

Nemko Korea Co., Ltd.

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FCC and IC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Samsung Electronics Co., Ltd.
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, Korea
(Post code : 16677)
Attn. : Minhyung. Cho

Dates of Issue : May 13, 2016
Test Report No. : NK-16-R-053
Test Site : Nemko Korea Co., Ltd.

FCC
IC

A3LRMCFTJ1AP1
649E-RMCFTJ1AP1

Brand Name

SAMSUNG

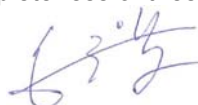
Contact Person

Samsung Electronics Co., Ltd.
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, Korea, 16677.
Minhyung Cho
Telephone No. : +82-31-277-2688

Applied Standard: FCC 47 CFR Part 15.247 and IC RSS-247 Issue 1
Classification: FCC Part 15 Spread Spectrum Transmitter (DSS)
EUT Type: Smart Control

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

 May 13, 2016

Tested By : Wonho Son
Engineer

 May 13, 2016

Reviewed By : Deokha Ryu
Technical Manager

TABLE OF CONTENTS

1.	Scope	4
2.	Introduction (Site Description)	5
	2.1 Test facility	5
	2.2 Accreditation and listing	6
3.	Test Conditions & EUT Information	7
	3.1 Operation During Test	7
	3.1.1 Table of test power setting	7
	3.1.2 Table of test channels	7
	3.1.3 Antenna TX mode information	7
	3.1.4 Additional Information Related to testing	7
	3.2 Support Equipment	8
	3.3 Setup Drawing	8
	3.4 EUT Information	9
4.	Summary of Test Results	10
5.	Recommendation / Conclusion	11
6.	Antenna Requirements	11
7.	Description of Test	12
	7.1 Radiated Emissions	12
	7.2 20 dB Bandwidth	13
	7.3 Carrier Frequency Separation	13
	7.4 Transmitter Average Time of Occupancy	14
	7.5 Number of Hopping Channels	14
	7.6 Maximum Peak Output Power	15
	7.7 Conducted Spurious Emissions	15
8.	Test Data	16
	8.1 Radiated Emissions	16

8.2	20 dB Modulated Bandwidth	18
8.3	Carrier Frequency Separation	24
8.4	Transmitter Average Time of Occupancy	27
8.5	Number of Hopping Channels	29
8.6	Peak Output Power and E.I.R.P	30
8.7	Conducted Spurious Emissions	36
8.8	Radiated Spurious Emissions	48
8.9	Radiated Bandedge	51
9.	Test Equipment	58
10	Accuracy of Measurement	59

1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15 and IC RSS-247 Issue1

Responsible Party :	Samsung Electronics Co., Ltd.
Contact Person :	Minhyung Cho
Manufacturer :	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea 16677

- FCC ID A3LRMCFTJ1AP1
- IC : 649E-RMCFTJ1AP1
- Model: RMCFTJ1AP1
- Brand Name: SAMSUNG
- EUT Type: Smart Control
- Classification: Part 15 Spread Spectrum Transmitter
- Applied Standard: FCC 47 CFR Part 15 subpart C and IC RSS-247 Issue 1
- Test Procedure(s): ANSI C63.10-2013
- Dates of Test: April 30, 2016 ~ May 11, 2016
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **Samsung Electronics Co., Ltd. FCC ID :**

A3LRMCFTJ1AP1 and IC : 649E-RMCFTJ1AP1.

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory**.

The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPUBLIC OF.

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.

It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.

The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.



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Fig. 1. The map above shows the Seoul in Korea vicinity area.

The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the transceiver which is the Bluetooth 3.0 module supporting BDR/EDR mode. The Laptop was used to control the EUT to transmit the wanted TX channel by the testing program (Bluetool) which manufacturer supported. The Laptop was removed after controlling the EUT to transmit the wanted signal. The EUT was tested at the lowest channel, middle channel and the highest channel with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

3.1.1 Table of test power setting

Frequency	Mode	Power setting Level
2402 MHz ~ 2480 MHz	GFSK	Specify Power Table Index 0
	$\pi/4$ DQPSK	
	8DPSK	

3.1.2 Table of test channels

Frequency band	Mode	Test Channel (CH)	Frequency (MHz)
2.4 GHz	GFSK, $\pi/4$ DQPSK, 8DPSK	0	2402
		39	2441
		78	2480

3.1.3 Antenna TX mode information:

Frequency band	Mode	Antenna TX mode	Support MIMO
2.4 GHz	GFSK, $\pi/4$ DQPSK, 8DPSK	☒ 1TX, ☐ 2TX	☐ Yes, ☒ No

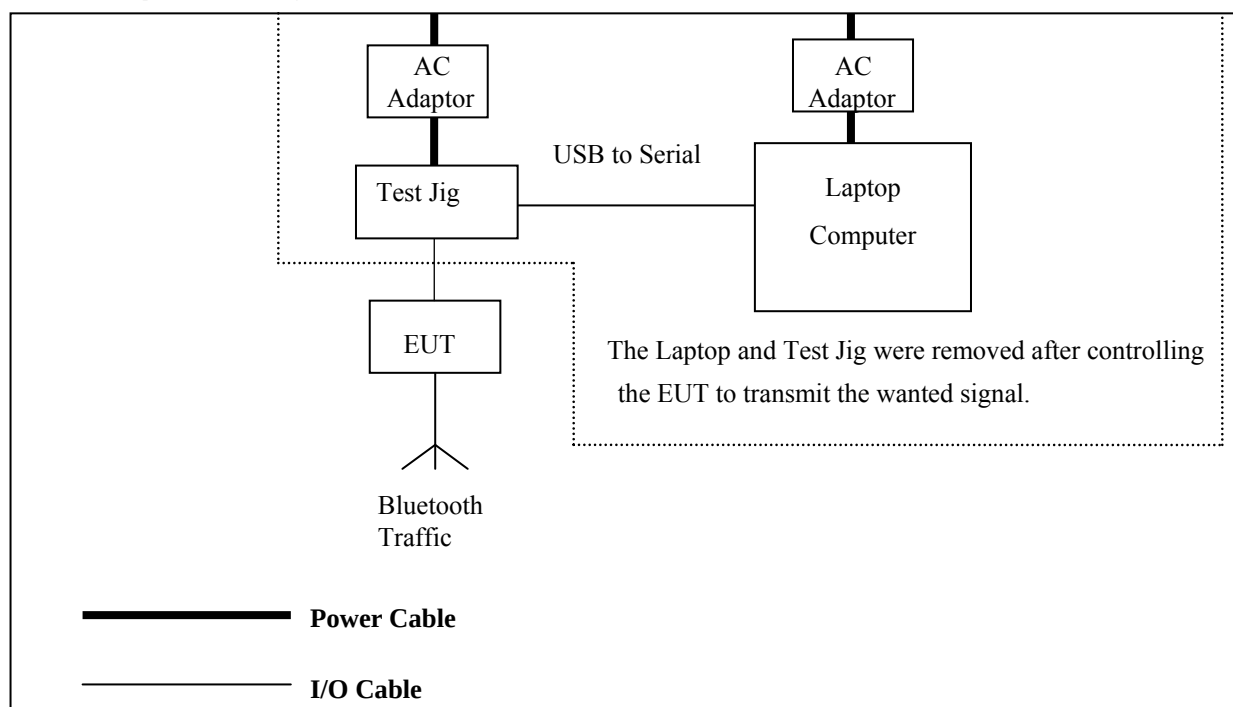
3.1.4. Additional Information Related to Testing

The cable and attenuator loss from 30MHz to 25GHz was reflected in spectrum analyzer with correction factor for all conducted testing.

3.2 Support Equipment

EUT	Samsung Electronics Co., Ltd. Model : RMCFTJ1AP1	S/N: N/A
Laptop Computer	Samsung Electronics Co., Ltd. Model : NT-R580 1.5 m shielded pin connector cable	FCC DOC S/N : ZNU793BZ200566M
AC/DC Adapter	LI SHIN INTERNATIONAL ENTERPRISE CORP. Model : AD-9019S 1.5 m unshielded power cable	FCC DOC S/N : CNBA4400215AD2VH9BQ9 226

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Samsung Smart Control FCC ID: A3LRMCFTJ1AP1, IC: 649E-RMCFTJ1AP1.**

This unit supports full qualified Bluetooth 3.0 with EDR standard system.

Specifications:

EUT Type	Smart Control
Model Name	RMCFTJ1AP1
Brand Name	SAMSUNG
RF Frequency	2402 MHz ~ 2480 MHz
Peak Power Output (Conducted)	12.54 dBm
FCC Classification	FCC Part 15 Spread Spectrum Transmitter (DSS)
Method/System	Frequency Hopping Spread Spectrum (FHSS)
Channel Number	79
Modulation	GFSK, $\pi/4$ DQPSK, 8DPSK
Antenna Gain	1.99 dBi (Peak)
Power	3 Vdc
Size (W x H x D)	About 17.5 cm x 4.3 cm X 1.8 cm
Weight	About 75 g
H/W Status	
S/W Status	
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	IC Paragraph No.	Result	Remark
Radiated Emission	15.209	RSS-GEN Issue 4 8.9	Complies	
20dB Bandwidth	15.247(a)(1)	RSS-247 Issue 1 5.1	Complies	
Carrier Frequency Separation	15.247(a)(1)	RSS-247 Issue 1 5.1(2)	Complies	
Transmitter Average Time of Occupancy	15.247(a)(1)(iii)	RSS-247 Issue 1 5.1(4)	Complies	
Maximum Peak Conducted Output Power and E.I.R.P	15.247(b)(1)	RSS-247 Issue 1 5.4(2)	Complies	
Conducted Spurious Emission	15.247(d)	RSS-247 Issue 1 5.5	Complies	
Radiated Spurious Emission	15.247(d)	RSS-247 Issue 1 5.5	Complies	
Number of Hopping channels	15.247(a)(1)(iii)	RSS-247 Issue 1 5.1(4)	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Samsung Smart Control FCC ID: A3LRMCFTJ1AP1, IC : 649E-RMCFTJ1AP1** is in compliance with Part 15.247 of the FCC Rule and RSS-247 Issue 1 of the IC specification.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C

: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna of the **Samsung Smart Control FCC ID: A3LRMCFTJ1AP1, IC : 649E-RMCFTJ1AP1** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.10-2013.

The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used.

For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0° to 360° and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

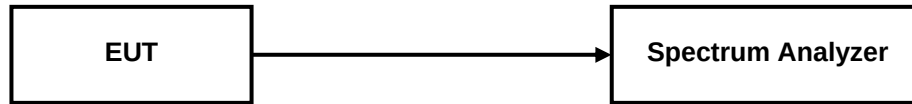
At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection. At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in ANSI C63.10-2013. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 1 kHz, Detector = Peak, Trace mode = max hold.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Radiated Emissions Limits per 47 CFR 15.209(a) and Radiated Emissions Limits per RSS-GEN Issue 4 8.9

7.2 20 dB Bandwidth

Test Setup



Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the spectrum analyzer.

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel

RBW = 1% to 5% of the OBW

VBW = approximately 3 x RBW

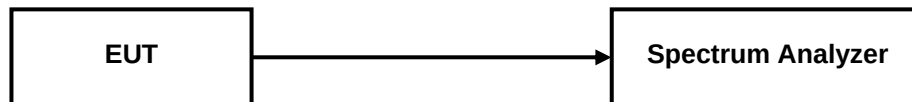
Sweep = auto

Detector function = peak

Trace = max hold

7.3 Carrier Frequency Separation

Test Setup



Test Procedure

The EUT must have its hopping function enabled. The following spectrum analyzer setting is used.

Span = wide enough to capture the peaks of two adjacent channels

RBW $\geq$ approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel

VBW $\geq$ RBW

Sweep = auto

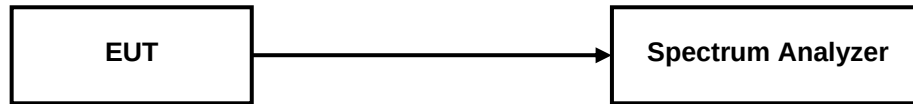
Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

7.4 Transmitter Average Time of Occupancy

Test Setup



Test Procedure

The transmitter output is connected to a spectrum analyzer. The following spectrum analyzer setting is used.

Span = Zero span, centered on a hopping channel

RBW $\gg 1 / T$, where T is the expected dwell time per channel.

VBW $\geq$ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

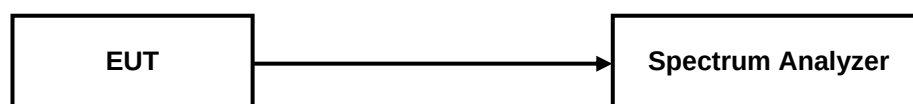
Detector function = Peak

Trace = Single sweep

Use the marker-delta function to determine the width of pulse

7.5 Number of Hopping Channels

Test Setup



Test Procedure

Span = The frequency band of operation.

RBW = less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW $\geq$ RBW

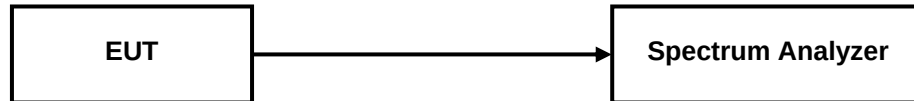
Sweep = Auto

Detector function = Peak

Trace = Max hold

7.6 Maximum Peak Output Power

Test Setup



Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the spectrum analyzer.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW = 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW

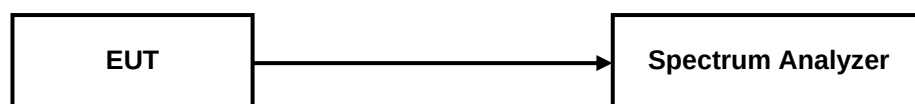
Sweep = auto

Detector function = peak

Trace = max hold

7.7 Conducted Spurious Emission

Test Setup



Test Procedure

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the Lowest, middle and highest channels.

RBW = 100kHz

VBW = 300kHz

Sweep = auto

Detector function = peak

Trace = max hold

8. TEST DATA

8.1 Radiated Emissions

FCC §15.209, RSS-Gen Issue 4 8.9

Result

Frequency (MHz)	Reading (dBμV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
31.99	47.60	V	198	262	-24.0	23.6	40.0	16.4
48.91	40.00	V	100	227	-22.1	17.9	40.0	22.1
55.46	47.80	V	100	338	-22.5	25.3	40.0	14.7
62.01	39.90	V	100	27	-23.6	16.3	40.0	23.7
81.22	41.10	H	309	61	-28.4	12.7	40.0	27.3
131.41	39.20	V	100	40	-26.6	12.6	43.5	30.9

Radiated Measurements at 3 meters

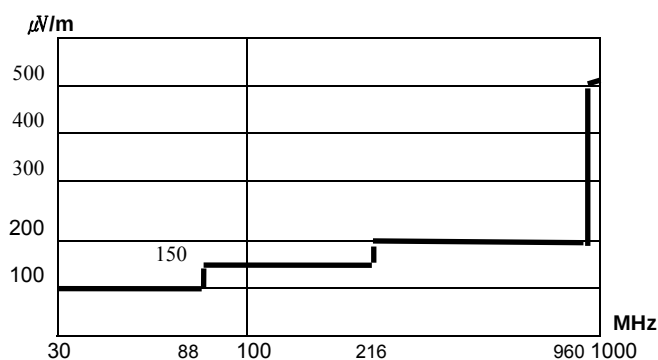


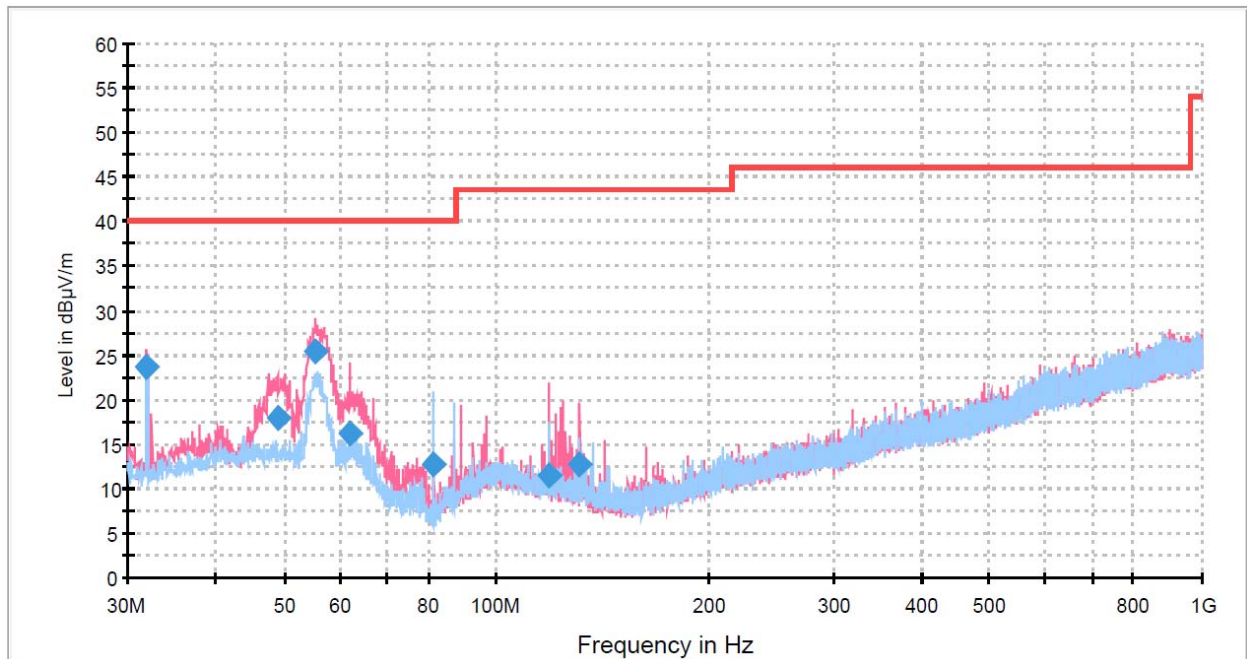
Fig. 3. Limits at 3 meters

Notes:

1. All modes were measured and the worst-case emission was reported.
2. The radiated limits are shown on Figure 3. Above 1GHz the limit is 500 μV /m.
3. *Pol. H = Horizontal, V = Vertical
4. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
5. Measurements using CISPR quasi-peak mode below 1 GHz.
6. The radiated emissions testing were made by rotating the receive antenna with horizontal, Vertical polarization. The worst date was recorded.
7. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

PLOTS OF EMISSIONS

Worst Case : 2441 MHz (below 1GHz) 8DPSK modulation



TEST DATA

8.2 20 dB Modulated Bandwidth

FCC §15.247(a)(1)(iii), IC RSS-247 Issue 1, 5.1

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

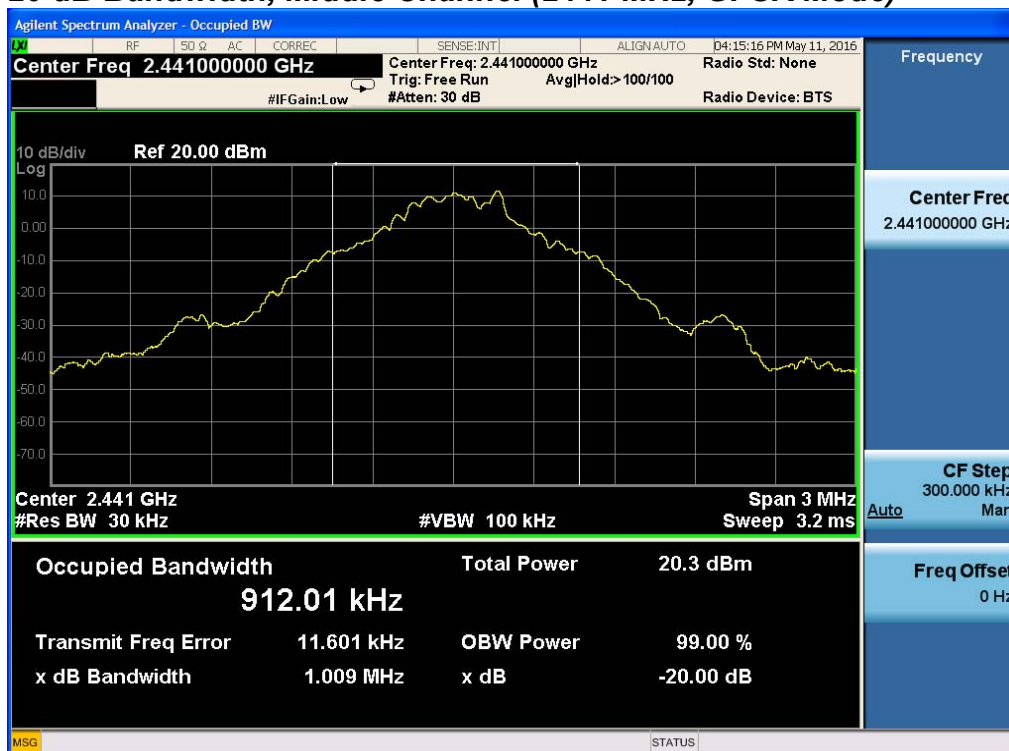
Modulation Mode	Frequency (MHz)	Result (kHz)	Limit (kHz)
GFSK	2402	1012.0	Non specified
GFSK	2441	1009.0	Non specified
GFSK	2480	1009.0	Non specified
$\pi/4$ DQPSK	2402	1341.0	Non specified
$\pi/4$ DQPSK	2441	1343.0	Non specified
$\pi/4$ DQPSK	2480	1346.0	Non specified
8DPSK	2402	1317.0	Non specified
8DPSK	2441	1317.0	Non specified
8DPSK	2480	1316.0	Non specified

PLOTS OF EMISSIONS

20 dB Bandwidth, Lowest Channel (2402 MHz, GFSK Mode)



20 dB Bandwidth, Middle Channel (2441 MHz, GFSK Mode)

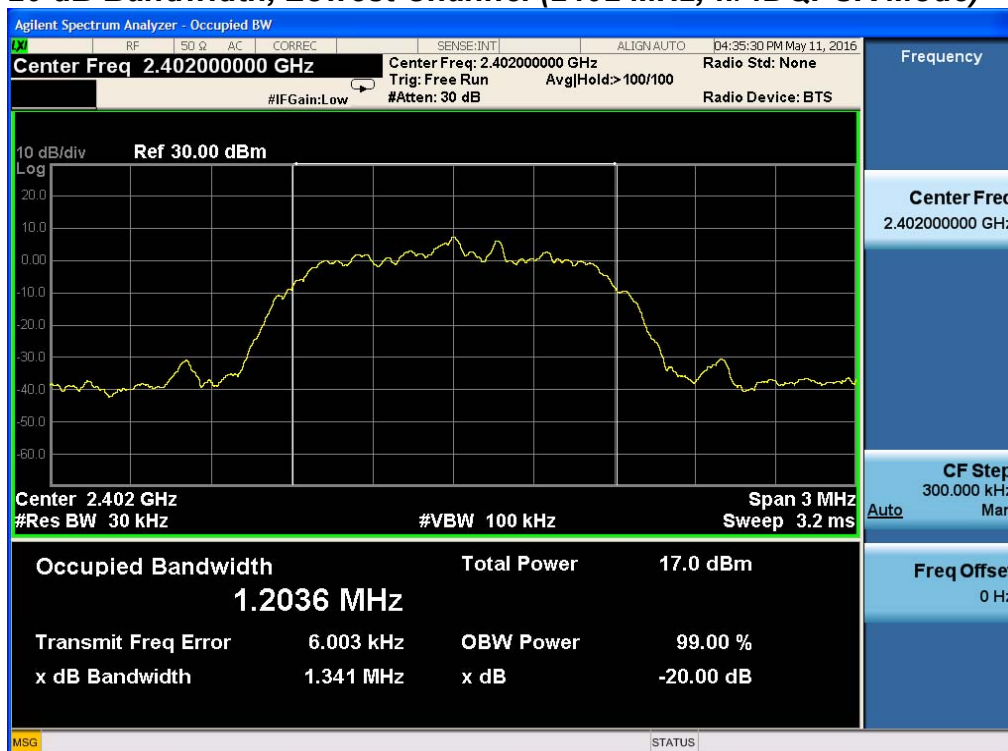


PLOTS OF EMISSIONS

20 dB Bandwidth, Highest Channel (2480 MHz, GFSK Mode)

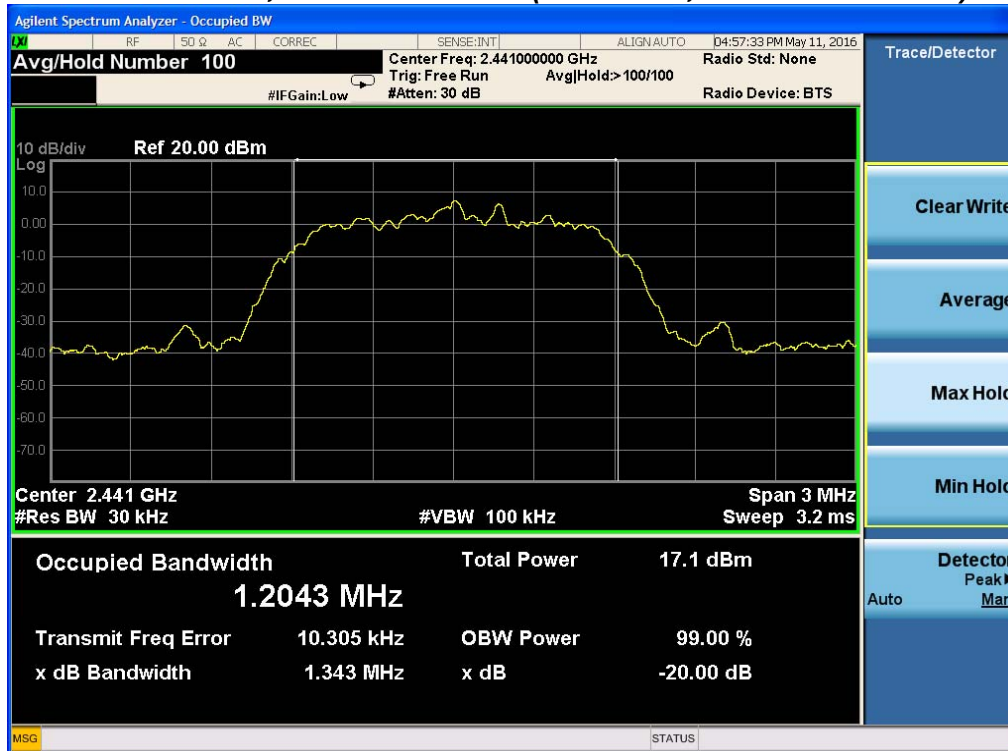


20 dB Bandwidth, Lowest Channel (2402 MHz, $\pi/4$ DQPSK Mode)

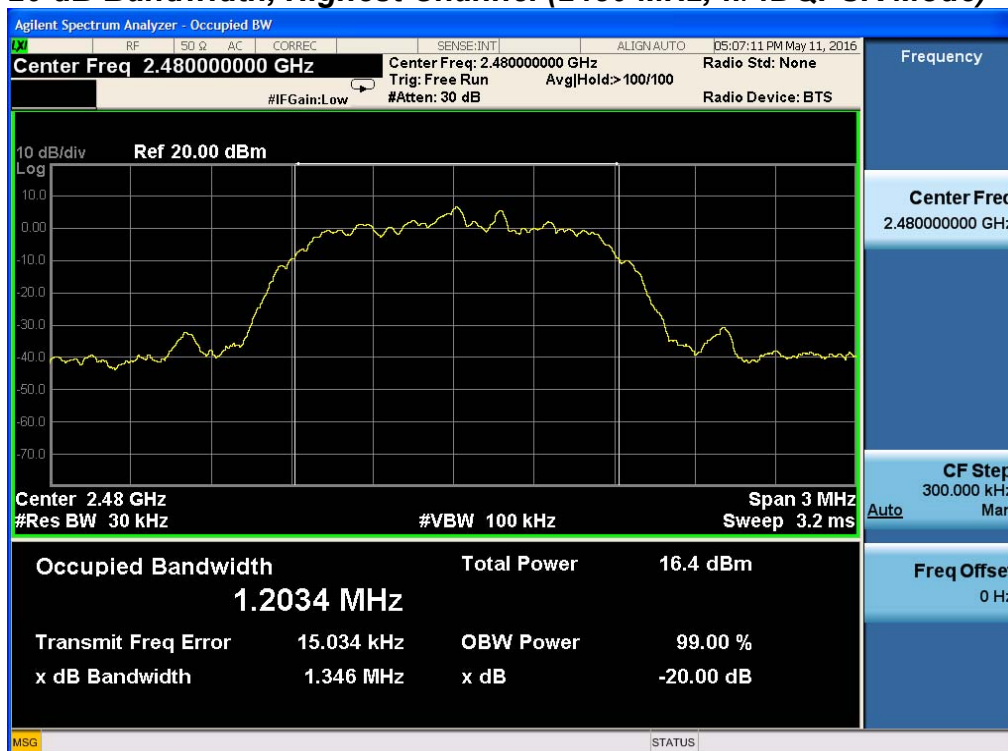


PLOTS OF EMISSIONS

20 dB Bandwidth, Middle Channel (2441 MHz, $\pi/4$ DQPSK Mode)

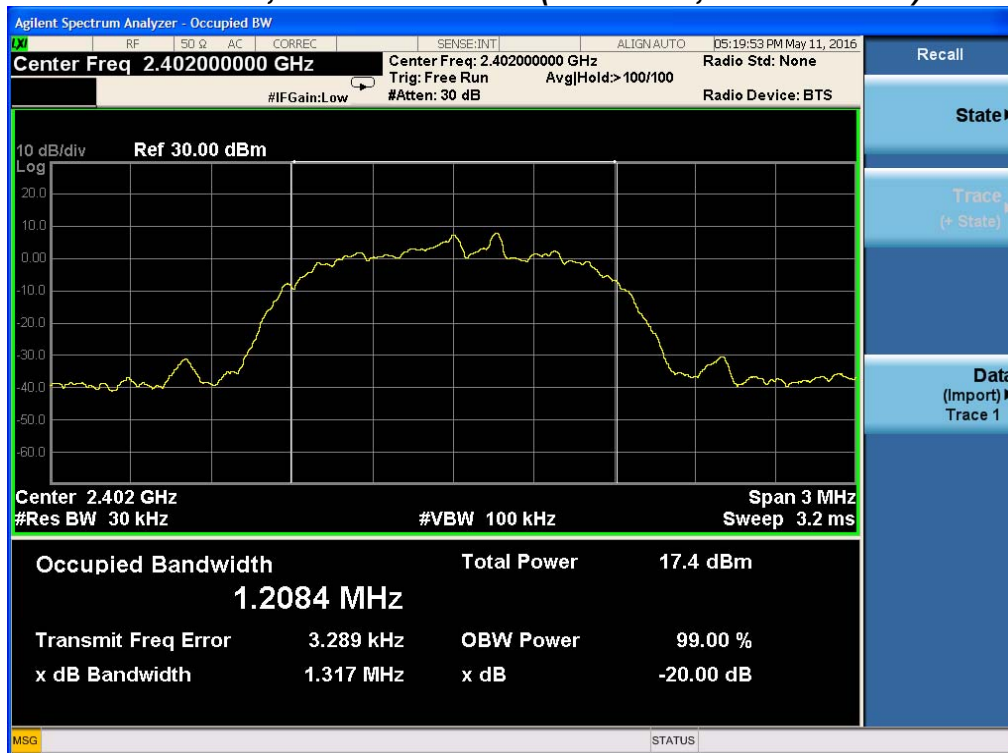


20 dB Bandwidth, Highest Channel (2480 MHz, $\pi/4$ DQPSK Mode)

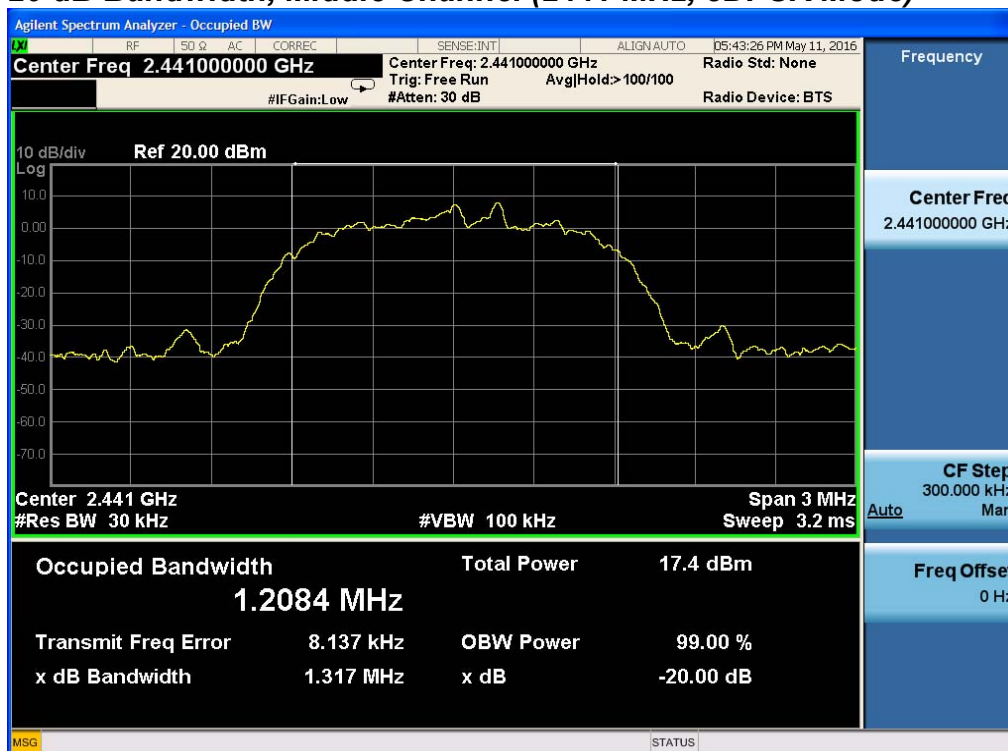


PLOTS OF EMISSIONS

20 dB Bandwidth, Lowest Channel (2402 MHz, 8DPSK Mode)

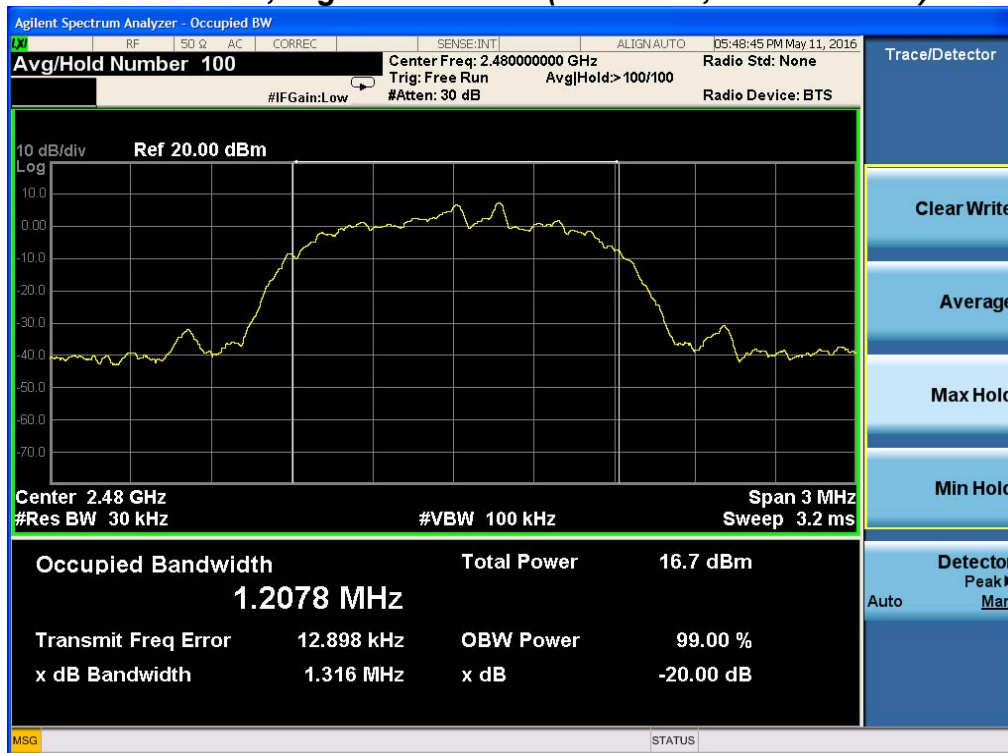


20 dB Bandwidth, Middle Channel (2441 MHz, 8DPSK Mode)



PLOTS OF EMISSIONS

20 dB Bandwidth, Highest Channel (2480 MHz, 8DPSK Mode)



TEST DATA

8.3 Carrier Frequency Separation

FCC §15.247(a)(1), IC RSS-247 Issue 1, 5.1(2)

Test Mode : Set to Hopping mode

Result

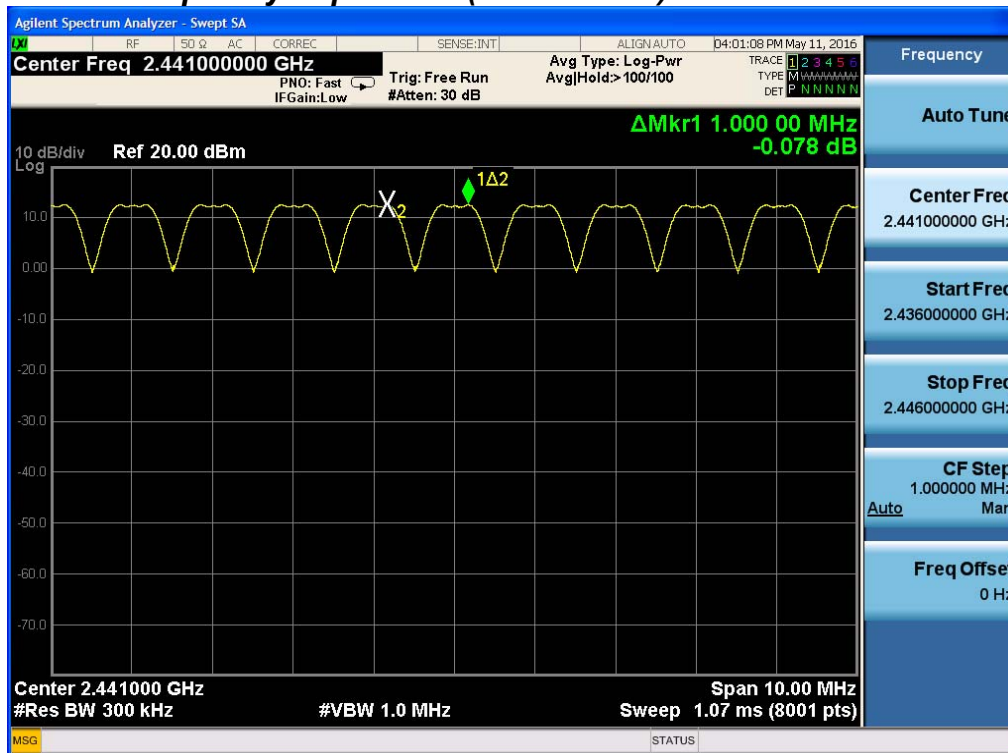
Modulation Mode	Carrier Frequency Separation (kHz)	Limit (2 / 3 of 20dB Bandwidth) (kHz)	Margin (kHz)
GFSK	1000	672.7	327.3
$\pi/4$ DQPSK	1005	894.0	111.0
8DPSK	1000	877.3	122.7

Note:

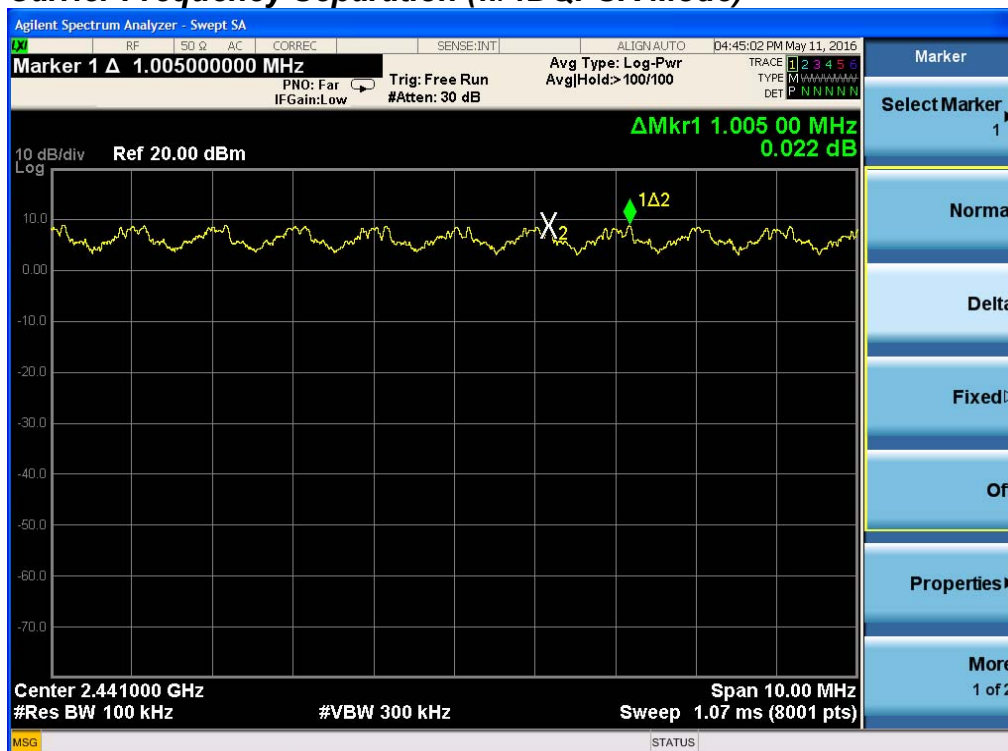
The EUT complies with the minimum channel separation requirement when it is operating **1x/EDR mode using 79 channels** and when operating in **AFH mode using 20 channels**.

PLOTS OF EMISSIONS

Carrier Frequency Separation (GFSK Mode)

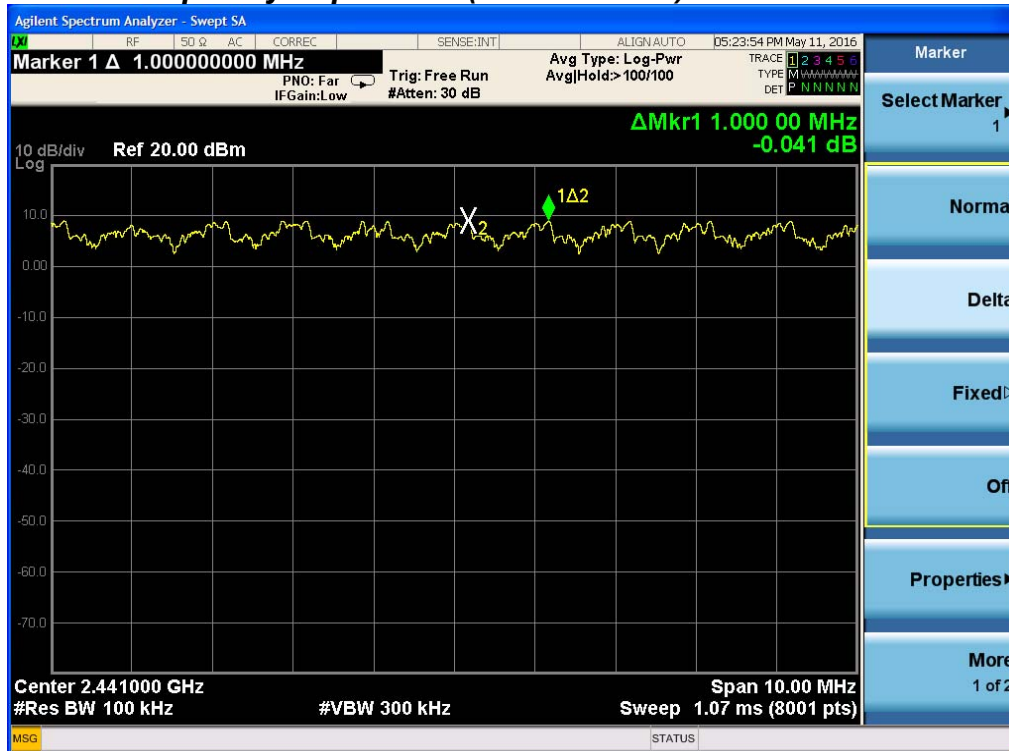


Carrier Frequency Separation ($\pi/4$ DQPSK Mode)



PLOTS OF EMISSIONS

Carrier Frequency Separation (8DPSK Mode)



TEST DATA

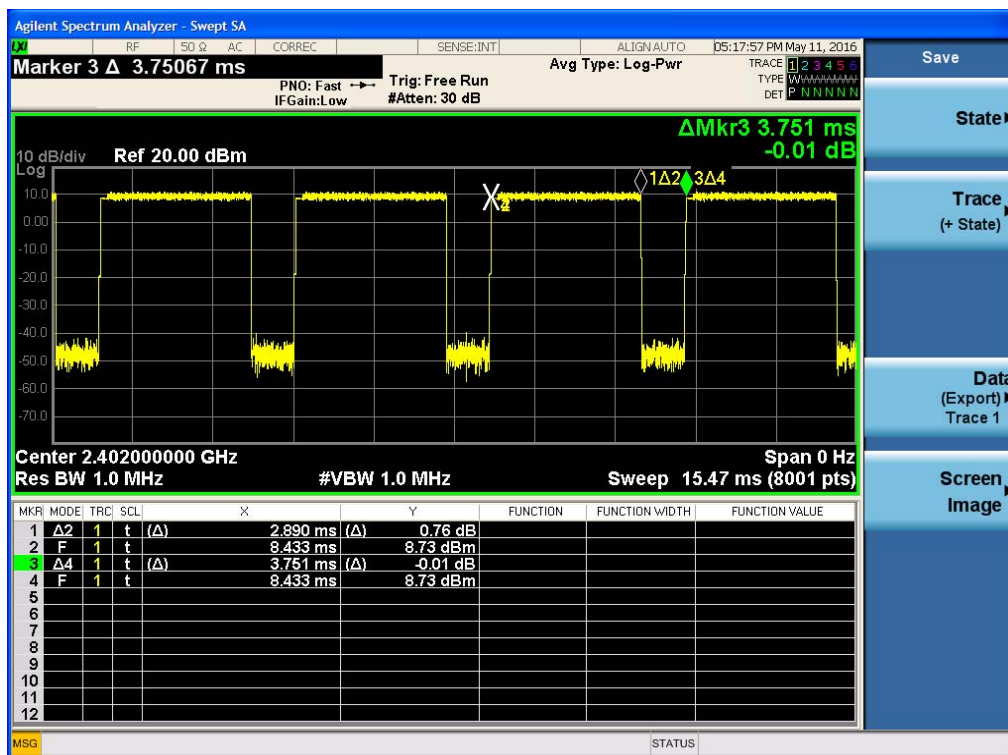
8.4 Transmitter Average Time of Occupancy

FCC §15.247(a)(1), IC RSS-247 Issue 1, 5.1(4)

Test mode : Set to Hopping mode

Result

Mode	Pulse width (ms)	^{*)} Numbers of slots	^{**)} Average time of Occupancy (ms)	Limit (ms)	Margin (ms)
1x/EDR	2.89	106.7	308.4	≤ 400	91.6
AFH	2.89	53.3	154.1	≤ 400	245.9



1x/EDR mode

- 1) This result was measured at DH5 mode in **1x/EDR mode**, which has longest time in one transmission burst.
- 2) Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s and 79 hopping channels.
- 3) The average time of occupancy in the specified 31.6 second period (79 channels x 0.4 s) is equal to pulse width x (hopping rate / 6) / 79 x (0.4 x hopping channels).
- 4) *) Numbers of slots in 31.6 sec = $(1600 / 6) / 79 \times 31.6$
- 5) **) Average time of Occupancy = $2.89 \text{ ms} \times 106.7 = 308.4 \text{ ms}$

AFH mode

- 1) This result was measured at DH5 mode in **AFH mode**, which has longest time in one transmission burst.
- 2) Bluetooth AFH mode has a channel hopping rate of 800 hops/s and 20 hopping channels.
- 3) The average time of occupancy in the specified 8 second period (20 channels x 0.4 s) is equal to pulse width x (hopping rate / 6) / 20 x (0.4 x hopping channels).
- 4) *) Numbers of slots in 20 sec = $(800 / 6) / 20 \times 8$
- 5) **) Average time of Occupancy = $2.89 \text{ ms} \times 53.33 = 154.1 \text{ ms}$

TEST DATA

8.5 Number of Hopping Channels

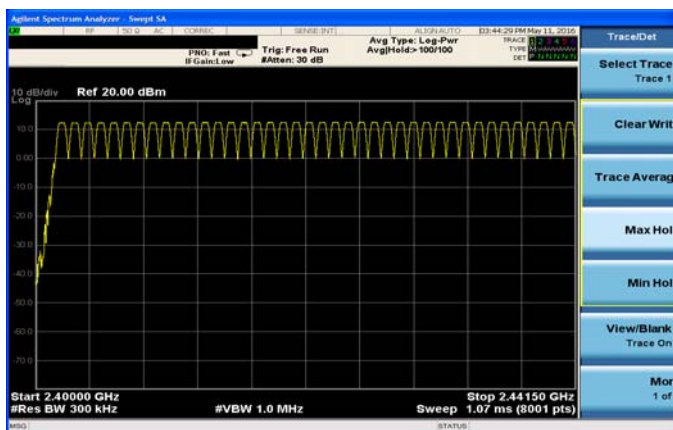
FCC §15.247(a)(1)(iii), IC RSS-247 Issue 1, 5.1(4)

Test mode : Set to Hopping mode

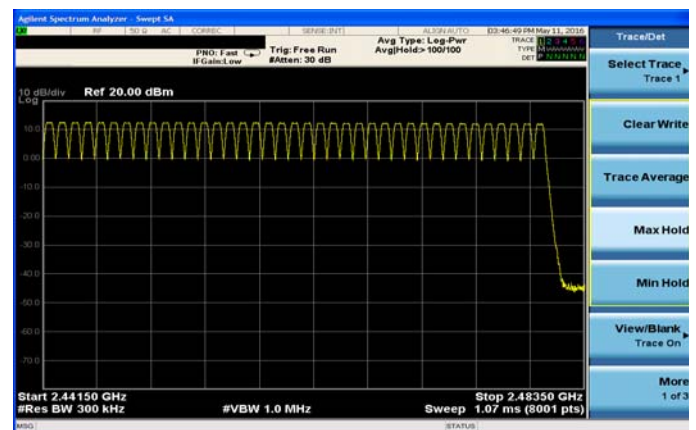
Result

The EUT complies with the minimum number of hopping channels when it is operating **1x/EDR mode using 79 channels** and when operating in **AFH mode using 20 channels**.

Top half of Authorized band(1x mode)



Bottom half of Authorized band(1x mode)



TEST DATA

8.6 Peak Output Power and E.I.R.P

FCC §15.247(b)(1), IC RSS-247 Issue 1, 5.4(2)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Modulation	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	E.I.R.P* (dBm)	E.I.R.P Limit (dB)	Result
GFSK	2402	12.41	30.00	14.40	36.00	Complies
GFSK	2441	12.54	30.00	14.53	36.00	Complies
GFSK	2480	11.99	30.00	13.98	36.00	Complies
π /4DQPSK	2402	11.16	30.00	13.15	36.00	Complies
π /4DQPSK	2441	11.27	30.00	13.26	36.00	Complies
π /4DQPSK	2480	10.62	30.00	12.61	36.00	Complies
8DPSK	2402	11.59	30.00	13.58	36.00	Complies
8DPSK	2441	11.73	30.00	13.72	36.00	Complies
8DPSK	2480	11.06	30.00	13.05	36.00	Complies

Note:

The following formular was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

*) E.I.R.P was calculated by following equation according to KDB412172 D01 Determining ERP and EIRP v01

$$E.I.R.P = P_T + G_T - L_C$$

P_T = Peak outputpower (dBm)

G_T = Gain of the transmitting antenna in dBi, Peak antenna gain is 1.99 dBi.

L_C = Signal attenuation in the connecting cable between the transmitter and antenna in dB. This factor of an integral antenna is negligible.