FCC CFR47 PART 15 SUBPART C

Bluetooth

CERTIFICATION TEST REPORT

FOR

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

MODEL NUMBER : SM-G611F/DS

FCC ID: A3LSMG611F

REPORT NUMBER: 4788217835-E3V1

ISSUE DATE: NOV 29, 2017

Prepared for
SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
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ACCREDITED
TL-637

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Rev.	Issue Date	Revisions	Revised By
V1	11/29/17	Initial issue	Junwhan Lee

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION:	GSM/WCDMA/LTE Phone + BT/BLE, DTS b/g/n and ANT+
MODEL NUMBER:	SM-G611F/DS
SERIAL NUMBER:	5203a883e8304309, R38H70DHYVE (Original, RADIATED); R38H60EJBGD (Original, CONDUCTED) R38JA06J7SM (Spot check, RADIATED);
DATE TESTED:	JUL 18, 2016 - AUG 05, 2016 (Original Test) NOV 13, 2017 (Spot check Test)

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.

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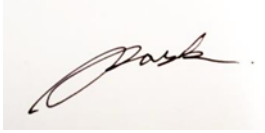
UL Korea, Ltd. By:



SungGil Park
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

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1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMG610F, DSS BLUETOOTH(FCC CFR 47 Part 15C). And the applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

1.2. DIFFERENCE

The FCC ID: A3LSMG611F shares the same enclosure and circuit board as FCC ID: A3LSMG610F. The BLUETOOTH circuitry and layout are identical between these two units. The BLUETOOTH antennas and surrounding circuitry are the same between these two units.

After confirming through preliminary radiated emissions that the performance of the FCC ID: A3LSMG610F remains representative of FCC ID: A3LSMG611F. The test data of FCC ID: A3LSMG610F being submitted for this application to cover BLUETOOTH features.

1.3. SPOT CHECK VERIFICATION DATA

Band	Test Item	Mode	Frequency	Test Limit	Original model	Spot check model	Deviation	Remark
					SM-G610F/DD Results	SM-G611F/DS Results		
					FCC ID : A3LSMG610F	FCC ID : A3LSMG611F		
DSS BT (2.4GHz)	Band Edge	GFSK	2480 MHz	54 dBuV/m	39.37 dBuV/m	39.35 dBuV/m	-0.02 dB	
	RSE	GFSK	7323 MHz	54 dBuV/m	43.82 dBuV/m	46.67 dBuV/m	2.85 dB	3rd Harmonic

Comparison of two models, deviation is within 3dB range and test results are under FCC Technical Limits.

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1.4. REFERENCE DETAIL

Reference application that contains the reused reference data.

Equipment Class	Reference FCC ID	Type Grant/Permissive Change	Reference Application	Folder Test/RF Exposure	Report Tittle / Section
DTS	A3LSMG610F	Grant	16K23775-E2V1	Test	FCC Report BLE / All sections
DSS	A3LSMG610F	Grant	16K23775-E3V1	Test	FCC Report BT / All sections
DXX	A3LSMG610F	Grant	16K23775-E4V1	Test	FCC Report ANT+ / All sections

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. FCC DA 00-705 Filling and measurement guidelines for FHSS systems
4. ANSI C63.10-2013.

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

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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

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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	3.86 dB
Radiated Disturbance, Above 1 GHz	5.97 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Phone + Bluetooth/BLE, DTS b/g/n and ANT+.
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	9.530	8.974
		Peak	10.105	10.245
	Enhanced Pi/4-DPSK	Average	5.620	3.648
		Peak	8.025	6.346
	Enhanced 8PSK	Average	5.630	3.656
		Peak	8.397	6.914

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 internal antenna, with a maximum gain of -2.1 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 X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X 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-TA50IWE	DK2H418VS/A-E	N/A
Data Cable	SAMSUNG	EP-DG915UWE	N/A	N/A
Earphone	SAMSUNG	EHS61ASFWE	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
2	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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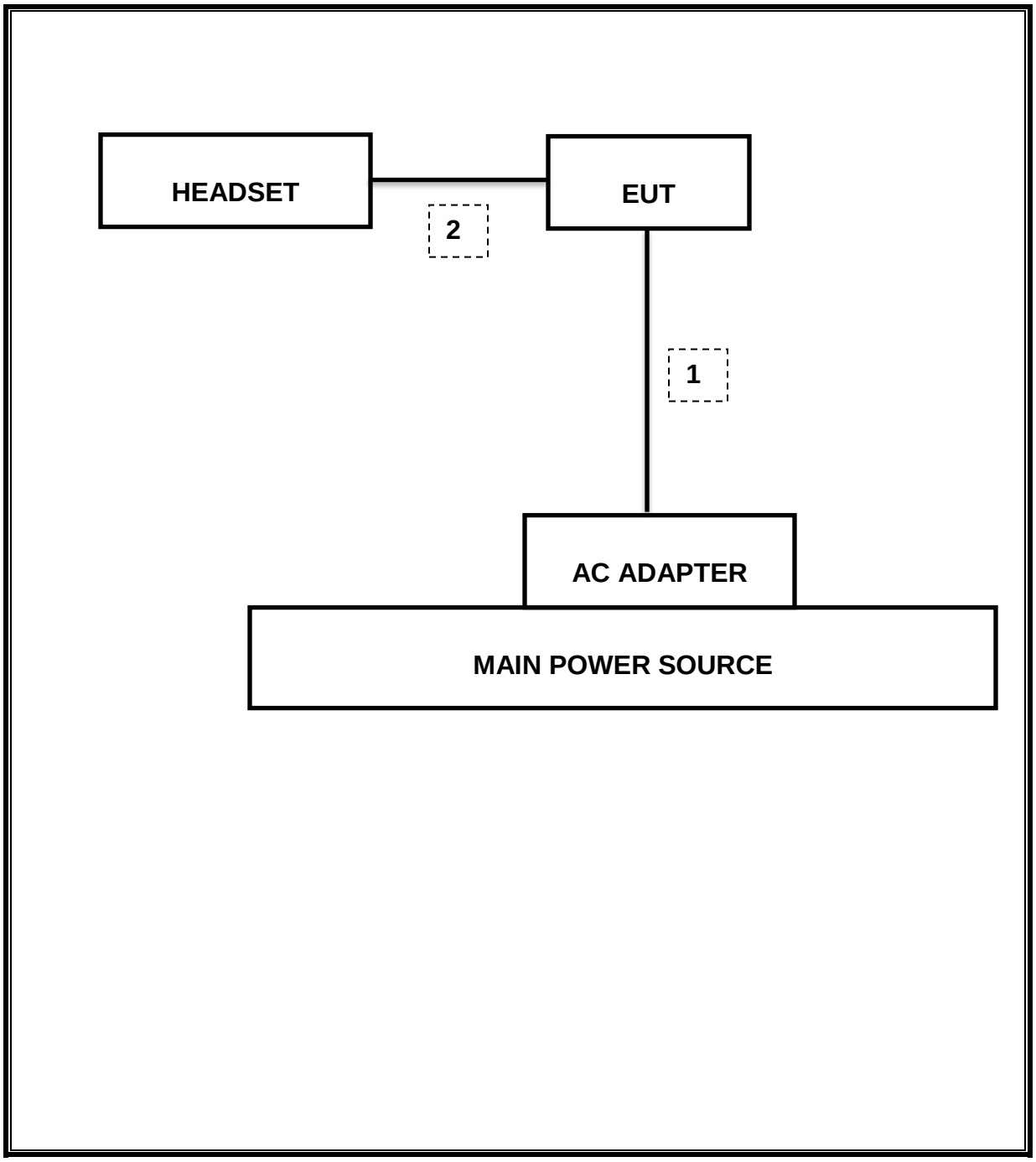
SETUP DIAGRAM FOR TESTS



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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	750	08-31-19
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-14-19
Antenna, Horn, 18 GHz	ETS	3115	00167211	10-14-18
Antenna, Horn, 18 GHz	ETS	3115	00161451	03-10-19
Antenna, Horn, 18 GHz	ETS	3117	00168724	05-31-19
Antenna, Horn, 18 GHz	ETS	3117	00168717	05-31-19
Antenna, Horn, 40 GHz	ETS	3116C	00166155	11-30-17
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	12-15-17
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-09-18
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-07-18
Preamplifier	ETS	3115-PA	00167475	08-09-18
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-08-18
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-08-18
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-08-18
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-08-18
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-07-18
Combiner	WEINSCHEL	1575	2152	08-08-18
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-08-18
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-08-18
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-07-18
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-08-18
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-08-18
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-08-18
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-08-18
High Pass Filter 6GHz	Micro-Tronics	HPM17542	009	08-08-18
High Pass Filter 6GHz	Micro-Tronics	HPM17542	016	08-08-18
LISN	R&S	ENV-216	101837	08-09-18
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	10-26-19
UL Software				
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

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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	1.200 MHz
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-37.394 dBm
15.247 (b)(1)	TX conducted output power	<21dBm		Pass	10.105 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	0.34632 sec
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	56.07 dBuV (Qp)
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	43.82 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 [KHz]
Low	2402	1.051	927.890
Mid	2441	1.050	903.540
High	2480	1.051	930.010
Worst		1.051	930.010

8.1.2. ENHANCED DATA RATE Pi/4-DQPSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.298	1.194
Mid	2441	1.351	1.194
High	2480	1.295	1.200
Worst		1.351	1.200

8.1.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.314	1.196
Mid	2441	1.313	1.196
High	2480	1.315	1.198
Worst		1.315	1.198

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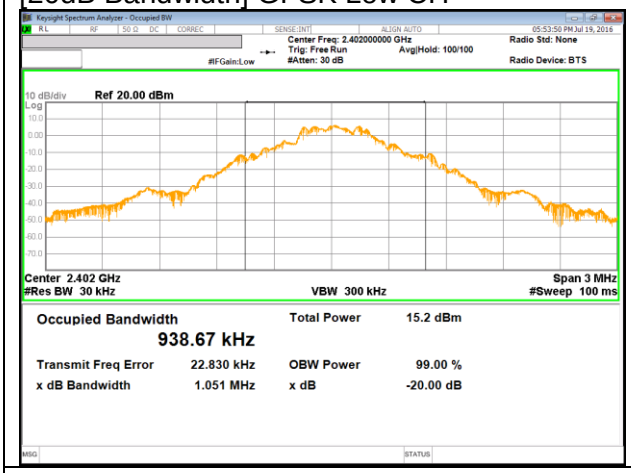
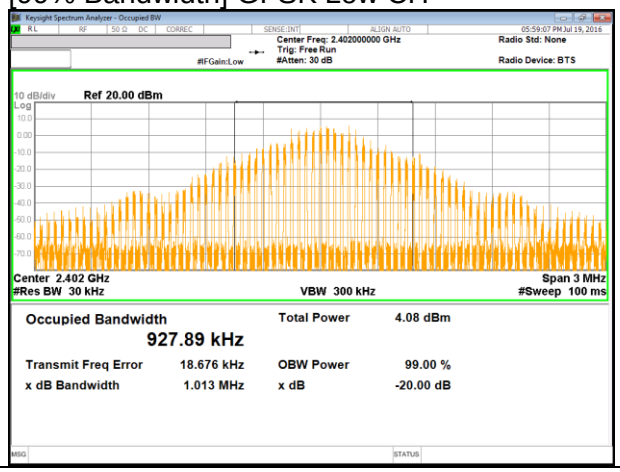
8.1.4. 20 dB AND 99% BANDWIDTH PLOTS

GFSK BANDWIDTH

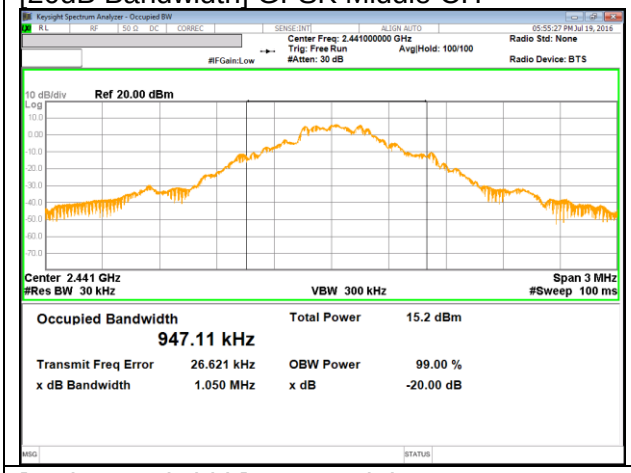
[20dB Bandwidth] GFSK Low CH



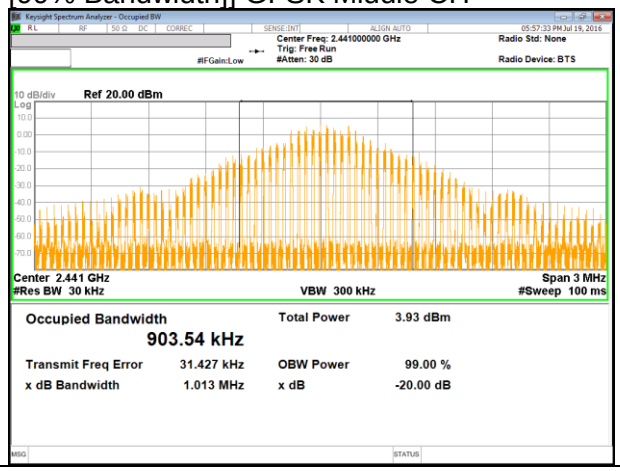
[99% Bandwidth] GFSK Low CH



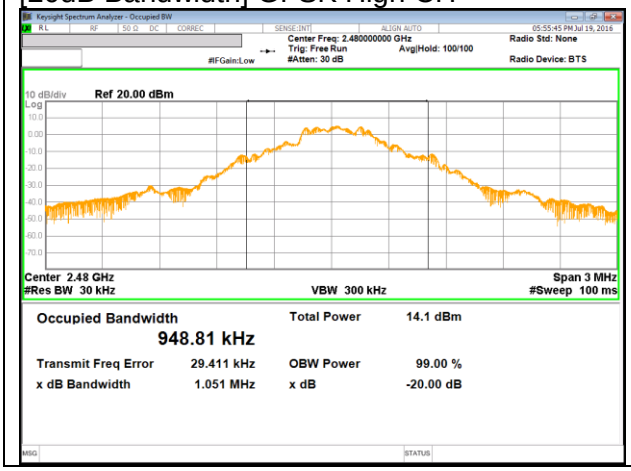
[20dB Bandwidth] GFSK Middle CH



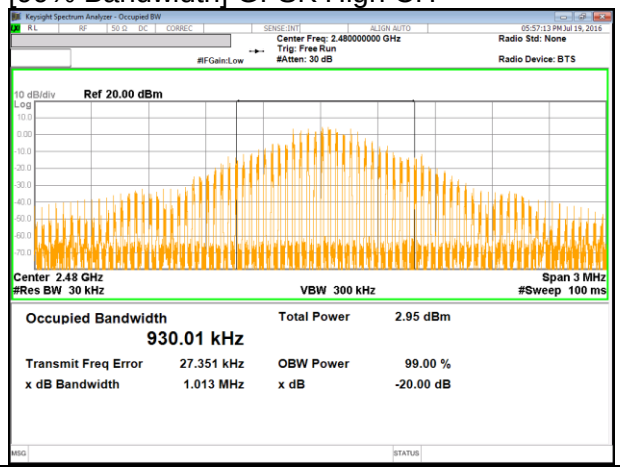
[99% Bandwidth]] GFSK Middle CH



[20dB Bandwidth] GFSK High CH



[99% Bandwidth] GFSK High CH



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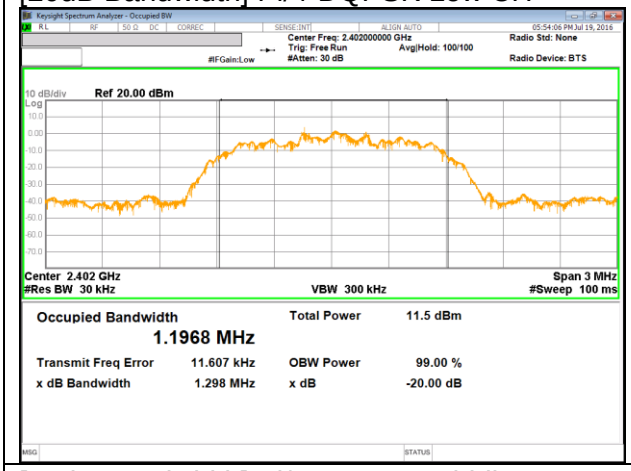
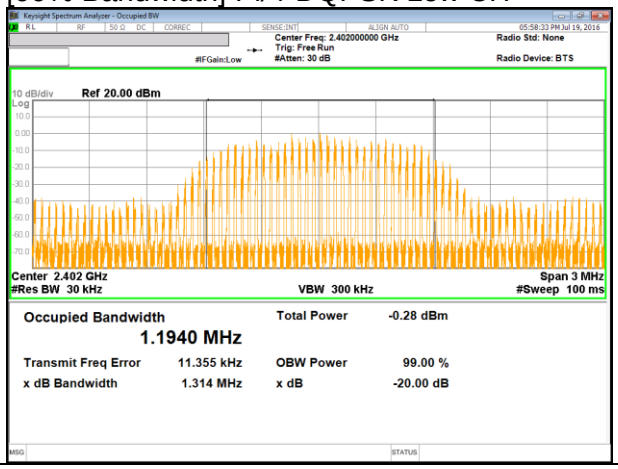
Pi/4-DQPSK BANDWIDTH

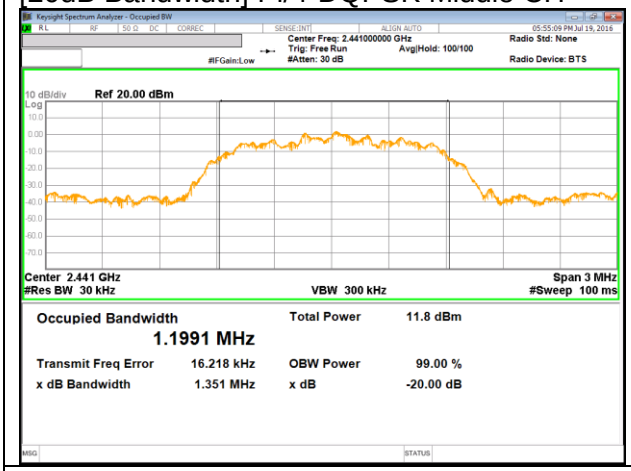
[20dB Bandwidth] Pi/4-DQPSK Low CH



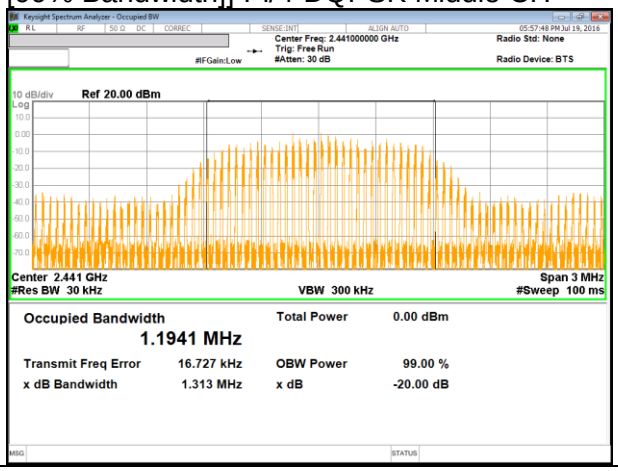
[99% Bandwidth] Pi/4-DQPSK Low CH



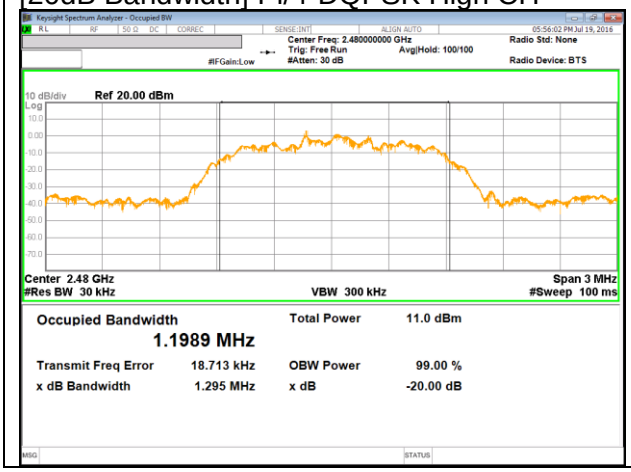
[20dB Bandwidth] Pi/4-DQPSK Middle CH



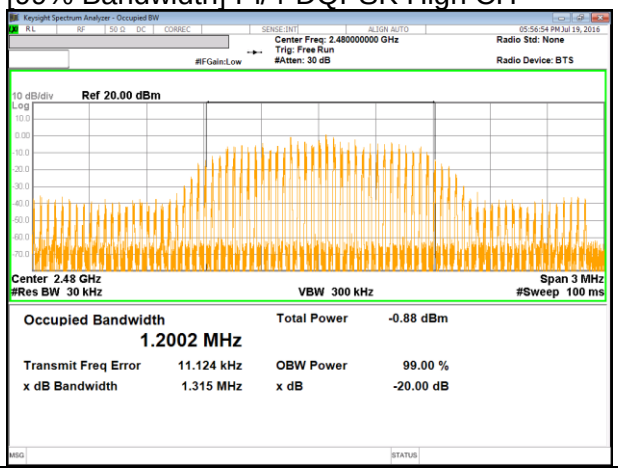
[99% Bandwidth]] Pi/4-DQPSK Middle CH



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



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



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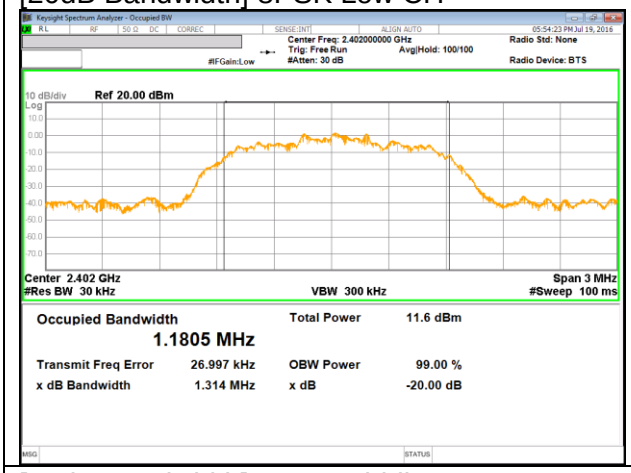
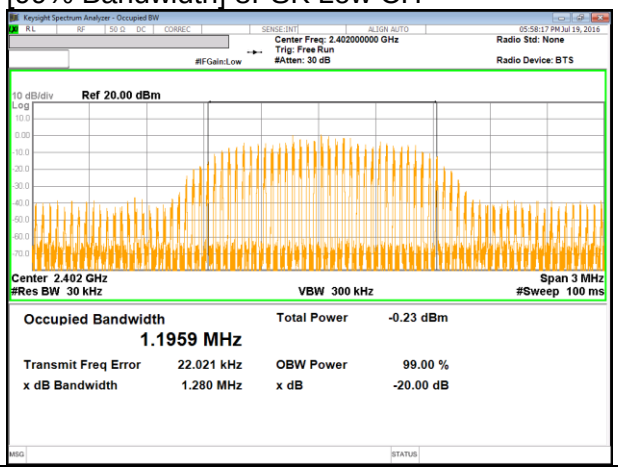
8PSK BANDWIDTH

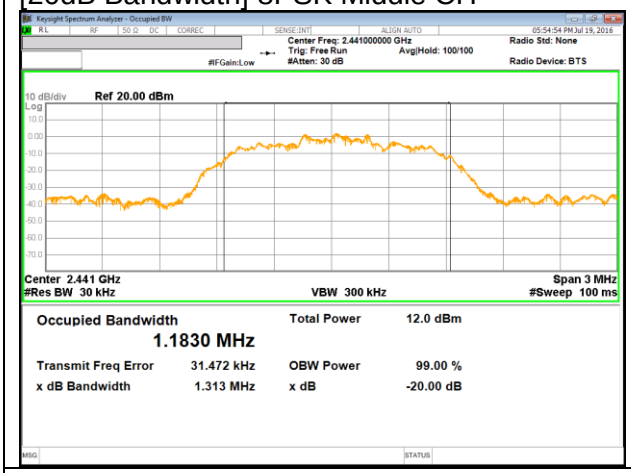
[20dB Bandwidth] 8PSK Low CH



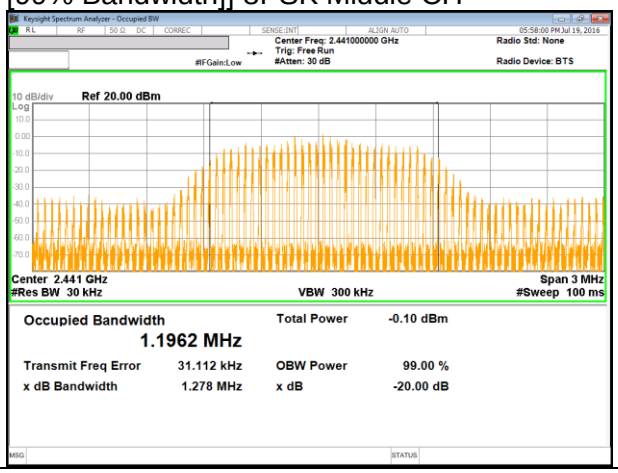
[99% Bandwidth] 8PSK Low CH



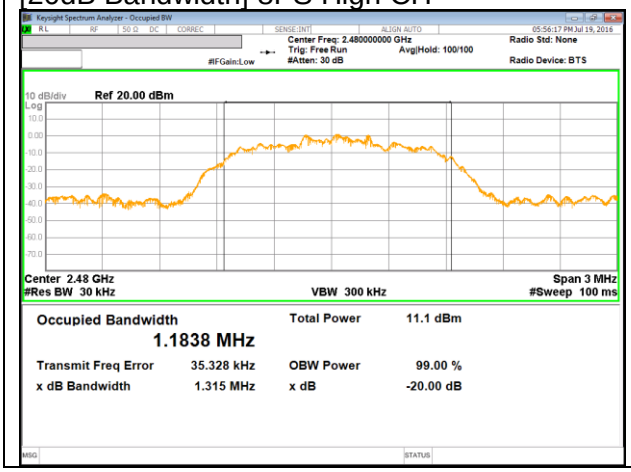
[20dB Bandwidth] 8PSK Middle CH



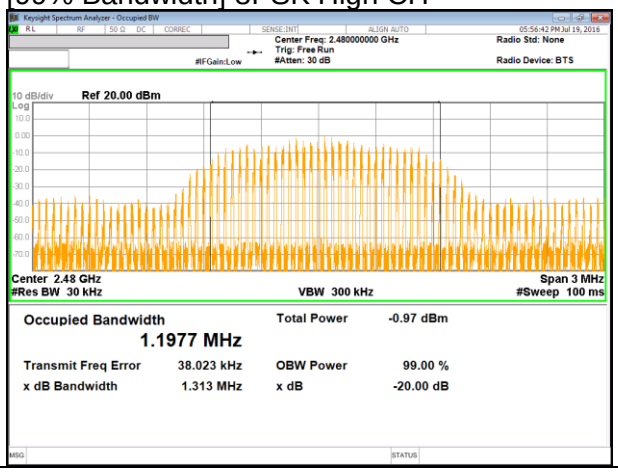
[99% Bandwidth]] 8PSK Middle CH



[20dB Bandwidth] 8PS High CH



[99% Bandwidth] 8PSK High CH



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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.

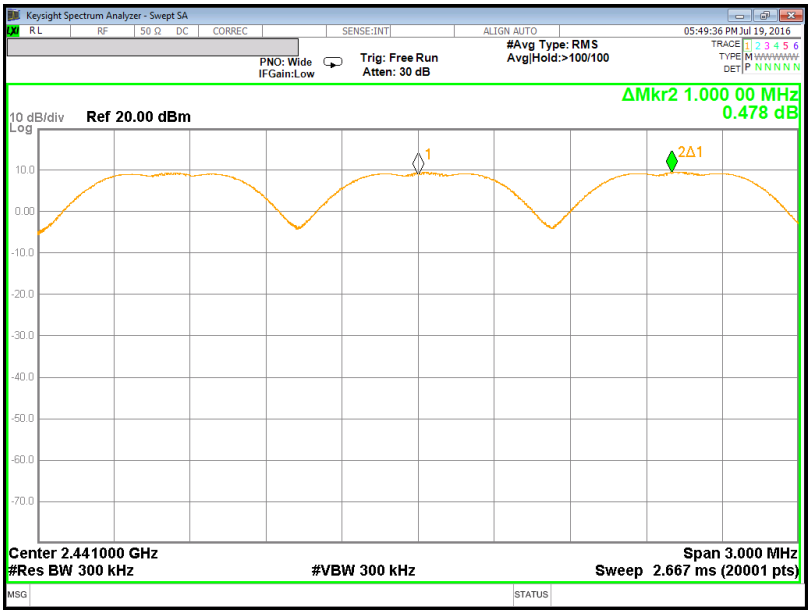
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



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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.

NUMBER OF HOPPING CHANNELS PLOTS

NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)

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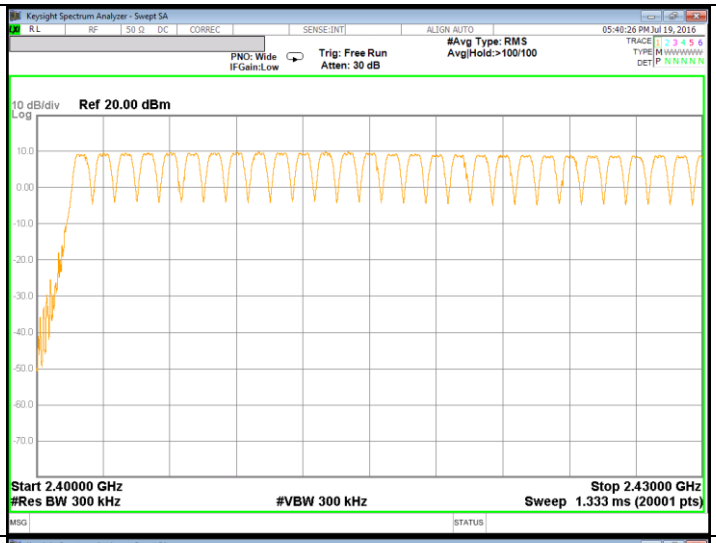
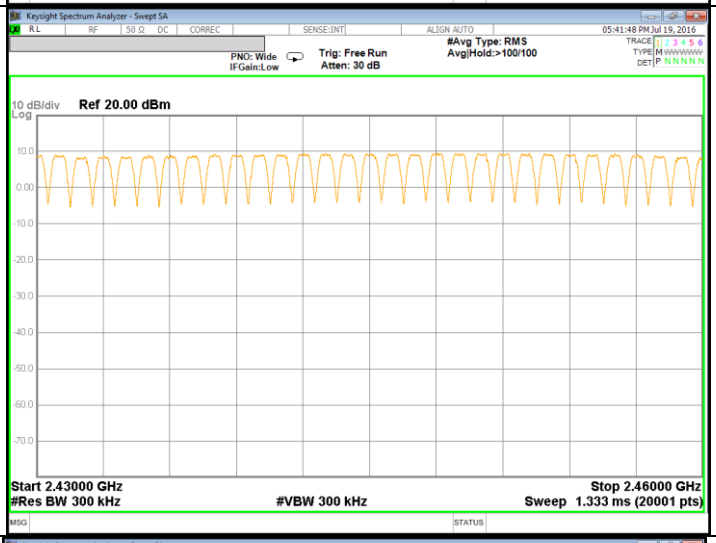
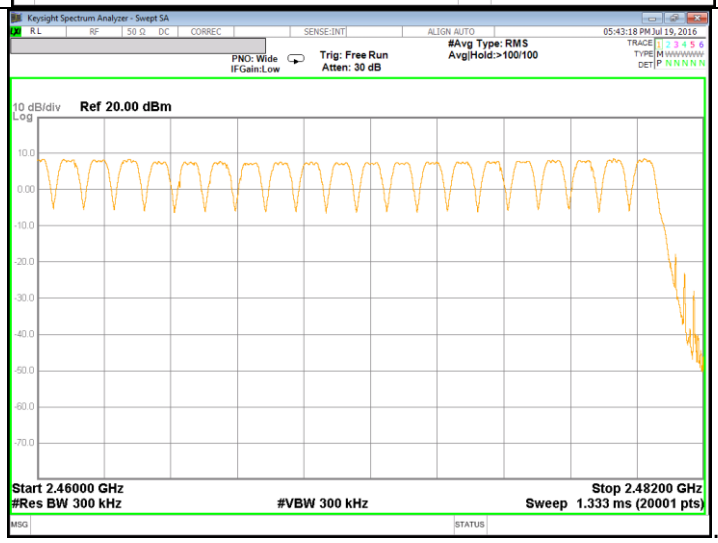
1st SEGMENT 2400 to 2430 MHz		
2nd SEGMENT 2430 to 2460 MHz		
3rd SEGMENT 2460 to 2482 MHz		

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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	0.122336	0.4	-0.2777
DH3	1.636	16	0.261760	0.4	-0.1382
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	0.030584	0.4	-0.36942
DH3	1.636	4	0.065440	0.4	-0.33456
DH5	2.886	3	0.086580	0.4	-0.31342

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DH1

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

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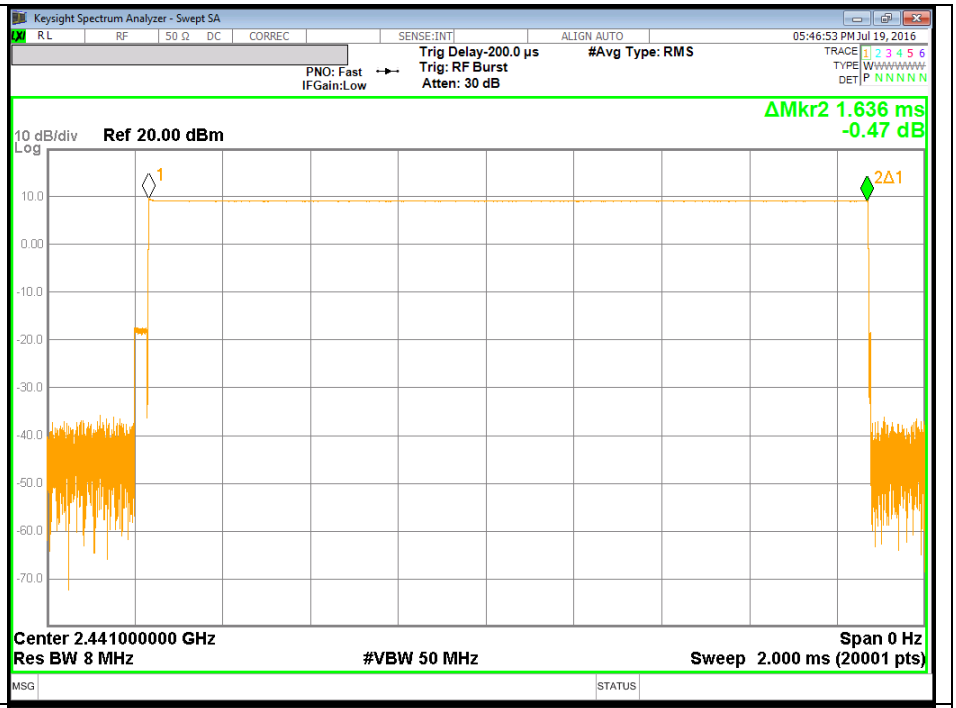
DH3

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

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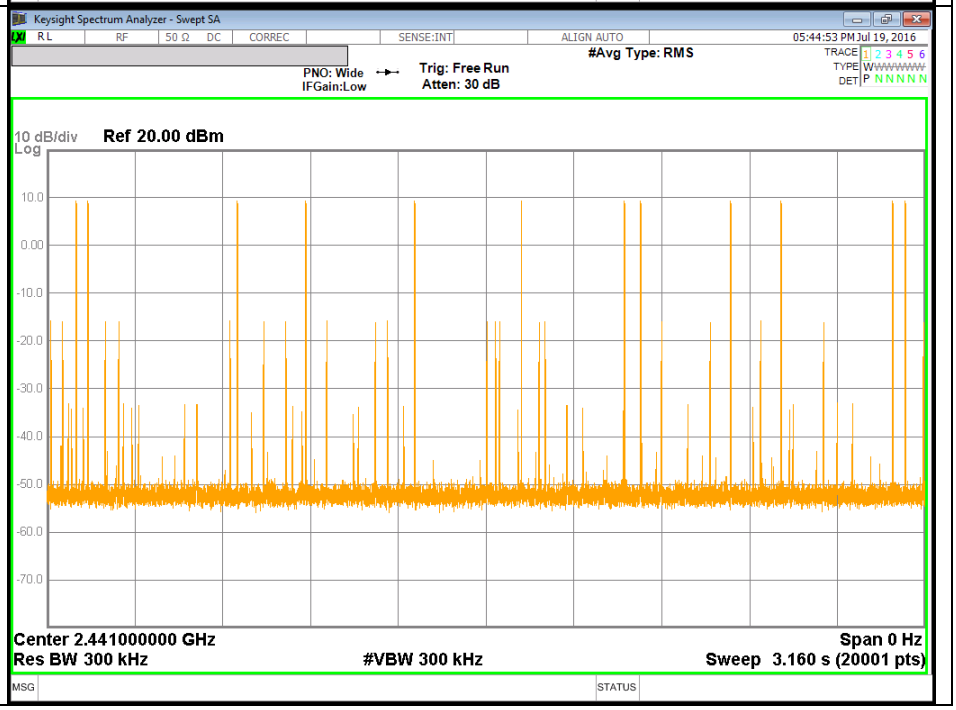
DH5

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

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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	10.033	21	-10.967
Middle	2441	10.105	21	-10.895
High	2480	9.211	21	-11.789
Worst		10.105	21	-10.895

8.5.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	7.784	21	-13.216
Middle	2441	8.025	21	-12.975
High	2480	7.068	21	-13.932
Worst		8.025	21	-12.975

8.5.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	8.226	21	-12.774
Middle	2441	8.397	21	-12.603
High	2480	7.439	21	-13.561
Worst		8.397	21	-12.603

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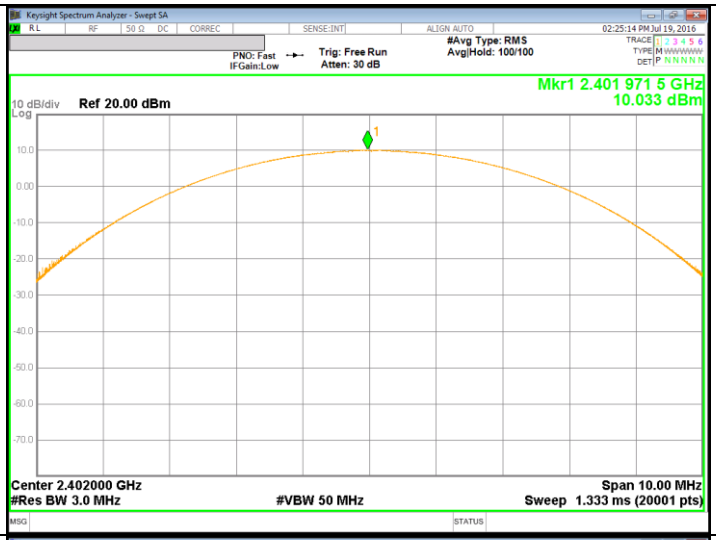
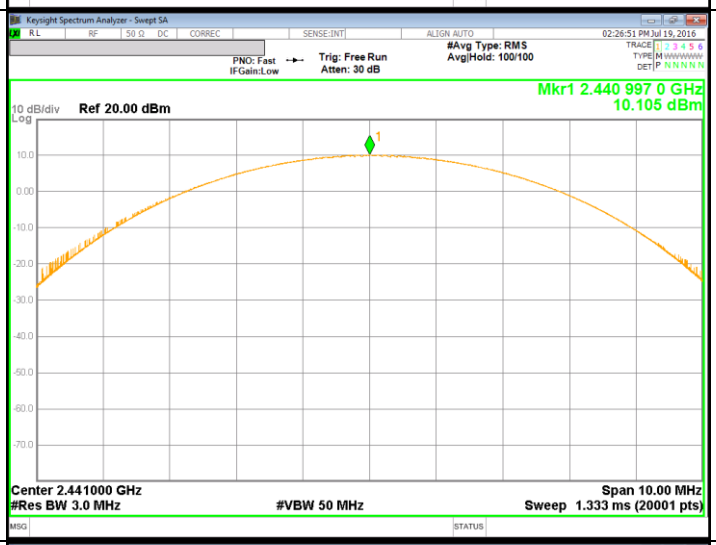
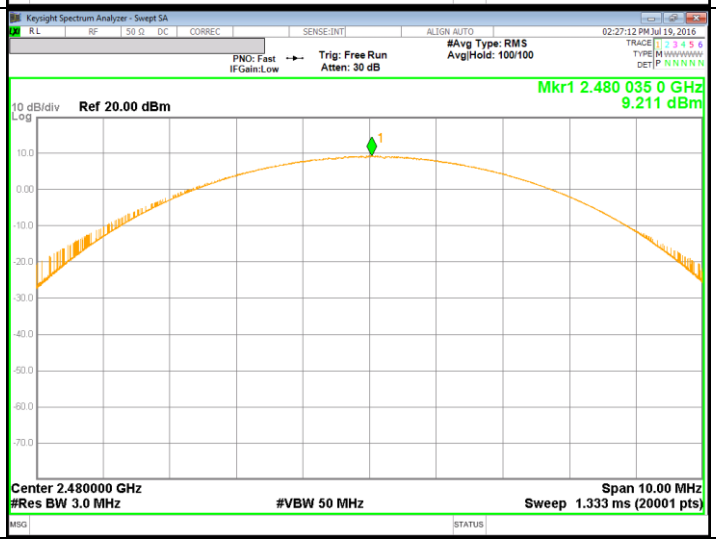
8.5.4. OUTPUT POWER PLOTS

GFSK OUTPUT POWER

GFSK Low CH		
GFSK Middle CH		
GFSK High CH		

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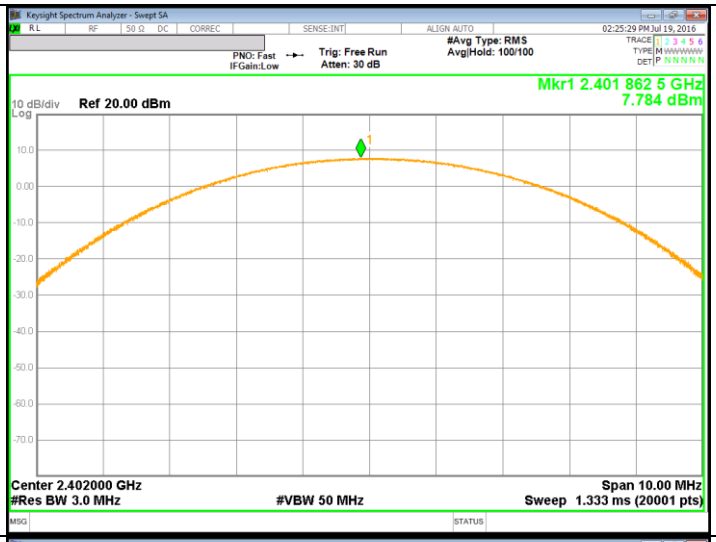
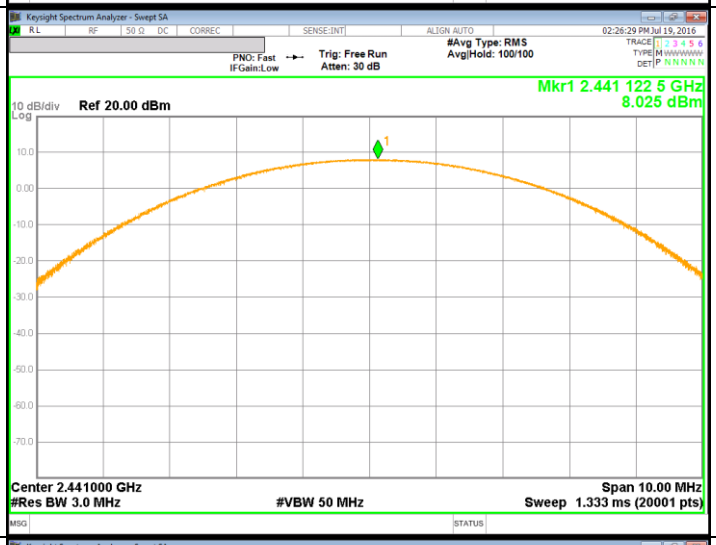
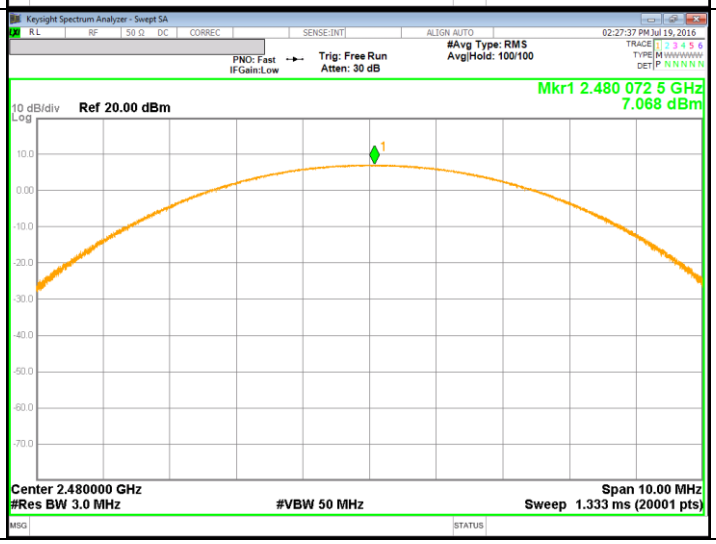
Pi/4-DPSK OUTPUT POWER

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

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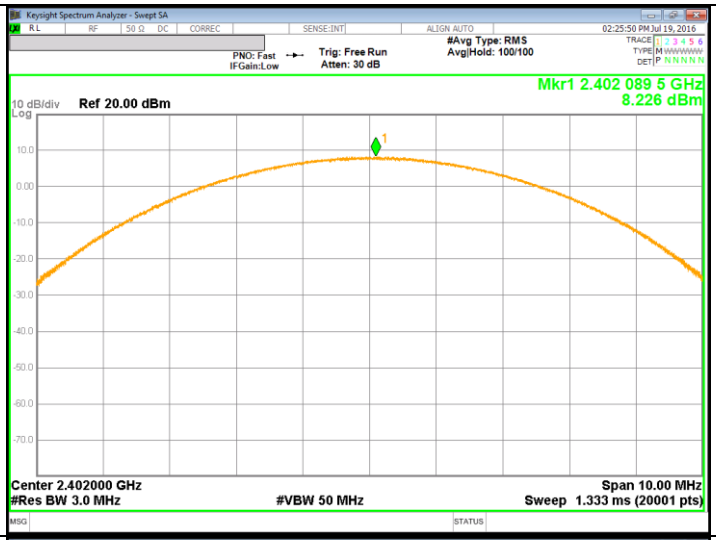
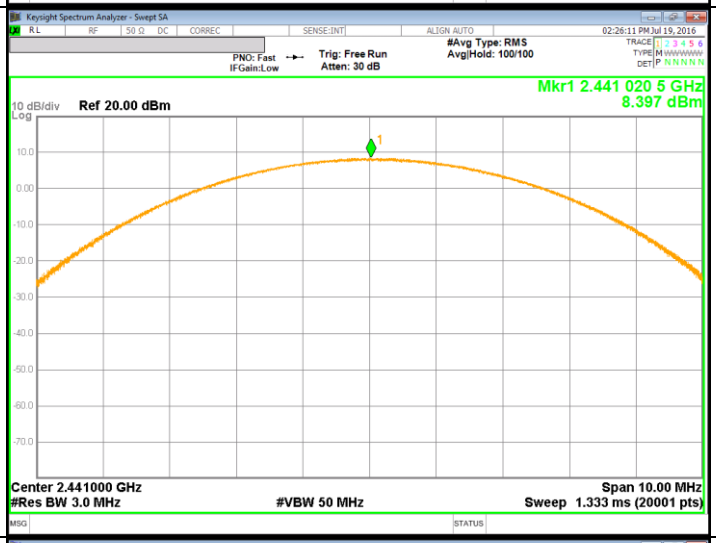
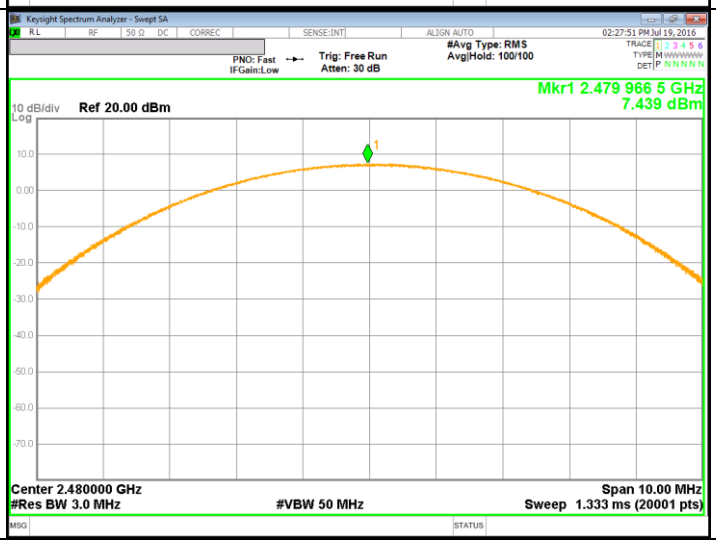
8PSK OUTPUT POWER

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	9.530	8.97
Middle	2441	9.520	8.95
High	2480	8.430	6.97

8.6.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	5.550	3.59
Middle	2441	5.620	3.65
High	2480	4.600	2.88

8.6.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	5.590	3.62
Middle	2441	5.630	3.66
High	2480	4.620	2.90

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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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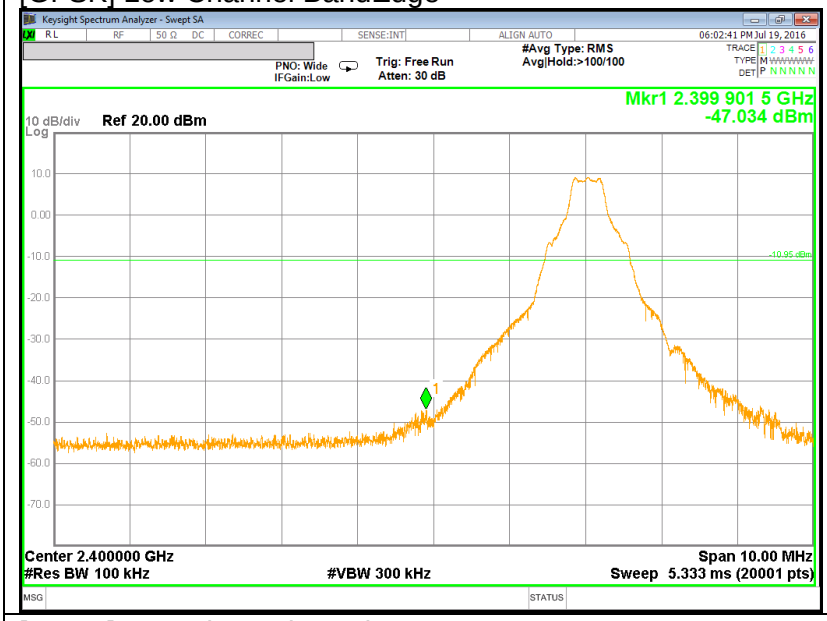
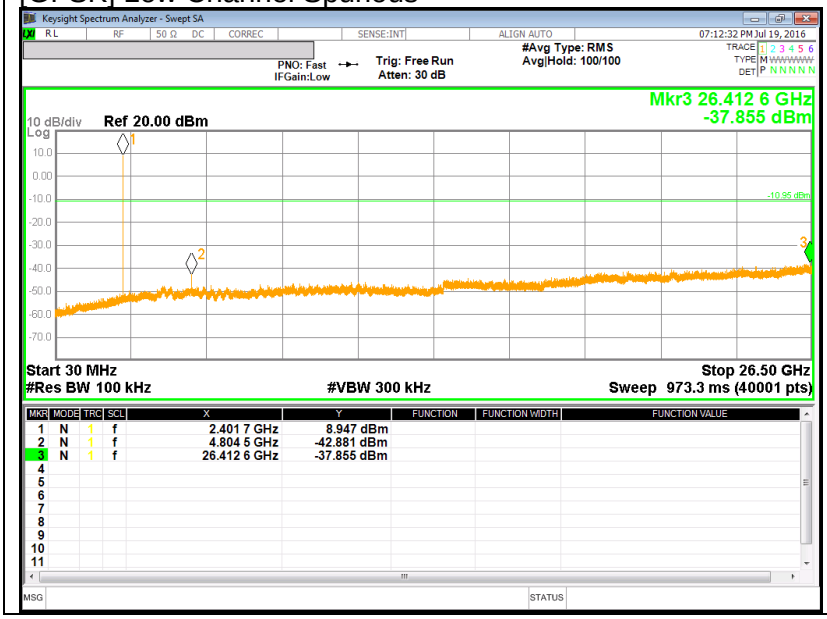
8.7.1. BASIC DATA RATE GFSK MODULATION

GFSK Mode

[GFSK] Low Channel BandEdge



[GFSK] Low Channel Spurious



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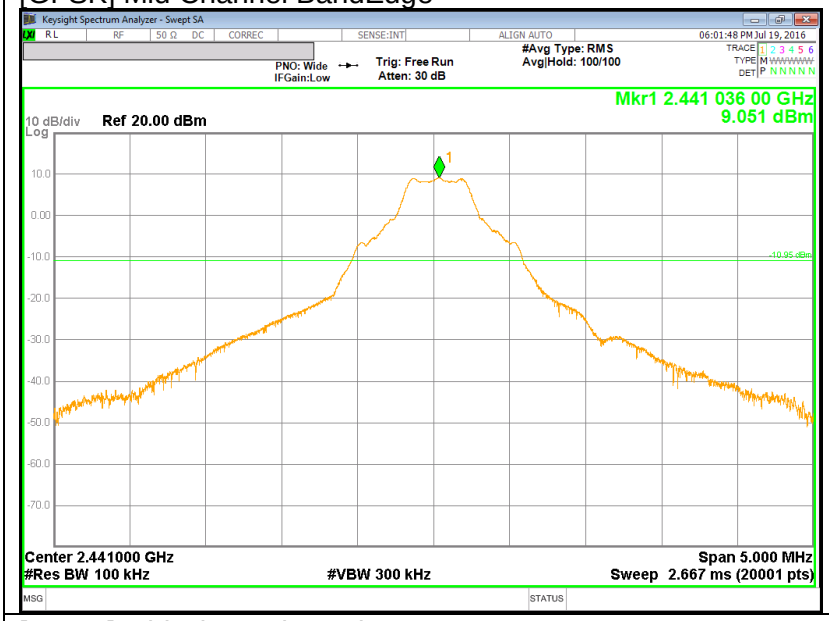
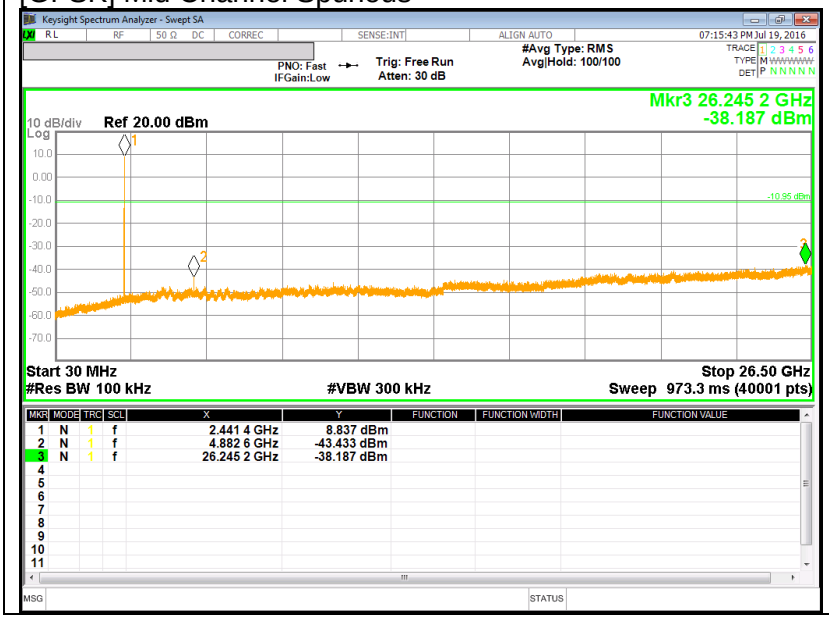
[GFSK] Mid Channel BandEdge



[GFSK] Mid Channel Spurious



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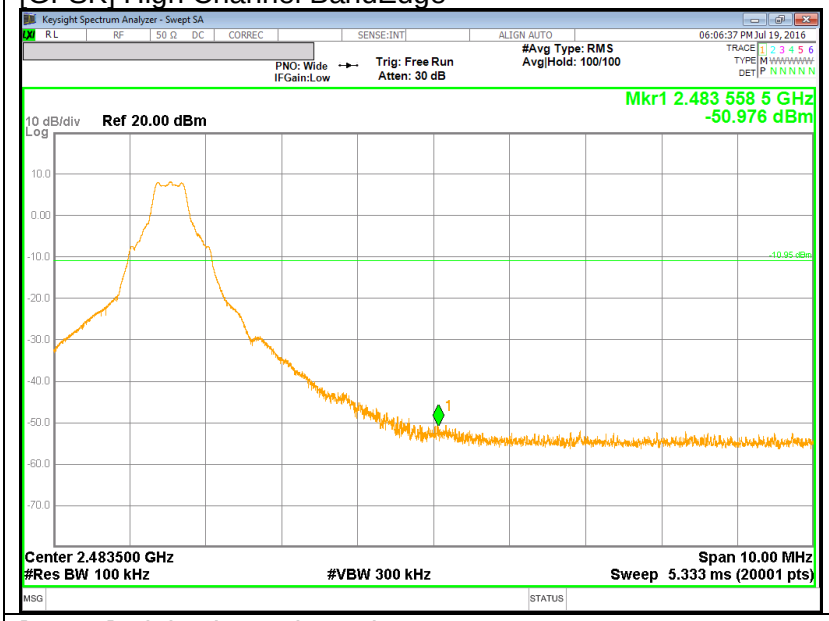
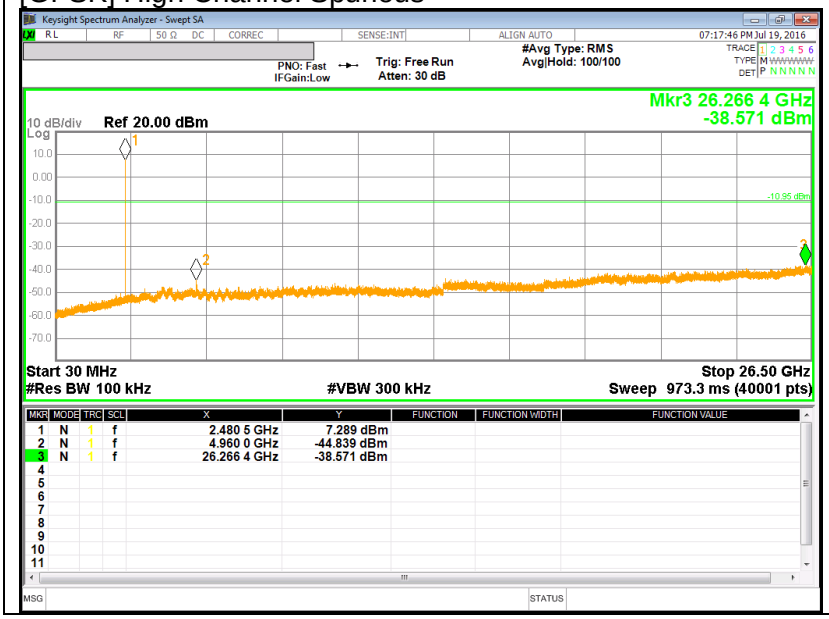
[GFSK] High Channel BandEdge



[GFSK] High Channel Spurious



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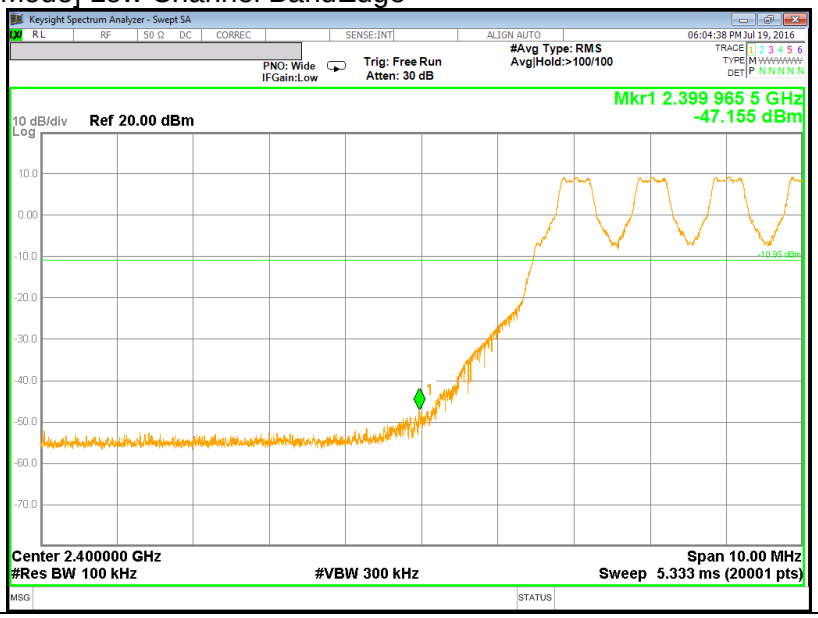
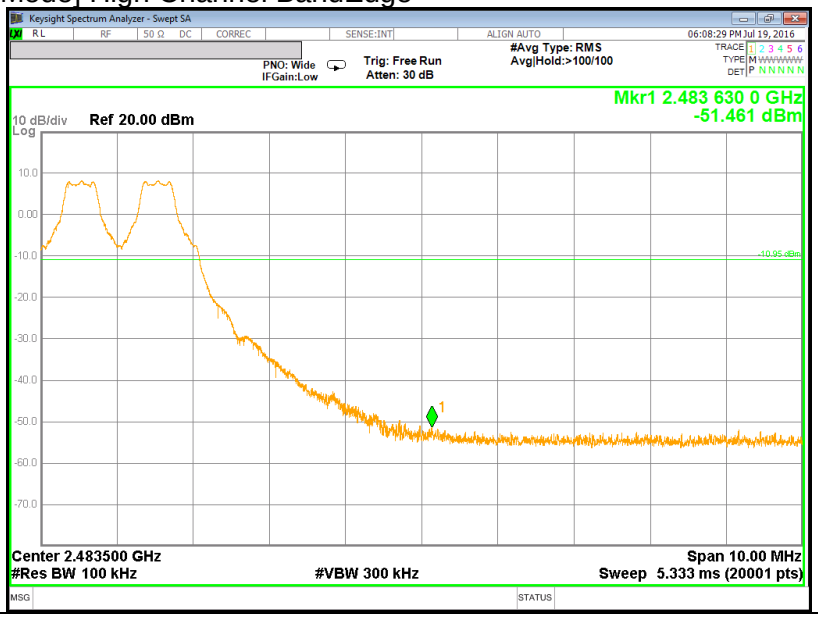
BandEdge Emission at GFSK Hopping Mode

[GFSK Hopping Mode] Low Channel BandEdge



[GFSK Hopping Mode] High Channel BandEdge



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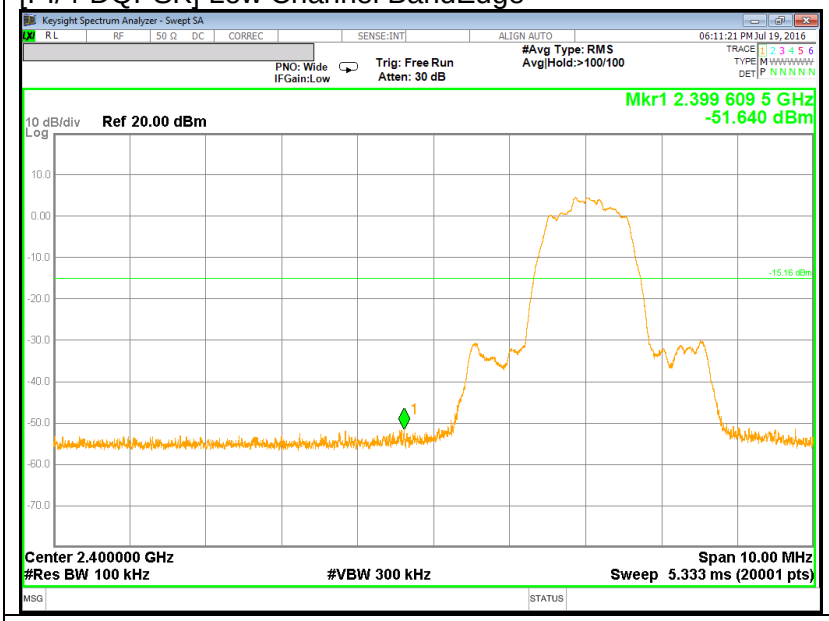
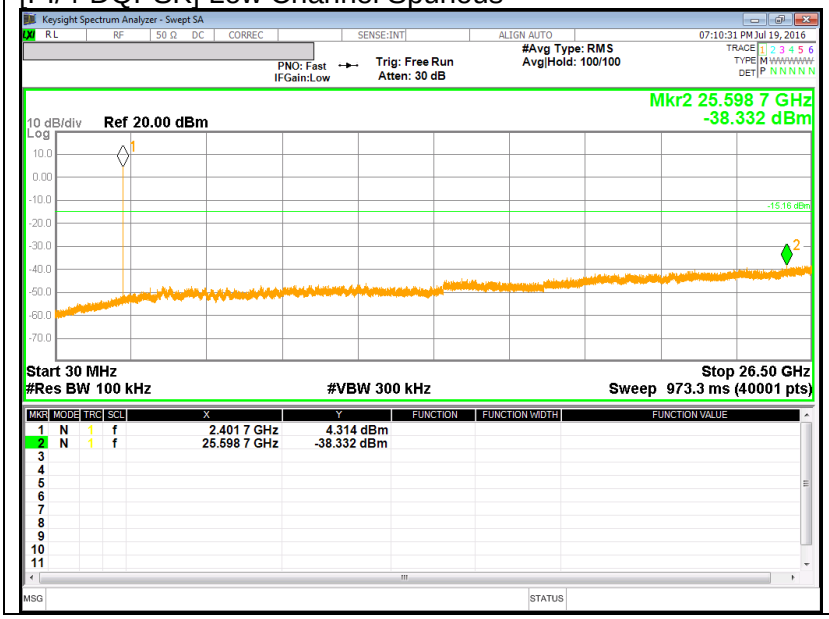
PI/4-DQPSK Mode

[PI/4-DQPSK] Low Channel BandEdge



[PI/4-DQPSK] Low Channel Spurious



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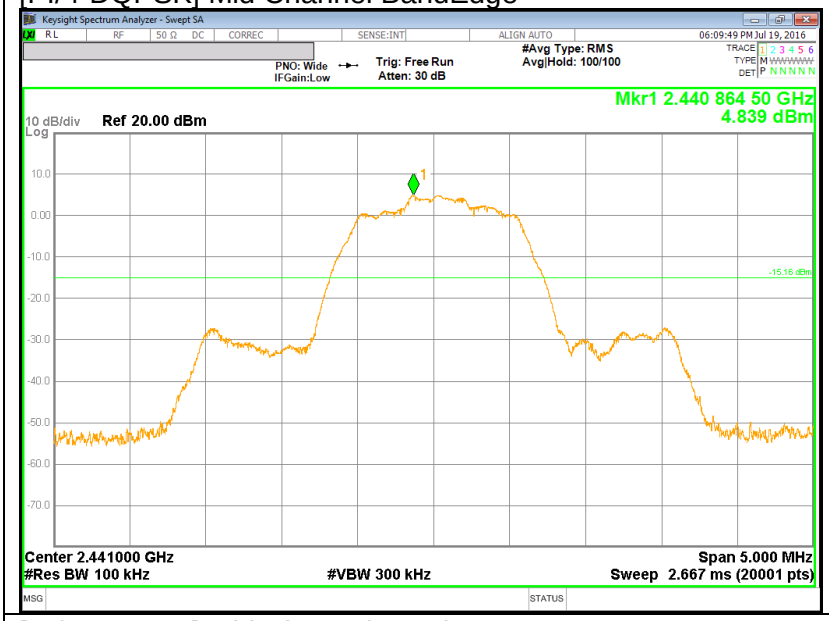
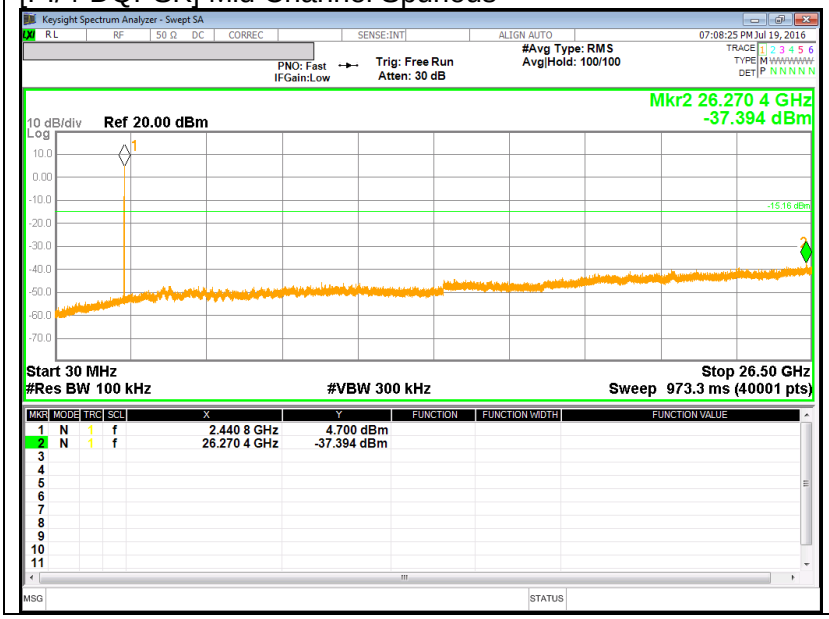
[PI/4-DQPSK] Mid Channel BandEdge



[PI/4-DQPSK] Mid Channel Spurious



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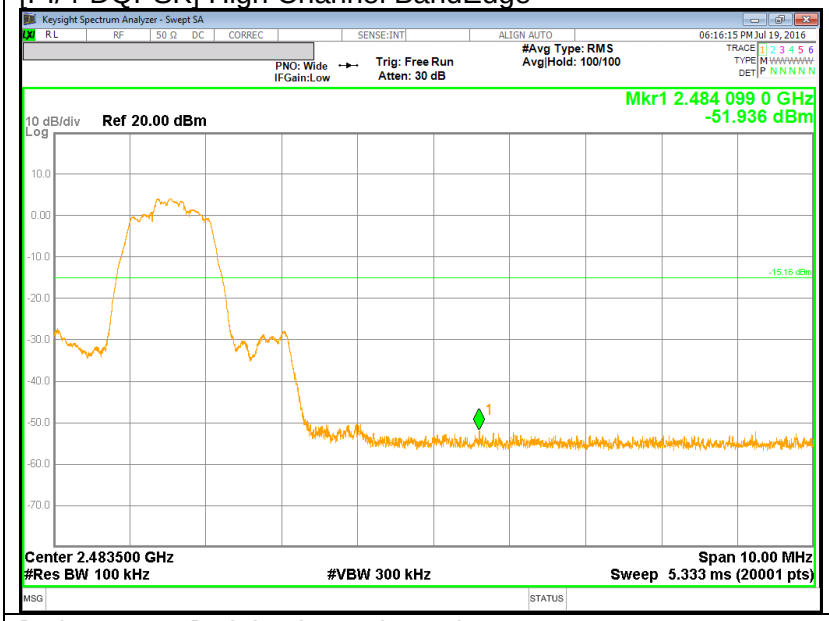
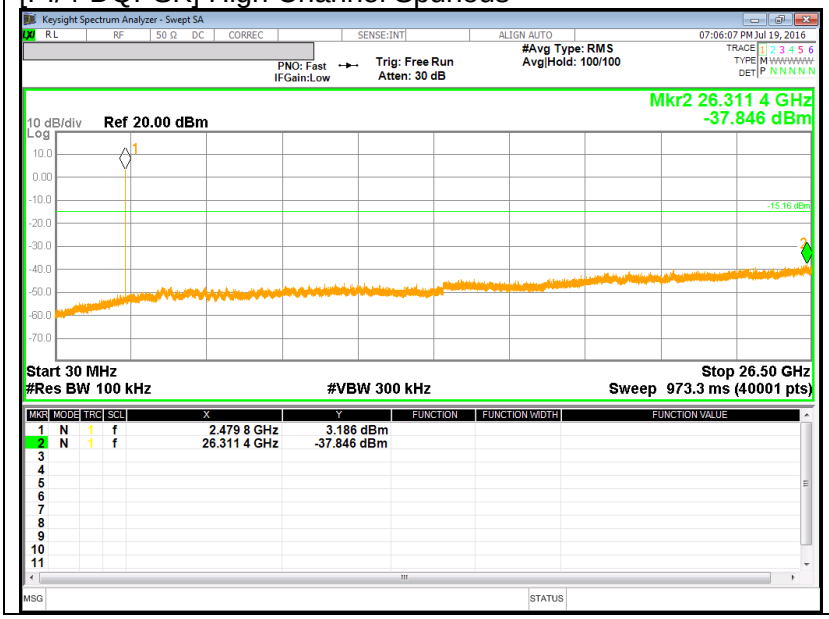
[PI/4-DQPSK] High Channel BandEdge



[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

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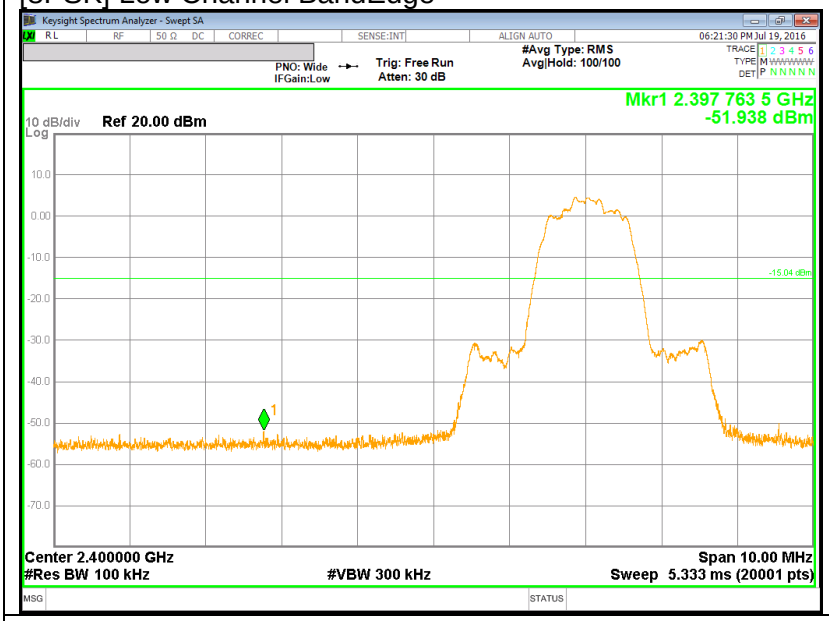
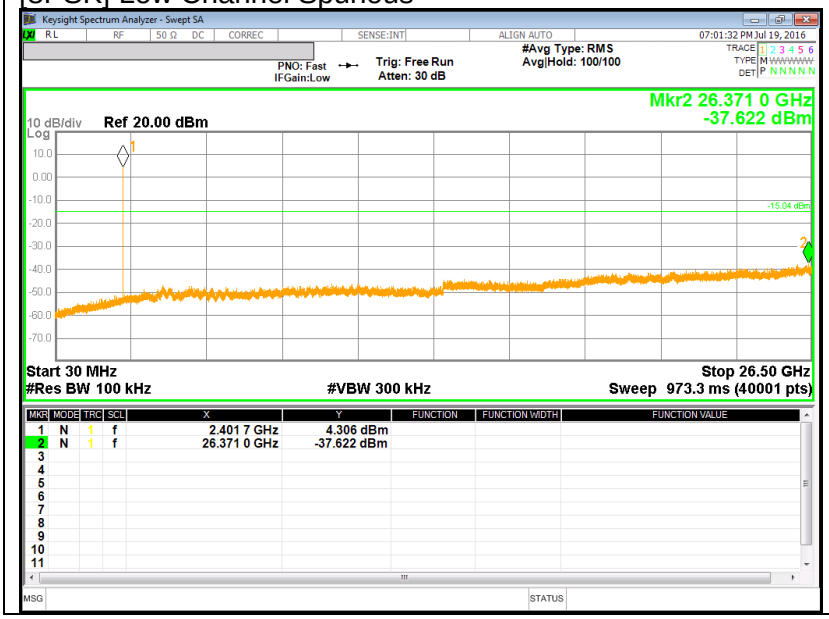
8PSK Mode

[8PSK] Low Channel BandEdge



[8PSK] Low Channel Spurious



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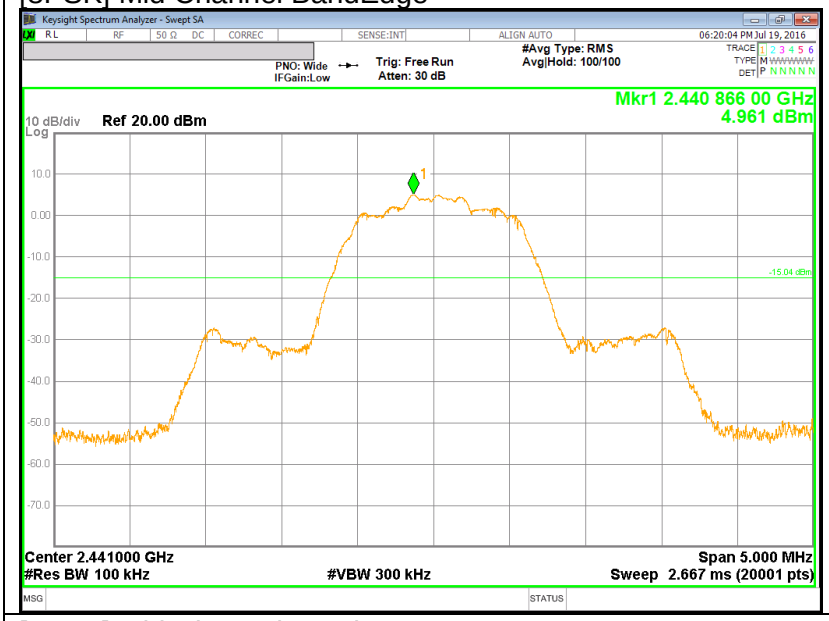
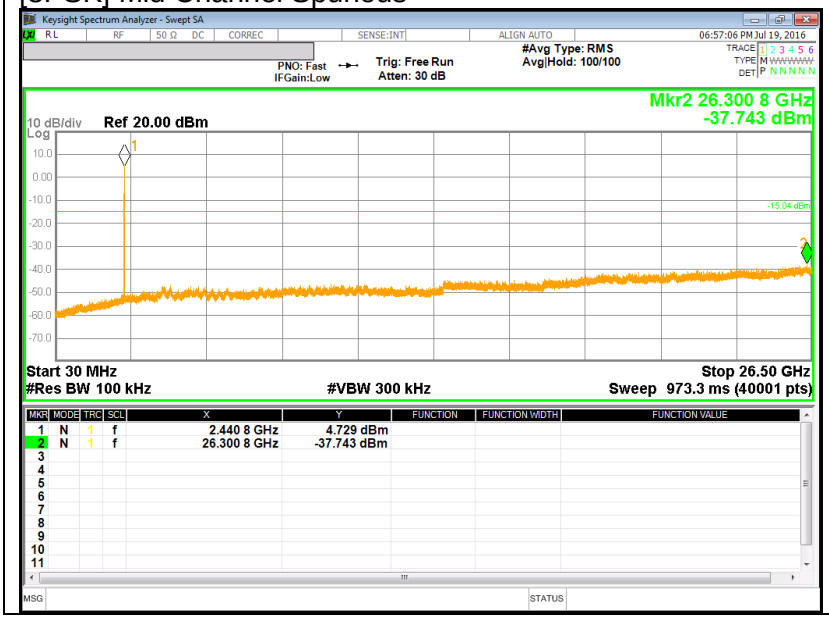
[8PSK] Mid Channel BandEdge



[8PSK] Mid Channel Spurious



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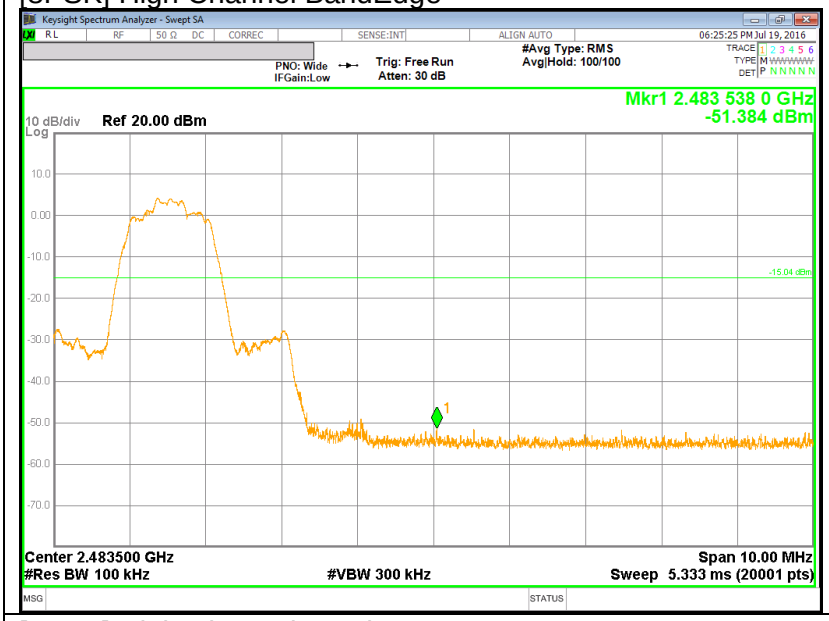
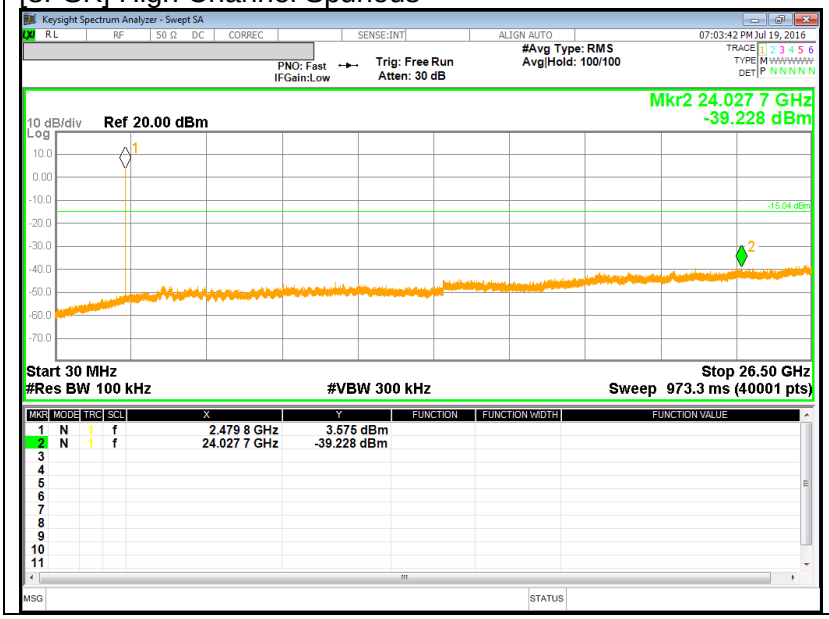
[8PSK] High Channel BandEdge



[8PSK] High Channel Spurious



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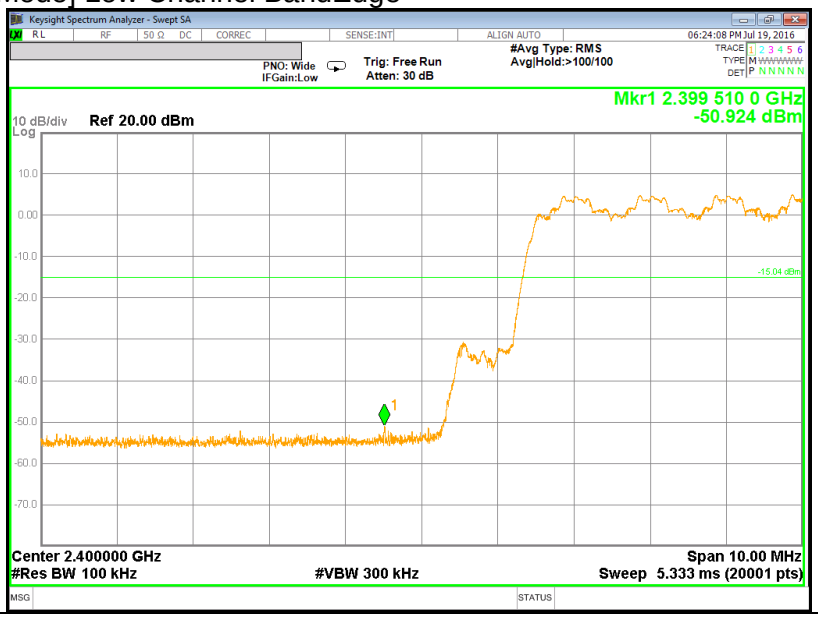
BandEdge Emission at 8PSK Hopping Mode

[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

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (μV/m)	Measurement Distance (m)
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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.

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TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. 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.

Note : Emission was pre-scanned from 9KHz to 30MHz; No emissions were detected which was at least 20dB below the specification limit (consider distance correction factor).
Per FCC part 15.31(o), test results were not reported.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site.
Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the one of tests made in an open field based on KDB 414788.

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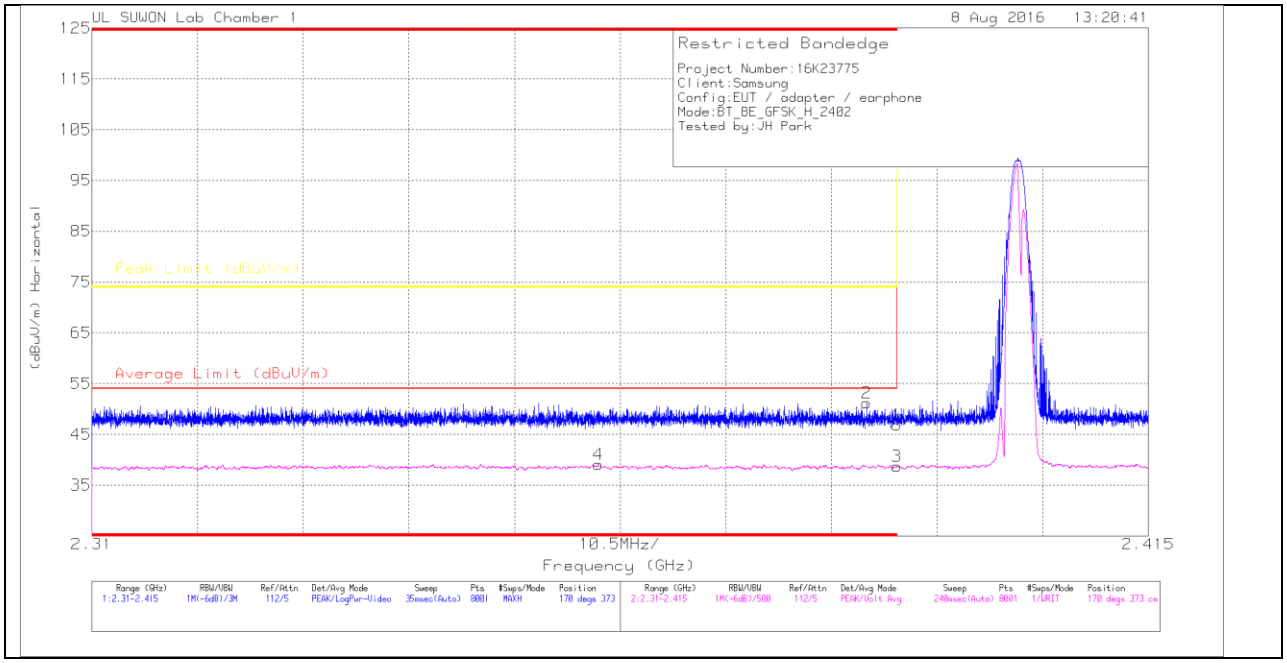
9.2. TRANSMITTER ABOVE 1 GHz

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	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	44.07	Pk	31.8	-29	46.87	-	-	74	-27.13	170	373	H
2	* 2.387	48.39	Pk	31.8	-29	51.19	-	-	74	-22.81	170	373	H
3	* 2.39	35.86	VA1T	31.8	-29	38.66	54	-15.34	-	-	170	373	H
4	* 2.36	36.4	VA1T	31.7	-29	39.1	54	-14.9	-	-	170	373	H

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

Pk - Peak detector

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

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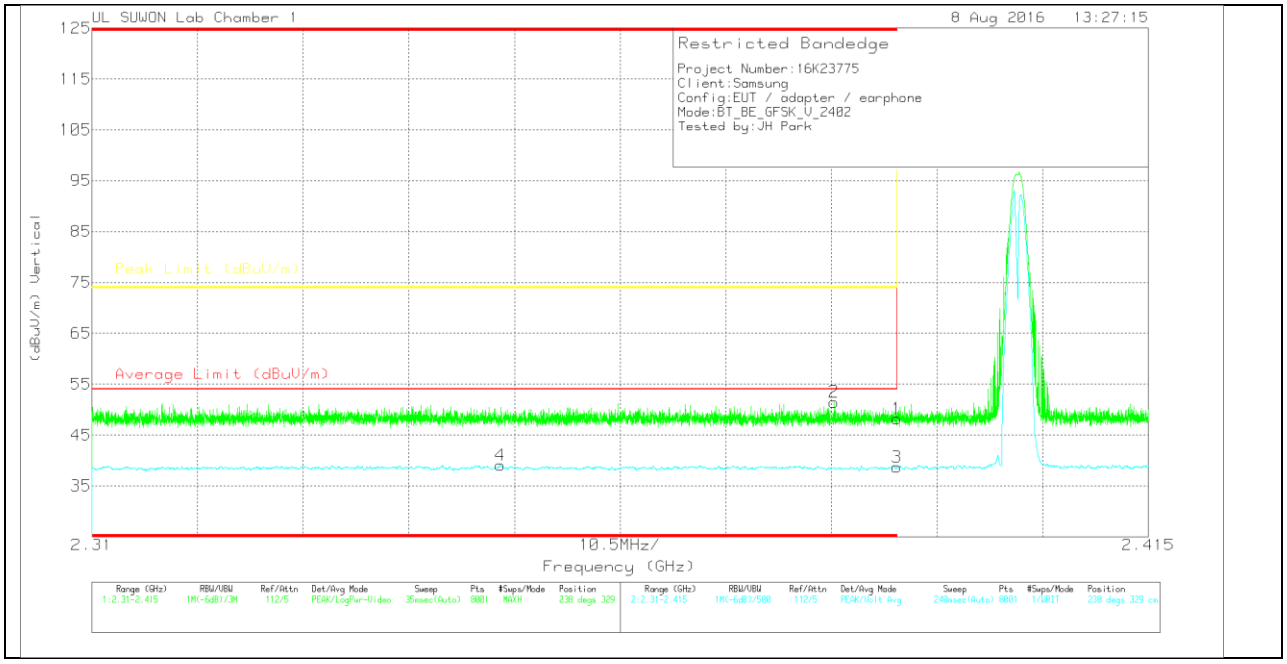
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.43	Pk	31.8	-29	48.23	-	-	74	-25.77	238	329	V
2	* 2.384	48.7	Pk	31.8	-29	51.5	-	-	74	-22.5	238	329	V
3	* 2.39	35.88	VA1T	31.8	-29	38.68	54	-15.32	-	-	238	329	V
4	* 2.351	36.35	VA1T	31.7	-29	39.05	54	-14.95	-	-	238	329	V

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

Pk - Peak detector

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

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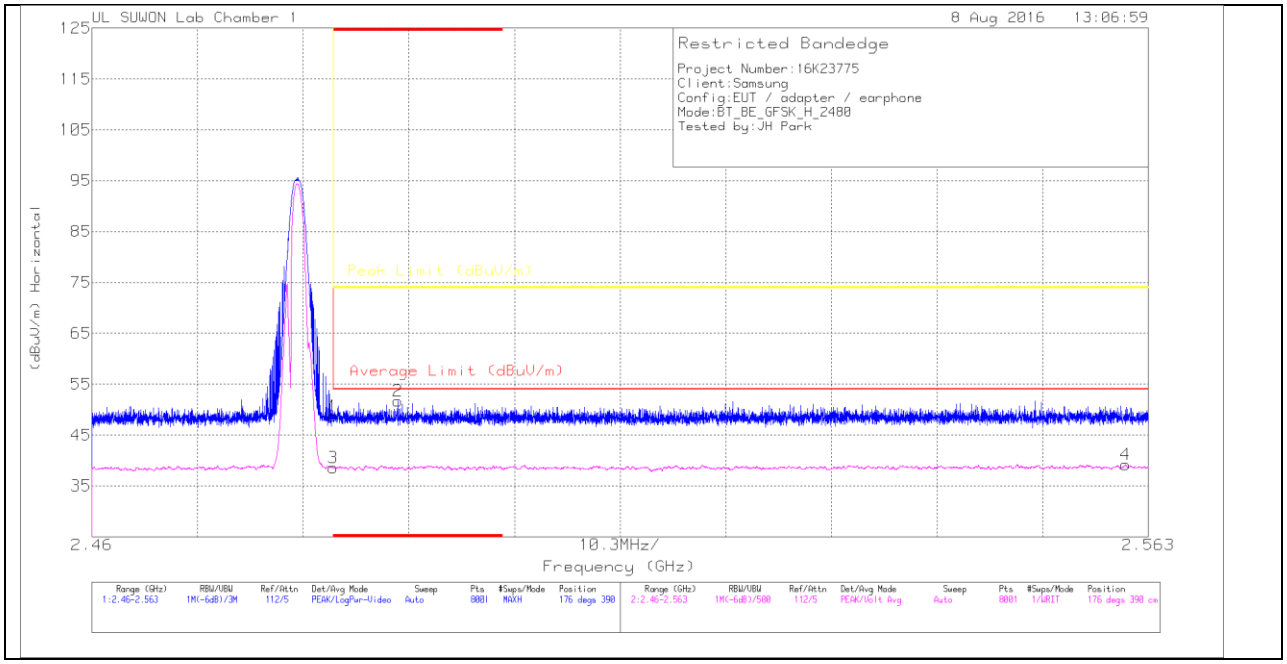
AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(001688717)_150619	Path_2	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	45.67	Pk	32	-28.9	48.77	-	-	74	-25.23	176	390	H
2	* 2.49	48.59	Pk	32	-28.9	51.69	-	-	74	-22.31	176	390	H
3	* 2.484	35.47	VA1T	32	-28.9	38.57	54	-15.43	-	-	176	390	H
4	2.561	35.98	VA1T	32	-28.8	39.18	54	-14.82	-	-	176	390	H

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

Pk - Peak detector

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

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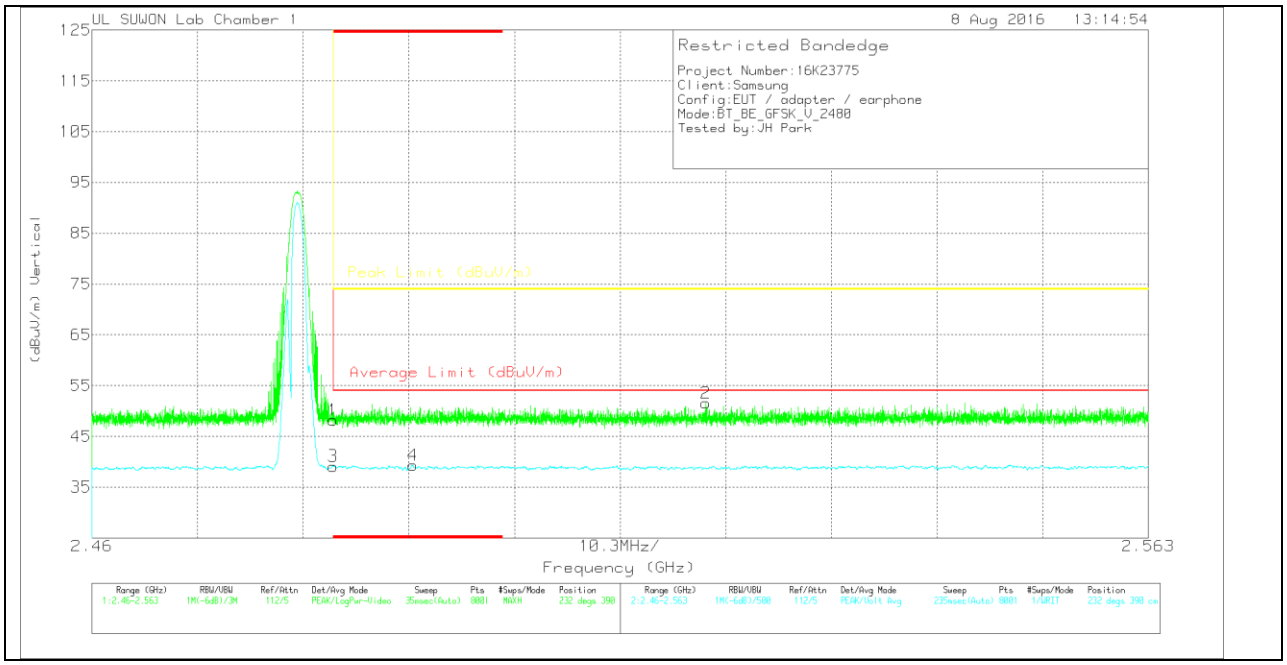
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.17	Pk	32	-28.9	48.27	-	-	74	-25.73	232	390	V
2	2.52	48.47	Pk	32	-28.9	51.57	-	-	74	-22.43	232	390	V
3	* 2.484	36.03	VA1T	32	-28.9	39.13	54	-14.87	-	-	232	390	V
4	* 2.491	36.27	VA1T	32	-28.9	39.37	54	-14.63	-	-	232	390	V

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

Pk - Peak detector

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

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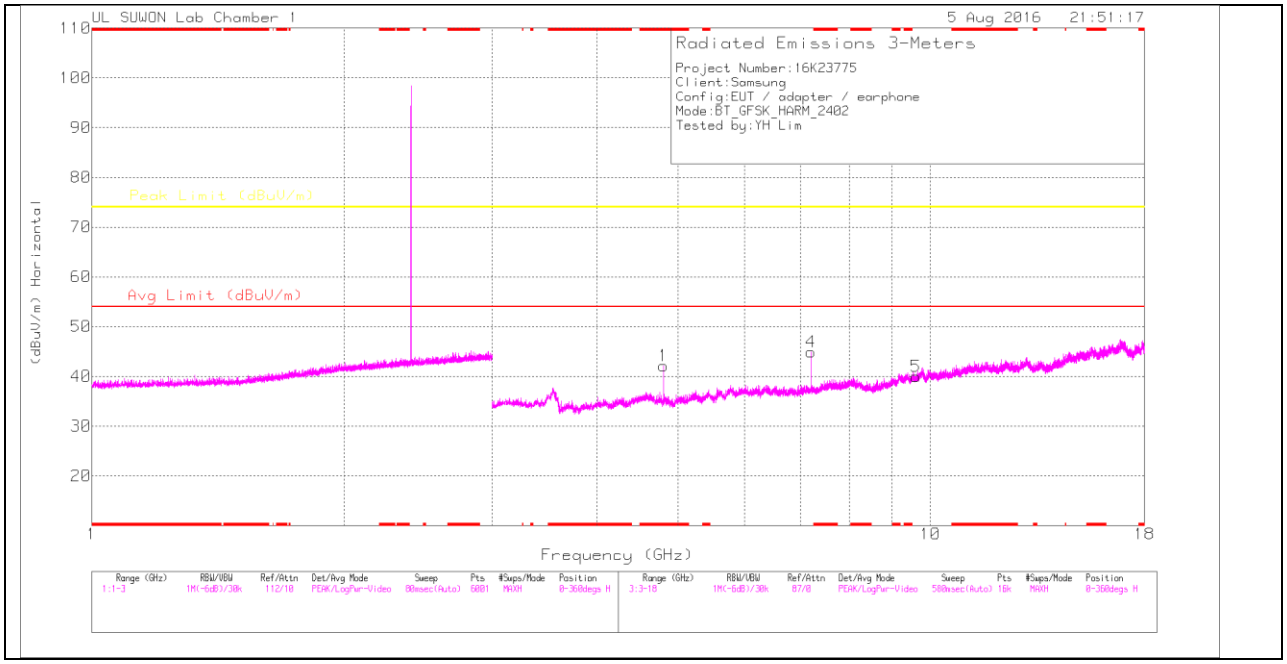
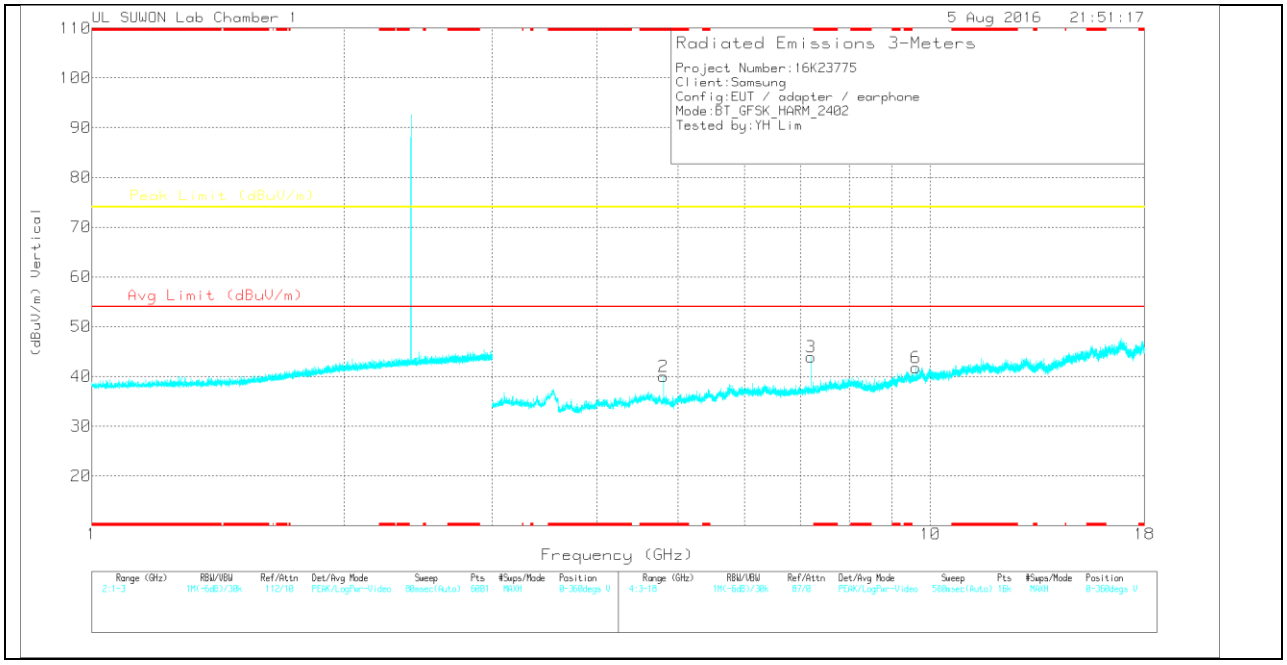
HARMONICS AND SPURIOUS EMISSIONS

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.

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LOW CHANNEL DATA

Trace Markers

Marker	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
1	* 4.804	41.89	PK	34	-33.8	42.09	-	-	74	-31.91	0-360	150	H
4	7.206	40	PK	35.7	-30.8	44.9	-	-	74	-29.1	0-360	150	H
5	9.604	30.32	PK	37	-27.3	40.02	-	-	74	-33.98	0-360	150	H
2	* 4.804	39.75	PK	34	-33.8	39.95	-	-	74	-34.05	0-360	250	V
3	7.206	39.02	PK	35.7	-30.8	43.92	-	-	74	-30.08	0-360	250	V
6	9.609	32.04	PK	37	-27.3	41.74	-	-	74	-32.26	0-360	250	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
* 4.804	49.71	PK2	34	-33.8	49.91	-	-	74	-24.09	292	100	H
* 4.804	41.77	VA1T	34	-33.8	41.97	54	-12.03	-	-	292	100	H
* 4.805	46.66	PK2	34	-33.8	46.86	-	-	74	-27.14	151	300	V
* 4.804	33.12	VA1T	34	-33.8	33.32	54	-20.68	-	-	151	300	V
7.206	46.4	PK2	35.7	-30.8	51.3	-	-	74	-22.7	17	300	V
7.207	46.52	PK2	35.7	-30.8	51.42	-	-	74	-22.58	311	317	H

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

PK2 - KDB558074 Method: Maximum Peak

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

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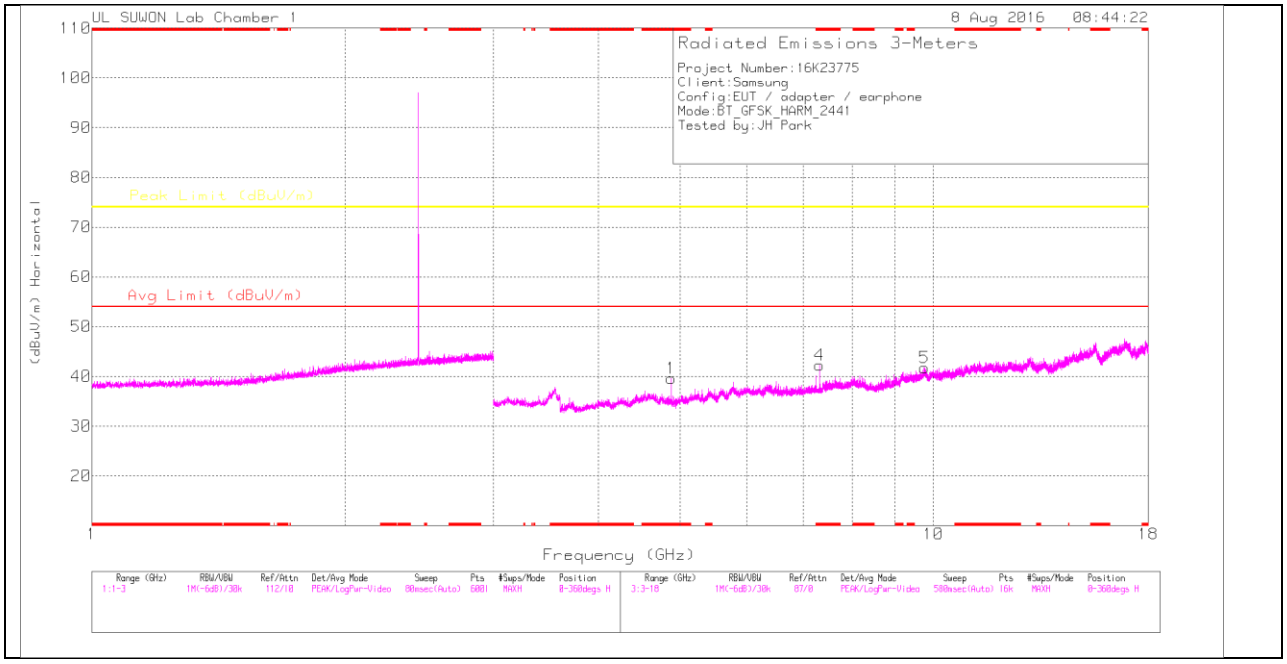
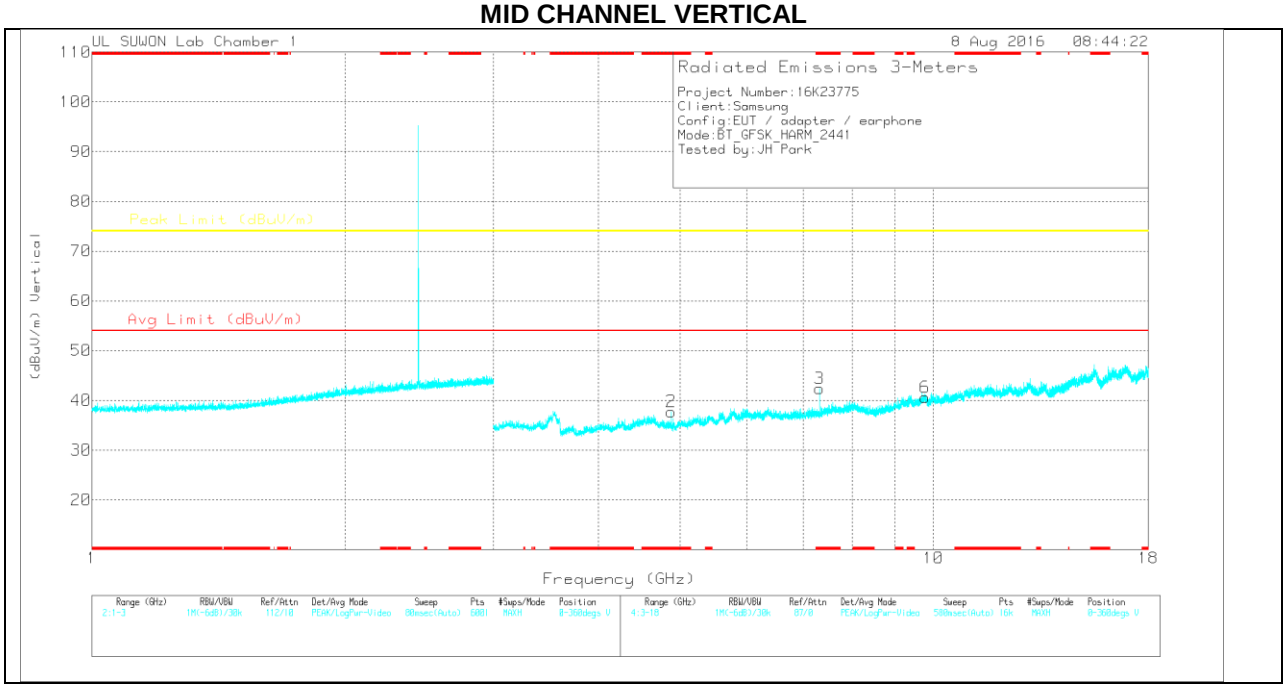
MID CHANNEL HORIZONTAL



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.

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MID CHANNEL DATA

Trace Markers

Marker	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
1	* 4.882	39.56	PK	34	-34	39.56	-	-	74	-34.44	0-360	150	H
4	* 7.323	37.41	PK	35.8	-30.9	42.31	-	-	74	-31.69	0-360	150	H
5	9.764	31.16	PK	37.2	-26.6	41.76	-	-	74	-32.24	0-360	250	H
2	* 4.881	37.77	PK	34	-34	37.77	-	-	74	-36.23	0-360	150	V
3	* 7.323	37.51	PK	35.8	-30.9	42.41	-	-	74	-31.59	0-360	250	V
6	9.778	29.82	PK	37.2	-26.4	40.62	-	-	74	-33.38	0-360	250	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
* 7.323	47.56	PK2	35.8	-30.9	52.46	-	-	74	-21.54	302	264	H
* 7.323	38.92	VA1T	35.8	-30.9	43.82	54	-10.18	-	-	302	264	H
* 7.323	46.8	PK2	35.8	-30.9	51.7	-	-	74	-22.3	5	150	V
* 7.323	37.4	VA1T	35.8	-30.9	42.3	54	-11.7	-	-	5	150	V
* 4.882	48.17	PK2	34	-34	48.17	-	-	74	-25.83	1	100	V
* 4.882	36.46	VA1T	34	-34	36.46	54	-17.54	-	-	1	100	V
* 4.882	48.62	PK2	34	-34	48.62	-	-	74	-25.38	294	100	H
* 4.882	39.21	VA1T	34	-34	39.21	54	-14.79	-	-	294	100	H

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

PK2 - KDB558074 Method: Maximum Peak

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

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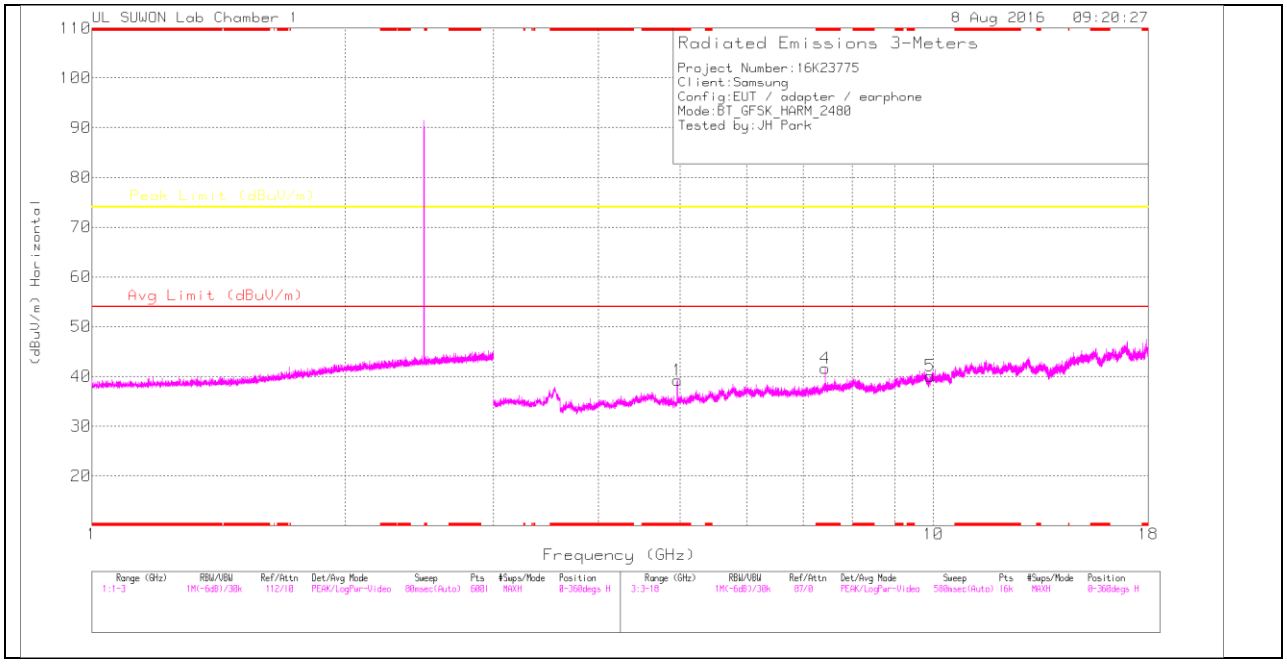
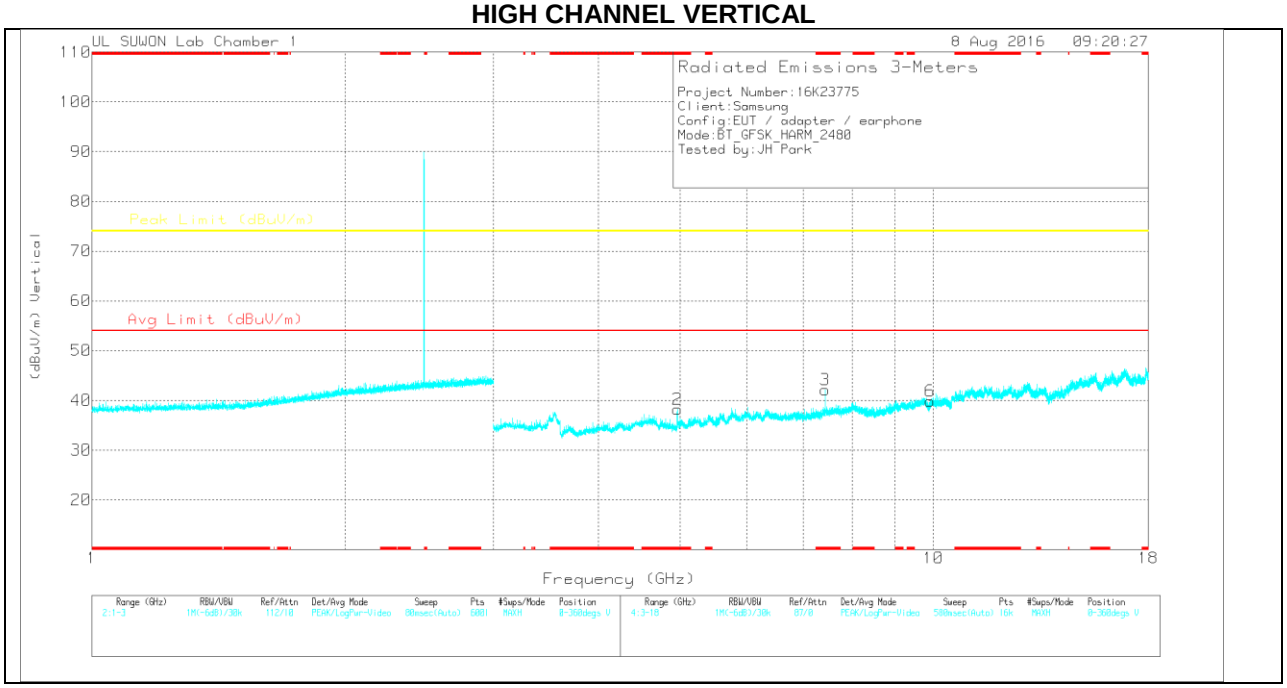
HIGH CHANNEL HORIZONTAL



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.

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HIGH CHANNEL DATA

Trace Markers

Marker	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
1	* 4.96	39.21	PK	34	-34	39.21	-	-	74	-34.79	0-360	150	H
4	* 7.441	36.55	PK	35.8	-30.7	41.65	-	-	74	-32.35	0-360	250	H
5	9.908	30.15	PK	37.4	-27.5	40.05	-	-	74	-33.95	0-360	250	H
2	* 4.96	38.2	PK	34	-34	38.2	-	-	74	-35.8	0-360	250	V
3	* 7.44	37.06	PK	35.8	-30.7	42.16	-	-	74	-31.84	0-360	250	V
6	9.915	29.79	PK	37.4	-27.3	39.89	-	-	74	-34.11	0-360	150	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
* 7.44	45.8	PK2	35.8	-30.7	50.9	-	-	74	-23.1	298	139	H
* 7.44	35.33	VA1T	35.8	-30.7	40.43	54	-13.57	-	-	298	139	H
* 7.44	46.31	PK2	35.8	-30.7	51.41	-	-	74	-22.59	360	100	V
* 7.44	35.83	VA1T	35.8	-30.7	40.93	54	-13.07	-	-	360	100	V
* 4.96	47.1	PK2	34	-34	47.1	-	-	74	-26.9	360	100	V
* 4.96	35.95	VA1T	34	-34	35.95	54	-18.05	-	-	360	100	V
* 4.96	47.78	PK2	34	-34	47.78	-	-	74	-26.22	360	100	H
* 4.96	38.13	VA1T	34	-34	38.13	54	-15.87	-	-	360	100	H

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

PK2 - KDB558074 Method: Maximum Peak

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

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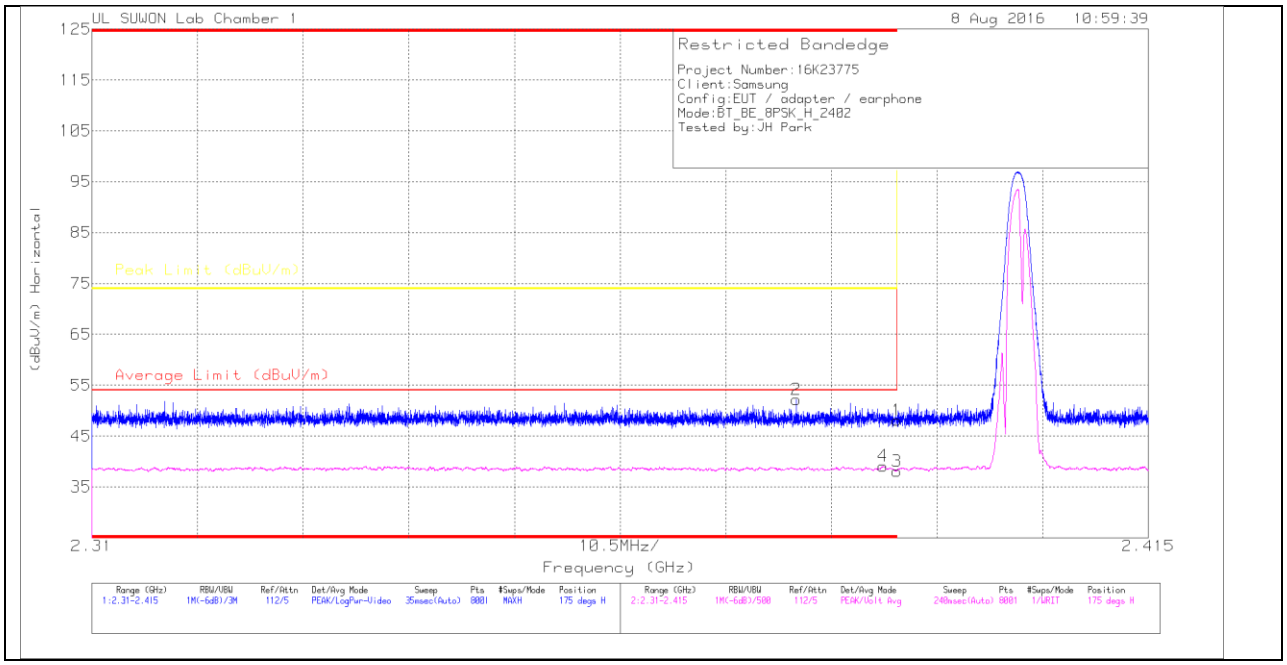
9.2.2. ENHANCED DATA RATE 8PSK MODULATION RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.34	Pk	31.8	-29	48.14	-	-	74	-25.86	175	359	H
2	* 2.38	49.39	Pk	31.8	-29	52.19	-	-	74	-21.81	175	359	H
3	* 2.39	35.27	VA1T	31.8	-29	38.07	54	-15.93	-	-	175	359	H
4	* 2.389	36.33	VA1T	31.8	-29	39.13	54	-14.87	-	-	175	359	H

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

Pk - Peak detector

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

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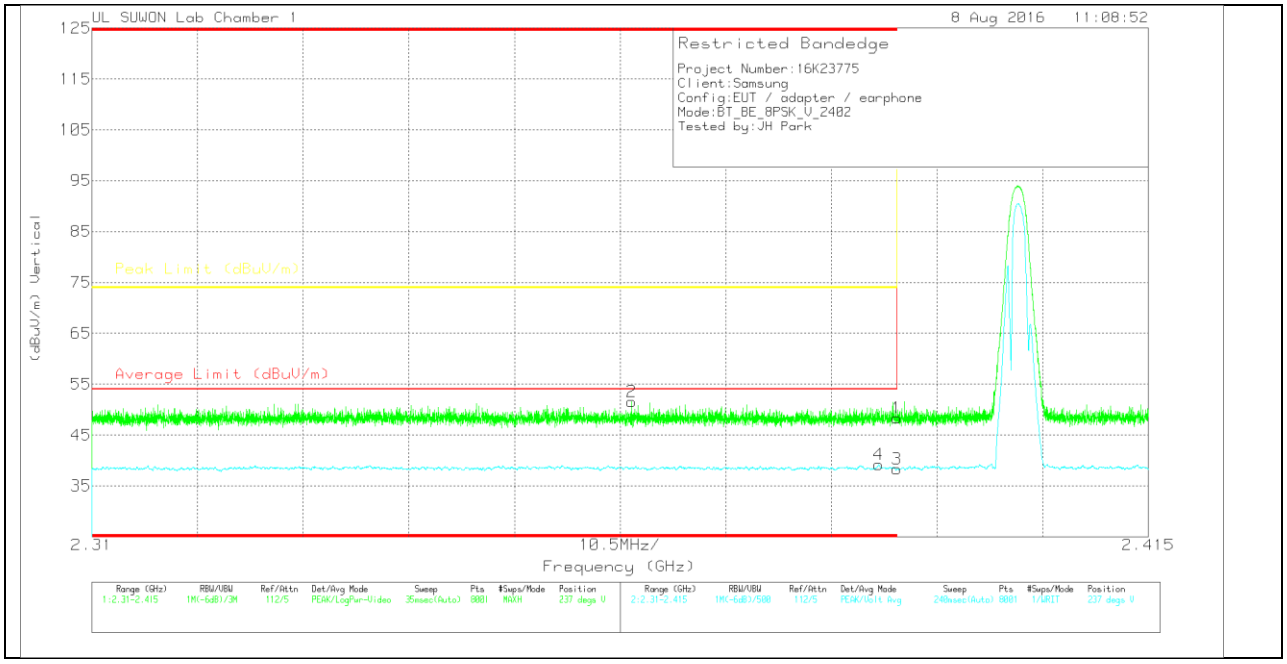
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.5	Pk	31.8	-29	48.3	-	-	74	-25.7	237	335	V
2	* 2.364	48.73	Pk	31.8	-29	51.53	-	-	74	-22.47	237	335	V
3	* 2.39	35.5	VA1T	31.8	-29	38.3	54	-15.7	-	-	237	335	V
4	* 2.388	36.37	VA1T	31.8	-29	39.17	54	-14.83	-	-	237	335	V

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

Pk - Peak detector

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

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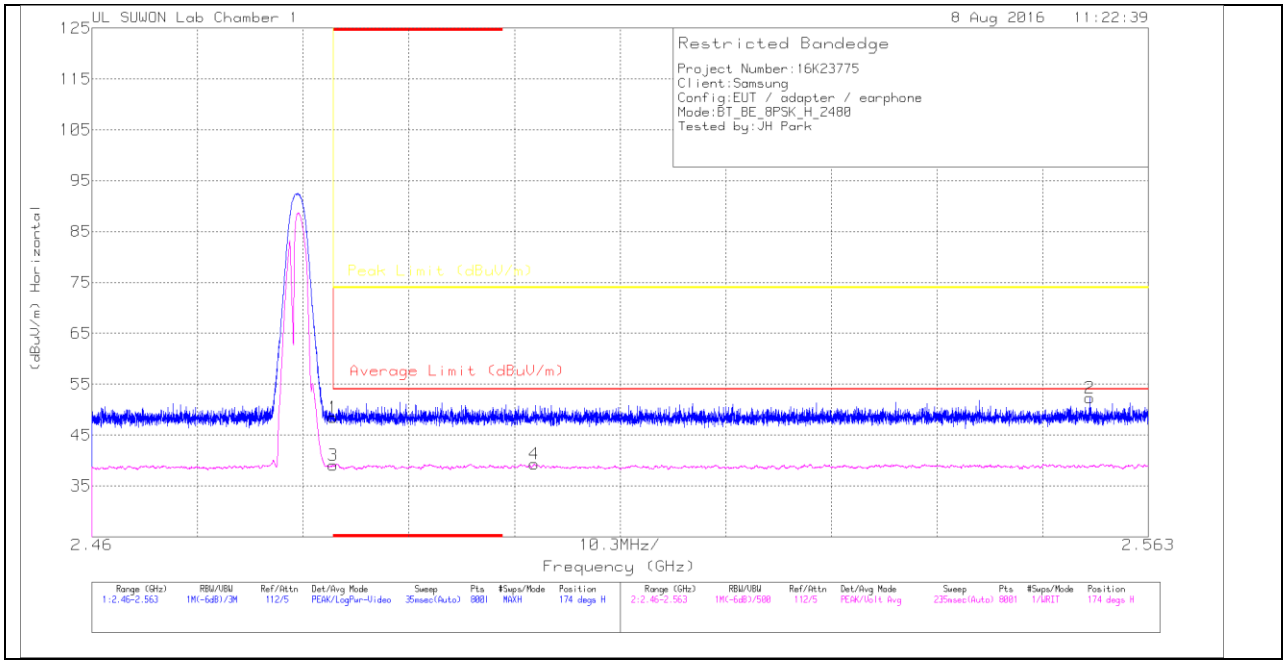
AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.39	Pk	32	-28.9	48.49	-	-	74	-25.51	174	394	H
2	2.557	49.13	Pk	32	-28.8	52.33	-	-	74	-21.67	174	394	H
3	* 2.484	35.95	VA1T	32	-28.9	39.05	54	-14.95	-	-	174	394	H
4	2.503	36.17	VA1T	32	-28.9	39.27	54	-14.73	-	-	174	394	H

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

Pk - Peak detector

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

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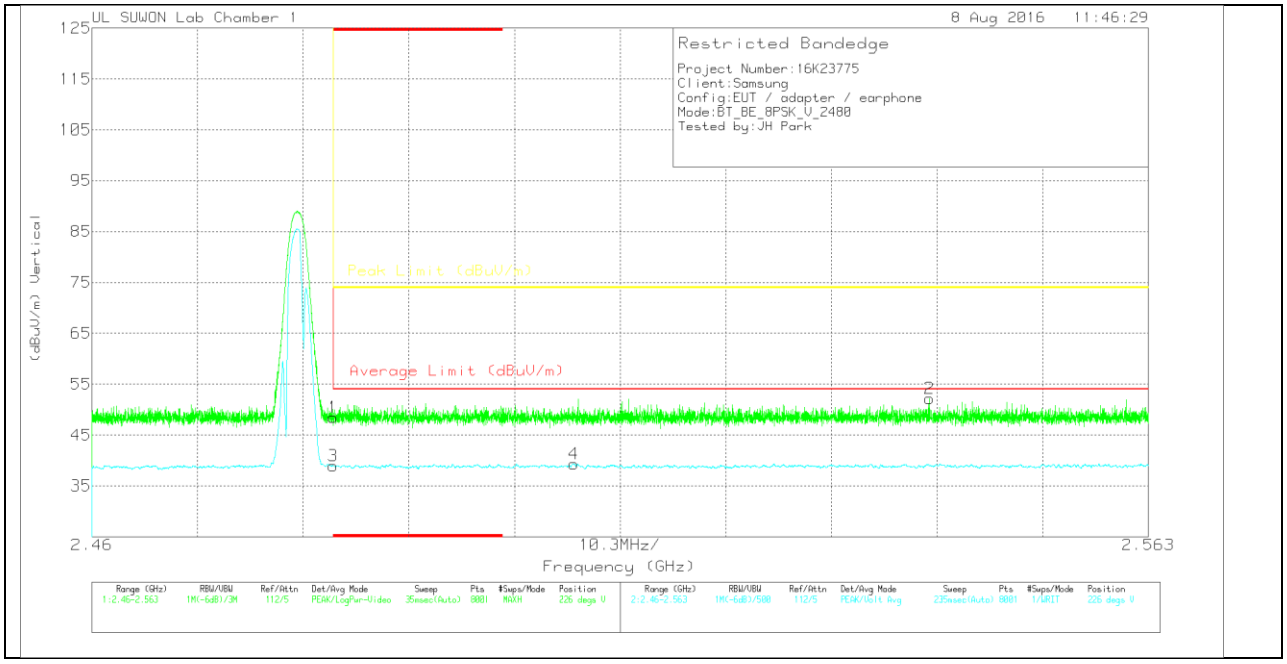
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	Path_2	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	45.4	Pk	32	-28.9	48.5	-	-	74	-25.5	226	321	V
2	2.542	48.94	Pk	32	-28.8	52.14	-	-	74	-21.86	226	321	V
3	* 2.484	35.86	VA1T	32	-28.9	38.96	54	-15.04	-	-	226	321	V
4	2.507	36.23	VA1T	32	-28.9	39.33	54	-14.67	-	-	226	321	V

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

Pk - Peak detector

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

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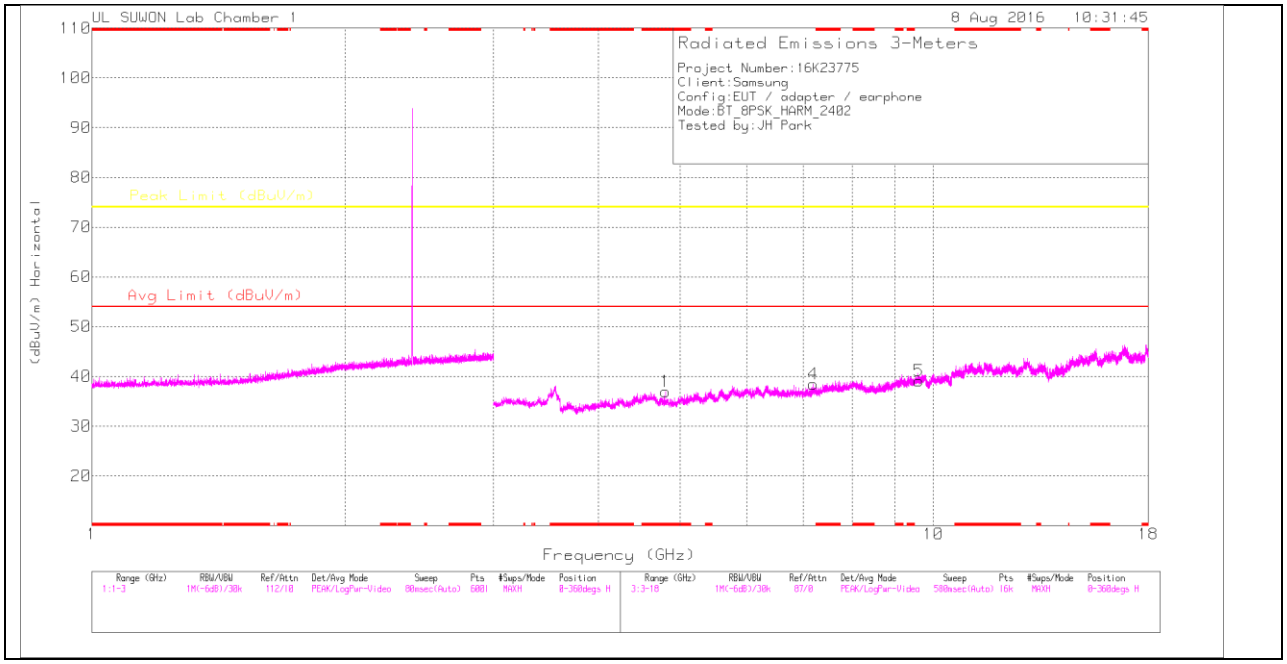
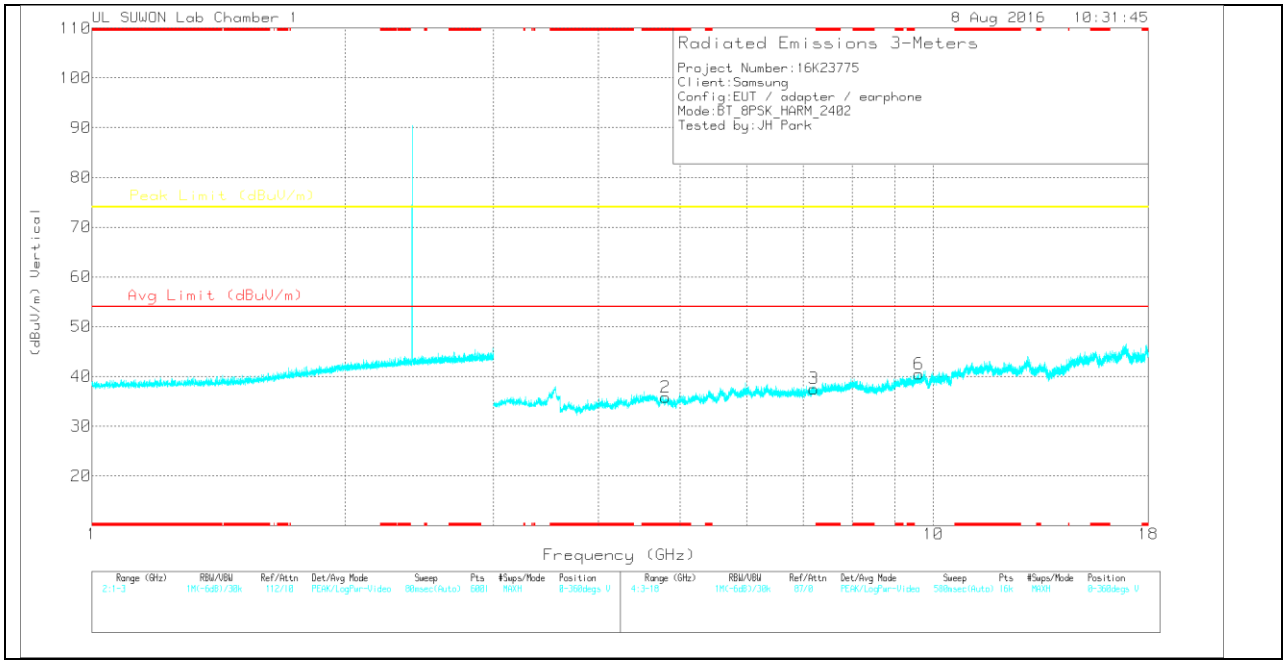
HARMONICS AND SPURIOUS EMISSIONS

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.

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LOW CHANNEL DATA

Trace Markers

Marker	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
1	* 4.804	36.7	PK	34	-33.8	36.9	-	-	74	-37.1	0-360	250	H
4	7.2	33.47	PK	35.7	-30.7	38.47	-	-	74	-35.53	0-360	250	H
5	9.608	29.4	PK	37	-27.3	39.1	-	-	74	-34.9	0-360	250	H
2	* 4.808	35.59	PK	34	-33.8	35.79	-	-	74	-38.21	0-360	250	V
3	7.205	32.62	PK	35.7	-30.8	37.52	-	-	74	-36.48	0-360	150	V
6	9.614	30.7	PK	37	-27.2	40.5	-	-	74	-33.5	0-360	150	V

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

PK – Peak Detector

Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limt (54dBuV/m).

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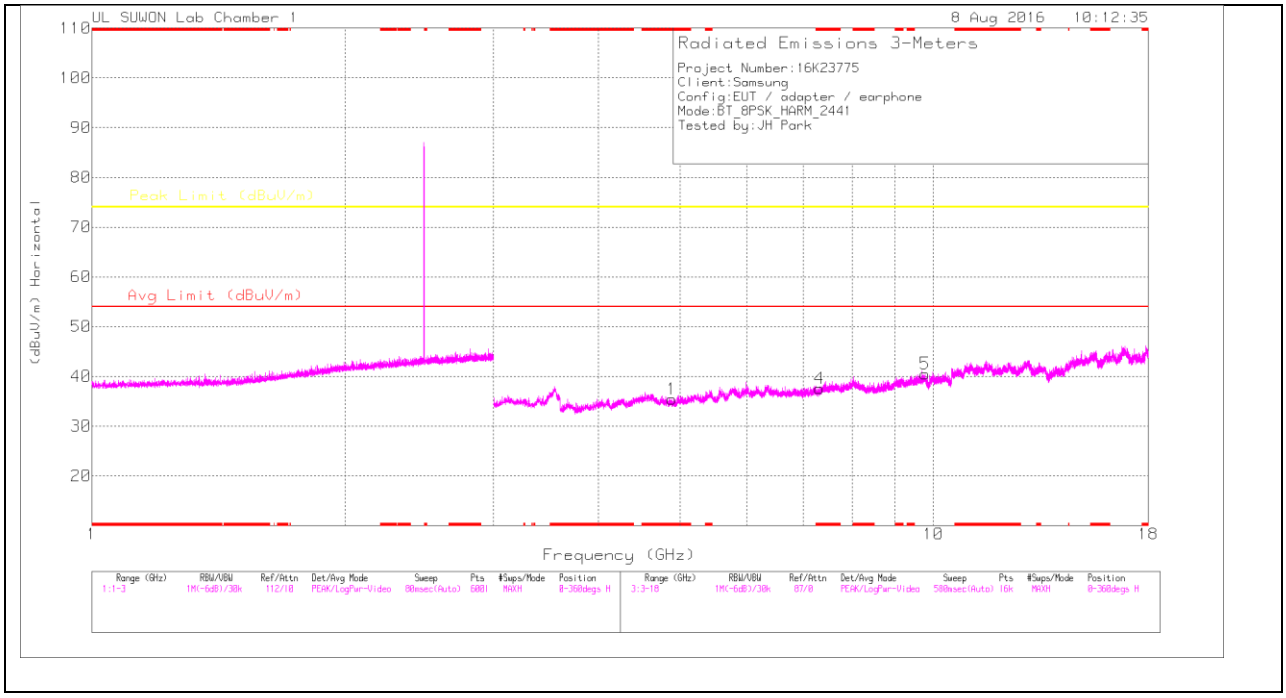
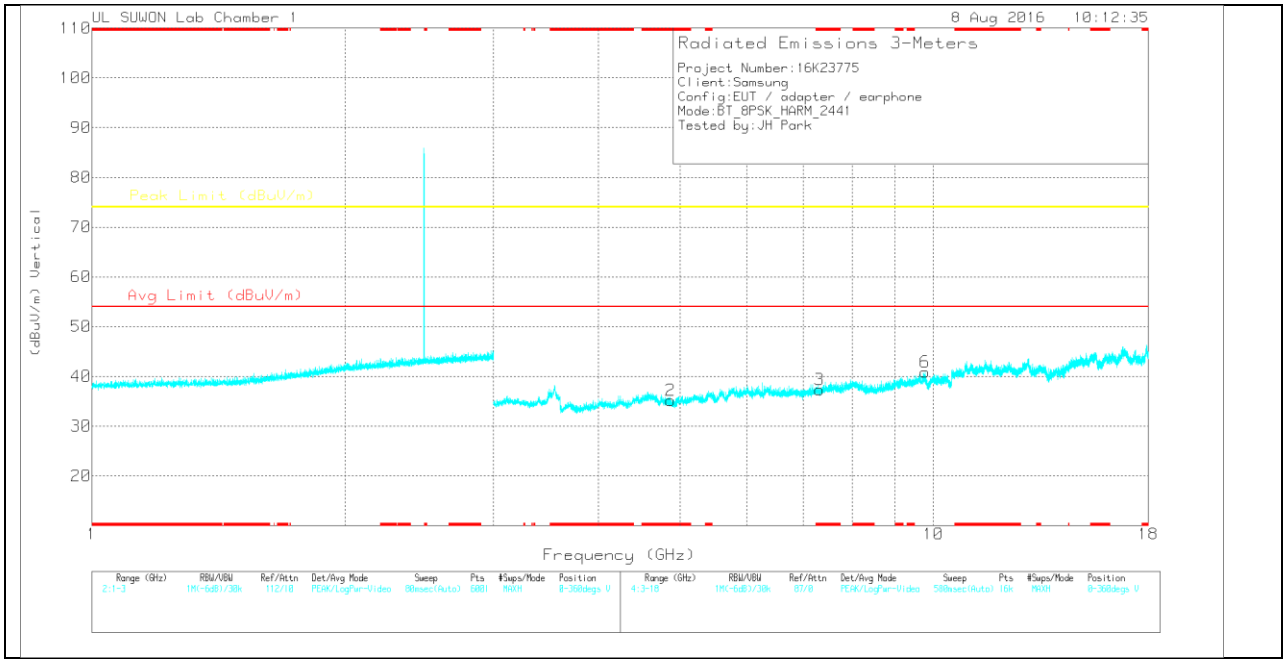
MID CHANNEL HORIZONTAL



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.

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MID CHANNEL DATA

Trace Markers

Marker	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
1	* 4.884	35.47	PK	34	-34	35.47	-	-	74	-38.53	0-360	150	H
4	* 7.318	32.69	PK	35.8	-30.9	37.59	-	-	74	-36.41	0-360	250	H
5	9.773	29.85	PK	37.2	-26.5	40.55	-	-	74	-33.45	0-360	250	H
2	* 4.874	35.23	PK	34	-34	35.23	-	-	74	-38.77	0-360	250	V
3	* 7.326	32.31	PK	35.8	-30.8	37.31	-	-	74	-36.69	0-360	250	V
6	9.775	30.08	PK	37.2	-26.4	40.88	-	-	74	-33.12	0-360	250	V

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

PK – Peak Detector

Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limt (54dBuV/m).

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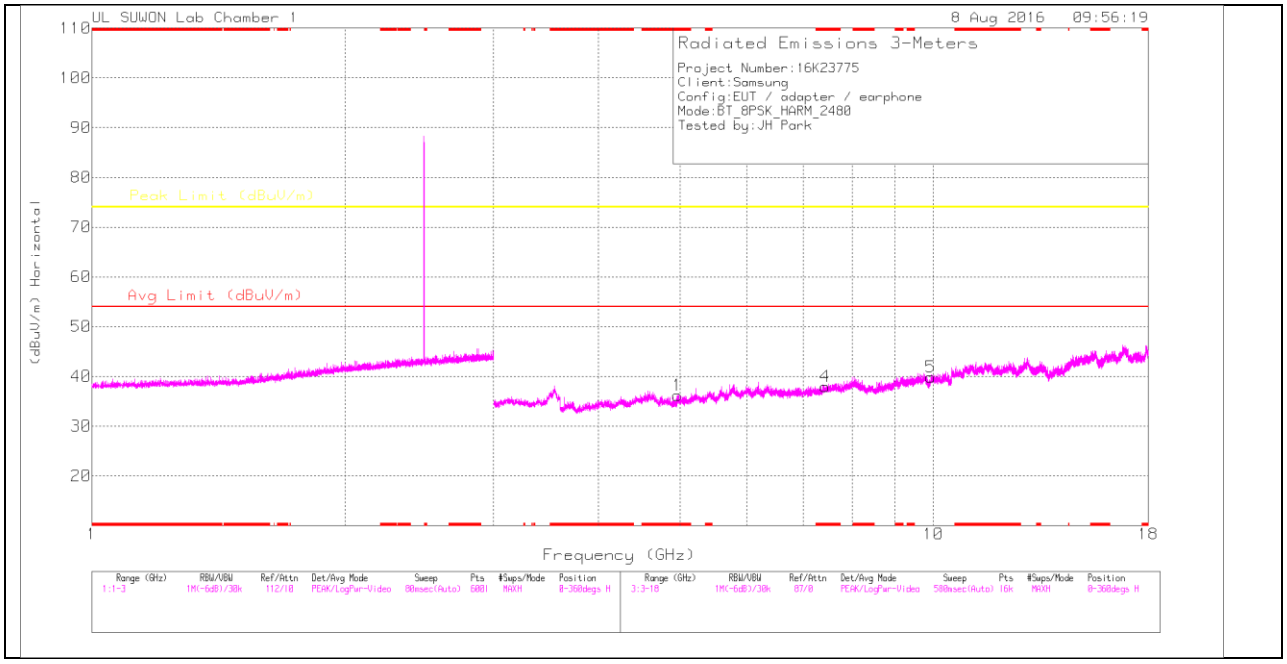
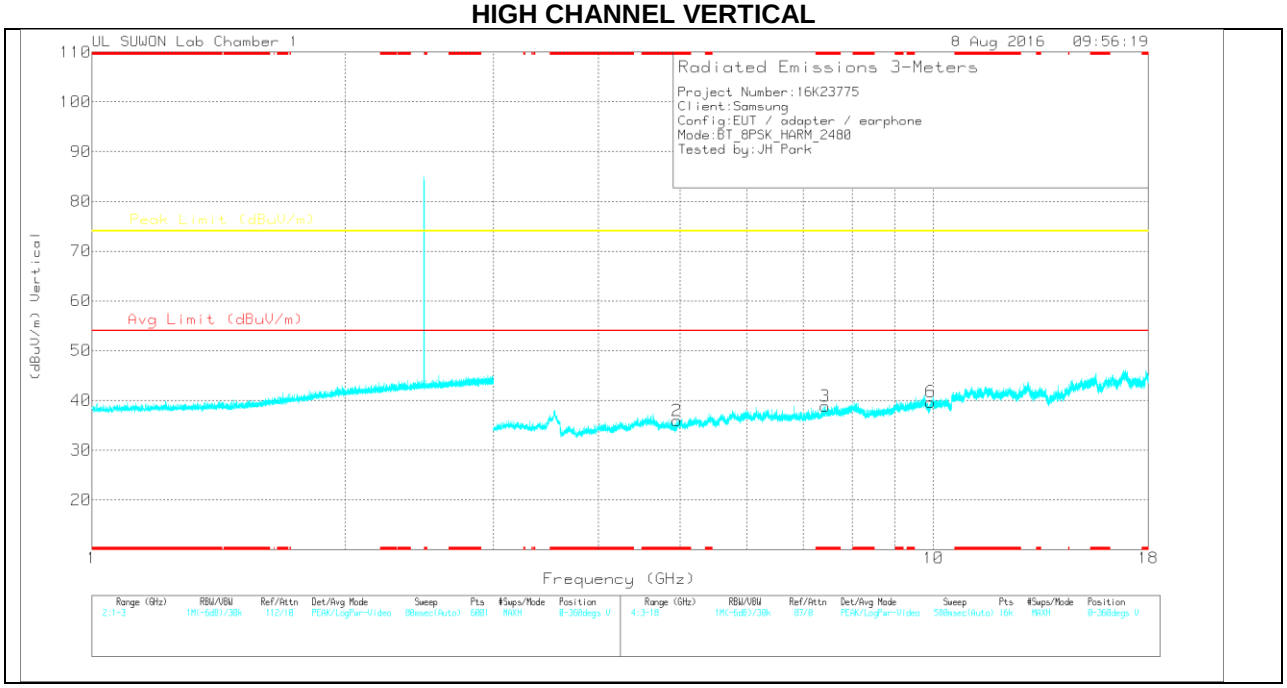
HIGH CHANNEL HORIZONTAL



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.

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HIGH CHANNEL DATA

Trace Markers

Marker	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
1	* 4.96	36.15	PK	34	-34	36.15	-	-	74	-37.85	0-360	150	H
4	* 7.432	32.84	PK	35.8	-30.7	37.94	-	-	74	-36.06	0-360	250	H
5	9.924	29.59	PK	37.4	-27.1	39.89	-	-	74	-34.11	0-360	250	H
2	* 4.959	35.93	PK	34	-34	35.93	-	-	74	-38.07	0-360	150	V
3	* 7.435	33.69	PK	35.8	-30.7	38.79	-	-	74	-35.21	0-360	150	V
6	9.919	29.47	PK	37.4	-27.2	39.67	-	-	74	-34.33	0-360	150	V

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

PK – Peak Detctor

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