



FCC CFR47 PART 15 SUBPART C

Bluetooth

CERTIFICATION TEST REPORT

FOR

Bluetooth/BLE Earset

MODEL NUMBER : SM-R140

FCC ID: A3LSMR140L

REPORT NUMBER: 4788060293-E4V2

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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

Rev.	Issue Date	Revisions	Revised By
V1	07/28/17	Initial issue	Junwhan Lee
V2	08/08/17	Removed ISED information	Junwhan Lee

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: Bluetooth/BLE Earset
MODEL NUMBER: SM-R140
SERIAL NUMBER: R3AJ7002T6J, R3AJ7002T9D (RADIATED);
R3AJ7002TAF (CONDUCTED)
DATE TESTED: JUL 10, 2017 - JUL 14, 2017

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.

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

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 Bluetooth/BLE Earset.
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	11.119	12.939
		Peak	11.406	13.823
	Enhanced Pi/4-DPSK	Average	6.948	4.952
		Peak	9.443	8.796
	Enhanced 8PSK	Average	6.961	4.967
		Peak	9.886	9.741

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal antenna, with a maximum gain of -4.94 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

NONE

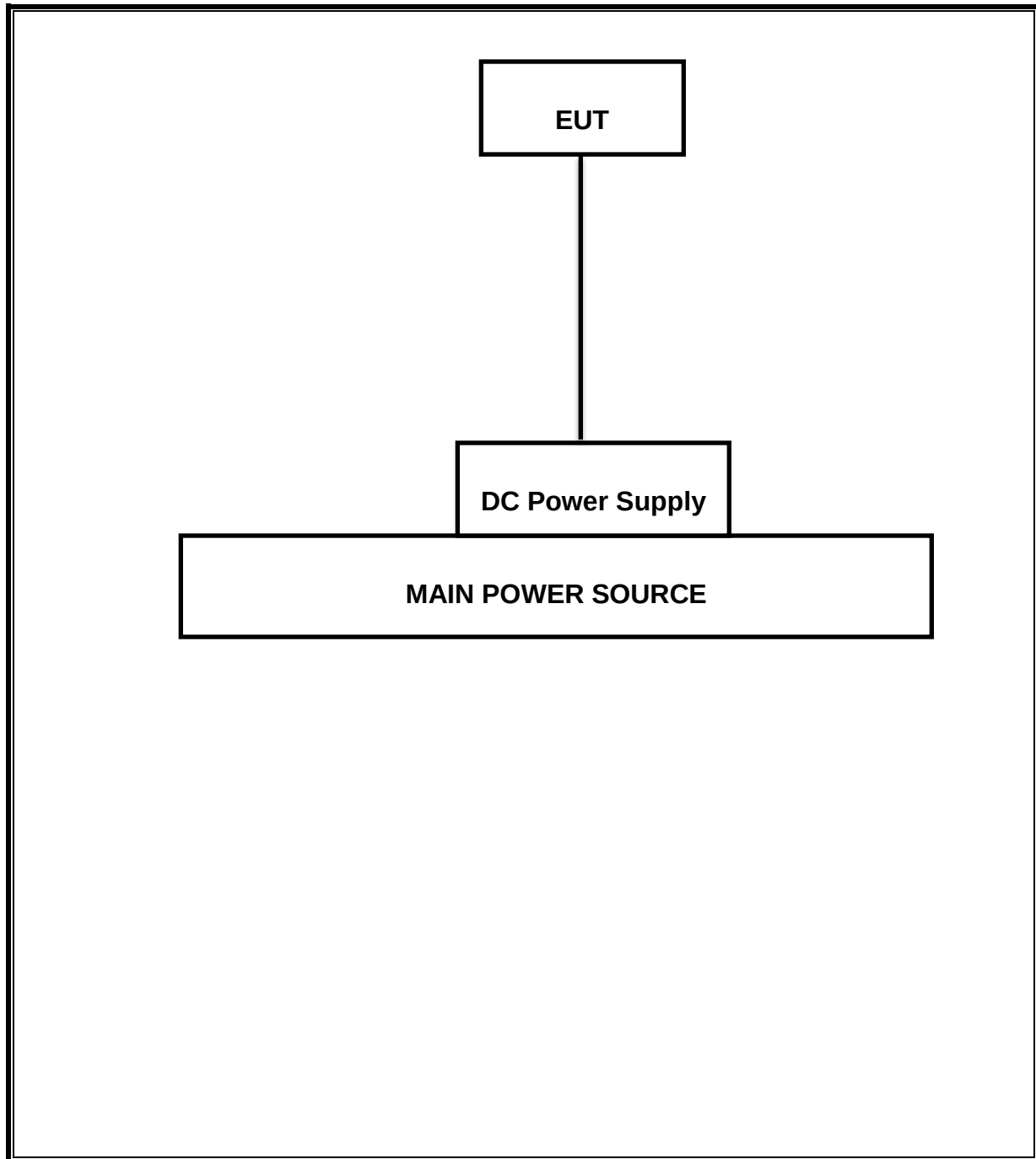
- This EUT didn't operated during charging mode.

TEST SETUP

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

SETUP DIAGRAM FOR TESTS(Conducted)

For radiated test, test were performed EUT standalone condition.



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	10-14-18
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	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
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-17-17
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-16-17
Preamplifier	ETS	3115-PA	00167475	08-17-17
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-16-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-17-17
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-18-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	03-09-18
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-16-17
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-16-17
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-17-17
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-16-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-17-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-16-17
High Pass Filter 6GHz	Micro-Tronics	HPM17542	009	08-17-17
High Pass Filter 6GHz	Micro-Tronics	HPM17542	016	08-16-17
Attenuator	PASTERNAK	PE7087-10	A009	08-16-17
Combiner	WEINSCHTEL	1575	2152	08-16-17
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 [MHz]	99% Bandwidth [KHz]
Low	2402	1.045	901.010
Mid	2441	1.046	899.830
High	2480	1.045	899.540
Worst		1.046	901.010

7.1.2. ENHANCED DATA RATE $\pi/4$ -DQPSK MODULATION

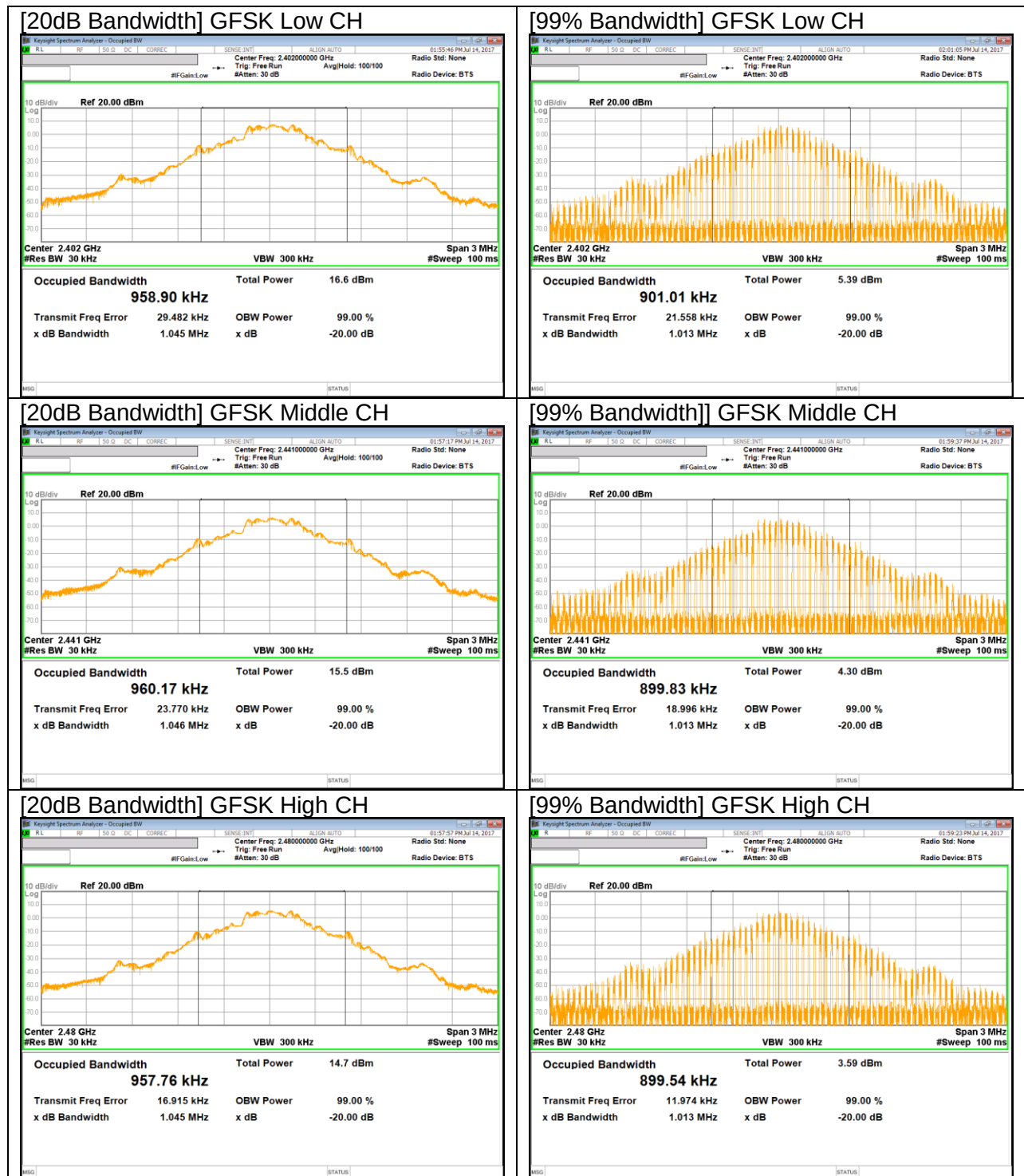
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.346	1.165
Mid	2441	1.346	1.165
High	2480	1.347	1.166
Worst		1.347	1.166

7.1.3. ENHANCED DATA RATE 8PSK MODULATION

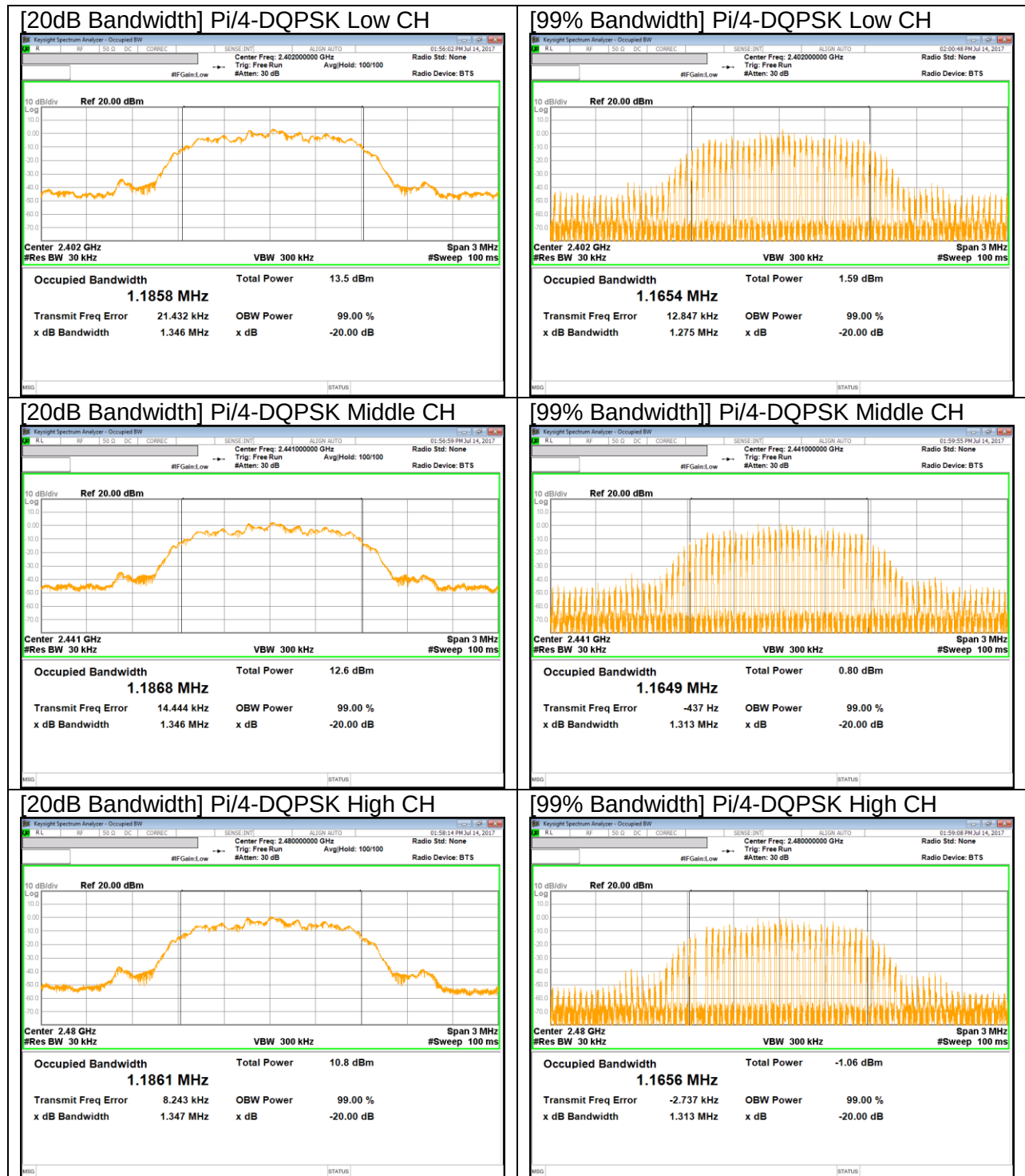
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.308	1.163
Mid	2441	1.308	1.165
High	2480	1.307	1.195
Worst		1.308	1.195

7.1.4. 20 dB AND 99% BANDWIDTH PLOTS

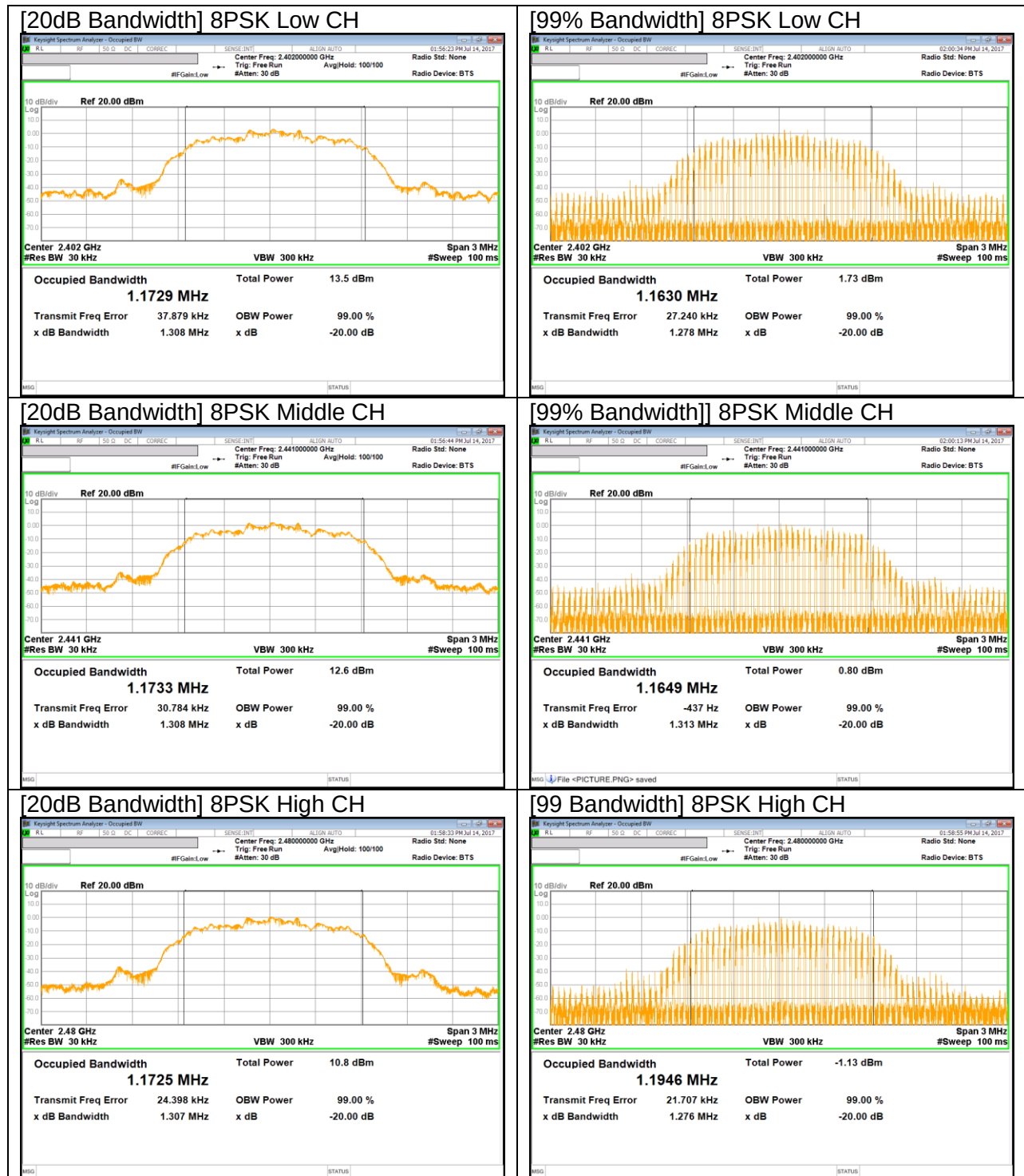
GFSK BANDWIDTH



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	-34.733 dBm
15.247 (b)(1)	TX conducted output power	<21dBm		Pass	11.406 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	0.37518 sec
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	45.14 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.

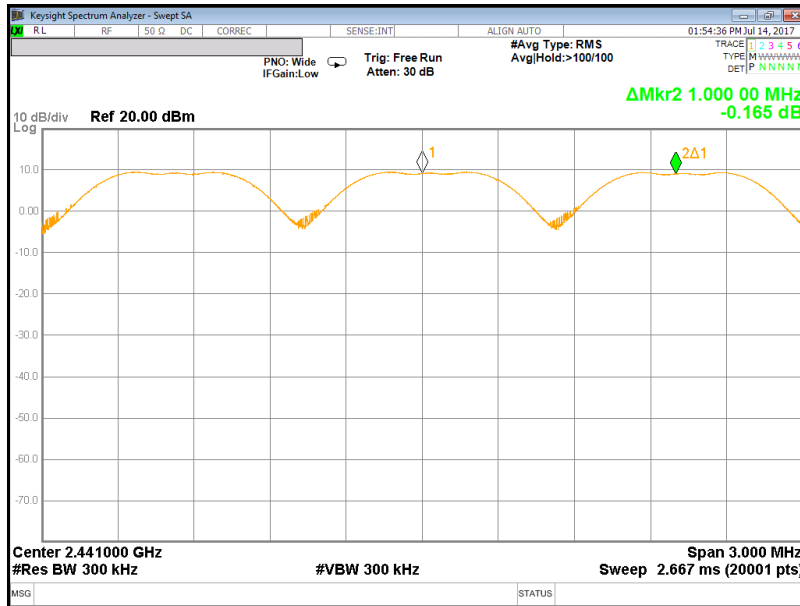
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

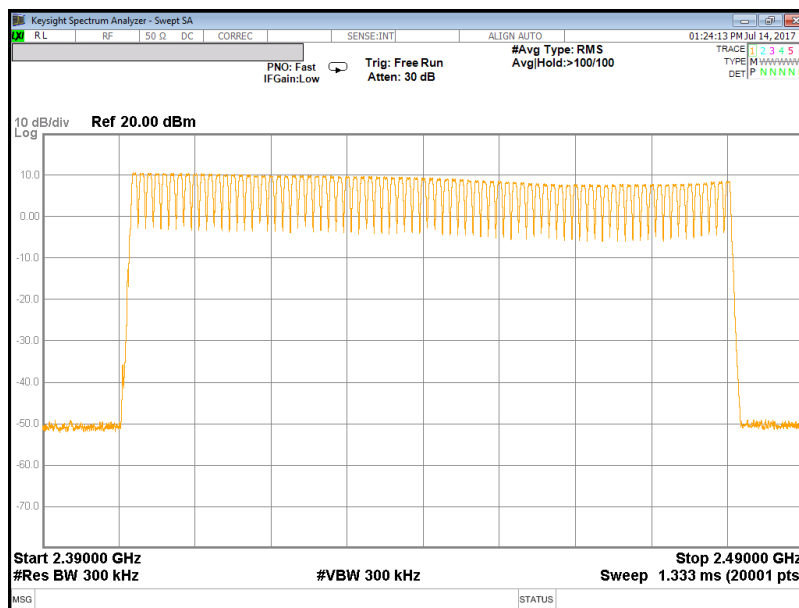
DA 00-705: The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

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.

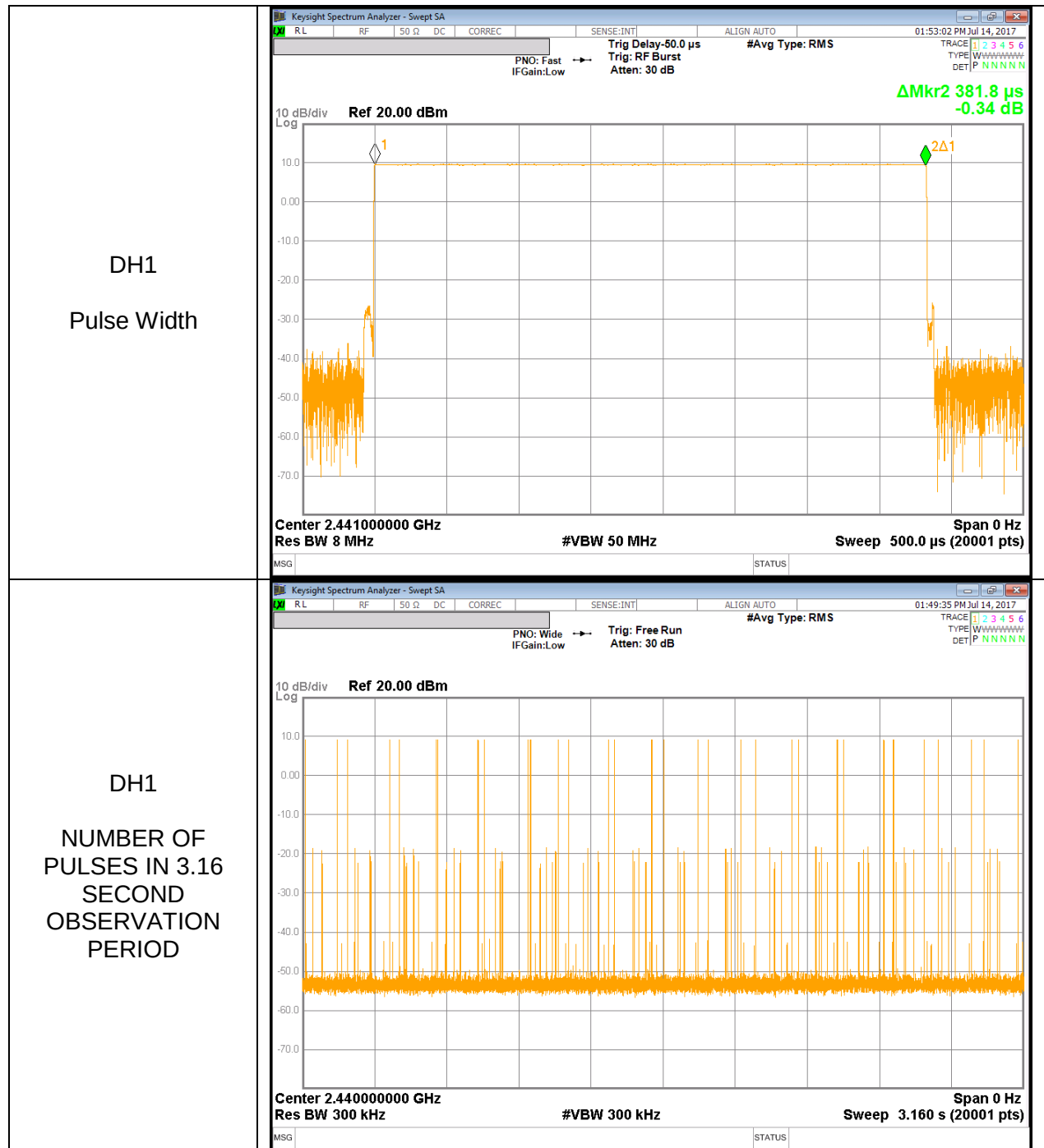
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

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

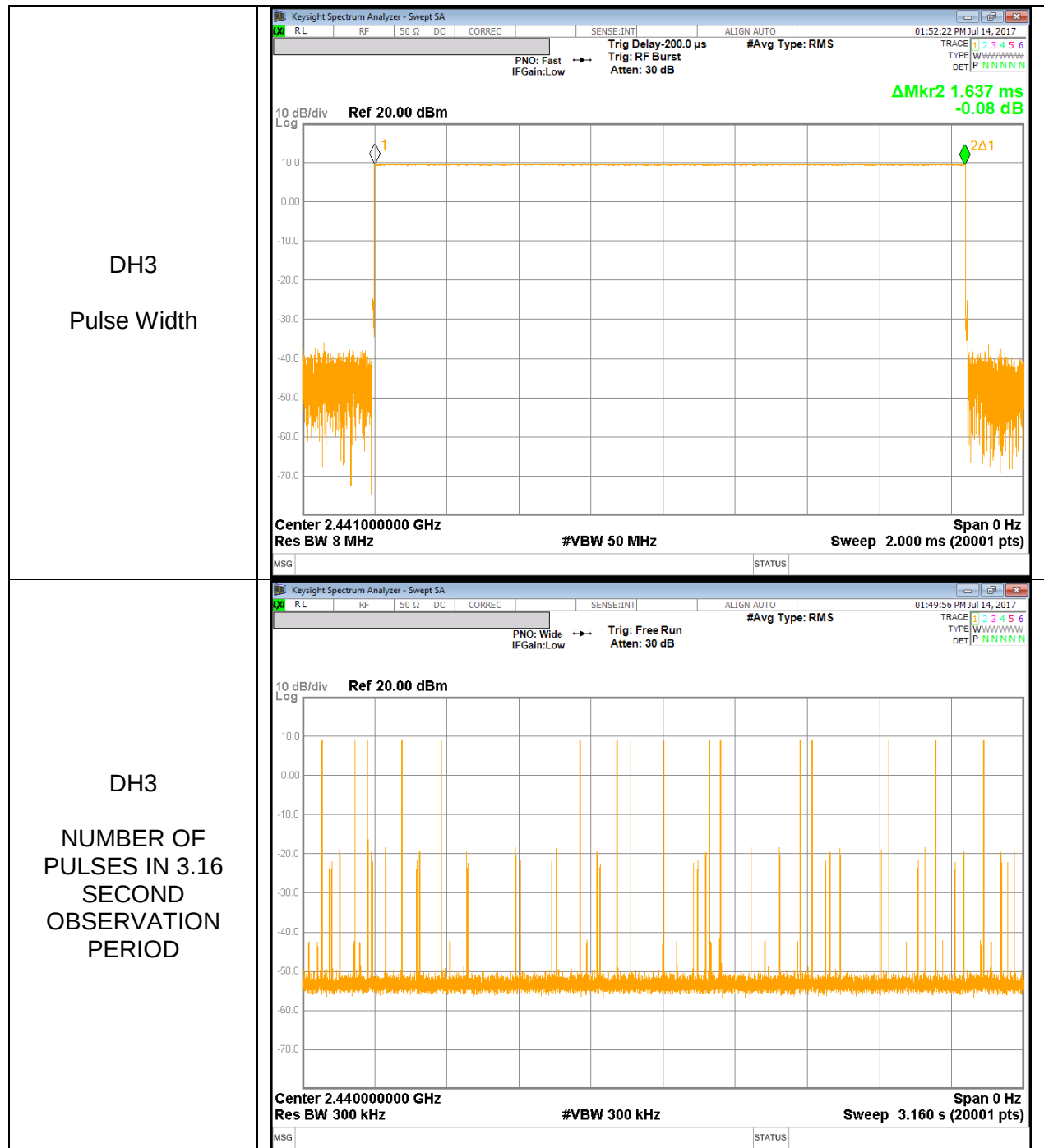
RESULTS

DH Packet	Pulse Width [msec]	Number of Pulses in 3.16 seconds	Average Time of Occupancy [sec]	Limit [sec]	Margin [sec]
GFSK Normal					
DH1	0.382	32	0.122176	0.4	-0.2778
DH3	1.637	16	0.261920	0.4	-0.1381
DH5	2.886	13	0.375180	0.4	-0.0248
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	0.030544	0.4	-0.36946
DH3	1.637	4	0.065480	0.4	-0.33452
DH5	2.886	3.25	0.093795	0.4	-0.30621

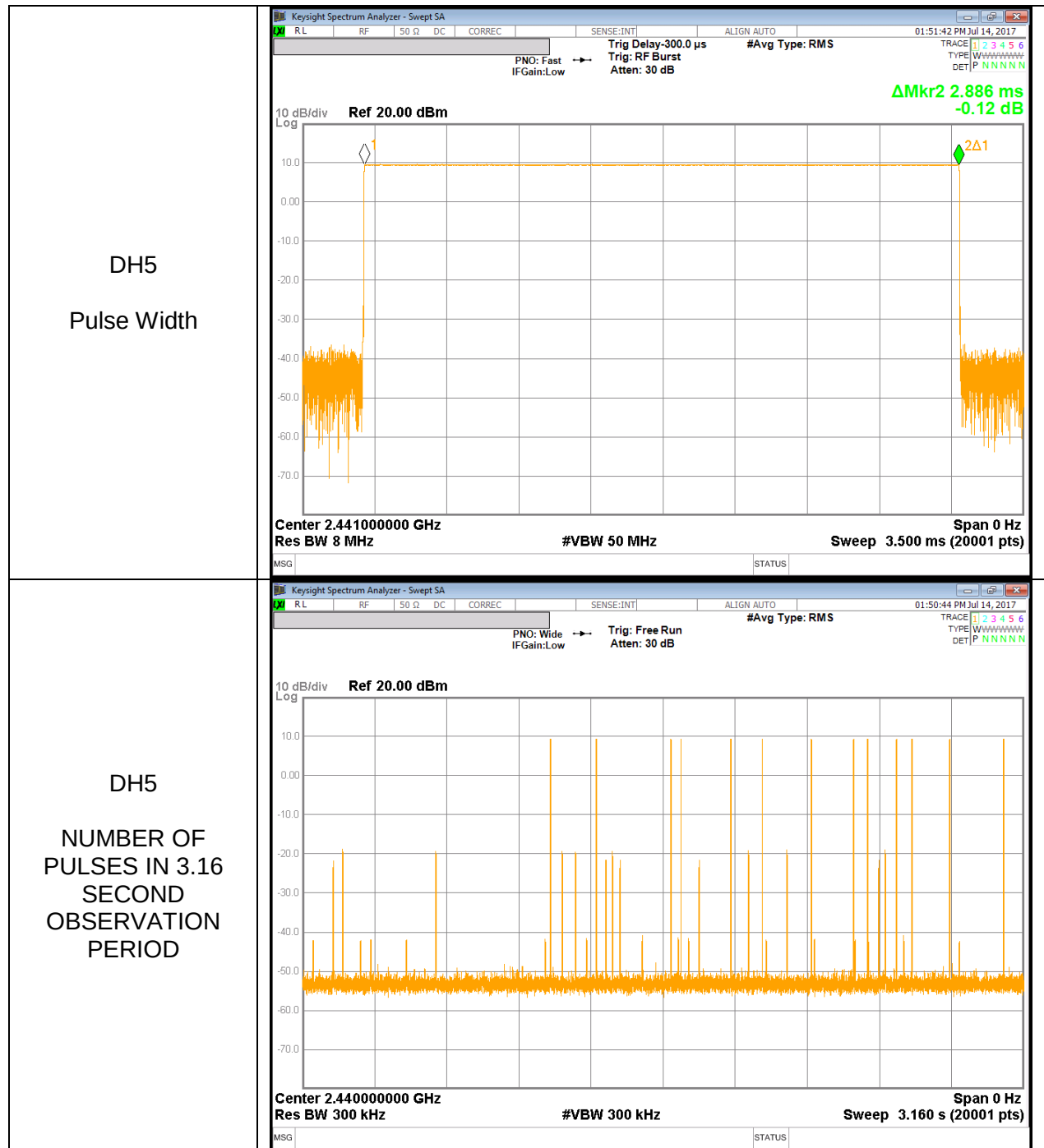
DH1



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	11.406	21	-9.594
Middle	2441	11.119	21	-9.881
High	2480	10.693	21	-10.307
Worst		11.406	21	-9.594

9.4.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

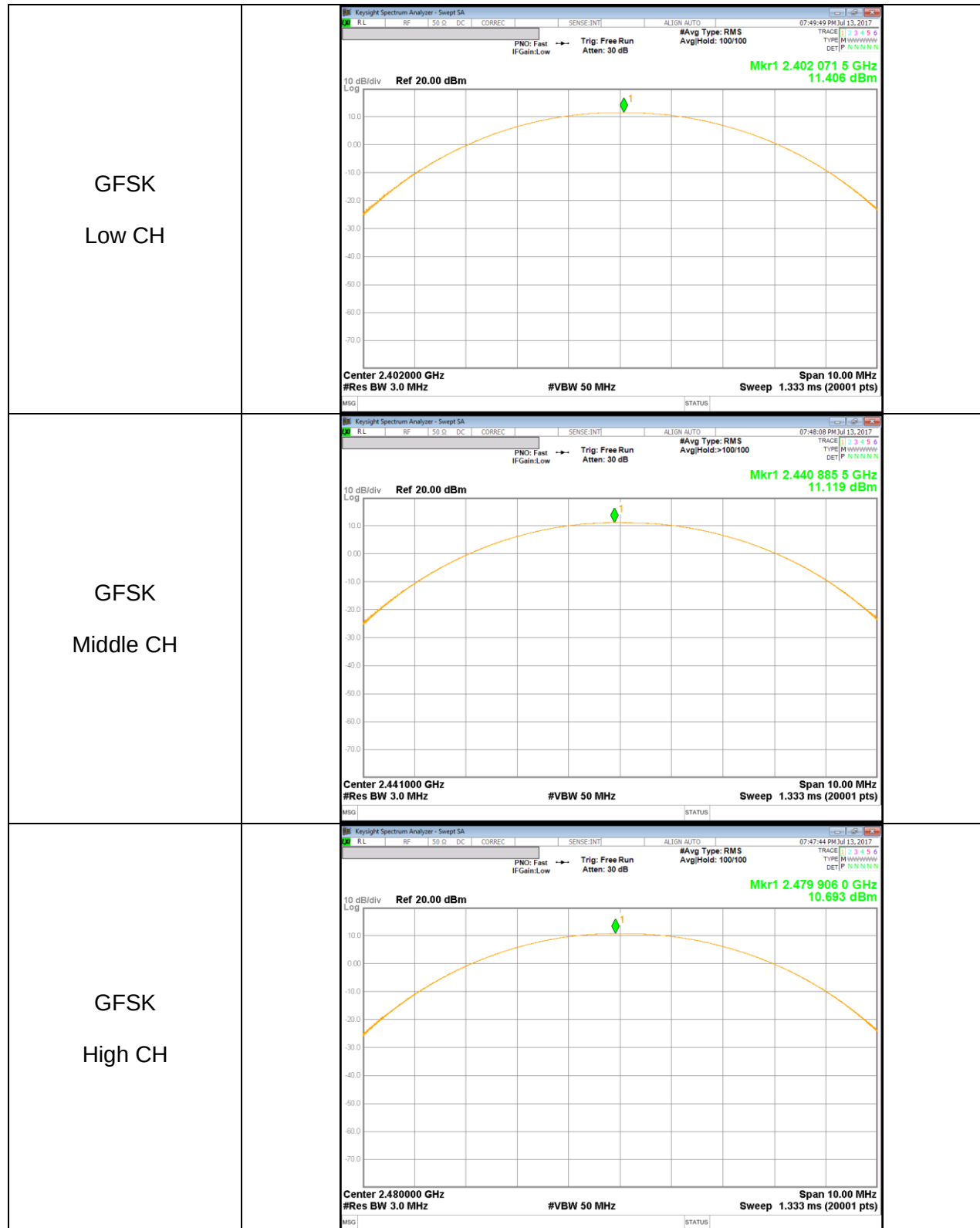
Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	9.443	21	-11.557
Middle	2441	9.382	21	-11.618
High	2480	8.424	21	-12.576
Worst		9.443	21	-11.557

9.4.3. ENHANCED DATA RATE 8PSK MODULATION

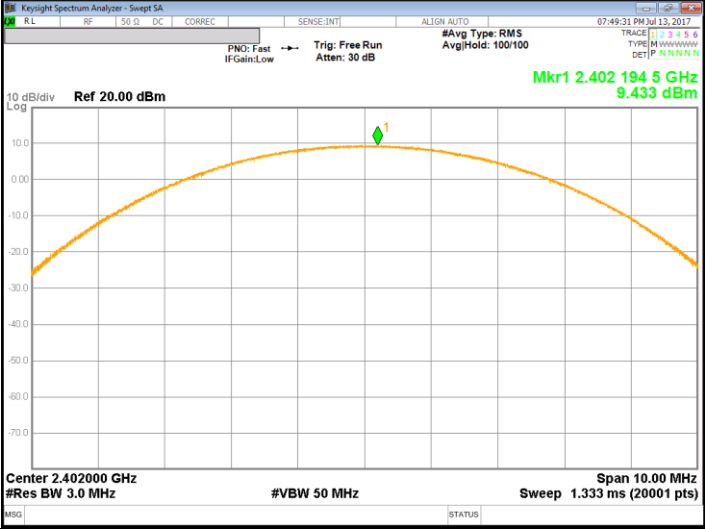
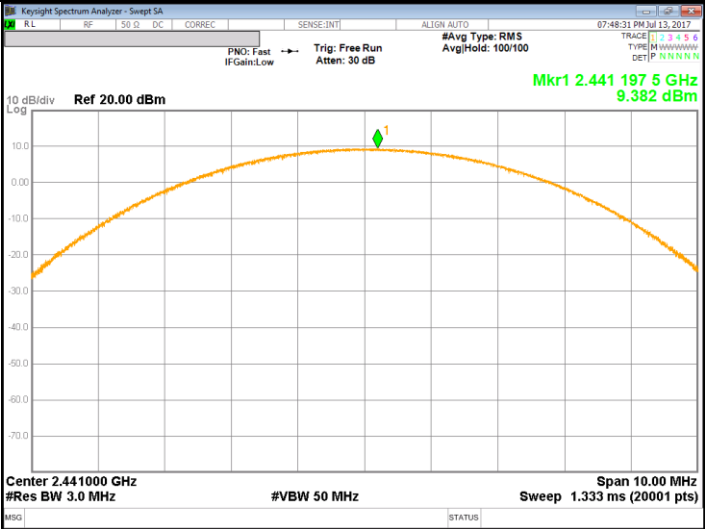
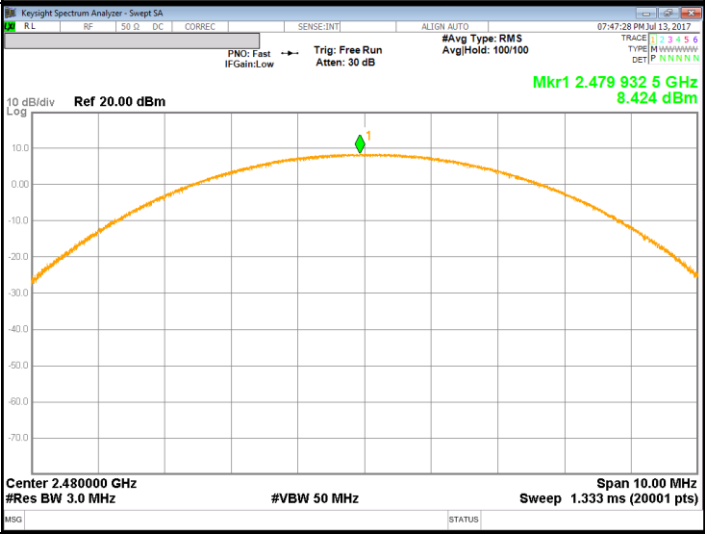
Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	9.886	21	-11.114
Middle	2441	9.737	21	-11.263
High	2480	8.909	21	-12.091
Worst		9.886	21	-11.114

9.4.4. OUTPUT POWER PLOTS

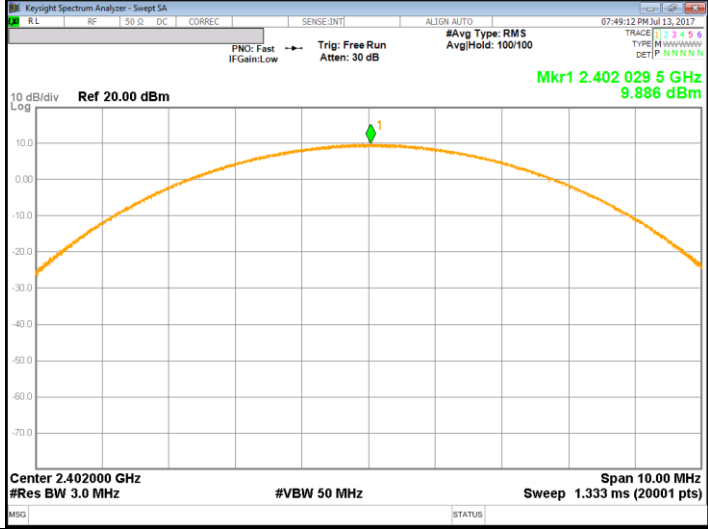
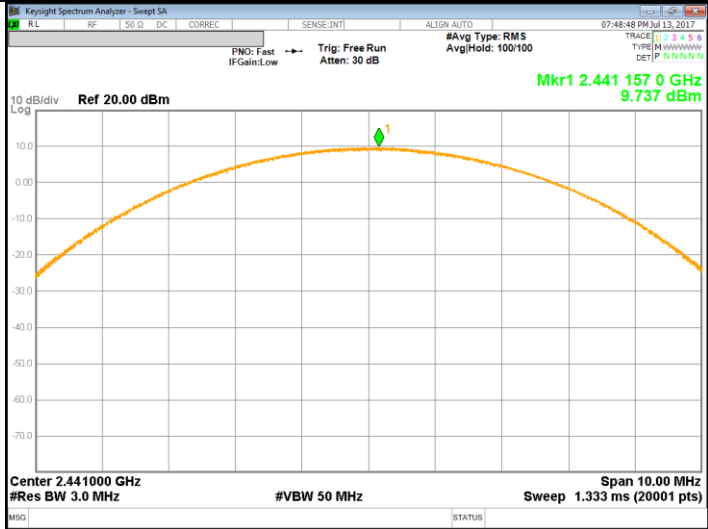
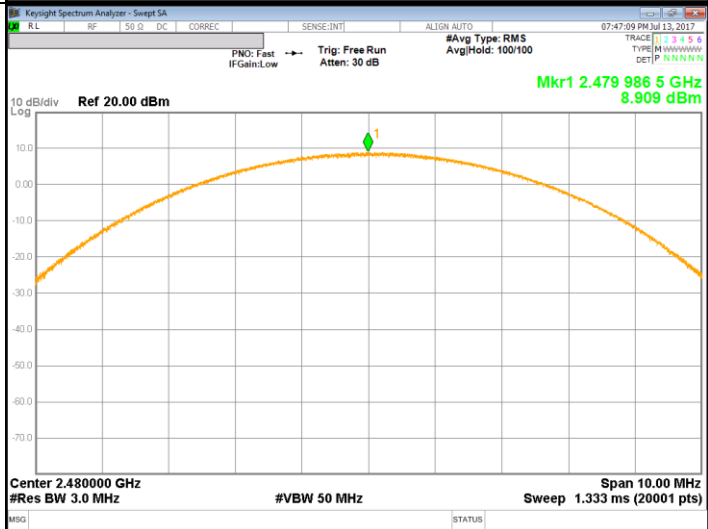
GFSK OUTPUT POWER



Pi/4-DPSK OUTPUT POWER

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

8PSK OUTPUT POWER

8PSK Low CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC CORREC SENSE:INT ALIGN AUTO 07:49:12 PM Jul 13, 2017 PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS Avg Hold: 100/100 Mkr1 2.402 029 5 GHz 9.886 dBm 10 dB/div Log 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) MSG STATUS
8PSK Middle CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC CORREC SENSE:INT ALIGN AUTO 07:48:48 PM Jul 13, 2017 PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS Avg Hold: 100/100 Mkr1 2.441 157 0 GHz 9.737 dBm 10 dB/div Log 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) MSG STATUS
8PSK High CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC CORREC SENSE:INT ALIGN AUTO 07:47:09 PM Jul 13, 2017 PNO: Fast IF Gain: Low Trig: Free Run Atten: 30 dB #Avg Type: RMS Avg Hold: 100/100 Mkr1 2.479 986 5 GHz 8.909 dBm 10 dB/div Log 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) MSG STATUS

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	11.119	12.94
Middle	2441	10.990	12.56
High	2480	10.599	11.48

9.5.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	6.764	4.75
Middle	2441	6.948	4.95
High	2480	5.998	3.98

9.5.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	6.777	4.76
Middle	2441	6.961	4.97
High	2480	6.014	3.99

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.

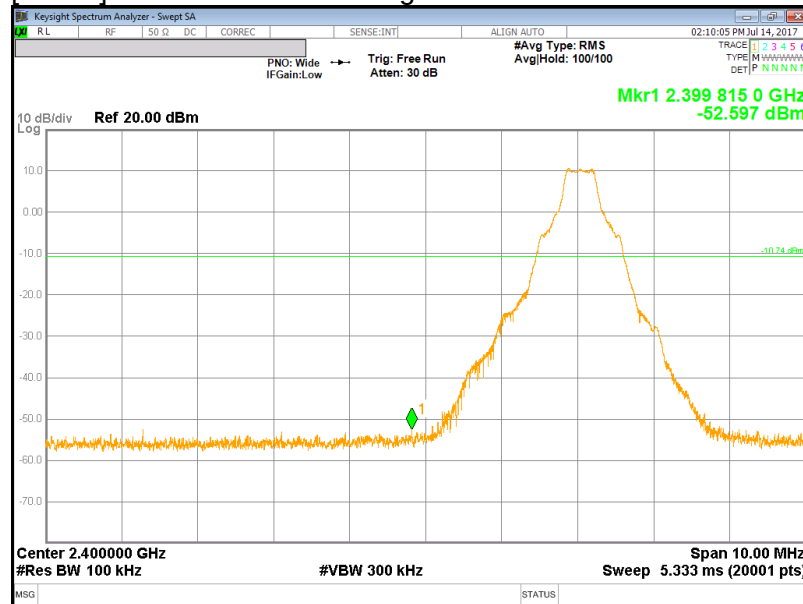
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

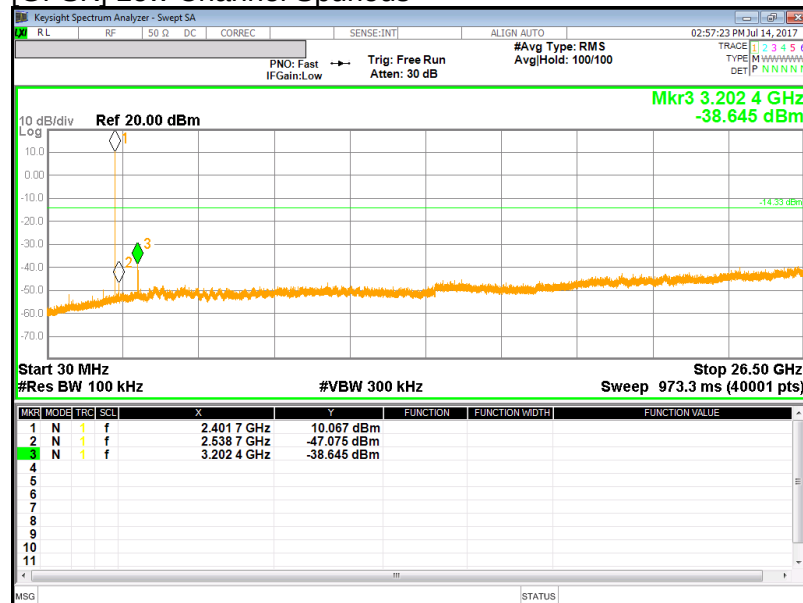
9.6.1. BASIC DATA RATE GFSK MODULATION

GFSK Mode

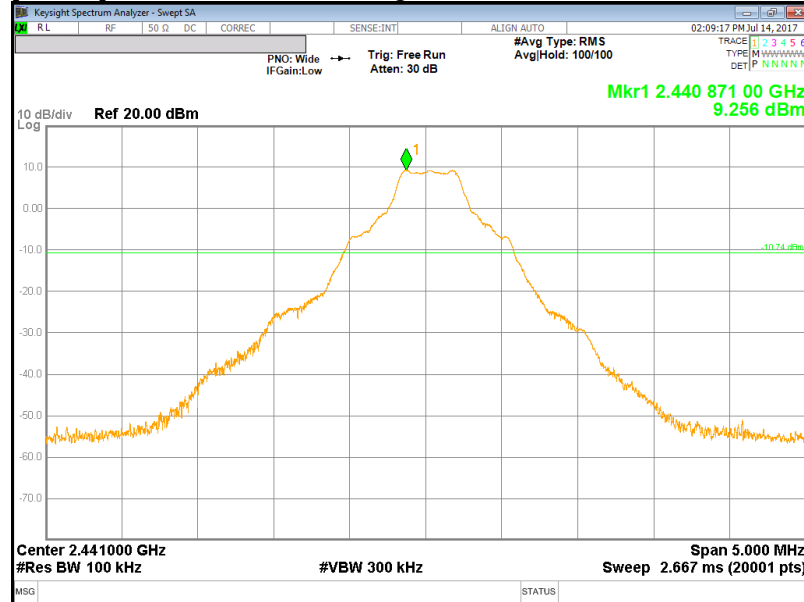
[GFSK] Low Channel BandEdge



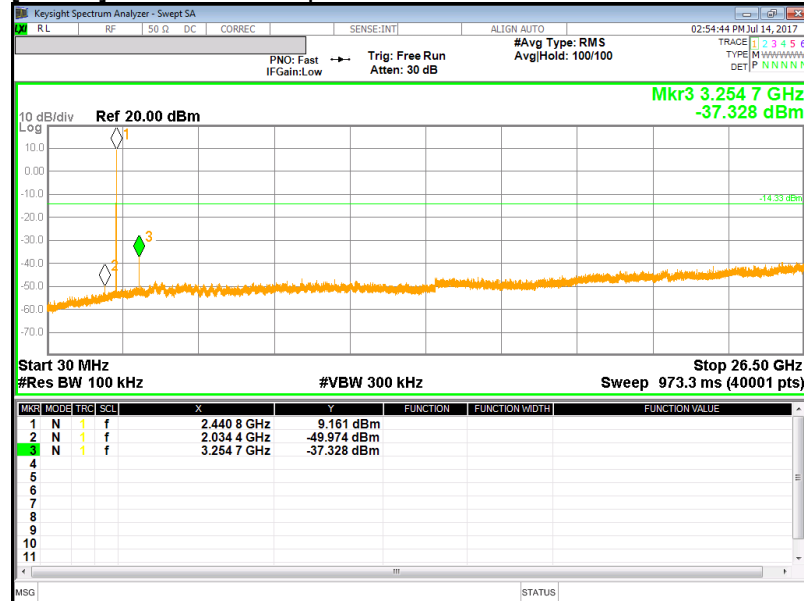
[GFSK] Low Channel Spurious



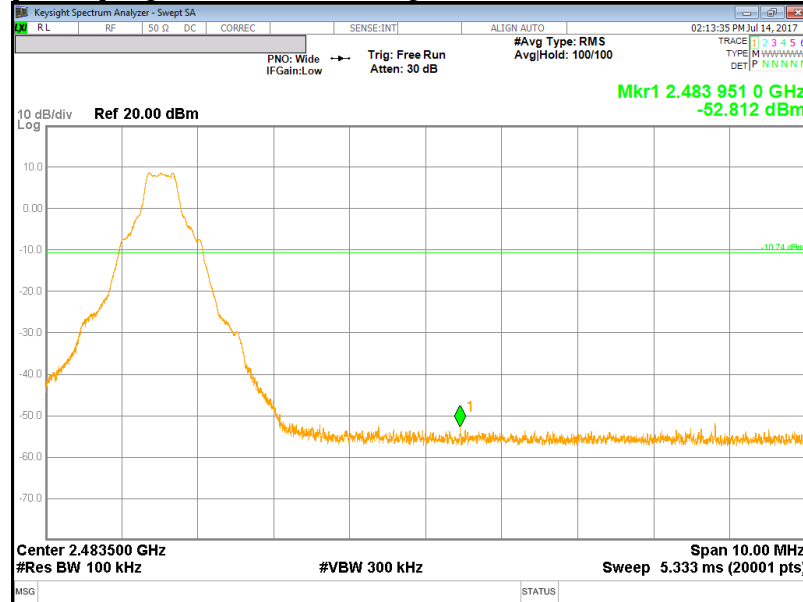
[GFSK] Mid Channel BandEdge



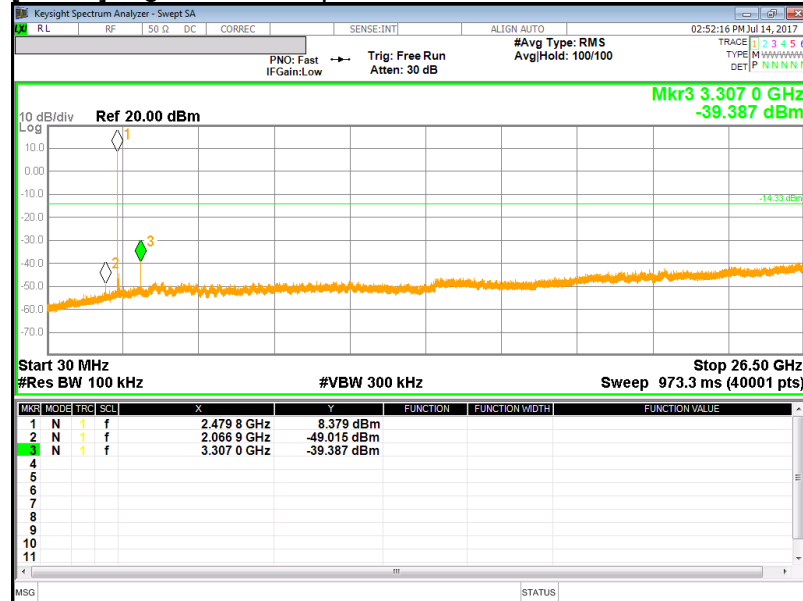
[GFSK] Mid Channel Spurious



[GFSK] High Channel BandEdge



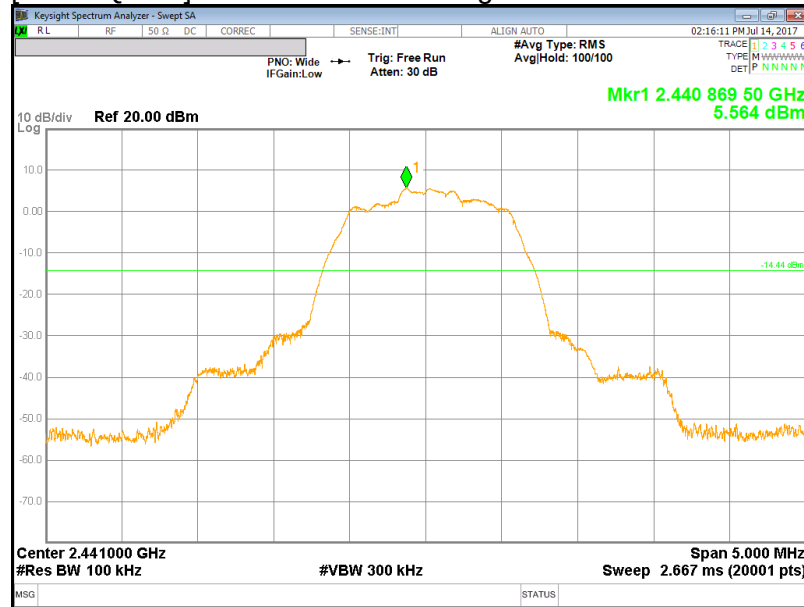
[GFSK] High Channel Spurious



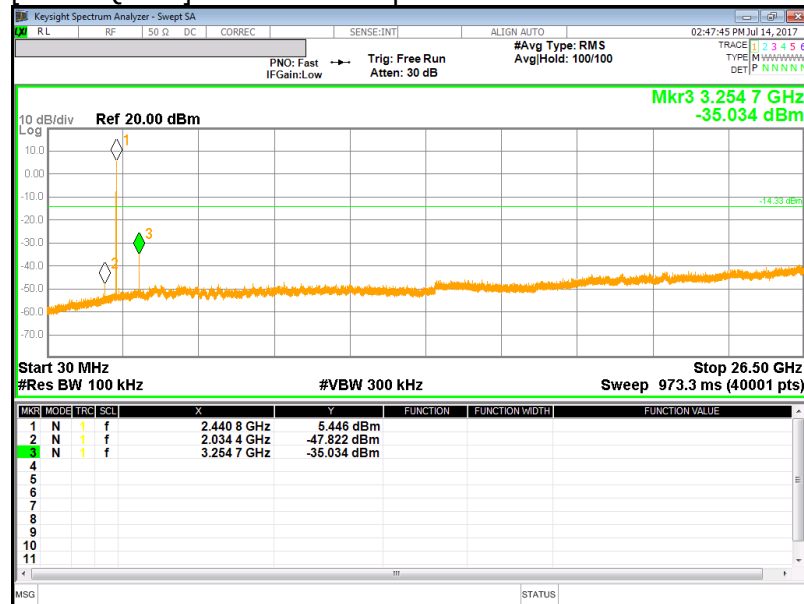
PI/4-DQPSK Mode



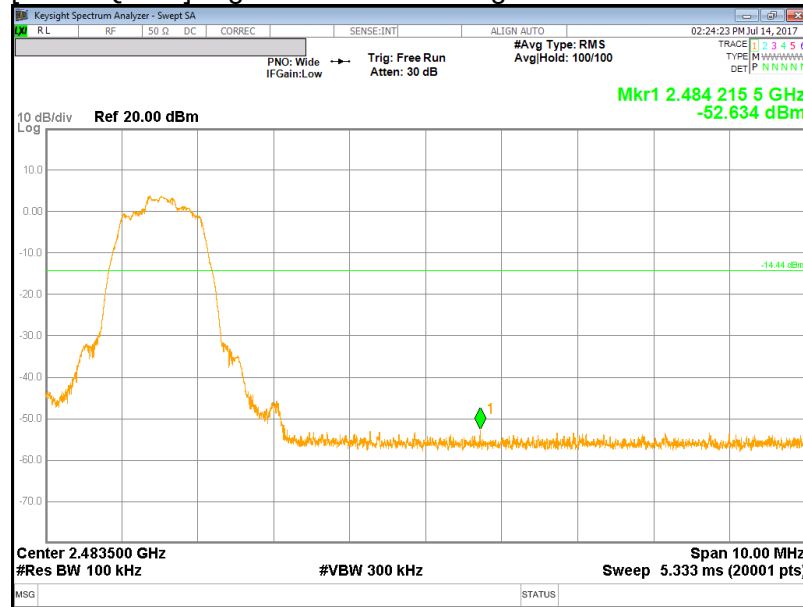
[PI/4-DQPSK] Mid Channel BandEdge



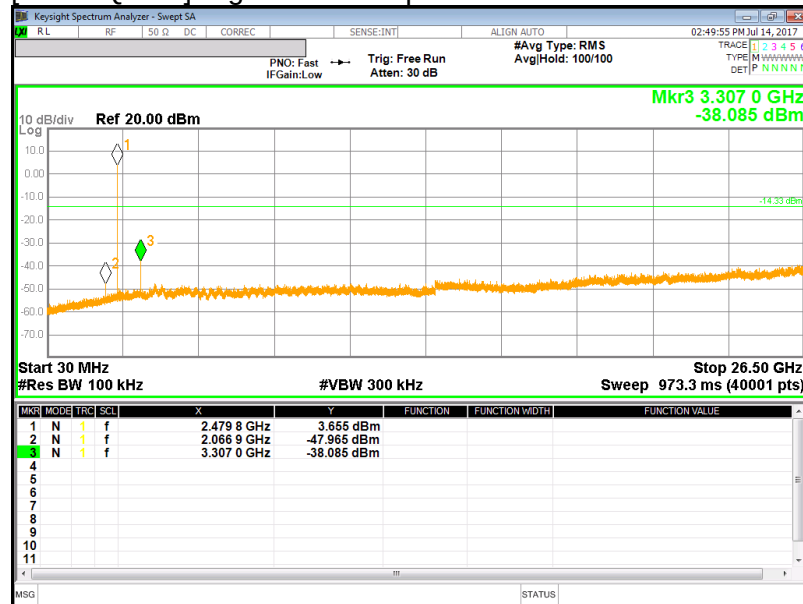
[PI/4-DQPSK] Mid Channel Spurious



[PI/4-DQPSK] High Channel BandEdge

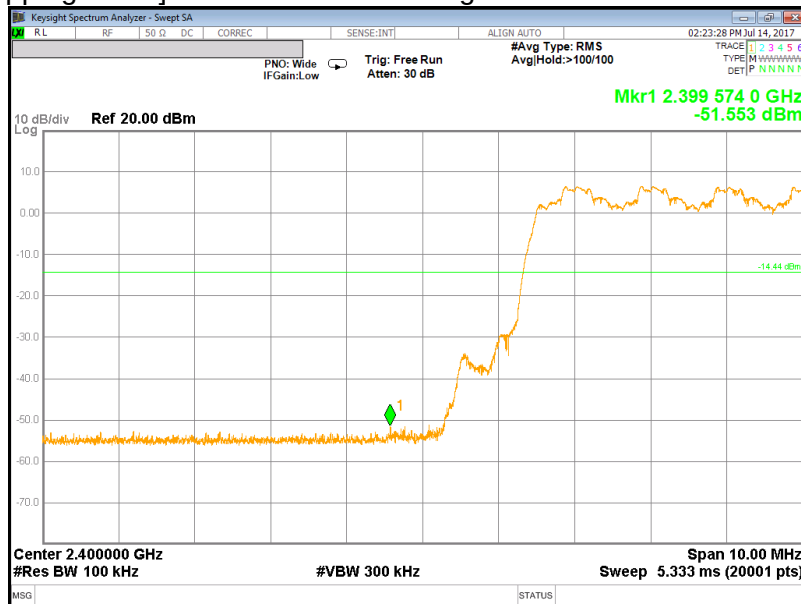


[PI/4-DQPSK] High Channel Spurious



BandEdge Emission at PI/4-DQPSK Hopping Mode

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

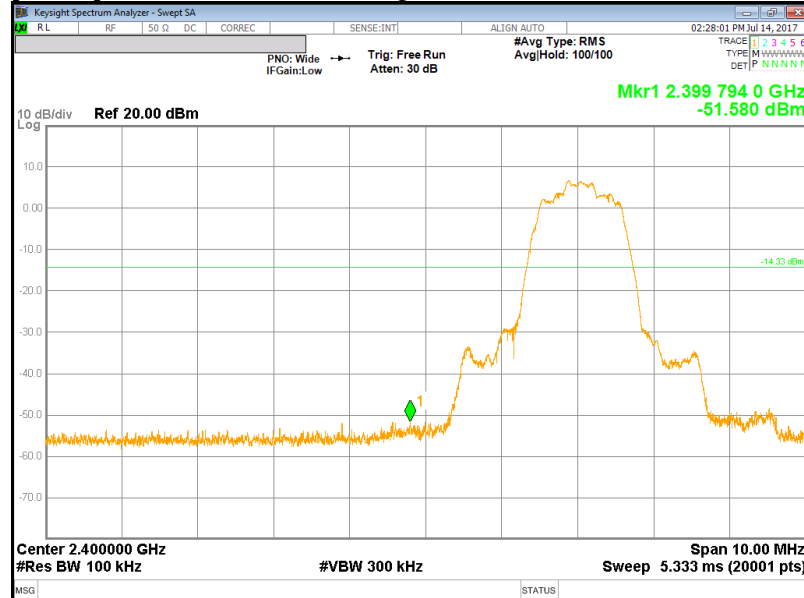


[PI/4-DQPSK Hopping Mode] High Channel BandEdge

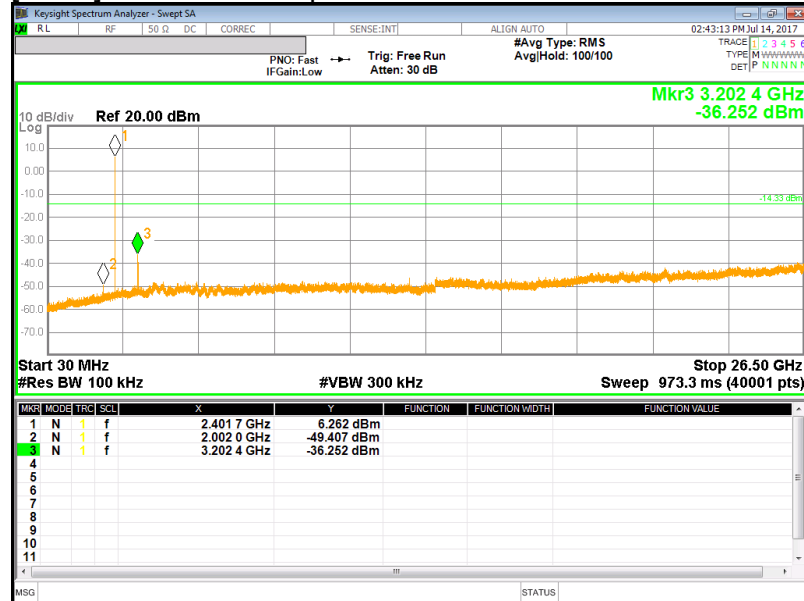


8PSK Mode

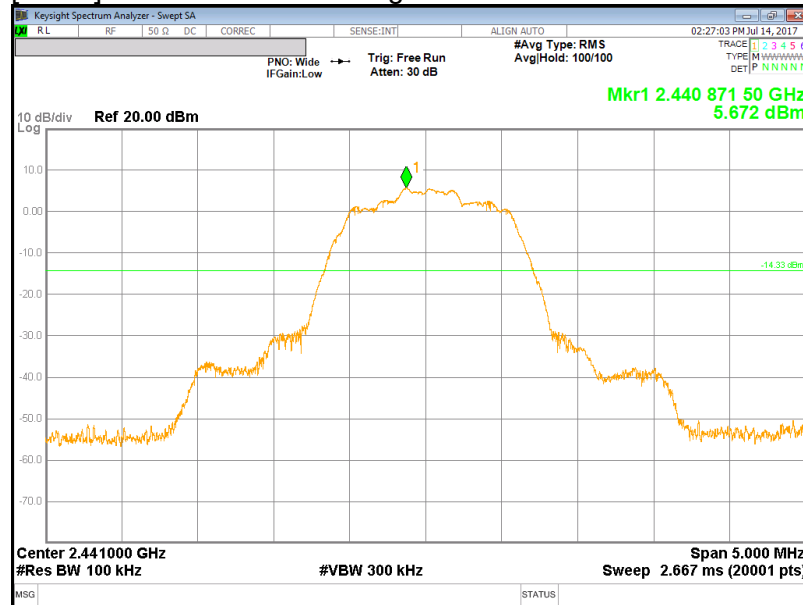
[8PSK] Low Channel BandEdge



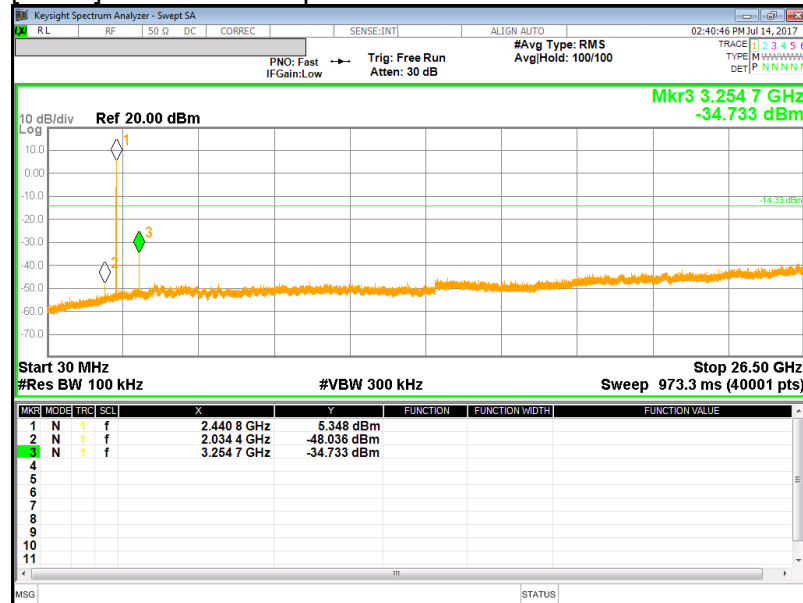
[8PSK] Low Channel Spurious



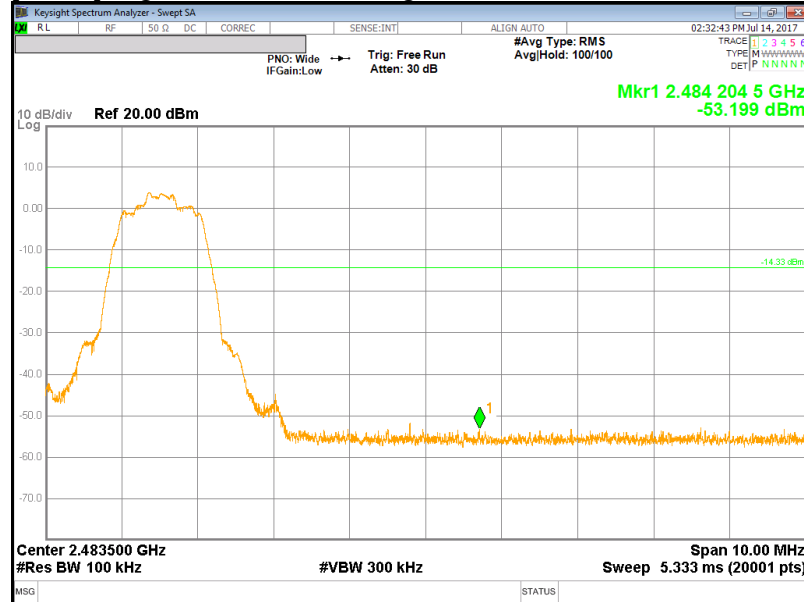
[8PSK] Mid Channel BandEdge



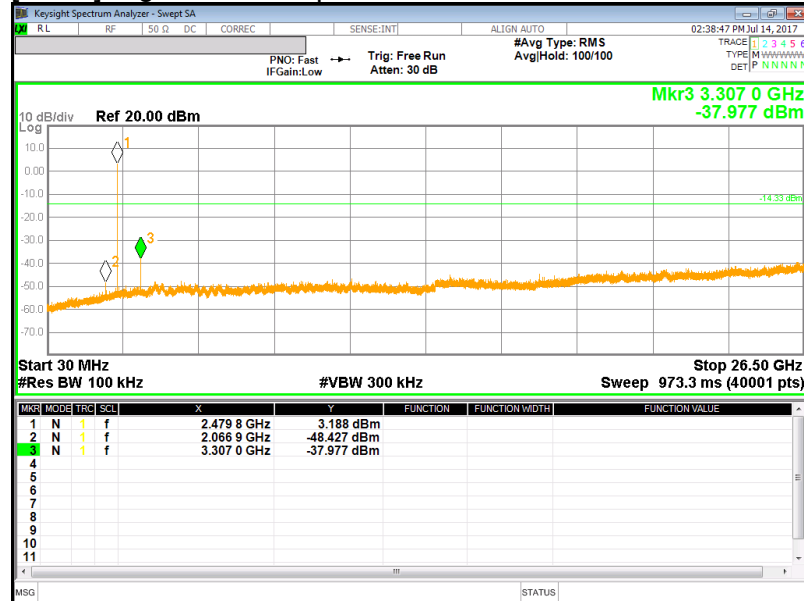
[8PSK] Mid Channel Spurious



[8PSK] High Channel BandEdge



[8PSK] High Channel Spurious



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.

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

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.

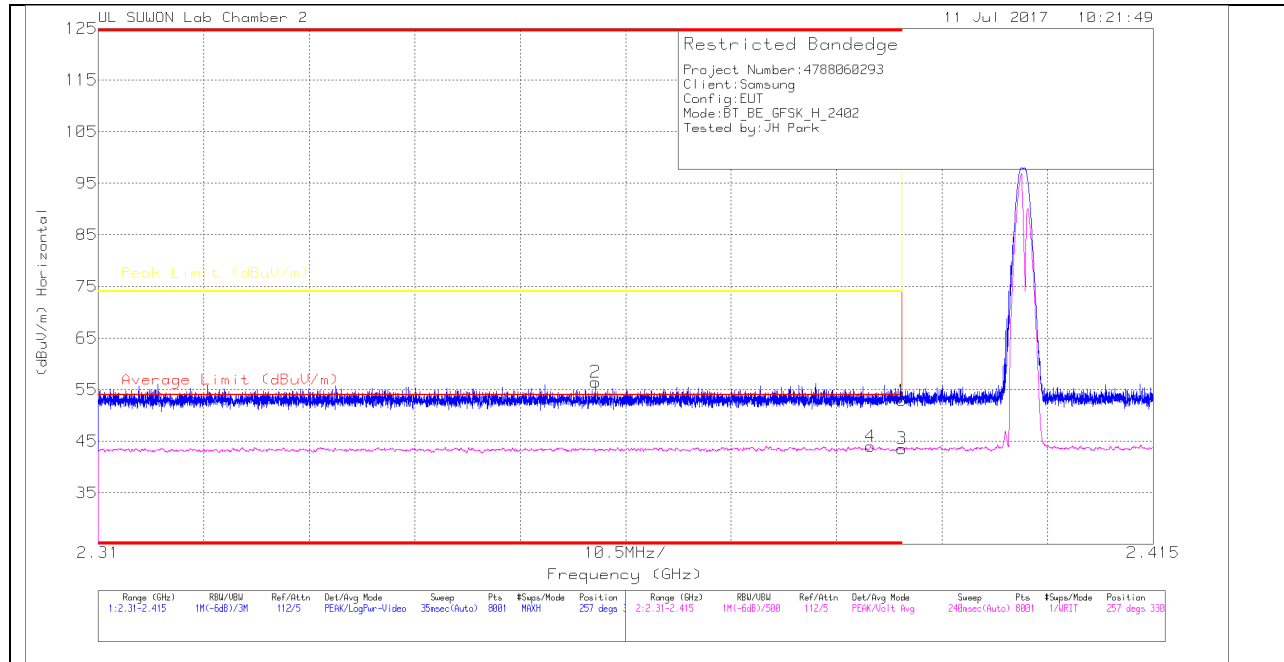
Note : Emission was pre-scanned from 9KHz to 30MHz; No emissions were detected which was at least 20dB below the specification limit (consider distance correction factor).
Per FCC part 15.31(o), test results were not reported.

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

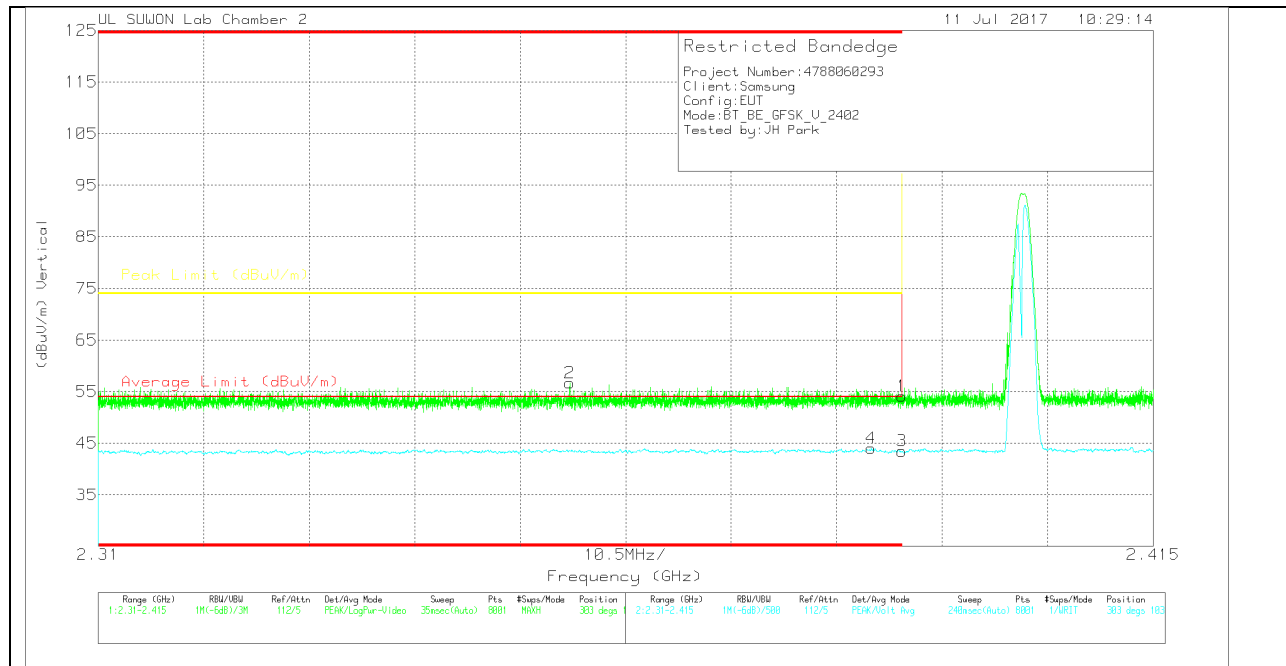
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.79	Pk		-18.2	52.89	-	-	74	-21.11	257	330	H
2	* 2.359	43.57	Pk		-18.3	56.47	-	-	74	-17.53	257	330	H
3	* 2.39	30.48	VA1T		-18.2	43.58	54	-10.42	-	-	257	330	H
4	* 2.387	30.91	VA1T		-18.2	44.01	54	-9.99	-	-	257	330	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

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.01	Pk	31.3	-18.2	54.11	-	-	74	-19.89	303	103	V
2	* 2.357	43.8	Pk	31.2	-18.3	56.7	-	-	74	-17.3	303	103	V
3	* 2.39	30.39	VA1T	31.3	-18.2	43.49	54	-10.51	-	-	303	103	V
4	* 2.387	30.9	VA1T	31.3	-18.2	44	54	-10	-	-	303	103	V

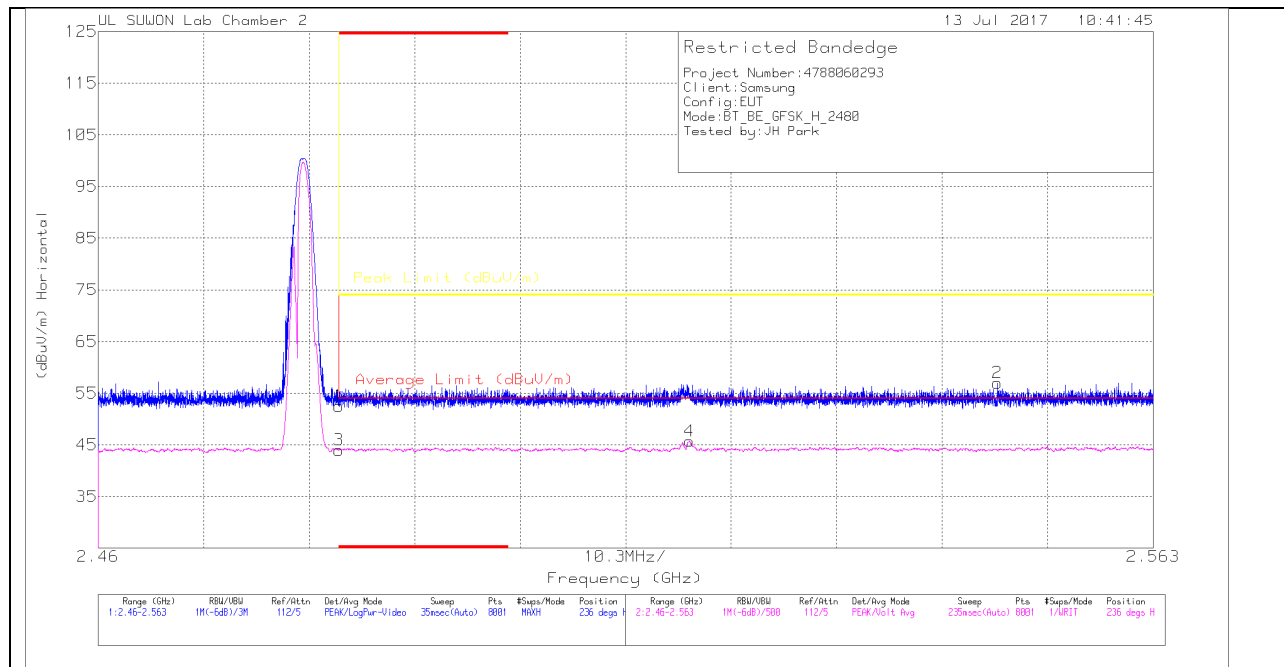
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

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

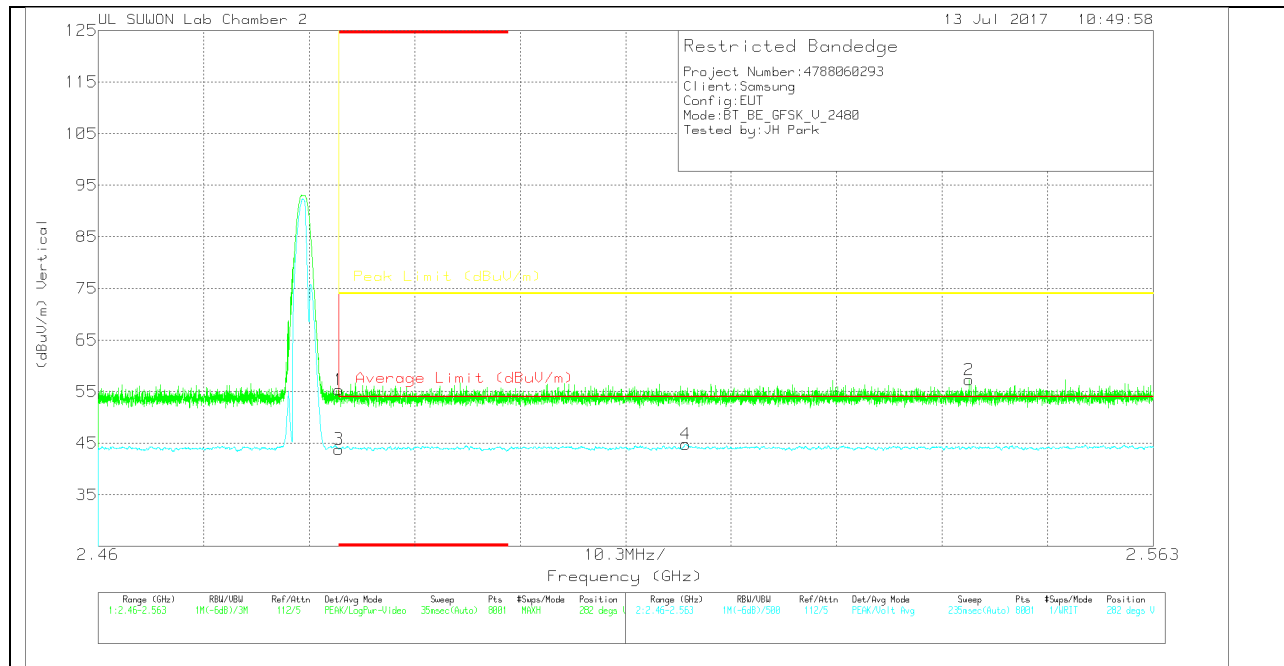
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.9	Pk	31.6	-18	52.5	-	-	74	-21.5	236	114	H
2	2.548	43.3	Pk	31.7	-18	57	-	-	74	-17	236	114	H
3	* 2.484	30.38	VA1T	31.6	-18	43.98	54	-10.02	-	-	236	114	H
4	2.518	32.11	VA1T	31.6	-18	45.71	54	-8.29	-	-	236	114	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

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.74	Pk		-18	55.34	-	-	74	-18.66	282	123	V
2	2.545	43.61	Pk		-18	57.31	-	-	74	-16.69	282	123	V
3	* 2.484	30.22	VA1T		-18	43.82	54	-10.18	-	-	282	123	V
4	2.517	31.23	VA1T		-18	44.83	54	-9.17	-	-	282	123	V

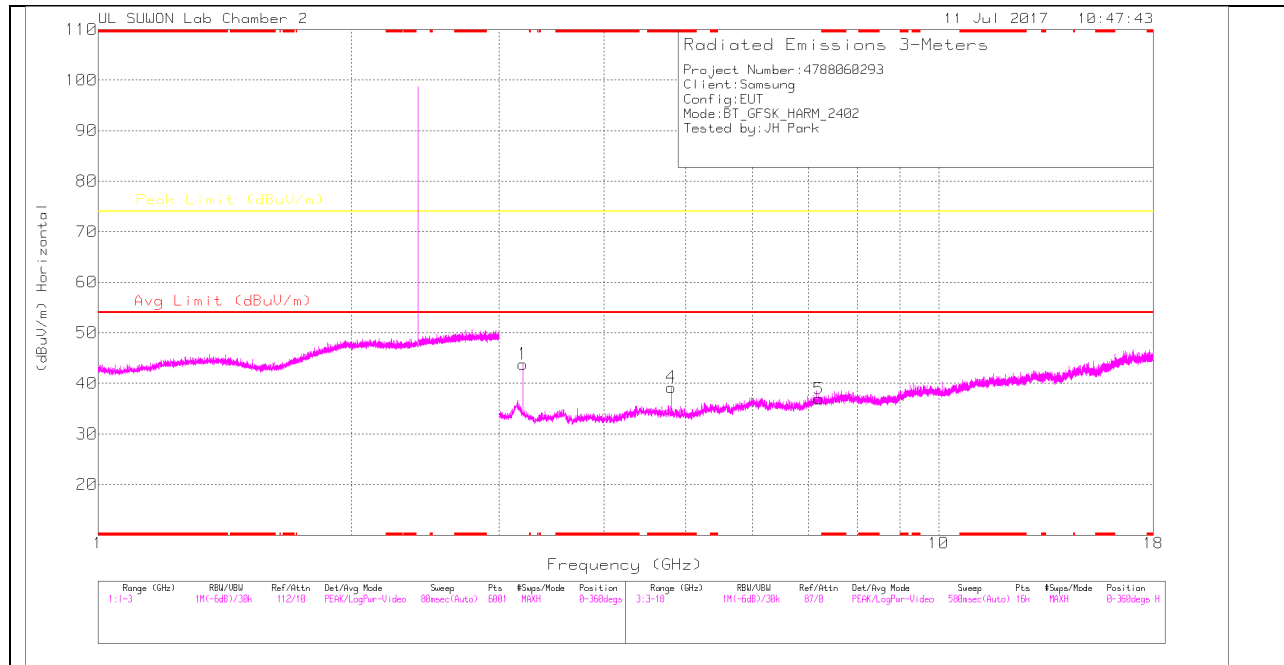
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

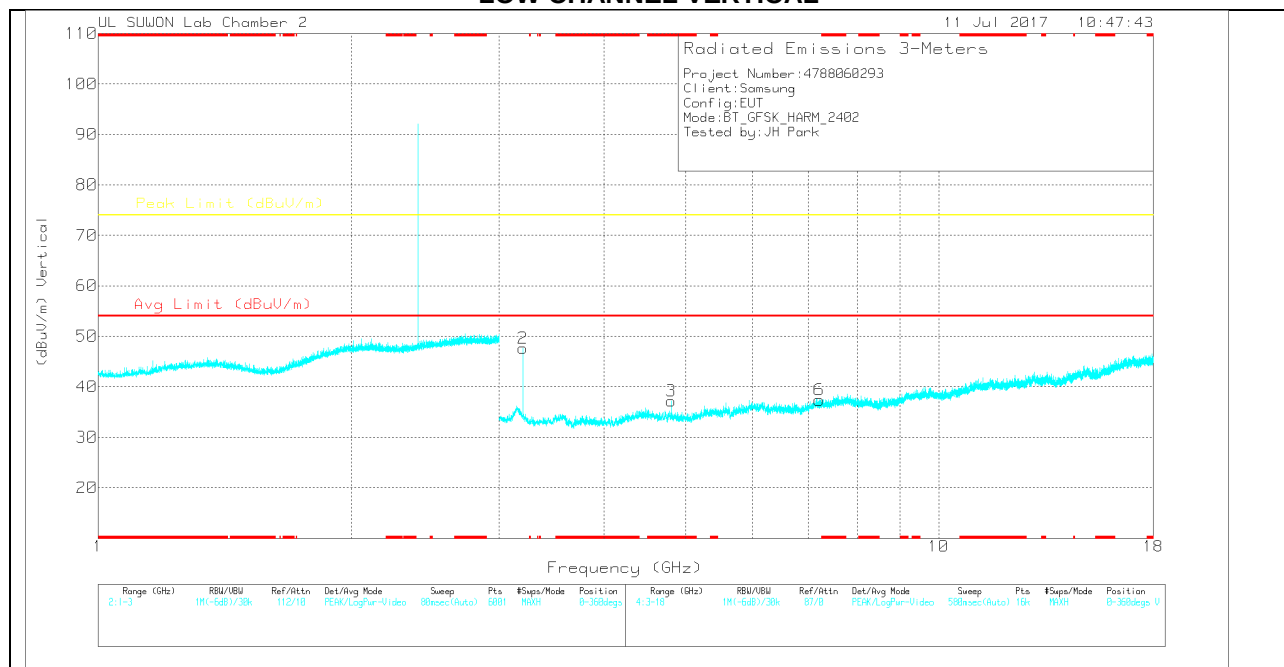
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.202	36.13	PK	33.4	-25.7	43.83	-	-	74	-30.17	0-360	150	H
4	* 4.804	29.72	PK	33.8	-24.3	39.22	-	-	74	-34.78	0-360	150	H
5	7.205	22.74	PK	35.9	-21.7	36.94	-	-	74	-37.06	0-360	250	H
2	3.202	39.9	PK	33.4	-25.7	47.6	-	-	74	-26.4	0-360	149	V
3	* 4.804	27.68	PK	33.8	-24.3	37.18	-	-	74	-36.82	0-360	149	V
6	7.21	23.18	PK	35.9	-21.7	37.38	-	-	74	-36.62	0-360	250	V

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

PK – Peak Detector

Radiated Emissions

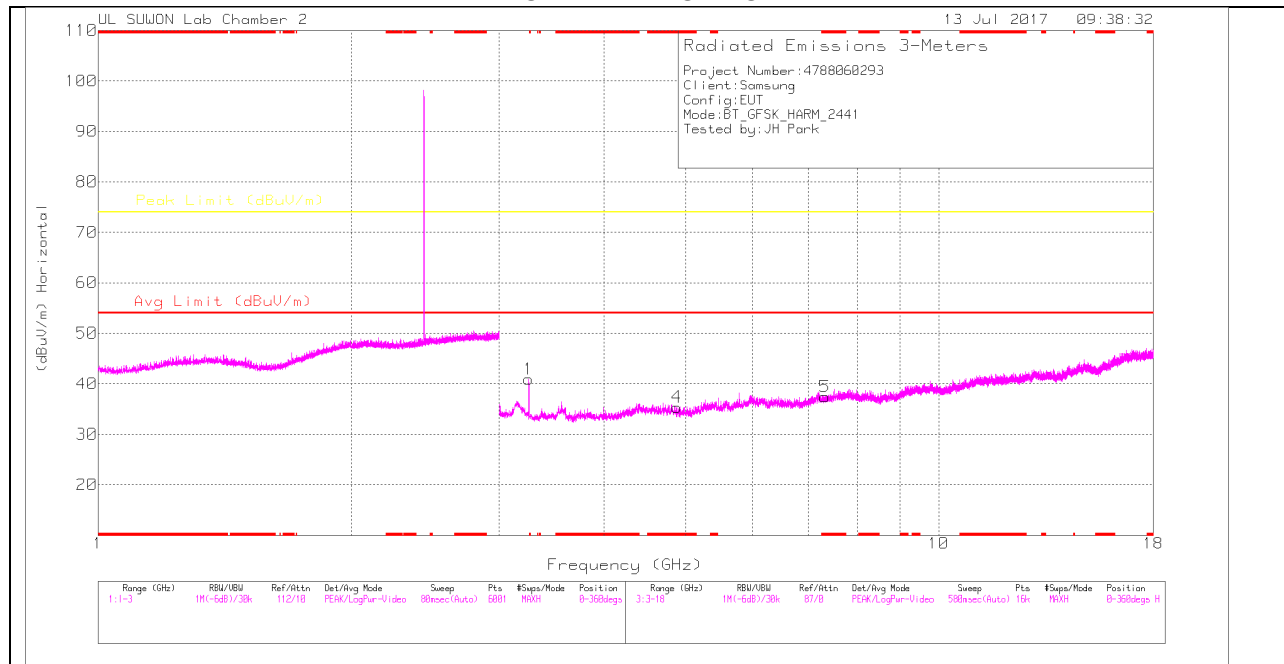
Frequency (GHz)	Meter Reading (dBuV)	Det	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.203	41.44	PK2	33.4	-25.7	49.14	-	-	74	-24.86	238	115	H
3.203	45.13	PK2	33.4	-25.7	52.83	-	-	74	-21.17	189	124	V
* 4.804	37.5	PK2	33.8	-24.3	47	-	-	74	-27	168	142	V
* 4.804	26.59	VA1T	33.8	-24.3	36.09	54	-17.91	-	-	168	142	V
* 4.804	37.76	PK2	33.8	-24.3	47.26	-	-	74	-26.74	191	348	H
* 4.804	26.89	VA1T	33.8	-24.3	36.39	54	-17.61	-	-	191	348	H

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

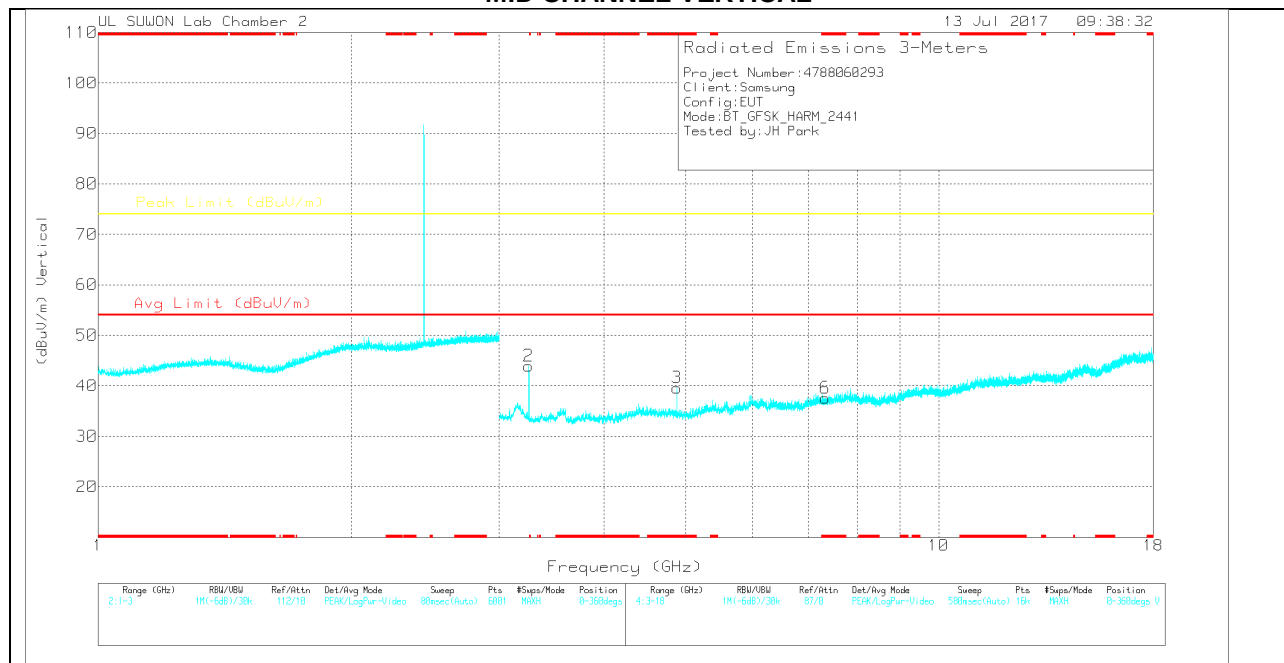
PK2 - KDB558074 Method: Maximum Peak

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

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.254	34.2	PK	32.7	-26	40.9	-	-	74	-33.1	0-360	250	H
4	* 4.881	26.16	PK	33.8	-24.6	35.36	-	-	74	-38.64	0-360	150	H
5	* 7.323	23.44	PK	35.9	-21.9	37.44	-	-	74	-36.56	0-360	150	H
2	3.254	37.22	PK	32.7	-26	43.92	-	-	74	-30.08	0-360	150	V
3	* 4.881	30.41	PK	33.8	-24.6	39.61	-	-	74	-34.39	0-360	150	V
6	* 7.327	23.58	PK	35.9	-21.9	37.58	-	-	74	-36.42	0-360	250	V

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

PK – Peak Detector

Radiated Emissions

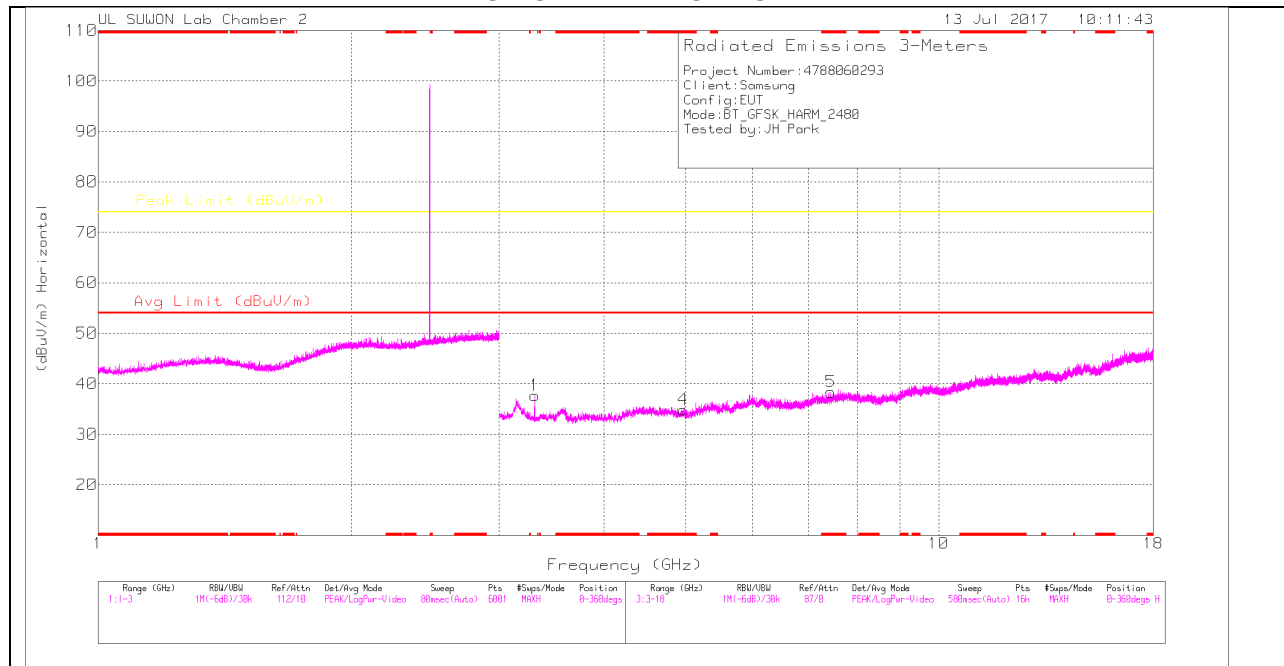
Frequency (GHz)	Meter Reading (dBuV)	Det	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.255	41.44	PK2	32.7	-26	48.14	-	-	74	-25.86	269	358	H
3.255	42.41	PK2	32.7	-26	49.11	-	-	74	-24.89	127	157	V
* 4.882	38.57	PK2	33.8	-24.6	47.77	-	-	74	-26.23	176	135	V
* 4.882	29.12	VA1T	33.8	-24.6	38.32	54	-15.68	-	-	176	135	V

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

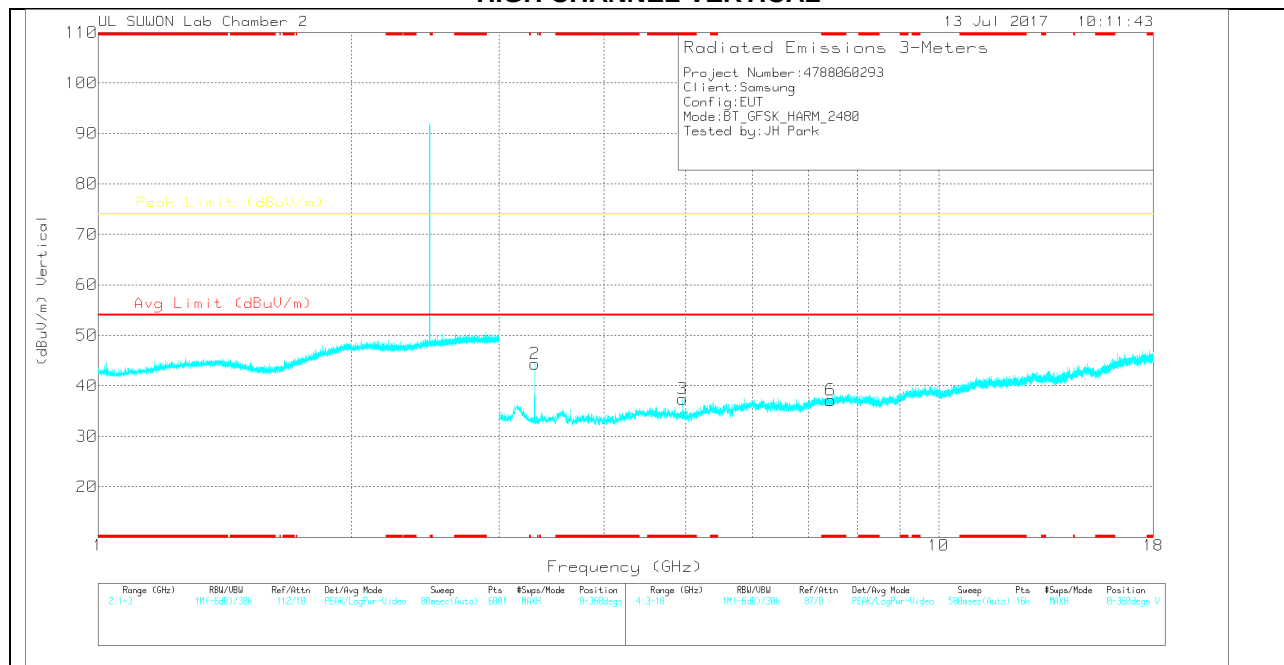
PK2 - KDB558074 Method: Maximum Peak

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

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.307	31	PK	32.5	-25.8	37.7	-	-	74	-36.3	0-360	150	H
4	* 4.964	25.77	PK	33.8	-24.7	34.87	-	-	74	-39.13	0-360	150	H
5	* 7.44	23.47	PK	35.9	-21	38.37	-	-	74	-35.63	0-360	150	H
2	3.307	37.66	PK	32.5	-25.8	44.36	-	-	74	-29.64	0-360	150	V
3	* 4.96	28.28	PK	33.8	-24.7	37.38	-	-	74	-36.62	0-360	250	V
6	* 7.436	22.24	PK	35.9	-21	37.14	-	-	74	-36.86	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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.307	39.67	PK2	32.5	-25.8	46.37	-	-	74	-27.63	255	245	H
3.307	42.72	PK2	32.5	-25.8	49.42	-	-	74	-24.58	192	114	V
* 4.96	37.9	PK2	33.8	-24.7	47	-	-	74	-27	160	161	V
* 4.96	27.56	VA1T	33.8	-24.7	36.66	54	-17.34	-	-	160	161	V

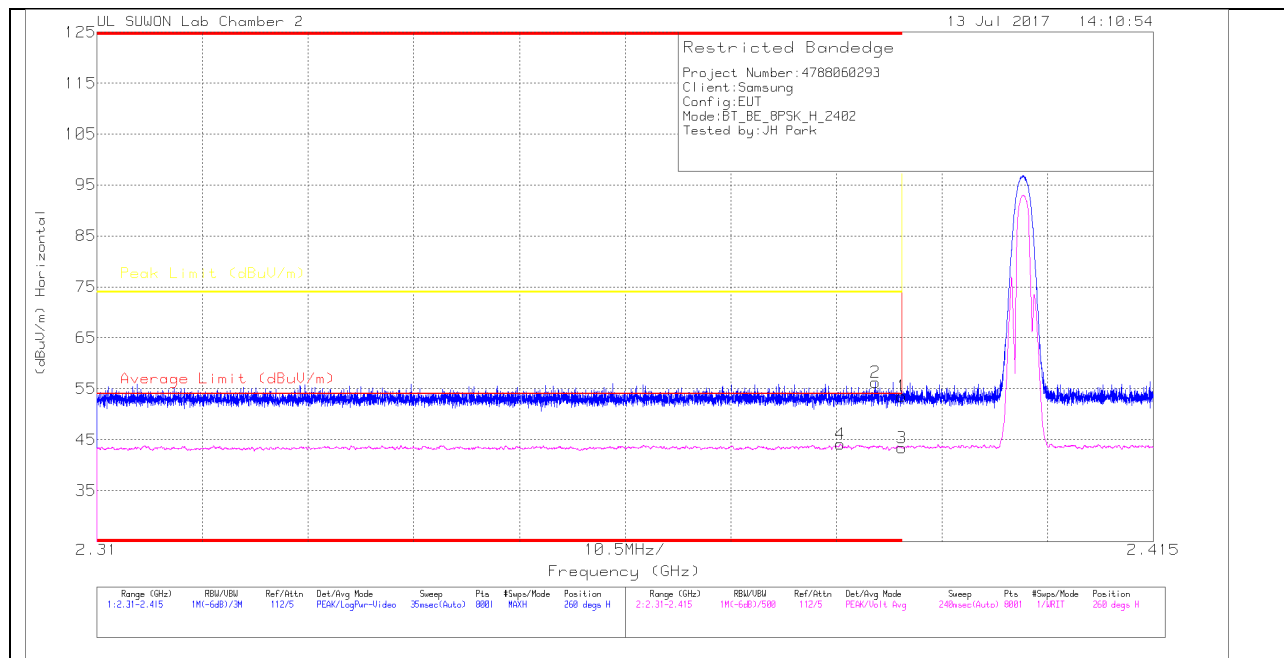
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

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

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

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

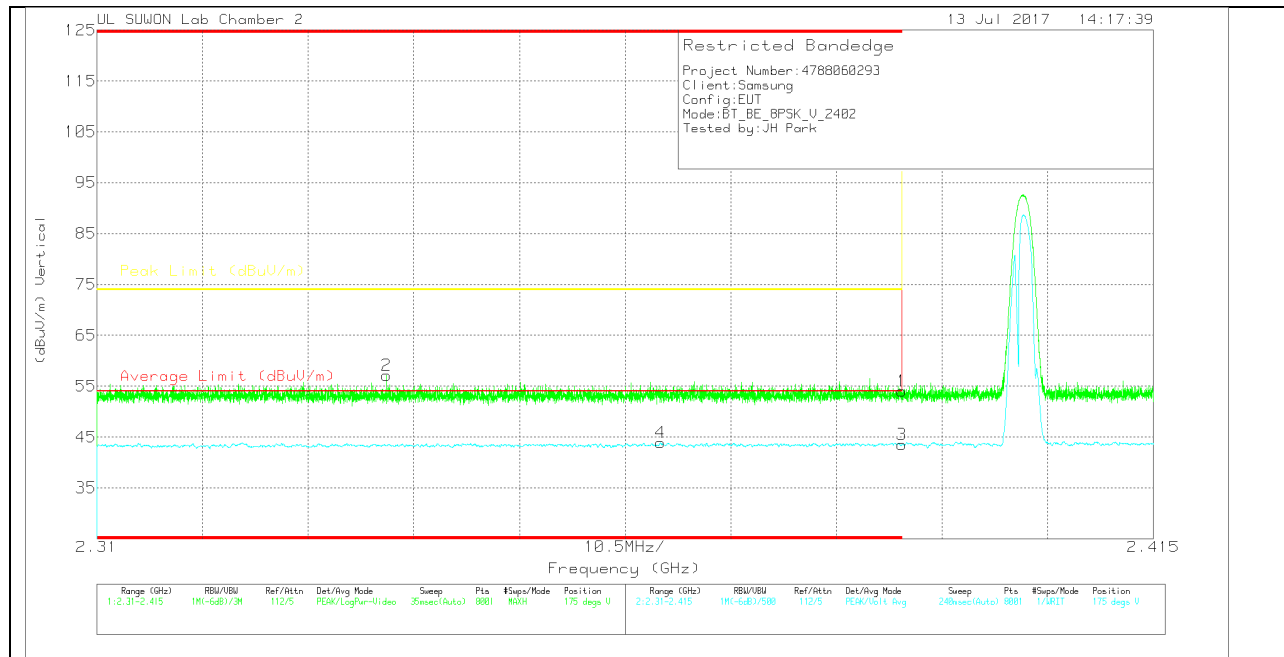
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.4	Pk	31.3	-18.2	53.5	-	-	74	-20.5	260	122	H
2	* 2.387	43.22	Pk	31.3	-18.2	56.32	-	-	74	-17.68	260	122	H
3	* 2.39	30.28	VA1T	31.3	-18.2	43.38	54	-10.62	-	-	260	122	H
4	* 2.384	31.01	VA1T	31.3	-18.2	44.11	54	-9.89	-	-	260	122	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

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.95	Pk	31.3	-18.2	54.05	-	-	74	-19.95	175	291	V
2	* 2.339	44.27	Pk	31.2	-18.3	57.17	-	-	74	-16.83	175	291	V
3	* 2.39	30.39	VA1T	31.3	-18.2	43.49	54	-10.51	-	-	175	291	V
4	* 2.366	30.94	VA1T	31.2	-18.3	43.84	54	-10.16	-	-	175	291	V

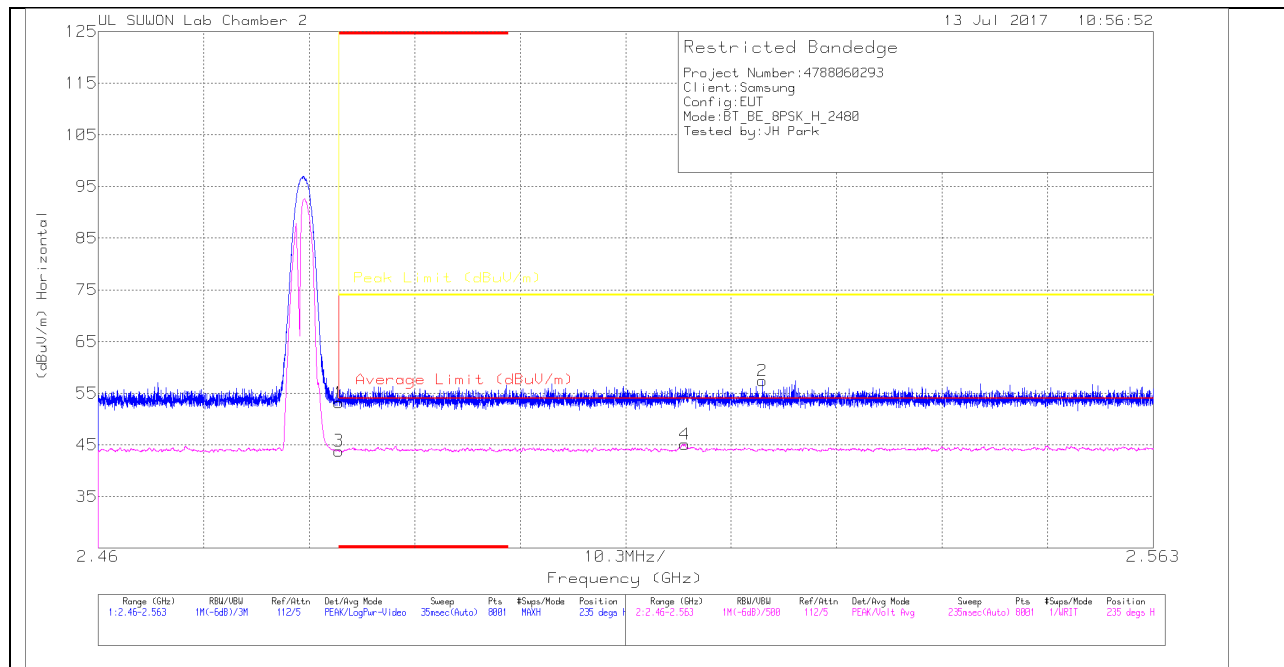
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

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

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

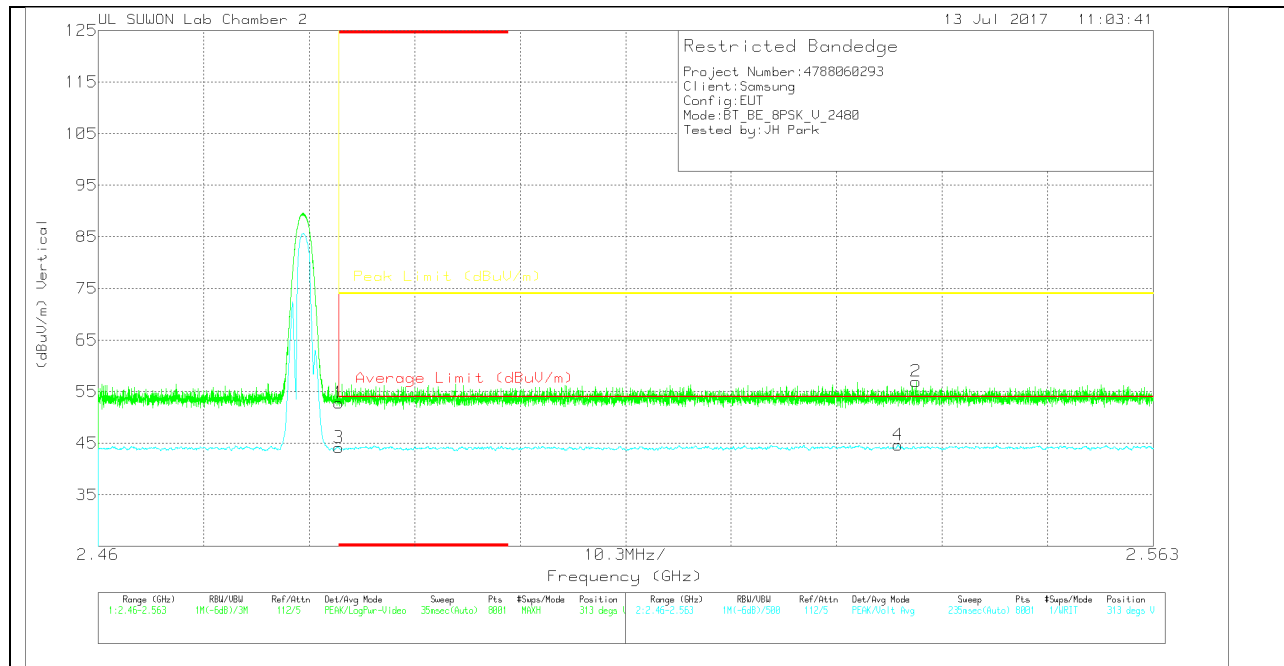
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	39.56	Pk	31.6	-18	53.16	-	-	74	-20.84	235	112	H
2	2.525	43.81	Pk	31.6	-18	57.41	-	-	74	-16.59	235	112	H
3	* 2.484	30.22	VA1T	31.6	-18	43.82	54	-10.18	-	-	235	112	H
4	2.517	31.54	VA1T	31.6	-18	45.14	54	-8.86	-	-	235	112	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

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	170531_3 117[00168 724]	10dB[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	39.23	Pk		-18	52.83	-	-	74	-21.17	313	120	V
2	2.54	43.29	Pk		-18	56.99	-	-	74	-17.01	313	120	V
3	* 2.484	30.58	VA1T		-18	44.18	54	-9.82	-	-	313	120	V
4	2.538	30.98	VA1T		-18	44.68	54	-9.32	-	-	313	120	V

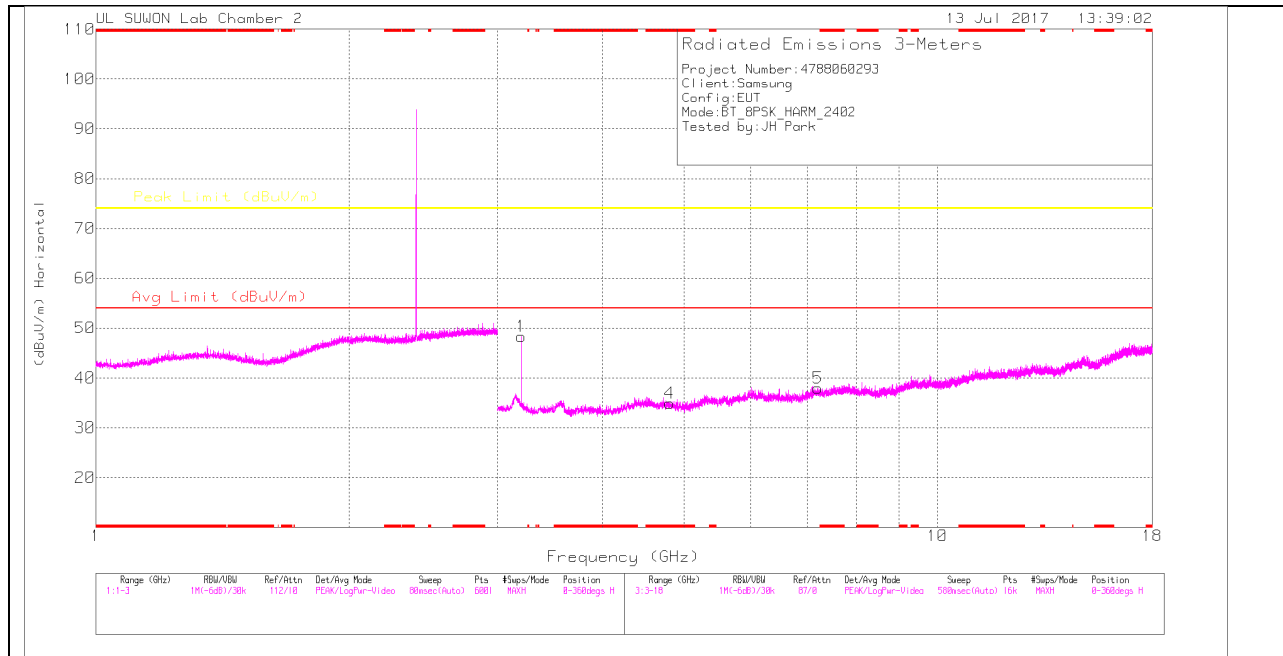
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

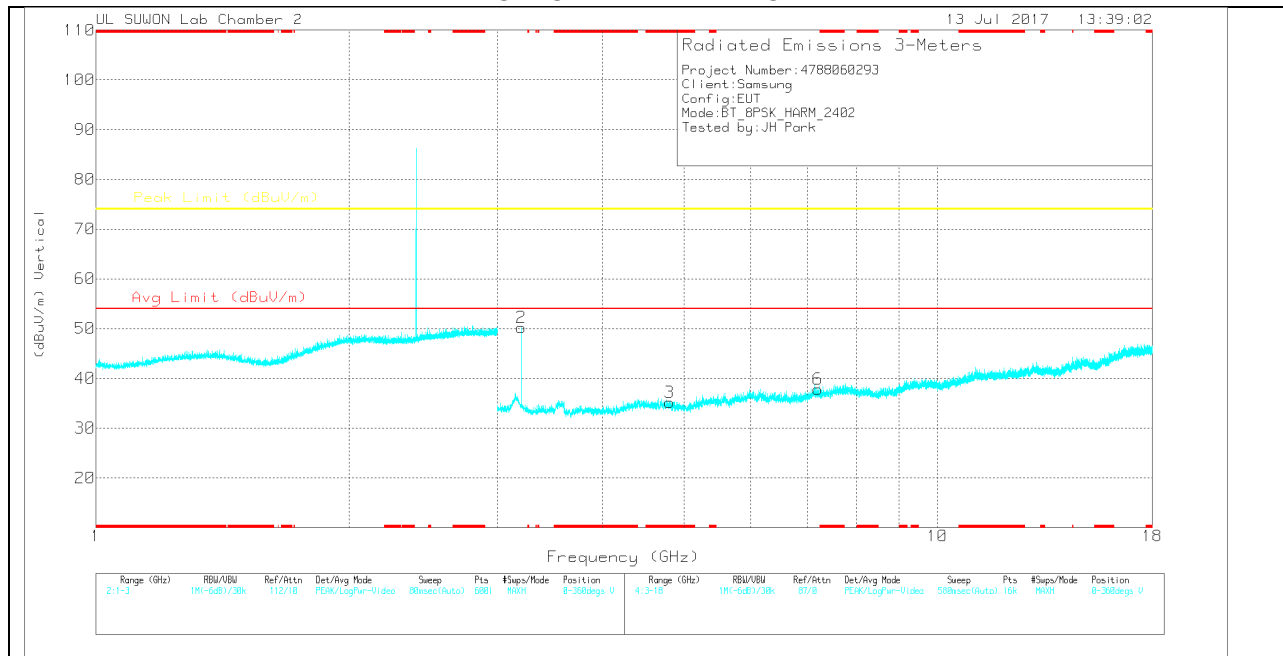
VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.202	40.68	PK	33.4	-25.7	48.38	-	-	74	-25.62	0-360	250	H
4	* 4.807	25.39	PK	33.8	-24.3	34.89	-	-	74	-39.11	0-360	250	H
5	7.207	23.77	PK	35.9	-21.7	37.97	-	-	74	-36.03	0-360	250	H
2	3.202	42.54	PK	33.4	-25.7	50.24	-	-	74	-23.76	0-360	150	V
3	* 4.806	25.68	PK	33.8	-24.3	35.18	-	-	74	-38.82	0-360	250	V
6	7.204	23.59	PK	35.9	-21.7	37.79	-	-	74	-36.21	0-360	250	V

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

PK – Peak Detector

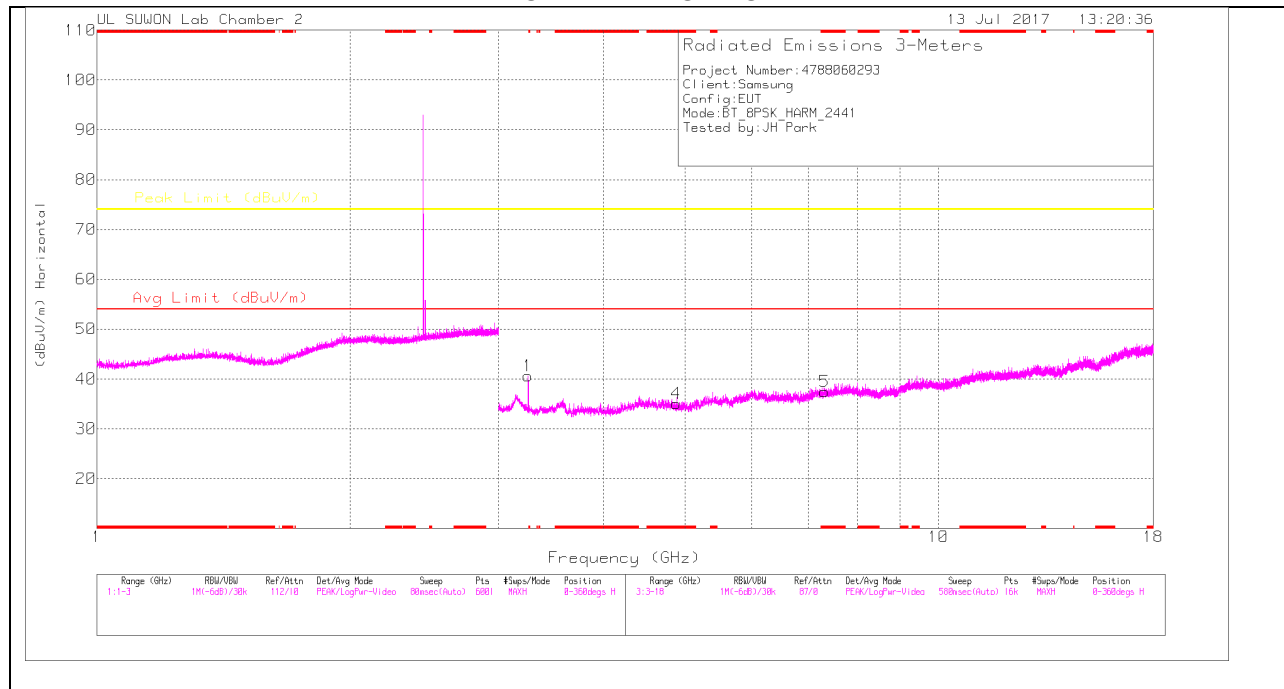
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	170531_31 17[0016872 4]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.203	44.46	PK2	33.4	-25.7	52.16	-	-	74	-21.84	253	211	H
3.203	46.82	PK2	33.4	-25.7	54.52	-	-	74	-19.48	137	127	V

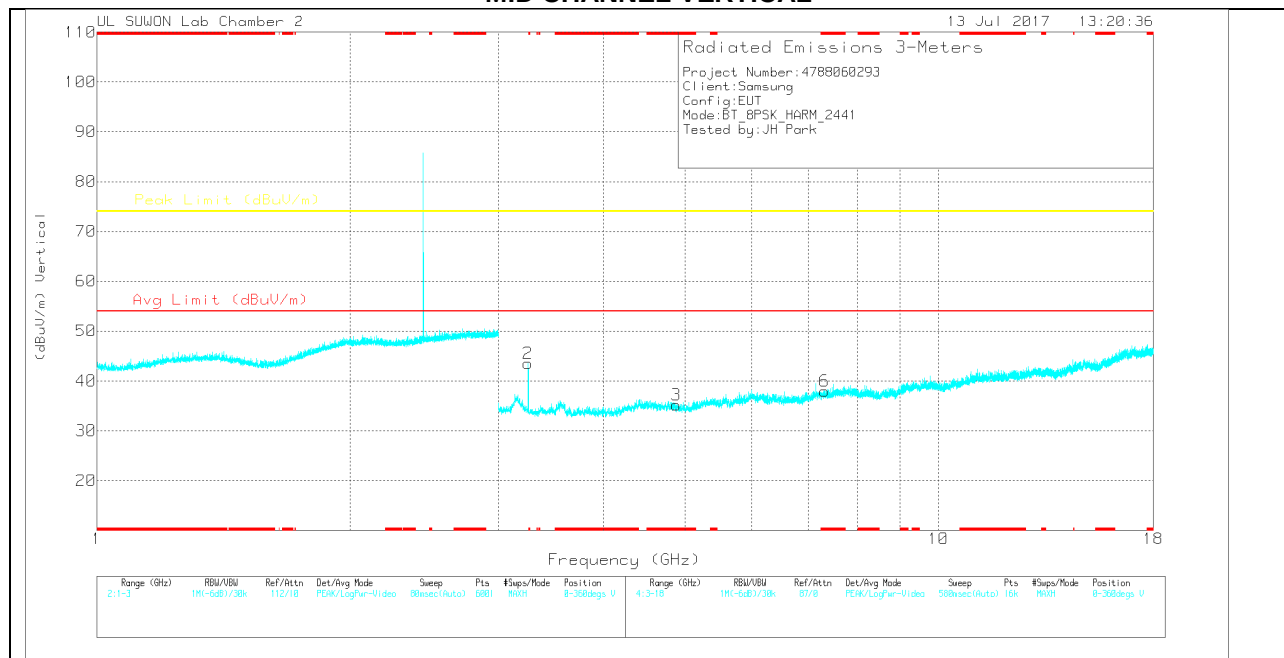
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.254	33.91	PK	32.7	-26	40.61	-	-	74	-33.39	0-360	150	H
4	* 4.883	25.8	PK	33.8	-24.6	35	-	-	74	-39	0-360	150	H
5	* 7.323	23.5	PK	35.9	-21.9	37.5	-	-	74	-36.5	0-360	150	H
2	3.254	36.77	PK	32.7	-26	43.47	-	-	74	-30.53	0-360	150	V
3	* 4.881	25.99	PK	33.8	-24.6	35.19	-	-	74	-38.81	0-360	250	V
6	* 7.32	24.01	PK	35.9	-22	37.91	-	-	74	-36.09	0-360	150	V

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

PK – Peak Detector

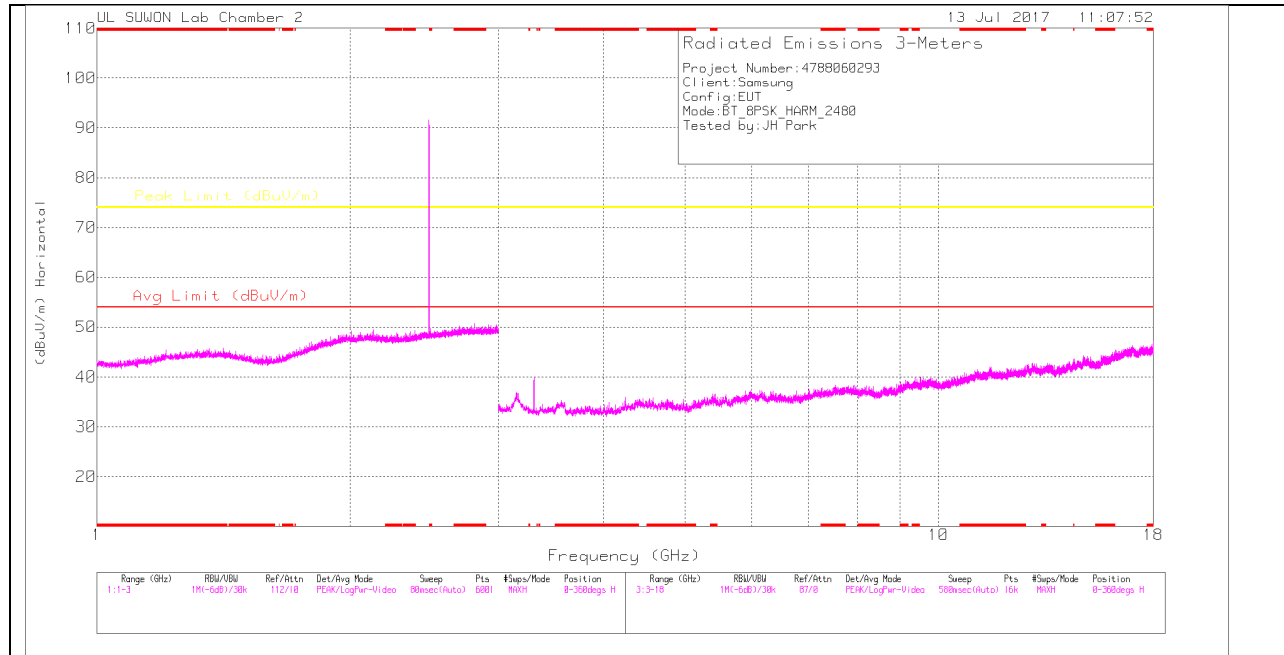
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	170531_31 17[0016872 4]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.255	42.97	PK2	32.7	-26	49.67	-	-	74	-24.33	242	162	H
3.255	44.95	PK2	32.7	-26	51.65	-	-	74	-22.35	202	134	V

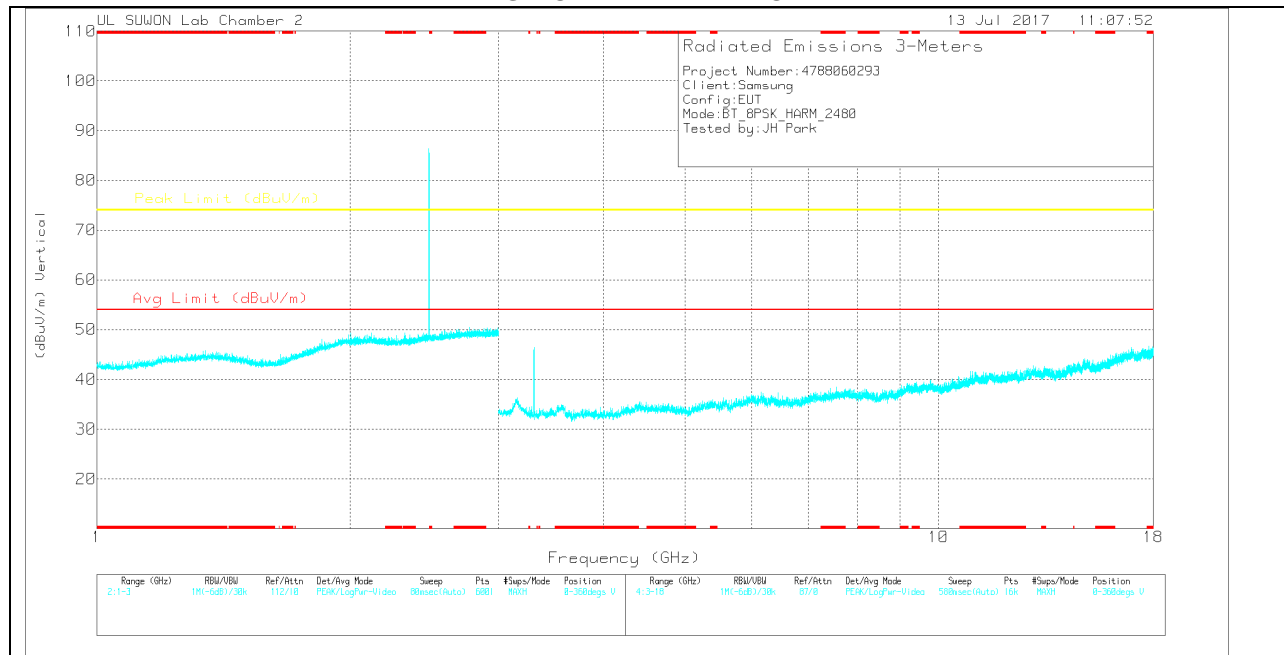
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

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	170531_31 17[001687 24]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.307	33.27	PK	32.5	-25.8	39.97	-	-	74	-34.03	0-360	250	H
3	* 4.961	25.29	PK	33.8	-24.7	34.39	-	-	74	-39.61	0-360	250	H
6	* 7.442	22.04	PK	35.9	-21	36.94	-	-	74	-37.06	0-360	150	H
2	3.307	39.75	PK	32.5	-25.8	46.45	-	-	74	-27.55	0-360	150	V
4	* 4.958	25.4	PK	33.8	-24.7	34.5	-	-	74	-39.5	0-360	150	V
5	* 7.439	23.36	PK	35.9	-21	38.26	-	-	74	-35.74	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	170531_31 17[0016872 4]	3GHz_HP[d B]	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3.307	40.9	PK2	32.5	-25.8	47.6	-	-	74	-26.4	270	343	H
3.307	43.77	PK2	32.5	-25.8	50.47	-	-	74	-23.53	194	130	V

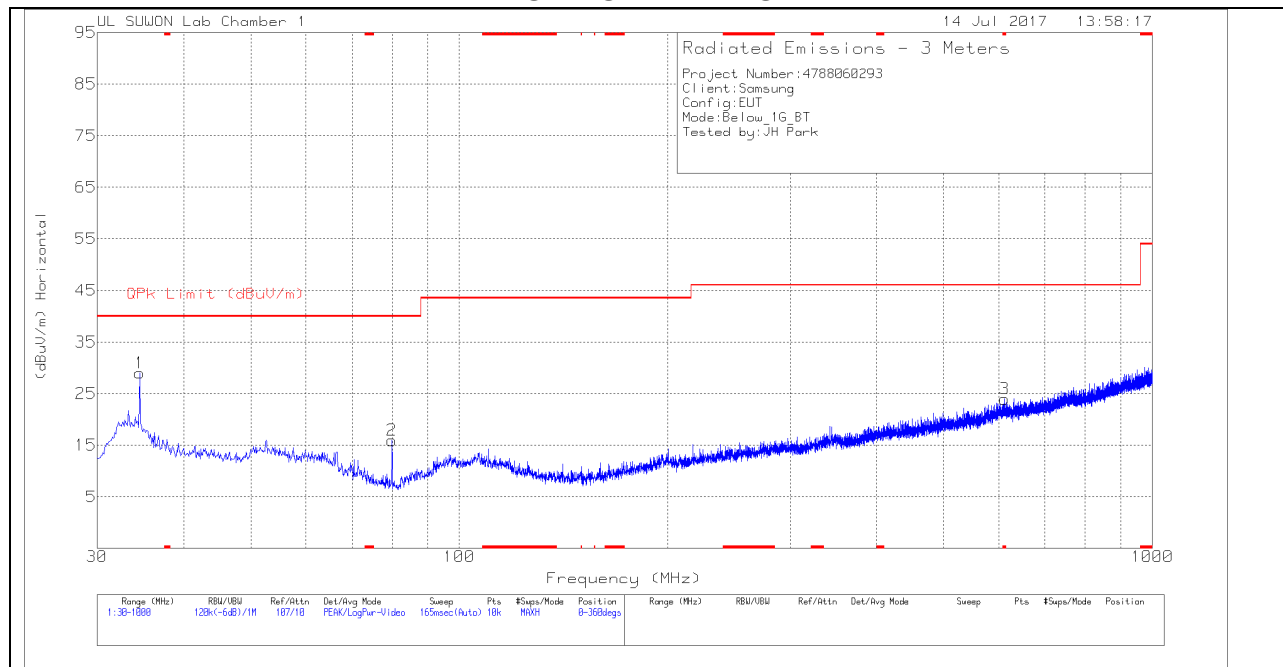
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

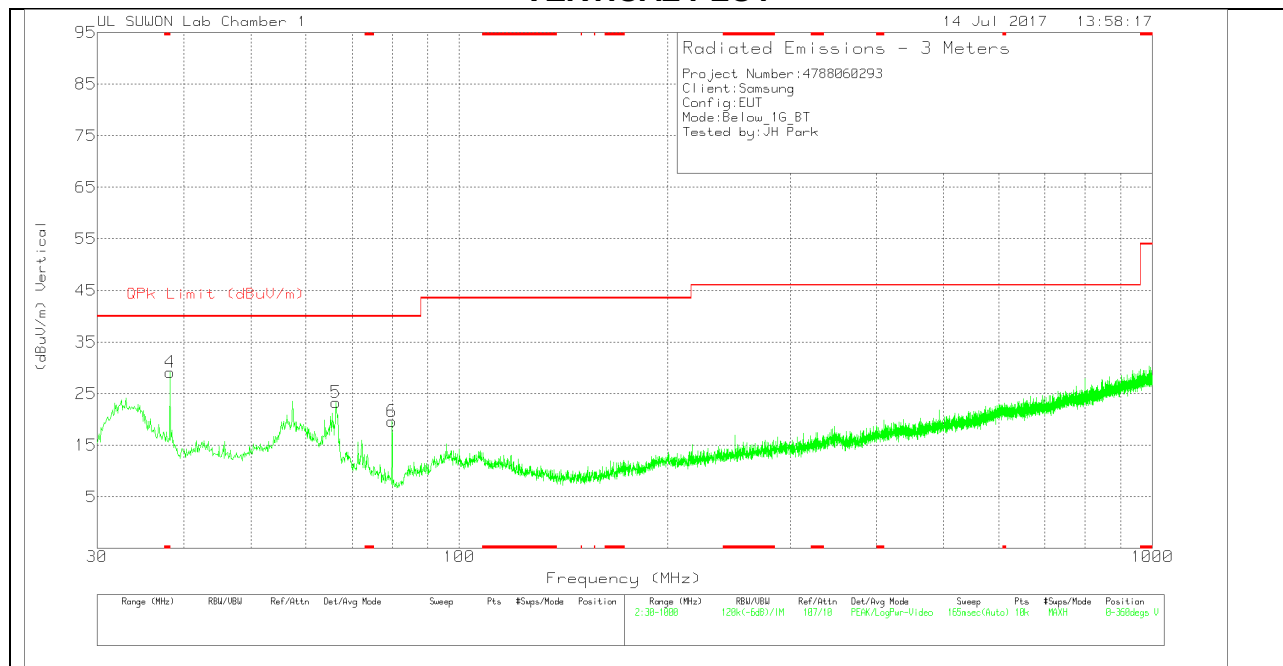
10.3. WORST-CASE BELOW 1 GHz

GFSK SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



VERTICAL PLOT



BELOW 1 GHz TABLE

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163_7 50(dB)	30-1000MHz[dB]	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	34.559	47.91	Pk	10.7	-29.6	29.01	40	-10.99	0-360	300	H
2	79.955	37.63	Pk	7	-28.7	15.93	40	-24.07	0-360	400	H
3	* 612.485	30.37	Pk	19.2	-25.6	23.97	46.02	-22.05	0-360	200	H
4	* 38.245	46.86	Pk	11.9	-29.6	29.16	40	-10.84	0-360	300	V
5	66.375	41.41	Pk	10.8	-28.9	23.31	40	-16.69	0-360	100	V
6	79.955	41.35	Pk	7	-28.7	19.65	40	-20.35	0-360	100	V

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

Pk - Peak detector