



TCJ-M4BBDAUU MARK-IV UHF BROADBAND SIGNAL BOOSTER

RF Exposure Information

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Submitted by:
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1 PURPOSE

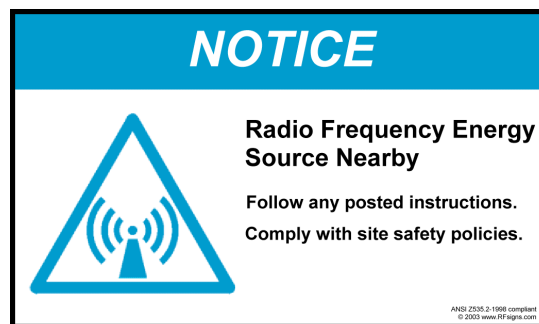
This document presents RF Exposure recommendations for the Mark-IV UHF Broadband Signal Booster.

2 RF EXPOSURE RECOMMENDATIONS

The RF Field Strengths that an individual will be exposed to while doing maintenance are well below the limits set forth by the FCC & State Laws.

Nevertheless, there are Safety Precautions that should be adhered when performing any RF Tests:

1. Never Operate a Transmitter, or Booster Amplifier without adequate Load/Termination on the Output Port.
2. Ensure all Connections are tight and secured.
3. Ensure all Coaxial Cable Insulation covers the Outer Shield of the cable.
4. Do Not Touch Exposed System Ports or Coaxial Cable if system is Transmitting.





3 MAXIMUM ANTENNA GAIN



The Input antenna and output antenna are not included with this equipment. Nevertheless, if this device is used in an application that requires direct connection to an antenna, Canam Technology recommends following the FCC guidelines for its installation.

According to FCC rule § 1.1310 Radiofrequency radiation exposure limits the limits for maximum permissible exposure (MPE) are as follow:

Table 1 – Limits for maximum permissible exposure (MPE)

	Frequency range (MHz)	Power density (mW/cm ²)
Occupational Controlled Exposures	300-1500	f/300
General Population Uncontrolled Exposure	300-1500	f/1500

The Maximum antenna gain is determined using the Friis transmission equation:

$$P_d = (P_{out} * G) / (4 * \pi r^2)$$

where:

P_d = Power density (mW/cm²).

P_{out} = Output power (mW).

G = Antenna gain (linear scale).

r = Distance between observation point and center of the radiator in cm

The calculated Antenna Gain for $r = 100\text{cm}$ the maximum permissible exposure (MPE) is shown in Table 2.

Table 2 – Limits for maximum permissible exposure (MPE)

	Frequency (MHz)	Maximum Antenna Gain (dBi)
Occupational Controlled Exposures	480	16.04
General Population Uncontrolled Exposure	480	9.053

- Antenna Installation should be performed by qualified technical personnel. The installations instructions are for the purpose of complying with FCC RF Exposure and are not optional.
- All antennas should be fixed mounted and physically secured to one location.
- Non-building mounted donor antennas must be greater than 10 meters above ground.

Exposure of humans to RF fields

The product under test is a UHF bi-directional amplifier (repeater) that transmits in the 406.1 – 430.0 MHz band and the 450.0 – 470 MHz.

It has been assumed that the connecting cables are short and have no associated losses.

The client advises that high gain directional antennas will be used.

The composite power of the amplifier when operating with a duty cycle of 100% is +37 dBm (5 watts) where 16 channels are used each with an output power of +25 dBm (316 mW).

As per FCC KDB 447498 D01 and Section 2.1091 radio frequency transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels.

Calculations have been made using the General Public/Uncontrolled Exposure limits that are defined in Section 1.1310.

The limits for maximum permissible exposure (MPE) have been calculated below for a worst case at 403 MHz

- Occupational /Controlled exposure is $f/300$ which gives a limit of 1.343 mW/cm²
- General Population / Uncontrolled exposure is $f/1500$ which gives a limit of 0.269 mW/cm²

Minimum safe distances have been calculated below.

For a Controlled Environment

$$\text{Power Density} = 1.343 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{1.343 \times 3770}$$

$$E = 71.2 \text{ V/m}$$

For an Uncontrolled Environment

$$\text{Power Density} = 0.269 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{0.269 \times 3770}$$

$$E = 31.8 \text{ V/m}$$

The rated maximum transmitter power = 0.316 W (+25 dBm).

A worst case scenario duty cycle of 100% has been used for the calculations.

The client advises an antenna gain of +11.3 dBi which equates to a numeric gain of 13.5.

The minimum distance from the antenna at which the MPE is met is calculated from the following

Field strength in V/m (FS),
Transmit power in watts (P)
Transmit antenna gain (G)
Transmitter duty cycle (DC)
Separation distance in metres (D)

The calculation is as follows:

$$FS = (\sqrt{(30 * P * G * DC)}) / D$$

For Uncontrolled environments, the minimum distance is:

$$D = (\sqrt{(30 * P * G * DC)}) / FS$$

$$P = 5.0 \text{ W}$$

$$FS = E = 71.2 \text{ V/m}$$

$$G = 13.5$$

$$DC = 1$$

$$D = (\sqrt{(30 * 5.0 * 13.5 * 1)}) / 71.2$$

$$D = 0.632 \text{ m or } 63.2 \text{ cm}$$

For Controlled environments, the minimum distance is:

$$D = (\sqrt{(30 * P * G * DC)}) / FS$$

$$P = 5.0 \text{ W}$$

$$FS = E = 31.8 \text{ V/m}$$

$$G = 13.5$$

$$DC = 1$$

$$D = (\sqrt{(30 * 5.0 * 13.5 * 1)}) / 31.8$$

$$D = 1.415 \text{ m or } 141.5 \text{ cm}$$

Result: Complies if the safe distances shown above are applied based upon the assumptions presented.