

# **TEST REPORT**

| Report No.:          | BCTC2410930951-1E                                |              |  |  |  |  |
|----------------------|--|--------------|--|--|--|--|
| Applicant:           | Shenzhen Qichang Intelligent Technology Co., Ltd |              |  |  |  |  |
| Product Name:        | Smart phone                                      |              |  |  |  |  |
| Test Model:          | S3   |              |  |  |  |  |
| Tested Date:         | 2024-10-14 to 2024-11-06                         |              |  |  |  |  |
| Issued Date:         | 2024-11-07                                       |              |  |  |  |  |
|                      |  |              |  |  |  |  |
| She                  | enzhen BCTC Testing Co., Ltd.                    |              |  |  |  |  |
|                      |  |              |  |  |  |  |
| No.: BCTC/RF-EMC-005 | Page: 1 of 83                                    | Edition: B.2 |  |  |  |  |



# FCC ID: 2BAK2-S3

| Product Name:         | Smart phone   |
|-----------------------|---|
| Trademark:            | <b>T</b> OSSIBOT  |
| Model/Type Reference: | S3<br>S3 Pro, S3 Plus, S3 P, S3 +   |
| Prepared For:         | Shenzhen Qichang Intelligent Technology Co., Ltd  |
| Address:              | Room 510, Building 7, Yunli Intelligent Park, No. 7, Bantian Street, Longgang ,<br>Shenzhen   |
| Manufacturer:         | Shenzhen Qichang Intelligent Technology Co., Ltd  |
| Address:              | Room 510, Building 7, Yunli Intelligent Park, No. 7, Bantian Street, Longgang ,<br>Shenzhen   |
| Prepared By:          | Shenzhen BCTC Testing Co., Ltd.   |
| Address:              | 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road,<br>Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China |
| Sample Received Date: | 2024-10-14  |
| Sample tested Date:   | 2024-10-14 to 2024-11-06  |
| Issue Date:           | 2024-11-07  |
| Report No.:           | BCTC2410930951-1E   |
| Test Standards        | FCC Part15.247<br>ANSI C63.10-2013  |
| Test Results          | PASS \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \  |
| Remark:               | This is Bluetooth Classic radio test report.  |
|                       |   |

Tested by:

Vare

Brave Zeng/ Project Handler

Approved by:

Zero Zhou/Reviewer

The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen BCTC Testing Co., Ltd, this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.



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(Note: N/A Means Not Applicable)

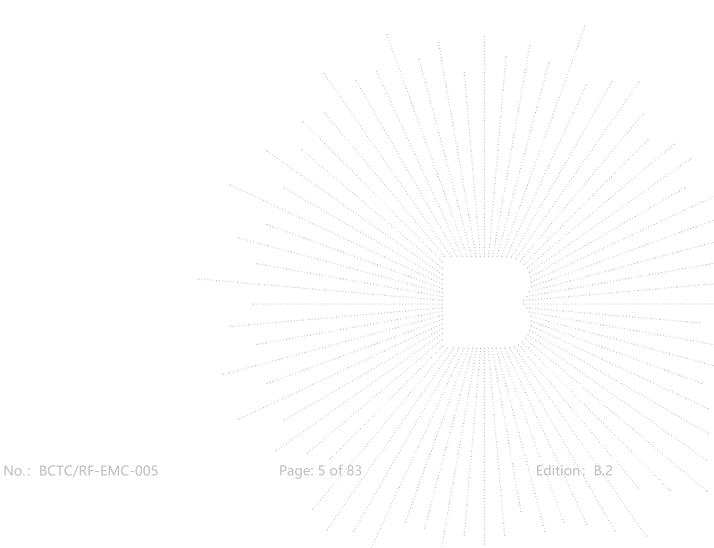
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# 1. Version

| Report No.        | Issue Date | Description | Approved |
|-------------------|------------|-------------|----------|
| BCTC2410930951-1E | 2024-11-07 | Original    | Valid    |
|                   |            |             |          |





# 2. Test Summary

The Product has been tested according to the following specifications:

| No. | Test Parameter                              | Clause No.                        | Results |
|-----|---|-----------------------------------|---------|
| 1   | Conducted emission AC power port            | §15.207                           | PASS    |
| 2   | Conducted peak output power for FHSS        | §15.247(b)(1)                     | PASS    |
| 3   | 20dB Occupied bandwidth                     | §15.247(a)(1)                     | PASS    |
| 4   | Hopping channel separation                  | §15.247(a)(1)                     | PASS    |
| 5   | Number of hopping frequencies               | §15.247(a)(1)(iii)                | PASS    |
| 6   | Dwell Time                                  | §15.247(a)(1)(iii)                | PASS    |
| 7   | Spurious RF conducted emissions             | §15.247(d)                        | PASS    |
| 8   | Band edge                                   | §15.247(d)                        | PASS    |
| 9   | Spurious radiated emissions for transmitter | §15.247(d) & §15.209 &<br>§15.205 | PASS    |
| 10  | Antenna Requirement                         | 15.203                            | PASS    |

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### 3. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product 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.

| No. | Item  | Uncertainty |
|-----|---|-------------|
| 1   | 3m chamber Radiated spurious<br>emission(30MHz-1GHz)  | U=4.3dB     |
| 2   | 3m chamber Radiated spurious emission(9KHz-30MHz)     | U=3.7dB     |
| 3   | 3m chamber Radiated spurious emission(1GHz-18GHz)     | U=4.5dB     |
| 4   | 3m chamber Radiated spurious<br>emission(18GHz-40GHz) | U=3.34dB    |
| 5   | Conducted Emission (150kHz-30MHz)                     | U=3.20dB    |
| 6   | Conducted Adjacent channel power                      | U=1.38dB    |
| 7   | Conducted output power uncertainty Above 1G           | U=1.576dB   |
| 8   | Conducted output power uncertainty below 1G           | U=1.28dB    |
| 9   | humidity uncertainty                                  | U=5.3%      |
| 10  | Temperature uncertainty                               | U=0.59°C    |



# 4. Product Information And Test Setup

#### 4.1 Product Information

| Model/Type reference: | S3<br>S3 Pro, S3 Plus, S3 P, S3 +  |
|-----------------------|--|
| Model differences:    | All the model are the same circuit and RF module, except model names.  |
| Bluetooth Version:    | 5.0  |
| Hardware Version:     | E1A_01   |
| Software Version:     | FOSSiBOT_S3_E  |
| Operation Frequency:  | 2402-2480MHz   |
| Type of Modulation:   | GFSK, π/ 4 DQPSK, 8DPSK  |
| Number Of Channel     | 79CH   |
| Antenna installation: | Internal antenna   |
|                       | -1.9 dBi   |
| Antenna Gain:         | Remark:<br>The antenna gain of the product comes from the antenna report provided by the customer, and the test data is affected by the customer information.<br>The antenna gain of the product is provided by the customer, and the test data is affected by the customer information. |
| Ratings:              | DC 9V from adapter/DC 3.87V from battery   |
| Adapter Information:  | Model: TPD-203A120167UF01<br>Input: 100-240V~ 50/60Hz 0.6A<br>USB-C Output: 5.0V 3A or 9.0V 2.22A or 12.0V 1.67A   |

# 4.2 Test Setup Configuration

See test photographs attached in *EUT TEST SETUP PHOTOGRAPHS* for the actual connections between Product and support equipment.



# 4.3 Support Equipment

| No. | Device Type | Brand           | Model                  | Series No. | Note      |
|-----|-------------|-----------------|------------------------|------------|-----------|
| E-1 | Smart phone | <b>O</b> SSIBOT | S3                     | N/A        | EUT       |
| E-2 | Adapter     | N/A             | TPD-203A12<br>0167UF01 | N/A        | Auxiliary |

| ltem | Shielded Type | Ferrite Core | Length | Note                |
|------|---------------|--------------|--------|---------------------|
| C-1  | N/A           | N/A          | 1M     | DC cable unshielded |

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

#### 4.4 Channel List

| СН | Frequency<br>(MHz) | СН | Frequency<br>(MHz) | СН | Frequency<br>(MHz) | СН | Frequency<br>(MHz) |
|----|--------------------|----|--------------------|----|--------------------|----|--------------------|
| 0  | 2402               | 1  | 2403               | 2  | 2404               | 3  | 2405               |
| 4  | 2406               | 5  | 2407               | 6  | 2408               | 7  | 2409               |
| 8  | 2410               | 9  | 2411               | 10 | 2412               | 11 | 2413               |
| 12 | 2414               | 13 | 2415               | 14 | 2416               | 15 | 2417               |
| 16 | 2418               | 17 | 2419               | 18 | 2420               | 19 | 2421               |
| 20 | 2422               | 21 | 2423               | 22 | 2424               | 23 | 2425               |
| 24 | 2426               | 25 | 2427               | 26 | 2428               | 27 | 2429               |
| 28 | 2430               | 29 | 2431               | 30 | 2432               | 31 | 2433               |
| 32 | 2434               | 33 | 2435               | 34 | 2436               | 35 | 2437               |
| 36 | 2438               | 37 | 2439               | 38 | 2440               | 39 | 2441               |
| 40 | 2442               | 41 | 2443               | 42 | 2444               | 43 | 2445               |
| 44 | 2446               | 45 | 2447               | 46 | 2448               | 47 | 2449               |
| 48 | 2450               | 49 | 2451               | 50 | 2452               | 51 | 2453               |
| 52 | 2454               | 53 | 2455               | 54 | 2456               | 55 | 2457               |
| 56 | 2458               | 57 | 2459               | 58 | 2460               | 59 | 2461               |
| 60 | 2462               | 61 | 2463               | 62 | 2464               | 63 | 2465               |
| 64 | 2466               | 65 | 2467               | 66 | 2468               | 67 | 2469               |
| 68 | 2470               | 69 | 2471               | 70 | 2472               | 71 | 2473               |
| 72 | 2474               | 73 | 2475               | 74 | 2476               | 75 | 2477               |
| 76 | 2478               | 77 | 2479               | 78 | 2480               | 79 |                    |



#### 4.5 Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Test Mode | Test mode                | Low channel | Middle channel | High channel |
|-----------|--------------------------|-------------|----------------|--------------|
| 1         | Transmitting(GFSK)       | 2402MHz     | 2441MHz        | 2480MHz      |
| 2         | Transmitting(π/ 4 DQPSK) | 2402MHz     | 2441MHz        | 2480MHz      |
| 3         | Transmitting(8DPSK)      | 2402MHz     | 2441MHz        | 2480MHz      |
| 4         |                          | Link        |                |              |

Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

(2) Fully-charged battery is used during the test

#### 4.6 Table Of Parameters Of Text Software Setting

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters

| Test software Version | CMD      |          |          |  |  |
|-----------------------|----------|----------|----------|--|--|
| Frequency             | 2402 MHz | 2441 MHz | 2480 MHz |  |  |
| Parameters            | DEF      | DEF      | DEF      |  |  |



#### 5. Test Facility And Test Instrument Used

#### 5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Testing Co., Ltd. Address: 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards. FCC Test Firm Registration Number: 712850 A2LA certificate registration number is: CN1212 ISED Registered No.: 23583

ISED CAB identifier: CN0017

| Conducted Emissions Test |   |            |             |              |              |  |  |  |
|--------------------------|---|------------|-------------|--------------|--------------|--|--|--|
| Equipment                | Equipment Manufacturer Model# Serial# Last Cal. Next Cal. |            |             |              |              |  |  |  |
| Receiver                 | R&S   | ESR3       | 102075      | May 16, 2024 | May 15, 2025 |  |  |  |
| LISN                     | R&S   | ENV216     | 101375      | May 16, 2024 | May 15, 2025 |  |  |  |
| Software                 | Frad  | EZ-EMC     | EMC-CON 3A1 | \            | ١            |  |  |  |
| Pulse limiter            | Schwarzbeck   | VTSD9561-F | 01323       | May 16, 2024 | May 15, 2025 |  |  |  |

#### 5.2 Test Instrument Used

| RF Conducted Test                   |              |                |            |               |               |  |  |
|-------------------------------------|--------------|----------------|------------|---------------|---------------|--|--|
| Equipment                           | Manufacturer | Model#         | Serial#    | Last Cal.     | Next Cal.     |  |  |
| Power meter                         | Keysight     | E4419          | 1          | May 16, 2024  | May 15, 2025  |  |  |
| Power Sensor<br>(AV)                | Keysight     | E9300A         |            | May 16, 2024  | May 15, 2025  |  |  |
| Signal<br>Analyzer20kH<br>z-26.5GHz | Keysight     | N9020A         | MY49100060 | May 16, 2024  | May 15, 2025  |  |  |
| Spectrum<br>Analyzer9kHz-<br>40GHz  | R&S          | FSP40          | 100363     | May 16, 2024  | May 15, 2025  |  |  |
| Communication test set              | R&S          | CMW500         | 126173     | Nov. 13. 2023 | Nov. 12, 2024 |  |  |
| Radio<br>frequency<br>control box   | MAIWEI       | MW200-RFC<br>B |            |               |               |  |  |
| Software                            | MAIWEI       | MTS 8200       | ·····      |               | L.            |  |  |



| Radiated Emissions Test (966 Chamber01) |                                     |                   |                  |              |              |  |  |  |
|---|-------------------------------------|-------------------|------------------|--------------|--------------|--|--|--|
| Equipment                               | Manufacturer                        | Model#            | Serial#          | Last Cal.    | Next Cal.    |  |  |  |
| 966 chamber                             | ChengYu                             | Yu 966 Room 966   |                  | May 15, 2023 | May 14, 2026 |  |  |  |
| Receiver                                | R&S                                 | ESR3              | 102075           | May 16, 2024 | May 15, 2025 |  |  |  |
| Receiver                                | R&S                                 | ESRP              | 101154           | May 16, 2024 | May 15, 2025 |  |  |  |
| Amplifier                               | Schwarzbeck                         | BBV9744           | 9744-0037        | May 16, 2024 | May 15, 2025 |  |  |  |
| TRILOG<br>Broadband<br>Antenna          | Schwarzbeck                         | VULB9163          | 942              | May 21, 2024 | May 20, 2025 |  |  |  |
| Loop<br>Antenna(9KHz<br>-30MHz)         | tenna <sup>(</sup> 9KHz Schwarzbeck |                   | FMZB1519B 00014  |              | May 20, 2025 |  |  |  |
| Amplifier                               | olifier SKET LAP                    |                   | SK202104090<br>1 | May 16, 2024 | May 15, 2025 |  |  |  |
| Horn Antenna                            | Schwarzbeck                         | BBHA9120D         | 1541             | May 21, 2024 | May 20, 2025 |  |  |  |
| Amplifier(18G<br>Hz-40GHz)              | MITEQ                               | TTA1840-35-<br>HG | 2034381          | May 16, 2024 | May 15, 2025 |  |  |  |
| Horn<br>Antenna(18G<br>Hz-40GHz)        | Schwarzbeck                         | BBHA9170          | 00822            | May 21, 2024 | May 20, 2025 |  |  |  |
| Spectrum<br>Analyzer9kHz-<br>40GHz      | R&S                                 | FSP40             | 100363           | May 16, 2024 | May 15, 2025 |  |  |  |
| Communication test set                  | R&S                                 | CMW500            | 126173           | May 16, 2024 | May 15, 2025 |  |  |  |
| Software                                | Frad                                | EZ-EMC            | FA-03A2 RE       | \            | \            |  |  |  |

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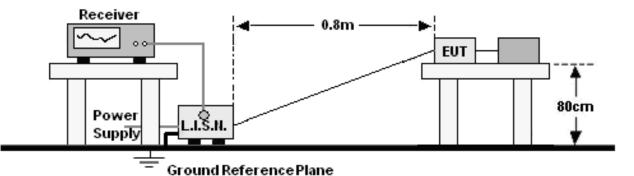
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#### 6. Conducted Emissions

#### 6.1 Block Diagram Of Test Setup



#### 6.2 Limit

|                 | Limit (dBuV) |           |  |  |  |
|-----------------|--------------|-----------|--|--|--|
| Frequency (MHz) | Quas-peak    | Average   |  |  |  |
| 0.15 -0.5       | 66 - 56 *    | 56 - 46 * |  |  |  |
| 0.50 -5.0       | 56.00        | 46.00     |  |  |  |
| 5.0 -30.0       | 60.00        | 50.00     |  |  |  |

Notes:

1. \*Decreasing linearly with logarithm of frequency.

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

#### 6.3 Test procedure

| Setting  |
|----------|
| 10 dB    |
| 0.15 MHz |
| 30 MHz   |
| 9 kHz    |
|          |

a. The Product was placed on a nonconductive table 0.8 m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).

b. The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.

c. For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

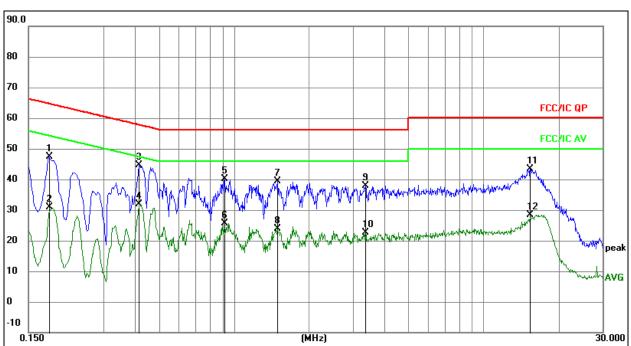
#### 6.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.



#### 6.5 Test Result

| Temperature: | <b>26</b> ℃ | Relative Humidity: | 54%         |
|--------------|-------------|--------------------|-------------|
| Pressure:    | 101KPa      | Phase :            | L           |
| Test Mode:   | Mode 4      | Test Voltage :     | AC120V/60Hz |



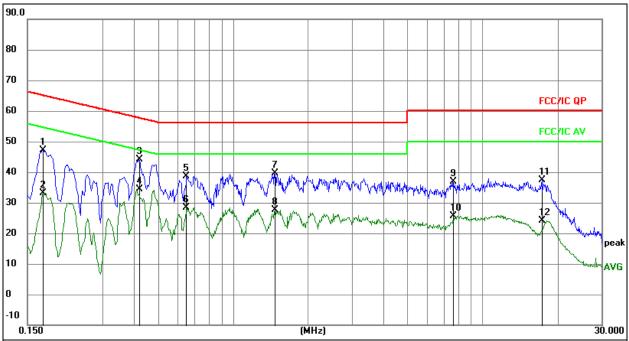
#### Remark:

All readings are Quasi-Peak and Average values.
 Factor = Insertion Loss + Cable Loss.
 Measurement = Reading Level + Correct Factor
 Over = Measurement - Limit

| -   |     |         | -                |                   |                  |       |        |          |
|-----|-----|---------|------------------|-------------------|------------------|-------|--------|----------|
| No. | Mk. | Freq.   | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limit | Over   |          |
|     |     | MHz     |                  | dB                | dBuV             | dBuV  | dB     | Detector |
| 1   |     | 0.1806  | 27.22            | 20.07             | 47.29            | 64.46 | -17.17 | QP       |
| 2   |     | 0.1806  | 10.78            | 20.07             | 30.85            | 54.46 | -23.61 | AVG      |
| 3   | *   | 0.4148  | 24.61            | 20.08             | 44.69            | 57.55 | -12.86 | QP       |
| 4   |     | 0.4148  | 11.84            | 20.08             | 31.92            | 47.55 | -15.63 | AVG      |
| 5   |     | 0.9136  | 20.14            | 20.09             | 40.23            | 56.00 | -15.77 | QP       |
| 6   |     | 0.9136  | 5.53             | 20.09             | 25.62            | 46.00 | -20.38 | AVG      |
| 7   |     | 1.4953  | 19.21            | 20.09             | 39.30            | 56.00 | -16.70 | QP       |
| 8   |     | 1.4953  | 3.68             | 20.09             | 23.77            | 46.00 | -22.23 | AVG      |
| 9   |     | 3.3635  | 17.69            | 20.13             | 37.82            | 56.00 | -18.18 | QP       |
| 10  |     | 3.3635  | 2.52             | 20.13             | 22.65            | 46.00 | -23.35 | AVG      |
| 11  |     | 15.3883 | 23.04            | 20.31             | 43.35            | 60.00 | -16.65 | QP       |
| 12  |     | 15.3883 | 8.19             | 20.31             | 28.50            | 50.00 | -21.50 | AVG      |



| Temperature: | <b>26</b> ℃ | Relative Humidity: | 54%         |
|--------------|-------------|--------------------|-------------|
| Pressure:    | 101KPa      | Phase :            | Ν           |
| Test Mode:   | Mode 4      | Test Voltage :     | AC120V/60Hz |



Remark:

All readings are Quasi-Peak and Average values.
 Factor = Insertion Loss + Cable Loss.

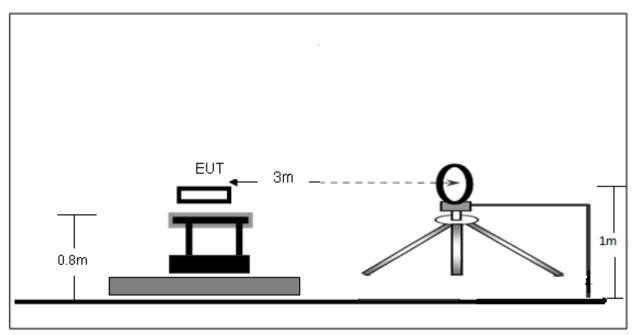
| <ol><li>Facto</li></ol> | r = Inser | tion Loss + ( | Cable Loss.    |          |          |       |        | 1        |
|-------------------------|-----------|---------------|----------------|----------|----------|-------|--------|----------|
| 3. Meas                 | urement   | = Reading L   | _evel + Correc | t Factor |          |       |        | 1        |
| 4. Over                 | = Measu   | irement - Lin | nit            |          |          |       |        |          |
|                         |           |               | Reading        | Correct  | Measure- |       |        |          |
| No.                     | Mk.       | Freq.         | Level          | Factor   | ment     | Limit | Over   |          |
|                         |           | MHz           |                | dB       | dBu∨     | dBuV  | dB     | Detector |
| 1                       |           | 0.1722        | 26.99          | 20.07    | 47.06    | 64.85 | -17.79 | QP       |
| 2                       |           | 0.1722        | 13.18          | 20.07    | 33.25    | 54.85 | -21.60 | AVG      |
| 3                       |           | 0.4193        | 24.04          | 20.08    | 44.12    | 57.46 | -13.34 | QP       |
| 4                       | *         | 0.4193        | 14.18          | 20.08    | 34.26    | 47.46 | -13.20 | AVG      |
| 5                       |           | 0.6508        | 18.61          | 20.09    | 38.70    | 56.00 | -17.30 | QP       |
| 6                       |           | 0.6508        | 8.29           | 20.09    | 28.38    | 46.00 | -17.62 | AVG      |
| 7                       |           | 1.4640        | 19.44          | 20.09    | 39.53    | 56.00 | -16.47 | QP       |
| 8                       |           | 1.4640        | 7.55           | 20.09    | 27.64    | 46.00 | -18.36 | AVG      |
| 9                       |           | 7.6060        | 16.84          | 20.16    | 37.00    | 60.00 | -23.00 | QP       |
| 10                      |           | 7.6060        | 5.47           | 20.16    | 25.63    | 50.00 | -24.37 | AVG      |
| 11                      |           | 17.2908       | 17.18          | 20.32    | 37.50    | 60.00 | -22.50 | QP       |
| 12                      |           | 17.2908       | 3.88           | 20.32    | 24.20    | 50.00 | -25.80 | AVG      |
|                         |           |               |                |          |          |       |        |          |



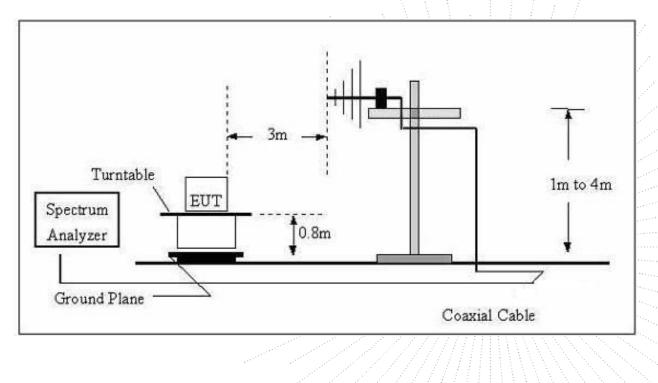
#### 7. Radiated emissions

### 7.1 Block Diagram Of Test Setup

(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz





# Turntable EUT 1.5m Im to 4m Ground Plane Ground Plane

#### (C) Radiated Emission Test-Up Frequency Above 1GHz

#### 7.2 Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequency     | Field Strength | Distance | Field Strength Limit at 3m Distance |                                      |  |
|---------------|----------------|----------|-------------------------------------|--------------------------------------|--|
| (MHz)         | uV/m           | (m)      | uV/m                                | dBuV/m                               |  |
| 0.009 ~ 0.490 | 2400/F(kHz)    | 300      | 10000 * 2400/F(kHz)                 | 20log <sup>(2400/F(kHz))</sup> + 80  |  |
| 0.490 ~ 1.705 | 24000/F(kHz)   | 30 .     | 100 * 24000/F(kHz)                  | 20log <sup>(24000/F(kHz))</sup> + 40 |  |
| 1.705 ~ 30    | 30             | 30       | 100 * 30                            | 20log <sup>(30)</sup> + 40           |  |
| 30 ~ 88       | 100            | 3        | 100                                 | 20log <sup>(100)</sup>               |  |
| 88 ~ 216      | 150            | 3        | 150                                 | 20log <sup>(150)</sup>               |  |
| 216 ~ 960     | 200            | 3        | 200                                 | 20log <sup>(200)</sup>               |  |
| Above 960     | 500            | 3        | 500                                 | 20log <sup>(500)</sup>               |  |

Limits Of Radiated Emission Measurement (Above 1000MHz)

|                 | Limit (dBuV/m) (at 3M) |         |
|-----------------|------------------------|---------|
| Frequency (MHz) | Peak                   | Average |
| Above 1000      | 74                     | 54      |

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).



Frequency Range Of Radiated Measurement

(a) For an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator operates at or above 95 GHz: To the third harmonic of the highest fundamental frequency or to 750 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.
(5) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up

to the range specified in paragraphs (a) (1)through (4) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

#### 7.3 Test procedure

| Receiver Parameter | Setting           |  |  |
|--------------------|-------------------|--|--|
| Attenuation        | Auto              |  |  |
| 9kHz~150kHz        | RBW 200Hz for QP  |  |  |
| 150kHz~30MHz       | RBW 9kHz for QP   |  |  |
| 30MHz~1000MHz      | RBW 120kHz for QP |  |  |

| Spectrum Parameter | Setting  |
|--------------------|--|
| 1-25GHz            | RBW 1 MHz /VBW 1 MHz for Peak,<br>RBW 1 MHz / VBW 10Hz for Average |

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.



Above 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel, the middlest channel, the Highest channel. Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

#### 7.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

#### 7.5 Test Result

Below 30MHz

| Temperature: | <b>26</b> ℃ | Relative Humidity: | 54%         |
|--------------|-------------|--------------------|-------------|
| Pressure:    | 101KPa      | Test Voltage:      | AC120V/60Hz |
| Test Mode:   | Mode 4      | Polarization :     |             |
|              |             |                    |             |

| Freq. | Reading  | Limit Margin  | State |
|-------|----------|---------------|-------|
| (MHz) | (dBuV/m) | (dBuV/m) (dB) | P/F   |
|       |          |               | PASS  |
|       |          |               | PASS  |

Note:

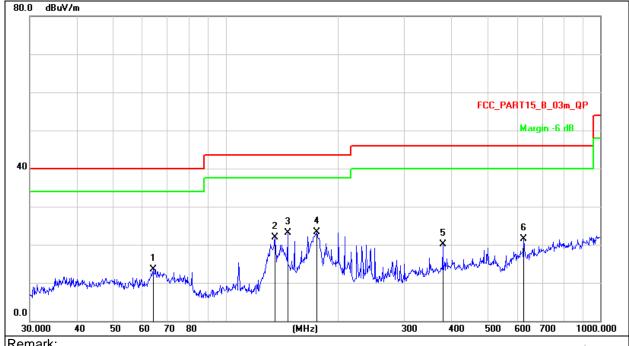
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB); Limit line = specific limits(dBuv) + distance extrapolation factor.



| Temperature: | <b>26</b> ℃ | Relative Humidity: | 54%         |
|--------------|-------------|--------------------|-------------|
| Pressure:    | 101KPa      | Phase :            | Horizontal  |
| Test Mode:   | Mode 4      | Test Voltage:      | AC120V/60Hz |





#### Remark:

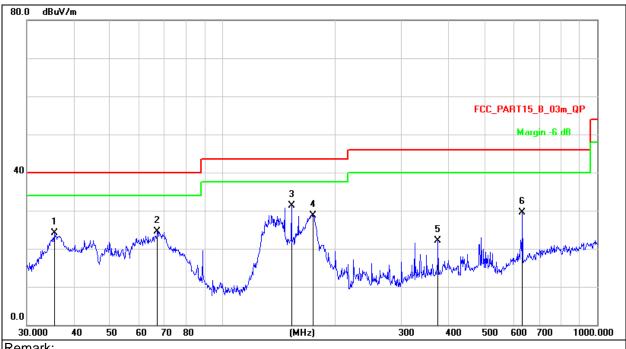
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement = Reading Level + Correct Factor
 Over = Measurement - Limit

| No. | Mk. | Freq.    | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limit | Over   |          |
|-----|-----|----------|------------------|-------------------|------------------|-------|--------|----------|
|     |     | MHz      | dBuV             | dB                | dBuV/m           | dB/m  | dB     | Detector |
| 1   |     | 63.9828  | 29.84            | -16.35            | 13.49            | 40.00 | -26.51 | QP       |
| 2   |     | 135.5062 | 40.38            | -18.42            | 21.96            | 43.50 | -21.54 | QP       |
| 3   |     | 146.3735 | 42.35            | -19.18            | 23.17            | 43.50 | -20.33 | QP       |
| 4   | *   | 175.0368 | 40.92            | -17.57            | 23.35            | 43.50 | -20.15 | QP       |
| 5   | ;   | 379.9141 | 31.13            | -11.10            | 20.03            | 46.00 | -25.97 | QP       |
| 6   |     | 625.0780 | 28.19            | -6.59             | 21.60            | 46.00 | -24.40 | QP       |



| Temperature: | <b>26</b> ℃ | Relative Humidity: | 54%         |
|--------------|-------------|--------------------|-------------|
| Pressure:    | 101KPa      | Phase :            | Vertical    |
| Test Mode:   | Mode 4      | Test Voltage:      | AC120V/60Hz |



#### Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement = Reading Level + Correct Factor
 Over = Measurement - Limit

| No. | Mk. | Freq.    | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limit | Over   |          |
|-----|-----|----------|------------------|-------------------|------------------|-------|--------|----------|
|     |     | MHz      | dBuV             | dB                | dBuV/m           | dB/m  | dB     | Detector |
| 1   |     | 35.4993  | 39.63            | -15.59            | 24.04            | 40.00 | -15.96 | QP       |
| 2   |     | 66.9669  | 41.63            | -17.17            | 24.46            | 40.00 | -15.54 | QP       |
| 3   | * , | 152.6641 | 50.53            | -19.23            | 31.30            | 43.50 | -12.20 | QP       |
| 4   |     | 174.4241 | 46.34            | -17.62            | 28.72            | 43.50 | -14.78 | QP       |
| 5   | 3   | 375.9385 | 33.34            | -11.15            | 22.19            | 46.00 | -23.81 | QP       |
| 6   | (   | 631.6884 | 36.01            | -6.47             | 29.54            | 46.00 | -16.46 | QP       |
|     |     |          |                  |                   |                  |       |        |          |



| Polar | Fre-<br>quency   | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limits   | Over   | Detector |
|-------|------------------|------------------|-------------------|------------------|----------|--------|----------|
| (H/V) | (MHz)            | (dBuV/m)         | (dB)              | (dBuV/m)         | (dBuV/m) | (dB)   | Туре     |
|       | GFSK Low channel |                  |                   |                  |          |        |          |
| V     | 4804.00          | 74.72            | -19.99            | 54.73            | 74.00    | -19.27 | PK       |
| V     | 4804.00          | 66.07            | -19.99            | 46.08            | 54.00    | -7.92  | AV       |
| V     | 7206.00          | 67.06            | -14.22            | 52.84            | 74.00    | -21.16 | PK       |
| V     | 7206.00          | 56.20            | -14.22            | 41.98            | 54.00    | -12.02 | AV       |
| Н     | 4804.00          | 70.99            | -19.99            | 51.00            | 74.00    | -23.00 | PK       |
| Н     | 4804.00          | 60.29            | -19.99            | 40.30            | 54.00    | -13.70 | AV       |
| Н     | 7206.00          | 65.58            | -14.22            | 51.36            | 74.00    | -22.64 | PK       |
| Н     | 7206.00          | 56.66            | -14.22            | 42.44            | 54.00    | -11.56 | AV       |
|       |                  |                  | GFSK Mide         | dle channel      |          |        |          |
| V     | 4882.00          | 72.77            | -19.84            | 52.93            | 74.00    | -21.07 | PK       |
| V     | 4882.00          | 64.04            | -19.84            | 44.20            | 54.00    | -9.80  | AV       |
| V     | 7323.00          | 61.96            | -13.90            | 48.06            | 74.00    | -25.94 | PK       |
| V     | 7323.00          | 53.13            | -13.90            | 39.23            | 54.00    | -14.77 | AV       |
| Н     | 4882.00          | 70.22            | -19.84            | 50.38            | 74.00    | -23.62 | PK       |
| Н     | 4882.00          | 59.23            | -19.84            | 39.39            | 54.00    | -14.61 | AV       |
| Н     | 7323.00          | 60.75            | -13.90            | 46.85            | 74.00    | -27.15 | PK       |
| Н     | 7323.00          | 52.78            | -13.90            | 38.88            | 54.00    | -15.12 | AV       |
|       |                  |                  | GFSK Hig          | h channel        |          |        | 1        |
| V     | 4960.00          | 73.99            | -19.68            | 54.31            | 74.00    | -19.69 | PK       |
| V     | 4960.00          | 63.32            | -19.68            | 43.64            | 54.00    | -10.36 | AV       |
| V     | 7440.00          | 65.55            | -13.57            | 51.98            | 74.00    | -22.02 | PK       |
| V     | 7440.00          | 55.02            | -13.57            | 41.45            | 54.00    | -12.55 | AV       |
| Н     | 4960.00          | 71.52            | -19.68            | 51.84            | 74.00    | -22.16 | PK       |
| Н     | 4960.00          | 61.08            | -19.68            | 41.40            | 54.00    | -12.60 | AV       |
| Н     | 7440.00          | 64.29            | -13.57            | 50.72            | 74.00    | -23.28 | PK       |
| Н     | 7440.00          | 55.68            | -13.57            | 42.11            | 54.00    | -11.89 | AV       |

#### Between 1GHz - 25GHz

Remark:

1.Measurement = Reading Level + Correct Factor,

Correct Factor = Antenna Factor + Cable Loss - Pre-amplifier,

Over= Measurement - Limit

2.If peak below the average limit, the average emission was no test.

3. In restricted bands of operation, The spurious emissions below the permissible value more than 20dB

4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

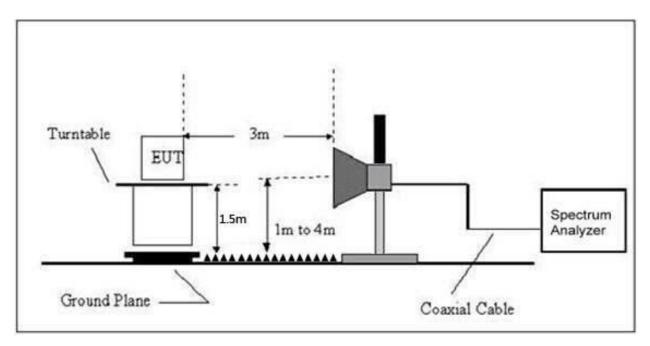
5.All the Modulation are test, the worst mode is GFSK, the data recording in the report.



#### 8. Radiated Band Emission Measurement And Restricted Bands Of Operation

#### 8.1 Block Diagram Of Test Setup

Radiated Emission Test-Up Frequency Above 1GHz



#### 8.2 Limit

FCC Part15 C Section 15.209 and 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                      | MHz                 | MHz           | 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              | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4        |
| 8.37625-8.38675          | 156.7-156.9         | 2690-2900     | 22.01-23.12      |
| 8.41425-8.41475          | 162.0125-167.17     | 3260-3267     | 23.6-24.0        |
| 12.29-12.293             | 167.72-173.2        | 3332-3339     | 31.2-31.8        |
| 12.51975-12.52025        | 240-285             | 3345.8-3358   | 36.43-36.5       |
| 12.57675-12.57725        | 322-335.4           | 3600-4400     | ( <sup>2</sup> ) |
| 13.36-13.41              |                     |               |                  |



#### Limits Of Radiated Emission Measurement (Above 1000MHz)

|                 | Limit (dBuV/m) (at 3M) |         |  |  |
|-----------------|------------------------|---------|--|--|
| Frequency (MHz) | Peak                   | Average |  |  |
| Above 1000      | 74                     | 54      |  |  |

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

#### 8.3 Test procedure

| Receiver Parameter                    | Setting  |  |  |  |
|---------------------------------------|--|--|--|--|
| Attenuation                           | Auto   |  |  |  |
| Start Frequency                       | 2300MHz  |  |  |  |
| Stop Frequency                        | 2520   |  |  |  |
| RB / VB (Emission In Restricted Band) | 1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average |  |  |  |

Above 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel, the middlest channel, the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

#### 8.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.



#### 8.5 Test Result

| Test mode | Polar<br>(H/V)       | Fre-<br>quency<br>(MHz) | Reading<br>Level<br>(dBuV/m) | Correct<br>Factor<br>(dB) | Measure-<br>ment<br>(dBuV/m)<br>PK | Limits<br>(dBuV/m) |       | Result |  |
|-----------|----------------------|-------------------------|------------------------------|---------------------------|------------------------------------|--------------------|-------|--------|--|
|           |                      |                         |                              |                           |                                    | PK                 | AV    |        |  |
|           | Low Channel 2402MHz  |                         |                              |                           |                                    |                    |       |        |  |
| GFSK      | Н                    | 2390.00                 | 71.51                        | -25.43                    | 46.08                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2400.00                 | 74.98                        | -25.40                    | 49.58                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2390.00                 | 72.07                        | -25.43                    | 46.64                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2400.00                 | 76.11                        | -25.40                    | 50.71                              | 74.00              | 54.00 | PASS   |  |
|           | High Channel 2480MHz |                         |                              |                           |                                    |                    |       |        |  |
|           | Н                    | 2483.50                 | 74.19                        | -25.15                    | 49.04                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2500.00                 | 69.45                        | -25.10                    | 44.35                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2483.50                 | 75.24                        | -25.15                    | 50.09                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2500.00                 | 71.02                        | -25.10                    | 45.92                              | 74.00              | 54.00 | PASS   |  |
|           | Low Channel 2402MHz  |                         |                              |                           |                                    |                    |       |        |  |
| π/4DQPSK  | Н                    | 2390.00                 | 71.31                        | -25.43                    | 45.88                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2400.00                 | 74.43                        | -25.40                    | 49.03                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2390.00                 | 71.61                        | -25.43                    | 46.18                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2400.00                 | 75.37                        | -25.40                    | 49.97                              | 74.00              | 54.00 | PASS   |  |
|           | High Channel 2480MHz |                         |                              |                           |                                    |                    |       |        |  |
|           | Н                    | 2483.50                 | 73.69                        | -25.15                    | 48.54                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2500.00                 | 69.42                        | -25.10                    | 44.32                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2483.50                 | 75.62                        | -25.15                    | 50.47                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2500.00                 | 70.74                        | -25.10                    | 45.64                              | 74.00              | 54.00 | PASS   |  |
|           | Low Channel 2402MHz  |                         |                              |                           |                                    |                    |       |        |  |
| 8DPSK     | Н                    | 2390.00                 | 71.60                        | -25.43                    | 46.17                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2400.00                 | 75.54                        | -25.40                    | 50.14                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2390.00                 | 72.54                        | -25.43                    | 47.11                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2400.00                 | 76.65                        | -25.40                    | 51.25                              | 74.00              | 54.00 | PASS   |  |
|           | High Channel 2480MHz |                         |                              |                           |                                    |                    |       |        |  |
|           | Н                    | 2483.50                 | 76.07                        | -25.15                    | 50.92                              | 74.00              | 54.00 | PASS   |  |
|           | Н                    | 2500.00                 | 70.19                        | -25.10                    | 45.09                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2483.50                 | 76.78                        | -25.15                    | 51.63                              | 74.00              | 54.00 | PASS   |  |
|           | V                    | 2500.00                 | 73.04                        | -25.10                    | 47.94                              | 74.00              | 54.00 | PASS   |  |

Over= Measurement - Limit

2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

3 In restricted bands of operation, The spurious emissions below the permissible value more than 20dB 4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.



#### 9. Spurious RF Conducted Emissions

#### 9.1 Block Diagram Of Test Setup



#### 9.2 Limit

Regulation 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 §15.205(c))

#### 9.3 Test procedure

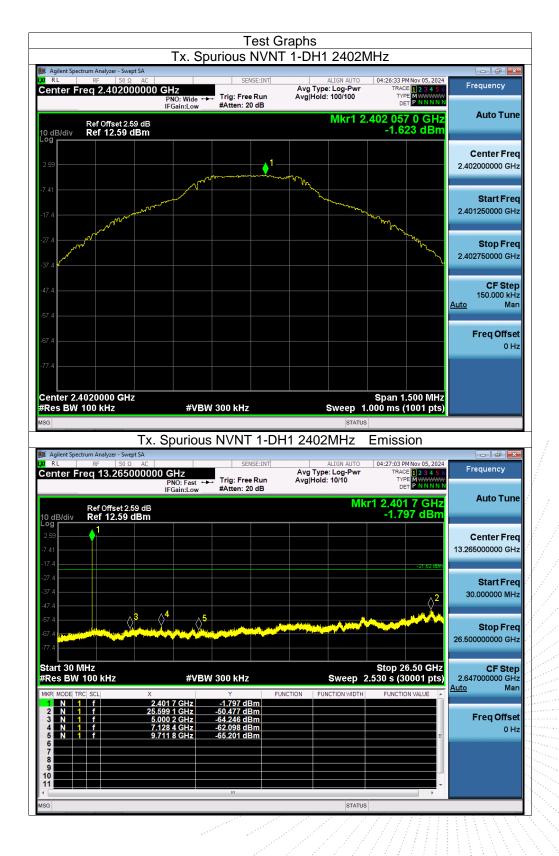
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto Detector function = peak, Trace = max hold

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#### 9.4 Test Result

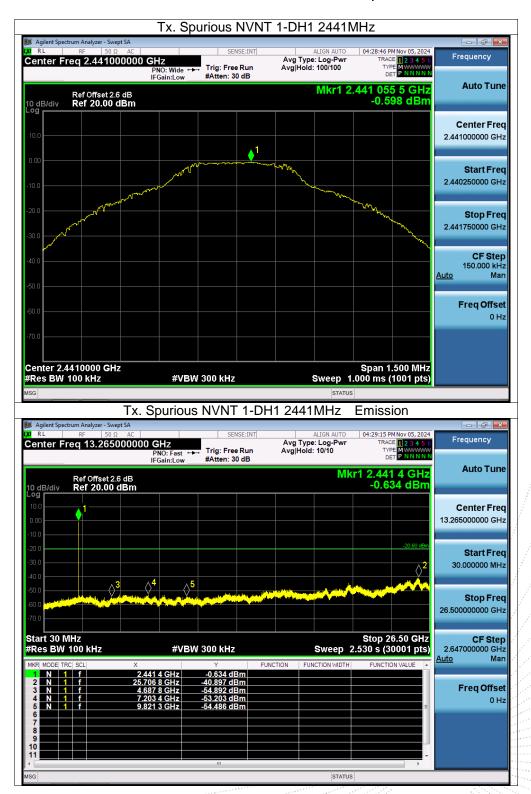


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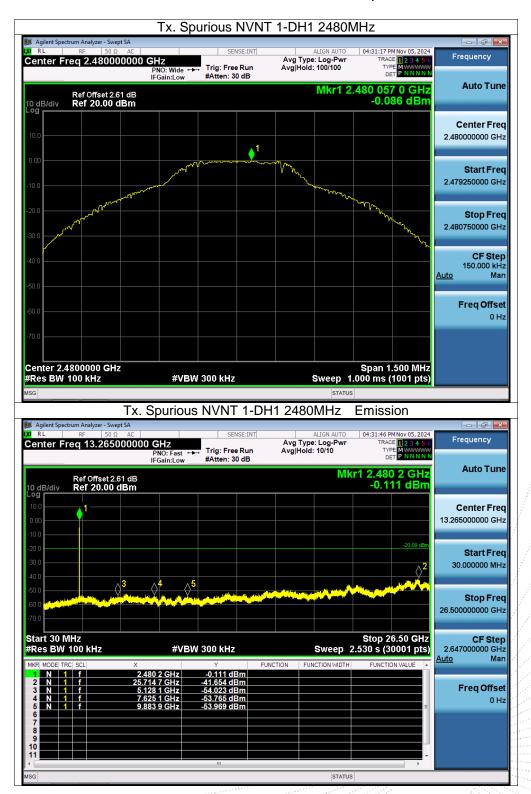
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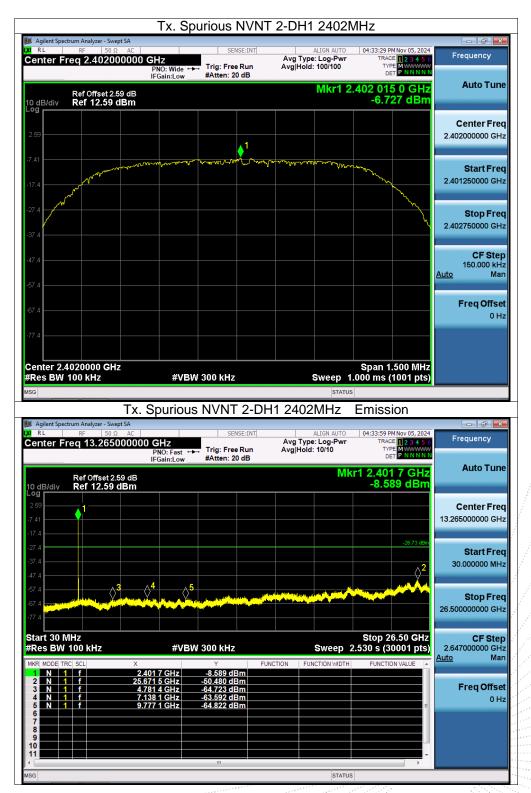






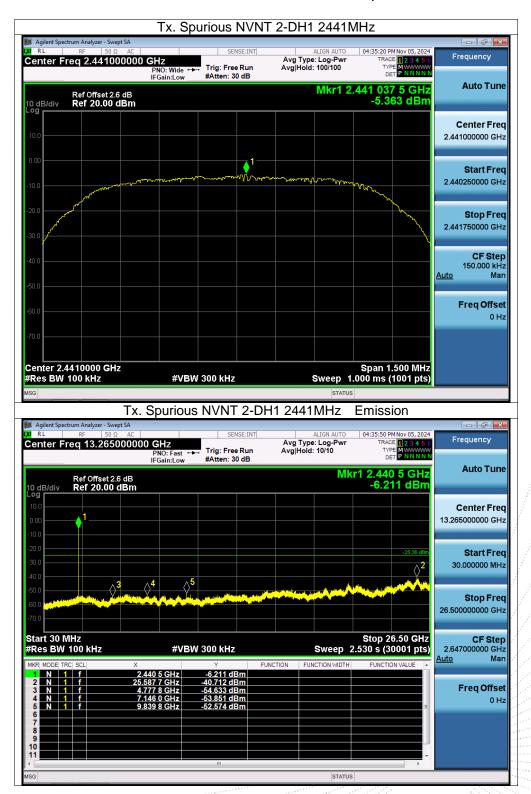






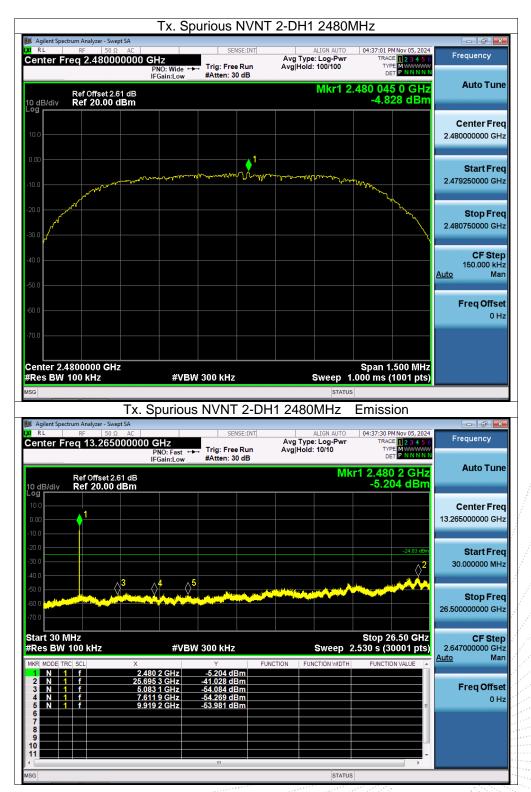
Edition: B.2





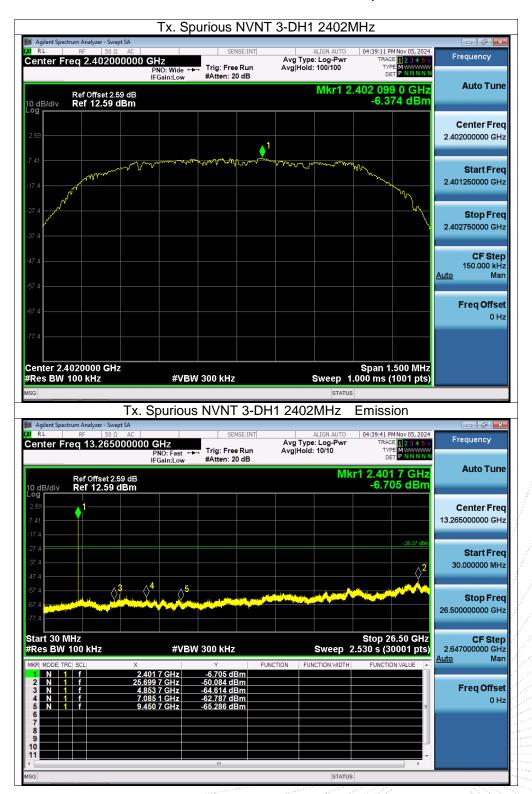
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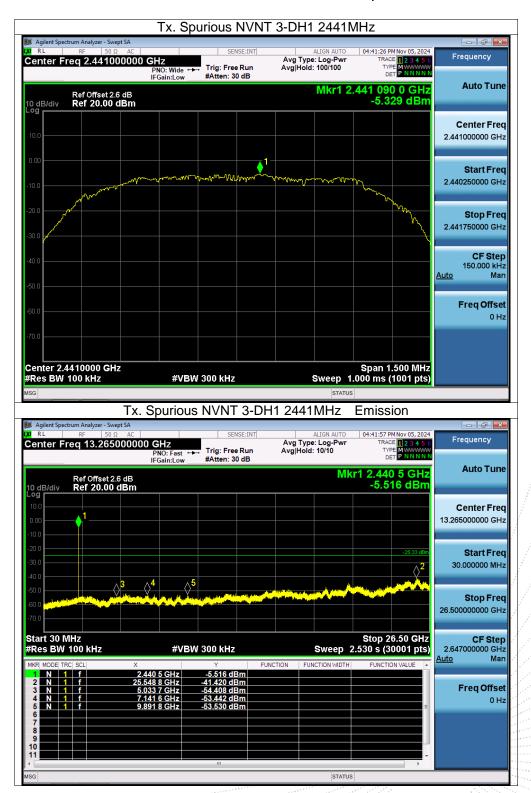


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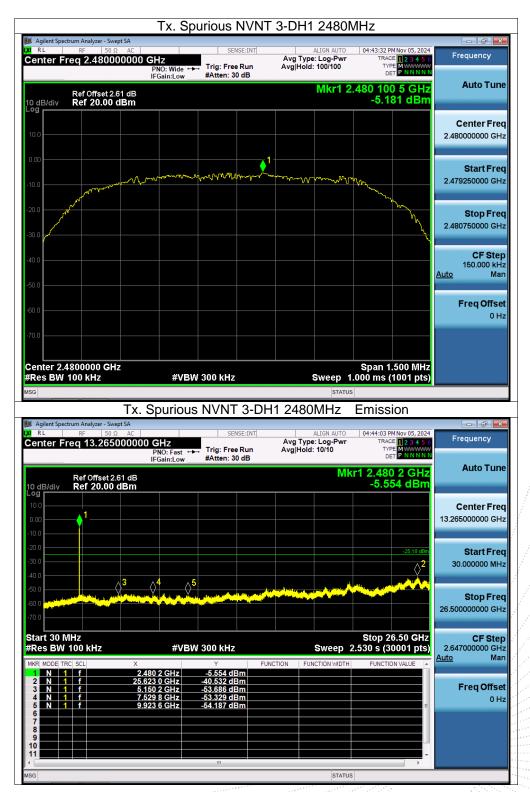




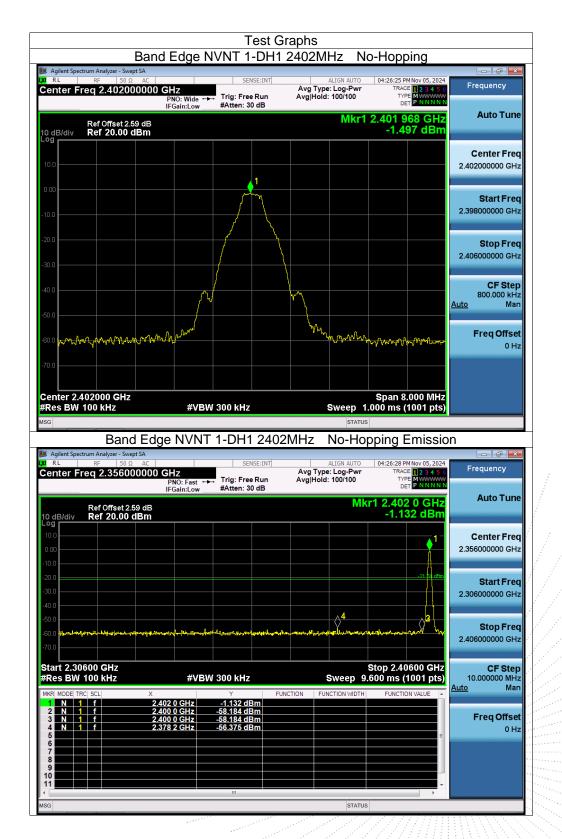


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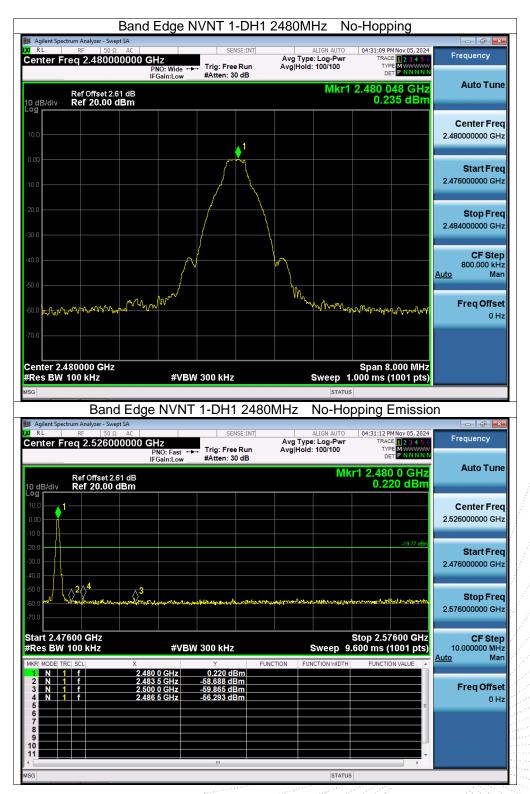




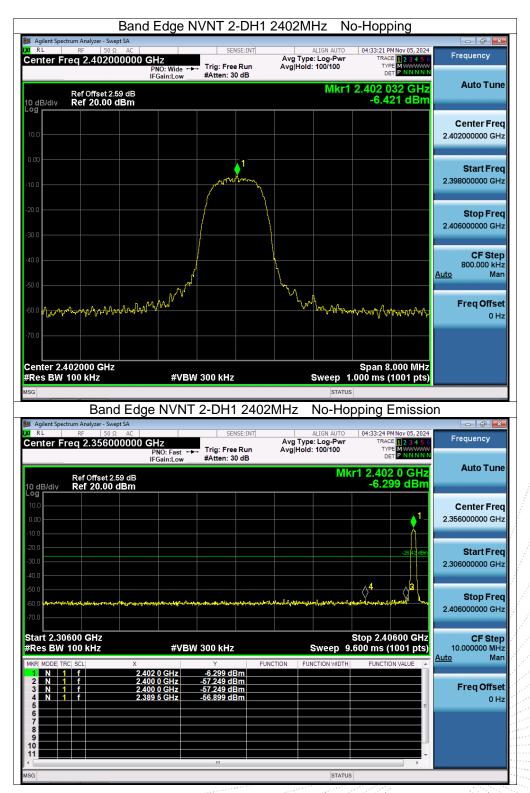






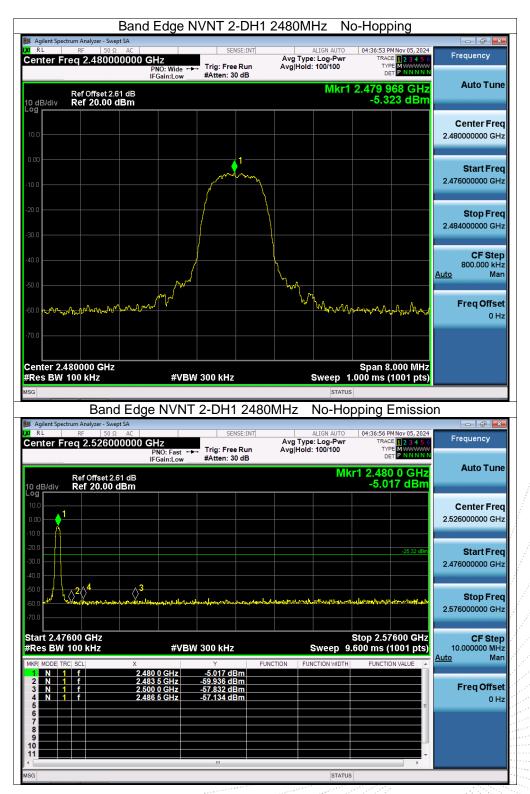




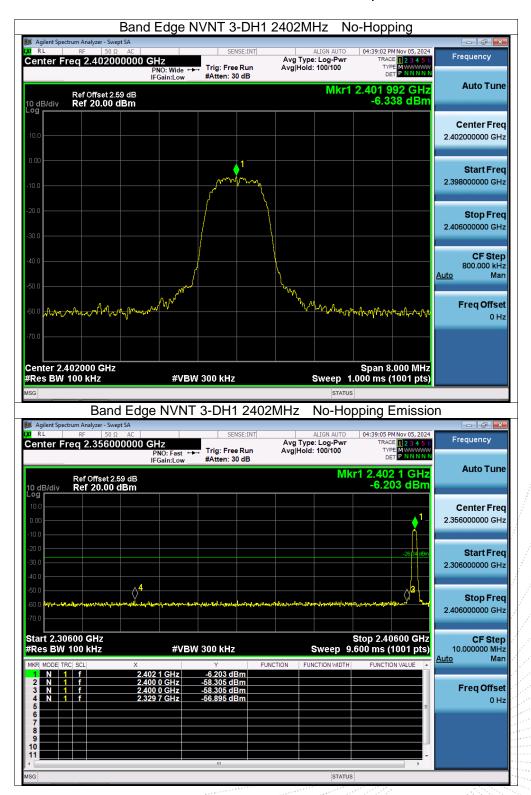


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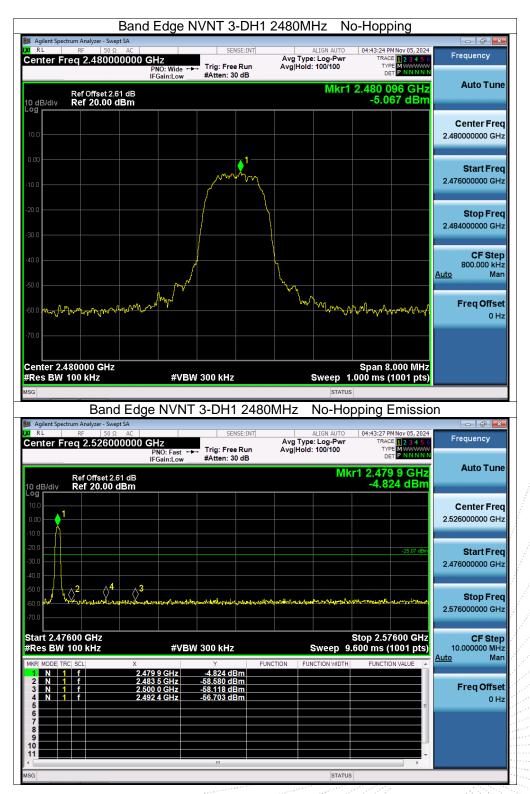






Edition: B.2





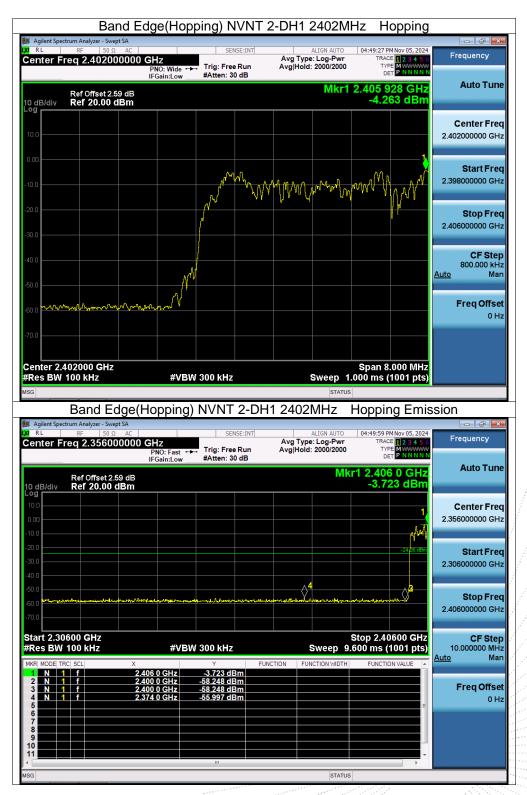


























# 10. 20 dB Bandwidth

#### 10.1 Block Diagram Of Test Setup



#### 10.2 Limit

N/A

#### 10.3 Test procedure

1. Set RBW = 30kHz.

2. Set the video bandwidth (VBW)  $\ge$  3 x RBW.

3. Detector = Peak.

4. Trace mode = max hold.

5. Sweep = auto couple.

6. Allow the trace to stabilize.

7. 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 6 dB relative to the maximum level measured in the fundamental emission.

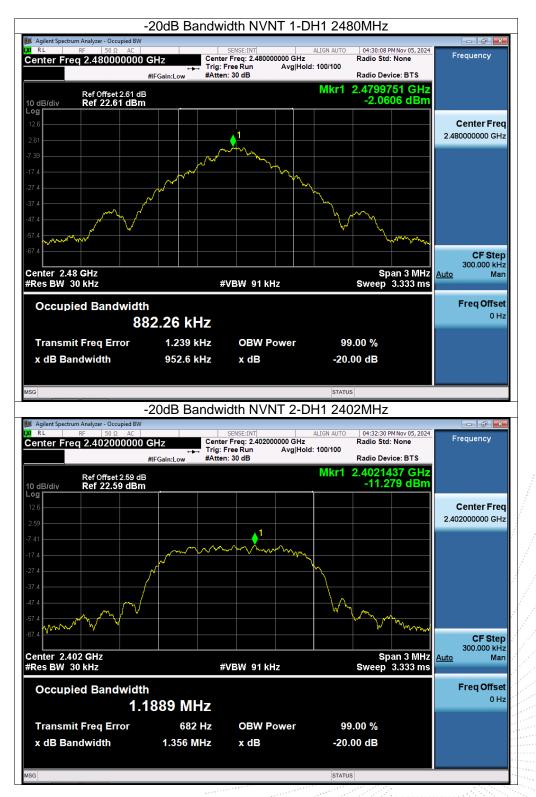
#### 10.4 Test Result

| Condition | Mode  | Frequency (MHz) | -20 dB Bandwidth<br>(MHz) | Verdict |
|-----------|-------|-----------------|---------------------------|---------|
| NVNT      | 1-DH1 | 2402            | 0.959                     | Pass    |
| NVNT      | 1-DH1 | 2441            | 0.952                     | Pass    |
| NVNT      | 1-DH1 | 2480            | 0.953                     | Pass    |
| NVNT      | 2-DH1 | 2402            | 1.356                     | Pass    |
| NVNT      | 2-DH1 | 2441            | 1.361                     | Pass    |
| NVNT      | 2-DH1 | 2480            | 1.359                     | Pass    |
| NVNT      | 3-DH1 | 2402            | 1.343                     | Pass    |
| NVNT      | 3-DH1 | 2441            | 1.346                     | Pass    |
| NVNT      | 3-DH1 | 2480            | 1.345                     | Pass    |

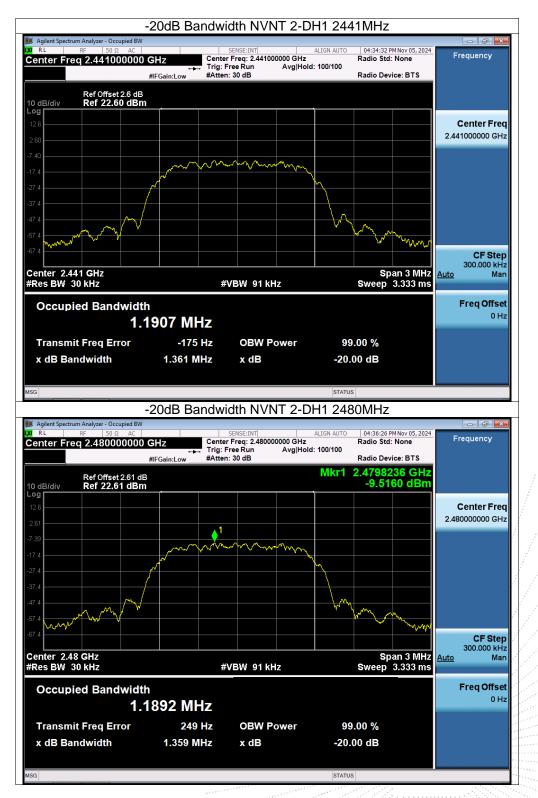




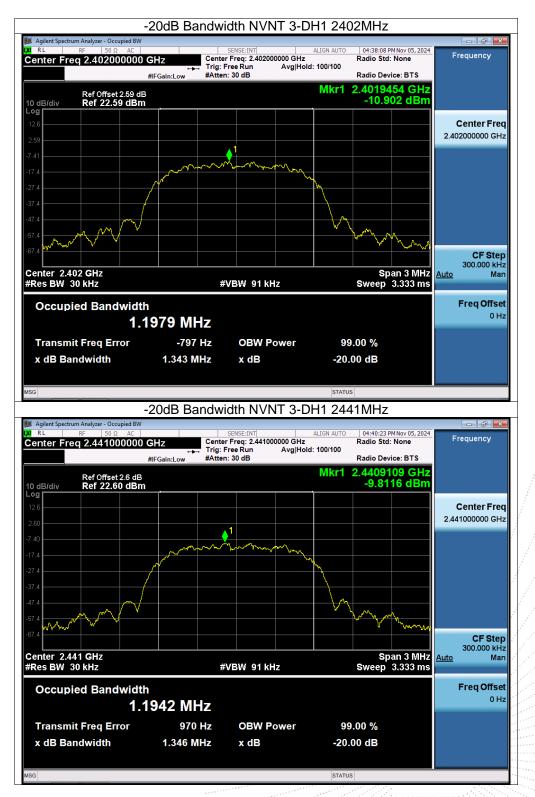




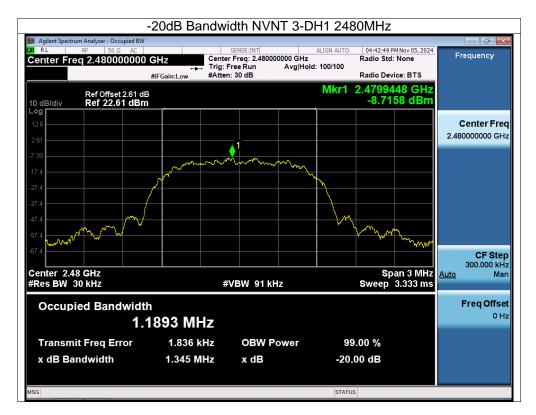












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## 11. Maximum Peak Output Power

### 11.1 Block Diagram Of Test Setup



#### 11.2 Limit

|              | FCC Part15 (15.247) , Subpart C             |                     |             |      |  |  |  |  |  |
|--------------|---|---------------------|-------------|------|--|--|--|--|--|
| Section      | Test Item Limit Frequency Range (MHz) Resul |                     |             |      |  |  |  |  |  |
| 15.247(b)(1) | Peak Output<br>Power                        | 0.125 watt or 21dBm | 2400-2483.5 | PASS |  |  |  |  |  |

## 11.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

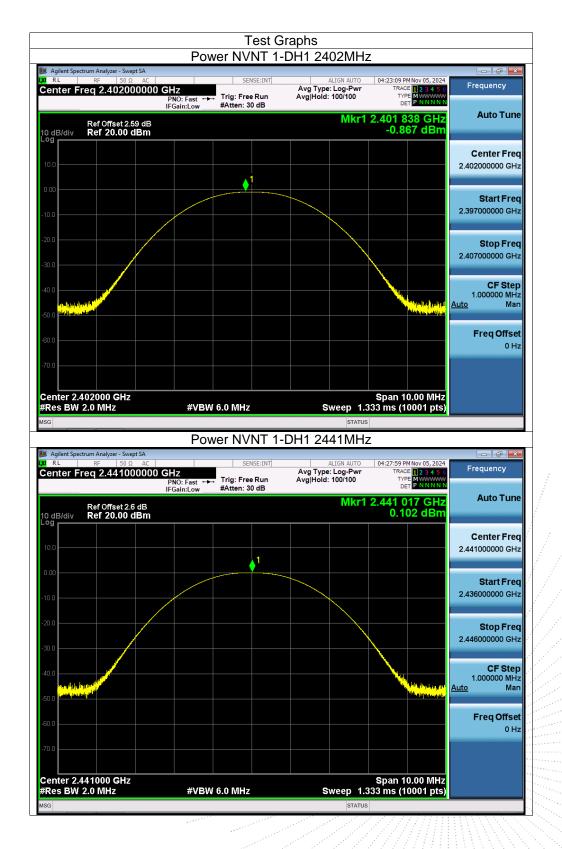
2. Set the spectrum analyzer: RBW = 2MHz. VBW = 6MHz. Sweep = auto; Detector Function = Peak.

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

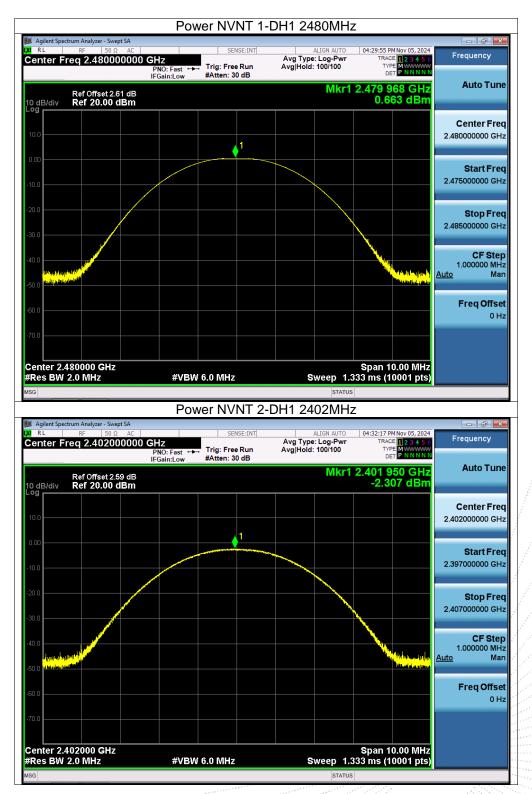
### 11.4 Test Result

| Condition | Mode  | Frequency<br>(MHz) | Conducted<br>Power (dBm) | Limit (dBm) | Verdict |
|-----------|-------|--------------------|--------------------------|-------------|---------|
| NVNT      | 1-DH1 | 2402               | -0.87                    | 21          | Pass    |
| NVNT      | 1-DH1 | 2441               | 0.1                      | 21          | Pass    |
| NVNT      | 1-DH1 | 2480               | 0.66                     | 21          | Pass    |
| NVNT      | 2-DH1 | 2402               | -2.31                    | 21          | Pass    |
| NVNT      | 2-DH1 | 2441               | -1.21                    | 21          | Pass    |
| NVNT      | 2-DH1 | 2480               | -0.52                    | 21          | Pass    |
| NVNT      | 3-DH1 | 2402               | -2                       | 21          | Pass    |
| NVNT      | 3-DH1 | 2441               | -0.93                    | 21          | Pass    |
| NVNT      | 3-DH1 | 2480               | 0.09                     | 21          | Pass    |



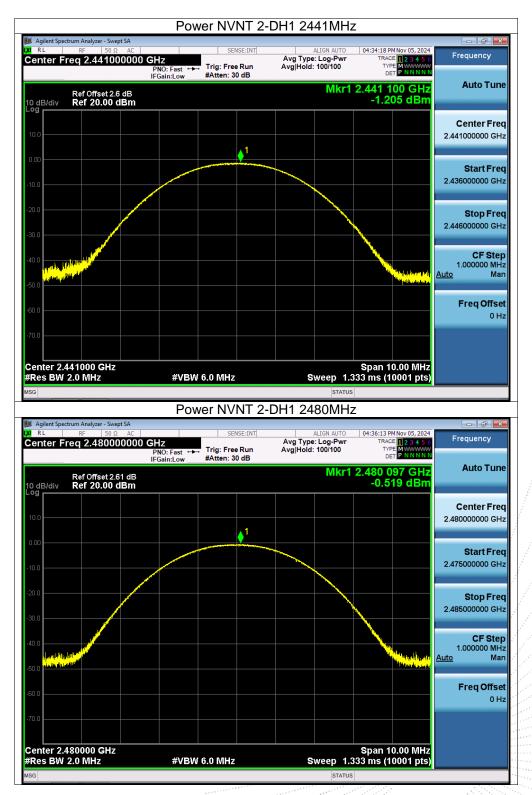




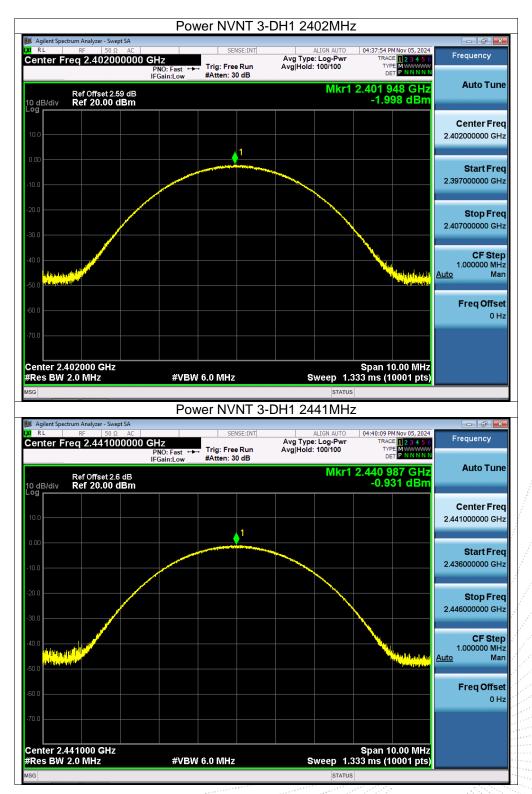


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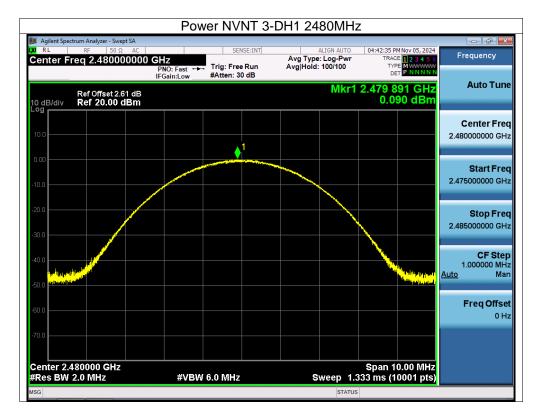






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# 12. Hopping Channel Separation

#### 12.1 Block Diagram Of Test Setup



#### 12.2 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125W.

#### 12.3 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.

| Condition | Mode  | Hopping<br>Freq1 (MHz) | Hopping<br>Freq2 (MHz) | HFS (MHz) | Limit (MHz) | Verdict |
|-----------|-------|------------------------|------------------------|-----------|-------------|---------|
| NVNT      | 1-DH1 | 2401.974               | 2402.972               | 0.998     | 0.639       | Pass    |
| NVNT      | 1-DH1 | 2440.972               | 2441.974               | 1.002     | 0.635       | Pass    |
| NVNT      | 1-DH1 | 2478.974               | 2479.972               | 0.998     | 0.635       | Pass    |
| NVNT      | 2-DH1 | 2401.98                | 2403.146               | 1.166     | 0.904       | Pass    |
| NVNT      | 2-DH1 | 2440.984               | 2442.142               | 1.158     | 0.907       | Pass    |
| NVNT      | 2-DH1 | 2479.144               | 2480.14                | 0.996     | 0.906       | Pass    |
| NVNT      | 3-DH1 | 2401.914               | 2402.948               | 1.034     | 0.895       | Pass    |
| NVNT      | 3-DH1 | 2440.914               | 2441.914               | 1         | 0.897       | Pass    |
| NVNT      | 3-DH1 | 2478.916               | 2479.91                | 0.994     | 0.897       | Pass    |

#### 12.4 Test Result



|  | CI                                  |  | Braphs<br>DH1 2402MHz   |  |   |
|--|-------------------------------------|--|---|--|---|
| Agilent Spectrum Analyzer - Sw<br>RL RF 50<br>Center Freq 2.4025   | Ω AC                                | SENSE:INT<br>Trig: Free Run<br>#Atten: 30 dB | ALIGN AUTO<br>Avg Type: Log-Pwr<br>Avg Hold:>100/100                          | 04:26:19 PM Nov 05, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE MWWWWW<br>DET PNNNNN | Frequency                                     |
| Ref Offset 2<br>10 dB/div Ref 20.00  |                                     |  | Mkr1  | 2.401 974 GHz<br>-3.528 dBm  | Auto Tun                                      |
| 10.0   | 1                                   |  | 2<br>2  | ~  | <b>Center Fre</b><br>2.402500000 GH           |
| -20.0  |                                     |  |   |  | Start Fre<br>2.401500000 GH                   |
| -60.0  |                                     |  |   |  | Stop Fre<br>2.403500000 GH                    |
| Center 2.402500 GH<br>#Res BW 30 kHz   | #VBV                                | V 100 kHz                                    |   | Span 2.000 MHz<br>133 ms (1001 pts)  | <b>CF Ste</b><br>200.000 kH<br><u>Auto</u> Ma |
| MKR         MODE         TRC         SCL           1         N         1         f           2         N         1         f           3         1         f           4         -         -           5         -         -           6         -         -           7         -         -           8         -         -           9         -         - | X<br>2.401 974 GHz<br>2.402 972 GHz | Y FI<br>-3.528 dBm<br>-3.527 dBm             | FUNCTION FUNCTION WIDTH   | FUNCTION VALUE   | Freq Offse<br>0 H                             |
| 11       MSG       Aglient Spectrum Analyzer - Sw       XI     RF       SO     Center Freq 2.4415  | vept SA<br>Ω AC                     | SENSE:INT                                    | STATUS<br>DH1 2441MHz<br>ALIGN AUTO<br>Avg Type: Log-Pwr<br>Avg Hold:>100/100 | 04:28:38 PM Nov 05, 2024<br>TRACE 12 2 3 4 5 0<br>TYPE PMWWW<br>DET PMNNNN | ा छि 💌  |
| Ref Offset 2<br>10 dB/div Ref 20.00  | 2.6 dB                              | #Atten: 00 dB                                | Mkr1  | 2.440 972 GHz<br>-2.586 dBm  | Auto Tun                                      |
| 10.0<br>.10.0  |                                     |  | 2   |  | Center Fre<br>2.441500000 GH                  |
| -20.0  |                                     |  |   |  | Start Fre<br>2.440500000 GH                   |
| -50.0  |                                     |  |   |  | <b>Stop Fre</b><br>2.442500000 GH             |
| Center 2.441500 GH<br>#Res BW 30 kHz   | #VBV                                | V 100 kHz                                    |   | Span 2.000 MHz<br>133 ms (1001 pts)  | <b>CF Ste</b><br>200.000 kH<br><u>Auto</u> Ma |
| MKR         MODE         TRC         SCL           1         N         1         f           2         N         1         f           3         -         -           4         -         -           5         -         -           6         -         -   | ×<br>2.440 972 GHz<br>2.441 974 GHz | Y FI<br>-2.586 dBm<br>-2.574 dBm             | UNCTION FUNCTION WIDTH  | FUNCTION VALUE   | Freq Offse<br>0 H                             |



|  | C                                   | FS NVNT 1-E                                    | JIII 2400101112                                      |  |  |
|--|-------------------------------------|--|--|--|--|
| 📕 Agilent Spectrum Analyzer - Sw   |                                     |  |  |  |  |
| enter Freq 2.4795  |                                     | SENSE:INT<br>→ Trig: Free Run<br>#Atten: 30 dB | ALIGN AUTO<br>Avg Type: Log-Pwr<br>Avg Hold:>100/100 | 04:30:40 PM Nov 05, 2024<br>TRACE 2 3 4 5 6<br>TYPE MWWWW<br>DET P NNNN        | Frequency  |
| Ref Offset 2<br>0 dB/div Ref 20.00   | .61 dB                              |  | Mkr1   | 2.478 974 GHz<br>-2.007 dBm  | Auto Tu  |
| .og<br>10.0<br>0.00  |                                     |  | 2  |  | <b>Center Fr</b><br>2.479500000 G  |
| 30.0   |                                     |  |  |  | <b>Start Fr</b><br>2.478500000 G   |
| 50.0   |                                     |  |  |  | <b>Stop Fr</b><br>2.480500000 G  |
| enter 2.479500 GHz<br>Res BW 30 kHz  |                                     | W 100 kHz                                      | Sweep 2  | Span 2.000 MHz<br>.133 ms (1001 pts)   | CF Sto<br>200.000 k  |
| IKR MODE TRC SCL<br>1 N 1 F<br>2 N 1 F<br>3 4  | ×<br>2.478 974 GHz<br>2.479 972 GHz | Y FU<br>-2.007 dBm<br>-2.030 dBm               | UNCTION FUNCTION WIDTH                               | FUNCTION VALUE   | Auto M<br>Freq Offs<br>0   |
| 5<br>6<br>7<br>8<br>9<br>9   |                                     |  |  | E  |  |
| 11   |                                     |  |  |  |  |
| G  |                                     |  | STATUS   |  |  |
|  | C                                   | ES NVNT 2-                                     | DH1 2402MHz  |  |  |
| Agilent Spectrum Analyzer - Sw   |                                     |  |  |  |  |
| RL RF 509<br>enter Freq 2.4025   |                                     | SENSE:INT<br>Trig: Free Run<br>#Atten: 30 dB   | ALIGN AUTO<br>Avg Type: Log-Pwr<br>Avg Hold:>100/100 | 04:33:15 PM Nov 05, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE MWWWW<br>DET P N N N N N | Frequency  |
| Ref Offset 2<br>0 dB/div Ref 20.00   | .59 dB                              |  | Mkr1   | 2.401 980 GHz<br>-8.502 dBm  | Auto Tu  |
|  | 1                                   |  |  | <br>⊘²   | <b>Center Fr</b><br>2.402500000 G  |
| 20.0   |                                     |  |  | $\sim$   | Start Fr   |
|  |                                     |  |  |  |  |
| 40.0<br>50.0<br>50.0   |                                     |  |  |  | 2.401500000 G<br>Stop Fr   |
| 40.0<br>50.0<br>70.0<br>Senter 2.402500 GHz  |                                     | W 100 kHz                                      | Sweep 2  | Span 2.000 MHz<br>.133 ms (1001 pts)   | 2.401500000 G<br>Stop Fr<br>2.403500000 G<br>CF Str<br>200.000 k                             |
| 40.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0<br>50.0 | #VB                                 | Y FU   | Sweep 2  |  | 2.401500000 G<br>Stop Fr<br>2.403500000 G<br>CF Ste<br>200.000 k<br><u>Auto</u> M            |
| 40.0<br>50.0<br>50.0<br>Center 2.402500 GHz<br>Res BW 30 kHz<br>KR MODE TRC SCL<br>1 N 1 f<br>2 N 1 f<br>3 4   | #VB                                 |  |  | .133 ms (1001 pts)   | 2.401500000 G<br>Stop Fr<br>2.403500000 G<br>CF St<br>200.000 k<br>Auto<br>Freq Offs         |
| 40.0<br>50.0<br>Center 2.402500 GHz<br>Res BW 30 kHz<br>IKR MODE TRC SCL<br>1 N 1 f<br>2 N 1 f<br>3 4 5<br>5 5<br>6 7<br>8 8   | #VB<br>×<br>2.401 980 GHz           | Y FU<br>-8.502 dBm                             |  | .133 ms (1001 pts)   | 2.401500000 G<br>Stop Fr<br>2.403500000 G<br>CF Sto<br>200.000 k<br><u>Auto</u><br>Freq Offs |
| 40.0<br>50.0<br>50.0<br>Center 2.402500 GHz<br>Res BW 30 kHz<br>KR MODE TRC SCL<br>1 N 1 f<br>2 N 1 f<br>3 4<br>5 5<br>6 7<br>7  | #VB<br>×<br>2.401 980 GHz           | Y FU<br>-8.502 dBm                             |  | .133 ms (1001 pts)   | 2.401500000 G<br>Stop Fra<br>2.403500000 G<br>CF Sta<br>200.000 k                            |



|  | С                              | FS NVNT 2                 | -DH1 2441MHz                           | 2   |                              |
|--|--------------------------------|---------------------------|--|---|------------------------------|
| Agilent Spectrum Analyzer - Swe<br>RL RF 50 Ω  |                                | SENSE:INT                 | ALIGN AUTO                             | 04:35:13 PM Nov 05, 2024                        | - 6                          |
| center Freq 2.44150  |                                |                           | Avg Type: Log-Pwr<br>Avg Hold:>100/100 | TRACE 1 2 3 4 5 6<br>TYPE M WWWW<br>DET P NNNNN | Frequency                    |
| Ref Offset 2.0<br>0 dB/div Ref 20.00   | 6 dB                           |                           | Mkr1                                   | 2.440 984 GHz<br>-9.981 dBm                     | Auto Tur                     |
| og   |                                |                           |  |   | Querte -                     |
| 0.00   |                                |                           |  |   | Center Fre<br>2.441500000 GH |
| 10.0   |                                |                           |  | $\diamond^2$                                    |                              |
| 20.0   |                                |                           |  |   | Start Fre                    |
| 30.0   |                                |                           |  |   | 2.440500000 GI               |
| 40.0   |                                |                           |  |   |                              |
| 50.0   |                                |                           |  |   | Stop Fre                     |
| 70.0   |                                |                           |  |   | 2.442500000 G                |
|  |                                |                           |  |   |                              |
| enter 2.441500 GHz<br>Res BW 30 kHz  |                                | W 100 kHz                 | Sweep 2                                | Span 2.000 MHz<br>2.133 ms (1001 pts)           | CF Ste<br>200.000 k          |
| KR MODE TRC SCL  | Х                              | Y                         | FUNCTION FUNCTION WIDTH                | FUNCTION VALUE                                  | <u>Auto</u> M                |
| 1 N 1 f<br>2 N 1 f   | 2.440 984 GHz<br>2.442 142 GHz | -9.981 dBm<br>-10.053 dBm |  |   | Freq Offs                    |
| 3 4  |                                |                           |  |   | 01                           |
| 5<br>6   |                                |                           |  | E   |                              |
| 7 8  |                                |                           |  |   |                              |
| 9  |                                |                           |  |   |                              |
|  |                                |                           |  |   |                              |
| SG   |                                |                           | STATU                                  | IS  |                              |
|  | С                              | FS NVNT 2                 | -DH1 2480MHz                           | <u> </u>  |                              |
| Agilent Spectrum Analyzer - Swe  |                                | SENSE:INT                 | ALIGN AUTO                             | 04:36:45 PM Nov 05, 2024                        |                              |
| enter Freq 2.47950   | 00000 GHz                      | THE FOR                   | Avg Type: Log-Pwr<br>Avg Hold:>100/100 | TRACE 123456<br>TYPE MWWWW<br>DET P NNNNN       | Frequency                    |
|  | PNO: Wide O<br>IFGain:Low      | #Atten: 30 dB             |  |   | Auto Tui                     |
| Ref Offset 2.  |                                |                           | Mkr1                                   | 2.479 144 GHz<br>-9.395 dBm                     | Auto Tu                      |
| 0 dB/div Ref 20.00 (   | dBm                            |                           |  | -9.393 uBm                                      |                              |
| 10.0   |                                |                           |  |   | Center Fre                   |
| ).00 <b></b>   | <b>↓ ↓ ↓ ↓ ↓</b>               |                           |  | <b>∂</b> <sup>2</sup>                           | 2.479500000 G                |
| 20.0   |                                | ······                    | $\sim$                                 | $\sim$  |                              |
| 30.0   |                                |                           |  |   | Start Fre<br>2.478500000 G   |
| 40.0   |                                |                           |  |   | 2.478500000 Gi               |
| 50.0   |                                |                           |  |   |                              |
| 60.0   |                                |                           |  |   | Stop Fr<br>2.480500000 G     |
| 70.0   |                                |                           |  |   |                              |
|  |                                |                           |  | Span 2.000 MHz                                  | CF Ste                       |
|  |                                |                           | <b>O</b>                               | 2.133 ms (1001 pts)                             | 200.000 kł                   |
| Res BW 30 kHz  |                                | W 100 kHz                 | -                                      |   | Auto M                       |
| Res BW 30 kHz  | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | FUNCTION FUNCTION WIDTH                |   | Auto Ma                      |
| Res BW 30 KHz  | #VB                            | Y                         | -                                      |   |                              |
| 2 N 1 f  | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | -                                      |   | Auto Ma<br>Freq Offs<br>0 H  |
| Res         BW 30 kHz           KR         MODE         TRC         SCL           1         N         1         f           2         N         1         f           3         4         4         4  | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | -                                      |   | Freq Offs                    |
| Res         BW 30 kHz           Image: Non-Example of the state of the stateo | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | -                                      |   | Freq Offs                    |
| Res BW 30 kHz           IKR MODELTRC SCL           IN         1           IN <td>#VB<br/>X<br/>2.479 144 GHz</td> <td>Y<br/>-9.395 dBm</td> <td>-</td> <td></td> <td>Freq Offs</td>  | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | -                                      |   | Freq Offs                    |
| Res         BW         30 kHz           kR         MODE         TRC         SCL           1         N         1         f           2         N         1         f           3         -         -         -           4         -         -         -           5         -         -         -           6         -         -         -           7         -         -         -           8         -         -         -           9         -         -         -  | #VB<br>X<br>2.479 144 GHz      | Y<br>-9.395 dBm           | -                                      |   | Freq Offs                    |



| Agilent Spectrum Analyzer - Swe  |                                     | FS NVNT 3-D                        |  |  |  |
|--|-------------------------------------|------------------------------------|--|--|--|
|  | 2 AC<br>00000 GHz<br>PNO: Wide C    | SENSE:INT                          | ALIGN AUTO<br>Avg Type: Log-Pwr<br>Avg Hold:>100/100 | 04:38:55 PM Nov 05, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE MWWWW<br>DET P N N N N N | Frequency  |
| Ref Offset 2.<br>dB/div Ref 20.00  |                                     | #Atten: 30 dB                      | Mkr1   | 2.401 914 GHz<br>-10.302 dBm   | Auto Tur   |
|  |                                     |                                    |  |  | Center Fro   |
| 0.0  |                                     |                                    | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~               |  | Start Fro  |
| 0.0  |                                     |                                    |  |  | 2.401500000 G  |
| D.0<br>D.0<br>D.0  |                                     |                                    |  |  | <b>Stop Fr</b><br>2.403500000 G  |
| enter 2.402500 GHz<br>Res BW 30 kHz  |                                     | W 100 kHz                          | Sweep 2.   | Span 2.000 MHz<br>133 ms (1001 pts)  | CF St<br>200.000 k   |
| MODE         TRC         SCL           1         N         1         f           2         N         1         f           3 | X<br>2.401 914 GHz<br>2.402 948 GHz | Y FU<br>-10.302 dBm<br>-10.272 dBm | INCTION FUNCTION WIDTH                               | FUNCTION VALUE   | Auto M<br>Freq Offs<br>0   |
| 6<br>7<br>8<br>9<br>0  |                                     |                                    |  |  |  |
| g  |                                     |                                    | STATUS   |  |  |
| 3  | С                                   | FS NVNT 3-[                        | DH1 2441MHz  |  |  |
| Agilent Spectrum Analyzer - Swe  | ept SA                              | SENSE:INT                          | ALIGN AUTO   | 04:41:19 PM Nov 05, 2024   |  |
| enter Freq 2.4415  |                                     |                                    | Avg Type: Log-Pwr<br>Avg Hold:>100/100               | TRACE 1 2 3 4 5 6<br>TYPE MWWWW<br>DET P NNNNN                                 | Frequency  |
| Ref Offset 2.<br>dB/div Ref 20.00  |                                     |                                    | Mkr1   | 2.440 914 GHz<br>-9.200 dBm  | Auto Tu  |
| 0.0  |                                     |                                    |  |  | Contor Er  |
|  |                                     |                                    | 2  |  |  |
|  |                                     |                                    | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~               |  | 2.441500000 G<br>Start Fr  |
|  |                                     |                                    | ~~~~~ <sup>2</sup> ~~~                               |  | 2.441500000 G<br>Start Fr<br>2.440500000 G<br>Stop Fr  |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  |                                     | W 100 kHz                          |  | Span 2.000 MHz<br>133 ms (1001 pts)  | 2.441500000 G<br>Start Fr<br>2.440500000 G<br>Stop Fr<br>2.442500000 G<br>CF St<br>200.000 k   |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  |                                     |                                    |  |  | 2.441500000 G<br>Start Fr<br>2.440500000 G<br>Stop Fr<br>2.442500000 G<br>CF Str<br>200.000 k<br>Auto M                                    |
| 2 N 1 f<br>3 4<br>5 6  | #VB<br>×<br>2.440 914 GHz           | Y FU<br>-9.200 dBm                 | Sweep 2.   | 133 ms (1001 pts)  | Center Fr<br>2.441500000 G<br>Start Fr<br>2.440500000 G<br>Stop Fr<br>2.442500000 G<br>CF Sto<br>200.000 k<br>Auto<br>M<br>Freq Offs<br>01 |
| 0.0  | #VB<br>×<br>2.440 914 GHz           | Y FU<br>-9.200 dBm                 | Sweep 2.   | 133 ms (1001 pts)  | 2.441500000 G<br>Start Fr<br>2.440500000 G<br>Stop Fr<br>2.442500000 G<br>CF Sta<br>200.000 k<br>Auto M                                    |



|                                       | (                                  | CFS NVNT                       | 3-DH1         | 2480MHz                                      |                      |   |                                     |
|---------------------------------------|------------------------------------|--------------------------------|---------------|--|----------------------|---|-------------------------------------|
| Agilent Spectrum Analyzer - Swept SA  |                                    | 05105                          | X & LTY       |  |                      |   | - P X                               |
| Center Freq 2.4795000                 | 000 GHz<br>PNO: Wide<br>IEGain:Low | Trig: Free Ru<br>#Atten: 30 dB | Avg<br>un Avg | ALIGN AUTO<br>Type: Log-Pwr<br>Hold:>100/100 | TRAC                 | M Nov 05, 2024<br>E 1 2 3 4 5 6<br>PE M WWWWWW<br>T P N N N N N | Frequency                           |
| Ref Offset 2.61                       | iB                                 |                                |               | Mkr1   | 2.478 9<br>-9.1      | 16 GHz<br>13 dBm  | Auto Tune                           |
| Log<br>10.0<br>.00                    | 1                                  |                                |               | ¢ <sup>2</sup>                               |                      |   | Center Fred<br>2.479500000 GHz      |
| -20.0<br>-30.0<br>-40.0               |                                    |                                |               |  |                      |   | Start Fred<br>2.478500000 GHz       |
| -50.0                                 |                                    |                                |               |  |                      |   | <b>Stop Fred</b><br>2.480500000 GHz |
| Center 2.479500 GHz<br>#Res BW 30 kHz | #VI                                | BW 100 kHz                     |               | Sweep 2                                      | Span 2.<br>.133 ms ( | .000 MHz<br>1001 pts)   | CF Step<br>200.000 kHz<br>Auto Mar  |
| MKR MODE TRC SCL                      | ×<br>2.478 916 GHz                 | ۲<br>-9.113 dBm                | FUNCTION      | FUNCTION WIDTH                               | FUNCTIO              | ON VALUE  | <u>Auto</u> Mar                     |
| 2 N 1 f<br>3 4<br>5                   | 2.479 910 GHz                      | -8.653 dBm                     |               |  |                      |   | Freq Offset<br>0 Hz                 |
| 6<br>7<br>8<br>9                      |                                    |                                |               |  |                      |   |                                     |
| 11                                    |                                    | III                            |               |  |                      |   |                                     |
| MSG                                   |                                    |                                |               | STATU  | S                    |   |                                     |

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# 13. Number Of Hopping Frequency

#### 13.1 Block Diagram Of Test Setup



## 13.2 Limit

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

#### 13.3 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.

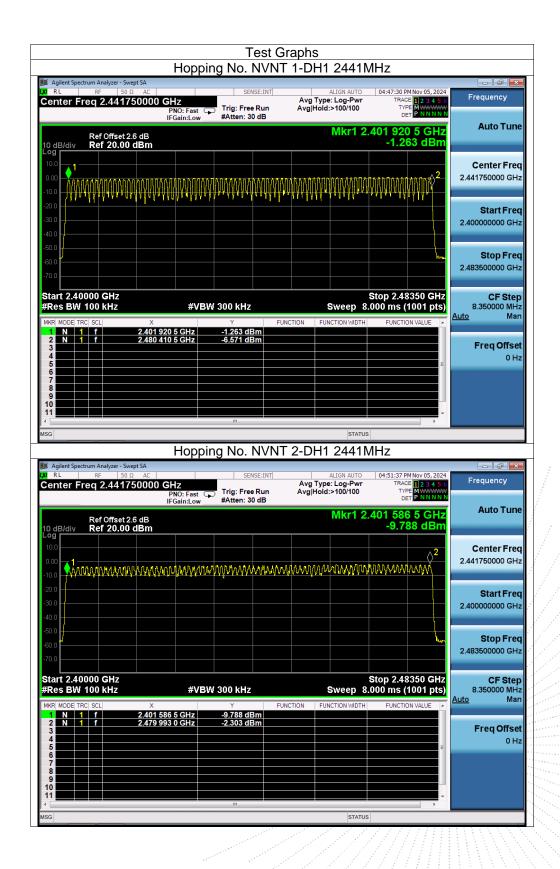
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

#### 13.4 Test Result

| Condition | Mode  | Hopping Number | Limit | Verdict |
|-----------|-------|----------------|-------|---------|
| NVNT      | 1-DH1 | 79             | 15    | Pass    |
| NVNT      | 2-DH1 | 79             | 15    | Pass    |
| NVNT      | 3-DH1 | 79             | 15    | Pass    |









| Нор   | ping No. NVNT                                | 3-DH1 2441                             | ЛНz                                    |                              |
|---|--|--|--|------------------------------|
| Agilent Spectrum Analyzer - Swept SA  X RL RF 50 Ω AC | SENSE:INT                                    | ALIGN AUTO                             | 04:56:05 PM Nov 05, 2024               |                              |
| Center Freq 2.441750000 GHz                           |  | Avg Type: Log-Pwr<br>AvglHold:>100/100 | TRACE 1 2 3 4 5 6<br>TYPE M WWWWW      | Frequency                    |
| IFGain:Lov  |  |  | DET PNNNN                              | Auto Tune                    |
| Ref Offset 2.6 dB<br>10 dB/div Ref 20.00 dBm          |  | Mkr1 2                                 | 402 004 0 GHz<br>-3.489 dBm            | Auto Funo                    |
| 10.0  |  |  |  | Center Freg                  |
| 0.00 <b>1</b><br>-10.0 <b>1</b>                       | 10.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5     | հնորիներիններին                        | 80000A0000A000                         | 2.441750000 GHz              |
|   | <u>₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩</u> | <u>NAMANAAAAAAAAAAAAAA</u>             | 480044644444444                        |                              |
| -20.0   |  |  |  | Start Freq                   |
| -40.0   |  |  |  | 2.400000000 GHz              |
| -50.0   |  |  |  | Ctop Frog                    |
| -60.0   |  |  | ц <u>ь</u>                             | Stop Freq<br>2.483500000 GHz |
| -70.0   |  |  |  |                              |
| Start 2.40000 GHz<br>#Res BW 100 kHz #V               | /BW 300 kHz                                  |  | Stop 2.48350 GHz<br>.000 ms (1001 pts) | CF Step<br>8.350000 MHz      |
| MKR MODE TRC SCL X<br>1 N 1 f 2.402 004 0 GHz         | Y FUN<br>-3.489 dBm                          | ICTION FUNCTION WIDTH                  | FUNCTION VALUE                         | <u>Auto</u> Man              |
| 2 N 1 f 2.479 993 0 GHz                               | -1.835 dBm                                   |  |  | Freg Offset                  |
| 4 5   |  |  | =                                      | 0 Hz                         |
| 6   |  |  |  |                              |
| 8 9 9   |  |  |  |                              |
| 10  |  |  | -                                      |                              |
| MSG   | m  | STATUS                                 | •                                      |                              |

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# 14. Dwell Time

#### 14.1 Block Diagram Of Test Setup



#### 14.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

## 14.3 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).

|           |       |                         | ·. ·.                 |                                |                |                        | 2 1 2 2 2     |         |
|-----------|-------|-------------------------|-----------------------|--------------------------------|----------------|------------------------|---------------|---------|
| Condition | Mode  | Fre-<br>quency<br>(MHz) | Pulse<br>Time<br>(ms) | Total<br>Dwell<br>Time<br>(ms) | Burst<br>Count | Period<br>Time<br>(ms) | Limit<br>(ms) | Verdict |
| NVNT      | 1-DH1 | 2441                    | 0.383                 | 121.028                        | 316            | 31600                  | 400           | Pass    |
| NVNT      | 1-DH3 | 2441                    | 1.639                 | 247.489                        | 151            | 31600                  | 400           | Pass    |
| NVNT      | 1-DH5 | 2441                    | 2.887                 | 323.344                        | 112            | 31600                  | 400           | Pass    |
| NVNT      | 2-DH1 | 2441                    | 0.392                 | 123.48                         | 315            | 31600                  | 400           | Pass    |
| NVNT      | 2-DH3 | 2441                    | 1.643                 | 266.166                        | 162            | 31600                  | 400           | Pass    |
| NVNT      | 2-DH5 | 2441                    | 2.892                 | 326.796                        | 113            | 31600                  | 400           | Pass    |
| NVNT      | 3-DH1 | 2441                    | 0.392                 | 124.264                        | 317            | 31600                  | 400           | Pass    |
| NVNT      | 3-DH3 | 2441                    | 1.643                 | 243.164                        | 148            | 31600                  | 400           | Pass    |
| NVNT      | 3-DH5 | 2441                    | 2.894                 | 321.234                        | 111            | 31600                  | 400           | Pass    |

#### 14.4 Test Result

Note: Total Dwell Time (ms) = Pulse Time (ms)\*Burst Count



|                                    |                       |  |  | est Gr                                      |      |                                  |                                    |                 |   |
|------------------------------------|-----------------------|--|--|---|------|----------------------------------|------------------------------------|-----------------|---|
|                                    |                       | ell NV/  | NT 1-D   | H1 24                                       | 41MH | z One                            | e Burst                            |                 |   |
| Agilent Spectrum Analyzer          | - Swept SA<br>50 Ω AC |  | SEN  | ISE:INT                                     |      | ALIGN AUTO                       | 04:47:35 PM Nov                    | 05,2024         | - 6 -   |
| Center Freq 2.44                   | 1000000 GH            | IZ<br>NO: Fast ↔<br>Gain:Low   | Trig Delay   | γ-500.0 μs<br>o                             |      | : Log-Pwr                        |                                    | 23456           | Frequency   |
| Ref Offs<br>10 dB/div Ref 20.      | et 2.6 dB<br>00 dBm   |  |  |   |      | L                                | Mkr1 383<br>3.0                    | .0 μs<br>5 dB   | Auto Tune   |
| 10.0                               |                       |  |  |   |      |                                  |                                    |                 | Center Fred   |
| 0.00 <b>1</b> <u>A</u> 2 -         |                       |  |  |   | į    |                                  |                                    |                 | 2.441000000 GHz   |
| -10.0                              |                       |  |  |   | ]    |                                  |                                    | TRIG LVL        |   |
| -20.0                              |                       |  |  |   | i    |                                  |                                    |                 | Start Free  |
| -30.0                              |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH:   |
|                                    |                       | and the local state of the stat | and the second states of the | म् त्यात् । सम्ब में । <sup>भू</sup> स्य भ् |      | in the state in the state in the | and this are provided a low of the | त्। कार्यप्रकार |   |
|                                    | and the type of the   |  |  |   |      |                                  |                                    |                 | Stop Fred<br>2.441000000 GHz  |
| -70.0                              |                       |  |  |   |      |                                  |                                    |                 |   |
| Center 2.4410000<br>Res BW 1.0 MHz | 00 GHz                | #\/B\4   | / 3.0 MHz  |   | 6    | woop 10                          | Spar<br>00 ms (1000.               | 1 0 Hz          | CF Step<br>1.000000 MH  |
|                                    | X                     | #909   | 7 3.0 WIHZ   | FUNC  |      | истіом міртні                    | FUNCTION VA                        |                 | uto Mar   |
| 1 Δ2 1 t (Δ)<br>2 F 1 t            | 38                    | 3.0 μs (Δ)<br>2.0 μs   | 3.05 c   | dB  |      |                                  |                                    |                 |   |
| 3 4                                |                       |  |  |   |      |                                  |                                    |                 | Freq Offse<br>0 Hi  |
| 5 6                                |                       |  |  |   |      |                                  |                                    | =               | 0 11  |
| 7 8                                |                       |  |  |   |      |                                  |                                    |                 |   |
| 9 10                               |                       |  |  |   |      |                                  |                                    |                 |   |
| 11                                 |                       |  |  |   |      |                                  |                                    | • •             |   |
| ISG                                |                       |  |  |   |      | STATUS                           |                                    |                 |   |
|                                    | Dwe                   | II NVN   | T 1-DH   | 11 244                                      | 1MHz | Accu                             | mulated                            |                 |   |
| Agilent Spectrum Analyzer          | - Swept SA<br>50 Ω AC |  | SEN  | ISE:INT                                     |      | ALIGN AUTO                       | 04:48:09 PM Nov                    | 05,2024         |   |
| Center Freq 2.44                   |                       | IZ<br>NO:Fast ↔  | Trig: Free   | Run   |      | e: Log-Pwr                       | TRACE 1                            | 2 3 4 5 6       | Frequency   |
|                                    |                       | Gain:Low   | #Atten: 30   | ) dB  |      |                                  | DET                                | NNNNN           | Auto Tune   |
| Ref Offse                          | t 2.6 dB              |  |  |   |      |                                  |                                    |                 |   |
| In dBidiy Ref 20                   | 00 dBm                |  |  |   |      |                                  |                                    |                 | 1   |
| 10 dB/div Ref 20.                  | 00 dBm                |  |  |   | 1    |                                  |                                    |                 | Contor Fro  |
| In dBidiy Ref 20                   | 00 dBm                |  |  |   |      |                                  |                                    |                 |   |
| 10 dB/div Ref 20.                  | 00 dBm                |  |  |   |      |                                  |                                    |                 | Center Fred<br>2.441000000 GHz  |
| og Ref 20.                         |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH;   |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH:<br>Start Free   |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH:<br>Start Frec<br>2.441000000 GH:  |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH:<br>Start Frec<br>2.441000000 GH:<br>Stop Frec   |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH:<br>Start Frec<br>2.441000000 GH:<br>Stop Frec   |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH;<br>Start Free<br>2.441000000 GH;<br>Stop Free<br>2.441000000 GH;<br>CF Step   |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH;<br>Start Free<br>2.441000000 GH;<br>Stop Free<br>2.441000000 GH;<br>CF Step<br>1.000000 MH;                         |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 |   |
| 10.0 BJ/div Ref 20.                |                       |  |  |   |      |                                  |                                    |                 | 2.44100000 GH2<br>Start Free<br>2.44100000 GH2<br>Stop Free<br>2.441000000 GH2<br>CF Step<br>1.000000 MH2<br>uto Mar<br>Freq Offset |
| 10 dB/div Ref 20.                  |                       |  |  |   |      |                                  |                                    |                 | 2.441000000 GH;<br>Start Free<br>2.441000000 GH;<br>Stop Free<br>2.441000000 GH;<br>CF Step<br>1.000000 MH;<br>uto Mar              |
| 10.0 BJ/div Ref 20.                |                       |  |  |   |      |                                  |                                    |                 | 2.44100000 GH;<br>Start Free<br>2.44100000 GH;<br>Stop Free<br>2.441000000 GH;<br>CF Step<br>1.000000 MH;<br>uto Mar<br>Freq Offse  |
| 10.0 BJ/div Ref 20.                |                       |  |  |   |      |                                  |                                    |                 | 2.44100000 GH:<br>Start Free<br>2.44100000 GH:<br>Stop Free<br>2.441000000 GH:<br>CF Step<br>1.00000 MH:<br>uto Mar<br>Freq Offse   |
| 0 dB/div Ref 20.                   |                       | #\//BIA  | ( 3.0 MHz  |   |      | Sween_1                          | Span<br>31.60 s (1000              | n o Hz          | 2.44100000 GH:<br>Start Free<br>2.44100000 GH:<br>Stop Free<br>2.441000000 GH:<br>CF Step<br>1.00000 MH:<br>uto Mar<br>Freq Offse   |