



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

CERTIFICATION TEST REPORT

FOR

**iPhone With GSM WCDMA 1xRTT/CDMA 1xEVDO Rev. A, Bluetooth EDR 2.1,
Bluetooth 4.0 LE, and WiFi 802.11 bgn**

MODEL NUMBER: A1387

**FCC ID: BCG-E2430A
IC: 579C-E2430A**

REPORT NUMBER: 11U13896-3, Revision B

ISSUE DATE: SEPTEMBER 16, 2011

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NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	8/29/11	Initial Issue	T. Chan
A	09/08/11	Revised EUT description	A. Zaffar
B	09/16/11	Revised section 7.1.2	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: iPhone With GSM WCDMA 1xRTT/CDMA 1xEVDO Rev. A,
Bluetooth EDR 2.1, Bluetooth 4.0 LE, and WiFi 802.11 bgn

MODEL: A1387

SAMPLE TESTED: BOM #1(D0415), BOM#2 (D0485), BOM #3(D0930)

HARDWARE VERSION: DVT

SERIAL NUMBER: C39G500HDRT3, C39G507FDRT1, C39G50APDRT1

DATE TESTED: JULY 04 - AUGUST 23, 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:



THU CHAN
ENGINEERING MANAGER
UL CCS

Tested By:



DAVID GARCIA
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, and 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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	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 iPhone, Model A1387, is a mobile phone with multimedia functions (music, application support, and video), cellular GSM, WCDMA-HSDPA & HSUPA, CDMA -1xRTT, EV-DO Rev 0 & Rev A radio, IEEE 802.11b/g/n radio and Bluetooth radio. This device measures 115.6 mm (4.55 inches) tall x 59.3 mm (2.33 inches) and 9.36 mm (0.368 inches) thick and weighs 140 grams (4.9 oz.). The rechargeable battery is not user accessible.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	GFSK	14.26	26.67
2402 - 2480	DQPSK	13.67	23.28
2402 - 2480	8PSK	13.69	23.39

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of -1.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 0.15.06.

The EUT software installed during testing was 9A287.

The EUT is also linked in Bluetooth Enable Test mode with Rohde & Schwarz CBT Test box.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-position was the EUT with highest emissions. To determine the worst-case, the EUT is a portable device that has three orientations; therefore X, Y and Z orientations have been investigated, and the worst case was found to be at X position.

The BOM Variant 1 was used to perform on full RF radiated and conducted tests as worst case by comparing the output power measurement; Both BOM VARIANT 2 and 3 units were only to perform on RF conducted output power test.

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
Headset	Apple	NA	NA	NA

I/O CABLES (CONDUCTED)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	In/Out	1	SMA	Shielded	0.2m	NA
2	In/Out	1	SMA	Shielded	0.6m	NA
3	Antenna Port	1	SMA	Shielded	0.1m	NA

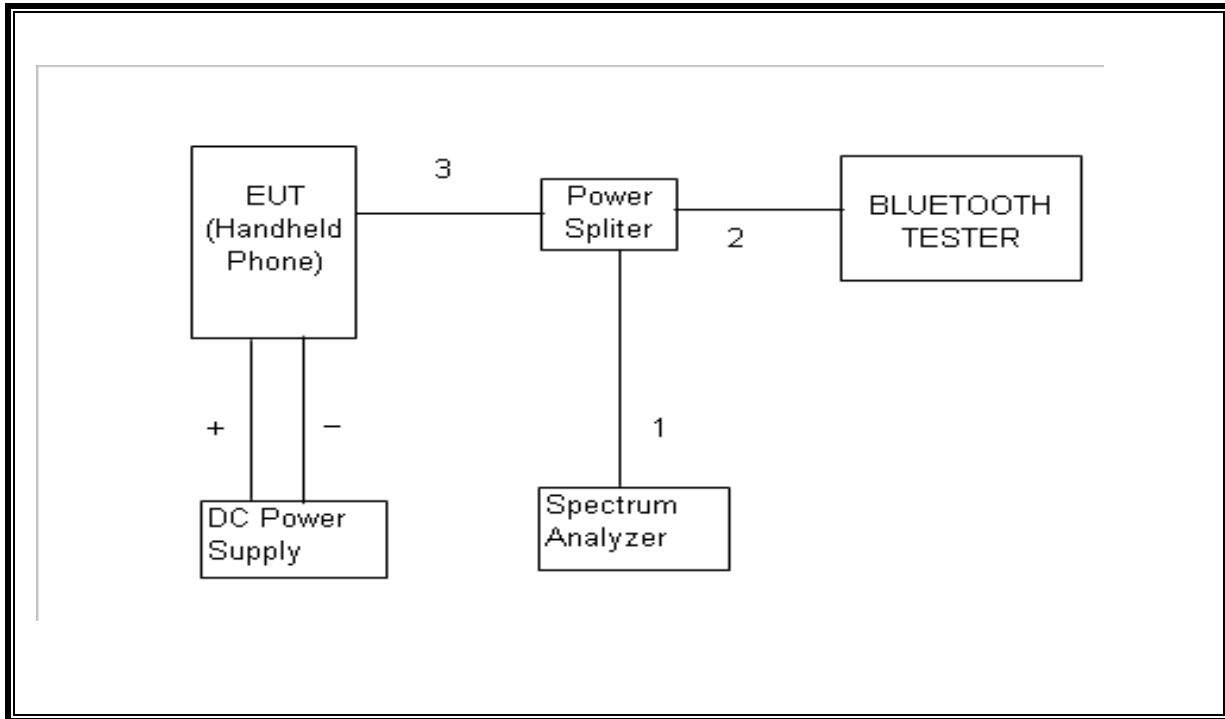
I/O CABLES (RADIATED)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115VAC	Shielded	2m	NA
2	DC	1	DC	Shielded	1m	NA
3	Jack	1	Earphone	Shielded	0.5m	NA
4	Antenna Port	1	Horn	Un-shielded	2m	NA

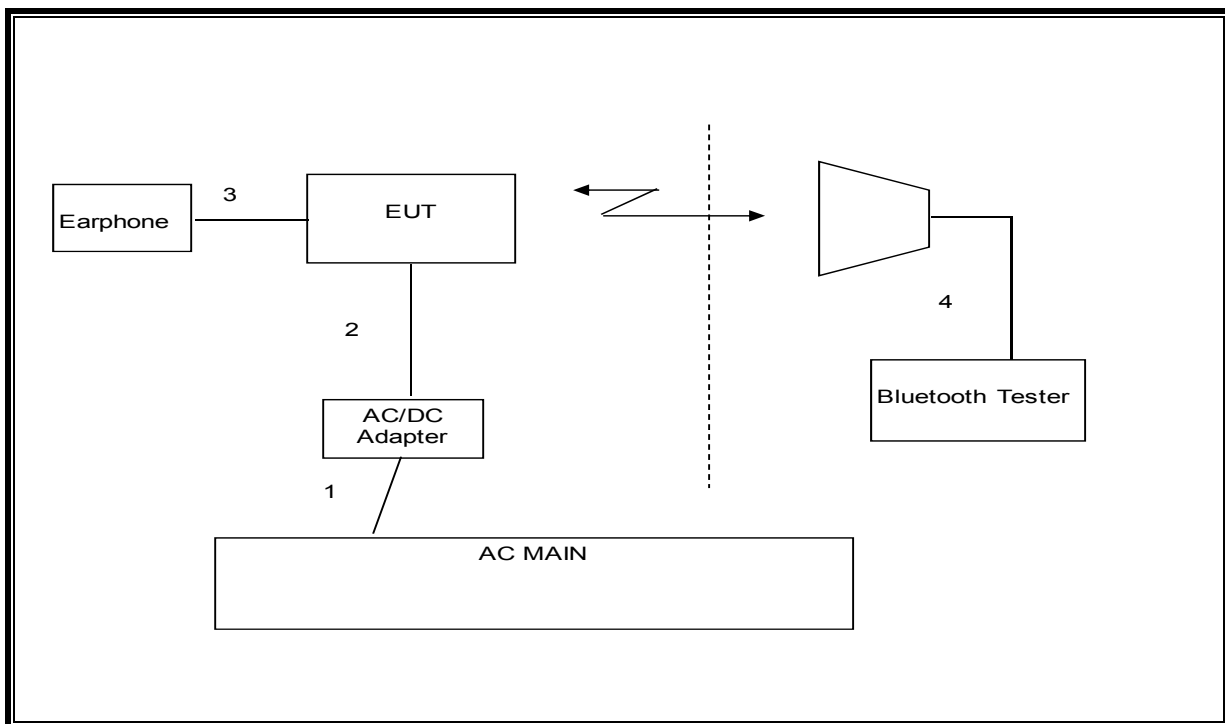
TEST SETUP

The EUT is a stand-alone device.

SETUP DIAGRAM FOR TESTS (CONDUCTED)



SETUP DIAGRAM FOR TESTS (RADIATED)



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, 44 GHz	Agilent / HP	E4446A	C01159	05/11/12
Antenna, Horn, 18 GHz	EMCO	3115	C00872	06/29/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	07/16/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01/27/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	07/12/12
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/06/12
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/10/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	01/07/12
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/11
Bluetooth Test	R&S	CBT	NA	05/01/12

7. ANTENNA PORT TEST RESULTS

BOM VARIANT 1

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

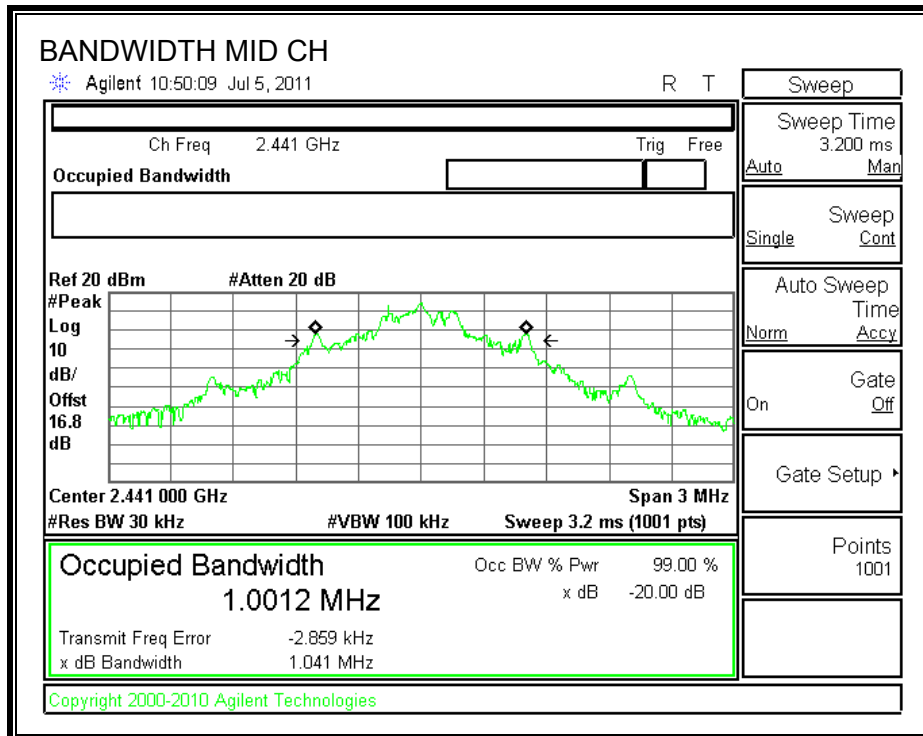
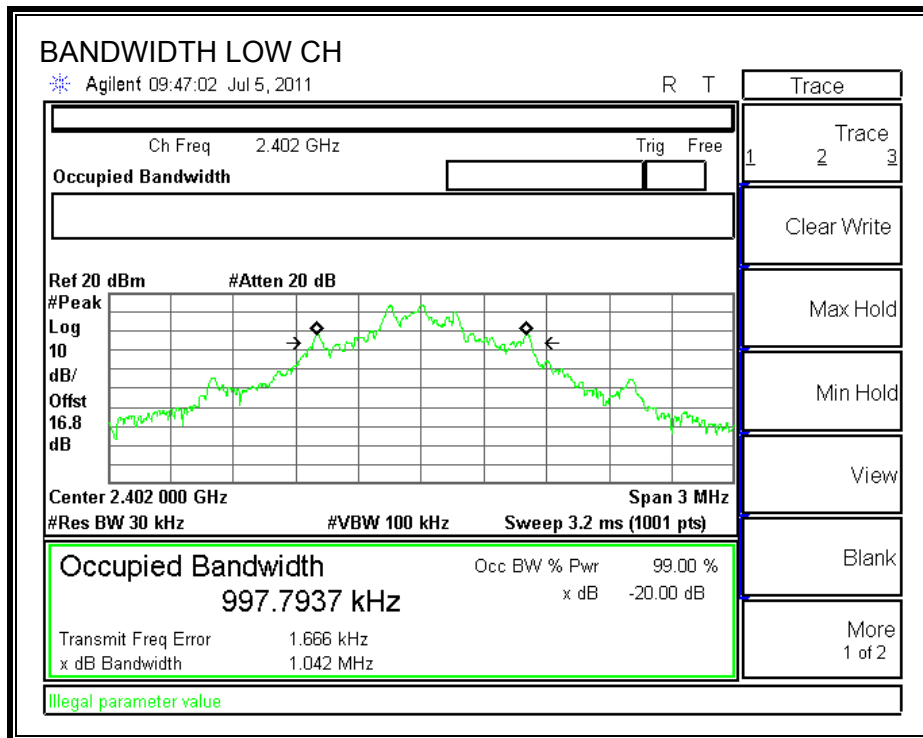
TEST PROCEDURE

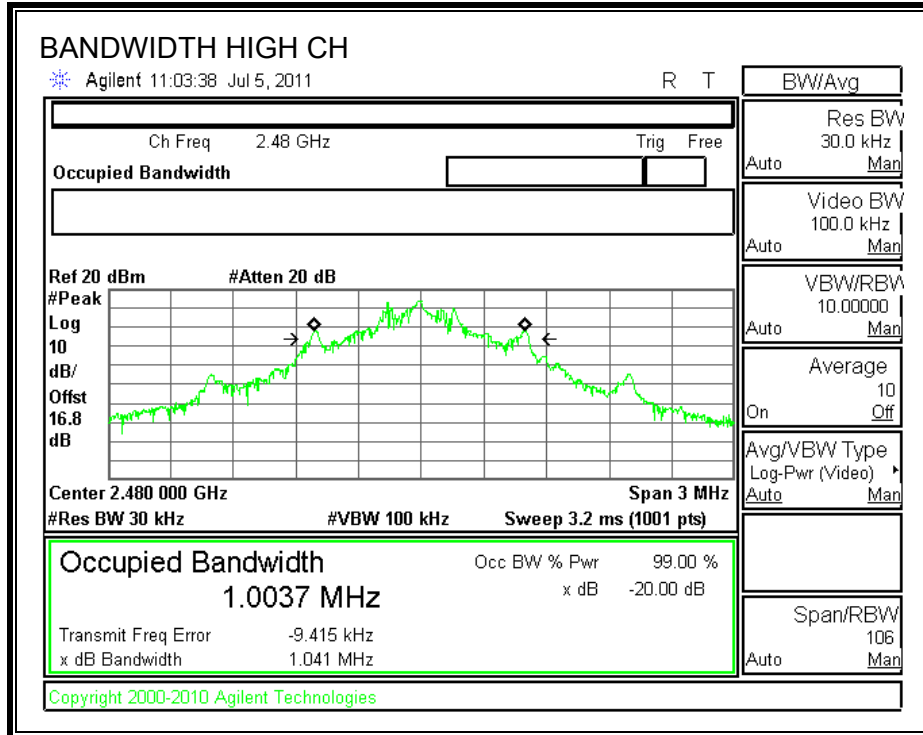
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

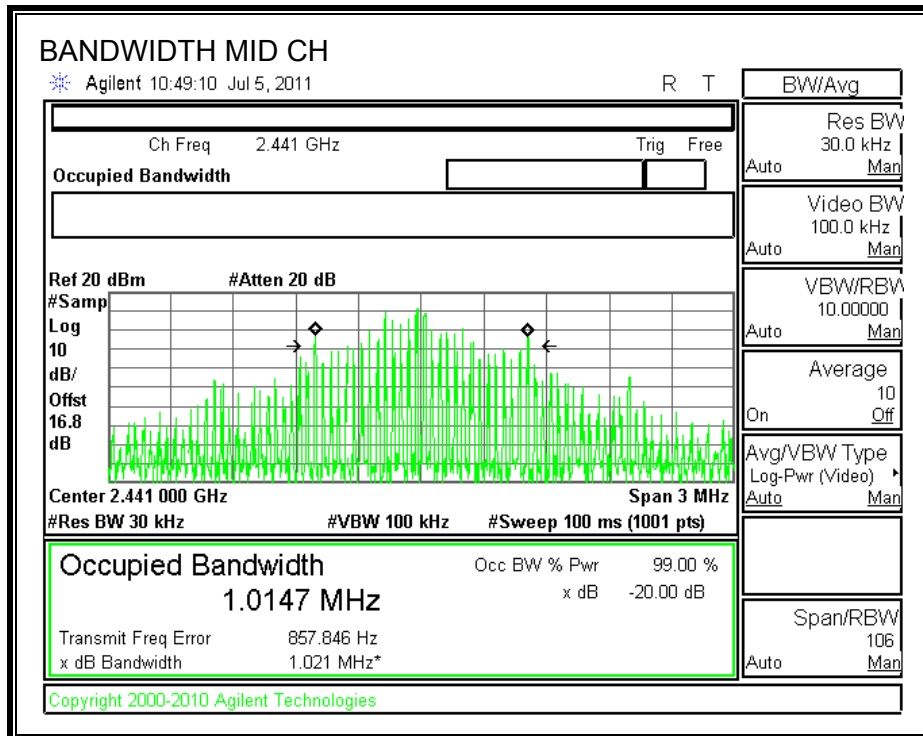
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.042	1.0148
Middle	2441	1.041	1.0147
High	2480	1.041	1.0131

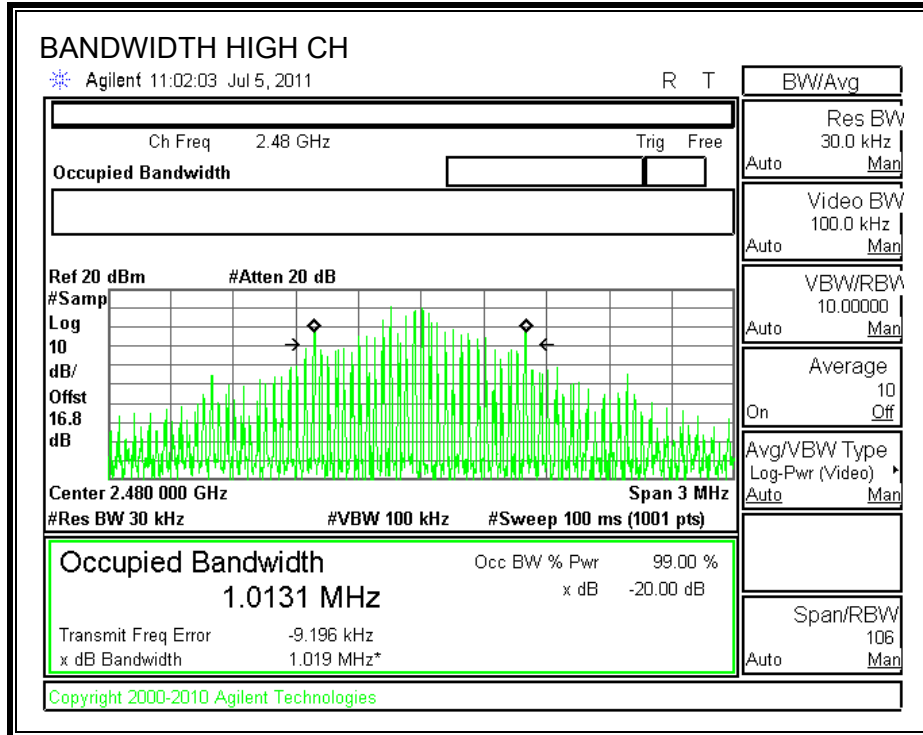
20 dB BANDWIDTH





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 hopping channel, whichever is greater.

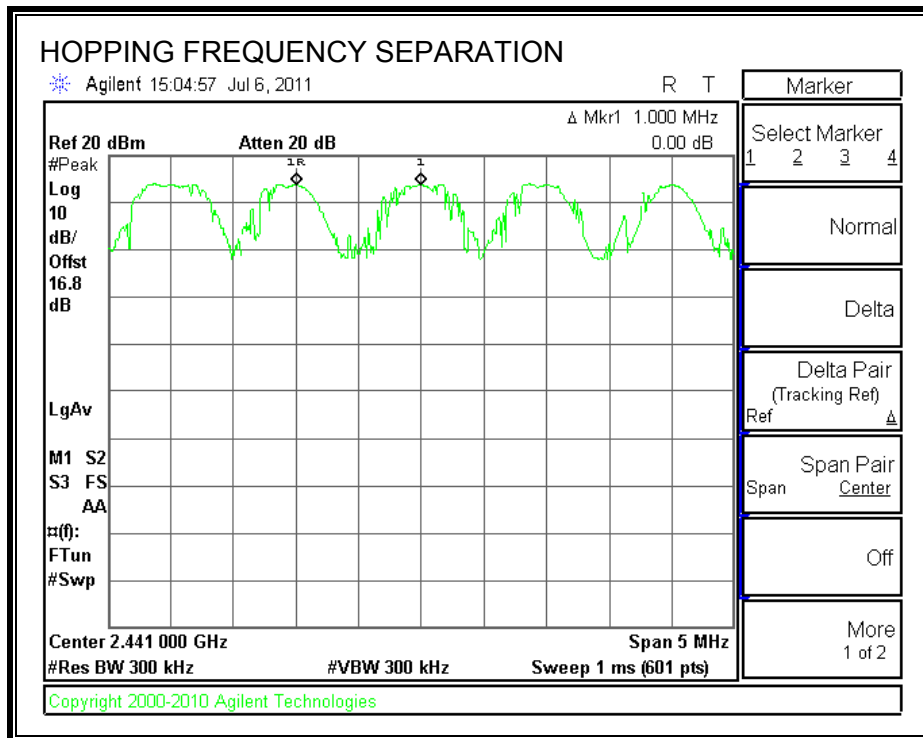
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

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

RESULTS

HOPPING FREQUENCY SEPARATION



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.

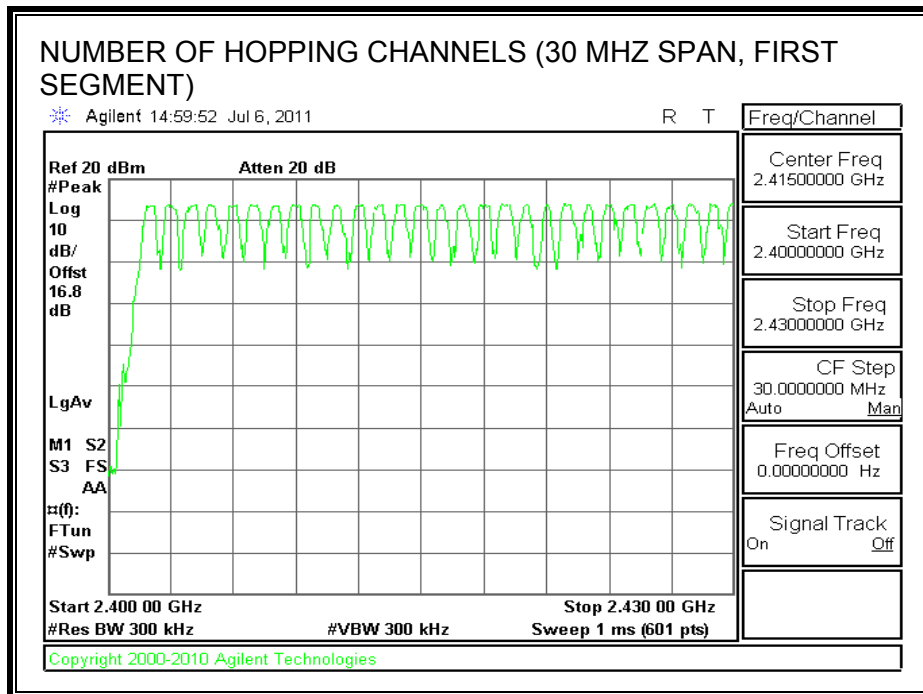
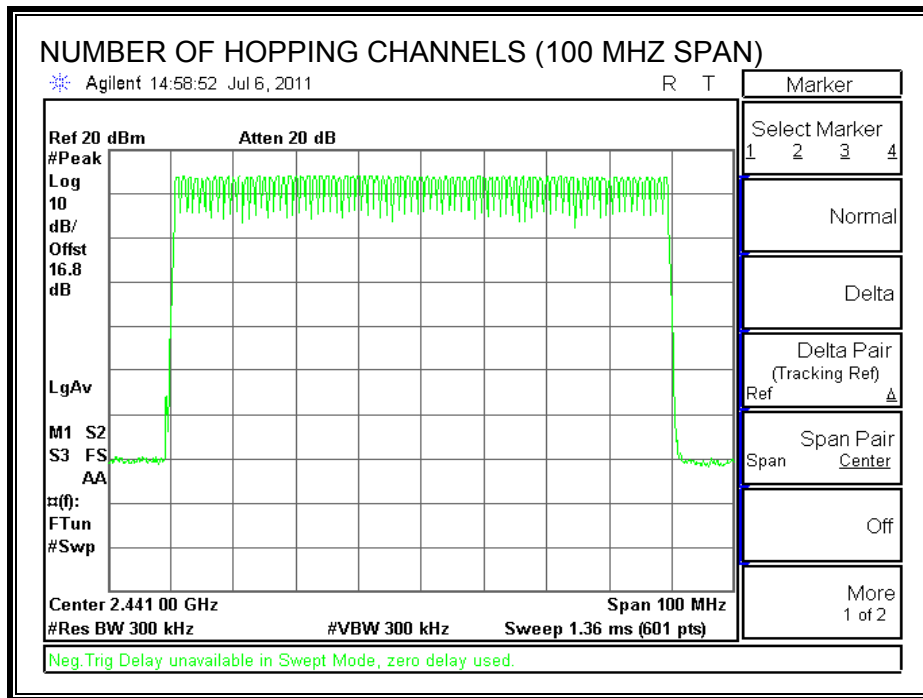
TEST PROCEDURE

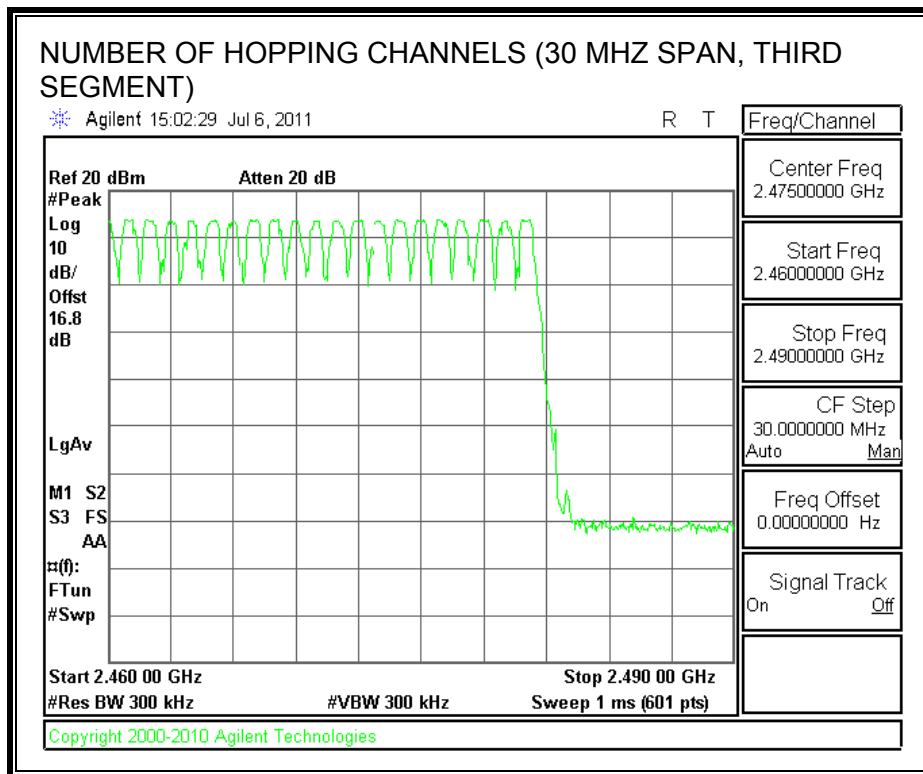
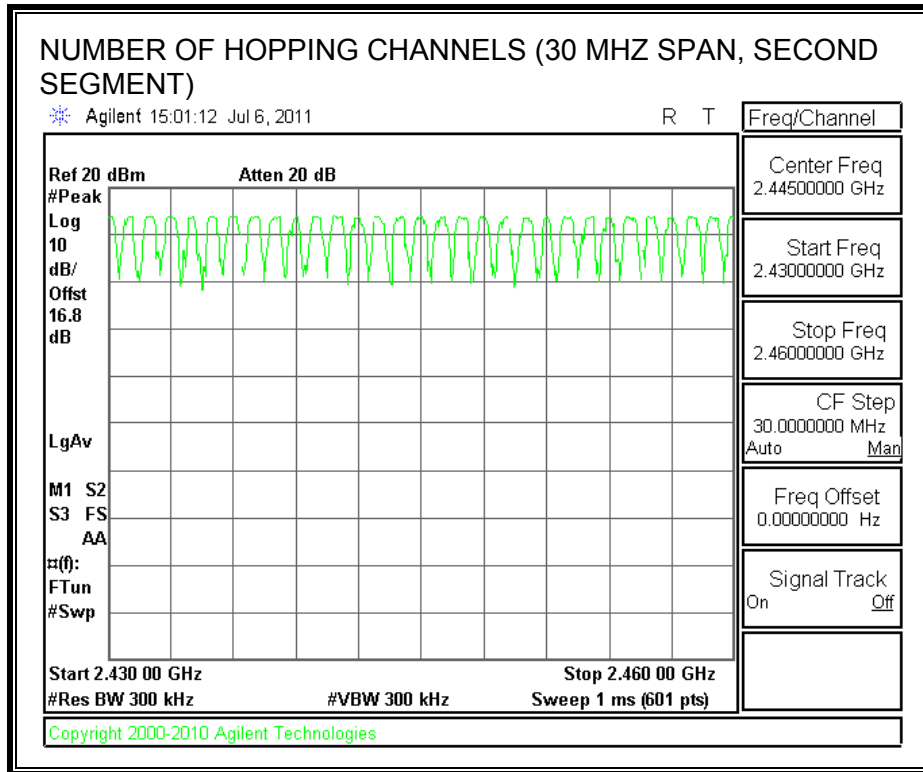
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

79 Channels observed.

NUMBER OF HOPPING CHANNELS





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.

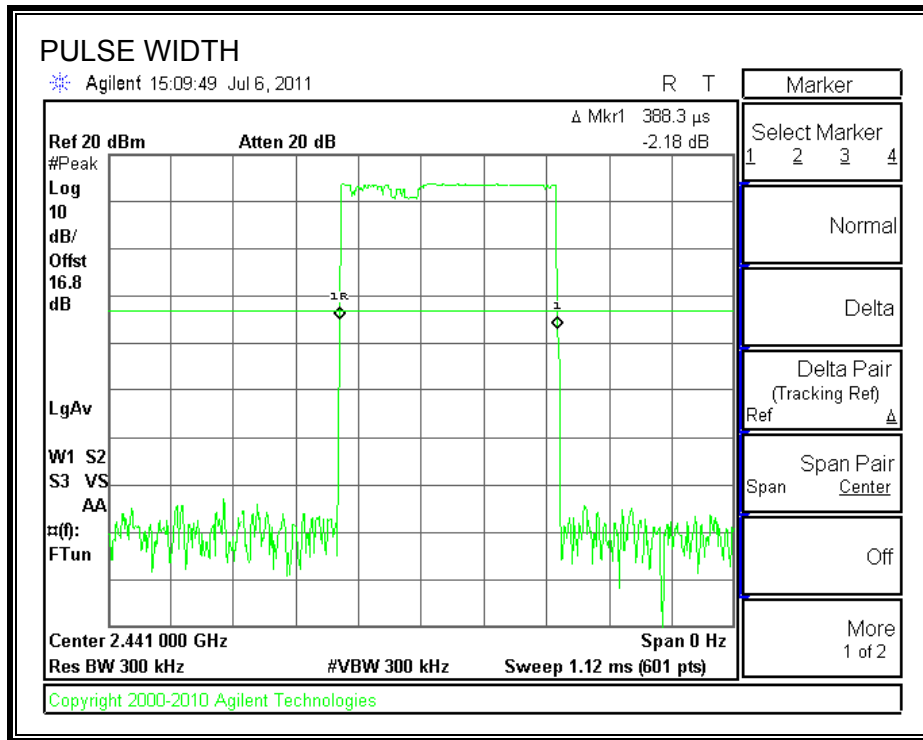
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

RESULTS

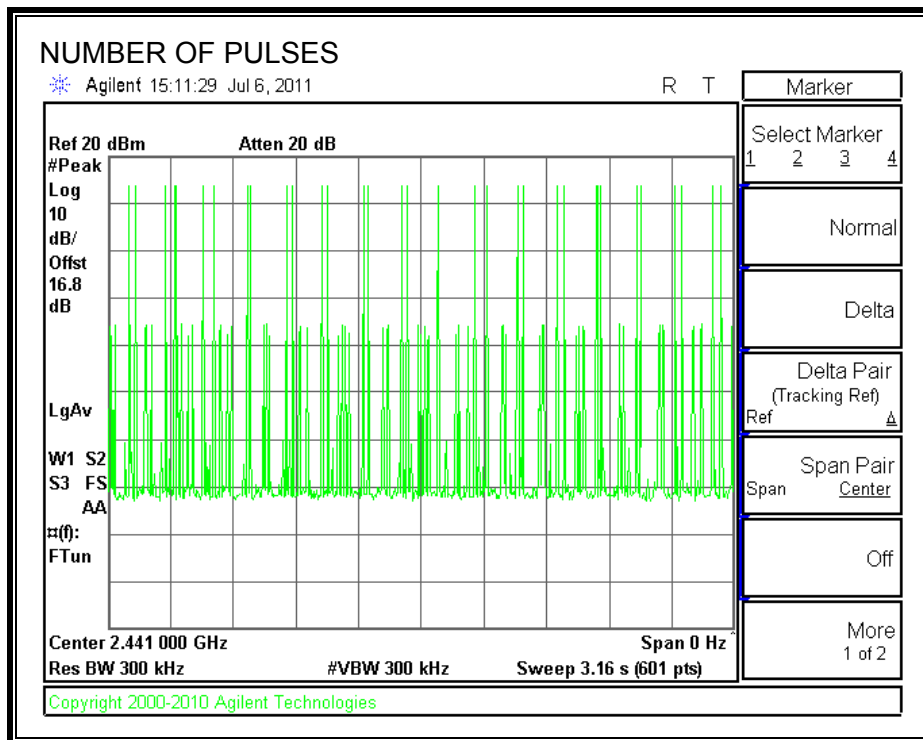
GFSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.388	33	0.128	0.4	0.272
DH3	1.647	13	0.214	0.4	0.186
DH5	2.890	8	0.231	0.4	0.169

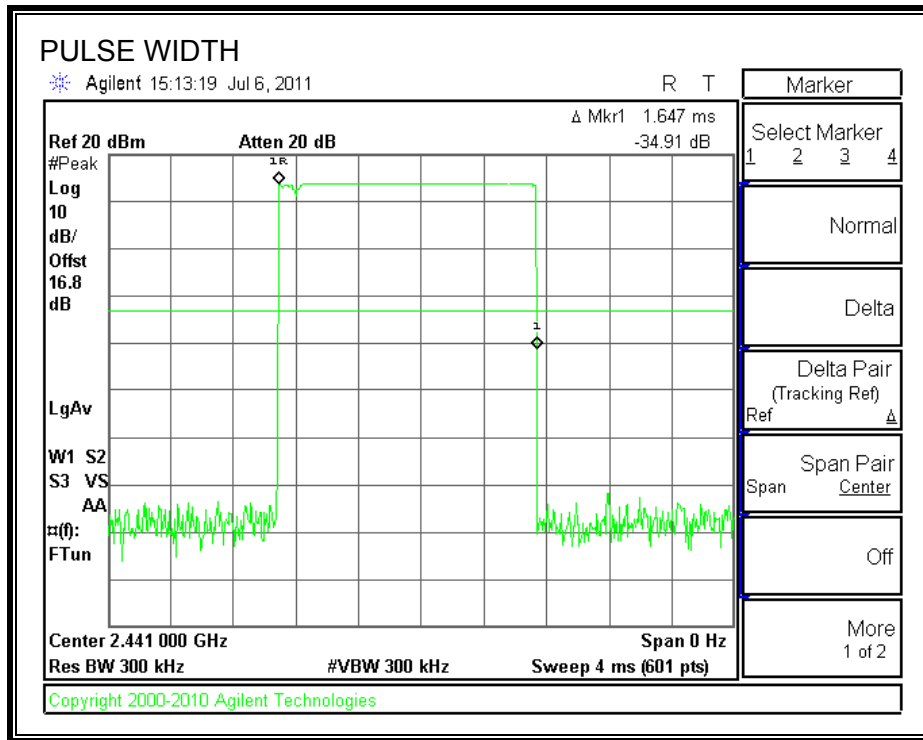
PULSE WIDTH GFSK DH1



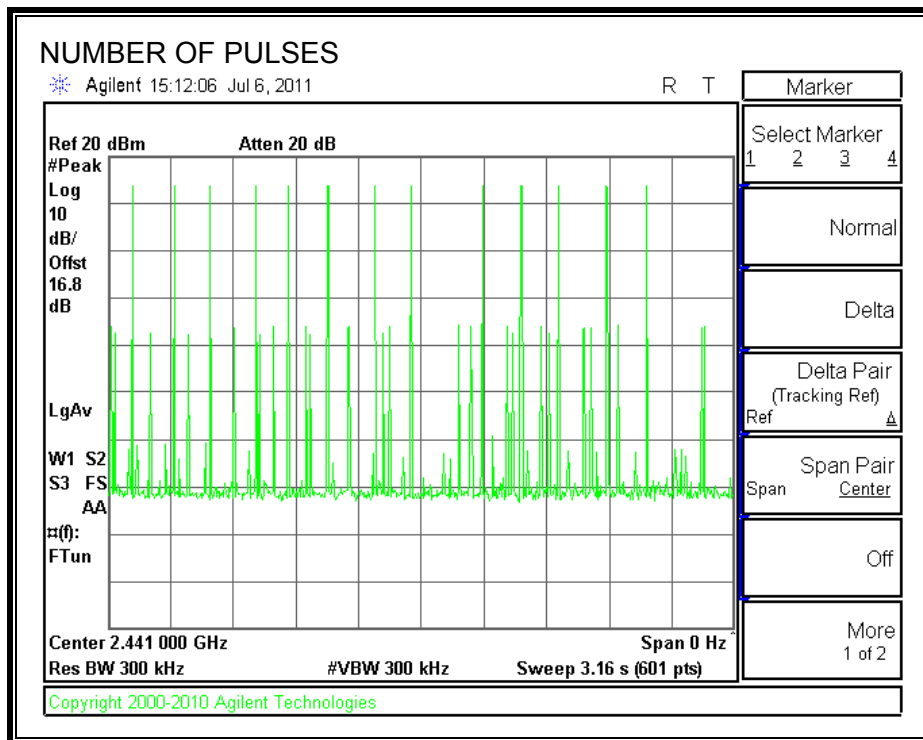
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



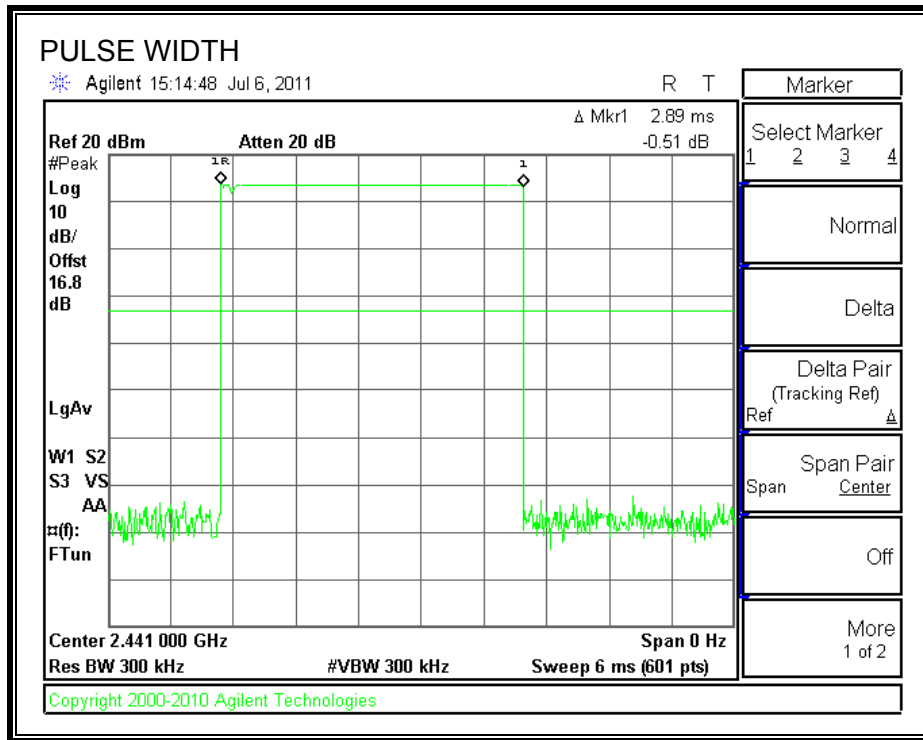
PULSE WIDTH GFSK DH3



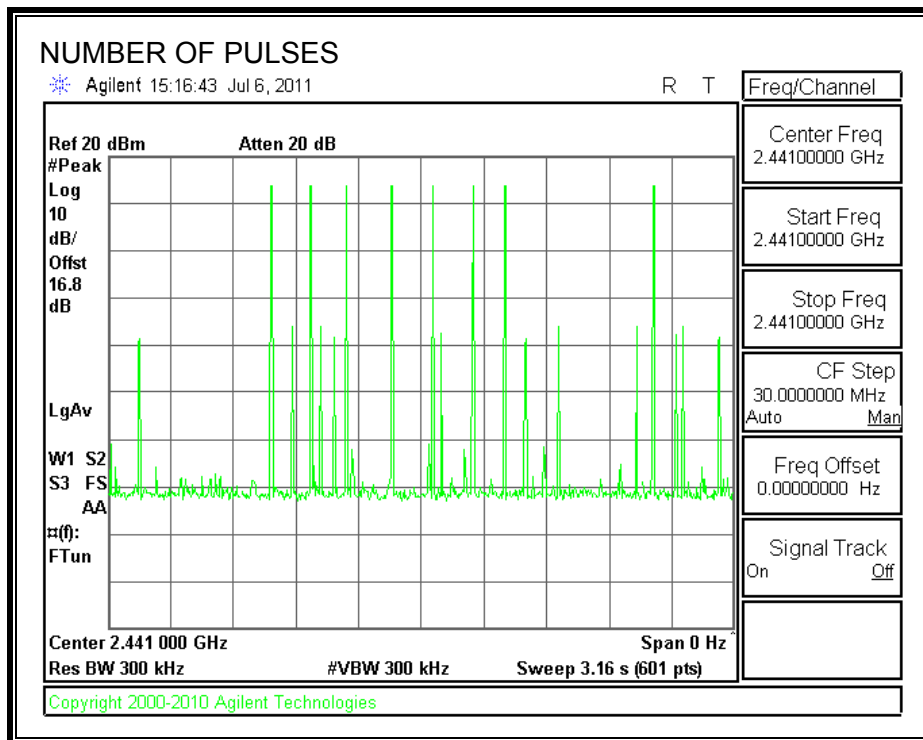
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



PULSE WIDTH GFSK DH5



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.

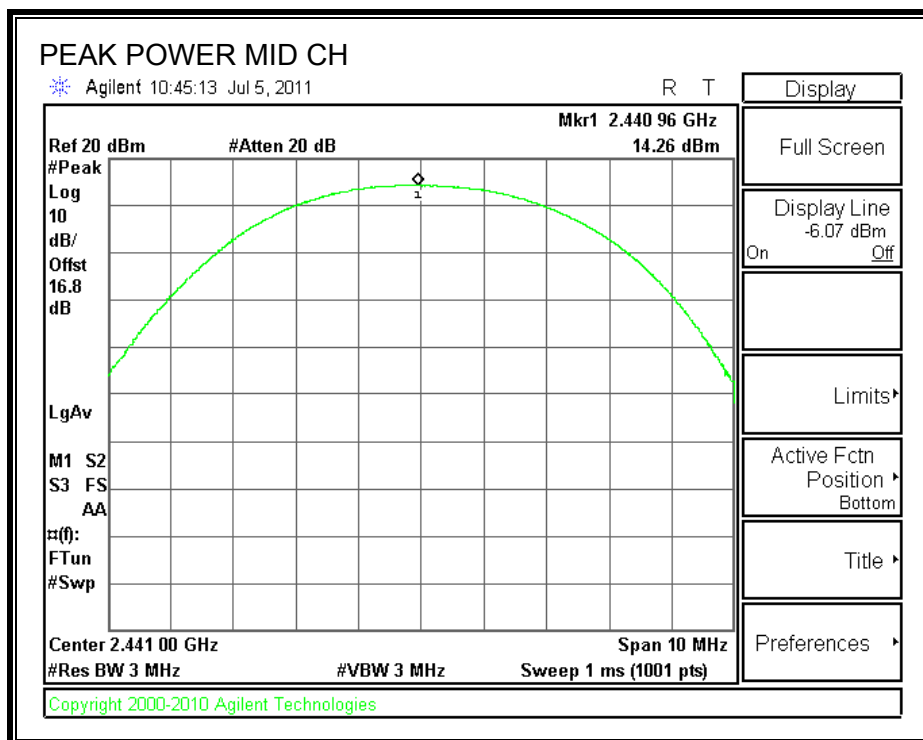
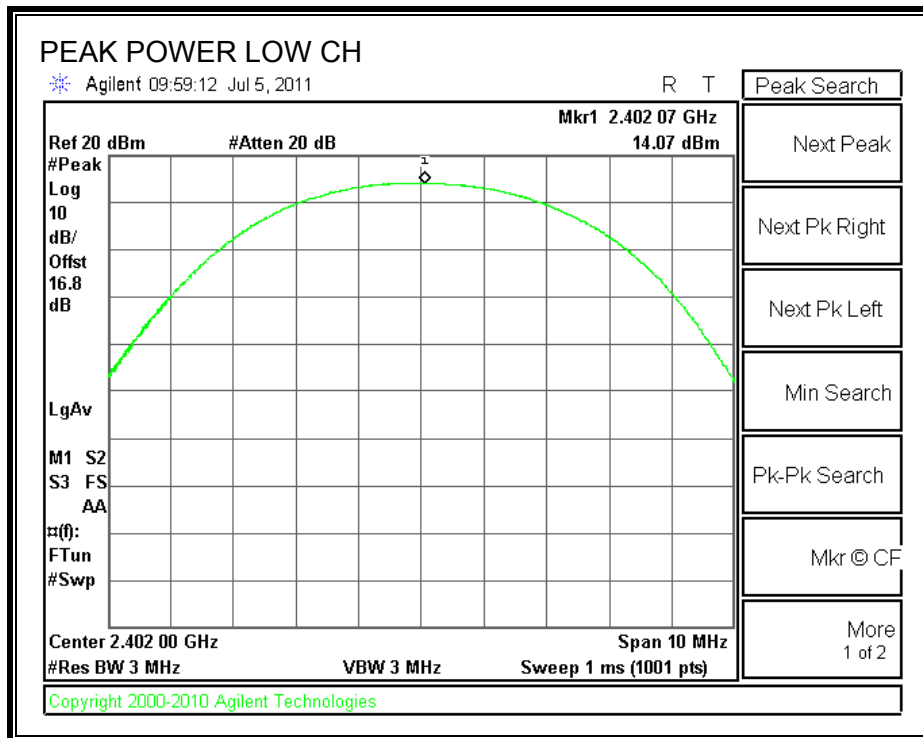
TEST PROCEDURE

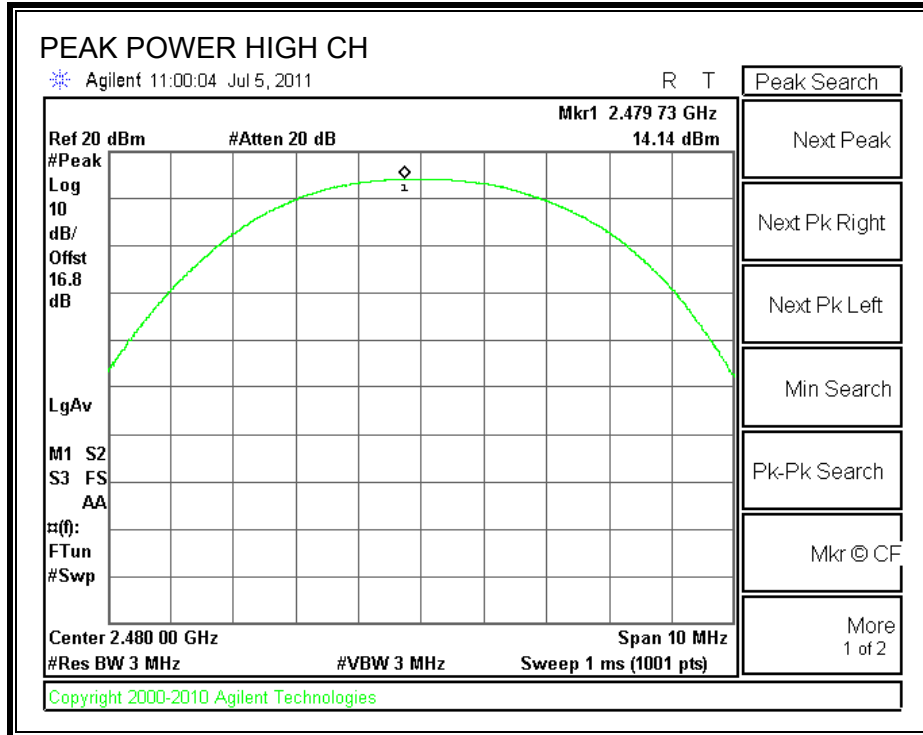
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.07	30	-15.93
Middle	2441	14.26	30	-15.74
High	2480	14.14	30	-15.86

OUTPUT POWER





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 10.4 dB (including 10 dB pad and 0.4 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	13.50
Middle	2441	13.70
High	2480	13.70

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

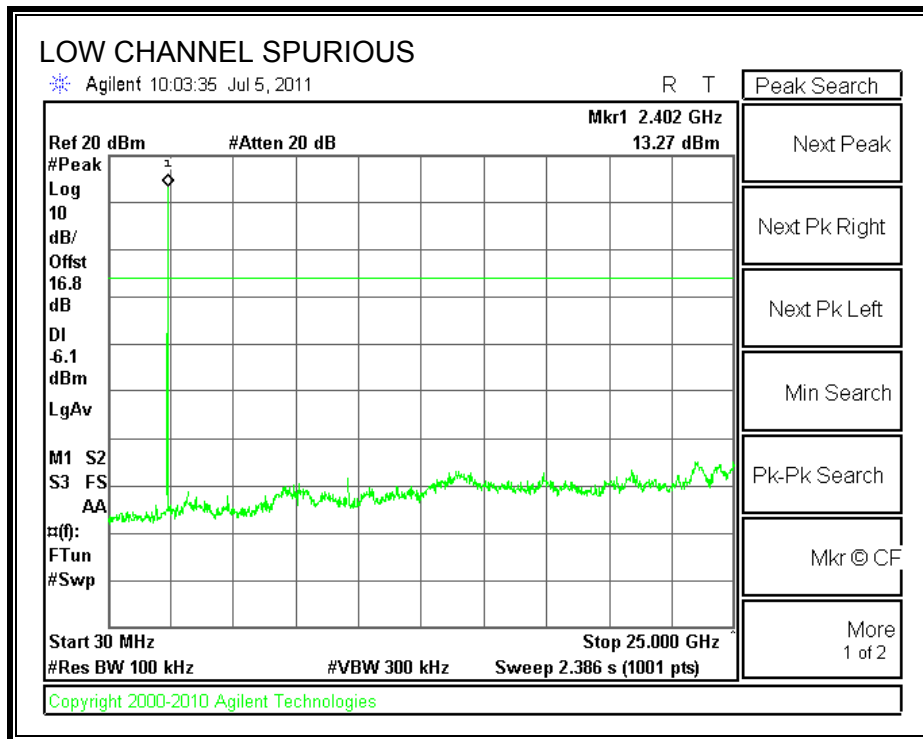
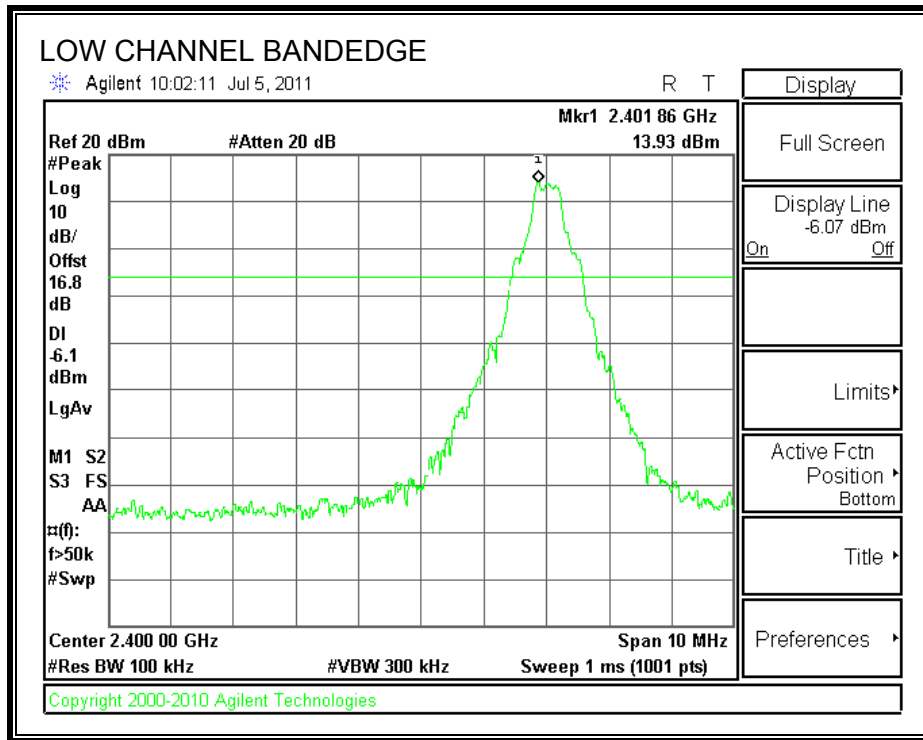
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

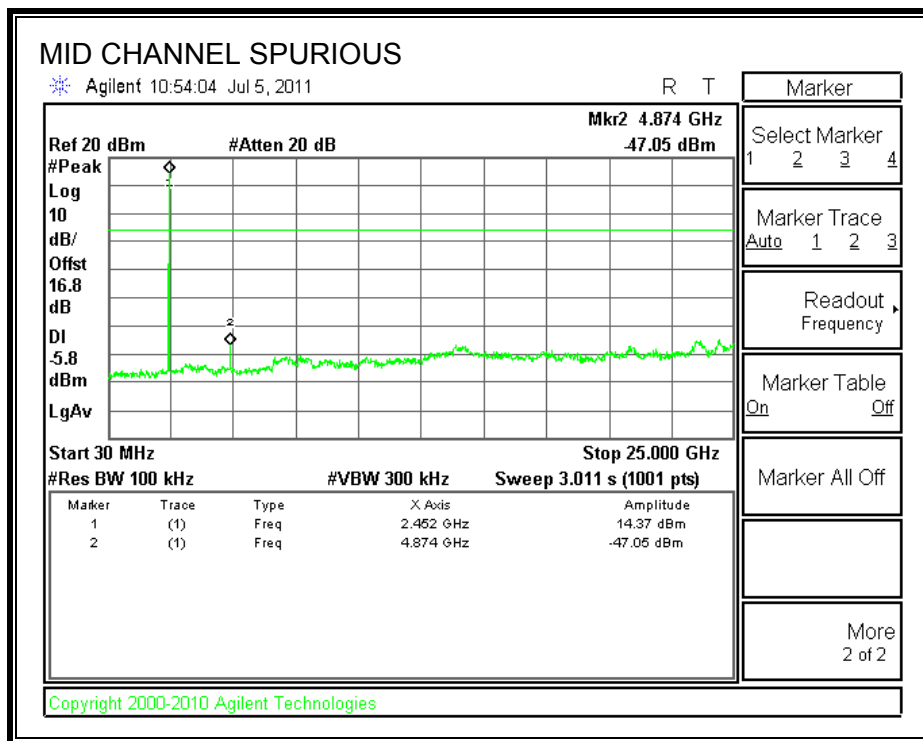
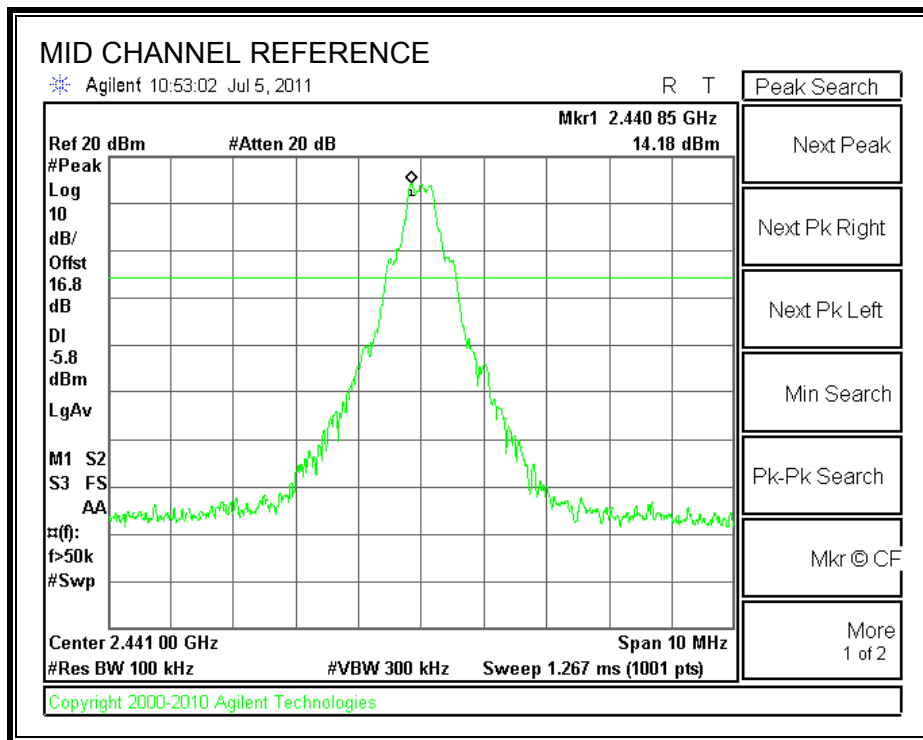
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

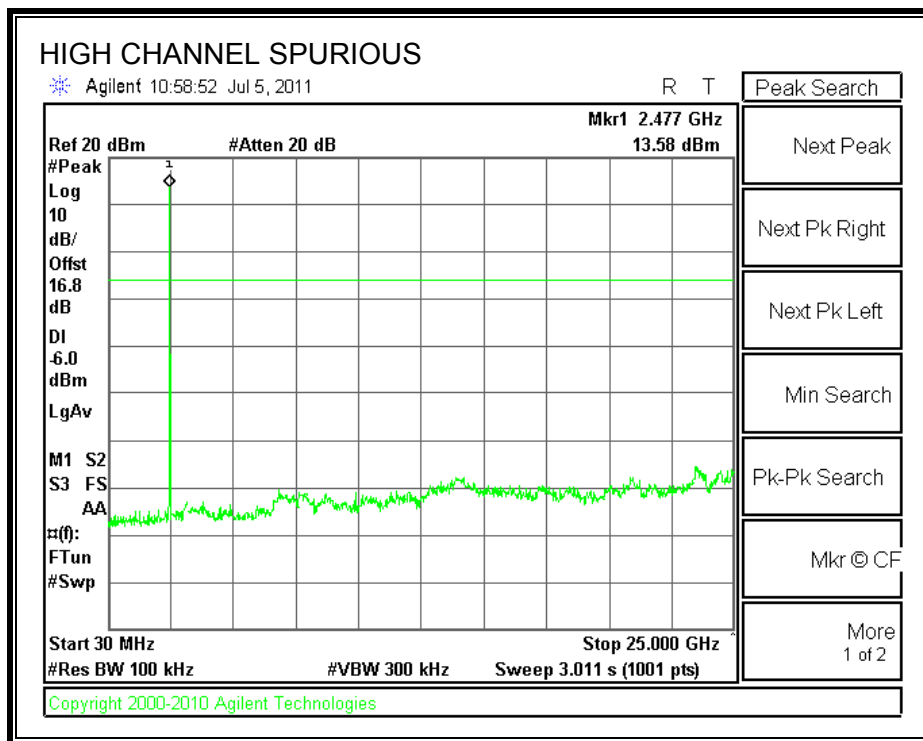
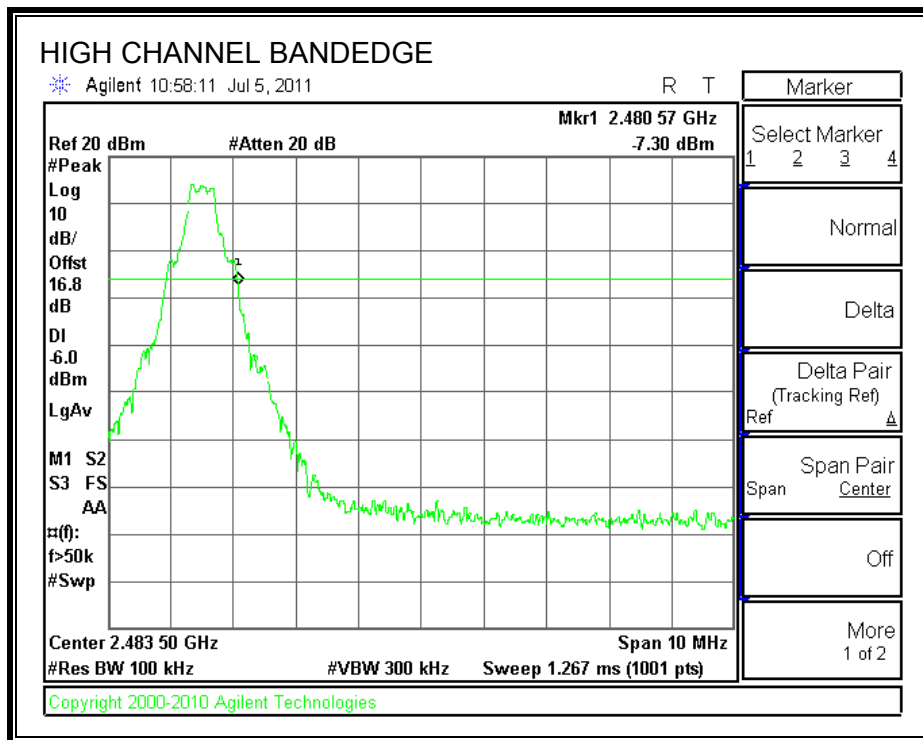
SPURIOUS EMISSIONS, LOW CHANNEL



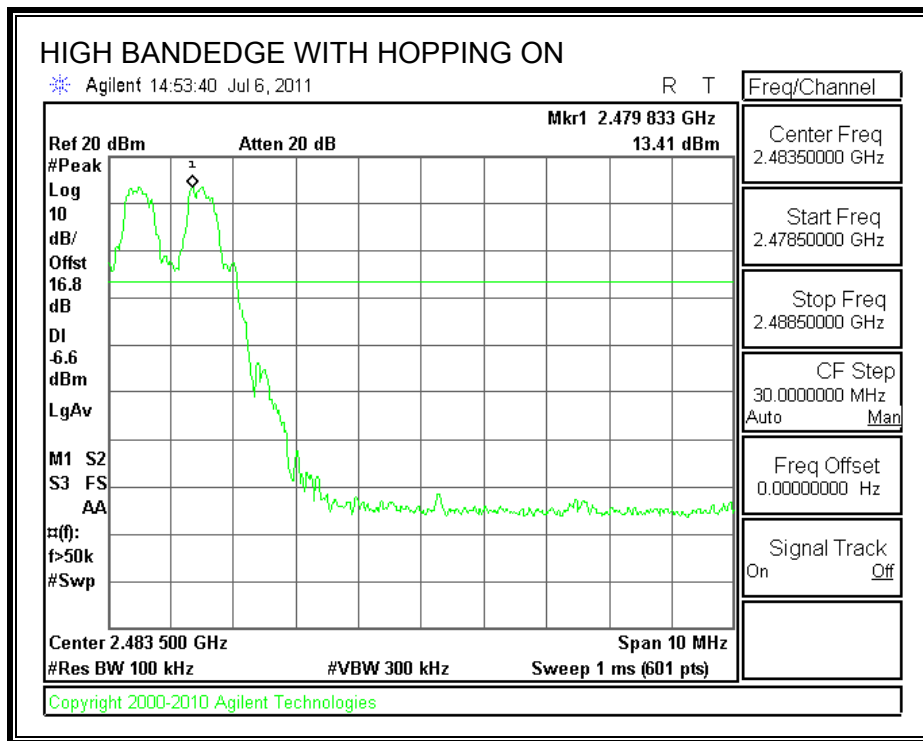
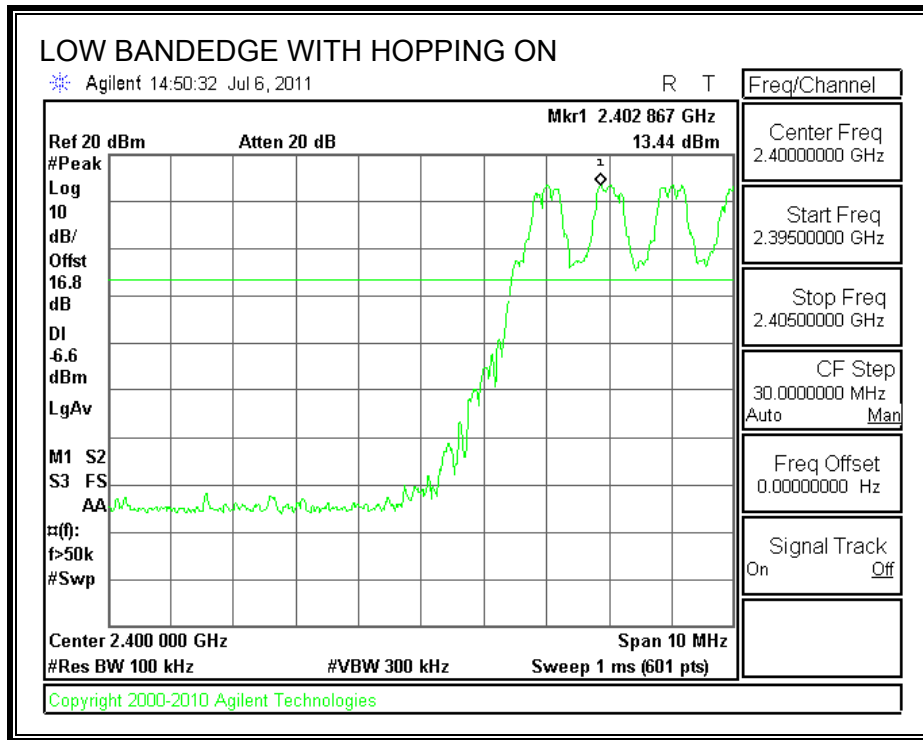
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



7.2. DQPSK MODULATION

7.2.1. 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.

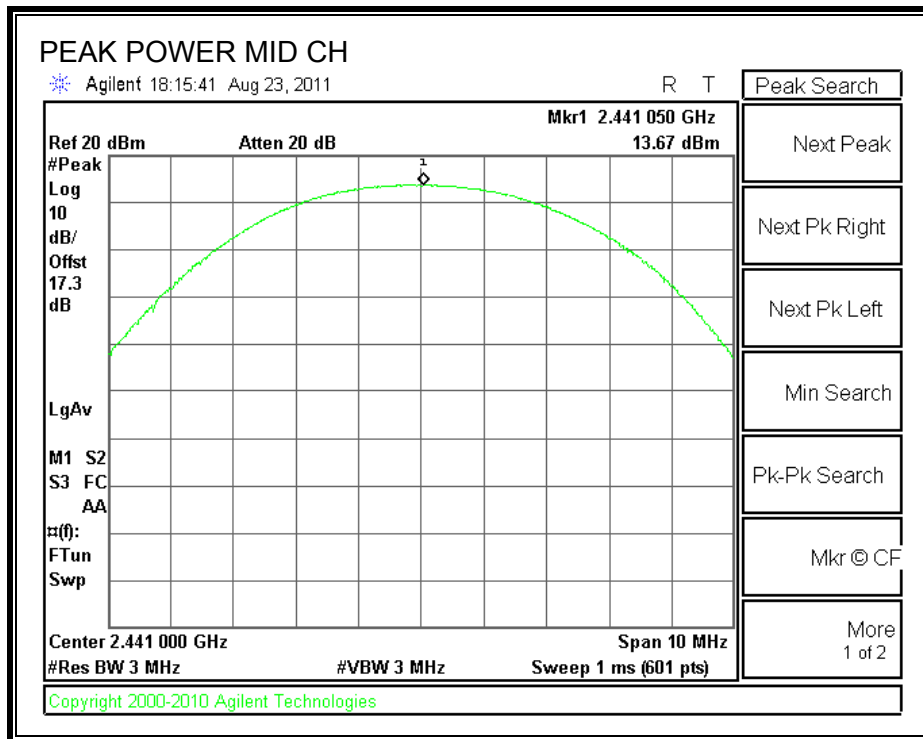
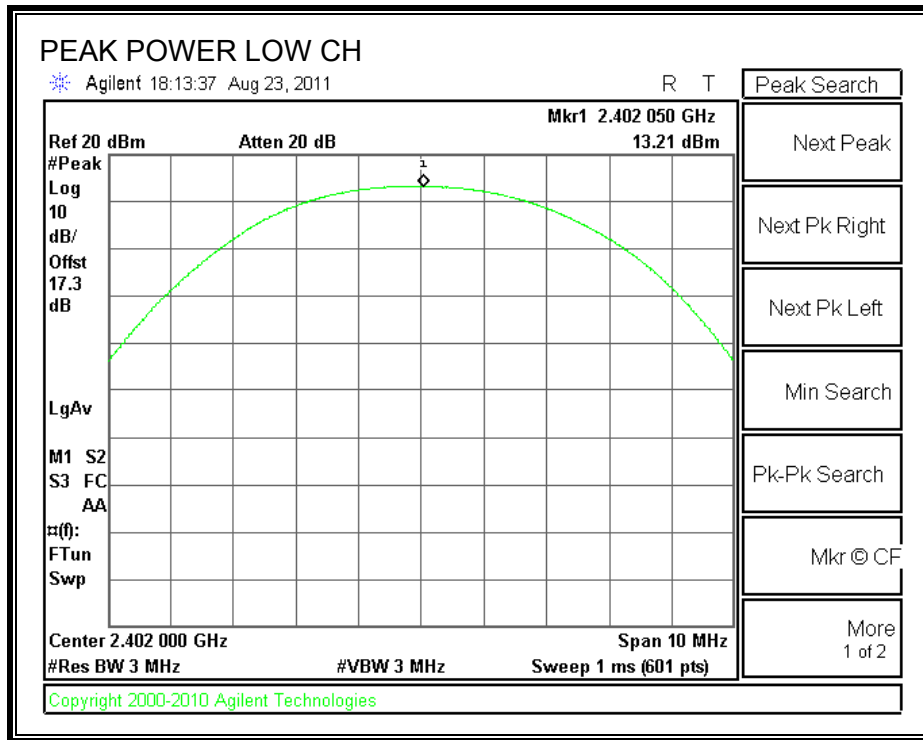
TEST PROCEDURE

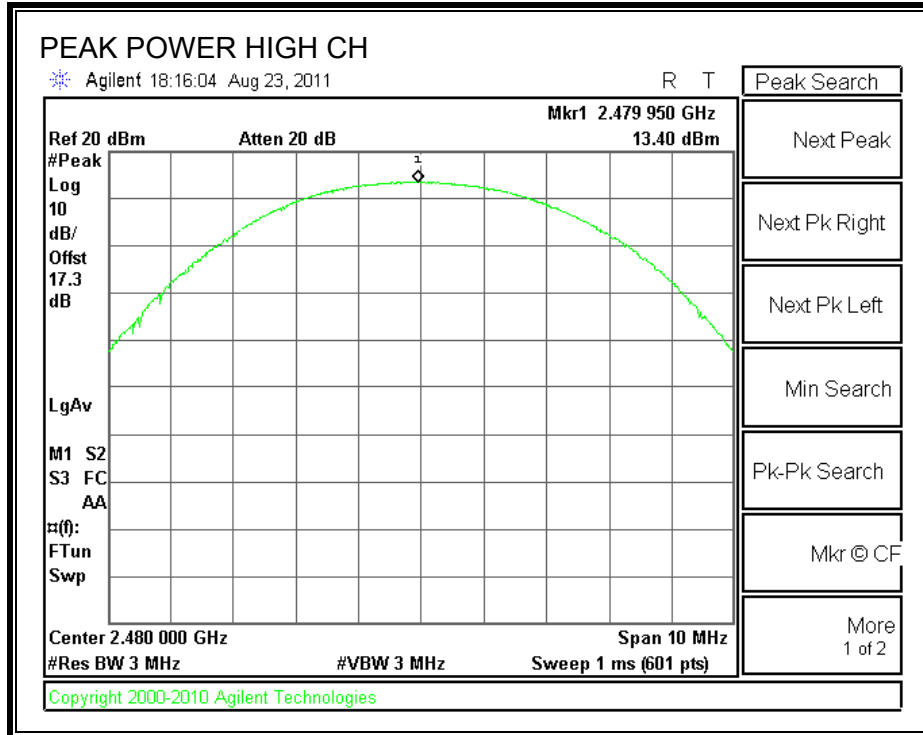
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.24	21	-7.76
Middle	2441	13.67	21	-7.33
High	2480	13.40	21	-7.60

OUTPUT POWER





7.2.2. 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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.70
Middle	2441	11.80
High	2480	11.70

7.3. ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

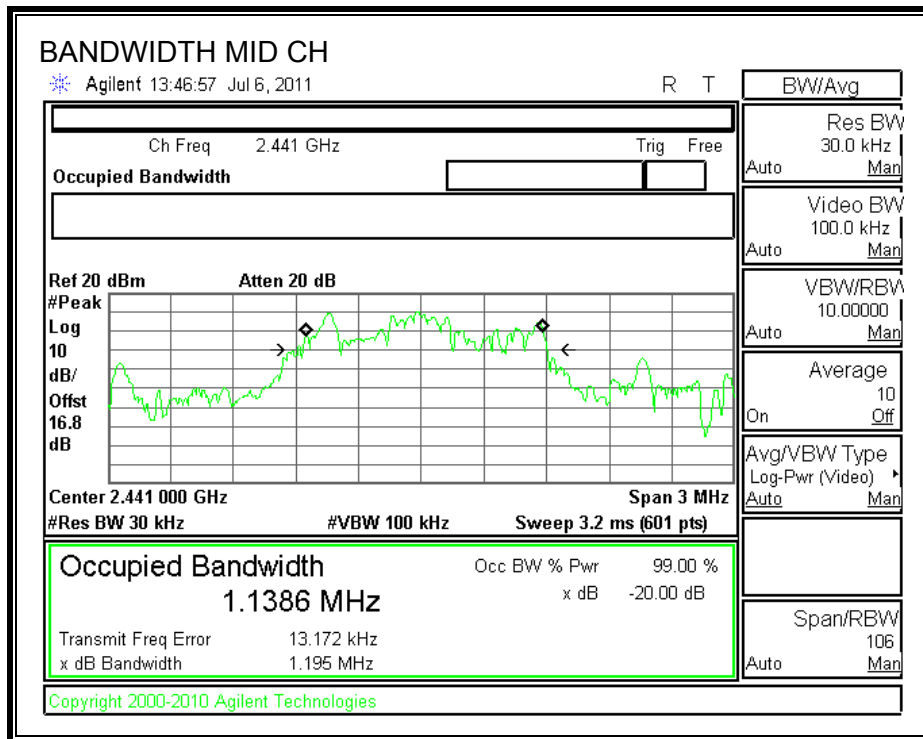
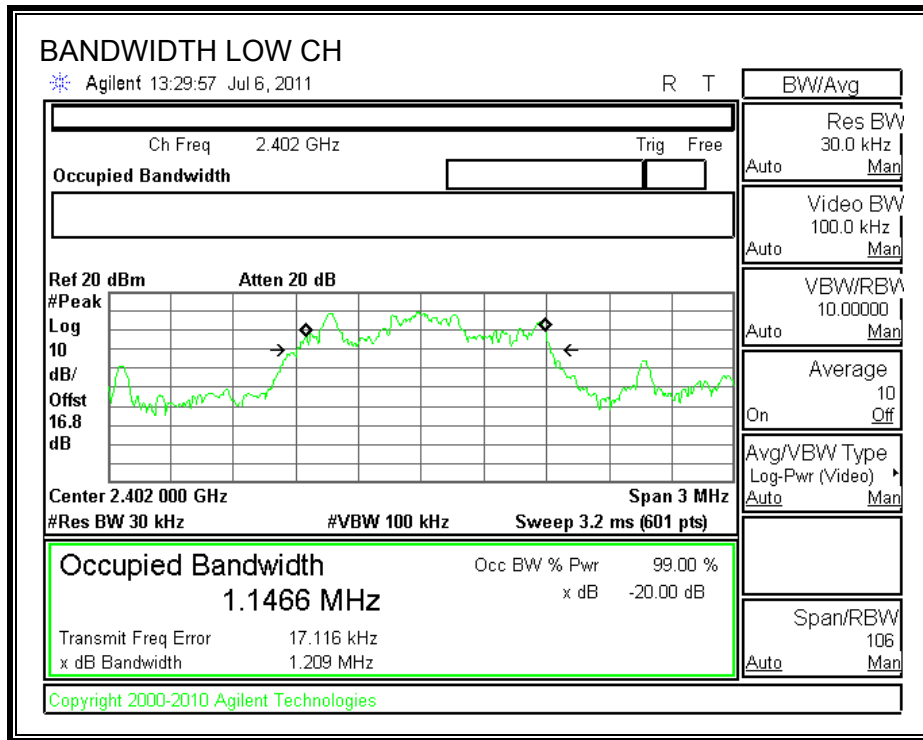
TEST PROCEDURE

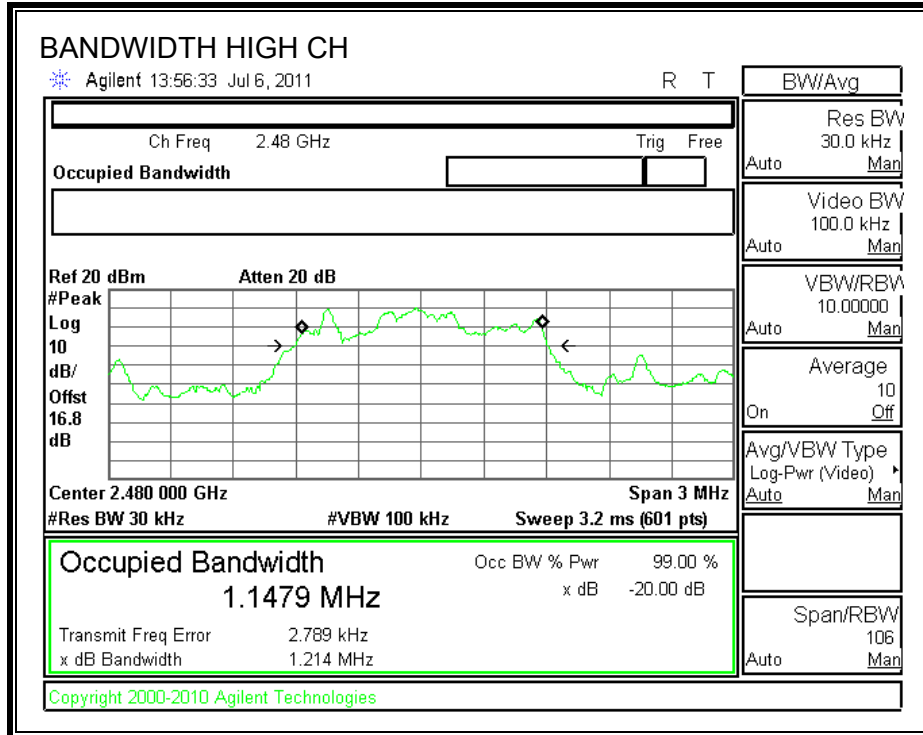
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

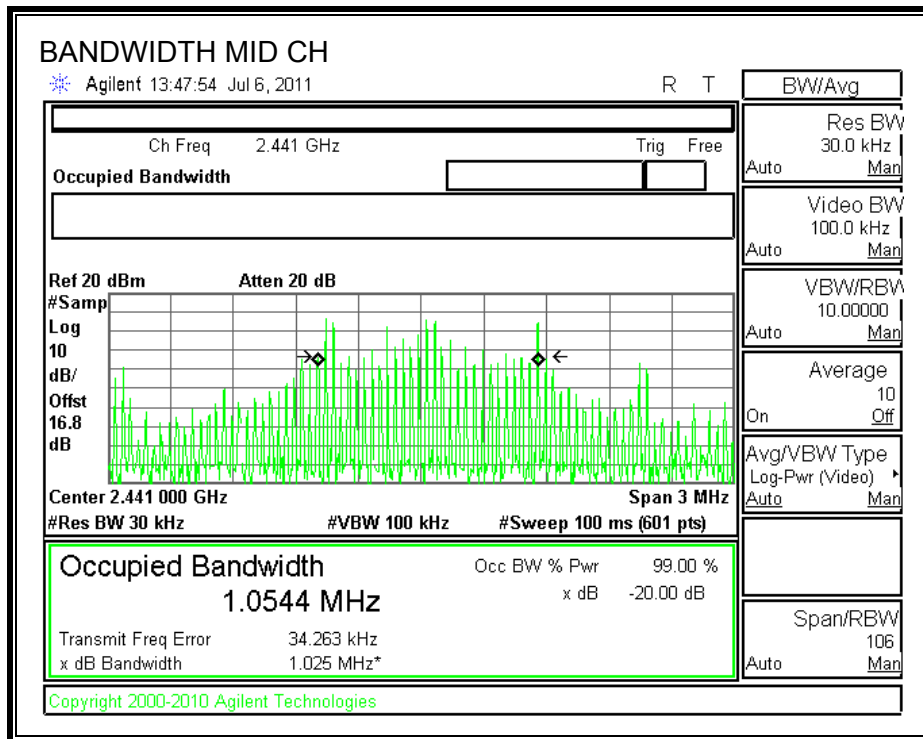
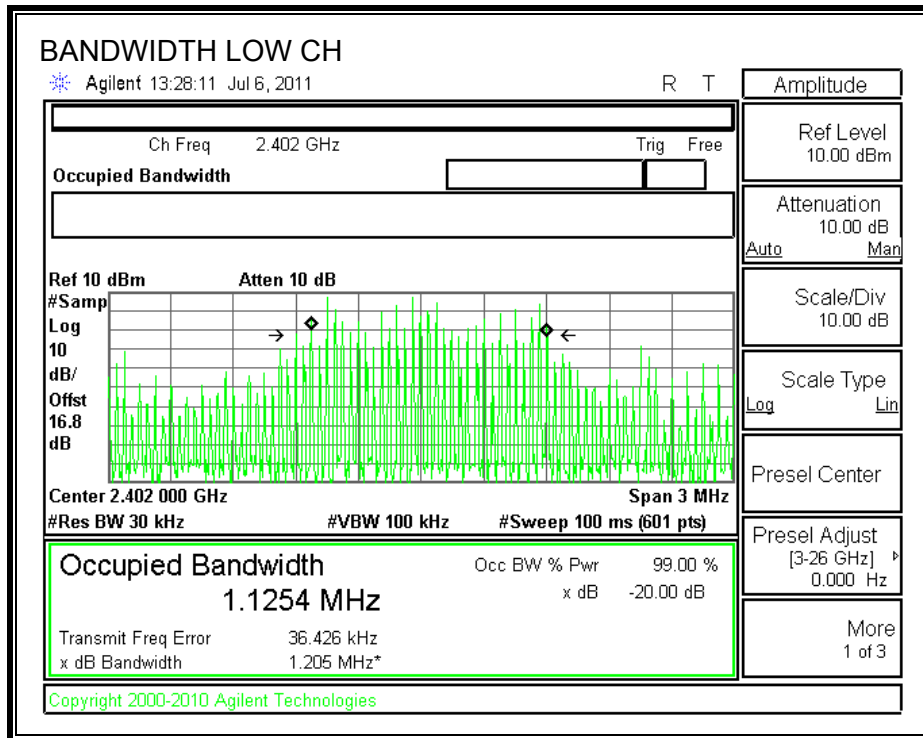
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.209	1.1254
Middle	2441	1.195	1.0544
High	2480	1.214	1.0860

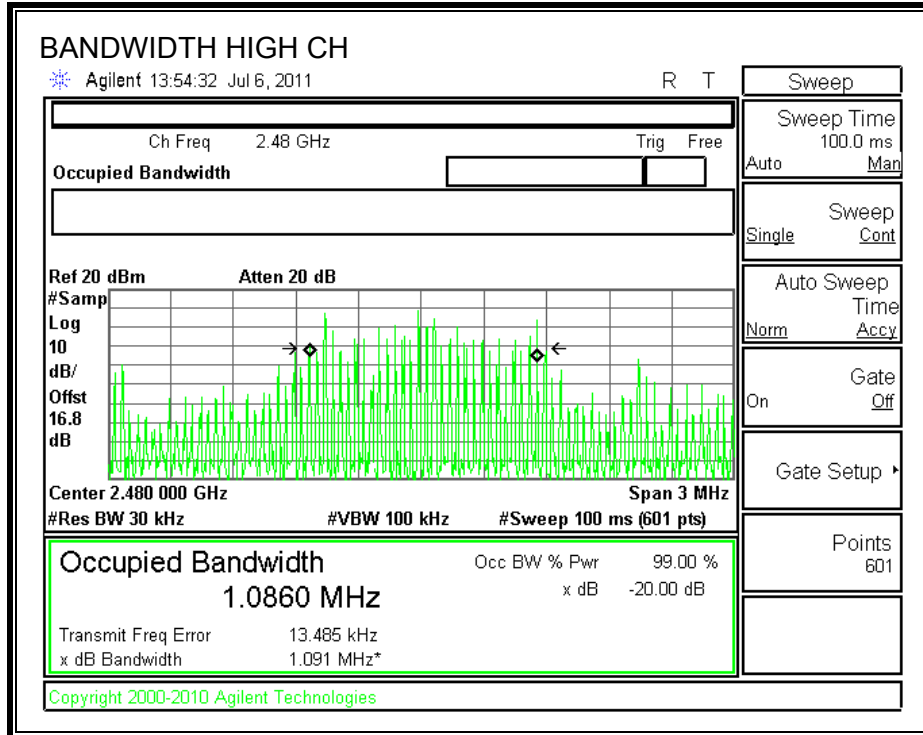
20 dB BANDWIDTH





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 hopping channel, whichever is greater.

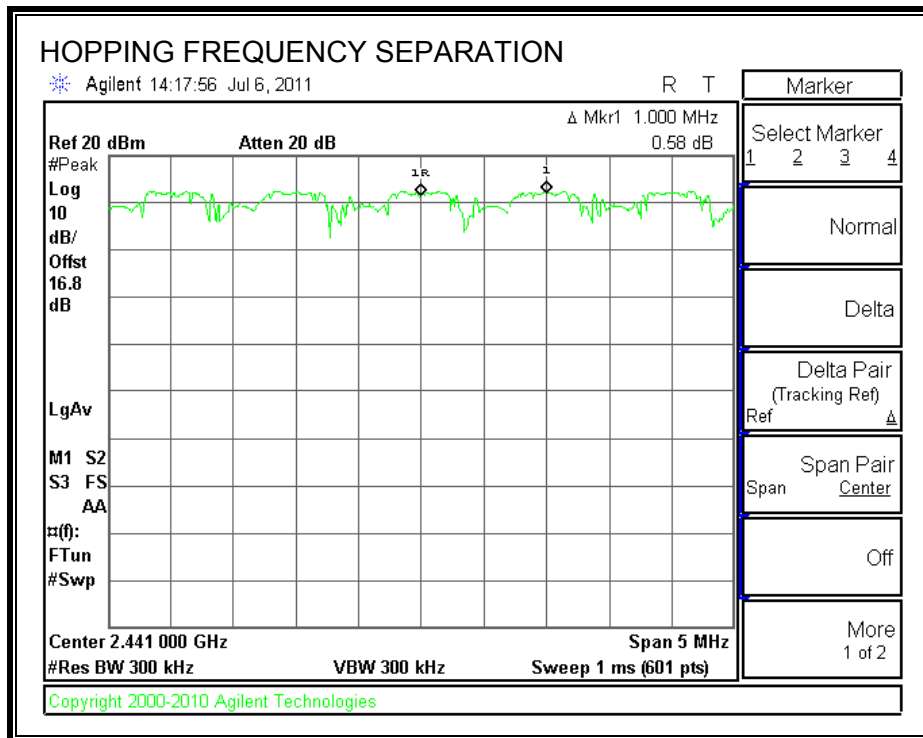
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

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.

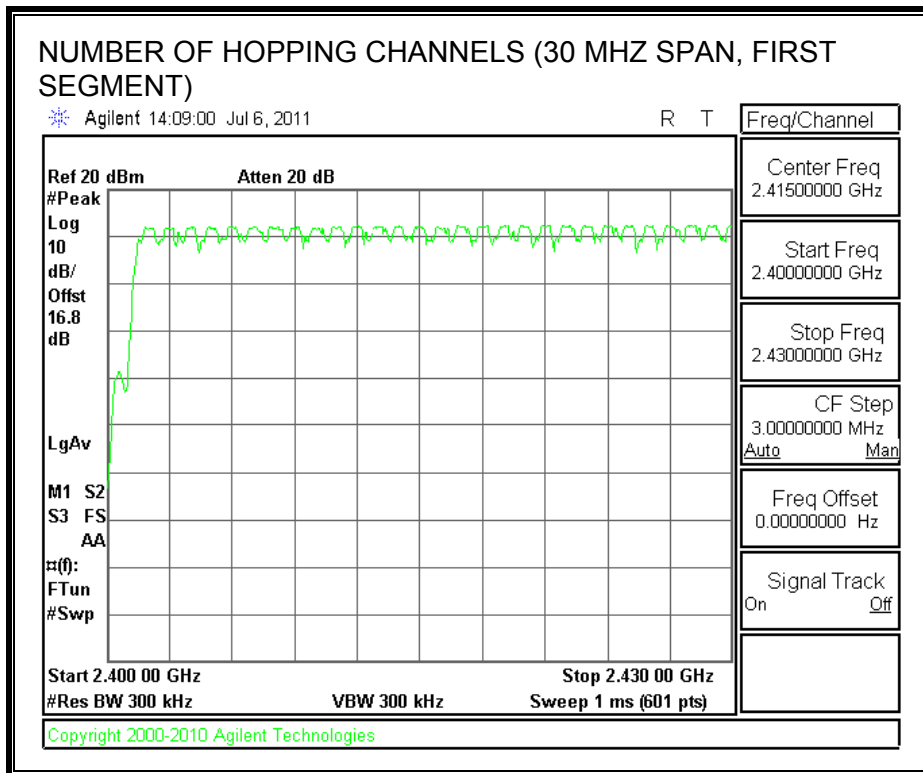
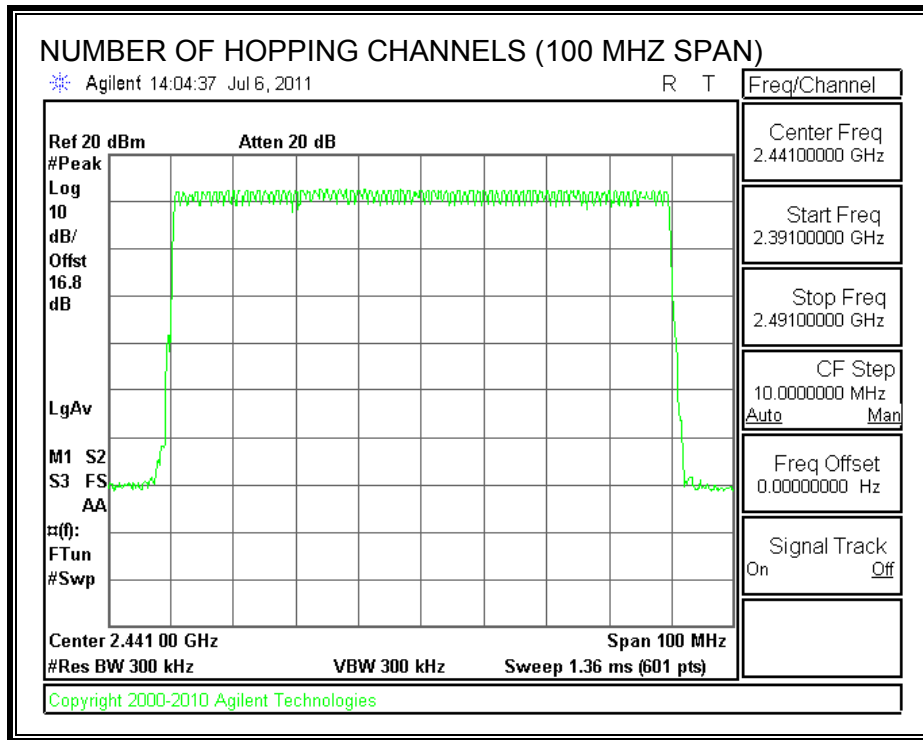
TEST PROCEDURE

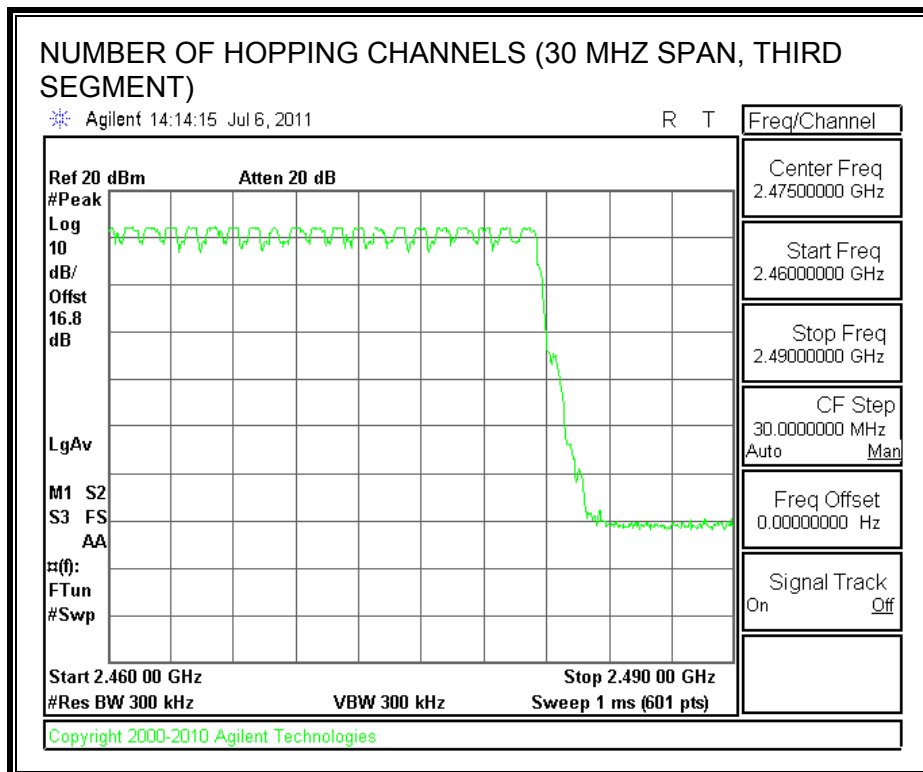
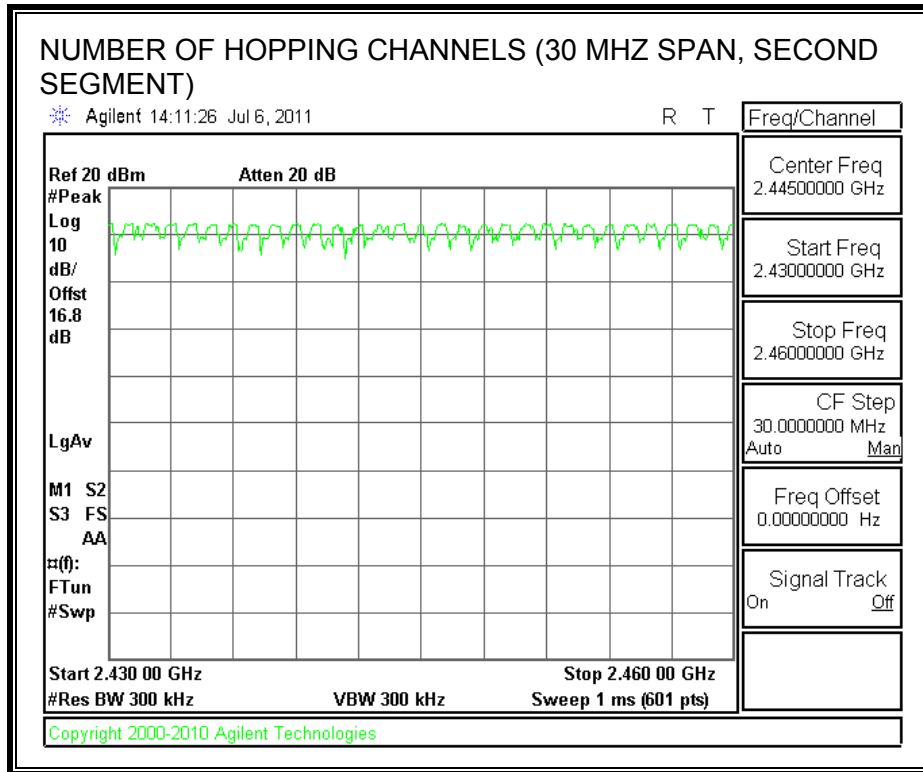
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

79 Channels observed.

NUMBER OF HOPPING CHANNELS





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.

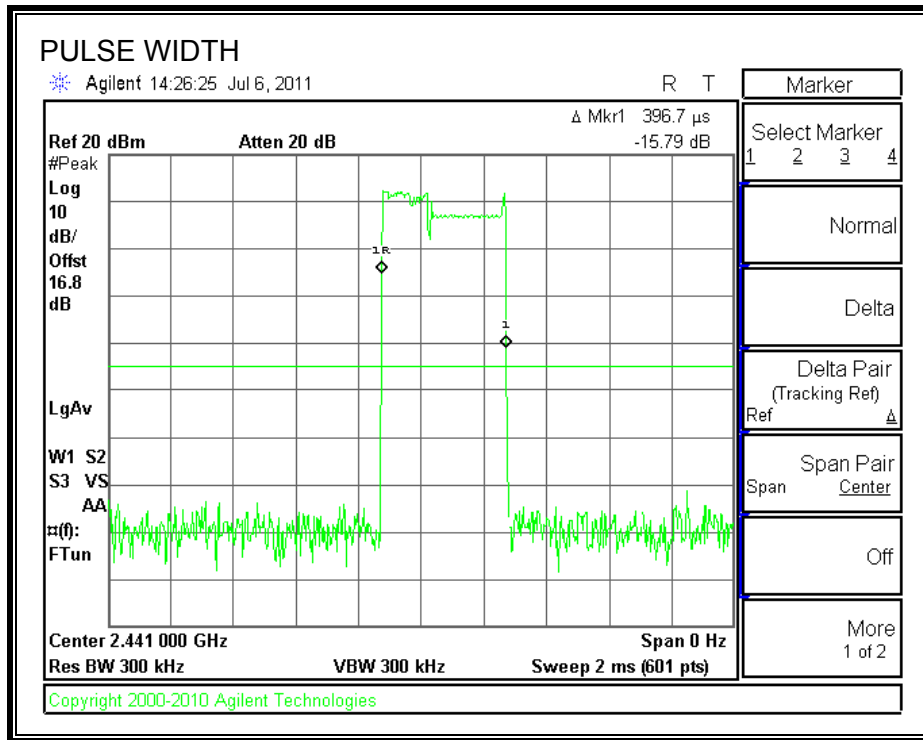
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

RESULTS

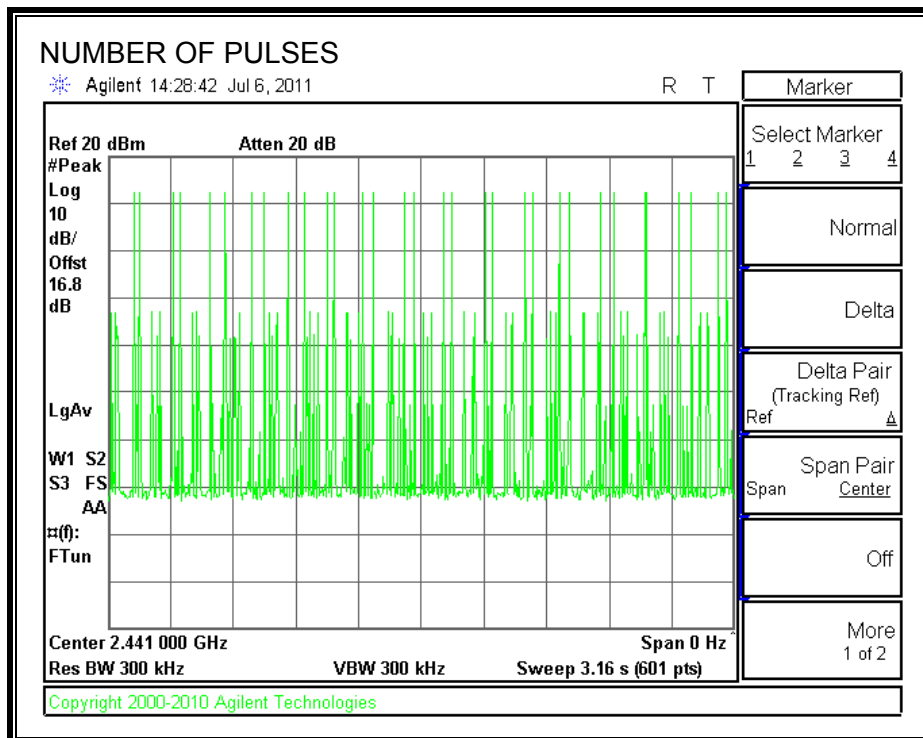
8PSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.3967	31	0.123	0.4	0.277
DH3	1.6500	11	0.182	0.4	0.219
DH5	2.9000	8	0.232	0.4	0.168

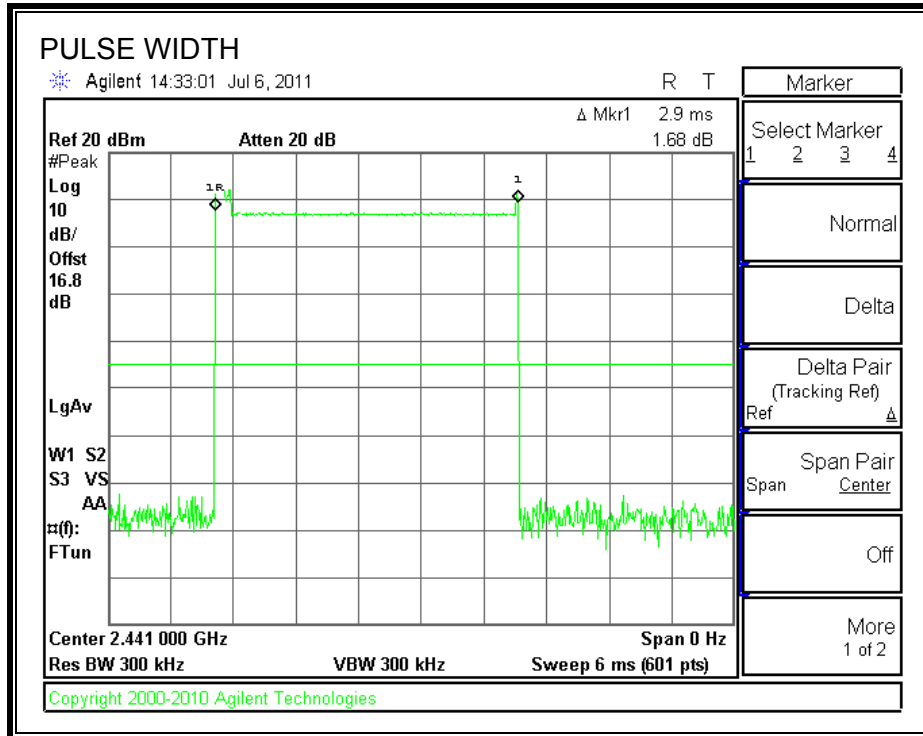
PULSE WIDTH 8PSK DH1



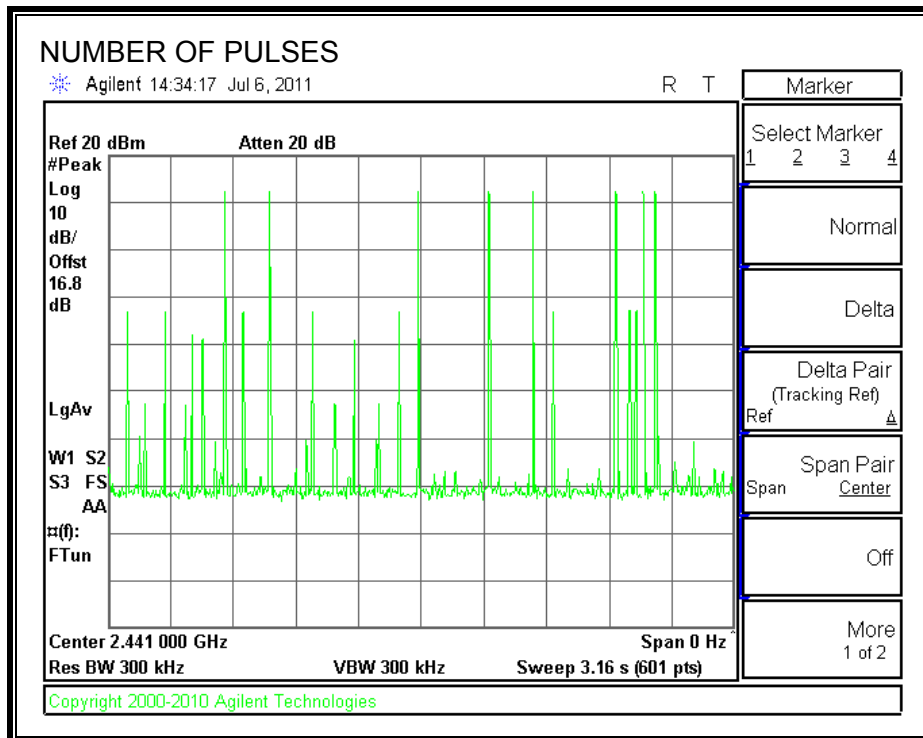
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



PULSE WIDTH 8PSK DH5



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.

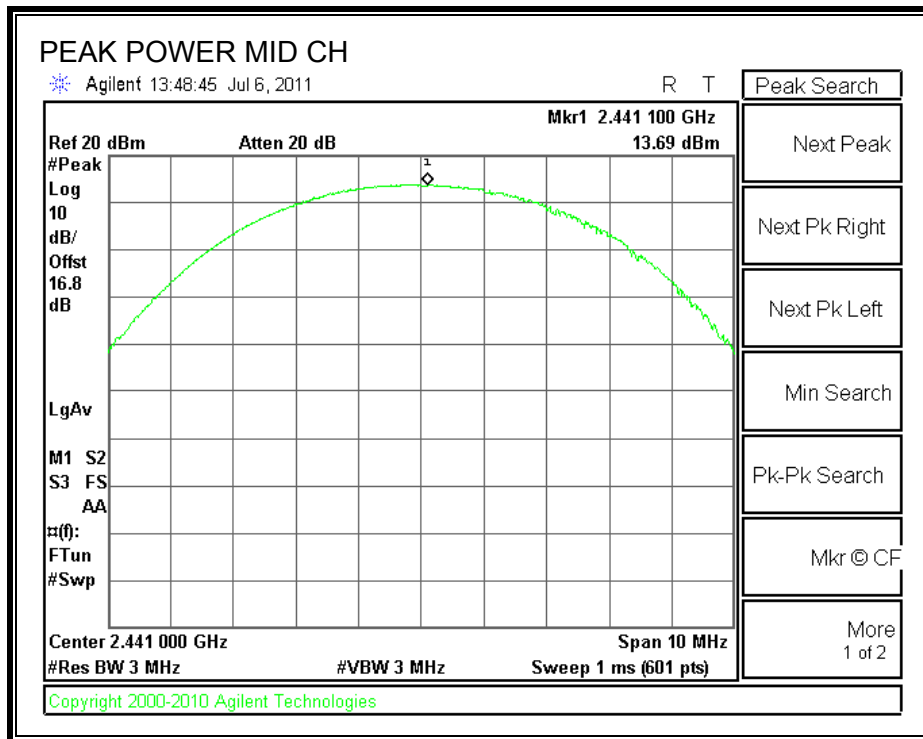
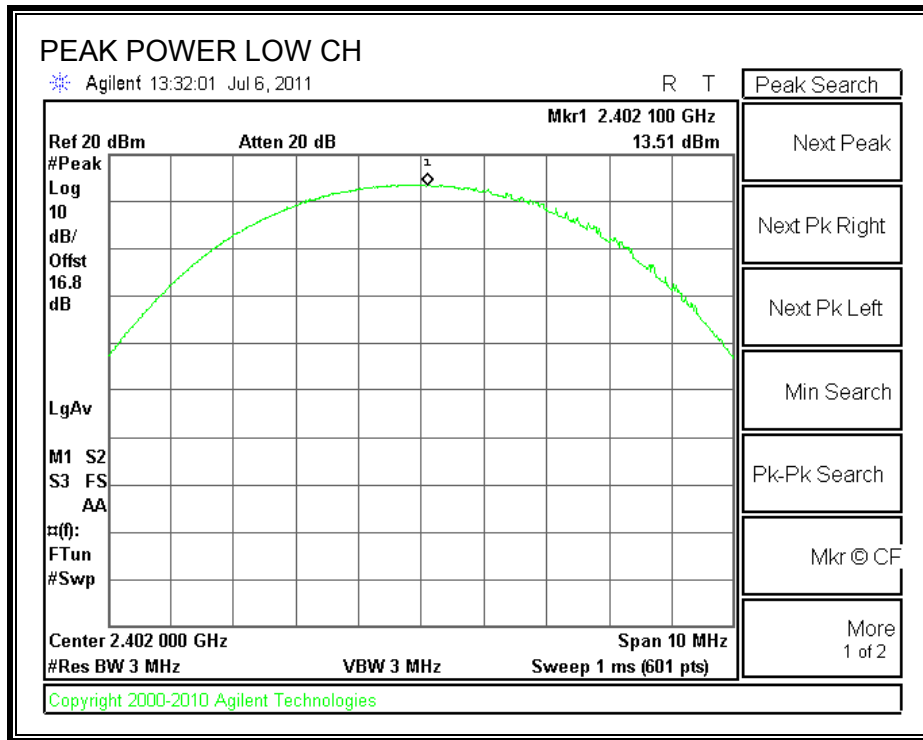
TEST PROCEDURE

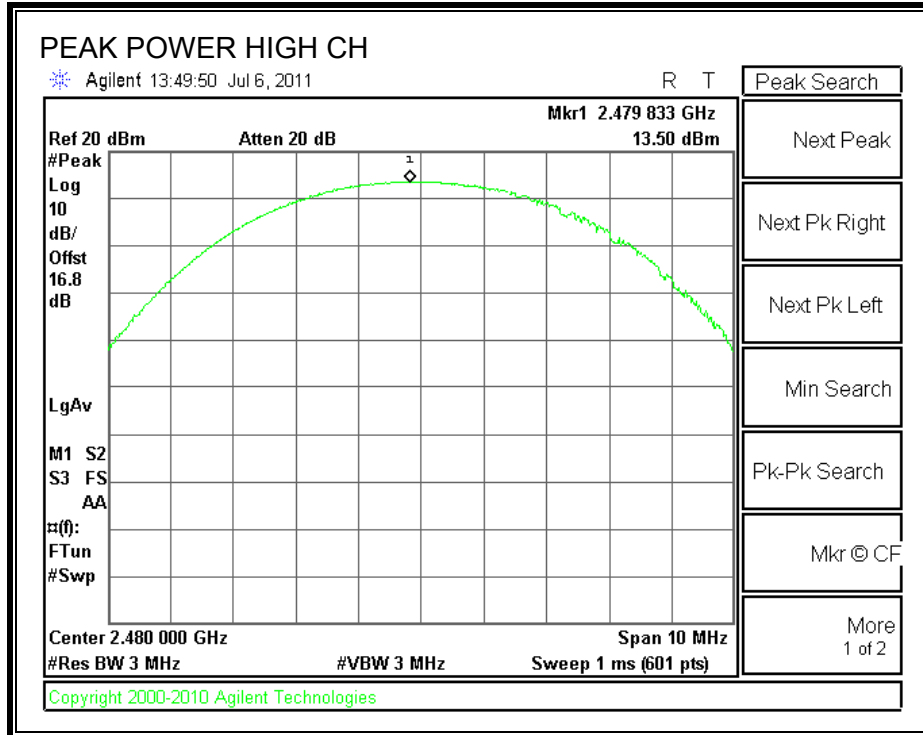
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.51	21	-7.49
Middle	2441	13.69	21	-7.31
High	2480	13.50	21	-7.50

OUTPUT POWER





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 10.4 dB (including 10 dB pad and 0.4 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	12.00
Middle	2441	12.00
High	2480	11.70

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

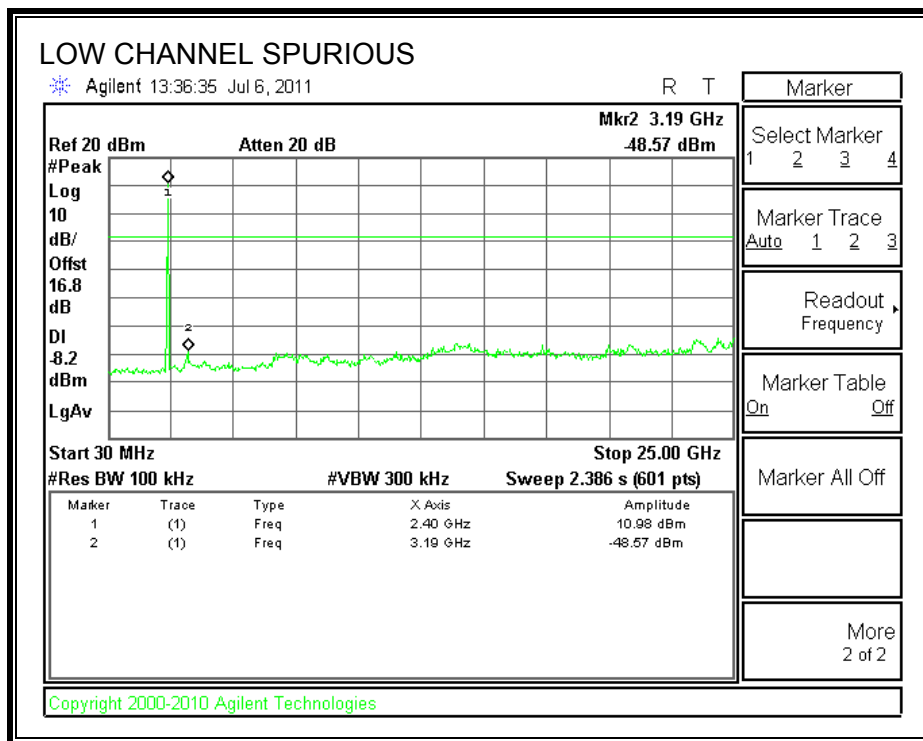
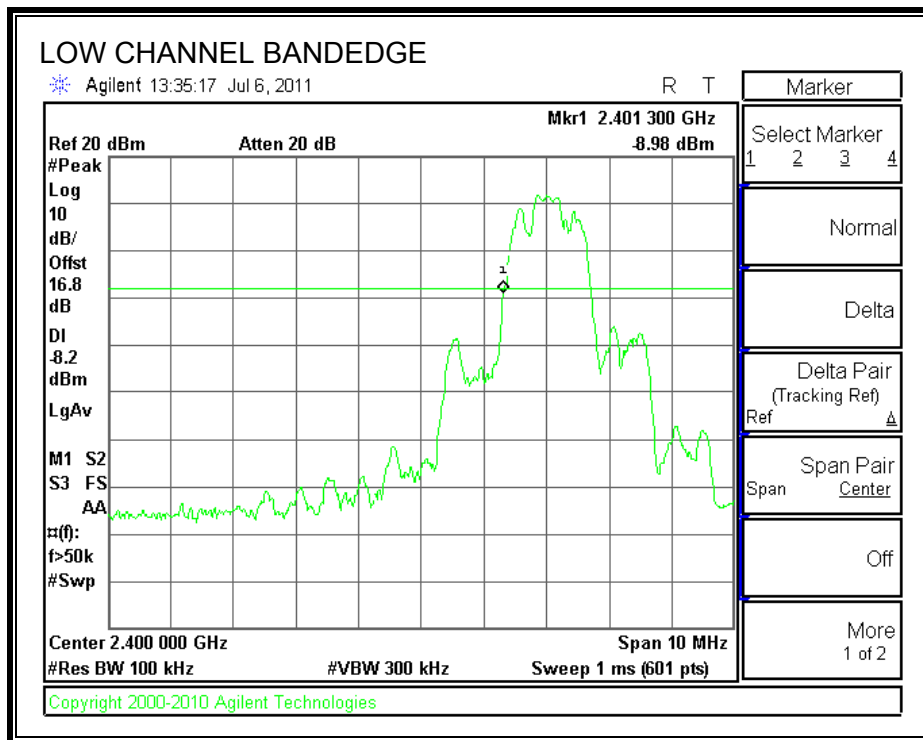
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

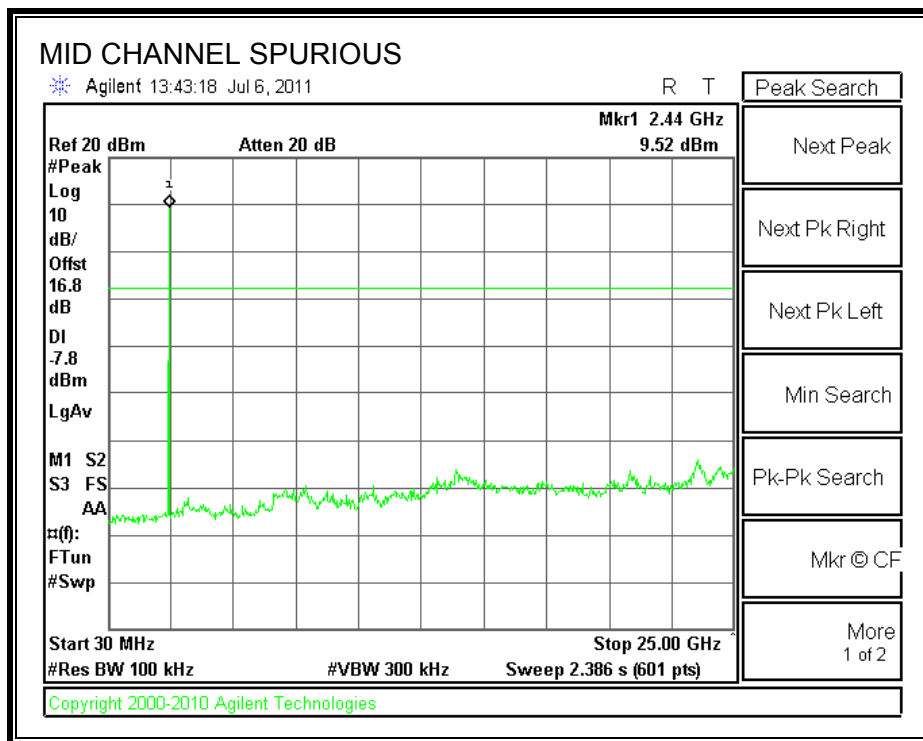
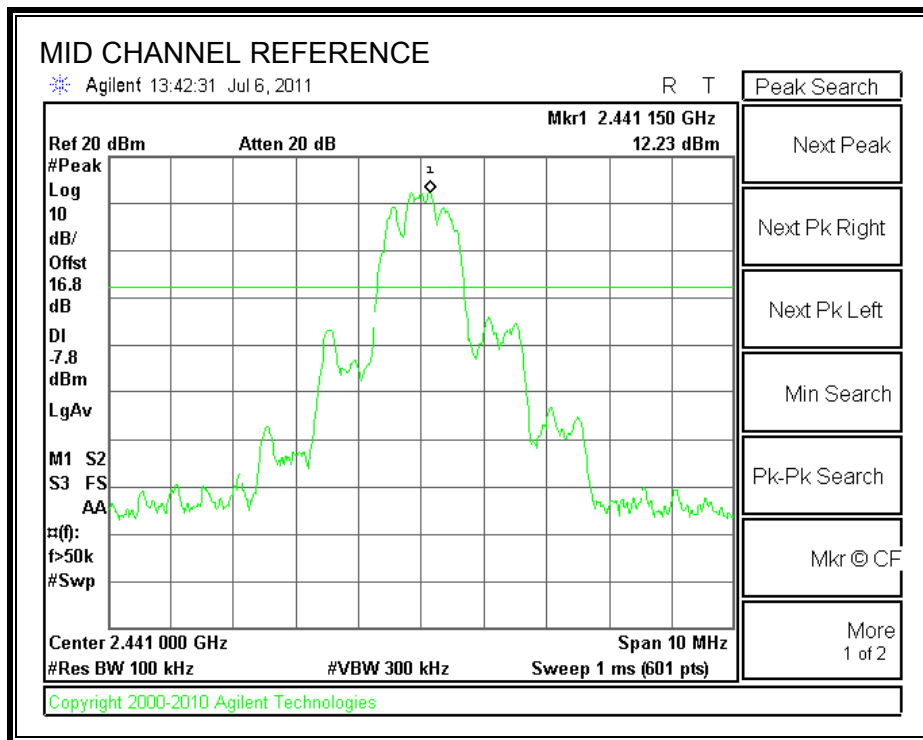
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

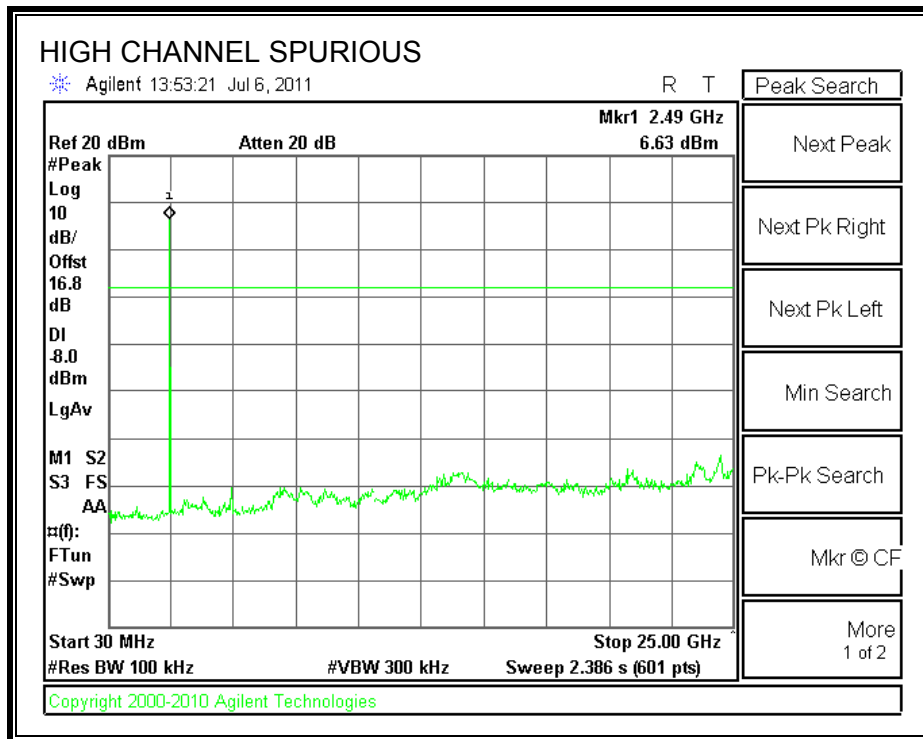
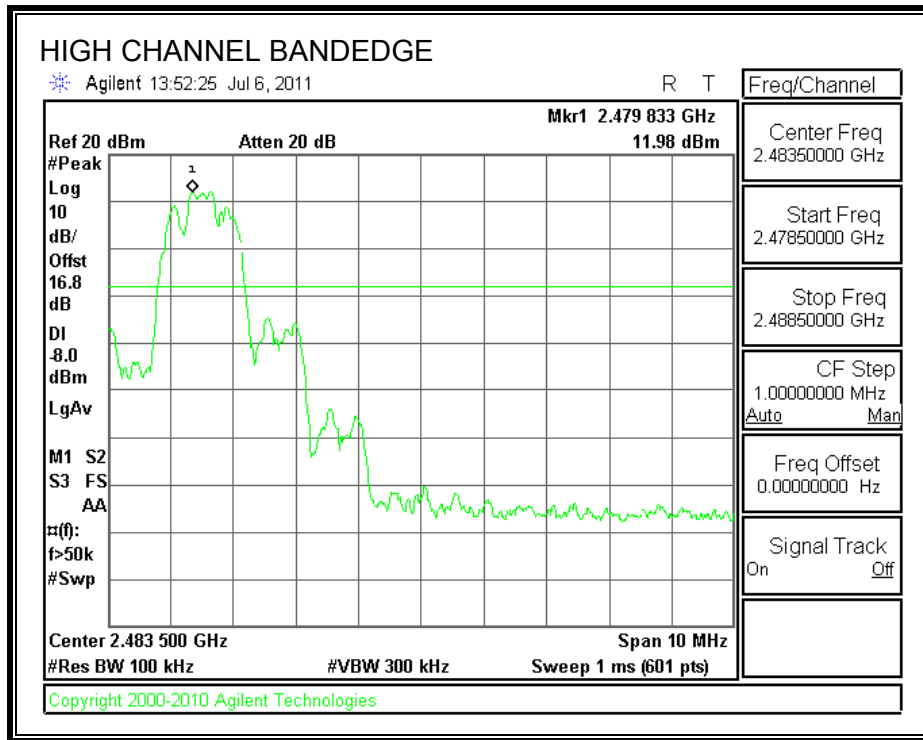
SPURIOUS EMISSIONS, LOW CHANNEL



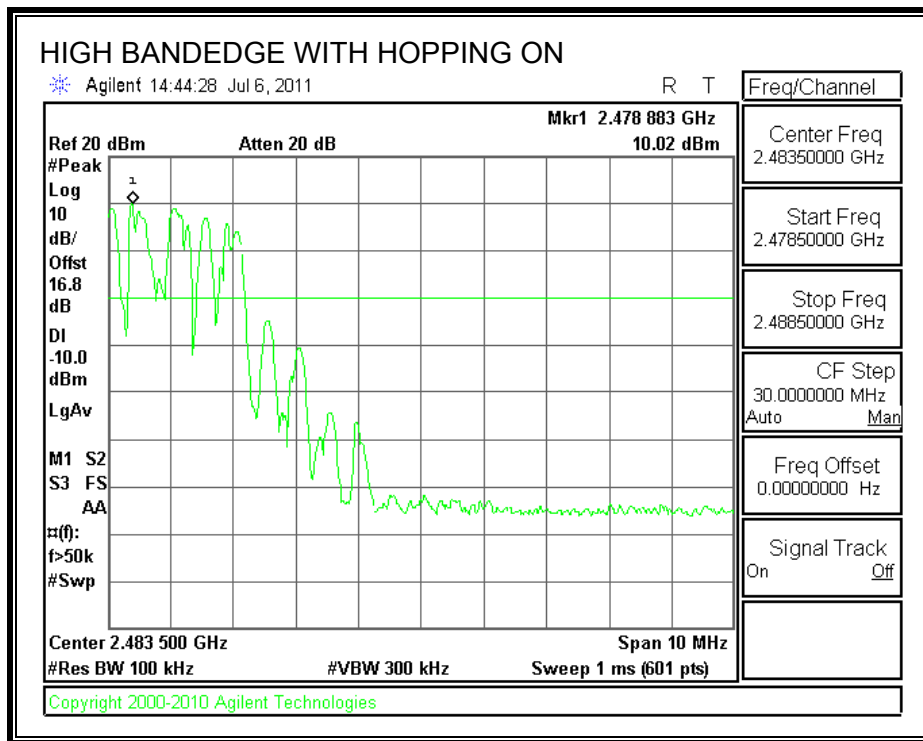
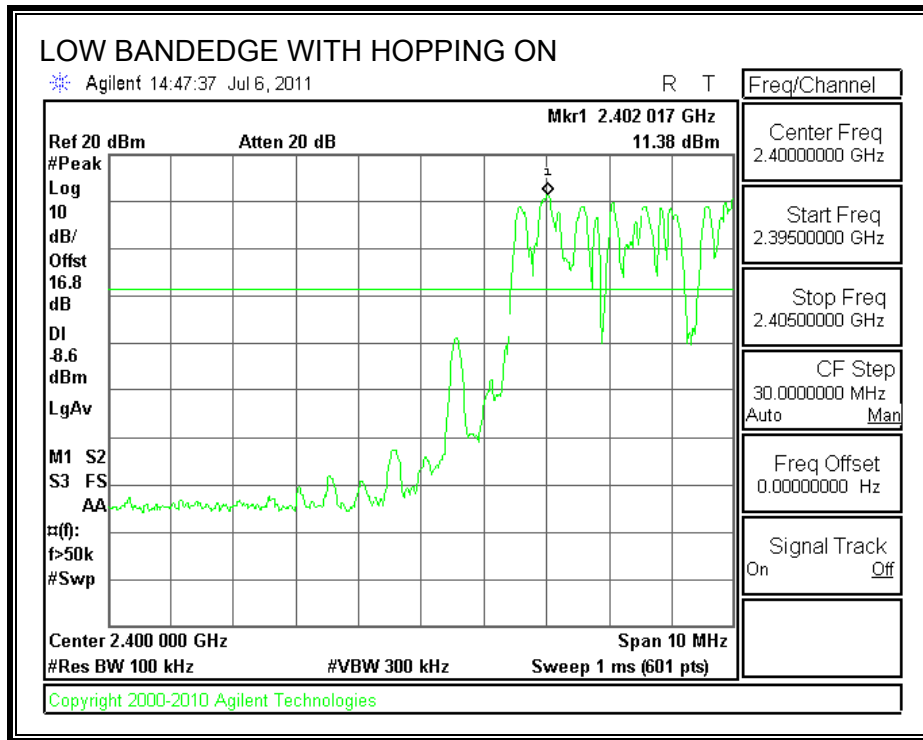
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



BOM VARINAT 2

7.4. BASIC DATA RATE GFSK MODULATION

7.4.1. 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.

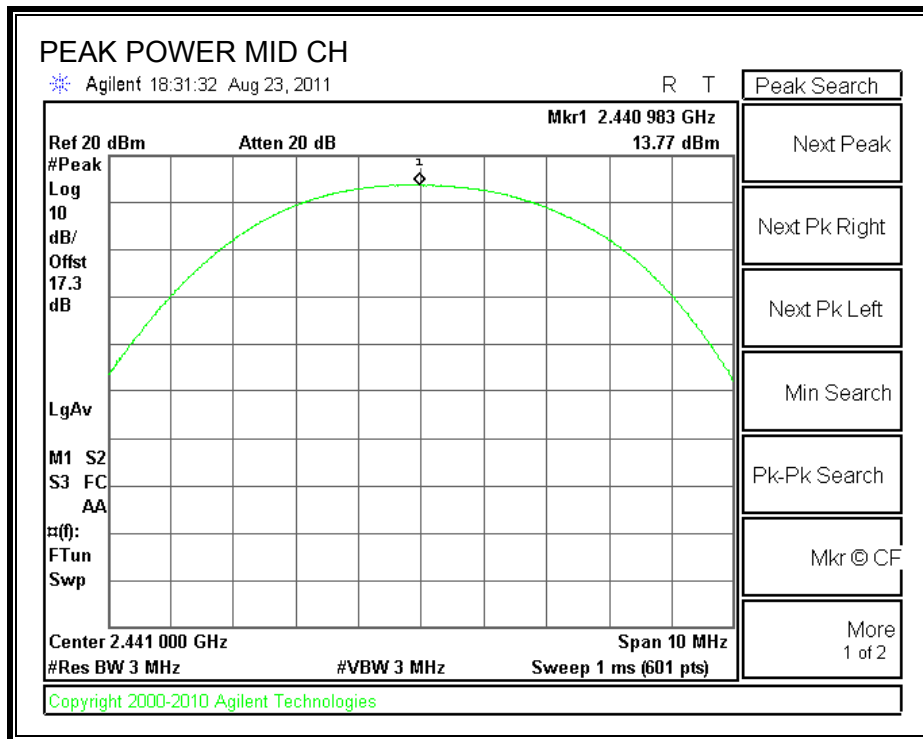
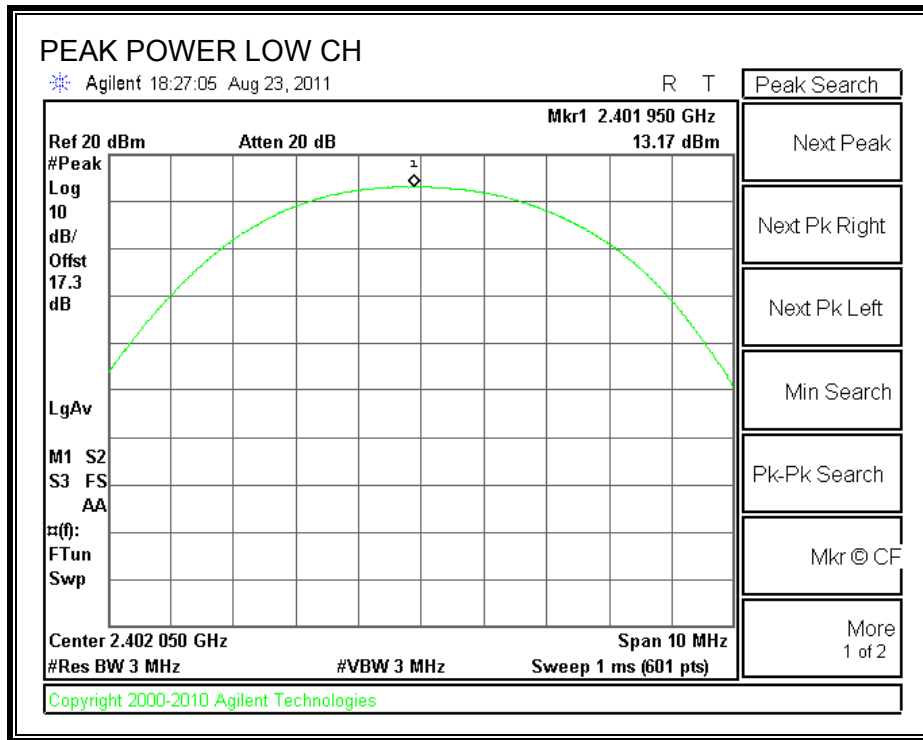
TEST PROCEDURE

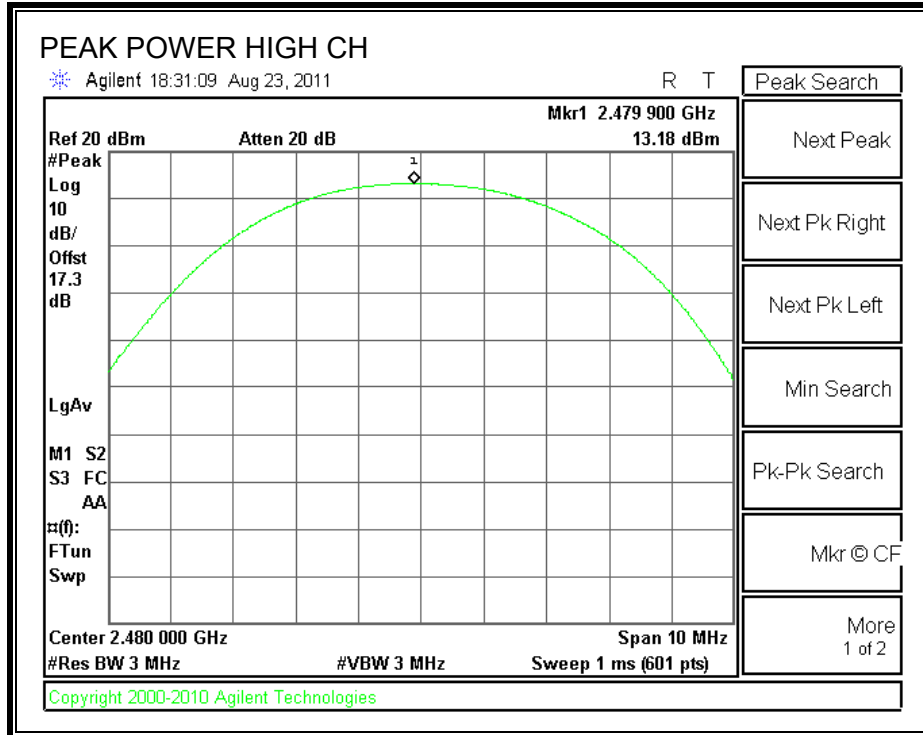
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.17	21	-7.83
Middle	2441	13.77	21	-7.23
High	2480	13.18	21	-7.82

OUTPUT POWER





7.4.2. 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 10.4 dB (including 10 dB pad and 0.4 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	12.45
Middle	2441	13.00
High	2480	12.45

7.5. DQPSK MODULATION

7.5.1. 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.

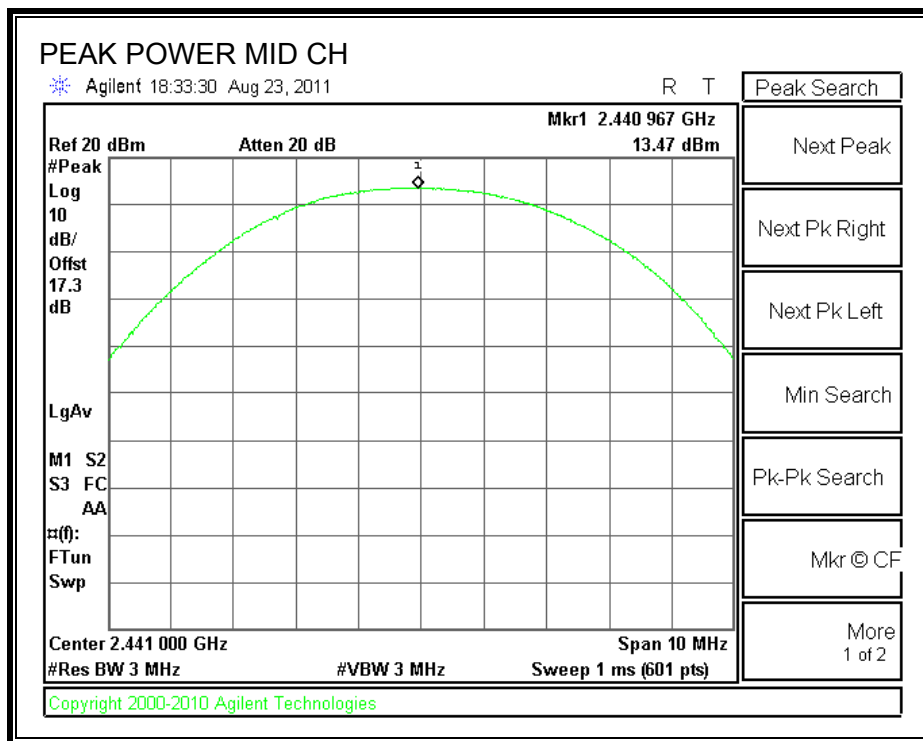
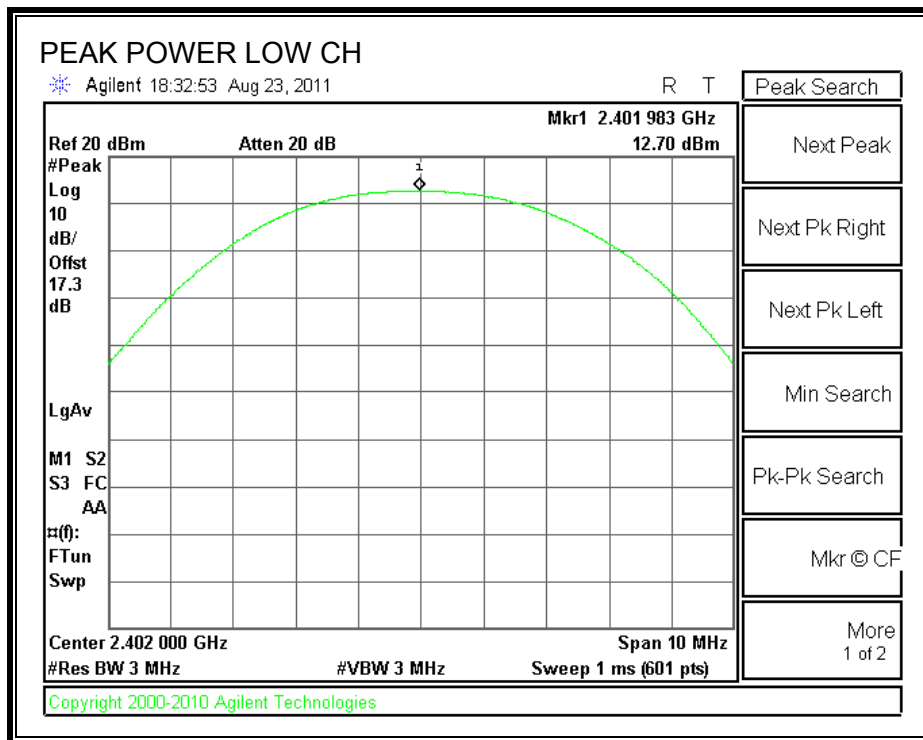
TEST PROCEDURE

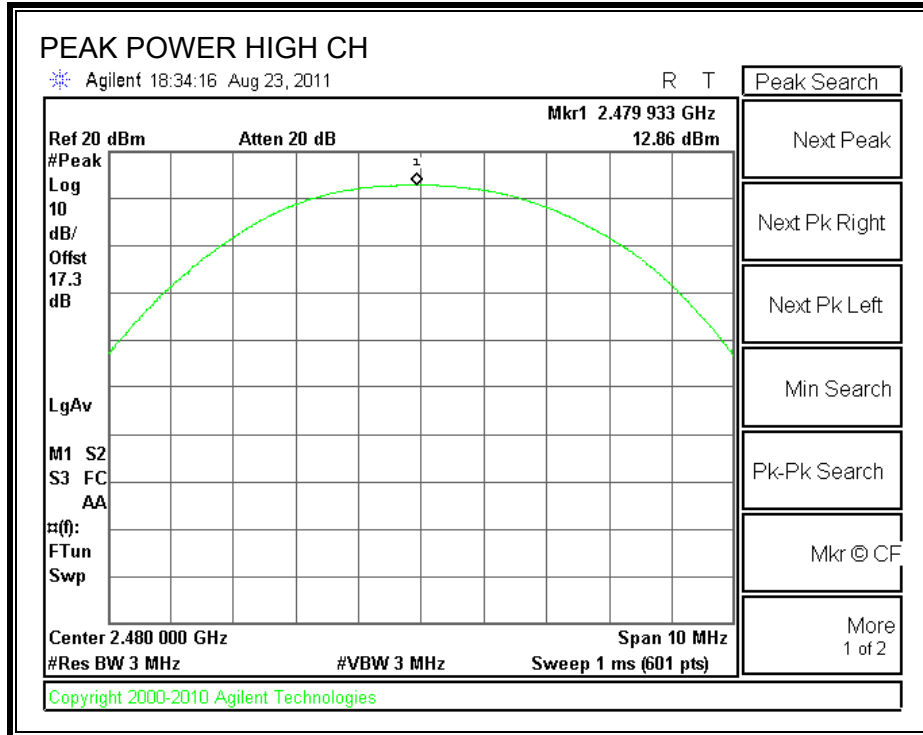
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.70	21	-8.30
Middle	2441	13.47	21	-7.53
High	2480	12.86	21	-8.14

OUTPUT POWER





7.5.2. 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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.15
Middle	2441	11.60
High	2480	11.15

7.6. ENHANCED DATA RATE 8PSK MODULATION

7.6.1. 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.

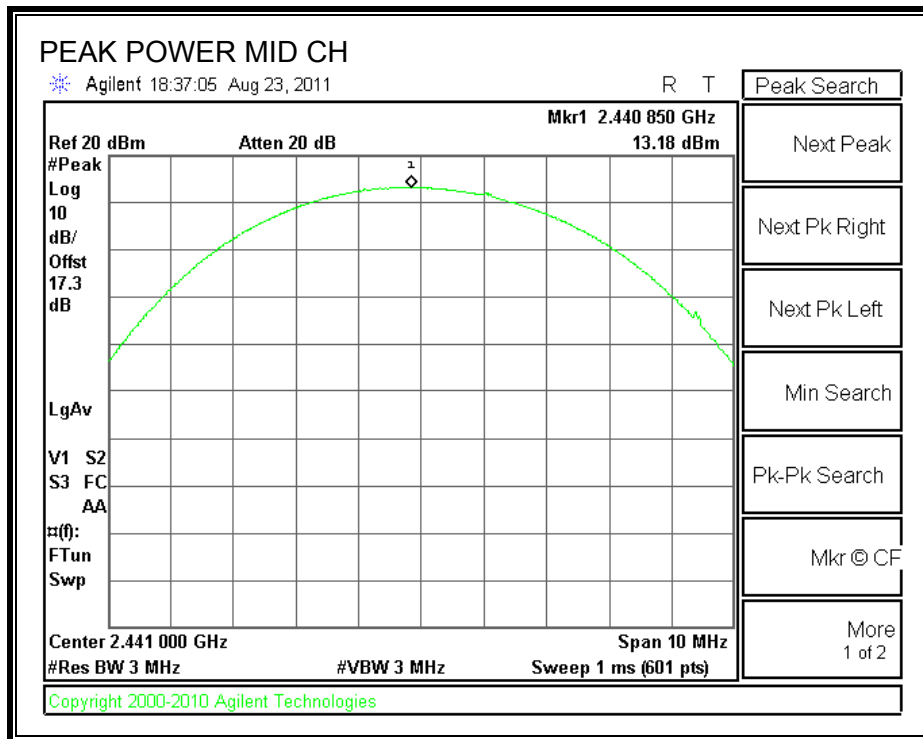
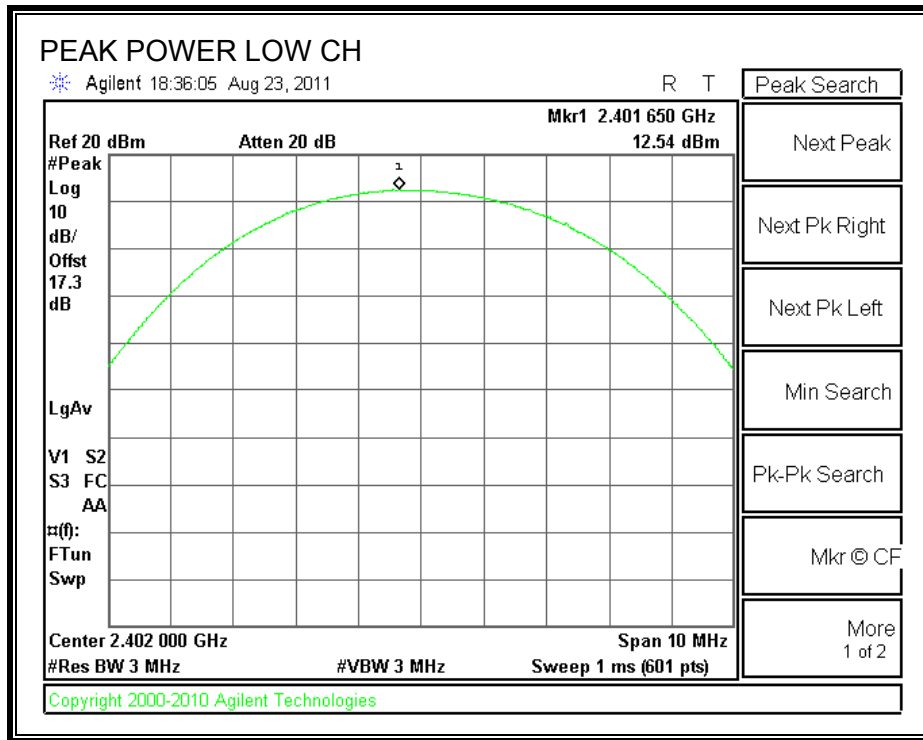
TEST PROCEDURE

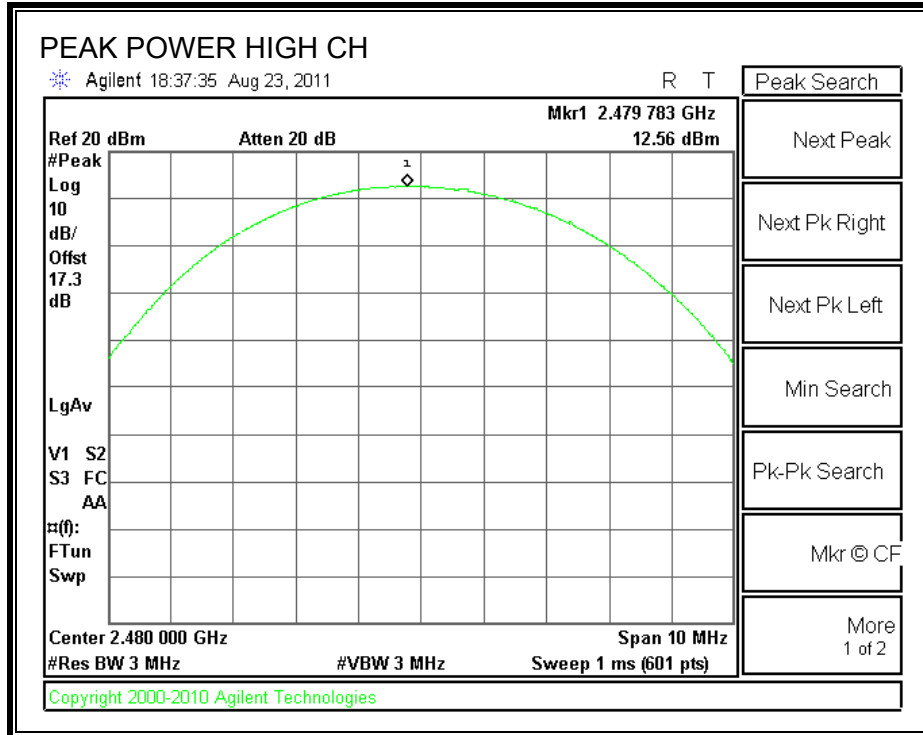
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.54	21	-8.46
Middle	2441	13.18	21	-7.82
High	2480	12.56	21	-8.44

OUTPUT POWER





7.6.2. 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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.05
Middle	2441	11.50
High	2480	10.75

BOM VARIANT 3

7.7. BASIC DATA RATE GFSK MODULATION

7.7.1. 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.

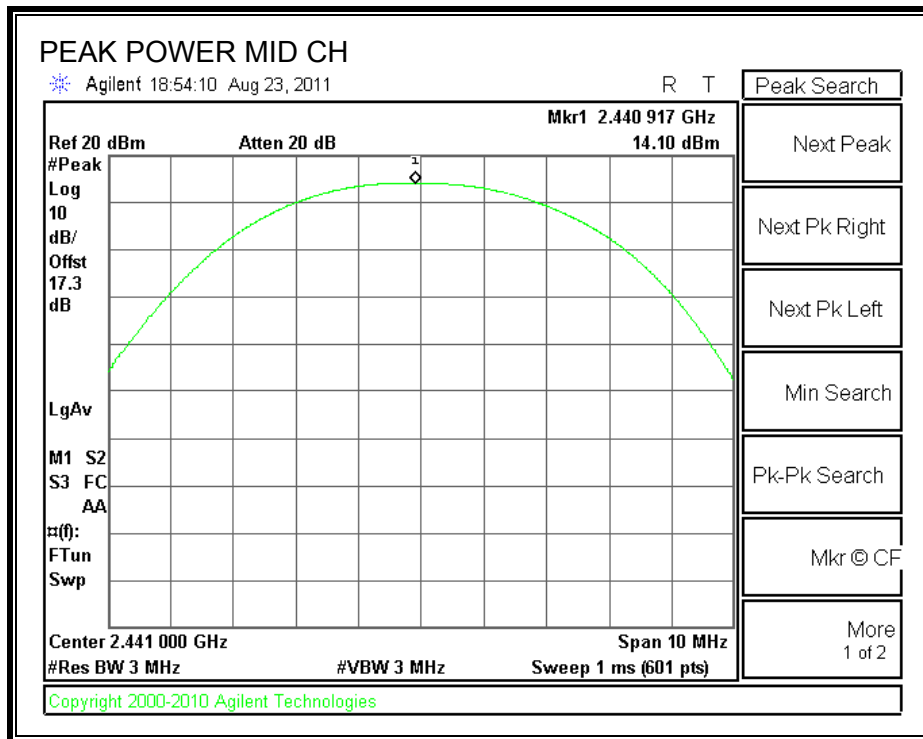
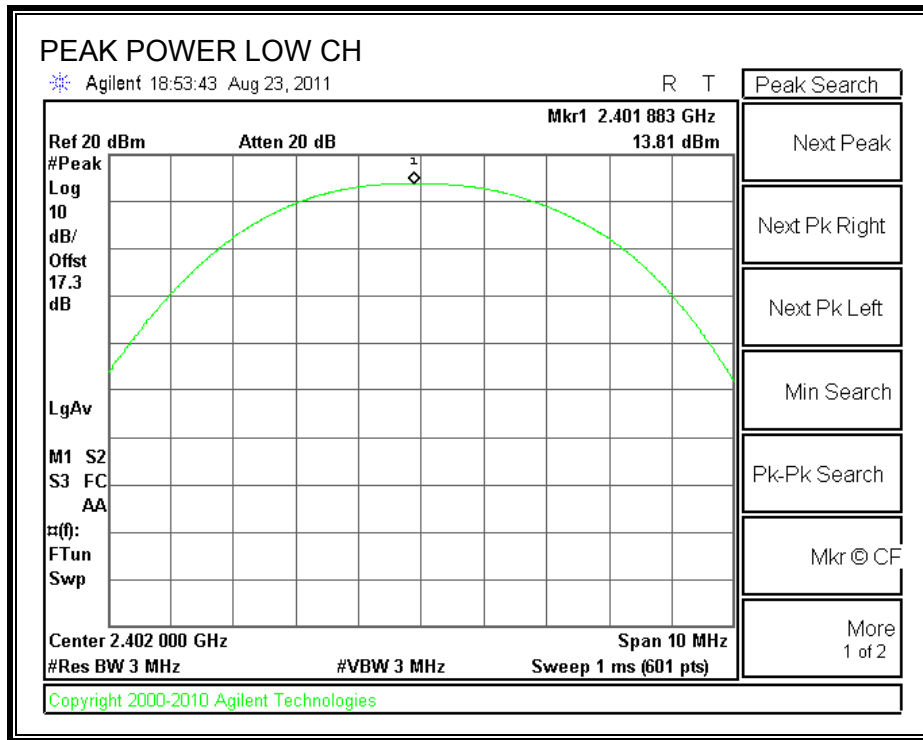
TEST PROCEDURE

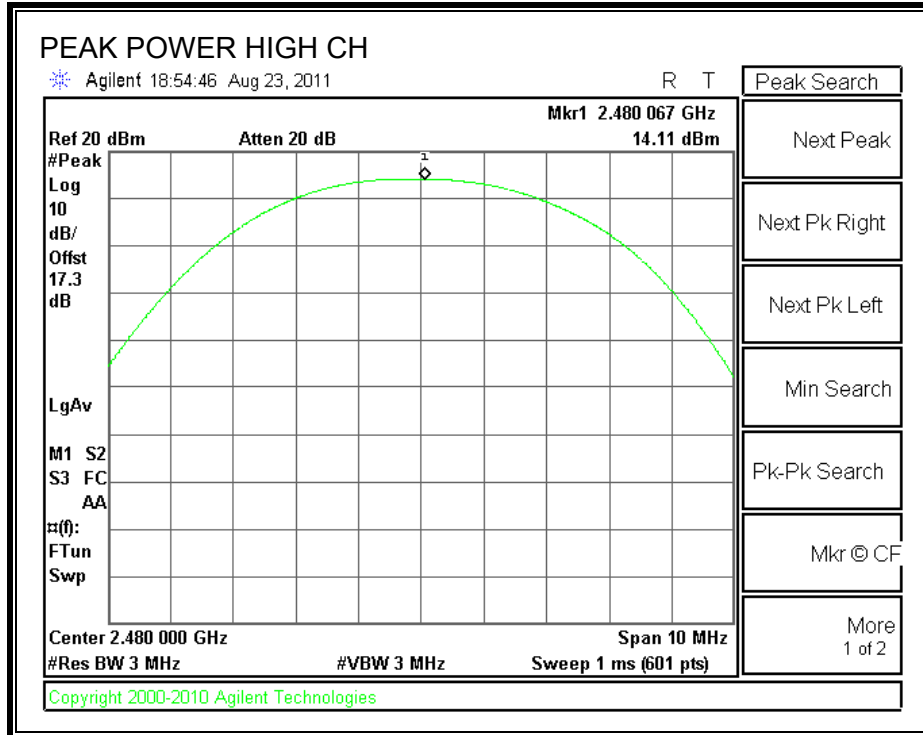
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.81	21	-7.19
Middle	2441	14.10	21	-6.90
High	2480	14.11	21	-6.89

OUTPUT POWER





7.7.2. 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 10.4 dB (including 10 dB pad and 0.4 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	13.10
Middle	2441	13.30
High	2480	13.40

7.8. DQPSK MODULATION

7.8.1. 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.

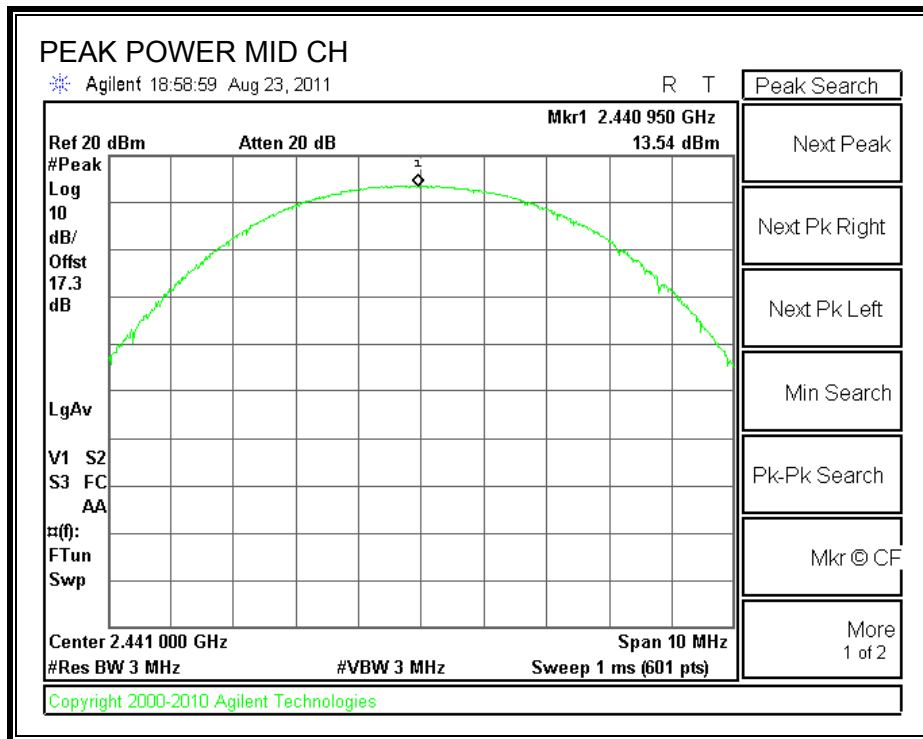
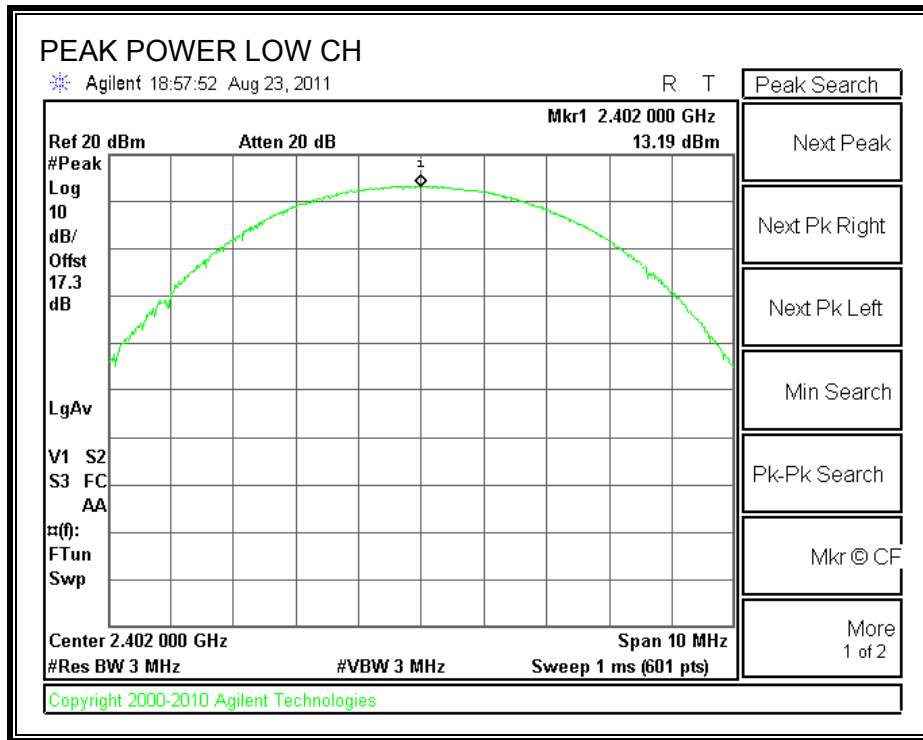
TEST PROCEDURE

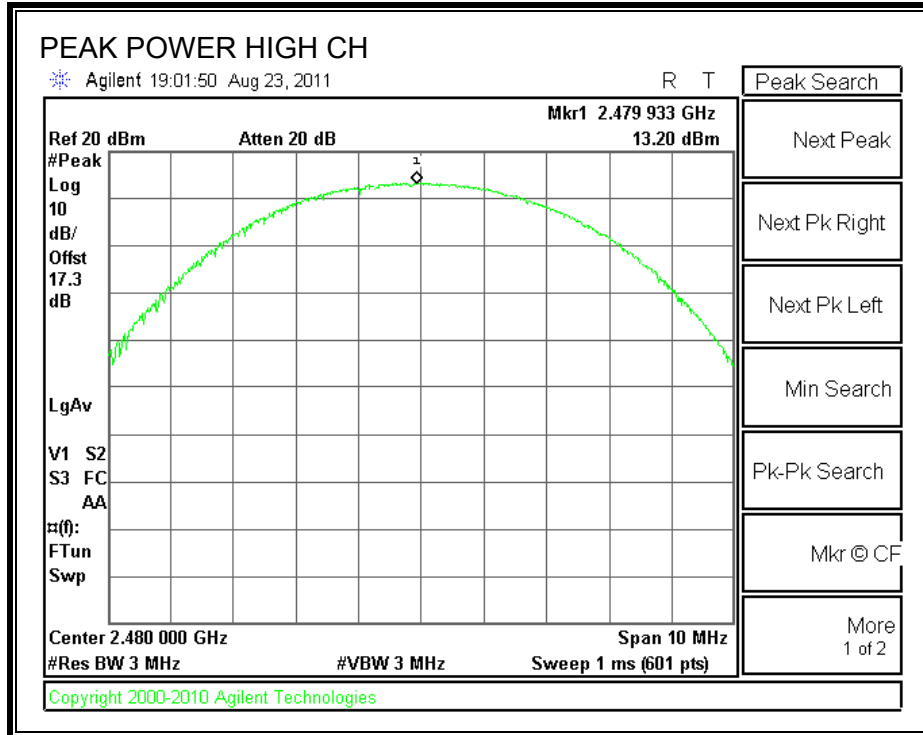
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.19	21	-7.81
Middle	2441	13.54	21	-7.46
High	2480	13.20	21	-7.80

OUTPUT POWER





7.8.2. 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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.65
Middle	2441	11.65
High	2480	11.50

7.9. ENHANCED DATA RATE 8PSK MODULATION

7.9.1. 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.

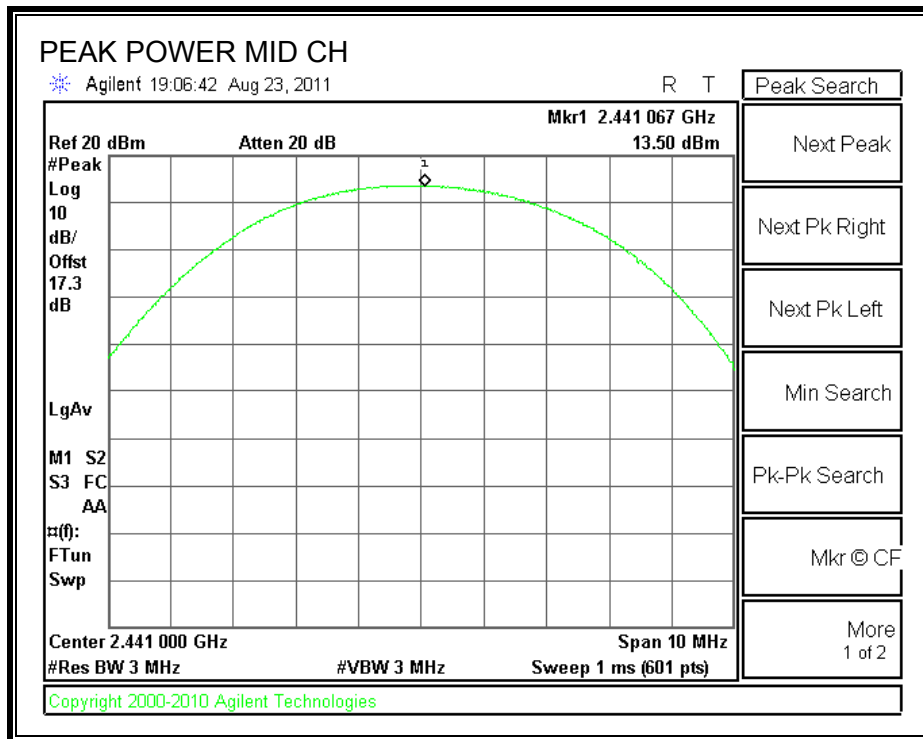
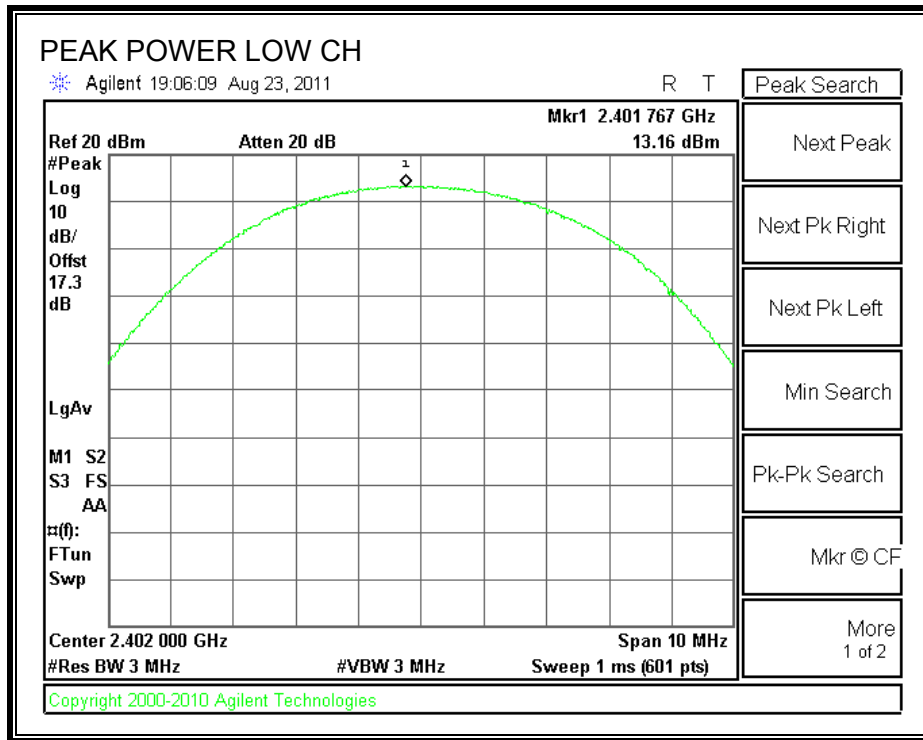
TEST PROCEDURE

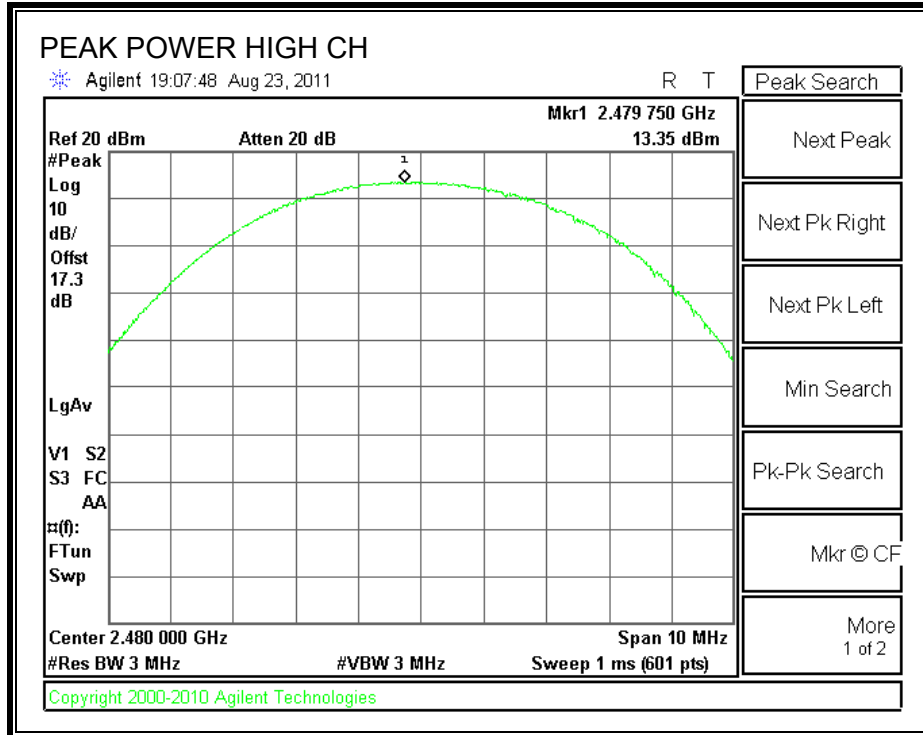
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.16	21	-7.84
Middle	2441	13.50	21	-7.50
High	2480	13.35	21	-7.65

OUTPUT POWER





7.9.2. 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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.65
Middle	2441	11.80
High	2480	11.55

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.

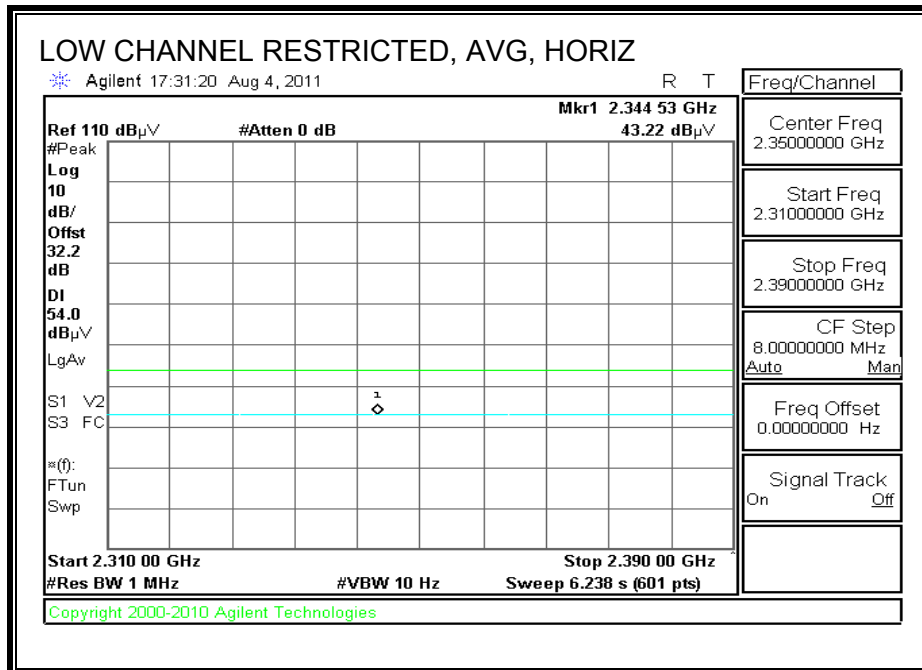
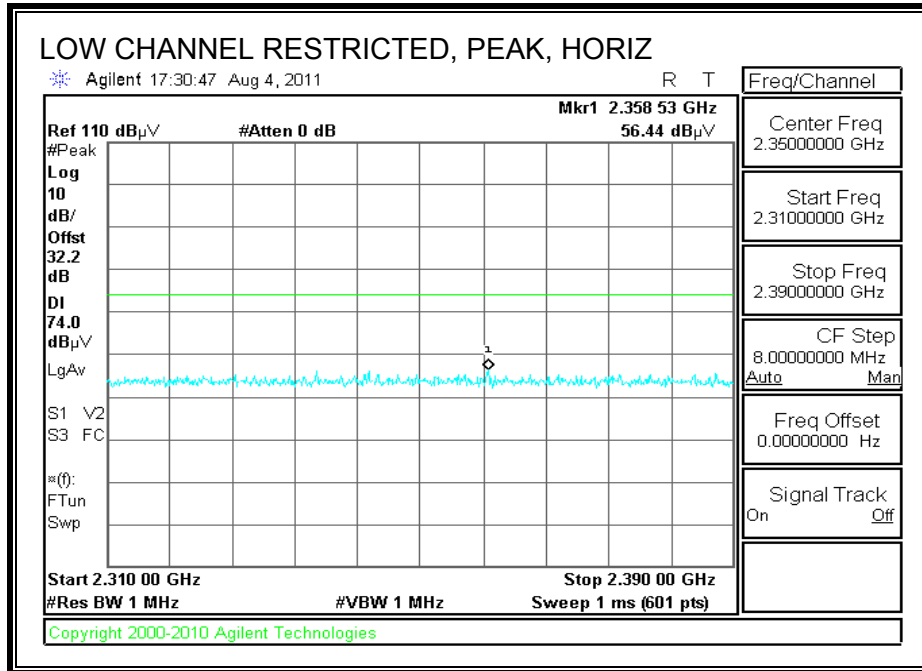
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

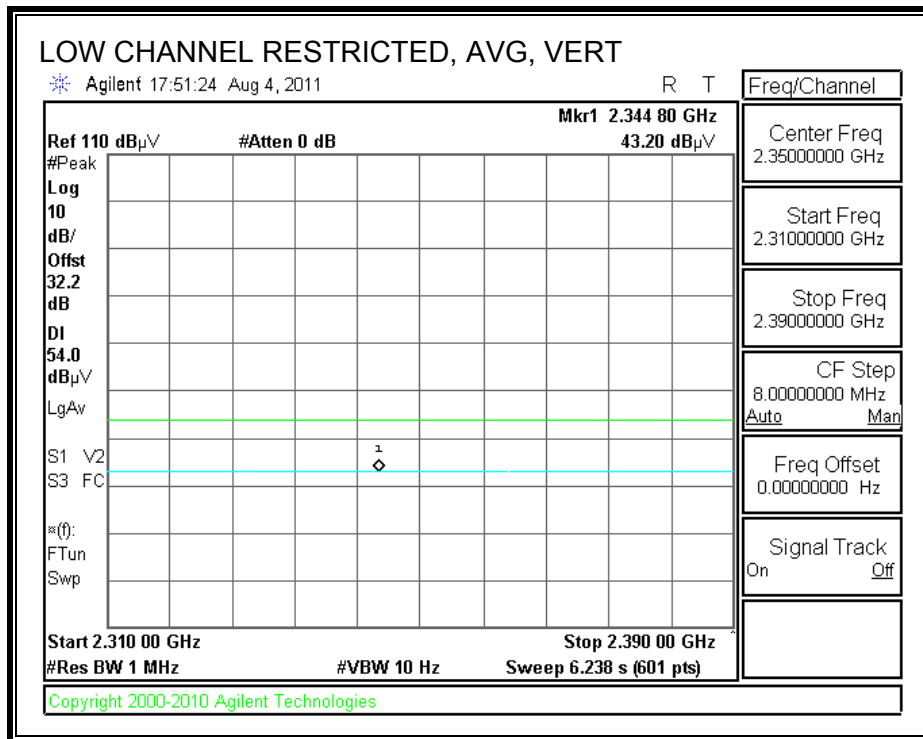
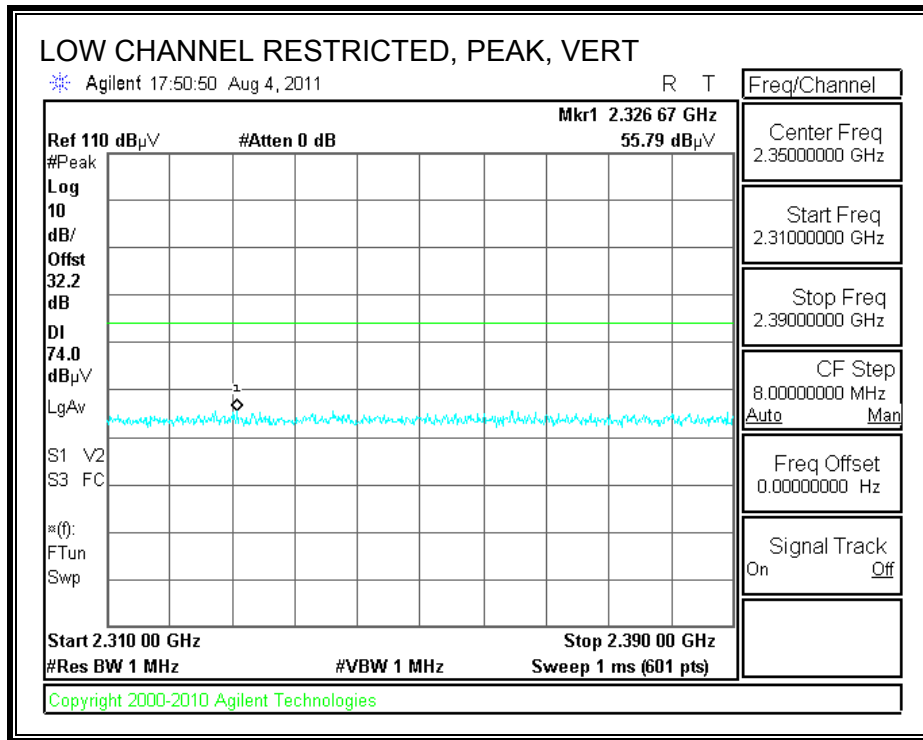
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

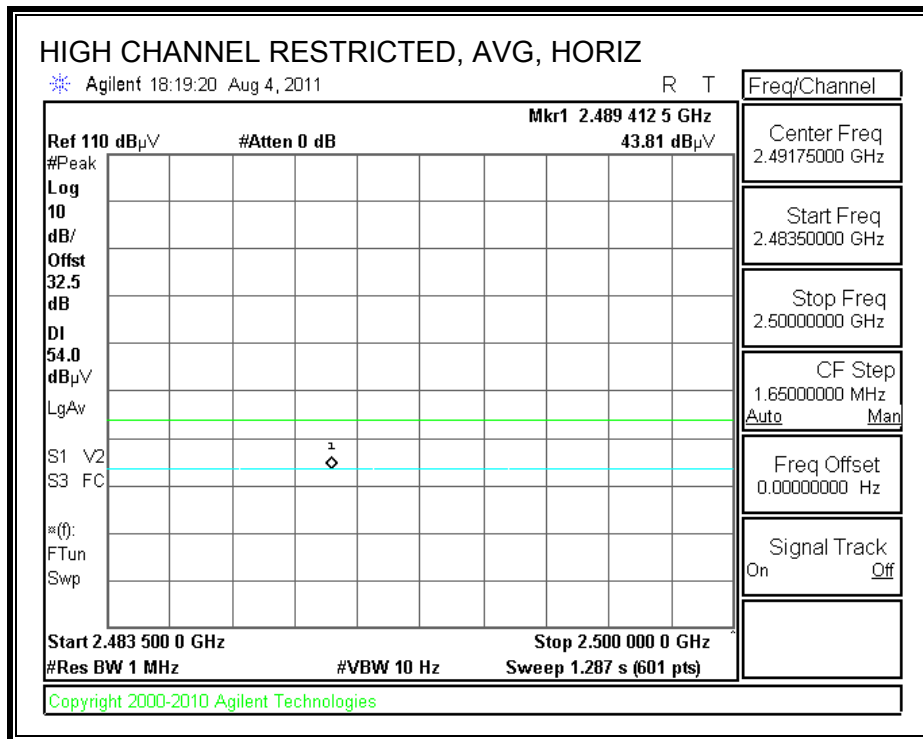
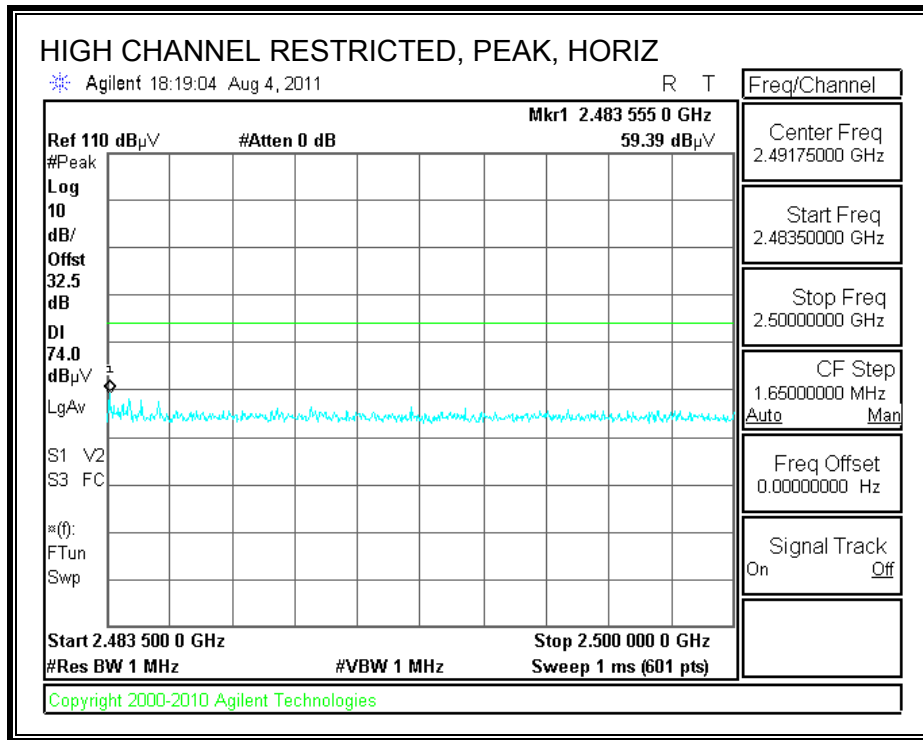
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



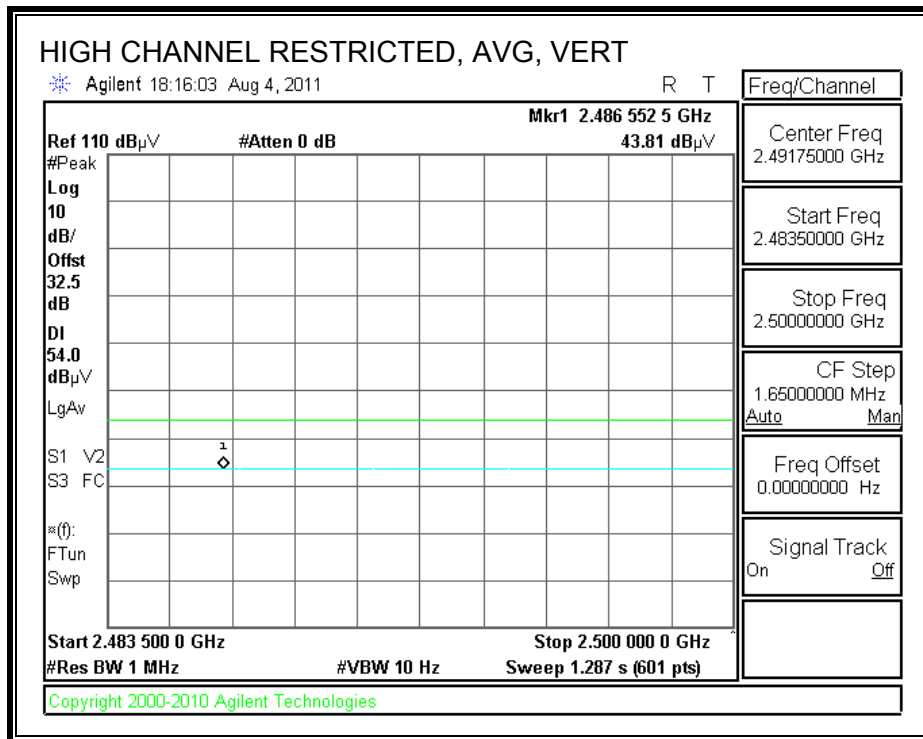
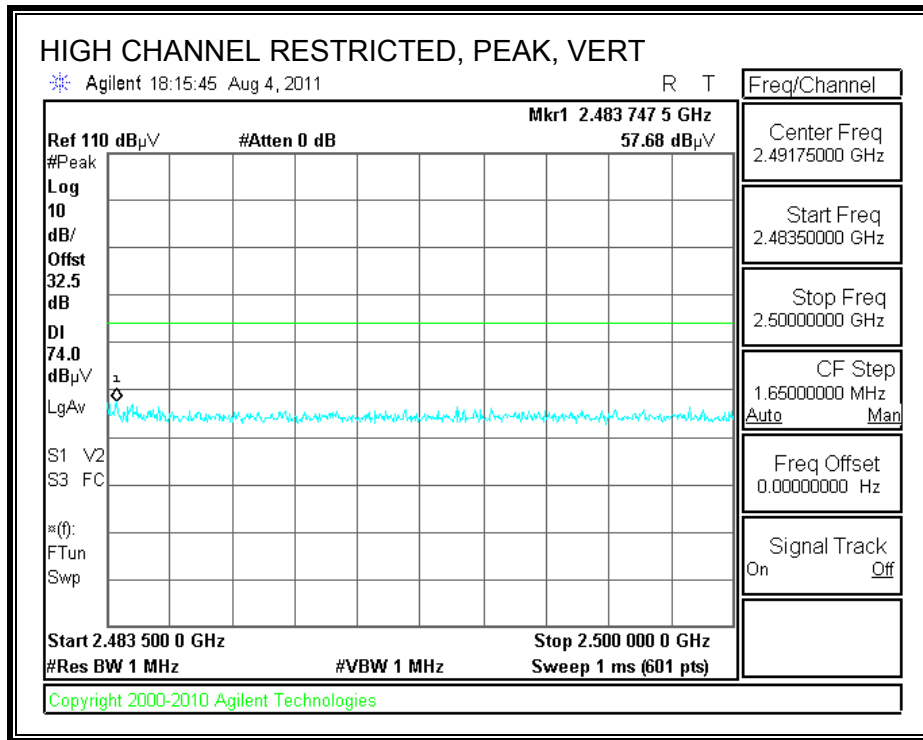
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

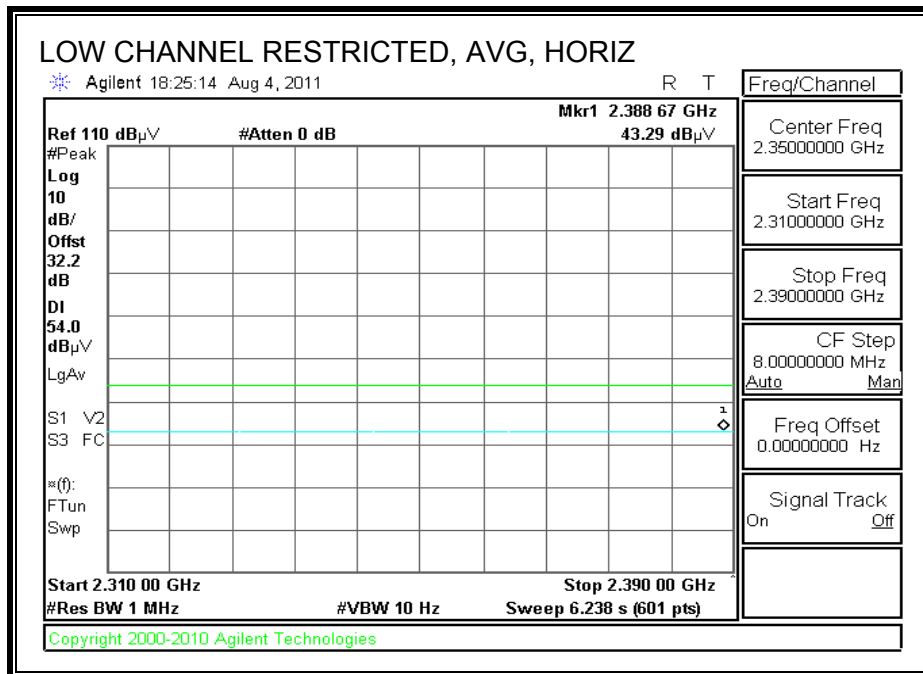
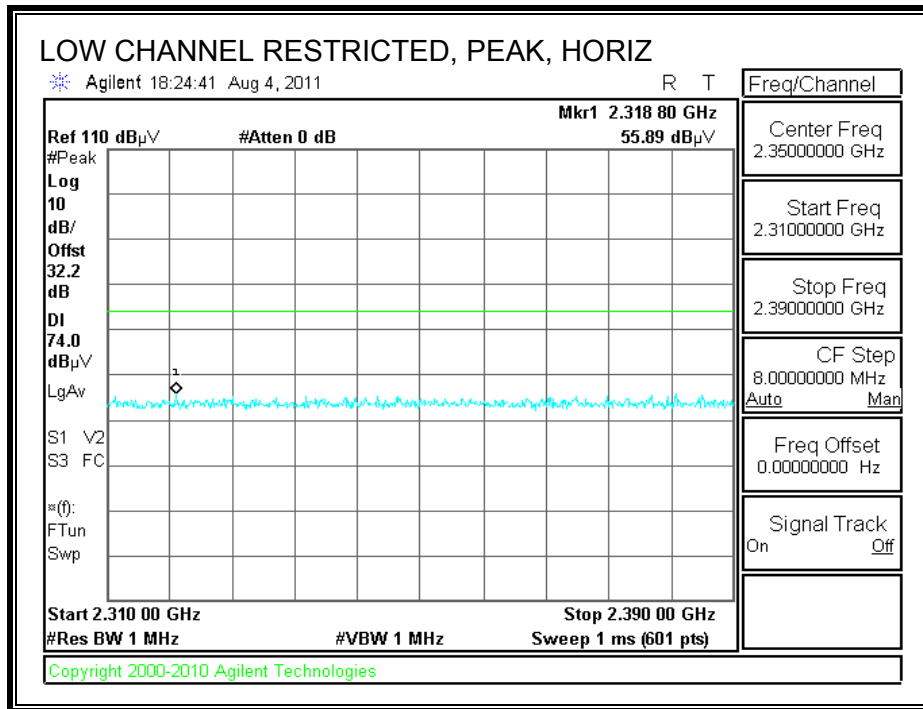


HARMONICS AND SPURIOUS EMISSIONS

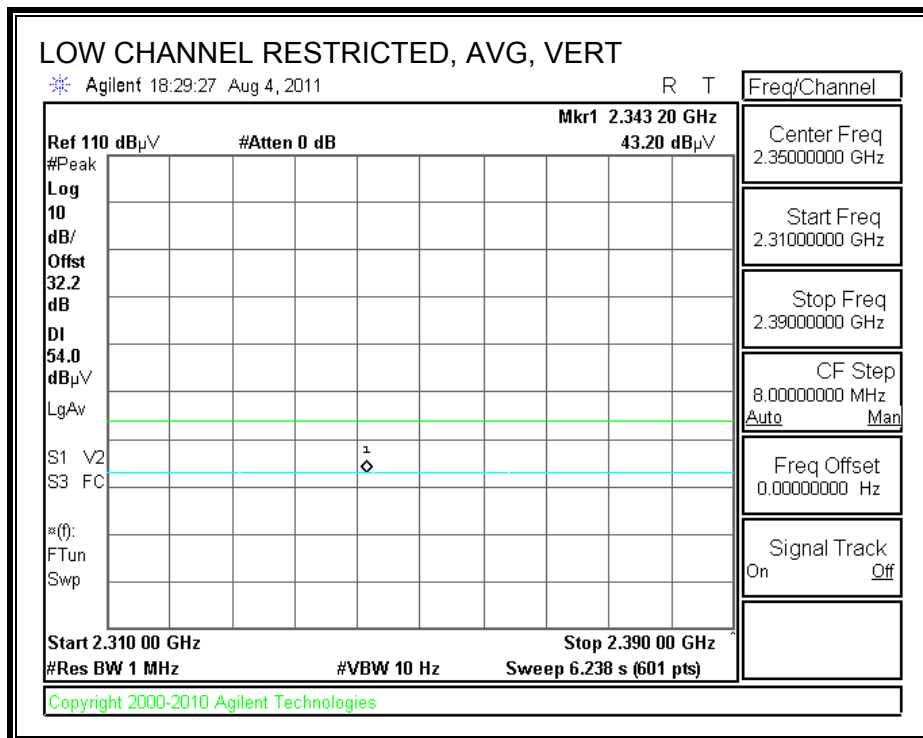
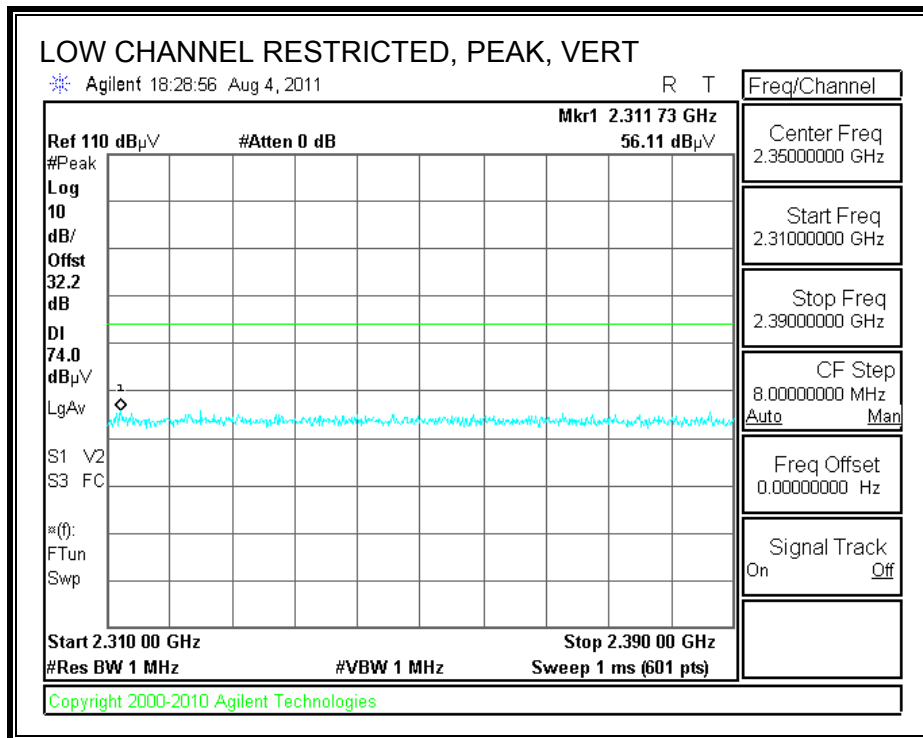
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		08/04/11											
Project #:		11U13896											
Company:		Apple											
Test Target:		FCC 15.247											
Mode Oper:		TX, GFSK mode											
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit									
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit									
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit									
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit									
CL	Cable Loss	HPF	High Pass Filter										
f	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
Low Ch, 2402MHz													
4.804	3.0	47.8	33.1	6.3	-34.8	0.0	0.0	52.4	74.0	-21.6	V	P	
4.804	3.0	40.5	33.1	6.3	-34.8	0.0	0.0	45.1	54.0	-8.9	V	A	
4.804	3.0	47.5	33.1	6.3	-34.8	0.0	0.0	52.1	74.0	-21.9	H	P	
4.804	3.0	40.8	33.1	6.3	-34.8	0.0	0.0	45.4	54.0	-8.6	H	A	
Mid Ch, 2441MHz													
4.882	3.0	43.9	33.2	6.3	-34.8	0.0	0.0	48.6	74.0	-25.4	V	P	
4.882	3.0	37.0	33.2	6.3	-34.8	0.0	0.0	41.8	54.0	-12.2	V	A	
7.323	3.0	41.4	36.2	8.5	-34.9	0.0	0.0	51.2	74.0	-22.8	V	P	
7.323	3.0	33.1	36.2	8.5	-34.9	0.0	0.0	42.9	54.0	-11.1	V	A	
4.882	3.0	44.6	33.2	6.3	-34.8	0.0	0.0	49.3	74.0	-24.7	H	P	
4.882	3.0	37.5	33.2	6.3	-34.8	0.0	0.0	42.3	54.0	-11.7	H	A	
7.323	3.0	42.2	36.2	8.5	-34.9	0.0	0.0	51.9	74.0	-22.1	H	P	
7.323	3.0	33.4	36.2	8.5	-34.9	0.0	0.0	43.2	54.0	-10.8	H	A	
High Ch, 2480MHz													
4.960	3.0	45.4	33.3	6.4	-34.8	0.0	0.0	50.3	74.0	-23.7	V	P	
4.960	3.0	38.4	33.3	6.4	-34.8	0.0	0.0	43.3	54.0	-10.7	V	A	
7.440	3.0	39.8	36.4	8.5	-34.9	0.0	0.0	49.7	74.0	-24.3	V	P	
7.440	3.0	29.8	36.4	8.5	-34.9	0.0	0.0	39.7	54.0	-14.3	V	A	
4.960	3.0	44.4	33.3	6.4	-34.8	0.0	0.0	49.3	74.0	-24.7	H	P	
4.960	3.0	37.3	33.3	6.4	-34.8	0.0	0.0	42.2	54.0	-11.8	H	A	
7.440	3.0	39.5	36.4	8.5	-34.9	0.0	0.0	49.4	74.0	-24.6	H	P	
7.440	3.0	29.4	36.4	8.5	-34.9	0.0	0.0	39.3	54.0	-14.7	H	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.2. ENHANCED DATA RATE 8PSK MODULATION

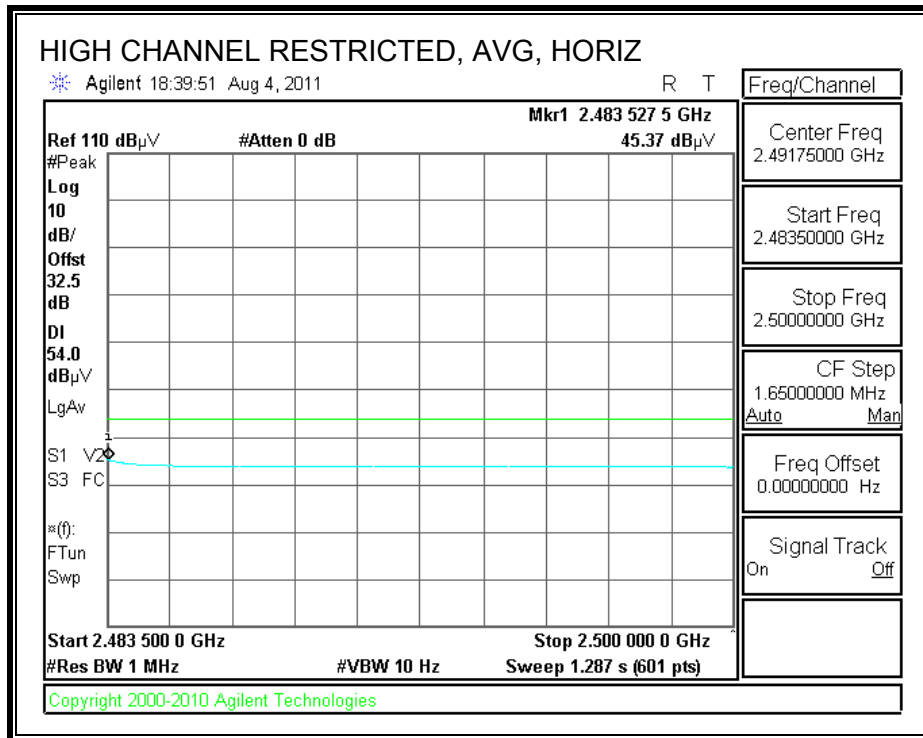
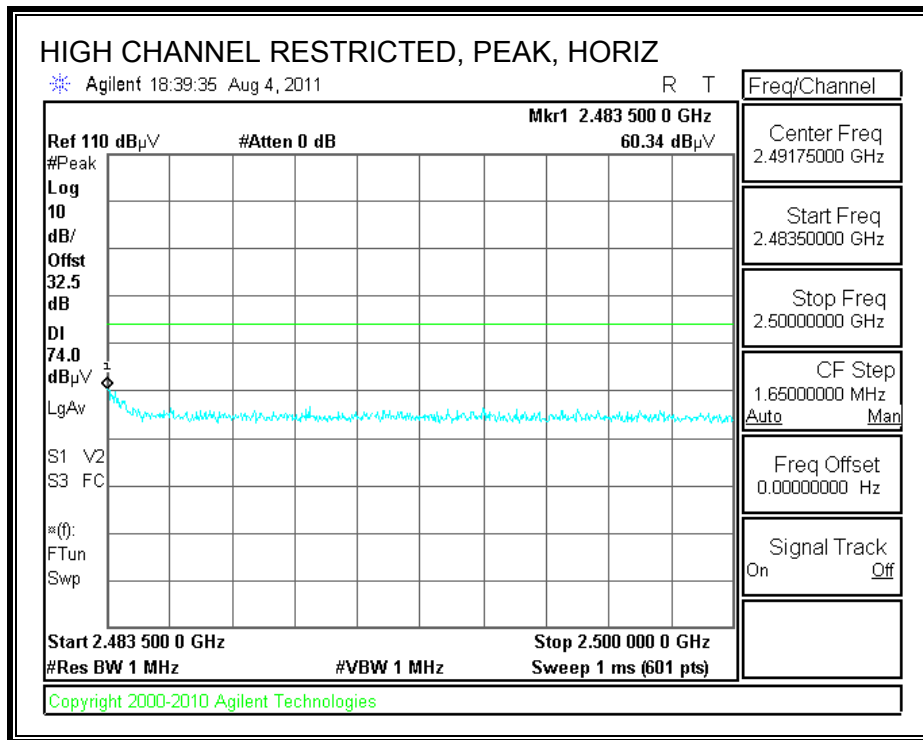
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



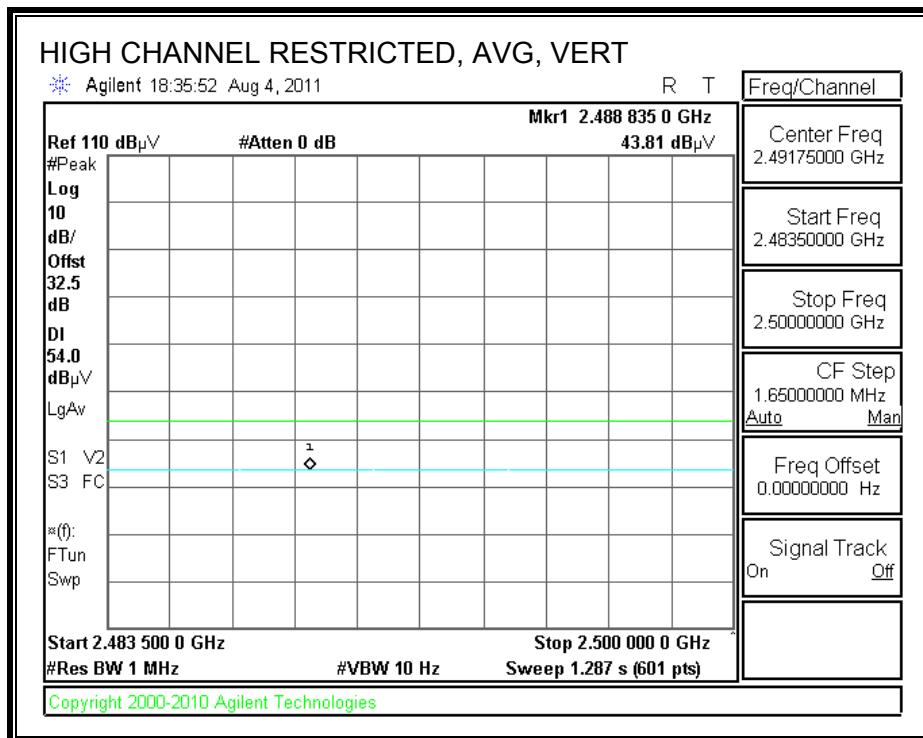
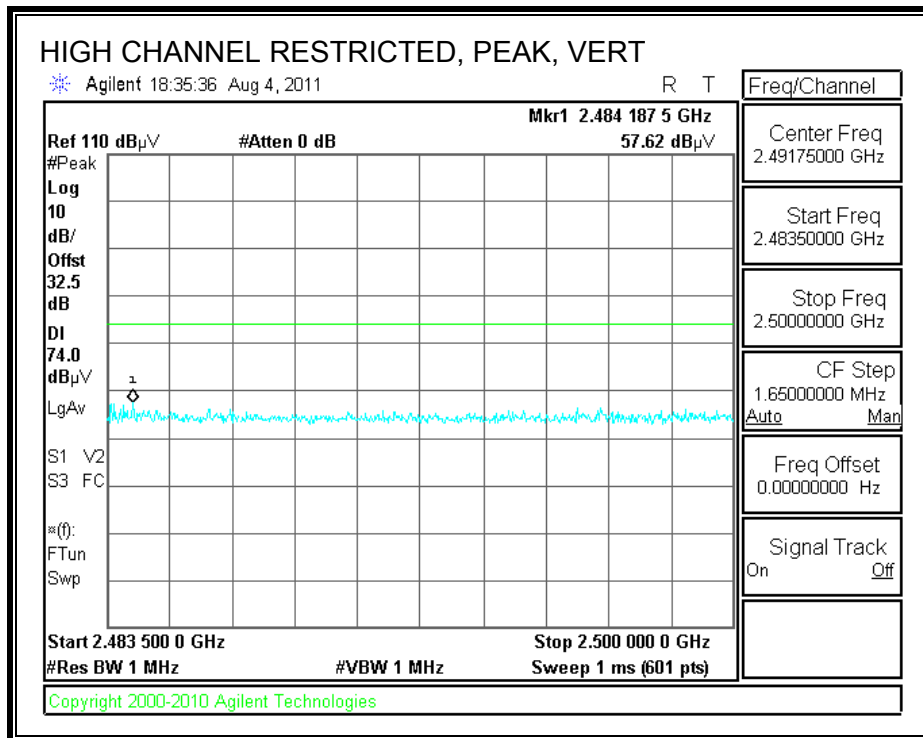
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANEDGE (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:		08/04/11											
Project #:		11U13896											
Company:		Apple											
Test Target:		FCC 15.247											
Mode Oper:		BT, 8PSK											
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	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
Low Ch, 2402MHz													
4.804	3.0	46.7	33.1	6.3	-34.8	0.0	0.0	51.3	74.0	-22.7	H	P	
4.804	3.0	37.8	33.1	6.3	-34.8	0.0	0.0	42.4	54.0	-11.6	H	A	
4.804	3.0	46.2	33.1	6.3	-34.8	0.0	0.0	50.8	74.0	-23.2	V	P	
4.804	3.0	36.9	33.1	6.3	-34.8	0.0	0.0	41.5	54.0	-12.5	V	A	
Mid Ch, 2441MHz													
4.882	3.0	43.4	33.2	6.3	-34.8	0.0	0.0	48.2	74.0	-25.8	H	P	
4.882	3.0	34.8	33.2	6.3	-34.8	0.0	0.0	39.6	54.0	-14.4	H	A	
7.323	3.0	39.9	36.2	8.5	-34.9	0.0	0.0	49.6	74.0	-24.4	H	P	
7.323	3.0	28.7	36.2	8.5	-34.9	0.0	0.0	38.5	54.0	-15.5	H	A	
4.882	3.0	42.2	33.2	6.3	-34.8	0.0	0.0	47.0	74.0	-27.0	V	P	
4.882	3.0	33.0	33.2	6.3	-34.8	0.0	0.0	37.8	54.0	-16.2	V	A	
7.323	3.0	41.3	36.2	8.5	-34.9	0.0	0.0	51.1	74.0	-22.9	V	P	
7.323	3.0	29.5	36.2	8.5	-34.9	0.0	0.0	39.3	54.0	-14.7	V	A	
High Ch, 2480MHz													
4.960	3.0	43.7	33.3	6.4	-34.8	0.0	0.0	48.6	74.0	-25.4	H	P	
4.960	3.0	34.4	33.3	6.4	-34.8	0.0	0.0	39.3	54.0	-14.7	H	A	
7.440	3.0	37.3	36.4	8.5	-34.9	0.0	0.0	47.3	74.0	-26.7	H	P	
7.440	3.0	26.0	36.4	8.5	-34.9	0.0	0.0	36.0	54.0	-18.0	H	A	
4.960	3.0	43.8	33.3	6.4	-34.8	0.0	0.0	48.7	74.0	-25.3	V	P	
4.960	3.0	34.7	33.3	6.4	-34.8	0.0	0.0	39.6	54.0	-14.4	V	A	
7.440	3.0	39.0	36.4	8.5	-34.9	0.0	0.0	48.9	74.0	-25.1	V	P	
7.440	3.0	27.5	36.4	8.5	-34.9	0.0	0.0	37.4	54.0	-16.6	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.3. RECEIVER ABOVE 1 GHz

8.3.1. RX ABOVE 1 GHz FOR BLUETOOTH

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber-B

Company: Apple
 Project #: 11U13896
 Date: 8/5/2011
 Test Engineer: Chin Pang
 Configuration: EUT with AC Adapter and Earphone
 Mode: RX mode, BT

Test Equipment:

Horn 1-18GHz T59; S/N: 3245 @3m	Pre-amplifier 1-26GHz T145 Agilent 3008A0056	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit RX RSS 210
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Hi Frequency Cables

3' cable 22807700 3' cable 22807700	12' cable 22807600 12' cable 22807600	20' cable 22807500 20' cable 22807500	HPF	Reject Filter	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	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
3.487	3.0	43.0	30.4	31.4	5.3	-35.0	0.0	0.0	44.6	32.0	74	54	-29.4	-22.0	H
3.973	3.0	45.0	36.0	32.1	5.7	-34.9	0.0	0.0	47.9	38.9	74	54	-26.1	-15.1	H
3.507	3.0	43.2	31.0	31.4	5.3	-35.0	0.0	0.0	44.8	32.6	74	54	-29.2	-21.4	V
3.960	3.0	52.3	39.5	32.1	5.7	-34.9	0.0	0.0	55.2	42.4	74	54	-18.8	-11.6	V

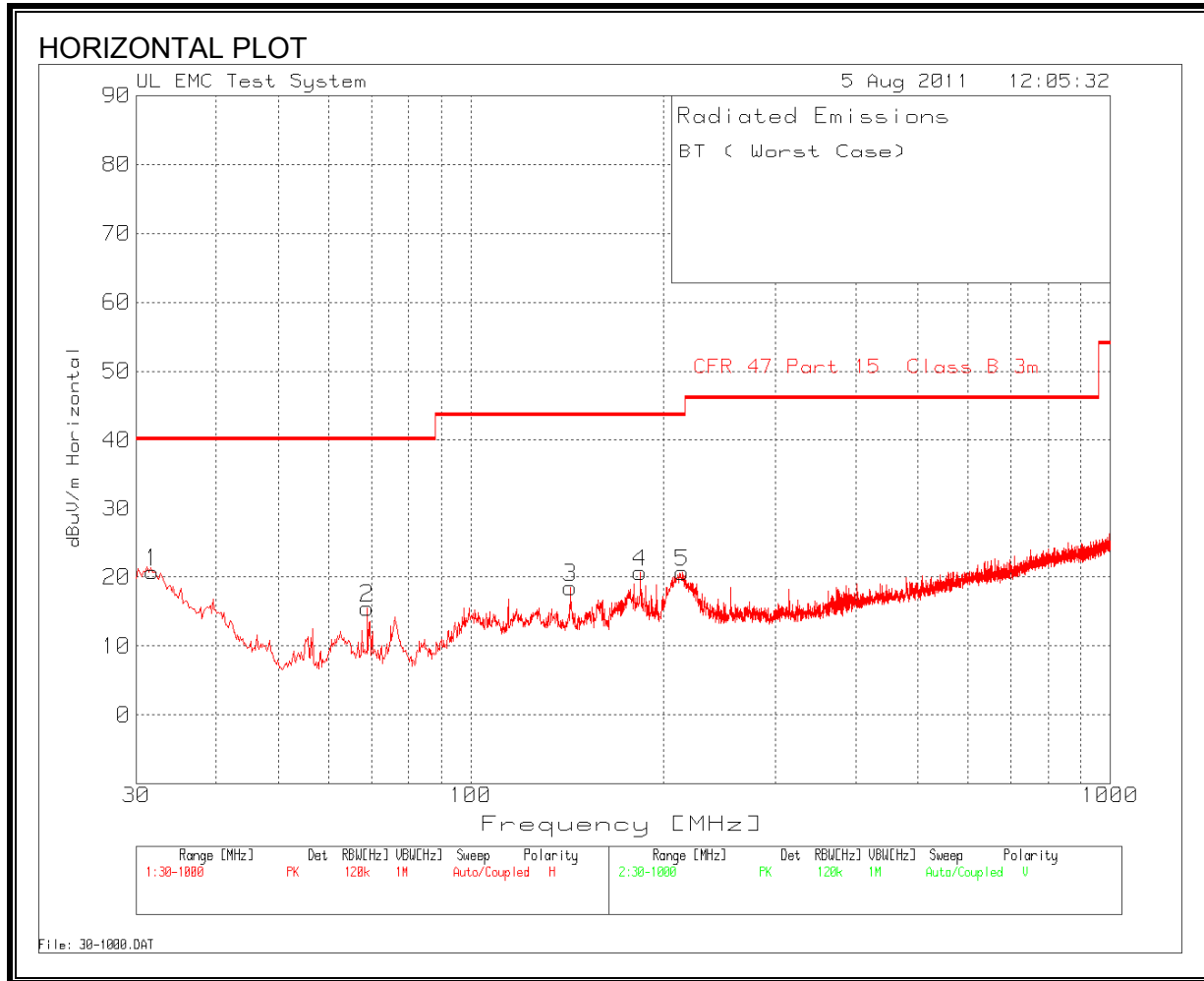
Rev. 07.08.11
 Note: No other emissions were detected above the system noise floor.

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		

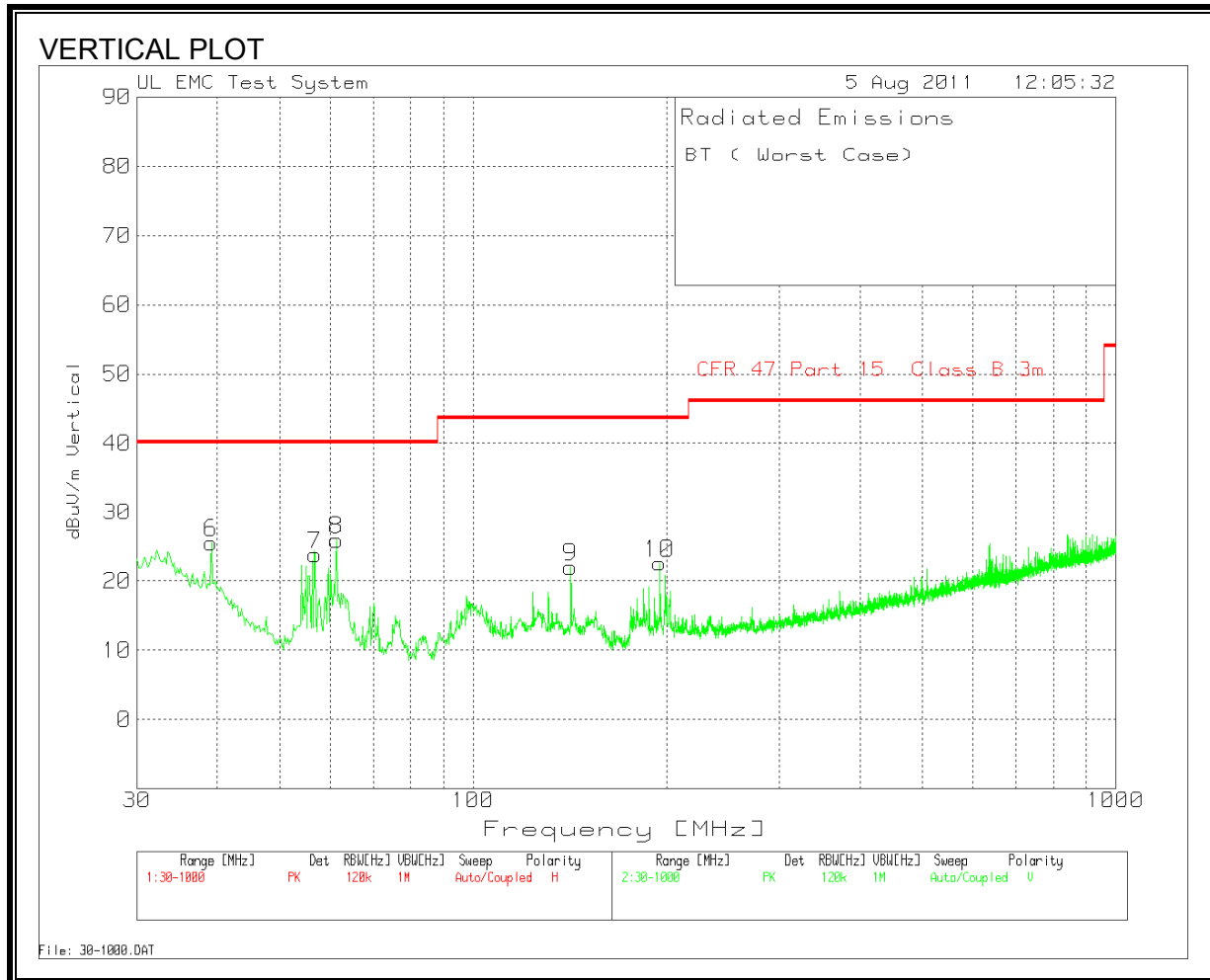
8.4. WORST-CASE BELOW 1 GHz

BLUETOOTH

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



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



HORIZONTAL AND VERTICAL DATA

Range 1 30 - 1000MHz									
Frequency	Reading	Detector	Chamber E	PreAmp[dB]	Bilog Factors	dBuV/m	Part 15B 3m	Margin	Polarity
31.7446	29.86	PK	0.9	-29.5	19.5	20.76	40	-19.24	Horz
68.9628	35.53	PK	1.2	-29.4	8.2	15.53	40	-24.47	Horz
143.0116	33.03	PK	1.7	-29.2	13	18.53	43.5	-24.97	Horz
184.3006	36.75	PK	1.9	-29	11	20.65	43.5	-22.85	Horz
214.5404	35.65	PK	2	-28.9	11.9	20.65	43.5	-22.85	Horz
Range 2 30 - 1000MHz									
Frequency	Reading	Detector	Chamber E	PreAmp[dB]	Bilog Factors	dBuV/m	Part 15B 3m	Margin	Polarity
39.1107	39.32	PK	0.9	-29.5	14.8	25.52	40	-14.48	Vert
56.7506	44.16	PK	1.1	-29.4	7.9	23.76	40	-16.24	Vert
61.4029	46.21	PK	1.2	-29.4	7.9	25.91	40	-14.09	Vert
141.8485	36.45	PK	1.7	-29.2	13.1	22.05	43.5	-21.45	Vert
195.1559	37.98	PK	1.9	-28.9	11.6	22.58	43.5	-20.92	Vert

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.

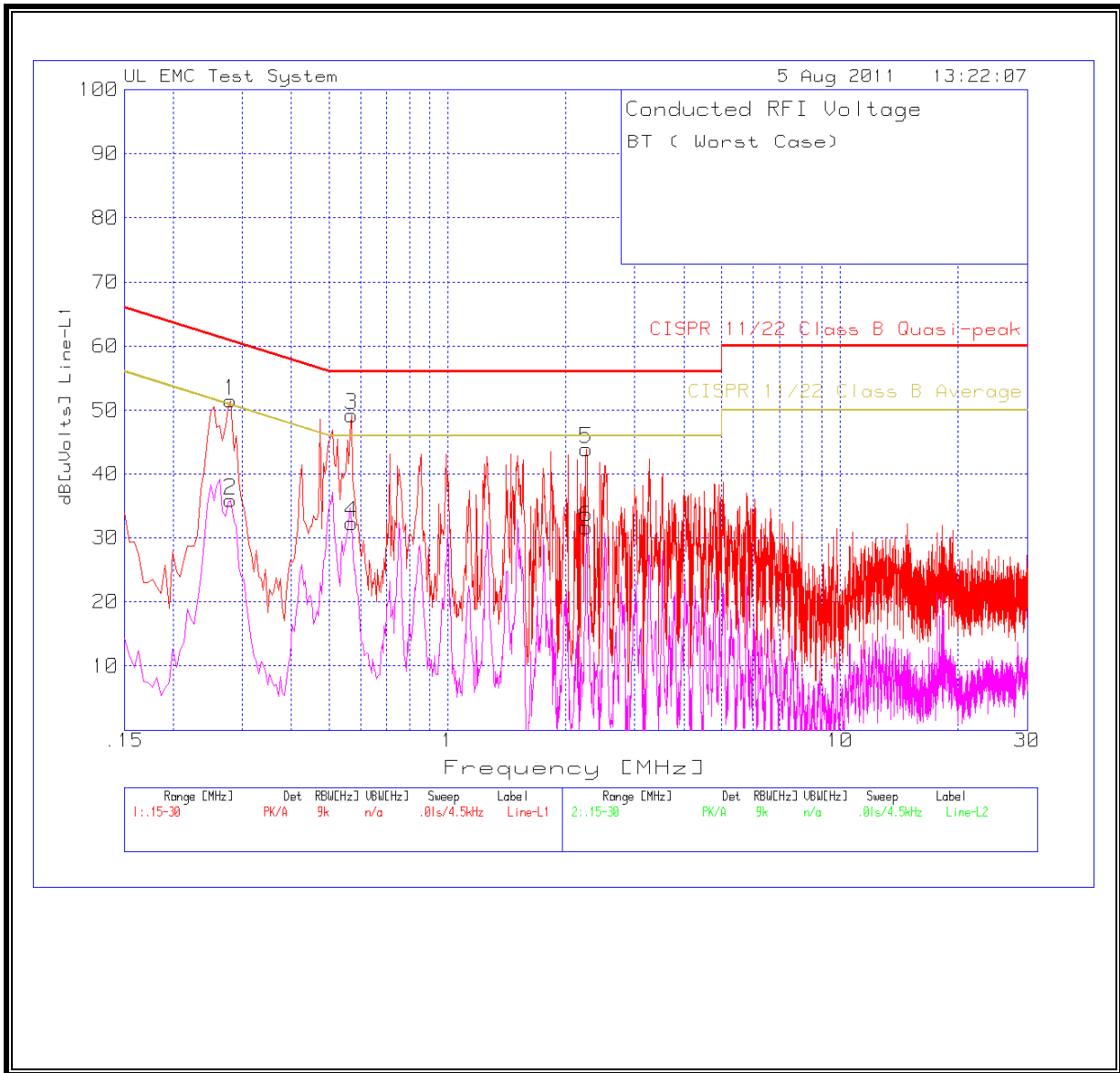
RESULTS

6 WORST EMISSIONS

BLUETOOTH

Line-L1 .15 - 30MHz									
Frequency	Reading	Detector	LISN [dB]	Cable [dB]	dB[uVolts]	CISPR B Qp	Margin	CISPR B Avg	Margin
0.2805	51.52	PK	0	0	51.52	60.8	-9.28	50.8	0.72
0.2805	35.86	Av	0	0	35.86	-	-	50.8	-14.94
0.5685	49.28	PK	0	0	49.28	56	-6.72	46	3.28
0.5685	32.27	Av	0	0	32.27	-	-	46	-13.73
2.256	43.96	PK	0	0	43.96	56	-12.04	46	-2.04
2.256	31.6	Av	0	0	31.6	-	-	46	-14.4
Line-L2 .15 - 30MHz									
Frequency	Reading	Detector	LISN [dB]	Cable [dB]	dB[uVolts]	CISPR B Qp	Margin	CISPR B Avg	Margin
0.2445	47	PK	0	0	47	61.9	-14.9	51.9	-4.9
0.2445	36.48	Av	0	0	36.48	-	-	51.9	-15.42
0.483	46.9	PK	0	0	46.9	56.3	-9.4	46.3	0.6
0.483	28.53	Av	0	0	28.53	-	-	46.3	-17.77
0.5685	45.08	PK	0	0	45.08	56	-10.92	46	-0.92
0.5685	26.45	Av	0	0	26.45	-	-	46	-19.55

LINE 1 RESULTS



LINE 2 RESULTS

