

VERIFICATION OF COMPLIANCE FCC MPE CLASS II PERMISSIVE CHANGE

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Applicant Information:

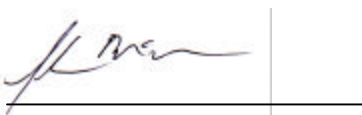
CISCO SYSTEMS INC.
170 West Tasman Drive
San Jose, CA 95134-1706

FCC ID:	LDK102040
Model(s):	AIR-LMC350, AIR-LMC352
Equipment Type:	PCMCIA 2.4GHz Spread Spectrum Wireless LAN Card installed in Itronix IX550 Laptop PC with Vehicle Cradle & (2) Magnetic Mount Vehicle Rooftop Antennas
Tx Frequency Range:	2412 - 2462 MHz
Conducted Power Levels:	18.30 dBm (2412 MHz) 18.80 dBm (2437 MHz) 19.00 dBm (2462 MHz)
FCC Rule Part(s):	2.1091; 1.1310; ET Docket 93-62
Original Grant Date:	October 27, 2000
Class II Change(s):	1. Add (2) Vehicle Rooftop Magnetic Mount Antennas a) MaxRad BMAXC24503 Mobile Antenna (3dBi Gain) b) MaxRad BMAXC24505 Mobile Antenna (5dBi Gain)

This wireless mobile and/or portable device, with the Class II Permissive Change(s) described in this report, has been shown to be compliant for localized Maximum Permissible Exposure (MPE) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3-1999.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Celltech Research Inc. certifies that no party to this application has been denied FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).



Shawn McMillen
General Manager
Celltech Research Inc.



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SCOPE

Environmental evaluation measurements of Maximum Permissible Exposure (MPE) to radio frequency (RF) radiation from transmitting devices for compliance with the technical rules and regulations of the U.S. Federal Communications Commission (1).

1.0 INTRODUCTION

This measurement report describes the Maximum Permissible Exposure (MPE) tests of Cisco Systems Inc. Models: AIR-LMC350, AIR-LMC352 2.4GHz Wireless LAN Card FCC ID: LDK102040 installed in Itronix IX550 Laptop PC with vehicle cradle and two (2) vehicle rooftop magnetic mount antennas as described in this report. The test procedures described in FCC CFR47 2.1091, 1.1310, American National Standards Institute C95.1-1992 (2), C95.3-1992 (3), and FCC OET Bulletin 65 (Edition 97-01)(4) were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 DESCRIPTION of Equipment Under Test (EUT)

EUT Type	2.4GHz DSSS Wireless LAN Card installed in Itronix IX550 Laptop PC with Vehicle Cradle & (2) Vehicle Rooftop Magnetic Mount Antennas	Equipment Class	Part 15 Spread Spectrum Transmitter (DSS)
Tx Frequency Range (MHz)	2412 - 2462	FCC ID	LDK102040
Conducted Output Power Tested	18.30 dBm (2412 MHz) 18.80 dBm (2437 MHz) 19.00 dBm (2462 MHz)	Model(s)	AIR-LMC350 AIR-LMC352
Application Type	FCC Part 15 (Class II Permissive Change)	Signal Modulation(s)	Direct Sequence Spread Spectrum
Class II Change(s)	Add (2) Vehicle Rooftop Magnetic Mount Antennas	Antenna Type(s)	#1. MaxRad BMAXC24503 (3dBi Gain) #2. MaxRad BMAXC24505 (5dBi Gain)

3.0 MPE MEASUREMENT GUIDELINES

The Federal Communications Commission (FCC) has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public from the potential hazards of RF emissions (1). The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized MPE in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz (2). The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave (3) is used for guidance in measuring MPE due to RF exposure from the particular transmitting device. The new guidelines incorporate limits for MPE in terms of electric and magnetic field strength, and power density for transmitters operating at frequencies between 300 kHz and 100 GHz. This criteria for MPE evaluation is also described in OET Bulletin 65 (Edition 97-01), Evaluation Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields (4).

4.0 DEFINITION

MPE is the rms and peak electric and magnetic field strength, their squares, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect, and with an acceptable safety factor.

The MPE prescribed by the standard are set in terms of different parameters of effects, depending on the frequency generated by the device. The MPE levels are set in terms of power density, whose definition and relationship to electric and magnetic field strengths are described by the following equation:

$$S(\text{mW} / \text{cm}^2) = \frac{E^2}{3770} = 37.7H^2$$

where:

S = Power density (mW/cm²)

Power per unit area normal to the direction of propagation usually expressed in units of watts per square meter (W/m²), or units of milliwatts per square centimeter (mW/cm²). For plane waves, power density, electric field strength (E), and magnetic field strength (H) are related by the impedance of free space (377 Ω).

E = Electric field strength (V/m)

H = Magnetic field strength (A/m)

5.0 MPE LIMITS

(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

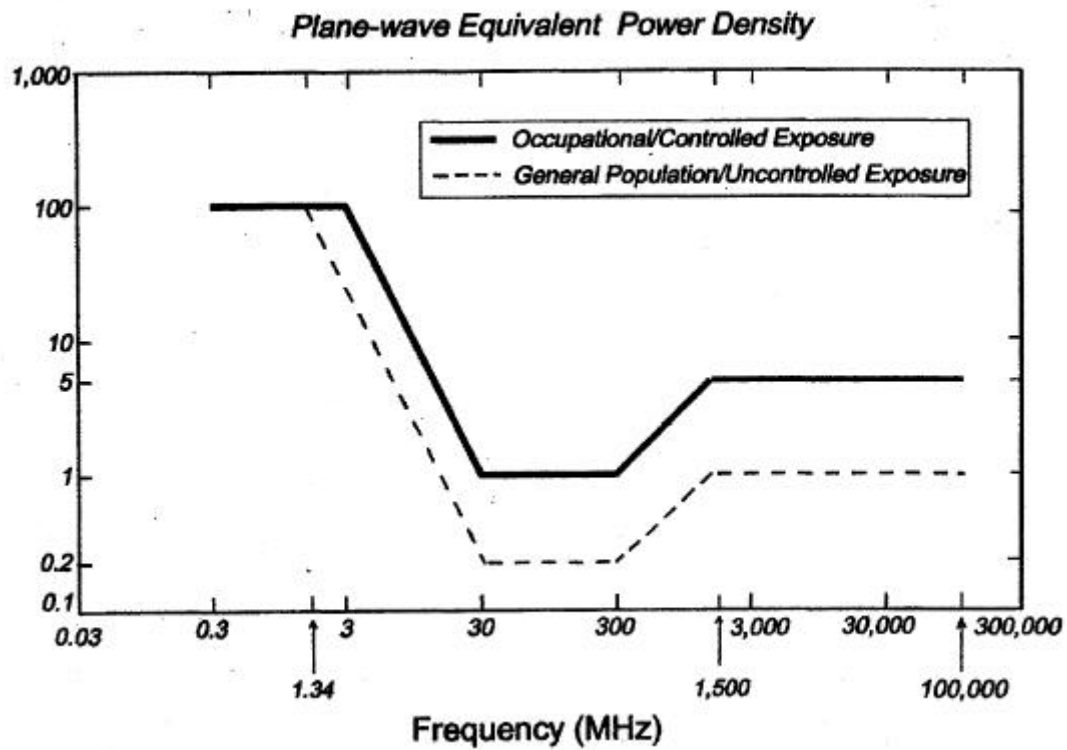
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz

*Plane-wave equivalent power density

NOTE 1: *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.

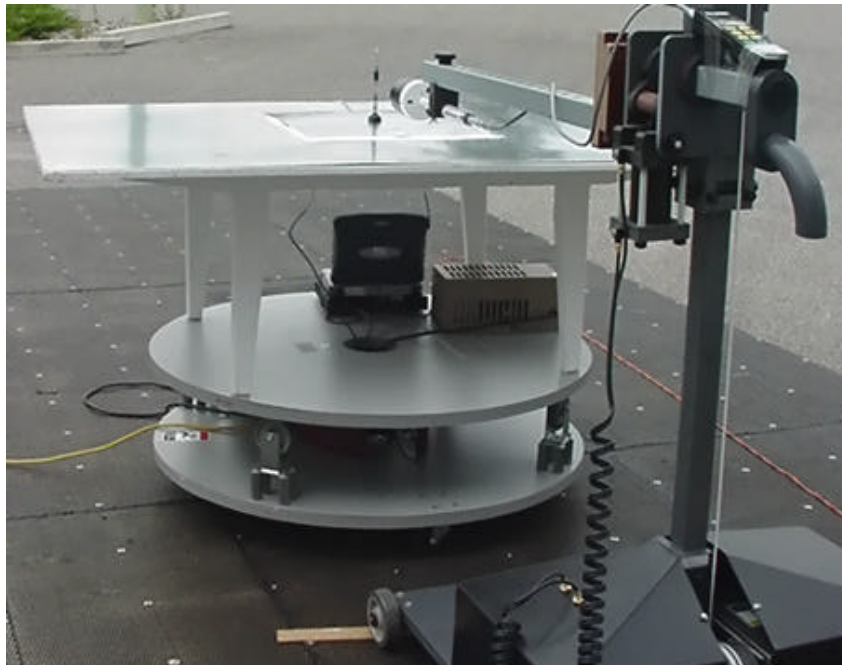
NOTE 2: *General population/uncontrolled* exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.



6.0 DETAILS OF MPE EVALUATION

The Cisco Systems Inc. Models: AIR-LMC350, AIR-LMC352 2.4GHz Wireless LAN Card FCC ID: LDK102040 installed in Itronix IX550 Laptop PC with vehicle cradle and two (2) vehicle rooftop magnetic mount antennas was found to be compliant for MPE based on the following test provisions and conditions:

- 1) The probe was positioned above a simulated metal vehicle rooftop at a separation distance of 20.0cm from the radiating antenna and at a starting height of 5.0cm to the center of the probe.
- 2) The turntable was positioned so that the initial start angle was 0 degrees.
- 3) The EUT was turned on to allow for sufficient time for stabilization. The EUT was operated at full power on a desired frequency.
- 4) The Survey Meter was set for maximum hold and on the appropriate power range.
- 5) The turntable was rotated about 360 degrees and the maximum reading was obtained for that elevation.
- 6) The EUT was then turned off and the probe raised by 5.0cm. This process was repeated to a sufficient distance past the tip of the antenna or where the maximum radiation was reduced by a significant factor to warrant no further measurement. The data was then tabulated and graphed in the charts and tables shown on next pages.



MPE Test Setup

7.0 MPE MEASUREMENT SUMMARY

The measurement results were obtained with the EUT tested in the conditions described in this report.

ANTENNA #1 - MaxRad BMAXC24503 3dBi Gain

2412MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.09	1.00	0.09	f/1500
10	0.06	1.00	0.06	f/1500
15	0.06	1.00	0.06	f/1500
20	0.05	1.00	0.05	f/1500
25	0.04	1.00	0.04	f/1500

2437MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.10	1.00	0.10	f/1500
10	0.07	1.00	0.07	f/1500
15	0.06	1.00	0.06	f/1500
20	0.05	1.00	0.05	f/1500
25	0.04	1.00	0.04	f/1500

2462MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.09	1.00	0.09	f/1500
10	0.05	1.00	0.05	f/1500
15	0.05	1.00	0.05	f/1500
20	0.04	1.00	0.04	f/1500
25	0.04	1.00	0.04	f/1500

ANTENNA #2 - MaxRad BMAXC24505 5dBi Gain

2412MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.08	1.00	0.08	f/1500
10	0.05	1.00	0.05	f/1500
15	0.05	1.00	0.05	f/1500
20	0.04	1.00	0.04	f/1500
25	0.04	1.00	0.04	f/1500

2437MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.10	1.00	0.10	f/1500
10	0.05	1.00	0.05	f/1500
15	0.05	1.00	0.05	f/1500
20	0.04	1.00	0.04	f/1500
25	0.04	1.00	0.04	f/1500

2462MHz

Height Above Ground Plane (cm)	Measured Power Density at 20cm (mW/cm ²)	Correction Factor to Obtain Actual mW/cm ²	Total E-Field Equivalent Power Density	MPE Limit (mW/cm ²)
5	0.09	1.00	0.09	f/1500
10	0.05	1.00	0.05	f/1500
15	0.05	1.00	0.05	f/1500
20	0.04	1.00	0.04	f/1500
25	0.04	1.00	0.04	f/1500

8.0 SYSTEM CALIBRATION

Prior to the assessment for MPE, the Electromagnetic Radiation Survey Meter and probe was calibrated as per the operating instructions in the operations manual. The unit was placed into the units electrically sealed storage case and allowed sufficient time for both units to acquire the same temperature. The system was then calibrated by a built in software routine and zeroed in an electromagnetic free environment

9.0 MPE SYSTEM SPECIFICATIONS

Radiation Detection Specifications

Electromagnetic Radiation Survey Meter:	Narda Model 8712
Isotropic Electric Field Probe:	Model 8761D
Frequency Range:	300 kHz - 3 GHz

Positioning System

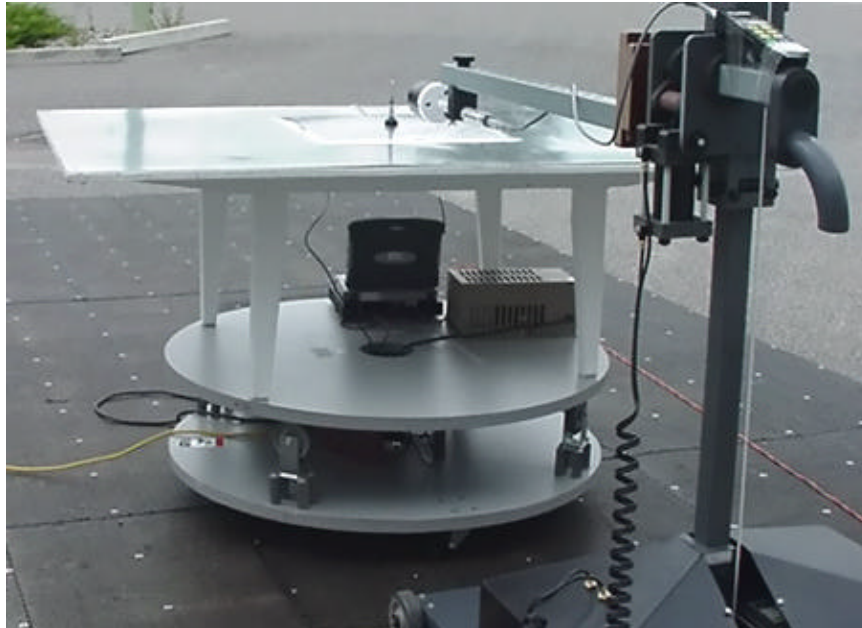
Multi-Device Controller	EMCO 2090	S/N: 9912-1484
Mini-Mast	EMCO 2075	S/N: 0001-2277
Turntable	EMCO 2080-1.2/1.5	S/N: 0002-1002

10.0 REFERENCES

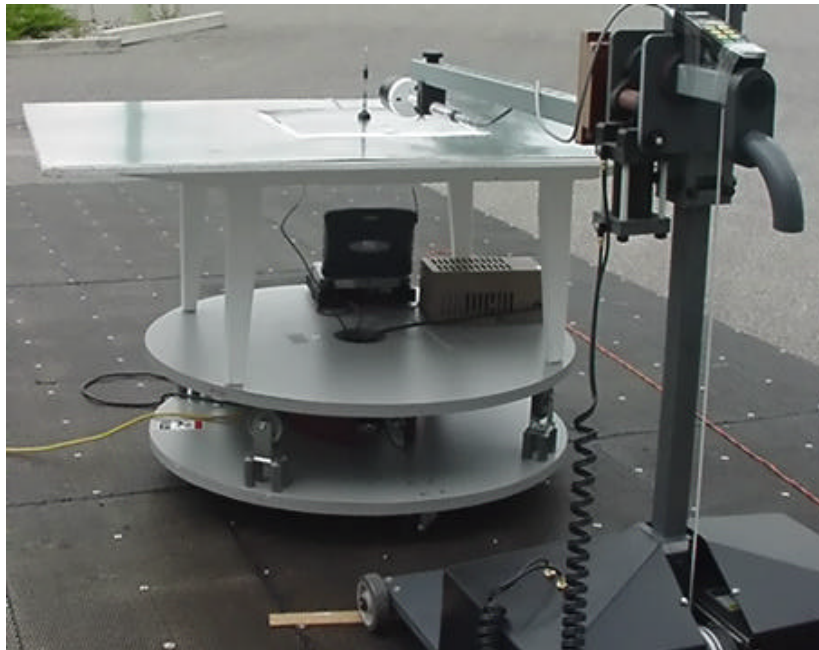
- (1) Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.
- (2) ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.
- (3) ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.
- (4) OET Bulletin 65 (Edition 97-01), Evaluation Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

APPENDIX A - MPE PHOTOGRAPHS

MPE TEST SETUP PHOTOGRAPHS
MaxRad BMAXC24503 Mobile Antenna



MPE TEST SETUP PHOTOGRAPHS
MaxRad BMAXC24505 Mobile Antenna



EUT PHOTOGRAPHS

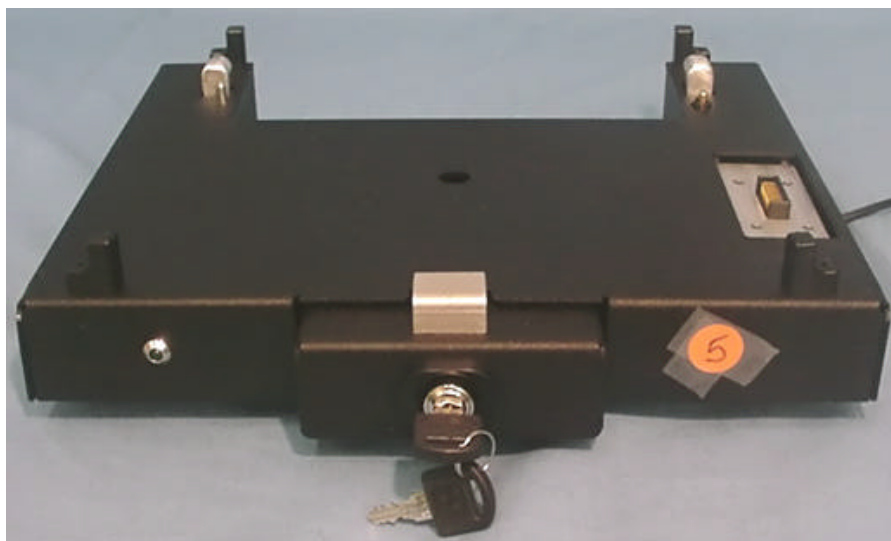


MaxRad BMAXC24503



MaxRad BMAXC24505

EUT PHOTOGRAPHS



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Test Report S/N: 080101-140LDK
Date(s) of Tests: August 01, 2001
FCC MPE Measurements

EUT PHOTOGRAPHS



APPENDIX B - ANTENNA SPECIFICATIONS

2.4 GHz ISM Mobile Antennas

The 2.4 GHz ISM mobile antennas cover frequencies from 2.400 to 2.4835 GHz. The (B)MAXC models feature MAXRAD's popular BMAX molded polymer base, a plated spring-loaded contact pin, and a .100" diameter stainless steel whip for long lasting, trouble free service. The MUF model is a chrome nut antenna with a .062" stainless steel whip. Various mount and connector options provide low-loss mounting for a variety of metal surfaces.

General Specifications:

2.4 GHz ISM mobile antennas

Radiator Material:

- .100" dia. stainless steel; bright (MAXC) or black finish (BMAXC)
- .062" dia. stainless steel; bright finish - MUF model

Antenna Base:

- Molded polymer with a plated brass insert ring and a spring-loaded, brass contact pin - (B)MAXC models
- Brass mount nut with bright chrome finish - MUF model

Maximum Power:

100 Watts - all models

VSWR:

<1.5:1

Nominal Impedance:

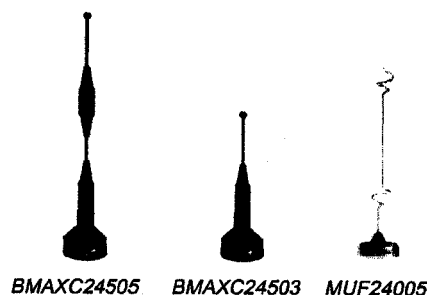
50 Ohms

Antenna Type:

- Collinear array - (B)MAXC models
- Dual open coil chrome nut - MUF model

Rod Ferrule:

5/16" - 24 thread; bright or black chrome plated brass - (B)MAXC models



Electrical Specifications

2.4 GHz ISM Mobile Antennas

Model #	Frequency Range	Factory Tuned Frequency	Coil Type	Gain
(B)MAXC24503	2.400 - 2.4835 GHz	2.45 GHz	Closed	3 dBi
(B)MAXC24505	2.400 - 2.4835 GHz	2.45 GHz	Closed	5 dBi
MUF24005	2.400 - 2.4835 GHz	2.45 GHz	Open	5 dBi

* Prefix "B" indicates black

Mechanical Specifications

2.4 GHz ISM Mobile Antennas

Model #	Antenna Height	Weight
(B)MAXC24503	5-1/4"	0.12 lbs.
(B)MAXC24505	7-1/2"	0.16 lbs.
MUF24005	8-3/4"	0.10 lbs.

* Prefix "B" indicates black

Mounts

Model #	Mount Type	Description	Length of Coax Cable*	Coax	Connector
MTPM800	Permanent Bulkhead, Thick Plate	5/8" hole; 1-1/8" - 18 thread	None	N/A	N Female
SMML195NCP	Stainless Steel "M" Series Permanent	3/4" hole; 1-1/8" - 18 thread; installs from above	17'	LMR-195	N Male
SMML195BN	Stainless Steel "M" Series Permanent	3/4" hole; 1-1/8" - 18 thread; installs from above	17'	LMR-195	BNC Male
SMML195C	Stainless Steel "M" Series Permanent	3/4" hole; 1-1/8" - 18 thread; installs from above	17'	LMR-195	TNC Male
(B)GMML195NCP	GM Series Magnetic	2-3/8" magnetic mount	12'	LMR-195	N Male

Other lengths of cable and various connectors are also available. Please consult the factory for specific requirements.