

TEST REPORT



DT&C Co., Ltd.

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Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1611-0144

2. Customer

• Name : POINTMOBILE CO., LTD

• Address : B-9F, Kabul Great Valley 32 Digital-ro 9-gil, Geumcheon-gu Seoul South Korea
153-709

3. Use of Report : FCC Original Grant

4. Product Name / Model Name : Bluetooth Scanner / PM3

FCC ID : V2X-PM3

5. Test Method Used : FCC Part 15 Subpart C.247

6. Date of Test : 2016-09-22 ~ 2016-10-11

7. Testing Environment : See appended test report

8. Test Result : Refer to the attached Test Result

Affirmation	Tested by	Technical Manager
	Name : Inhee Bae (Signature)	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.

2016 . 11 . 08 .

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
DRTFCC1611-0144	Nov. 08, 2016	Initial issue

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1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.		
Standard	Site number	Address
FCC	☒ 165783	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐ 804488	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐ 596748	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐ 678747	683-3, Yubang-dong, Cheoin-gu, Yongin-si, Kyeonggi-do, Korea, 449-080
IC	☐ 5740A-3	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
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Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.2 Details of Applicant

Applicant : POINTMOBILE CO., LTD
 Address : B-9F, Kabul Great Valley 32 Digital-ro 9-gil, Geumcheon-gu Seoul South Korea 153-709
 Contact person : Wilson Park

1.3 Description of EUT

EUT	Bluetooth Scanner
Model Name	PM3
Add Model Name	NA
Serial Number	Identical prototype
Hardware version	4
Software version	91.17
Power Supply	DC 3.7 V
Frequency Range	2402 MHz ~ 2480 MHz
Modulation Technique	GFSK, $\pi/4$ -DQPSK, 8DPSK
Number of Channels	79
Antenna Type	Internal Antenna
Antenna Gain	PK : -0.08 dBi

1.4 Declaration by the applicant / manufacturer

- NA

1.5 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
 - 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.

1.6 Test conditions

Ambient Condition	
▪ Temperature	+24 °C ~ +25 °C
▪ Relative Humidity	41 % ~ 44 %

1.7 Measurement Uncertainty

Test items	Measurement uncertainty
Transmitter Output Power	0.71 dB (The confidence level is about 95 %, k = 2)
Conducted spurious emission	0.94 dB (The confidence level is about 95 %, k = 2)
AC conducted emission	2.36 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)

1.8 Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
MXA Signal Analyzer	Agilent	N9020A	16/08/05	17/08/05	MY46471622
Dynamic Measurement DC Source	Agilent Technologies	66332A	16/09/08	17/09/08	US36320377
P-Series Power Meter	Agilent	N1911A	15/10/20	16/10/20	MY53360016
Wideband Power Sensor	Agilent	N1921A	15/10/20	16/10/20	MY53360018
Signal Generator	Rohde Schwarz	SMF100A	16/06/23	17/06/23	102341
Vector Signal Generator	Rohde Schwarz	SMBV100A	16/01/05	17/01/05	255571
Thermohygrometer	BODYCOM	BJ5478	16/04/22	17/04/22	120612-2
Power Splitter	Anritsu	K241B	16/02/24	17/02/24	1301184
BlueTooth Tester	TESCOM	TC-3000B	16/01/06	17/01/06	3000B770243
Multimeter	Agilent Technologies	34401A	16/01/05	17/01/05	MY41037027
PreAmplifier	Agilent	8449B	16/02/24	17/02/24	3008A00370
Loop Antenna	Schwarzbeck	FMZB1513	16/04/22	18/04/22	1513-128
Double-Ridged Guide Antenna	ETS-LINDGREN	3117	16/05/03	18/05/03	140394
Horn Antenna	A.H.Systems Inc.	SAS-574	15/04/30	17/04/30	154
BILOG ANTENNA	SCHAFFNER	CBL6112B	14/12/10	16/12/10	2737
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESU	16/07/18	17/07/18	100469
High-pass filter	Wainwright Instruments	WHKX3.0	16/01/06	17/01/06	12
Highpass Filter	Wainwright Instruments	WHNX6-6320- 8000-26500-40CC	16/09/13	17/09/13	1
Low Noise Pre Amplifier	tsj	MLA-010K01-B01- 27	16/03/10	17/03/10	1844539
EMI TEST RECEIVER	R&S	ESCI	16/02/25	17/02/25	100364
SINGLE-PHASE MASTER	NF	4420	16/09/08	17/09/08	3049354420023
ARTIFICIAL MAINS NETWORK	Narda S.T.S. / PMM	PMM L2-16B	16/06/22	17/06/22	000WX20305

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 =< 1 Watt , if CHs >= 75 Others =< 0.125 W For IC if CHs >= 75 =< 1 Watt For Conducted Power =< 4 Watt For e.i.r.p, Others =< 0.125 W For Conducted Power. =< 0.5 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.	Radiated	C
RSS Gen(6.6)	Occupied Bandwidth (99 %)	N/A		NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits RSS-Gen 8.9	Radiated	C Note2
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	C
15.203 RSS-Gen(8.3)	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 each axis and the worst case data was reported.

Note 3 : The sample was tested according to the following specifications :

- ANSI C63.10-2013

1.10 Conclusion of worst-case and operation mode

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

Therefore all applicable requirements were tested with all the modulations.

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 and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels

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 bandwidth 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 $\geq$ 20 dB BW
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

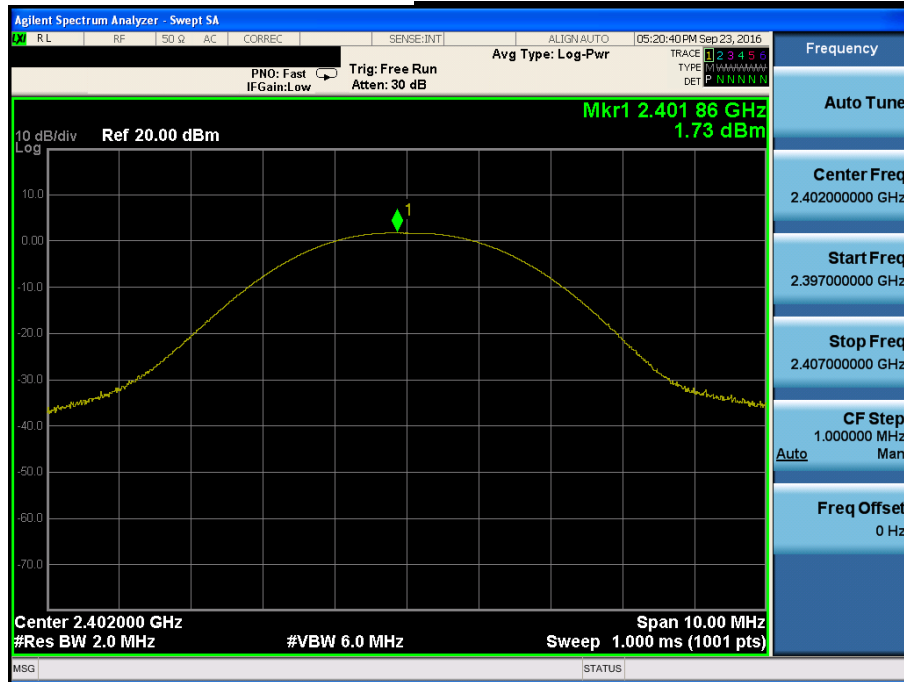
2.4 Test Results

Modulation	Tested Channel	Frame Average Output Power		Peak Output Power	
		dBm	mW	dBm	mW
<u>GFSK</u>	Lowest	1.02	1.265	1.73	1.489
	Middle	1.15	1.303	2.06	1.607
	Highest	-0.16	0.964	0.86	1.219
<u>$\pi/4$DQPSK</u>	Lowest	-0.50	0.891	2.16	1.644
	Middle	-0.90	0.813	2.02	1.592
	Highest	-2.54	0.557	0.45	1.109
<u>8DPSK</u>	Lowest	-0.47	0.897	2.43	1.750
	Middle	-0.88	0.817	2.29	1.694
	Highest	-2.53	0.558	0.72	1.180

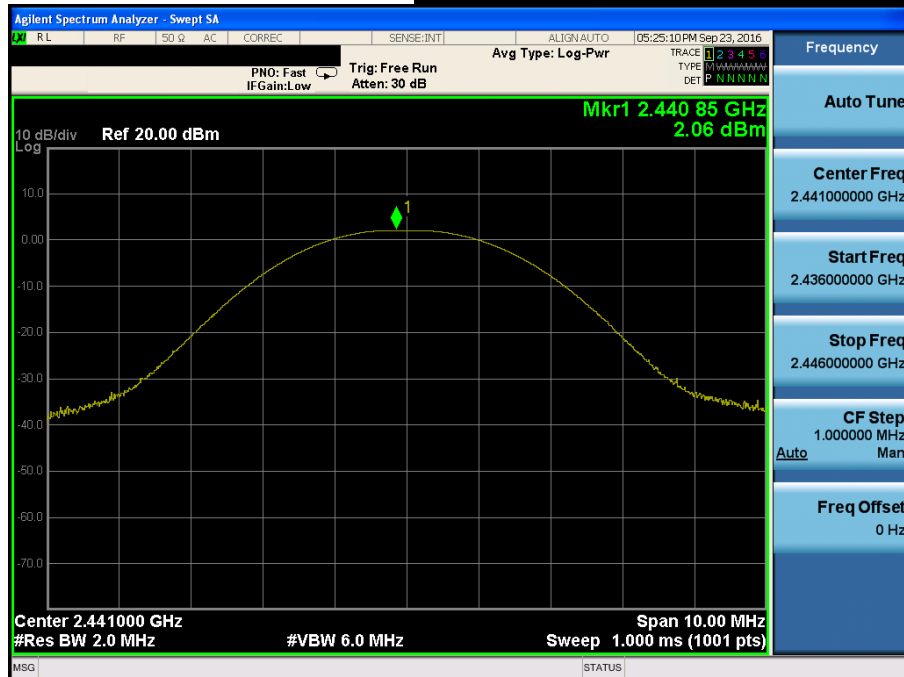
Note 1 : Average output power was using the average power meter for reference only.

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

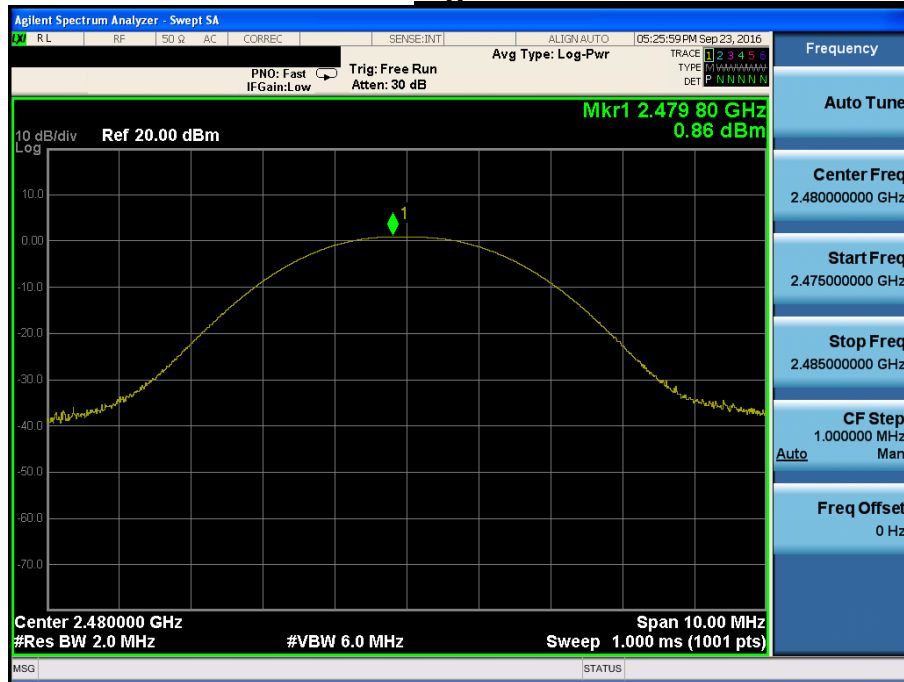
Peak Output Power

Lowest Channel & Modulation : GFSK

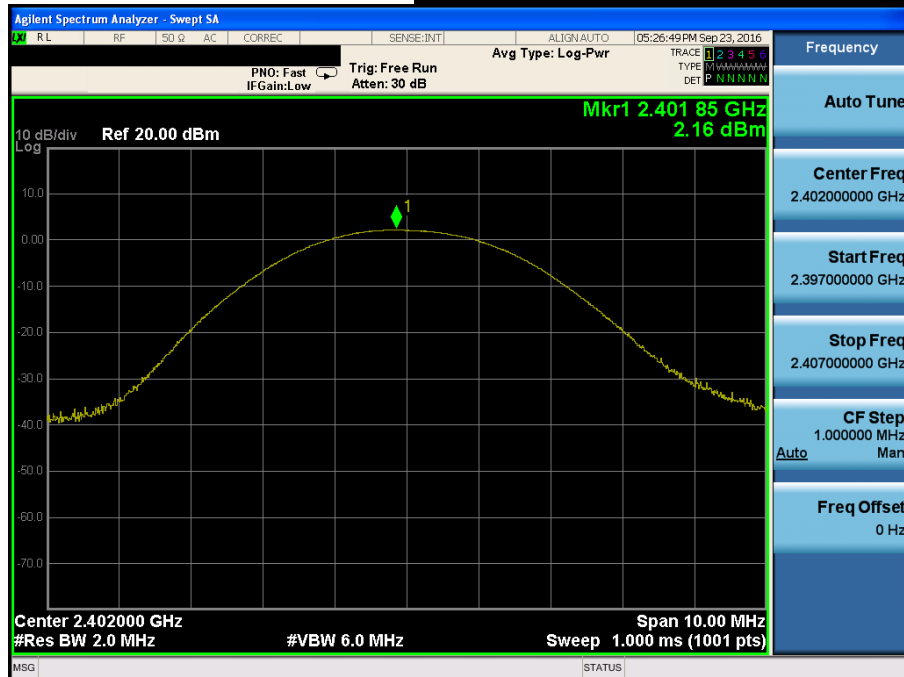
Peak Output Power

Middle Channel & Modulation : GFSK

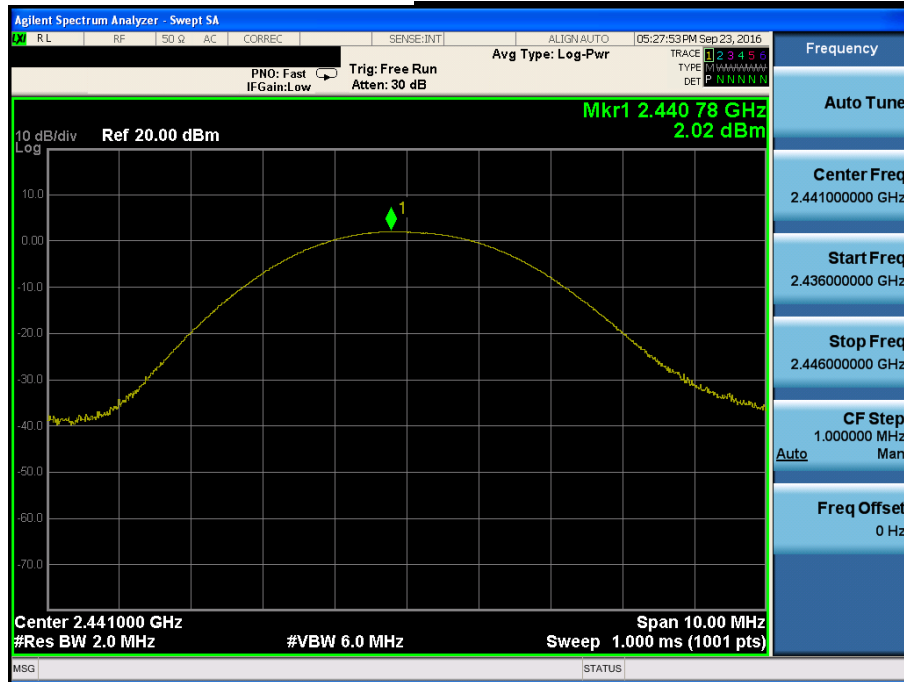
Peak Output Power

Highest Channel & Modulation : GFSK

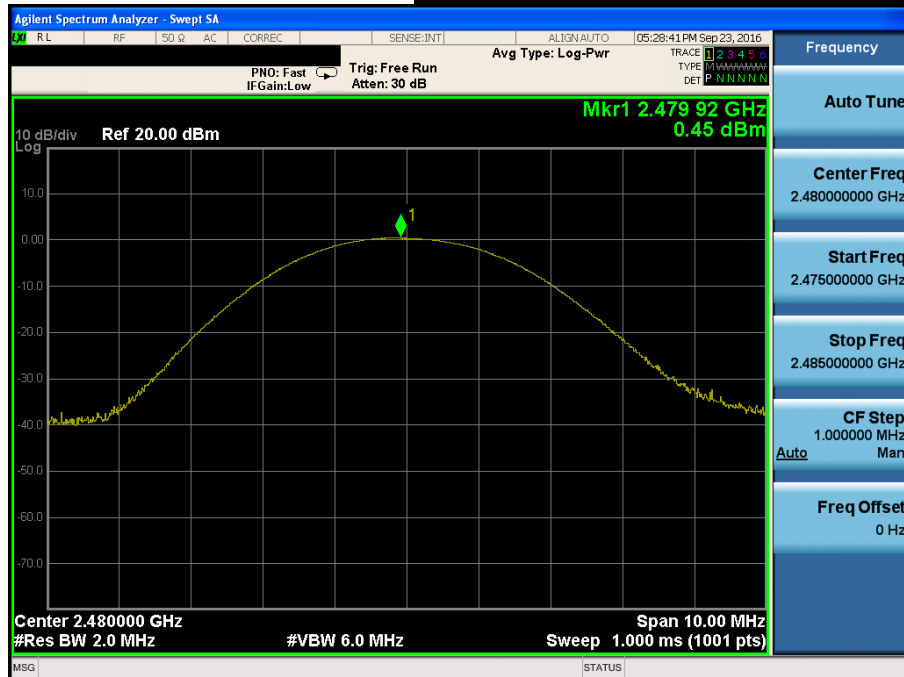
Peak Output Power

Lowest Channel & Modulation : $\pi/4$ DQPSK

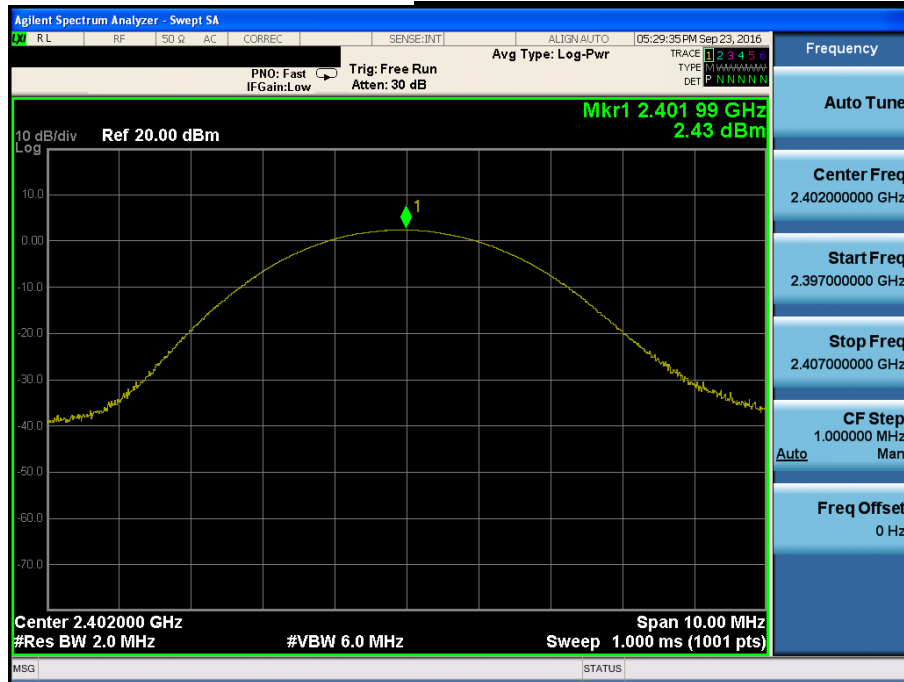
Peak Output Power

Middle Channel & Modulation : $\pi/4$ DQPSK

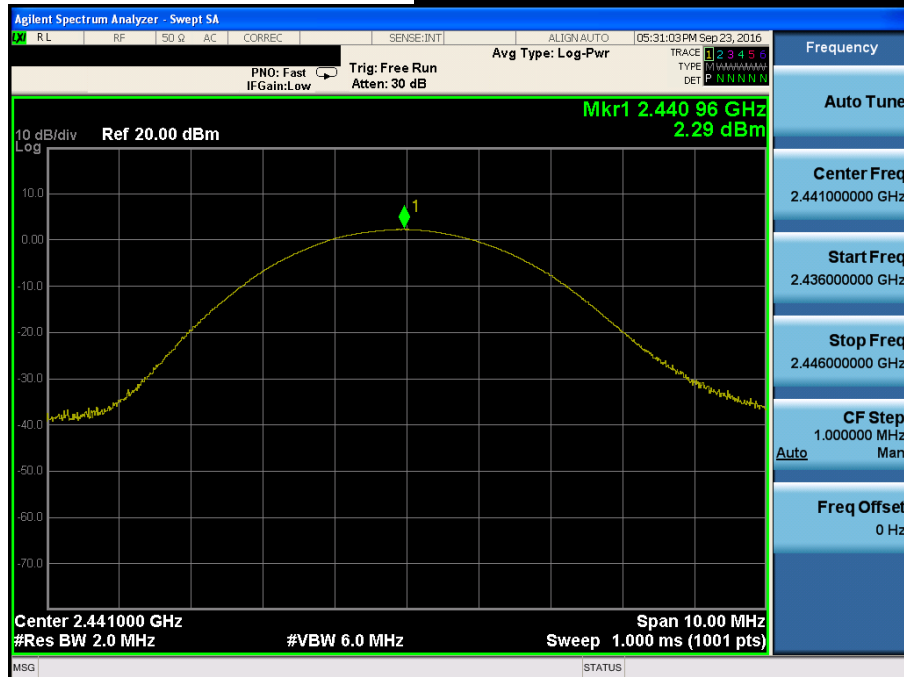
Peak Output Power

Highest Channel & Modulation : $\pi/4$ DQPSK

Peak Output Power

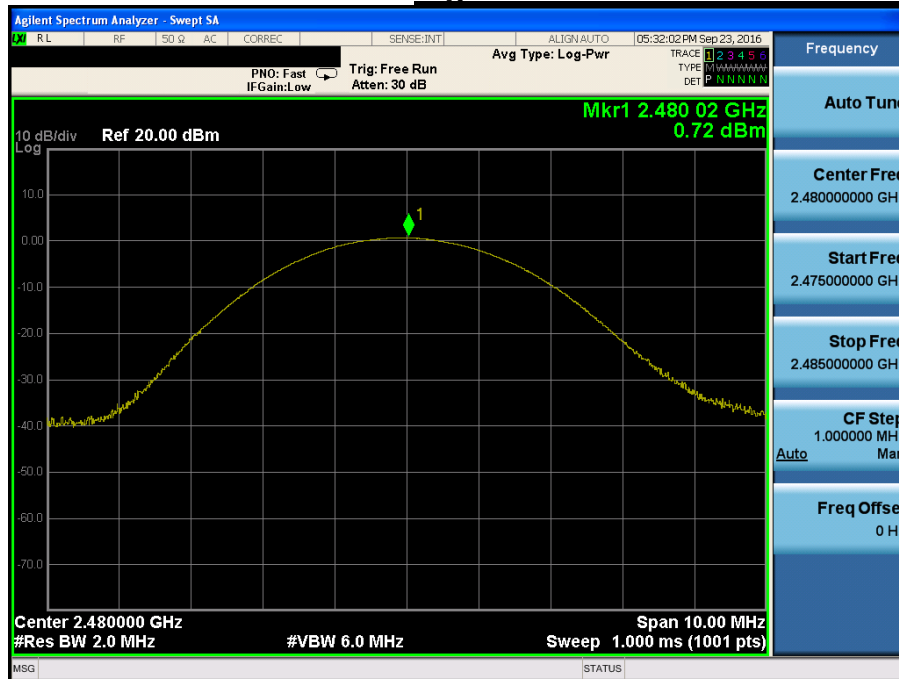
Lowest Channel & Modulation : 8DPSK

Peak Output Power

Middle Channel & Modulation : 8DPSK

Peak Output Power

Highest Channel & Modulation : 8DPSK



3. 20 dB BW

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

Limit : Not Applicable

3.3 Test Procedure

1. The 20 dB 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 shall be in the range of 1% to 5% of the 20 dB bandwidth and VBW $\geq 3 \times$ RBW, Span = between two times and five times the 20 dB bandwidth.

3.4 Test Results

Modulation	Tested Channel	20 dB BW (MHz)
<u>GFSK</u>	Lowest	0.94
	Middle	0.94
	Highest	0.95
<u>$\pi/4$DQPSK</u>	Lowest	1.26
	Middle	1.24
	Highest	1.26
<u>8DPSK</u>	Lowest	1.25
	Middle	1.25
	Highest	1.25

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

20 dB Bandwidth

Lowest Channel & Modulation : GFSK

20 dB Bandwidth

Middle Channel & Modulation : GFSK

20 dB Bandwidth

Highest Channel & Modulation : GFSK

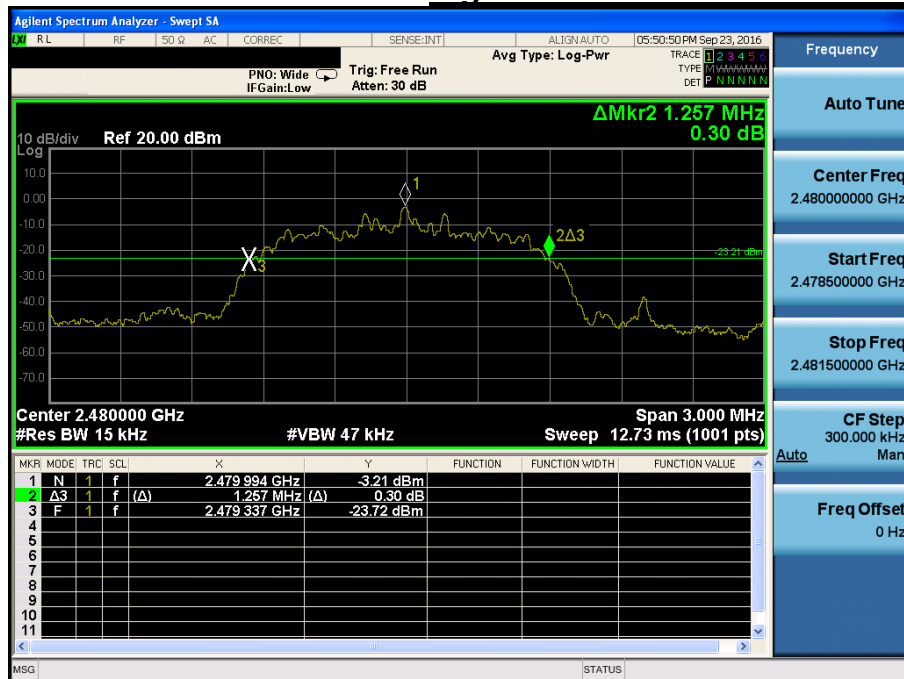
20 dB Bandwidth

Lowest Channel & Modulation : $\pi/4$ DQPSK

20 dB Bandwidth

Middle Channel & Modulation : $\pi/4$ DQPSK

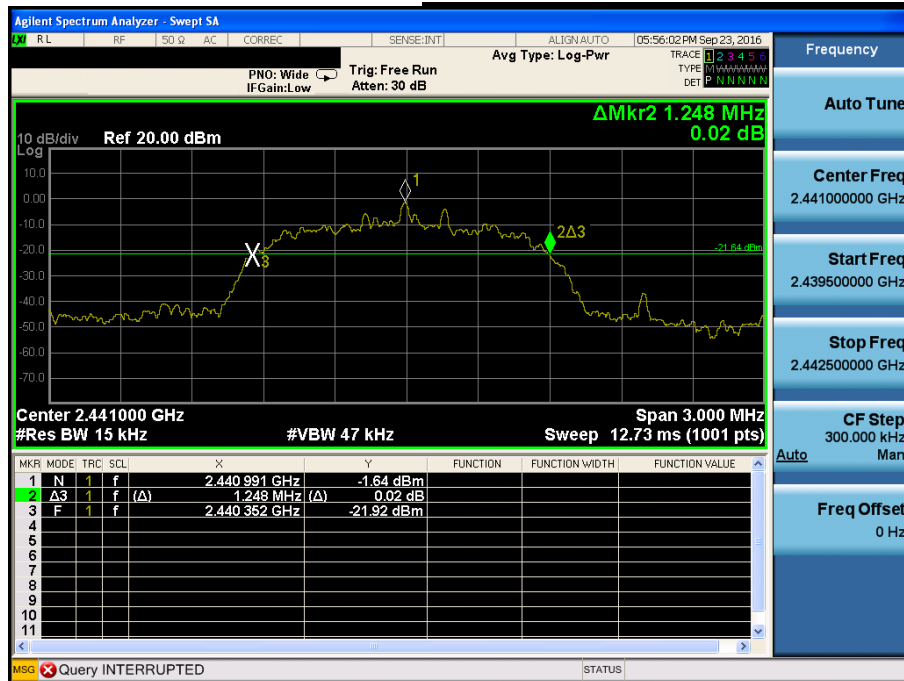
20 dB Bandwidth

Highest Channel & Modulation : $\pi/4$ DQPSK

20 dB Bandwidth

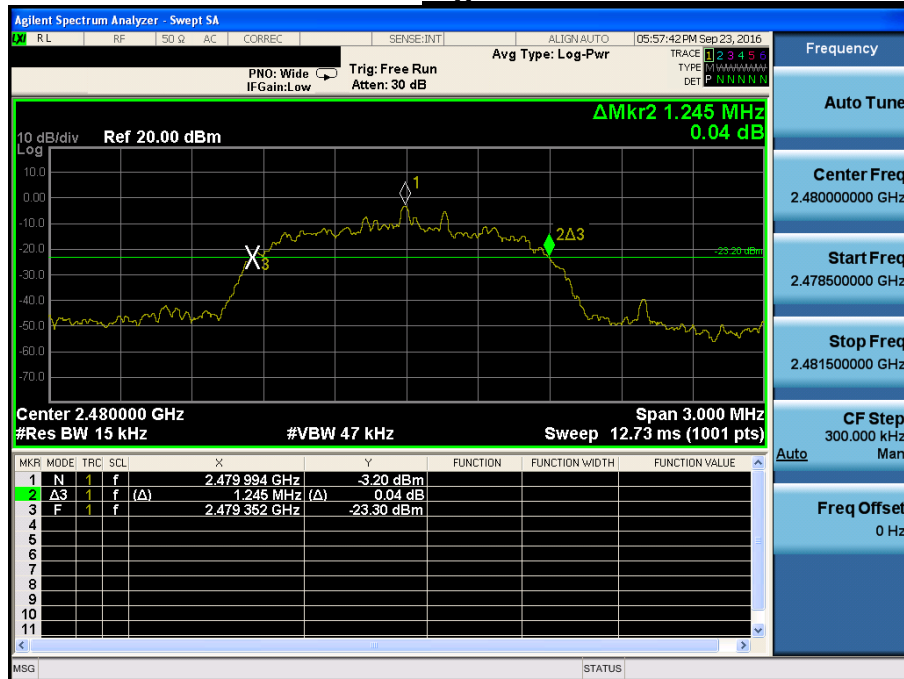
Lowest Channel & Modulation : 8DPSK

20 dB Bandwidth

Middle Channel & Modulation : 8DPSK

20 dB Bandwidth

Highest Channel & Modulation : 8DPSK



4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : ≥ 25 kHz or $\geq$ 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 $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

4.4 Test Results

FH mode

Hopping Mode	Test Mode	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2440.982	2441.990	1.008
	$\pi/4$ -DQPSK	2439.989	2440.991	1.002
	8DPSK	2439.989	2440.991	1.002

AFH mode

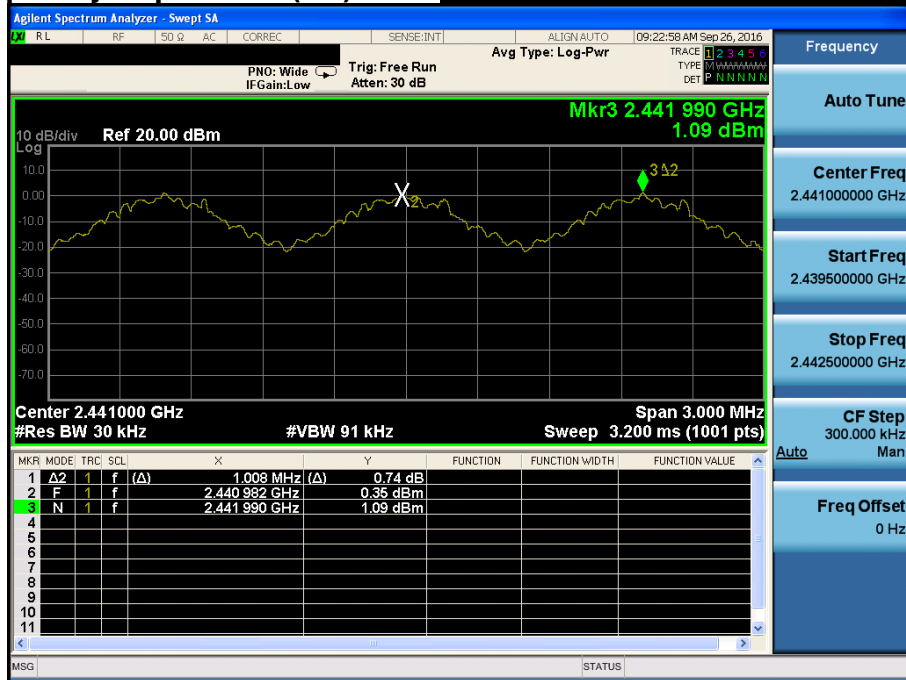
Hopping Mode	Test Mode	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2409.986	2410.994	1.008
	$\pi/4$ -DQPSK	2409.986	2410.988	1.002
	8DPSK	2410.988	2411.990	1.002

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

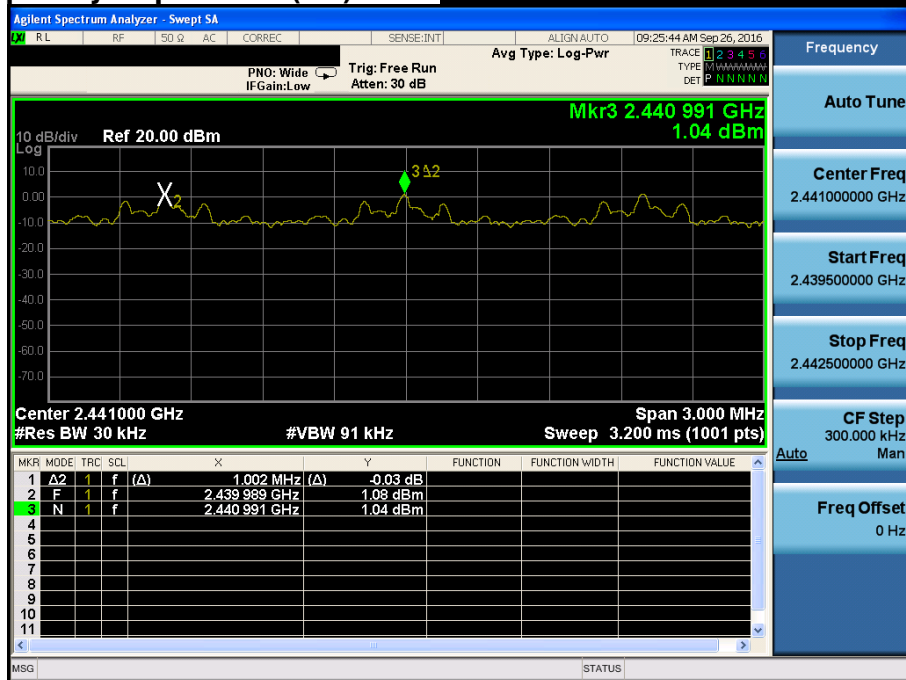
- Minimum Standard :

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.
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)

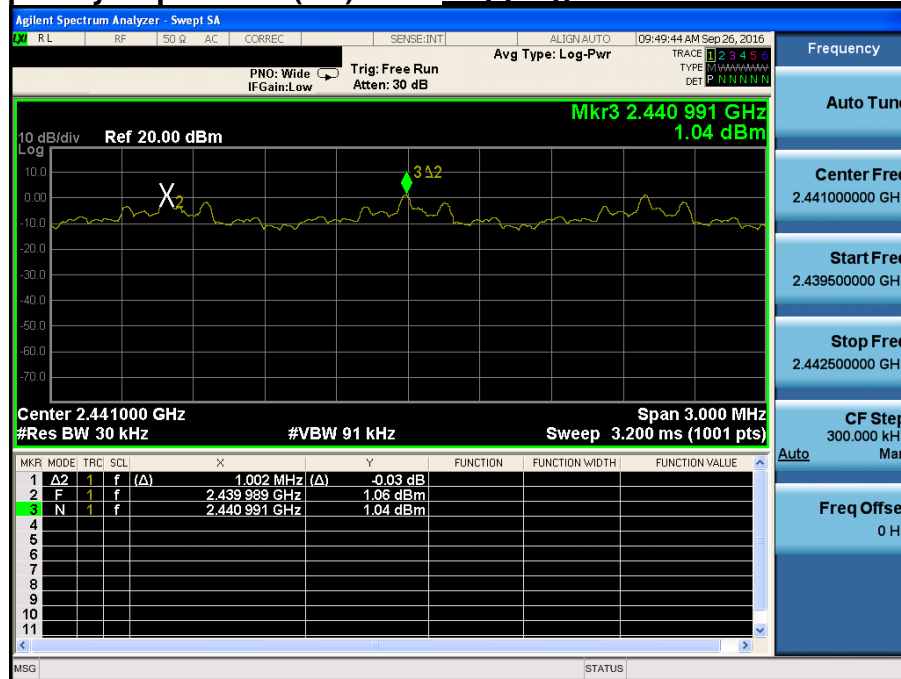
Hopping mode : Enable & GFSK

Carrier Frequency Separation (FH)

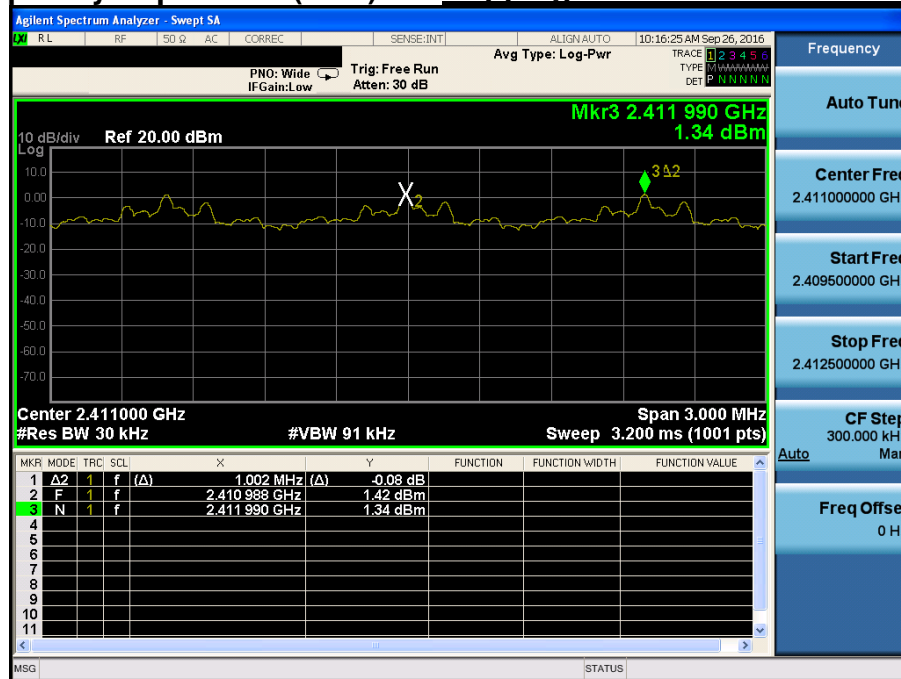
Hopping mode : Enable & $\pi/4$ -DQPSK

Carrier Frequency Separation (FH)

Hopping mode : Enable & 8DPSK



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 = 30 MHz Start Frequency = 2396.0 MHz, Stop Frequency = 2426.0 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 $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

5.4 Test Results

FH mode

Hopping mode	Test mode	Test Result (Total Hops)
Enable	GFSK	79
	$\pi/4$ -DQPSK	79
	8DPSK	79

AFH mode

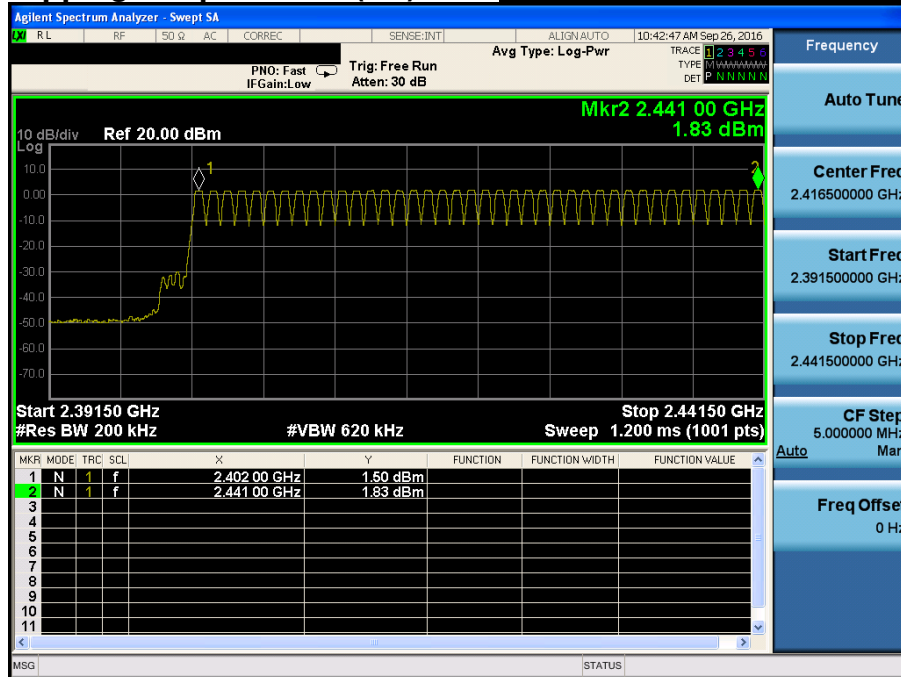
Hopping mode	Test mode	Test Result (Total Hops)
Enable	GFSK	20
	$\pi/4$ -DQPSK	20
	8DPSK	20

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

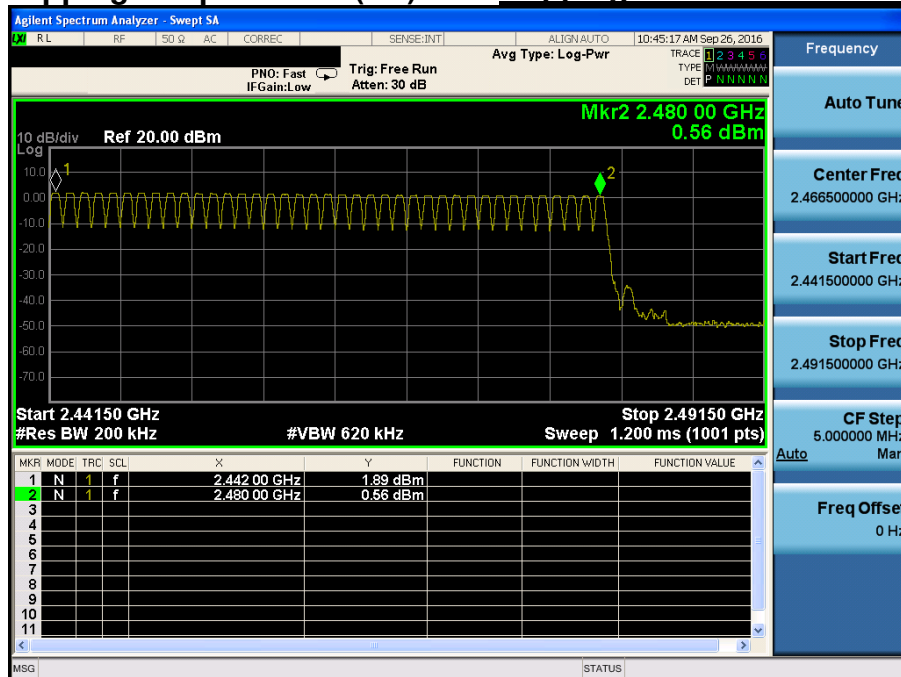
- Minimum Standard :

At least 15 hops

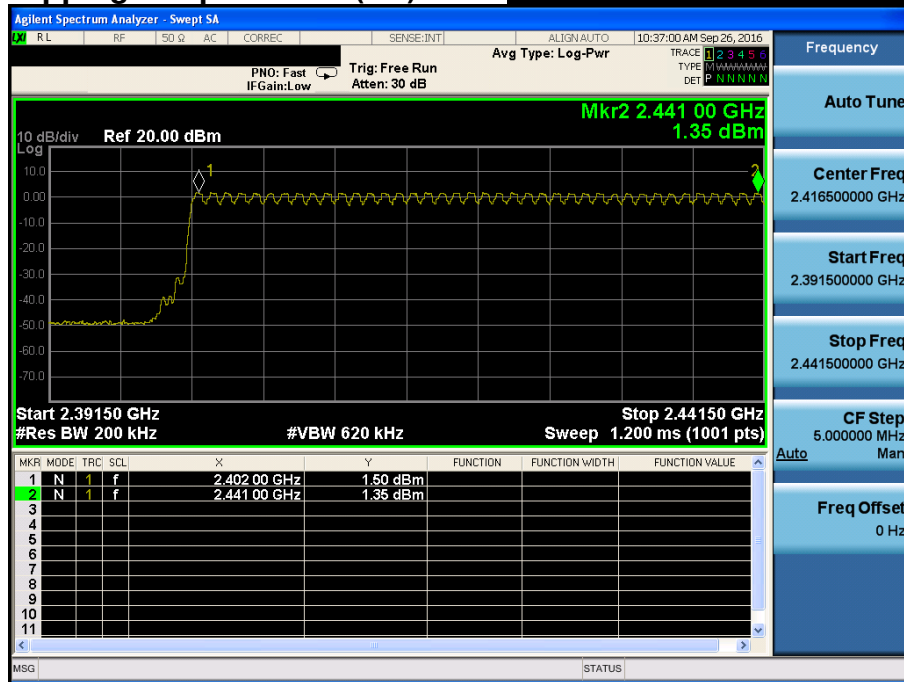
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & GFSK

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & GFSK

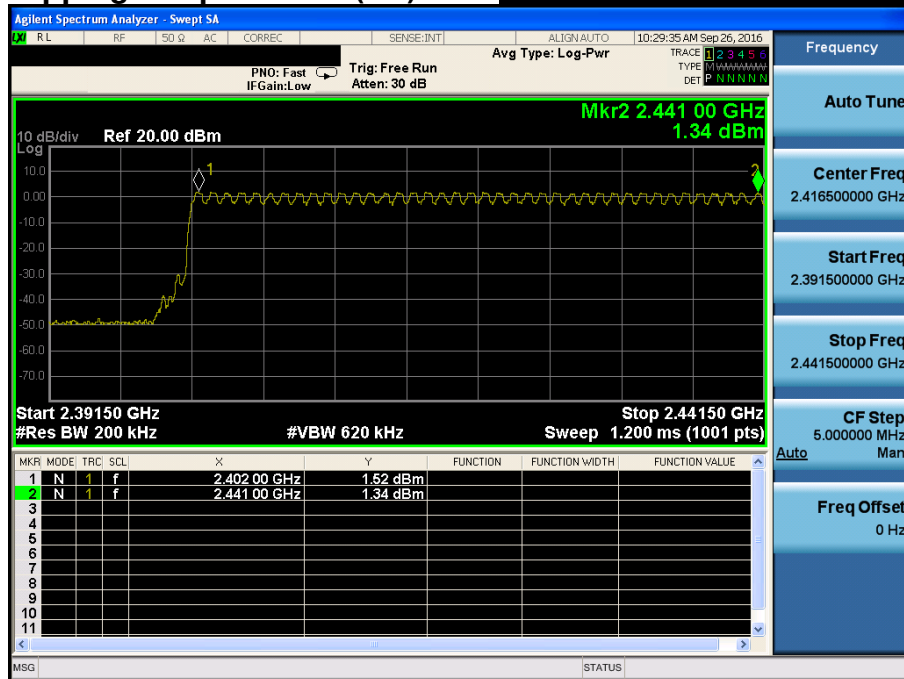
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & $\pi/4$ -DQPSK

Number of Hopping Frequencies 2(FH)

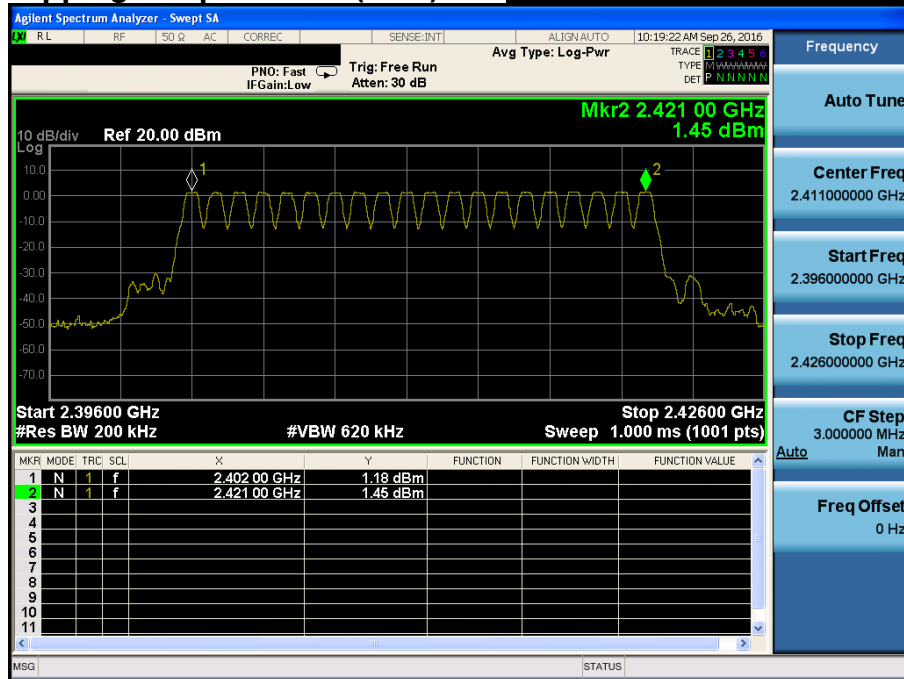
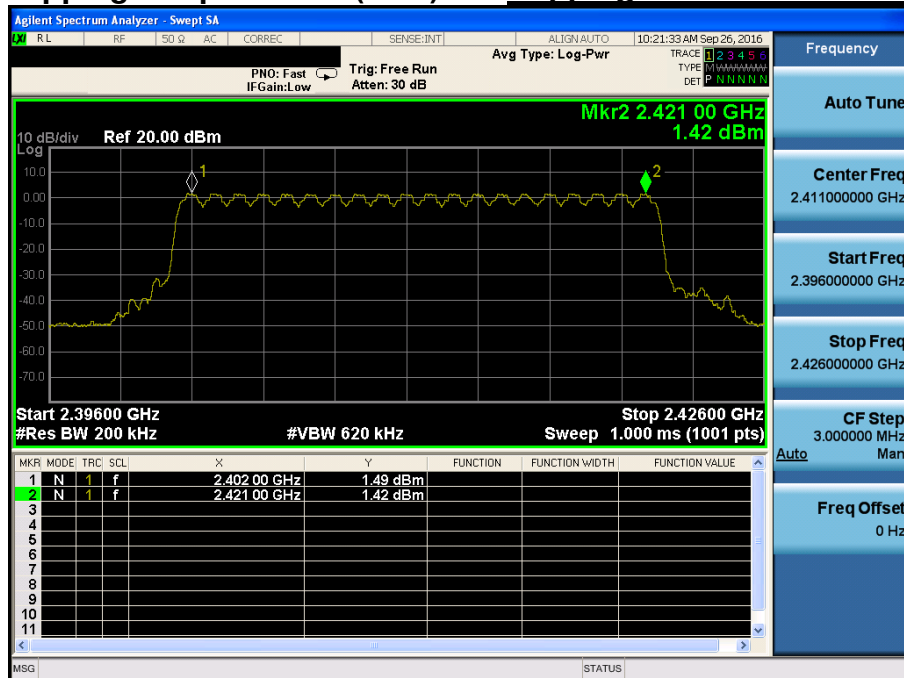
Hopping mode : Enable & $\pi/4$ -DQPSK

Number of Hopping Frequencies 1(FH)

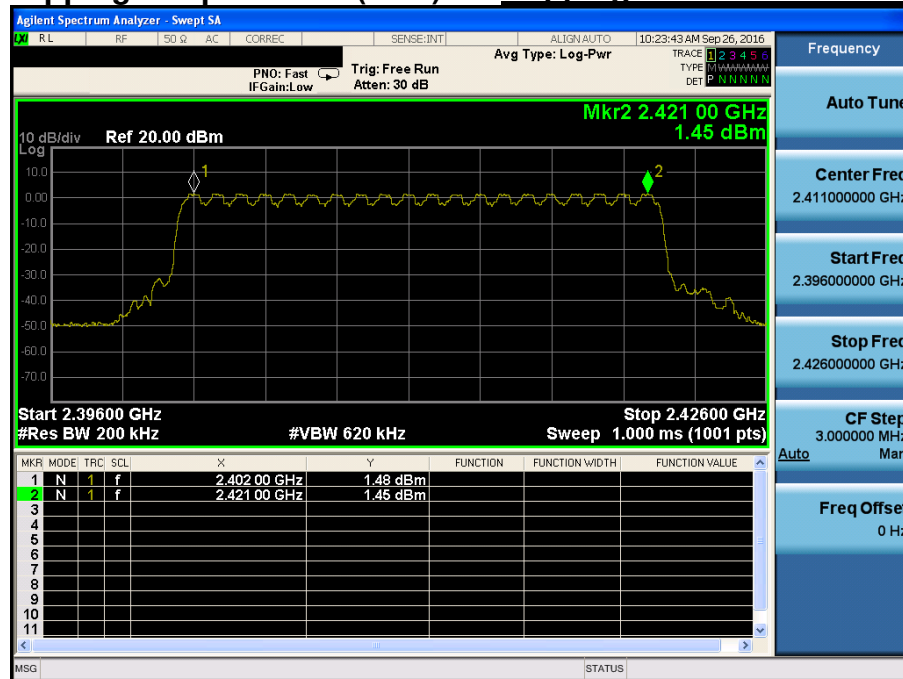
Hopping mode : Enable & 8DPSK

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 & $\pi/4$ -DQPSK***

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 $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel)

VBW $\geq$ 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 = $0.4 \times \text{Hopping channel} \times \text{Burst ON time} \times$

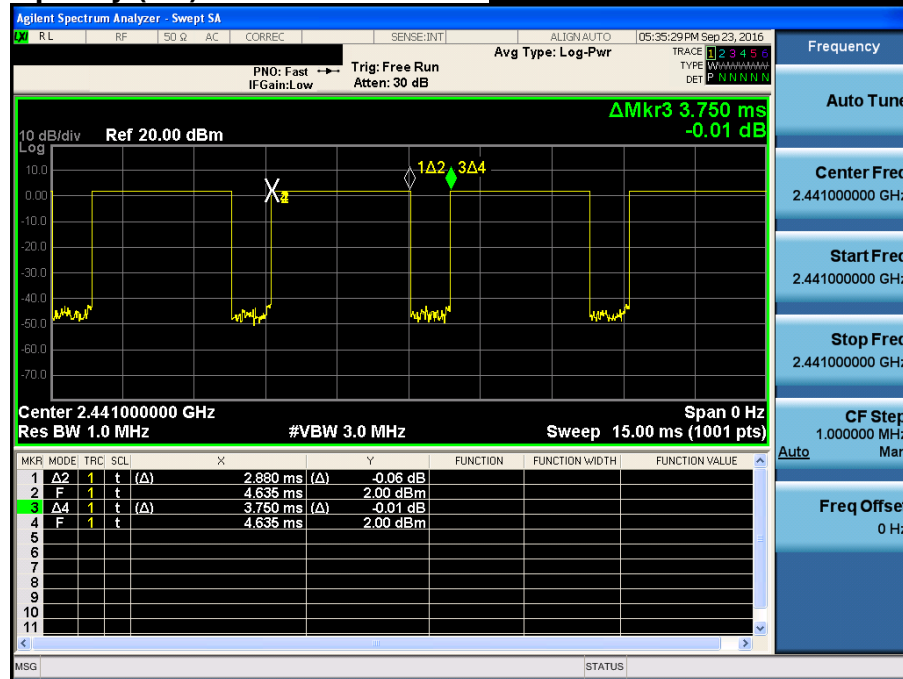
$((\text{Hopping rate} \div \text{Time slots}) \div \text{Hopping channel})$

- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)

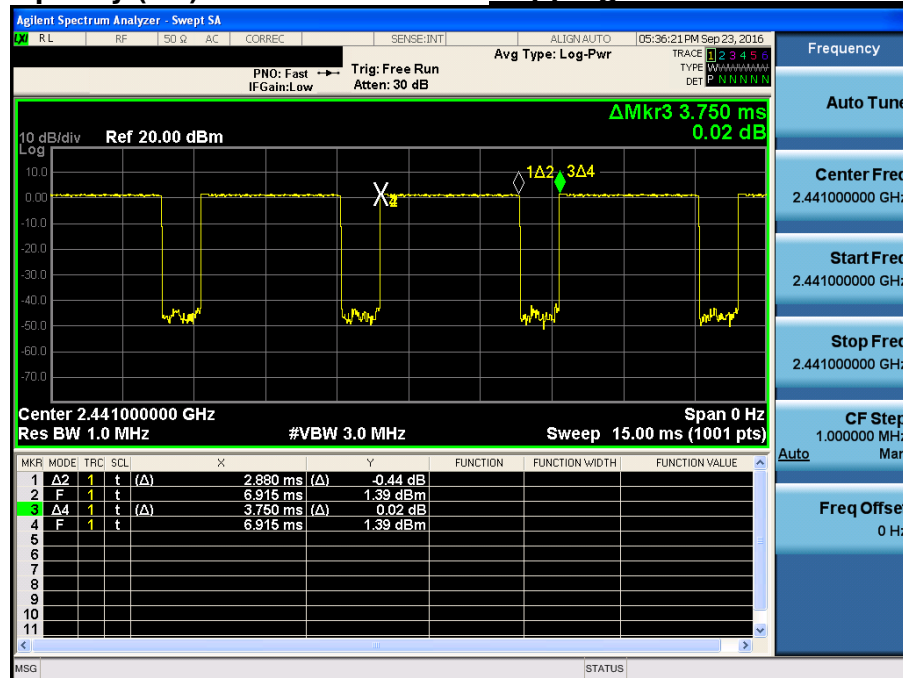
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

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

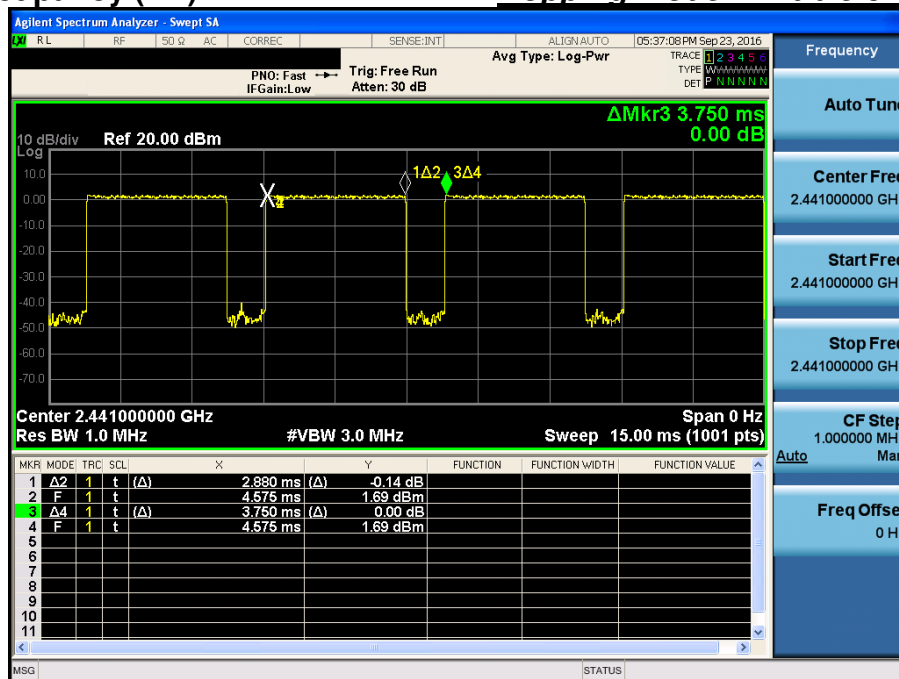
Time of Occupancy (FH)

Hopping mode : Enable & GFSK

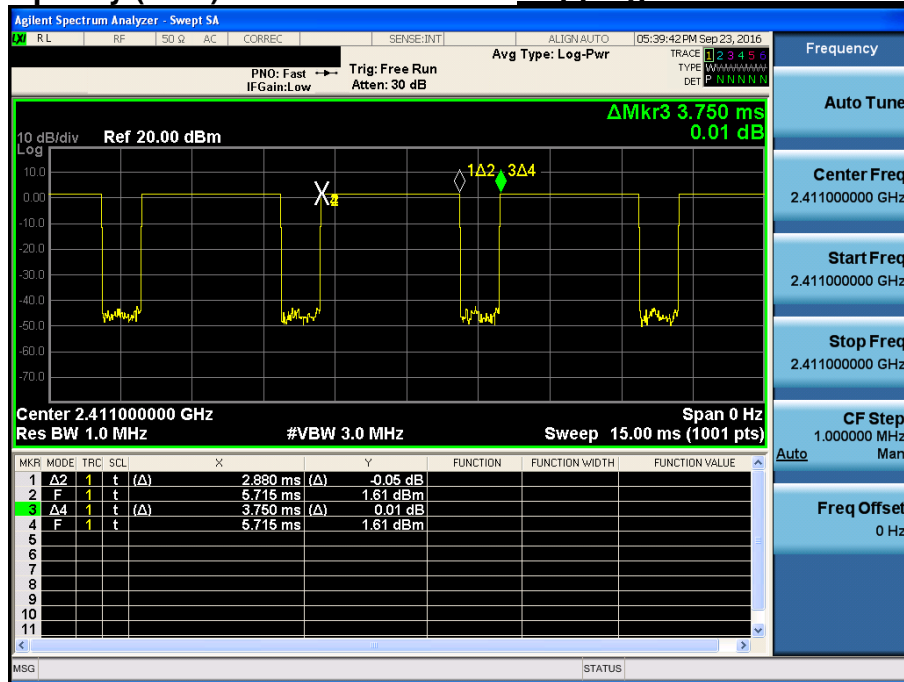
Time of Occupancy (FH)

Hopping mode : Enable & $\pi/4$ -DQPSK

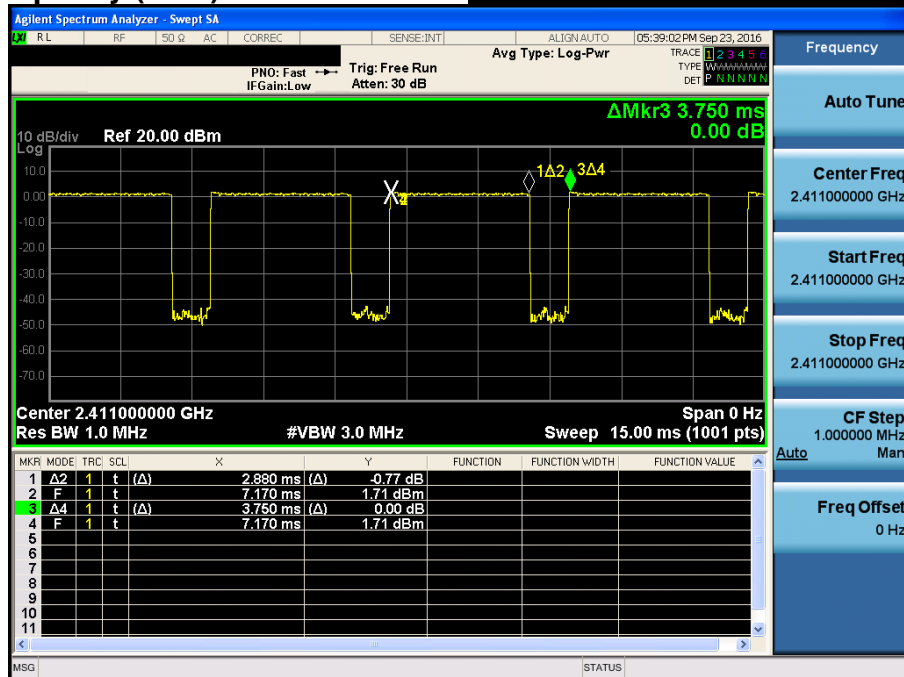
Hopping mode : Enable & 8DPSK



Time of Occupancy (AFH)

Hopping mode : Enable & GFSK

Time of Occupancy (AFH)

Hopping mode : Enable & π/4-DQPSK

Time of Occupancy (AFH)

Hopping mode : Enable & 8DPSK

