

TRICOM
RESEARCH, INC.

**OPERATOR'S MANUAL
TCR-MBA-75 NBT
MULTI-BAND RF AMPLIFIER**



DAMA CERTIFIED

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TCR-MBA-75 NBT OPERATOR'S MANUAL

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Note: The information contained herein is for reference only and does not constitute a warranty of performance.

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| Revision | Description | Date |
|----------|--|--------------|
| Rev A | Initial Release | 22 JUNE 2010 |
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1.0 INTRODUCTION

1.1 GENERAL INFORMATION

This manual provides operating instructions for the DAMA certified TCR-MBA-75 NBT Multiband Amplifier shown in Figure 1-1. The designation NBT (non-bias tee) simply indicates the ability to use the amplifier without the need for a bias tee by using the front panel DC connector. The TCR-MBA-75 NBT is designed as a form and fit replacement for the AM-SAT-50 UHF SATCOM or TCR-MBA-75 Amplifier with enhanced functionality. The footprint and mounting provisions for the AM-SAT-50, TCR-MBA-75 and TCR-MBT-75 NBT are identical. The TCR-MBA-75 NBT is an amplifier/pre-amplifier designed to provide transmit and receive gain for:

- Multiband line of sight (LOS) 30~512 MHz communications;
- HAVEQUICK 225-400 MHz and SINCGARS frequency hopping 30~88 MHz operation; and,
- UHF Tactical SATCOM (242~268 MHz receive and 292~318 MHz transmit) frequencies with Low Noise Amplifier (LNA) and Cosite suppression.

Part number: 11000-00678

The TCR-MBA-75 NBT is DAMA Certified with several UHF SATCOM terminals. For a listing of the current certifications please see the Joint Interoperability Test Command (JITC) Website:

<http://jitc.fhu.disa.mil/reg/dama.html>



Figure 1-1. TCR-MBA-75 NBT Amplifier

1.2 ABBREVIATIONS AND GLOSSARY

| | |
|--------|--|
| AGC | Automatic gain control |
| ALC | Automatic level control |
| AM | Amplitude modulation |
| ANT | Antenna |
| BPS | Bits per second |
| CT | Cipher text |
| CW | Continuous wave |
| COMSEC | Communications security |
| dB | Decibel |
| dBm | Decibel referenced to 1 milliwatt (0 dBm = 1 mW) |
| FM | Frequency modulation |
| Hz | Hertz |
| IW | Integrated Waveform |
| JITC | Joint Interoperability Test Center (DISA) |
| KHz | Kilohertz |
| LED | Light emitting diode |
| LNA | Low Noise Amplifier |
| LOS | Line of sight |
| MHz | Megahertz |
| mW | Milliwatt |
| PT | Plain text |
| PTT | Push to Talk |
| RCV | Receive |
| SATCOM | Satellite Communications |
| UHF | Ultra-high frequency |
| VDC | Volts, direct current |
| VSWR | Voltage standing wave ratio |
| W | Watt |
| X-MODE | Connector for COMSEC equipment |
| XMT | Transmit |

1.3 EQUIPMENT DESCRIPTION

The TCR-MBA-75 NBT Multi-band RF Amplifier operates in 30 MHz to 512 MHz AM and FM Line-of Sight (LOS), 30 MHz to 88 MHz SINCGARS Frequency Hopping, 225 MHz to 400 MHz HAVEQUICK, and UHF Tactical SATCOM modes. It is suitable for vehicular, airborne, or fixed-station applications and is compatible with most military and commercial radios operating in the 30-512Mhz frequency spectrum. The amplifier is weather-resistant and may be located outdoors with the antenna via Bias Tee I (for information on this see Para. 2.3.3.1 Normal Operations). The operation of the amplifier is controlled via front panel push button switches. The amplifier has a single power connection, an RF input port and two frequency specific output antenna ports. The LOS port is for frequency hopping and multiband Line of Site operation anywhere between 30 and 512 MHz. The SATCOM port is used with UHF SATCOM antennas in the 292-318 MHz uplink and 242-268 MHz downlink bands. The Mode push button switch provides for selection of LOS AM or FM, SATCOM, Frequency Hopping (SINCGARS), and Frequency Hopping AM (Have Quick). The LNA push button switch allows the LNA to be enabled or disabled in SATCOM. The TX power push button switch provides the amplifier output power selection in SATCOM mode. Some equipment that is compatible with the TCR-MBA-75 NBT includes but is not limited to:

- LOS, multiband and SATCOM radios, including the AN/PRC-148 JEM and MBITR, the AN/PSC-5 series, AN/PRC-117F, AN/PRC-117G AN/PRC-152 Falcon III Handheld, and the AN/PRC-119 SINCGARS terminals.
- Directional and broadband antennas with 50 Ohm impedance
- Conditioned power from a 28 VDC nominal source.

1.4 FEATURES

The TCR-MBA-75 NBT has the following features:

- JITC DAMA Certified
- Coverage from 30 to 512 MHz, including SINCGARS FM and HAVEQUICK AM Frequency Hopping compatibility
- IW Compatibility
- Connections for both a SATCOM and an LOS antenna
- Pre-amplification of received RF signals from antennas in SATCOM mode
- Power amplification of transmit signals to 35, 50 or 75 Watts in SATCOM mode

- Transmit and receive band filtering to suppress interference from co-located radios and amplifiers in SATCOM mode
- Amplifier front panel indication of system status

1.5 TCR-MBA-75 NBT SYSTEM

The TCR-MBA-75 NBT is pictured in Figure 1-1.

1.5.1 Amplifier Components

The Amplifier consists of several printed circuit assemblies, a filtering and switching network, and RF connectors housed in an environmentally sealed aluminum housing. With normal care and maintenance, the assembly is highly resistant to corrosion from the elements. The RF connections to the RF input, SATCOM and LOS antennas are Female Type N. Power to operate the amplifier is applied via a cable connected to the 5 pin circular Mil DC input connector. A 3ft Power cable is supplied with each system.

1.5.2 Power Cable

A multi-conductor cable connects the amplifier with a 28 VDC power source. A wiring diagram for the cable is shown in Section 3 of this manual. The cable is identical to the power cable used for the AM-SAT-50 and AM-SAT-100 amplifiers.

1.5.2.3 Optional components

An optional Bias Tee I may be used to remotely power the TCR-MBA-75 NBT and allow it to be placed closer to the antenna to overcome system transmit and receive losses and improve receive signal strength utilizing the built in Satcom Low Noise Amplifier (LNA) in the TCR-MBA-75 NBT.

1.6 Specifications

The operating parameters, physical characteristics, and environmental specifications are shown in the following tables.

Table 1-1. TCR-MBA-75 Nominal Performance Specifications

TRANSMIT SECTION

SATCOM OPERATION

| | |
|-----------------|---|
| Frequency Range | 292-318 MHz |
| Input Power | 5 Watts typical (2-20 Watts) |
| Output Power | 35/50/75 Watts |
| Switching Speed | DAMA Certified/IW compatible |
| Modulation | FM or multiphase, 5 or 25 KHz bandwidth |

Filtering
Harmonics

Cosite suppression
-60 dBc

LOS OPERATION

Frequency Range 30-512 MHz
Band Selection Fully automatic
Input Power 5 Watts typical (2-20 Watts)
Output Power 50 Watts FM, 25 Watts CW AM
Modulation AM, FM or multiphase, 5 or 25 KHz bandwidth
Harmonics -60 dBc

FREQ HOP OPERATION

Frequency Range 30-88 MHz FM (SINCGARS)
225-400 AM (HAVEQUICK)
Band Selection Fully automatic
Input Power 5 Watts typical (2-20 Watts)
Output Power 50 Watts FM, 25 Watts CW AM
Harmonics -60 dBc

RECEIVE SECTION

SATCOM OPERATION

Frequency Range 242-268 MHz
Noise Figure 3.5 dB
Receive Gain 10 dB (or bypass LNA)
Filtering Cosite Suppression

LOS OPERATION

Frequency Range 30-512 MHz
Insertion Loss 1.5 dB

ADDITIONAL SPECIFICATIONS

Input/Output VSWR 2.0:1
RF Connections Type N female
Protection VSWR, temperature
Indicators DC PWR, LOS, SATCOM, F HOP, TX,
LNA, TX PWR Level, TEMP, Fault
DC Power 24-32 VDC
Operating Temperature -30 to +60 C
Bypass Operation Routes Radio signal to LOS port
Dimensions 3" H x 6" W x 12" L
Weight 12 lbs.
Controls Mode: SATCOM, LOS, FREQ HOP, AM
Transmit Power Level
LNA on/off

Environmental

DC on/off
IP-67

Table 1-2. TCR-MBA-75 Interconnect Characteristics

| Connection | Signal/Pin | Connector Function |
|------------------|-------------------|--|
| AMPLIFIER | | |
| DC IN | DC power input | MS3102E-14S-5P (mating connector for cable use is MS3106F-14S-5S) |
| | PIN A | +28 VDC Input |
| | PIN B | +28 VDC Input |
| | PIN C | Electrical GND |
| | PIN D | Electrical GND |
| | PIN E | +28 VDC Input |
| RADIO | RF from radio | Type N female |
| LOS | To LOS Antenna | Type N female |
| SAT | To SATCOM Antenna | Type N female |

2.0 OPERATION

2.1 General

This section provides information for operating the TCR-MBA-75.

WARNING

Electromagnetic radiation from the antenna can damage eyes and other body tissue when the system is transmitting. DO NOT stand directly in front of the antenna or in close proximity to the sides or back of the antenna when transmitting.

2.2 Controls, Indicators, and Connectors

The TCR-MBA-75 NBT has push Button switches to control:

- On/ Off (Bypass)
- Transmit power selection (35, 50 or 75 Watts – SATCOM only)
- Operational mode (SATCOM, LOS, LOS AM, FHOP, FHOP AM)
- DC Power (amplifier bypass to LOS power in off)

There are also several status indicators on the Amplifier's front panel as shown in Figures 2-1. The functions of these are specified in Tables 2-1 and 2-2.

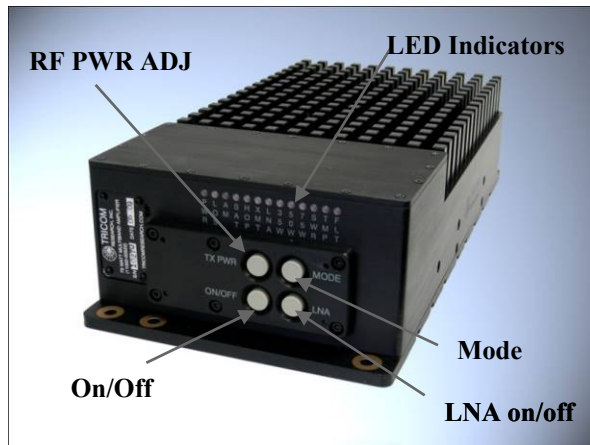


Figure 2-1. Amplifier Controls & Indicators

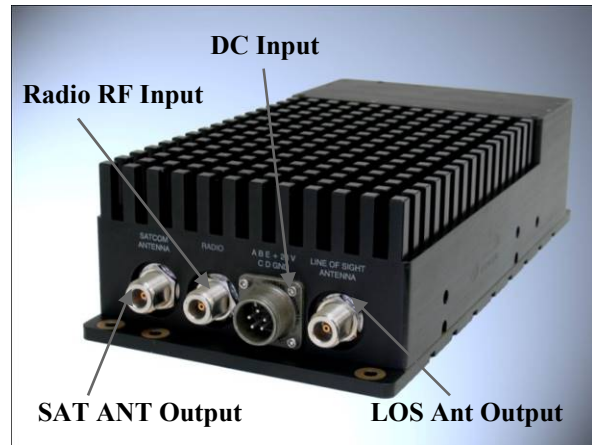


Figure 2-2. Amplifier Connections

| INDICATOR | TYPE | FUNCTION |
|-----------|------|--|
| PWR | LED | Indicates that DC power is supplied to the amplifier and the amplifier is powered on |
| LOS | LED | Indicates the Line of Sight connection has been enabled |
| AM | LED | Indicates the amplifier AM mode of operation has been enabled |
| SAT | LED | Indicates the SATCOM connection has been enabled |
| HOP | LED | Indicates the amplifier frequency hopping mode of operation has been enabled |
| XMT | LED | Indicates that the amplifier is in the transmit mode |
| LNA | LED | Indicates that the Low Noise Amplifier is on |
| 35W | LED | Indicates the amplifier is in 35Watt mode |
| 50W | LED | Indicates the amplifier is in 50Watt mode |
| 75W | LED | Indicates the amplifier is in 75Watt mode |
| TMP | LED | Indicates a high temperature condition exists |
| FLT | LED | Indicates a fault condition exists |
| | | |

| CONNECTION | TYPE | FUNCTION |
|---------------------------|------------------------|--|
| SATCOM ANTENNA | N Type RF connector | Used to attach SATCOM Antenna |
| RADIO | N Type RF Connector | Used to attach to Transceiver |
| Line Of Sight Antenna | N Type RF Connector | Used to attach Line of Sight Antenna |
| DC Power input connection | Circular Mil connector | Used to attach DC power input to amplifier |
| CONTROLS | TYPE | FUNCTION |
| TX Power | Push to select | Selects RF power output in SATCOM Mode |
| ON/OFF | Hold to turn on/off | Selects ON or Off (Bypass) mode of operation |
| MODE | Push to select | Selects the mode of operation |
| LNA | Push to select | Turns LNA ON and OFF |

Table 2-1. TCR-MBA-75 NBT Controls, Indicators, and Connectors

2.3 Operational Procedures

2.3.1 General Information

The TCR-MBA-75 NBT can be used for operation once it has been installed as described in Section 3.

2.3.2 Equipment Set-up

Refer to Paragraph 2.2 for the locations and functional description of the controls and indicators. Make sure that the TCR-MBA-75 NBT has been installed according to the instructions provided in Section 3.

2.3.3 Operating Procedures

2.3.3.1 Normal Operation

In Normal operation, the TCR-MBA-75 NBT provides transmit power amplification for radios operating in the 30-512 MHz VHF and UHF bands. It also provides for receive gain amplification in SATCOM Mode. The Mode switch provides selection for either the SATCOM, LOS (Line of Sight), Frequency Hopping and AM or FM modes (Refer to Table 2.1 Controls, Connectors and Indicators and Figure 2-3. flow chart for information). RF output to the SATCOM or LOS antenna ports is automatically selected and determined by the mode selected.

2.3.3.1.1 Switch Operation

Mode- When SATCOM is selected using the Mode Push Button Switch; RF is routed to the SATCOM RF port. This allows selectable RF output power using the TX PWR adjust push button switch. When in SATCOM mode the user can select to turn on the Low Noise Amplifier on to increase Receive gain sensitivity. The LNA option is enabled or disabled using the LNA Push Button Switch to provide an average 10dB receive gain for use in disadvantaged installations where either Omni-directional SATCOM antennas are used or when there are long runs of RF cable loss to overcome.

TX PWR- The transmit power switch selects the power level for SATCOM operation. The default transmit power for LOS operation is 50 Watts FM and 25 W CW AM and is not controlled by the transmit power switch.

LNA-The LNA push button switch selects whether the LNA is On or Off when in the SATCOM mode of operation. In LOS operation the LNA is automatically disabled.

ON/OFF- To power on or power off the TCR-MBA-75 NBT the ON/Off push button switch must be held down for approximately 2 seconds. The ON/OFF push button switch cycles the TCR-MBA-75 NBT from power On to power Off Bypass mode. In Power Off Bypass the RF is automatically routed to the LOS antenna port directly from the transceiver. The Amplifier returns to the previous operational mode when power is cycled.

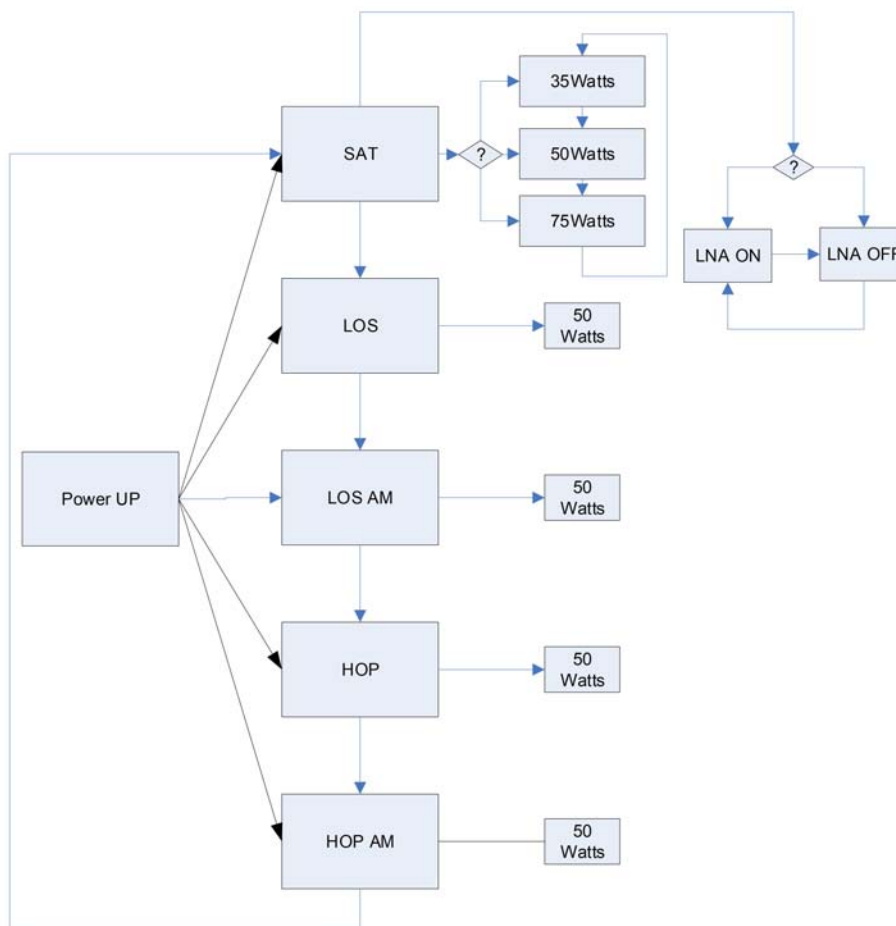


Figure 2-3. Mode, RF power and LNA flow Chart

2.3.3.2 MBITR Specific Operation

There may be an interoperability issue when operating the MBITR radio with amplifiers that have a receive Low Noise Amplifier (LNA). Using the LNA ON setting with the MBITR may cause intermittent Squelch break on the radio. To resolve this

possible issue simply turn the LNA operation off via front panel LNA Push Button Switch selection.

2.3.3.3 Remote Operation

The TCR-MBA-75 NBT can be powered remotely using the Bias Tee I, the same Bias Tee used with the AM-SAT-50 and AM-SAT 100 (See Figure 2-4). When DC power is supplied from a conditioned 24-28 Volt source to the Bias Tee (circular Mil connector), and the On/Off switch is in the On position, power will be routed to the TCR-MBA-75 NBT via the RF cable that is attached between the Bias Tee (To Amplifier) and Radio input connector on the amplifier (refer to figure 2-5).

To power on the TCR-MBA-75 NBT the ON/Off switch on the Bias Tee must be in the On position and then the user must also press the ON/OFF button on the TCR-MBA-75 NBT for approximately 2 seconds.

The Amplifier will power down if the RF cable (to the amplifier) is removed or if the power at the Bias Tee input is interrupted. The unit will not automatically power on when the RF cable (to the amplifier) or the DC at the Bias tee power is restored without also pressing the ON/OFF button at the amplifier.



Figure 2-4. Bias Tee I for remote operation

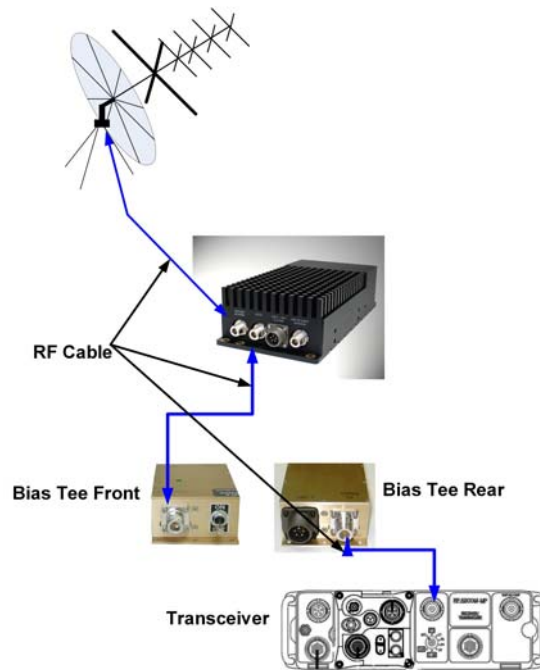


Figure 2-5. Remote Operation Setup

2.3.3.4 Out of Band Operation

Operating outside of the UHF SATCOM frequency bands with the SATCOM mode selected will cause an alarm to occur. Returning to the receive mode will clear the transmit frequency fault alarm.

Operating on SATCOM frequencies while in the LOS mode with an antenna connected to the LOS port will not cause an alarm and it will operate properly, however, the amplifier will not comply with the timing requirements for DAMA operation.

2.3.3.5 Bypass Operation

When DC power is removed or when the AMP Bypass position is selected the radio port is directly connected to the LOS antenna port.

2.3.3.6 Troubleshooting

If the communications system seems to be operating improperly, check to make sure that the equipment is configured in accordance with Section 2 Operation and section 3 Installation. If the problem persists follow the instructions below.

2.3.3.7 Collocation

Collocation with other transmitters or ECM/ECCM equipment. The TCR-MBA-75 attempts to prevent high levels of RF energy present in dense antenna or jamming environments from inadvertently keying the amplifier. If this condition exists there may be intermittent keying or chattering of the equipment and its TX indicator. Increased isolation from the offending RF power source will help to reduce the condition, if present.

Table 2-2. TCR-MBA-75 NBT System Troubleshooting Guide

| SYMPTOM | PROBABLE CAUSE | SUGGESTED FIX |
|-------------------------------------|---|---|
| XMT light flashes when transmitting | Incorrect operating frequency for selected mode | Change mode or frequency for proper operation |
| TMP Led Lite | Excessive heat build-up | Decrease duty cycle or provide increased ventilation |
| Low output power | Low input voltage or drive level | Check DC voltage while transmitting and radio output power setting |
| FLT LED Lit | Internal Processor error | Cycle power to clear. If persists return to manufacture for diagnosis |

3.0 INSTALLATION

3.1 General Information

This section contains information necessary for preparing the TCR-MBA-75 NBT for use.

3.2 Preparation for Use

After unpacking the system and inspecting for physical damage, select an appropriate location for the Amplifier. Although the Amplifier is weather-resistant, placing it in a location where it is protected from direct salt spray, rain, and sunlight will increase its service life. Make sure that adequate air flow is available to keep the heat sink of the amplifier cool.

3.3 Cable Interconnections

Attach the DC power source to the DC IN connector located on the rear of the amplifier (See Fig 3-1 and Table 3-1 for connector pinout and location). Attach an RF cable to the input from the transceiver to the Radio input Connector. Attach RF cables/antennas to either one or both of the antenna connections located on the rear of the amplifier. Select the operating

mode with the push button Mode switch. RF output is routed to the appropriate Antenna connection determined by the mode selected.

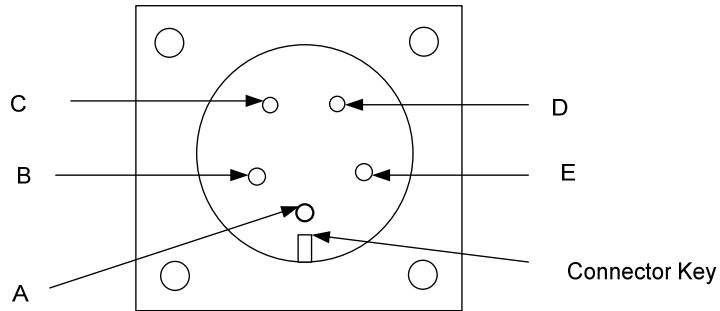


Figure 3-1 Amplifier DC input connector

| Pin # | Connection |
|-------|--------------------------|
| Pin A | +28V DC (positive) |
| Pin B | +28V DC (positive) |
| Pin C | Ground (negative return) |
| Pin D | Ground (negative return) |
| Pin E | +28V DC (positive) |

Table 3-1. DC

Connector Pin Out

Input Power

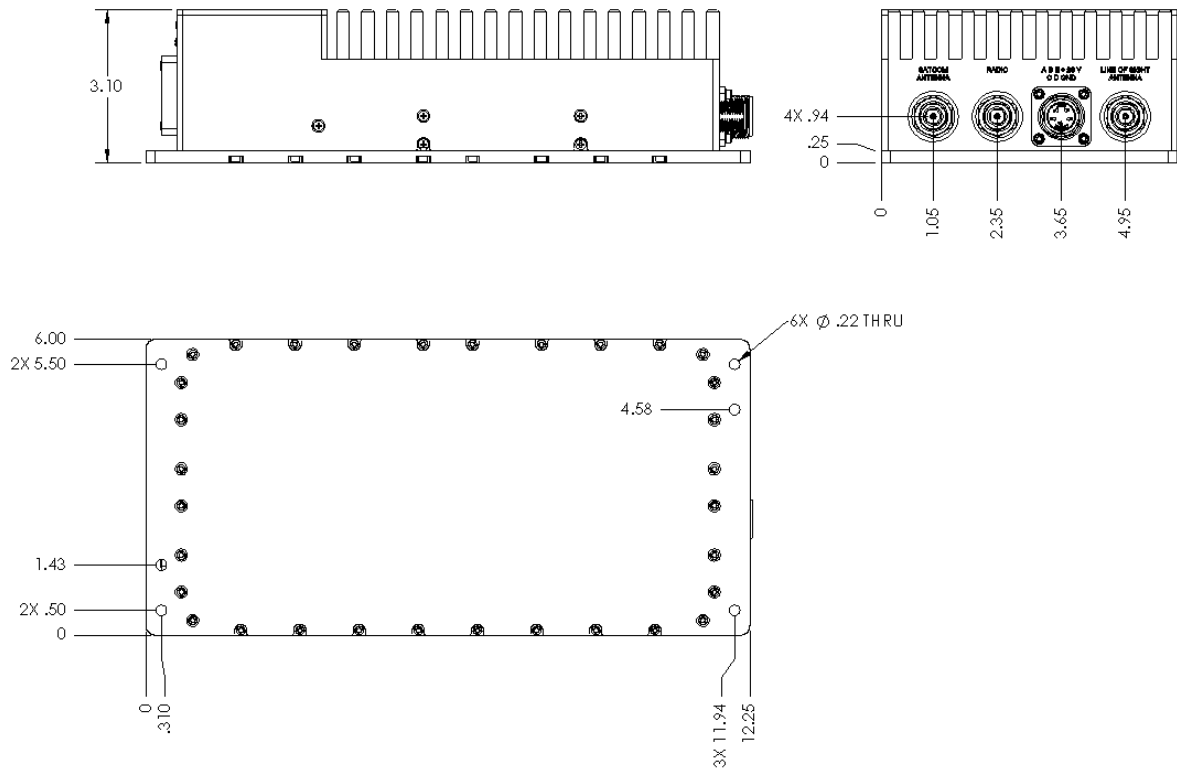


Figure 3-2 Amplifier Mounting Dimensions