FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

TABLET DEVICE

MODEL NUMBER: A1566

FCC ID: BCGA1566

IC: 579C-A1566

REPORT NUMBER: 14U18207-E1, Revision A

ISSUE DATE: SEPTEMBER 12, 2014

Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/02/14	Initial Issue	F. de Anda
A	09/12/14	Updated sections 5.5, 9.1.2 and 9.2.2	F. de Anda

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: TABLET DEVICE

MODEL: A1566

SERIAL NUMBER: DLXMX010G4LV(Conducted), DLXMX00JG4LV(Radiated)

DATE TESTED: July 14, 2014 - July 25, 2014

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	PASS
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	PASS
INDUSTRY CANADA RSS-GEN Issue 3	PASS

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

FRANCISCO DE ANDA
EMC SUPERVISOR
UL Verification Services Inc.

Tested By:

Nancy Garcia
Lab Technician
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 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.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☒ Chamber D
☐ Chamber B	☐ Chamber E
☐ Chamber C	☐ Chamber F
	☐ Chamber G
	☒ Chamber H

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	±3.52 dB
Radiated Disturbance, 30 to 1000 MHz	±4.94 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a tablet with multimedia functions (music, application support, and video), IEEE 802.11a/b/g/n/ac radio, Bluetooth and BLE radio. The rechargeable battery is not user accessible.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	12.76	18.87
2402 - 2480	Enhanced 8PSK	12.95	19.72

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA antenna, with a maximum gain of +2.016dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 12B331

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case configuration used for 30-1000 MHz and >18 GHz radiated and power line conducted emissions included headset and AC charger. The mode tested was GFSK.

The EUT is a portable device that has three orientations; therefore X, Y and Z orientations have been investigated with AC adapter and Headset, and the worst case was found to be at Y (Landscape) position without AC adapter and headset.

Based on the manufacturer's attestation that the nominal output power is reduced as the data rate increases, the data rates tested represent the highest power and worst-case with respect to EMC performance.

Worst-case data rates were:

GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC adapter	Apple	A1357	N/A	NA
Earphone	Apple	NA	NA	NA
Laptop	Apple	A1278	C02HJ0A7DTY4	NA
DC power supply	Sorensen	XT 15-4	1319A02780	NA

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	DC	1	DC	Un-shielded	0.8	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None used						

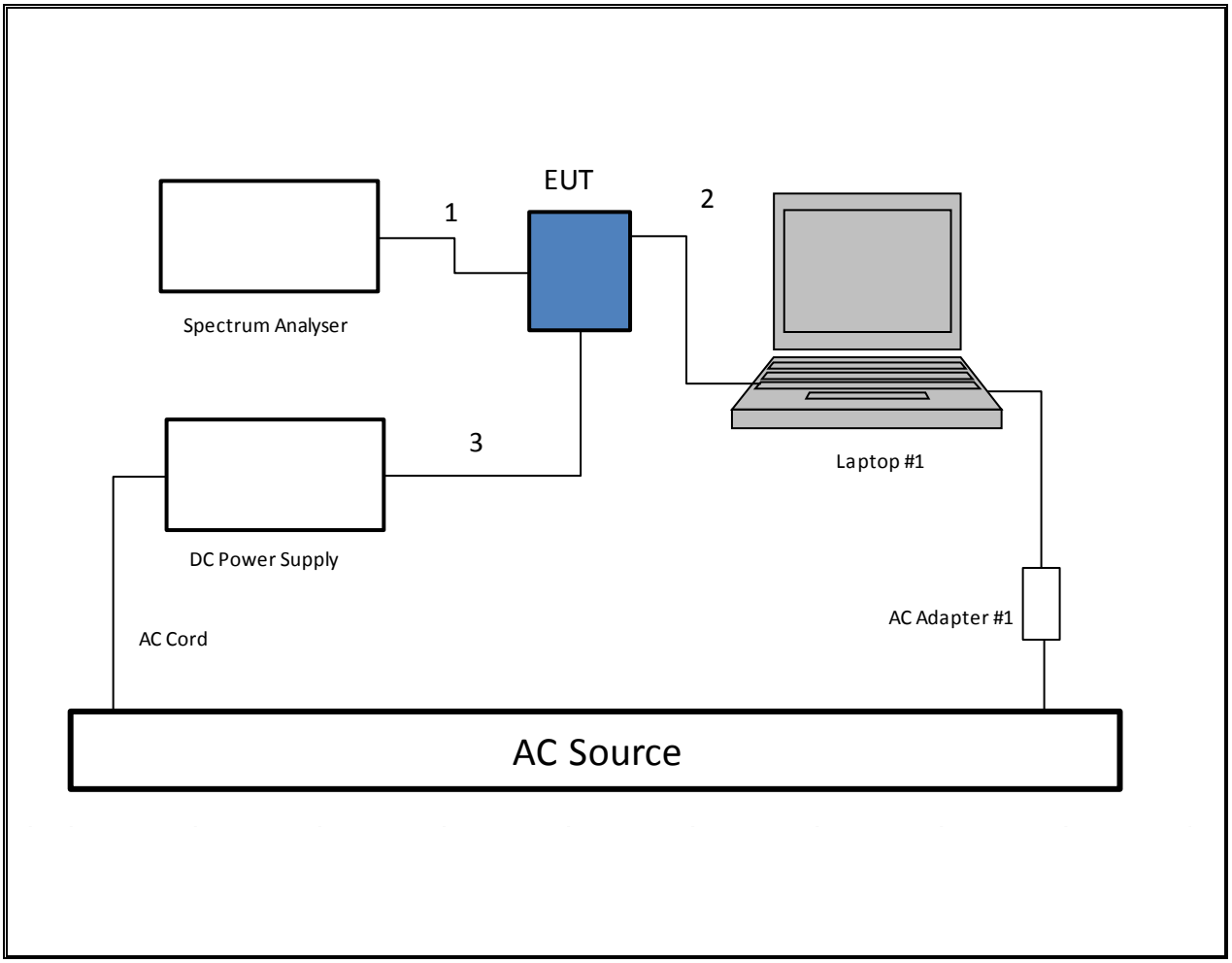
I/O CABLES (AC POWER CONDUCTED TEST and below 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115	Un-Shielded	0.8	NA
2	DC	1	lightning	Un-Shielded	1	NA
3	Audio	1	Jack	Un-Shielded	0.5	NA

TEST SETUP- CONDUCTED PORT

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

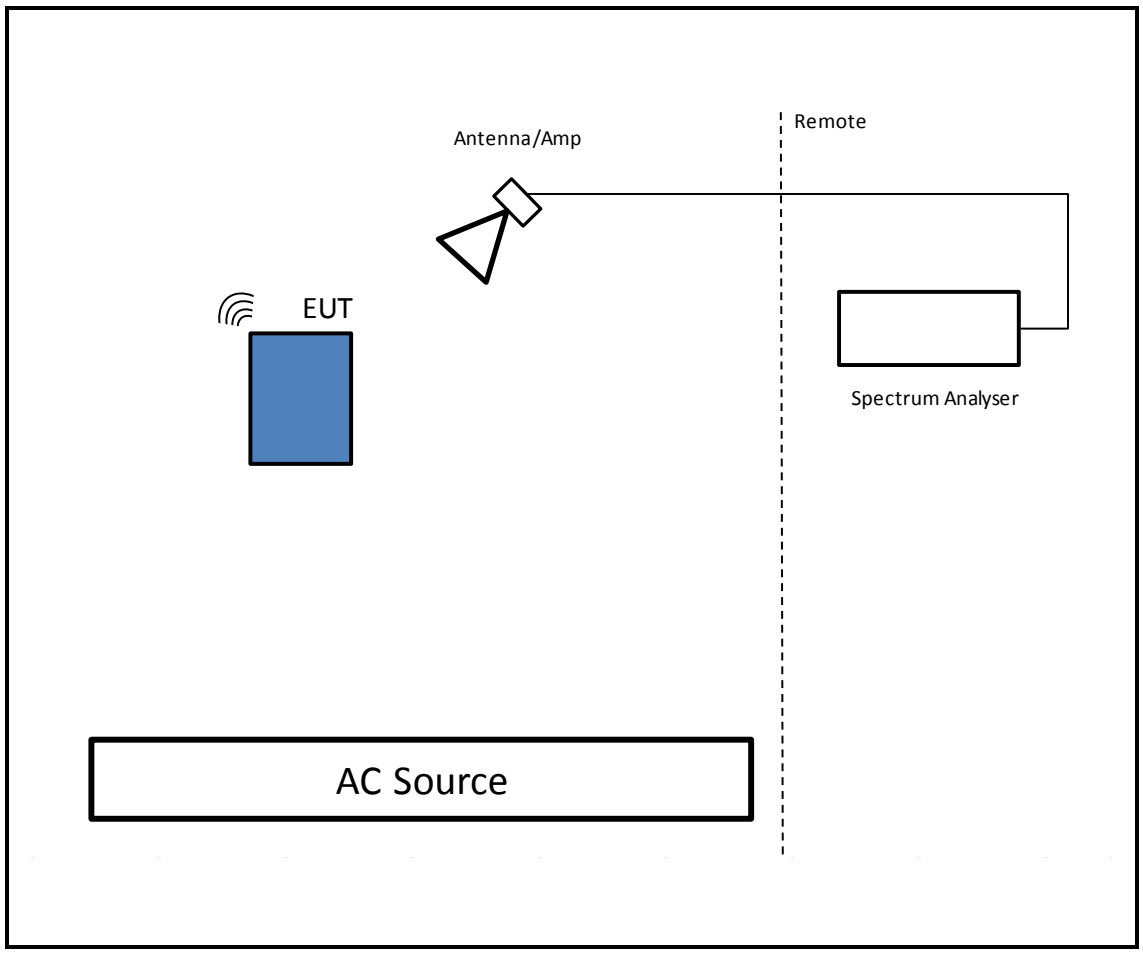
SETUP DIAGRAM



TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was tested battery powered. Test software exercised the EUT.

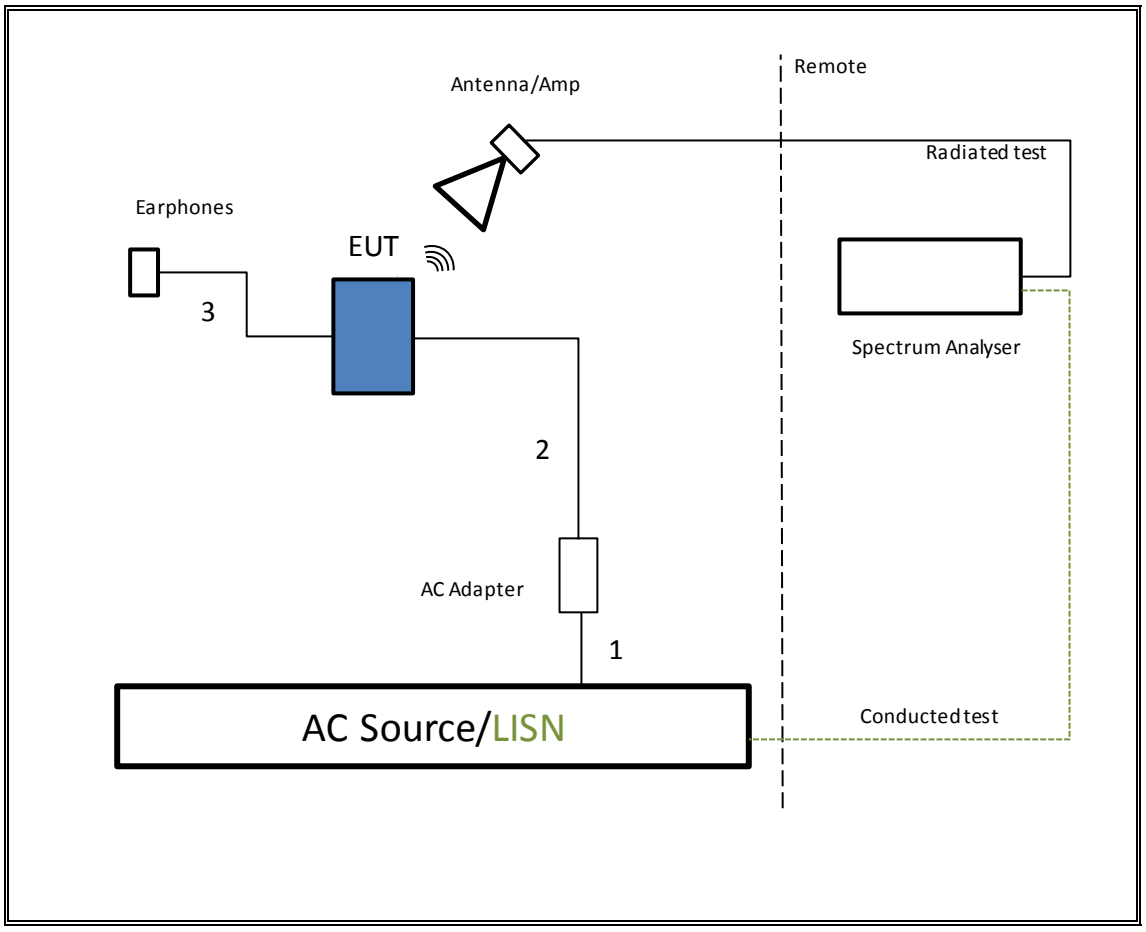
SETUP DIAGRAM



TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was tested with earphones connected and powered by AC adapter. Test software exercised the EUT.

SETUP DIAGRAM



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**	**Asset**	**Cal Due**
Antenna, Horn, 18 GHz	ETS Lindgren	3117	00165318	04/04/15
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/26/14
Wideband Power Sensor	Agilent	N1921A	F00360	09/30/14
Peak Power Meter	Agilent / HP	N1911A	F00025	05/06/15
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY53310593	05/07/15
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A-544	RENTAL	05/02/15
Antenna, Bilog, 2 GHz	Sunol Sciences	JB3	A051314-2	05/14/15
Preamplifier, 1300 MHz (T835)	Sonoma	310	N02891	12/30/14
Preamplifier, 26.5 GHz	Agilent / HP	8449B	F00167	03/25/15
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	F00092	09/05/14
LISN, 30 MHz	FCC	LISN-50/250-25-2	C00626	01/14/15
Filter, LPF 5GHz	Micro-Tronics	LPS17541	F00174	08/24/14
RF-Amplifier 1-18Ghz	Miteq	AFS42-00101800-25-s-	F00005	08/24/14

7. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01.

Output Power: KDB 558074 D01.

Power Spectral Density: KDB 558074 D01.

Out-of-band emissions in non-restricted bands: KDB 558074 D01.

Out-of-band emissions in restricted bands: KDB 558074 D01.

8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

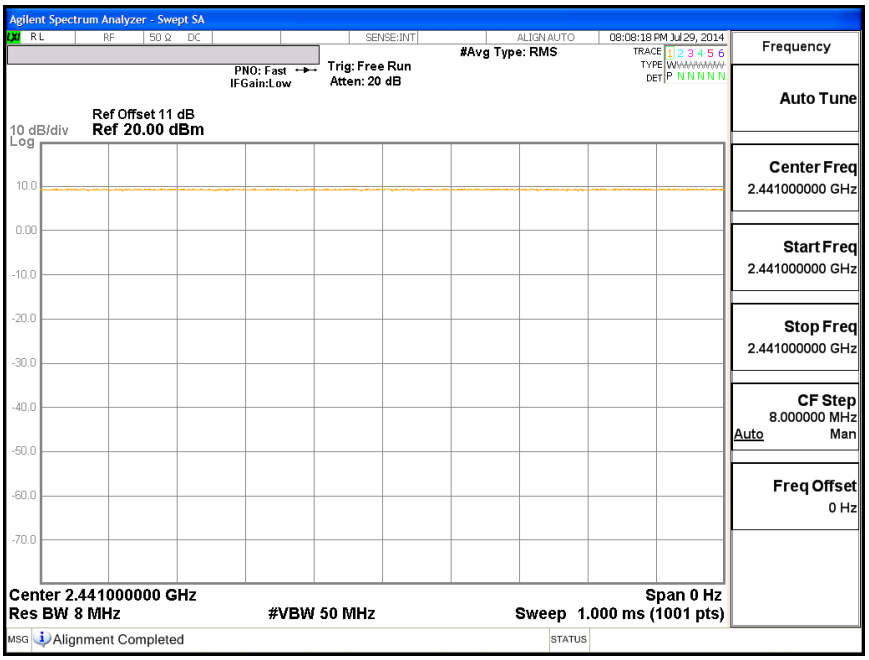
KDB 789033 Zero-Span Spectrum Analyzer Method.

8.1. ON TIME AND DUTY CYCLE RESULTS

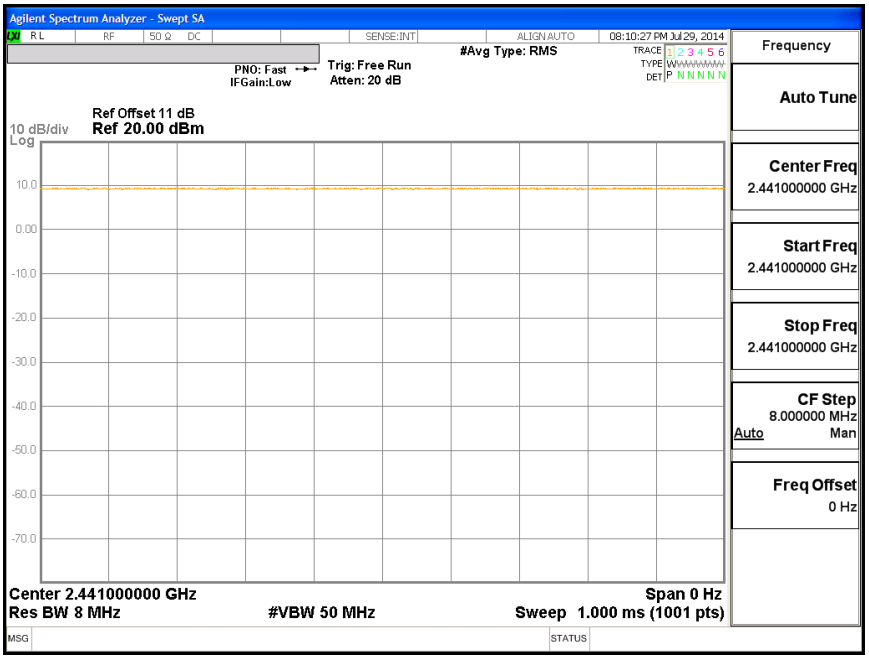
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
GFSK	1.000	1.000	1.000	100.0%	0.000	1.000
8PSK	1.000	1.000	1.000	100.0%	0.000	1.000

8.2. DUTY CYCLE PLOTS

DUTY CYCLE MODE GFSK



DUTY CYCLE MODE 8PSK



9. ANTENNA PORT TEST RESULTS

9.1. BASIC DATA RATE GFSK MODULATION

9.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

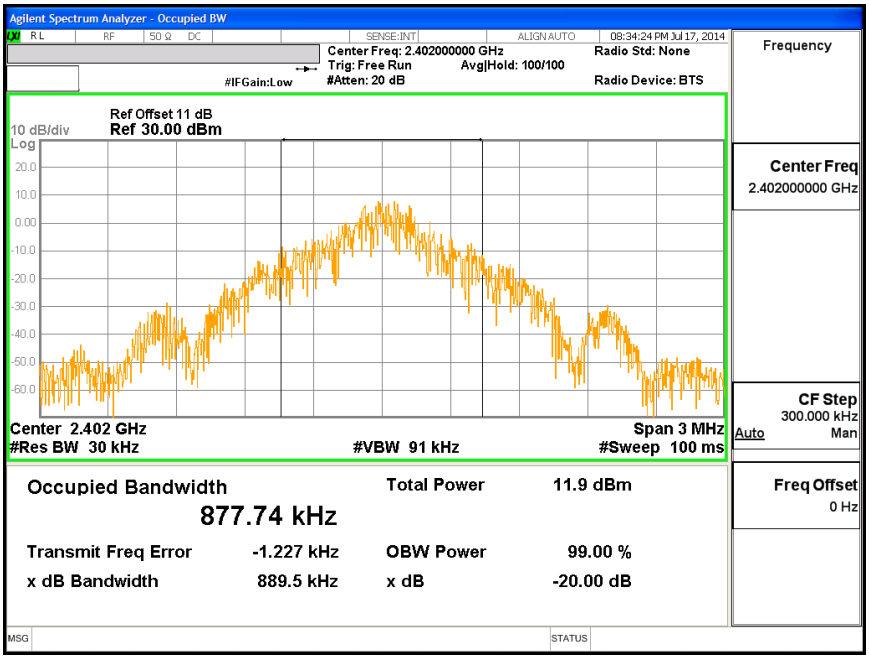
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

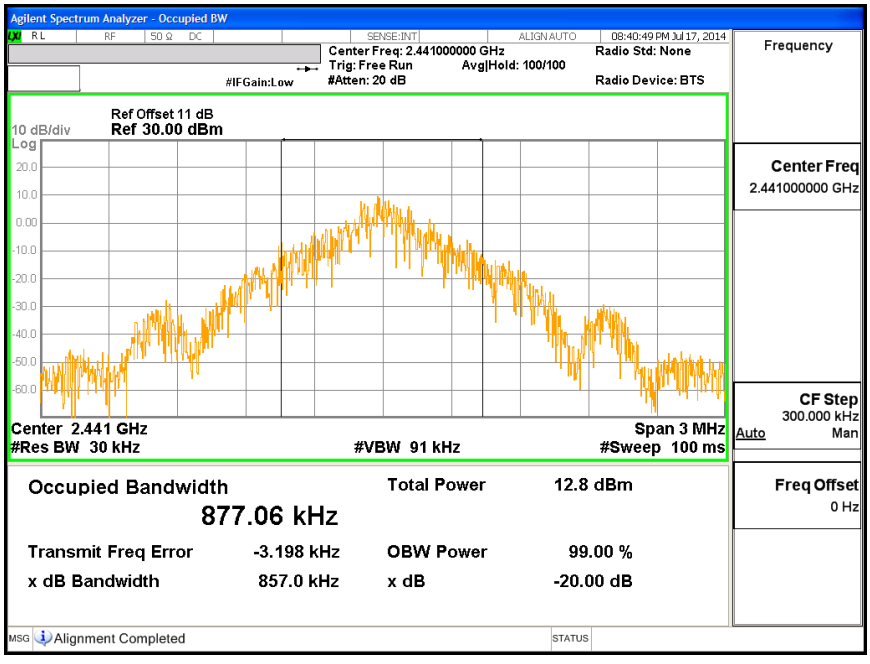
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	889.5	877.74
Middle	2441	857	877.06
High	2480	861.7	908.32

20 dB AND 99% BANDWIDTH

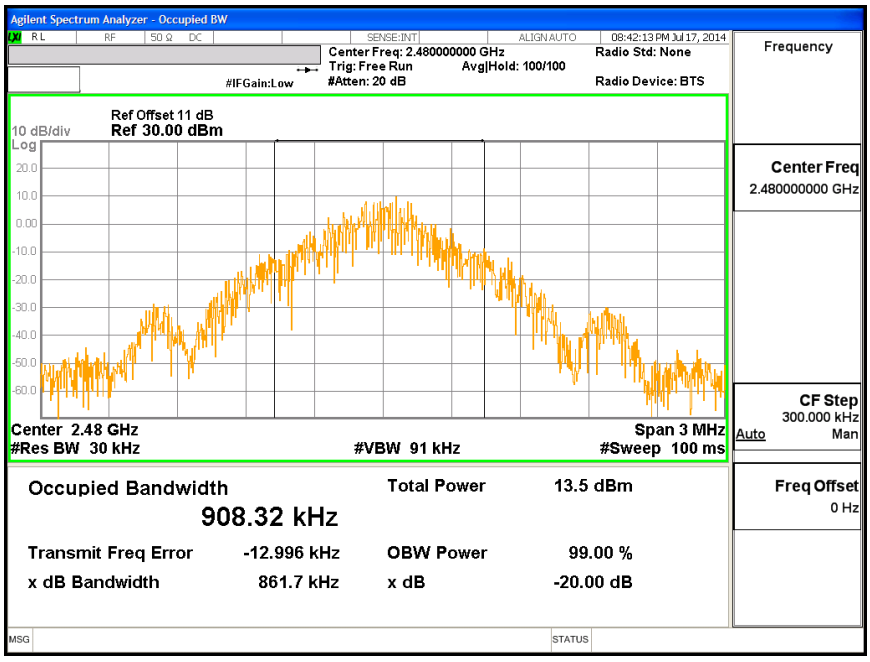
BANDWIDTH LOW CH



BANDWIDTH MID CH



BANDWIDTH HIGH CH



9.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

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

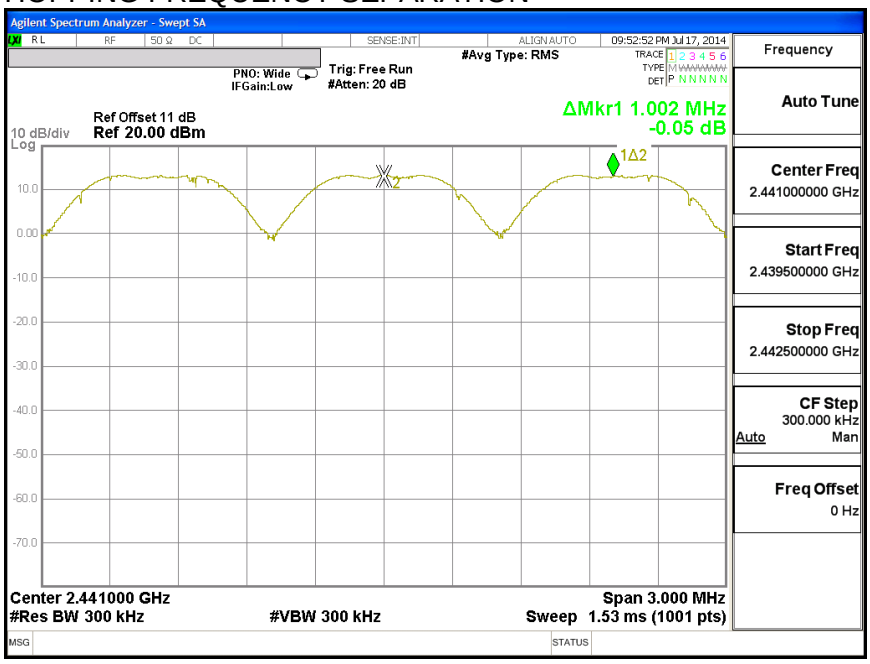
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to => RBW. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION

HOPPING FREQUENCY SEPARATION



9.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

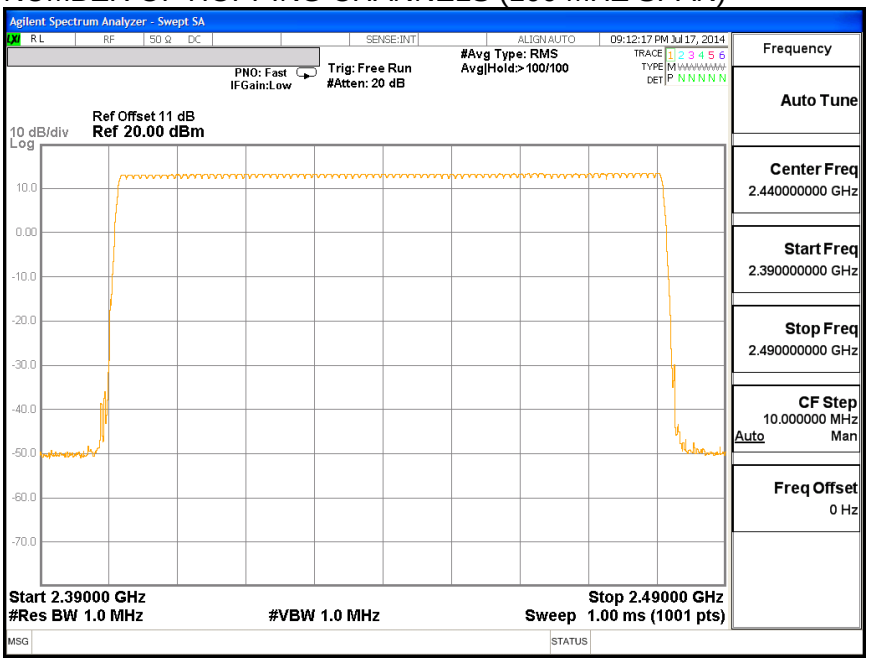
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

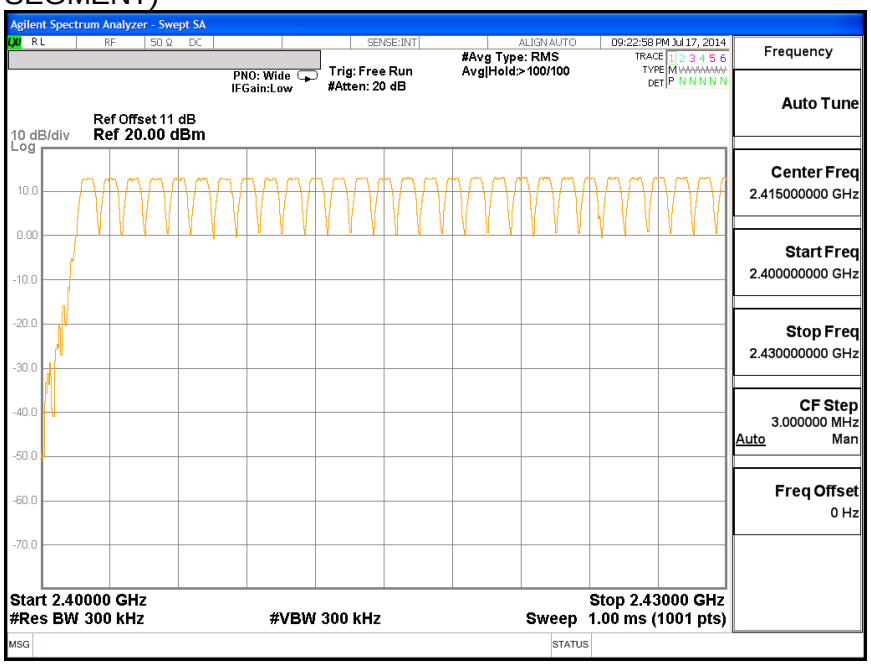
Normal Mode: 79 Channels observed.
.

NUMBER OF HOPPING CHANNELS

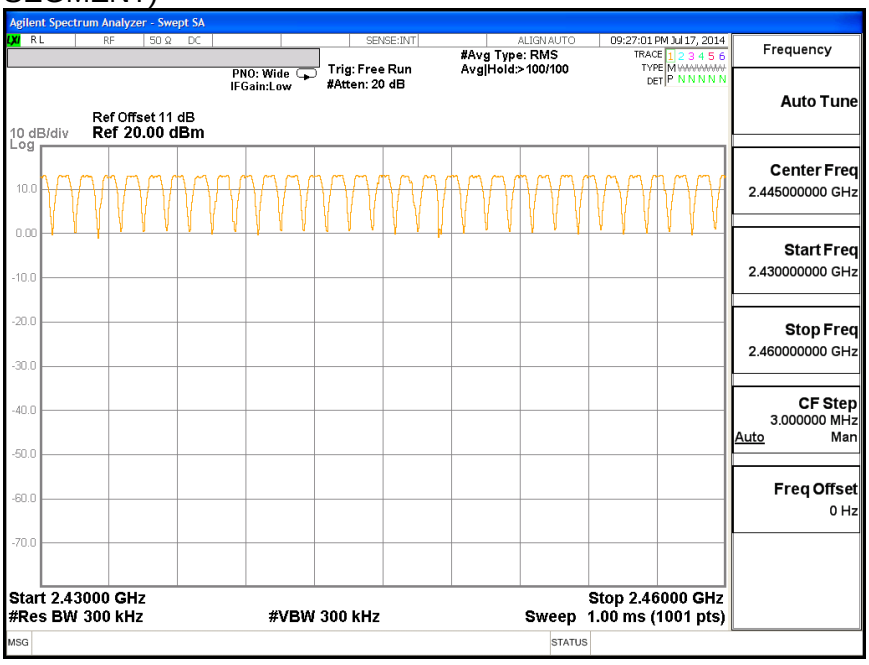
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



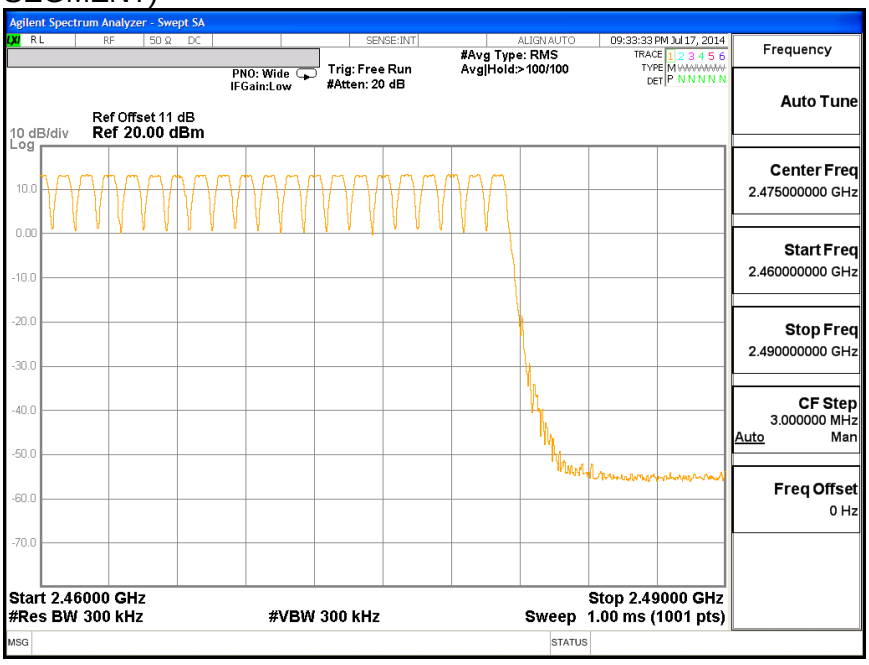
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)



9.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

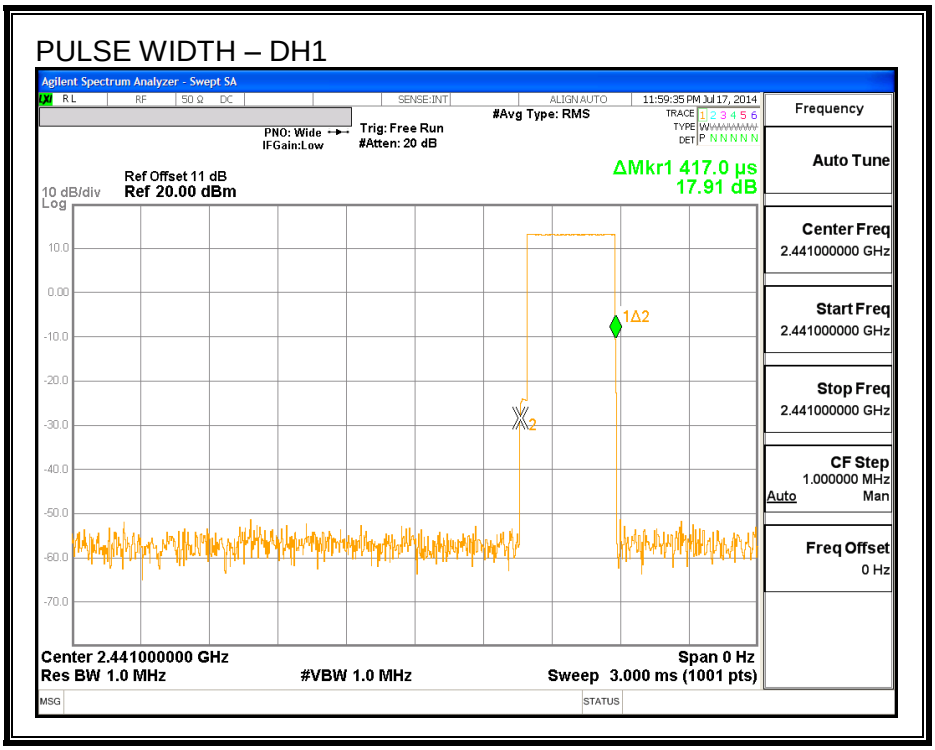
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

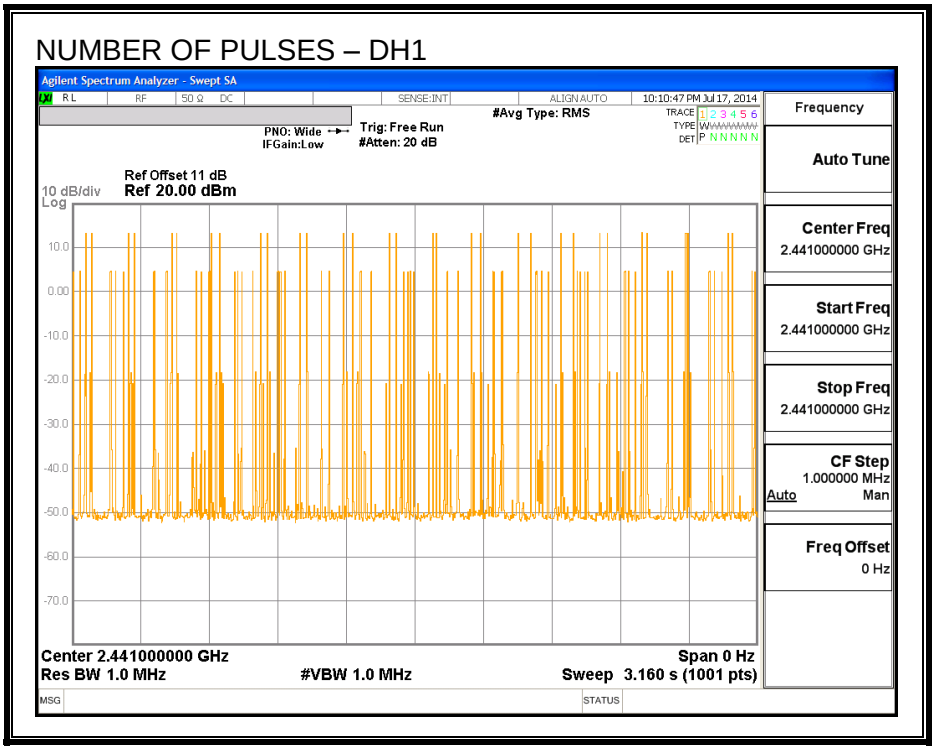
RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.417	32	0.133	0.4	-0.267
DH3	1.674	19	0.318	0.4	-0.082
DH5	2.91	10	0.291	0.4	-0.109

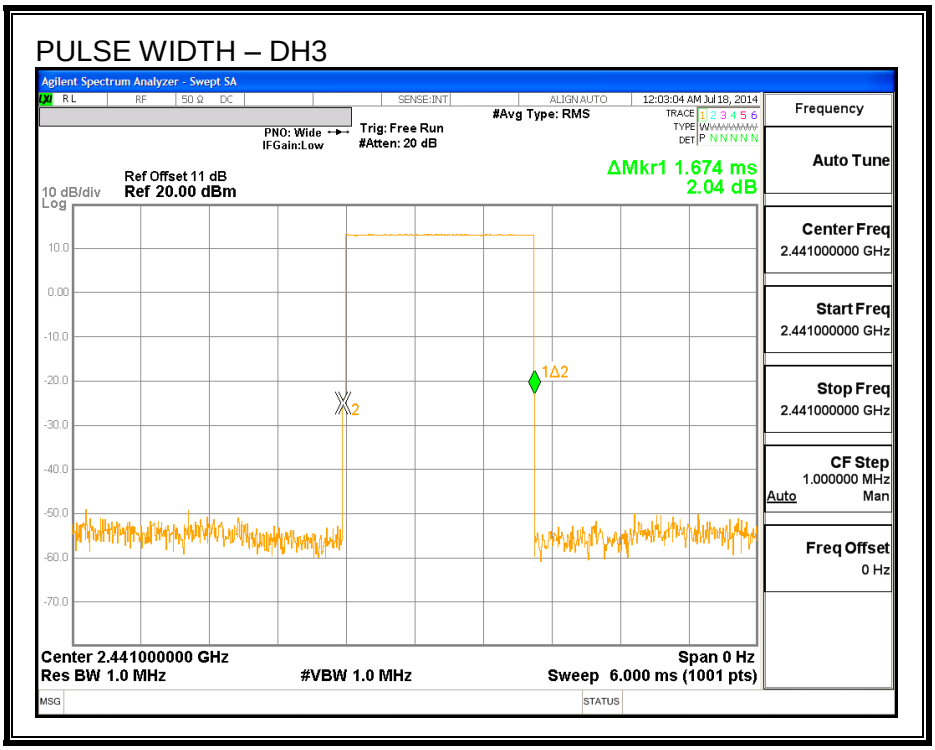
PULSE WIDTH - DH1



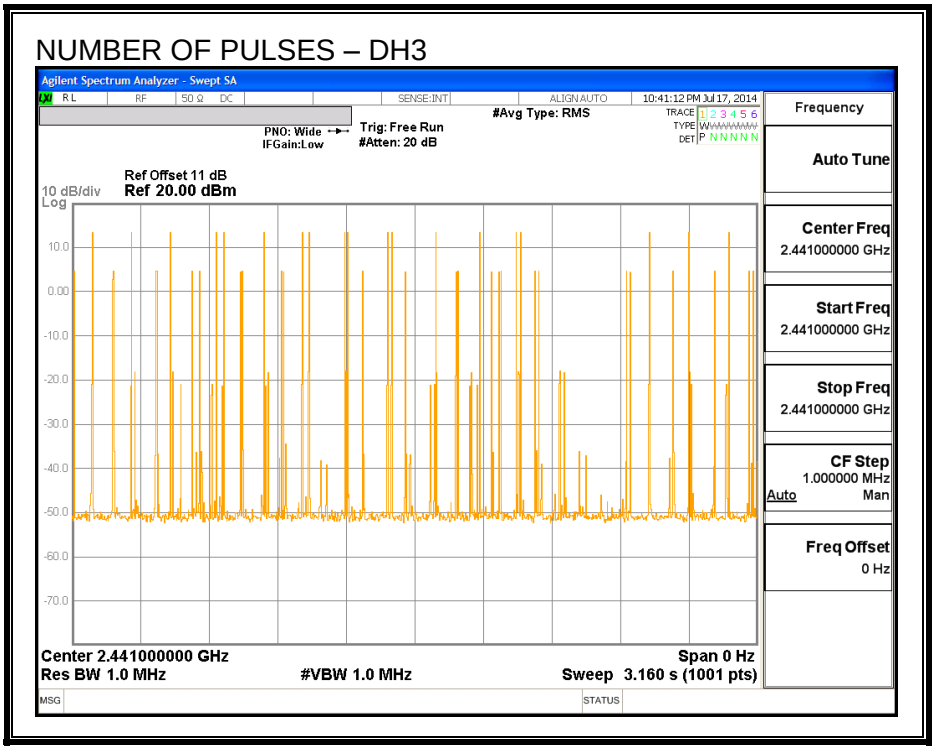
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



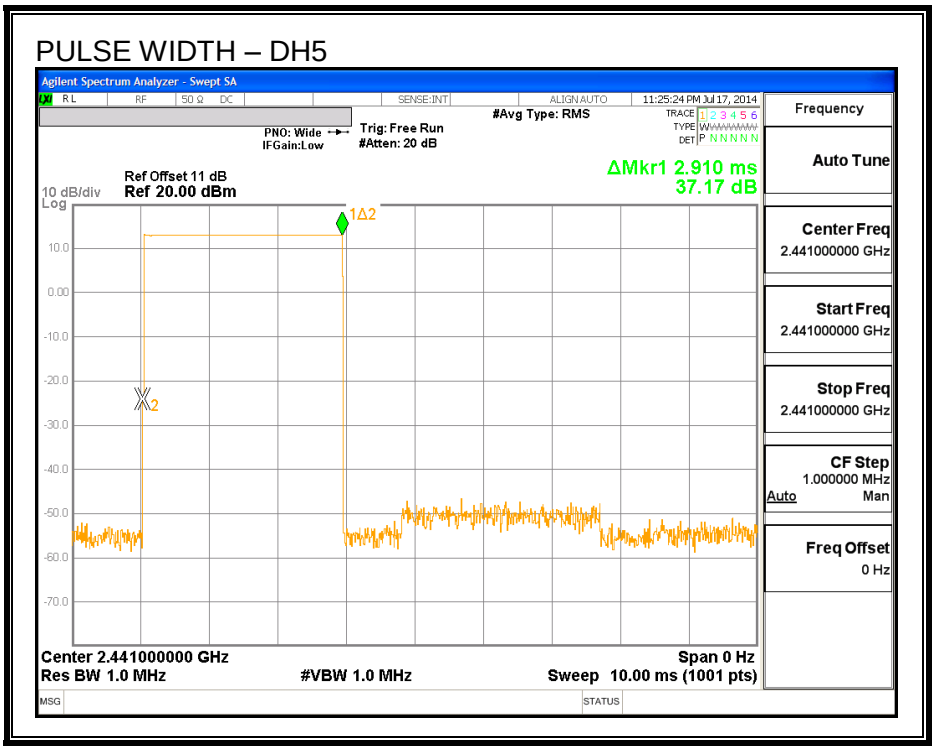
PULSE WIDTH – DH3



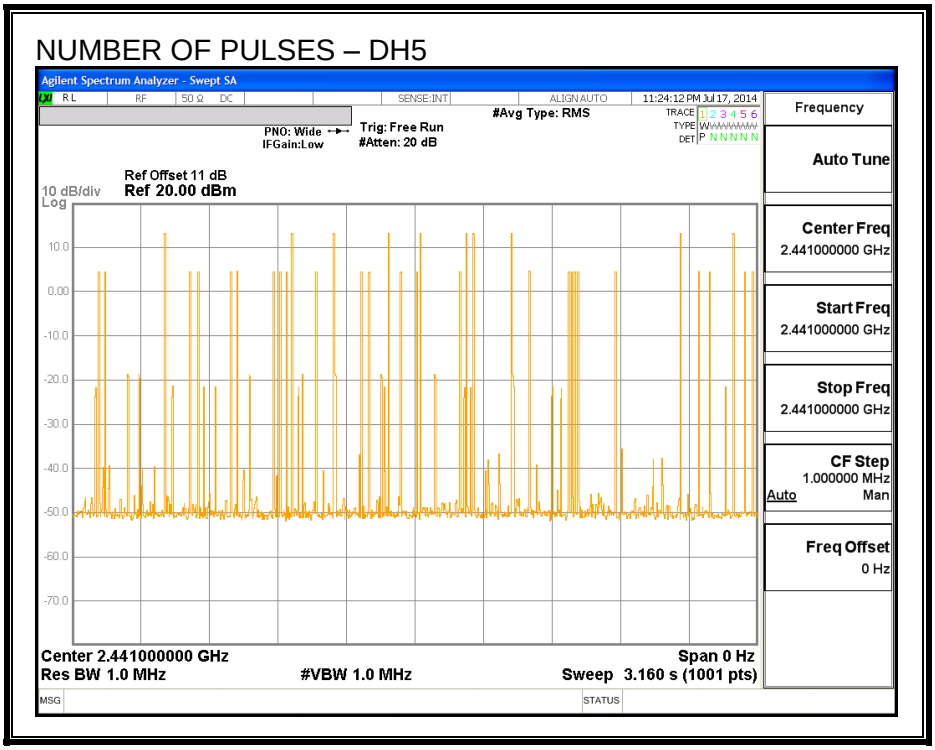
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



9.1.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

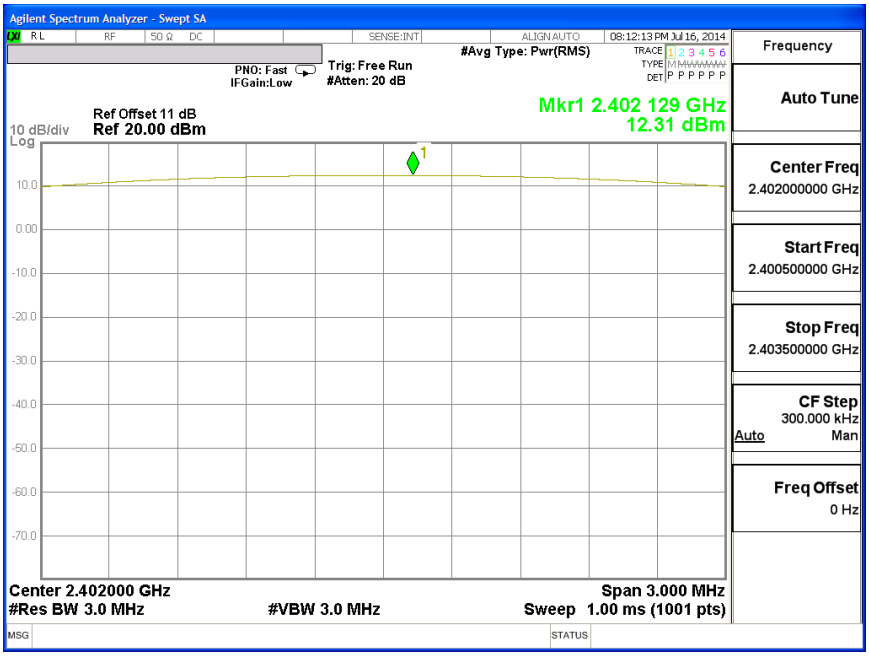
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

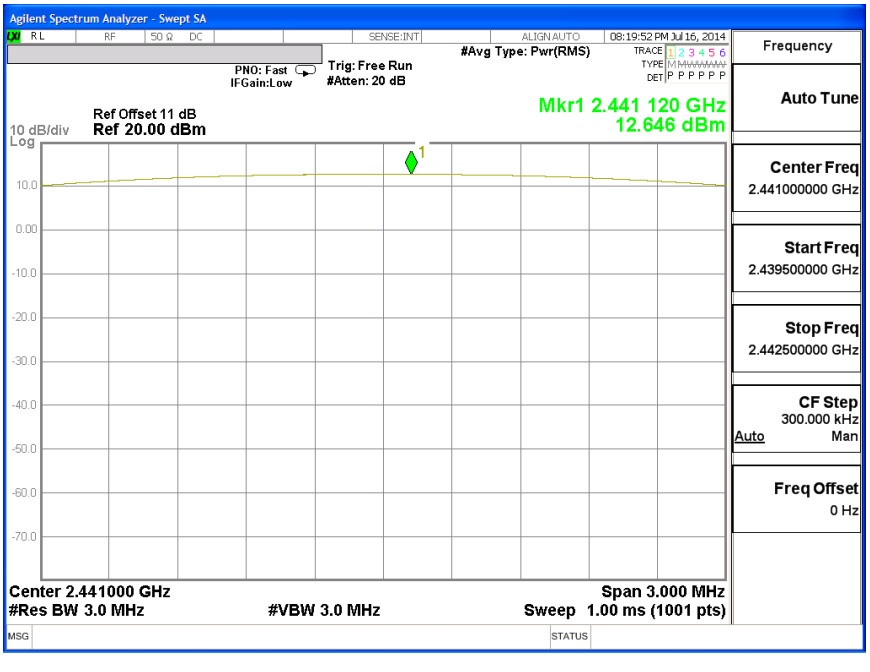
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.31	30	-17.69
Middle	2441	12.65	30	-17.35
High	2480	12.76	30	-17.24

OUTPUT POWER

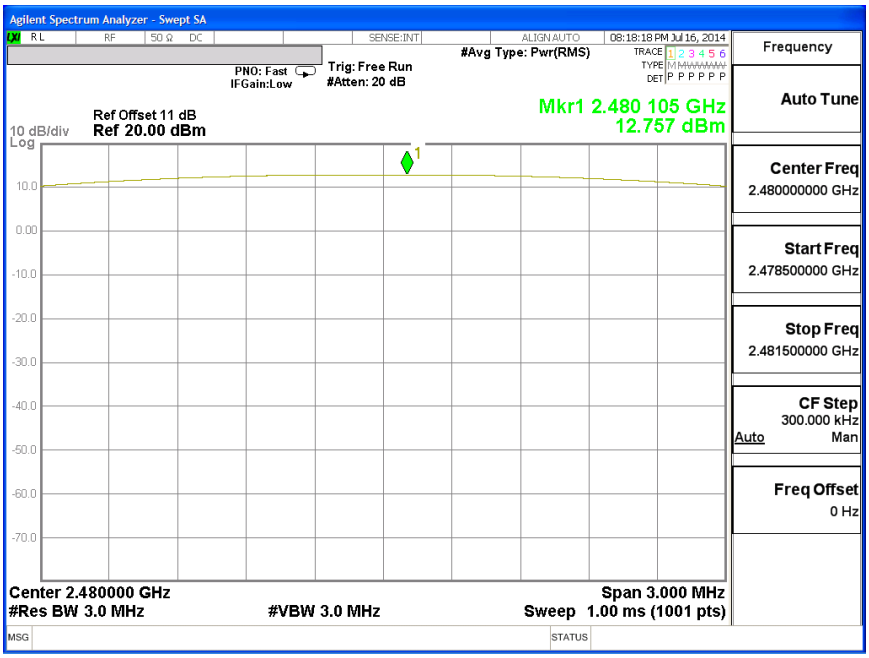
PEAK POWER LOW CH



PEAK POWER MID CH



PEAK POWER HIGH CH



9.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.26
Middle	2441	11.65
High	2480	11.78

9.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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.

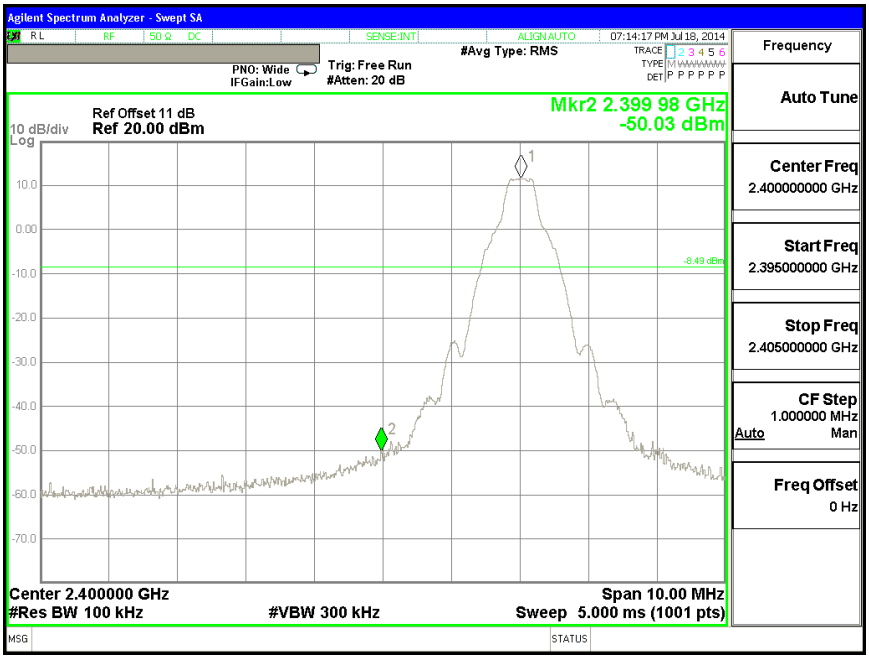
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

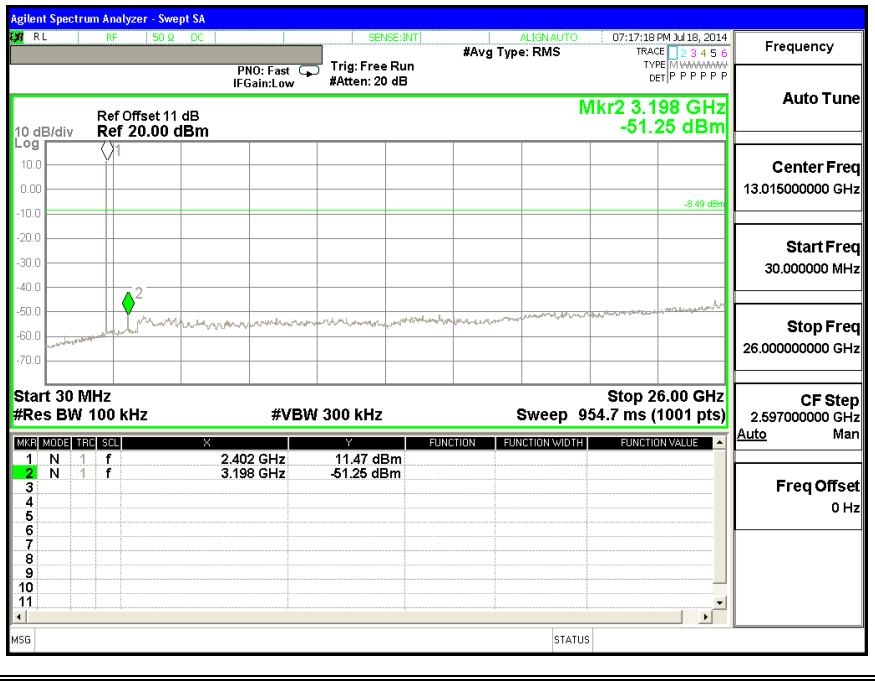
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

LOW CHANNEL BANDEDGE

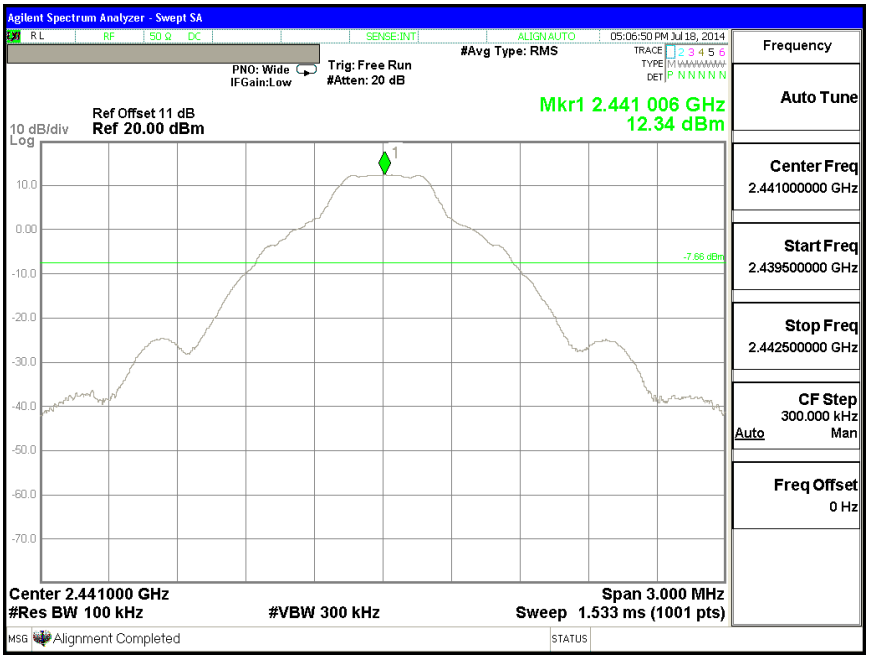


LOW CHANNEL SPURIOUS

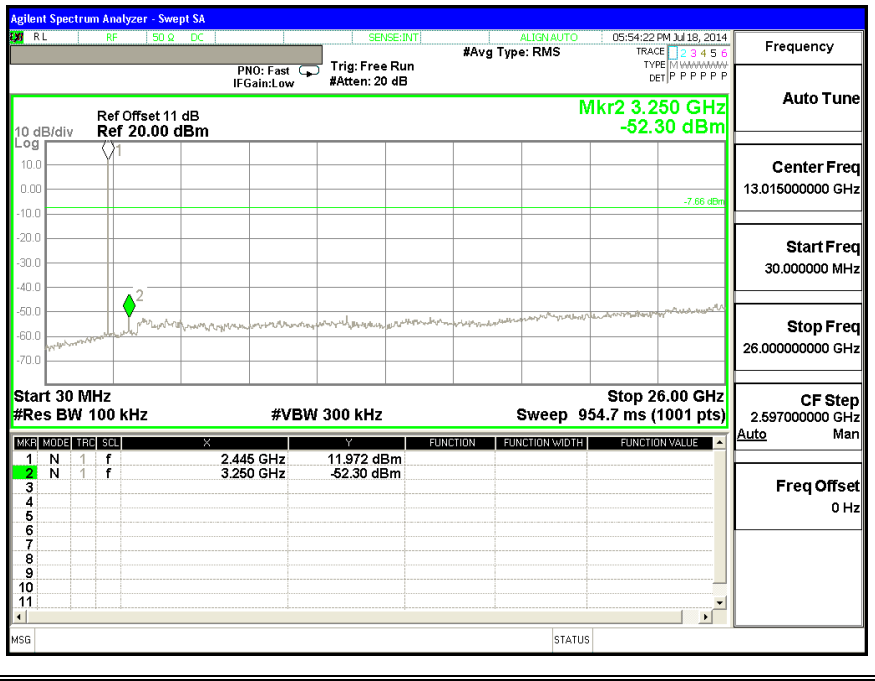


SPURIOUS EMISSIONS, MID CHANNEL

MID CHANNEL REFERENCE

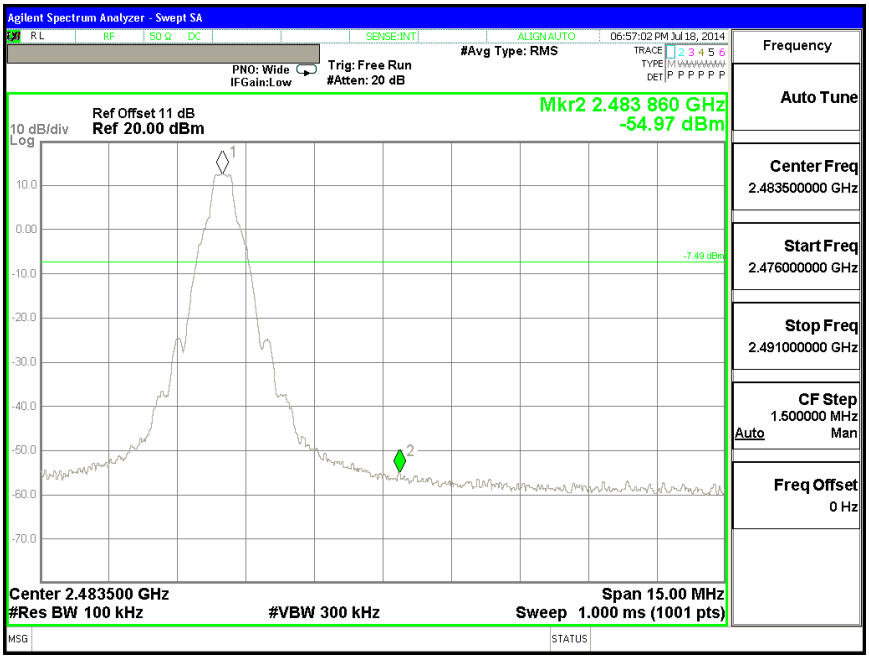


MID CHANNEL SPURIOUS

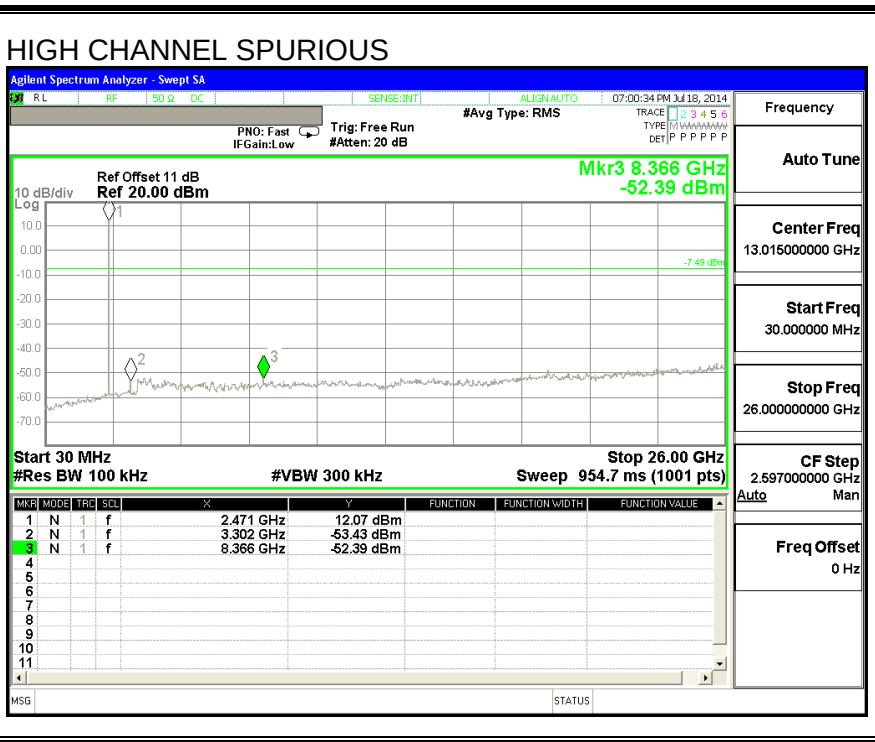


SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CHANNEL BANDEDGE

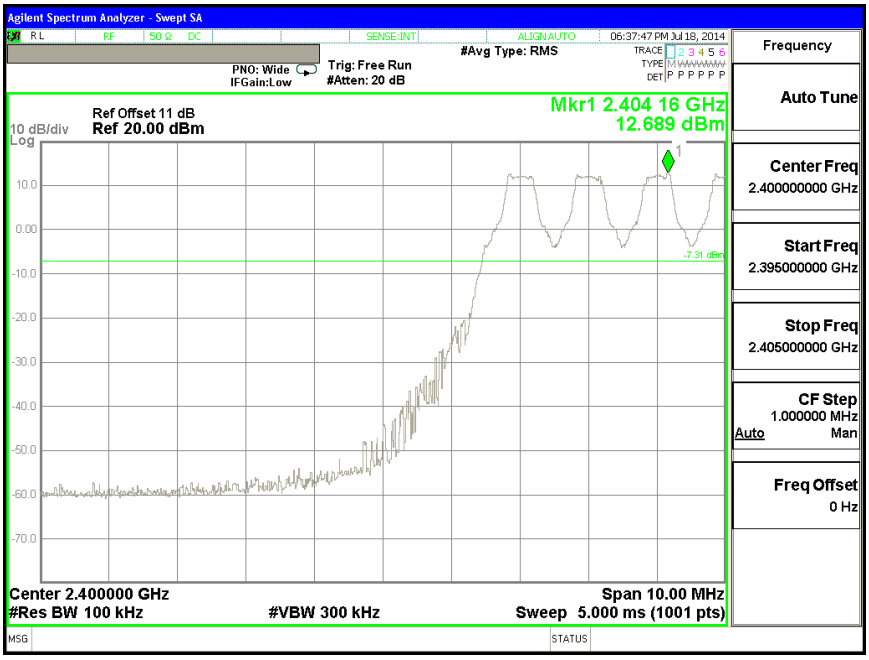


HIGH CHANNEL SPURIOUS

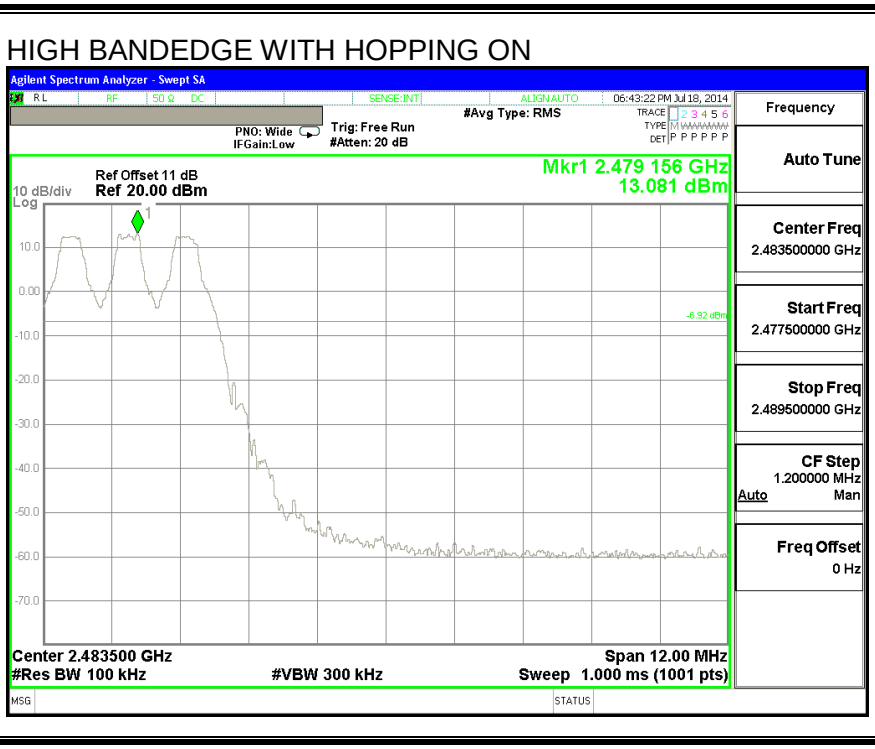


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



9.2. ENHANCED DATA RATE 8PSK MODULATION

9.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

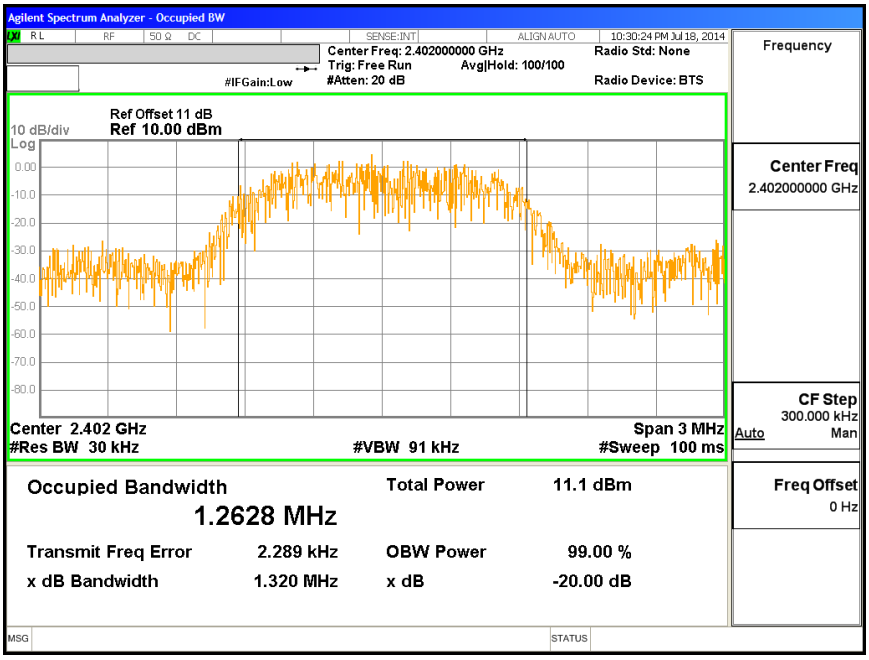
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

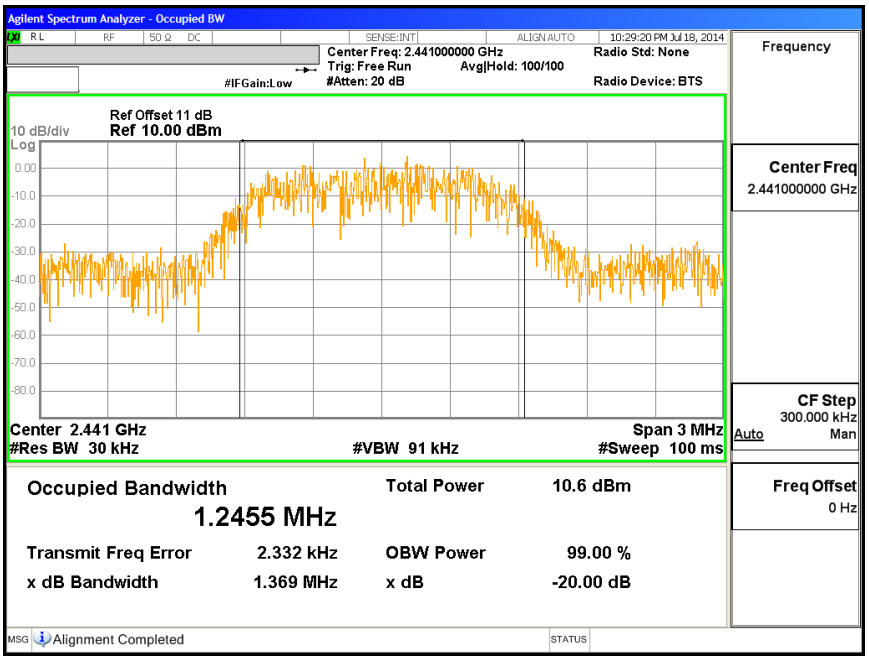
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.32	1.2628
Middle	2441	1.369	1.2455
High	2480	1.384	1.2416

20 dB AND 99% BANDWIDTH

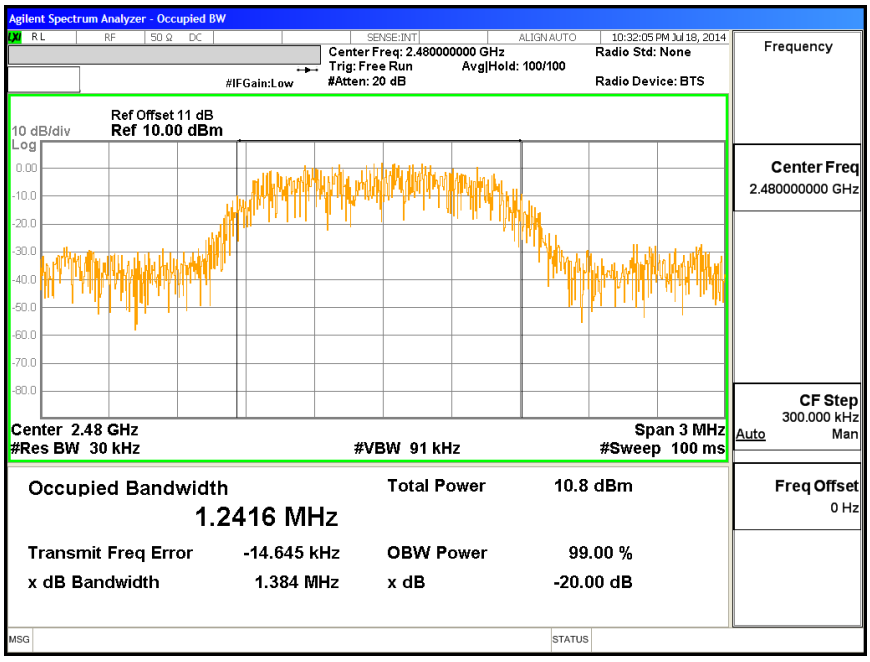
BANDWIDTH LOW CH



BANDWIDTH MID CH



BANDWIDTH HIGH CH



9.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

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

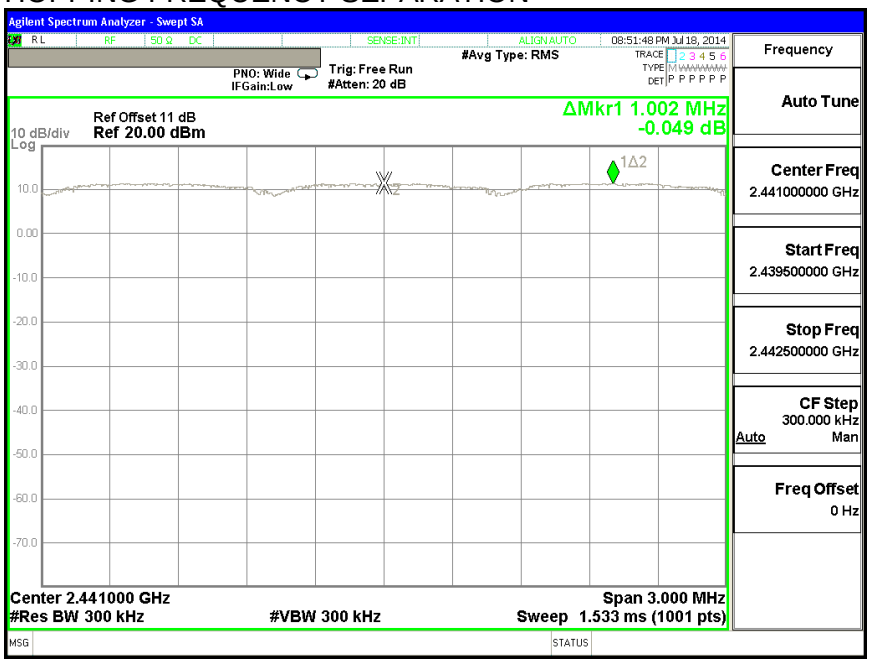
TEST PROCEDURE

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

HOPPING FREQUENCY SEPARATION



9.2.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

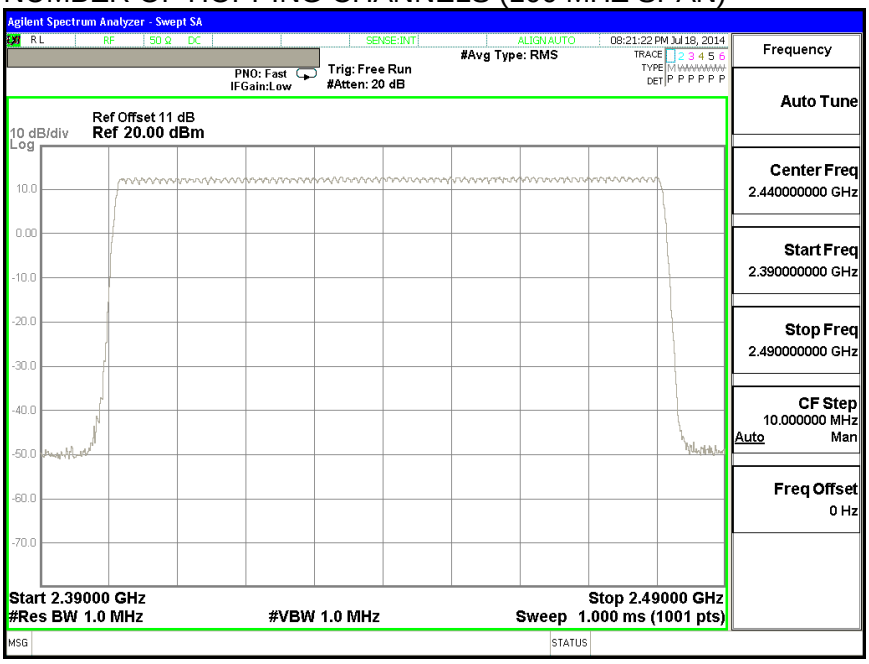
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

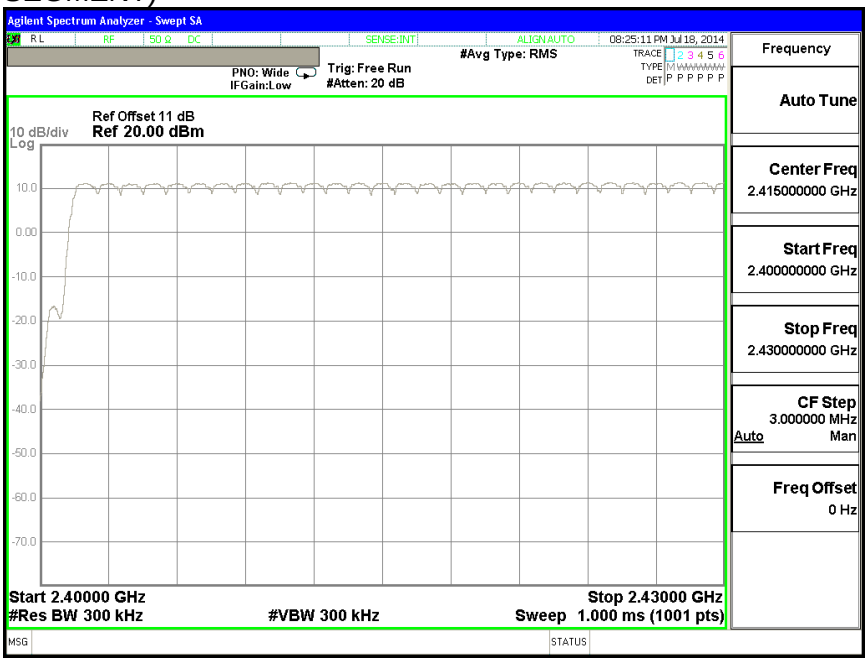
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS

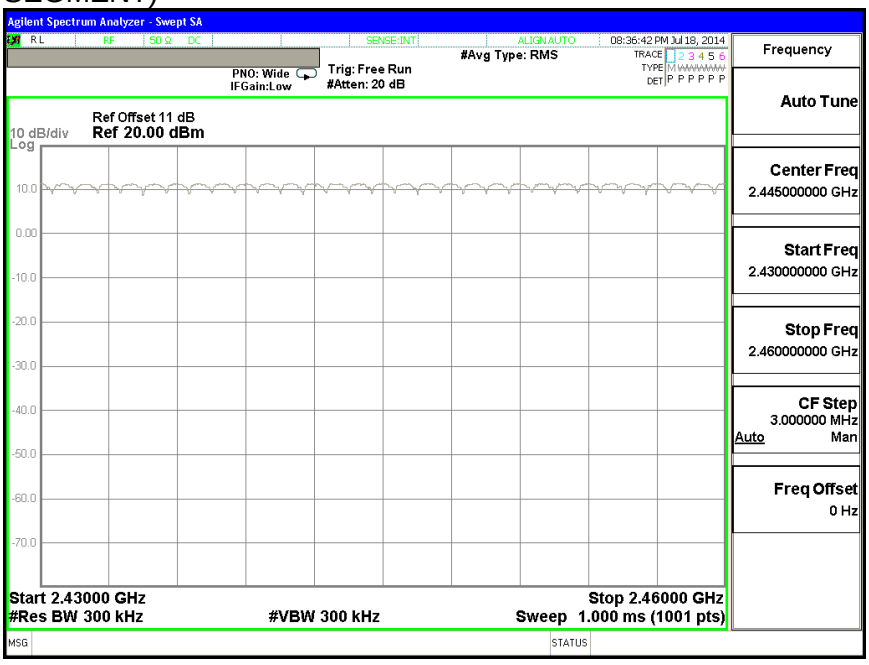
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



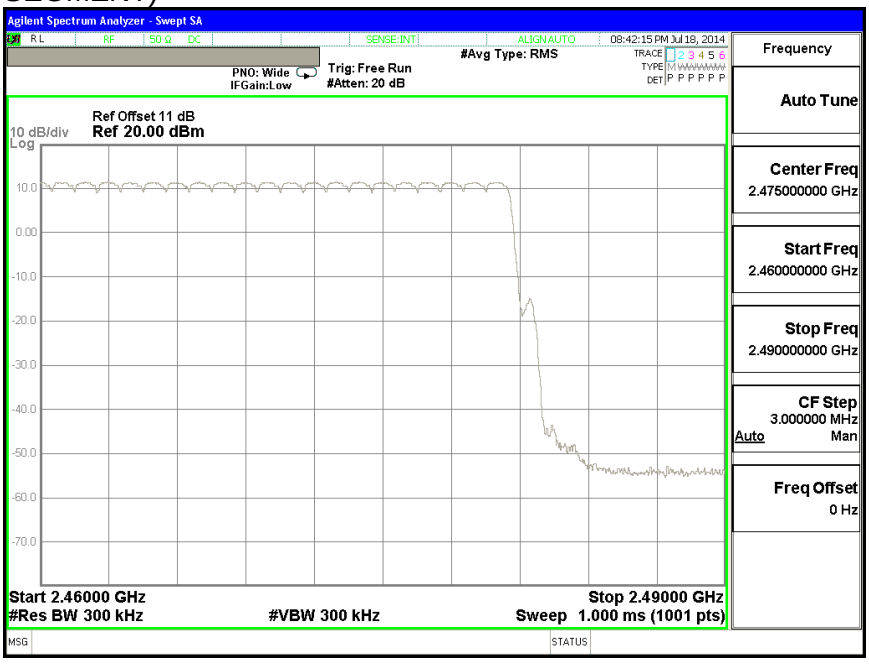
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)



9.2.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

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

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

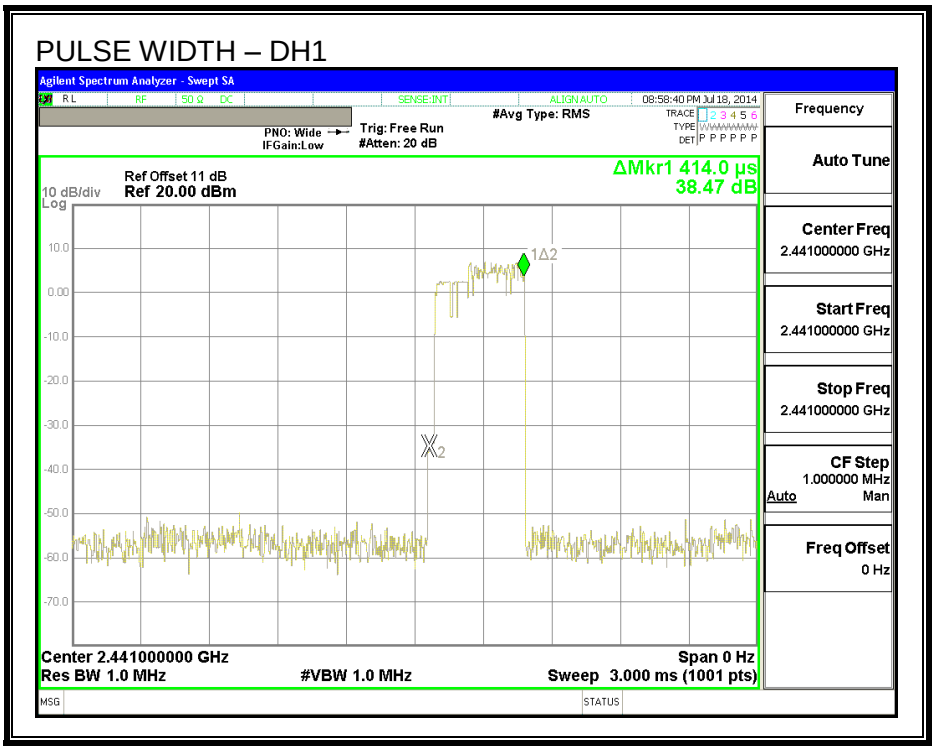
RESULTS

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

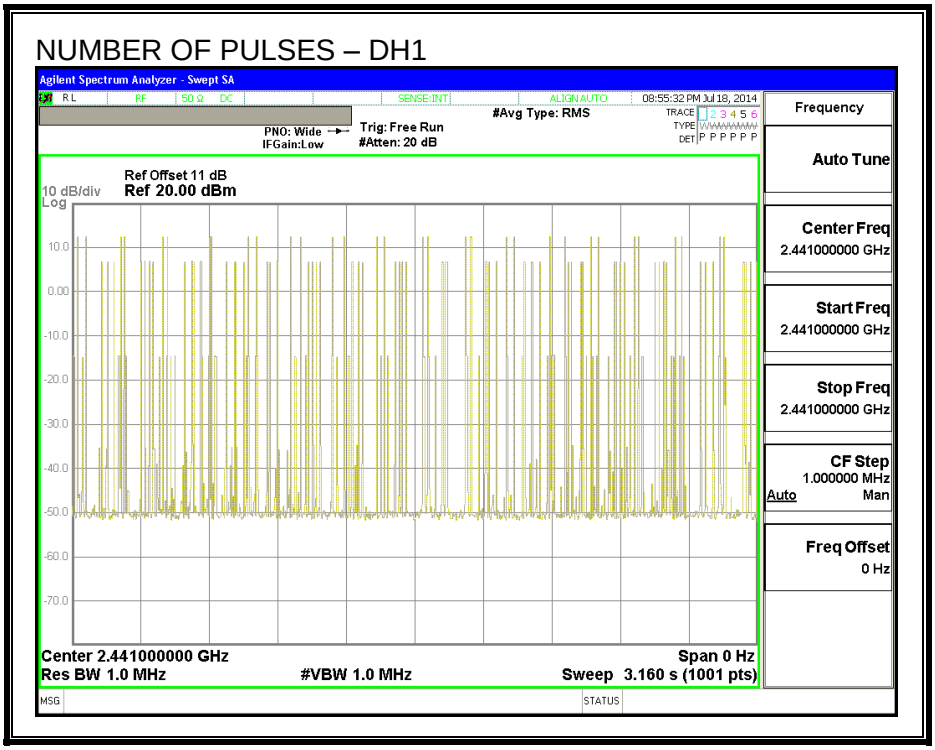
8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.414	31	0.128	0.4	-0.272
3DH3	1.65	17	0.281	0.4	-0.120
3DH5	2.89	11	0.318	0.4	-0.082

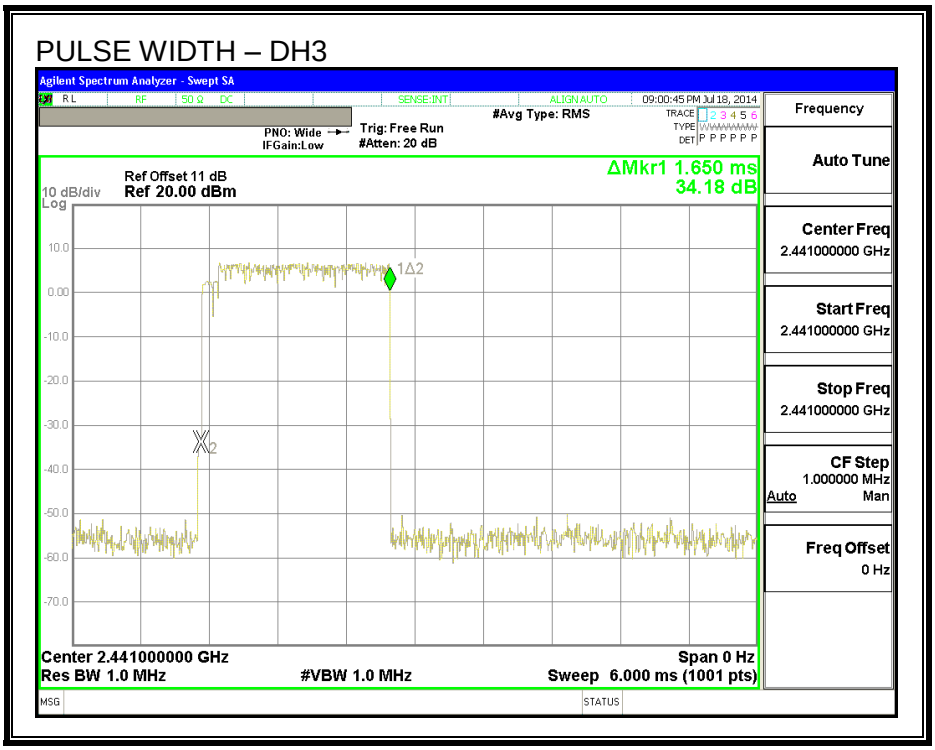
PULSE WIDTH - DH1



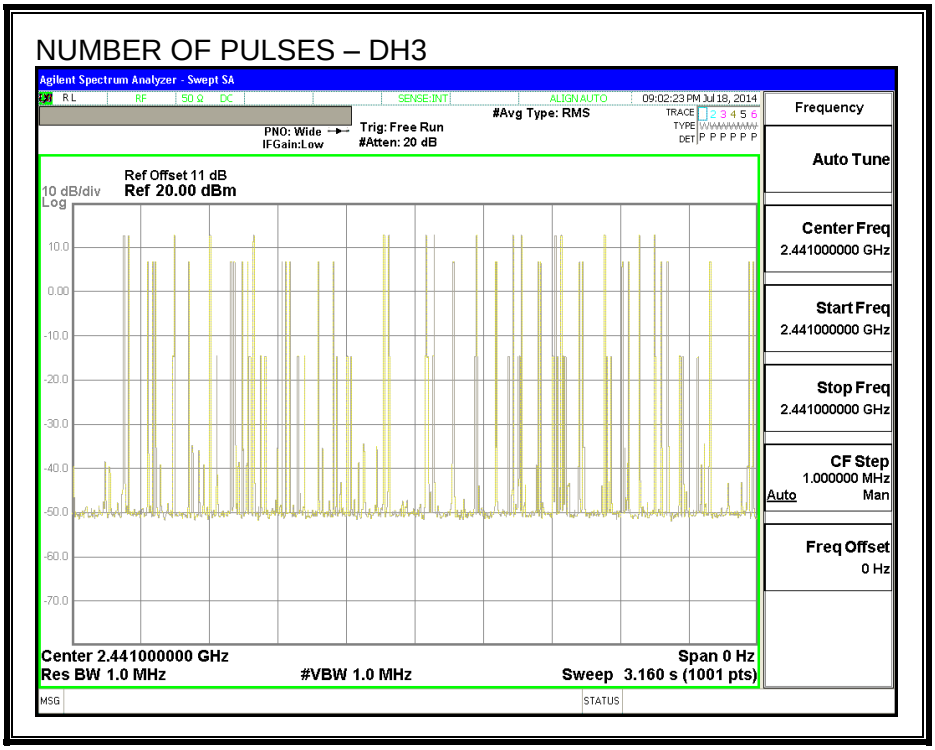
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



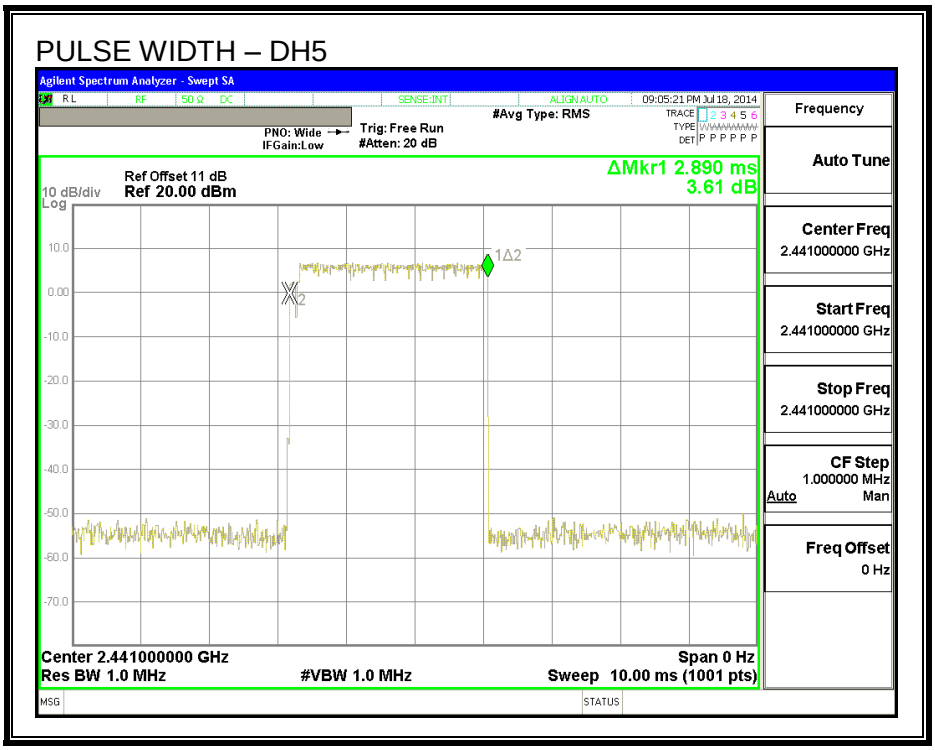
PULSE WIDTH – DH3



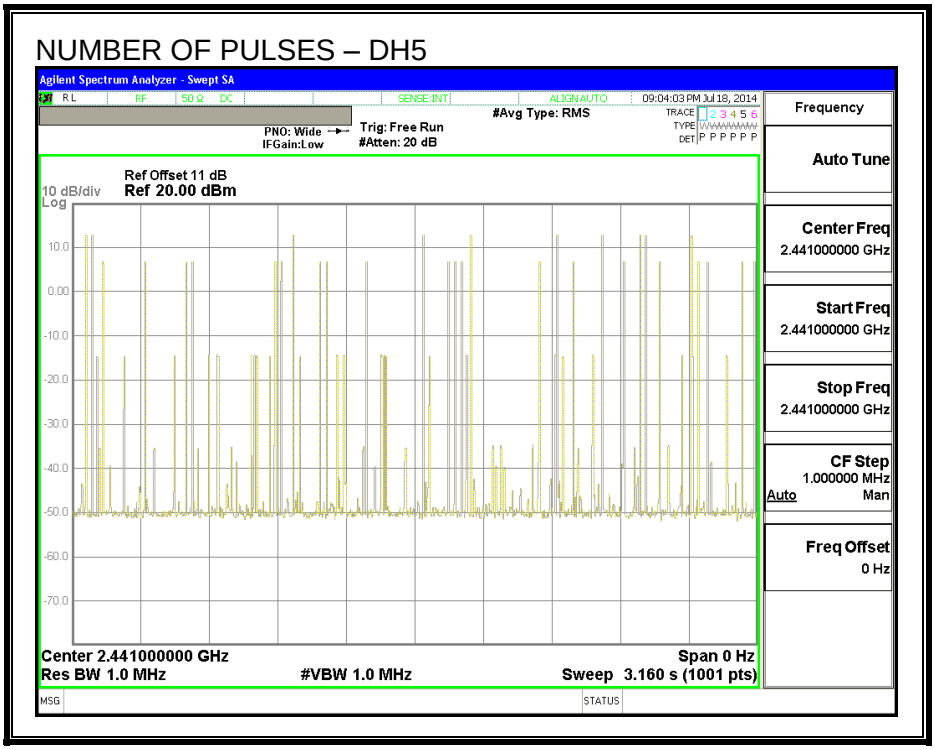
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



9.2.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

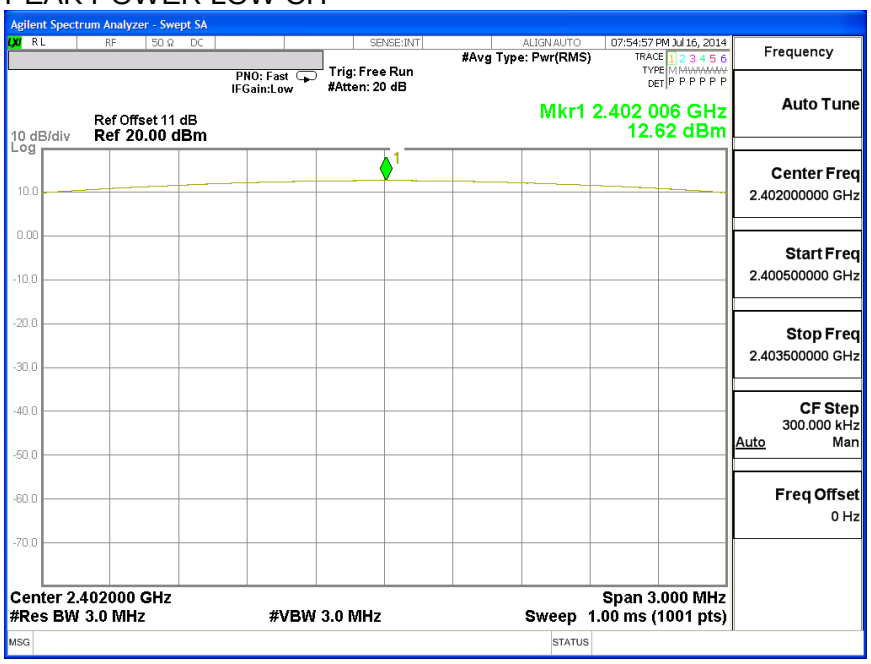
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

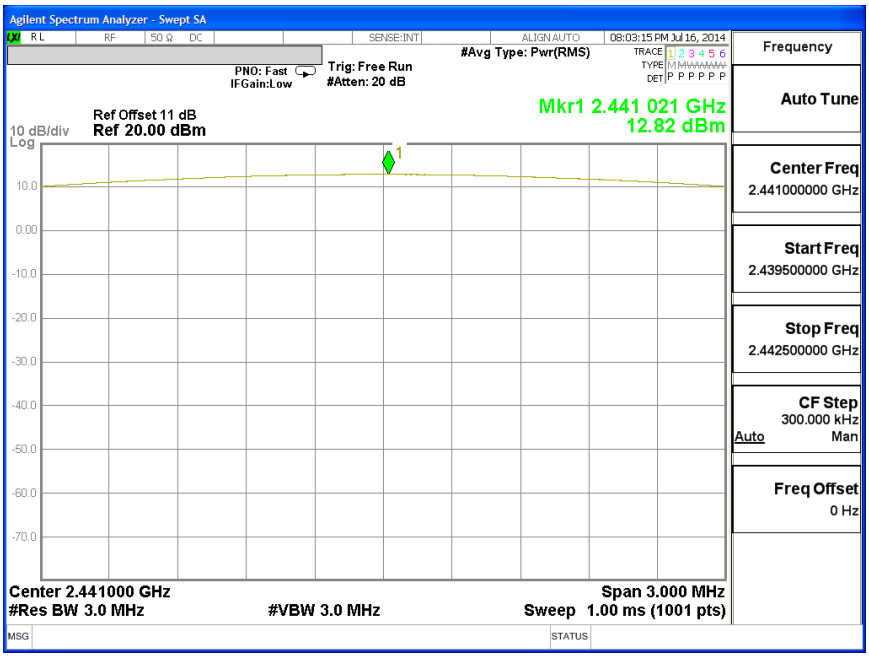
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.62	30	-17.38
Middle	2441	12.82	30	-17.18
High	2480	12.95	30	-17.05

OUTPUT POWER

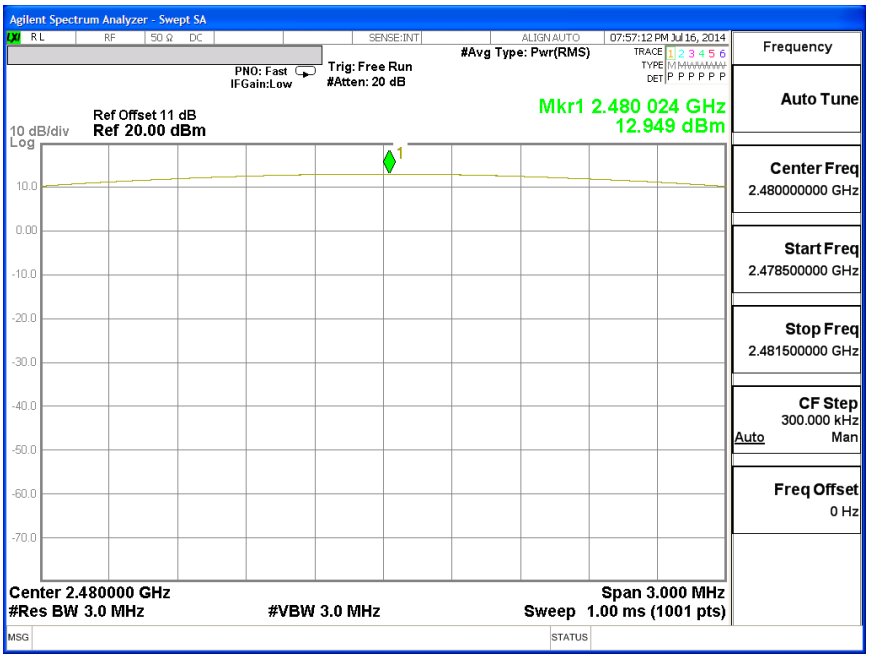
PEAK POWER LOW CH



PEAK POWER MID CH



PEAK POWER HIGH CH



9.2.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.71
Middle	2441	10.02
High	2480	9.67

9.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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.

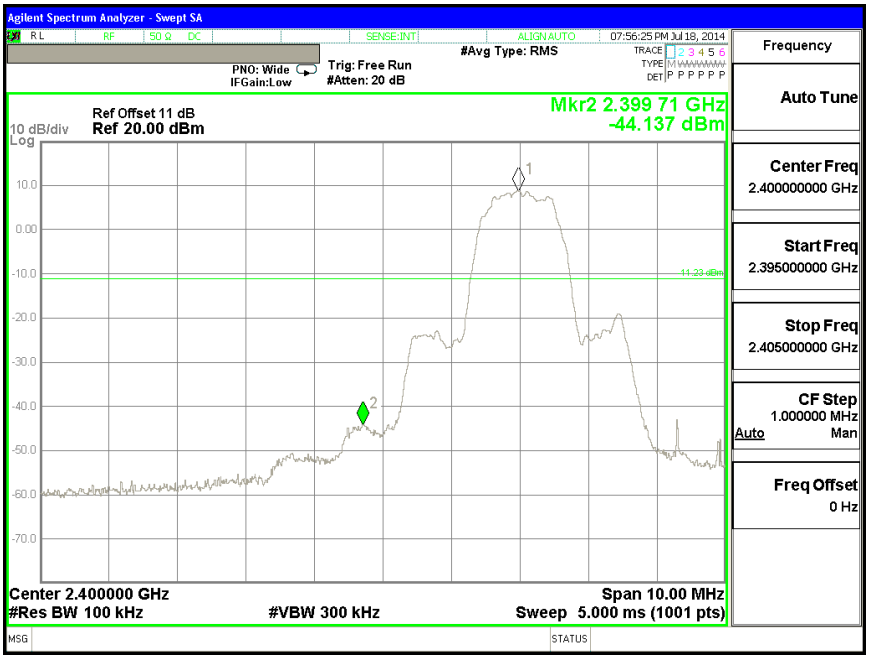
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

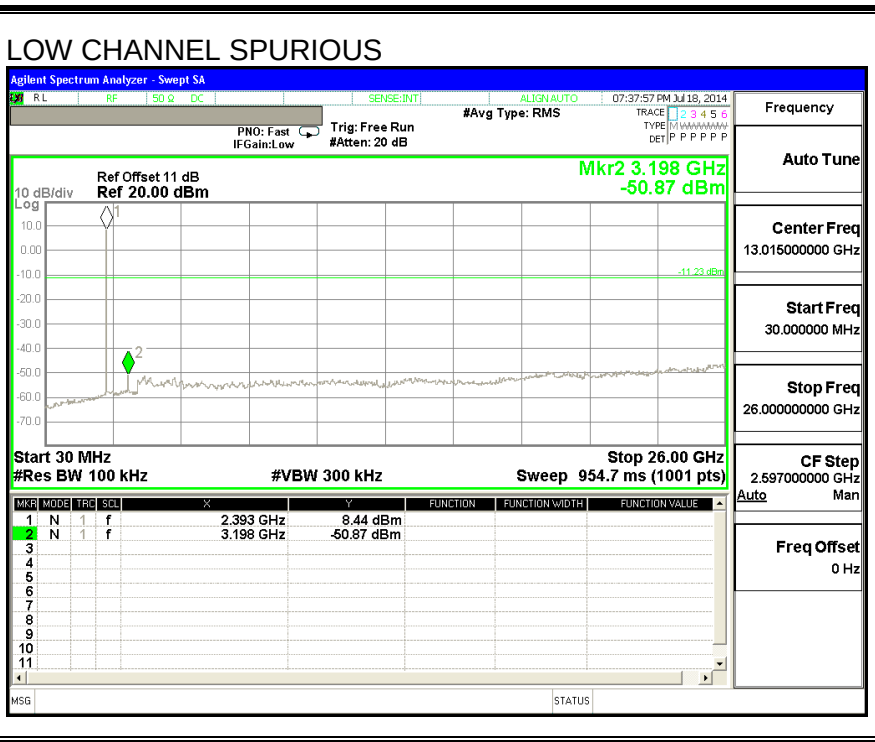
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

LOW CHANNEL BANDEDGE

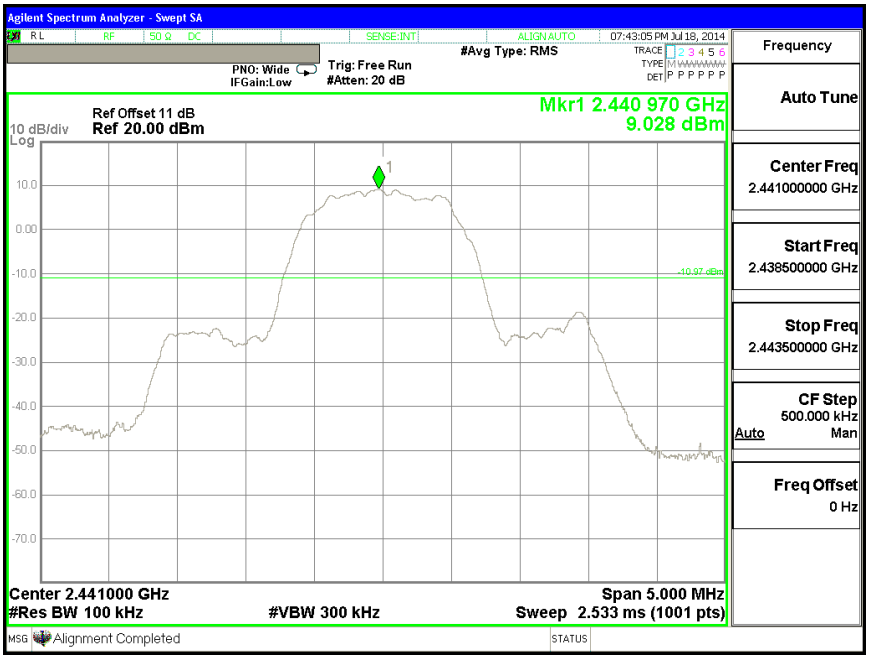


LOW CHANNEL SPURIOUS

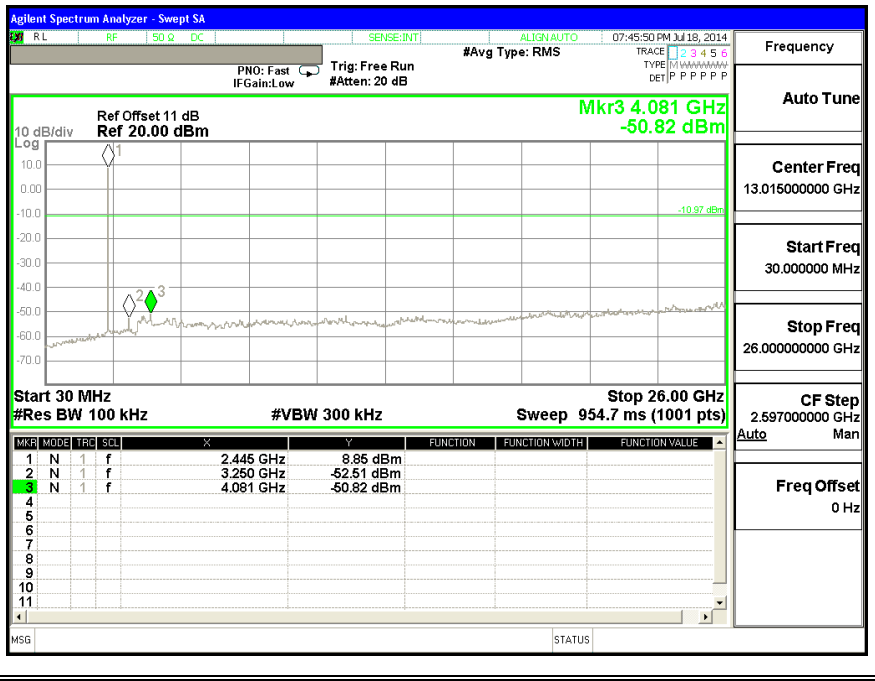


SPURIOUS EMISSIONS, MID CHANNEL

MID CHANNEL REFERENCE

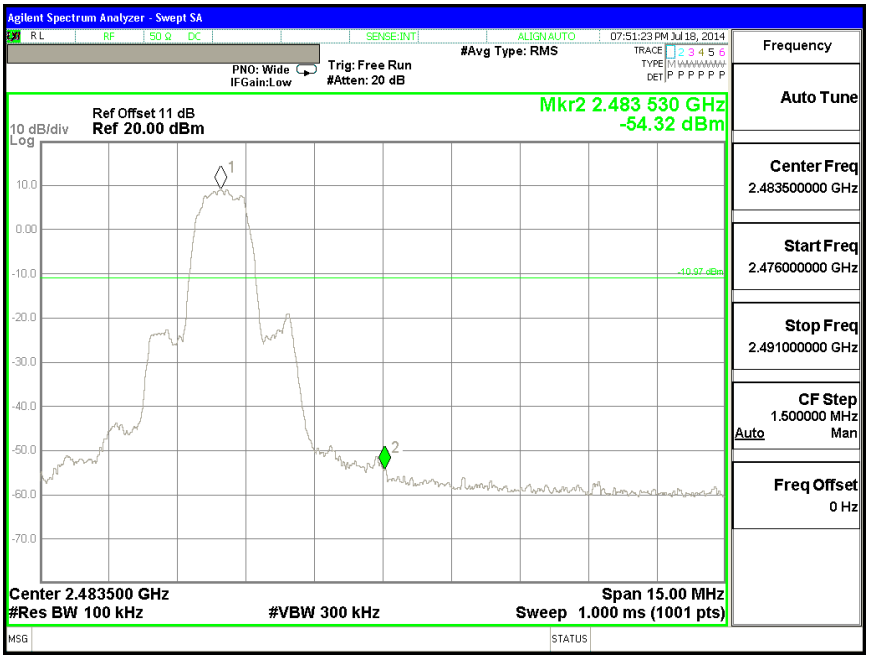


MID CHANNEL SPURIOUS

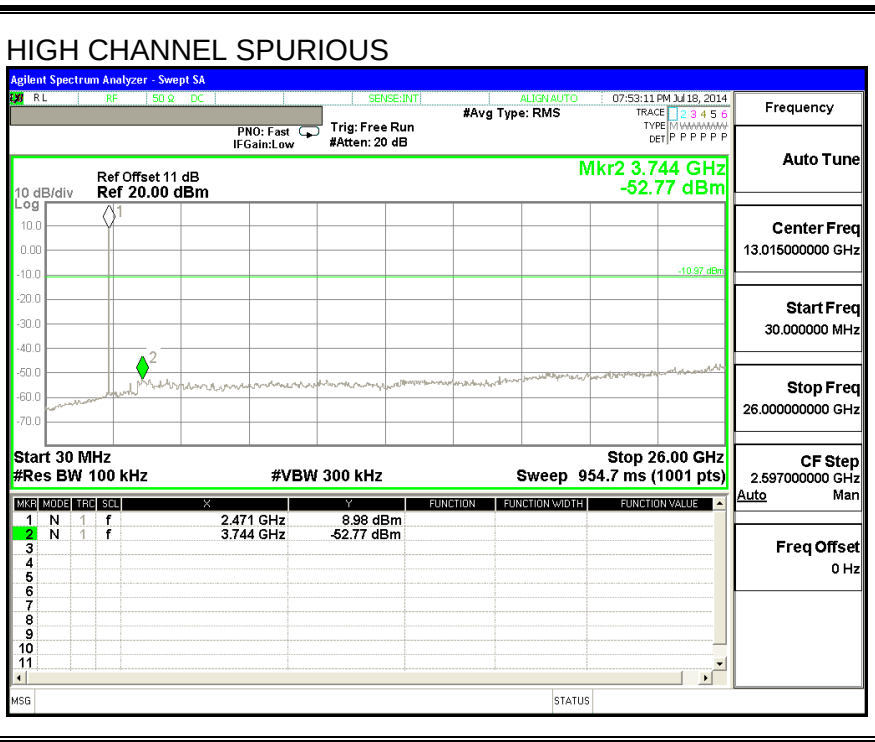


SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CHANNEL BANDEDGE

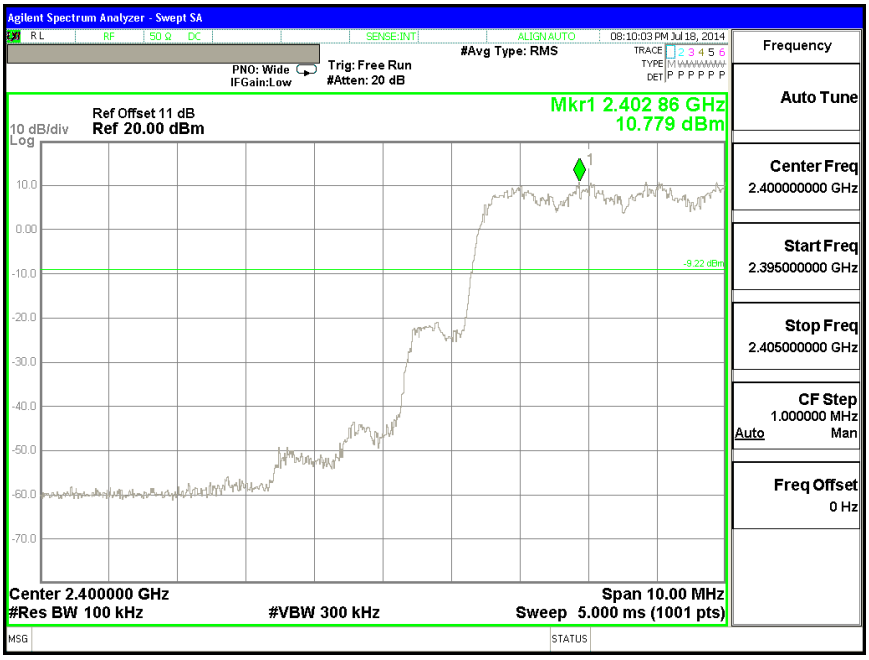


HIGH CHANNEL SPURIOUS

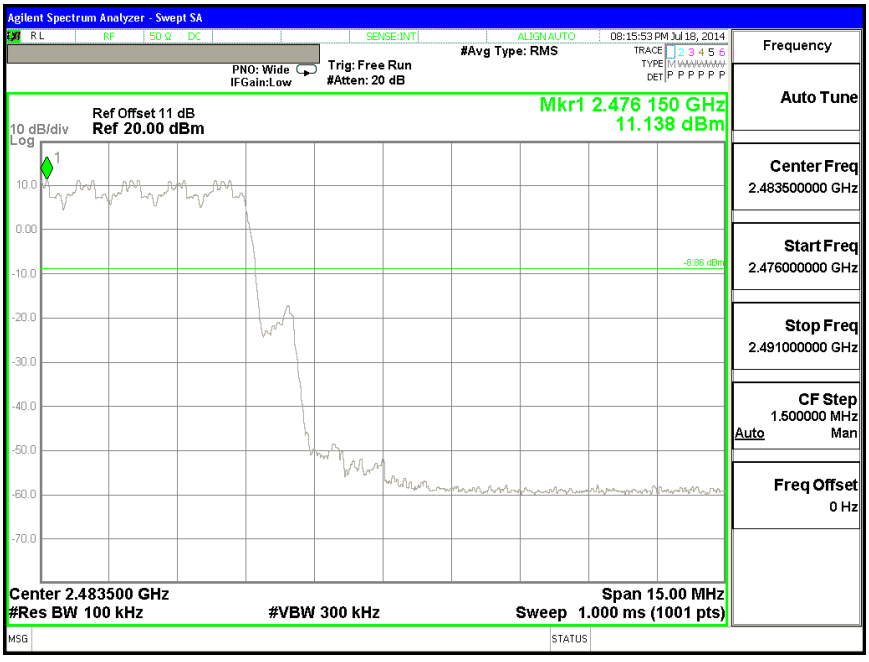


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (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 C63.4. 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, then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

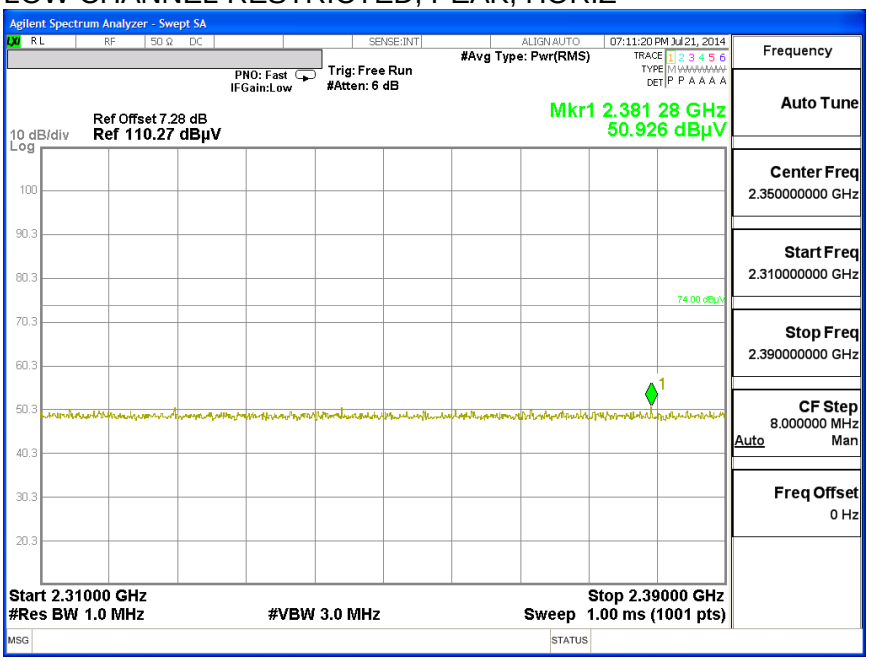
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

10.2. TRANSMITTER ABOVE 1GHz

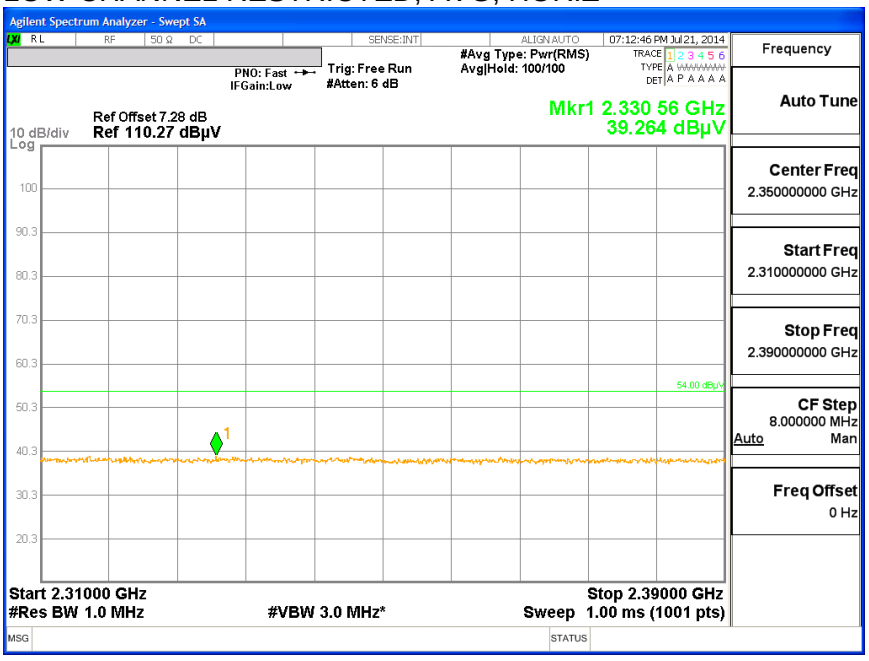
10.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

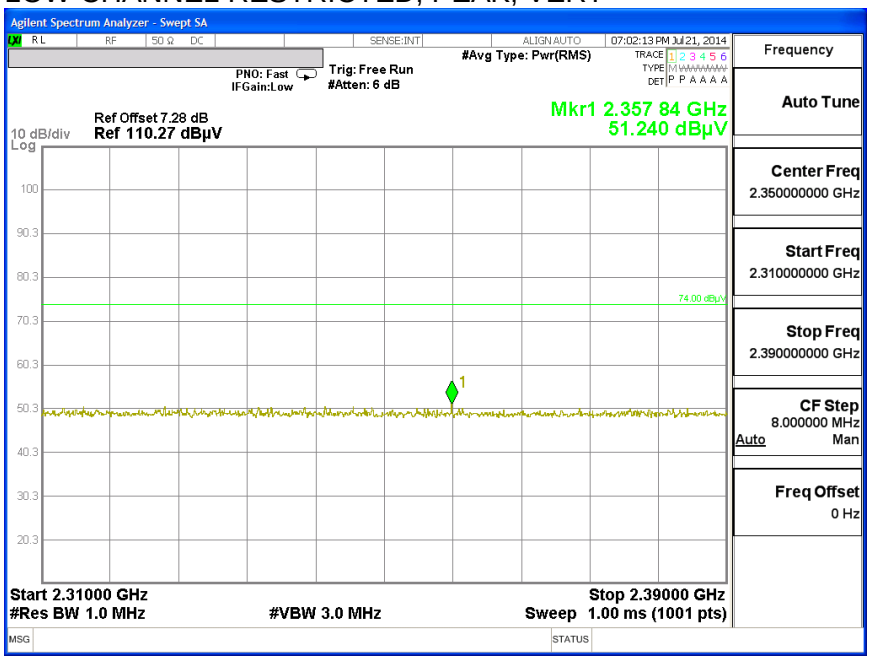


LOW CHANNEL RESTRICTED, AVG, HORIZ

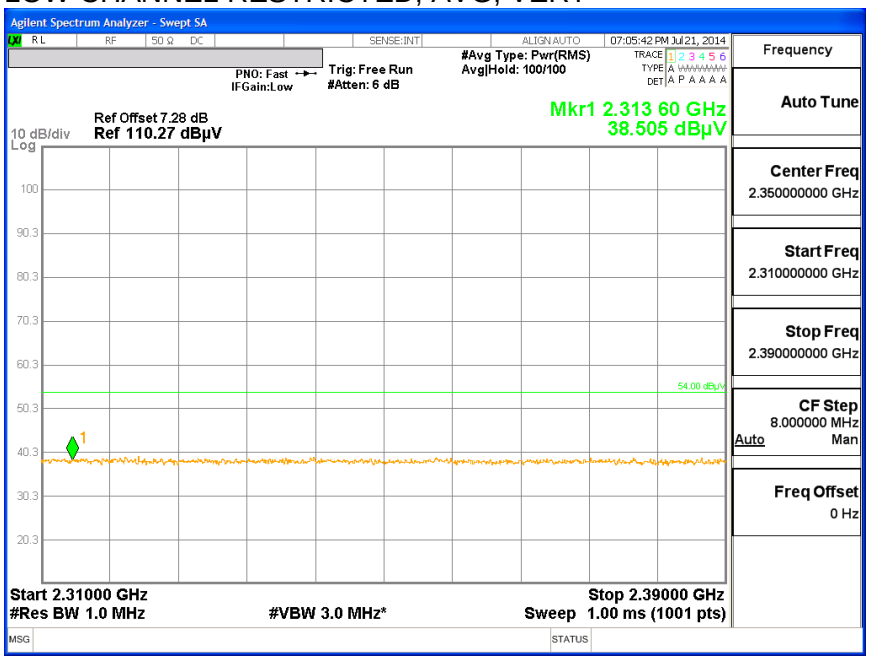


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

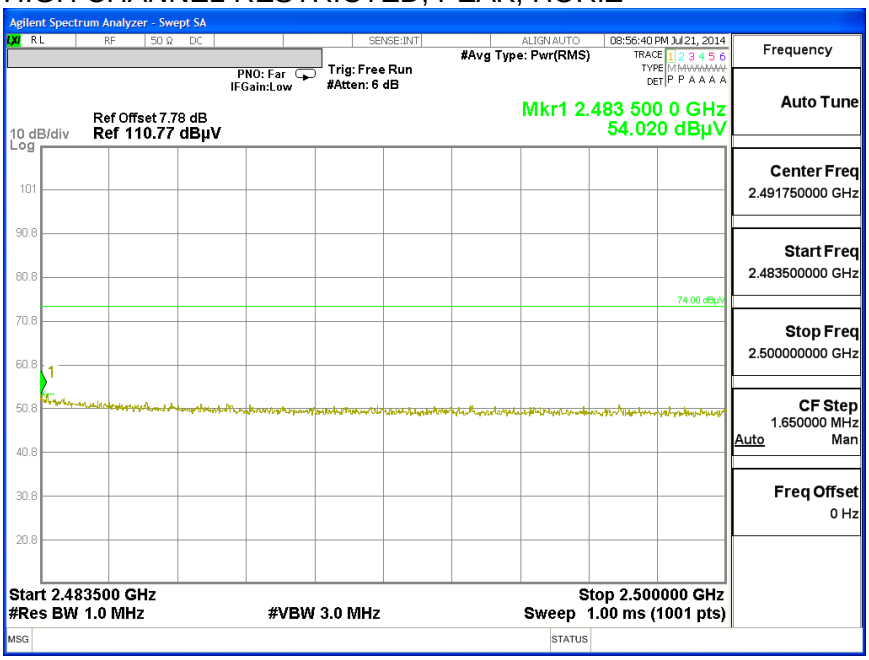


LOW CHANNEL RESTRICTED, AVG, VERT

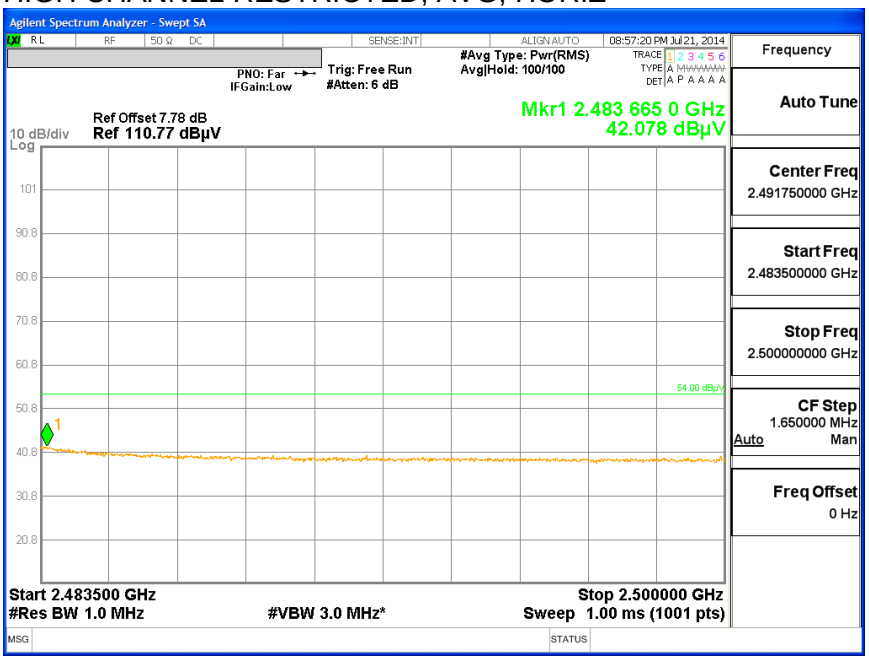


RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL RESTRICTED, PEAK, HORIZ

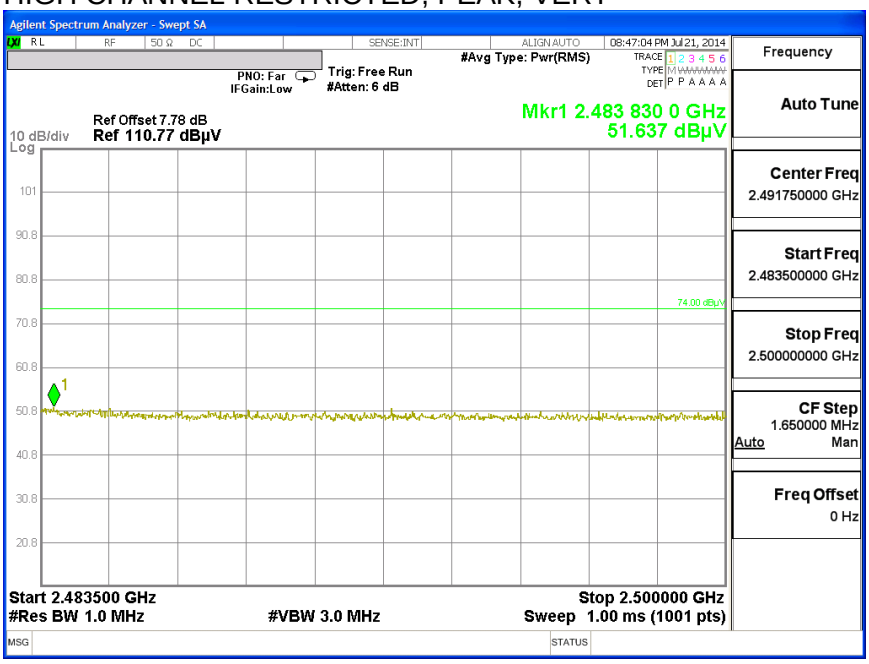


HIGH CHANNEL RESTRICTED, AVG, HORIZ

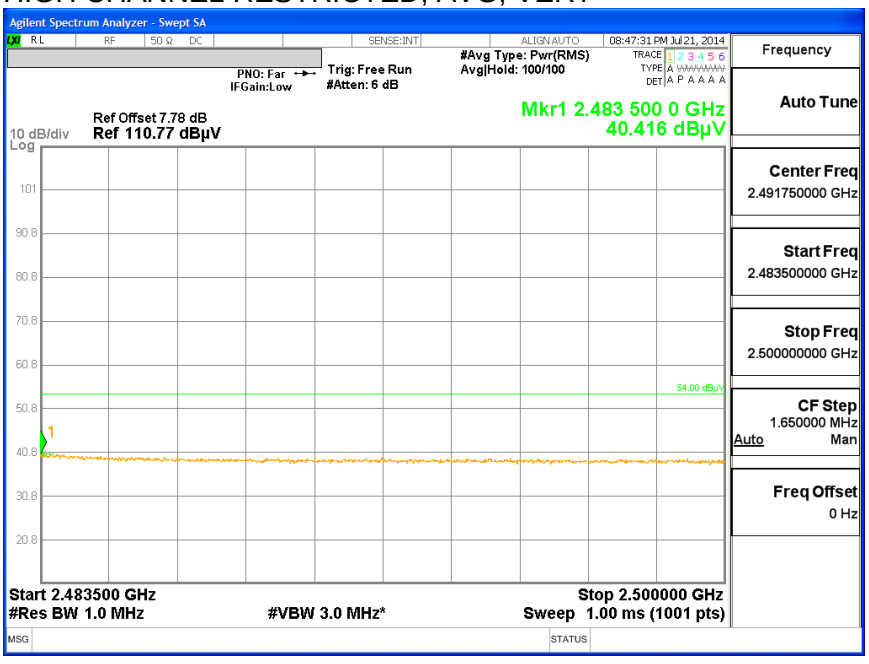


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL RESTRICTED, PEAK, VERT

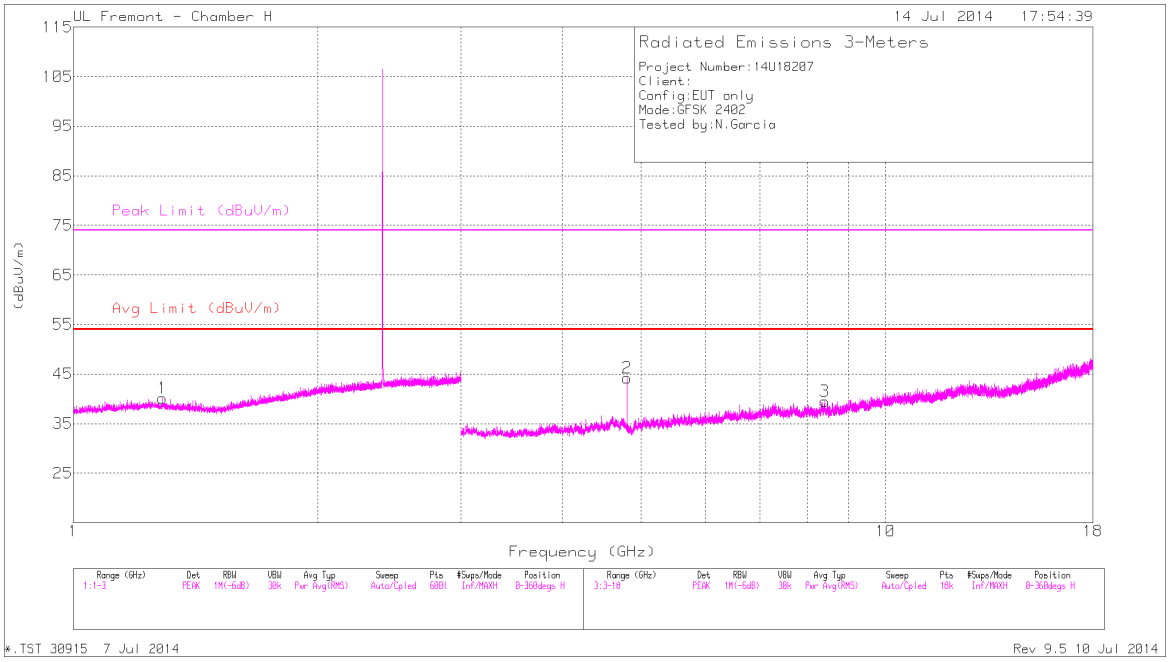


HIGH CHANNEL RESTRICTED, AVG, VERT

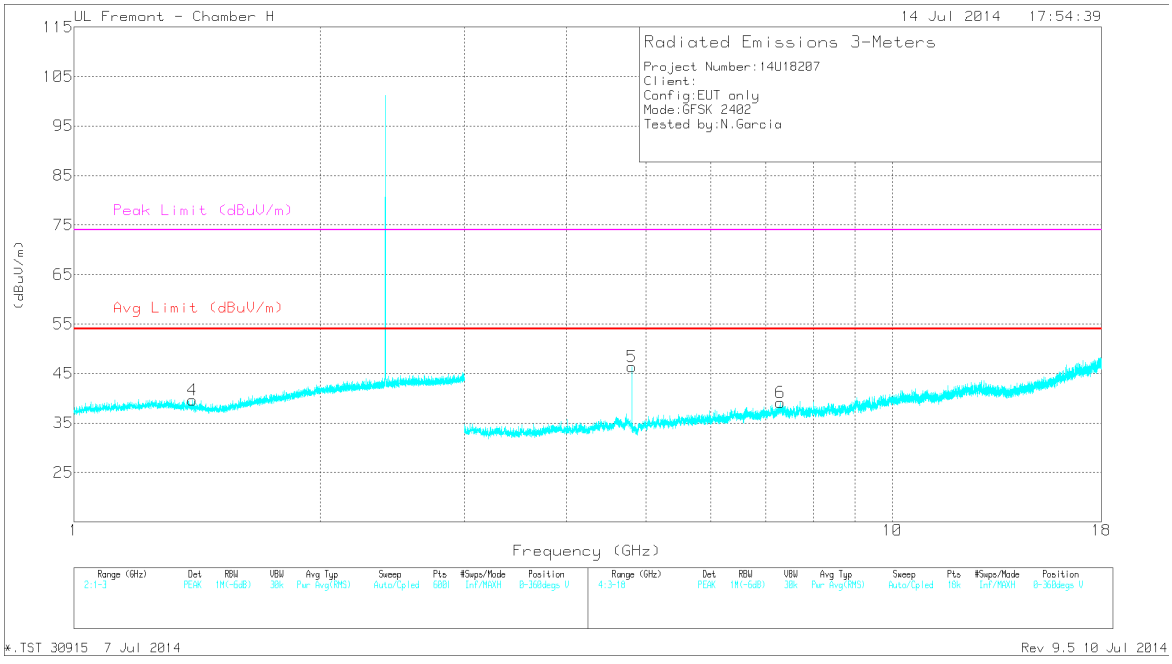


LOW CHANNEL HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.288	44.13	PK3	28.8	-25.8	47.13	-	-	74	-26.87	55	107	H
	* 1.287	31.1	VB10	28.8	-25.8	34.1	54	-19.9	-	-	55	107	H
4	* 1.396	43.91	PK3	28.2	-25.6	46.51	-	-	74	-27.49	115	197	V
	* 1.394	30.82	VB10	28.2	-25.6	33.42	54	-20.58	-	-	115	197	V
3	* 8.418	38.29	PK3	36.1	-27.6	46.79	-	-	74	-27.21	121	100	H
	* 8.42	25.58	VB10	36.1	-27.7	33.98	54	-20.02	-	-	121	100	H
2	* 4.804	46.79	PK3	34.3	-32.5	48.59	-	-	74	-25.41	11	110	H
	* 4.804	41.08	VB10	34.3	-32.5	42.88	54	-11.12	-	-	11	110	H
5	* 4.804	49.24	PK3	34.3	-32.5	51.04	-	-	74	-22.96	8	168	V
	* 4.804	44.96	VB10	34.3	-32.5	46.76	54	-7.24	-	-	8	168	V
6	* 7.296	38.96	PK3	36.2	-29.2	45.96	-	-	74	-28.04	127	209	V
	* 7.296	26.46	VB10	36.2	-29.2	33.46	54	-20.54	-	-	127	209	V

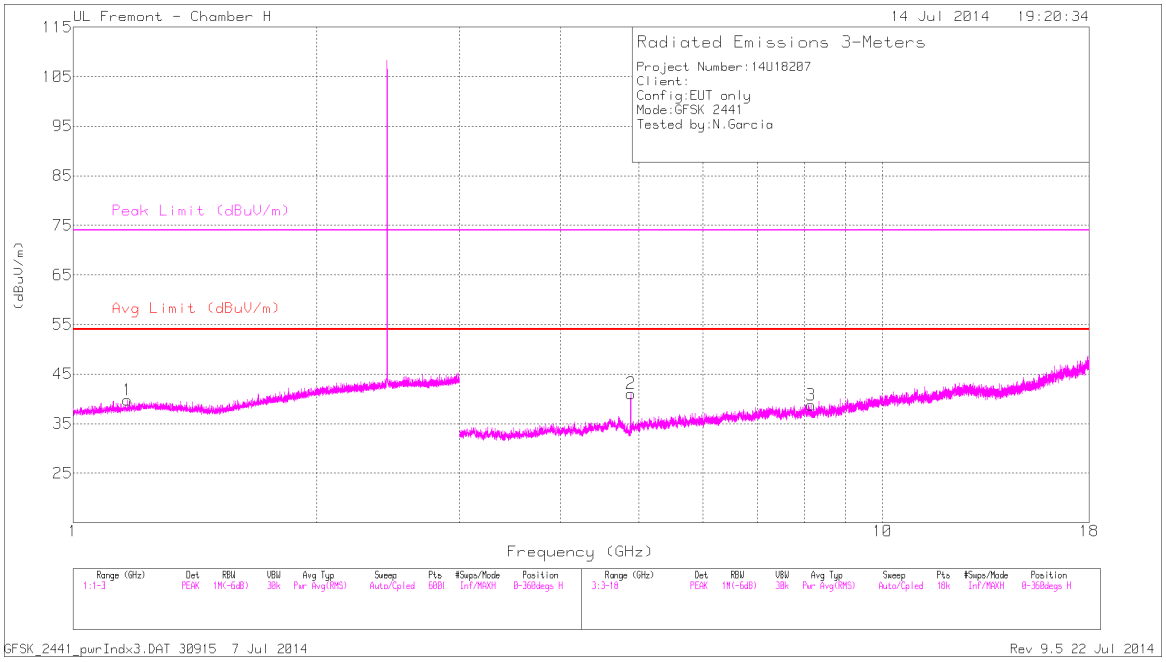
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

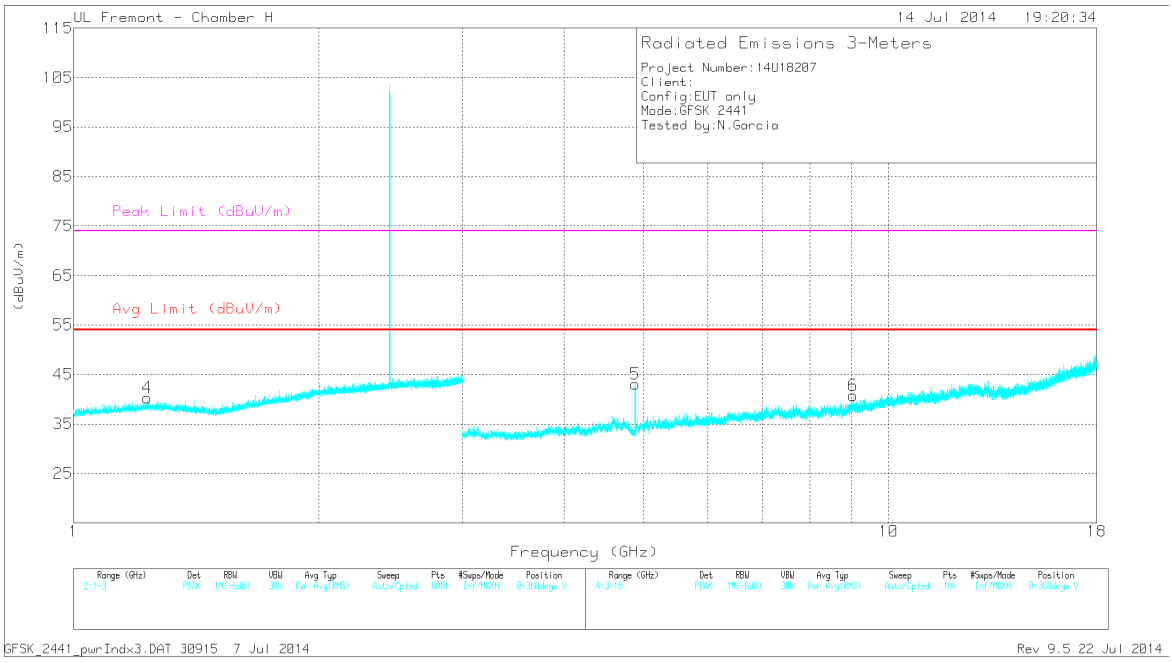
VB10Hz - FHSS Method: 10Hz Video Bandwidth

MID CHANNEL HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.166	43.9	PK3	28.6	-25.9	46.6	-	-	74	-27.4	100	212	H
	* 1.168	31.06	VB10	28.6	-25.9	33.76	54	-20.24	-	-	100	212	H
4	* 1.231	44.11	PK3	28.9	-25.9	47.11	-	-	74	-26.89	130	100	V
	* 1.234	31.11	VB10	28.9	-25.9	34.11	54	-19.89	-	-	130	100	V
2	* 4.884	44.59	PK3	34.3	-32	46.89	-	-	74	-27.11	84	146	H
	* 4.884	38.36	VB10	34.3	-32	40.66	54	-13.34	-	-	84	146	H
3	* 8.152	39.69	PK3	36.1	-29.3	46.49	-	-	74	-27.51	49	195	H
	* 8.155	26.66	VB10	36.1	-29.3	33.46	54	-20.54	-	-	49	195	H
5	* 4.884	45.37	PK3	34.3	-32	47.67	-	-	74	-26.33	41	200	V
	* 4.884	40.28	VB10	34.3	-32	42.58	54	-11.42	-	-	41	200	V
6	* 9.05	37.28	PK3	36.4	-26.7	46.98	-	-	74	-27.02	117	100	V
	* 9.052	24.95	VB10	36.4	-26.7	34.65	54	-19.35	-	-	117	100	V

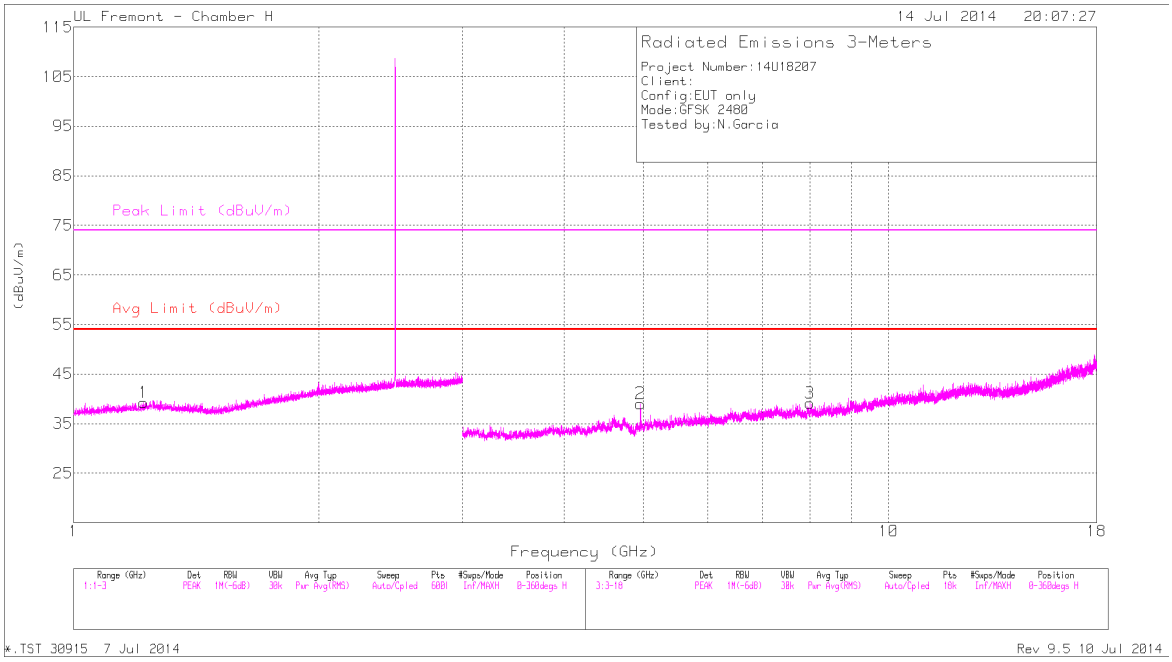
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

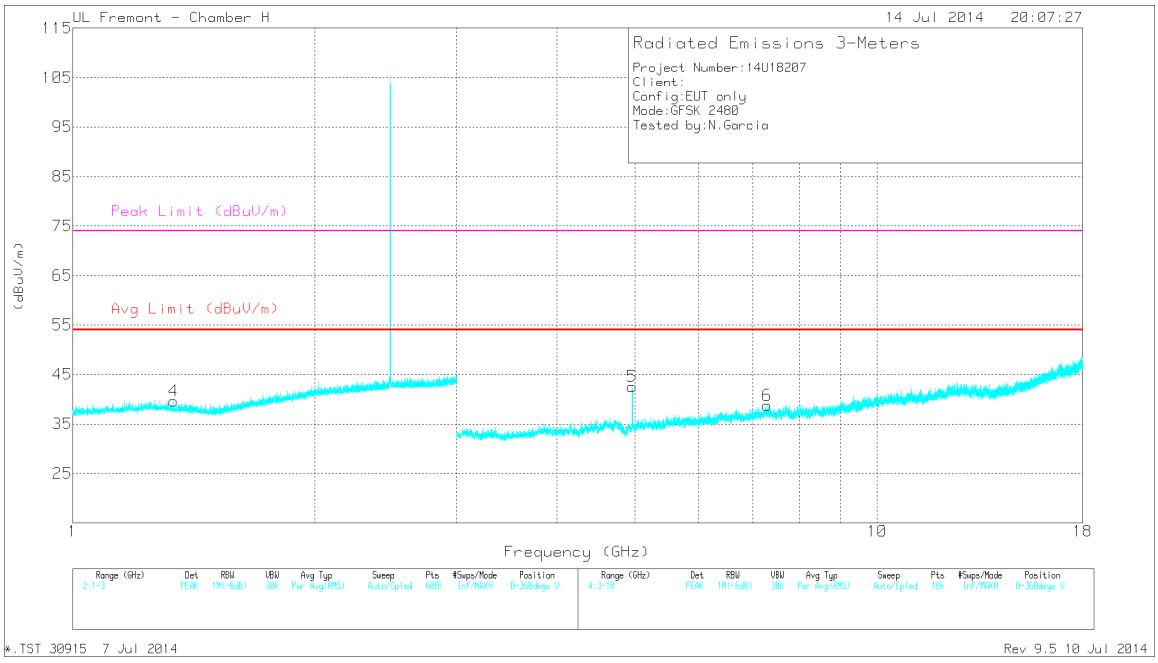
VB10Hz - FHSS Method: 10Hz Video Bandwidth

HIGH CHANNEL HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.22	44.04	PK3	28.8	-25.9	46.94	-	-	74	-27.06	2	265	H
	* 1.22	30.96	VB10	28.8	-25.9	33.86	54	-20.14	-	-	2	265	H
4	* 1.336	43.92	PK3	28.6	-25.7	46.82	-	-	74	-27.18	29	100	V
	* 1.334	30.82	VB10	28.6	-25.7	33.72	54	-20.28	-	-	29	100	V
2	* 4.96	42.72	PK3	34.3	-31.8	45.22	-	-	74	-28.78	247	383	H
	* 4.96	33.63	VB10	34.3	-31.8	36.13	54	-17.87	-	-	247	383	H
5	* 4.96	46.51	PK3	34.3	-31.8	49.01	-	-	74	-24.99	38	180	V
	* 4.96	40.71	VB10	34.3	-31.8	43.21	54	-10.79	-	-	38	180	V
6	* 7.298	39.05	PK3	36.2	-29.1	46.15	-	-	74	-27.85	55	202	V
	* 7.301	26.49	VB10	36.2	-29.1	33.59	54	-20.41	-	-	55	202	V
3	8.005	25.78	VB10	36	-28.5	33.28	-	-	-	-	247	100	H
	8.006	38.68	PK3	36	-28.4	46.28	-	-	-	-	247	100	H

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

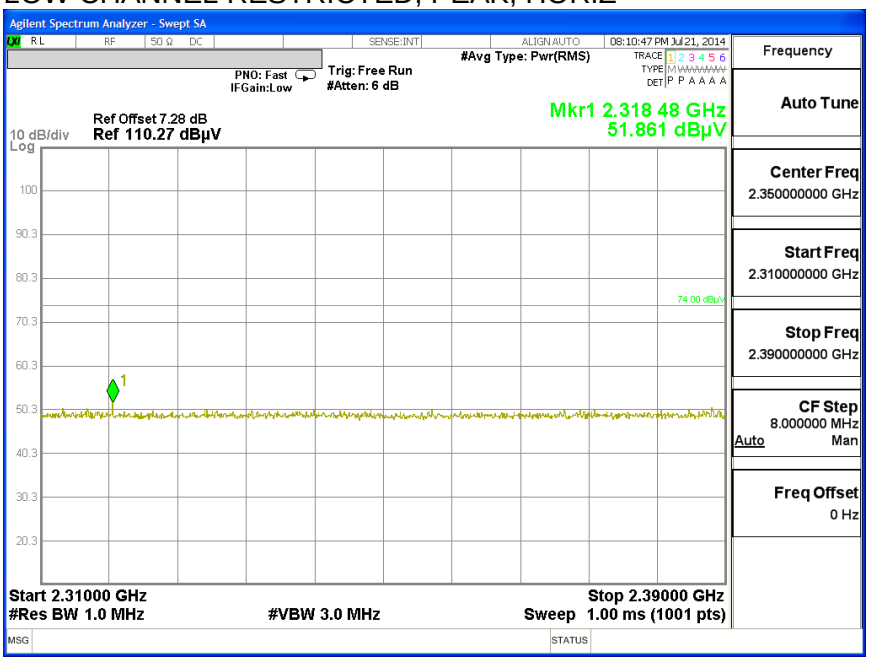
PK3 - FHSS Method: Maximum Peak

VB10Hz - FHSS Method: 10Hz Video Bandwidth

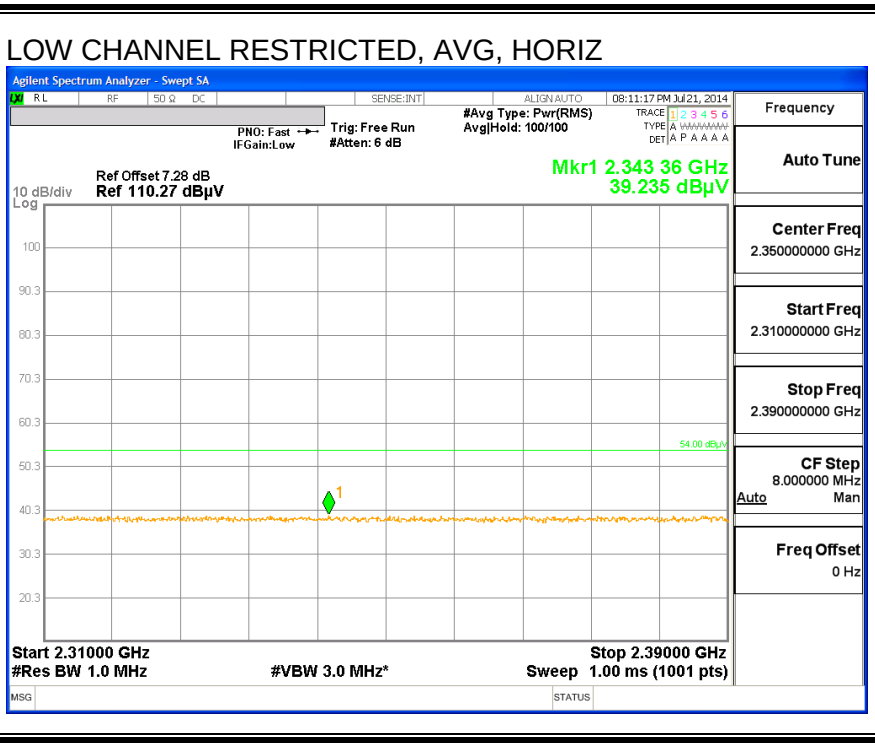
10.2.2. ENHANCED DATA RATE 8PSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

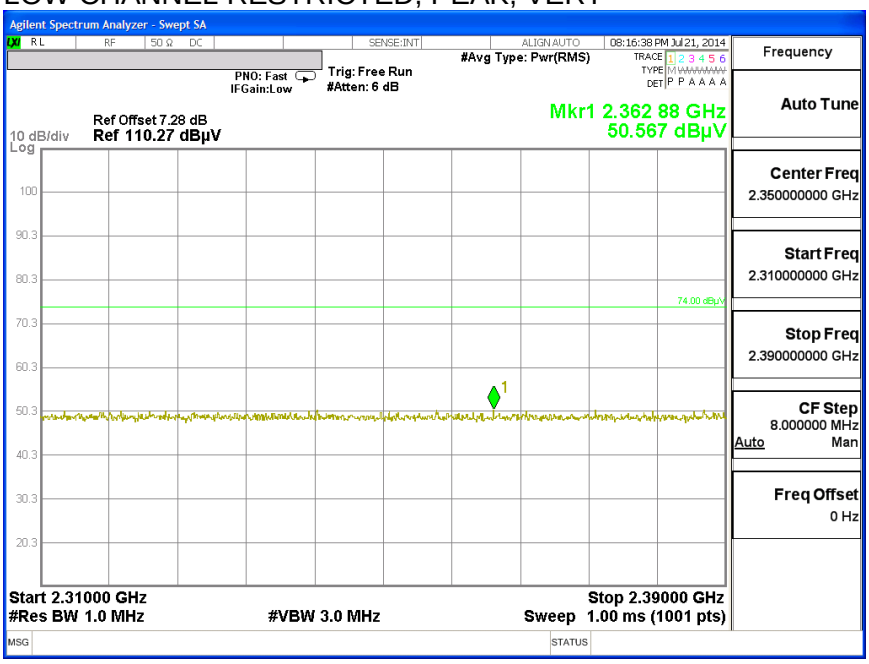


LOW CHANNEL RESTRICTED, AVG, HORIZ

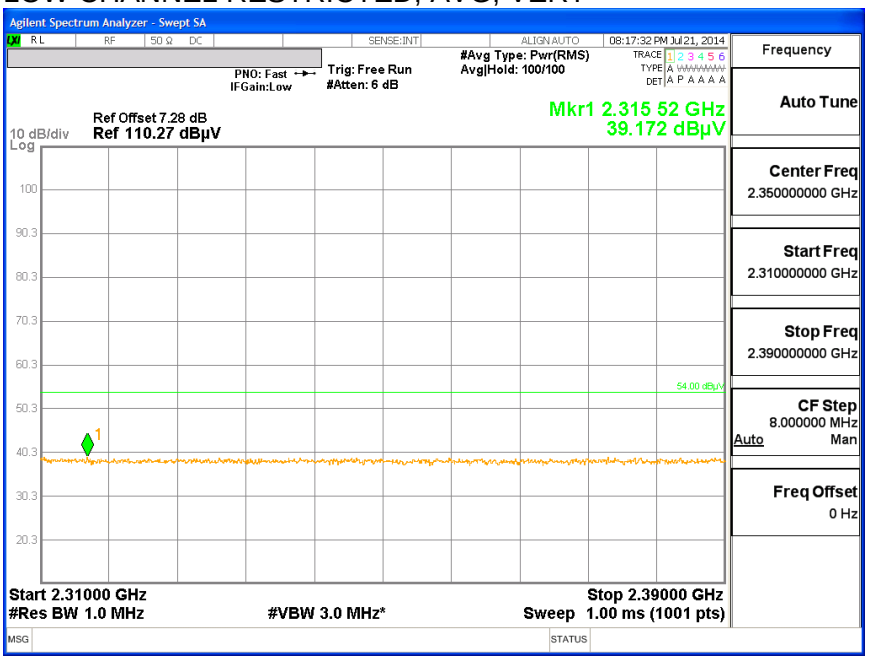


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

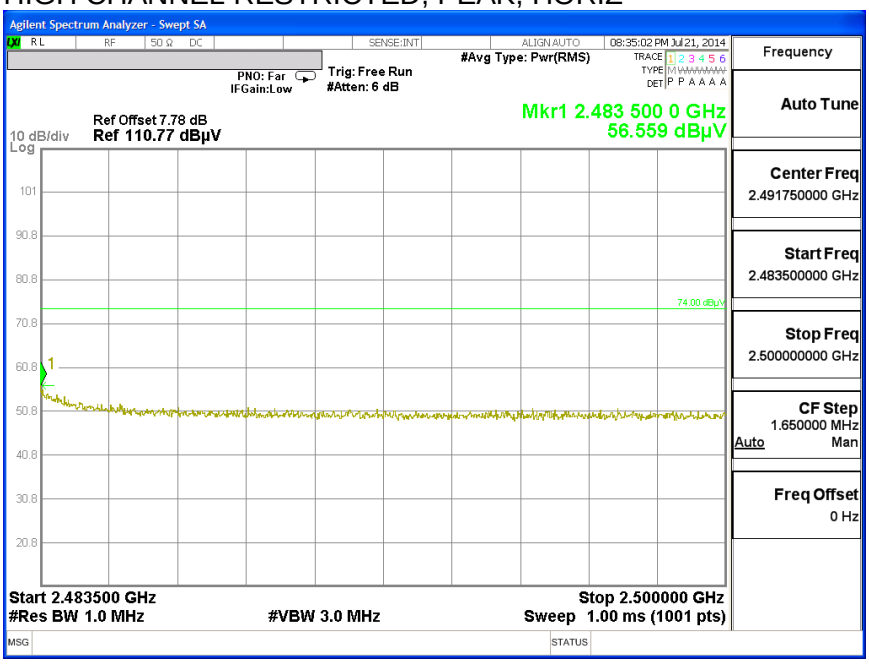


LOW CHANNEL RESTRICTED, AVG, VERT

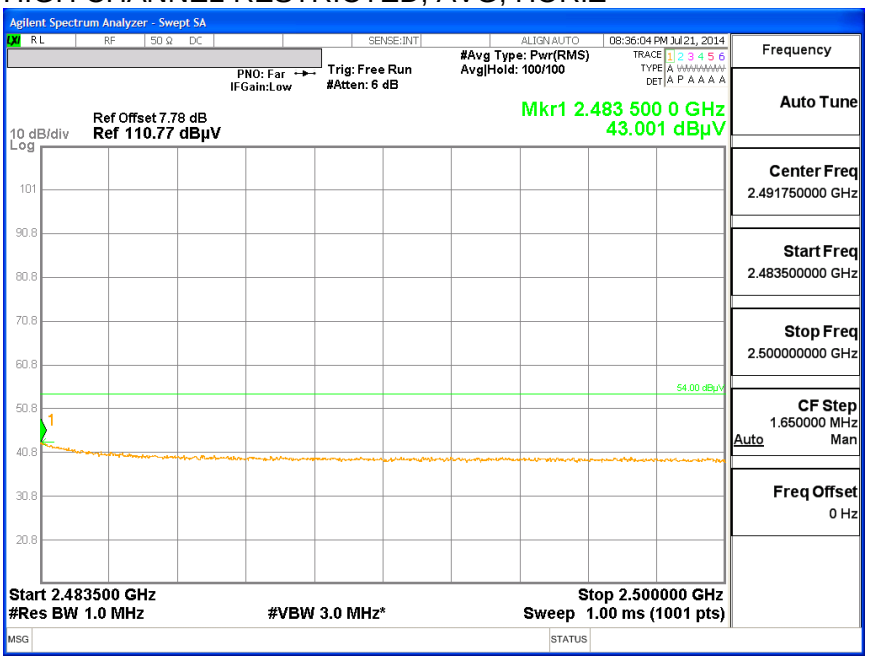


RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL

HIGH CHANNEL RESTRICTED, PEAK, HORIZ

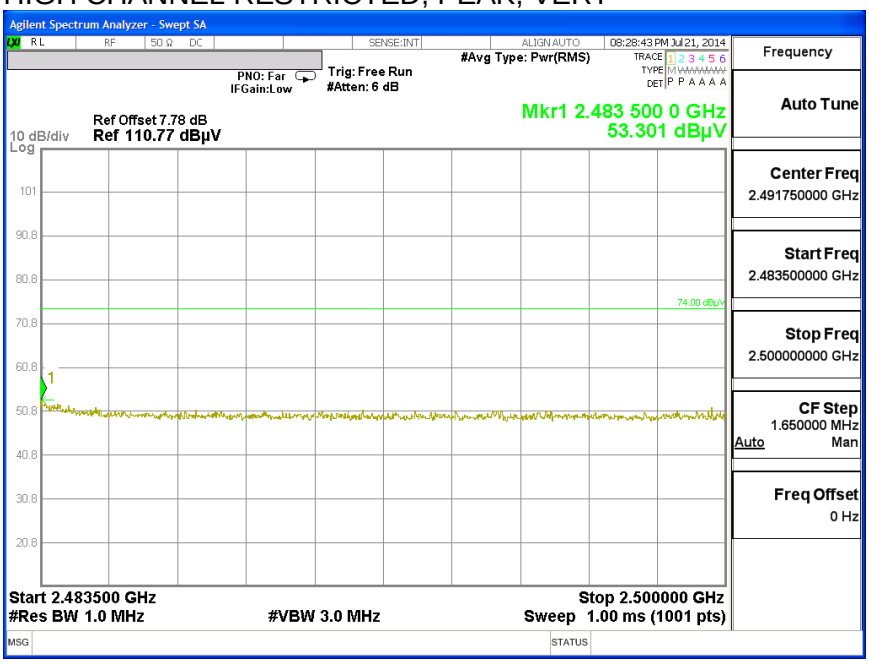


HIGH CHANNEL RESTRICTED, AVG, HORIZ

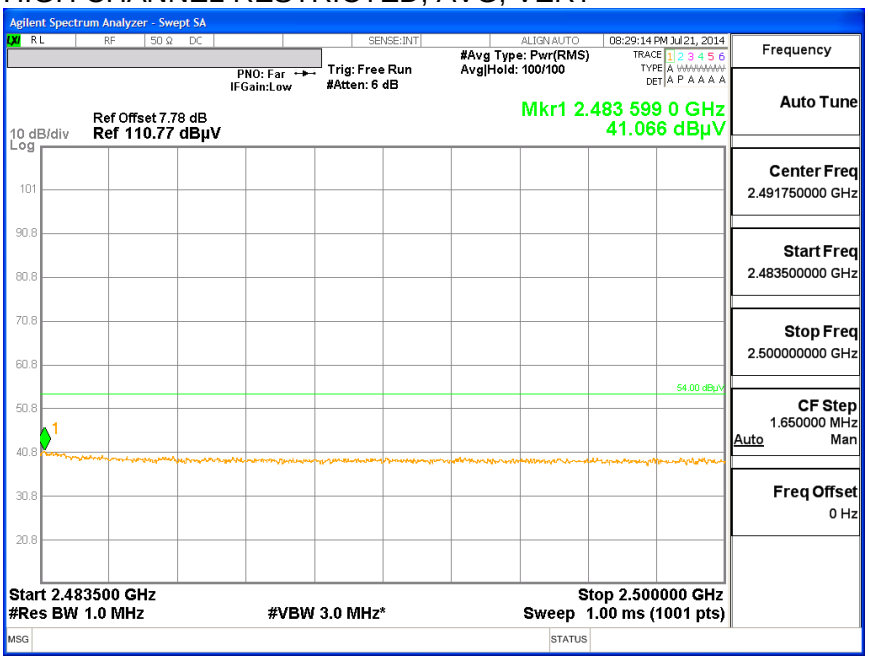


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL RESTRICTED, PEAK, VERT

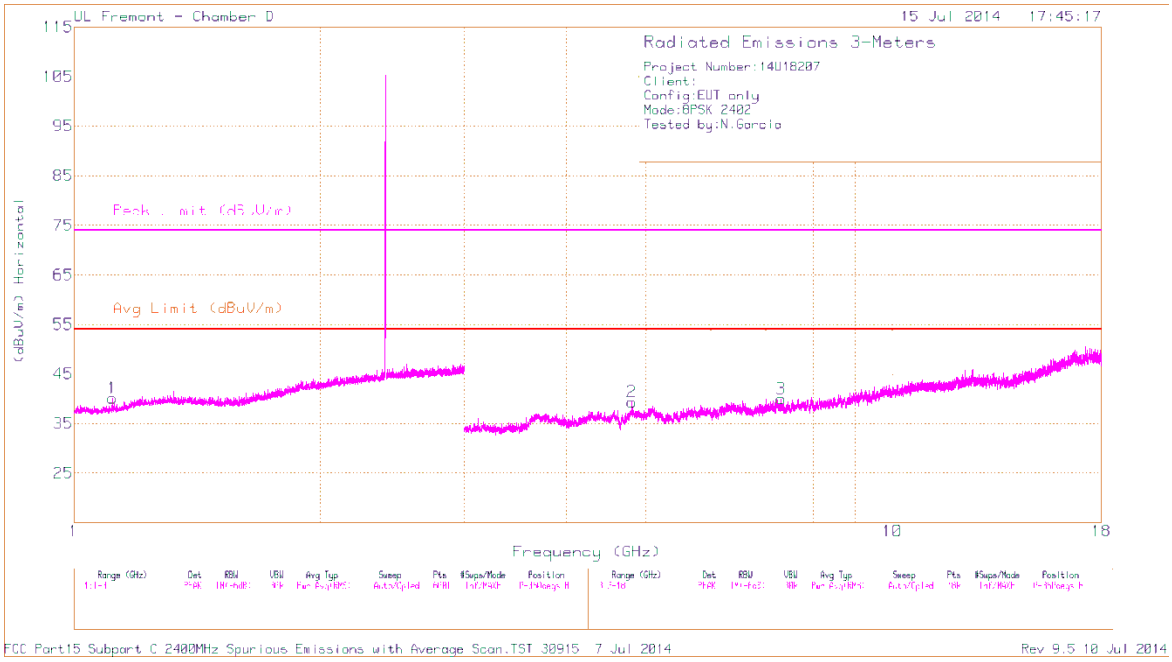


HIGH CHANNEL RESTRICTED, AVG, VERT

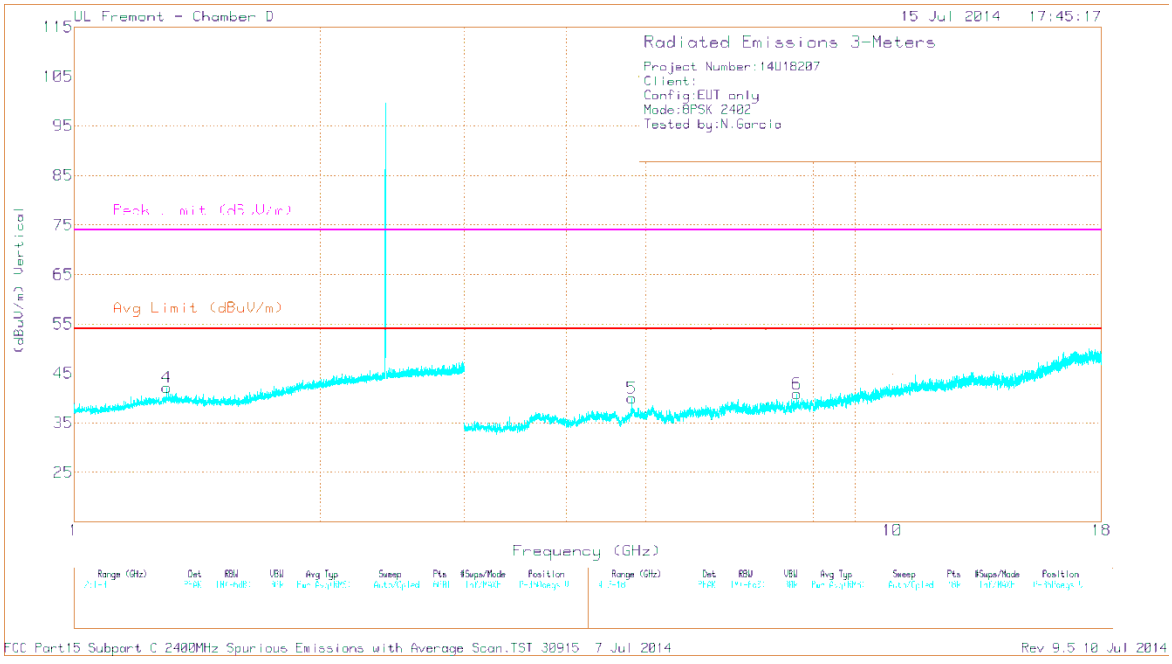


LOW CHANNEL HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.116	41.74	PK3	27.2	-22.1	46.84	-	-	74	-27.16	340	202	H
	* 1.114	28.67	VB10	27.2	-22.1	33.77	54	-20.23	-	-	340	202	H
4	* 1.3	41.61	PK3	28.8	-21.9	48.51	-	-	74	-25.49	145	183	V
	* 1.3	28.73	VB10	28.8	-21.9	35.63	54	-18.37	-	-	145	183	V
2	* 4.804	39.81	PK3	34.2	-27.1	46.91	-	-	74	-27.09	272	140	H
	* 4.804	28.74	VB10	34.2	-27.1	35.84	54	-18.16	-	-	272	140	H
3	* 7.309	36.53	PK3	35.7	-24.8	47.43	-	-	74	-26.57	314	172	H
	* 7.309	23.37	VB10	35.7	-24.8	34.27	54	-19.73	-	-	314	172	H
5	* 4.804	40.15	PK3	34.2	-27.1	47.25	-	-	74	-26.75	202	183	V
	* 4.804	30.03	VB10	34.2	-27.1	37.13	54	-16.87	-	-	202	183	V
6	* 7.642	35.54	PK3	35.7	-25	46.24	-	-	74	-27.76	160	105	V
	* 7.646	23.46	VB10	35.7	-24.8	34.36	54	-19.64	-	-	160	105	V

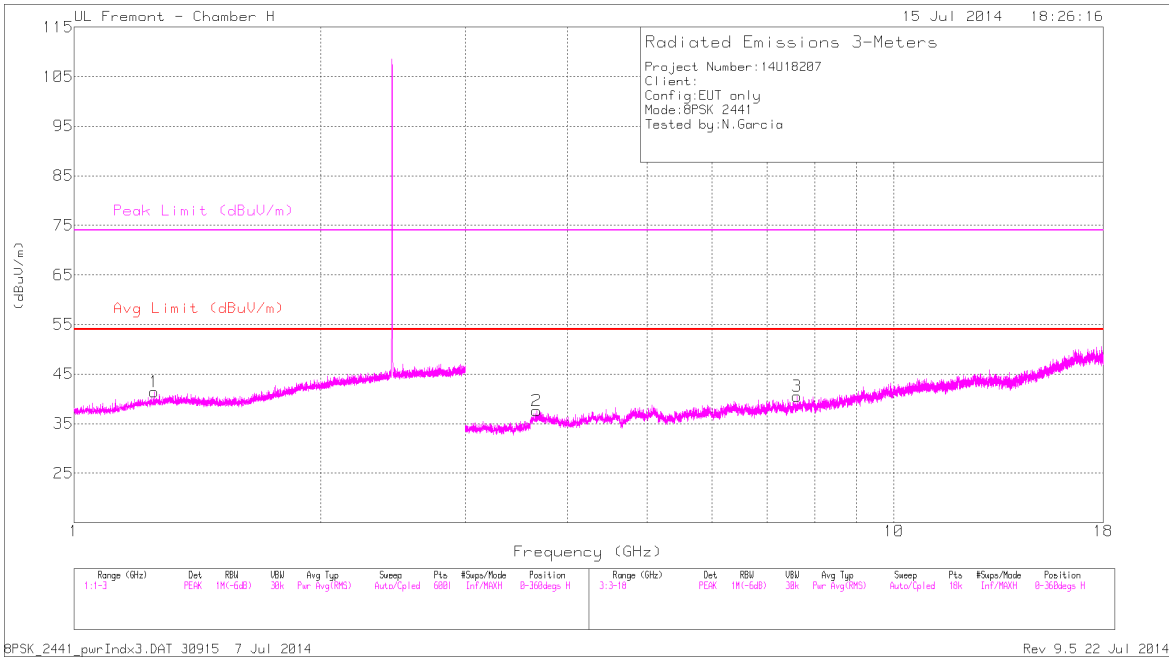
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

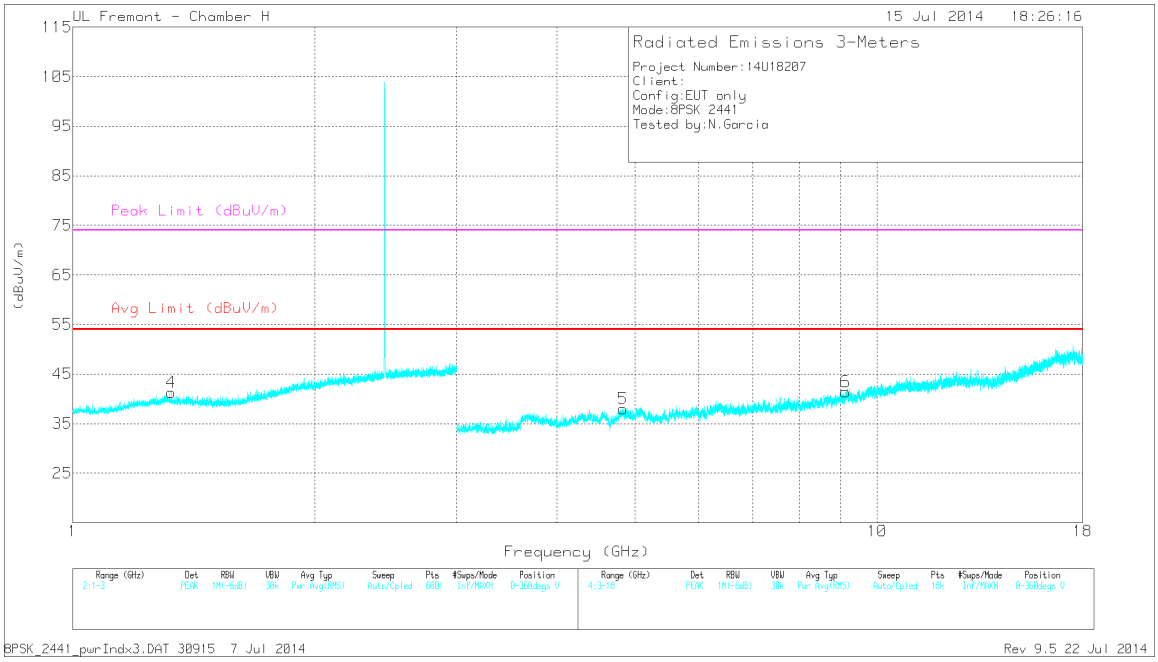
VB10Hz - FHSS Method: 10Hz Video Bandwidth

MID CHANNEL HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.251	41.65	PK3	28.5	-22.1	48.05	-	-	74	-25.95	66	241	H
	* 1.253	28.75	VB10	28.5	-22.1	35.15	54	-18.85	-	-	66	241	H
4	* 1.326	41.8	PK3	28.8	-22	48.6	-	-	74	-25.4	9	113	V
	* 1.326	28.65	VB10	28.8	-22	35.45	54	-18.55	-	-	9	113	V
2	* 3.667	39.11	PK3	33.3	-28.1	44.31	-	-	74	-29.69	19	101	H
	* 3.665	25.77	VB10	33.3	-28.1	30.97	54	-23.03	-	-	19	101	H
3	* 7.618	36.53	PK3	35.7	-24.9	47.33	-	-	74	-26.67	26	119	H
	* 7.617	23.42	VB10	35.7	-24.9	34.22	54	-19.78	-	-	26	119	H
5	* 4.828	37.83	PK3	34.2	-26.7	45.33	-	-	74	-28.67	88	198	V
	* 4.83	24.83	VB10	34.2	-26.7	32.33	54	-21.67	-	-	88	198	V
6	* 9.132	34.29	PK3	36.3	-21.7	48.89	-	-	74	-25.11	114	221	V
	* 9.134	21.93	VB10	36.3	-21.7	36.53	54	-17.47	-	-	114	221	V

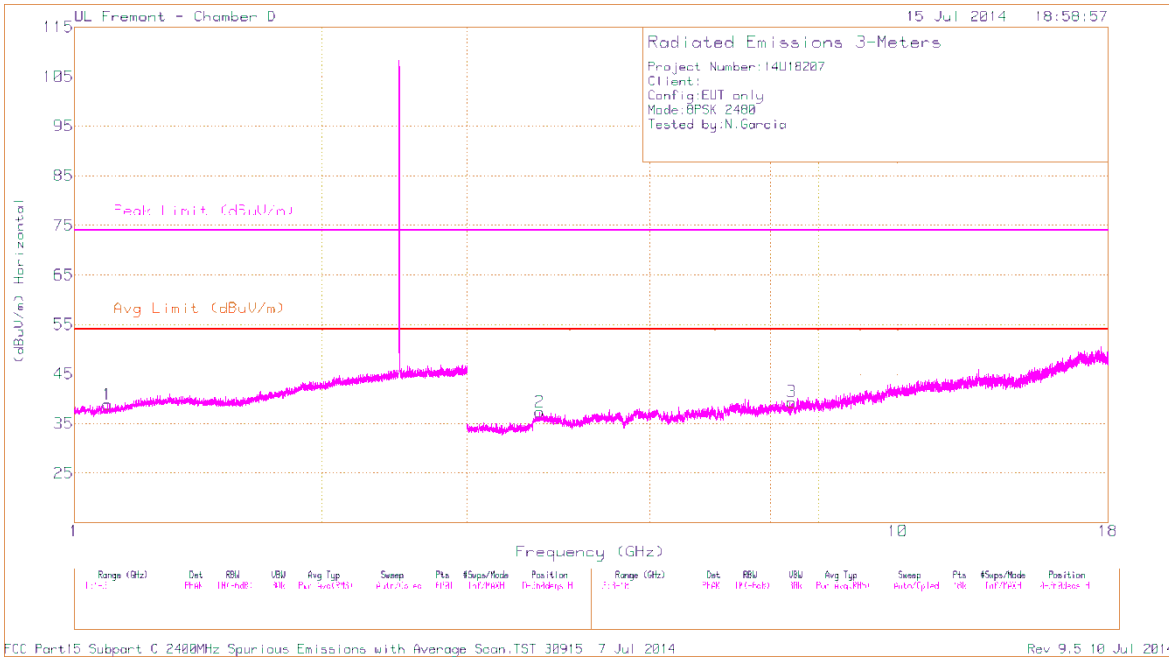
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

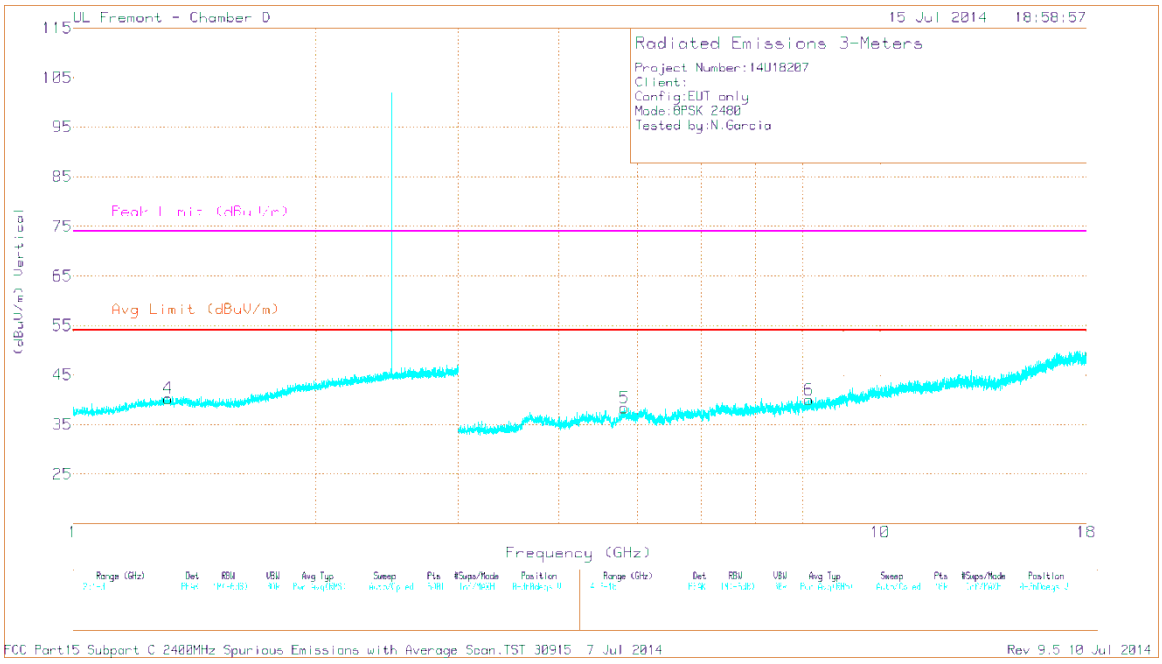
VB10Hz - FHSS Method: 10Hz Video Bandwidth

HIGH CHANNEL HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

Radiated Emissions

	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.097	41.84	PK3	27	-22.3	46.54	-	-	74	-27.46	0	100	H
	* 1.097	28.8	VB10	27	-22.3	33.5	54	-20.5	-	-	0	100	H
4	* 1.314	42.55	PK3	28.8	-22	49.35	-	-	74	-24.65	0	100	V
	* 1.312	28.74	VB10	28.8	-21.9	35.64	54	-18.36	-	-	0	100	V
2	* 3.674	38.56	PK3	33.3	-28.1	43.76	-	-	74	-30.24	0	100	H
	* 3.675	25.85	VB10	33.3	-28.1	31.05	54	-22.95	-	-	0	100	H
3	* 7.44	36.22	PK3	35.6	-24.8	47.02	-	-	74	-26.98	0	202	H
	* 7.443	23.55	VB10	35.6	-24.9	34.25	54	-19.75	-	-	0	202	H
5	* 4.822	36.84	PK3	34.2	-26.7	44.34	-	-	74	-29.66	349	344	V
	* 4.822	24.86	VB10	34.2	-26.7	32.36	54	-21.64	-	-	349	344	V
6	* 8.158	35.56	PK3	35.8	-23.9	47.46	-	-	74	-26.54	349	201	V
	* 8.16	22.7	VB10	35.8	-23.9	34.6	54	-19.4	-	-	349	201	V

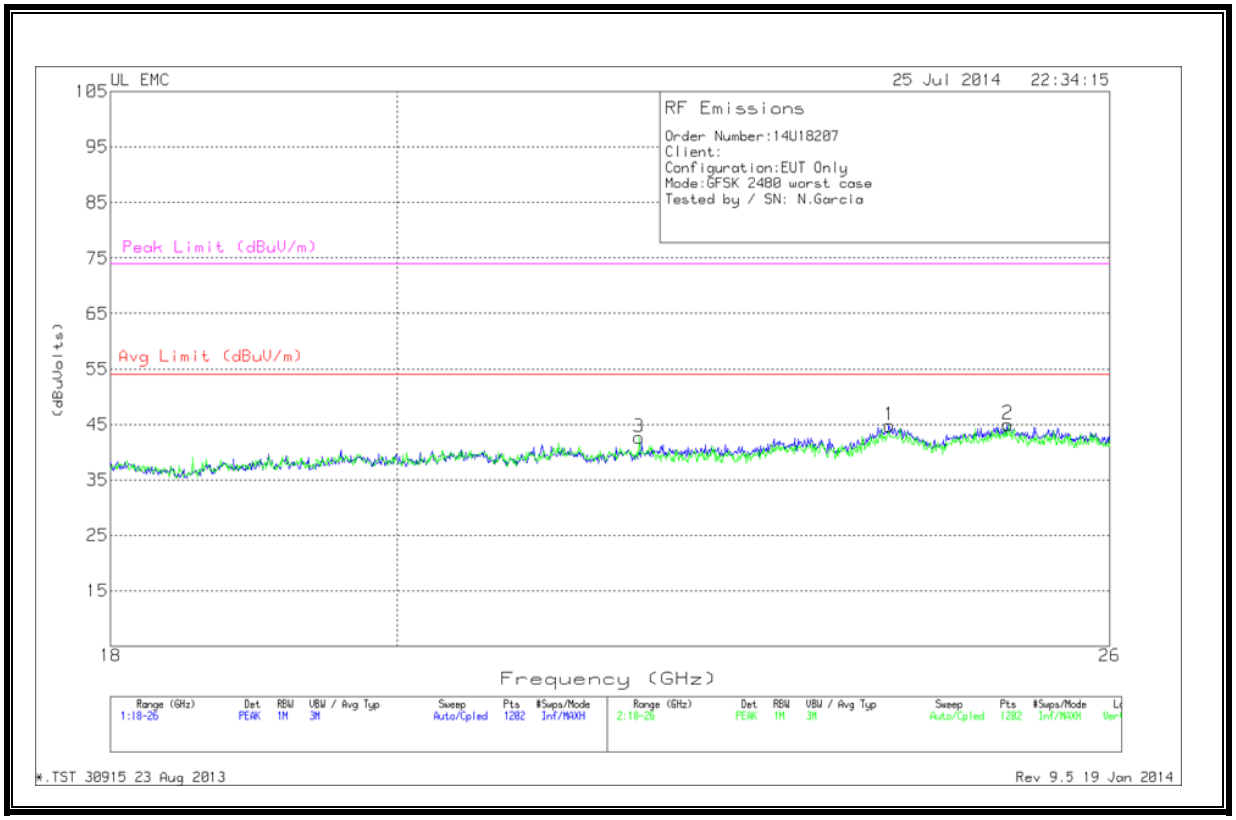
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

VB10Hz - FHSS Method: 10Hz Video Bandwidth

10.3. WORST-CASE ABOVE 18 GHz

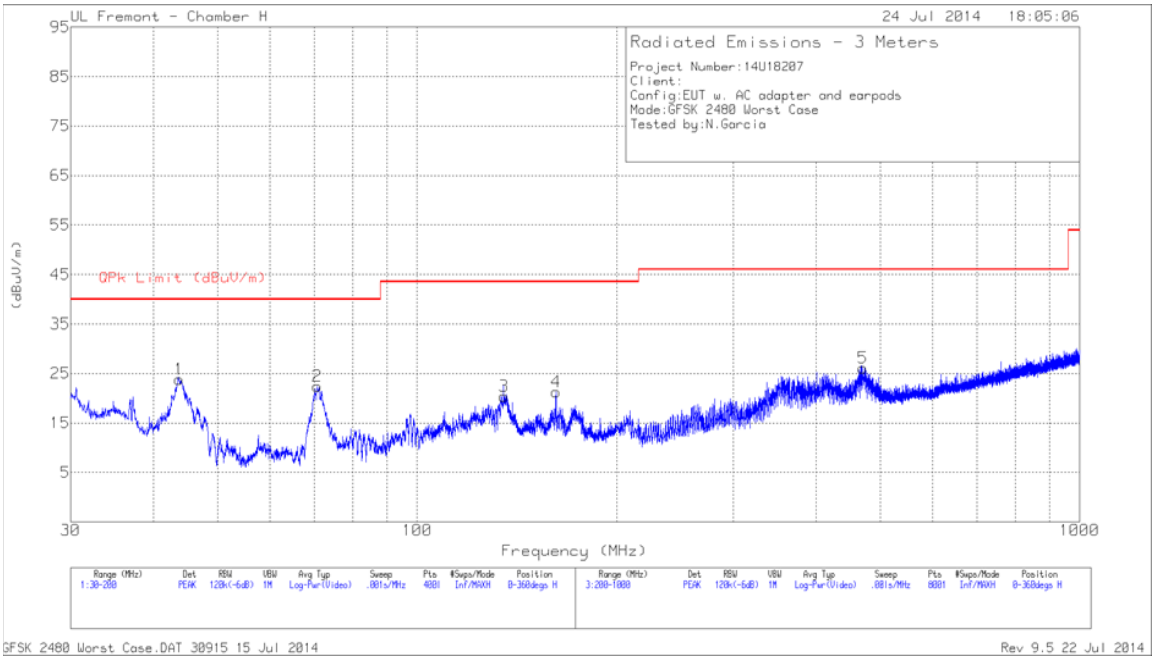
SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)



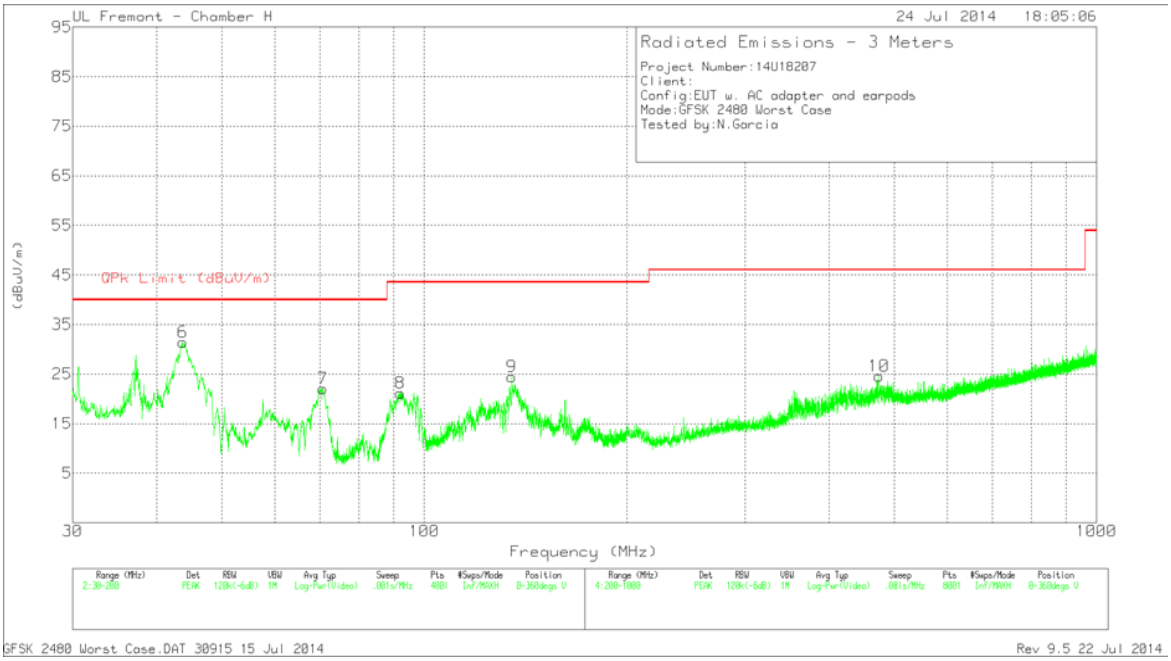
10.4. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Hybrid	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 135.3575	33.45	PK	16.6	-29.7	20.35	43.52	-23.17	0-360	201	H
9	* 135.0175	37.62	PK	16.6	-29.8	24.42	43.52	-19.1	0-360	100	V
1	43.7275	40.21	PK	14.4	-30.8	23.81	40	-16.19	0-360	401	H
6	43.77	47.81	PK	14.4	-30.8	31.41	40	-8.59	0-360	100	V
7	70.63	41.26	PK	11.2	-30.4	22.06	40	-17.94	0-360	100	V
2	70.6725	41.57	PK	11.2	-30.4	22.37	40	-17.63	0-360	201	H
8	92.0925	40.36	PK	11	-30.2	21.16	43.52	-22.36	0-360	100	V
4	162.005	35.64	PK	15.1	-29.5	21.24	43.52	-22.28	0-360	201	H
5	470.5	33.35	PK	20.3	-27.5	26.15	46.02	-19.87	0-360	201	H
10	474.7	31.86	PK	20.4	-27.7	24.56	46.02	-21.46	0-360	201	V

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

PK - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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 C63.4.

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

LINE 1 RESULTS

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin to Limit (dB)	CFR 47 Part 15 Class B Avg	Margin to Limit (dB)
1	.159	38.57	PK	1.3	0	39.87	65.5	-25.63	55.5	-15.63
2	.159	24.45	Av	1.3	0	25.75	65.5	-39.75	55.5	-29.75
3	.1995	38.67	PK	.9	0	39.57	63.6	-24.03	53.6	-14.03
4	.1995	30.49	Av	.9	0	31.39	63.6	-32.21	53.6	-22.21
5	.303	39.73	PK	.6	0	40.33	60.2	-19.87	50.2	-9.87
6	.303	24.27	Av	.6	0	24.87	60.2	-35.33	50.2	-25.33
7	.573	42.53	PK	.3	0	42.83	56	-13.17	46	-3.17
8	.573	25.74	Av	.3	0	26.04	56	-29.96	46	-19.96
9	1.6935	26.78	PK	.2	.1	27.08	56	-28.92	46	-18.92
10	1.6935	10.73	Av	.2	.1	11.03	56	-44.97	46	-34.97
11	7.269	33.69	PK	.2	.1	33.99	60	-26.01	50	-16.01
12	7.269	24.4	Av	.2	.1	24.7	60	-35.3	50	-25.3
13	29.697	17.88	PK	.3	.3	18.48	60	-41.52	50	-31.52
14	29.697	5.72	Av	.3	.3	6.32	60	-53.68	50	-43.68

PK - Peak detector, Av - average detection

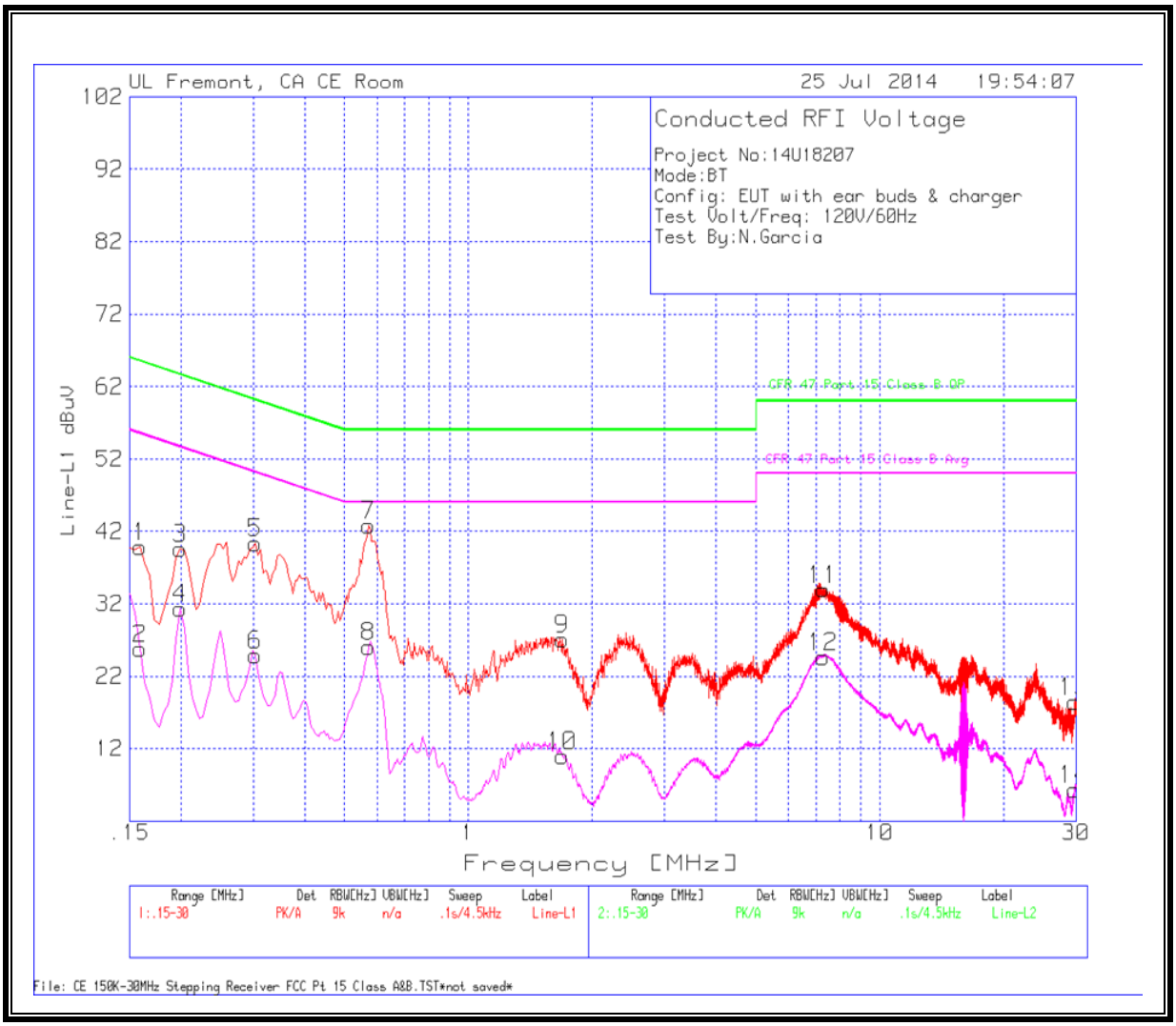
LINE 2 RESULTS

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin to Limit (dB)	CFR 47 Part 15 Class B Avg	Margin to Limit (dB)
15	.1995	39.51	PK	1	0	40.51	63.6	-23.09	53.6	-13.09
16	.1995	31.69	Av	1	0	32.69	63.6	-30.91	53.6	-20.91
17	.303	39.06	PK	.6	0	39.66	60.2	-20.54	50.2	-10.54
18	.303	27.09	Av	.6	0	27.69	60.2	-32.51	50.2	-22.51
19	.573	40.75	PK	.3	0	41.05	56	-14.95	46	-4.95
20	.573	29.38	Av	.3	0	29.68	56	-26.32	46	-16.32
21	1.644	29.63	PK	.2	.1	29.93	56	-26.07	46	-16.07
22	1.644	17.52	Av	.2	.1	17.82	56	-38.18	46	-28.18
23	7.2825	30.6	PK	.2	.1	30.9	60	-29.1	50	-19.1
24	7.2825	20.72	Av	.2	.1	21.02	60	-38.98	50	-28.98
25	29.4135	39.24	PK	.3	.3	39.84	60	-20.16	50	-10.16
26	29.4135	14.61	Av	.3	.3	15.21	60	-44.79	50	-34.79

PK - Peak detector, Av - average detection

LINE 1 PLOT



LINE 2 PLOT