FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

802.11a/b/g/n/ac WLAN + Bluetooth PCI-E Mini Card

MODEL NUMBER: BCM94352HMB

FCC ID: QDS-BRCM1068
IC: 4324A-BRCM1068

REPORT NUMBER: 12U14473-4, Revision A

ISSUE DATE: SEPTEMBER 13, 2012

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/04/12	Initial Issue	F. Ibrahim
A	09/13/12	Revised section 7.1.4, 7.2.4, and 7.2.5	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A.

EUT DESCRIPTION: 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E Mini Card

MODEL: BCM94352HMB

SERIAL NUMBER: 265 (P238)

DATE TESTED: August 23 - 29, 2012

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 CCS 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 CCS By:

FRANK IBRAHIM
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Tested By:

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UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2003, 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 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

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 an 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E Mini Card.

The radio module is manufactured by Broadcom.

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	3.60	2.29
2402 - 2480	Enhanced 8PSK	6.82	4.81

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 802.11a/g/n WLAN + Bluetooth antenna with a maximum gain of 3.9dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom Bluetooth 4.0 + HS USB Device, version 5.6.0.3200.

The test utility software used during testing was Blue Tool, ver. 1.6.0.4.

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC. The EUT was oriented in a flat orientation, similar to the orientation it would have in real installations; see setup photos for details.

Worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was the mode and channel with the highest output power.

5.6. DESCRIPTION OF TEST SET

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	G560	CBU4473193	DoC
AC/DC Adapter	Lenovo	PA-1650-56LC	11S36001646ZZ400008KCM8	DoC
Jig Board	Catalyst	MINI2EXP	BRCM 2011-05	N/A

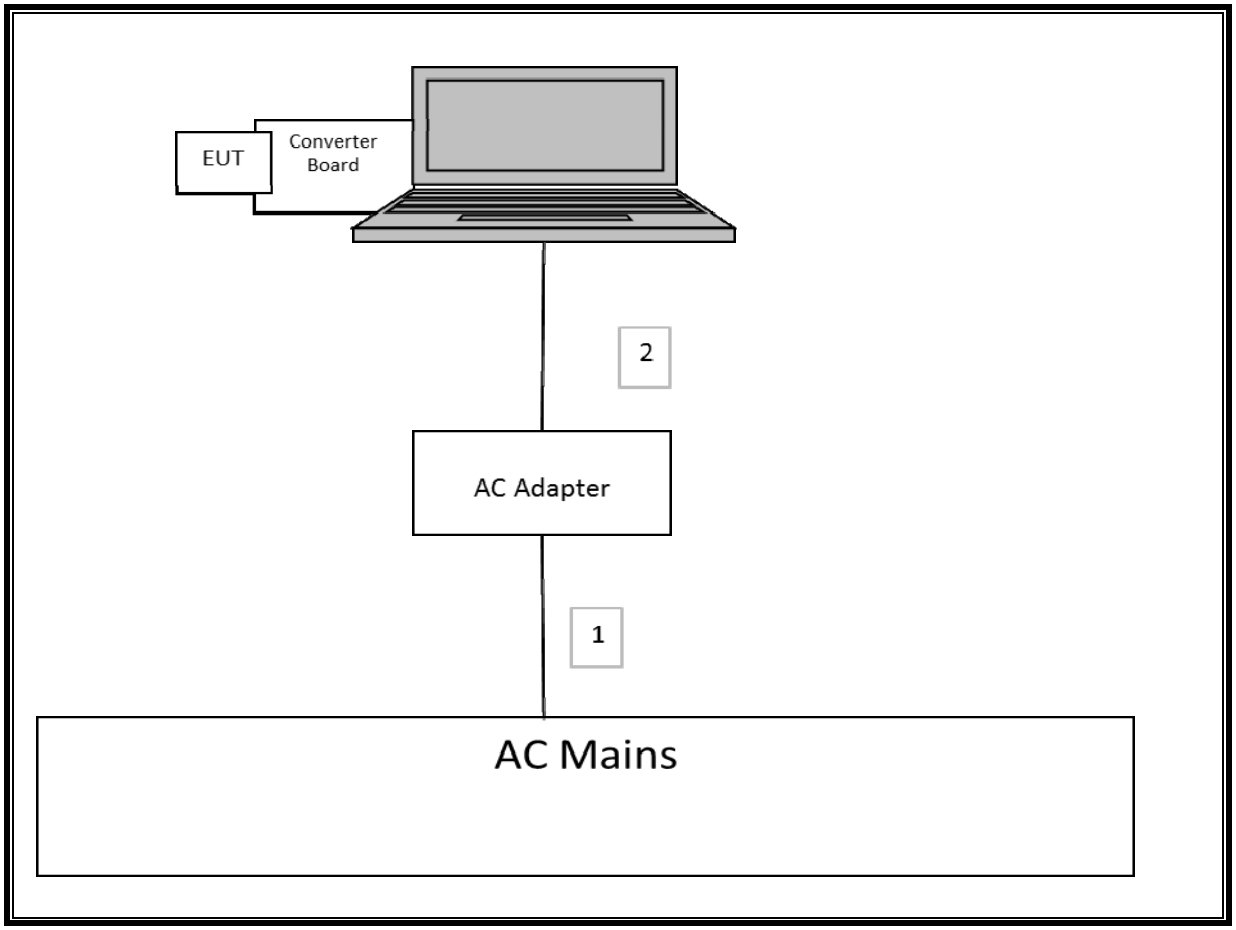
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	US 115V	Shielded	1.5m	NA
2	DC	1	DC	Un-shielded	1.5m	Ferrite at laptop's end

TEST SETUP

The EUT is attached to a jig board which is installed in the PCMCI slot of a host laptop computer during the tests. Test software exercised the radio card.

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**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/15/11	12/15/12
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09/02/11	09/02/12
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/13/12	07/06/13
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/19/11	08/19/13
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/11	12/13/12
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/11	12/13/12
Antenna, Horn, 18 GHz	EMCO	3115	C00872	09/20/11	09/20/12
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	11/01/11	11/01/12
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	C00682	02/07/12	02/07/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	11/11/11	11/11/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	07/12/12	07/12/13
LISN, 30 MHz	FCC	50/250-25-2	C00626	12/13/11	12/13/12
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRC13192	N02683	CNR	CNR

7. ANTENNA PORT TEST RESULTS

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

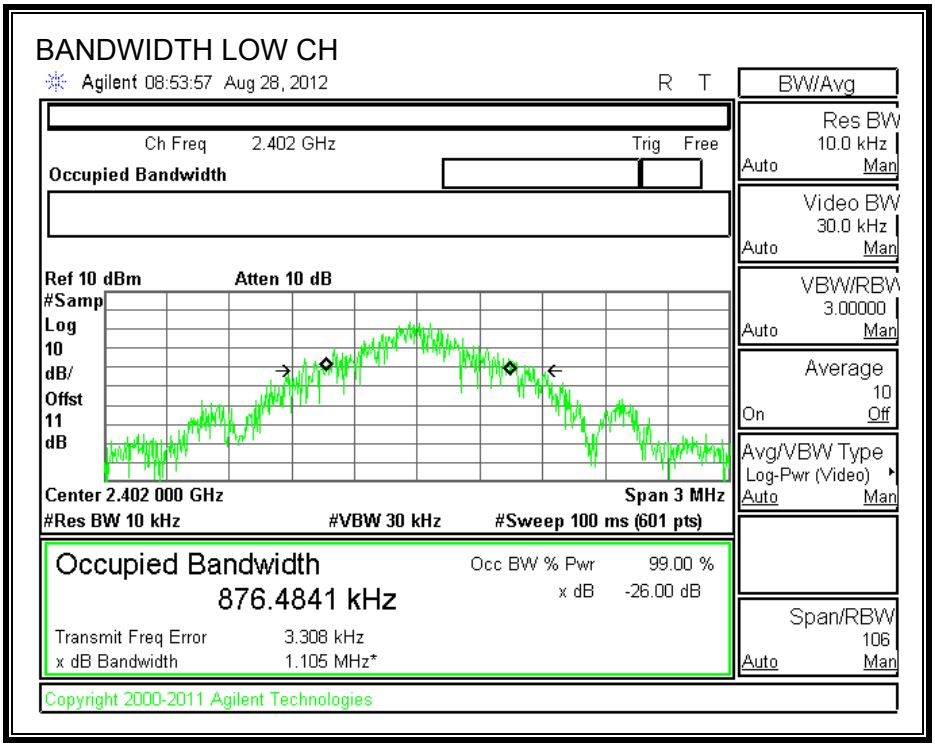
TEST PROCEDURE

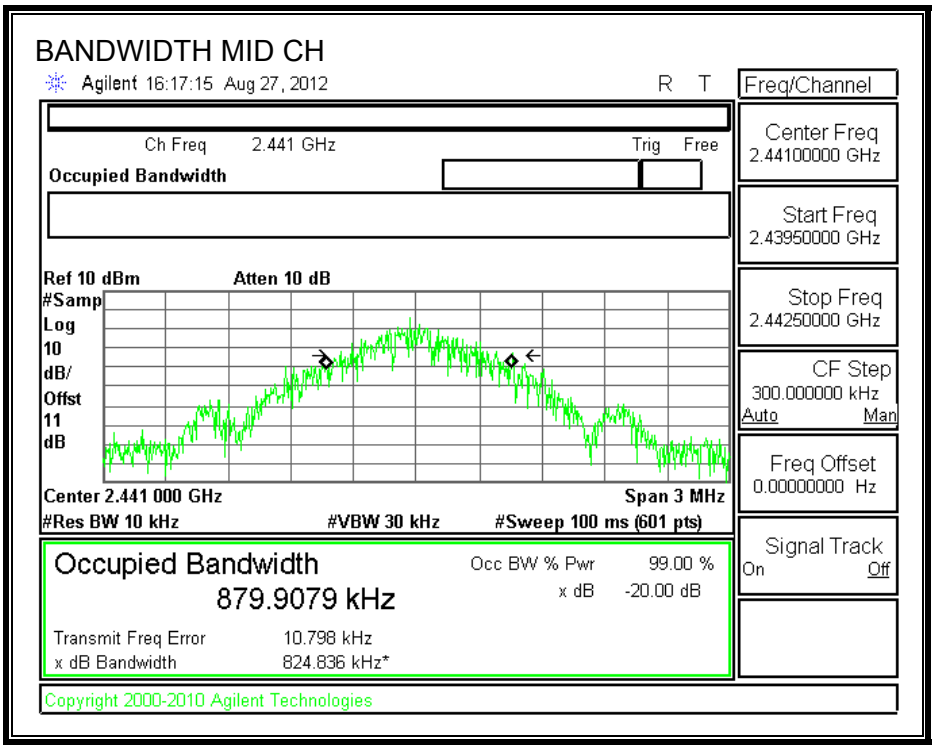
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 99% bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

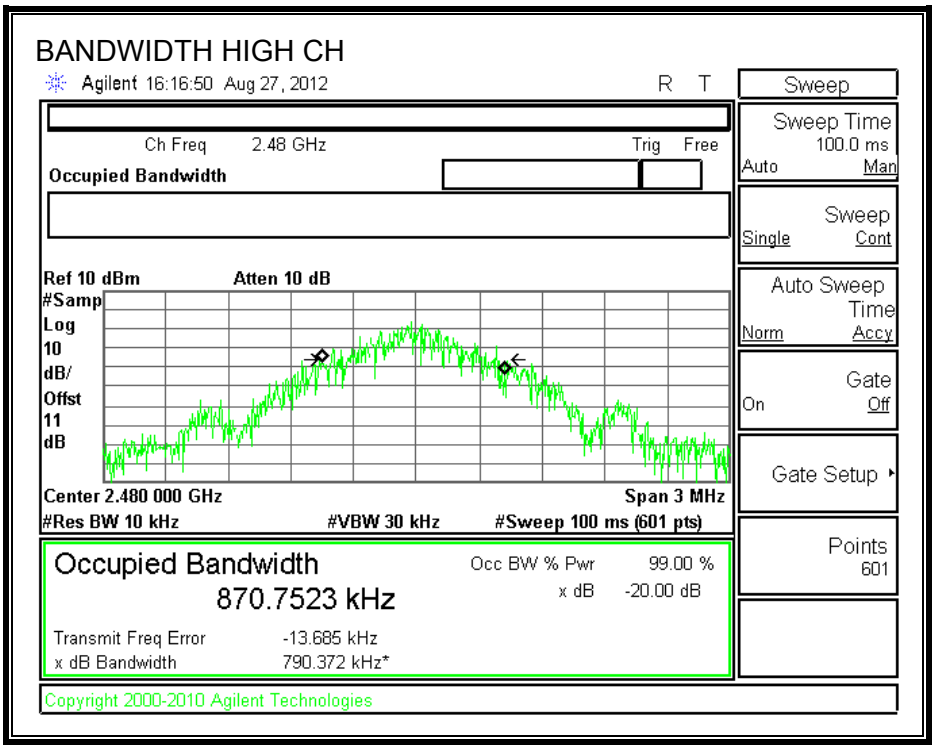
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (kHz)
Low	2402	876.4841
Middle	2441	879.9079
High	2480	870.7523

99% BANDWIDTH







7.1.2. 20 dB BANDWIDTH

LIMIT

None; for reporting purposes only.

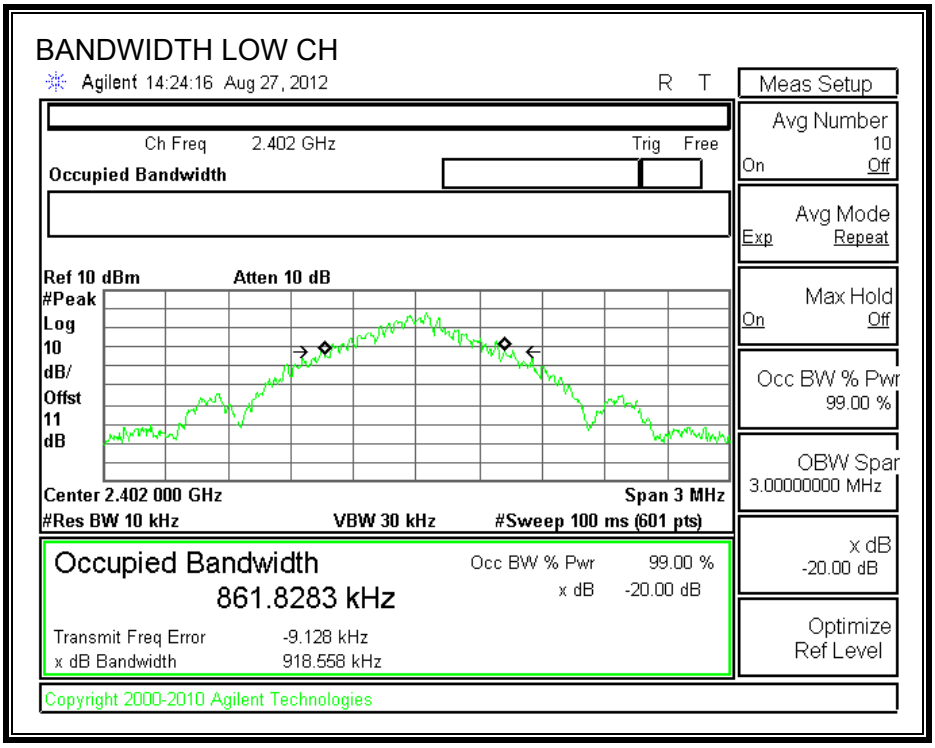
TEST PROCEDURE

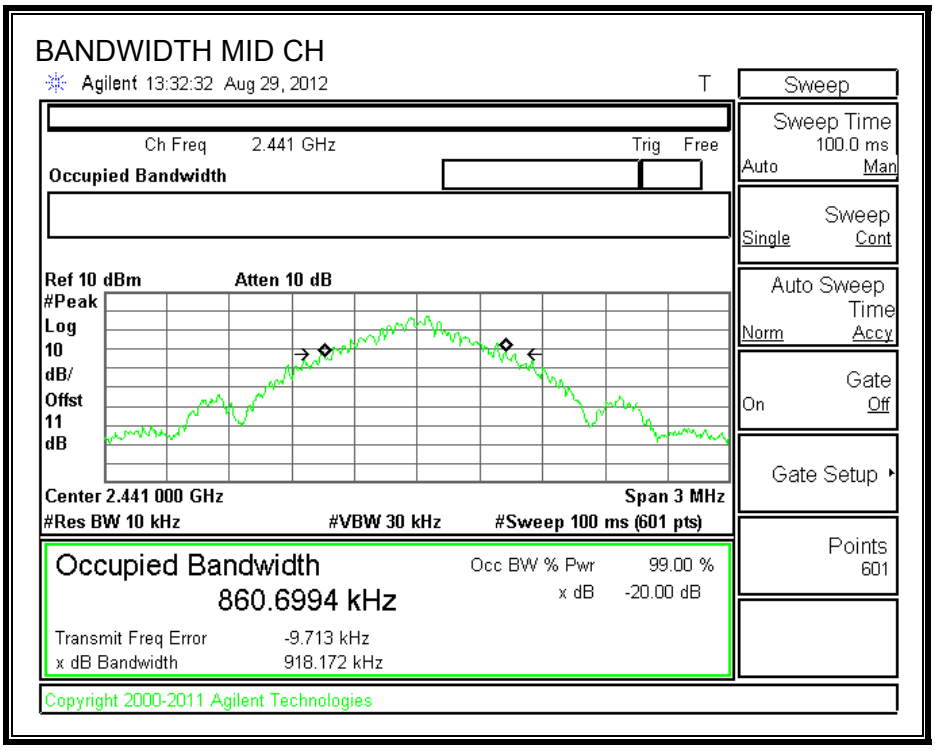
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

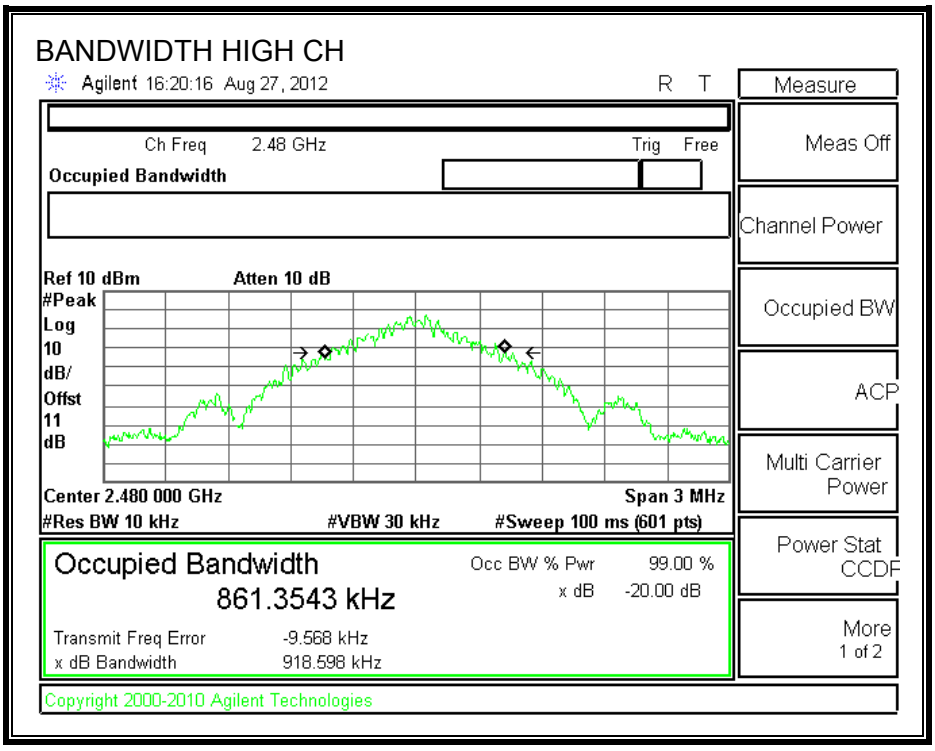
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2402	918.558
Middle	2441	918.172
High	2480	918.598

20 dB BANDWIDTH







7.1.3. 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.

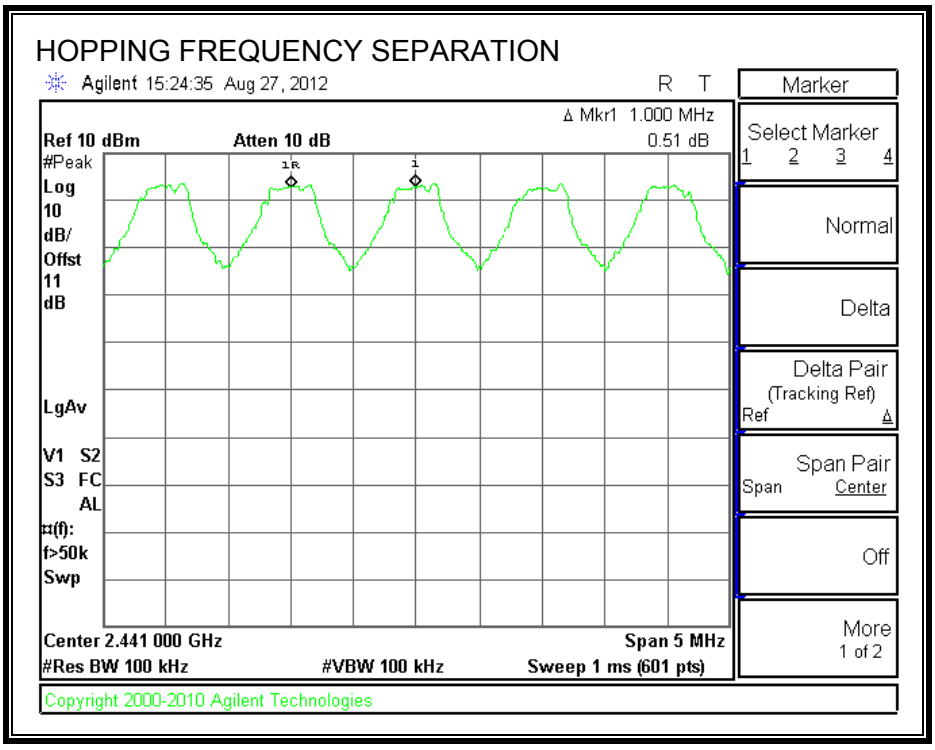
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.4. 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

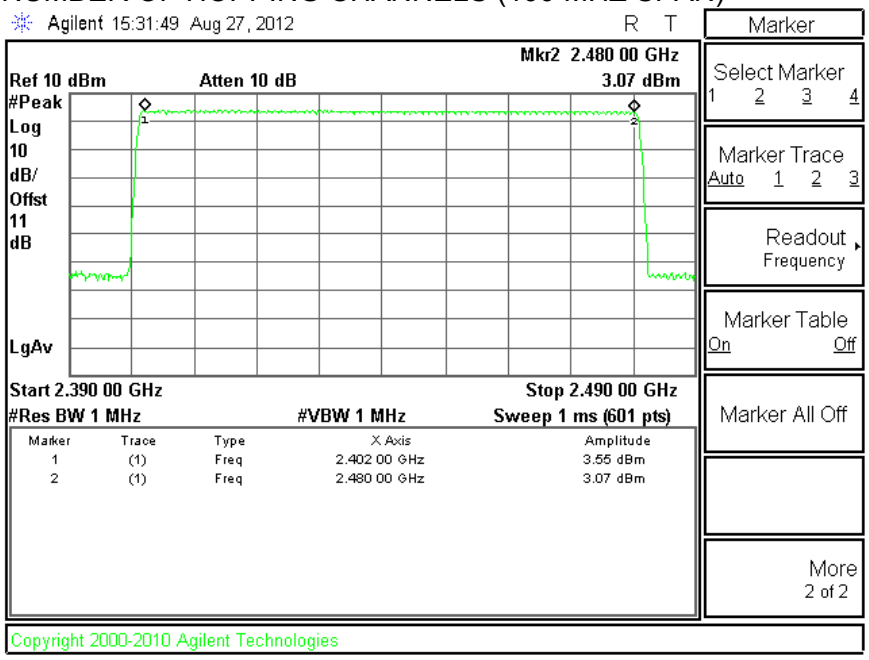
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

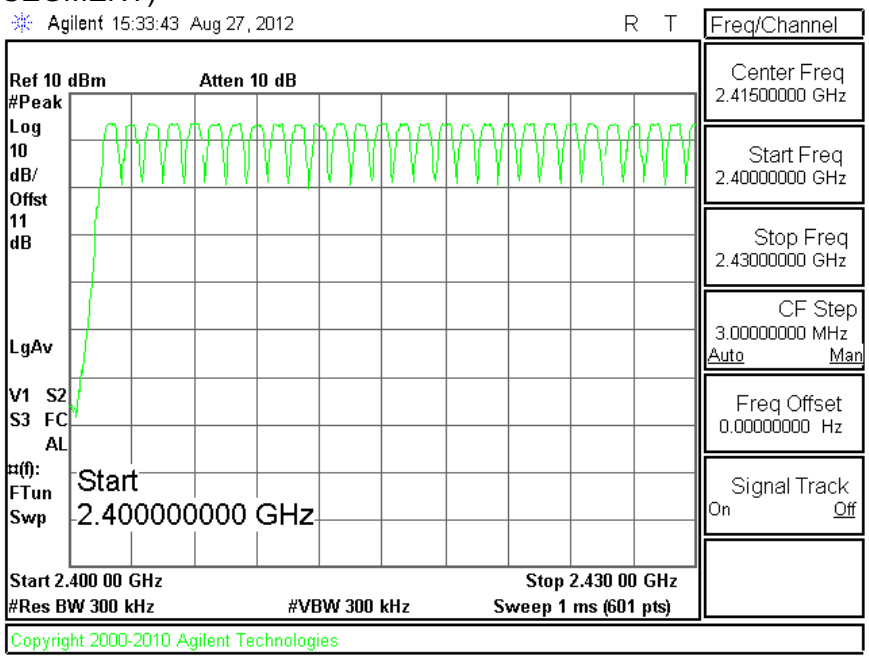
Normal Mode: 79 are observed
AFH Mode: Minimum channels are 20 and maximum channels are 79

NUMBER OF HOPPING CHANNELS

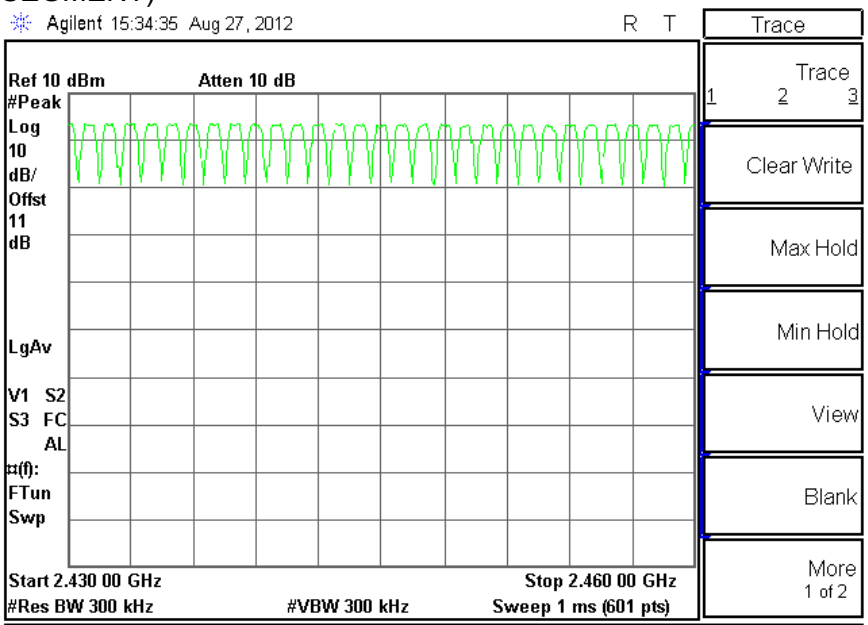
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



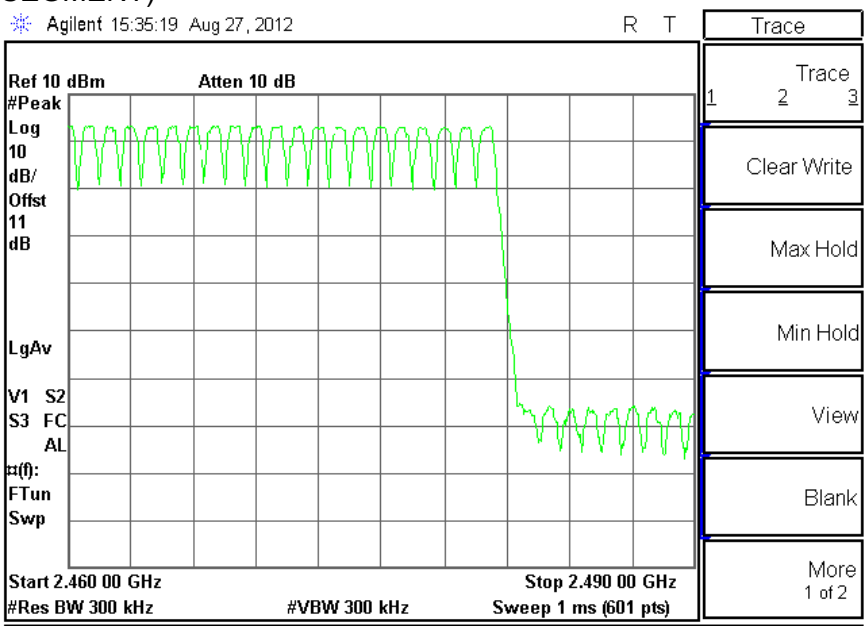
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



7.1.5. 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.

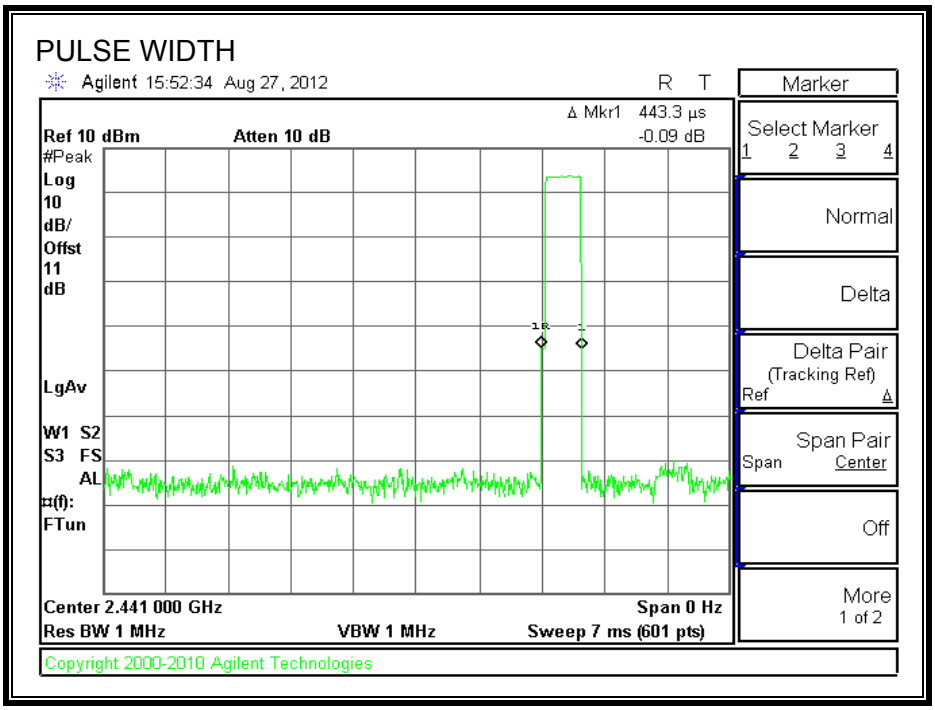
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

RESULTS

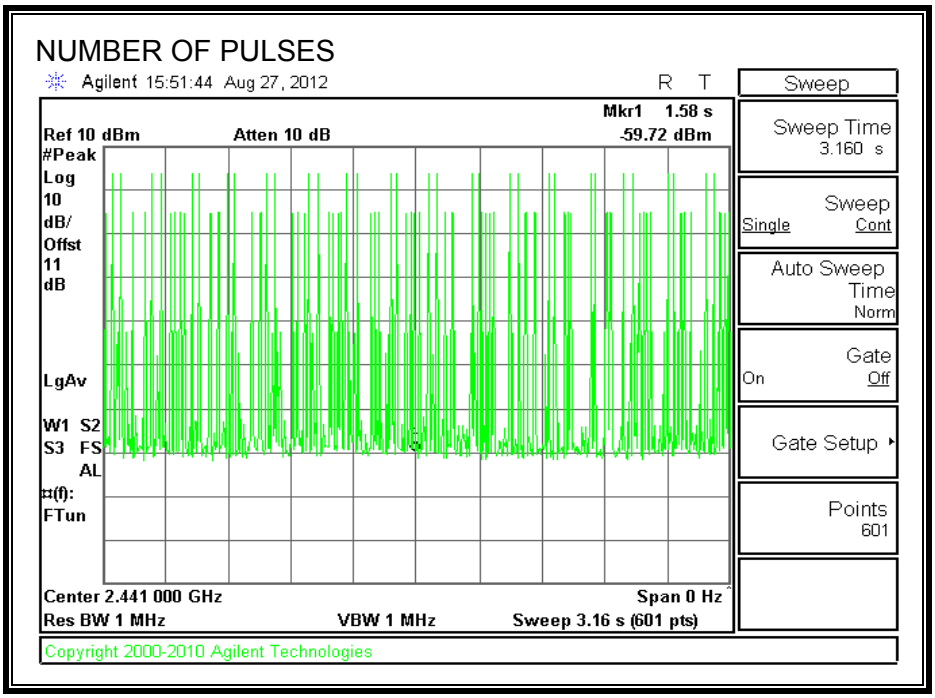
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.443	32	0.1419	0.4	-0.258
DH3	1.703	20	0.3406	0.4	-0.059
DH5	2.952	12	0.3542	0.4	-0.046
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.443	8	0.035	0.4	-0.365
DH3	1.703	5	0.085	0.4	-0.315
DH5	2.952	3	0.089	0.4	-0.311

DH1

PULSE WIDTH

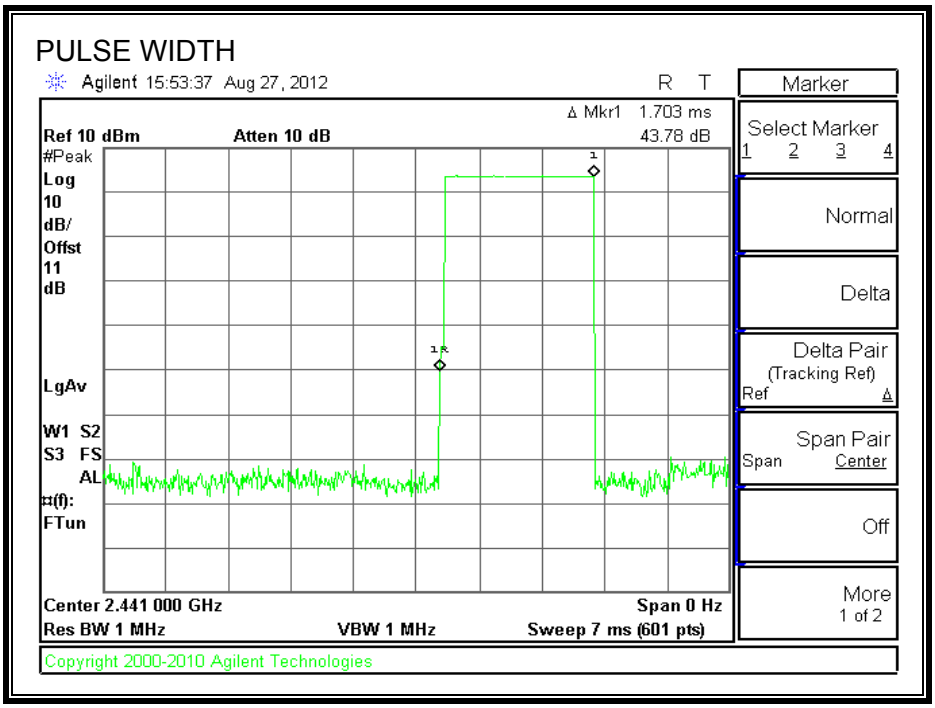


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

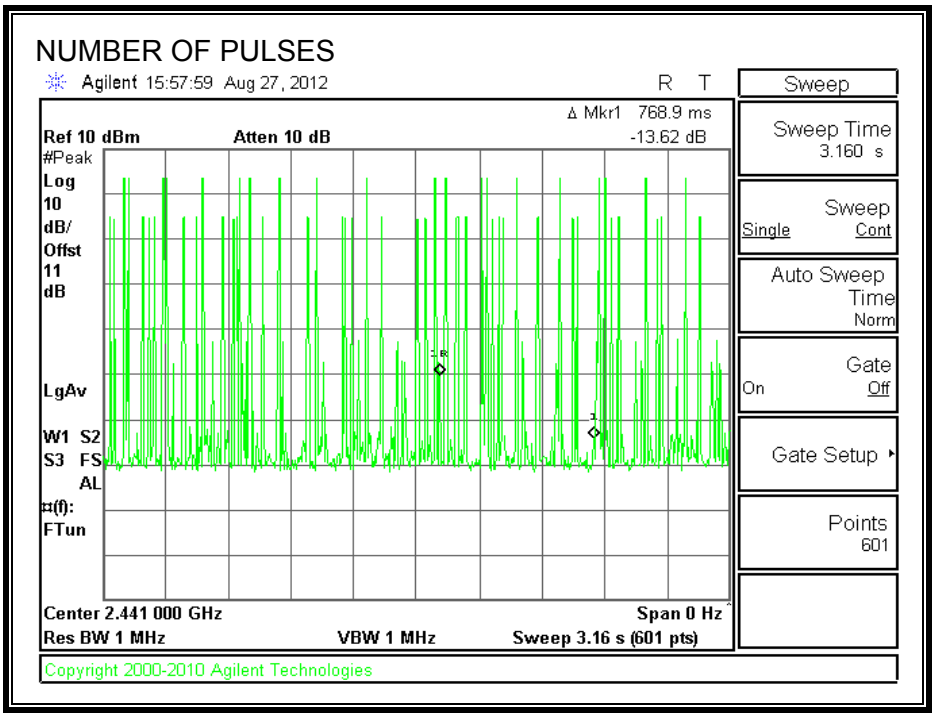


DH3

PULSE WIDTH

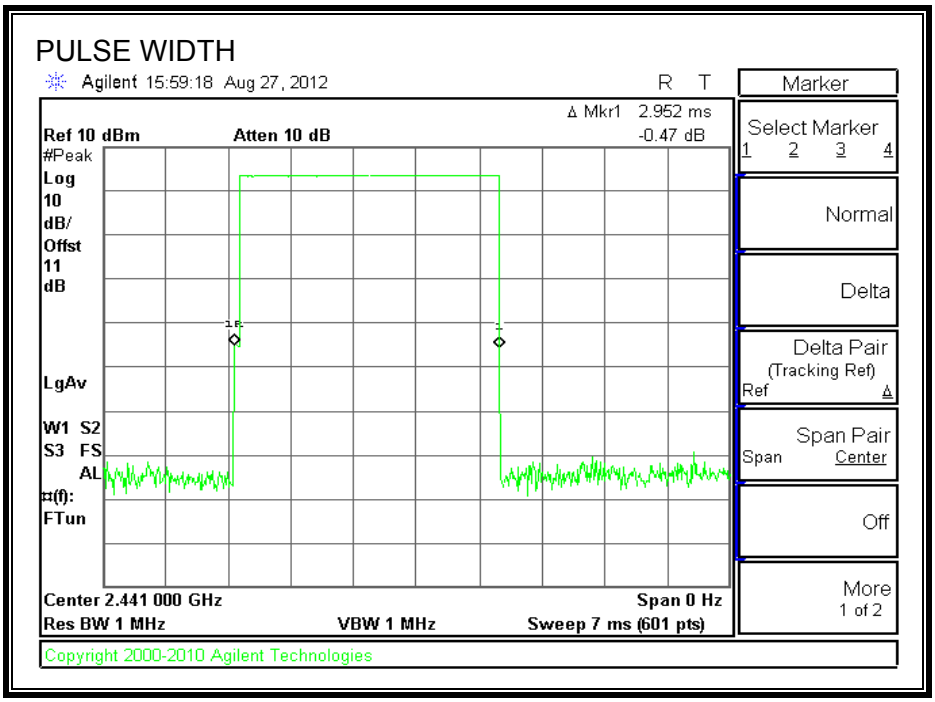


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

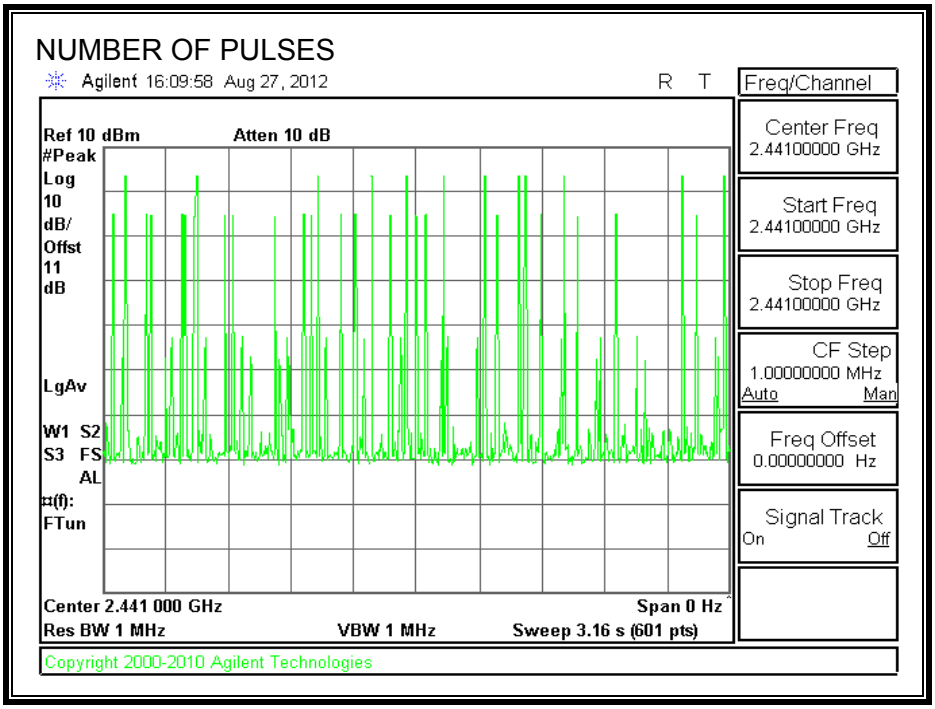


DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.1.6. 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.

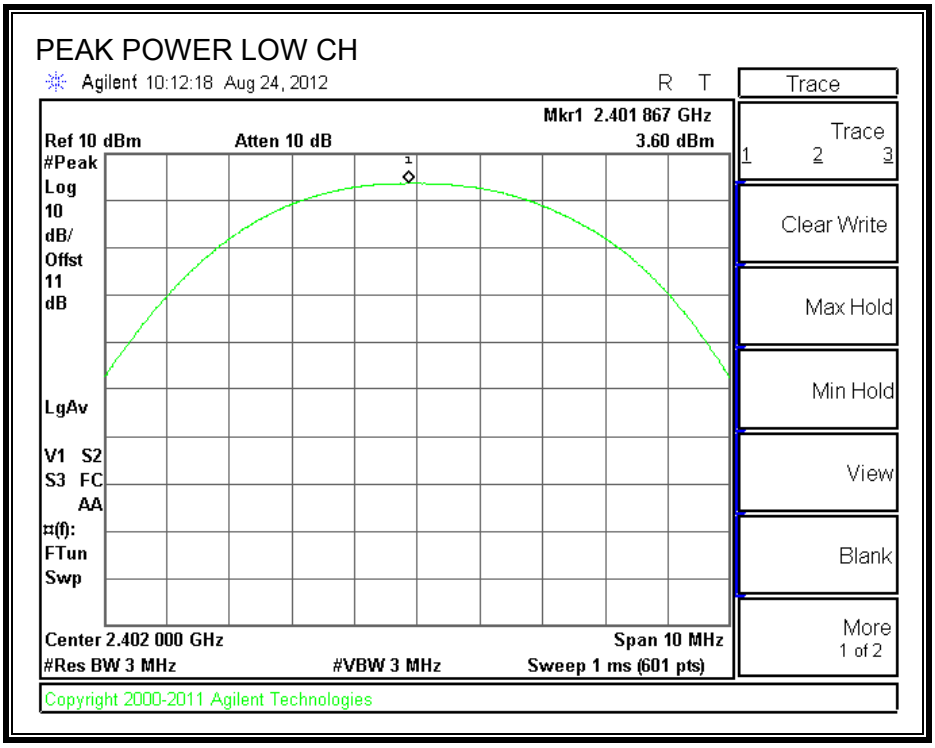
TEST PROCEDURE

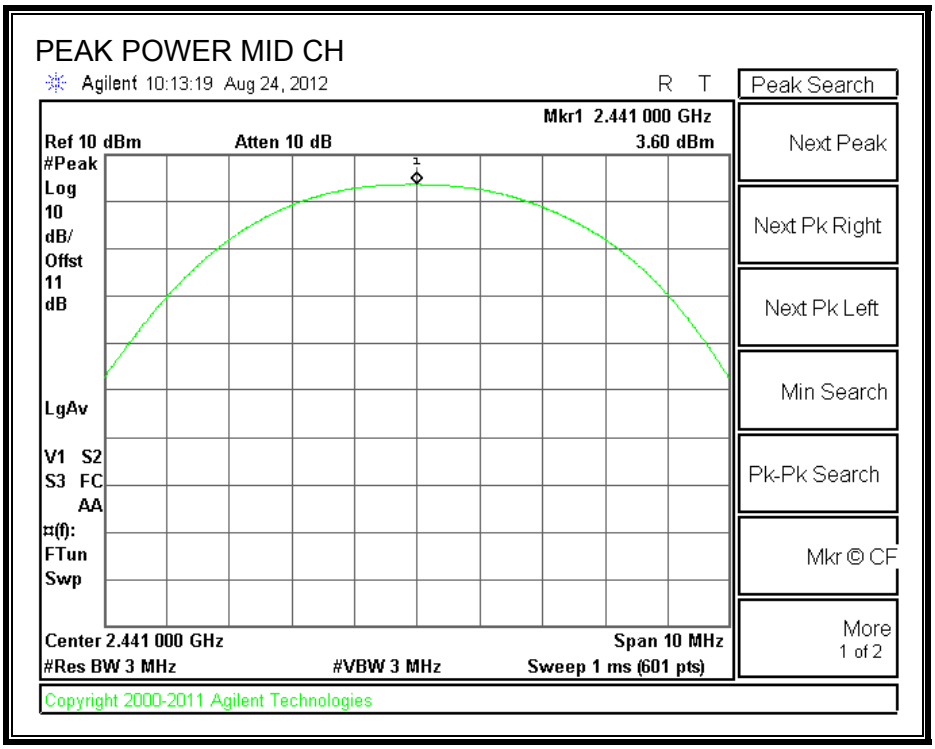
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

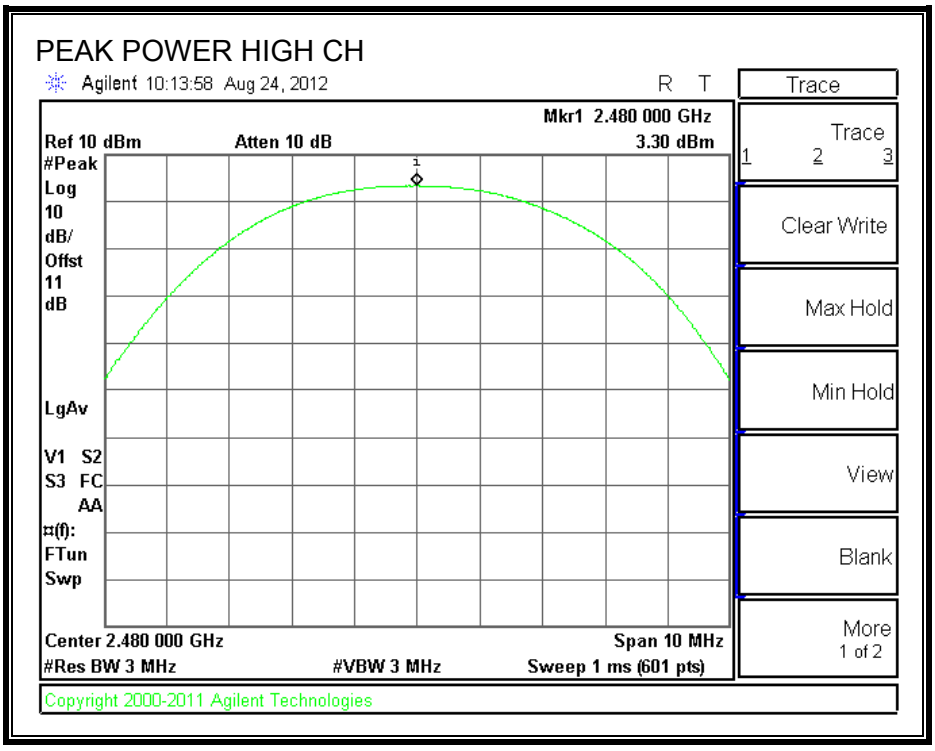
RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.60	30	-26.40
Middle	2441	3.60	30	-26.40
High	2480	3.30	30	-26.70

OUTPUT POWER







7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

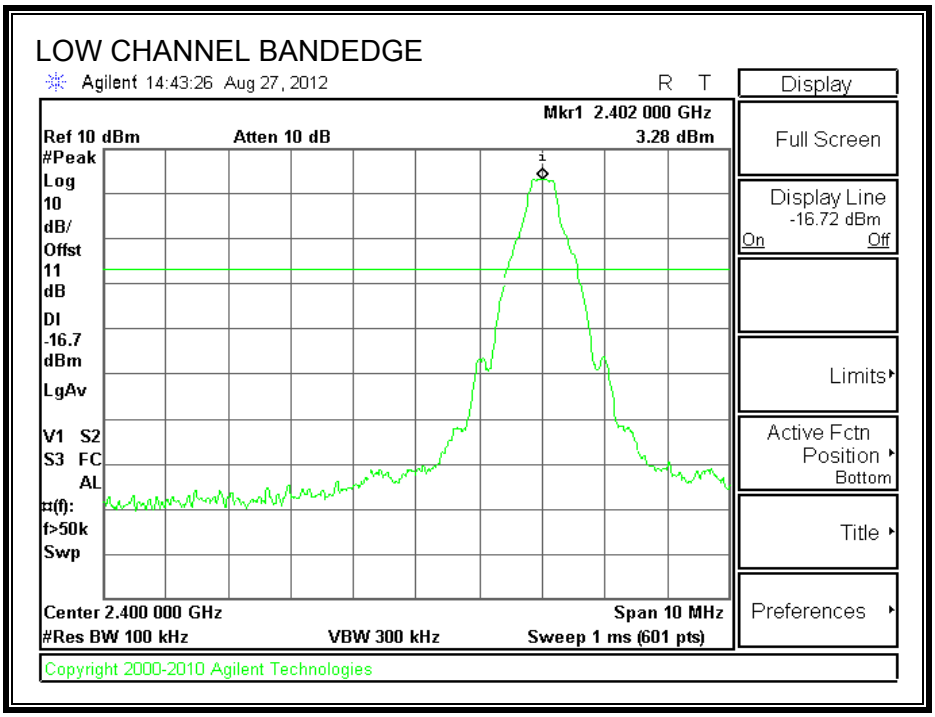
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

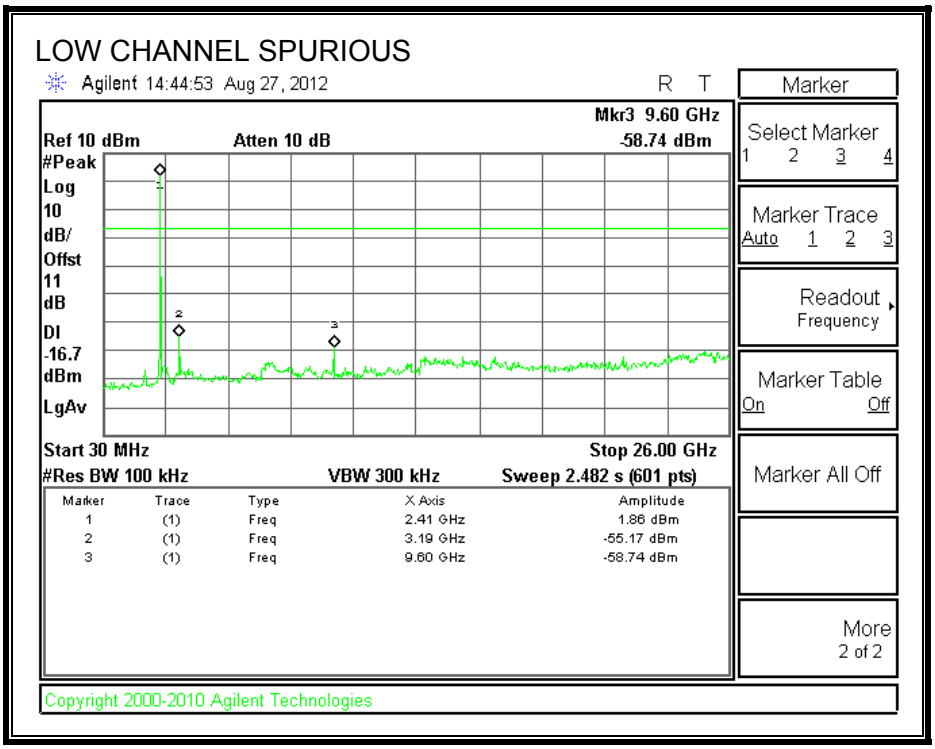
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

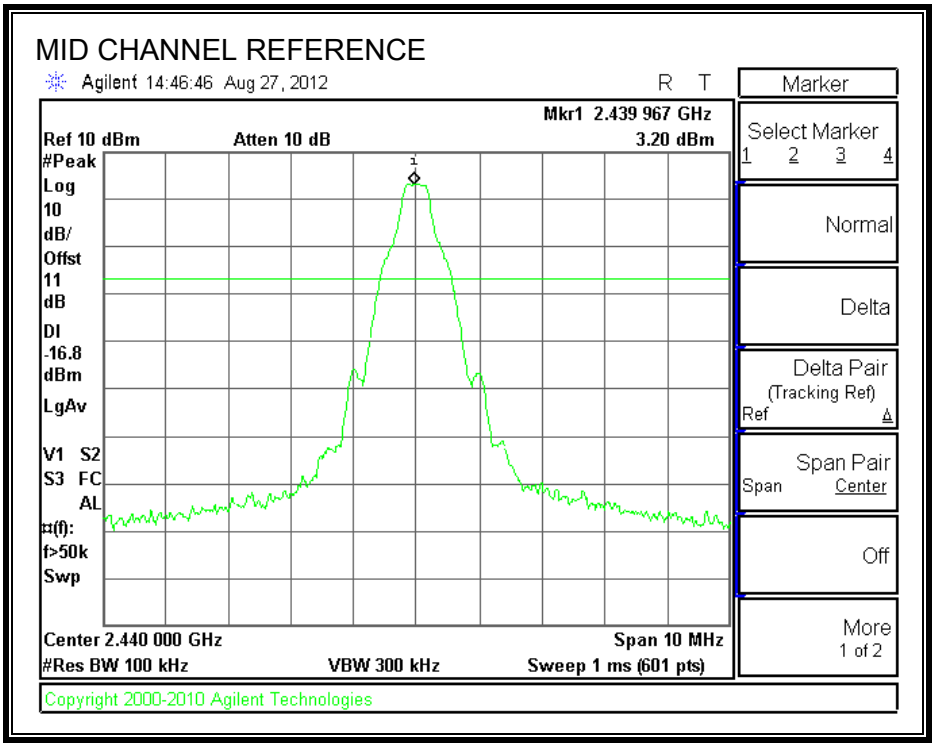
RESULTS

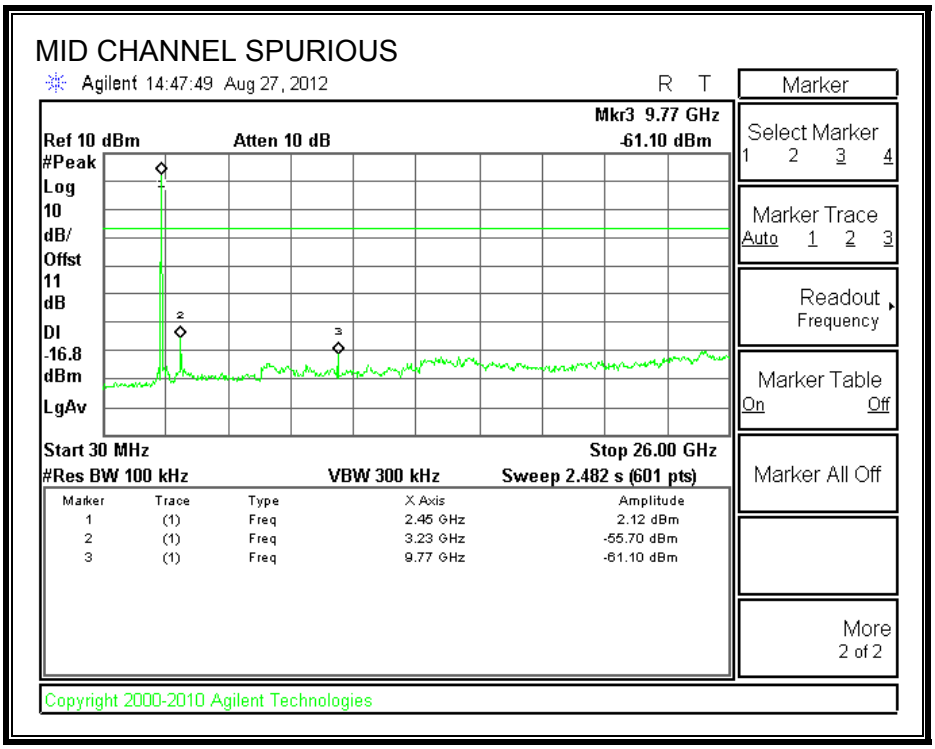
SPURIOUS EMISSIONS, LOW CHANNEL



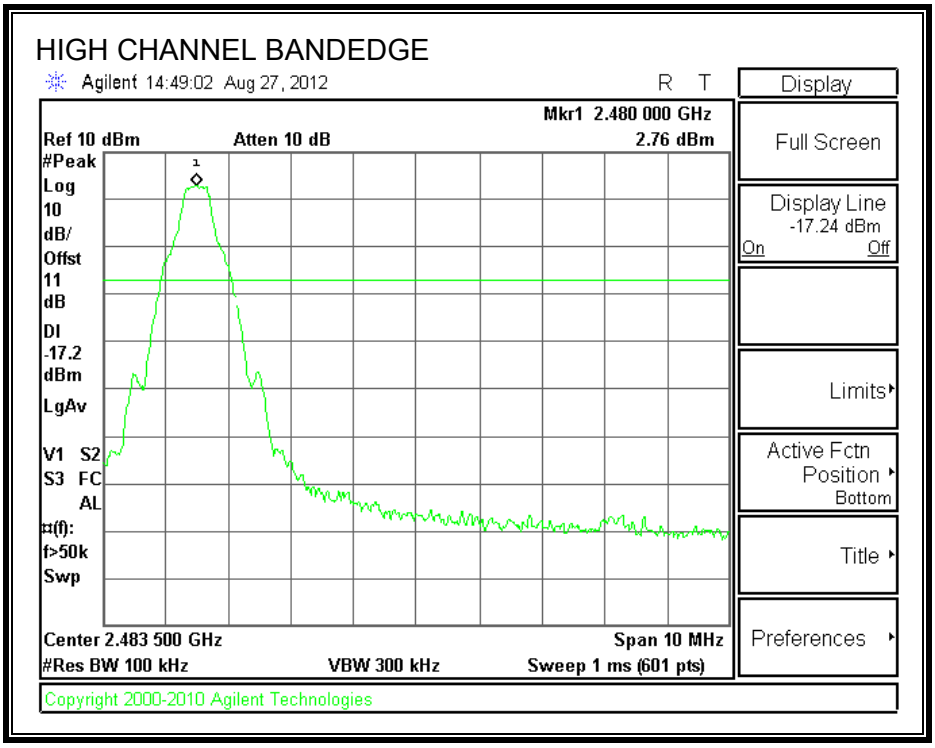


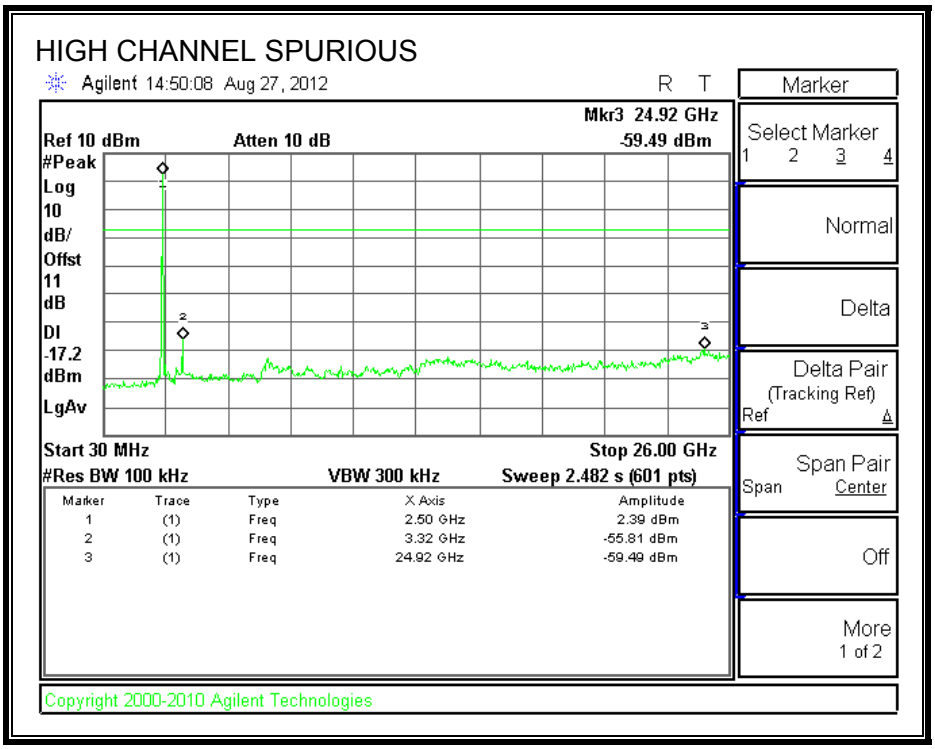
SPURIOUS EMISSIONS, MID CHANNEL





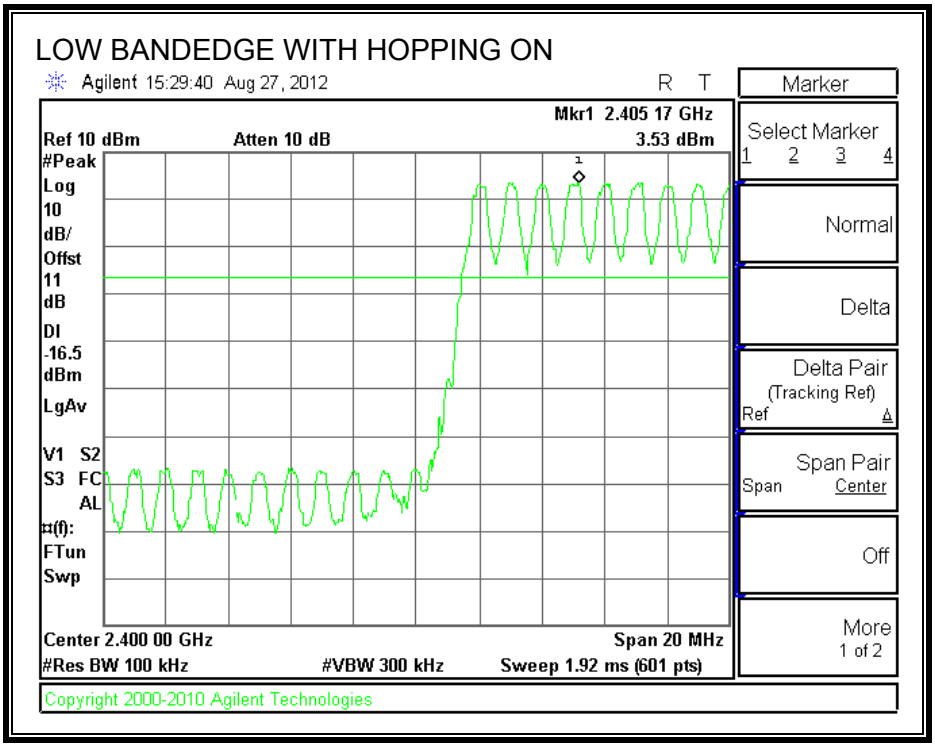
SPURIOUS EMISSIONS, HIGH CHANNEL



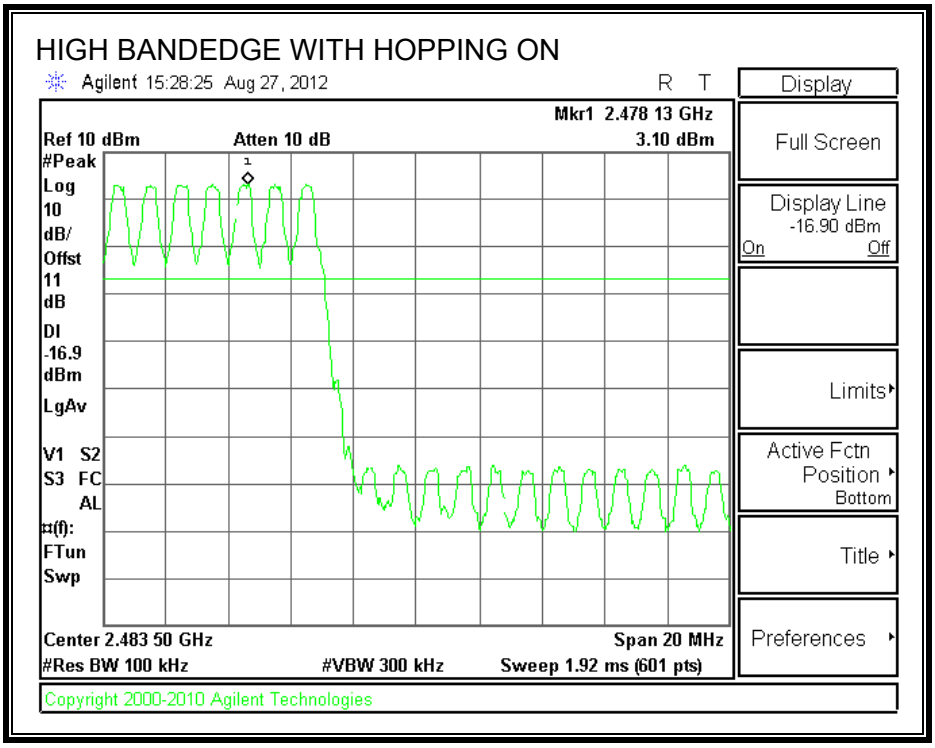


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



7.2. ENHANCED DATA RATE 8PSK MODULATION

7.2.1. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

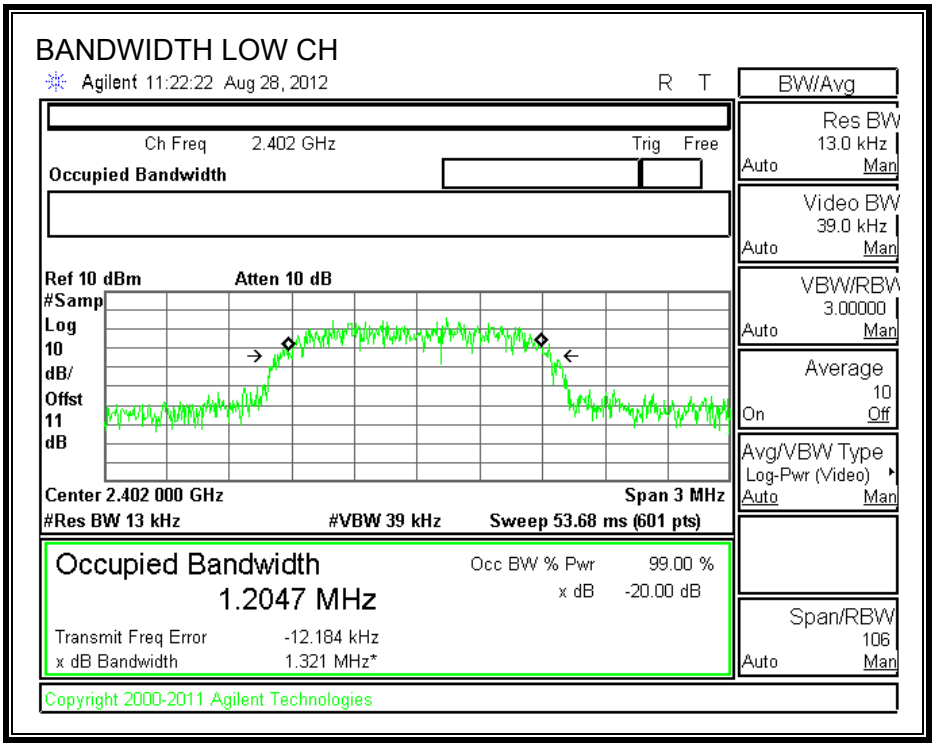
TEST PROCEDURE

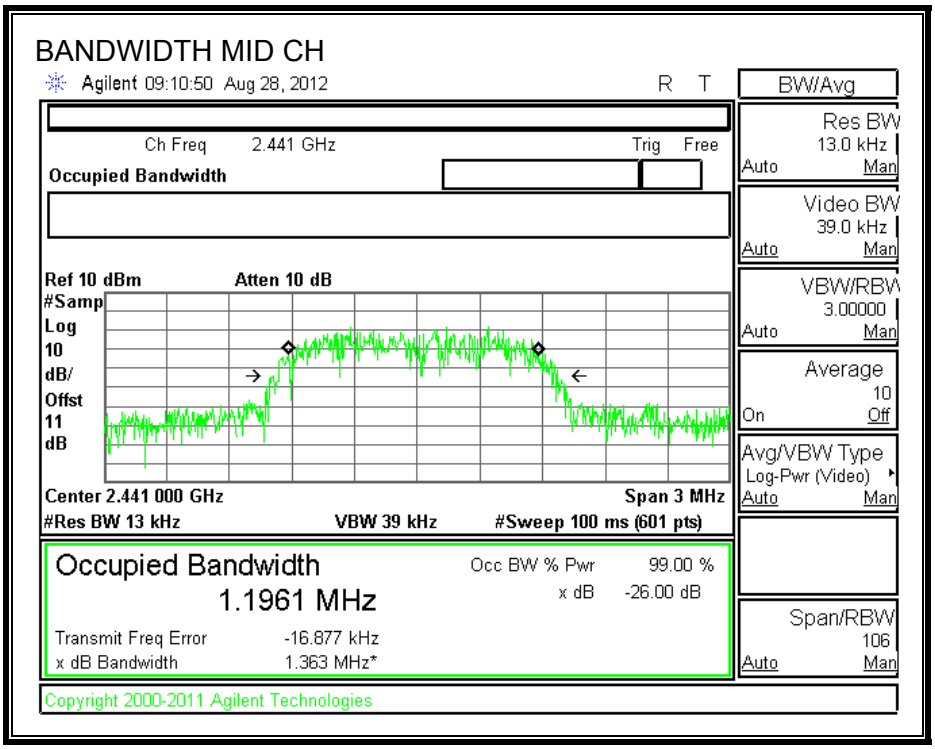
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 99% bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

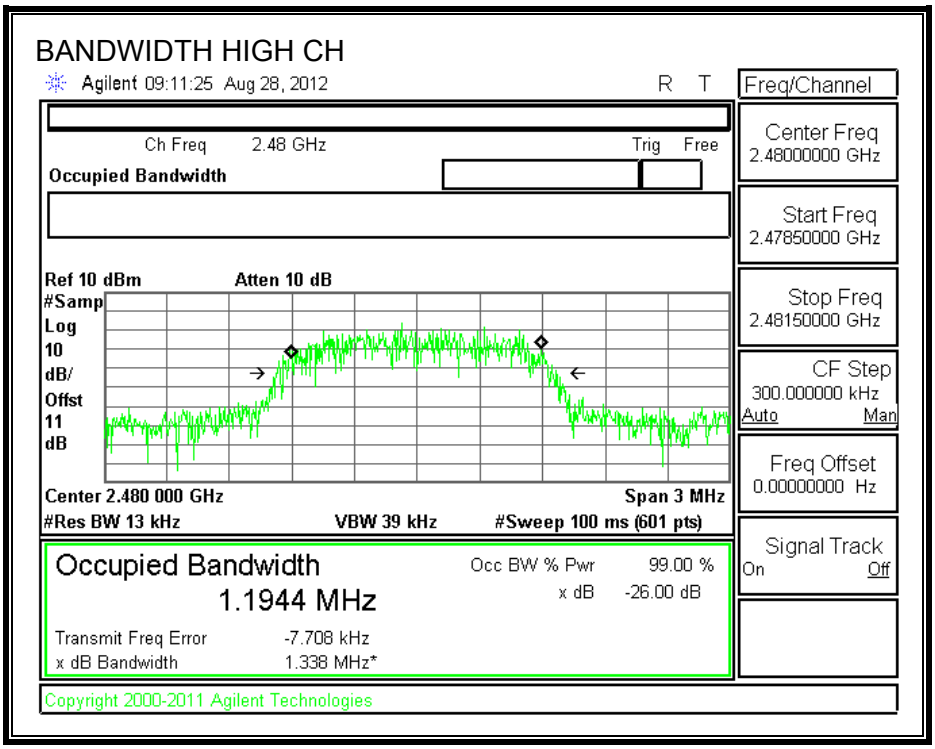
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.2047
Middle	2441	1.1961
High	2480	1.1944

99% BANDWIDTH







7.2.2. 20dB BANDWIDTH

LIMIT

None; for reporting purposes only.

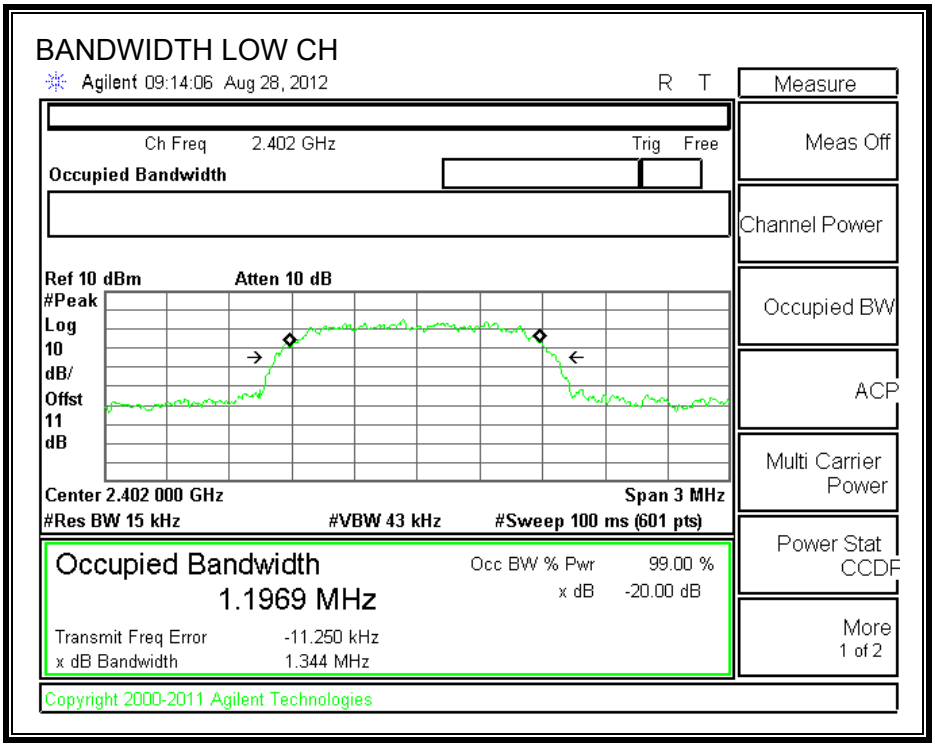
TEST PROCEDURE

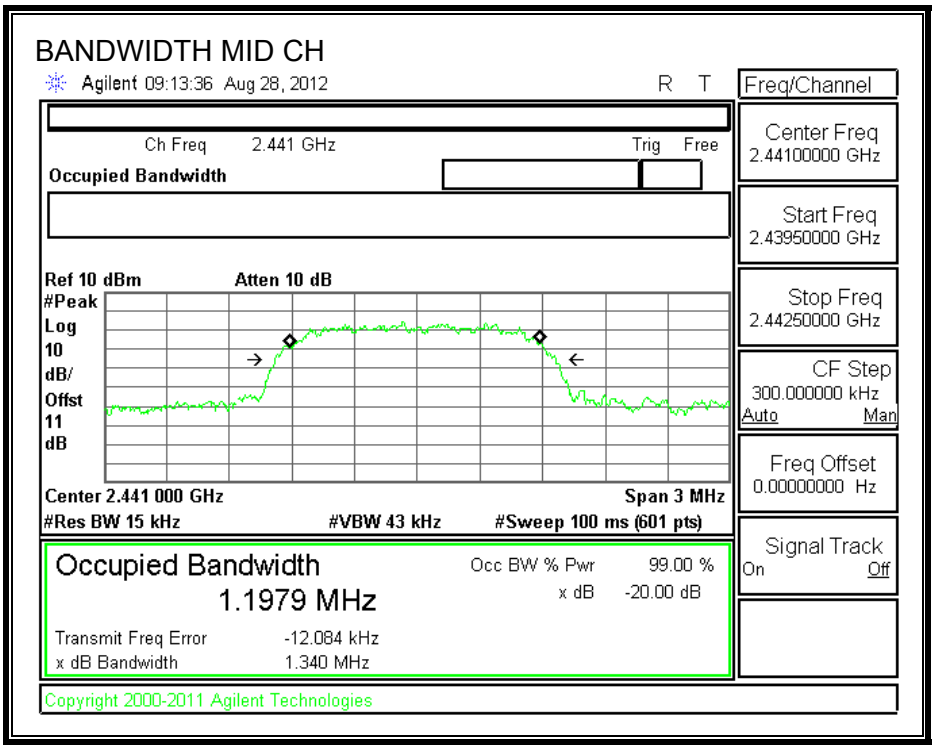
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

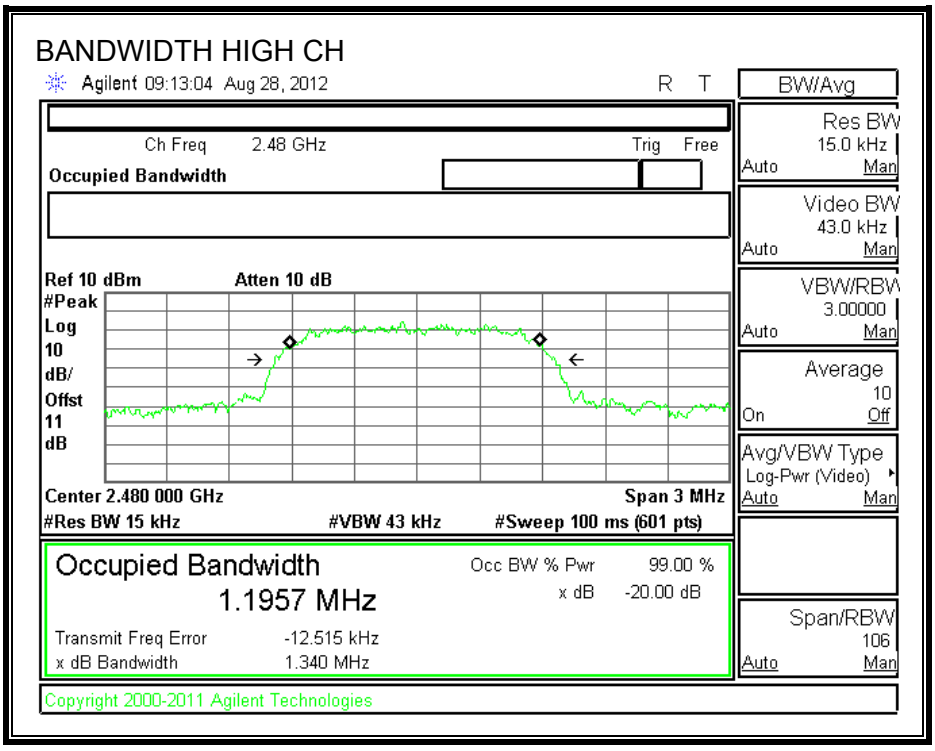
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.344
Middle	2441	1.340
High	2480	1.340

20 dB BANDWIDTH







7.2.3. 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.

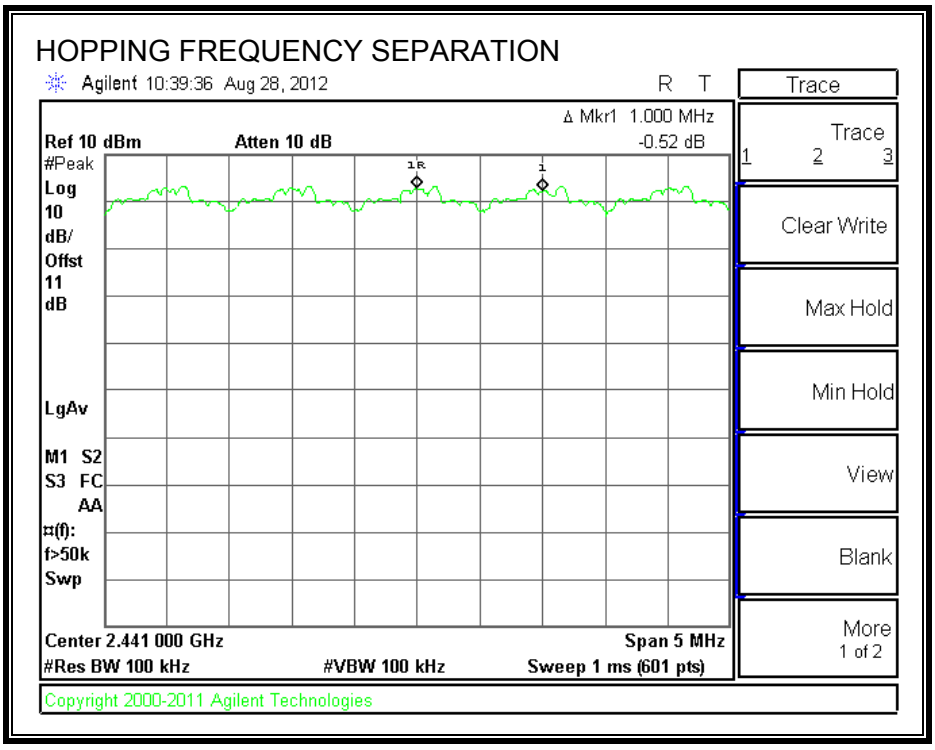
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.2.4. 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

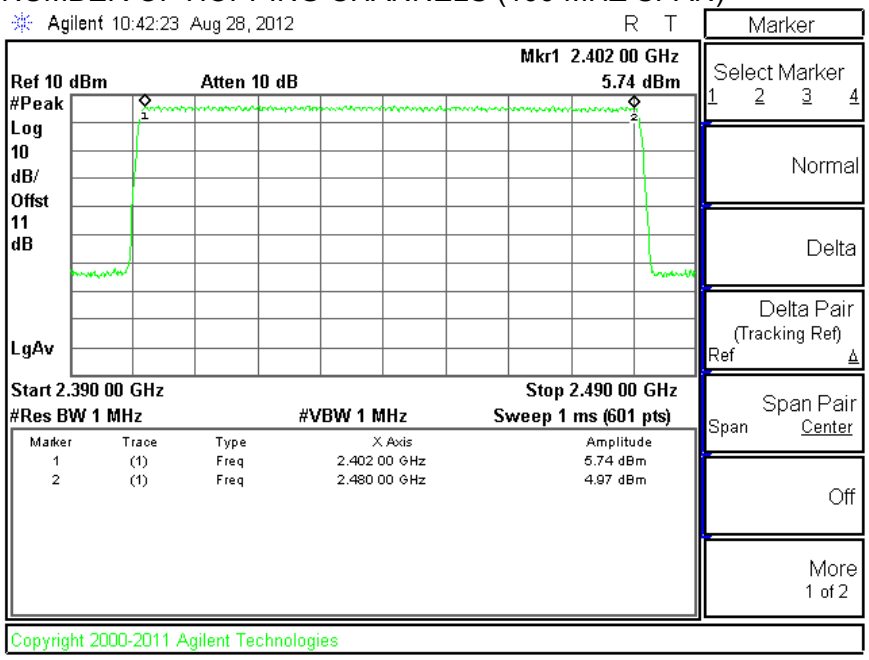
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

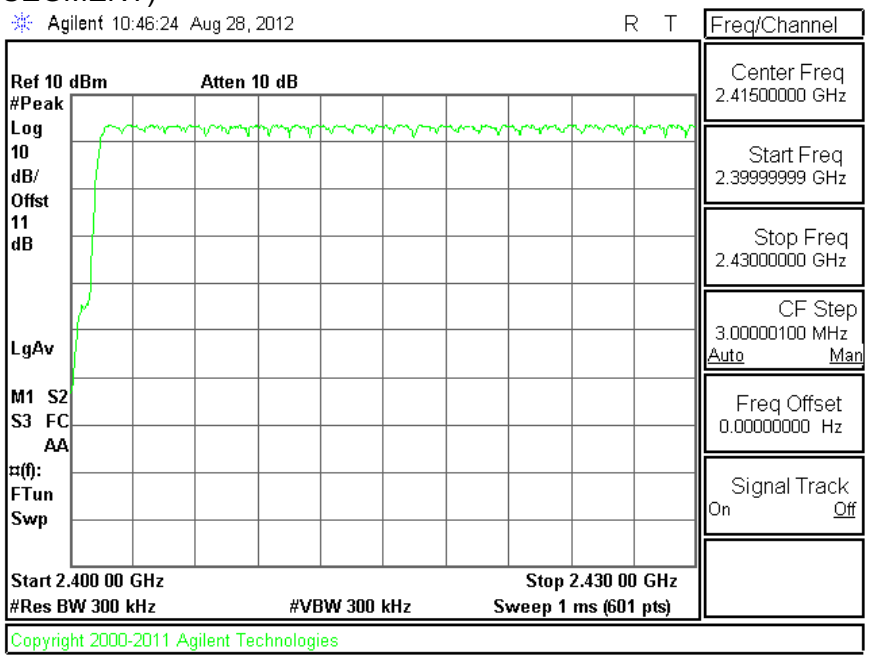
Normal Mode: 79 channels are observed
AFH Mode: Minimum channels are 20 and maximum channels are 79

NUMBER OF HOPPING CHANNELS

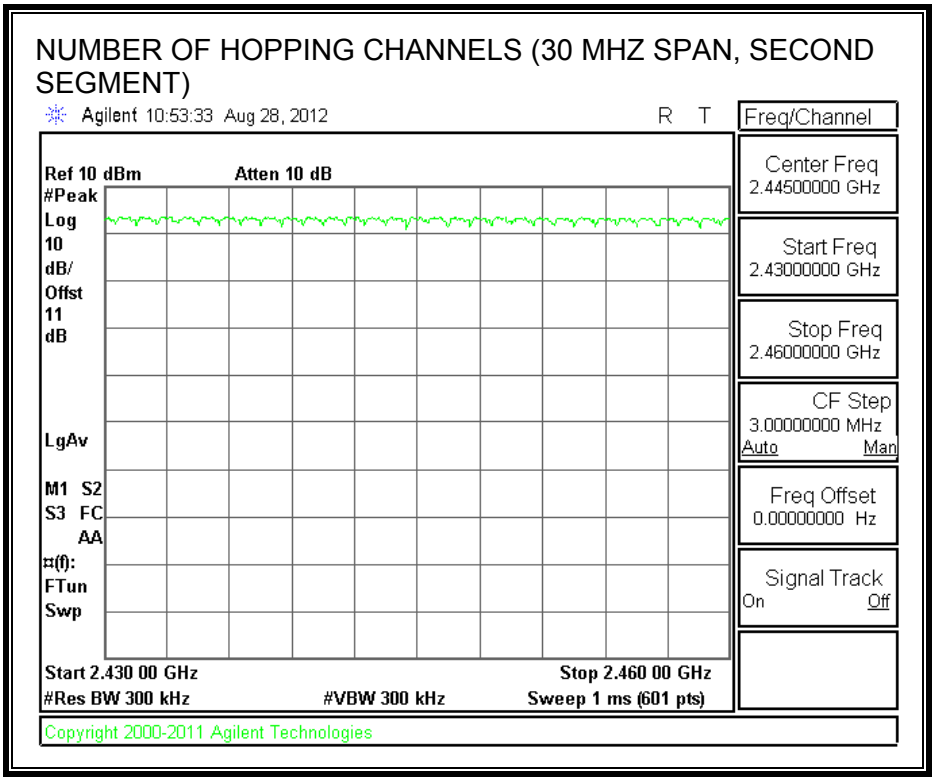
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



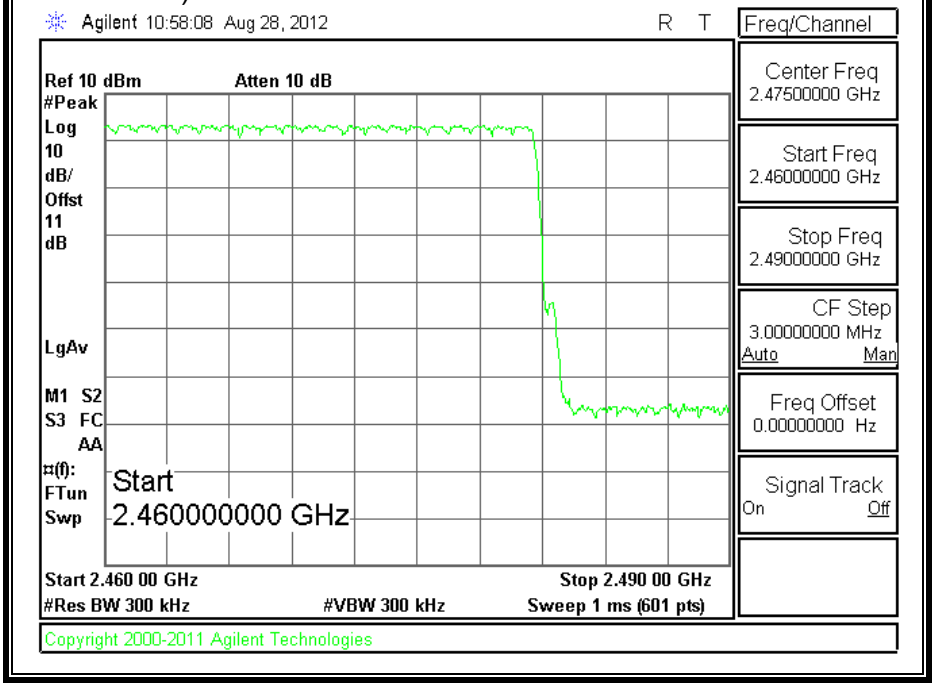
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



7.2.5. 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.

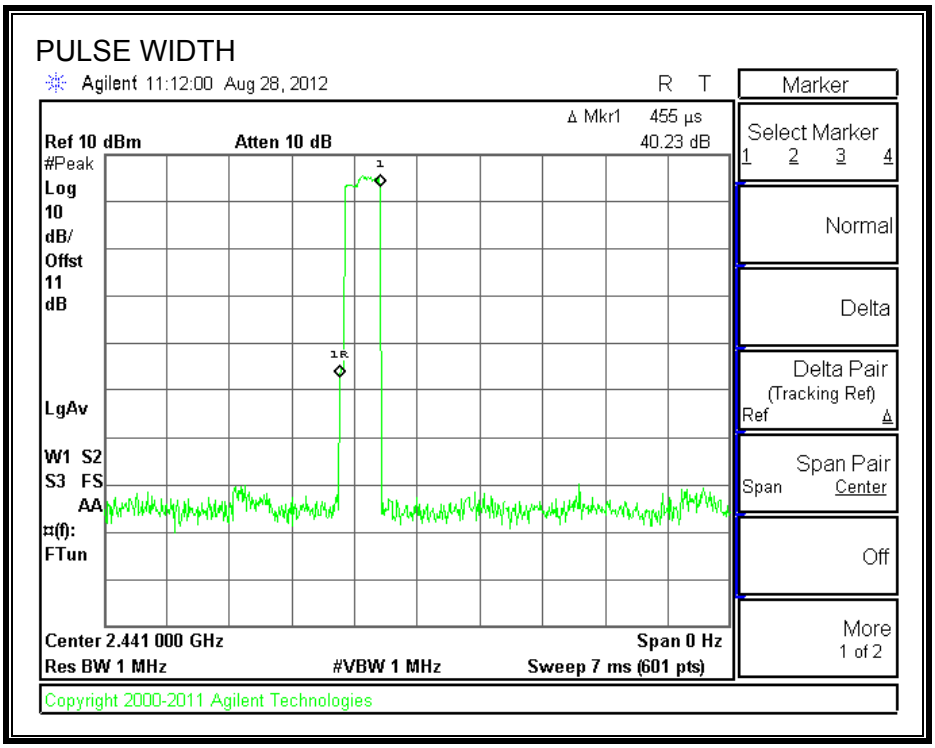
RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.455	32	0.1456	0.4	-0.2544
DH3	1.703	19	0.3236	0.4	-0.0764
DH5	2.952	12	0.3542	0.4	-0.0458

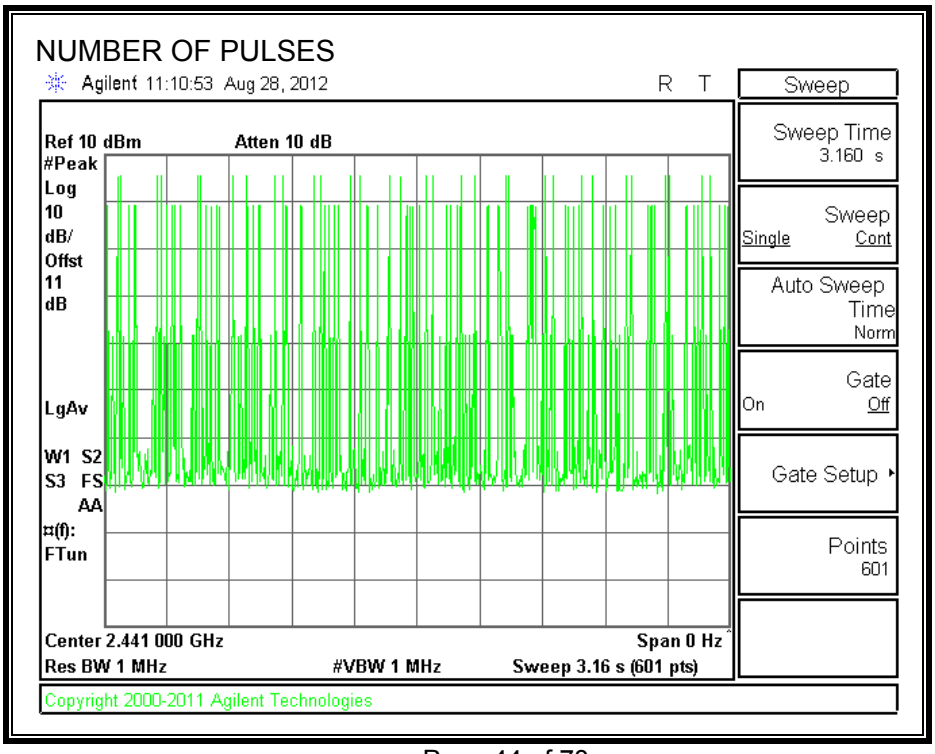
Note: for AFH (8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 21 demonstrates compliance with channel occupancy when AFH is employed.

DH1

PULSE WIDTH

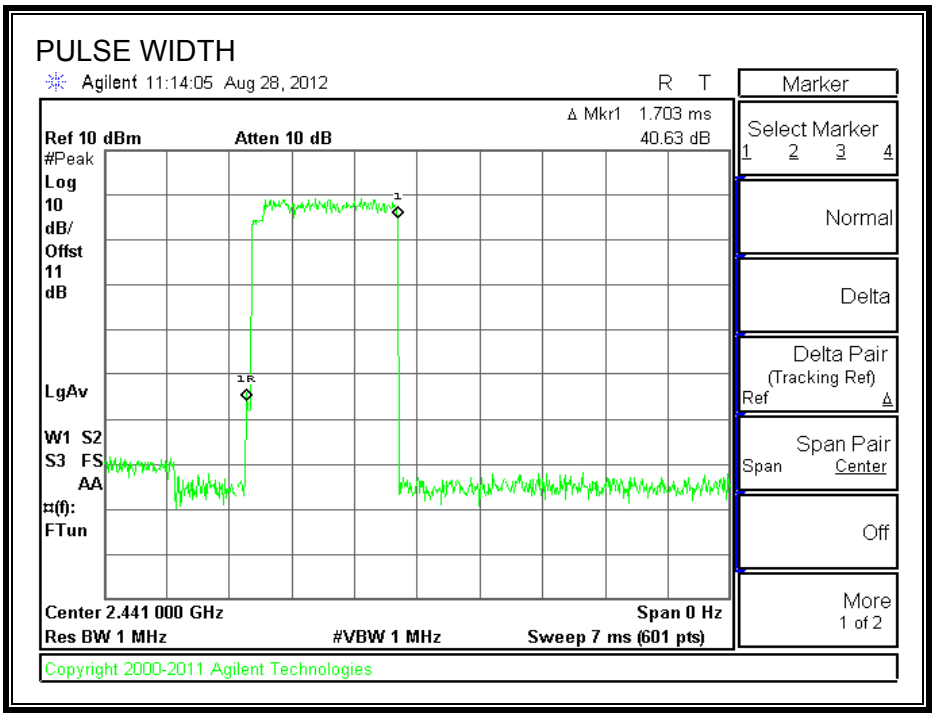


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

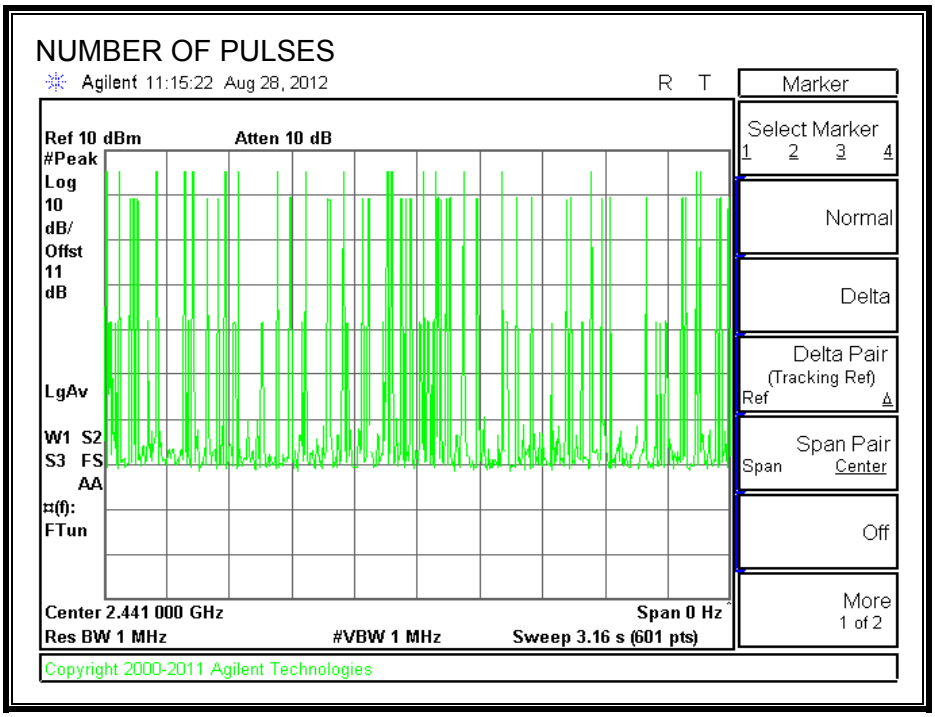


DH3

PULSE WIDTH

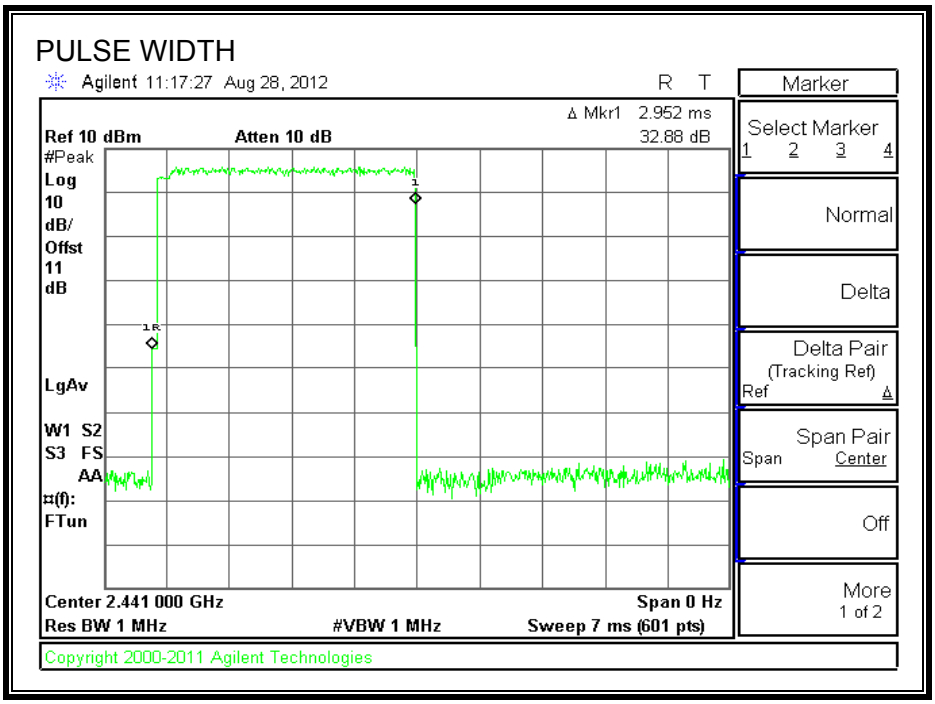


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

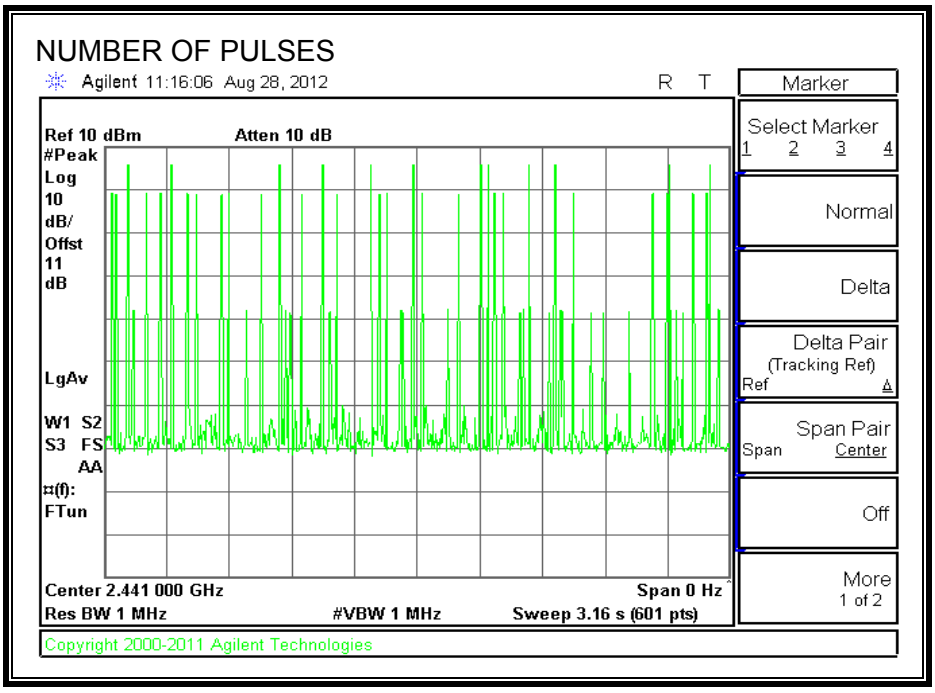


DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.2.6. 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 20.97 dBm.

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

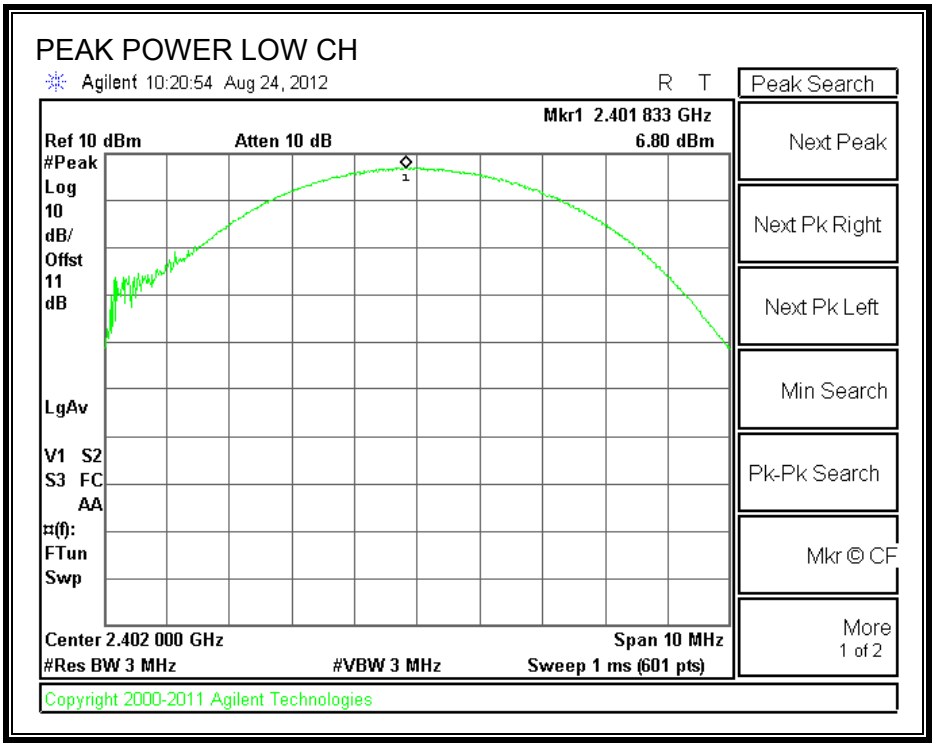
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

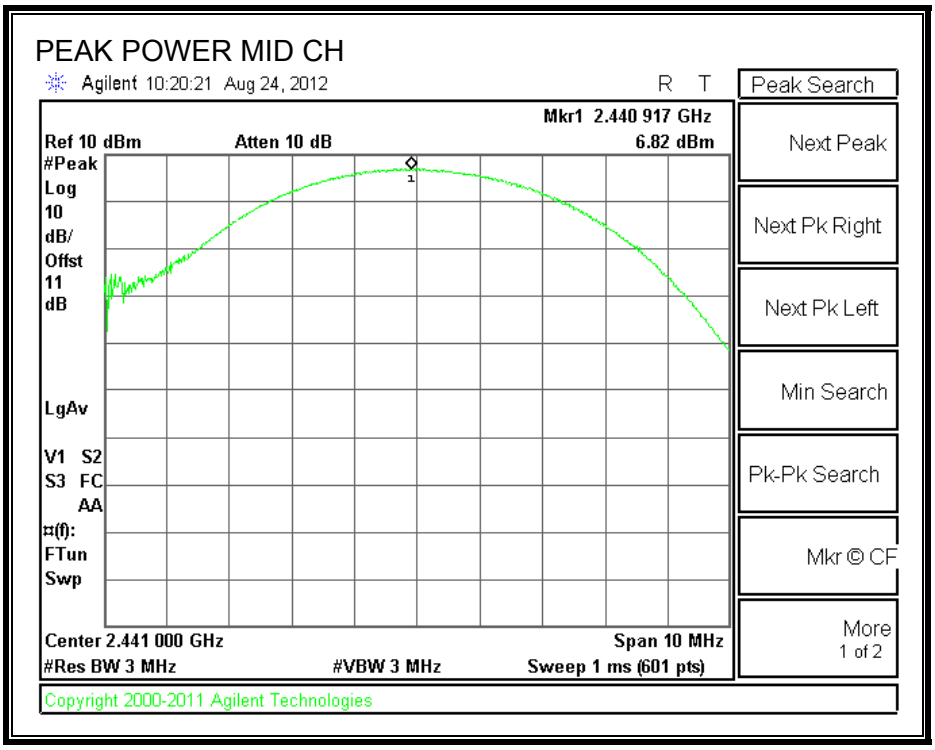
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	6.80	20.97	-14.17
Middle	2441	6.82	20.97	-14.15
High	2480	6.51	20.97	-14.46

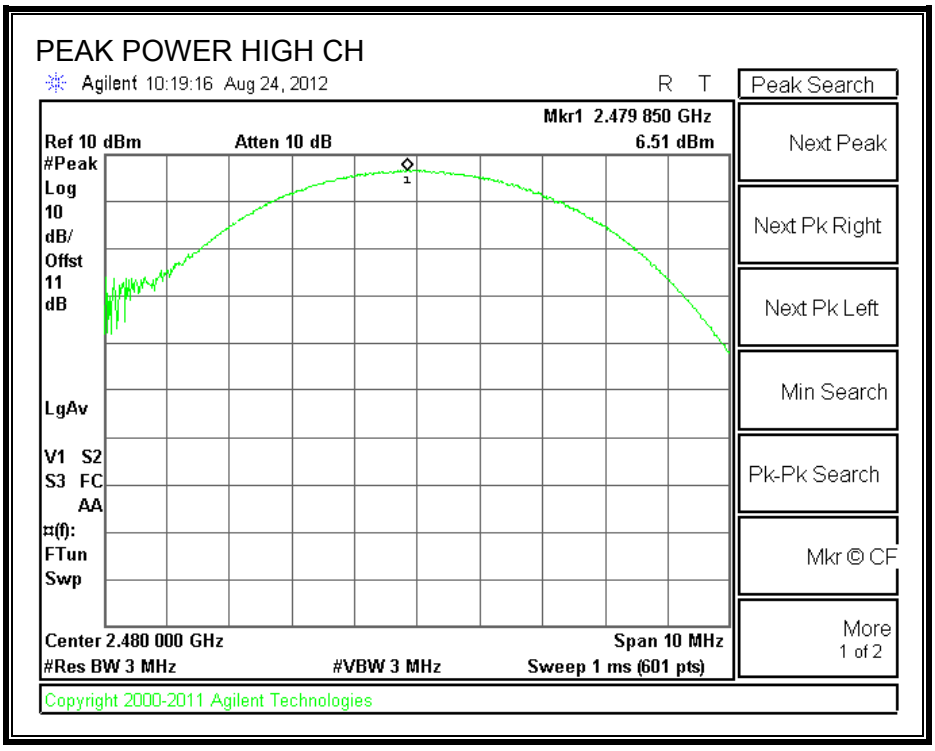
OUTPUT POWER

PEAK POWER LOW CH



PEAK POWER MID CH





7.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

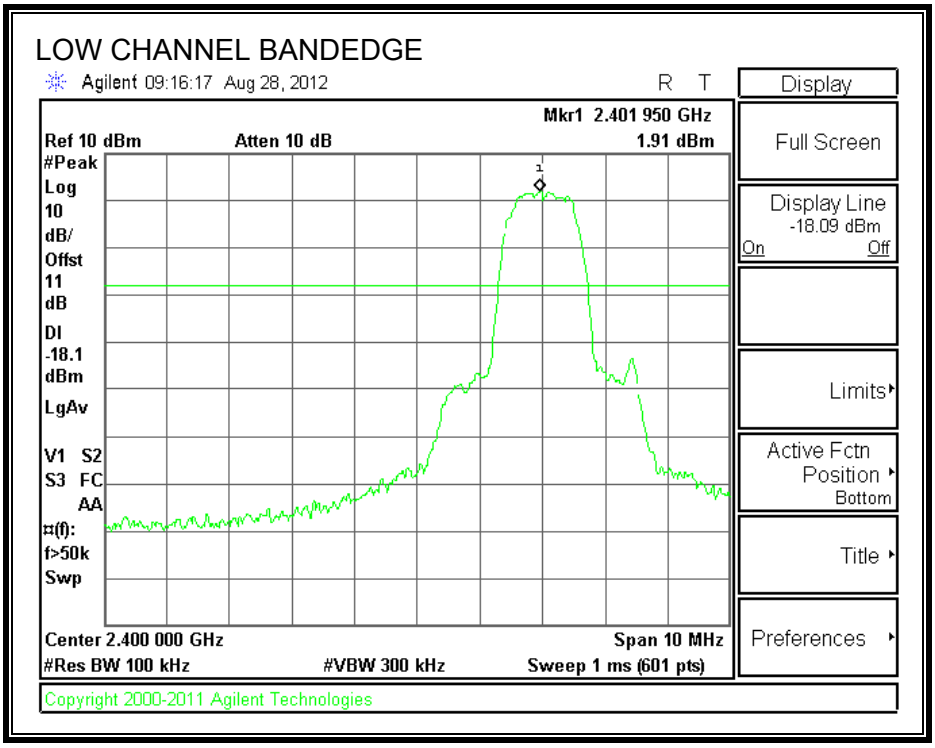
TEST PROCEDURE

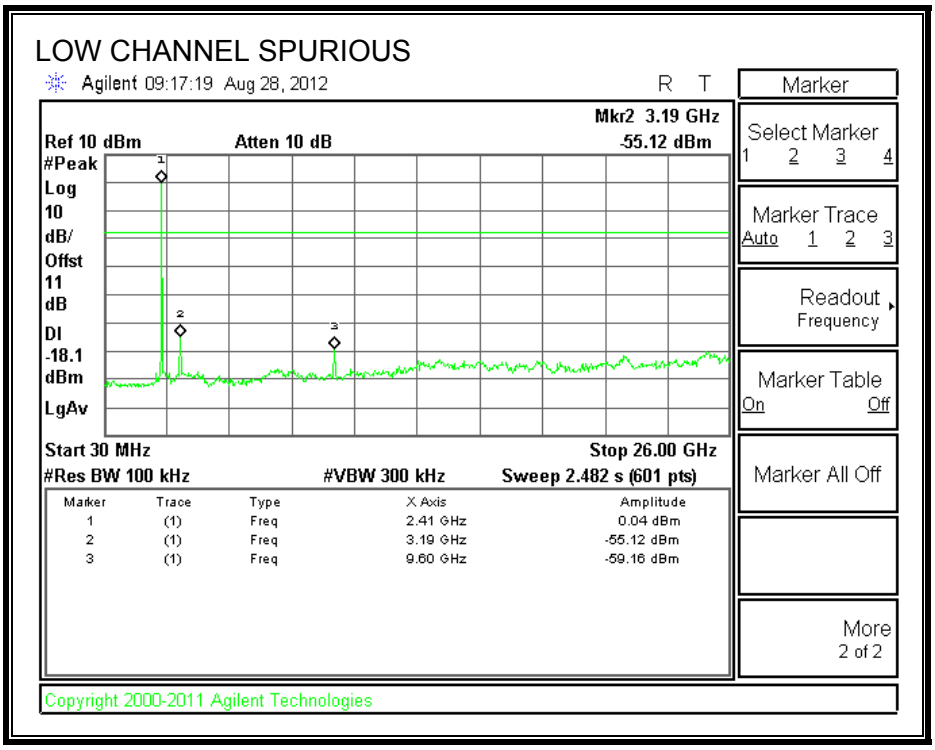
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

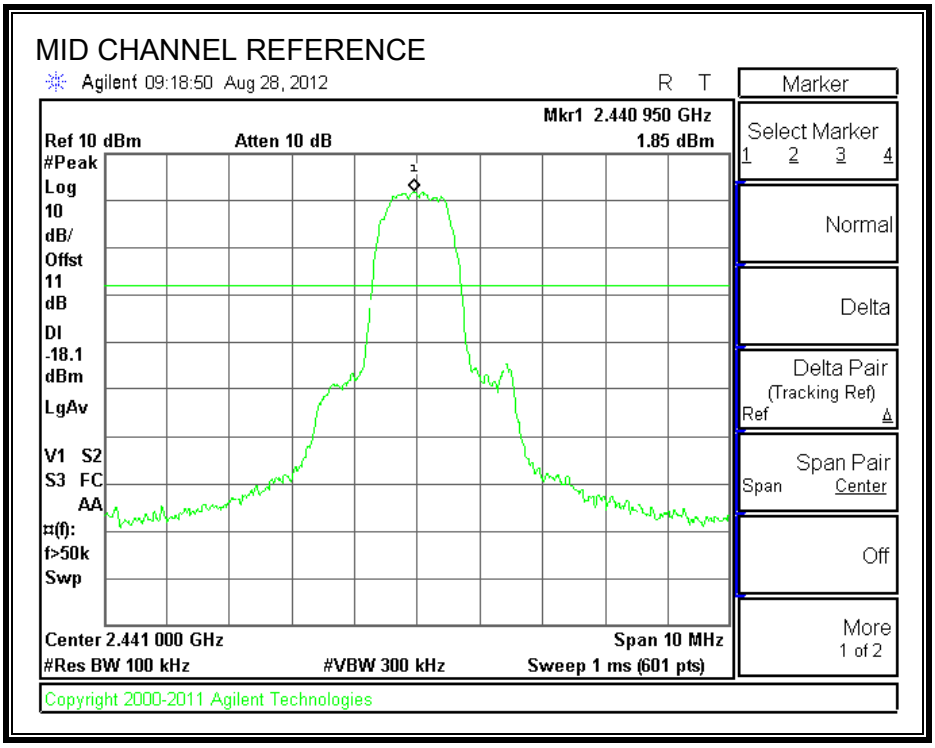
The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

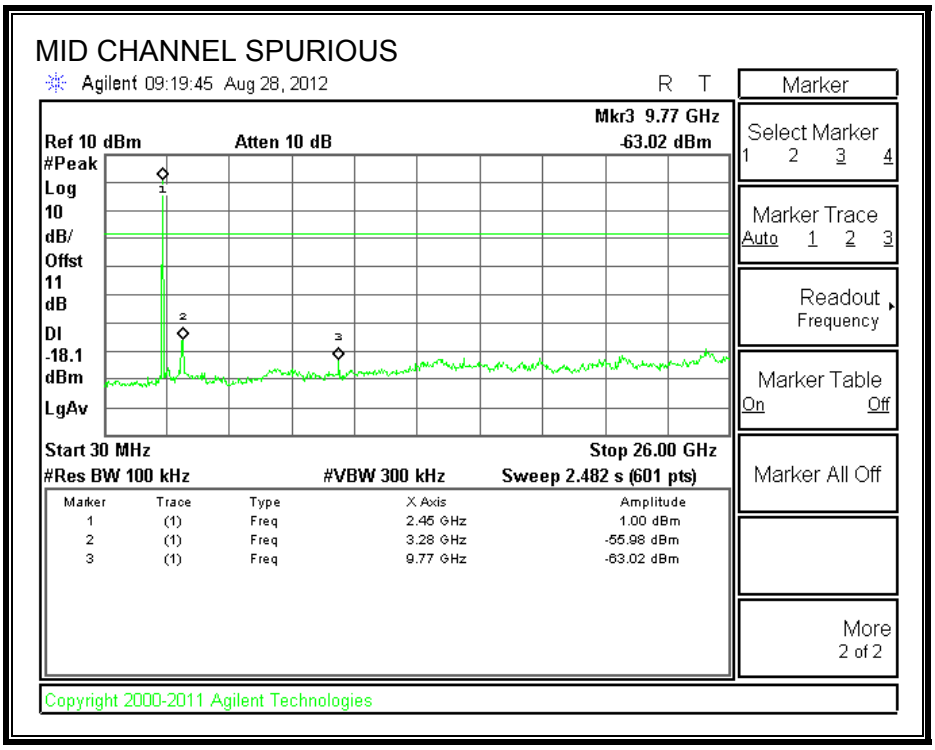
SPURIOUS EMISSIONS, LOW CHANNEL



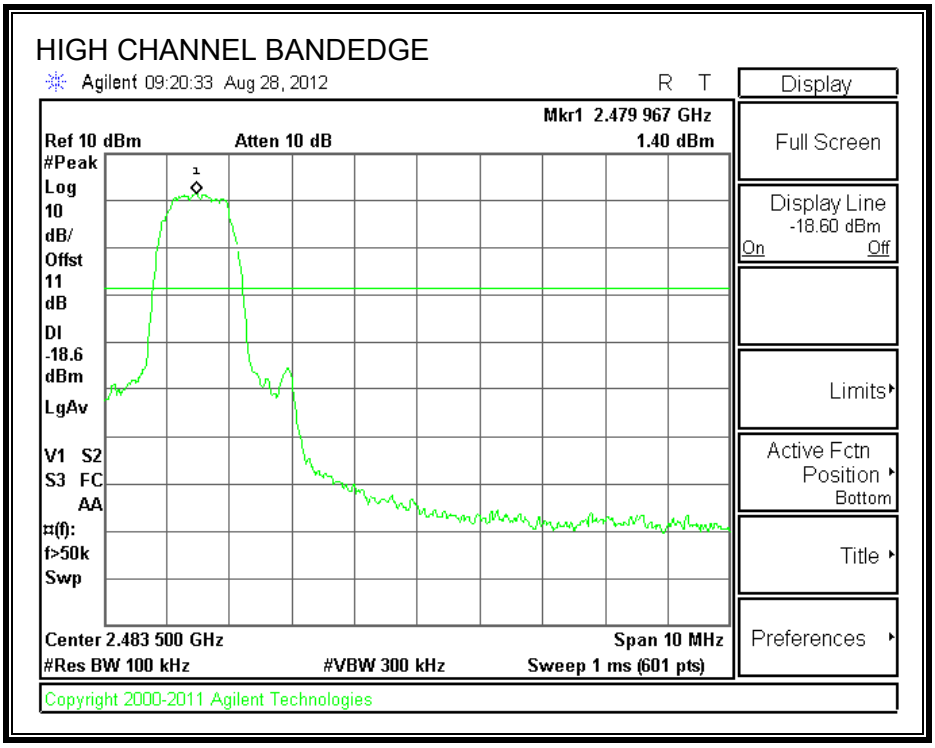


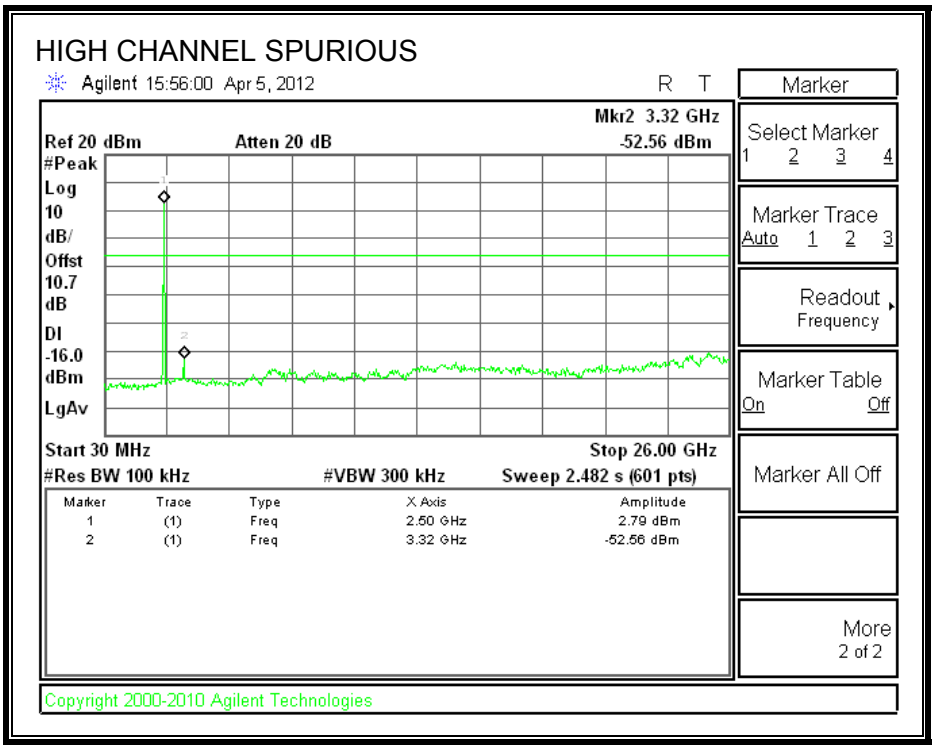
SPURIOUS EMISSIONS, MID CHANNEL



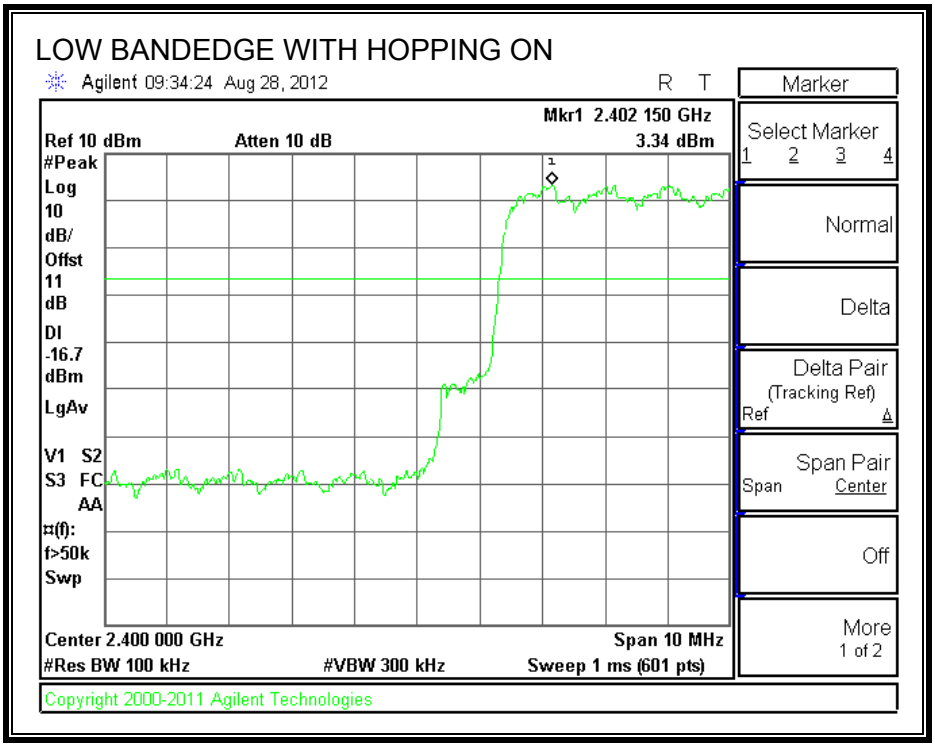


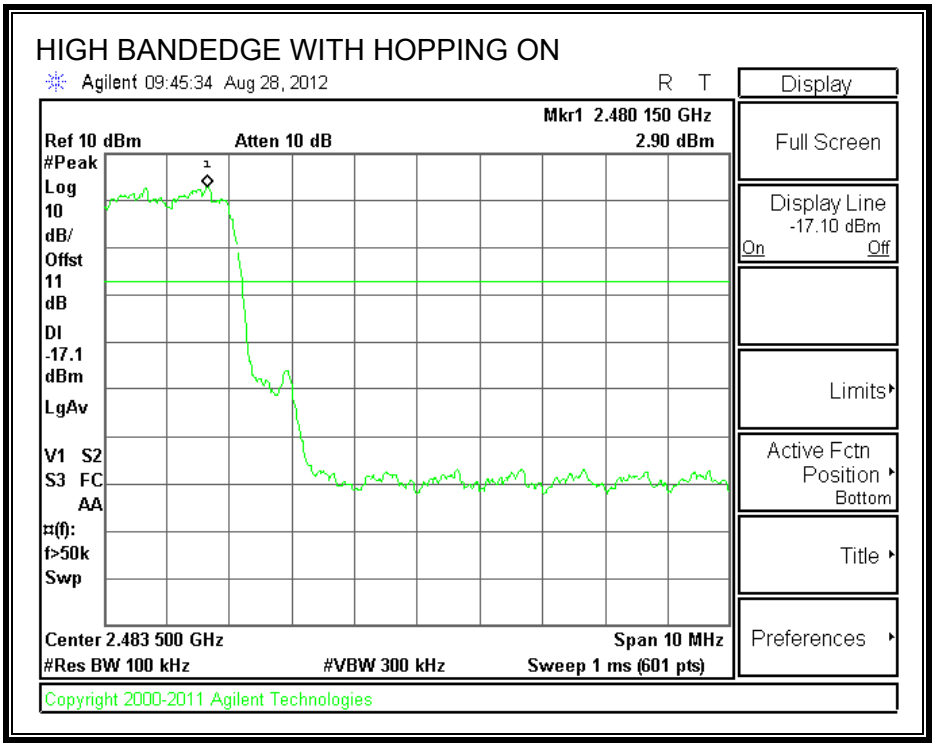
SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





8. RADIATED TEST RESULTS

8.1. 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, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

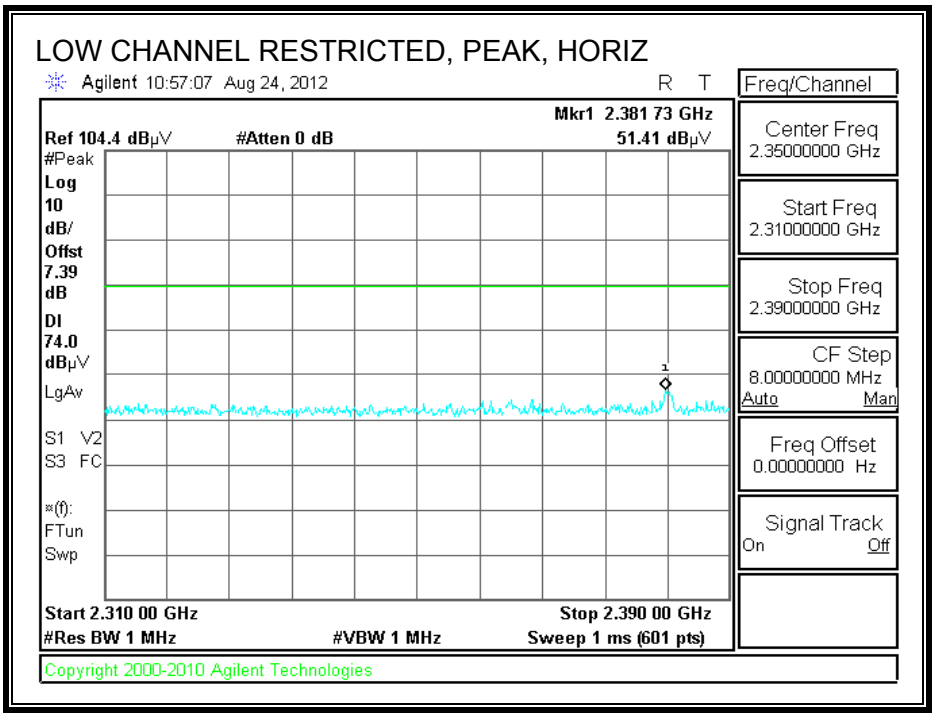
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

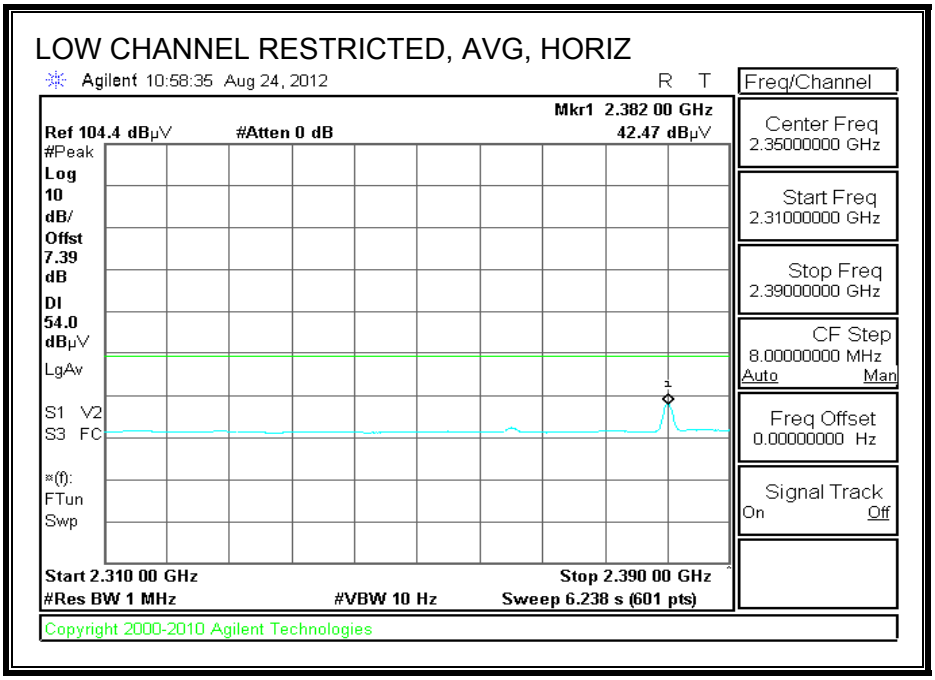
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TX SPURIOUS ABOVE 1 GHz

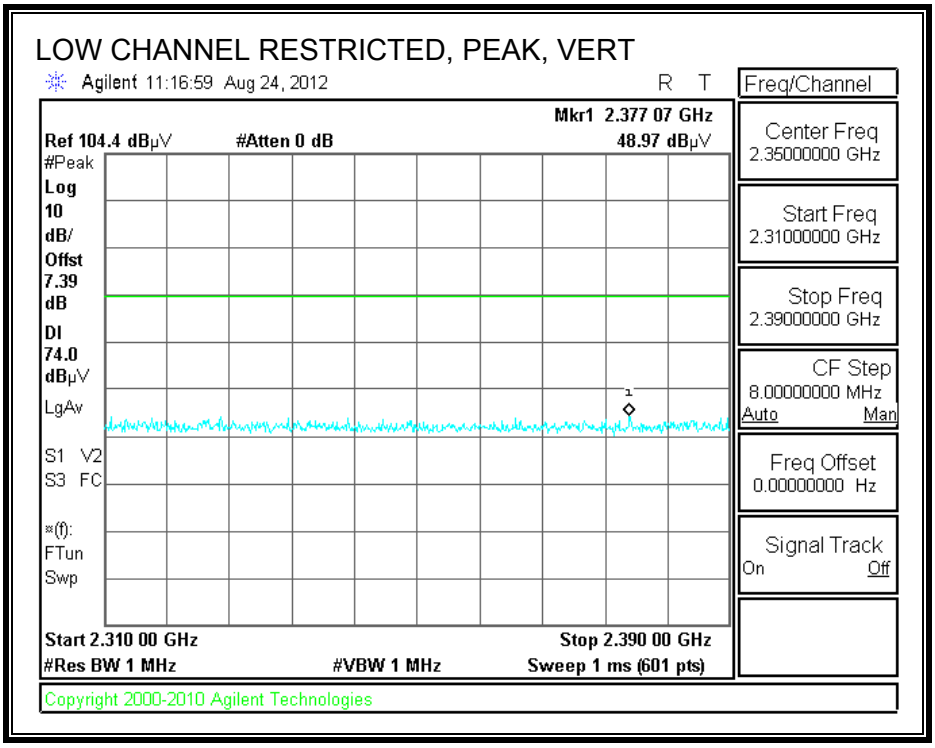
8.2.1. BASIC DATA RATE GFSK MODULATION

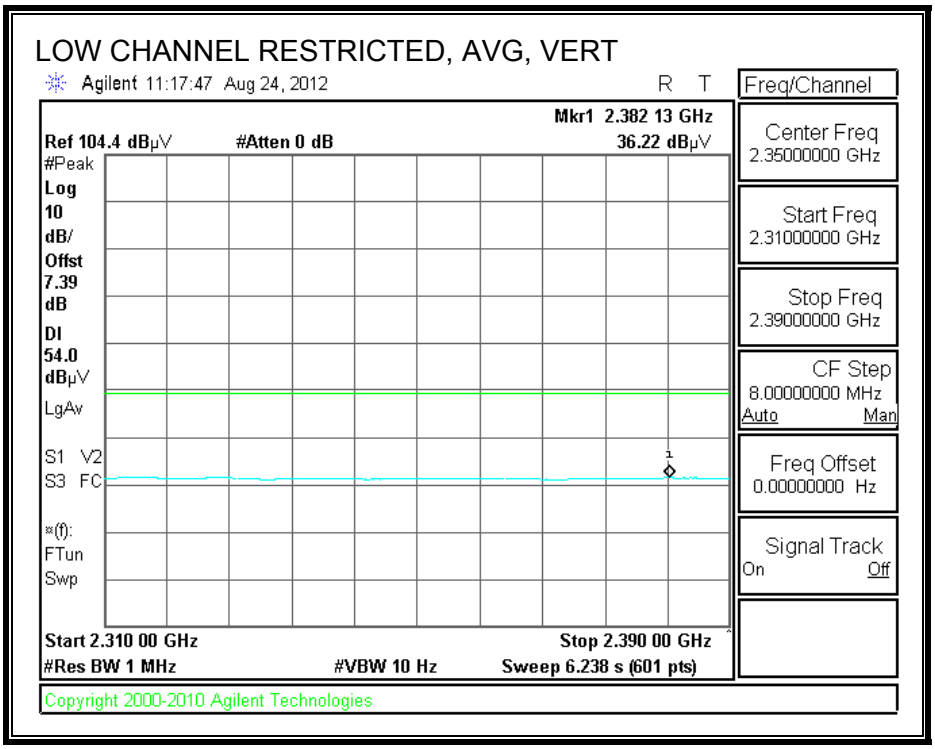
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



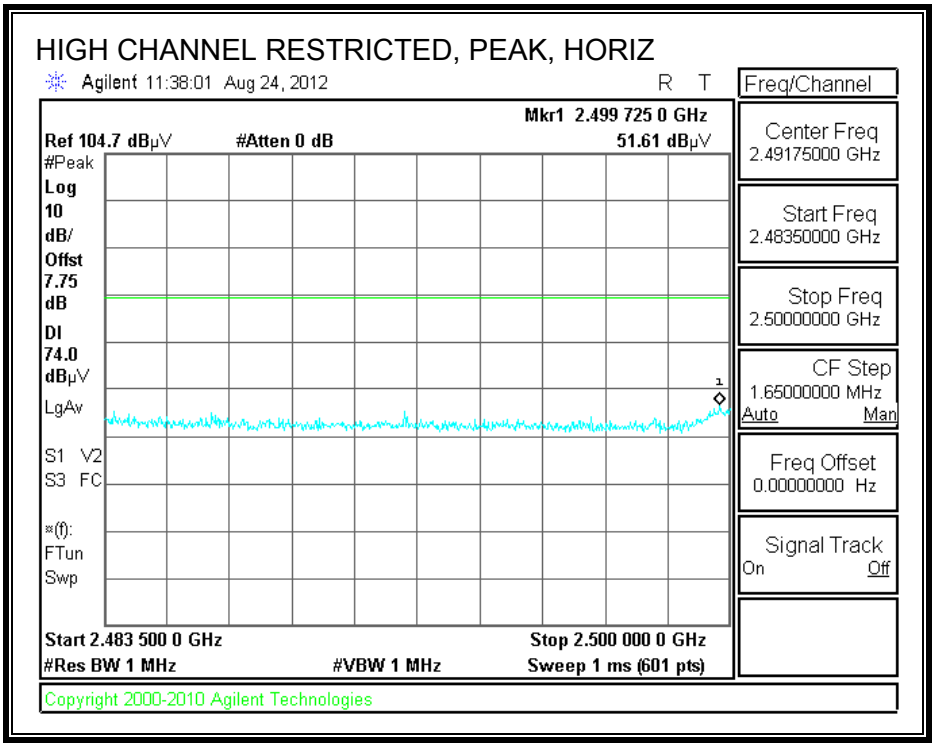


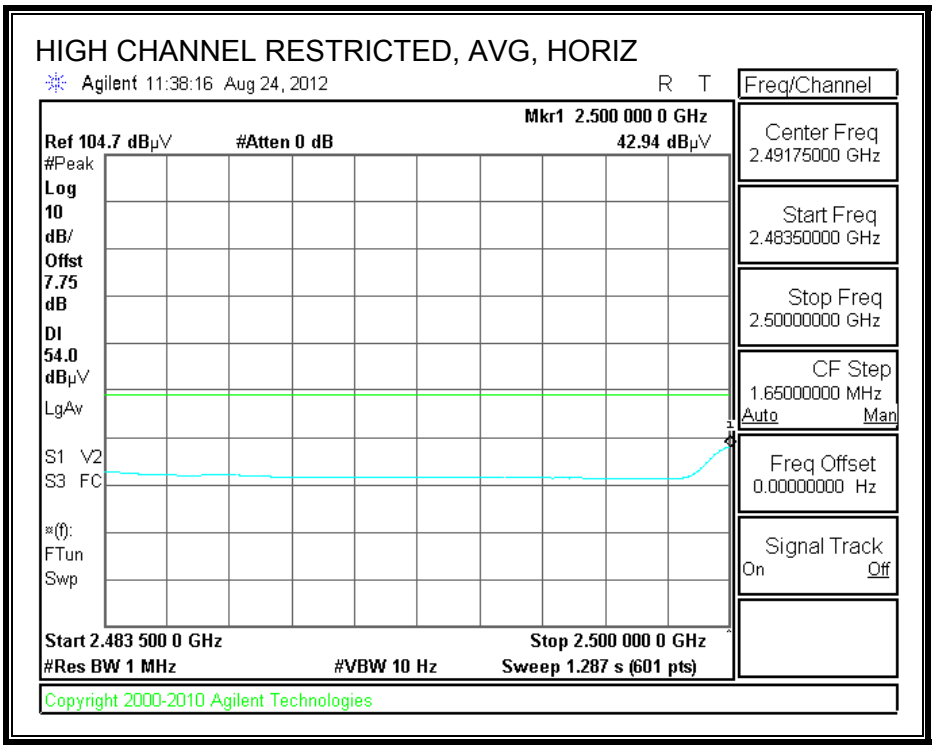
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



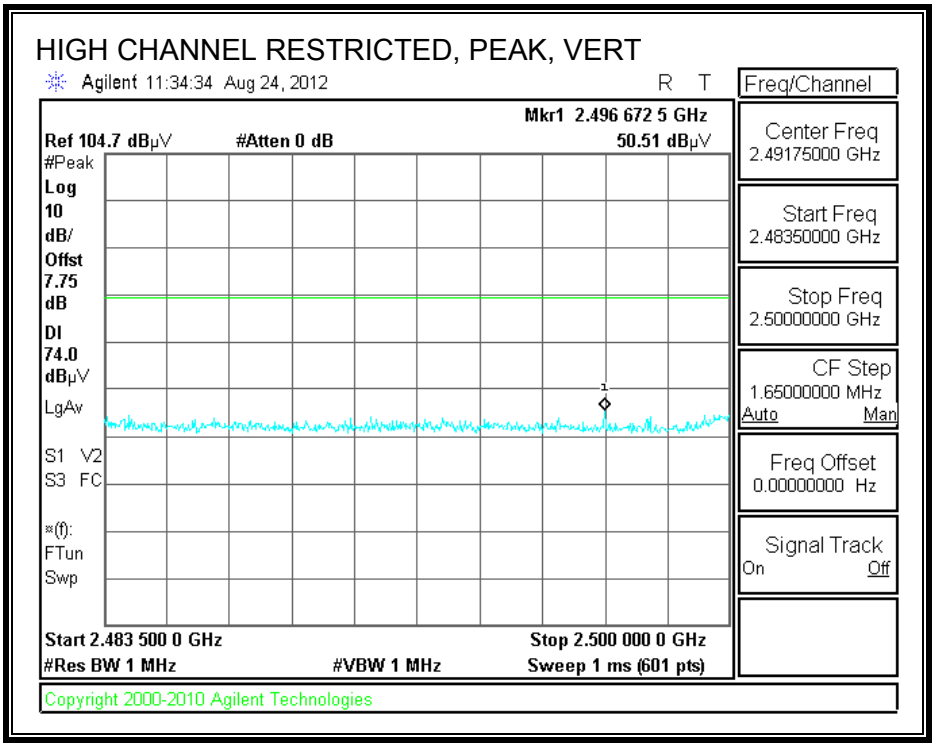


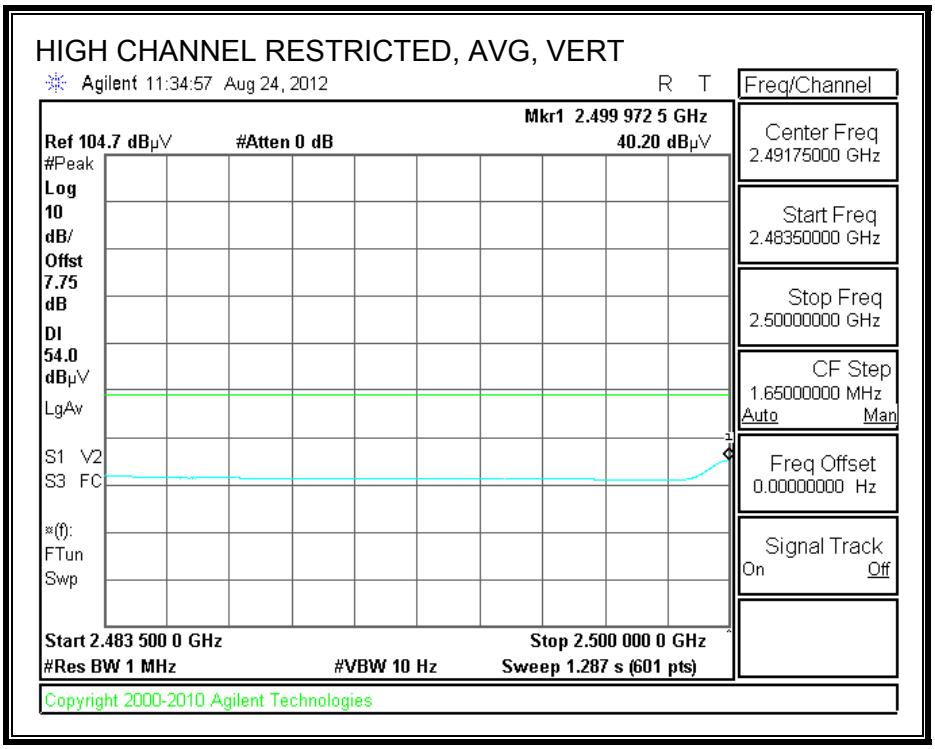
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Vien Tran
Date: 08/24/12
Project #: 12U14473
Company: Broadcom
Test Target: FCC 15.247
Mode Oper: Tx GFSK Mode

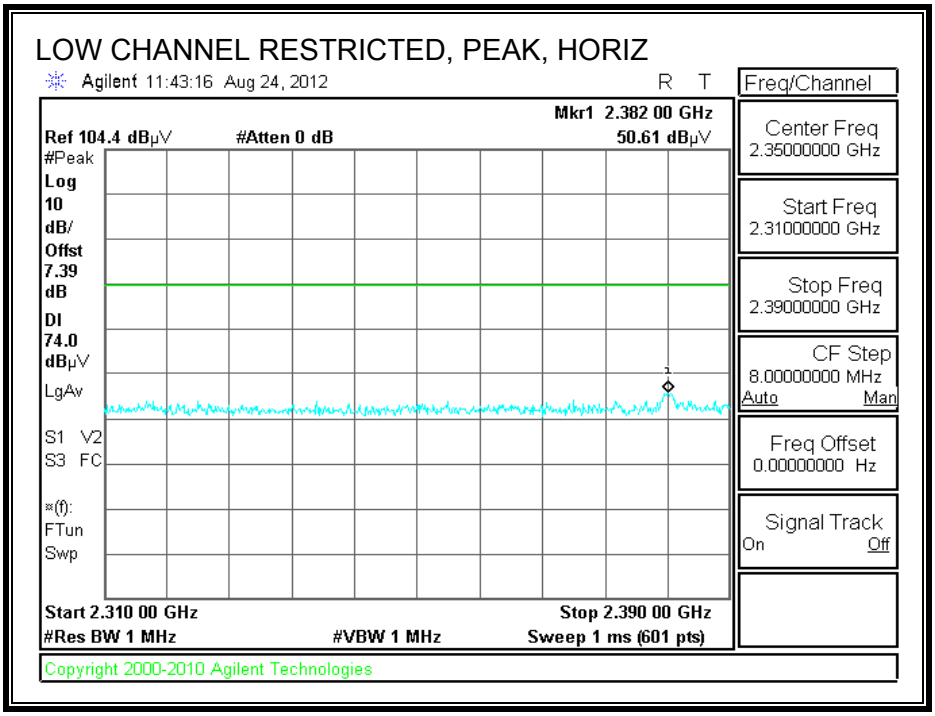
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

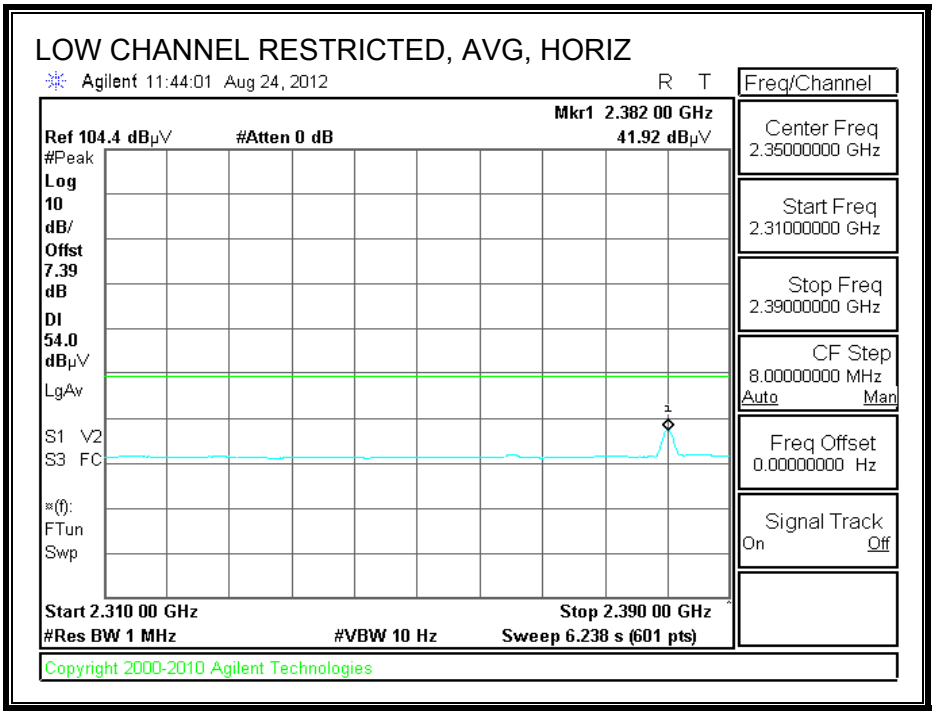
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
LOW CHANNEL (0), 2402MHz															
4.804	3.0	39.4	33.1	6.8	-34.1	0.0	0.0	45.3	74.0	-28.8	V	P	128.0	355.0	
4.804	3.0	31.3	33.1	6.8	-34.1	0.0	0.0	37.1	54.0	-16.9	V	A	128.0	355.0	
4.804	3.0	37.8	33.1	6.8	-34.1	0.0	0.0	43.6	74.0	-30.4	H	P	128.0	14.0	
4.804	3.0	28.1	33.1	6.8	-34.1	0.0	0.0	33.9	54.0	-20.1	H	A	128.0	14.0	
MID CHANNEL (40), 2441MHz															
4.882	3.0	39.3	33.2	6.8	-34.0	0.0	0.0	45.2	74.0	-28.8	V	P	100.0	15.0	
4.882	3.0	31.3	33.2	6.8	-34.0	0.0	0.0	37.2	54.0	-16.8	V	A	100.0	15.0	
7.323	3.0	35.8	36.3	9.1	-33.1	0.0	0.0	48.1	74.0	-25.9	V	P	158.0	298.0	
7.323	3.0	23.0	36.3	9.1	-33.1	0.0	0.0	35.3	54.0	-18.7	V	A	158.0	298.0	
4.882	3.0	39.5	33.2	6.8	-34.0	0.0	0.0	45.4	74.0	-28.6	H	P	126.0	326.0	
4.882	3.0	31.7	33.2	6.8	-34.0	0.0	0.0	37.7	54.0	-16.3	H	A	126.0	326.0	
7.323	3.0	36.3	36.3	9.1	-33.1	0.0	0.0	48.6	74.0	-25.4	H	P	121.0	118.0	
7.323	3.0	23.0	36.3	9.1	-33.1	0.0	0.0	35.3	54.0	-18.7	H	A	121.0	118.0	
HIGH CHANNEL (78), 2480MHz															
4.960	3.0	37.9	33.2	6.9	-34.0	0.0	0.0	43.9	74.0	-30.1	V	P	98.0	175.0	
4.960	3.0	28.9	33.2	6.9	-34.0	0.0	0.0	34.9	54.0	-19.1	V	A	98.0	175.0	
7.440	3.0	34.6	36.5	9.1	-33.0	0.0	0.0	47.2	74.0	-26.8	V	P	100.0	293.0	
7.440	3.0	22.6	36.5	9.1	-33.0	0.0	0.0	35.1	54.0	-18.9	V	A	100.0	293.0	
4.960	3.0	38.1	33.2	6.9	-34.0	0.0	0.0	44.2	74.0	-29.8	H	P	148.0	291.0	
4.960	3.0	28.8	33.2	6.9	-34.0	0.0	0.0	34.8	54.0	-19.2	H	A	148.0	291.0	
7.440	3.0	35.2	36.5	9.1	-33.0	0.0	0.0	47.7	74.0	-26.3	H	P	187.0	36.0	
7.440	3.0	22.8	36.5	9.1	-33.0	0.0	0.0	35.4	54.0	-18.6	H	A	187.0	36.0	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

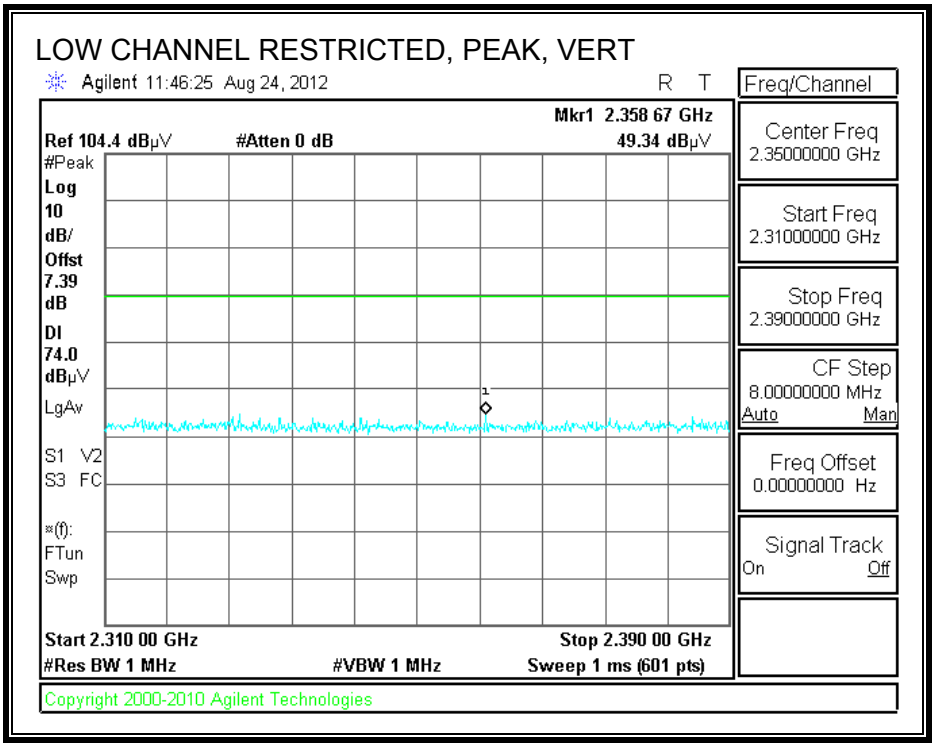
8.2.2. ENHANCED DATA RATE 8PSK MODULATION

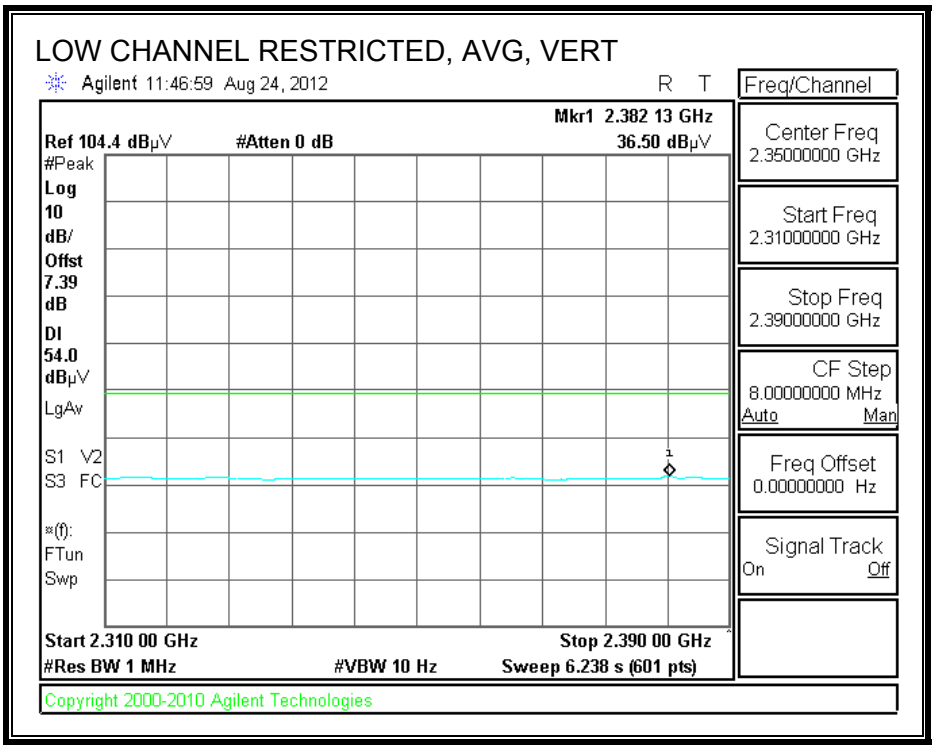
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



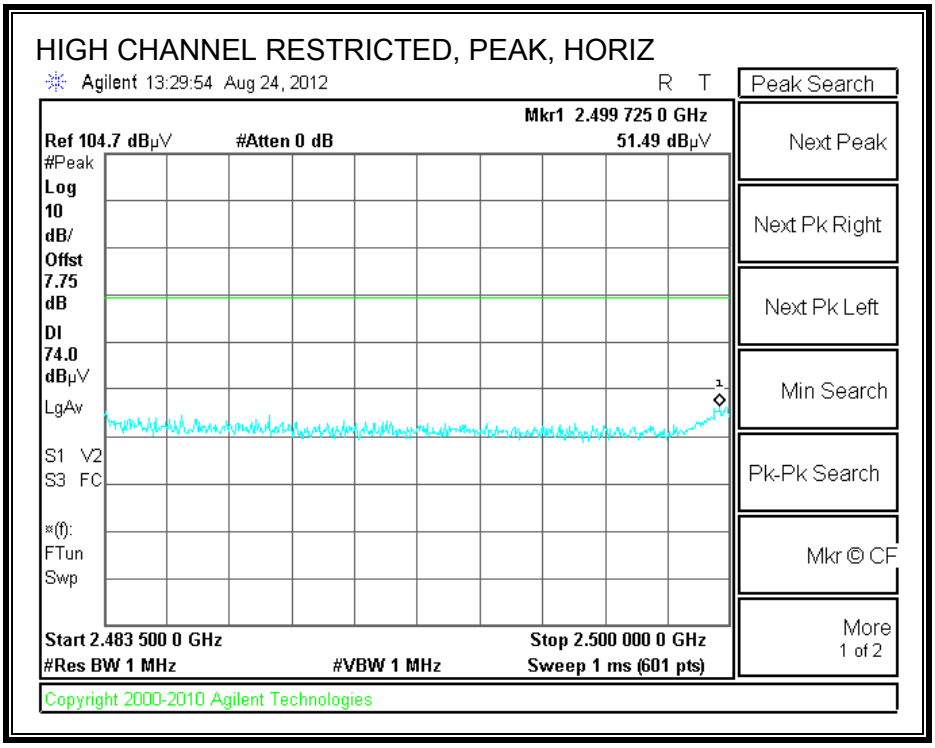


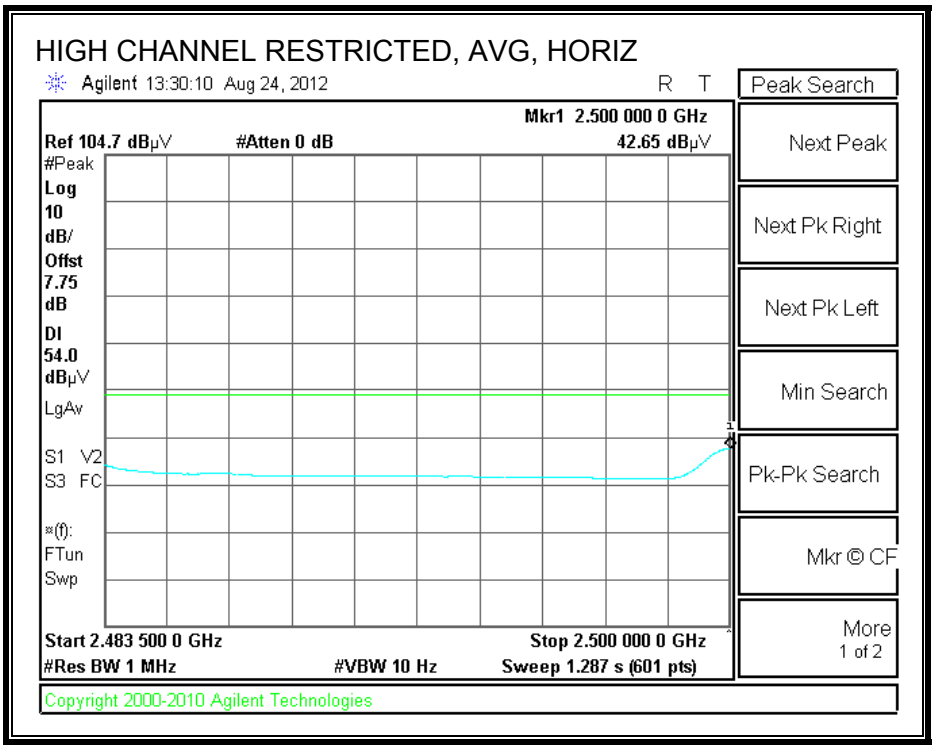
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



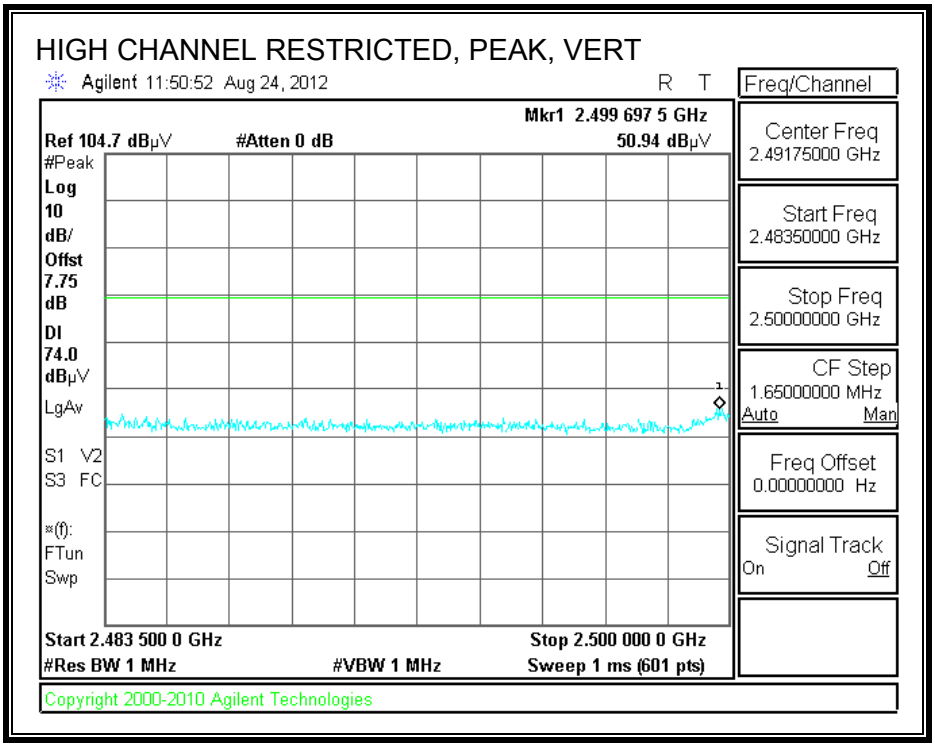


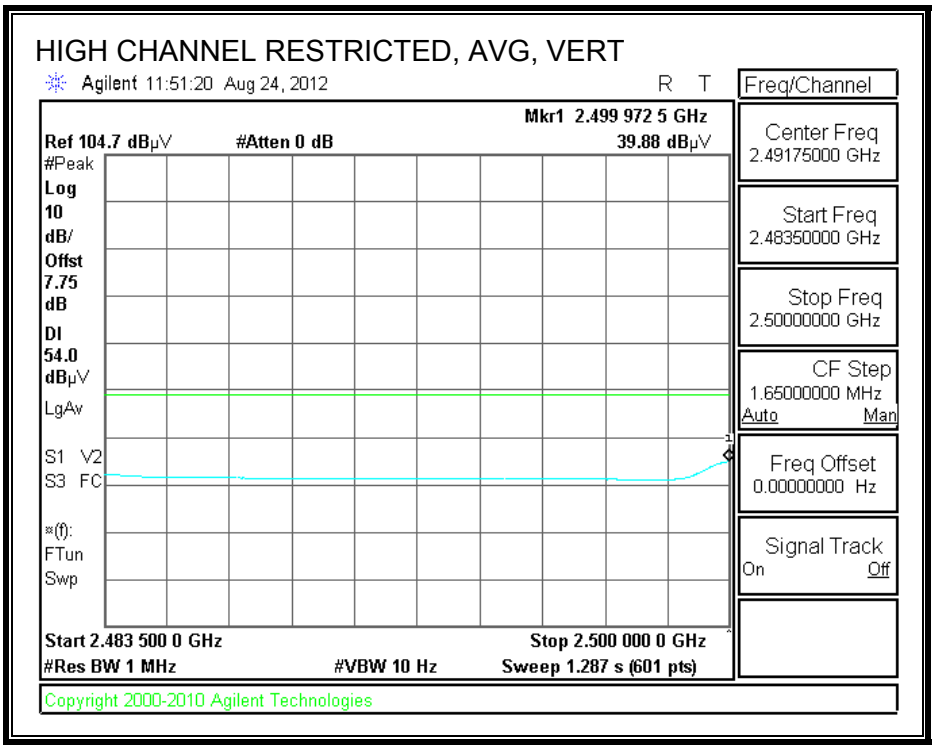
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Vien Tran
Date: 08/24/12
Project #: 12U14473
Company: Broadcom
Test Target: FCC 15.247
Mode Oper: Tx 8PSK Mode

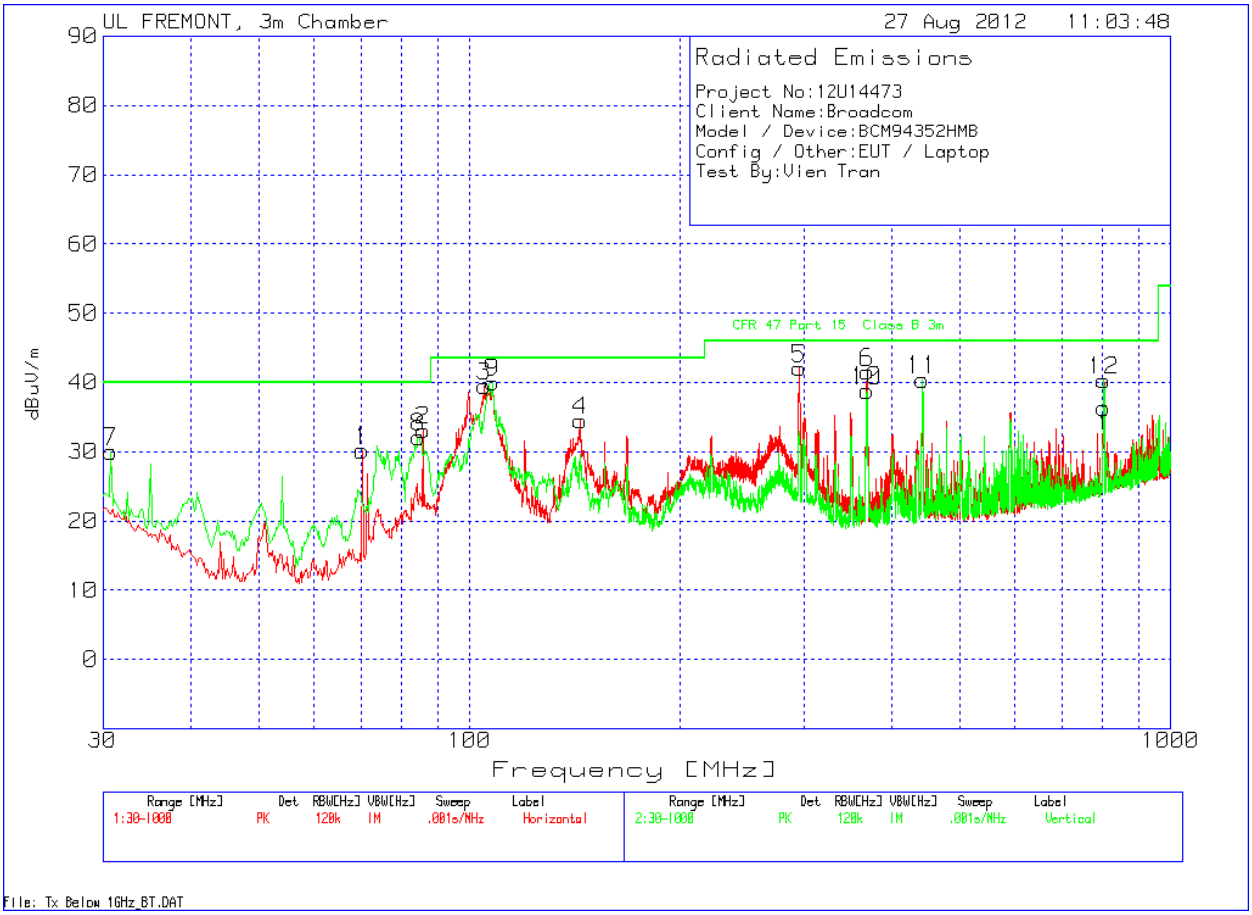
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
LOW CHANNEL (0), 2402MHz															
4.804	3.0	41.0	33.1	6.8	-34.1	0.0	0.0	46.8	74.0	-27.2	V	P	143.0	360.0	
4.804	3.0	31.8	33.1	6.8	-34.1	0.0	0.0	37.6	54.0	-16.4	V	A	143.0	360.0	
4.804	3.0	38.2	33.1	6.8	-34.1	0.0	0.0	44.0	74.0	-30.0	H	P	113.0	319.0	
4.804	3.0	28.5	33.1	6.8	-34.1	0.0	0.0	34.3	54.0	-19.7	H	A	113.0	319.0	
MID CHANNEL (40), 2441MHz															
4.882	3.0	37.5	33.2	6.8	-34.0	0.0	0.0	43.4	74.0	-30.6	V	P	98.0	169.0	
4.882	3.0	27.1	33.2	6.8	-34.0	0.0	0.0	33.1	54.0	-20.9	V	A	98.0	169.0	
7.323	3.0	34.8	36.3	9.1	-33.1	0.0	0.0	47.1	74.0	-26.9	V	P	98.0	166.0	
7.323	3.0	22.9	36.3	9.1	-33.1	0.0	0.0	35.2	54.0	-18.8	V	A	98.0	166.0	
4.882	3.0	39.6	33.2	6.8	-34.0	0.0	0.0	45.5	74.0	-28.5	H	P	128.0	326.0	
4.882	3.0	30.3	33.2	6.8	-34.0	0.0	0.0	36.3	54.0	-17.7	H	A	128.0	326.0	
7.323	3.0	35.2	36.3	9.1	-33.1	0.0	0.0	47.5	74.0	-26.5	H	P	107.0	10.0	
7.323	3.0	22.8	36.3	9.1	-33.1	0.0	0.0	35.1	54.0	-18.9	H	A	107.0	10.0	
HIGH CHANNEL (78), 2480MHz															
4.960	3.0	39.8	33.2	6.9	-34.0	0.0	0.0	45.8	74.0	-28.2	V	P	171.0	355.0	
4.960	3.0	29.8	33.2	6.9	-34.0	0.0	0.0	35.9	54.0	-18.1	V	A	171.0	355.0	
7.440	3.0	35.3	36.5	9.1	-33.0	0.0	0.0	47.8	74.0	-26.2	V	P	171.0	355.0	
7.440	3.0	22.5	36.5	9.1	-33.0	0.0	0.0	35.0	54.0	-19.0	V	A	171.0	355.0	
4.960	3.0	38.7	33.2	6.9	-34.0	0.0	0.0	44.8	74.0	-29.2	H	P	144.0	293.0	
4.960	3.0	28.6	33.2	6.9	-34.0	0.0	0.0	34.7	54.0	-19.3	H	A	144.0	293.0	
7.440	3.0	35.6	36.5	9.1	-33.0	0.0	0.0	48.1	74.0	-25.9	H	P	143.0	293.0	
7.440	3.0	22.5	36.5	9.1	-33.0	0.0	0.0	35.0	54.0	-19.0	H	A	143.0	293.0	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

8.3. WORST-CASE BELOW 1 GHz

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



Trace Markers

Horizontal 30 - 1000MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	25MHz-1GHz Chambr 3m Amplified (dB)	Antenna T185 (dB)	Corrected Reading dBuV/m	CFR 47 Part 15 Class B 3m	Margin to Limit (dB)	Height (cm)	Polarity
1	70.3197	49.11	PK	-27.1	8.2	30.21	40	-9.79	301	Horz
2	85.8273	52.79	PK	-27	7.3	33.09	40	-6.91	400	Horz
3	105.018	55	PK	-26.8	11.3	39.5	43.5	-4	201	Horz
4	143.9808	48.23	PK	-26.4	12.7	34.53	43.5	-8.97	201	Horz
5	295.7614	53.93	PK	-25.2	13.3	42.03	46	-3.97	99	Horz
6	369.0348	52	PK	-25.5	15	41.5	46	-4.5	99	Horz

Vertical 30 - 1000MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	25MHz-1GHz Chambr 3m Amplified (dB)	Antenna T185 (dB)	Corrected Reading dBuV/m	CFR 47 Part 15 Class B 3m	Margin to Limit (dB)	Height (cm)	Polarity
7	30.7754	36.8	PK	-27.5	20.7	30	40	-10	100	Vert
8	84.6643	51.74	PK	-27	7.4	32.14	40	-7.86	100	Vert
9	107.9257	54.6	PK	-26.7	12.1	40	43.5	-3.5	100	Vert
10	369.0348	49.32	PK	-25.5	15	38.82	46	-7.18	301	Vert
11	443.0835	49.53	PK	-25.8	16.7	40.43	46	-5.57	100	Vert
12	804.0228	43.59	PK	-24.6	21.3	40.29	46	-5.71	100	Vert

PK - Peak detector

9. 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.

6 WORST EMISSIONS

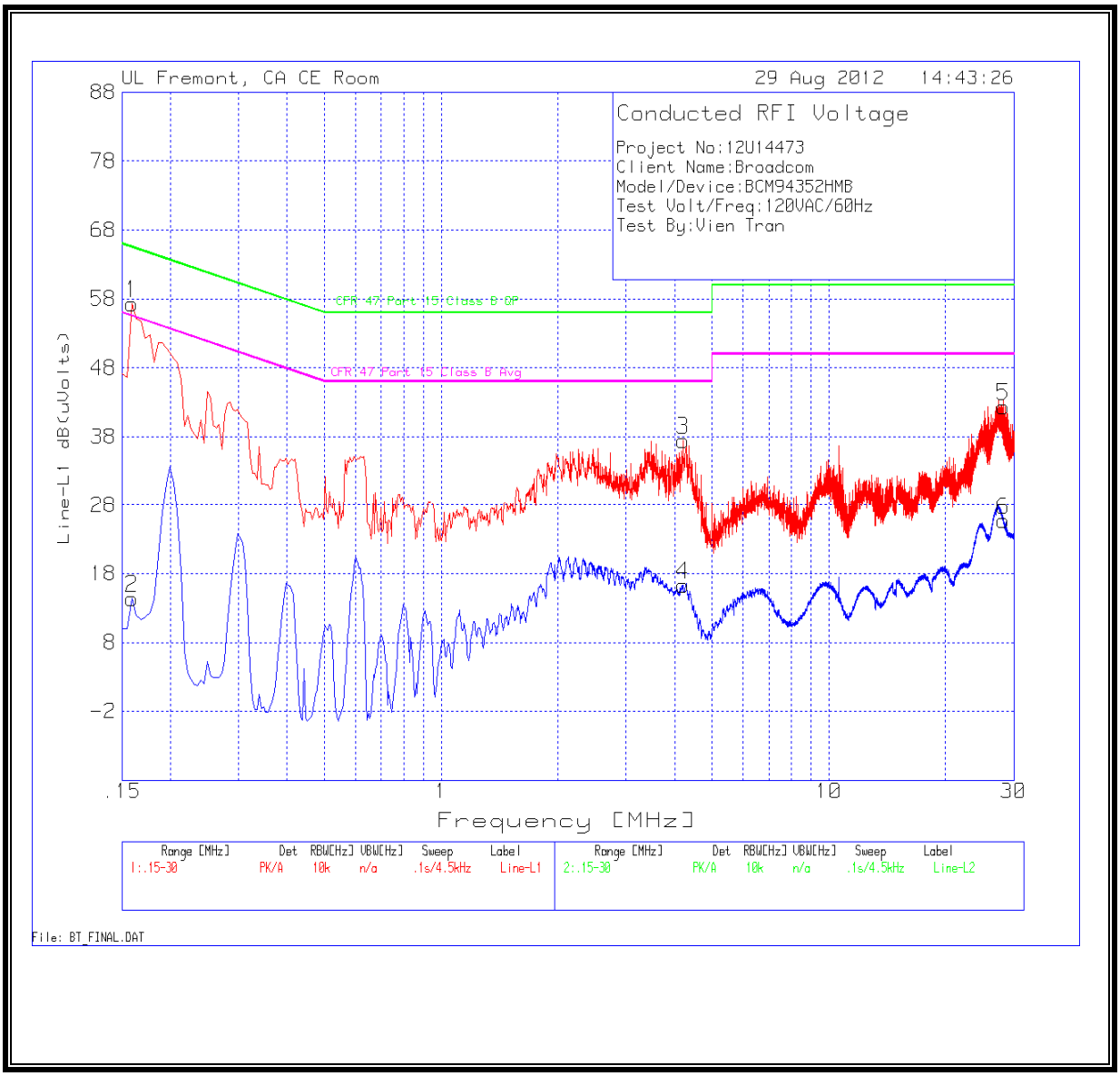
Project No:12U14473
Client Name:Broadcom
Model/Device:BCM94352HMB
Test Volt/Freq:120VAC/60Hz
Test By:Vien Tran

Frequency MHz	Reading dB(µV)	Detector	T24 LISN dB	Cables dB	Corrected dB(µV)	Class B QP Limit dB(µV)	QP Margin dB	Class B Av Limit dB(µV)	Av Margin dB
Line-L1 .15 - 30MHz									
0.159	57.22	PK	0.1	0	57.32	65.5	-8.18	-	-
0.159	14.27	Av	0.1	0	14.37	-	-	55.5	-41.13
4.2	37.26	PK	0.1	0.1	37.46	56	-18.54	-	-
4.2	16.08	Av	0.1	0.1	16.28	-	-	46	-29.72
28.1715	41.56	PK	0.5	0.3	42.36	60	-17.64	-	-
28.1715	24.89	Av	0.5	0.3	25.69	-	-	50	-24.31

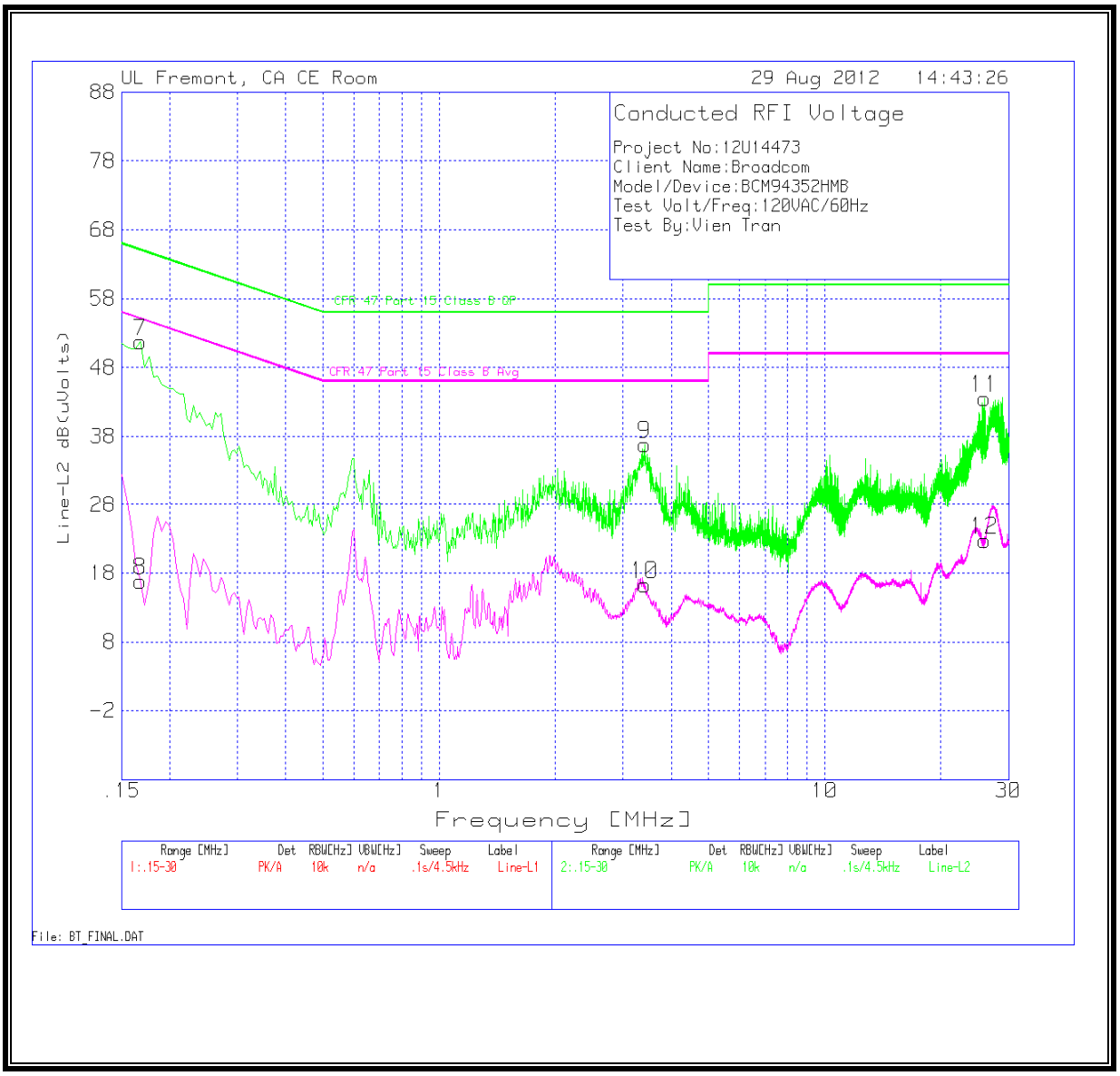
Frequency MHz	Reading dB(µV)	Detector	T24 LISN dB	Cables dB	Corrected dB(µV)	Class B QP Limit dB(µV)	QP Margin dB	Class B Av Limit dB(µV)	Av Margin dB
Line-L2 .15 - 30MHz									
0.168	51.61	PK	0.1	0	51.71	65.1	-13.39	-	-
0.168	16.77	Av	0.1	0	16.87	-	-	55.1	-38.23
3.417	36.62	PK	0.1	0.1	36.82	56	-19.18	-	-
3.417	16.16	Av	0.1	0.1	16.36	-	-	46	-29.64
25.9395	42.72	PK	0.5	0.3	43.52	60	-16.48	-	-
25.9395	21.99	Av	0.5	0.3	22.79	-	-	50	-27.21

PK - Peak detector
QP - Quasi-Peak detector
LnAv - Linear Average detector
LgAv - Log Average detector
Av - Average detector
CAV - CISPR Average detector
RMS - RMS detection
CRMS - CISPR RMS detection
Text File: BT_FINAL.TXT
File: BT_FINAL.DAT

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
2.4 GHz	Bluetooth	0.20	6.82	3.90	0.0235	0.0023