# TEST REPORT

**DT&C Co., Ltd.**
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Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1811-0258

2. Customer
   - Name (FCC): Nolangroup S.p.A.
   - Name (IC): NOLANGROUP S.P.A. con Socio Unico
   - Address (FCC) : Nolangroup S.p.A. , via Terzi di S.Agata 2 24030 - Brembate di sopra (BG) – Italia
   - Address (IC) : Via G. Terzi di S.Agata n.2 24030 Brembate di Sopra (BG) Italy

3. Use of Report : FCC & IC Original Grant

4. Product Name / Model Name : N-Com B901 X / B901 X
   FCC ID : Y6MNCOM21 / IC : 9455A-NCOM21

5. Test Method Used : ANSI C63.10-2013
   Test Specification : FCC Part 15 Subpart C.247
   RSS-247 Issue 2 (2017-02), RSS-GEN Issue 5 (2018-04)

6. Date of Test : 2018.10.30 ~ 2018.11.07

7. Testing Environment : See appended test report.

8. Test Result : Refer to the attached test result.

| | | |
|---|---|---|
| Affirmation | Tested by<br>Name : JaeHyeok Bang (Signature) | Reviewed by<br>Name : Geunki Son (Signature) |

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

**2018 . 11 . 21 .**

**DT&C Co., Ltd.**

**If this report is required to confirmation of authenticity, please contact to report@dtnc.net**

# Test Report Version

| Test Report No. | Date | Description |
|---|---|---|
| DRTFCC1811-0258 | Nov. 21, 2018 | Initial issue |
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# 1. General Information

## 1.1 Testing Laboratory

| DT&C Co., Ltd. | | |
|---|---|---|
| The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042.<br>The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.<br><br>**- FCC MRA Accredited Test Firm No. : KR0034**<br>**- IC Test site No. : 5740A-4, 5740A-5** | | |
| www.dtnc.net | | |
| Telephone | : | + 82-31-321-2664 |
| FAX | : | + 82-31-321-1664 |

## 1.2 Testing Environment

| Ambient Condition | |
|---|---|
| ▪ Temperature | +20 ℃ ~ +24 ℃ |
| ▪ Relative Humidity | 40 % ~ 44 % |

## 1.3 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

| Test items | Measurement uncertainty |
|---|---|
| Transmitter Output Power | 0.7 dB (The confidence level is about 95 %, k = 2) |
| Conducted spurious emission | 0.9 dB (The confidence level is about 95 %, k = 2) |
| AC conducted emission | 2.4 dB (The confidence level is about 95 %, k = 2) |

## 1.4 Details of Applicant

| | | |
|---|---|---|
| Applicant(FCC) | : | Nolangroup S.p.A. |
| Applicant(IC) | : | NOLANGROUP S.P.A. con Socio Unico |
| Address(FCC) | : | Nolangroup S.p.A. , via Terzi di S.Agata 2 24030 - Brembate di sopra (BG) – Italia |
| Address(IC) | : | Via G. Terzi di S.Agata n.2 24030 Brembate di Sopra (BG) Italy |
| Contact person | : | Claudio Corollo |

## 1.5 Description of EUT

| | |
|---|---|
| **EUT** | N-Com B901 X |
| **Model Name** | B901 X |
| **Add Model Name** | NA |
| **Hardware version** | 1.0 |
| **Software version** | 1.0 |
| **Power Supply** | DC 5V |
| **Frequency Range** | 2402 MHz ~ 2480 MHz |
| **Modulation Technique** | GFSK, π/4-DQPSK, 8DPSK |
| **Number of Channels** | 79 |
| **Antenna Type** | Dipole Antenna |
| **Antenna Gain** | PK: 1.70 dBi |

## 1.6 Declaration by the applicant / manufacturer

- NA

## 1.7 Information about the FHSS characteristics

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following :

A) The hopping sequence is pseudorandom

Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25, 33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

.. The System receiver have input bandwidths that match the hopping channel bandwidths of Their corresponding transmitters and shift frequencies in synchroniztation with the transmit Ted signals.

B) All channels are used equally on average

C) The receiver input bandwidth equals the transmit bandwidth

D) The receiver hops in sequence with the transmit signal

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

## 1.8 Test Equipment List

| Type | Manufacturer | Model | Cal.Date (yy/mm/dd) | Next.Cal.Date (yy/mm/dd) | S/N |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent Technologies | N9020A | 18/07/09 | 19/07/09 | MY50200834 |
| Multimeter | FLUKE | 17B | 17/12/26 | 18/12/26 | 26030065WS |
| Signal Generator | Rohde Schwarz | SMBV100A | 17/12/27 | 18/12/27 | 255571 |
| Signal Generator | ANRITSU | MG3695C | 18/02/12 | 19/02/12 | 173501 |
| Thermohygrometer | BODYCOM | BJ5478 | 1801/03 | 19/01/03 | 120612-1 |
| HYGROMETER | TESTO | 608-H1 | 18/02/10 | 19/02/10 | 34862883 |
| Power Meter &<br>Wide Bandwidth Sensor | Anritsu | ML2495A<br>MA2490A | 18/07/04 | 19/07/04 | 1338003<br>1249304 |
| EMI TEST RECEIVER | ROHDE&SCHWARZ | ESR7 | 17/11/16 | 18/11/16 | 101109 |
| SINGLE-PHASE MASTER | NF | 4420 | 18/08/30 | 19/08/30 | 3049354420023 |
| TWO-LINE V-NETWORK | ROHDE&SCHWARZ | ENV216 | 17/12/18 | 18/12/18 | 101979 |
| Cable | DTNC | CABLE | 18/06/22 | 19/06/22 | RF-82 |
| Cable | DTNC | CABLE | 18/06/25 | 19/06/25 | RF-07 |

Note1: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

## 1.9 Summary of Test Results

| FCC Part RSS Std. | Parameter | Limit (Using in 2400~ 2483.5 MHz) | Test Condition | Status Note 1 |
|---|---|---|---|---|
| 15.247(a) RSS-247(5.1) | Carrier Frequency Separation | >= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater. | Conducted | C |
| | Number of Hopping Frequencies | >= 15 hops | | C |
| | 20 dB Bandwidth | N/A | | C |
| | Dwell Time | =< 0.4 seconds | | C |
| 15.247(b) RSS-247(5.4) | Transmitter Output Power | **For FCC**<br>=< 1 Watt , if CHs >= 75<br>Others =< 0.125 W<br>**For IC**<br>if CHs >= 75<br>=< 1 Watt For Conducted Power<br>=< 4 Watt For e.i.r.p,<br>Others<br>=< 0.125 W For Conducted Power.<br>=< 4 Watt For e.i.r.p | | C |
| 15.247(d) RSS-247(5.5) | Conducted Spurious Emissions | The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density. | | C |
| RSS Gen(6.7) | Occupied Bandwidth (99 %) | N/A | | C |
| 15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10) | Radiated Spurious Emissions | FCC 15.209 Limits | Radiated | NT Note2 |
| 15.207 RSS-Gen(8.8) | AC Conducted Emissions | FCC 15.207 Limits | AC Line Conducted | C |
| 15.203 - | Antenna Requirements | FCC 15.203 | - | C |

Note 1 : **C** = Comply **NC** = Not Comply **NT** = Not Tested **NA** = Not Applicable

Note 2: This test item was performed in other laboratory according to applicant's request.
Please refer to the Radiated Test Report

## 1.10 Conclusion of worst-case and operation mode

The EUT has three type of modulation (GFSK, π/4DQPSK and 8DPSK).

Therefore all applicable requirements were tested with all the modulations.

And packet type was tested at the worst case(DH5).

The field strength of spurious emission was measured in three orthogonal EUT positions (X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function : Enable

| | TX Frequency (MHz) | RX Frequency (MHz) |
|---|---|---|
| **Hopping Band** | 2402 ~ 2480 | 2402 ~ 2480 |

- Hopping Function : Disable

| | TX Frequency (MHz) | RX Frequency (MHz) |
|---|---|---|
| **Lowest Channel** | 2402 | 2402 |
| **Middle Channel** | 2441 | 2441 |
| **Highest Channel** | 2480 | 2480 |

# 2. Maximum Peak Output Power Measurement

## 2.1 Test Setup

Refer to the APPENDIX I.

## 2.2 Limit

### ▣ FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 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 125 mW.
2. §15.247(b)(1), For frequency hopping systems operating in the 2400 – 2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725 – 5805 MHz band : 1 Watt.

### ▣ IC Requirements

1. RSS-247(5.4), For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e)

## 2.3 Test Procedure

1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 20 dB BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

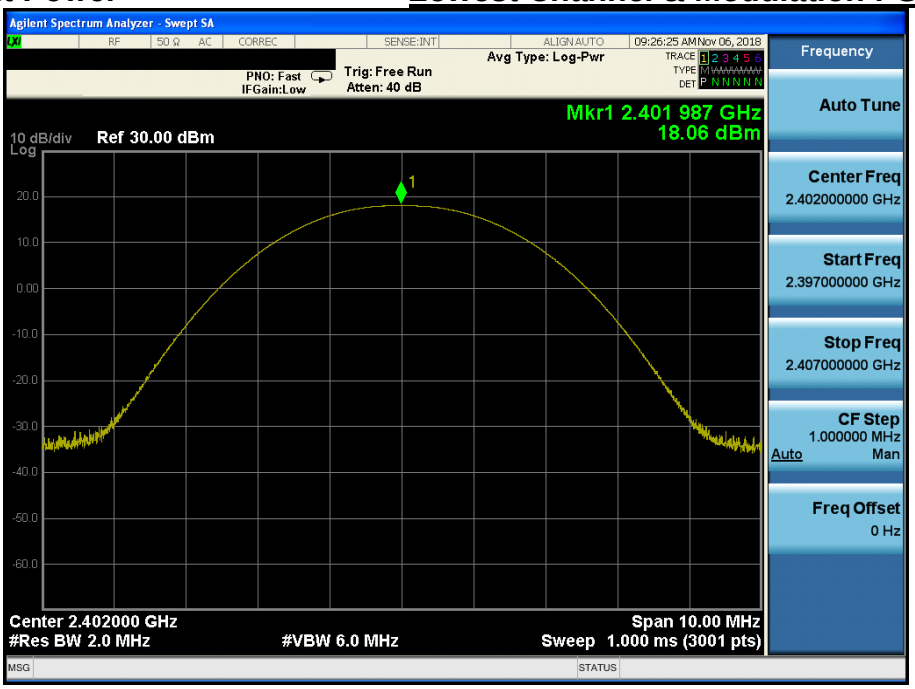
## 2.4 Test Results

| Modulation | Tested Channel | Frame Average Output Power | | Peak Output Power | |
|---|---|---|---|---|---|
| | | dBm | mW | dBm | mW |
| ***GFSK*** | **Lowest** | 16.02 | 39.99 | 18.06 | 63.97 |
| | **Middle** | 17.29 | 53.58 | 19.19 | 82.99 |
| | **Highest** | **17.35** | **54.33** | **19.43** | **87.70** |
| ***π/4DQPSK*** | **Lowest** | 5.10 | 3.24 | 8.84 | 7.66 |
| | **Middle** | **6.71** | **4.69** | **10.86** | **12.19** |
| | **Highest** | 5.79 | 3.79 | 9.95 | 9.89 |
| ***8DPSK*** | **Lowest** | 5.08 | 3.22 | 9.54 | 8.99 |
| | **Middle** | **6.70** | **4.68** | **11.69** | **14.76** |
| | **Highest** | 5.76 | 3.77 | 10.80 | 12.02 |

Note 1 : The frame average output power was tested using an average power meter for reference only.

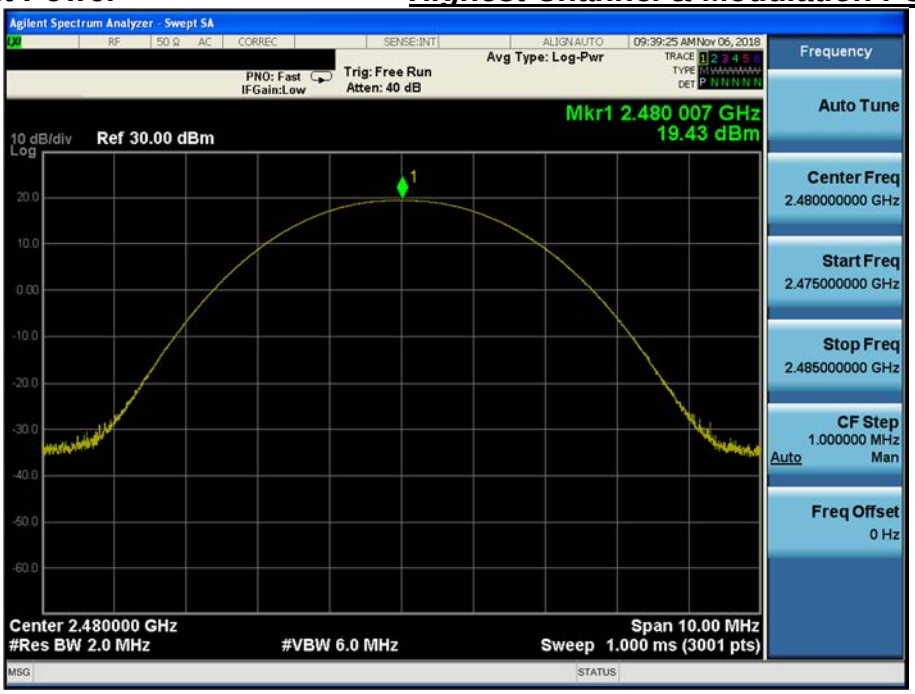
Note 2 : See next pages for actual measured spectrum plots.

**Peak Output Power** ***Lowest Channel & Modulation : GFSK***

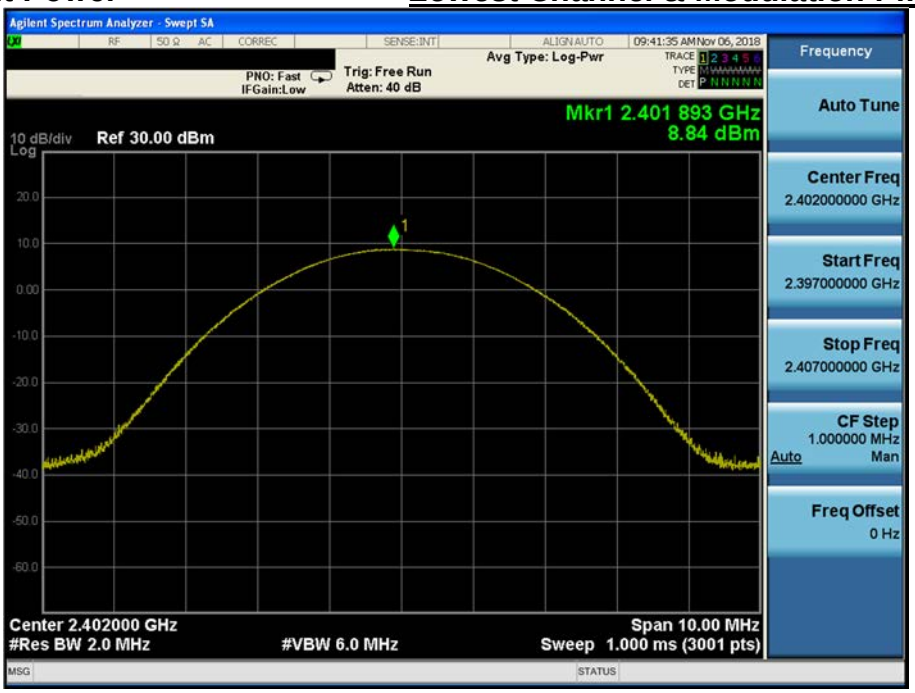



**Peak Output Power** ***Middle Channel & Modulation : GFSK***

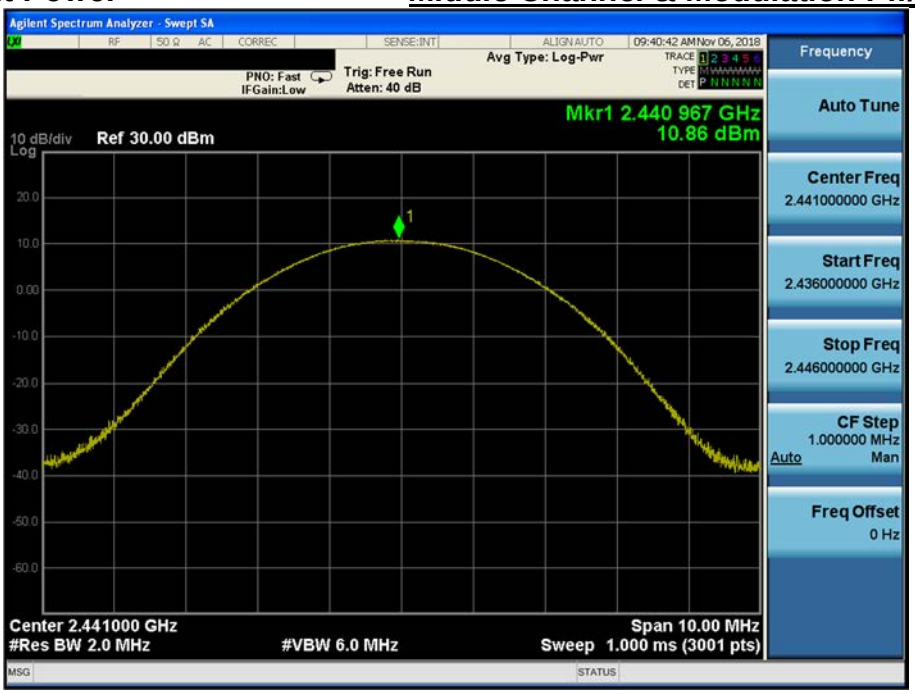
**Peak Output Power** ***Highest Channel & Modulation : GFSK***



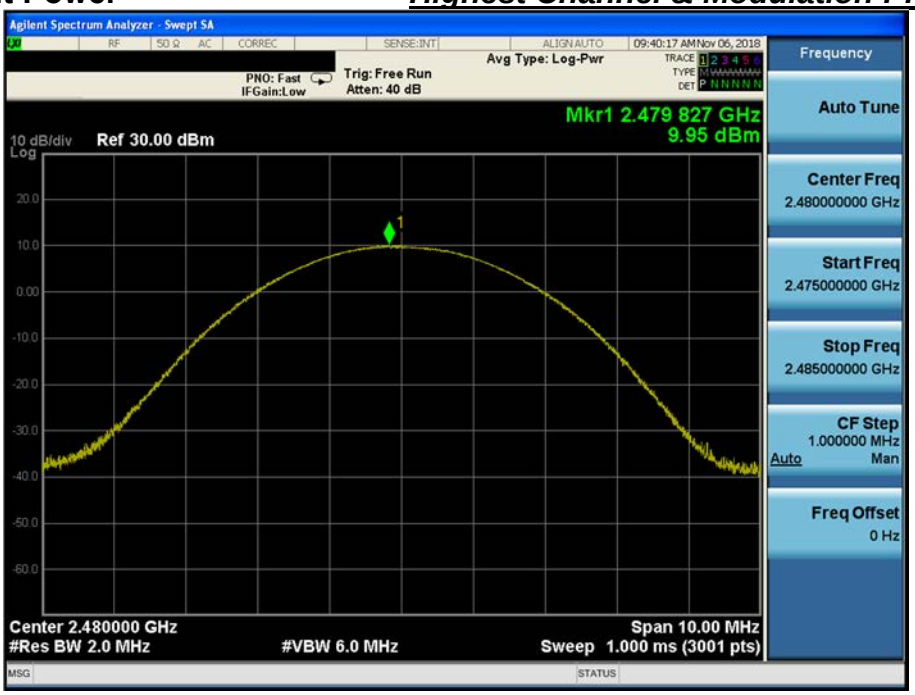

**Peak Output Power** ***Lowest Channel & Modulation : π/4DQPSK***



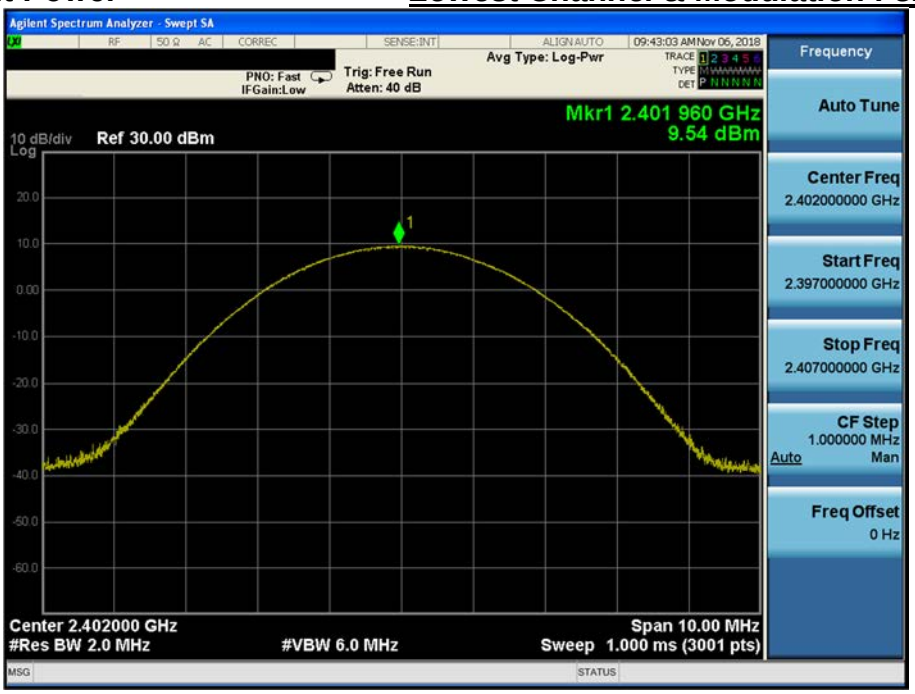
**Peak Output Power** ***Middle Channel & Modulation : π/4DQPSK***



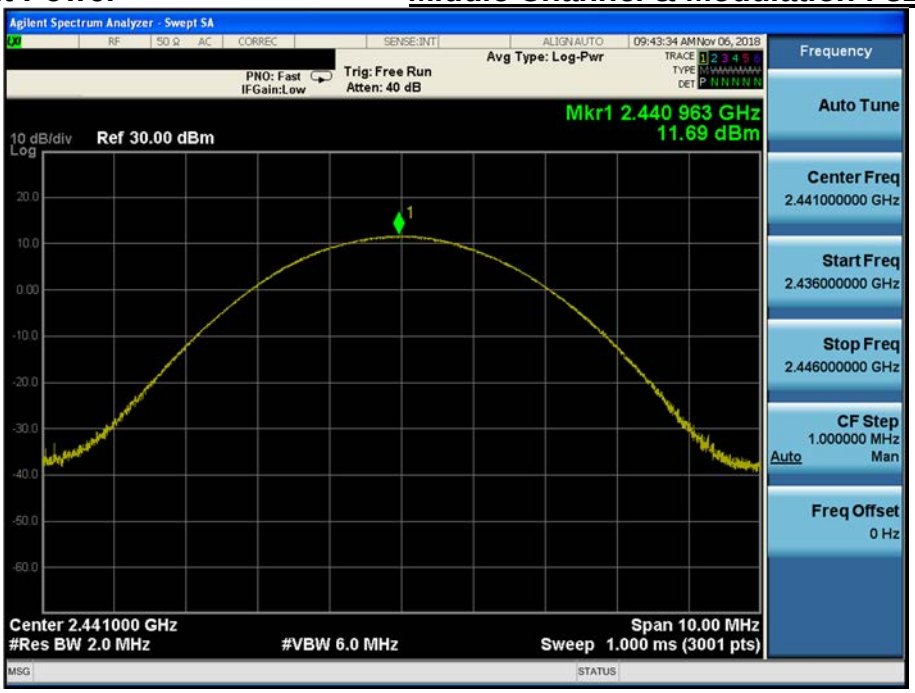

**Peak Output Power** ***Highest Channel & Modulation : π/4DQPSK***



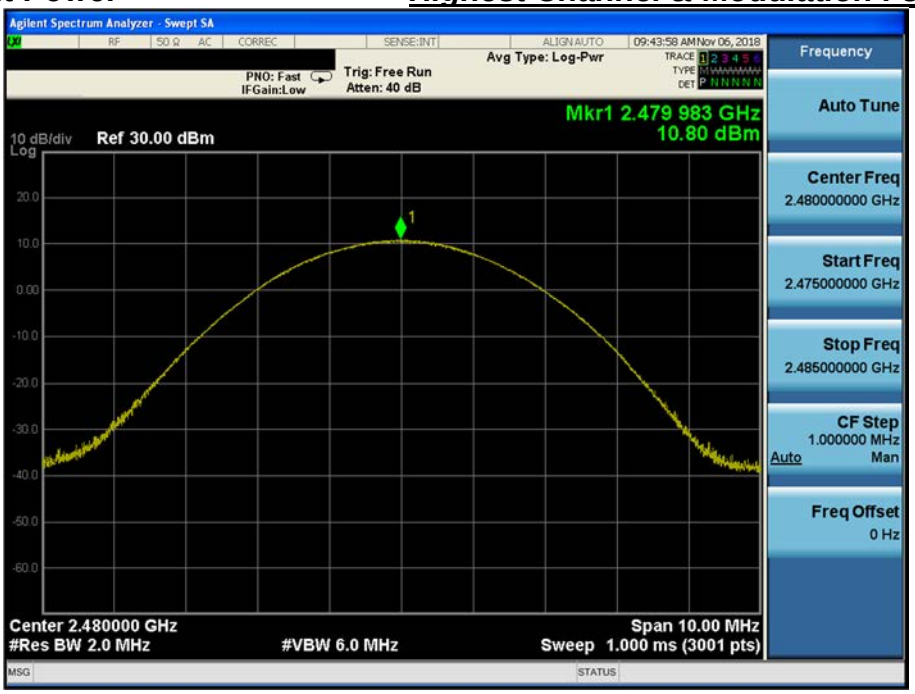
**Peak Output Power** ***Lowest Channel & Modulation : 8DPSK***




**Peak Output Power** ***Middle Channel & Modulation : 8DPSK***



**Peak Output Power** ***Highest Channel & Modulation : 8DPSK***



# 3. 20 dB BW & Occupied BW

## 3.1 Test Setup

Refer to the APPENDIX I.

## 3.2 Limit

Limit : Not Applicable

## 3.3 Test Procedure

1. The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
   RBW = 1% to 5% of the 20 dB BW & Occupied BW
   VBW ≥ 3 × RBW
   Span = between two times and five times the 20 dB bandwidth & Occupied BW
   Sweep = auto
   Detector function = peak
   Trace = max hold

## 3.4 Test Results

| Modulation | Tested Channel | 20 dB BW (MHz) | Occupied BW (MHz) |
|---|---|---|---|
| ***GFSK*** | **Lowest** | 0.962 | 0.910 |
| | **Middle** | 0.966 | 0.916 |
| | **Highest** | **1.023** | **0.977** |
| ***π/4DQPSK*** | **Lowest** | 1.240 | 1.167 |
| | **Middle** | 1.237 | 1.172 |
| | **Highest** | **1.255** | **1.175** |
| ***8DPSK*** | **Lowest** | **1.262** | 1.163 |
| | **Middle** | 1.254 | **1.170** |
| | **Highest** | 1.252 | 1.170 |

## 20 dB Bandwidth & Occupied BW *Lowest Channel & Modulation : GFSK*

## 20 dB Bandwidth & Occupied BW *Middle Channel & Modulation : GFSK*

## 20 dB Bandwidth & Occupied BW *Highest Channel & Modulation : GFSK*

## 20 dB Bandwidth & Occupied BW *Lowest Channel & Modulation : π/4DQPSK*

## 20 dB Bandwidth & Occupied BW *Middle Channel & Modulation : π/4DQPSK*

## 20 dB Bandwidth & Occupied BW *Highest Channel & Modulation : π/4DQPSK*

## 20 dB Bandwidth & Occupied BW *Lowest Channel & Modulation : 8DPSK*

## 20 dB Bandwidth & Occupied BW *Middle Channel & Modulation : 8DPSK*

## 20 dB Bandwidth & Occupied BW ***Highest Channel & Modulation : 8DPSK***

# 4. Carrier Frequency Separation

## 4.1 Test Setup

Refer to the APPENDIX I.

## 4.2 Limit

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater.

## 4.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.
The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels
RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
VBW ≥ RBW Sweep = auto
Detector function = peak Trace = max hold

## 4.4 Test Results

**FH mode**

| Hopping Mode | Modulation | Peak of center channel (MHz) | Peak of adjacent Channel (MHz) | Test Result (MHz) |
|---|---|---|---|---|
| Enable | GFSK | 2441.180 | 2442.179 | 0.999 |
| | π/4-DQPSK | 2441.021 | 2442.023 | 1.002 |
| | 8DPSK | 2441.021 | 2442.020 | 0.999 |

**AFH mode**

| Hopping Mode | Modulation | Peak of center channel (MHz) | Peak of adjacent Channel (MHz) | Test Result (MHz) |
|---|---|---|---|---|
| Enable | GFSK | 2441.180 | 2442.182 | 1.002 |
| | π/4-DQPSK | 2441.021 | 2442.020 | 0.999 |
| | 8DPSK | 2441.021 | 2442.020 | 0.999 |

Note 1 : See next pages for actual measured spectrum plots.

**- Minimum Standard :**

| |
|---|
| 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.<br>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 125 mW |

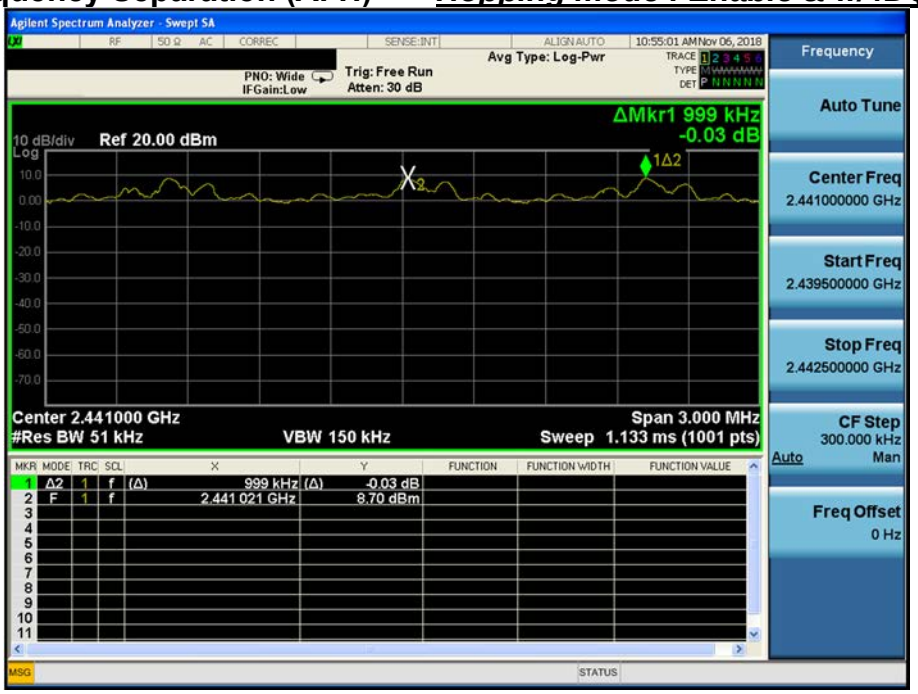
**Carrier Frequency Separation (FH)** ***Hopping mode : Enable & GFSK***

**Carrier Frequency Separation (FH)** ***Hopping mode : Enable & π/4DQPSK***

**Carrier Frequency Separation (FH)** ***Hopping mode : Enable & 8DPSK***

**Carrier Frequency Separation (AFH)** ***Hopping mode : Enable & GFSK***

**Carrier Frequency Separation (AFH)** ***Hopping mode : Enable & π/4DQPSK***



## Carrier Frequency Separation (AFH) ***Hopping mode : Enable & 8DPSK***

# 5. Number of Hopping Frequencies

## 5.1 Test Setup

Refer to the APPENDIX I.

## 5.2 Limit

Limit : >= 15 hops

## 5.3 Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 2400 ~ 2483.5 MHz were examined.

The spectrum analyzer is set to :

Span for FH mode = 50 MHz Start Frequency = 2391.5 MHz, Stop Frequency = 2441.5 MHz
Start Frequency = 2441.5 MHz, Stop Frequency = 2491.5 MHz
Span for AFH mode = 40 MHz Start Frequency = 2421.0 MHz, Stop Frequency = 2461.0 MHz
RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW ≥ RBW Sweep = auto
Detector function = peak Trace = max hold

## 5.4 Test Results

**FH mode**

| Hopping mode | Modulation | Test Result (Total Hops) |
|---|---|---|
| Enable | GFSK | 79 |
| | π/4-DQPSK | 79 |
| | 8DPSK | 79 |

**AFH mode**

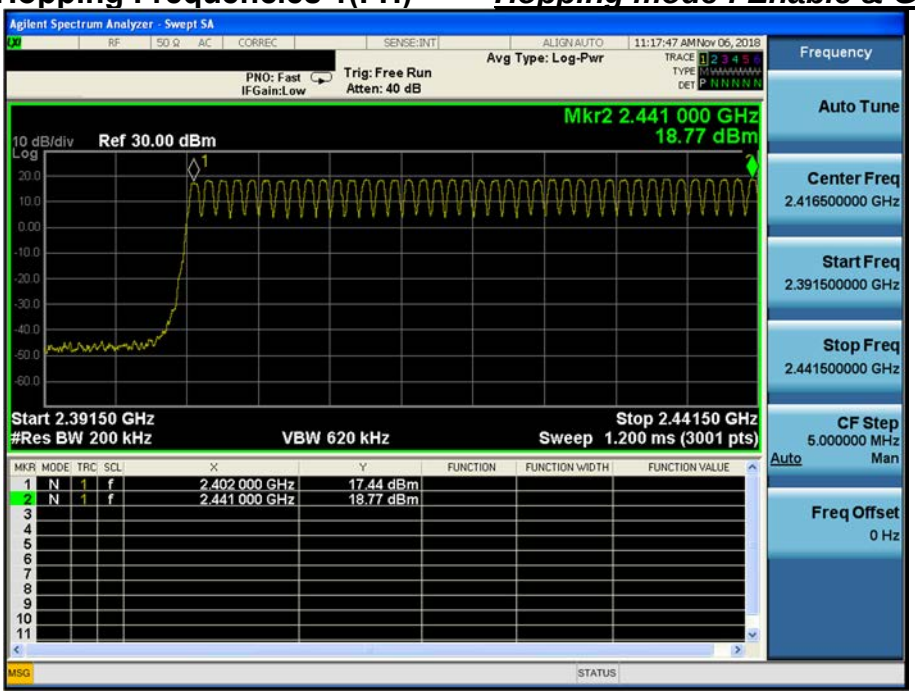
| Hopping mode | Modulation | Test Result (Total Hops) |
|---|---|---|
| Enable | GFSK | 20 |
| | π/4-DQPSK | 20 |
| | 8DPSK | 20 |

Note 1 : See next pages for actual measured spectrum plots.

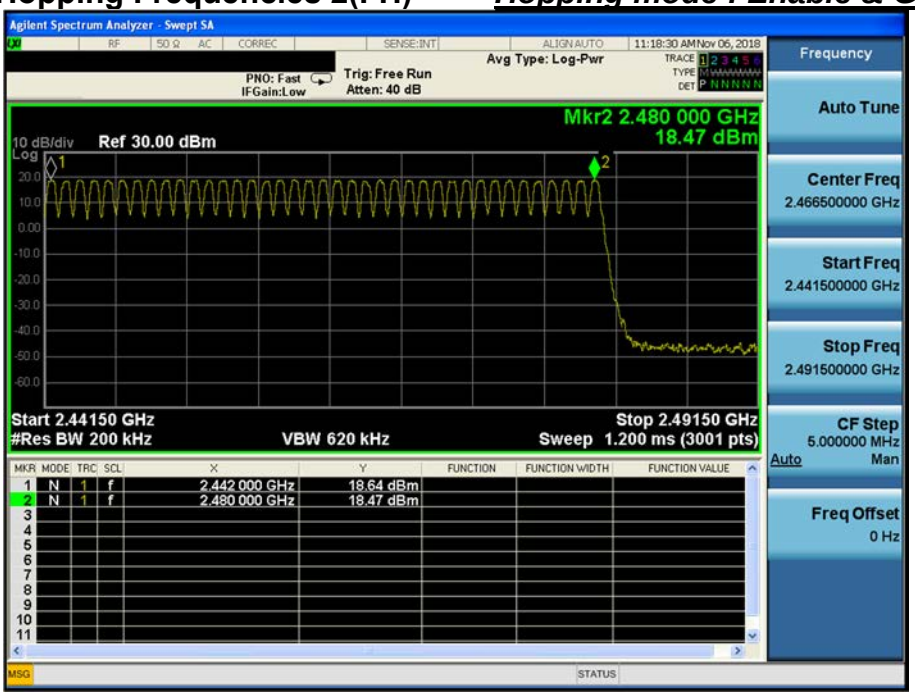
**- Minimum Standard :**

| |
|---|
| At least 15 hopes |

## Number of Hopping Frequencies 1(FH) *Hopping mode : Enable & GFSK*

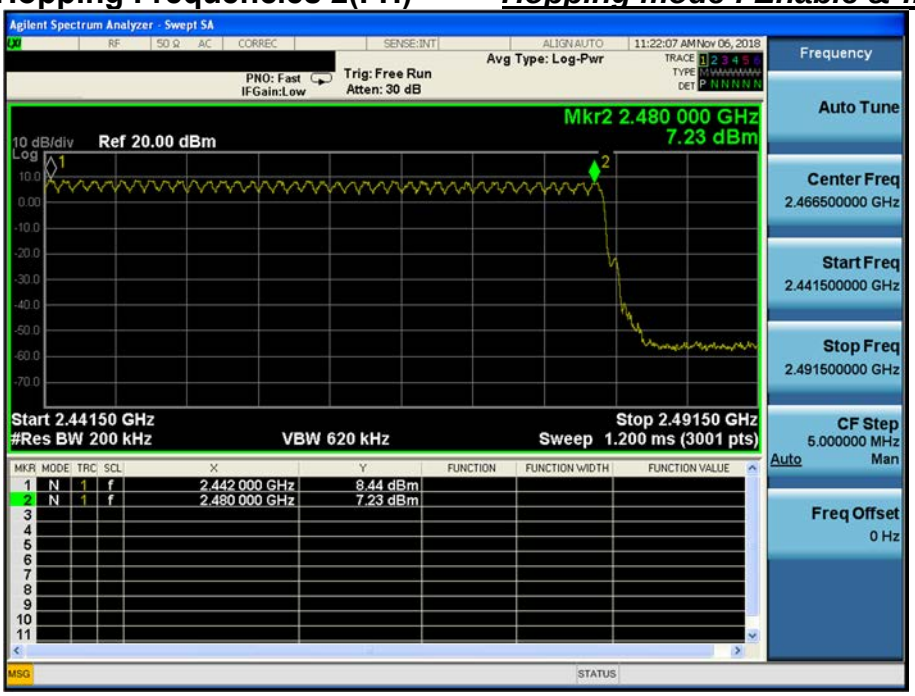



## Number of Hopping Frequencies 2(FH) *Hopping mode : Enable & GFSK*



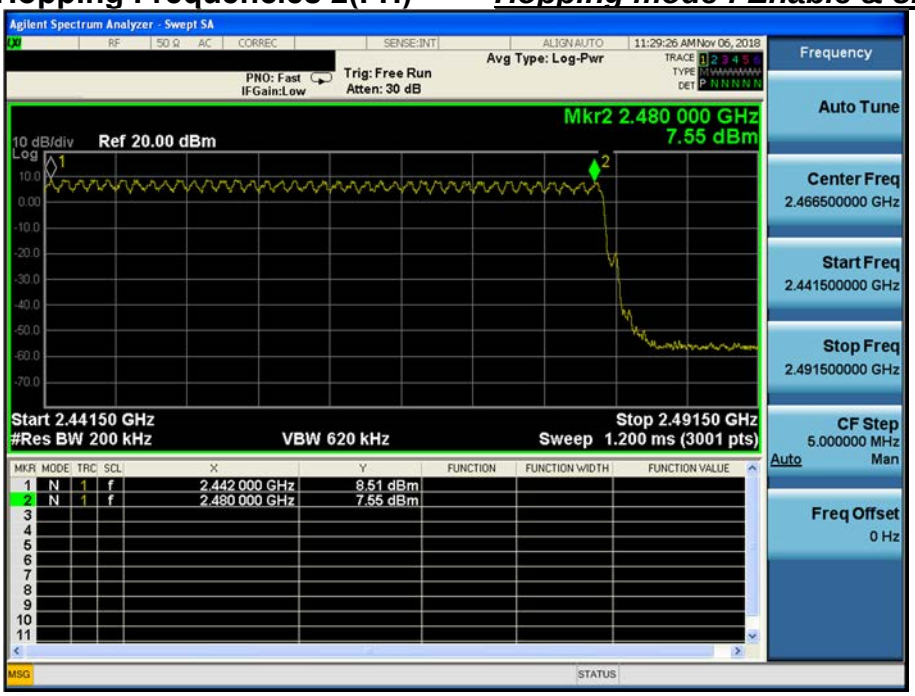
## Number of Hopping Frequencies 1(FH) *Hopping mode : Enable & π/4DQPSK*

## Number of Hopping Frequencies 2(FH) *Hopping mode : Enable & π/4DQPSK*

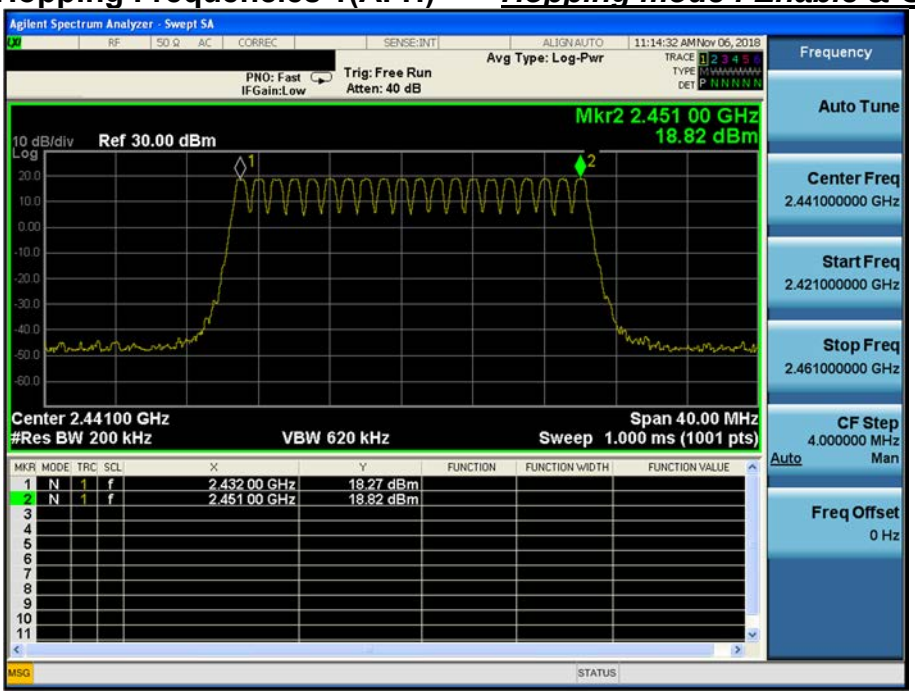


**Number of Hopping Frequencies 1(FH)** ***Hopping mode : Enable & 8DPSK***

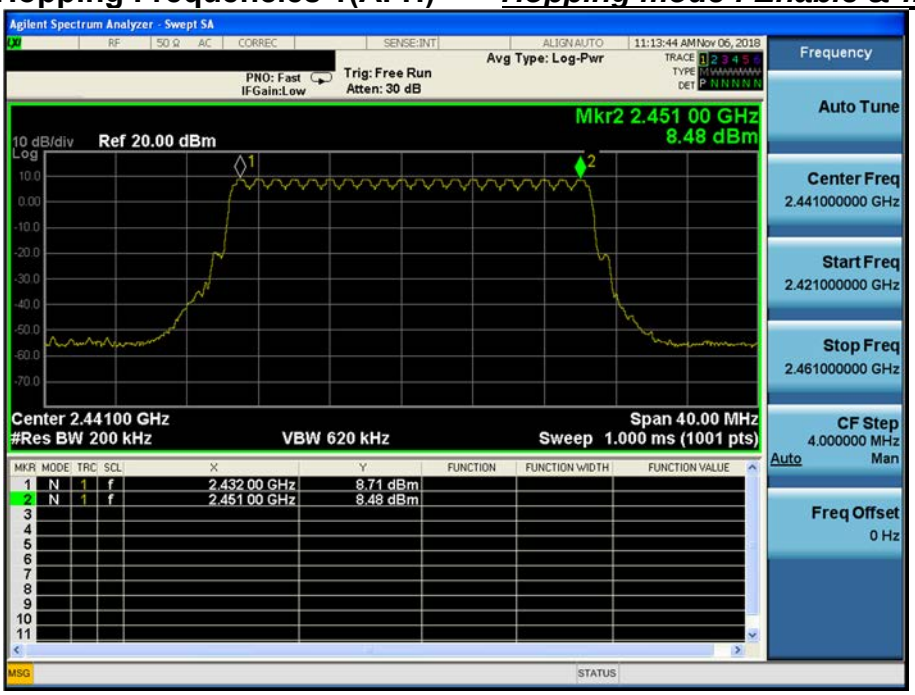
**Number of Hopping Frequencies 2(FH)** ***Hopping mode : Enable & 8DPSK***



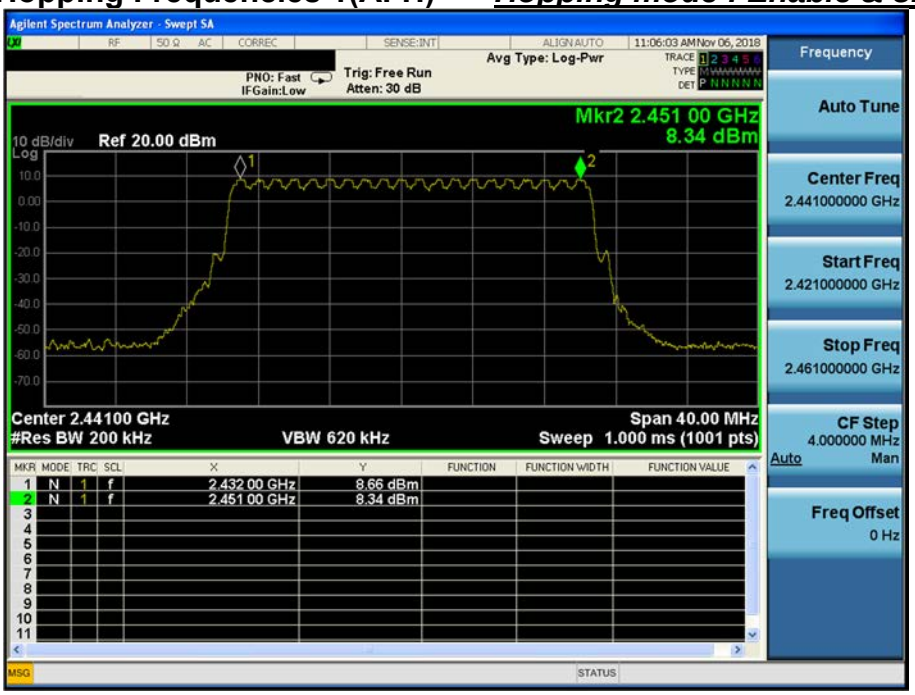
**Number of Hopping Frequencies 1(AFH)** ***Hopping mode : Enable & GFSK***




**Number of Hopping Frequencies 1(AFH)** ***Hopping mode : Enable & π/4DQPSK***



**Number of Hopping Frequencies 1(AFH)** ***Hopping mode : Enable & 8DPSK***



# 6. Time of Occupancy (Dwell Time)

## 6.1 Test Setup

Refer to the APPENDIX I.

## 6.2 Limit

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

## 6.3 Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 2441 MHz Span = zero

RBW = 1 MHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW Detector function = peak

Trace = max hold

## 6.4 Test Results

**FH mode**

| Hopping mode | Packet Type | Number of hopping Channels | Burst On Time (ms) | Period (ms) | Test Result (sec) |
|---|---|---|---|---|---|
| Enable | DH 5 | 79 | 2.880 | 3.750 | 0.307 |
| | 2 DH 5 | 79 | 2.880 | 3.750 | 0.307 |
| | 3 DH 5 | 79 | 2.880 | 3.750 | 0.307 |

**AFH mode**

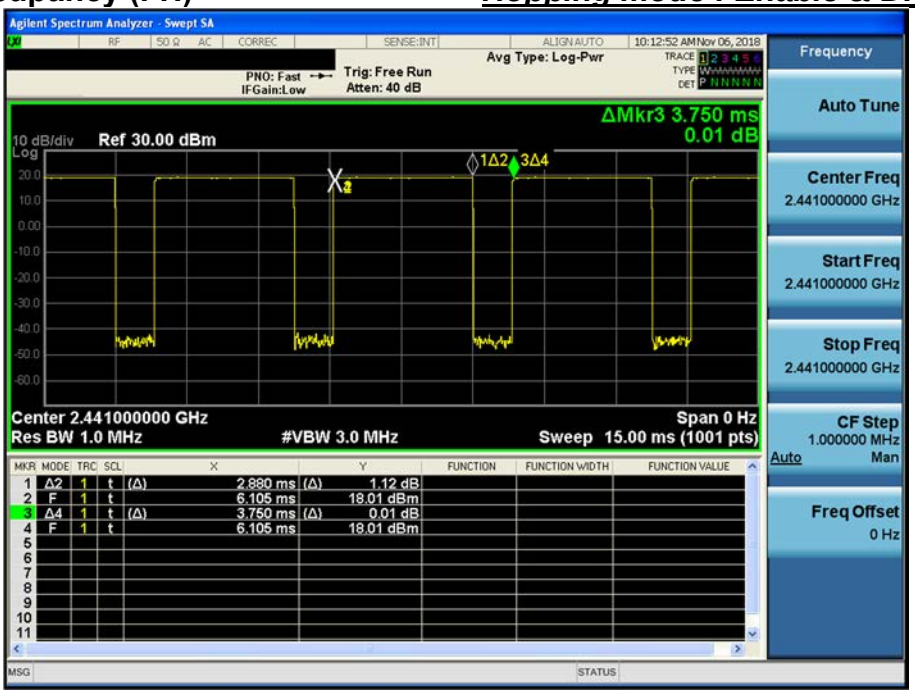
| Hopping mode | Packet Type | Number of hopping Channels | Burst On Time (ms) | Period (ms) | Test Result (sec) |
|---|---|---|---|---|---|
| Enable | DH 5 | 20 | 2.880 | 3.750 | 0.154 |
| | 2 DH 5 | 20 | 2.880 | 3.750 | 0.154 |
| | 3 DH 5 | 20 | 2.880 | 3.750 | 0.154 |

Note 1 : Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)

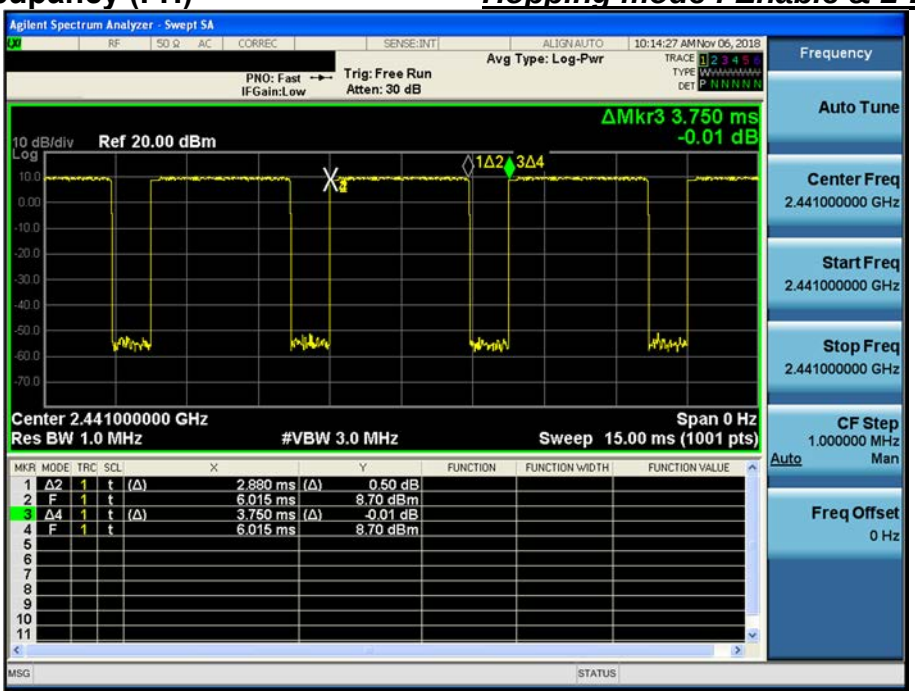
- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2 : See next pages for actual measured spectrum plots.

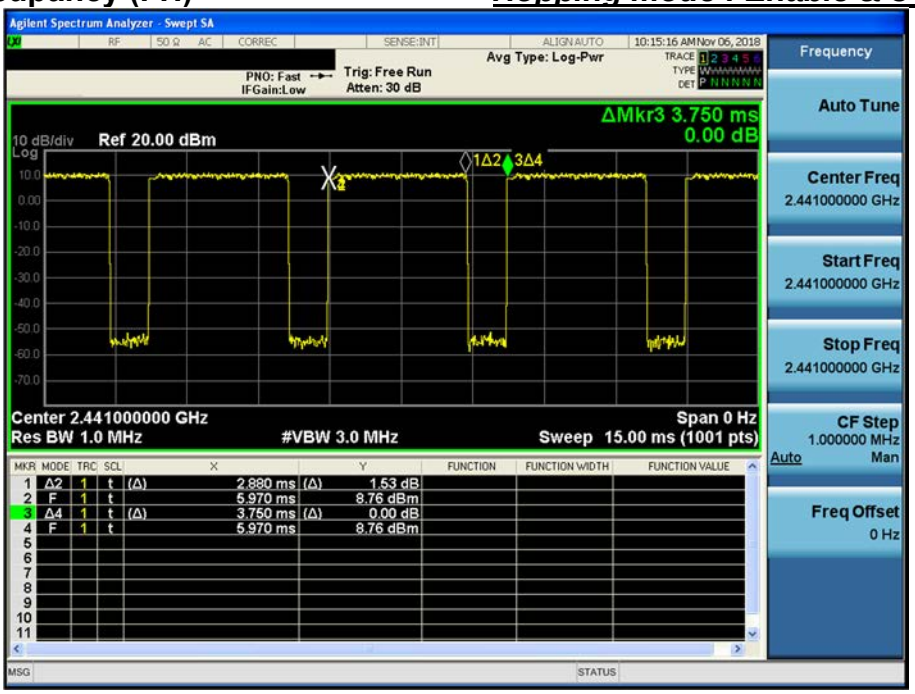
**Time of Occupancy (FH)** ***Hopping mode : Enable & DH5***



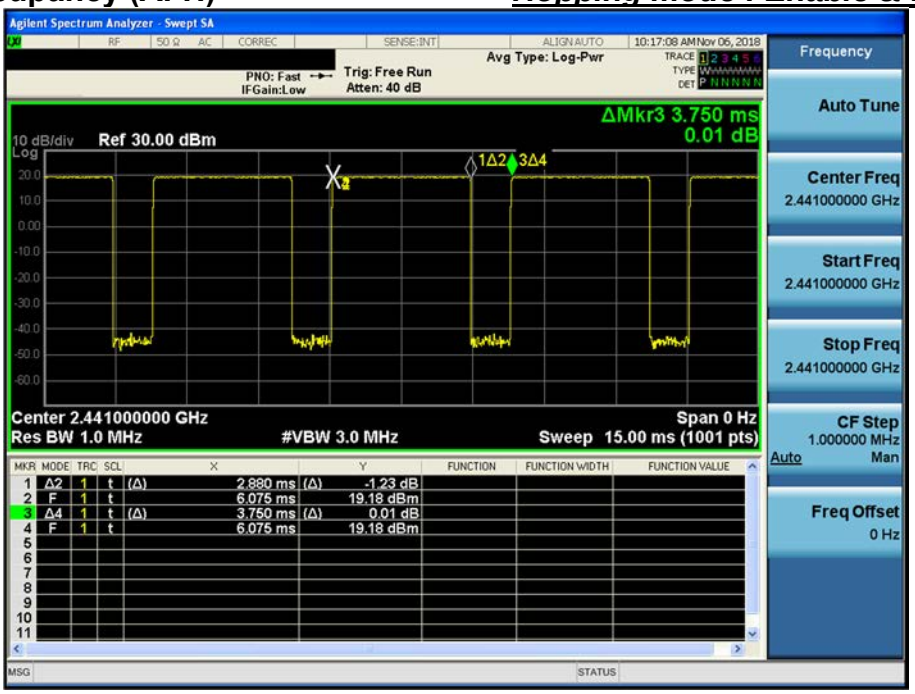

**Time of Occupancy (FH)** ***Hopping mode : Enable & 2-DH5***



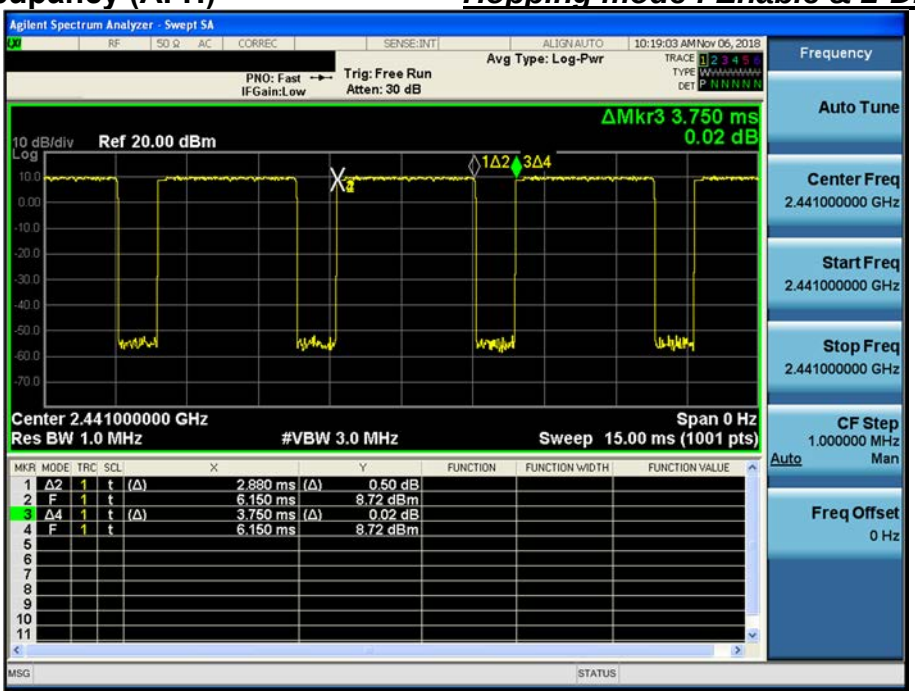
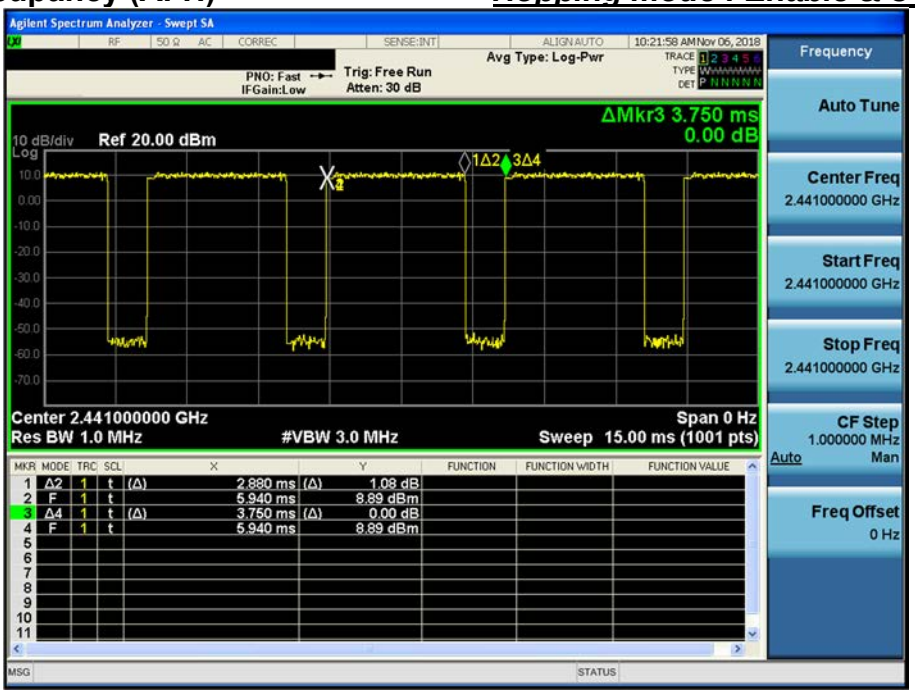
**Time of Occupancy (FH)** ***Hopping mode : Enable & 3-DH5***



**Time of Occupancy (AFH)** ***Hopping mode : Enable & DH5***




**Time of Occupancy (AFH)** ***Hopping mode : Enable & 2-DH5***



## Time of Occupancy (AFH) ***Hopping mode : Enable & 3-DH5***