TEST REPORT



DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042 Tel: 031-321-2664, Fax: 031-321-1664

1. Report No: DRTFCC1912-0307

2. Customer

• Name : HYUNDAI MOBIS CO., LTD.

Address: 203, Teheran-ro Gangnam-gu, Seoul, South Korea, 135-977

3. Use of Report: FCC Original Grant

4. Product Name / Model Name: DIGITAL CAR AUDIO SYSTEM / ADC10SVGG

FCC ID: TQ8-ADC10SVGG

5. Test Method Used: KDB 558074 D01v05r02, ANSI C63.10-2013

Test Specification: FCC Part 15.247

6. Date of Test: 2019.11.05 ~ 2019.11.22

7. Testing Environment: See appended test report.

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

Affirmation Tested by

Name : InHee Bae

Reviewed by

Name: JaeJin Lee

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.

2019.12.04.

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
DRTFCC1912-0307	Dec. 04, 2019	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.

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The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.

- FCC MRA Accredited Test Firm No.: KR0034

www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.2 Testing Environment

Ambient Condition	
 Temperature 	+21 °C ~ +24 °C
Relative Humidity	35 % ~ 43 %

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)	
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)	

1.4 Details of Applicant

Applicant : HYUNDAI MOBIS CO., LTD.

Address : 203, Teheran-ro Gangnam-gu, Seoul, South Korea, 135-977

Report No.: DRTFCC1912-0307

Contact person : Seung Hoon Choe

1.5 Description of EUT

EUT	DIGITAL CAR AUDIO SYSTEM		
Model Name	ADC10SVGG		
Add Model Name	ADC11SVGG, ADC12SVGG, ADC13SVGG, ADC10SVGN, ADC11SVGN, ADC10SVMG, ADC10SVMG, ADC14SVGG		
Hardware Version	1.0		
Software Version	1.0		
Serial Number	Identical prototype		
Power Supply	DC 14.4 V		
Frequency Range	2402 MHz ~ 2480 MHz		
Modulation Technique (Data rate)	GFSK (1Mbps), π/4DQPSK (2Mbps), 8DPSK (3Mbps)		
Number of Channels	79		
Antenna Type	PCB Pattern Antenna		
Antenna Gain	PK : -0.18 dBi		

1.6 Declaration by the applicant / manufacturer

- NA

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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 sequenc e 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

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY49060056
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	19/06/26	20/06/26	MY46471251
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43001173
DC Power Supply	SM techno	SDP30-5D	19/06/25	20/06/25	305DMG304
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
Signal Generator	ANRITSU	MG3695C	18/12/10	19/12/10	173501
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-2
Thermohygrometer	BODYCOM	BJ5478	19/07/03	20/07/03	N/A
Loop Antenna	ETS	6502	19/09/18	21/09/18	00226186
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3115	18/01/30	20/01/30	6419
Horn Antenna	Schwarzbeck	BBHA 9120C	17/12/04	19/12/04	9120C-561
Horn Antenna	A.H.Systems Inc.	SAS-574	19/07/03	21/07/03	155
PreAmplifier	tsj	MLA-0118-J01-45	18/12/19	19/12/19	17138
PreAmplifier	tsj	MLA-1840-J02-45	19/06/27	20/06/27	16966-10728
PreAmplifier	H.P	8447D	18/12/18	19/12/18	2944A07774
Power Divider	Weinschel	WA1574	19/06/25	20/06/25	WA1574-4
Bluetooth Tester	Tescom	TC-3000C	19/06/24	20/06/24	3000C000563
High Pass Filter	Wainwright Instruments	WHKX12-935- 1000-15000-40SS	19/06/26	20/06/26	8
High Pass Filter	Wainwright Instruments	WHKX10-2838- 3300-18000-60SS	19/06/26	20/06/26	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5- 6SS	19/06/27	20/06/27	3
Attenuator(10dB)	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
Attenuator(6dB)	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
Attenuator(3dB)	Aeroflex/Weinschel	20515	19/06/27	20/06/27	Y2370
Attenuator(3dB)	SMAJK	SMAJK-2-3	19/06/27	20/06/27	2
Attenuator(3dB)	Cernexwave	CFADC2603U5	19/06/27	20/06/27	C11729
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	19/06/27	20/06/27	1338003 1249304
EMI Receiver	ROHDE&SCHWARZ	ESW44	19/07/30	20/07/30	101645
Cable	Junkosha	MWX241	19/01/14	20/01/14	G-04
Cable	Junkosha	MWX241	19/01/14	20/01/14	G-07
Cable	DT&C	Cable	19/01/14	20/01/14	G-13
Cable	DT&C	Cable	19/01/14	20/01/14	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	19/01/14	20/01/14	G-15
Cable	Radiall	TESTPRO3	19/01/16	20/01/16	M-01
Cable	Junkosha	MWX315	19/01/16	20/01/16	M-05
Cable	Junkosha	MWX221	19/01/16	20/01/16	M-06
Cable	DT&C	Cable	19/01/14	20/01/14	RF-10

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Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017. Note2: 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
	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.		С
15.247(a) RSS-247(5.1)	Number of Hopping Frequencies	>= 15 hops		С
1100 217 (0.1)	20 dB Bandwidth	N/A		С
	Dwell Time	=< 0.4 seconds		С
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	Conducted	С
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.		С
RSS Gen(6.7)	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	Radiated	С
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	NA Note3
15.203	Antenna Requirements	FCC 15.203	-	С

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

Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated With OATS.

Note 3: This device is installed in a car. Therefore the power source is a battery of car.

1.10 Conclusion of worst-case and operation mode

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

Therefore all applicable requirements were tested with all the modulations.

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

Tested frequency information,

- Hopping Function : Enable

	TX Frequency (MHz)	RX Frequency (MHz)		
Hopping Band	2402 ~ 2480	2402 ~ 2480		

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- 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.

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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. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

■ IC Requirements

1. RSS-247(5.4) (b), 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

- 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

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2.4 Test Results

Modulation	Tested Channel	Frame Average Output Power		Peak Output Power	
		dBm	mW	dBm	mW
	Lowest	0.15	1.04	1.77	1.50
<u>GFSK</u>	Middle	0.80	1.20	1.69	1.48
	Highest	0.43	1.10	1.55	1.43
π/4DQPSK	Lowest	-4.58	0.35	-1.15	0.77
	Middle	-3.69	0.43	-0.85	0.82
	Highest	-4.04	0.39	-1.09	0.78
<u>8DPSK</u>	Lowest	-4.55	0.35	-0.70	0.85
	Middle	-3.67	0.43	-0.59	0.87
	Highest	-3.93	0.40	-0.69	0.85

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.



Lowest Channel & Modulation : GFSK



Peak Output Power

Middle Channel & Modulation : GFSK





Highest Channel & Modulation : GFSK



Peak Output Power

Lowest Channel & Modulation : π/4DQPSK



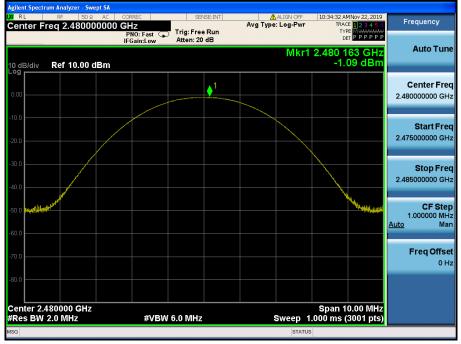


Middle Channel & Modulation : π/4DQPSK



Peak Output Power

Highest Channel & Modulation : π/4DQPSK







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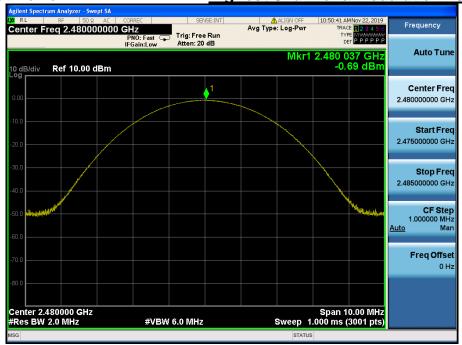


Peak Output Power





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 & 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.

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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 x 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)
	Lowest	0.957
<u>GFSK</u>	Middle	0.957
	Highest	0.957
π/4DQPSK	Lowest	1.344
	Middle	1.344
	Highest	1.351
	Lowest	1.344
<u>8DPSK</u>	Middle	1.344
	Highest	1.345



Lowest Channel & Modulation : GFSK



20 dB BW

Middle Channel & Modulation : GFSK









20 dB BW

Lowest Channel & Modulation : π/4DQPSK



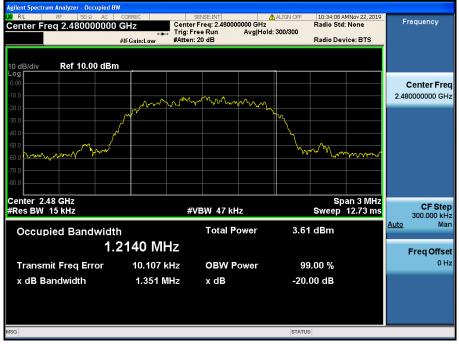


Middle Channel & Modulation : π/4DQPSK



20 dB BW

Highest Channel & Modulation : π/4DQPSK





Lowest Channel & Modulation: 8DPSK



20 dB BW

Middle Channel & Modulation: 8DPSK





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.

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After the trace being stable, the reading value between the peaks of the adjacent channels using the markerdelta 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 reference channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2441.006	2442.012	1.006
	π/4DQPSK	2441.014	2442.012	0.998
	8DPSK	2441.010	2442.012	1.002

AFH mode

Hopping Mode	Modulation	Peak of reference channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2441.017	2442.015	0.998
	π/4DQPSK	2441.013	2442.012	0.999
	8DPSK	2441.012	2442.007	0.995

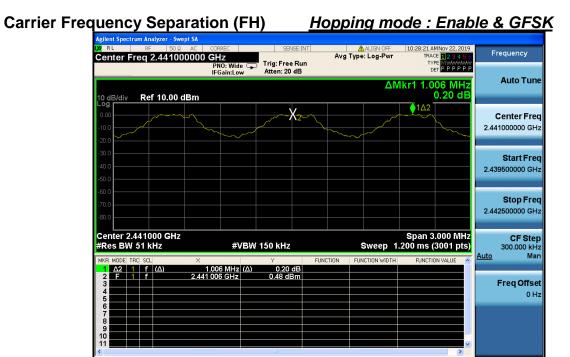
Note 1: See next pages for actual measured spectrum

- 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



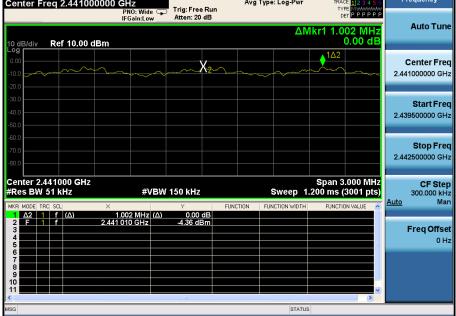


Carrier Frequency Separation (FH) <u>Hopping mode : Enable & π/4DQPSK</u>

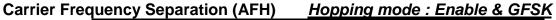












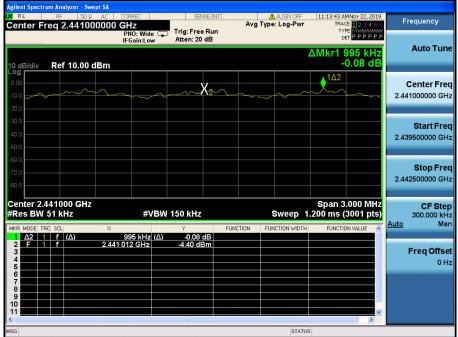


Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & π/4DQPSK</u>











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.

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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 = 2426.0 MHz, Stop Frequency = 2456.0 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

5.4 Test Results

FH mode

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

AFH mode

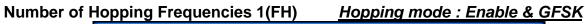
Hopping mode	Modulation	Test Result (Total Hops)
Enable	GFSK	20
	π/4DQPSK	20
	8DPSK	20

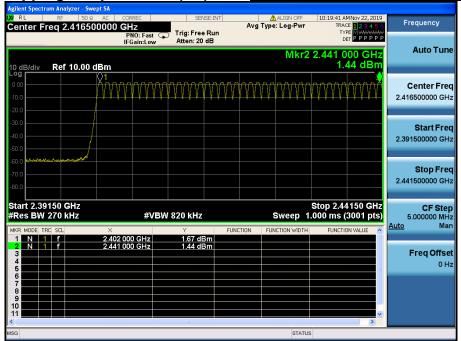
Note 1 : See next pages for actual measured spectrum plots.

- Minimum Standard:

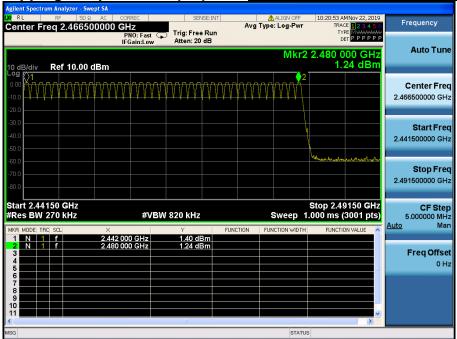
At least 15 hopes





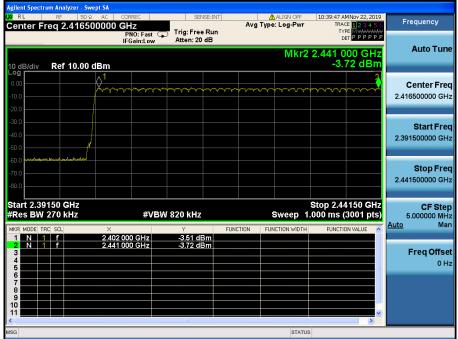


Number of Hopping Frequencies 2(FH) <u>Hopping mode : Enable & GFSK</u>

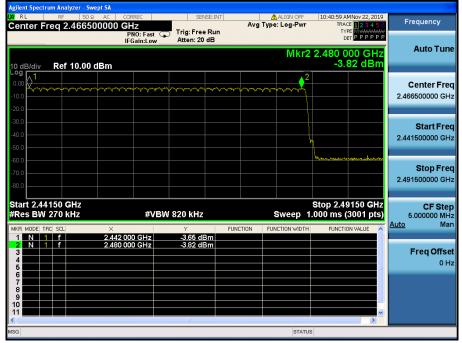




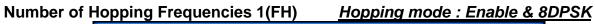


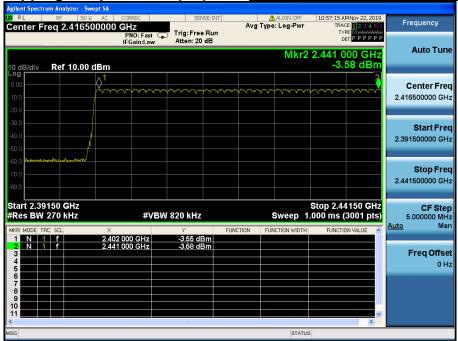


Number of Hopping Frequencies 2(FH) <u>Hopping mode : Enable & π/4DQPSK</u>

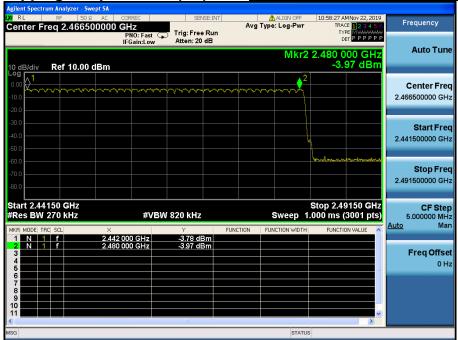






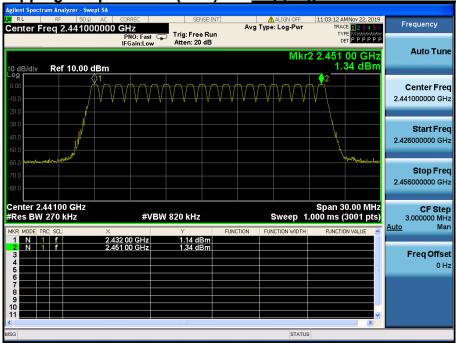


Number of Hopping Frequencies 2(FH) <u>Hopping mode : Enable & 8DPSK</u>

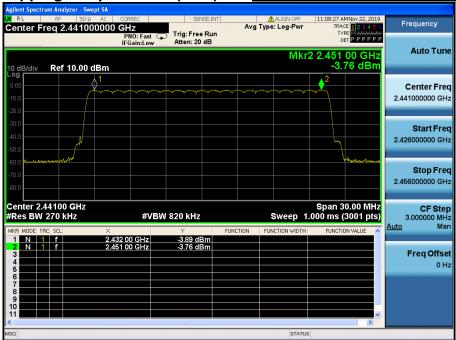




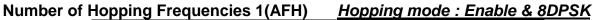


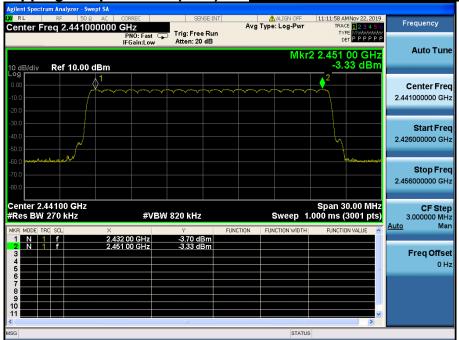


Number of Hopping Frequencies 1(AFH) <u>Hopping mode : Enable & π/4DQPSK</u>









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.

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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	0.299
	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 x Hopping channel x Burst ON time x

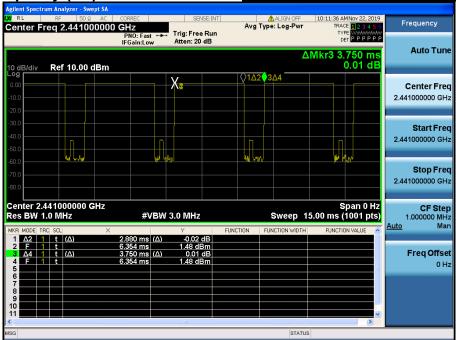
((Hopping rate ÷ Time slots) ÷ Hopping channel)

- 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.

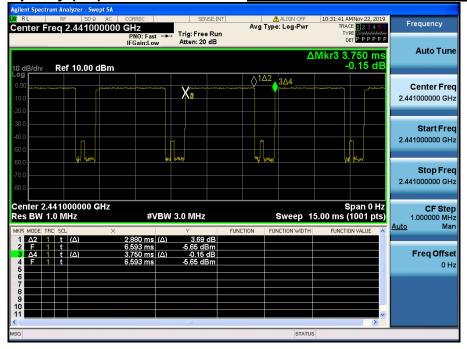






Time of Occupancy (FH)

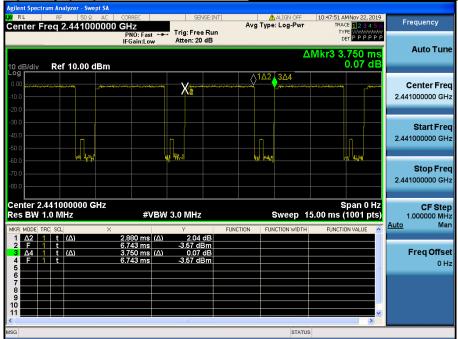
Hopping mode : Enable & 2-DH5





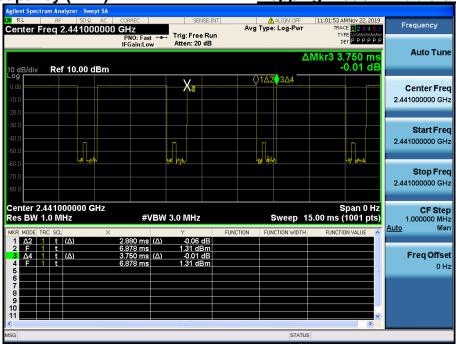


Hopping mode: Enable & 3-DH5

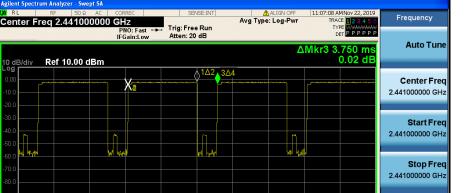








Time of Occupancy (AFH)



Hopping mode : Enable & 2-DH5









