HCT CO., LTD.

CERTIFICATE OF COMPLIANCE

FCC Certification

Applicant Name:
HYUNDAI MOBIS CO., LTD.

Address:
80-9, Mabook-Dong, Giheung-Gu Yongin-shi
Gyunggi-Do, 446-912 South Korea

Date of Issue:
September 11, 2012

Location:
HCT CO., LTD., 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, Korea

Test Report No.: HCTR1209FR04

HCT FRN: 0005866421

IC Recognition No.: 5944A-3

FCC ID	**: TQ8-AC1A0A7AN**
IC	**: 5074A-AC1A0A7KN**
APPLICANT	**: HYUNDAI MOBIS CO., LTD.**

FCC Model(s):	AC1A0A7AN
Additional FCC Model(s):	AC1A1A7AN
IC Model(s):	AC1A0A7KN
EUT Type:	CAR AUDIO
Max. RF Output Power:	-1.399 dBm(0.73 mW)
Frequency Range:	2402 - 2480 MHz (Bluetooth)
Modulation type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
FCC Classification:	FCC Part 15 Spread Spectrum Transceiver
FCC Rule Part(s):	Part 15 subpart C 15.247
IC Rule :	RSS-210 , RSS-GEN

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by
: Jong Seok Lee
Test Engineer of RF Team

Approved by
: Chang Seok Choi
Manager of RF Team

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCTR1209FR04	September 11, 2012	- First Approval Report
		- Report Revise the antenna manufacturer on page 4 (LG Innotek → csr)

Table of Contents

1. GENERAL INFORMATION

Applicant Name:	HYUNDAI MOBIS CO., LTD.
Address:	80-9, Mabook-Dong, Giheung-Gu Yongin-shi Gyunggi-Do, 446-912 South Korea
FCC ID:	TQ8-AC1A0A7AN
IC	5074A-AC1A0A7KN
EUT:	CAR AUDIO
FCC Model name(s):	AC1A0A7AN
Additional FCC Model name(s):	AC1A1A7AN
IC Model name(s):	AC1A0A7KN
Date(s) of Tests:	August 17, 2012 ~ August 21, 2012
Place of Tests:	HCT Co., Ltd. 105-1, Jangam-ri , Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811, KOREA. (IC Recognition No. : 5944A-3)

2. EUT DESCRIPTION

EUT Type	CAR AUDIO
FCC Model Name	AC1A0A7AN
Additional FCC Model Name	AC1A1A7AN
IC Model Name	AC1A0A7KN
Power Supply	DC 12 V
Frequency Range	2402 - 2480 MHz (Bluetooth)
Transmit Power	-1.399 dBm(0.73 mW)
BT Operating Mode	Normal, EDR, AFH
Modulation Type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
Modulation Technique	FHSS
Number of Channels	79Channels, Minimum 20 Channels(AFH)
Antenna Specification	Manufacturer : csr Antenna type: Pattern Antenna Peak Gain : 0.1 dBi

※ 15.247 Requirements for Bluetooth transmitter

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

1) This system is hopping pseudo-randomly.

2) Each frequency is used equally on the average by each transmitter.

3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters

4) The receiver shifts frequencies in synchronization with the transmitted signals.

▪ 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.

▪ 15.247(h): 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.

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.10-2009) and FCC Public Notice DA 00-705 dated March 30, 2000 entitled “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” were used in the measurement of the **HYUNDAI MOBIS CO., LTD.**

CAR AUDIO FCC ID: TQ8-AC1A0A7AN

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2009) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical according to the requirements in Section 6.3 of ANSI C63.10. (Version: 2009)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated March 02, 2011 (Registration Number: 90661)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 shall be considered sufficient to comply with the provisions of this section.”

* The antennas of this E.U.T are permanently attached.

*The E.U.T Complies with the requirement of §15.203

7. SUMMARY OF TEST RESULTS

Test Description	IC Part Section(s)	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	RSS-210, A8.1(a)	§15.247(a)(1)(ii) or (iii)	NA	CONDUCTED	PASS
Occupied Bandwidth	RSS-210, A1.1.3	NA	NA		PASS
Conducted Maximum Peak Output Power	RSS-210, A8.4(2)	§15.247(b)(1)	< 1 Watts		PASS
Carrier Frequency Separation	RSS-210, A8.1(b)	§15.247(a)(1)	>25 kHz or >2/3 of the 20dB BW		PASS
Number of Hopping Frequencies	RSS-210, A8.1(d)	§15.247(a)(1)(iii)	>15		PASS
Time of Occupancy	RSS-210, A8.1(d)	§15.247(a)(1)(iii)	<400 ms		PASS
Conducted Spurious Emissions	RSS-210, A 8.5 RSS-GEN, Section 7.2.3	§15.247(d)	< 20 dB for all out-of band emissions		PASS
Band Edge(Out of Band Emissions)	RSS-210, A 8.5	§15.247(d)	< 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	RSS-GEN, Section 7.2.2	§15.207(a)	cf. Section 8.7		PASS
Radiated Spurious Emissions	RSS-210, A2.9, A 8.5	§15.247(d), 15.205, 15.209	cf. Section 8.6.2	RADIATED	PASS
Radiated Restricted Band Edge	RSS-210, A2.9, A 8.5	§15.247(d), 15.205, 15.209	cf. Section 8.6.4		PASS
Receiver Spurious Emissions	RSS-GEN, Section 7.2.3	§15.109	cf. Section 8.6.3		PASS

8. FCC PART 15.247 REQUIREMENTS

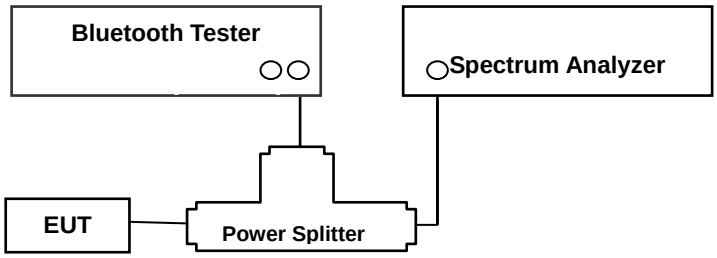
8.1 PEAK POWER

LIMIT

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

1. For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt.
2. 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.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

1. Span = 2 MHz (GFSK) / 5 MHz (π/4DQPSK and 8DPSK)
2. RBW = 1 MHz (GFSK) / 3 MHz (π/4DQPSK and 8DPSK)
3. VBW = 1 MHz (GFSK) / 3 MHz (π/4DQPSK and 8DPSK)
4. Sweep = auto
5. Packet type= DH5 (GFSK) / 2-DH5 (π/4DQPSK) / 3-DH5 (8DPSK)

SAMPLE CALCULATION

Output Power = Spectrum Reading Power + Power Splitter loss + Cable loss(2 ea)

= 10 dBm + 6 dB + 1.5 dB = 17.5 dBm

Note :

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.4 dB at 2.4 GHz. We used the particular cable type that is supported by manufacture.

TEST RESULTS

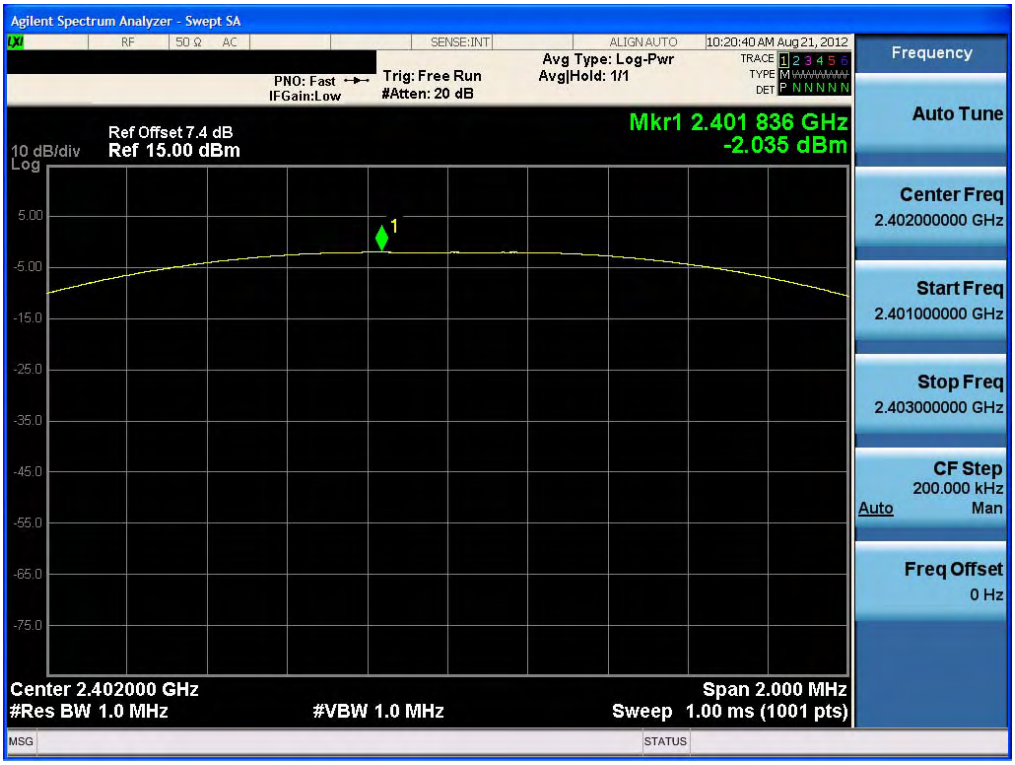
No non-compliance noted

Test Data

Channel	Frequency (MHz)	Output Power (GFSK)		Output Power (8DPSK)		Output Power (π/4DQPSK)		Limit (W)	Result
		(dBm)	(mW)	(dBm)	(mW)	(dBm)	(mW)		
Low	2402	-2.035	0.63	-2.675	0.54	-2.882	0.52	1	PASS
Mid	2441	-1.531	0.70	-2.439	0.57	-2.480	0.57		PASS
High	2480	-1.399	0.73	-2.924	0.51	-2.948	0.51		PASS

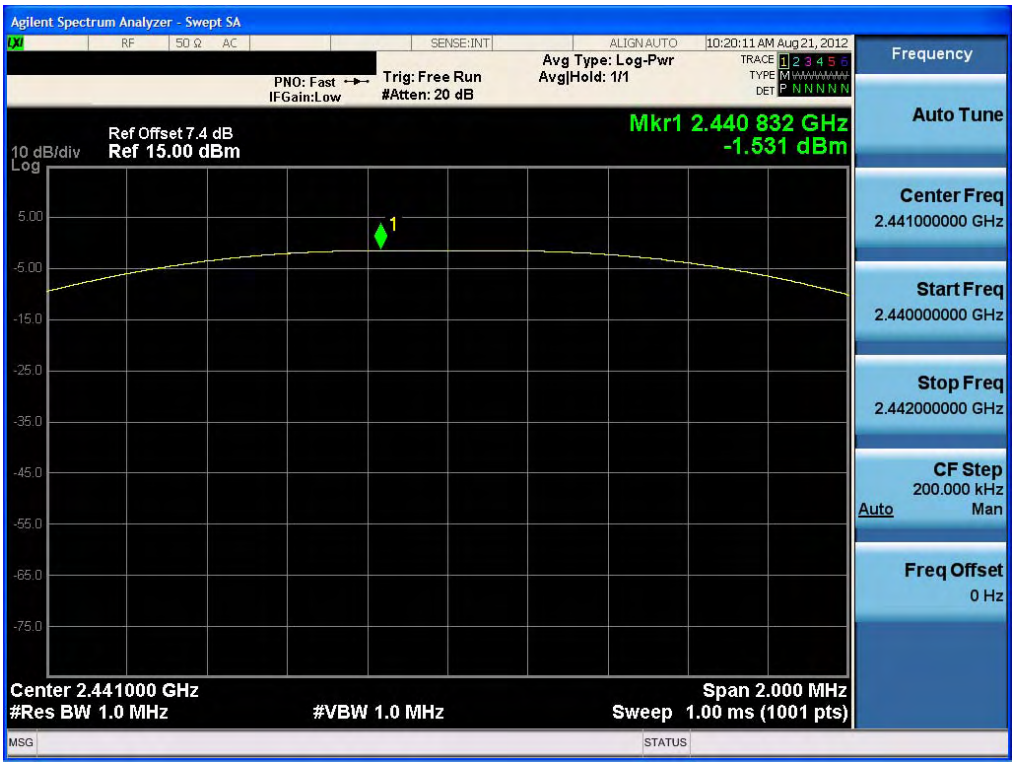
Test Plots (GFSK)

Peak Power (Low-CH)



Test Plots (GFSK)

Peak Power (Mid-CH)



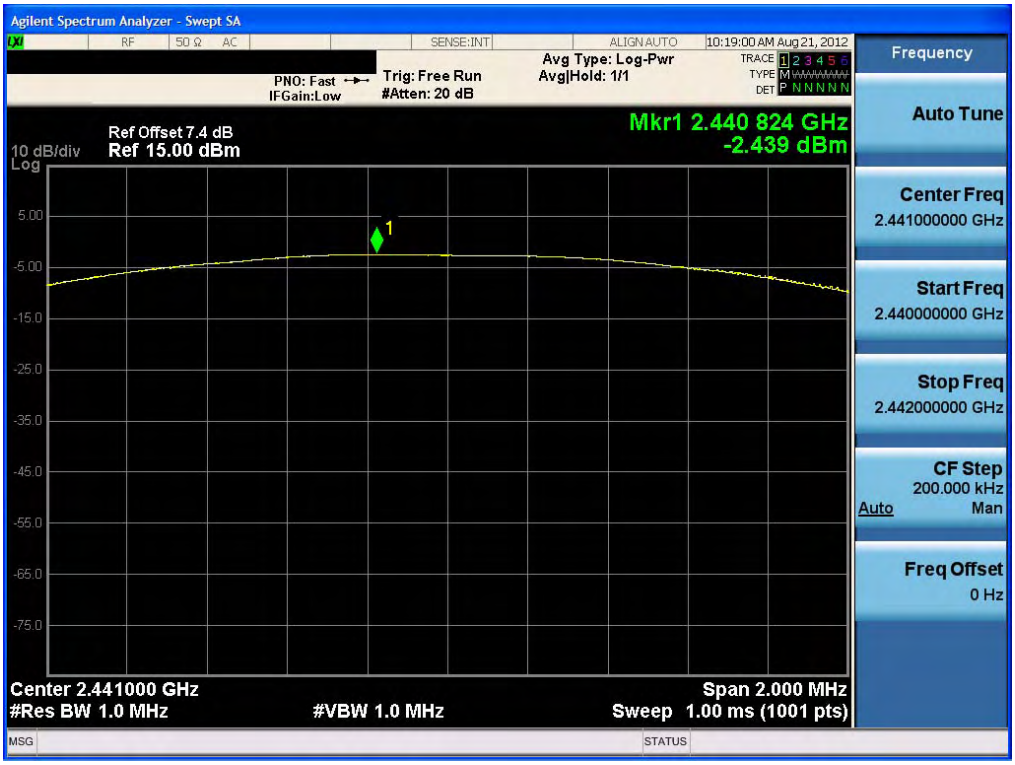
Test Plots (GFSK)

Peak Power (High-CH)

Test Plots (8DPSK)

Peak Power (Low-CH)

Test Plots (8DPSK)
Peak Power (Mid-CH)



Test Plots (8DPSK)
Peak Power (High-CH)

Test Plots (π/4DQPSK)
Peak Power (Low-CH)

Test Plots (π/4DQPSK)
Peak Power (Mid-CH)

Test Plots (π/4DQPSK)

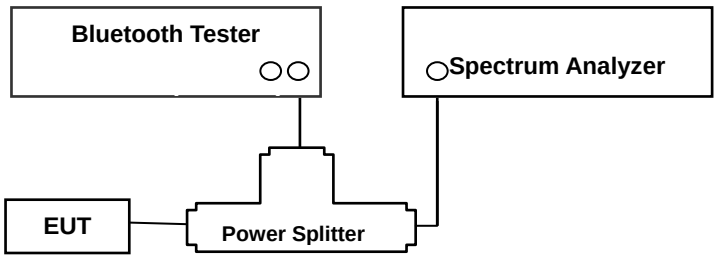
Peak Power (High-CH)

8.2 BAND EDGES

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off and hopping on.

The spectrum analyzer is set to :

1. Span = 8 MHz / 10 MHz(with hopping)
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Sweep = auto
5. Detector Mode = Peak

TEST RESULTS

See attached.

Note :

1. The results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.4 dB at 2.4 GHz. We used the particular cable type that is supported by manufacture.

Test Plots without hopping (GFSK)
Band Edges (Low-CH)

Test Plots without hopping (GFSK)
Band Edges (High-CH)

Test Plots without hopping (8DPSK)
Band Edges (Low-CH)

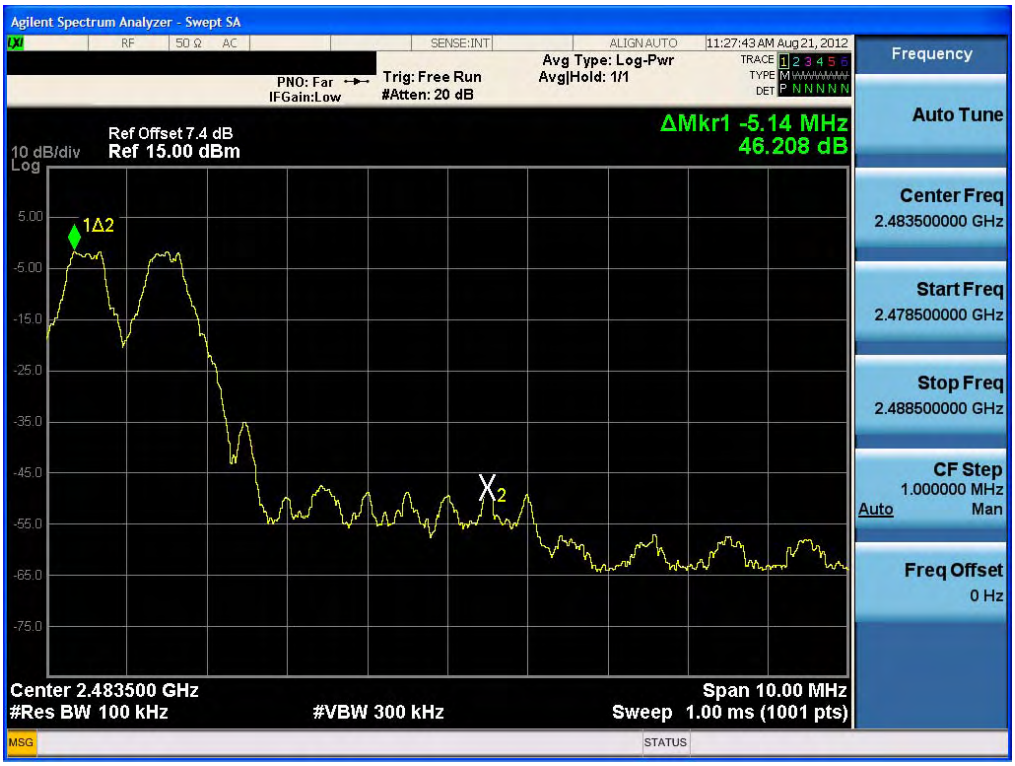
Test Plots without hopping (8DPSK)
Band Edges (High-CH)

Test Plots without hopping (π/4DQPSK)
Band Edges (Low-CH)

Test Plots without hopping (π/4DQPSK)
Band Edges (High-CH)

Test Plots with hopping (GFSK)
Band Edges (Low-CH)

Test Plots with hopping (GFSK)
Band Edges (High-CH)



Test Plots with hopping (8DPSK)

Band Edges (Low-CH)

Test Plots with hopping (8DPSK)

Band Edges (High-CH)

Test Plots with hopping (π/4DQPSK)
Band Edges (Low-CH)

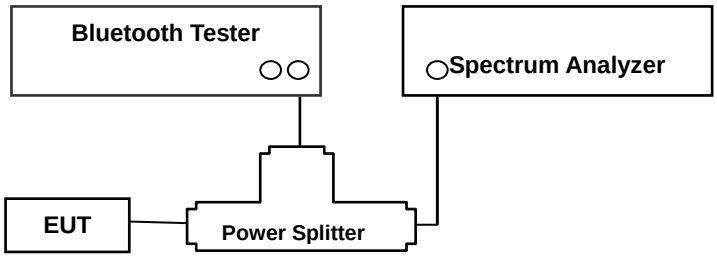
Test Plots with hopping (π/4DQPSK)
Band Edges (High-CH)

8.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

LIMIT

According to §15.247(a)(1), 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.

Test Configuration



TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The spectrum analyzer is set to :

1. Span = 3 MHz
2. RBW = 30 kHz
3. VBW = 100 kHz
4. Sweep = auto

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

TEST RESULTS

No non-compliance noted

Test Data

Channel Separation (kHz)			20dB Bandwidth (kHz)				Limit (kHz)	Result
GFSK	8DPSK	π/4DQPSK	Channel	GFSK	8DPSK	4DQPSK		
999	999	999	Low CH	944.9	1266.0	1235.0	>25 or >2/3 of the 20dB BW	Pass
			Middle CH	947.9	1264.0	1242.0		
			High CH	946.5	1262.0	1253.0		

Occupied Bandwidth (99% BW)

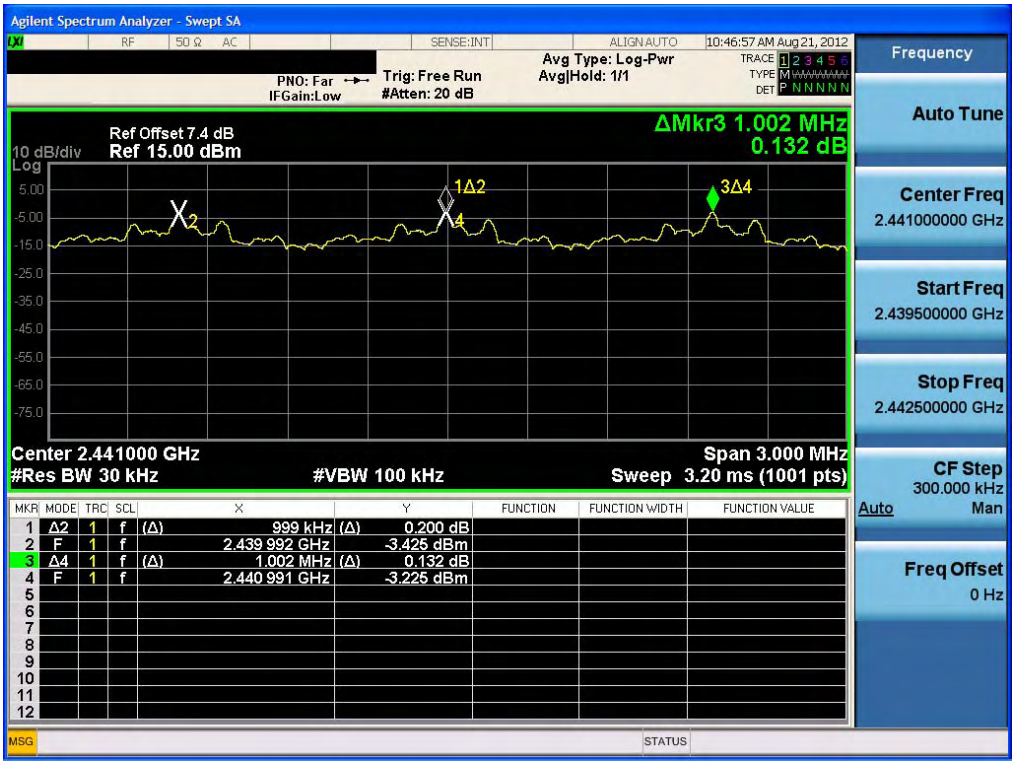
99% BW (kHz)			
Channel	GFSK	8DPSK	4DQPSK
Low CH	893.3	1189.4	1171.6
Middle CH	984.4	1187.5	1170.1
High CH	890.0	1185.3	1171.5

Test Plots (GFSK)

Channel Separation

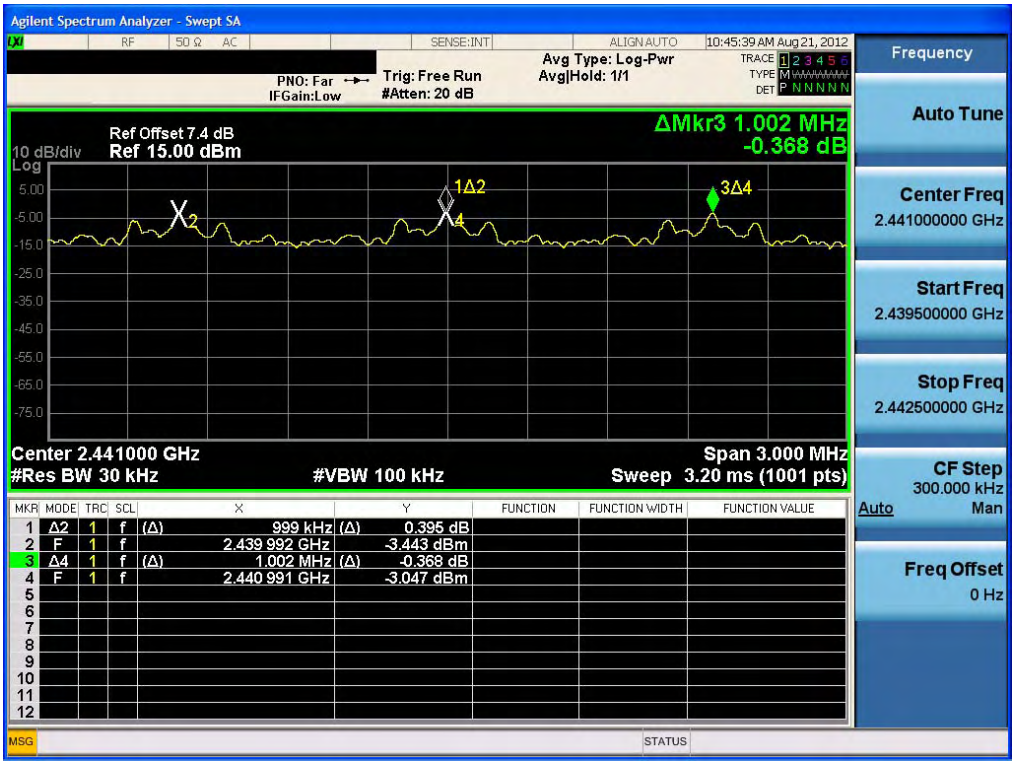
Test Plots (8DPSK)

Channel Separation



Test Plots (π/4DQPSK)

Channel Separation



Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)

Test Plots (GFSK)

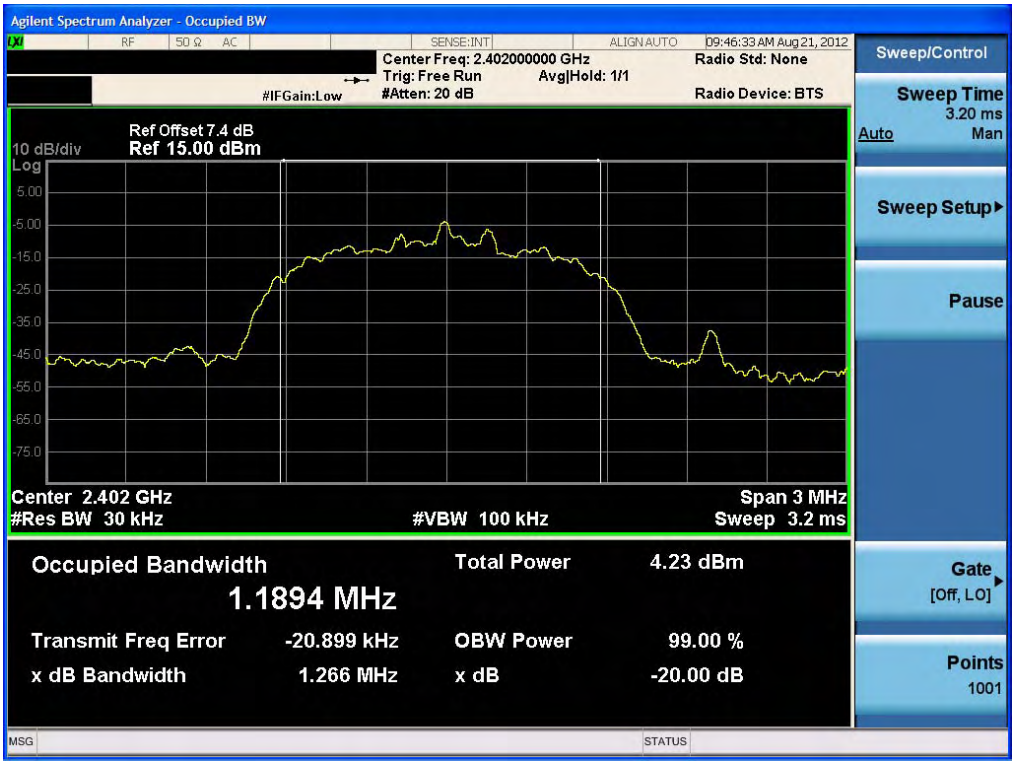
20 dB Bandwidth & Occupied Bandwidth (Mid-CH)

Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)

Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)



Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (Mid-CH)

Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (Mid-CH)

Test Plots (π/4DQPSK)

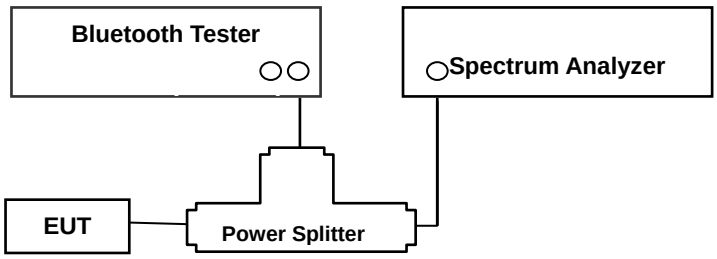
20 dB Bandwidth & Occupied Bandwidth (High-CH)

8.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer was set to :

1. Span = the frequency band of operation (Start = 2400 MHz, Stop = 2483.5 MHz)
2. RBW = 300 kHz
3. VBW = 300 kHz
4. Sweep = auto

The trace was allowed to stabilize.

TEST RESULTS

No non-compliance noted

Test Data

Result (No. of CH)			Limit	Result
GFSK	8DPSK	π/4DQPSK		
79	79	79	>15	Pass

Note : In case of AFH mode, minimum number of hopping channels is 20.

Test Plots (GFSK)

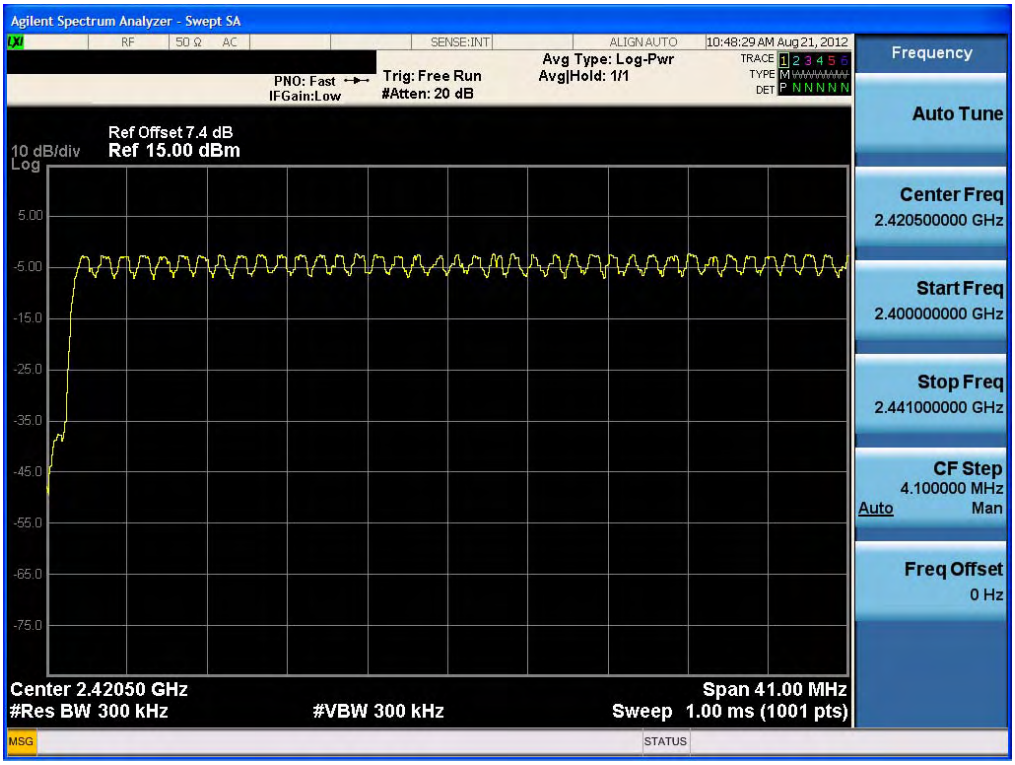
Number of Channels (2.4 GHz - 2.441 GHz)

Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

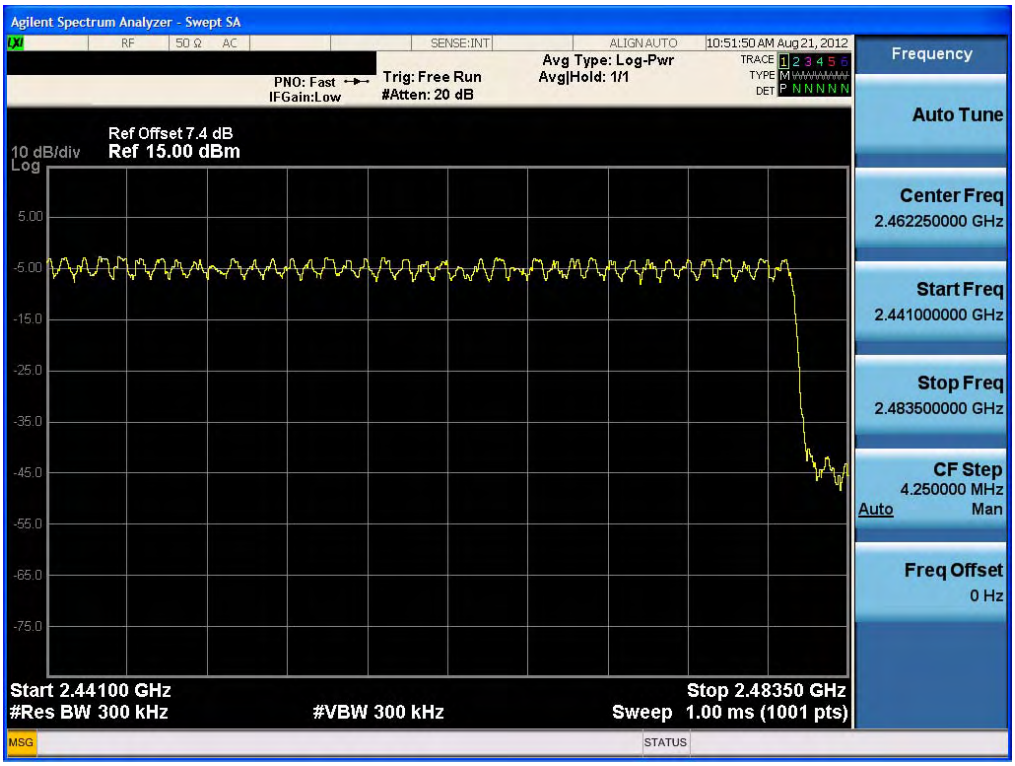
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

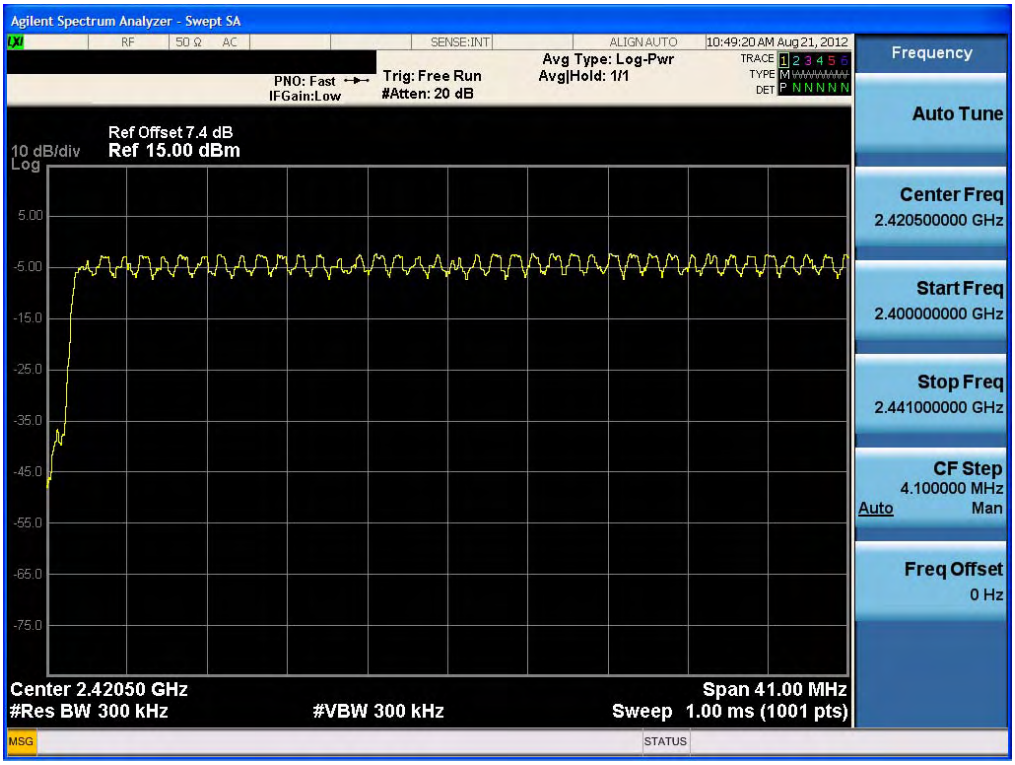


Test Plots (8DPSK)

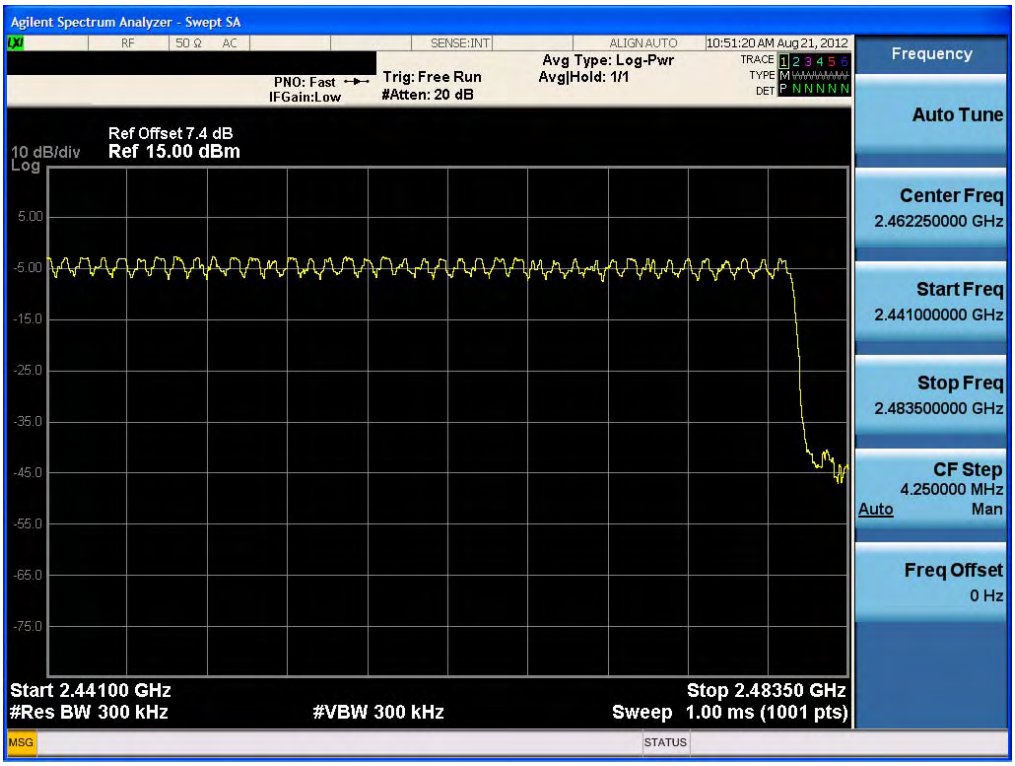
Number of Channels (2.441 GHz - 2.4835 GHz)



Test Plots (π/4DQPSK)
Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (π/4DQPSK)
Number of Channels (2.441 GHz - 2.4835 GHz)

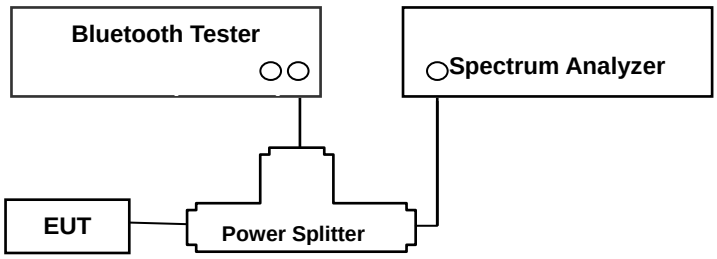


8.5 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

1. Span = zero span
2. RBW = 1 MHz
3. VBW = 1 MHz
4. Sweep = as necessary to capture the entire dwell time per channel

The marker-delta function was used to determine the dwell time.

Normal Mode / EDR Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.895 * (1600/6)/79 * 31.6 = 308.80 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.900 * (1600/6)/79 * 31.6 = 309.33 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.910 * (1600/6)/79 * 31.6 = 310.40 (ms)

AFH Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.895 * (800/6)/20 * 8.0 = 154.40 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.900 * (800/6)/20 * 8.0 = 154.67 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.910 * (800/6)/20 * 8.0 = 155.20 (ms)

Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance. Each tx-time per appearance of DH5 is 2.883 ms.

Dwell time = Tx-time * 106.7

TEST RESULTS

See the table.

Channel	Pulse Time (ms)			Total of Dwell (ms)			Period Time (s)	Limit (ms)	Result
	GFSK	8DPSK	π/4DQPSK	GFSK	8DPSK	π/4DQPSK			
Low	2.895	2.900	2.905	308.80	309.33	309.87	31.6	400	PASS
Mid	2.895	2.910	2.900	308.80	310.40	309.33	31.6		PASS
High	2.890	2.905	2.900	308.27	309.87	309.33	31.6		PASS

Test Plots (GFSK)
Dwell Time (Low-CH)

Test Plots (GFSK)
Dwell Time (Mid-CH)