



**FCC CFR47 PART 15 SUBPART C**

**CERTIFICATION TEST REPORT**

**FOR**

**2.4GHz RF REMOTE CONTROL**

**MODEL NUMBER: N2QBYB000005**

**FCC ID: ACJ-N2QBYB000005**

**REPORT NUMBER: 09J12388-1**

**ISSUE DATE: FEBRUARY 09, 2009**

*Prepared for*  
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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	02/09/09	Initial Issue	T. Chan

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** PANASONIC CORPORATION OF NORTH AMERICA  
ONE PANASONIC WAY  
4B-8 SECAUCUS, NJ 07094, U.S.A.

**EUT DESCRIPTION:** 2.4GHz RF REMOTE CONTROL

**MODEL:** N2QBYB000005

**SERIAL NUMBER:** CCS # 2257 (Antenna Port Sample)  
CCS # 2258 (Radiated Emission Sample)

**DATE TESTED:** FEBRUARY 06 – 09, 2008

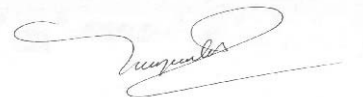
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. 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:



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THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

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VIEN TRAN & THANH NGUYEN  
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, and FCC CFR 47 Part 15.

## 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 2.4GHz RF Remote Control, which receives and transmits in the frequency range of 2425 – 2475 MHz.

The radio module is manufactured by SMK Corporation.

### 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2425 - 2475	802.15.4	-0.33	0.93

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an Inverted F antenna, with a maximum gain of -1.80 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Tera Term.

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

The worst-case configuration has been evaluated on EUT with antenna @ Y-position by comparing the fundamental output power.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	Pavilion DV1000	CNF63928VZ	DoC
AC/DC Adpater	HP	HPPP000H	F3-06072698200B	N/A
Test JIG	SMK	FD5001-02A	N/A	N/A
AC/DC Adpater	SinoAmerican	SA106A-0512-6	N/A	N/A

### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identica Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	1.5m	N/A
2	DC	2	DC Plug	Un-shielded	2m	N/A
3	USB	1	USB	Shielded	.5m	N/A
4	Data	1	Pin	Twistapair	.2m	N/A

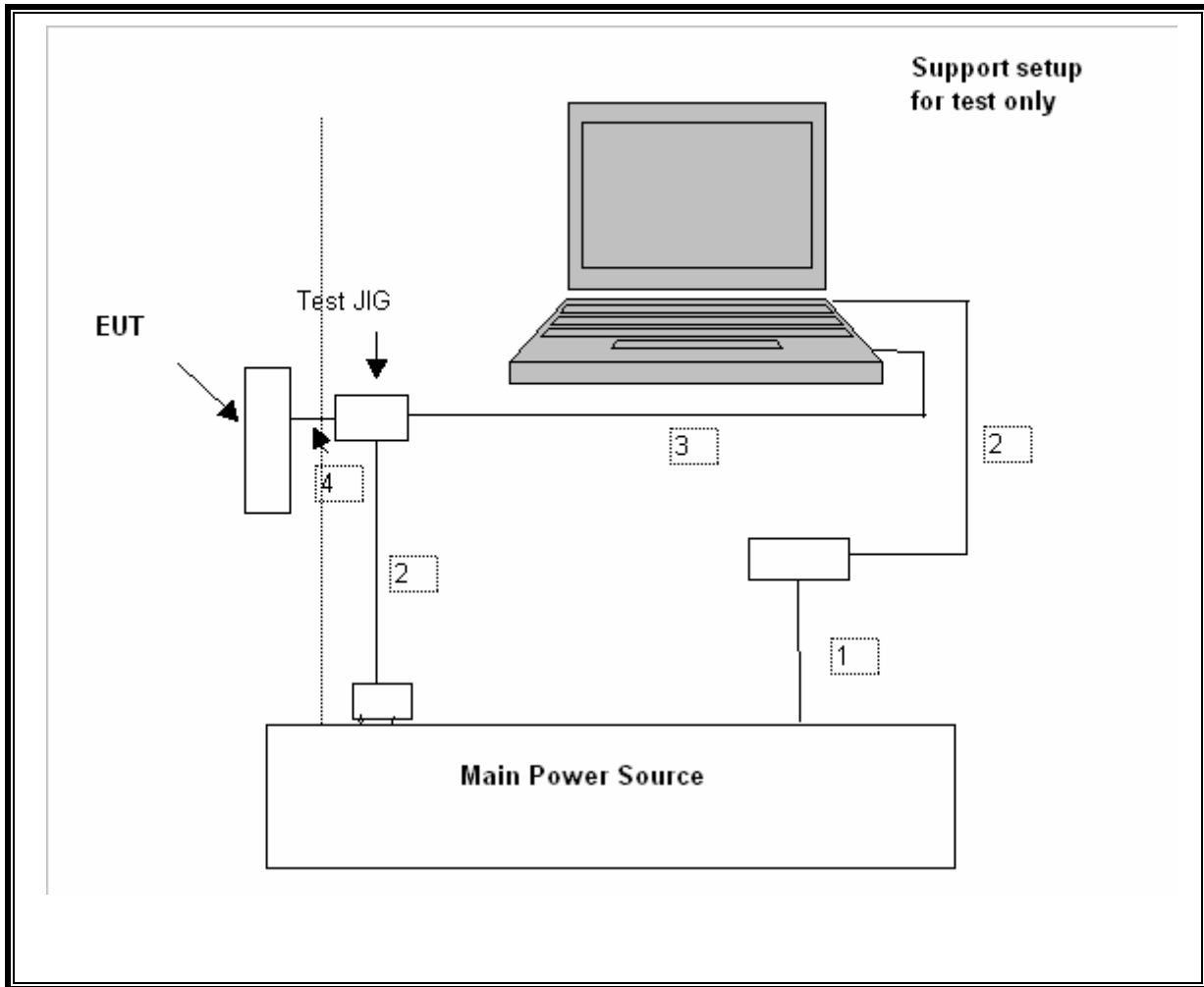
### TEST SETUP

\_For antenna port testing; the EUT is connected to a host laptop computer via test JIG and USB cable during the test to setup the channel, model and modulation.

\_For radiated emission testing; the EUT is connected to a host laptop computer via test JIG and USB cable and removed off site during the test after the channel, mode and modulation were setup.

Test software (Tera Term) exercised the radio card.

**SETUP DIAGRAM FOR 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 Due
Antenna, Horn, 18 GHz	EMCO	3115	C00872	04/22/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	12/01/09
Spectrum Analyzer	Agilent / HP	E4446A	C00986	05/30/09
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	09/19/09
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	09/19/09
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/10
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/07/09
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/09
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRC13192	N02683	CNR
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	3/31/2009

## 7. ANTENNA PORT TEST RESULTS

### 7.1.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.247 (a) (2)

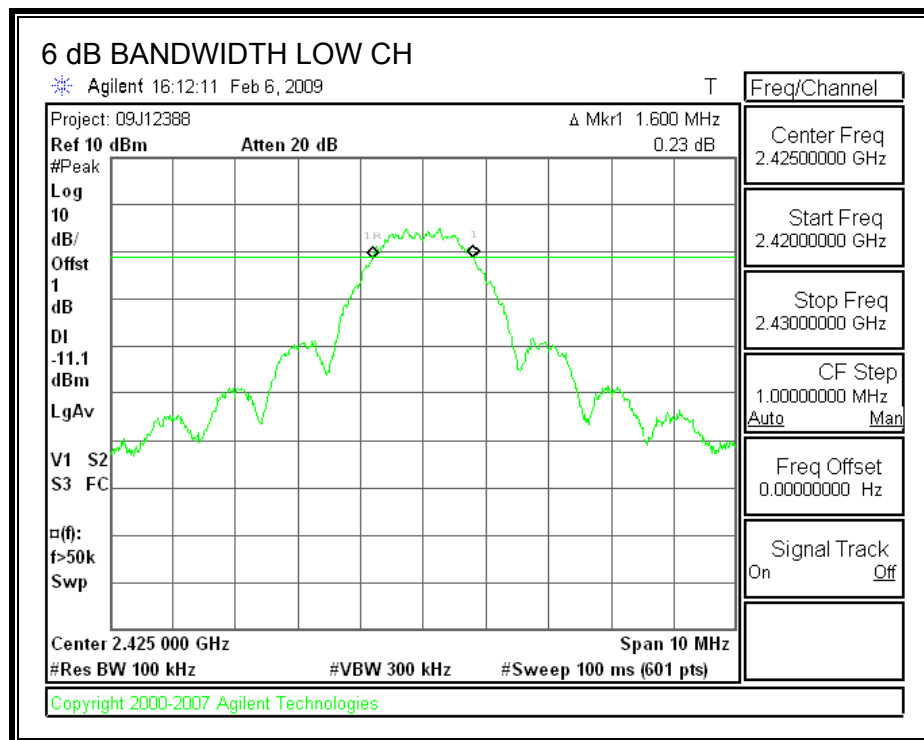
The minimum 6 dB bandwidth shall be at least 500 kHz.

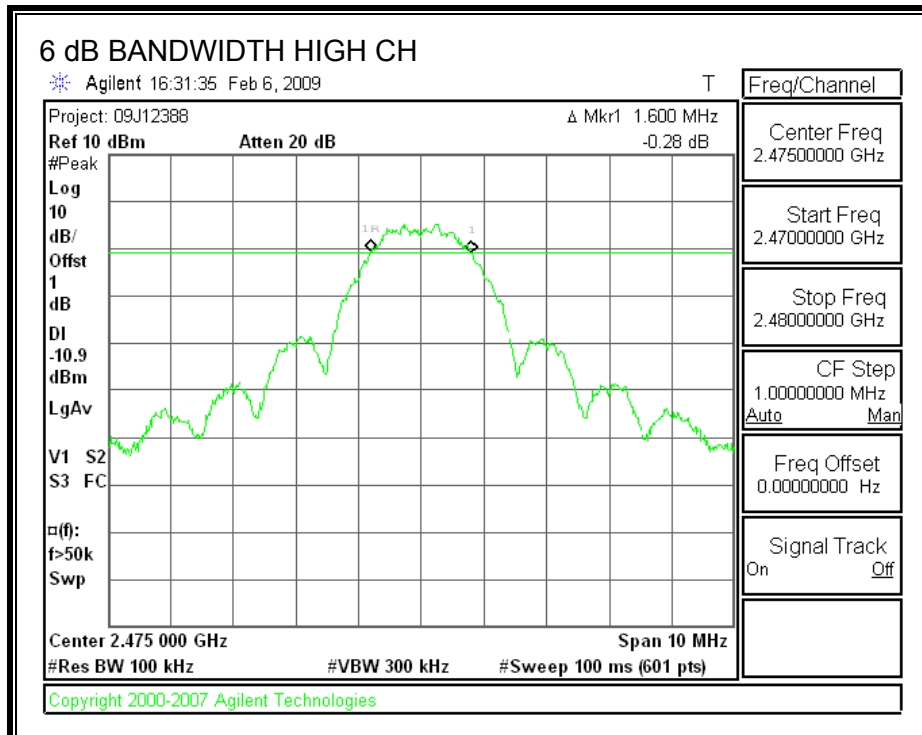
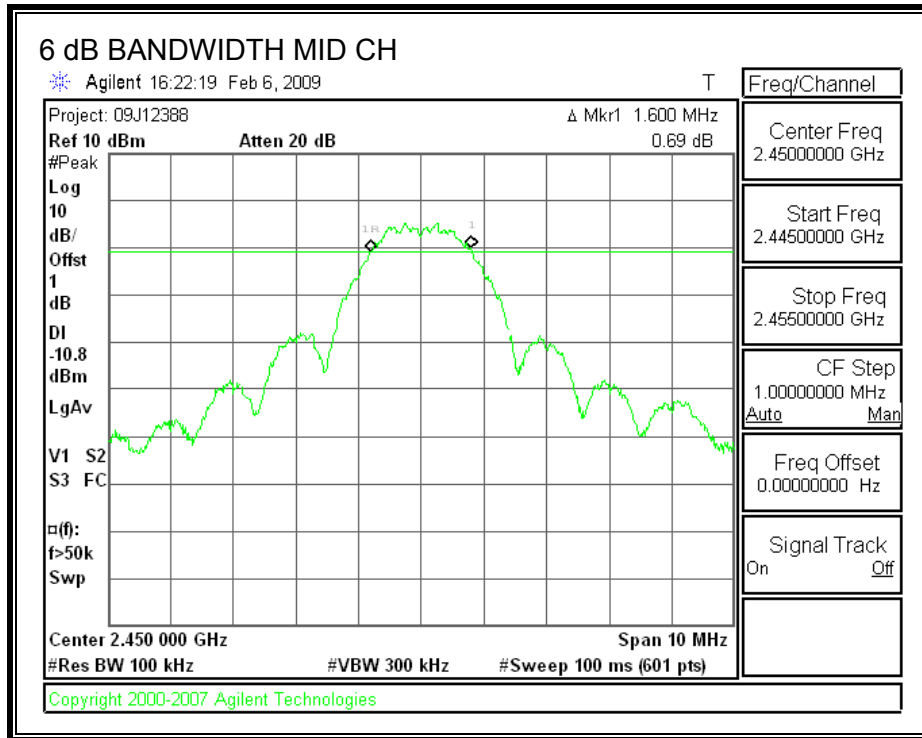
#### TEST PROCEDURE

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	2425	1.60	0.5
Middle	2450	1.60	0.5
High	2475	1.60	0.5





### 7.1.2. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

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

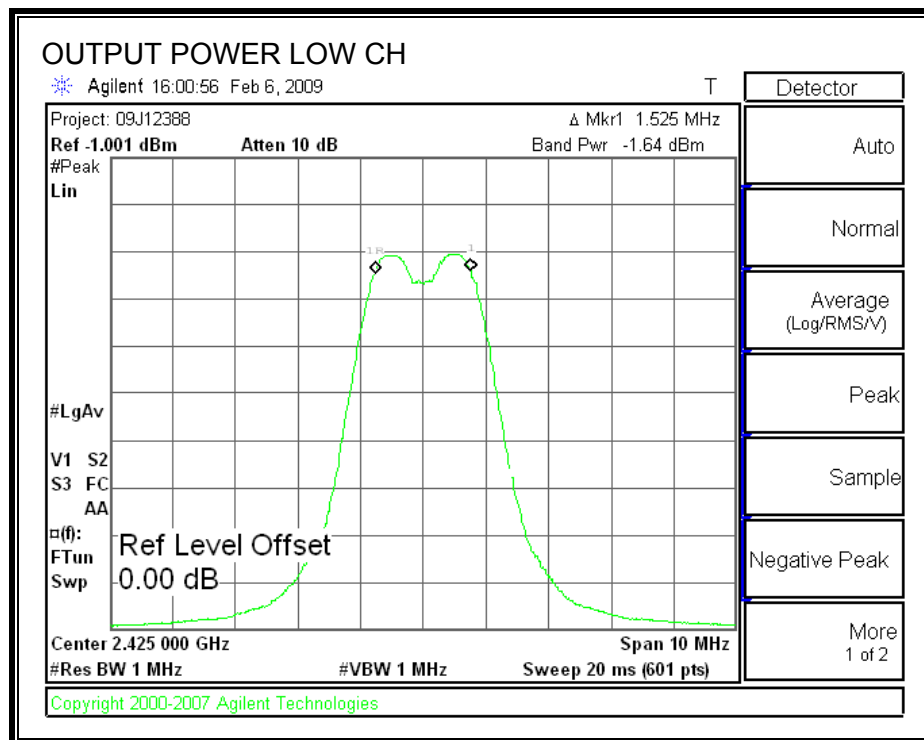
#### TEST PROCEDURE

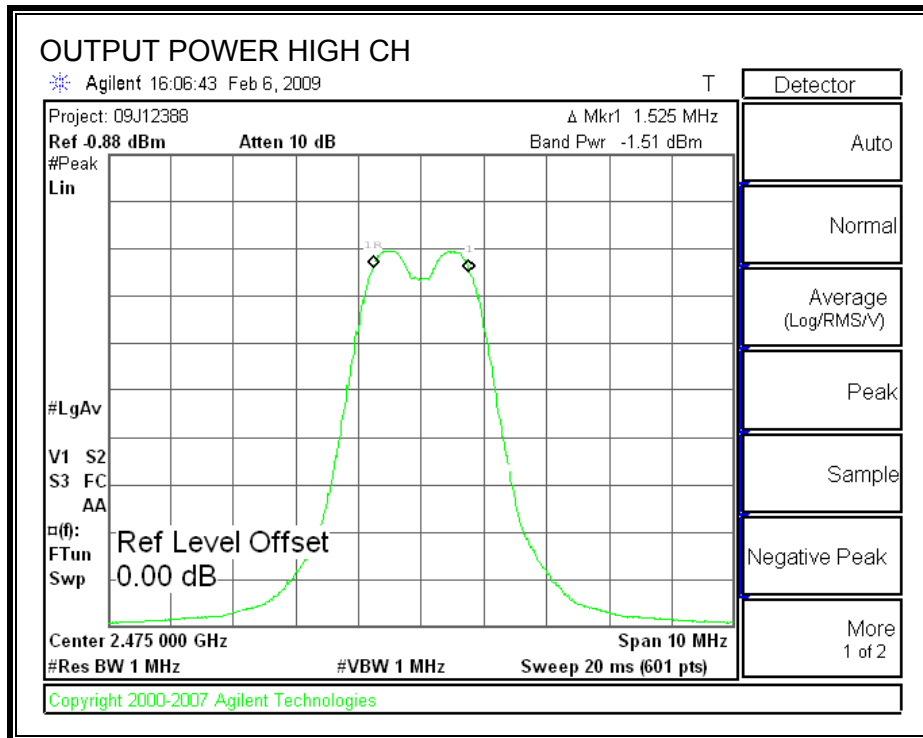
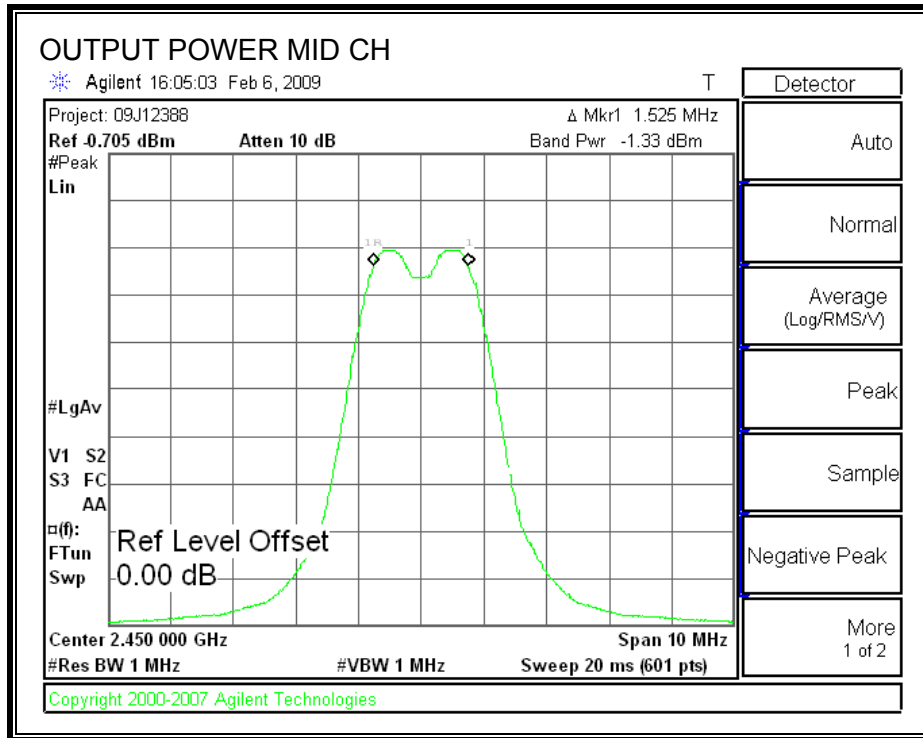
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

#### RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-1.64	1.00	-0.64	30	-30.64
Middle	2450	-1.33	1.00	-0.33	30	-30.33
High	2475	-1.51	1.00	-0.51	30	-30.51

#### OUTPUT POWER





### 7.1.3. 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 1 dB (including 0 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2425	-2.34
Middle	2450	-2.11
High	2475	-2.09

### 7.1.4. POWER SPECTRAL DENSITY

#### LIMITS

FCC §15.247 (e)

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.

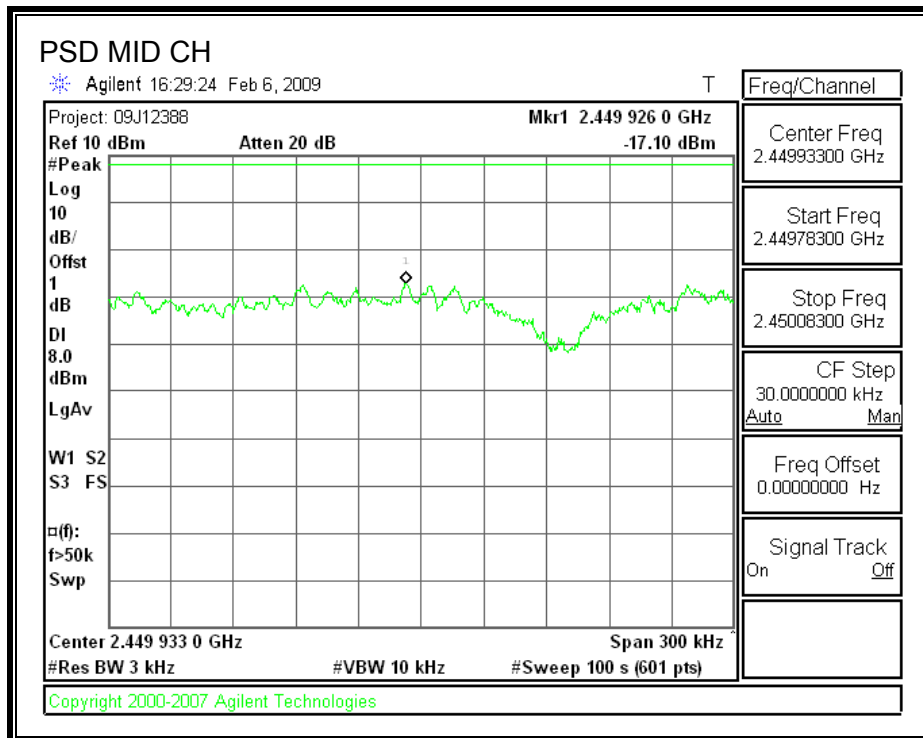
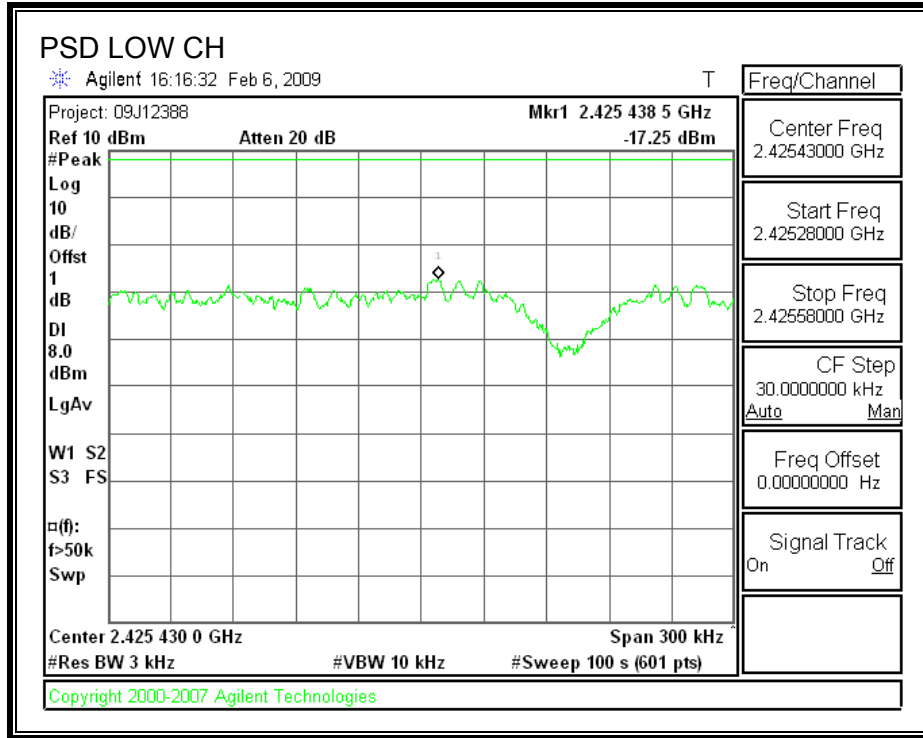
#### TEST PROCEDURE

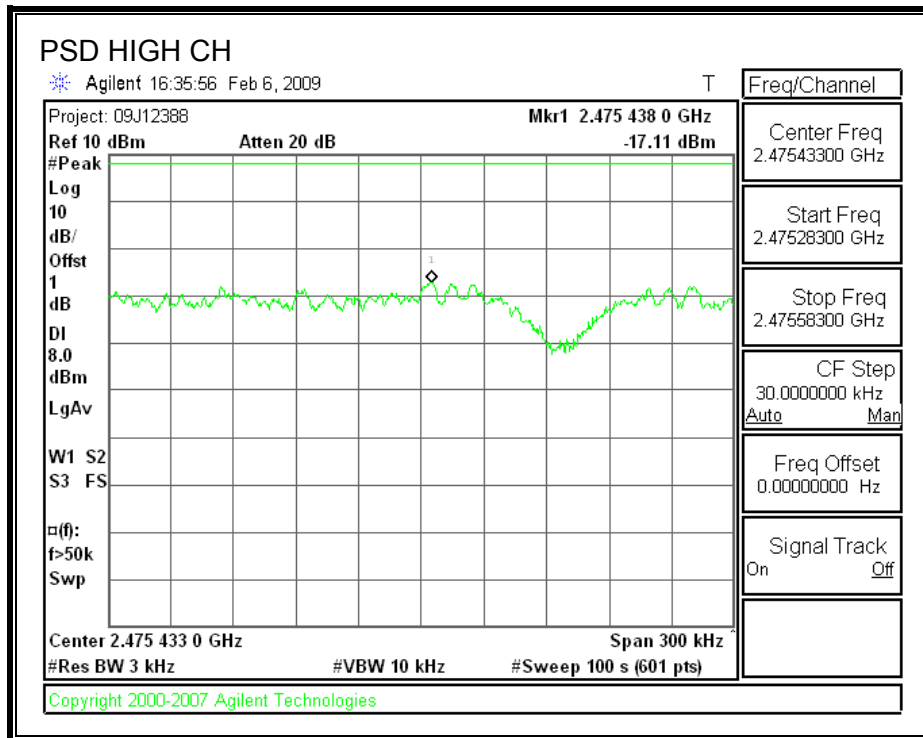
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

#### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-17.25	8	-25.25
Middle	2450	-17.10	8	-25.10
High	2475	-17.11	8	-25.11

**POWER SPECTRAL DENSITY**





## **7.1.5. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

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

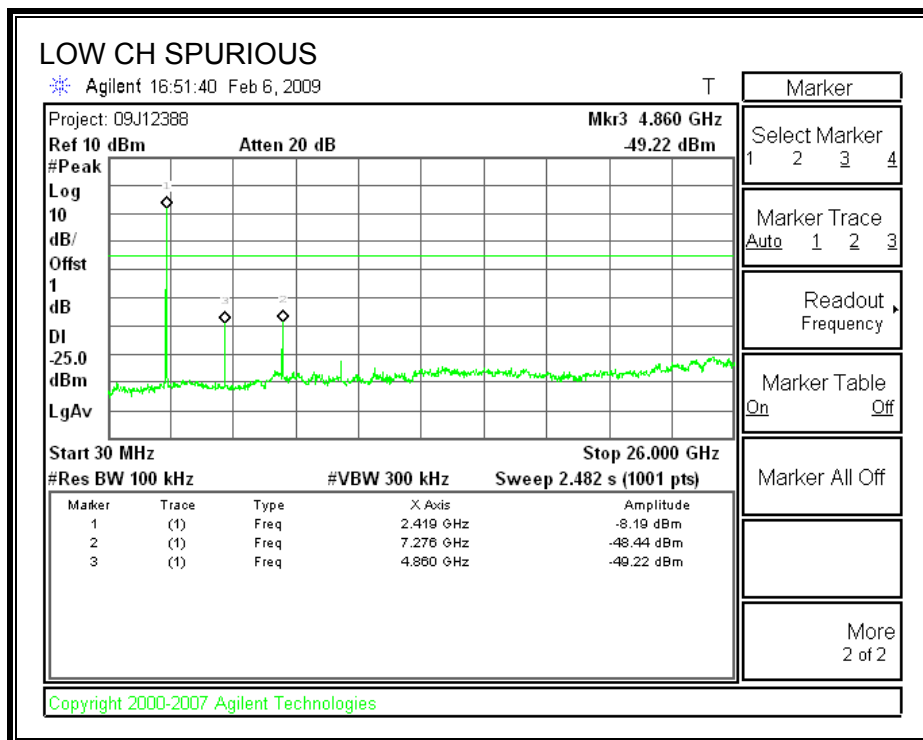
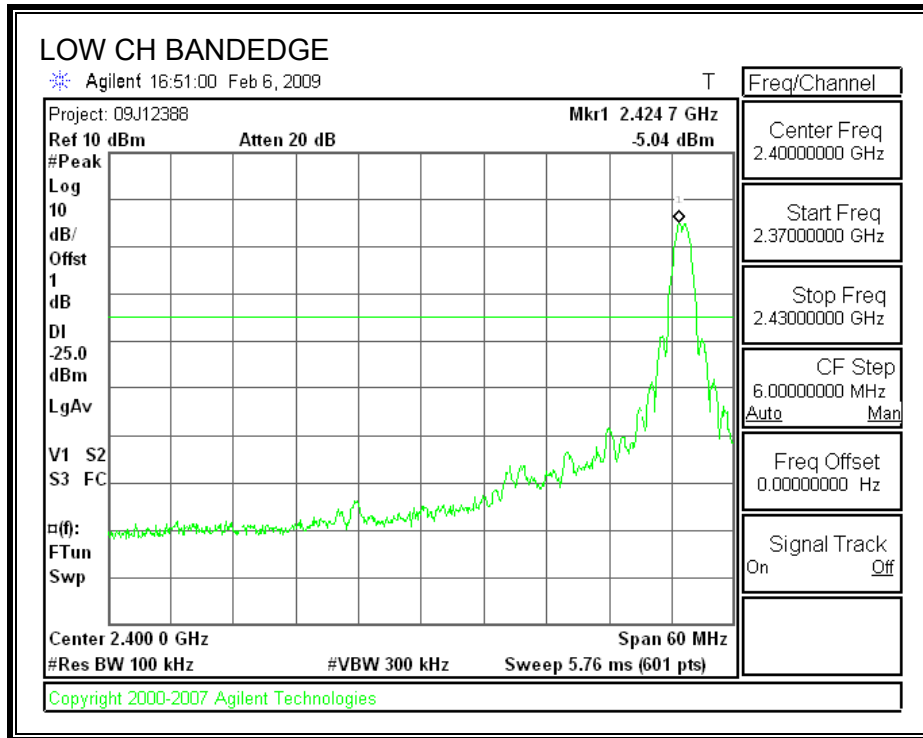
### **TEST PROCEDURE**

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.

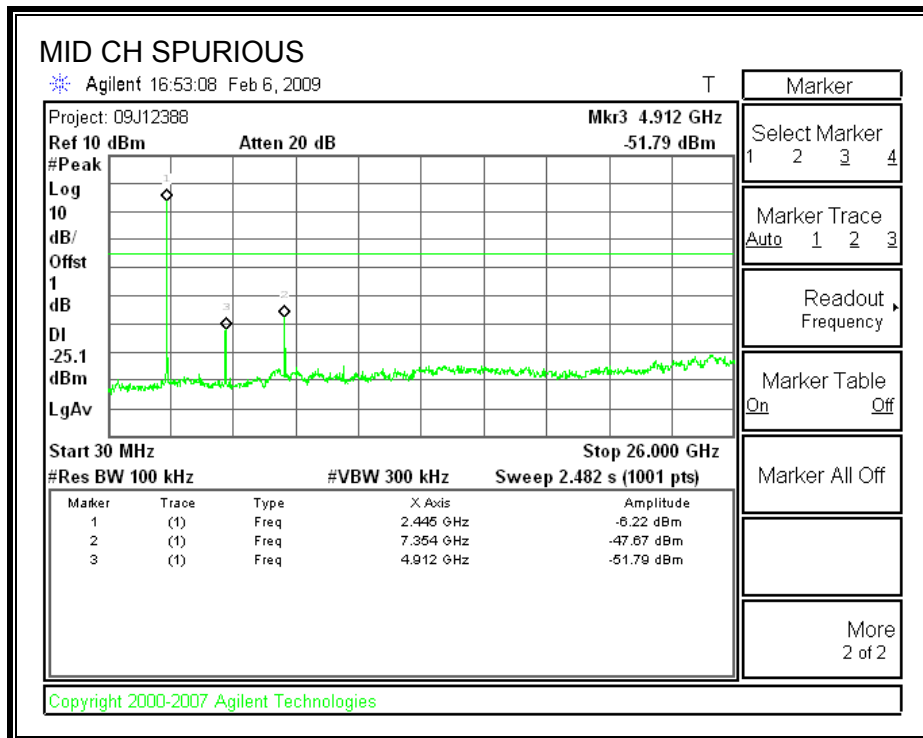
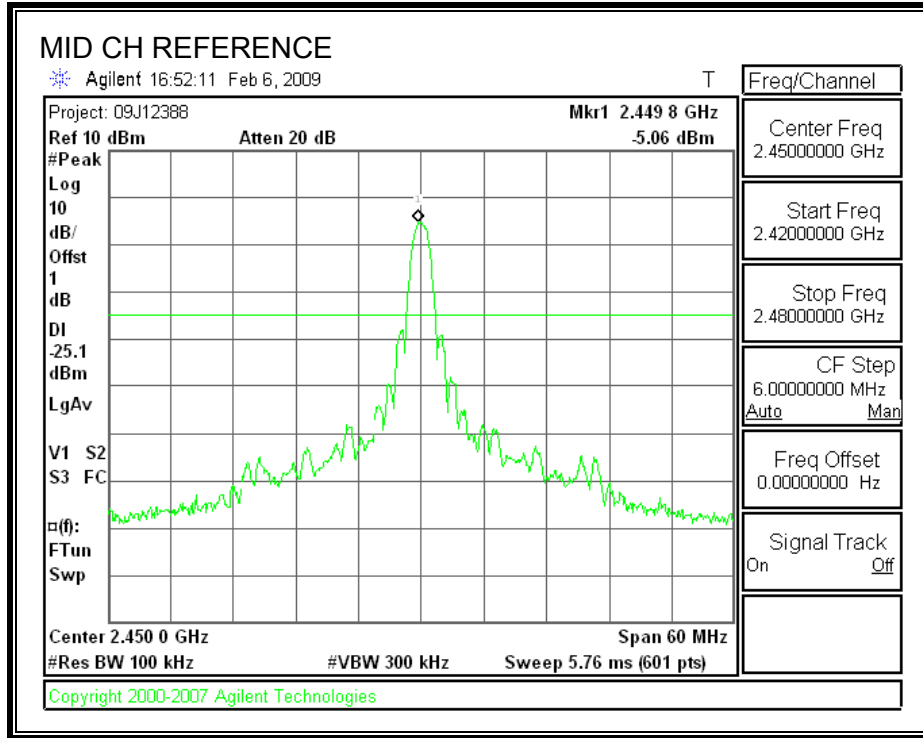
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

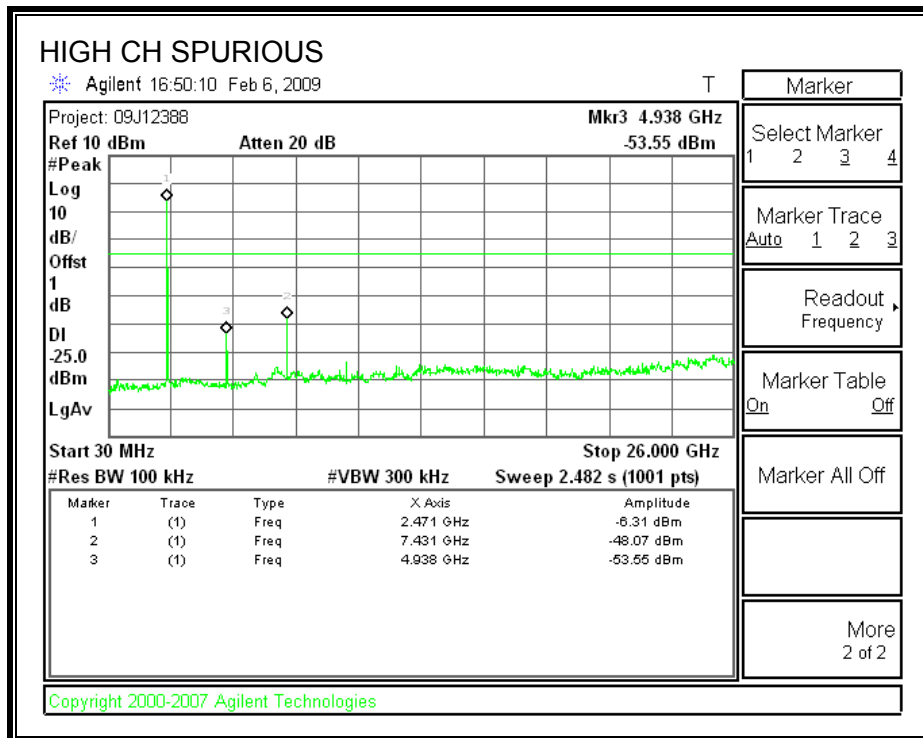
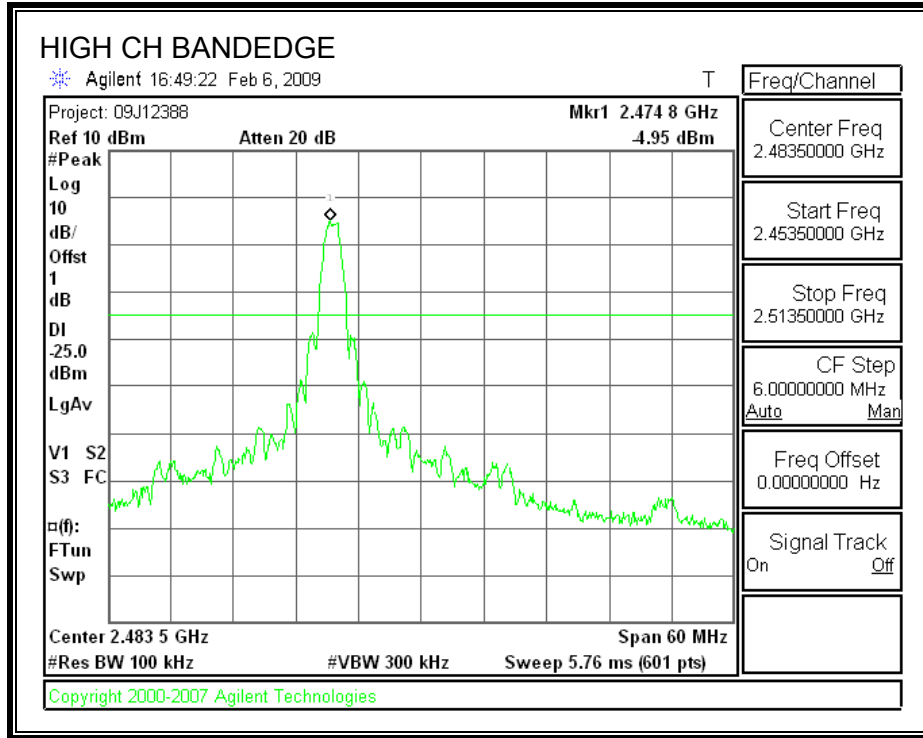
**SPURIOUS EMISSIONS, LOW CHANNEL**



**SPURIOUS EMISSIONS, MID CHANNEL**



**SPURIOUS EMISSIONS, HIGH CHANNEL**



## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

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, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

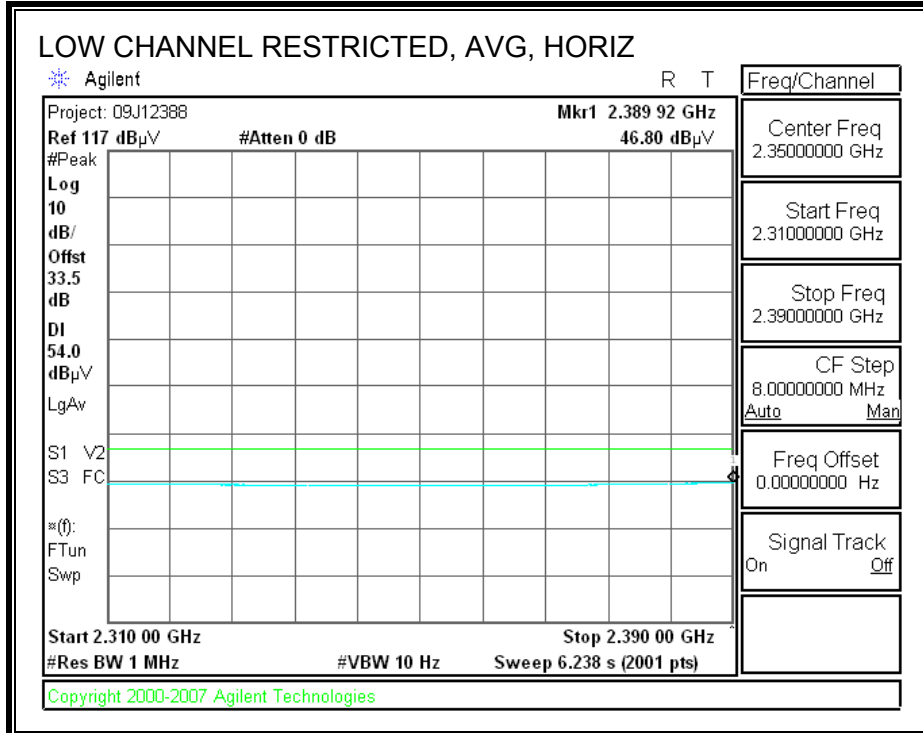
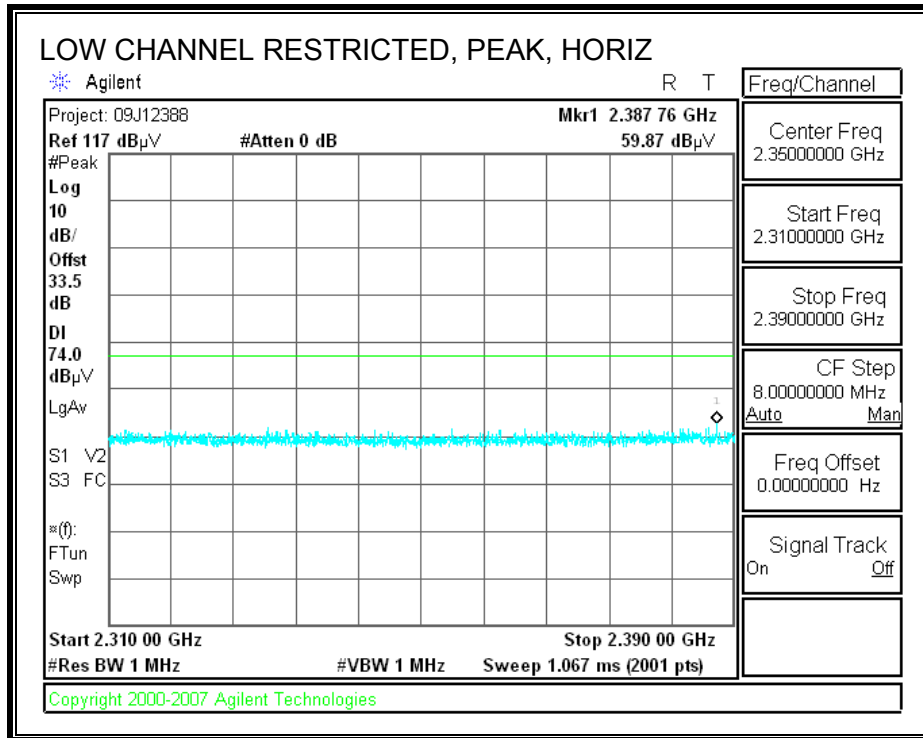
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

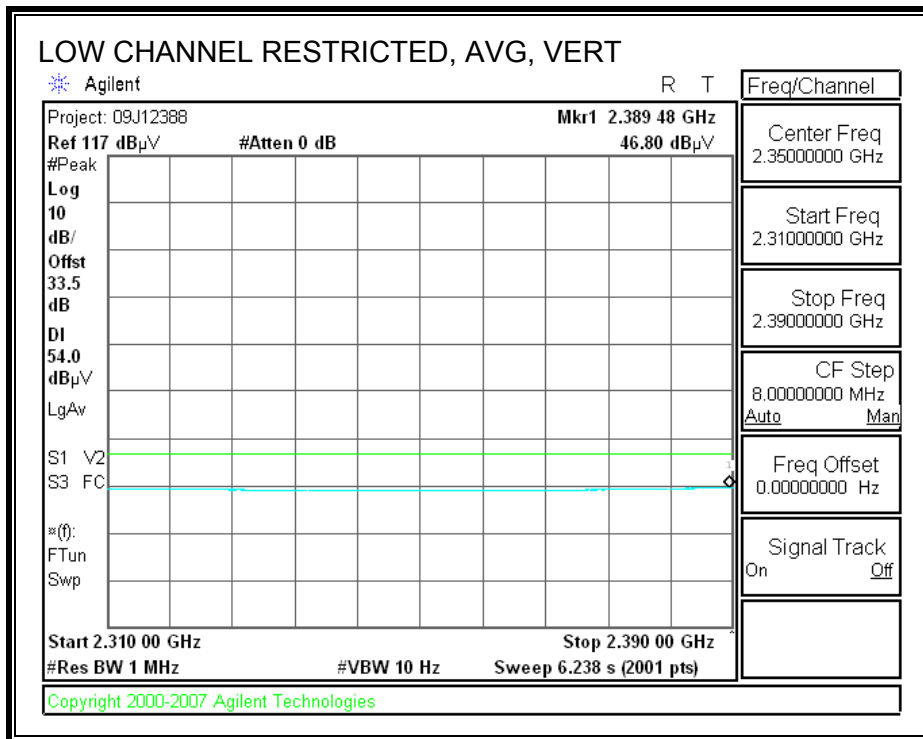
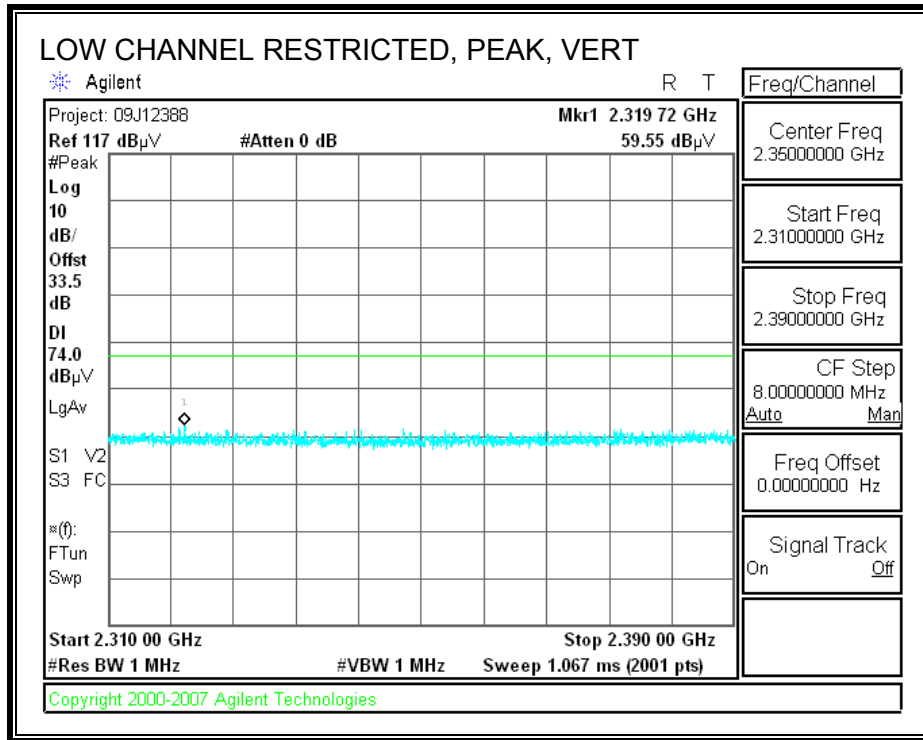
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

## 8.2. TRANSMITTER ABOVE 1 GHz

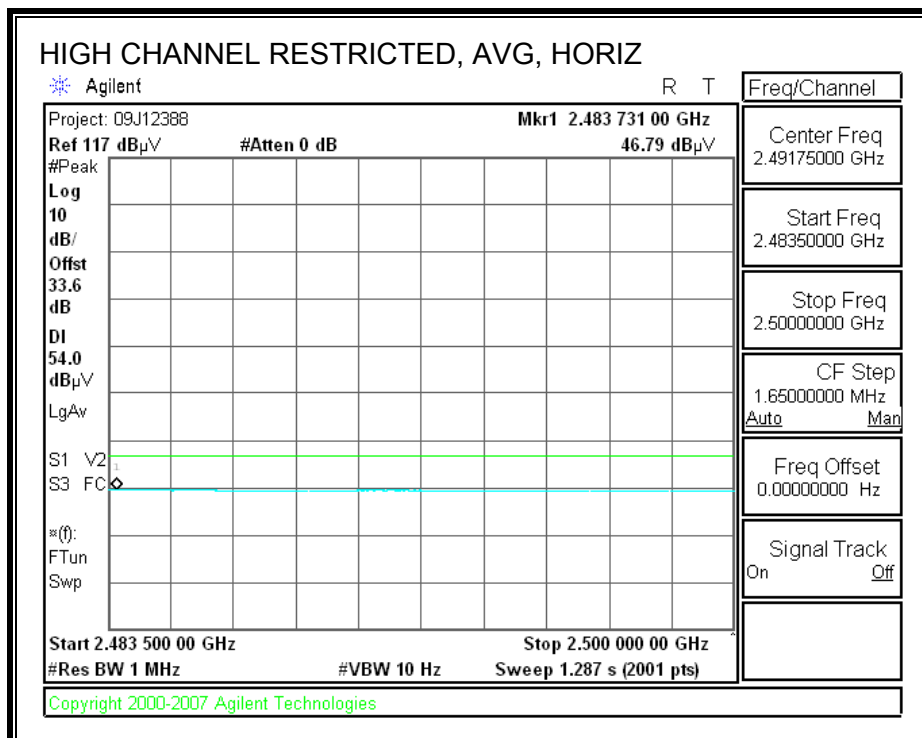
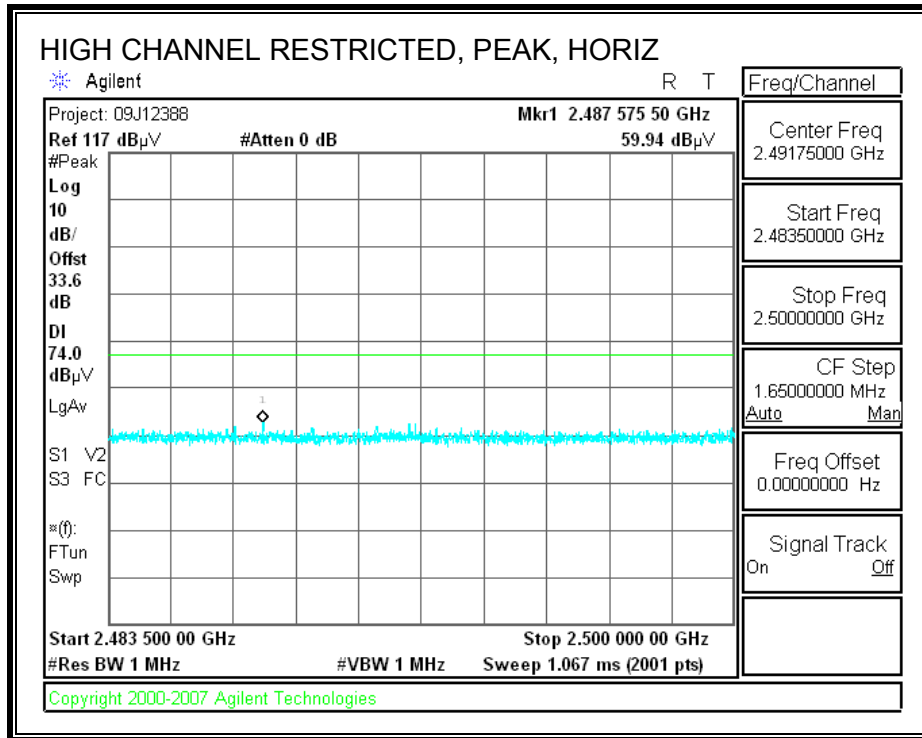
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



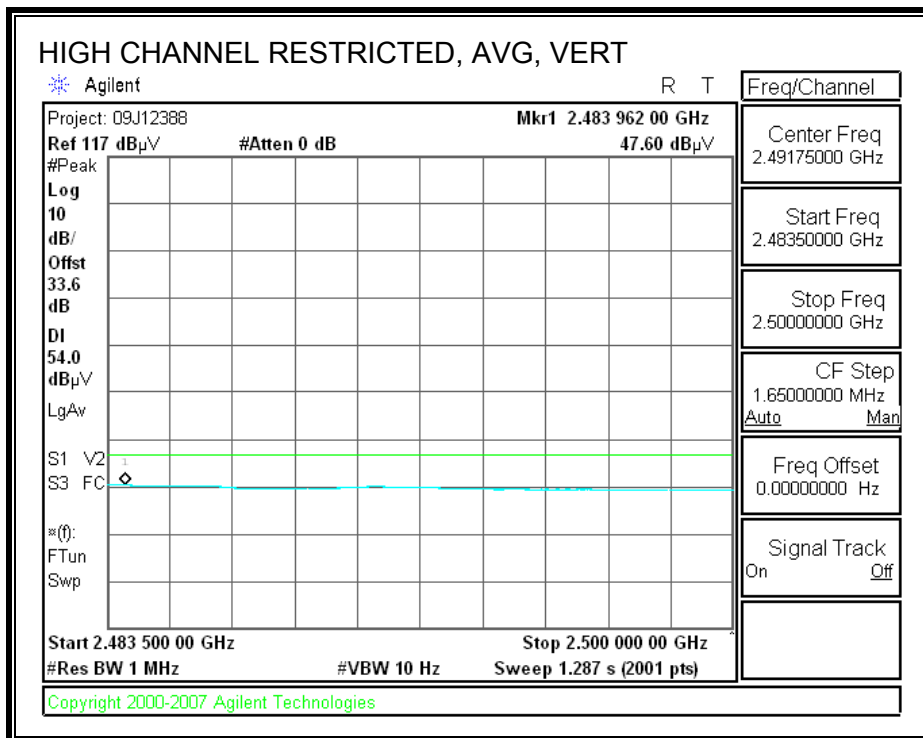
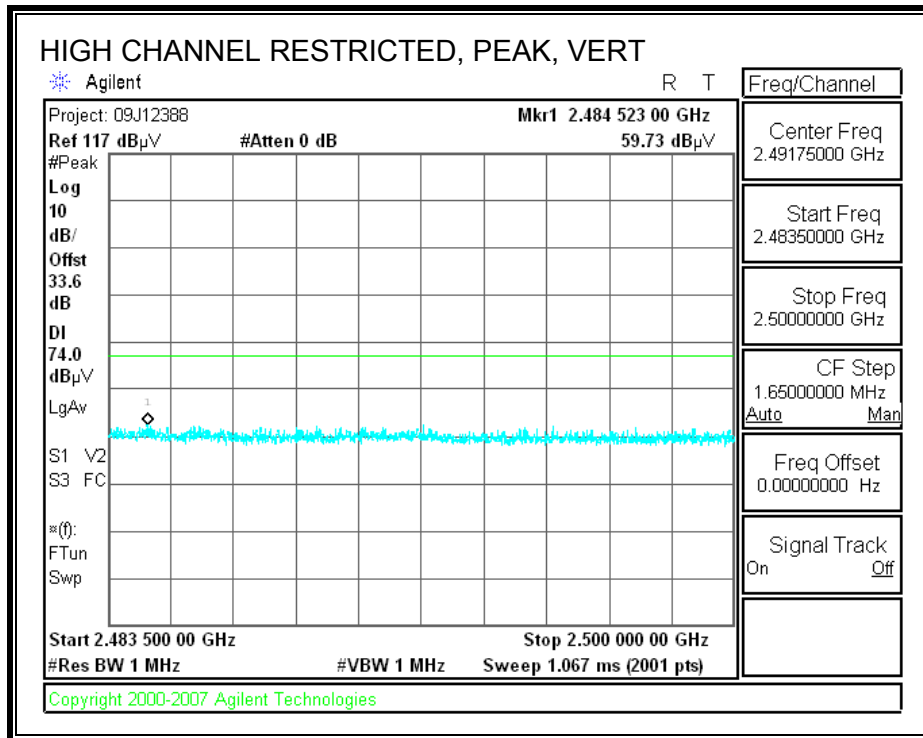
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



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



**HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement																	
Compliance Certification Services, Fremont 5m Chamber																	
Company:		SMK Corporation															
Project #:		09J12388															
Date:		2/7/09															
Test Engineer:		Thanh Nguyen															
Configuration:		EUT only															
Mode:		Tx Mode															
Test Equipment:																	
Horn 1-18GHz				Pre-amplifier 1-26GHz				Pre-amplifier 26-40GHz				Horn > 18GHz				Limit	
T60: S/N: 2238 @3m				T34 HP 8449B												FCC 15.209	
Hi Frequency Cables																	
3' cable 22807700				12' cable 22807600				20' cable 22807500				HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz, VBW=10Hz	
3' cable 22807700				12' cable 22807600				20' cable 22807500						R_001			
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)		
<b>Low CH 2425MHz</b>																	
4.850	3.0	51.8	40.1	33.7	5.8	-34.8	0.0	0.0	56.5	44.8	74	54	-17.5	-9.2	V		
7.275	3.0	36.4	24.1	36.7	7.2	-34.1	0.0	0.0	46.2	33.9	74	54	-27.8	-20.1	Noise Floor		
4.850	3.0	52.1	42.7	33.7	5.8	-34.8	0.0	0.0	56.8	47.4	74	54	-17.2	-6.6	H		
7.275	3.0	37.4	25.2	36.7	7.2	-34.1	0.0	0.0	47.3	35.0	74	54	-26.7	-19.0	Noise Floor		
<b>Mid CH 2450MHz</b>																	
4.900	3.0	51.5	41.5	33.8	5.9	-34.8	0.0	0.0	56.3	46.2	74	54	-17.7	-7.8	V		
7.350	3.0	36.3	24.6	36.8	7.3	-34.1	0.0	0.0	46.3	34.5	74	54	-27.7	-19.5	Noise Floor		
4.900	3.0	49.1	38.1	33.8	5.9	-34.8	0.0	0.0	53.9	42.9	74	54	-20.1	-11.1	H		
7.350	3.0	36.1	23.8	36.8	7.3	-34.1	0.0	0.0	46.0	33.7	74	54	-28.0	-20.3	Noise Floor		
<b>High CH 2475MHz</b>																	
4.950	3.0	48.8	38.5	33.8	5.9	-34.8	0.0	0.0	53.6	43.4	74	54	-20.4	-10.6	V		
7.425	3.0	36.1	23.7	36.8	7.3	-34.1	0.0	0.0	46.1	33.8	74	54	-27.9	-20.2	Noise Floor		
4.950	3.0	46.1	35.2	33.8	5.9	-34.8	0.0	0.0	51.0	40.1	74	54	-23.0	-13.9	H		
7.425	3.0	36.6	24.7	36.8	7.3	-34.1	0.0	0.0	46.7	34.8	74	54	-27.3	-19.2	Noise Floor		
No other emissions were detected above system noise floor.																	
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										

### 8.3. WORST-CASE BELOW 1 GHz

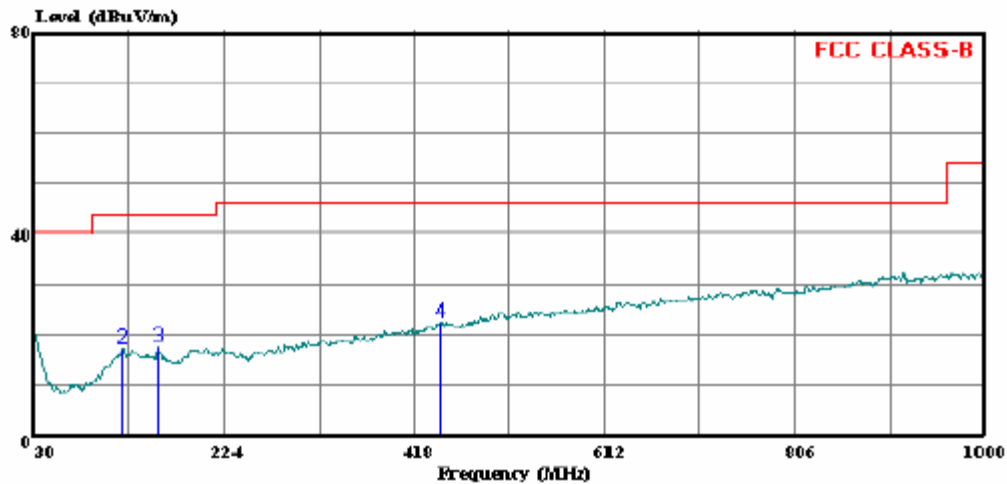
#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL



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

Data#: 6 File#: 09J12388.EMI Date: 02-07-2009 Time: 16:42:29



(Fremont)  
 Trace: 5

Ref Trace:

Condition: FCC CLASS-B 3m HORIZONTAL  
 Test Operator:: Thanh Nguyen  
 Project #: : 09J12388  
 Company: : SMK  
 Model: : N2QBYB000005  
 Configuration: : BUT Stand Alone  
 Mode : : Transmit worst case  
 Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	28.27	-7.41	20.86	40.00	-19.14	Peak
2	120.210	29.59	-12.44	17.15	43.50	-26.35	Peak
3	155.130	31.54	-14.02	17.53	43.50	-25.98	Peak
4	445.160	29.00	-6.64	22.36	46.00	-23.64	Peak

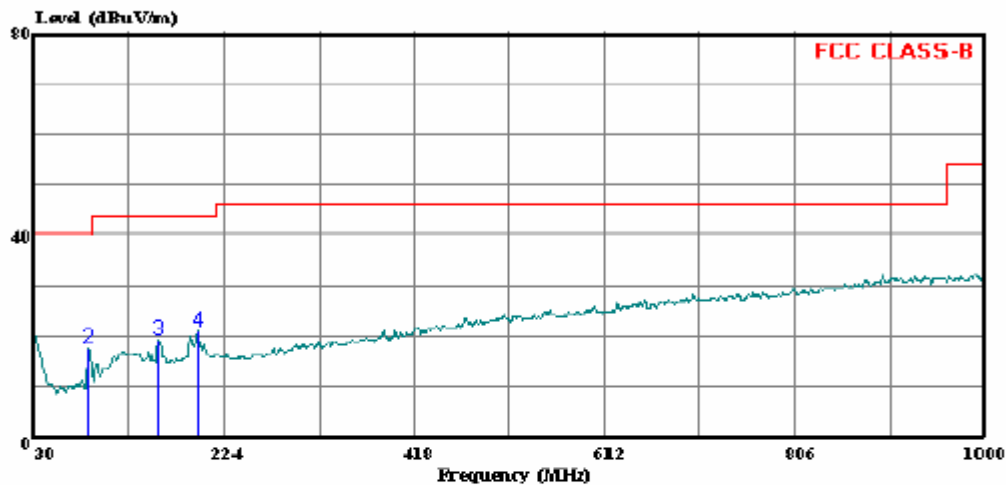
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL



Compliance Certification Services  
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Data#: 8 File#: 09J12388.EMI Date: 02-07-2009 Time: 16:50:40



(Frequency)

Trace: 7

Ref Trace:

Condition: FCC CLASS-B 3m VERTICAL  
 Test Operator:: Thanh Nguyen  
 Project #: : 09J12388  
 Company: : SMK  
 Model: : N2QBYB000005  
 Configuration:: BUT Stand Alone  
 Mode : : Transmit worst case  
 Target: : FCC Class B

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	Read	Limit	Over			
Freq	Level	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	28.45 -7.41	21.04	40.00	-18.96	Peak
2	85.290	36.62 -18.86	17.76	40.00	-22.24	Peak
3	155.130	33.53 -14.02	19.52	43.50	-23.99	Peak
4	196.840	33.77 -12.71	21.06	43.50	-22.44	Peak

## 9. 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 <sup>2</sup> )	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 <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 Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	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 <sup>2</sup> )	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.

**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/cm<sup>2</sup>

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.

**LIMITS**

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

**RESULTS**

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )
802.15.4	2.4 GHz	20.0	-0.33	-1.80	0.0001