

## 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

ISSUE DATE: JUNE 18, 2008

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

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

NVLAP LAB CODE 200065-0

### **Revision History**

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

Page 2 of 97

# TABLE OF CONTENTS

1.	ATTESTATION OF TEST RESULTS	5
2.	TEST METHODOLOGY	6
3.	FACILITIES AND ACCREDITATION	6
4.	CALIBRATION AND UNCERTAINTY	6
4	.1. MEASURING INSTRUMENT CALIBRATION	6
4	2.2. MEASUREMENT UNCERTAINTY	6
5.	EQUIPMENT UNDER TEST	7
5	.1. DESCRIPTION OF EUT	7
5	2. DESCRIPTION OF MODELS DIFFERENCES	7
5	.3. MAXIMUM OUTPUT POWER	7
5	.4. DESCRIPTION OF AVAILABLE ANTENNAS	7
5	5.5. SOFTWARE AND FIRMWARE	7
5	6. WORST-CASE CONFIGURATION AND MODE	8
5	7. DESCRIPTION OF TEST SETUP	9
6.	TEST AND MEASUREMENT EQUIPMENT	12
0.		
7.	ANTENNA PORT TEST RESULTS	
7	7.1. 802.11b MODE IN THE 2.4 GHz BAND 7.1.1. 6 dB BANDWIDTH	
	7.1.2. 99% BANDWIDTH	
	7.1.3. OUTPUT POWER	21
	7.1.4. AVERAGE POWER	
	<ul><li>7.1.5. POWER SPECTRAL DENSITY</li><li>7.1.6. CONDUCTED SPURIOUS EMISSIONS</li></ul>	
7	7.2. 802.11g MODE IN THE 2.4 GHz BAND	
1	7.2.1. 6 dB BANDWIDTH	
	7.2.2. 99% BANDWIDTH	
	7.2.3. OUTPUT POWER	
	<ul><li>7.2.4. AVERAGE POWER</li><li>7.2.5. POWER SPECTRAL DENSITY</li></ul>	
	7.2.6. CONDUCTED SPURIOUS EMISSIONS	
8.	RADIATED TEST RESULTS	.61
8	2.1. LIMITS AND PROCEDURE	
8	2.2. TRANSMITTER ABOVE 1 GHz	
	8.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND	
	8.2.2. TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND	71
8	3. RECEIVER ABOVE 1 GHz	
	8.3.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 2.4 GHz BAND	80
	Page 3 of 97 MPLIANCE CERTIFICATION SERVICES FORM NO: CCSUP403	
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8	.4.	WORST-CASE BELOW 1 GHz	81
9.	AC	C POWER LINE CONDUCTED EMISSIONS	85
10.		MAXIMUM PERMISSIBLE EXPOSURE	89
11.		SETUP PHOTOS	93

Page 4 of 97

## **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME:	RABBIT SEMICONDUCTOR INCO A DIGI INTERNATIONAL COMPA 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			
ST	ANDARD	TEST RESULTS		
CFR 47 Part 15 S	Subpart C and Subpart E	PASS		
RSS-210 Issue 7 Anr	nex 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

Page 5 of 97

# 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 <u>http://www.ccsemc.com</u>.

# 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%.

Page 6 of 97

# 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	Mode	Output Power	Output Power
(MHz)		(dBm)	(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

Page 7 of 97

## 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.

Page 8 of 97

## 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**

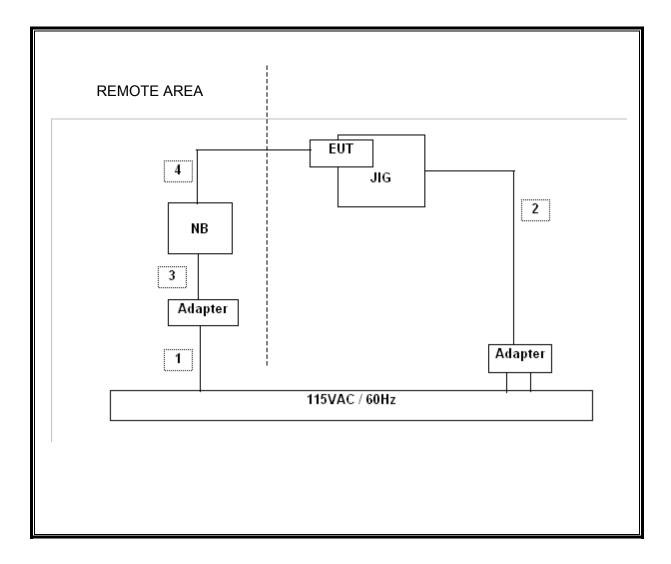
	I/O CABLE LIST							
Cable No.	Port	# of Identica Ports	Connector Type	Cable Type	Cable Length	Remarks		
1	AC	1	AC	Unshielded	1.5m			
2	DC	1	DC	Unshielded	1.2m	TO LAPTOP PC		
3	DC	1	DC	Unshielded	1.5m	TO JIG Broad		
4	USB	1	USB	Unshielded	2M			

### **Configuration 2**

	I/O CABLE LIST						
Cable No.	Port	# of Identica 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		

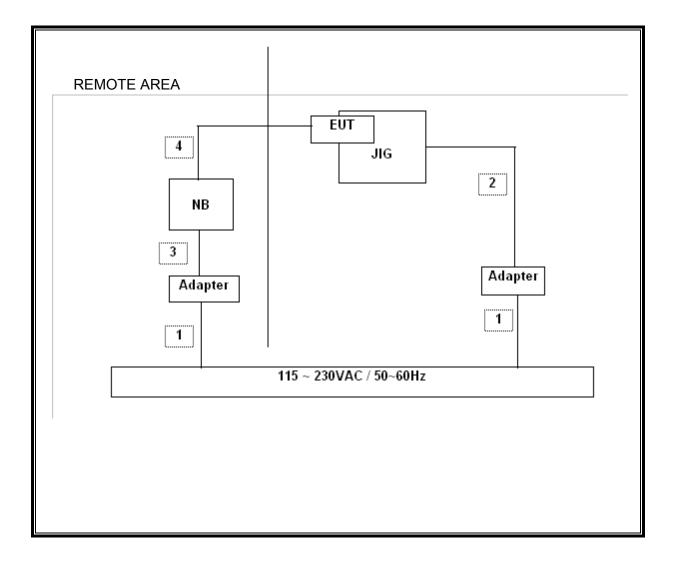
#### SETUP DIAGRAM FOR TESTS

#### Configuration 1: For Antenna Port Tests



Page 10 of 97

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



Page 11 of 97

# 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	

Page 12 of 97

# 7. ANTENNA PORT TEST RESULTS

## 7.1. 802.11b MODE IN THE 2.4 GHz BAND

## 7.1.1.6 dB BANDWIDTH

#### <u>LIMITS</u>

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

#### TEST PROCEDURE

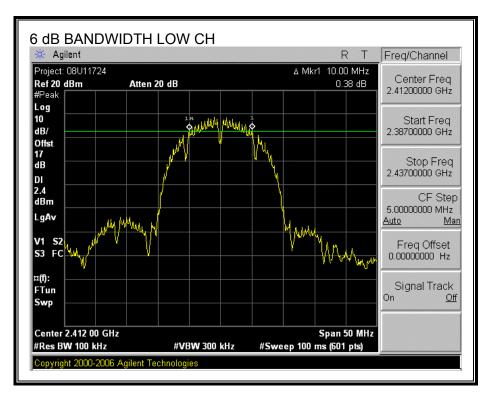
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### **RESULTS**

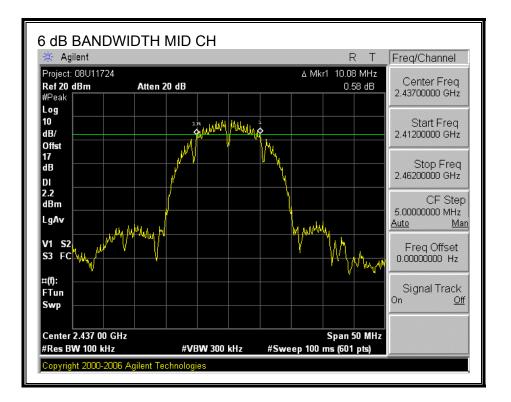
Channel	Frequency	6 dB Bandwidth	Minimum Limit
	(MHz)	(MHz)	(MHz)
Low	2412	10.00	0.5
Middle	2437	10.08	0.5
High	2462	10.08	0.5

Page 13 of 97

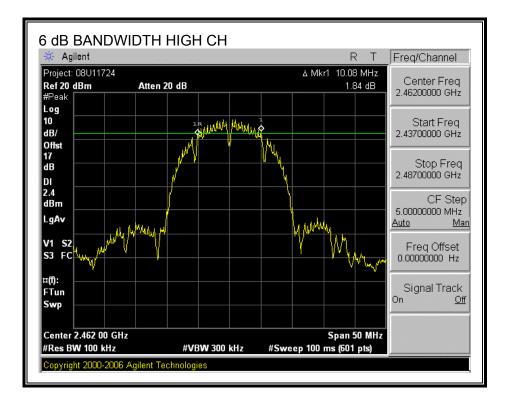
#### 6 dB BANDWIDTH



Page 14 of 97



Page 15 of 97



Page 16 of 97

# 7.1.2. 99% BANDWIDTH LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

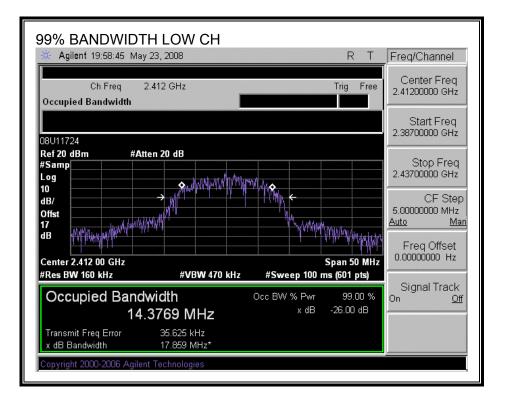
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### **RESULTS**

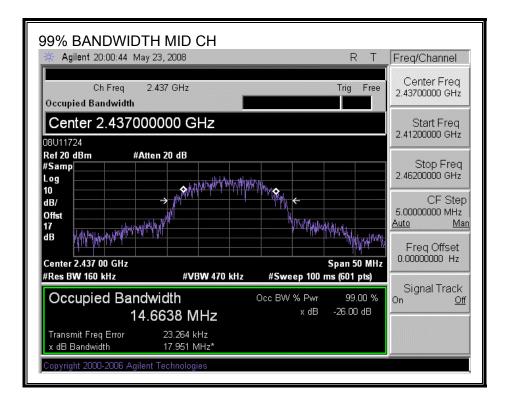
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	2412	14.3769
Middle	2437	14.6638
High	2462	14.4736

Page 17 of 97

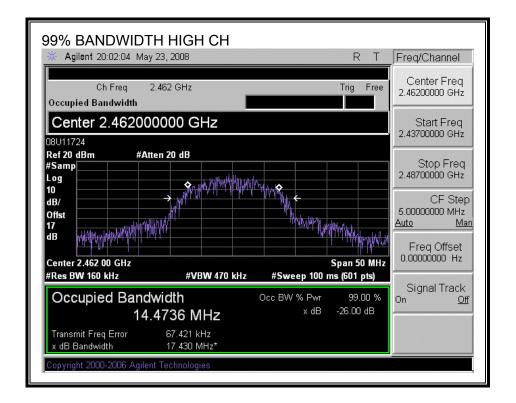
#### 99% BANDWIDTH



Page 18 of 97



Page 19 of 97



Page 20 of 97

# 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

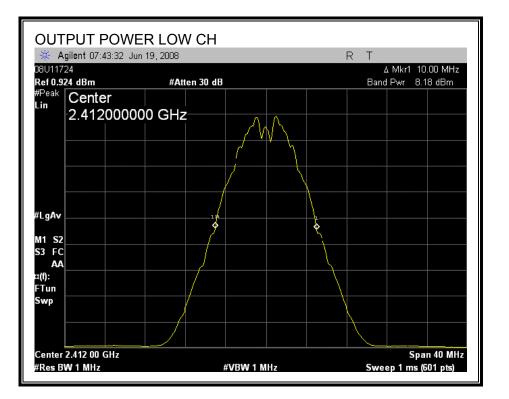
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

#### **RESULTS**

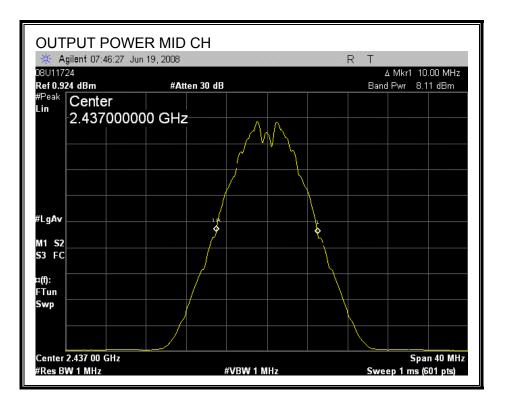
Channel	Frequency	Spectrum	Attenuator and	Output	Limit	Margin
		Analyzer Reading	Cable Offset	Power		
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Low	2412	8.18	10.7	18.88	30	-11.12
Middle	2437	8.11	10.7	18.81	30	-11.19
High	2462	8.00	10.7	18.70	30	-11.30

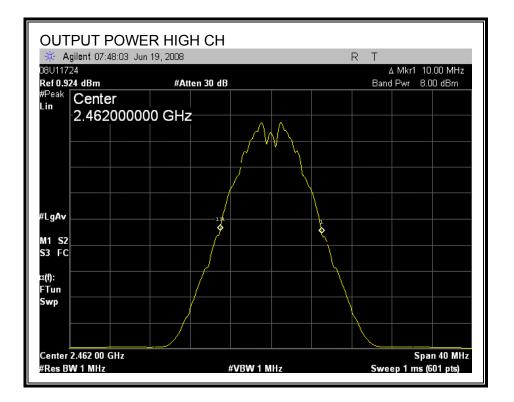
Page 21 of 97

#### **OUTPUT POWER**



Page 22 of 97





Page 24 of 97

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

Page 25 of 97

## 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.

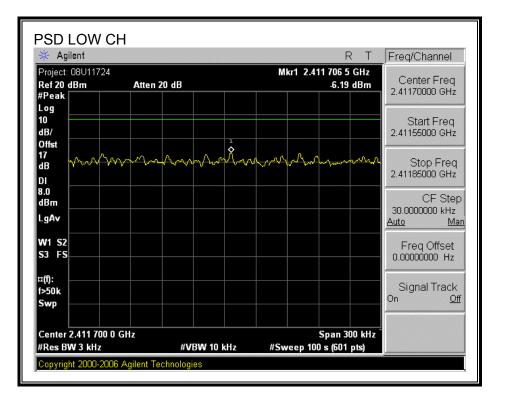
#### TEST PROCEDURE

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.

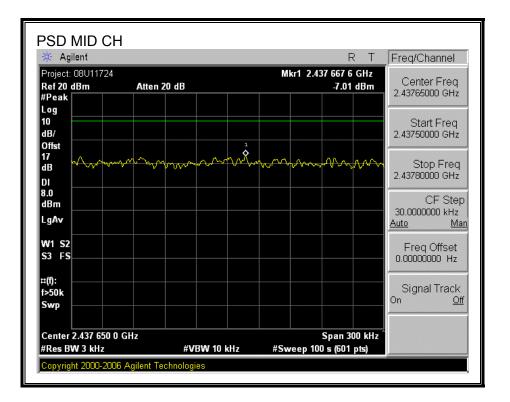
#### **RESULTS**

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

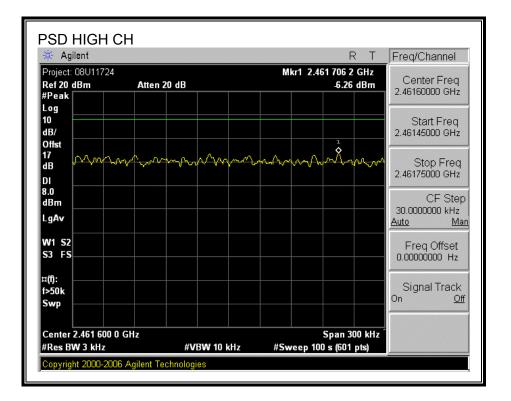
#### POWER SPECTRAL DENSITY



Page 27 of 97



Page 28 of 97



Page 29 of 97

## 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

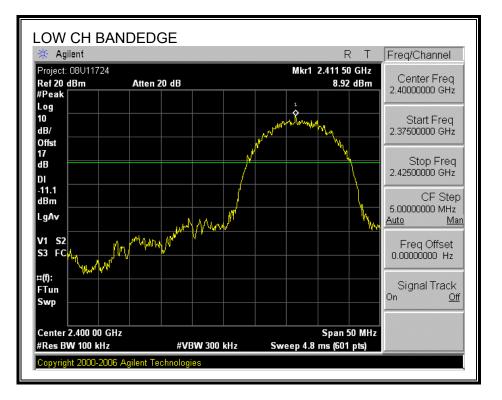
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

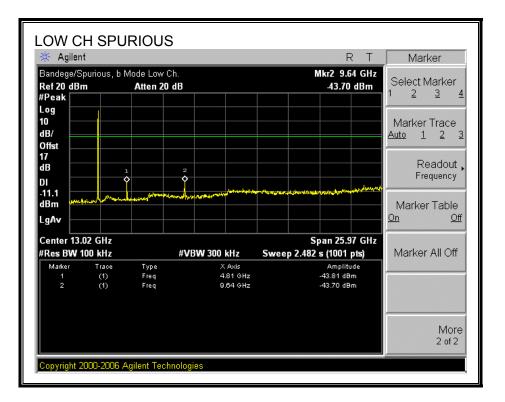
Page 30 of 97

#### **RESULTS**

#### SPURIOUS EMISSIONS, LOW CHANNEL

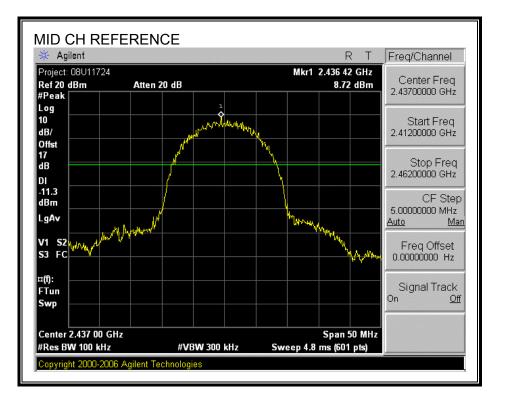


Page 31 of 97



Page 32 of 97

#### SPURIOUS EMISSIONS, MID CHANNEL

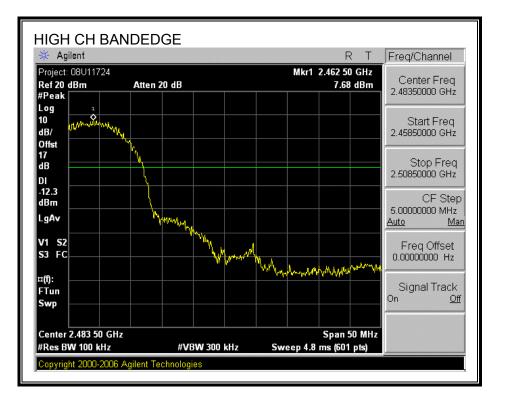


Page 33 of 97

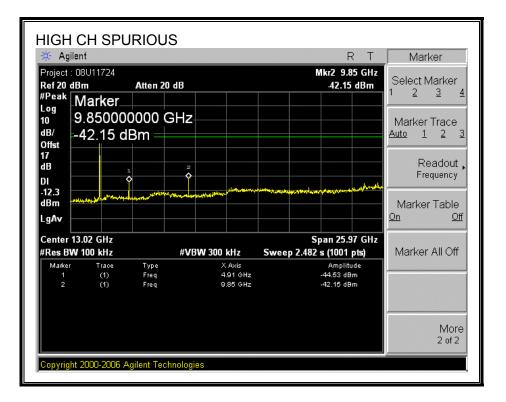
🔆 Ag	ilent					R	: Т	Marker
Ref 20 #Peak	<sup>dBm</sup> Marker	Atten 20	dB			Mkr2 9.7 42.13		Select Marker 1 <u>2 3</u>
10	9.74000 -42.13 c		iHz					Norma
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	13.02 GHz W 100 kHz	Turn	#VBW 30		Sweep	Span 25.9 2.482 s (1001 p	ots)	Span Pai Span <u>Cente</u>
Marker 1 2	Trace (1) (1)	Type Freq Freq		X Axis 2.45 GHz 9.74 GHz		Amplitu -38.08 dBr -42.13 dBr	m 🛛	OI
								Mor 1 of 2

Page 34 of 97

#### SPURIOUS EMISSIONS, HIGH CHANNEL



Page 35 of 97



Page 36 of 97

# 7.2. 802.11g MODE IN THE 2.4 GHz BAND

# 7.2.1. 6 dB BANDWIDTH

## <u>LIMITS</u>

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

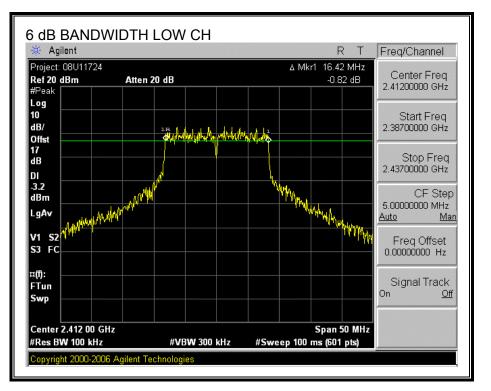
#### TEST PROCEDURE

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.

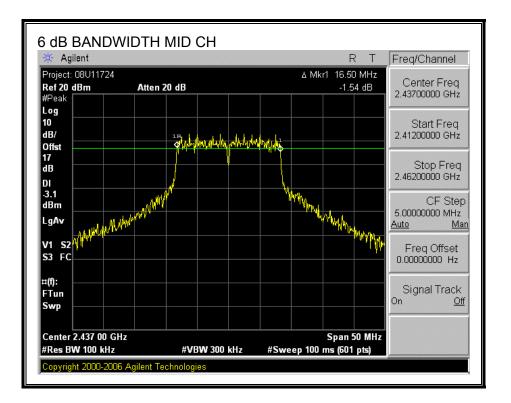
#### **RESULTS**

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

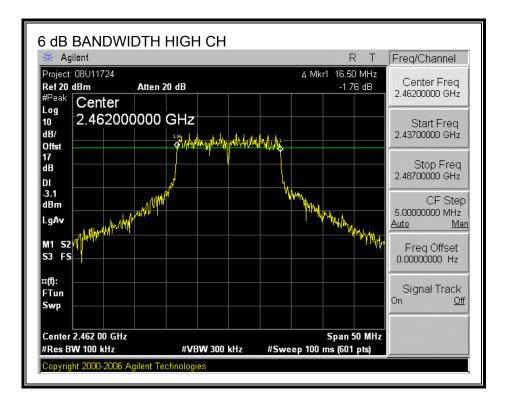
#### 6 dB BANDWIDTH



Page 38 of 97



Page 39 of 97



Page 40 of 97

## 7.2.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

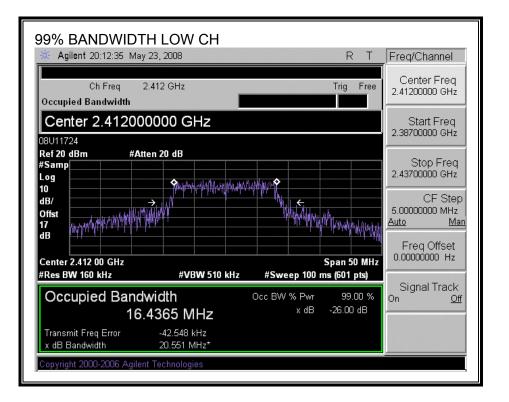
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### RESULTS

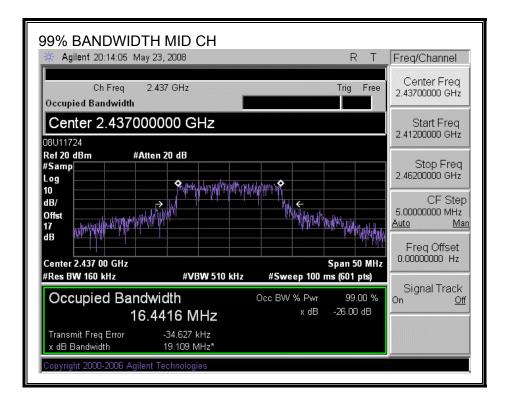
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	2412	16.4365
Middle	2437	16.4416
High	2462	16.4157

Page 41 of 97

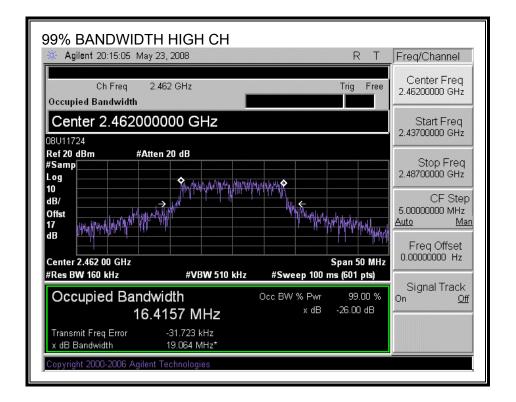
#### 99% BANDWIDTH



Page 42 of 97



Page 43 of 97



Page 44 of 97

# 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

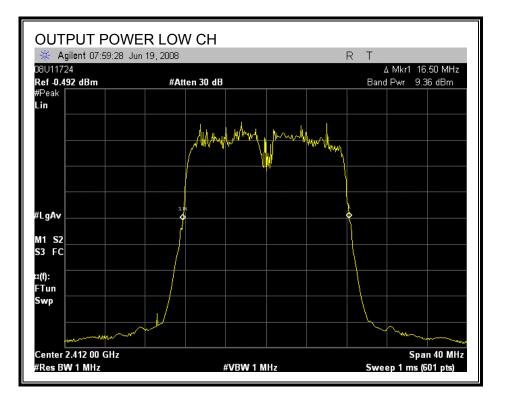
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 99% bandwidth.

#### **RESULTS**

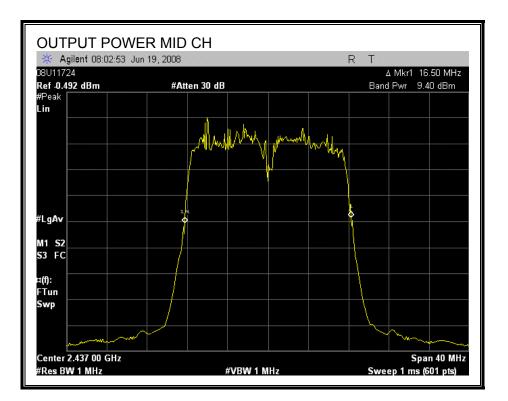
Channel	Frequency	Spectrum	Attenuator and	Output	Limit	Margin
		Analyzer Reading	Cable Offset	Power		
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Low	2412	9.36	10.7	20.06	30	-9.94
Middle	2437	9.40	10.7	20.10	30	-9.90
High	2462	9.32	10.7	20.02	30	-9.98

Page 45 of 97

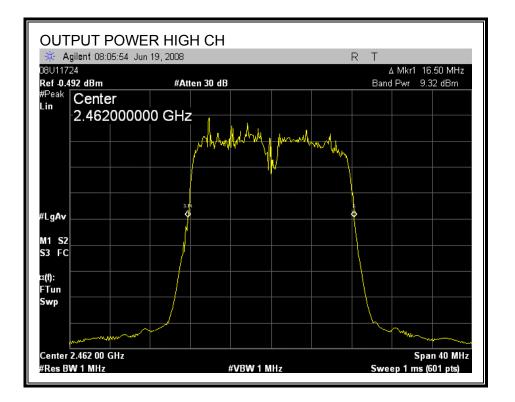
#### **OUTPUT POWER**



Page 46 of 97



Page 47 of 97



Page 48 of 97

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

Page 49 of 97

# 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

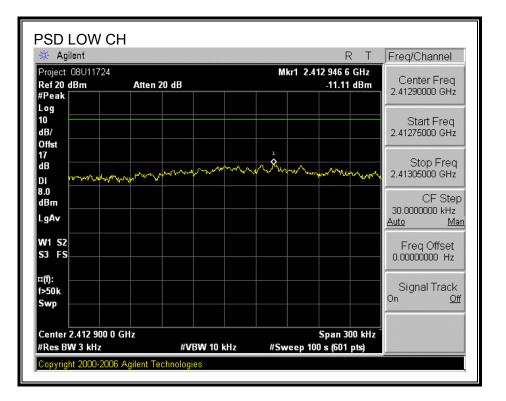
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

#### **RESULTS**

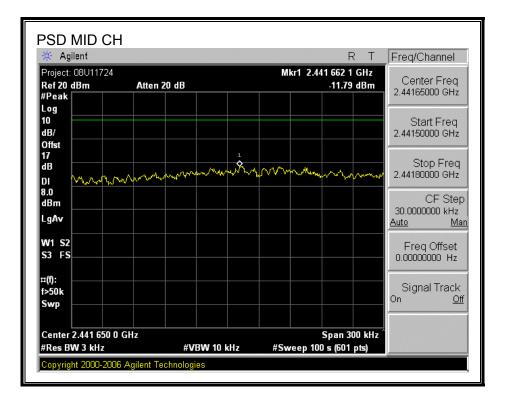
Channel	Frequency	PPSD	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2412	-11.11	8	-19.11
Middle	2437	-11.79	8	-19.79
High	2462	-12.06	8	-20.06

Page 50 of 97

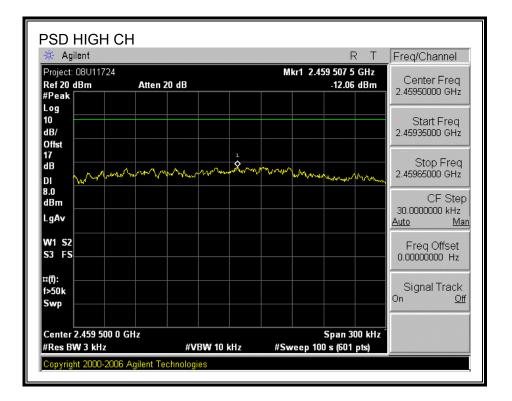
#### POWER SPECTRAL DENSITY



Page 51 of 97



Page 52 of 97



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Page 53 of 97

# 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

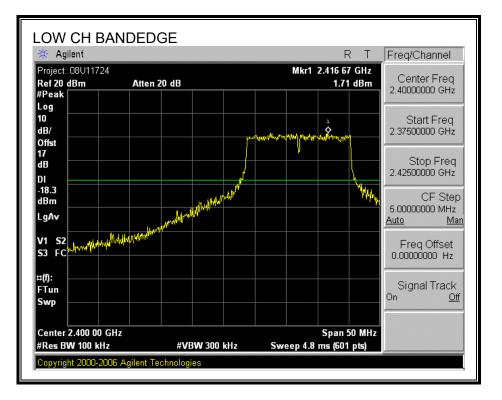
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

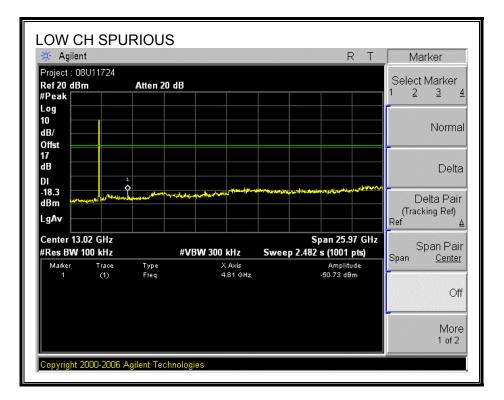
Page 54 of 97

#### **RESULTS**

#### SPURIOUS EMISSIONS, LOW CHANNEL

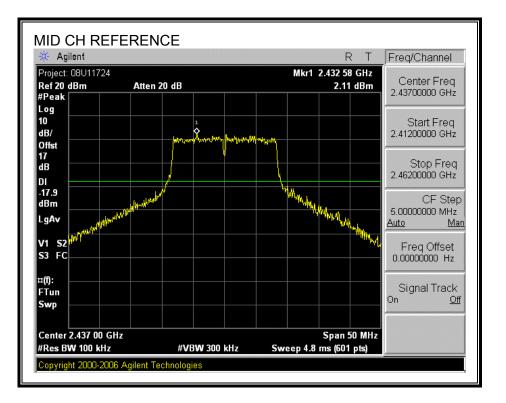


Page 55 of 97

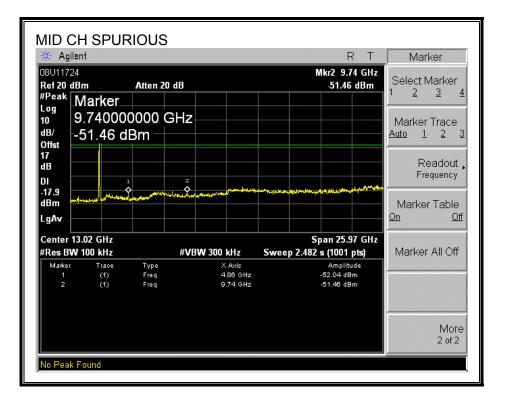


Page 56 of 97

#### SPURIOUS EMISSIONS, MID CHANNEL

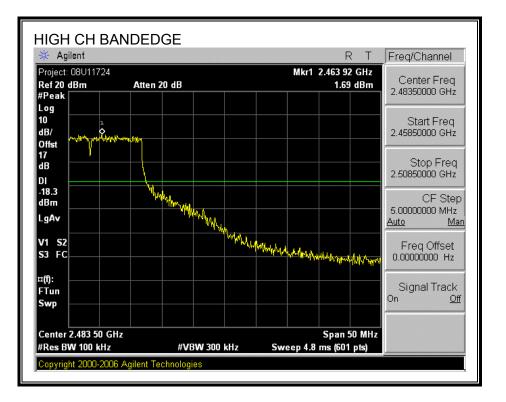


Page 57 of 97

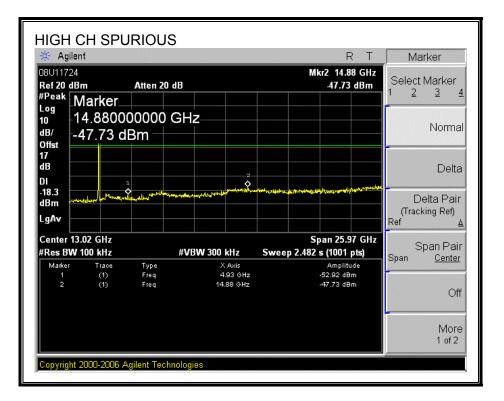


Page 58 of 97

#### SPURIOUS EMISSIONS, HIGH CHANNEL



Page 59 of 97



Page 60 of 97

# 8. RADIATED TEST RESULTS

# 8.1. LIMITS AND PROCEDURE

## <u>LIMITS</u>

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.

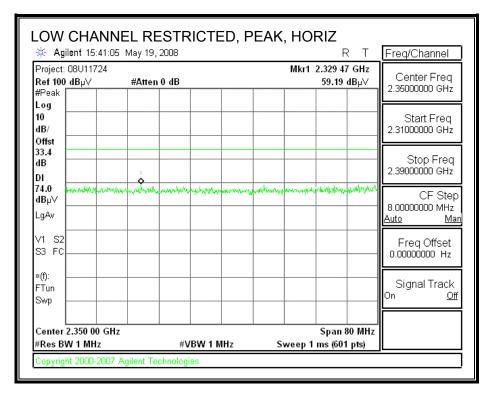
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

Page 61 of 97

# 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)**



Page 62 of 97

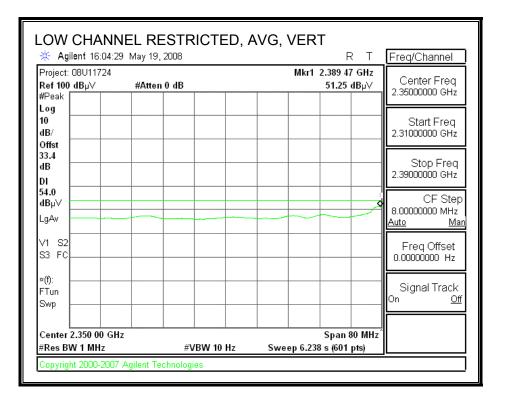
LOW CHANN	IEL RESTRIC	CTED, A	VG, HOR	IZ	
🔆 Agilent 15:42:16	6 May 19, 2008			RL	Freq/Channel
Project: 08∪11724 <b>Ref 100 dB</b> µ∨ #Peak	#Atten 0 dB		Mkr1	2.389 47 GHz 46.97 dBµ∨	Center Freq 2.35000000 GHz
Log 10 dB/ Offst					Start Freq 2.3100000 GHz
dB					Stop Freq 2.39000000 GHz
54.0 dBµ∨ LgAv					CF Step 8.00000000 MHz Auto Man
V1 S2 S3 FC					Freq Offset 0.00000000 Hz
×(f): FTun Swp					Signal Track On <u>Off</u>
Center 2.350 00 GH #Res BW 1 MHz		W 10 Hz	Sweep 6.238	Span 80 MHz 3 s (601 pts)	
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Page 63 of 97

#### **RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

3 FC				0.00000000 Hz Signal Track
4.0 η,ημωνηγγ  Βμ∨ gAv /1 S2	ener miner energy	 Maria making para ara		CF Step 8.00000000 MHz <u>Auto Ma</u> Freq Offset
3.4 IB 01 4.0			1	Stop Freq 2.39000000 GHz
.og 0 IB/ Dffst				Start Freq 2.31000000 GHz
Project: 08U11724 <b>Xef 100 dB</b> µ∨ Peak	#Atten 0 dB	Mkr1 2.388 4 62.15	iu Griz idBµ∨	Center Freq 2.35000000 GHz

Page 64 of 97



Page 65 of 97

#### **RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

IGH CHANI	NEL RESTRIC 8 May 19, 2008	TED, PE	AK, HORIZ	RТ	Freq/Channel
Project: 08U11724 <b>Ref 100 dB</b> µ∨ #Peak	#Atten 0 dB		Mkr1 2.484 517 59.1	5GHz 9dBµ∨	Center Freq 2.49175000 GHz
_og  0  B/ Dffst					Start Freq 2.48350000 GHz
33.6 dB DI					Stop Freq 2.50000000 GHz
7 <b>4.0 ∧</b>	energhall descent of the sector of the secto	water water water	www.commenty.com/www.dks	in a second s	CF Step 1.65000000 MHz <u>Auto Mar</u>
/1 S2 33 FC					Freq Offset 0.00000000 Hz
(f): Tun Swp					Signal Track On <u>Off</u>
Center 2.491 750 0 Res BW 1 MHz	GHz #VBW	1 MHz	Span 1 Sweep 1 ms (6	6.5 MHz 01 pts)	
Copyright 2000-2007	Agilent Technologies		• •	•	

Page 66 of 97

HIGH CHANN	IEL RESTRIC	TED, A	AVG, HOR	RIZ	
🔆 Agilent 15:51:51	May 19, 2008			RT	Freq/Channel
Project: 08U11724 <b>Ref 100 dB</b> µ∨ #Peak	#Atten 0 dB		Mkr1 2.48	k4 517 5 GHz 46.55 dBµ∀	Center Freq 2.49175000 GHz
Log 10 dB/ Offst					Start Freq 2.48350000 GHz
33.6 dB DI					Stop Freq 2.5000000 GHz
54.0 dBµ∀ LgAv ◆					CF Step 1.6500000 MHz <u>Auto Man</u>
V1 S2 S3 FC					Freq Offset 0.00000000 Hz
»(f): FTun Swp					Signal Track On <u>Off</u>
Center 2.491 750 0 6 #Res BW 1 MHz	GHz #VBW	10 Hz	S Sweep 1.287	5pan 16.5 MHz ´ ´s (601 pts)	
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Page 67 of 97

#### **RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**

Project:     08U11724     Mkr1 2.497 057 5 GHz       Ref 100 dBµ√     #Atten 0 dB     59.90 dBµ√       #Peak	IGH CHANN		CTED, P	EAK, VE	RT	Freq/Channel
10 dB/ Offst 33.6 dB DI 74.0 dBμ/ LgAv V1 S2 S3 FC *(0:	roject: 08∪11724 tef 100 dBµ∨ Peak			Mkr1 2.4		Center Freq 2.49175000 GHz
dB         1         1         1           DI         74.0         1         1         1           dBµV         1	0 B/					Start Freq 2.48350000 GHz
dBµ∨	B				1 ¢	Stop Freq 2.5000000 GHz
x(f): FTun	Bµ∨	the southed with the state of		venenghyddalmhaaj	the Maleur and Maleur and	CF Step 1.6500000 MHz <u>Auto Man</u>
FTun FTun						Freq Offset 0.00000000 Hz
	Tun					Signal Track On <u>Off</u>
Center 2.491 750 0 GHz Span 16.5 Mi #Res BW 1 MHz #VBW 1 MHz Sweep 1 ms (601 pts)			V 1 MHz		Span 16.5 MHz ms (601 pts)	

Page 68 of 97

HIGH CHANN		TED,	AVG, VEF		
🔆 Agilent 15:56:55	May 19, 2008			RT	Freq/Channel
Project:08U11724 <b>Ref 100 dB</b> µ∨ #Peak	#Atten 0 dB		Mkr1 2.4	l85 397 5 GHz 47.64 dBµ∨	Center Freq 2.49175000 GHz
Log 10 dB/ Offst					Start Freq 2.48350000 GHz
33.6 dB DI					Stop Freq 2.5000000 GHz
54.0 dBµ∀ LgAvΟ					CF Step 1.6500000 MHz <u>Auto Man</u>
V1 S2 S3 FC					Freq Offset 0.00000000 Hz
≈(f): FTun Swp					Signal Track On <u>Off</u>
Center 2.491 750 0 G #Res BW 1 MHz	Hz #VBW	10 Hz		Span 16.5 MHz Î 37 s (601 pts)	
Copyright 2000-2007 A	Agilent Technologies				

Page 69 of 97

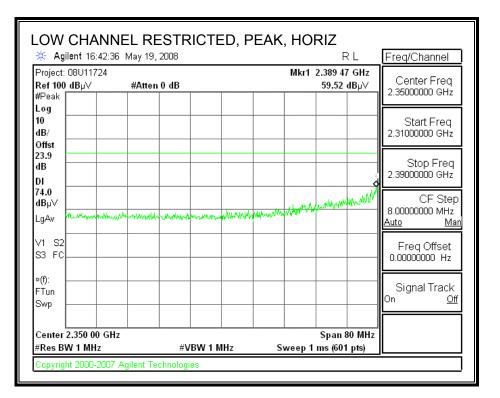
#### HARMONICS AND SPURIOUS EMISSIONS

'ompa roject		Digi Internat 08U11724	ional												
nte: Set Fr	naineer	5/19/2008 Tom Che:	n												
	0	EUT only													
ode:		802.11 b Мо	de, TX on L / N	I/H, 5.5	Mbps										
est E	quipmen	t:													
Horn 1-18GHz         Pre-amplifer 1-26GHz           T60; S/N: 2238 @3m         T34 HP 8449B				Pre-am	Pre-amplifer 26-40GHz Horn > 18GHz							Limit			
				· ·							5; ARA 18-2	6GHz: S/N	:1007		FCC 15.209 🗸
		•	· 134 III	04450		•					0,7401101			•	
Hi Fre	quency Ca	bles	1												
	2 foot	cable	3	foot	able		12	foot c	able		HPF	Re	ject Filte		<u>k Measurements</u> W=VBW=1MHz
		1					A-5m C	hamb	er			- R	001	_	nge Measurements
			•			•			• •			<u> </u>			=1MHz; VBW=10Hz
f	Dist	Read PL	Read Avg.	AF	CL	Amp	D Corr	Fltr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB		dBuV/m	1	dBuV/m	dB	dB	(V/H)
	2412 MHz														
324 236	3.0	49.5 37.0	29.5 25.5	33.7 36.7	3.0 8.4	-34.8 -34.1	0.0 0.0	0.0 0.0	51.4 47.9	31.4 36.4	74 74	54 54	-22.6 -26.1	-22.6 -17.6	v
324	3.0	42.4	27.0	33.7	6.9	-34.8	0.0	0.0	48.2	30.4	74 74	54 54	-25.8	-21.3	Ĥ
236	3.0	36.5	25.0	36.7	8.4	-34.1	0.0	0.0	47.4	35.9	74	54	- <b>26.6</b>	- <b>18.1</b>	Н
d Ch.	2437 MHz	Σ													
374	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
811 874	3.0 3.0	38.1 42.4	25.5 26.5	36.7 33.7	8.4 6.9	-34.1 -34.8	0.0 0.0	0.0 0.0	49.1 48.2	36.5 32.3	74 74	54 54	-24.9 -25.8	-17.5 -21.7	V H
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
ብት ርጉ	. 2462 MI														
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
386	3.0 3.0	37.2	25.1	36.8	8.4 7.0	-34.1 -34.8	0.0	0.0	48.3 48.3	36.2	74	54	-25.7 -25.7	-17.8	V
924 386	3.0	42.4 36.1	27.2 25.5	33.8 36.8	7.0 8.4	-34.8	0.0 0.0	0.0 0.0	48.3	33.1 36.6	74 74	54 54	-25.7 -26.8	-20.9 -17.4	H H
o more	signal fo	und													
	À				Å			Å					Å		
	f	Measurem	ent Frequenc <sup>,</sup>			Amp	Preamp	Gain				Aug Tim	Average	Field Streng	th Timit
	Dist	Distance to		,		-	-		ct to 3 met	ers		-	-	d Strength I	
		Analyzer R	eading			Avg			Strength @					. Average I	
	Read					Peak	Calculate	ed Peal	c Field Stre	ength		Pk Mar	Margin va	. Peak Limi	t
	Read AF CL	Antenna F: Cable Los:				HPF	High Pas								

Page 70 of 97

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

#### **RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



Page 71 of 97

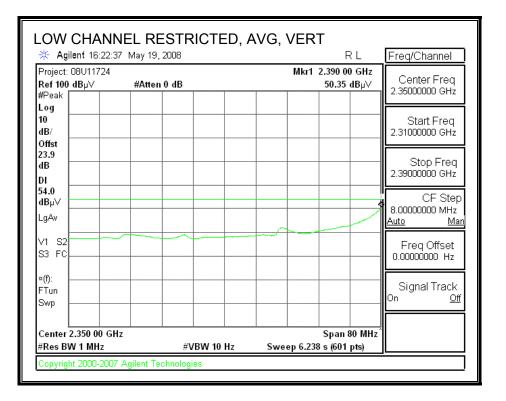
🔆 Agilent 16:43:26 May 1		AVG, HORIZ	Freq/Channel
Project:08U11724 <b>Ref 100 dB</b> µ∨ #Atte #Peak	en 0 dB	Mkr1 2.390 00 GHz 41.86 dBµ∨	Center Freq 2.35000000 GHz
Log 10 dB/ Offst			Start Freq 2.31000000 GHz
dB			Stop Freq 2.39000000 GHz
54.0 dBµ∨ LgAv			CF Step 8.00000000 MHz Auto Mar
V1 S2			Freq Offset 0.00000000 Hz
×(f): FTun Swp			Signal Track On <u>Off</u>
Center 2.350 00 GHz #Res BW 1 MHz	#VBW 10 Hz	Span 80 MHz Sweep 6.238 s (601 pts)	

Page 72 of 97

### **RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

Agilent 16:21:3	6 May 19, 2008			RΤ	Freq/Channel
roject: 08∪11724 <b>ef 100 dB</b> µ∨ ⊃eak	#Atten 0 dB			.390 00 GHz 69.09 dBµ∨	Center Freq 2.3500000 GHz
og ) B/					Start Freq 2.31000000 GHz
3.9				Marray marriely and	Stop Freq 2.3900000 GHz
<b>1.0</b> Βμ∨ gAv <sup>A</sup> ~~~~~h~~~~h~~~~	whate they are warden at they have	Handpeld mapping	ek statur verpeterver		CF Step 8.00000000 MHz <u>Auto Ma</u>
1 S2 3 FC					Freq Offset 0.00000000 Hz
(f): Tun wp					Signal Track On <u>Of</u>
enter 2.350 00 GH Res BW 1 MHz	-	/ 1 MHz	Sweep 1 n	Span 80 MHz ns (601 pts)	

Page 73 of 97



Page 74 of 97

### **RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

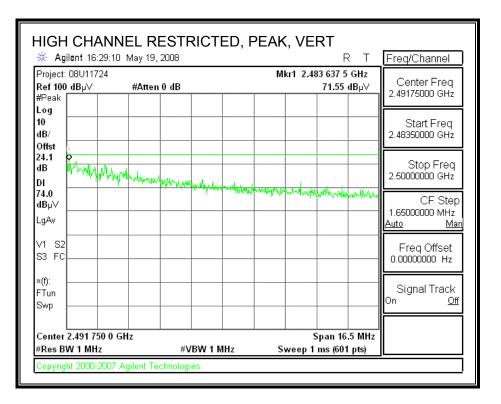
11GH CHAN Agilent 16:34:4		ICTED, P	EAK, HORIZ	RТ	Freq/Channel
Project: 08∪11724 <b>Ref 100 dB</b> µ∀ #Peak	#Atten 0 dB		Mkr1 2.483 995 58.8	0 GHz 7 dBµ∨	Center Freq 2.49175000 GHz
.og  0  B/ Dffst					Start Freq 2.48350000 GHz
24.1 IB					Stop Freq 2.50000000 GHz
′4.0 ΙΒμ∨ ΜΨμηγμήψηγ .gAv	hell pour and man to and	nan teen and her her her	mander	man	CF Step 1.65000000 MHz <u>Auto Mar</u>
/1 S2 33 FC					Freq Offset 0.00000000 Hz
(f): :Tun Swp					Signal Track On <u>Off</u>
Center 2.491 750 0 Res BW 1 MHz		BW 1 MHz	Span 1 Sweep 1 ms (6	6.5 MHz 01 pts)	

Page 75 of 97

HIGH CHANNE		ED, AVG,		
🔆 Agilent 16:35:21 N	ay 19, 2008		RT	Freq/Channel
Project: 08U11724 <b>Ref 100 dB</b> µ∨ #Peak	#Atten 0 dB	MF	αr1 2.483 500 0 GHz 39.85 dBμ∀	Center Freq 2.49175000 GHz
Log 10 dB/				Start Freq 2.48350000 GHz
Offst 24.1 dB DI				- Stop Freq 2.5000000 GHz
54.0 dBμV				CF Step 1.6500000 MHz <u>Auto Man</u>
V1 S2 S3 FC				Freq Offset 0.00000000 Hz
×(f): FTun Swp				Signal Track On <u>Off</u>
Center 2.491 750 0 GHz #Res BW 1 MHz	#VBW 10	) Hz Swee	Span 16.5 MH: p 1.287 s (601 pts)	z
Copyright 2000-2007 Agi	lent Technologies			

Page 76 of 97

### **RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



Page 77 of 97

Agilent 16:29:45 May	RESTRICTED, 19, 2008	R T	Freq/Channel
#Peak	ten 0 dB	Mkr1 2.483 500 0 GHz 48.87 dBµ∨	Center Freq 2.49175000 GHz
Log 10 dB/ Offst			Start Freq 2.48350000 GHz
24.1 dB DI			Stop Freq 2.50000000 GHz
54.0 dBµV LgAv			CF Step 1.65000000 MHz <u>Auto Mar</u>
V1 S2 S3 FC			Freq Offset 0.00000000 Hz
×(f): FTun Swp			Signal Track On <u>Off</u>
Center 2.491 750 0 GHz #Res BW 1 MHz	#VBW 10 Hz	Span 16.5 MHz Sweep 1.287 s (601 pts)	

Page 78 of 97

### HARMONICS AND SPURIOUS EMISSIONS

Digi Interna 08U11724 571/2008 er: Tom Che n: EUT only 802.11 g Mo hent: 1-18GHz 2238 @3m	en ode, TX on L. Pre-	/ M / H, 48M •amplifer	-										
5/19/2008 er: Tom Che n: EUT only 802.11 g Mo nent: 1-18GHz	ode, TX on L.		-										
er: Tom Che n: EUT only 802.11 gMo nent: 1-18GHz	ode, TX on L.		-	4									
802.11 g Mo <u>nent:</u> 1-18GHz	Pre-		-	4									
<u>nent:</u> 1-18GHz	Pre-		-										
1-18GHz		amplifer											
		amplifer		<u> </u>									
'238 @3m			1-260	GHz	Pre-am	nplifer	26-40GH	Iz	H	orn > 180	GHz		Limit
	T34	HP 8449B	5	-				T12	5; ARA 18-2	26GHz; S/N:	:1007	•	FCC 15.209 🗸
/ Cables					10			ה 📩				Bool	
ot cable		3 foot c	able		12	foot c	able		HPF	Re	ject Filte		<u>k Measurements</u> W=VBW=1MHz
				_	B-5m (	Chamb(	er 🗸				001	Avera	ge Measurements
												📩 RBW=	1MHz; VBW=10Hz
st Read Pk	Read Av	g. AF	CL	Amp	D Corr	Fltr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
	dBuV	dB/m		dB	dB	dB		· · ·	1	-	dB	dB	(V/H)
						-							
	33.2 25.5	33.7 36.7	3.0 8.6	-34.8 -34.1	0.0	0.0 0.0	46.5	35.1 36.6	74 74	54 54	-27.5 -26.2	-18.9 -17.4	v
0 39.9	26.5	33.7	7.1	-34.8	0.0	0.0	45.9	32.5	74	54	- <b>28.1</b>	-21.5	Н
0 36.5	25.0	36.7	6.8	-34.1	Q.O	0.0	47.6	36.1	74	54	-26.4	-17 <i>9</i>	H
	31.5	33.7	7.2	-34.8	0.0	0.0	49.8	37.6 36.8	74 74	54 54	-24.2	-16.4	v v
	25.5 26.1	36.7 33.7	8.0 7.2	-34.1	U.U 0.0	0.0	47.8 44.4	36.8 32.2	74 74	54 54	-20.2 -29.6	-17.2 -21.8	и Н
	25.5	36.7	6.8	-34.1	0.0	0.0	48.0	36.8	74	54	- <b>26.0</b>	-17.2	Н
MHz							1						
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
								···					<u>v</u> н
	20.5	36.8	8.7	-34.0	0.0	0.0	45.4	36.9	74	54 54	-26.0	-21.5	H
l found								1				****	
	ist Read Pk n) dBuV MHz 0 44.6 0 36.7 0 39.9 0 36.5 MHz 0 43.7 0 36.5 0 38.3 0 36.7 MHz 0 43.5 0 35.5 0 39.2 0 36.5	ist         Read Pk dBuV         Read Av; dBuV           0         44.6         33.2           0         36.7         25.5           0         36.7         25.5           0         36.5         25.0           MHz	ist Read Pk Read Avg. AF a) dBuV dBuV dB/m MHz 0 44.6 33.2 33.7 0 36.7 25.5 36.7 0 39.9 26.5 33.7 0 36.5 25.0 36.7 MHz 0 43.7 31.5 33.7 0 36.5 25.5 36.7 0 38.3 26.1 33.7 0 36.7 25.5 36.7 0 36.7 25.5 36.8 0 36.5 25.5	ist         Read Pk dBuV         Read Avg. dBuV         AF dBuV         CL dB/m           0         d46         33.2         33.7         3.0           0         36.7         25.5         36.7         8.6           0         36.7         25.5         36.7         8.6           0         36.5         25.0         36.7         8.6           0         36.5         25.0         36.7         8.6           0         36.5         25.0         36.7         8.6           0         36.5         25.5         36.7         8.6           0         36.5         25.5         36.7         8.6           0         36.5         25.5         36.7         8.6           0         36.7         25.5         36.7         8.6           0         36.7         25.5         36.7         8.6           MHz	ist         Read Avg dBuV         AF dBuV         CL dB/m         Amp dB           0         dBuV         dB/m         dB         dB           0         44.6         33.2         33.7         3.0         -34.8           0         36.7         25.5         36.7         8.6         -34.1           0         36.7         25.5         36.7         8.6         -34.1           0         36.5         25.0         36.7         8.6         -34.1           0         36.5         25.0         36.7         7.2         -34.8           0         36.5         25.5         36.7         8.6         -34.1           0         43.7         31.5         33.7         7.2         -34.8           0         36.7         25.5         36.7         8.6         -34.1           0         36.7         25.5         36.7         8.6         -34.1           0         36.7         25.5         36.7         8.6         -34.1           0         36.7         25.5         36.8         8.7         -34.8           0         35.5         25.5         36.8         8.7         -34.1	Interview         Interview <t< td=""><td>International and the second state of the s</td><td>Ist         Read Pk         Read Avg.         AF         CL         Amp         D Corr         Fltr         Peak           abuV         dBuV         dBv         dB/m         dB         dB</td><td>Intervention         Intervention           Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention         Intervention           Interventintervention         Intervention</td><td>Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction</td><td>Init         Init         Init         Red           ist         Read Pk         Read Avg.         AF         CL         Amp         D Corr         Fltr         Peak         Avg         Pk Lim         Avg Lim         R_           ist         Read Pk         Read Avg.         AF         CL         Amp         D Corr         Fltr         Peak         Avg         Pk Lim         Avg Lim         dBuV/m         dBuV/m</td><td><math display="block">\begin{array}{ c c c c c c c c c c c c c c c c c c c</math></td><td>NOT Cable         O 100 Cable         D 100 Cable         <thd 100="" cable<="" th=""> <thd 100="" cable<="" th="">         &lt;</thd></thd></td></t<>	International and the second state of the s	Ist         Read Pk         Read Avg.         AF         CL         Amp         D Corr         Fltr         Peak           abuV         dBuV         dBv         dB/m         dB         dB	Intervention         Intervention           Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention           Intervention         Intervention         Intervention         Intervention         Intervention           Interventintervention         Intervention	Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction           Introduction         Introduction         Introduction         Introduction	Init         Init         Init         Red           ist         Read Pk         Read Avg.         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Page 79 of 97

## 8.3. RECEIVER ABOVE 1 GHz

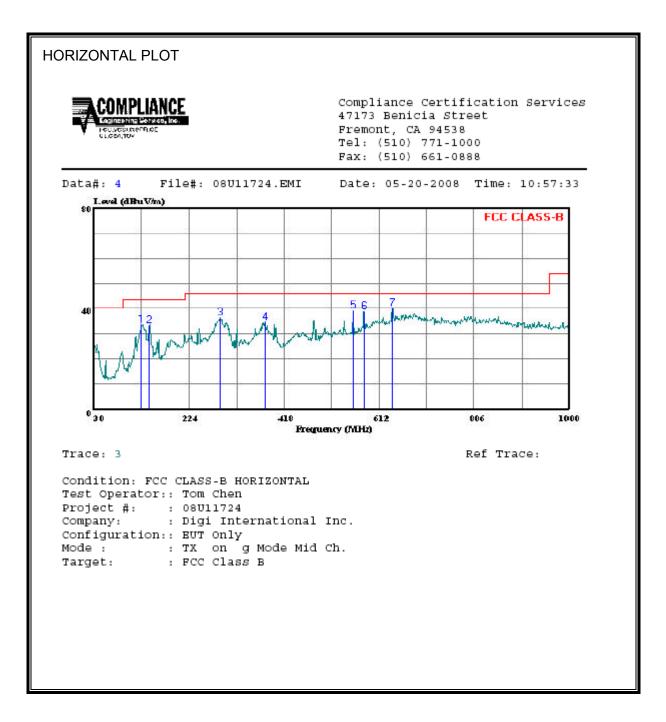
## 8.3.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 2.4 GHz BAND

	gineer: ration:	08U11724 5/19/2008 Tom Che: EUT only		Ŧ											
	uipmen		de, RX Mid Cl	-											
н	orn 1-	18GHz	Pre-a	mplifer	1-26	GHz	Pre-am	plifer	26-40GH	z	н	orn > 180	GHz		Limit
T60; S	5/N: 2238	3 @3m	▼ T34 H	P 8449B		•				•				-	RX RSS 210 🗸
	uency Cat 2 foot			3 foot d	able		12	foot c	able		HPF	Re	ject Filte		<u>k Measurements</u> W=VBW=1MHz
			•			•	B-5m C	hamb	er 💌			•		Avera	age Measurements =1MHz ; VBW=10Hz
f GHz	Dist (m)	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		Pk Mar dB	Avg Mar dB	Notes (V/H)
id Ch. 2 140	437 MHz 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
525	3.0	44.6	26.4	27.8	39	-37.5	0.0	0.0	38.7	20.6	74	54	-35.3	-33.4	v
625 105	3.0 3.0	40.4 51.5	25.5 31.5	32.2 26.7	6.1 3.4	-35.3 -38.1	0.0 0.0	0.0 0.0	43.4 43.4	28.5 23.4	74 74	54 54	-30.6 -30.6	-25.5 -30.6	V Н
537	3.0	44.6	25.5	20.7	3A 39	-36.1	0.0	0.0	43.A 38.8	23.4 19.7	74 74	54 54	-30.0	-30.0	H
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	Н
lo more :	signal for	սով													
o more .	31 <u>6</u> nai 10.														

Page 80 of 97

## 8.4. WORST-CASE BELOW 1 GHz

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

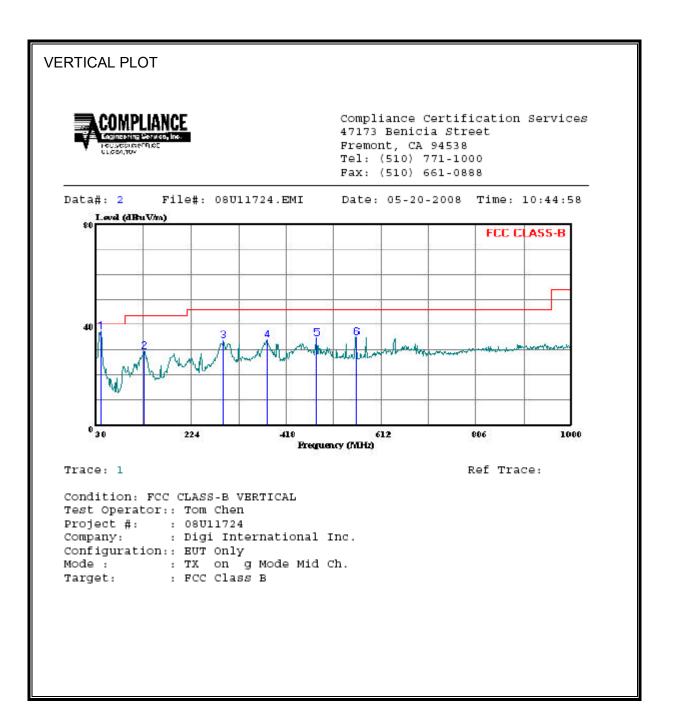


Page 81 of 97

HORIZON	TAL DATA						
	Freq	Read Level	Factor	Level	Limit Line		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

Page 82 of 97

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



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Page 83 of 97

VERTICAL D	ATA						
	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

Page 84 of 97

# 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted I	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

Page 85 of 97

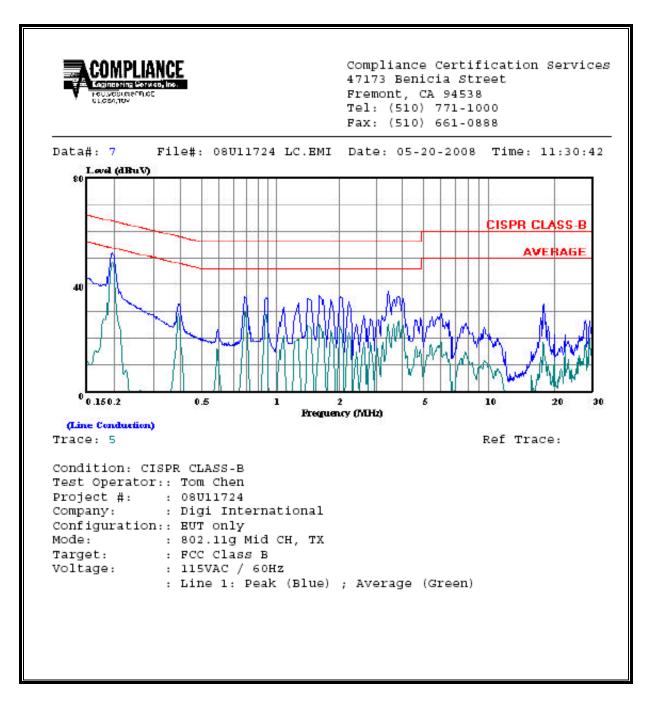
### **RESULTS**

#### **<u>6 WORST EMISSIONS</u>**

0.20 5	<b>(dBuV)</b> 51.86	QP (dBuV)	AV (dBuV)	(dB)	QP	4			
					IV I	AV	QP (dB)	AV (dB)	L1 / L2
0.78 3			48.57	0.00	63.82	53.82	-11.96	-5.25	L1
	35.55		30.24	0.00	56.00	46.00	-20.45	-15.76	L1
3.53 3	37.65		25.34	0.00	56.00	46.00	-18.35	-20.66	L1
0.20 5	50.80		47.37	0.00	63.82	53.82	-13.02	-6.45	L2
0.79 3	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

Page 86 of 97

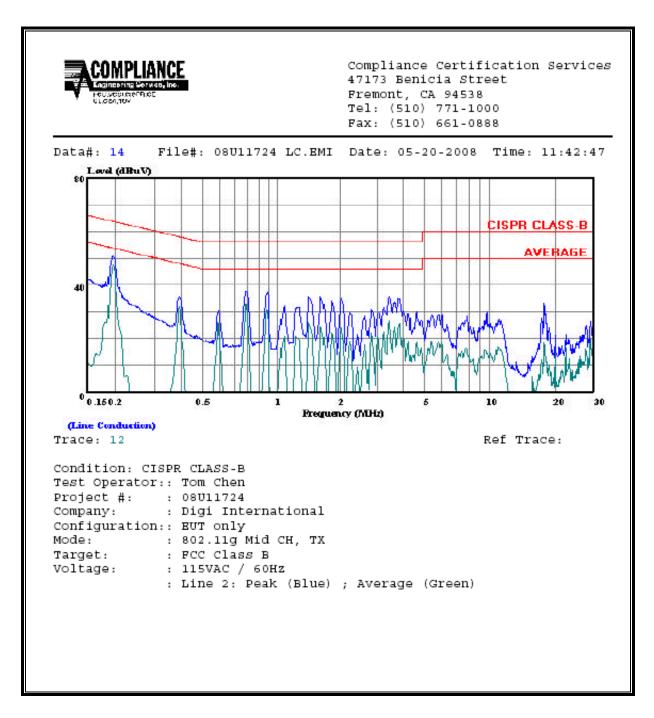
### LINE 1 RESULTS



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Page 87 of 97

### LINE 2 RESULTS



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Page 88 of 97

#### 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.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
(A) Lim	its for Occupational	I/Controlled Exposu	res	
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits	for General Populati	ion/Uncontrolled Exp	posure	
0.3–1.34	614	1.63	*(100)	30
1.34–30	824 <i>/</i> f	2.19/f	*(180/f <sup>2</sup> )	30

#### TABLE 1-LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

#### 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/cm²)	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 NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their 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 occu-pational/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 ex-posed, 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.

Page 89 of 97

### 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 Ex-
posed 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 <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/f	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> <sup>0.5</sup>	0.0042f <sup>0.5</sup>	f/150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 /f <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> f <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> f	616 000 /f <sup>1.2</sup>

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

Notes: 1. Frequency, f, is in MHz.

- 2. A power density of 10 W/m<sup>2</sup> is equivalent to  $1 \text{ mW/cm}^2$ .
- A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

Page 90 of 97

### CALCULATIONS

Given

and

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

where

E = Field Strength in Volts/meter

P = Power in Watts

S = E ^ 2 / 3770

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) / √ S

where

d = MPE distance in cm P = Power in dBm G = Antenna Gain in dBi S = Power Density Limit in mW/cm^2

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/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.

Page 91 of 97

### <u>LIMITS</u>

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm<sup>2</sup>

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m<sup>2</sup>

### **RESULTS**

(MPE distance equals 20 cm)

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

Page 92 of 97