FCC CFR47 PART 15 SUBPART C

Bluetooth

CERTIFICATION TEST REPORT

FOR

GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC

MODEL NUMBER : SM-A510F/DS, SM-A510F

FCC ID: A3LSMA510F

REPORT NUMBER: 15K22047-E3

ISSUE DATE: NOV 26, 2015

Prepared for
SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Prepared by
UL Korea, Ltd. Suwon Laboratory
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ACCREDITED
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
--	11/26/15	Initial issue	SungGil Park

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION:	GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC
MODEL NUMBER:	SM-A510F/DS
SERIAL NUMBER:	R38FA0JNM9W/ 330091e6a336920d (RADIATED); 3300228292a67257 (CONDUCTED)
DATE TESTED:	OCT 19, 2015 - NOV 26, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass

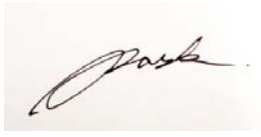
UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

CY Choi
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:



SungGil Park
Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro
☒ Chamber 1
☒ Chamber 2

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at http://www.iasonline.org/PDF/TL/TL-637.pdf.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB
Radiated Disturbance, Above 1 GHz	5.97 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC.

This test report addresses the DSS (BT) operational mode.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range [MHz]	Mode	Power Mode	Output Power [dBm]	Output Power [mW]
2402 - 2480	Basic GFSK	Average	8.92	7.81
		Peak	9.06	8.06
	Enhanced Pi/4-DPSK	Average	4.81	3.03
		Peak	7.20	5.24
	Enhanced 8PSK	Average	4.82	3.03
		Peak	7.56	5.70

Note: GFSK, Pi/4-DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on this mode to showing compliance. For average power data please refer to section 8.6.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -1.19 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

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5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA20UWE	R37G9EN04S1DK3	N/A
Data Cable	SAMSUNG	ECB-DU4AWE	N/A	N/A
Earphone	SAMSUNG	GH59-11720H	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	Mini-USB	Shielded	0.8m	N/A
1	Audio	1	Mini-Jack	Unshielded	1.0m	N/A

TEST SETUP

The EUT is continuously communicating to the Bluetooth tester during the tests.
EUT was set in the Hidden menu mode to enable BT communications.

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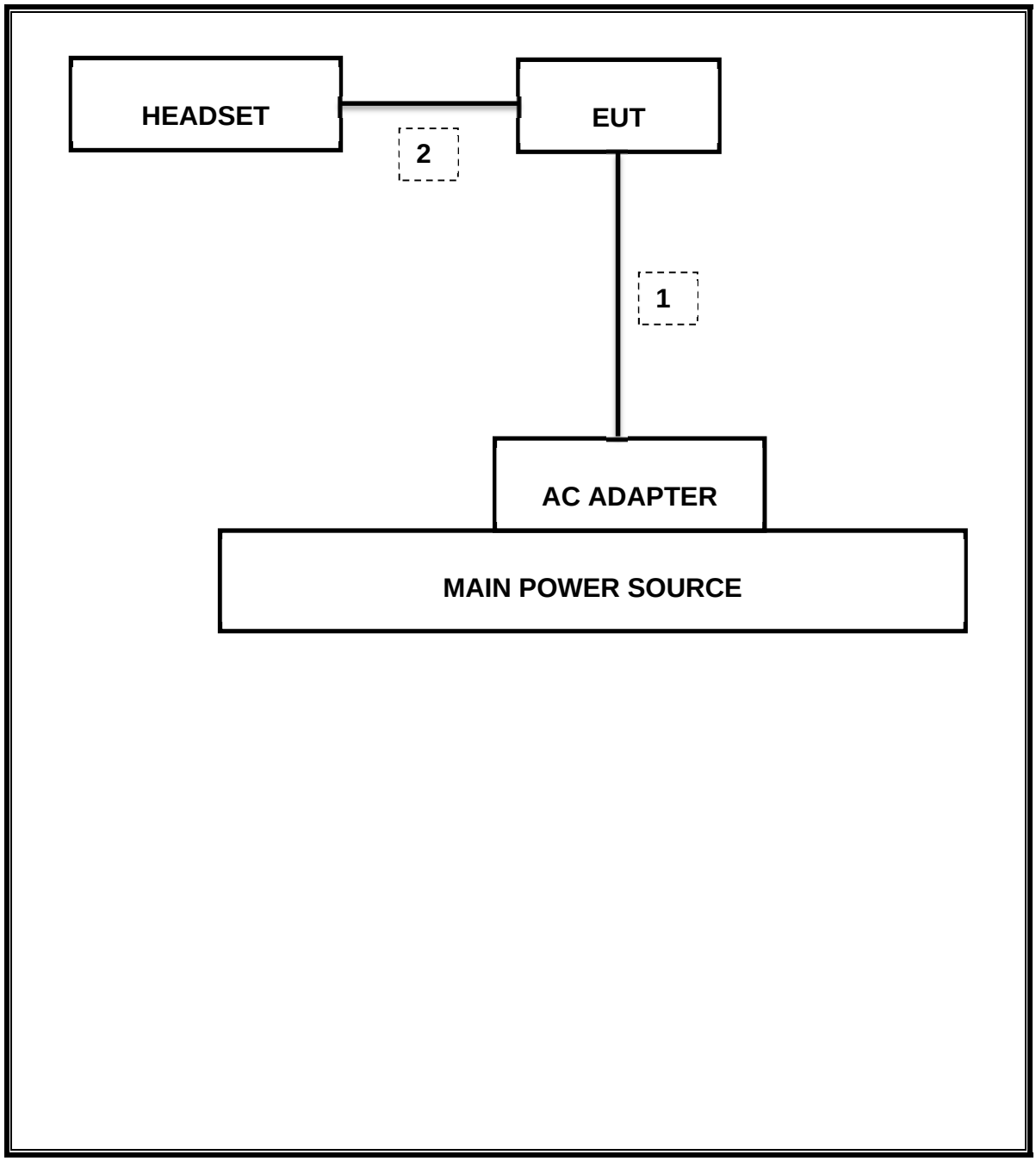
SETUP DIAGRAM FOR TESTS



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	**Manufacturer**	**Model**	**S/N**	**Cal Due**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-16
Antenna, Horn, 18 GHz	ETS	3115	00161451	05-17-16
Antenna, Horn, 18 GHz	ETS	3117	00168724	06-17-16
Antenna, Horn, 18 GHz	ETS	3117	00168717	06-17-16
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-18-16
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-18-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-19-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-19-16
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-18-16
Average Power Sensor	R&S	NRZ-Z91	102681	08-18-16
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-18-16
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-19-16
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-19-16
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-19-16
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	009	08-18-16
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	015	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	009	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	010	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	016	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	015	08-18-16
LISN	R&S	ENV-216	101836	08-19-16
LISN	R&S	ENV-216	101837	08-19-16
Combiner	WEINSCHEL	1575	2153	08-20-16

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
2.1049	Occupied Band width (99%)	N/A	Conducted	Pass	1.198 MHz
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-44.942 dBm
15.247 (b)(1)	TX conducted output power	<21dBm		Pass	9.064 dBm (Peak)
15.247 (a)(1)	Hopping frequency separation	> 25KHz		Pass	1 MHz
15.247 (a)(1)(iii)	Number of Hopping channels	More than 15 non-overlapping channels		Pass	79
15.247 (a)(1)(iii)	Avg Time of Occupancy	< 0.4sec		Pass	0.346 sec
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	42.11 dBuV (QP)
15.205, 15.209	Radiated Spurious Emission	< 40dBuV/m	Radiated	Pass	32.58 dBuV/m (AV)

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8. ANTENNA PORT TEST RESULTS

8.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

8.1.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.054	0.904
Mid	2441	1.054	0.904
High	2480	1.027	0.904
Worst		1.054	0.904

8.1.2. ENHANCED DATA RATE Pi/4-DQPSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.361	1.196
Mid	2441	1.360	1.196
High	2480	1.295	1.198
Worst		1.361	1.198

8.1.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.319	1.168
Mid	2441	1.324	1.168
High	2480	1.323	1.198
Worst		1.324	1.198

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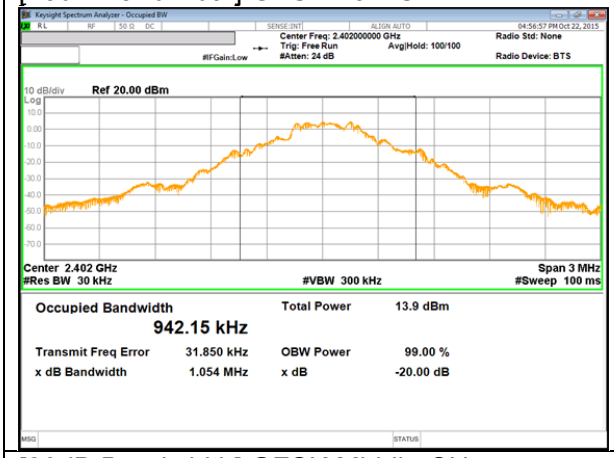
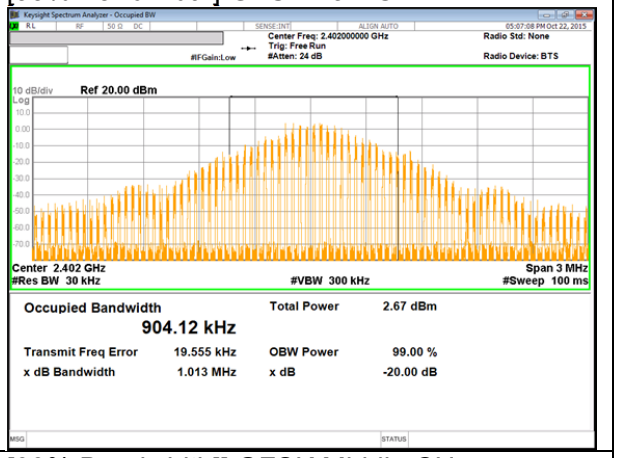
8.1.4. 20 dB AND 99% BANDWIDTH PLOTS

GFSK BANDWIDTH

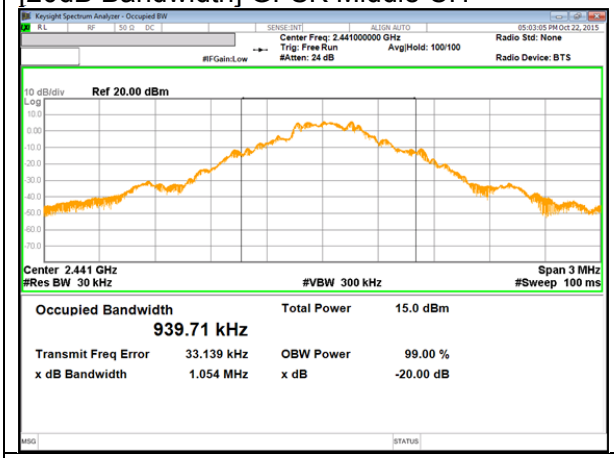
[20dB Bandwidth] GFSK Low CH



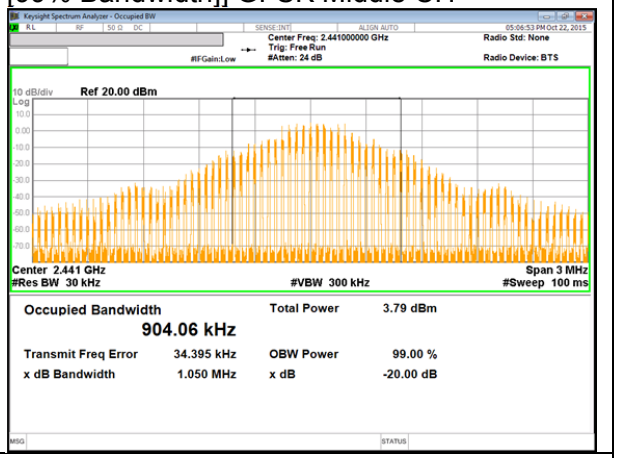
[99% Bandwidth] GFSK Low CH



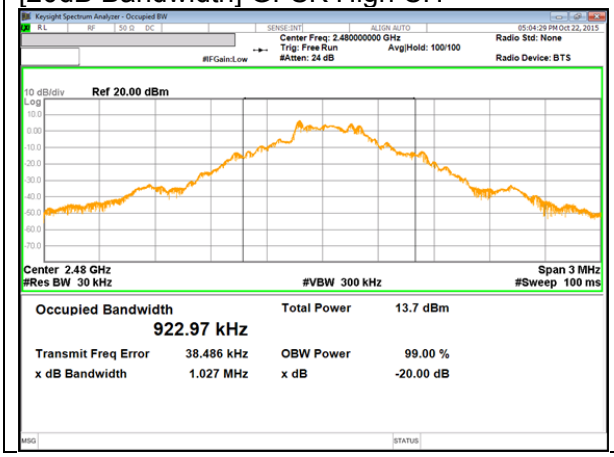
[20dB Bandwidth] GFSK Middle CH



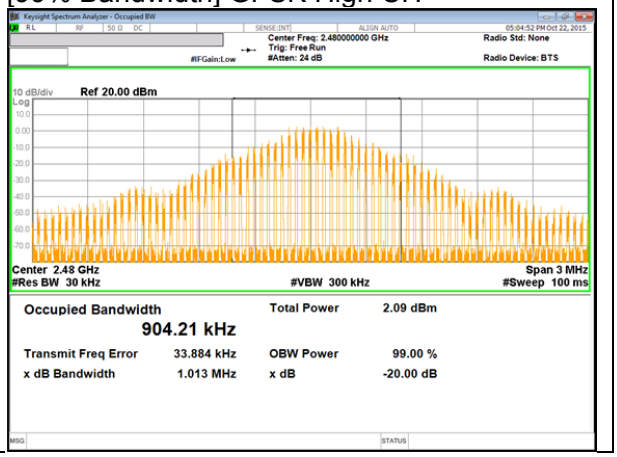
[99% Bandwidth]] GFSK Middle CH



[20dB Bandwidth] GFSK High CH

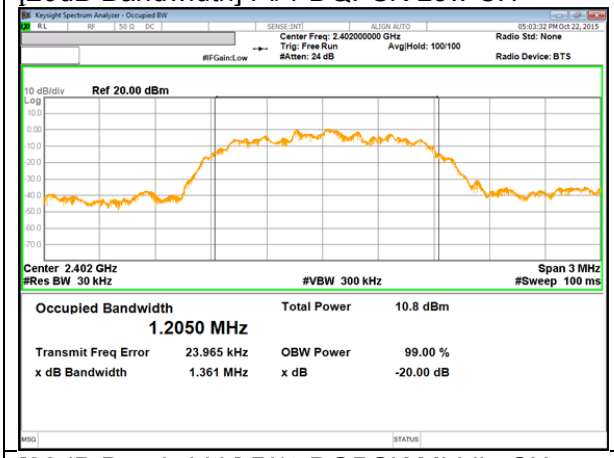


[99% Bandwidth] GFSK High CH

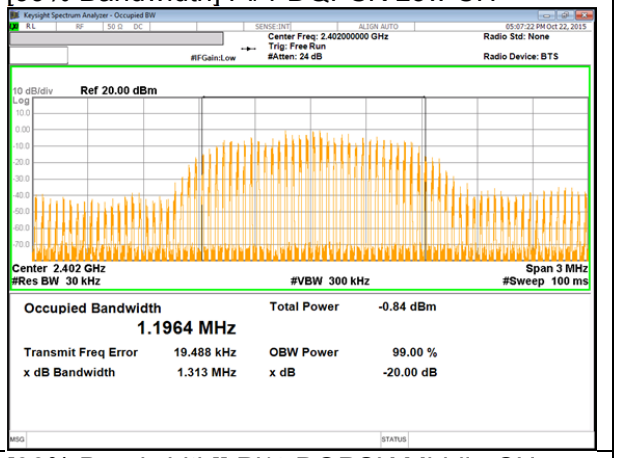


Pi/4-DQPSK BANDWIDTH

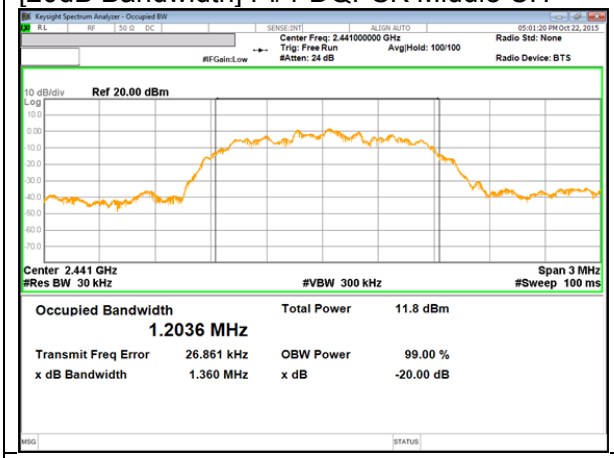
[20dB Bandwidth] Pi/4-DQPSK Low CH



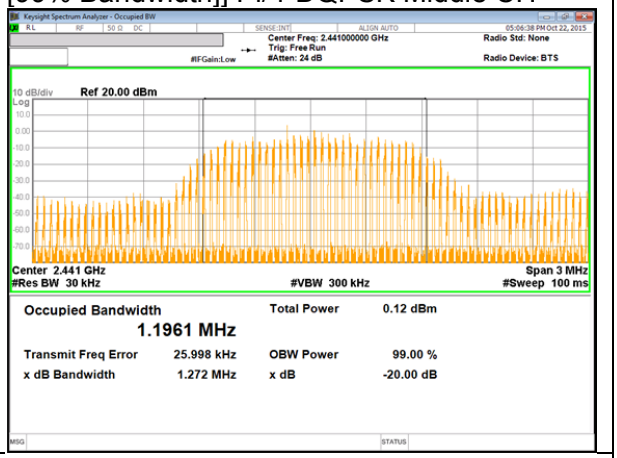
[99% Bandwidth] Pi/4-DQPSK Low CH



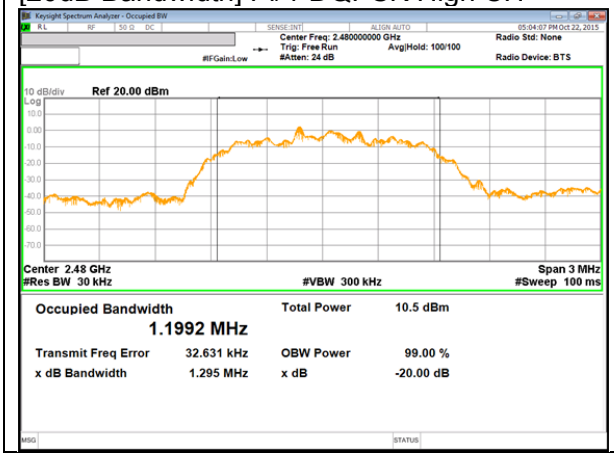
[20dB Bandwidth] Pi/4-DQPSK Middle CH



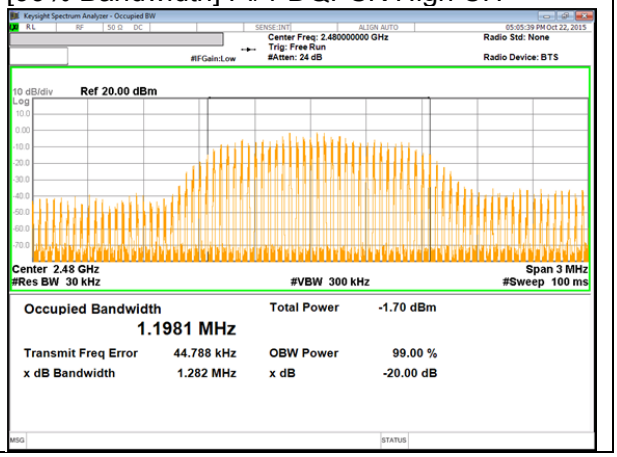
[99% Bandwidth]] Pi/4-DQPSK Middle CH



[20dB Bandwidth] Pi/4-DQPSK High CH



[99% Bandwidth] Pi/4-DQPSK High CH



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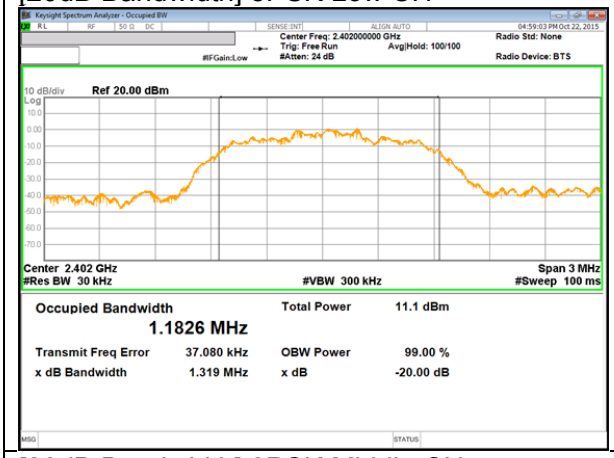
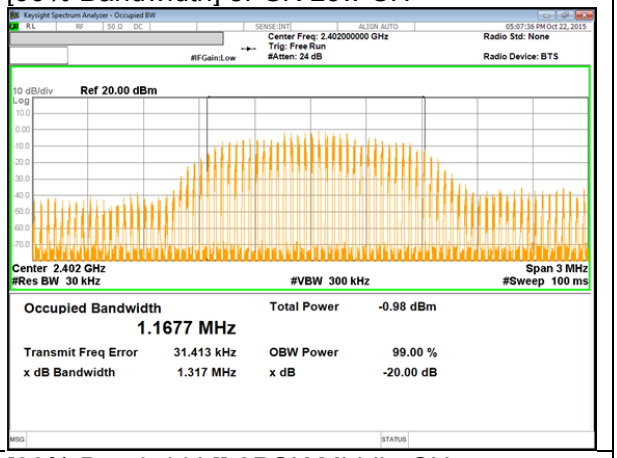
8PSK BANDWIDTH

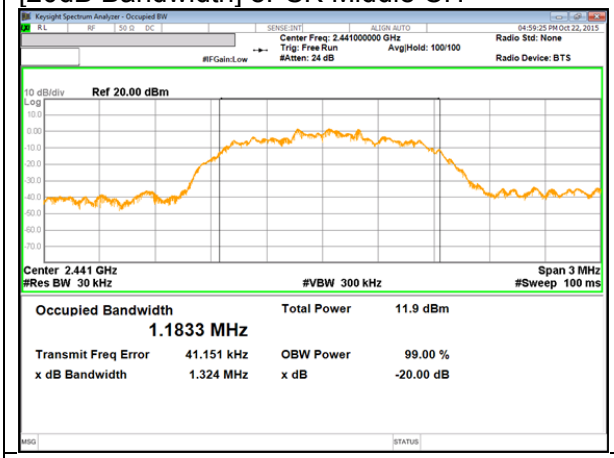
[20dB Bandwidth] 8PSK Low CH



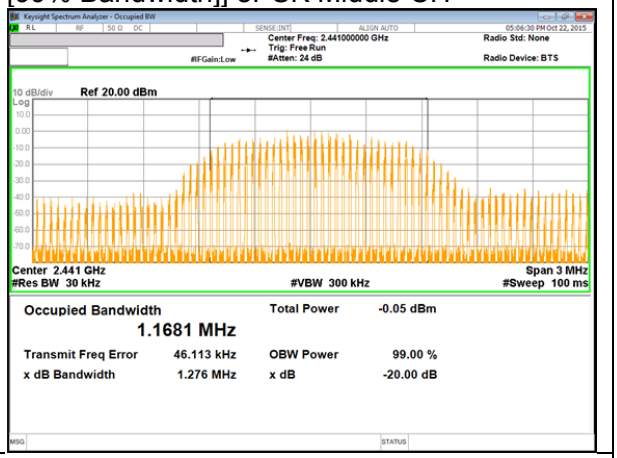
[99% Bandwidth] 8PSK Low CH



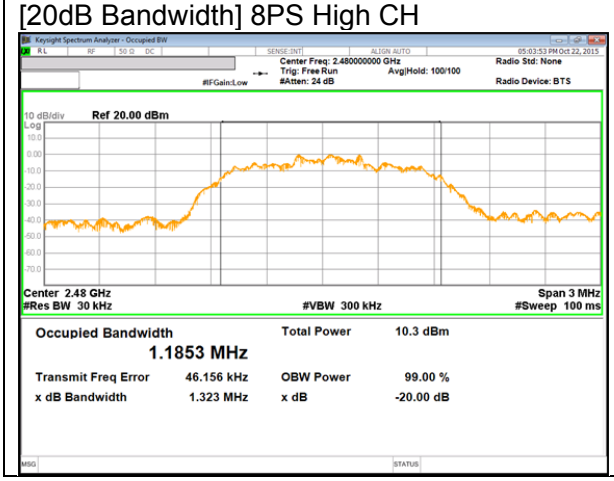
[20dB Bandwidth] 8PSK Middle CH



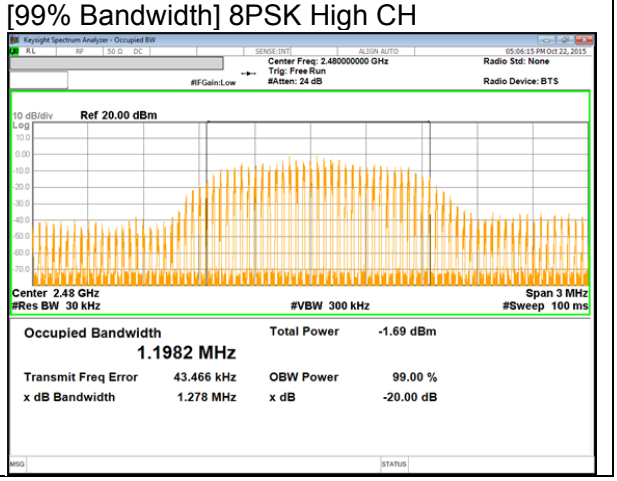
[99% Bandwidth]] 8PSK Middle CH



[20dB Bandwidth] 8PS High CH



[99% Bandwidth] 8PSK High CH



8.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §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 hoping channel, whichever is greater.

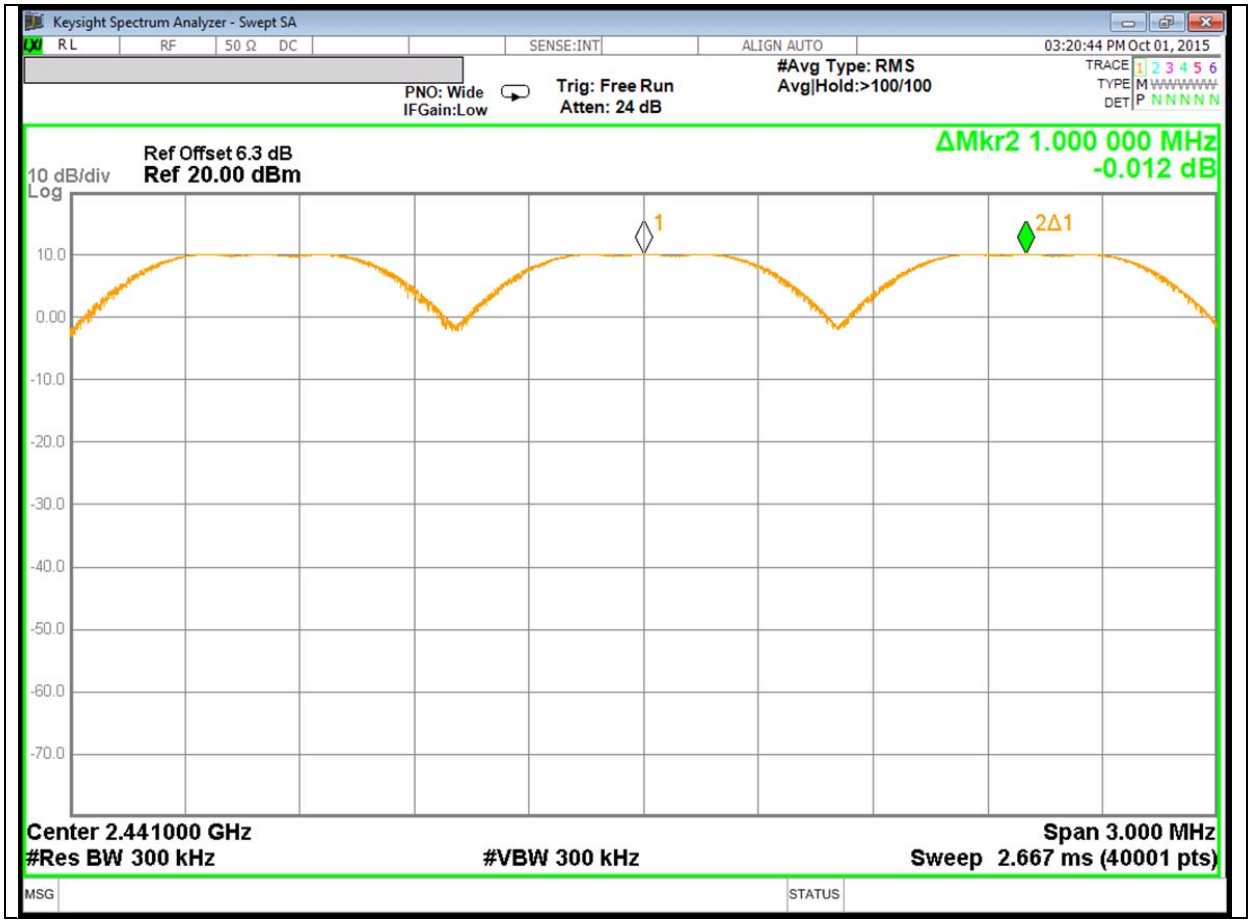
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION PLOT



8.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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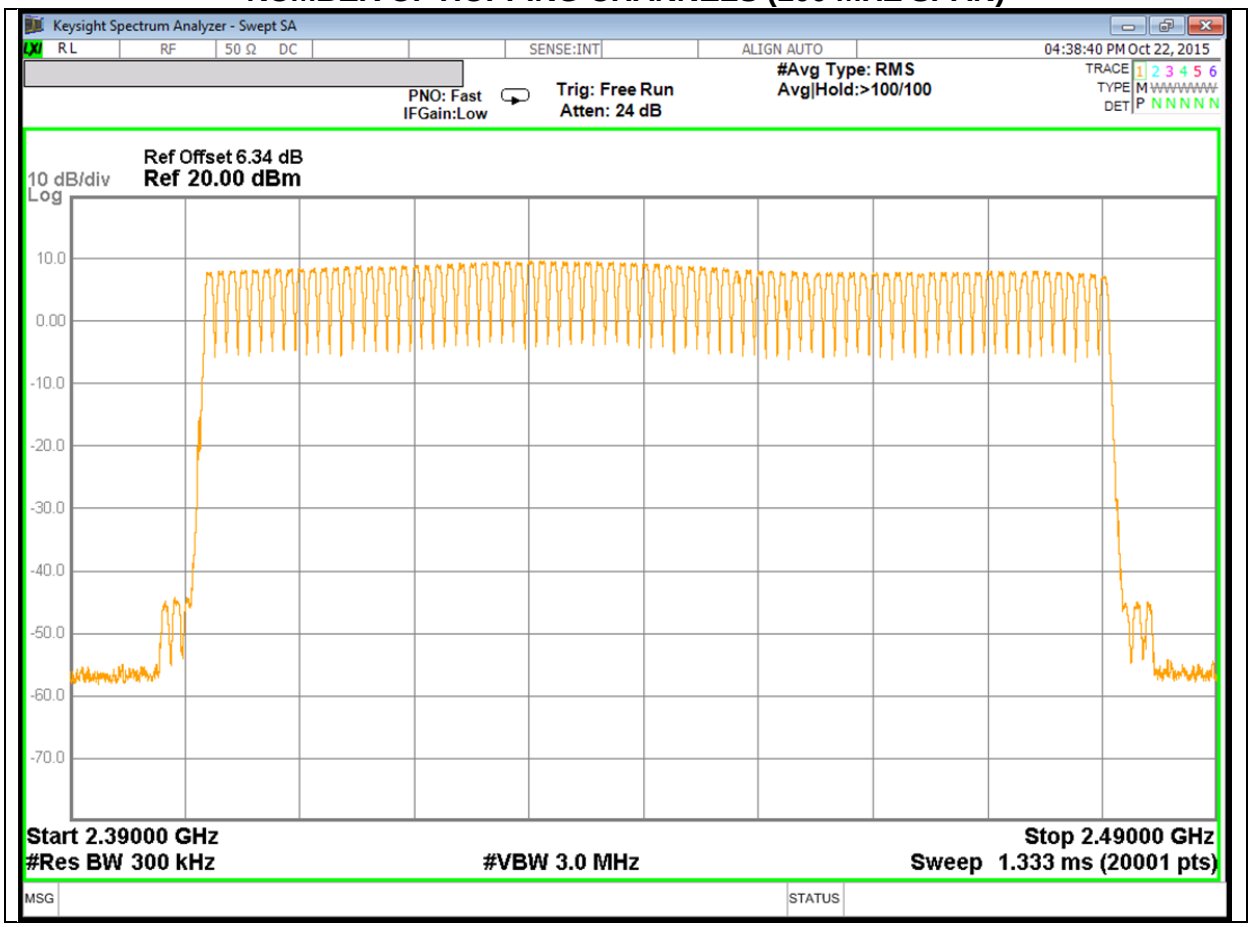
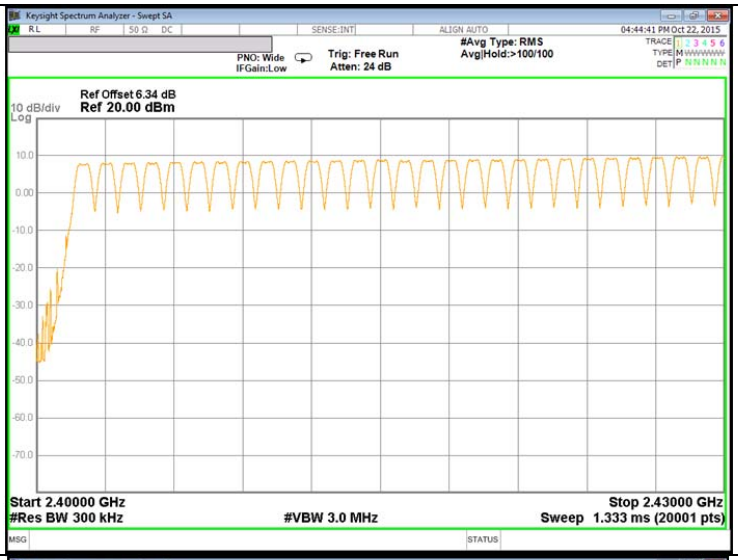
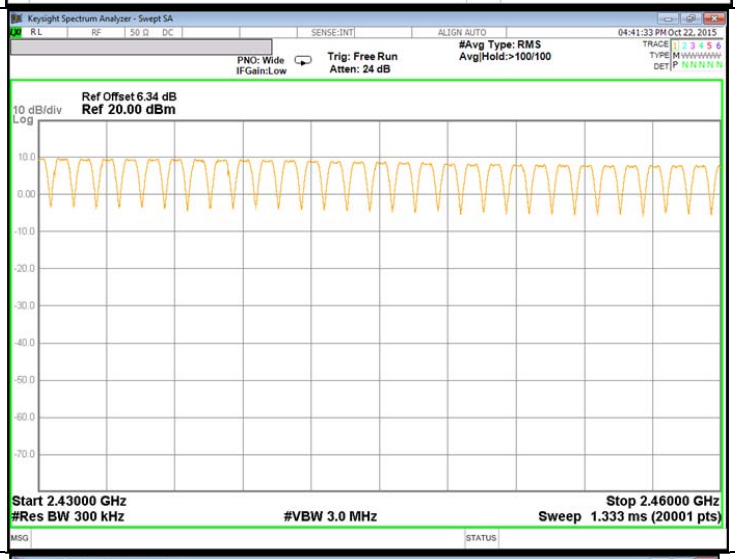
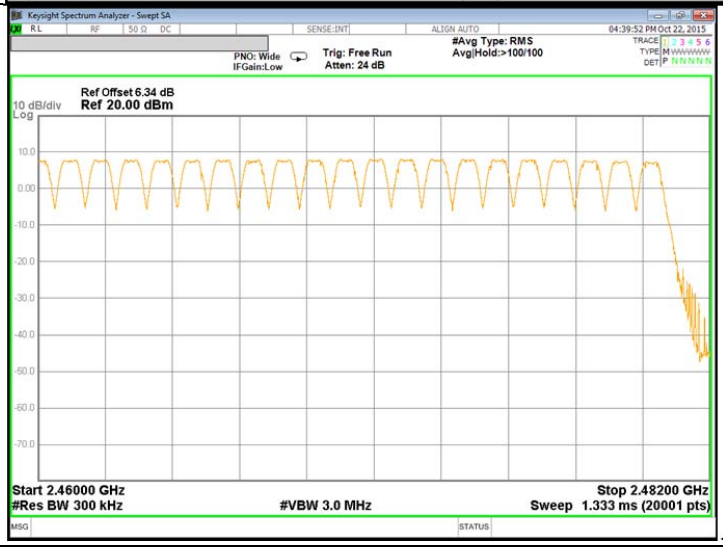
NUMBER OF HOPPING CHANNELS PLOTS

NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



1st SEGMENT 2400 to 2430 MHz	
2nd SEGMENT 2430 to 2460 MHz	
3rd SEGMENT 2460 to 2482 MHz	

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8.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

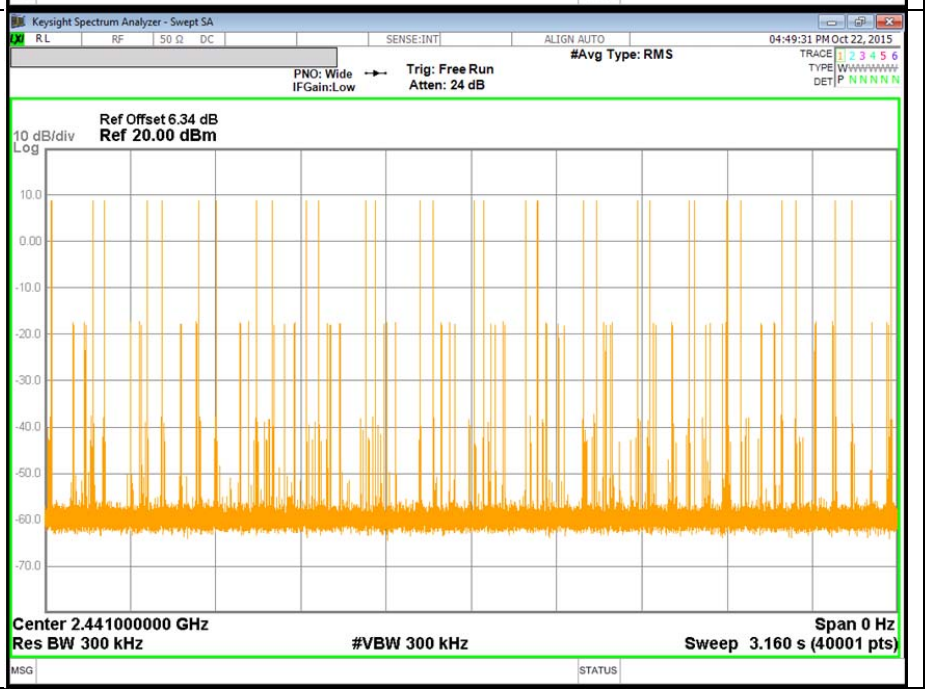
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

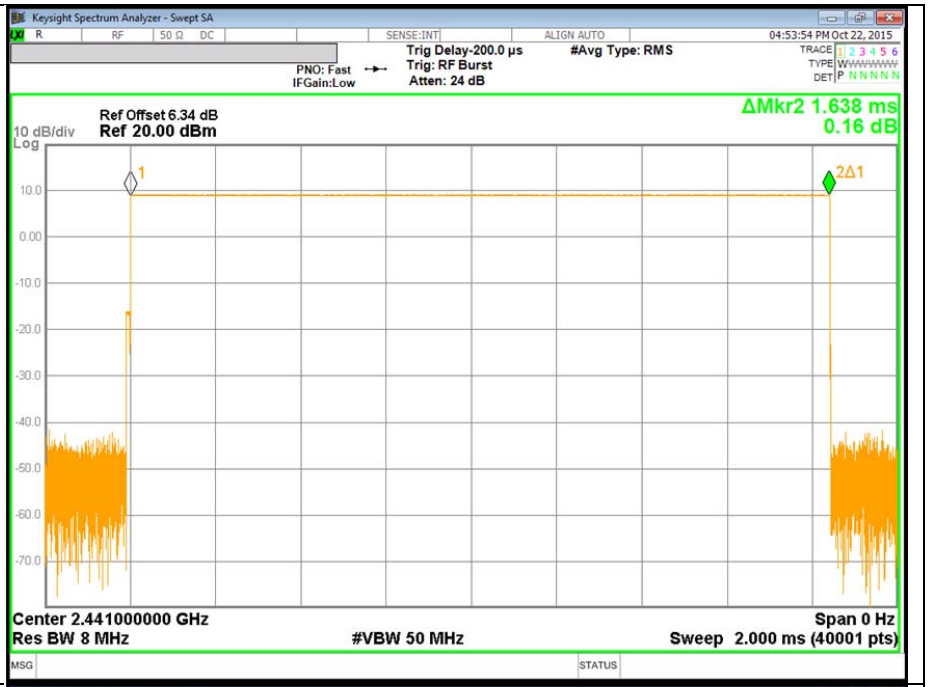
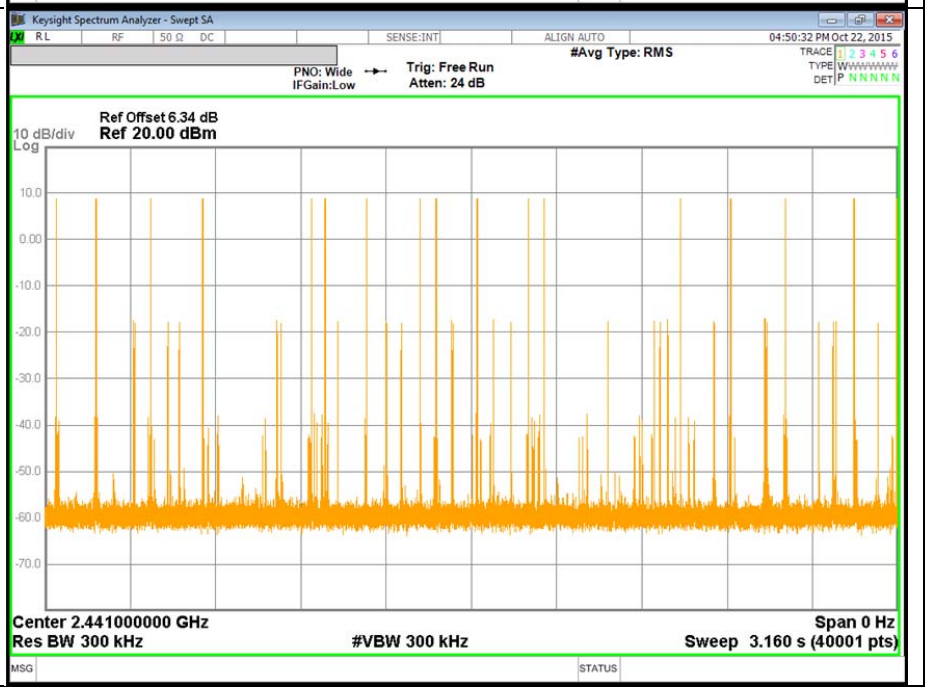
RESULTS

DH Packet	Pulse Width [msec]	Number of Pulses in 3.16 seconds	Average Time of Occupancy [sec]	Limit [sec]	Margin [sec]
GFSK Normal					
DH1	0.382	32	0.122368	0.4	-0.2776
DH3	1.638	17	0.278460	0.4	-0.1215
DH5	2.886	12	0.346320	0.4	-0.0537
DH Packet	Pulse Width [msec]	Number of Pulses in 0.8 seconds	Average Time of Occupancy [sec]	Limit [sec]	Margin [sec]
GFSK AFH					
DH1	0.382	8	0.030592	0.4	-0.36941
DH3	1.638	4.25	0.069615	0.4	-0.33039
DH5	2.886	3	0.086580	0.4	-0.31342

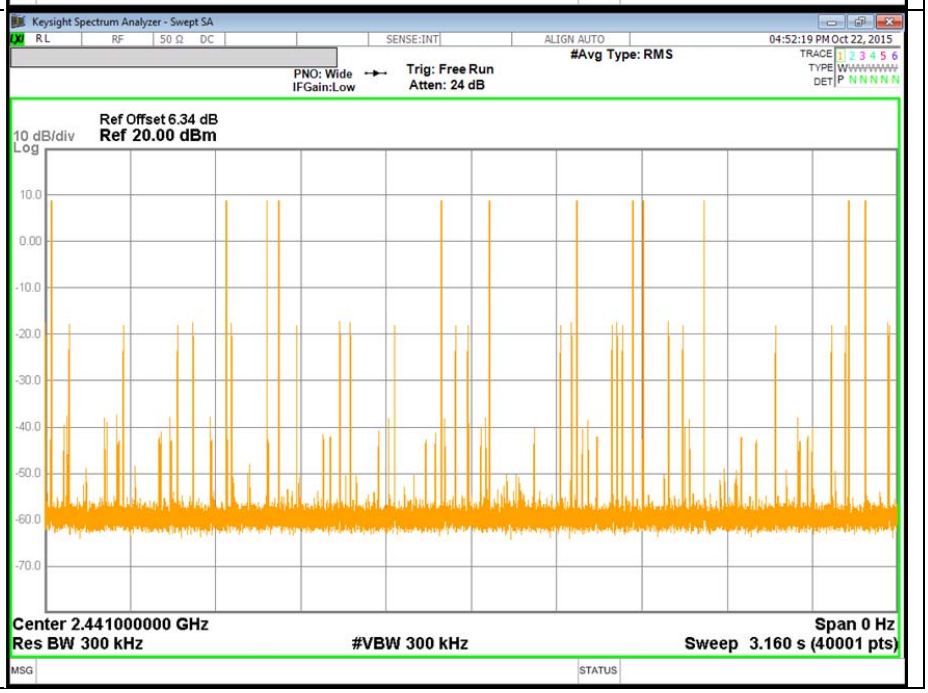
DH1

DH1 Pulse Width	
DH1 NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD	

DH3

DH3 Pulse Width	
DH3 NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD	

DH5

DH5 Pulse Width	
DH5 NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD	

8.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

The maximum antenna gain is less than 6 dBi, therefore the limit is 21 dBm.

TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

8.5.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	7.883	21	-13.117
Middle	2441	9.064	21	-11.936
High	2480	7.318	21	-13.682
Worst		9.064	21	-11.936

8.5.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	6.348	21	-14.652
Middle	2441	7.195	21	-13.805
High	2480	5.502	21	-15.498
Worst		7.195	21	-13.805

8.5.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	6.689	21	-14.311
Middle	2441	7.562	21	-13.438
High	2480	5.739	21	-15.261
Worst		7.562	21	-13.438

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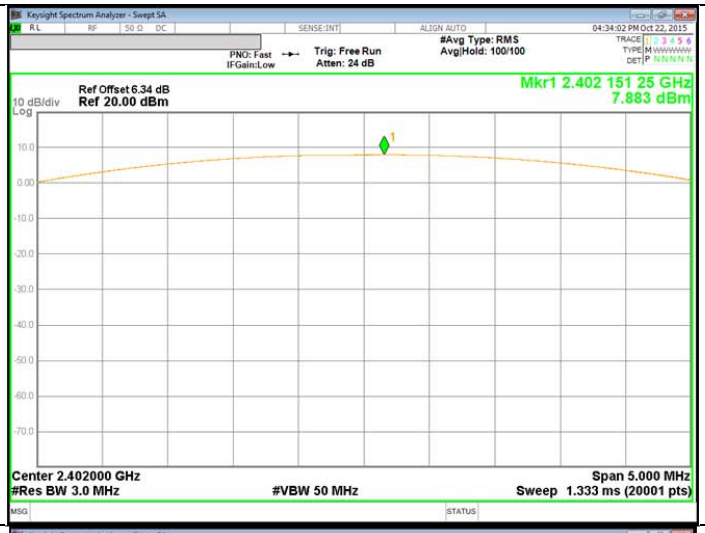
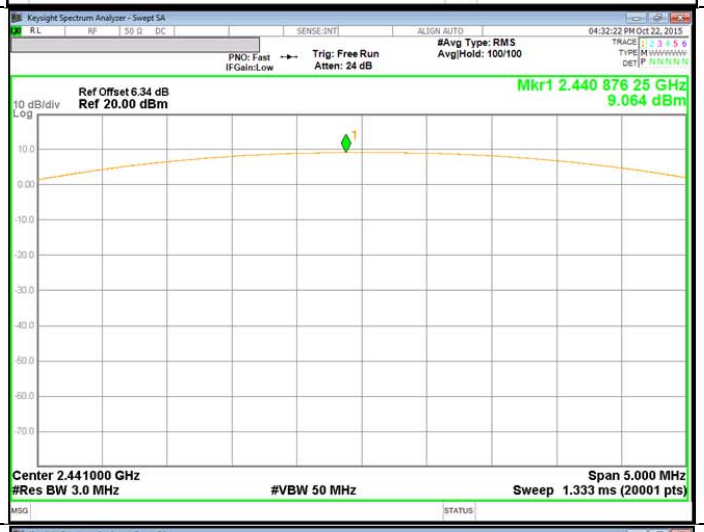
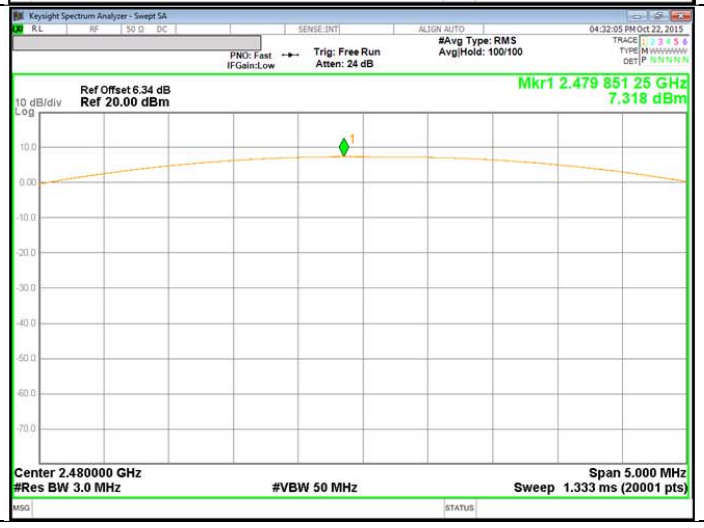
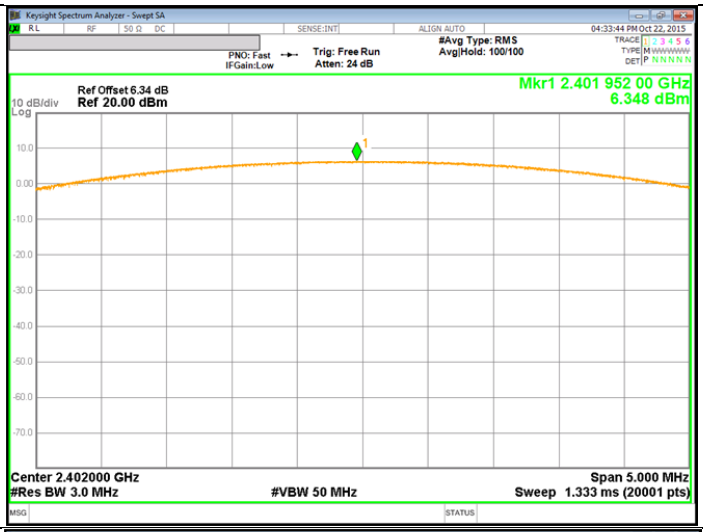
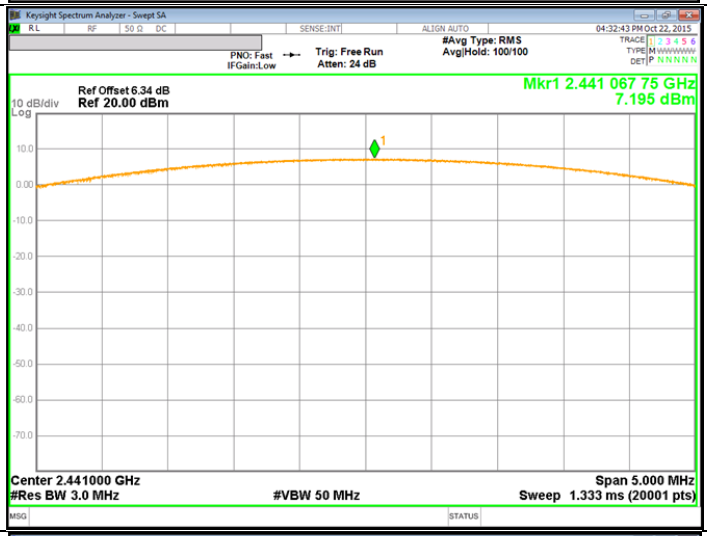
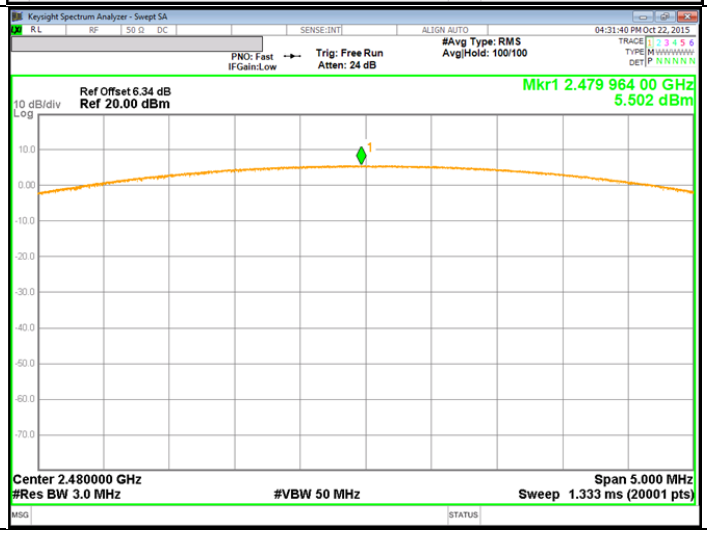
8.5.4. OUTPUT POWER PLOTS

GFSK OUTPUT POWER

GFSK Low CH		
GFSK Middle CH		
GFSK High CH		

Pi/4-DPSK OUTPUT POWER

Pi/4-DPSK Low CH		
Pi/4-DPSK Middle CH		
Pi/4-DPSK High CH		

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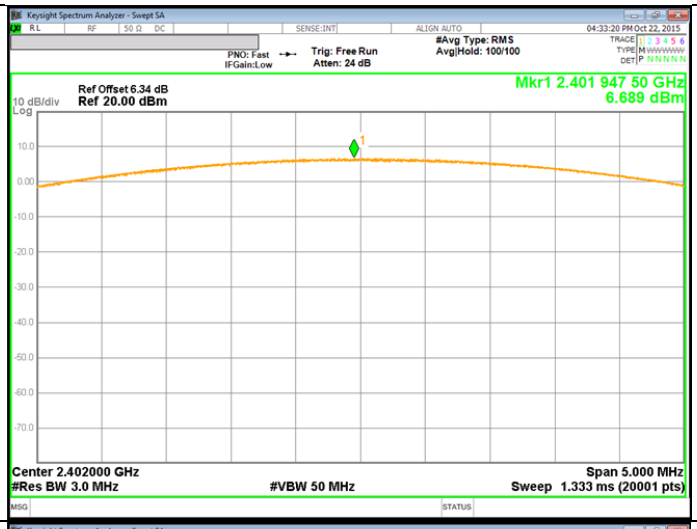
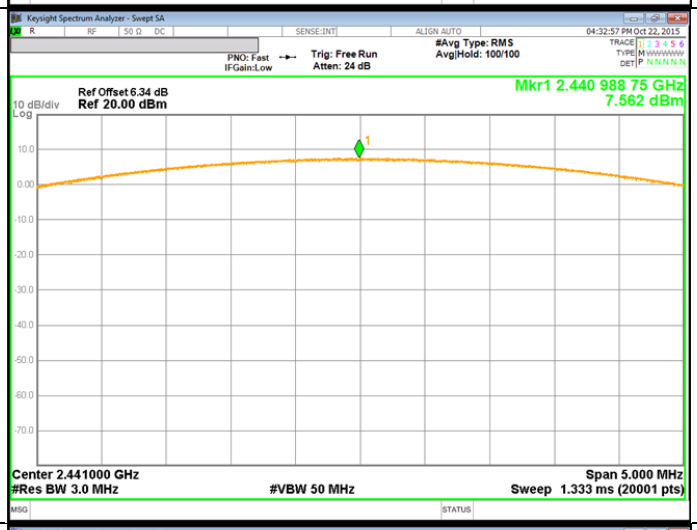
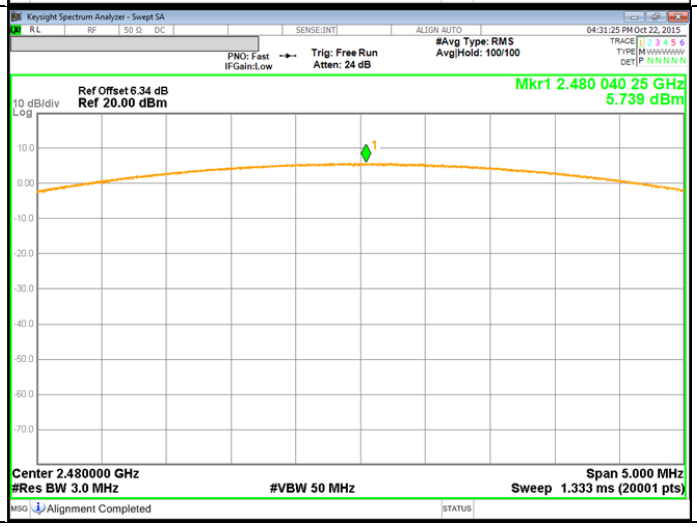
8PSK OUTPUT POWER

8PSK Low CH			
8PSK Middle CH			
8PSK High CH			

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8.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

DA 00-705: The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.1 dB (including 10 dB pad and 0.1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

8.6.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	7.65	5.82
Middle	2441	8.92	7.81
High	2480	7.09	5.12

8.6.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	3.91	2.46
Middle	2441	4.81	3.03
High	2480	3.19	2.09

8.6.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	3.94	2.47
Middle	2441	4.82	3.03
High	2480	3.21	2.09

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8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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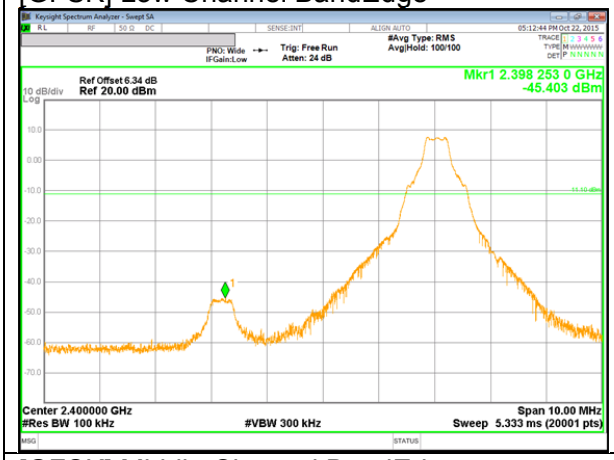
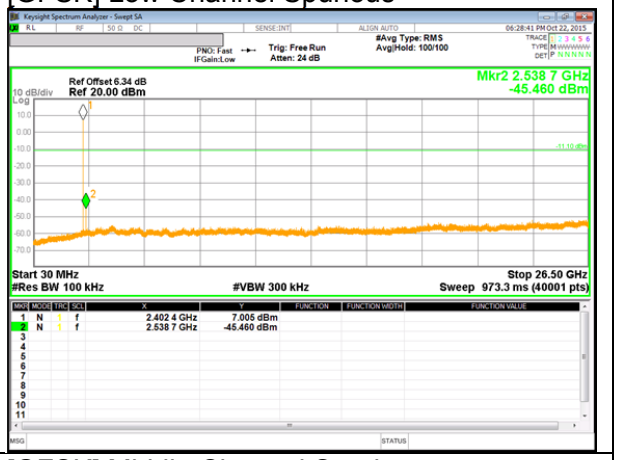
8.7.1. BASIC DATA RATE GFSK MODULATION

GFSK Mode

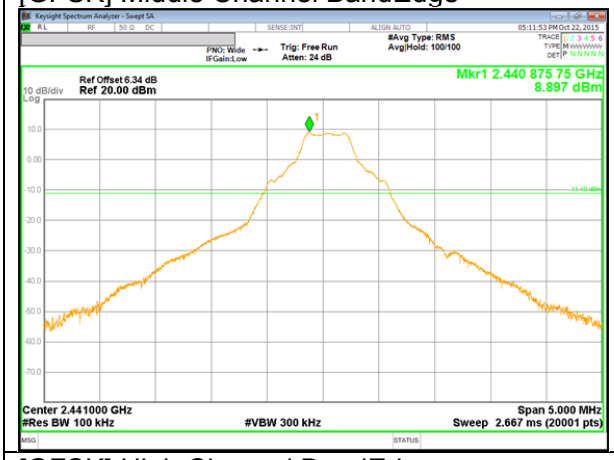
[GFSK] Low Channel BandEdge



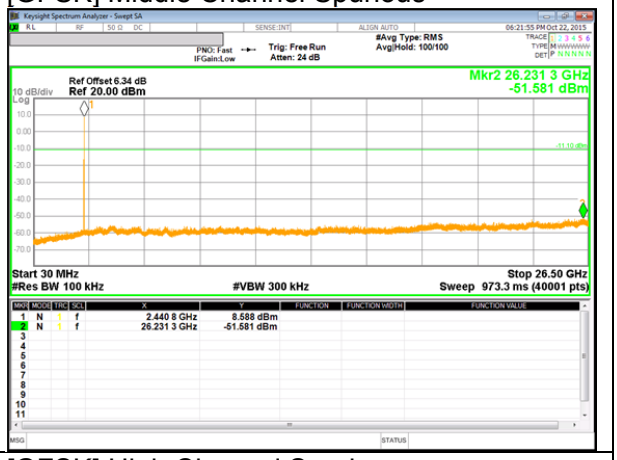
[GFSK] Low Channel Spurious



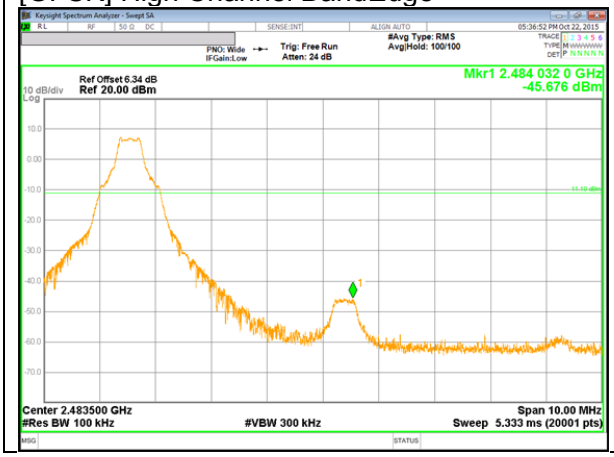
[GFSK] Middle Channel BandEdge



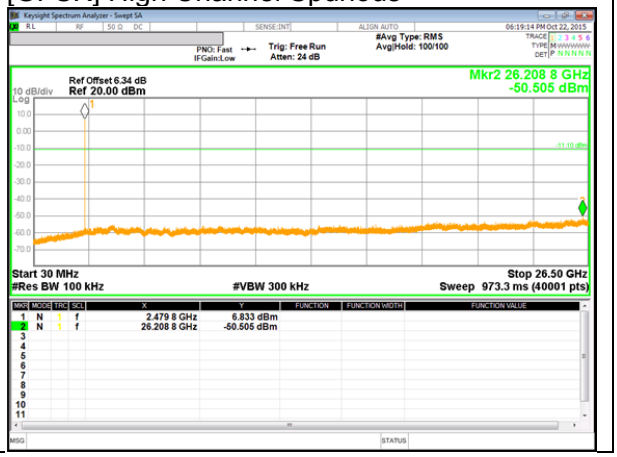
[GFSK] Middle Channel Spurious



[GFSK] High Channel BandEdge

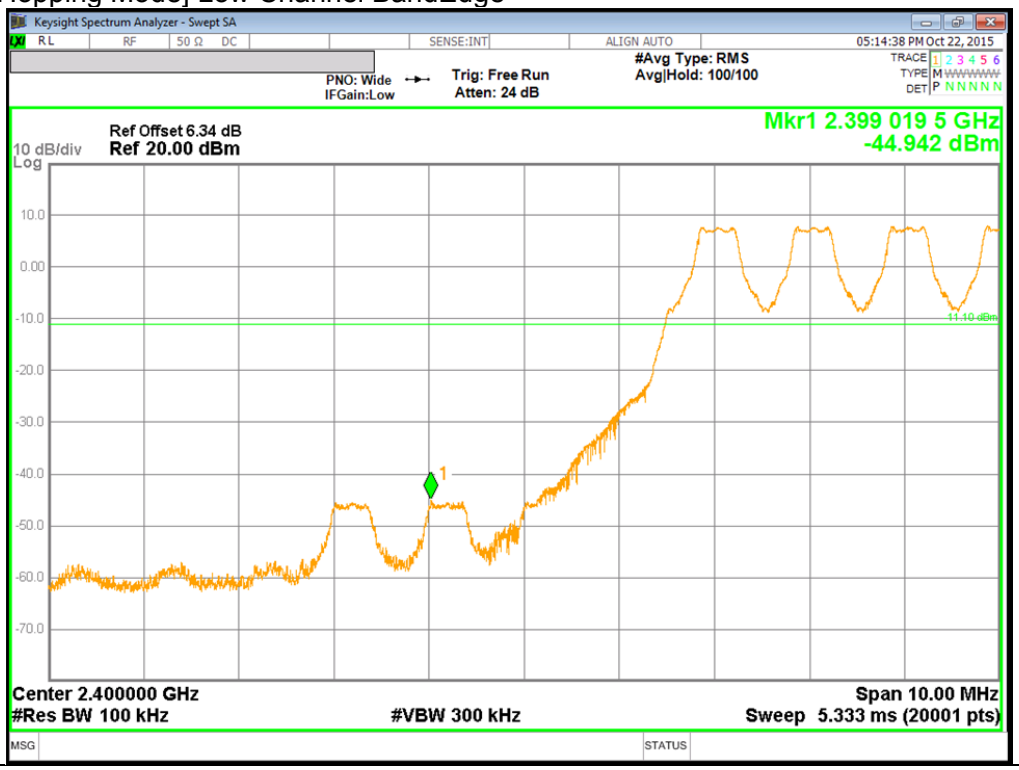


[GFSK] High Channel Spurious



BandEdge Emission at GFSK Hopping Mode

[GFSK Hopping Mode] Low Channel BandEdge

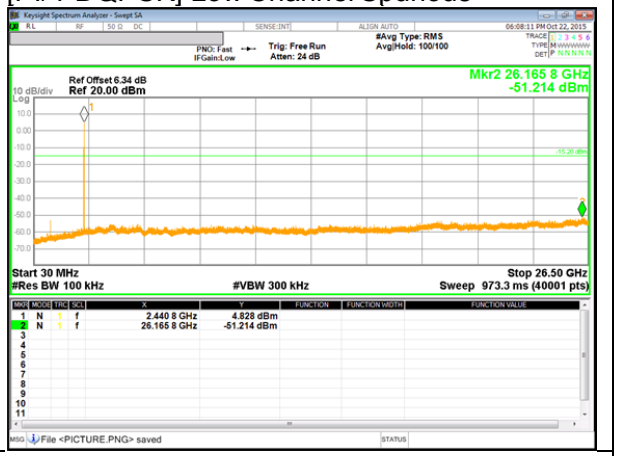


[GFSK Hopping Mode] High Channel BandEdge

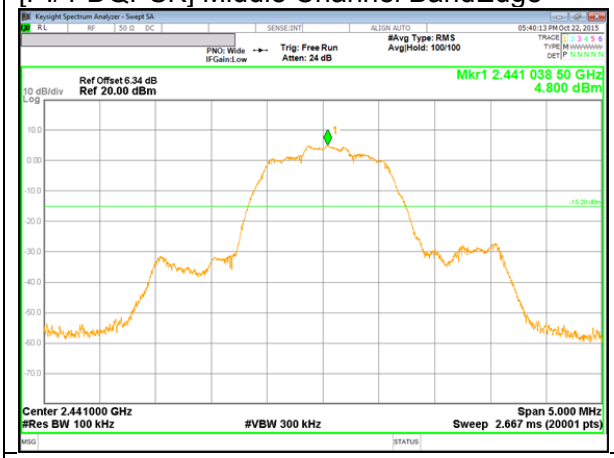
PI/4-DQPSK Mode

[PI/4-DQPSK] Low Channel BandEdge

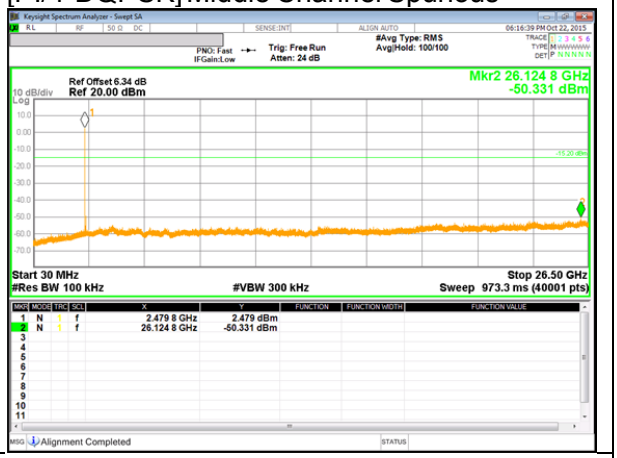
[PI/4-DQPSK] Low Channel Spurious



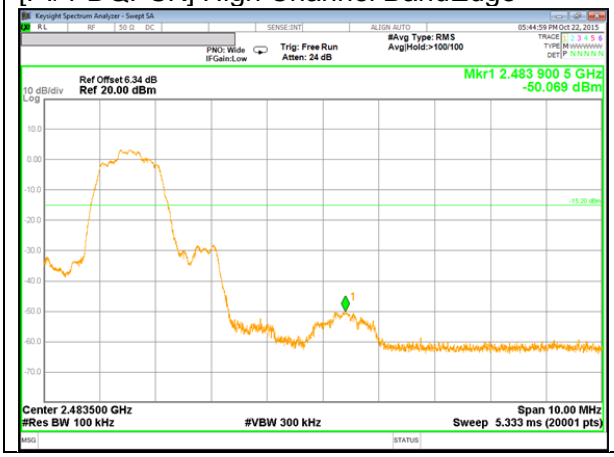
[PI/4-DQPSK] Middle Channel BandEdge



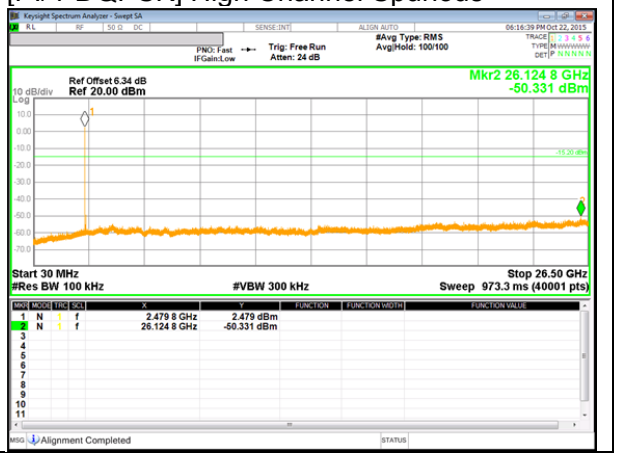
[PI/4-DQPSK] Middle Channel Spurious



[PI/4-DQPSK] High Channel BandEdge



[PI/4-DQPSK] High Channel Spurious



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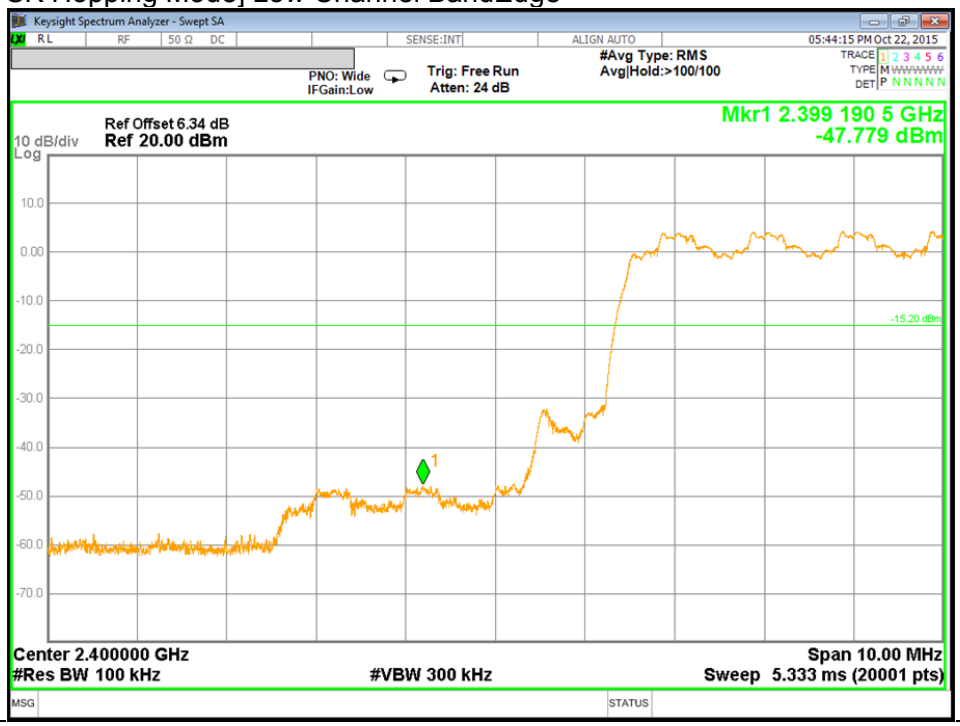
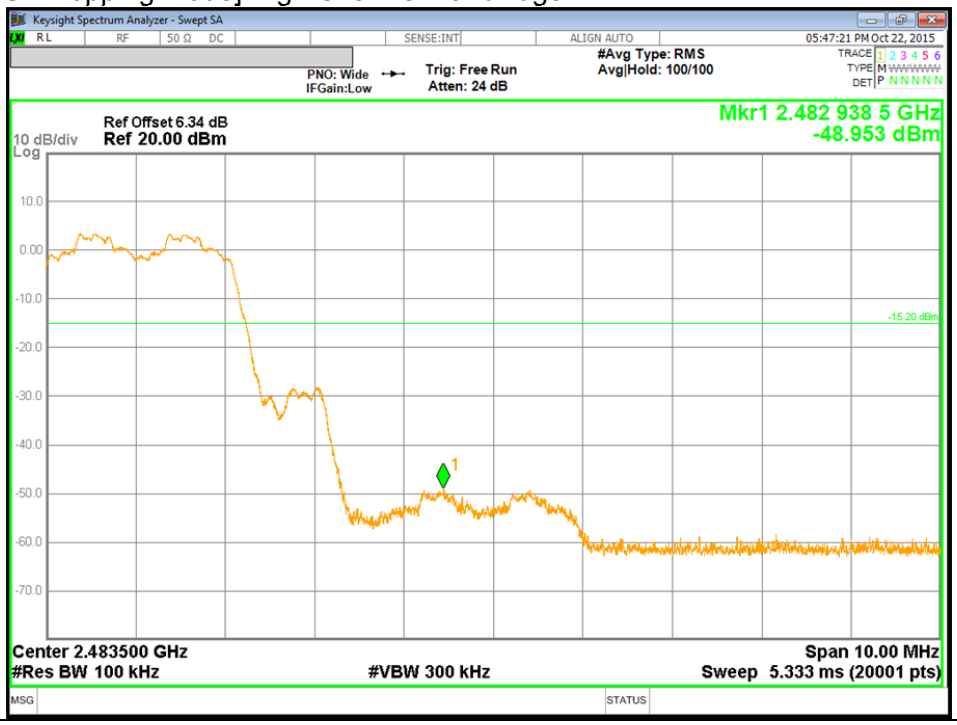
BandEdge Emission at PI/4-DQPSK Hopping Mode

[PI/4-DQPSK Hopping Mode] Low Channel BandEdge



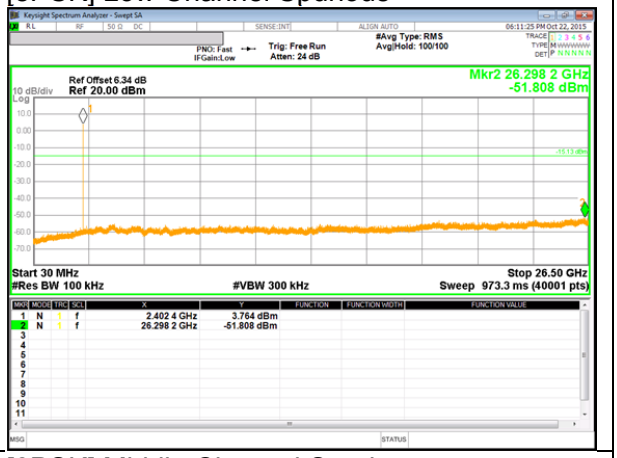
[PI/4-DQPSK Hopping Mode] High Channel BandEdge



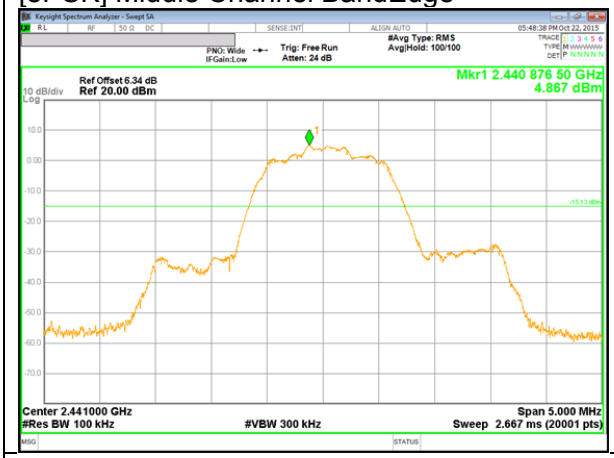
8PSK Mode

[8PSK] Low Channel BandEdge

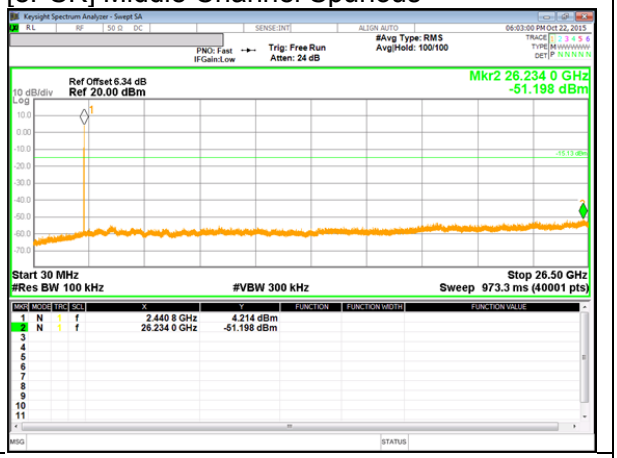
[8PSK] Low Channel Spurious



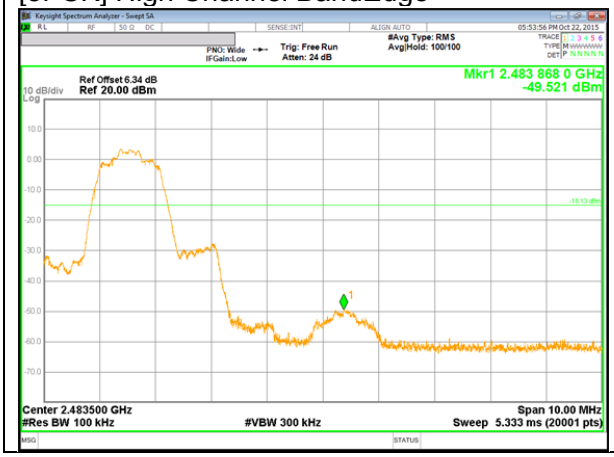
[8PSK] Middle Channel BandEdge



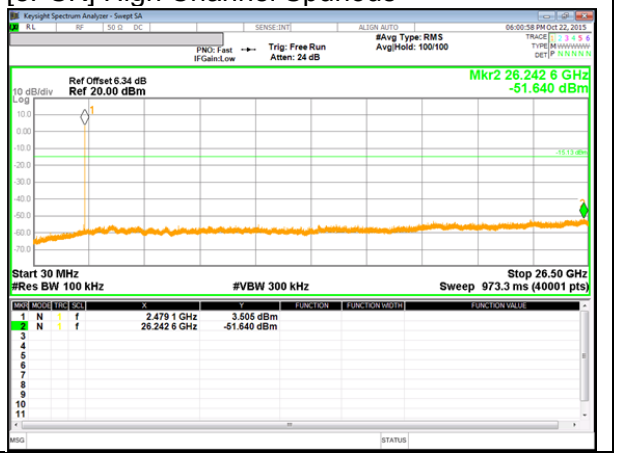
[8PSK] Middle Channel Spurious



[8PSK] High Channel BandEdge



[8PSK] High Channel Spurious



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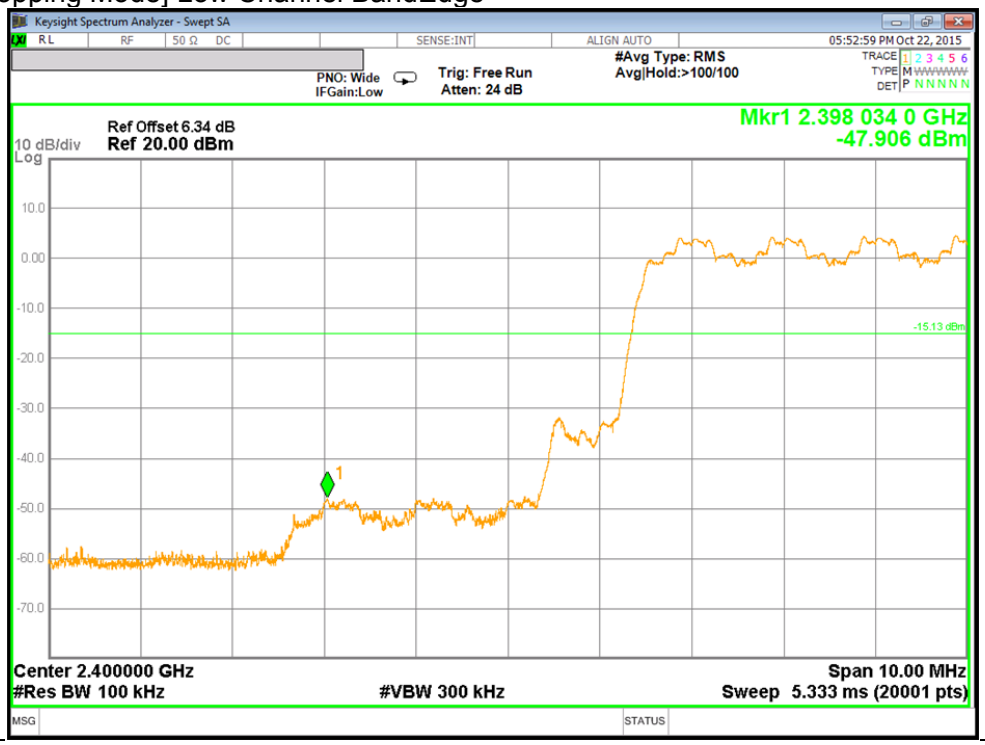
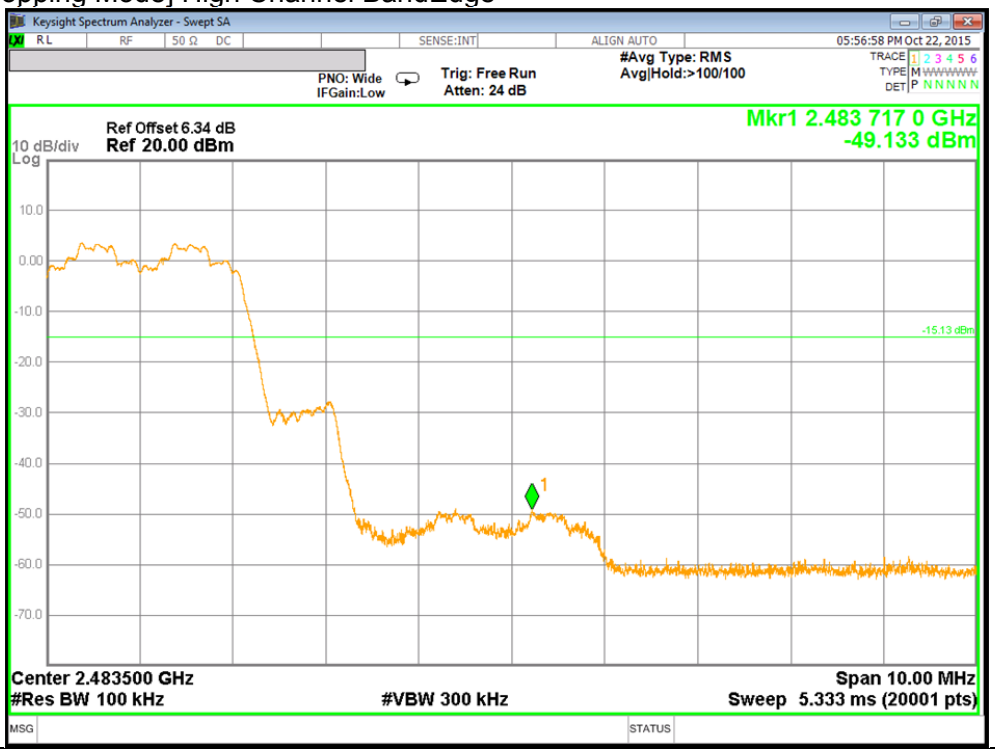
BandEdge Emission at 8PSK Hopping Mode

[8PSK Hopping Mode] Low Channel BandEdge



[8PSK Hopping Mode] High Channel BandEdge



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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For band edge measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 1/T (on time) for average measurement.

GFSK = 1/T = 1 / 0.0029S = 350Hz.

The spectrum from 1GHzHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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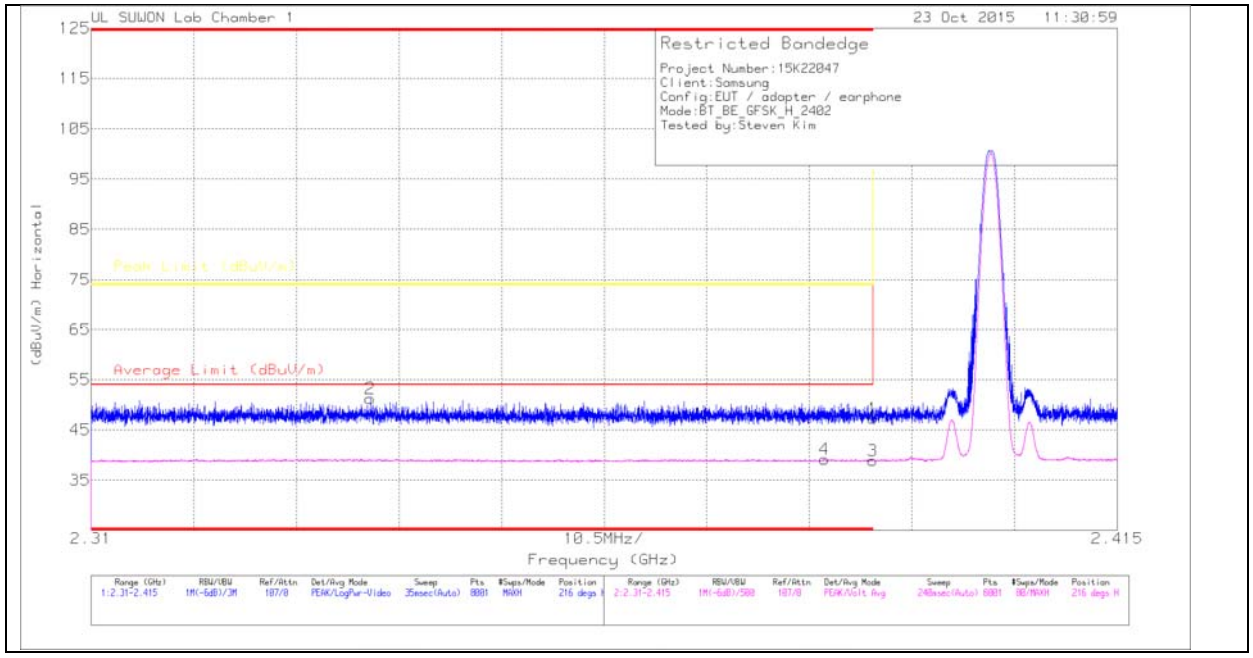
9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

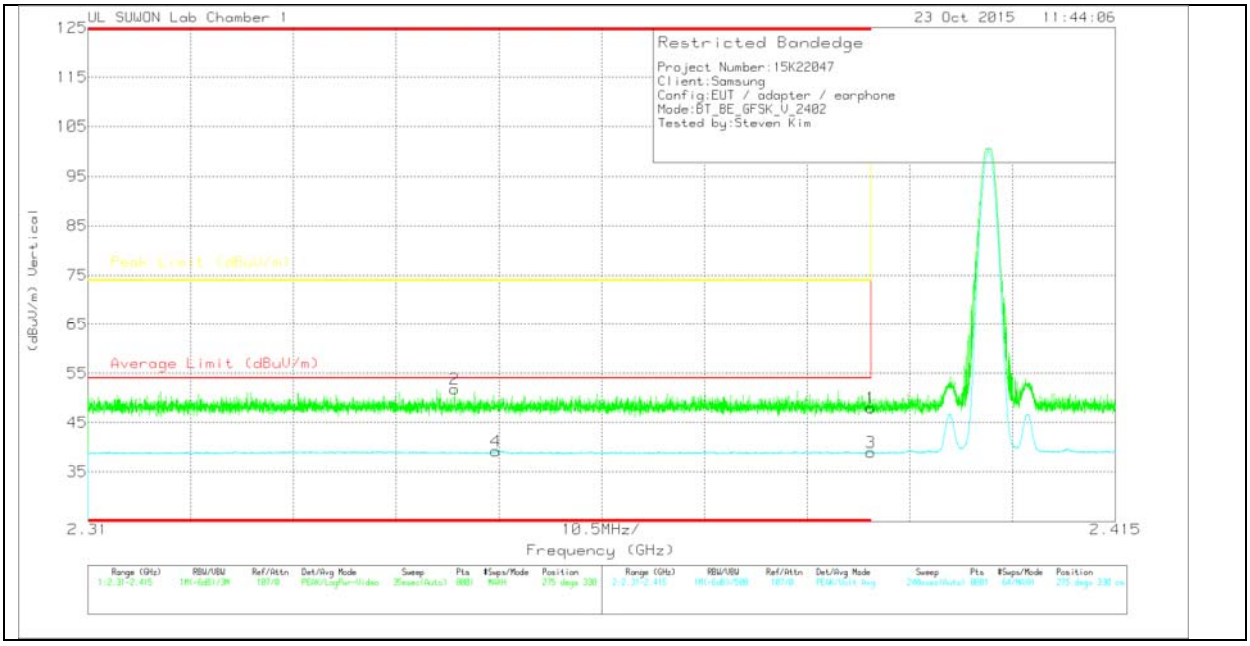
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	43.93	Pk	31.8	-28.4	47.33	-	-	74	-26.67	216	100	H
2	* 2.339	48.03	Pk	31.7	-28.5	51.23	-	-	74	-22.77	216	100	H
3	* 2.39	35.51	V1TV	31.8	-28.4	38.91	54	-15.09	-	-	216	100	H
4	* 2.385	35.89	V1TV	31.8	-28.5	39.19	54	-14.81	-	-	216	100	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

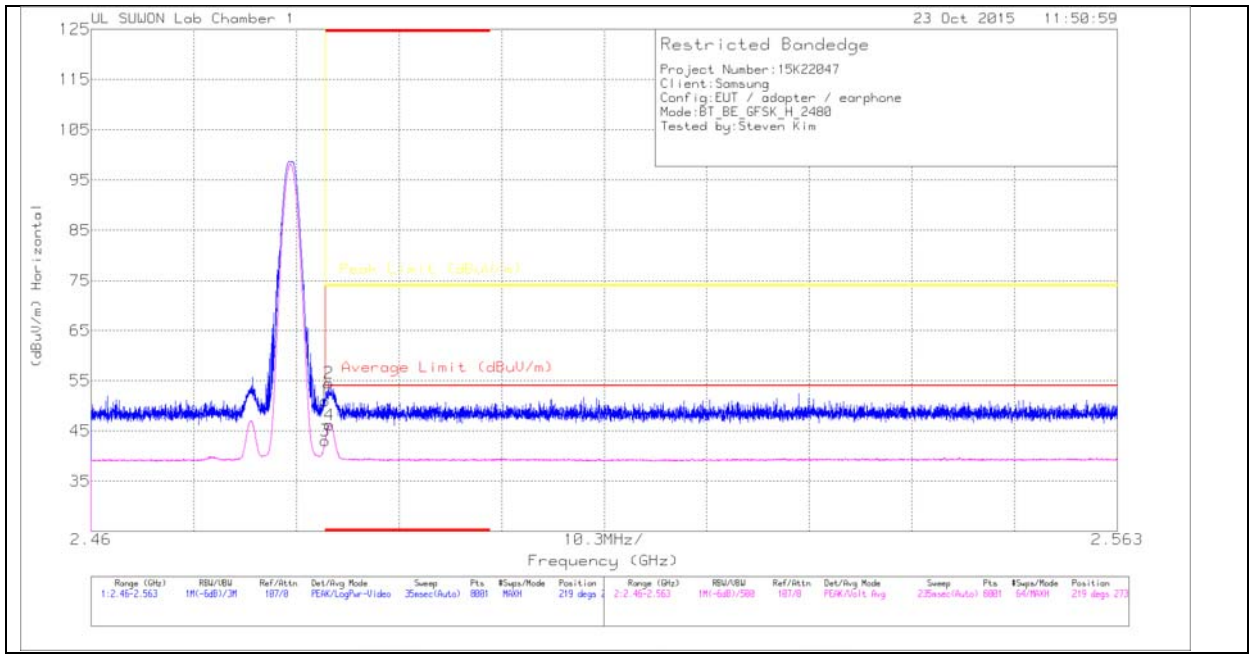
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2_10dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	44.54	Pk	31.8	-28.4	47.94	-	-	74	-26.06	275	330	V
2	* 2.347	48.65	Pk	31.7	-28.5	51.85	-	-	74	-22.15	275	330	V
3	* 2.39	35.54	V1TV	31.8	-28.4	38.94	54	-15.06	-	-	275	330	V
4	* 2.352	36.01	V1TV	31.7	-28.5	39.21	54	-14.79	-	-	275	330	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

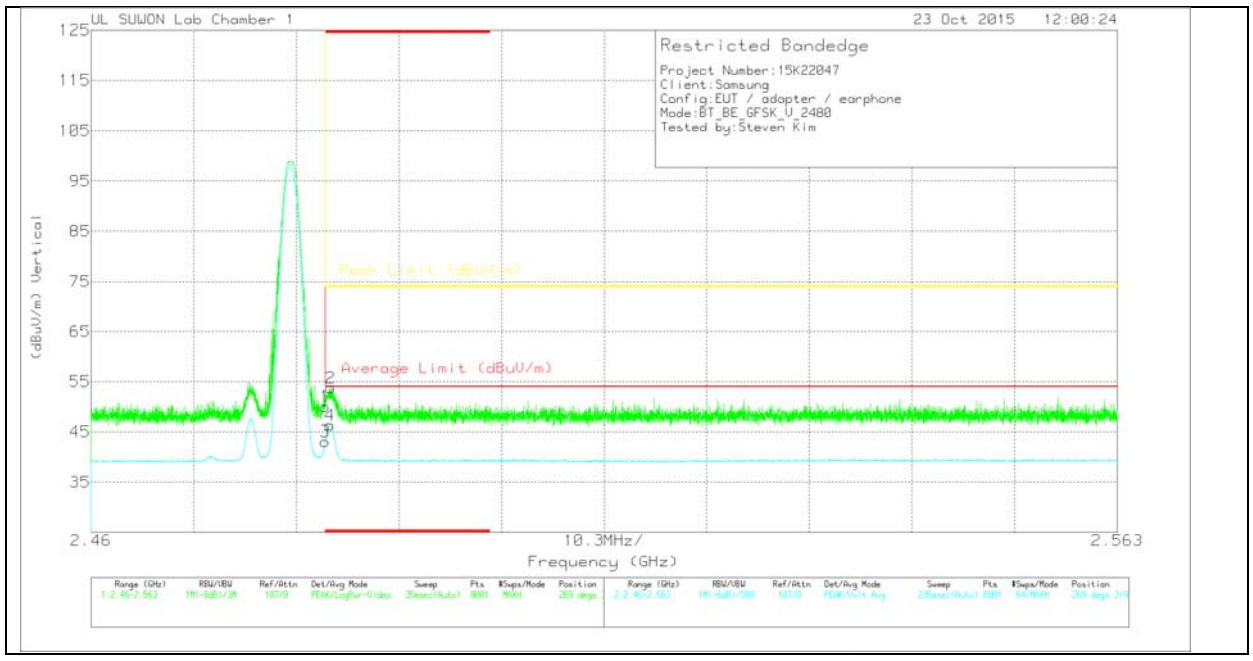
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8717)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.33	Pk	32	-28.3	51.03	-	-	74	-22.97	219	273	H
2	* 2.484	50.82	Pk	32	-28.3	54.52	-	-	74	-19.48	219	273	H
3	* 2.484	39.39	V1TV	32	-28.3	43.09	54	-10.91	-	-	219	273	H
4	* 2.484	42.53	V1TV	32	-28.3	46.23	54	-7.77	-	-	219	273	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

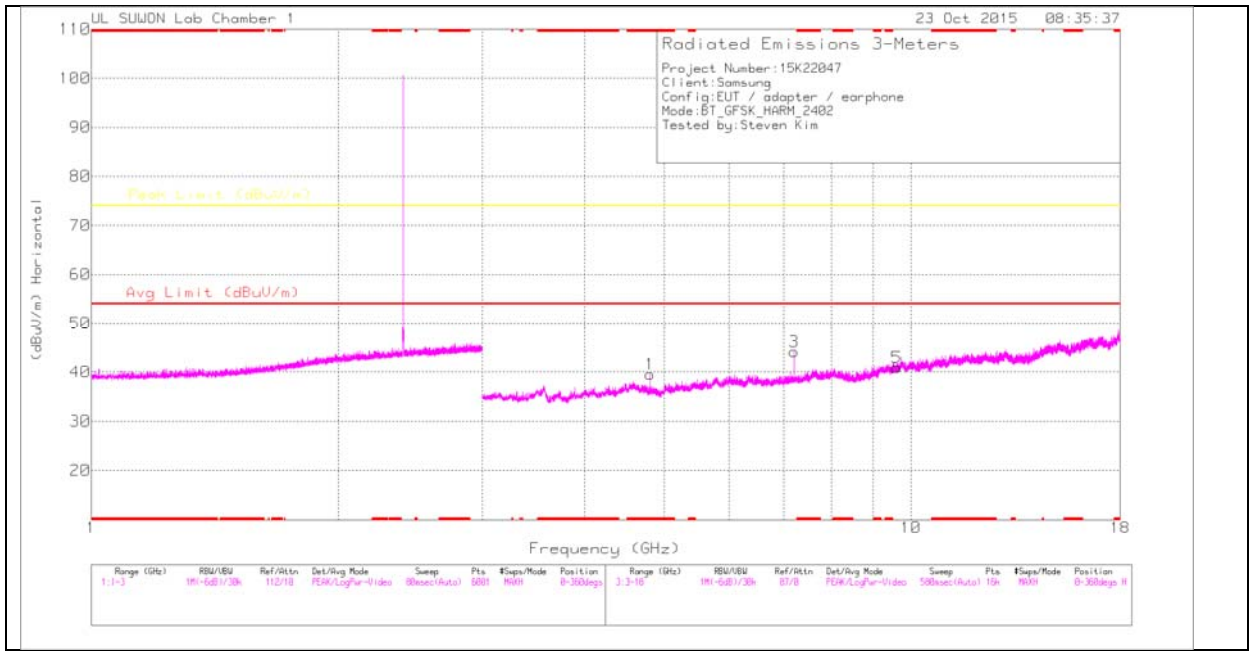
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	46.34	Pk	32	-28.3	50.04	-	-	74	-23.96	269	319	V
2	* 2.484	50.08	Pk	32	-28.3	53.78	-	-	74	-20.22	269	319	V
3	* 2.484	39.4	V1TV	32	-28.3	43.1	54	-10.9	-	-	269	319	V
4	* 2.484	42.61	V1TV	32	-28.3	46.31	54	-7.69	-	-	269	319	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

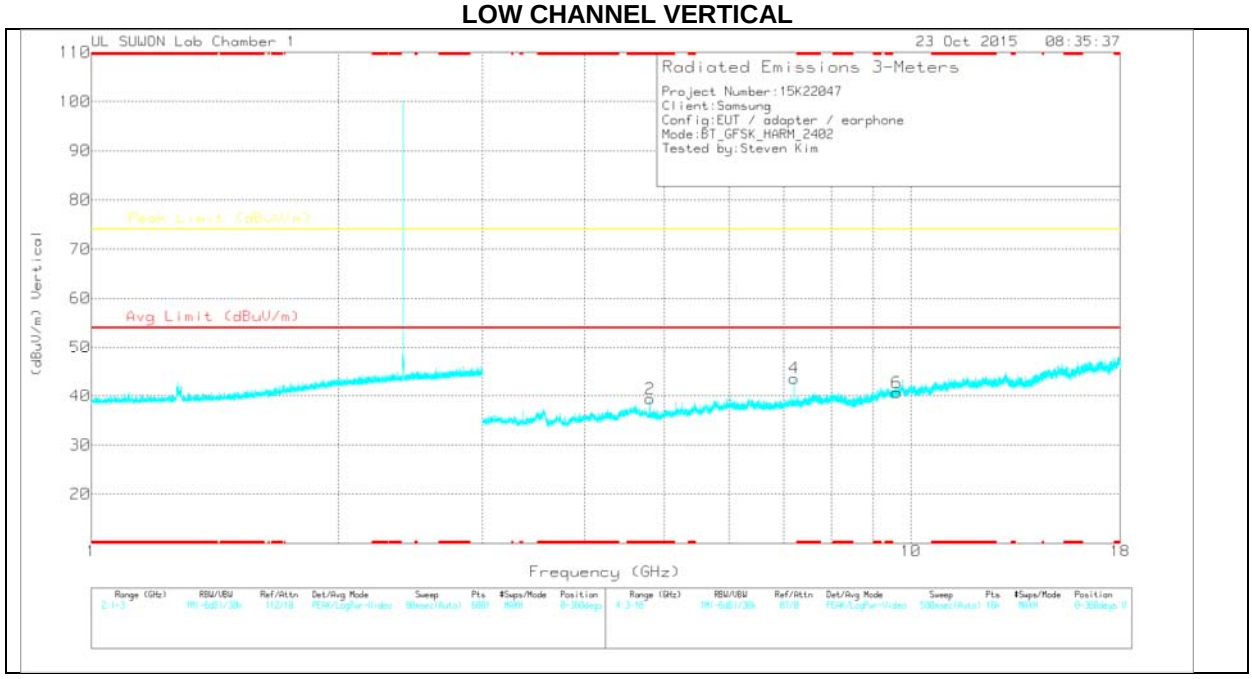
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_3_3GHP	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.804	38.52	PK	34	-33	39.52	-	-	74	-34.48	0-360	100	H
3	7.206	38.43	PK	35.7	-30	44.13	-	-	74	-29.87	0-360	200	H
5	9.609	30.5	PK	37	-26.6	40.9	-	-	74	-33.1	0-360	100	H
2	* 4.804	38.4	PK	34	-33	39.4	-	-	74	-34.6	0-360	200	V
4	7.206	37.89	PK	35.7	-30	43.59	-	-	74	-30.41	0-360	100	V
6	9.61	30.26	PK	37	-26.6	40.66	-	-	74	-33.34	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_3_3GHP	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.805	48.53	PK2	34	-33	49.53	-	-	74	-24.47	178	303	H
* 4.804	36.47	VA1T	34	-33	37.47	54	-16.53	-	-	178	303	H
7.205	46.64	PK2	35.7	-30	52.34	-	-	74	-21.66	351	213	H
* 4.804	48.55	PK2	34	-33	49.55	-	-	74	-24.45	56	270	V
* 4.804	37.26	VA1T	34	-33	38.26	54	-15.74	-	-	56	270	V
7.205	46.98	PK2	35.7	-30	52.68	-	-	74	-21.32	280	101	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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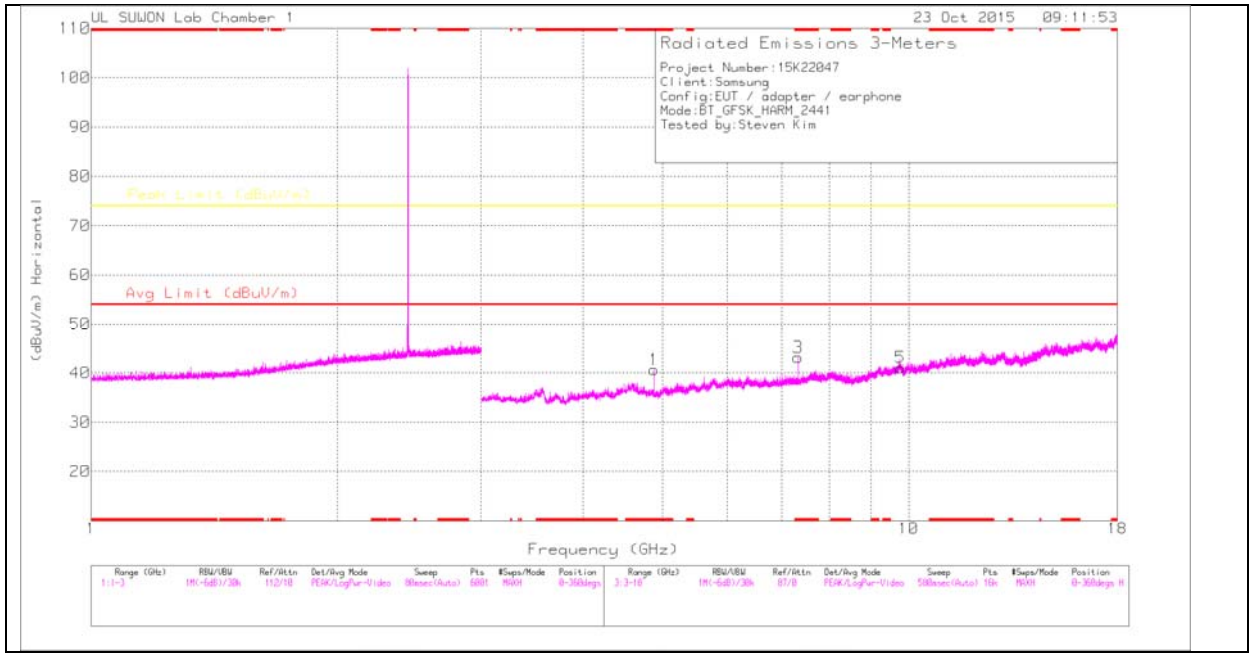
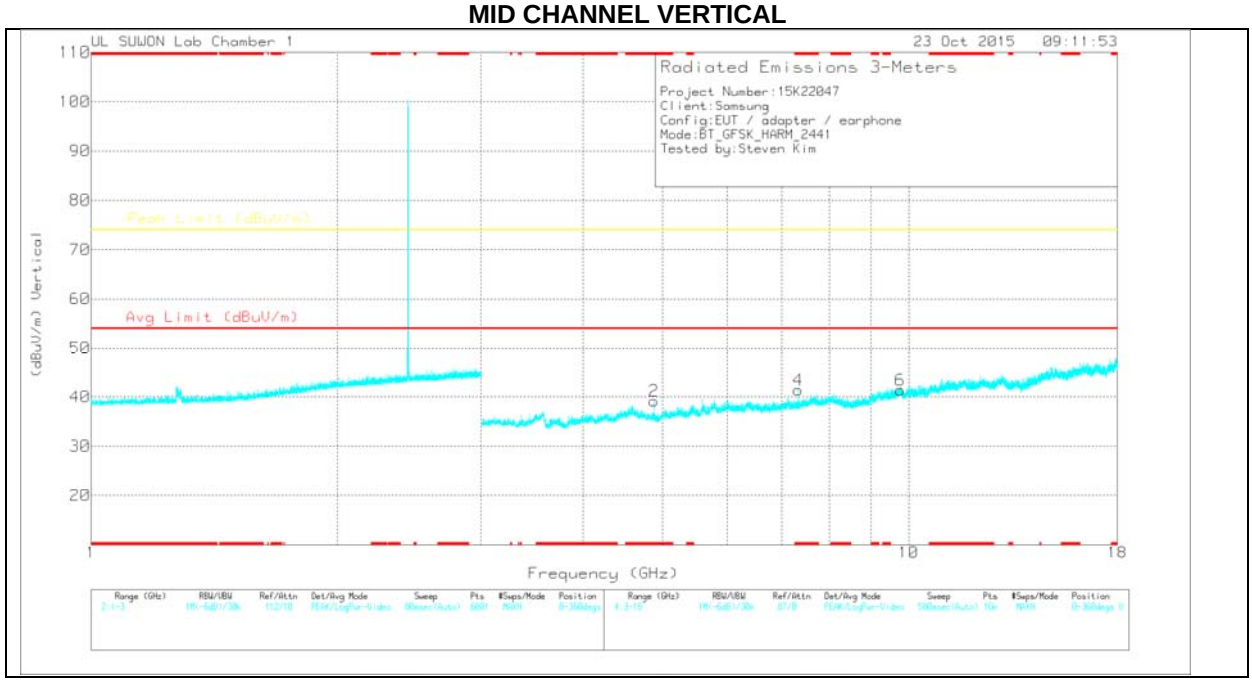
MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8717)_150 619	Path_3_3G HP	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.881	39.78	PK	34	-33.1	40.68	-	-	74	-33.32	0-360	200	H
3	* 7.323	37.37	PK	35.8	-30	43.17	-	-	74	-30.83	0-360	200	H
5	9.765	29.9	PK	37.2	-26	41.1	-	-	74	-32.9	0-360	200	H
2	* 4.882	38.29	PK	34	-33.1	39.19	-	-	74	-34.81	0-360	100	V
4	* 7.323	35.61	PK	35.8	-30	41.41	-	-	74	-32.59	0-360	100	V
6	9.766	30.22	PK	37.2	-26	41.42	-	-	74	-32.58	0-360	200	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

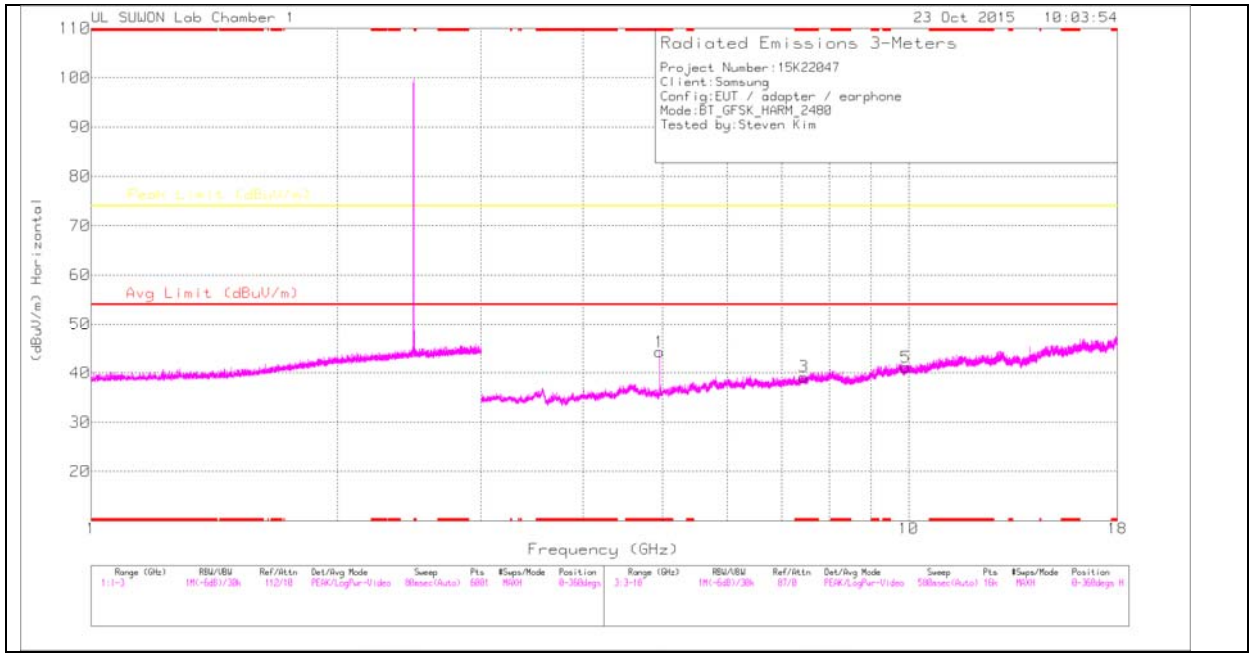
Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8717)_150 619	Path_3_3G HP	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.882	49.4	PK2	34	-33.1	50.3	-	-	74	-23.7	303	306	H
* 4.882	39.69	VA1T	34	-33.1	40.59	54	-13.41	-	-	303	306	H
* 7.324	44.78	PK2	35.8	-30	50.58	-	-	74	-23.42	22	307	H
* 7.323	31.16	VA1T	35.8	-30	36.96	54	-17.04	-	-	22	307	H
* 4.882	49.34	PK2	34	-33.1	50.24	-	-	74	-23.76	47	221	V
* 4.882	39.07	VA1T	34	-33.1	39.97	54	-14.03	-	-	47	221	V
* 7.322	46.53	PK2	35.8	-30	52.33	-	-	74	-21.67	280	100	V
* 7.323	35.4	VA1T	35.8	-30	41.2	54	-12.8	-	-	280	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

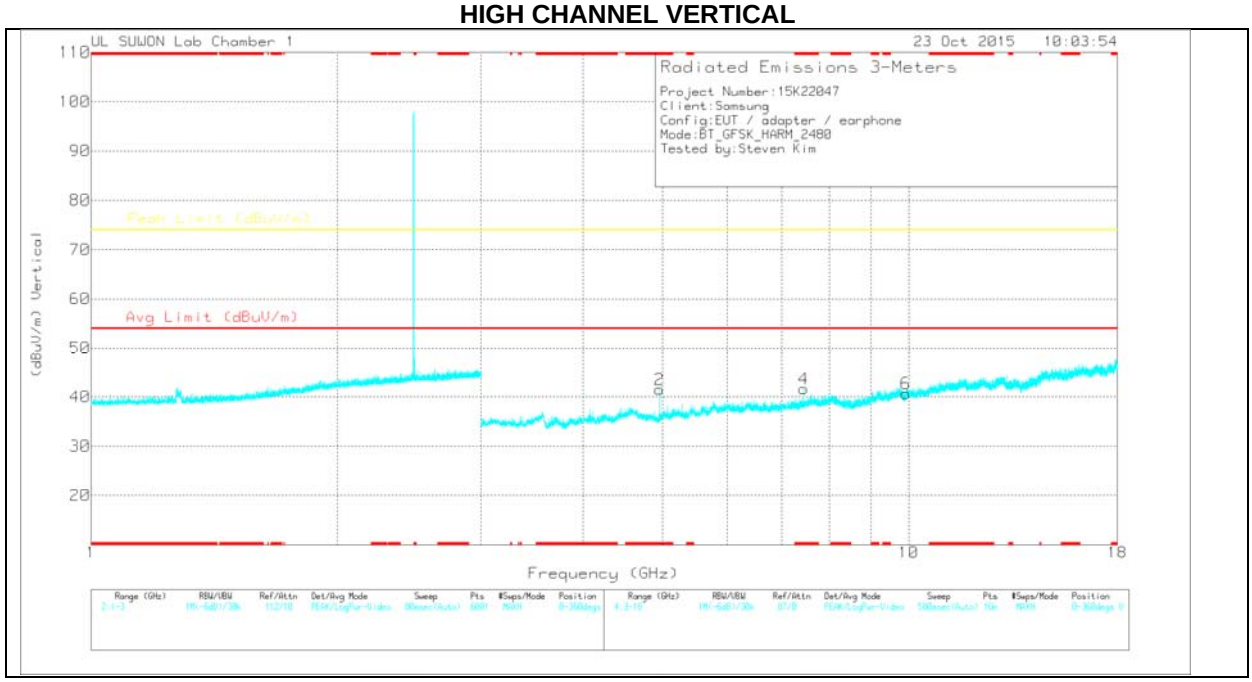
PK2 - Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_3_3GHP	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.96	43.36	PK	34	-33.1	44.26	-	-	74	-29.74	0-360	100	H
3	* 7.444	33.34	PK	35.8	-29.9	39.24	-	-	74	-34.76	0-360	100	H
5	9.919	30.33	PK	37.4	-26.6	41.13	-	-	74	-32.87	0-360	100	H
2	* 4.96	40.62	PK	34	-33.1	41.52	-	-	74	-32.48	0-360	200	V
4	* 7.44	35.77	PK	35.8	-29.9	41.67	-	-	74	-32.33	0-360	200	V
6	9.92	29.88	PK	37.4	-26.6	40.68	-	-	74	-33.32	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.96	50.09	PK2	34	-33.1	50.99	-	-	74	-23.01	147	100	H
* 4.96	42.43	VA1T	34	-33.1	43.33	54	-10.67	-	-	147	100	H
* 4.96	49.05	PK2	34	-33.1	49.95	-	-	74	-24.05	41	209	V
* 4.96	40.7	VA1T	34	-33.1	41.6	54	-12.4	-	-	41	209	V
* 7.438	43.95	PK2	35.8	-29.9	49.85	-	-	74	-24.15	273	241	V
* 7.44	30.26	VA1T	35.8	-29.9	36.16	54	-17.84	-	-	273	241	V

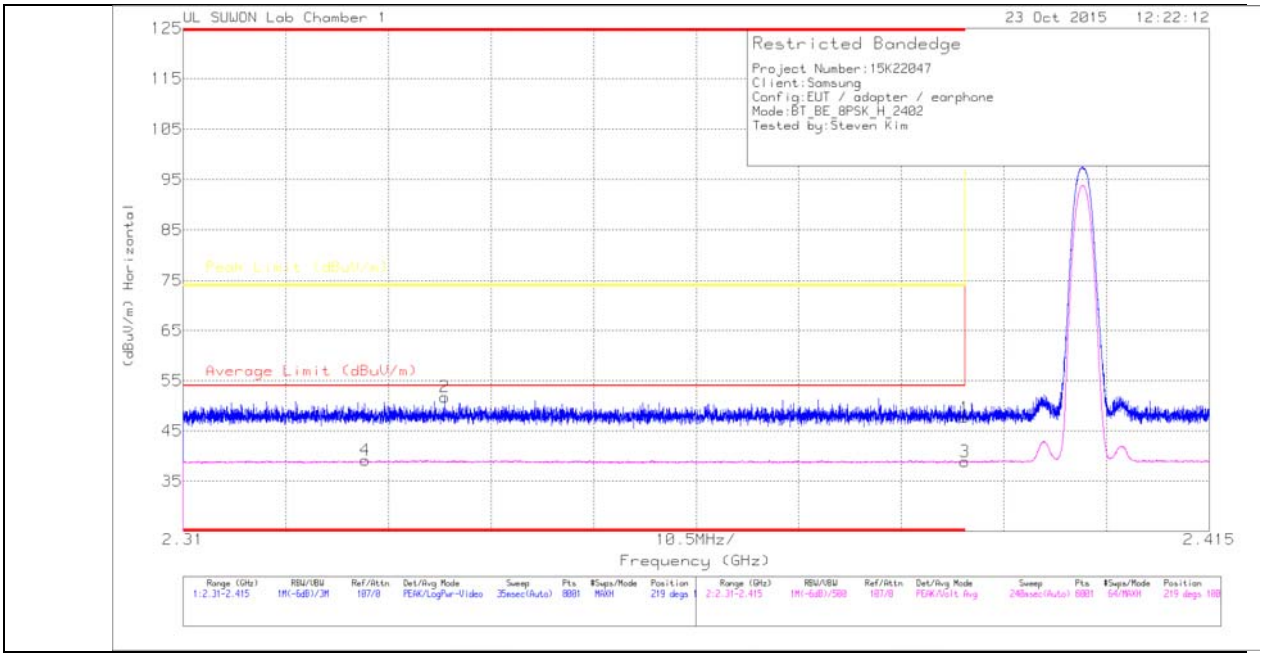
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

9.2.2. ENHANCED DATA RATE 8PSK MODULATION RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

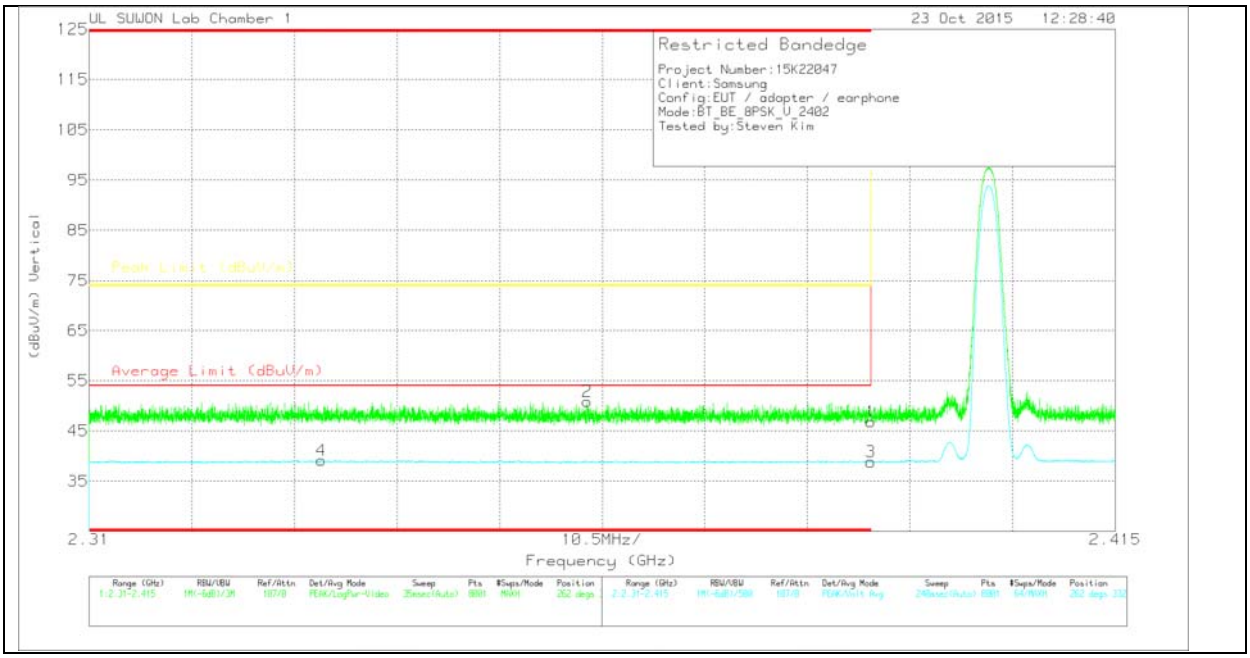
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	44.29	Pk	31.8	-28.4	47.69	-	-	74	-26.31	219	100	H
2	* 2.337	48.56	Pk	31.7	-28.5	51.76	-	-	74	-22.24	219	100	H
3	* 2.39	35.54	V1TV	31.8	-28.4	38.94	54	-15.06	-	-	219	100	H
4	* 2.329	36.01	V1TV	31.7	-28.5	39.21	54	-14.79	-	-	219	100	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

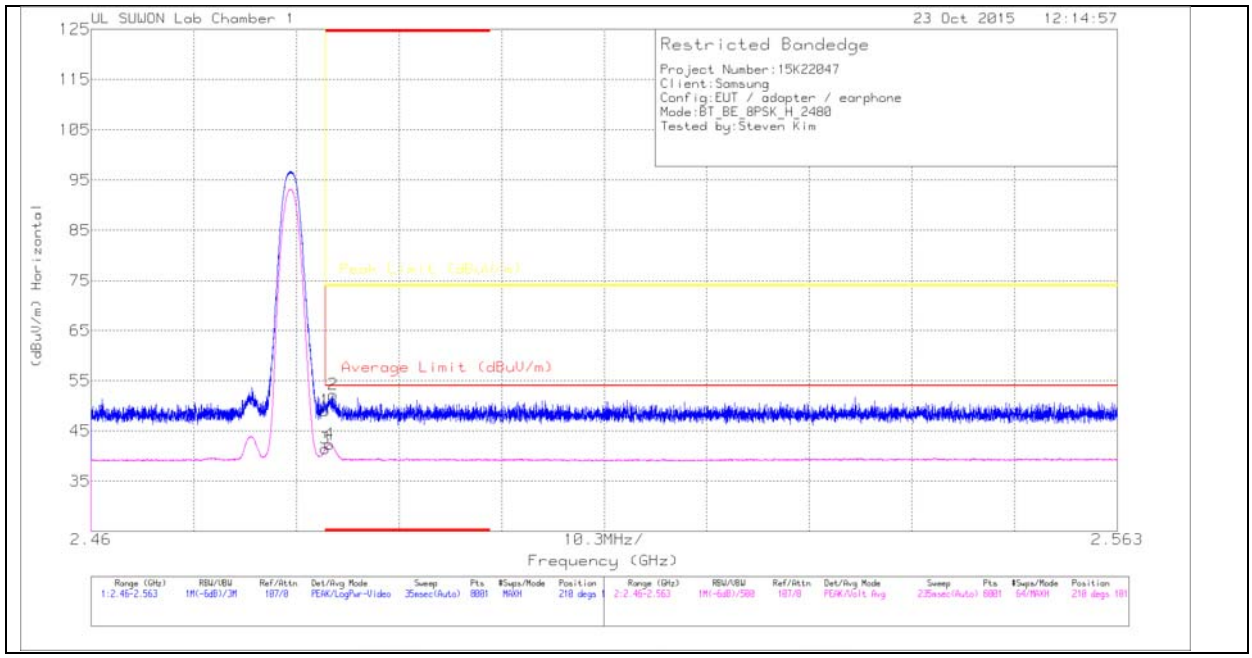
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	43.4	Pk	31.8	-28.4	46.8	-	-	74	-27.2	262	332	V
2	* 2.361	47.67	Pk	31.7	-28.5	50.87	-	-	74	-23.13	262	332	V
3	* 2.39	35.47	V1TV	31.8	-28.4	38.87	54	-15.13	-	-	262	332	V
4	* 2.334	35.97	V1TV	31.7	-28.5	39.17	54	-14.83	-	-	262	332	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8717)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	45.35	Pk	32	-28.3	49.05	-	-	74	-24.95	210	101	H
2	* 2.484	48.55	Pk	32	-28.3	52.25	-	-	74	-21.75	210	101	H
3	* 2.484	37.83	V1TV	32	-28.3	41.53	54	-12.47	-	-	210	101	H
4	* 2.484	38.67	V1TV	32	-28.3	42.37	54	-11.63	-	-	210	101	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector