**FCC CFR47 PART 15 SUBPART C**
**INDUSTRY CANADA RSS-210 ISSUE 8**

# CERTIFICATION TEST REPORT

**FOR**

**2.4 GHz ZigBee Radio Module**

**MODEL NUMBER: AIR-CAP1552Sx-A-K9**

**FCC ID: LDK102078P**
**IC: 2461B-102078P**

**REPORT NUMBER: 11U13912-2, Revision C**

**ISSUE DATE: DECEMBER 02, 2011**

*Prepared for*
**CISCO SYSTEMS, INC.**
**170 WEST TASMAN DRIVE**
**SAN JOSE, CA 95134**

*Prepared by*
**COMPLIANCE CERTIFICATION SERVICES (UL CCS)**
**47173 BENICIA STREET**
**FREMONT, CA 94538, U.S.A.**
**TEL: (510) 771-1000**
**FAX: (510) 661-0888**

NVLAP LAB CODE 200065-0

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 08/08/11 | Initial Issue | F. Ibrahim |
| A | 09/30/11 | Revised FCC and IC ID | A. Zaffar |
| B | 10/07/11 | Update client address | A. Zaffar |
| C | 12/02/11 | Added one more table for MPE | F. Ibrahim |

# TABLE OF CONTENTS

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA 95134

**EUT DESCRIPTION:** 2.4 GHz ZigBee Radio Module

**MODEL:** AIR-CAP1552Sx-A-K9

**SERIAL NUMBER:** 47-24455-01 (#26)
NSN (#19) – used for Radiated Emissions 30M-1GHz

**DATE TESTED:** July 13 – Aug 8, 2011

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | Pass |
| INDUSTRY CANADA RSS-210 Issue 8 Annex 8 | Pass |
| INDUSTRY CANADA RSS-GEN Issue 3 | Pass |

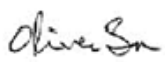
Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties 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 UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL 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 UL CCS By:

FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

Tested By:



OLIVER SU
EMC ENGINEER
UL CCS

# 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 3, and RSS-210 Issue 8.

# 3. FACILITIES AND ACCREDITATION

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

UL 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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

## 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 an 802.15.4 (ZigBee) transceiver.

The radio module is manufactured by Honeywell.

## 5.2. MAXIMUM OUTPUT POWER

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

| Frequency Range | Mode | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|
| 2405 - 2475 | 802.15.4 (ZigBee) | 18.34 | 68.23 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an omni-directional antenna, with a maximum peak gain of 5 dBi.

## 5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was BRR_SimpleIR, rev. 5.5.2.

## 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. Radiated Emissions 30-1000 MHz and Power Line Conducted Emissions were performed with the EUT set to transmit continuously at the channel with highest output power.

There's only one valid mounting configuration: WiFi Antenna Pointing up and ZigBee Antenna pointing down.

There is only one modulation for this device, which is OQPSK-DSSS, and one data rate, which is 250 kbps.

## 5.6. DESCRIPTION OF TEST SETUP

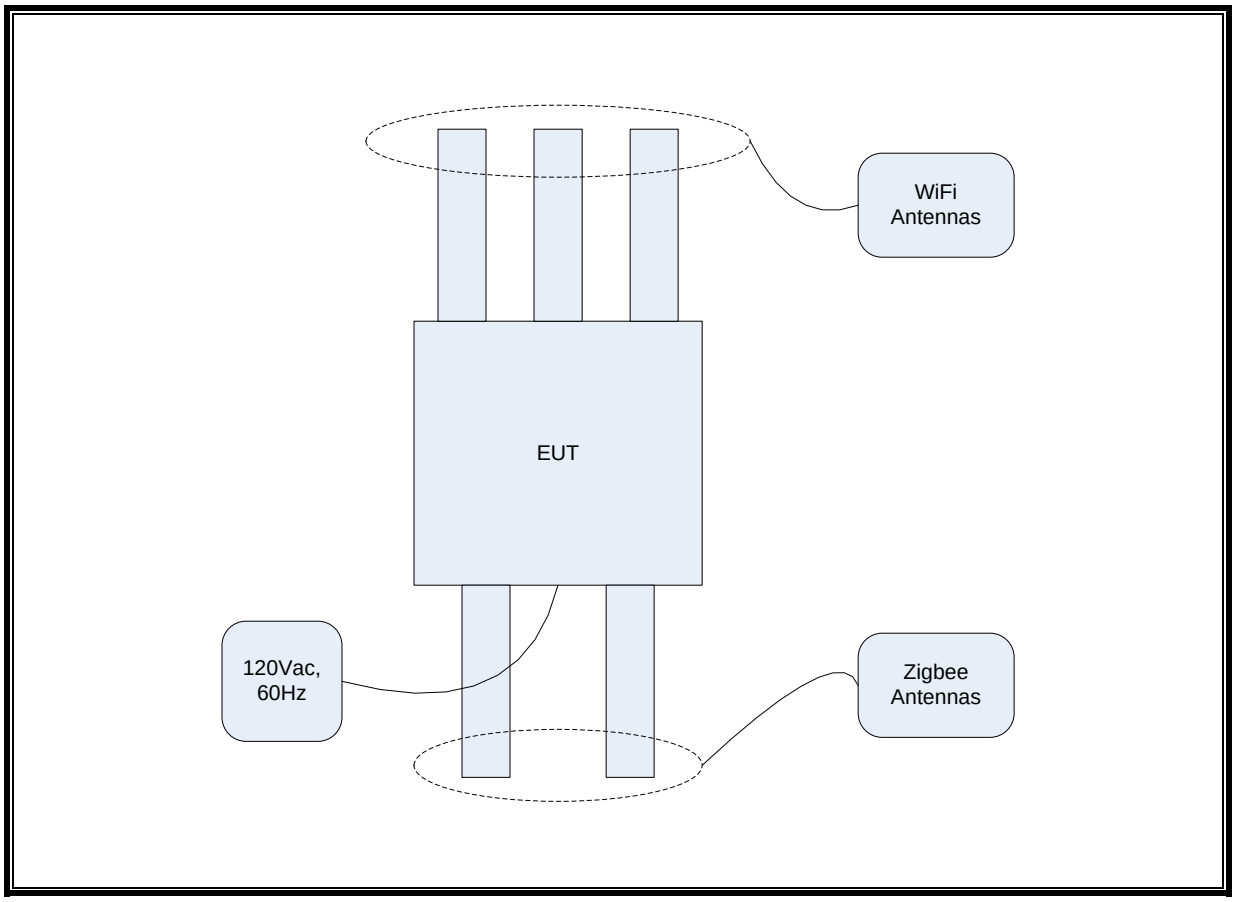
**SUPPORT EQUIPMENT**

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop | Dell | Latitude D620 | HF974 A02 | E2KWM3945ABG |
| AC Adapter | Dell | PA-1650-05D | CN-05U092-71615-4BL-02DA | DoC |

**TEST SETUP**

The EUT is installed in a host enclosure during the tests. Test software 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 Date** | **Cal Due** |
| Spectrum Analyzer, 44GHz | Agilent | E4446A | T99 | 05/04/11 | 11/04/12 |
| Power Meter | HP | 438A | T147 | 06/17/11 | 09/17/12 |
| Power Sensor | Agilent | 8481A | CCS-0078 | 10/28/09 | 07/28/11 |
| Spectrum Analyzer, 44GHz | Agilent | E4446A | T146 | 04/07/11 | 04/07/12 |
| Preamplifier, 1300MHz | HP | 8447D | T15 | 01/27/11 | 01/27/12 |
| Antenna, Bilog, 2GHz | Sunol | JB1 | T185 | 07/16/11 | 07/16/12 |
| Antenna, Horn, 18GHz | EMCO | 3115 | T60 | 06/09/11 | 06/09/12 |
| Antenna, Horn, 26.5GHz | ARA | SWH-28 | T125 | 07/28/11 | 07/28/12 |
| Preamplifier, 26.5GHz | HP | 8449B | T34 | 07/18/11 | 07/18/12 |
| EMI Test Receiver 9kHz-7GHz | Rohde & Schwarz | ESCI 7 | T212 | 07/06/11 | 07/06/12 |
| LISN, 30MHz (EUT) | Fisher Comm Corp | LISN-50/250-25-2 | T25 | 11/10/10 | 11/10/11 |
| LISN, 10kHz-30MHz (Support) | Solar | 8012-50-R-24-BNC | T29 | 11/10/10 | 11/10/11 |

# 7. ANTENNA PORT TEST RESULTS

## 7.1. 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.

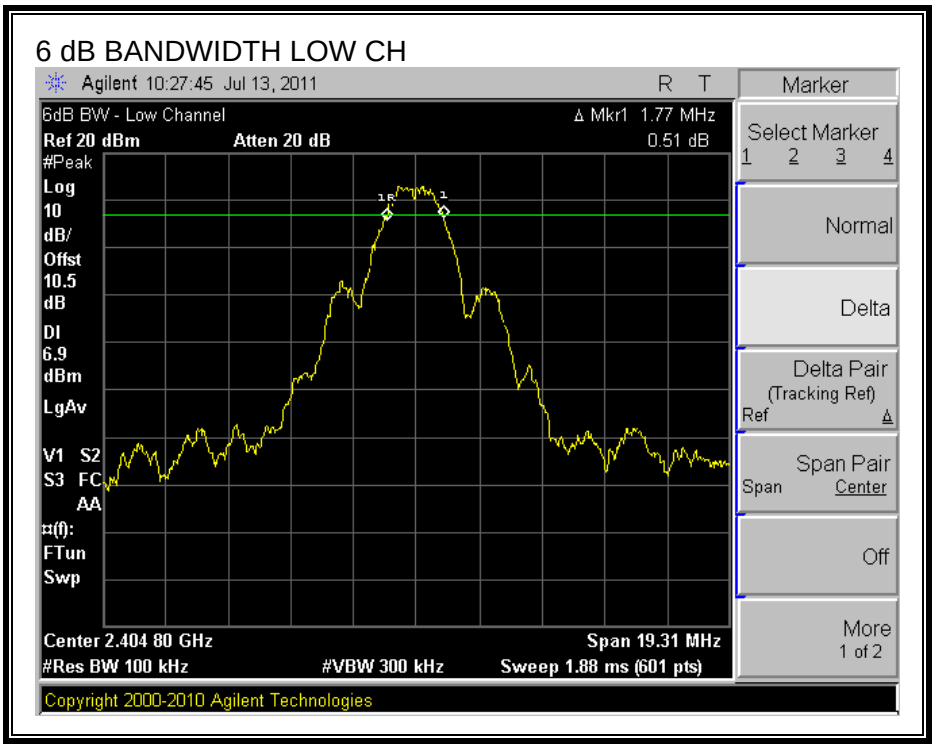
**TEST PROCEDURE**

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.

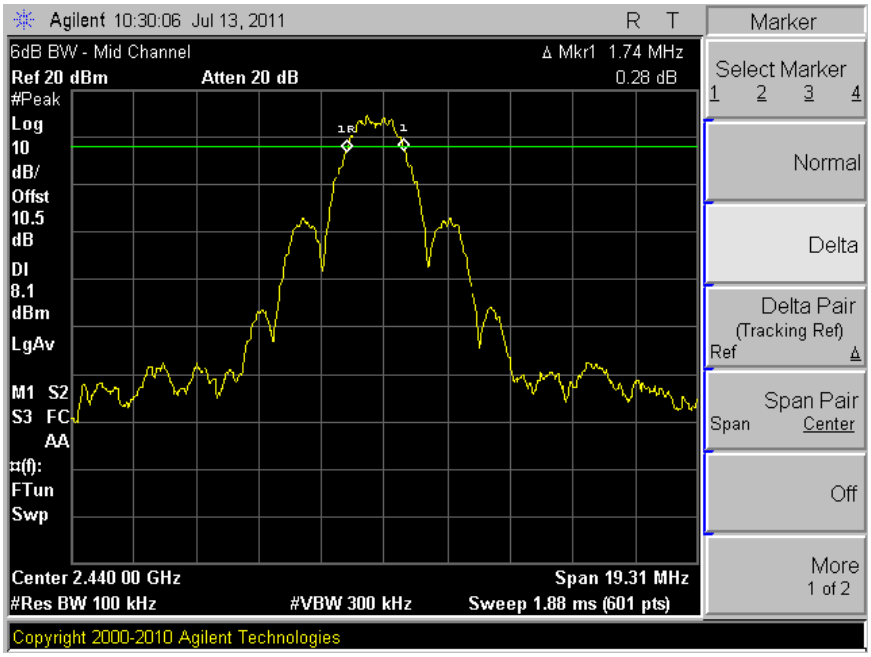
**RESULTS**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---|---|---|---|
| Low | 2405 | 1.77 | 0.5 |
| Middle | 2440 | 1.74 | 0.5 |
| High | 2475 | 1.7 | 0.5 |

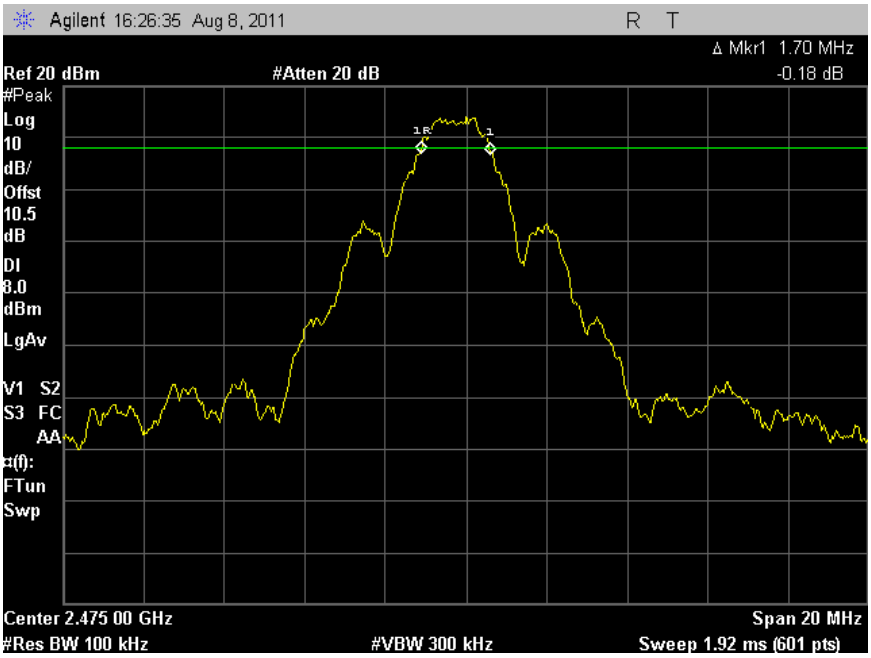
**6 dB BANDWIDTH**



6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH



## 7.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

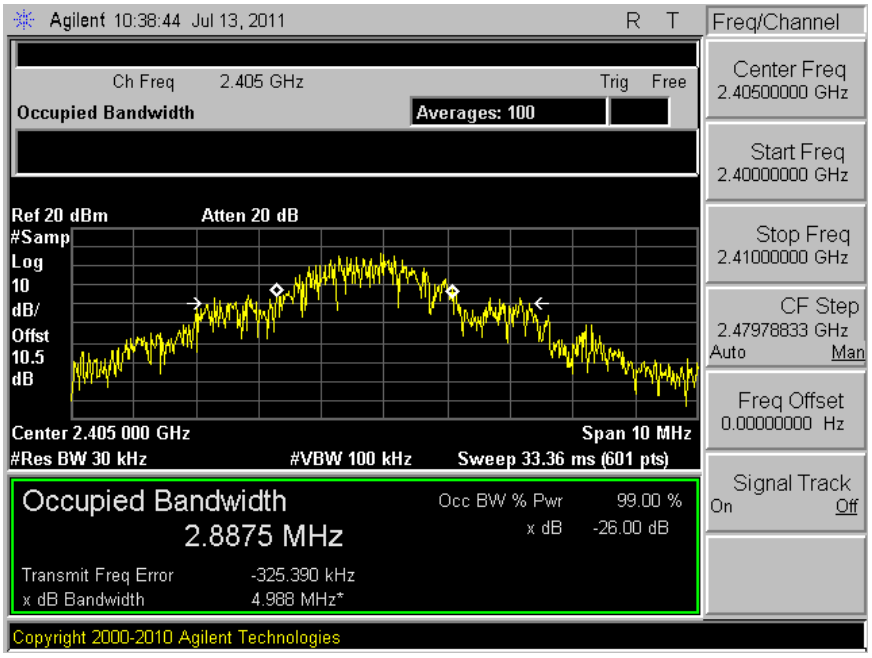
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

**RESULTS**

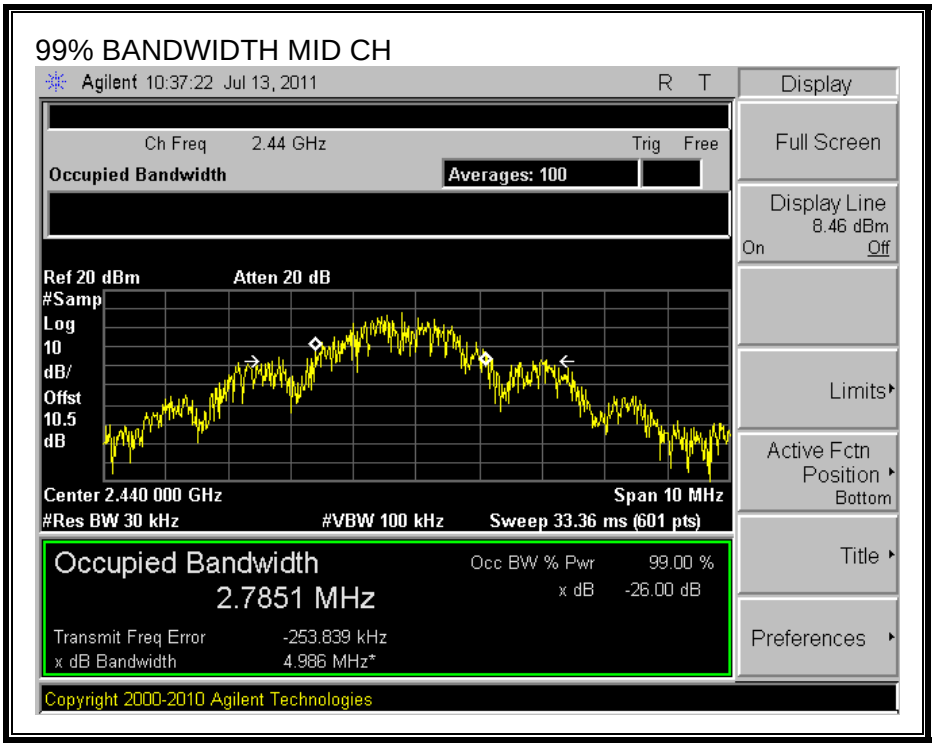
| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 2405 | 2.8875 |
| Middle | 2440 | 2.7851 |
| High | 2475 | 2.9477 |

**99% BANDWIDTH**

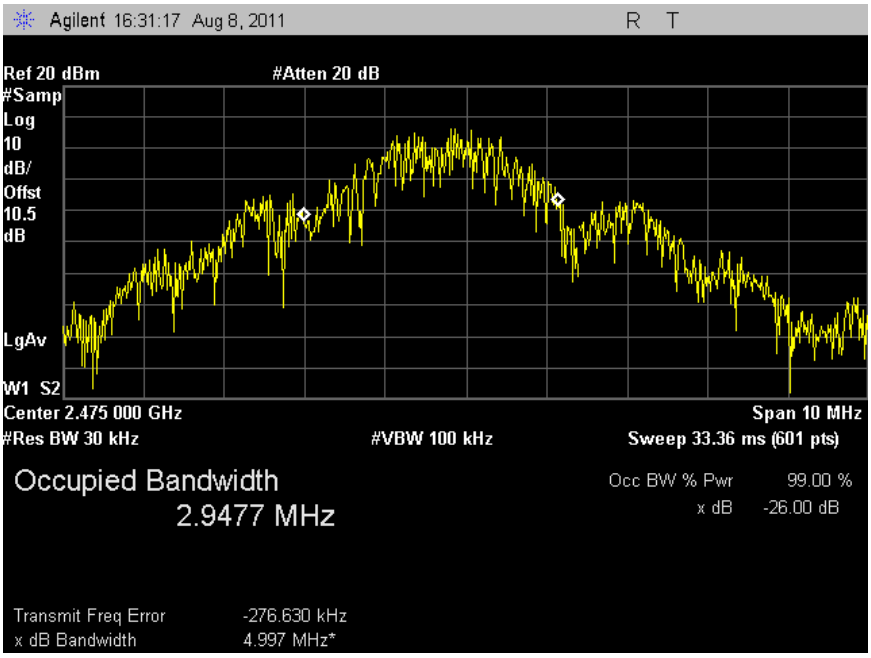
99% BANDWIDTH LOW CH



99% BANDWIDTH MID CH



99% BANDWIDTH HIGH CH



## 7.3. OUTPUT POWER

**LIMITS**

FCC §15.247 (b)

IC RSS-210 A8.4

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

**TEST PROCEDURE**

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

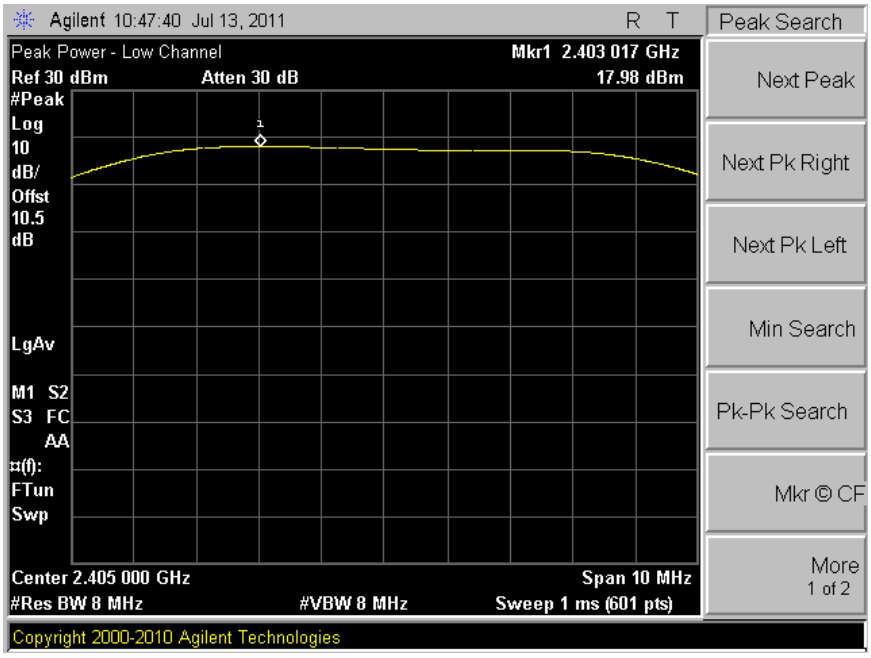
**RESULTS**

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 2405 | 17.98 | 0 | 17.98 | 30 | -12.02 |
| Middle | 2440 | 18.08 | 0 | 18.08 | 30 | -11.92 |
| High | 2475 | 18.34 | 0 | 18.34 | 30 | -11.66 |

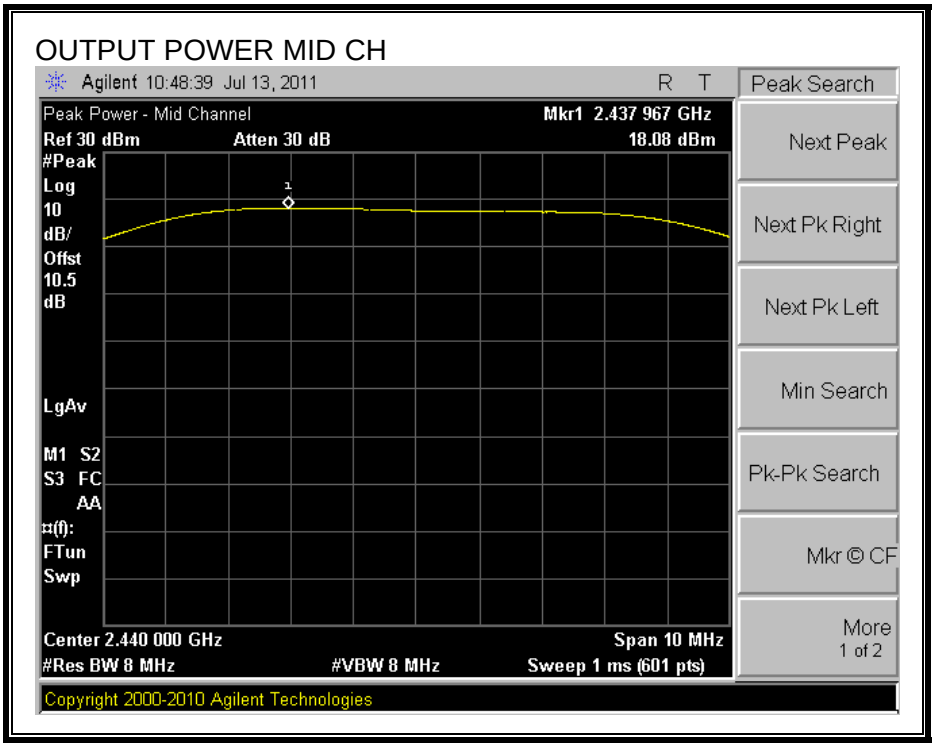
Note: Attenuator/cable offset was included in the spectrum analyzer measurement.

**OUTPUT POWER**

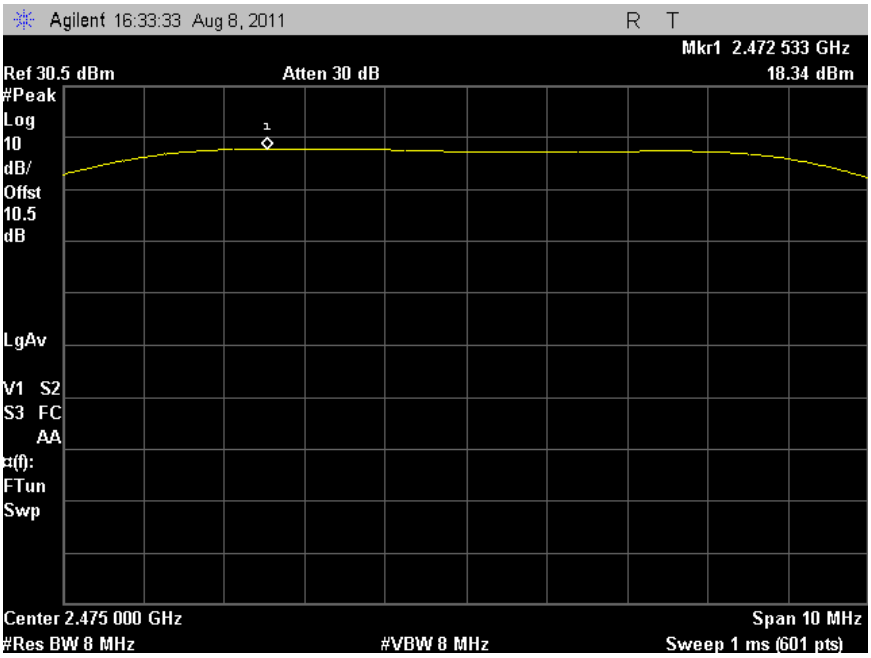
OUTPUT POWER LOW CH



OUTPUT POWER MID CH



OUTPUT POWER HIGH CH



## 7.4. 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 10.54 dB (including 10 dB pad and 0.54 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 2405 | 16.89 |
| Middle | 2440 | 16.90 |
| High | 2475 | 17.20 |

## 7.5. 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**

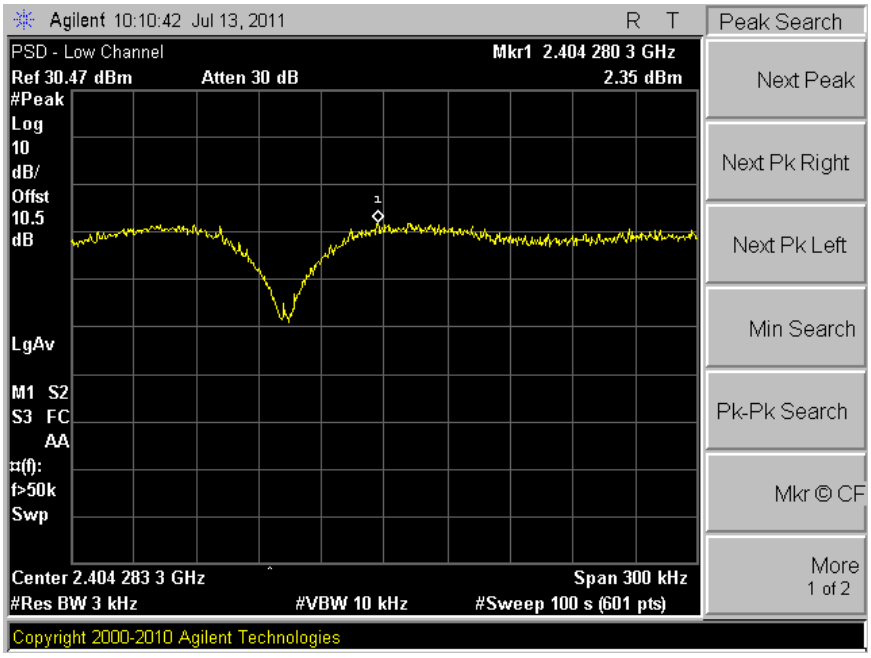
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

**RESULTS**

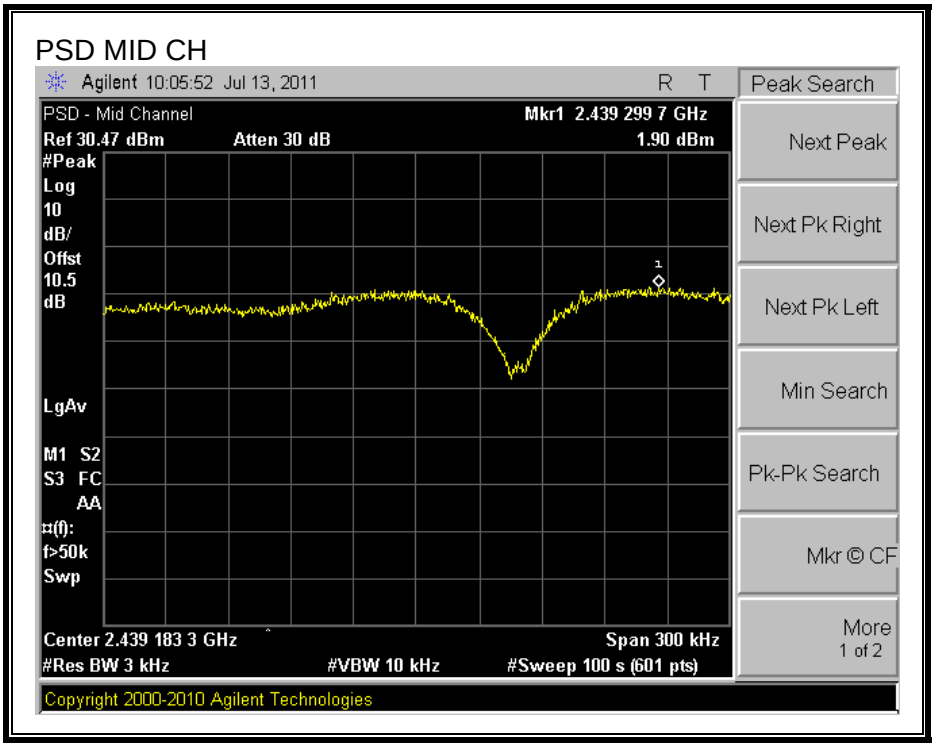
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2405 | 2.35 | 8 | -5.65 |
| Middle | 2440 | 1.90 | 8 | -6.10 |
| High | 2475 | 3.29 | 8 | -4.71 |

**POWER SPECTRAL DENSITY**

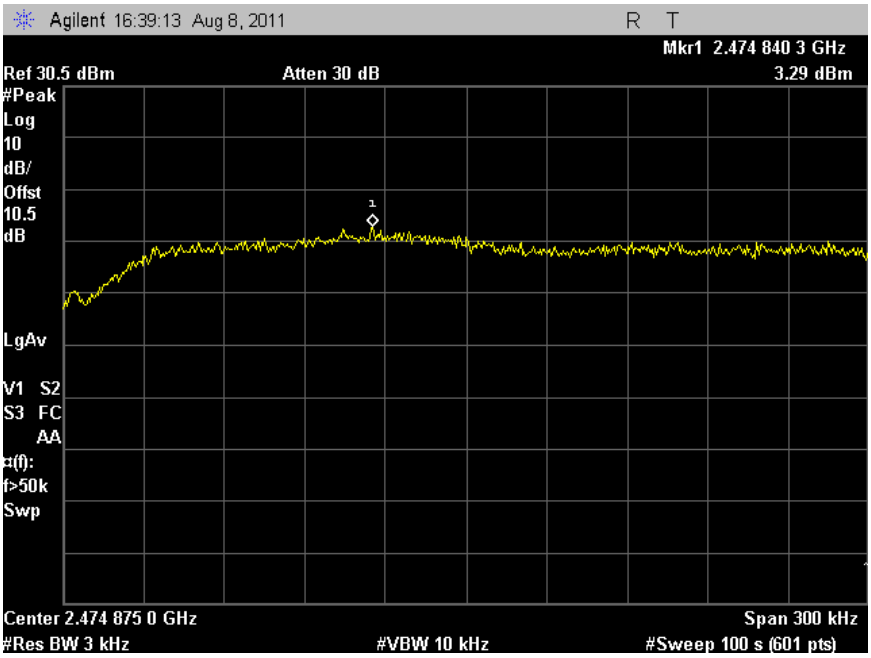
PSD LOW CH



PSD MID CH



PSD HIGH CH



## 7.6. CONDUCTED TX 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**

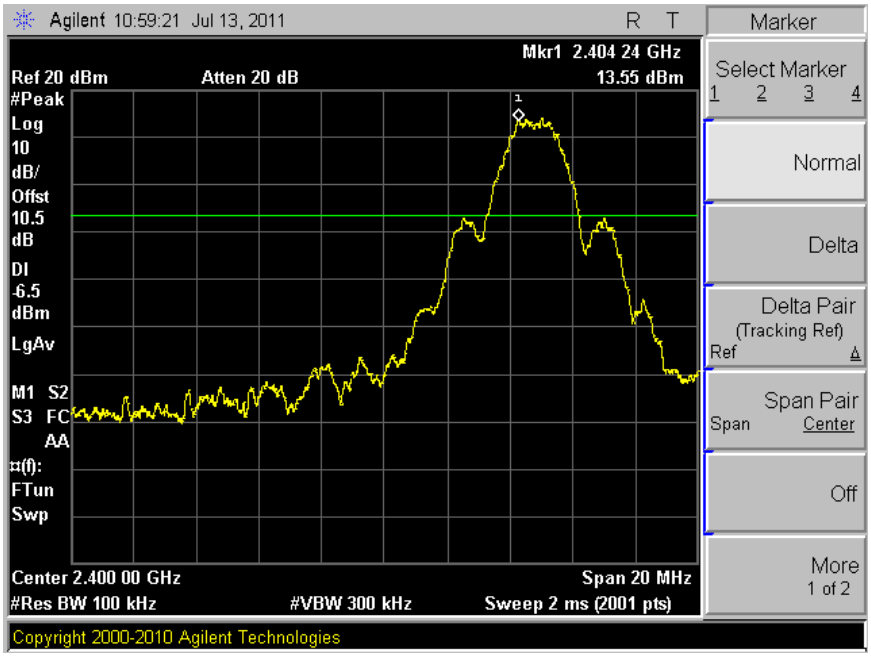
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

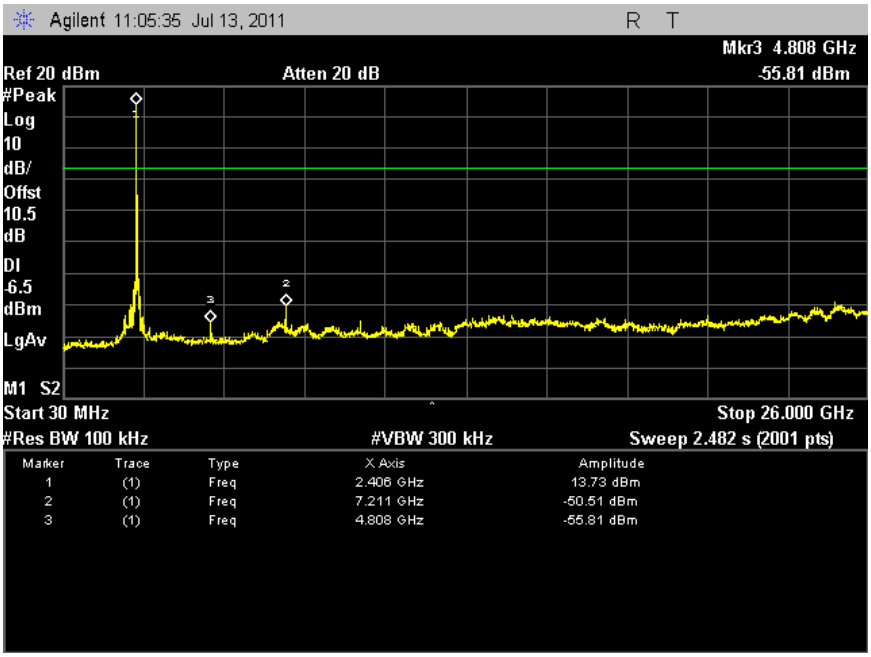
## RESULTS

## SPURIOUS EMISSIONS, LOW CHANNEL

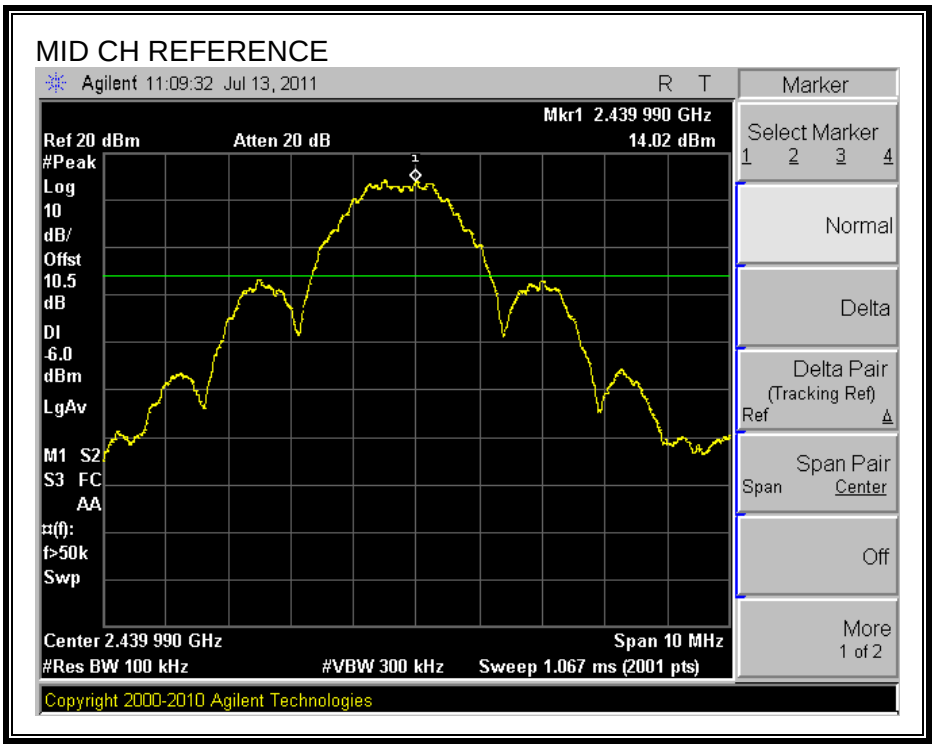
LOW CH BANDEDGE



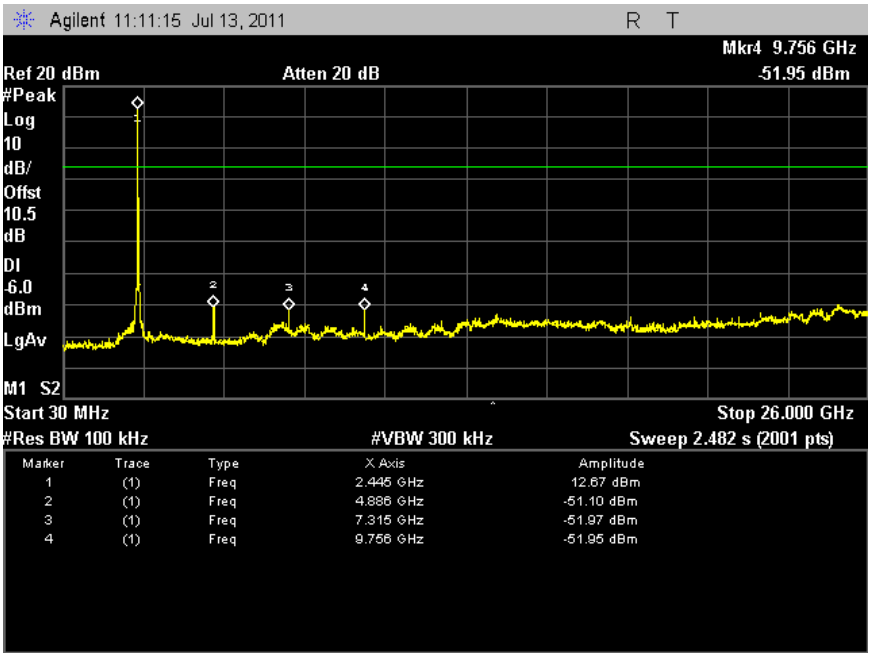
LOW CH SPURIOUS



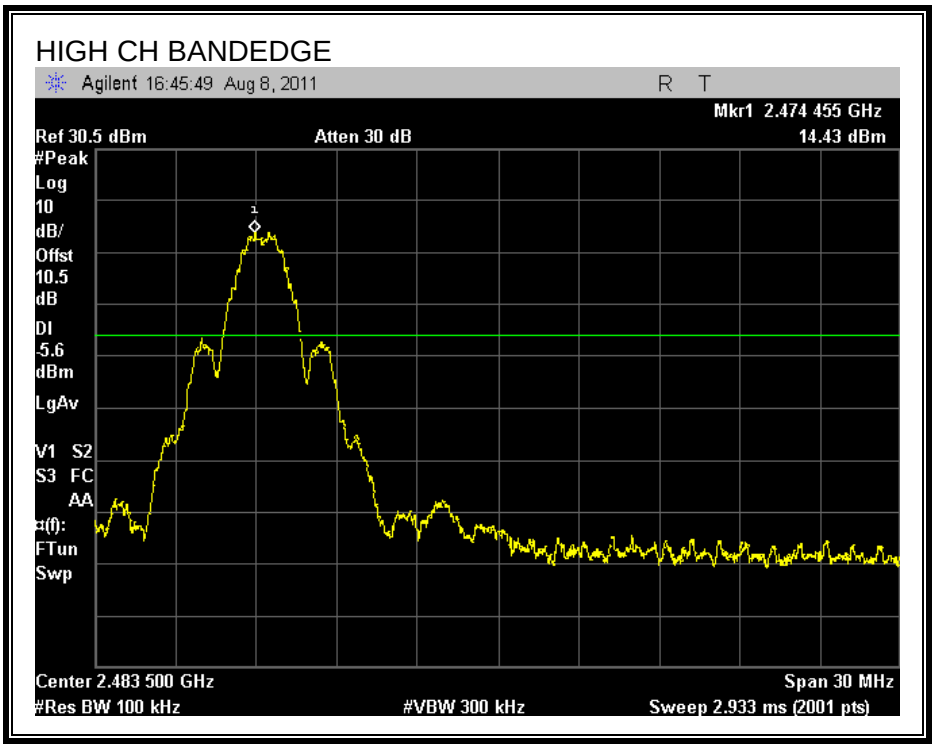
**SPURIOUS EMISSIONS, MID CHANNEL**



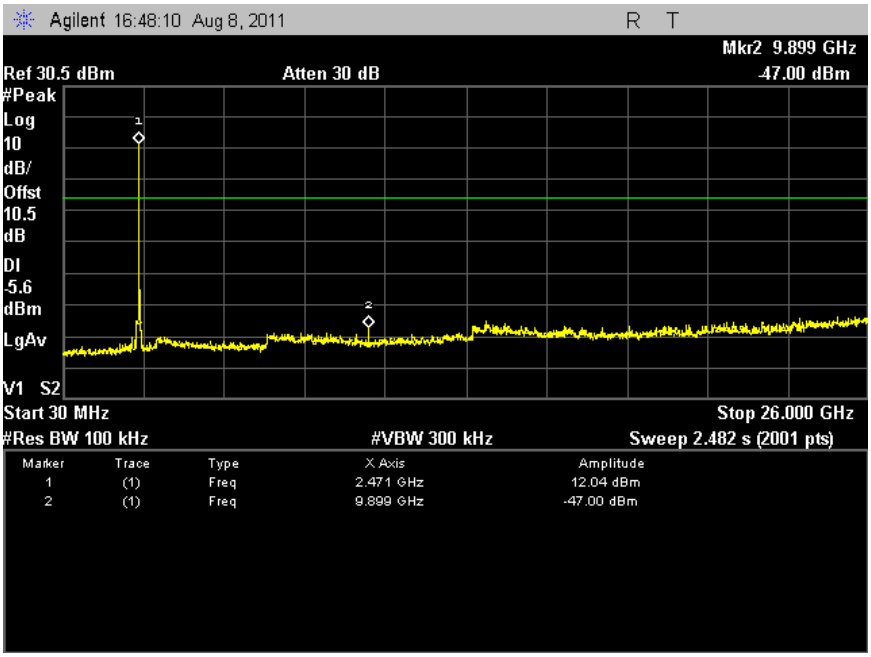
MID CH SPURIOUS



**SPURIOUS EMISSIONS, HIGH CHANNEL**



HIGH CH SPURIOUS



## 7.7. CONDUCTED RX SPURIOUS EMISSIONS

**LIMITS**

IC RSS-Gen Section 6.2 (Antenna Conducted Limits)

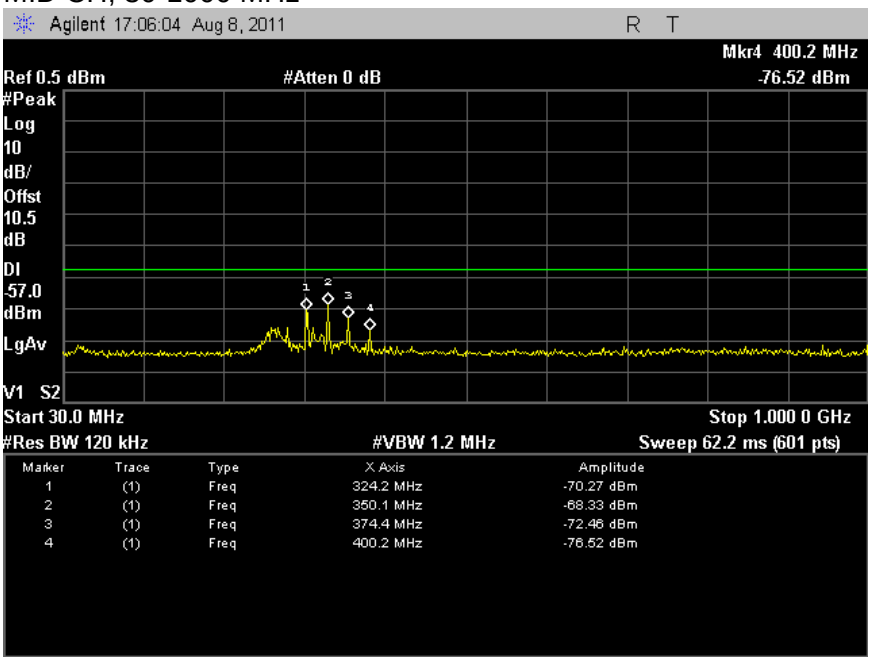
**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. For the frequency range of 30-1000 MHz, the resolution bandwidth is set to 120 kHz, video bandwidth is set to 1.2 MHz. For the frequency range of 1000-8000 MHz, the resolution bandwidth is set to 300 kHz, video bandwidth is set to 1 MHz.

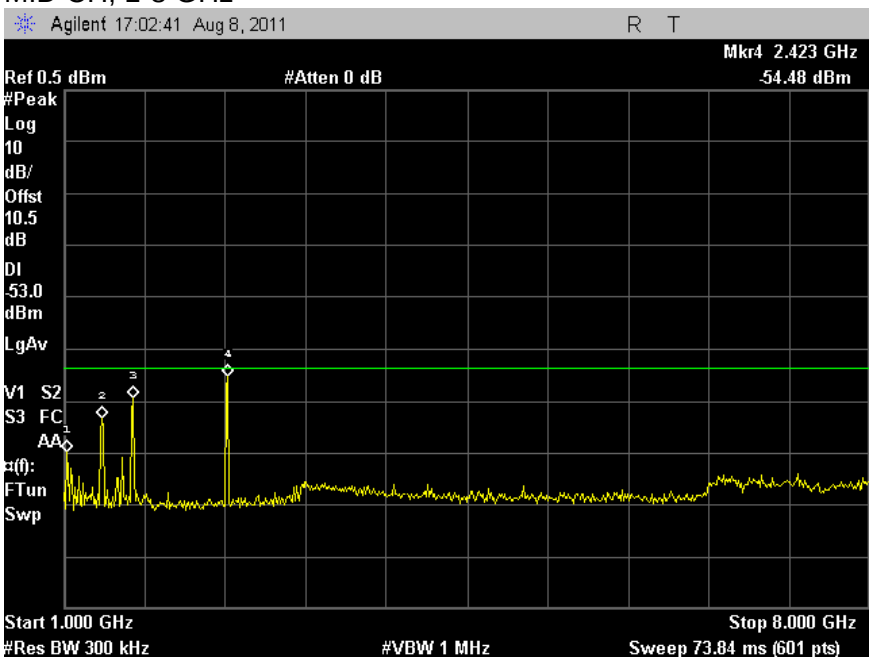
The spectrum from 30 MHz to 8 GHz is investigated with the receiver set to the middle channel.

**RX SPURIOUS EMISSIONS, MID CHANNEL**

MID CH, 30-1000 MHz



MID CH, 1-8 GHz



# 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.

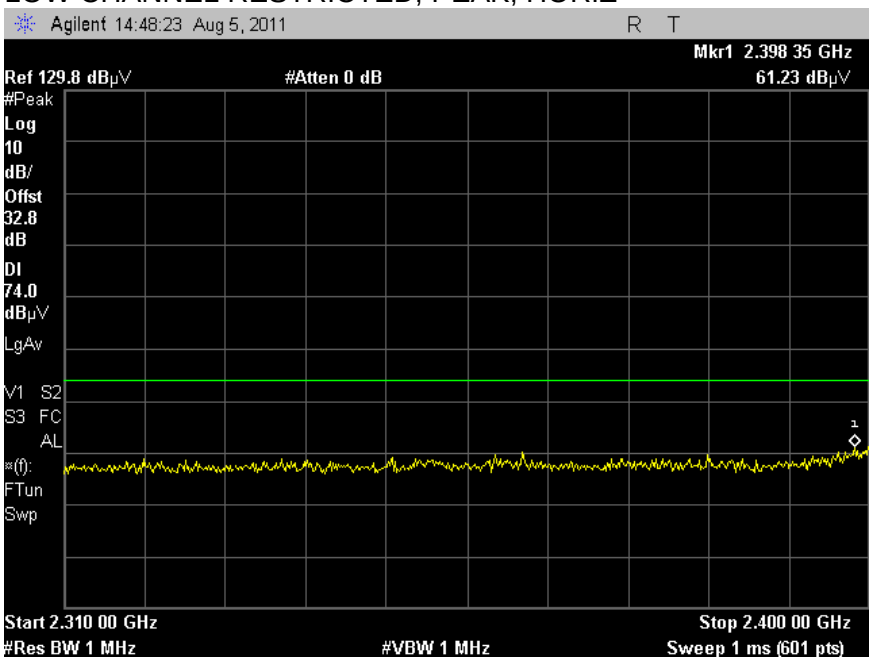
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The 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.

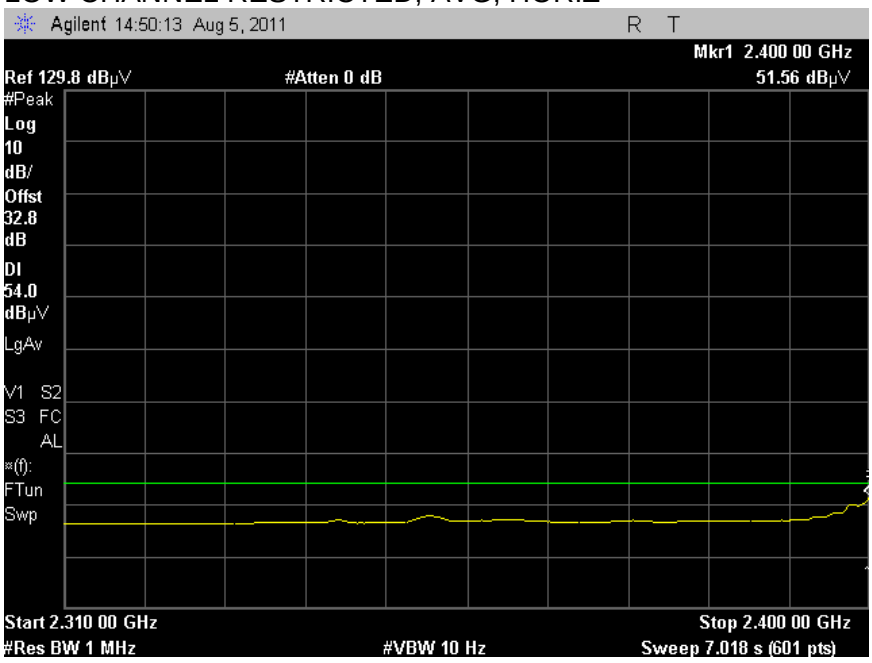
## 8.2. TRANSMITTER ABOVE 1 GHz

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

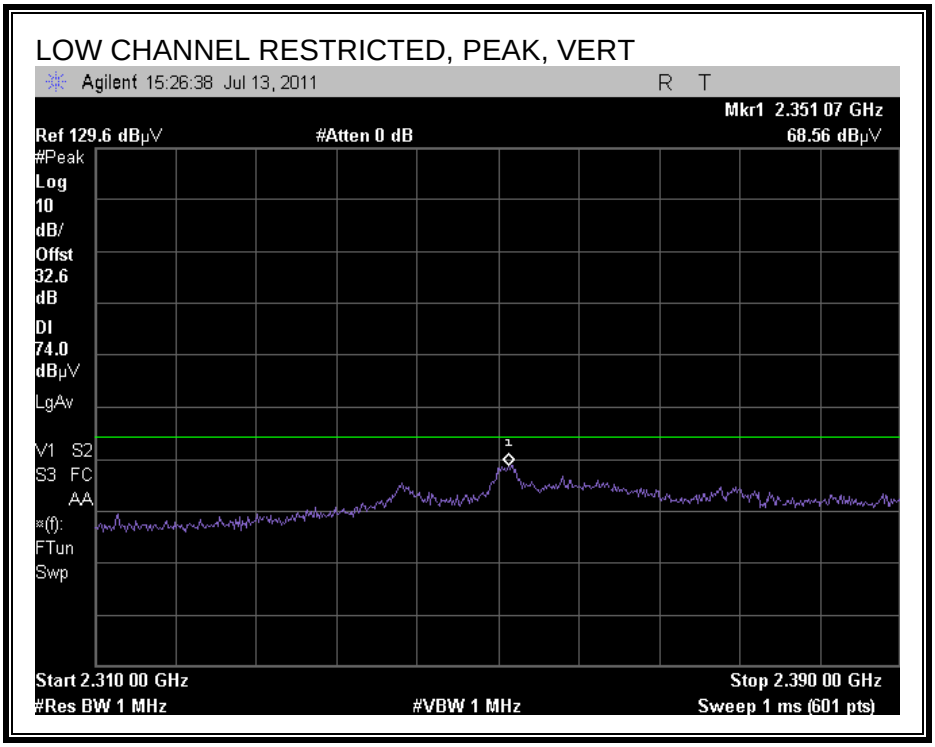
LOW CHANNEL RESTRICTED, PEAK, HORIZ



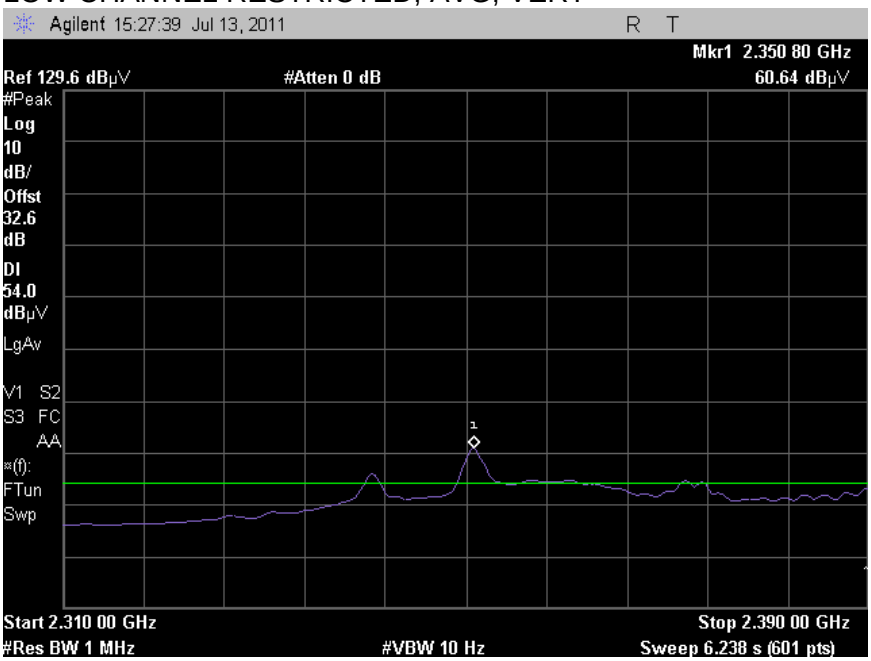
LOW CHANNEL RESTRICTED, AVG, HORIZ



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



LOW CHANNEL RESTRICTED, AVG, VERT



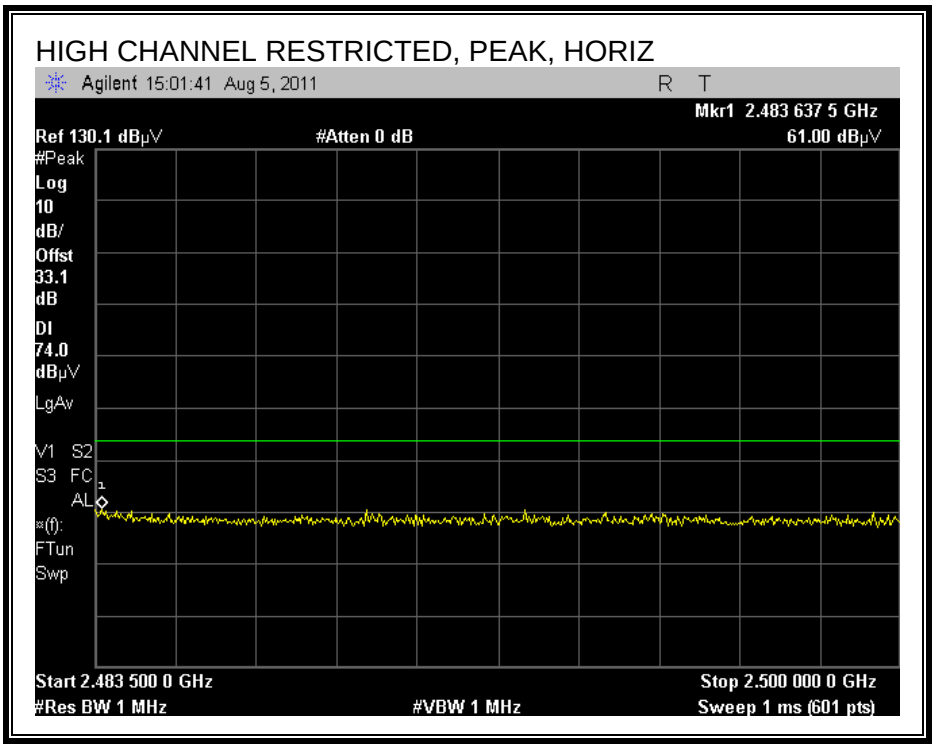

**Note: Duty Cycle = 41.21%**

**Duty Cycle Correction Factor = 7.7 dB**

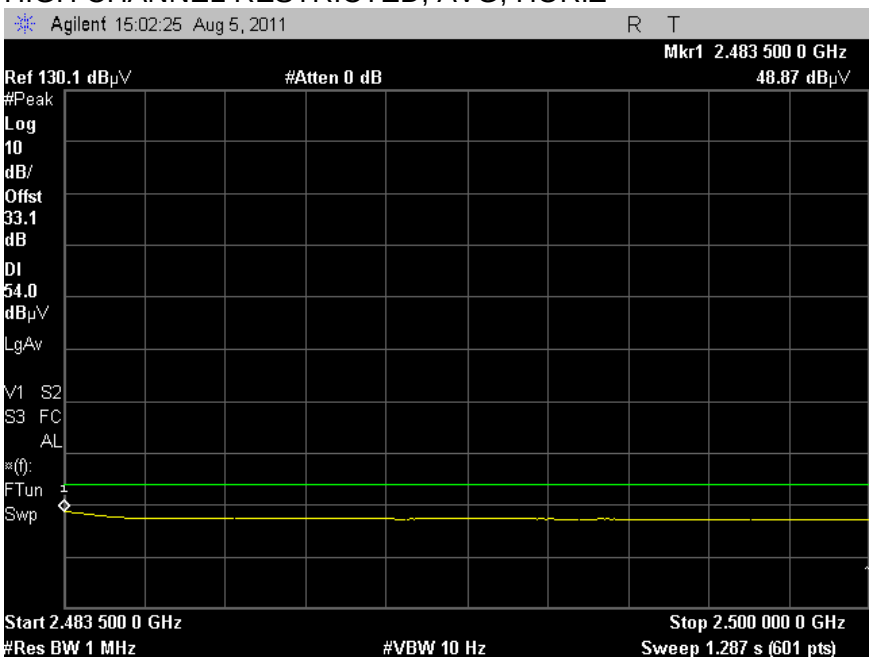
**Corrected Reading = 60.64 – 7.7 = 52.94 dBuV/m**

**Passing Margin = 52.94 – 54 = -1.06 dB**

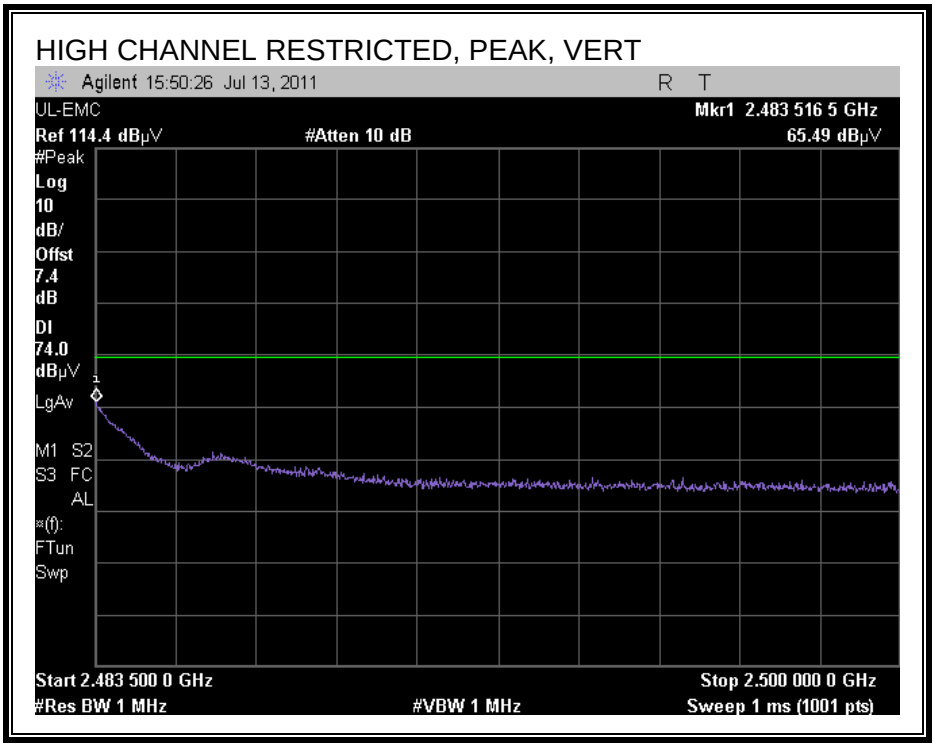
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



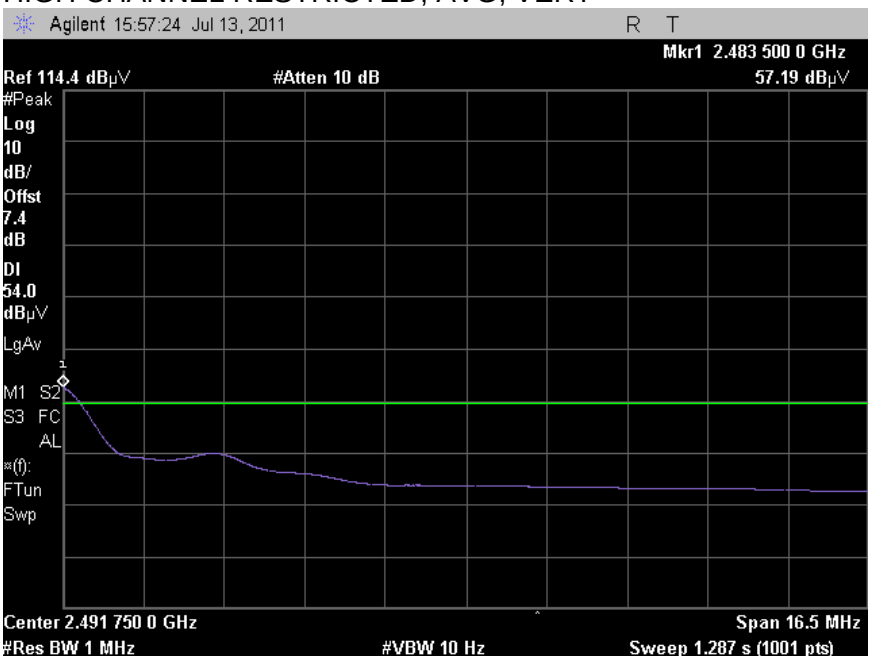
HIGH CHANNEL RESTRICTED, AVG, HORIZ



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



HIGH CHANNEL RESTRICTED, AVG, VERT




**Note: Duty Cycle = 41.21%**

**Duty Cycle Correction Factor = 7.7 dB**

**Corrected Reading = 57.19 – 7.7 = 49.49 dBuV/m**

**Passing Margin = 49.49 – 54 = -4.51 dB**

## HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**
**Compliance Certification Services, Fremont 3m Chamber**

**Company:** Cisco
**Project #:** 11U13912
**Date:** 07/13/11
**Test Engineer:** Michael Antola
**Configuration:** Stand-alone EUT
**Mode:** TX ON, Zigbee radio

**Test Equipment:**

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T60; S/N: 2238 @3m | T34 HP 8449B | | T125; ARA 18-26GHz; S/N:1007 | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

**Peak Measurements**
RBW=VBW=1MHz
**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 | Fltr 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 (2405 MHz)** | | | | | | | | | | | | | | | |
| 4.810 | 3.0 | 39.8 | 29.1 | 32.7 | 6.8 | -34.8 | 0.0 | 0.0 | 44.4 | 33.7 | 74 | 54 | -29.6 | -20.3 | H |
| 12.025 | 3.0 | 37.2 | 25.3 | 38.5 | 11.9 | -32.5 | 0.0 | 0.0 | 55.2 | 43.3 | 74 | 54 | -18.8 | -10.7 | H (Noise Floor) |
| 4.810 | 3.0 | 47.9 | 38.6 | 32.7 | 6.8 | -34.8 | 0.0 | 0.0 | 52.5 | 43.2 | 74 | 54 | -21.5 | -10.8 | V |
| 12.025 | 3.0 | 38.3 | 25.3 | 38.5 | 11.9 | -32.5 | 0.0 | 0.0 | 56.3 | 43.3 | 74 | 54 | -17.7 | -10.7 | V (Noise Floor) |
| **Mid Channel (2440 MHz)** | | | | | | | | | | | | | | | |
| 4.880 | 3.0 | 49.0 | 35.6 | 32.7 | 6.8 | -34.8 | 0.0 | 0.0 | 53.7 | 40.3 | 74 | 54 | -20.3 | -13.7 | V |
| 7.320 | 3.0 | 46.0 | 36.2 | 35.5 | 9.1 | -34.1 | 0.0 | 0.0 | 56.5 | 46.7 | 74 | 54 | -17.5 | -7.3 | V |
| 12.200 | 3.0 | 38.9 | 26.2 | 38.5 | 12.0 | -32.5 | 0.0 | 0.0 | 56.8 | 44.2 | 74 | 54 | -17.2 | -9.8 | V (Noise Floor) |
| 4.880 | 3.0 | 46.3 | 36.9 | 32.7 | 6.8 | -34.8 | 0.0 | 0.0 | 51.0 | 41.6 | 74 | 54 | -23.0 | -12.4 | H |
| 7.320 | 3.0 | 43.9 | 33.1 | 35.5 | 9.1 | -34.1 | 0.0 | 0.0 | 54.3 | 43.6 | 74 | 54 | -19.7 | -10.4 | H |
| 12.200 | 3.0 | 38.2 | 25.9 | 38.5 | 12.0 | -32.5 | 0.0 | 0.0 | 56.2 | 43.8 | 74 | 54 | -17.8 | -10.2 | H (Noise Floor) |
| **High Channel (2475 MHz)** | | | | | | | | | | | | | | | |
| 4.950 | 3.0 | 40.4 | 29.2 | 32.8 | 6.9 | -34.8 | 0.0 | 0.0 | 45.2 | 34.0 | 74 | 54 | -28.8 | -20.0 | H |
| 7.425 | 3.0 | 40.2 | 28.8 | 35.6 | 9.1 | -34.1 | 0.0 | 0.0 | 50.8 | 39.4 | 74 | 54 | -23.2 | -14.6 | H |
| 12.375 | 3.0 | 39.0 | 25.8 | 38.4 | 12.0 | -32.5 | 0.0 | 0.0 | 57.0 | 43.8 | 74 | 54 | -17.0 | -10.2 | H (Noise Floor) |
| 4.950 | 3.0 | 45.4 | 35.9 | 32.8 | 6.9 | -34.8 | 0.0 | 0.0 | 50.2 | 40.7 | 74 | 54 | -23.8 | -13.3 | V |
| 7.425 | 3.0 | 44.2 | 33.2 | 35.6 | 9.1 | -34.1 | 0.0 | 0.0 | 54.8 | 43.8 | 74 | 54 | -19.2 | -10.2 | V |
| 12.375 | 3.0 | 37.7 | 25.7 | 38.4 | 12.0 | -32.5 | 0.0 | 0.0 | 55.7 | 43.7 | 74 | 54 | -18.3 | -10.3 | V (Noise Floor) |

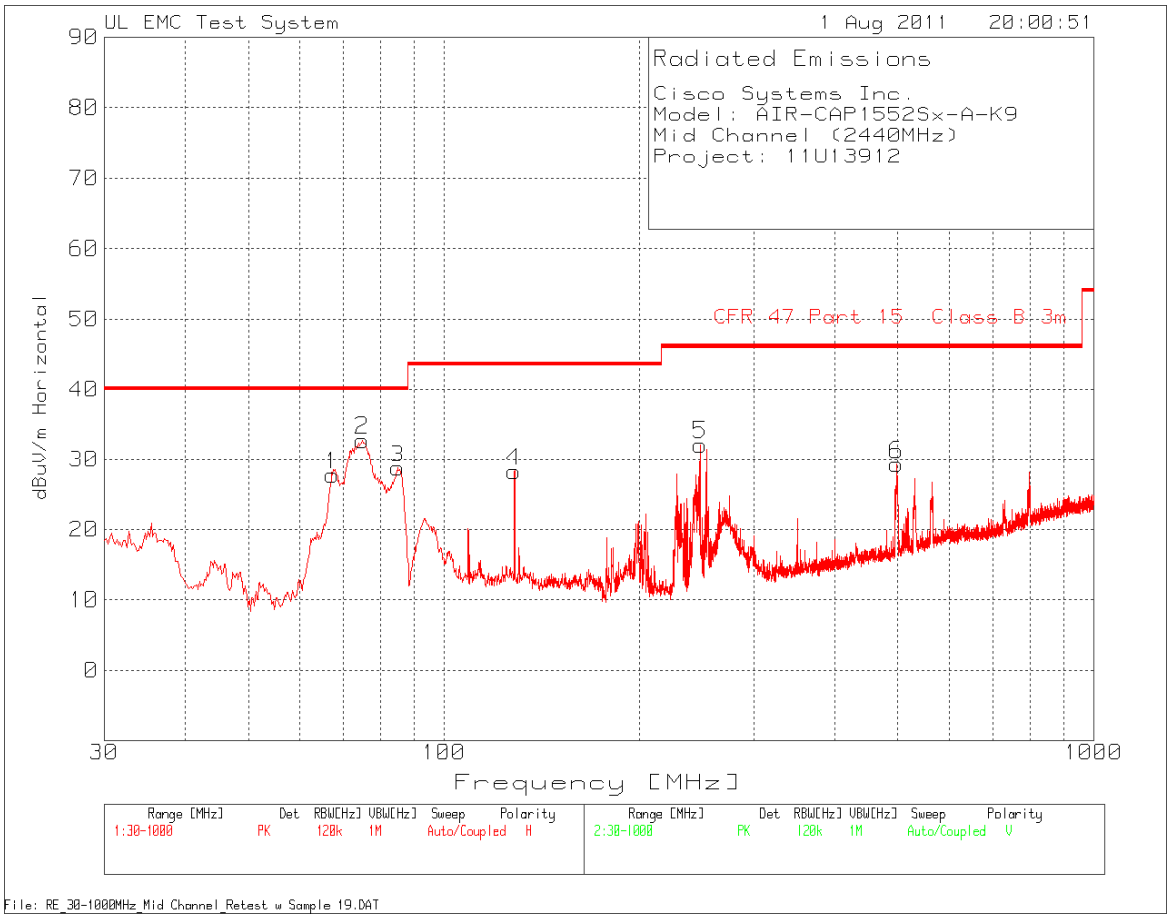
Rev. 07.08.11

| | | | | | |
|---|---|---|---|---|---|
| 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

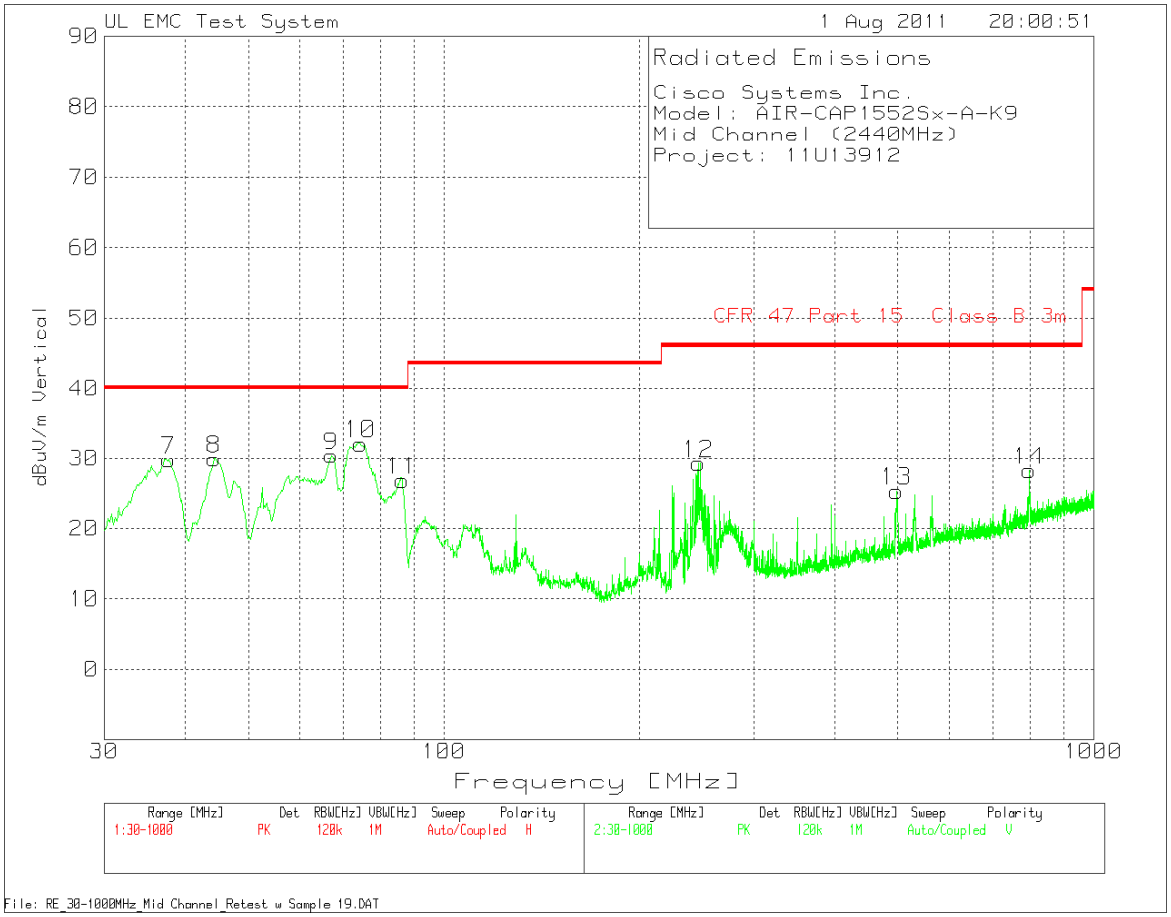
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)**

HORIZONTAL PLOT



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

VERTICAL PLOT



## DATA

Cisco Systems Inc.
Model: AIR-CAP1552Sx-A-K9
Mid Channel (2440MHz)
Project: 11U13912

Horizontal 30 - 1000MHz

| Test Frequency [MHz] | Meter Reading [dBuV/m] | Detector | Cable Loss [dB] | Preamp Gain [dB] | Antenna [dB] | Corrected Reading [dBuV/m] | FCC Class B 3m | Margin | Height [cm] | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 67.4121 | 46.91 | PK | 0.9 | -28.2 | 8.2 | 27.81 | 40 | -12.19 | 176 | Horz |
| 74.972 | 51.82 | PK | 1 | -28.1 | 8.1 | 32.82 | 40 | -7.18 | 251 | Horz |
| 84.8581 | 48.22 | PK | 1 | -28.1 | 7.6 | 28.72 | 40 | -11.28 | 251 | Horz |
| 128.2794 | 41.13 | PK | 1.1 | -27.9 | 13.9 | 28.23 | 43.5 | -15.27 | 251 | Horz |
| 247.8817 | 46.3 | PK | 1.6 | -27.5 | 11.8 | 32.2 | 46 | -13.8 | 251 | Horz |
| 497.554 | 38.79 | PK | 2.2 | -28.5 | 16.8 | 29.29 | 46 | -16.71 | 100 | Horz |

Vertical 30 - 1000MHz

| Test Frequency [MHz] | Meter Reading [dBuV/m] | Detector | Cable Loss [dB] | Preamp Gain [dB] | Antenna [dB] | Corrected Reading [dBuV/m] | FCC Class B 3m | Margin | Height [cm] | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 37.7538 | 42.11 | PK | 0.7 | -28.2 | 15.2 | 29.81 | 40 | -10.19 | 101 | Vert |
| 44.3445 | 45.5 | PK | 0.7 | -28.2 | 12 | 30 | 40 | -10 | 101 | Vert |
| 67.0244 | 49.6 | PK | 0.9 | -28.2 | 8.1 | 30.4 | 40 | -9.6 | 101 | Vert |
| 74.3905 | 51.18 | PK | 1 | -28.1 | 8.1 | 32.18 | 40 | -7.82 | 101 | Vert |
| 86.215 | 46.39 | PK | 1 | -28.1 | 7.6 | 26.89 | 40 | -13.11 | 176 | Vert |
| 246.3309 | 43.42 | PK | 1.6 | -27.5 | 11.8 | 29.32 | 46 | -16.68 | 251 | Vert |
| 497.554 | 34.79 | PK | 2.2 | -28.5 | 16.8 | 25.29 | 46 | -20.71 | 101 | Vert |
| 796.6567 | 32.56 | PK | 2.9 | -28 | 20.8 | 28.26 | 46 | -17.74 | 101 | Vert |

PK - Peak detector
QP - Quasi-Peak detector
LnAv - Linear Average detector
LgAv - Log Average detector
Av - Average detector
CAV - CISPR Average detector
RMS - RMS detection
CRMS - CISPR RMS detection
Text File: RE_30-1000MHz_Mid Channel_Retest w Sample 19.TXT
File: RE_30-1000MHz_Mid Channel_Retest w Sample 19.DAT

# 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**

Cisco Systems Inc.
Model: AIR-CAP1552Sx-A-K9
Mid Channel (2440MHz)
Project 11U13912
120V 60Hz

Line-L1 .15 - 30MHz

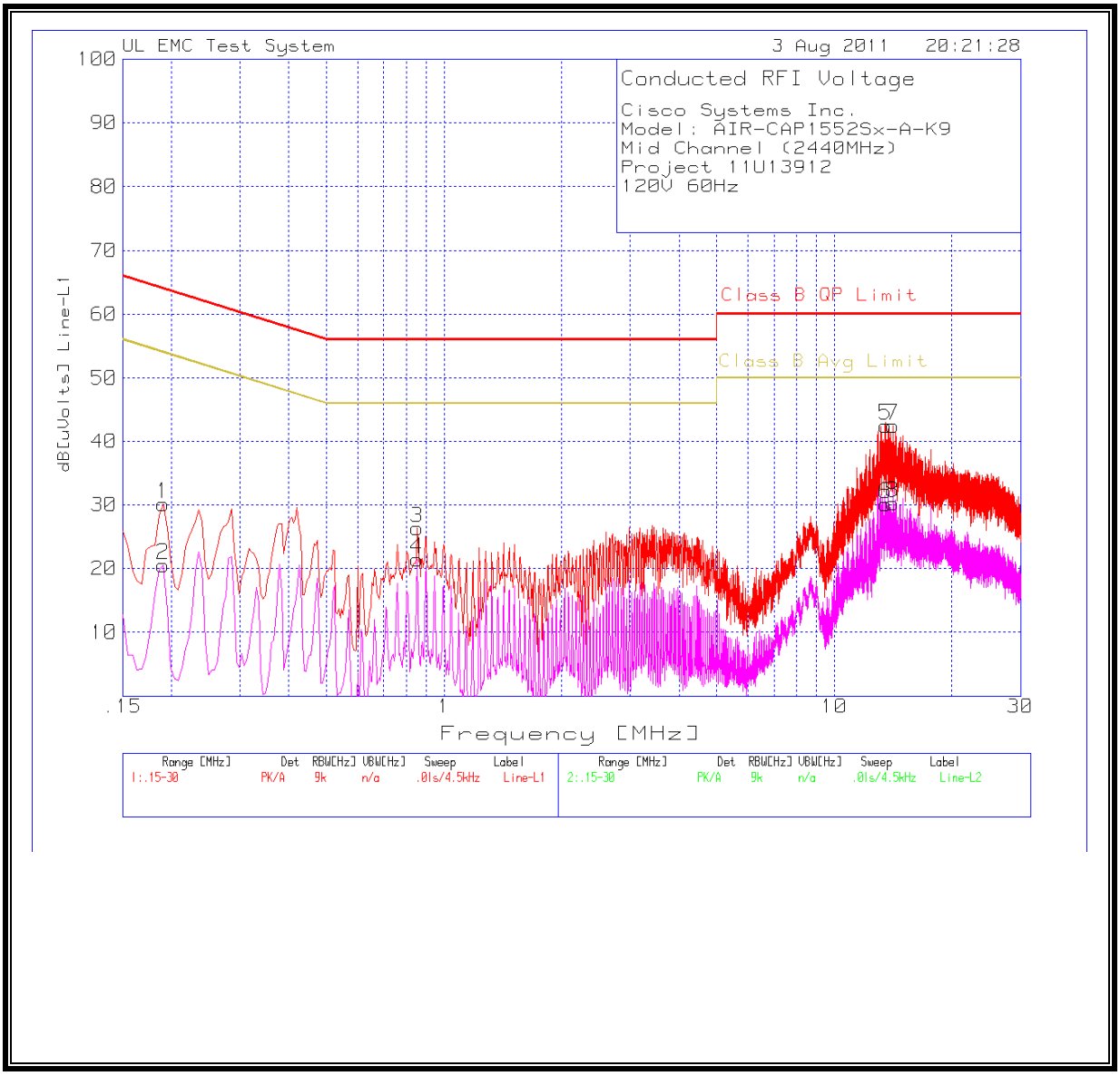
| Test Frequency [MHz] | Meter Reading [dBuV] | Detector | LISN Loss [dB] | Cable Loss [dB] | Corrected Reading [dBuV] | Class B QPK Limit | Margin | Class B AVG Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| 0.1905 | 30.08 | PK | 0 | 0 | 30.08 | 64 | -33.92 | 54 | -23.92 |
| 0.1905 | 20.52 | Av | 0 | 0 | 20.52 | 64 | -43.48 | 54 | -33.48 |
| 0.852 | 26.29 | PK | 0 | 0 | 26.29 | 56 | -29.71 | 46 | -19.71 |
| 0.852 | 21.48 | Av | 0 | 0 | 21.48 | 56 | -34.52 | 46 | -24.52 |
| 13.533 | 42.54 | PK | 0 | 0 | 42.54 | 60 | -17.46 | 50 | -7.46 |
| 13.533 | 30.09 | Av | 0 | 0 | 30.09 | 60 | -29.91 | 50 | -19.91 |
| 14.154 | 42.53 | PK | 0 | 0 | 42.53 | 60 | -17.47 | 50 | -7.47 |
| 14.154 | 30.19 | Av | 0 | 0 | 30.19 | 60 | -29.81 | 50 | -19.81 |

Line-L2 .15 - 30MHz

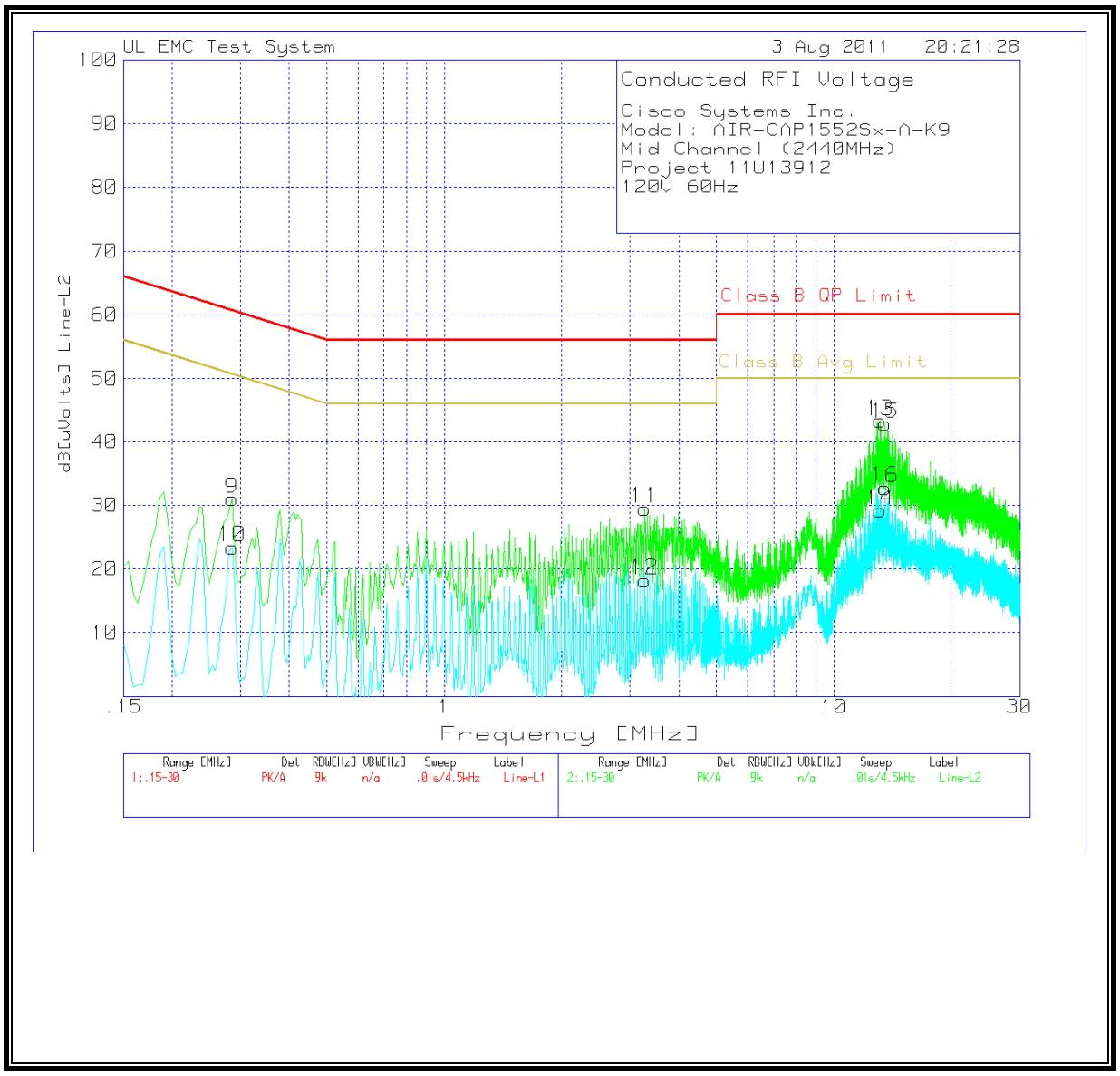
| Test Frequency [MHz] | Meter Reading [dBuV] | Detector | LISN Loss [dB] | Cable Loss [dB] | Corrected Reading [dBuV] | Class B QPK Limit | Margin | Class B AVG Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| 0.285 | 30.95 | PK | 0 | 0 | 30.95 | 60.7 | -29.75 | 50.7 | -19.75 |
| 0.285 | 23.43 | Av | 0 | 0 | 23.43 | 60.7 | -37.27 | 50.7 | -27.27 |
| 3.273 | 29.51 | PK | 0 | 0 | 29.51 | 56 | -26.49 | 46 | -16.49 |
| 3.273 | 18.21 | Av | 0 | 0 | 18.21 | 56 | -37.79 | 46 | -27.79 |
| 13.1685 | 43.37 | PK | 0 | 0 | 43.37 | 60 | -16.63 | 50 | -6.63 |
| 13.1685 | 29.14 | Av | 0 | 0 | 29.14 | 60 | -30.86 | 50 | -20.86 |
| 13.5015 | 42.86 | PK | 0 | 0 | 42.86 | 60 | -17.14 | 50 | -7.14 |
| 13.5015 | 32.75 | Av | 0 | 0 | 32.75 | 60 | -27.25 | 50 | -17.25 |

PK - Peak detector
QP - Quasi-Peak detector
LnAv - Linear Average detector
LgAv - Log Average detector
Av - Average detector
CAV - CISPR Average detector
RMS - RMS detection
CRMS - CISPR RMS detection
Text File: CDE_150k-30MHz_FCC Part 15 Class B_Mid Channel 2440_Sample 19_120V 60Hz.TXT

**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.

**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 ($W/m^2$) | 5 Averaging Time (min) |
|---|---|---|---|---|
| 0.003–1 | 280 | 2.19 | | 6 |
| 1–10 | $280/f$ | $2.19/f$ | | 6 |
| 10–30 | 28 | $2.19/f$ | | 6 |
| 30–300 | 28 | 0.073 | 2* | 6 |
| 300–1 500 | $1.585f^{0.5}$ | $0.0042f^{0.5}$ | $f/150$ | 6 |
| 1 500–15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000–150 000 | 61.4 | 0.163 | 10 | $616\,000/f^{1.2}$ |
| 150 000–300 000 | $0.158f^{0.5}$ | $4.21 \times 10^{-4}f^{0.5}$ | $6.67 \times 10^{-5}f$ | $616\,000/f^{1.2}$ |

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

**Notes:** 1. Frequency, $f$, is in MHz.
2. A power density of 10 $W/m^2$ is equivalent to 1 $mW/cm^2$.
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 = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

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^2

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

## RESULTS

**2.4 GHz Band**

| Multiple chain or colocated transmitters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **Mode** | **Chain for MIMO** | **Separation Distance (m)** | **Output AV Power (dBm)** | **Antenna Gain (dBi)** | **EIRP (dBm)** | **EIRP (W)** | **IC Power Density (W/m^2)** | **FCC Power Density (mW/cm^2)** |
| 2.4 GHz | Zigbee | N/A | | 17.20 | 5.00 | 22.20 | 0.17 | | |
| 2.4 GHz | WLAN | 1 | | 25.00 | 4.00 | 29.00 | 0.79 | | |
| 2.4 GHz | WLAN | 2 | | 25.00 | 4.00 | 29.00 | 0.79 | | |
| Combined | | | 0.20 | | | | 1.75 | 3.49 | 0.349 |

**5.8 GHz Band**

| Multiple chain or colocated transmitters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **Mode** | **Chain for MIMO** | **Separation Distance (m)** | **Output AV Power (dBm)** | **Antenna Gain (dBi)** | **EIRP (dBm)** | **EIRP (W)** | **IC Power Density (W/m^2)** | **FCC Power Density (mW/cm^2)** |
| 2.4 GHz | Zigbee | N/A | | 17.20 | 5.00 | 22.20 | 0.17 | | |
| 5.8 GHz | WLAN | 1 | | 25.00 | 7.00 | 32.00 | 1.58 | | |
| 5.8 GHz | WLAN | 2 | | 25.00 | 7.00 | 32.00 | 1.58 | | |
| Combined | | | 0.20 | | | | 3.34 | 6.64 | 0.664 |

**2.4 GHz Band**

| Multiple chain or colocated transmitters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **Mode** | **Chain for MIMO** | **Separation Distance (m)** | **Output AV Power (dBm)** | **Antenna Gain (dBi)** | **EIRP (dBm)** | **EIRP (W)** | **IC Power Density (W/m^2)** | **FCC Power Density (mW/cm^2)** |
| 2.4 GHz | Zigbee | N/A | | 16.46 | 14.00 | 30.46 | 1.11 | | |
| 2.4 GHz | WLAN | 1 | | 25.00 | 4.00 | 29.00 | 0.79 | | |
| 2.4 GHz | WLAN | 2 | | 25.00 | 4.00 | 29.00 | 0.79 | | |
| Combined | | | 0.20 | | | | 2.70 | 5.37 | 0.537 |

**5.8 GHz Band**

| Multiple chain or colocated transmitters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **Mode** | **Chain for MIMO** | **Separation Distance (m)** | **Output AV Power (dBm)** | **Antenna Gain (dBi)** | **EIRP (dBm)** | **EIRP (W)** | **IC Power Density (W/m^2)** | **FCC Power Density (mW/cm^2)** |
| 2.4 GHz | Zigbee | N/A | | 16.46 | 14.00 | 30.46 | 1.11 | | |
| 5.8 GHz | WLAN | 1 | | 25.00 | 7.00 | 32.00 | 1.58 | | |
| 5.8 GHz | WLAN | 2 | | 25.00 | 7.00 | 32.00 | 1.58 | | |
| Combined | | | 0.20 | | | | 4.28 | 8.52 | 0.852 |

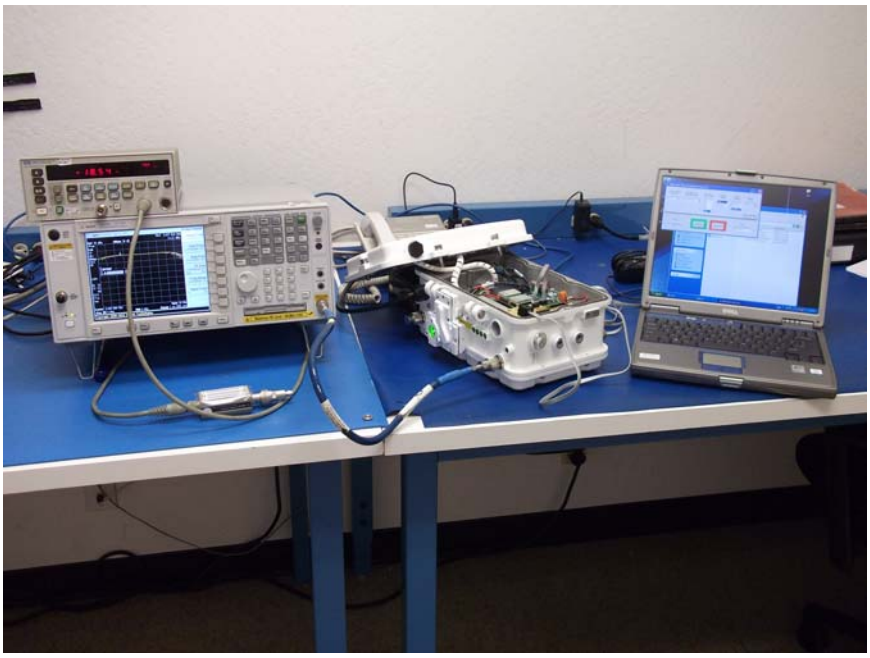
**Note:**
The AV output power for WLAN and the antenna gains for WLAN for both 2.4 GHz and 5.8 GHz bands are taken from the reports with the following numbers:

1552_Series_2400_2483.5_Test_Report.pdf
1552_Series_5725_5850_Test_Report.pdf

# 11. SETUP PHOTOS

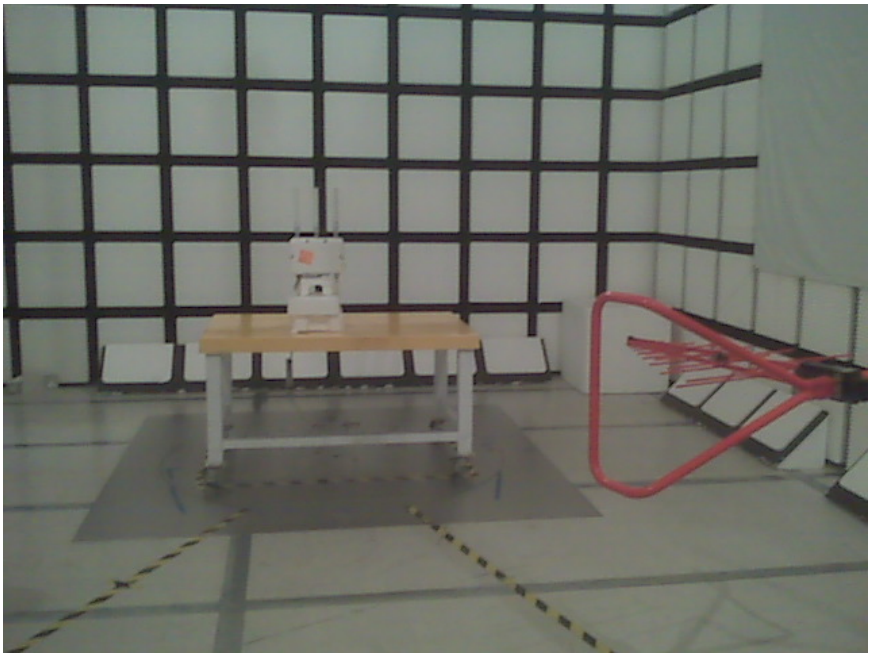
**ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP**

ANTENNA PORT CONDUCTED PHOTO

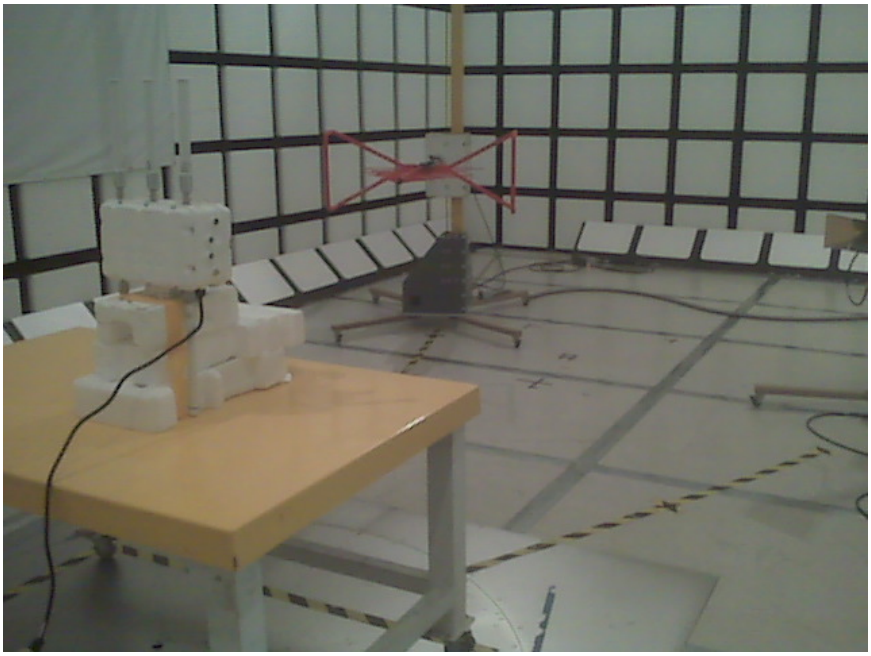


**RADIATED RF MEASUREMENT SETUP**

RADIATED FRONT PHOTO



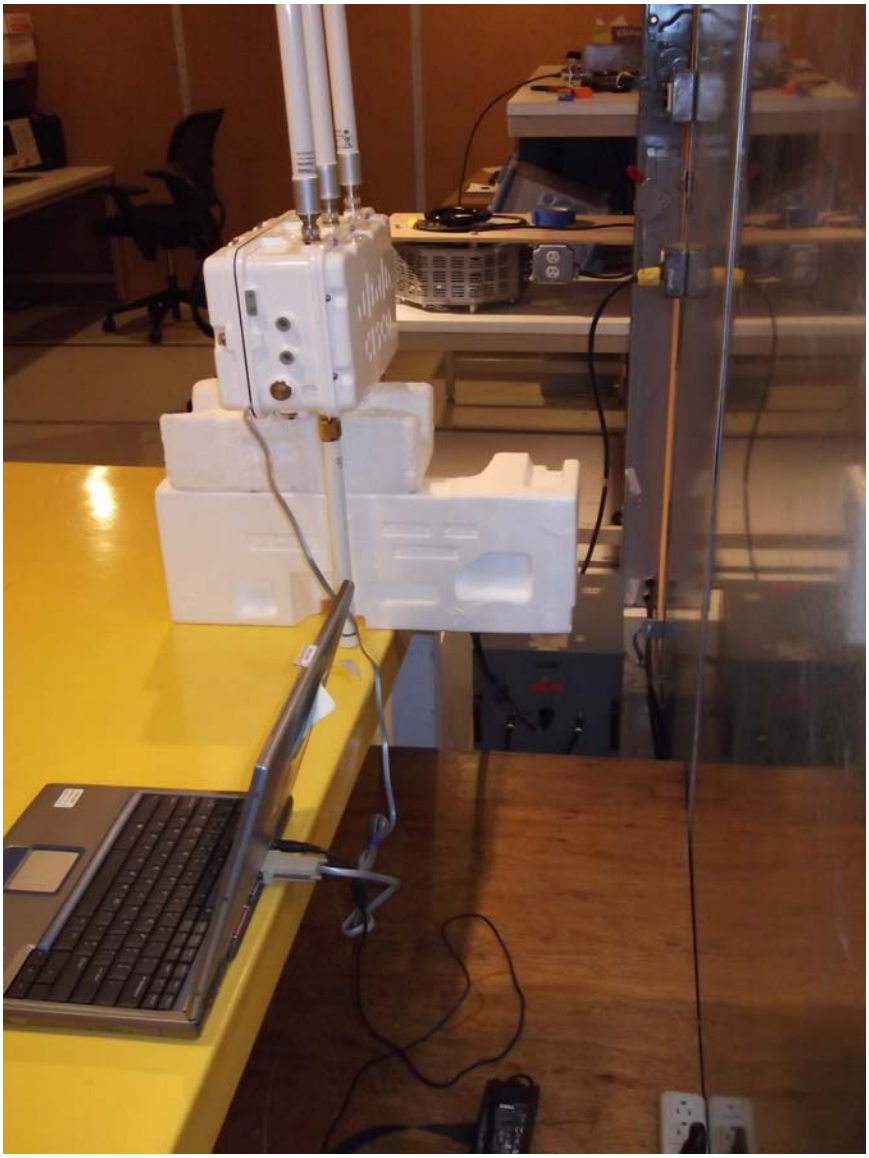
RADIATED BACK PHOTO



**POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP**

LINE CONDUCTED FRONT PHOTO

LINE CONDUCTED BACK PHOTO



# END OF REPORT