COMPLIANCE WORLDWIDE INC.
TEST REPORT 354-10

In Accordance with the Requirements of
Federal Communications Commission CFR Title 47 Part 15.249, Subpart C
Industry Canada RSS 210, Issue 7

Low Power License-Exempt Radio Communication Devices
Intentional Radiators

Invivo
a division of
Philips Medical Systems
3000 Minuteman Drive
Andover, MA 01810
978-659-2800

for the

Invivo N-Vue SP02 ECG Monitor

FCC ID: S6WESSENTIAL
IC: 6331A-ESSENTIAL

Report Issued on September 10, 2010

Tested by

Brian F. Breault

Reviewed by

Larry K. Stillings

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1. Scope

This test report certifies that the Invivo a division of Philips Medical Systems Invivo N-Vue SP02 ECG Monitor, as tested, meets the FCC Part 15, Subpart C and Industry Canada RSS 210, Issue 7 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required.

2. Product Details

2.1. Manufacturer: Invivo a division of Philips Medical Systems

2.2. Model Number: N-Vue SP02 ECG Monitor

2.3. Serial Number: USA10171015

2.4. Description: The N-Vue is a wireless patient monitor intended to provide multi-vital sign patient monitoring capability in the MRI environment, i.e. within the magnet room and in close proximity to an MRI scanner magnet. The N-Vue is intended to be used either as a standalone SpO2 MRI monitor or a basic companion monitor together with other Invivo monitors. The monitor acquires patient data/waveforms from up to 2 wireless transmitters, ECG (WECG) and SpO2 (WSPO2), applied to the patient.
ECG and SpO2 waveforms and data are sent to the N-Vue by the Wireless Modules. The N-Vue includes a color touch screen.

2.5. Power Source: 11.1 Volts DC (1 Custom Li-Poly Battery)

2.6. Hardware Revs.: Not Listed

2.7. Software Rev.: APP SW 0.1

2.8. EMC Modifications: None

3. Product Configuration

3.1. EUT Hardware

Device	Manufacturer	Model	Serial No.	Comment
N-Vue MRI Compatible Monitor	Philips/Invivo	453564198611	#USA10171015	

3.2. Support Equipment

Device	Manufacturer	Model	Serial No.	Comment
11.1 V, 2.2 mAh, 24 W Lithium Ion Battery Pack	Micro Power	300-001832-002	US10311005	

3.3. Cables

Cable Type	Length	Shield	From	To
No external cables				

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3. Product Configuration (continued)

3.4. Operational Characteristics & Software

1. Test Facility

The Test Facility provides the ability to configure the radios and initiate tests via the use of commands. The Test Facility dialog, see Figure 1, is displayed by pressing the Main Setup button, then selecting the Service menu item, followed by selecting the Test Facility menu item. An example of the Test Facility dialog is below. Radio tests are active only while the Test Facility dialog is displayed. If a test is in progress, and the user closes the Test Facility dialog, the test will be aborted.

Figure 1

2. Command Format

A single command is made up of a set of 3 discrete values, each of which can be from 0 to 255. Commands are formatted as a “master command” which is the leftmost numeric value, a “sub-command” which is the center value, and a “data value” which is the rightmost numeric value.

The master command identifies the overall context of a command, for example a master command of 1 is a Radio command. The sub-command identifies a smaller scope of work for a given master command, for example sub-command 1 of the Radio master command is the Radio Frequency command. And the data value is simply data that is used by the command. For example, for the Radio master command, and the Radio Frequency sub-command, sending a data value of 11 indicates setting the radio frequency to 2402 MHz, and sending a value of 12 indicates setting the radio frequency to 2403 MHz. See Table 1 for a full list of commands. Commands are entered using arrow buttons and are executed by selecting the Confirm (checkmark) button.

Example

To set the radio to frequency 2402 MHz, the user would enter the master command of 1 (Radio command), the sub-command of 1 (Radio Frequency sub-command), and a data value of 11 (2402 MHz), and then press the Confirm button.

To initiate a radio test at the frequency of 2402 MHz, using radio A, the user would enter the following commands in the following order, pressing the Confirm (checkmark) button after selecting (or dialing in) each of the command values.

1	1	11	Set radio frequency to 2402 MHz
1	2	0	Select radio A
1	0	1	Enable radio transmit

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3. Product Configuration (continued)

3.4. Operational Characteristics & Software (continued)

3. Radio Frequency Channels

11 – 2402 MHz[1]	16 – 2479 MHz
12 – 2403 MHz	17 – 2480 MHz
13 – 2404 MHz	18 – 2481 MHz
14 – 2405 MHz	19 – 2482 MHz[1]
15 – 2440 MHz[1]	

[1] Channel selected for test

3.5. Block Diagram

Invivo N-Vue SP02 ECG Monitor

4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	Agilent	E4407B	MY4510449	7/09/2011
EMI Receiver	Hewlett Packard	8546A	3330A00115	10/28/2010
Microwave Preamp	Hewlett Packard	8449B	3008A01323	9/22/2010
Bilog Antenna	Com-Power	AC-220	25509	8/30/2011
Horn Antenna	Com-Power	AH-118	10078	7/23/2011
Horn Antenna	Com-Power	AH-826	081051	6/30/2012

4.2. Measurement & Equipment Setup

Test Dates:	9/2/2010 - 9/8/2010
Test Engineers:	Brian Breault
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	30 MHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF/Resolution Bandwidth:	100 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Average/Video Bandwidth:	300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

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4. Measurements Parameters (continued)

4.3. Measurement Procedure

Test measurements were made in accordance FCC Part 15.249, IC RSS-210 Annex II: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

The test methods used to generate the data in this test report is in accordance with ANSI C63.4: 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

The device under test was tested in its tabletop orientation. Rotating the device through three orthogonal axes in accordance with ANSI C63.4-2003, section 13.1.4.1, c) was not required.

4.4. Choice of Operating Frequencies

The Philips Medical Systems Invivo N-Vue SP02 ECG Monitor employs 9 channels in the 2400 MHz to 2483.5 MHz frequency range. In accordance with ANSI C63.4, Section 13.1.1, three channels are detailed in this test report:

Low Channel	–	Channel 11: 2402 MHz
Middle Channel	–	Channel 15: 2440 MHz
High Channel	–	Channel 19: 2482 MHz

The Philips Medical Systems Invivo N-Vue SP02 ECG Monitor employs two identical transmitters. Transmitter A was used for all testing.

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5. Measurement Summary

Test Requirement	FCC Requirement	Test Section	Result	Comment
Antenna Requirement	15.203	6.1	Compliant	Unit has an internal PCB antenna.
Radiated Field Strength of Fundamental	15.249 (a),(c)	6.2	Compliant	
Radiated Field Strength of Harmonics	15.249 (a),(c)	6.3	Compliant	
Fixed, Point-to-Point Operation	15.249 (b)	---	Not Required	
Band Edge Measurements	15.249 (d) 15.209	6.4	Compliant	
Spurious Radiated Emissions	15.249 (d), 15.209	6.5	Compliant	
Occupied Bandwidth	ANSI C63.4 § 13.1.7	6.6	Compliant	
99% Bandwidth	IC RSS-GEN	6.7	Compliant	
Conducted Emissions	15.207	N/A	Not Required	DUT uses batteries only.
Public Exposure to Radio Frequency Energy Levels	1.1307 (b) (1)	6.9	Compliant	
Spurious Emissions of License Exempt Receivers	RSS-210 2.3 RSS-GEN 7.2.3	6.10	Compliant	

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6. Measurement Data

6.1. Antenna Requirement (Section 15.203)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

Status: The antennas are internally mounted and utiliz reverse F type connectors.

6.2. Radiated Field Strength of Fundamental (15.249, Section (a), (c)), IC RSS-210 A2.9

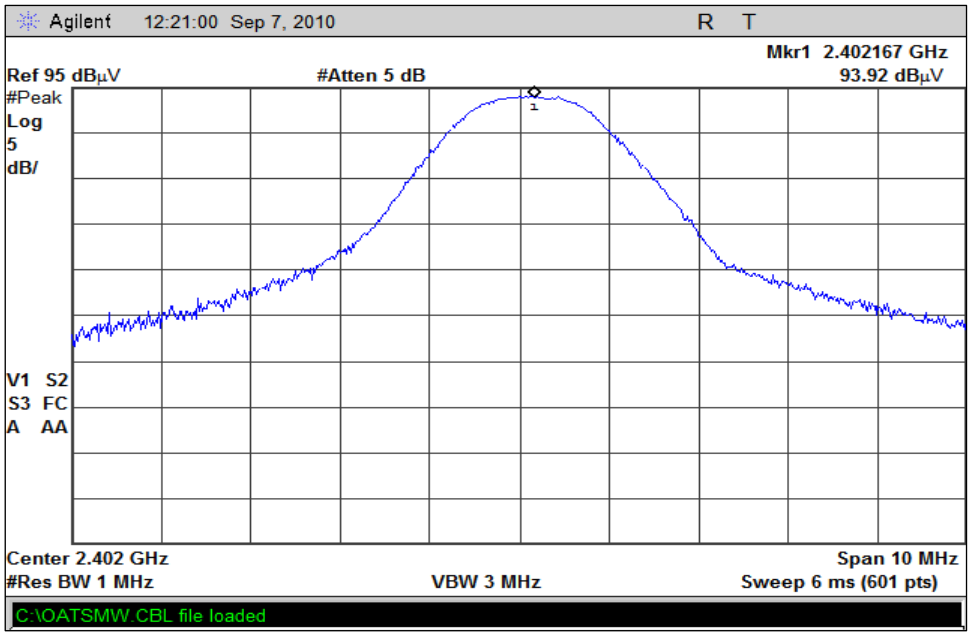
Requirement: The 3 meter field strength of the fundamental emissions from intentional radiators operated within the 2400-2483.5 MHz frequency bands shall comply with the following requirement: 50 millivolts/meter (94 dBµV/m), quasi-peak mode measurement.

Site Temperature: 22.4ºC Site Humidity: 31% RH

Chan.	Freq.	Amplitude[1] (dBµV/m)		Limit (dBµV/m)		Average Margin	Ant Polarity	Ant Height	Turntable Azimuth
		Peak	Average	Peak	Average		H/V	cm	Deg
Low	2402	93.92	66.67	114	94	-27.3	V	103	80
Mid	2440	92.95	66.24	114	94	-27.8	V	111	2
High	2482	93.17	65.73	114	94	-28.3	V	106	285

[1] All correction factors are included in the measurement values

6.2.1. Radiated Field Strength of Fundamental – Low Channel



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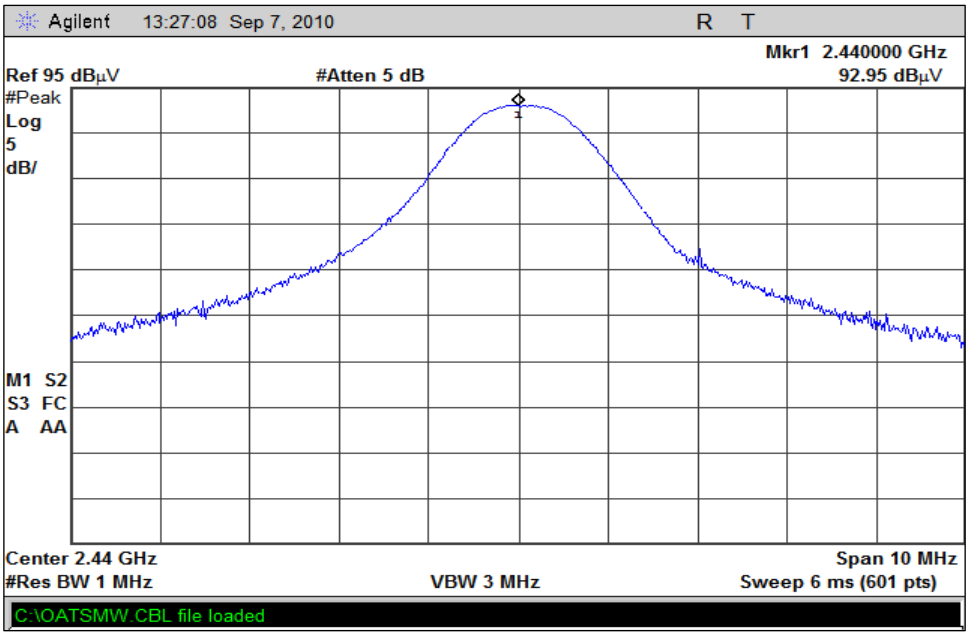
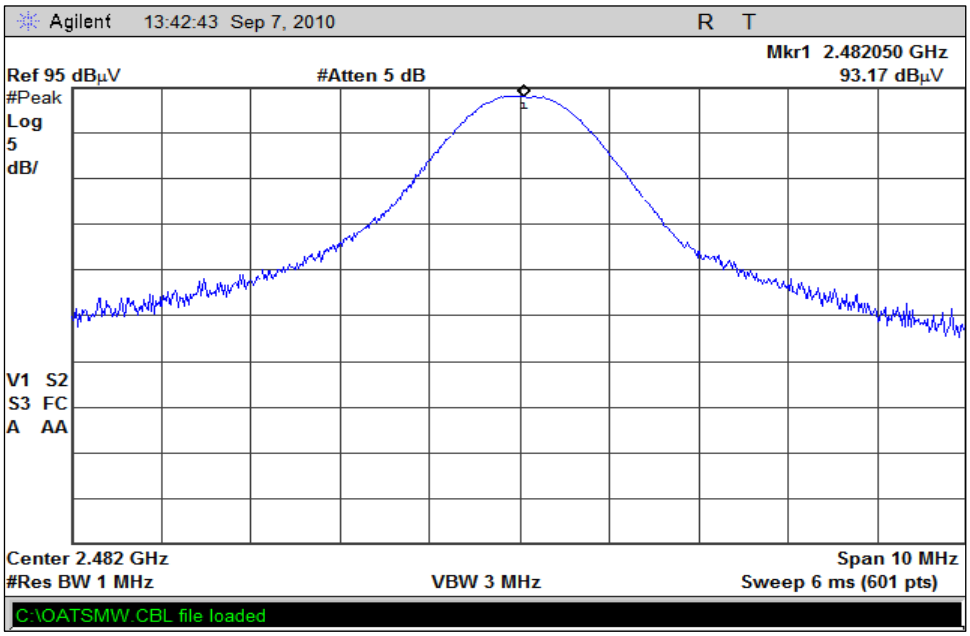
6. Measurement Data (continued)

6.2. Radiated Field Strength of Fundamental (15.249, Section (a)), IC RSS-210 A2.9

6.2.2. Radiated Field Strength of Fundamental – Middle Channel



6.2.3. Radiated Field Strength of Fundamental – High Channel



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6. Measurement Data (continued)

6.3. Radiated Field Strength of Harmonics (15.249, Section (a)), IC RSS-210 A2.9

Requirement: The 3 meter field strength of the harmonic emissions from intentional radiators operated within the 902-928 MHz frequency bands shall comply with the following: 500 microvolts/meter (54 dBµV/m), average mode measurement. Peak field strength may not be greater than 20 dB above the average limit (74 dBµV/m).

Test Note: The harmonic emissions tabled in this section represent the absolute worst case emissions from both antenna polarities.

6.3.1. Low Frequency

Fundamental Frequency (MHz)	Harmonic	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)		Ant Pol (H/V)	Antenna Height (cm)	Turntable Position (deg)
		Peak	Average	Peak	Average	Peak	Average			
2402	4804.000	53.07	35.36	74.00	54.00	-20.93	-18.64	V	100	355
	7206.000	61.00	41.52	74.00	54.00	-13.00	-12.48	V	100	90
	9608.000	54.09	41.20	74.00	54.00	-19.91	-12.80	V	100	90
	12010.000	54.53	43.15	74.00	54.00	-19.47	-10.85	V	100	190
	14412.000	56.43	47.52	74.00	54.00	-17.57	-6.48	V	100	0
	16814.000	58.07	48.00	74.00	54.00	-15.93	-6.00	V	100	0
	19216.000	51.04	39.77	74.00	54.00	-22.96	-14.23	V	100	0
	21618.000	52.26	41.32	74.00	54.00	-21.74	-12.68	V	100	0
	24020.000	54.65	44.50	74.00	54.00	-25.43	-14.16	V	100	0

6.3.2. Middle Frequency

Fundamental Frequency (MHz)	Harmonic	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)		Ant Pol (H/V)	Antenna Height (cm)	Turntable Position (deg)
		Peak	Average	Peak	Average	Peak	Average			
2440	4880.000	50.76	34.49	74.00	54.00	-23.24	-19.51	V	108	70
	7320.000	53.67	39.00	74.00	54.00	-20.33	-15.00	V	113	90
	9760.000	52.41	41.45	74.00	54.00	-21.59	-12.55	V	110	0
	12200.000	50.90	42.85	74.00	54.00	-23.10	-11.15	V	110	0
	14640.000	56.96	47.97	74.00	54.00	-17.04	-6.03	V	110	0
	17080.000	60.08	49.93	74.00	54.00	-13.92	-4.07	V	110	0
	19520.000	53.53	41.08	74.00	54.00	-20.47	-12.92	V	100	0
	21960.000	52.96	42.59	74.00	54.00	-21.04	-11.41	V	100	0
	24400.000	58.62	48.18	74.00	54.00	-15.38	-5.82	V	100	0

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6. Measurement Data (continued)

6.3. Radiated Field Strength of Harmonics (15.249, Section (a)), IC RSS-210 A2.9

6.3.3. High Frequency

Fundamental Frequency (MHz)	Harmonic	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)		Ant Pol (H/V)	Antenna Height (cm)	Turntable Position (deg)
		Peak	Average	Peak	Average	Peak	Average			
2482	4964.000	55.58	36.66	74.00	54.00	-18.42	-17.34	V	100	254
	7446.000	55.42	39.32	74.00	54.00	-18.58	-14.68	H	100	0
	9928.000	54.63	42.51	74.00	54.00	-19.37	-11.49	V	135	0
	12410.000	54.00	42.74	74.00	54.00	-20.00	-11.26	V	120	270
	14892.000	57.47	46.43	74.00	54.00	-16.53	-7.57	V	123	355
	17374.000	63.57	52.00	74.00	54.00	-10.43	-2.00	V	107	0
	19856.000	49.85	39.11	74.00	54.00	-24.15	-14.89	V	100	0
	22338.000	52.74	42.14	74.00	54.00	-21.26	-11.86	V	100	0
	24820.000	57.53	47.77	74.00	54.00	-16.47	-6.23	V	100	0

6.4. Band Edge Measurements

Requirement: Emissions radiated outside of the specified frequency band of 2400 MHz to 2483.5 MHz, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

Frequency	Band Edge (dBµV/m)			Limit (dBµV/m)	Margin (dB)	Result
	Freq MHz	Peak	Average	Average		
2402.000	2400	56.76	48.50	54	-5.5	Compliant
2482.000	2484	57.39	50.81	54	-3.2	Compliant

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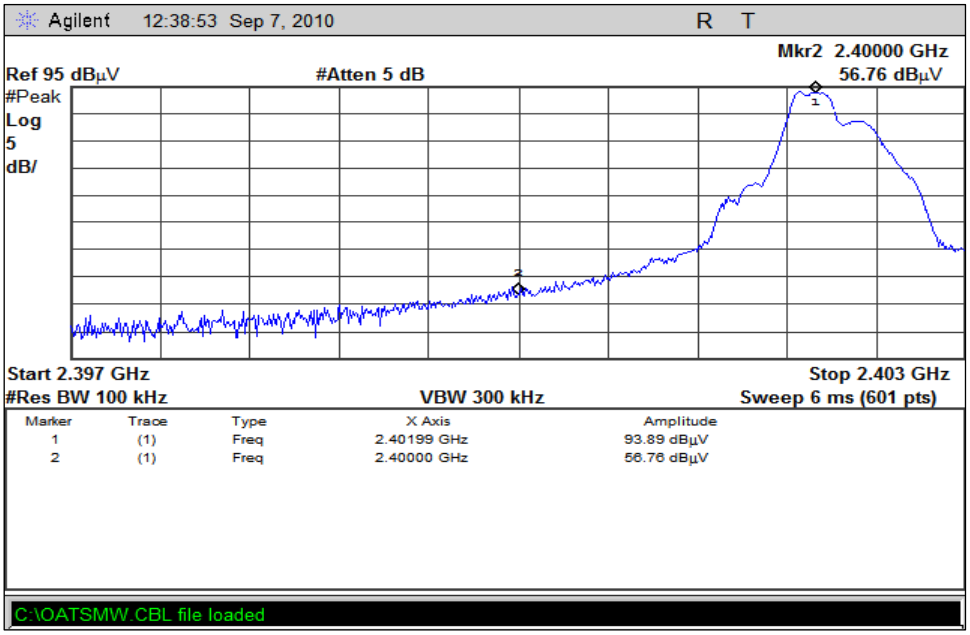
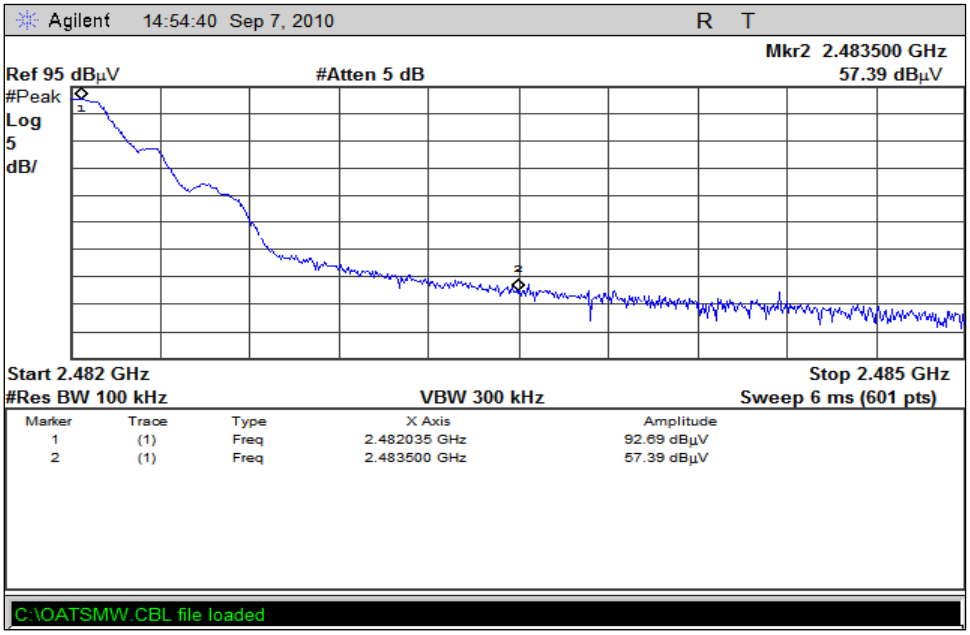
6. Measurement Data (continued)

6.4. Band Edge Measurements

6.4.1. Band Edge Measurements - Lower Band Edge



6.4.2. Band Edge Measurements - Upper Band Edge



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6. Measurement Data (continued)

6.5. Spurious Radiated Emissions, 30 MHz to EUT 10th Harmonic (15.249, Section (d)), IC RSS-GEN

Requirement: Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

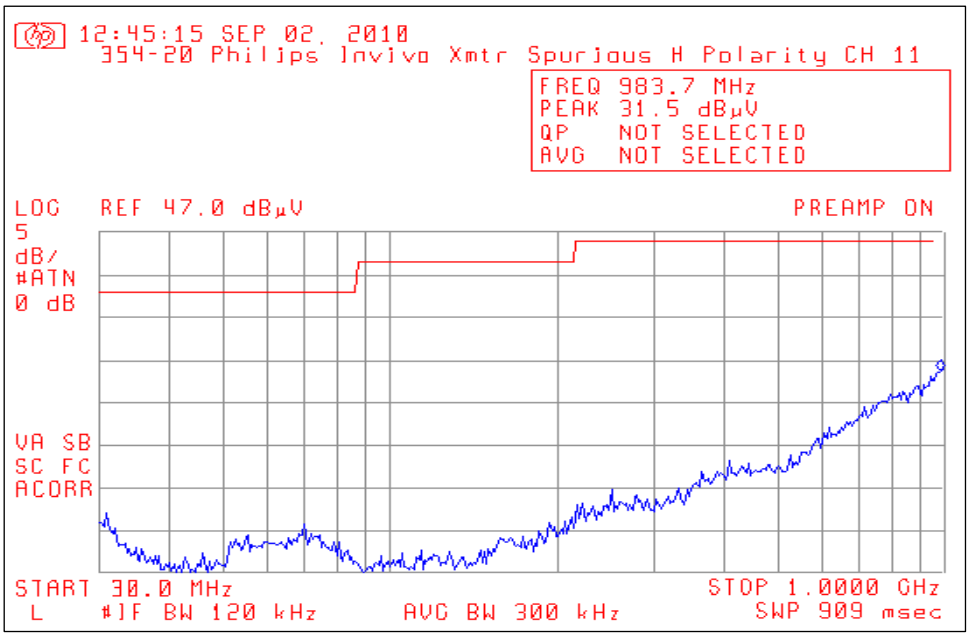
Test Note: The spurious emissions detailed in this section represent the combined worst case emissions of the low, middle and high operating frequencies.

6.5.1. Regulatory Limit: FCC Part 209, Quasi-Peak

Frequency Range (MHz)	Distance (Meters)	Limit (dBµV/m)
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
Above 960	3	54.0

6.5.2. Test Results, 30 MHz to 1 GHz

6.5.2.1. Channel 11, Horizontal Polarity



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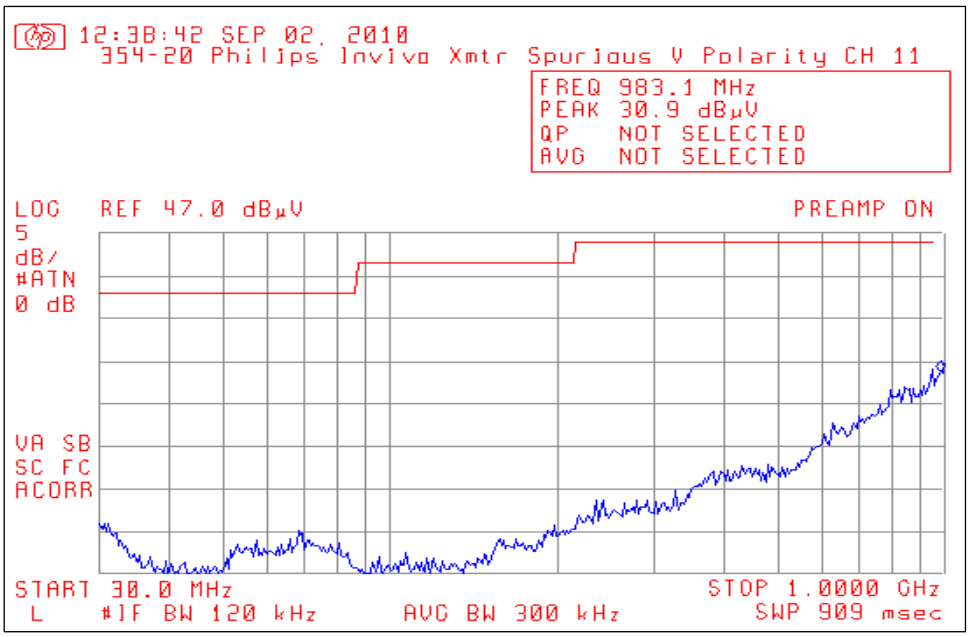
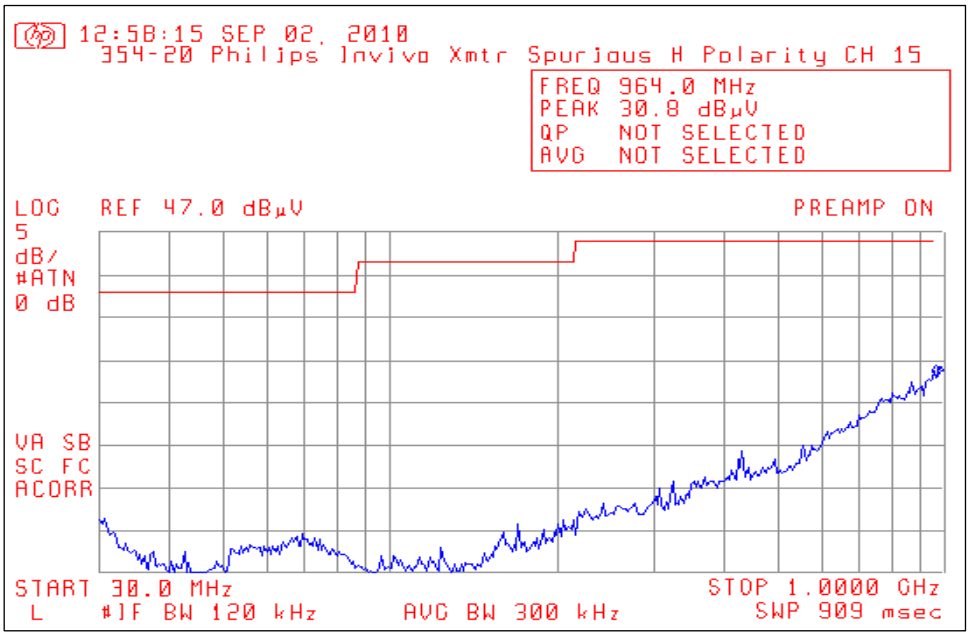
6. Measurement Data (continued)

6.5.2. Test Results, 30 MHz to 1 GHz

6.5.2.2. Channel 11, Vertical Polarity



6.5.2.3. Channel 15, Horizontal Polarity



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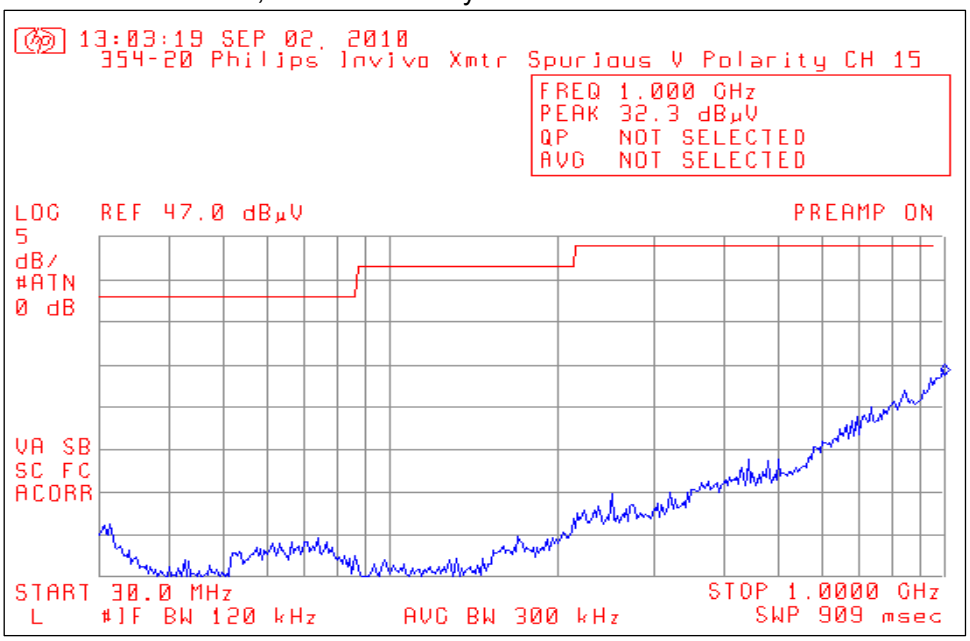
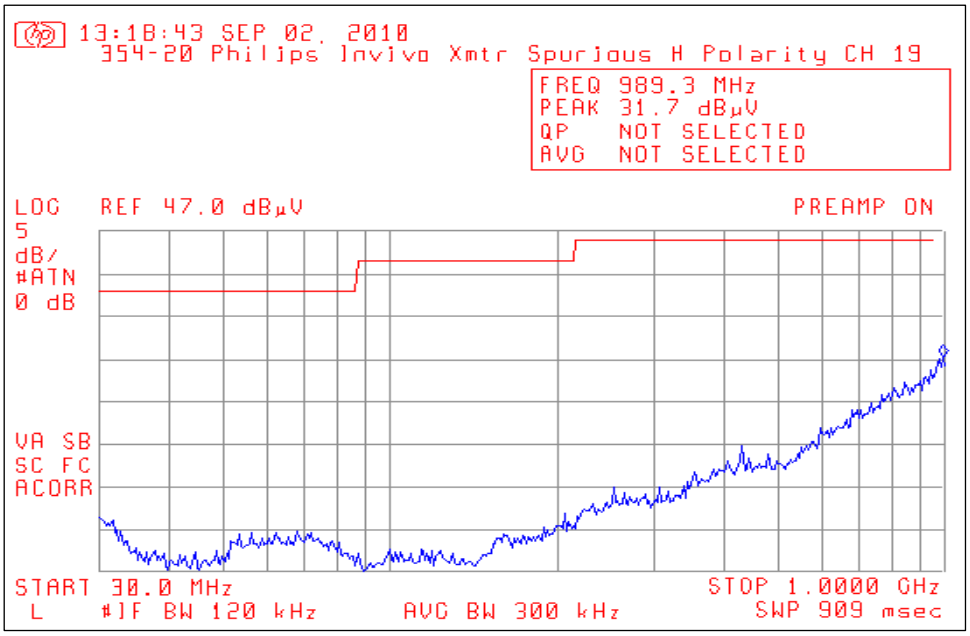
6. Measurement Data (continued)

6.5.2. Test Results, 30 MHz to 1 GHz

6.5.2.4. Channel 15, Vertical Polarity



6.5.2.5. Channel 19, Horizontal Polarity



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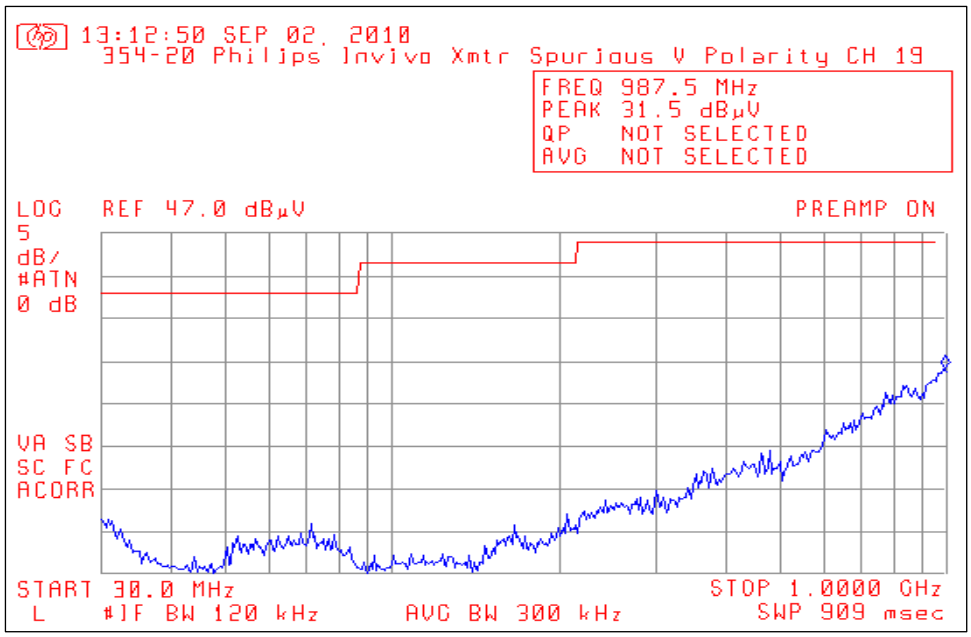
6. Measurement Data (continued)

6.5.2. Test Results, 30 MHz to 1 GHz

6.5.2.5. Channel 19, Vertical Polarity



6.5. Spurious Radiated Emissions, 30 MHz to EUT 10th Harmonic (15.249, Section (d)), IC RSS-GEN

There were no measureable emissions above 1 GHz except the harmonic emissions detailed in section 6.3 of this test report.

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6. Measurement Data (continued)

6.6 Occupied Bandwidth (ANSI C63.4, Section 13.1.7)

Requirement: The occupied bandwidth measurements on an intentional radiator shall be made in accordance with the requirements outlined in ANSI C63.4-2003, Section 13.1.7. If no bandwidth requirement is specified by the procuring or regulatory agency, measure the bandwidth at –26 dB with respect to the reference level.

Channel	Frequency (MHz)	-26 dB Bandwidth (MHz)	Result
Low	2402.000	1.504	Compliant
Middle	2440.000	1.678	Compliant
High	2482.000	1.279	Compliant

6.7. 99% Bandwidth (RSS 210)

Requirement: The 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70-900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

Channel	Channel Frequency	99% Power Bandwidth	Allowable Power Bandwidth	Result
	MHz	MHz	MHz	
Low	2402.000	1.232	12.010	Compliant
Middle	2440.000	1.418	12.200	Compliant
High	2482.000	1.058	12.410	Compliant

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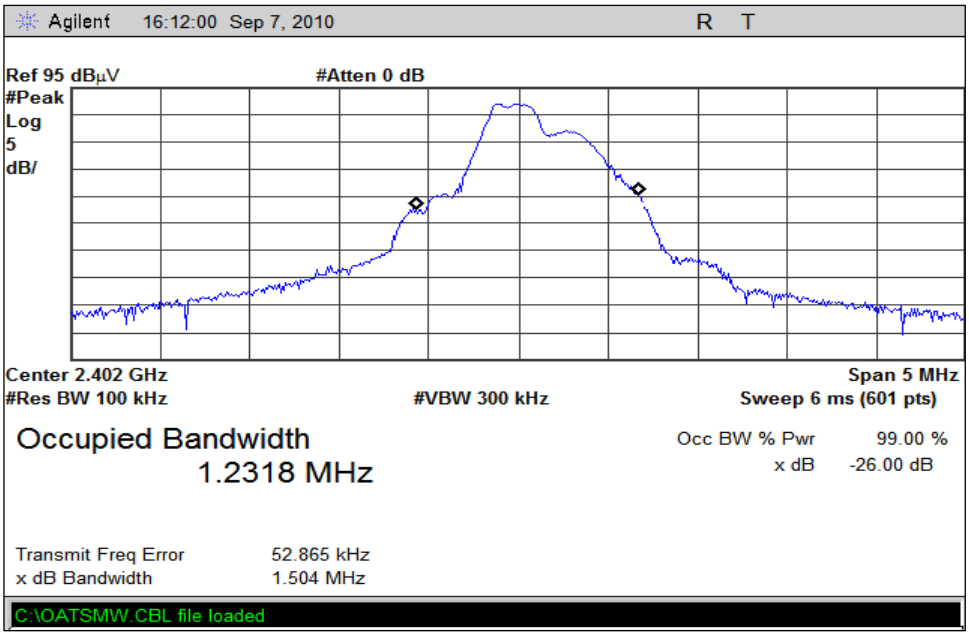
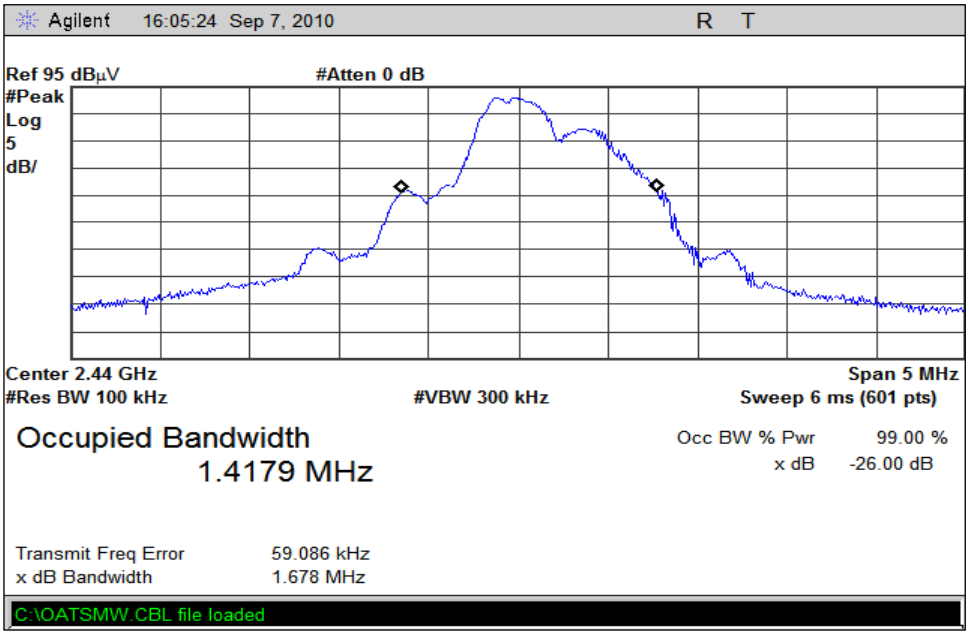
6. Measurement Data (continued)

6.8. Occupied (-26 dB) Bandwidth / 99% Bandwidth Plots

Low Frequency (2402 MHz)



Middle Frequency (2440 MHz)



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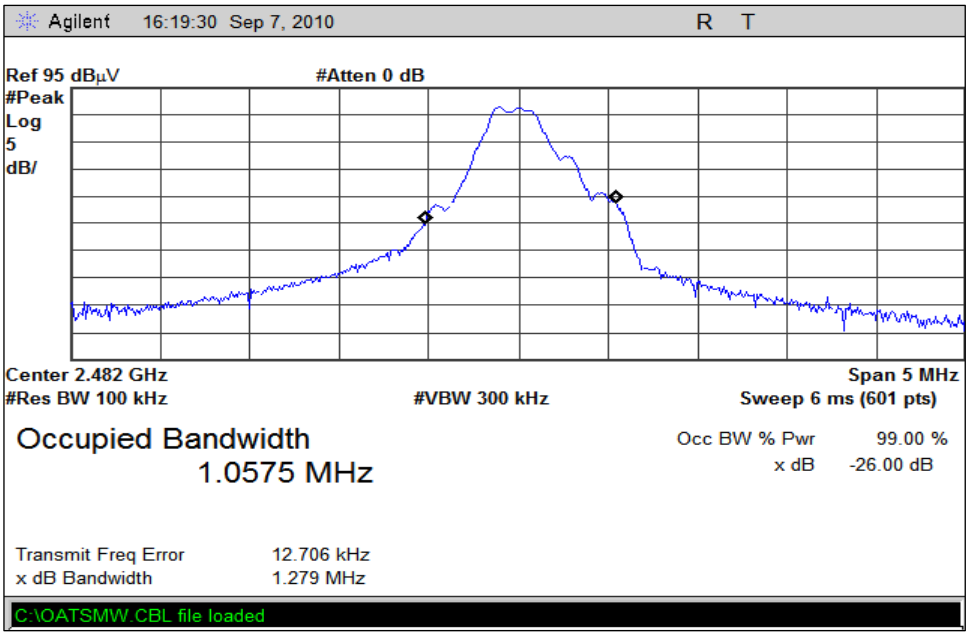
6. Measurement Data (continued)

6.8. Occupied (-26 dB) Bandwidth / 99% Bandwidth Plots

High Frequency (2482 MHz)



6.9. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1) RSS-GEN 5.5, RSS 102)

6.9.1. Note: The following equation is used to determine the output power from the measured field strength:

$$P = \frac{(E \times d)^2}{(30 \times G)}$$

P = the power in Watts.
E = the measured maximum field in V/m
G = the numeric gain of the transmitting antenna over an isotropic radiator.
d = the distance in meters of the field strength measurement.

Channel	Frequency	Peak Field Strength	Distance	Antenna Gain[1]	Measured Output Power
	(MHz)	(dBµV/m)	(m)	(dBi)	(mW)
Low	2402	93.92	3.0	2.10	0.4561643
Mid	2440	92.95	3.0	2.10	0.3648558
High	2482	93.17	3.0	2.10	0.3838144

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6. Measurement Data (continued)

6.9. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1)) RSS-GEN 5.5, RSS 102

6.9.2. Radio Frequency Energy Levels

Channel	Freq.	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		Limit (mW/cm2)	Result
					(mW/cm2)	(W/m2)		
		(1)	(2)	(3)	(4)		(5)	
Low	2402	20.0	-3.41	2.10	0.0001472	0.0014718	1	Compliant
Mid	2440	20.0	-4.38	2.10	0.0001177	0.0011772	1	Compliant
High	2482	20.0	-4.16	2.10	0.0001238	0.0012384	1	Compliant

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

PD = Power Density (mW/cm2)
OP = DUT Output Power (dBm)
AG = DUT Antenna Gain (dBi)
d = MPE Distance (cm)

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
2. Sections 6.2 of this test report.
3. Data provided by the product manufacturer.
4. Power density is calculated from field strength measurement and antenna gain.
5. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.

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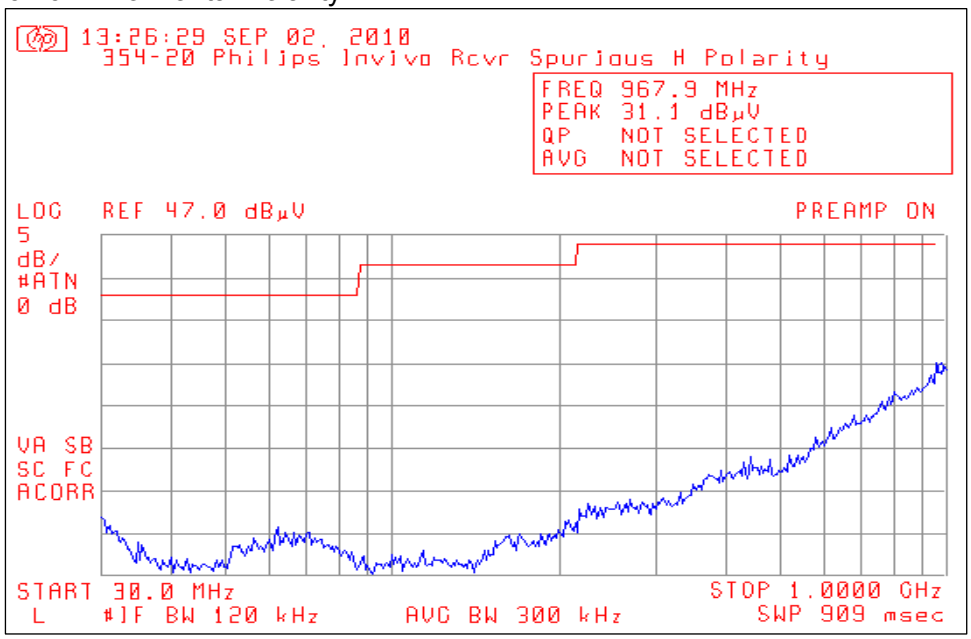
6. Measurement Data (continued)

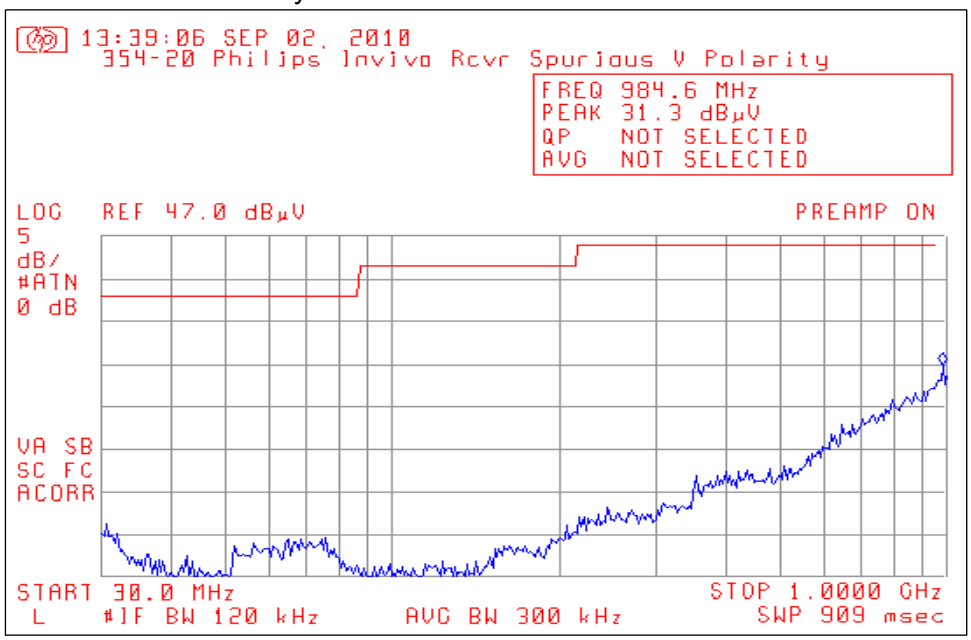
6.10. Spurious Emissions of License Exempt Receivers RSS-210 2.3, RSS-GEN 7.2.3

Requirement: Category I license-exempt receivers are required to have their spurious emissions comply with Section 7.2.3 of RSS-Gen.

6.10.1. Horizontal Polarity



6.10.2. Vertical Polarity



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7. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with Federal Communications Commission (FCC) and Industry Canada standards. A description of the test sites is on file with the FCC (registration number **96392**) and Industry Canada (file number **IC 3023A-1)**.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022.

Both sites are designed to test products or systems 1.5 meter W x 1.5 meter L x 2.0 meter H, floor standing or table top.

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