



FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

TRANSCEIVER MODULE

MODEL NUMBER: RXR1000-02XXE

FCC ID: GT3FC009

REPORT NUMBER: 10J13167-1

ISSUE DATE: MAY 06, 2010

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>
--	05/05/10	Initial Issue	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: TRANSCEIVER MODULE

MODEL: RXR1000-02XXE

SERIAL NUMBER: 00-00-00-73-B5 (CONDUCTED);
00-00-00-73-DB (RADIATED)

DATE TESTED: APRIL 23 AND 26, 2009

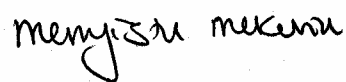
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

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. 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:

Tested By:



THU CHAN
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

MENGISTU MEKURIA
EMC 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 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. 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 Average and Peak conducted output power as follows:

Frequency Range (MHz)	Mode	Average Power (dBm)	Average Power (mW)	Peak Power (dBm)	Peak Power (mW)
2425-2475	802.15.4	-5.025	0.31	-4.85	0.33

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PCB (Monopole) antenna, with a maximum gain of +0.6dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was impulse_receiver_1_2_full Ver. 1.2. The test utility software used during testing was ProjUSBrom_CodeChk20100405.exe.

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 Orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
DC Power Supply	ELF Gaussmeter	FW Bell	911007	DoC

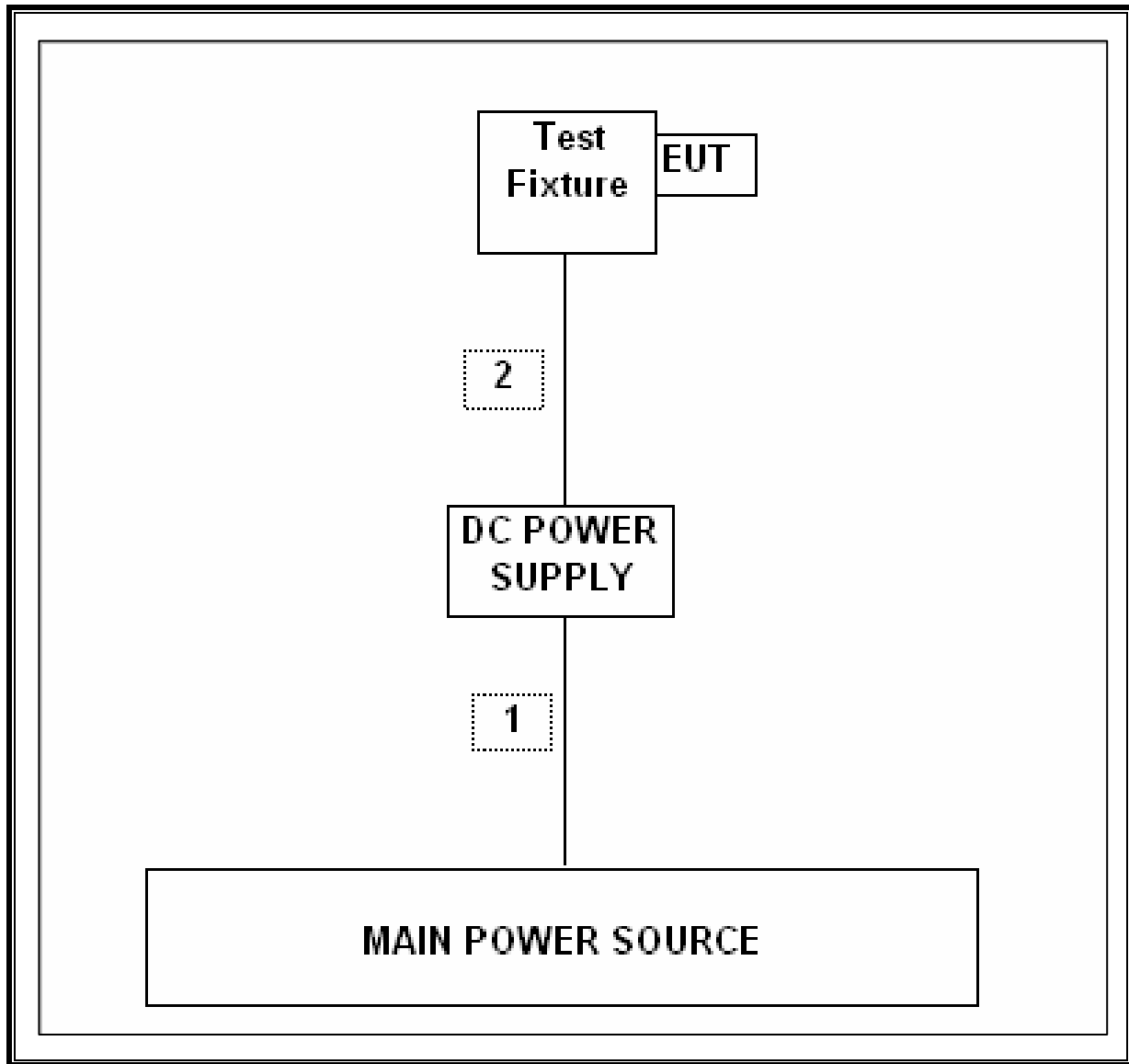
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	2.0 m	N/A
2	DC	1	DC	Unshielded	1.0 m	N/A

TEST SETUP

The EUT is installed in a test board JIG. Laptop is used only to program the EUT. Test software exercised the radio card. 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	C01069	03/05/11
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01179	08/24/10
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01178	08/31/10
Peak Power Sensor	Boonton	57006	C01202	02/23/11
Peak Power Meter	Boonton	4541	C01189	02/26/11
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/06/10
Antenna, Horn, 18 GHz	EMCO	3115	C00945	07/29/10
Antenna, Horn, 18 GHz	EMCO	3115	C00783	07/29/10
Antenna, Bilog, 2 GHz	Sundt Sciences	JB1	C01011	07/14/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	07/06/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	08/04/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	08/04/10

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)

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

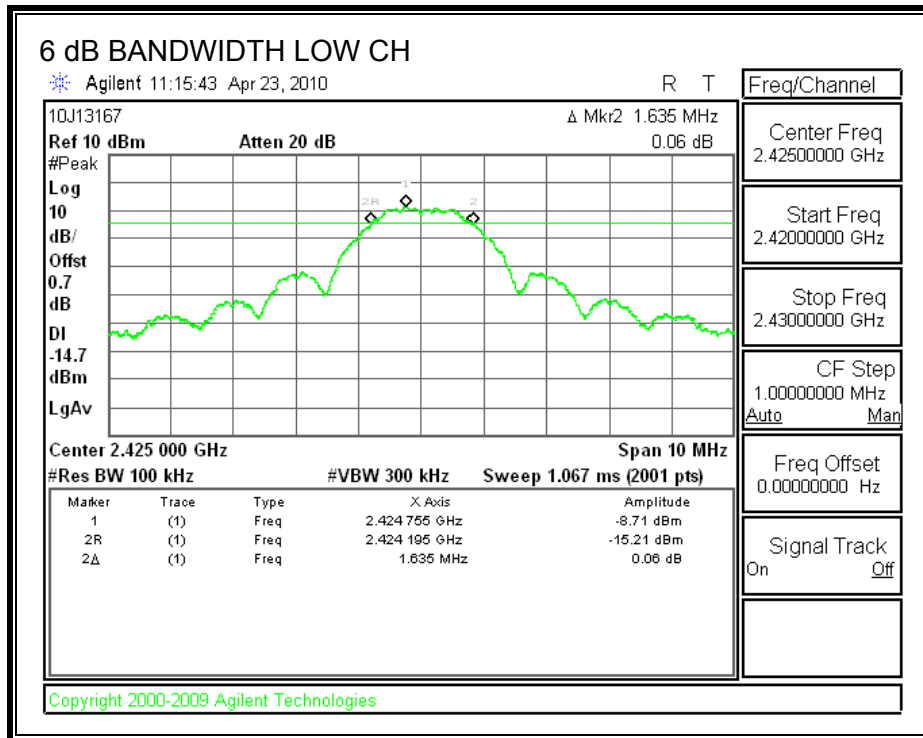
TEST PROCEDURE

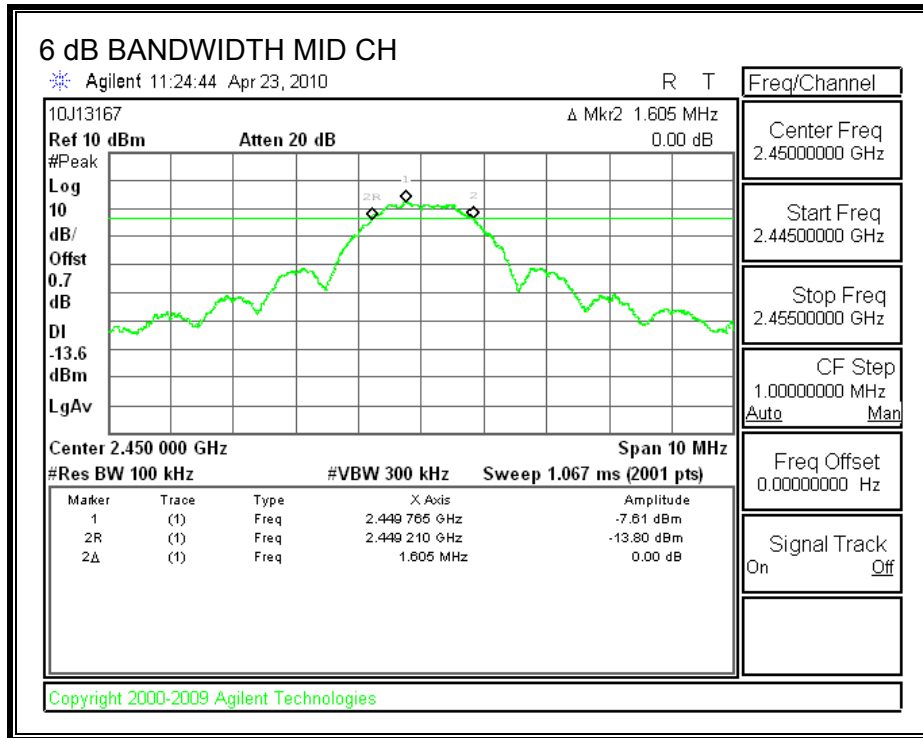
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

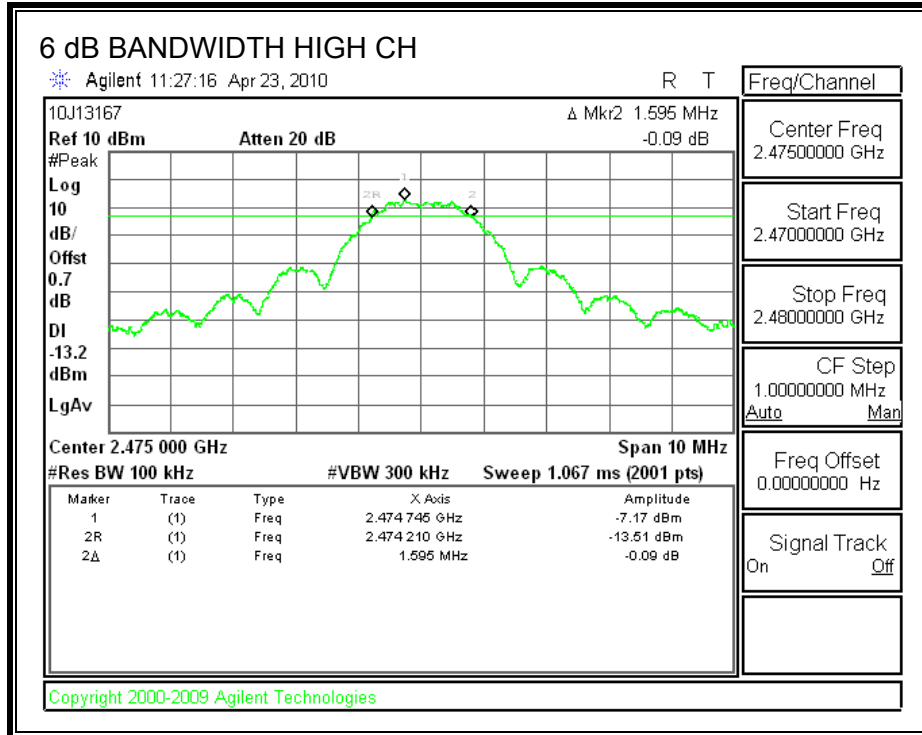
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2425	1.635	0.5
Middle	2450	1.605	0.5
High	2475	1.595	0.5

6 dB BANDWIDTH







7.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

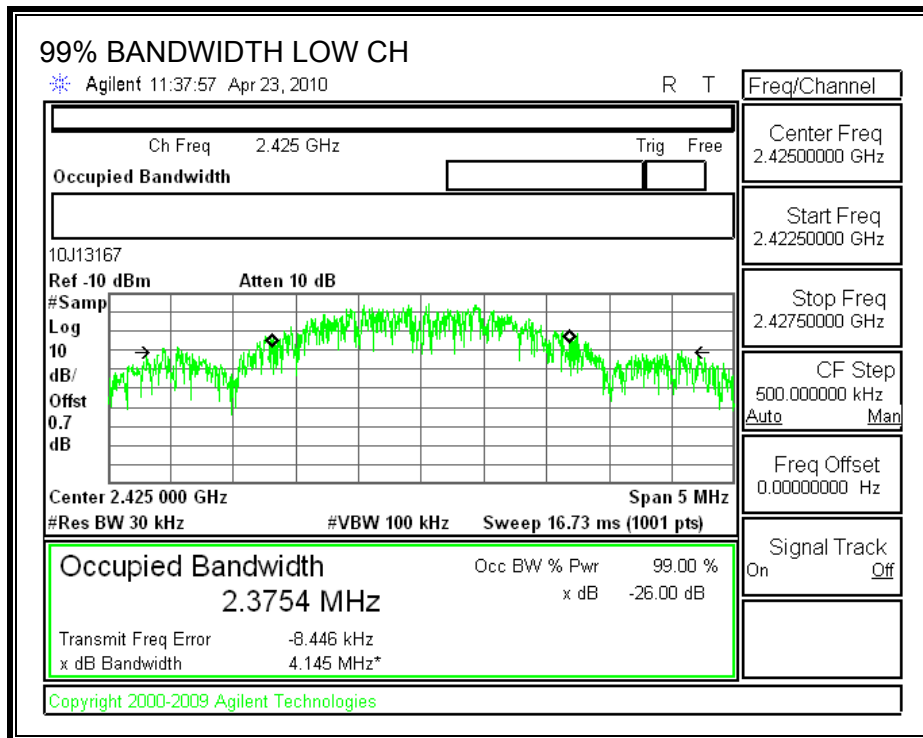
TEST PROCEDURE

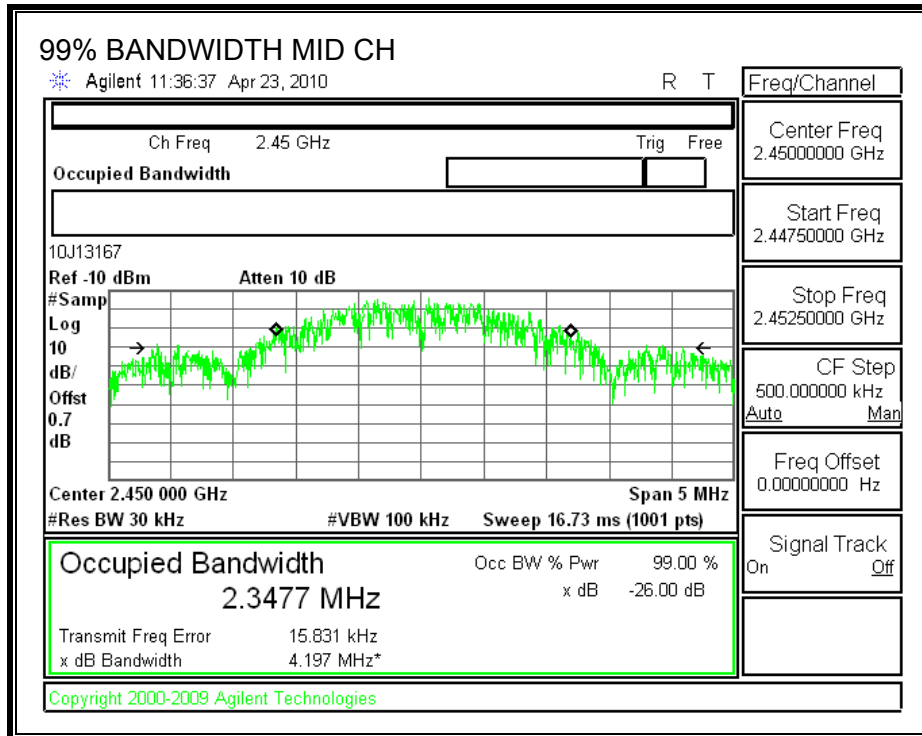
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

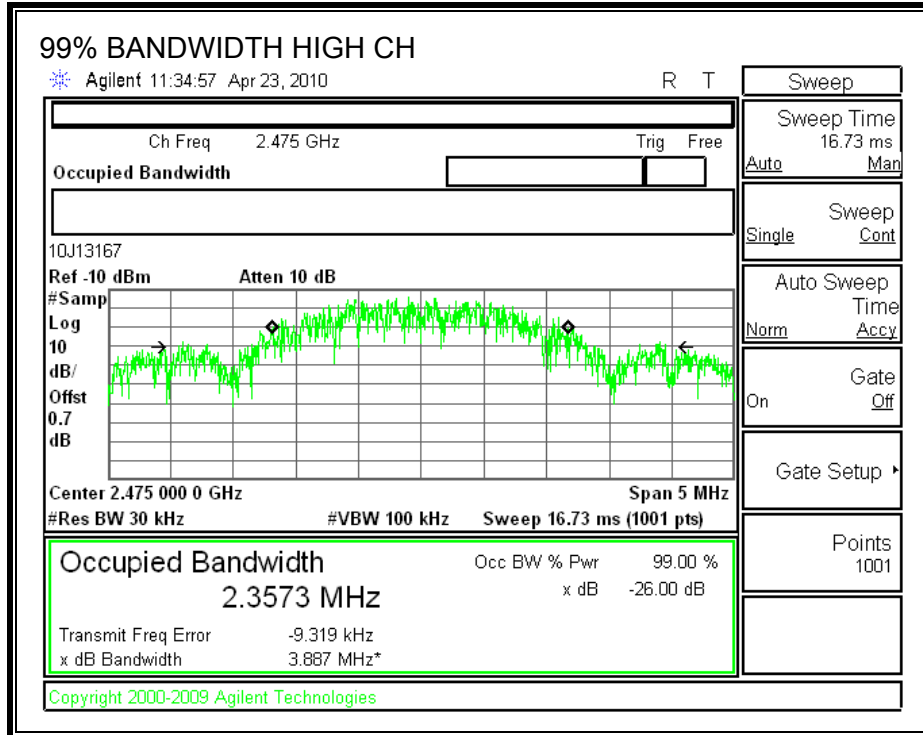
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2425	2.3754
Middle	2450	2.3477
High	2475	2.3573

99% BANDWIDTH







7.1.3. 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

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 0.70dB 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	-5.496	30	-35.50
Middle	2450	-5.132	30	-35.13
High	2475	-4.852	30	-34.85

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 0.70dB was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2425	-5.676
Middle	2450	-5.322
High	2475	-5.025

7.1.5. 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.

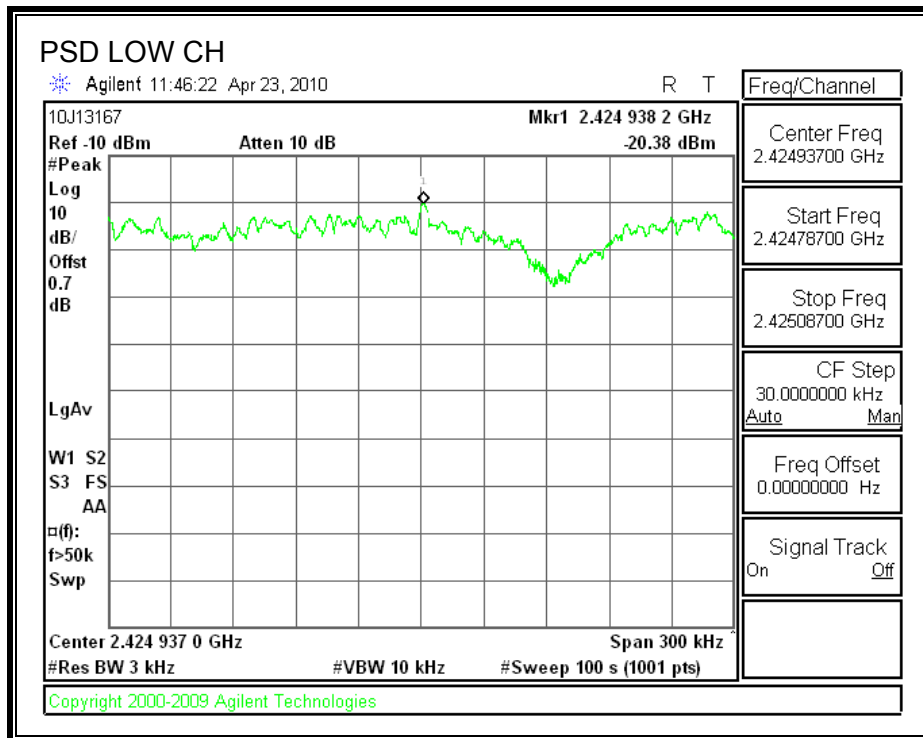
TEST PROCEDURE

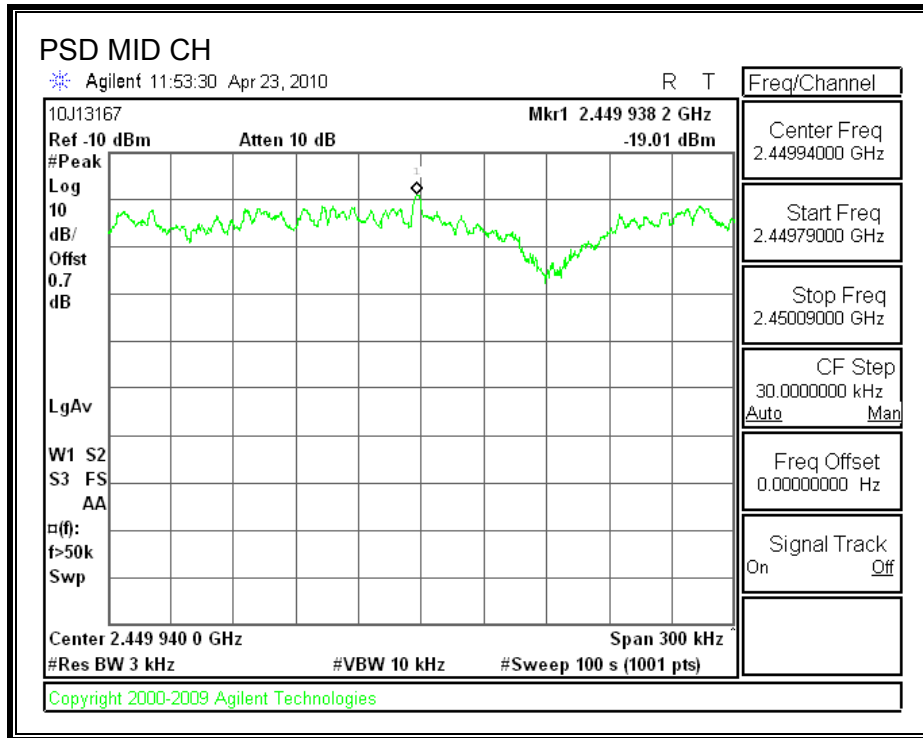
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

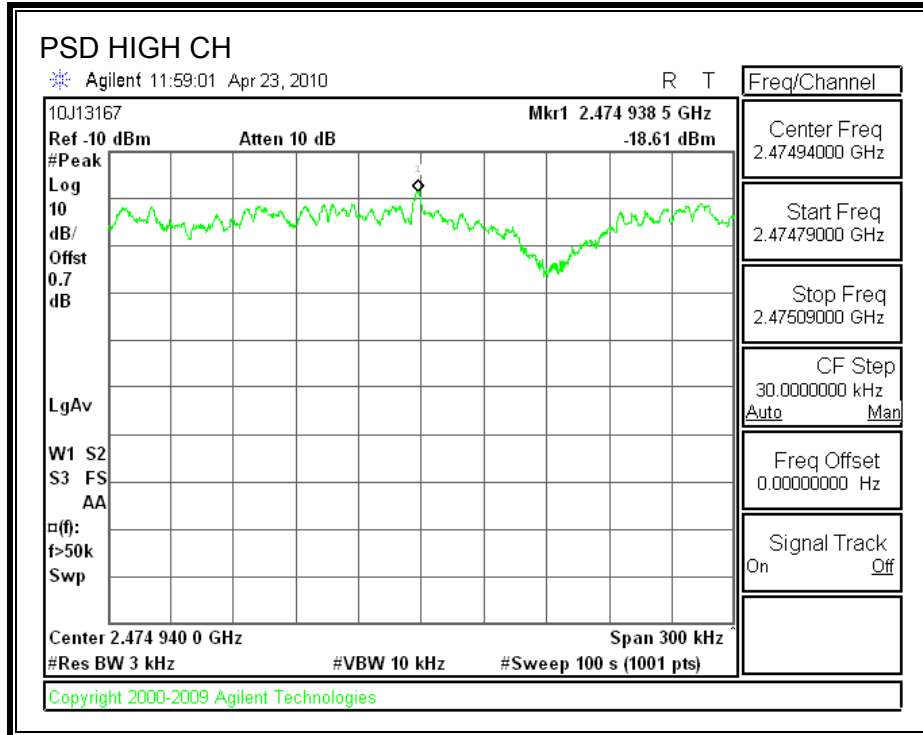
RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-20.38	8	-28.38
Middle	2450	-19.01	8	-27.01
High	2475	-18.61	8	-26.61

POWER SPECTRAL DENSITY







7.1.6. 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.

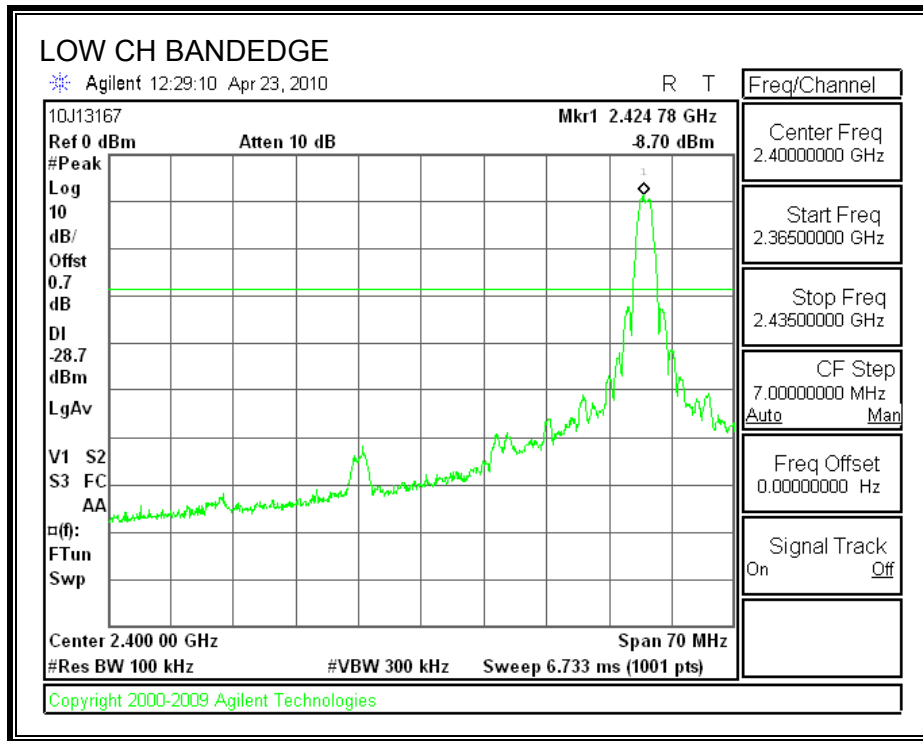
TEST PROCEDURE

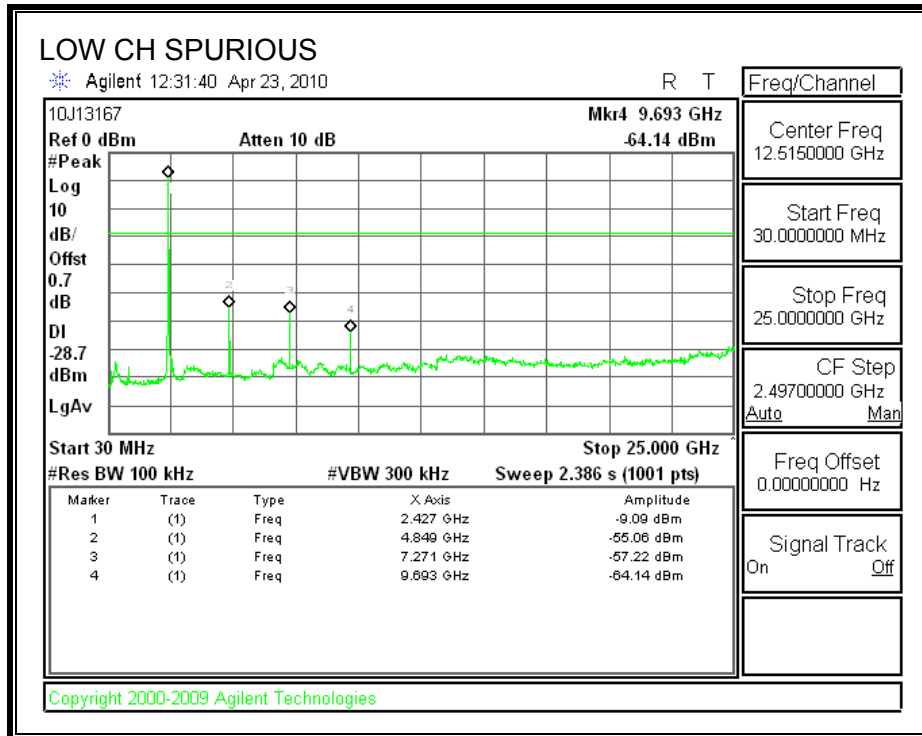
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

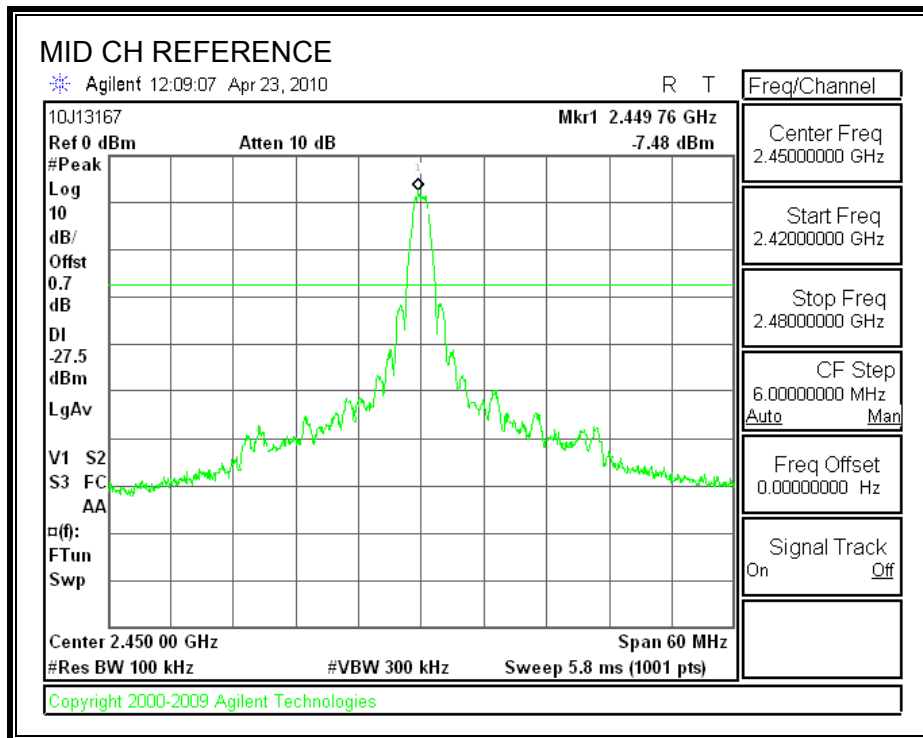
RESULTS

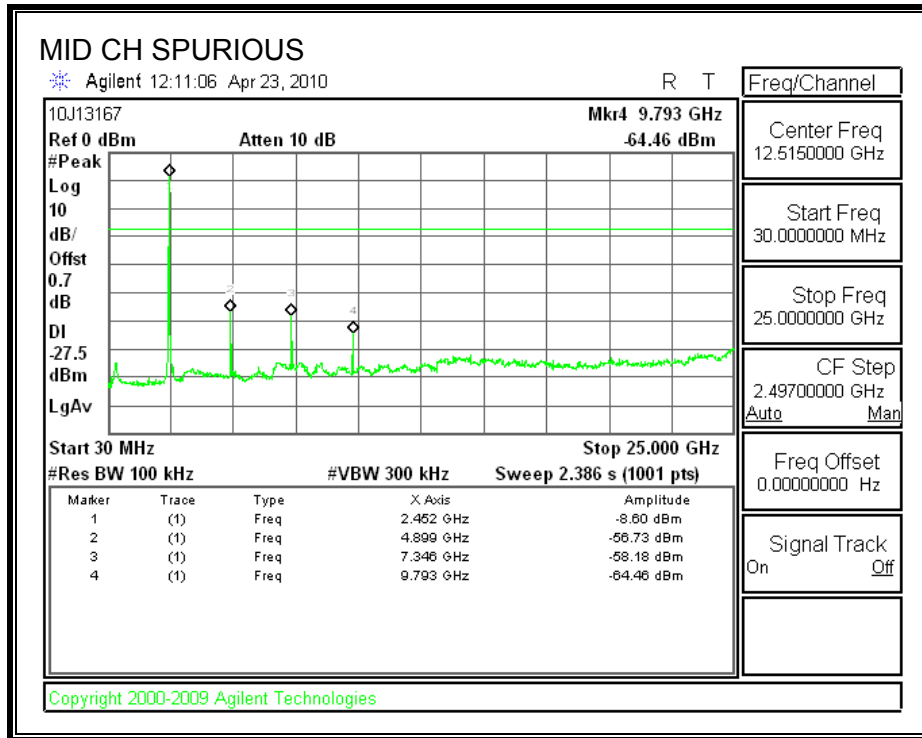
SPURIOUS EMISSIONS, LOW CHANNEL



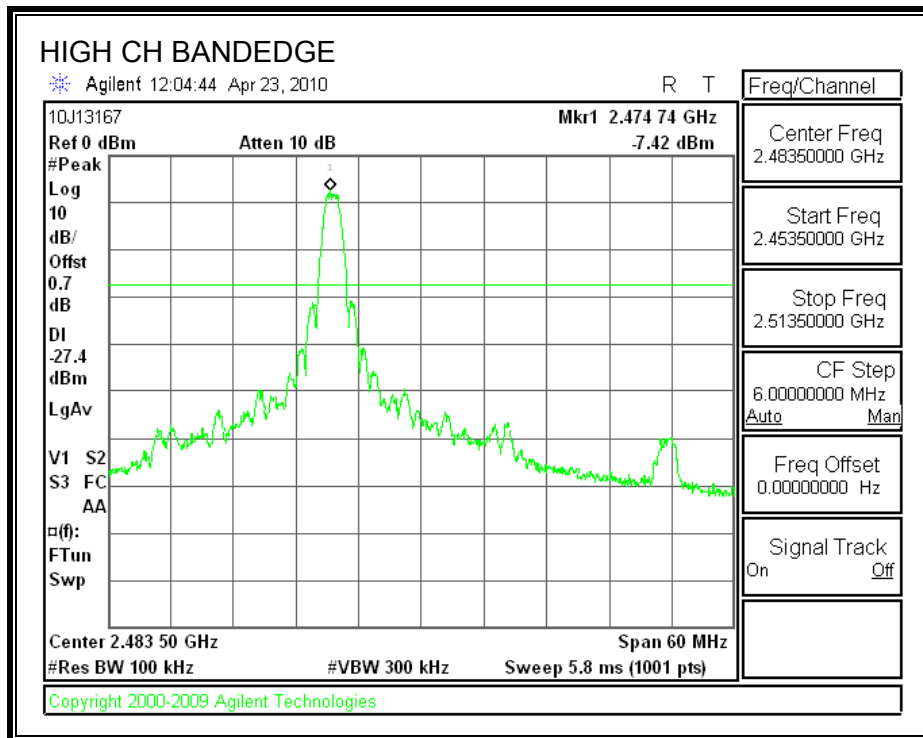


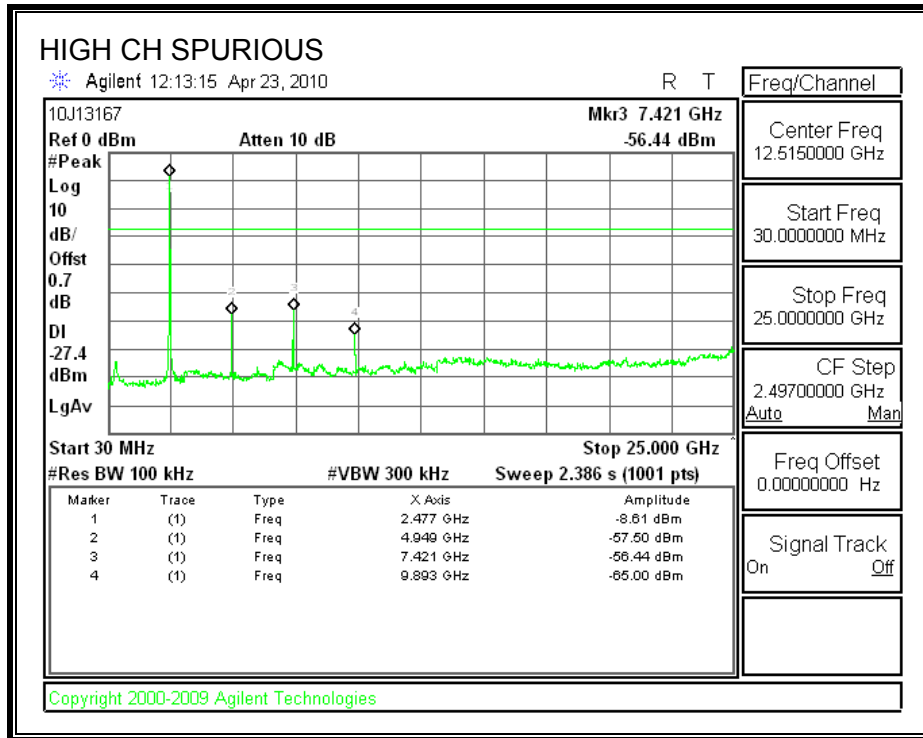
SPURIOUS EMISSIONS, MID CHANNEL





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, 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.

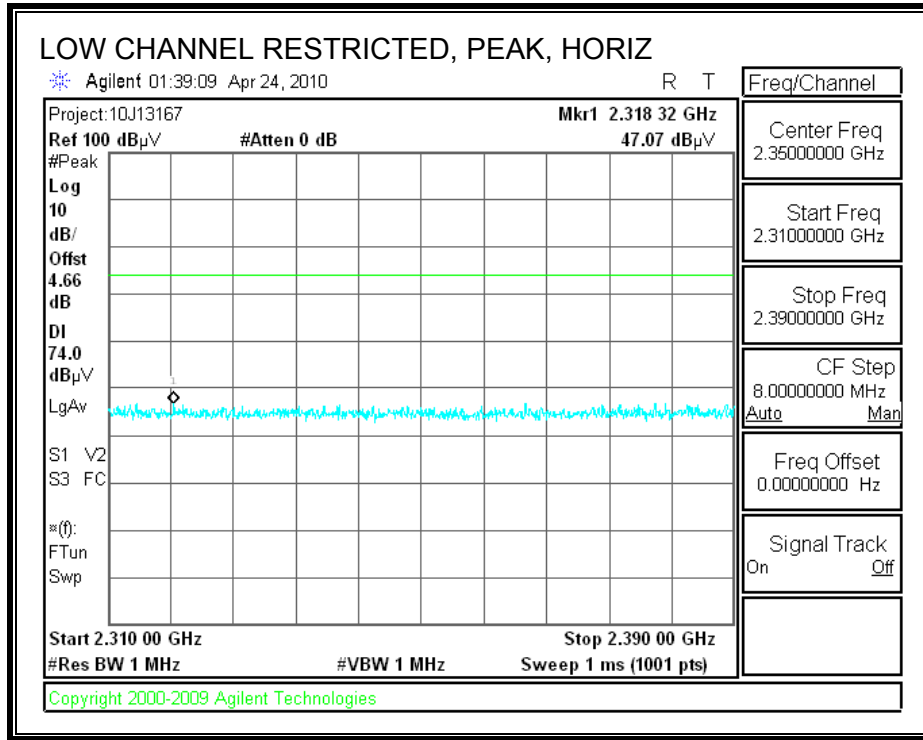
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

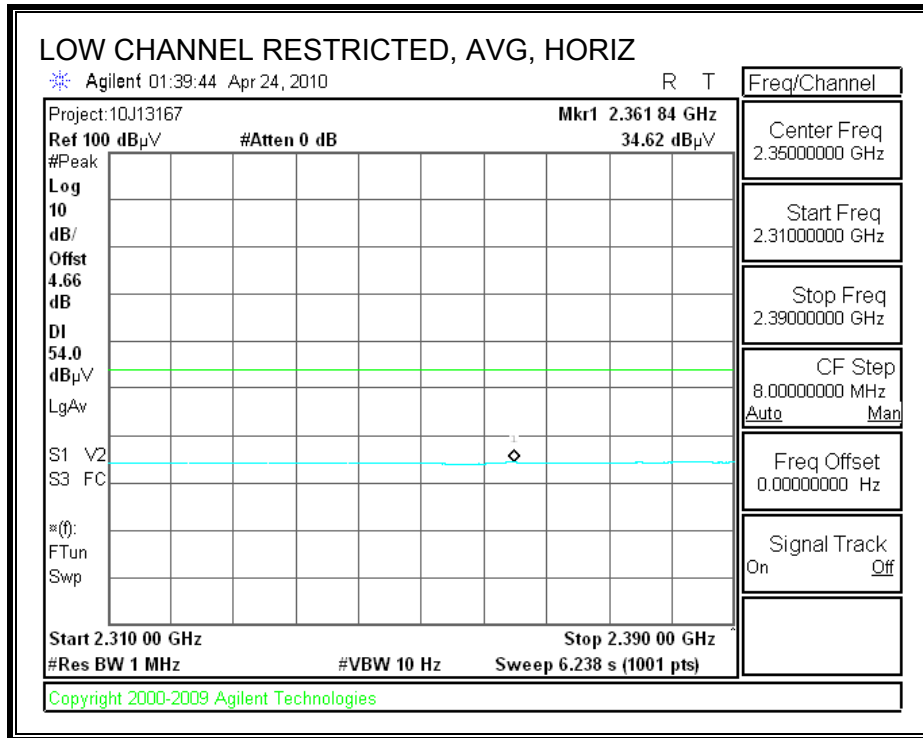
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

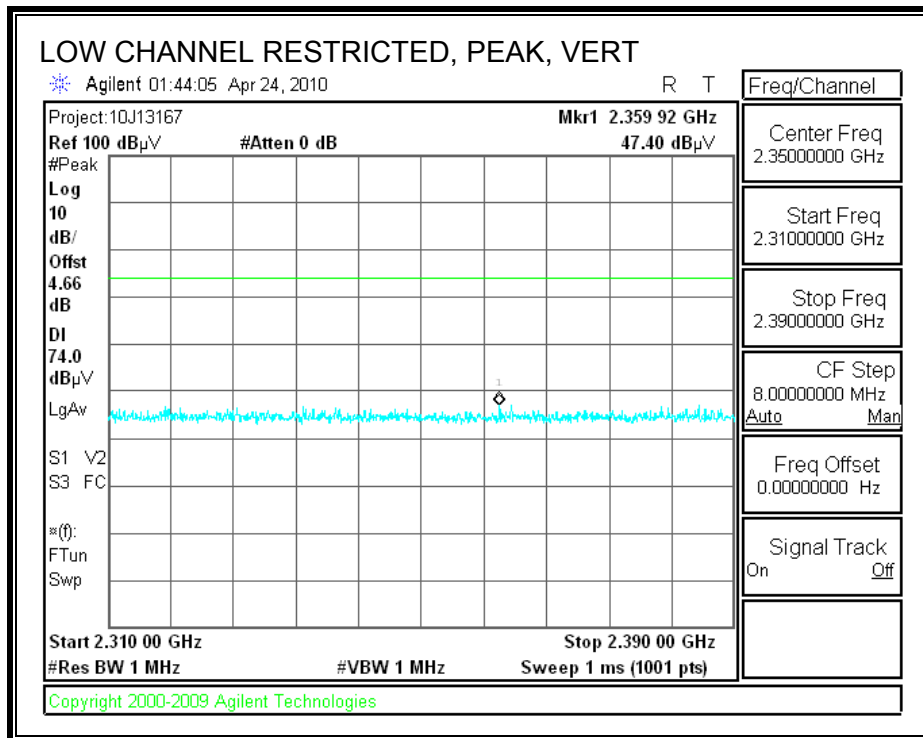
8.2.1. TRANSMITTER ABOVE 1 GHz FOR 802.15.4 IN THE 2.4 GHz BAND

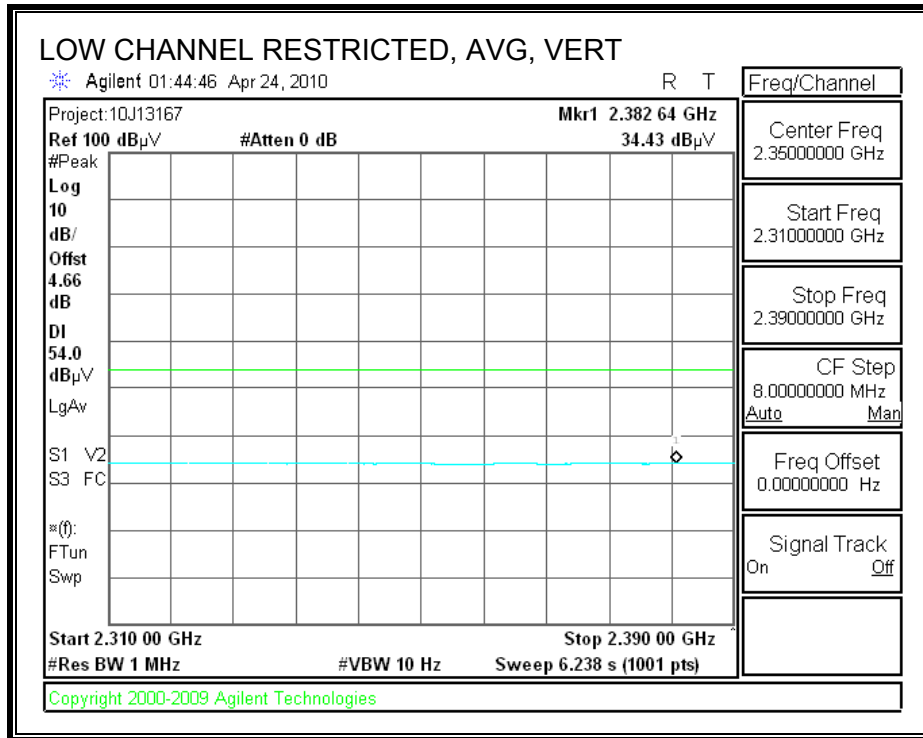
RESTRICTED BANEDGE (LOW CHANNEL, HORIZONTAL)



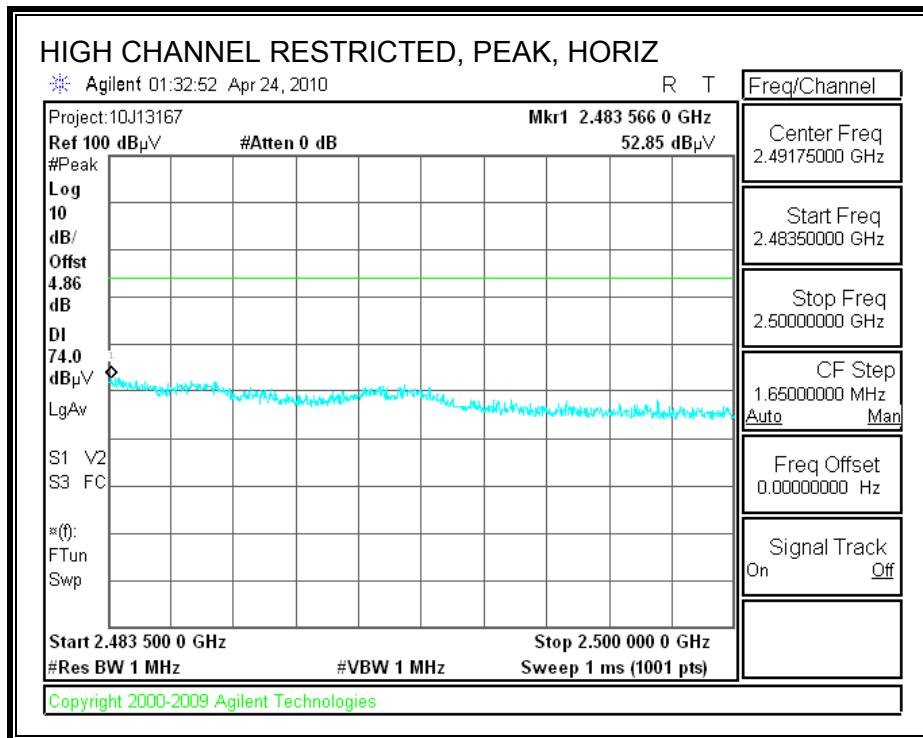


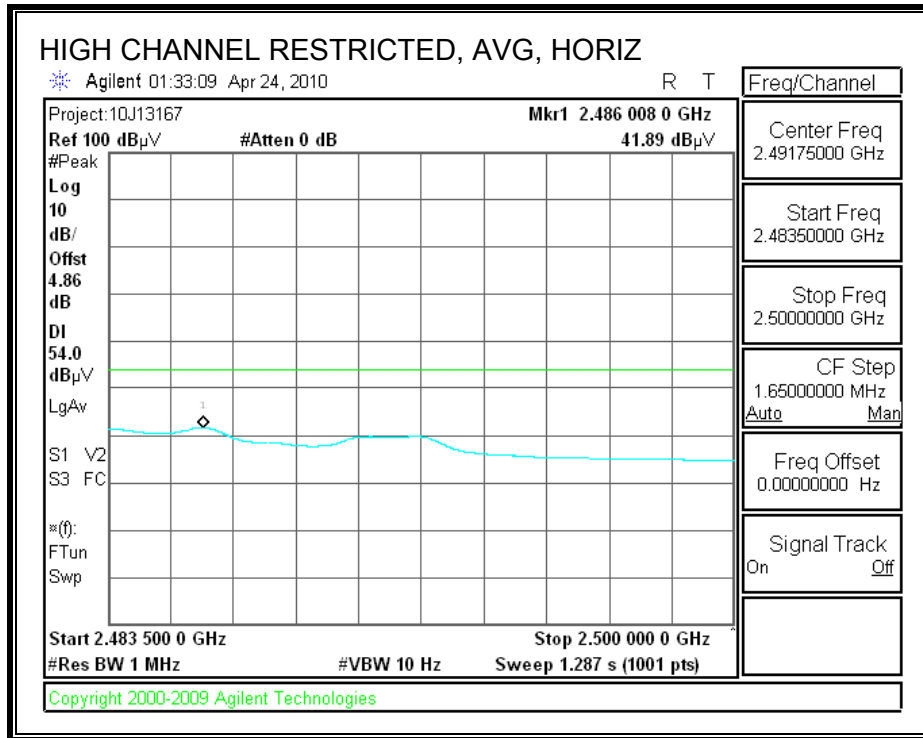
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



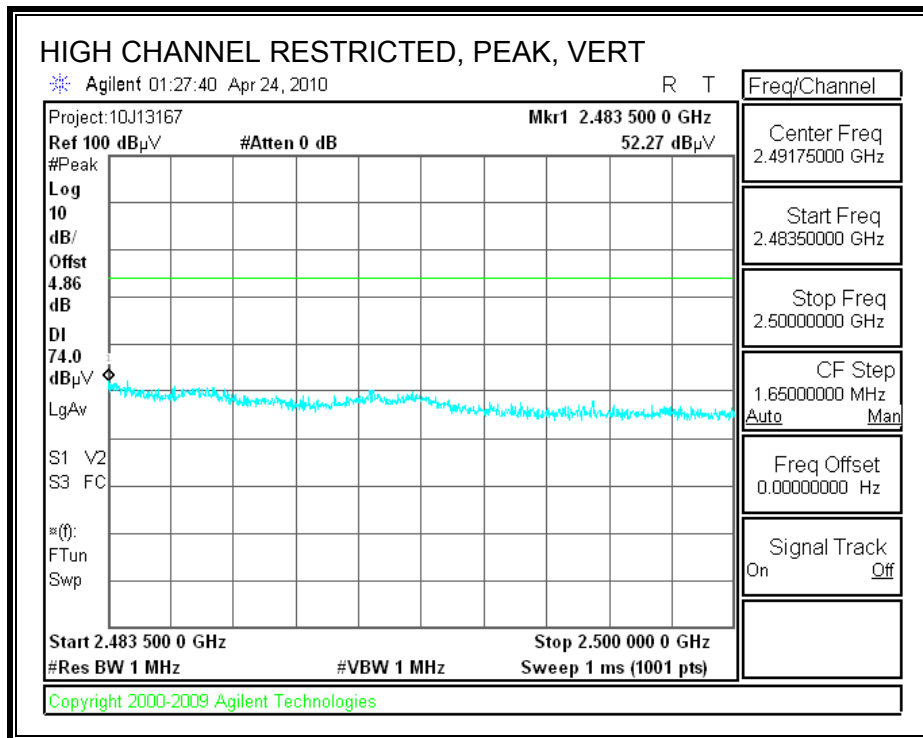


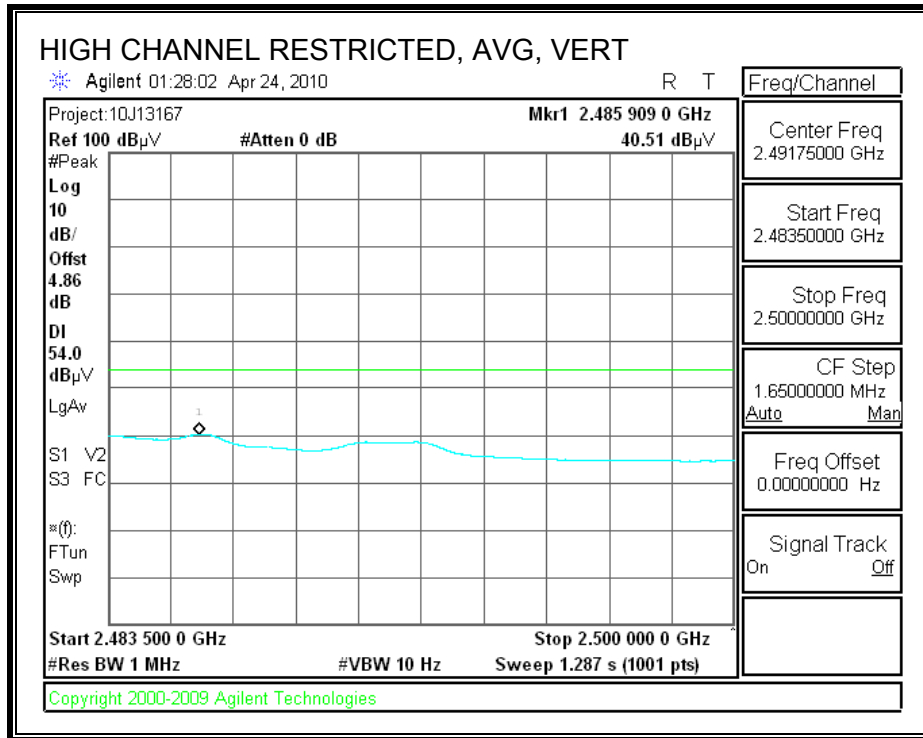
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: SMK CORPORATION
 Project #: 10J13167
 Date: 4/26/2010
 Test Engineer: MENGISTU MEKURIA
 Configuration: EUT AND DC POWER SUPPLY
 Mode: TX MODE

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T59; S/N: 3245 @3m	T145 Agilent 3008A005			FCC 15.205

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	

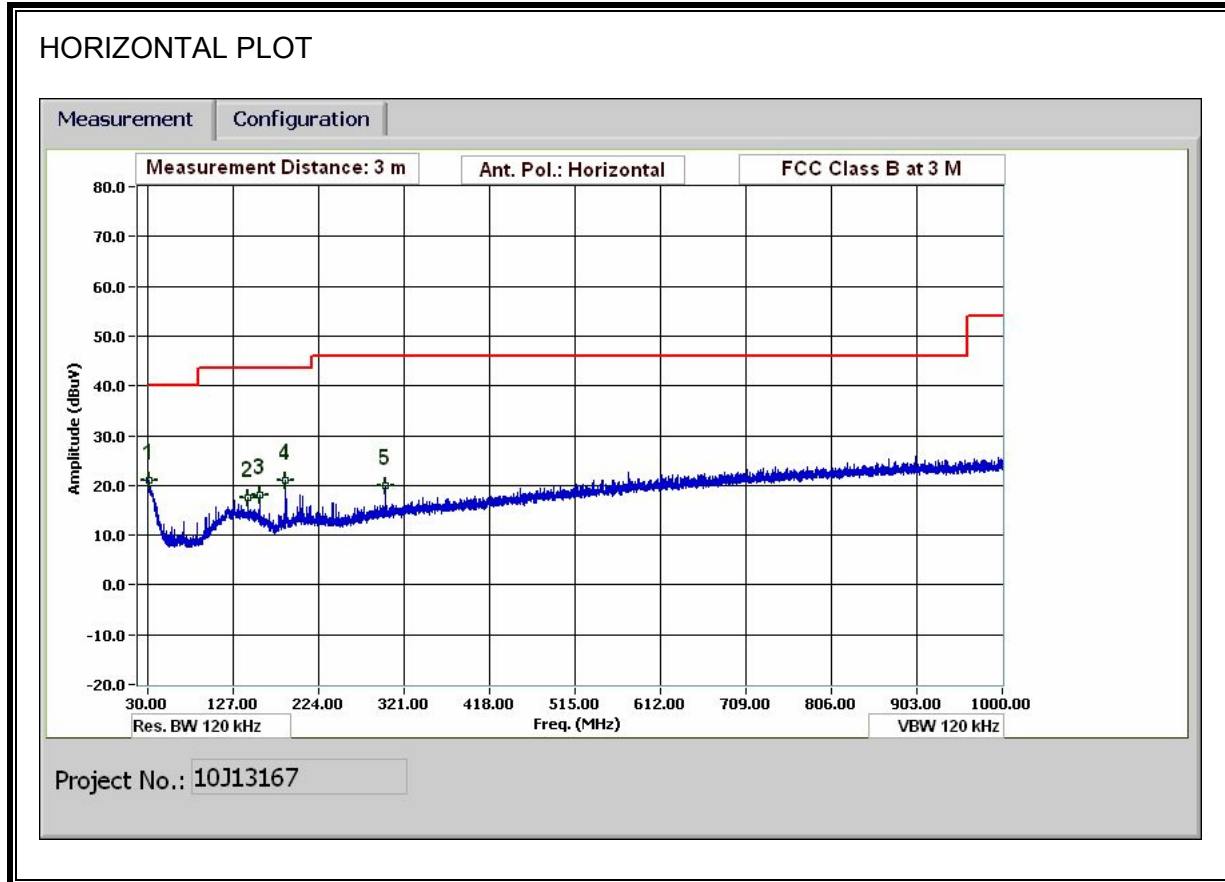
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Channel (2425.00 MHz)															
4.850	3.0	45.8	36.2	32.8	5.8	-34.8	0.0	0.0	49.6	40.0	74	54	-24.4	-14.0	V
7.275	3.0	40.4	29.6	35.1	7.2	-34.7	0.0	0.0	48.1	37.3	74	54	-25.9	-16.7	V
4.850	3.0	44.6	35.0	32.8	5.8	-34.8	0.0	0.0	48.4	38.8	74	54	-25.6	-15.2	H
7.275	3.0	39.8	28.1	35.1	7.2	-34.7	0.0	0.0	47.5	35.8	74	54	-26.5	-18.2	H
Mid Channel (2450.00 MHz)															
4.900	3.0	45.1	35.5	32.8	5.9	-34.9	0.0	0.0	48.9	39.3	74	54	-25.1	-14.7	V
7.350	3.0	39.6	27.9	35.2	7.3	-34.6	0.0	0.0	47.5	35.8	74	54	-26.5	-18.2	V
4.900	3.0	46.5	35.3	32.8	5.9	-34.9	0.0	0.0	50.3	39.1	74	54	-23.7	-14.9	H
7.350	3.0	38.9	27.6	35.2	7.3	-34.6	0.0	0.0	46.8	35.5	74	54	-27.2	-18.5	H
Hi Channel (2475.00 MHz)															
4.950	3.0	44.8	34.8	32.9	5.9	-34.9	0.0	0.0	48.7	38.7	74	54	-25.3	-15.3	V
7.425	3.0	41.1	30.0	35.4	7.3	-34.6	0.0	0.0	49.1	38.0	74	54	-24.9	-16.0	V
4.950	3.0	45.1	34.3	32.9	5.9	-34.9	0.0	0.0	49.0	38.2	74	54	-25.0	-15.8	H
7.425	3.0	38.7	27.6	35.4	7.3	-34.6	0.0	0.0	46.8	35.6	74	54	-27.2	-18.4	H

Rev. 07.22.09

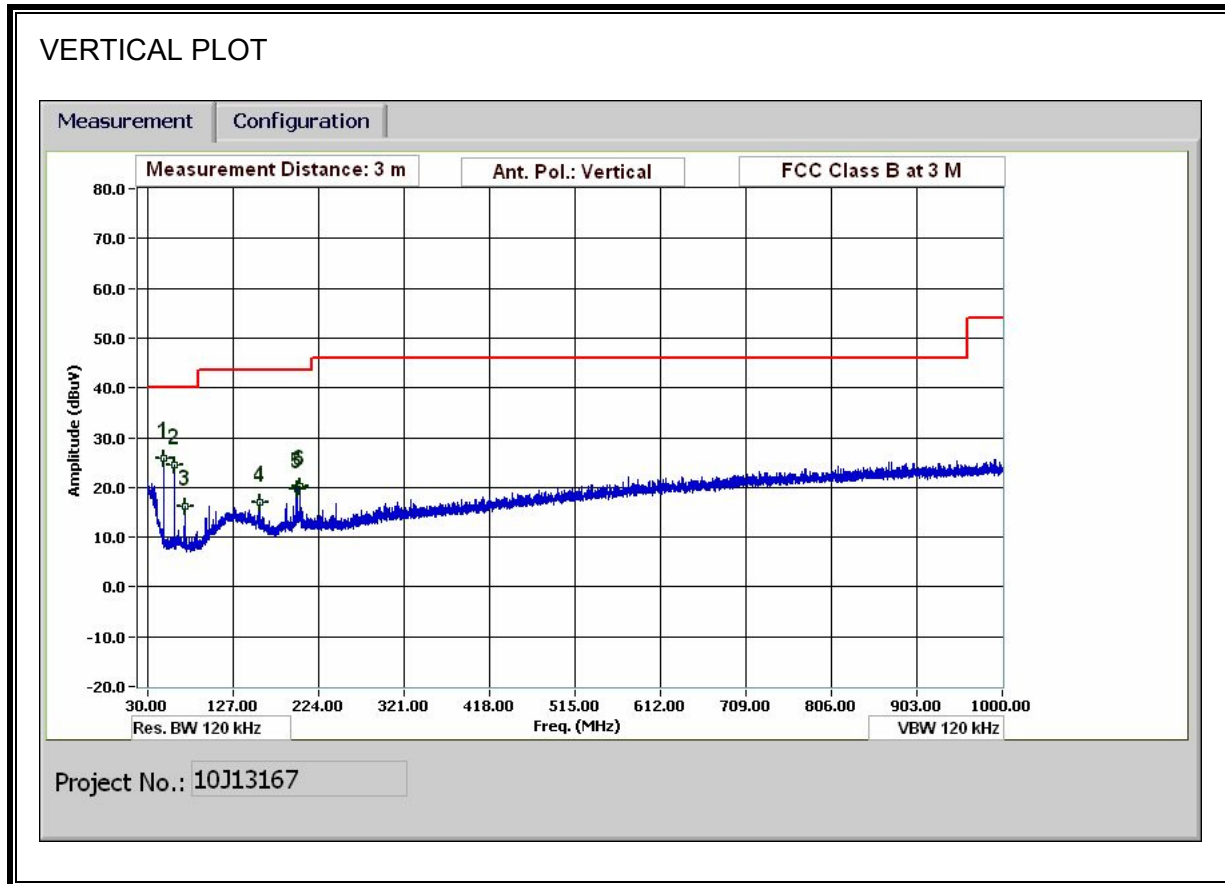
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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



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



HORIZONTAL AND VERTICAL DATA

30-1000MHz Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		MENGISTU MEKURIA											
Date:		04/23/09											
Project #:		10J13167											
Company:		SMK CORPORATION											
EUT Description:		2.4 GHz ZIGBEE TRANSCEIVER MODULE											
EUT M/N:		RXR1000-02XXE											
Test Target:		FCC CLASS B											
Mode Oper:		TX MODE											
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	
31.320	3.0	29.3	19.5	0.5	28.4	0.0	0.0	21.0	40.0	-19.0	H	P	
143.165	3.0	31.7	13.1	1.1	28.3	0.0	0.0	17.5	43.5	-26.0	H	P	
157.565	3.0	33.4	11.9	1.1	28.3	0.0	0.0	18.2	43.5	-25.3	H	P	
186.126	3.0	36.7	11.3	1.2	28.2	0.0	0.0	20.9	43.5	-22.6	H	P	
299.891	3.0	33.2	13.4	1.5	28.1	0.0	0.0	20.0	46.0	-26.0	H	P	
48.001	3.0	44.1	9.3	0.6	28.4	0.0	0.0	25.7	40.0	-14.3	V	P	
60.001	3.0	44.3	7.9	0.7	28.4	0.0	0.0	24.5	40.0	-15.5	V	P	
72.002	3.0	35.9	7.9	0.7	28.3	0.0	0.0	16.2	40.0	-23.8	V	P	
157.565	3.0	32.2	11.9	1.1	28.3	0.0	0.0	17.0	43.5	-26.5	V	P	
199.087	3.0	34.6	11.9	1.2	28.2	0.0	0.0	19.6	43.5	-23.9	V	P	
202.807	3.0	35.1	12.0	1.3	28.2	0.0	0.0	20.1	43.5	-23.4	V	P	
Rev. 1.27.09													
Note: No other emissions were detected above the system noise floor.													

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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

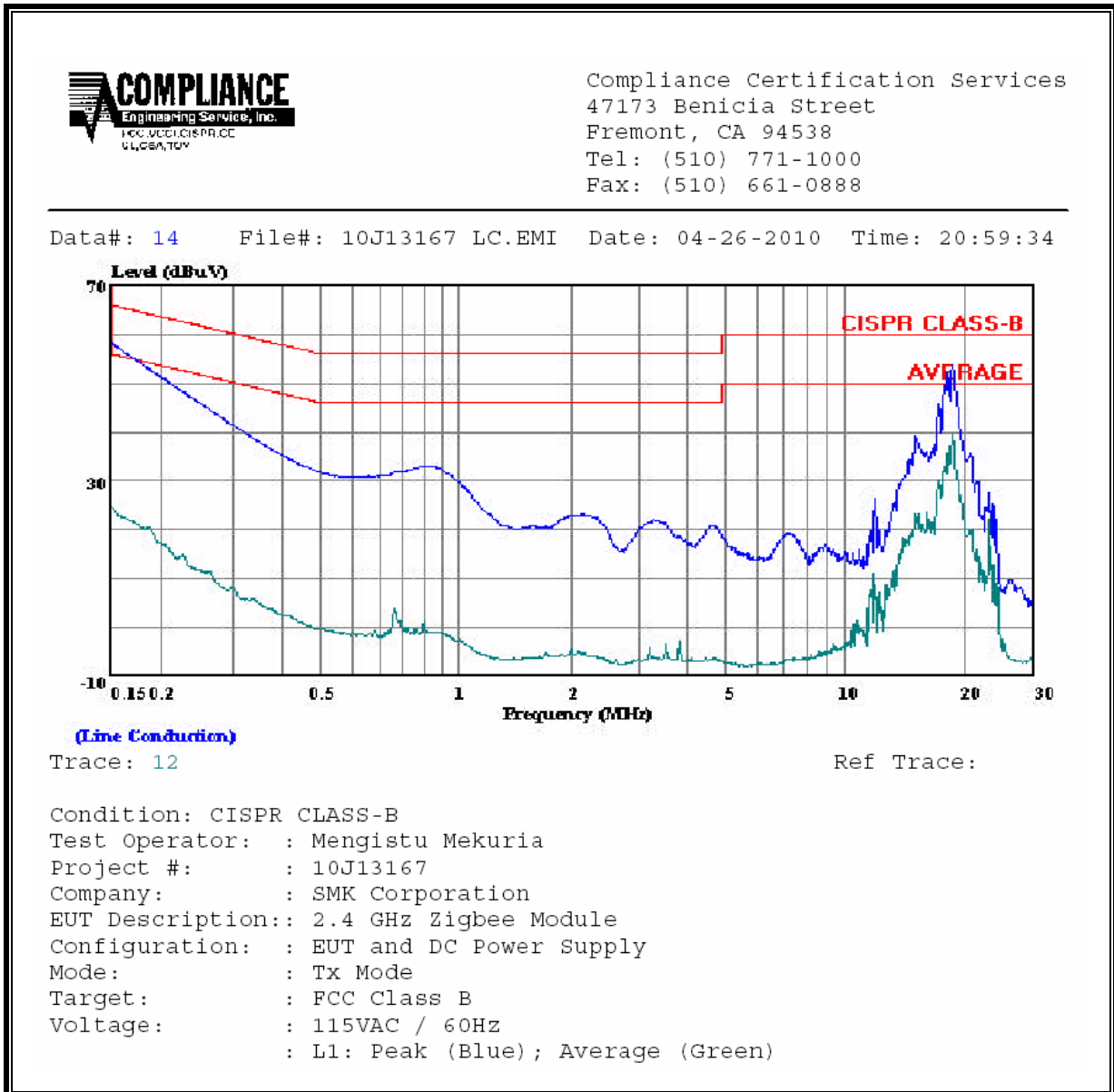
ANSI C63.4

RESULTS

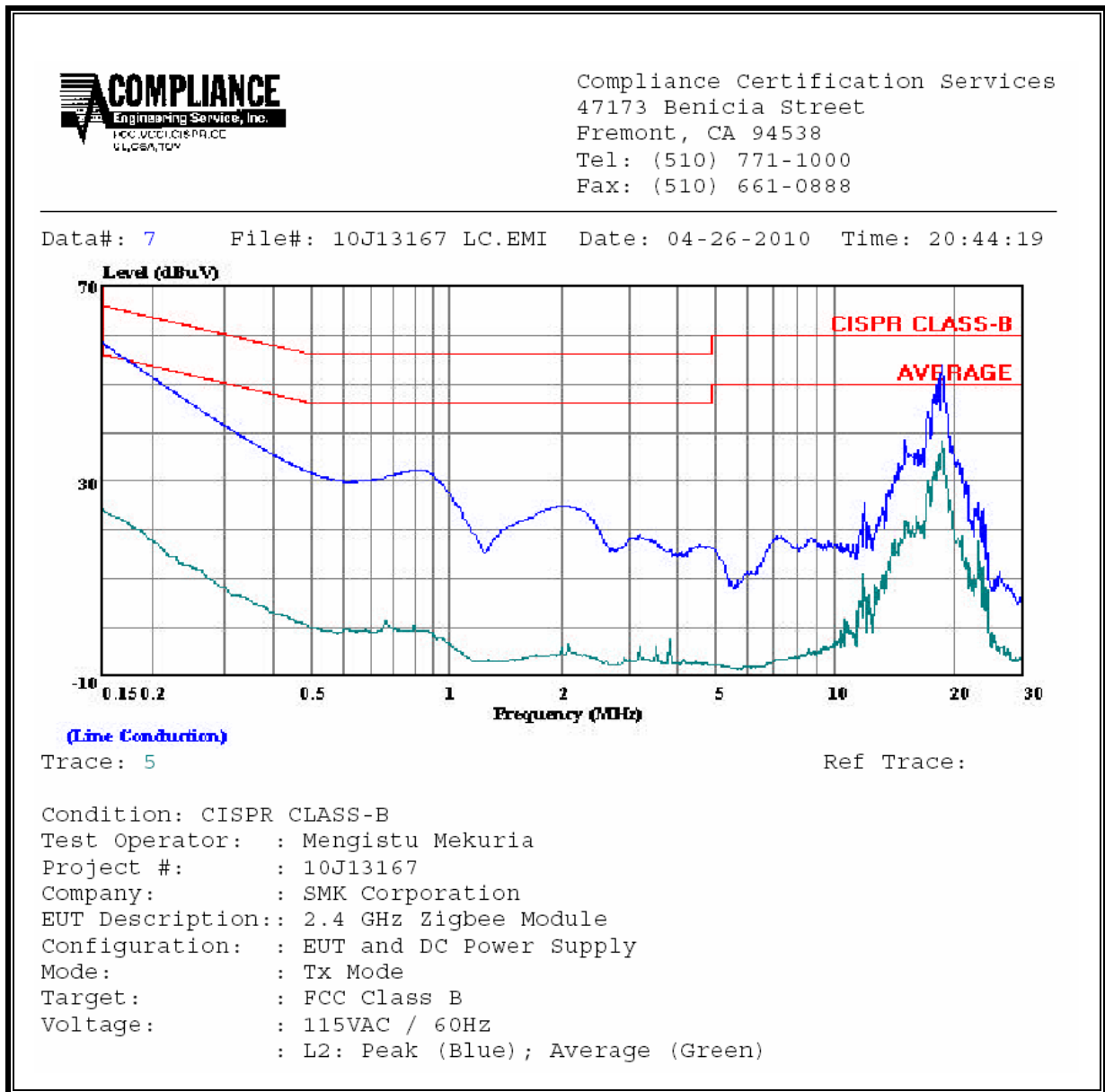
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)										
Freq. (MHz)	Reading			Class (dB)	Limit QP	EN B		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)			AV	QP (dB)	AV (dB)		
0.15	58.44	--	24.33	0.00	66.00	56.00	-7.56	-31.67	L1	
0.90	33.01	--	1.28	0.00	56.00	46.00	-22.99	-44.72	L1	
18.72	53.87	--	39.44	0.00	60.00	50.00	-6.13	-10.56	L1	
0.15	58.52	--	24.17	0.00	66.00	56.00	-7.48	-31.83	L2	
0.91	32.39	--	0.05	0.00	56.00	46.00	-23.61	-45.95	L2	
18.72	53.69	--	38.07	0.00	60.00	50.00	-6.31	-11.93	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 ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

EQUATIONS

Power density is given by:

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

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m² is converted to units of mW/cm² 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/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m ²)	FCC Power Density (mW/cm ²)
2.4 GHz	802.15.4	0.20	-4.85	0.60	0.0007	0.0001