Metricom®

FCC LABORATORY
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SEP 23 2 40 PM '99

REC

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o: Kwok Chan, Errol Chang,
rom: David Waitt
egarding: GNW 24000 / EA 93236 / Correspondence number 9462

nclosed you will find the documents that answer the latest questions regarding exposure concerns for the GNW 24000 Certification pplication.

will also submit this electronically, but I wanted you to have a hard copy to review as well.

lease let me know if you require any further information.

incerely

)avid Waitt
)avid@metricom.com
408 399 8126

o: David Waitt, null
rom: Errol Chang
echang@fcc.gov
FCC Application Processing Branch

e: FCC ID GNW24000
pplicant: Metricom Incorporated
orrespondence Reference Number: 9462
31 Confirmation Number: EA93236
ate of Original E-Mail: 08/31/1999

This is a dual band DSS, operating at 915 and 2450 MHz. The filing is requesting for 1.0 W output for both bands. Previously measured maximum outputs are 714 mW for 915 MHz and 506 mW for 2450 MHz. Revised measurements for the Network Radio have maximum outputs of 912 mW for 915 MHz and 467 mW for 2450 MHz. The latest, revised filing, has included an additional version of this device called an Ethernet Radio which has additional components on the digital board and somewhat different outputs. Measurements for the Ethernet radio have 883 mW for 915 MHz and 676 for 2450 MHz as maximum outputs. The requested outputs (1.0 W) should match measured data, for both bands.

NSWER: The 1.0 Watt level specified on the 731 form will be modified with the proper ower output levels.

Photos in the original filing showed only one RF output connection for this device, using a 6 dBi whip antenna for 900 MHz operation. It was mentioned that an internal patch antenna was included in the assembly for 2450 MHz operation and there was no data on antenna gain for the internal patch. Photos and data in the revised submission have added a panel antenna and the figure captions are showing 18 dBi gain at 2.4 GHz and 6 dBi at 900 MHz. Photos of the new (revised or additional, please clarify) assembly has two separate RF output connections both connected to this panel antenna. Antenna specification, performance information, operating conditions and installation procedures etc. for this panel antenna is needed for purposes of determining RF exposure requirements. Supporting information for demonstrating RF exposure compliance with respect to 15.247(b)(4) should be provided for this panel antenna.

'SWER: For clarification, the Network radio has one 'N' type antenna connector for 900 Hz. The 2.4 GHz antennas used by the Network radio are internal to the unit. Although here are 4 antennas in the unit, the radio can only transmit from one of the antennas at y given time.

e Ethernet radio has two 'N' connectors, one each for 900 MHz and the other for 2.4 z. Technical data for the Network radio internal 2.4 GHz patch and the dual, 900 MHz d 2.4 GHz patch antenna will be provided.

e 2.4 GHz gain of the antenna that was mentioned in the report for use with the hernet radio was stated incorrectly. The gain of the 2.4GHz antenna is 15 dBi, NOT 18 i. See the attached spec sheet.

e table below summarizes the antenna types and the antenna gains for the Network and e Ethernet radios

Radio Type	Band	Antenna Type	Antenna Location	Antenna Gain (dBi)
twork Radio	900 MHz	Omni- Monopole	External, connected to radio via 'N' connector	6
twork Radio	2.4 GHz	Patch	Internal, located in the corners of the unit	8
hernet Radio	900 MHz	Panel (Dual, 900MHz & 2.4GHz)	External, connected to radio via coax and 'N' connector	6
hernet Radio	2.4 GHz	Panel (Dual, 900MHz & 2.4GHz)	External, connected to radio via coax and 'N' connector	15

evised MPE documents will be provided for both the Network radio and the Ethernet radio.

It should be clarified if the antennas and radios used for this transmitter, including the panel, whip, patch, Network Radio and Ethernet Radio, can operate or transmit simultaneously at both frequency bands. If so, RF exposure compliance should be addressed accordingly.

NSWER: Yes, it is possible for the Network radio and the Ethernet radio to transmit imultaneously on 900 MHz and 2.4 GHz. The revised MPE documents for each type of radio ill reflect this.

The panel antenna has 18 dBi gain in the 2.4 GHz band. When used with the Ethernet version of this radio, it does not meet the maximum allowed antenna gain and output requirements. Clarification is needed and RF exposure should be addressed accordingly. Please also clarify if this panel antenna will or can be uses with the Network Radio.

NSWER: The gain of the 2.4 GHz antenna used with the Ethernet radio was stated ncorrectly in the report. The 2.4 GHz gain of the antenna is actually 15 dBi. With 15 Bi of antenna gain, the maximum allowable power out of the Ethernet radio at 2.4 GHz ould be:

$$30\text{dBm} - ((15\ \text{dBi} - 6\ \text{dBi})/ 3) = 27\ \text{dBm}.$$

he configuration of the production Ethernet radios will be automatically calibrated to o more than 27 dBm of transmit power in the manufacturing process. The transmit power of he Ethernet radio as tested was set manually, because the automatic power calibration as not in place at the time and because of human error, the power was inadvertently set o high.

he Ethernet radio panel antenna will NOT, under any circumstance, be used with the etwork radio. In fact, there is no way to connect the 2.4 GHz portion of the panel ntenna to the Network radio since the Network radio has no 2.4 GHz connectors, again, he 2.4 GHz antennas are internal to the Network radio.

RF exposure compliance will be determined according to supporting information and data for all antennas, installation, operating and exposure conditions for all versions of this transmitter. Please provide these, as indicated above, and revise previous submitted information (when necessary) for determining RF exposure compliance. A final version of the installation instructions and procedures for the antennas, Network and Ethernet Radios showing appropriate means for ensuring RF exposure compliance with respect to 15.247(b)(4) should be included in the filing.

SWER: The requested documentation will be provided as soon as possible to the FCC

It was mentioned in info provided through a previous e-mail that Metricom had done measurements which had showed this transmitter complies with RF exposure limits. Such data can also be used for demonstrating compliance to reduce the amount of information needed to demonstrate compliance with installation and operating procedures to fulfill requirements in 15.247(b)(4) (we are not requesting those data, it is Metricom's choice to use whatever is appropriate to support compliance to complete this filing).
Issues on whether certain warning statements, labels and responsible parties or procedures for ensuring compliance cannot be readily determined until additional supporting information for RF exposure compliance is available.

SWER: As a reminder, there are two types of radios. Network Radios and Ethernet dios. Neither radio is "sold" to a customer. These radios make up part of the frastructure of Metricom's micro Cellular Data Network. The network radio is installed predominantly existing streetlight poles. The Ethernet radio will be installed edominately on commercial rooftops, most likely with other transmitting equipment.

ere are two groups of people that need to be made aware of the dangers of RF exposure om each type of radio.
Metricom Employees performing the installation of the equipment.
Other technicians who may be working in the vicinity of the radios, either on the streetlight or the building rooftop

tricom proposes the following process for making people aware of RF exposure concerns.

TWORK RADIO,
oup 1:

The Network radio installation guide has been edited to include RF exposure warning n the appropriate places to make the installer aware of exposure once the radio has been owered on.

roup 2:

Metricom will make the public utilities department of the municipalities where adios are installed on streetlights aware of the exposure concerns. The public utilities epartment will then be able to pass this exposure warning on to streetlight service ersonal who may have to service the streetlight.

THERNET RADIO

roup 1:

Through Metricom's Health and Safety program, Metricom technicians installing the thernet radios on rooftops will be made aware of exposure concerns. They will also post NOTICE", "CAUTION" and "WARNING" signs at the installation site.

roup 2:

People who my access to a particular rooftop will be made aware of the dangers of F exposure by the signs that would have been installed during the installation of the quipment as part of Metricom's Health and Safety program.

uestions regarding the foregoing should be addressed to Kwok Chan at kchan@fcc.gov

e items indicated above must be submitted before processing can continue on the above referenced application. ilure to provide the requested information within 60 days of the original e-mail date may result in application dismissal rsuant to Section 2.917 (c) and forfeiture of the filing fee pursuant to section 1.1108.

O NOT reply to this e-mail by using the Reply button. In order for your response to be processed expeditiously, you ust upload your response via the Internet at www.fcc.gov, Electronic Filing, OET Equipment Authorization Electronic ing. If the response is submitted through Add Attachments, in order to expedite processing, a message which informs e processing staff that a new exhibit has been submitted must also be submitted via Submit Correspondence. Also, ease note that partial responses increase processing time and should not be submitted.

y questions about the content of this correspondence should be directed to the e-mail address listed below the name of e sender.

Larsen
Four Sector
15 dBi 2.310 to 2.490 GHz
6 dBi 902 MHz to 928 MHz
Dual Band
Panel Antenna

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Revision History

Rev	Date	Author	Revisions
A	10-07-98	R. Sherry	Initial Draft
B	03-01-99	R. Sherry	Revised to become Larsen part, was 108069

1.0 Electrical

Section	Parameter	Value
1.1	Frequency	
1.1.1		902 to 928 MHz
1.1.2		2.310 to 2.490 GHz
1.3	Gain	
1.3.1	902 to 928 MHz	6.0 dBi ± 0.5 dB
1.3.2	2.310 to 2.490 GHz	15.0 dBi ± 0.5 dB
1.4	VSWR at 50Ω	2.0:1 Maximum
1.5	Half Power Beam Width	
1.5.1	902 to 928 MHz	70° ± 3° H-plane
1.5.2		60° ± 3° E-plane
1.5.3	2.310 to 2.490 GHz	65° ± 3° H-plane
1.5.4		12° ± 3° E-plane
1.6	Polarization	Linear, vertical
1.7	Front/Back Ratio	>20 dB
1.8	Side Lobe Level	>13 dB down from main beam
1.9	Null Fill	TBD
1.10	Maximum Power Input	
1.10.1	902 to 928 MHz	10 Watts
1.10.2	2.310 to 2.490 GHz	100 Watts
1.11	Isolation Between Bands	>30 dB, Free Space

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2.0 Mechanical and Environmental

Section	Parameter	Value
2.1	Weight	
2.1.1	Pole Mount	<19 Lbs. Maximum, including mounting hardware
2.1.2	Wall Mount	<17 Lbs. Maximum, including mounting hardware
2.2	Connectors	N-type, female (2), lower end mounting desired
2.3	Mounting	Vertical polarization, drain holes if used at bottom
2.4	Configuration	Flat Panel
2.5	Length	<36.5 inches
2.6	Width	<6.25 inches
2.7	Depth	<3.5 inches, excluding mounting hardware
2.8	Depth	<6.75 inches with wall brackets
2.9	Temperature	
2.9.1	Operating	-40° C to +50° C
2.9.2	Storage	-50° C to +70° C

Section	Parameter	Value	
2.10	Humidity	100% Condensing, seven days, no visible corrosion	
2.11	Moisture Seal	Must withstand driving rain, sleet, snow	
2.11.1		If not submersible, drain hole required	
2.12	UV Radiation	Intended for outdoor installation, 20 year life	
2.13	Wind Speed	100 MPH in specification operation, 125 MPH survival	
2.14	Wind Load	Force information calculated per TIA/EIA-222F or latest revision	
		33 ft above average ground	100 ft above average ground
	100 MPH	<105 Lb.	<144 Lb.
	100 MPH + ½ inch Ice	<125 Lb.	<172 Lb.
	125 MPH	<163 Lb.	<224 Lb.
	125 MPH + ½ inch Ice	<194 Lb.	<268 Lb.
2.15	Mounting Bracket		
2.16	Pipe Mount	Galvanized steel, mount to 1.25" to 3.5" OD pipe, Up to +0° to -20° (down tilt).	
2.17	Wall Mount	Galvanized steel, +0° to -20° (down tilt), ± 60° laterally. Wall thickness: 14" maximum.	
2.18	Note	At 125 MPH wind speed, deflection of antenna beam less than ± 4°.	

3.0 Qualified Vendor

3.1 Larsen, 3611 NE 112th Avenue, Vancouver WA, 98682.

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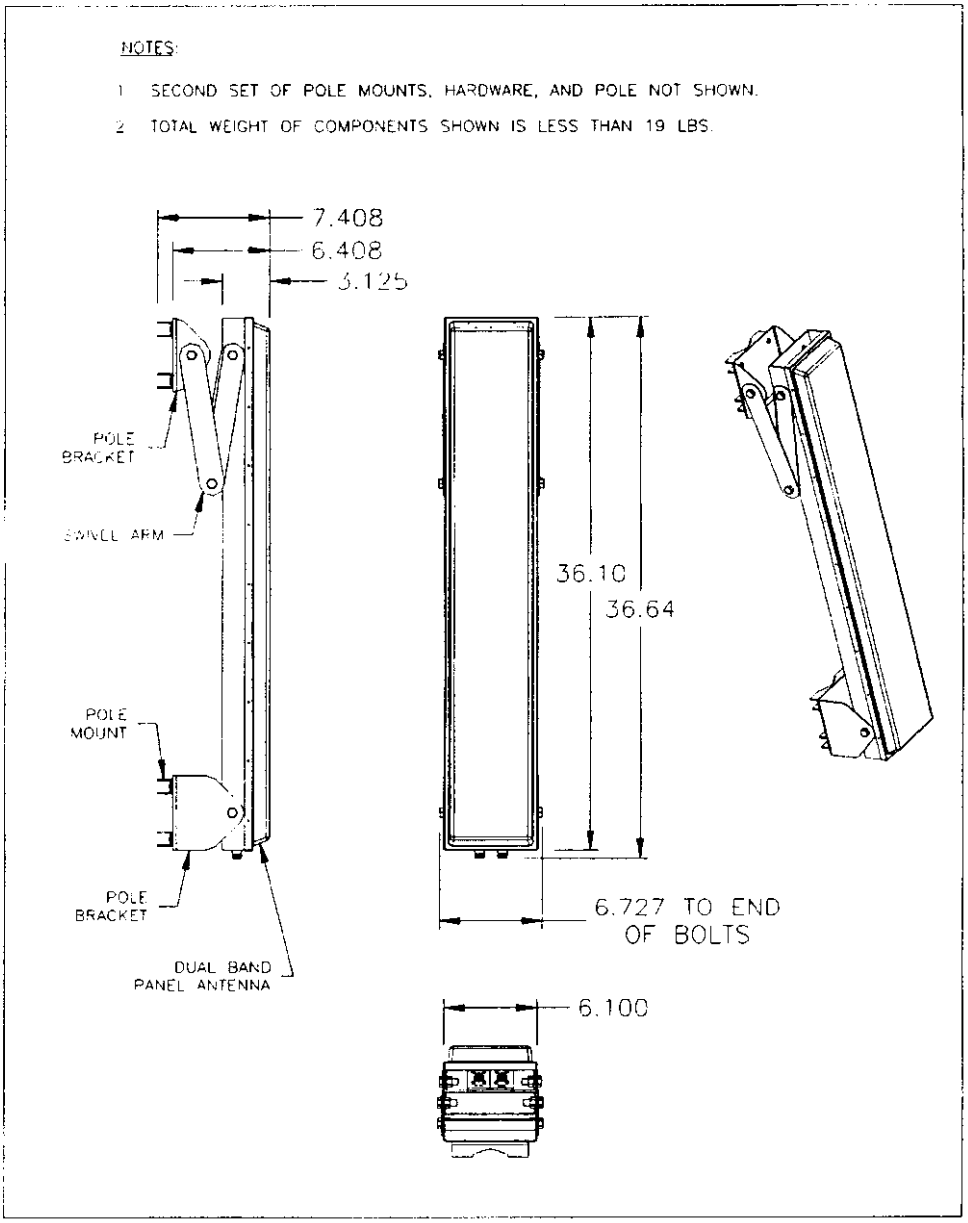

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Metricom Confidential Information

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Federal Communications Commission

Maximum Permissible Exposure Assessment

for the

Metricom Ethernet Radio, GNW 24000

In accordance with
FCC REPORT AND ORDER 96-326
Adopted: August 1, 1996

Prepared by David Waitt
Metricom, Inc.

Background:

Metricom has developed the second generation of its Microcellular Data Network (MCDN). In a broad sense this new network operates in a similar fashion to the current Metricom MCDN, (which is used to provide the Ricochet Wireless data service in the metropolitan areas of San Francisco, San Jose, Seattle and Washington D.C.) The most notable difference between the previous MCDN and the new MCDN is the speed of the network.

The network radio is a frequency hopping spread spectrum radio that operates within the 902-928 MHz and the 2.4–2.4835 MHz band. The peak transmit output power of the radio is 1 Watt on each band. The radio is capable of communicating with either Micro-Cellular Data Network (MCDN) microcell radios (GNW 21000) that make up the infrastructure of the MCDN network or Ricochet modems.

MPE Calculations.

The operating environment for the network radio (the top of a utility pole or streetlight) is a fixed, controlled environment. It is reasonable to assume that professional linesmen who work on utility poles and utility workers who work on streetlights will be aware, via their training, of the hazards of RF exposure. However, to yield a worst case analysis, the limits for an uncontrolled environment are used in this document. The definitions of controlled and uncontrolled environments are included below from the FCC Report and Order 96-326:

> B. Definitions of Controlled and Uncontrolled Environments
>
> 35. The 1992 ANSI/IEEE guidelines specify two sets of exposure limits based on the "environment" in which the exposure takes place. These environments are classified as either "controlled" or "uncontrolled." **Controlled environments are defined as locations where "there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels may be above [the exposure and induced current levels permitted for uncontrolled environment but not those permitted for controlled environments]."** Uncontrolled environments are defined as "locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed [the exposure and induced current levels permitted for uncontrolled environments]."

Duty Cycle correction: Even though the duty cycle of the MCDN Network radio is source-based, to yield a worst case MPE distance, a duty cycle of 100 % is used in the following MPE calculations. From Part 2(d)(2) of the FCC Report and Order 96-326, General Rules and Regulations:

> (2) Time-averaging provisions may not be used in determining typical exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in 1.1310 of this chapter. **However, "source-based" time-averaging based on an inherent property or duty-cycle of a device is allowed.** An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal. In general, maximum average power levels must be used to determine compliance.

Fixed, Uncontrolled Environment:
Spec: 900 MHz: f(MHz)/1500 mW/cm^2 = 902/1500 = **.601 mW/cm^2**
2.4 GHz: **1.0 mW/cm^2**

$$\textit{Exposure (mW/cm}^2\textit{) = Pout (mW)*Duty Cycle*(Antenna Gain(as a ratio)/(4*PI* Radius}^2\textit{(cm)))}$$

Solving the above for Radius, General MPE Calculation

$$\text{Radius} = \sqrt{\frac{\text{Pout(mw)*Duty Cycle*(Antenna Gain(as a ratio)}}{\text{Exposure (mW/cm}^2\text{) * 4 * Pi}}}$$

MPE Calculation for two bands

$$\text{Radius} = \sqrt{\frac{\text{(900MHzP(mw)*900MHzAnt Gain(ratio))+(2.4GHzP(mw)*2.4GHzAnt Gain(ratio))* Duty Cycle}}{\text{Exposure (mW/cm}^2\text{) * 4 * Pi}}}$$

$$\text{Radius} = \sqrt{\frac{\text{(900MHz EIRP(mw)+ 2.4GHz EIRP(mw))* Duty Cycle}}{\text{Exposure (mW/cm}^2\text{) * 4 * Pi}}}$$

$$\text{Radius} = \sqrt{\frac{\text{(Total EIRP (mw))* Duty Cycle}}{\text{Exposure (mW/cm}^2\text{) * 4 * Pi}}}$$

2.4 GHz EIRP:
2.4 GHzEIRP = Pout(dBm) + Antenna Gain (dBi)
27 dBm + 15 dBi = 42 dBm EIRP = 15848 mWatts EIRP

900 MHz EIRP
EIRP = Pout(dBm) + Antenna Gain (dBi)
30 dBm + 6 dBi = 36 dBm EIRP = 4000 mWatts EIRP

Total Watts EIRP
15848 mw EIRP + 4000 mw EIRP = 19848 mWatts EIRP

900MHz & 2.4 GHz Combined MPE Distance Calculation:
(Note: The specification used in the calculation below is 900MHz specification, the lower of the two.)

$$\text{MPE Distance} = \sqrt{\frac{19848\text{mW} * 1.0}{.601 * 4 * \text{Pi}}} \Rightarrow \sqrt{\frac{19848}{7.55}} \Rightarrow \textbf{51.27 cm}$$

MPE Distance = **20.18 Inches**

Conclusion:

The MCDN Ethernet radios are to be located on the top of commercial rooftops, most likley with other RF transmitting equipment. Metricom personal installing the equipment will be made aware of the dangers of RF exposure via the Metricom Health and Safety program. As part of the Ethernet radio installation, signs warning of the dangers of RF radiation exposure will be installed to alert people who may have access to the rooftop of the danger.

Exposure Limits from FCC96-326 Report and Order, Appendix C, Final Rules is given below.

Table 1. Limits for Maximum Permissible Exposure (MPE)

(A) **Limits for Occupational/Controlled Exposure**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f2)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	**f/300**	**6**
1500-100,000	--	--	5	6

f = frequency in MHz
* = Plane-wave equivalent power density

(B) **Limits for General Population/Uncontrolled Exposure**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f2)*	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 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.

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Federal Communications Commission

Maximum Permissible Exposure Assessment

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Metricom Network Radio, GNW 24000

In accordance with
FCC REPORT AND ORDER 96-326
Adopted: August 1, 1996

Prepared by David Waitt
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The network radio is a frequency hopping spread spectrum radio that operates within the 902-928 MHz and the 2.4–2.4835 MHz band. The peak transmit output power of the radio is 1 Watt on each band. The radio is capable of communicating with either Micro-Cellular Data Network (MCDN) microcell radios (GNW 21000) that make up the infrastructure of the MCDN network or Ricochet modems.

MPE Calculations.

The operating environment for the network radio (the top of a utility pole or streetlight) is a fixed, controlled environment. It is reasonable to assume that professional linesmen who work on utility poles and utility workers who work on streetlights will be aware, via their training, of the hazards of RF exposure. However, to yield a worst case analysis, the limits for an uncontrolled environment are used in this document. The definitions of controlled and uncontrolled environments are included below from the FCC Report and Order 96-326:

> B. Definitions of Controlled and Uncontrolled Environments
>
> 35. The 1992 ANSI/IEEE guidelines specify two sets of exposure limits based on the "environment" in which the exposure takes place. These environments are classified as either "controlled" or "uncontrolled." **Controlled environments are defined as locations where "there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels may be above [the exposure and induced current levels permitted for uncontrolled environment but not those permitted for controlled environments]."** Uncontrolled environments are defined as "locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed [the exposure and induced current levels permitted for uncontrolled environments]."

Duty Cycle correction: Even though the duty cycle of the MCDN Network radio is source-based, to yield a worst case MPE distance, a duty cycle of 100 % is used in the following MPE calculations. From Part 2(d)(2) of the FCC Report and Order 96-326, General Rules and Regulations:

> (2) Time-averaging provisions may not be used in determining typical exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in 1.1310 of this chapter. **However, "source-based" time-averaging based on an inherent property or duty-cycle of a device is allowed.** An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal. In general, maximum average power levels must be used to determine compliance.

Fixed, Uncontrolled Environment:
Spec: 900 MHz: f(MHz)/1500 mW/cm^2 = 902/1500 = **.601 mW/cm^2**
2.4 GHz: **1.0 mW/cm^2**

$$Exposure\ (mW/cm^2) = Pout\ (mW) * Duty\ Cycle * (Antenna\ Gain(as\ a\ ratio) / (4 * PI * Radius^2(cm)\ )\ )$$

Solving the above for Radius, General MPE Calculation

$$Radius = \sqrt{\frac{Pout(mw) * Duty\ Cycle * (Antenna\ Gain(as\ a\ ratio)}{Exposure\ (mW/cm^2) * 4 * Pi}}$$

MPE Calculation for two bands

$$Radius = \sqrt{\frac{(900MHzP(mw) * 900MHzAnt\ Gain(ratio)) + (900MHzP(mw) * 900MHzAnt\ Gain(ratio)) * Duty\ Cycle}{Exposure\ (mW/cm^2) * 4 * Pi}}$$

$$Radius = \sqrt{\frac{(900MHz\ EIRP(mw) + 2.4GHz\ EIRP(mw)) * Duty\ Cycle}{Exposure\ (mW/cm^2) * 4 * Pi}}$$

$$Radius = \sqrt{\frac{(Total\ EIRP\ (mw)) * Duty\ Cycle}{Exposure\ (mW/cm^2) * 4 * Pi}}$$

2.4 GHz EIRP:
EIRP = Pout(dBm) + Antenna Gain (dBi)
29 dBm + 8 dBi = 37dBm EIRP = 5011 mWatts EIRP

900 MHz EIRP
EIRP = Pout(dBm) + Antenna Gain (dBi)
30 dBm + 6 dBi = 36 dBm EIRP = 4000 mWatts EIRP

Total Watts EIRP
5011 mW EIRP + 4000 mW EIRP = 9011 mWatts EIRP

900MHz & 2.4 GHz Combined MPE Distance Calculation:
(Note: The specification used in the calculation below is 900MHz specification, the lower of the two.)

$$MPE\ Distance = \sqrt{\frac{9011mw * 1.0}{.601 * 4 * Pi}} \Rightarrow \sqrt{\frac{9011}{7.552}} \Rightarrow 34.54\ cm$$

MPE Distance = **13.6 Inches**

Conclusion:

The MCDN network radios are to be located at, or near the top of telephone poles and streetlights. Given this location, the only personnel that will likely come within the MPE distance of the radio will be trained professional utility workers. These workers may be contracted by Metricom to replace or install a radio, or they may be contracted by the city in witch the pole is located to perform maintenance or repair on the utility pole or streetlight.

It is safe to assume that these individuals will be familiar with the hazards of RF exposure. However, to be certain that no worker is exposed to levels of RF above the guidelines, Metricom will make the municipality in which the radio is installed aware, in writing, of these exposure issues such that the municipality can pass the information on to whomever they contract to work on the poles.

With regards to contractors hired by Metricom, Metricom will modify the radio installation guide to warn about RF exposure.

Exposure Limits from FCC96-326 Report and Order, Appendix C, Final Rules is given below.

Table 1. Limits for Maximum Permissible Exposure (MPE)

(A) **Limits for Occupational/Controlled Exposure**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f2)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	**f/300**	**6**
1500-100,000	--	--	5	6

f = frequency in MHz
* = Plane-wave equivalent power density

(B) **Limits for General Population/Uncontrolled Exposure**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f2)*	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 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.

NETWORK RADIO INTERNAL PATCH ANTENNA DATA.

Wiltron

1B

DEL:		DATE:	09/28/98	15:03	Page 1
VICE ID:		OPERATOR:			
ART:	2.400000000 GHz	GATE START:	-	ERROR CORR:	12-TERM
OP:	2.482500000 GHz	GATE STOP:	-	AVERAGING:	1 PT
EP:	0.000625000 GHz	GATE:	-	IF BNDWDTH:	1 KHz
		WINDOW:	-		

----------CH3----------

RAMETER:	-S21-
RMALIZATION:	OFF
FERENCE PLANE:	0.0000 mm
OOTHING:	8.0 PERCENT
LAY APERTURE:	-

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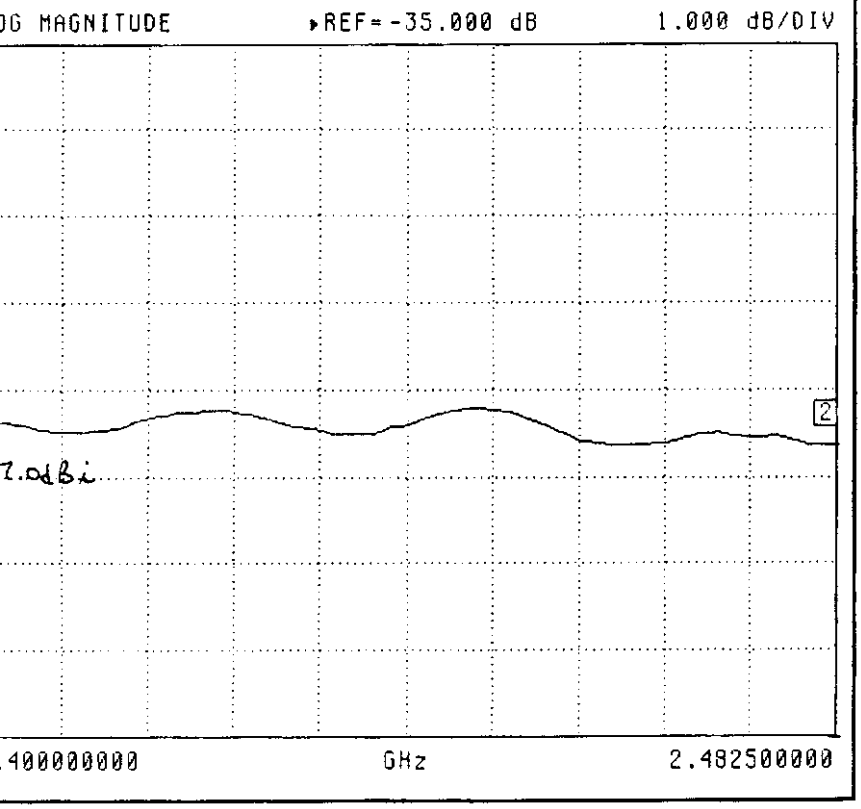
21 FORWARD TRANSMISSION



SET SCALING
OR PRESS
<AUTOSCALE>

-LOG MAG-

▸RESOLUTION
1.000 dB/DIV

REFERENCE VALUE
-35.000 dB

REFERENCE LINE
4

NETWORK RADIO PATCH ANTENNA

YAGI GAIN STANDARD 9/28/98
R. [illegible]

Anritsu

DEL:
VICE ID:

DATE: 09/28/98 12:57 Page 1
OPERATOR:

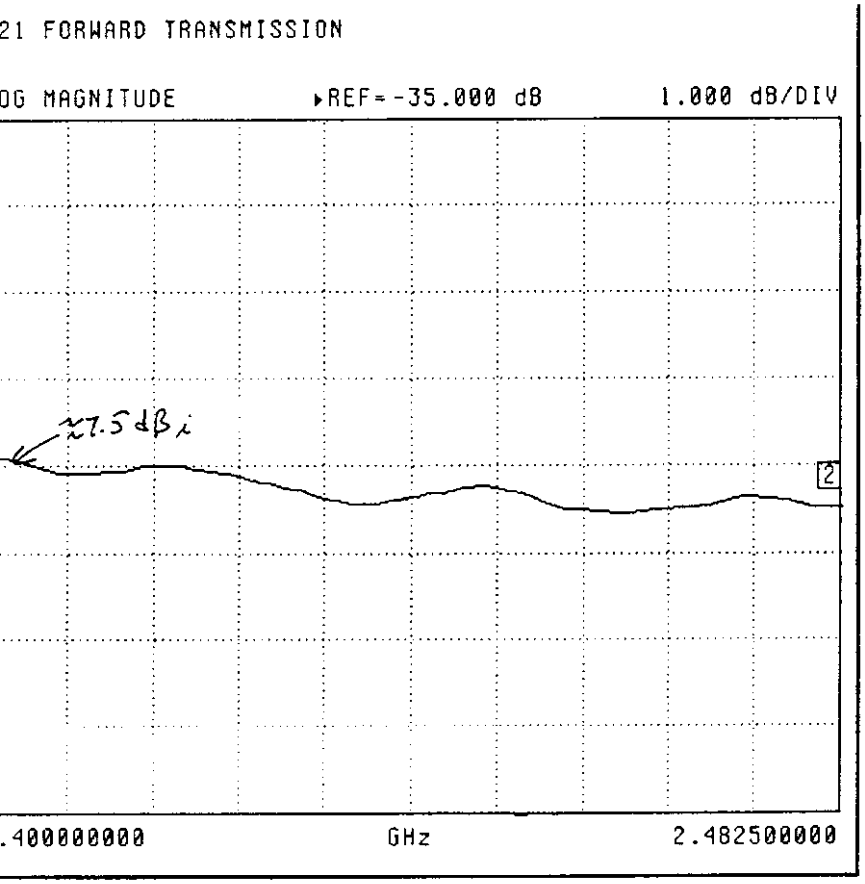
ART:	2.400000000 GHz	GATE START:	-	ERROR CORR:	12-TERM
OP:	2.482500000 GHz	GATE STOP:	-	AVERAGING:	1 PT
EP:	0.000625000 GHz	GATE:	-	IF BNDWDTH:	1 KHz
		WINDOW:	-		

----------CH3----------

RAMETER:	-S21-
RMALIZATION:	OFF
FERENCE PLANE:	0.0000 mm
OOTHING:	8.0 PERCENT
LAY APERTURE:	-

Metricom Proprietary Information
No duplication, use or disclosure without prior written approval

21 FORWARD TRANSMISSION



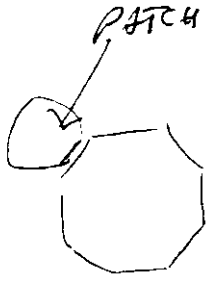
SET SCALING
OR PRESS
<AUTOSCALE>

-LOG MAG-

▸RESOLUTION
1.000 dB/DIV

REFERENCE VALUE
-35.000 dB

REFERENCE LINE
4



ONE PATCH of PUCK TOP UNIT
WITH RADOME.

9/28/98 R. Sherry

GAIN TEST By ~~Substitution~~ Substitution

METRICOM

HEALTH AND SAFETY PROGRAM FOR EXPOSURE TO RADIO FREQUENCY RADIATION

April 1999

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LIST OF ENCLOSURES

METRICOM

SECTION I.

I. INTRODUCTION AND PURPOSE OF THE PROGRAM

As directed by the 1996 Telecommunications Act, the Federal Communications Commission (FCC) has revised guidelines for human exposure to RFR (Radio Frequency Radiation). The FCC adopted as their standard a combination of the ANSI/IEEE C95.1-1992 and NCRP 1986 standards. This FCC standard is both preventative and precautionary in nature and applies to both "Controlled/Occupational" and "Uncontrolled/General Population" exposures of individuals- as defined in the FCC's OET Bulletin No. 65.

This safety program addresses the tower and rooftop antenna cell sites of METRICOM. The guidelines incorporated into the safety program will assist METRICOM employees, ~~technicians~~, contractors, and consultants working in a "Controlled/Occupational" environment and the public in a "Uncontrolled/General Population environment in complying with RFR maximum permissible exposure (MPE) standards.

METRICOM

SECTION II.

II. SAFETY POLICY

In order to minimize the risk of overexposure to any individuals, it is the policy of METRICOM to:

1. Identify and control by engineering design, protective equipment, or administrative actions, hazardous RFR and other dangers associated with each antenna tower and/or roof-top antenna site and accompanying electronic equipment. This policy shall be adhered to during all phases of equipment design, acquisition, installation, operation, and maintenance.

2. Limit personnel exposure to RFR levels that are within the applicable MPE limits.

3. Assume maximum RFR exposure to individuals from all RF sources may exceed the MPE limits, and control exposure appropriately.

4. Ensure that individuals are aware of potential RFR at the METRICOM antenna sites and the control measures implemented to limit their exposure to RFR. Only authorized personnel are allowed entrance to the sites.

5. Investigate and document all alleged RFR overexposure incidents.

6. Mandate that all employees contractors, and consultants performing work or that enter the antenna tower sites and/or antenna roof-top sites for METRICOM be required to sign a form prior to or upon entering the controlled area stating that:

    a. They have received and understand RFR awareness training.

    b. They understand how the RFR personal monitor works and why they are required to wear it.

    c. They are aware of the potential effects on medical implants and those individuals implanted with such devices enter the restricted area at their own risk.

7. Mandate that all employees, contractors, and consultants accessing the antenna sites for METRICOM will:

   a. Report any encountered RFR effects to METRICOM.

   b. Test the RFR personal monitor according to manufacturer's test procedures before and after usage to verify the RFR personal monitor was operating properly throughout the period that it was worn.

   c. Use the RFR personal monitor and employ the monitor with switch in "On" position during the period that they are in the controlled area.

8. The provisions of this program must be followed by METRICOM employees, contractors, and consultants when working on METRICOM facilities. These procedures were written with the assumption that METRICOM employees, technicians, contractors, and consultants will be in a "Controlled/Occupational" environment as they will have the ability to control their exposures based on the health and safety program implemented by METRICOM. This ability will come from RFR health and safety training, posted signs, and administrative and/or engineering controls. Any technical or procedural questions about the policy or program should be directed to the METRICOM safety officer. In the event that any portion of this policy or program conflicts with state or federal regulations, standards, or guidelines pertaining to employees, technicians, contractors, consultants, or general public exposure to RFR, the federal regulations will apply over those described in this document.

TRICOM

SECTION III.

III. SAFETY OFFICER'S RESPONSIBILITIES

1. METRICOM will designate a safety officer responsible for RFR exposure protection policies. The safety officer shall establish and maintain the RFR protection program that must be followed when any METRICOM employees, technicians, or contractors are conducting operations involving actual or potential exposure to RFR. The safety officer shall also ensure that all personnel follow the specified procedures such that exposure to METRICOM or their customers' employees, technicians, or contractors does not exceed the applicable MPE as a result of RFR.

2. During the construction or development phase, the designated local safety officer is the GSA construction manager. The national safety officer is the engineering services site engineer.

3. During the operational phase, the designated local safety officer is the GSA manager. The national safety officer is the engineering services site engineer.

METRICOM

SECTION IV.

IV. The RFR Health and Safety Program consists of the following elements:

1. **Utilization of installed RF transmitters, which meet applicable RF and safety standards during the time of use, including after any modifications:**

   a. Certification will be required on all future installations or modifications for RF amplified equipment at METRICOM antenna tower sites or antenna rooftop sites. This will ensure that the equipment installed in the transmitter room meets the new FCC MPE standard.

   b. Any service, modification, or action that has been performed on equipment that is currently installed, which is responsible for amplifying or coupling amplified RF signals, will be checked with RF survey equipment immediately after service and before returning that item or system to operational status. The RFR personal monitor may be used for this purpose. Records of the RFR check must be prepared and forwarded to the safety officer within three (3) days of leaving the site. The record will be maintained by the safety officer. No new or modified equipment will be allowed to operate at METRICOM facilities without the above certification.

2. **RFR hazard identification and periodic surveillance:**

   RFR hazard identification has been assessed by means of calculating theoretical exposure potential from typical antennas. METRICOM will also conduct a thorough modeling analysis and/or on-site survey at several representative antenna sites. Sites will also be evaluated for conducting objects to ensure they do not constitute RF shock and burn hazards. Periodic surveillance will be conducted by a competent person who has been trained to perform surveys of new or existing installations in order to assess changes in exposure potential.

3. **Implementation of controls to insure RF exposure levels are in compliance with applicable guidelines:**

a. ADMINISTRATIVE CONTROLS

1. Appropriate controls will be implemented in all areas where the "Uncontrolled/General Population" limits may be exceeded. These controls will consist of restricting access and placing signs to alert those potentially affected by the anticipated RF levels.

2. Although field limits are specified as both "whole-body and time averaged," it is the policy of METRICOM to control all occurrences of RFR above the "Uncontrolled/General Population" levels. METRICOM presumes all antennas at each site have the potential to exceed MPE levels. Signs will be placed as follows to ensure compliance:

b. SIGNS

1. The placement of signs will be determined by calculating "Controlled/Occupational and "Uncontrolled/General Population" exposure limit distances utilizing measures such as Maximum Permissible Exposure (MPE) evaluations, site modeling, or RF Site Surveys.

2. Signs should be placed at the climbing access point for antenna communication towers with the following information:

   i. Contact telephone number
   ii. Site identification number

3. Signs should be placed near or attached to the transmitting antennas located on a rooftop with the following information:

   i. Contact telephone number
   ii. Site identification number
   iii. Limited exposure distance from antenna

4. *SITE GUIDELINES*:

   i. The site shall have signs posted which indicate a safety plan is in place for the site and provide guidelines regarding general RF safety awareness.

5. *NOTICE:*

   i. Signs shall be posted which provide a notice indicating radio frequency transmitting devices are in operation in the area.

   ii. The limits associated with this notification must be less than the "Controlled/Occupational" maximum permissible exposure (MPE) standard.

   iii. The notice shall distinguish the boundary between "Controlled/Occupational" and the "Uncontrolled/General Population" areas.

   iv. The boundary will usually be the fence for the property, gate entrance, or rooftop to the equipment room.

6. *CAUTION*:

   i. The caution sign identifies RF controlled areas where RF exposure can exceed the "Controlled/Occupational" maximum permissible exposure (MPE) standard.

   ii. The site will have signs posted at critical locations where RF levels may exceed "Controlled/Occupational" limits.

   iii. All authorized workers for RF controlled areas must have RFR awareness training.

7. *WARNING*:

   i. The warning sign denotes the boundary of areas with RF levels above the FCC limit for "Controlled/Occupational" maximum permissible exposure (MPE) standard.

   ii. Employees, technicians, contractors, or consultants should not enter these areas unless special procedures are followed.

8. Signs will be conspicuously mounted and placed at the normal site access points, e.g. antenna tower site access gate, and will include the RFR symbol which consists of a triangle with an RF radiation source depicted graphically in the center of the triangle.

9. Signs will be placed to alert and inform the viewer in sufficient time to take appropriate evasive actions to avoid potential harm from the RFR hazard. They will be legible, non-distracting and non-hazardous in themselves. Signs will not be located where they may be blocked by moveable panels such as doors, windows, racks, gates, etc.

10. Placement of RFR safety signs will advise "Occupational" personnel as well as the "General Population" of potential RFR exposure from the antennas.

c. RESTRICTED AREAS

1. Only authorized personnel are allowed access to the antenna tower sites and/or antenna rooftop sites. At no time are individuals allowed to work in areas that exceed the "Uncontrolled/General Population" exposure limits without a personal monitor. When it is determined that technical personnel must work in fields that exceed the alarm threshold of the RFR personal monitors (i.e., 50% of Controlled/Occupational limits), prior written approval must first be obtained from the local METRICOM safety officer.

d. ENGINEERING CONTROLS

1. RFR MONITORS

i. The RFR personal monitor is designed to detect a wide range of frequencies and can be used in most environments.

ii. All personnel performing any activity that will require being 30 feet or less from antennas for six (6) minutes or more must wear approved RFR personal monitors.

iii. Carry the RFR personal monitor should be carried inside outer garments or fastened to a shirt or jacket pocket or to a belt using the clip provided on the instrument. Do not locate the unit near any metallic object.

iv. Approach unknown fields cautiously, starting from as far away as possible and extending the RFR personal monitor at arm's length toward the energy source.

v. Before or while site activity is in progress, if the RFR personal monitor issues an alarm, discontinue work and calmly move away from the area. If you must remain in close proximity to the radiation source, corrective action such as de-energizing the RF source before returning to the area in question must be performed, unless passage through the area of concern is only incidental. The RFR personal monitor must be kept in an "ON" position and worn while in the controlled area, even after the RFR source has been de-energized. Lock-out/Tag-out procedures must be followed while the RF source is de-energized.

2. *RFR SURVEY EQUIPMENT*

i. METRICOM may request that a survey be performed after any modification to the antenna tower sites and/or antenna rooftop sites or when transmit power levels are increased.

ii. Approved RF survey equipment will be used to perform and document RF surveys. Employees or other potential affected persons may request that a survey be conducted for just cause. METRICOM will evaluate such requests on a case-by-case basis.

iii. Records of surveys will be maintained at METRICOM's corporate office.

e. <u>WORK PROCEDURES</u>

1. BEFORE BEGINNING WORK

i. Before entering the antenna tower area or antenna rooftop area, workers will look for advisory signs that warn of areas having potentially excessive levels of RFR.

ii. If work is be performed within (30) feet of antennas for more than six (6) minutes, approved RFR monitors must be worn.

iii. Transmitter equipment will be controlled by lock-out/tag-out procedures where possible when work is being performed.

iv. Whenever natural light is insufficient to adequately illuminate the work site, artificial illumination shall be provided by licensee or tower owner to enable the employee, technician, contractor, or consultant to perform the work safely.

v. Exposure times should be kept as short as reasonably possible.

vi. Needless exposure to RF fields should be avoided.

2. WHILE PERFORMING WORK:

i. Assume all antennas are active and radiating at full power unless the antenna has been placed in lock-out/tag-out mode. The intermittent nature of communications activity makes it difficult to know the transmitter status for all site transmitters.

ii. Keep a safe distance. During activity on tower antenna sites and/or antenna rooftop sites, personnel should strive to keep their distance from antennas. Be aware of the potential for more than one antenna to impact any given area. Caution must be exercised in accordance with other work practices discussed to insure that close proximity will not lead to excessive RFR exposures. If work is to be performed on antennas or within "Standoff Distances" from antennas, transmitters must be deactivated before beginning work. If in doubt as to where "Standoff Distances" begin for a specific antenna, deactivate transmitters before beginning work.

iii. Be sensitive to time spent in RFR fields. The most reliable practice for complying with RFR exposure limits is to avoid the use of time-averaging provisions of RFR exposure standards. When working near tower mounted antennas or rooftop mounted antennas, workers should avoid unnecessary and prolonged exposure in close proximity to antennas.

iv. Protective clothing. At the METRICOM tower antenna sites and/or rooftop antenna sites, concerns over requiring transmitter shut downs to accommodate maintenance activities may in some situations leave the workers with virtually no apparent options for controlling exposure to RFR. In such circumstances, the worker should consider the use of protective clothing as a means of reducing RFR exposure if the personal monitor indicates exposure is above the standard in areas where work must be performed. Currently, there is no protective clothing that is ideal for all working conditions. While there is a potential to reduce RFR, side effects such as restricted vision and an increase of body temperature to workers, especially in hot environments, limits usage. This option should not be excluded, as more ideal protective gear is likely to become available in the future. METRICOM will continue to review this option as a means of protecting workers from RF radiation.

v. Protect your eyes. The only way to protect against eye damage is to avoid exposure. Never look into an open wave-guide that may be connected to an energized source of radiation. Do not assume conditions are safe on the backside of antennas since RF energy can emanate from these areas due to leaks. Whenever possible, lock-out/tag-out transmitting equipment prior to entering an area of potential RFR exposure.

vi. Sources of RF radiation should be properly shielded to minimize stray radiation.

vii. Never operate transmitters without shields during normal operation.

viii. Do not operate antennas inside equipment rooms.

3. WHEN SITE WORK IS COMPLETE:

   i. Remove equipment from the site and depart area before re-energizing transmitters.

   ii. Report to METRICOM any hardware or configuration changes made to the site, which may create new or altered RFR areas (for example: the addition of transmitters or antennas or change of antenna configuration). METRICOM will update the sites' log and may perform surveys of all new, repaired, or modified equipment to determine the RFR exposure potential.

   iii. Assure RFR personal monitors are turned off to conserve battery life.

4. PRECAUTIONS APPLYING TO RADIO FREQUENCY (RF) TRANSMITTING EQUIPMENT WORK AND INSTALLATION:

   i. Personnel working on open RF transmitting equipment or any radiating device shall deactivate equipment as necessary to avoid non-compliant RF exposure. If possible, simply shut off and lockout the transmitting equipment that you are utilizing or servicing.

   ii. When servicing radio equipment, disconnect or adequately ground transmission lines that may carry RF signals induced from other sources into otherwise deactivated radio equipment. Specific procedures that must be followed for grounding antennas and lines are included in Enclosure 6.

f. RF SAFETY AND HEALTH TRAINING

1. METRICOM requires training based on two different categories of potentially affected people. Awareness training shall be accomplished with reading materials, classroom instruction, and/or RFR awareness videos. Awareness training increases sensitivity of the worker to RFR trouble spots thereby assisting proper compliance with exposure limits. RFR awareness training shall be tailored to meet the degree of potential exposure at the antenna tower sites and antenna rooftop sites as appropriate.

2. The first category includes people not required to have significant technical knowledge beyond their specific operating functions, e.g., custodians, visitors, etc. Category 1 personnel must be provided with a simple understanding of the nature and effects of RFR safety practices such as the purpose of safety shields, why they should not be removed, the reason for posting safety signs, and why access is restricted. Personal monitors shall also be reviewed and conditions that require usage of such monitors shall be outlined.

3. METRICOM and their customers' employees, technicians, contractors, and consultants that are expected to work in "Controlled/Occupational" environments will have Category 2 training to ensure that they understand the RF hazards to which they may be exposed and the means by which the hazards are controlled. Affected employees, technicians, and contractors consist of all those who enter the antenna and equipment installation locations and all those who service and/or maintain RF transmitting equipment. The basis for training for Category 2 will be similar to Category 1 but with more in-depth emphasis for certain categories of information.

4. All individuals entering restricted areas (areas that may result in exposure to RFR above the Uncontrolled/General population level) must wear monitors and know how they work and why they are required to wear them. The monitor must be tested before and after each use in order to ensure that it is working. The worker will be required to sign a statement that the monitor was working properly and operated in accordance with manufacturer's guidelines.

g. METRICOM AND THEIR CUSTOMERS' EMPLOYEES, TECHNICIANS, CONTRACTORS INVOLVEMENT

METRICOM and their customers' employees, technicians, contractors, and consultants who visit the site on a regular basis are encouraged to participate in the structure and operation of the program and in decisions that affect their safety and health. Active participation in the development and implementation of the RFR safety policy will encourage their understanding and commitment to safe work practices. RF screening measurements may be made in the presence of employees, technicians, contractors, or consultants to facilitate understanding and confidence in the program.

h. MEDICAL SURVEILLANCE PROGRAM AND FIRST AID FOR EXPOSURE TO EXCESSIVE RF RADIATION

1. Remove worker from exposure area to a cool environment and provide cool drinking water.

2. Apply cold water or ice to burned areas.

3. Seek immediate medical attention.

4. Severe RF overexposure may damage internal tissues without apparent skin injury, so a follow-up physical examination is advisable.

5. All RF burns, shocks, implanted medical device failures, or the sensation of non-routine heating must be reported to the designated METRICOM safety officer. Anyone exposed to RFR exceeding the MPE should report to the nearest medical center. METRICOM will attempt to determine the nature of the overexposure and implement corrective actions.

6. All personnel entering the restricted area are required to log in and acknowledge awareness that medical implants may be affected by RF radiation and, if they are using such a device, they enter the site at their own risk.

7. First aid supplies recommended by a consulting physician shall be placed in weatherproof containers (unless stored indoors) and shall be easily accessible to METRICOM personnel. Each first aid kit shall be inspected at least once a month by the safety officer and expended items shall be replaced.

i. HAZARD ASSESSMENT

Hazard assessment is part of the overall METRICOM safety plan. To minimize the potential for overexposure to RFR, the safety inspection checklist (see Enclosure 6) includes a routine inspection of signs, shields, and feed lines.

j. NON-ROUTINE TASKS

Safety training required by METRICOM should include a discussion of non-routine tasks that may be undertaken by METRICOM employees, customers', contractors, consultants, and others.

k. PROGRAM REVIEW

This program will be reviewed annually by METRICOM and updated as often as necessary to ensure that the program reflects METRICOM's current position concerning human exposure to RF radiation. METRICOM will monitor and assess the most current information and incorporate such information into the program.

l. COMPLIANCE REVIEW

1. All of the procedures described in this program must be followed by all affected employees, technicians, contractors and consultants doing work for METRICOM or customers in the RFR areas at the antenna site. Failure to comply with these guidelines could result in disciplinary action up to and including dismissal, being refused future access to the site, removing equipment from the site, and reporting violations to the FCC and/or OSHA. METRICOM also reserves the right to assess charges for RFR compliance costs.

1. This safety plan cannot cover every situation that may be encountered in the workplace, but it does address typical scenarios. If situations that are not covered are encountered, employees, technicians, contractors and consultants should consult their safety officer or METRICOM. In general, never work in an area or on equipment where you might expect to exceed averaged FCC exposure limits without using a personal monitor and without having RFR awareness training and applying appropriate RFR safety practices.

METRICOM

SECTION V.

V. OSHA 29 CFR 1910.268: TELECOMMUNICATION STANDARDS

Requirements for the RF and microwave industry under OSHA 29 CFR 1910.268 apply to all employees, technicians, contractors and consultants doing work for METRICOM in the RFR areas at the antenna tower site, antenna rooftop site, or transmitter area. This section of the OSHA rules sets forth safety and health standards that apply to the work conditions, practices, means, methods, operations, installations and processes performed at telecommunications centers which are located in building spaces. Telecommunications center work includes the installation, operation, maintenance, rearrangement, and removal of communications equipment and other associated equipment in telecommunications switching centers. Field work includes the installation, operation, maintenance, rearrangement, and removal of conductors and other equipment used for signal or communication service, and of their supporting or containing structures, overhead or underground, on public or private rights of way, including buildings or other structures. Compliance with all aspects of this written safety plan will ensure compliance with the requirements of 29 CFR 1910.268.

Telecommunications transmitter sites contain numerous hazards, beyond whatever hazard may be presented from potential exposure to high intensity RFR fields near active antennas. These include trip hazards, electrical shock hazards and falling hazards. While an area may not appear to be a fall hazard area, certain antennas may have the potential to shock or burn a worker, which in turn could cause him to fall backwards into an unprotected area. Another non-RF hazard is the potential for falling tools from elevated levels.

METRICOM is committed to maintaining a safe work environment. Although this written safety plan contains the guidelines which, if implemented, will ensure the ongoing safety of all personnel, it is the responsibility of each individual to maintain a personal commitment to the safety of themselves and others with whom they work.

METRICOM

SECTION VI.

A. LOCK-OUT/TAG-OUT PROTOCOLS

Maintenance rarely follows a set pattern since each job tends to be different. A clearly defined policy covering the positive locking of switches during maintenance work will prevent injury on the job that can result from the accidental release of closed switches.

B. SCOPE

This program covers the requirements for lock-out/tag-out by any individual, to prevent the release of materials and for isolation of energy sources such as, but not limited to, chemical, electrical, thermal, mechanical, pneumatic, hydraulic, and RF radiation during servicing and maintenance of machines and equipment.

C. DEFINITIONS

Lock-out: Utilizing a lock on a power source with a lock-out device that physically holds an energy control point, such as a lever or switch in the "off" position and makes it impossible to operate.

Tag-out: The placement of a written warning that tells co-workers not to operate a switch or lever that could release hazardous energy or set a machine in motion. Though the tag acts as a warning device, it does not physically prevent someone from releasing the energy.

Lock-out and Tag-out: Procedures designed and implemented to protect workers from the accidental release of energy. Success is dependent upon understanding and using the procedures outlined in this program.

D. POLICY

1. METRICOM maintains a program to provide safe equipment and usage for all employees, technicians, contract workers, licensees, tenants and consultants. All individuals servicing an antenna tower site or antenna rooftop site for METRICOM are responsible for performing their duties in the safest manner possible and for minimizing hazards to themselves, to other personnel, and to equipment.

2. All METRICOM personnel are authorized to use locks and tags upon completion of appropriate training. Use of locks and tags will protect themselves and other personnel at the site from potential danger.

3. Locks and tags are not to be used over extended periods of time nor in lieu of permanent safeguards. Padlocks are to be used as necessary to secure main electrical disconnects switches.

4. Danger tags shall be used when working on unlocked equipment covered by this procedure.

5. Notice tags are for use when it is necessary to attach written instruction to equipment.

E. PROCEDURES

1. Making sure equipment is safe

a. Notify Network operations prior to shutting off power to any transmitting facility.

b. Make sure before beginning to work that equipment is disconnected from its source of power, if possible, or that all push buttons or remote controls are positioned and locked or tagged securely so that the lock and tag cannot be accidentally detached.

c. Contact the Site Safety Officer if you are not certain that the equipment has been properly locked out.

2. Use of Locks and Tags

a. Locks and tags are available at the company truck if the worker does not have his own lock.

b. Locks and tags should be left on equipment temporarily overnight and over weekends when work is incomplete and temporarily suspended. Site owners and operators must be made aware during any situations in which this condition will exist.

c. Tags and locks should be removed promptly when work is completed in order to avoid unnecessary delay and potential confusion.

d. When more than one individual is working on a piece of equipment, group lock-out/tag-out procedures will follow the procedures for a single lock-out.

e. The last worker to remove his lock or tag will notify the designated Site Safety Officer.

3. Responsibilities of Designated Site Safety Officer

a. Ensure that locks and tags are available on the company truck.

b. Ensure that lock-out/tag-out procedures are being properly followed.

c. Verify that tags or locks can be removed and equipment can be started safely if a worker is not able to remove his own tag or lock after a job is completed and the equipment must be made operative.

d. It is the Safety Officer's responsibility to see that all employees, technicians, contractors, licensees, tenants and consultants obey all company rules. This includes wearing required safety equipment and personal RFR monitor.

4. Training

a. Training on lock-out/tag-out procedures will be provided to employees, tenants and licensees. Training will be fully documented, including name of the trainee and trainer, dates of training, and indication as to whether the employee is a user or nonuser of lock-out/tag-out procedures.

b. Training will be given to all new personnel as necessary concerning the lock-out/tag-out process. Employees that will not be directly affected by lock-out/tag-out must still be trained on the importance of the danger tag, and understand that they cannot operate or alter the position of either the danger tag or the equipment that it is identifying.

c. There will be annual training to ensure that the purpose and function of the energy control program (tag-out program) is understood by all employees and that the knowledge and skills required for safe application, usage and removal of the energy controls are acquired by employees. The basic training for tags and locks includes:

   i) Tags may invoke a false sense of security and their meaning needs to be understood as part of the overall energy control program.

   ii) Tags are essentially warning devices affixed to isolating devices and do not provide the physical restraint on those devices that a lock provides.

   iii) When a danger tag is attached to an isolating device, that device is not to be operated under any circumstance, and the tag must not be removed, ignored or otherwise defeated.

   iv) Tags and their means of attachment must be made of materials, which will withstand the environment conditions encountered in the workplace.

   v) Danger tags must be legible and understandable to be effective.

   vi) Danger tags must be securely attached to the isolating device so they cannot be inadvertently or accidentally detached.

   vii) Violation of the lock-out/tag-out procedure will result in corrective action. Corrective action could include days off without pay or termination.

d. Re-training will be required under the following circumstances:

i) Annually

ii) When there is a change in lock-out/tag-out procedures.

iii) When an audit or incident reveals deviations from established procedures.

iv) When there are changes in machines, equipment or job assignments (only the workers affected).

v) When there appears to be deficiencies in any employees' understanding of the program.

vi) The retraining shall re-establish employee proficiency and introduce new or revised control methods and procedures, as necessary.

LOCK-OUT/TAG-OUT QUIZ

PRINTED NAME: _____

_____
SIGNATURE OF PERSON COMPLETING QUIZ

_____ _____
SOCIAL SECURITY NUMBER DATE OF QUIZ

CIRCLE THE LETTER OF CHOICE FOR YOUR ANSWER

1. **Any employee can lock-out a machine.**

   A. True B. False

2. **It is impossible to activate equipment that has been locked-out.**

   A. True B. False

3. **All switches, controls, and buttons should be placed in the "off" position during lock-out/tag-out procedures.**

   A. True B. False

4. **After the job has been completed and the isolation devices and locks removed, the tags should be:**

   A. Left on the equipment for the rest of the day so other workers will know it had been locked out.

   B. Removed, signed and turned into the designated Site Safety Officer as soon as the job has been completed.

   C. Left for the designated Site Safety Officer to remove once he is sure the equipment operates properly.

5. **If the job isn't finished in one day, the worker leaving the job site should:**

   A. Leave his lock on and remove it the next day.

   B. Remove his lock and leave.

   C. Wait until he has completed his work before removing his own lock.

6. A final check of all start buttons and levers should be made to release any stored energy and to make sure that you have isolated the right energy source.

A. True B. False

7. Most equipment will have more than one source of energy.

A. True B. False

8. It is okay not to lock-out a piece of equipment you are working on as long as you can see the control switches from where you are working.

A. True B. False

9. Lock-out and tag-out procedures are for maintenance personnel only.

A. True B. False

10. If three people are working on the same equipment, only one tag needs to be attached to the isolating device as long as they have all used their own locks.

A. True B. False

ENCLOSURE 1

RADIO FREQUENCY RADIATION
"SAFETY PROGRAM GUIDELINES"
SIGN

NOTICE

RF SAFETY PROGRAM
IN EFFECT AT THIS SITE

JIDELINES:

- All personnel must have RF SAFETY TRAINING as per the written RF SAFETY PROGRAM for this site.
- ONLY AUTHORIZED PERSONNEL may enter this site.
- Obey all posted signs.
- Assume all antennas are active, unless LOCKED OUT.
- Before working on antennas, notify owners and DISABLE APPROPRIATE TRANSMITTERS.
- Maintain a safe distance from all antennas.
- Do not stop or work in front of active antennas.
- USE personal RF MONITORS while in restricted area.
- Replace all transmitter shields after service.
- Do not mount or use antennas in equipment rooms.

ENCLOSURE 2

RADIO FREQUENCY RADIATION
"NOTICE" SIGN

NOTICE

Radio frequency fields beyond this point may exceed the FCC general public exposure limit.

Obey all posted signs and site guidelines for working in radio frequency environments.

In accordance with Federal Communications Commission [illegible] frequency emission [illegible]

ENCLOSURE 3

RADIO FREQUENCY RADIATION
"CAUTION" SIGN

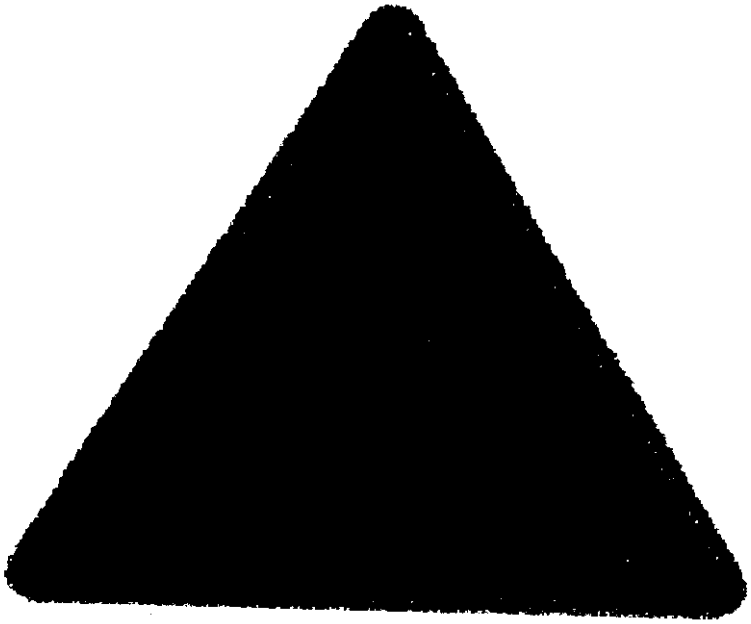
CAUTION

Beyond this point:
Radio frequency fields at this site may exceed FCC rules for human exposure.

For your safety, obey all posted signs and site guidelines for working in radio frequency environments.

ENCLOSURE 4

RADIO FREQUENCY RADIATION
"WARNING" SIGN



Beyond this point:
Radio frequency fields at this site exceed the FCC rules for human exposure.

Failure to obey all posted signs and site guidelines for working in radio frequency environments could result in serious injury.