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**TRICOM RESEARCH, INC.**

**OPERATOR'S MANUAL**

**TCR-MBA-75**

**REMOTE MULT-IBAND AMPLIFIER**



**DOCUMENT # 90400-01050**

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

# TCR-MBA-75 OPERATOR'S MANUAL

## 1.0 INTRODUCTION

### 1.1 GENERAL INFORMATION

This manual provides operating instructions for the DAMA certified TCR-MBA-75 Remote Amplifier Multiband Platform shown in Figure 1-1. The TCR-MBA-75 is designed as a form and fit replacement for the AM-SAT-50 UHF SATCOM Amplifier with enhanced functionality. The footprint and mounting provisions for the AM-SAT-50 and TCR-MBA-75 are identical. The Bias Tee and Bias Tee II have identical footprints and mounting, but the Bias Tee II has a slightly higher profile to house the added remote control circuitry required for the TCR-MBA-75. The TCR-MBA-75 is an amplifier/pre-amplifier designed to provide transmit and receive gain for:

- Multiband line of sight (LOS) 30~512 MHz communications;
- SINCGARS frequency hopping 30~88 MHz operation; and,
- UHF Tactical SATCOM (242~268 MHz receive and 292~318 MHz transmit) frequencies with cosite suppression.

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



Figure 1-1. TCR-MBA-75 System Components

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## 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
KHz	Kilohertz
LED	Light emitting diode
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

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## 1.3 EQUIPMENT DESCRIPTION

The TCR-MBA-75 Remote Amplifier Multiband Platform provides transmit and receive amplification for the 30 MHz to 512 MHz Line-of Sight (LOS), 30 MHz to 88 MHz SINCGARS Frequency Hopping, and the UHF Tactical SATCOM bands. It is suitable for man-pack, vehicular, airborne, or fixed-station applications and is compatible with most military and commercial radios. The Amplifier is weather-resistant and may be located outdoors with the antenna. The Bias Tee II is splashproof and is normally located with the radio but may be placed anywhere between the radio and amplifier. The Bias Tee II controls the operation of the amplifier via front panel switches and may be connected to a PC serial port for remote control with the TCR-MBA-75 windows application. The amplifier has a single connection to the Bias Tee II and two frequency specific antenna ports. The LOS port is for frequency hopping and multiband operation anywhere between 30 and 512 MHz. The SATCOM port is used with UHF SATCOM antennas. The Bias Tee II connection to the amplifier carries the control signals for the amplifier as well as the RF communications signal. The Bias Tee II provides for selection of LOS, SATCOM, Frequency Hopping or Amplifier Bypass Modes, allows the LNA to be enabled or disabled and also provides the amplifier output power selection. Some equipment that is compatible with the TCR-MBA-75 includes:

- Directional and broadband antennas with a 50 Ohm impedance
- LOS, multiband and SATCOM radios, including the MBITR, the AN/PSC-5, the AN/PRC-117, and the SINCGARS terminals.
- Conditioned power from a 28 VDC source.

## 1.4 FEATURES

The TCR-MBA-75 has the following features:

- JITC DAMA Compatible
- Coverage from 30 to 512 MHz, including SINCGARS Frequency Hopping compatibility
- Connections for both a SATCOM and an LOS antenna
- Bias Tee II and PC remote control of amplifier functions
- Pre-amplification of received RF signals from antennas
- Power amplification of transmit signals to 35, 50 or 75 Watts

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

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## 1.5 TCR-MBA-75 SYSTEM

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

### 1.5.1 Amplifier

The Amplifier consists of several printed circuit assemblies, a filtering and switching network, and RF connectors housed in a water resistant aluminum housing. With normal care and maintenance, the assembly is highly resistant to corrosion from the elements. The RF connections to the Bias Tee II and to the SATCOM and LOS antennas are Female Type N. Power to operate the amplifier is sent over the RF cable connected to the BIAS Tee II. There is no provision to power the amplifier on the amplifier housing and operation without a Bias Tee II is not possible. The amplifier will not interoperate with the bias tee used with the AM-SAT-50.

### 1.5.2 Bias Tee II

The Bias Tee II consists of several printed circuit assemblies and associated connectors and switches housed in a water resistant aluminum housing. With normal care and maintenance, the assembly is highly resistant to corrosion from the elements. The Bias Tee II has three switches controlling: 1) Transmit power level, 2) LNA active, LNA bypass and system bypass, and 3) SATCOM, LOS and Frequency Hopping operation. Type N connections are provided for the radio and amplifier signals. A female 9 pin D-subminiature connection is provided for optional remote control operation from the serial port of a PC. The Bias Tee II will auto detect the connection to a PC serial port and configure itself for remote control operation.

### 1.5.3 Power Cable

A multi-conductor cable connects the Bias Tee II 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.



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## 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 (2-18 Watts)
Output Power	35/50/75 Watts
Switching Speed	DAMA Certified
Modulation	FM or multiphase, 5 or 25 KHz bandwidth
Filtering	Cosite suppression
Harmonics	-60 dBc

#### **LOS OPERATION**

Frequency Range	30-512 MHz
Band Selection	Fully automatic
Input Power	5 Watts typical (2-18 Watts)
Output Power	50 Watts
Modulation	AM, FM or multiphase, 5 or 25 KHz bandwidth
Harmonics	-60 dBc

#### **FREQ HOP OPERATION**

Frequency Range	30~88 MHz
Band Selection	Fully automatic
Input Power	5 Watts typical (2-18 Watts)
Output Power	50 Watts
Modulation	SINCGARS FM
Harmonics	-60 dBc

#### **General**

Transmit Duty Cycle	100 % with sufficient natural convection
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### RECEIVE SECTION

#### **SATCOM OPERATION**

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

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### 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 ON, LOS, SATCOM, XMT, COMM FAULT, HI VSWR, HI TEMP
DC Power	28 VDC, 12 A XMT, 500 mA RCV
Operating Temperature	-20 to +60 C
Bypass Operation	Routes Radio signal to LOS port
Environmental	IP-67
Dimensions	6 x 3 x 12 inches
Weight	Same as AM-SAT-50 10 lbs

### BIAS TEE II SPECIFICATIONS

Input/Output VSWR	2.0:1
RF Connections	Type N female
Protection	Short circuit
Indicators	RS-232 FAULT, COMM FAULT, HI VSWR, HI TEMP, DC ON, XMT
Controls	Power: 35/50/75 Watts Bypass: LNA on, LNA bypass, amplifier bypass Mode: SATCOM, LOS, Freq Hopping
Operating Temperature	-20 to +60 C
Remote Operation	RS-232 serial PC communications
Environmental	IP-67
Dimensions	3 x 5 x 2 inches 1/2 inch taller than standard Bias Tee
Weight	1 lbs

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

Connection	Signal/Pin	Connector Function
<b>AMPLIFIER</b>		
BIAS TEE	RF and control to Bias Tee II	Type N female
SATCOM	RF to SATCOM antenna	Type N female
LOS	RF to LOS antenna	Type N female
	Bias Tee II	
DC IN	DC power input	MS3102E-14S-5P on BIAS TEE II (mating connector for cable use is MS3106F-14S-5S)
	PIN A	+28 VDC Input
	PIN B	+28 VDC Input
	PIN C	GND
	PIN D	GND
	PIN E	+28 VDC Input
RADIO	RF to radio	Type N female
AMPLIFIER	RF to amplifier	Type N female
COMM PORT	Remote control from PC serial port	D sub 9 position female
	1	N/C
	2	TXD
	3	RXD
	4	N/C
	5	GND
	6	N/C
	7	CTS
	8	RTS
	9	N/C

# TCR-MBA-75 OPERATOR'S MANUAL

## 2.0 OPERATION

### 2.1 General Information

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's BIAS TEE II has toggle switches to control:

- Transmit power selection (35, 50 or 75 Watts)
- Operational mode (LNA on, LNA bypass, or remote control)
- Frequency band (SATCOM, LOS or Amplifier bypass)

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



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

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

CONTROL, INDICATOR, CONNECTOR	TYPE	FUNCTION
DC On	LED	Indicates that DC power is supplied to the amplifier
LOS	LED	Indicates the Line of Sight connection has been enabled
SATCOM	LED	Indicates the SATCOM connection has been enabled
XMT	LED	Indicates that the amplifier is in the transmit mode
COMM Fault	LED	Indicates a communications fault between the amplifier and Bias Tee II
HI VSWR	LED	Indicates that the amplifier has sensed a high VSWR condition
HI Temp	LED	Indicates that the amplifier has sensed a high temperature condition
SAT ANT	TYPE N	Connect to SATCOM antenna
BIAS TEE	TYPE N	Connect to the BIAS TEE II
LOS ANT	TYPE N	Connect to Line of sight antenna



Figure 2-2. BIAS TEE II Controls, Indicators, and Connectors

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Table 2-2. BIAS TEE II Controls, Indicators, and Connectors

CONTROL, INDICATOR, CONNECTOR	TYPE	FUNCTION
RS-232 Fault	LED	Indicates a problem with the RS-232 interface when illuminated
Comm Fault	LED	Indicates a communications fault between the amplifier and Bias Tee II
Hi VSWR	LED	Indicates a high VSWR condition on the selected antenna port
Hi Temp	LED	Indicates a high temperature condition
DC On	LED	Indicates DC power to the Bias Tee II
XMT	LED	Indicates that the amplifier is in the transmit mode
To Radio	TYPE N	Connect to SATCOM/LOS/Multiband radio
To Amplifier	TYPE N	Connect to the TCR-MBA-75 Amplifier
DC Power	MS3102E-14S-5P	Connect to 28 VDC power source
Comm Port	9 pos d-sub female	Connect to PC serial port (optional)
TX Power	3 position toggle	35, 50, 75 W SATCOM (50 W LOS only)
Mode	3 position toggle	LNA On, LNA Bypass, AMP Bypass
Antenna	3 position toggle	SATCOM, LOS, Frequency Hopping

### 2.3 Operational Procedures

#### 2.3.1 General Information

The TCR-MBA-75 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 has been installed according to the instructions provided in Section 3.

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### 2.3.3 Operating Procedures

#### 2.3.3.1 Normal Operation

In operation, the TCR-MBA-75 provides receive gain and transmit power amplification for radios operating in the UHF SATCOM band when the SATCOM connector is selected using the SAT/LOS/BYPASS switch and the LNA option is selected with the Mode switch. It provides a low loss RF path with no gain and transmit power amplification for radios operating anywhere in the 30-512 MHz band when the LOS connector is selected using the SAT/LOS/BYPASS switch.

Operating outside of the UHF SATCOM frequency bands with the SATCOM mode selected will cause an alarm to occur. The equipment will not transmit correctly until the amplifier power switch has been cycled off.

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.

The transmit power switch selects the power level for SATCOM operation. The default transmit power for LOS operation is 50 Watts and is not controlled by the transmit power switch.

The Mode switch selects the LNA On or Off condition for SATCOM operation. In LOS operation the LNA is automatically disabled.

The antenna select switch provides selection for either the SATCOM or LOS antenna connector. When the AMP BYPASS is selected the amplifier is powered off and the BIAS TEE port is internally routed to the LOS port on the amplifier. If DC power is removed from the Bias Tee II the BIAS TEE port is internally routed to the LOS port on the amplifier.

#### 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 prevent the radio from operating properly

#### 2.3.3.3 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.

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### 2.3.3.4 Improper Operation

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

Table 2-2. TCR-MBA-75 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
High Temp Light	Excessive heat build-up	Decrease duty cycle or provide increased ventilation
COMM fault	Bad connection from Bias-Tee to Amplifier	Check cables, cycle DC power
Hi VSWR	Antenna problem or bad cable	Check antenna spec and cable
Low output power	Low input voltage or drive level	Check DC voltage while transmitting and radio output power setting



## **3.0 INSTALLATION**

### **3.1 General Information**

This section contains information necessary for preparing the TCR-MBA-75 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. Attach one or two antennas to the antenna ports. Select the antenna and operating mode with the selector switches.

### **3.4 Software Installation**

Remote control of the TCR-MBA-75 amplifier can be accomplished using a PC serial port with the TCR-MBA-75 GUI installed. Run the setup file and follow the on-screen prompts. When the Bias Tee is connected to an active serial port and the remote control software will override the switches on the front panel of the Bias Tee.