



FCC CFR47 PART 15 SUBPART C

Bluetooth

CERTIFICATION TEST REPORT

FOR

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

MODEL NUMBER : SM-T395C

FCC ID: A3LSMT395C

REPORT NUMBER: 4788148881-E3V1

ISSUE DATE: OCT 13, 2017

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

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



Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	10/13/17	Initial issue	Junwhan Lee

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
1.1. INTRODUCTION OF TEST DATA REUSE.....	6
1.2. DIFFERENCE.....	6
1.3. SPOT CHECK VERIFICATION DATA	6
1.4. REFERENCE DETAIL	7
2. TEST METHODOLOGY	8
3. FACILITIES AND ACCREDITATION	8
4. CALIBRATION AND UNCERTAINTY	8
4.1. MEASURING INSTRUMENT CALIBRATION	8
4.2. SAMPLE CALCULATION	8
4.3. MEASUREMENT UNCERTAINTY.....	9
5. EQUIPMENT UNDER TEST	10
5.1. DESCRIPTION OF EUT	10
5.2. MAXIMUM OUTPUT POWER.....	10
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	10
5.4. WORST-CASE CONFIGURATION AND MODE.....	10
5.5. DESCRIPTION OF TEST SETUP.....	11
6. TEST AND MEASUREMENT EQUIPMENT	13
7. REFERENCE MEASUREMENT RESULTS.....	14
7.1. 20 dB AND 99% BANDWIDTH	14
7.1.1. BASIC DATA RATE GFSK MODULATION	14
7.1.2. ENHANCED DATA RATE Pi/4-DQPSK MODULATION.....	14
7.1.3. ENHANCED DATA RATE 8PSK MODULATION	14
7.1.4. 20 dB AND 99% BANDWIDTH PLOTS.....	15
8. SUMMARY TABLE	18
9. ANTENNA PORT TEST RESULTS.....	19
9.1. HOPPING FREQUENCY SEPARATION	19
9.2. NUMBER OF HOPPING CHANNELS.....	20
9.3. AVERAGE TIME OF OCCUPANCY.....	22
9.4. OUTPUT POWER.....	26
9.4.1. BASIC DATA RATE GFSK MODULATION	26
9.4.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION	26
9.4.3. ENHANCED DATA RATE 8PSK MODULATION	26

9.4.4.	OUTPUT POWER PLOTS	27
9.5.	AVERAGE POWER	30
9.5.1.	BASIC DATA RATE GFSK MODULATION	30
9.5.2.	DATA RATE PI/4-DQPSK MODULATION	30
9.5.3.	ENHANCED DATA RATE 8PSK MODULATION	30
9.6.	CONDUCTED SPURIOUS EMISSIONS.....	31
9.6.1.	BASIC DATA RATE GFSK MODULATION	32
10.	RADIATED TEST RESULTS	44
10.1.	LIMITS AND PROCEDURE.....	44
10.2.	TRANSMITTER ABOVE 1 GHz.....	46
10.2.1.	BASIC DATA RATE GFSK MODULATION	46
10.2.2.	ENHANCED DATA RATE 8PSK MODULATION.....	56
10.3.	BANDEDGE (on Worst case) equipped with protective case.....	66
10.4.	HARMONICS AND SPURIOUS EMISSIONS (on Worst case) equipped with protective case	67
10.5.	WORST-CASE BELOW 1 GHz	69
11.	AC POWER LINE CONDUCTED EMISSIONS	71
12.	SETUP PHOTOS	76

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/WCDMA/LTE Tablet + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC

MODEL NUMBER: SM-T395C

SERIAL NUMBER: R32J500ANHD, R32J500B9LL (RADIATED, Original model);
R32J500B6RB (CONDUCTED, Original model)
R22J9005ZNF, R22J9008P2V (RADIATED, Spot check model);

DATE TESTED: AUG 02, 2017 - AUG 25, 2017 (Original Test)
OCT 10 – OCT 12, 2017 (Spot check and Additional 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.

Approved & Released For
UL Korea, Ltd. By:

Tested By:



SungGil Park
Suwon Lab Engineer
UL Korea, Ltd.



Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMT395, DSS BT(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: A3LSMT395C hares the same enclosure and circuit board as FCC ID: A3LSMT395. The BT circuitry and layout are identical between these two units.
 The BT antennas and surrounding circuitry are the same between these two units.

After confirming through preliminary radiated emissions that the performance of the FCC ID: A3LSMT395 remains representative of FCC ID: A3LSMT395C. The test data of FCC ID: A3LSMT395 being submitted for this application to cover BT features.

Due to difference of charger, radiated emission under 1GHz and AC line conducted test were performed newly.

1.3. SPOT CHECK VERIFICATION DATA

Band	Test Item	Mode	Frequency	Test Limit	Original model	Spot check model	Deviation	Remark
					SM-T395 Results	SM-T395C Results		
					FCC ID : A3LSMT395	FCC ID : A3LSMT395C		
DSS BT (2.4GHz)	Band Edge	GFSK	2480 MHz	54 dBuV/m	39.54 dBuV/m	39.5 dBuV/m	-0.04 dB	
	RSE	GFSK	2441 MHz	74 dBuV/m	41.02 dBuV/m	39.24 dBuV/m	-1.78 dB	Noise floor level (Both data)

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

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 Title / Section
DTS	A3LSMT395	Grant	4788060215-E2V2	Test	FCC Report BLE / All sections (Except Section 10.5, 11)
			4788060215-E1V2	Test	FCC Report DTS / All sections (Except Section 10.5, 11)
DSS	A3LSMT395	Grant	4788060215-E3V2	Test	FCC Report BT / All sections (Except Section 10.5, 11)
DXX	A3LSMT395	Grant	4788060215-E5V1	Test	FCC Report ANT+ / All sections (Except Section 7.2.4, 8)
			4788060215-E6V2	Test	FCC Report NFC / All sections (Except Section 8.1.2, 9)
NII	A3LSMT395	Grant	4788060215-E4V3	Test	FCC Report UNII / All sections (Except Section 11, 12)

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	
<input checked="" type="checkbox"/>	Chamber 1
<input type="checkbox"/>	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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

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 Tablet + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC Tablet. 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	8.072	6.415
		Peak	8.617	7.273
	Enhanced Pi/4-DPSK	Average	4.669	2.930
		Peak	7.555	5.695
	Enhanced 8PSK	Average	4.701	2.952
		Peak	7.961	6.253

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal antenna, with a maximum gain of -1.3 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

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

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 9.5.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA12CBC	DK2J606HS/B- E	N/A
Data Cable	SAMSUNG	EP-DN930CWE	N/A	N/A
Earphone	SAMSUNG	EO-EG920BW	N/A	N/A

I/O CABLES

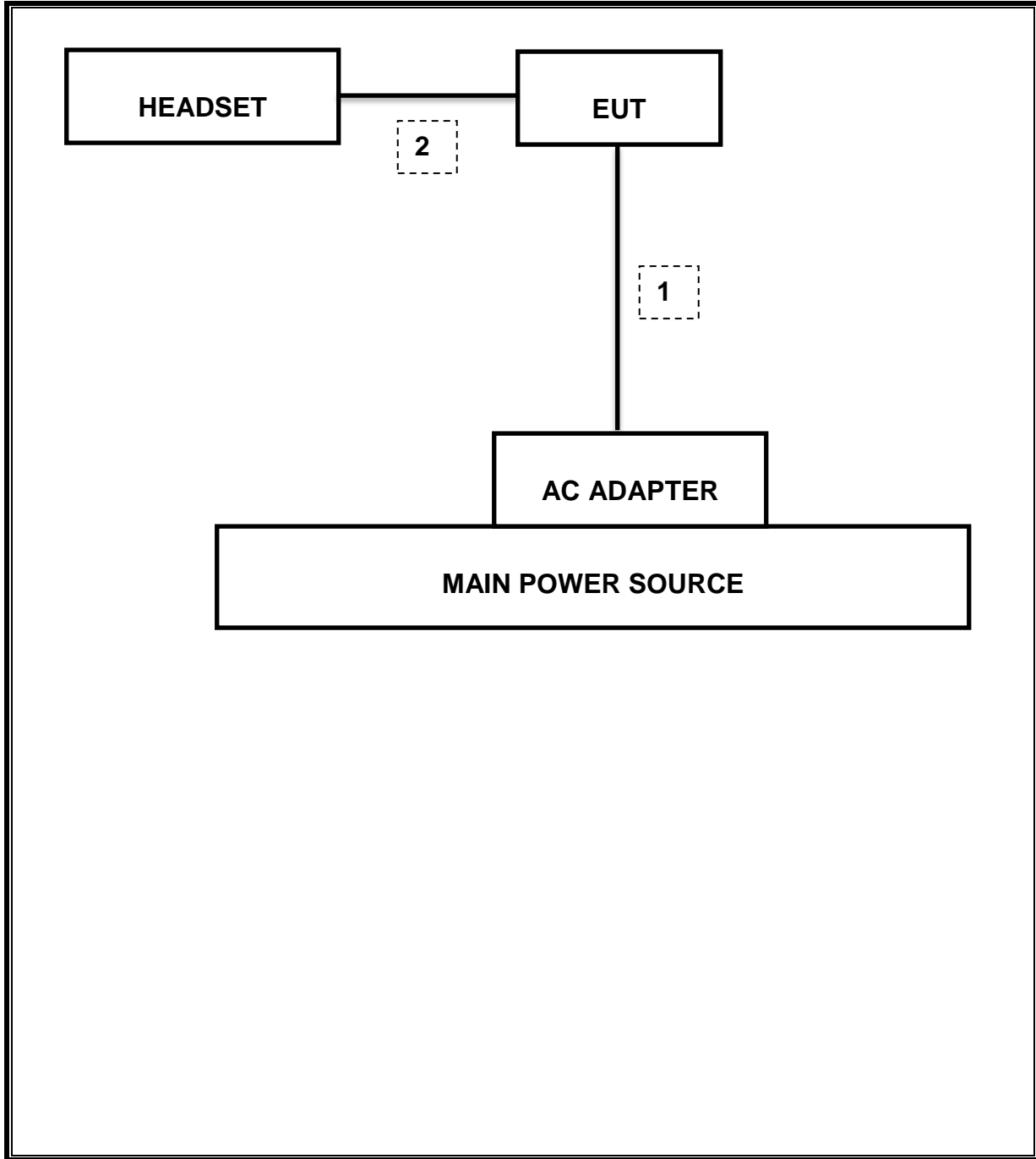
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	C-type	Shielded	1.2m	N/A
2	Audio	2	Mini-Jack	Unshielded	1.2m	N/A

NOTE : Protective cover (with S-pen) is in-box item. So additional radiated spurious emission measurements were performed on worst case equipped with protective case.

TEST SETUP

The EUT is continuously communicating to the Bluetooth tester during the tests.
 Test software enable BT communications.

SETUP DIAGRAM FOR TESTS



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	WEINSCHTEL	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	11-25-17
UL Software				
Description	Manufacturer	Model	Version	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

7. REFERENCE MEASUREMENT RESULTS

7.1. 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 $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

7.1.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [kHz]	99% Bandwidth [kHz]
Low	2402	866.000	896.900
Mid	2441	973.300	896.670
High	2480	972.600	900.760
Worst		973.300	900.760

7.1.2. ENHANCED DATA RATE Pi/4-DQPSK MODULATION

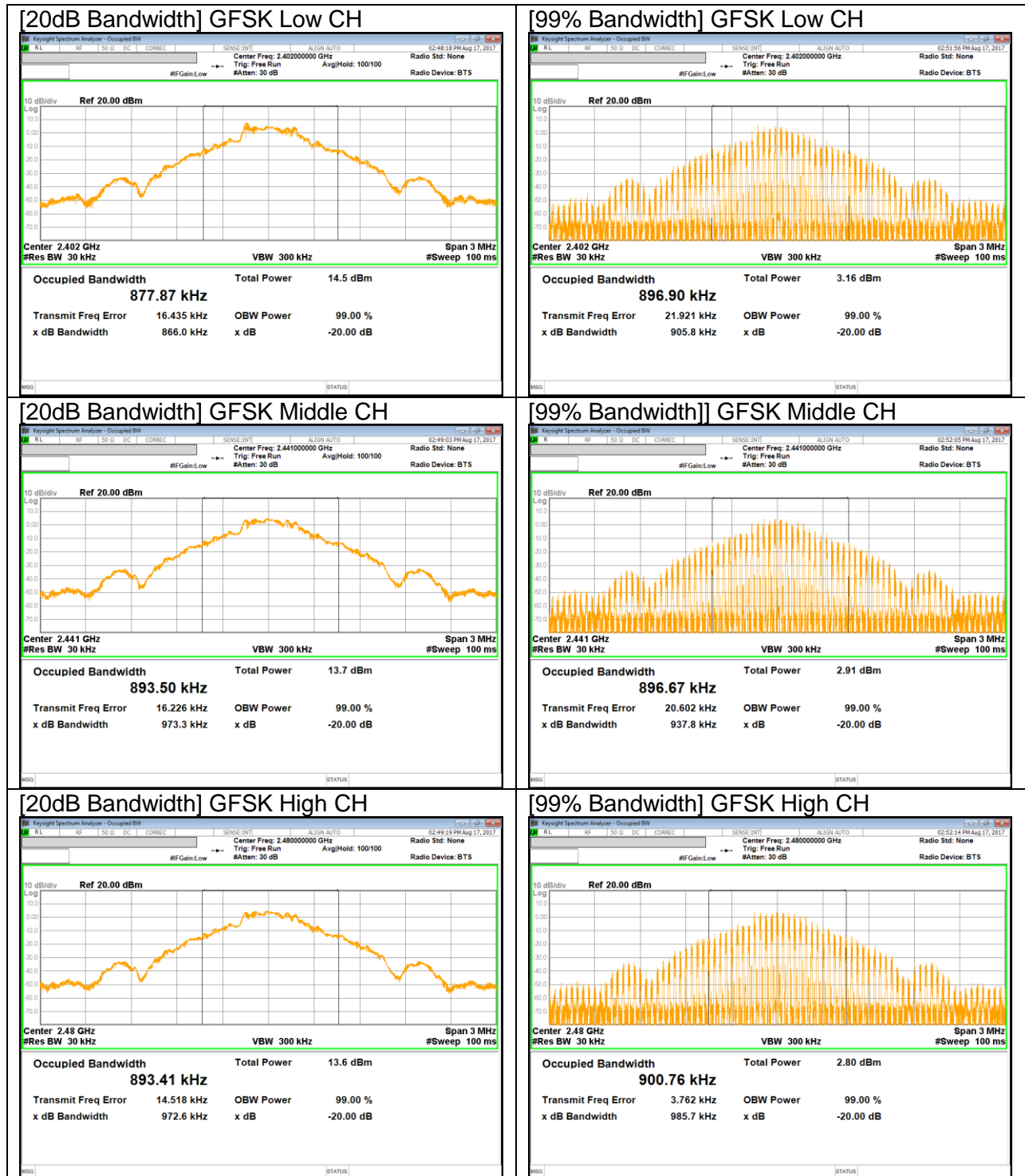
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.243	1.159
Mid	2441	1.309	1.131
High	2480	1.308	1.131
Worst		1.309	1.159

7.1.3. ENHANCED DATA RATE 8PSK MODULATION

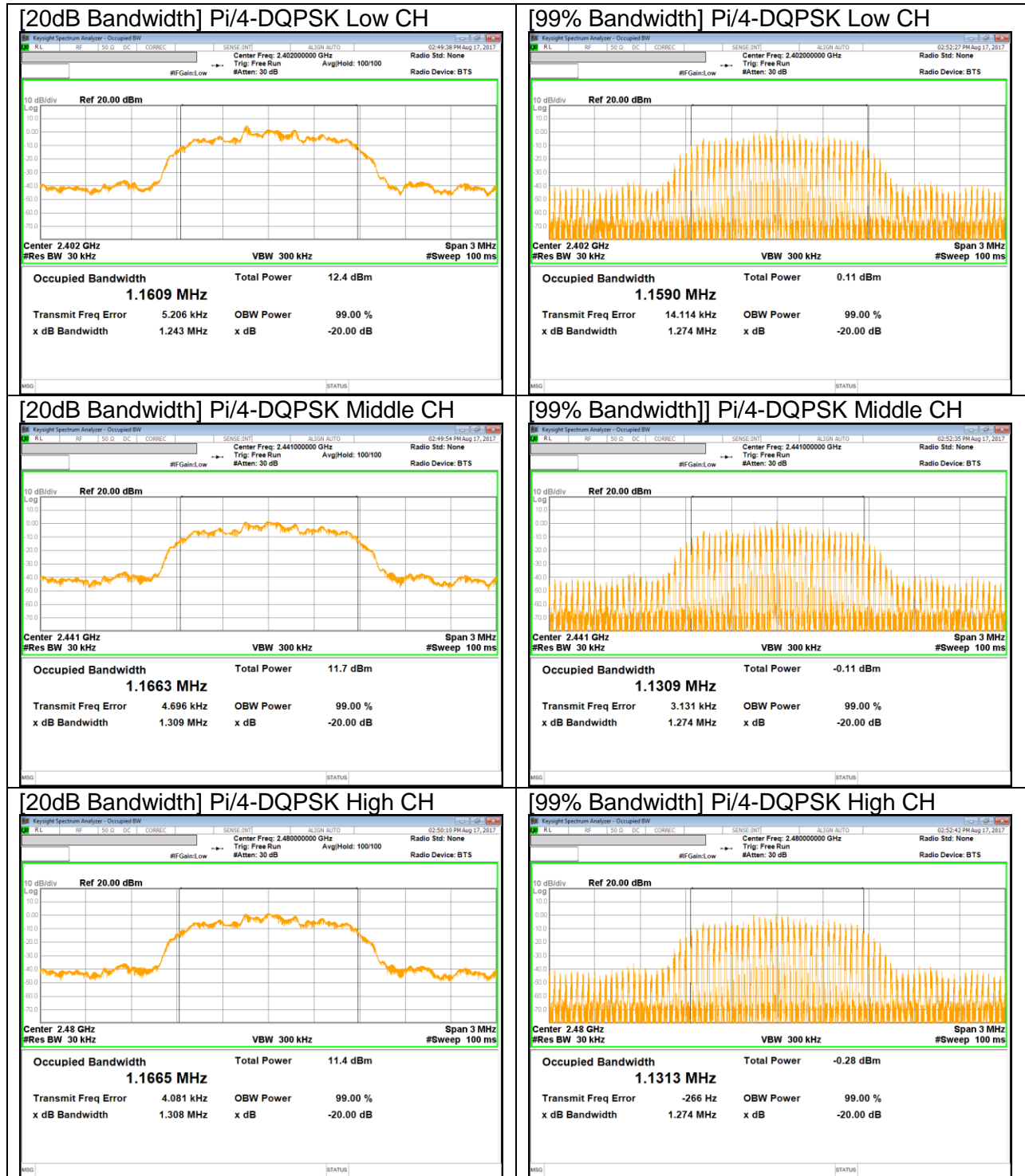
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.261	1.163
Mid	2441	1.268	1.162
High	2480	1.269	1.162
Worst		1.269	1.163

7.1.4. 20 dB AND 99% BANDWIDTH PLOTS

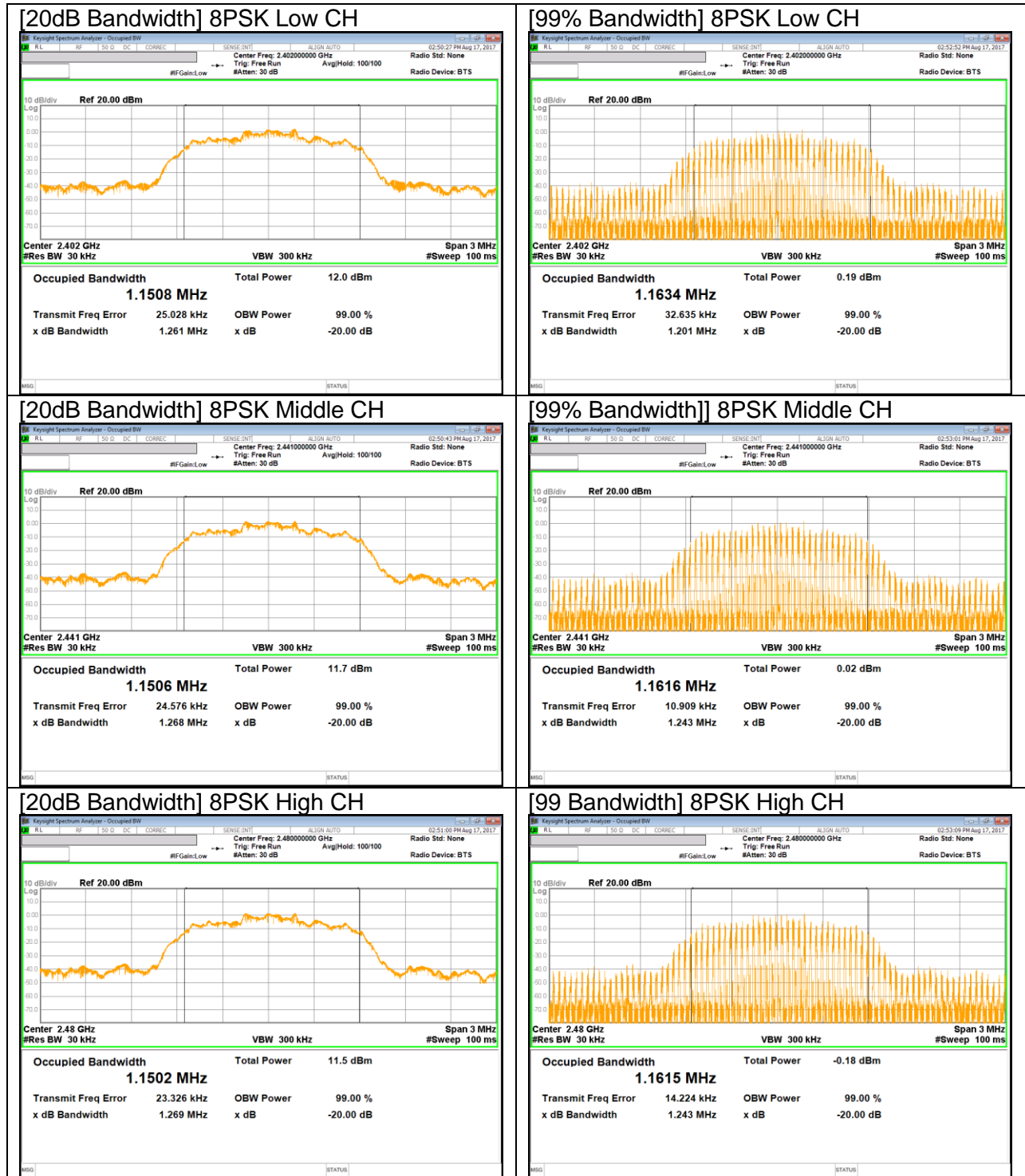
GFSK BANDWIDTH



Pi/4-DQPSK BANDWIDTH



8PSK BANDWIDTH



8. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-39.914 dBm
15.247 (b)(1)	TX conducted output power	<21dBm		Pass	8.617 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	0.34596 sec
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	38.59 dBuV (Pk)
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	39.54 dBuV/m (AV)

9. ANTENNA PORT TEST RESULTS

9.1. 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 hopping channel, whichever is greater.

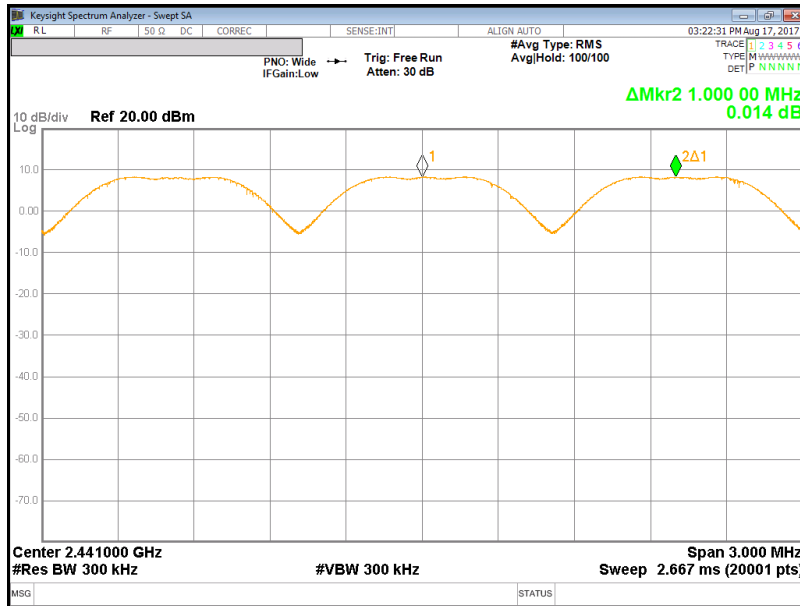
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

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



9.2. 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

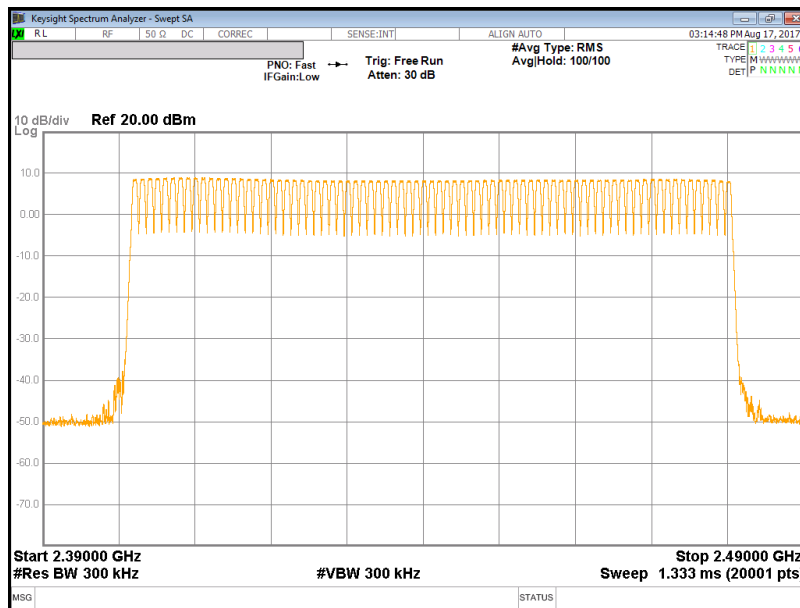
DA 00-705: The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

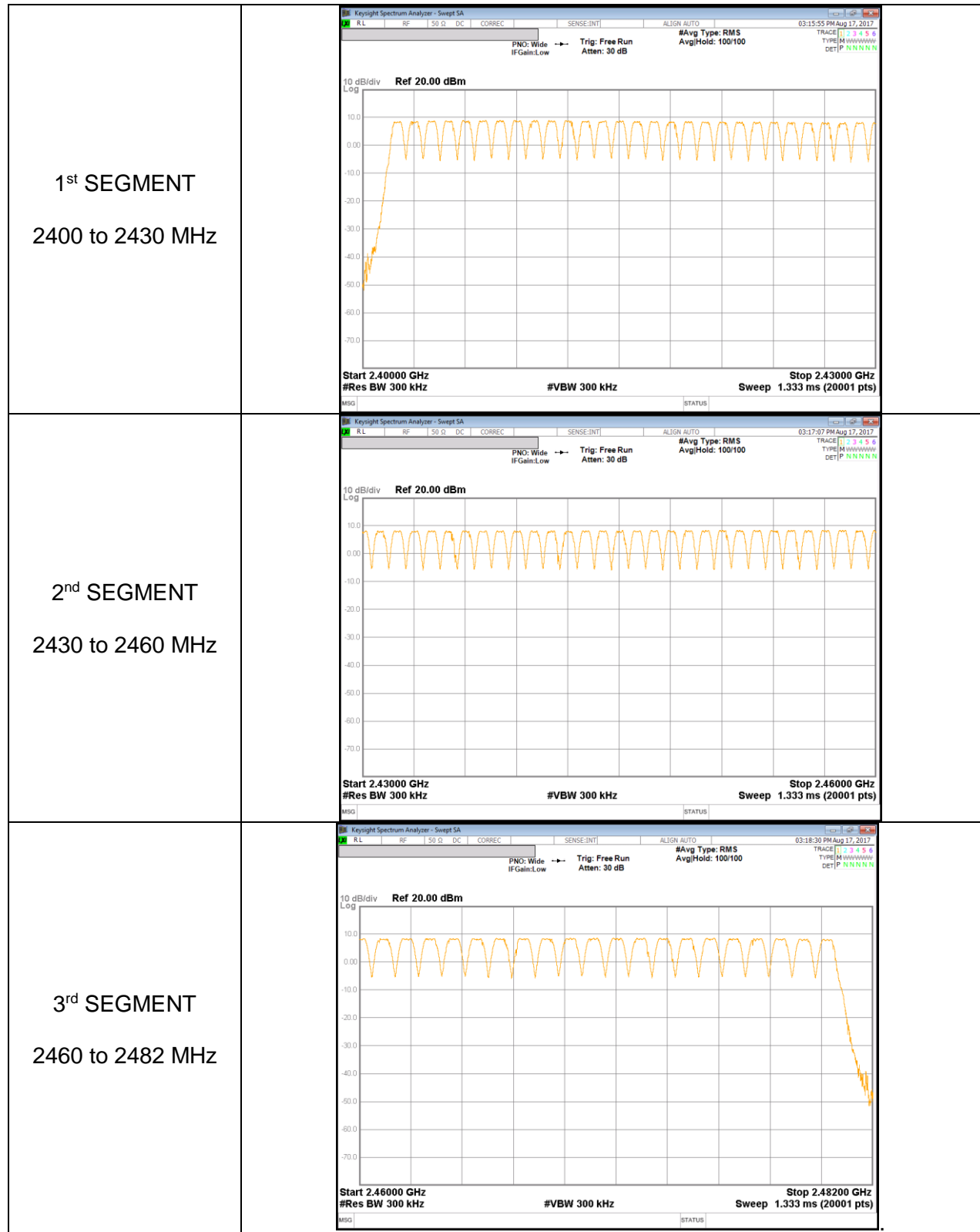
RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS PLOTS

NUMBER OF HOPPING CHANNELS (100 MHz SPAN)





9.3. 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.

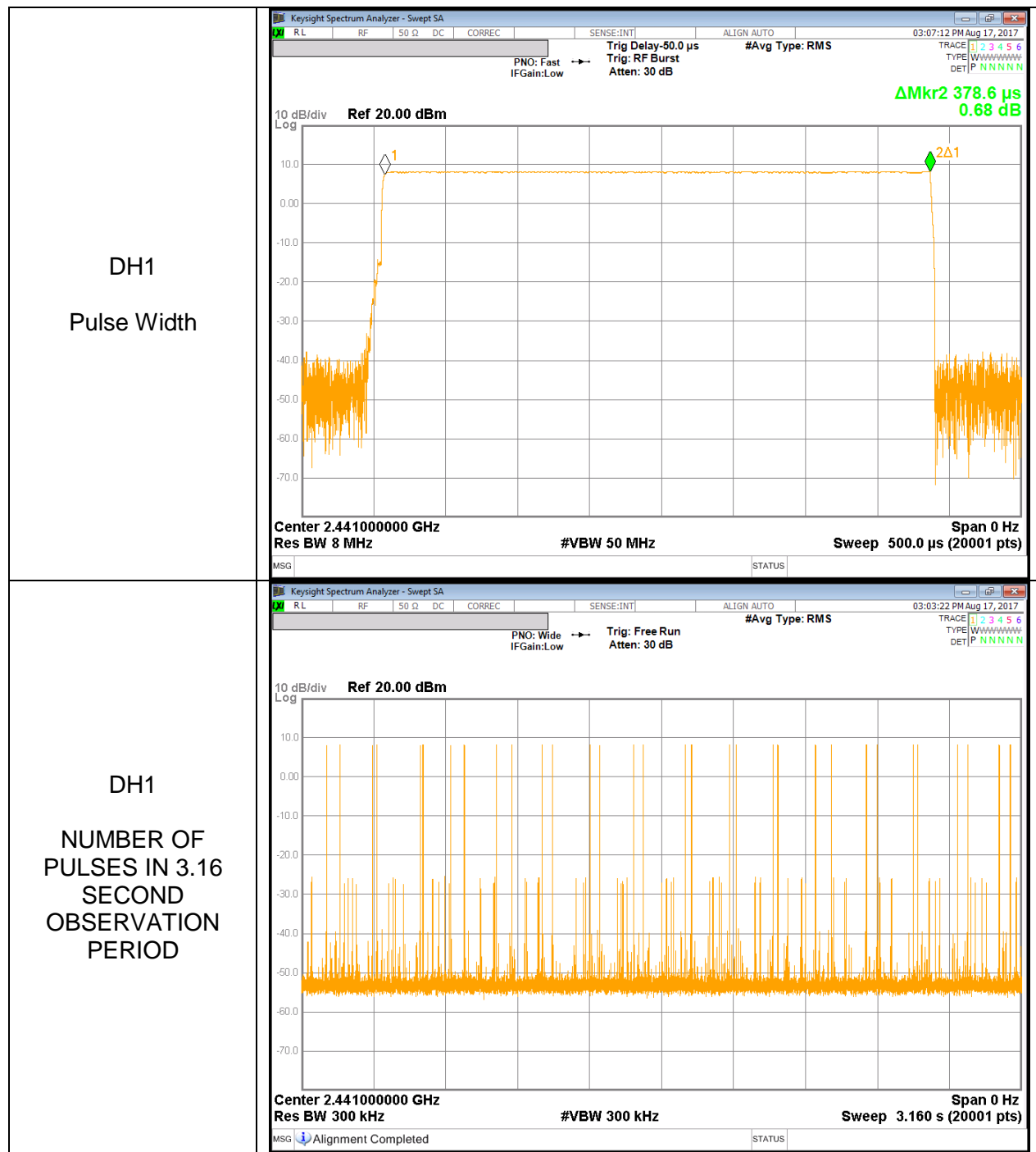
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

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

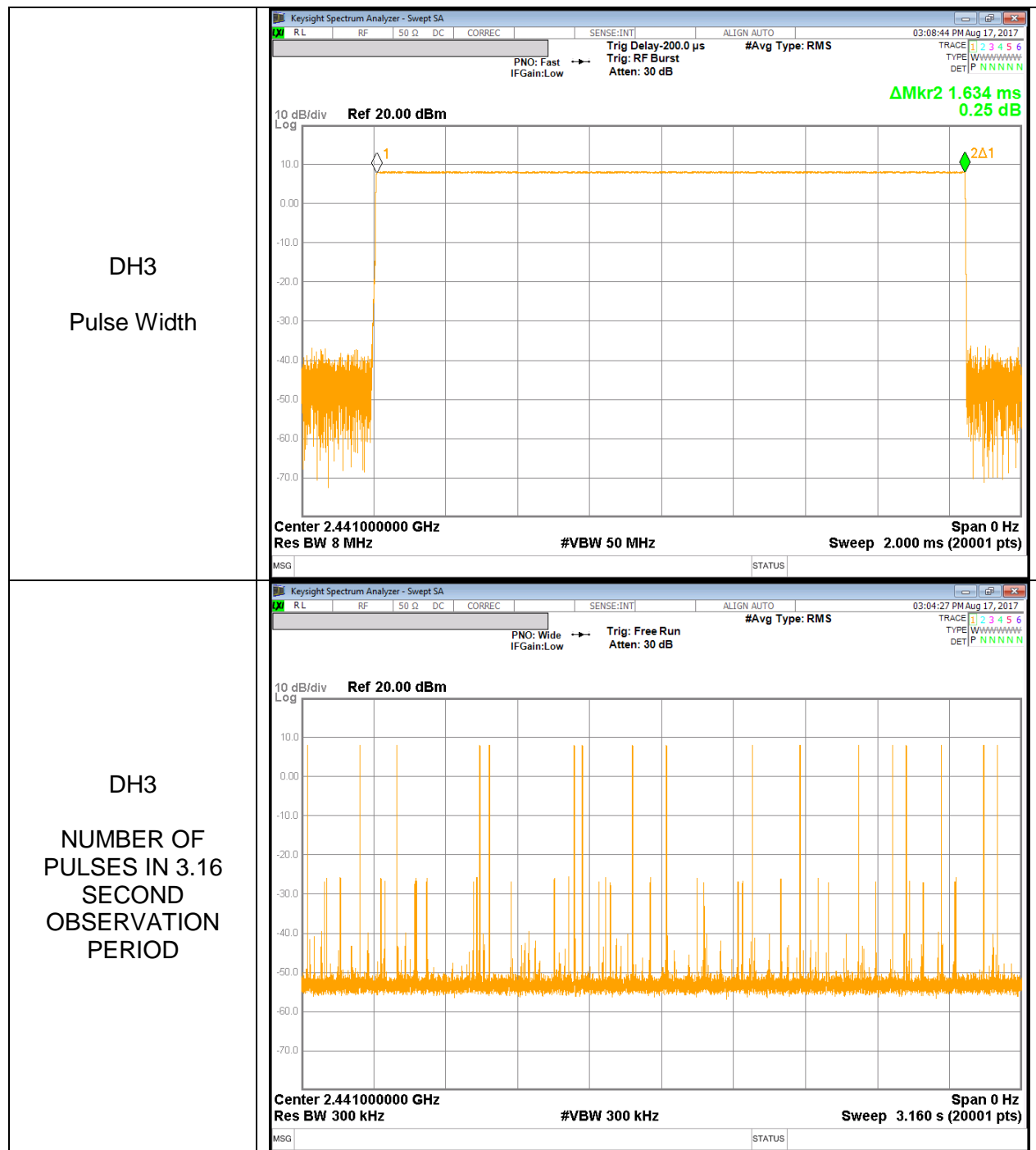
RESULTS

DH Packet	Pulse Width [msec]	Number of Pulses in 3.16 seconds	Average Time of Occupancy [sec]	Limit [sec]	Margin [sec]
GFSK Normal					
DH1	0.379	32	0.121152	0.4	-0.2788
DH3	1.634	17	0.277780	0.4	-0.1222
DH5	2.883	12	0.345960	0.4	-0.0540
GFSK AFH					
DH Packet	Pulse Width [msec]	Number of Pulses in 0.8 seconds	Average Time of Occupancy [sec]	Limit [sec]	Margin [sec]
GFSK AFH					
DH1	0.379	8	0.030288	0.4	-0.36971
DH3	1.634	4.25	0.069445	0.4	-0.33056
DH5	2.883	3	0.086490	0.4	-0.31351

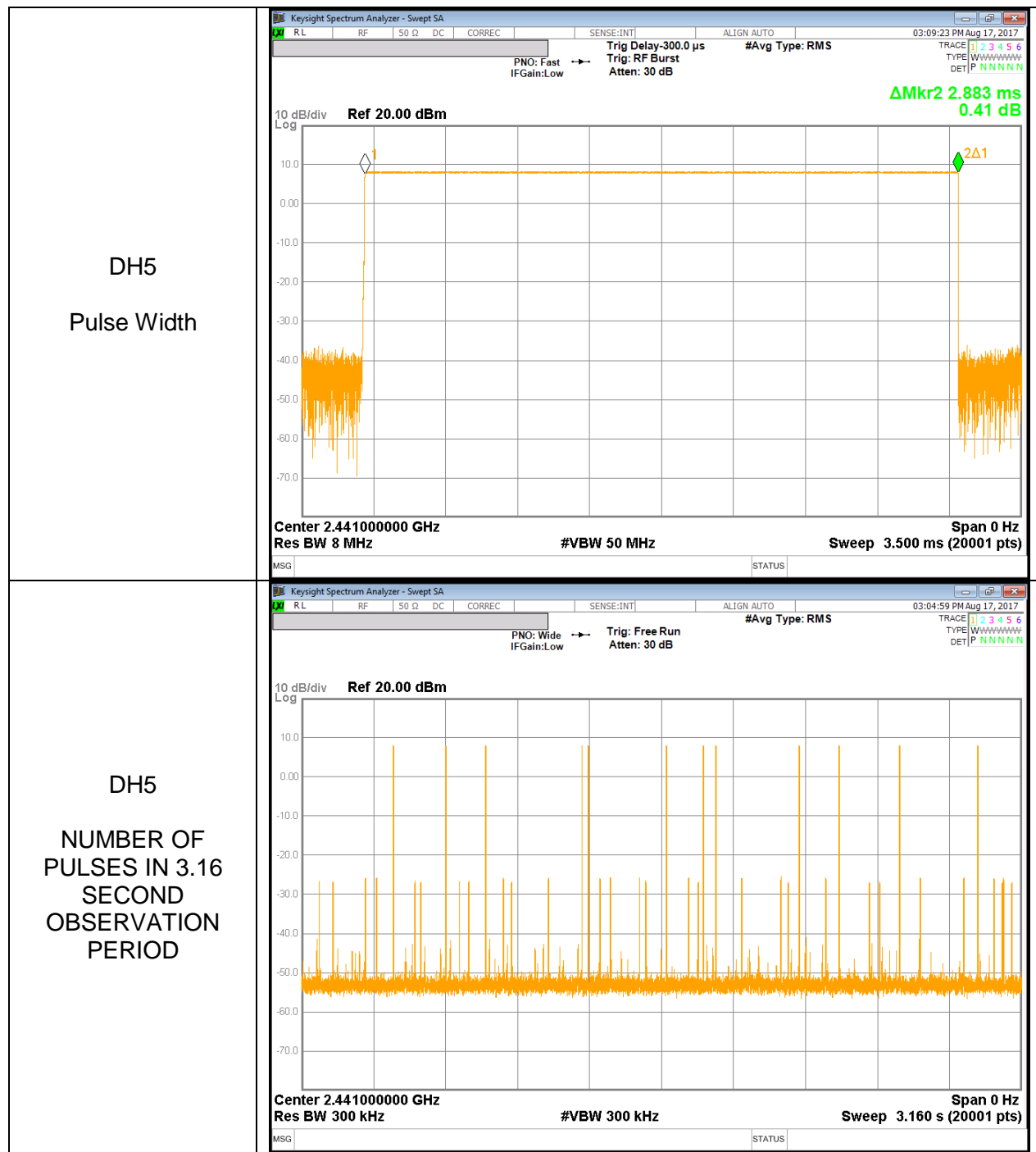
DH1



DH3



DH5



9.4. 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

9.4.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	8.617	21	-12.383
Middle	2441	8.228	21	-12.772
High	2480	8.113	21	-12.887
Worst		8.617	21	-12.383

9.4.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	7.555	21	-13.445
Middle	2441	7.215	21	-13.785
High	2480	7.031	21	-13.969
Worst		7.555	21	-13.445

9.4.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	7.961	21	-13.039
Middle	2441	7.619	21	-13.381
High	2480	7.481	21	-13.519
Worst		7.961	21	-13.039

9.4.4. OUTPUT POWER PLOTS

GFSK OUTPUT POWER

<p>GFSK Low CH</p>	<p>Key: Keysight Spectrum Analyzer - Swept SA PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS AvgHold: 100/100 Ref 20.00 dBm Mkr1 2.401 996 0 GHz 8.617 dBm Center 2.402000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>
<p>GFSK Middle CH</p>	<p>Key: Keysight Spectrum Analyzer - Swept SA PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS AvgHold: 100/100 Ref 20.00 dBm Mkr1 2.440 988 0 GHz 8.228 dBm Center 2.441000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>
<p>GFSK High CH</p>	<p>Key: Keysight Spectrum Analyzer - Swept SA PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS AvgHold: 100/100 Ref 20.00 dBm Mkr1 2.479 875 0 GHz 8.113 dBm Center 2.480000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>

Pi/4-DPSK OUTPUT POWER

<p>Pi/4-DPSK Low CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:45:41 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.402 203 0 GHz 7.555 dBm Ref 20.00 dBm Center 2.402000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>
<p>Pi/4-DPSK Middle CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:45:51 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.441 146 0 GHz 7.215 dBm Ref 20.00 dBm Center 2.441000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>
<p>Pi/4-DPSK High CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:46:00 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.480 111 5 GHz 7.031 dBm Ref 20.00 dBm Center 2.480000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 10.00 MHz Sweep 1.333 ms (20001 pts)</p>

8PSK OUTPUT POWER

<p>8PSK Low CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:46:12 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.401 959 5 GHz 7.961 dBm Ref 20.00 dBm 10 dB/div Log Center 2.402000 GHz #Res BW 3.0 MHz #VBW 50 MHz Sweep 1.333 ms (20001 pts)</p>
<p>8PSK Middle CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:46:21 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.440 996 0 GHz 7.619 dBm Ref 20.00 dBm 10 dB/div Log Center 2.441000 GHz #Res BW 3.0 MHz #VBW 50 MHz Sweep 1.333 ms (20001 pts)</p>
<p>8PSK High CH</p>	<p>KeySight Spectrum Analyzer - Swept SA 02:46:31 PM Aug 17, 2017 #Avg Type: RMS AvgHold: 100/100 Mkr1 2.480 065 0 GHz 7.481 dBm Ref 20.00 dBm 10 dB/div Log Center 2.480000 GHz #Res BW 3.0 MHz #VBW 50 MHz Sweep 1.333 ms (20001 pts)</p>

9.5. 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 was entered as an offset in the power meter to allow for direct reading of power.

9.5.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	8.072	6.42
Middle	2441	7.423	5.52
High	2480	7.304	5.38

9.5.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	4.669	2.93
Middle	2441	4.325	2.71
High	2480	4.159	2.61

9.5.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	4.701	2.95
Middle	2441	4.357	2.73
High	2480	4.203	2.63

9.6. 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.

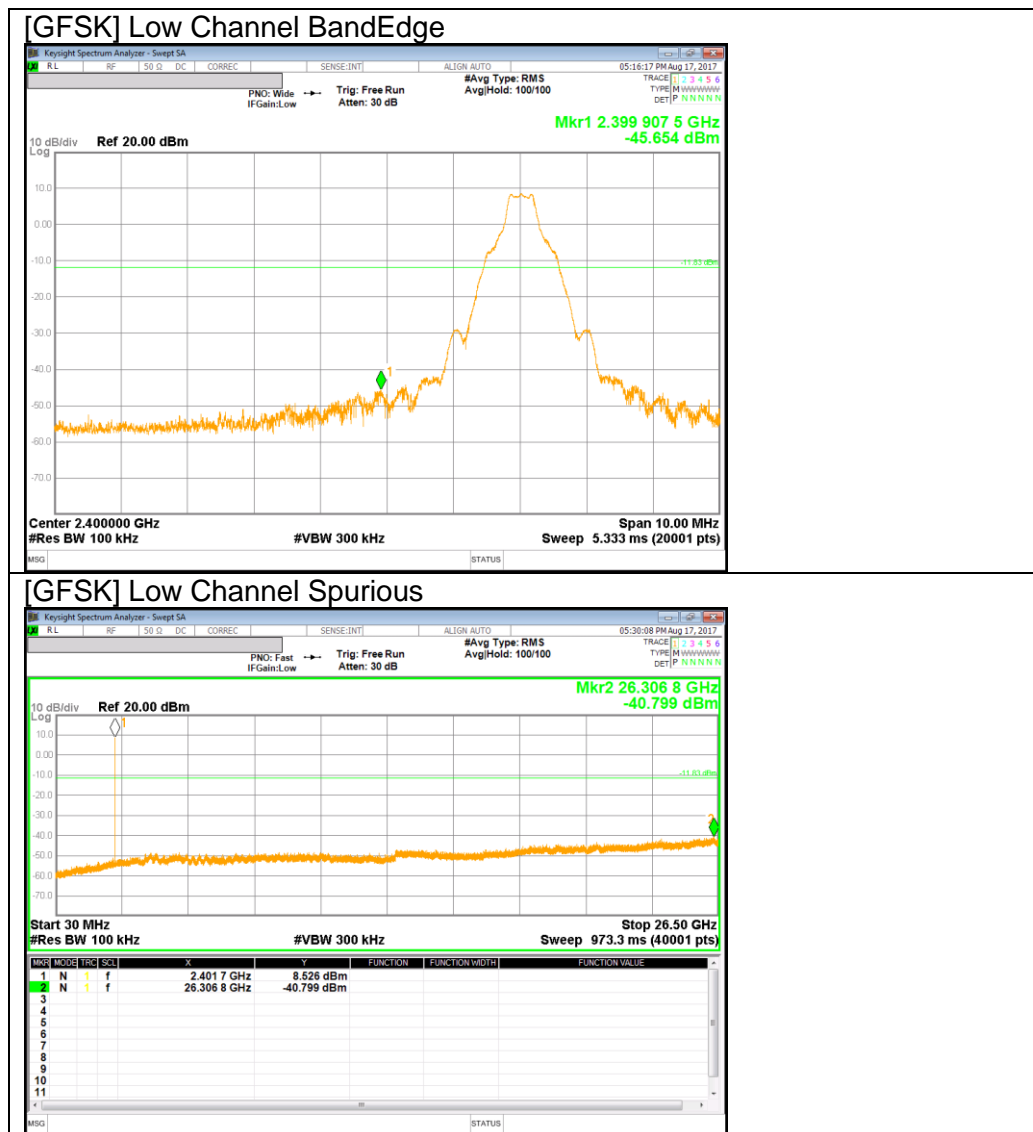
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

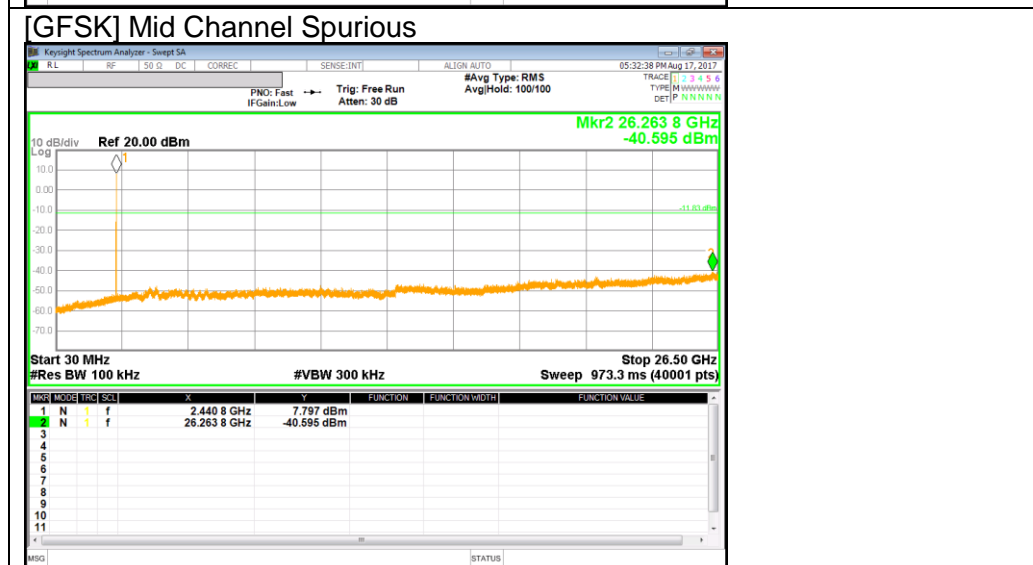
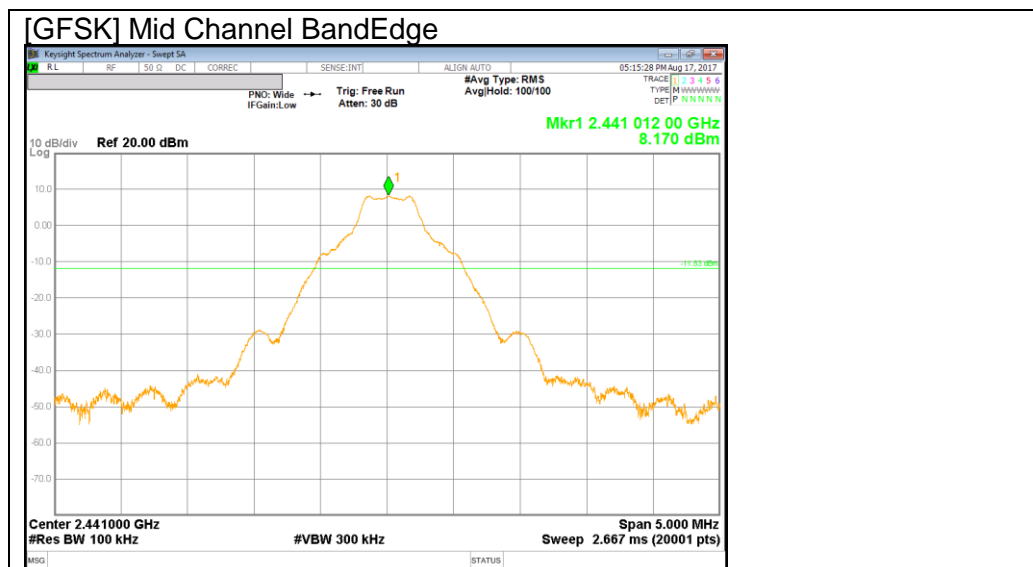
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

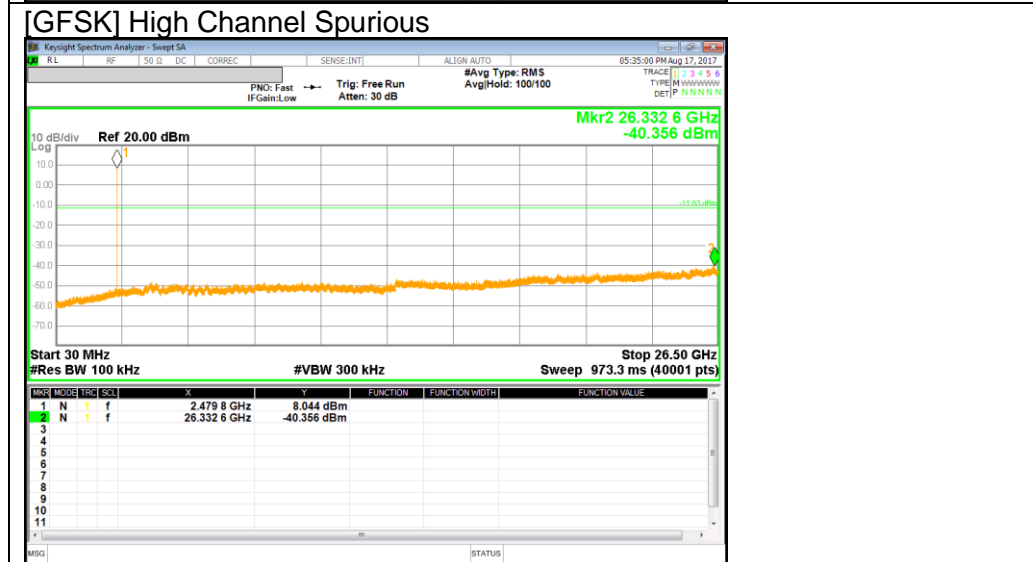
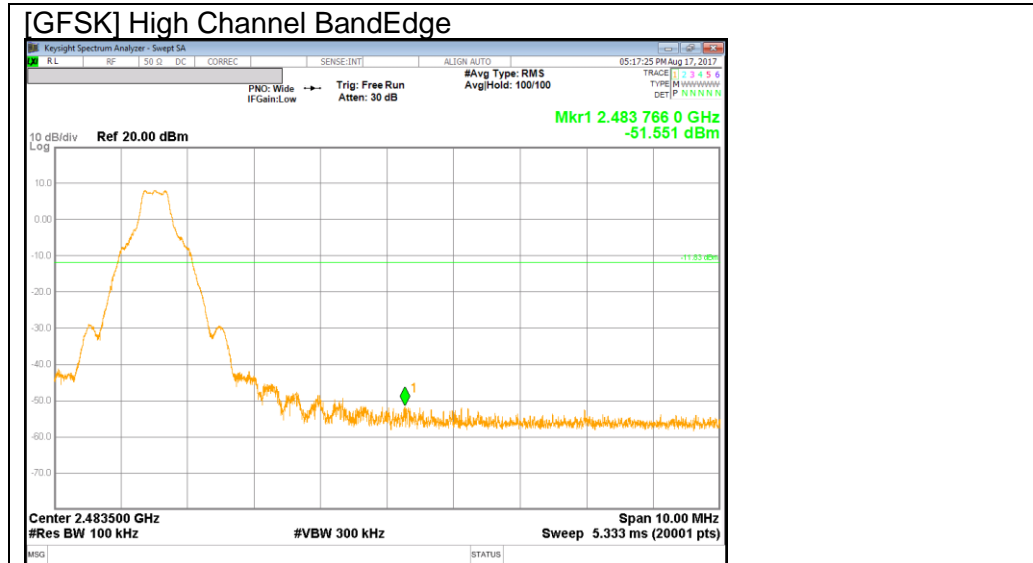
RESULTS

9.6.1. BASIC DATA RATE GFSK MODULATION

GFSK Mode

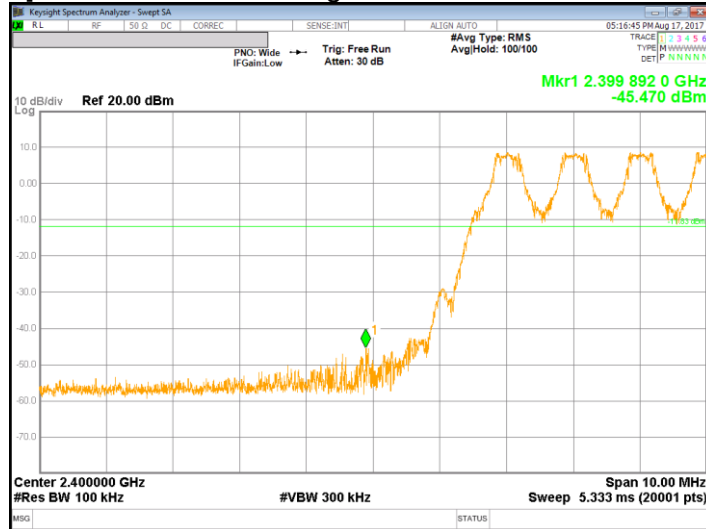




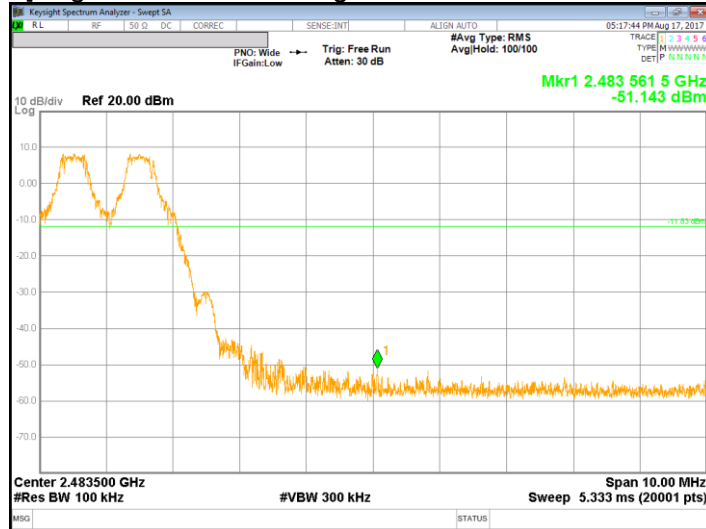


BandEdge Emission at GFSK Hopping Mode

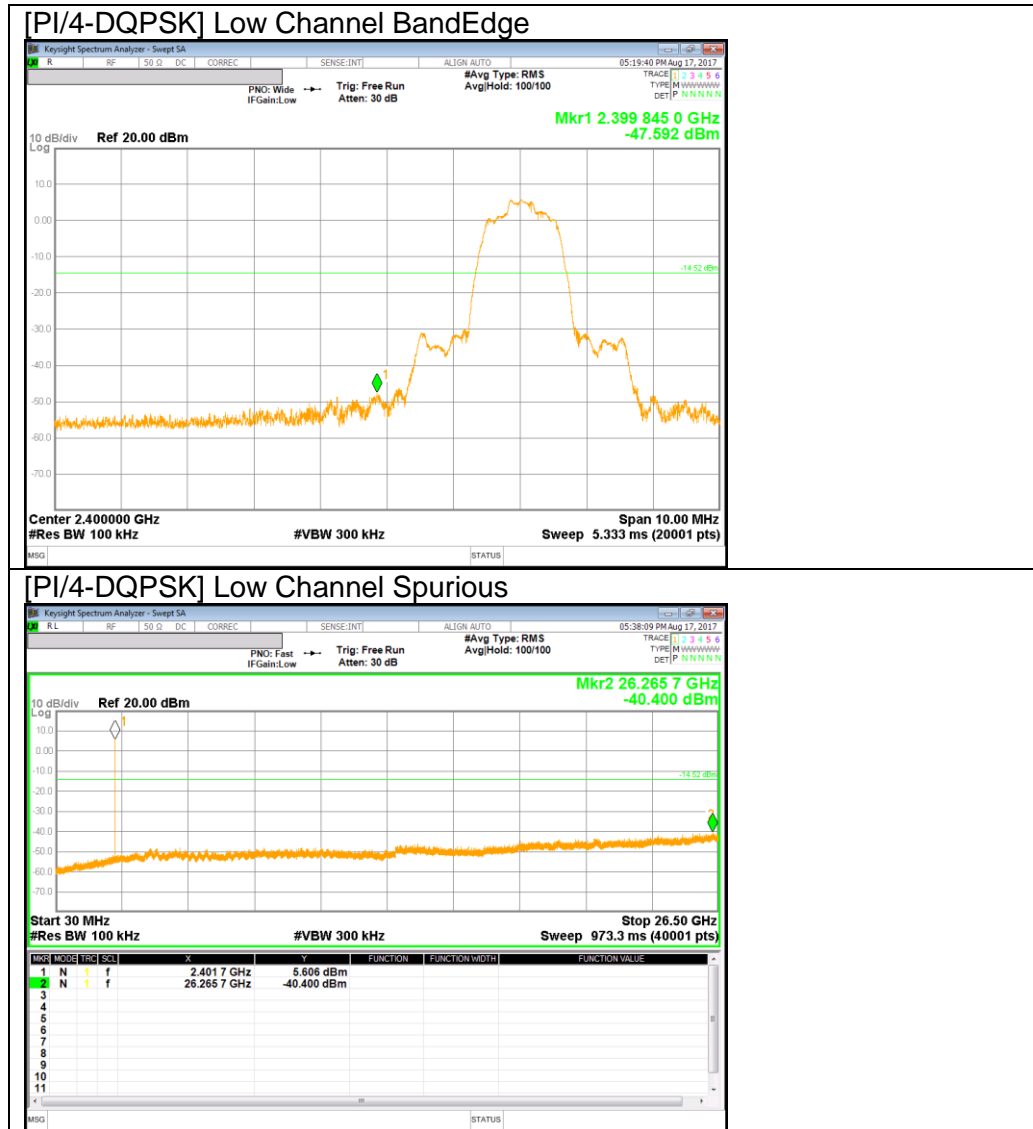
[GFSK Hopping Mode] Low Channel BandEdge

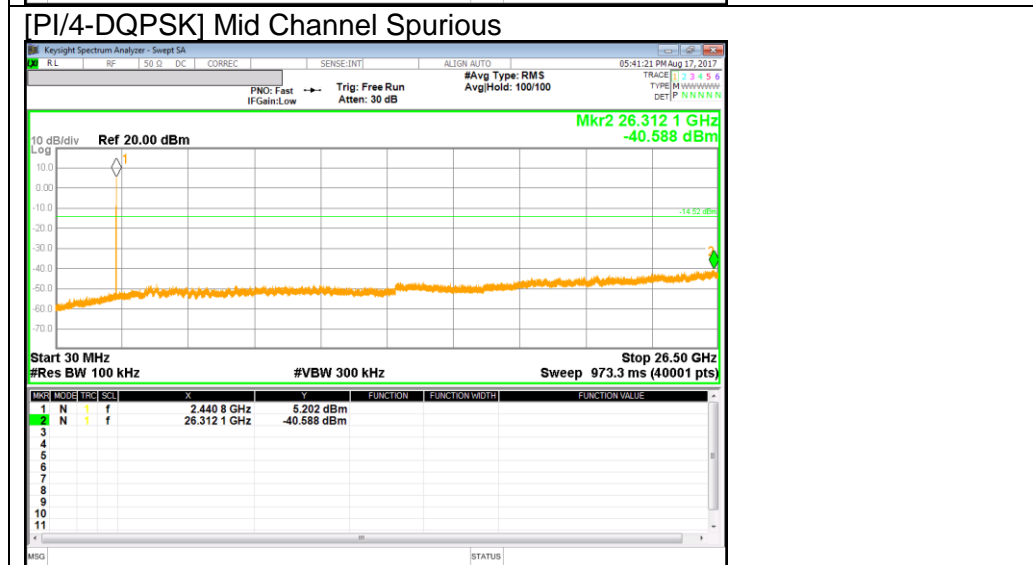
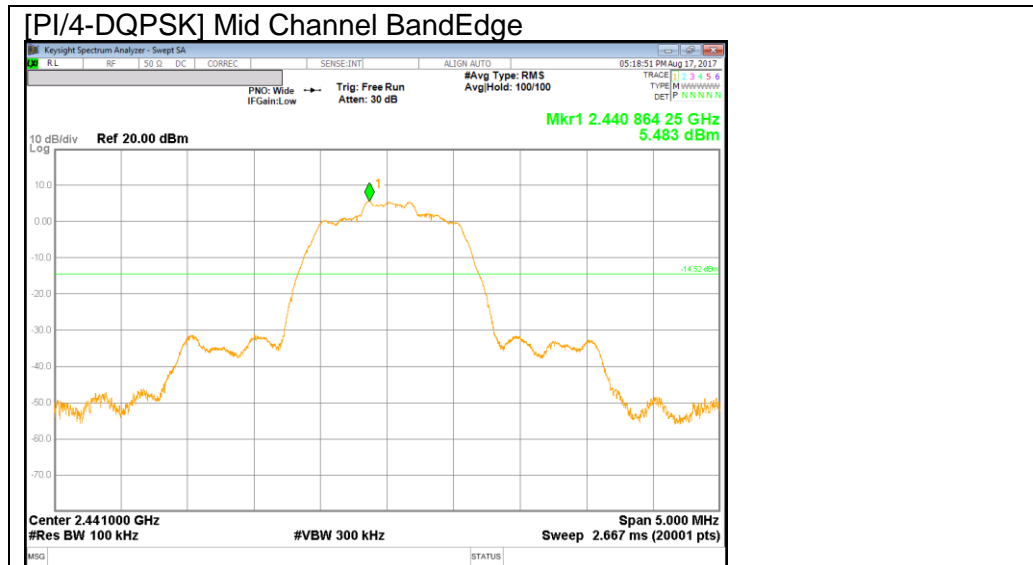


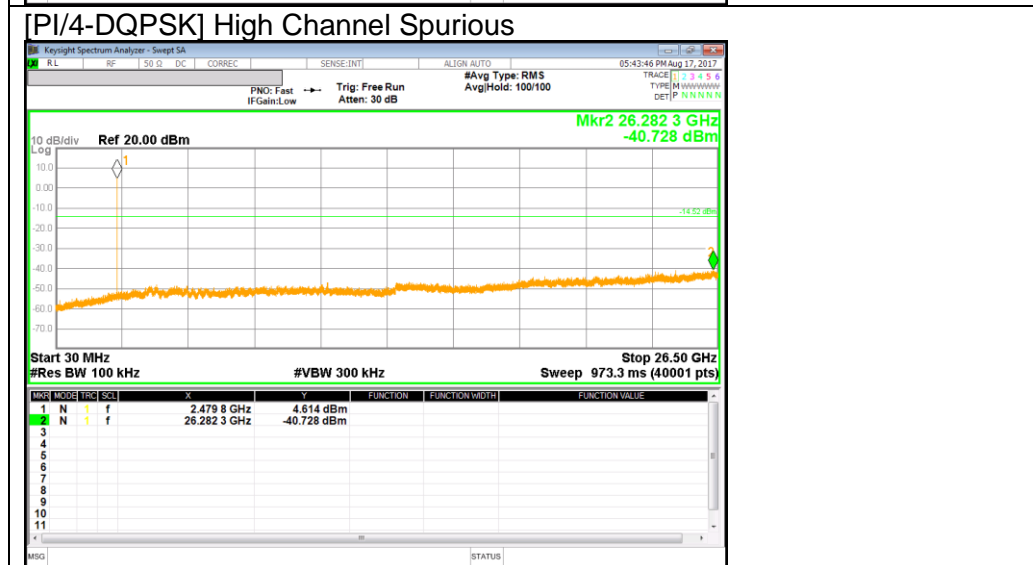
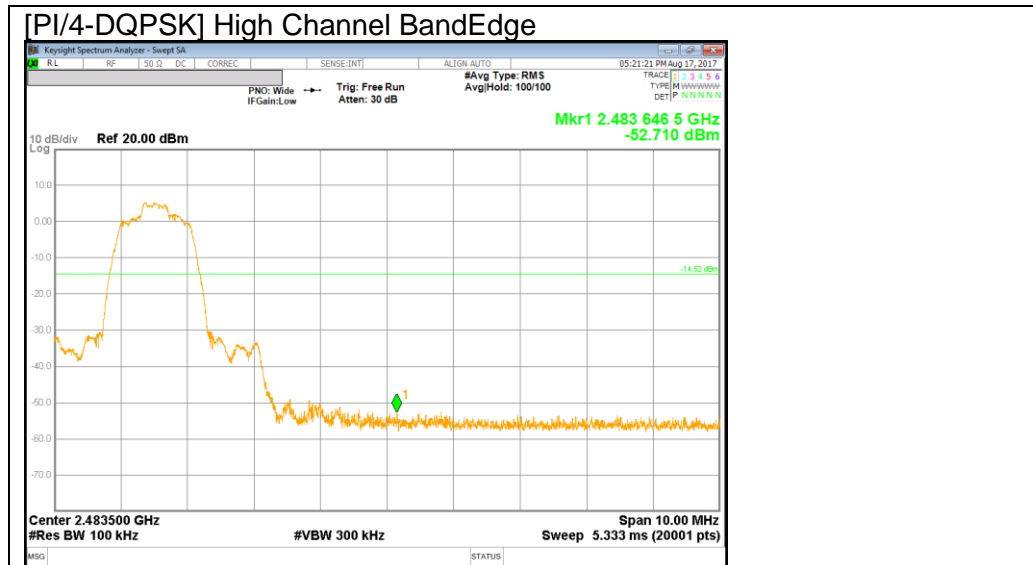
[GFSK Hopping Mode] High Channel BandEdge



PI/4-DQPSK Mode

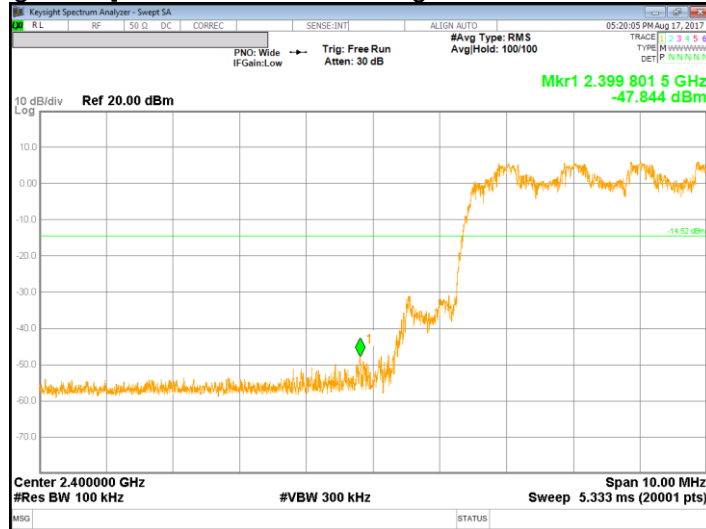






BandEdge Emission at PI/4-DQPSK Hopping Mode

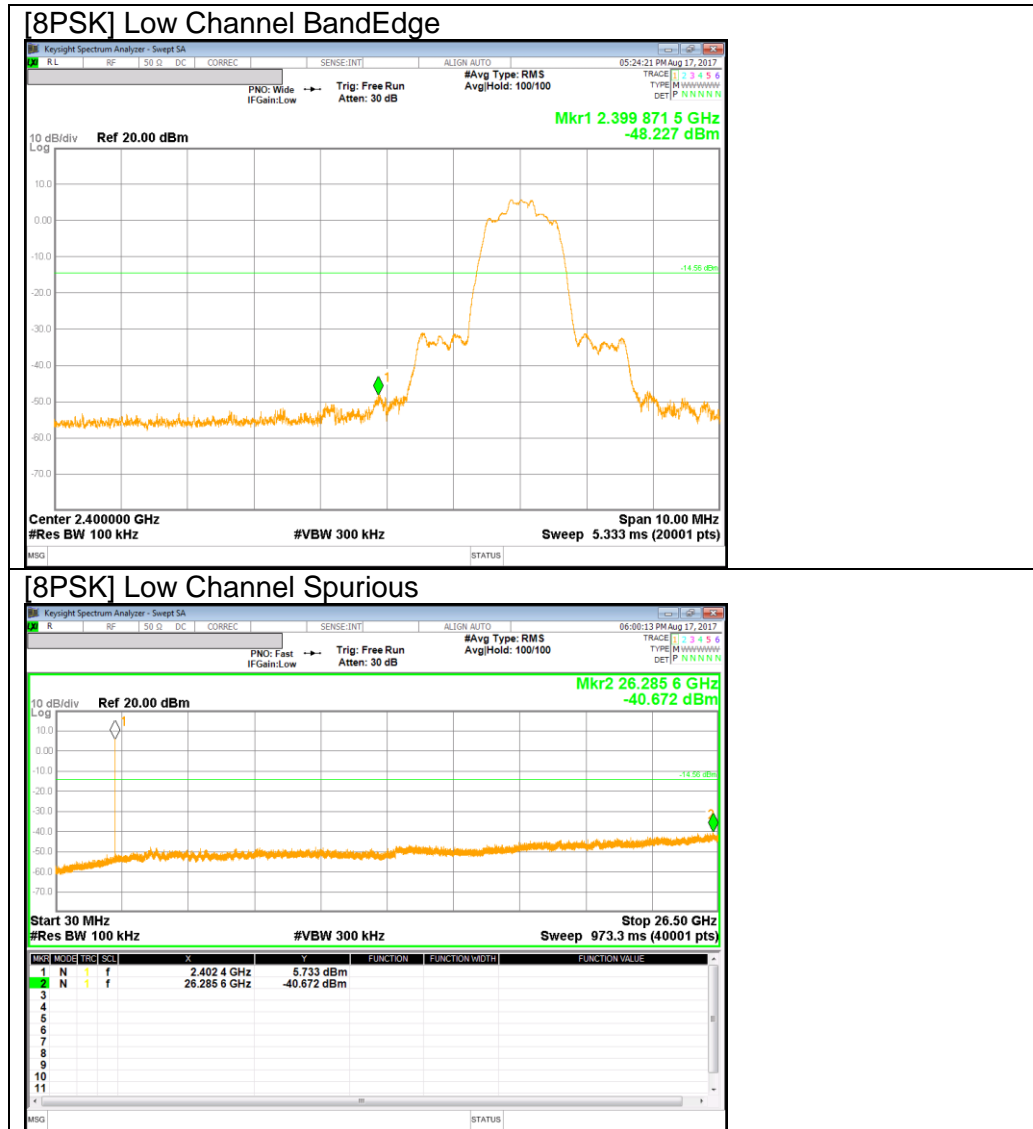
[PI/4-DQPSK Hopping Mode] Low Channel BandEdge

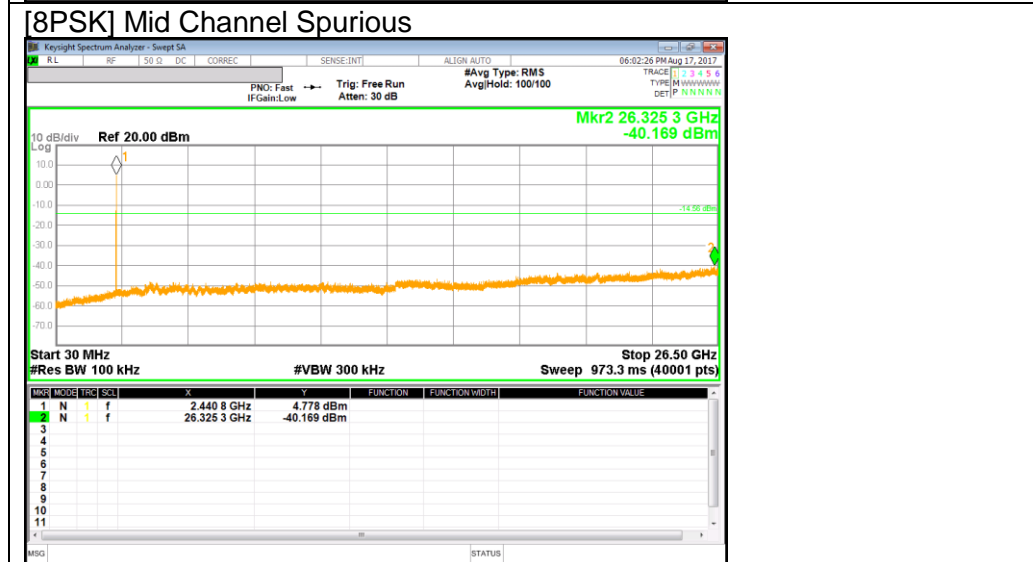
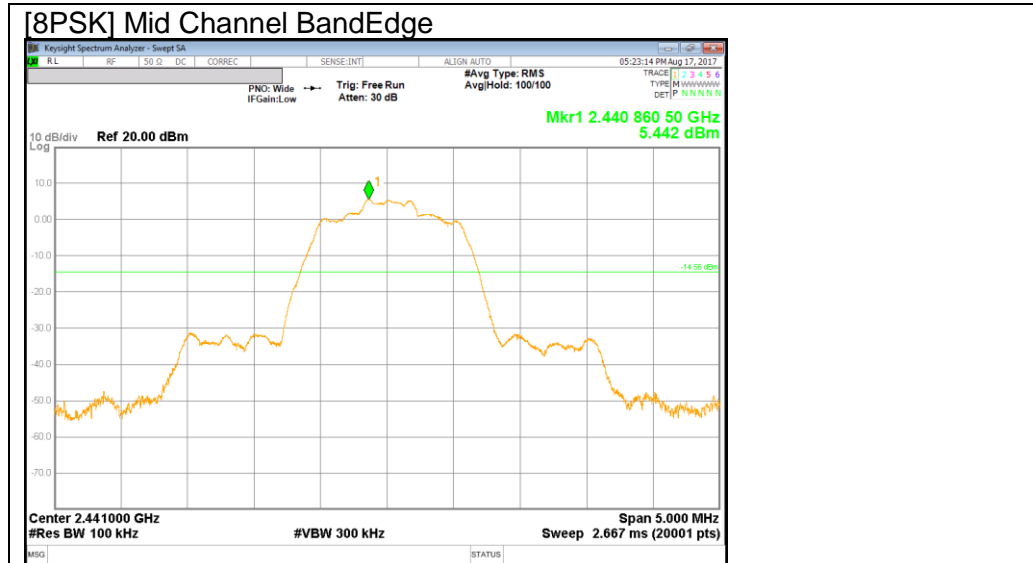


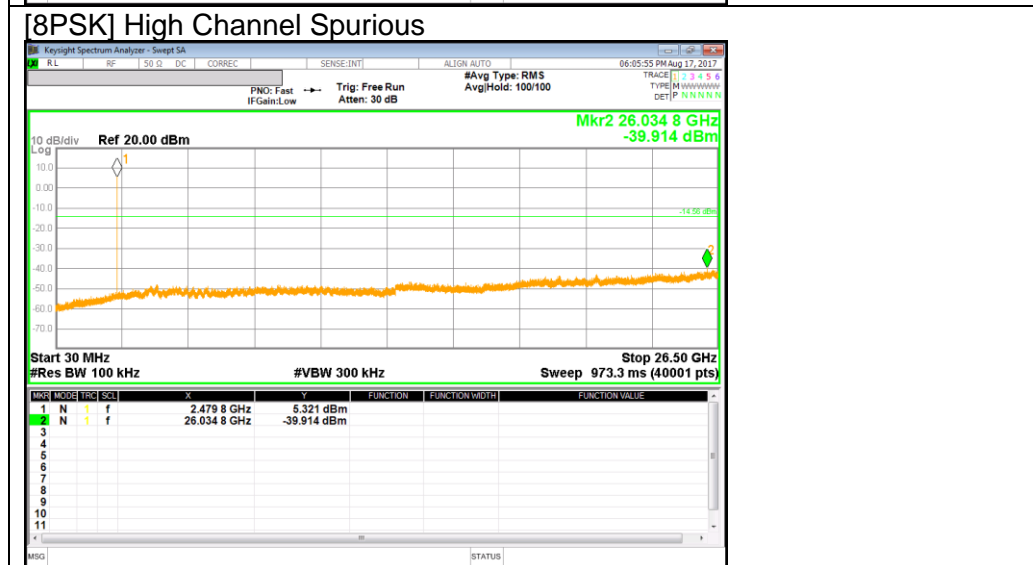
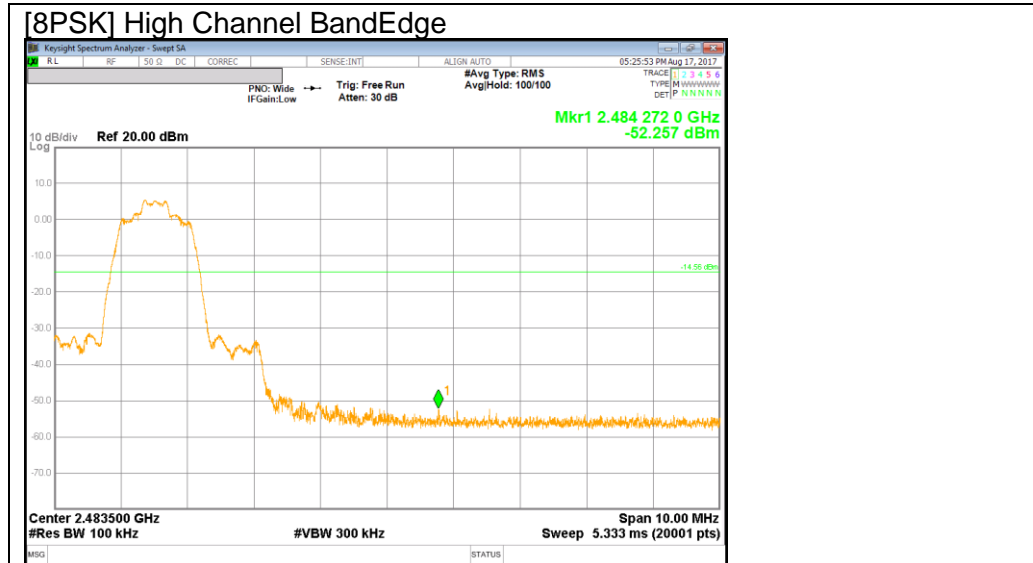
[PI/4-DQPSK Hopping Mode] High Channel BandEdge



8PSK Mode

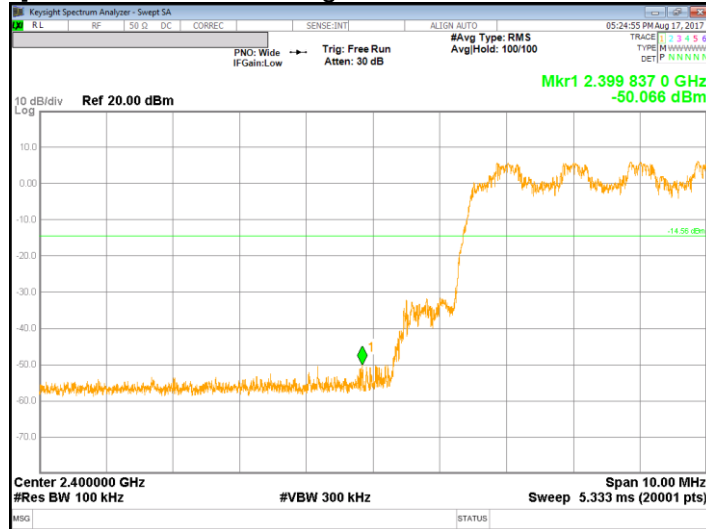




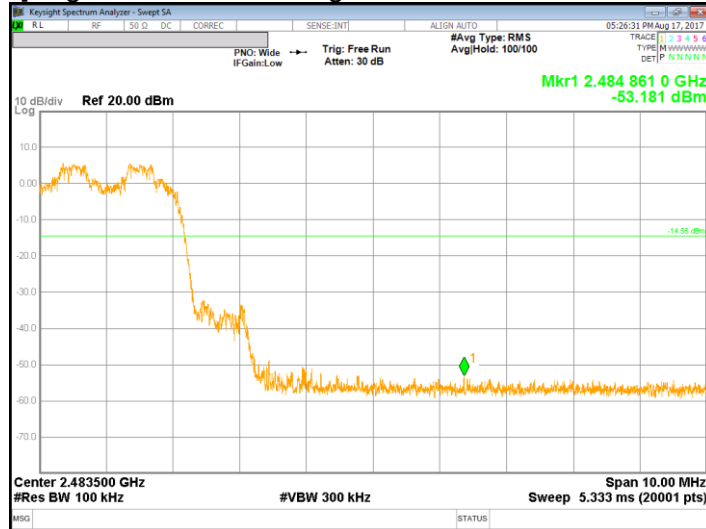


BandEdge Emission at 8PSK Hopping Mode

[8PSK Hopping Mode] Low Channel BandEdge



[8PSK Hopping Mode] High Channel BandEdge



10. RADIATED TEST RESULTS

10.1. 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.

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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.(Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.)

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.

$$\text{GFSK} = 1/T = 1 / 0.0029\text{S} = 350\text{Hz}.$$

The minimum VBW was 350Hz, but test receiver(ESU40) couldn't set value 350Hz. Due to this reason, testing VBW was set to 500Hz(Worst cases).

The spectrum from 1GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.
(From 30MHz to 1GHz, test was performed with the EUT set to transmit at the channel with highest output power)

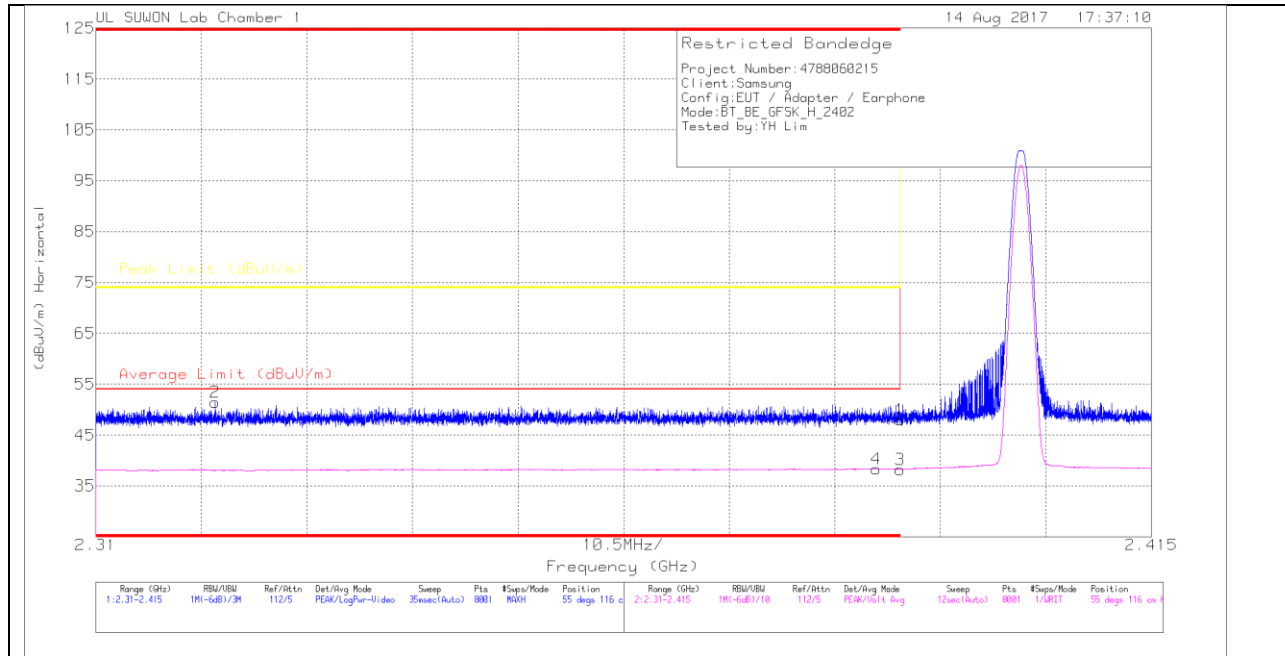
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

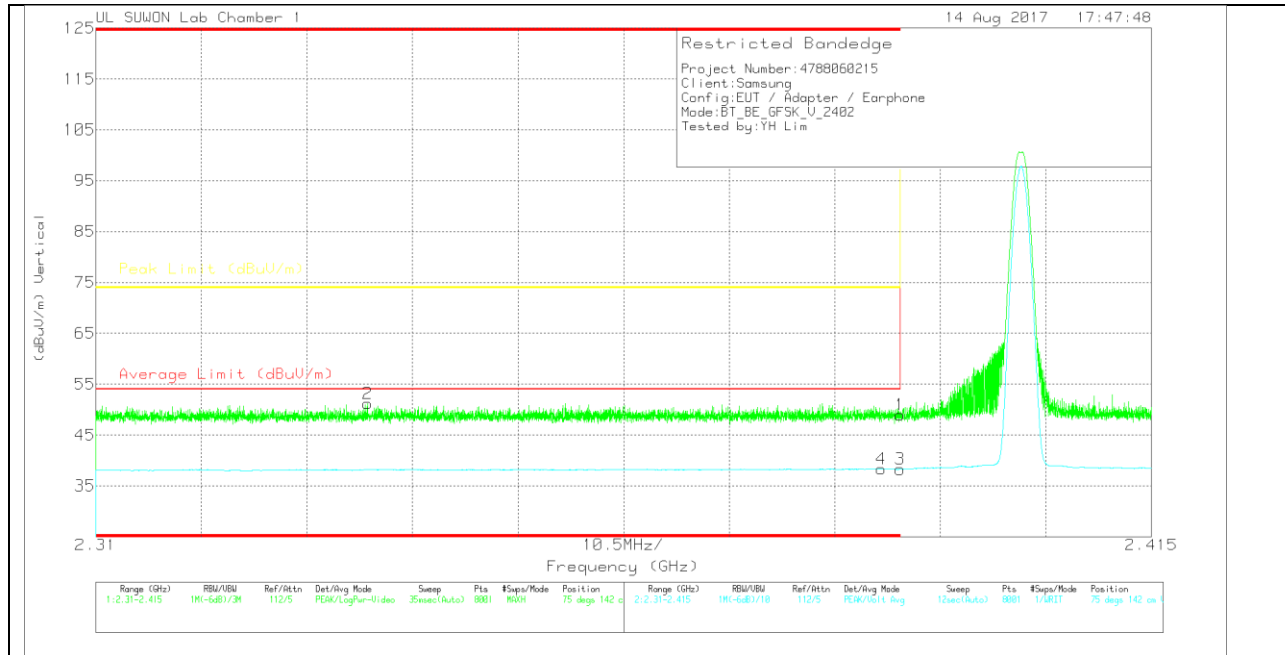
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_170809	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	42.35	Pk	31.3	-25.7	47.95	-	-	74	-26.05	55	116	H
2	* 2.322	46.13	PK	31.2	-25.9	51.43	-	-	74	-22.57	55	116	H
3	* 2.39	32.64	VA1T	31.3	-25.7	38.24	54	-15.76	-	-	55	116	H
4	* 2.388	32.78	VA1T	31.3	-25.7	38.38	54	-15.62	-	-	55	116	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_1708_09	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	43.38	Pk	31.3	-25.7	48.98	-	-	74	-25.02	75	142	V
2	* 2.337	45.79	Pk	31.2	-25.8	51.19	-	-	74	-22.81	75	142	V
3	* 2.39	32.67	VA1T	31.3	-25.7	38.27	54	-15.73	-	-	75	142	V
4	* 2.388	32.78	VA1T	31.3	-25.7	38.38	54	-15.62	-	-	75	142	V

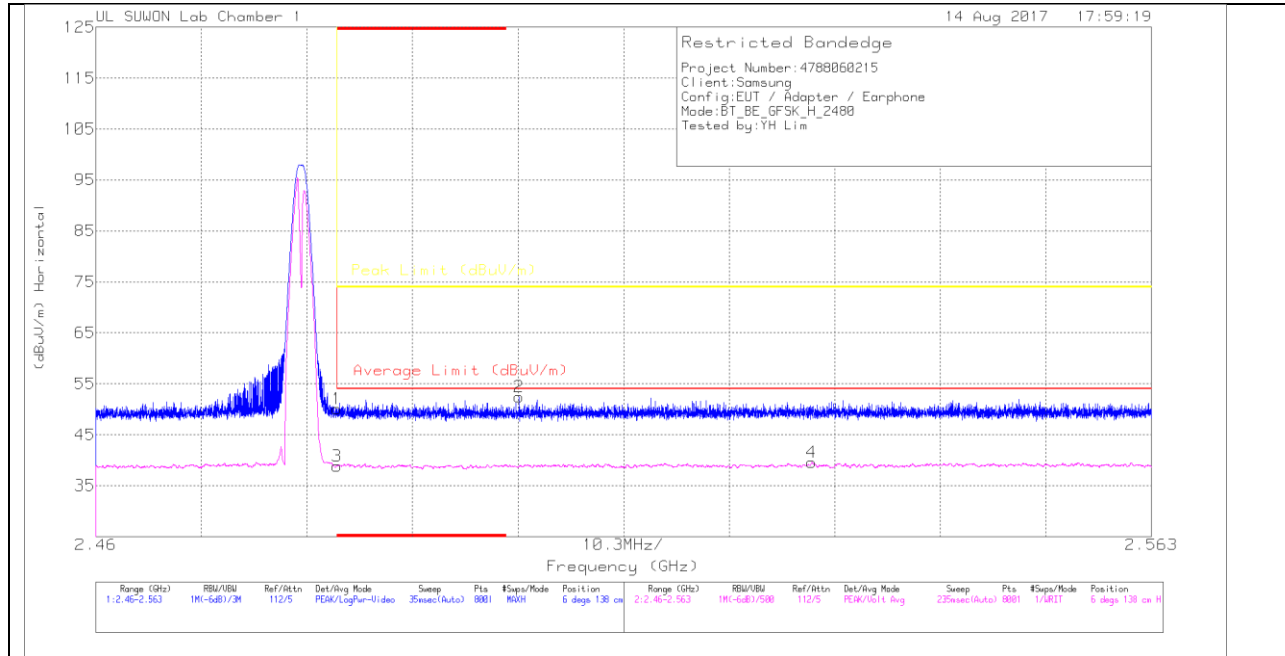
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

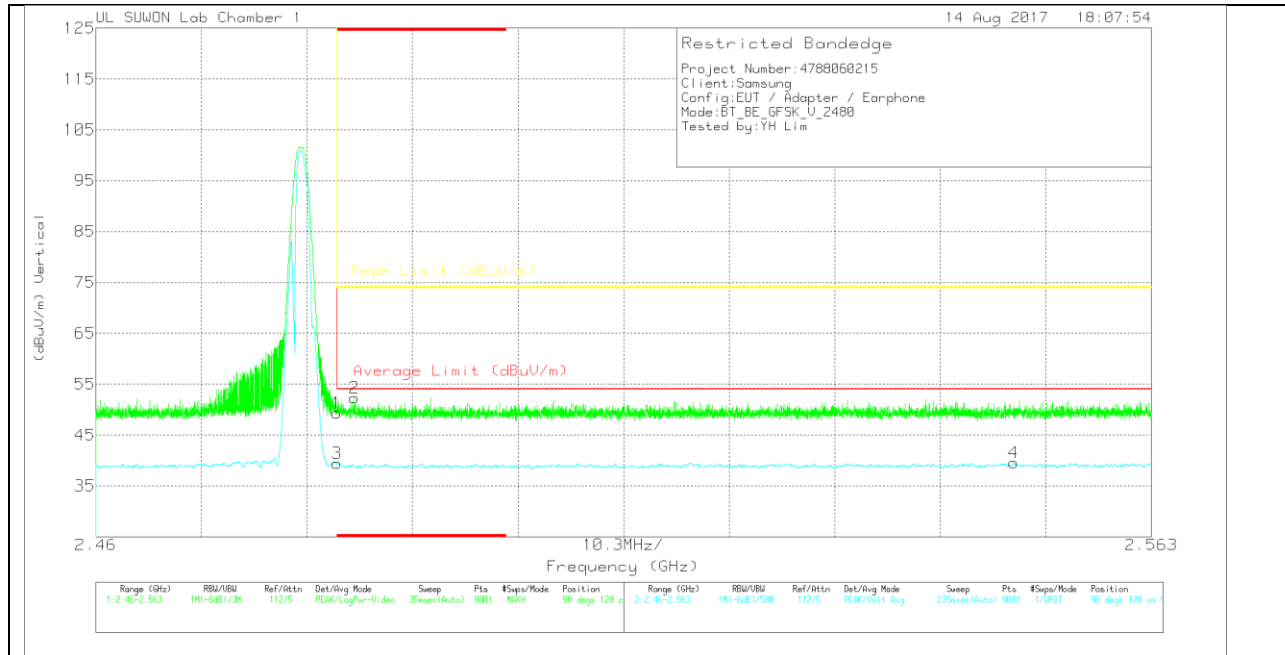
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_170809	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	43.98	Pk	31.6	-25.5	50.08	-	-	74	-23.92	6	138	H
2	2.501	46.22	Pk	31.6	-25.4	52.42	-	-	74	-21.58	6	138	H
3	* 2.484	32.69	VA1T	31.6	-25.5	38.79	54	-15.21	-	-	6	138	H
4	2.53	33.14	VA1T	31.7	-25.3	39.54	54	-14.46	-	-	6	138	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_170809	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	43.29	Pk			49.39	-	-	74	-24.61	98	128	V
2	* 2.485	46.24	Pk			52.34	-	-	74	-21.66	98	128	V
3	* 2.484	33.31	VA1T			39.41	54	-14.59	-	-	98	128	V
4	2.55	33.02	VA1T			39.52	54	-14.48	-	-	98	128	V

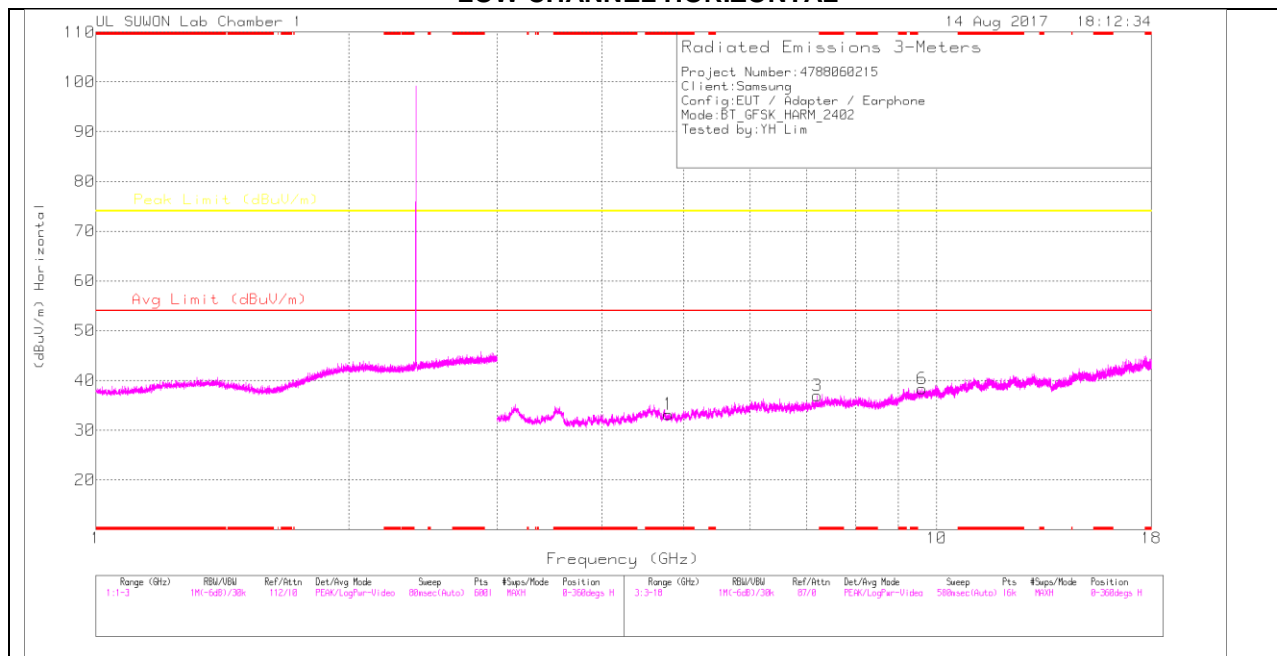
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

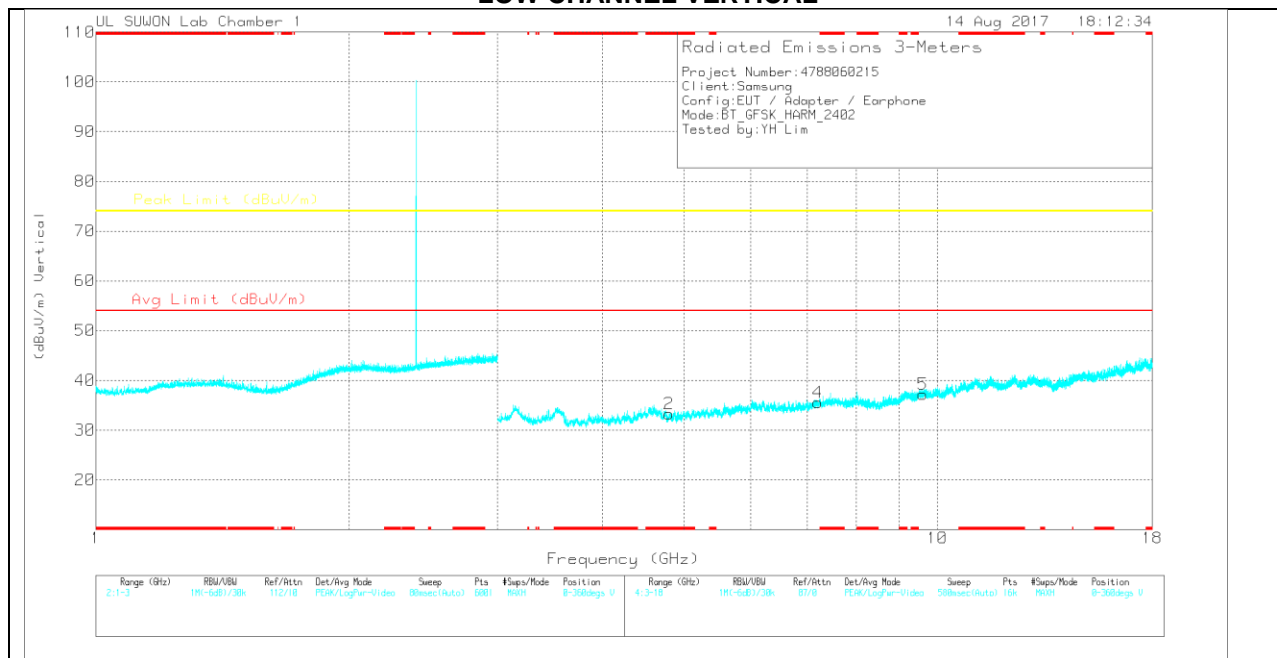
VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

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

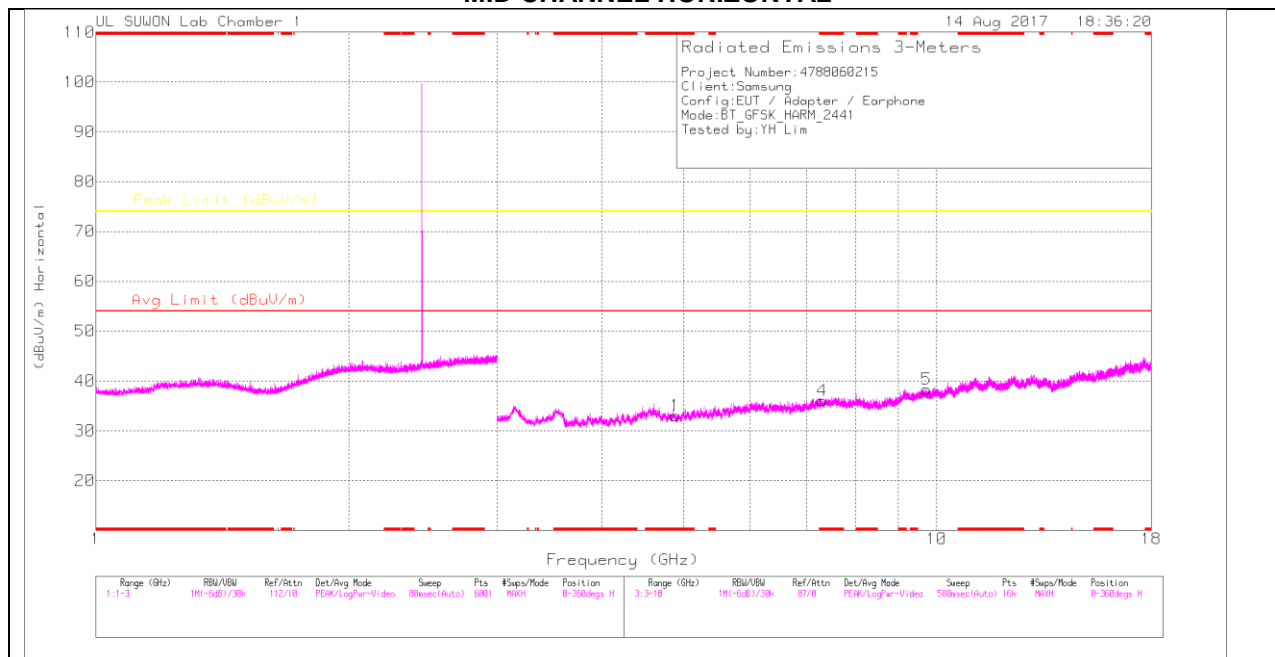
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	3GHz_HP(dB)_170809	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.8	31.02	PK	33.8	-31.6	33.22	-	-	74	-40.78	0-360	150	H
3	7.211	29.11	PK	35.9	-28.1	36.91	-	-	74	-37.09	0-360	250	H
6	9.611	25.12	PK	36.7	-23.5	38.32	-	-	74	-35.68	0-360	150	H
2	* 4.8	31.07	PK	33.8	-31.6	33.27	-	-	74	-40.73	0-360	150	V
4	7.209	27.81	PK	35.9	-28.1	35.61	-	-	74	-38.39	0-360	150	V
5	9.613	24.12	PK	36.7	-23.6	37.22	-	-	74	-36.78	0-360	250	V

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

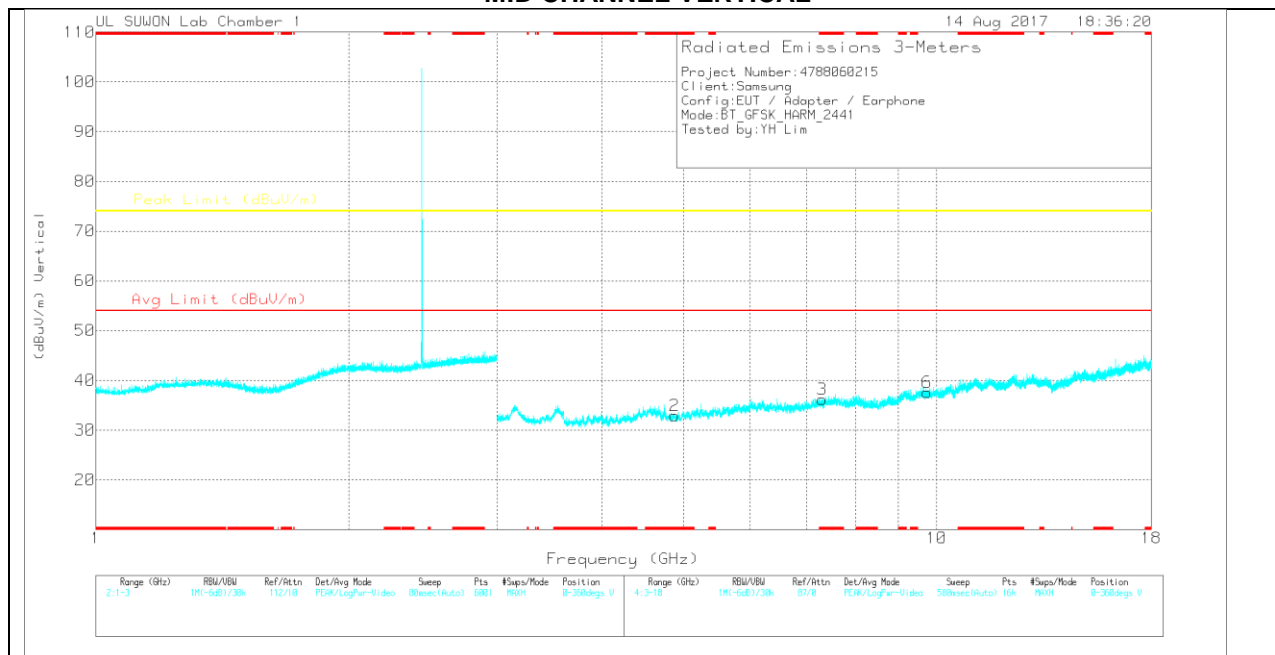
PK – Peak detector

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

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

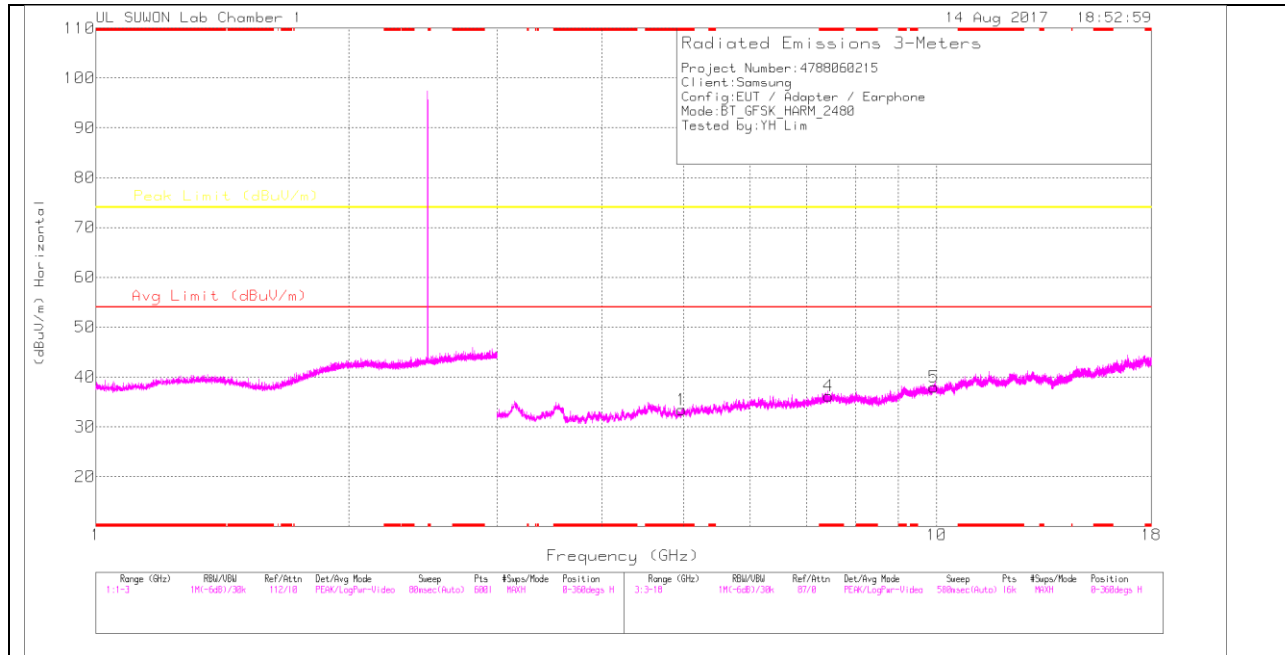
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	3GHz_HP(dB)_170809	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.884	30.88	PK	33.8	-31.7	32.98	-	-	74	-41.02	0-360	150	H
4	* 7.314	27.72	PK	35.9	-27.6	36.02	-	-	74	-37.98	0-360	250	H
5	9.727	25.63	PK	36.9	-24.2	38.33	-	-	74	-35.67	0-360	150	H
2	* 4.88	30.84	PK	33.8	-31.7	32.94	-	-	74	-41.06	0-360	250	V
3	* 7.31	27.94	PK	35.9	-27.6	36.24	-	-	74	-37.76	0-360	250	V
6	9.742	24.91	PK	36.9	-24.2	37.61	-	-	74	-36.39	0-360	250	V

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

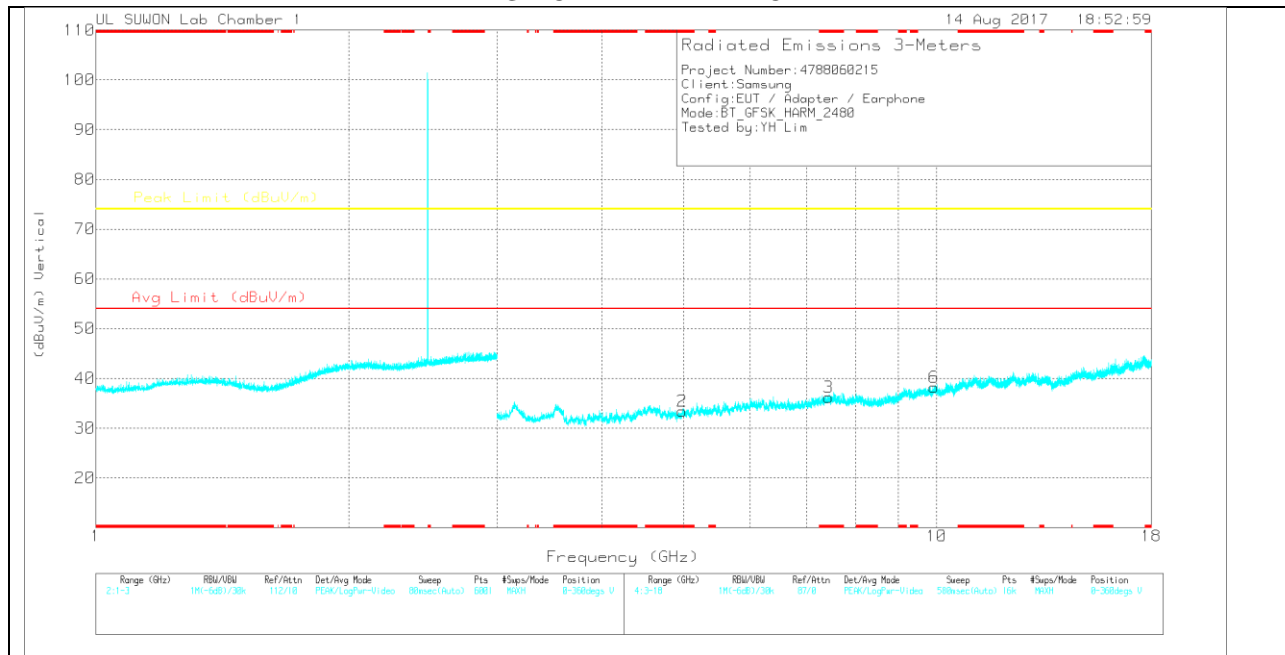
PK – Peak detector

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

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	20170531_3117_00168717	3GHz_HP(dB)_170809	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.973	31.2	PK	33.8	-31.6	33.4	-	-	74	-40.6	0-360	250	H
4	* 7.432	27.43	PK	35.9	-27.1	36.23	-	-	74	-37.77	0-360	150	H
5	9.924	23.09	PK	37.1	-22.2	37.99	-	-	74	-36.01	0-360	250	H
2	* 4.978	31.17	PK	33.8	-31.6	33.37	-	-	74	-40.63	0-360	150	V
3	* 7.435	27.44	PK	35.9	-27.1	36.24	-	-	74	-37.76	0-360	150	V
6	9.923	23.51	PK	37.1	-22.4	38.21	-	-	74	-35.79	0-360	250	V

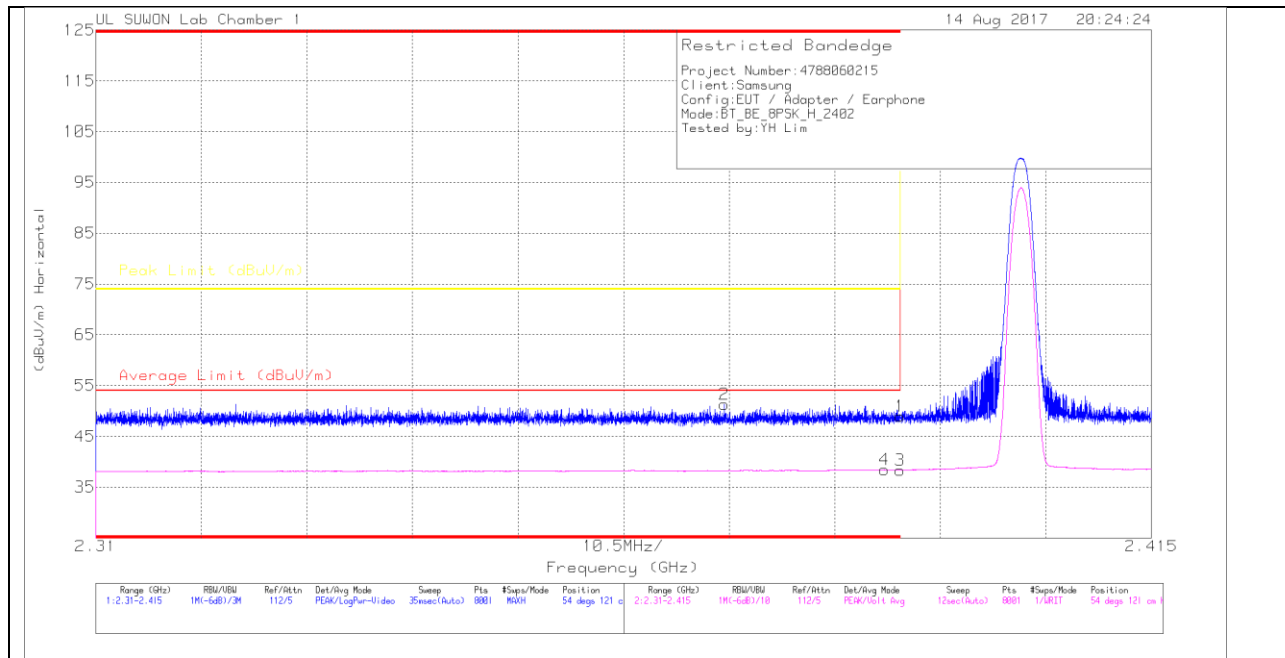
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak detector

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

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

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

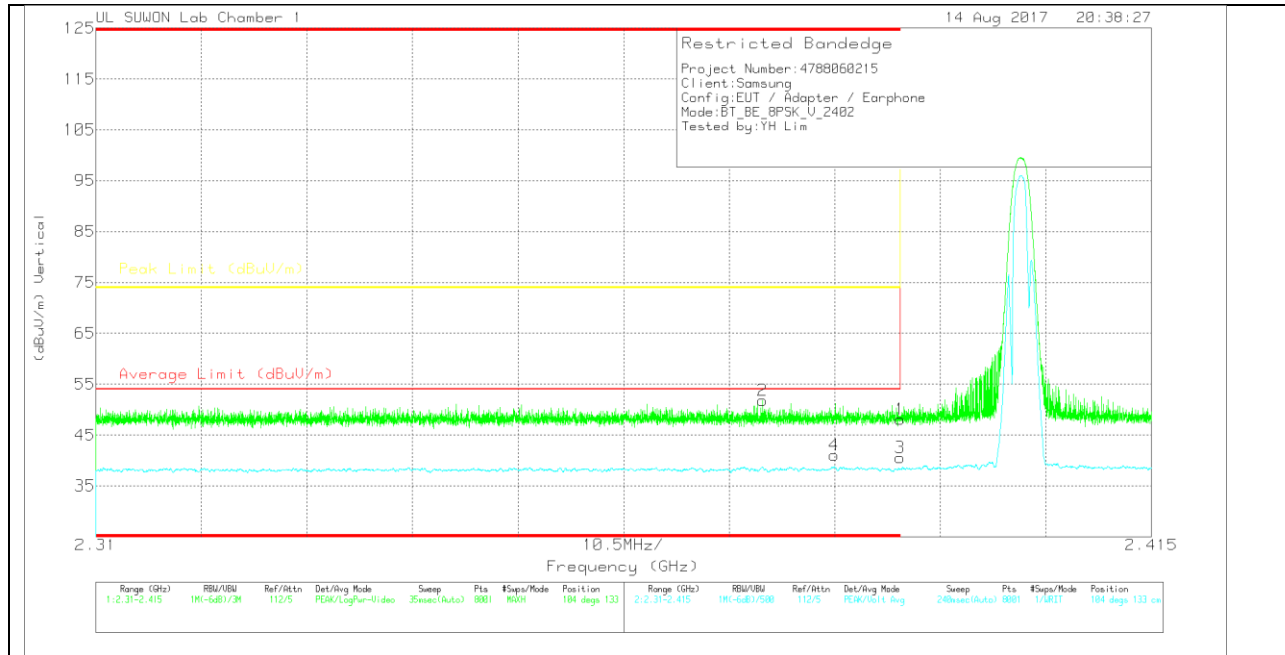
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_170809	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	43.32	Pk		31.3	-25.7	48.92	-	74	-25.08	54	121	H
2	* 2.373	45.89	Pk		31.2	-25.8	51.29	-	74	-22.71	54	121	H
3	* 2.39	32.75	VA1T		31.3	-25.7	38.35	54	-15.65	-	54	121	H
4	* 2.388	32.8	VA1T		31.3	-25.7	38.4	54	-15.6	-	54	121	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_1708_09	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	42.48	Pk	31.3	-25.7	48.08	-	-	74	-25.92	104	133	V
2	* 2.376	46.27	Pk	31.3	-25.8	51.77	-	-	74	-22.23	104	133	V
3	* 2.39	32.64	VA1T	31.3	-25.7	38.24	54	-15.76	-	-	104	133	V
4	* 2.383	33.17	VA1T	31.3	-25.7	38.77	54	-15.23	-	-	104	133	V

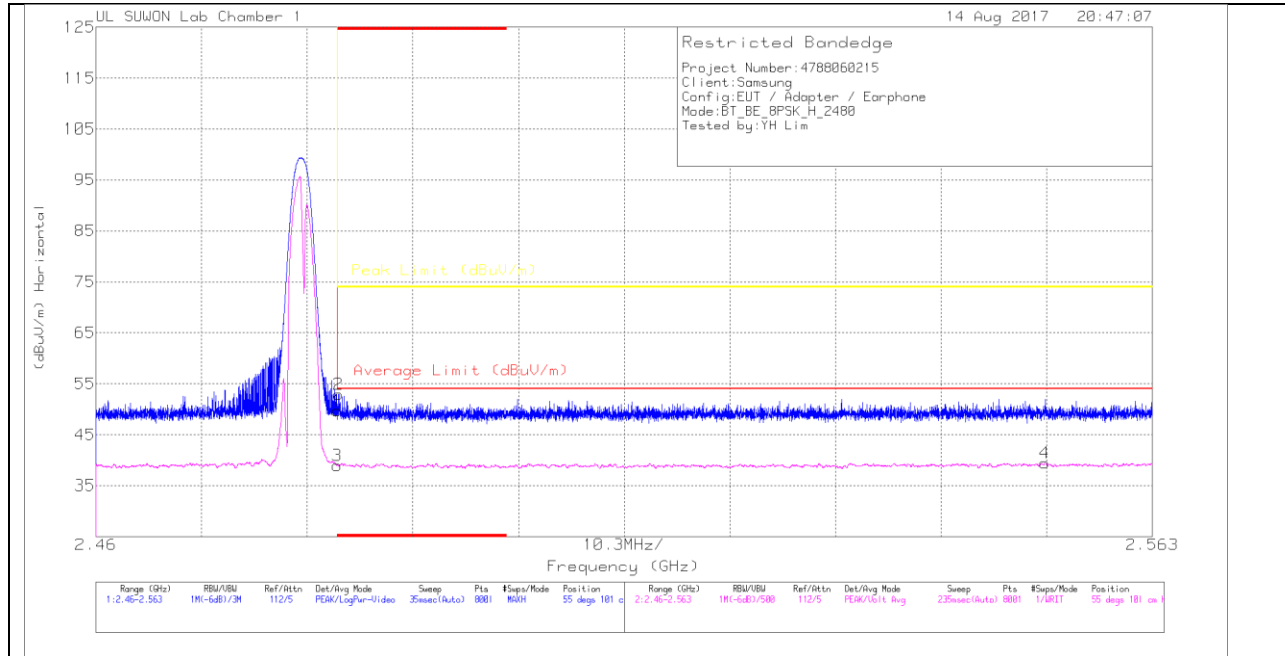
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00_168717	10dB_ATT (dB)_170809	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	43.62	Pk	31.6	-25.5	49.72	-	-	74	-24.28	55	101	H
2	* 2.484	46.87	Pk	31.6	-25.5	52.97	-	-	74	-21.03	55	101	H
3	* 2.484	32.84	VA1T	31.6	-25.5	38.94	54	-15.06	-	-	55	101	H
4	2.553	33.01	VA1T	31.7	-25.3	39.41	54	-14.59	-	-	55	101	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration