



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-247 ISSUE 1**

Bluetooth

CERTIFICATION TEST REPORT

FOR

Bluetooth/BLE, DTS b/g/n WATCH

MODEL NUMBER : SM-R720

FCC ID: A3LSMR720

IC ID: 649E-SMR720

REPORT NUMBER: 15K21506-E3

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Prepared for
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Revision History

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--	08/25/15	Initial issue	SungGil Park

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: Bluetooth/BLE and DTS b/g/n WATCH
MODEL NUMBER: SM-R720
SERIAL NUMBER: 11075, 11085 (RADIATED); CF50031AE534941 (CONDUCTED)
DATE TESTED: AUG 07, 2015 - AUG 25, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

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

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

Approved & Released For
UL Korea, Ltd. By:



CY Choi
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UL Korea, Ltd.

Tested By:



SungGil Park
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UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, and KDB 558074 D01 v03r03, ANSI C63.10-2009 for FCC and ANSI C63.10-2013 for IC, RSS-GEN Issue 4, and RSS-247 Issue 1.

ANSI C63.10-2009 Deviation

Radiated spurious emission above 1GHz EUT height is 1.5m not 0.8m.

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, 443-823, 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 and DTS b/g/n WATCH.

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	13.19	20.84
		Peak	13.50	22.37
	Enhanced Pi/4-DPSK	Average	8.84	7.66
		Peak	11.25	13.34
	Enhanced 8PSK	Average	8.96	7.87
		Peak	11.71	14.83

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

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -5.78 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

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

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

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Adapter	SAMSUNG	ETA0U60JBE	DK1G725HS/7-E	N/A
Wireless Charger	SAMSUNG	EP-OR720	N/A	N/A
Data Cable	SAMSUNG	ECB-DU6ABE	N/A	N/A

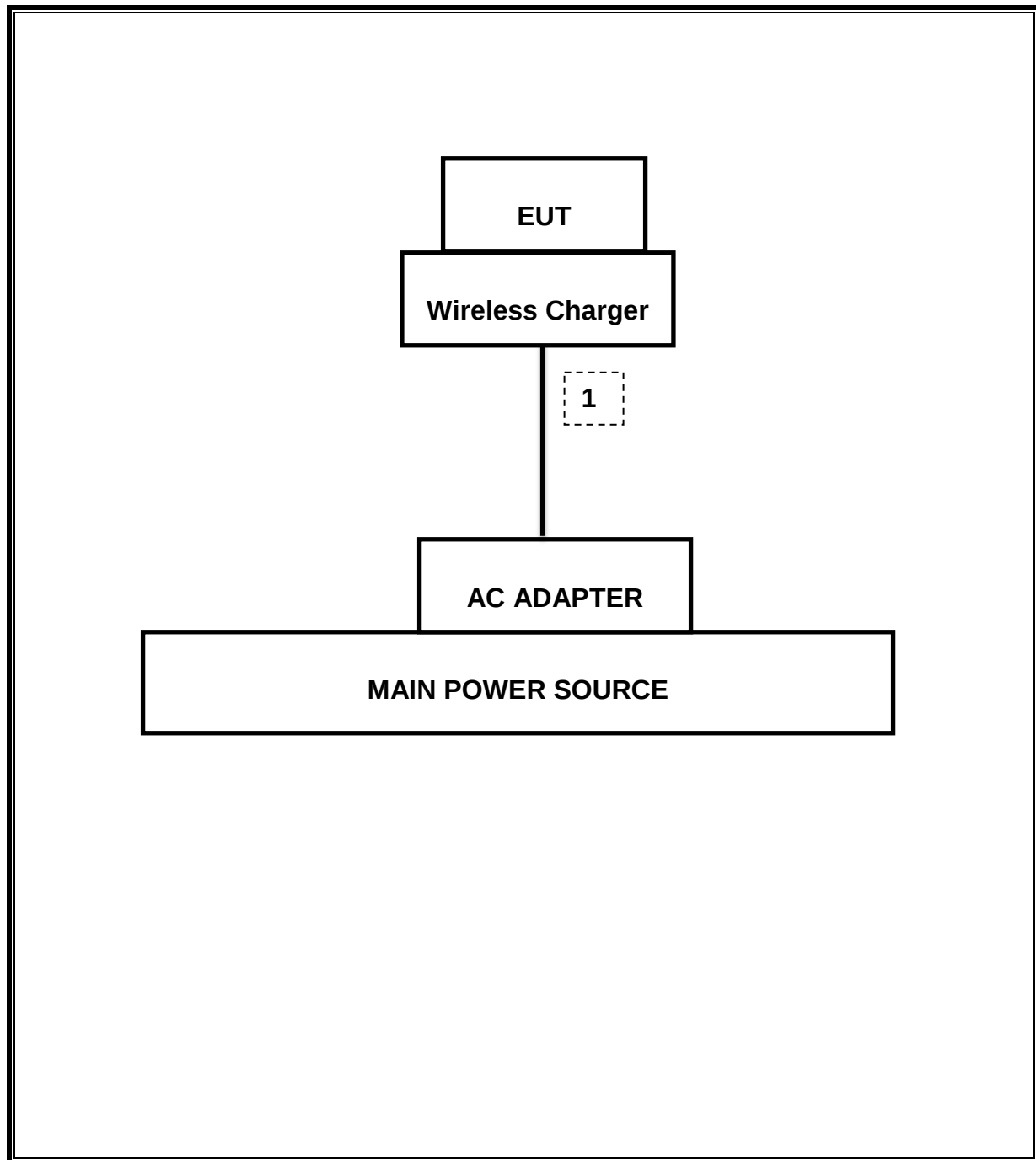
I/O CABLES

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

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.

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	11-17-15
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-16
Antenna, Horn, 18 GHz	ETS	3115	00167211	09-20-15
Antenna, Horn, 18 GHz	ETS	3115	00161451	05-17-16
Antenna, Horn, 18 GHz	ETS	3117	00168724	06-17-16
Antenna, Horn, 18 GHz	ETS	3117	00168717	06-17-16
Antenna, Horn, 40 GHz	ETS	3116C	00166255	09-23-15
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	09-29-15
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-18-16
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-18-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-19-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-19-16
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-18-16
Average Power Sensor	R&S	NRZ-Z91	102681	08-18-16
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-18-16
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-19-16
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-19-16
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-19-16
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	009	08-18-16
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	015	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	009	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	010	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	016	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	015	08-18-16
LISN	R&S	ENV-216	101836	08-19-16
LISN	R&S	ENV-216	101837	08-19-16
Combiner	WEINSCHEL	1575	2153	08-20-16

7. SUMMARY TABLE

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Worst Case
2.1049	RSS-GEN 6.6	Occupied Band width (99%)	N/A	Conducted	Pass	1.202 MHz
2.1051, 15.247 (d)	RSS-247 5.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-46.036 dBm
15.247 (b)(1)	RSS-247 5.4(1)	TX conducted output power	<21dBm		Pass	13.496 dBm (Peak)
15.247 (a)(1)	RSS-247 5.1 (1)	Hopping frequency separation	> 25KHz		Pass	1 MHz
15.247 (a)(1)(iii)	RSS-247 5.1(4)	Number of Hopping channels	More than 15 non-overlapping channels		Pass	79
15.247 (a)(1)(iii)	RSS-247 5.1(4)	Avg Time of Occupancy	< 0.4sec		Pass	0.345 sec
15.207 (a)	RSS-GEN 8.8	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	38.86 dBuV (QP)
15.205, 15.209	RSS-GEN 8.9	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	39.36 dBuV/m (AV)

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

RESULTS

8.1.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.027	0.902
Mid	2441	1.054	0.968
High	2480	1.026	0.904
Worst		1.054	0.968

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

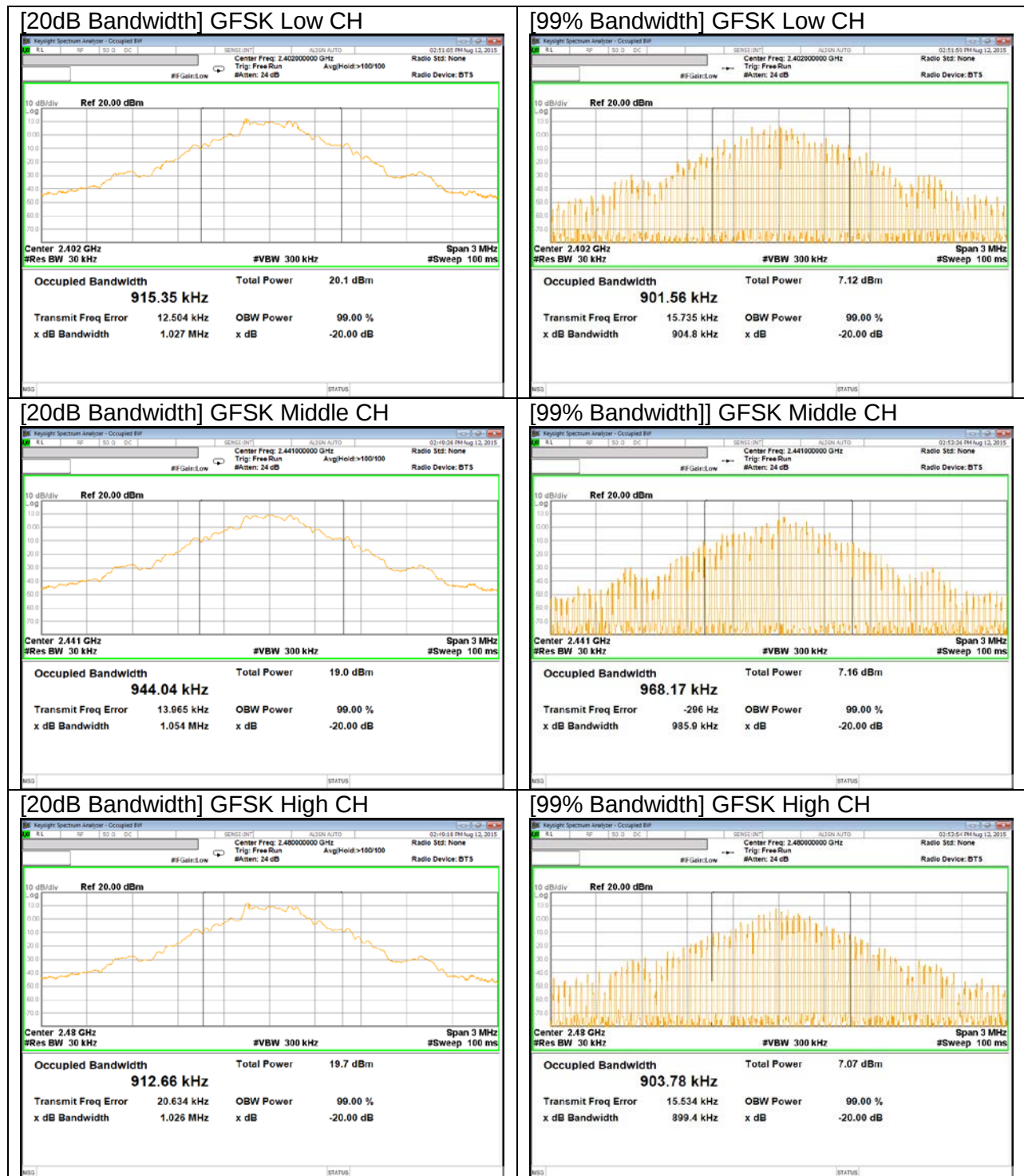
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.358	1.202
Mid	2441	1.359	1.201
High	2480	1.358	1.199
Worst		1.359	1.202

8.1.3. ENHANCED DATA RATE 8PSK MODULATION

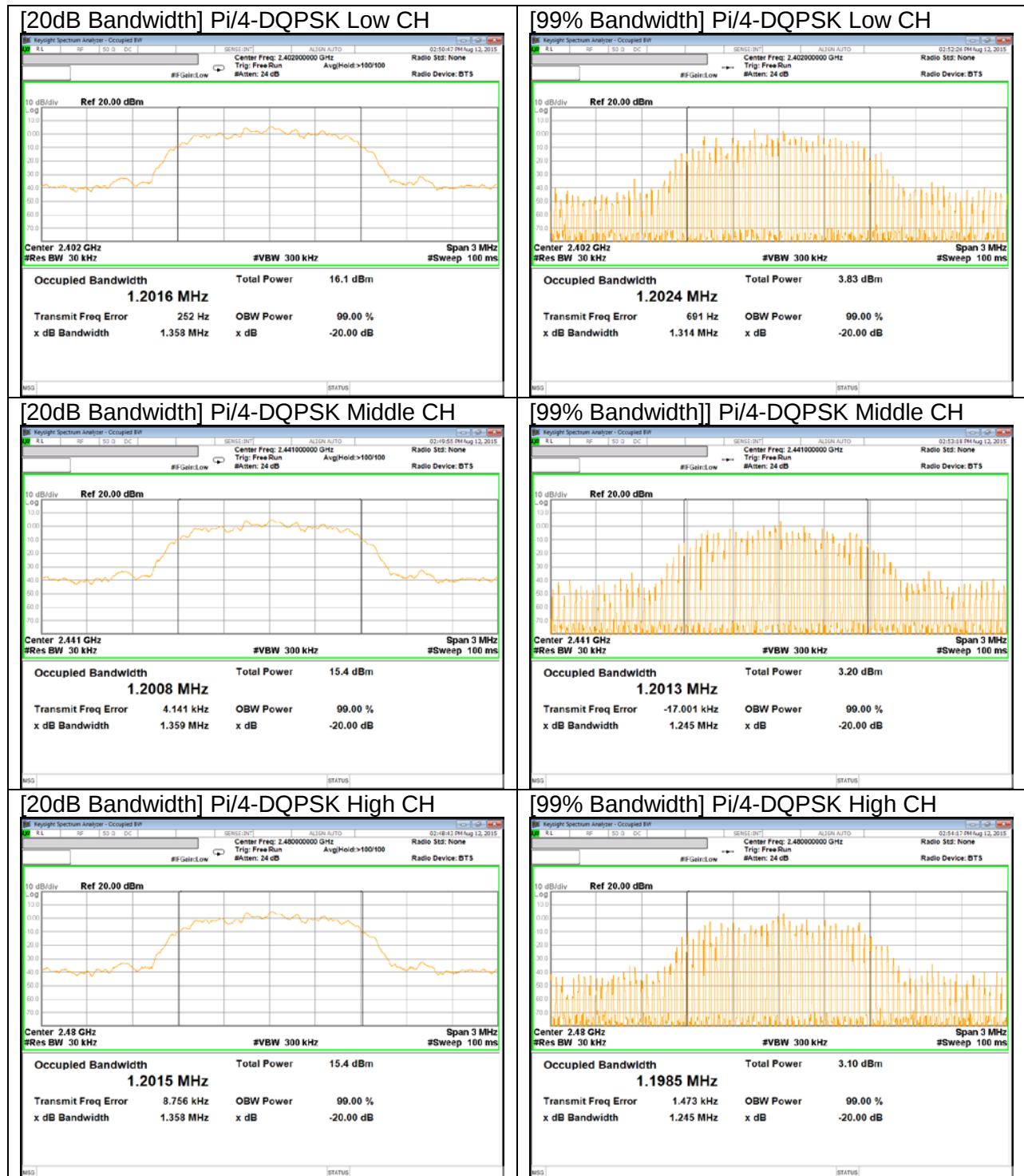
Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]
Low	2402	1.320	1.200
Mid	2441	1.318	1.197
High	2480	1.319	1.194
Worst		1.320	1.200

8.1.4. 20 dB AND 99% BANDWIDTH PLOTS

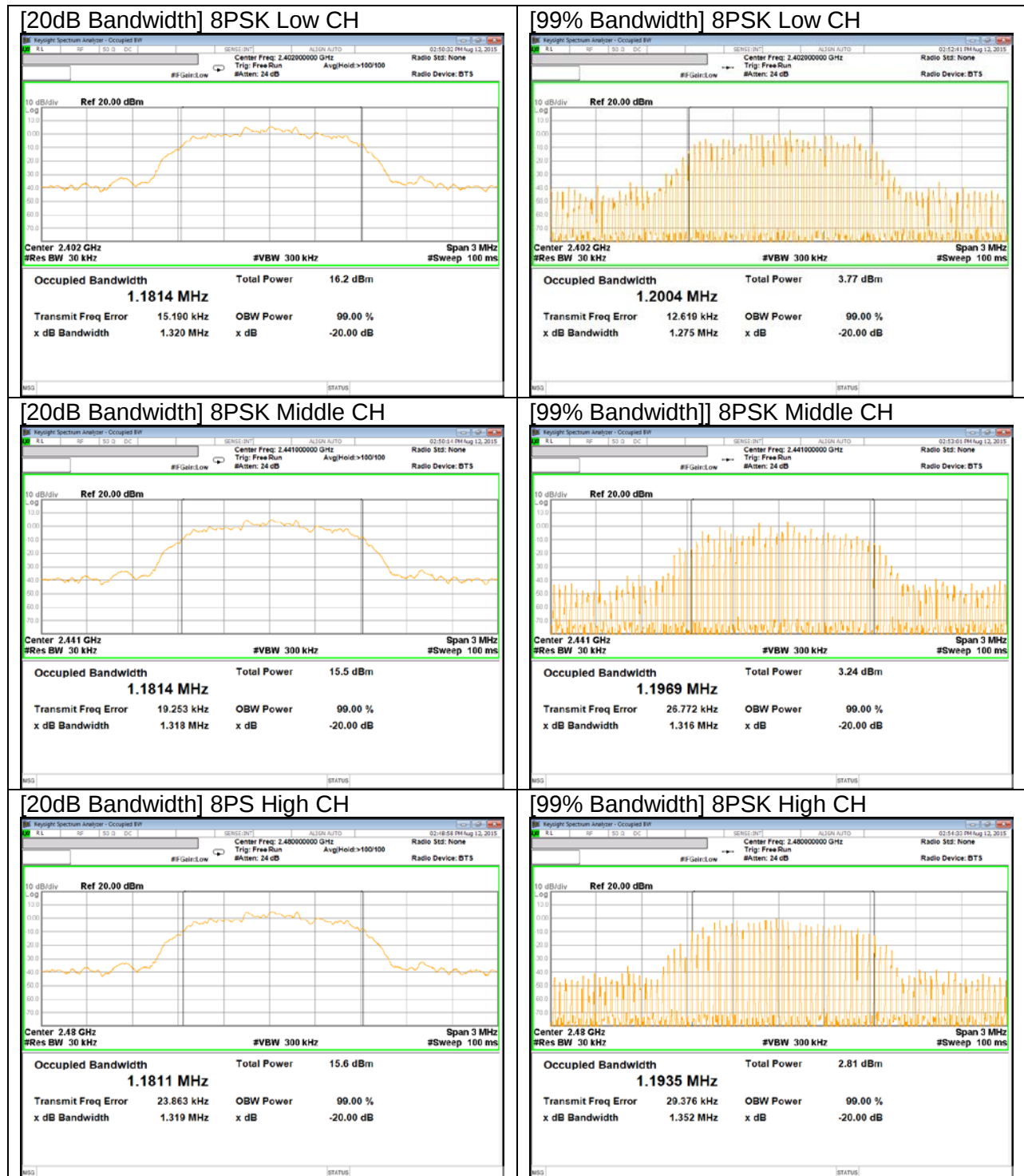
GFSK BANDWIDTH



Pi/4-DQPSK BANDWIDTH



8PSK BANDWIDTH



8.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)
IC RSS-247 5.1(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.

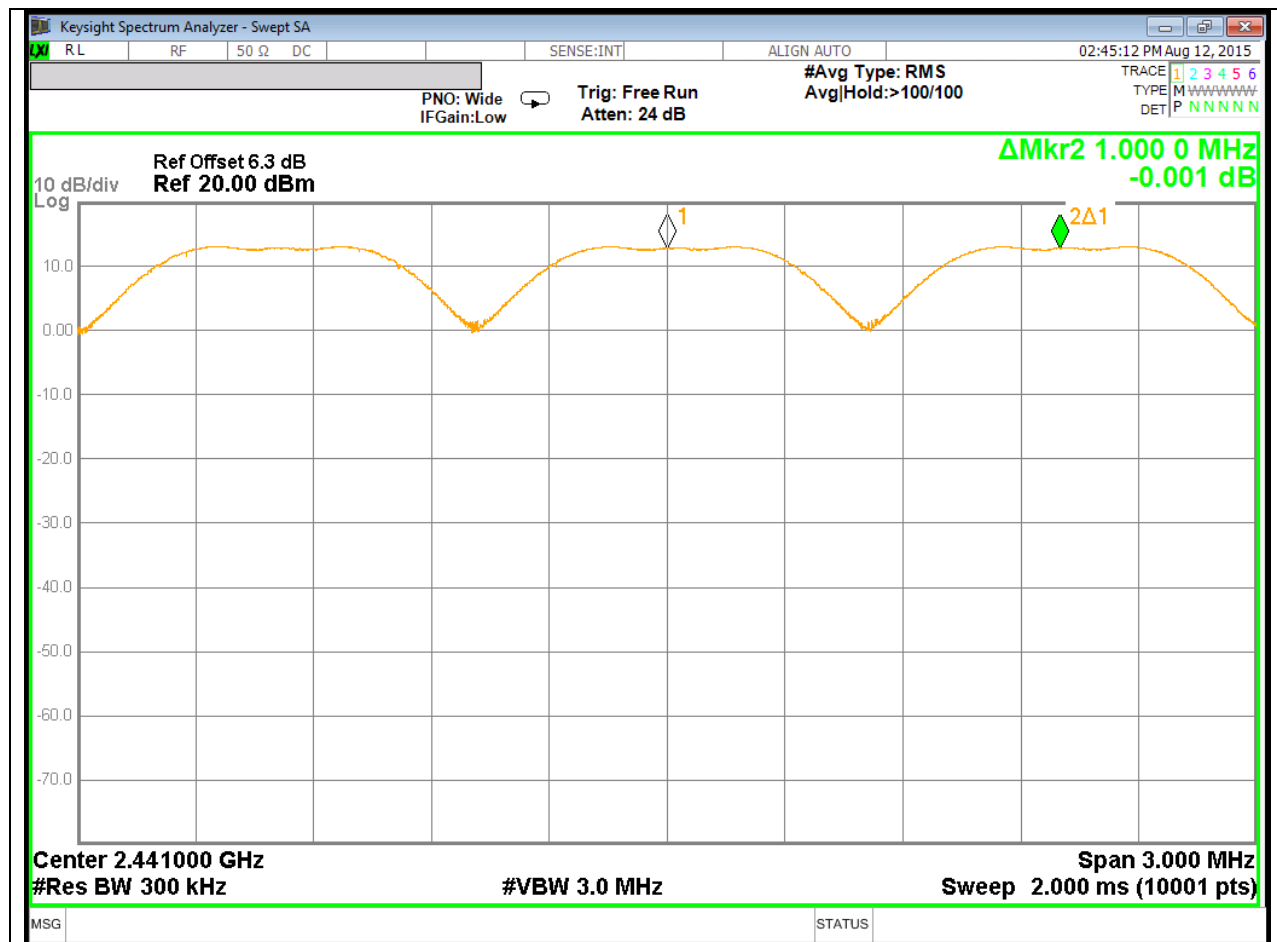
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



8.3. NUMBER OF HOPPING CHANNELS

LIMIT

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

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

TEST PROCEDURE

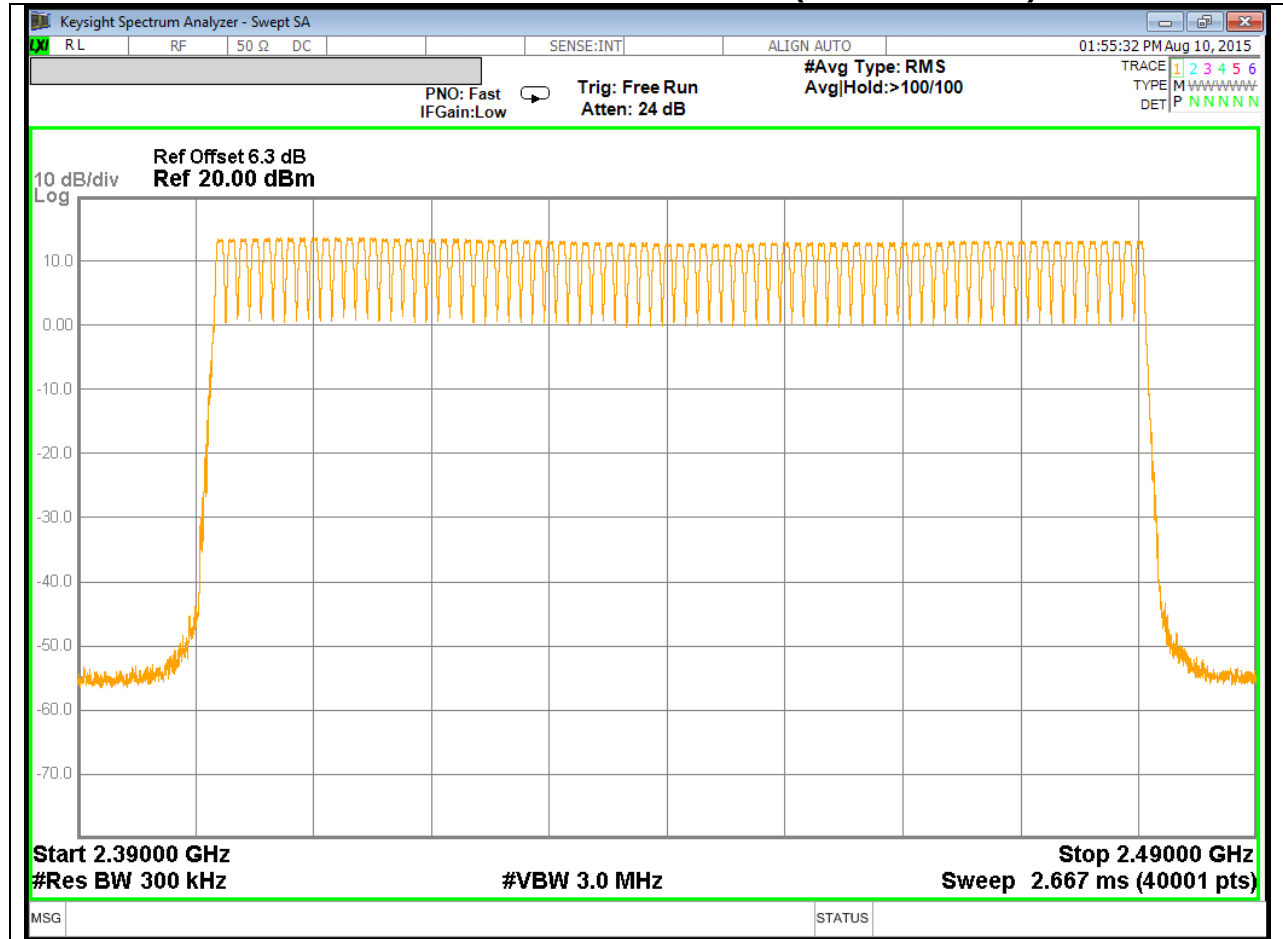
DA 00-705: The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

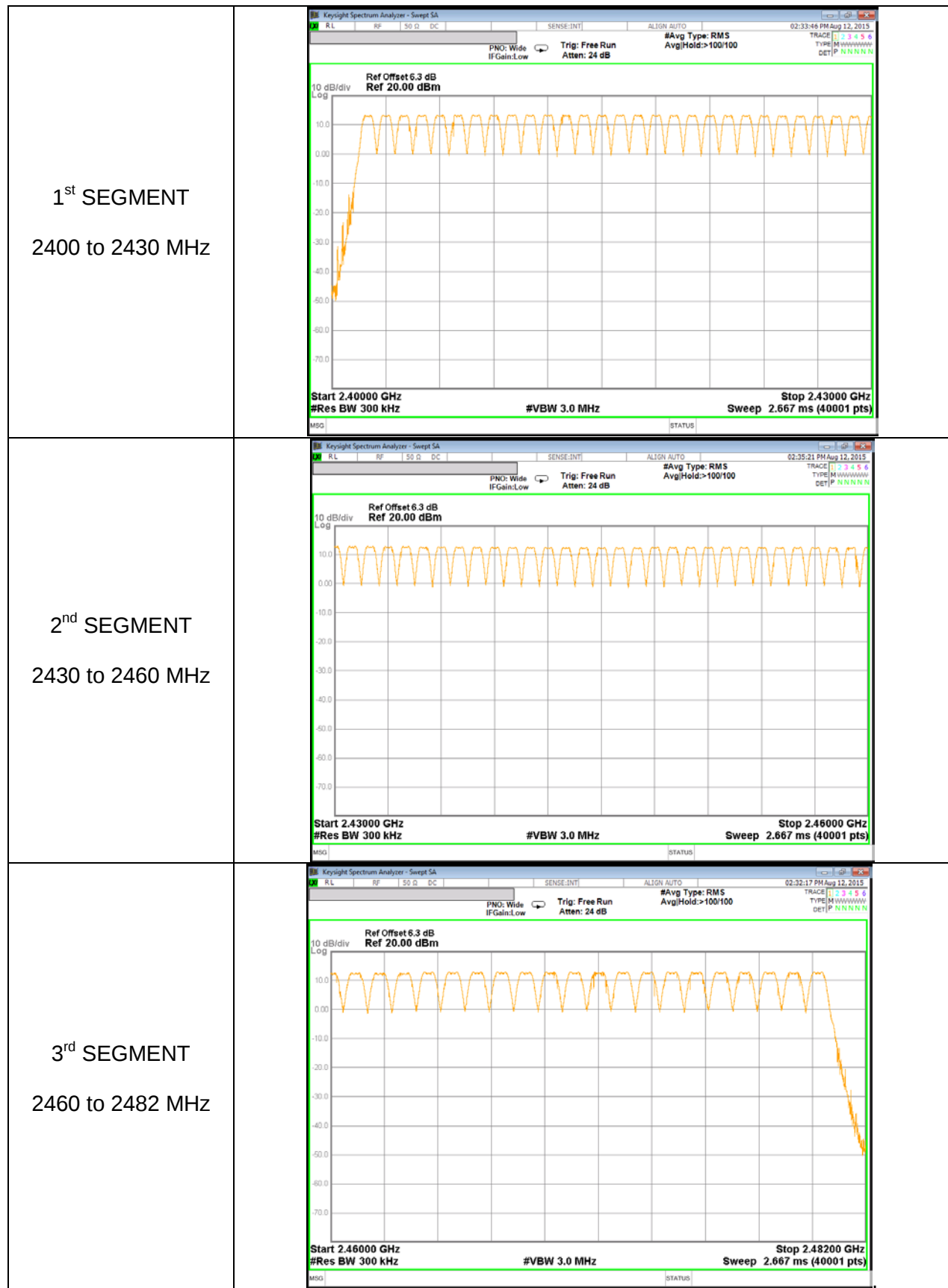
RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS PLOTS

NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)





8.4. AVERAGE TIME OF OCCUPANCY

LIMIT

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

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.

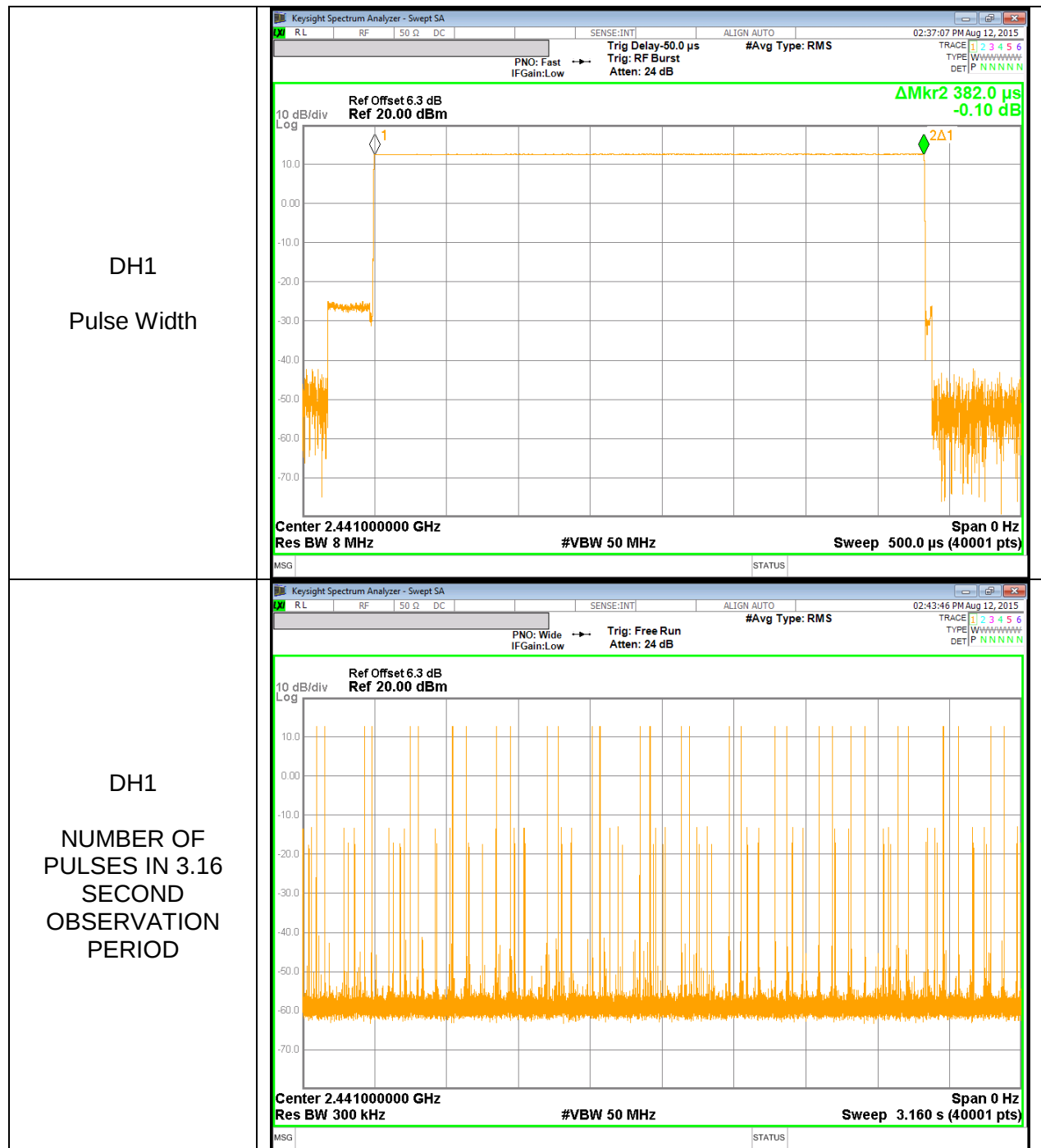
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

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

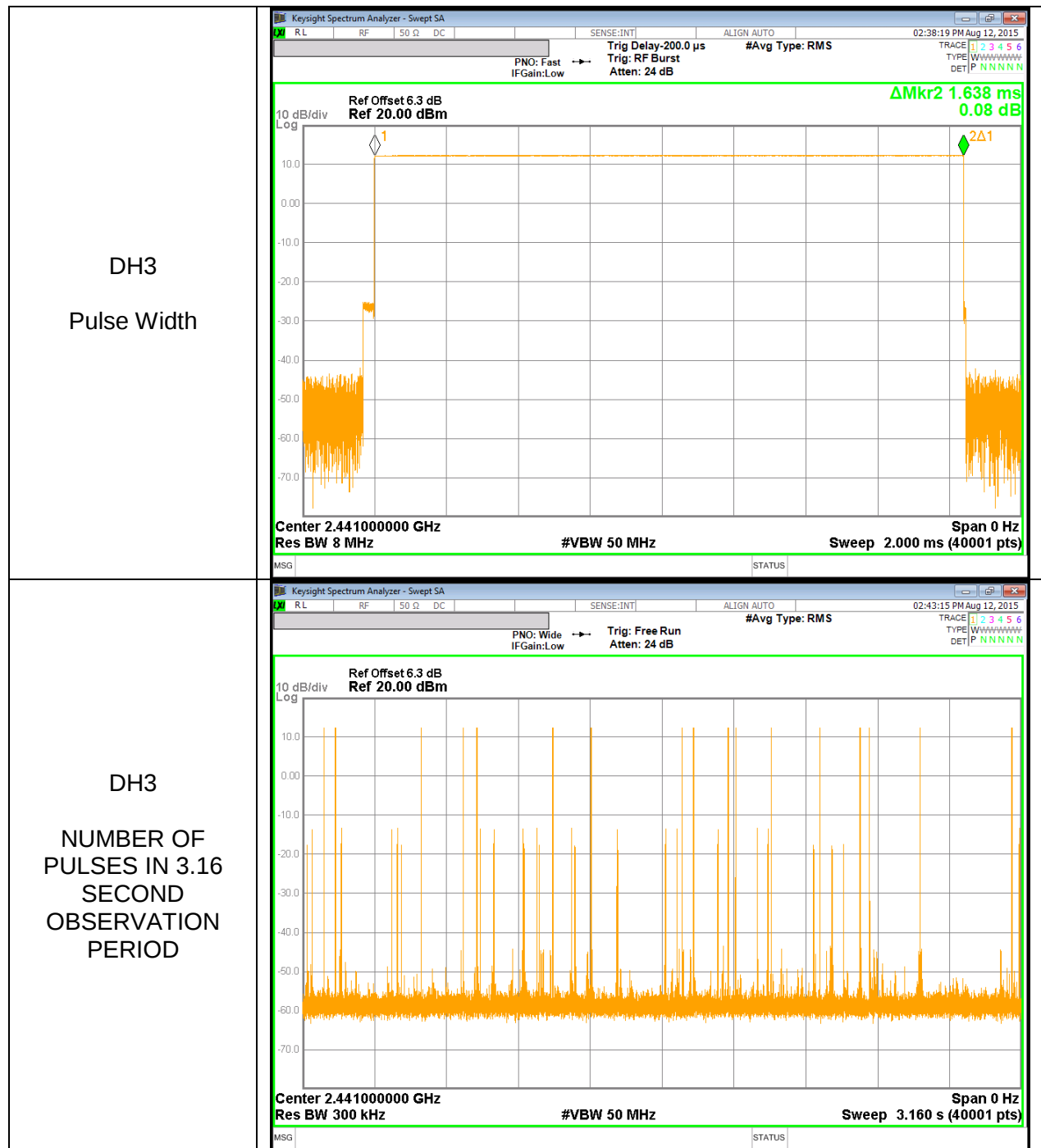
RESULTS

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	0.122240	0.4	-0.2778
DH3	1.638	17	0.278460	0.4	-0.1215
DH5	2.882	12	0.345840	0.4	-0.0542
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	0.382	8	0.030560	0.4	-0.36944
DH3	1.638	4.25	0.069615	0.4	-0.33039
DH5	2.882	3	0.086460	0.4	-0.31354

DH1



DH3



DH5

Pulse Width

Ref Offset 6.3 dB
Ref 20.00 dBm

10 dB/div
Log

Center 2.441000000 GHz
Res BW 8 MHz

#VBW 50 MHz

Sweep 3.500 ms (40001 pts)

Span 0 Hz

MSG STATUS

KeySight Spectrum Analyzer - Swept SA

RL RF 50 Ω DC

SENSE:INT

ALIGN AUTO

02:39:08 PM Aug 12, 2015

PNO: Fast IFGain:Low

Trig Delay-300.0 μ s

Trig: RF Burst

Atten: 24 dB

#Avg Type: RMS

TRACE 1 2 3 4 5 6

TYPE: W W W W W W W W

DET: P N N N N N

Δ Mkr2 2.882 ms

0.14 dB

2 Δ 1

DH5

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

Ref Offset 6.3 dB
Ref 20.00 dBm

10 dB/div
Log

Center 2.441000000 GHz
Res BW 300 kHz

#VBW 50 MHz

Sweep 3.160 s (40001 pts)

Span 0 Hz

MSG STATUS

KeySight Spectrum Analyzer - Swept SA

RL RF 50 Ω DC

SENSE:INT

ALIGN AUTO

02:42:44 PM Aug 12, 2015

PNO: Wide IFGain:Low

Trig: Free Run

Atten: 24 dB

#Avg Type: RMS

TRACE 1 2 3 4 5 6

TYPE: W W W W W W W W

DET: P N N N N N

8.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)
RSS-247 5.4(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	13.496	21	-7.504
Middle	2441	12.799	21	-8.201
High	2480	13.201	21	-7.799
Worst		13.496	21	-7.504

8.5.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

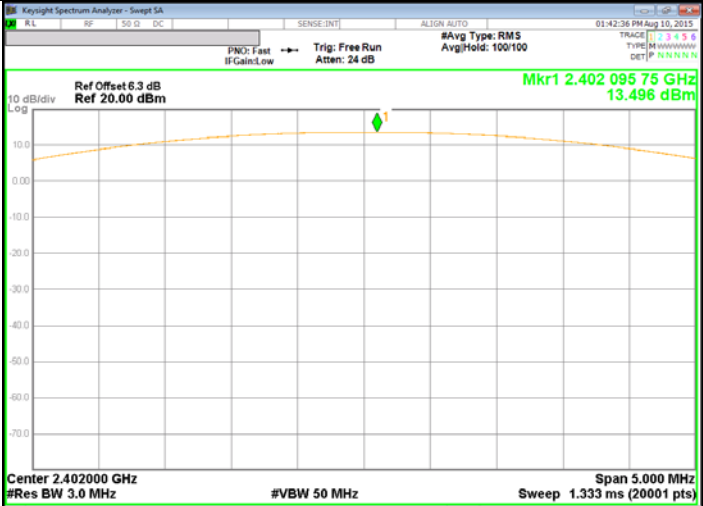
Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	11.253	21	-9.747
Middle	2441	10.949	21	-10.051
High	2480	11.011	21	-9.989
Worst		11.253	21	-9.747

8.5.3. ENHANCED DATA RATE 8PSK MODULATION

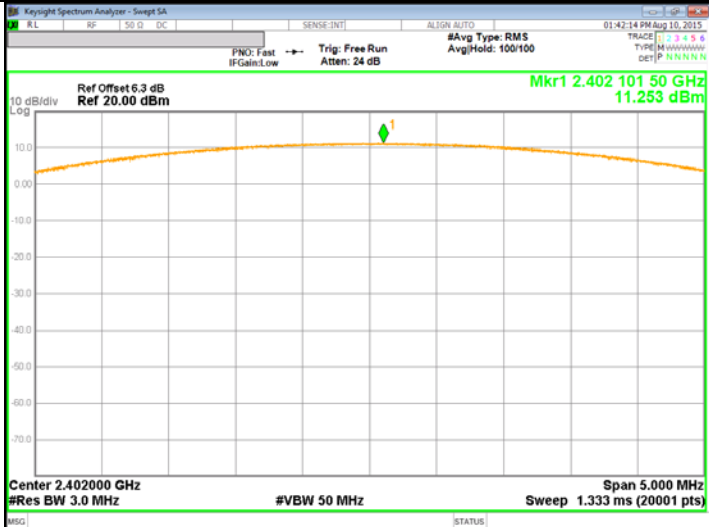
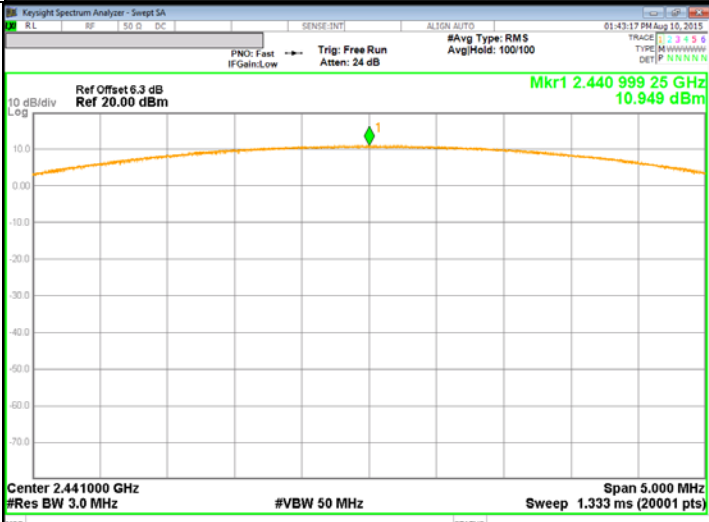
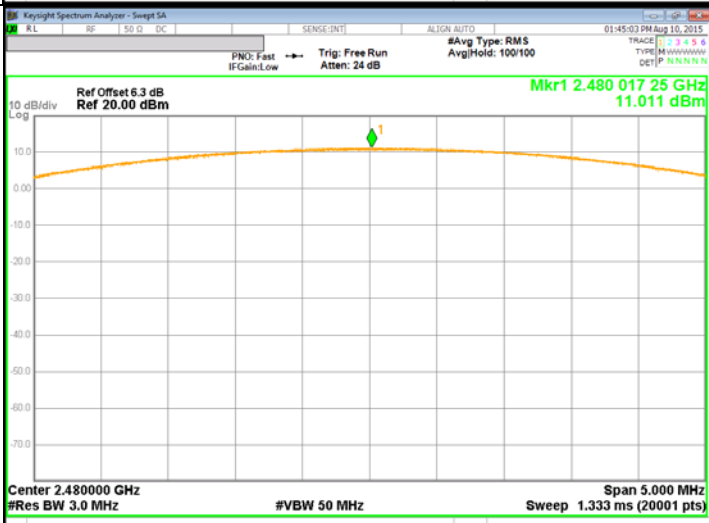
Channel	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Margin [dB]
Low	2402	11.712	21	-9.288
Middle	2441	11.417	21	-9.583
High	2480	11.461	21	-9.539
Worst		11.712	21	-9.288

8.5.4. OUTPUT POWER PLOTS

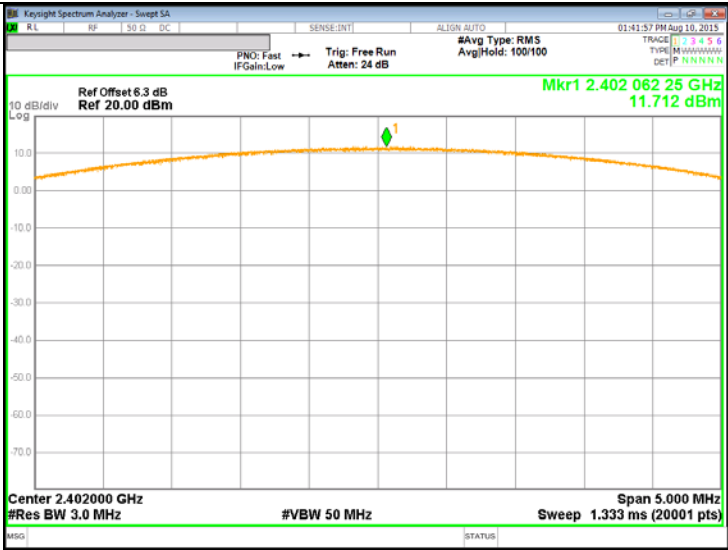
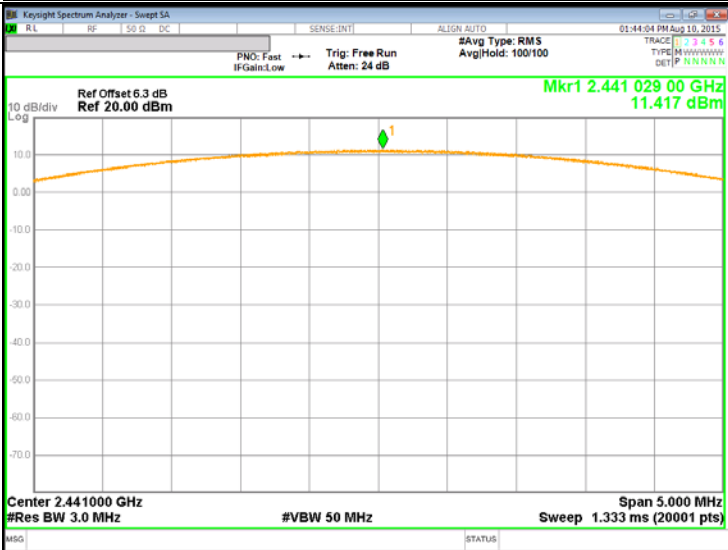
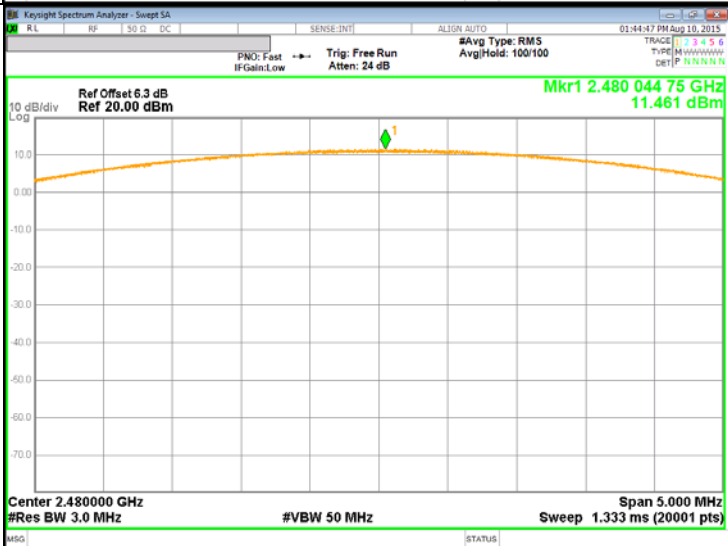
GFSK OUTPUT POWER

GFSK Low CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC SENSE:INT ALIGN: AUTO 01:42:36 PM Aug 10, 2015 PN0: Fast IF Gain: Low Trig: Free Run Atten: 24 dB #Avg Type: RMS Avg/Hold: 100/100 Ref Offset 6.3 dB Ref 20.00 dBm Mkr1 2.402 095 75 GHz 13.496 dBm Center 2.402000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 5.000 MHz Sweep 1.333 ms (20001 pts) 10 dB/div Log
GFSK Middle CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC SENSE:INT ALIGN: AUTO 01:42:38 PM Aug 10, 2015 PN0: Fast IF Gain: Low Trig: Free Run Atten: 24 dB #Avg Type: RMS Avg/Hold: 100/100 Ref Offset 6.3 dB Ref 20.00 dBm Mkr1 2.441 051 50 GHz 12.799 dBm Center 2.441000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 5.000 MHz Sweep 1.333 ms (20001 pts) 10 dB/div Log
GFSK High CH	 KeySight Spectrum Analyzer - Swept SA RL RF 50 Ω DC SENSE:INT ALIGN: AUTO 01:45:23 PM Aug 10, 2015 PN0: Fast IF Gain: Low Trig: Free Run Atten: 24 dB #Avg Type: RMS Avg/Hold: 100/100 Ref Offset 6.3 dB Ref 20.00 dBm Mkr1 2.480 029 50 GHz 13.201 dBm Center 2.480000 GHz #Res BW 3.0 MHz #VBW 50 MHz Span 5.000 MHz Sweep 1.333 ms (20001 pts) 10 dB/div Log

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	
8PSK Middle CH	
8PSK High CH	

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	13.19	20.86
Middle	2441	12.53	17.92
High	2480	12.94	19.67

8.6.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	8.84	7.66
Middle	2441	8.56	7.17
High	2480	8.59	7.23

8.6.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency [MHz]	AV power [dBm]	AV power [mW]
Low	2402	8.96	7.87
Middle	2441	8.66	7.35
High	2480	8.72	7.44

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)
IC RSS-247 5.5

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.

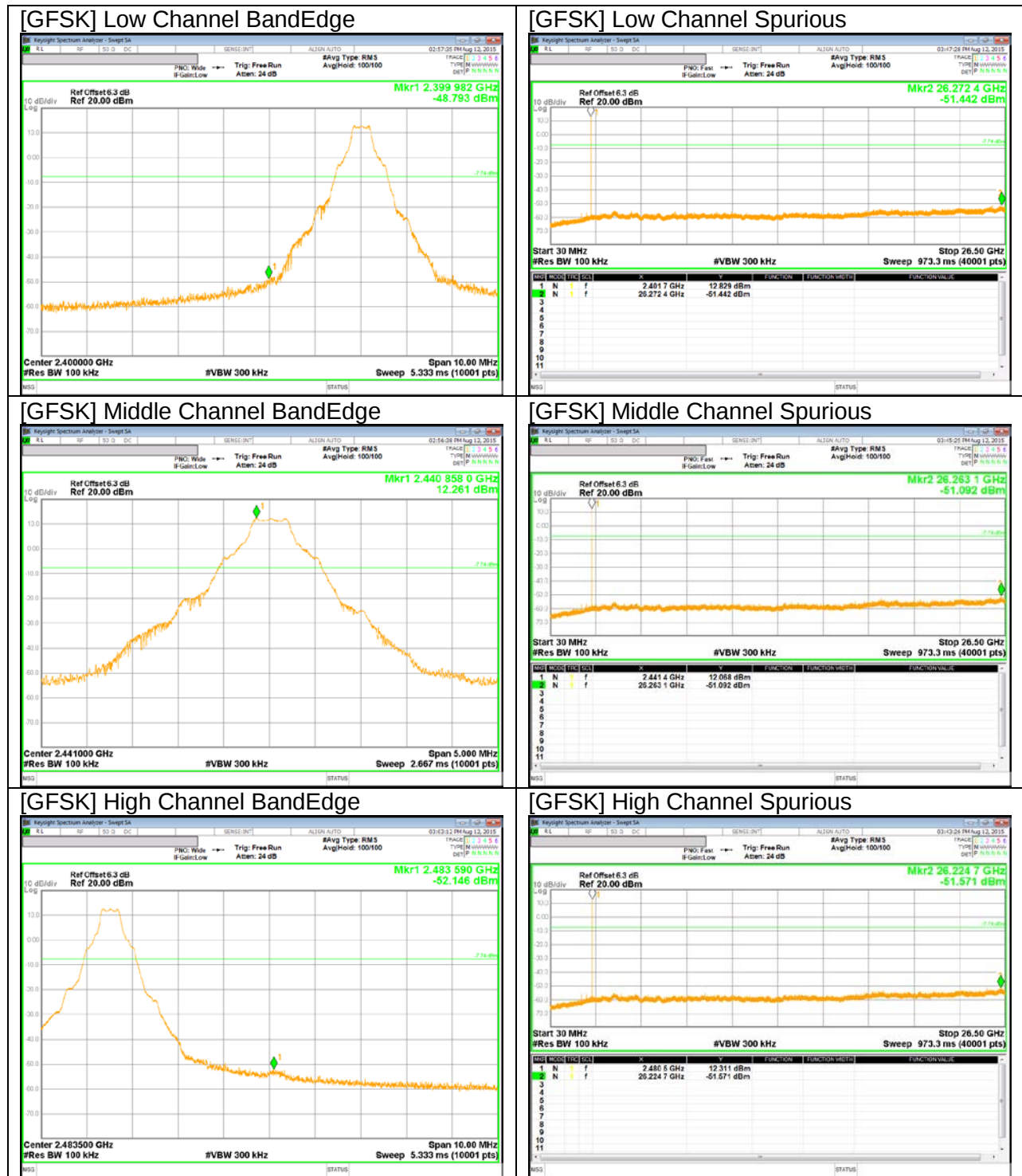
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

RESULTS

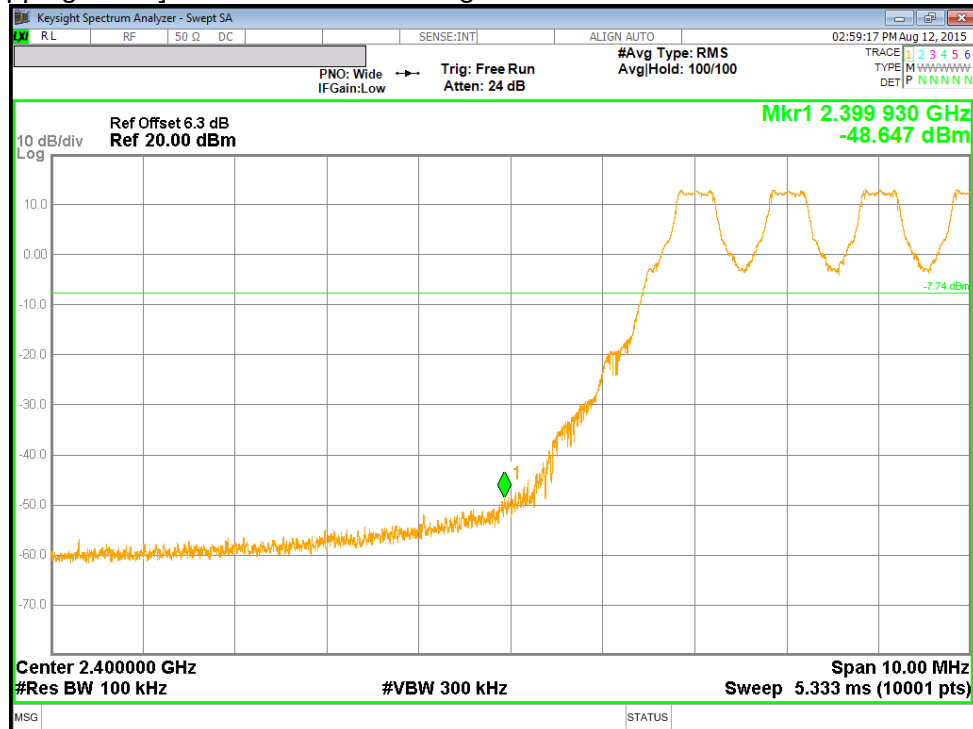
8.7.1. BASIC DATA RATE GFSK MODULATION

GFSK Mode

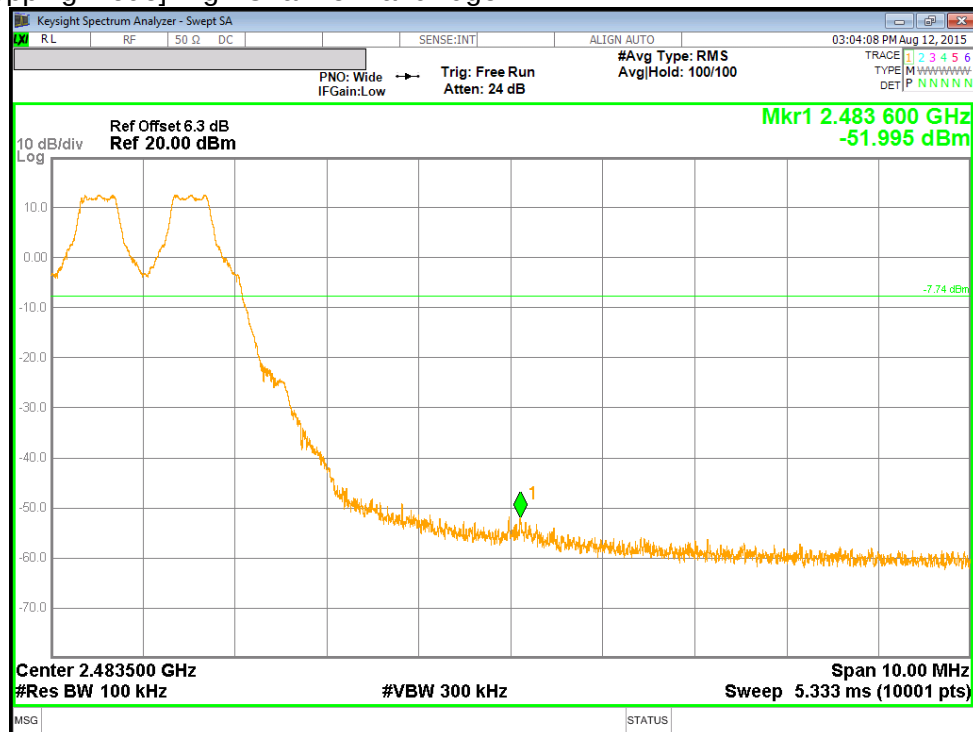


BandEdge Emission at GFSK Hopping Mode

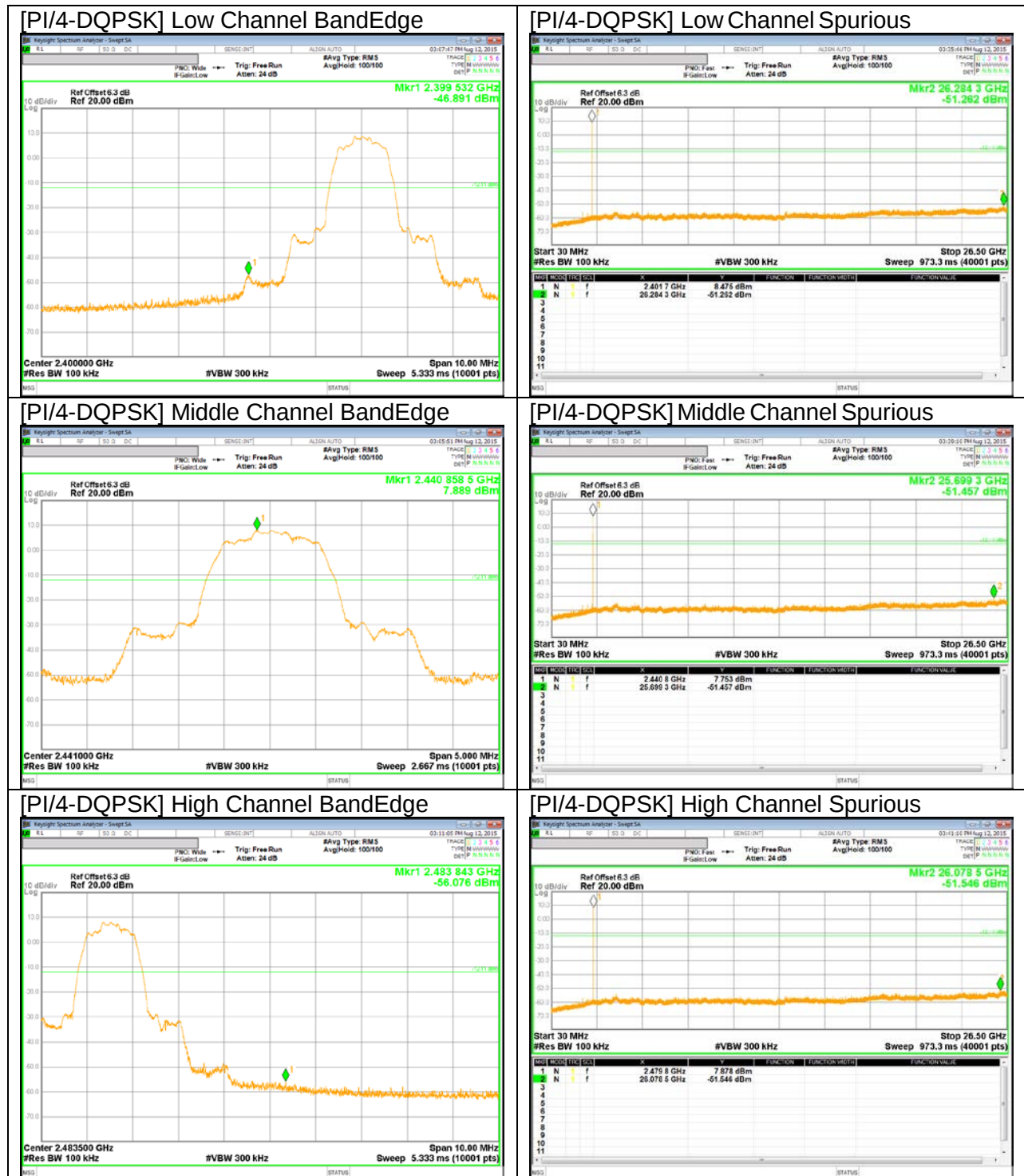
[GFSK Hopping Mode] Low Channel BandEdge



[GFSK Hopping Mode] High Channel BandEdge

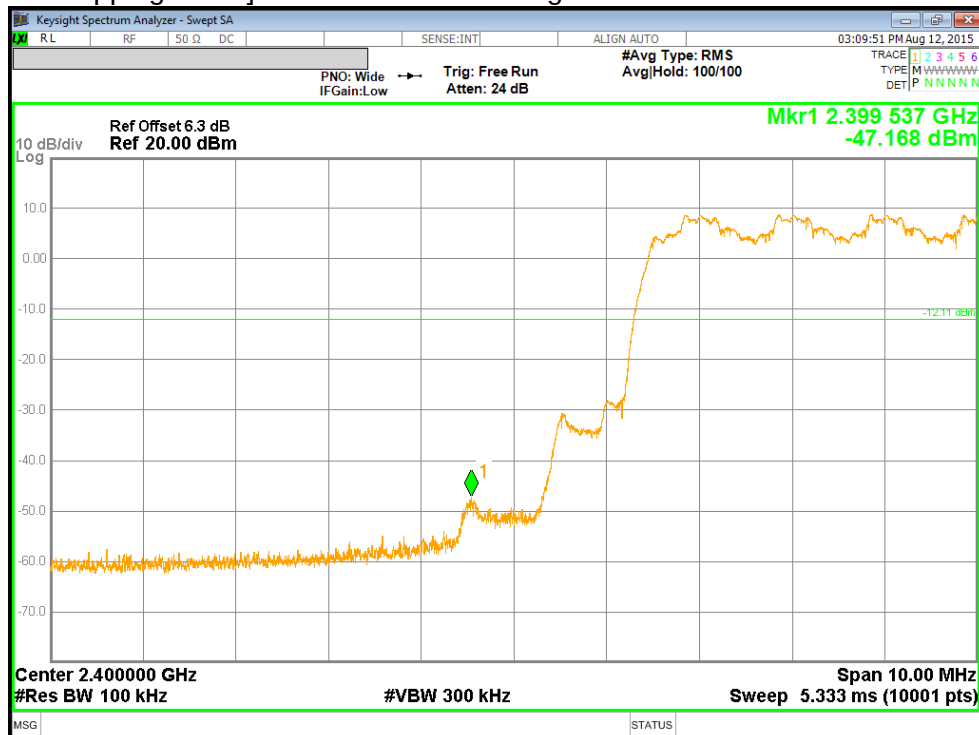


PI/4-DQPSK Mode

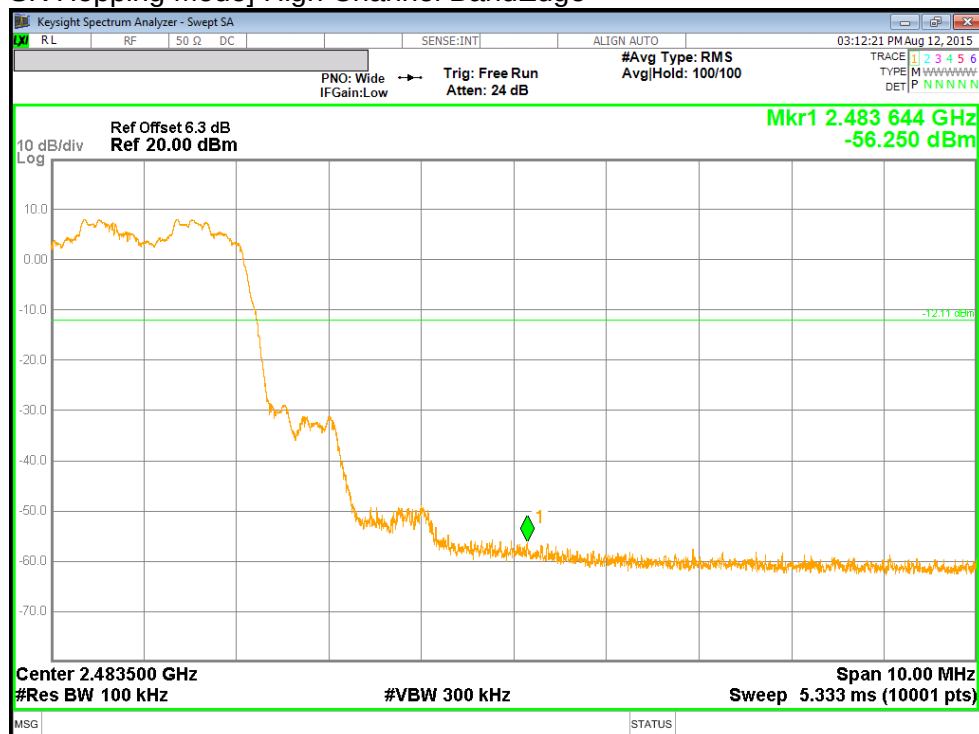


BandEdge Emission at PI/4-DQPSK Hopping Mode

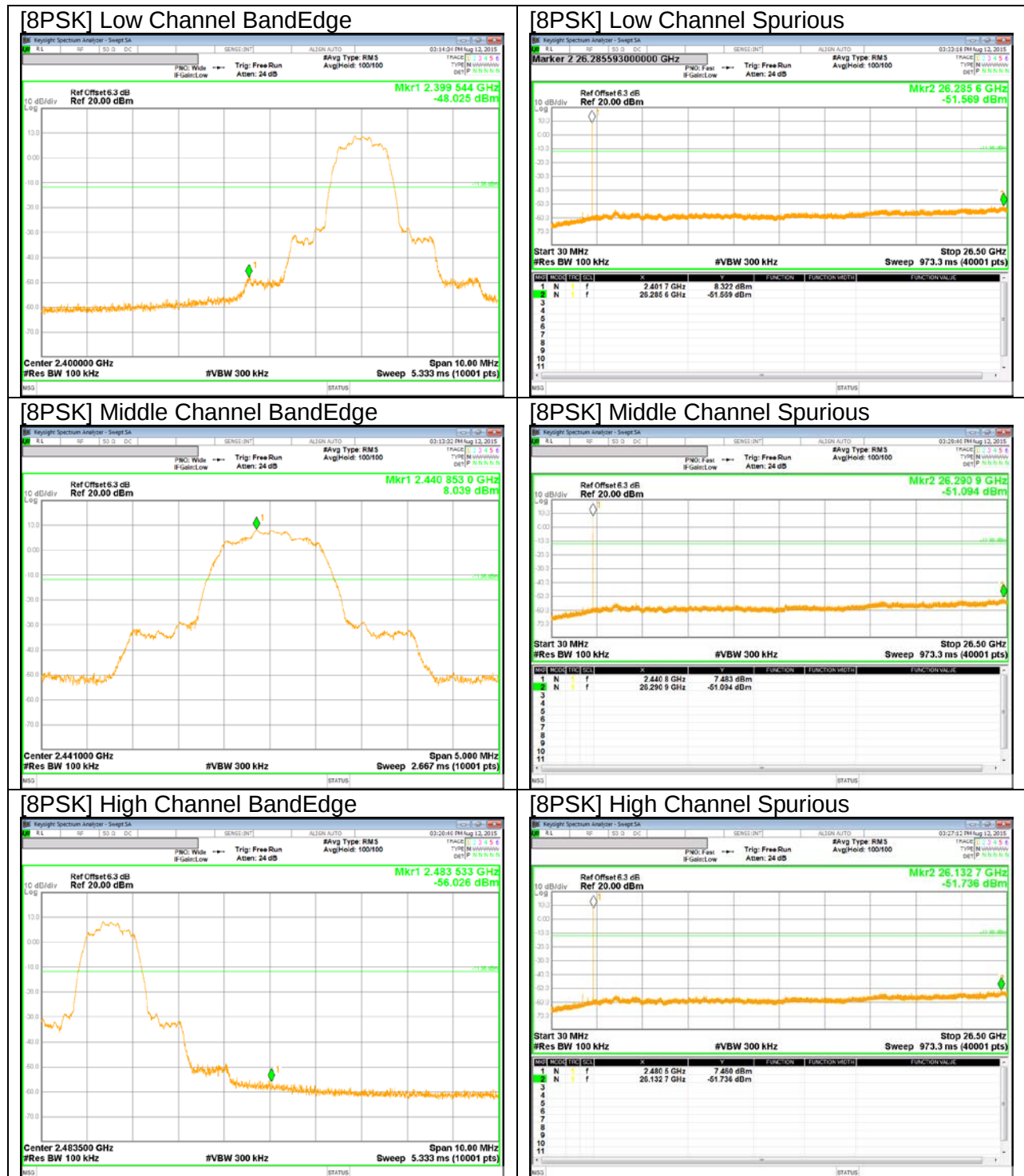
[PI/4-DQPSK Hopping Mode] Low Channel BandEdge



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

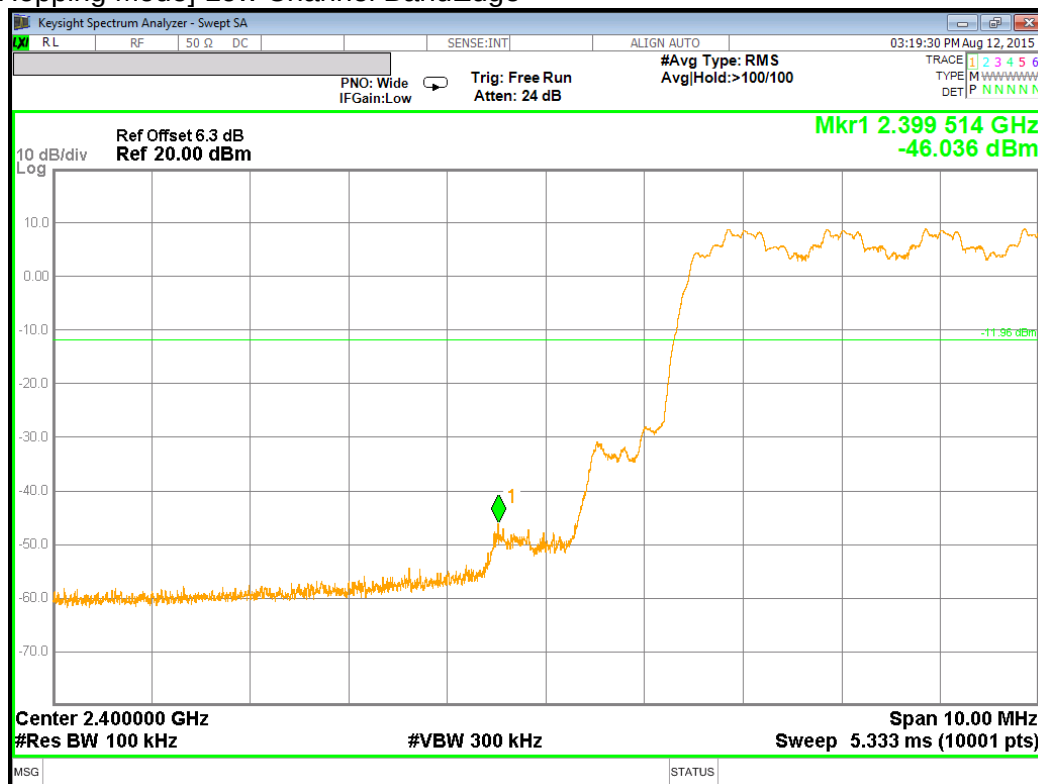


8PSK Mode

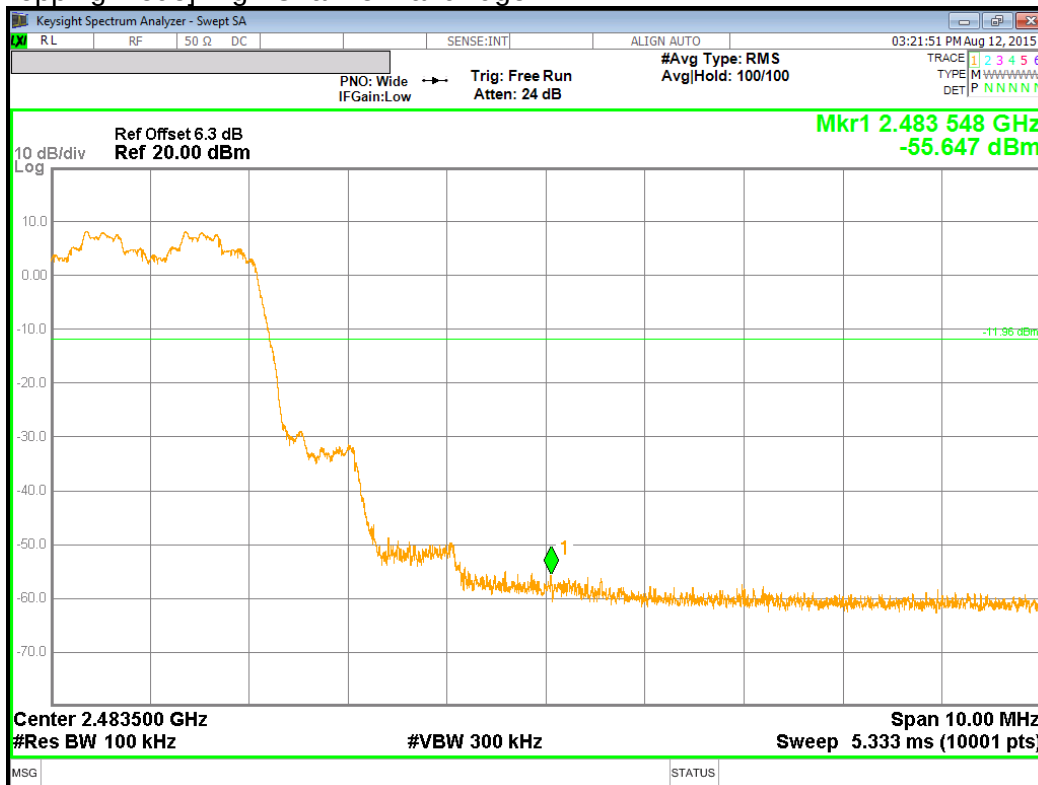


BandEdge Emission at 8PSK Hopping Mode

[8PSK Hopping Mode] Low Channel BandEdge



[8PSK Hopping Mode] High Channel BandEdge



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
IC RSS-GEN Clause 8.9 (Transmitter)
IC RSS-GEN Clause 7 (Receiver)

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

TEST PROCEDURE

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

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

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

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

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.

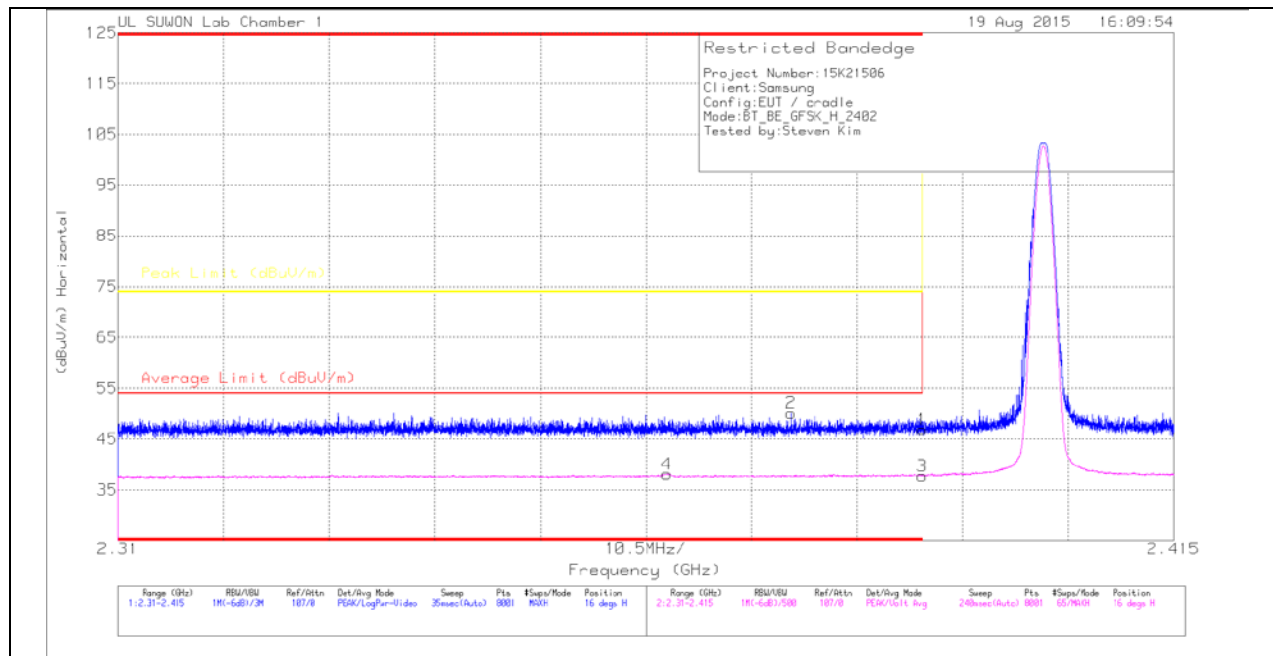
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

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

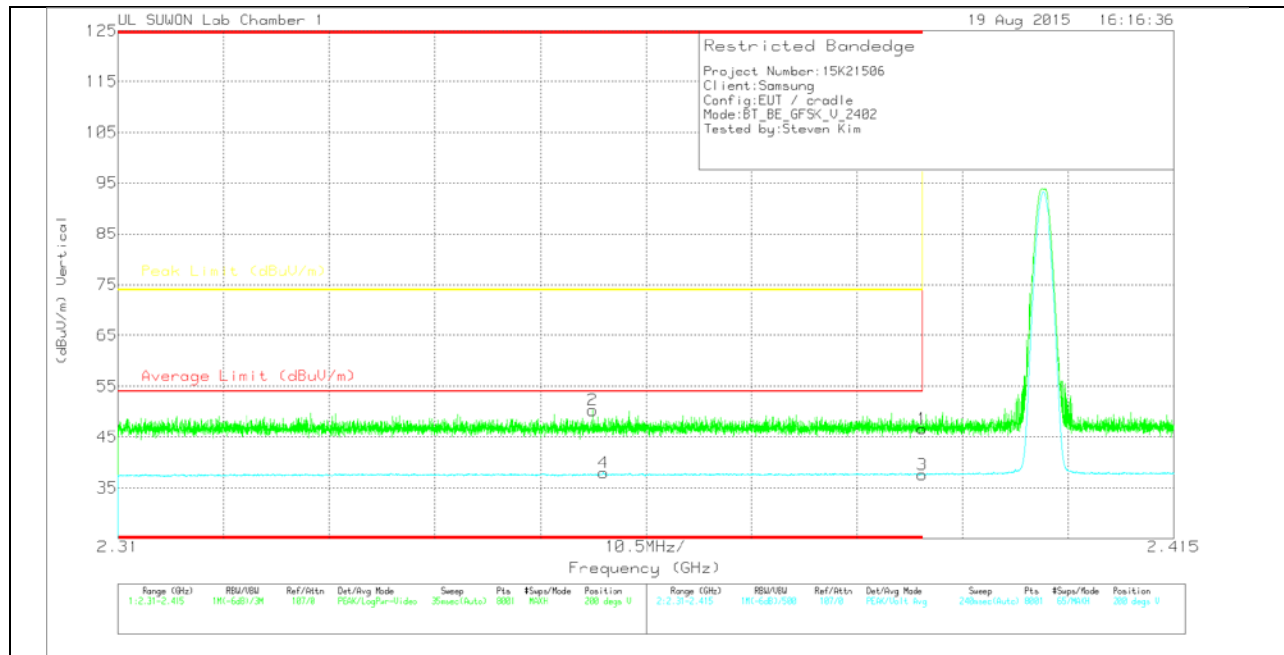
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	37.83	Pk	31.8	-22.8	46.83	-	-	74	-27.17	16	100	H
2	* 2.377	41.14	Pk	31.8	-22.8	50.14	-	-	74	-23.86	16	100	H
3	* 2.39	28.7	V1TV	31.8	-22.8	37.7	54	-16.3	-	-	16	100	H
4	* 2.365	29.09	V1TV	31.8	-22.8	38.09	54	-15.91	-	-	16	100	H

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

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

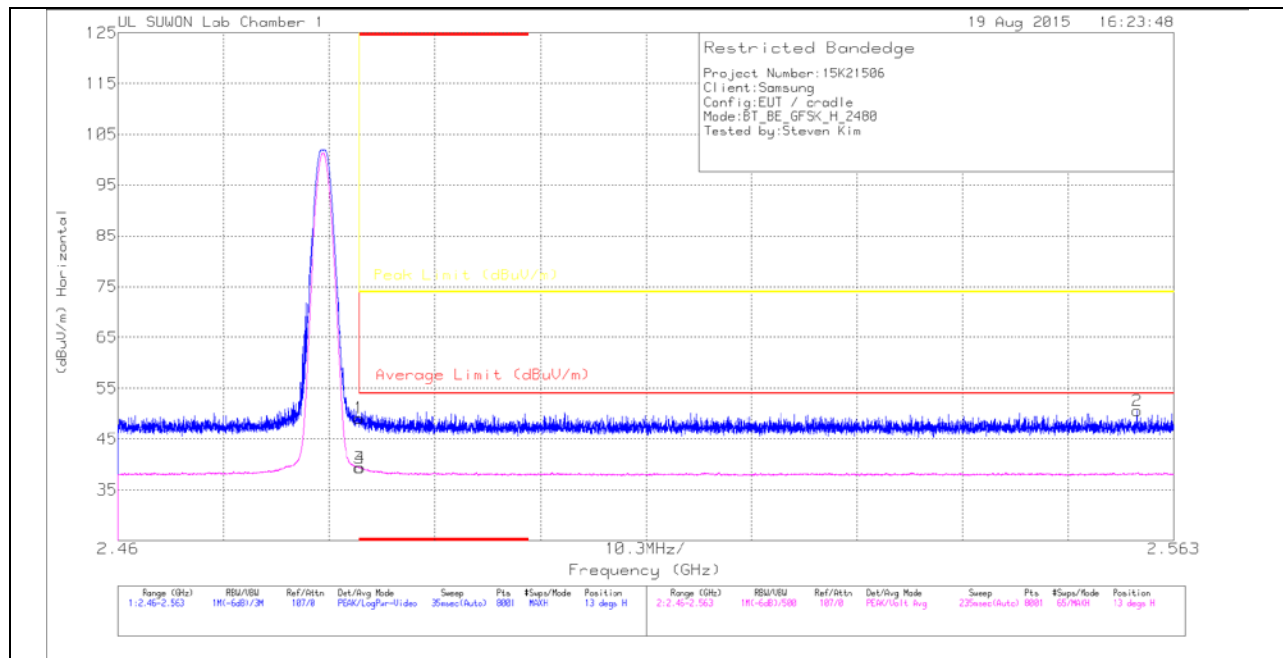
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	37.61	Pk	31.8	-22.8	46.61	-	-	74	-27.39	200	151	V
2	* 2.357	41.37	Pk	31.7	-22.8	50.27	-	-	74	-23.73	200	151	V
3	* 2.39	28.64	V1TV	31.8	-22.8	37.64	54	-16.36	-	-	200	151	V
4	* 2.358	29.11	V1TV	31.7	-22.8	38.01	54	-15.99	-	-	200	151	V

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

Pk - Peak detector

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

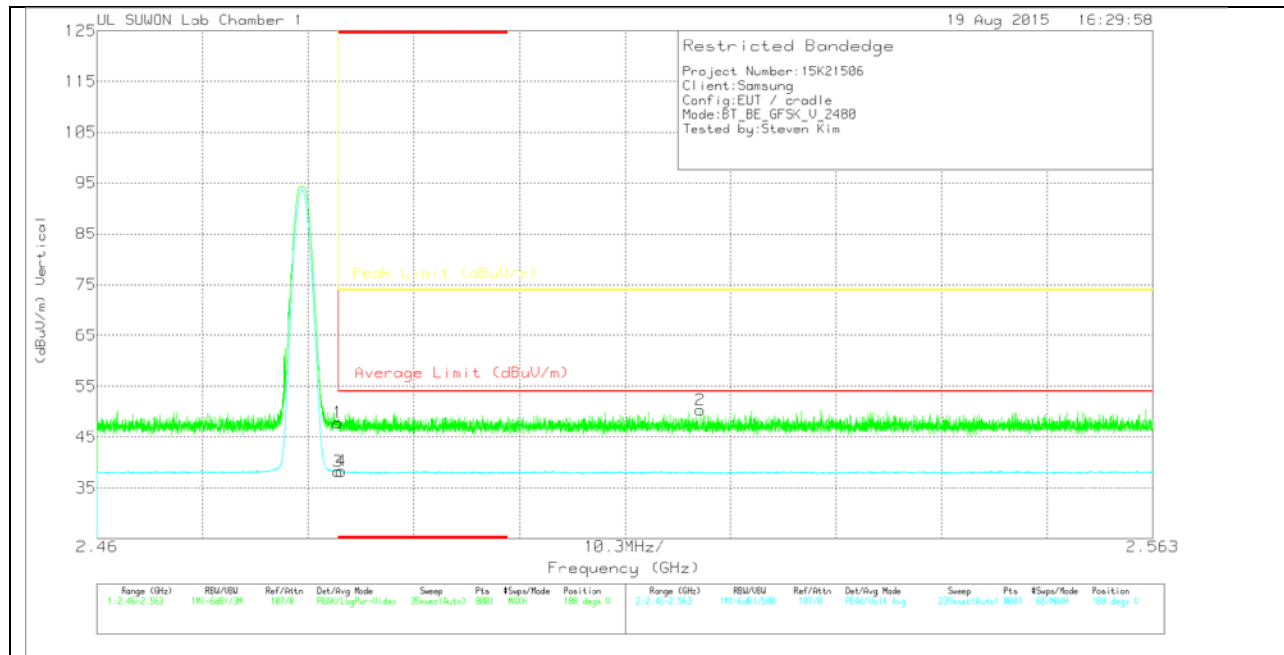
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	39.7	Pk	32	-22.6	49.1	-	-	74	-24.9	13	100	H
2	2.559	41.21	Pk	32	-22.6	50.61	-	-	74	-23.39	13	100	H
3	* 2.484	29.91	V1TV	32	-22.6	39.31	54	-14.69	-	-	13	100	H
4	* 2.484	29.96	V1TV	32	-22.6	39.36	54	-14.64	-	-	13	100	H

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

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

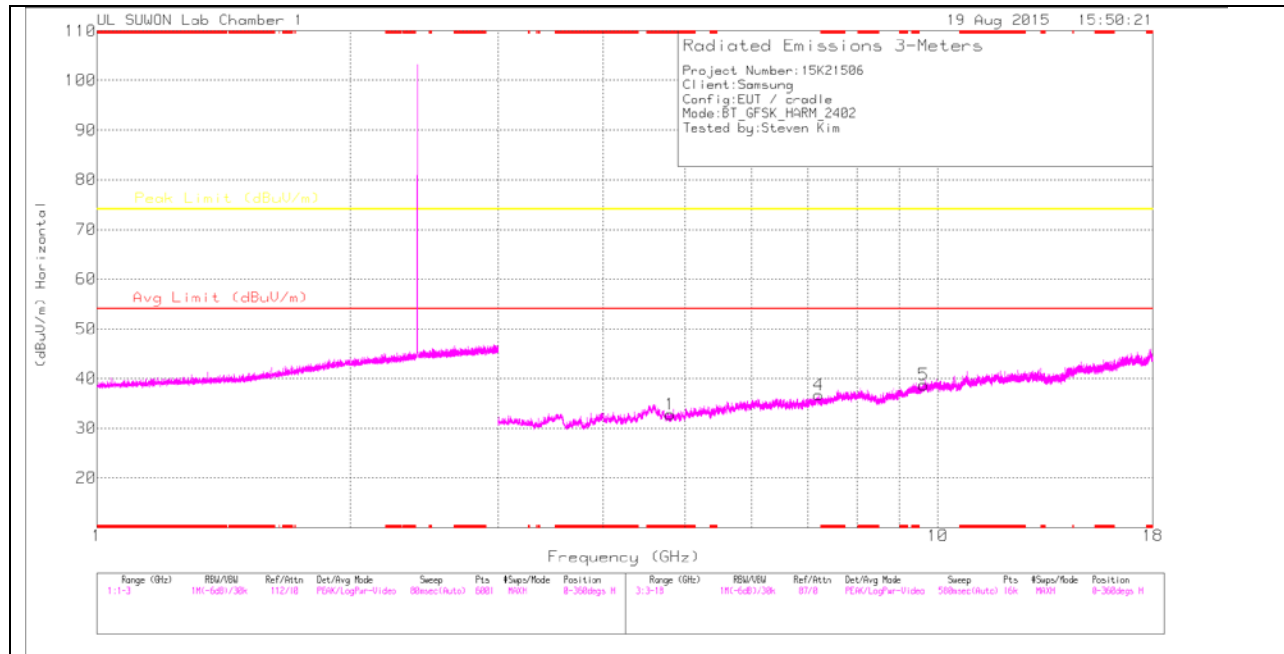
Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBUV/m)	Average Limit (dBUV/m)	Margin (dB)	Peak Limit (dBUV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.5	Pk	32	-22.6	47.9	-	-	74	-26.1	188	100	V
2	2.519	40.96	Pk	32	-22.6	50.36	-	-	74	-23.64	188	100	V
3	* 2.484	28.78	V1TV	32	-22.6	38.18	54	-15.82	-	-	188	100	V
4	* 2.484	28.87	V1TV	32	-22.6	38.27	54	-15.73	-	-	188	100	V

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

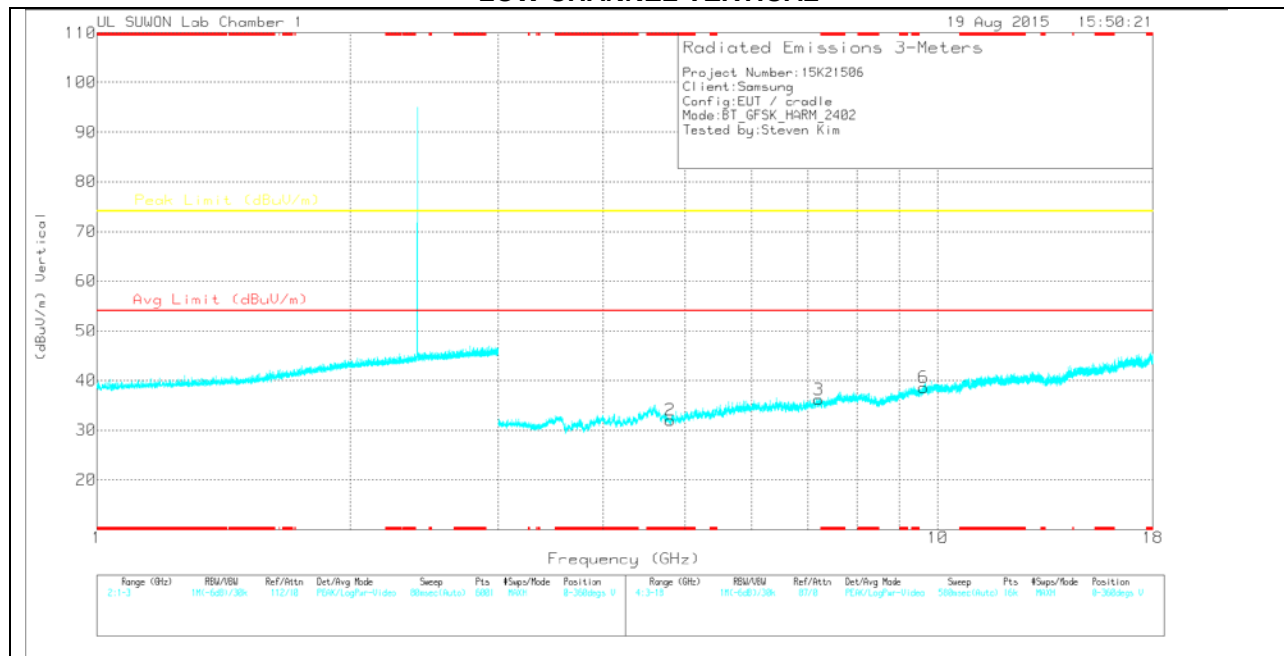
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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

LOW CHANNEL DATA

Trace Markers

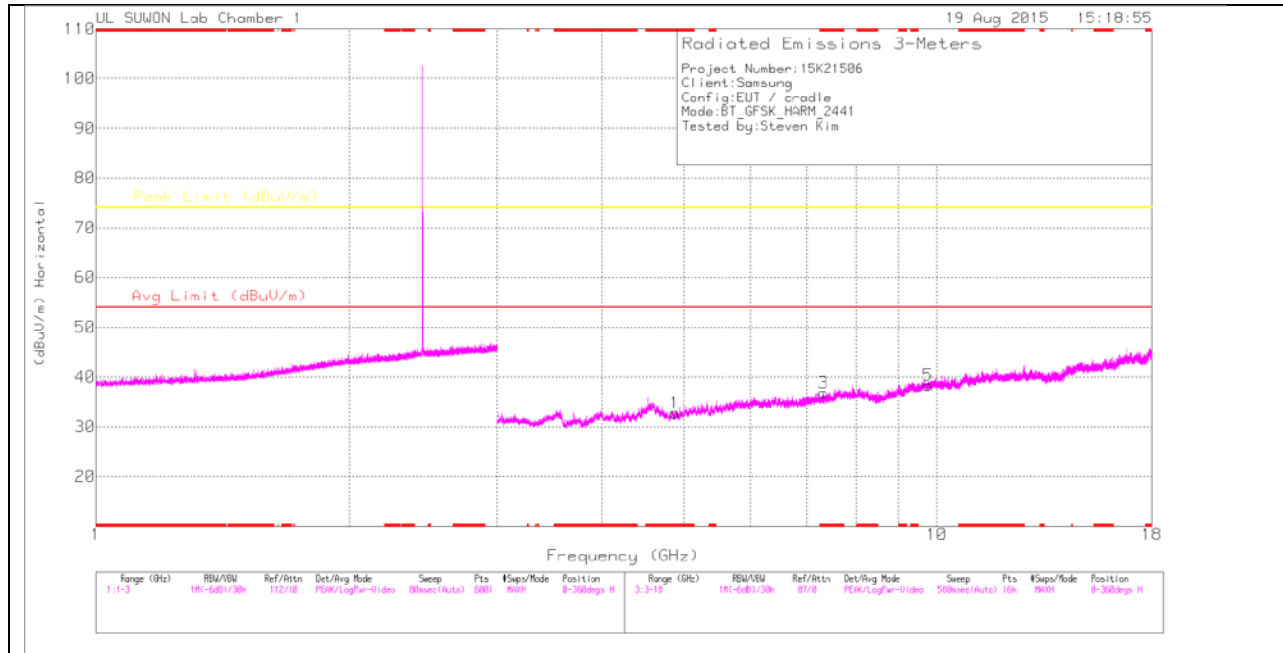
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.804	28.6	PK	34	-29.8	32.8	-	-	74	-41.2	0-360	200	H
4	7.206	26.45	PK	35.7	-25.4	36.75	-	-	74	-37.25	0-360	200	H
5	9.608	22.72	PK	37	-21	38.72	-	-	74	-35.28	0-360	200	H
2	* 4.803	27.78	PK	34	-29.8	31.98	-	-	74	-42.02	0-360	200	V
3	7.206	25.86	PK	35.7	-25.4	36.16	-	-	74	-37.84	0-360	100	V
6	9.607	22.6	PK	37	-21	38.6	-	-	74	-35.4	0-360	200	V

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

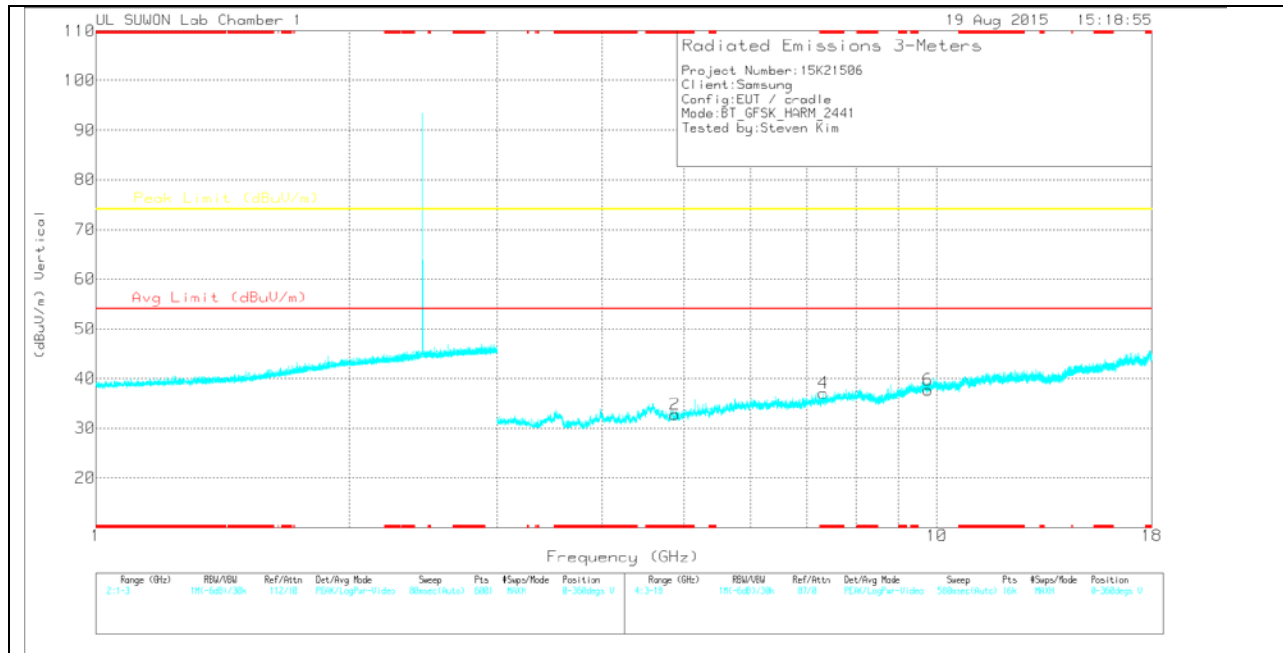
PK – Peak detector

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

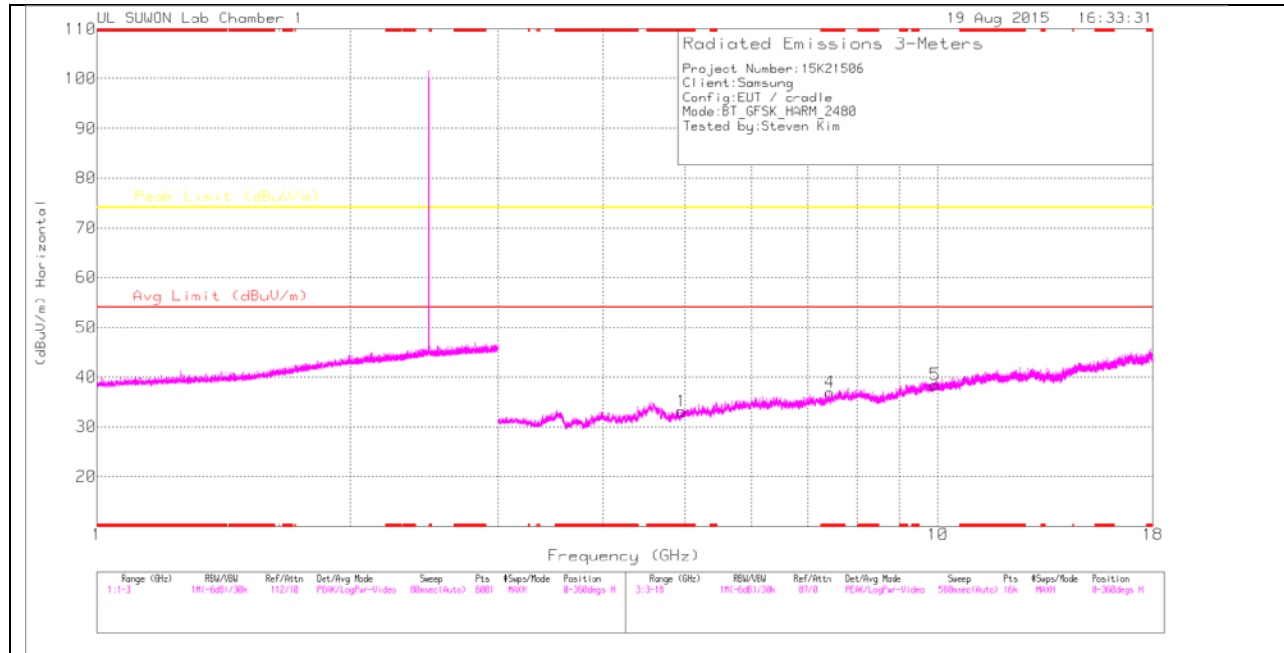
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.883	27.84	PK	34	-29.1	32.74	-	-	74	-41.26	0-360	100	H
3	* 7.323	26.67	PK	35.8	-25.6	36.87	-	-	74	-37.13	0-360	200	H
5	9.764	23.1	PK	37.2	-22	38.3	-	-	74	-35.7	0-360	100	H
2	* 4.881	27.9	PK	34	-29.1	32.8	-	-	74	-41.2	0-360	200	V
4	* 7.323	26.88	PK	35.8	-25.6	37.08	-	-	74	-36.92	0-360	100	V
6	9.764	22.47	PK	37.2	-22	37.67	-	-	74	-36.33	0-360	100	V

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

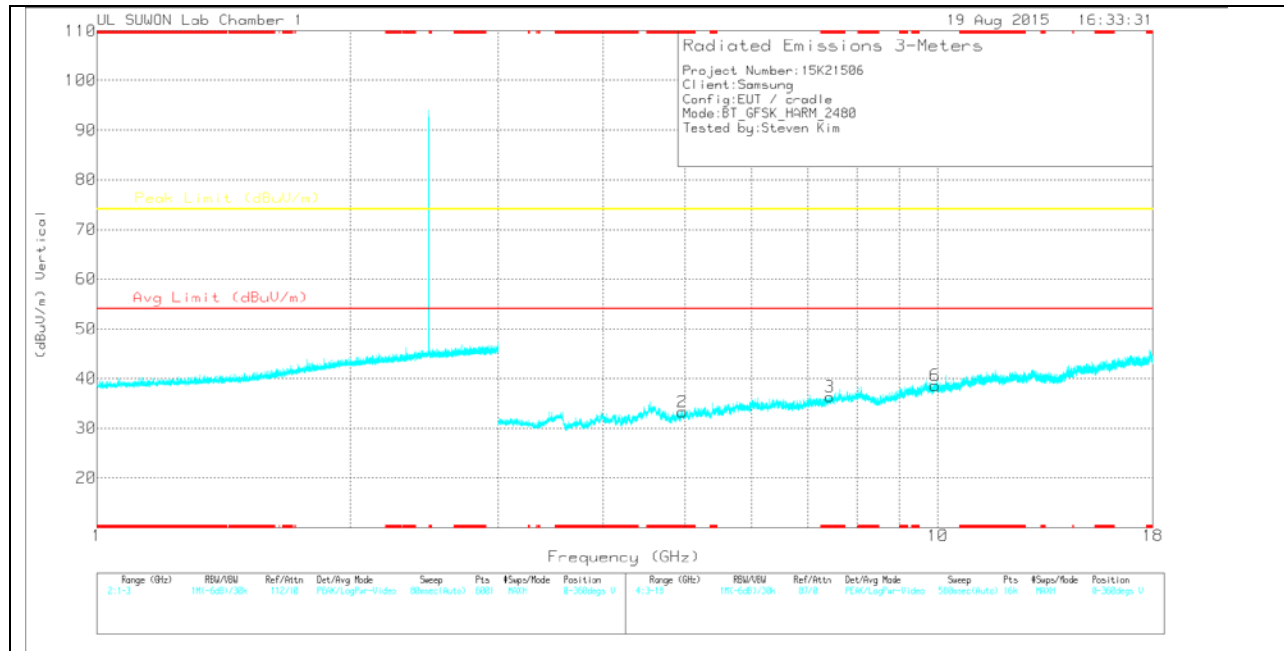
PK – Peak detector

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

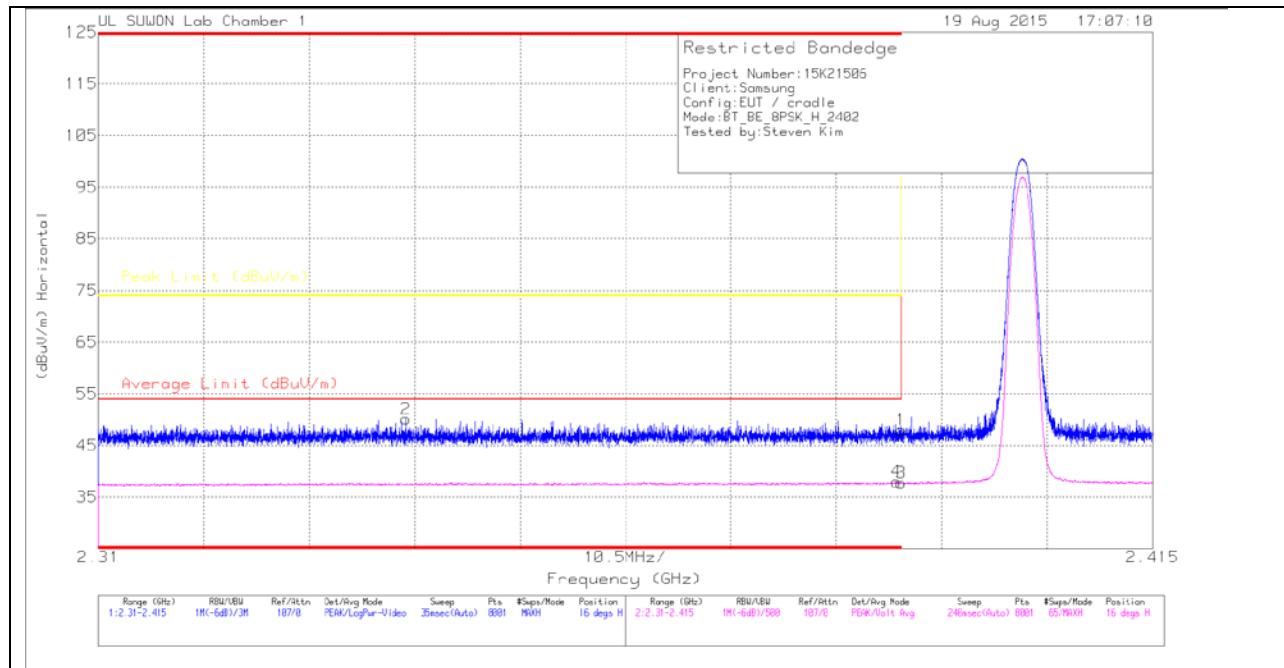
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.959	28.05	PK	34	-28.9	33.15	-	-	74	-40.85	0-360	100	H
4	* 7.44	25.96	PK	35.8	-24.8	36.96	-	-	74	-37.04	0-360	200	H
5	9.919	21.51	PK	37.4	-20.4	38.51	-	-	74	-35.49	0-360	100	H
2	* 4.964	28.15	PK	34	-28.9	33.25	-	-	74	-40.75	0-360	200	V
3	* 7.441	25.33	PK	35.8	-24.8	36.33	-	-	74	-37.67	0-360	200	V
6	9.918	21.65	PK	37.4	-20.4	38.65	-	-	74	-35.35	0-360	100	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).

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



HORIZONTAL DATA

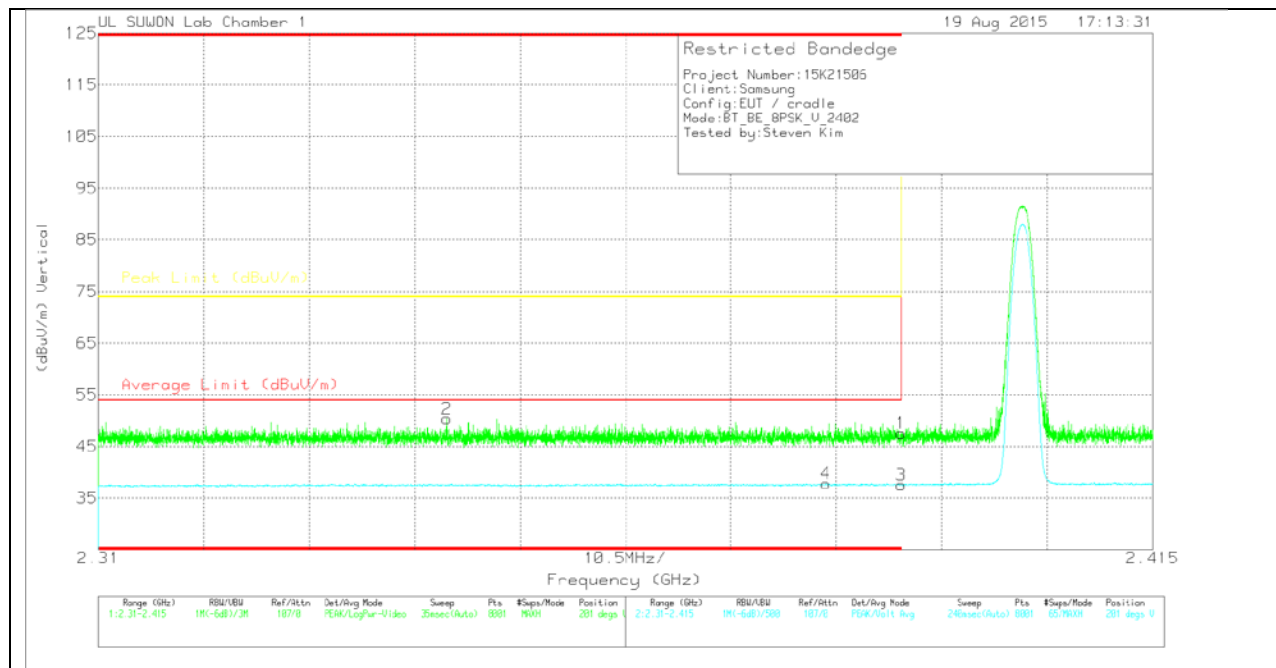
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.06	Pk	31.8	-22.8	48.06	-	-	74	-25.94	16	103	H
2	* 2.341	41.3	Pk	31.7	-22.9	50.1	-	-	74	-23.9	16	103	H
3	* 2.39	28.78	V1TV	31.8	-22.8	37.78	54	-16.22	-	-	16	103	H
4	* 2.389	29.03	V1TV	31.8	-22.8	38.03	54	-15.97	-	-	16	103	H

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

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

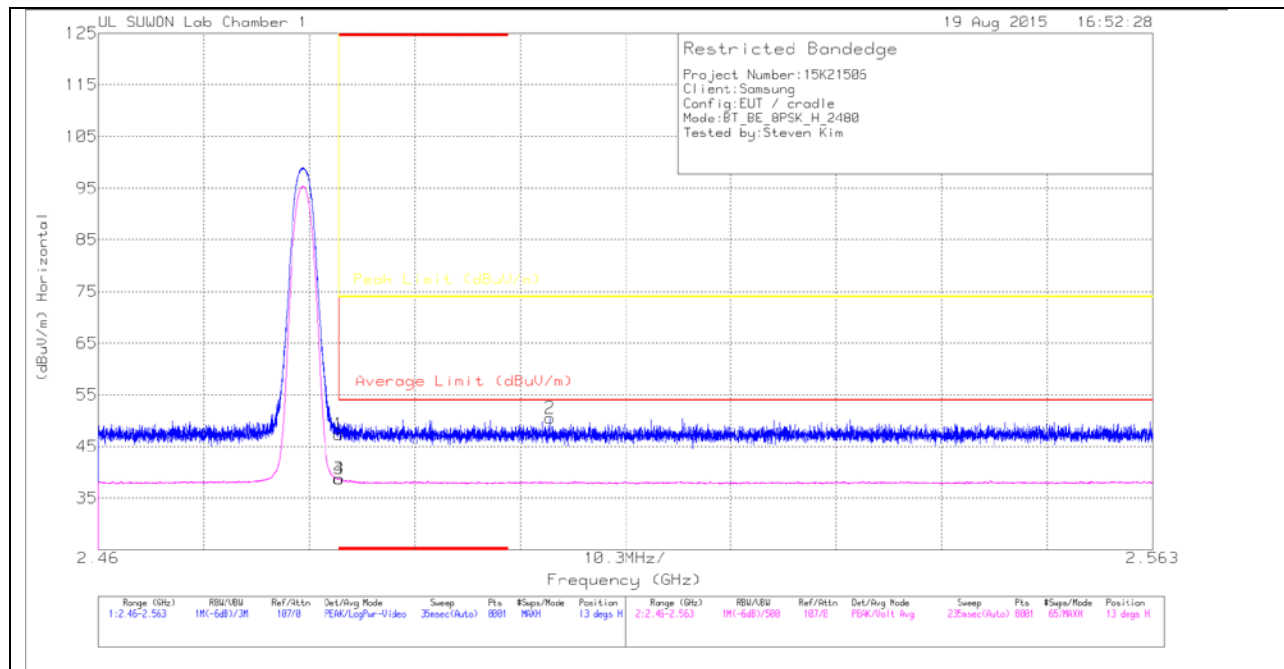
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.54	Pk	31.8	-22.8	47.54	-	-	74	-26.46	201	148	V
2	* 2.345	41.55	Pk	31.7	-22.9	50.35	-	-	74	-23.65	201	148	V
3	* 2.39	28.56	V1TV	31.8	-22.8	37.56	54	-16.44	-	-	201	148	V
4	* 2.383	28.84	V1TV	31.8	-22.8	37.84	54	-16.16	-	-	201	148	V

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

Pk - Peak detector

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

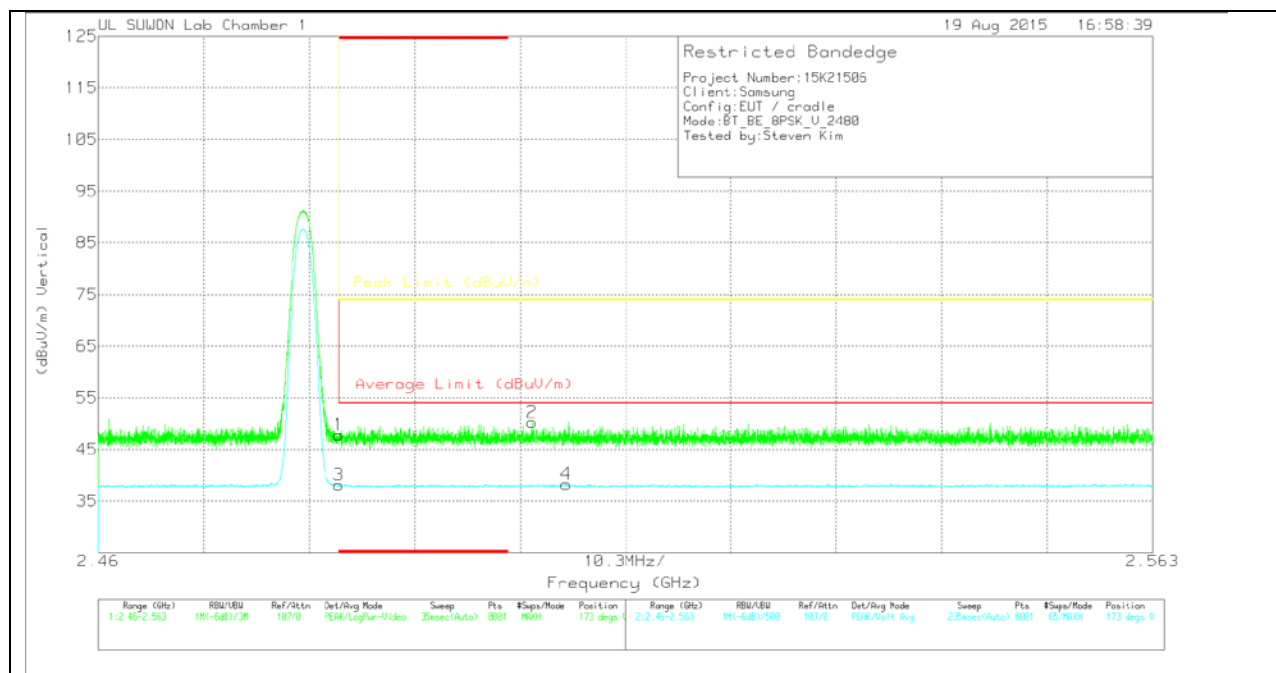
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	37.95	Pk	32	-22.6	47.35	-	-	74	-26.65	13	100	H
2	2.504	41.11	Pk	32	-22.6	50.51	-	-	74	-23.49	13	100	H
3	* 2.484	29.39	V1TV	32	-22.6	38.79	54	-15.21	-	-	13	100	H
4	* 2.484	29.37	V1TV	32	-22.6	38.77	54	-15.23	-	-	13	100	H

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

Pk - Peak detector

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

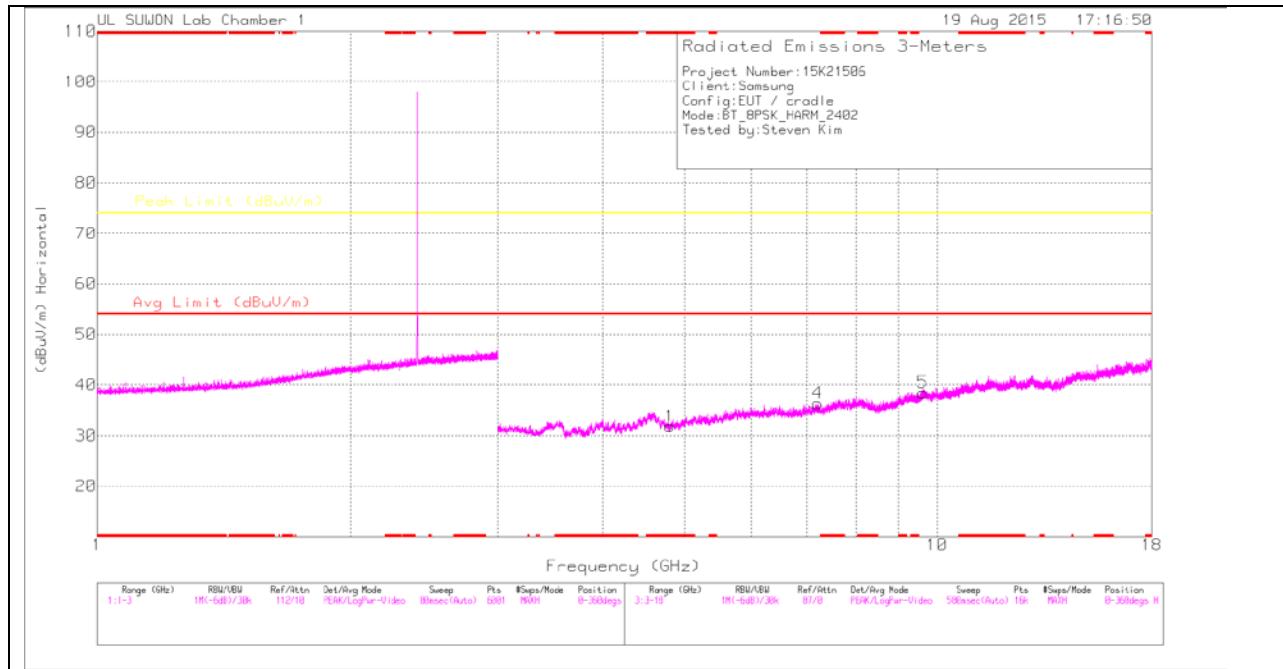
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(0016 8724)_150 619	Path_2_10 dB	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.45	Pk	32	-22.6	47.85	-	-	74	-26.15	173	390	V
2	2.502	40.89	Pk	32	-22.6	50.29	-	-	74	-23.71	173	390	V
3	* 2.484	28.76	V1TV	32	-22.6	38.16	54	-15.84	-	-	173	390	V
4	2.506	28.93	V1TV	32	-22.6	38.33	54	-15.67	-	-	173	390	V

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

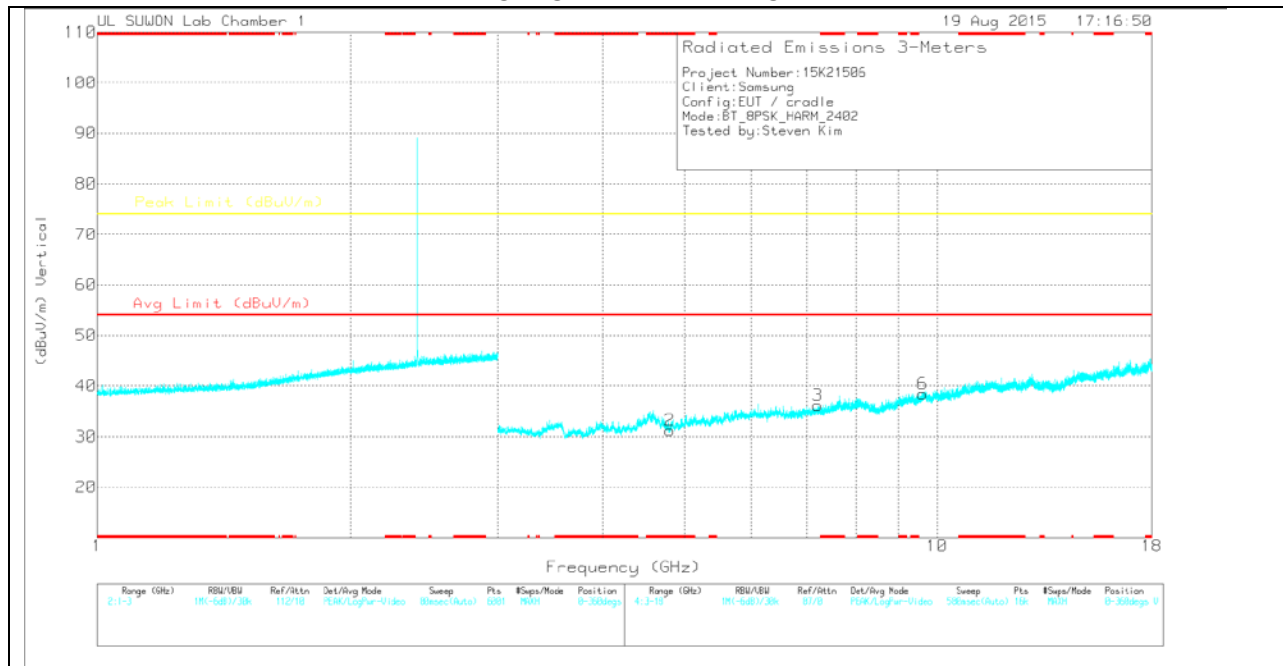
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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

LOW CHANNEL DATA

Trace Markers

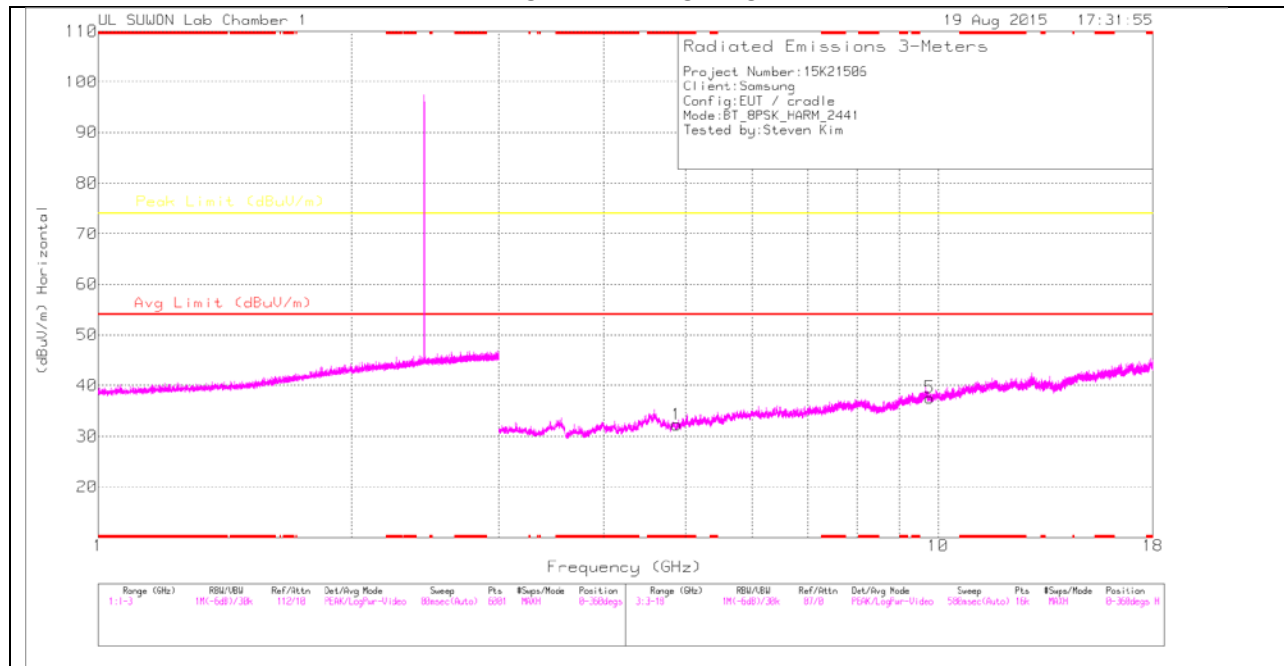
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.806	27.63	PK	34	-29.8	31.83	-	-	74	-42.17	0-360	100	H
4	7.207	26.1	PK	35.7	-25.4	36.4	-	-	74	-37.6	0-360	200	H
5	9.609	22.48	PK	37	-21	38.48	-	-	74	-35.52	0-360	200	H
2	* 4.805	26.98	PK	34	-29.8	31.18	-	-	74	-42.82	0-360	200	V
3	7.207	25.86	PK	35.7	-25.4	36.16	-	-	74	-37.84	0-360	100	V
6	9.606	22.44	PK	37	-21	38.44	-	-	74	-35.56	0-360	100	V

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

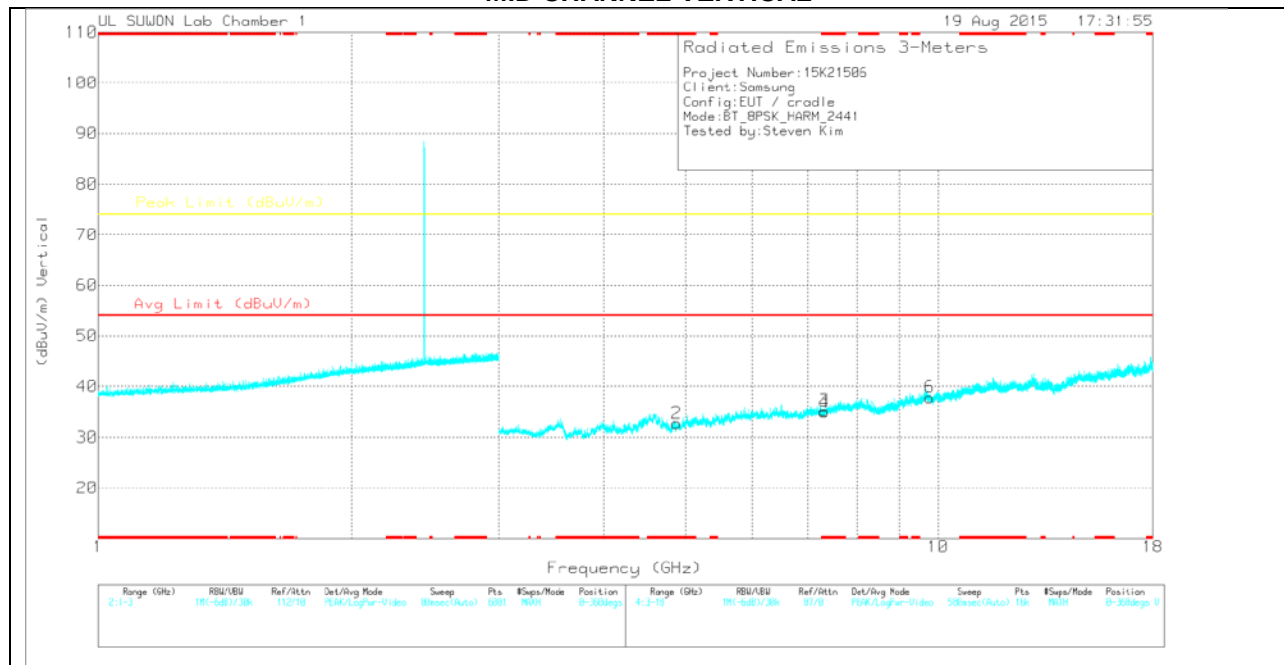
PK – Peak detector

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

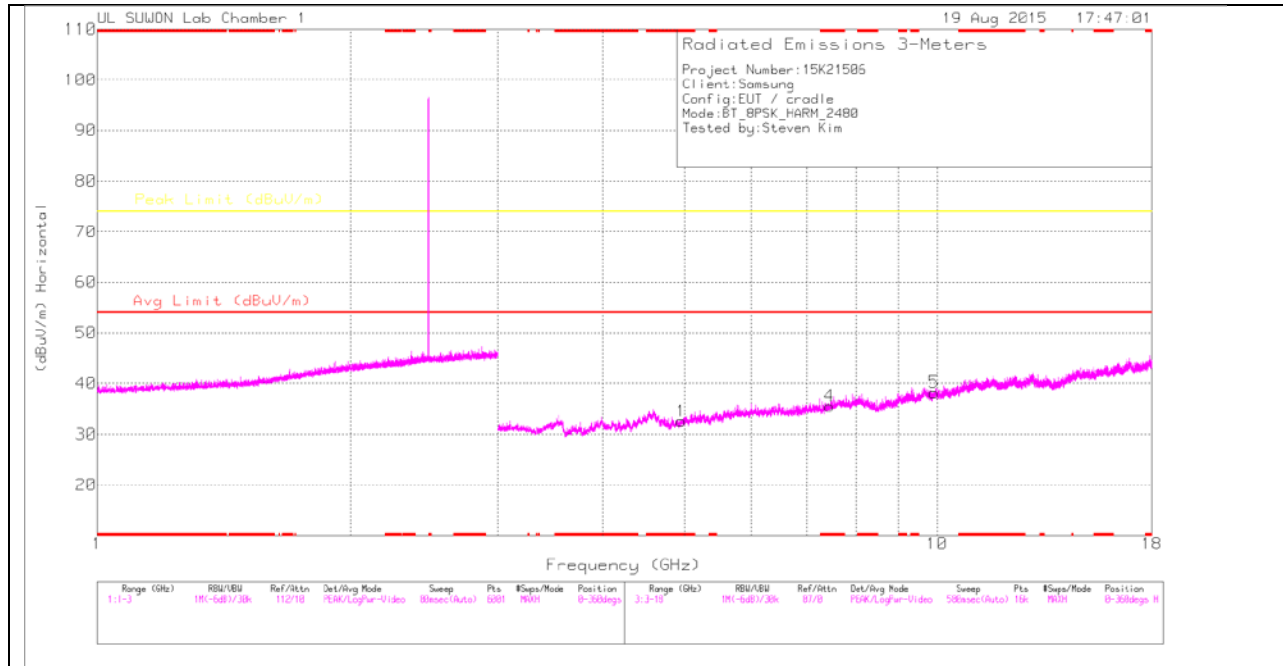
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.881	27.39	PK	34	-29.1	32.29	-	-	74	-41.71	0-360	200	H
5	9.765	22.38	PK	37.2	-22	37.58	-	-	74	-36.42	0-360	100	H
2	* 4.883	27.84	PK	34	-29.1	32.74	-	-	74	-41.26	0-360	100	V
3	* 7.323	25.04	PK	35.8	-25.6	35.24	-	-	74	-38.76	0-360	200	V
4	* 7.32	24.76	PK	35.8	-25.6	34.96	-	-	74	-39.04	0-360	100	V
6	9.764	22.67	PK	37.2	-22	37.87	-	-	74	-36.13	0-360	100	V

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

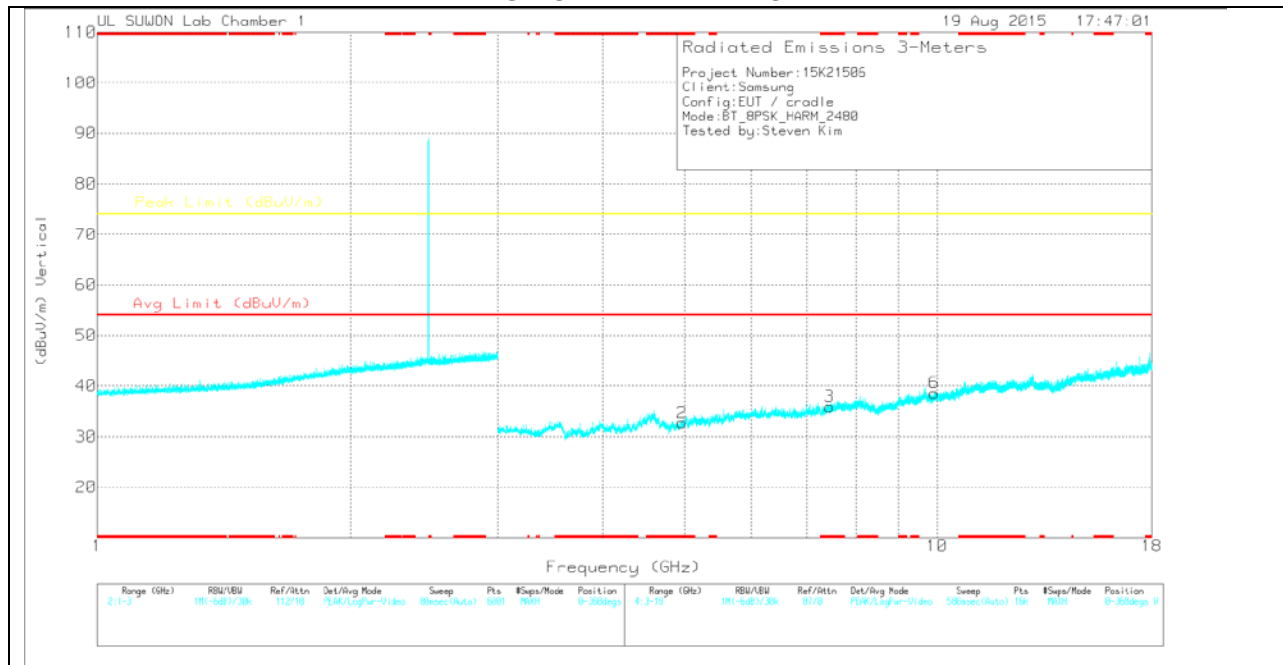
PK – Peak detector

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	3117(00168 724)_15061 9	Path_3	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.959	27.47	PK	34	-28.9	32.57	-	-	74	-41.43	0-360	200	H
4	* 7.443	24.55	PK	35.8	-24.8	35.55	-	-	74	-38.45	0-360	200	H
5	9.92	21.21	PK	37.4	-20.4	38.21	-	-	74	-35.79	0-360	200	H
2	* 4.964	27.59	PK	34	-28.9	32.69	-	-	74	-41.31	0-360	200	V
3	* 7.442	24.94	PK	35.8	-24.8	35.94	-	-	74	-38.06	0-360	100	V
6	9.923	21.61	PK	37.4	-20.4	38.61	-	-	74	-35.39	0-360	100	V

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

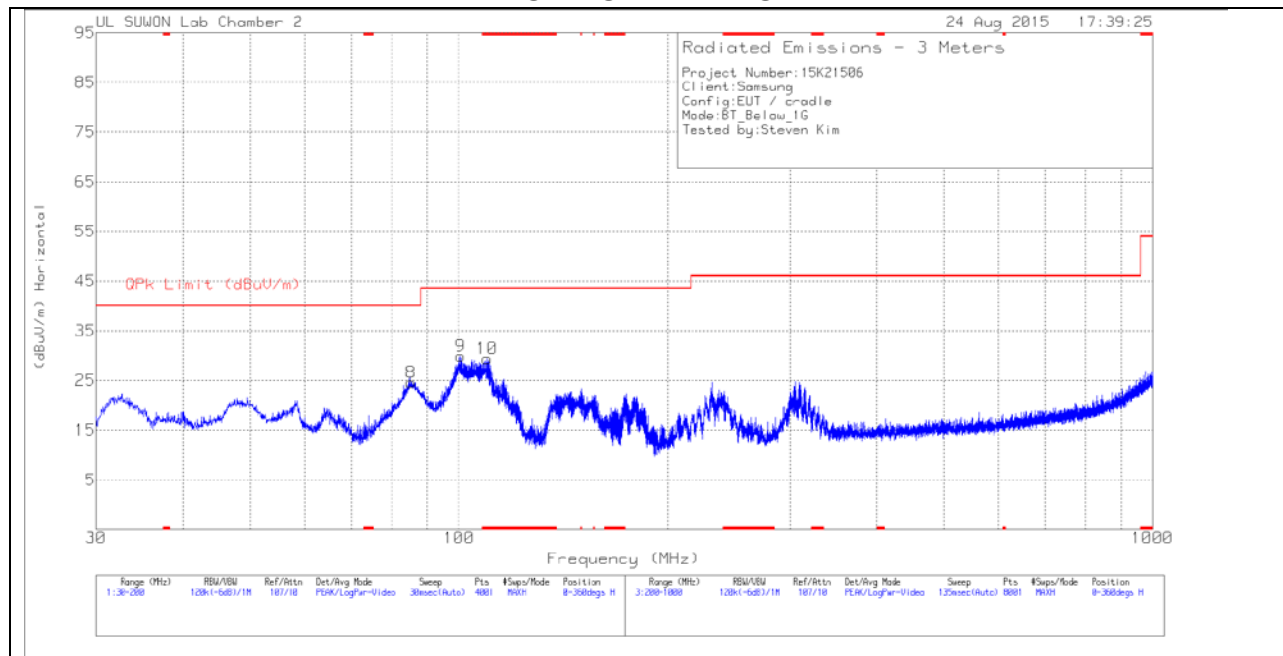
PK – Peak detector

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

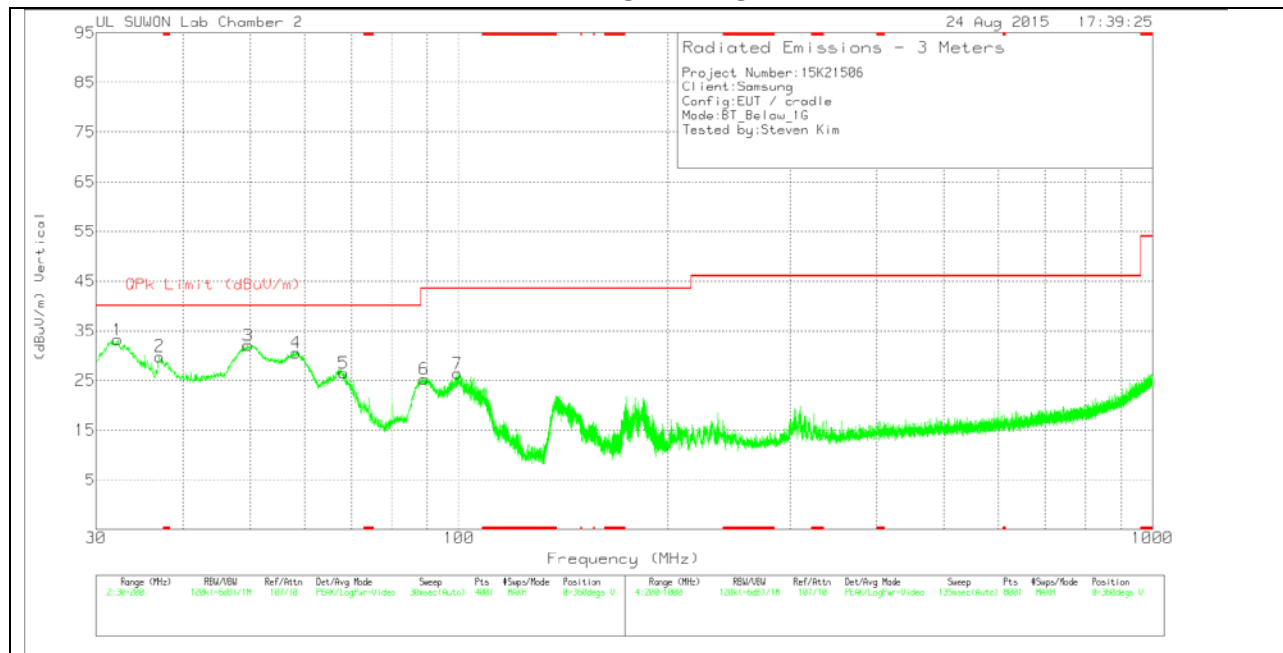
9.3. WORST-CASE BELOW 1 GHz

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	VULB9163-749	Below_1G	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
8	85.2075	46.75	Pk	8.4	-30.6	24.55	40	-15.45	0-360	200	H
9	100.55	48.96	Pk	11.5	-30.5	29.96	43.52	-13.56	0-360	300	H
10	* 109.815	49.14	Pk	10.8	-30.5	29.44	43.52	-14.08	0-360	300	H
1	32.21	53.53	Pk	10.5	-30.8	33.23	40	-6.77	0-360	100	V
2	37.0125	49.05	Pk	11.6	-30.8	29.85	40	-10.15	0-360	100	V
3	49.635	48.66	Pk	14.1	-30.7	32.06	40	-7.94	0-360	100	V
4	58.1775	48.28	Pk	13	-30.7	30.58	40	-9.42	0-360	100	V
5	68.165	46.85	Pk	10.2	-30.6	26.45	40	-13.55	0-360	100	V
6	89.16	46.5	Pk	9.4	-30.6	25.3	43.52	-18.22	0-360	100	V
7	99.4875	45.32	Pk	11.5	-30.5	26.32	43.52	-17.2	0-360	100	V

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

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)
RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

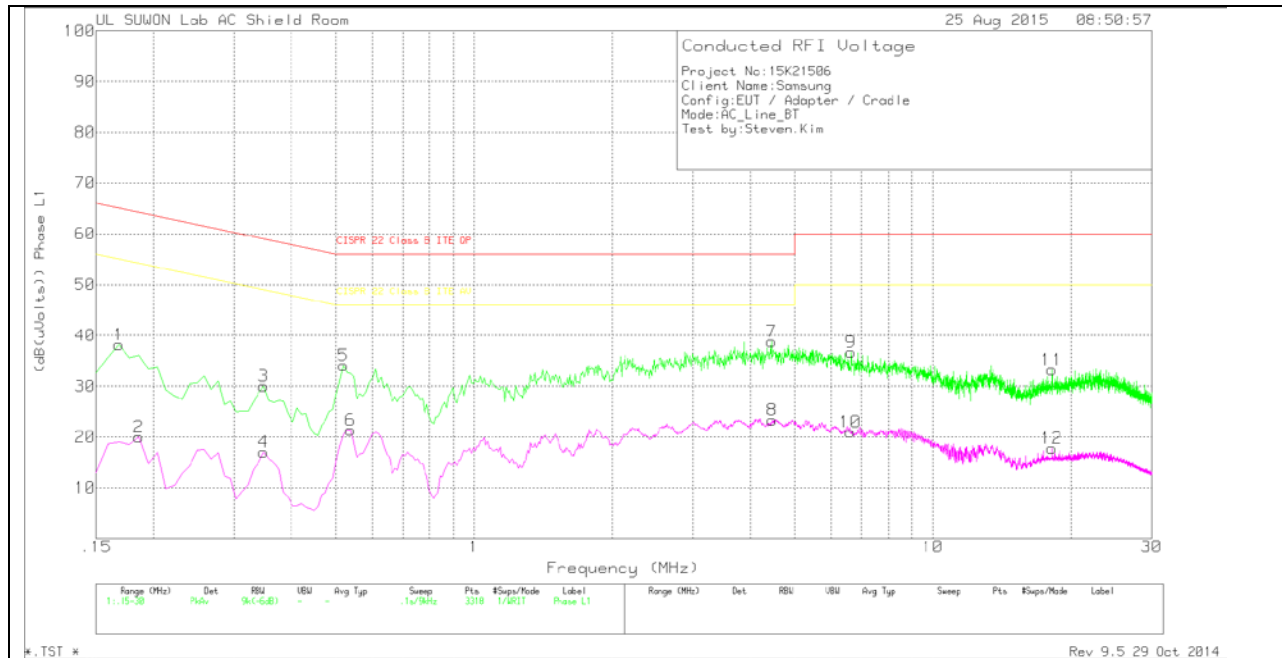
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

WORST EMISSIONS

LINE 1 PLOT



LINE 1 RESULTS

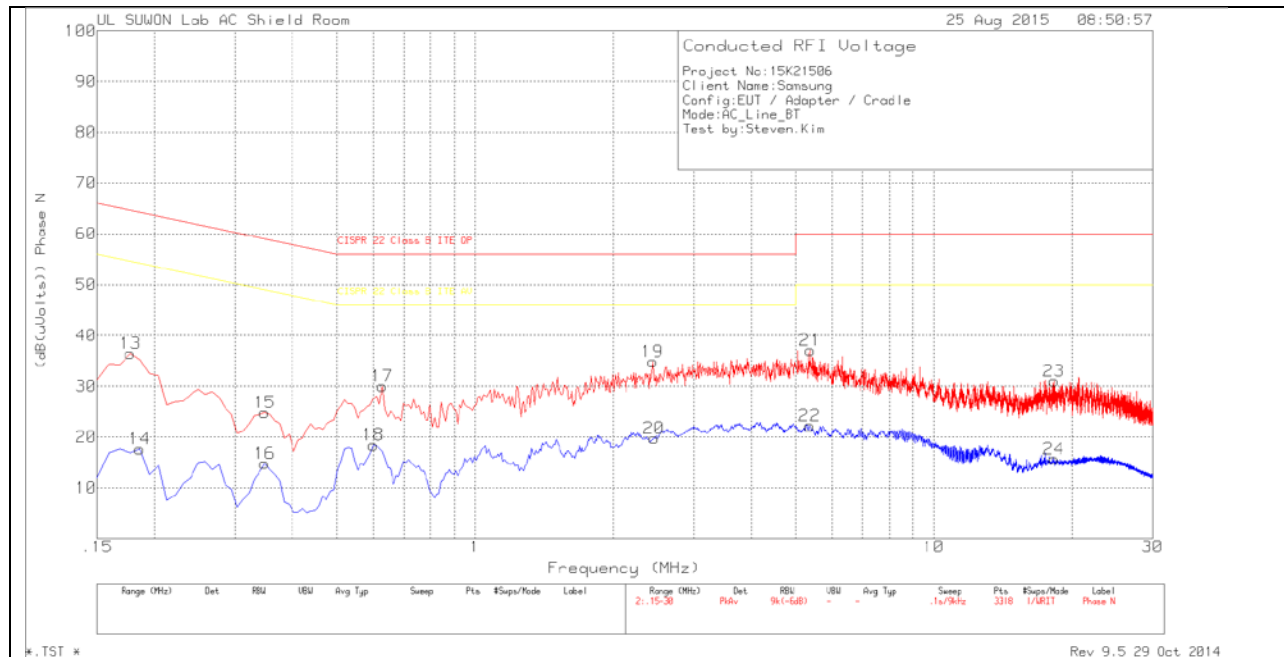
Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_w ith ex-cord_L1	CE Shield Room	Corrected Reading (dBuV)	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
1	.168	27.97	Pk	10.2	0	38.17	65.06	-26.89	-	-
2	.186	9.87	Av	10.1	0	19.97	-	-	54.21	-34.24
3	.348	19.99	Pk	10	0	29.99	59.01	-29.02	-	-
4	.348	7.02	Av	10	0	17.02	-	-	49.01	-31.99
5	.519	24.01	Pk	10.1	0	34.11	56	-21.89	-	-
6	.537	11.24	Av	10.1	0	21.34	-	-	46	-24.66
7	4.452	28.96	Pk	9.8	.1	38.86	56	-17.14	-	-
8	4.47	13.4	Av	9.8	.1	23.3	-	-	46	-22.7
9	6.63	26.78	Pk	9.8	.1	36.68	60	-23.32	-	-
10	6.603	11.15	Av	9.8	.1	21.05	-	-	50	-28.95
11	18.168	22.76	Pk	10.3	.2	33.26	60	-26.74	-	-
12	18.168	7.33	Av	10.3	.2	17.83	-	-	50	-32.17

Pk - Peak detector

Av - Average detection

LINE 2 PLOT



LINE 2 RESULTS

Phase N .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_w ith ex-cord_N	CE Shield Room	Corrected Reading (dBuV)	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
13	.177	26.32	Pk	10.1	0	36.42	64.63	-28.21	-	-
14	.186	7.69	Av	10	0	17.69	-	-	54.21	-36.52
15	.348	14.88	Pk	10	0	24.88	59.01	-34.13	-	-
16	.348	4.77	Av	10	0	14.77	-	-	49.01	-34.24
17	.627	19.98	Pk	10	0	29.98	56	-26.02	-	-
18	.6	8.36	Av	10.1	0	18.46	-	-	46	-27.54
19	2.436	24.99	Pk	9.8	.1	34.89	56	-21.11	-	-
20	2.454	9.9	Av	9.8	.1	19.8	-	-	46	-26.2
21	5.388	27.16	Pk	9.8	.1	37.06	60	-22.94	-	-
22	5.361	12.38	Av	9.8	.1	22.28	-	-	50	-27.72
23	18.276	20.27	Pk	10.5	.2	30.97	60	-29.03	-	-
24	18.285	5.03	Av	10.5	.2	15.73	-	-	50	-34.27

Pk - Peak detector

Av - Average detection