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

CERTIFICATION TEST REPORT

FOR

NEMO BLUETOOTH RADIO MODULE

MODEL NUMBER: UGWC821RSMA133

FCC ID: R8KUGWC821R
IC: 5125A-UGWC821R

REPORT NUMBER: 11U13608-1

ISSUE DATE: MAY 04, 2011

Prepared for
Unigen Corporation
45388 Warm Springs Blvd.
Fremont, CA, 94538
U.S.A.

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/04/11	Initial Issue	F. Ibrahim

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This report shall not be reproduced except in full, without the written approval of UL CCS.

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Unigen Corporation.
45388 Warm Springs Blvd.
Fremont, CA 94538
U.S.A.

EUT DESCRIPTION: Nemo Bluetooth Radio Module

MODEL: UGWC821RSMA133

SERIAL NUMBER: N/A

DATE TESTED: April 25 -28, 2011

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

Compliance Certification Services (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
EMC SUPERVISOR
UL CCS

Tested By:

WILLIAM ZHUANG
EMC ENGINEER
UL CCS

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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 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%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth Module.

The radio module is manufactured by Unigen.

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	9.82	9.59
2402 - 2480	Enhanced QPSK	6.98	4.99
2402 - 2480	Enhanced 8PSK	7.34	5.42

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a monopole antenna with a maximum gain of 2.0 dBi.

5.1. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Prolific USB-to-Serial Bridge, v2.0.0.24.

The test utility software used during testing was CSR BlueSuite Tools v2.3.0.15.

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5.2. WORST-CASE CONFIGURATIONS AND MODE

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio.

All final tests in the GFSK mode were made at 1 Mb/s.
All final tests in the 8PSK mode were made at 3 Mb/s.

For radiated emissions below 1 GHz and power line conducted emissions the worst-case configuration is determined to be the mode and channel with the highest output power.

The EUT was investigated in two different positions, X and Y; it was determined that Y orientation was worst-orientation; therefore, all final radiated emissions testing was performed with the EUT laid down in the Y orientation.

Output power was measured for all modulations; GFSK, DQPSK and 8PSK, since the output power for DQPSK is not the highest GFSK and 8PSK were fully tested as worst-case modulations since GFSK has the highest output power and 8PSK has the highest data rate.

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5.3. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Lenovo	4446-23U	L3-ABL4C	DoC
AC Adapter	Lenovo	ADP-65YB B	11S42T4458Z1ZF4K9361YT	N/A
Conversion Board	Unigen	Nemo2	230-000013	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	AC	Unshielded	1.0m	N/A
2	DC	1	DC	Unshielded	1.8m	N/A
3	USB	1	USB	Shielded	1.0m	N/A
4	AC	1	AC	Unshielded	1.0m	N/A

TEST SETUP

The EUT is connected to a host laptop computer via conversion board with USB cable during the test. Test software exercised the radio card.

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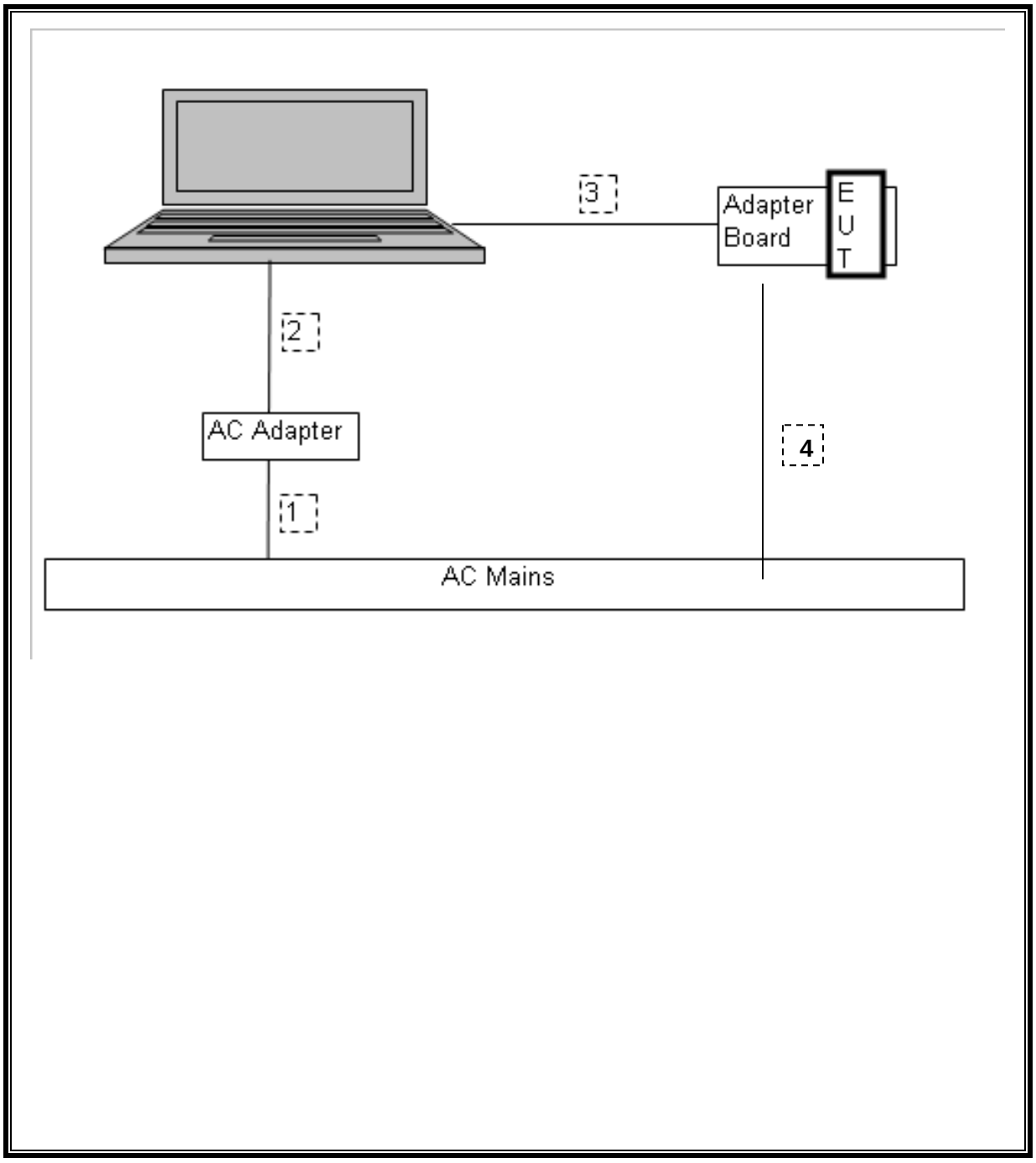
SETUP DIAGRAM FOR TESTS



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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**
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01176	08/10/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	06/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	06/25/11
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/14/11
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/12/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	01/27/12
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/10/11
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09/03/11
Power Meter	Agilent / HP	438A	C01068	06/16/11
Power Sensor, 18 GHz	Agilent / HP	8481A	N02782	07/28/11

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7. ANTENNA PORT TEST RESULTS

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 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	855	805.0691
Middle	2441	955	855.4965
High	2480	950	883.4038

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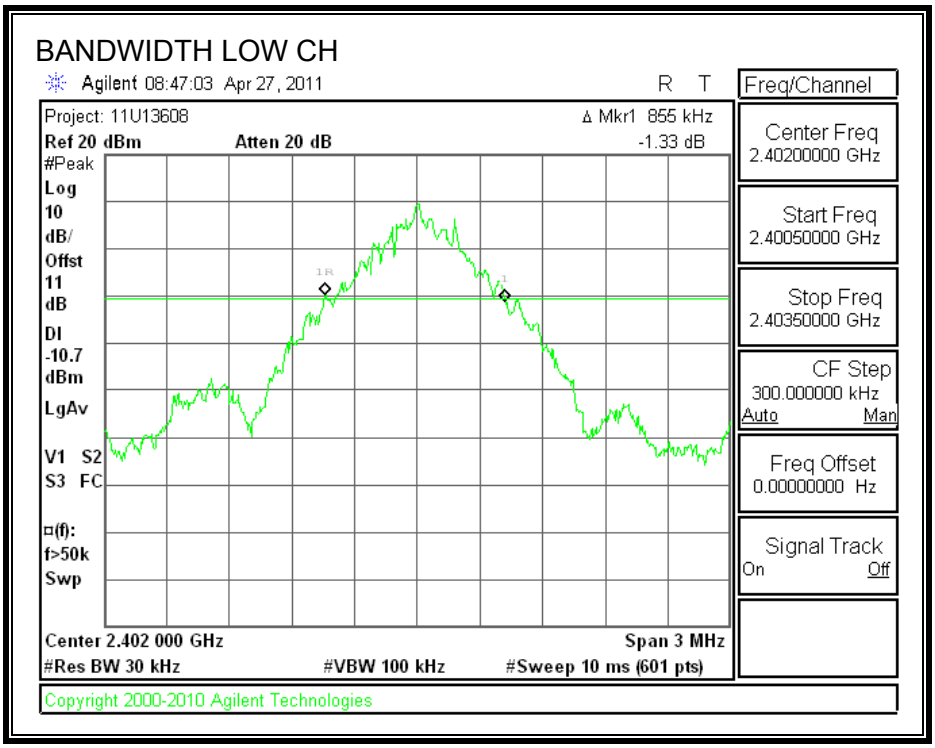
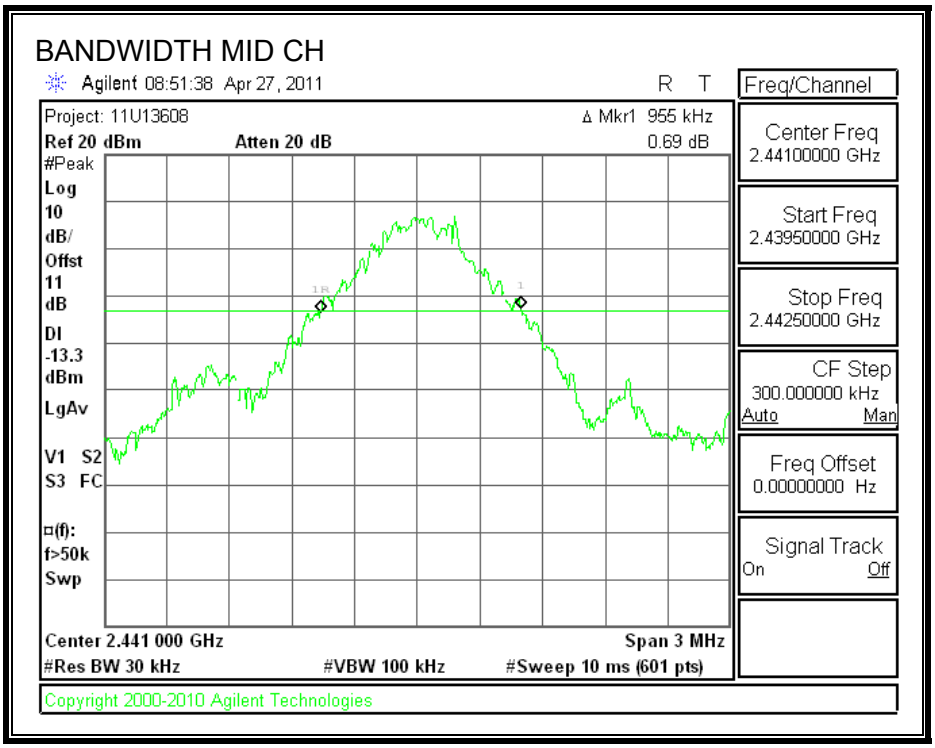
20 dB BANDWIDTH





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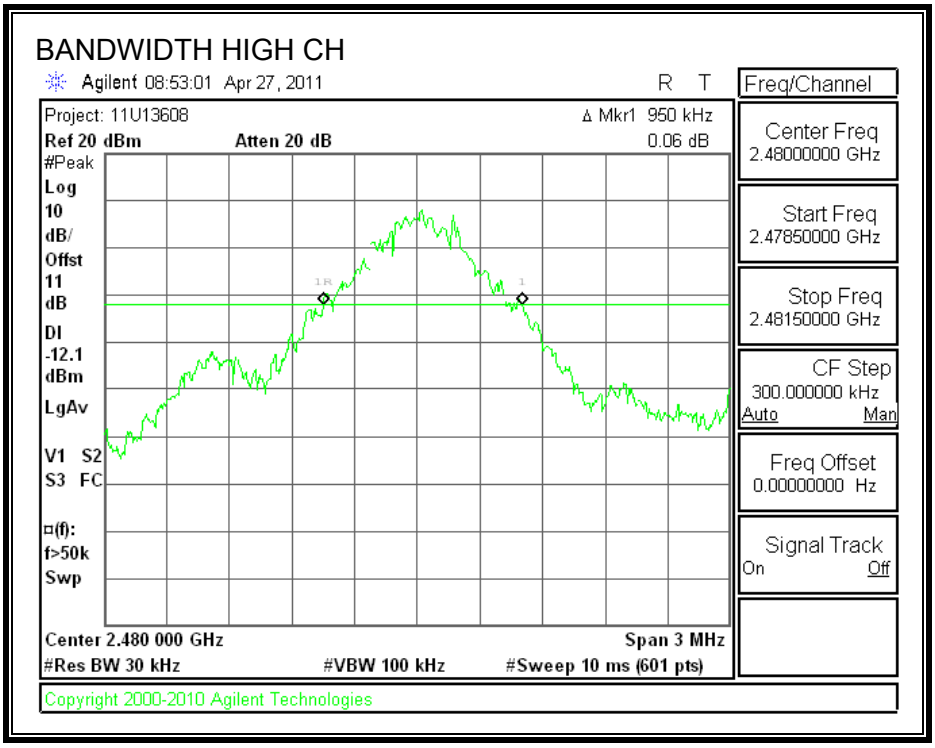

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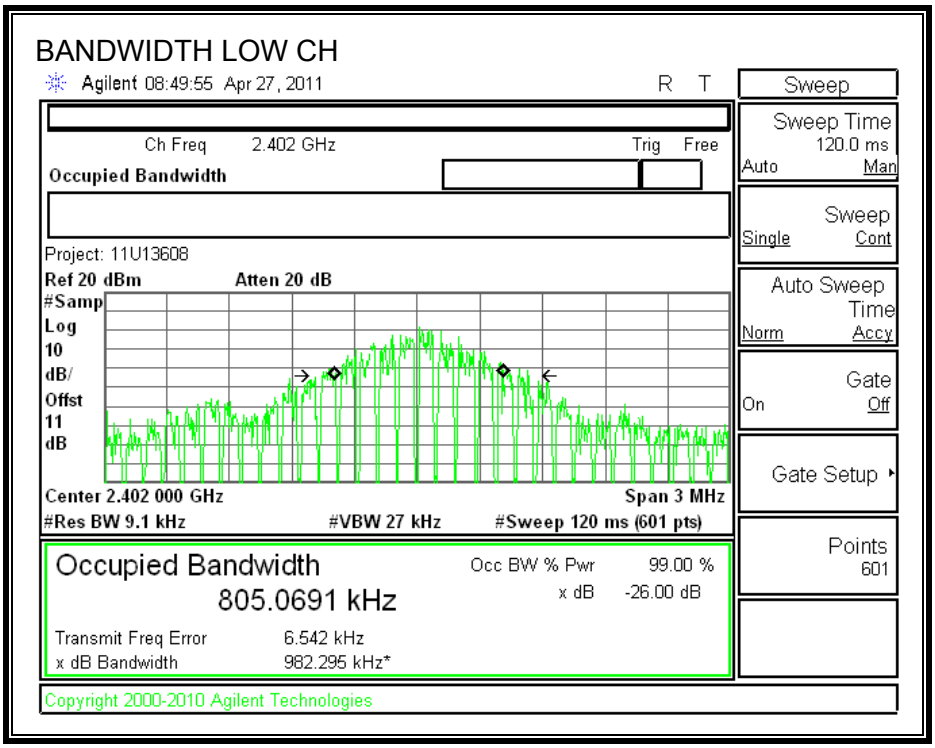
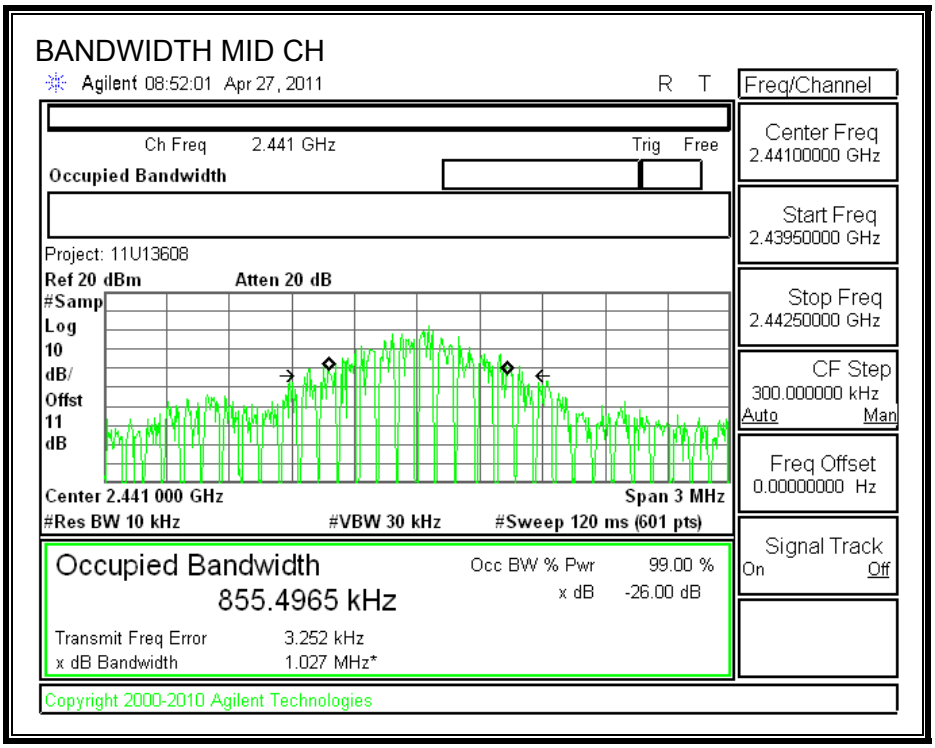
99% BANDWIDTH





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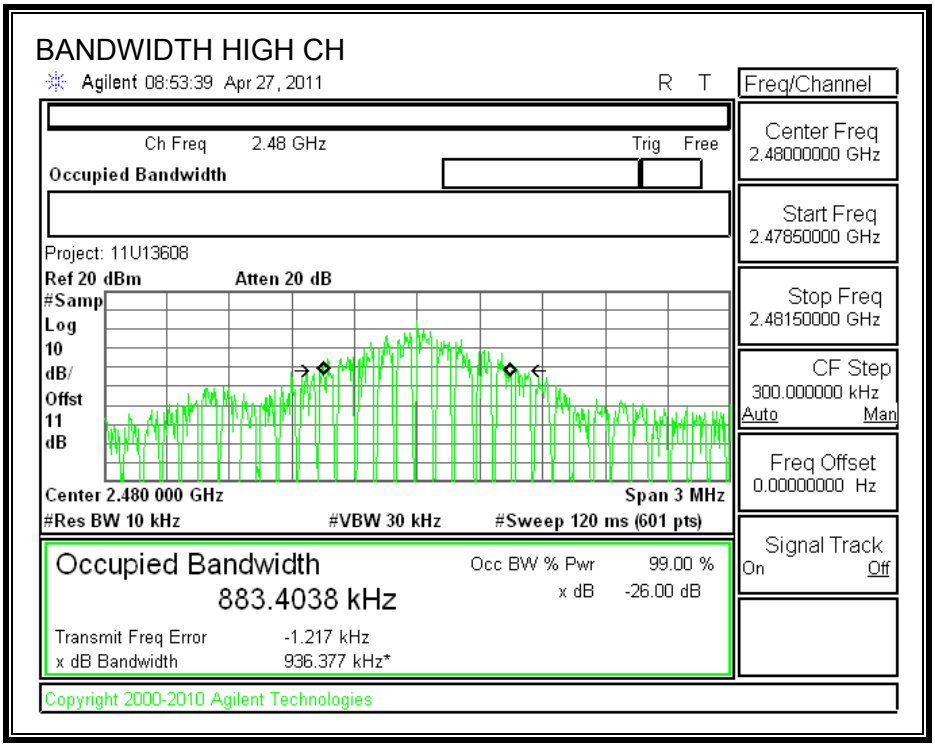

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7.1.2. HOPPING FREQUENCY SEPARATION

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 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

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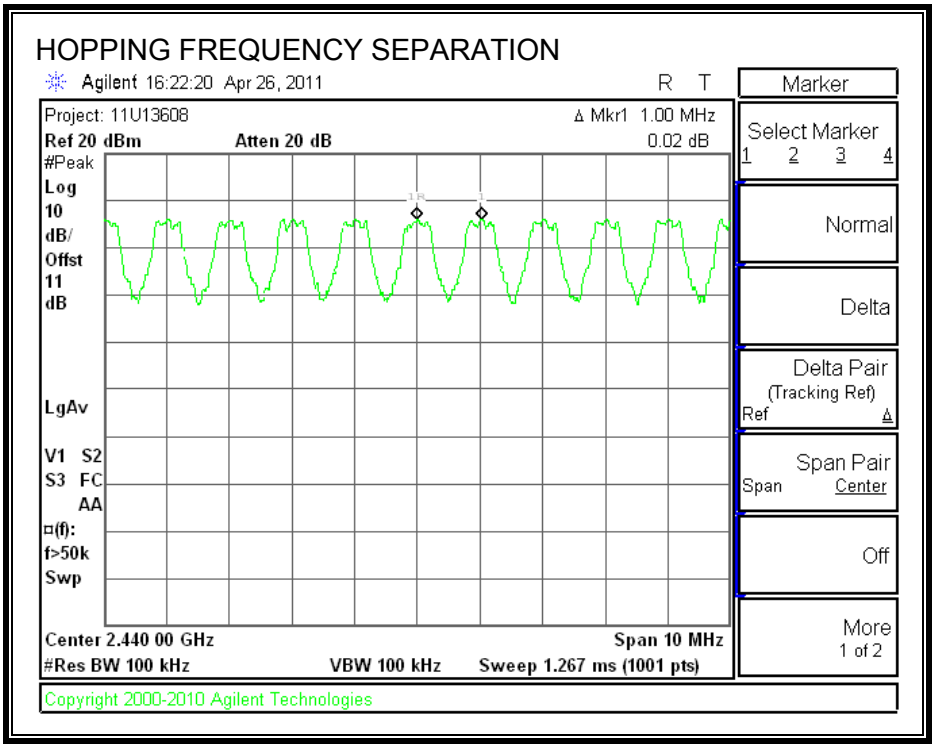
RESULTS

HOPPING FREQUENCY SEPARATION



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7.1.3. 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

79 Channels observed.

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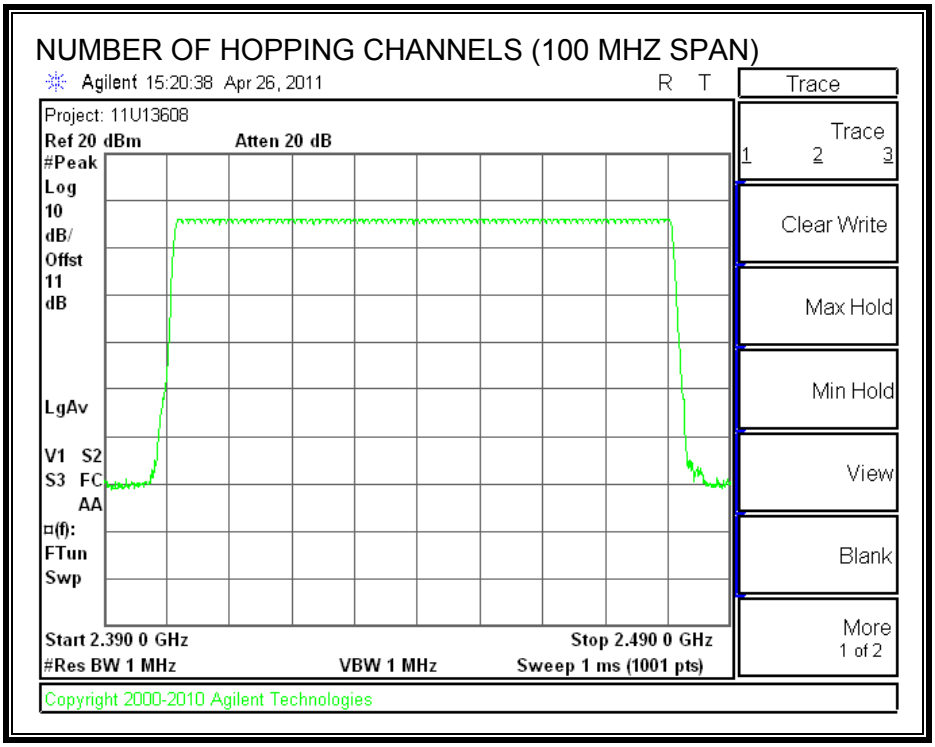
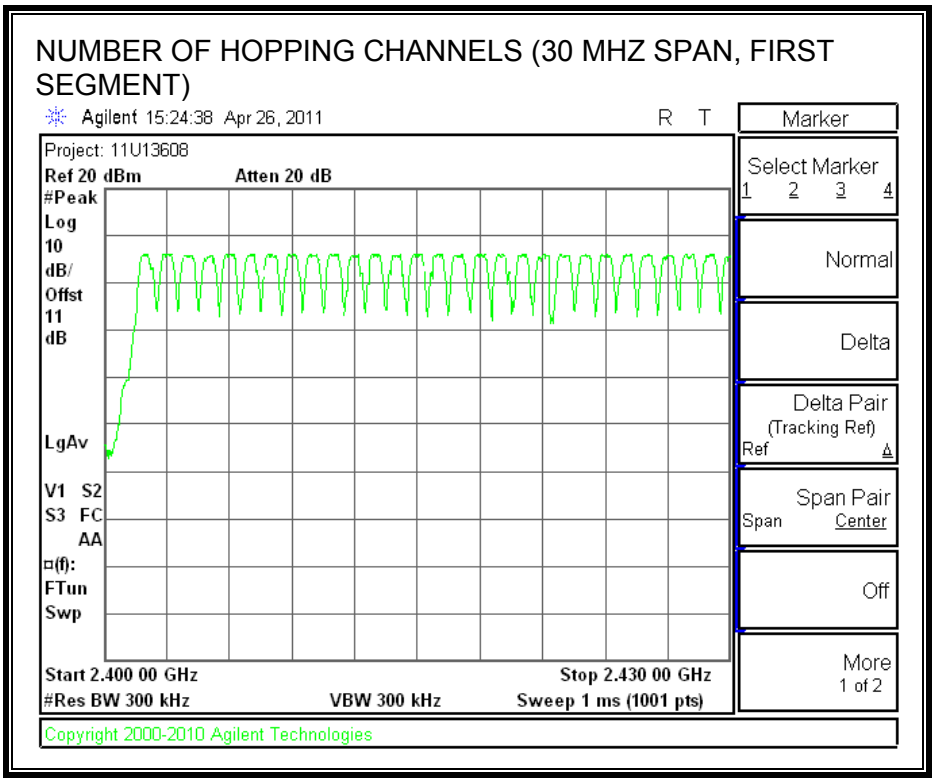
NUMBER OF HOPPING CHANNELS

NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



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



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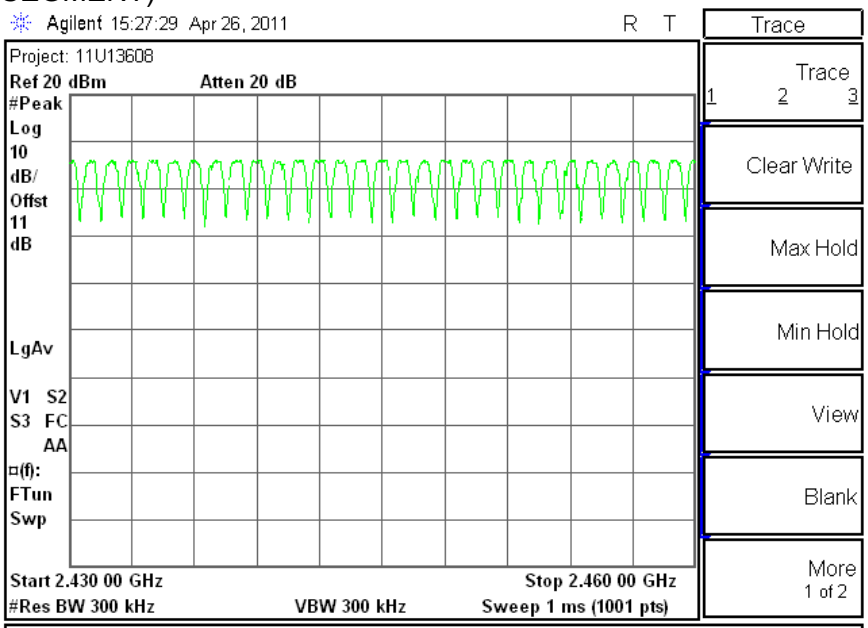
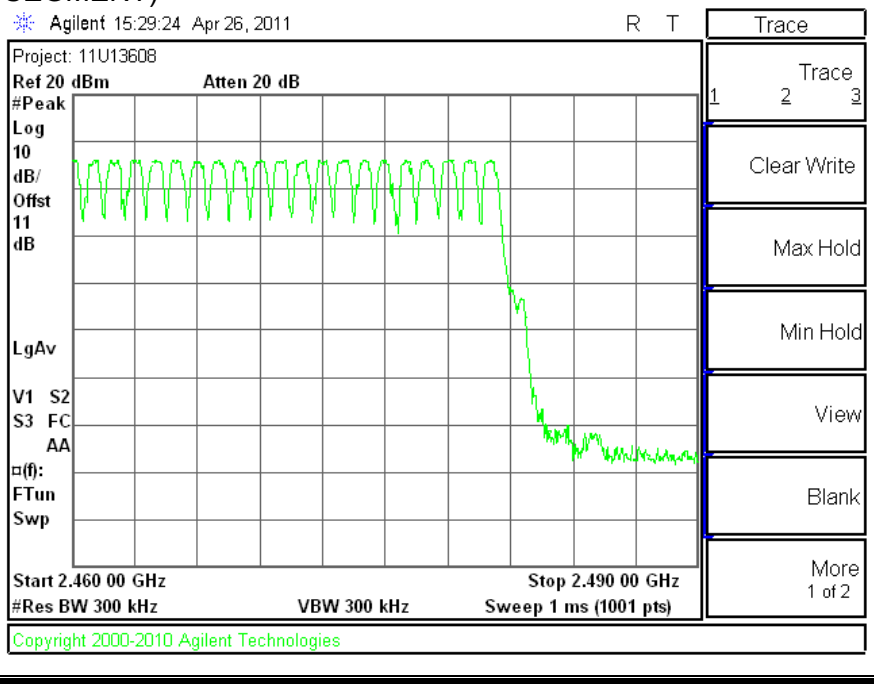
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



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



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7.1.4. 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

GFSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.5233	32	0.167	0.4	-0.233
DH3	1.792	16	0.287	0.4	-0.113
DH5	2.867	10	0.287	0.4	-0.113

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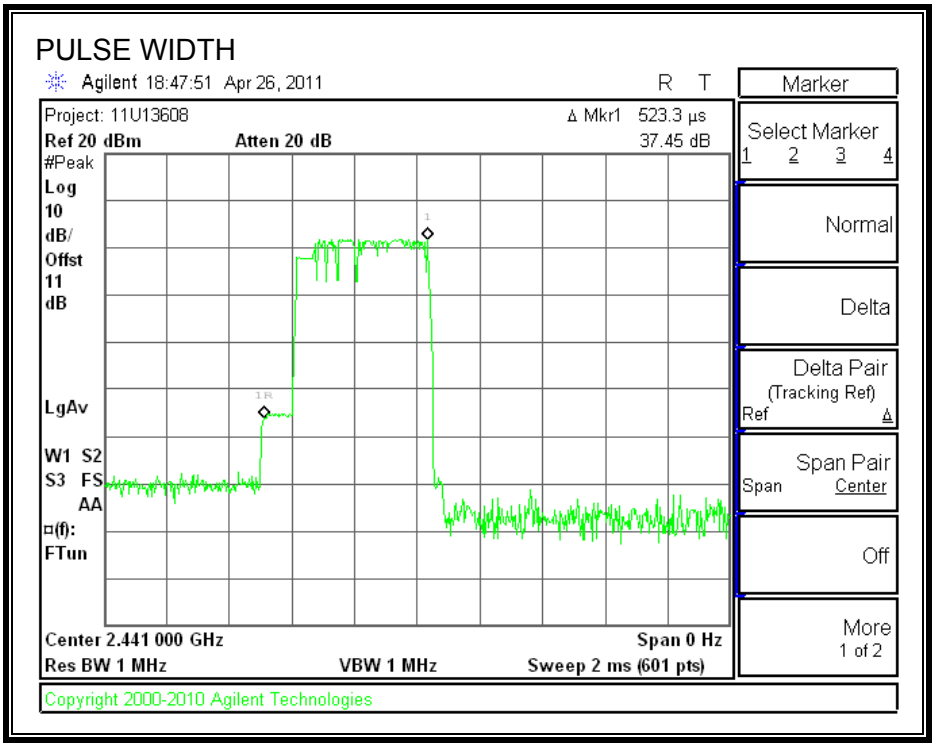
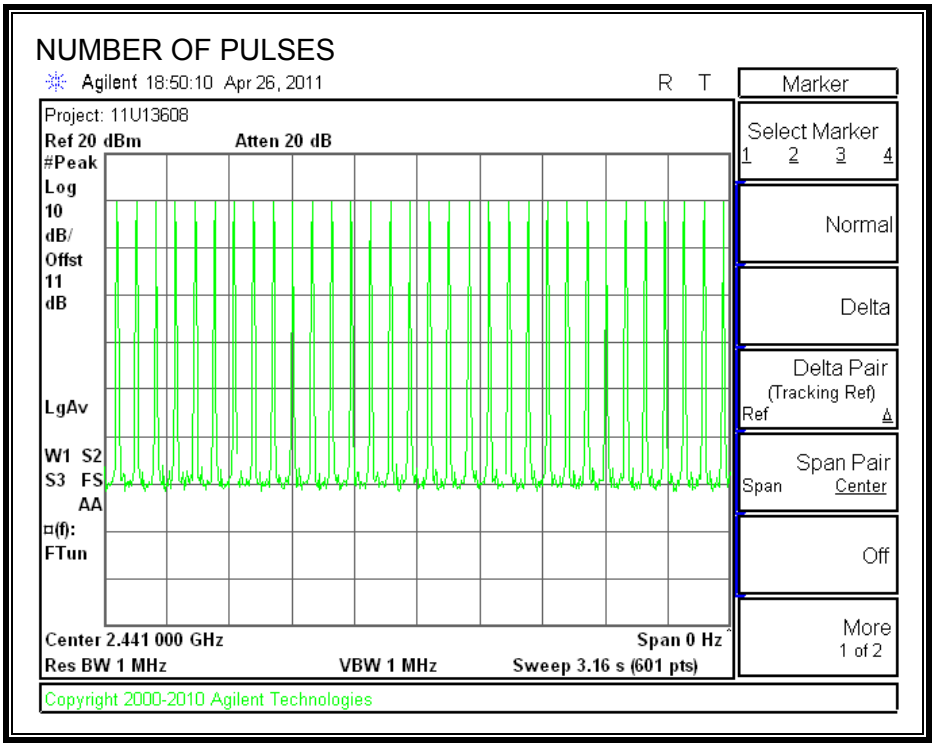
DH1

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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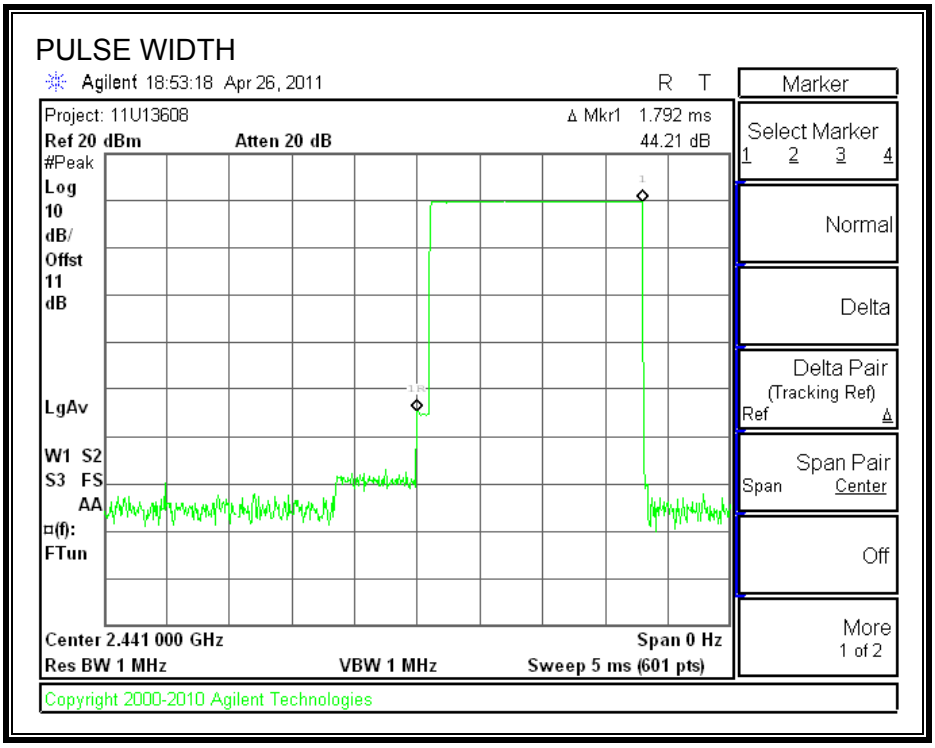
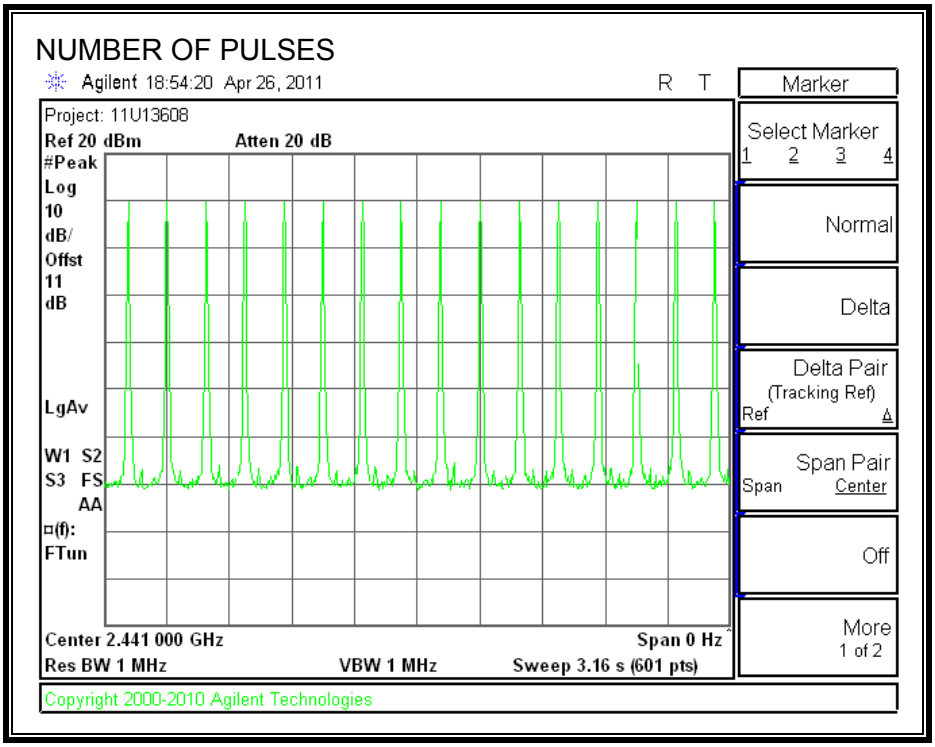
DH3

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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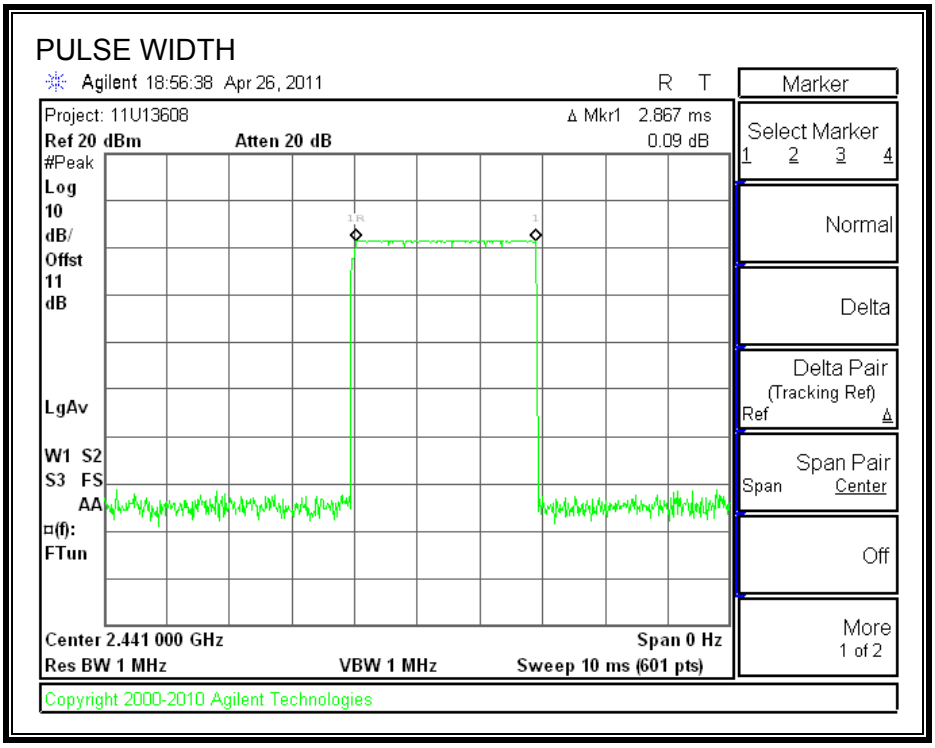
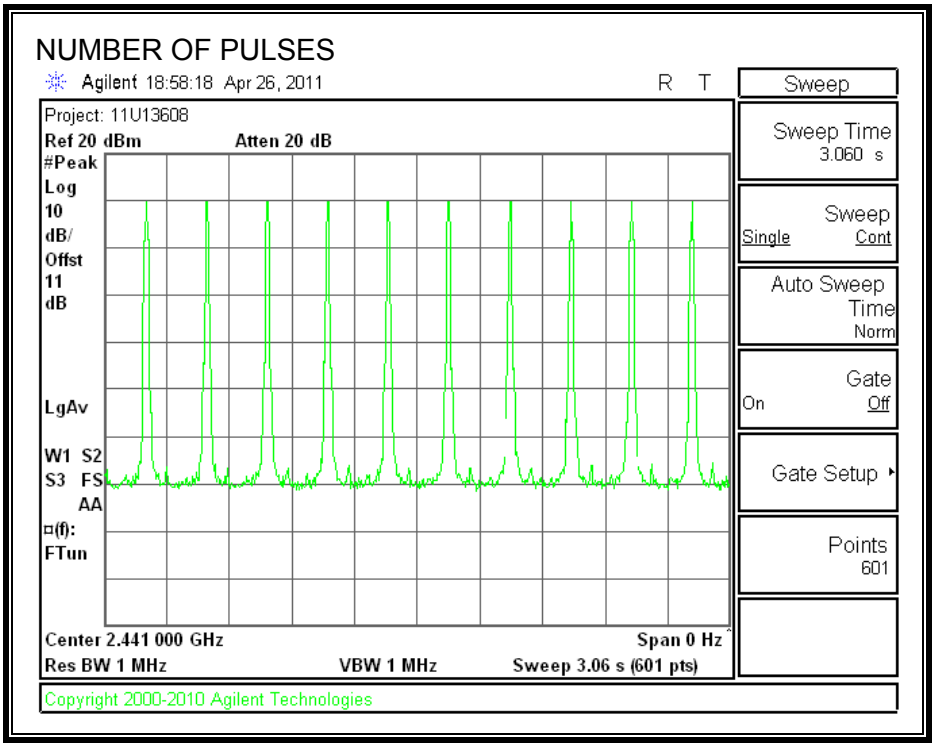
DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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7.1.5. 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	9.59	30	-20.41
Middle	2441	9.82	30	-20.18
High	2480	9.71	30	-20.29

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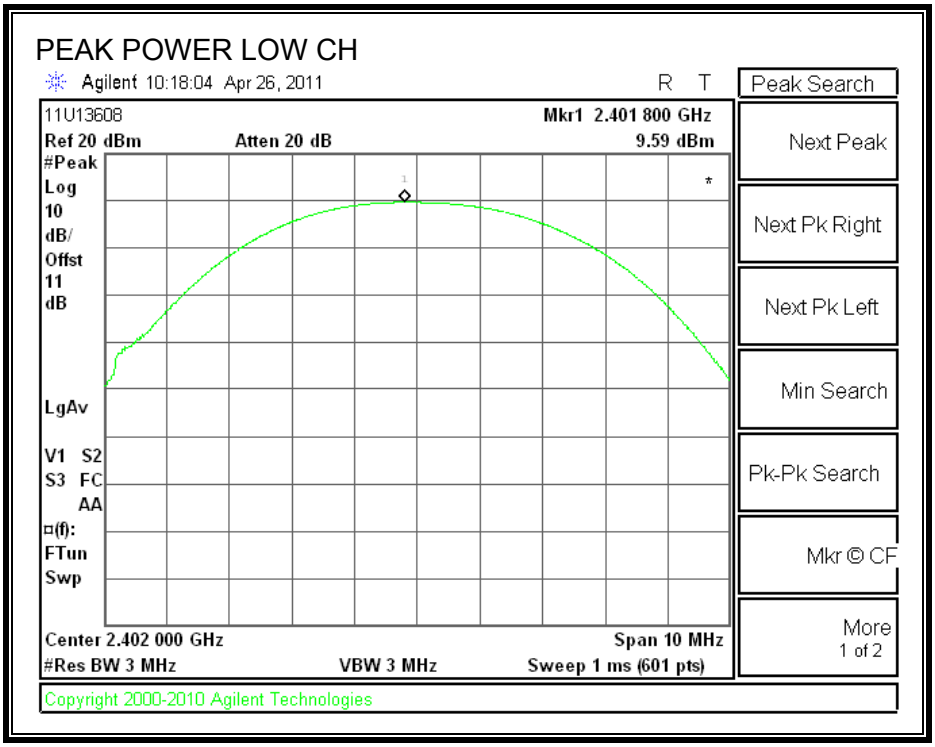
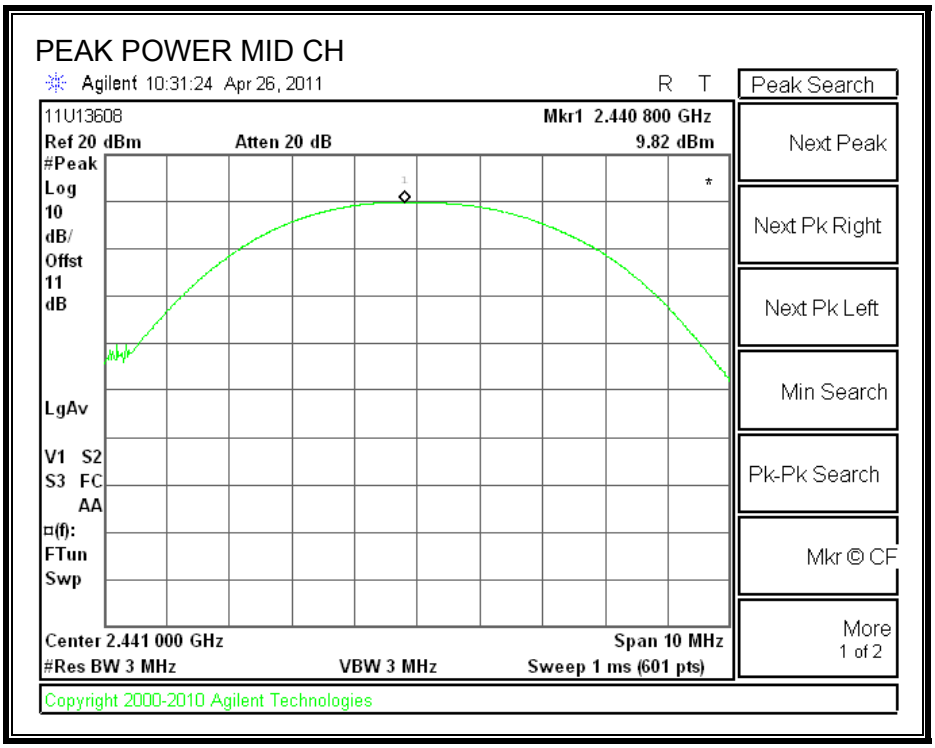
OUTPUT POWER

PEAK POWER LOW CH



PEAK POWER MID CH



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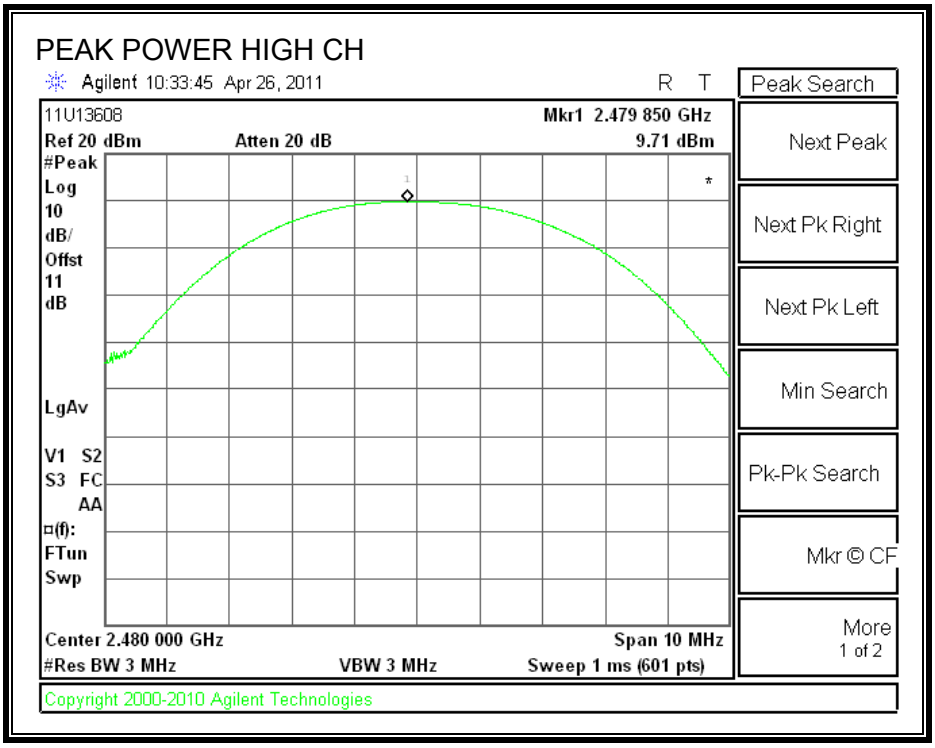
PEAK POWER HIGH CH



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7.1.6. 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 1.0 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	8.45
Middle	2441	8.59
High	2480	8.43

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

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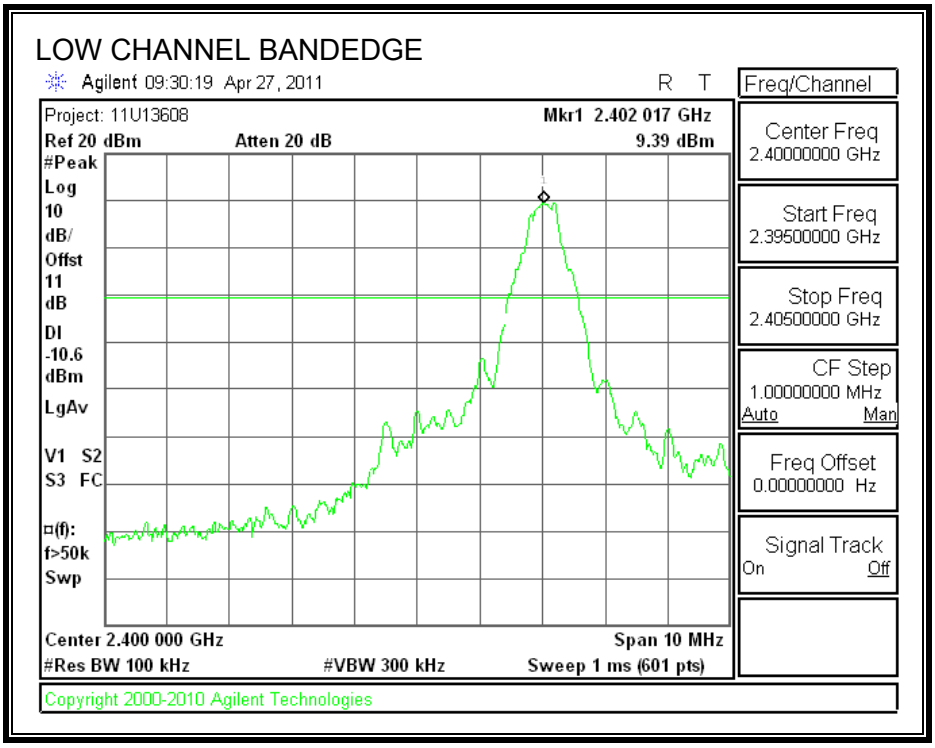
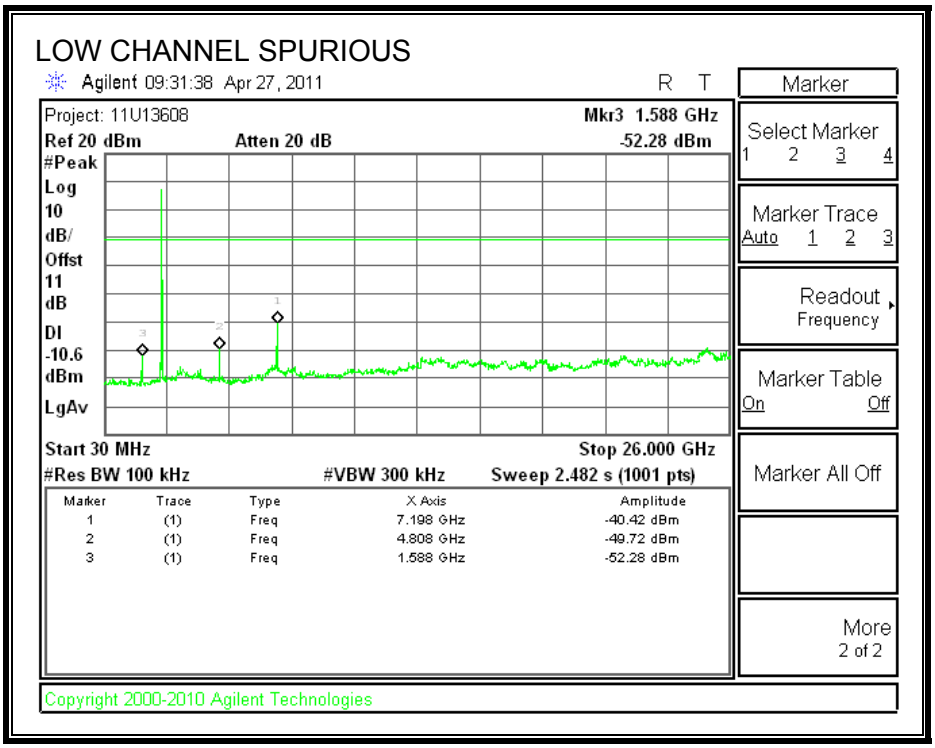
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL





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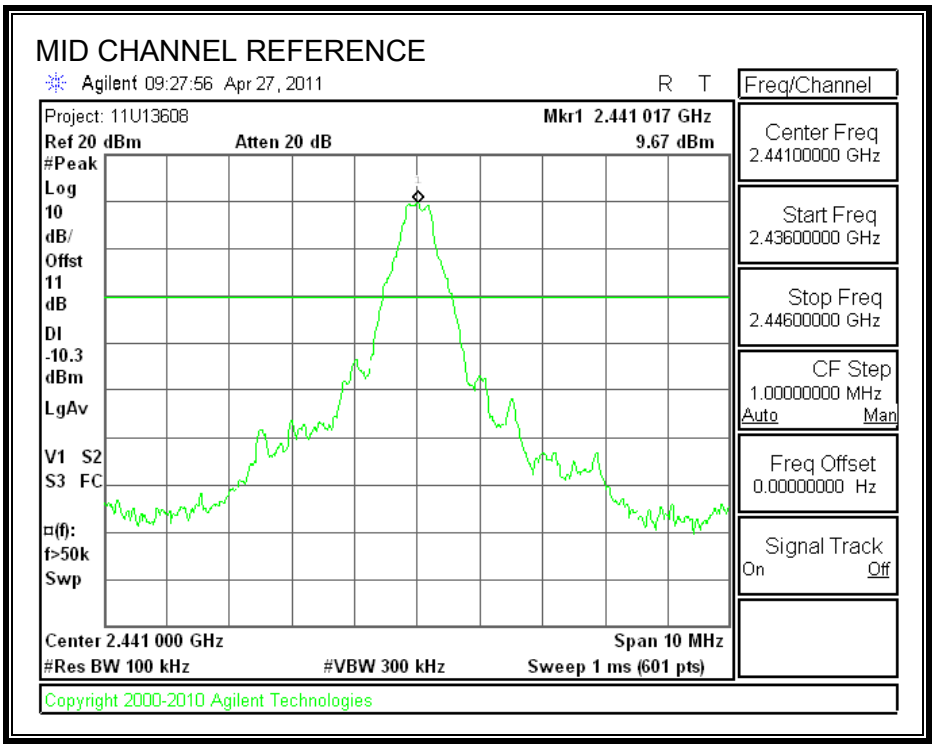
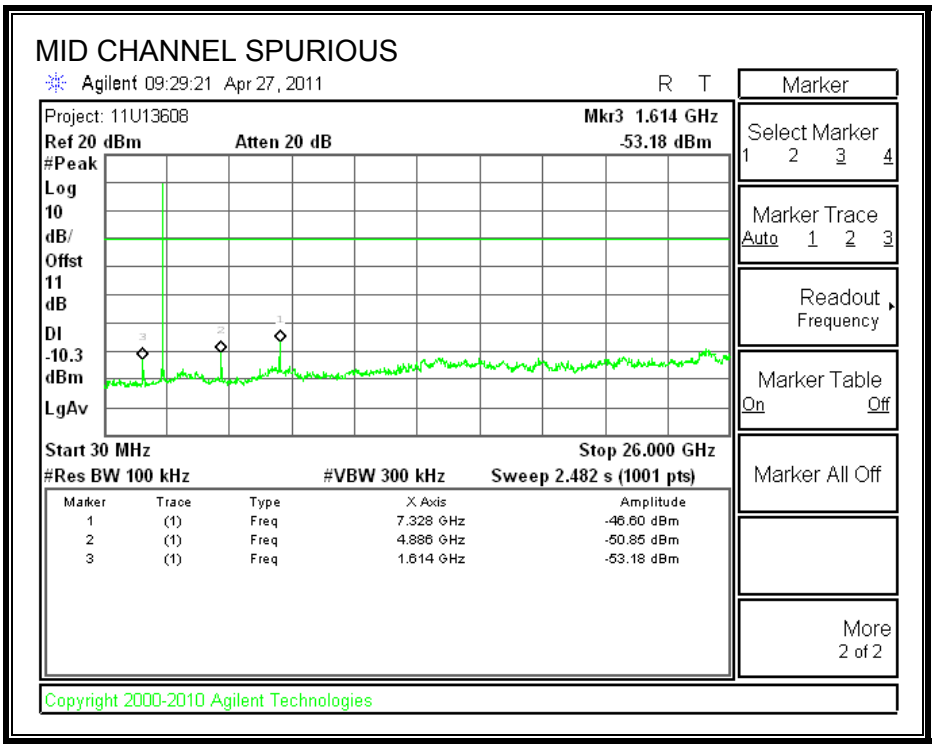
SPURIOUS EMISSIONS, MID CHANNEL





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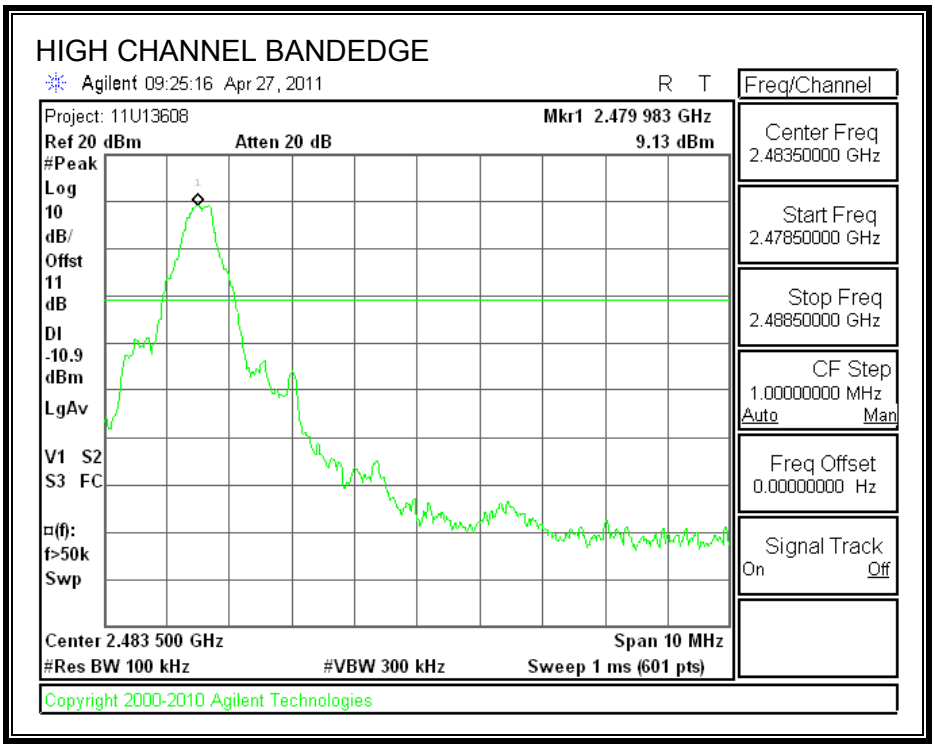
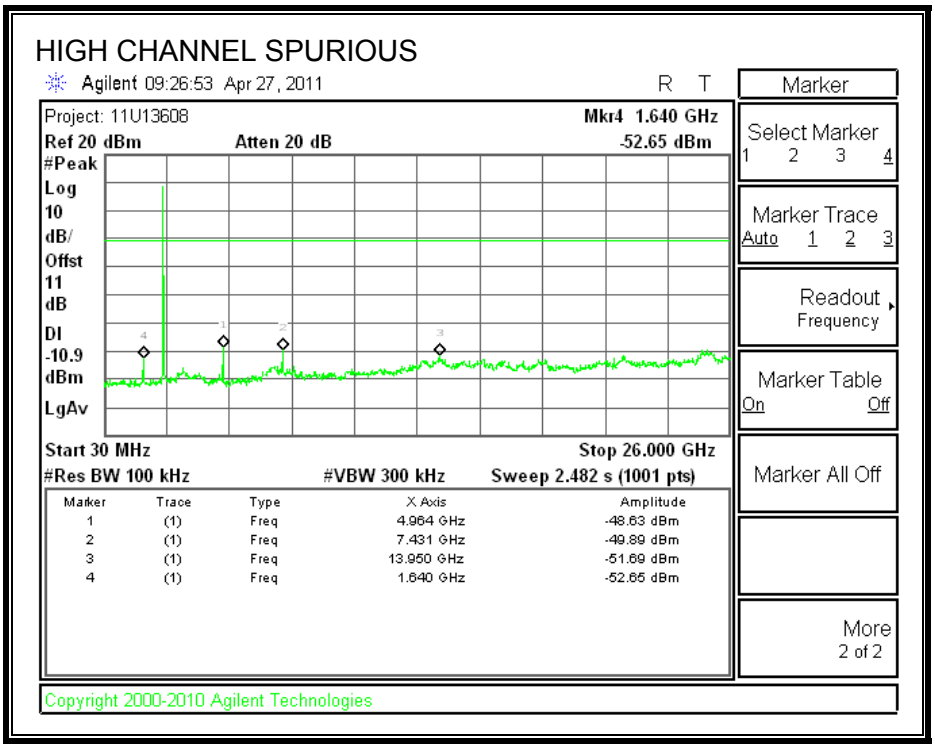
SPURIOUS EMISSIONS, HIGH CHANNEL





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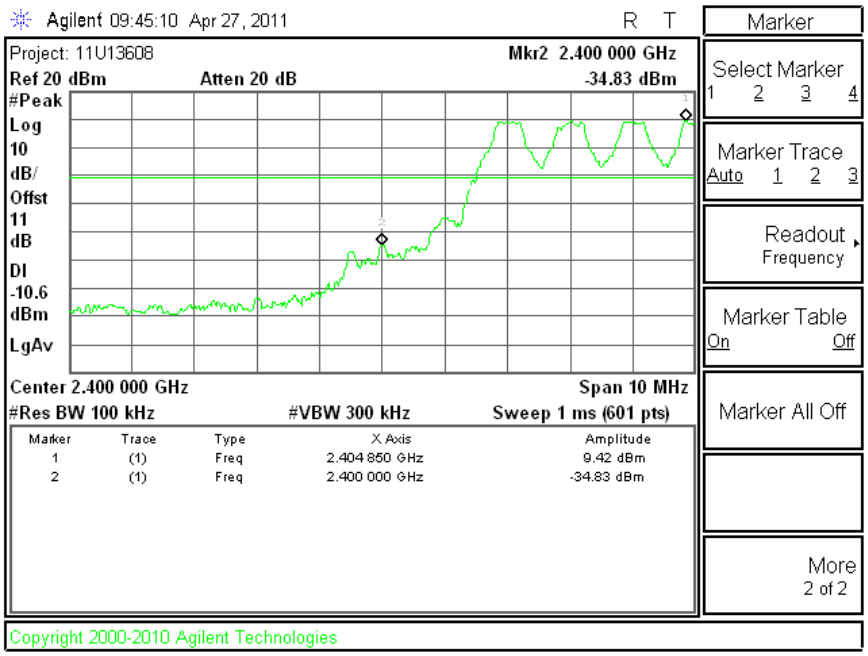
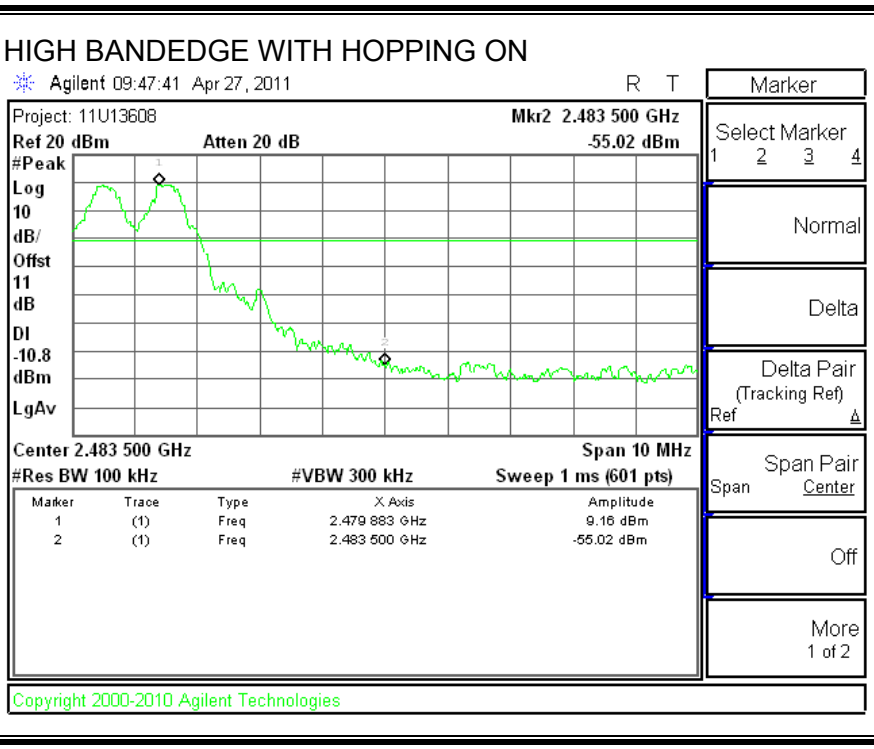
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



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7.2. ENHANCED DATA RATE 8PSK MODULATION

7.2.1. 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 (kHz)	99% Bandwidth (kHz)
Low	2402	1280.0	1210.8
Middle	2441	1305.0	1203.0
High	2480	1240.0	1178.0

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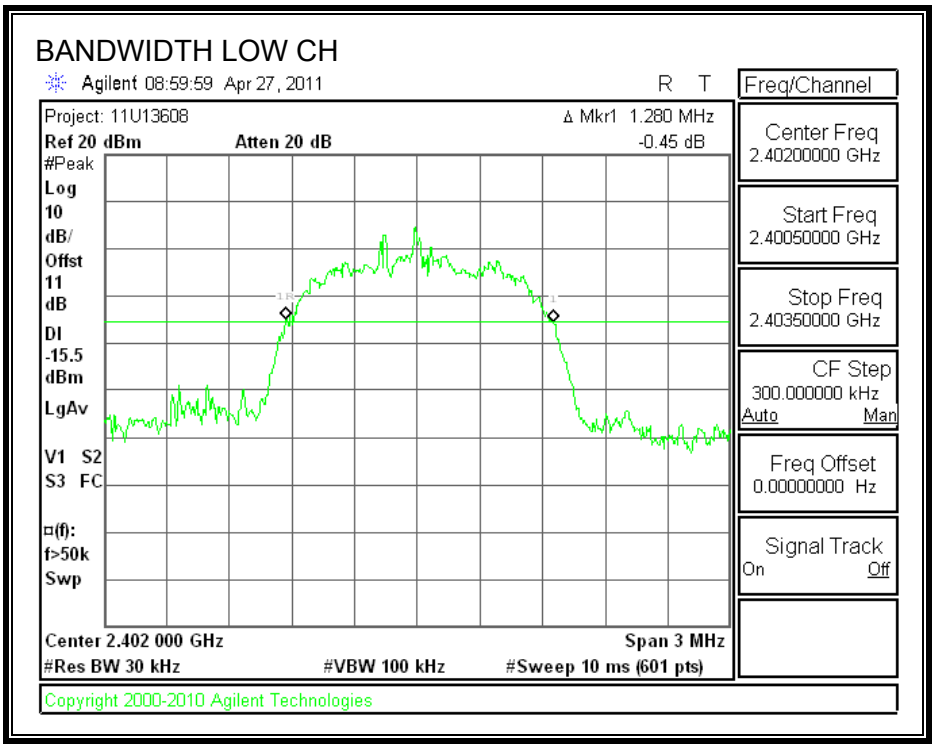
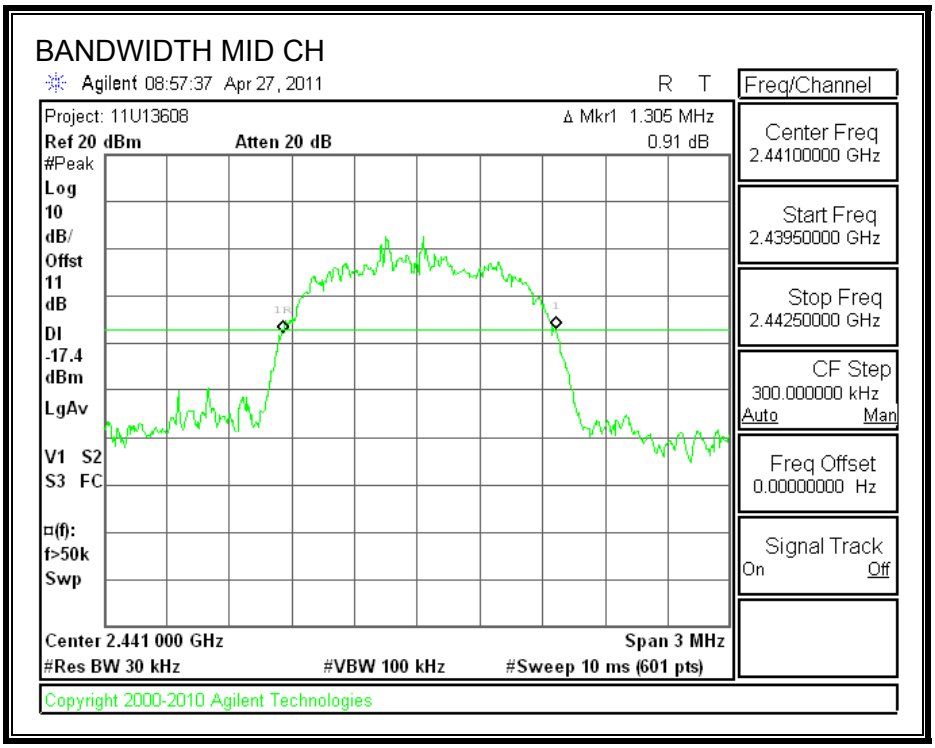
20 dB BANDWIDTH





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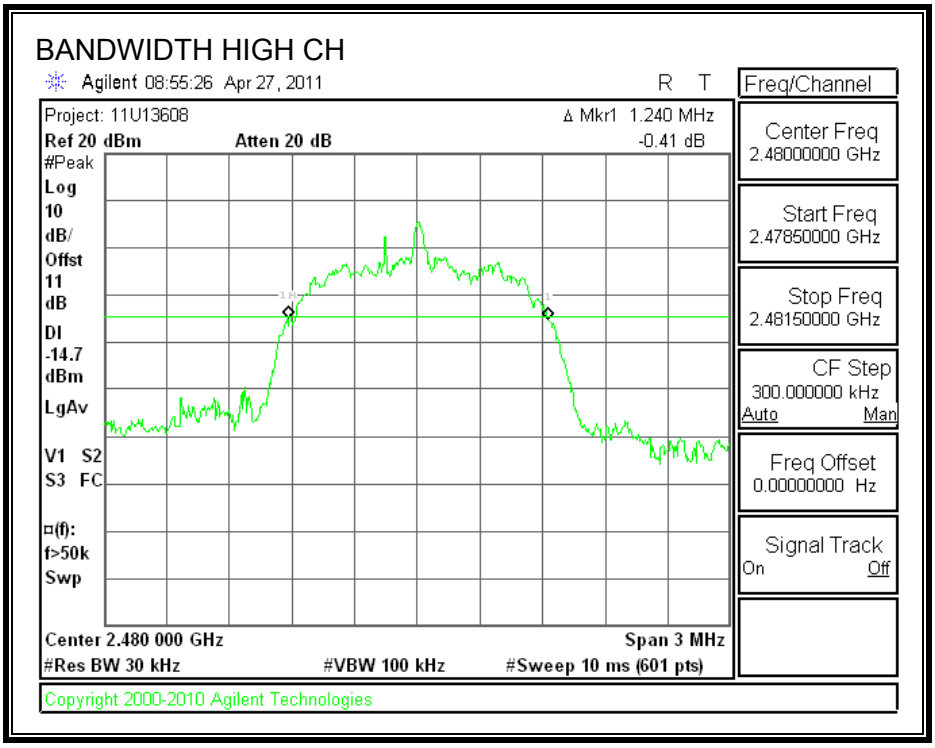

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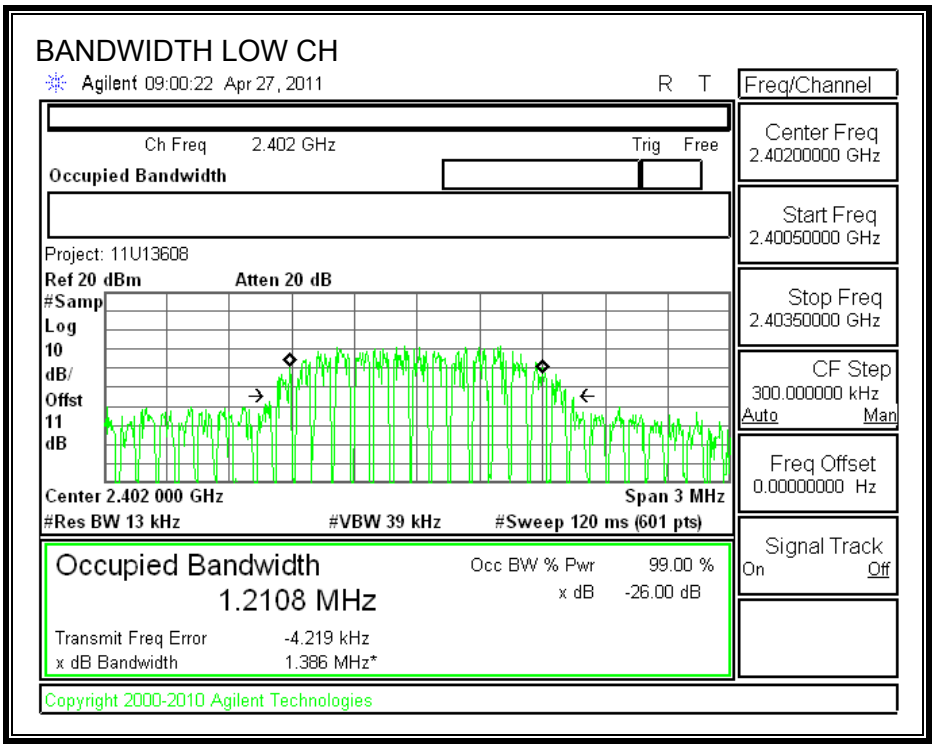
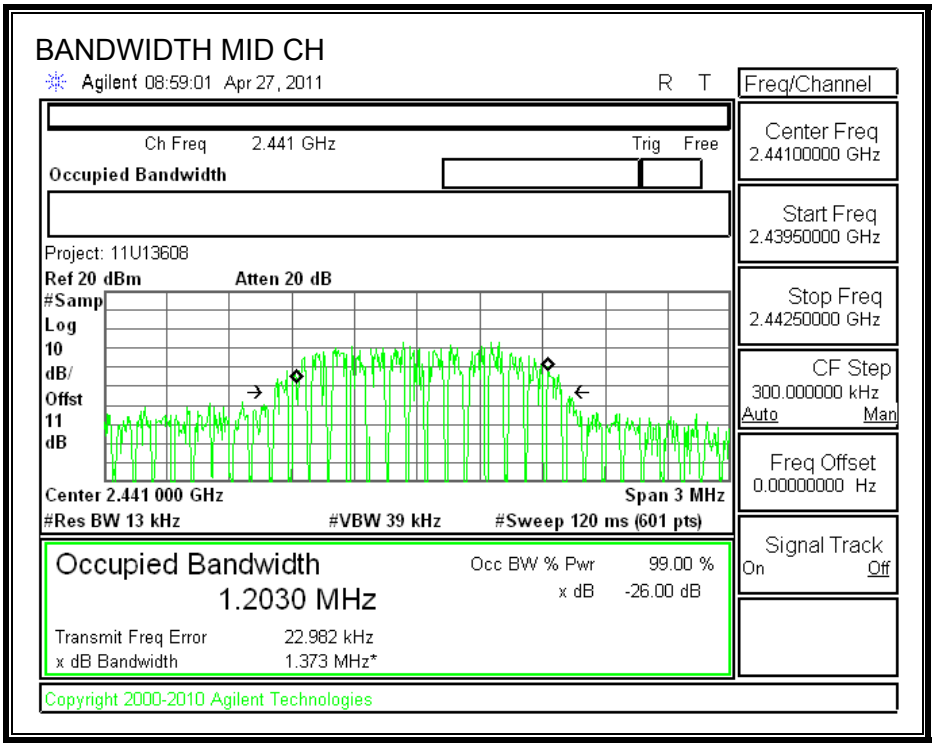
99% BANDWIDTH





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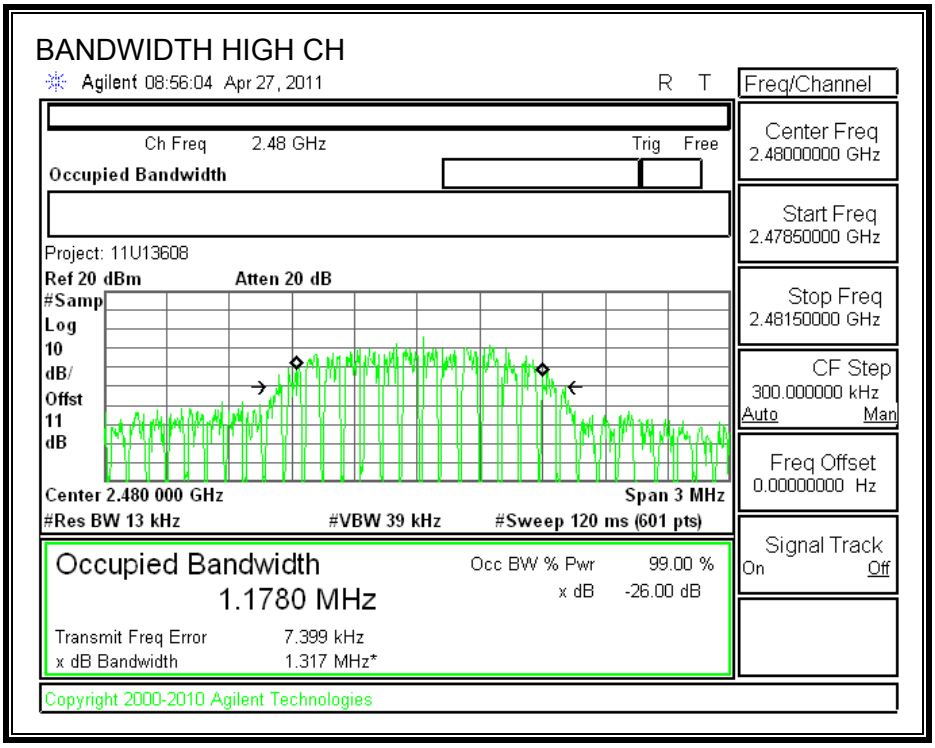

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7.2.2. HOPPING FREQUENCY SEPARATION

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 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

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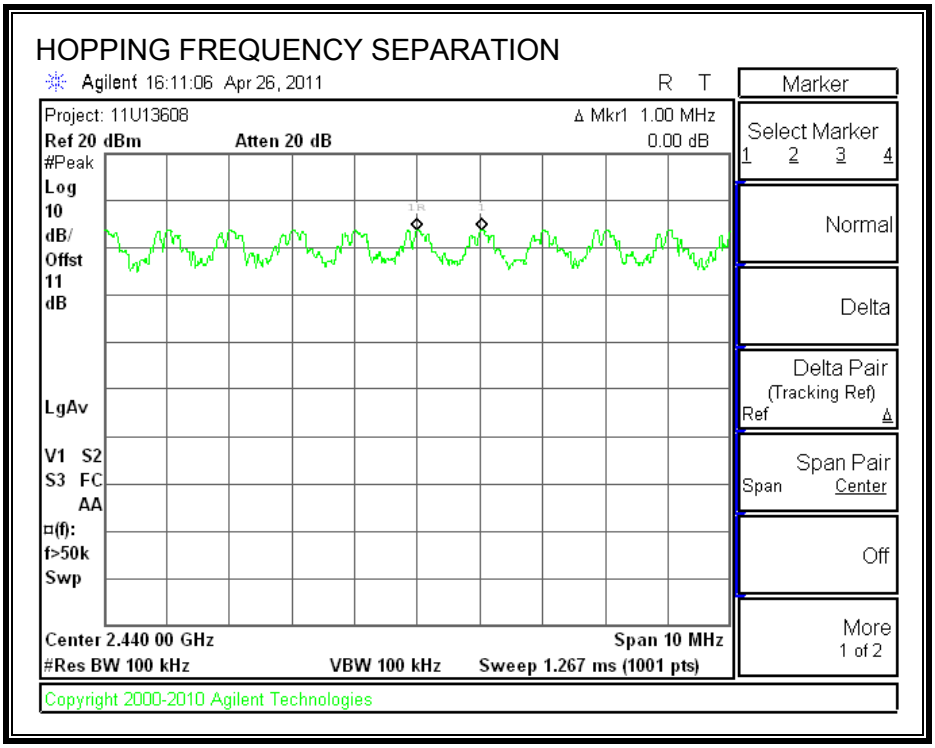
RESULTS

HOPPING FREQUENCY SEPARATION



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7.2.3. 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

79 Channels observed.

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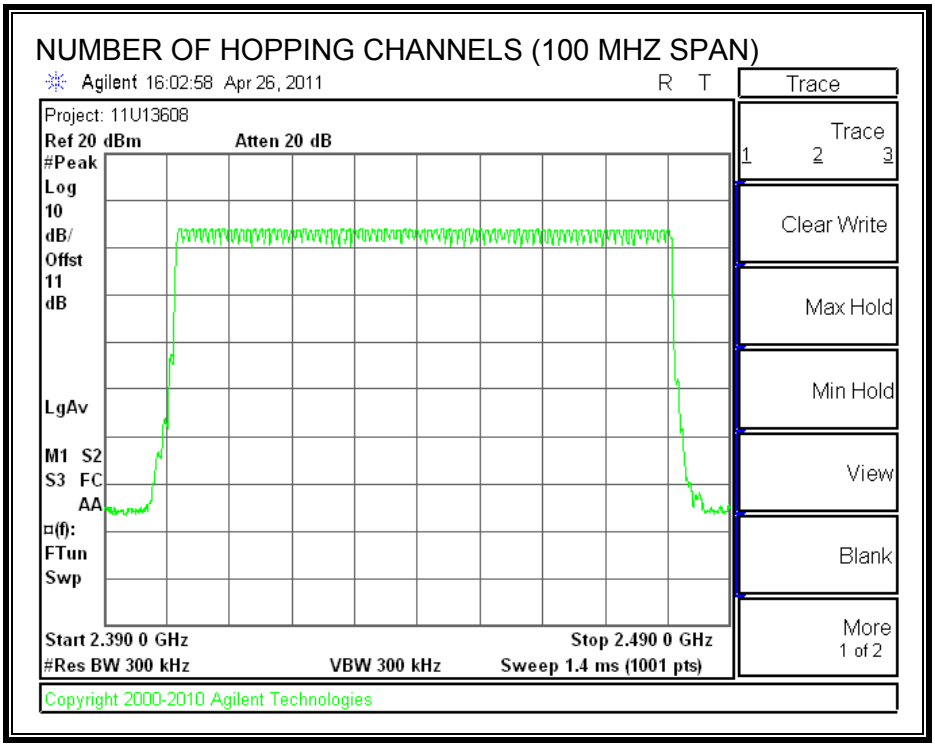
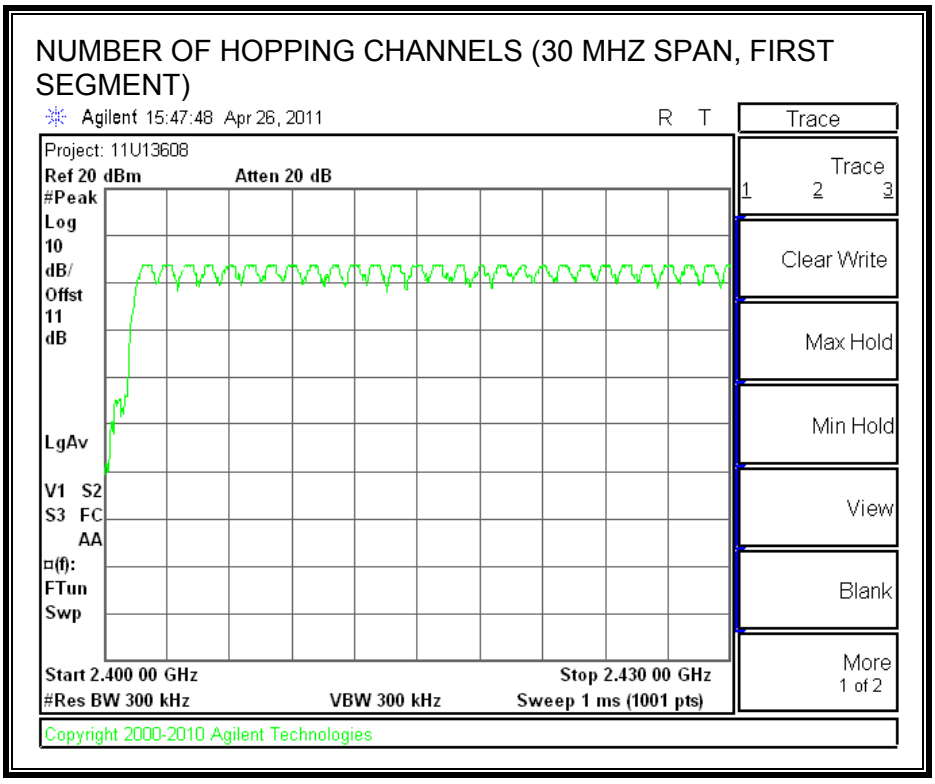
NUMBER OF HOPPING CHANNELS

NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



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



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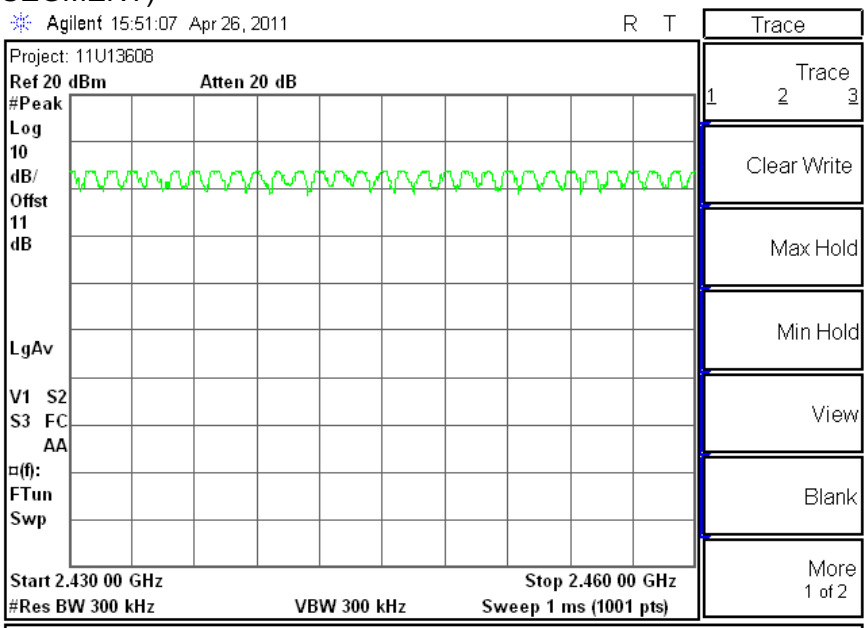
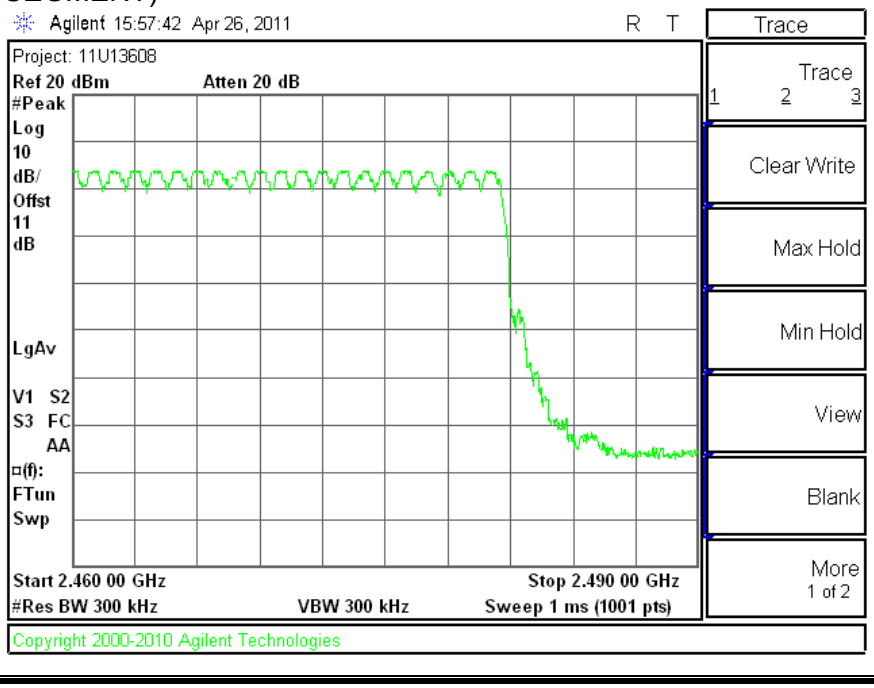
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



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



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7.2.4. 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

8PSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.4367	32	0.140	0.4	-0.260
DH3	1.792	16	0.287	0.4	-0.113
DH5	3.033	11	0.334	0.4	-0.066

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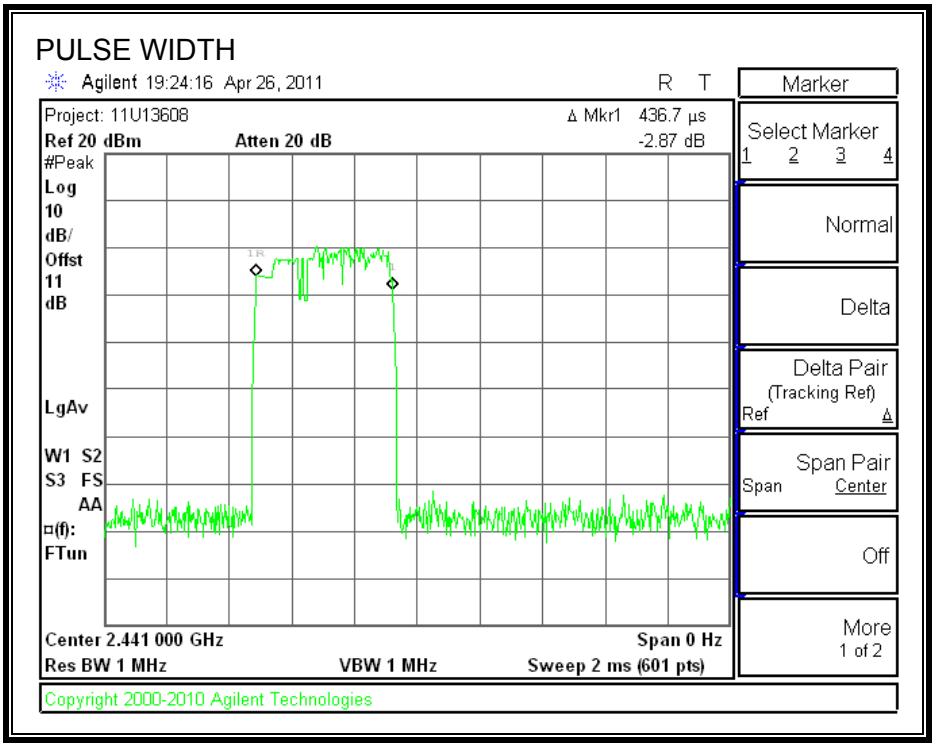
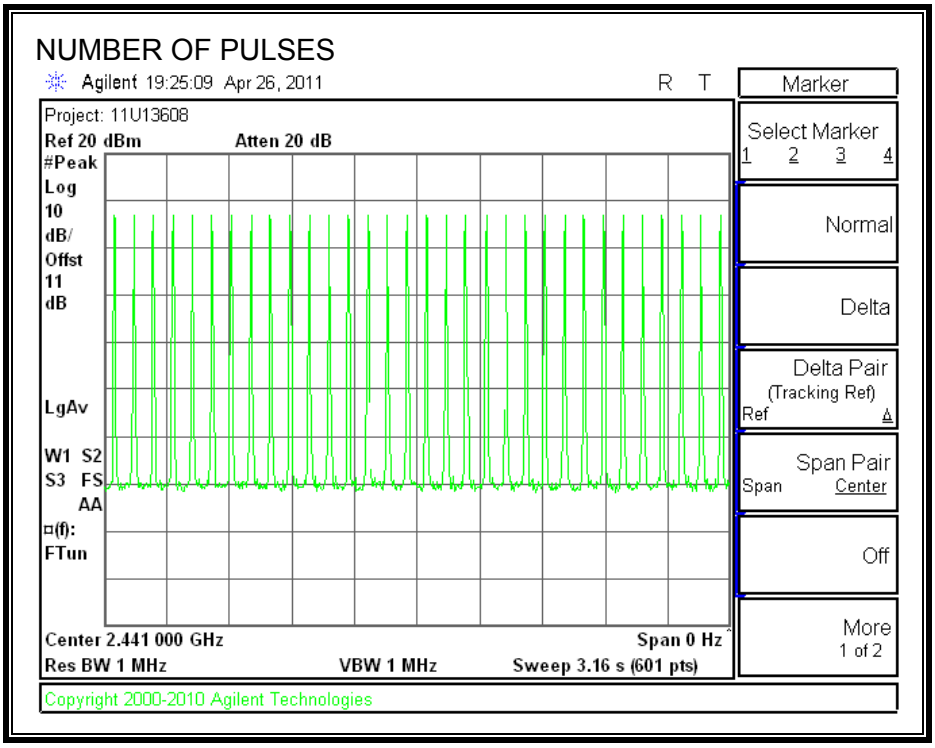
DH1

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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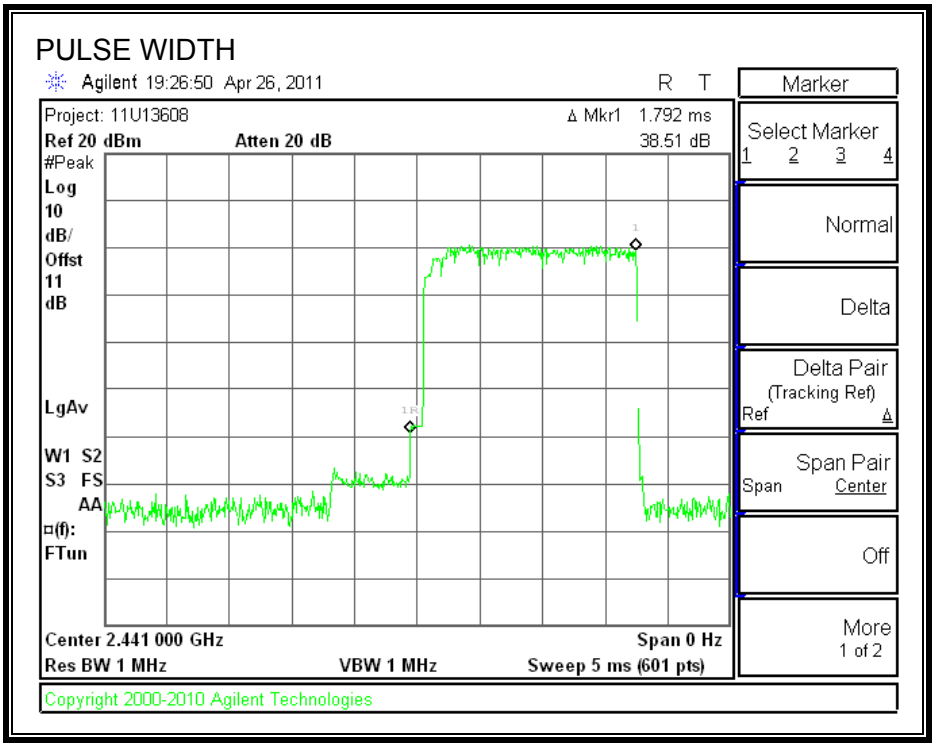
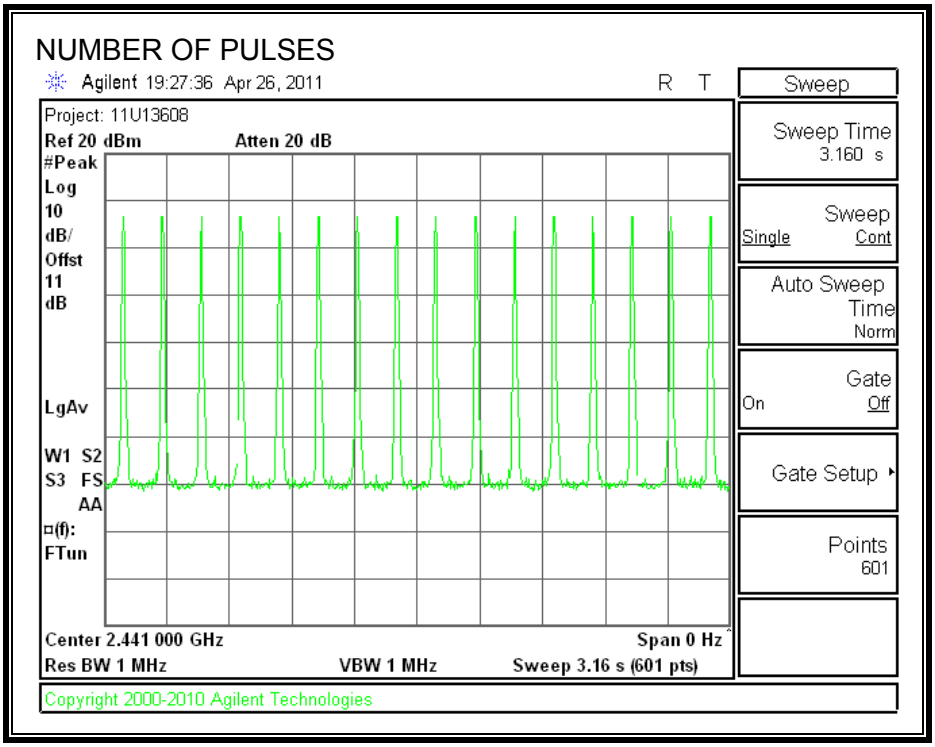
DH3

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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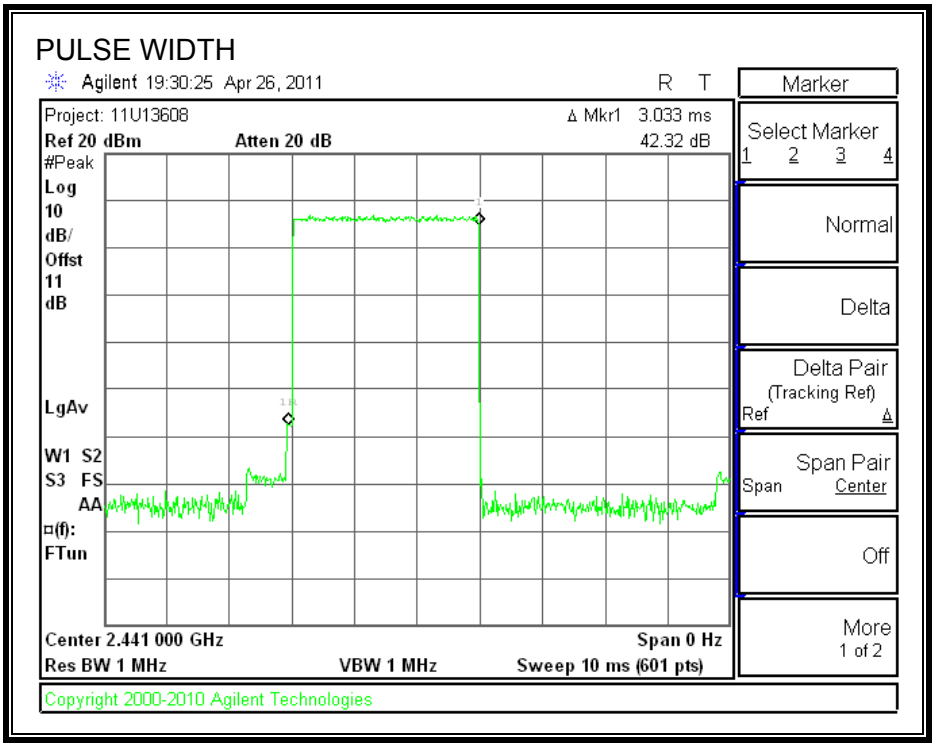
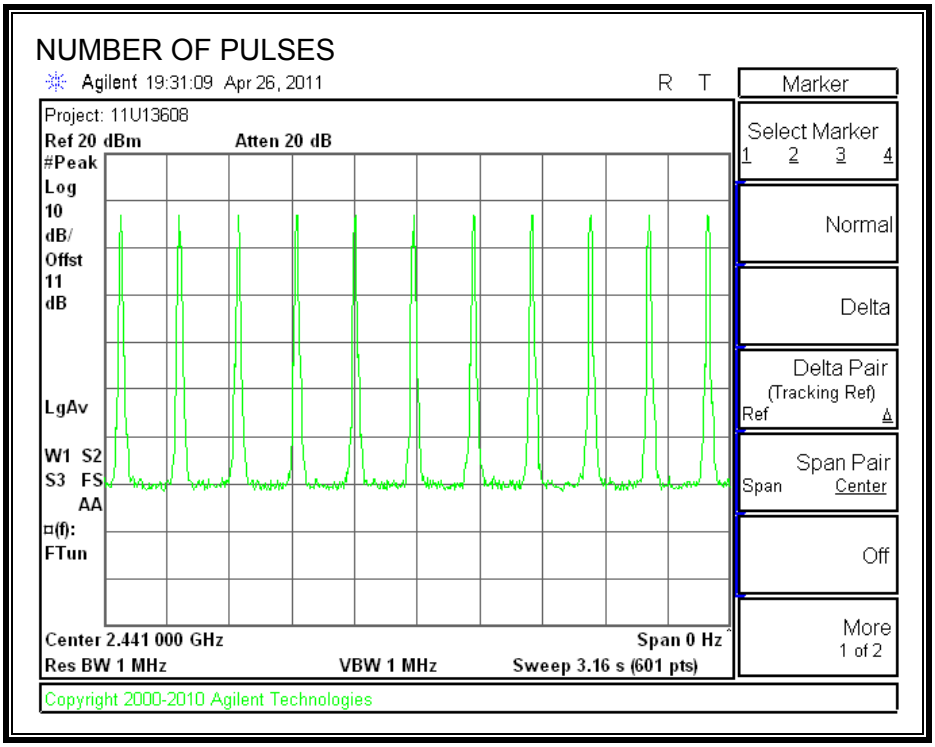
DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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7.2.5. 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.

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	7.34	30	-22.66
Middle	2441	7.23	30	-22.77
High	2480	6.85	30	-23.15

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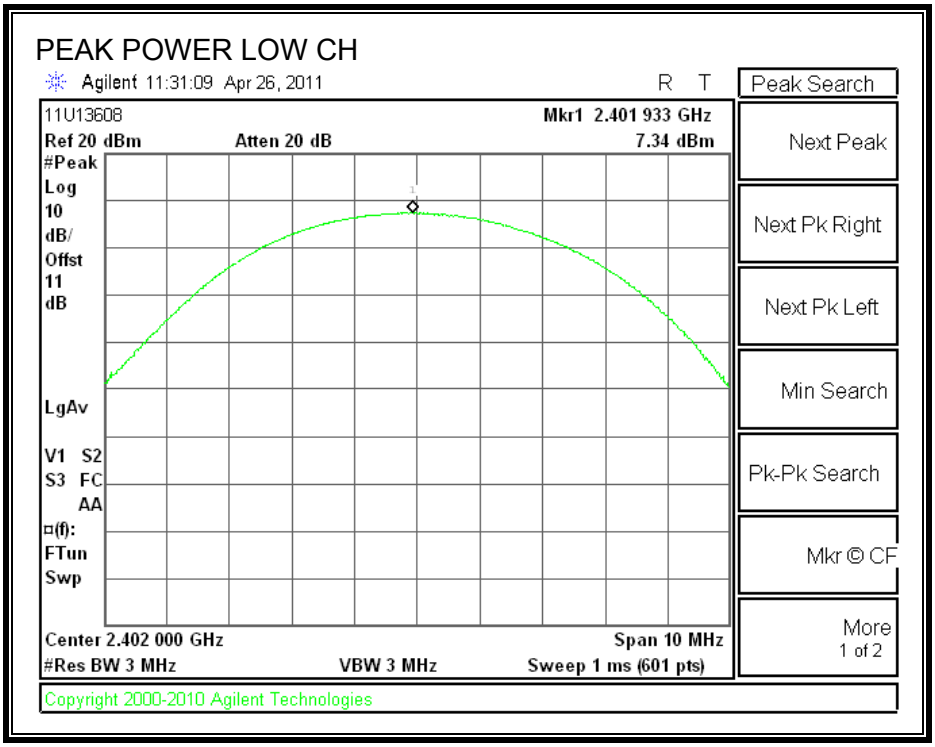
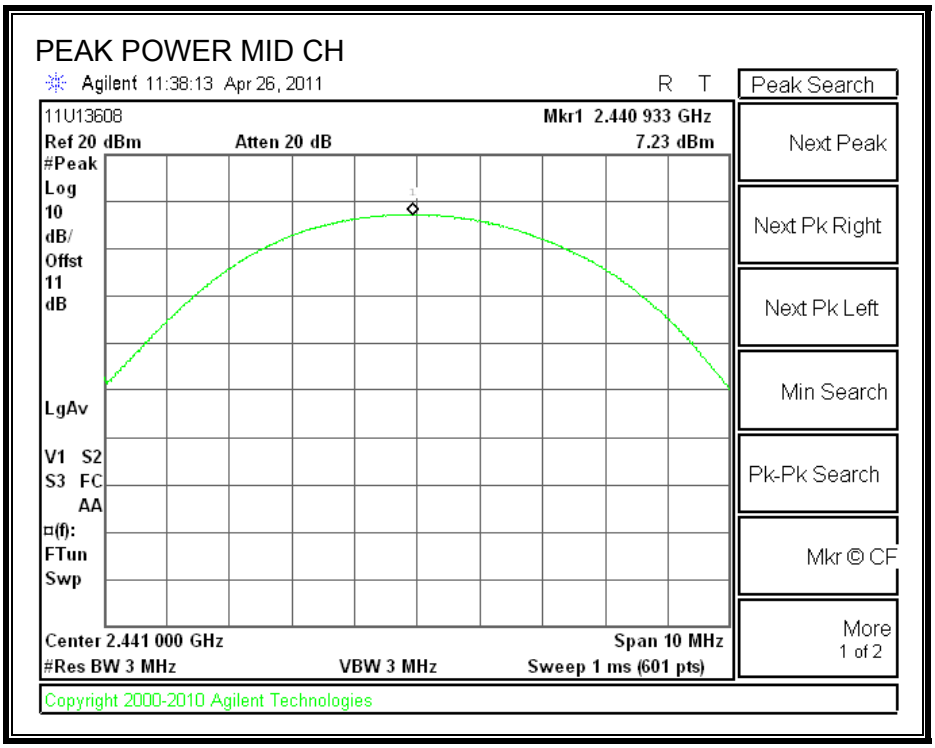
OUTPUT POWER

PEAK POWER LOW CH



PEAK POWER MID CH



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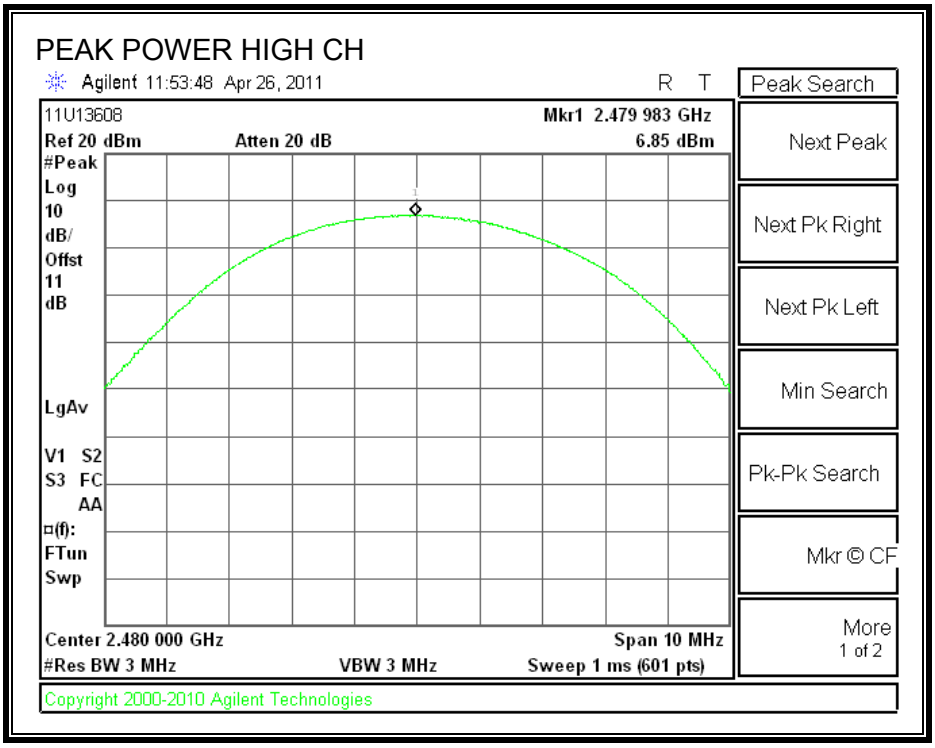
PEAK POWER HIGH CH



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7.2.6. 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 1.0 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	3.94
Middle	2441	3.74
High	2480	3.20

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

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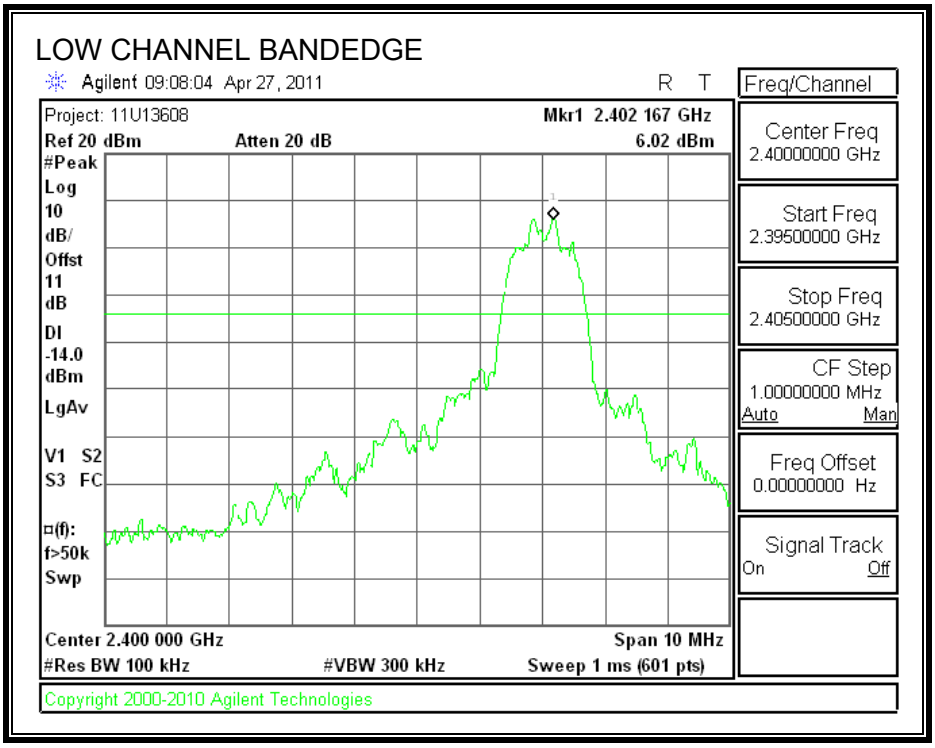
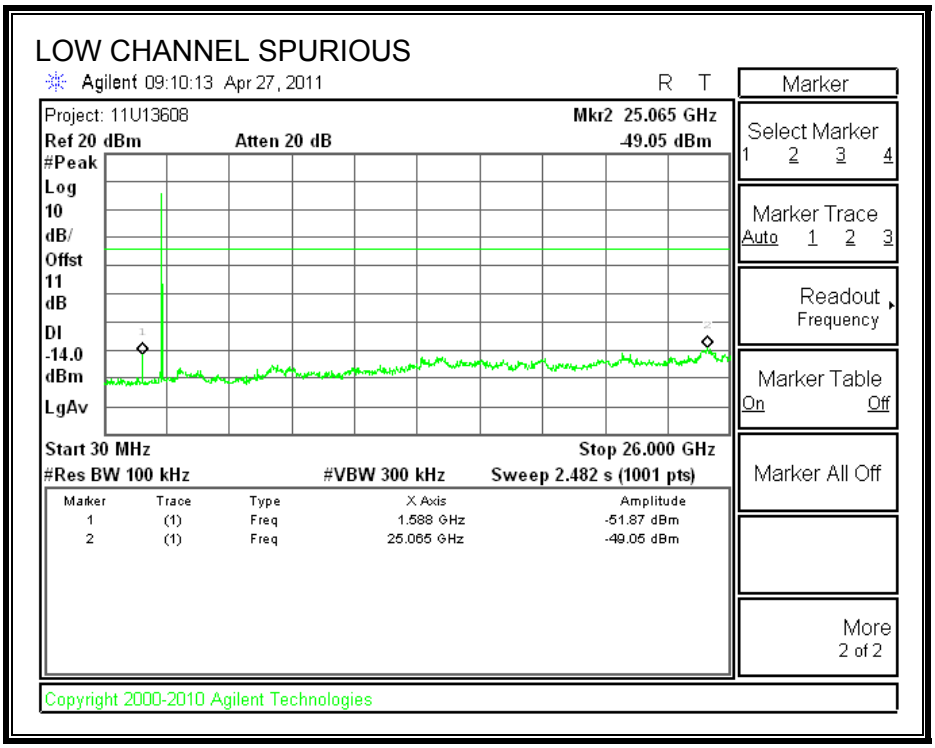
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL





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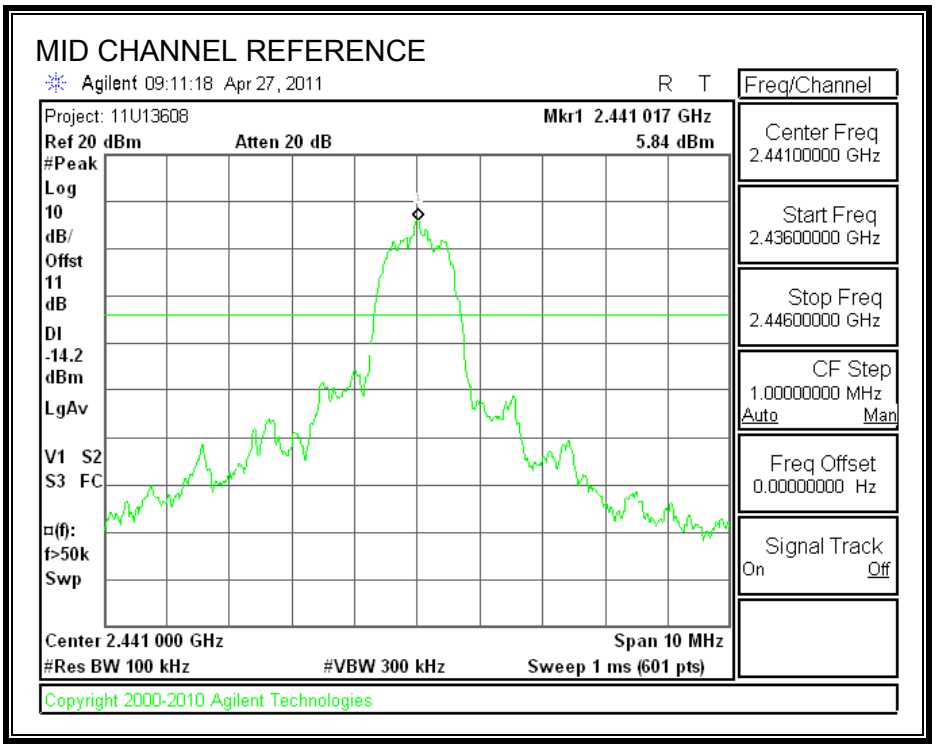
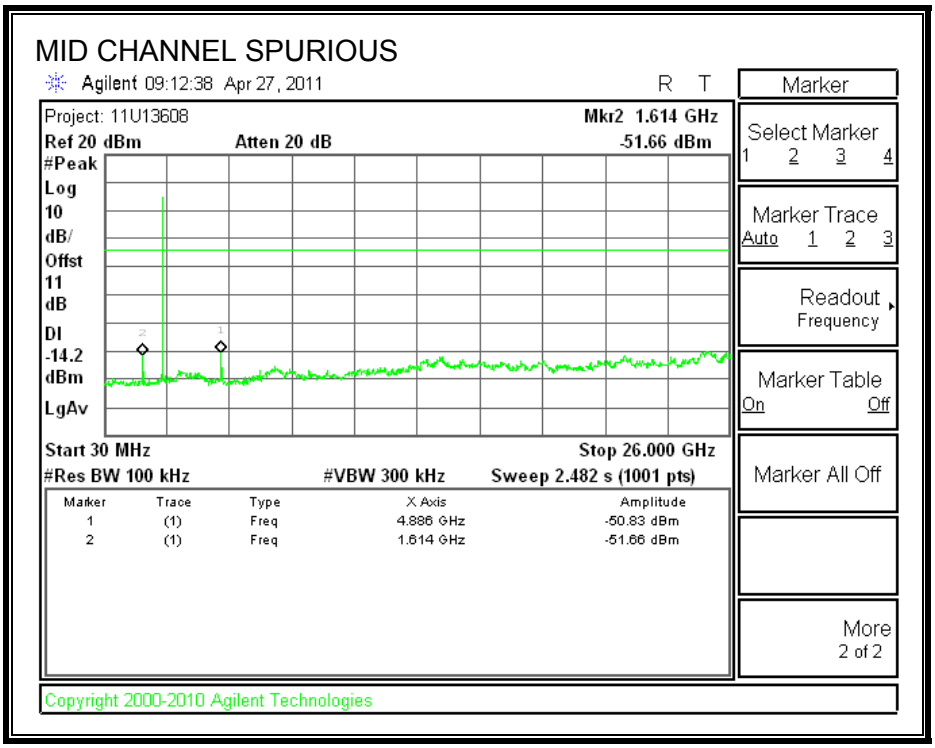
SPURIOUS EMISSIONS, MID CHANNEL





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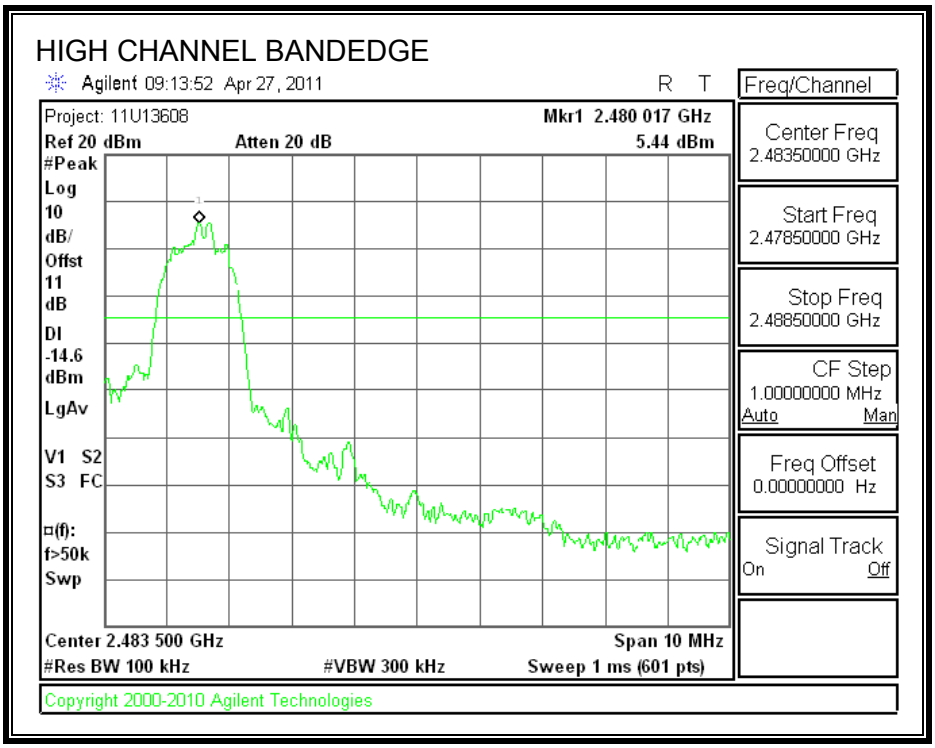
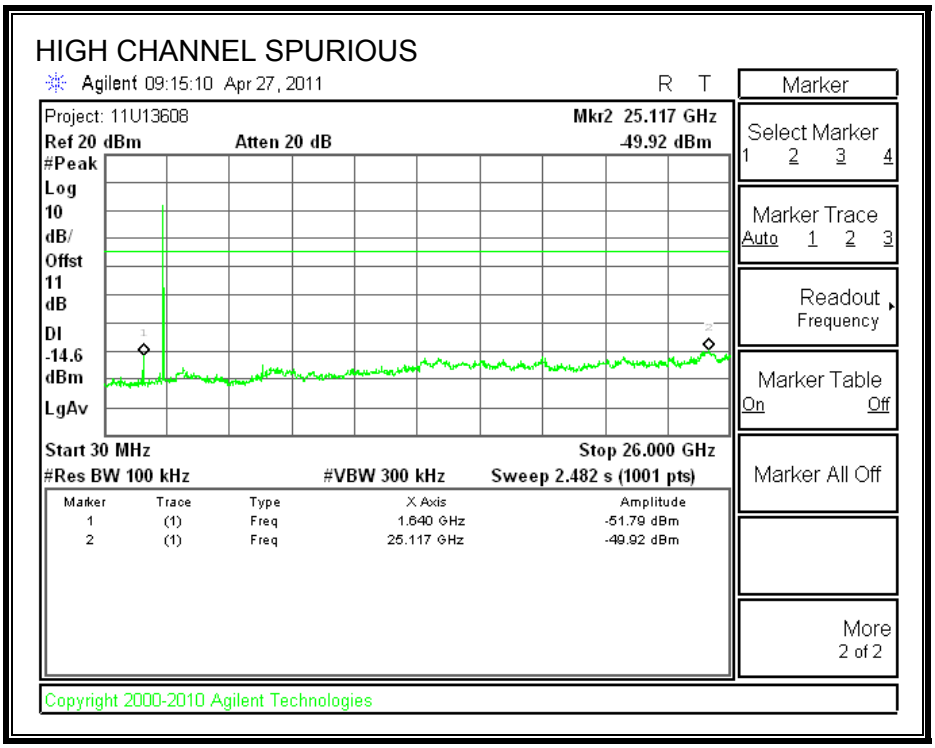
SPURIOUS EMISSIONS, HIGH CHANNEL





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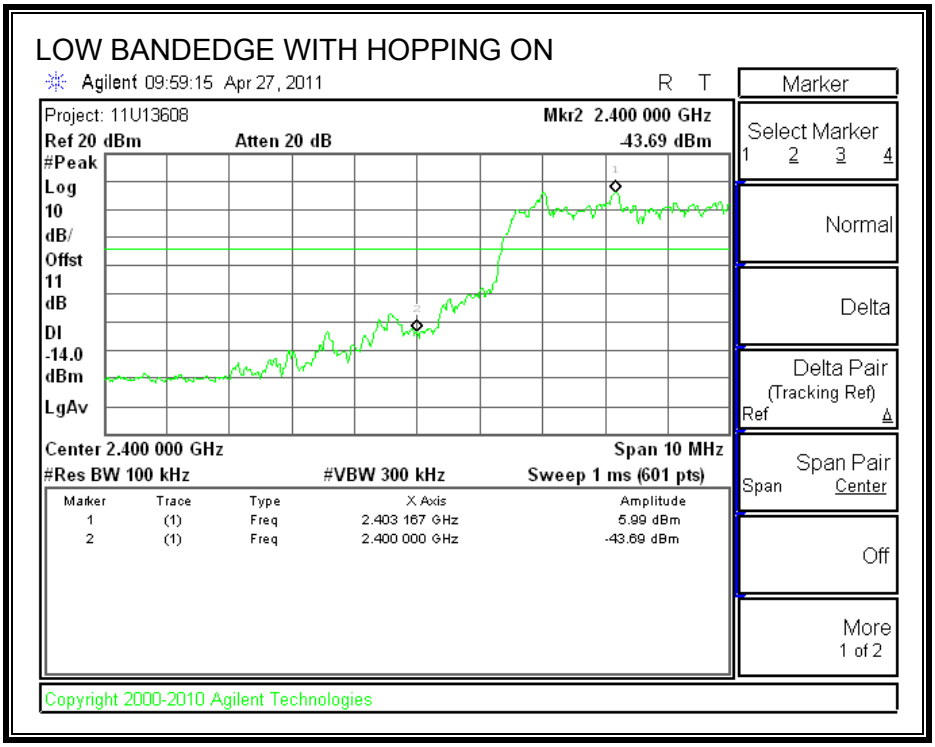
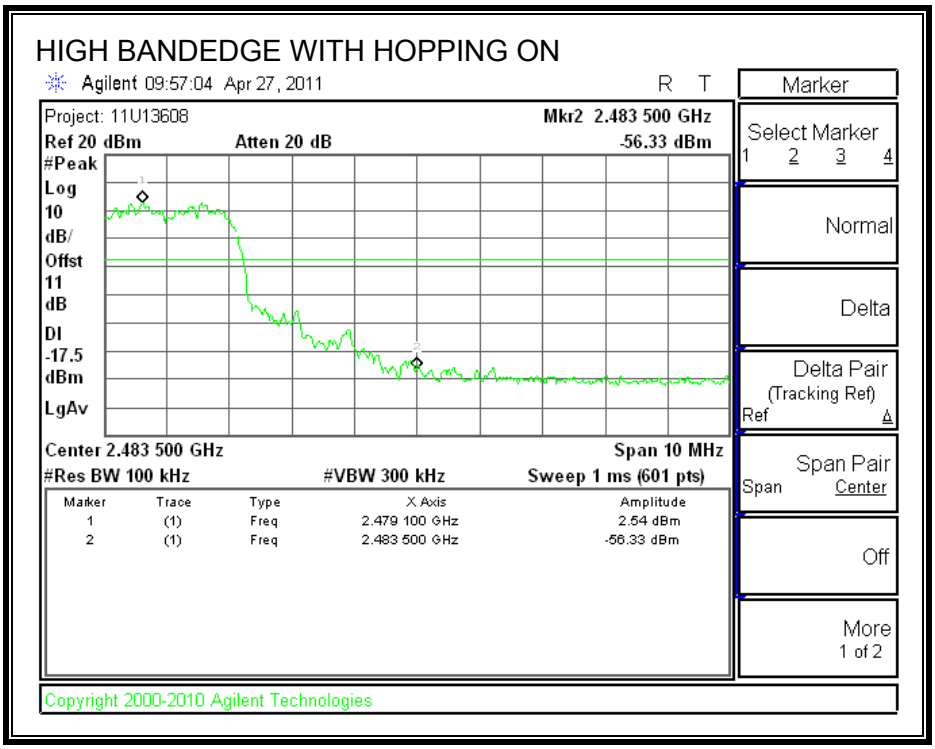
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



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7.3. DQPSK MODULATION

7.3.1. 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.

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RESULTS

QPSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.4367	32	0.140	0.4	0.260
DH3	1.683	16	0.269	0.4	0.131
DH5	2.917	11	0.321	0.4	0.079

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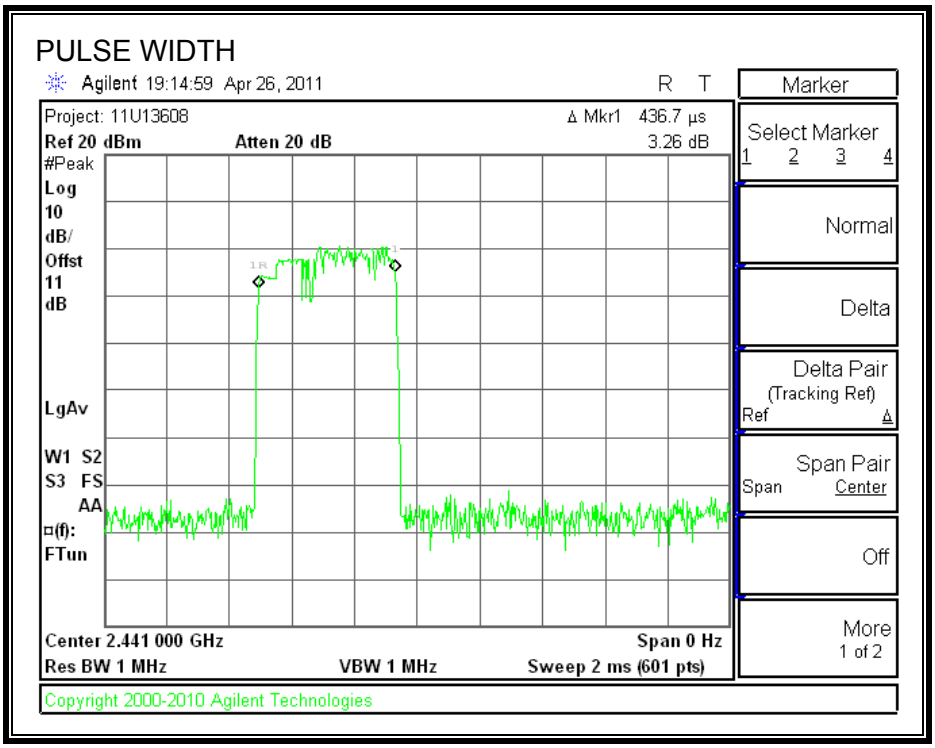
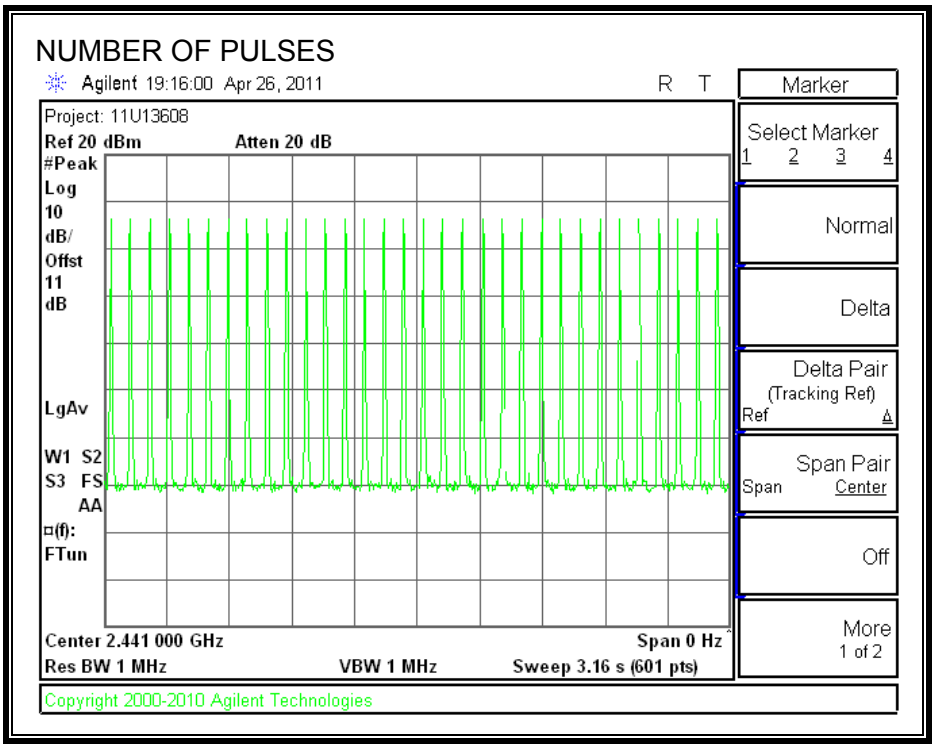
DH1

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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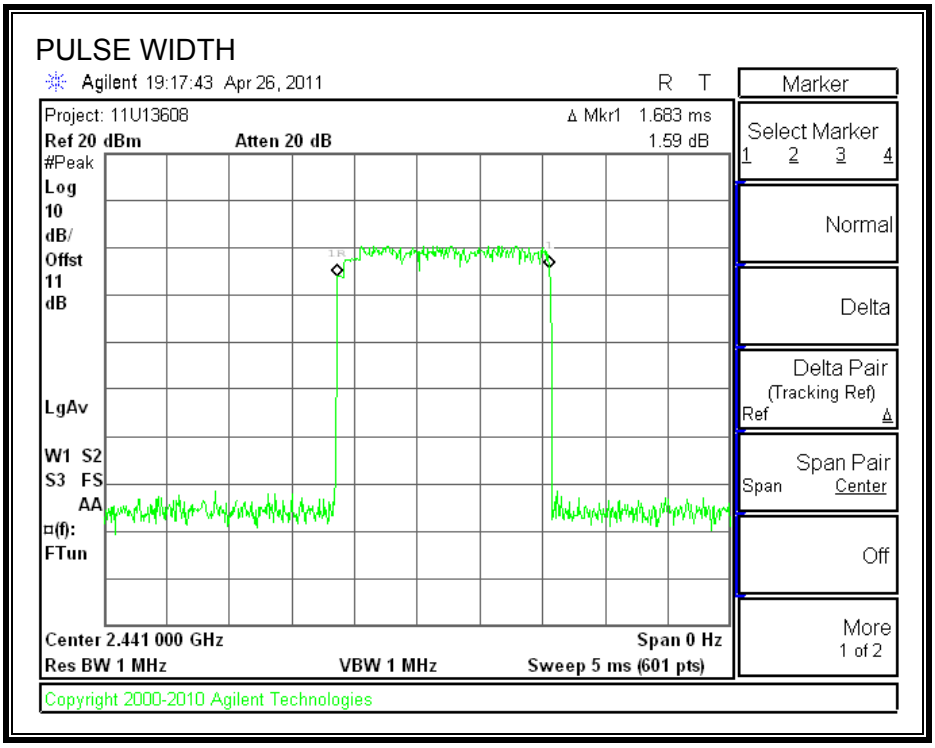
DH3

PULSE WIDTH



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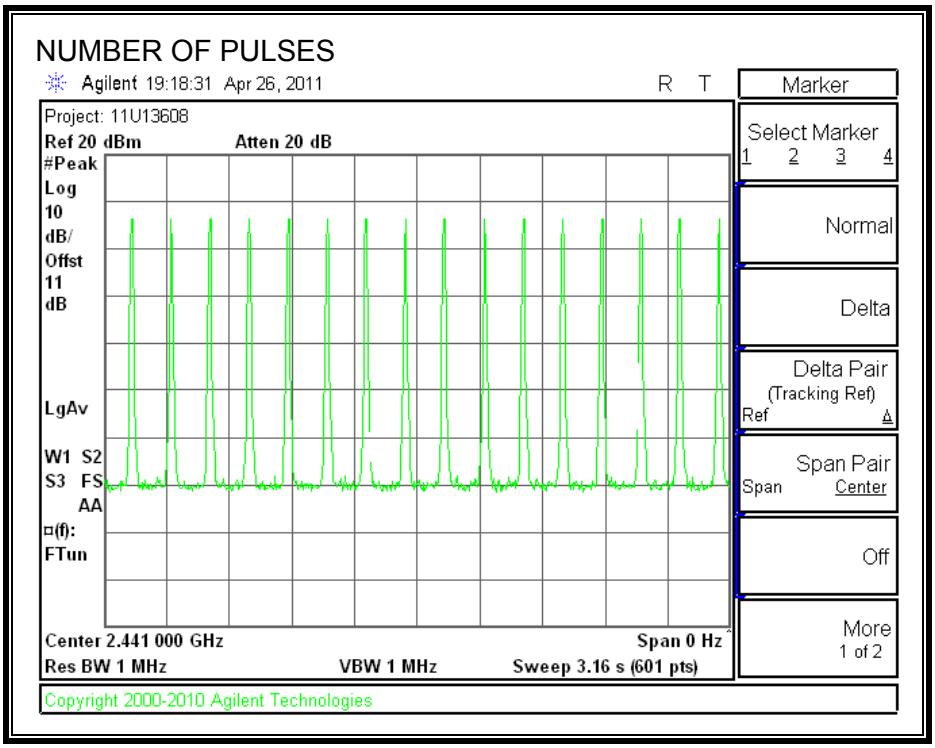
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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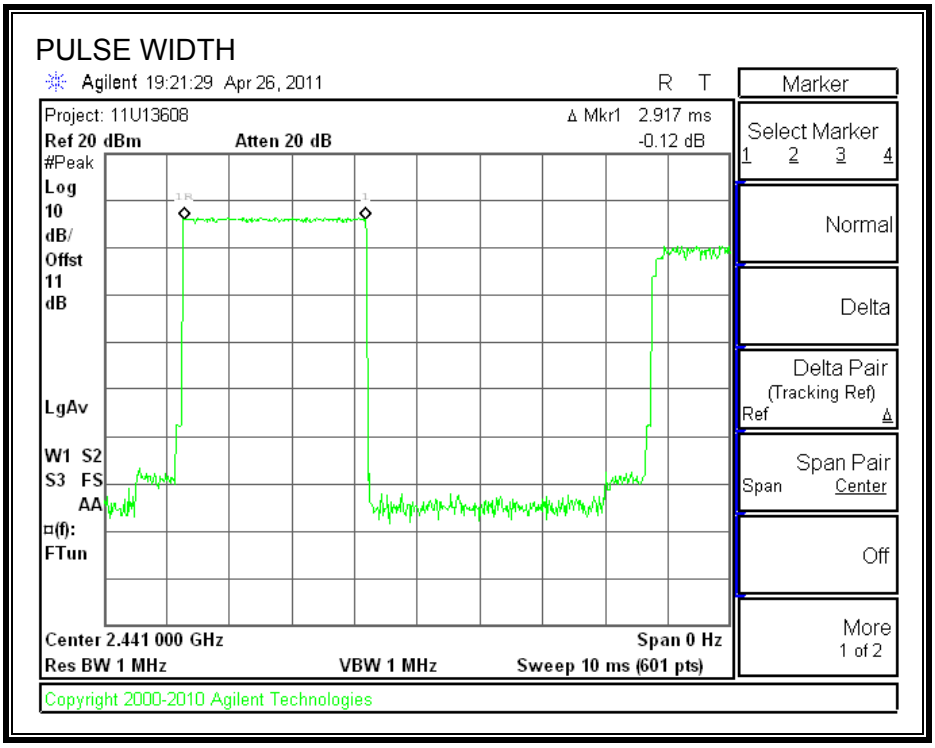
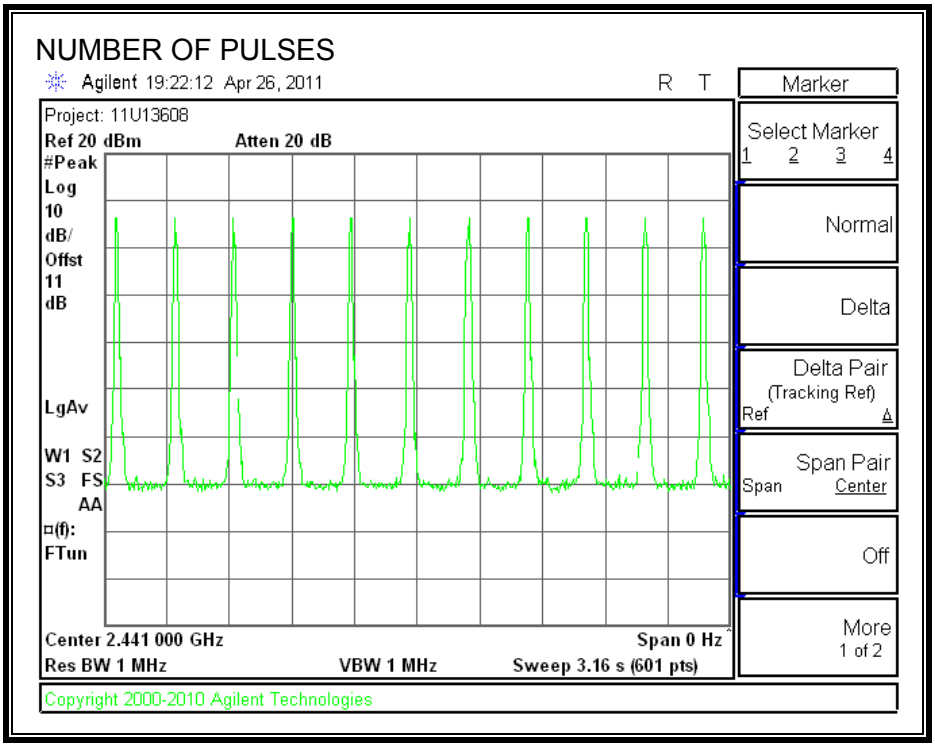
DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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7.3.2. 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	6.98	30	-23.02
Middle	2440	6.88	30	-23.12
High	2480	6.46	30	-23.54

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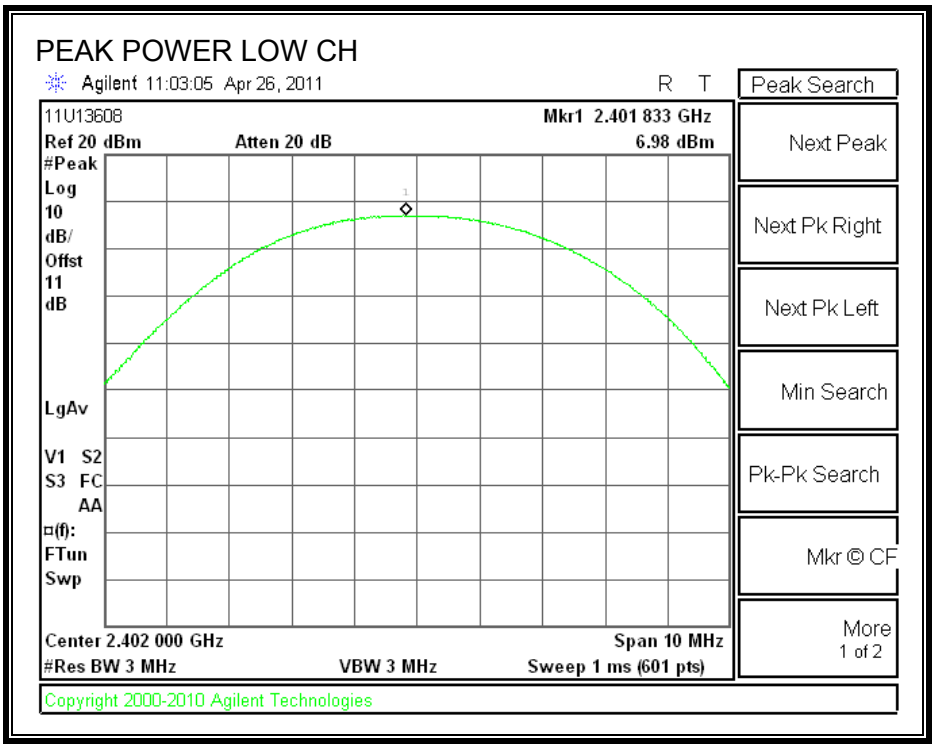
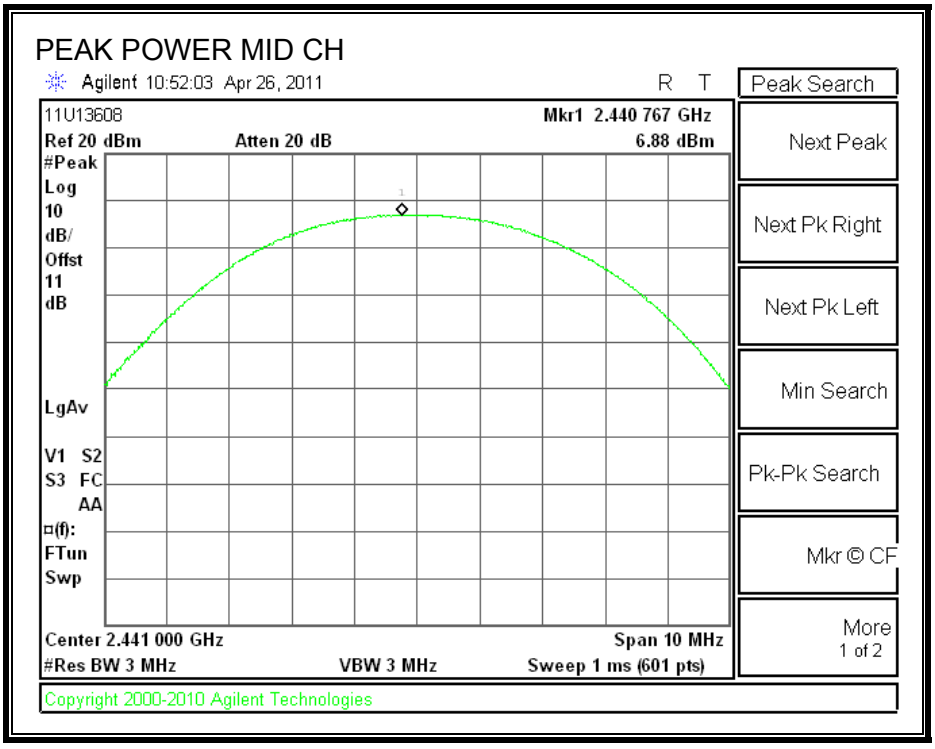
OUTPUT POWER





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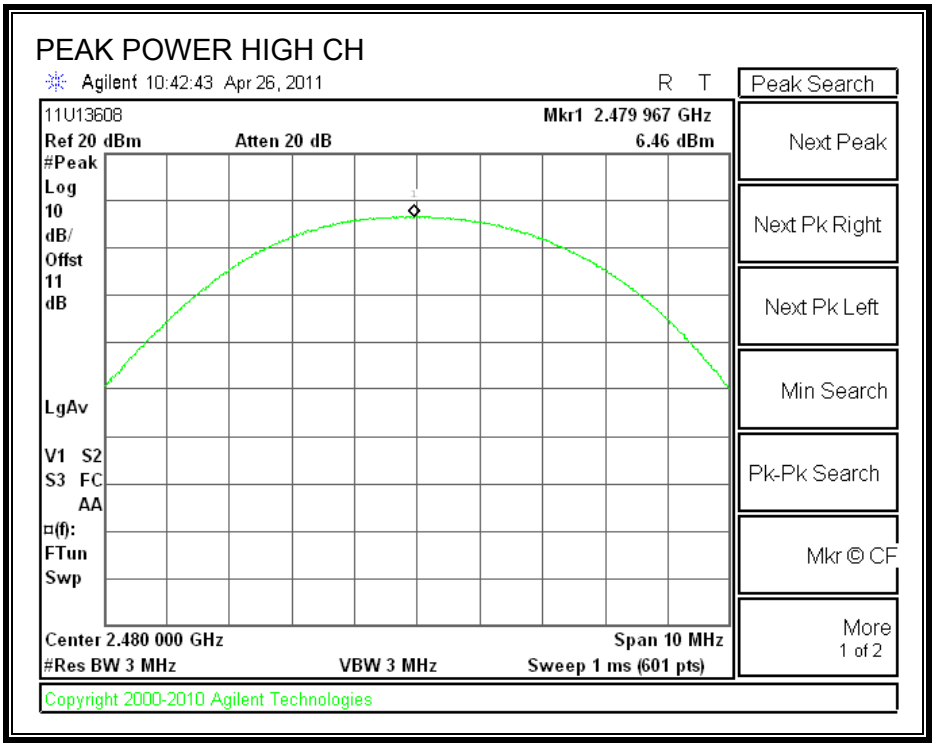
PEAK POWER HIGH CH



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7.3.3. 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	3.92
Middle	2440	3.74
High	2480	3.21

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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, 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.

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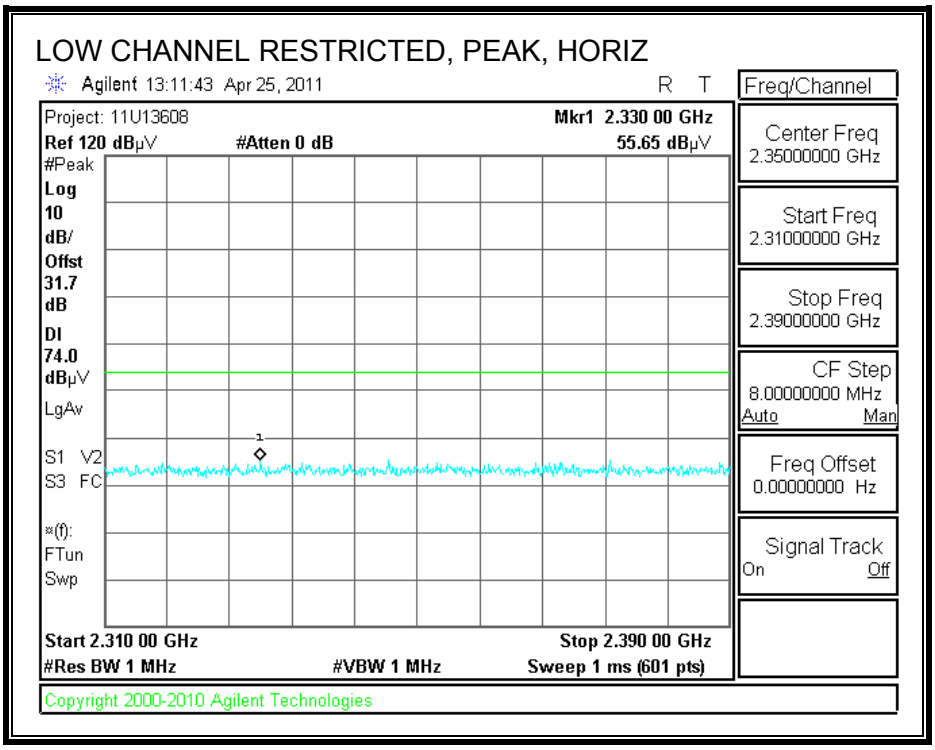
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



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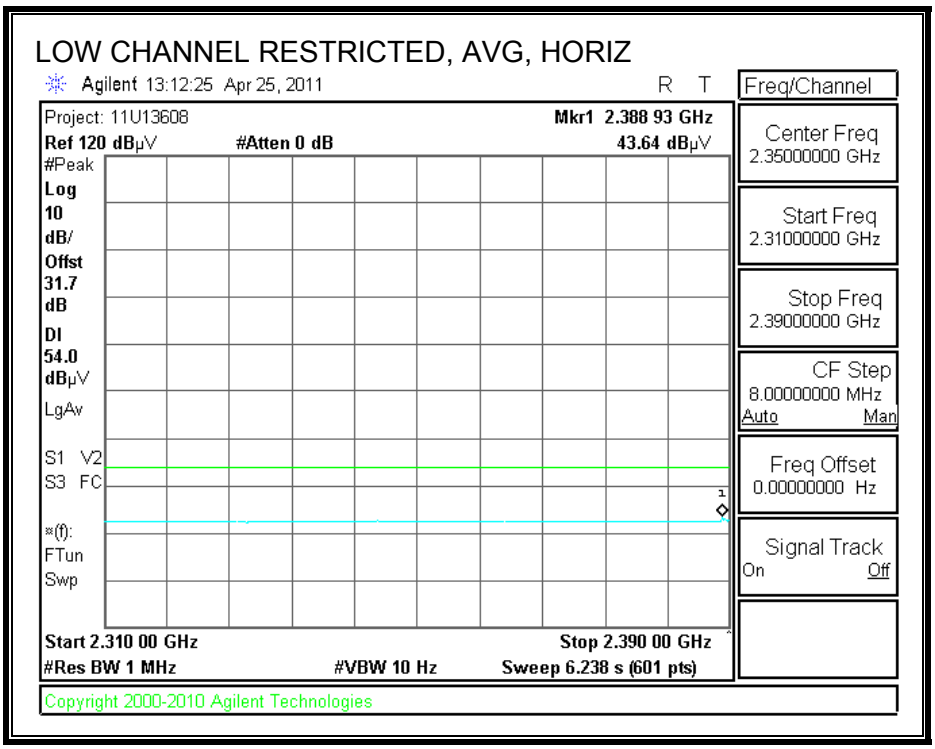
LOW CHANNEL RESTRICTED, AVG, HORIZ



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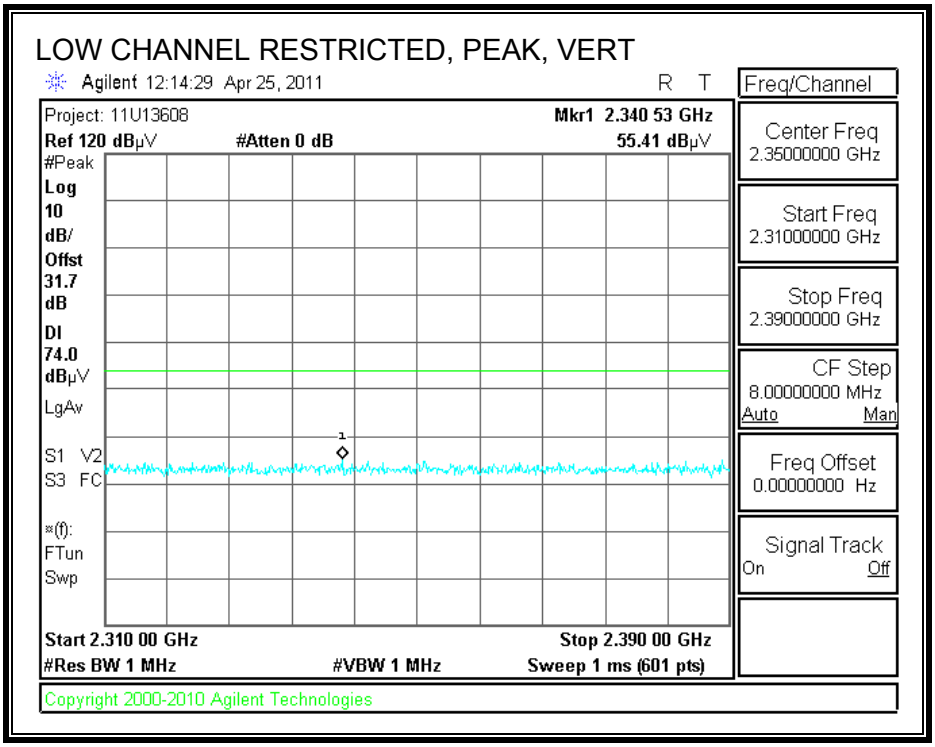
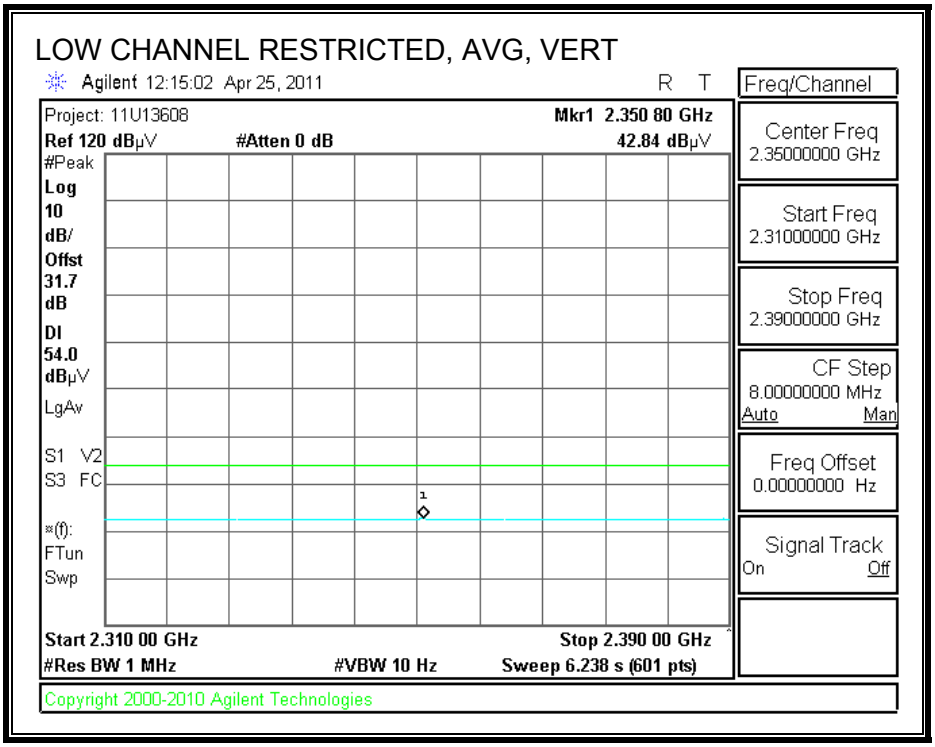
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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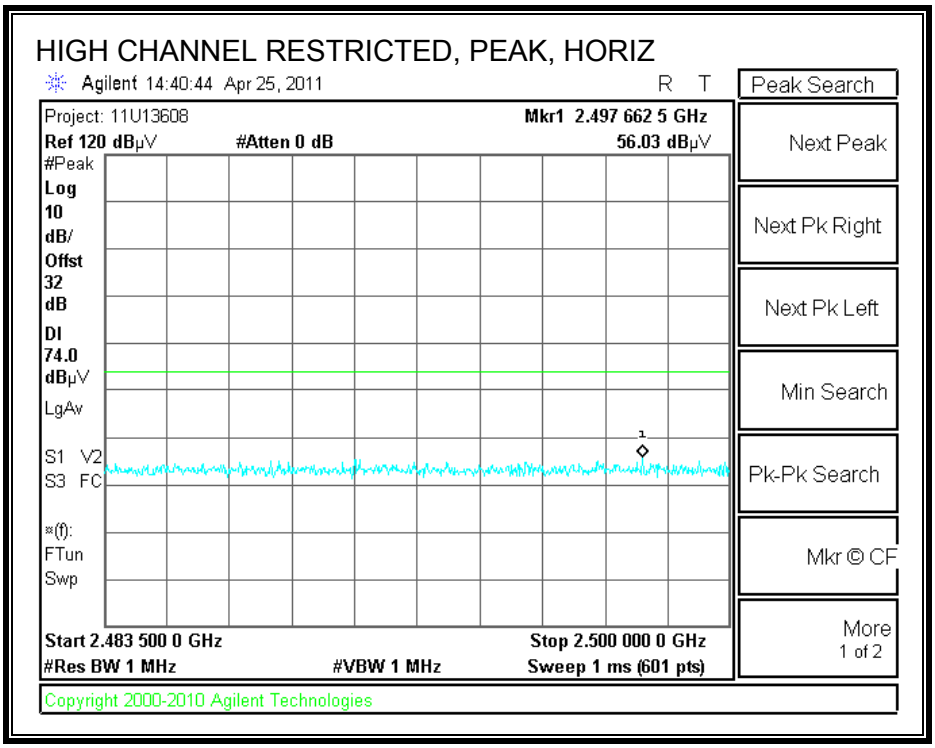
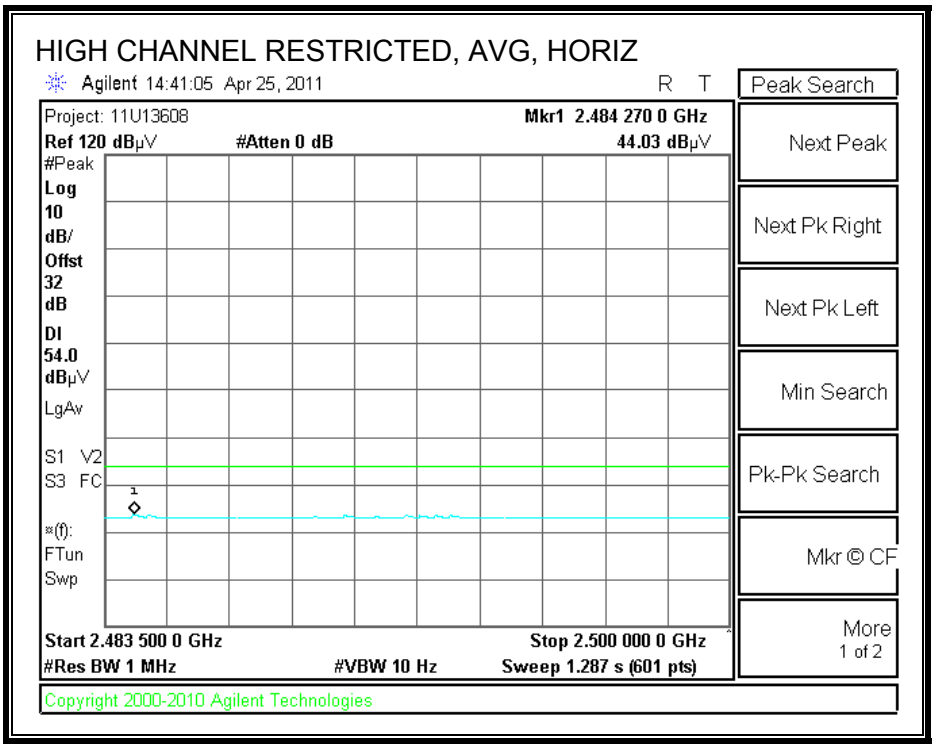
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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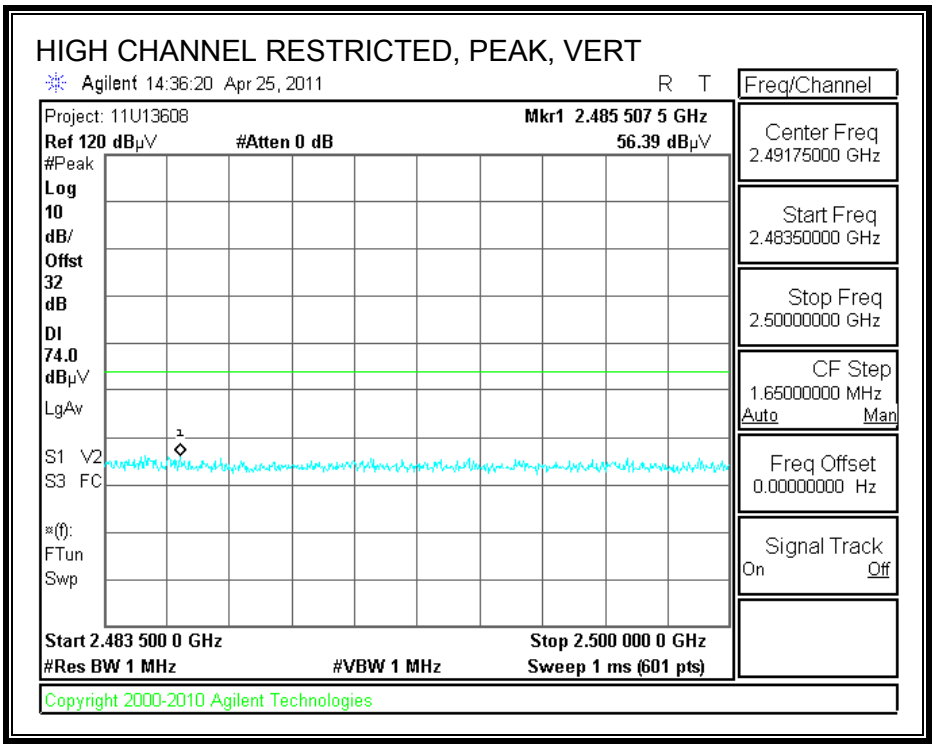
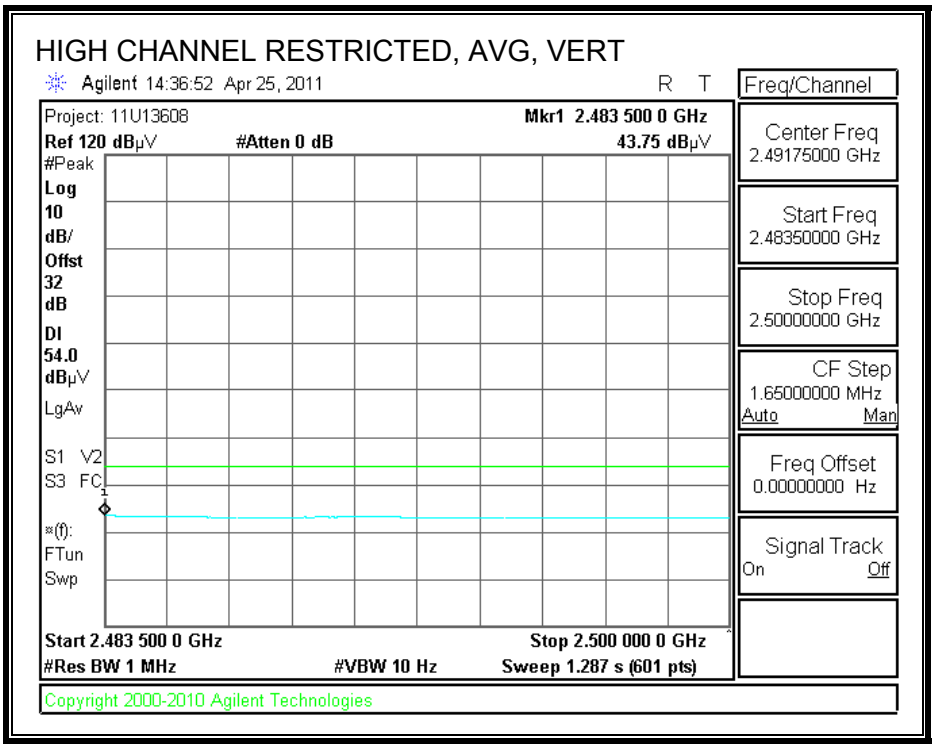
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 04/25/10
Project #: 11U13608
Company: Global Certification Corporation
Test Target: FCC 15.247
Mode Oper: Tx On, GFSK Modulation

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 Ch. 2402 MHz															
4.804	3.0	54.4	32.8	5.8	-34.8	0.0	0.0	58.1	74.0	-16.0	V	P	108.5	53.1	
4.804	3.0	32.1	32.8	5.8	-34.8	0.0	0.0	35.8	54.0	-18.2	V	A	108.5	53.1	
4.804	3.0	48.8	32.8	5.8	-34.8	0.0	0.0	52.5	74.0	-21.5	H	P	149.0	46.5	
4.804	3.0	29.9	32.8	5.8	-34.8	0.0	0.0	33.6	54.0	-20.4	H	A	149.0	46.5	
Mid Ch. 2441 MHz															
4.882	3.0	57.7	32.8	5.8	-34.9	0.0	0.0	61.5	74.0	-12.5	V	P	178.3	66.2	
4.882	3.0	32.5	32.8	5.8	-34.9	0.0	0.0	36.3	54.0	-17.7	V	A	178.3	66.2	
4.882	3.0	50.7	32.8	5.8	-34.9	0.0	0.0	54.5	74.0	-19.5	H	P	174.4	24.8	
4.882	3.0	29.5	32.8	5.8	-34.9	0.0	0.0	33.3	54.0	-20.7	H	A	174.4	24.8	
7.323	3.0	43.9	35.2	7.3	-34.7	0.0	0.0	51.7	74.0	-22.3	V	P	100.0	360.0	
7.323	3.0	29.2	35.2	7.3	-34.7	0.0	0.0	37.0	54.0	-17.0	V	A	100.0	360.0	
7.323	3.0	40.1	35.2	7.3	-34.7	0.0	0.0	47.9	74.0	-26.1	H	P	100.6	342.4	
7.323	3.0	27.7	35.2	7.3	-34.7	0.0	0.0	35.5	54.0	-18.5	H	A	100.6	342.4	
High Ch. 2480 MHz															
4.960	3.0	60.3	32.9	5.9	-34.9	0.0	0.0	64.2	74.0	-9.8	V	P	159.4	114.5	
4.960	3.0	33.0	32.9	5.9	-34.9	0.0	0.0	36.9	54.0	-17.1	V	A	159.4	114.5	
4.960	3.0	52.6	32.9	5.9	-34.9	0.0	0.0	56.5	74.0	-17.5	H	P	100.0	102.0	
4.960	3.0	30.0	32.9	5.9	-34.9	0.0	0.0	33.9	54.0	-20.1	H	A	100.0	102.0	
7.440	3.0	46.8	35.4	7.3	-34.6	0.0	0.0	54.9	74.0	-19.1	V	P	155.4	36.7	
7.440	3.0	30.9	35.4	7.3	-34.6	0.0	0.0	38.9	54.0	-15.1	V	A	155.4	36.7	
7.440	3.0	40.0	35.4	7.3	-34.6	0.0	0.0	48.1	74.0	-25.9	H	P	152.4	44.3	
7.440	3.0	27.6	35.4	7.3	-34.6	0.0	0.0	35.6	54.0	-18.4	H	A	152.4	44.3	

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

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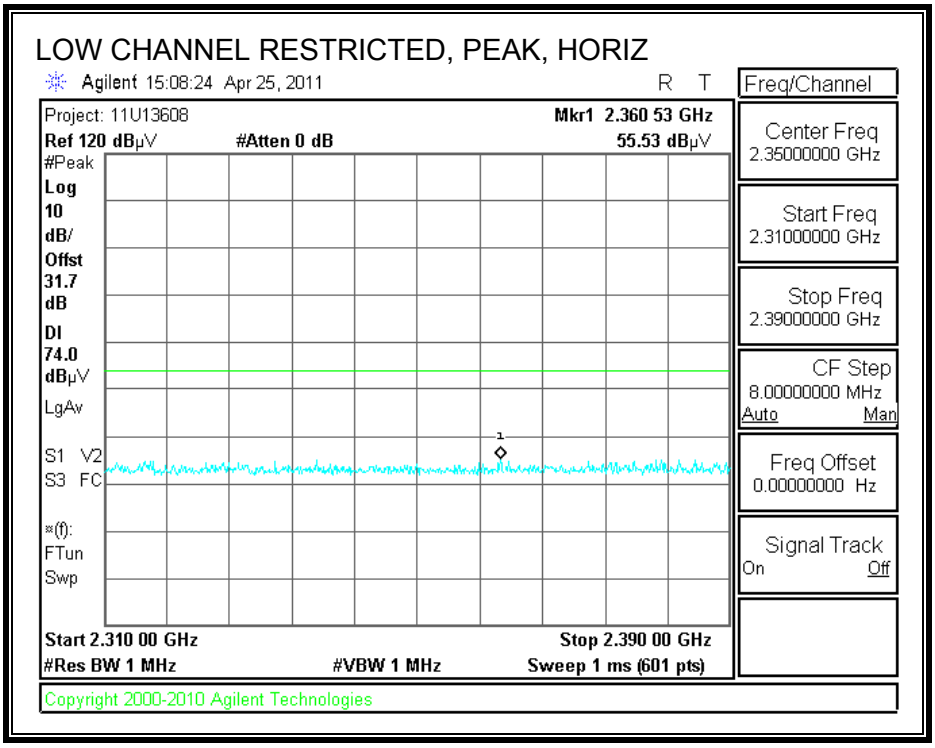
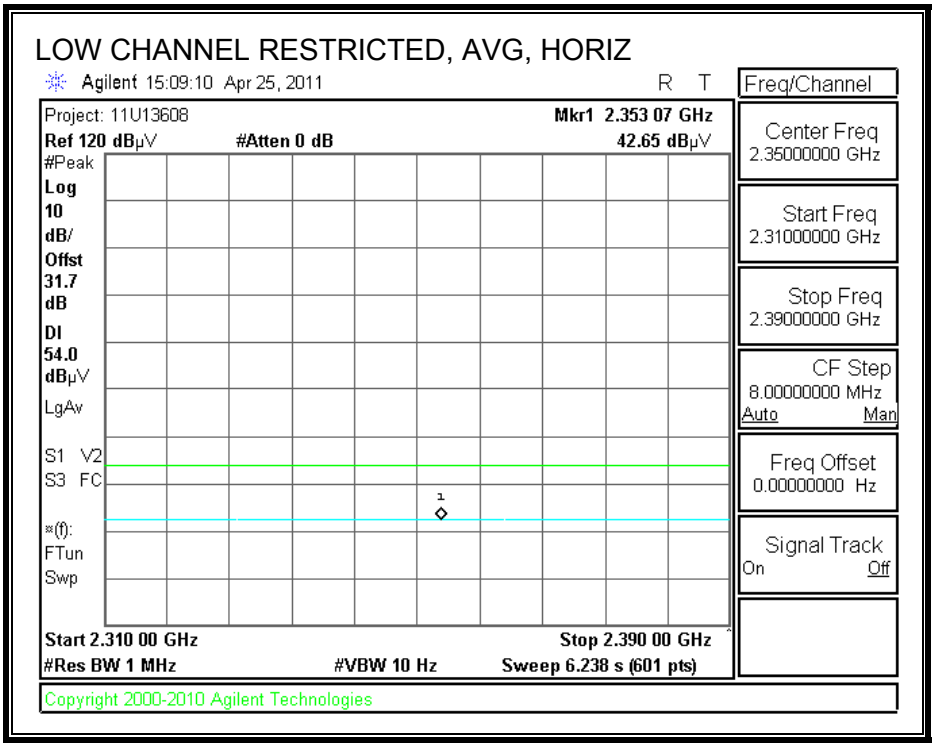
8.2.2. ENHANCED DATA RATE 8PSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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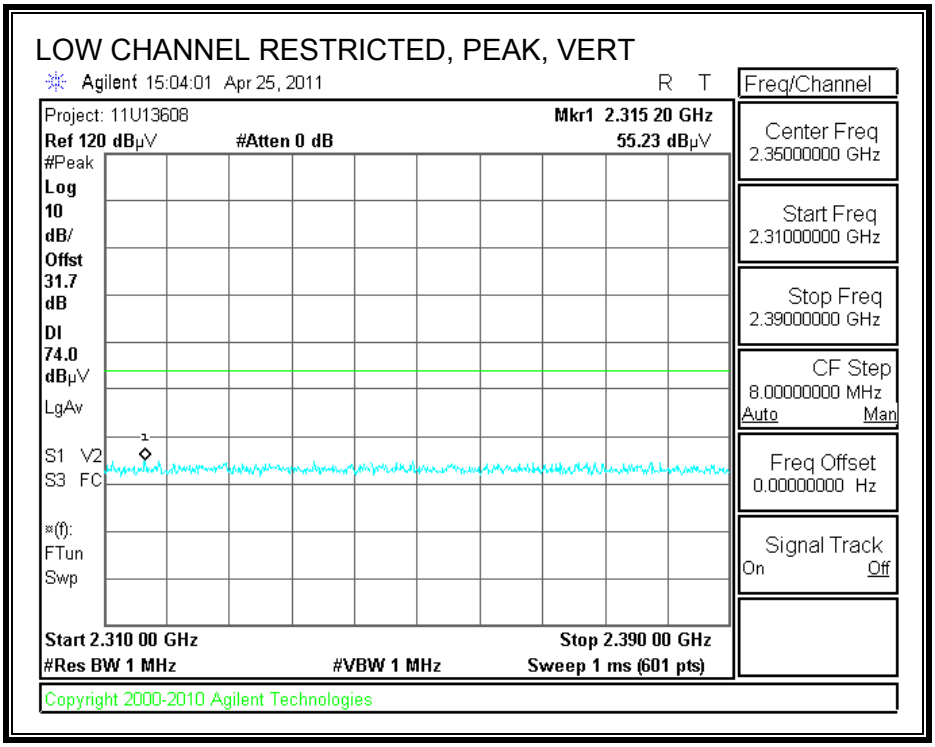
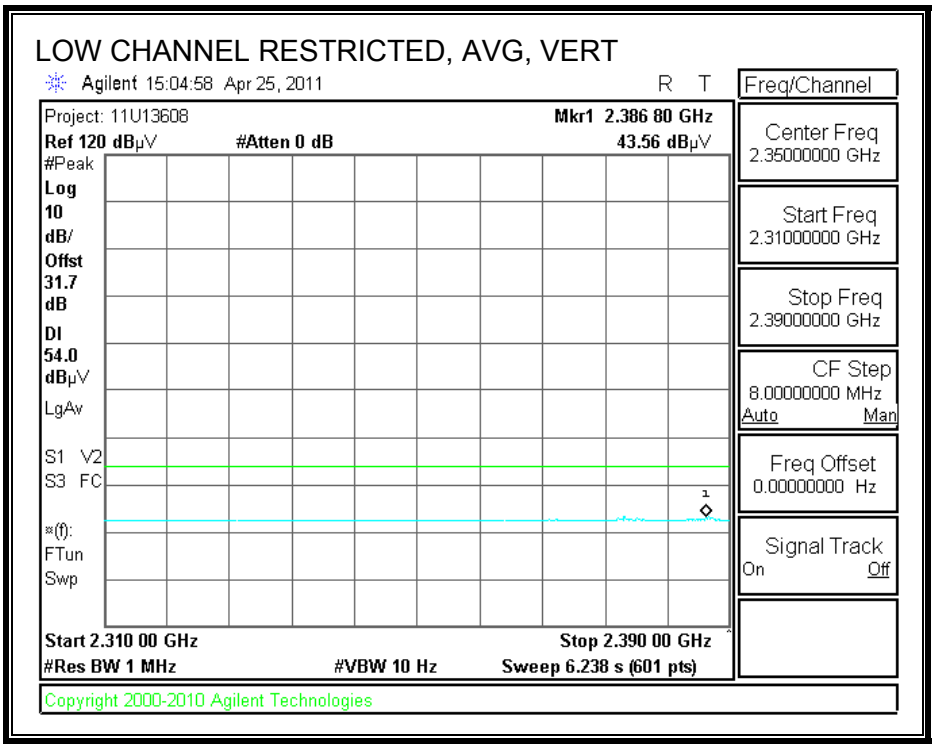
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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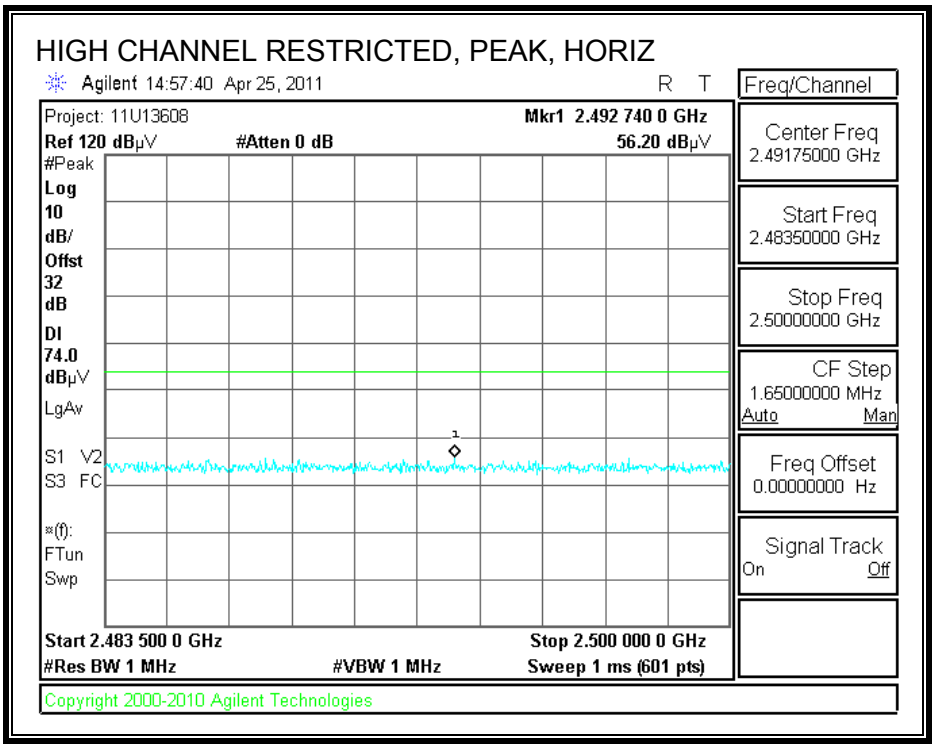
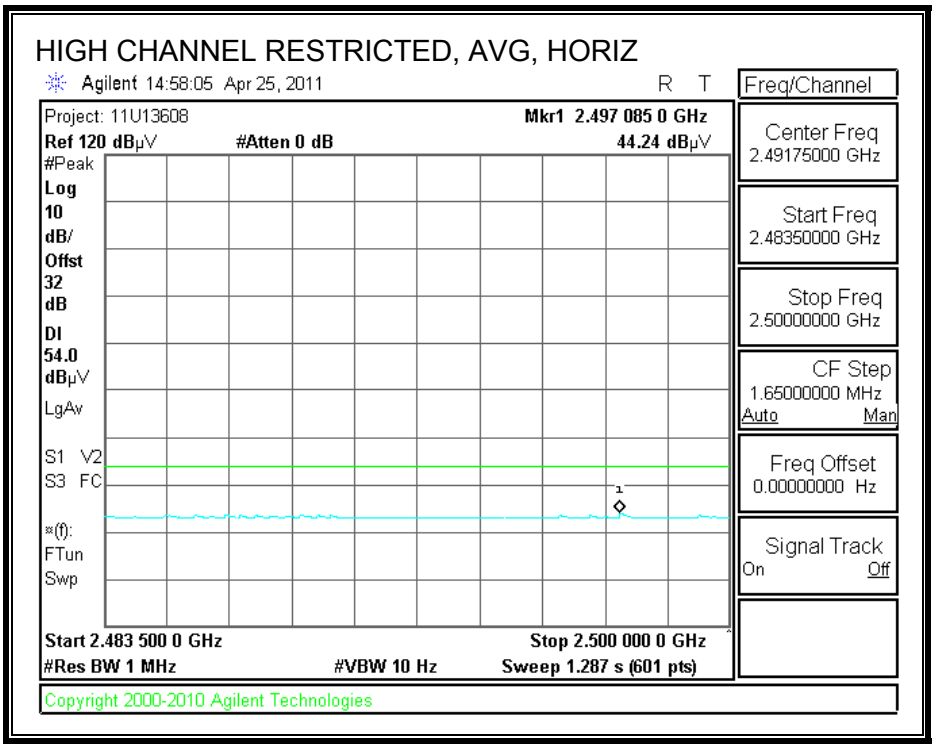
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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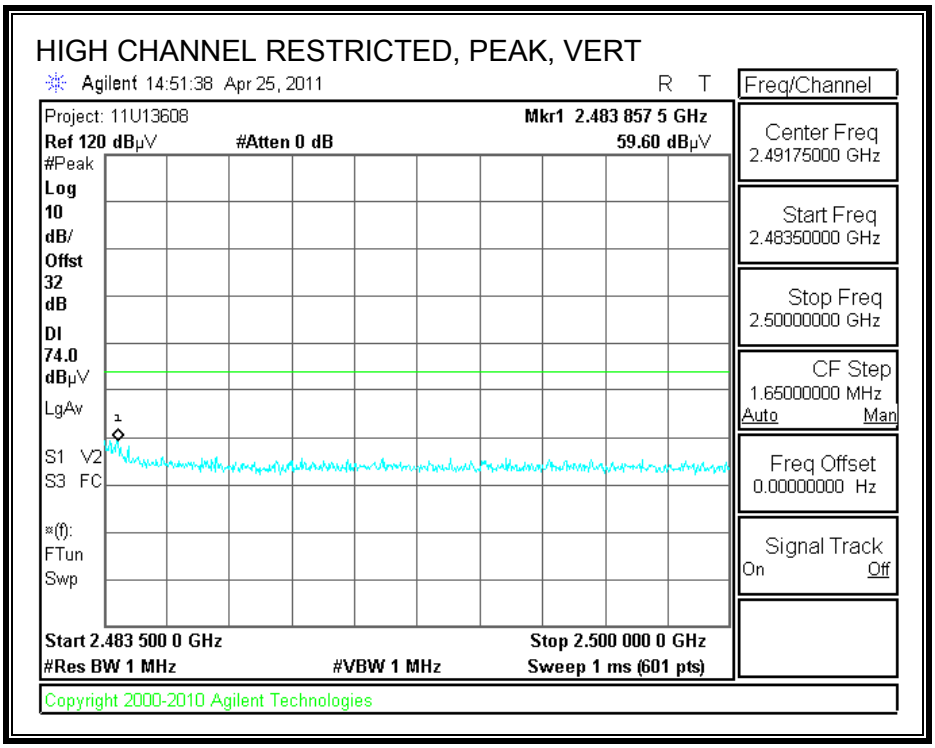
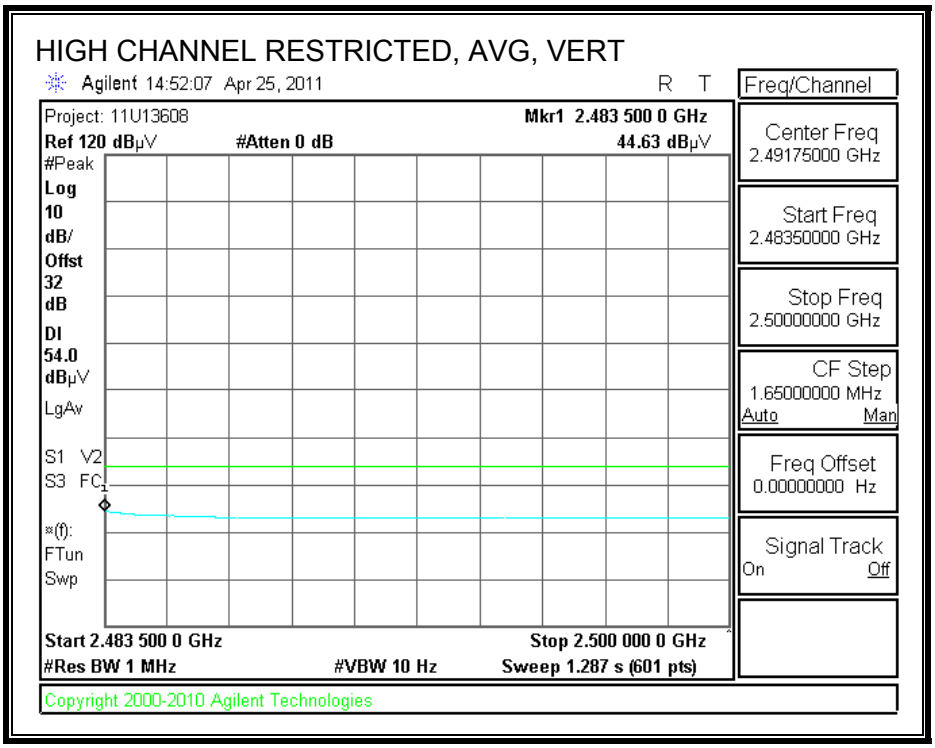
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 04/25/10
Project #: 11U13608
Company: Global Certification Corporation
Test Target: FCC 15.247
Mode Oper: Tx On, 8PSK Modulation

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

Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

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 Ch. 2402 MHz															
4.804	3.0	45.3	32.8	5.8	-34.8	0.0	0.0	49.0	74.0	-25.0	V	P	100.4	68.7	
4.804	3.0	28.6	32.8	5.8	-34.8	0.0	0.0	32.3	54.0	-21.7	V	A	100.4	68.7	
4.804	3.0	41.4	32.8	5.8	-34.8	0.0	0.0	45.1	74.0	-28.9	H	P	100.4	45.5	
4.804	3.0	26.9	32.8	5.8	-34.8	0.0	0.0	30.6	54.0	-23.4	H	A	100.4	45.5	
Mid Ch. 2441 MHz															
4.882	3.0	47.1	32.8	5.8	-34.9	0.0	0.0	50.9	74.0	-23.1	V	P	103.0	114.5	
4.882	3.0	27.6	32.8	5.8	-34.9	0.0	0.0	31.4	54.0	-22.6	V	A	103.0	114.5	
4.882	3.0	44.5	32.8	5.8	-34.9	0.0	0.0	48.3	74.0	-25.7	H	P	100.8	50.2	
4.882	3.0	27.2	32.8	5.8	-34.9	0.0	0.0	31.0	54.0	-23.0	H	A	100.8	50.2	
7.323	3.0	37.1	35.2	7.3	-34.7	0.0	0.0	44.9	74.0	-29.1	V	P	102.8	0.8	
7.323	3.0	26.2	35.2	7.3	-34.7	0.0	0.0	34.0	54.0	-20.0	V	A	102.8	0.8	
7.323	3.0	37.8	35.2	7.3	-34.7	0.0	0.0	45.7	74.0	-28.3	H	P	128.4	182.4	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	H	A	128.4	182.4	
High Ch. 2480 MHz															
4.960	3.0	50.4	32.9	5.9	-34.9	0.0	0.0	54.3	74.0	-19.7	V	P	100.4	113.4	
4.960	3.0	27.8	32.9	5.9	-34.9	0.0	0.0	31.7	54.0	-22.3	V	A	100.4	113.4	
4.960	3.0	44.5	32.9	5.9	-34.9	0.0	0.0	48.4	74.0	-25.6	H	P	100.0	106.2	
4.960	3.0	26.2	32.9	5.9	-34.9	0.0	0.0	30.1	54.0	-23.9	H	A	100.0	106.2	
7.440	3.0	36.7	35.4	7.3	-34.6	0.0	0.0	44.8	74.0	-29.2	V	P	194.1	357.4	
7.440	3.0	24.7	35.4	7.3	-34.6	0.0	0.0	32.8	54.0	-21.2	V	A	194.1	357.4	
7.440	3.0	37.1	35.4	7.3	-34.6	0.0	0.0	45.2	74.0	-28.8	H	P	100.6	214.1	
7.440	3.0	24.5	35.4	7.3	-34.6	0.0	0.0	32.6	54.0	-21.4	H	A	100.6	214.1	

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

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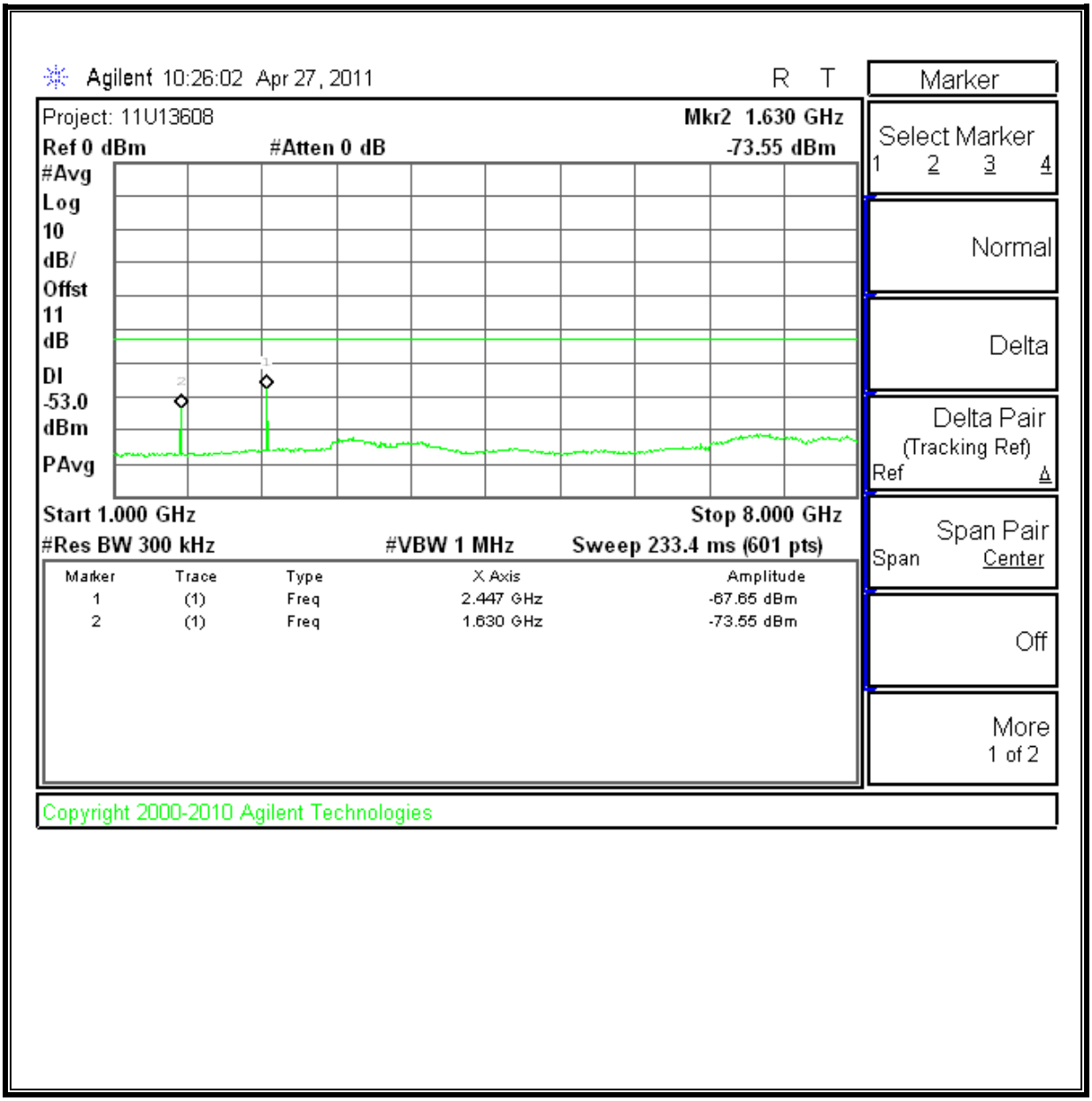
8.3. RECEIVER ABOVE 1 GHz



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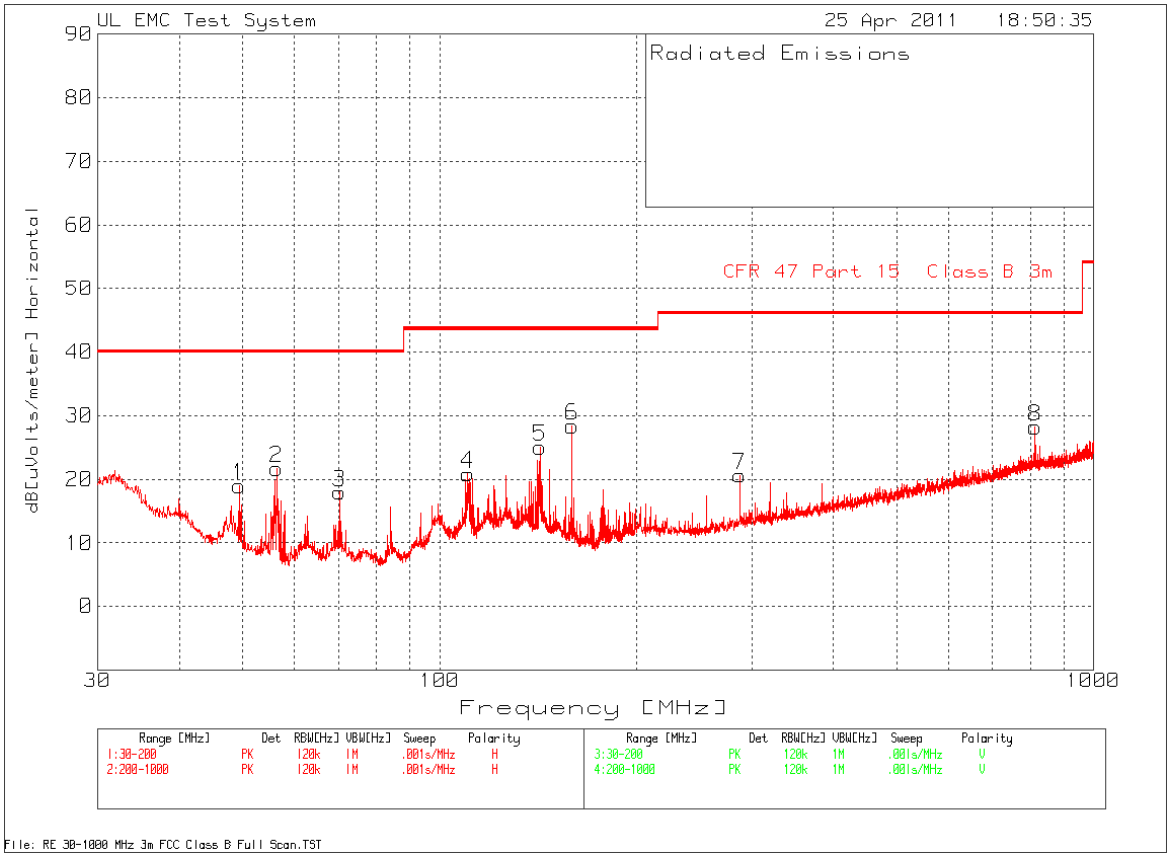
8.4. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



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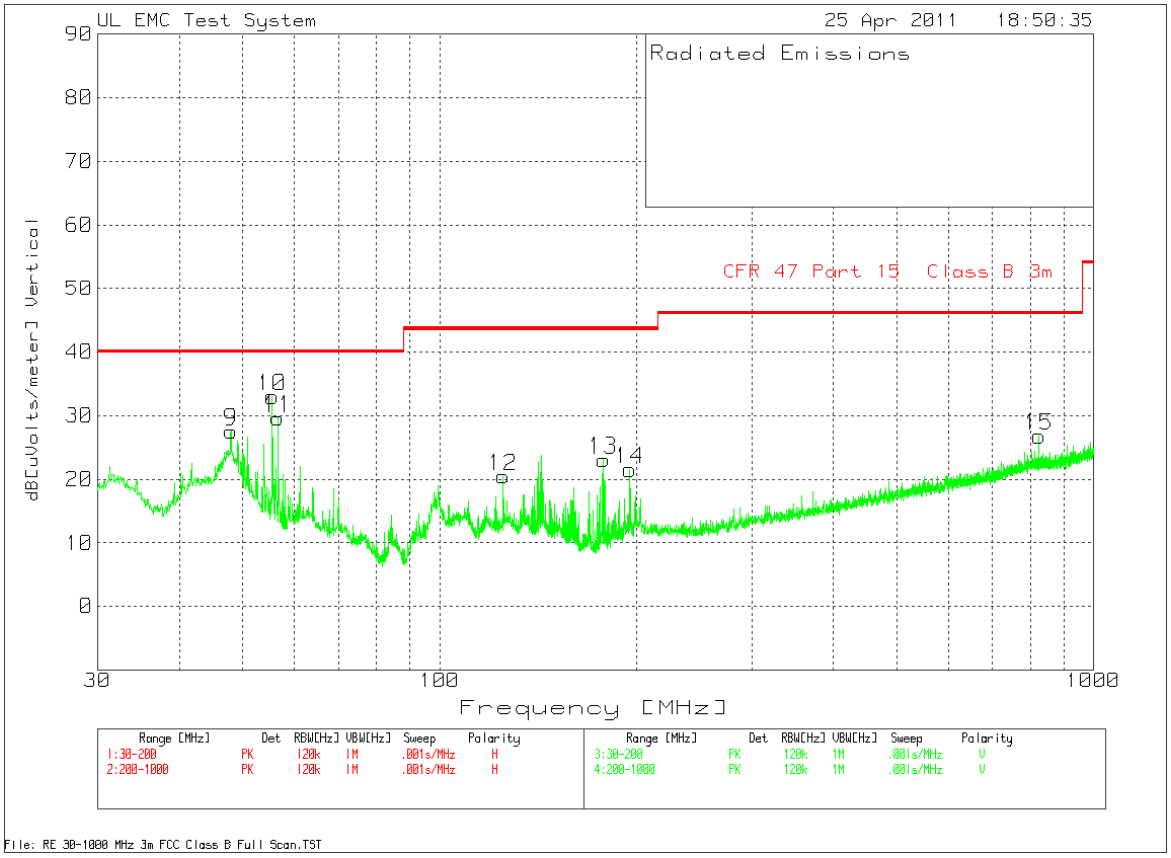
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



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HORIZONTAL AND VERTICAL DATA

Range 1 30 - 200MHz										
Test Frequency	Meter Reading	Detector	Chamber 5B Below 1GHz Cable.TX [dB]	T10 Below 1 GHz PreAmp. TXT [dB]	T130 Bilog Factors. TXT [dB]	dB[uVolts /meter]	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
49.3703	38.97	PK	1	-29.4	8.4	18.97	40	-21.03	300	Horz
56.3368	42.1	PK	1.1	-29.4	7.9	21.7	40	-18.3	300	Horz
70.3548	37.96	PK	1.2	-29.4	8.2	17.96	40	-22.04	400	Horz
110.3698	36.66	PK	1.5	-29.3	12	20.86	43.5	-22.64	400	Horz
142.3138	39.46	PK	1.7	-29.2	13.1	25.06	43.5	-18.44	200	Horz
159.3903	44.87	PK	1.7	-29.1	10.9	28.37	43.5	-15.13	200	Horz
Range 2 200 - 1000MHz										
Test Frequency	Meter Reading	Detector	Chamber 5B Below 1GHz Cable.TX [dB]	T10 Below 1 GHz PreAmp. TXT [dB]	T130 Bilog Factors. TXT [dB]	dB[uVolts /meter]	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
287.9414	33.95	PK	2.4	-28.6	12.9	20.65	46	-25.35	100	Horz
814.2572	32	PK	4	-28.9	21.1	28.2	46	-17.8	100	Horz
Range 3 30 - 200MHz										
Test Frequency	Meter Reading	Detector	Chamber 5B Below 1GHz Cable.TX [dB]	T10 Below 1 GHz PreAmp. TXT [dB]	T130 Bilog Factors. TXT [dB]	dB[uVolts /meter]	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
48.011	46.75	PK	1	-29.4	9.2	27.55	40	-12.45	109	Vert
55.4873	53.41	PK	1.1	-29.4	7.9	33.01	40	-6.99	109	Vert
56.5917	50.02	PK	1.1	-29.4	7.9	29.62	40	-10.38	109	Vert
125.0675	34.25	PK	1.6	-29.2	13.8	20.45	43.5	-23.05	109	Vert
177.996	39.79	PK	1.8	-29	10.5	23.09	43.5	-20.41	109	Vert
195.4123	36.92	PK	1.9	-28.9	11.6	21.52	43.5	-21.98	109	Vert
Range 4 200 - 1000MHz										
Test Frequency	Meter Reading	Detector	Chamber 5B Below 1GHz Cable.TX [dB]	T10 Below 1 GHz PreAmp. TXT [dB]	T130 Bilog Factors. TXT [dB]	dB[uVolts /meter]	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
825.1832	30.5	PK	4	-28.8	21.1	26.8	46	-19.2	100	Vert

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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.

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RESULTS

6 WORST EMISSIONS

Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	LISN [dB]	Conducted Emission Cable [dB]	dB[uVolts]	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.195	40.95	PK	0	0	40.95	63.8	-22.85	53.8	-12.85
0.195	25.16	Av	0	0	25.16	-	-	53.8	-28.64
0.8205	45.92	PK	0	0	45.92	56	-10.08	46	-0.08
0.8205	24.48	Av	0	0	24.48	-	-	46	-21.52
1.9545	39.88	PK	0	0	39.88	56	-16.12	46	-6.12
1.9545	17.09	Av	0	0	17.09	-	-	46	-28.91
Line-L2 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	LISN [dB]	Conducted Emission Cable [dB]	dB[uVolts]	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.249	54.55	PK	0	0.1	54.65	61.8	-7.15	51.8	2.85
0.249	38.84	Av	0	0.1	38.94	-	-	51.8	-12.86
0.3975	53.56	PK	0	0.1	53.66	57.9	-4.24	47.9	5.76
0.3975	38.59	Av	0	0.1	38.69	-	-	47.9	-9.21
0.6765	53.19	PK	0	0.1	53.29	56	-2.71	46	7.29
0.6765	35.02	Av	0	0.1	35.12	-	-	46	-10.88

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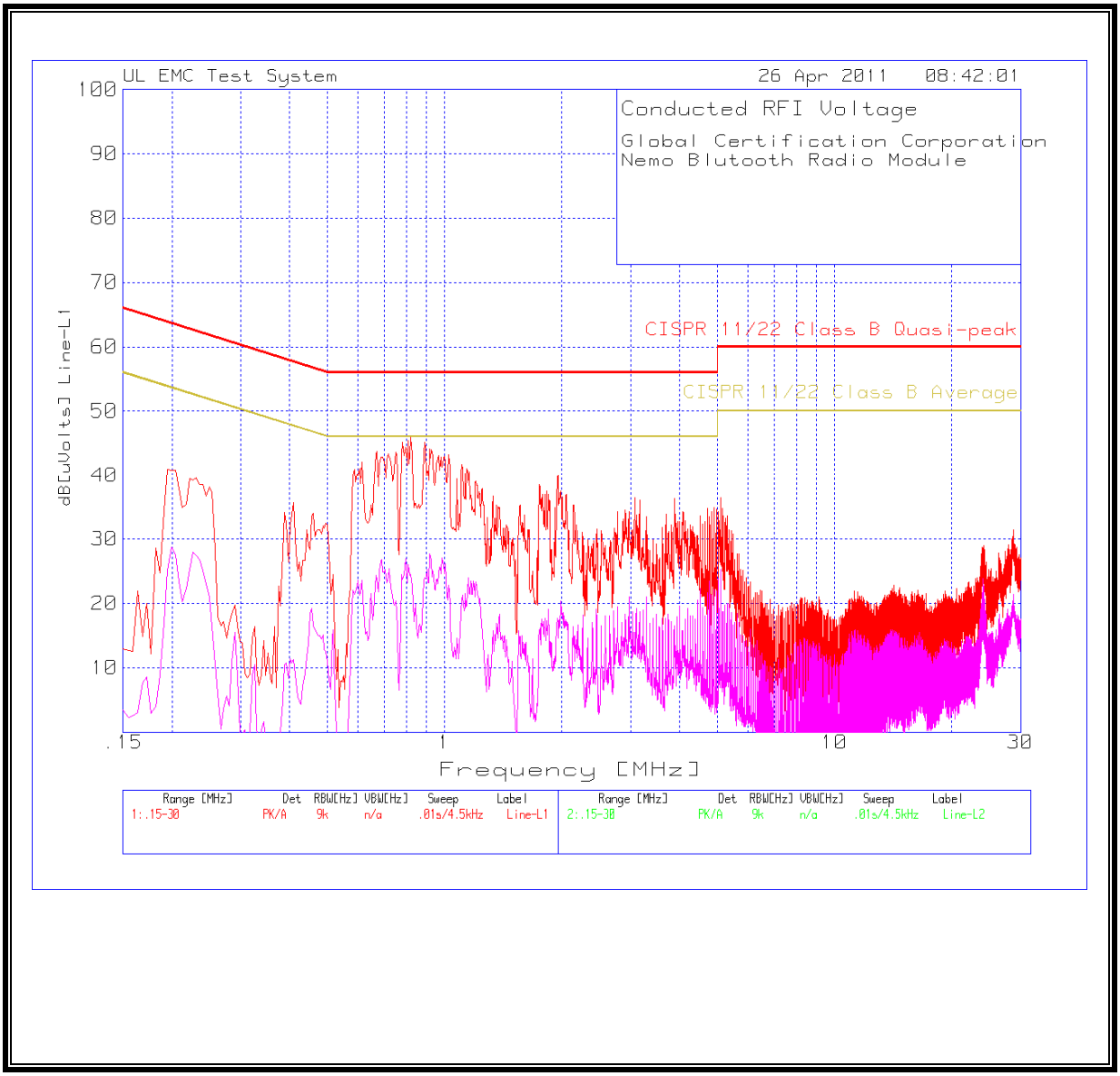
LINE 1 RESULTS



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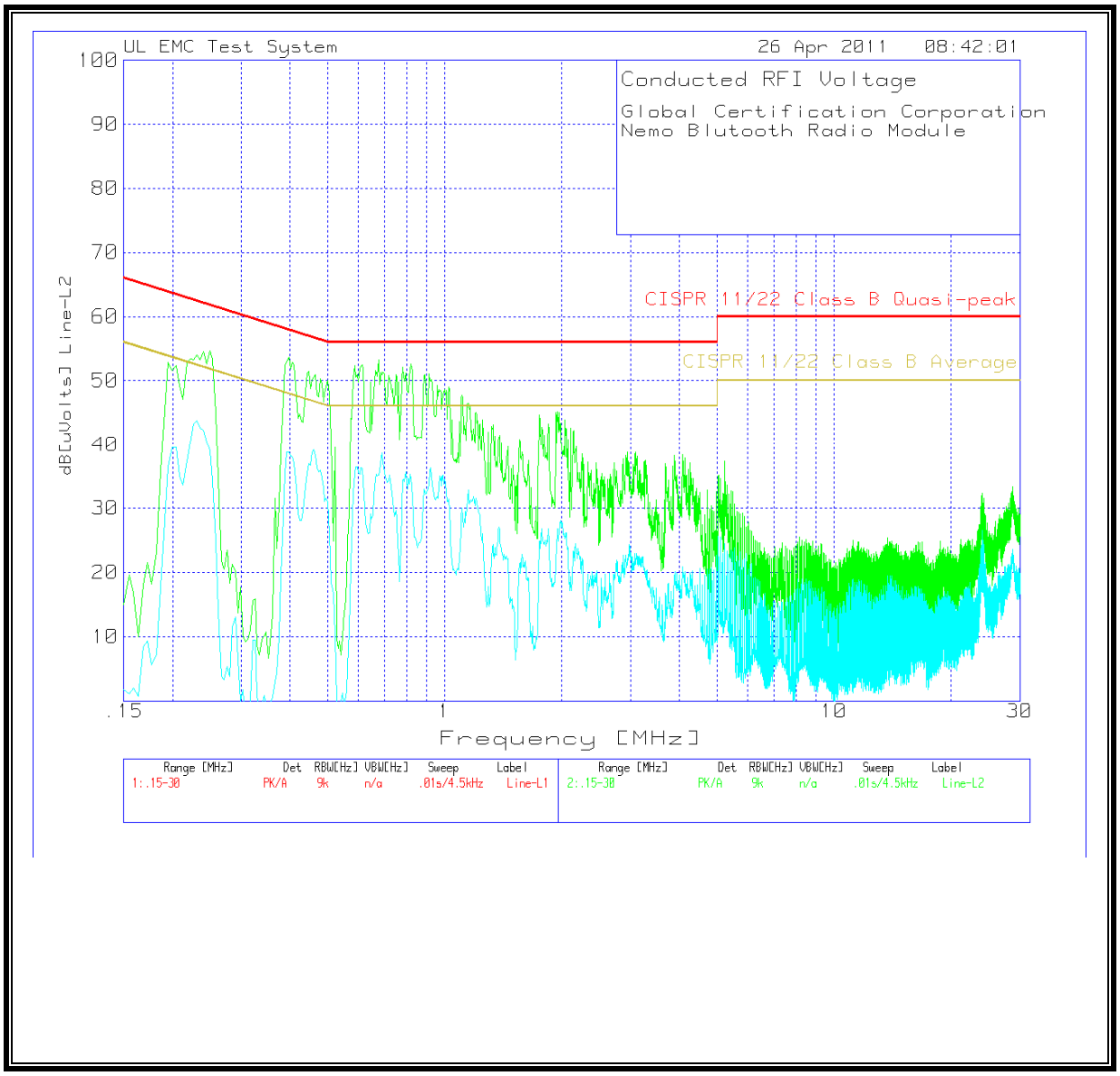
LINE 2 RESULTS



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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.

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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).

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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

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RESULTS

Band	Mode	Separation Distance (m)	Output AV Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
2.4 GHz	Bluetooth	0.20	8.59	2.00	0.02	0.002

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