



RF Exposure Study - Engineering Analysis per

FCC 2.1093

Industry Canada RSS-102

2.4GHz WLAN Radio 802.11 b/g/n

5GHz WLAN Radio 802.11a/an/ac

Model : WRP500

FCC ID : LDKWRP501156

IC : 2461L-WRP501156

Supplementary Appendix to Report(s) EDCS# 1465480, EDC# 1465481,
EDC# 1465482

Prepared By: Cisco Systems Inc
170 West Tasman
San Jose, CA 95134
USA

1.0: Attestation Statement of Compliance

The Cisco Systems WRP500-A-K9, 802.11 b/g/an/ac

P/N: 74-12879-01 has been evaluated for Maximum Permissible Exposure in compliance with 47 Code of Federal Regulations 2.1093. The evaluation was in accordance with methodology as referenced in FCC KDB 447498 D01 General RF Exposure Guidance v05r02

This report serves as the additional technical analysis of the Cisco radio modules

The limits used for this evaluation are in line with the recommendations of the World Health Organizations (WHO) International Committee on Non Ionizing Radiation Protection (ICNIRP) as well as the American National Standards Institute (ANSI) C95.1.

The limits chosen are of **General Population/Uncontrolled Exposure**.

This analysis also complies with the requirements stated in Industry Canada RSS-102 as well as the applicable Australian and New Zealand regulations.

Only the following case scenario was used which are:

2.4GHz WLAN Radio: FCC ID: LDKWRP501156 , IC : 2461L-WRP501156

5150-5250MHz WLAN Radio: FCC ID: LDKWRP501156 , IC : 2461L-WRP501156

5725-5850MHz WLAN Radio: FCC ID: LDKWRP501156 , IC : 2461L-WRP501156

Output power listed is conducted. The antenna(s) used for this device must be installed to provide a separation distance of at least 20 cm from all persons. Installers must be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

Based on the study this case scenario, the General Population/Uncontrolled Exposure and the minimum recommended distance is around 20cm (8 inches) from the antenna.

Jose Aguirre
Cisco Systems Inc
Corporate Compliance and Certifications
125 West Tasman Drive
San Jose, CA 95134
Email: joaguirr@cisco.com

2.0 EUT Description.

WRP500-A-k9 Dual Band Wireless 802.11a/ac/b/g/n Router

The **WRP500-A-k9** is the dual band Wireless-B, G, A, AC, N Broadband router with one WAN port, four 10/100 LAN ports for wired connections and two phone jacks for voice over Internet Protocol (VoIP) functionality. The WRP500-A-K9 uses advanced quality-of-service (QoS) functionality to preserve the consistency and clarity of voice and video communications. It keeps your data safe by supporting WPS2.0 and WPA/WPA2 and WAPI wireless security protocols, access limitations based on MAC and IP addresses, and a robust firewall that prevents against malicious external attacks to the network.

3.0 Methodology

All calculations were made in accordance with ANSI C95.1, and FCC 447498 D01 General RF Exposure Guidance v05r02

4.0 Technical Requirements

4.1 Single Band Operation – Limits

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
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

Frequency	Electric Field	Magnetic Field	Power Density	Averaging Time
-----------	----------------	----------------	---------------	----------------

Range (MHz)	Strength (E) (V/m)	Strength (H) (A/m)	(S) (mW/cm ²)	E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
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: See Section 1 for discussion of exposure categories.

NOTE 2: The averaging time for General Population/Uncontrolled exposure to fixed transmitters is not applicable for mobile and portable transmitters. See 47 CFR §§2.1091 and 2.1093 on source-based time-averaging requirements for mobile and portable transmitters.

5.0 Calculations

The Power Density (mW/cm²) is calculated as follows:

$$S = PG(\text{Duty Cycle}) / 4\pi R^2 \quad (\text{Equation 1})$$

Solve for R

$$R = \sqrt{\frac{PG(\text{duty cycle})}{4\pi S}} \quad (\text{Equation 2})$$

Where:

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

6.0 Results

Test Reports used in evaluation are :

2.4GHz WLAN Radio: EDCS - 1465480

5150-5250MHz WLAN Radio: EDCS - 1465481

5725-5850MHz WLAN Radio: EDCS - 1465482

EDCS#: 1465483

S=1mW/cm² maximum. The highest supported antenna gain is 2.0 dBi. Using the peak power levels recorded in the test report along with Equation 2 above, the MPE distances are calculated as follows.

Frequency (MHz)	Bit Rate (Mbps)	Power Density (mW/cm ²)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
2437	6	1	21.3	2	4.13	20	15.87
5240	6.5	1	20.4	2	3.70	20	16.30
5825	6.5	1	20.7	2	3.85	20	16.15

MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 1, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	Bit Rate (Mbps)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Margin (mW/cm ²)
2437	1	20	21.3	2	0.04	1	0.96
5240	1	20	20.4	2	0.03	1	0.97
5825	1	20	20.7	2	0.04	1	0.96

Calculations with simultaneous transmitters

Scenerio 1 :

2400MHz to 2483.5MHz radio

5150MHz to 5250MHz radio

Tx1	Tx2	Tx3	Tx4	Tx5	% of Standard
0.04	0.03				0.07

$$D \text{ (estimate)} = 20 * \sqrt{\%}$$

$$D = 5.292 \text{ cm}$$

Scenerio 2 :

2400MHz to 2483.5MHz radio

5725MHz to 52850MHz radio

Tx1	Tx2	Tx3	Tx4	Tx5	% of Standard
0.04				0.04	0.08

$$D \text{ (estimate)} = 20 * \sqrt{\%}$$

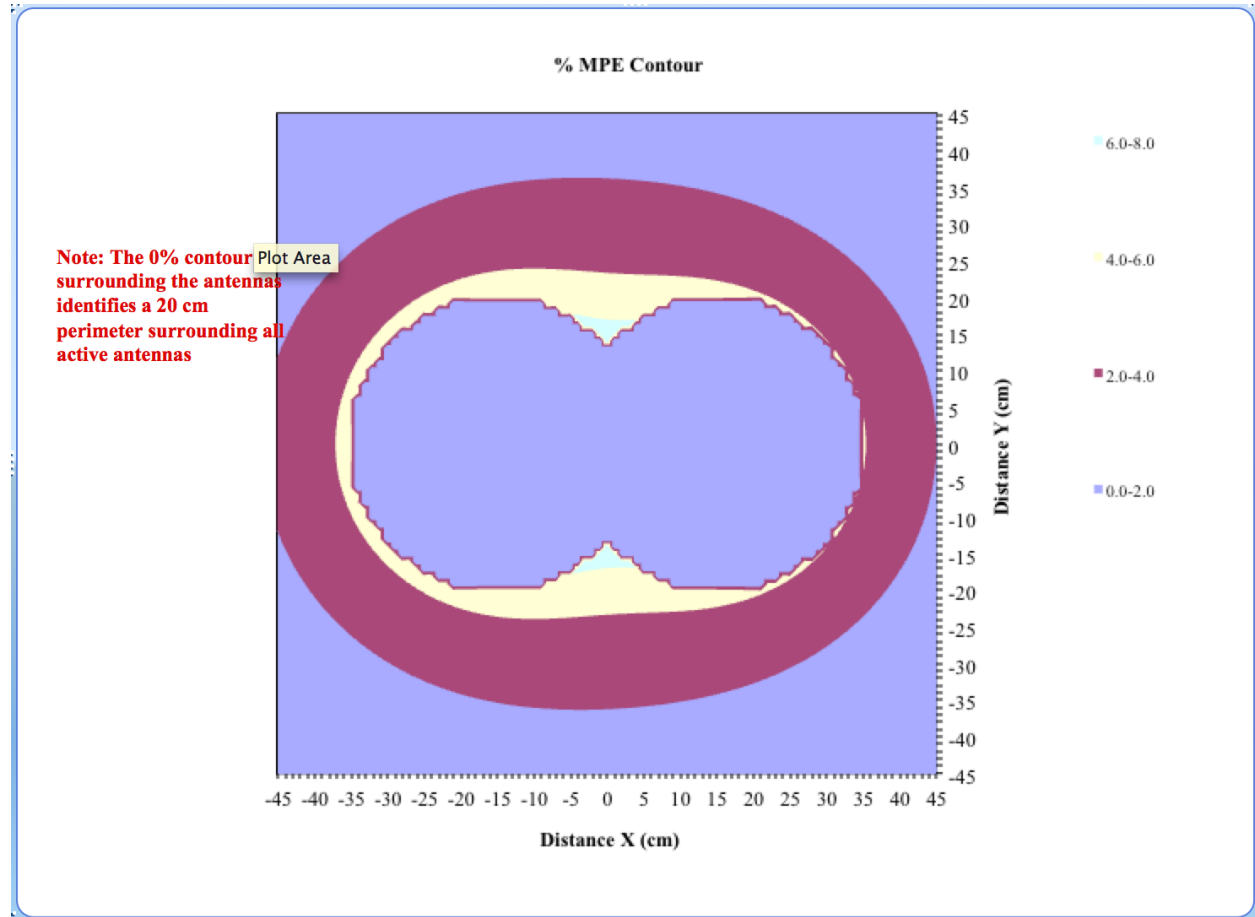
$$D = 5.657 \text{ cm}$$

EDCS#: 1465483

The calculation is for **General Population/Uncontrolled exposure**. The minimum distance recommended is **20cm (8 inches)**.

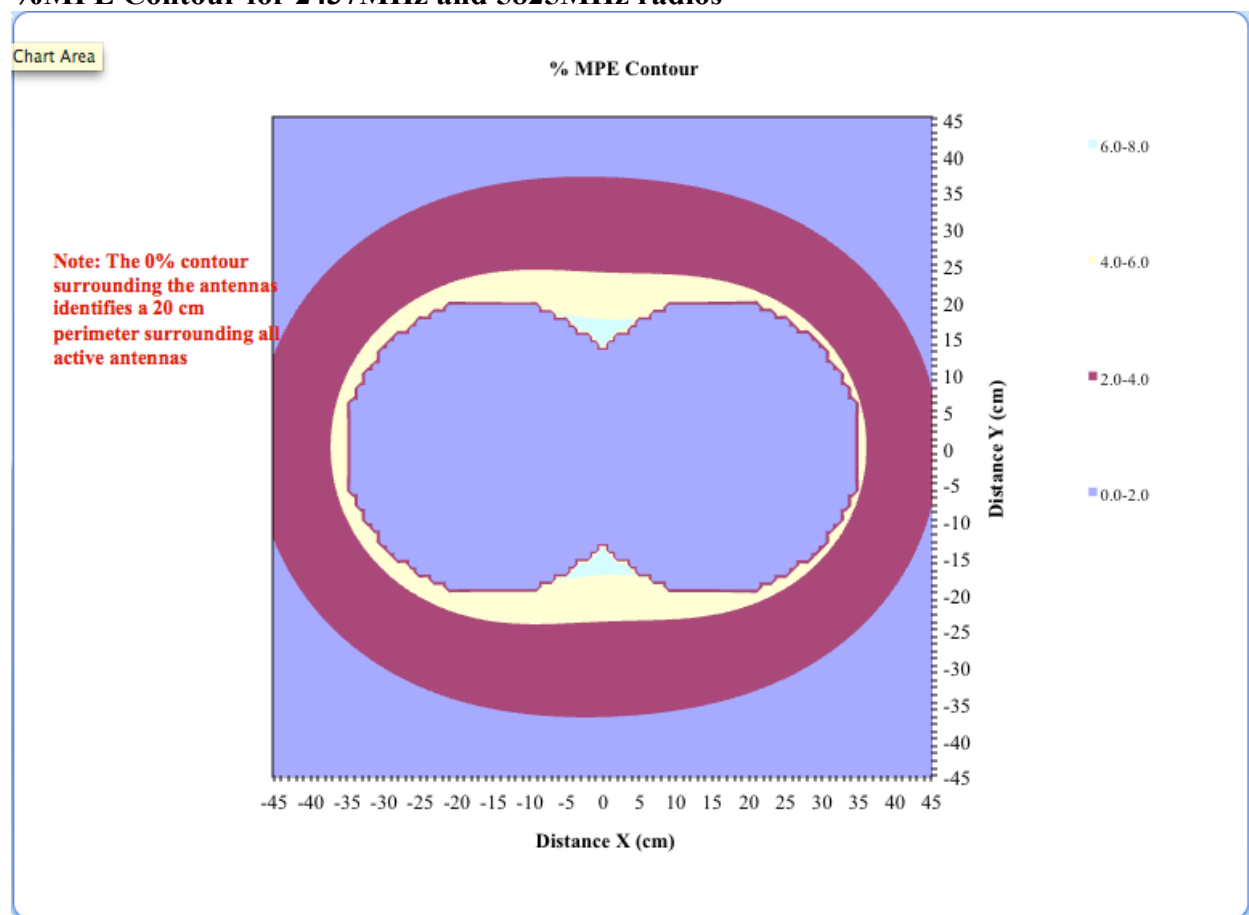
Using the provided FCC MPE-Mobile.xls file, the “**% MPE contour**” charts are given below for the simultaneous cases listed above.

%MPE contour of 2437MHz & 5240MHz radios



EDCS#: 1465483

%MPE Contour for 2437MHz and 5825MHz radios



References

American National Standards Institute (ANSI), "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992 (previously issued as IEEE C95.1-1991). Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, N.Y. 10017. For copies contact the IEEE: 1-800-678-4333 or 1-908-981-1393.

American National Standards Institute (ANSI), "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave". ANSI/IEEE C95.3-1992. Copyright 1992, The Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, NY 10017. For copies contact the IEEE: 1-800-678-4333 or 1-908-981-1393.

FCC KDB 447498 D01 General RF Exposure Guidance v05r02