

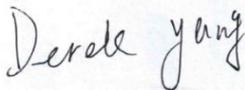
# FCC TEST REPORT

**Application No.:** AR/2021/10008  
**Applicant:** Xiaomi Communications Co., Ltd.  
**Address of Applicant** #019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085  
**Manufacturer:** Xiaomi Communications Co., Ltd.  
**Address of Manufacturer** #019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085  
**EUT Description:** Mobile Phone  
**Model No.:** M2103K19G / M2103K19PG  
**Trade Mark:** Redmi / POCO  
**FCC ID:** 2AFZZK19G  
**Standards:** 47 CFR Part 15, Subpart C  
**Date of Receipt:** 2021/2/8  
**Date of Test:** 2021/2/8 to 2021/3/17  
**Date of Issue:** 2021/3/18

|                      |               |
|----------------------|---------------|
| <b>Test Result :</b> | <b>PASS *</b> |
|----------------------|---------------|

\* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:



Derek Yang  
 Wireless Laboratory Manager



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# 1 Version

| Revision Record |         |            |          |          |
|-----------------|---------|------------|----------|----------|
| Version         | Chapter | Date       | Modifier | Remark   |
| 01              |         | 2021-03-18 |          | Original |
|                 |         |            |          |          |
|                 |         |            |          |          |

|                          |  |   |  |
|--------------------------|--|---|--|
| Authorized for issue by: |  |   |  |
| Prepared By              |  | <br>_____<br>(Dee Zheng) / Engineer      |  |
| Checked By               |  | <br>_____<br>(Daniel Wang) / Reviewer |  |



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## 2 Test Summary

| Test Item                            | Test Requirement | Test Method        | Test Result | Result |
|--------------------------------------|------------------|--------------------|-------------|--------|
| Duty cycle                           | -                | -                  | Clause 4.3  | PASS   |
| Conducted Peak Output Power          | 15.247 (b)(1)    | ANSI C63.10 (2013) | Clause 4.4  | PASS   |
| 20dB Emission Bandwidth              | 15.247 (a)(1)    | ANSI C63.10 (2013) | Clause 4.5  | PASS   |
| Carrier Frequencies Separation       | 15.247 (a)(1)    | ANSI C63.10 (2013) | Clause 4.6  | PASS   |
| Hopping Channel Number               | 15.247 (a)(1)    | ANSI C63.10 (2013) | Clause 4.7  | PASS   |
| Dwell Time                           | 15.247 (a)(1)    | ANSI C63.10 (2013) | Clause 4.8  | PASS   |
| Band-edge for RF Conducted Emissions | 15.247(d)        | ANSI C63.10 (2013) | Clause 4.9  | PASS   |
| RF Conducted Spurious Emissions      | 15.247(d)        | ANSI C63.10 (2013) | Clause 4.10 | PASS   |

Note: The differences between M2103K19G (K19) and M2103K19PG (K19P) are as below:

| Model name | Brand Name | rear cover   |
|------------|------------|--|
| M2103K19G  | Redmi      | The material is the same, drawing is different, laser engraving is different |
| M2103K19PG | POCO       |  |

Except listings above, the others are all the same as previous version.

Based on the above differences, the main test only performs M2103K19G



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### 3 General Information

#### 3.1 Details of Client

|                         |   |
|-------------------------|---|
| Applicant:              | Xiaomi Communications Co., Ltd.   |
| Address of Applicant    | #019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085 |
| Manufacturer:           | Xiaomi Communications Co., Ltd.   |
| Address of Manufacturer | #019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085 |

#### 3.2 Test Location

|            |   |
|------------|---|
| Company:   | SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch                             |
| Address:   | No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China |
| Post code: | 518057  |



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### 3.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.



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### 3.4 General Description of EUT

|                       |  |
|-----------------------|--|
| EUT Description:      | Mobile Phone   |
| Model No.:            | M2103K19G / M2103K19PG   |
| Trade Mark:           | Redmi / POCO   |
| Hardware Version:     | P2   |
| Software Version:     | MIUI 12  |
| Operation Frequency:  | 2400MHz~2483.5MHz<br>$f_c = 2402 \text{ MHz} + N * 2 \text{ MHz}$ , where:<br>- $f_c$ = "Operating Frequency" in MHz,<br>- $N$ = "Channel Number" with the range from 0 to 39. |
| Bluetooth version:    | Bluetooth V5.1   |
| Modulation Technique: | Frequency Hopping Spread Spectrum(FHSS)  |
| Modulation Type:      | GFSK, $\pi/4$ DQPSK, 8DPSK   |
| Number of Channel:    | 79   |
| Hopping Channel Type: | Adaptive Frequency Hopping systems   |
| Sample Type:          | <input checked="" type="checkbox"/> Portable Device, <input type="checkbox"/> Module   |
| Antenna Type:         | PIFA Antenna   |
| Antenna Gain:         | -1.3dBi  |

**Operation Frequency of each channel**

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



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|    |         |    |         |    |         |    |         |
|----|---------|----|---------|----|---------|----|---------|
| 17 | 2419MHz | 37 | 2439MHz | 57 | 2459MHz | 77 | 2479MHz |
| 18 | 2420MHz | 38 | 2440MHz | 58 | 2460MHz | 78 | 2480MHz |
| 19 | 2421MHz | 39 | 2441MHz | 59 | 2461MHz |    |         |

**Remark:**

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel                   | Frequency |
|---------------------------|-----------|
| The Lowest channel(CH0)   | 2402MHz   |
| The Middle channel(CH39)  | 2441MHz   |
| The Highest channel(CH78) | 2480MHz   |

### 3.5 Test Environment

| Operating Environment: |            |
|------------------------|------------|
| Temperature:           | 25.0 °C    |
| Humidity:              | 50 % RH    |
| Atmospheric Pressure:  | 101.30 KPa |

### 3.6 Description of Support Units

The EUT has been tested independent unit.



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## 4 Test results and Measurement Data

### 4.1 Antenna Requirement

|  |  |
|--|--|
| <b>Standard requirement:</b>   | 47 CFR Part 15C Section 15.203 /247(c) |
| <p>15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</p> <p>15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p> |  |
| <p>The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -1.3dBi.</p>  |  |



## 4.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

### 4.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

### 4.2.2 Conclusion

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

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

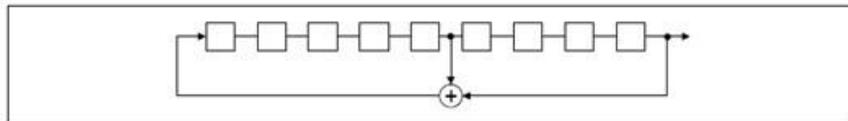
> Number of shift register stages: 9

> Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits

> Longest sequence of zeros: 8 (non-inverted signal)

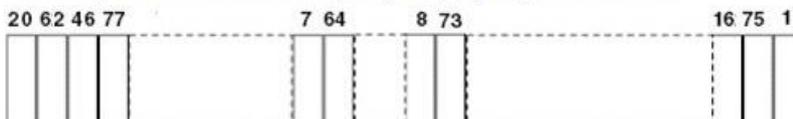
Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the RF system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels. The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



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### 4.3 Duty cycle

#### 4.3.1 Test Results

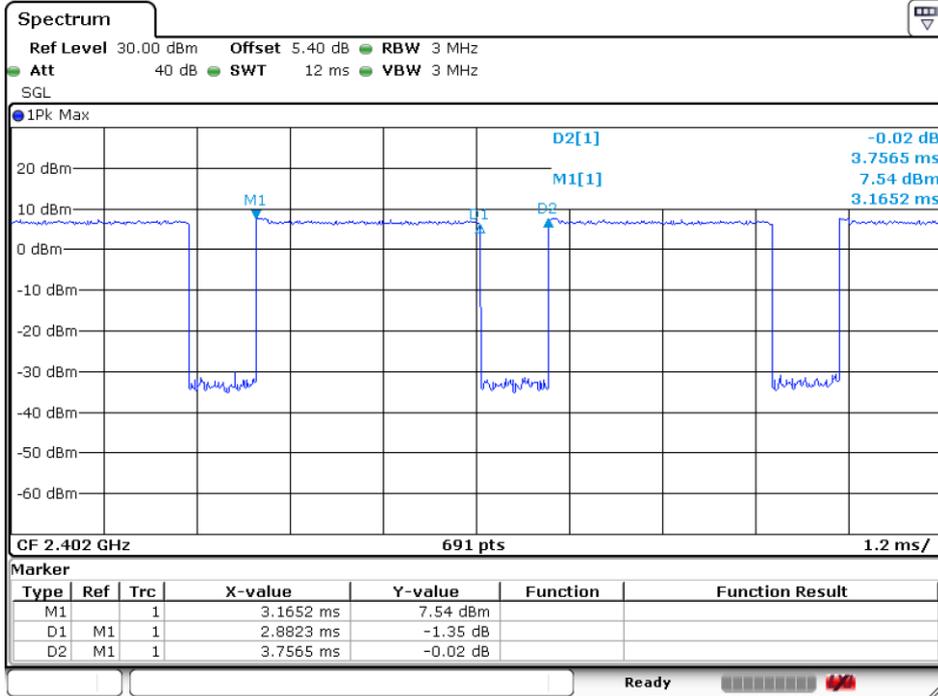
| Mode     | Test Channel  | Duty cycle [%] | T(ms) | 1/T(kHz) | VBW(kHz) |
|----------|---------------|----------------|-------|----------|----------|
| GFSK     | CH0,CH39,CH78 | 76.27          | 0.286 | 3.497    | 10       |
| π/4DQPSK | CH0,CH39,CH78 | 76.73          | 0.288 | 3.472    | 10       |
| 8DPSK    | CH0,CH39,CH78 | 76.73          | 0.288 | 3.472    | 10       |



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Test mode: π/4DQPSK

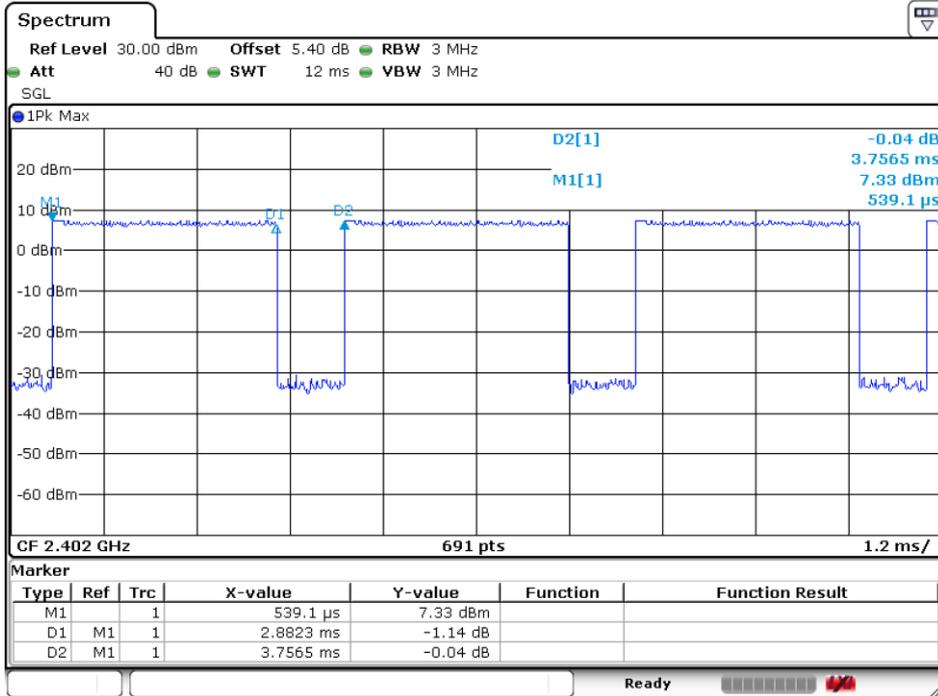


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Test mode: 8DPSK

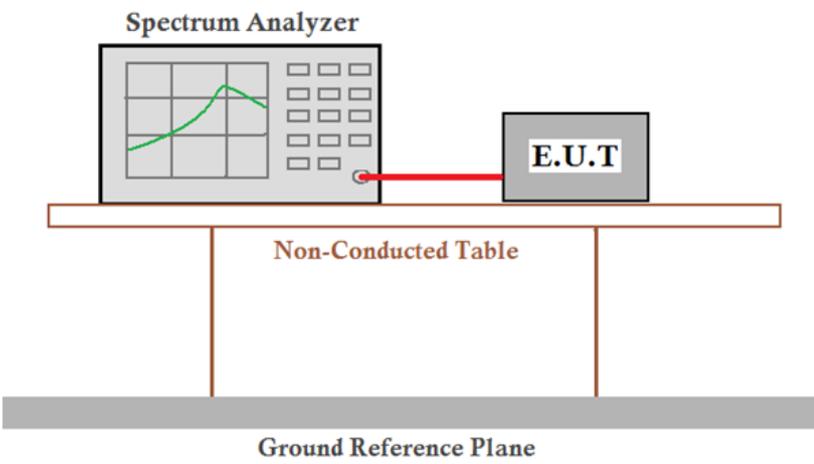


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#### 4.4 Conducted Output Power

|                        |   |
|------------------------|---|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (b)(1)   |
| Test Method:           | ANSI C63.10:2013 Section 7.8.5  |
| Test Setup:            |   |
| Test Instruments:      | Refer to section 6 for details  |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type.   |
| Final Test Mode:       | Through Pre-scan, find the<br>DH5 of data type is the worst case of GFSK modulation type,<br>2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type,<br>3-DH5 of data type is the worst case of 8DPSK modulation type. |
| Limit:                 | (20.97dBm) 125mW  |
| Test Results:          | Pass  |



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**4.4.1 Test Results**

**Measurement Data of Peak Power:**

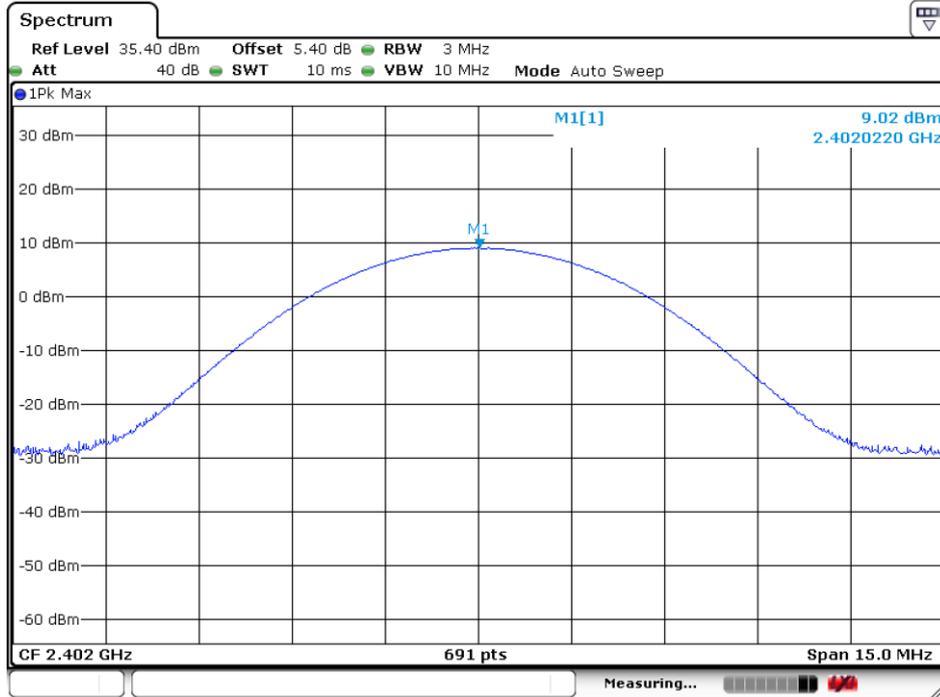
| GFSK mode     |                         |             |        |
|---------------|-------------------------|-------------|--------|
| Test Channel  | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest        | 9.02                    | 20.97       | Pass   |
| Middle        | 8.52                    | 20.97       | Pass   |
| Highest       | 9.49                    | 20.97       | Pass   |
| π/4DQPSK mode |                         |             |        |
| Test Channel  | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest        | 8.05                    | 20.97       | Pass   |
| Middle        | 7.49                    | 20.97       | Pass   |
| Highest       | 8.67                    | 20.97       | Pass   |
| 8DPSK mode    |                         |             |        |
| Test Channel  | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest        | 7.89                    | 20.97       | Pass   |
| Middle        | 7.45                    | 20.97       | Pass   |
| Highest       | 8.55                    | 20.97       | Pass   |



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### 4.4.2 Test Plots

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Lowest |
|------------|------|---------------|--------|



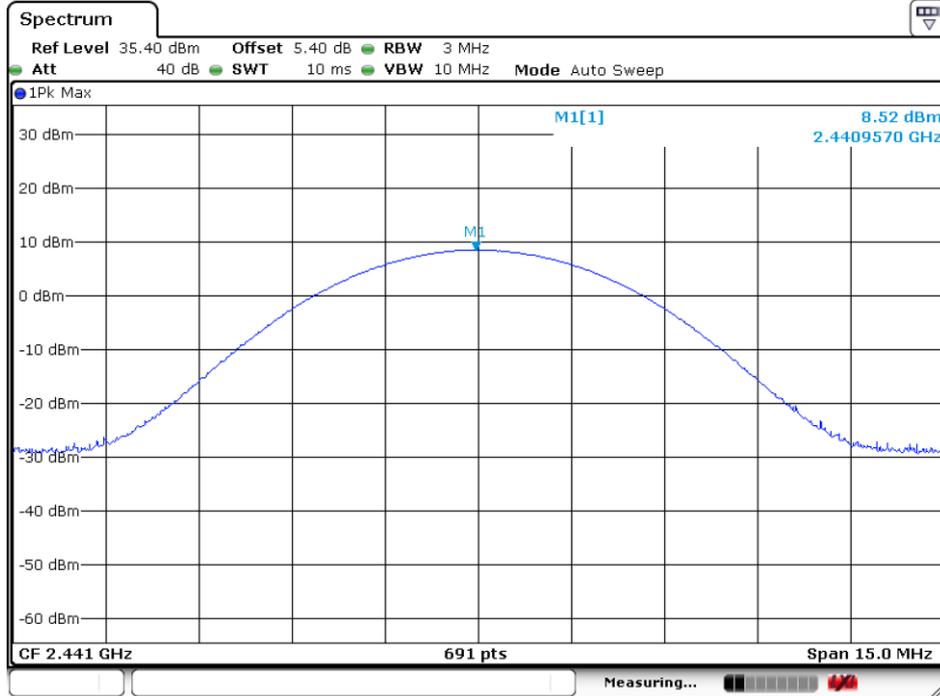
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|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



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|            |      |               |         |
|------------|------|---------------|---------|
| Test mode: | GFSK | Test channel: | Highest |
|------------|------|---------------|---------|



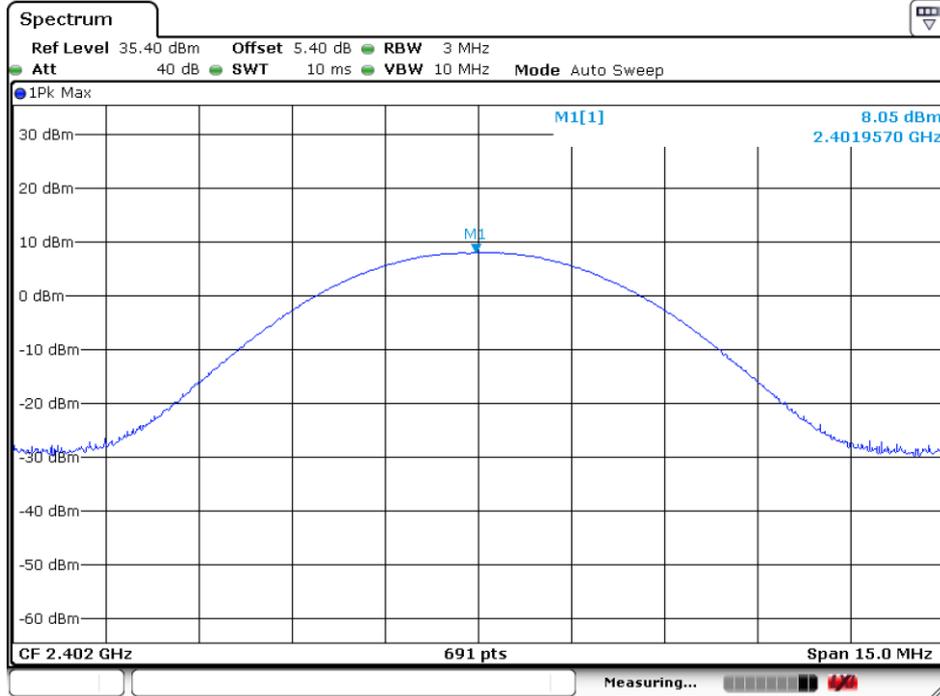
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest |
|------------|---------------|---------------|--------|



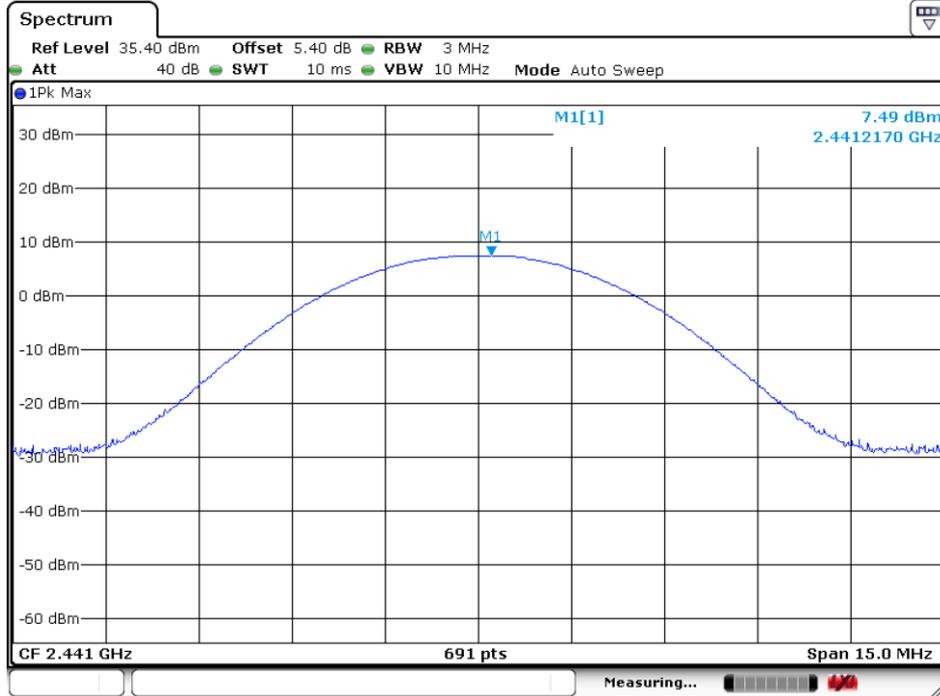
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|



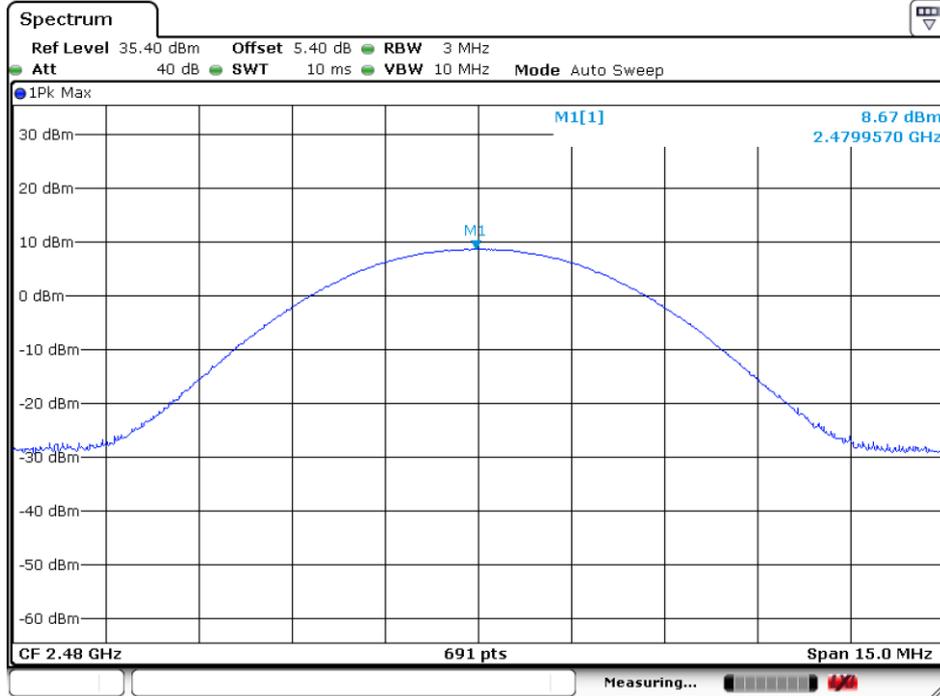
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|            |               |               |         |
|------------|---------------|---------------|---------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest |
|------------|---------------|---------------|---------|



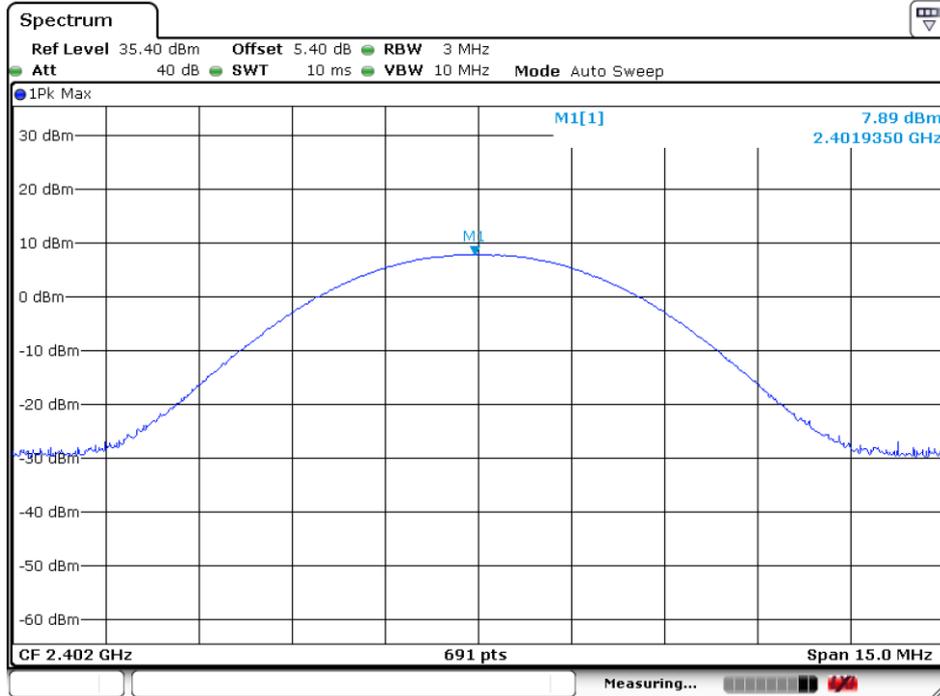
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Lowest |
|------------|-------|---------------|--------|



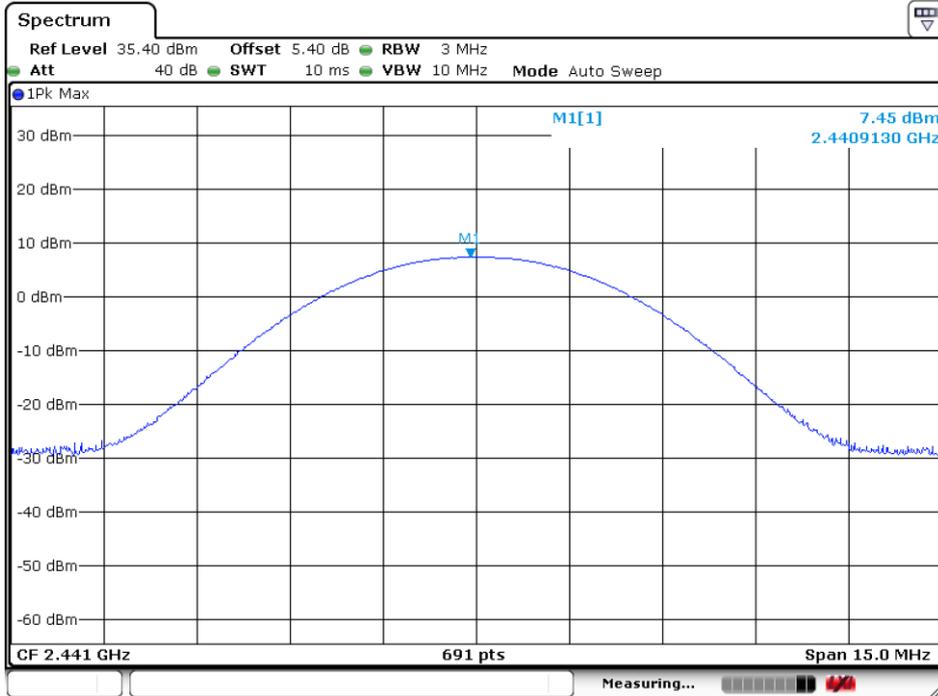
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



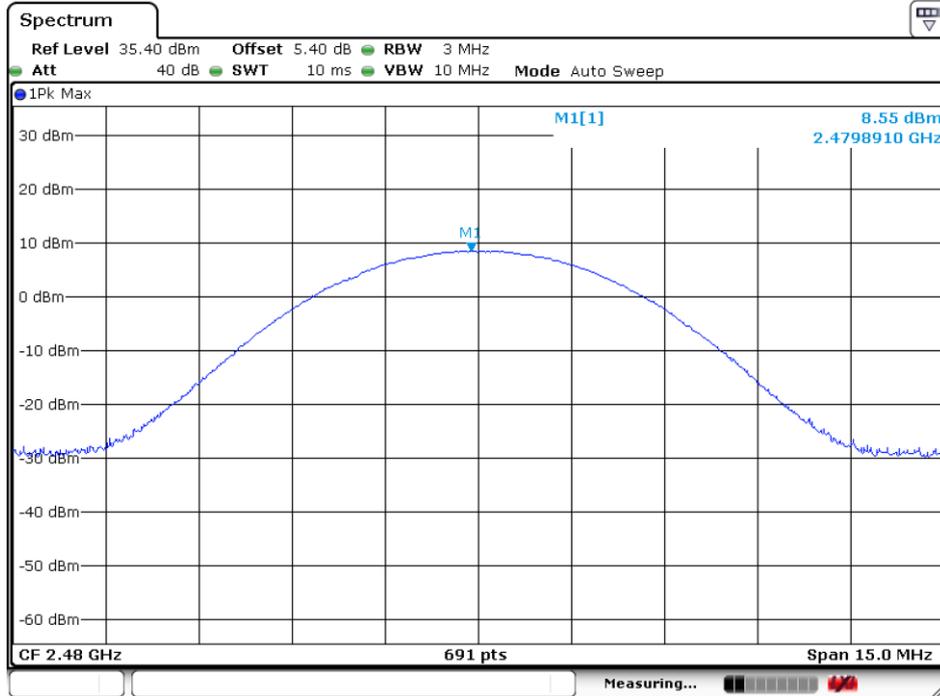
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|            |       |               |         |
|------------|-------|---------------|---------|
| Test mode: | 8DPSK | Test channel: | Highest |
|------------|-------|---------------|---------|



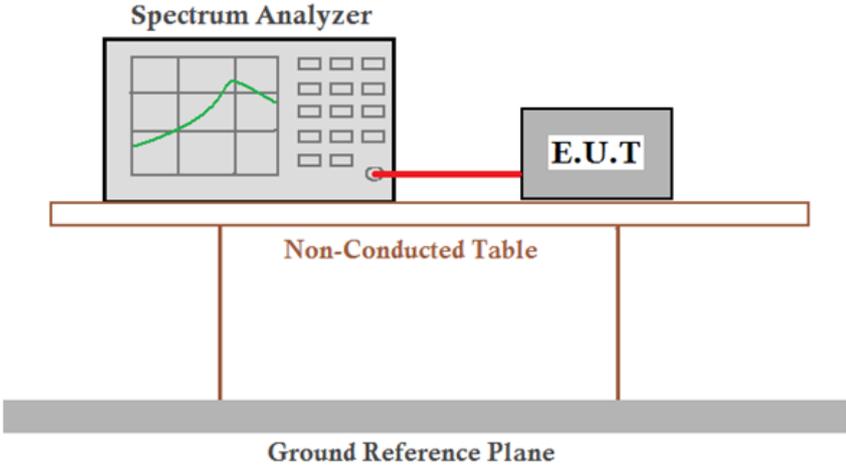
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### 4.5 20dB Emission Bandwidth

|                        |   |
|------------------------|---|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (a)(1)   |
| Test Method:           | ANSI C63.10:2013 Section 7.8.7  |
| Test Setup:            |    |
| Instruments Used:      | Refer to section 6 for details  |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type.   |
| Final Test Mode:       | Through Pre-scan, find the<br>DH5 of data type is the worst case of GFSK modulation type,<br>2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type,<br>3-DH5 of data type is the worst case of 8DPSK modulation type. |
| Limit:                 | NA  |
| Test Results:          | Pass  |



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**4.5.1 Test Results**

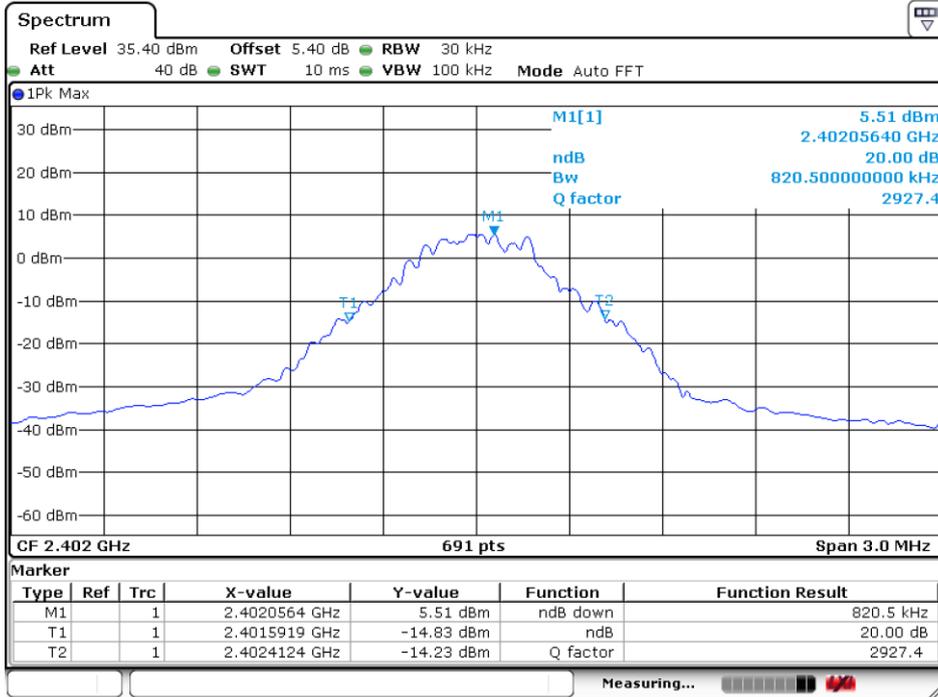
| Mode     | Test Channel | 20dB Emission Bandwidth (KHz) | Result |
|----------|--------------|-------------------------------|--------|
| GFSK     | Lowest       | 820.5                         | Pass   |
|          | Middle       | 816.2                         | Pass   |
|          | Highest      | 820.5                         | Pass   |
| π/4DQPSK | Lowest       | 1259.0                        | Pass   |
|          | Middle       | 1254.7                        | Pass   |
|          | Highest      | 1254.7                        | Pass   |
| 8DPSK    | Lowest       | 1272.1                        | Pass   |
|          | Middle       | 1267.7                        | Pass   |
|          | Highest      | 1267.7                        | Pass   |



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### 4.5.2 Test Plots

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Lowest |
|------------|------|---------------|--------|



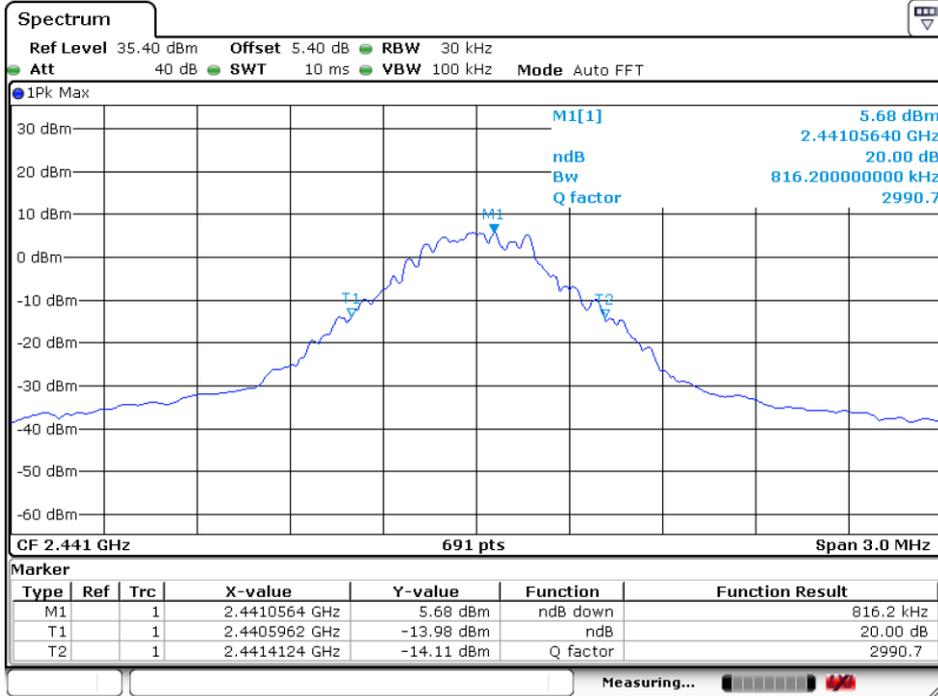
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|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



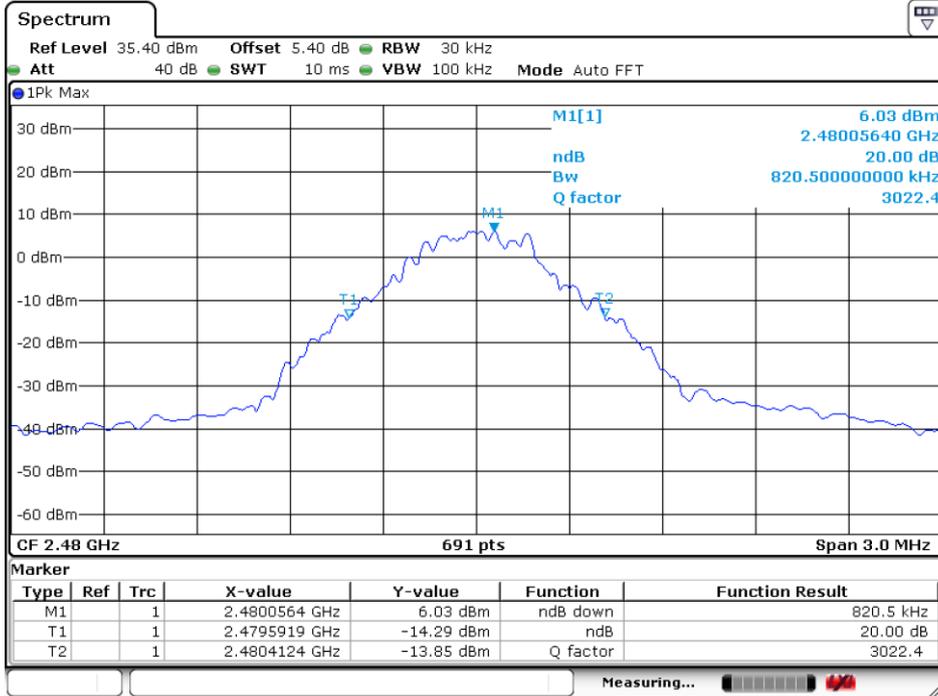
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|            |      |               |         |
|------------|------|---------------|---------|
| Test mode: | GFSK | Test channel: | Highest |
|------------|------|---------------|---------|



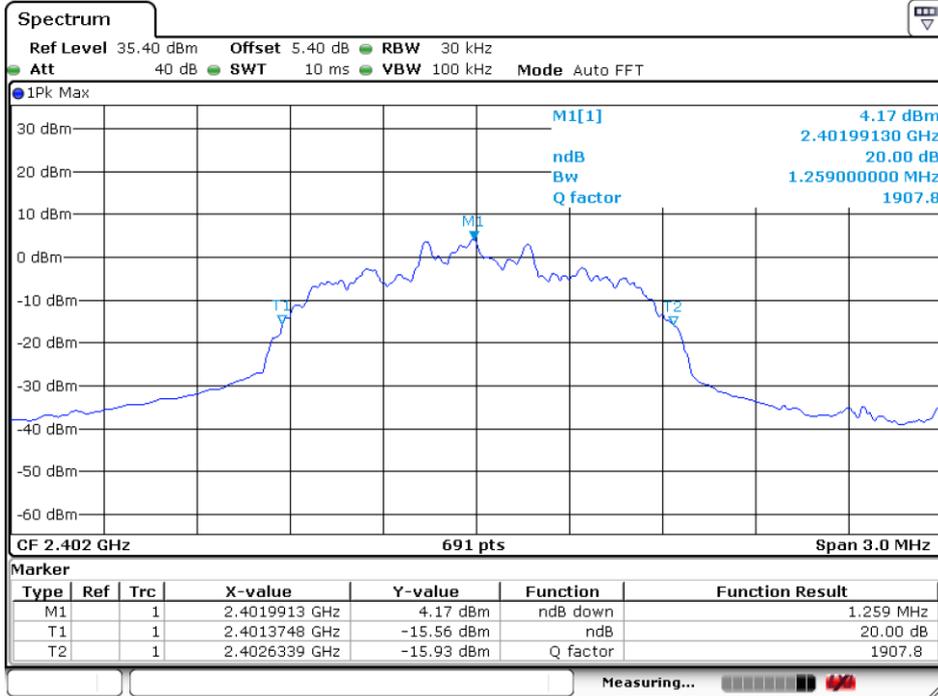
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest |
|------------|---------------|---------------|--------|



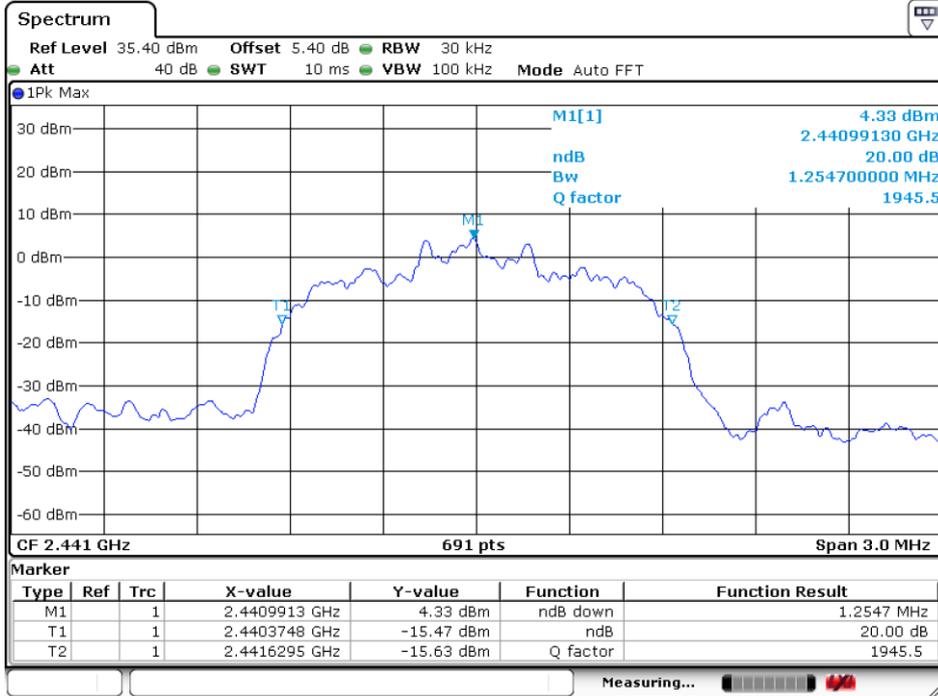
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|



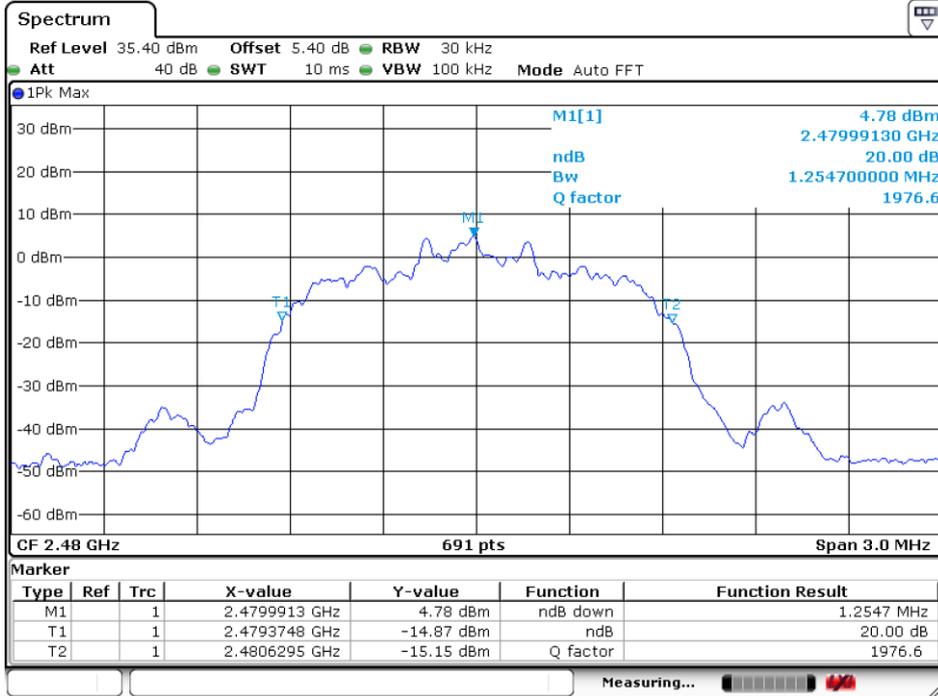
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|            |               |               |         |
|------------|---------------|---------------|---------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest |
|------------|---------------|---------------|---------|



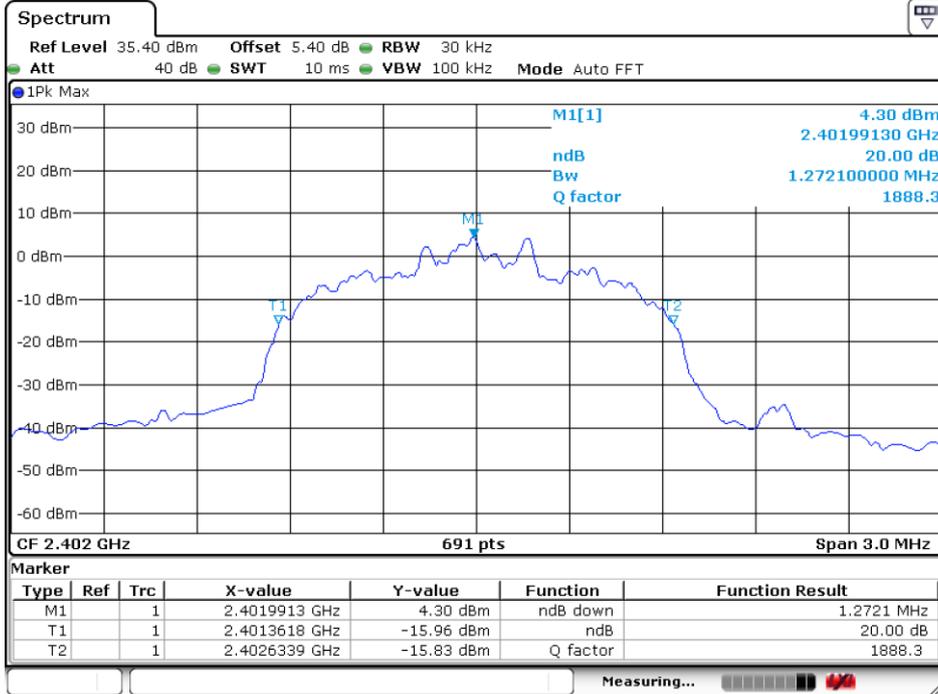
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Lowest |
|------------|-------|---------------|--------|



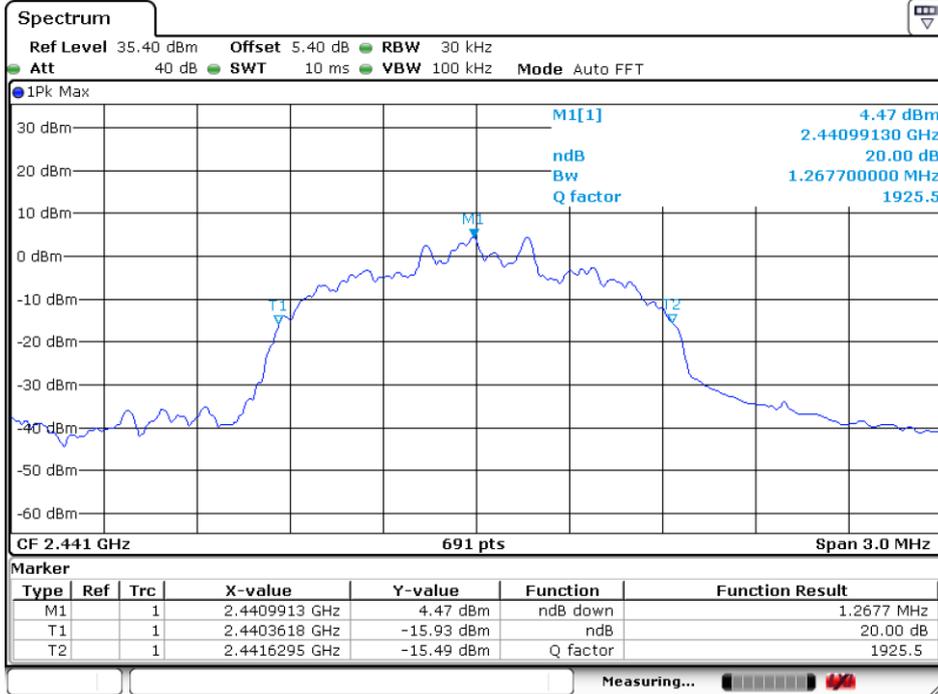
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



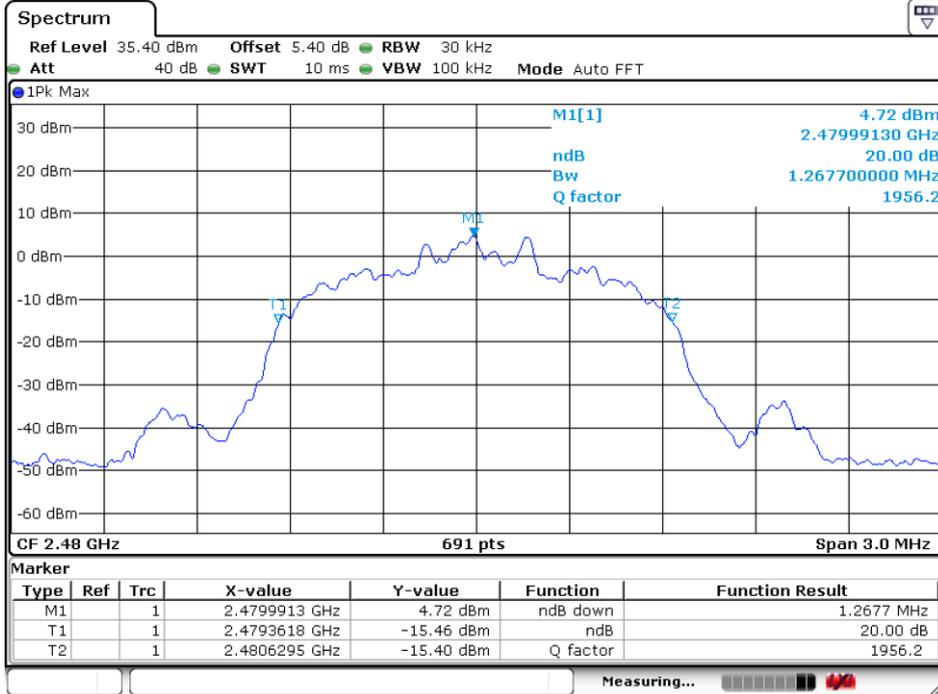
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|            |       |               |         |
|------------|-------|---------------|---------|
| Test mode: | 8DPSK | Test channel: | Highest |
|------------|-------|---------------|---------|



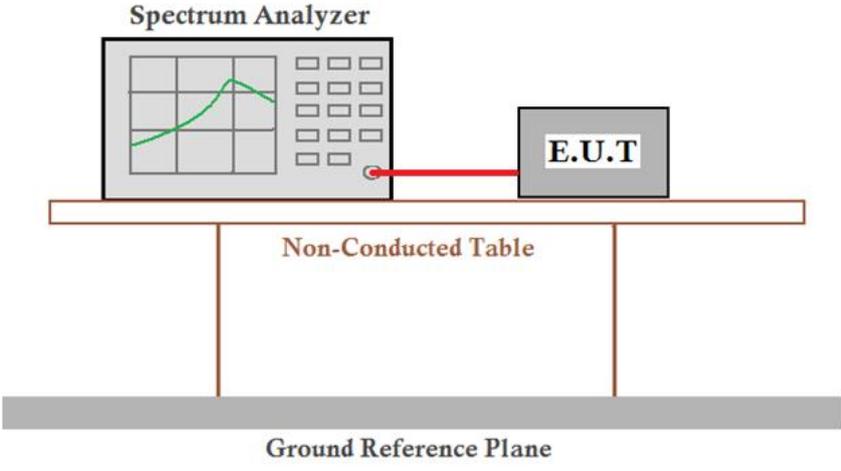
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### 4.6 Carrier Frequencies Separationy

|                        |   |
|------------------------|---|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (a)(1)   |
| Test Method:           | ANSI C63.10:2013 Section 7.8.2  |
| Test Setup:            |    |
| Test Instruments:      | Refer to section 6 for details  |
| Exploratory Test Mode: | Hopping transmitting with all kind of modulation and all kind of data type.   |
| Final Test Mode:       | Through Pre-scan, find the<br>DH5 of data type is the worst case of GFSK modulation type,<br>2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type,<br>3-DH5 of data type is the worst case of 8DPSK modulation type. |
| Limit:                 | 2/3 of the 20dB bandwidth<br>Remark: the transmission power is less than 0.125W.  |
| Test Results:          | Pass  |



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4.6.1 Test Results

| GFSK mode          |                                      |             |        |
|--------------------|--------------------------------------|-------------|--------|
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 1003                                 | 547.0       | PASS   |
| $\pi/4$ DQPSK mode |                                      |             |        |
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 1007                                 | 839.3       | PASS   |
| 8DPSK mode         |                                      |             |        |
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 1004                                 | 848.1       | PASS   |

Remark: According to section 4.5,

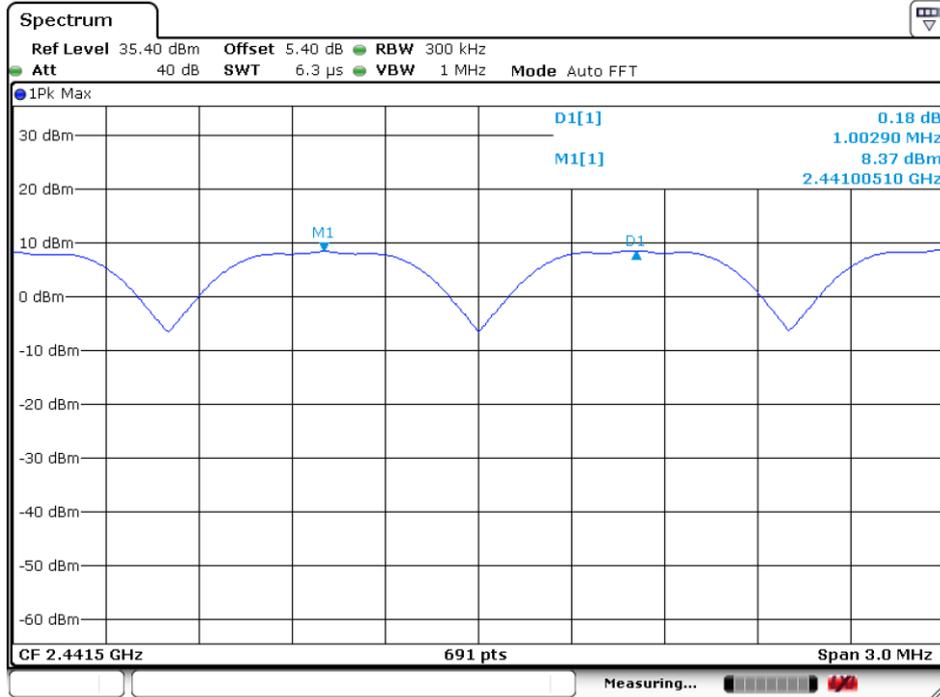
| Mode          | 20dB bandwidth (kHz)<br>(worse case) | Limit (kHz)<br>(Carrier Frequencies Separation) |
|---------------|--------------------------------------|---|
| GFSK          | 820.5                                | 547.0   |
| $\pi/4$ DQPSK | 1259.0                               | 839.3   |
| 8DPSK         | 1272.1                               | 848.1   |



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### 4.6.2 Test Plots

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



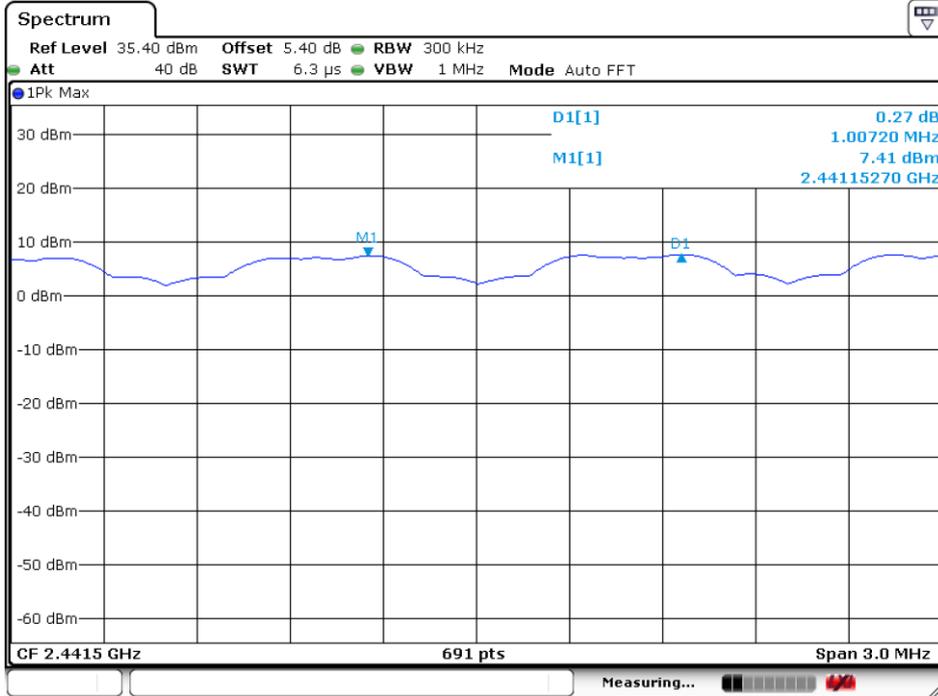
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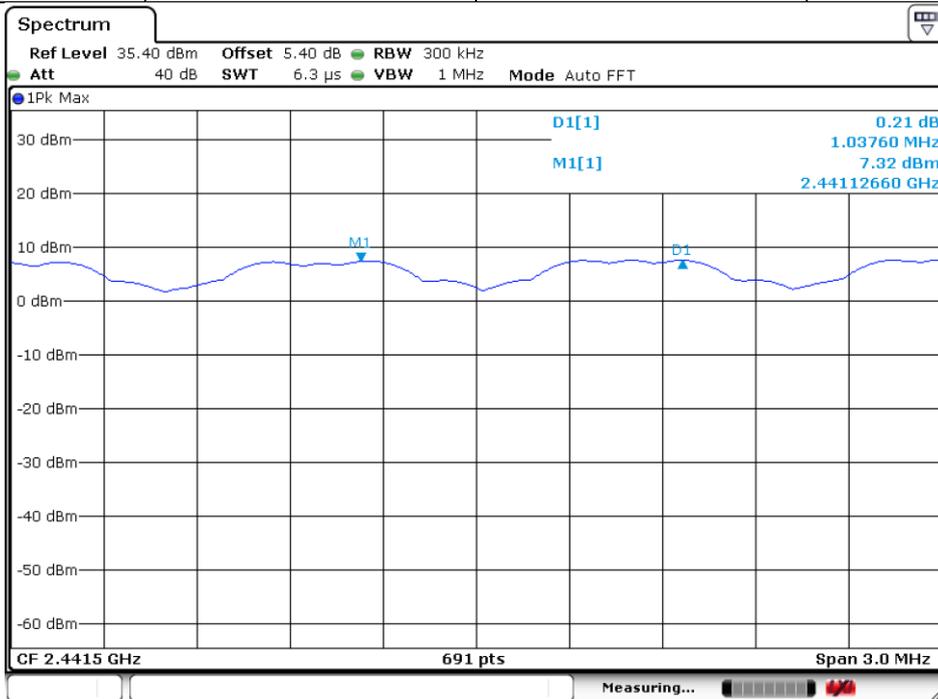
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|



Date: 11.MAR.2021 10:24:56

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



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### 4.7 Hopping Channel Number

|                   |  |
|-------------------|--|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1)            |
| Test Method:      | ANSI C63.10:2013 Section 7.8.3                   |
| Test Setup:       |  |
| Instruments Used: | Refer to section 6 for details                   |
| Test Mode:        | Hopping transmitting with all kind of modulation |
| Limit:            | At least 15 channels                             |
| Test Results:     | Pass   |

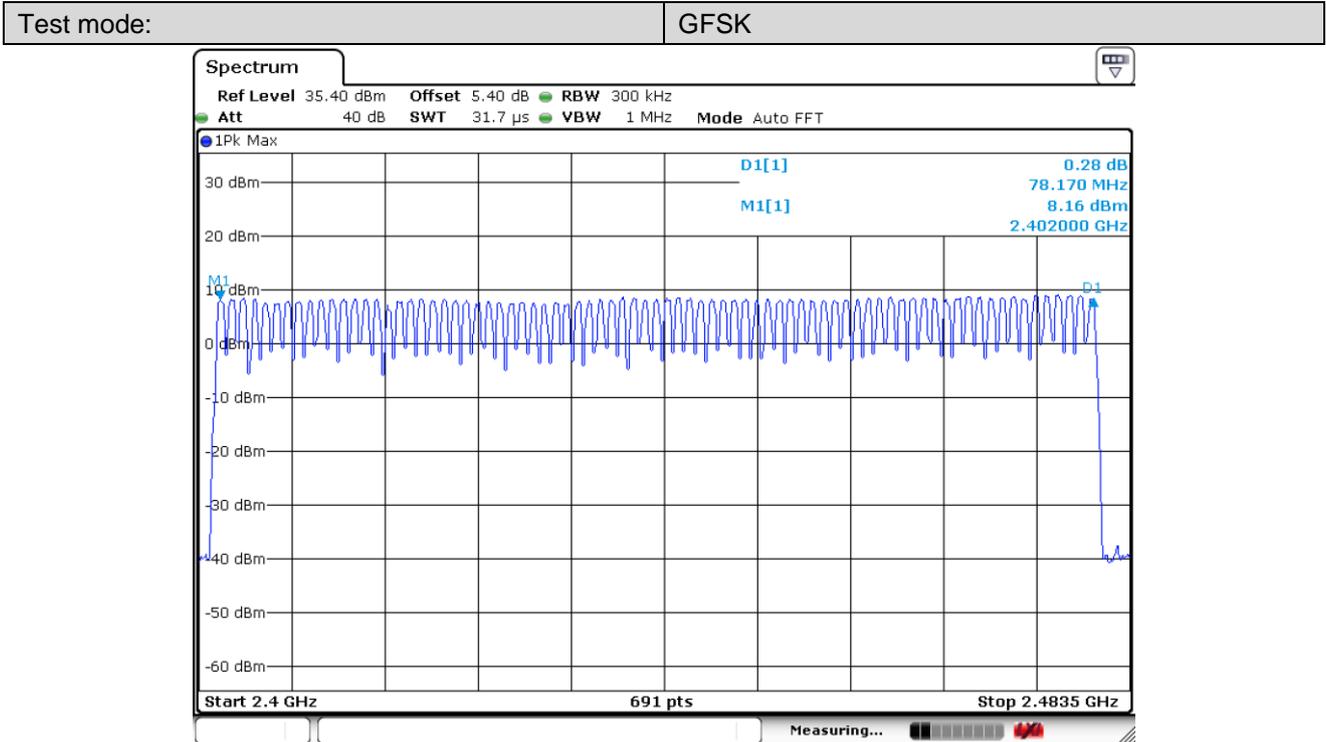
#### 4.7.1 Test Results

| Mode          | Hopping channel numbers | Limit |
|---------------|-------------------------|-------|
| GFSK          | 79                      | ≥15   |
| $\pi/4$ DQPSK | 79                      | ≥15   |
| 8DPSK         | 79                      | ≥15   |



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### 4.7.2 Test Plots



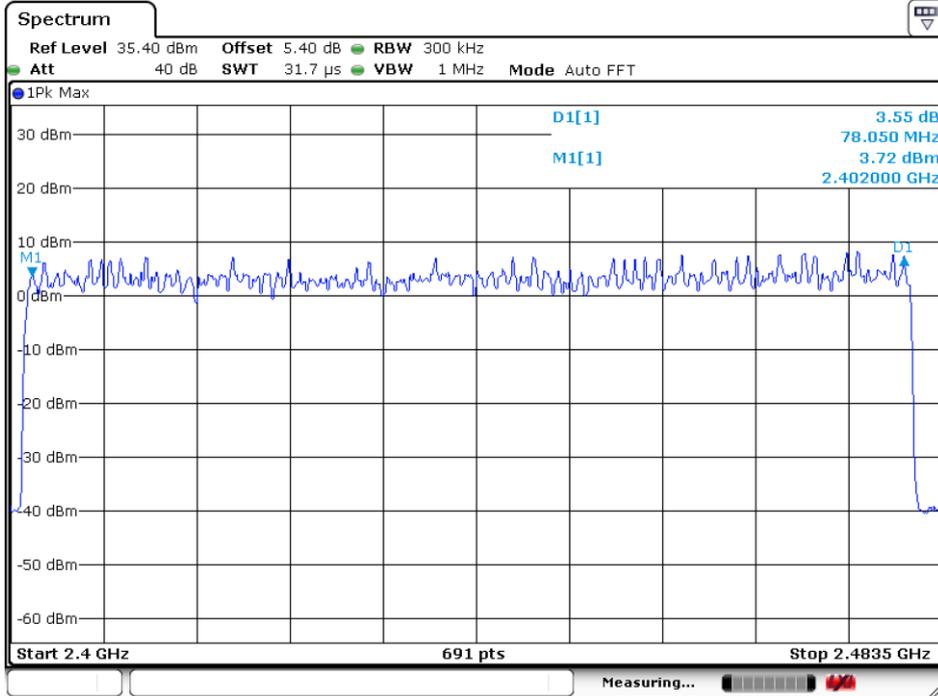
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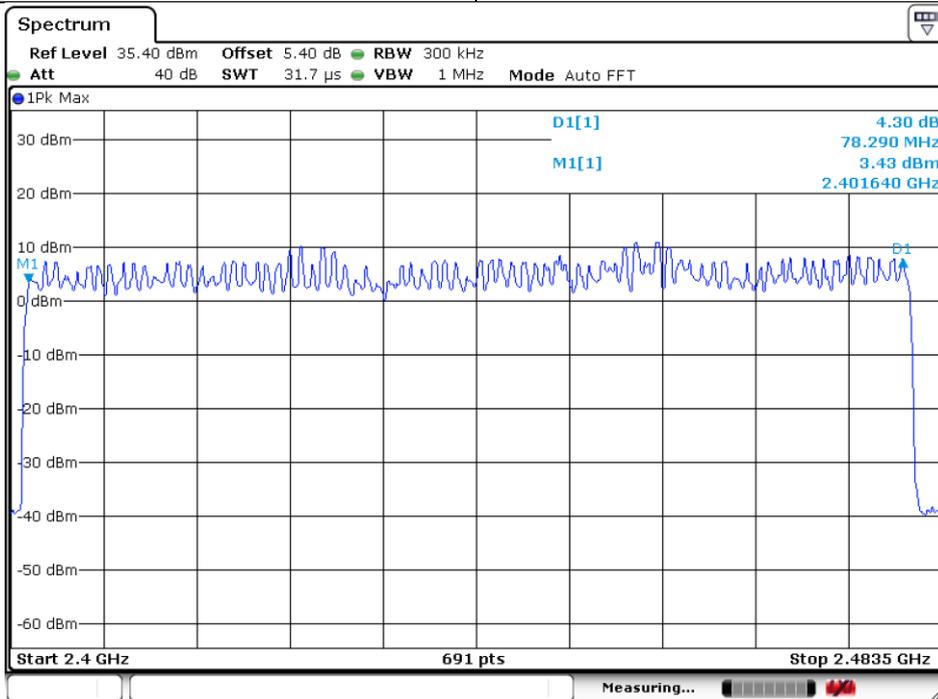
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Test mode: π/4DQPSK



Date: 11.MAR.2021 10:18:53

Test mode: 8DPSK

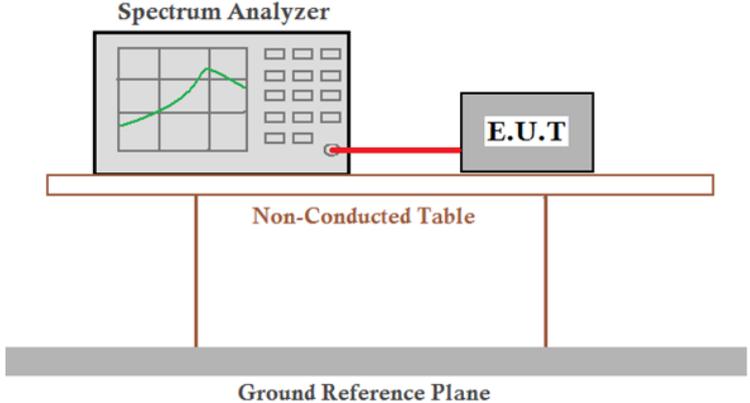


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### 4.8 Dwell Time

|                   |  |
|-------------------|--|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1)  |
| Test Method:      | ANSI C63.10:2013 Section 7.8.4   |
| Test Setup:       |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p> |
| Instruments Used: | Refer to section 6 for details   |
| Test Mode:        | Hopping transmitting with all kind of modulation and all kind of data type.  |
| Limit:            | 0.4 Second   |
| Test Results:     | Pass   |



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**4.8.1 Test Results**

| Operation Modes | On time (ms) on one channel |
|-----------------|-----------------------------|
| DH1             | 0.381                       |
| DH3             | 1.665                       |
| DH5             | 2.920                       |
| 2-DH1           | 0.392                       |
| 2-DH3           | 1.674                       |
| 2-DH5           | 2.906                       |
| 3-DH1           | 0.393                       |
| 3-DH2           | 1.670                       |
| 3-DH5           | 2.920                       |

**Bluetooth Time of Occupancy Calculation**

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s, since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of  $1600/6=266.67$  hop/s/slot

$400\text{ms} \times 79 \text{ Channel} = 31.6 \text{ s}$  (Time of Occupancy Limit)

Worst case BT has 266.67 hops/second (for 1x/EDR modes with 3-DH5 operation)

$266.67 \text{ hops/second} / 79 \text{ channels} = 3.38 \text{ hops/second}$  (# of hops/second on one channel)

$3.38 \text{ hops/second} / \text{channel} \times 31.6 \text{ seconds} = 106.67 \text{ hops}$  (#hops over a 31.6 second period)

$106.67 \text{ hops} \times 2.920 \text{ ms/channel} = 311.48 \text{ ms}$  (worst case dwell time for one channel in 1x/EDR

modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800hops/s, AFH mode also uses 6 slots so the Bluetooth transmitter hops at a rate of  $800/6=133.3$  hops/s/slot

$400\text{ms} \times 20 \text{ Channel} = 8 \text{ s}$  (Time of Occupancy Limit)

Worst case BT has 133.3 hops/second/slot (for AFH mode with 3-DH5 operation)

$133.3 \text{ hops/second} / 20 \text{ channels} = 6.67 \text{ hops/second}$  (#hops/second on one channel)

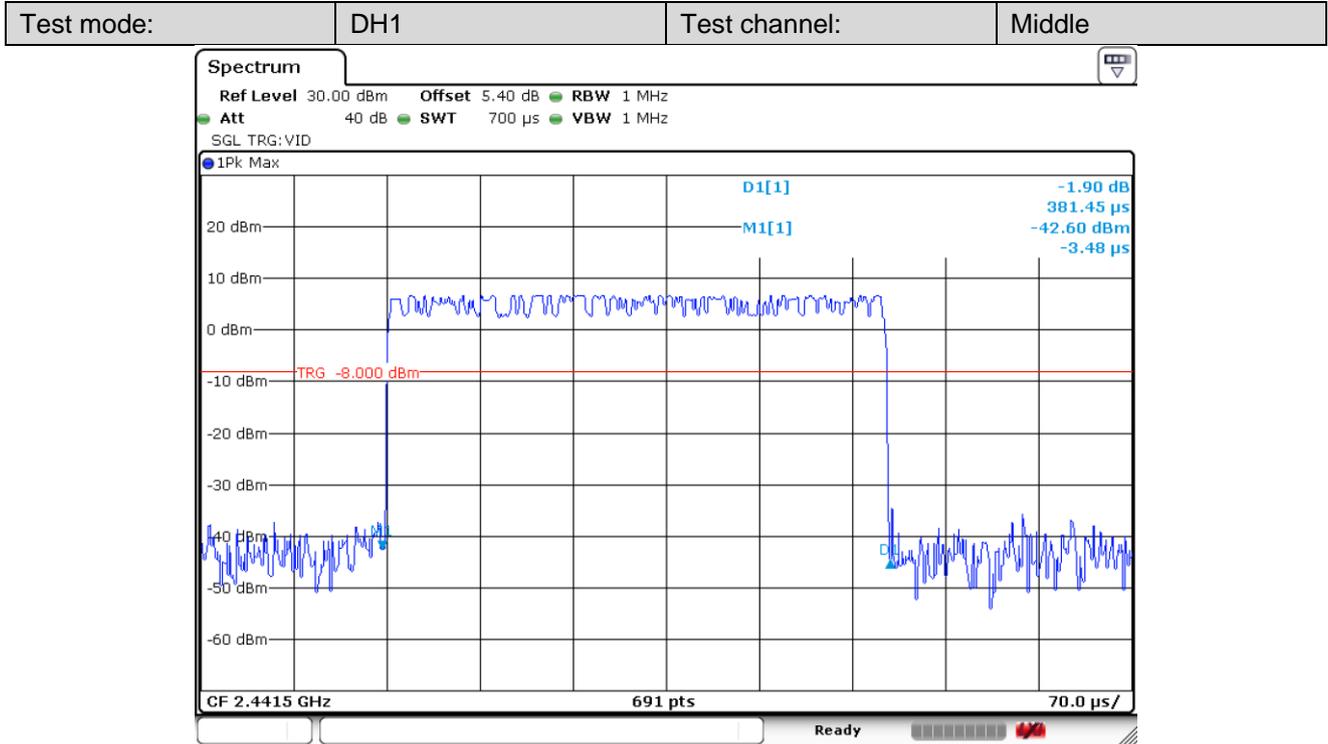
$6.67 \text{ hops/second} \times 8 \text{ seconds} = 53.34 \text{ hops}$  (#hops over a 8 seconds period)

$53.34 \text{ hops} \times 2.920 \text{ ms/channel} = 155.75 \text{ ms}$  (worst case dwell time for one channel in AFH mode)



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### 4.8.2 Test Plots



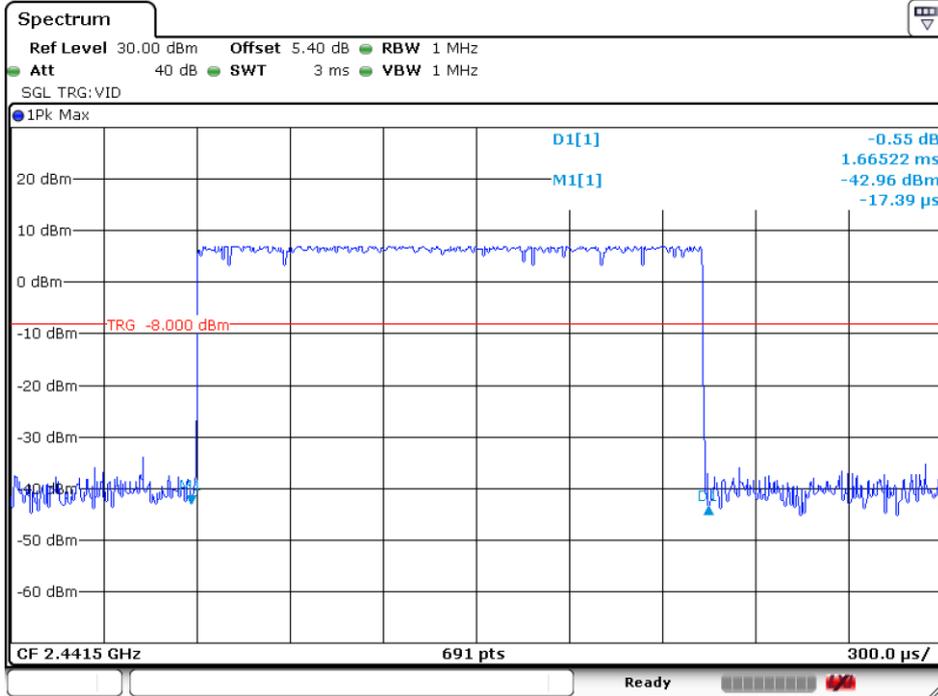
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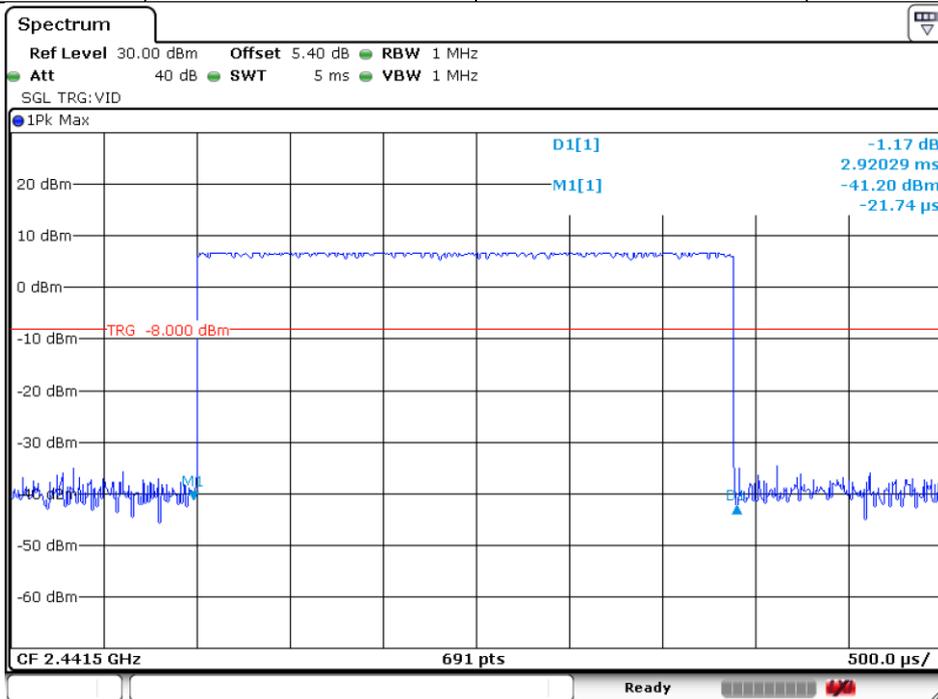
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|            |     |               |        |
|------------|-----|---------------|--------|
| Test mode: | DH3 | Test channel: | Middle |
|------------|-----|---------------|--------|



Date: 11.MAR.2021 10:27:16

|            |     |               |        |
|------------|-----|---------------|--------|
| Test mode: | DH5 | Test channel: | Middle |
|------------|-----|---------------|--------|



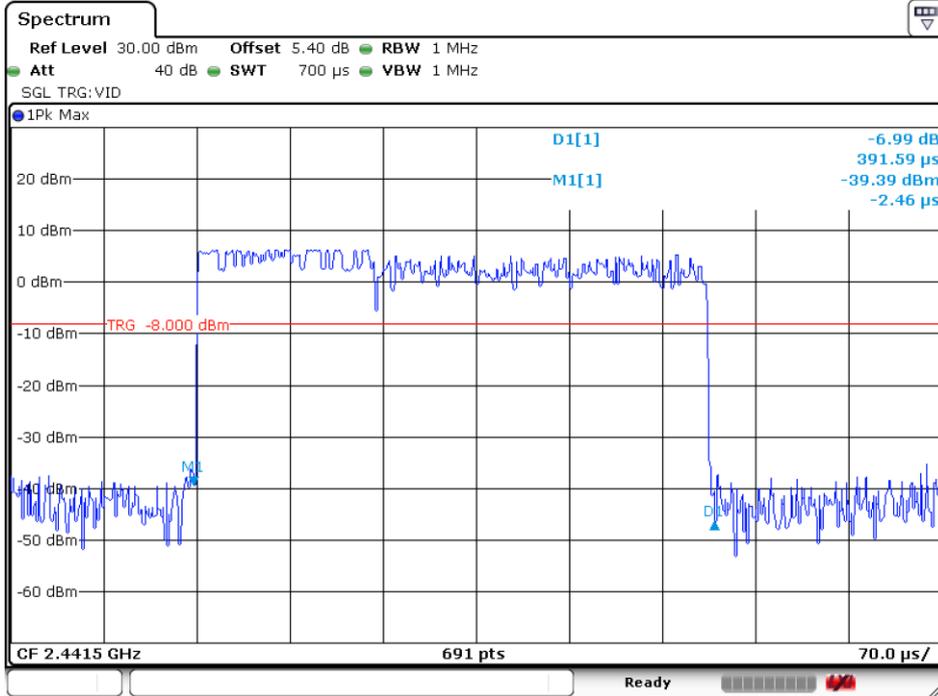
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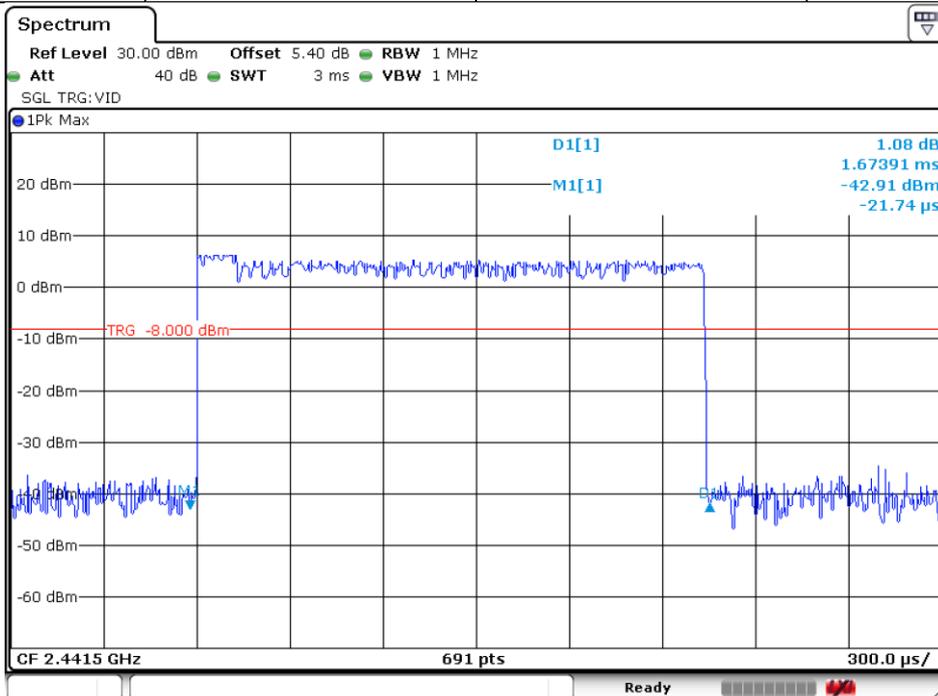
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 2-DH1 | Test channel: | Middle |
|------------|-------|---------------|--------|



Date: 11.MAR.2021 10:30:11

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 2-DH3 | Test channel: | Middle |
|------------|-------|---------------|--------|

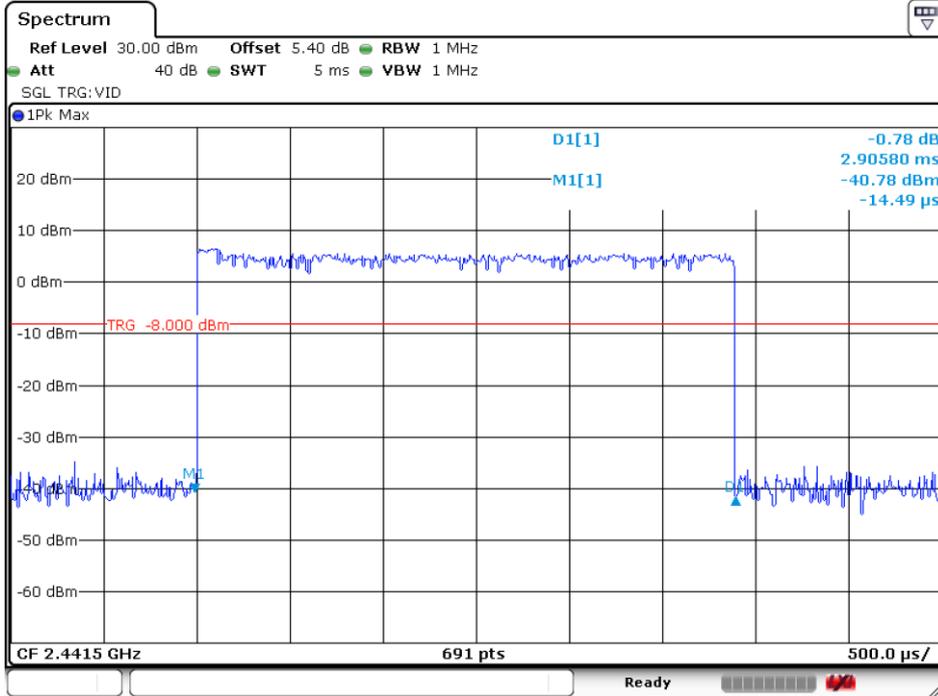


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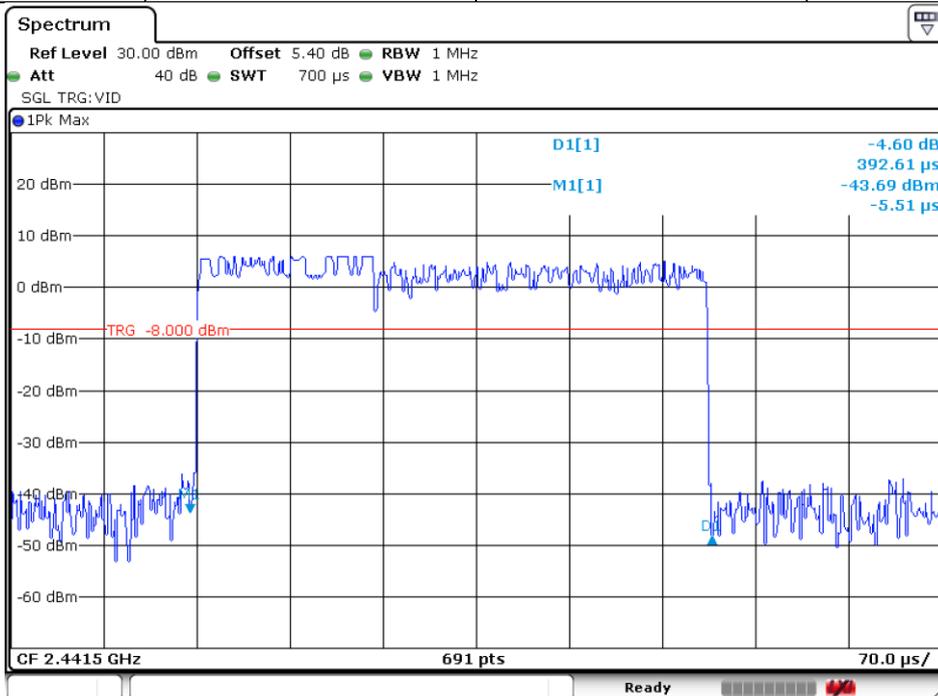
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 2-DH5 | Test channel: | Middle |
|------------|-------|---------------|--------|



Date: 11.MAR.2021 10:25:55

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 3-DH1 | Test channel: | Middle |
|------------|-------|---------------|--------|



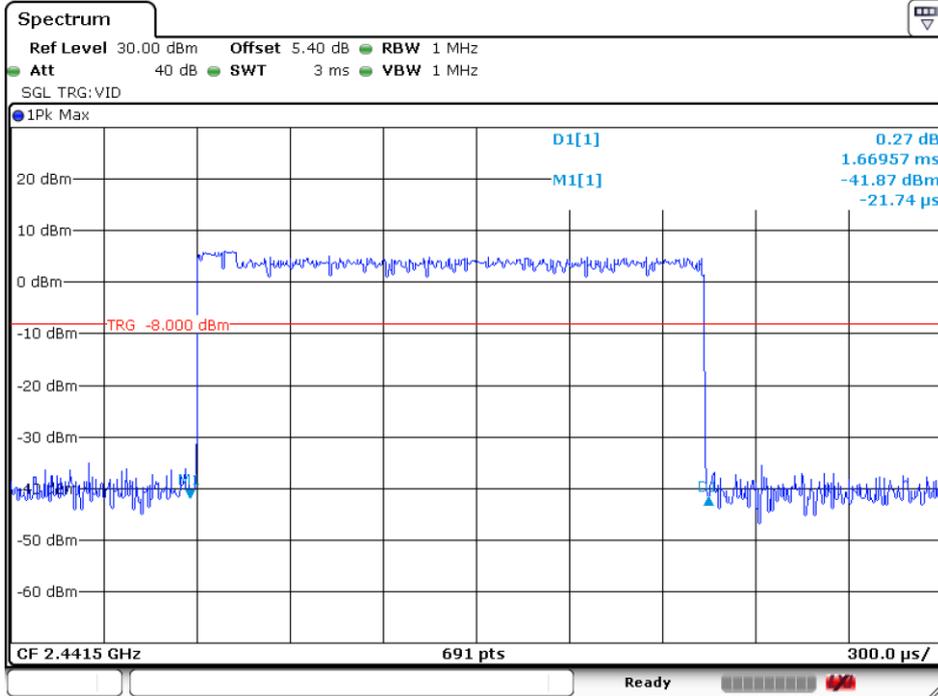
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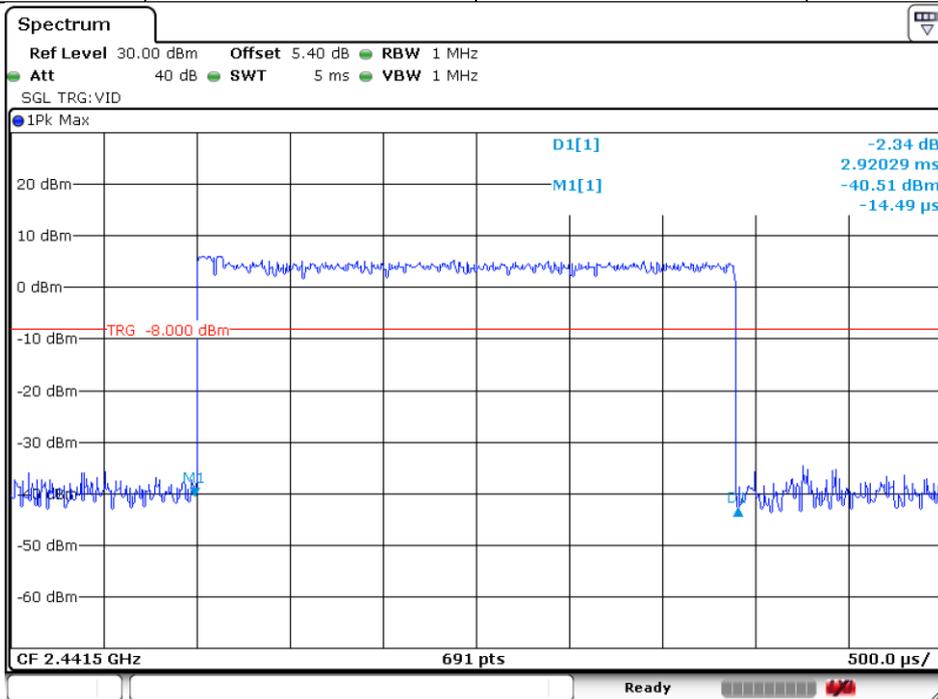
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 3-DH3 | Test channel: | Middle |
|------------|-------|---------------|--------|



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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 3-DH5 | Test channel: | Middle |
|------------|-------|---------------|--------|



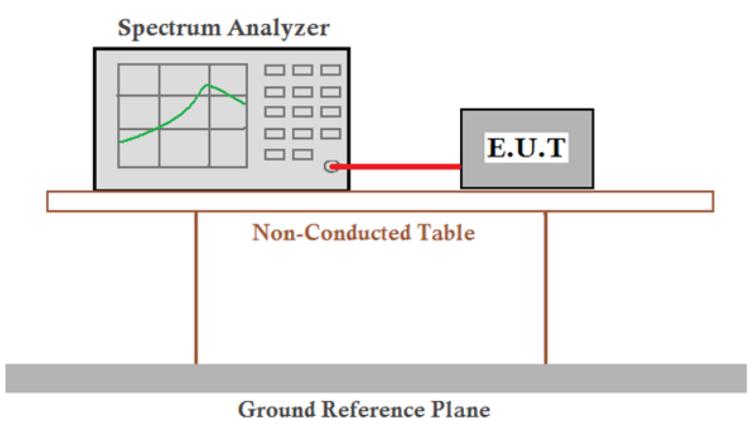
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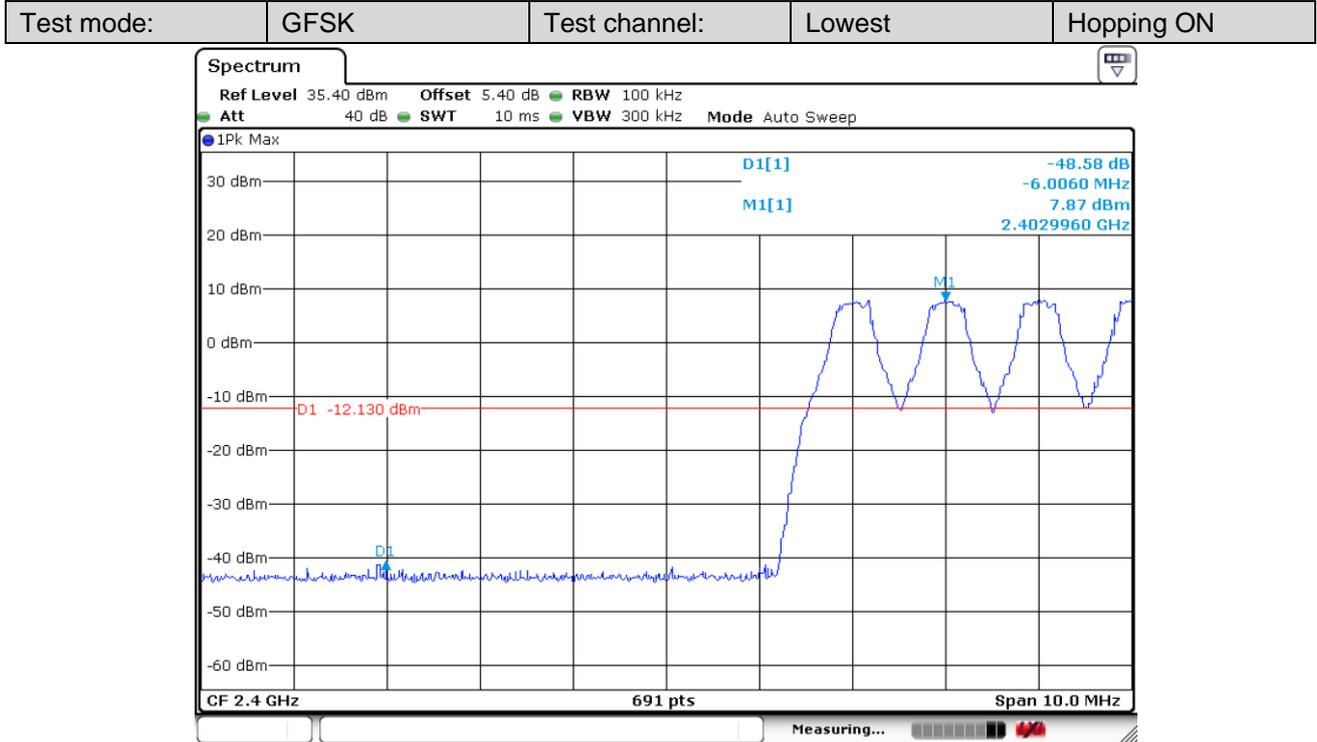
### 4.9 Band-edge for RF Conducted Emissions

|                        |   |
|------------------------|---|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (d)  |
| Test Method:           | ANSI C63.10:2013 Section 7.8.6  |
| Test Setup:            |   |
| Instruments Used:      | Refer to section 6 for details  |
| Exploratory Test Mode: | Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type.   |
| Final Test Mode:       | Through Pre-scan, find the<br>DH5 of data type is the worst case of GFSK modulation type,<br>2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type,<br>3-DH5 of data type is the worst case of 8DPSK modulation type.   |
| Limit:                 | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test Results:          | Pass  |



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### 4.9.1 Test Plots



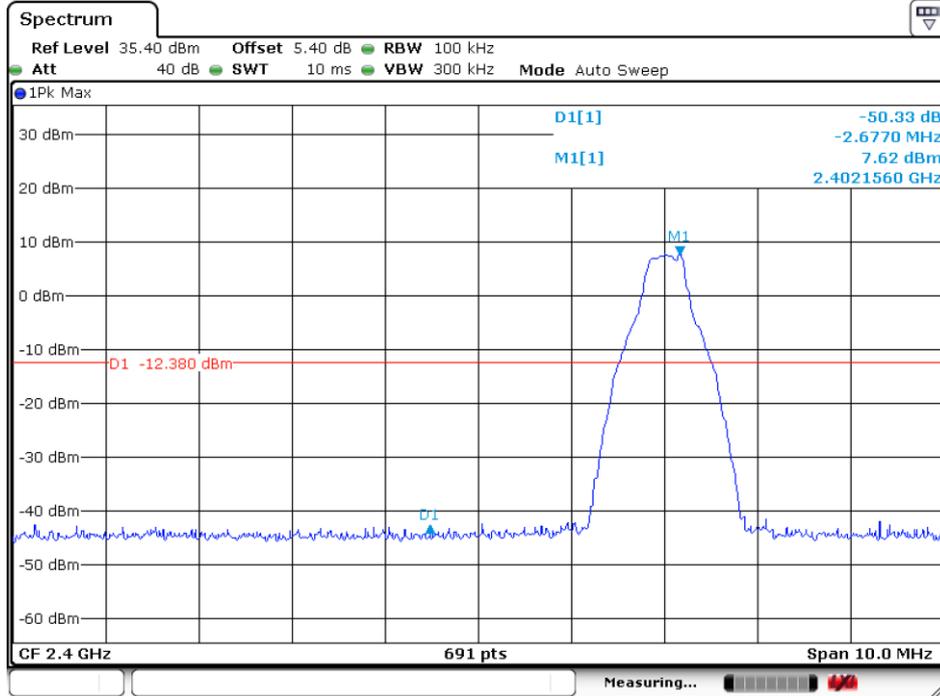
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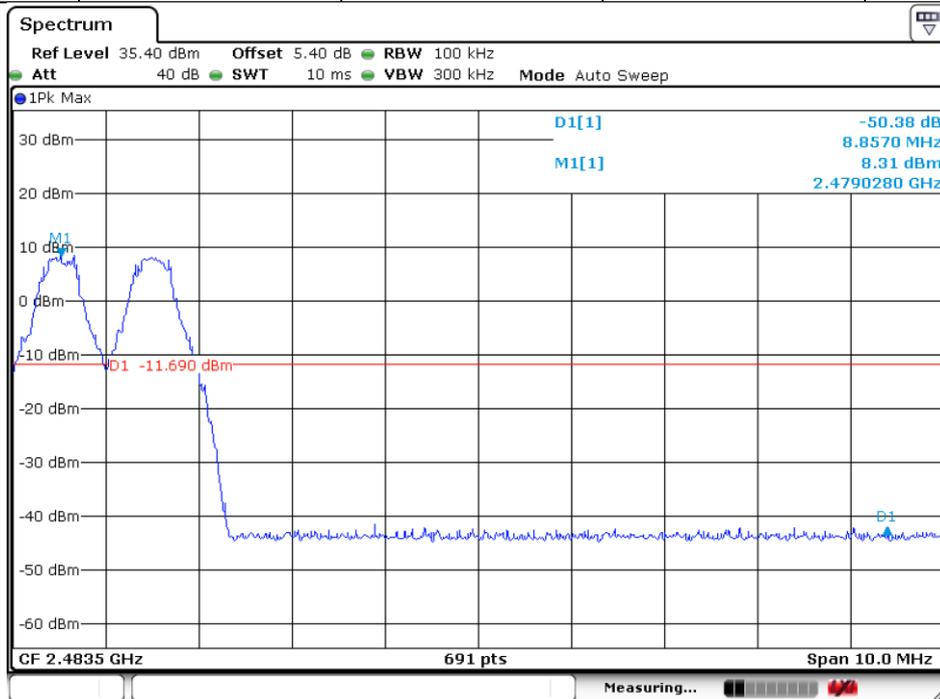
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|            |      |               |        |             |
|------------|------|---------------|--------|-------------|
| Test mode: | GFSK | Test channel: | Lowest | Hopping OFF |
|------------|------|---------------|--------|-------------|



Date: 11.MAR.2021 09:56:30

|            |      |               |         |            |
|------------|------|---------------|---------|------------|
| Test mode: | GFSK | Test channel: | Highest | Hopping ON |
|------------|------|---------------|---------|------------|



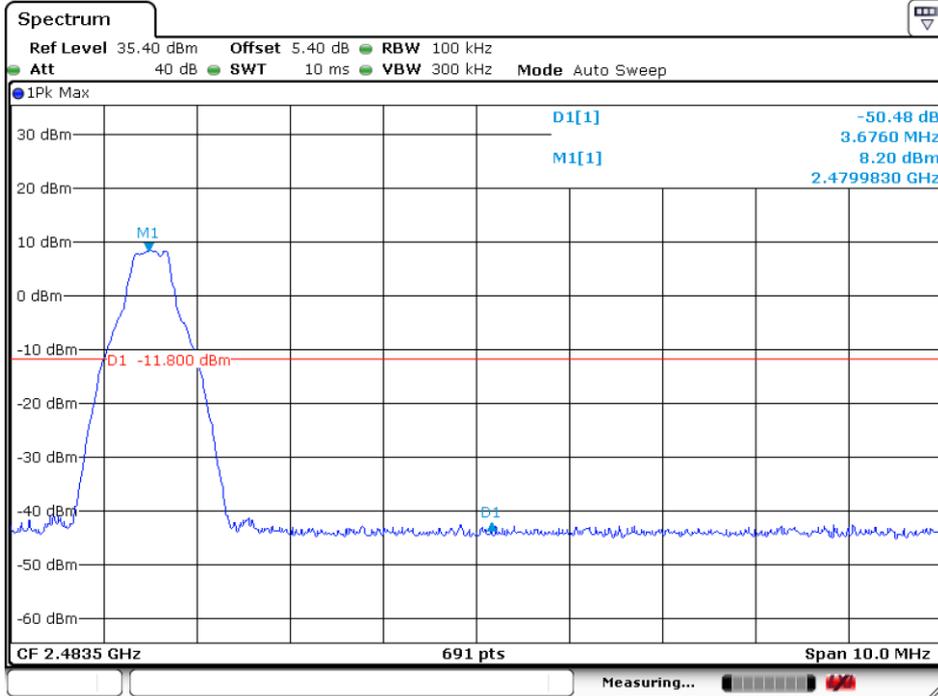
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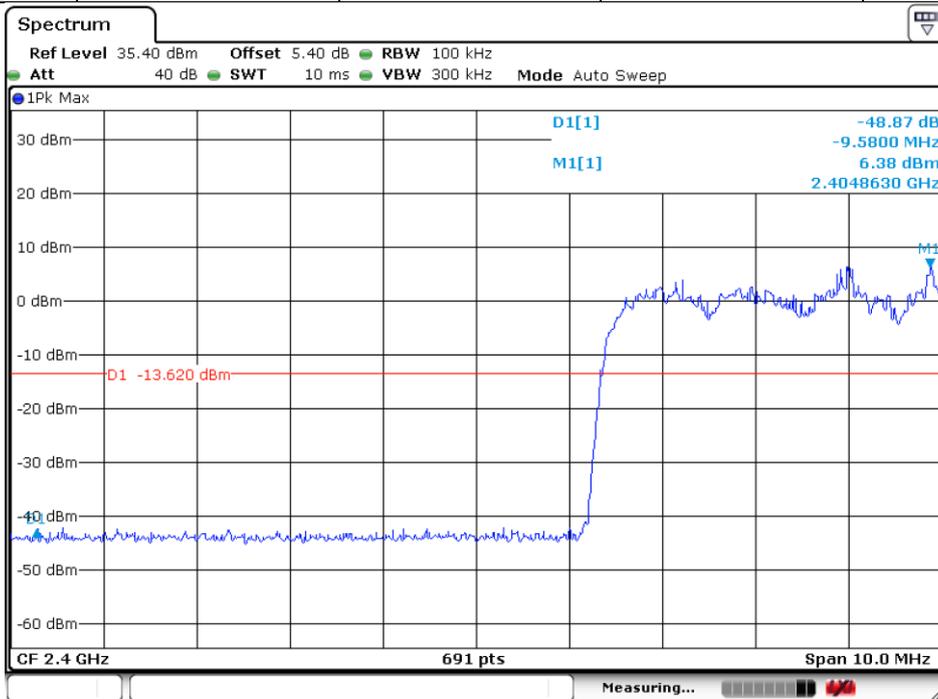
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|            |      |               |         |             |
|------------|------|---------------|---------|-------------|
| Test mode: | GFSK | Test channel: | Highest | Hopping OFF |
|------------|------|---------------|---------|-------------|



Date: 11.MAR.2021 09:55:58

|            |               |               |        |            |
|------------|---------------|---------------|--------|------------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest | Hopping ON |
|------------|---------------|---------------|--------|------------|

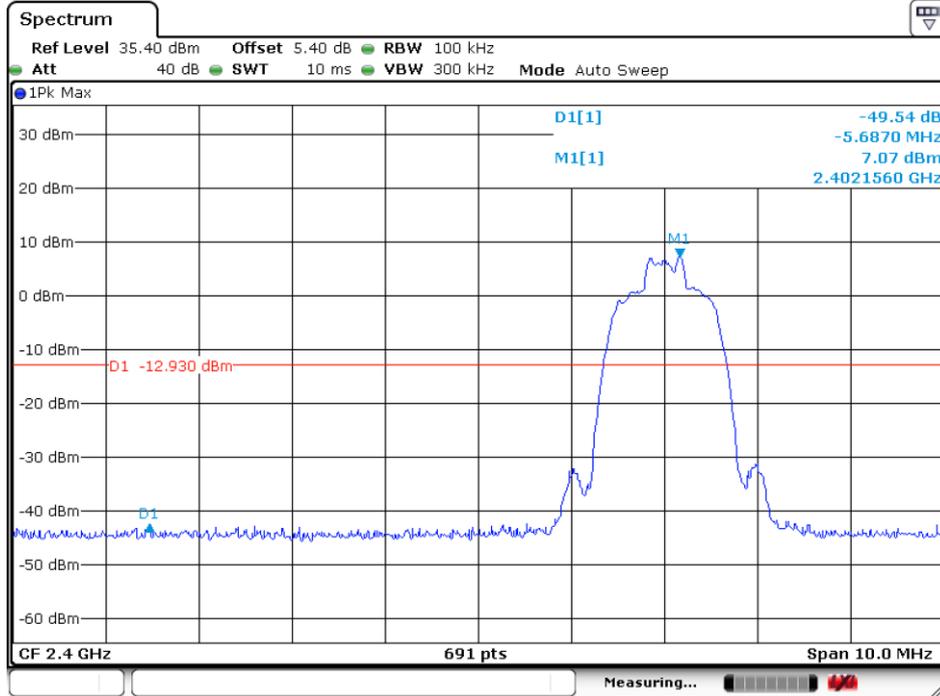


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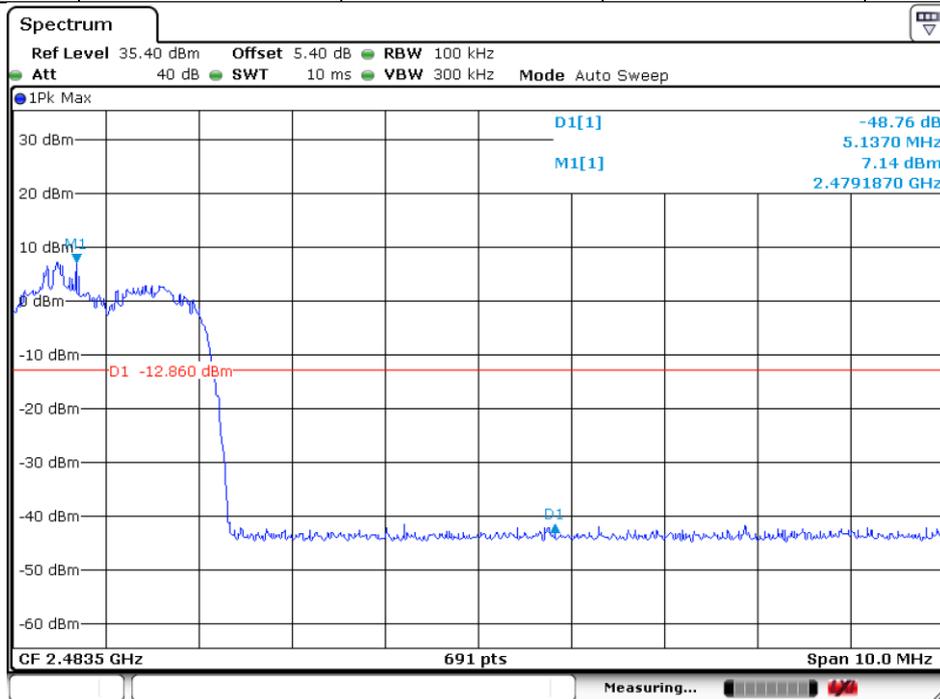
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|            |               |               |        |             |
|------------|---------------|---------------|--------|-------------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest | Hopping OFF |
|------------|---------------|---------------|--------|-------------|



Date: 11.MAR.2021 09:53:34

|            |               |               |         |            |
|------------|---------------|---------------|---------|------------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest | Hopping ON |
|------------|---------------|---------------|---------|------------|

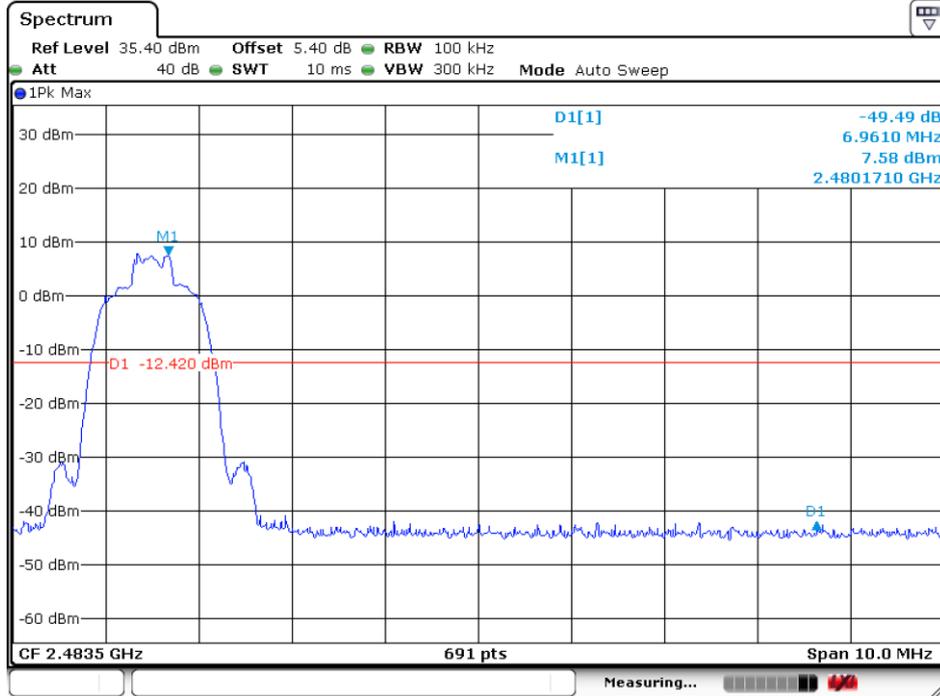


Date: 11.MAR.2021 10:05:03



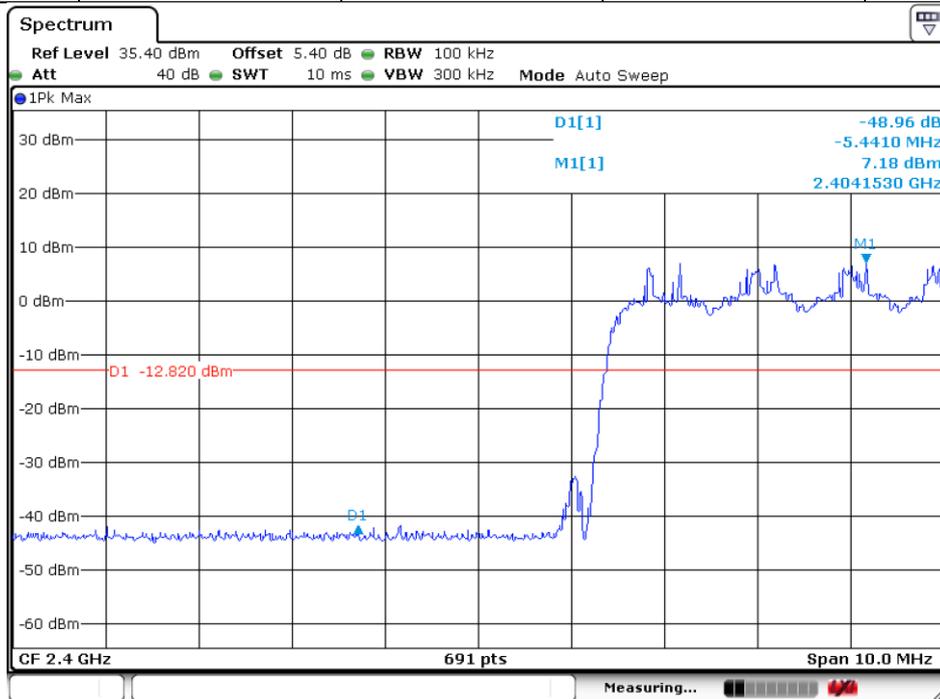
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|            |               |               |         |             |
|------------|---------------|---------------|---------|-------------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest | Hopping OFF |
|------------|---------------|---------------|---------|-------------|



Date: 11.MAR.2021 09:53:00

|            |       |               |        |            |
|------------|-------|---------------|--------|------------|
| Test mode: | 8DPSK | Test channel: | Lowest | Hopping ON |
|------------|-------|---------------|--------|------------|

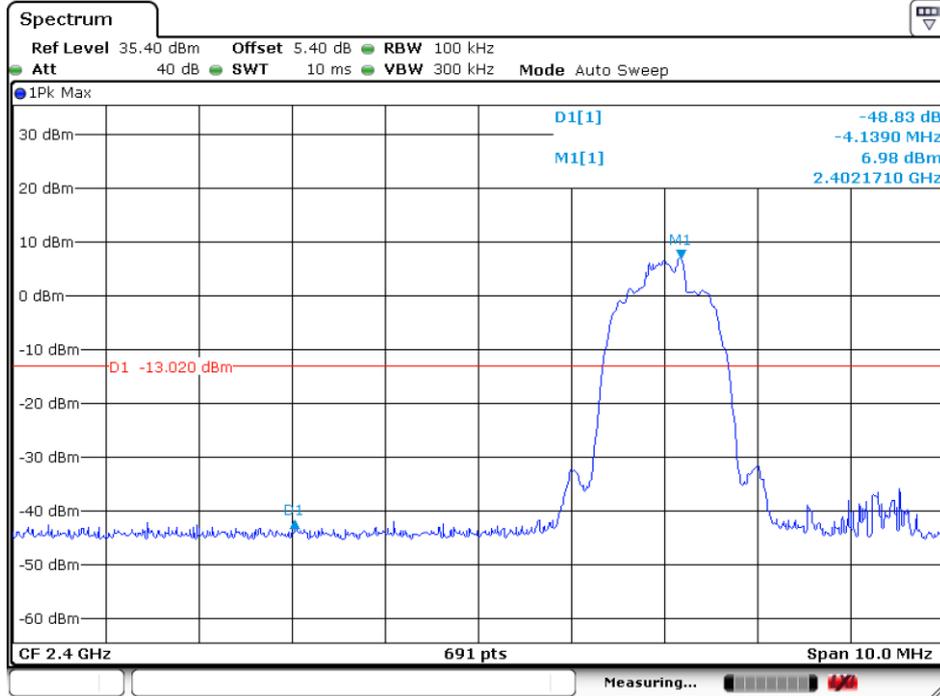


Date: 11.MAR.2021 10:09:50



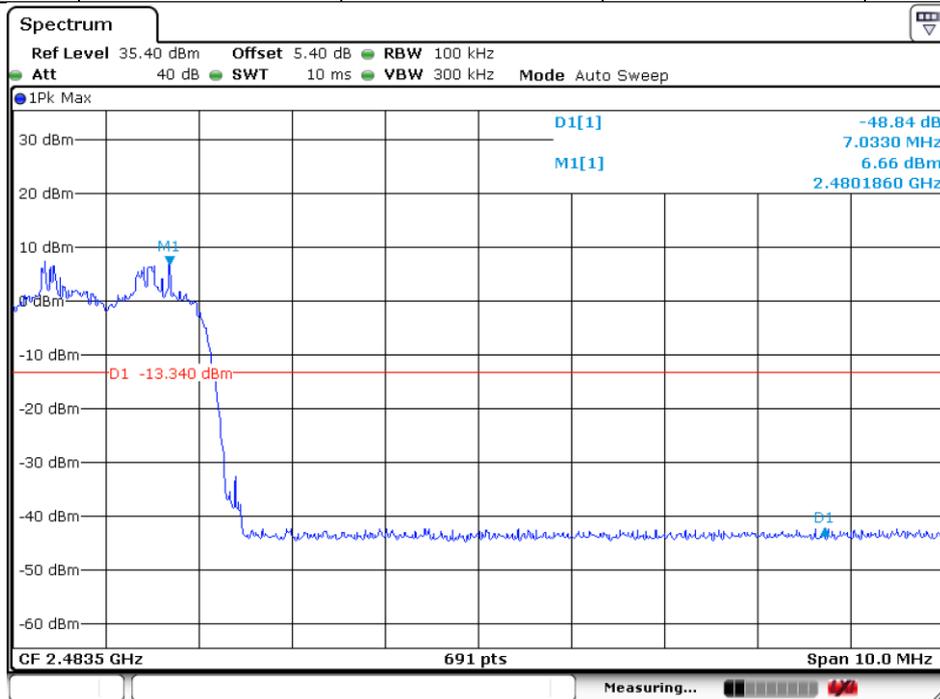
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|            |       |               |        |             |
|------------|-------|---------------|--------|-------------|
| Test mode: | 8DPSK | Test channel: | Lowest | Hopping OFF |
|------------|-------|---------------|--------|-------------|



Date: 11.MAR.2021 09:54:27

|            |       |               |         |            |
|------------|-------|---------------|---------|------------|
| Test mode: | 8DPSK | Test channel: | Highest | Hopping ON |
|------------|-------|---------------|---------|------------|



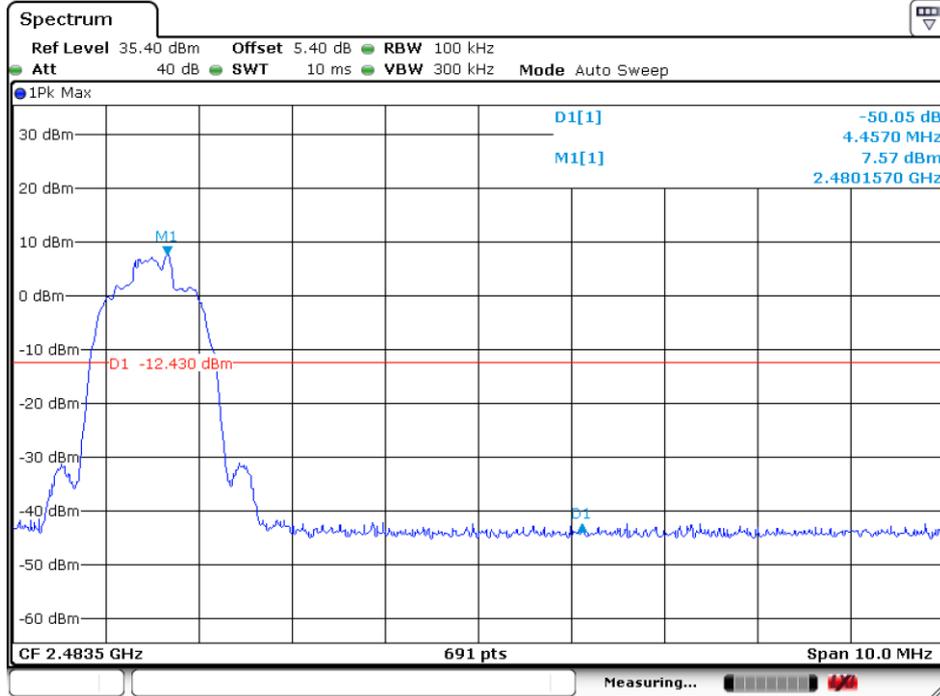
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|            |       |               |         |             |
|------------|-------|---------------|---------|-------------|
| Test mode: | 8DPSK | Test channel: | Highest | Hopping OFF |
|------------|-------|---------------|---------|-------------|



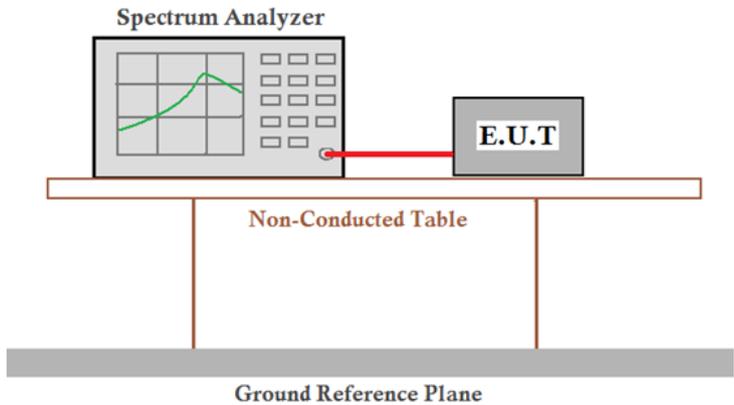
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### 4.10 Spurious RF Conducted Emissions

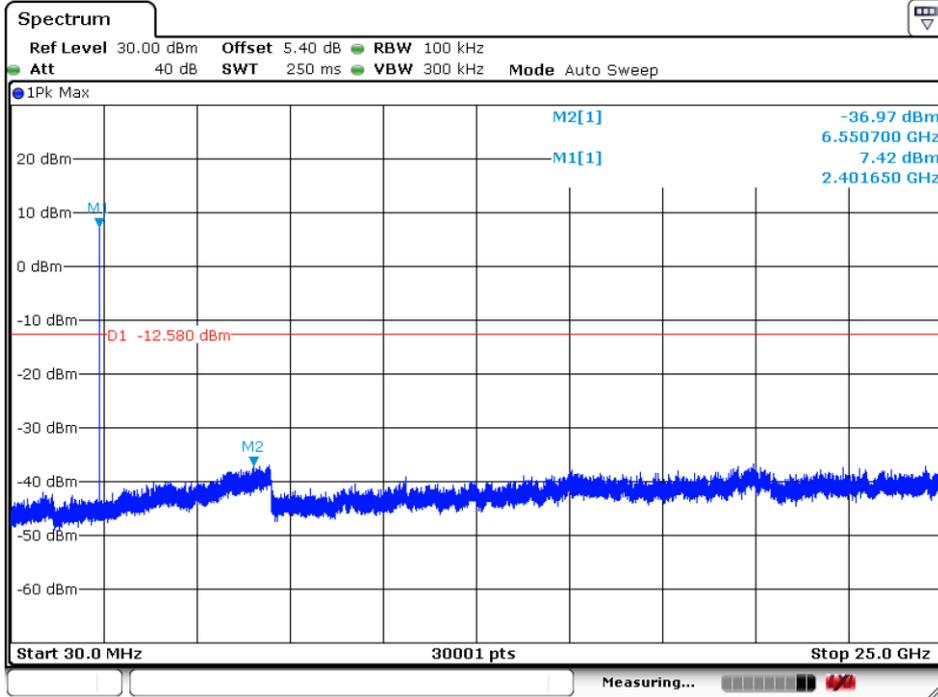
|                        |   |
|------------------------|---|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (d)  |
| Test Method:           | ANSI C63.10:2013 Section 7.8.8  |
| Test Setup:            |   |
| Instruments Used:      | Refer to section 6 for details  |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type.   |
| Final Test Mode:       | Through Pre-scan, find the<br>DH5 of data type is the worst case of GFSK modulation type,<br>2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type,<br>3-DH5 of data type is the worst case of 8DPSK modulation type.   |
| Limit:                 | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test Results:          | Pass  |



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### 4.10.1 Test Plots

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Lowest |
|------------|------|---------------|--------|



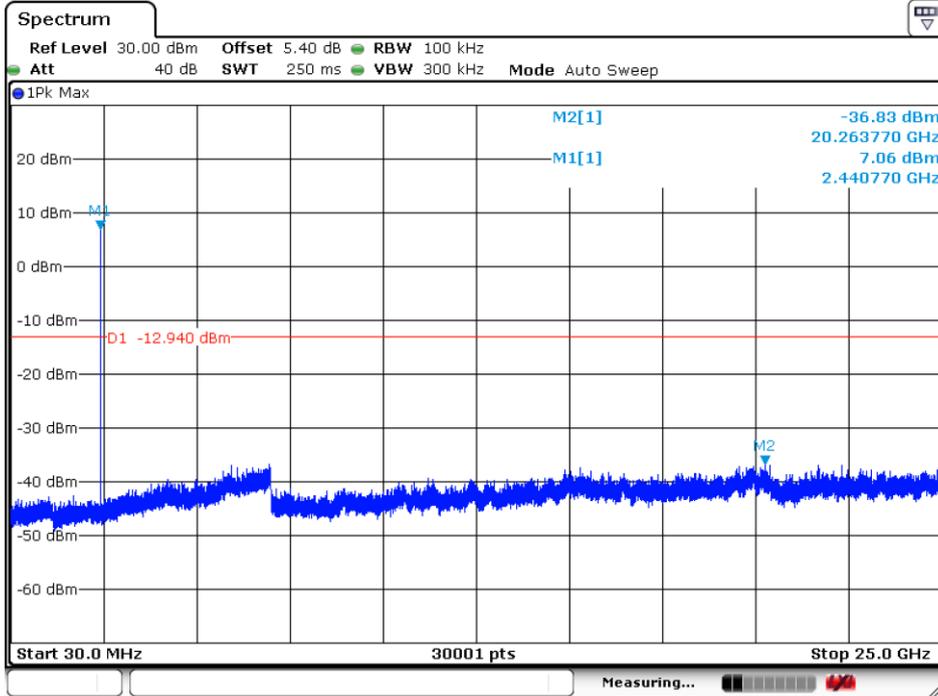
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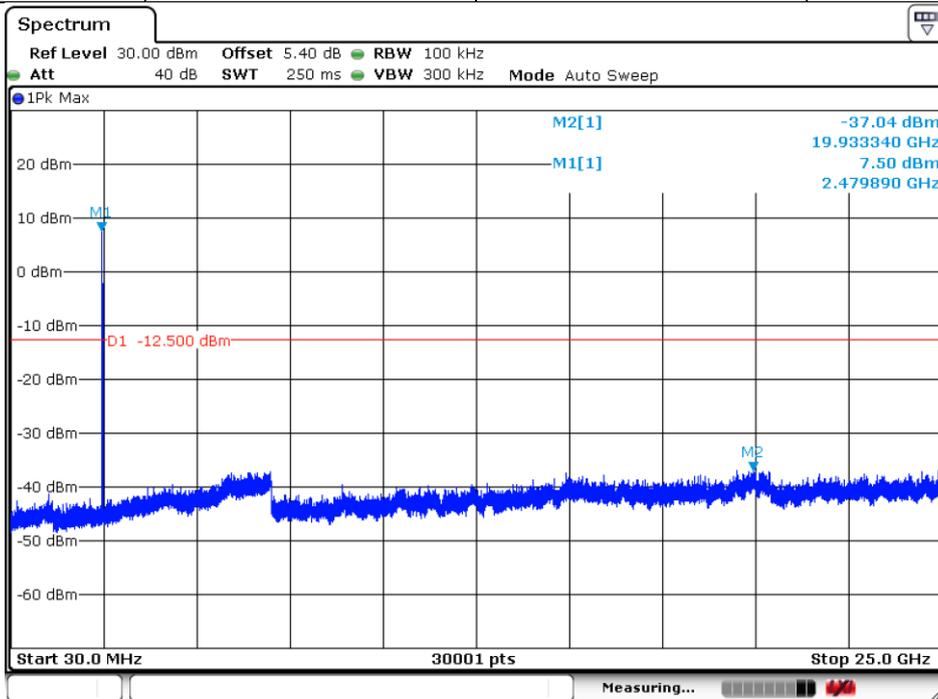
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|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



Date: 11.MAR.2021 10:46:10

|            |      |               |         |
|------------|------|---------------|---------|
| Test mode: | GFSK | Test channel: | Highest |
|------------|------|---------------|---------|

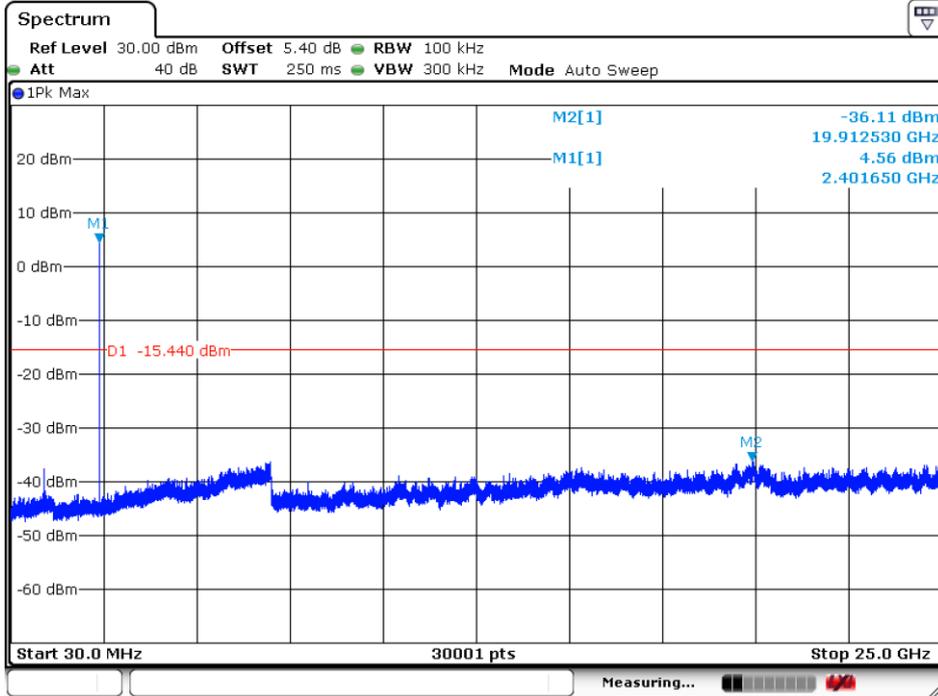


Date: 11.MAR.2021 10:47:14



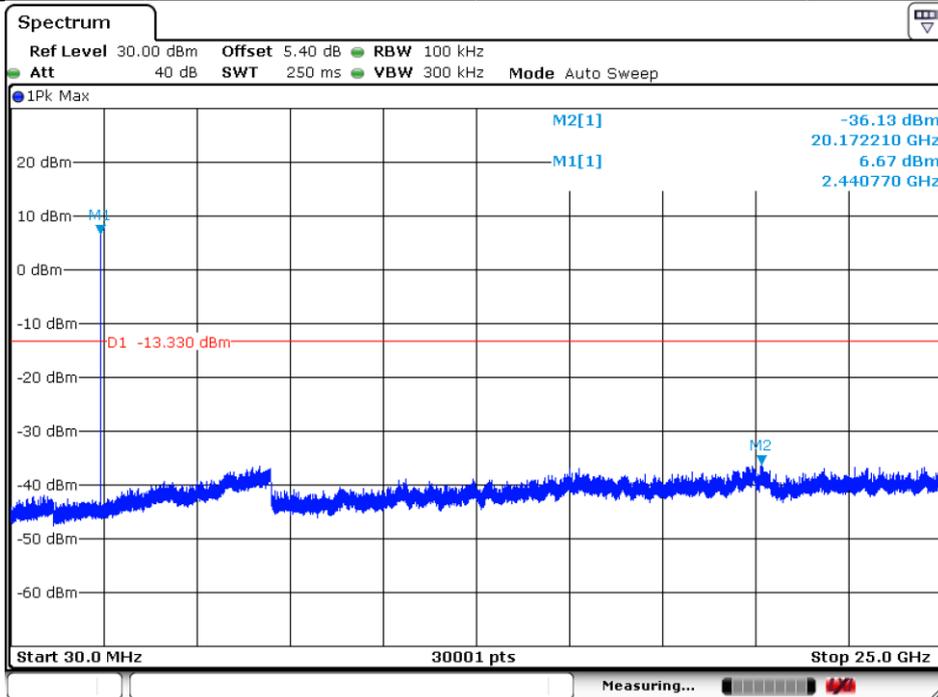
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|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest |
|------------|---------------|---------------|--------|



Date: 11.MAR.2021 10:43:49

|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|

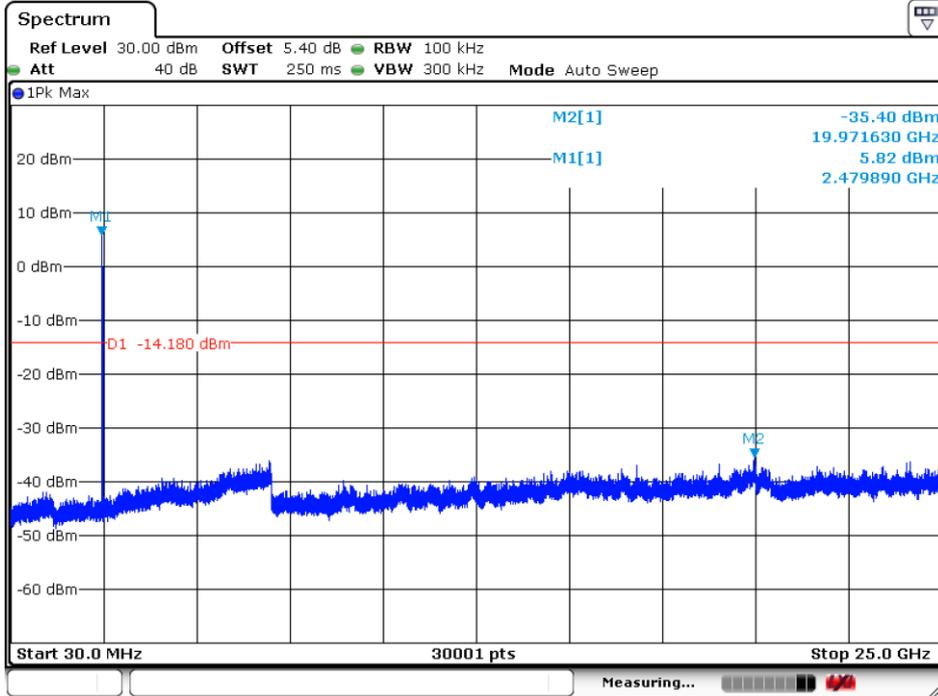


Date: 11.MAR.2021 10:41:52



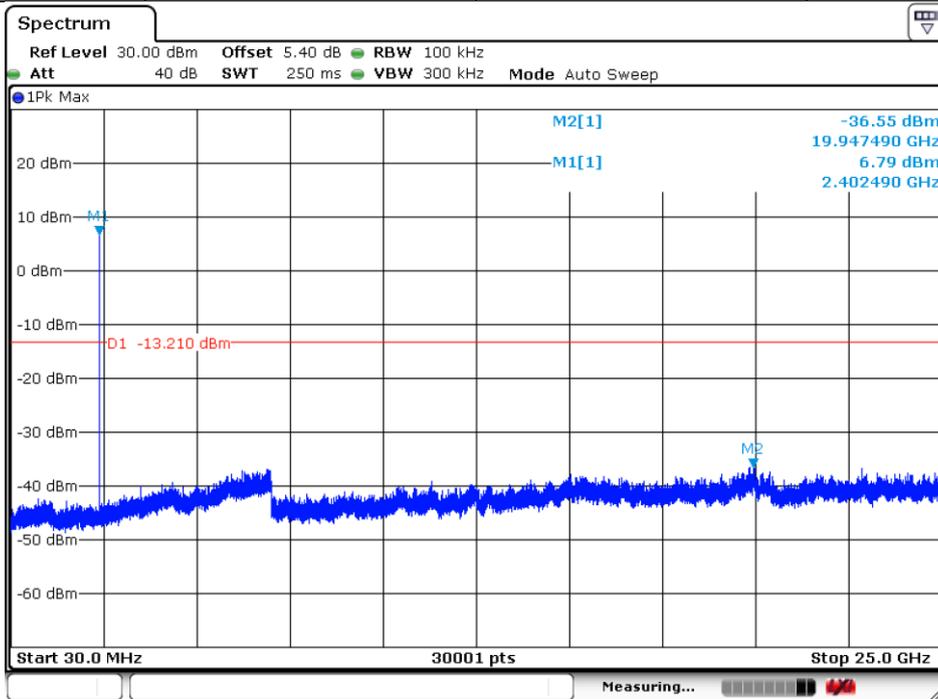
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|            |               |               |         |
|------------|---------------|---------------|---------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest |
|------------|---------------|---------------|---------|



Date: 11.MAR.2021 10:39:34

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Lowest |
|------------|-------|---------------|--------|



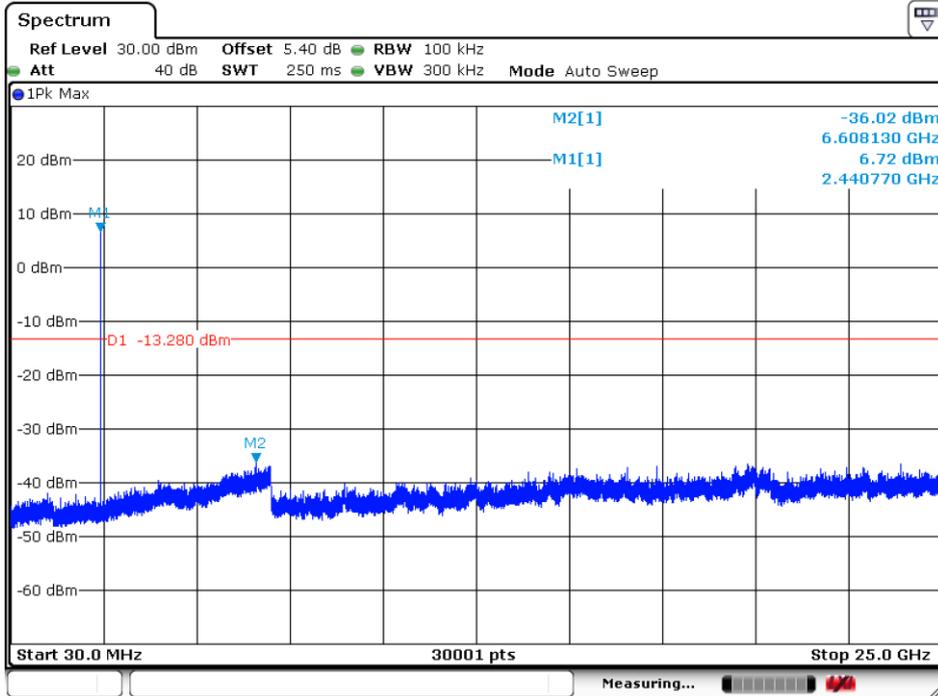
Date: 11.MAR.2021 10:35:09



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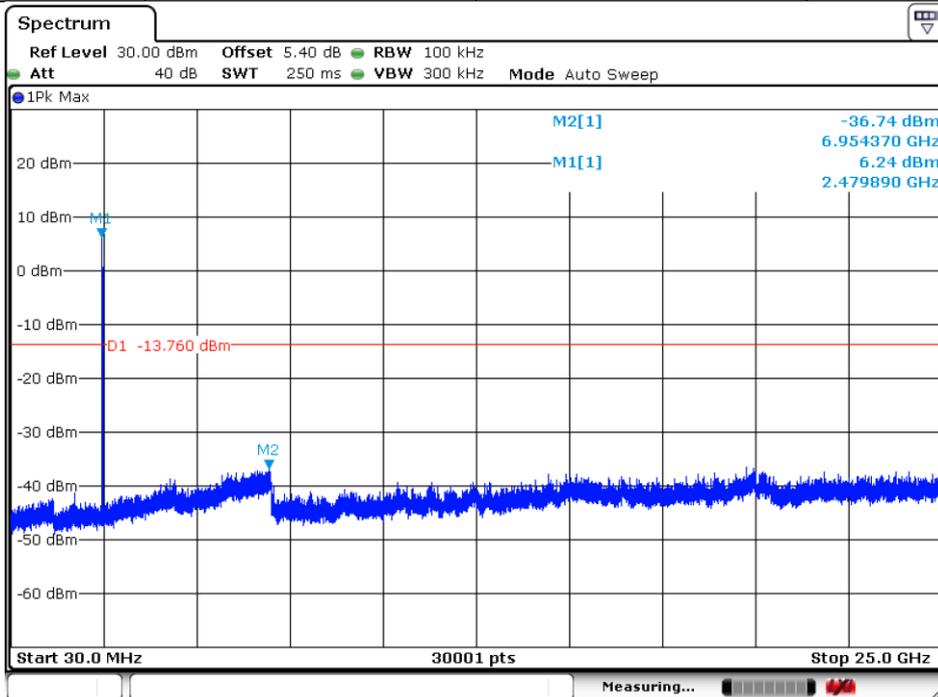
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|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



Date: 11.MAR.2021 10:36:02

|            |       |               |         |
|------------|-------|---------------|---------|
| Test mode: | 8DPSK | Test channel: | Highest |
|------------|-------|---------------|---------|



Date: 11.MAR.2021 10:38:28



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Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20Db below the limit need not be reported.



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## 5 Measurement Uncertainty (95% confidence levels, k=2)

| No. | Item                          | Measurement Uncertainty |
|-----|-------------------------------|-------------------------|
| 1   | Total RF power, conducted     | ±0.75Db                 |
| 2   | RF power density, conducted   | ±2.84Db                 |
| 3   | Spurious emissions, conducted | ±0.75Db                 |
| 4   | Temperature test              | ±1°C                    |
| 5   | Humidity test                 | ±3%                     |
| 6   | DC and low frequency voltages | ±0.5%                   |



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## 6 Equipment List

| RF conducted test   |                         |                     |              |              |              |
|---------------------|-------------------------|---------------------|--------------|--------------|--------------|
| Test Equipment      | Manufacturer            | Model No.           | Inventory No | Cal. date    | Cal.Duedate  |
|                     |                         |                     |              | (yyyy-mm-dd) | (yyyy-mm-dd) |
| DC Power Supply     | Agilent Technologie Inc | 66311B              | W009-09      | 2020/7/15    | 2021/7/15    |
| Signal Analyzer     | Rohde & Schwarz         | FSV                 | W025-05      | 2021/1/3     | 2022/1/2     |
| Coaxial Cable       | SGS                     | N/A                 | SEM031-01    | 2020/6/12    | 2021/6/11    |
| Attenuator          | Weinschel Associates    | WA41                | SEM021-09    | N/A          | N/A          |
| Signal Generator    | KEYSIGHT                | N5173B              | SEM006-05    | 2020/7/14    | 2021/7/14    |
| Temperature Chamber | GIANT FORCE             | ICT-150-40-CP<br>AR | W027-03      | 2020/10/27   | 2021/10/27   |
| Power Meter         | Rohde & Schwarz         | NRVS                | SEM014-02    | 2020/7/14    | 2021/7/14    |

The End



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