



Engineering Analysis of

Transceiver ModelAIR-LMC35X Series

FCC ID: LDK102040

To

Federal Communications Commission

Part 1.1310 Radio Frequency Exposure Limits

&

OET 65 Supplement C

01/04/01

This analysis was done per the requirements of Part 15.247.4 of the FCC rules as part of the FCC certification requirements for spread spectrum devices.

The Aironet radio modules analyzed have a maximum TX power of 100mW (+20dBm) and all calculations were based on that power output (except where power reduction was required to meet the total EIRP limit of +36dBm).

The formulas and Maximum Permissible Exposure (MPE) limit requirements referenced in this report can be found in FCC Bulletin OET-65 and specifically OET-65 Supplement C which addresses devices such as low power spread spectrum.

All calculations were done in the worse case mode, the Uncontrolled environment with the radio duty cycle at 100%. It should be understood that under normal operating conditions, the Aironet radios would not operate at this duty cycle and most likely operate below 50% duty cycle.

Based on the MPE calculation using the limits of the uncontrolled environment, the Aironet radio modules do not exceed the MPE requirements set forth in these documents providing the minimum safe distance between antenna and operator is met. For handheld or body worn systems, the recommend distance is about 2.8 cm (1.1 inch) from antenna and that is based on a 100% duty cycle.

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I Equipment Under Test

FCC ID: LDK102040
Model: AIR-LMC35X series
Type: PCMCIA Wireless LAN Adapter
Max Power 0.1 Watts
Duty Cycle N \ A

Max EIRP for antenna combinations

21 dBi Parabolic +36dBm

II MPE Distances

Calculations based on 100% duty cycle.

Antenna	TX Power	EIRP	MPE Distance
21.0 dBi Parabolic	+13dBm	+36dBm \ 4W	18.3 cm
16.0 dBi Patch	+20dBm	+36dBm \ 4W	17.8 cm
12.0 dBi Omni	+20dBm	+32dBm \ 1.8 W	11.2 cm

III Maximum Permissible Exposure

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	E Field Strength (V/m)	M Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (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 Range (MHz)	E Field Strength (V/m)	M Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (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

The uncontrolled environment represents the most restrictive limits.

In an uncontrolled environment, the maximum permissible exposure from a radio device operating at 2.4 GHz is 1mW/cm² average over a 30 minute period.

Based on the calculated power density, the high gain antenna must be mounted at a minimum distance of 15 cm from the user. The following warning statement will be placed in the user manuals to caution the user on correct and safe use of this antenna.

For High Gain wall mount or mast mount antennas: These high gain antennas are designed to be professionally installed and should be located away from the user by a minimum of 15 cm. Please contact your professional installer, VAR, or antenna manufacturer for proper installation requirements

In the controlled environment, the maximum permissible exposure from a radio device operating at 2.4 GHz is 5mW/ cm² over a 6 minute period. Since the analysis is favorable in the Uncontrolled Environment, it is unnecessary to analyze the device to the less restrictive limits of the Controlled Environment or Partial Body Exposure

Based on the calculated distance (determined by the uncontrolled environment) the minimum recommended mounting distance is 3.5cm away from the body (1.37 inches) based on the radio operating at a 100% duty cycle.

Excerpts from OET 65-C

Transmitters using a monopole or dipole type antennas that are $\leq 0.2\text{W}@2450$ Mhz
These transmitters are not expected to exceed 1.0mW/cm² at 2450 Mhz

Transmitters that are carried next to body if user or operate at a distance of less than 5cm from user whose power is $>0.2\text{W}@2450$ Mhz : Generally above 200mW EIRP at 2450 MHz, the potential for exceeding MPE \ SAR limits is dependent on design of antenna and device operating condition,

$$\sqrt{\frac{\text{EIRP}}{4 \pi r^2}} =$$

$$10^{\frac{\text{dBm} - 30}{10}} \text{ mW} = \text{mW}$$

$$10^{\frac{\text{dBm}}{10}} \text{ mW} = \text{mW}$$

$$\frac{\text{EIRP}}{4 \pi r^2} = \text{Pd}$$

- 1) For calculating MPE Distance
- 2) Conversion mW to dBm
- 3) Conversion dBm to mW
- 4) Power Density

- 1) CFR 47, Federal Communication Commission FCC Parts 1.1310 and FCC Part 15.247 (1998)
- 2) FCC Office of Engineering and Technology Bulletin 65 Edition 97-01 Evaluating Compliance with the FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- 3) FCC Office of Engineering and Technology Bulletin Supplement C Evaluating Compliance with the FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- 4) IEEE (ANSI) C95.1-1991 IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3Khz to 300 Ghz.
- 5) Reference Data For Engineers, 8th Edition, Sams Publishing
- 6) Part 15 Devices and RF Safety , 1998 CE Reference Guide
- 7) Radio Frequency Radiation from Portable and Mobile Devices, 1998 CE Reference Guide.