FCC RF EXPOSURE REPORT

FOR

CISCO 802.11bg and 802.11abg WIRELESS RADIOS

MODEL NUMBERS: HWIC-AP-G-A and HWIC-AP-AG-A

FCC IDS: LDKXSARCD11 and LDKXSNIAG13

REPORT NUMBER: 07U10816-1

ISSUE DATE: MARCH 8, 2007

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

Prepared by
COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA, 94538, USA
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	03/08/07	Initial Issue	M.H.

TABLE OF CONTENTS

1. ATTESTATION OF CALCULATIONS

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

EUT DESCRIPTION: CISCO 802.11bg WIRELESS RADIO
MODEL NUMBER: HWIC-AP-G-A
FCC ID: LDKXSARCD13

EUT DESCRIPTION: CISCO 802.11abg WIRELESS RADIO
MODEL NUMBER: HWIC-AP-AG-A
FCC ID: LDKXSNIAG11

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PARTS 1 AND 2 OET BULLETIN 65	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. calculated the MPE of the above equipment in accordance with the requirements set forth in the above standards. The results show that the equipment is capable of demonstrating compliance with the requirements as documented in this report.

Note: The calculations documented in this report are based on the frequency bands, output powers and antenna gains as documented herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

MICHAEL HECKROTTE
ENGINEERING MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

THU CHAN
SENIOR ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The calculations documented in this report were performed in accordance with FCC CFR 47 Parts 1 and 2, and OET Bulletin 65.

3. FACILITIES AND ACCREDITATION

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

4. RADIO MODULE APPROVAL CONDITIONS

Sierra Wireless WWAN module Approval Conditions

	Max. RF conducted output power @850 MHz	Max. Antenna Gain (dBi) @ 850 MHz including cable lost	Max. RF conducted output power @1900 MHz	Max. Antenna Gain (dBi) @ 1900 MHz including cable lost	Separation Distance to user or near by person
FCC ID: N7N-MC5725	25.57 dBm	4.65	25.72 dBm	3.35	>20 cm
FCC ID: N7NMC8775	32.06 dBm	8	29.14dBm	4	>20 cm

Cisco WLAN Module Approval Conditions

	Max. RF conducted output power @2.4GHz	Max. Antenna Gain (dBi) @ 2.4 GHz including cable lost	Max. RF conducted output power @5 GHz	Max. Antenna Gain (dBi) @ 5 GHz including cable lost	Separation Distance to user or near by person
FCC ID: LDKXSARCD11	23.6 dBm	5.5	22.3 dBm	6	>20 cm
FCC ID: LDKXSNIAG13	23.98 dBm	5.2	N/A	N/A	>20 cm

5. RADIO MODULE AND ANTENNA COMBINATIONS

5.1. WWAN Modules

Module	SKU
CDMA	HWIC-3G-CDMA
GSM	HWIC-3G-GSM

5.2. Router Platforms

	Max. HWIC card slots	No of WLAN Module	No of CDMA WWAN module	No of GSM WWAN module
CISCO 3845	4	Max. 1	Max 1	Max. 1
CISCO 3825	4	Max. 1	Max 1	Max. 1
CISCO 2851	4	Max. 1	Max 1	Max. 1
CISCO 2821	4	Max. 1	Max 1	Max. 1
CISCO 2811	4	Max. 1	Max 1	Max. 1
CISCO 2801	2	Max. 1	Either one CDMA WWAN or GSM WAN module	
CISCO 1841	2	Max. 1	Either one CDMA WWAN or GSM WAN module	

Note: Some systems may have both a CDMA and a GSM module installed.

5.3. WWAN Antenna

	dBi Gain @ 850 MHz	dBi Gain @ 1900 MHz	Separation Distance to user or near by person	Separation Distance to WLAN antenna
3G-ANTM1919D	0	0	> 20 cm	< 20 cm

6. RF EXPOSURE CLASSIFICATION

Systems operating under the provision of 47 CFR 1.1307(b)(1) shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the FCC guidelines.

The Cisco router platform will only be used with a separation of 20 centimeters or greater between the antennas and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b).

7. EQUATIONS

The equations used are based on methods described in OET Bulletin 65 and appendices.

Given

$E = \sqrt{(30 * P * G) / d}$

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 ^ ((P + G) / 20) / \sqrt{S}$

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$

8. FCC LIMITS

8.1. MPE LIMITS

§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.

8.2. CO-LOCATED MPE LIMITS

Per OET Bulletin 65, for frequency bands with the same MPE limits, the Power Densities produced by each transmitter are summed. The summation must be under the limit for the band.

Per OET Bulletin 65, for frequency bands with different limits the Power Densities are calculated separately for each band, divided by the limit for the band and the results are then summed. The summation must be less than 1.

9. WORST CASE EVALUATIONS

9.1. CONTRIBUTION OF EACH TRANSMITTER

For the Part 22 Transmitter, 824 MHz is used for the calculation.

For the Part 24 Transmitter, 1850 MHz is used for the calculation.

For the 2.4 GHz band Transmitter, 2412 MHz is used for the calculation, both the highest power level and the highest antenna gain are used for the calculation.

For the 5 GHz band Transmitter, 5180 MHz is used for the calculation.

Transmitter Frequency Band, MHz	Power, dBm	Antenna Gain, dBi	Power Density at 20 cm, mW/cm^2	Power Density limits mW/cm^2	**Fraction of the Limit**, Dimensionless
824.7 – 848.31	32.07	0	0.452	0.55	0.452/0.55= **0.821**
1851.25 – 1908.75	29.14	0	0.290	1	**0.290**
2412.0 – 2462.0	23.98	5.5	0.176	1	**0.176**
5180.0 – 5240.0 / 5260.0 – 5320.0 / 5745.0 – 5825.0	22.3	6	0.134	1	**0.134**

9.2. SIMULTANEOUS TRANSMISSION CONSIDERATION

9.2.1. TWO TRANSMITTER CONFIGURATOIN

The sum of the Fraction of the Limit for each of two transmitters operating simultaneously is as follows:

Active Transmitter Bands, MHz	Active Transmitter Bands, MHz	MPE Distance (cm)	**Colocated Fraction of the Limit**	**Units for Bold Values**	**Limit**
824.7 – 848.31	2412.0 – 2462.0	20	0.821+0.176 = **0.997**	**Fraction of the Limit,** Dimensionless	**1**
824.7 – 848.31	5180.0 – 5240.0 / 5260.0 – 5320.0 / 5725.0 – 5850.0	20	0.821+0.134 = **0.955**		**1**
1851.25 – 1908.75	2412.0 – 2462.0	20	0.29+0.176 = **0.466**		**1**
1851.25 – 1908.75	5180.0 – 5240.0 / 5260.0 – 5320.0 / 5725.0 – 5850.0	20	0.29+0.134 = **0.424**		**1**

9.2.2. THREE TRANSMITTER CONFIGURATOIN

The sum of the Fraction of the Limit for the GSM, CDMA, and a WLAN transmitter operating simultaneously will exceed the fractional limit. Since power density is proportional to the inverse of the distance squared, an estimate of the required distance can be made by the equation:

$D_{estimated}$ = 20 cm * (√ Fraction of the Limit)

Active Transmitter Bands, MHz	Active Transmitter Bands, MHz	Active Transmitter Bands, MHz	**Colocated Fraction of the Limit**	Estimated MPE Distance to meet the Fractional Limit of 1 (cm)
824.7 – 848.31	1851.25 – 1908.75	2412.0 – 2462.0	0.821+0.29+0.176 = **1.287**	22.6
824.7 – 848.31	1851.25 – 1908.75	5180.0 – 5240.0 / 5260.0 – 5320.0 / 5725.0 – 5850.0	0.821+0.29+0.134 = **1.245**	22.3

Setting the MPE distance at 23 cm yields the following fractional contributions of each transmitter:

Transmitter Frequency Band, MHz	Power, dBm	Antenna Gain, dBi	Power Density at 23 cm, mW/cm^2	Power Density limits mW/cm^2	**Fraction of the Limit**, Dimensionless
824.7 – 848.31	32.07	0	0.242	0.55	0.242/0.55 = **0.440**
1851.25 – 1908.75	29.14	0	0.123	1	**0.123**
2412.0 – 2462.0	23.98	5.5	0.133	1	**0.133**
5180.0 – 5240.0 / 5260.0 – 5320.0 / 5745.0 – 5825.0	22.3	6	0.102	1	**0.102**

The sum of the Fraction of the Limit for each of three transmitters operating simultaneously is as follows:

Active Transmitter Bands, MHz	Active Transmitter Bands, MHz	Active Transmitter Bands, MHz	MPE Distance (cm)	**Colocated Fraction of the Limit**	**Units for Bold Values**	**Limit**
824.7 – 848.31	1851.25 – 1908.75	2412.0 – 2462.0	23	0.440+0.123+0.133 = **0.893**	**Fraction of the Limit,** Dimensionless	1
824.7 – 848.31	1851.25 – 1908.75	5180.0 – 5240.0 / 5260.0 – 5320.0 / 5725.0 – 5850.0	23	0.440+0.123+0.102 = **0.665**		1

END OF REPORT