Engineering Analysis of

Transceiver Model LM4511

FCC ID: LOZ102035

To

Federal Communications Commission

Part 1.1310 Radio Frequency Exposure Limits

&

OET 65 Supplement C

10/29/1998

David A. Case N.C.E.
Sr. EMC Engineer
Aironet Wireless Communications
3875 Embassy Parkway, 3rd Floor
Akron, OH 44333
330-664-7396

I Equipment Under Test

FCC ID:	LOZ102035
Model:	LM4511 (
Type:	PCMCIA Wireless LAN Adapter
Max Power	0.25 Watts
Duty Cycle	0.5

Antenna	TX Power	EIRP	Install Distance (Recommended)	Min MPE Distance*
20dB Parabolic +16dBm		+36dBm	20 inches	
13.5dB Yagi	+20dBm	+33.5dBm	20 cm	13.3cm
12dB Omni	+20dBm	+32dBm	20 cm	11.2cm
8.5dBi Patch	+20dBm	+28.5dBm	20 cm	7.5 cm
5.2dBi Omni	+20dBm	+25.1dBm	20 cm	5.0 cm
2.2dBi Dipole	+20dBm	+22.2dBm	6cm	3.6cm
0.0dBi Snap On	+24dBm	+24dBm	6cm	4.5 cm

Per OET 65 Supplement C page 23

II Power Density

Ref: Reference Data for Engineers 8th edition p32-7

$$\sqrt{\frac{EIRP}{4\pi\ 10}}$$

$$P := \frac{Pt \cdot Gant}{\left(4 \cdot \pi \cdot R^2\right)}$$

P	=	Power Density in $\frac{W}{m^2}$
Pt	=	Power radiated by an isotropic radiator (watts)
Gant	=	Antenna Gain
R	=	distance in measurement from source

Justification: Antennas are designed for mast mounted outdoor use and should be located above and away from user for maximum signal integrity, These combinations are not hand held nor is it designed to positioned close to the human body for extended periods during normal use. (per manufacturers specifications) For worst case duty cycle of 100% will be used

III Maximum Permissible Exposure

Ref: FCC Rules, CFR 47 1.1310

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.

IV. Summary

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 20 Centimeters from the user. This antenna focuses it's energy on a narrow path (about 12 degrees) and is designed to be mounted on a mast above the user. By design, this antennas placement in the field would be mast mounted and located usually on a roof or tower, normally out of the near field of the user.

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.

LOZ102035

Safety Information

The FCC with it's action in ET Docket 96-8 has adopted a safety standard for human exposure to radiated frequency (RF) electromagnetic energy emitted by FCC certified equipment. The Aironet products meet the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. For proper operation of this radio according to the instructions found in this manual will result in the user exposure to be substantially below the FCC recommended limits.

- Do not touch or move the LM4511 antenna while unit is transmitting or receiving
- Do not hold any component containing the radio such that the antenna is very close or touching , any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate a portable transmitter near unshielded blasting caps or in an explosive environment unless it is a type especially qualified for such use
- Do not operate radio or attempt to transmit data unless the antenna is connected , if not, the radio may be damaged.
-

For Wall \ Ceiling Mount Antennas (not exceeding 8.5dBi Gain)

In order to comply with the FCC RF exposure limits, it is recommended that when using the wall mount antennas that the antenna should not be positioned closer than 10 inches from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 20cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4511 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

Parabolic, Yagi, and 12dB Omni antennas

It is recommended that these all weather mast mounted antennas be installed outdoors on a rooftop mast or on a tower keeping the antenna a minimum distance of 20cm from the user at all times. The Parabolic Dish and other high gain antennas require professional installation for RF Safety reasons. If using the Yagi antenna indoors, for RF safety consideration and a good RF signal link, it should be located several feet above and away (minimum of 20cm for RF Safety reasons) from the user and if possible oriented as such to reduce user's long time exposure. Please contact your professional installer, VAR, or antenna manufacturer for additional installation requirements

Warning for laptop user

In order to comply with the FCC RF exposure limits, it is recommended that when using a laptop with a dipole antenna, that the antenna should not be positioned closer than 6cm (2.1 inches) from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 6cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4511 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

FAX Cover Sheet

Federal Communications Commission Laboratory
7435 Oakland Mills Road
Columbia, MD 21046 U.S.A.
Main Telephone: (301) 362-3000
Facsimile: (301) 344-2050

Date: 10/30 Time: _____ a. m. / p. m.

From: Joe Dichoso 301-362-3024

To: Dave Case

Organization: Aironet

Telephone: _____ Facsimile: 330 664 7301

This Cover Sheet is Page 1 of 4 pages. Please direct inquiries, if any, to the sender's telephone number. Thank you.

COMMENTS:

Dear Dave, In reference to FCC ID: LQZ102035, please see Kwok's comments. Please verify that you will make the changes/corrections such as stating the 20 cm distance for the Parabolic, Yagi an 12 dB Omni Antennas and removing "recommended" instructions with "must" or "mandatory".

LOZ102036

Safety Information

The FCC with it's action in ET Docket 96-8 has adopted a safety standard for human exposure to radiated frequency (RF) electromagnetic energy emitted by FCC certified equipment. The Aironet products meet the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. For proper operation of this radio according to the instructions found in this manual will result in the user exposure to be substantially below the FCC recommended limits.

- Do not touch or move the PC3500 / AP3500 antenna while unit is transmitting or receiving
- Do not hold any component containing the radio such that the antenna is very close or touching , any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate a portable transmitter near unshielded blasting caps or in an explosive environment unless it is a type especially qualified for such use
- Do not operate radio or attempt to transmit data unless the antenna is connected , if not, the radio may be damaged.
-

For Wall \ Ceiling Mount Antennas (not exceeding 8.5dBi Gain)

In order to comply with the FCC RF exposure limits, it is recommended that when using the wall mount antennas that the antenna should not be positioned closer than 20 cm from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 10 cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4800 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

Parabolic, Yagi, and 12dB Omni antennas

These all weather mast mounted antennas are designed to be installed outdoors on a rooftop mast or on a tower. The use of a professional installer is highly recommended to help insure RF Safety. The indoor use of the Parabolic Dish and High Gain Omni is not recommended. If using the Yagi antenna indoors, for RF safety consideration and a good RF signal link, it should be located above and away from the user and if possible oriented as such to reduce user's long time exposure. Please contact your professional installer, VAR, or antenna manufacturer for additional installation requirements

Warning for laptop user

In order to comply with the FCC RF exposure limits; it is recommended that when using a laptop with a snap on antenna, that the antenna should not be positioned closer than 6cm (2.1 inches) from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 6cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4800 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

LM4511 ??

* * * TRANSMISSION RESULT REPORT (OCT.30.1998 10:08AM) * * *

TTI FCC LAB 301-344-2050

DATE	TIME	ADDRESS	MODE	TIME	PAGE	RESULT	PERS. NAME	FILE
OCT.30.	10:07AM	330 664 7301	TES	1'15"	P. 4	OK		630

# : BATCH	C : CONFIDENTIAL	$: TRANSFER	P : POLLING
M : MEMORY	L : SEND LATER	@ : FORWARDING	E : ECM
S : STANDARD	D : DETAIL	F : FINE	> : REDUCTION

AIRONET WIRELESS COMMUNICATIONS, INC.
3875 Embassy Parkway
Akron, OH 44334

Facsimile Cover Sheet

To: Kwok Chan

Company: _____

Fax #: _____

From: Dave Case

Phone: 330/664-~~7980~~ 7356

Fax: 330/664-7301

Date: 10-27-98

Pages Including Cover Sheet: 7

COMMENTS:

Kwok,

I hope this is what you need. Please Contact me if anything else is needed.

Dave Case

Joe: Please fax this page to Aironet so that we don't have to keep fixing these calculations for them every time. It has been too many times.

LOZ102035

I Equipment Under Test

FCC ID:	LOZ102035
Model:	LM4511
Type:	PCMCIA Wireless LAN Adapter
Max Power	0.25 Watts
Duty Cycle	0.5

Antenna	TX Power	EIRP	Install Distance (Recommended)	Min MPE Distance*		
20dB Parabolic	+16dBm	+36dBm	20 cm	~~8.5cm~~	13.3	3.981 W
13.5dB Yagi	+20dBm	+33.5dBm	20 cm	~~16.9cm~~	11.7	2.239 W
12dB Omni	+20dBm	+32dBm	20 cm	~~14.1cm~~	7.5	1.585 W
8.5dBi Patch	+20dBm	+28.5dBm	20 cm	~~9.3 cm~~	5.0	708 mW
5.2dBi Omni	+20dBm	+25.1dBm	20 cm	~~6 cm~~	3.6	324
2.2dBi Dipole	+20dBm	+22.2dBm	6cm	~~5.5cm~~	4.5	166 mW
0.0dBi Snap On	+24dBm	+24dBm	6cm	~~6 cm~~		251

Per OET 65 Supplement C page 23

II Power Density

Ref: Reference Data for Engineers 8th edition p32-7

$$P := \frac{Pt \cdot Gant}{\left(4 \cdot \pi \cdot R^2\right)}$$

MPE minimum distance @ 2480 MHz is $\sqrt{\frac{EIRP}{4\pi 10}}$ meter

$1.0 \frac{mW}{cm^2} = 10 \frac{W}{m^2}$

$\frac{W}{m^2}$

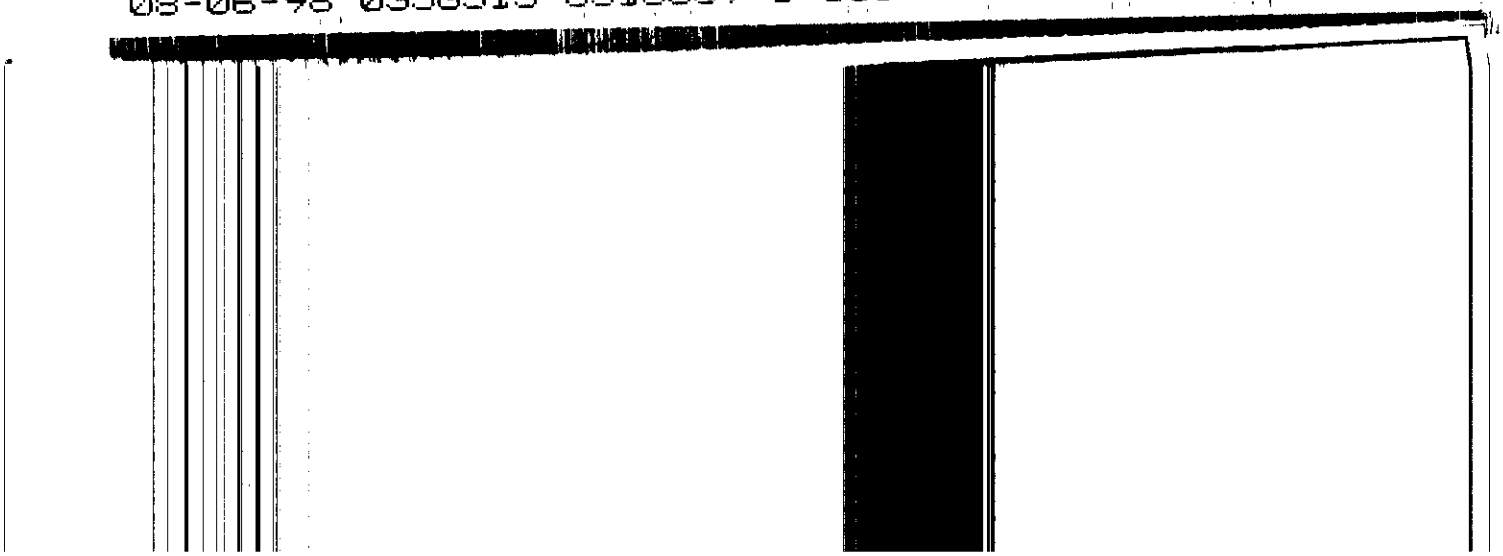
P = Power Density in

Pt = Power radiated by an isotropic radiator (watts)

Gant = Antenna Gain

R = distance in measurement from source

Assume R = 0.2 meters (~8 inches) ← this is for calculating power density @ known distance, but no P.d are listed above.



Joe - Please fax this page to Aironet so that we don't have to keep fixing these calculations for them every time. It has been too many times.

LOZ102035

I Equipment Under Test

FCC ID:	LOZ102035
Model:	LM4511
Type:	PCMCIA Wireless LAN Adapter
Max Power	0.25 Watts
Duty Cycle	0.5

Antenna	TX Power	EIRP	Install Distance (Recommended)	Min MPE Distance*	
20dB Parabolic	+16dBm	+36dBm	20 cm	8.5cm	
13.5dB Yagi	+20dBm	+33.5dBm	20 cm	16.9cm	
12dB Omni	+20dBm	+32dBm	20 cm	14.1cm	
8.5dBi Patch	+20dBm	+28.5dBm	20 cm	9.3 cm	
5.2dBi Omni	+20dBm	+25.1dBm	20 cm	6 cm	
2.2dBi Dipole	+20dBm	+22.2dBm	6cm	5.5cm	
0.0dBi Snap On	+24dBm	+24dBm	6cm	6 cm	

Per OET 65 Supplement C page 23

II Power Density

Ref: Reference Data for Engineers 8th edition p32-7

$$P := \frac{Pt \cdot Gant}{\left(4 \cdot \pi \cdot R^2\right)}$$

minimum distance @ 2480 MHz is $\sqrt{\frac{EIRP}{4\pi 10}}$ meter

1.0 $\frac{mW}{cm^2}$ = 10 $\frac{W}{m^2}$

P = Power Density in $\frac{W}{m^2}$

Pt = Power radiated by an isotropic radiator (watts)

Gant = Antenna Gain

R = distance in measurement from source

Assume R = 0.2 meters (~8 inches) ← this is for calculating power density @ known distance, but no P.I are listed above.

Justification: Antennas are designed for mast mounted outdoor use and should be located above and away from user for maximum signal integrity, These combinations are not hand held nor is it designed to positioned close to the human body for extended periods during normal use. (per manufacturers specifications)

For worst case duty cycle of 100% will be used.

III Maximum Permissible Exposure

Ref: FCC Rules, CFR 47 1.1310

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.

IV. Summary

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.

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.

LOZ102036

Safety Information

The FCC with it's action in ET Docket 96-8 has adopted a safety standard for human exposure to radiated frequency (RF) electromagnetic energy emitted by FCC certified equipment. The Aironet products meet the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. For proper operation of this radio according to the instructions found in this manual will result in the user exposure to be substantially below the FCC recommended limits.

- Do not touch or move the PC3500 / AP3500 antenna while unit is transmitting or receiving
- Do not hold any component containing the radio such that the antenna is very close or touching , any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate a portable transmitter near unshielded blasting caps or in an explosive environment unless it is a type especially qualified for such use
- Do not operate radio or attempt to transmit data unless the antenna is connected , if not, the radio may be damaged.
-

For Wall \ Ceiling Mount Antennas (not exceeding 8.5dBi Gain)

In order to comply with the FCC RF exposure limits, it is recommended that when using the wall mount antennas that the antenna should not be positioned closer than 20 cm from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 10 cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4800 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

Parabolic, Yagi, and 12dB Omni antennas

These all weather mast mounted antennas are designed to be installed outdoors on a rooftop mast or on a tower. The use of a professional installer is highly recommended to help insure RF Safety. The indoor use of the Parabolic Dish and High Gain Omni is not recommended. If using the Yagi antenna indoors, for RF safety consideration and a good RF signal link, it should be located above and away from the user and if possible oriented as such to reduce user's long time exposure. Please contact your professional installer, VAR, or antenna manufacturer for additional installation requirements

Warning for laptop user

In order to comply with the FCC RF exposure limits; it is recommended that when using a laptop with a snap on antenna, that the antenna should not be positioned closer than 6cm (2.1 inches) from the body or nearby persons for extended periods of time while it is transmitting (or operating). If the antenna is positioned less then 6cm from the user, it is recommended that the user limit his exposure time or engage the power saving features of the LM4800 radio to reduce RF exposure. (see technical reference guide for proper operation of power savings mode).

LM4500 ??