



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

CERTIFICATION TEST REPORT

FOR

Wireless 802.11 b/g Embedded Module

MODEL NUMBER: RCM5450W, RCM5400W*

FCC ID: VCB-E59C4472

IC ID: 7143A-E59C4472

REPORT NUMBER: 08U11724-2, Revision B

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Prepared for

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* Models differences are indicated within the body of this report.



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/28/08	Initial Issue	F. Ibrahim
A	06/09/08	Added MPE section.	F. Ibrahim
B	06/18/08	Revised the Output Power section.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: RABBIT SEMICONDUCTOR INCORPORATED -
A DIGI INTERNATIONAL COMPANY
2900 SPAFFORD STREET
DAVIS, CA 95618, U.S.A.

EUT DESCRIPTION: Wireless 802.11 b/g Embedded Module

MODEL: RCM5450W

SERIAL NUMBER: D35221

DATE TESTED: MAY 19-21, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C and Subpart E	PASS
RSS-210 Issue 7 Annex 8 and 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 expressions of Pass/Fail in this report are opinions expressed by CCS based on interpretations of the test results. 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. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

TOM CHEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, 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. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Wireless 802.11 b/g Embedded Module.

The radio module is manufactured by Airoha Technology Corp.

5.2. DESCRIPTION OF MODELS DIFFERENCES

RCM5450W and RCM5400W have the same design and RF circuitry, the only difference is that model RCM5450W has more flash memory and static RAM.

5.3. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	18.88	77.27
2412 - 2462	802.11g	20.10	102.33

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antennas:

- 1) Dipole Antenna, with a maximum gain of 2 dBi.
- 2) Dipole Antenna Assembly, with a maximum gain of 1.8 dBi.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Dynamic C 10.40

The test utility software used during testing was FCC_TEST_PROGRAM_RCM5450W_V1.C

5.6. WORST-CASE CONFIGURATION AND MODE

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

All final tests in the 802.11b mode were made at 5.5 Mb/s.

All final tests in the 802.11g mode were made at 48 Mb/s.

The worst-case channel is determined as the channel with the highest output power, the channel with the highest output power was mid channel in 11g mode; therefore, radiated below 1 GHz and conducted emissions were performed with EUT set to mid channel in 11g mode.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	SONY	PCG-672R	3000226	Doc
Adapter	SONY	VGP-AC16V8	1478860220115500	Doc
USB to RS232 Converter	Digi International	901-0184	N/A	N/A
JIG Broad	Digi International	N/A	N/A	N/A
Adapter	KGCOMP	SPN15-015	N/A	N/A
Adapter	ELPAC	WM075-01950	N/A	N/A

I/O CABLES

Configuration 1

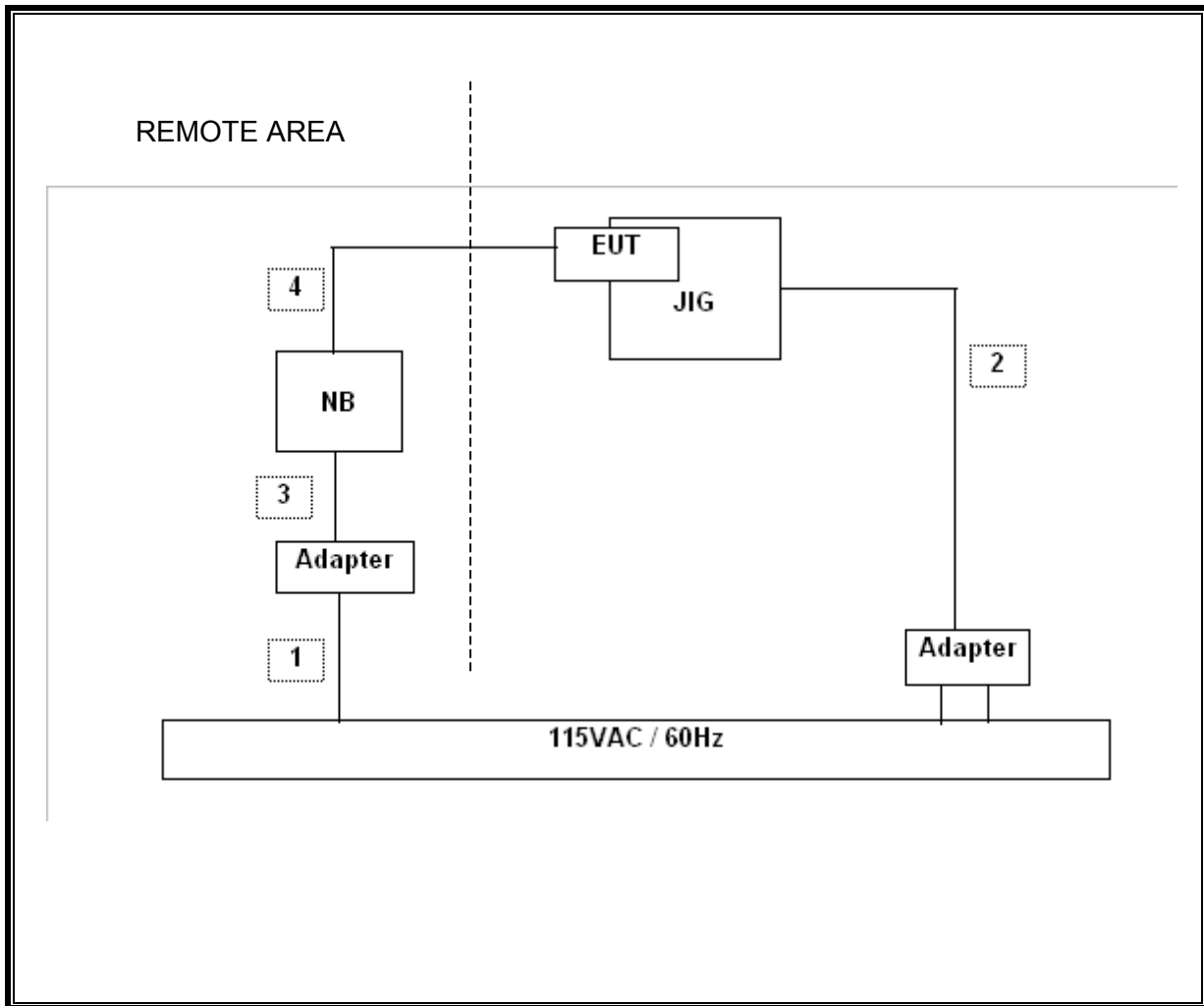
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.5m	
2	DC	1	DC	Unshielded	1.2m	TO LAPTOP PC
3	DC	1	DC	Unshielded	1.5m	TO JIG Broad
4	USB	1	USB	Unshielded	2M	

Configuration 2

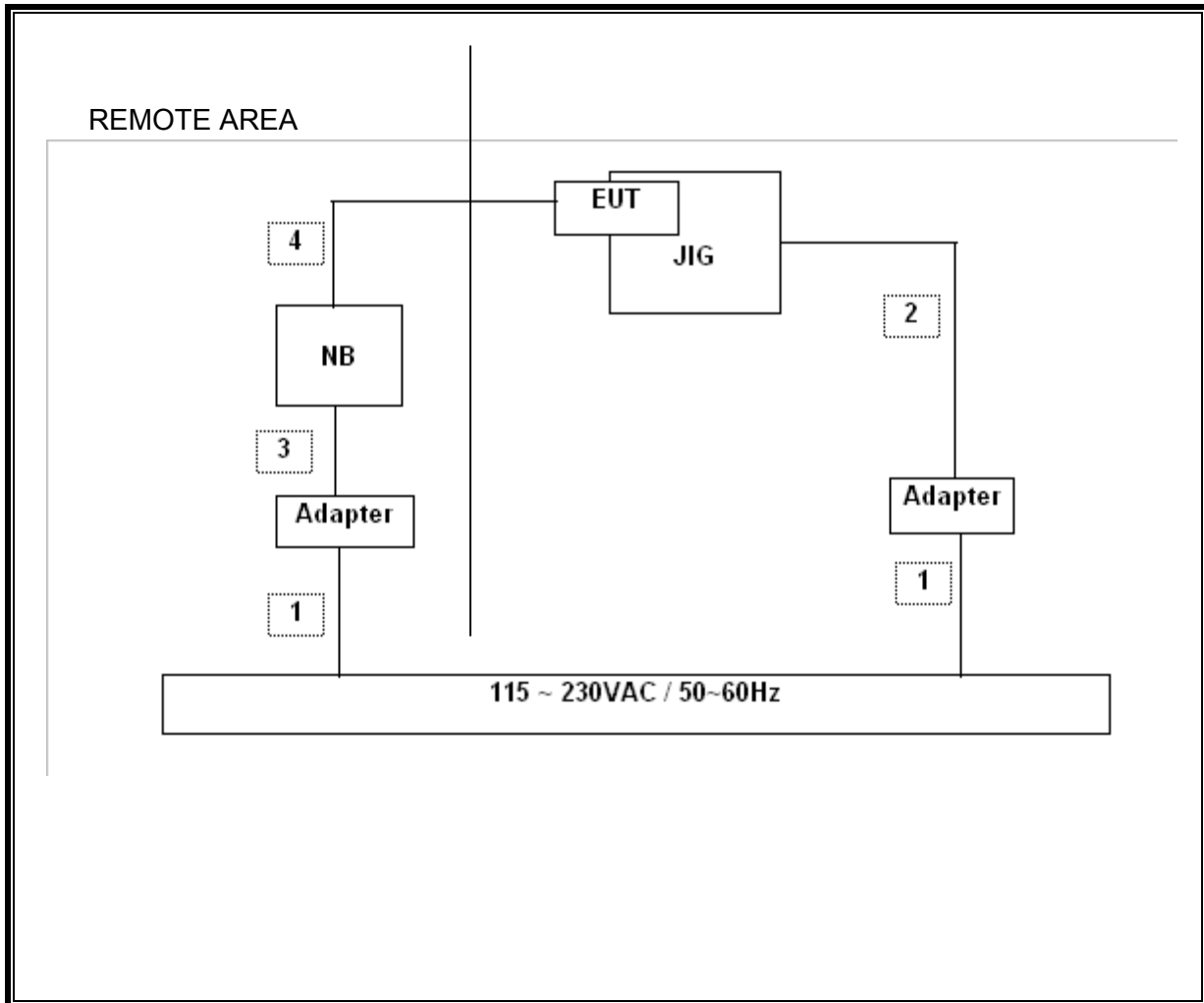
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	AC	Unshielded	1.5m	
2	DC	1	DC	Unshielded	1.2m	TO LAPTOP PC
3	DC	1	DC	Unshielded	1.5m	TO JIG Broad
4	USB	1	USB	Unshielded	2M	

SETUP DIAGRAM FOR TESTS

**Configuration 1:
For Antenna Port Tests**



**Configuration 2:
For Radiated and Power Line Conducted Emission tests**



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	Asset	Cal Date	Cal Due
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	2/6/2008	08/06/09
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/2007	10/25/08
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	9/28/2007	09/28/08
Power Sensor, 18 GHz	Agilent / HP	8481A	N02782	6/12/2007	08/22/08
Power Meter	Agilent / HP	438A	C01068	3/20/2007	06/20/08
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	1/0/1900	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00872	4/22/2008	04/22/09
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	9/29/2007	09/28/08
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	8/3/2007	09/27/08
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	10/11/2007	10/11/08
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	2/6/2007	06/12/08
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	2/6/2007	06/12/08

7. ANTENNA PORT TEST RESULTS

7.1. 802.11b MODE IN THE 2.4 GHz BAND

7.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

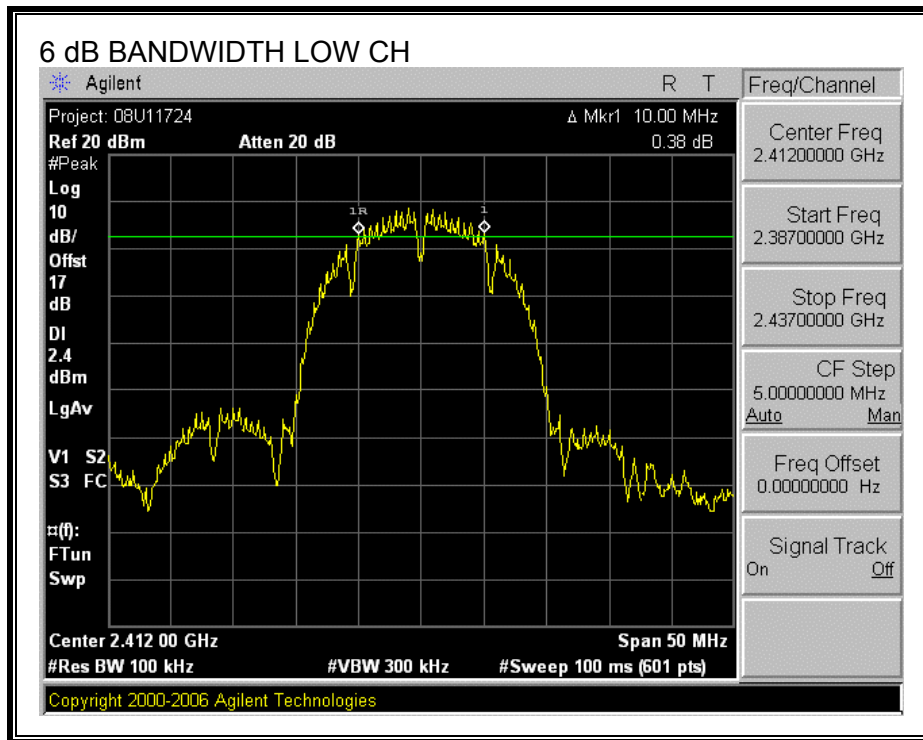
TEST PROCEDURE

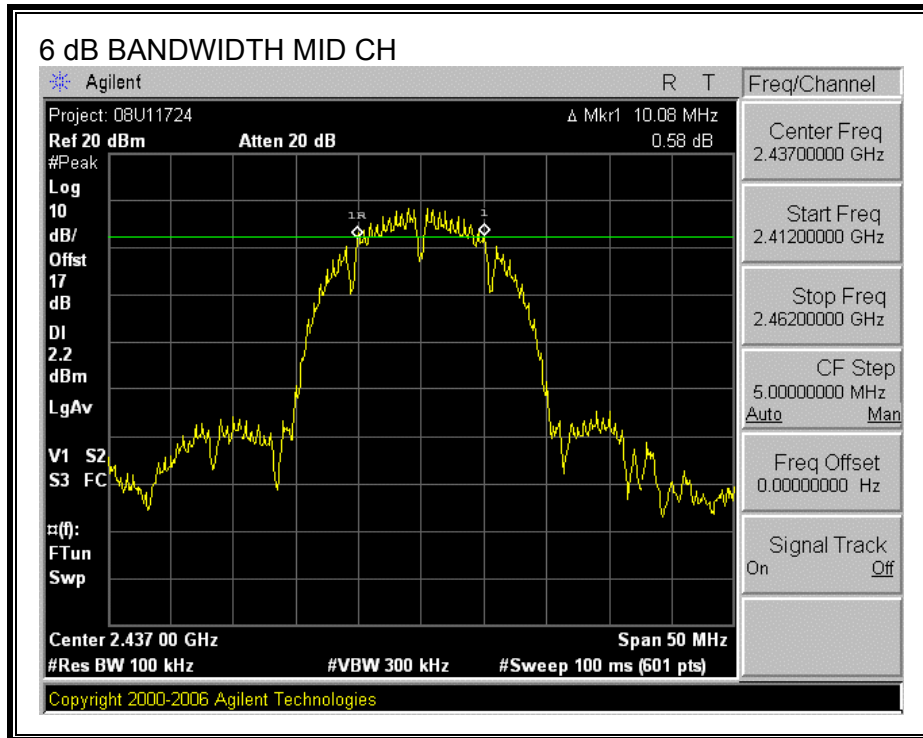
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

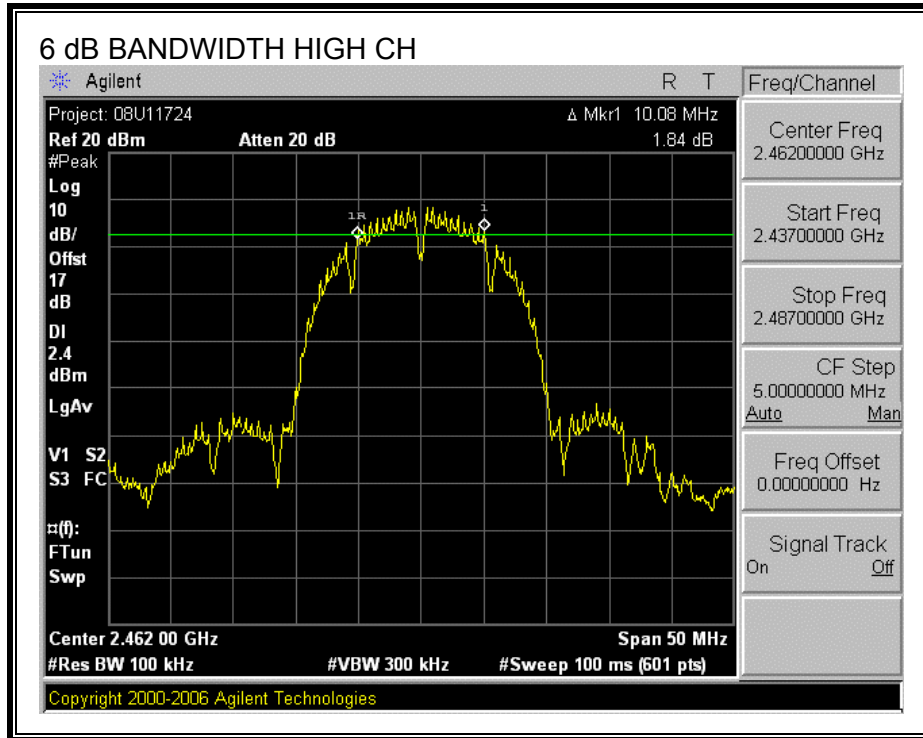
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	10.00	0.5
Middle	2437	10.08	0.5
High	2462	10.08	0.5

6 dB BANDWIDTH







**7.1.2. 99% BANDWIDTH
LIMITS**

None; for reporting purposes only.

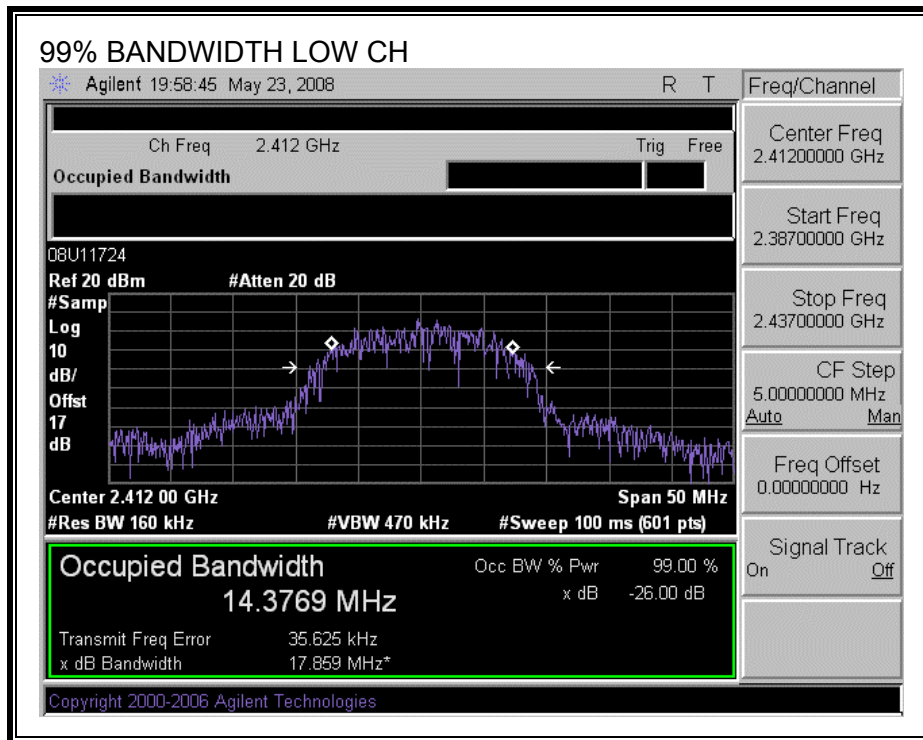
TEST PROCEDURE

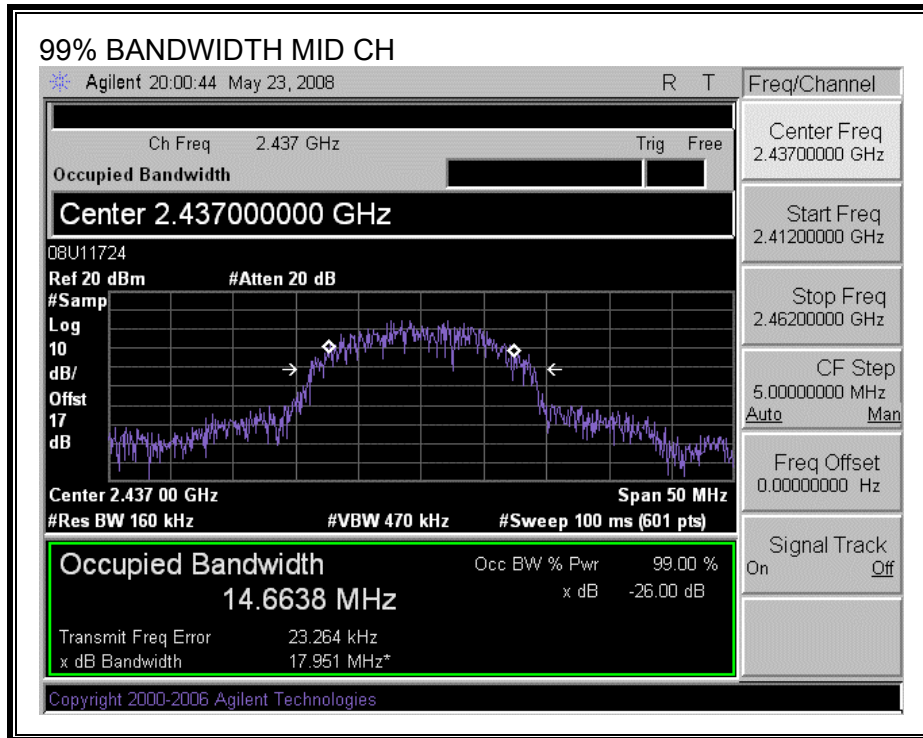
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

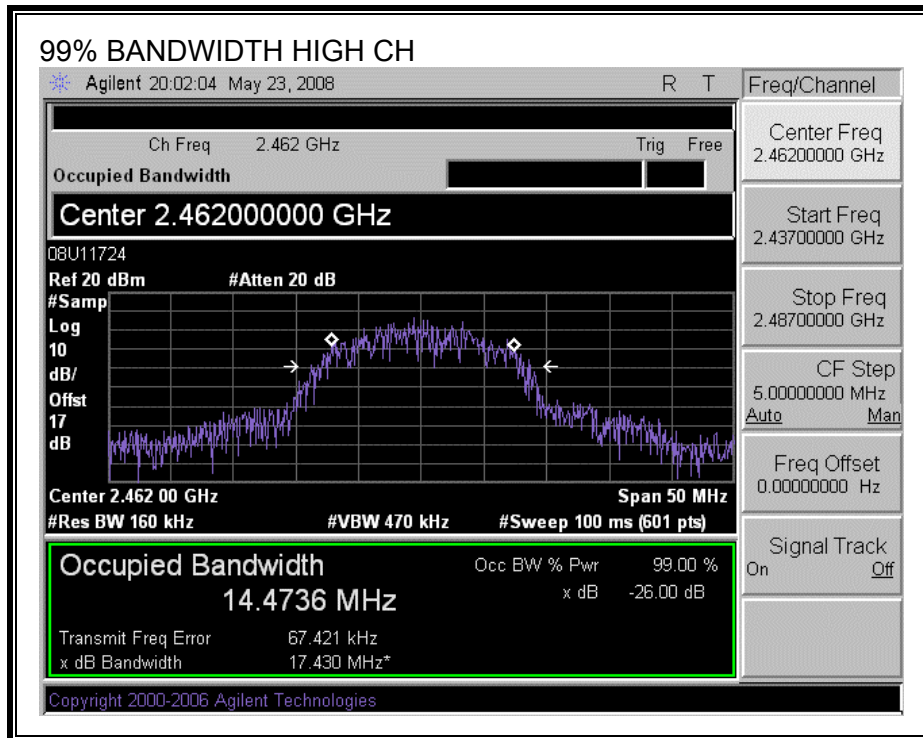
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	14.3769
Middle	2437	14.6638
High	2462	14.4736

99% BANDWIDTH







7.1.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

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

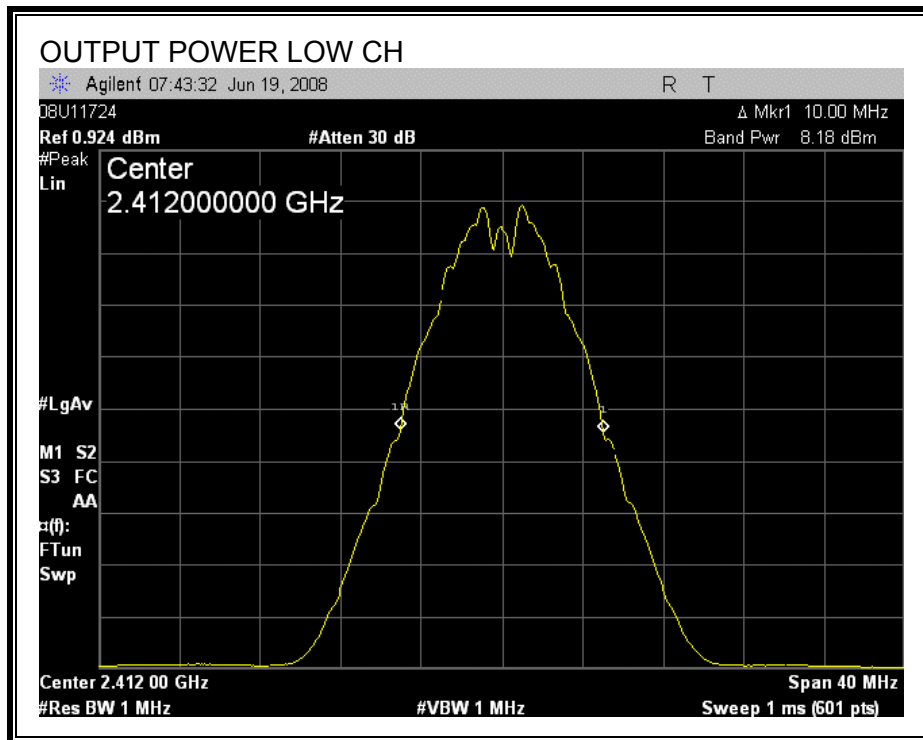
TEST PROCEDURE

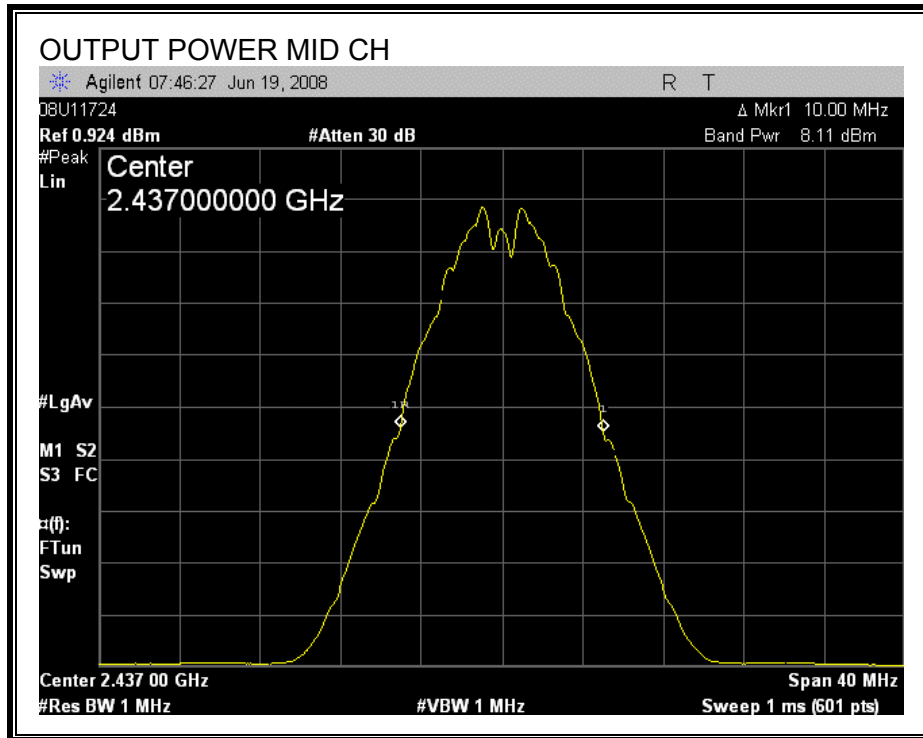
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

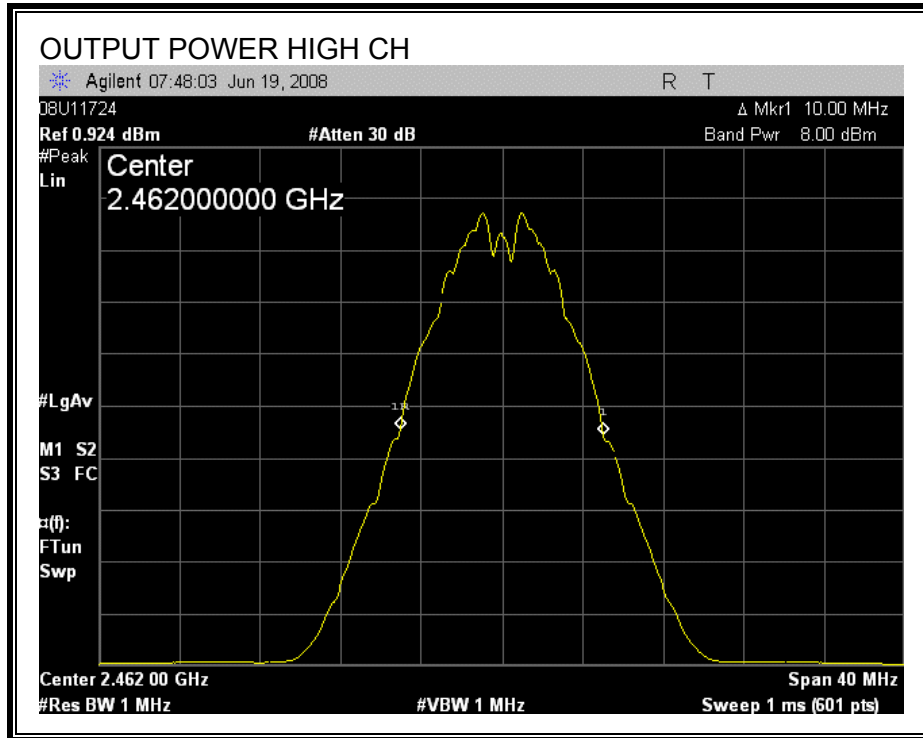
RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	8.18	10.7	18.88	30	-11.12
Middle	2437	8.11	10.7	18.81	30	-11.19
High	2462	8.00	10.7	18.70	30	-11.30

OUTPUT POWER







7.1.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 17 dB (including 16.3 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.94
Middle	2437	16.52
High	2462	16.44

7.1.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

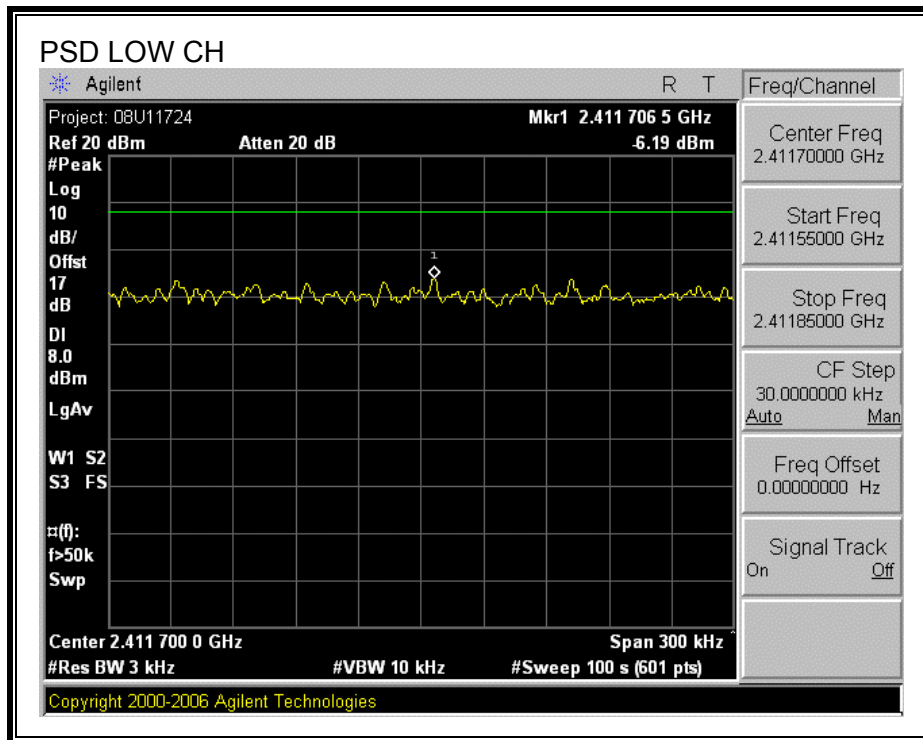
TEST PROCEDURE

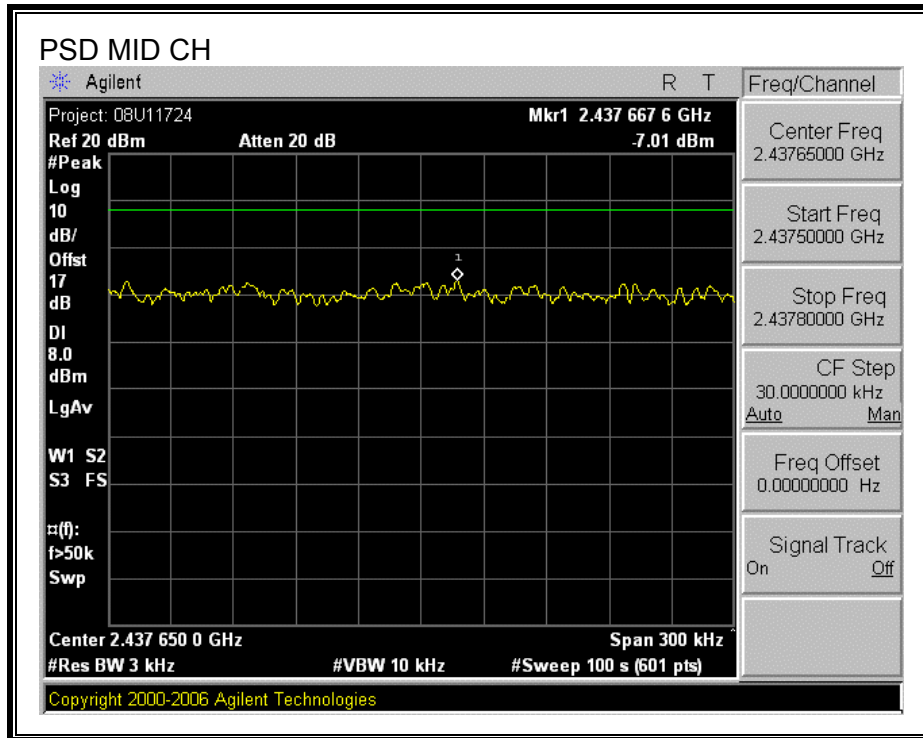
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

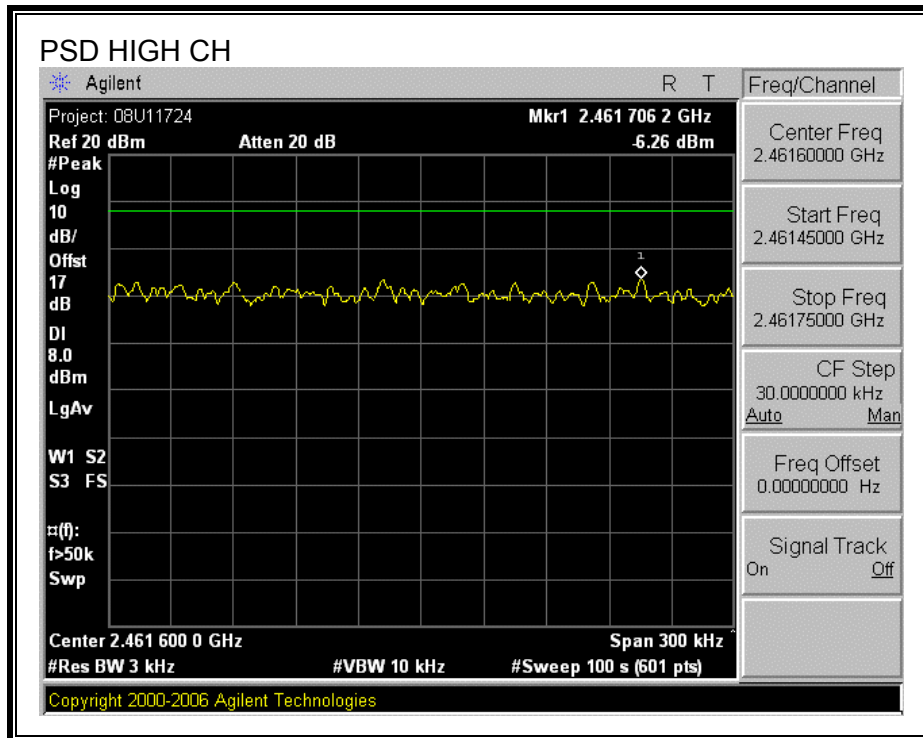
RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-6.19	8	-14.19
Middle	2437	-7.01	8	-15.01
High	2462	-6.26	8	-14.26

POWER SPECTRAL DENSITY







7.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

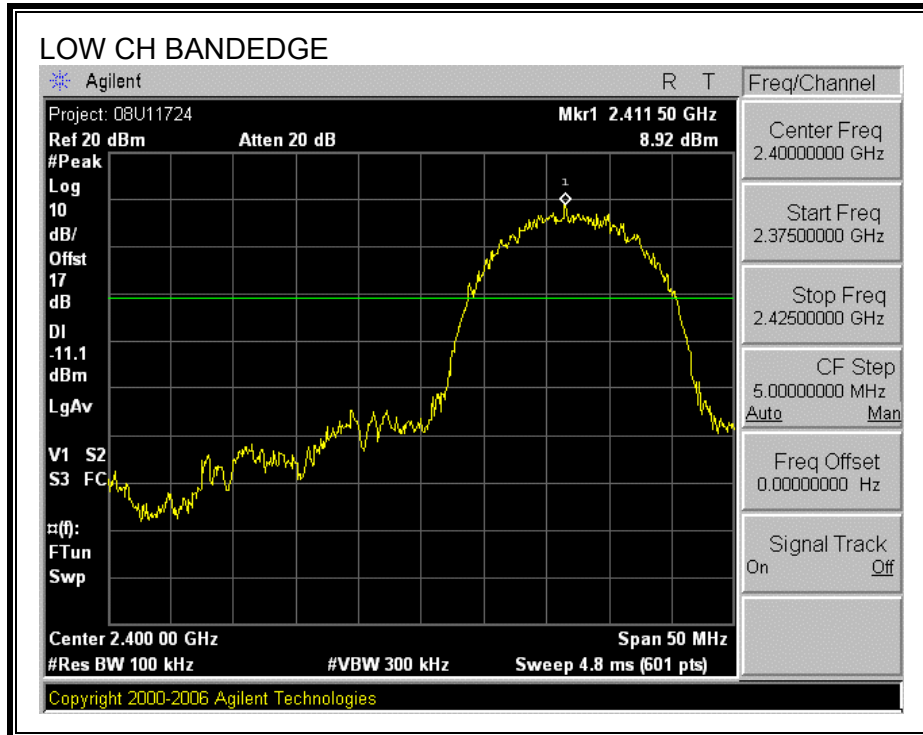
TEST PROCEDURE

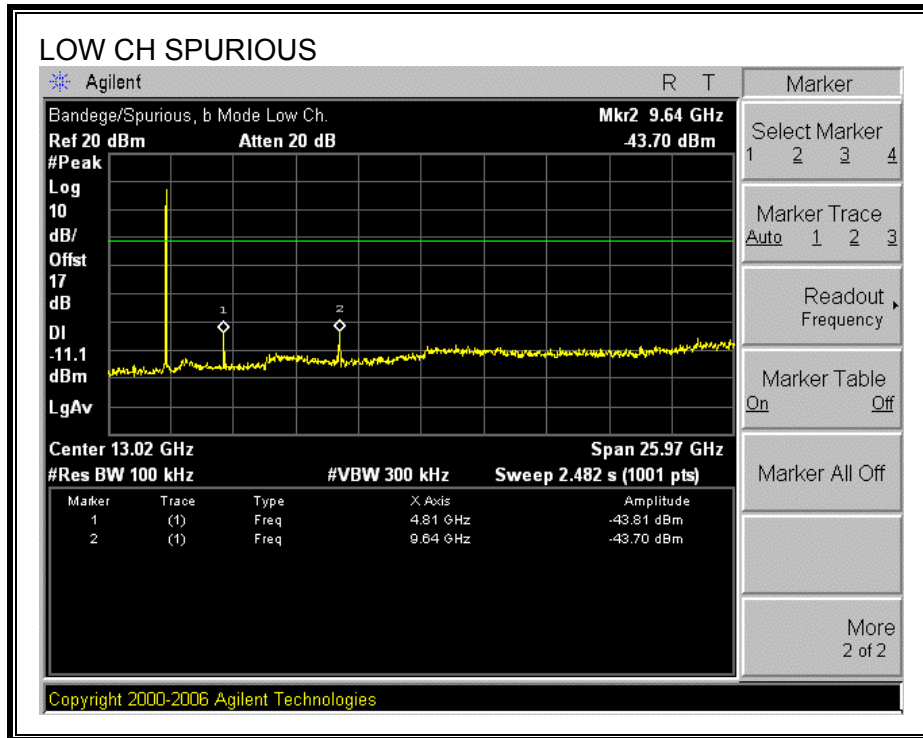
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

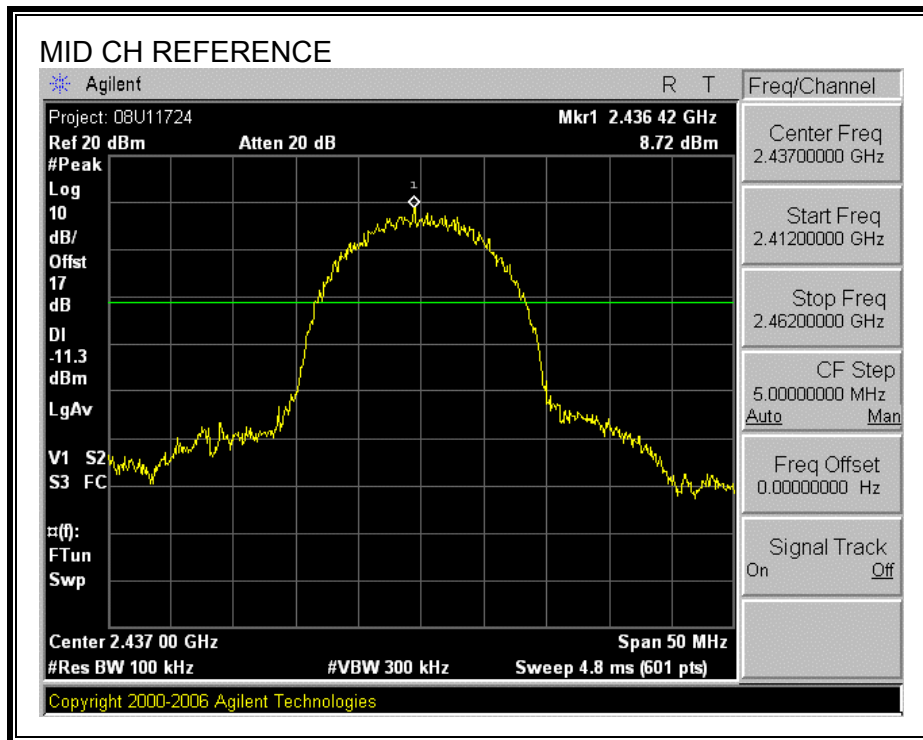
RESULTS

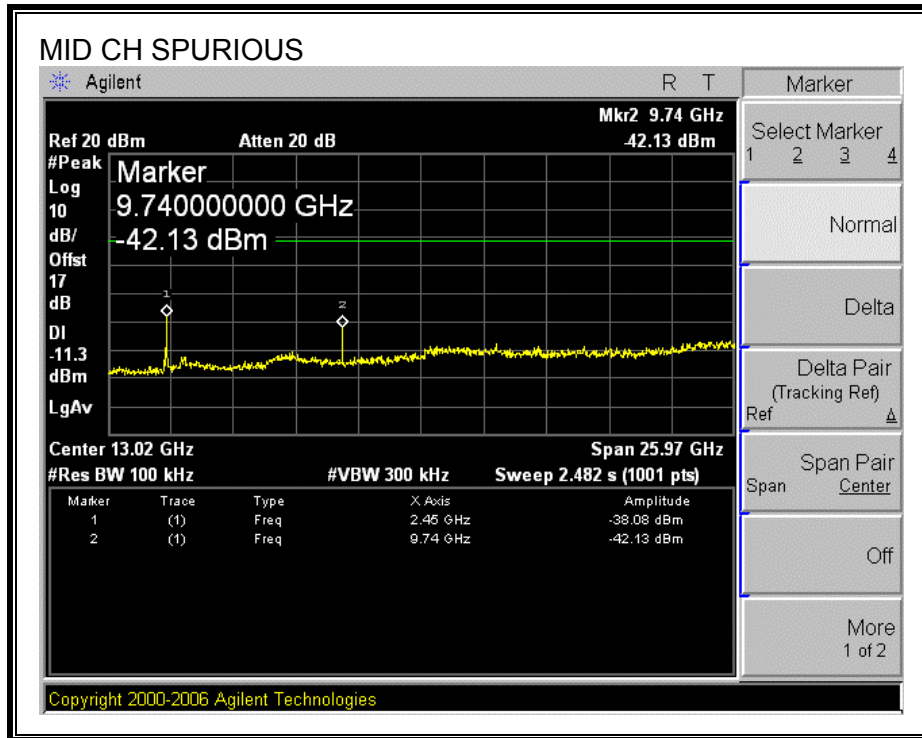
SPURIOUS EMISSIONS, LOW CHANNEL



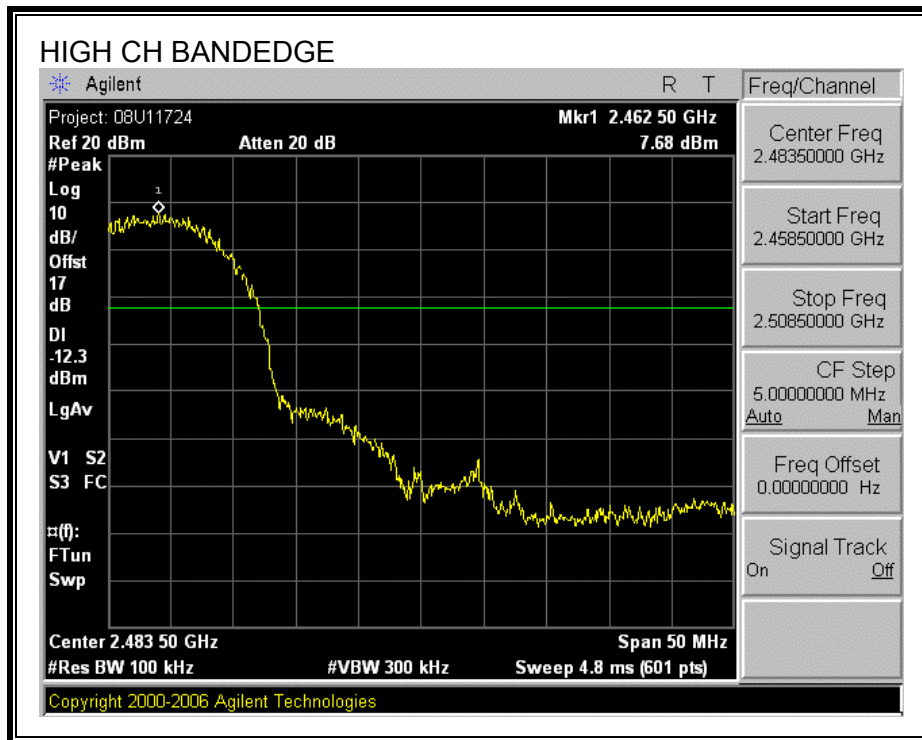


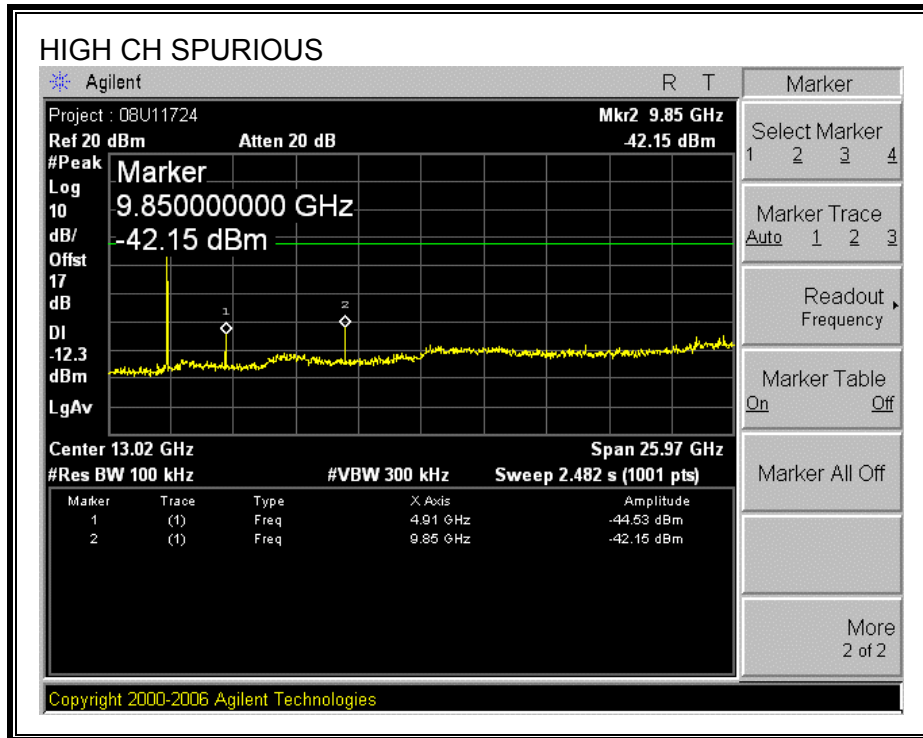
SPURIOUS EMISSIONS, MID CHANNEL





SPURIOUS EMISSIONS, HIGH CHANNEL





7.2. 802.11g MODE IN THE 2.4 GHz BAND

7.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

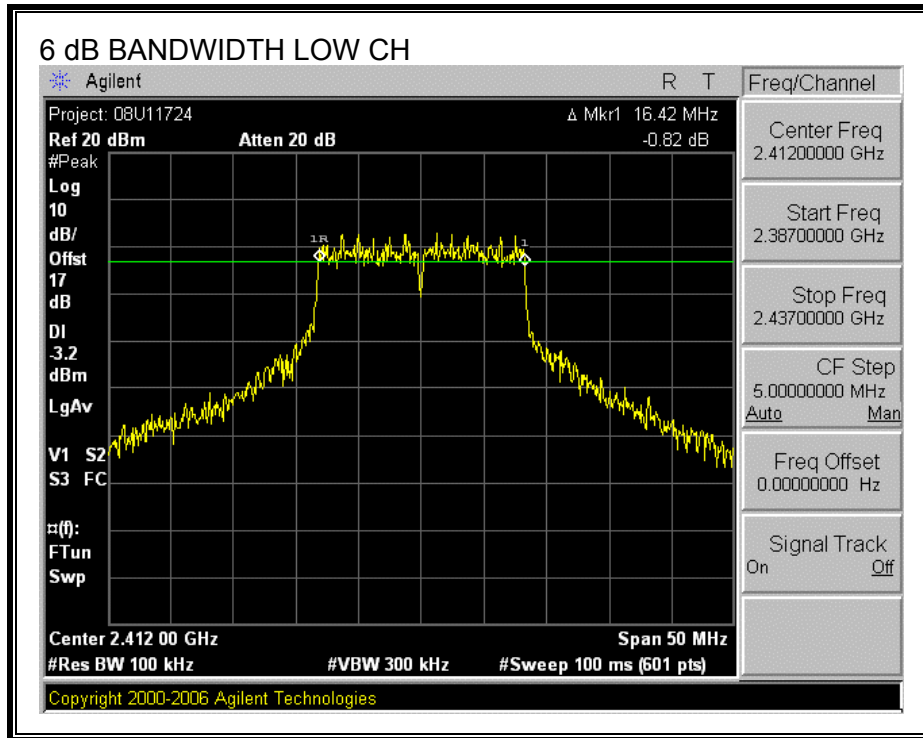
TEST PROCEDURE

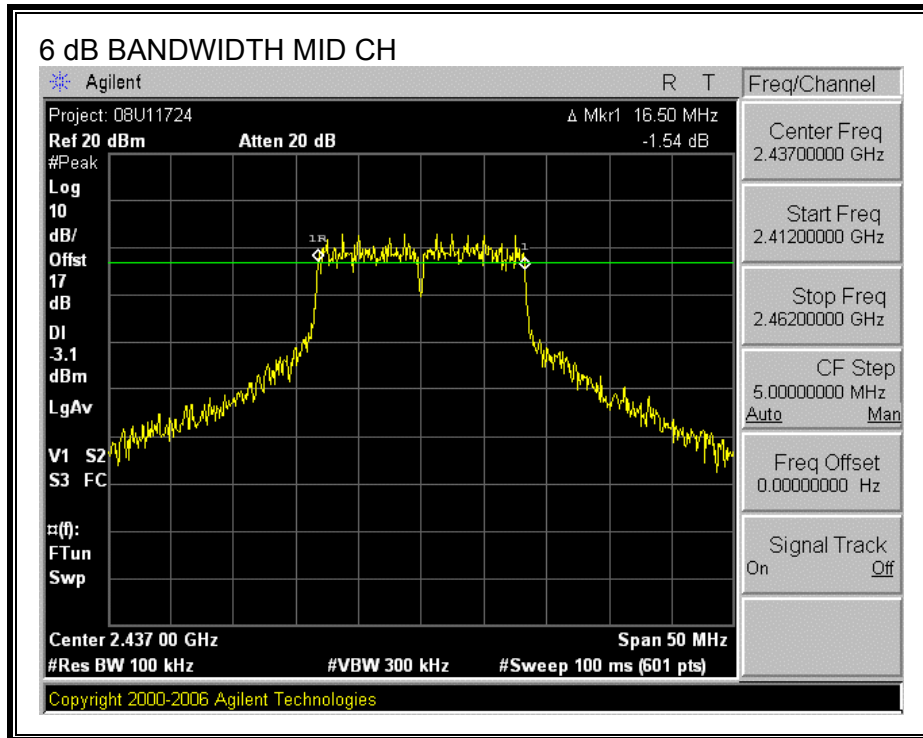
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

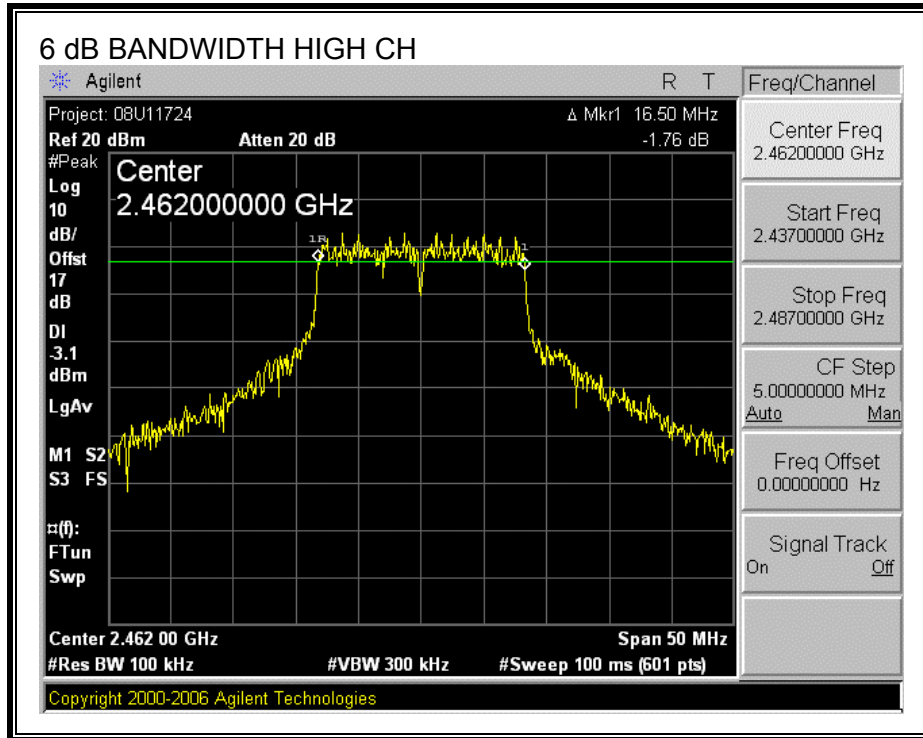
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	16.42	0.5
Middle	2437	16.50	0.5
High	2462	16.50	0.5

6 dB BANDWIDTH







7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

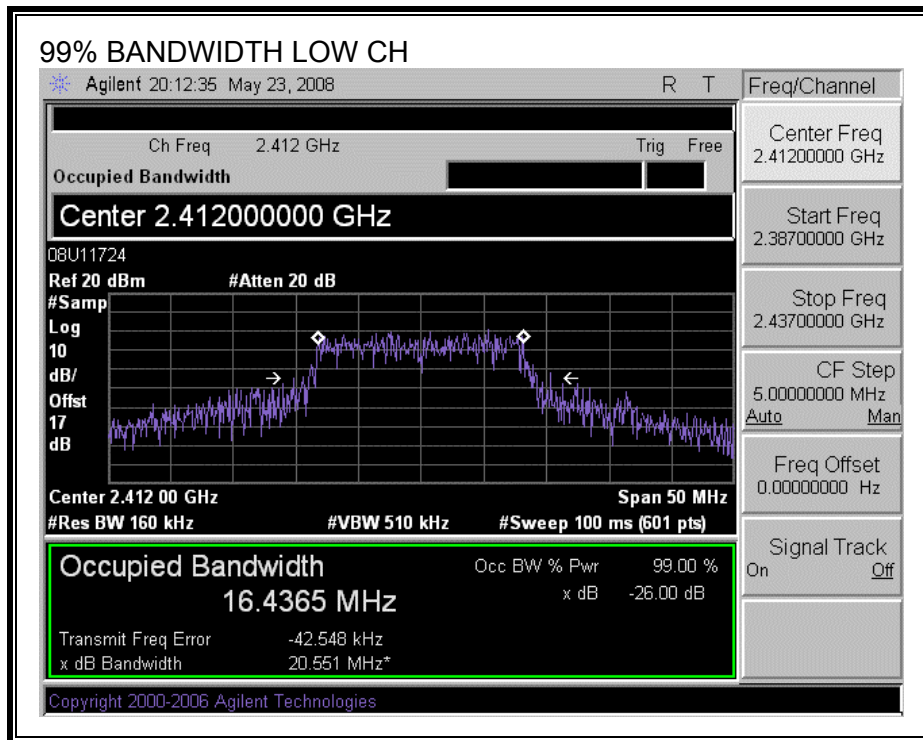
TEST PROCEDURE

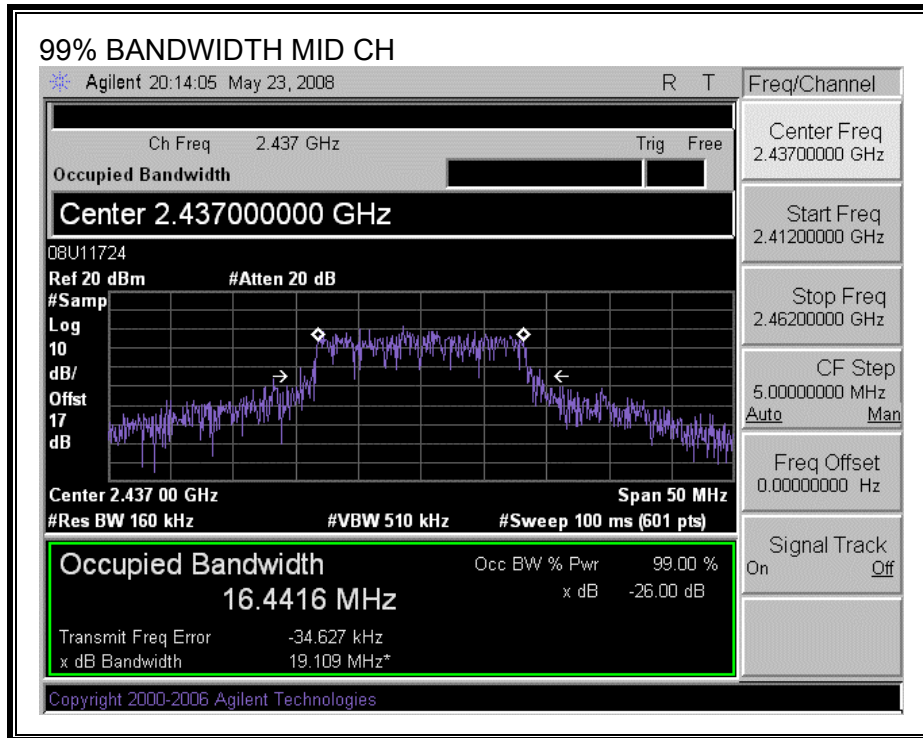
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

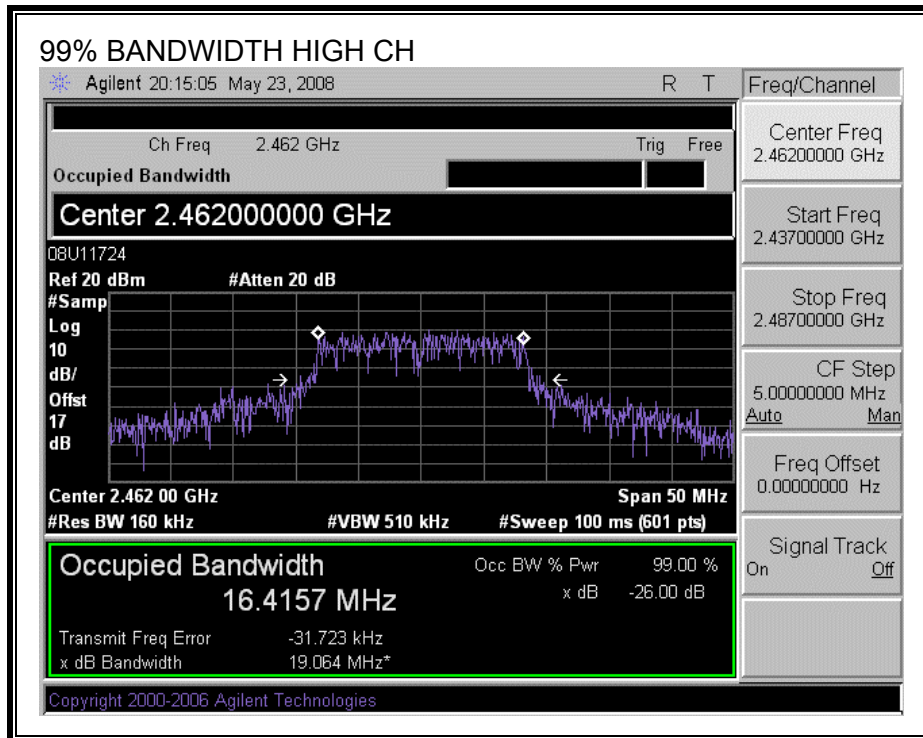
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.4365
Middle	2437	16.4416
High	2462	16.4157

99% BANDWIDTH







7.2.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

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

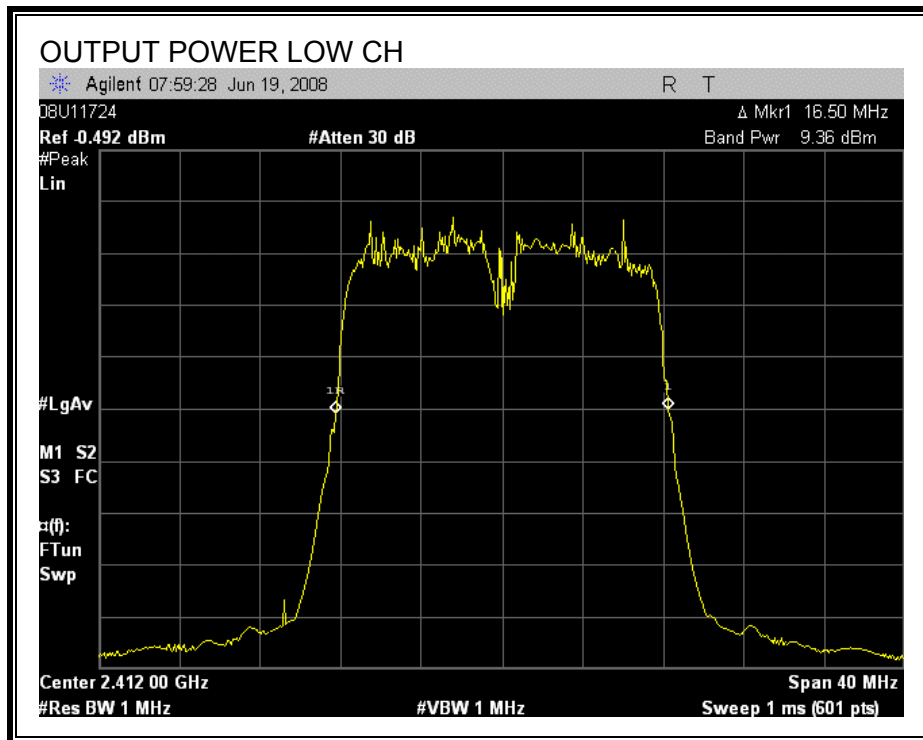
TEST PROCEDURE

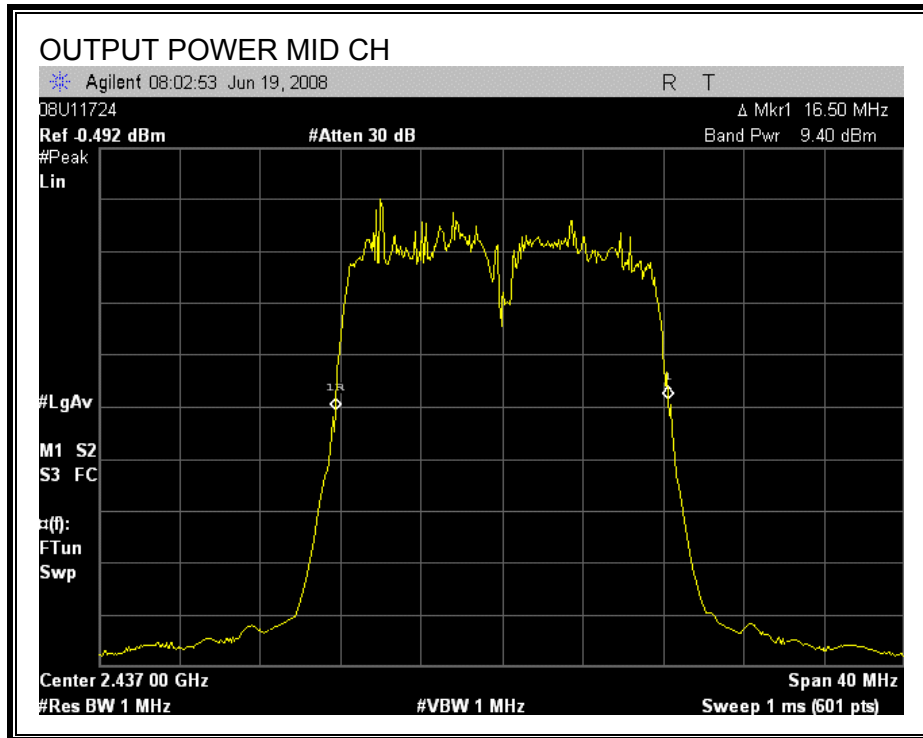
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 99% bandwidth.

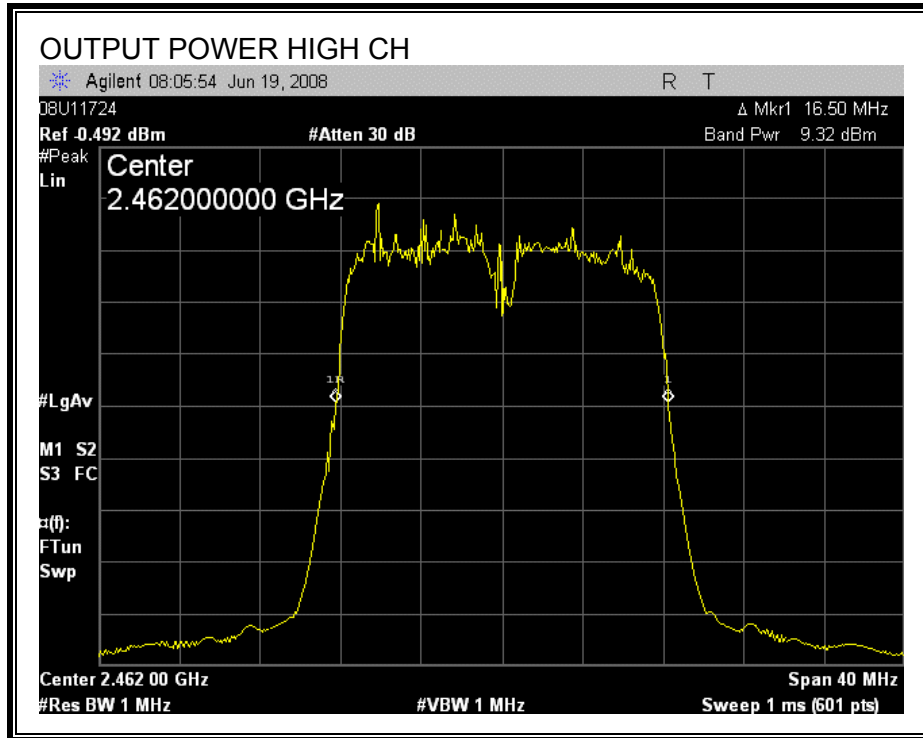
RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	9.36	10.7	20.06	30	-9.94
Middle	2437	9.40	10.7	20.10	30	-9.90
High	2462	9.32	10.7	20.02	30	-9.98

OUTPUT POWER







7.2.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 17 dB (including 16.3 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	12.88
Middle	2437	12.95
High	2462	12.56

7.2.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

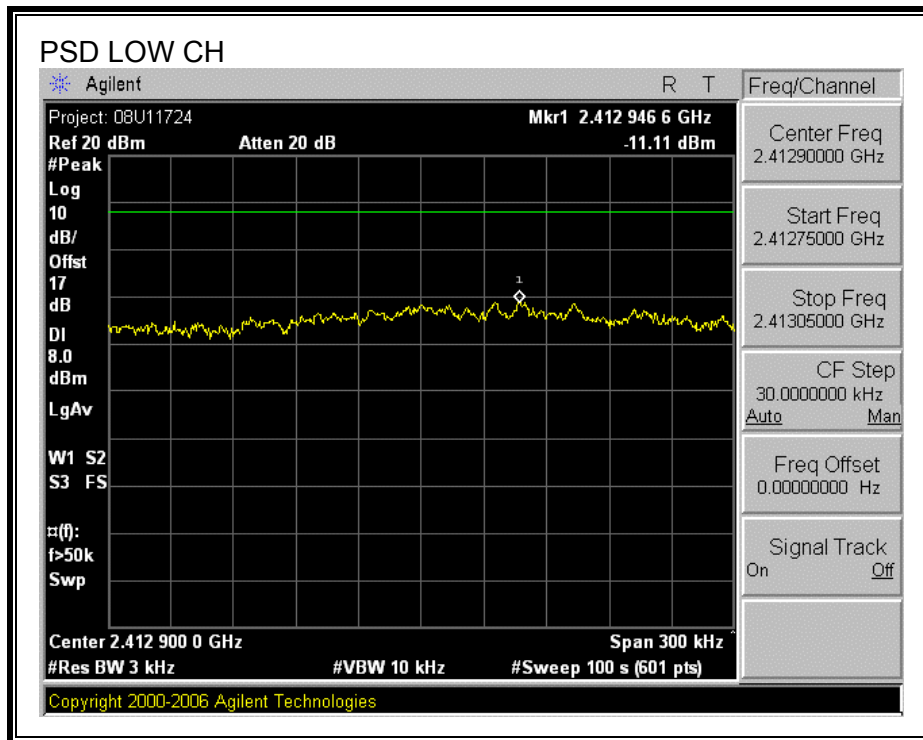
TEST PROCEDURE

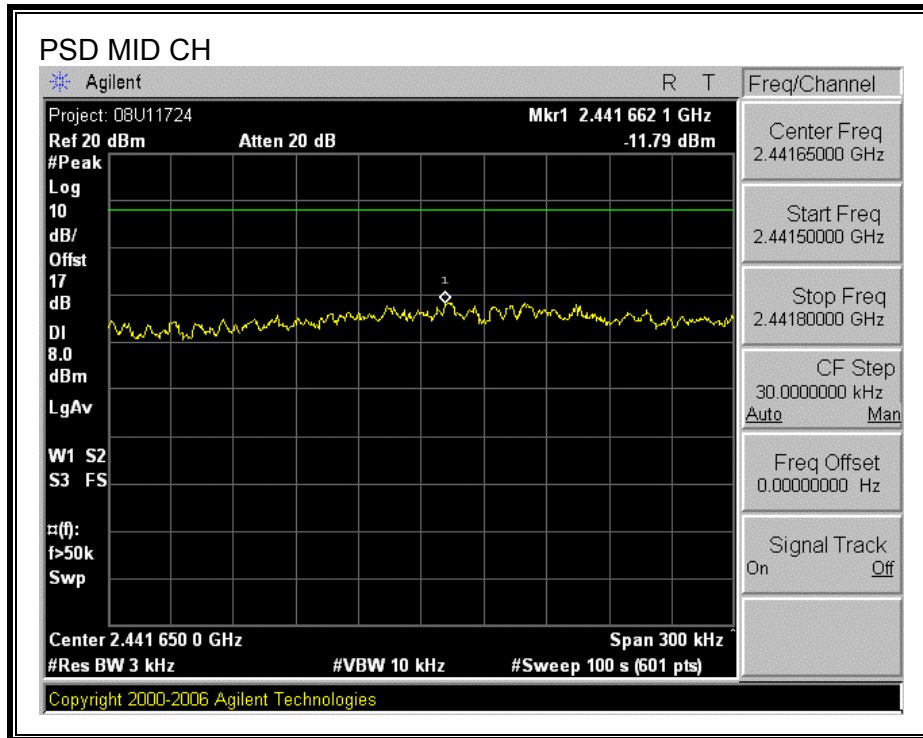
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

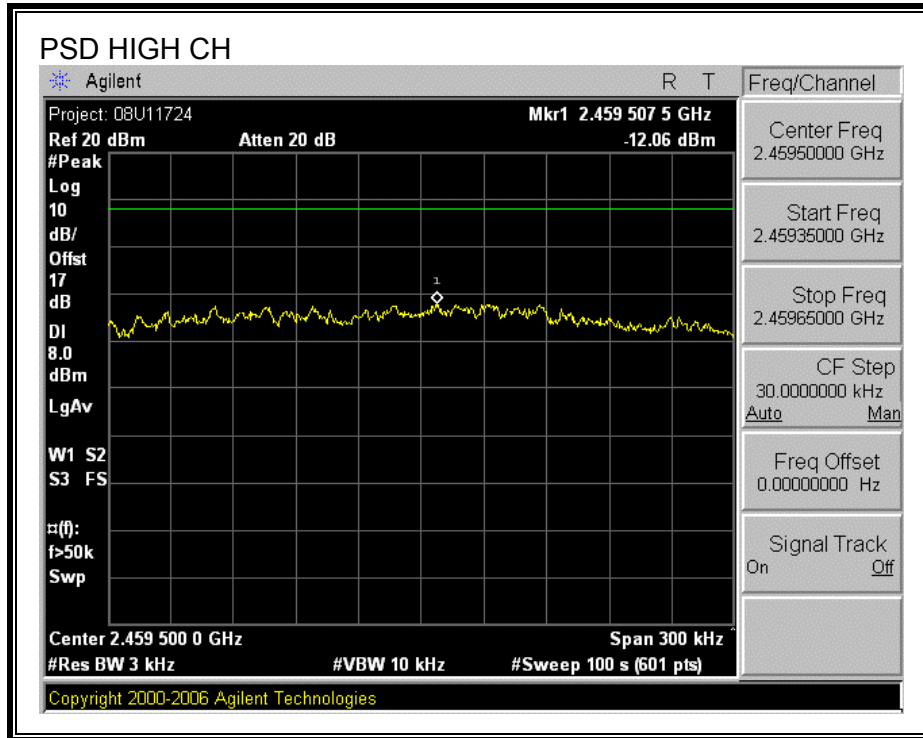
RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-11.11	8	-19.11
Middle	2437	-11.79	8	-19.79
High	2462	-12.06	8	-20.06

POWER SPECTRAL DENSITY







7.2.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

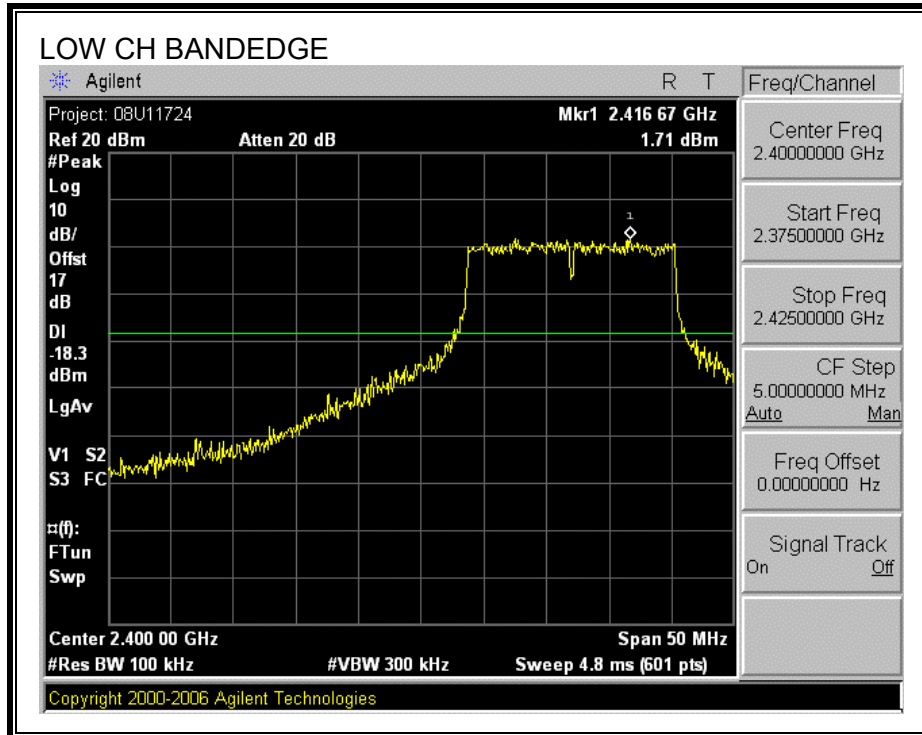
TEST PROCEDURE

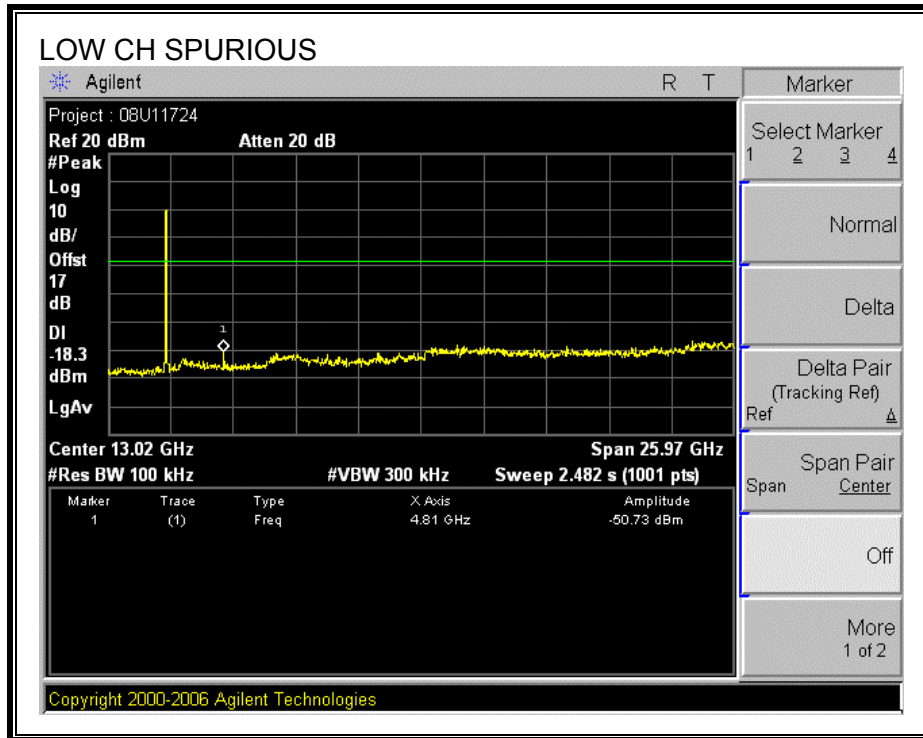
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

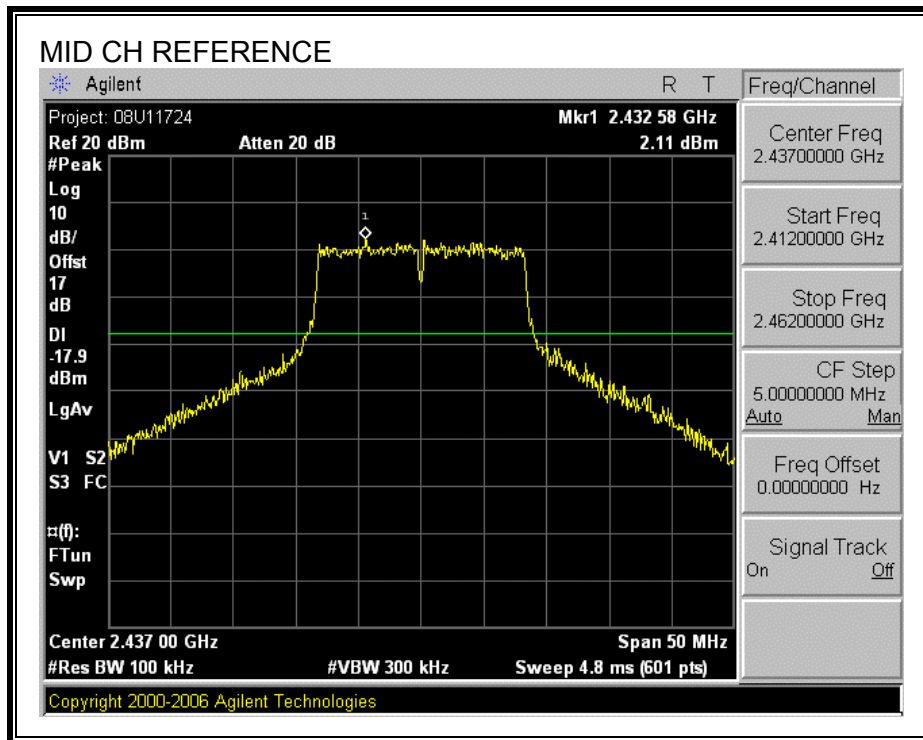
RESULTS

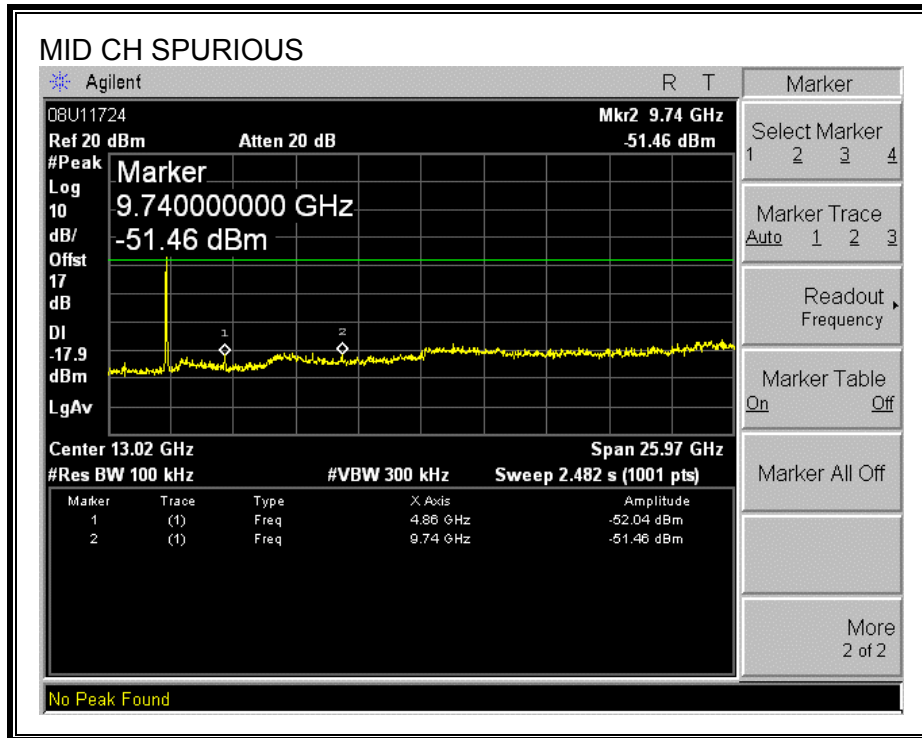
SPURIOUS EMISSIONS, LOW CHANNEL



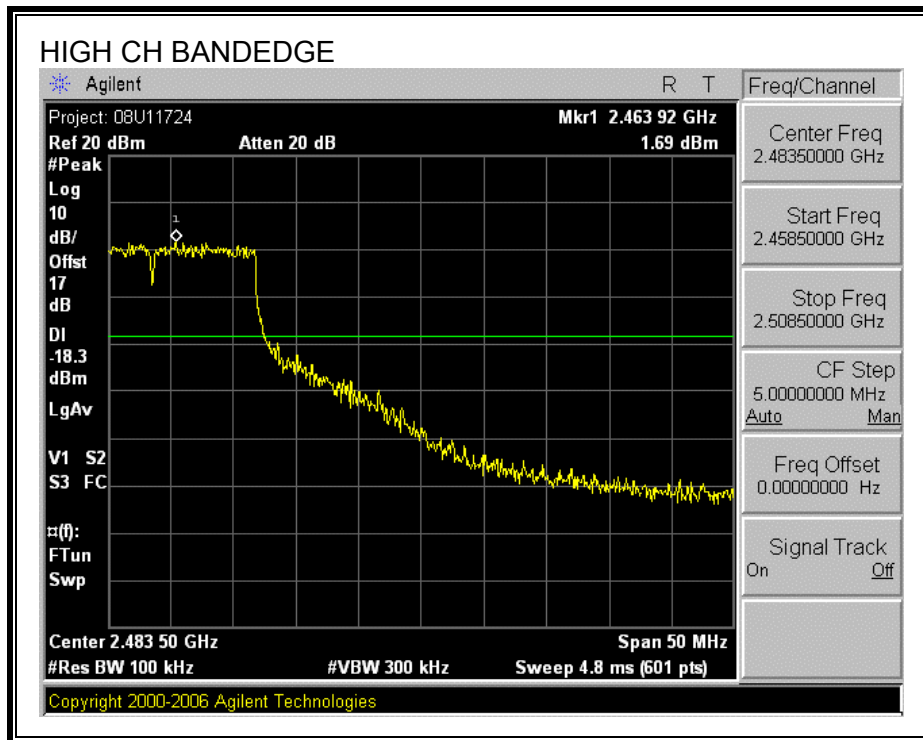


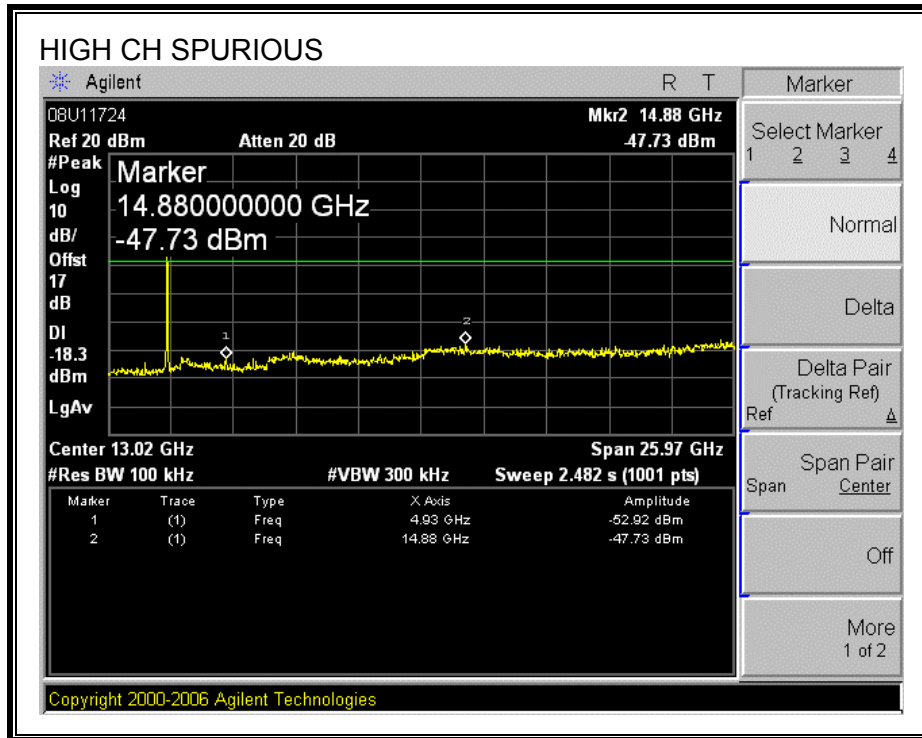
SPURIOUS EMISSIONS, MID CHANNEL





SPURIOUS EMISSIONS, HIGH CHANNEL





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.

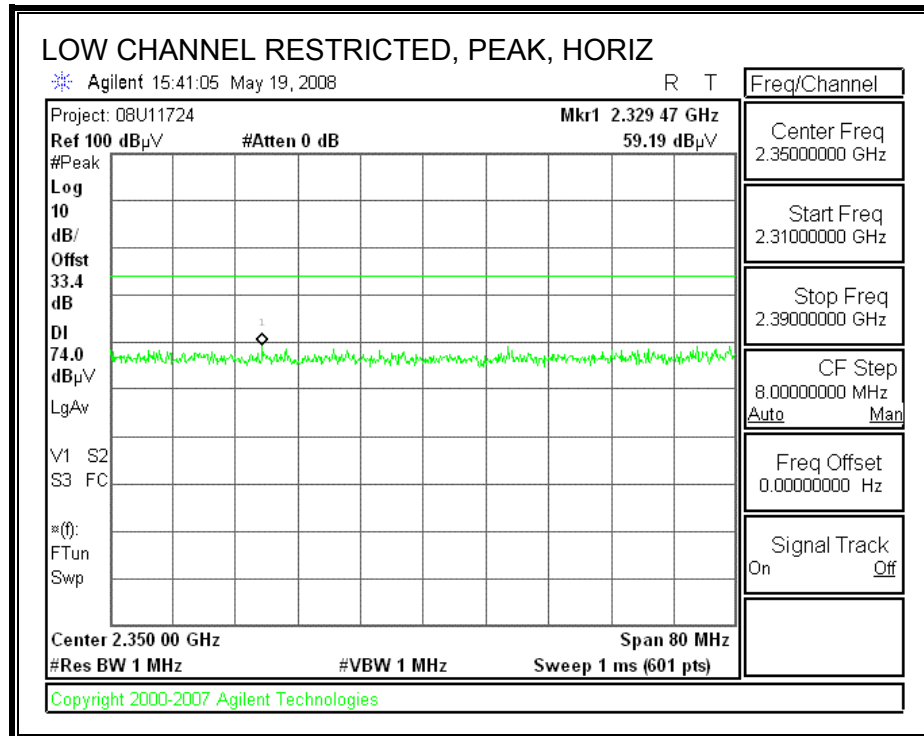
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

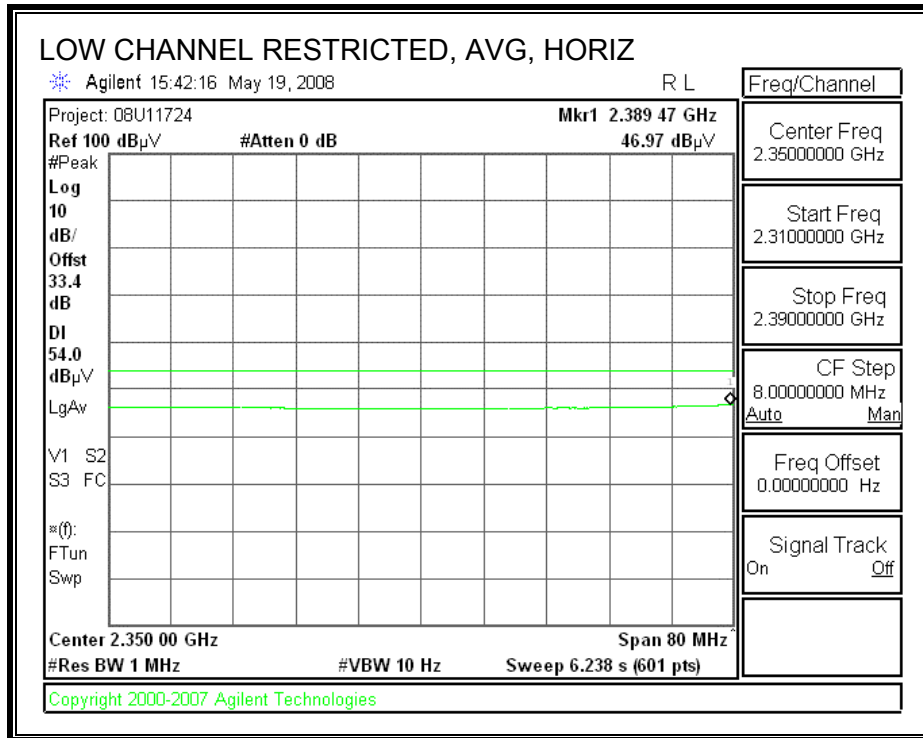
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

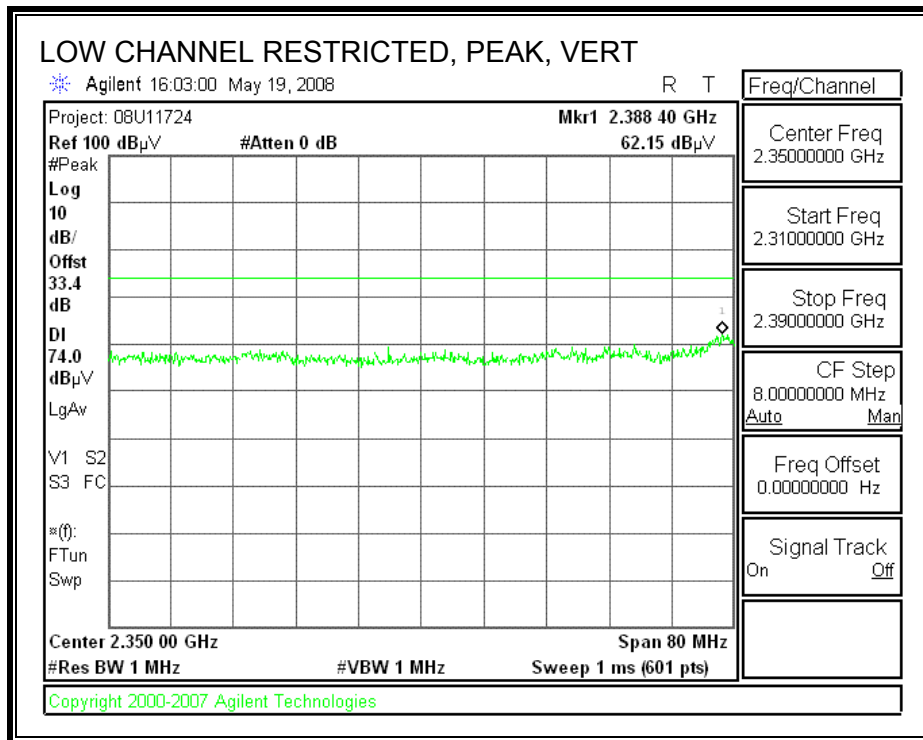
8.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND

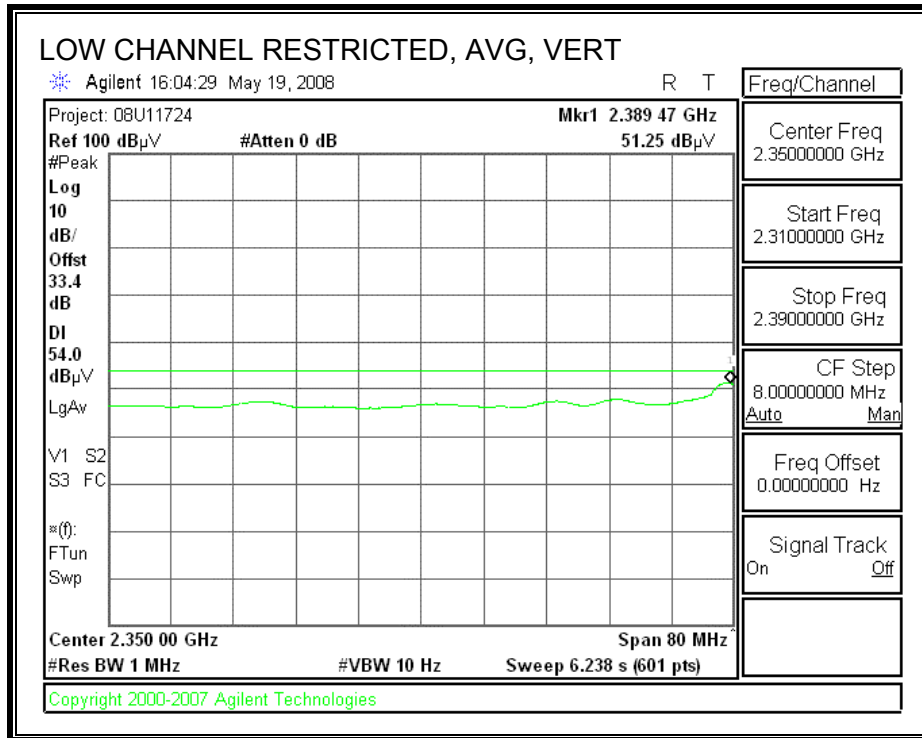
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



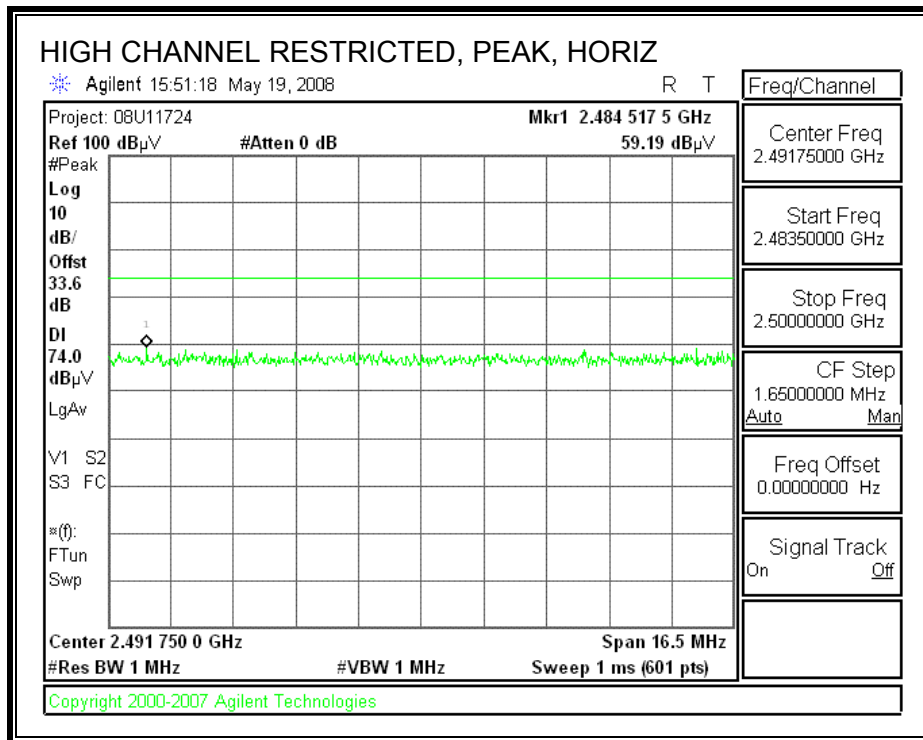


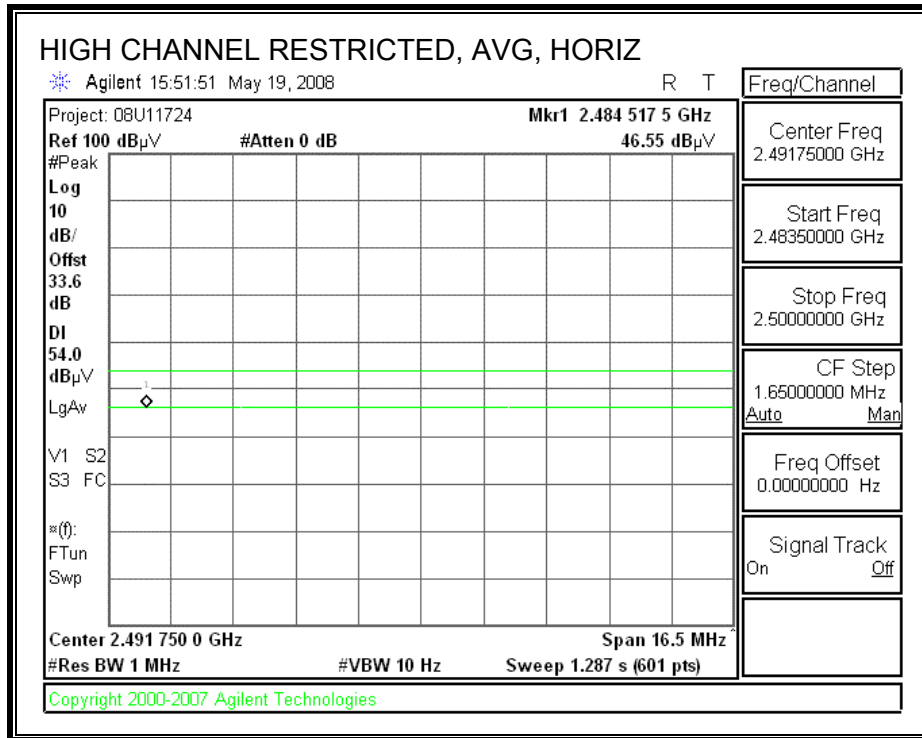
RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL)



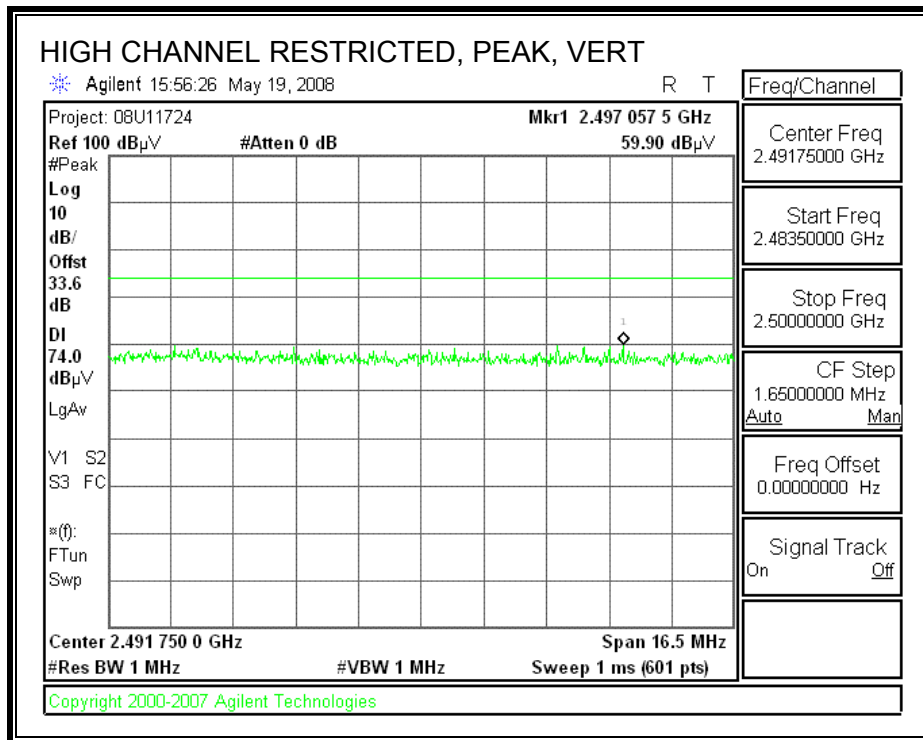


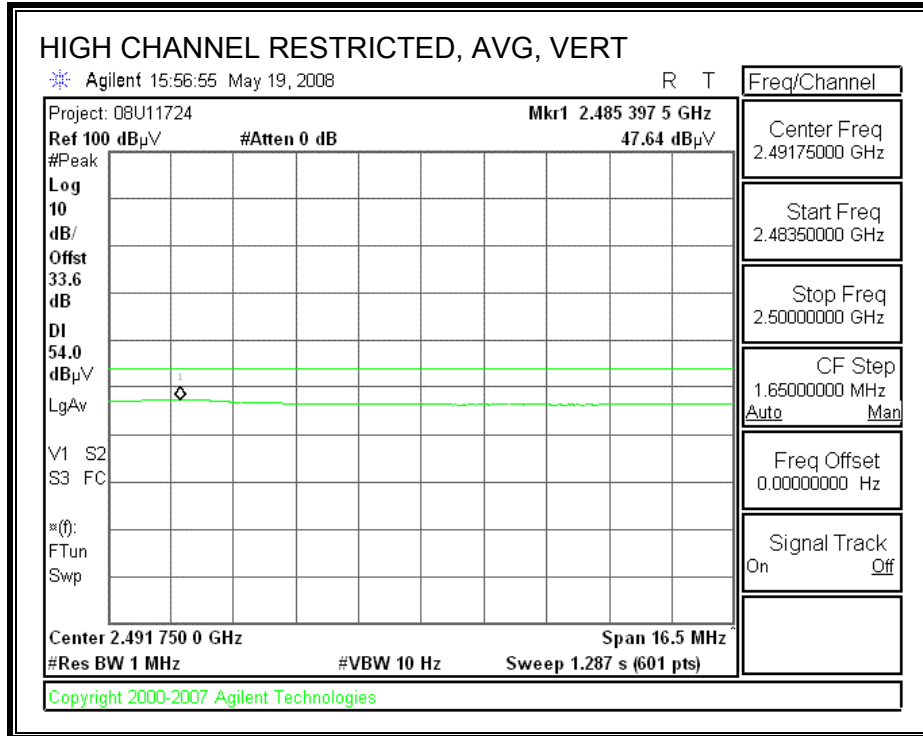
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U11724
 Date: 5/19/2008
 Test Engineer: Tom Chen
 Configuration: EUT only
 Mode: 802.11 b Mode, TX on L / M / H, 5.5Mbps

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

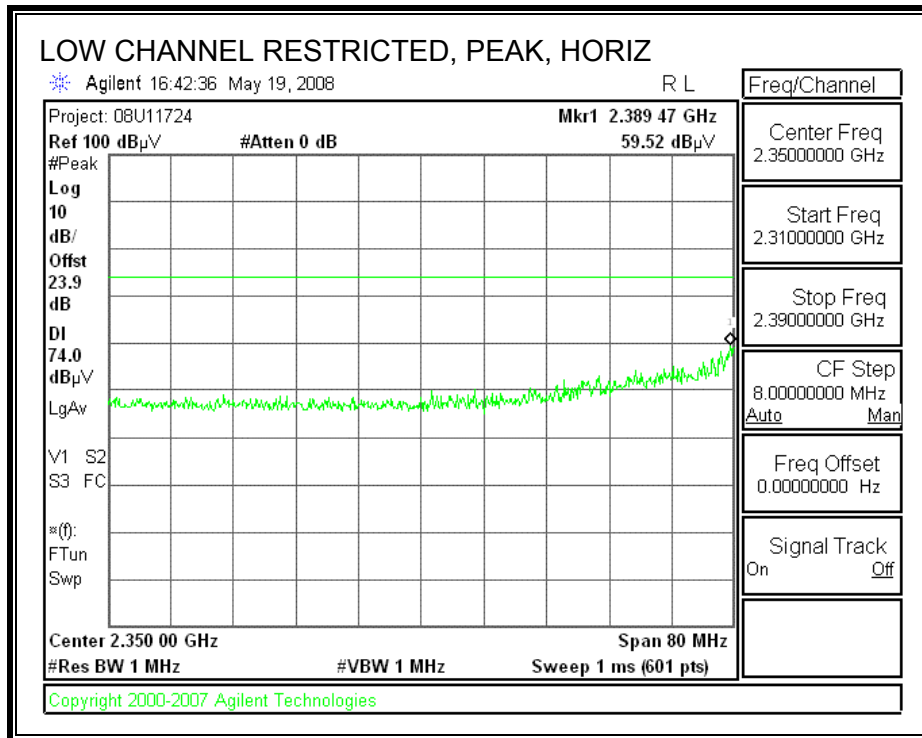
2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
		A-5m Chamber		R_001	Average Measurements RBW=1MHz, VBW=10Hz

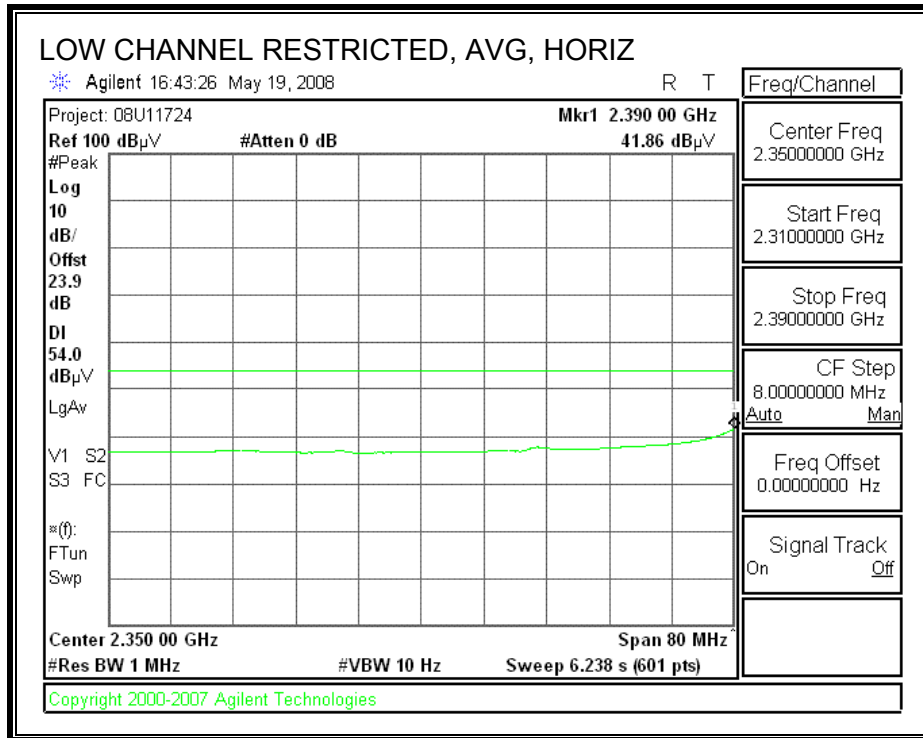
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch.2412 MHz															
4.824	3.0	49.5	29.5	33.7	3.0	-34.8	0.0	0.0	51.4	31.4	74	54	-22.6	-22.6	V
7.236	3.0	37.0	25.5	36.7	8.4	-34.1	0.0	0.0	47.9	36.4	74	54	-26.1	-17.6	V
4.824	3.0	42.4	27.0	33.7	6.9	-34.8	0.0	0.0	48.2	32.7	74	54	-25.8	-21.3	H
7.236	3.0	36.5	25.0	36.7	8.4	-34.1	0.0	0.0	47.4	35.9	74	54	-26.6	-18.1	H
Mid Ch. 2437 MHz															
4.874	3.0	46.5	29.5	33.7	6.9	-34.8	0.0	0.0	52.3	35.3	74	54	-21.7	-18.7	V
7.311	3.0	38.1	25.5	36.7	8.4	-34.1	0.0	0.0	49.1	36.5	74	54	-24.9	-17.5	V
4.874	3.0	42.4	26.5	33.7	6.9	-34.8	0.0	0.0	48.2	32.3	74	54	-25.8	-21.7	H
7.311	3.0	36.2	25.2	36.7	8.4	-34.1	0.0	0.0	47.2	36.2	74	54	-26.8	-17.8	H
High Ch. 2462 MHz															
4.924	3.0	48.5	29.2	33.8	7.0	-34.8	0.0	0.0	54.4	35.1	74	54	-19.6	-18.9	V
7.386	3.0	37.2	25.1	36.8	8.4	-34.1	0.0	0.0	48.3	36.2	74	54	-25.7	-17.8	V
4.924	3.0	42.4	27.2	33.8	7.0	-34.8	0.0	0.0	48.3	33.1	74	54	-25.7	-20.9	H
7.386	3.0	36.1	25.5	36.8	8.4	-34.1	0.0	0.0	47.2	36.6	74	54	-26.8	-17.4	H
No more signal found															

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		

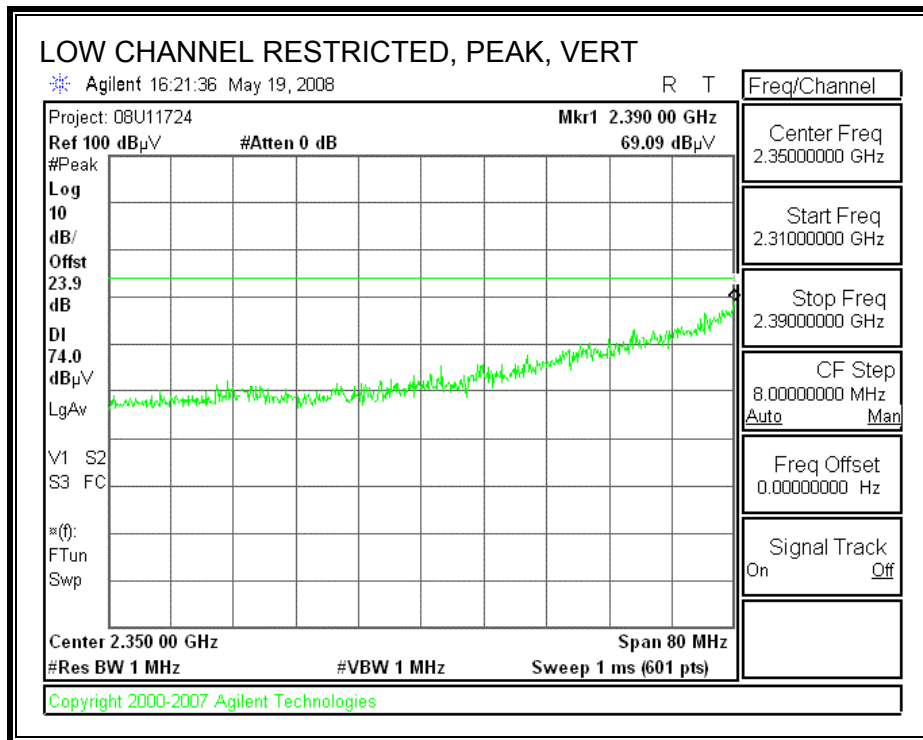
8.2.2. TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND

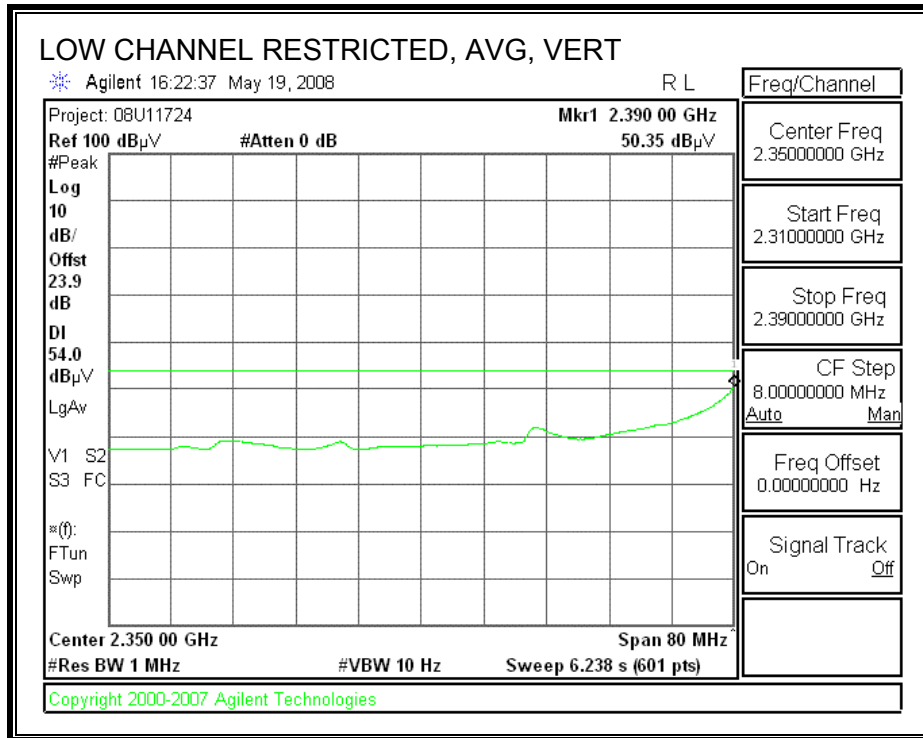
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



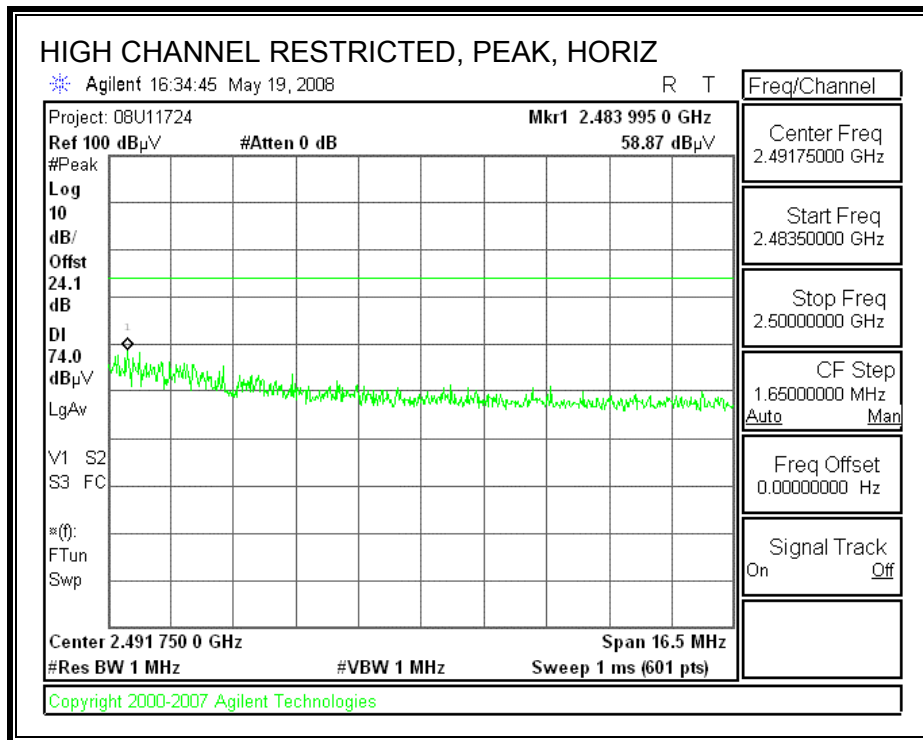


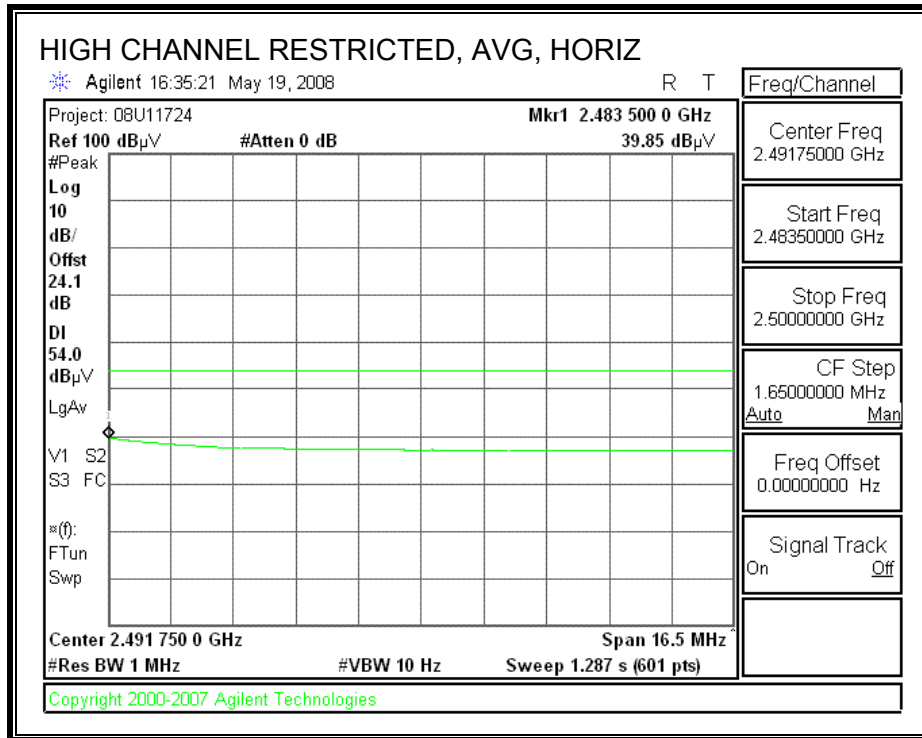
RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL)



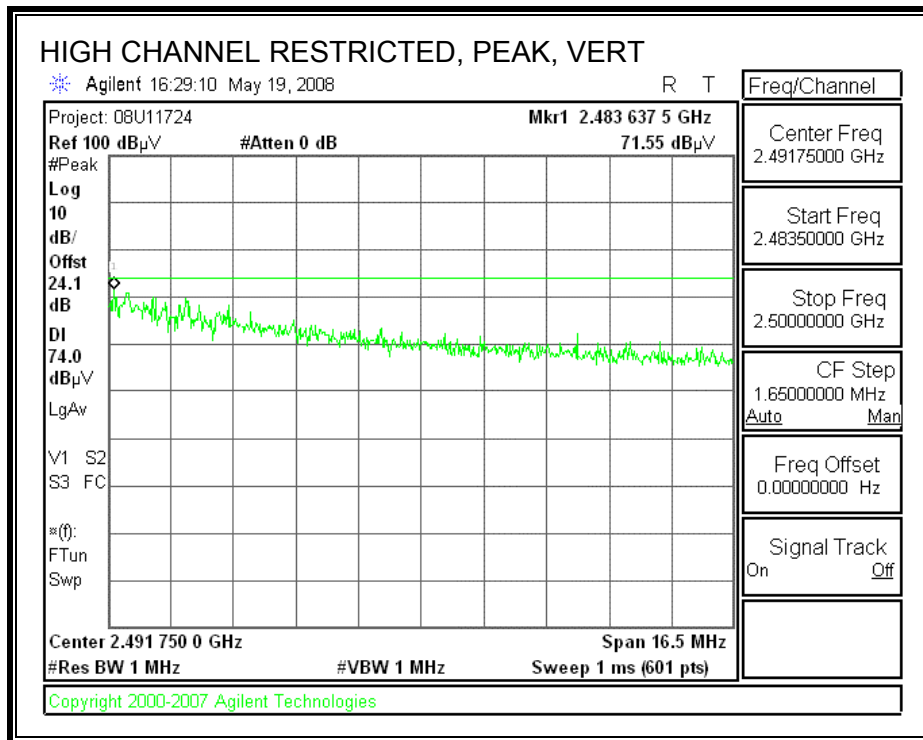


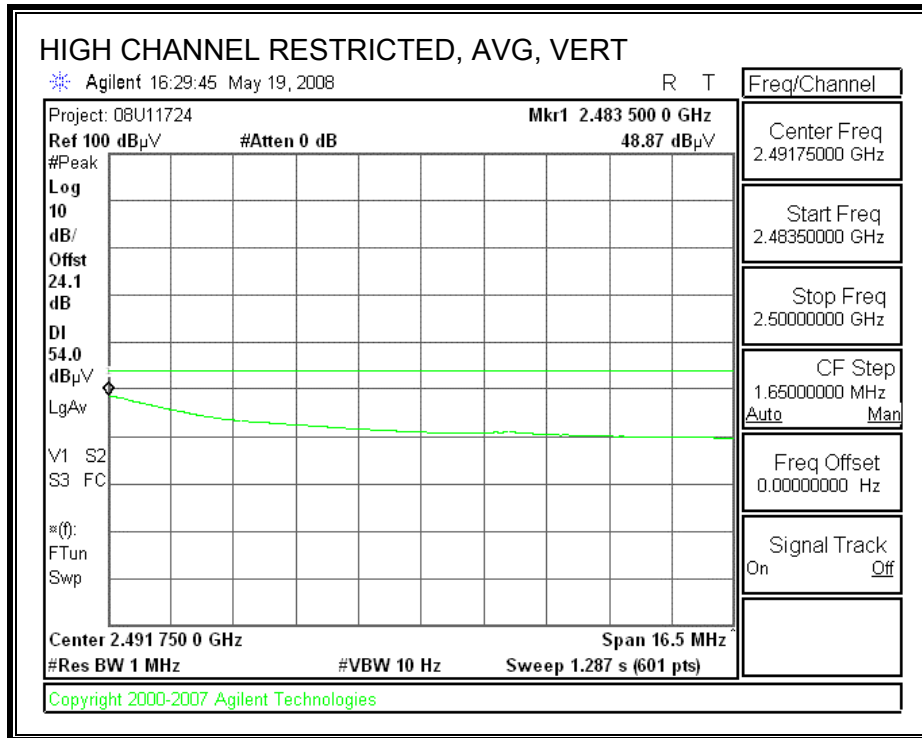
RESTRICTED BANDEGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U11724
 Date: 5/19/2008
 Test Engineer: Tom Chen
 Configuration: EUT only
 Mode: 802.11 g Mode, TX on L / M / H, 48Mbps

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

HI Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
		B-5m Chamber		R_001	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)
Low Ch. 2412 MHz															
4.824	3.0	44.6	33.2	33.7	3.0	-34.8	0.0	0.0	46.5	35.1	74	54	-27.5	-18.9	V
7.236	3.0	36.7	25.5	36.7	8.6	-34.1	0.0	0.0	47.8	36.6	74	54	-26.2	-17.4	V
4.824	3.0	39.9	26.5	33.7	7.1	-34.8	0.0	0.0	45.9	32.5	74	54	-28.1	-21.5	H
7.236	3.0	36.5	25.0	36.7	8.6	-34.1	0.0	0.0	47.6	36.1	74	54	-26.4	-17.9	H
Mid Ch. 2437 MHz															
4.874	3.0	43.7	31.5	33.7	7.2	-34.8	0.0	0.0	49.8	37.6	74	54	-24.2	-16.4	V
7.311	3.0	36.5	25.5	36.7	8.6	-34.1	0.0	0.0	47.8	36.8	74	54	-26.2	-17.2	V
4.874	3.0	38.3	26.1	33.7	7.2	-34.8	0.0	0.0	44.4	32.2	74	54	-29.6	-21.8	H
7.311	3.0	36.7	25.5	36.7	8.6	-34.1	0.0	0.0	48.0	36.8	74	54	-26.0	-17.2	H
High Ch. 2462 MHz															
4.924	3.0	43.5	31.3	33.8	7.2	-34.8	0.0	0.0	49.7	37.5	74	54	-24.3	-16.5	V
7.386	3.0	35.5	25.5	36.8	8.7	-34.1	0.0	0.0	46.9	36.9	74	54	-27.1	-17.1	V
4.924	3.0	39.2	26.5	33.8	7.2	-34.8	0.0	0.0	45.4	32.7	74	54	-28.6	-21.3	H
7.386	3.0	36.5	25.5	36.8	8.7	-34.1	0.0	0.0	47.9	36.9	74	54	-26.1	-17.1	H
No more signal found															

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		

8.3. RECEIVER ABOVE 1 GHz

8.3.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 2.4 GHz BAND

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U11724
 Date: 5/19/2008
 Test Engineer: Tom Chen
 Configuration: EUT only
 Mode: 802.11 b Mode, RX Mid CH

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	B-5m Chamber
--------------	--------------	---------------	-----	---------------	--------------

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

f	Dist	Read Pk	Read Avg	AF	CL	Amp	D Corr	Ftr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	(V/H)
Mid Ch. 2437 MHz															
1.140	3.0	48.7	29.3	26.8	3.4	-38.1	0.0	0.0	40.9	21.4	74	54	-33.1	-32.6	V
1.525	3.0	44.6	26.4	27.8	3.9	-37.5	0.0	0.0	38.7	20.6	74	54	-35.3	-33.4	V
3.625	3.0	40.4	25.5	32.2	6.1	-35.3	0.0	0.0	43.4	28.5	74	54	-30.6	-25.5	V
1.105	3.0	51.5	31.5	26.7	3.4	-38.1	0.0	0.0	43.4	23.4	74	54	-30.6	-30.6	H
1.537	3.0	44.6	25.5	27.8	3.9	-37.5	0.0	0.0	38.8	19.7	74	54	-35.2	-34.3	H
3.613	3.0	40.3	25.5	32.2	6.1	-35.3	0.0	0.0	43.2	28.4	74	54	-30.8	-25.6	H
No more signal found															

8.4. WORST-CASE BELOW 1 GHz

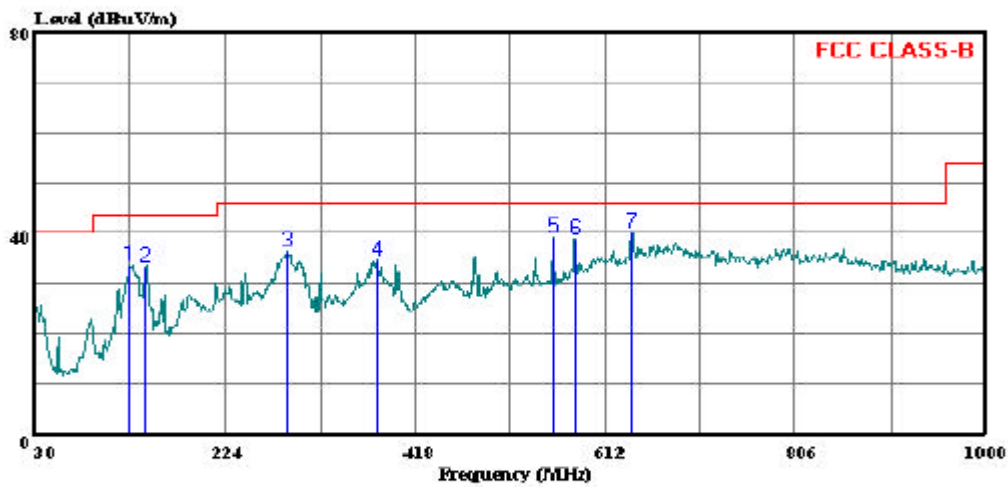
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

Data#: 4 File#: 08U11724.EMI Date: 05-20-2008 Time: 10:57:33



Trace: 3

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Tom Chen
Project #: 08U11724
Company: Digi International Inc.
Configuration:: BUT Only
Mode: TX on g Mode Mid Ch.
Target: FCC Class B

HORIZONTAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	127.000	46.50	-12.96	33.54	43.50	-9.96	Peak
2	143.490	46.75	-13.49	33.26	43.50	-10.24	Peak
3	287.050	49.17	-12.82	36.35	46.00	-9.65	Peak
4	379.200	44.83	-10.36	34.47	46.00	-11.53	Peak
5	559.620	45.50	-6.28	39.22	46.00	-6.78	Peak
6	580.960	44.17	-5.42	38.74	46.00	-7.26	Peak
7	640.130	44.58	-4.56	40.03	46.00	-5.97	Peak

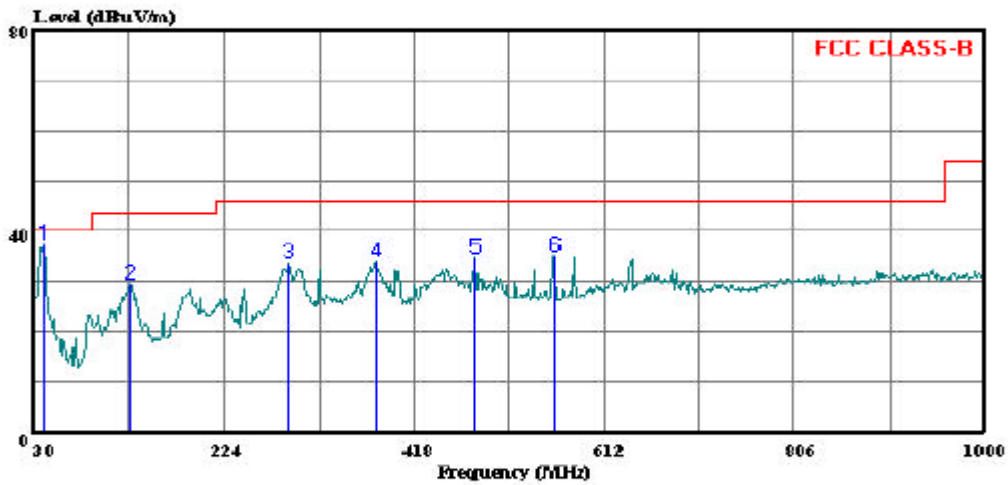
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



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

Data#: 2 File#: 08U11724.EMI Date: 05-20-2008 Time: 10:44:58



Trace: 1

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Tom Chen
Project #: : 08U11724
Company: : Digi International Inc.
Configuration:: BUT Only
Mode : : TX on g Mode Mid Ch.
Target: : FCC Class B

VERTICAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	39.700	49.50	-12.19	37.31	40.00	-2.69	Peak
2	127.970	42.50	-13.00	29.50	43.50	-14.00	Peak
3	289.960	46.33	-12.71	33.62	46.00	-12.38	Peak
4	379.200	44.17	-10.36	33.81	46.00	-12.19	Peak
5	481.050	42.33	-7.70	34.64	46.00	-11.36	Peak
6	561.560	41.33	-6.28	35.05	46.00	-10.95	Peak

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

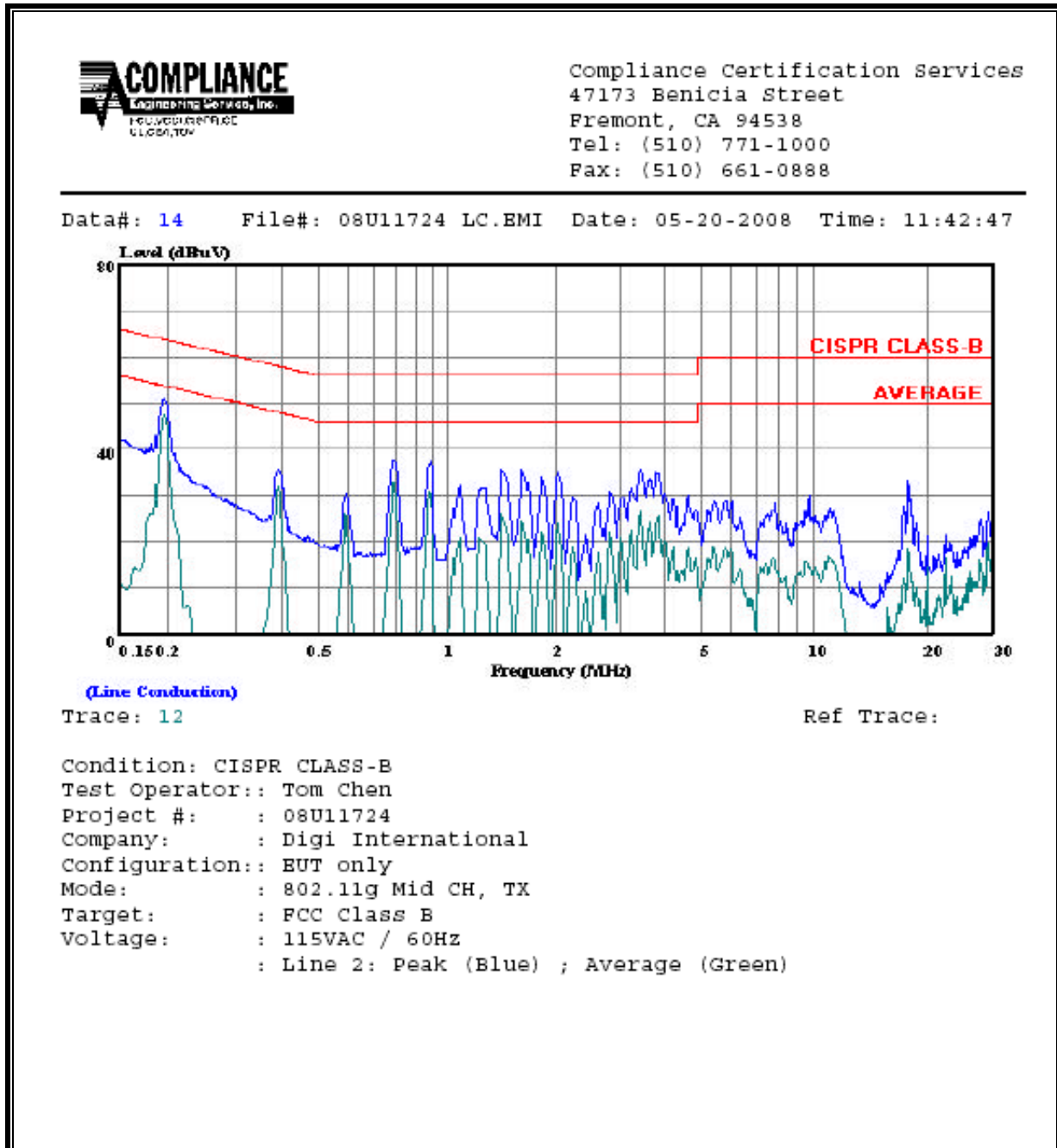
ANSI C63.4

RESULTS

6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)										
Freq. (MHz)	Reading			Class (dB)	Limit QP	FCC B		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)			AV	QP (dB)	AV (dB)		
0.20	51.86	--	48.57	0.00	63.82	53.82	-11.96	-5.25	L1	
0.78	35.55	--	30.24	0.00	56.00	46.00	-20.45	-15.76	L1	
3.53	37.65	--	25.34	0.00	56.00	46.00	-18.35	-20.66	L1	
0.20	50.80	--	47.37	0.00	63.82	53.82	-13.02	-6.45	L2	
0.79	37.69	--	33.00	0.00	56.00	46.00	-18.31	-13.00	L2	
0.99	37.29	--	30.56	0.00	56.00	46.00	-18.71	-15.44	L2	
6 Worst Data										

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/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616 000 / <i>f</i> ^{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/m² is equivalent to 1 mW/cm².
 3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

CALCULATIONS

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm²

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm² is converted to units of W/m² by multiplying by a factor of 10.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0 \text{ mW/cm}^2$

From IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10 \text{ W/m}^2$

RESULTS

(MPE distance equals 20 cm)

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
WLAN	2.4 GHz	20.0	20.33	2.00	0.03	0.34