FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 7

CERTIFICATION TEST REPORT

FOR

802.11 bgn + BT 2.1 (EDR)

MODEL NUMBER: A1367

FCC ID: BCG-E2407
IC: 579C-E2407

REPORT NUMBER: 10U13294-2

ISSUE DATE: JULY 20, 2010

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

Prepared by
COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	07/20/2010	Initial Issue	T. Chan

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11 bgn + BT 2.1 (EDR)

MODEL: A1367

SERIAL NUMBER: A0551 (Radiated Unit); 0429 (Conducted Unit)

DATE TESTED: JULY 11-15, 2010

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (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 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by 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 CCS By:

THU CHAN
ENGINEERING MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

CHIN PANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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 Apple Model Number A1367 is an iPod Touch product. This is a handheld touch screen iPod music device with 802.11b/g/n and Bluetooth radio functions. The A1367 measures 110.8 mm (4.362 inches) long x 58.9 mm (2.318 inches) wide x 7.2 mm (0.283 inches) thick and weighs 99.2 grams (3.5 oz.). The rechargeable battery is not user accessible. The Apple A1367 comes with one of three memory configurations, 8 / 16 / 32 / 64 Giga Bytes for storing music, video or data. The Apple A1367 function is fully compatible with Apple's iTunes software. The Apple A1367 in box materials include; Apple ear buds (no microphone), and 30 pin to USB cable.

The radio module is manufactured by Murata.

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	11.93	15.60
2402 - 2480	Enhanced QPSK	13.36	21.68
2402 - 2480	Enhanced 8PSK	11.41	13.84

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of 0.38 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Baker 8B 72.

The test utility software used during testing was Bluetooth Test Mode with CBT.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-position was the EUT with highest emissions. To determine the worst-case, the EUT was investigated for X, Y, and Z-Positions, and the worst position among X, Y, and Z with AC/DC adapter. After the investigations Y-position without AC/DC adapter turns out to be the worst-case.

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

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
BT Tester	Rohde & Schwarz	CBT	12/17/2174	NA
Splitter	NA	NA	NA	NA
Omni-Directional	D-link	ANT24-0400	EMOS159001360	NA

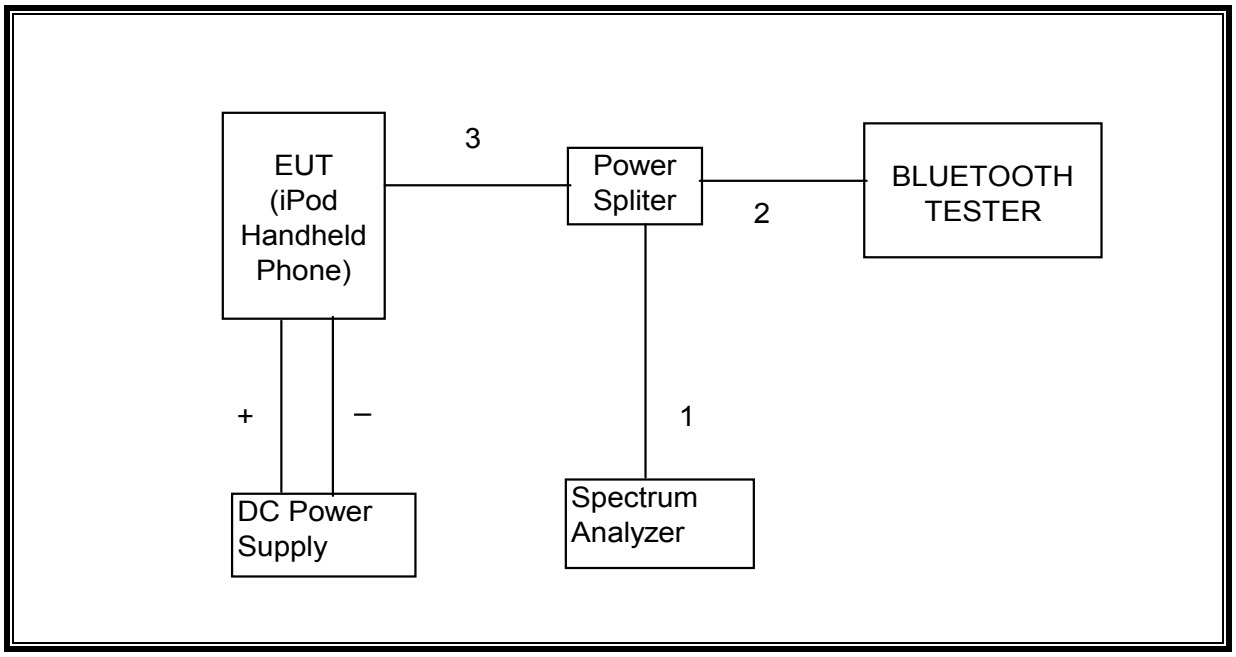
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	In/Out	1	N-Type	Shielded	2m	NA
2	In/Out	1	N-Type	Shielded	2m	NA
3	Antenna Port	1	SMA	Un-shielded	1.2m	NA
4	In/Out	1	SMA	Un-shielded	2m	NA

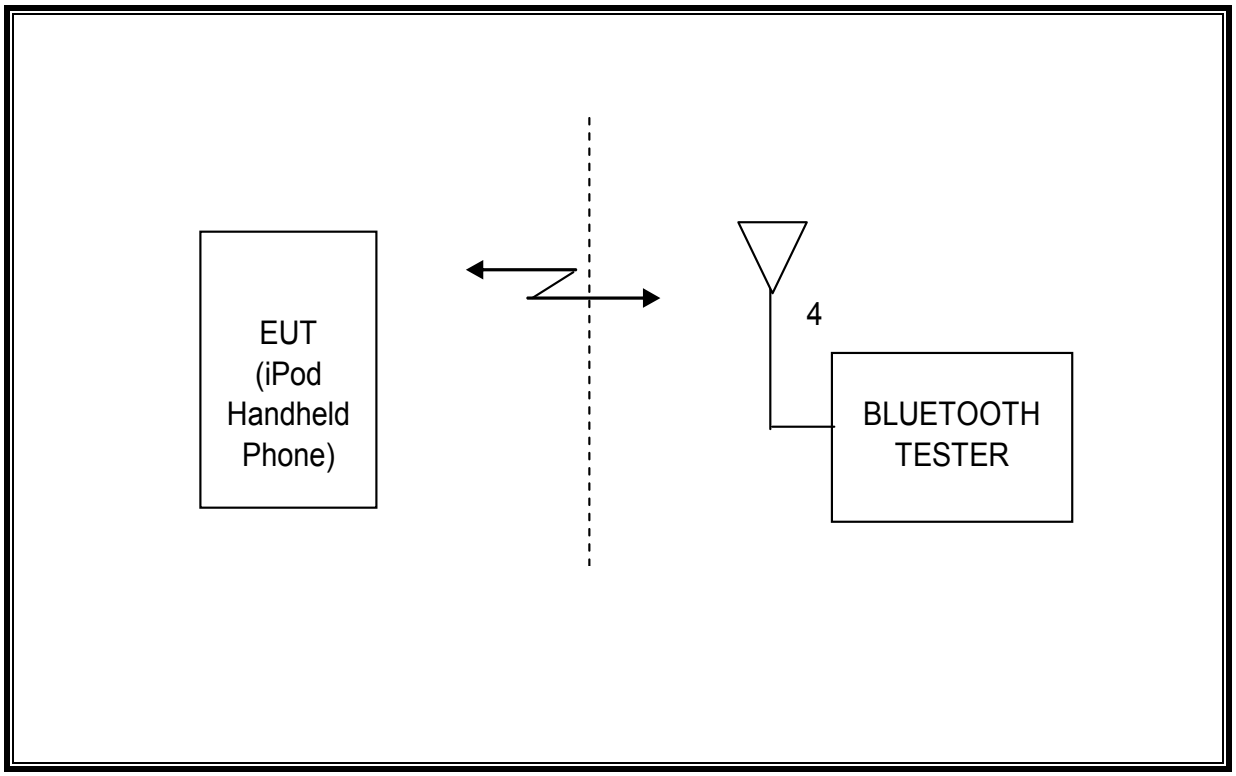
TEST SETUP

The EUT is linked to a Bluetooth Tester during the tests.

SETUP DIAGRAM FOR TESTS (CONDUCTED SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED SETUP)



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	C01178	08/31/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	08/04/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/14/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	07/06/11
Antenna, Horn, 18 GHz	EMCO	3115	C00783	07/29/10
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/06/10
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	01/07/12
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/11
Peak Power Meter	Boonton	4541	C01189	02/26/11
Peak Power Sensor	Boonton	57318	C01202	02/23/11
Bluetooth Test	R&S	CBT	NA	05/01/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR

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.

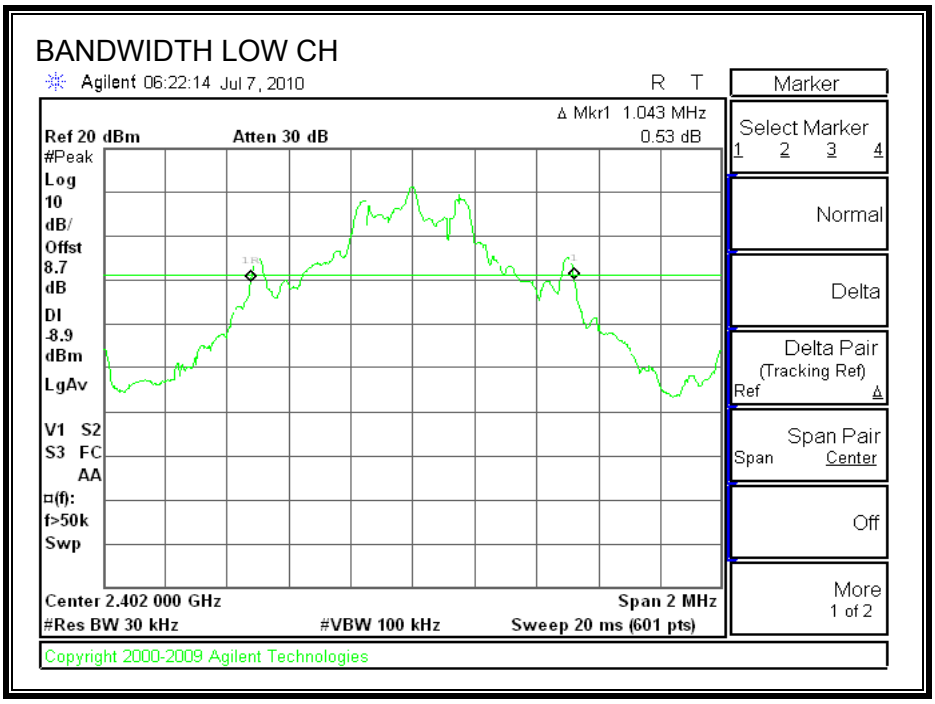
TEST PROCEDURE

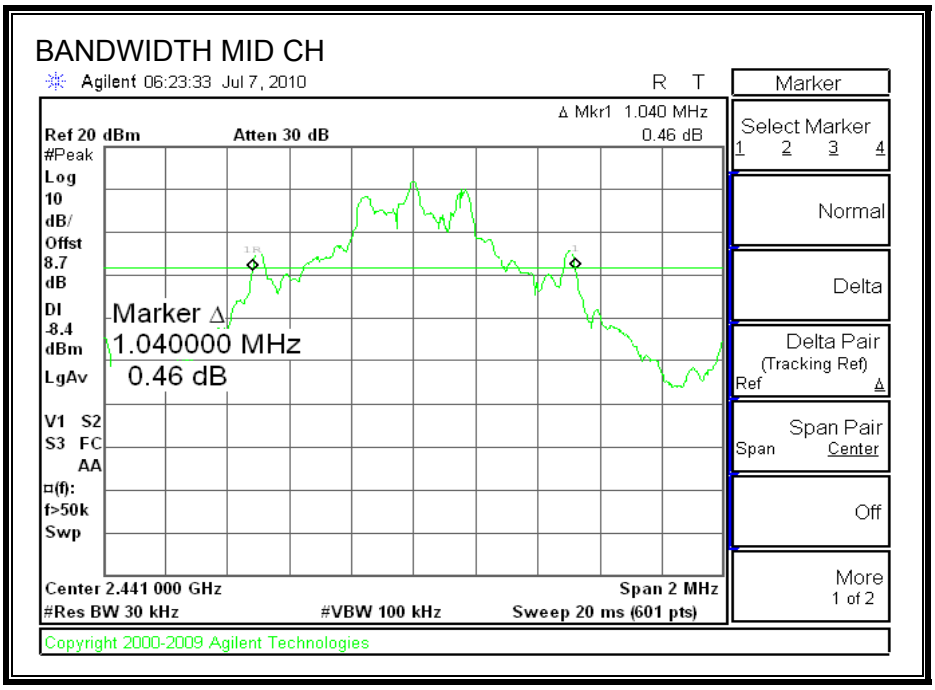
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

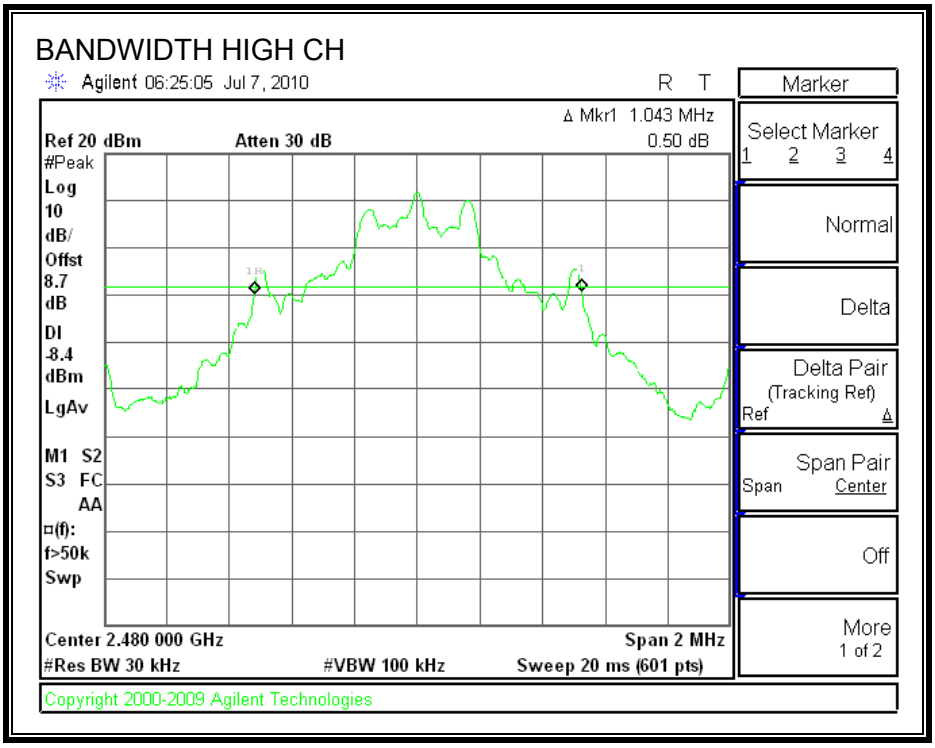
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.043	1.0186
Middle	2441	1.040	1.0204
High	2480	1.043	1.0219

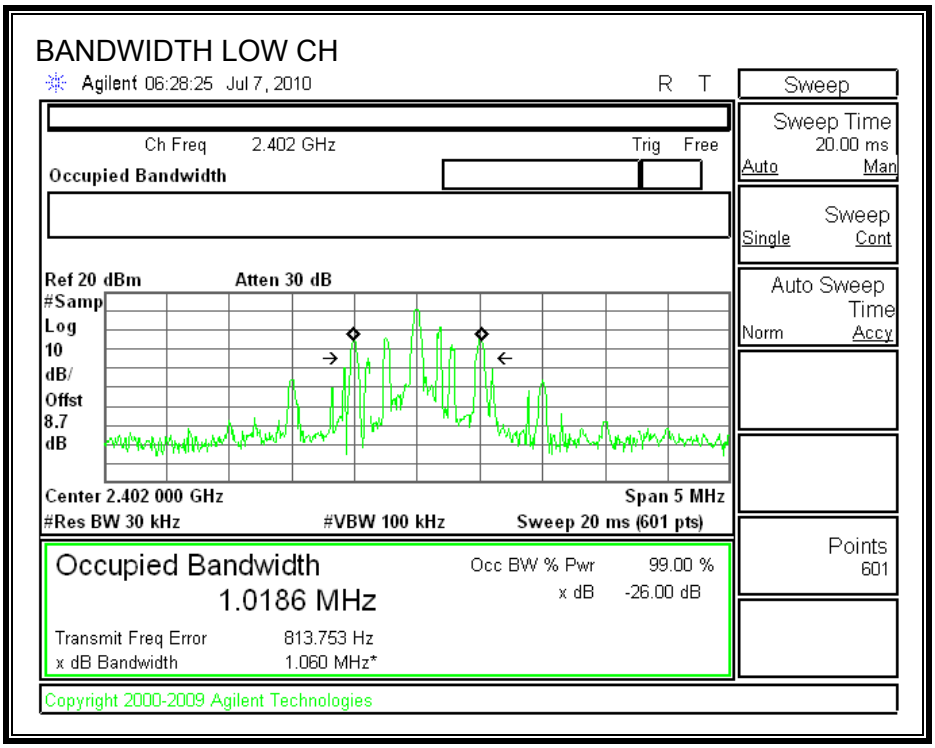
20 dB BANDWIDTH

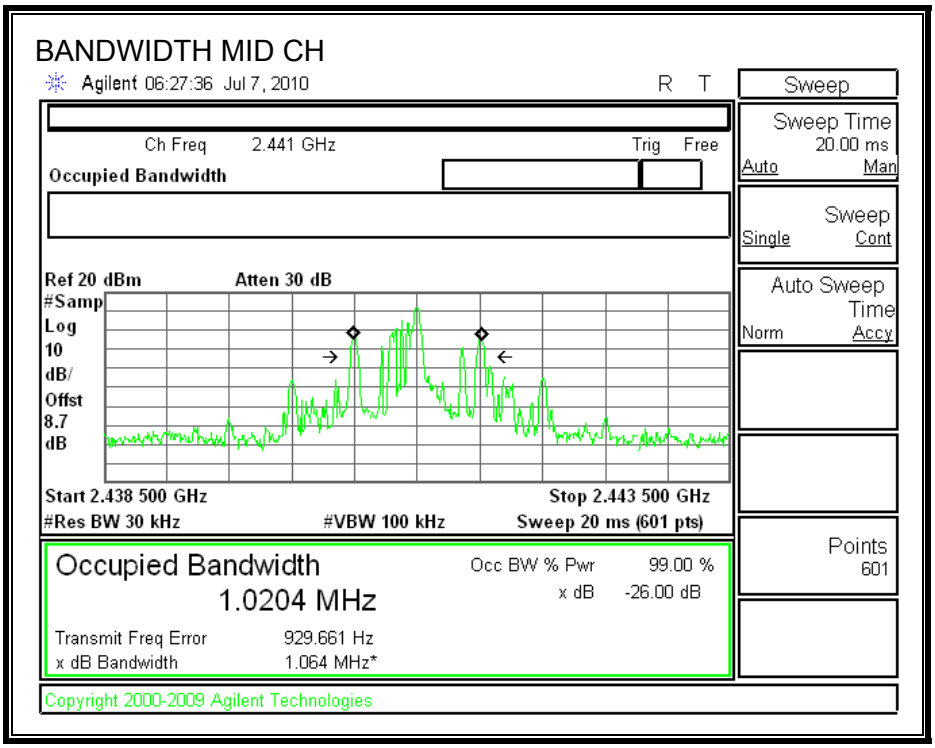


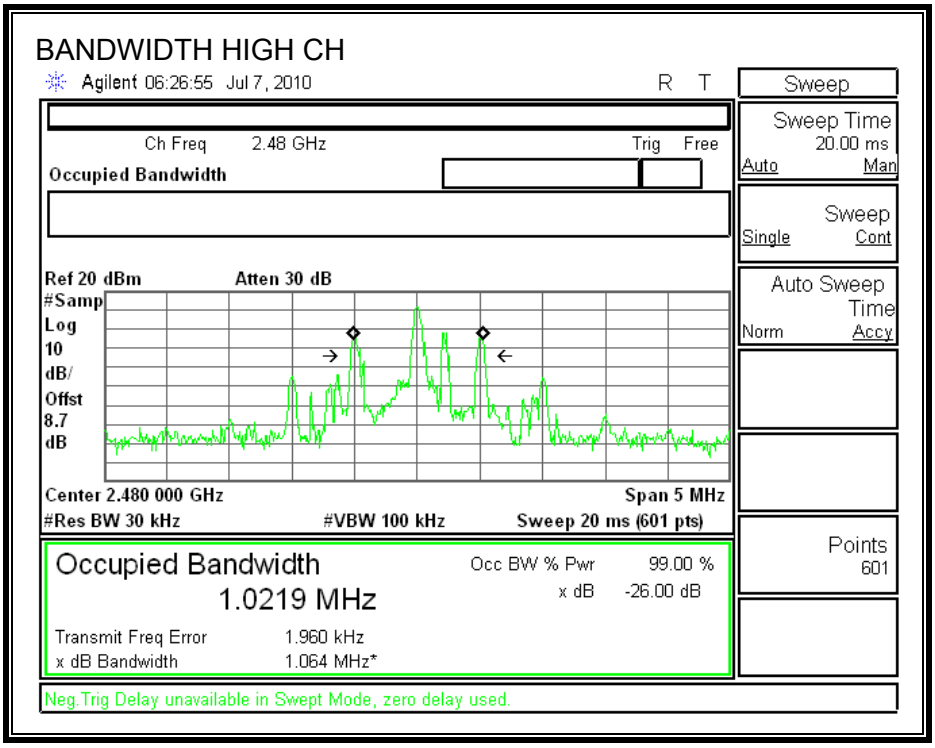




99% BANDWIDTH







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.

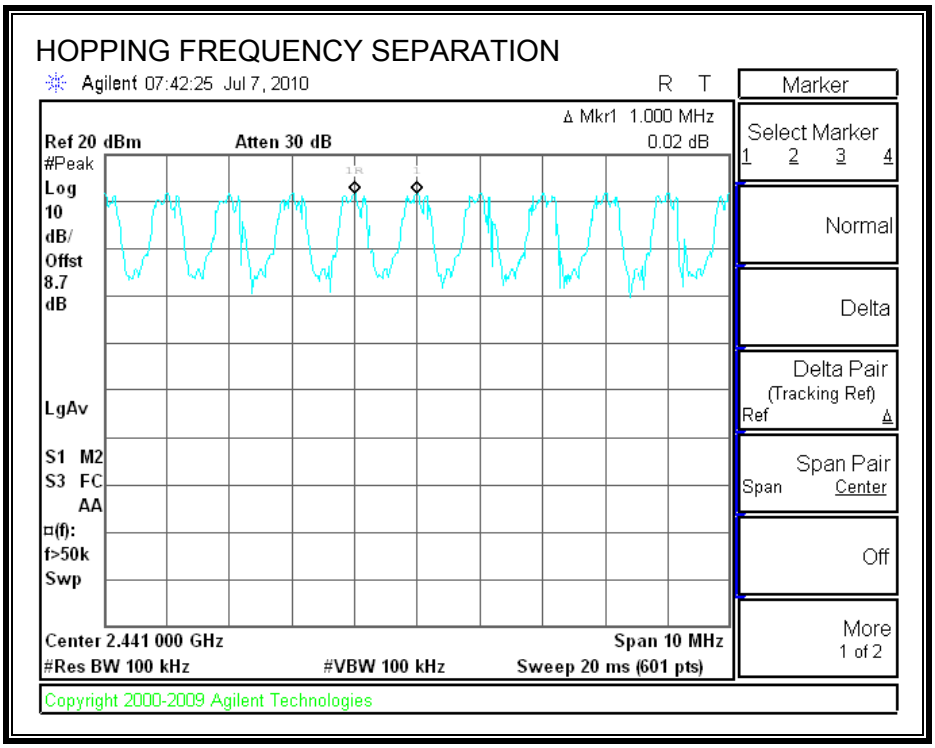
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



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

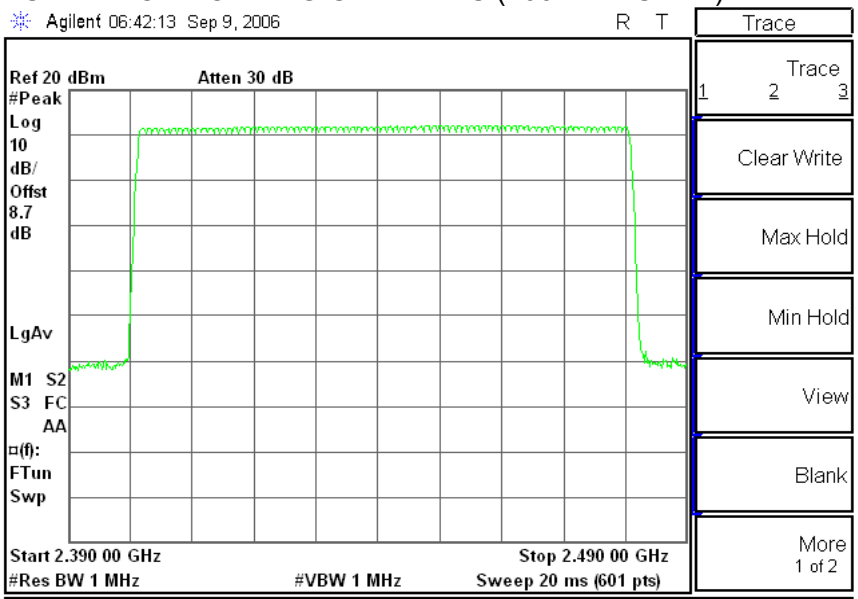
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

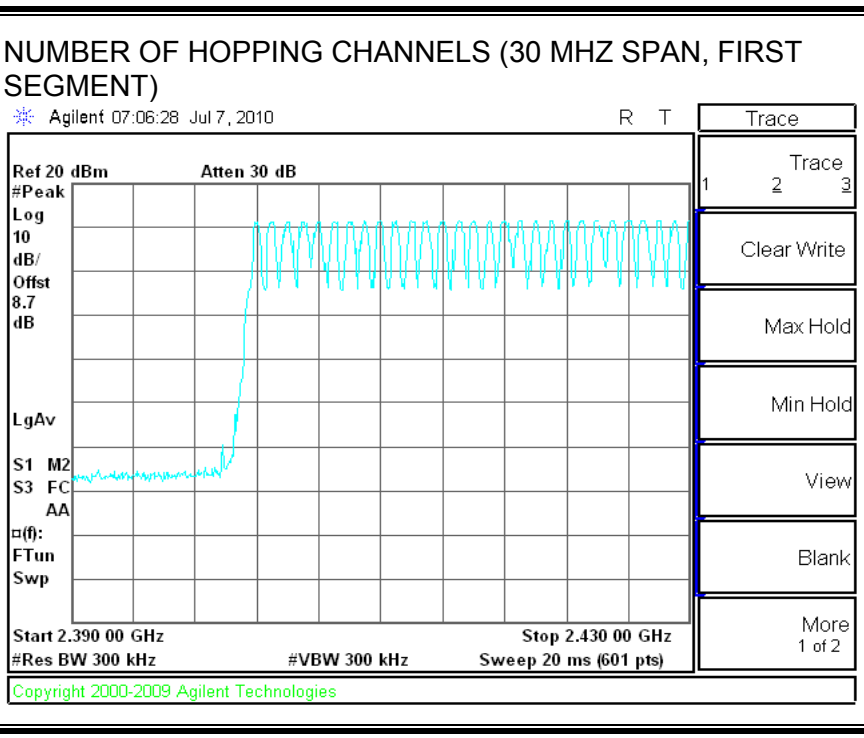
79 Channels observed.

NUMBER OF HOPPING CHANNELS

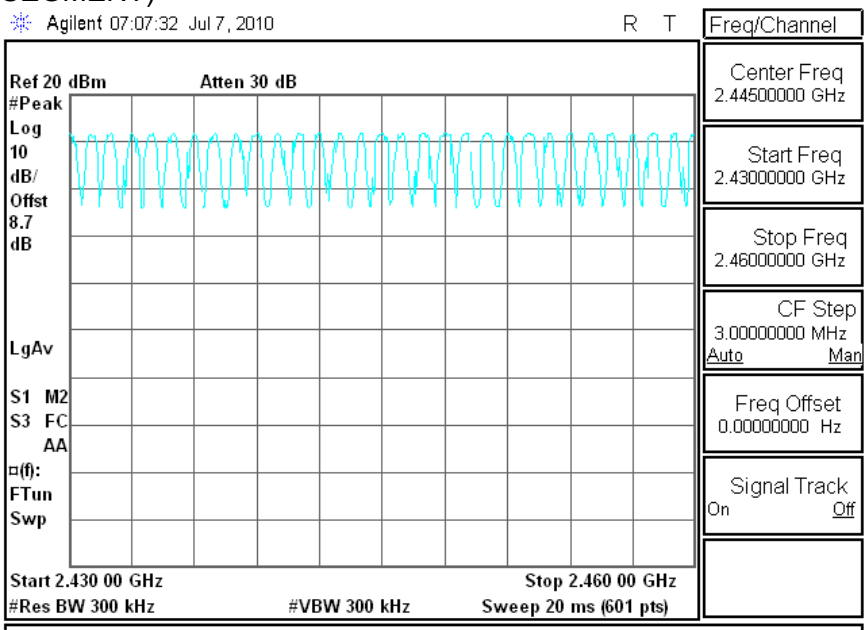
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



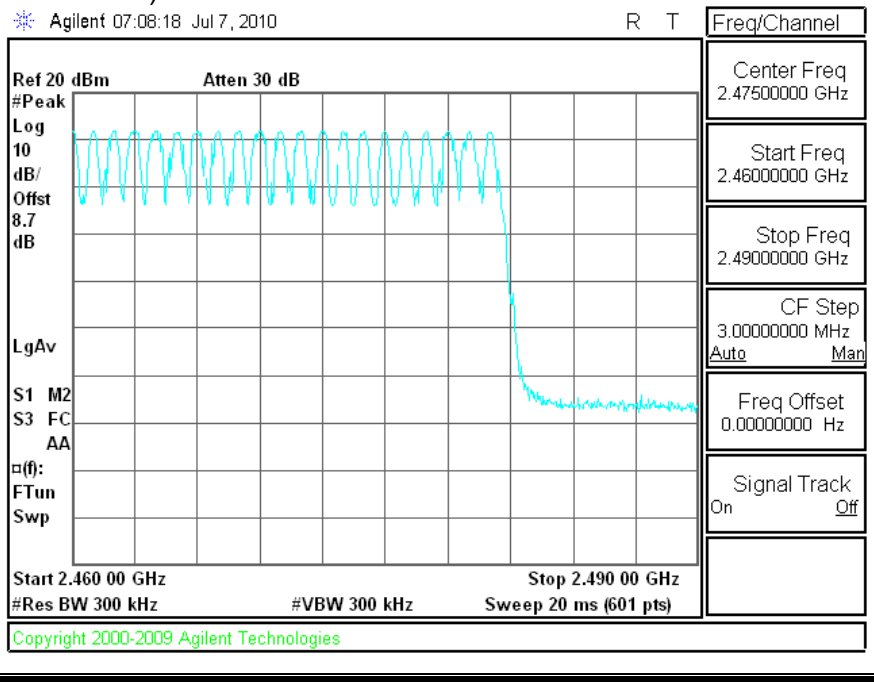
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



7.1.4. 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.

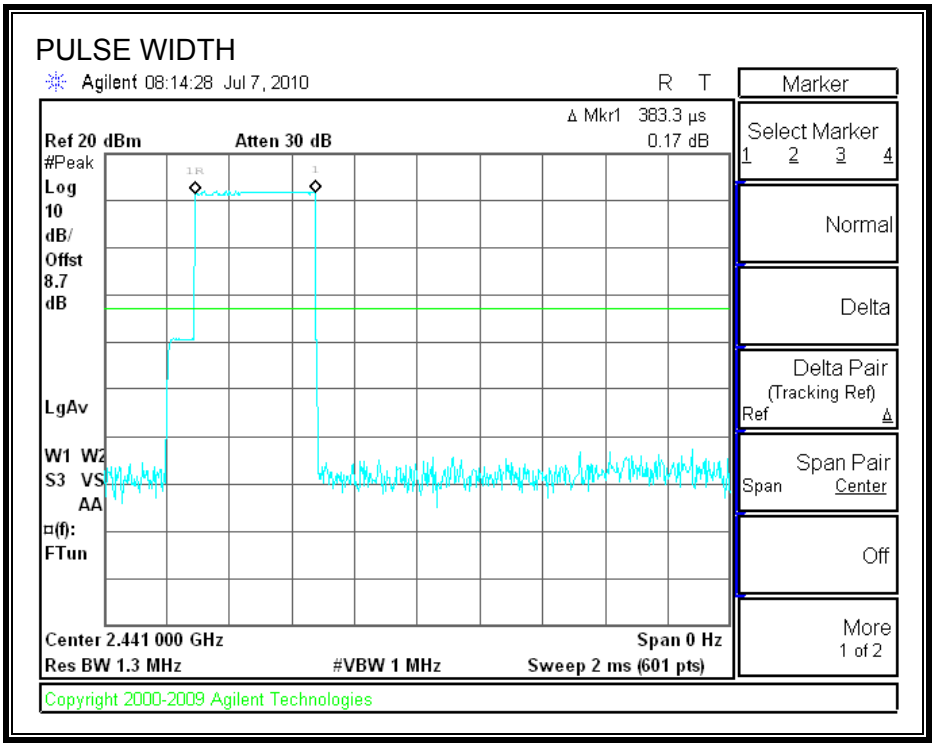
RESULTS

GFSK Mode

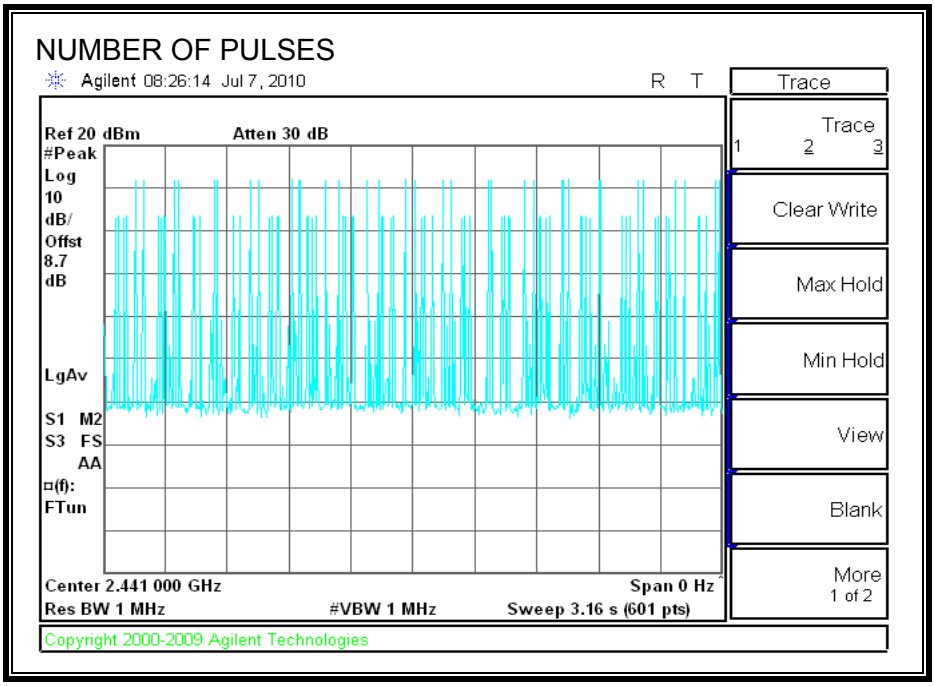
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.383	34	0.130	0.4	0.270
DH3	1.633	15	0.245	0.4	0.155
DH5	2.883	12	0.346	0.4	0.054

DH1

PULSE WIDTH

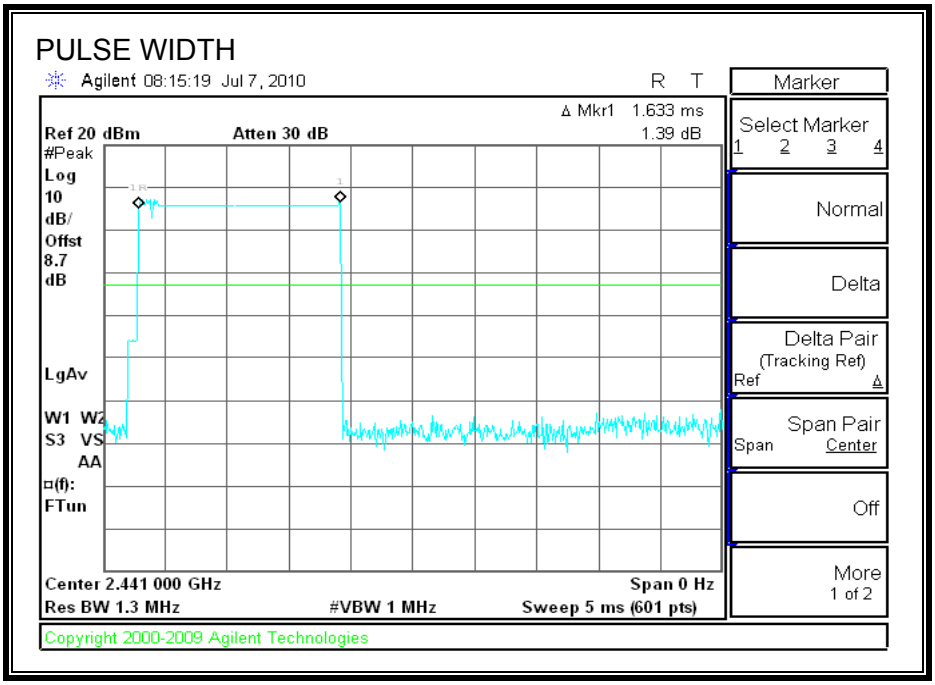


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

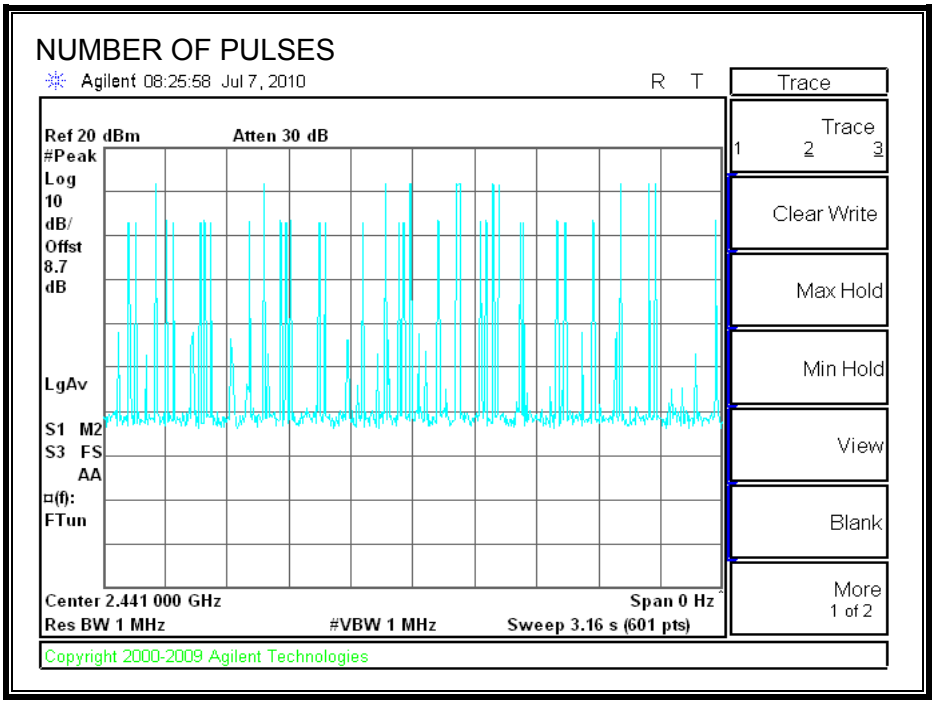


DH3

PULSE WIDTH

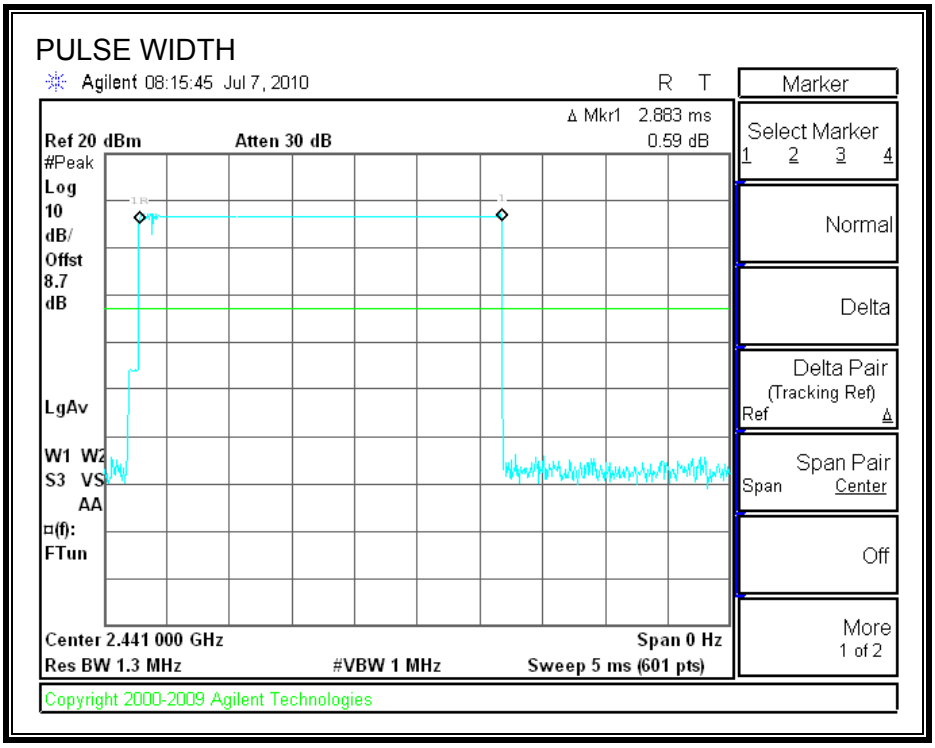


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

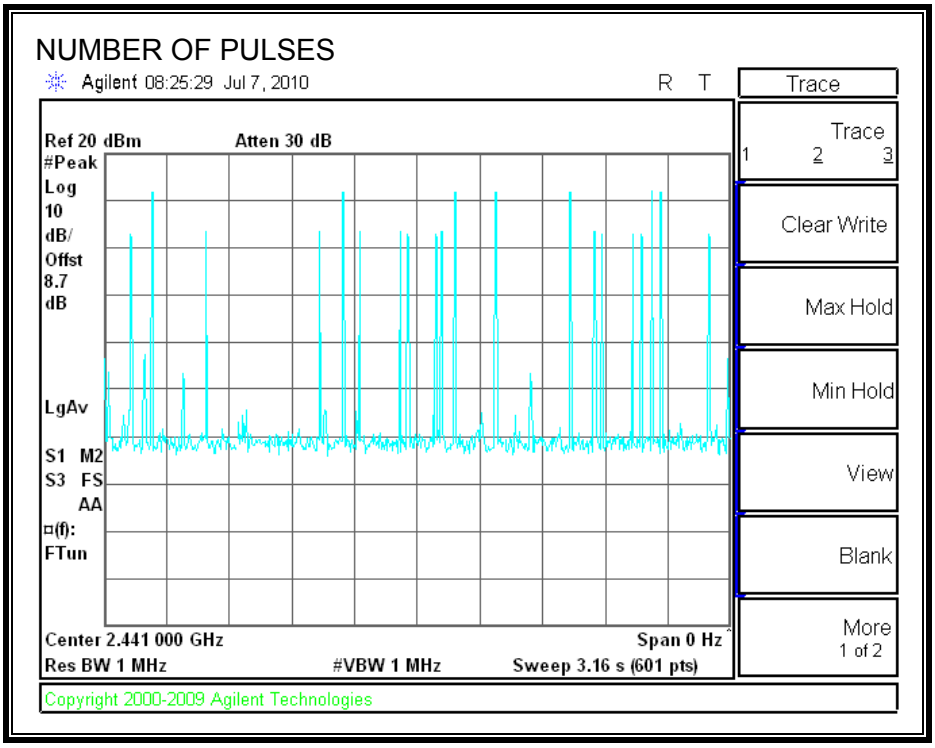


DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.1.5. 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.

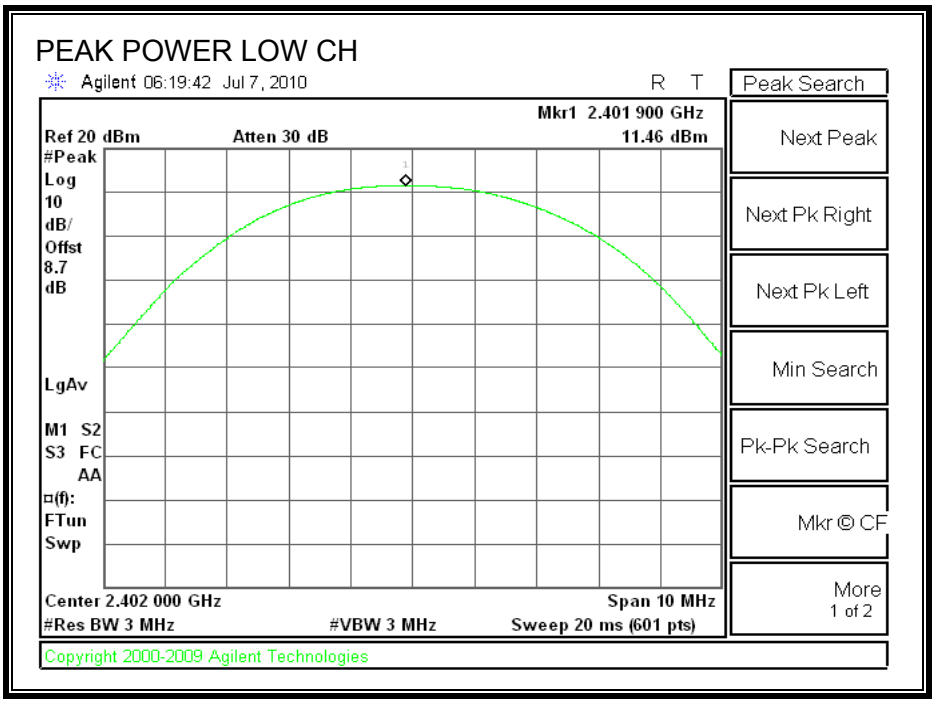
TEST PROCEDURE

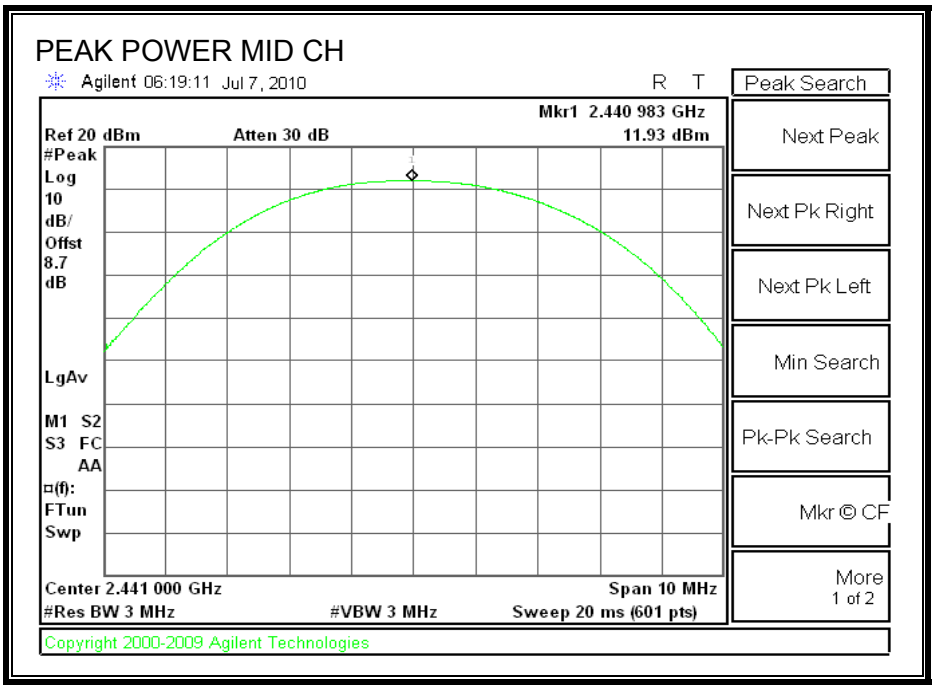
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

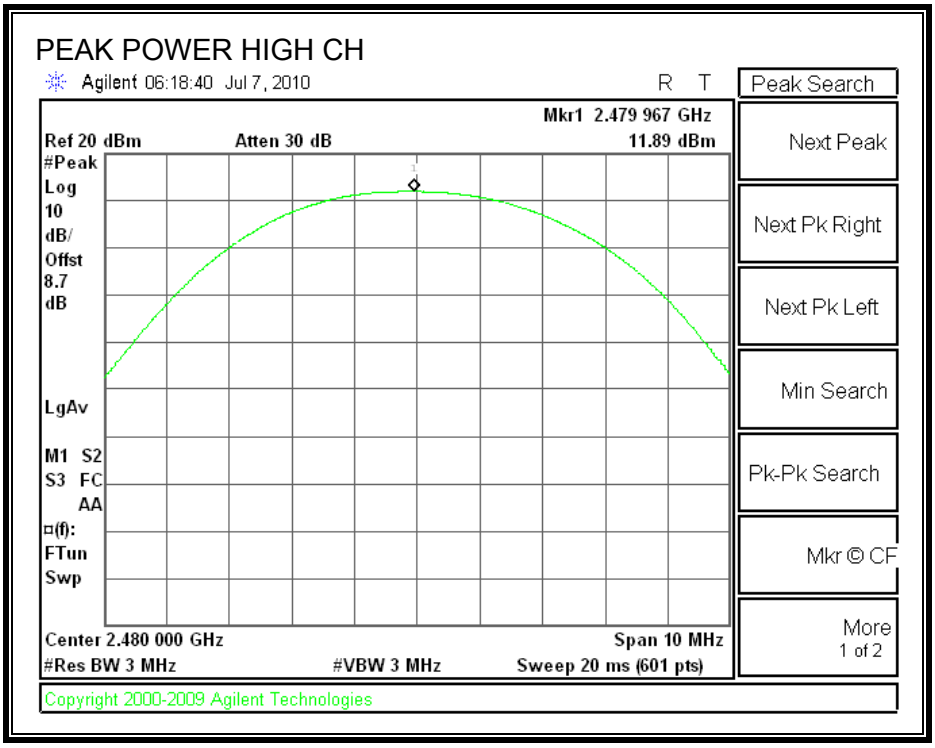
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.46	21	-9.51
Middle	2441	11.93	21	-9.04
High	2480	11.89	21	-9.08

OUTPUT POWER





PEAK POWER HIGH CH



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 8.7 dB (including splitter 6.5 dB and 2.2 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	10.70
Middle	2441	11.20
High	2480	11.50

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

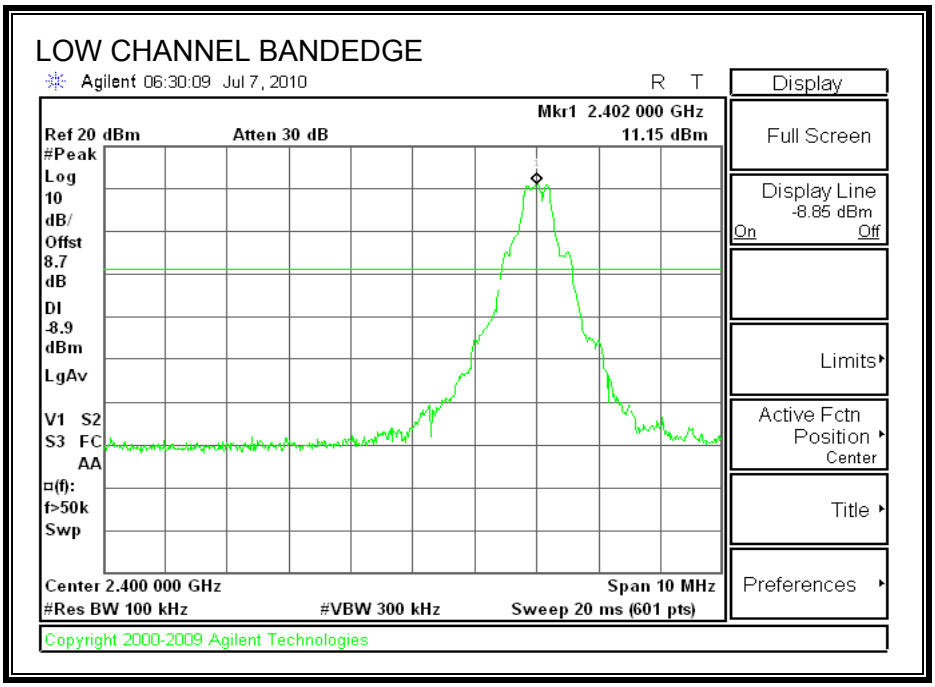
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

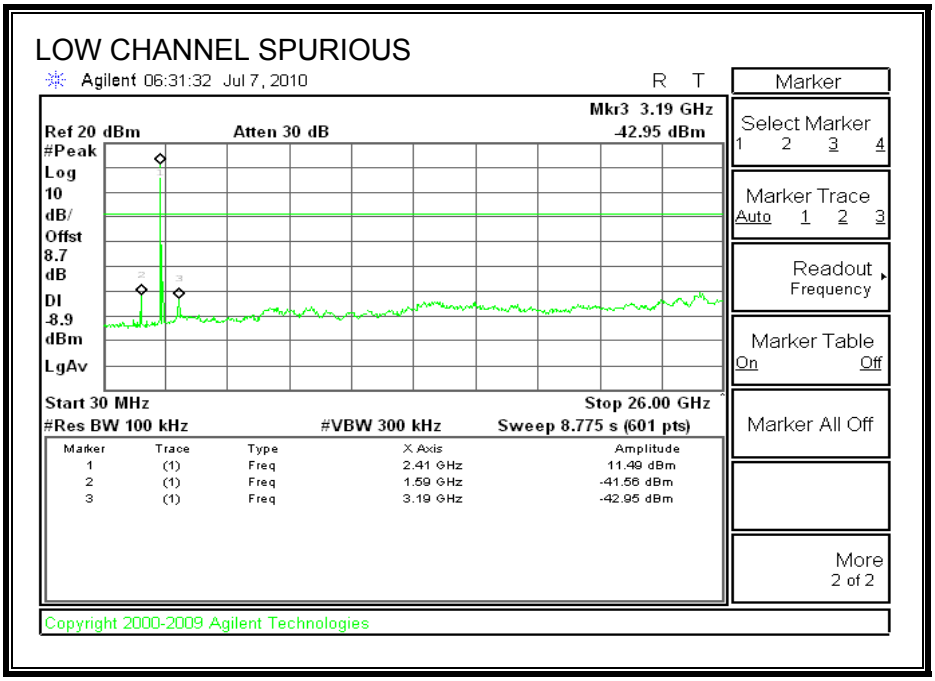
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

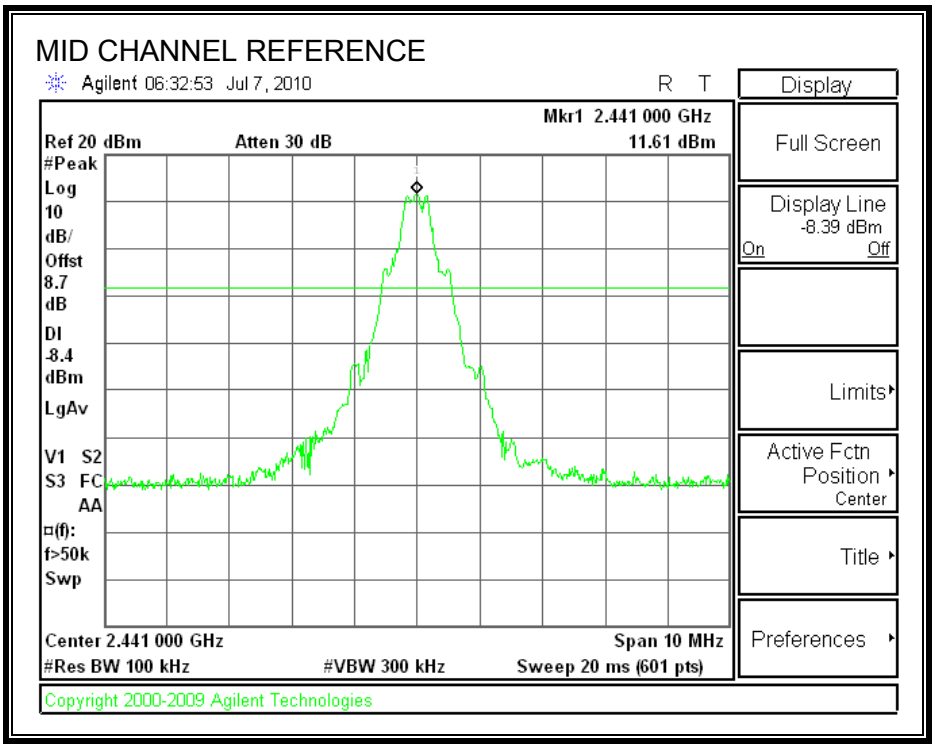
RESULTS

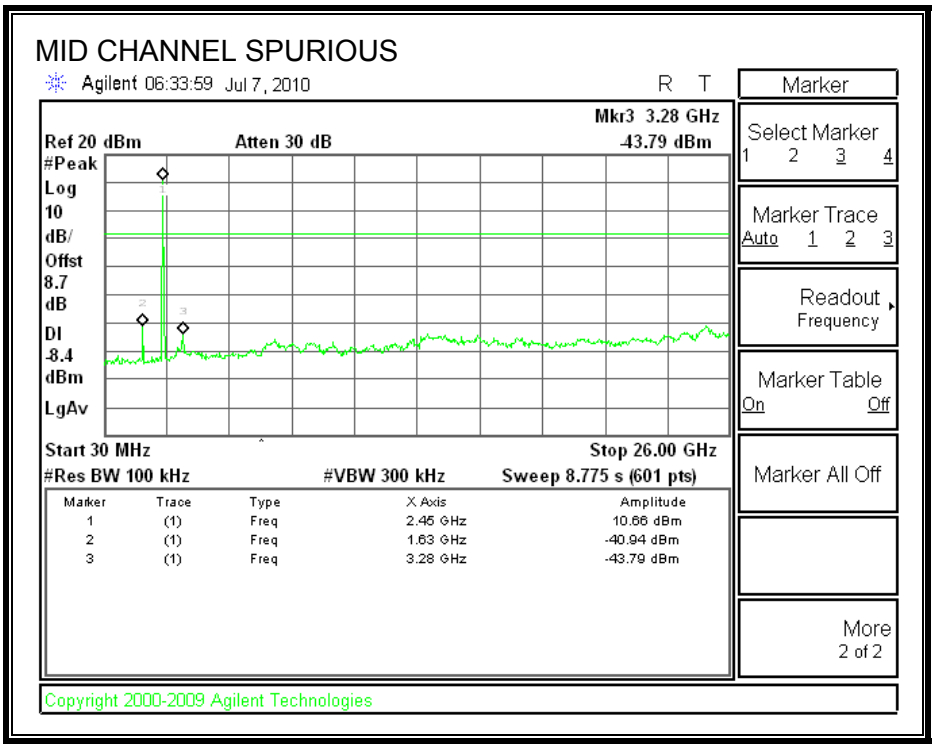
SPURIOUS EMISSIONS, LOW CHANNEL



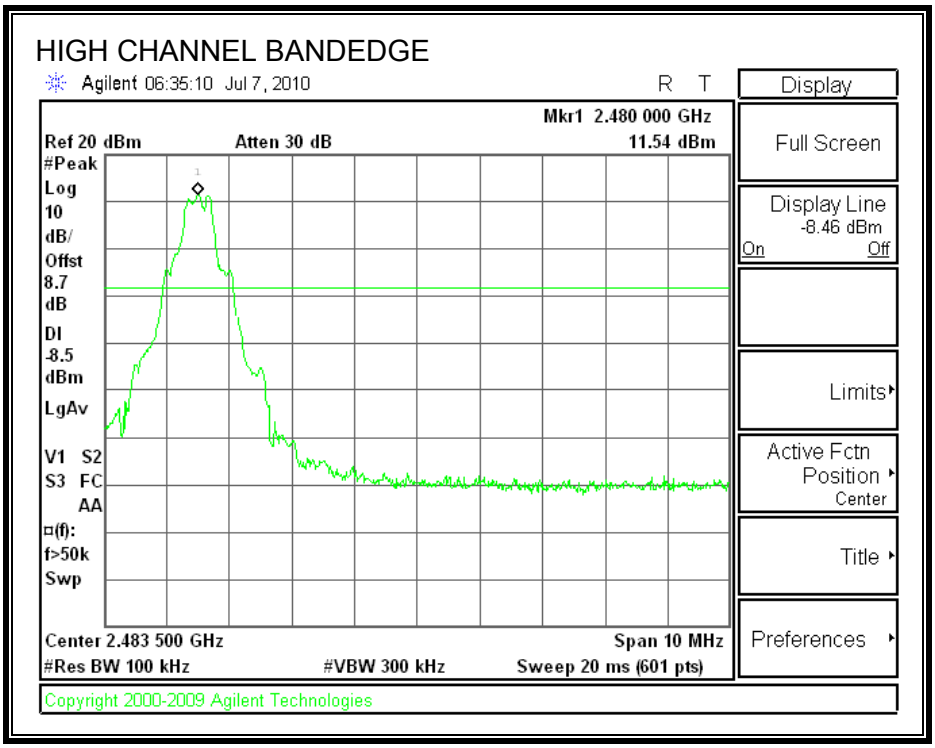


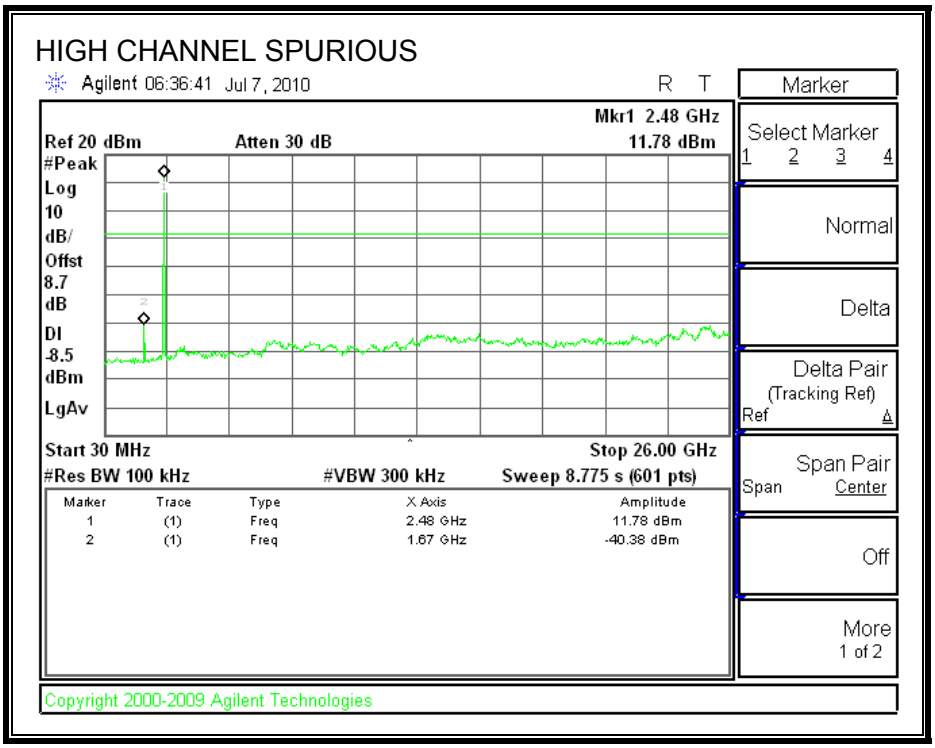
SPURIOUS EMISSIONS, MID CHANNEL





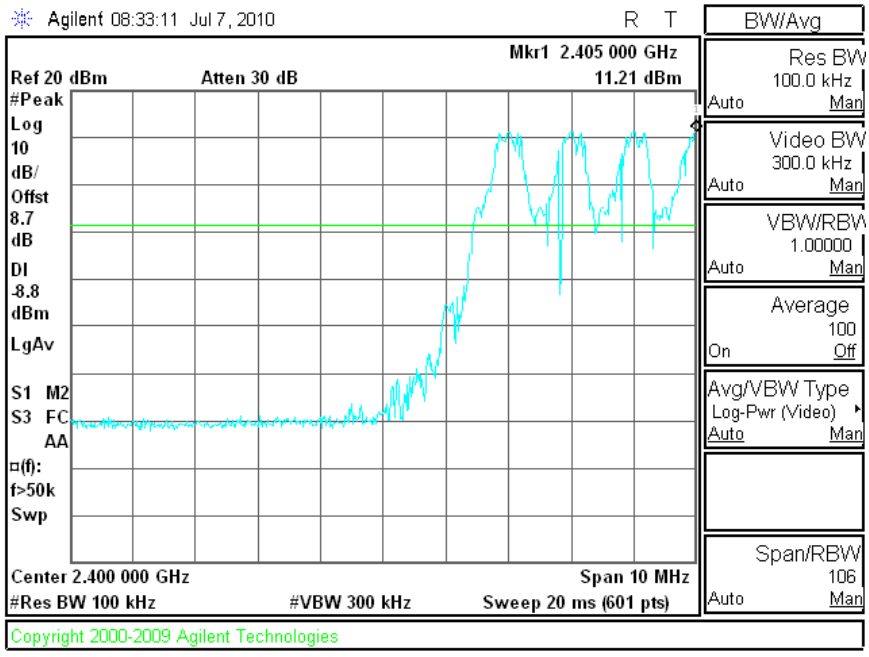
SPURIOUS EMISSIONS, HIGH CHANNEL



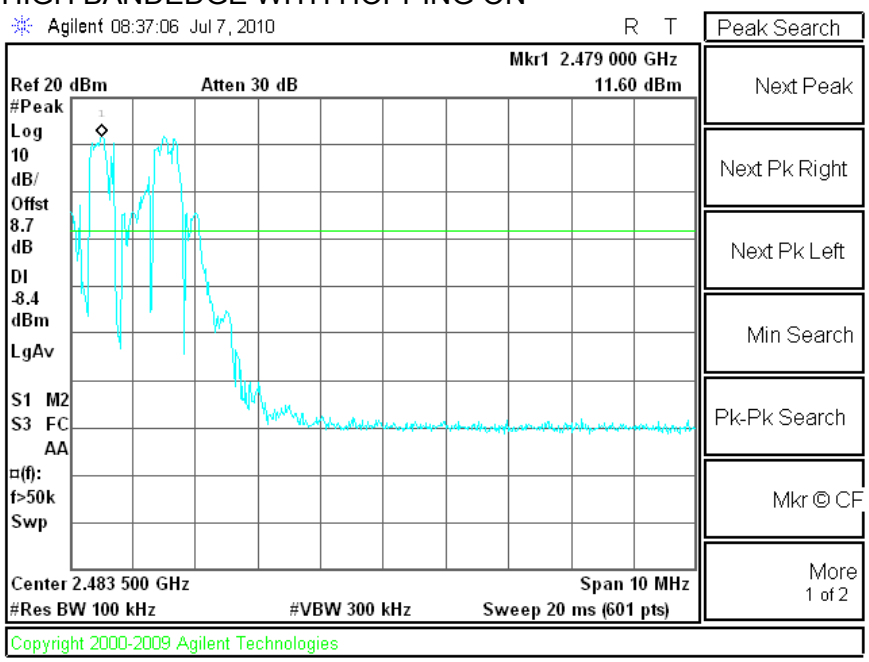


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



7.2. ENHANCED DATA RATE QPSK MODULATION

7.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

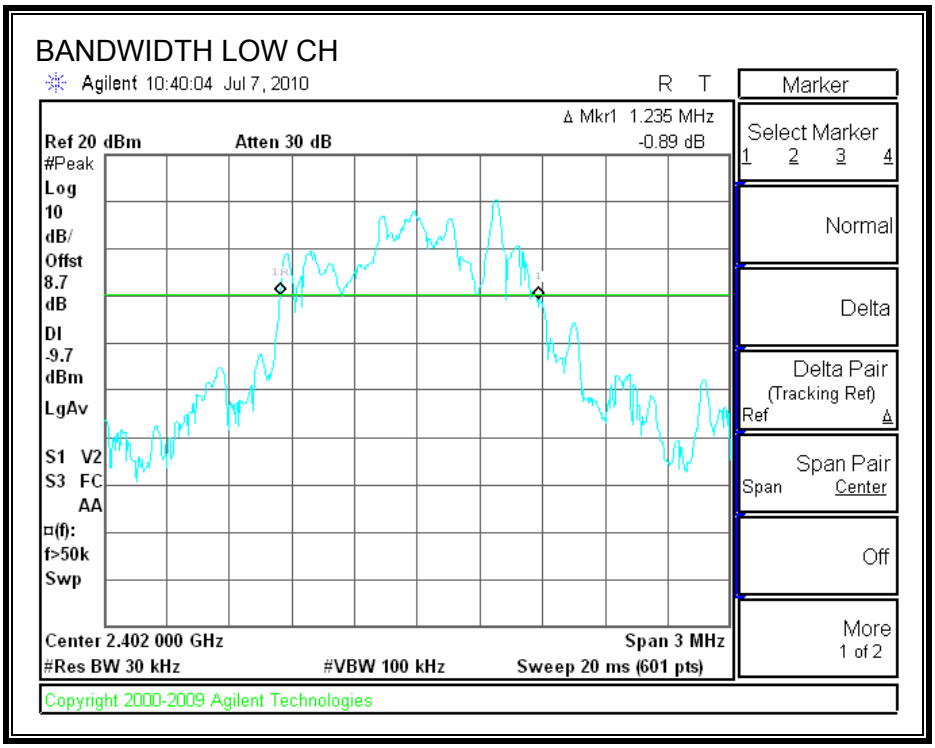
TEST PROCEDURE

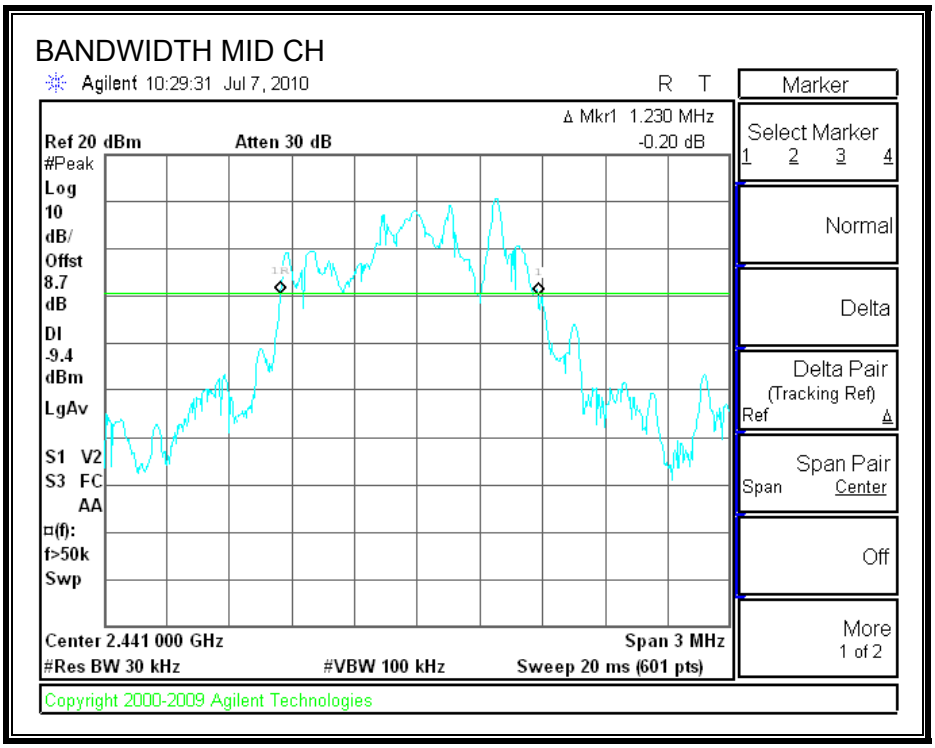
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

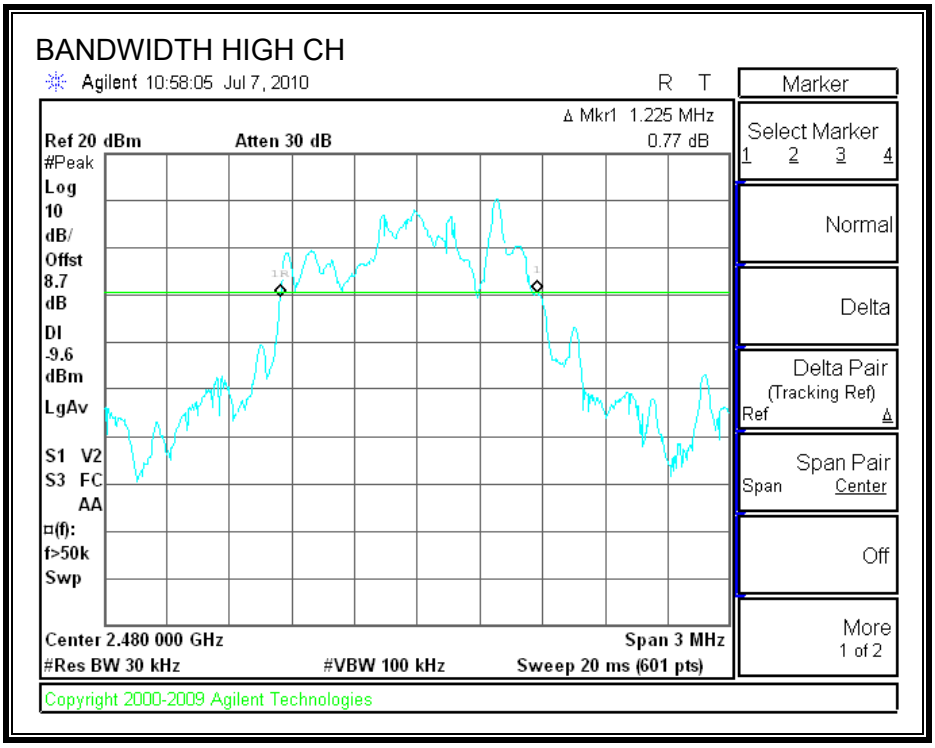
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.235	1.0532
Middle	2441	1.230	1.0522
High	2480	1.225	1.0432

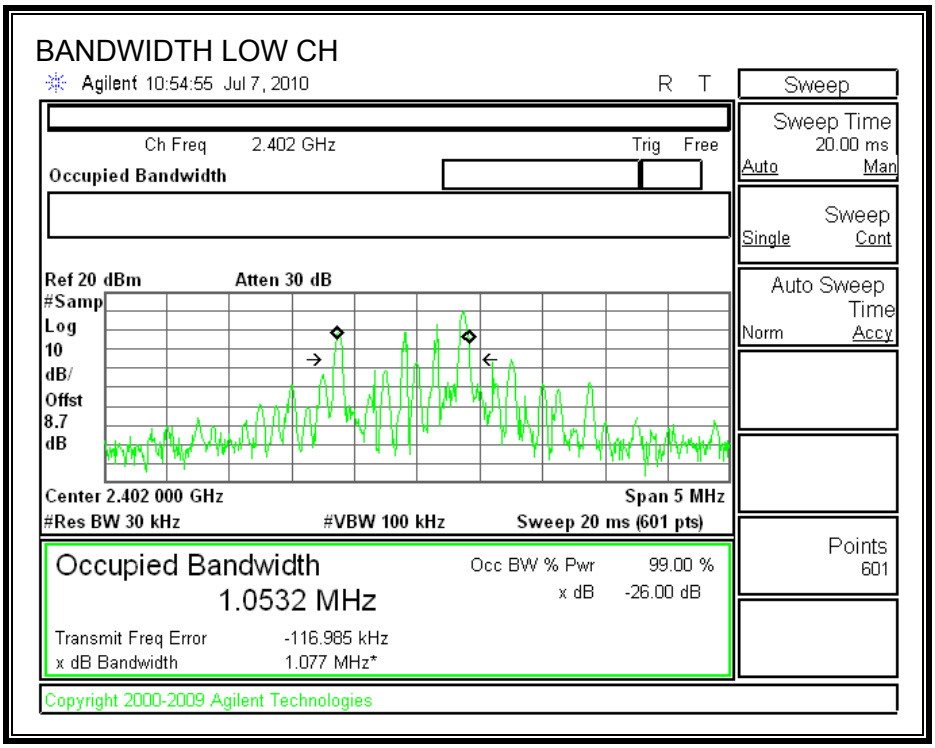
20 dB BANDWIDTH

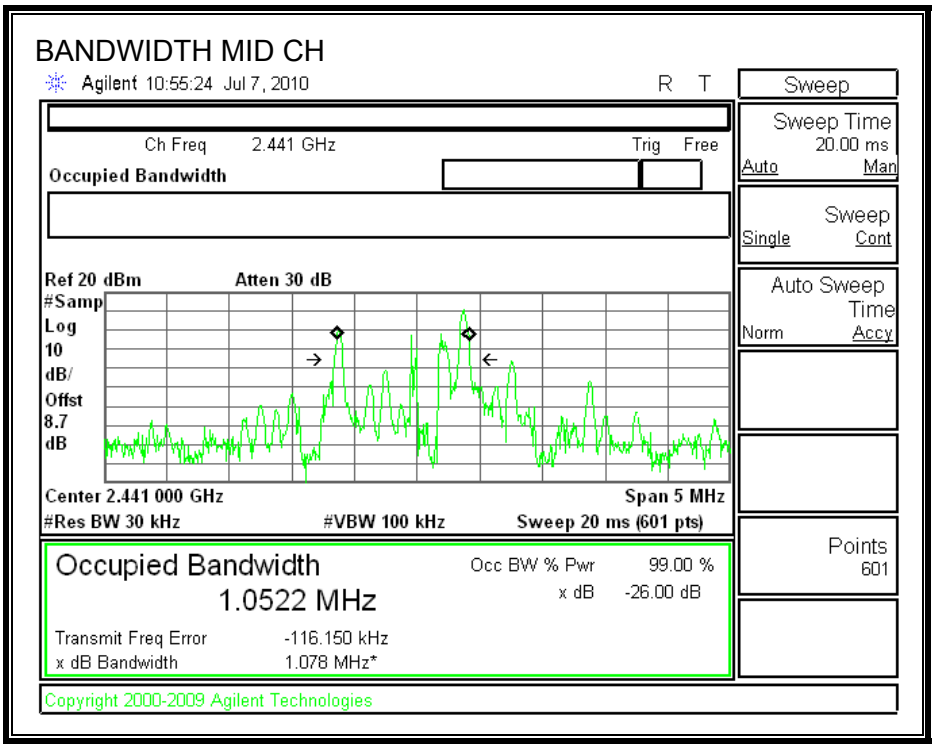


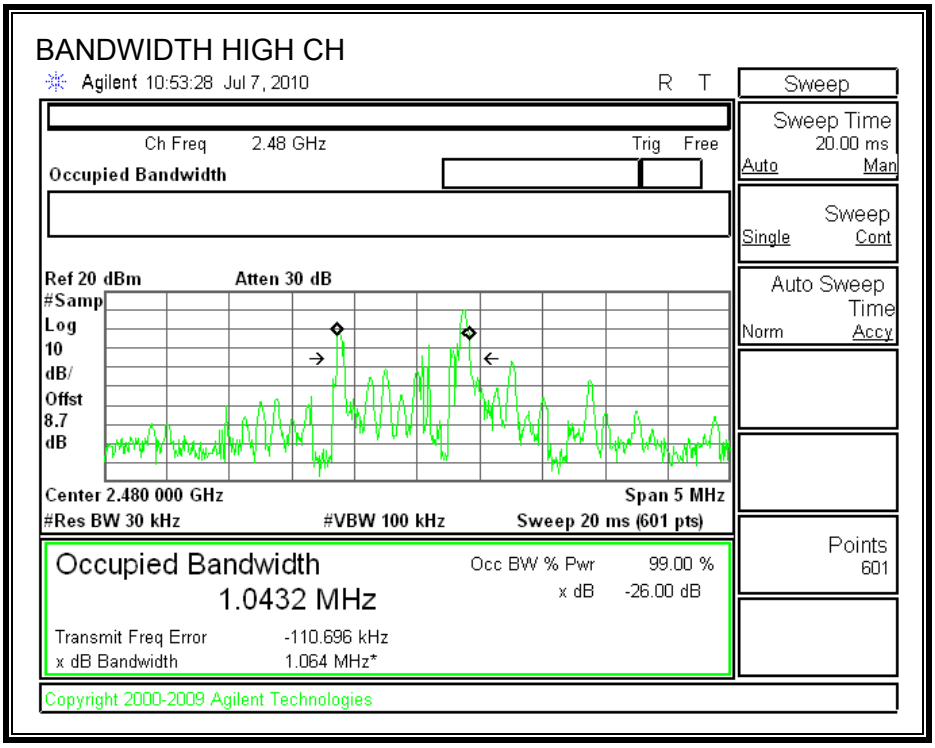




99% BANDWIDTH







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.

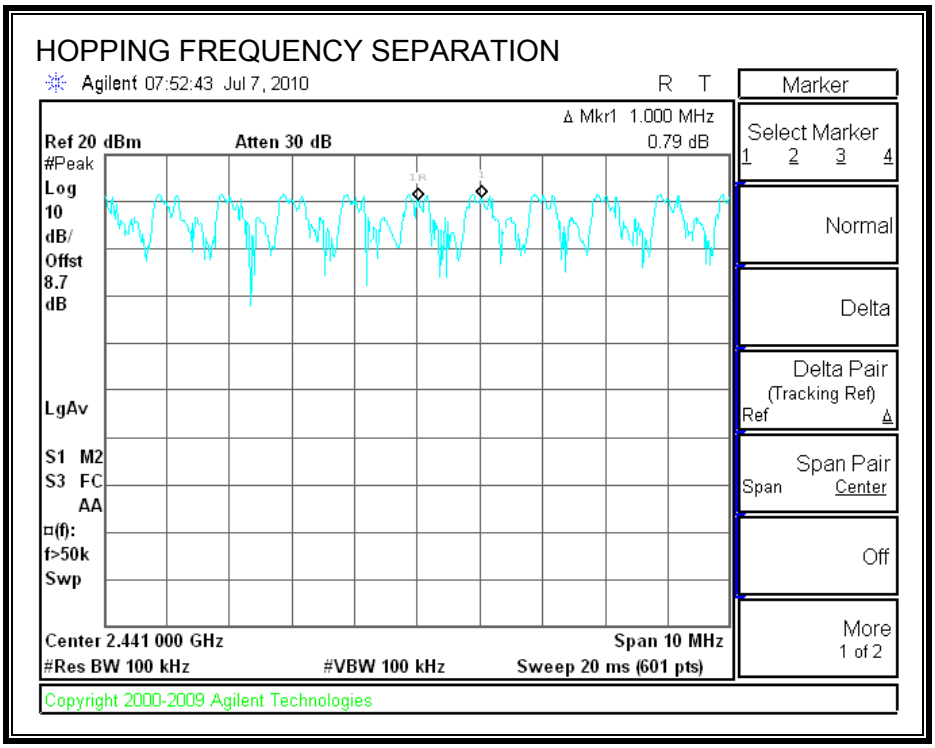
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



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

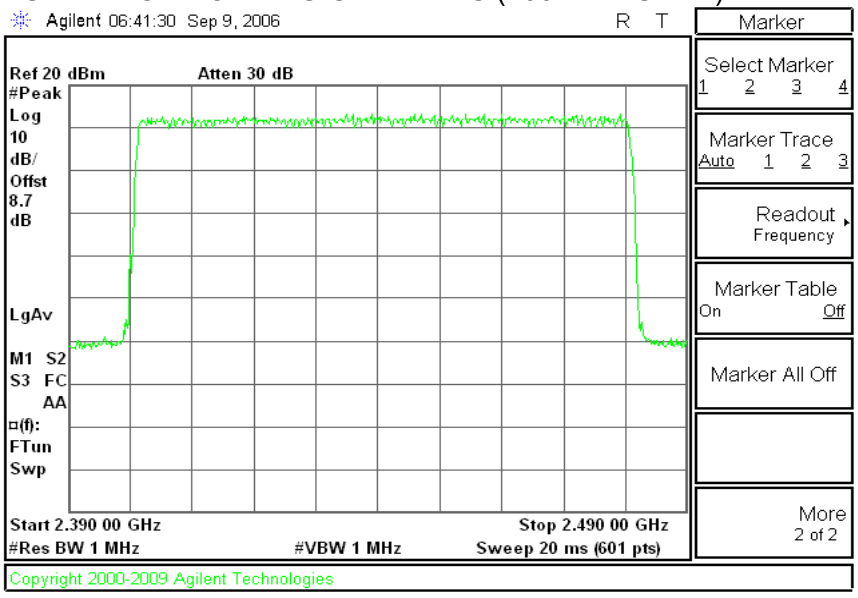
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

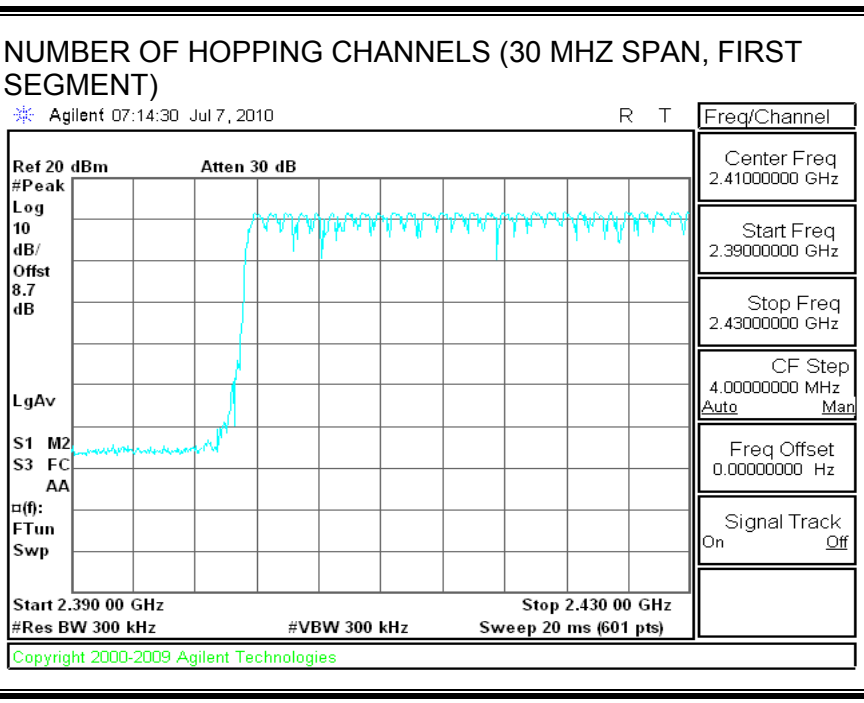
79 Channels observed.

NUMBER OF HOPPING CHANNELS

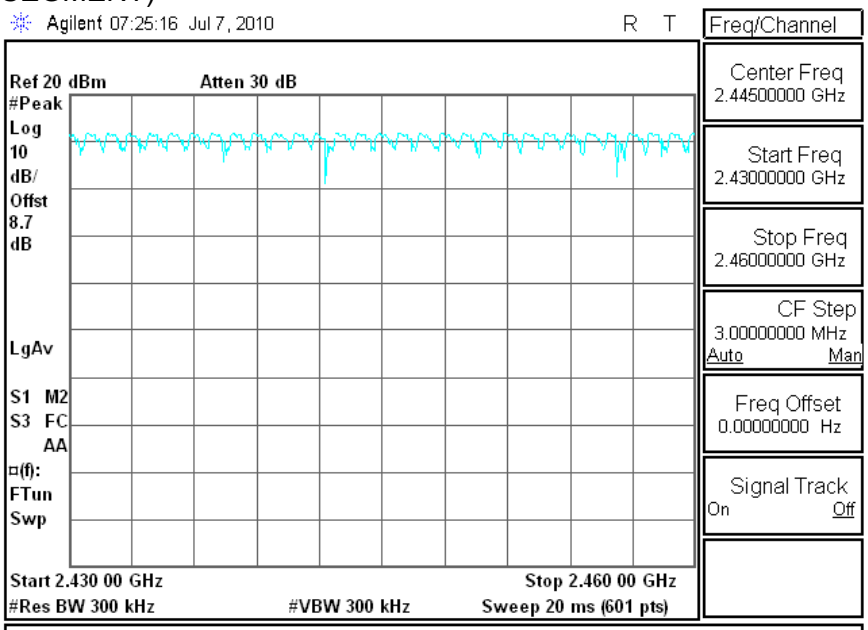
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



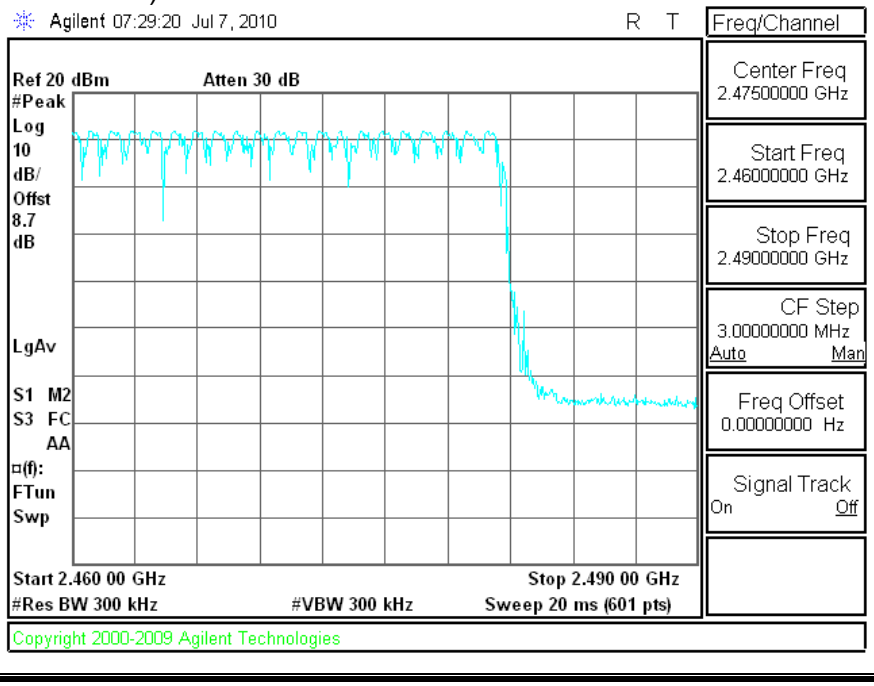
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



7.2.4. 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.

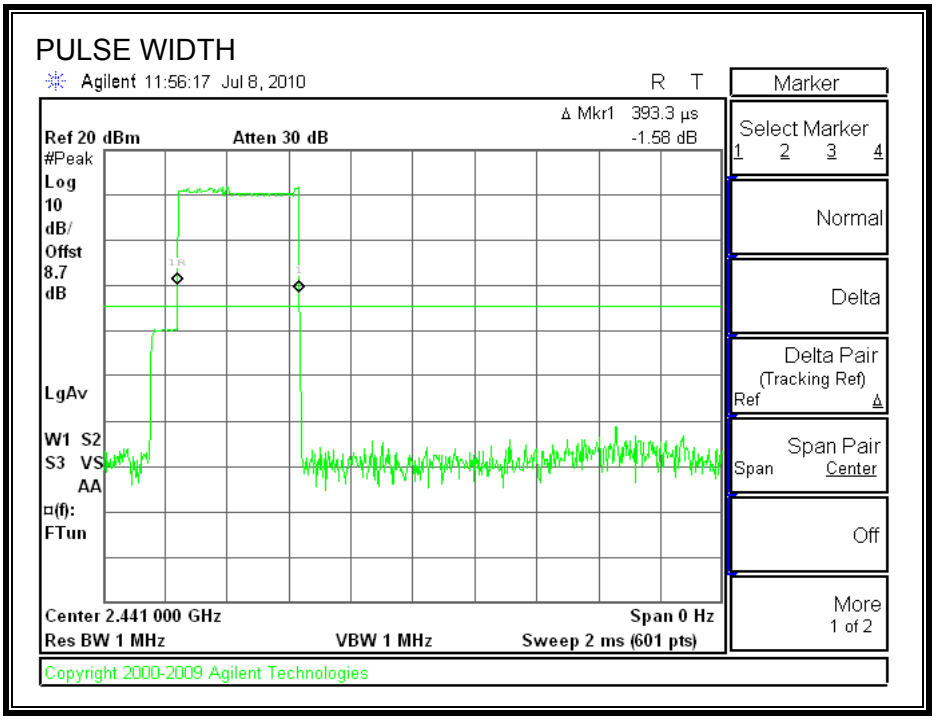
RESULTS

QPSK Mode

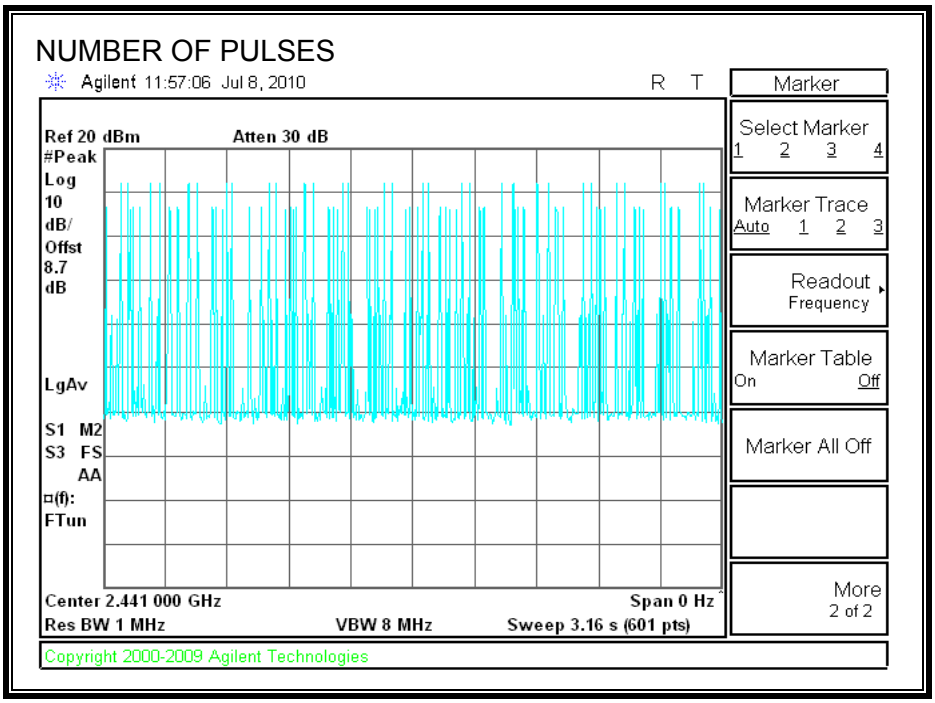
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.393	37	0.146	0.4	0.254
DH3	1.633	21	0.343	0.4	0.057
DH5	2.883	13	0.375	0.4	0.025

2-DH1

PULSE WIDTH

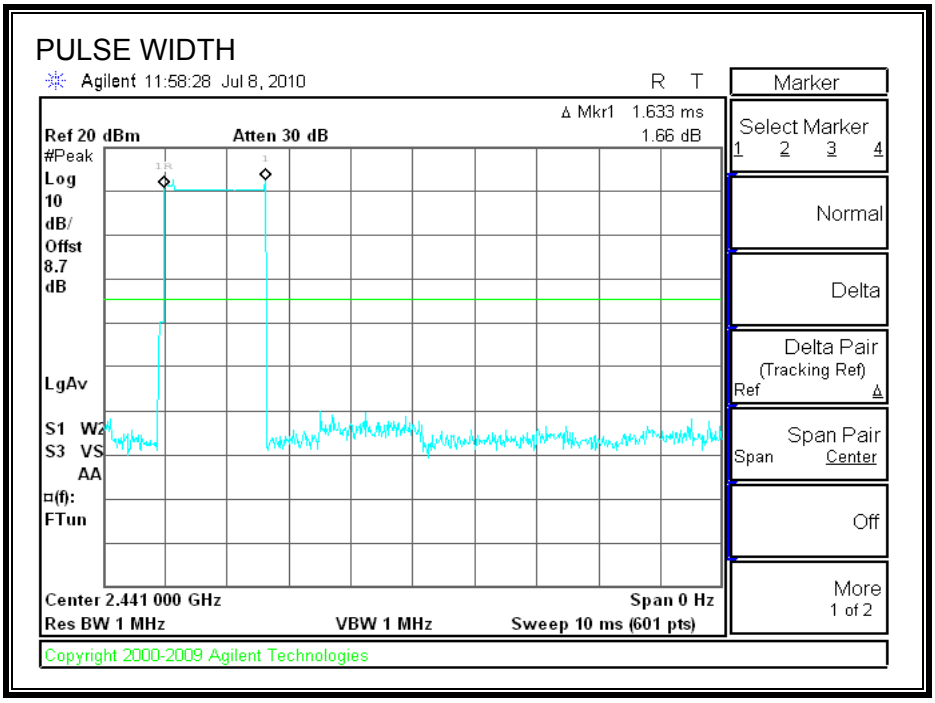


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

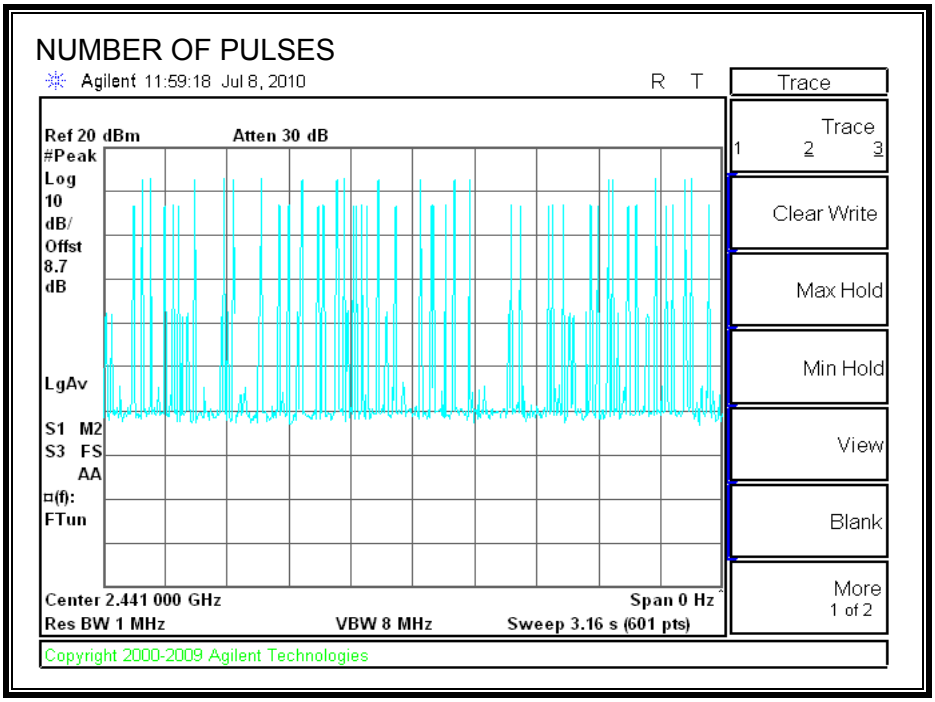


2-DH3

PULSE WIDTH

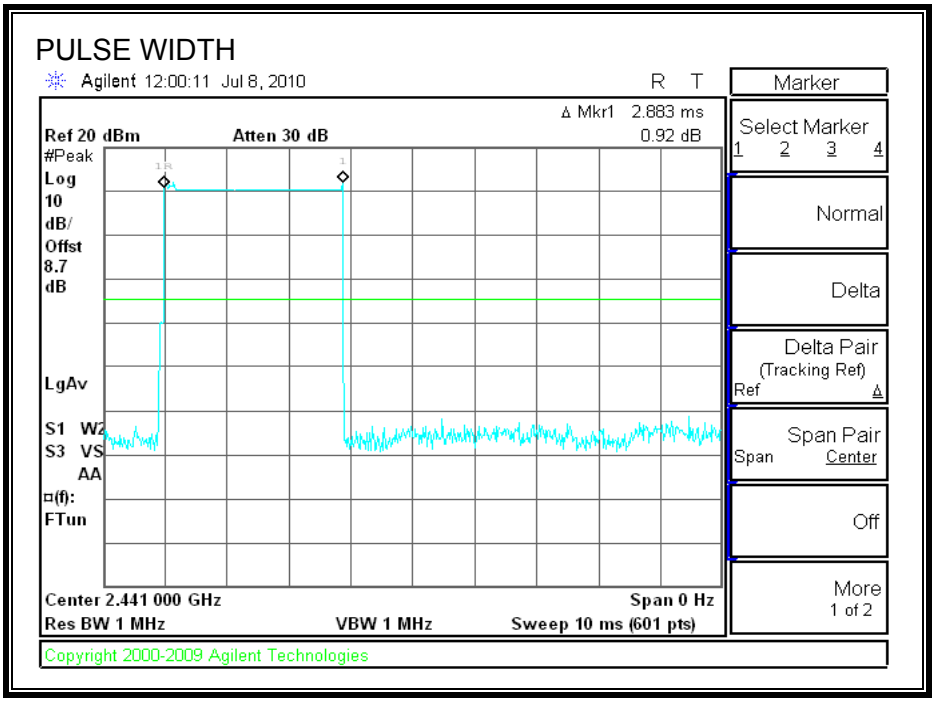


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

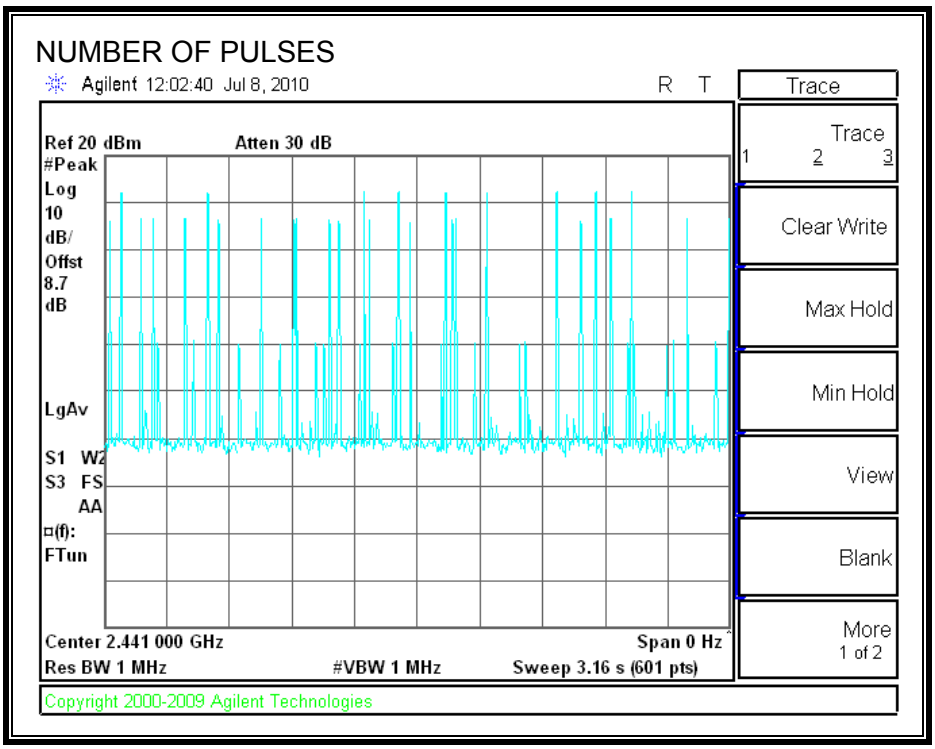


2-DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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.

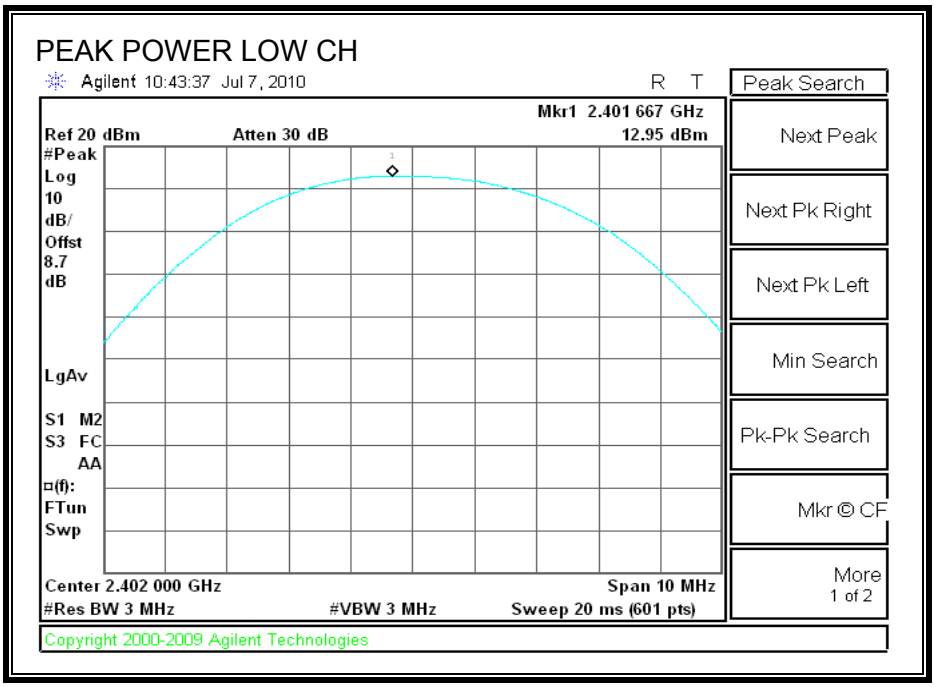
TEST PROCEDURE

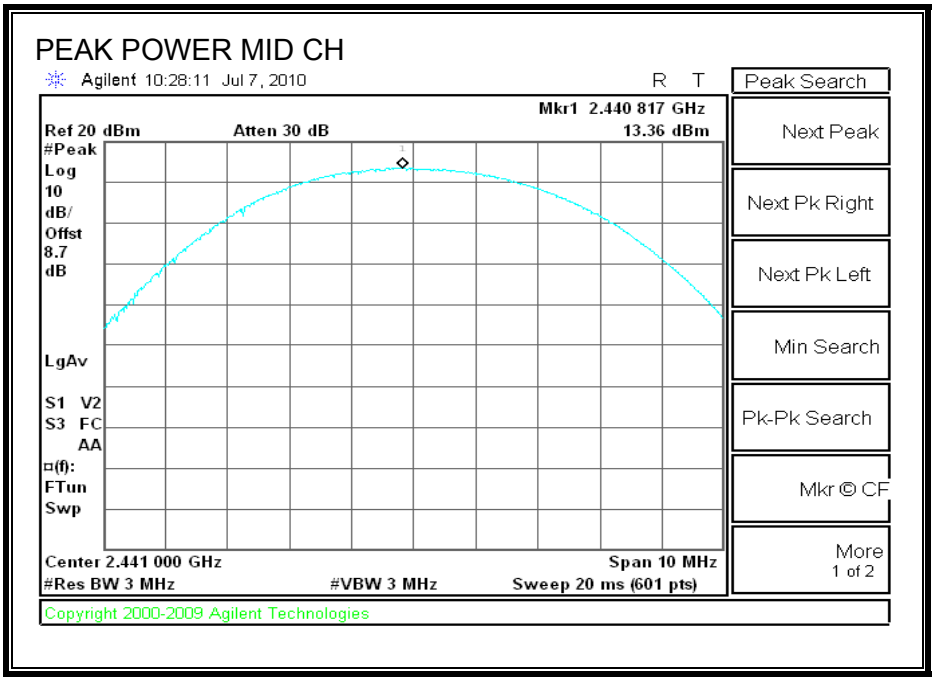
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

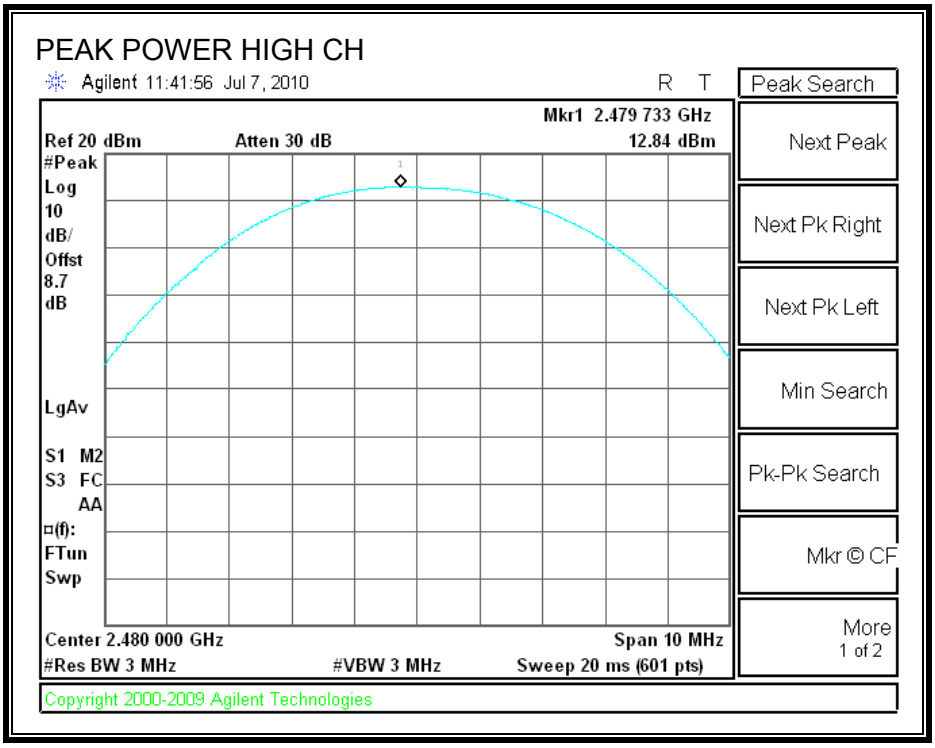
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.95	21	-8.05
Middle	2441	13.36	21	-7.64
High	2480	12.84	21	-8.16

OUTPUT POWER





PEAK POWER HIGH CH



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 11.2 dB (including 6.5 dB pad and 2.2 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	10.00
Middle	2441	10.20
High	2480	10.20

7.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

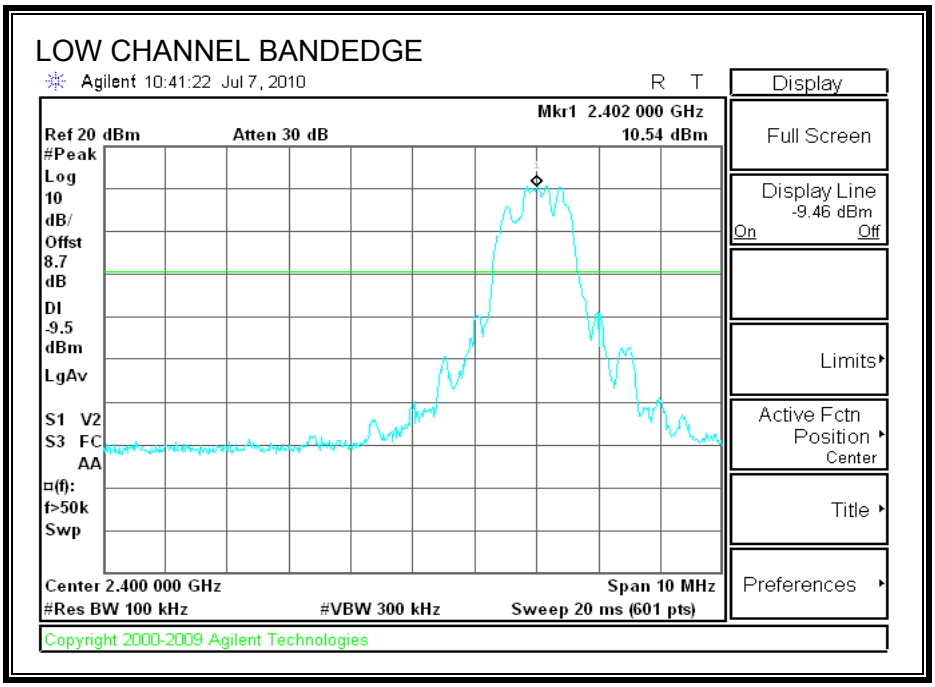
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

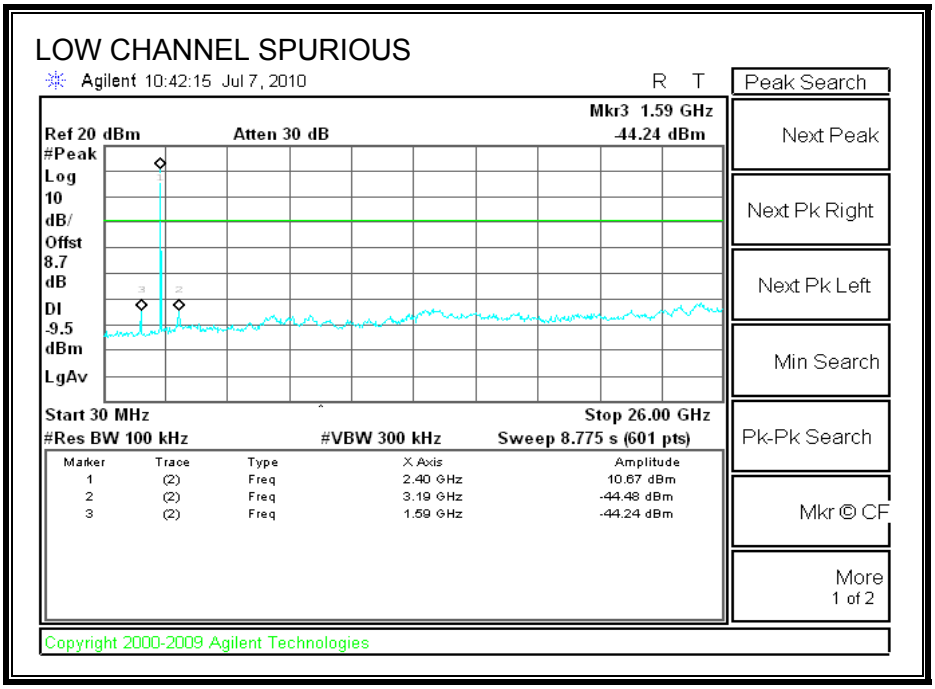
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

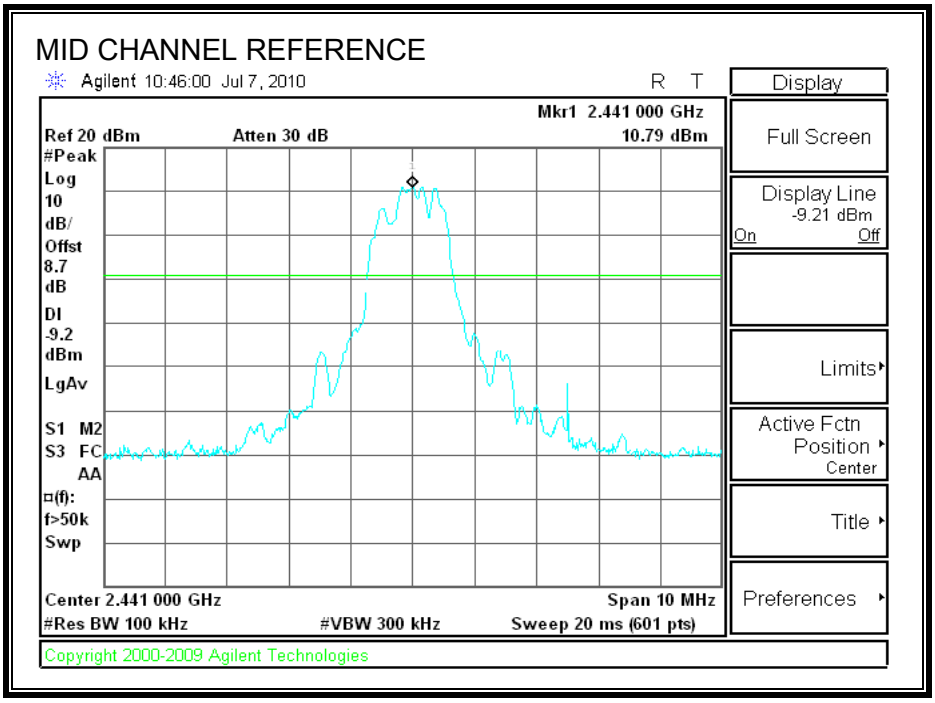
RESULTS

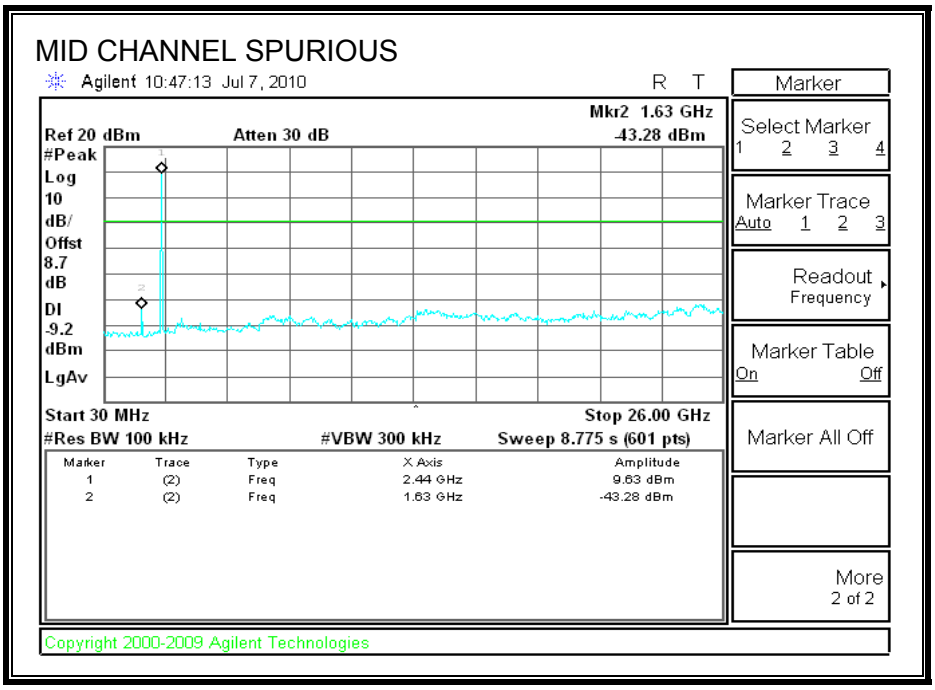
SPURIOUS EMISSIONS, LOW CHANNEL



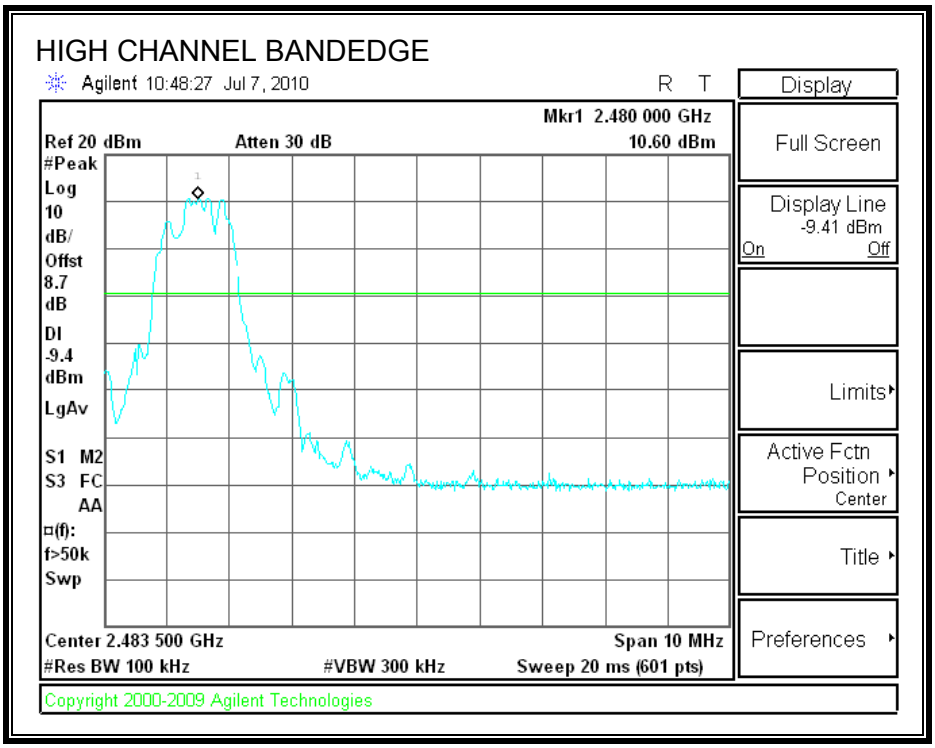


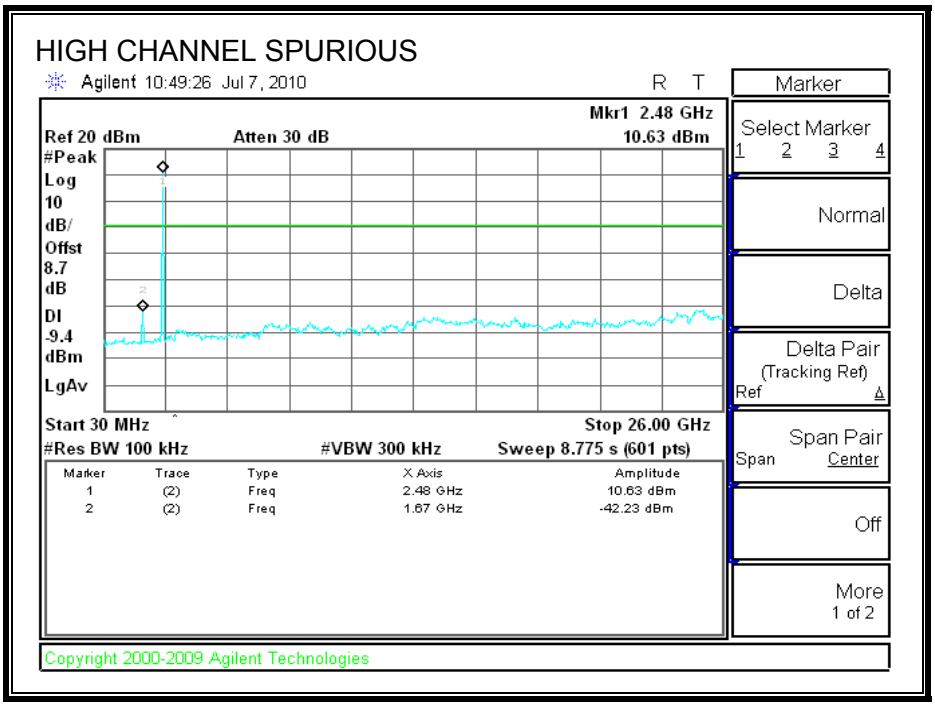
SPURIOUS EMISSIONS, MID CHANNEL





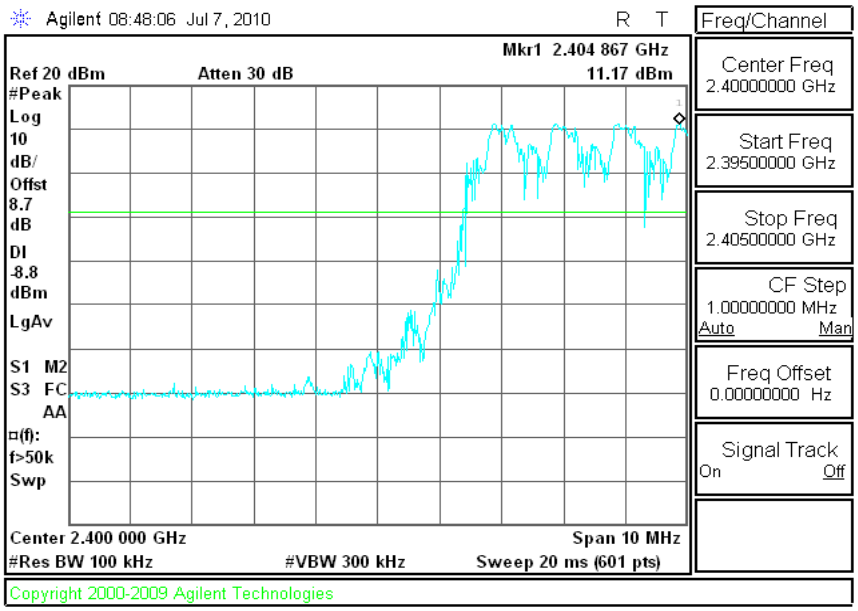
SPURIOUS EMISSIONS, HIGH CHANNEL



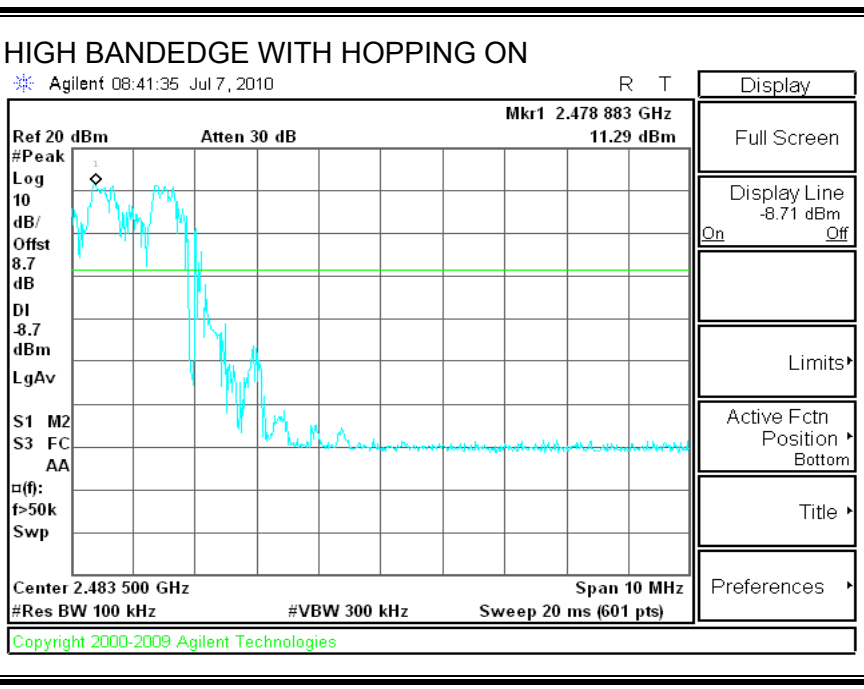


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



7.3. ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

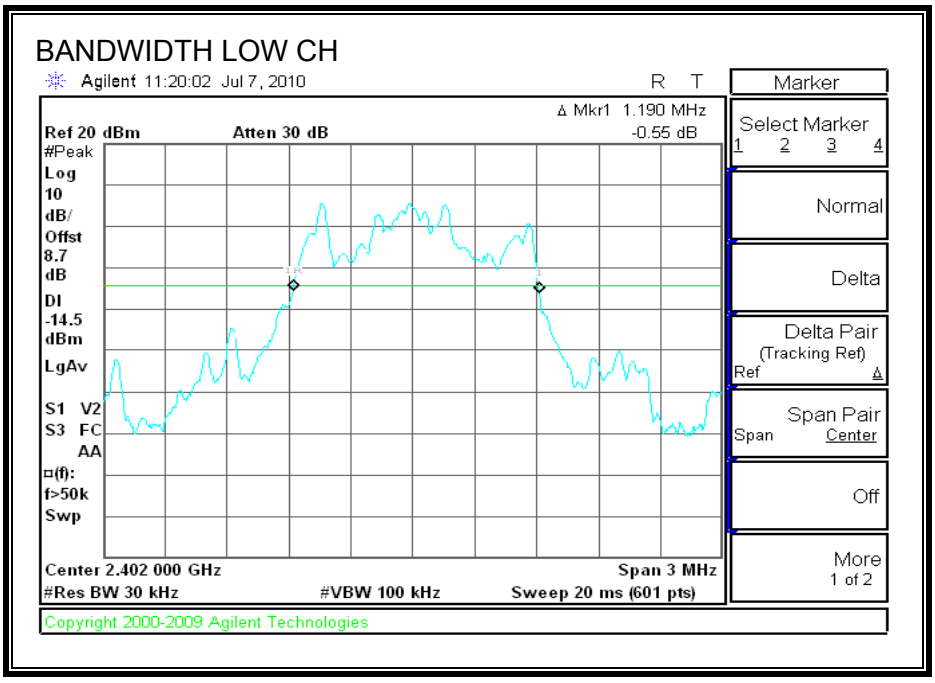
TEST PROCEDURE

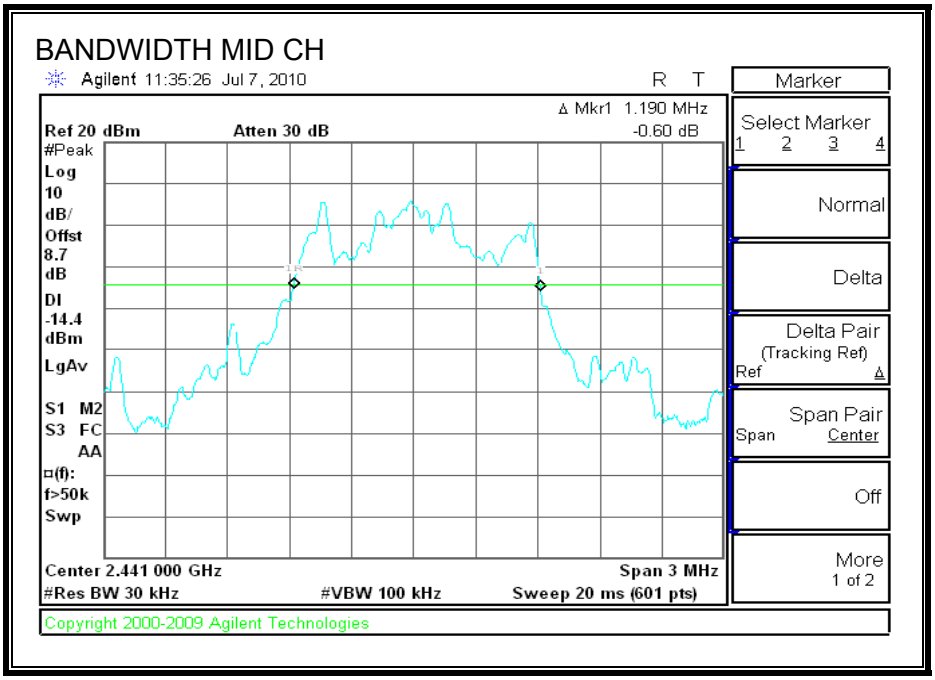
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

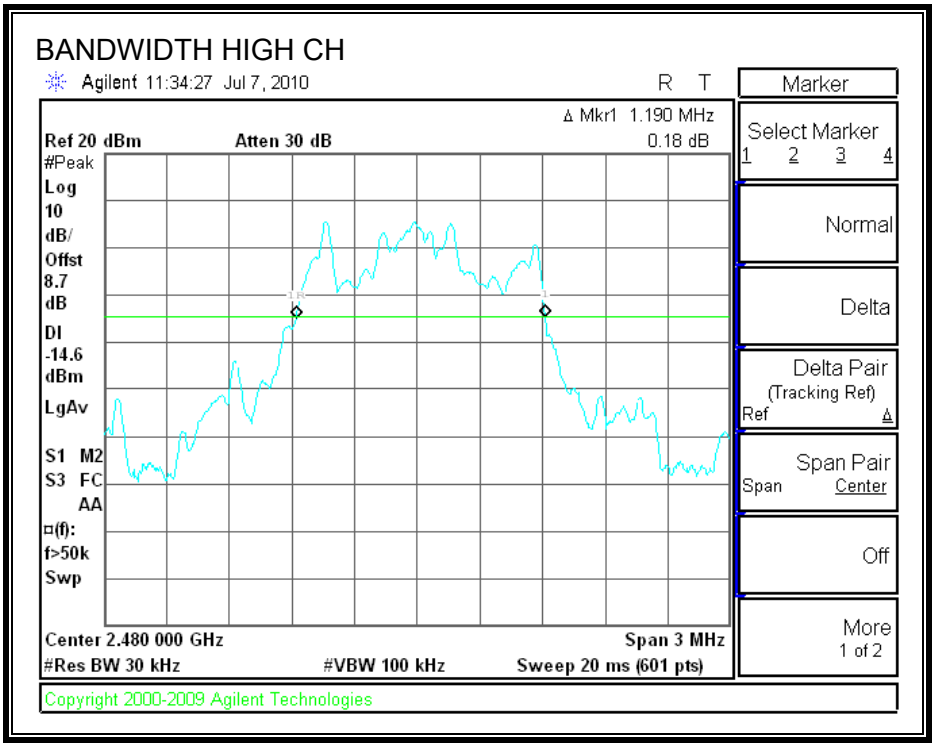
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.190	1.0560
Middle	2441	1.190	1.0537
High	2480	1.190	1.0571

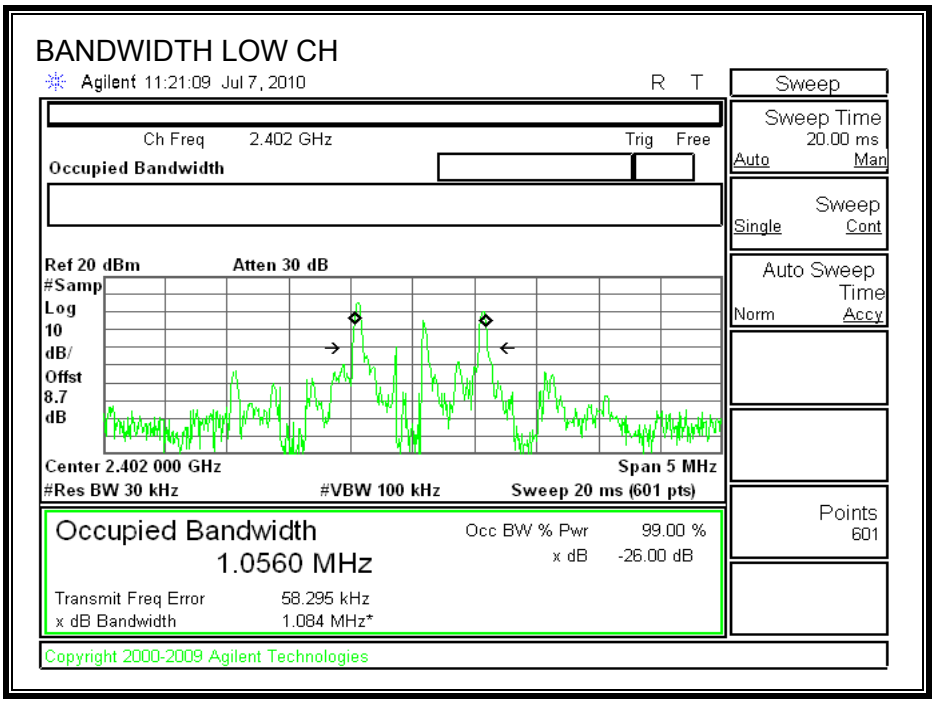
20 dB BANDWIDTH

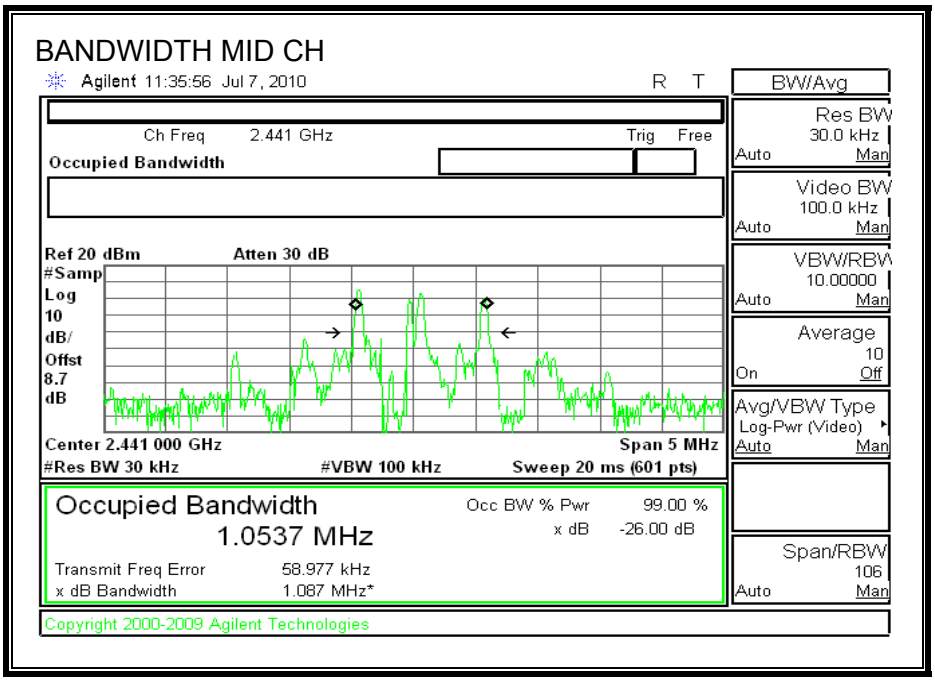


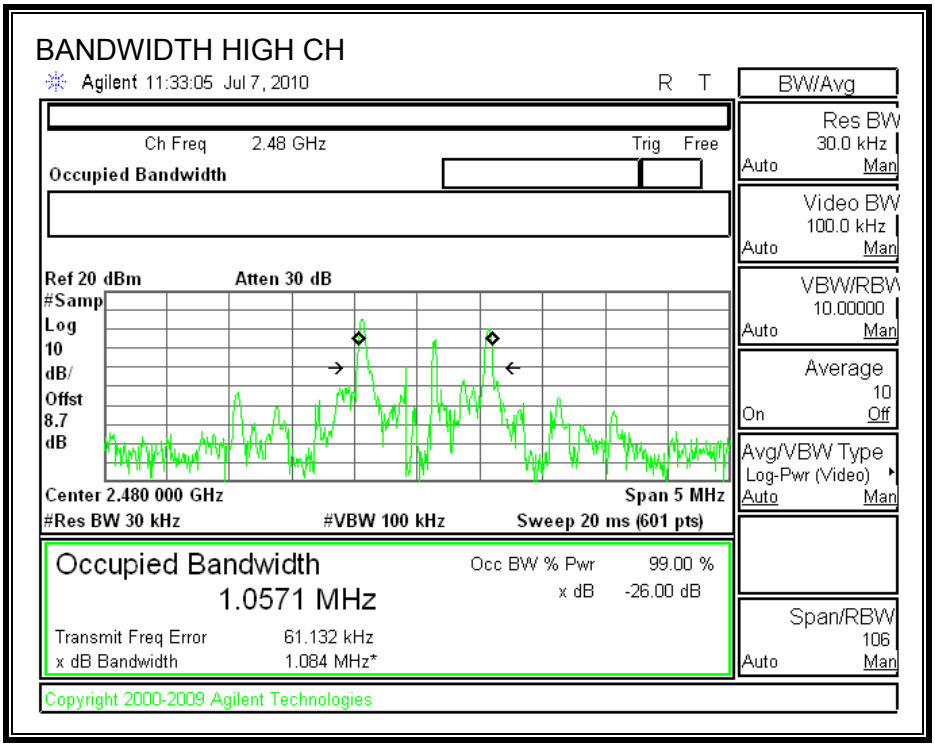




99% BANDWIDTH







7.3.2. 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.

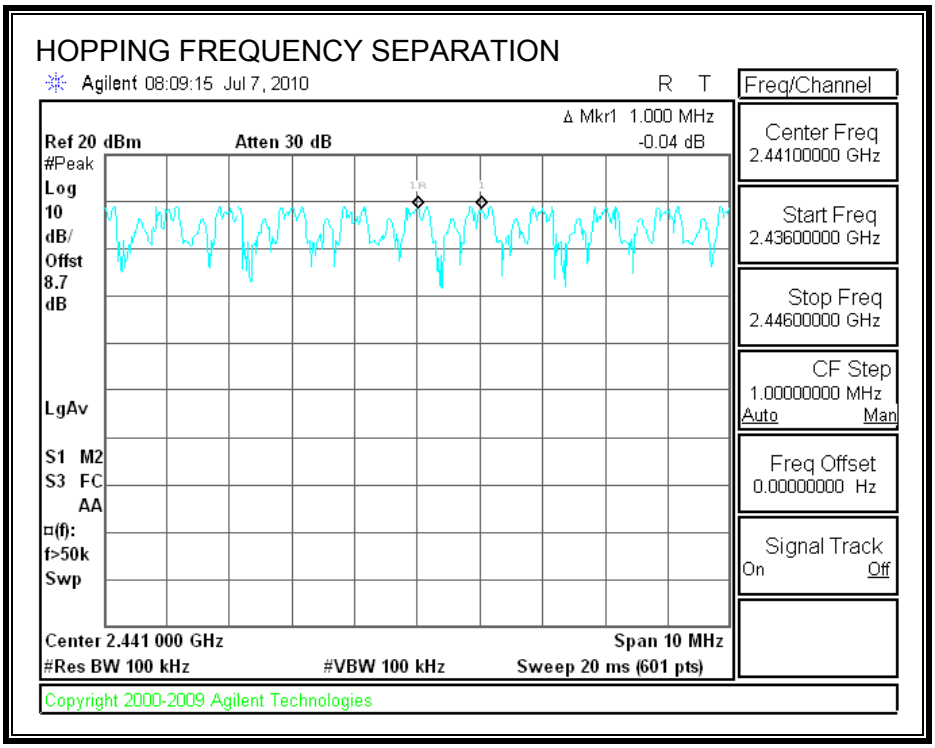
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



7.3.3. 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

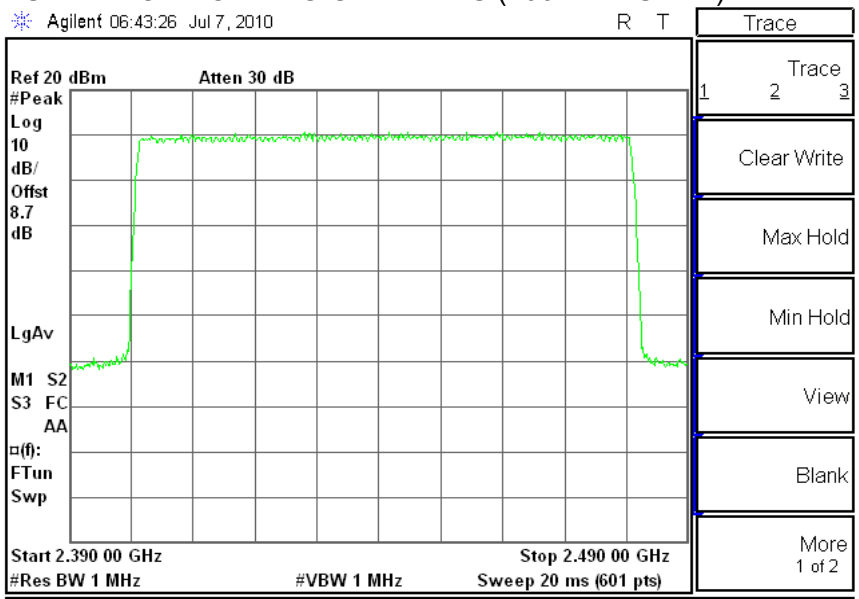
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

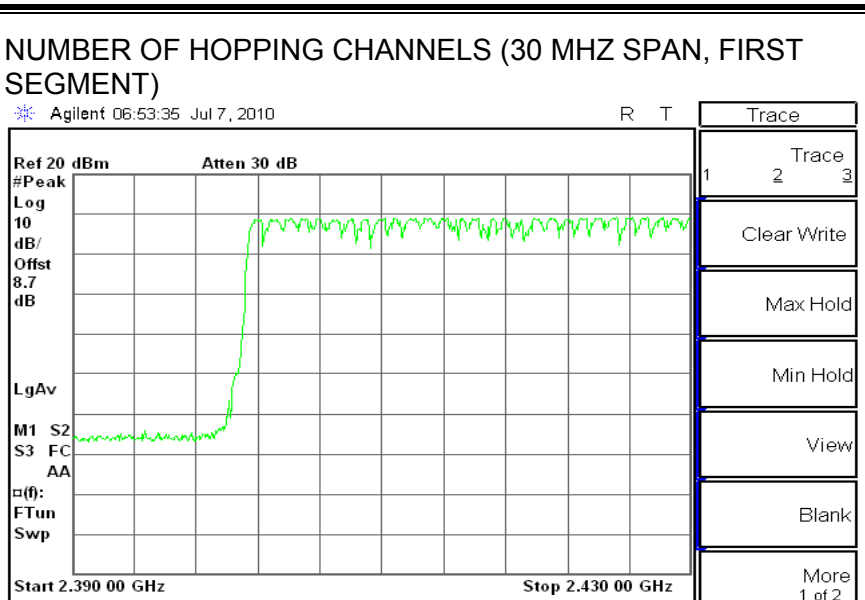
79 Channels observed.

NUMBER OF HOPPING CHANNELS

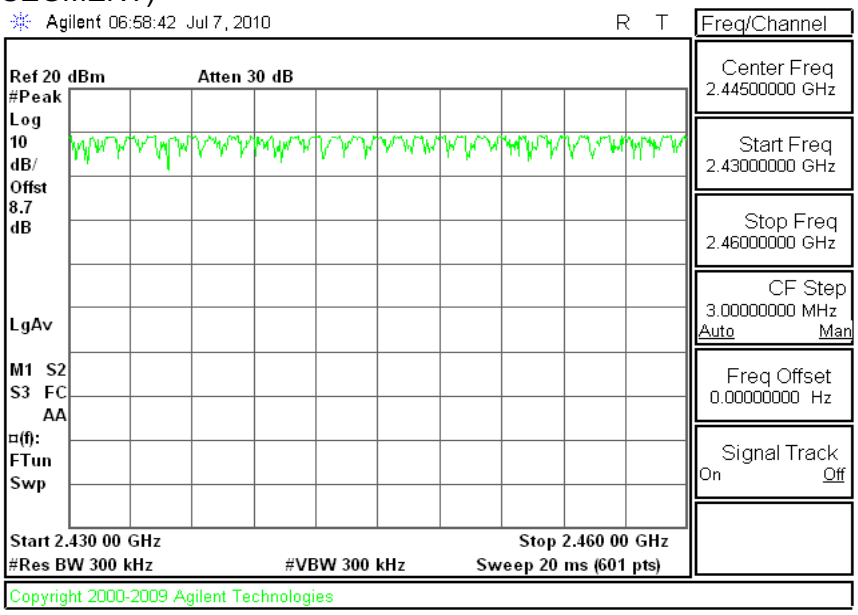
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



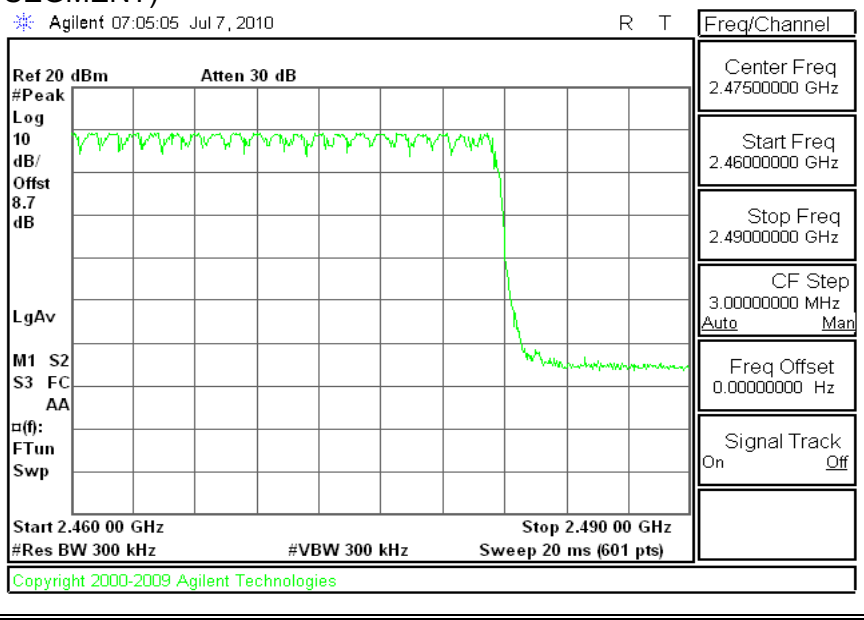
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



7.3.4. 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.

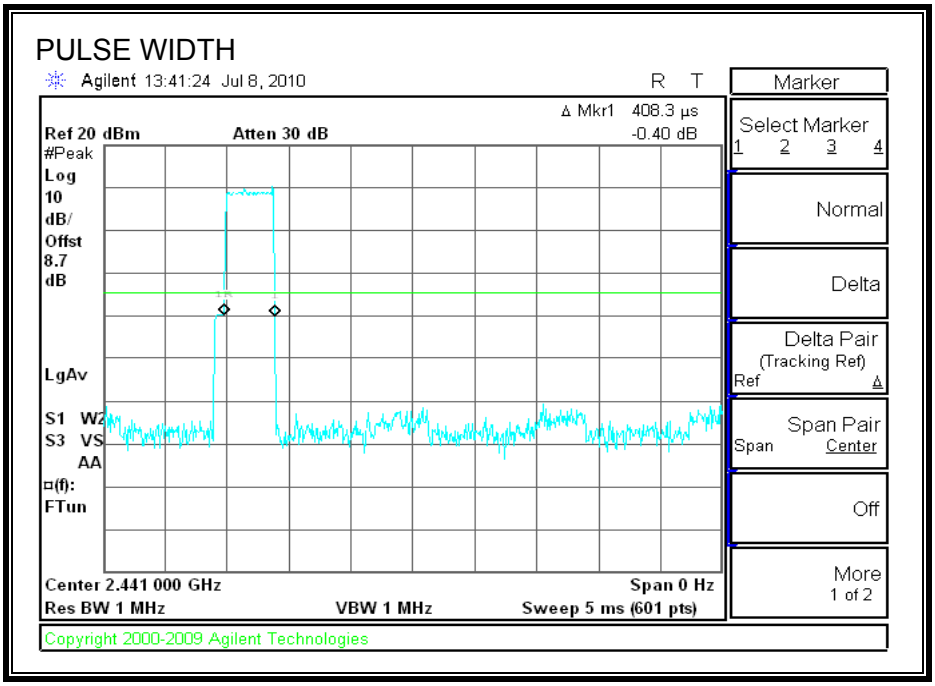
RESULTS

8PSK

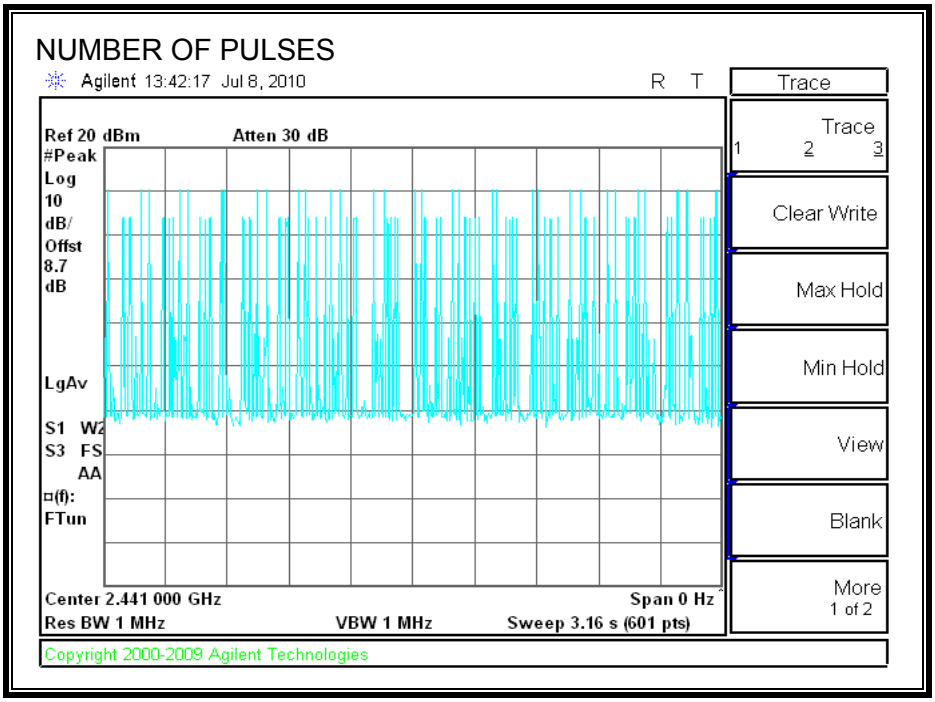
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.4083	35	0.143	0.4	0.257
DH3	1.65	20	0.330	0.4	0.070
DH5	2.90	11	0.319	0.4	0.081

3-DH1

PULSE WIDTH

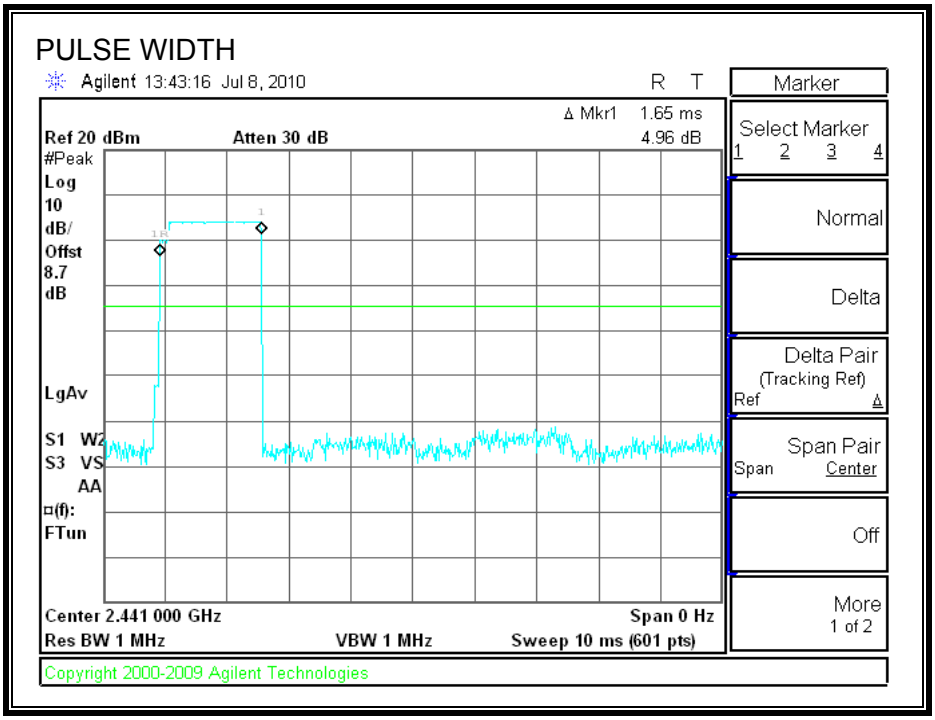


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

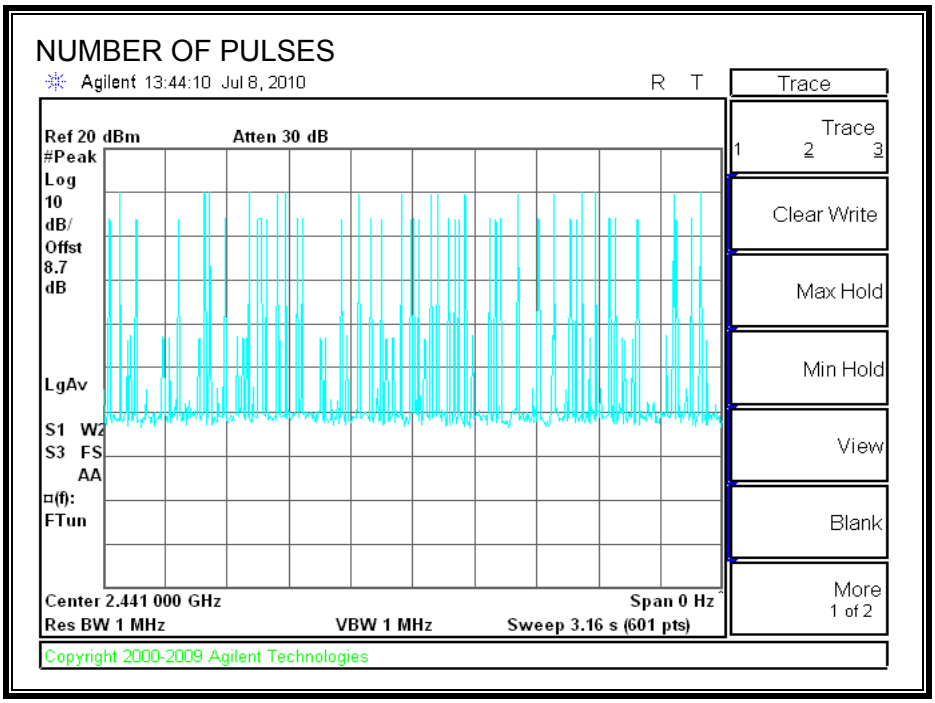


3-DH3

PULSE WIDTH

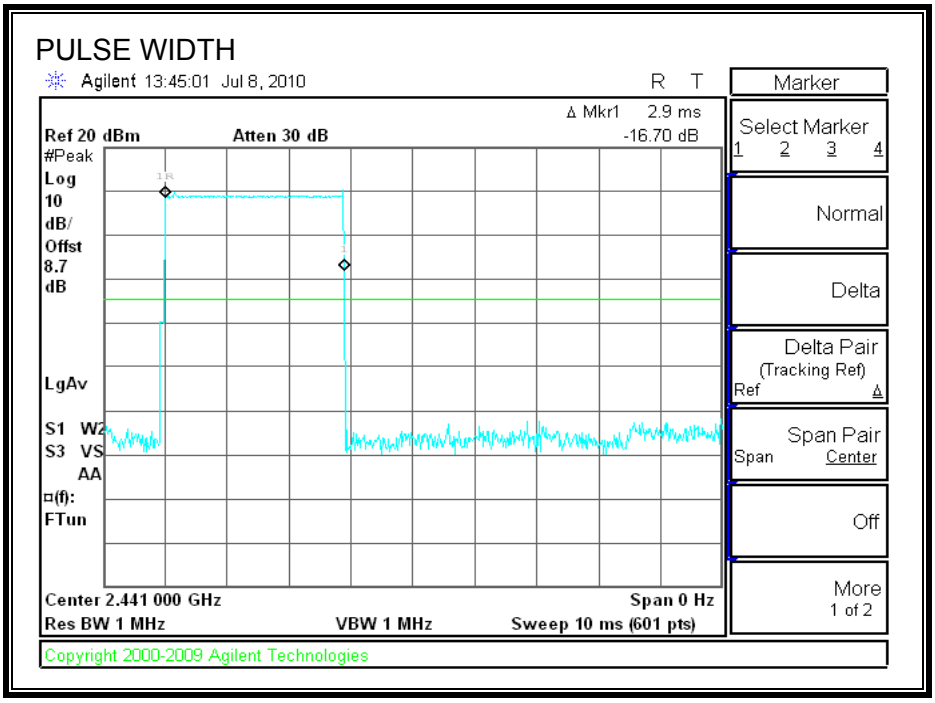


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

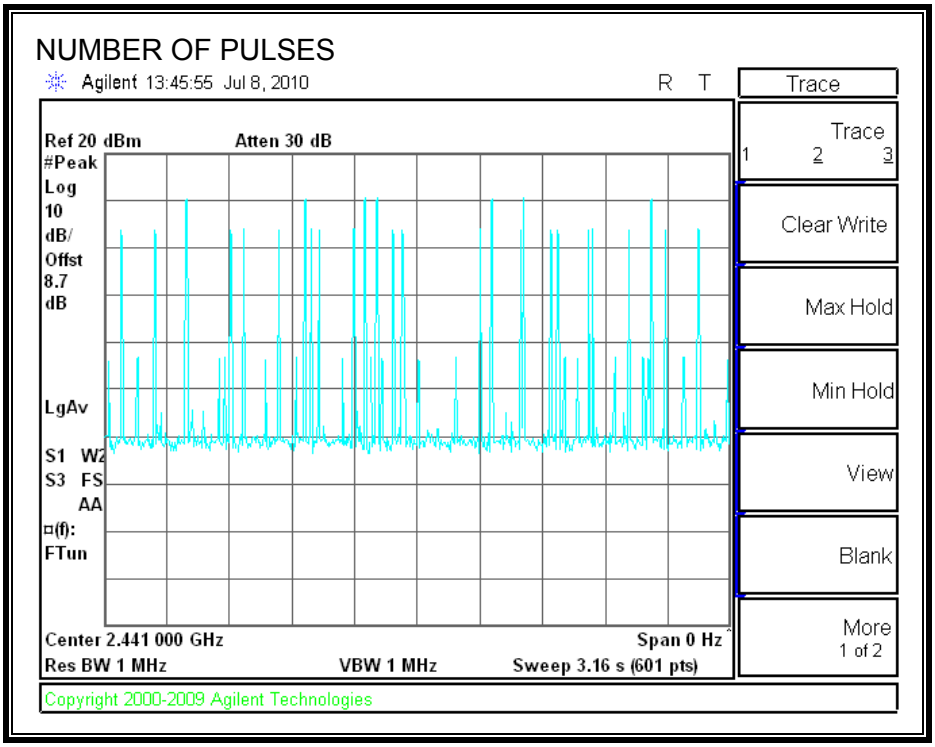


3-DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.3.5. 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.

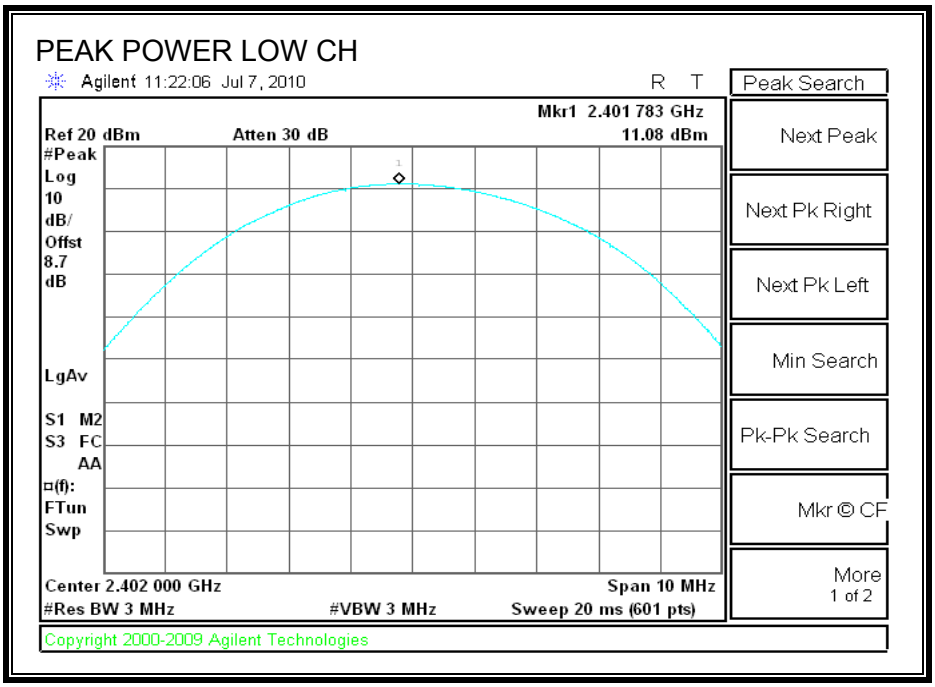
TEST PROCEDURE

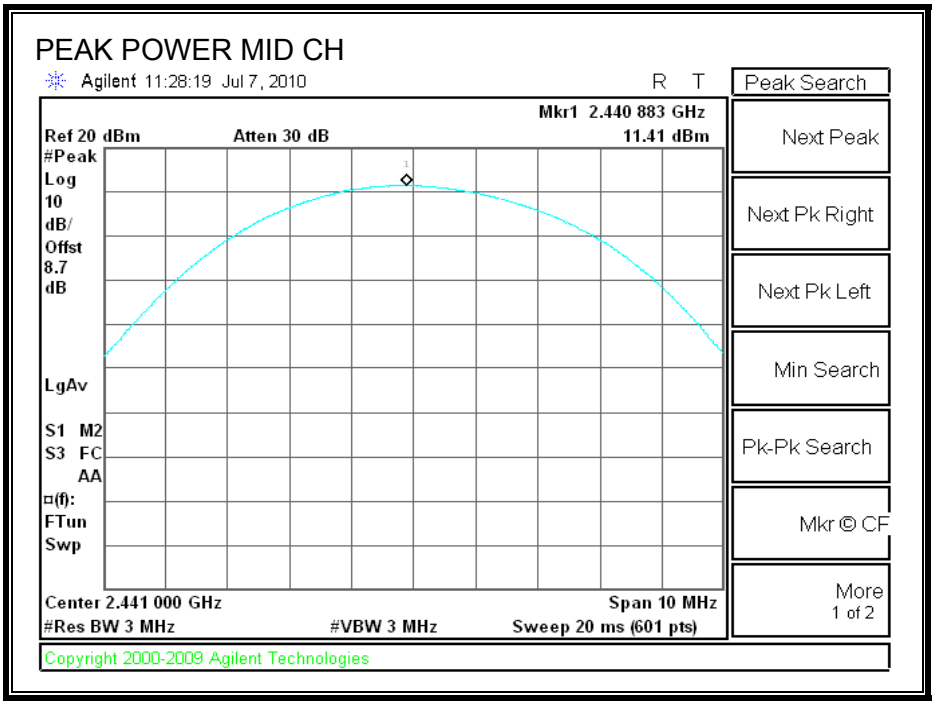
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

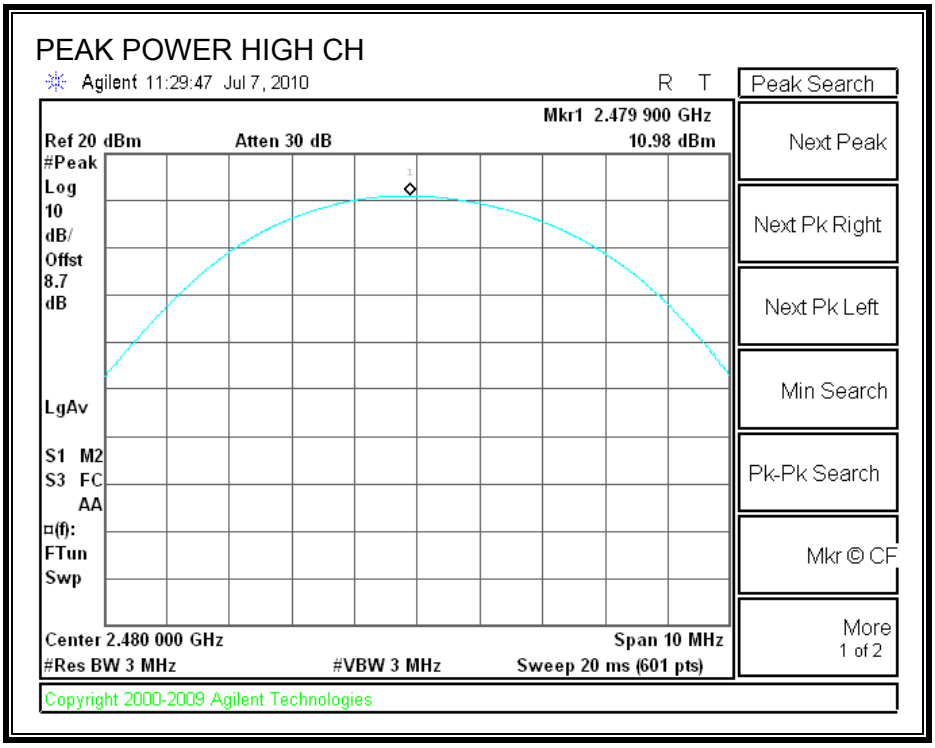
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.08	21	-9.92
Middle	2441	11.41	21	-9.59
High	2480	10.98	21	-10.02

OUTPUT POWER





PEAK POWER HIGH CH



7.3.6. 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 8.7 dB (including splitter 6.5 dB pad and 2.2 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	7.90
Middle	2441	8.20
High	2480	8.10

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

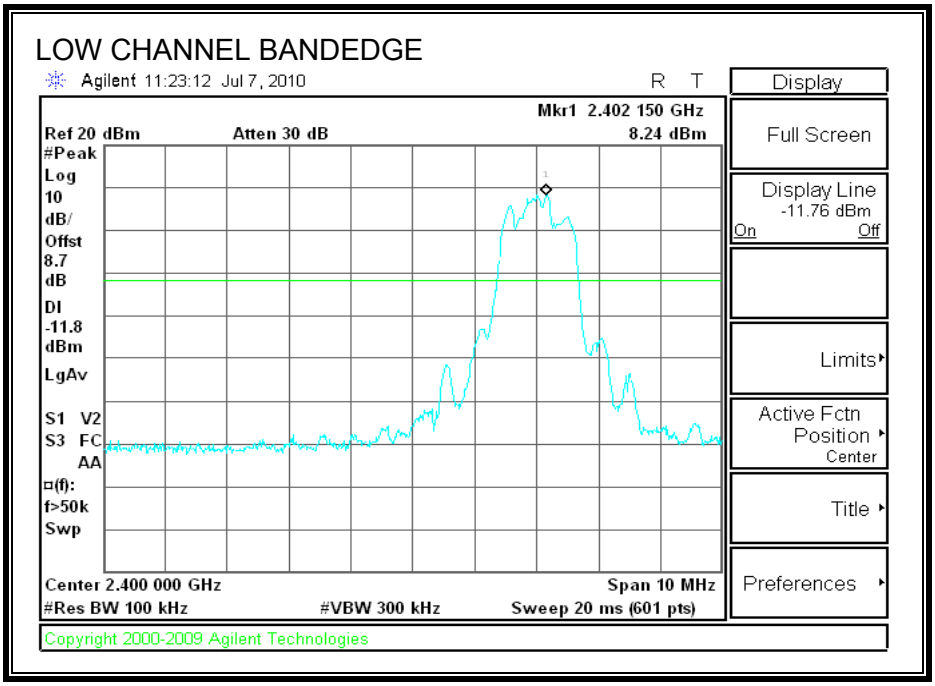
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

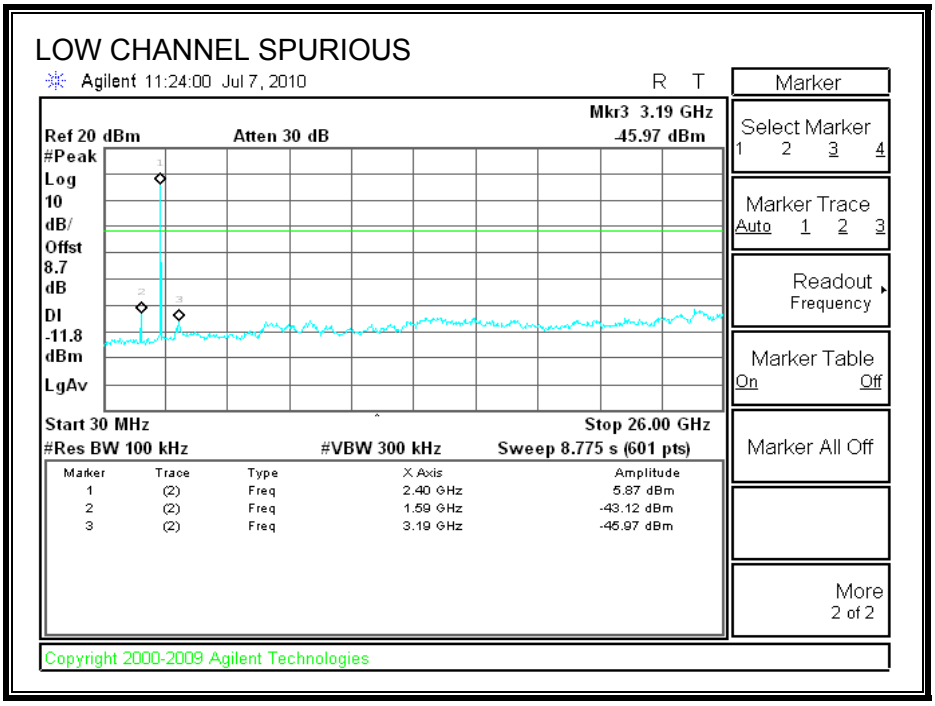
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

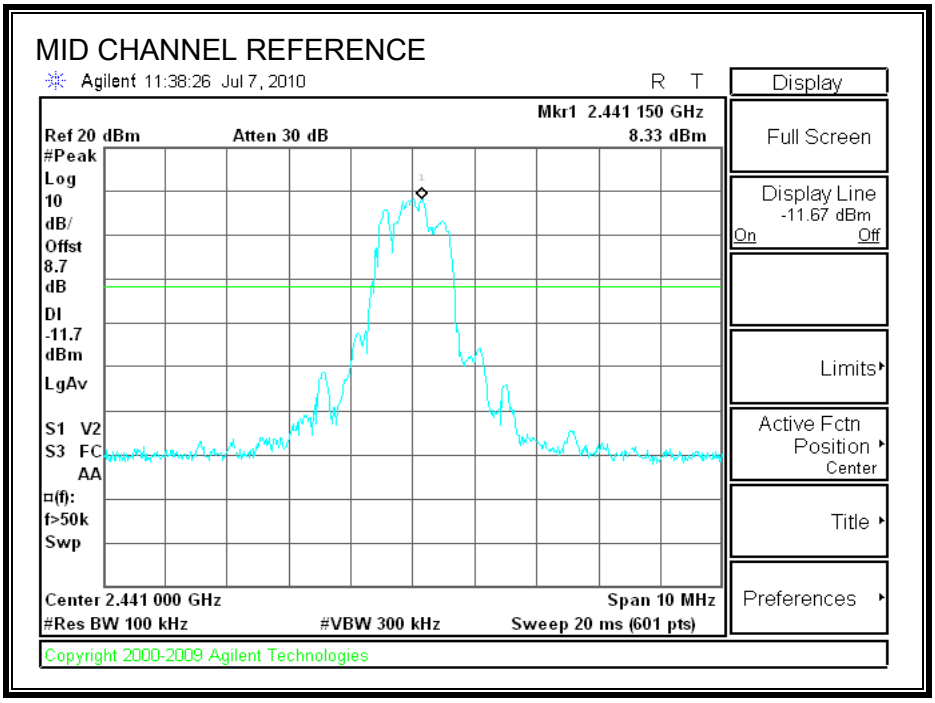
RESULTS

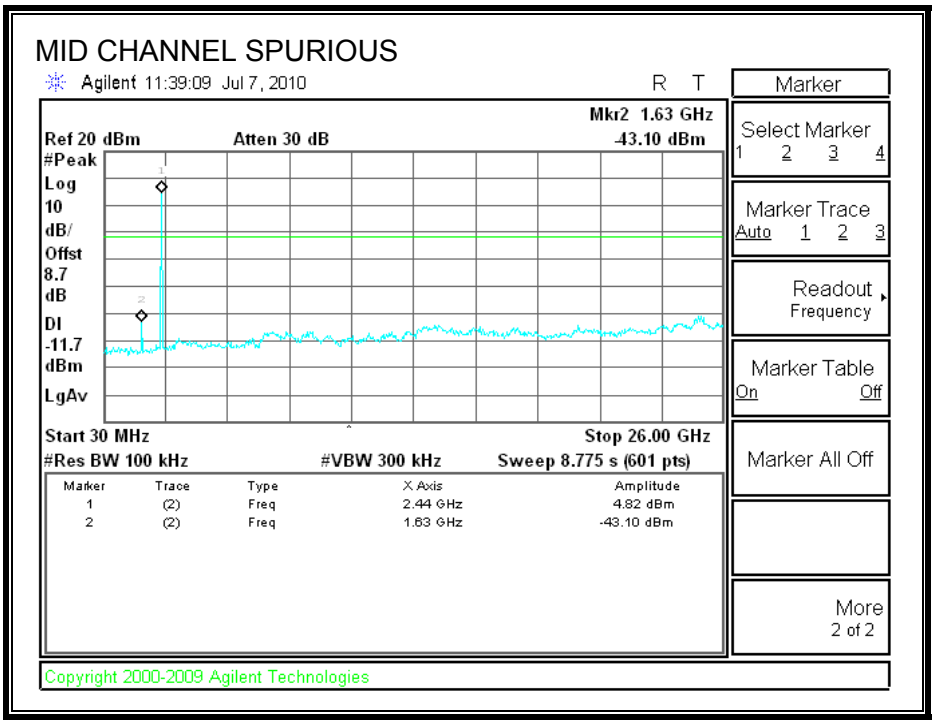
SPURIOUS EMISSIONS, LOW CHANNEL



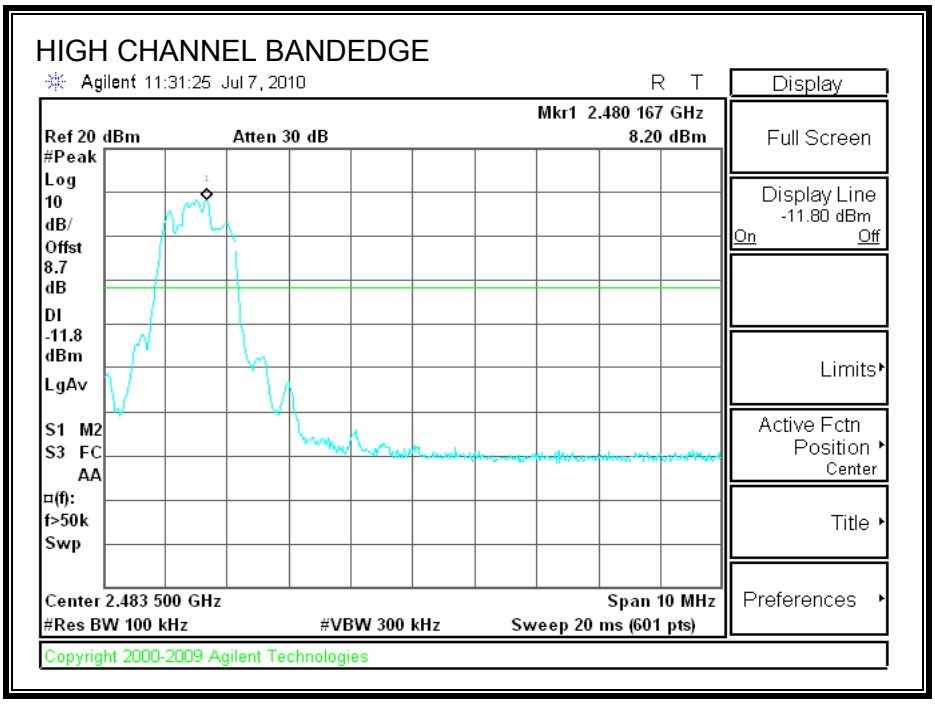


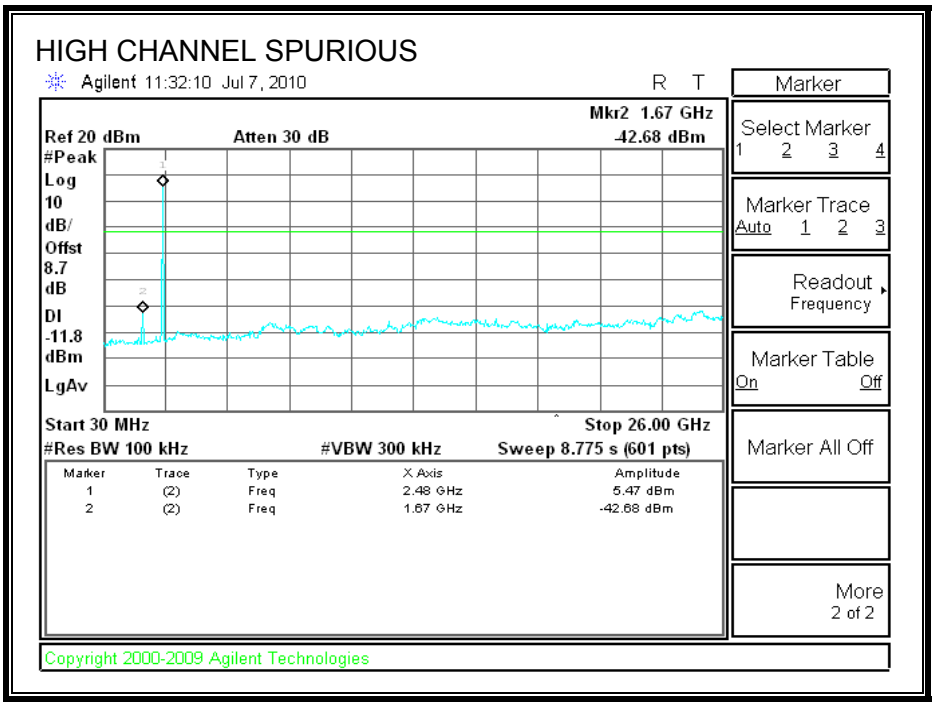
SPURIOUS EMISSIONS, MID CHANNEL





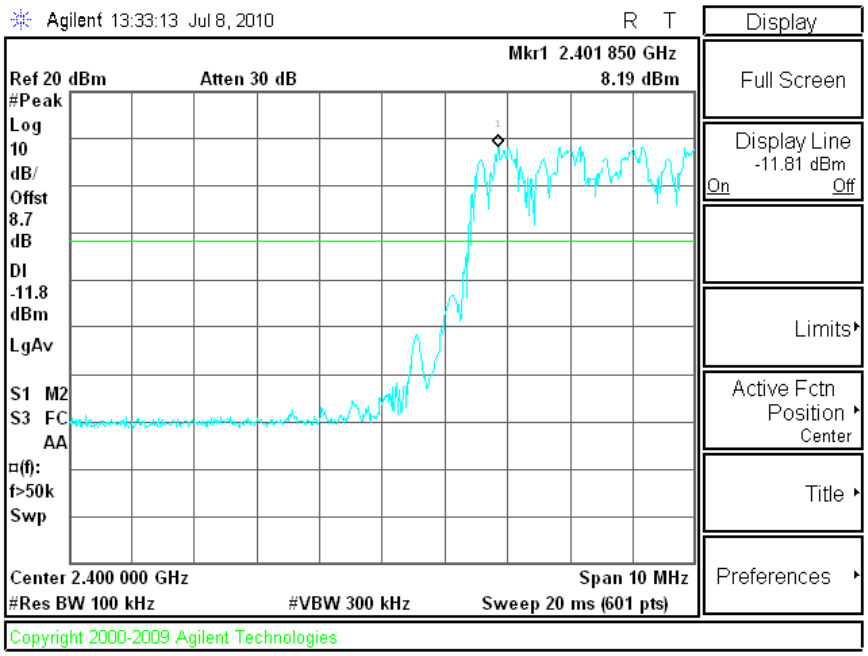
SPURIOUS EMISSIONS, HIGH CHANNEL



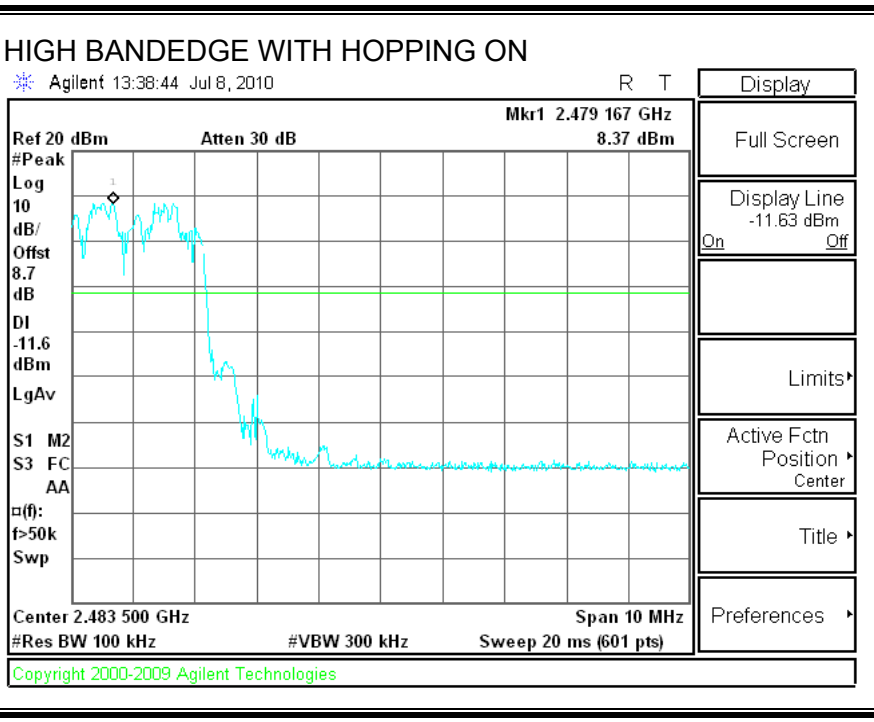


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE 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, 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.

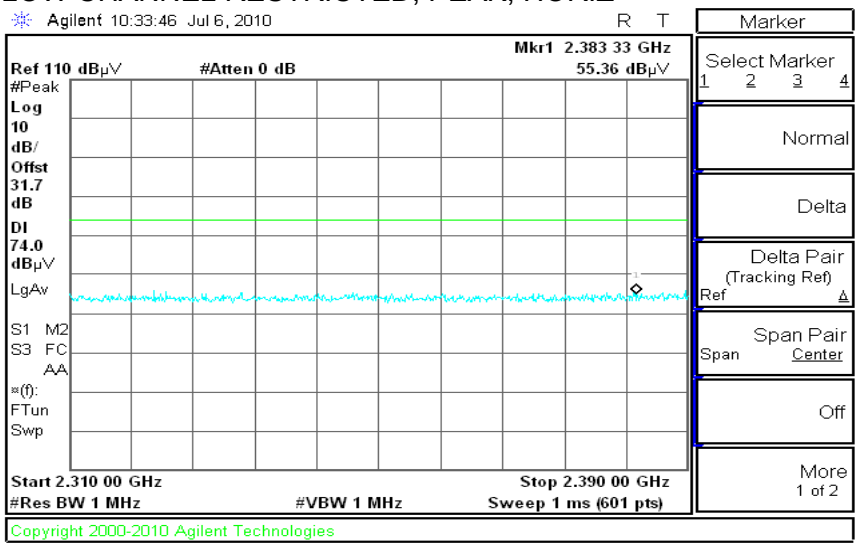
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

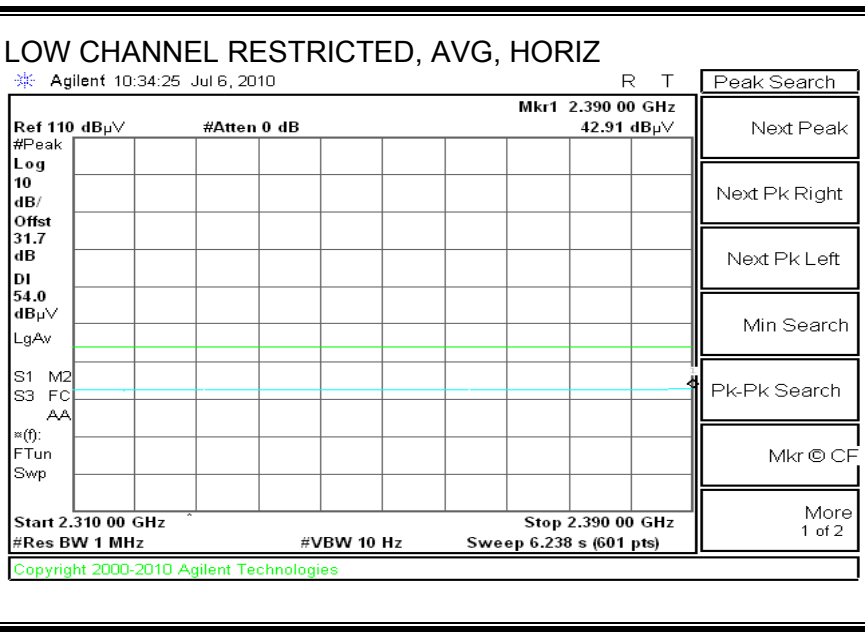
8.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

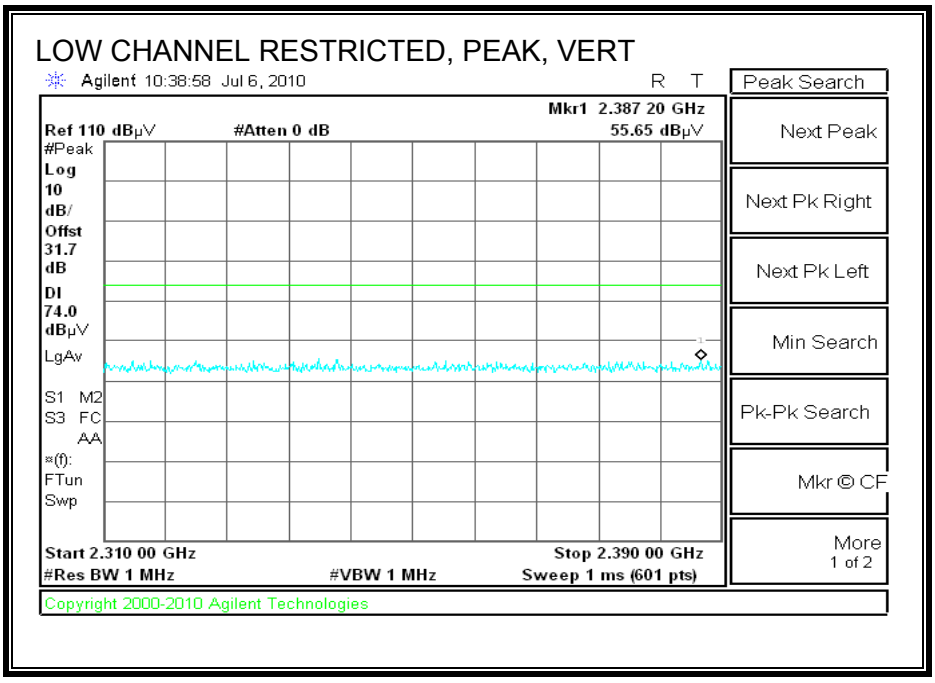
LOW CHANNEL RESTRICTED, PEAK, HORIZ

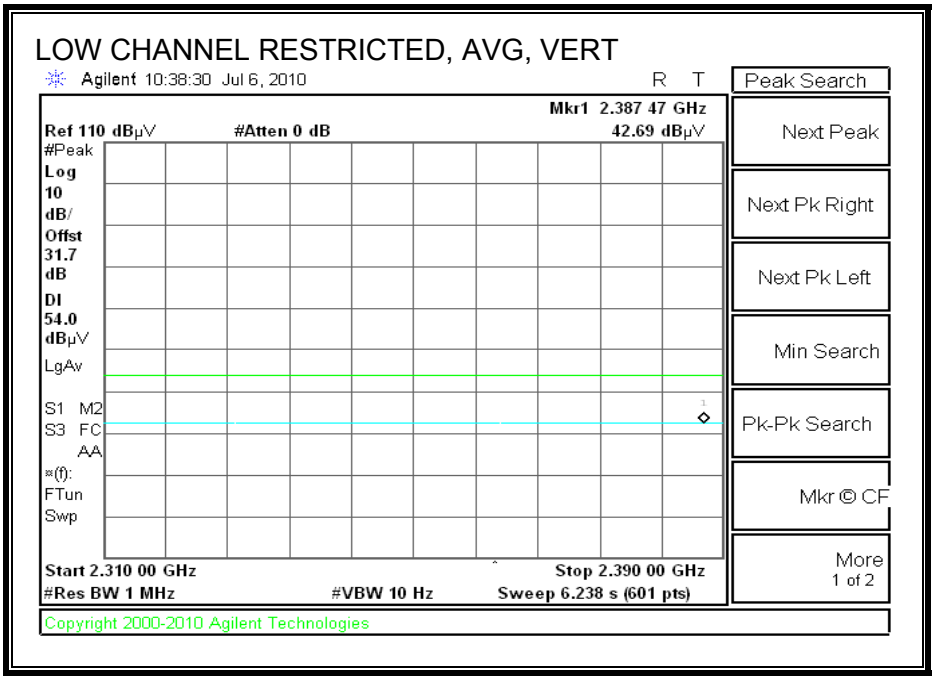


LOW CHANNEL RESTRICTED, AVG, HORIZ

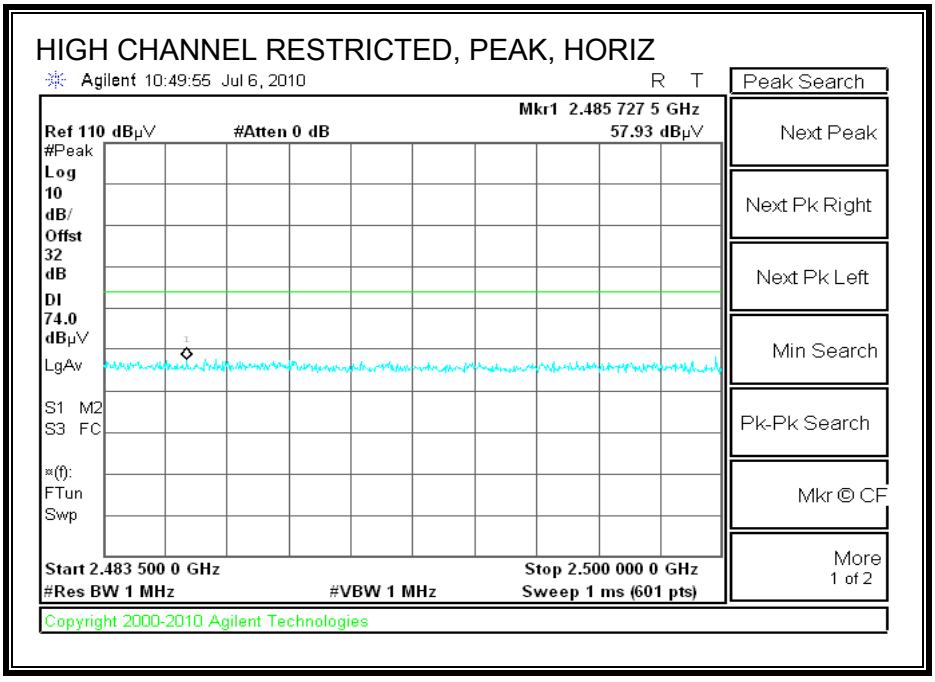


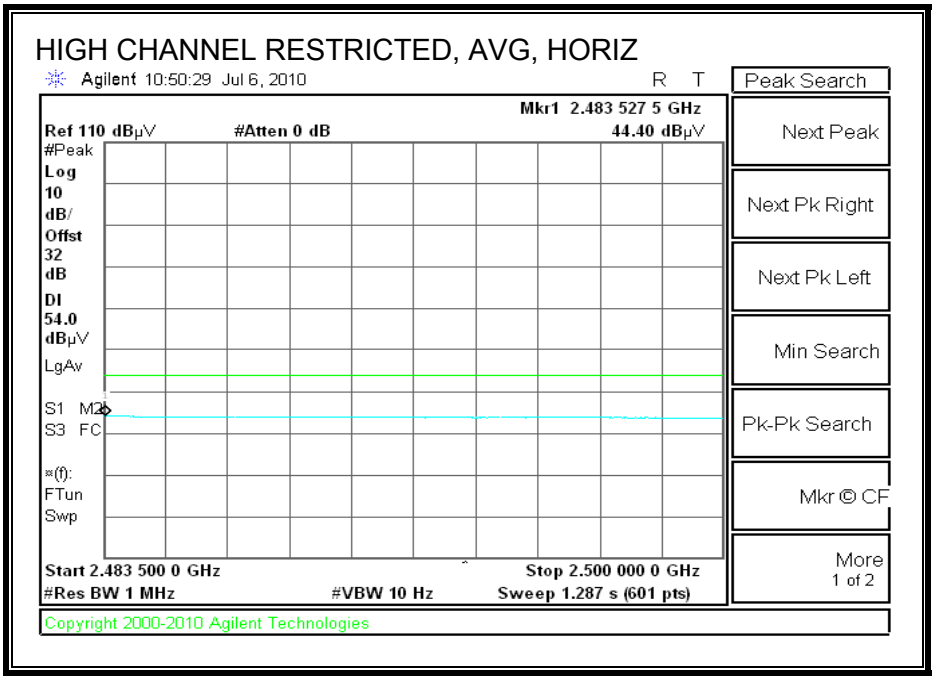
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



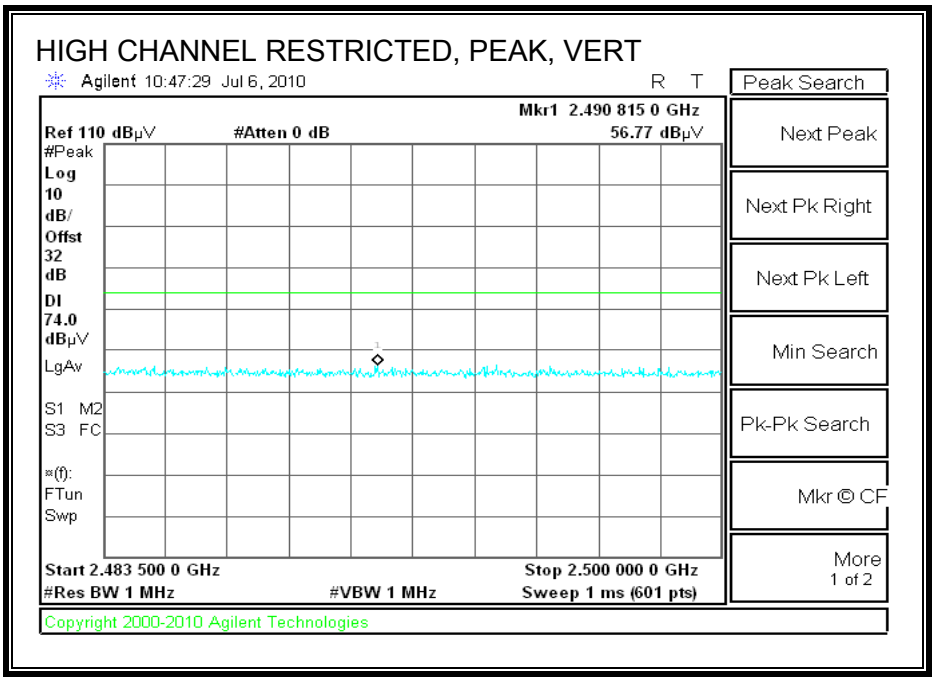


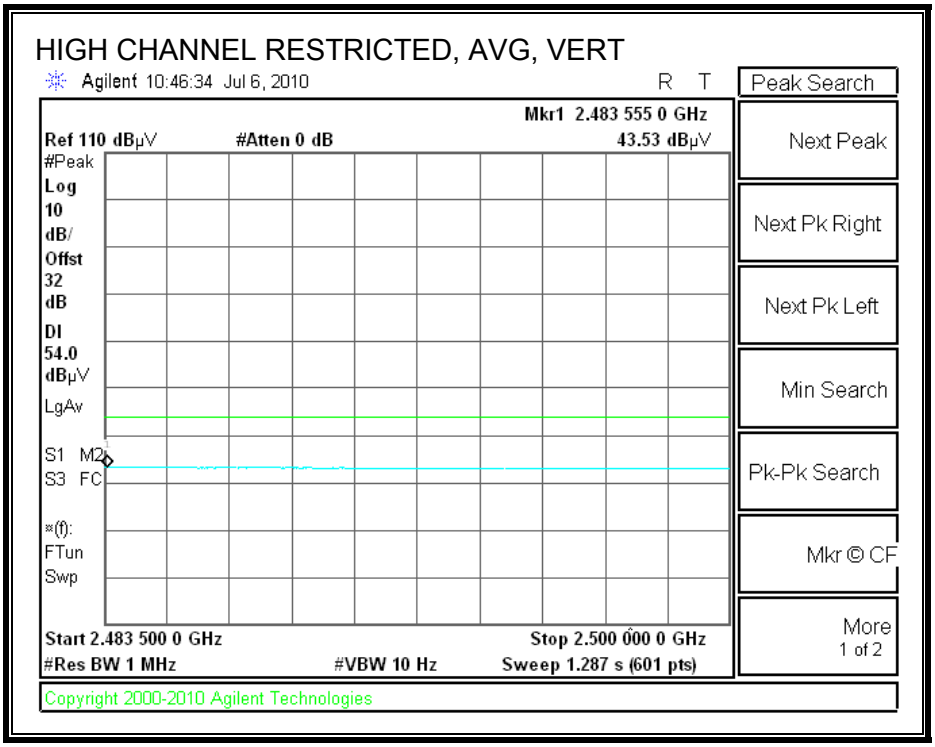
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 07/06/10
Project #: 10U13294
EUT Description: 802.11 bgn+BT (EDR)
Test Target: FCC 15.247
Mode Oper: TX, BT, GFSK

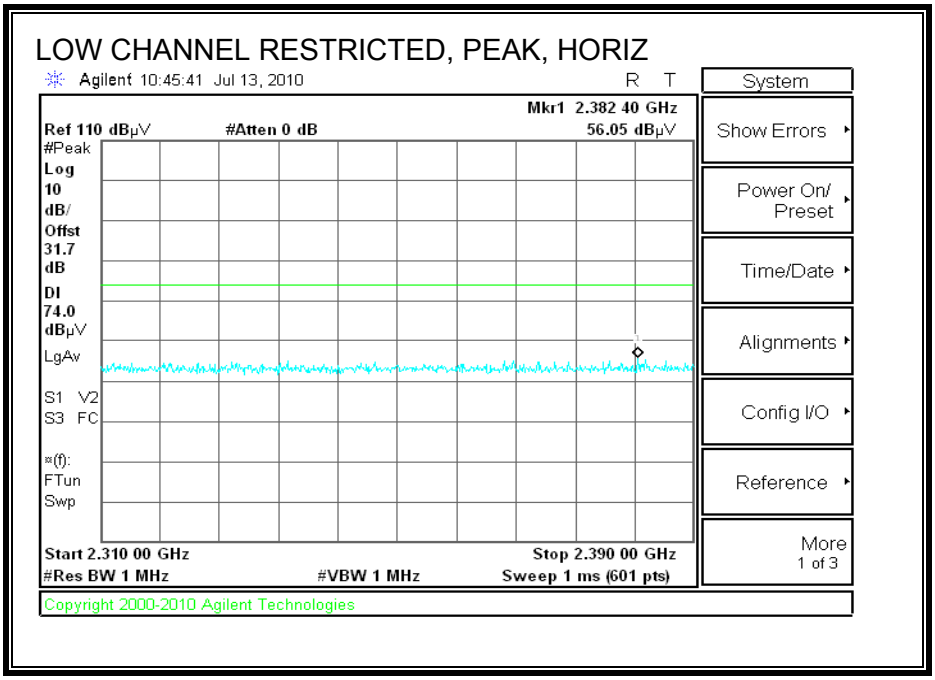
f	Measurement Frequency	Amp	Preamp Gain
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m
AF	Antenna Factor	Peak	Calculated Peak Field Strength
CL	Cable Loss	HPF	High Pass Filter

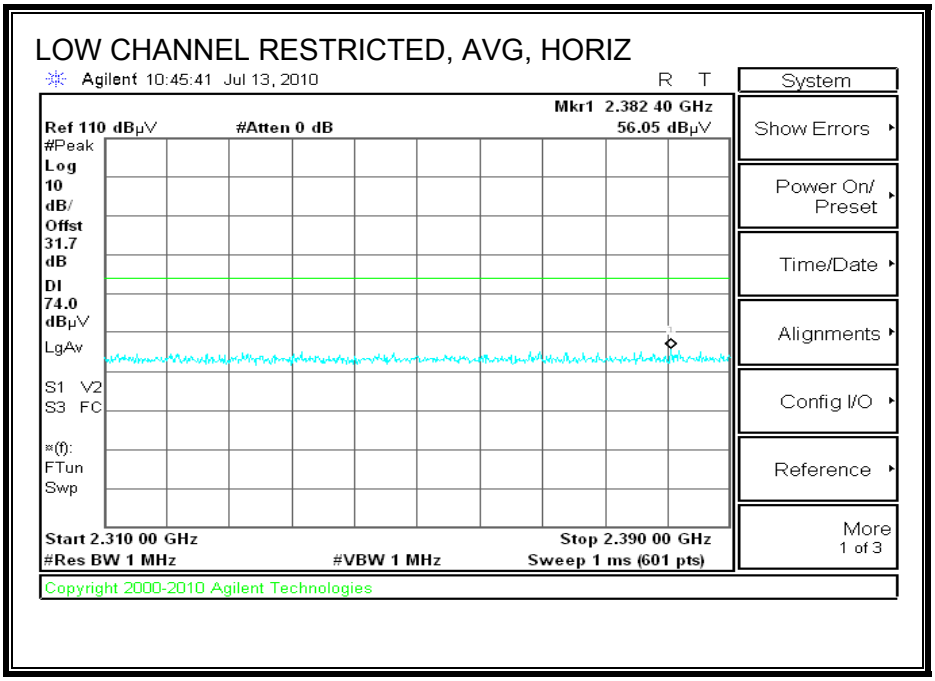
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 2402MHz													
4.804	3.0	37.8	32.8	5.8	-34.8	0.0	0.0	41.5	74.0	-32.5	H	P	
4.804	3.0	25.6	32.8	5.8	-34.8	0.0	0.0	29.3	54.0	-24.7	H	A	
4.804	3.0	38.2	32.8	5.8	-34.8	0.0	0.0	41.9	74.0	-32.1	V	P	
4.804	3.0	25.6	32.8	5.8	-34.8	0.0	0.0	29.3	54.0	-24.7	V	A	
Mid Ch, 2441MHz													
4.882	3.0	37.8	32.8	5.8	-34.9	0.0	0.0	41.6	74.0	-32.4	H	P	
4.882	3.0	25.4	32.8	5.8	-34.9	0.0	0.0	29.2	54.0	-24.8	H	A	
7.323	3.0	37.7	35.2	7.3	-34.7	0.0	0.0	45.6	74.0	-28.4	H	P	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	H	A	
4.882	3.0	37.8	32.8	5.8	-34.9	0.0	0.0	41.6	74.0	-32.4	V	P	
4.882	3.0	25.4	32.8	5.8	-34.9	0.0	0.0	29.2	54.0	-24.8	V	A	
7.323	3.0	37.4	35.2	7.3	-34.7	0.0	0.0	45.3	74.0	-28.7	V	P	
7.323	3.0	25.4	35.2	7.3	-34.7	0.0	0.0	33.2	54.0	-20.8	V	A	
High Ch, 2480MHz													
4.960	3.0	37.2	32.9	5.9	-34.9	0.0	0.0	41.1	74.0	-32.9	H	P	
4.960	3.0	25.4	32.9	5.9	-34.9	0.0	0.0	29.3	54.0	-24.7	H	A	
7.440	3.0	37.2	35.4	7.3	-34.6	0.0	0.0	45.3	74.0	-28.7	H	P	
7.440	3.0	24.6	35.4	7.3	-34.6	0.0	0.0	32.7	54.0	-21.3	H	A	
4.960	3.0	38.4	32.9	5.9	-34.9	0.0	0.0	42.4	74.0	-31.6	V	P	
4.960	3.0	25.3	32.9	5.9	-34.9	0.0	0.0	29.2	54.0	-24.8	V	A	
7.440	3.0	37.2	35.4	7.3	-34.6	0.0	0.0	45.3	74.0	-28.7	V	P	
7.440	3.0	24.8	35.4	7.3	-34.6	0.0	0.0	32.8	54.0	-21.2	V	A	

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

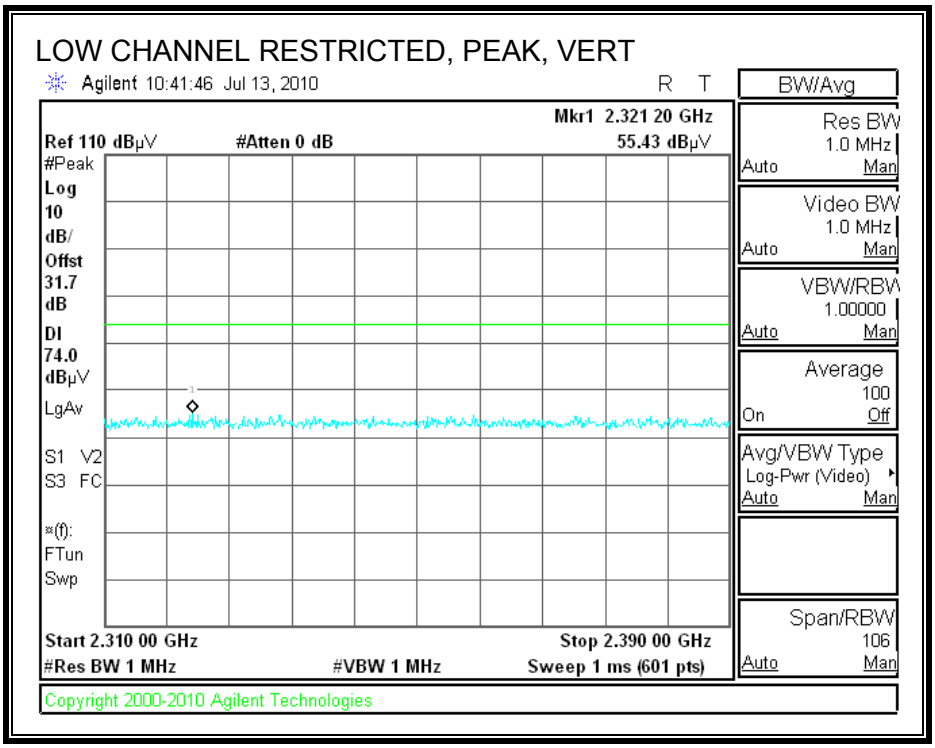
8.2.2. ENHANCED DATA RATE QPSK MODULATION

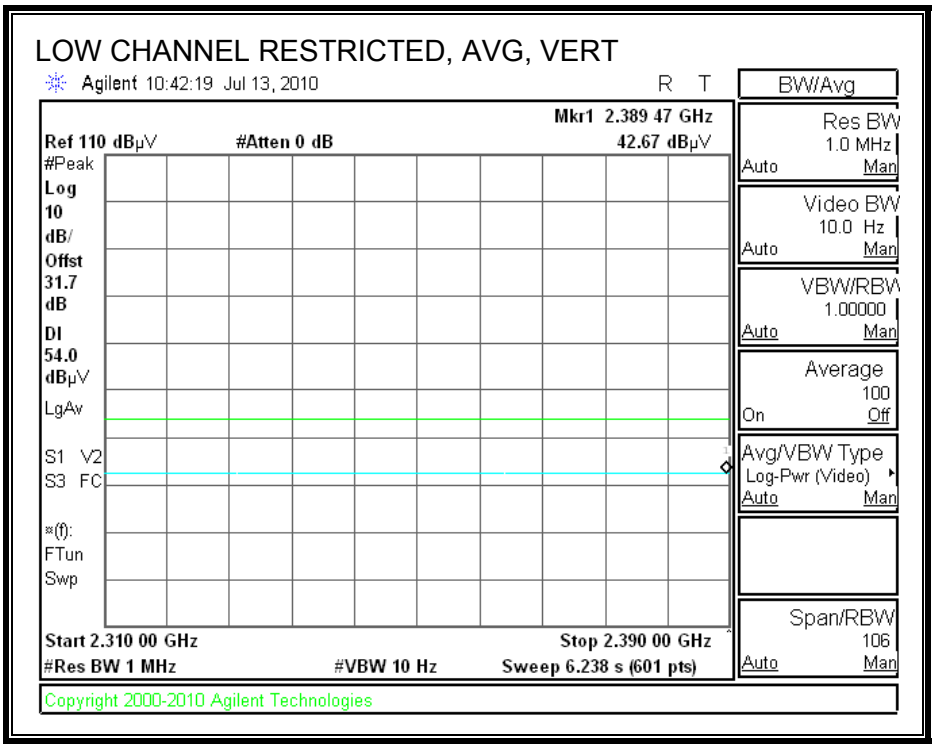
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



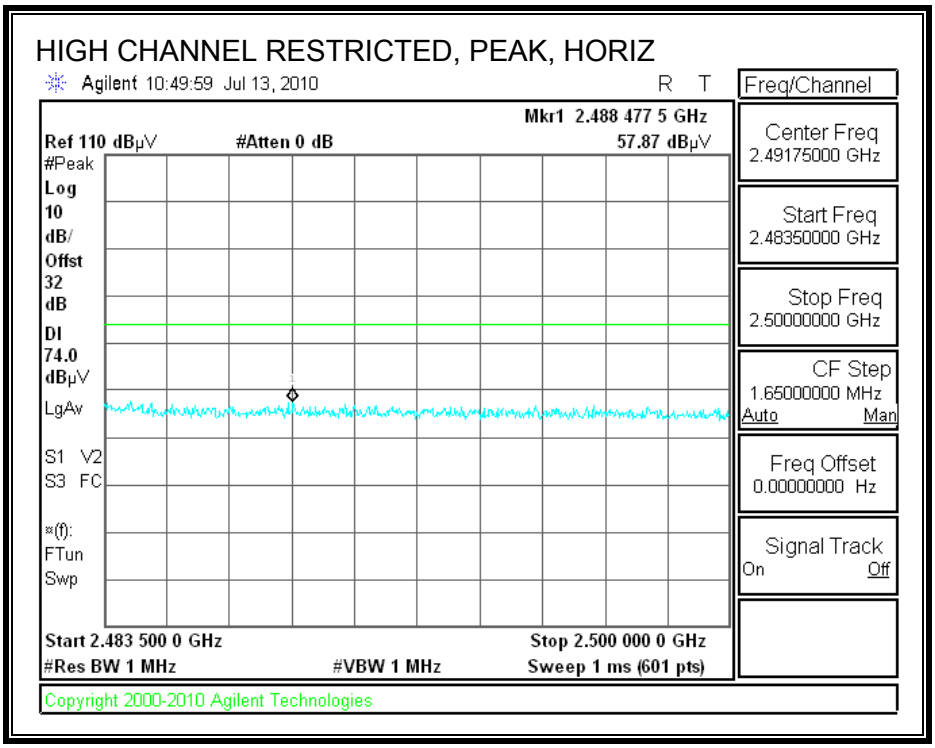


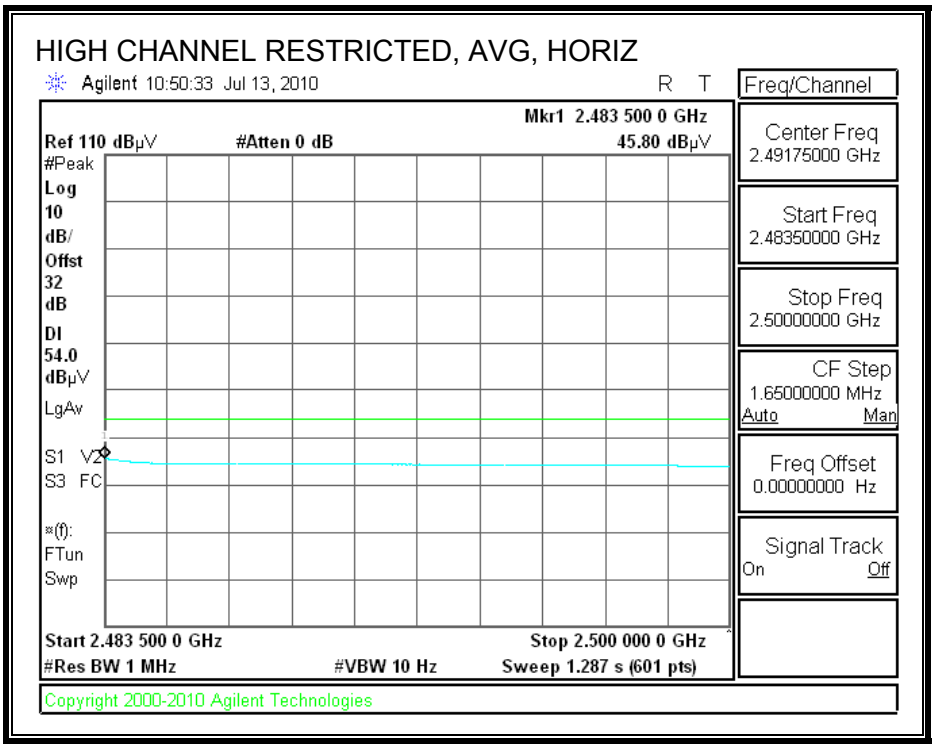
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



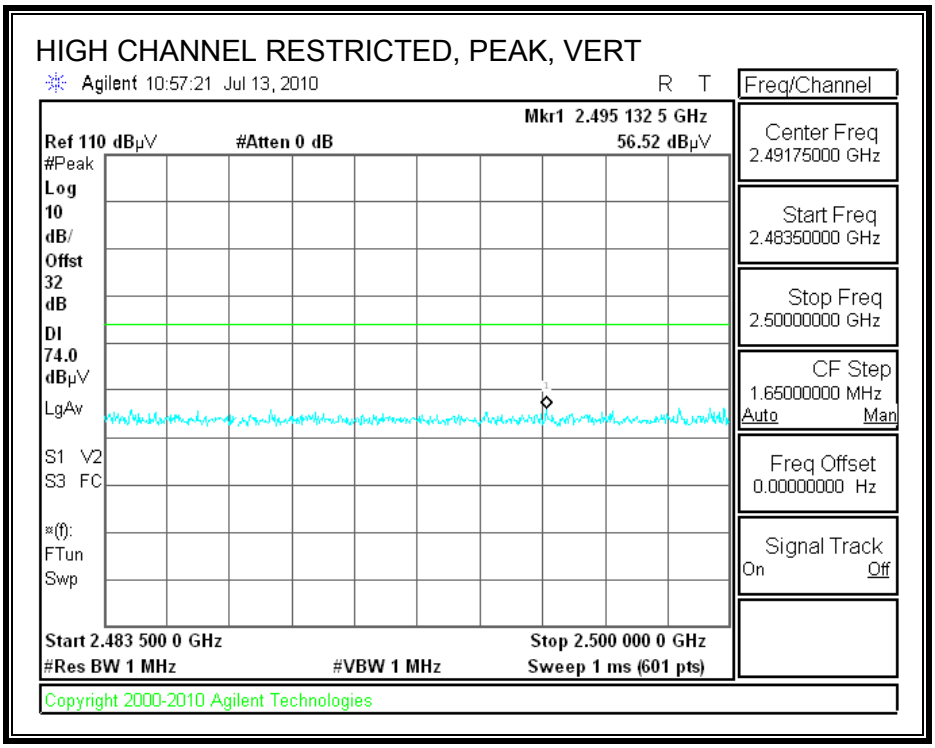


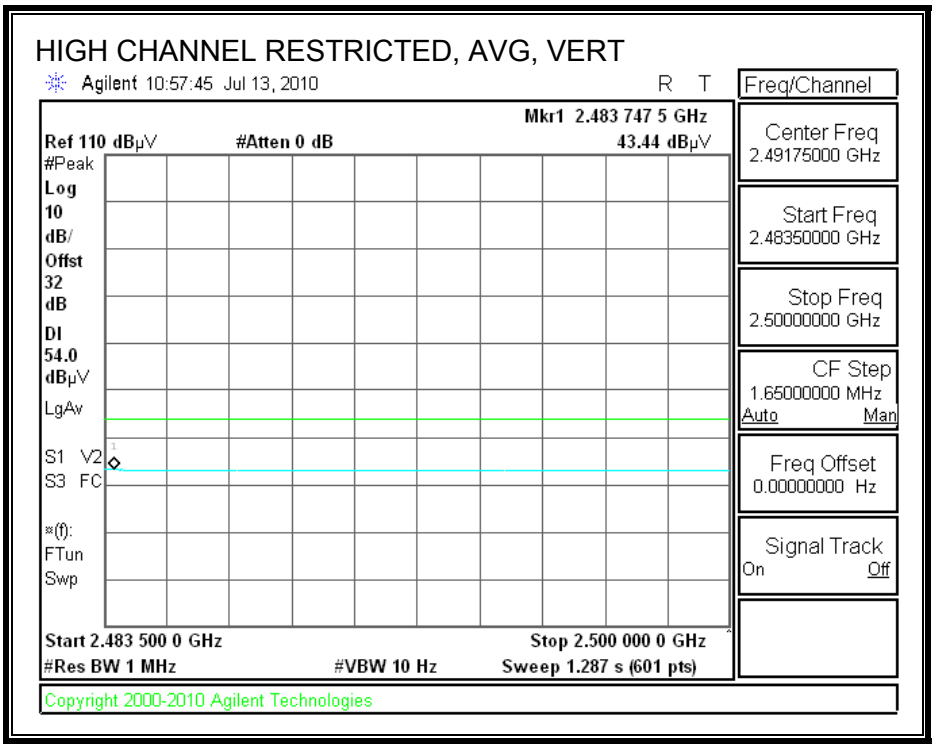
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 07/13/10
Project #: 10U13294
EUT Description: 802.11 bgn + BT 2.1 (EDR)
Test Target: FCC 15.247
Mode Oper: TX, BT QPSK

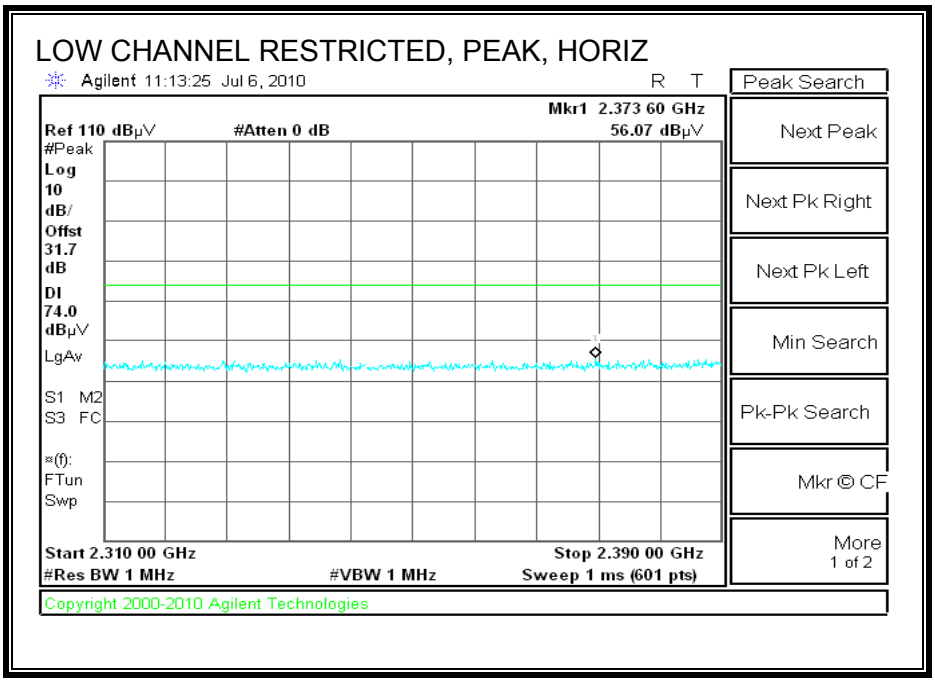
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

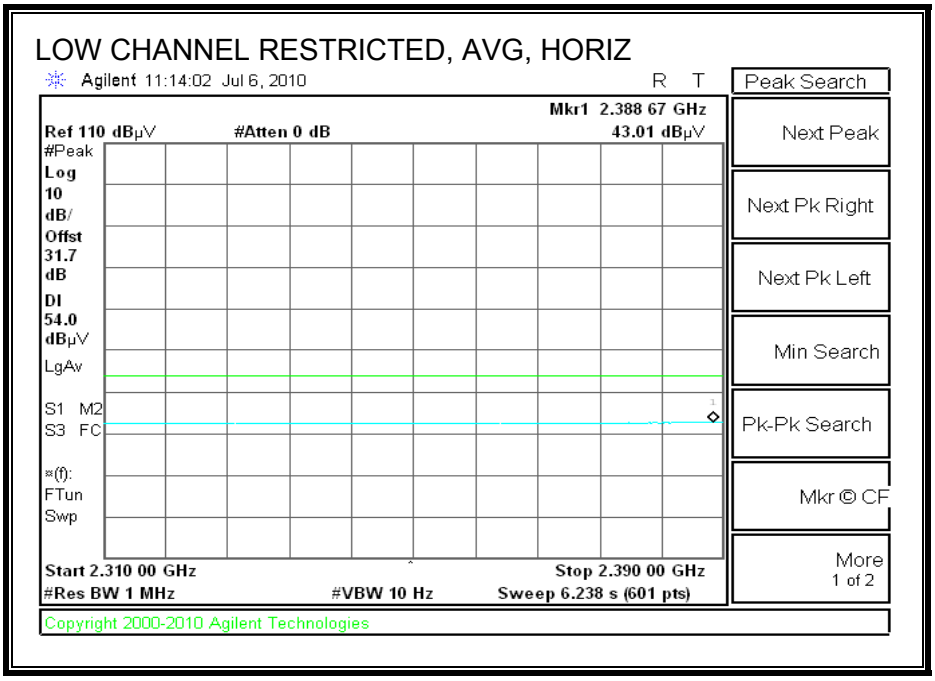
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 2402MHz													
4.804	3.0	39.1	32.8	5.8	-34.8	0.0	0.0	42.8	74.0	-31.2	H	P	
4.804	3.0	26.0	32.8	5.8	-34.8	0.0	0.0	29.7	54.0	-24.3	H	A	
4.804	3.0	38.9	32.8	5.8	-34.8	0.0	0.0	42.6	74.0	-31.4	V	P	
4.804	3.0	26.0	32.8	5.8	-34.8	0.0	0.0	29.7	54.0	-24.3	V	A	
Mid Ch, 2441MHz													
4.882	3.0	38.3	32.8	5.8	-34.9	0.0	0.0	42.1	74.0	-31.9	H	P	
4.882	3.0	26.4	32.8	5.8	-34.9	0.0	0.0	30.2	54.0	-23.8	H	A	
7.323	3.0	37.2	35.2	7.3	-34.7	0.0	0.0	45.0	74.0	-29.0	H	P	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	H	A	
4.882	3.0	37.6	32.8	5.8	-34.9	0.0	0.0	41.4	74.0	-32.6	V	P	
4.882	3.0	25.5	32.8	5.8	-34.9	0.0	0.0	29.3	54.0	-24.7	V	A	
7.323	3.0	36.9	35.2	7.3	-34.7	0.0	0.0	44.7	74.0	-29.3	V	P	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	V	A	
High Ch, 2480MHz													
4.960	3.0	37.6	32.9	5.9	-34.9	0.0	0.0	41.5	74.0	-32.5	H	P	
4.960	3.0	25.5	32.9	5.9	-34.9	0.0	0.0	29.4	54.0	-24.6	H	A	
7.440	3.0	36.9	35.4	7.3	-34.6	0.0	0.0	45.0	74.0	-29.0	H	P	
7.440	3.0	24.7	35.4	7.3	-34.6	0.0	0.0	32.8	54.0	-21.2	H	A	
4.960	3.0	37.8	32.9	5.9	-34.9	0.0	0.0	41.7	74.0	-32.3	V	P	
4.960	3.0	25.4	32.9	5.9	-34.9	0.0	0.0	29.3	54.0	-24.7	V	A	
7.440	3.0	37.0	35.4	7.3	-34.6	0.0	0.0	45.1	74.0	-28.9	V	P	
7.440	3.0	24.8	35.4	7.3	-34.6	0.0	0.0	32.9	54.0	-21.1	V	A	

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

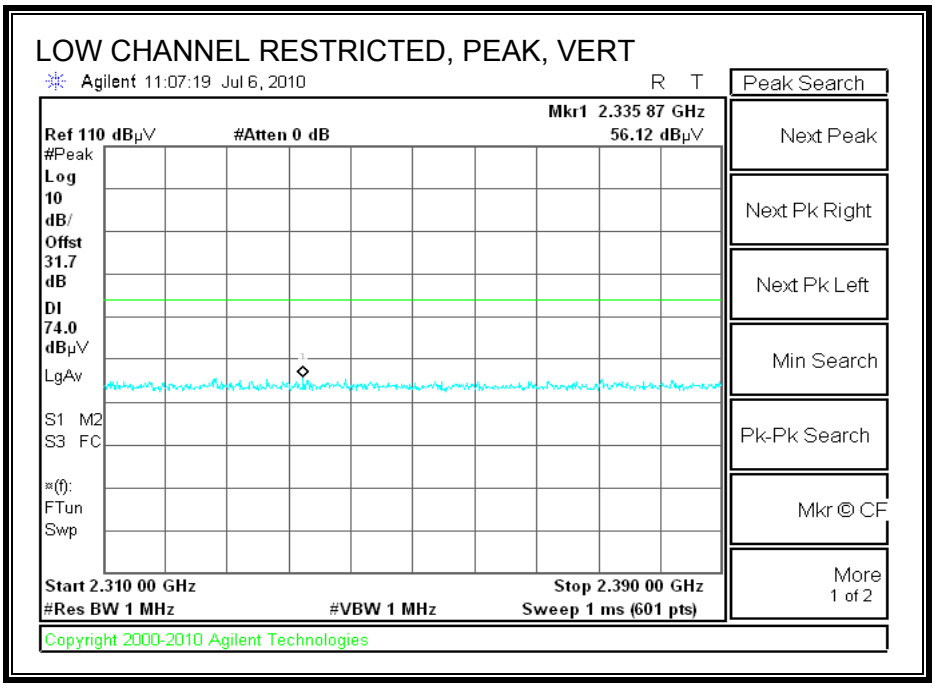
8.2.3. ENHANCED DATA RATE 8PSK MODULATION

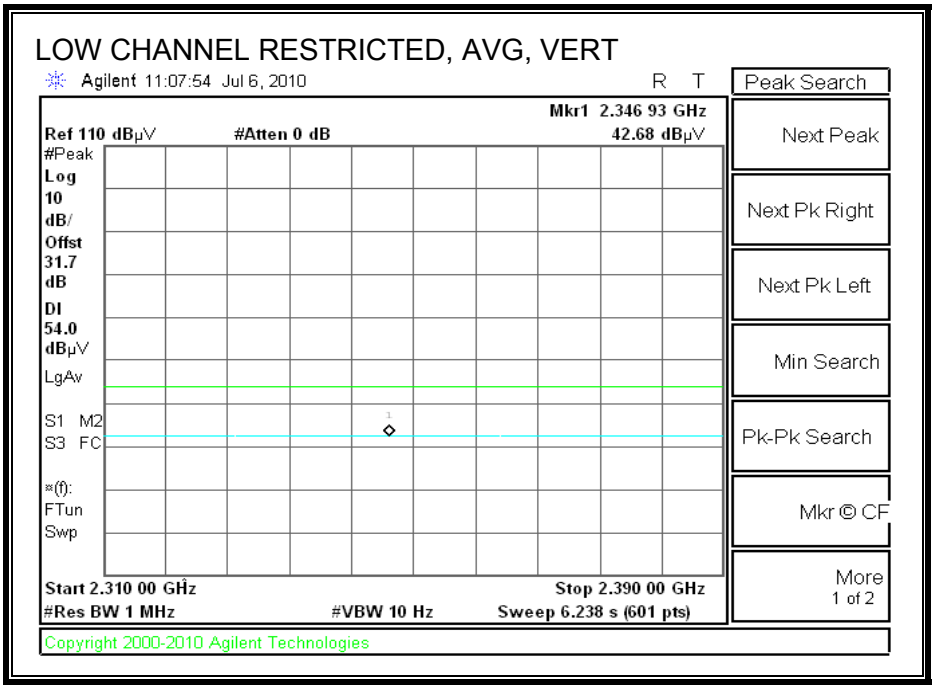
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



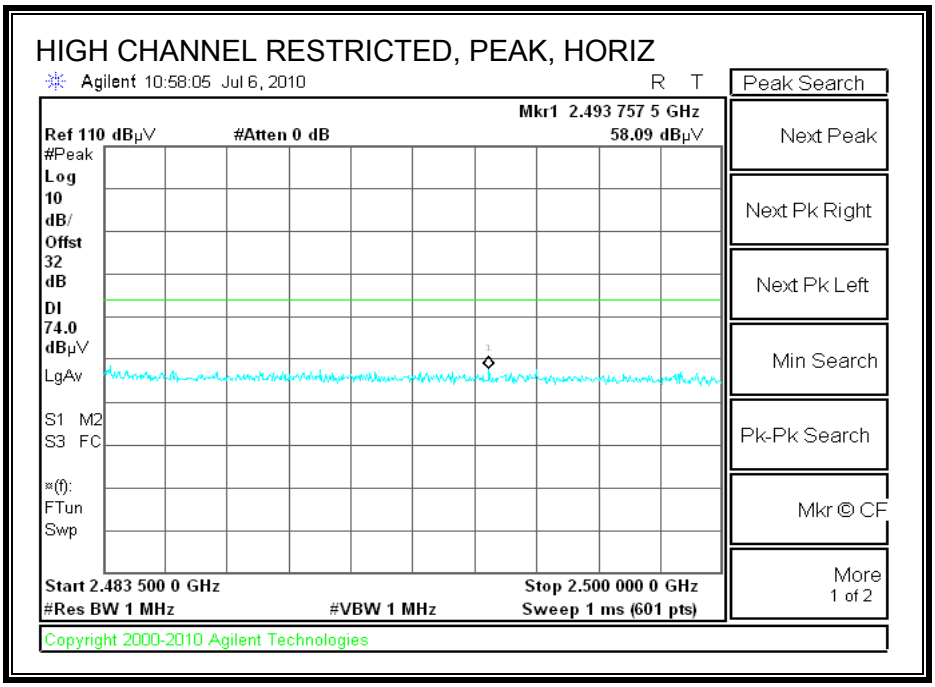


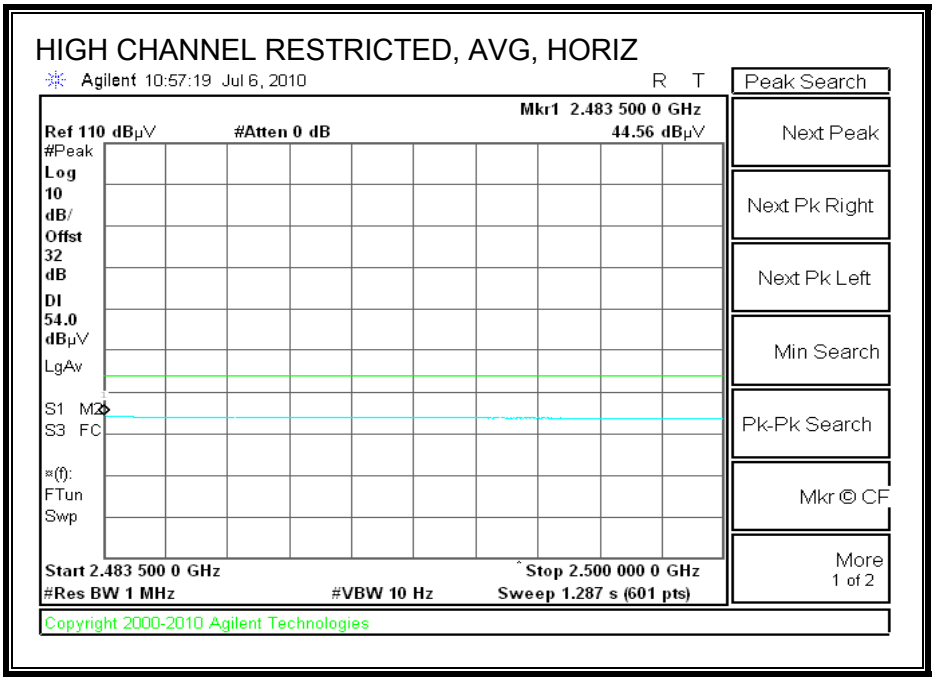
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



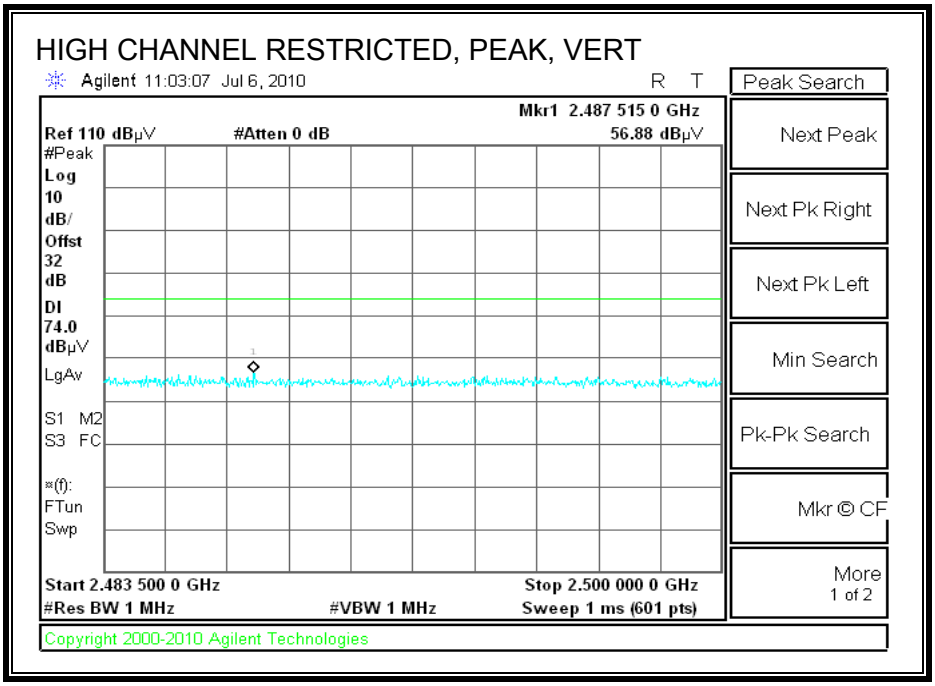


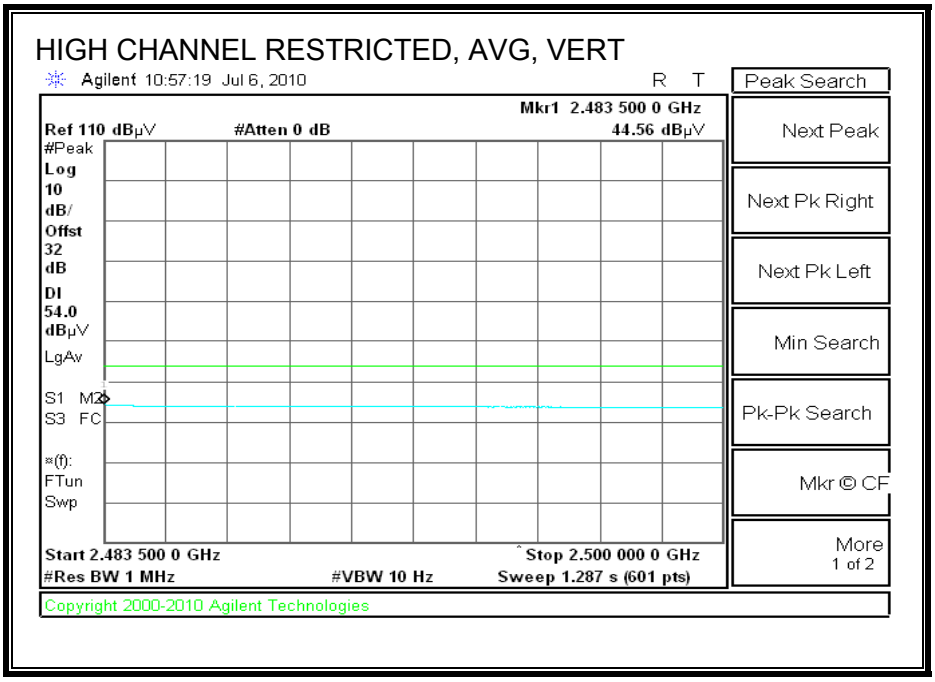
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 07/06/10
Project #: 10U13294
EUT Description: 802.11 bgn+BT (EDR)
Test Target: FCC 15.247
Mode Oper: TX, BT, 8PSK

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	Notes
Low Ch, 2402MHz													
4.804	3.0	37.9	32.8	5.8	-34.8	0.0	0.0	41.6	74.0	-32.4	V	P	
4.804	3.0	25.6	32.8	5.8	-34.8	0.0	0.0	29.3	54.0	-24.7	V	A	
4.804	3.0	38.0	32.8	5.8	-34.8	0.0	0.0	41.7	74.0	-32.3	H	P	
4.804	3.0	25.7	32.8	5.8	-34.8	0.0	0.0	29.4	54.0	-24.6	H	A	
Mid Ch, 2441MHz													
4.882	3.0	37.6	32.8	5.8	-34.9	0.0	0.0	41.4	74.0	-32.6	V	P	
4.882	3.0	25.3	32.8	5.8	-34.9	0.0	0.0	29.1	54.0	-24.9	V	A	
7.323	3.0	37.2	35.2	7.3	-34.7	0.0	0.0	45.1	74.0	-28.9	V	P	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	V	A	
4.882	3.0	37.4	32.8	5.8	-34.9	0.0	0.0	41.2	74.0	-32.8	H	P	
4.882	3.0	25.3	32.8	5.8	-34.9	0.0	0.0	29.1	54.0	-24.9	H	A	
7.323	3.0	37.0	35.2	7.3	-34.7	0.0	0.0	44.8	74.0	-29.2	H	P	
7.323	3.0	24.6	35.2	7.3	-34.7	0.0	0.0	32.4	54.0	-21.6	H	A	
High Ch, 2480MHz													
4.960	3.0	38.4	32.9	5.9	-34.9	0.0	0.0	42.3	74.0	-31.7	V	P	
4.960	3.0	25.3	32.9	5.9	-34.9	0.0	0.0	29.2	54.0	-24.8	V	A	
7.440	3.0	37.5	35.4	7.3	-34.6	0.0	0.0	45.5	74.0	-28.5	V	P	
7.440	3.0	24.8	35.4	7.3	-34.6	0.0	0.0	32.9	54.0	-21.1	V	A	
4.960	3.0	37.7	32.9	5.9	-34.9	0.0	0.0	41.7	74.0	-32.3	H	P	
4.960	3.0	25.3	32.9	5.9	-34.9	0.0	0.0	29.2	54.0	-24.8	H	A	
7.440	3.0	36.5	35.4	7.3	-34.6	0.0	0.0	44.5	74.0	-29.5	H	P	
7.440	3.0	24.6	35.4	7.3	-34.6	0.0	0.0	32.7	54.0	-21.3	H	A	

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

8.3. RECEIVER ABOVE 1 GHz

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Project #: 10U13294
Date: 7/6/2010
Test Engineer: Chin Pang
Configuration: EUT and AC Adapter
Mode: RX, BT

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T59; S/N: 3245 @3m	T145 Agilent 3008A0056			FCC 15.209

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.037	3.0	46.5	32.0	24.1	2.4	-36.1	0.0	0.0	36.9	22.4	74	54	-37.1	-31.6	H
1.680	3.0	45.0	30.0	26.4	3.1	-35.6	0.0	0.0	38.9	23.9	74	54	-35.1	-30.1	H
1.720	3.0	44.4	29.5	26.6	3.2	-35.6	0.0	0.0	38.6	23.7	74	54	-35.4	-30.3	H
1.137	3.0	46.3	32.0	24.4	2.5	-36.0	0.0	0.0	37.2	22.9	74	54	-36.8	-31.1	V
1.680	3.0	45.3	30.6	26.4	3.1	-35.6	0.0	0.0	39.2	24.5	74	54	-34.8	-29.5	V
1.720	3.0	44.6	31.3	26.6	3.2	-35.6	0.0	0.0	38.8	25.5	74	54	-35.2	-28.5	V

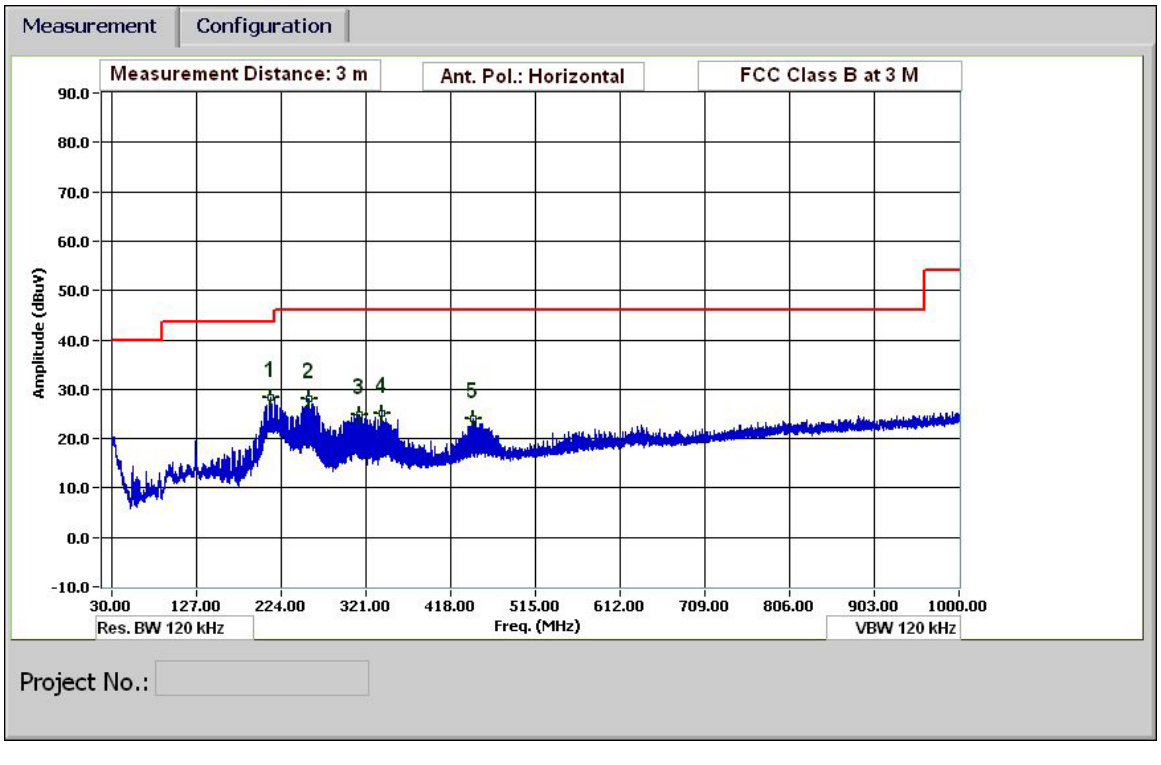
Note: No emissions were found above 1GHz within 20dB of the limit.
Rev. 07.22.09

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

8.4. WORST-CASE BELOW 1 GHz

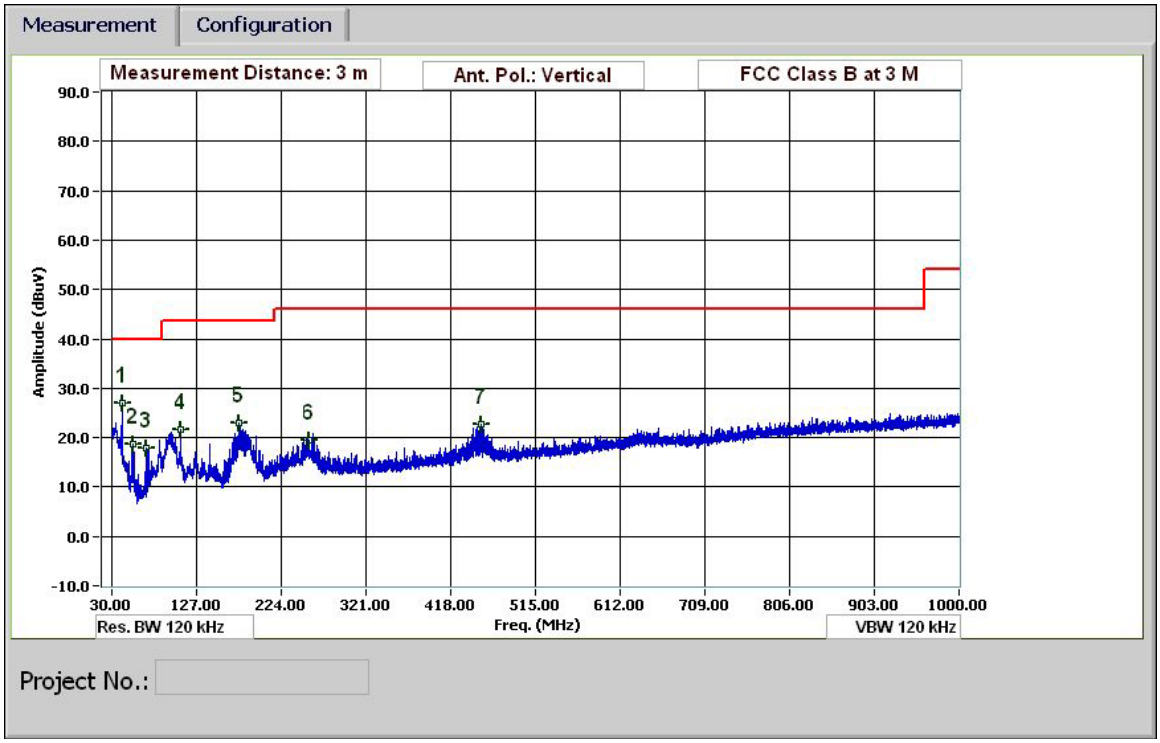
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

VERTICAL PLOT



VERTICAL& HORIZONTAL DATA

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 07/06/10
Project #: 10U13294
EUT Description: 802.11 bgn + BT 2.1 (EDR)
Test Target: FCC 15C
Mode Oper: TX, BT (Worst Case)

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
212.048	3.0	44.0	12.0	1.3	28.9	0.0	0.0	28.4	43.5	-15.1	H	P	
256.209	3.0	43.3	12.0	1.4	28.8	0.0	0.0	27.9	46.0	-18.1	H	P	
312.732	3.0	38.5	13.5	1.6	28.8	0.0	0.0	24.8	46.0	-21.2	H	P	
339.133	3.0	38.5	14.0	1.7	29.0	0.0	0.0	25.2	46.0	-20.8	H	P	
444.017	3.0	35.6	15.8	2.0	29.5	0.0	0.0	24.0	46.0	-22.0	H	P	
42.241	3.0	43.5	12.7	0.6	29.6	0.0	0.0	27.1	40.0	-12.9	V	P	
53.761	3.0	39.8	7.9	0.6	29.6	0.0	0.0	18.8	40.0	-21.2	V	P	
70.082	3.0	38.5	8.3	0.7	29.6	0.0	0.0	17.9	40.0	-22.1	V	P	
109.563	3.0	38.5	11.8	0.9	29.5	0.0	0.0	21.7	43.5	-21.8	V	P	
175.686	3.0	40.9	10.0	1.2	29.2	0.0	0.0	22.9	43.5	-20.6	V	P	
256.569	3.0	34.8	12.0	1.5	28.8	0.0	0.0	19.5	46.0	-26.5	V	P	
452.417	3.0	34.2	16.0	2.0	29.5	0.0	0.0	22.7	46.0	-23.3	V	P	

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

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.

RESULTS

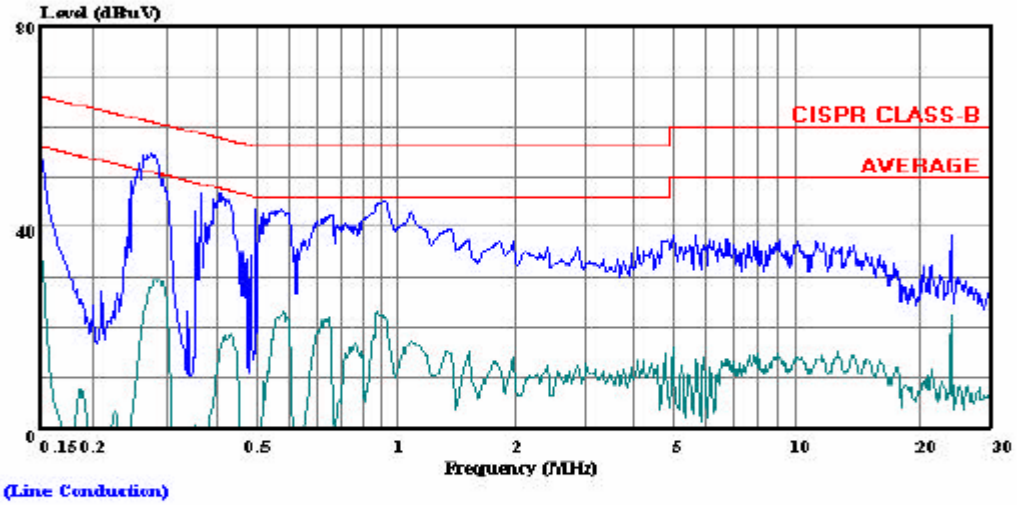
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.21	58.44	--	38.66	0.00	63.05	53.05	-4.61	-14.39	L1
0.44	52.17	--	36.39	0.00	57.12	47.12	-4.95	-10.73	L1
1.08	50.05	--	29.58	0.00	56.00	46.00	-5.95	-16.42	L1
0.23	51.77	--	37.58	0.00	62.31	52.31	-10.54	-14.73	L2
0.46	49.47	--	36.16	0.00	56.62	46.62	-7.15	-10.46	L2
0.71	48.00	--	30.16	0.00	56.00	46.00	-8.00	-15.84	L2
6 Worst Data									

LINE 1 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 21 File#: 10U13294.EMI Date: 07-15-2010 Time: 10:06:55

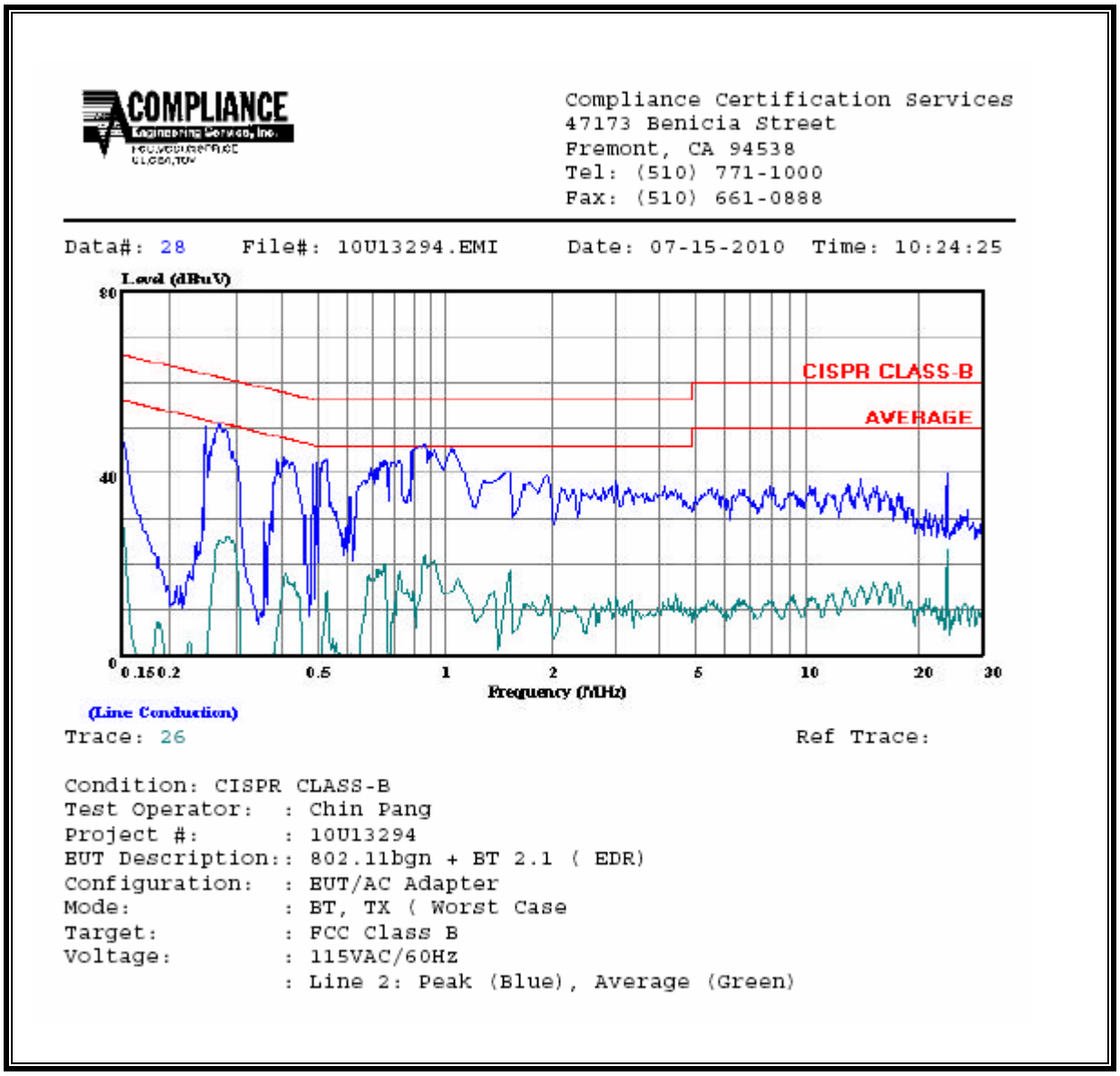


(Line Conduction)

Trace: 19 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Chin Pang
Project #: : 10U13294
EUT Description:: 802.11bgn + BT 2.1 (EDR)
Configuration: : EUT/AC Adapter
Mode: : BT, TX (Worst Case)
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: Line 1: Peak (Blue), Average (Green)

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	13.36	0.38	0.05	0.005