



## RF MEASUREMENT REPORT

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**FCC ID:** HD5-HONSR28PRT

**Applicant:** Honeywell International In  
Honeywell Safety and Productivity Solutions

**Product:** Wireless Module

**Model No.:** HON-SR28-PRT, HON-SR28-BT

**Brand Name:** Honeywell

**FCC Classification:** FCC Part 15 Spread Spectrum Transmitter (DSS)

**FCC Rule Part(s):** Part15 Subpart C (Section 15.247)

**Result:** Complies

**Received Date:** 2023-08-04

**Test Date:** 2023-08-07 ~ 2023-08-13

**Reviewed By:**

\_\_\_\_\_  
Jame Yuan

**Approved By:**

\_\_\_\_\_  
Robin Wu



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Shenzhen) Co., Ltd.

**Revision History**

| Report No.    | Version | Description              | Issue Date | Note    |
|---------------|---------|--------------------------|------------|---------|
| 2305RSU049-U2 | V01     | Initial Report           | 2023-08-16 | Invalid |
| 2305RSU049-U2 | V02     | Update Bluetooth version | 2023-08-25 | Valid   |
|               |         |                          |            |         |

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## 1. General Information

### 1.1. Applicant

Honeywell International In

## Honeywell Safety and Productivity Solutions

9680 Old Bailes Rd. Fort Mill, SC 29707 United States

## 1.2. Manufacturer

Honeywell International In

## Honeywell Safety and Productivity Solutions

9680 Old Bailes Rd. Fort Mill, SC 29707 United States

### 1.3. Testing Facility

|                                     |                                                                                                 |                                  |                                  |                                  |  |
|-------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|--|
| <input type="checkbox"/>            | <b>Test Site – MRT Suzhou Laboratory</b>                                                        |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Location (Suzhou - Wuzhong)</b>                                                   |                                  |                                  |                                  |  |
|                                     | D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China              |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Location (Suzhou - SIP)</b>                                                       |                                  |                                  |                                  |  |
|                                     | 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China    |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Accreditations</b>                                                                |                                  |                                  |                                  |  |
| A2LA: 3628.01                       |                                                                                                 | CNAS: L10551                     |                                  |                                  |  |
| FCC: CN1166                         |                                                                                                 | ISED: CN0001                     |                                  |                                  |  |
| VCCI:                               | <input type="checkbox"/> R-20025                                                                | <input type="checkbox"/> G-20034 | <input type="checkbox"/> C-20020 | <input type="checkbox"/> T-20020 |  |
|                                     | <input type="checkbox"/> R-20141                                                                | <input type="checkbox"/> G-20134 | <input type="checkbox"/> C-20103 | <input type="checkbox"/> T-20104 |  |
| <input checked="" type="checkbox"/> | <b>Test Site – MRT Shenzhen Laboratory</b>                                                      |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Location (Shenzhen)</b>                                                           |                                  |                                  |                                  |  |
|                                     | 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Accreditations</b>                                                                |                                  |                                  |                                  |  |
|                                     | A2LA: 3628.02                                                                                   |                                  | CNAS: L10551                     |                                  |  |
|                                     | FCC: CN1284                                                                                     |                                  | ISED: CN0105                     |                                  |  |
| <input type="checkbox"/>            | <b>Test Site – MRT Taiwan Laboratory</b>                                                        |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Location (Taiwan)</b>                                                             |                                  |                                  |                                  |  |
|                                     | No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)                        |                                  |                                  |                                  |  |
|                                     | <b>Laboratory Accreditations</b>                                                                |                                  |                                  |                                  |  |
|                                     | TAF: L3261-190725                                                                               |                                  |                                  |                                  |  |
| FCC: 291082, TW3261                 |                                                                                                 | ISED: TW3261                     |                                  |                                  |  |

#### 1.4. Product Information

|                                                                                                                                                                                                                                                                                                                 |                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Product Name                                                                                                                                                                                                                                                                                                    | Wireless Module                                                       |
| Model No.                                                                                                                                                                                                                                                                                                       | HON-SR28-PRT, HON-SR28-BT                                             |
| EUT Identification No.                                                                                                                                                                                                                                                                                          | 20230804Sample#01 (for Conducted)<br>20230804Sample#03 (for Radiated) |
| Wi-Fi Specification                                                                                                                                                                                                                                                                                             | 802.11a/b/g/n/ac                                                      |
| Bluetooth Specification                                                                                                                                                                                                                                                                                         | v5.0, dual mode                                                       |
| <p>Note 1: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.</p> <p>Note 2: HON-SR28-PRT support Wi-Fi &amp; Bluetooth, HON-SR28-BT disable Wi-Fi via software based on HON-SR28-PRT, the hardware is the same.</p> |                                                                       |

#### 1.5. Radio Specification under Test

|                     |                         |
|---------------------|-------------------------|
| Operating Frequency | 2402~2480MHz            |
| Channel Number      | 79                      |
| Type of modulation  | GFSK, Pi/4 DQPSK, 8DPSK |
| Data Rate           | 1Mbps, 2Mbps, 3Mbps     |
| Antenna Type        | FPC Antenna             |
| Antenna Gain        | 4.2dBi                  |

Note:

- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

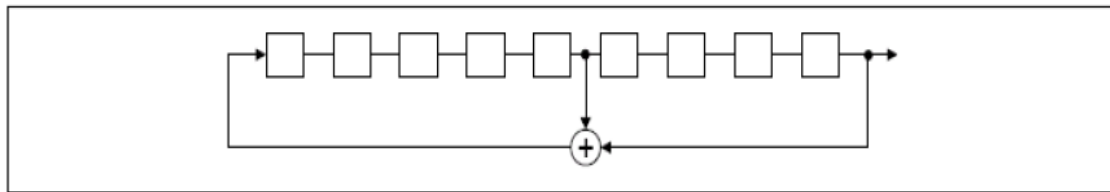
### 1.6. Working Frequencies

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

### 1.7. Pseudorandom Frequency Hopping Sequence

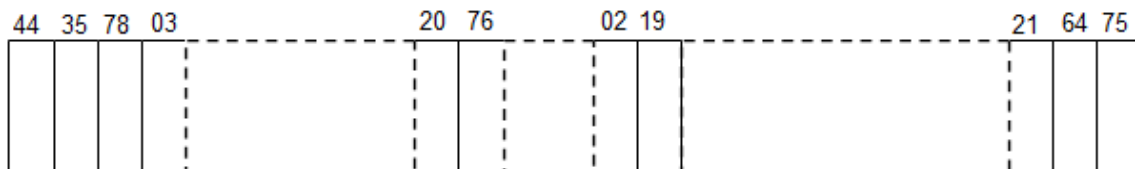
The pseudorandom sequence may be generated in a nine-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

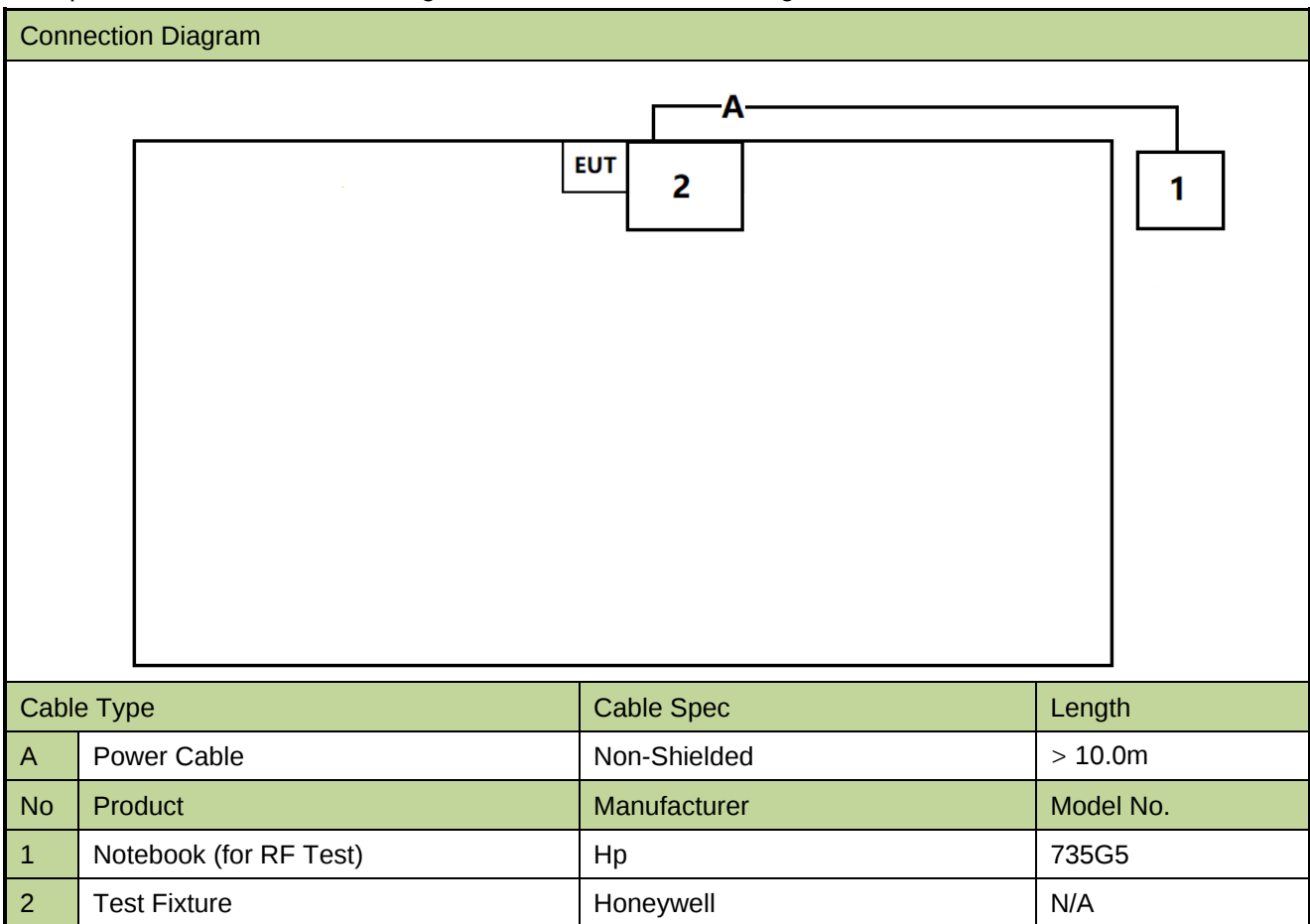
## 2. Test Configuration

### 2.1. Test Mode

|                          |
|--------------------------|
| Mode 1: Transmit by DH5  |
| Mode 2: Transmit by 2DH5 |
| Mode 3: Transmit by 3DH5 |

### 2.2. Test System Connection Diagram

The device was tested per the guidance ANSI C63.10: 2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.



### 2.3. Test Software

The test utility software used during testing was “Putty”, and the version was 0.78.

#### 2.4. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15.247
- KDB 558074 D01v05r02
- ANSI C63.10-2013

#### 2.5. Test Environment Condition

|                     |            |
|---------------------|------------|
| Ambient Temperature | 15 ~ 35 °C |
| Relative Humidity   | 20 ~75 %RH |

### 3. Antenna Requirement

**Excerpt from §15.203 of the FCC Rules/Regulations:**

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 Bluetooth antenna of the device uses a unique IPEX connector.

**Conclusion:**

The unit complies with the requirement of §15.203.

#### 4. Measuring Instrument

| Instrument          | Manufacturer         | Model No.   | Asset No.   | Cali. Interval | Cali. Due Date | Test Site     |
|---------------------|----------------------|-------------|-------------|----------------|----------------|---------------|
| TRILOG Antenna      | Sunol Sciences Corp. | JB1         | MRTSUE06021 | 1 year         | 2024-04-09     | NS-AC1        |
| Horn Antenna        | Schwarzbeck          | BBHA 9170   | MRTSUE06292 | 1 year         | 2023-10-18     | NS-AC1        |
| Anechoic Chamber    | BOOMWAVE             | NS-AC1      | MRTSUE06496 | 1 year         | 2024-07-12     | NS-AC1        |
| Horn Antenna        | Schwarzbeck          | BBHA 9120D  | MRTSUE06572 | 1 year         | 2024-03-31     | NS-AC1        |
| TRILOG Antenna      | Schwarzbeck          | VULB 9162   | MRTSUE06573 | 1 year         | 2024-06-09     | NS-AC1        |
| Preamplifier        | Schwarzbeck          | BBV 9718    | MRTSUE06574 | 1 year         | 2024-07-07     | NS-AC1        |
| EMI Test Receiver   | R&S                  | ESR3        | MRTSUE06575 | 1 year         | 2024-06-18     | NS-AC1        |
| Preamplifier        | EMCI                 | EMC184045SE | MRTSUE06641 | 1 year         | 2024-01-12     | NS-AC1        |
| Thermohygrometer    | testo                | 608-H1      | MRTSUE11020 | 1 year         | 2024-05-03     | NS-AC1        |
| Thermohygrometer    | testo                | 608-H1      | MRTSUE11104 | 1 year         | 2024-05-03     | NS-AC1        |
| Signal Analyzer     | Agilent              | N9010A      | MRTSUE06195 | 1 year         | 2023-12-20     | NS-AC1/NS-TR2 |
| Signal Analyzer     | Keysight             | N9020A      | MRTSUE10065 | 1 year         | 2023-12-20     | NS-AC1/NS-TR2 |
| Signal Generator    | Agilent              | E4438C      | MRTSUE06026 | 1 year         | 2024-06-30     | NS-SR2        |
| Shielding Room      | BOOMWAVE             | NS-SR2      | MRTSUE06551 | 5 years        | 2024-06-03     | NS-SR2        |
| EMI Test Receiver   | R&S                  | ESL3        | MRTSUE06576 | 1 year         | 2024-06-18     | NS-SR2        |
| Two-Line V-Network  | R&S                  | ENV216      | MRTSUE06577 | 1 year         | 2024-04-25     | NS-SR2        |
| Two-Line V-Network  | R&S                  | ENV216      | MRTSUE06578 | 1 year         | 2024-04-25     | NS-SR2        |
| ISN                 | R&S                  | ENY81       | MRTSUE06579 | 1 year         | 2024-06-12     | NS-SR2        |
| ISN                 | R&S                  | ENY81-CA6   | MRTSUE06580 | 1 year         | 2024-05-24     | NS-SR2        |
| Thermohygrometer    | testo                | 608-H1      | MRTSUE11106 | 1 year         | 2024-05-03     | NS-SR2        |
| USB Power Sensor    | Keysight             | U2021XA     | MRTSUE06581 | 1 year         | 2024-06-30     | NS-TR2        |
| Thermohygrometer    | DELI                 | NO.8813     | MRTSUE06783 | 1 year         | 2023-12-28     | NS-TR2        |
| Temperature Chamber | OUKE                 | OK-TH-100C  | MRTSUE06899 | 1 year         | 2024-04-25     | NS-TR2        |
| EMI Test Receiver   | R&S                  | ESR7        | MRTSUE06001 | 1 year         | 2023-12-28     | WZ-AC1        |
| Thermohygrometer    | testo                | 608-H1      | MRTSUE11039 | 1 year         | 2023-11-01     | WZ-AC1        |
| Loop Antenna        | Schwarzbeck          | FMZB 1519   | MRTSUE06025 | 1 year         | 2023-09-29     | WZ-AC1/WZ-AC2 |

| Software             | Version | Function               |
|----------------------|---------|------------------------|
| EMI Software         | V3.0.0  | EMI Test Software      |
| Agilent Power Panel  | V 3.9   | Power                  |
| Controller_T-E-TAC-2 | 1.02    | RE Antenna & Turntable |
| Controller_MF 7802   | 2.03C   | RE Antenna & Turntable |

## 5. Decision Rules and Measurement Uncertainty

### 5.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2.  
(Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k = 2$ .

|                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AC Conducted Emission Measurement</b>                                                                                                                             |
| Measurement Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ):<br>9kHz~150kHz: 3.58dB<br>150kHz~30MHz: 3.20dB                                             |
| <b>Radiated Disturbance</b>                                                                                                                                          |
| Measurement Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ):<br>9kHz~30MHz: 2.60dB<br>30MHz~200MHz: 4.06dB<br>200MHz~1GHz: 5.28dB<br>1GHz~40GHz: 4.98dB |
| <b>Spurious Emissions, Conducted</b>                                                                                                                                 |
| Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ):<br>2.3dB                                                                                     |
| <b>Output Power</b>                                                                                                                                                  |
| Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ):<br>1.5dB                                                                                     |
| <b>Occupied Bandwidth</b>                                                                                                                                            |
| Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ):<br>3.2%                                                                                      |

## 6. Test Result

### 6.1. Summary

| FCC Section(s)    | Test Description                                                   | Test Condition | Verdict |
|-------------------|--------------------------------------------------------------------|----------------|---------|
| 15.247(a)(1)      | 20dB Bandwidth                                                     | Conducted      | Pass    |
| 15.247(b)(1)      | Peak Transmitter Output Power                                      |                | Pass    |
| 15.247(a)(1)      | Channel Separation                                                 |                | Pass    |
| 15.247(a)(1)(iii) | Number of Channels                                                 |                | Pass    |
| 15.247(a)(1)(iii) | Time of Occupancy                                                  |                | Pass    |
| 15.247(d)         | Band Edge / Out- of-Band Emissions                                 |                | Pass    |
| 15.205, 15.209    | General Field Strength<br>(Restricted Bands and Radiated Emission) | Radiated       | Pass    |
| 15.207            | AC Conducted Emissions<br>150kHz - 30MHz                           | Line Conducted | Pass    |

**Note:**

1. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

## 6.2. Occupied Bandwidth Measurement

### 6.2.1. Test Limit

N/A

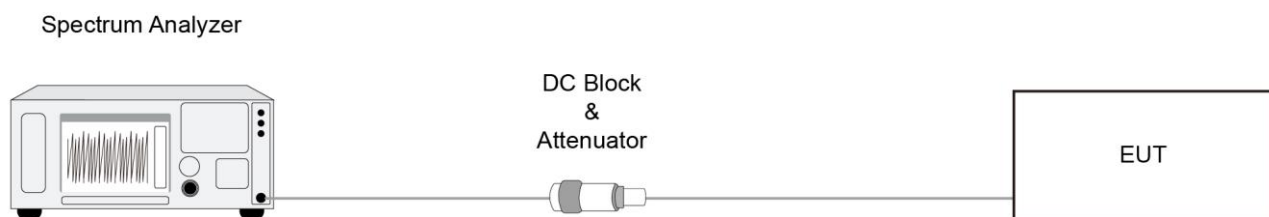
### 6.2.2. Test Procedure

ANSI C63.10-2013 - Section 6.9.2 (20dB Bandwidth)

### 6.2.3. Test Setting

1. Set RBW = 1% to 5% of the 20dB bandwidth
2. VBW = approximately three times RBW
3. Span = approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

### 6.2.4. Test Setup



### 6.2.5. Test Result

Refer to Appendix A.2.

### 6.3. Output Power Measurement

#### 6.3.1. Test Limit

For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 non-overlapping hopping channels: 1watt (30dBm). For all other frequency hopping systems in the 2400 - 2483.5MHz band: 0.125 watt (20.97dBm).

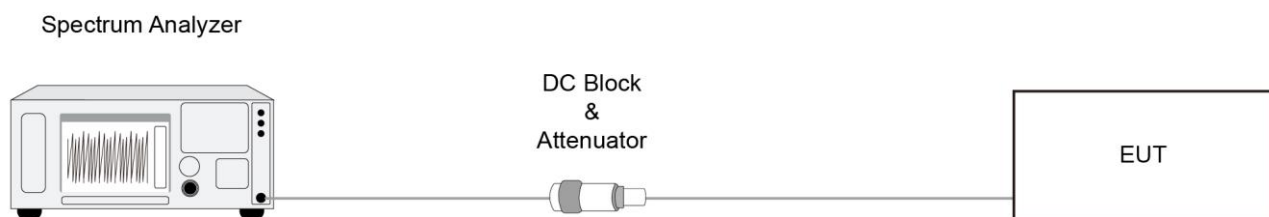
#### 6.3.2. Test Procedure

ANSI C63.10-2013 - Section 7.8.5

#### 6.3.3. Test Setting

1. Set RBW > the 20 dB bandwidth of the emission being measured.
2. VBW  $\geq$  RBW
3. Span = approximately five times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. 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 (don't forget added the external attenuation and cable loss)

#### 6.3.4. Test Setup



#### 6.3.5. Test Result

Refer to Appendix A.3.

## 6.4. Carrier Frequency Separation Measurement

### 6.4.1. Test Limit

The minimum permissible channel separation for this system is  $\frac{2}{3}$  the value of the 20dB BW.

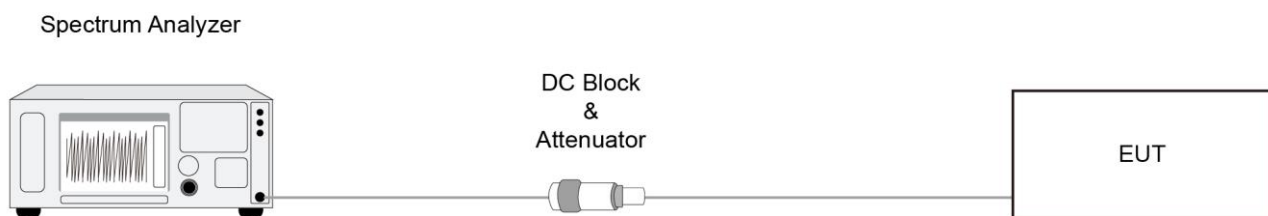
### 6.4.2. Test Procedure

ANSI C63.10-2013 - Section 7.8.2.

#### 6.4.3. Test Setting

1. Span = wide enough to capture the peaks of two adjacent channels.
2. Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. VBW  $\geq$  RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allowed the trace to stabilize
8. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

#### 6.4.4. Test Setup



#### 6.4.5. Test Result

Refer to Appendix A.4.

## 6.5. Number of Hopping Channels Measurement

### 6.5.1. Test Limit

This frequency hopping system must employ a minimum of 15 hopping channels.

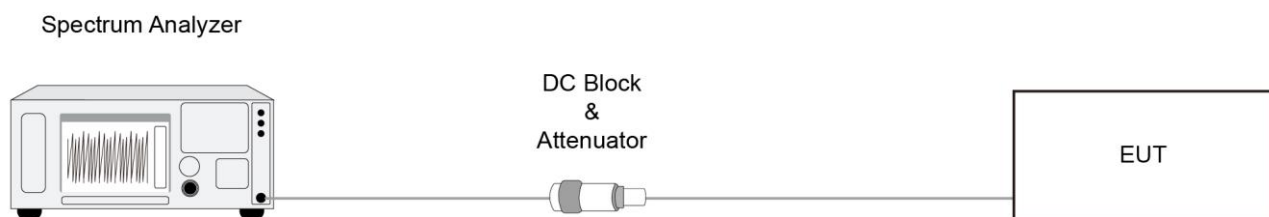
### 6.5.2. Test Procedure

ANSI C63.10-2013 - Section 7.8.3.

### 6.5.3. Test Setting

1. Span = the frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3.  $VBW \geq RBW$
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allow the trace to stabilize

### 6.5.4. Test Setup



### 6.5.5. Test Result

Refer to Appendix A.5.

## 6.6. Time of Occupancy Measurement

### 6.6.1. Test Limit

The maximum permissible time of occupancy is 400ms within a period of 400ms multiplied by the number of hopping channels employed.

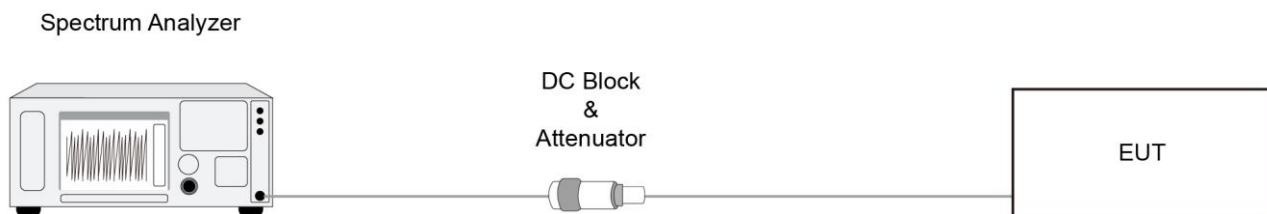
### 6.6.2. Test Procedure

ANSI C63.10-2013 - Section 7.8.4.

### 6.6.3. Test Setting

1. Span = zero span, centered on a hopping channel.
2. RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
3. VBW  $\geq$  RBW
4. Sweep time = as necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = max hold
7. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

### 6.6.4. Test Setup



### 6.6.5. Test Result

Refer to Appendix A.6.

## 6.7. Band-edge Compliance Measurement

### 6.7.1. Test Limit

The maximum permissible emission level is 20dBc. Any emissions were lying outside of the emission bandwidth and in authorized band edges to a field strength limit specified in Section 15.209 of the Title 47 CFR.

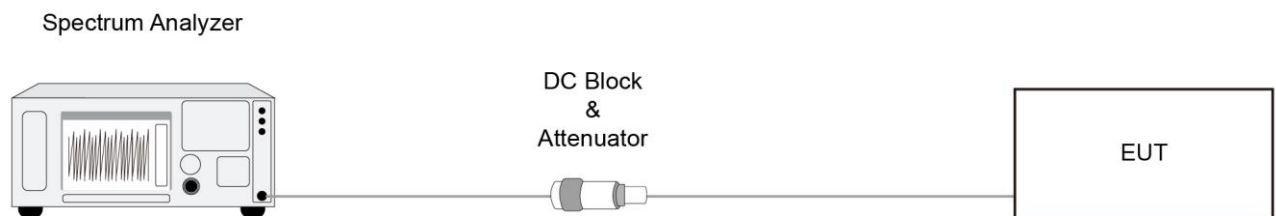
### 6.7.2. Test Procedure

ANSI C63.10-2013 - Section 6.10.4.

### 6.7.3. Test Setting

1. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize
8. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

### 6.7.4. Test Setup



### 6.7.5. Test Result

Refer to Appendix A.7.

## 6.8. Conducted Spurious Emissions Measurement

### 6.8.1. Test Limit

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 or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

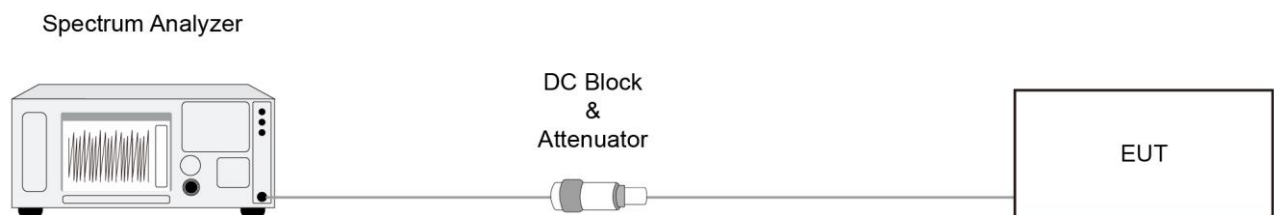
### 6.8.2. Test Procedure

ANSI C63.10-2013 - Section 7.8.8.

### 6.8.3. Test Setting

1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
2. RBW = 100KHz
3. VBW = 300KHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize
8. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

### 6.8.4. Test Setup



### 6.8.5. Test Result

Refer to Appendix A.8.



## 6.9. Radiated Spurious Emission Measurement

### 6.9.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

| FCC Part 15 Subpart C Paragraph 15.209 |                          |                               |
|----------------------------------------|--------------------------|-------------------------------|
| Frequency<br>[MHz]                     | Field Strength<br>[uV/m] | Measured Distance<br>[Meters] |
| 0.009 - 0.490                          | 2400/F (kHz)             | 300                           |
| 0.490 - 1.705                          | 24000/F (kHz)            | 30                            |
| 1.705 - 30                             | 30                       | 30                            |
| 30 - 88                                | 100                      | 3                             |
| 88 - 216                               | 150                      | 3                             |
| 216 - 960                              | 200                      | 3                             |
| Above 960                              | 500                      | 3                             |

### 6.9.2. Test Procedure

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.4 (Standard test method below 30MHz)

ANSI C63.10 Section 6.5 (Standard test method above 30MHz to 1GHz)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

### 6.9.3. Test Setting

**Table 1 - RBW as a function of frequency**

| Frequency     | RBW           |
|---------------|---------------|
| 9 ~ 150 kHz   | 200 ~ 300 Hz  |
| 0.15 ~ 30 MHz | 9 ~ 10 kHz    |
| 30 ~ 1000 MHz | 100 ~ 120 kHz |
| > 1000 MHz    | 1 MHz         |

**Quasi-Peak Measurements below 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as specified in Table 1
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

**Peak Measurements above 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

**Average Measurements above 1GHz (Method VB)**

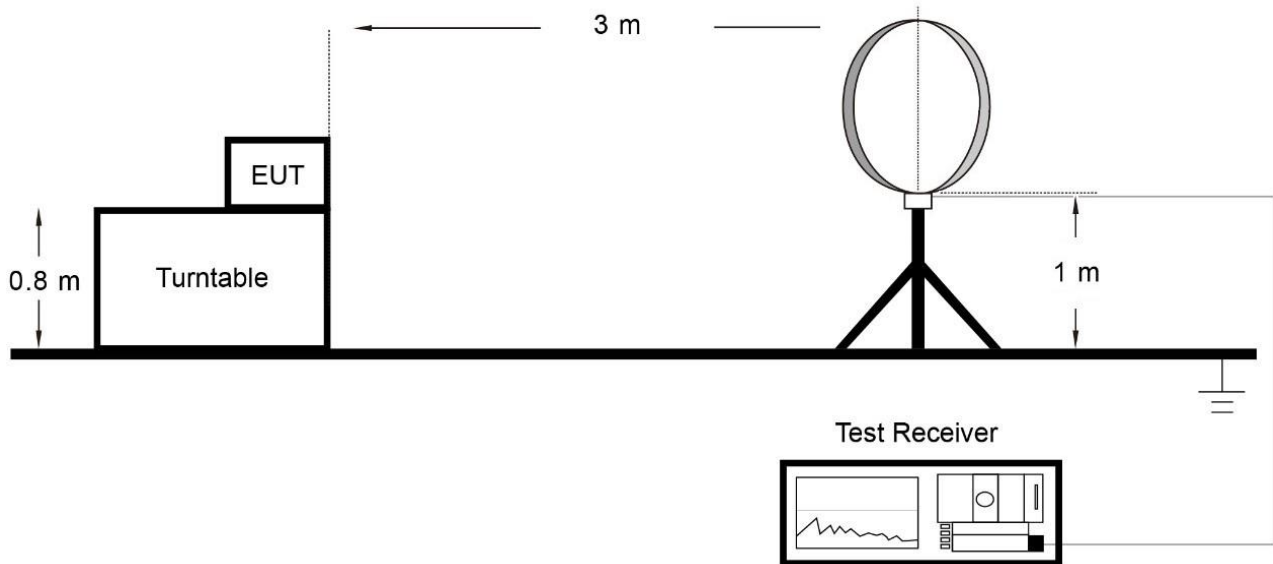
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle  $\geq 98\%$ , set VBW = 10 Hz.

If the EUT duty cycle is  $< 98\%$ , set VBW  $\geq 1/T$ . T is the minimum transmission duration.

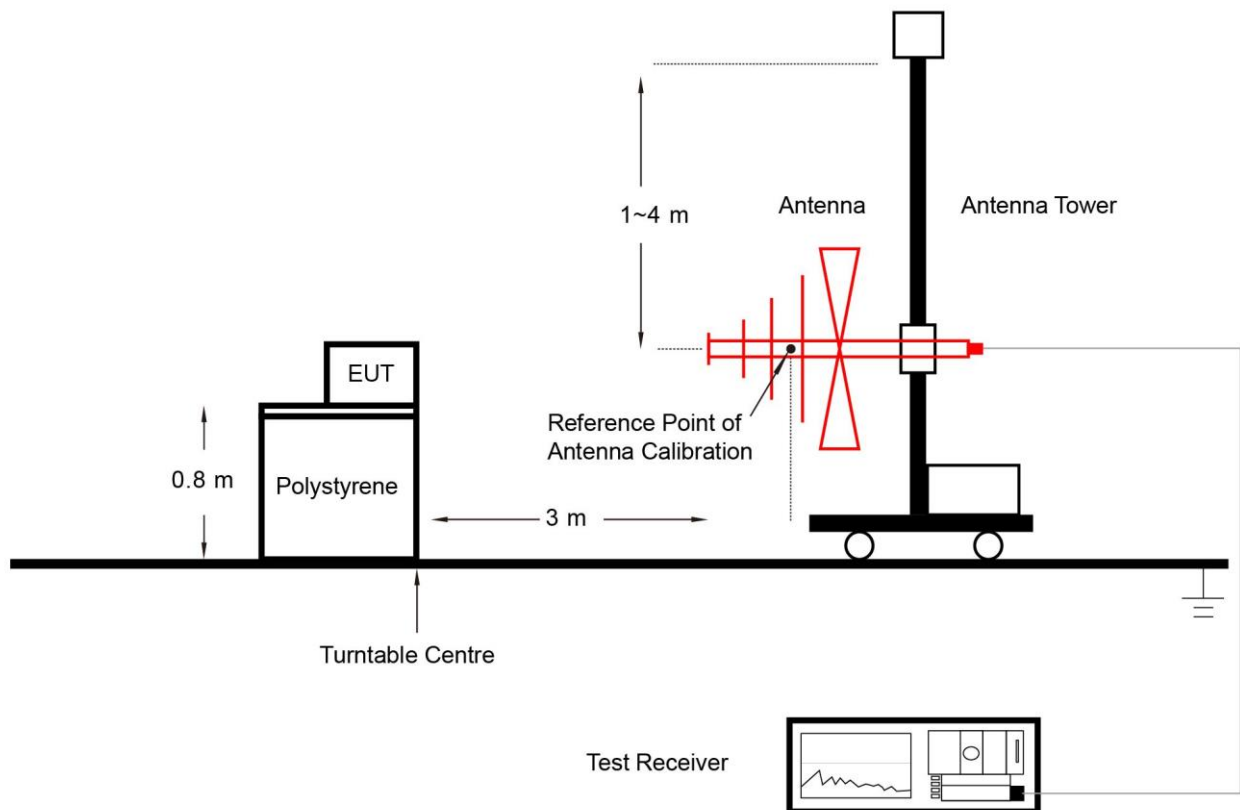
4. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Trace was allowed to stabilize

#### 6.9.4. Test Setup

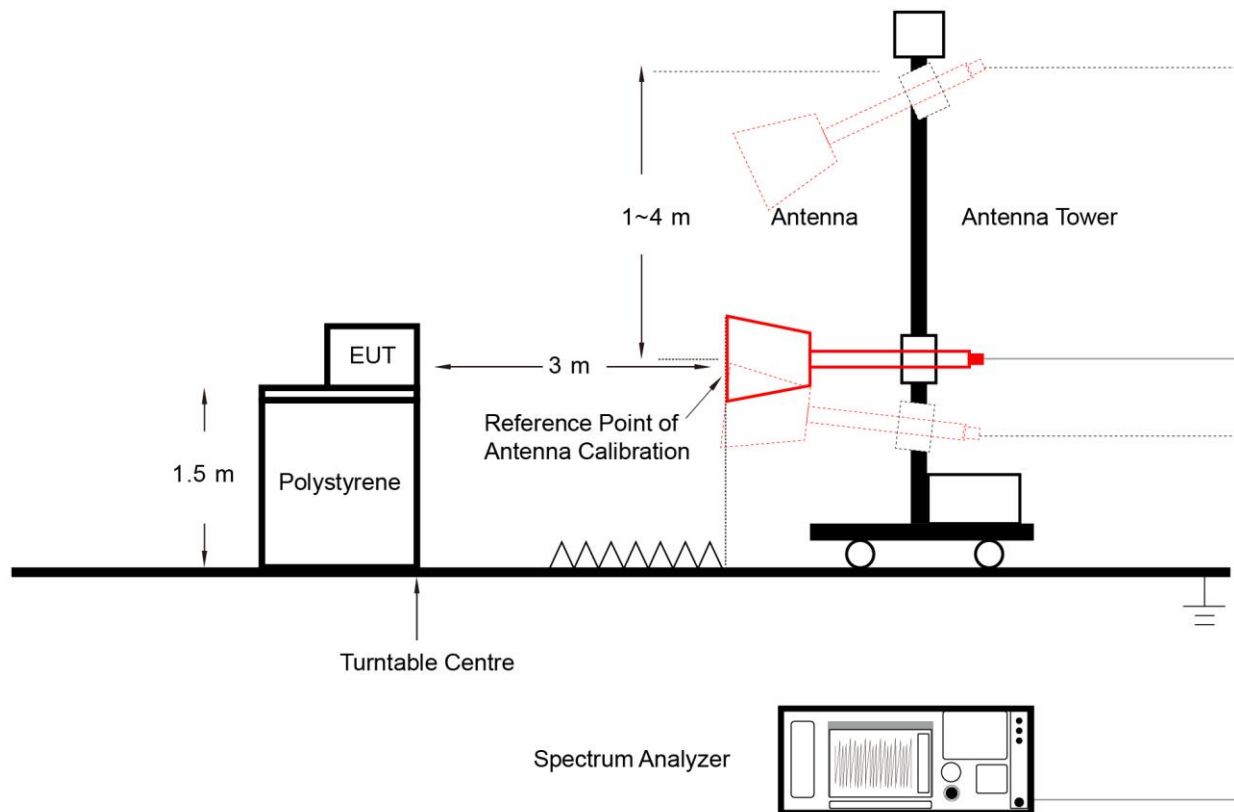
Below 30MHz Test Setup:



Below 1GHz Test Setup:



### Above 1GHz Test Setup:



### 6.9.5. Test Result

Refer to Appendix A.9.

## 6.10. Radiated Restricted Band Edge Measurement

### 6.10.1. Test Limit

#### For 15.205 requirement:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a).

| Frequency<br>(MHz)         | Frequency<br>(MHz)  | Frequency<br>(MHz) | Frequency<br>(GHz) |
|----------------------------|---------------------|--------------------|--------------------|
| 0.090 - 0.110              | 16.42 - 16.423      | 399.9 - 410        | 4.5 - 5.15         |
| <sup>1</sup> 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 - 156.525 | 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        | ( <sup>2</sup> )   |
| 13.36 - 13.41              | --                  | --                 | --                 |

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

| FCC Part 15 Subpart C Paragraph 15.209 |                          |                               |
|----------------------------------------|--------------------------|-------------------------------|
| Frequency<br>[MHz]                     | Field Strength<br>[uV/m] | Measured Distance<br>[Meters] |
| 0.009 - 0.490                          | 2400/F (kHz)             | 300                           |
| 0.490 - 1.705                          | 24000/F (kHz)            | 30                            |
| 1.705 - 30                             | 30                       | 30                            |
| 30 - 88                                | 100                      | 3                             |
| 88 - 216                               | 150                      | 3                             |
| 216 - 960                              | 200                      | 3                             |
| Above 960                              | 500                      | 3                             |

#### 6.10.2. Test Procedure

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

#### 6.10.3. Test Setting

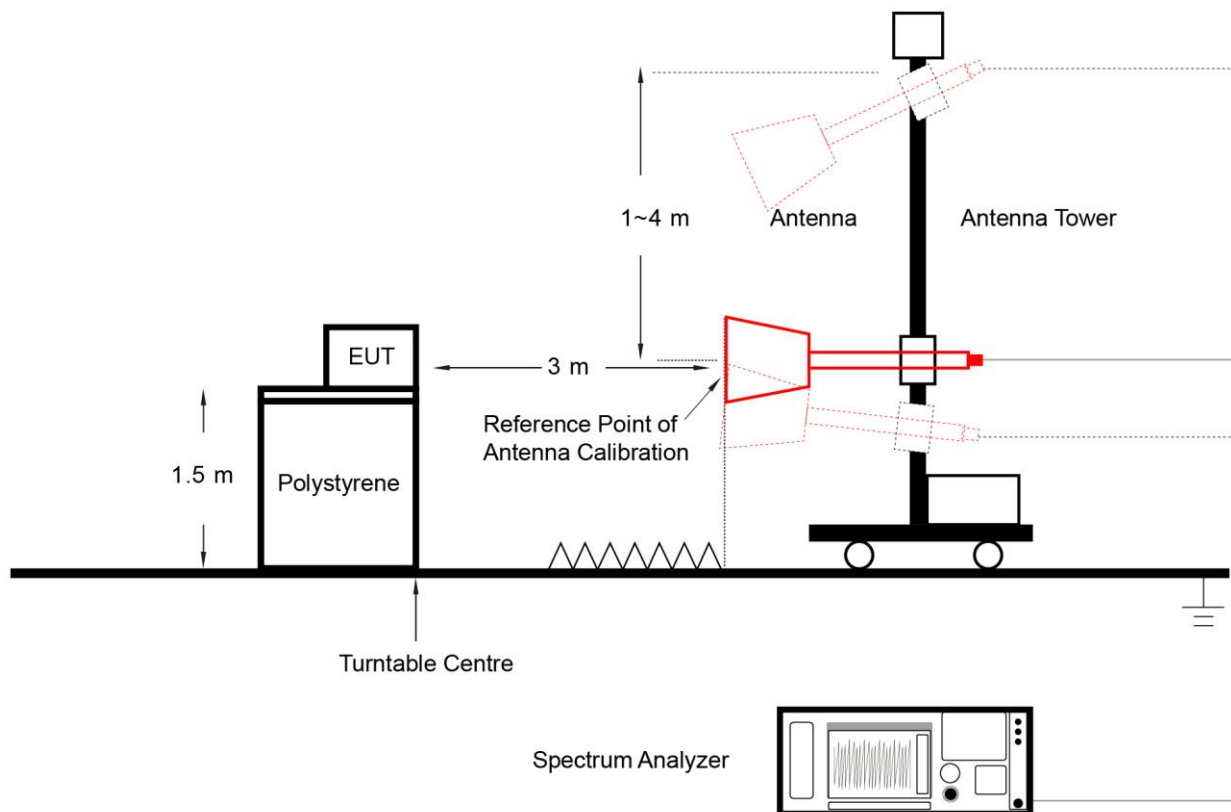
##### Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

#### Average Measurements above 1GHz (Method VB)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle  $\geq 98\%$ , set VBW = 10 Hz.  
If the EUT duty cycle is  $< 98\%$ , set VBW  $\geq 1/T$ . T is the minimum transmission duration.
4. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Trace was allowed to stabilize

#### 6.10.4. Test Setup



#### 6.10.5. Test Result

Refer to Appendix A.10.

## 6.11. AC Conducted Emissions Measurement

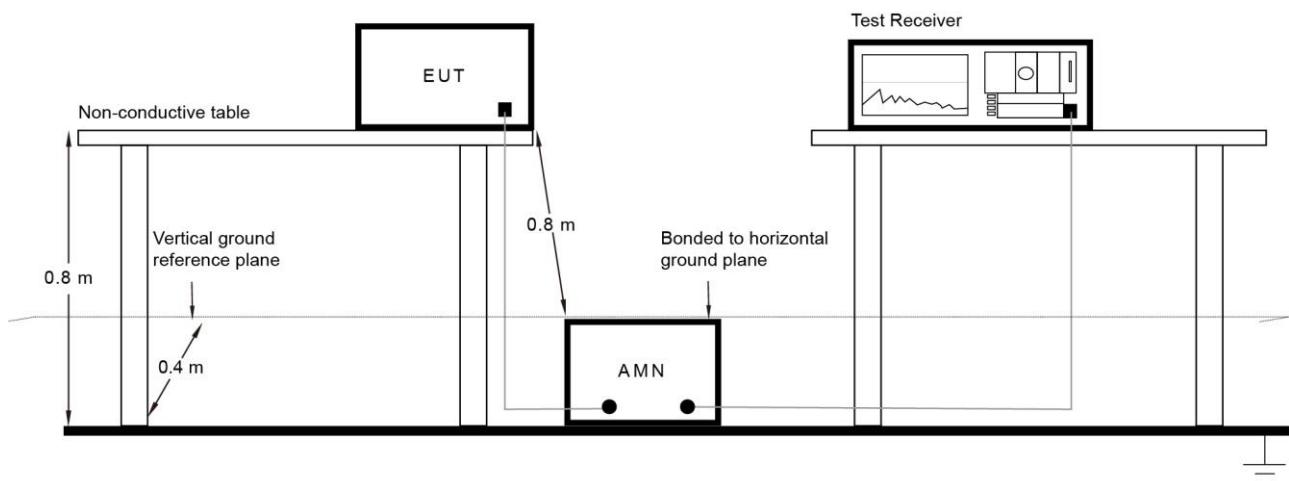
### 6.11.1. Test Limit

| FCC Part 15 Subpart C Paragraph 15.207 Limits |                 |                      |
|-----------------------------------------------|-----------------|----------------------|
| Frequency (MHz)                               | QP (dB $\mu$ V) | Average (dB $\mu$ V) |
| 0.15 - 0.50                                   | 66 - 56         | 56 - 46              |
| 0.50 - 5.0                                    | 56              | 46                   |
| 5.0 - 30                                      | 60              | 50                   |

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

### 6.11.2. Test Setup



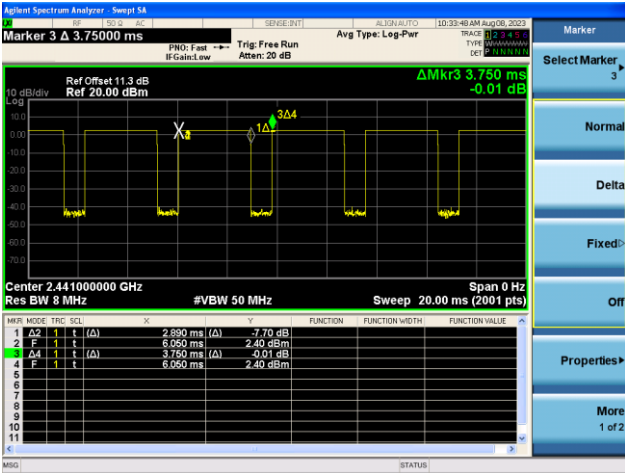
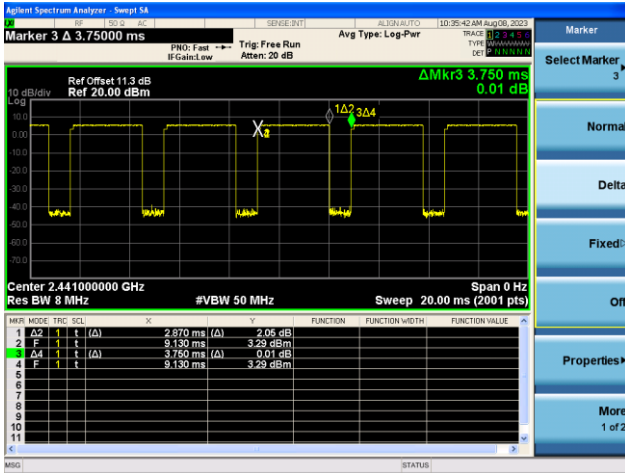
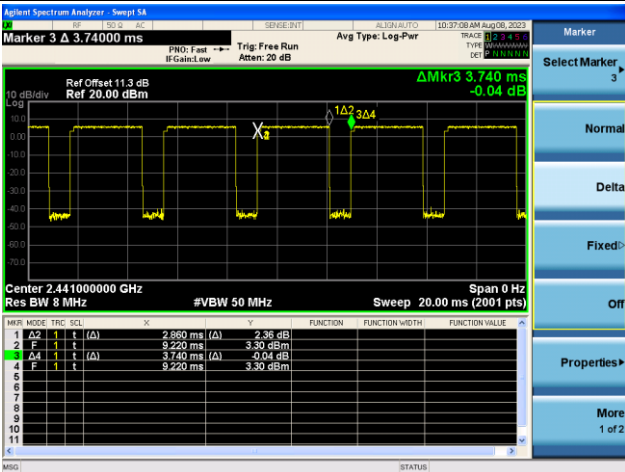
### 6.11.3. Test Result

Refer to Appendix A.11.

## Appendix A - Test Result

### A.1 Duty Cycle Test Result

|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-08 |               |             |

| Test Mode                                                                           | Duty Cycle                                                                          |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| DH5                                                                                 | 77.07%                                                                              |
| 2DH5                                                                                | 76.53%                                                                              |
| 3DH5                                                                                | 76.47%                                                                              |
| Duty Cycle                                                                          |                                                                                     |
| DH5 (T = 2.890ms)                                                                   | 2DH5 (T = 2.870ms)                                                                  |
|   |  |
| 3DH5 (T = 2.860ms)                                                                  |                                                                                     |
|  |                                                                                     |

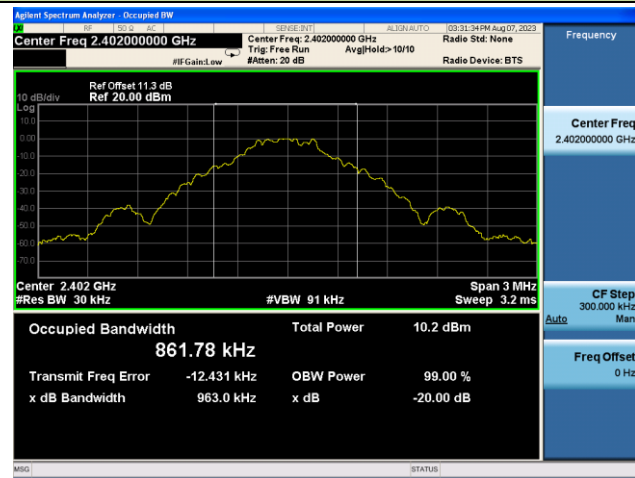
## A.2 20dB Bandwidth Test Result

|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-07 |               |             |

| Test Mode | Channel No. | Frequency (MHz) | 20dB Bandwidth (kHz) | Result |
|-----------|-------------|-----------------|----------------------|--------|
| DH5       | 00          | 2402            | 963.0                | Pass   |
| DH5       | 39          | 2441            | 962.5                | Pass   |
| DH5       | 78          | 2480            | 962.2                | Pass   |
| 2DH5      | 00          | 2402            | 1315                 | Pass   |
| 2DH5      | 39          | 2441            | 1317                 | Pass   |
| 2DH5      | 78          | 2480            | 1316                 | Pass   |
| 3DH5      | 00          | 2402            | 1304                 | Pass   |
| 3DH5      | 39          | 2441            | 1300                 | Pass   |
| 3DH5      | 78          | 2480            | 1304                 | Pass   |

## DH5 20dB Bandwidth

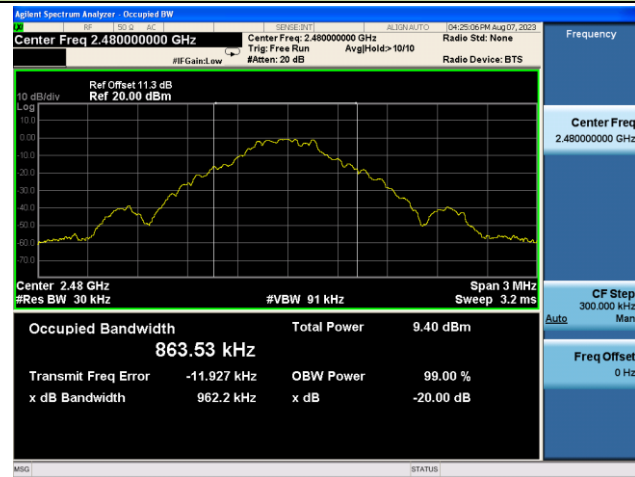
### Channel 00 (2402MHz)



### Channel 39 (2441MHz)

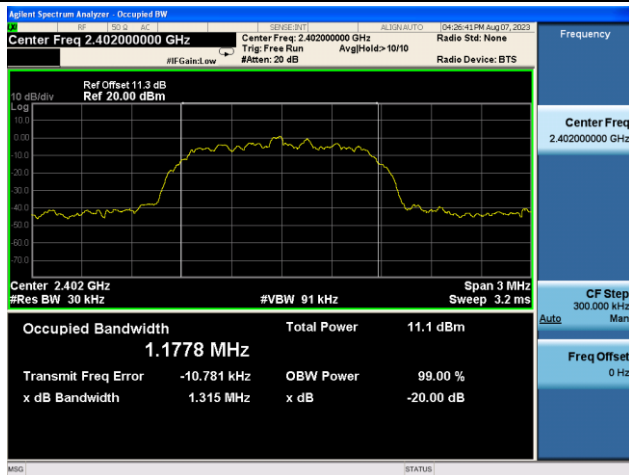


### Channel 78 (2480MHz)

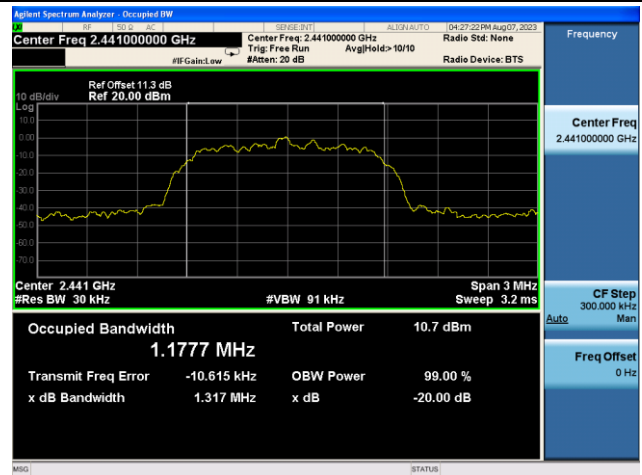


## 2DH5 20dB Bandwidth

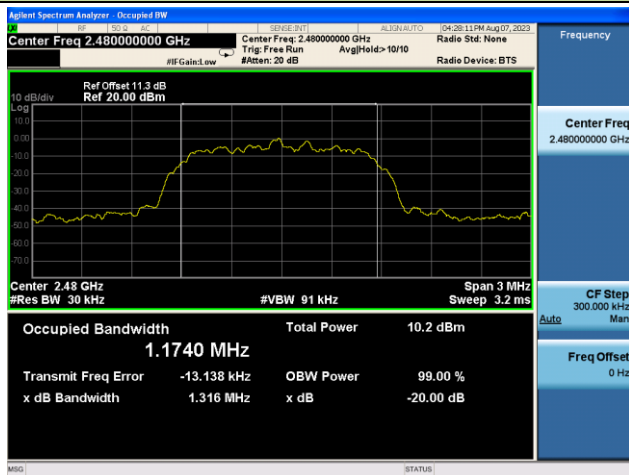
## Channel 00 (2402MHz)



## Channel 39 (2441MHz)



## Channel 78 (2480MHz)





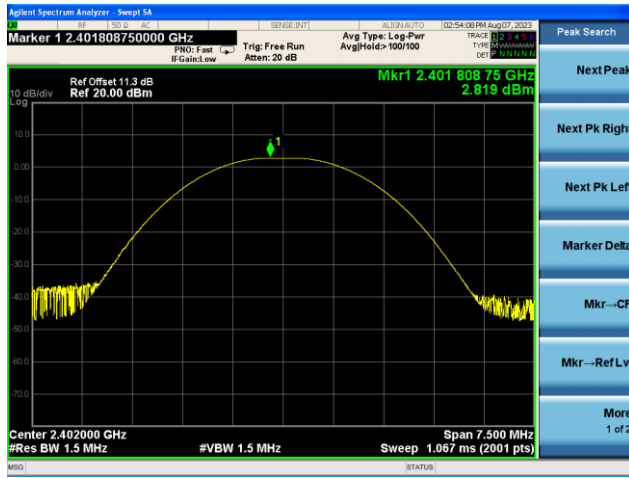
### A.3 Output Power Test Result

|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-07 |               |             |

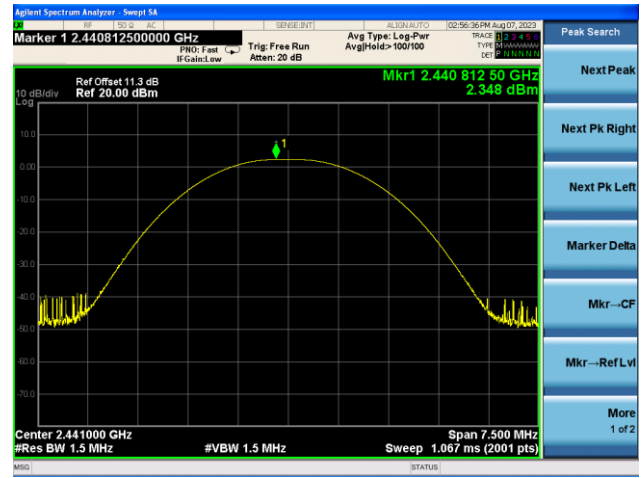
| Test Mode | Channel No. | Frequency (MHz) | Output Power (dBm) | Limit (dBm)  |
|-----------|-------------|-----------------|--------------------|--------------|
| DH5       | 00          | 2402            | 2.819              | $\leq 20.97$ |
| DH5       | 39          | 2441            | 2.348              | $\leq 20.97$ |
| DH5       | 78          | 2480            | 1.891              | $\leq 20.97$ |
| 2DH5      | 00          | 2402            | 5.821              | $\leq 20.97$ |
| 2DH5      | 39          | 2441            | 5.427              | $\leq 20.97$ |
| 2DH5      | 78          | 2480            | 4.938              | $\leq 20.97$ |
| 3DH5      | 00          | 2402            | 6.146              | $\leq 20.97$ |
| 3DH5      | 39          | 2441            | 5.737              | $\leq 20.97$ |
| 3DH5      | 78          | 2480            | 5.279              | $\leq 20.97$ |

## DH5 Output Power

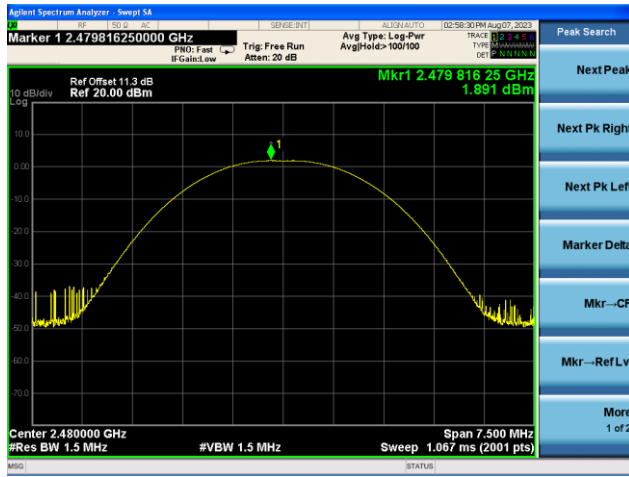
### Channel 00 (2402MHz)



### Channel 39 (2441MHz)

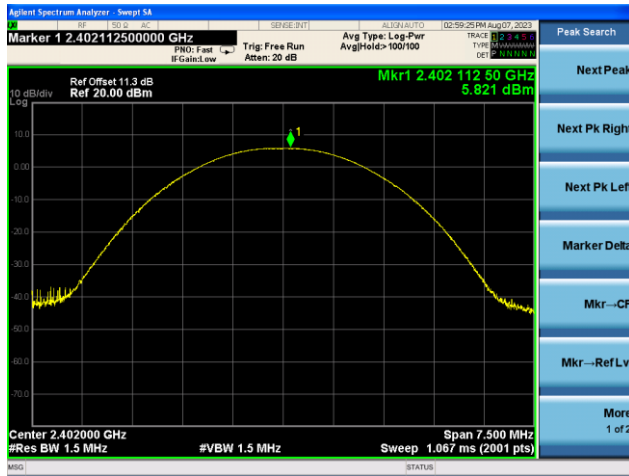


### Channel 78 (2480MHz)

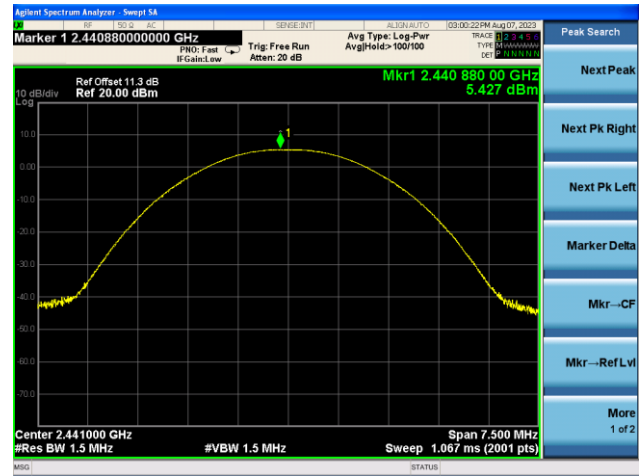


## 2DH5 Output Power

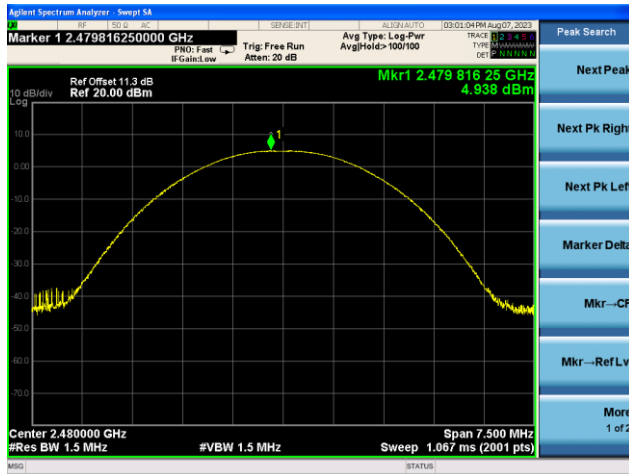
## Channel 00 (2402MHz)



## Channel 39 (2441MHz)

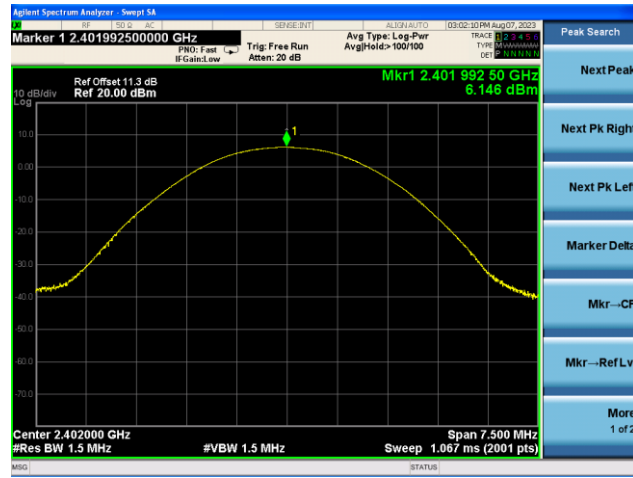


## Channel 78 (2480MHz)



### 3DH5 Output Power

#### Channel 00 (2402MHz)



#### Channel 39 (2441MHz)



#### Channel 78 (2480MHz)



#### A.4 Carrier Frequency Separation Test Result

|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-07 |               |             |

| Test Mode | Channel No. | Frequency (MHz) | Carrier Frequency Separation (kHz) | Limit (kHz)   | Result |
|-----------|-------------|-----------------|------------------------------------|---------------|--------|
| DH5       | 00          | 2402            | 1000                               | $\geq 642.00$ | Pass   |
| DH5       | 39          | 2441            | 1000                               | $\geq 641.67$ | Pass   |
| DH5       | 78          | 2480            | 1000                               | $\geq 641.47$ | Pass   |
| 2DH5      | 00          | 2402            | 1000                               | $\geq 876.67$ | Pass   |
| 2DH5      | 39          | 2441            | 1000                               | $\geq 878.00$ | Pass   |
| 2DH5      | 78          | 2480            | 1000                               | $\geq 877.33$ | Pass   |
| 3DH5      | 00          | 2402            | 1000                               | $\geq 869.33$ | Pass   |
| 3DH5      | 39          | 2441            | 1000                               | $\geq 866.67$ | Pass   |
| 3DH5      | 78          | 2480            | 1000                               | $\geq 869.33$ | Pass   |

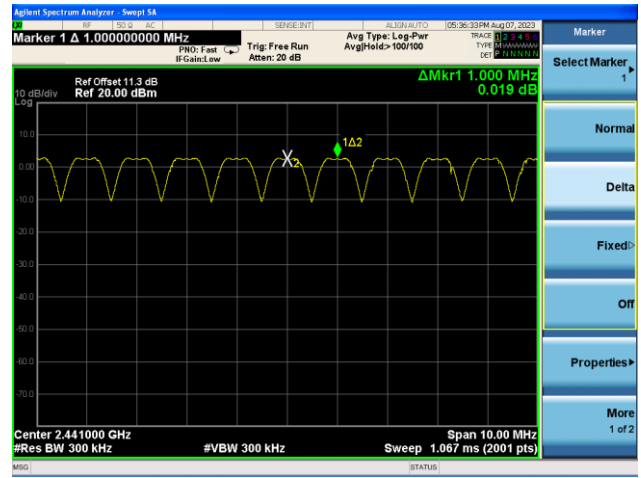
Note: The Limit is 2/3 the value of the 20dB BW.

## DH5 Carrier Frequency Separation

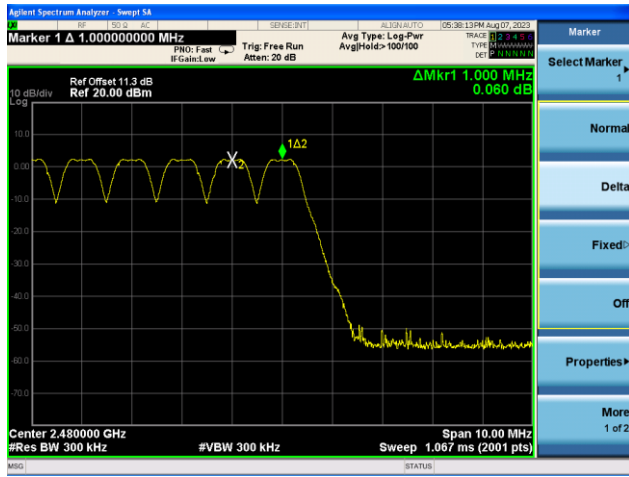
### Channel 00 (2402MHz)



### Channel 39 (2441MHz)



### Channel 78 (2480MHz)



## 2DH5 Carrier Frequency Separation

### Channel 00 (2402MHz)



### Channel 39 (2441MHz)



### Channel 78 (2480MHz)

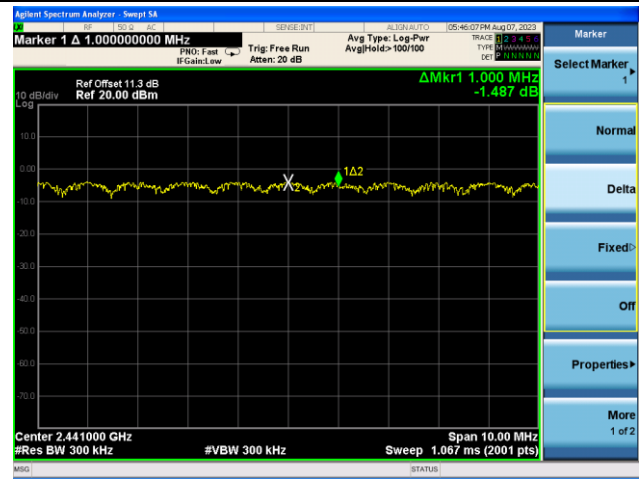


### 3DH5 Carrier Frequency Separation

Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



### A.5 Number of Hopping Channels Test Result

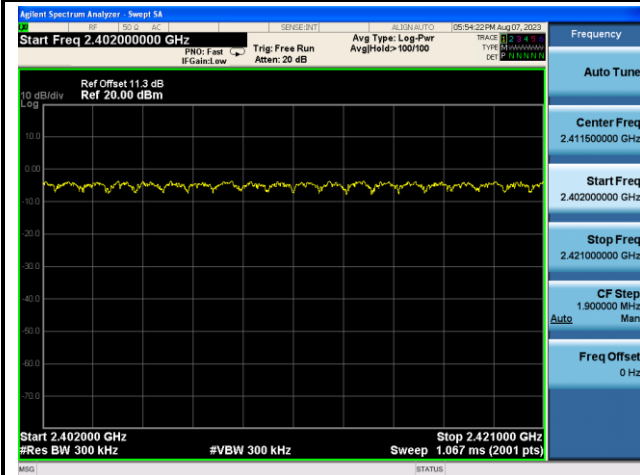
|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-07 |               |             |

| Test Mode (Hopping) | Channel Numbers | Frequency (MHz) | Limit (Hopping Channels) | Result |
|---------------------|-----------------|-----------------|--------------------------|--------|
| DH5                 | 79              | 2402~2480       | $\geq 15$                | Pass   |
| 2DH5                | 79              | 2402~2480       | $\geq 15$                | Pass   |
| 3DH5                | 79              | 2402~2480       | $\geq 15$                | Pass   |

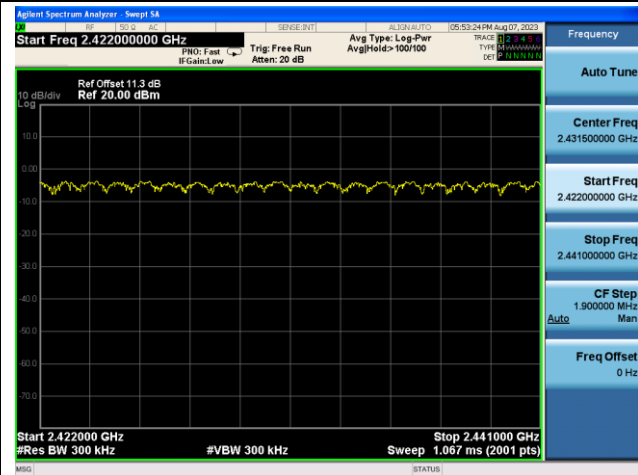


## 2DH5 Number of Hopping Channels

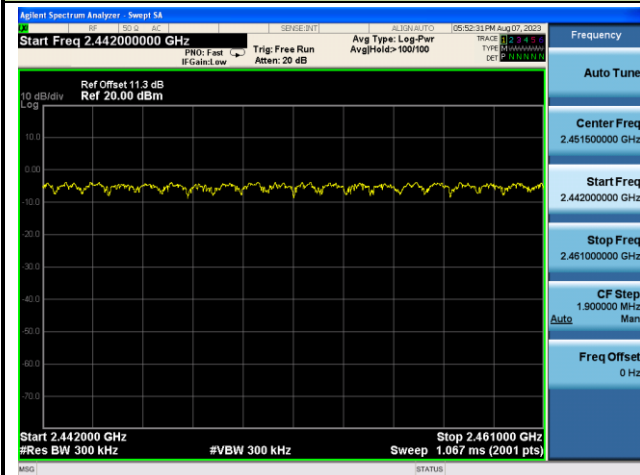
2402 ~ 2421MHz



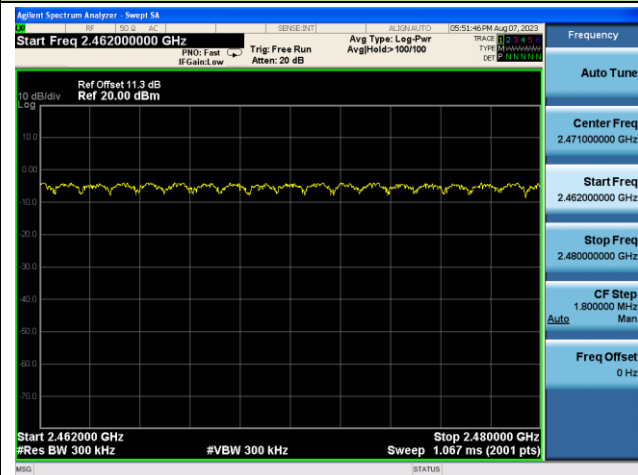
2422 ~ 2441MHz



2442 ~ 2461MHz

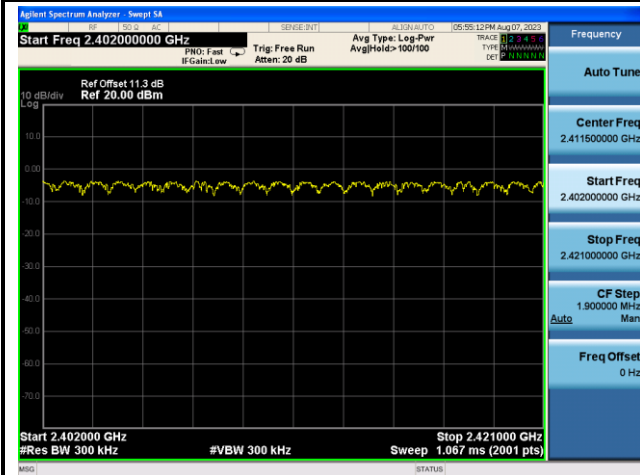


2462 ~ 2480MHz

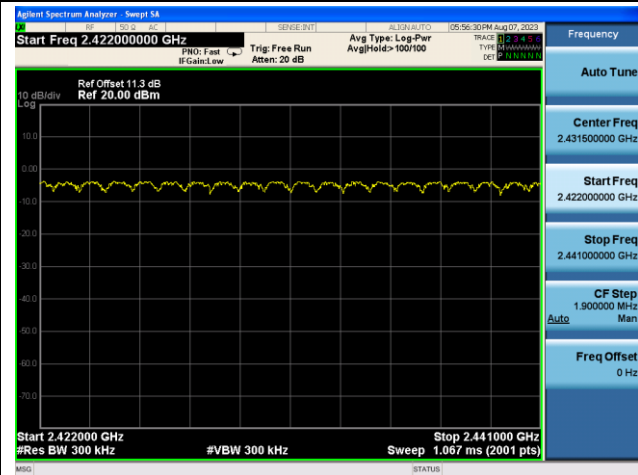


### 3DH5 Number of Hopping Channels

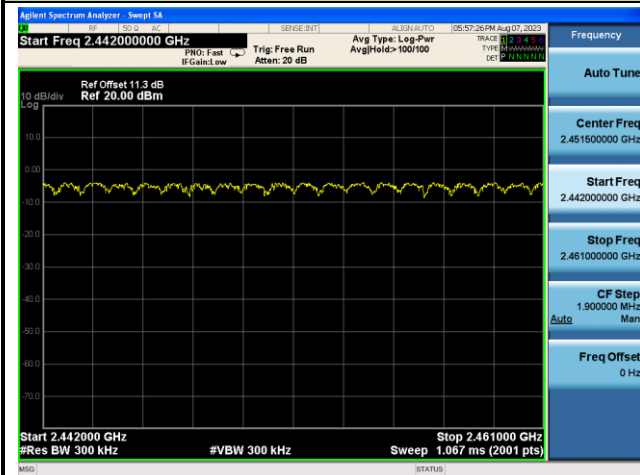
2402 ~ 2421MHz



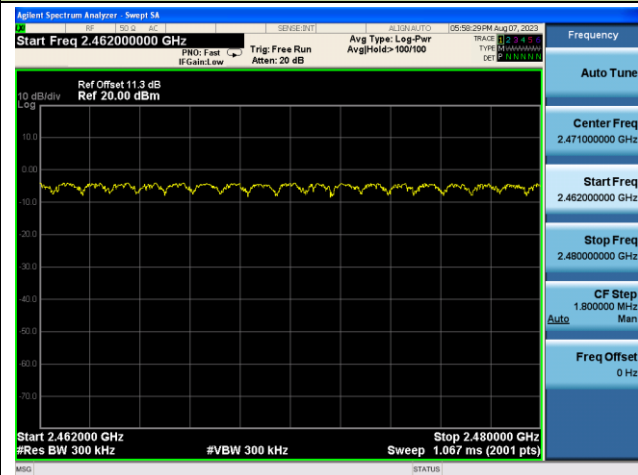
2422 ~ 2441MHz



2442 ~ 2461MHz



2462 ~ 2480MHz



### A.6 Time of Occupancy Test Result

|           |            |               |             |
|-----------|------------|---------------|-------------|
| Test Site | NS-TR2     | Test Engineer | Summer Tang |
| Test Date | 2023-08-08 |               |             |

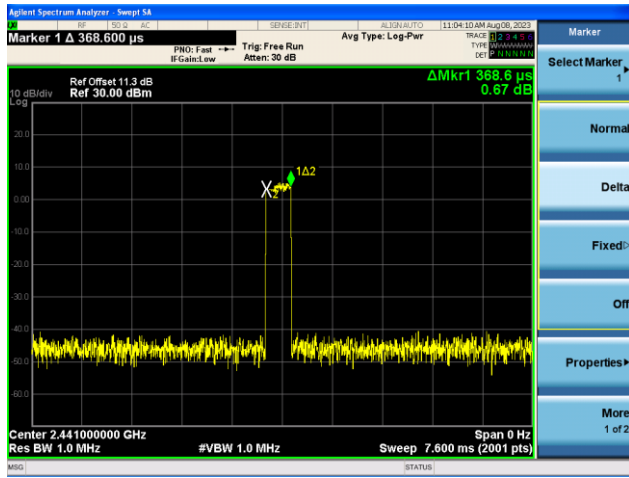
| Test Mode | Channel No. | Frequency (MHz) | Transmit Time Per Hop (ms) | Observation Period (s) | Number of Hops in Sweep Time | Number of Hops in Observation Period | Time of Occupancy (ms) | Limit (ms) | Result |
|-----------|-------------|-----------------|----------------------------|------------------------|------------------------------|--------------------------------------|------------------------|------------|--------|
| 3DH1      | 00~78       | 2402~2480       | 0.3686                     | 31.6                   | 58                           | 305                                  | 112.42                 | ≤ 400      | Pass   |
| 3DH3      | 00~78       | 2402~2480       | 1.605                      | 31.6                   | 30                           | 158                                  | 253.59                 | ≤ 400      | Pass   |
| 3DH5      | 00~78       | 2402~2480       | 2.800                      | 31.6                   | 17                           | 90                                   | 252.00                 | ≤ 400      | Pass   |

Note:

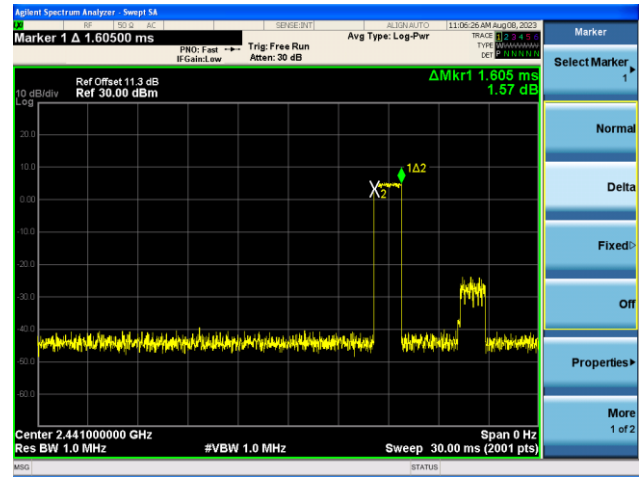
1. Number of Hops in Observation Period = Number of Hops in Sweep Time \* (Observation Period / Sweep Time), Sweep Time = 6.002s.
2. Time of Occupancy (ms) = Number of Hops in Sweep Time (ms) \* Number of Hops in Observation Period

# Transmit Time Per Hop

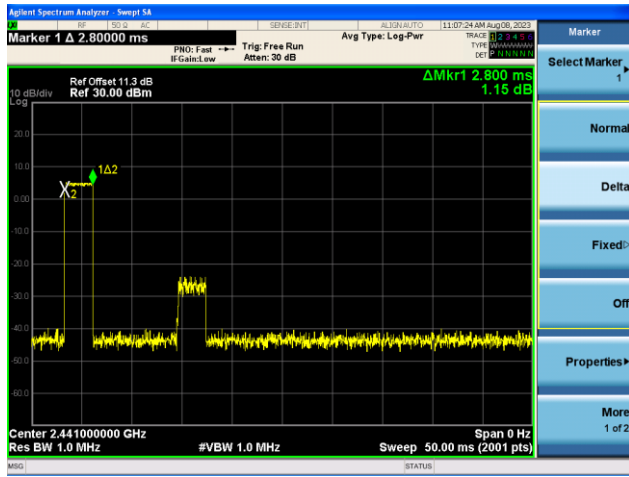
## 3DH1



## 3DH3

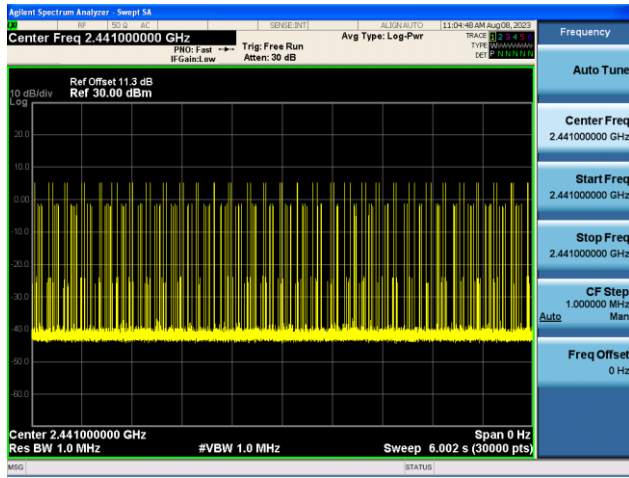


## 3DH5

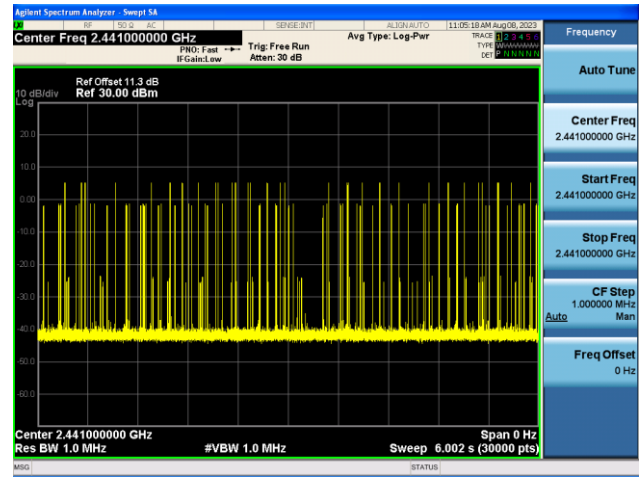


# Number of Hops in Sweep Time

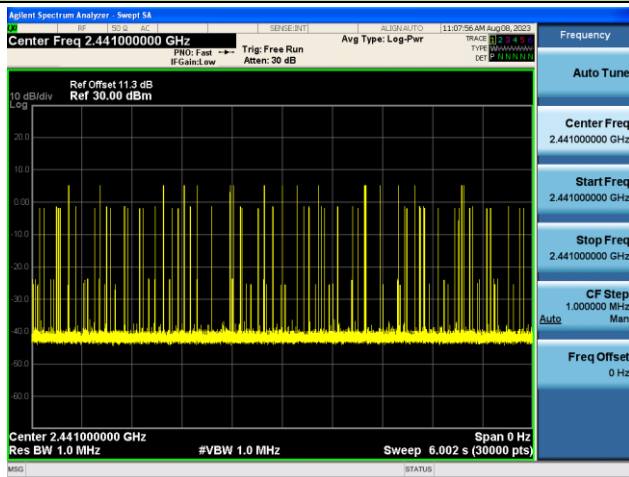
## 3DH1



## 3DH3



## 3DH5



### A.7 Band-edge Compliance Test Result

|           |                       |               |             |
|-----------|-----------------------|---------------|-------------|
| Test Site | NS-TR2                | Test Engineer | Summer Tang |
| Test Date | 2023-08-07~2023-08-08 |               |             |

| Test Mode | Channel No. | Frequency<br>(MHz) | Limit | Result |
|-----------|-------------|--------------------|-------|--------|
| DH5       | 00          | 2402               | 20dBc | Pass   |
| DH5       | 78          | 2480               | 20dBc | Pass   |
| 2DH5      | 00          | 2402               | 20dBc | Pass   |
| 2DH5      | 78          | 2480               | 20dBc | Pass   |
| 3DH5      | 00          | 2402               | 20dBc | Pass   |
| 3DH5      | 78          | 2480               | 20dBc | Pass   |