MOTOROLA

MTR3000

BASE STATION/REPEATER

MOTOTRBO™ MTR3000
Base Station/Repeater
Product Planner and Ordering Guide

September 2010

PURPOSE AND SCOPE

This document defines the site considerations and ordering instructions for the MTR3000 Base Station/Repeater and the MTR2000 MOTOTRBO Upgrade. This document will be available on both the ECAT and MOL price pages.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

4FSK	Constant Envelope 4-level Frequency Shift Key
A	Amp
AC	Alternating Current
ARM	Advanced RISC (Reduced Instruction Set Computer) Machines
AUX	Auxiliary
AWG	American Wire Gage
BER	Bit Error Rate
BSI	Base Station Identifier
BTU	British Thermal Unit
BW	Bandwidth
CPU	Central Processing Unit
CPS	Customer Programming Software
CQS	Carrier Squelch
dB	Decibel
dBm	Decibels relative to one milliWatt
DC	Direct Current
DNS	Domain Name System
DPL	Digital Private Line
DSP	Digital Signal Processor
ECAT	Electronic Catalog
EEPROM	Electrically Erasable Programmable Read-only Memory
E & M	Ear and Mouth
ETS	European Telecommunication Standard
FM	Frequency Modulation
FRU	Field Replacement Unit
GPIO	General Purpose Input/Output
HVAC	Heating, Ventilation, and Air Conditioning
IEC	International Electrotechnical Commission
IMA	Intermodulation Attenuation
IP	Internet Protocol
ISPO	Infrastructure Support Products Organization
kHz	Kilohertz
LAN	Local Area Network
LED	Light Emitting Diode
LPF	Low Pass Filter
LTR	Logic Trunked Radio
MB	Megabyte
MHz	Megahertz
MOL	Motorola On Line
MSB	Most Significant Bit
MSU	Mobile Subscriber Unit
mV	Millivolt
Ni-Cd	Nickel Cadmium
NVM	Non-volatile Memory
OAB	Off-Channel Acceptance Bandwidth
OCXO	Oven Controlled Crystal Oscillator

OMAP	Open Multimedia Application Platform
PA	Power Amplifier
PIM	Passive Intermodulation
PL	Private Line
ppb	Parts Per Billion
ppm	Parts Per Million
PTT	Push to Talk
RDAC	Repeater Diagnostics and Control
RF	Radio Frequency
RFDS	Radio Frequency Distribution System
RMS	Root Mean Squared
RoHS	Reduction of Hazardous Substances
RU	Rack Unit
RX	Receive
SCM	Station Control Module
SPI	Serial Peripheral Interface
TCXO	Temperature Compensated Crystal Oscillator
TDMA	Time Division Multiple Access
TIA	Telecommunications Industry Association
TRC	Tone Remote Control
TX	Transmit
USB	Universal Serial Bus
V	Volt
VAC	Volts Alternating Current
VCO	Voltage Controlled Oscillator
VDC	Volts Direct Current
VSWR	Voltage Standing Wave Ratio
W	Watts
XCVR	Transceiver

Welcome to the MTR3000 MOTOTRBO™!

MTR3000 INTRODUCTION

MTR3000 combines the reliability and quality of MTR2000 with the future of communications ~ MOTOTRBO 2-slot TDMA!

MTR3000 is a MOTOTRBO integrated voice and data base station/repeater designed to meet the requirements of small public safety, utilities and professional organizations. The MTR3000 operates in digital mode supporting MOTOTRBO Conventional, IP Site Connect, Connect Plus (UHF Only), and Capacity Plus systems delivering increased capacity, spectral efficiency, integrated data applications and enhanced voice communications.

In addition the MTR3000 can also operate in analog mode for conventional systems providing a flexible high power base station/repeater.

MTR3000 Standard Features

- Operates in analog or MOTOTRBO digital mode with a LED indicating mode of operation
- Migration path from analog to digital mode
- 12.5 or 25 kHz programmable channel spacing
- 6.25e compliant
- Reliable 100W Continuous Duty Cycle Operation
- Operation down to 8W with 100W Stations
- Analog and digital conventional are all standard in one base station without the cost of additional software or hardware
- RoHS (Restriction of Hazardous Substances) compliant
- Switching power supply functions over a wide range of voltages and frequencies

MTR3000 Programmed in MOTOTRBO Mode

- Supports two simultaneous voice paths in digital 12.5 kHz TDMA (6.25e compliant)
- Divides existing channel into two timeslots delivering twice the capacity through a single repeater
- Supports MOTOTRBO IP Site Connect for increased wide area coverage
- Supports MOTOTRBO Capacity Plus single site Trunking without a separate hardware controller
- Support MOTOTRBO Connect Plus multi site trunking (UHF Only) with a separate hardware controller
- Supports MOTOTRBO Dynamic Mix Mode to facilitate the analog to digital migration in conventional repeater applications
- Supports MOTOTRBO Transmit Interrupt for greater subscriber unit control and flexibility

MTR3000 Serviceability

- Repeater diagnostic and control software provides remote or local site monitoring
- Easy to replace components with functionally separate Field Replaceable Units (FRU)
- Software based design simplifies feature upgrades
- Easy access to station ports (no need to remove the front panel) shortening installation and maintenance time
- For ease of installation, minimal station alignment is needed.
- **NEW! Backed by Motorola's 2-year standard warranty**

Total Cost of Ownership

- Analog Conventional, Digital Conventional are standard in one base station without the cost of additional software
- Twice the spectral efficiency; One frequency pair provides 2 logical voice paths
- Effectively twice the power efficiency as compared to 2 analog stations when operating in Digital mode
- Integrated Components optimizes expensive site space:
    - One physical station provides the capacity of two in Digital Mode

Station Mechanics

- Compact design
- MTR3000 dimensions, 3 Rack Units (5.25″ or 13.3 cm), optimizes expensive site space efficiently
- Lightweight (40 lbs. /19 kg.)
- Standard EIA 19″ rack mount configuration

MTR3000 Overview

The Motorola MTR3000 Base Station/Repeater provides a modular, flexible analog and digital station design for today's communication systems and for the future. The station is available for use in Analog Conventional, Digital Conventional (MOTOTRBO), MOTOTRBO Capacity Plus Trunking and Connect Plus (UHF Only) multi site trunking configurations.

When configured for analog operation, MTR3000 can either be configured as a base station or as a repeater. As a repeater, it listens on one uplink frequency, and then re-transmits on a downlink frequency, thus providing the RF interface to the field subscribers. When configured as a base station, MTR3000 is designed to operate with most existing analog systems.

When configured for digital operation, the base station/repeater offers additional services. The digital base station/repeater operates in TDMA mode, which essentially divides one channel into two virtual channels using time slots; therefore the user capacity is doubled. The base station/repeater utilizes embedded signaling to inform the field radios of the busy/idle status of each channel (time slot), the type of traffic, and even the source and destination information.

Note: When configured in Digital Mode, MTR3000 can only be used as a repeater.
At any given time, MTR3000 either operates as a digital repeater or as an analog repeater.

The MTR3000 base station/repeater is divided into functional modules that separate the frequency band specific and transmitter power specific circuits from other circuits and has separate modules for the control interface. These modules are self contained functional blocks with module-specific alarms. This design facilitates the field replaceable unit (FRU) concept of field repair to maximize system uptime. The description of the FRUs is as follows:

- The **Receiver FRU** is a dual heterodyne receiver which receives the RF signal from the subscriber's transmitter. It then converts the resulting final intermediate frequency (IF) from an analog signal to that of a digital word. Finally, the receiver delivers the digital word, via the data bus, to the SCM for demodulation. Additionally, the receiver also provides its own metering and diagnostics via software, as well as a self-contained calibration (no field tuning needed).
- The **Exciter FRU** converts a two-port base band data signal, sent over the data bus from the SCM, to an analog signal representation. The analog signal then modulates a low power RF transmitter carrier that is generated by the exciter. The low power modulated RF carrier is then amplified and delivered to the PA for further amplification. The Exciter and PA constitute the transmitter of the MTR3000. Additionally, the exciter also provides its own metering and diagnostics via software, as well as a self-contained calibration (no field tuning needed).
- The heart of the **SCM FRU** is that of two Texas Instruments OMAP series processors, with each OMAP containing an ARM Host and a C55 DSP processor. One of the two OMAP processors is dedicated to the receiver DSP operations, while the other OMAP provides for all other functionality, which includes the transmitter functions. In general the SCM provides for the entire coordination of the base station/repeater functions, but more specifically, the SCM provides for the following functionality:

    - Contains and runs the preloaded base station/repeater software.
    - Manages inbound and outbound RF and Audio traffic.
    - Provides external speaker and microphone ports (analog only)
    - Provides an on-board USB port for local configuring, alignment and diagnostics via the following applications:

        - Customer Programming Software (CPS),
        - Tuner application
        - Repeater Diagnostic and Control (RDAC) software.

    - Provides an Ethernet port for IP site connectivity and remote RDAC.
    - Provides GPIO connectivity for 3rd party controller interfaces.
    - Provides analog base station audio connectivity.
    - Data and Control to the receiver
    - Data and Control to the exciter
    - Control of the PA's set power

- Generates the internal station frequency reference.
- Provides control of the front panel status indicators.

- The **PA FRU** amplifies the low level modulated RF signal from the exciter module. It then delivers the amplified signal to the transmitter antenna port at the rated power of the base station/repeater, or less if the customer desires, for transmission to the subscriber's receiver. In addition to its primary task of amplification, the PA provides the following hardware functions for the base station/repeater's:

  - Harmonic attenuation
  - Intermodulation attenuation (IMA) suppression
  - VSWR detection
  - RF power control (primary means).
  - Self contained cooling fan and control circuit
  - Diagnostics
  - Power rollback for temperature, VSWR, and voltage
  - Self-Contained calibration (No field alignment for MTR3000 PAs only)

- The **PS FRU** provides DC power to the receiver, exciter, SCM, PA, and select third party controllers via one or more of the three DC output taps; 28.6VDC, 14.2VDC, and 5.1VDC. It can also provide auxiliary power to a number of third party controllers. Additionally, it can operate in three different input modes:

  - AC Input Only
  - DC Input Only
  - AC with Battery Revert

  In addition to providing power to the noted FRU's and controllers, the PS also provides for the following:

  - AC Failure detect signaling to the SCM
  - Output over-current protection for all three outputs
  - Self contained cooling fan and control circuit
  - Thermal shut down if the environmental temperatures exceed the cooling capacity afforded by the fan.
  - Further details can be found in the individual "Theory of Operation" sections of the respective FRUs.

- The **Wireline FRU** provides the connection to an analog audio source/sink (such as a console) to the MTR3000 Base Station/Repeater. Specifically, the Wireline board provides for the following:

  Tone Remote Control
  DC Remote Control
  4-wire balanced audio connection
  2-wire balanced audio connection

MTR3000 Base Station/Repeater Views

Figure 1. MTR3000 Base Station/Repeater Front View

Figure 2. MTR3000 Base Station/Repeater Front View (Without Cover)

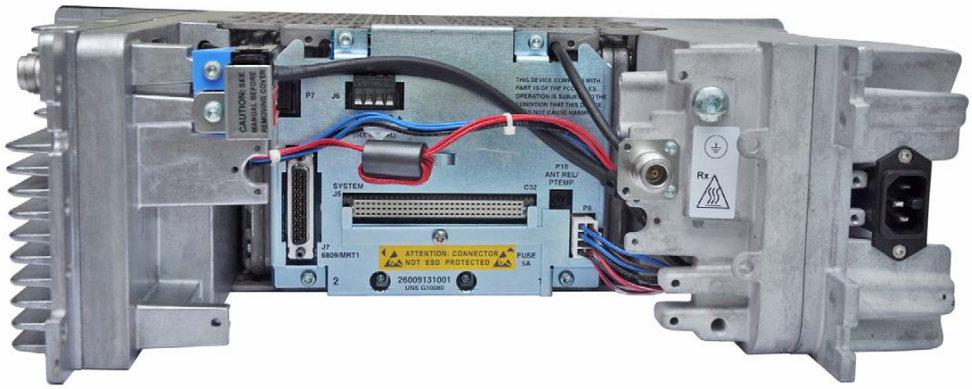


Figure 3. MTR3000 Base Station/Repeater Rear View

MTR2000 MOTOTRBO UPGRADE *(Non-RTTE countries only)*

Overview

The FRU architecture of the MTR30000 Base Station/Repeater allows the ability to upgrade an existing MTR2000. An upgrade requires that the MTR3000 station core module (exciter, receiver and station control module) be used to replace the MTR2000 exciter, receiver and control module. The upgrade allows a customer to move from an analog platform to a digital platform and increase their call capacity with the MOTOTRBO technology.

Table 1. Migration Path Considerations

If Your Station is:	You Can Migrate to:	Hardware/Software Needed:
MTR2000 Analog Conventional	MOTOTRBO Digital Conventional	MTR2000 MOTOTRBO Upgrade Kit (T2003)
MTR2000 Analog Conventional	MOTOTRBO IP SITE Connect	MTR2000 MOTOTRBO Upgrade Kit (T2003) & Software Programming
MTR2000 Analog Conventional	MOTOTRBO Capacity Plus	MTR2000 MOTOTRBO Upgrade Kit (T2003) & Capacity Plus Software Upgrade (HKVN4045A)
MTR3000 or Upgraded MTR2000 MOTOTRBO Digital Conventional	MOTOTRBO IP SITE Connect	Software Programming
MTR3000 or Upgraded MTR2000 MOTOTRBO Digital Conventional	MOTOTRBO Capacity Plus	Capacity Plus Software Upgrade (HKVN4045A)
MTR2000 Privacy Plus/SmartNet Trunking	MOTOTRBO Capacity Plus	MTR2000 MOTOTRBO Upgrade Kit (T2003) & Capacity Plus Software Upgrade (HKVN4045A)
MTR2000 Passport Trunking	MOTOTRBO Connect Plus	MTR2000 MOTOTRBO Upgrade Kit (T2003) & Connect Plus Software Upgrade

MTR2000 MOTOTRBO Upgrade Specs

When the MTR2000 is upgraded to an MTR3000, the specifications of the new components (exciter, receiver and station control module) are the specs of the MTR3000 modules. (See component specification tables.)

NOTE: The transmitter dynamic RF output power range will remain the same as it was prior to the upgrade.

MTR2000 MOTOTRBO Upgrade Installation

Upgrading an MTR2000 is a simple procedure. Depending on the proficiency of the technician the hardware upgrade takes approx 15 minutes to complete per Base Station/Repeater. Additional time will be required to program the station with the Customer Programming Software (CPS) to the customer specific configuration. Before beginning the upgrade, document the current code plug settings of the MTR2000, as they will need to be manually entered into the MTR3000 CPS.

Note: The codeplug file format of the MTR2000 is not compatible with the codeplug file format of the MTR3000, so manual entry of the codeplug configurations will be required.

Compatibility

The following charts identify the system types, stations, and controllers that are compatible with the MTR3000. Table 5 and Table 6 outline a direct feature comparison between the MTR3000 and the MTR2000. It is imperative that the differences between the two stations are understood when an MTR3000 is to be purchased for use in an analog system, as not all analog features that were offered with the MTR2000 are available with the MTR3000. Furthermore, the base station audio and control interface on the backplane has changed between the MTR3000 and MTR2000 stations. These interface differences are noted in the "Adding MTR3000 and/or Upgraded MTR2000 stations to MTR2000 sites" section of this manual.

Additionally, the MTR3000 platform offers a MTR2000 MOTOTRBO UPGRADE for existing high-power UHF MTR2000 stations. When a MTR2000 station has employed the MOTOTRBO Upgrade Digital Kit, the upgraded MTR2000 station will provide all digital functionality that a factory new MTR3000 provides. Analog features offered in an upgraded MTR2000 station are identical to that of a factory new MTR3000, however, there are subtle differences in the analog connectivity at the J7 backplane connection between an upgraded MTR2000 station and that of a factory new MTR30000 station. These differences are noted in the "Adding MTR3000 and/or Upgraded MTR2000 stations to MTR2000 sites" section of this manual.

Note: Since analog features will be lost with respect to the non-upgraded MTR2000, it is not recommended to purchase a "MOTOTRBO Digital Upgrade Kit" for the MTR2000 if one expects to operate the upgraded MTR2000 in analog mode. Upgrading the station and operating in analog mode may be a temporary configuration while migrating the subscribers. See Table 7 for specific configurations that are upgradeable.

The MOTOTRBO Upgrade Kit consists of the following individual items:

- MTR3000 Exciter FRU
- MTR3000 Receiver FRU
- MTR3000 Station Control Module FRU
- MTR3000 Front Bezel

- Preloaded MOTOTRBO SW
- TORX screws – T20 bit size required. (Used to assemble the three FRUs to one another)
- MTR3000 FCC upgrade label (Use to cover the MTR2000 FCC label located on the backplane)

Figure 4. MTR2000 MOTOTRBO Upgrade Kit Contents

Table 2. MTR3000 System Compatibility

MTR3000 System Type Compatibility	
Analog Conventional	
Base Station-Half Duplex	Yes
Base Station- Simplex	Future Release
Repeater	Yes
Voting	Future Release
Rx only	No
Simulcast	No
Digital Conventional	
MOTOTRBO IP Site Connect	Yes
MOTOTRBO Single Site	Yes
ASTRO (P25)	No
Analog Trunking	
Privacy Plus/SmartNet	No
Digital Trunking	
MOTOTRBO Capacity Plus	Yes
MOTOTRBO Connect Plus (UHF Only)	Yes
ASTRO (P25)	No

Table 3. MTR3000 Station Compatibility

MTR3000 Station Compatibility	
DR3000	Yes
MTR2000	Yes (See Table 4)
Quantar	Yes (Limited analog)
GTR 8000	No
STR 3000	No

Table 4. MTR3000 Site Equipment Compatibility

Existing MTR2000 Site Equipment	
Trident NTS Controller	Yes
Trident Marauder	Yes
Trident Raider	Yes (limited Analog)
6809 / MDC3600 Controller	No
Zetron Repeater Panel (Model 38)	Yes
Zetron Phone Patch (Model 30)	Yes
Tone Remote Adapter (L3276)	Yes
Duplexer (X182)	Yes
Preselector (X265)	Yes
Antenna Relay (X371)	Yes
Dual Circulator (X676)	Yes
External Freq. Reference (T5829)	Yes
Argus 28Volt Battery Charger (L1884A)	Yes
Argus 14Volt Battery Charger (L1883A)	Yes (MTR2000 MOTOTRBO Low Power Upgrades)
Battery Charging Cable (1-Z691)	Yes
Battery Charging Cable (1-Z692)	Yes

MTR2000 vs. MTR3000 COMPARISON

The following charts reflect the features and functionality differences between the MTR2000 and the MTR3000. Refer to MOL and ECAT for station features as they become available.

Table 5. MTR2000 vs. MTR3000 Comparison

Capability	MTR2000	MTR3000
Air Interface/Conventional		
Analog Conventional	Yes	Yes
MOTOTRBO (2-SLOT TDMA)	No	Yes
Station Operation		
Base Station/Repeater Analog	Yes	Yes
Base Station/Repeater MOTOTRBO	No	No
Repeater Analog	Yes	Yes
Repeater MOTOTRBO	No	Yes
Simplex	Yes	Future Release
Half Duplex	Yes	Yes
Full Duplex	Yes	Yes
Air Interface/Trunked		
Privacy Plus/SmartNet	Yes	No
MOTOTRBO Capacity Plus	No	Yes
MOTOTRBO Connect Plus Trunking	No	Yes
Mixed Mode Capability (Analog or MOTOTRBO)		
Static Mixed Mode	No	Yes
Dynamic Mixed Mode (Single Site Repeat)	No	Yes
Frequency		
VHF 136-154	Yes	Future Release
VHF 150-174	Yes	Future Release
UHF 330-403	Yes	No
UHF 403-470	Yes	Yes
UHF 470-524	No	Yes
800 MHz (RX: 806-824 TX: 851-870)	Yes	Yes
900 MHz (RX: 896-902 TX: 935-941)	Yes	Yes
Frequency Reference		
Internal 1.5ppm (800)	Yes	No
Internal 1.5ppm (VHF, UHF)	Yes	Yes
Internal 0.1ppm (800/900MHz) ~~(optional UHF/VHF)~~	No	Yes
External Reference Capable	Yes	Yes
Channels		
Programmable Channels	32	16
Channel Frequency Spacing		
Channel Spacing	12.5/15/20/25/30kHz	12.5/15/20/25/30kHz
6.25 equivalency	No	Yes

MTR2000 vs. MTR3000 Comparison (Continued)

Capability	MTR2000	MTR3000
Network Interface		
Ethernet	No	Yes
4-wire (E&M via GPIO)	Yes	Yes
4-wire (E&M)	Yes	Yes
Analog wireline	Yes	Yes
Voting		
Receive Only Station	Yes	No
Analog Voting	Yes	Future Release
Transmitter Capability		
Low Power (30/40W)	Yes	Yes
75/100 Watt Capability	Yes	Yes
Continuous Duty	Yes	Yes
Aux I/O		
Wildcard	Yes	No
GPIO (General Purpose Input/Output)	12 GP0 and 11 GPI (Optional)	7 GPIO and 2 GPI (Standard)
Main Stand-by (hot switchover)	Yes (Optional)	Yes (Standard)
COR (Carrier Operator Relay) & PTT	Yes	Future Release
Additional Hardware Features		
RoHS compliancy	No	Yes
DB25 Connector (for 3rd party controllers)	No	Yes
Standard Pin Connector	No	Yes
Additional Software Features		
IP Site Connect	No	Yes
Capacity Plus	No	Yes
Connect Plus (UHF only)	No	Yes
RDAC (Radio Diagnostic & Control)	No	Yes
Dynamic Mix Mode	No	Yes
Transmit Interrupt	No	Yes
Remote Diagnostics		
MOSCAD	Yes	No
RDAC	No	Yes

The following chart is a detailed analog comparison between the MTR2000 and MTR3000.

Table 6. Detailed MTR2000 to MTR3000 Analog Comparison

Detailed Base Station/Repeater Features	MTR2000	MTR3000
Analog Voice Receive and Transmit (Wireline)		
TX pre-emphasis	Yes	Yes
RX de-emphasis	Yes	Yes
RX PL filter	Yes	Future Release
RX Activation selection (PL, DPL, CSQ, PL& CSQ)	Yes	Future Release
Rx Activation selection (Select 5, Single Tone)	Yes	No
Analog Voice Receive and Transmit (E&M via GPIO)		
TX pre-emphasis	Yes	Yes
RX de-emphasis	Yes	Yes
RX PL filter	Yes	Yes
RX Activation selection (PL, DPL, CSQ, PL& CSQ)	Yes	Yes
RX Activation selection (Select 5/Single Tone)	Yes	No
In-cabinet repeat		
Activation selection (PL, DPL, CSQ, PL & CSQ, DPL & CSQ)	Yes	Yes
Activation selection (Select 5/Single Tone)	Yes	No
Hold in selection (PL, DPL, CSQ, PL & CSQ, DPL & CSQ)	Yes	No
Hold off Delay	Yes	No
Audio Boost	Yes	Yes
Deactivation Selection (Select 5/Single Tone)	Yes	No
Noise Cancellation	Yes	Yes
Companding	Yes	Yes
TX Priority (Programmable)	Yes	Yes
Base operation		
Fall back in-cabinet repeat	Yes	Future Release
Same RX & TX freq (simplex)	Yes	Future Release
Different RX & TX freq	Yes	Yes
Antenna Relay	Yes	Yes
PTT Types		
Repeat path Rx Audio	Yes	Yes
One Ext PTT (Console, Phone Patch, etc.)	Yes	Yes
Dedicated MIC PTT	Yes	Yes
Dedicated External Audio Connections (Local/Phone/Trunked Data)	Yes	Yes
Multiple Channels		
Multiple Channels - up to 16	Yes	Yes
Multiple Access Code Tables - up to 16	Yes	Yes
Channel set up parameters		
Repeater timeout timer	Yes	Yes
Repeater drop out delay (Hang Time)	Yes	Yes
Selectable Output power normal/battery backup	Yes	No
Console wireline Timeout timer	Yes	Future Release
Local timeout timer	Yes	Yes
Phone patch timeout timer	Yes	No

Detailed MTR2000 to MTR3000 Analog Comparison (Continued)

Detailed Base Station/Repeater Features	MTR2000	MTR3000
PL/DPL Types		
Motorola non-standard PL set	Yes	Yes
Motorola standard PL set	Yes	Yes
Selection of CSQ, PL, DPL	Yes	Yes
Standard PL /DPL set	Yes	Yes
Base Station Identification -		
Morse code ID (polite)	Yes	Yes
Morse code ID (not polite)	No	Yes
Programmable timer	Yes	Yes
Remote Control via external adapter		
DC Remote Control (DRC)	Yes	Future Release
Binary Remote Control	N/A	No
Tone Remote Control (TRC)	N/A	Yes
Console Commands via Integrated tone remote control		
Repeater Setup/Knockdown	Yes	Yes
Channel Change	Yes	Yes
PL/DPL Change	Yes	Future Release
Transmit and Receive PL/DPL On/OFF	Yes	Future Release
Monitor	Yes	Yes
Console Commands via Integrated DC remote control		
Channel Change	No	Yes
Monitor	No	Yes
External Inputs		
External Frequency Reference Capability	Yes	Yes
External PTT	Yes	Yes
Monitor	Yes	Yes
Repeater set up and knockdown	Yes	Yes
Unbalanced RX and TX audio	Yes	Yes
Microphone	Yes	Yes
TX inhibit (called disabled in MOTOTRBO)	Yes	Yes
RX Inhibit	Yes	No
Wildcard	Yes	No
2-wire and 4-wire Telco compatible	Yes	Yes
External Outputs		
CSQ Indication	Yes	Yes
Analog RSSI (Receive Signal Strength Indicator)	Yes	Yes
Speaker connection	Yes	Yes
Carrier operator relay (Dry Contact)	Yes	Future Release
2-wire and 4-wire Telco compatible	Yes	Yes
Service Features	**RSS**	**CPS, Tuner and RDAC**
Station Log Critical failure (Alarms and Events)	Yes	Yes
HW and SW version screens	Yes	Yes
Station Status	Yes	Yes
RSSI (Receive signal strength indication)	Yes	Yes
Hardware Metering screens	Yes	No

Detailed MTR2000 to MTR3000 Analog Comparison (Continued)

Detailed Base Station/Repeater Features	MTR2000	MTR3000
Miscellaneous		
Deviation Control	Yes	Yes
Full Duplex	Yes	Yes
Half Duplex	Yes	Yes
TX wireline squelch	Yes	Yes
Auto Level Control (ALC) wireline	Yes	Yes
Tx and Rx audio notch	Yes	Yes
Cross Banding	Yes	No
Alarm Tones	Yes	No
Options		
X371 – Antenna Relay	Yes	Yes
Phone Patch (used to be MTRI)	Yes	Yes
Selectable Fallback in cabinet repeat – Voting	Yes	Future Release
X269 – Voting Option (included in X777)	Yes	Future Release
X157 – Enhanced Wild Card	Yes	No
Wildcard Options		
Wildcard	Yes	No
Main stand-by	Yes	Yes
Receive Only Configuration		
Receiver	Yes	No

Considerations before beginning a migration plan

The purpose of an MTR2000 MOTOTRBO upgrade is to allow users to migrate to MOTOTRBO digital without having to purchase an entirely new station. When upgrading to an MTR3000, use the following chart to ensure features and/or functionality is supported.

Table 7. Upgrade Compatibility

MTR2000 Analog Upgrade Capability	
MTR2000 Feature Name	**Upgrade to MTR3000**
Analog Air Interface	
Conventional	Yes*
Privacy Plus/Smartnet	No
Analog Station Operation	
Base Station	Yes*
Repeater	Yes*
Receive Only	No
Channel Configuration	
Simplex	Future Release
Half Duplex	Yes
Full Duplex	Yes
Frequency	
VHF 136-154	Future Release
VHF 150-174	Future Release
UHF 330-403	No
UHF 403-470	Yes
800 MHz	Yes
900 MHz	Yes
Network Interface	
4-wire (E&M via GPIO)	Yes
4-wire (E&M)	Yes
Analog wireline	Yes
Voting	
Analog Voting	Future Release
Transmitter Capability	
Low Power (30/40W)	Yes
High Power (75/100W)	Yes
Custom Programming	
Aux I/O	No
Wildcard Programming	No
Hardware Peripheral compatability	
Duplexer	Yes
Preselector	Yes
Circulator	Yes
External Frequency Reference	Yes
Antenna Relay	Yes
Argus Battery Charger	Yes

Note: An Upgraded MTR2000 can be used in analog mode. However, since some analog functionality would be lost in this transition, this application would be best applied to a customer who intends to migrate to MOTOTRBO at some time in the future.

SPECIFICATIONS

Specification Definitions

Listed alphabetically are the definitions of some of the specifications described above. Information on whether the preferred specification would be smaller or larger is also given.

1) Adjacent Channel Power Ratio (Decibels/ dB): A measure of the level of undesired transmit signal that falls within the adjacent frequency channel. Often this is limited by the modulation type rather than hardware or software. A larger number is better.
2) Adjacent Channel Rejection {Selectivity} (Decibels/ dB)–Ability of the receiver to detect the desired signal, while rejecting signals on adjacent channels. The benefit is less interference. The preferred specification is larger. Effective system performance may be limited by the interfering subscriber units' transmitter noise or modulation characteristics
3) Bandwidth: As it applies to T-T or R-R (Megahertz/ MHz)–The maximum frequency separation from the lowest frequency to the highest frequency without degradation of specifications. The preferred specification for multi-channel base stations/repeaters should be wide enough to include all the channels that are used, depending upon the application.
4) Bandwidth: As it applies to T-R Spacing (Megahertz/ MHz)–The specified frequency separation between the transmitter and receiver is band dependent. The preferred specification is generally smaller, although it depends upon the specific site requirements.
5) Bit Error Rate Floor (%): A measure of the receiver's ability to detect and decode strong signals accurately. A small percentage is better.
6) Conducted Spurious Emissions (dBm): Undesired receiver output signals (on the antenna port). The benefit is reduced interference with other base stations/repeaters nearby. The preferred specification is a more negative number.
7) Co-Channel Rejection (Decibels/ dB): Ability of the receiver to reject on channel interference. This specification is usually determined by the modulation type. A smaller number is better.
8) Electronic Bandwidth: Operating range that can be obtained without any mechanical adjustments, such as tuning screws. Larger number is better. Full bandwidth is best.
9) Emissions Designator: An FCC designator describing bandwidth and modulation type.
10) Frequency Stability (+/-% OR parts per million/ppm OR parts per billion/ppb): The ability to stay on the assigned frequency over a temperature range of -30° to +60°C. The benefit is increased coverage, less interference and reduced background noise. The preferred specification is smaller, which implies a greater stability.
11) Harmonic Emissions Attenuation (Decibels/dB): Similar to spurious outputs (described below); multiples of the frequency of the final power amplifier (transmitter). The benefit is reduced interference to nearby base stations/repeaters. The preferred specification is a larger number.
12) Intermodulation Attenuation (Decibels/ dB): Reduces transmitter intermodulation by preventing undesired signals from entering into the transmitter's PA. This is

accomplished by using circulators or isolators. The preferred specification is larger. This specification is especially important at dense sites.

13) FSK Error (%): A measure of the transmitter's ability to accurately produce a digitally modulated signal. A smaller percentage is better.
14) Receiver Intermodulation/IMR (Decibels/ dB)–Mixing of undesired signals which interferes with the desired signal. This is important if the R-R bandwidth is large. The benefit is less interference. The preferred specification is larger.
15) Sensitivity (Microvolts/μV or dBm)–The ability of the receiver to detect and amplify weak signals. The benefit is increased coverage. 12 decibels SINAD is the threshold for intelligible analog voice communications. The preferred specification is smaller. 5% bit error rate is the threshold for intelligible digital voice communication.
16) Signal Displacement Bandwidth (Off-Channel Acceptance) (kHz)–The amount the signal can be off the tuned frequency and still be received. The preferred specification is larger and must be at least as good as the frequency stability of the transmitting subscriber units.
17) Spurious Emissions (Decibels/ dB)–Undesired transmitter output signals. The benefit is reduced interference with other base stations/repeaters nearby. The preferred specification is a larger number.
18) Spurious (Image) Response (Decibels/ dB)–Ability of the receiver to reject certain types of undesired or interfering signals related to the operating frequency. The preferred specification is larger.

For analog FM, TIA603D standards and methods are used unless otherwise noted for analog specs. Specifications regarding digital modulation use TIA102 methods.

MTR3000 Base Station/Repeater Specifications

Table 8. MTR3000 Base Station/Repeater General Specifications

Specification	All Bands FM and 4FSK
Model Number	T3000A
Height	133 mm 5.25 in 3 Rack Units
Width	483 mm 19.0 in
Depth	419 mm 16.5 in
Weight	19 kg 40 lb
Number of Channels	16
Operating Temperature Range	-30 to 60°C -22 to 140°F
Frequency Generation	Synthesized
Frequency Stability	Internal (1.5ppm)
Power Supply Type	Switching
Power Supply AC Input	85-264 VAC, 47-63 Hz
Power Supply DC Input	21.6-32 VDC
Power Consumption	See Table 11

Note: Specifications do not include optional equipment.

Table 9. MTR3000 Base Station/Repeater Transmitter Specifications

Transmitter Specification	UHF FM and 4FSK	800/900MHz FM and 4FSK
Frequency Range	403-470 or 470-524 MHz	851-870MHz & 935-941MHz
Electronic Bandwidth	Full Bandwidth	Full Bandwidth
Power output* (Continuous Duty)	8-100W	8-100W
FM Channel Spacing	12.5 kHz/25kHz	800MHz : 12.5kHz / 25kHz 900MHz : 12.5kHz
4FSK Channel Spacing	12.5kHz	12.5kHz
Rated System Deviation (25kHz/12.5kHz)	5kHz / 2.5kHz	800MHz : 5kHz / 2.5kHz 900MHz : 2.5kHz
Audio Distortion	< 3%	< 3%
FM Hum & Noise (25kHz/12.5kHz)	50dB / 45dB	50dB / 45dB
Spurious and Harmonic Emissions Attenuation	-90 dBc	800MHz : -90dBc 900MHz : -86dBc
Emissions Designators	FM 12.5kHz 11K0F3E 25kHz 16K0F3E 4FSK (12.5kHz) Data Only 7K60FXD Data/Voice 7K60FXE	FM 12.5kHz 11K0F3E 25kHz 16K0F3E 4FSK (12.5kHz) Data Only 7K60FXD Data/Voice 7K60FXE
Adjacent Channel Power Ratio (25kHz/12.5kHz)	75dB / 60 dB	75dB / 60 dB
Intermodulation Attenuation	55 dB	55 dB
RF Output Connector	N female	N female
RF Impedance	50 Ohms	50 Ohms
FCC Designation	Freq Range 406.1-470 MHz ABZ89FC4823 Freq Range 470-512 MHz ABZ89FC4825	Transmitter ; 851-870MHz and 935-941MHz ABZ89FC5817

***** With AC input or DC input voltages in the range of 25.7V to 30.7V for UHF, and 24.7V to 30.7V for the 800/900MHz band.

Table 10. MTR3000 Base Station/Repeater Receiver Specifications

Receiver Specification	UHF FM and 4FSK	800/900MHz FM and 4FSK
Frequency Range	403-470 MHz or 470-524 MHz	806-825MHz and 896-902MHz
Electronic Bandwidth	Full Band	Full Band
Sensitivity 12dB SINAD (no peripherals)	-117.5 dBm	-117.5 dBm
Sensitivity 5% Bit Error Rate Static (BER) 4FSK (no peripherals)	-117.5 dBm	-117.5 dBm
Sensitivity 12dB SINAD (with all peripherals except duplexer)	-116.1 dBm	116.1 dBm
Sensitivity 12dB SINAD (with duplexer)	-115 dBm	-114.2 dBm
Sensitivity 5% Bit Error Rate Static (BER) 4FSK (with all peripherals except duplexer)	-116.1 dBm	116.1 dBm
Sensitivity 5% Bit Error Rate Static (BER) 4FSK (with all peripherals except duplexer)	-115 dBm	-114.2 dBm
Intermodulation Rejection	85 dB	85 dB
Adjacent Channel Rejection (12.5kHz / 25kHz) TIA603 Single Tone Method	75 / 80 dB	75 / 85 dB
Adjacent Channel Rejection (12.5kHz / 25kHz) TIA603D	45 / 75 dB	45 / 75 dB
Spurious and Image Response Rejection	85 dB	90 dB
Spurious and Image Response Rejection with Optional Narrow Preselector	90 dB	N/A
Blocking Immunity	110 dB	110 dB
Signal Displacement Bandwidth (12.5kHz / 25kHz)	1kHz / 2kHz	1kHz / 2kHz
Conducted Spurious	316uV	316uV
Bit Error Rate Floor (-77dBm) ETSI113	0.01%	0.01%
Co-Channel Rejection Bandwidth (12.5kHz / 25kHz) ETSI 086	8dB / 12 dB	8dB / 12 dB
Intermediate Frequencies	73.35 MHz, 2.25 MHz	73.35 MHz, 2.25 MHz
RF Input Connector	N female	N female
RF Impedance	50 Ohms	50 Ohms
FCC Designation	Freq Range 403-470 MHz ABZ89FC4824 Freq Range 470-524 MHz ABZ89FC4826	Receiver: 806-825MHz and 896-902MHz ABZ89FR5818

Note: Specifications do not include optional equipment unless noted otherwise.
All analog specifications are in reference to TIA603D unless noted otherwise.
Specifications regarding digital modulation use TIA102 methods.

Power and Energy Consumption

The following chart shows the maximum total power consumption for each station to help determine wiring, power, and HVAC requirements. The power consumption listed below is in reference to the RF output power at the power amplifier's output connector.

Table 11. Power Consumption

Band/Mode	Power Source	Max Power Consumption (Watts)	Max Power Dissipation (BTU/Hour)
UHF (403-470 MHz) Tx = 100W	AC	340	820
UHF (403-470 MHz) Tx = 100W	DC	300	680
UHF (470-524 MHz) Tx = 100W	AC	380	960
UHF (470-524 MHz) Tx = 100W	DC	320	750
UHF (403-470 MHz) Rx Mode	AC	40	136
UHF (403-470 MHz) Rx Mode	DC	22	75
UHF (470-524 MHz) Rx Mode	AC	40	136
UHF (470-524 MHz) Rx Mode	DC	22	75
800/90MHz (850 – 870 MHz & 935 – 941 MHz) Tx = 100W	AC	440	1160
800/90MHz (850 – 870 MHz & 935 – 941 MHz) Tx = 100W	DC	390	990
800/900MHz (806 – 825 MHz & 896 – 902 MHz) Rx Mode	AC	40	136
800/900MHz (806 – 825 MHz & 896 – 902 MHz) Rx Mode	DC	22	75

Power and Energy Consumption Curves

The power consumption and current draw curves displayed on the following pages reflect typical performance. The power consumption and current draws are in reference to the RF output power at the power amplifier's output connector

Note, the DC power consumption and current draw curves only go down to a radio input potential of 25.7VDC for UHF and 24.7V for 800/900MHz as that is the lowest potential at which the radio is specified to deliver the rated transmitter output power of 100W. The "Power Source" section of this document outlines further considerations when the MTR3000 is operating under DC power.

Figure 5. UHF R1 and R2 --- AC Power Consumption Plots

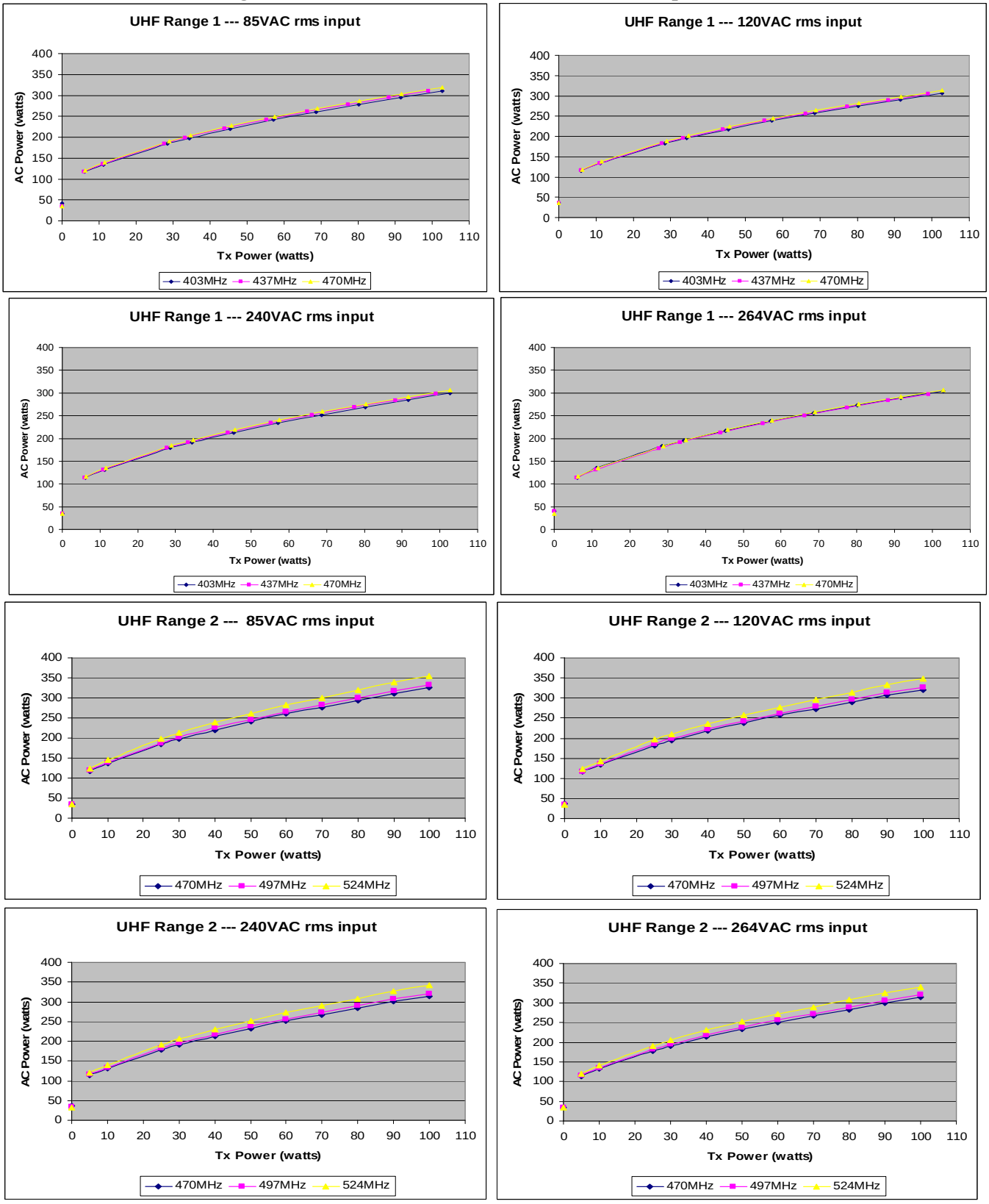


Figure 6. UHF R1 and R2 --- AC Current Draw Plots

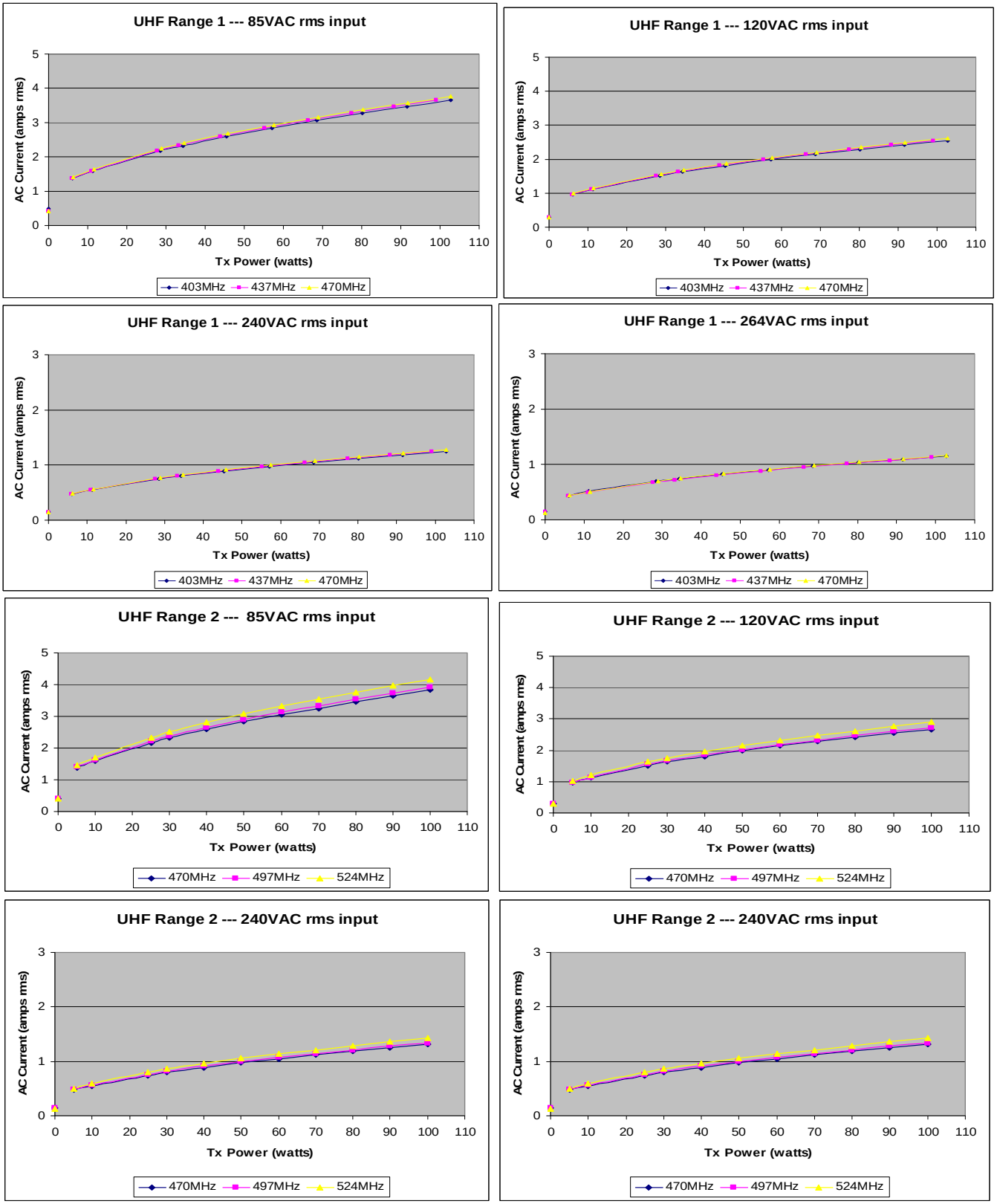


Figure 7. UHF R1 and R2 --- DC Power Consumption Plots

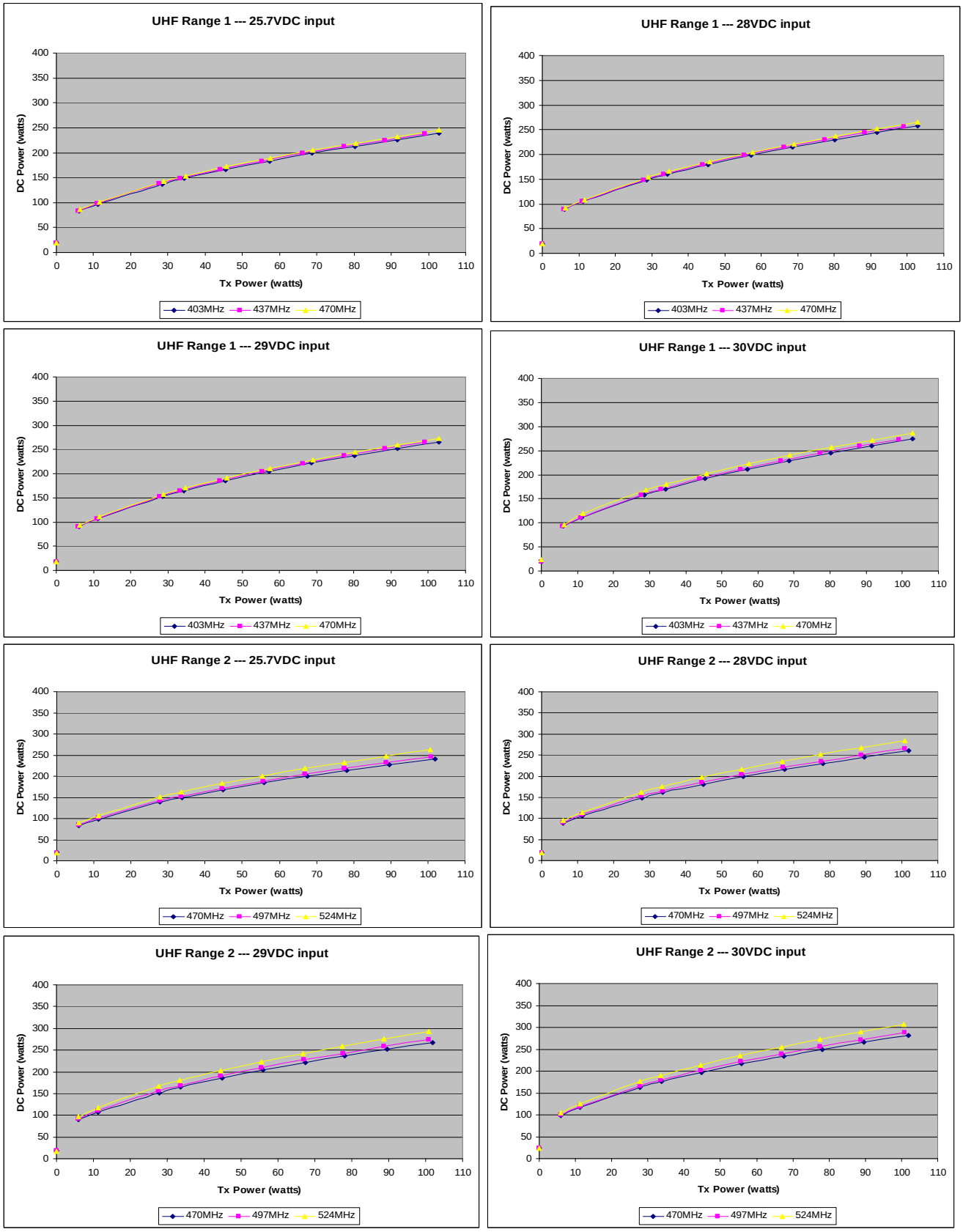


Figure 8. UHF R1 and R2 -DC Current Draw Plots

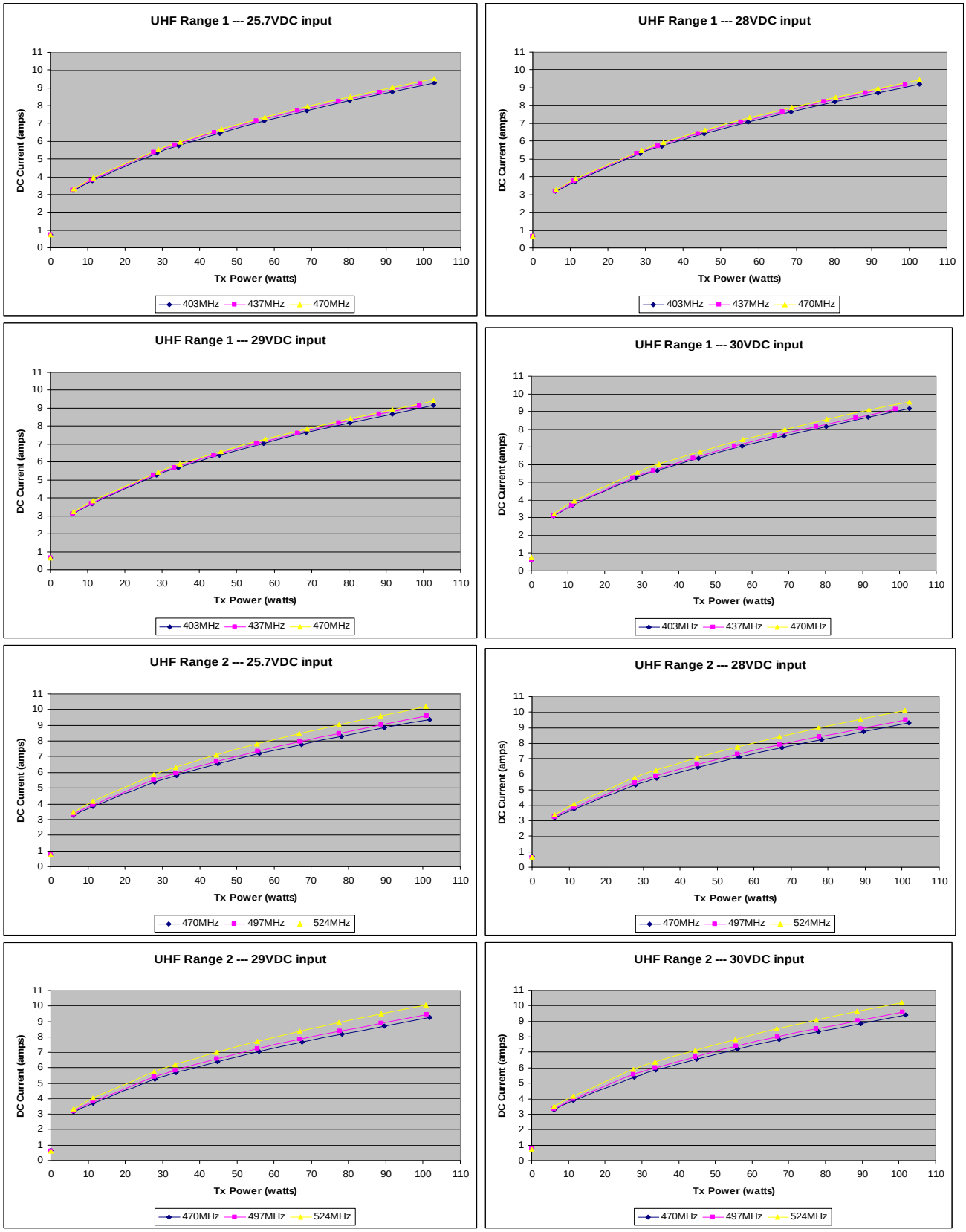
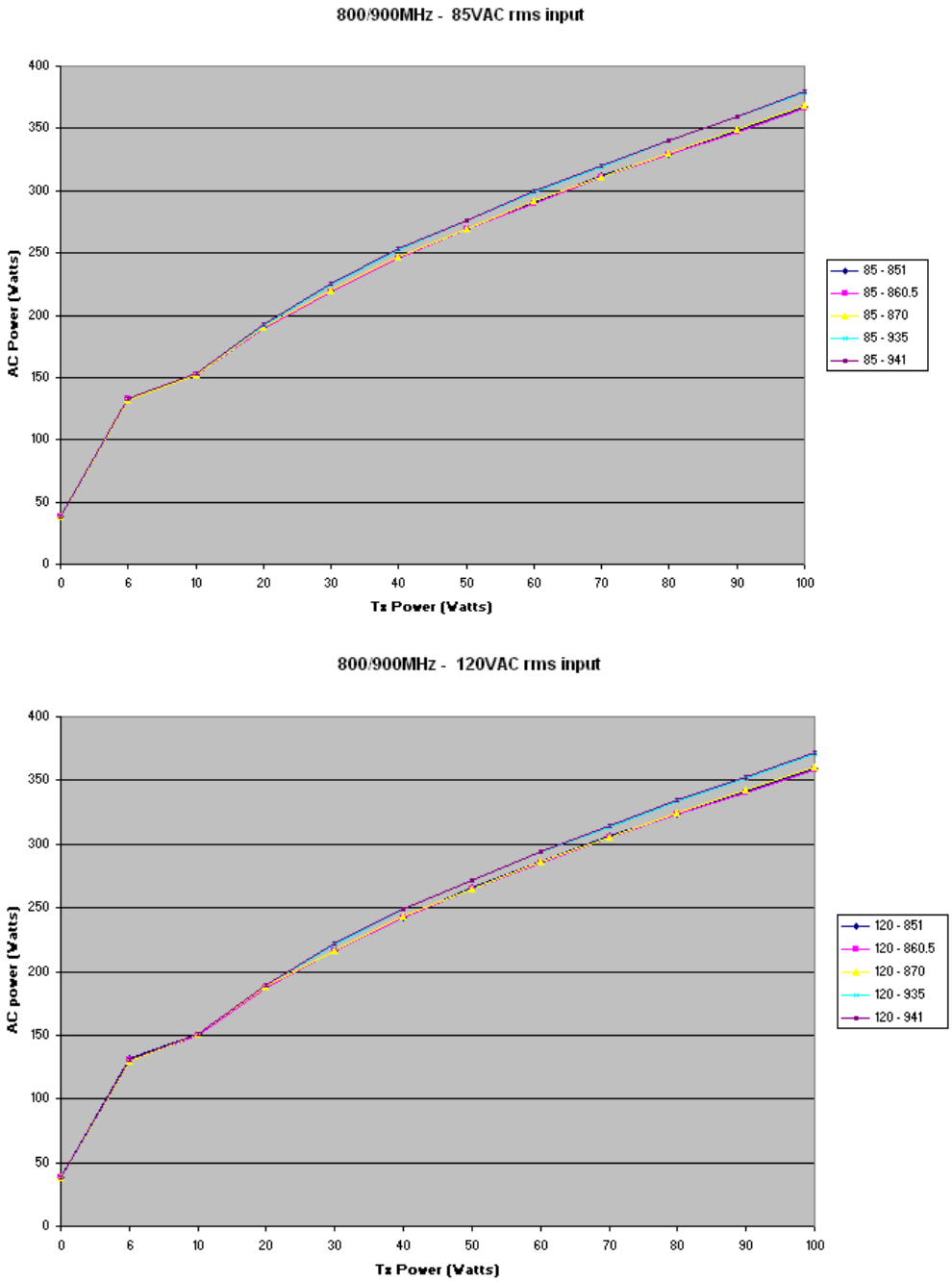
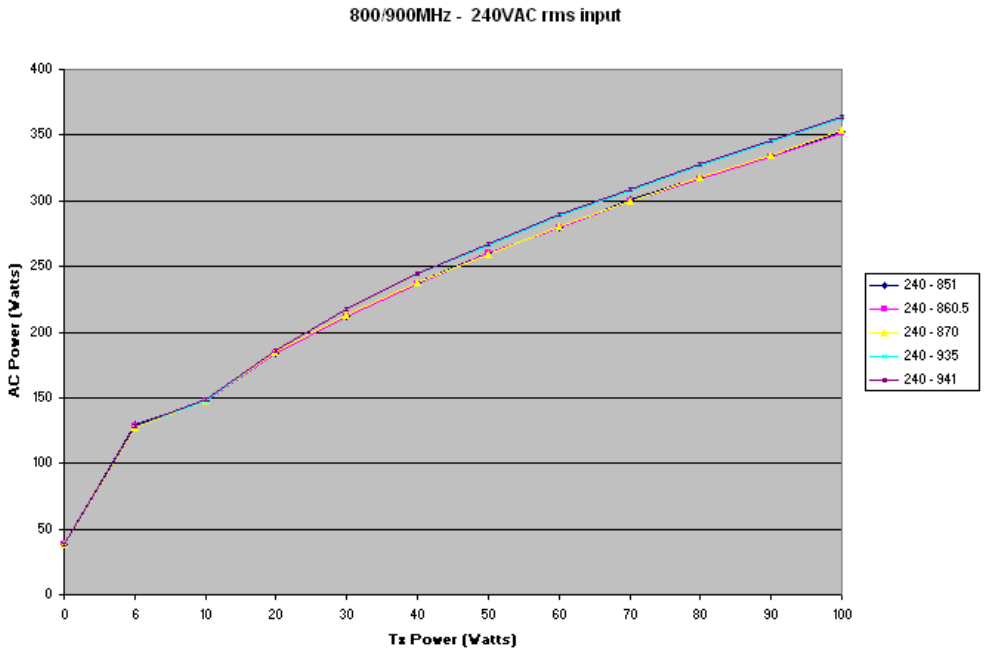


Figure 9 - 800/900MHz AC Power Consumption Plots




800/900MHz - 240VAC rms input
AC Power (Watts)
Tx Power (Watts)
0
50
100
150
200
250
300
350
400
0
6
10
20
30
40
50
60
70
80
90
100
240 - 851
240 - 860.5
240 - 870
240 - 935
240 - 941

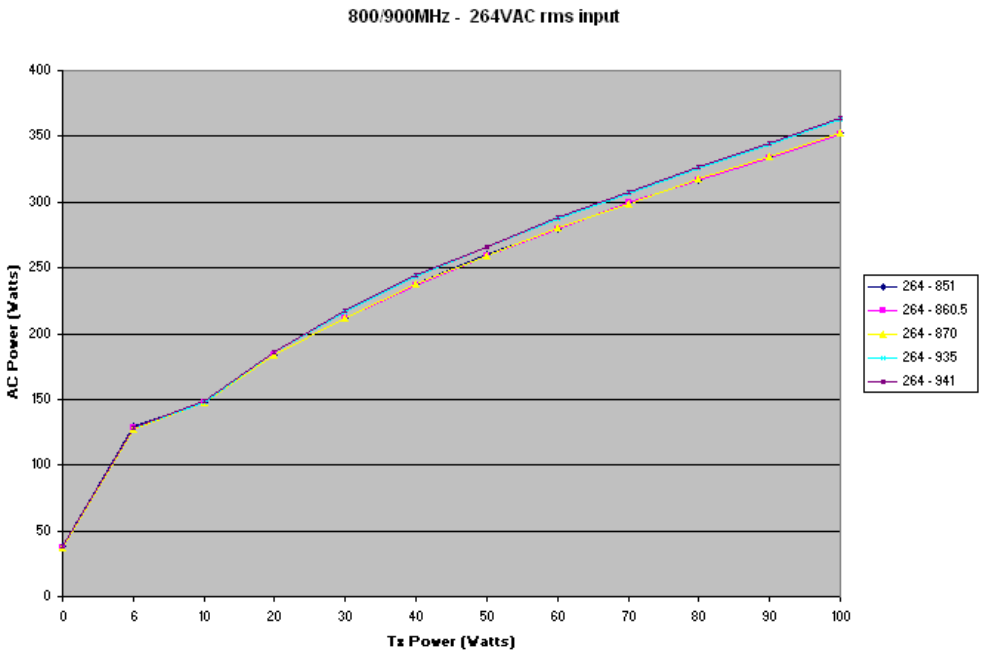
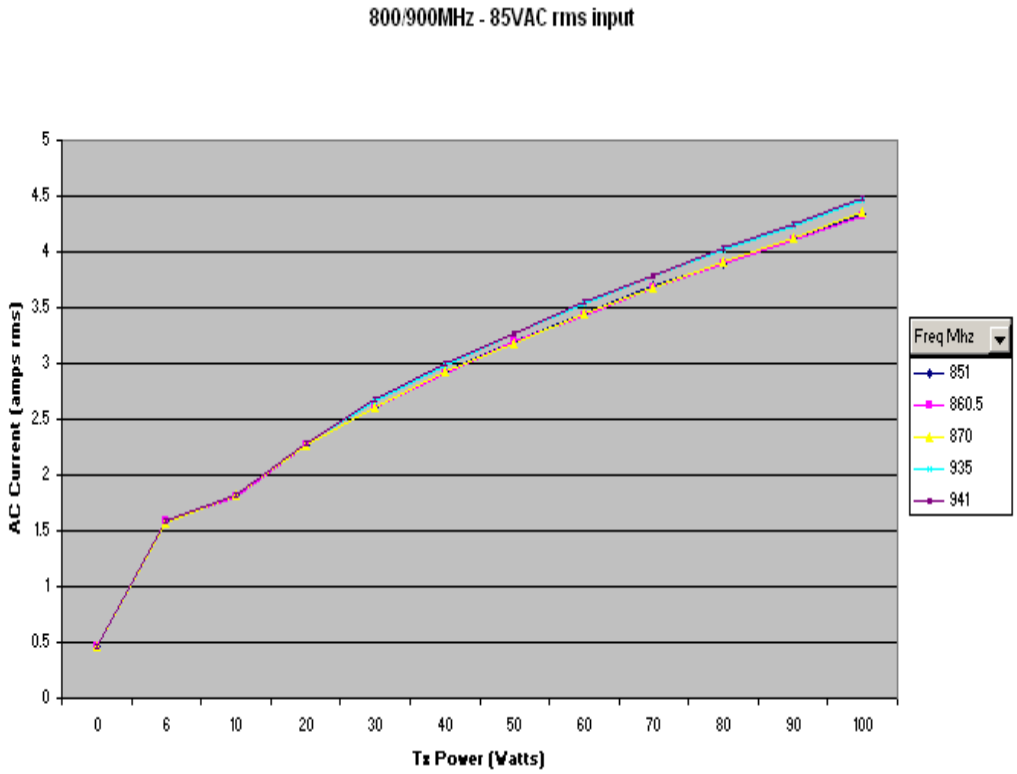
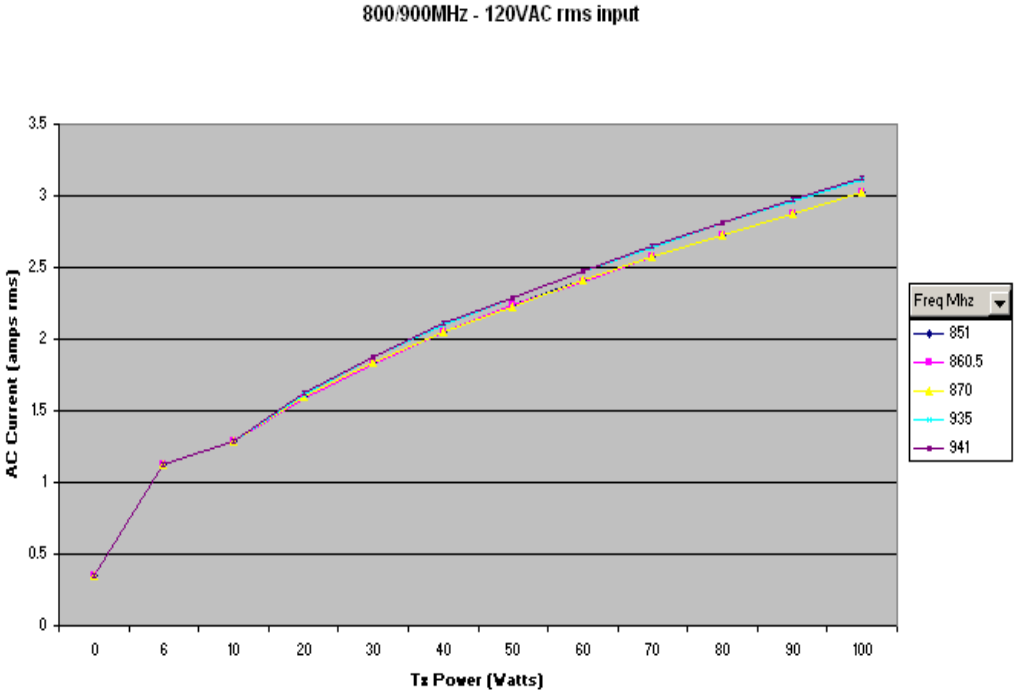
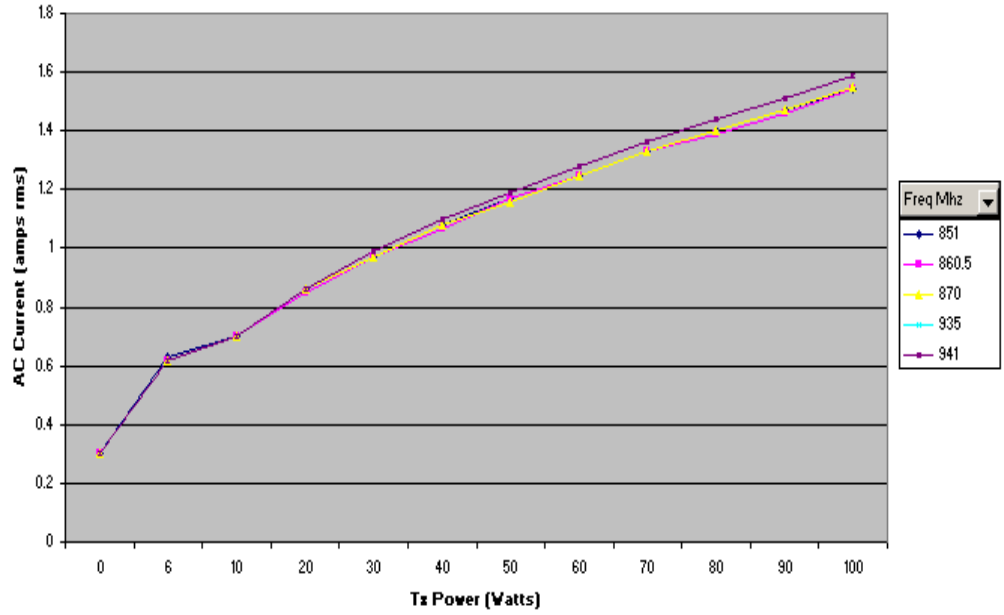

800/900MHz - 264VAC rms input
AC Power (Watts)
Tx Power (Watts)
0
50
100
150
200
250
300
350
400
0
6
10
20
30
40
50
60
70
80
90
100
264 - 851
264 - 860.5
264 - 870
264 - 935
264 - 941

Figure 10. 800/900MHz – AC Current Draw Plots





800/900MHz - 240VAC rms input



800/900MHz - 264VAC rms input

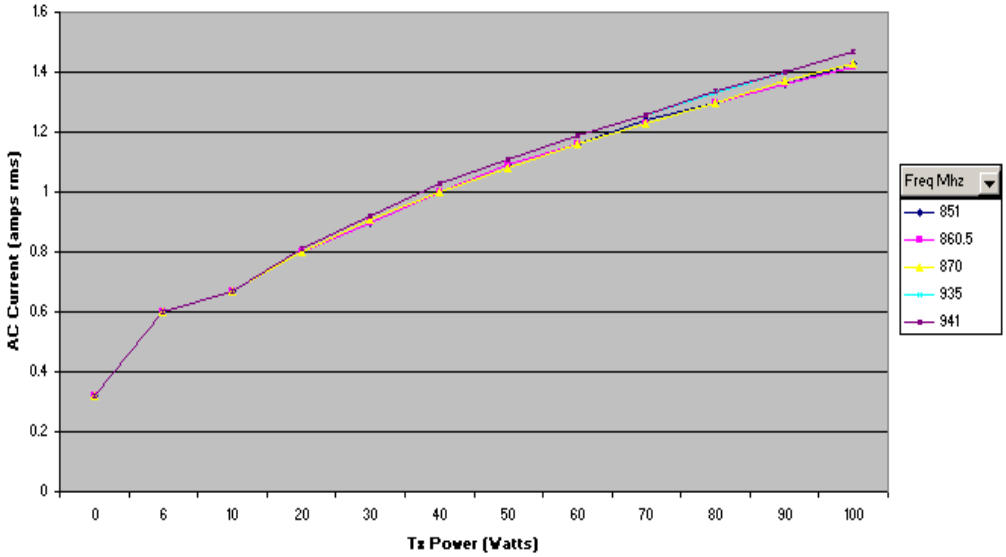
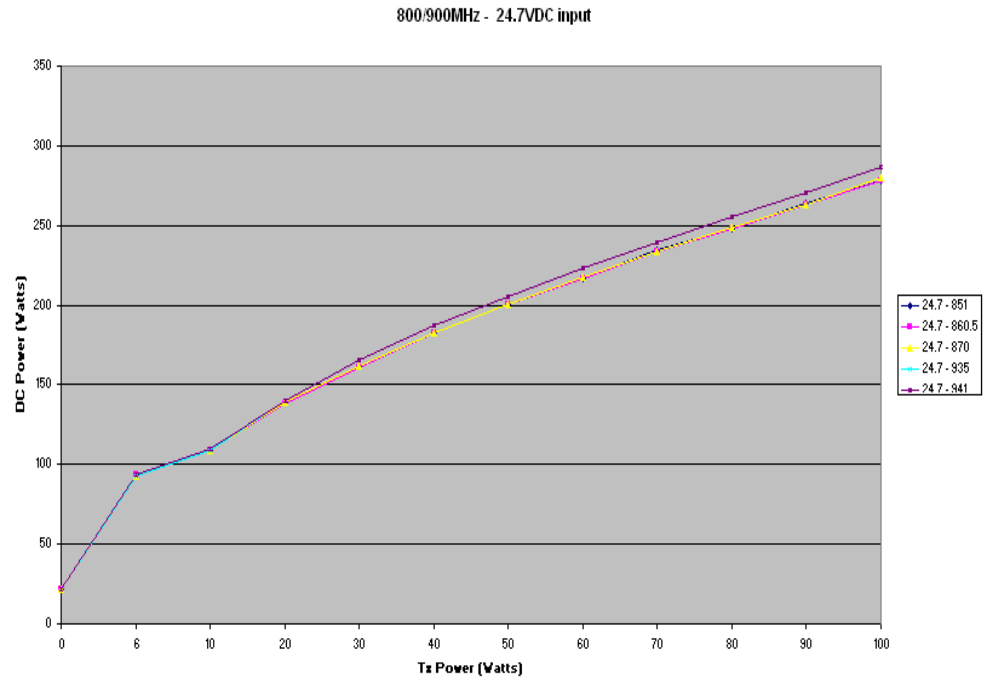
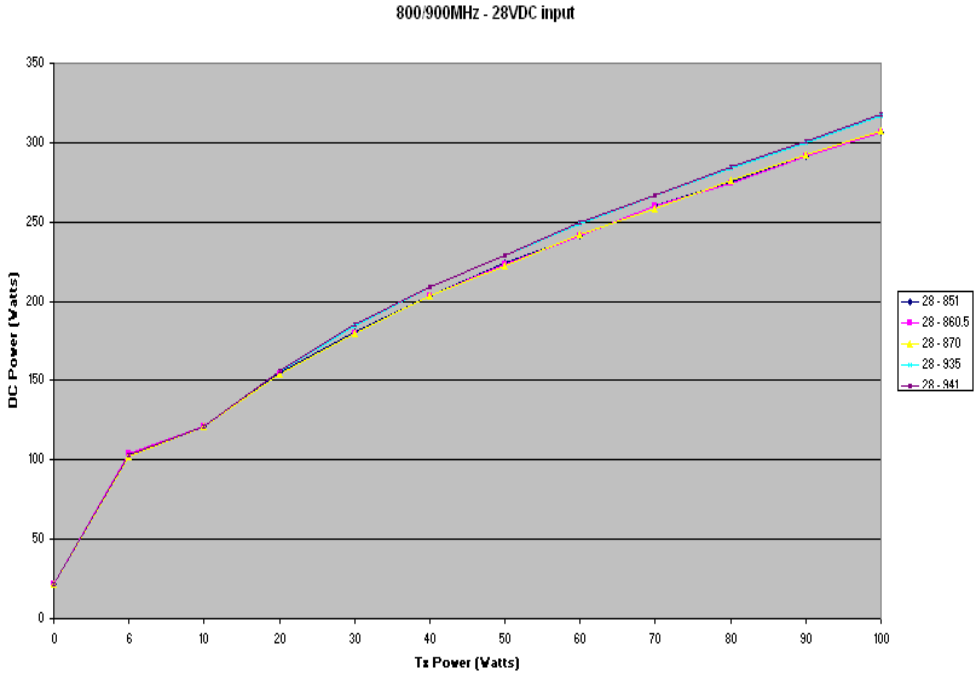


Figure 11 – 800/900MHz DC Power Consumption Plots





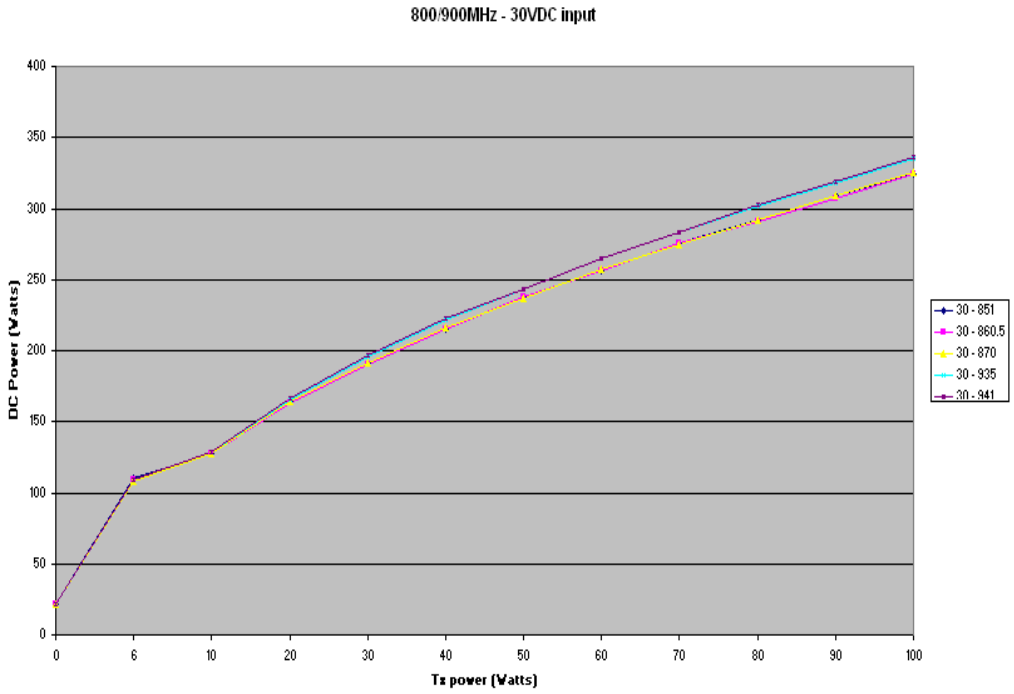
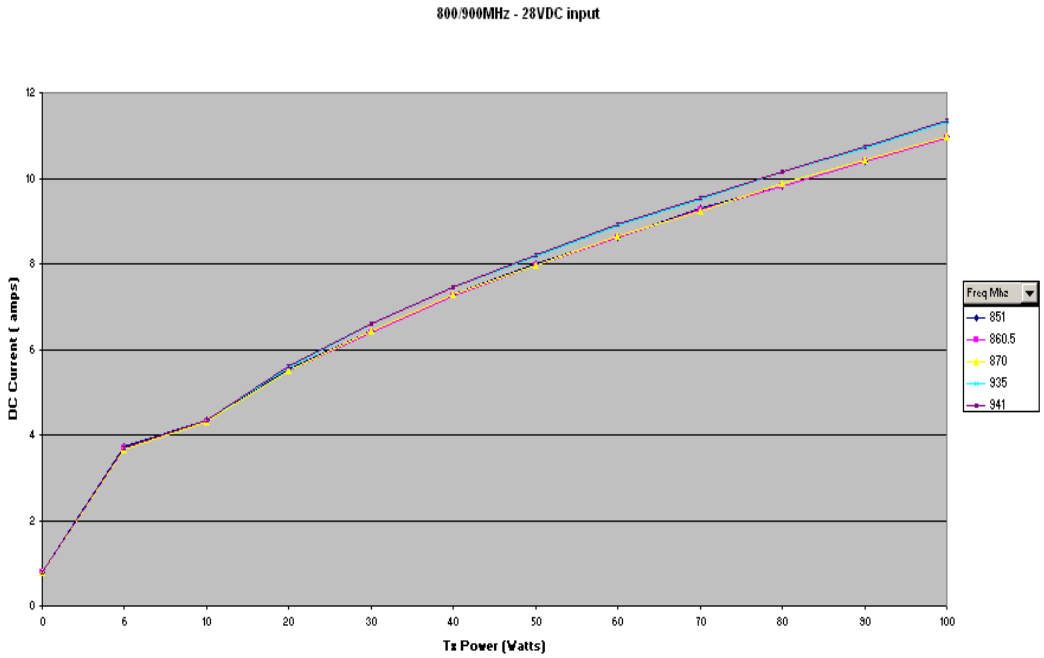
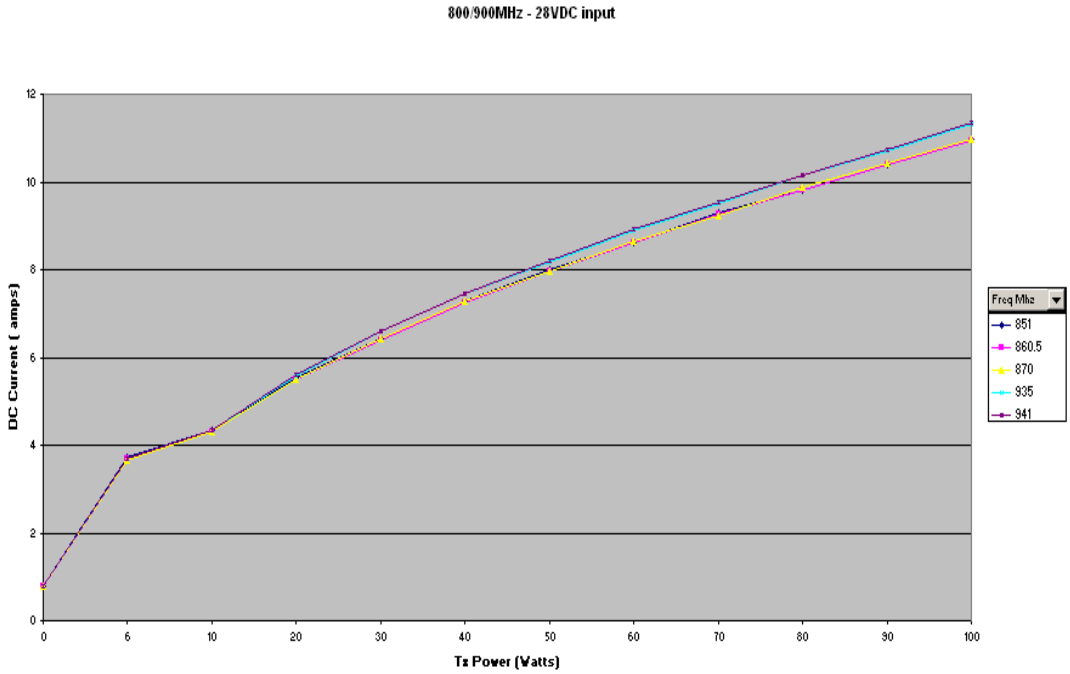
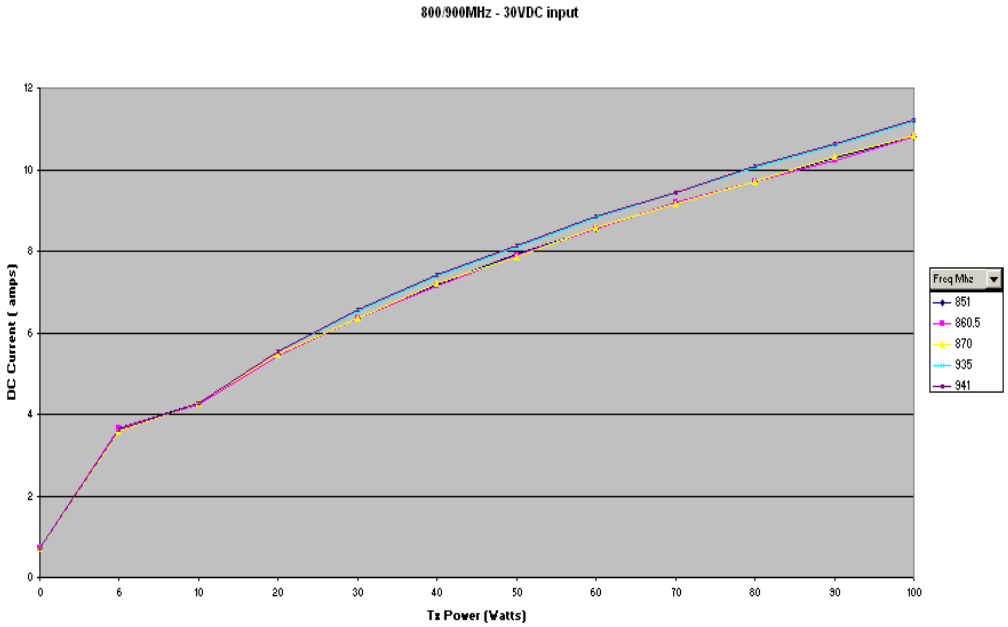

800/900MHz - 30VDC input
DC Power (Watts)
Tx power (Watts)
400
350
300
250
200
150
100
50
0
0
6
10
20
30
40
50
60
70
80
90
100
30 - 851
30 - 860.5
30 - 870
30 - 935
30 - 941

Figure 12 – 800/900MHz DC Current Draw Plots






800/900MHz - 30VDC input
DC Current (amps)
Tx Power (Watts)
0
2
4
6
8
10
12
0
6
10
20
30
40
50
60
70
80
90
100
Freq Mhz
851
860.5
870
935
941

Transmitter Noise

The following table provides detailed information on the noise characteristics of the MTR3000 transmitter. This data is at the power amplifier output connector, so it includes no external filters or peripherals of any kind.

Table 12. Transmitter Noise Performance

BAND:	UHF R1	UHF R2	800/900MHz
Offset (kHz)	(dBc/Hz)	(dBc/Hz)	(dBc/Hz)
100	-136	-136	-136
500	-150	-150	-150
1000	-152	-152	-152
3000	-157	-157	-157
> 5000	-157	-157	-157

Receiver Interference Rejection

The following table provides detailed information of the interference rejection characteristics of the MTR3000 receiver. This measured data was taken without the base station/repeater Preselector or peripherals of any kind. The designed signal is FM; the interfering signal is analog FM.

Table 13. Receiver Interference Rejection

BAND:	UHF R1	UHF R1	UHF R2	UHF R2	800MHz	900MHz
Carrier Offset (kHz)	Below Carrier (dB)	Above Carrier (dB)	Below Carrier (dB)	Above Carrier (dB)	Above Carrier (dB)	Above Carrier (dB)
50	92	92	92	92	93	93
100	98	98	98	98	99	98
200	105	105	104	104	105	104
500	108	108	112	112	112	109
1000	110	110	110	110	110	110
2000	110	110	110	110	110	110
5000	110	110	110	110	110	110
10000	110	110	110	110	110	110

STANDARDS

MTR3000 meets or exceeds the following standards:

Table 14. Standards

Standard	Description	Class or Revision
TIA/EIA-603-D	Analog FM performance	
ETSI EN 300 086 - 1	Analog FM performance	
ETSI EN 300 113 - 1	Digital performance	
RTTE	European Uniformity Directive	
Australia AS 3516.2:1998	Siting Guidelines	
AS/NZS 3548:1995	Electromagnetic Compatibility	
AS/NZS 4251.1:1994	Emissions	
AS/NZS 4252.1:1994	Immunity	
R56	Standard & Guidelines for Communications Sites	68-61089E50 iss B
EN 60529	Protection provided by enclosures	IP20
ETS 300 753	Acoustic noise	Meets classification of: “Attended telecommunications equipment rooms”
EN 61000-3-2	EMC limits for harmonic current emissions	
EN 61000-3-3	Limitations of voltage changes, voltage fluctuations & flicker	
IEC 61000-4-2	Electrostatic discharge immunity	Level 3
IEC 61000-4-3	Radiated RF EM field immunity	Level 3
IEC 61000-4-4	Electrical fast transient/burst immunity	Level 3
IEC 61000-4-5	Surge immunity test	Level 3
IEC 61000-4-6	Immunity to conducted disturbances induced by RF fields	Level 3
IEC 61000-4-7	Mains EMC: Harmonic & Inter-harmonic Currents	
IEC 61000-4-8	Power frequency magnetic field immunity	Level 3
IEC 61000-4-9	Pulse magnetic immunity	Level 3
IEC 61000-4-10	Damp oscillatory immunity	Level 3

Standards (Continued)

Standard	Description	Class or Revision
IEC 61000-4-11	Voltage dips, short interruptions & voltage variations immunity (AC)	**Batteries operating above 24VDC:** **Dips:** 40% & 70% voltage, 0.5 and 1 cycle, no batteries: no degradation of performance or loss of function. 40% & 70% voltage, >1 cycle, no batteries: self recovery after disturbance ceases. 40% & 70% voltage, >1 cycle, with batteries: no degradation of performance or loss of function (station reverts to batteries). **Variations:** 70% voltage (2s decrease transition, 1s at 70%, 2s increase transition) no batteries: no degradation of performance or loss of function in RX mode. Self recovery after disturbance ceases in TX mode. 40% voltage (2s decrease transition, 1s at 40%, 2s increase transition) with batteries: no degradation of performance or loss of function.
IEC 61000-4-12	Oscillatory waves immunity	Level 3
IEC 61000-4-14	Voltage fluctuation immunity	Level 3
IEC 61000-4-16	Immunity to conducted common mode disturbance	Level 3
IEC 61000-4-17	Ripple on DC input power port immunity	Level 3
IEC 61000-4-28	Variation of AC power frequency immunity	Level 3
IEC 61000-4-29	Voltage dips, short interruptions & voltage variations immunity (DC)	**AC off:** **Dips:** 40% & 70% voltage, 1 ms: no degradation of performance or loss of function. 40% & 70% voltage, >3 ms: self recovery after disturbance ceases. Short Interruptions: 0% voltage, 1 ms: no degradation of performance or loss of function. 0% voltage, >3 ms: self recovery after disturbance ceases. **Variations:** 80% & 120% voltage, 3 s: no degradation of performance or loss of function.
UL 60950-1	Safety	
EN 60950-1	Safety	
FCC 47 CFR 15	Emissions	
FCC 47 CFR 90	Emissions	
FCC 47 CFR 24	Emissions (900 Band Only)	
Industry Canada	Emissions	
IEC 61000-6-3	Emissions	

Altitude Derating

The MTR3000 meets full specified specifications from altitudes of -980 to 5900 feet (-300 to 1800 meters) referenced to mean sea level. With altitudes in the range of 5900 to 16400 feet (1801 to 5000 meters), the transmitter output power will automatically rollback as needed to keep the station within its thermal limits.

RFDS OPTIONS

The RFDS (radio frequency distribution system) provides interconnect between the base stations/repeaters and antennas. For the transmitters this includes isolator trays, duplexers, and antenna relays. For the receivers this includes preselectors, duplexers, and antenna relays. Various RFDS options exist for the MTR3000 Base Station/Repeater, which be outlined in the following pages.

RFDS Component Specifications

X182 Duplexers (UHF)

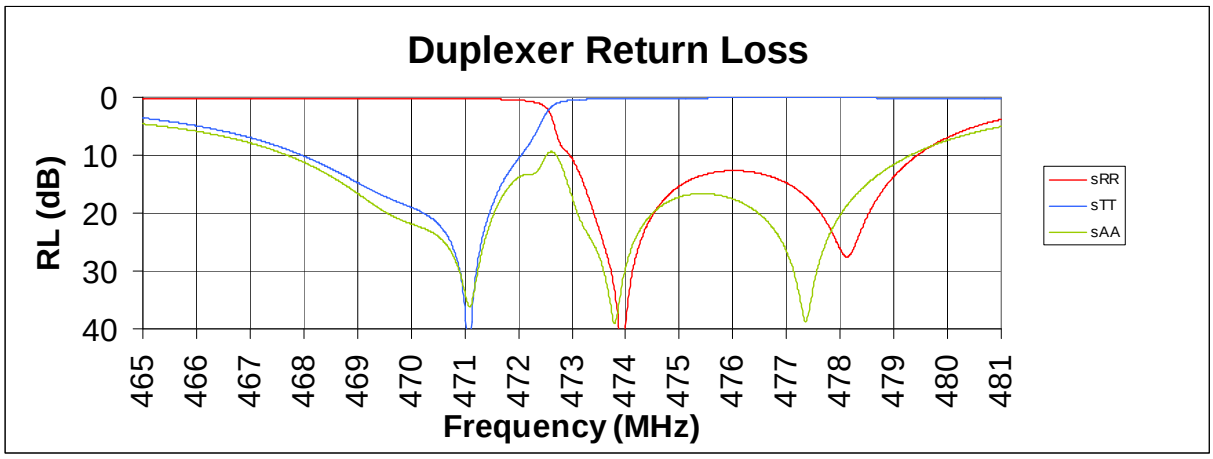
This filter provides the capability to use a single antenna for both transmit and receiver. Only one transmitter and receiver can be combined. The option is only available on the MTR3000 Base Station/Repeater configuration.

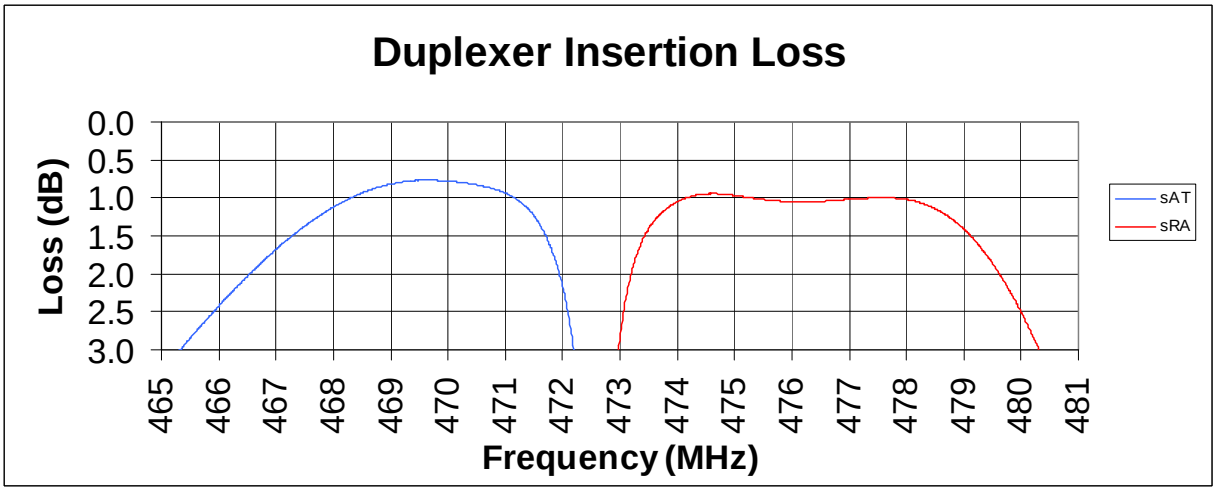
Figure 9. UHF Duplexer View

Table 15. UHF Duplexer Specifications

Parameter	Duplexer Spec Limit	Typical	Notes
Frequency range	403-435, 435-470, 470-494 or 494-512 MHz		
Insertion loss TX	1.3 dB	1.1 dB	Does not include cable loss
Insertion loss RX	1.3 dB	1.1 dB	
VSWR max.	1.3:1	1.2:1	
RX isolation <470 MHz >470 MHz	 100 dB 100 dB		 R/T 5 MHz R/T 3 MHz
TX isolation <470 MHz >470 MHz	 100 dB 100 dB		 R/T 5 MHz R/T 3 MHz
Antenna Connector	N female		
RX/TX Connectors	N female		

Figure 10. UHF Duplexer Plots (T-band) TX=471 MHz, RX=474 MHz





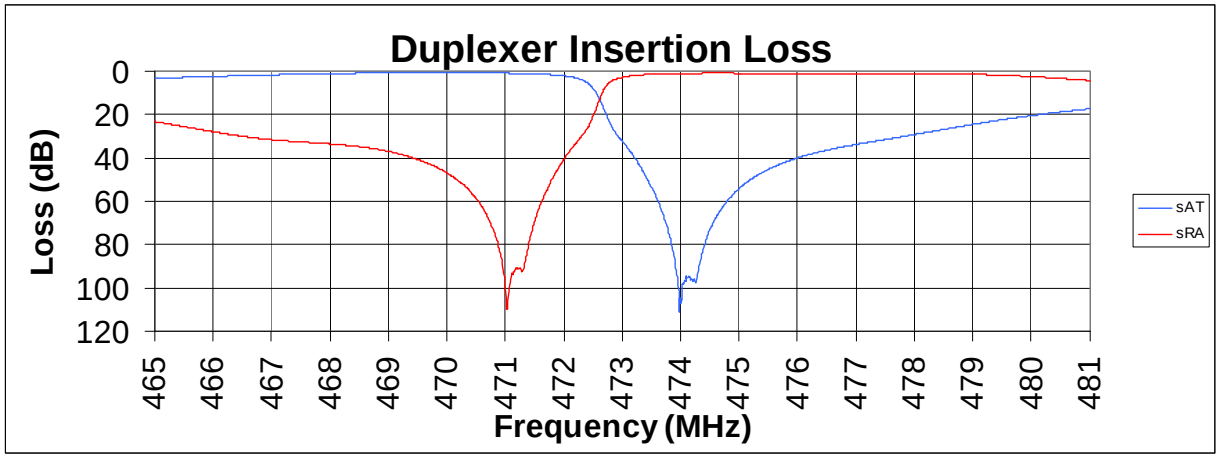
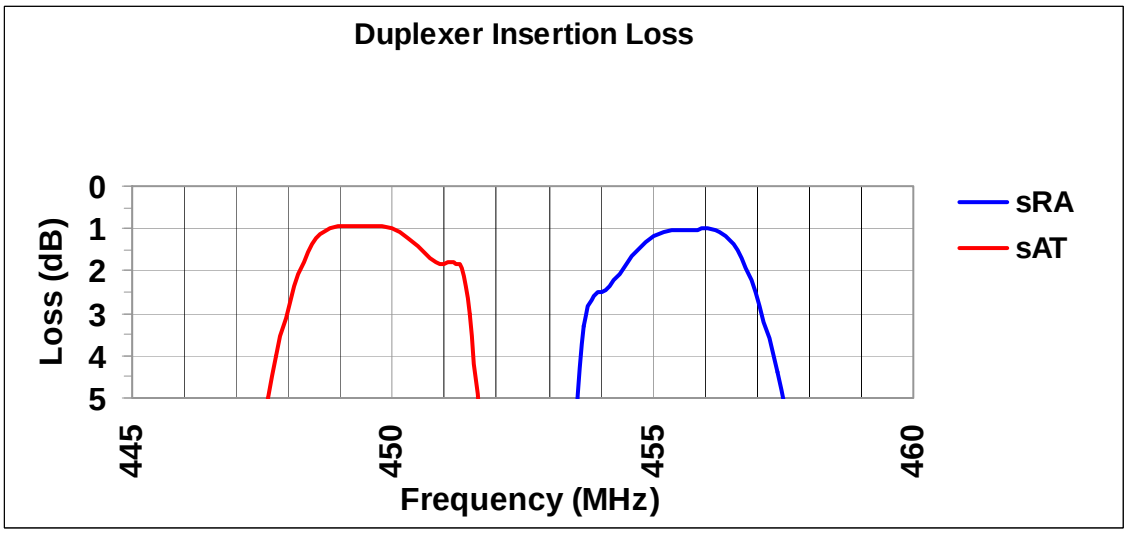
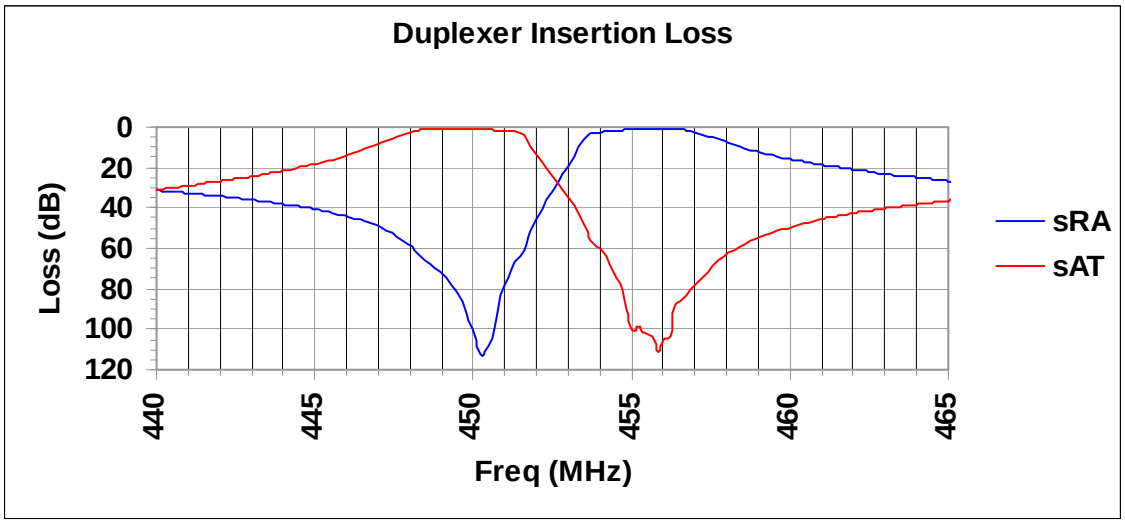


Figure 11. UHF Duplexer Plots 5 MHz T/R Spacing

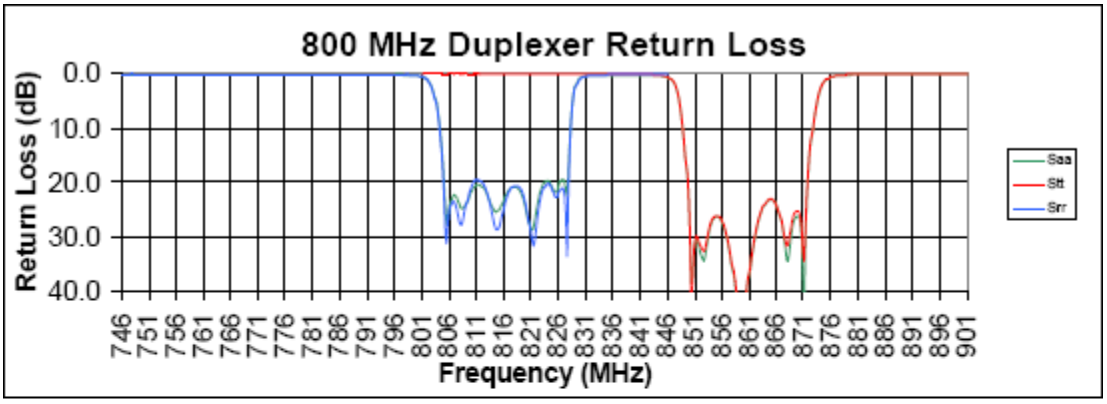


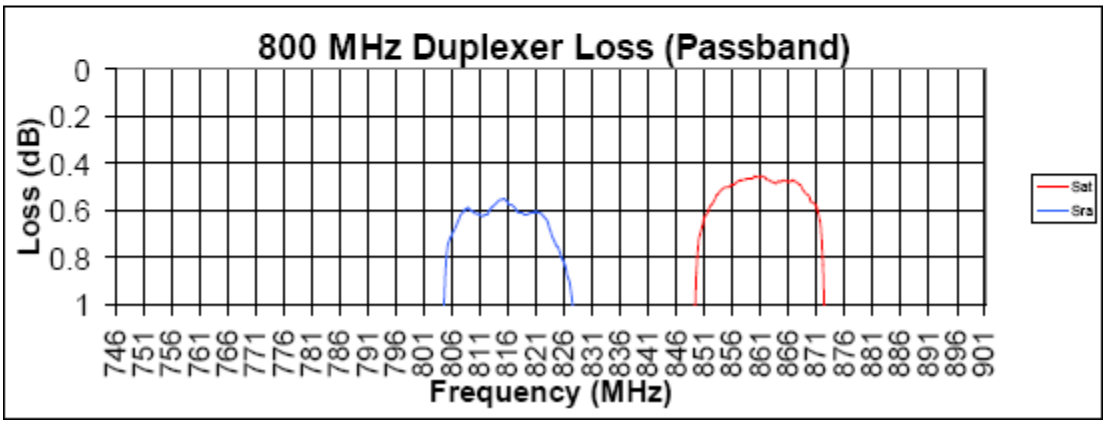


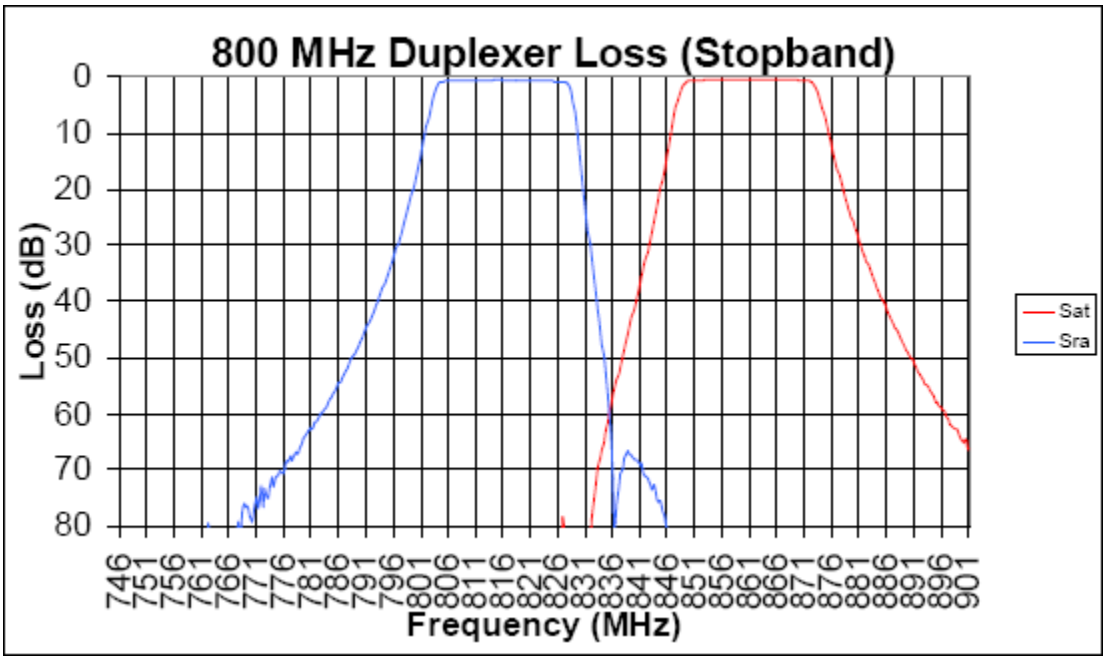
X182 Duplexer (800MHz)

Table 16 16. ~~UHF~~ 800MHz Duplexer Specifications

Parameter	Duplexer Spec Limit	Typical	Notes
Tx Frequency range	851MHz – 870MHz		
Rx Frequency range	806-825 MHz		
Insertion loss TX	1.0 dB	0.8 dB	Does not include cable loss
Insertion loss RX	1.0 dB	0.8 dB	
VSWR max.	1.5:1	1.23 :1	
RX isolation	80 dB	85dB	
TX isolation	80 dB	85dB	
Antenna Connector	QN		
RX/TX Connectors	QN		






800 MHz Duplexer Loss (Stopband)
Loss (dB)
0
10
20
30
40
50
60
70
80
746
751
756
761
766
771
776
781
786
791
796
801
806
811
816
821
826
831
836
841
846
851
856
861
866
871
876
881
886
891
896
901
Frequency (MHz)
Sat
Sra

X265 Base Station/Repeater Preselector (UHF)

The Base Station/Repeater Preselector provides additional rejection of unwanted signals including the transmitter signals from overloading the receiver. The filter is optional for the MTR3000 Base Station/Repeater. The base station/repeater preselector is not required when using a receiver multicoupler system since the preselector in the multicoupler should provide sufficient rejection. This filter can be retuned in the field.

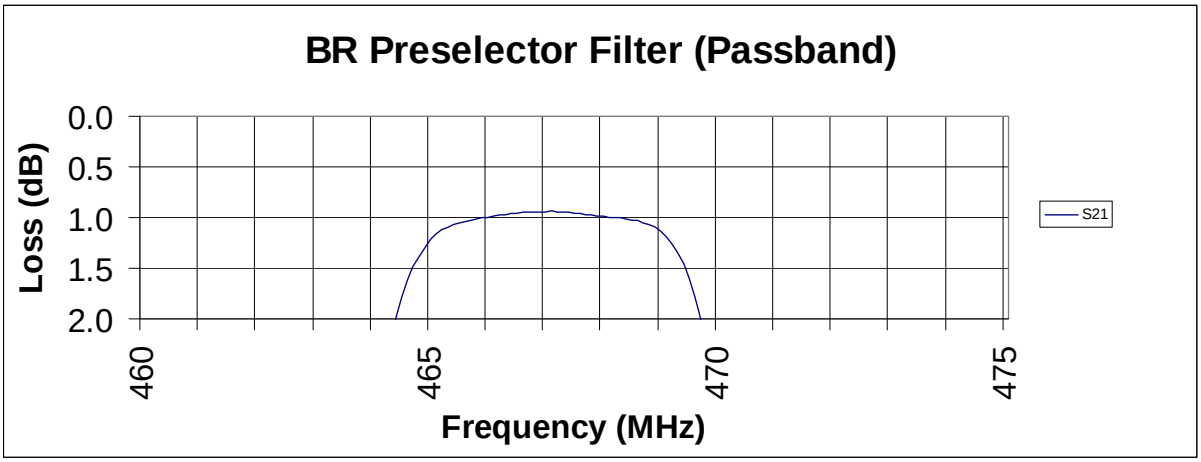
Figure 12. UHF Base Station/Repeater Preselector

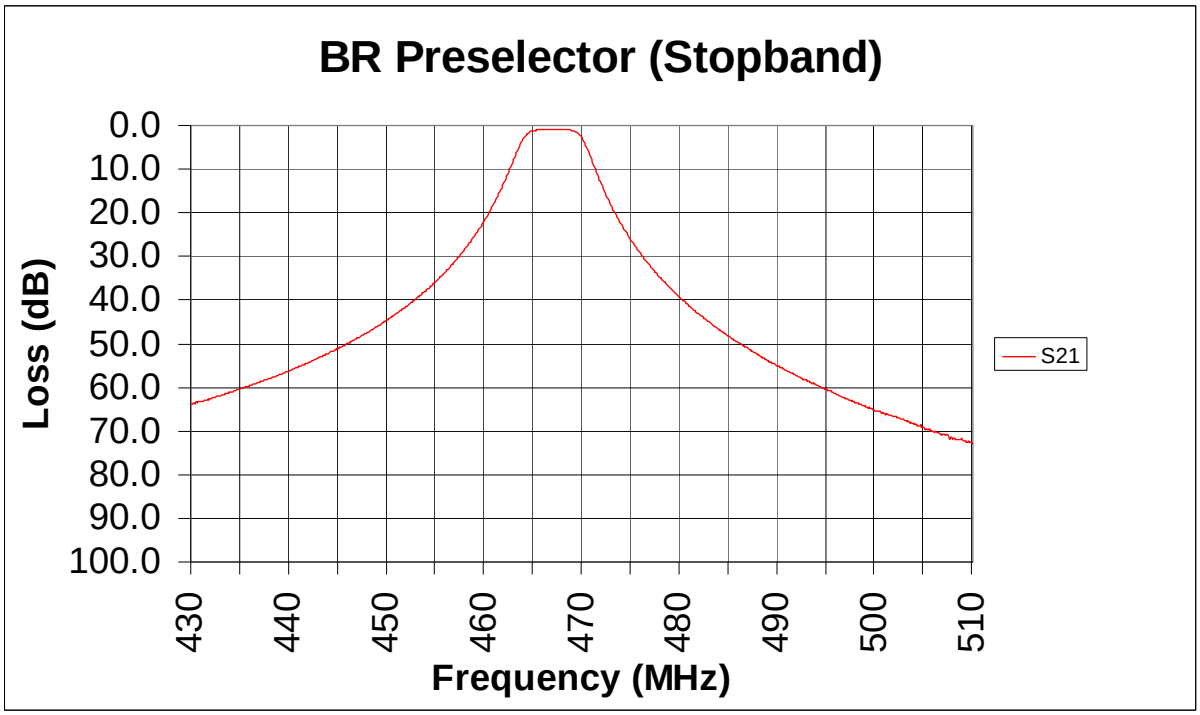
NOTE : The external preselector option is not offered in the 800/900MHz band.

Table 17. UHF Base UHF Base Station/Repeater Preselector Specifications

Parameter	Base Station/Repeater Preselector Spec Limit	Typical	Notes
Tuning Range	435-470 or 470-524 MHz		
Bandwidth	4 MHz		
Insertion loss	2 dB	1.3 dB	Does not include cable loss
VSWR max.	1.9:1	1.5:1	
Input Connector	Mini-UHF		
Output Connector	Mini-UHF		

Figure 13. UHF Base Station/Repeater Preselector Plots (f=467 MHz)





X676 External Dual Circulator

The external dual circulator option provides 2 additional circulators and a low pass filter in a 2 RU tray. This option provides additional transmitter intermodulation attenuation. It is useful at sites with other transmitters when the MTR3000 Base Station/Repeater connects directly to a transmit antenna or duplexer. This option is not needed when a cavity combiner with built in circulator (isolator) is used on the output of the MTR3000 Base Station/Repeater. The assembly includes an input cable which connects directly to the output of the MTR3000 Base Station/Repeater. The output is a panel mount N connector. No field tuning or alignment is possible or required.

Note: The circulator load temperature monitor function will not be available in the initial release of the MTR3000.

X676 (UHF)

For UHF, the units ship either as 403-470 or 470-512 MHz. The plots & specifications in the figures below include the loss of the low pass filter & cables for the 403-470 MHz version.

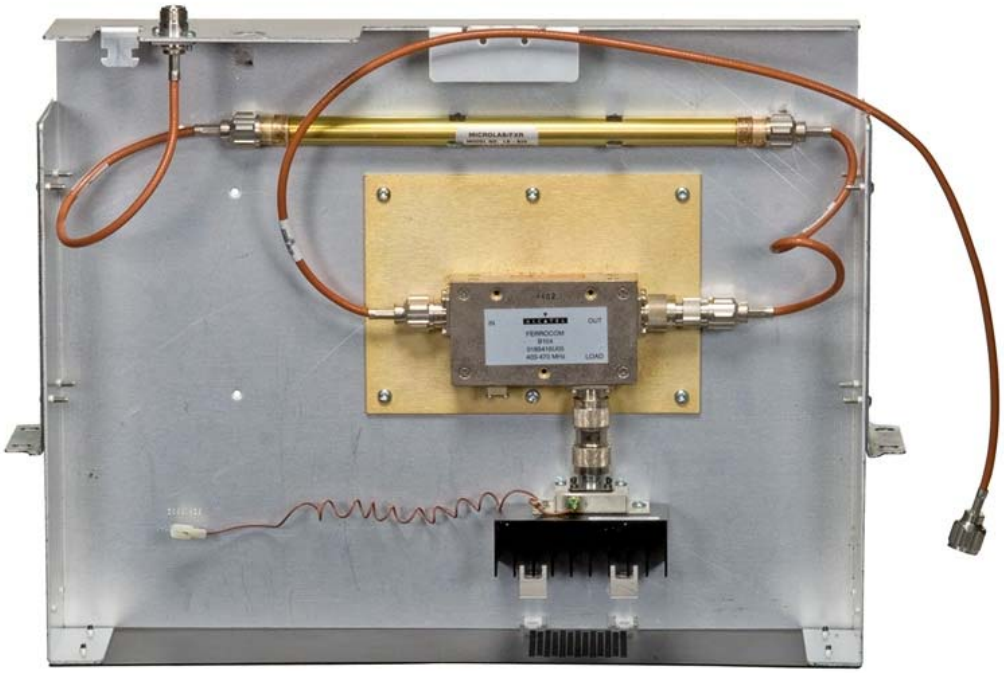
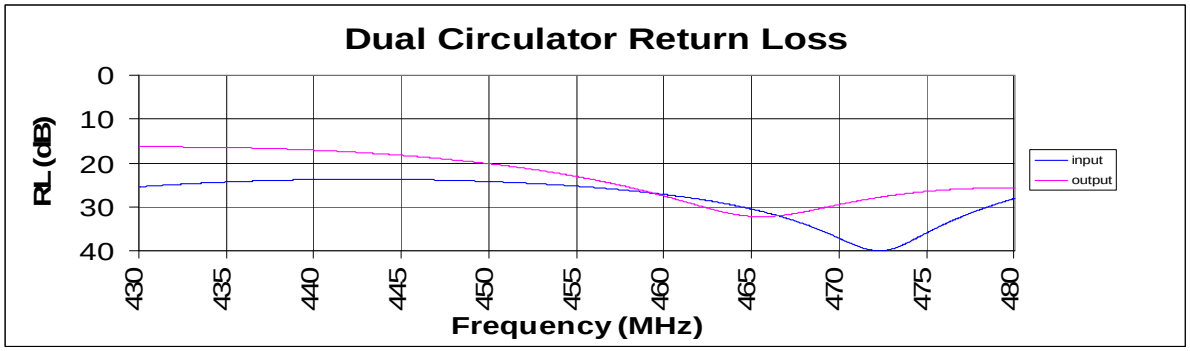


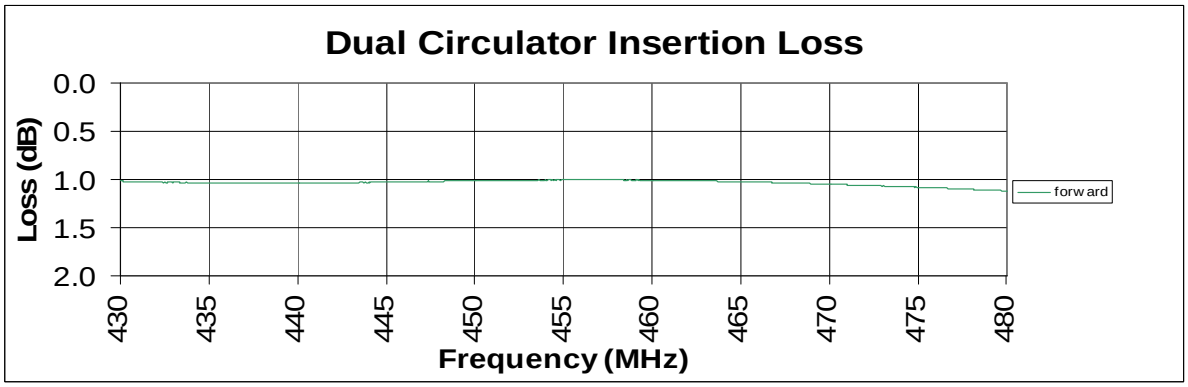
Figure 14. UHF External Dual Circulator Photo

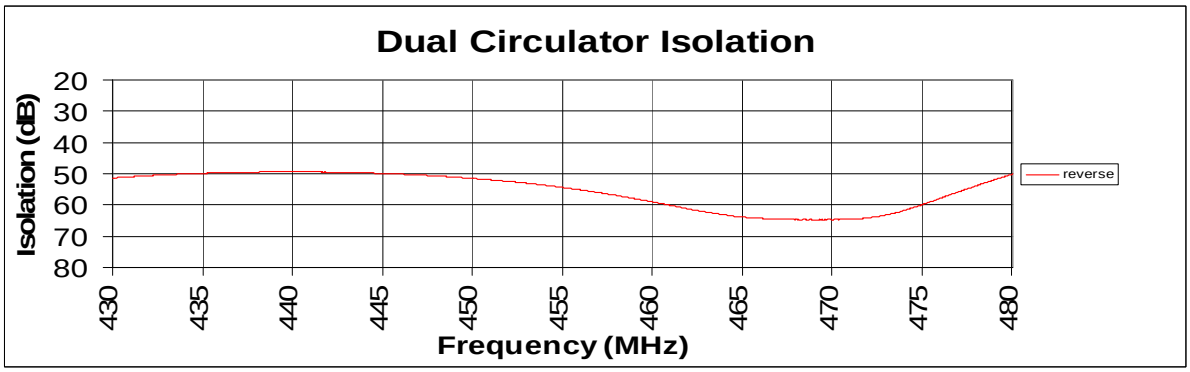
Table 18. UHF External Dual Circulator Specifications

Parameter	Limit	Typical	Notes
Operating Frequency Range	403-470 or 470-524 MHz		
Insertion Loss	1.6 dB	1.2 dB	Includes cable loss
Input Return Loss	18 dB	24 dB	
Reverse Isolation	40 dB	50 dB	
Power (continuous)	200 W		
Harmonic Attenuation < 10 GHz	55 dB		
Input Connector	RF Cable with N male		
Output Connector	N female		

Figure 15. External Dual Circulator Plots (403 - 470 MHz)







X676 (800MHz)

The plots & specifications in the figures below include the loss of the low pass filter & cables.

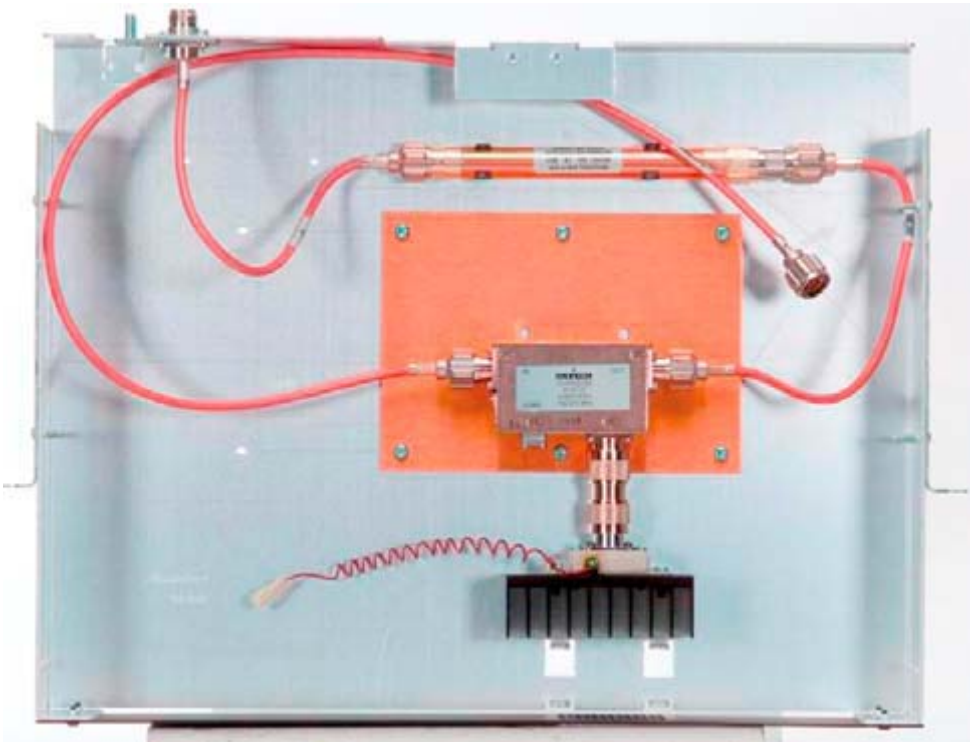
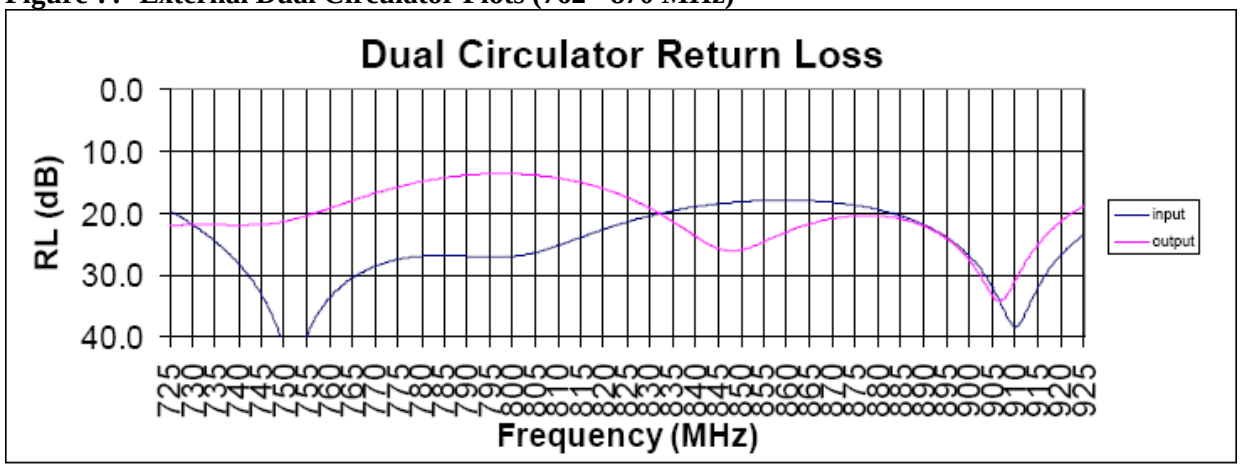


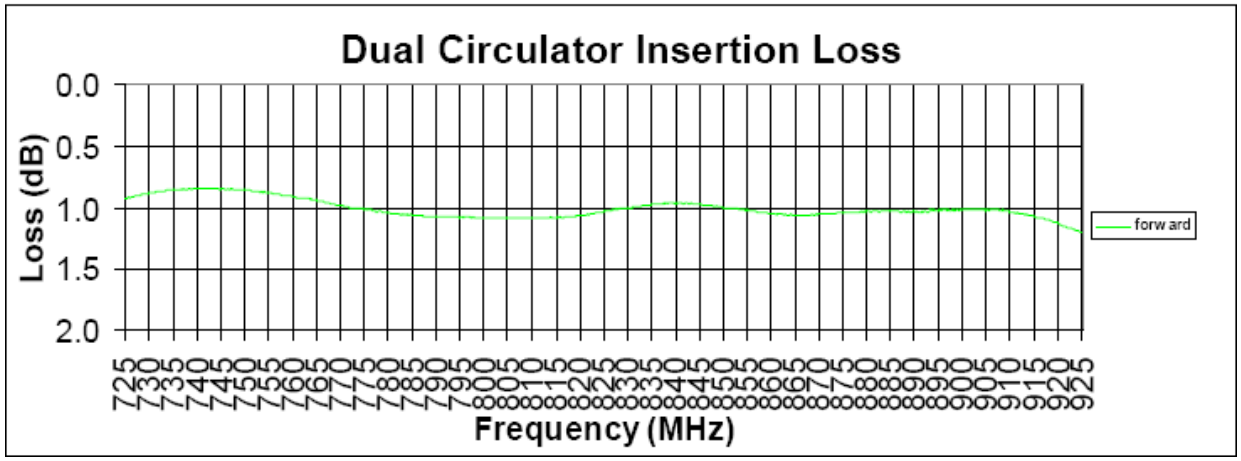
Figure ?? External Dual Circulator

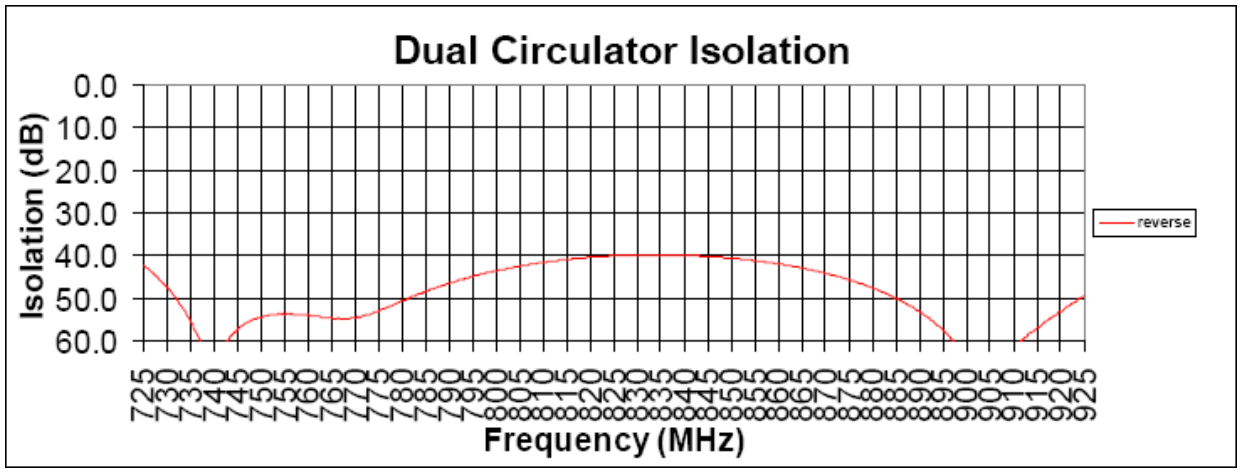
Table ?? UHF External Dual Circulator Specifications

Parameter	Limit	Typical	Notes
Operating Frequency Range	762 – 870 MHz		
Insertion Loss	1.6 dB	1.2 dB	Includes cable loss
Input Return Loss	18 dB		
Reverse Isolation	40 dB	42 dB	
Power (continuous)	200 W		
Harmonic Attenuation	60 dB		
Input Connector	RF Cable with N male		
Output Connector	N female		

Figure ?? External Dual Circulator Plots (762 - 870 MHz)







Minimum Antenna Isolation

For frequencies 403MHz to 470MHz without a RFDS, a minimum of 65dB isolation must be present between the receiver and transmitter antenna (including 2dB loss for each feed line). For 10dB gain antennas, this corresponds to a minimum vertical separation of 26ft tip to bottom with both antennas upright.

For frequencies 470MHz to 524MHz without RFDS, a minimum of 65dB isolation must be present between the receiver and transmitter antenna (including 2dB loss for each feed line). For 10dB gain antennas, this corresponds to a minimum vertical separation of 22ft tip to bottom with both antennas upright.

For the 800MHz band without a RFDS, a minimum of 69dB isolation must be present between the receiver and transmitter antenna (including 2dB loss for each feed line). For 10dB gain antennas, this corresponds to a minimum vertical separation of 13ft tip to bottom with both antennas upright.

Note: It is not recommended to rely on horizontal transmitter and receiver antenna separation for the needed isolation as the distances required are impractical.

For frequencies in the UHF, 800, and 900 bands with a RFDS, use Table 15 and Figure 10 and the characteristics of any RFDS (duplexers, etc) to determine the minimum antenna isolation.

MODULES

Power Supply Module

The MTR3000 Power Supply Module accepts an AC or a DC input and generates three output DC voltages to power the station modules. All three outputs provide over-voltage / over-current protection to their loads.

The power supply is a high-frequency switched mode design with power factor correction, all contained in a metal heat-sink and mounted on the left-hand side of the station.

The AC input connection is made at the rear of the station via an IEC-type connector keyed to accept only high temperature type mating connectors. Also provided is a DC input connection which can be used as the primary means to power the station or used for battery revert operation should the AC mains fail.

Power supply cooling is provided by a thermostatically controlled external fan (a field replaceable part itself) which provides forced air across the power supply heat sink fins.

Power Supply Connections

There are two electrical connection assemblies on the PS:

- Power supply connection and AC fail indication to backplane (rear cable harness)
- Power supply connection to power amplifier (rear cable harness)

PS Containment

The PS is secured to the station chassis with 6 TORX screws (T20 bit size required).

Figure 16. Power Supply Module

Performance Specifications

Table 19. Power Supply Performance Specifications (AC)

AC Performance Specifications	
Parameter	**Value or Range**
Input Voltage Range	85 VAC to 264 VAC
Input Frequency Range	47Hz to 63 Hz
Steady State Output Voltage	28.6V @ 13 A
	14.2V @ 8 A
	5.1V @ 2 A
Output Power (Rated)	500W
Output Ripple +28.6 VDC	50 mV p-p, @ 25°C (77°F)
Output Ripple +14.2 VDC	50 mV p-p, @ 25°C (77°F)
Output Ripple +5.1 VDC	100 mV p-p, @ 25°C (77°F)

Table 20. Power Supply Performance Specifications (DC)

DC Performance Specifications	
Parameter	**Value or Range**
Input Voltage Range	21.6 VDC to 32 VDC
Steady State Output Voltage	28.6V @ 13 A Input voltage dependent
	14.2V @ 8 A, Regulated
	5.1V @ 2 A, Regulated
Output Power (Rated)	500W
Output Ripple +28.6 VDC	Input voltage dependent (Argus)
Output Ripple +14.2 VDC	50 mV p-p, @ 25°C (77°F)
Output Ripple +5.1 VDC	100 mV p-p, @ 25°C (77°F)

Table 21. Power Supply Performance Specifications (Switching)

Typical Switching Frequencies	
Parameter	**Value or Range**
Power Factor Correction	82kHz
Main Converter	137kHz

Power Amplifier Module

Figure 17. MTR3000 Power Amplifier Module

The Power Amplifier (PA) is a forced convection-cooled continuous wave RF power amplifier. It accepts a low-level modulated RF signal from the Exciter Module, and amplifies the signal to the end users selected transmitter output power.

The PA is designed for continuous-duty operation across the specified band for all power levels. All PA modules contain a multi-stage power amplifier board at the input (RF Board), a circulator with isolation load termination, a low-pass filter, and directional couplers at the output (Output Board), and a DC Distribution Board incorporating circuitry for diagnostics and RF power control.

The PA provides alarms for VSWR, Low Output Power, High Temperature, Low/High DC voltage and Cooling Fan failures (cooling fan is field replaceable). In the event of these alarms, with their severity weighed, the PA in conjunction with the station firmware will take measures such as rolling the power back or de-keying the station to protect the hardware from damage or improper operation.

The PA and its sub-circuits are broad-band devices and require no manual tuning or alignment to operate at the site as their calibration parameters are stored in the PA's EEPROM. As such, in the event the PA requires replacement, no calibration is needed after its replacement.

Note: If the station is upgraded from MTR2000, refer to MTR2000 Basic Service Manual (included with the original MTR2000 station) for all PA information.

Power Amplifier Connections

There are three electrical connection assemblies on the PA:

- Power supply (rear cable harness)
- Communications connector (rear ribbon cable).
- RF input connector (BNC female)
- RF output connector (N-Type female).

PA Containment

The PA is secured to the station chassis with 6 TORX screws (T20 bit size required).

PA Basic Electrical Performance

Table 22. Power Amplifier Performance Specification

Parameter	Specification		
Operational Frequency Range	403-470 MHz	470-524 MHz	800/900MHz
Minimum Input Return Loss (TX mode)	7 dB	7 dB	10 dB
Rated RF Output Power Range	8 - 100 W	8 - 100 W	8 - 100 W
Rated RF Input Power Range	9.8 – 14 dBm	9.8 – 14 dBm	12.8 – 18.5 dBm
28 V Supply Nominal Voltage (AC Power)	28.6 V (+/- 4%)	28.6 V (+/- 4%)	28.6 V (+/- 4%)
14 V Supply Nominal Voltage	14.2 V (+/- 3.5%)	14.2 V (+/- 3.5%)	14.2 V (+/- 3.5%)
28V Supply Maximum Current Draw	12.6 A	12.6 A	12.6 A
14V Supply Maximum Current Draw	2.0 A	2.0 A	2.0 A
Maximum Standby Power Consumption	1.2 W	1.2 W	1.5 W

Power Meter Accuracy

The forward power meter is typically -/+10% at maximum rated output power. Keep in mind that the calibration point of the reading is the output connector of the PA. This is important to remember when duplexers, isolator trays, or antenna relays are installed.

Receiver Module

Figure 18. Receiver Module

The receiver provides the hardware portion of the receiver functionality for the station. The receiver module performs selective band-pass filtering (varactor tuned) and dual down-conversion of the desired RF signal. An application specific receiver IC then performs an analog-to-digital conversion of the desired received signal and outputs a differential data signal to the Station Control Module (SCM).

The receiver has the capability through CPS (Customer Programming Software) to be programmed for an analog or digital mode. For analog mode, the receiver is programmed for 12.5 kHz and 25 kHz bandwidths, on a per channel basis. This allows a single station to be programmed to function in various bandwidths without changing hardware

For UHF stations without the external preselector option, it is not recommended to allow a co-located transmitter frequency which is 36.675MHz above the receiver frequency.

Receiver Connections

There are two electrical connection assemblies on the receiver:

- Communications / Power / Digital signal (edge connector)
- RF input connector (BNC female)

Receiver Basic Electrical Performance

Table 23: Receiver Performance Specification

Parameter	Specification		
Operational Frequency Range	403-470 MHz	450-524 MHz	806-825MHz & 896-902MHz
Electronic Bandwidth	Full Bandwidth	Full Bandwidth	Full Bandwidth
Analog Sensitivity (12dB SINAD) Rx BNC	-118.8dBm (0.257uV) *Receiver FRU w/o cable loss*		117.8dBm (0.288uV) *Receiver FRU w/o cable loss*
Intermodulation Rejection	85dB		85dB
Adjacent Channel Rejection (TIA 603A)	75 dB at 12 kHz, 80 dB at 25 kHz		75 dB at 12 kHz, 85 dB at 25 kHz
Spurious and Image Response Rejection	85dB		90dB
Intermediate Frequencies	1st : 73.35 MHz 2nd : 2.25 MHz		1st : 73.35 MHz 2nd : 2.25 MHz
Current Draw (Maximum)	0.04A from 14.2 VDC supply 0.52A from 10 VDC supply 0.11A from 8 VDC supply		0.04A from 14.2 VDC supply 0.52A from 10 VDC supply 0.11A from 8 VDC supply
RF Impedance	50 Ω		50 Ω

Exciter Module

Figure 19. Exciter Module

The Exciter Module (in conjunction with the Power Amplifier Module) provides the transmitter functions for the station. Contained within a metal clamshell housing, the Exciter board generates a low-level modulated Radio Frequency (RF) signal that is delivered to the power amplifier module for further amplification and output to the transmit antenna. The Exciter Module interfaces directly with the Station Control Module (SCM), which provides control signals and monitoring, and routes transmit digitized audio to the Exciter.

The RF carrier is generated by a frequency synthesizer consisting of synthesizer circuitry and Voltage-Controlled Oscillator (VCO) circuitry. Exciter module control signals, monitoring, and audio processing are handled by the Station Control Module (SCM).

Exciter Connections

There are two electrical connection assemblies on the receiver:

- Communications / Power / Digital signal (edge connector)
- RF output connector (BNC female)

Exciter Basic Electrical Performance

Table 24. Exciter Performance Specification

Parameter	Specification		
Operational Frequency Range	403-470 MHz	450-524 MHz	851–870 MHz and 935–941 MHz
Electronic Bandwidth	Full Bandwidth	Full Bandwidth	Full Bandwidth (851–870 MHz & 935–941 MHz)
Output Power (Ex BNC)	10 - 14dBm		13–18 dBm (800 MHz), 14–18 dBm (900 MHz)
Current Draw (Maximum)	0.04A from 14.2 VDC supply 0.15A from 10 VDC supply 0.02A from 8 VDC supply		0.05 A from 14.2 VDC supply 0.15 A from 10 VDC supply 0.1 A from 8 VDC supply
Harmonics	-20dBc		-20dBc
RF Impedance	50 Ω		50 Ω

Station Control Module

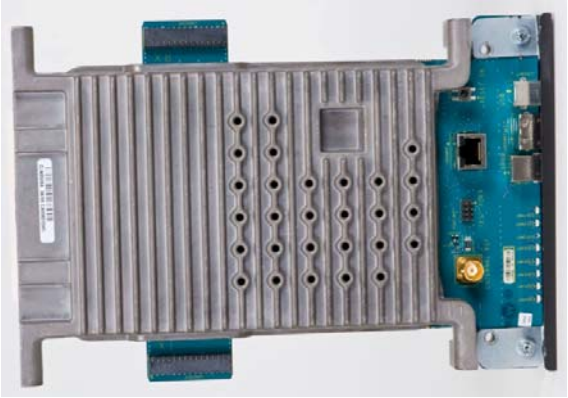


Figure 20. Station Control Module

The Station Control Module (SCM) performs station management, digital signal processing, data formatting and audio routing for the base station/repeater. It provides interfaces to the Exciter, Receiver and PA as well as the interfaces to external site equipment. The controller uses two TI OMAP series processors: One for transmit and overall base station/repeater control functions and one for all receive functions.

The audio interface provides flat and pre-emphasized transmit audio inputs as well as an independent data/PL/DPL input. Transmit and receive audio signals are accessible on the rear DB25 connector. A front panel microphone and speaker provide local audio (analog mode only).

The 10/100BaseT Ethernet port is used to connect to station to a local or wide area network for IP Site Connect and remote diagnostics & control. The front cover must be removed to access this connector. Alternatively, a short extension cable can be used to route this connection to the rear of the station.

A front accessible USB port provides the interface to the local service computer for radio configuration.

The SCM provides the station frequency reference to the Exciter and Receiver module. A TCXO (Temperature Compensated Crystal Oscillator) provides the stability required for UHF and VHF bands and an OCXO (Oven Controlled Crystal Oscillator) provides the stability required for 800/900MHz bands. An external frequency reference can be connected to a BNC connector behind the front panel to calibrate the onboard TCXO/OCXO. The front cover must be removed to access this connector.

If an external reference is to be used with the MTR3000, a short extension cable can be used to route this connection to the rear of the station. Alternately, the reference cable (and/or Ethernet cable) can be routed out the front of the station via the slots provided along the edge of the front bezel.

Status Indicators & Buttons

The diagram below shows the front panel of the SCM. The following tables describe the connectors and LEDs.

Figure 21. Station Control Module (Front View)

MTR3000 Controller Front Panel Connectors

Table 25. Table Controller Connector and Switch Definitions

Connector Name	Connector Type	Purpose
Service	USB Type B	Service Computer connection. This connector is accessible with front cover in place. V_{BUS} (+5 volts) is not provided on the USB connector to prevent potential damage to the Service Computer.
Mic	RJ45 (8 pin)	Microphone connection. Compatible with microphone GMMN4063 or equivalent (older model, GMN6147). This connector is accessible with front cover in place. Supported in analog mode only. **Note:** The MTR3000 does not support the 3 control buttons on the GMN6147 microphone for speaker volume, Rx monitor, and Intercom control functions.
Speaker	4P4C (4 pin)	Speaker connection. Compatible with Service Speaker HSN1000 or HSN1006. This connector is accessible with front cover in place. Supported in analog mode only
Ethernet	RJ45 (8 pin) (Vertical)	Provides for network connections (e.g. IP Site Connect). The front cover must be removed to access this connector. Alternatively, a short extension cable (straight or crossover) can be used to route this connection to the rear of the station.
Ext Ref	BNC (Vertical)	External reference input. The front cover must be removed to access this connector. Alternatively, a short extension cable can be used to route this input to the rear of the station.

MTR3000 Controller Software Controlled LEDs

Table 26. Controller Definition and Meaning

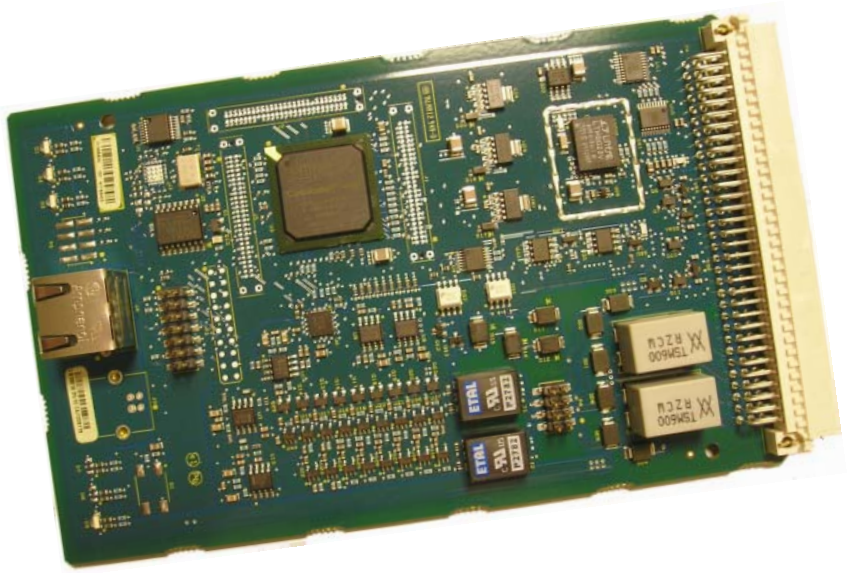
LED Function Name	Color	State	Condition
Power/Status	Off	N/A	Station Off
	Green	Flashing	Station Operating Normally, with DC power
		Solid	Station Operating Normally, with AC power
	Red	Flashing	Station Operational - Minor Alarm
		Solid	Station Not Operational and locked - Major Alarm
	Amber	Flashing	Station in Service Mode
		Flashing	Station in Boot Mode (all LEDs)
		Solid	Station is Disabled (Dekeyed)
Transmit Slot 1	Off	N/A	Transmitter is not transmitting
	Green	Solid	Transmitter is transmitting
	Amber	Flashing	Transmitter is transmitting, but at reduced power
		Flashing	Station in Boot Mode (all LEDs)
Transmit Slot 2 (not used with analog)	Off	N/A	Transmitter is not transmitting
	Green	Solid	Transmitter is transmitting
	Amber	Flashing	Transmitter is transmitting, but at reduced power
		Flashing	Station in Boot Mode (all LEDs)
Receive Slot 1	Off	N/A	Receiver qualifier has not been met
	Green	Solid	Receiver qualifier has been met
	Amber	Flashing	Station in Boot Mode (all LEDs)
Receive Slot 2 (not used with analog)	Off	N/A	Receiver qualifier has not been met
	Green	Solid	Receiver qualifier has been met
	Amber	Flashing	Station in Boot Mode (all LEDs)
Mode	Off	N/A	Analog Mode (FM)
	Blue	Solid	Digital Mode (2 Slot TDMA, 4FSK)
		Flashing	DMM feature is active, but no calls are currently being processed.

MTR3000 Controller Hardware Controlled LEDs

Table 27. Controller Definition and Meaning

LED Function Name	Color	State	Condition
Ethernet	Off	N/A	No Ethernet connection
	Green	Solid	Linked
	Green	Flash	Network Traffic
Ext Ref	Off	N/A	No external reference is present
	Amber	Solid	Training process is completed, and the calibration data has been written to the EEPROM, or an external reference is present after training (which the base station/repeater has phase locked to).
	Green	Solid	Locked to external reference, and training is in progress

Wireline Board



The Wireline Board is the interface between the MTR3000 base station/repeater and the customer's phone lines. The Wireline Board supports Local PTT, Tone, and DC Remote Control modes, of which the later two allow for channel selection and PTT signaling from compatible consoles. The Wireline Board can be configured for either 2-wire or 4-wire operation as needed.

The Wireline Board uses Digital Signal Processing (DSP) techniques to implement all required remote control functions, filtering algorithms, and audio adjustments. Audio enters and leaves the board as analog, but is converted to digital in the interim for processing.

Table: Wireline Performance Specifications

Parameter	Specifications
Wireline Transmit Level	+10 to -30 dBm
Wireline Receive Level	+7 to -30 dBm
Return Loss	> 20 dB
Distortion Introduced	< 0.5%

The Wireline board allows for configurable impedance matching to the greater wireline network. Line impedance is generally standardized by country or region as shown in the table below. The line impedance setting is configured using the CPS software configuration tool.

Table:. Selectable Wireline Impedances

Impedance	Typical Use Case
High Impedance	For use with external impedance matching.
600 Ohm	For Argentina, Canada, Chile, Columbia, Ecuador, El Salvador, Guam, Hong Kong, India, Indonesia, Japan, Jordan, Kazakhstan, Kuwait, Macao, Malaysia, Mexico, Oman, Pakistan, Peru, Philippines, Russia, Saudi Arabia, Singapore, South Korea, Taiwan, Thailand, UAE, USA and Yemen.
270 Ohm + (150 nF || 750 Ohm)	For Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Bahrain, Croatia, Cyprus, Czech Republic, Egypt, Hungary, Israel, Latvia, Lebanon, Malta, Morocco, Nigeria, Poland, Romania, Slovakia and Slovenia.
220 Ohm + (115 nF || 820 Ohm)	For Australia, Bulgaria and South Africa.
370 Ohm + (310 nF || 620 Ohm)	For New Zealand.
900 Ohm	For Brazil.
320 Ohm + (230 nF || 1050 Ohm)	For United Kingdom.
200 Ohm + (100 nF || 680 Ohm)	For China.
900 Ohm || 30 nF	For legacy MTR2000.

Tone Remote Control

A tone sequence must meet specific requirements for timing, amplitude, and frequency to be considered valid. The timing requirements for a tone sequence are defined in the tables below. All tone sequences must include a minimum of 120 mS of high level guard tone and 40 mS of function tone. i.e. A function tone is required (even on single frequency systems). Low Level Guard Tone (LLGT) is not required. This allows the console to change frequencies or manipulate alternate CPS defined GPIO functions without keying up the base station/repeater. When Low Level Guard Tone is present (at the end of a tone sequence), the base station/repeater will key up and remain transmitting for as long as LLGT is present.

The following tables reflect the predefined tone plans the MTR3000 base station/repeater supports (+/- 10Hz):

Function Tone Definition Table (TRC15)	
Tone (Hz)	**Function**
2050Hz	Monitor
1950Hz	Frequency 1
1850Hz	Frequency 2
1750Hz	Frequency 3
1650Hz	Frequency 4
1550Hz	Frequency 5
1450Hz	Frequency 6
1350Hz	Frequency 7
1250Hz	Frequency 8
1150Hz	Frequency 9
1050Hz	Frequency 10
950Hz	Frequency 11
850Hz	Frequency 12
750Hz	Frequency 13
650Hz	Frequency 14
550Hz	Frequency 15

Function Tone Definition Table (TR7)	
Tone (Hz)	**Function**
2050Hz	Monitor
1950Hz	Frequency 1
1850Hz	Frequency 2
1750Hz	Frequency 3
1650Hz	Frequency 4
1550Hz	Frequency 5
1450Hz	Frequency 6
1350Hz	Frequency 7
1250Hz	Not Used
1150Hz	GPIO8 Assert (see note)
1050Hz	GPIO8 De-assert (see note)
950Hz	GPIO9 Assert (see note)
850Hz	GPIO9 De-assert (see note)
750Hz	Not supported in initail release
650Hz	Not supported in initail release
550Hz	Not Used

NOTE: GPIO 8 and 9 do not support the CPS assignable “Disable” and “Tx Power Level” functions.

DC Remote Control

The following table reflects the predefined DC signaling plan the MTR3000 base station/repeater supports:

Current Definition Table	
Current (mA)	**Function**
-2.5mA (+/- 20%)	Monitor
-5.5mA (+/- 20%)	Frequency 3
-12mA (+/- 20%)	Frequency 4
2.5mA (+/- 20%)	Frequency 5
5.5mA (+/- 20%)	Frequency 1
12.5mA (+/- 20%)	Frequency 2

MTR3000 INSTALLATION

Rack and Cabinet Installation, Placement & Site Design

Site Design

There are certain rules which must be followed when designing a site with base stations/repeaters which are forced convection cooled. Since base stations/repeaters with forced convection cooling (fans) are typically smaller than those without fans, the natural tendency of the site designer is install as many base stations/repeaters in an area as possible. When cooling base stations/repeaters, the environment in which the base stations/repeaters are installed is just as important as the actual heat sink designs for the electronics. Some planning must go into the ventilation, and in most cases, air conditioning of the sites.

When an MTR3000 is placed in a cabinet, there must be vent openings on the sides for air to enter, and vents in the back for air to exit. To make sure the airflow through the cabinet is not restricted there must be a minimum of six inches of open area between the outlet of the air vent on the rear of the cabinet and any airflow obstructions. It is also desirable to avoid exhausting heat on cables to avoid shortening cable life span.

Warning: It is strongly recommended to NOT install batteries in the cabinet with the station. Hydrogen and oxygen gases produced during electrolysis are colorless and odorless. The hydrogen gas is of particular concern since it produces a potentially explosive atmosphere when it reaches a 4% level of concentration in the air. The room containing the battery must have sufficient natural or forced air ventilation to prevent a build-up of gas exceeding 2% of the room's occupied volume. In addition, the gas must be vented to the outside rather than re-circulated. Therefore, installing a battery in the cabinet could cause serious venting problems.

A convenient location should be chosen with regard to power, control line, and antenna access. Refer to the Motorola R56 Standards (hardcopy p/n: 68P81089E50-B, CD-ROM p/n: 98R80384V83) for proper placement and installation of these lines. The base station/repeater should also be readily accessible for future maintenance and servicing.

Providing adequate lightning protection is critical to a safe and reliable communications site. Telephone lines, RF transmission cables, and AC and DC power lines must all be protected to prevent lightning energy from entering the site building. RF transmission lines from the antenna, down the tower, and into the building must be grounded. All RF transmission lines, including unused spares, must contain a lighting surge suppresser. Further information can be found in the Motorola Quality Standards Fixed Network Equipment Installation manual, R56 (Part # 68-81089E50).

Equipment shall be installed in site meeting the requirements of a “restricted access location”, per UL60950-1, which is defined as follows: “Access can only be gained by service persons or by user who has been warned about the possible burn hazard on equipment metal housing and hazardous energy

level. Access to the equipment is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location".

Installation Considerations

Rear access is required for the MTR3000.

No clearance is required on the sides of the cabinet or racks; however, there must be provisions for proper ventilation which allows for air intake by the PA and PS fans, which draw air in from the side.

Service access for the MTR3000 Base Station/Repeater requires a minimum of two feet in front and rear of the rack or cabinet for servicing equipment.

Seismic Reliability

MTR3000 cabinets and open racks that are installed in seismically active areas may require additional anchoring and support. Refer to your local regulatory agency requirements regarding seismic considerations for your particular location. For installation guidelines, also refer to the Motorola Standards and Guidelines for Communications Sites (R56) document (Motorola Part Number 6881089E50).

Cabinet Stacking

Depending on the floor-to-ceiling height available, the MTR3000 cabinets and racks may be stacked. It is necessary to securely fasten the bottom cabinet or modular rack to the floor or other rigid surface capable of supporting the load of the stacked configuration. Order kit number TRN7750 for hardware between two cabinets or modular racks that are stacked. The maximum number of cabinets or modular racks that can be stacked is as follows:

The 30" Modular Rack can be stacked a maximum of 3 per stack (2286 mm (90 in.)).
The 45" Modular Rack can be stacked a maximum of 3 per stack (2286 mm (90 in.)).
The 52" Modular Rack can be stacked a maximum of 2 per stack (2640 mm (104 in.)).
The 30" Cabinet can be stacked a maximum of 3 per stack (2286 mm (90 in.)).
The 46" Cabinet can be stacked a maximum of 2 per stack (2337 mm (92 in.)).
The 60" Cabinets cannot be stacked.

Cabinet Mount

The mounting of only ONE STATION PER CABINET is recommended. More than one station per cabinet will result in degradation of thermal specifications at high ambient temperatures. Appropriate precautions should be taken to ensure that the station ambient temperature does not exceed +60˚ C (+140˚ F). These guidelines apply to closed cabinets. For open cabinets (i.e., no doors or side panels), refer to rack mount guidelines below for thermal impact.

Rack Mount

Multiple MTR3000 stations can be mounted in an open rack without degradation of specification. To maintain thermal specifications for equipment including the DLN6718 (Station Control OCXO), MTR3000 stations require 1 Rack Unit of spacing between stations. For stations with DLN6718 that are installed with no spacing, the station ambient temperature may not exceed +50˚ C (+122˚ F).

NOTE: The DLN6718 is standard/required in the 800/900MHz bands (T3000A and T2003A)

Adding MTR3000 and/or Upgraded MTR2000 stations to MTR2000 sites

An MTR3000 Base Station/Repeater can be added to existing repeater sites currently populated with MTR2000 stations. The following physical connections are backwards compatible between that of an MTR2000 and an Upgraded MTR2000/ MTR3000 station:

- External frequency reference
- RX antenna
- TX antenna
- DC Power
- AC Power
- Microphone (analog mode only)
- Speaker (analog mode only)

The peripherals that are used for the MTR2000 can remain in use for the MTR3000. There is no need to change out any of the following peripherals if a MTR2000 is upgraded or an MTR3000 is used in place of an MTR2000:

- Duplexer
- Preselector
- Dual circulator
- External frequency reference (EFR)
- Antenna relay
- Argus Battery Charger (L1884A)

The following connectors have changed between that of an MTR2000 and an Upgraded MTR2000 / MTR3000. They are as follows:

- Service port -- It is now a type B female USB
- Wireline Connector (Backplane J6) -- It is now a detachable screw terminal block.

Note: This connection is not functionally supported in the initial release of the MTR3000.

Analog Radio Interface

The analog radio interface at the System (J5) and Aux (J7) backplane connections has extensively changed between that of an MTR2000 and an Upgraded MTR2000 / MTR3000. All existing cables that connected to a MTR2000 station's J5 and J7 connector can not be used with an Upgraded MTR2000 / MTR3000. In general, all analog radio interfaces will be made at the J7 connector on the MTR3000. Details of the signals are provided in the "Backplane Connections" section of this manual.

The 3rd party controller cables that will connect to the MTR3000 J7 connector can be fabricated by the aid of the wiring diagrams provided in the Basic Service Manual (Appendix D). Alternately, the cables for the following 3rd party controllers can also be obtained directly from the noted manufactures.

- Model 30 World Patch (Motorola, X244AH)
- Model 38 Community Repeater Panel (Motorola, X244AJ)

NOTE: The MTR3000 base station/repeater doesn't require the use of the Wireline Board to support the above mentioned 3rd party controllers. This is being noted since the MTR2000 did require the use of its Wireline Board to support said 3rd party controllers.

Wireline Interface

The Wireline interface to the MTR3000 base station/repeater is provided by a the MTR3000 Wireline Board. Although the Wireline is installed as a card inside the MTR 3000 Base Station/Repeater, its operation is similar to an External Tone Remote or a DC Remote Adapter. The Wireline Board drives the same GPIO signals that an external controller would drive if it were connected to the J7 DB-25 connector on the back of the base station/repeater. Although the Wireline Board's functionality is similar with an external controller solution, almost all Wireline options are configured through the CPS and Tuner software configuration tools, just as the other base station/repeater options are.

The salient differences between the MTR3000 and MTR2000 Wireline functions are as follows:

- The MTR3000 Wireline supports (and the MTR2000 does not) the following:
  - DC remote
  - 2-Wire, 4-Wire, and multi-national impedance support with one FRU
  - CPS configurable impedances
  - FCC part 68 compliance
  - Preconfigured tone tables

- The MTR2000 Wireline supports (and the MTR3000 does not) the following:
  - Dynamic tone tables
  - Multiple commands per tone
  - 8-Wire

NOTE: The MTR3000 Wireline Board will not function in the MTR2000 base station/repeater

GPIO and Audio Configuration

The configuration of the MTR3000 GPIO and audio types for the various controllers noted in the "Analog Radio Interface" and "Wireline Interface" sections can be accomplished with the CPS application. Details of the specific configuration settings are noted in Appendix G of the Basic Service Manual.

Incompatible MTR2000 FRUs and Boards

The MTR2000 wireline boards are not compatible with an upgraded MTR2000 / MTR3000 station. After a MTR2000 has been upgraded, its existing wireline board (if present) should be removed.

Additionally, the Aux I/O board from the MTR2000 will not be supported in the initially releases for the upgraded MTR2000 / MTR3000. However, the COR and PTT functions (TIA986 E&M compliant) are planned to be supported in future releases via the MTR2000 Aux I/0 board.
The Main / Standby feature was often employed in the MTR2000 station, which required the Wild Card Option as well as the Aux I/O card itself. The upgraded MTR2000 / MTR3000 will support a version of the Main / Standby function as a standard feature. The configuration parameters to invoke this functionality are noted in the MOTOTRBO System Planner.

Note: With the Upgraded MTR2000 / MTR3000, once the standby station is the active repeater, the main repeater will be locked out of service even if its fault recovers. To unlock an Upgraded MTR2000 / MTR3000 station requires a local read / write of the station codeplug after the fault condition is corrected.

Lastly, MTR2000 receivers, exciters, and control FRUs can not be used in conjunction with any MTR3000 receiver, exciter, or control FRU.

MTR3000 and Upgraded MTR2000 Analog Radio Interface Differences

Via the components of a MTR2000 MOTOTRBO Digital Upgrade (T2003A), an upgraded MTR2000, will provide identical functionality to that of a MTR3000 with the exceptions of the following:

- The PA "sticker code calibration coefficients" must be entered into the codeplug for an Upgrade MTR2000 since the original MTR2000 PA does not have an onboard EEPROM for their storage.
- The Upgraded MTR2000 J7 backplane connector does not provide the accessory 14.2VDC (pin 20) or GPIO_10 (pin 5) functionality. For the Upgraded MTR2000, these signals must be accessed at the J5 System connector.
- The Upgraded MTR2000 will not support the MTR3000 wireline card, which provides integrated tone and DC remote control.

- NOTE: In regards to the 2nd and 3rd bullets above, an Upgraded MTR2000 can support said J7 backplane connections as well as the MTR3000 Wireline Board if the MTR2000 backplane is replaced/upgraded. The part number of the replacement/upgraded backplane is DLN6721.

MTR3000 and Upgraded MTR2000 Analog Radio RF Performance Differences

An Upgraded MTR2000 and MTR3000 will provide the same RF receiver and transmitter performance with the exception that the MTR3000 will allow an extended RF power out range for the high power models. The power output range of an MTR3000 is 8W-100W (UHF and 800/900), while an Upgraded MTR2000 or MTR2000 has a power output range of 25W-100W (UHF) and 20W-75W (800 or 900).

Station Grounding

The MTR3000 Base Station/Repeater is designed to accept a grounding cable adjacent to the receiver antenna connection at the rear of the station. An M8 tapped hole in the Power Supply module is equipped with a M8 machine screw with external tooth star washer. The grounding cable lug should be securely fastened to this point, which is marked with the international ground symbol. Refer to the Motorola R56 Standards (hardcopy p/n: 68P81089E50-B, CD-ROM p/n: 98R80384V83) for grounding cable specifications and routing guidelines.

Backplane Connections

MTR3000 Base Station/Repeater Backplane Connections

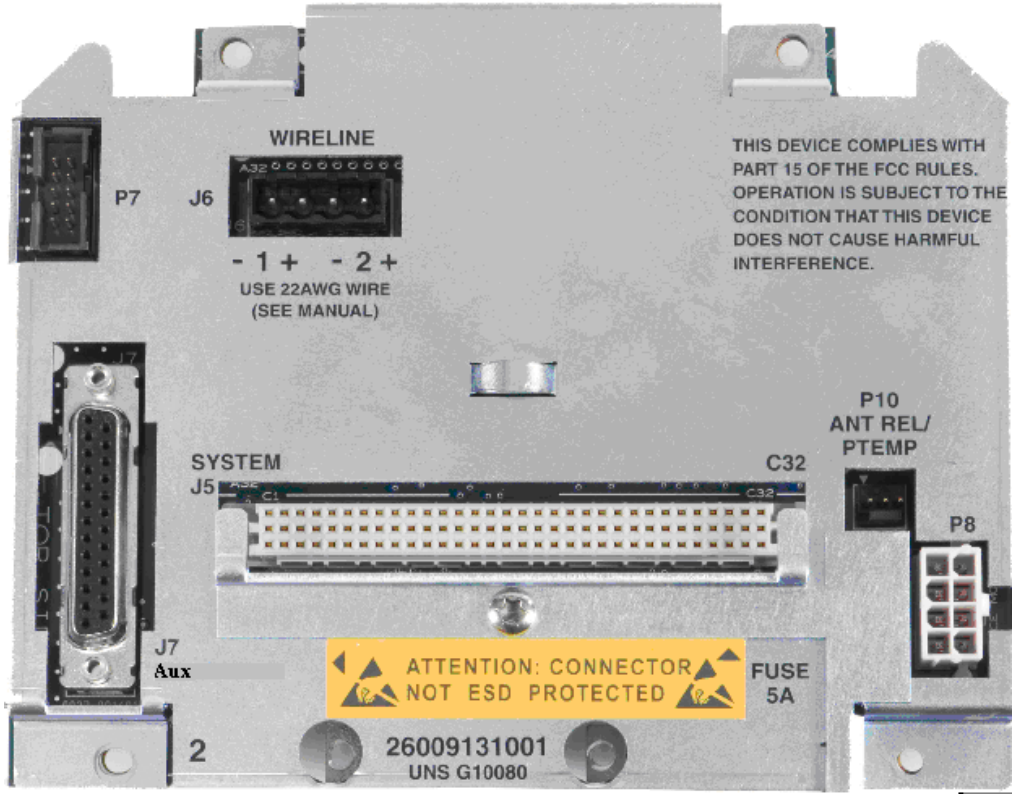


Figure 22. MTR3000 Base Station/Repeater BackplaneView

Table 28. MTR3000 Base Station/Repeater Backplane Connectors

Type of Connection	Description	Connector Type
J5	System (User Interface)	96 Pin Euro
J6	Wireline (User Interface)	4 Conductor Terminal Block
J7	Aux System (User Interface)	DB25
P7	Power Amplifier Control	10 Pin
P8	Power Supply	8 Pin
P10	Antenna Relay and Peripheral Temperature	3 Pin

The J7 Aux connection on the MTR3000 and Upgraded MTR2000 is the main analog radio interface to the station. Table 29 shows the signal names and functions as well as a cross reference to the MTR2000 signaling names. Note that Pins 3, 5, 6 and 20 are not supported in the Upgraded MTR2000 since the upgraded station is still using the MTR2000 backplane.

Table 29. MTR3000 J7 Aux Backplane Connections

DB25 Pin Number	MTR3000 / Upgraded MTR2000 Name	MTR3000 Function	MTR2000 Name (for reference)
1	Tx Audio	Transmit Audio	MRTI TX Audio
2	GPI_1	Programmable input	Trunk MRTI PTT*
3	Aux Rx Audio (not supported by Upgrade)	Auxilary Receive Audio	Spare (N/C)
4	GPIO_2	Programmable I/O	MRTI Monitor*
5	GPIO_10 (not supported by Upgrade)	Programmable I/O	Spare (N/C)
6	GPIO_9 (not supported by Upgrade)	Programmable I/O (not supported in 1st release)	Spare (N/C)
7	Rx Audio	Receive Audio	MRTI RX Audio
8	GPIO_6	Programmable I/O	Patch Inhibit* or RSTAT
9	GND	Ground	GND
10	GPIO_7	Programmable I/O	Aux Carrier* or TSTAT
11	Same as Pin 2	Same as Pin 2	Trunk MRTI PTT*
12	Same as Pin 10	Same as Pin 10	Aux Carrier* or TSTAT
13	Tx Data	Low Speed Data, PL, or DPL	Trunk TX Data+
14	Reserved	Reserved for Future Use	Spare (N/C)
15	GPIO_3	Programmable I/O	MRTI RX Carrier*
16	GND	Ground	GND
17	GND	Ground	GND
18	GND	Ground	GND
19	GND	Ground	GND
20	Fused 14.2VDC (not supported by Upgrade)	Power source for 3rd party control	Spare (N/C)
21	GPIO_8	Programmable I/O	Trunk TX Data–
22	Emph Tx Audio	Emphasized Tx Audio	Trunk RX Audio
23	GPI_4	Programmable input	Trunk Mute*
24	GPIO_5	Programmable I/O	PL Strip* or CCI*
25	Same as Pin 8	Same as Pin 8	Patch Inhibit* or RSTAT

The J5 connection on the MTR3000 and Upgraded MTR2000 supports a reduced function set relative to the MTR2000 J5 connection. Table 30 shows the supported functionality for the Upgraded MT2000 and MTR3000 J5 backplane connection.

Table 30. MTR3000 J5 System Backplane Connections

96 Pin Connector Pin Number	MTR3000 / Upgraded MTR2000 Name	MTR3000 Function
C29	GPIO9	Programmable I/O
C24	GPIO10 (not supported in initial release)	Programmable I/O
C14	Aux_Rx_Audio	Auxiliary Receive Audio
C11	RSSI (not supported in initial release)	Analog representation of receive signal strength
C10	Ext_PTT (GPI1)	Programmable input
B4	Carrier_Detect (GPIO3)	Programmable I/O
A4	AC_Fail	Logic Low indicates AC power interruption
A13	Antenna_Relay	Logic Low indicates Transmit function
A18, A32, B18, B32, C18, C32	Fused 14.2VDC	Power source for 3rd party control
A20, B20, C20	5VDC	
A19, A27, A31, B15, B19, B27, B31, C15, C16, C19, C27, C31	Ground	

POWER SOURCE

Block Diagram of AC & DC Flow

The MTR3000 Base Station/Repeater can operate from either AC or DC power as its primary power source. The MTR3000 Base Station/Repeater can also provides battery revert functionality when both an AC and DC source is interfaced to the Base Station/Repeater.

When both AC and DC sources are supplied, the station will operate from the AC power source unless the AC power source is interrupted, at which time the station will automatically revert to the DC power source.

Operation returns to the AC source when the AC source is restored. Switchover from AC to DC and back again is fully automatic. No operator action is required. Figure 50 shows the AC and DC power distribution in the MTR3000 Base Station/Repeater when an AC with battery revert system is employed.

Note: When both AC and DC sources are present at the station power supply, AC will always take precedence.

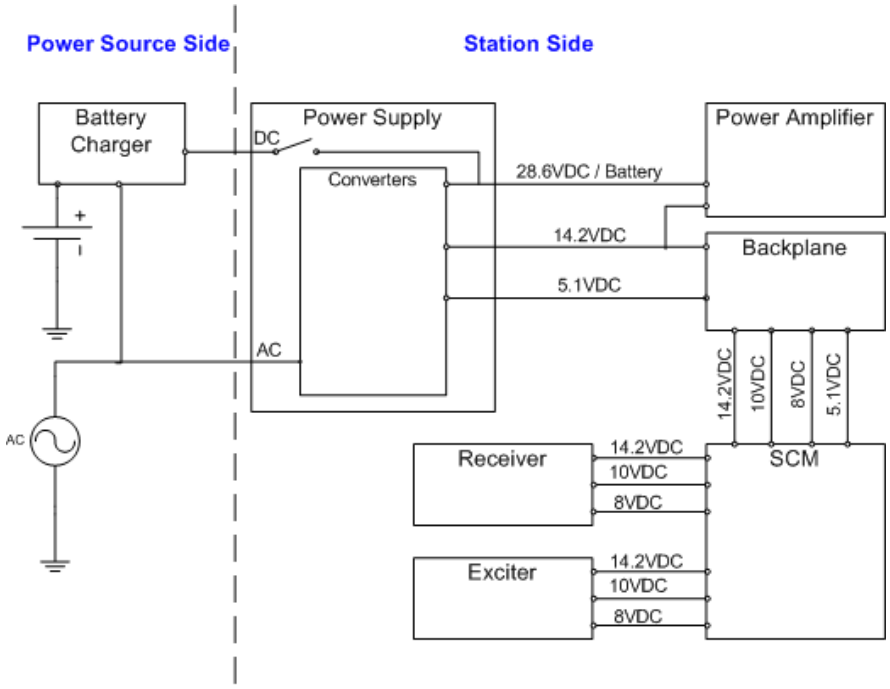


Figure 23. AC and DC Power Distribution, MTR3000 Base Station/Repeater

Power Rollback

It is important to note that when the Upgraded MTR2000 or MTR3000 is running from a DC source, the maximum RF output power is dependent on the station power supply's DC input voltage. Figure 24 shows a graphical representation of what the maximum RF output power is as a function of the DC input voltage of a UHF station and figure 25 shows the maximum RF output power as a function of the DC input voltage of a 800/900MHz station.

From Figure 24 and 25, the following can be seen:

- The station's max output power is equal to 0W when; 21.6VDC > DC input voltage > 32VDC
- The station's max output power is equal to 65W when; 30.7VDC < DC input voltage ≤ 32VDC
- For UHF, the station's max output power is equal to 100W when; 25.7VDC ≤ DC input voltage ≤ 30.7VDC
- For 800/900MHZ, the station's max output power is equal to 100W when; 24.7VDC ≤ DC input voltage ≤ 30.7VDC
- The station's max output power is equal to (DC input voltage – 21.6) * 10 + 60; when 21.6VDC ≤ DC input voltage < 25.7VDC

Note: 21.6VDC and 32VDC are the specified operating limits of the station. Beyond those limits, the power supply of the station will power itself (and the Base Station/Repeater) down for its own protection as well as the batteries.

Figure 24. UHF RF Power Out Rollback Curve

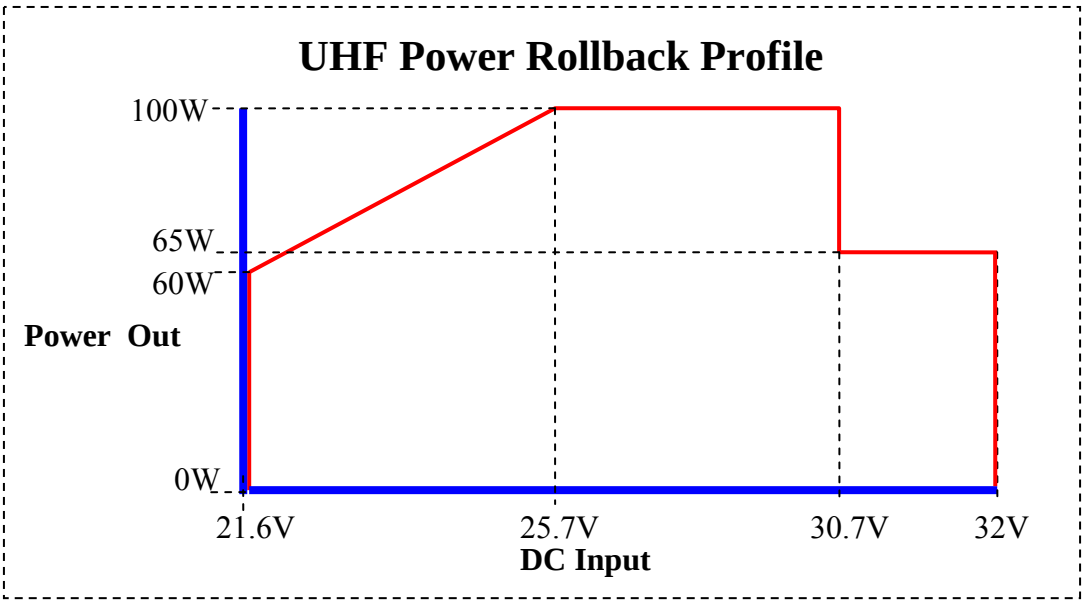
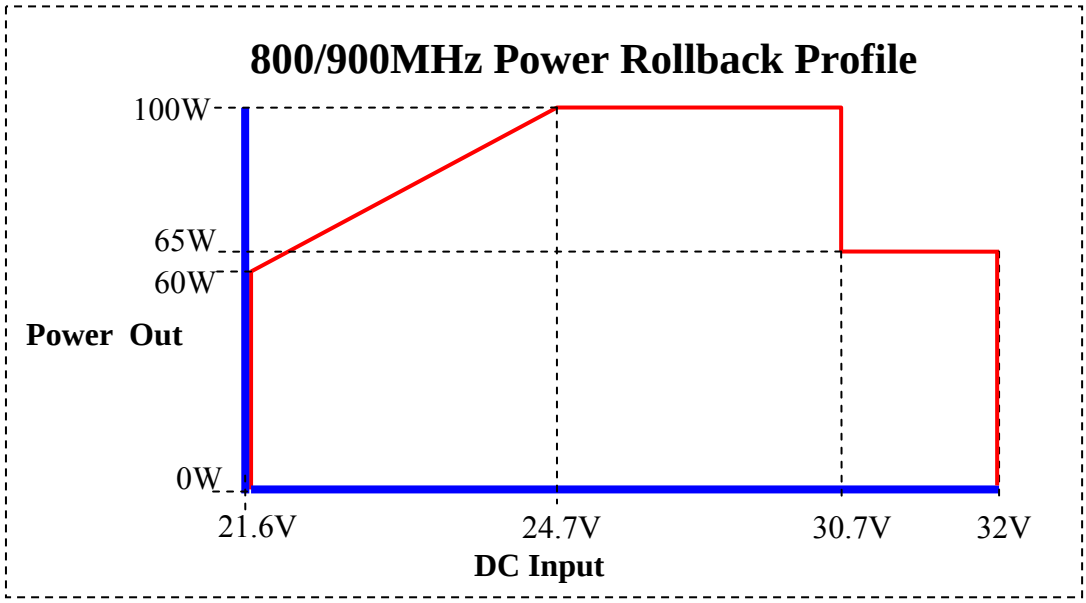


Figure 25. 800/900MHz RF Power Out Rollback Curve



Number of Battery Cells

When AC power is interrupted in a battery revert configuration, a typical 12 cell lead-acid battery (two 6 cell battery packs) will yield approximately 25.2VDC. Notice from Figure 24 that 25.2VDC results in a maximum of 95W output power at the initial moment of the battery bank's discharge.

If a 13 cell lead-acid battery is used (13 individual cells) instead, the battery bank will yield approximately 27.3VDC, which would allow the full maximum output power of 100W to be achieved. All other things being equal, this will also result in a longer run time in battery revert mode before 21.6VDC is reached. This configuration can be supported by the charging system noted in the "Battery Charging System and Wire Gauge Determination" section of this document.

Battery Charging System and Wire Gauge Determination

The MTR3000 station does not provide an integrated battery charging function. If battery charging is required for battery revert functionality, then the use of an external Motorola approved battery reverting charger is required. See Table 31.

Table 31. MTR3000 J5 System Backplane Connections

Battery Reverting Charger	Model Number	Both Cables Required
24VDC Charger	L1884	Z691, Charger Load Cable Z692, Charger Battery Cable

- **L1884** Battery Reverting 24V DC charger requires, in addition, the following cables:
  - **CDN6226A** CHGR LOAD CABLE MTR2000 (to connect the Battery charger with the MTR3000 Base Station Power Supply)
  - **CDN6227A** CHGR BAT CABLE MTR2000 (to connect the Battery charger to the battery)

Consult the Battery Reverting Charger Detailed Technical Specifications for information regarding charger specifications, battery selection, wiring gauge determinations, and precautions.

AC Breaker Recommendation

Each MTR3000 should have its own AC supply breaker in order to ensure that a fault which causes the breaker to open does not result in the loss of multiple transmit channels. However, multiple MTR3000 stations could be supported on a single circuit (see "Power and Energy Consumption Curves" section).

For a 120 VAC, 60Hz application, the AC supply breaker should be rated for a continuous current of no less than 15A, with a recommended rating of 20A.

For a 220 VAC, 50Hz application, the AC supply breaker should be rated for a continuous current of no less than 15A, with a recommended rating of 20A.

The above breaker current ratings are per R56 guide lines for communications equipment.

DC Breaker Recommendation

For information involving the sizing of cables and DC power distribution, please refer to the Motorola R56 standard *Standards and Guidelines for Communication Sites* (68P81089E50).
For each MTR3000 Base Station/Repeater, the DC supply breaker should be rated for a continuous current of 20A.

STATION MAINTENANCE & ALIGNMENT

Routine Maintenance

The station has been designed with state-of-the-art technology and operates under software control, thus requiring minimal routine maintenance. Virtually all station operating parameters are monitored and self-corrected by the Station Control Module (SCM), making adjustments and tuning virtually unnecessary. Provided that the equipment is installed in an area which meets the specified environmental requirements, the only routine maintenance task required is the yearly calibration of the station reference oscillator circuit.

Annual cleaning is recommended for dirty sites.

Alignment

The MTR3000 requires the alignment of up to three parameters. They are as follows:

- Modulation Limit: The alignment is only needed in cases where the station is interfaced to a 3rd party controller that requires the use of the TX Data port on the J7 backplane connection.
- Power Output Calibration (Upgraded MTR2000 Only): This alignment is to allow entry of the PA "sticker code calibration coefficients" into the stations codeplug.
- Speaker Volume: This alignment is for the adjustment of the speaker port audio output level. (analog mode only)
- Station Frequency Reference: Recommend to be verified / aligned once per year to maintain regulatory compliance.

Customer Programming Software

The Customer Programming Software (CPS) is the tool used to configure and service the base station/repeater. The CPS runs on a PC laptop or desktop.. The CPS program will be able to configure and service any device supported by the CPS. Once the configuration information has been read from a device, the CPS will tailor its menus and service screens to fit the needs of that device.

The CPS is designed to run the currently supported Microsoft Windows Operating Systems such as Windows XP Home and Professional, Windows 2000 & Vista.

The PC used to run the CPS requires at least 100 MB of free space to install the CPS. CPS software comes on a CD thus a CD drive is needed on the PC. Communication with the MTR3000 Base Station/Repeater requires both a serial port and an Ethernet port.

The CPS install disk contains three CPS applications; CPS, Repeater Diagnostics and Control (RDAC), and Tuner. Each of the three applications contains on line help to aid the user in configuring and aligning the station. In general, the purpose of the three applications is as follows:

- CPS: Is radio programming software for dealers and service technicians who need to configure the MTR3000. The CPS allows the user to access and program (e.g. read, write or clone) the codeplug of the MTR3000 in the available systems.
- Tuner: Is an application that allows for the alignment of the MTR3000 (Modulation Limit, Speaker Volume, and MTR2000 Upgrade PA sticker code entry). It also allows testing of the MTR3000 (Bit Error Rate).
- RDAC: Is an application for the system technicians who need to run diagnostics on the MTR3000. It allows the user to remotely or locally monitor the status of the radio and gather real-time radio hardware failure reports via alarm messages reported by the radio. In addition to the diagnostics capability, the application also allows the user to remotely control some of the parameters of a radio. The application can be used in a Single-Site (Local mode) or IP Site (IP Site mode) environment with the main purpose of maintaining all the radios registered within the system.

The MTR3000 and the MTR2000 MOTOTRBO Upgrade both use model GMVN5141 CPS. This is the same CPS that is used to program the MOTOTRBO mobiles, portables and DR3000 station. The software is developed to recognize the station it is programming; therefore you may see different options in the MTR3000 programming software that you have not seen in the DR3000.

MTR3000 stations use a standard type A to type B USB cable for connection to the CPS computer.

The cables used to program each MOTOTRBO product may be different. Refer to the MTR3000 and the DR3000 ordering guide and price pages to determine the cable that is required.

Base Station Software and Future Software Upgrades

The MOTOTRBO analog and digital software is pre-loaded on the Station Control Module. The station control module comes standard in the MTR3000 as well as the MTR2000 MOTOTRBO Upgrade. As software updates become available it can be downloaded for customers who have purchased either product. Station software releases are available approximately twice a year and are located on Motorola on line (MOL).

Periodically software features will be released that are available for purchase. Capacity Plus (HKVN4045A) is a software feature that fits into this category. You can purchase multiple software feature upgrades to one station unless otherwise noted. If the base station software is upgraded as described above you will maintain your license for the software features that have been purchased. For example if you purchase the Capacity Plus license and then download version 1.6 software from MOL your Capacity Plus software feature remains in the station.

The Customer Programming Software (CPS) periodically has new releases available.

The most current software release is located on Motorola on line (MOL).

MTR3000 ORDERING GUIDE

This ordering guide is designed to provide a detailed description of the MTR3000 Base Station/Repeater. Information is provided regarding the various options available as well as some ordering restrictions. It is necessary to go through each of the steps outlined in the guide to complete an order.

Only one model number can be ordered per line item. This is a requirement because each MTR3000 Base Station/Repeater is tuned to a specific frequency.

The following items are not part of the standard MTR3000 package but can be ordered through the ISP Organization:

- Power Rectifier
- Tower Top Amplifier

For further information on these items contact the ISPO organization.

MTR3000 Base Station/Repeater Ordering Matrix

This matrix provides a quick reference guide to ordering the MTR3000 Base Station/Repeater. Please reference ECAT or MOL for the latest pricing information and option descriptions.

Table 32. MTR3000 Base Station/Repeater Ordering Matrix

Model/Option Nomanclature	Description
Order Main Model	
T3000A	MTR3000 Base Station/Repeater
Required: Select 1 Frequency	
X340MT	ADD : UHF 100W POWER (403-470)
X540MT	ADD : UHF 100W POWER (470-524)
Optional: Software Feature	
HKVN4045A	MTR3000 CAPACITY PLUS SW UPGRADE
Optional: Select Duplexer	
X182UL	ADD : DUPLEXER, UHF 403-435 MHz
X182UM	ADD : DUPLEXER, UHF 435-470 MHz
X182UN	ADD : DUPLEXER, UHF 470-494 MHz
X182UH	ADD : DUPLEXER, UHF 494-512 MHz
Optional: Select Preselector (Required if ordering X182, Duplexer)	
X265UL	ADD: PRESELECTOR, UHF(380–435 MHZ)
X265UM	ADD: PRESELECTOR, UHF(435–470 MHZ)
X265UH	ADD: PRESELECTOR, UHF(470–524 MHZ)
Optional: Select Circulator	
X676UL	ADD: CIRCULATOR, UHF (403–470 MHZ)
X676UH	ADD: CIRCULATOR, UHF (470–524 MHZ)

MTR3000 Base Station/Repeater Ordering Matrix (Continued)

Model/Option Nomenclature	Description
Optional Select Antenna Relay (Not compatible if ordering X182, Duplexer)	
X371BA	ADD: ANTENNA RELAY
Optional: Select Power Cable (North America Cable ships standard)	
X187AK	ADD : POWER CABLE, EUROPE
X162AE	ADD : POWER CABLE, UK
X191AF	ADD : POWER CABLE, AUSTRALIA
CA01520AA	ADD : POWER CABLE, DC
Optional: Mounting Hardware	
U178AB	ADD: CABINET MOUNT HARDWARE
X153BA	ADD: RACK MOUNT HARDWARE
Optional: Manual on CD	
X347AF	ADD: MANUAL INSTALL & USER CD
Optional: Select System Cables	
X244AJ	ADD: AUXILIARY SYSTEM CABLE
X244AG	ADD: COMMUNITY REPEATER PANEL CABLE
X244AH	ADD: PHONE PATCH CABLE
C540AD	ADD: SYSTEM CONNECTOR CABLE
XA00032AA	ADD: ETHERNET CABLE 12'
Optional: Select Test Report	
X699BA	ADD: MTR3000 FACTORY TEST REPORT
Optional: Add FRU's as Necessary	
DLN6701A	FRU UHF 100W PA 403-470
DLN6702A	FRU UHF 100W PA 470-524
DLN6703A	FRU UHF 403-470 EXCITER
DLN6704A	FRU UHF 450-524 EXCITER
DLN6705A	FRU UHF 403-470 RECEIVER
DLN6706A	FRU UHF 450-524 RECEIVER
Optional: Add FRU's as Necessary	
DLN6707A	FRU MTR3000 AC/DC POWER SUPPLY
DLN6719A	FRU STATION CONTROL TCXO
THN6700A	12" INDOOR CABINET
THN6701A	30" INDOOR CABINET
THN6702A	46" INDOOR CABINET
0782099W01	30" MODULAR RACK (16 RK U)
0782099W02	45" MODULAR RK (24 RK U)
0782099W03	52" MODULAR RK (27 RK U)
CLN6679A	RACK MOUNT HARDWARE

MTR3000 Base Station/Repeater Model and Option Descriptions

Main Model Description

- MTR3000 Base Station/Repeater (T3000A)

T3000A is the MTR3000 Base Station/Repeater Model. This model number is always the first item entered on an order. It is only possible to order quantity one T3000A per line item. A TX/RX frequency must be specified for **EACH** MTR3000 Base Station/Repeater. The frequencies will be collected at the main model level. This model number will generate internally added options for all hardware components that are not generated by an orderable option. The Base Station/Repeater will not ship in a cabinet or rack. Cabinets and racks are available through the Aftermarket & Accessories division @ 800-422-4210.

Frequency Band and Power Level

- ADD : UHF 100W POWER (403-470) (X340MT)
- ADD : UHF 100W POWER (470-524) (X540MT)

One TX and one RX frequency must be specified and will be collected at the main model level. For 800/900 MHz and UHF, all frequencies must be divisible by 6.25 kHz. For VHF, all frequencies must be divisible by 6.25 kHz or 5 kHz. Please note that there must be 5 digits after the decimal point when requesting frequencies.

Frequency Rules for X340MT (UHF R1)

RX Range: 03.00000 – 470.00000 MHz.
TX Range: 03.00000 – 470.00000 MHz.

If Freq (TX) is 403-470 MHz, then Freq (RX) $\geq \pm$ .25 MHz TX

Frequency Rules for X540MT (UHF R2)

RX Range: 70.00000 – 524.00000 MHz.
TX Range: 70.00000 – 524.00000 MHz.

If Freq (TX) is 470-524 MHz, then Freq (RX) $\geq \pm$ .25 MHz TX

Base Station/Repeater Software & Features

Both analog and digital software are included in the MTR2000 Upgrade Kit. See section on upgrade capability in Table 2 for the list of analog features available after upgrading to an MTR3000. When ordering the MTR3000 there is no need to specify the station operation type. The MTR3000 is programmed via the CPS for either Analog or MOTOTRBO digital and Base

Station or Repeater mode. The latest version of software is included in the purchase price of the MTR3000. To receive the latest software version refer to the following path:

MOL > Resource Center > Software > Two-Way> MOTOTRBO > Firmware/Flashing Software Features and Repeater Software Upgrades.

Customer Programming Software (CPS)

GMVN5141	CPS Customer Programming Software

Customer Programming Software (CPS) is required to program the MTR3000. Order **GMVN5141** Portable, Mobile and Repeater Customer Programming Software (CPS) Package: Package includes CPS, Air Tracer, Tuner, Repeater Diagnostics and Control (RDAC), MOTOTRBO System Planner, and 3 year subscription. Software is compatible with Windows XP (Home and Professional Versions) Windows 2000 and Vista. The GMVN5141 software updates are posted on MOL

CPS Programming Cable (Part #: DDN9957): MTR3000 stations use a standard type A to type B USB cable for connection to the CPS computer.

Notes: Configure the MTR3000 to either base station or repeater operation through the CPS.
All Base Stations/Repeaters ship un-configured and must be field programmed via the CPS.
MTR3000 cannot utilize the MTR2000 RSS (RVN4148).
The GMVN5141 programs all MOTOTRBO products; MTR3000, DR3000 and MOTOTRBO mobiles and portable subscribers.

MTR3000 stations use a standard type A to type B connection USB for CPS programming.

Software Features

Software features are optional. As new software releases are available there may be software features offered for an additional charge for each Base Station/Repeater license. Order **HKVN4045A** to add Capacity Plus to each base station/repeater**.** Capacity Plus is a cost effective single site Trunking solution. Capacity plus does not require an additional controller; it is a software based solution. When ordering the HKVN4045A an email address must be provided as the software entitlement id will be emailed to the requestor. The entitlement id allows a user to download the software feature at their convenience when they are connected to the MTR3000. To download the software version the computer that is connected to the station (via USB) must have an internet connection.

HKVN4045A	Capacity Plus SW License Key

Peripheral Options

Duplexer

The Duplexer allows a single pair of transmit and receive channels to share a common antenna. The duplexer requires 3 rack units of space and will always require a cabinet or rack to be ordered (through the Parts department). The duplexer is factory tuned for single frequency operation only. It is not available for cross-band operation.

UHF (403-524 MHz): The following peripherals are optional.

- 403-435 = 5MHz min/32MHz max (100dB isolation)
- 435-470 = 5MHz min/35MHz max (100dB isolation)
- 470-494 = 3MHz min/24MHz max (100dB isolation)
- 494-512 = 3MHz min/18MHz max (100dB isolation)

- ADD: DUPLEXER, UHF 403-435 MHz (X182UL)
- ADD: DUPLEXER, UHF 435-470 MHz (X182UM)
- ADD: DUPLEXER, UHF 470-494 MHz (X182UN)
- ADD: DUPLEXER, UHF 494-512 MHz (X182UH)

X182UL provides the option of using the same antenna for receive and transmit in the UHF (403-435 MHz) base station/repeater. If the X182UL is ordered, X265UL (ADD: NARROW PRESELECTOR, 380-435 MHz) is required. The TX and RX frequency separation must be at least 5 MHz.

X182UM provides the option of using the same antenna for receive and transmit in the UHF (435-470 MHz) base station/repeater. If the X182UM is ordered, X265UM (ADD: NARROW PRESELECTOR, 435-470 MHz) is required. The TX and RX frequency separation must be at least 5 MHz.

X182UN provides the option of using the same antenna for receive and transmit in the UHF (470-494 MHz) base station/repeater. If the X182UN is ordered, X265UH (ADD: NARROW PRESELECTOR, 470-524 MHz) is required. The TX and RX frequency separation must be at least 3 MHz.

X182UH provides the option of using the same antenna for receive and transmit in the UHF (494-512 MHz) base station/repeater. If the X182UL is ordered, X265UH (ADD: NARROW PRESELECTOR, 470-524 MHz) is required. The TX and RX frequency separation must be at least 3 MHz.

Narrow Preselector

The Base Station/Repeater Preselector rejects unwanted signals including the transmitter signals from overloading the receiver. The filter is optional for the MTR3000 Base Station/Repeater. This filter must be included to fulfill TIA102-CAAB Class A spurious response rejection (90 dB). The filter is usually not required when using a receiver multicoupler system since the Preselector in the multicoupler should provide sufficient rejection.

If a narrow Preselector is required, order X265UL, X265UM, X265UH, X265VL, or X265VH based on the frequency band of the system. The Base Station/Repeater Preselector rejects unwanted signals including the transmitter signals from overloading the receiver. The filter is optional for the MTR3000 Base Station/Repeater. A narrow Preselector is required if a duplexer option is ordered for VHF or UHF systems. No Preselector is needed for 800/900 MHz.

Note: The Preselector is recommended for dense RF site applications, especially when station is to be located with other stations in the same frequency band. The Preselector may not be required when the station is used with a multicoupler at an RF site. For multiple channel operation, the receiver frequency separation cannot be greater than 4.0 MHz.

- ADD: PRESELECTOR, UHF (380 – 435 MHZ) X265UL
- ADD: PRESELECTOR, UHF (435 – 470 MHZ) X265UM
- ADD: PRESELECTOR, UHF (470 – 524 MHZ) X265UH

X265UL provides RX filtering in the UHF sub-band 380 - 435 MHz for the base station/repeater and is attached to the back side of the base station/repeater. When ordering this option, the frequency separation between the highest RX frequency and the lowest RX frequency can be no more than 4 MHz. Also, all RX frequencies must fall within the following sub-band: 380 - 435 MHz.

X265UM provides RX filtering in the UHF sub-band 435 - 470 MHz for the base station/repeater and is attached to the back side of the base station/repeater. When ordering this option, the frequency separation between the highest RX frequency and the lowest RX frequency can be no more than 4 MHz. Also, all RX frequencies must fall within the following sub-band: 435 - 470 MHz.

X265UH provides RX filtering in the UHF sub-band 470 - 524 MHz for the base station/repeater and is attached to the back side of the base station/repeater. When ordering this option, the frequency separation between the highest RX frequency and the lowest RX frequency can be no more than 4 MHz. Also, all RX frequencies must fall within the following sub-band: 470 - 524 MHz.

Dual Circulator

If an external dual circulator is needed, order quantity one of X676UL, X676UH based on the frequency of the system.

- ADD: CIRCULATOR, UHF (403-470 MHZ) (X676UL)
- ADD: CIRCULATOR, UHF (470-524 MHZ) (X676UH)

X676UL adds 2 circulators and a low pass filter that are mounted on a 2 rack unit tray for the UHF band (403 – 470 MHz). Since the power amplifier has one circulator, this option brings the total number of circulators to three.

X676UH adds 2 circulators and a low pass filter that are mounted on a 2 rack unit tray for the UHF band (470 – 524 MHz). Since the power amplifier has one circulator, this option brings the total number of circulators to three.

Antenna Relay

X371BA provides the option of using the same antenna for receive and transmit, in base station operation only. The X371 will operate at any frequency transmit and receive frequency in the 136 MHz to 940 MHz range.

If a X371 is required, then the difference between the RX and TX frequencies must be ≥ than 100 kHz

- ADD: ANTENNA RELAY (X371BA)

DC Power Cables

The MTR3000 Base Station/Repeater ships with the cabling required for powering the station with an AC current. If a DC power cable is required, please order the following option:

- ADD: POWER CABLE, DC (**CA01520AA**)

Battery Charging

For Battery Charging see ECAT/MOL price pages for Battery Reverting Charger. (Battery Reverting Charger Planner, R16-9-2)

International Power Cables

A 12 foot AC power cable will come standard with the base station/repeater. If a different power cable is required, please order one of the following power cables and it will be shipped instead of the domestic power cable.

- ADD: POWER CABLE, EUROPE (X189AE)
- ADD: POWER CABLE, UK (X162AD)
- ADD: POWER CABLE, AUSTRALIA (X191AD)

Mounting Hardware

Choose the Rack or Cabinet Mounting Hardware, if required.

- ADD: RACK MOUNT HARDWARE (X153AW)
- ADD: CABINET SLIDES HARDWARE (U178AB)

X153AW provides rack mount hardware for the base station/repeater as well as any associated optional/peripheral equipment. It should be selected if the base station/repeater will be installed in standard 19-inch relay racks. This option does not include rack. Use this option when a MTR3000 station to be installed in an existing customer supplied rack.

The U178AB cabinet slides hardware option provides L-brackets which support the weight of the base station/repeater prior to the insertion of the front mounting screws. This option is designed for use with Schroff Eurorack cabinets and is not compatible with cabinet models THN6700, THN6701, or THN6702.

Communication / Reference Cables

Add cables as necessary for your specific customer configuration.

- ADD: COMMUNITY REPEATER PANEL CABLE (X244AJ)
- ADD: PHONE PATCH CABLE (X244AH)
- ADD: AUXILIARY SYSTEM CABLE (X244AF)
- ADD: SYSTEM CONNECTOR CABLE (C540AD)
- ADD: ETHERNET CABLE 12' (XA00032AA)

X244AJ Auxiliary System Cable provides a 25 foot male DB25 to “open wire” cable. This cable is used to access the RX audio, TX audio, 14VDC power, and GPIO control connections to and from the rear of the base station/repeater for use with external 3rd party boxes.

C540AD System Connector Cable provides a 10 foot male 96 pin Euro connection to “open wire” cable. This cable is used to access the COR and opto-isolated PTT connections to and from the rear of the base station/repeater for use with external 3rd party boxes.

X244AG Community Repeater Panel Cable allows connectivity from the MTR3000 to the Zetron (Model 38-Max) Community Repeater Panel.

X244AF Phone Patch allows connectivity from the MTR3000 to the Zetron phone patch (Model 30).

XA00032AA Ethernet port cables are 12 feet long. This allows for IP connectivity in the station.

C540AD Adds the cable kit needed to interface to the system connector on the backplane of the station. Includes housing shell and 30 pieces of 2-meter long, 24 gauge wire with a pin for header on one end and unterminated at the other end.

Racks and Cabinets

The MTR3000 ships standard in a box without a rack or cabinet. Racks and Cabinets are optional and are available through Aftermarket Support (1-800-422-4210).

- 30" INDOOR CABINET (THN6701)
- 46" INDOOR CABINET (THN6702)
- 30" MODULAR RACK (16 RK U) (0782099W01)
- 45" MODULAR RACK (24 RK U) (0782099W02)
- 52" MODULAR RACK (27 RK U) (0782099W03)
- RACK MOUNT HARDWARE (CLN6679A)

30" Indoor Cabinet (THN6701)
The cabinet is constructed of steel finished with exterior grade vinyl. Dimensions of the cabinet are 30" H X 22" W X 20" D (762 x 559 x 508 mm). Provides standard 19" EIA rack mounting inside the cabinet. The cabinet has holes in the bottom for easy stacking. There are also two 3 5/8" diameter knockouts near the rear of the cabinet in the top and bottom for routing cable between and out of the cabinets.

46" Indoor Cabinet (THN6702)
The cabinet is constructed of steel finished with exterior grade vinyl. Dimensions of the cabinet are 46" H X 22" W X 20" D (1165 x 559 x 508 mm). Provides standard 19" EIA rack mounting inside the cabinet. The cabinet has holes in the bottom for easy stacking. There are also two 3 5/8" diameter knockouts near the rear of the cabinet in the top and bottom for routing cable between and out of the cabinets

30" Modular Rack (0782099W01)
The modular rack is constructed of 10 gauge cold rolled steel, with a black baked enamel finish. Dimensions of the footprint are 22" W X 20" D (559 x 508 mm). Provides standard 19" EIA rack mounting. The base and cap have holes for stacking and routing cable between and out of the modular racks. This rack has 16 rack units available. Refer to Detailed Rack Specifications below for a figure with additional dimensional details.

45" Modular Rack (0782099W02)
The modular rack is constructed of 10 gauge cold rolled steel, with a black baked enamel finish. Dimensions of the footprint are 22" W X 20" D (559 x 508 mm). Provides standard 19" EIA rack mounting. The base and cap have holes for stacking and routing cable between and out of the modular racks. This rack has 24 rack units available. Refer to Detailed Rack Specifications below for a figure with additional dimensional details.

52" Modular Rack
(0782099W03) The modular rack is constructed of 10 gauge cold rolled steel, with a black baked enamel finish. Dimensions of the footprint are 22" W X 20" D (559 x 508 mm). Provides standard 19" EIA rack mounting. The base and cap have holes for stacking and routing cable

between and out of the modular racks. This rack has 27 rack units available. Refer to Detailed Rack Specifications below for a figure with additional dimensional details.

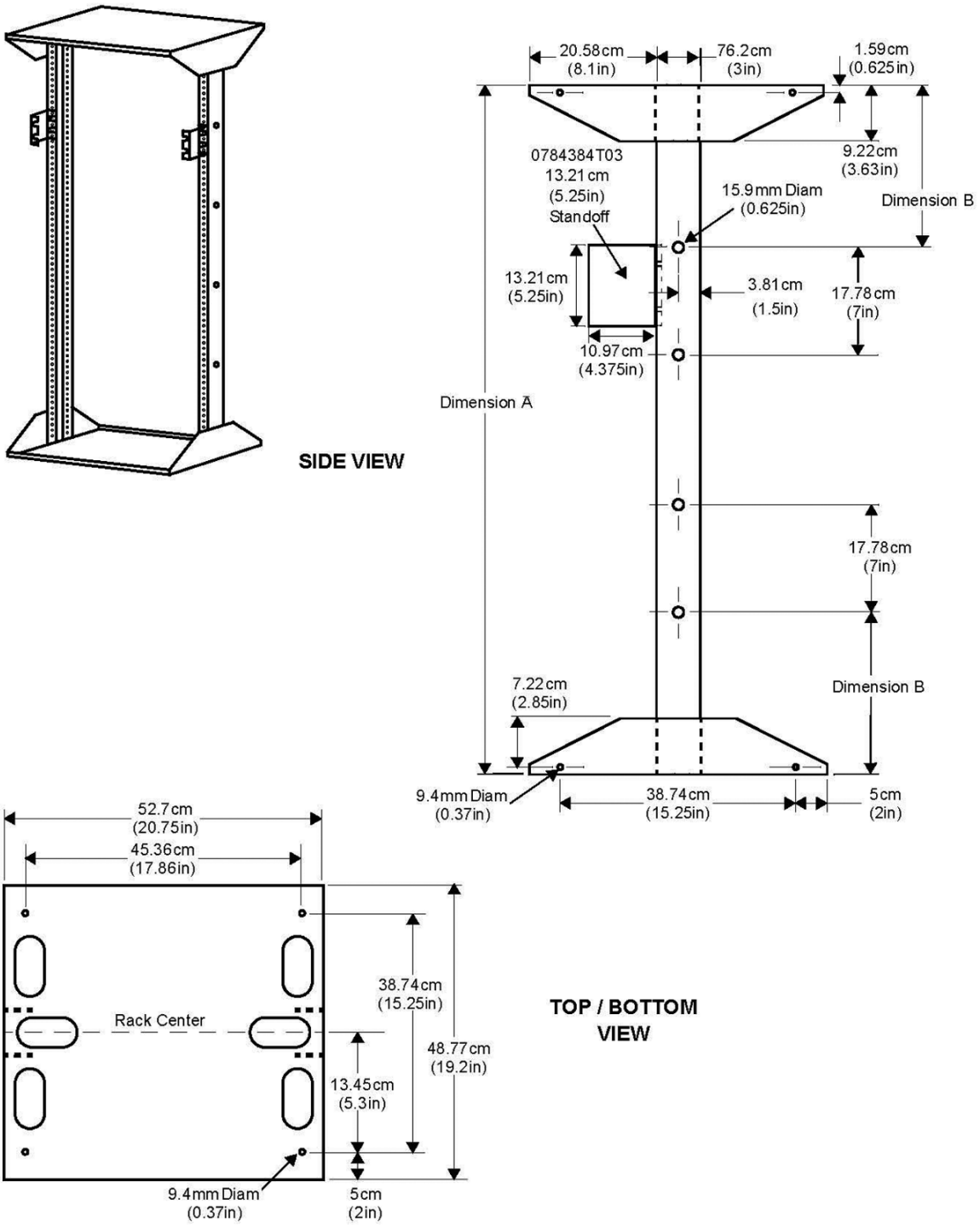


Figure 25. Detailed Rack Specifications

MTR2000 MOTOTRBO UPGRADE ORDERING MATRIX

This matrix provides a quick reference guide to ordering the MTR2000 MOTOTRBO Upgrade. Please reference ECAT or MOL for the latest pricing information and option descriptions.

Table 33. MTR2000 MOTOTRBO Upgrade

Model/Option Nomenclature	Description
Order Main Model	
T2003A	MTR2000 MOTOTRBO Upgrade
Required: Select 1 Frequency	
X340MT	ADD : UHF 100W POWER (403-470)
Optional: Software Feature	
HKVN4045A	MTR3000 CAPACITY PLUS SW UPGRADE
Optional: Manual on CD	
X347AF	ADD: MANUAL INSTALL & USER CD
Optional: Select System Cables	
XA00032AA	ADD: ETHERNET CABLE 12'
Optional: Add FRU's as Necessary	
DLN6701A	FRU UHF 100W PA 403-470
DLN6702A	FRU UHF 100W PA 470-524
DLN6703A	FRU UHF 403-470 EXCITER
DLN6704A	FRU UHF 450-524 EXCITER
DLN6705A	FRU UHF 403-470 RECEIVER
DLN6706A	FRU UHF 450-524 RECEIVER
DLN6707A	FRU MTR3000 AC/DC POWER SUPPLY
DLN6719A	FRU STATION CONTROL TCXO
THN6700A	12" INDOOR CABINET
THN6701A	30" INDOOR CABINET
THN6702A	46" INDOOR CABINET
0782099W01	30" MODULAR RACK (16 RK U)
0782099W02	45" MODULAR RK (24 RK U)
0782099W03	52" MODULAR RK (27 RK U)
CLN6679A	RACK MOUNT HARDWARE
CLN8629A	MTR3000 INSTALLATION AND USER MANUAL CD

MTR2000 MOTOTRBO UPGRADE ORDERING GUIDE

Main Model

The following main model must be ordered to upgrade the MTR2000 to a MTR3000 TRBO Base Station/Repeater.

T2003A	MTR2000 MOTOTRBO Upgrade

Order a quantity of one T2003A per line item. Each upgrade contains a separate Exciter, Receiver, Control Module and front panel. For specific instructions on the upgrade process, refer to the MTR3000 Service and Installation Manual option **X347AF.**

Notes: MTR2000 low power stations are not upgradeable at this time..
MTR2000 Receivers cannot be upgraded.

Frequency Band and Power Level

Enter the Frequency Band option X340MT. One Frequency band is required per T2003A upgrade.

- ADD : UHF 100W POWER (403-470) (X340MT)

One TX and one RX frequency must be specified and are collected at the main model level. For UHF, all frequencies must be divisible by 6.25 kHz. Please note that there must be five digits after the decimal point when requesting frequencies.

Frequency Rules for X340MT (UHF R1)

RX Range: 403.00000 – 470.00000 MHz.
TX Range: 403.00000 – 470.00000 MHz.

If Freq (TX) is 403-470 MHz, then Freq (RX) $\geq \pm$ .25 MHz TX

Base Station/Repeater Software & Features

Software: Both analog and digital software are included in the MTR2000 Upgrade Kit. See section on upgrade capability in Table 2 for the list of analog features available after upgrading to an MTR3000. When ordering the MTR3000 there is no need to specify the station operation type. The MTR3000 is programmed via the CPS for either Analog or MOTOTRBO digital and Base Station or Repeater mode. The latest version of software is included in the purchase price of the MTR3000.

Customer Programming Software (CPS)

GMVN5141	CPS Customer Programming Software

Customer Programming Software (CPS) is required to program the MTR3000. Order **GMVN5141** Portable, Mobile and Repeater Customer Programming Software (CPS) Package: Package includes CPS, Air Tracer, Tuner, Repeater Diagnostics and Control (RDAC), MOTOTRBO System Planner, and 3 year subscription. Software is compatible with Windows XP (Home and Professional Versions) Windows 2000 and Vista. The GMVN5141 software updates are posted on MOL.

Notes: Configure the MTR3000 to either base station or repeater operation through the CPS.
All Base Stations/Repeaters ship un-configured and must be field programmed via the CPS.
MTR3000 cannot utilize the MTR2000 RSS (RVN4148).
The GMVN5141 programs all MOTOTRBO products; MTR3000, DR3000 and MOTOTRBO mobiles and portable subscribers.

MTR3000 stations use a standard type A to type B connection USB for CPS programming.

Software Features

Software features are optional**.** As new software releases are available there may be software features offered for an additional charge for each Base Station/Repeater license. Order **HKVN4045A** to add Capacity Plus to each base station/repeater**.** Capacity Plus is a cost effective single site Trunking solution. Capacity plus does not require an additional controller; it is a software based solution. When ordering the HKVN4045A an email address must be provided as the software entitlement id will be emailed to the requestor. The entitlement id allows a user to download the software feature at their convenience when they are connected to the MTR3000. To download the software version the computer that is connected to the station (via USB) must have an internet connection.

HKVN4045A	Capacity Plus SW License Key

Communication Cable

XA00032AA	ETHERNET CABLE 12'

XA00032AA Ethernet port cables are 12 feet long. This allows for IP connectivity in the station.

Manuals

If a manual is desired order one manual on CD per upgrade. Each CD contains the following:

- MTR3000 Installation and User Manual (Including MTR2000 to MTR3000 TRBO Upgrade)
- MTR3000 Basic Service Manual

X347AF	ADD : Manual Install and User CD

Note: The T3000A and the T2003A and associated options are RoHS (Restriction of Hazardous Substances) compliant.

Field Replacement Units (FRU's)

Table 34. FRU's for MTR3000 and MTR2000 MOTOTRBO Upgrade

FRU's for MTR3000 and MTR2000 MOTOTRBO Upgrade	
Model	**UHF FRU**
DLN6701A	FRU UHF 100W PA 403-470
DLN6702A	FRU UHF 100W PA 470-524
DLN6703A	FRU UHF 403-470 EXCITER
DLN6704A	FRU UHF 450-524 EXCITER
DLN6705A	FRU UHF 403-470 RECEIVER
DLN6706A	FRU UHF 450-524 RECEIVER
	Power Supply FRU
DLN6707A	FRU MTR3000 AC/DC POWER SUPPLY
	Control/Miscellaneous FRU
DLN6719A	FRU STATION CONTROL TCXO
	Manuals
CLN8629A	MTR3000 Installation and User Manual
	Cabinets/Racks & Hardware
THN6700	12" INDOOR CABINET
THN6701	30" INDOOR CABINET
THN6702	46" INDOOR CABINET
0782099W01	30" MODULAR RACK (16 RK U)
0782099W02	45" MODULAR RK (24 RK U)
0782099W03	52" MODULAR RK (27 RK U)
CLN6679A	RACK MOUNT HARDWARE

Note: Existing peripherals that are being utilized for the MTR2000 can retrofit the MTR3000 once it is upgraded. There is no need to purchase a new Duplexer, Preselector or Circulator or Antenna Relay.

Ordering tips

- Model Numbers are intuitive; MTR3000 Station = T3000 & MTR2000 MOTOTRBO Upgrade = T2003
- Customer Programming Software (CPS) Model GMVN5141 is required to Program both the T3000 and the T2003
- GMVN5141 is the same CPS used to program MOTOTRBO mobiles, portables & station
- A standard type A to type B USB cable is needed to program the MTR3000
- Cabinets and Racks are no longer ordered as options, contact the Parts Department if cabinet and racks are needed.
- If customers are using specific features in MTR2000 be sure that their configuration is available prior to ordering the MTR3000 upgrade
- There are no orderable peripheral options available for the MTR2000 MOTOTRBO Upgrade, customers will need to order FRU's if peripherals are desired
- If a duplexer (X182) is added as a option to the T3000 the Preselector option (X265) is required.
- Only one freq UHF option (X340) applies for MTR2000 UHF Upgrades since MTR2000 did not extend beyond 470 MHz
- Capacity Plus is available for both the T3000 and the T2003; order model HKVN4045A.
- Manuals on CD are a no charge option (X347) for stations or upgrades; you must order the option it is not automatically included with a station order.

Checking the Order

The number one reason orders fail in the ordering system is due to improper frequency separation.

- There must be 5 decimals after the frequency. You can add a frequency with all zeros after the decimal point i.e. 403.00000
- If a duplexer is being added to the order the frequency separation must be 1.5 MHz.
- If a Preselector is added the frequency separation must be 4MHz
- Check the configuration; if a Duplexer is ordered a Preselector is required.

Other Helpful Material

- MTR3000 Installation and User Manual (X347)
- MTR3000 Basic Service Manual (X437)
- MTR3000 Spec Sheet online,also on Digital Toolkit): MTR3000 Spec Sheet
- MTR3000 online content on motorola.com: MTR3000 Website
- MOTOTRBO System Training on MOL: MOTOTRBO System Training

- MOTOTRBO System Planner – on CPS GMVN5141 CD and in Resource Center on MOL: MOTOTRBO System Planner
- MOTOTRBO IP Site Connect, Capacity Plus and System Brochure online, (also available on Digital Toolkit): http://www.motorola.com/Business/XU-EN/Product+Lines/MOTOTRBO
- Introduction to MTR3000 Training https://techtrain.motorola.com/IntroductiontoMTR3000