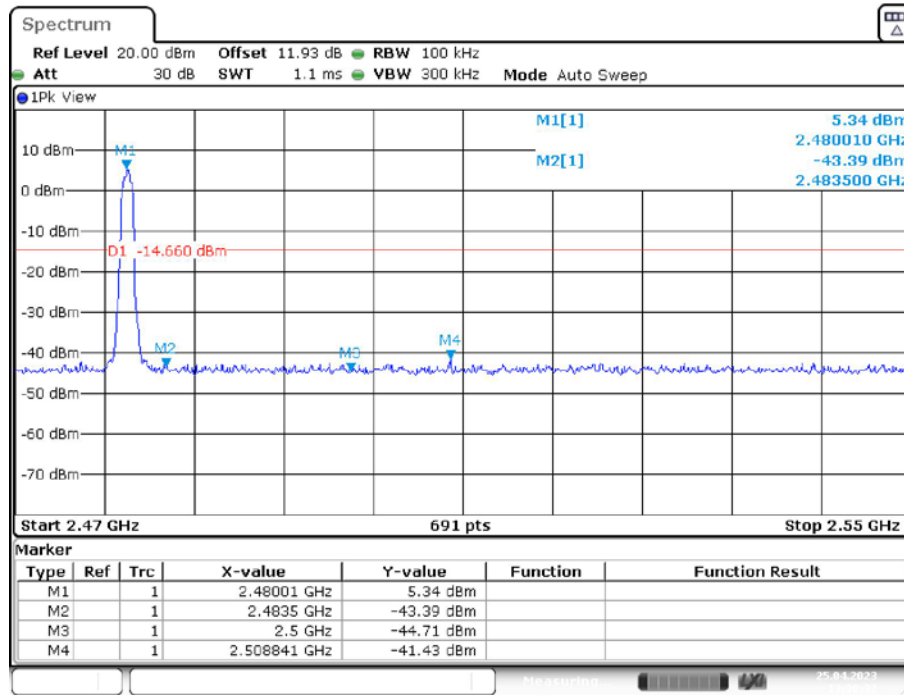| Spectrum						
Ref Level 20.00 dBm	Offset 11.93 dB	RBW 100 kHz				
Att 30 dB	SWT 1.1 ms	VBW 300 kHz	Mode Auto Sweep			

1Pk View

M1[1]   5.28 dBm
                2.478050 GHz
M2[1]   -43.58 dBm
                2.483500 GHz

D1 -14.720 dBm

M2   M3   M4

Start 2.47 GHz   691 pts   Stop 2.55 GHz

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47805 GHz	5.28 dBm		
M2		1	2.4835 GHz	-43.58 dBm		
M3		1	2.5 GHz	-44.71 dBm		
M4		1	2.51742 GHz	-41.94 dBm		

Date: 25.APR.2023   13:40:20

3DH5_Ant1_Low_2402

Date: 25.APR.2023   13:25:16

3DH5_Ant1_High_2480

Date: 25.APR.2023   13:30:32

3DH5_Ant1_Low_Hop_2402

Date: 25.APR.2023 13:41:49

3DH5_Ant1_High_Hop_2480

Date: 25.APR.2023 13:44:32

***** END OF REPORT *****