



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

**CERTIFICATION TEST REPORT**

**FOR**

**TRANCEIVER MODULE**

**MODEL NUMBER: RXX9000-15XX**

**FCC ID: GT3FC008  
IC: 3683A-FC008**

**REPORT NUMBER: 09J12958-1, Revision A**

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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>
--	12/17/09	Initial Issue	T. Chan
A	02/01/10	Corrected Antenna Gain & Added MPE Calculation	T. Chan

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SMK CORPORATION  
5-5 TOGOSHI 6-CHOME  
SHINAGAWA-KU TOKYO  
142-8511 JAPAN

**EUT DESCRIPTION:** TRANCEIVER MODULE

**MODEL:** RXX9000-15XX

**SERIAL NUMBER:** 1B, 4C

**DATE TESTED:** DECEMBER 9-16, 2009

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

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:



THU CHAN  
EMC MANAGER  
COMPLIANCE CERTIFICATION SERVICES

Tested By:



MONICA HARRISON  
SENIOR RF ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

## 3. FACILITIES AND ACCREDITATION

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

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

### 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a 2.4GHz transceiver, operating between 2.425-2.475GHz.

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	-2.249	0.60

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PCB (Inverted F) antenna, with a maximum gain of +4.64dBi.

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was TELECTEST\_Sip\_AB, rev. 1.0.

The Jig driver software installed in the support equipment during testing was CDM2.042.04.16 WHQL Certified, rev. 2.04.16.

The test utility software used during testing was TeraTerm Pro, rev. 4.56.

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. The worst-case position was determined to be in the X plane.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	HP	Pavillion	CNF63928VZ	DoC
AC Adaptor	HP	DC359A	F3-0607269800b	DoC

### I/O CABLES

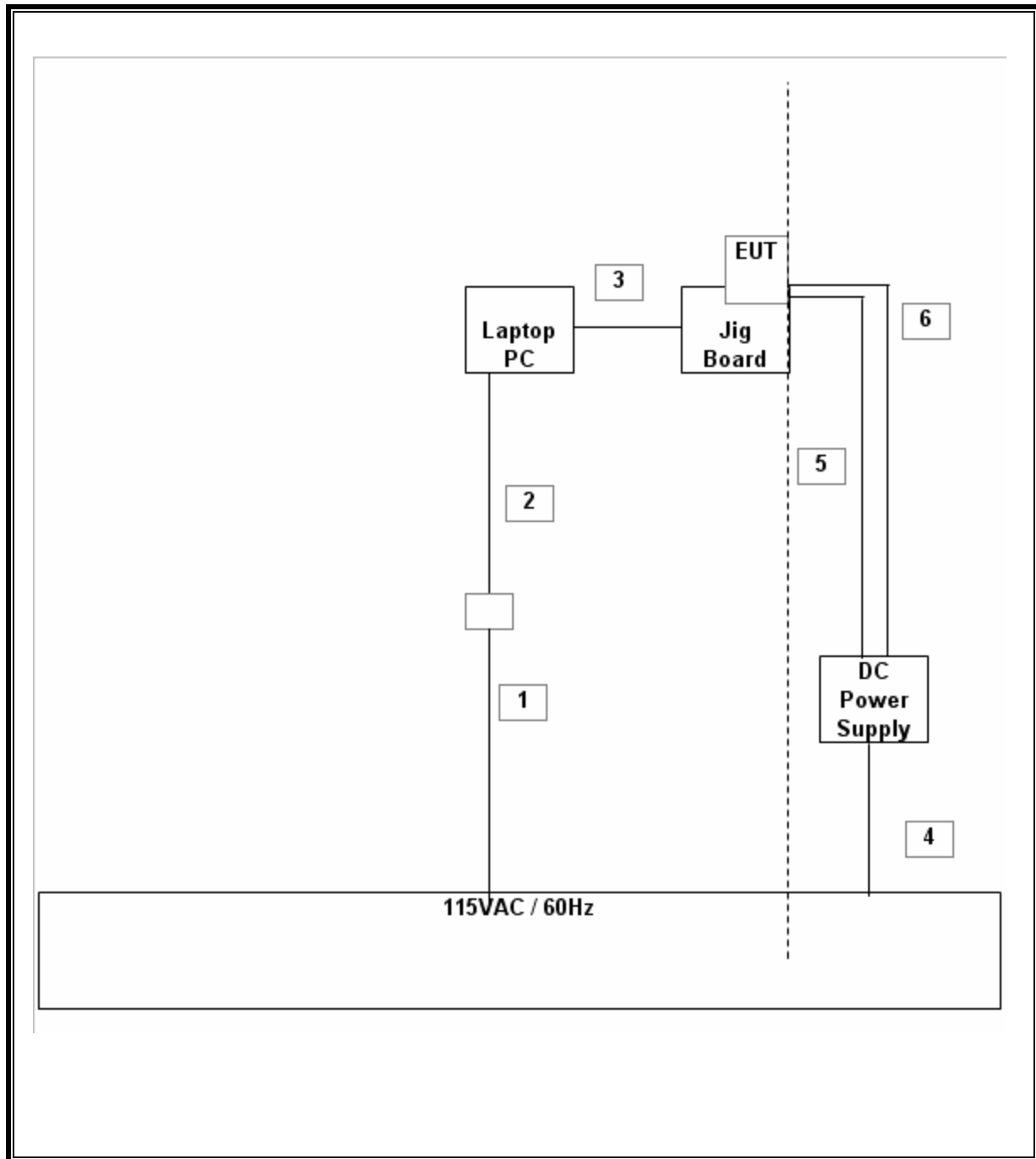
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.7m	
2	DC	1	DC	Unshielded	1.7m	
3	USB	1	USB	Unshielded	1m	
4	AC	1	AC	Unshielded	1m	
5	DC	2	DC	Banana	2m	
6	DC	2	DC	Banana	2m	

### TEST SETUP

The EUT is installed in a test board JIG, which is connected to the laptop via USB. Test software exercised the radio card. For below 1 GHz Emissions testing the EUT was powered with an external DC Power Supply.



**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
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	02/03/10
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/10
Peak Power Sensor	Boonton	57318		02/02/10
Peak Power Meter	Boonton	4541	C01186	01/19/10
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25	N02625	11/06/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	01/16/10
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01178	08/31/10
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	01/29/10
Power Supply 10V@ 10 Amp	Agilent / HP	6282A	NA	CNR
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	01/14/10
Antenna, Horn, 18 GHz	EMCO	3115	C00783	01/29/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	02/04/10
DMM	Fluke	77-11	N02303	10/30/11

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.15.4 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.

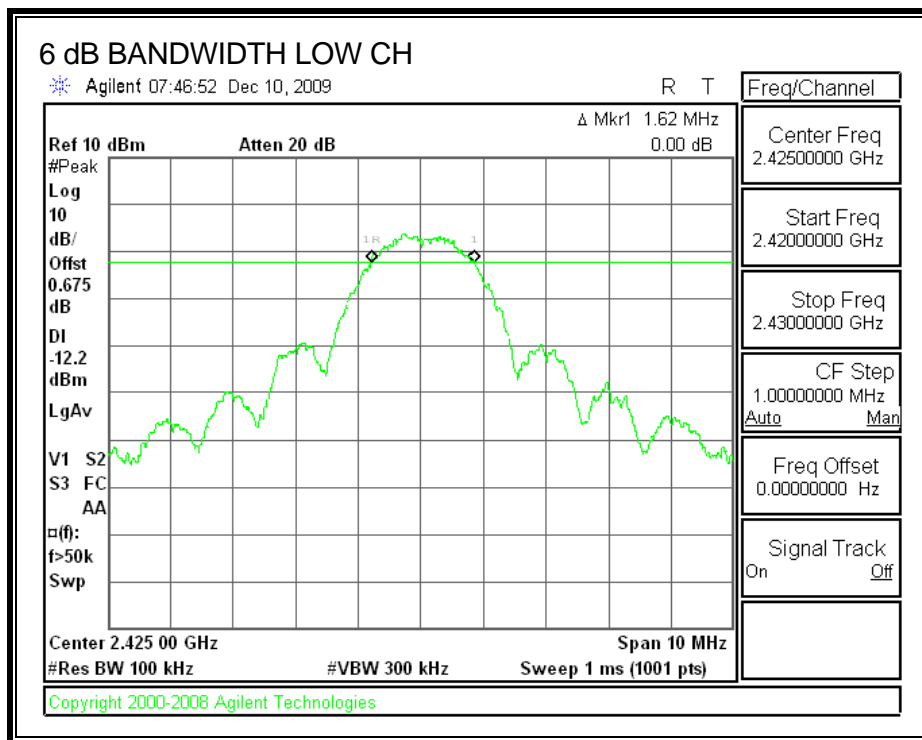
##### TEST PROCEDURE

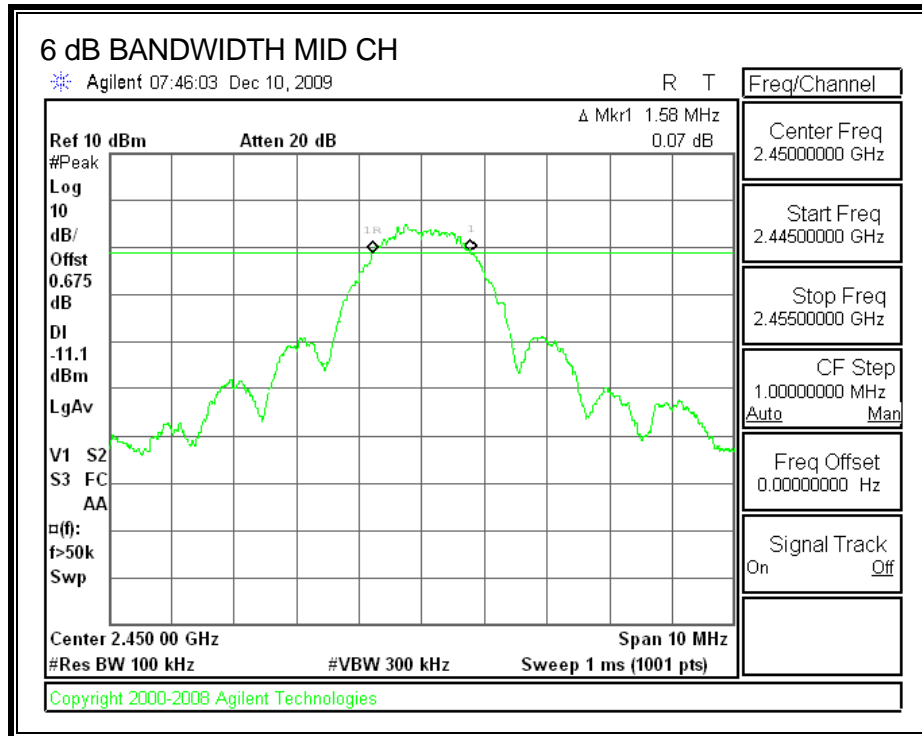
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

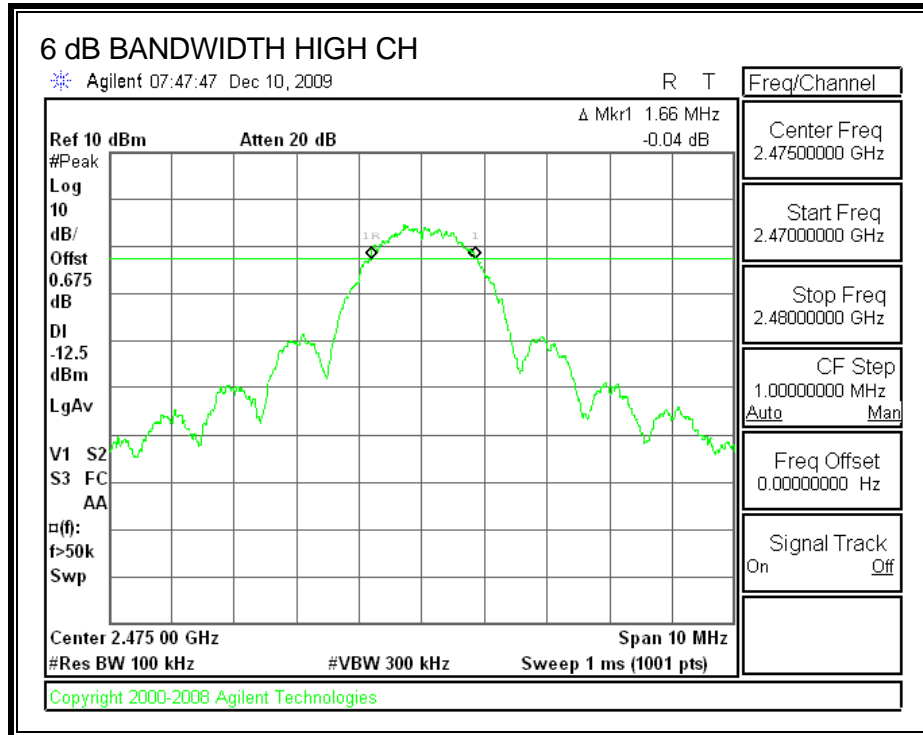
##### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2425	1.62	0.5
Middle	2450	1.58	0.5
High	2475	1.66	0.5

**6 dB BANDWIDTH**







### 7.1.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

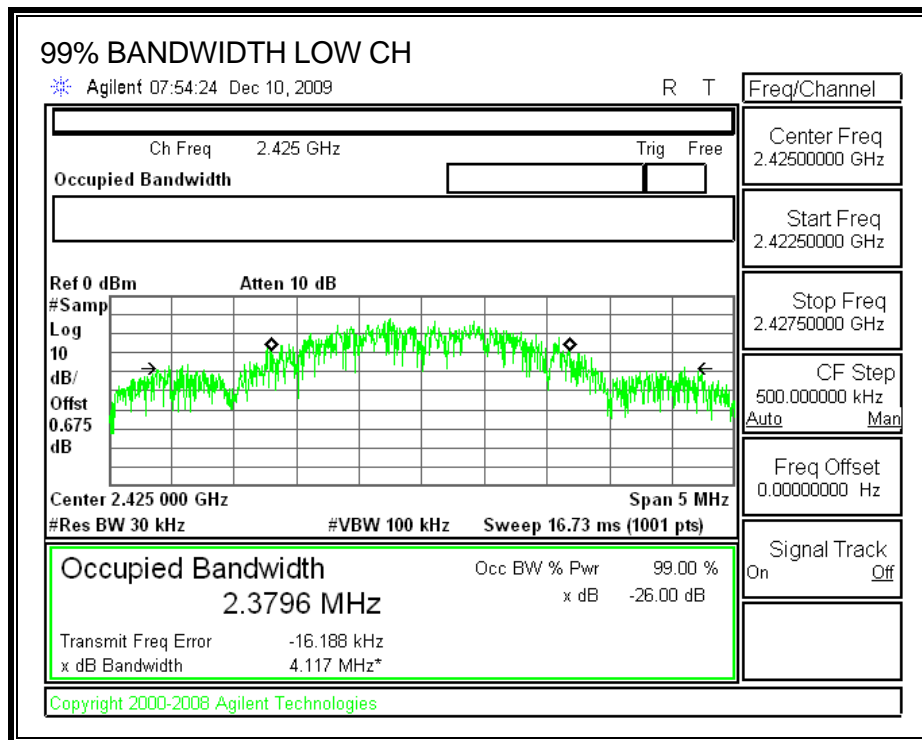
#### TEST PROCEDURE

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.

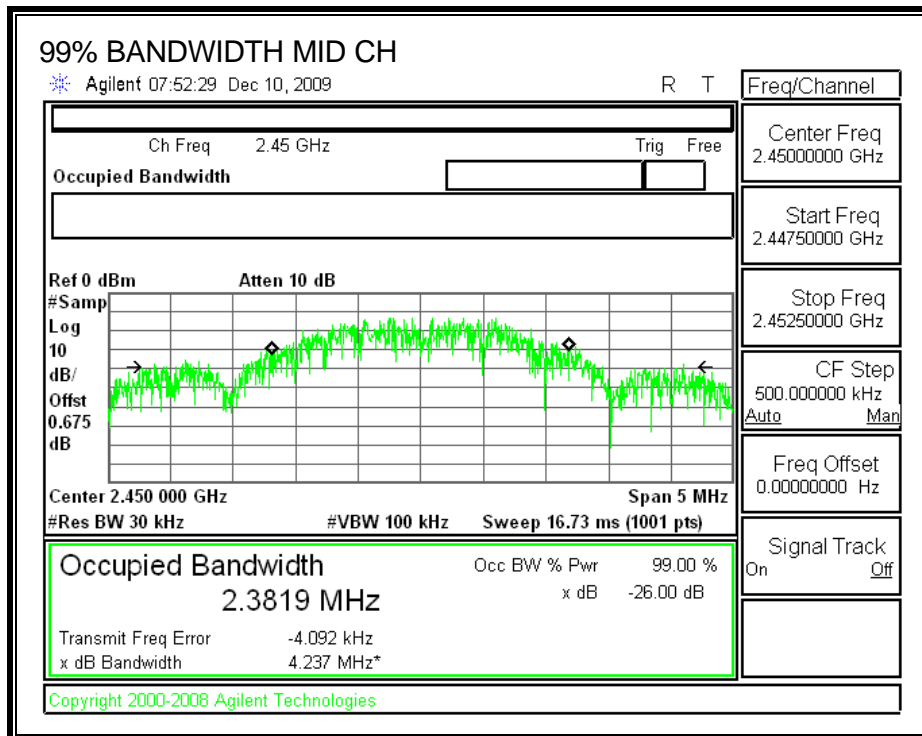
#### RESULTS

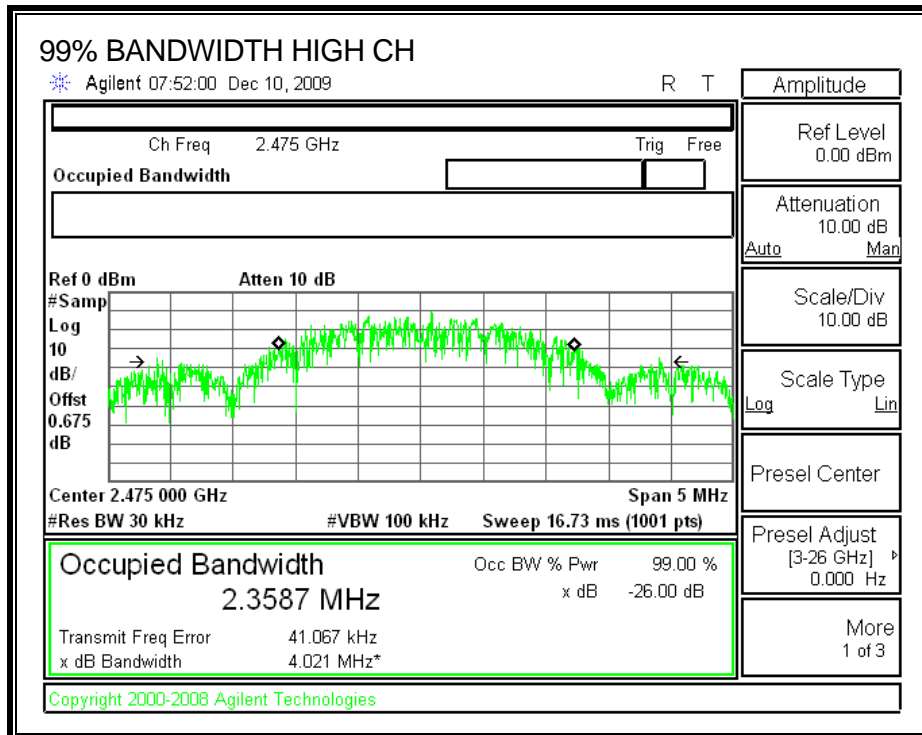
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2425	2.3796
Middle	2450	2.3819
High	2475	2.3587

**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

The transmitter output is connected to a power meter.

#### RESULTS

The cable assembly insertion loss of 0.675dB was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-2.612	30	-32.61
Middle	2450	-2.354	30	-32.35
High	2475	-2.249	30	-32.25

### 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 0.675 dB was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2425	-2.825
Middle	2450	-2.559
High	2475	-2.441

### 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.

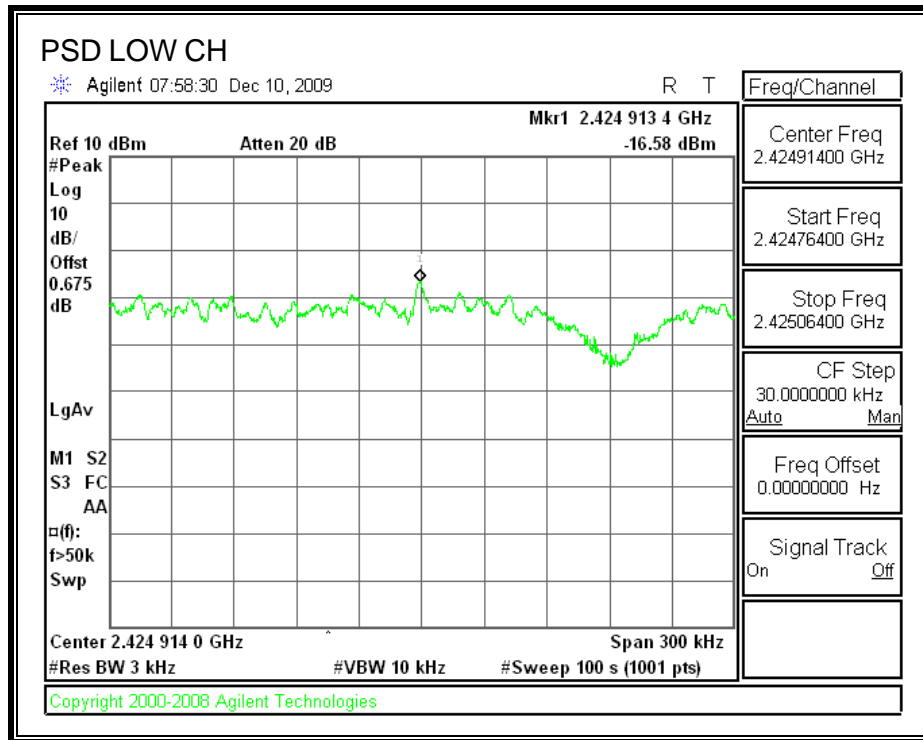
#### TEST PROCEDURE

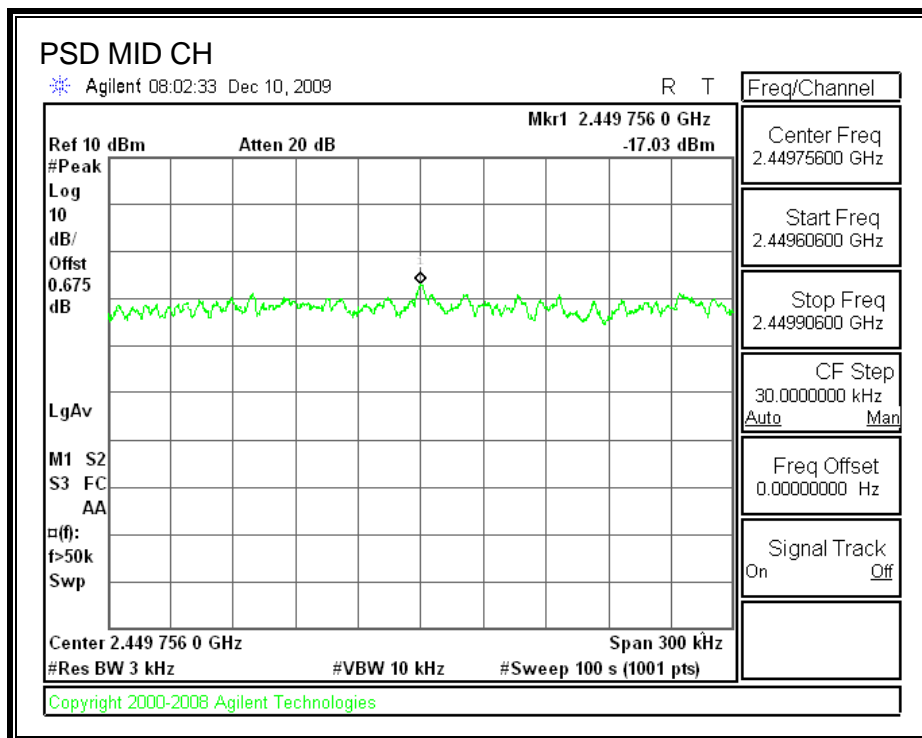
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

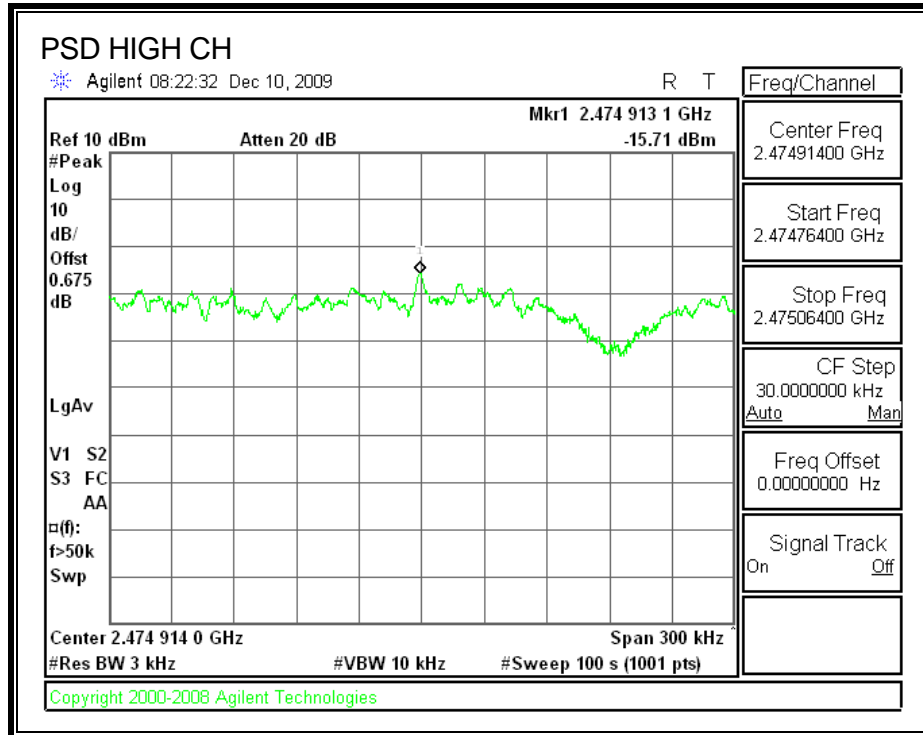
#### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-16.58	8	-24.58
Middle	2450	-17.03	8	-25.03
High	2475	-15.71	8	-23.71

**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.

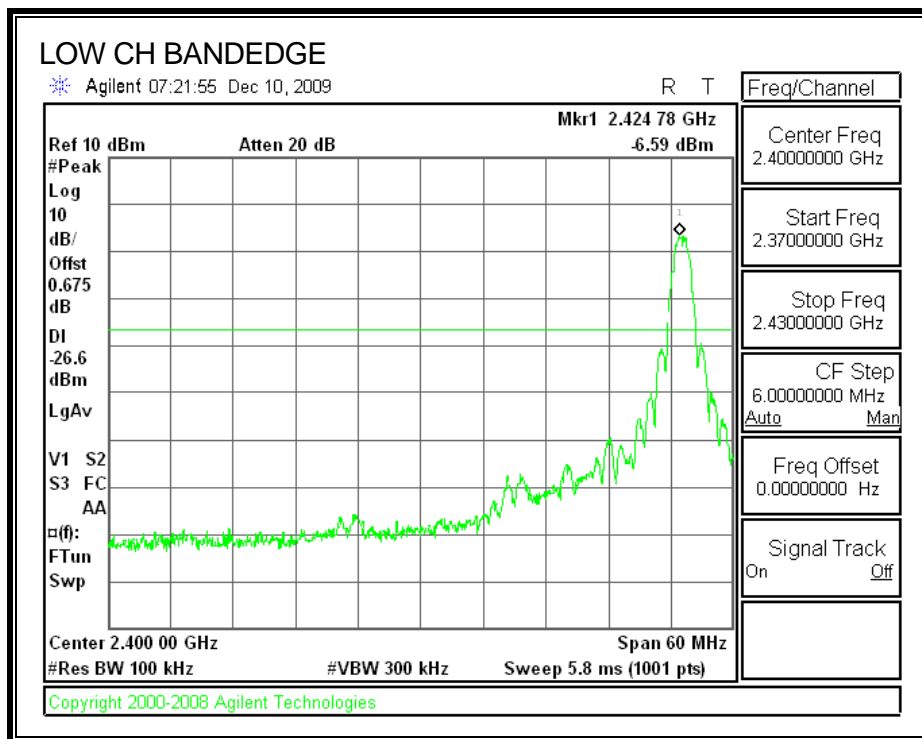
### **TEST PROCEDURE**

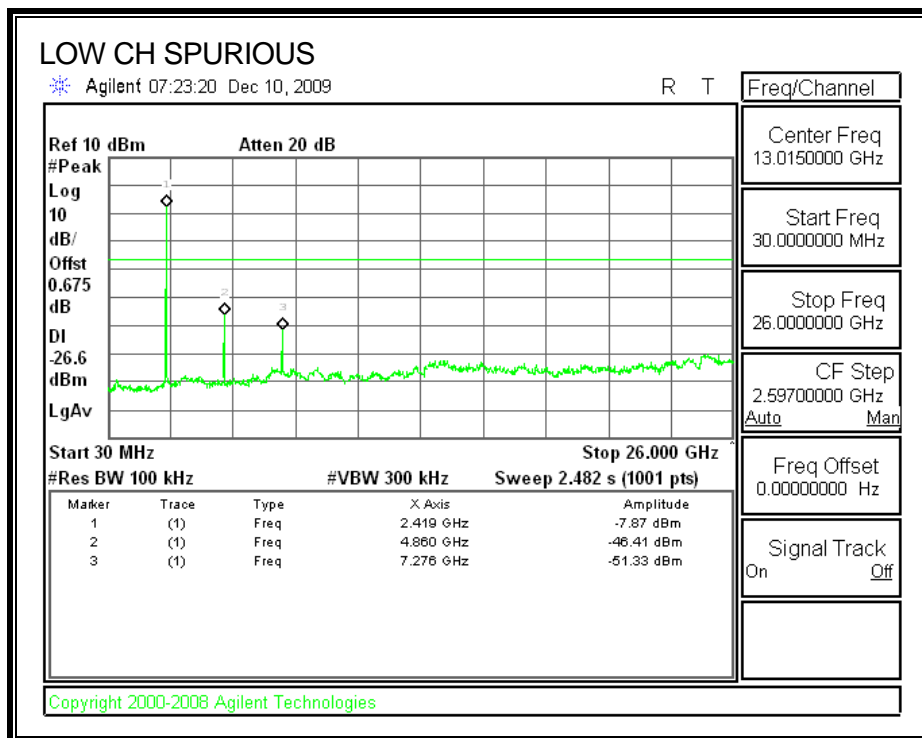
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

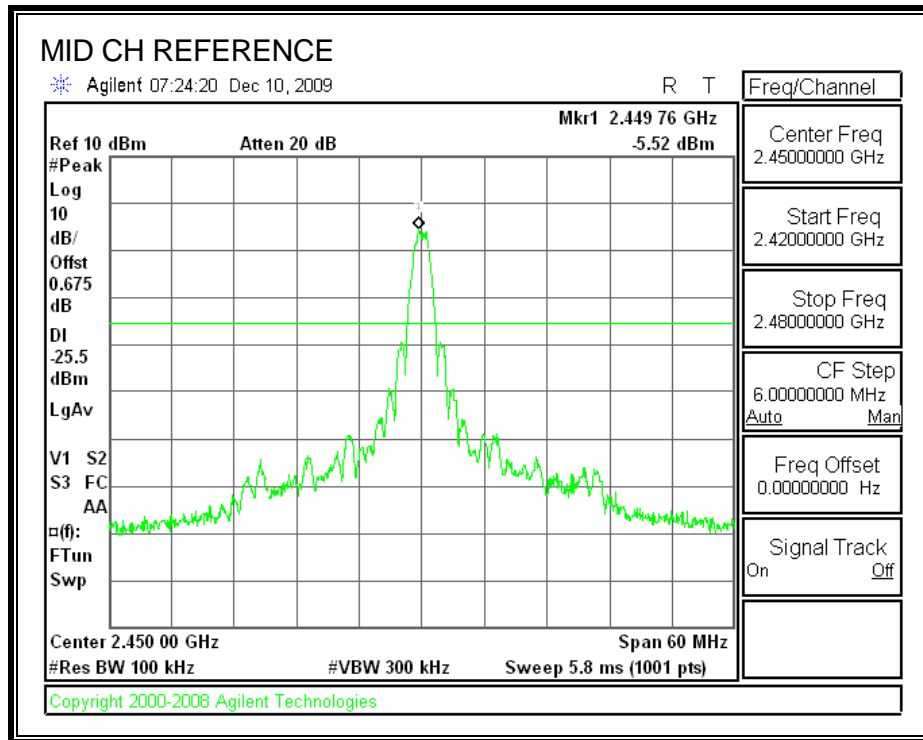
**RESULTS**

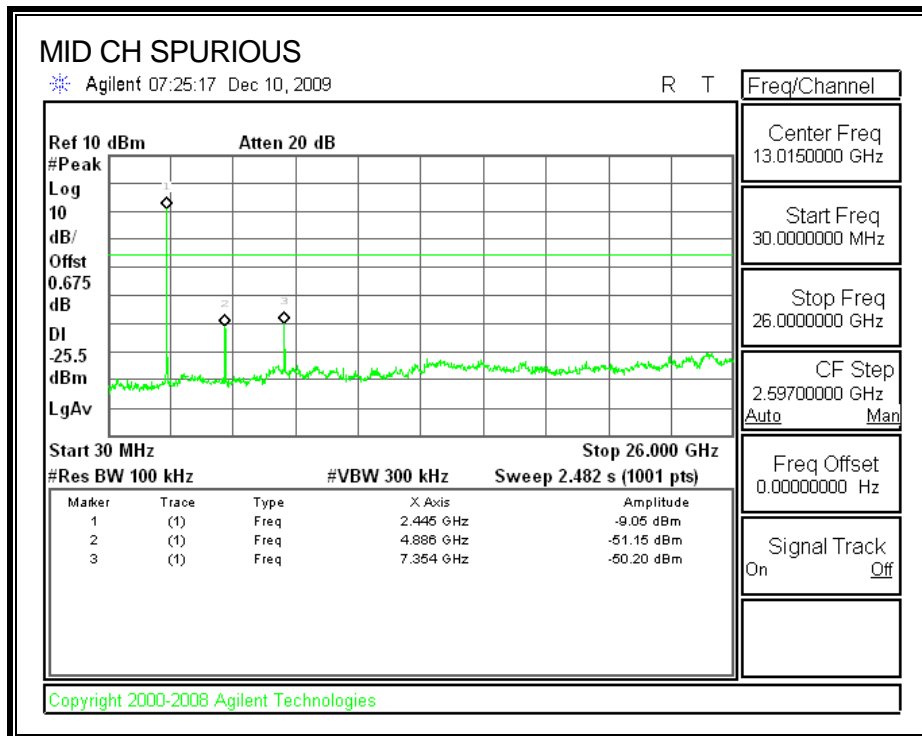
**SPURIOUS EMISSIONS, LOW CHANNEL**



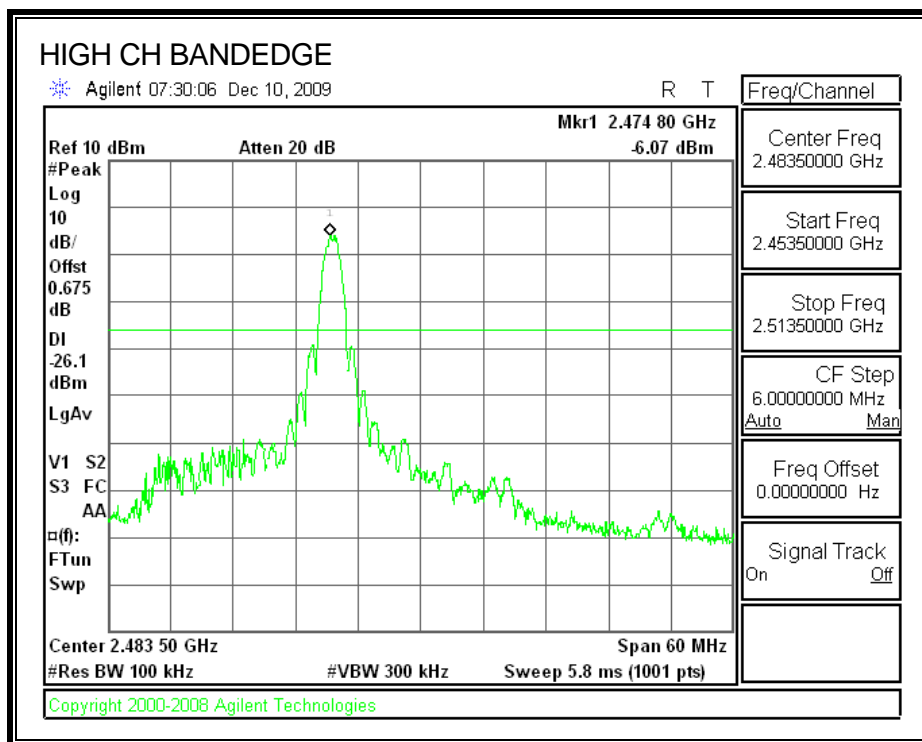


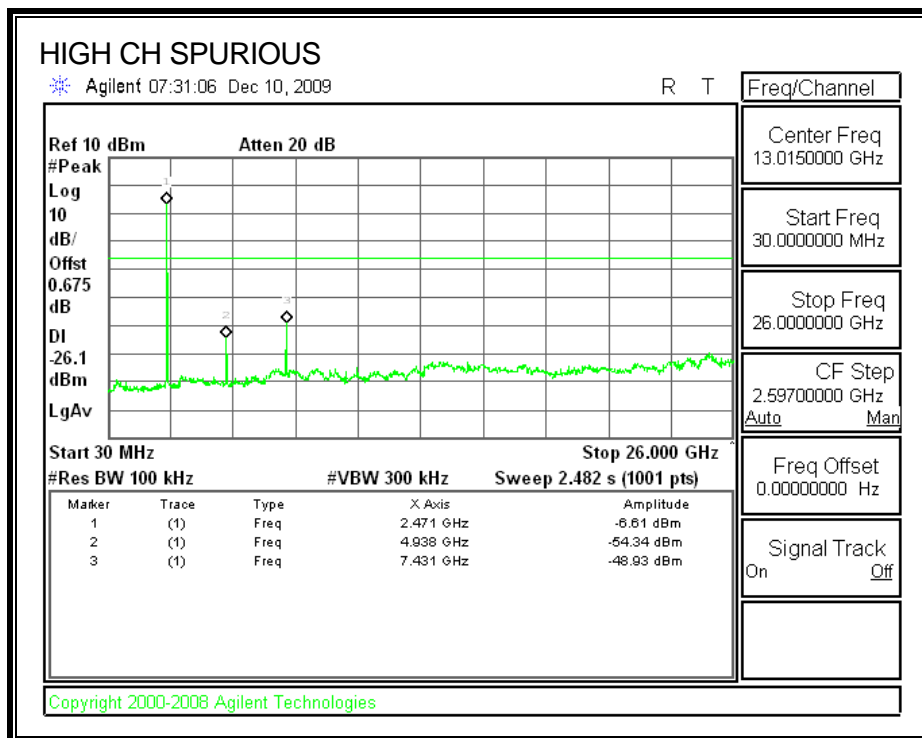
**SPURIOUS EMISSIONS, MID CHANNEL**





**SPURIOUS EMISSIONS, HIGH CHANNEL**





## 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.

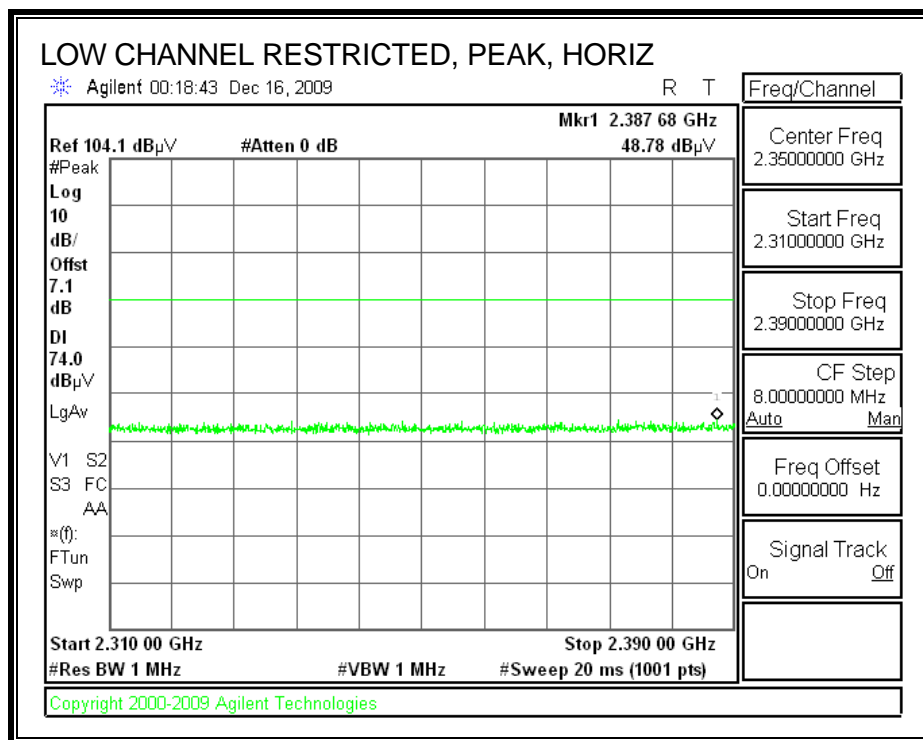
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

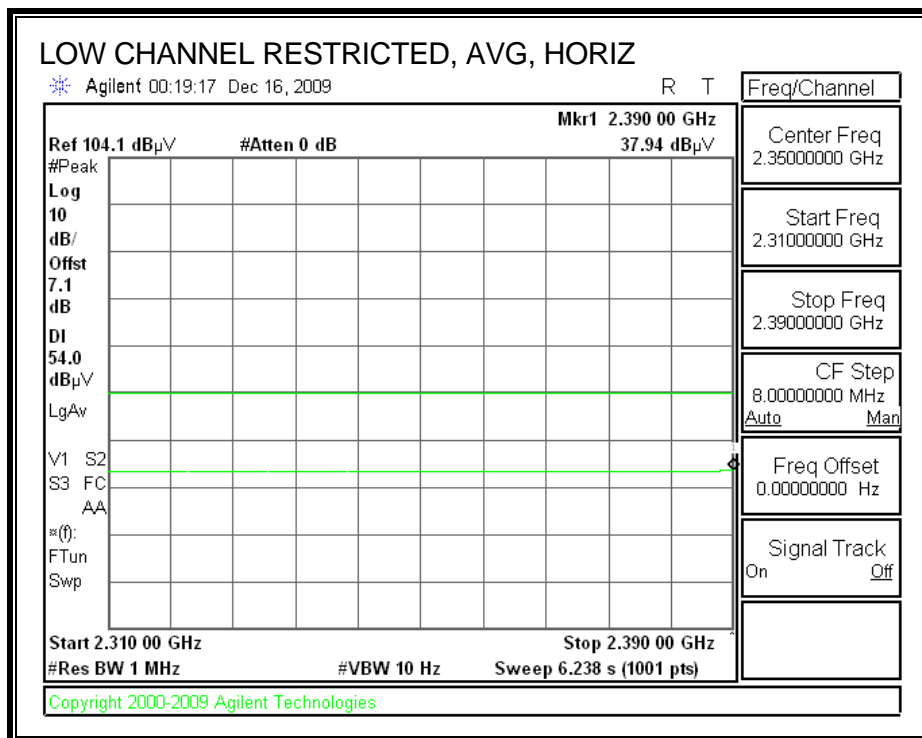


## 8.2. TRANSMITTER ABOVE 1 GHz

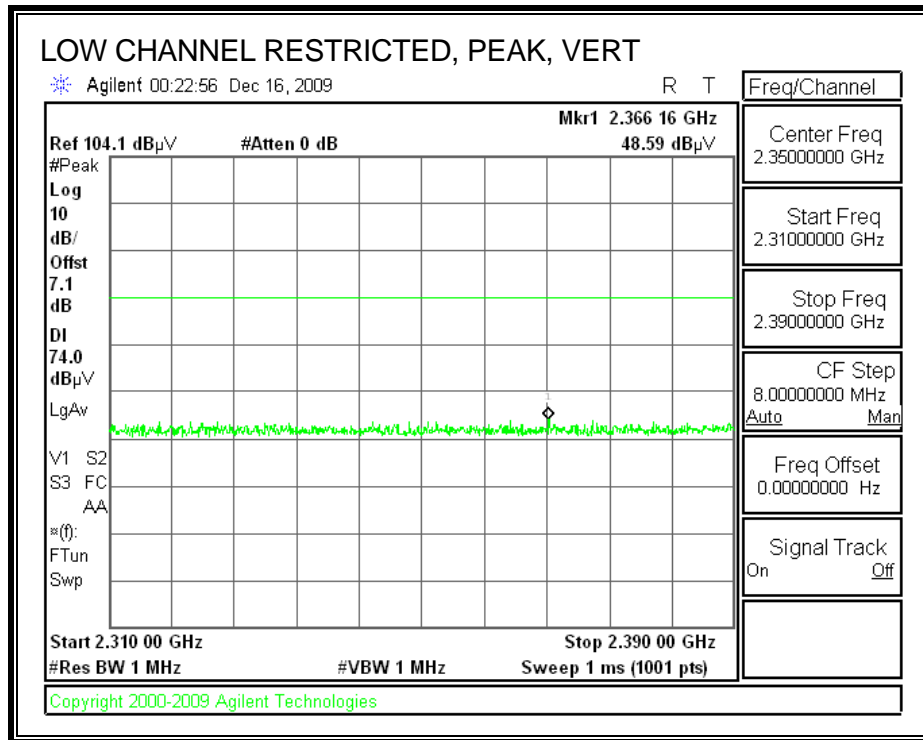
### 8.2.1. TRANSMITTER ABOVE 1 GHz FOR 802.15.4 IN THE 2.4 GHz BAND

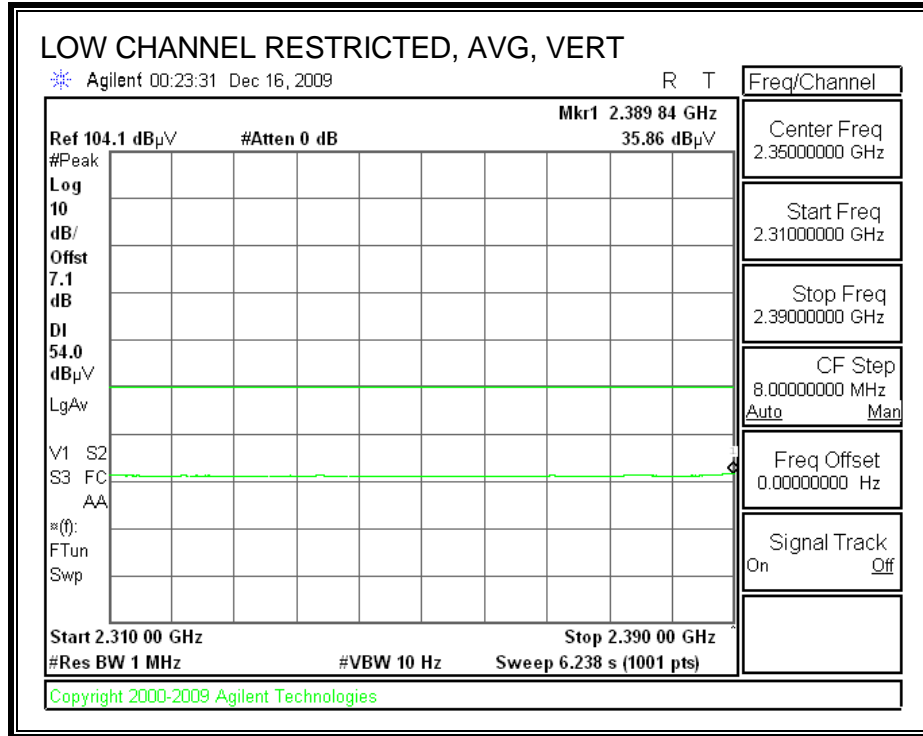
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



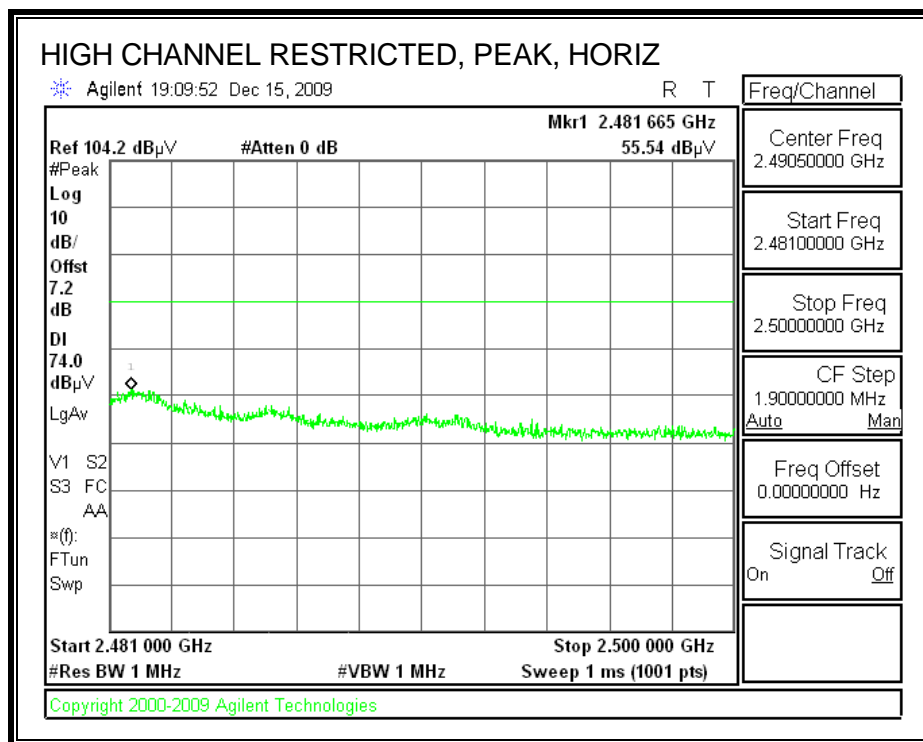


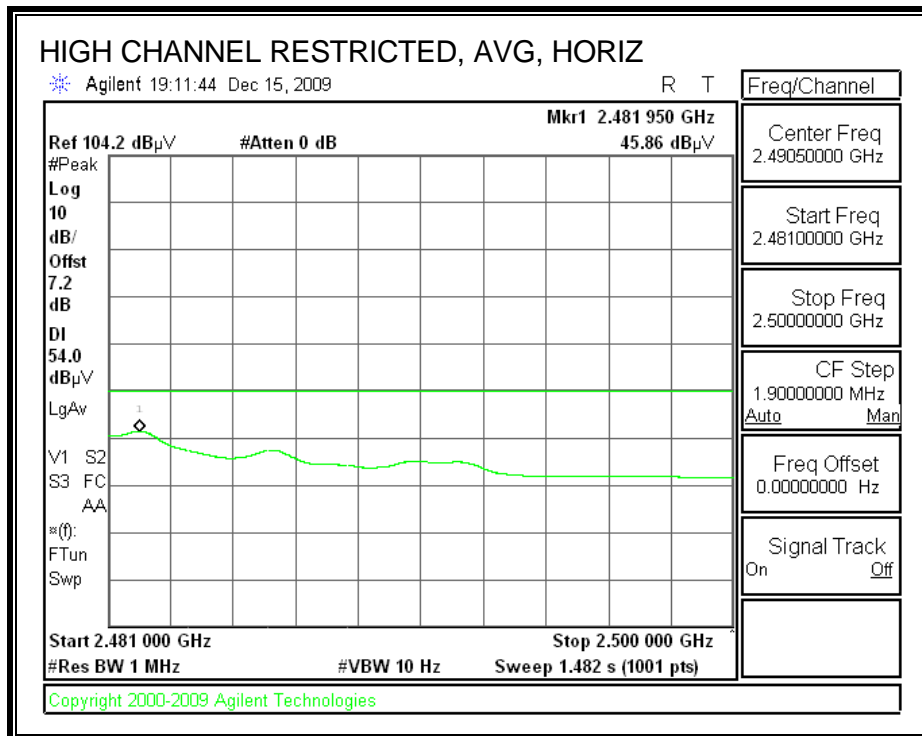
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



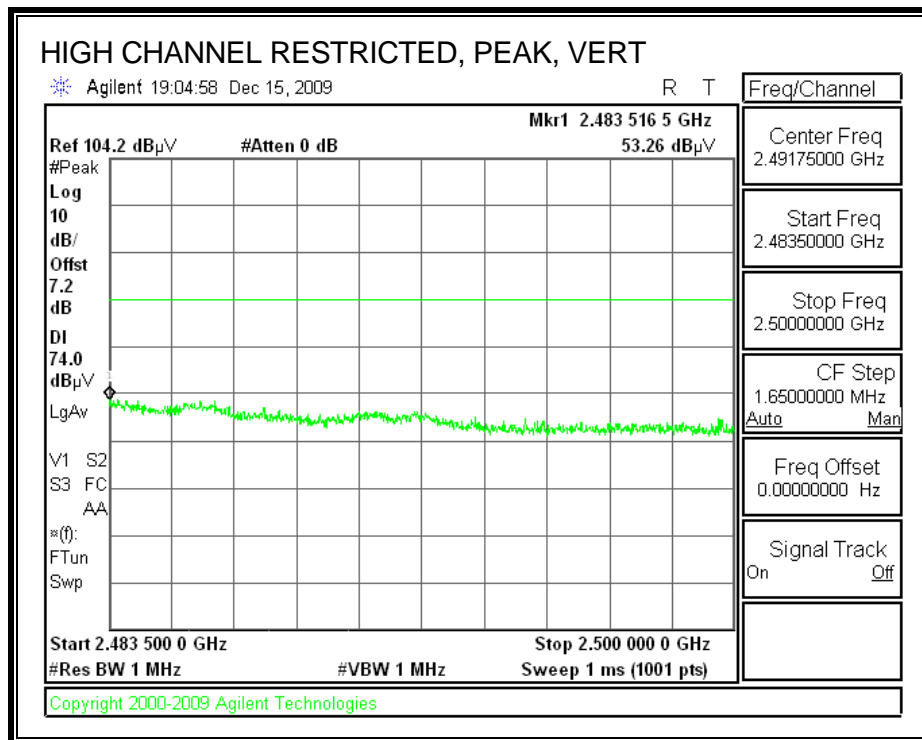


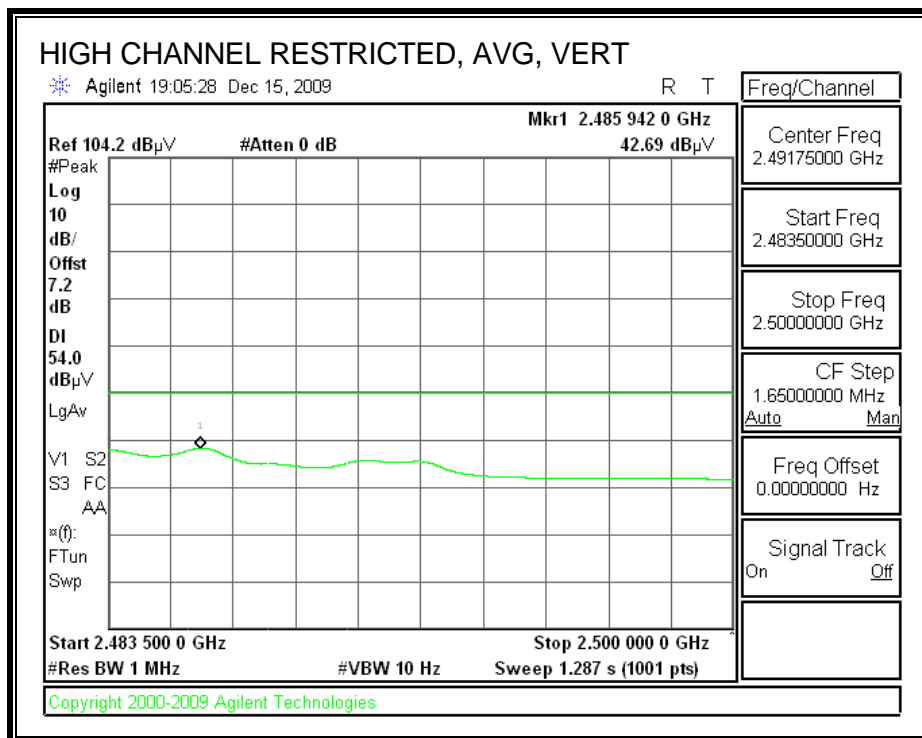
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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







**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: SMK Corporation  
 Project #: 09J12958  
 Date: December 15, 2009  
 Test Engineer: Monica Harrison  
 Configuration: TX w/USB  
 Mode: 2.4GHz DSSS Zigbee

**Test Equipment:**

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T59; S/N: 3245 @3m	T145 Agilent 3008A0056		T125; ARA 18.26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500		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)
<b>2.425</b>															
1.062	3.0	63.4	39.2	24.2	2.4	-36.1	0.0	0.0	53.9	29.7	74	54	-20.1	-24.3	H
1.593	3.0	61.1	32.6	26.1	3.0	-35.7	0.0	0.0	54.6	26.0	74	54	-19.4	-28.0	H
3.187	3.0	47.2	29.0	30.4	4.5	-35.1	0.0	0.0	47.0	28.8	74	54	-27.0	-25.2	H
7.276	3.0	44.3	33.4	35.1	7.2	-34.7	0.0	0.0	52.0	41.2	74	54	-22.0	-12.8	H
1.066	3.0	65.5	36.2	24.2	2.4	-36.1	0.0	0.0	56.1	26.8	74	54	-17.9	-27.2	V
1.596	3.0	65.9	35.6	26.1	3.0	-35.7	0.0	0.0	59.3	29.1	74	54	-14.7	-24.9	V
3.202	3.0	47.7	27.8	30.5	4.5	-35.1	0.0	0.0	47.5	27.6	74	54	-26.5	-26.4	V
5.000	3.0	44.4	26.1	32.9	5.9	-34.9	0.0	0.0	48.3	30.1	74	54	-25.7	-23.9	V
7.276	3.0	43.1	31.9	35.1	7.2	-34.7	0.0	0.0	50.8	39.6	74	54	-23.2	-14.4	V
<b>2.450</b>															
1.064	3.0	64.2	39.4	24.2	2.4	-36.1	0.0	0.0	54.7	29.9	74	54	-19.3	-24.1	V
1.596	3.0	64.9	35.6	26.1	3.0	-35.7	0.0	0.0	58.4	29.1	74	54	-15.6	-24.9	V
3.185	3.0	49.4	27.8	30.4	4.5	-35.1	0.0	0.0	49.1	27.6	74	54	-24.9	-26.4	V
4.990	3.0	44.8	26.3	32.9	5.9	-34.9	0.0	0.0	48.7	30.3	74	54	-25.3	-23.7	V
7.349	3.0	42.1	31.2	35.2	7.3	-34.6	0.0	0.0	50.0	39.0	74	54	-24.0	-15.0	V
1.062	3.0	62.8	39.1	24.2	2.4	-36.1	0.0	0.0	53.3	29.6	74	54	-20.7	-24.4	H
1.598	3.0	60.0	32.9	26.1	3.0	-35.7	0.0	0.0	53.5	26.4	74	54	-20.5	-27.6	H
3.187	3.0	44.4	27.7	30.4	4.5	-35.1	0.0	0.0	44.2	27.5	74	54	-29.8	-26.5	H
7.351	3.0	46.2	35.2	35.2	7.3	-34.6	0.0	0.0	54.1	43.1	74	54	-19.9	-10.9	H
<b>2.475</b>															
1.064	3.0	62.7	42.4	24.2	2.4	-36.1	0.0	0.0	53.2	32.9	74	54	-20.8	-21.1	H
1.593	3.0	59.3	33.0	26.1	3.0	-35.7	0.0	0.0	52.8	26.5	74	54	-21.2	-27.5	H
7.424	3.0	47.2	36.9	35.3	7.3	-34.6	0.0	0.0	55.2	44.9	74	54	-18.8	-9.1	H
1.063	3.0	60.3	40.4	24.2	2.4	-36.1	0.0	0.0	50.8	30.9	74	54	-23.2	-23.1	V
1.593	3.0	62.8	33.2	26.1	3.0	-35.7	0.0	0.0	56.2	26.6	74	54	-17.8	-27.4	V
3.193	3.0	48.6	28.0	30.4	4.5	-35.1	0.0	0.0	48.4	27.8	74	54	-25.6	-26.2	V
4.976	3.0	47.5	26.2	32.9	5.9	-34.9	0.0	0.0	51.4	30.1	74	54	-22.6	-23.9	V
7.424	3.0	40.8	29.3	35.4	7.3	-34.6	0.0	0.0	48.9	37.3	74	54	-25.1	-16.7	V

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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. RECEIVER ABOVE 1 GHz IN THE 2.4 GHz BAND

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

**Company:** SMK Corporation  
**Project #:** 09J12958  
**Date:** December 15, 2009  
**Test Engineer:** Monica Harrison  
**Configuration:** RX w/USB  
**Mode:** 2.4GHz DSSS Zigbee

**Test Equipment:**

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

Hi Frequency Cables

<b>3' cable 22807700</b>	<b>12' cable 22807600</b>	<b>20' cable 22807500</b>	<b>HPF</b>	<b>Reject Filter</b>	<b>Peak Measurements</b> RBW=VBW=1MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500			<b>Average Measurements</b> RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.064	3.0	65.0	38.6	24.2	2.4	-36.1	0.0	0.0	55.5	29.1	74	54	-18.5	-24.9	V
1.593	3.0	66.0	35.0	26.1	3.0	-35.7	0.0	0.0	59.4	28.5	74	54	-14.6	-25.5	V
2.488	3.0	54.9	29.1	28.5	3.9	-35.1	0.0	0.0	52.2	26.4	74	54	-21.8	-27.6	V
3.186	3.0	48.0	28.0	30.4	4.5	-35.1	0.0	0.0	47.8	27.8	74	54	-26.2	-26.2	V
4.981	3.0	45.4	26.2	32.9	5.9	-34.9	0.0	0.0	49.3	30.2	74	54	-24.7	-23.8	V
1.066	3.0	62.2	40.7	24.2	2.4	-36.1	0.0	0.0	52.7	31.2	74	54	-21.3	-22.8	H
1.597	3.0	58.3	31.7	26.1	3.0	-35.7	0.0	0.0	51.8	25.2	74	54	-22.2	-28.8	H
2.497	3.0	53.2	29.4	28.5	3.9	-35.1	0.0	0.0	50.5	26.7	74	54	-23.5	-27.3	H
3.185	3.0	48.0	28.0	30.4	4.5	-35.1	0.0	0.0	47.8	27.8	74	54	-26.2	-26.2	H

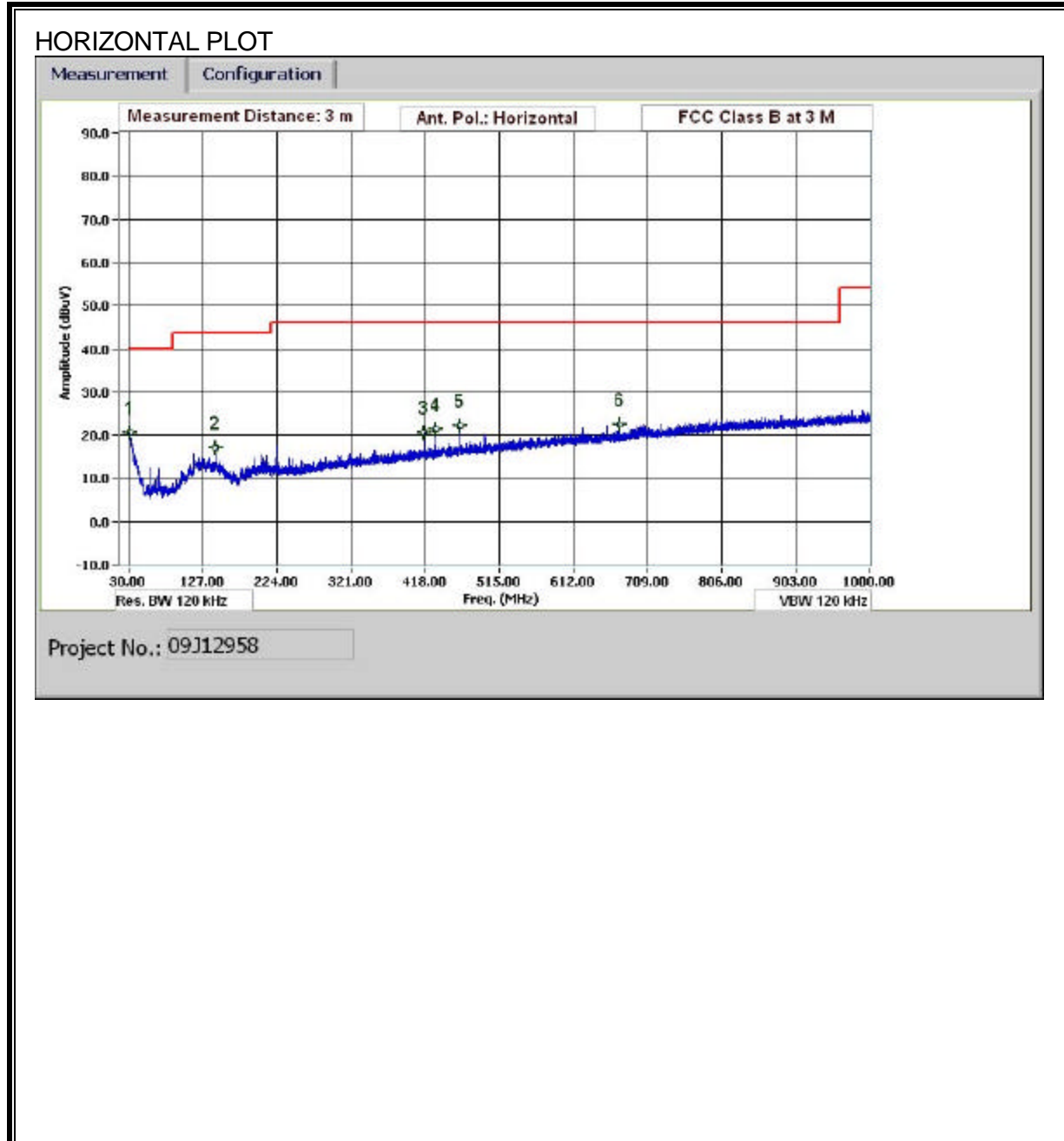
Rev. 11.10.08

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

### 8.4. WORST-CASE BELOW 1 GHz

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

For Below 1 GHz emissions testing, the EUT was powered with a DC Supply at 2.7V.



**HORIZONTAL DATA**

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

**Test Engr:** Monica Harrison  
**Date:** 12/15/09  
**Project #:** 09J12958  
**Company:** SMK Corporation  
**EUT Description:** 2.4GHz DSSS Zigbee Module

**EUT M/N:**

**Test Target:** FCC Class B

**Mode Oper:** TX w/DC Power

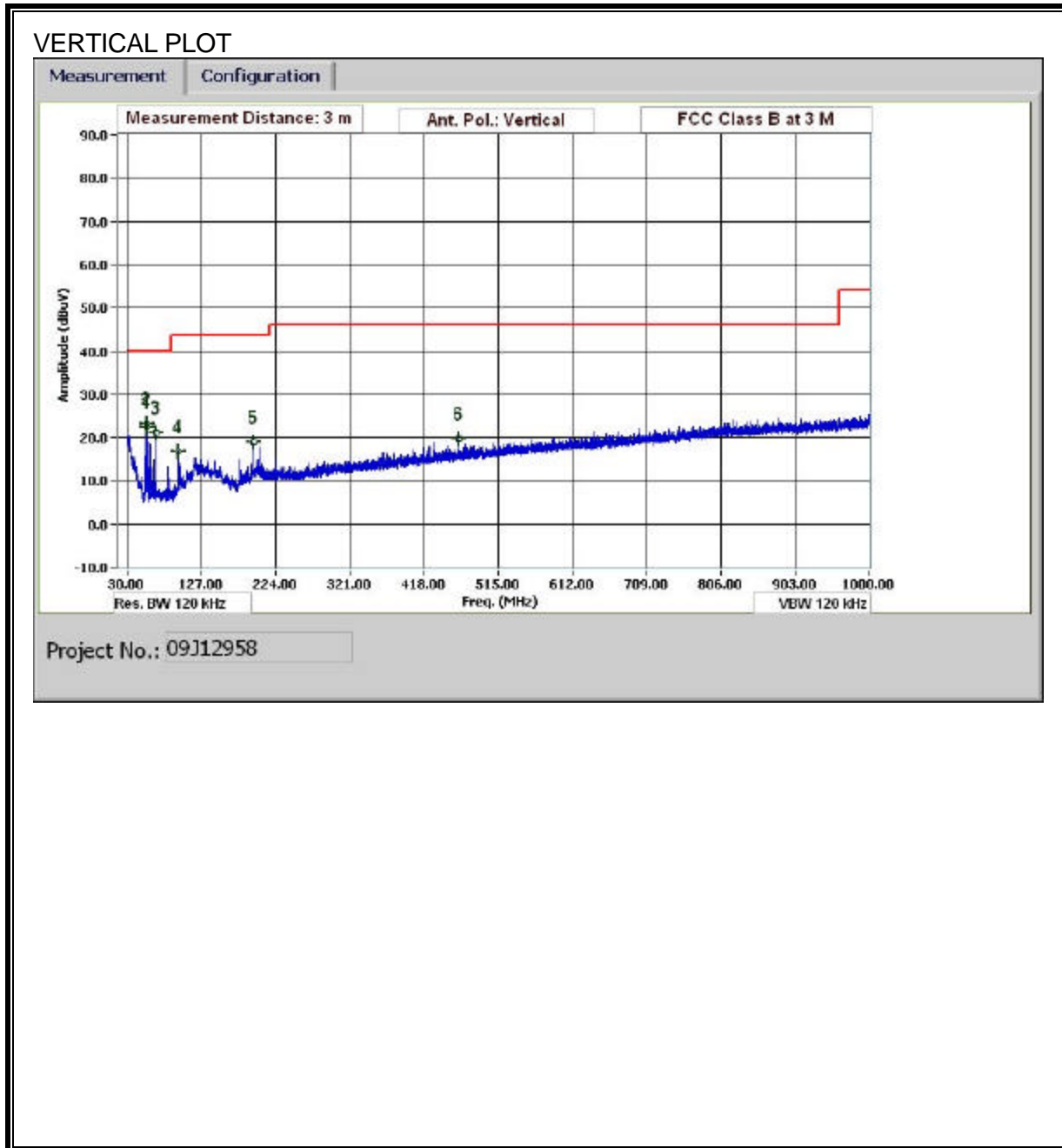
f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
31.560	3.0	30.0	19.6	0.5	29.7	0.0	0.0	20.5	40.0	-19.5	H	P	
143.165	3.0	32.4	13.0	1.1	29.3	0.0	0.0	17.1	43.5	-26.4	H	P	
416.056	3.0	32.8	15.3	1.9	29.4	0.0	0.0	20.7	46.0	-25.3	H	P	
432.017	3.0	33.3	15.6	2.0	29.4	0.0	0.0	21.5	46.0	-24.6	H	P	
464.058	3.0	33.4	16.2	2.1	29.6	0.0	0.0	22.0	46.0	-24.0	H	P	
672.026	3.0	30.5	19.0	2.5	29.6	0.0	0.0	22.4	46.0	-23.6	H	P	

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

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



VERTICAL DATA

30-1000MHz Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Monica Harrison											
Date:		12/15/09											
Project #:		09J12958											
Company:		SMK Corporation											
EUT Description:		2.4GHz DSSS Zigbee Module											
EUT M/N:													
Test Target:		FCC Class B											
Mode Oper:		TX w/DC Power											
f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit								
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters										
Read	Analyzer Reading	Filter	Filter Insert Loss										
AF	Antenna Factor	Corr.	Calculated Field Strength										
CL	Cable Loss	Limit	Field Strength Limit										
f	Dist	Read	AF	CL	Amp	D Corr	Filter	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
MHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
55.081	3.0	43.5	7.9	0.6	29.6	0.0	0.0	22.5	40.0	-17.5	V	P	
55.441	3.0	44.4	7.9	0.6	29.6	0.0	0.0	23.3	40.0	-16.7	V	P	
68.162	3.0	41.8	8.2	0.7	29.6	0.0	0.0	21.2	40.0	-18.8	V	P	
96.363	3.0	36.3	9.1	0.9	29.5	0.0	0.0	16.8	43.5	-26.7	V	P	
195.367	3.0	34.9	11.6	1.3	28.9	0.0	0.0	18.9	43.5	-24.6	V	P	
463.938	3.0	31.0	16.2	2.1	29.6	0.0	0.0	19.6	46.0	-26.4	V	P	

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

## 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

### TEST PROCEDURE

ANSI C63.4

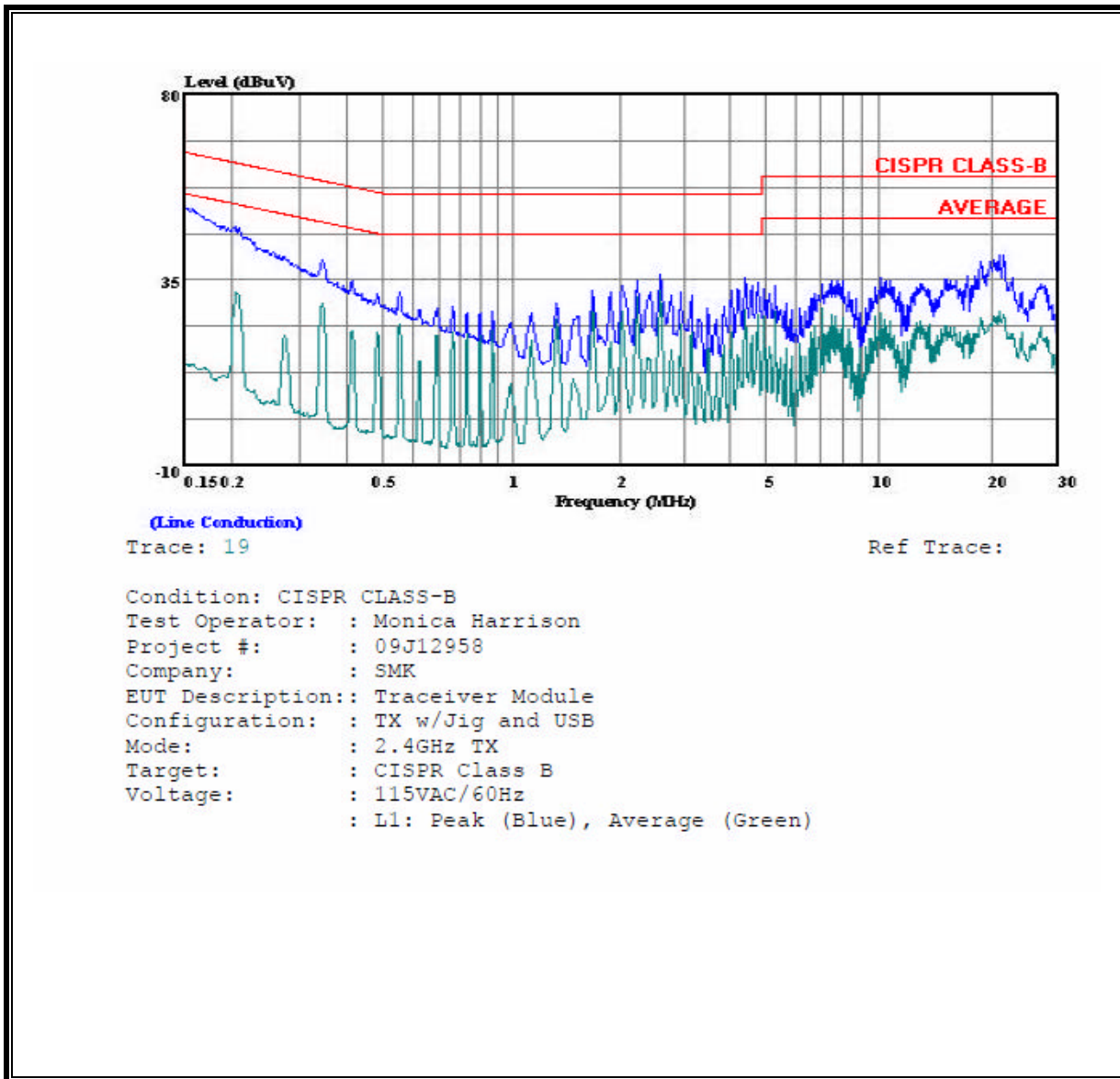
### RESULTS

**6 WORST EMISSIONS**

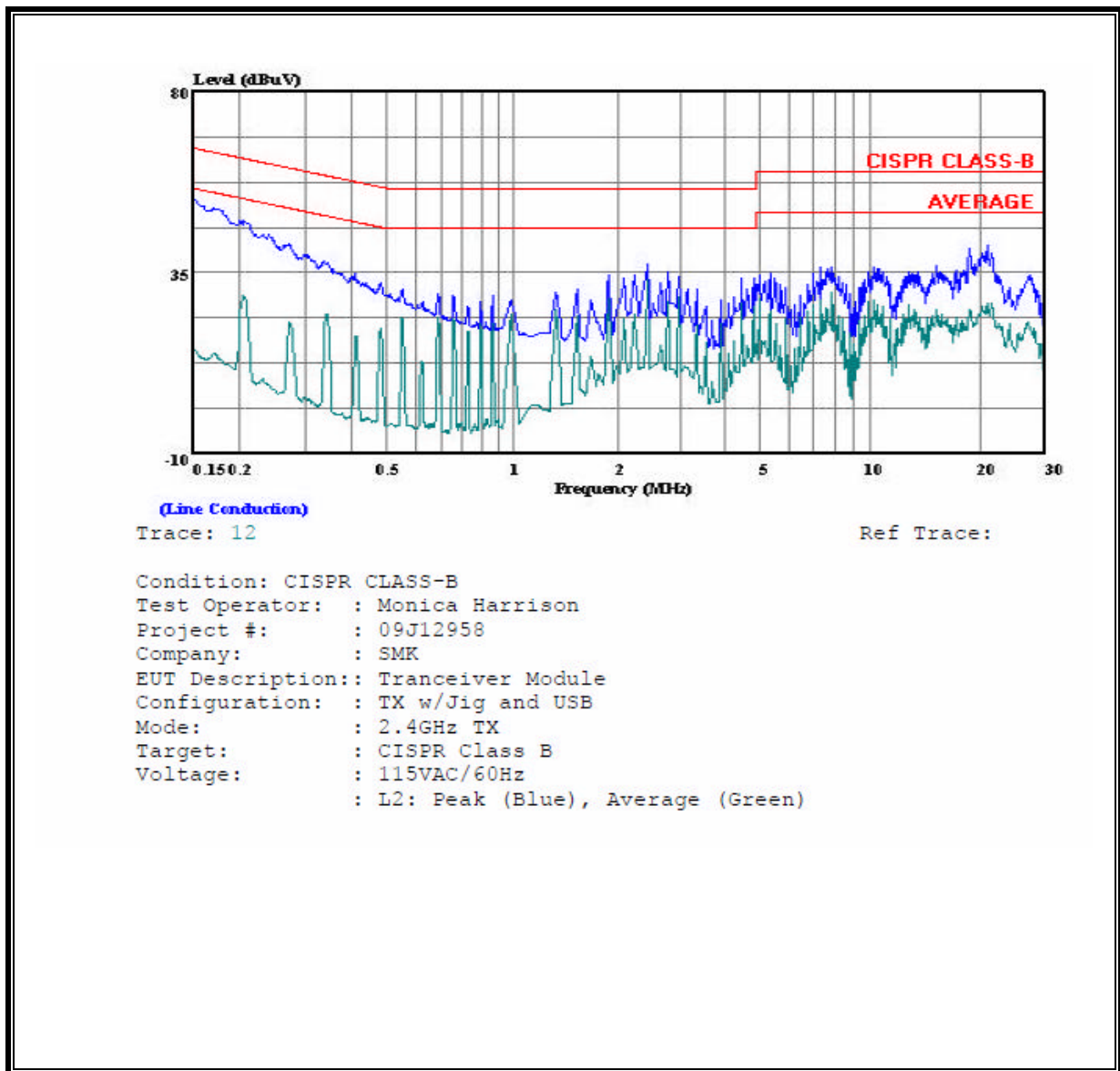
CONDUCTED EMISSIONS DATA (115VAC 60Hz)										
Freq. (MHz)	Reading			Class (dB)	Limit QP	FCC B		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)			AV	QP (dB)	AV (dB)		
0.15	52.39	--	15.73	0.00	65.89	55.89	-13.50	-40.16	L1	
0.20	47.48	--	31.77	0.00	63.53	53.53	-16.05	-21.76	L1	
0.35	39.95	--	29.44	0.00	59.06	49.06	-19.11	-19.62	L1	
0.17	50.65	--	14.59	0.00	64.77	54.77	-14.12	-40.18	L2	
0.21	47.74	--	28.71	0.00	63.37	53.37	-15.63	-24.66	L2	
21.04	41.55	--	27.22	0.00	60.00	50.00	-18.45	-22.78	L2	
6 Worst Data										



**LINE 1 RESULTS**



**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 <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.

**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 <sup>2</sup> )	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> <sup>0.5</sup>	0.0042 <i>f</i> <sup>0.5</sup>	<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> <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616 000 / <i>f</i> <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 mW/cm<sup>2</sup>.
  3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

**EQUATIONS**

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

where

- S = Power density in W/m<sup>2</sup>
- EIRP = Equivalent Isotropic Radiated Power in W
- D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mW/cm<sup>2</sup> by dividing by 10.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

**LIMITS**

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

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

**RESULTS**

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	802.15.4	0.20	-2.25	4.64	0.0035	0.0003