



## MASTR V VHF BASE STATION

{{{DRAFT VHF}}}}

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# 1 REGULATORY AND SAFETY INFORMATION

## 1.1 SAFETY SYMBOL CONVENTIONS

The following conventions are used throughout this manual to alert the user to general safety precautions that must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere violates safety standards of design, manufacture, and intended use of the product. HARRIS, Inc. assumes no liability for the customer's failure to comply with these standards.



The **WARNING** symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** symbol until the conditions identified are fully understood or met.



The **CAUTION** symbol calls attention to an operating procedure, practice, or the like, which, if not performed correctly or adhered to, could result in damage to the equipment or severely degrade equipment performance.



The **NOTE** symbol calls attention to supplemental information, which may improve system performance or clarify a process or procedure.



The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of Electro-Static Discharge. Proper precautions must be taken to prevent ESD when handling circuit boards or modules.



The electrical hazard symbol is a **WARNING** indicating there may be an electrical shock hazard present.

## 1.2 IMPORTANT SAFETY INSTRUCTIONS

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with dry cloth.

7. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.



13. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as when the power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
14. Warning: The lightning bolt signifies an alert to the user of the presence of un-insulated "dangerous voltage" within the product's enclosure that may be of significant magnitude to constitute a risk of electric shock to persons.



15. Warning: The exclamation point alerts the user to the presence of important operation and maintenance (service) instructions in the literature accompanying the product.
16. Outdoor Use Warning: To reduce the risk of Fire or Electric Shock, Do Not Expose This Apparatus to Rain or Moisture.
17. Wet Location Warning: Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.

## 1.3 MAXIMUM PERMISSIBLE EXPOSURE LIMITS

DO NOT TRANSMIT with this base station and antenna when persons are within the MAXIMUM PERMISSIBLE EXPOSURE (MPE) Radius of the antenna. The MPE Radius is the minimum distance from the antenna axis that ALL persons should maintain in order to avoid RF exposure higher than the allowable MPE level set by the FCC.



Failure to observe these limits may allow all persons within the MPE radius to experience RF radiation absorption, which exceeds the FCC maximum permissible exposure (MPE) limit. It is the responsibility of the base station operator to ensure that the maximum permissible exposure limits are observed at all times during base station transmission. The base station licensee is to ensure that no bystanders are within the radius limits.

## 1.4 DETERMINING MPE RADIUS

THE MAXIMUM PERMISSIBLE EXPOSURE RADIUS is unique for each site and is determined during site licensing time based on the complete installation environment (i.e. co-location, antenna type, transmit power level, etc.). Determination of the MPE distance is the responsibility of the installation licensee. Calculation of the MPE radius is required as part of the site licensing procedure with the FCC.

## 1.5 SAFETY TRAINING INFORMATION



Your MASTR®V base station generates RF electromagnetic energy during transmit mode. This base station is designed for and classified as “occupational use only” meaning it must be used only in the course of employment by individuals aware of the hazards and the ways to minimize such hazards. This base station is not intended for use by the “general population” in an uncontrolled environment. It is the responsibility of the base station licensee to ensure that the maximum permissible exposure limits determined in the previous section are observed at all times during transmission. The base station licensee is to ensure that no bystanders come within the radius of the maximum permissible exposure limits.

When licensed by the FCC, this base station complies with the FCC RF exposure limits when persons are beyond the MPE radius of the antenna. In addition, your HARRIS base station installation complies with the following Standards and Guidelines with regard to RF energy and electromagnetic energy levels and evaluation of such levels for exposure to humans:

- FCC OET Bulletin 65 Edition 97-01 Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- American National Standards Institute (C95.1 – 1992), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- American National Standards Institute (C95.3 – 1992), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.



To ensure that your exposure to RF electromagnetic energy is within the FCC allowable limits for occupational use, do not operate the base station in a manner that would create an MPE distance in excess of that allowable by the FCC.



This equipment generates or uses radio frequency energy. Any changes or modifications to this equipment not expressly approved by Tyco Electronics Corporation may cause harmful interference and could void the user's authority to operate the equipment.

## 1.6 REGULATORY APPROVALS

### 1.6.1 Federal Communications Commission

The transmitting device described within this manual has been tested and found to meet the following regulatory requirements.

| FCC FILING DATA FOR MASTR V BASE STATION |                                   |                            |                      |
|------------------------------------------|-----------------------------------|----------------------------|----------------------|
| FREQUENCY BAND (MHz)                     | POWER OUTPUT (ADJUSTABLE) (Watts) | FCC TYPE ACCEPTANCE NUMBER | APPLICABLE FCC RULES |
| 150-174                                  | 10 – 100                          | TDB                        | Part 90              |

This receiver associated with this transmitting device has been tested and declared to meet the regulatory requirements defined in the following sub-sections. Associated FCC labeling may be found on page 2.

#### 1.6.1.1 FCC Compliance

**This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:**

- 1. This device may not cause harmful interference, and**
- 2. This device must accept any interference received, including interference that may cause undesired operation.**

##### 1.6.1.1.1 Information to the User

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment does generate, use, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### 1.6.2 Industry Canada

| INDUSTRY CANADA FILING DATA FOR MASTR V BASE STATION |                                      |                                  |
|------------------------------------------------------|--------------------------------------|----------------------------------|
| FREQUENCY BAND (MHZ)                                 | INDUSTRY CANADA CERTIFICATION NUMBER | APPLICABLE INDUSTRY CANADA RULES |
| 150-174                                              | TBD                                  | RSS-119                          |

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.



**The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website [www.hc-sc.gc.ca/rpb](http://www.hc-sc.gc.ca/rpb).**

**Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.**

## **2 SPECIFICATIONS\* (GENERAL)**

### **2.1 GENERAL SPECIFICATIONS**

|                                           |                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------|
| Multi-Channel Transceiver Shelf Assembly: | 5 RU – T/R Shelf                                                                              |
| HPA/PS Shelf Assembly (1 per channel):    | 2 RU – HPA/PSU Shelf                                                                          |
| Duty Cycle (EIA) Continuous:              | Transmit and Receive at 100%                                                                  |
| Operating Temperature:                    | -22°F to +140°F (-30°C to +60°C)                                                              |
| Humidity (EIA):                           | 90% at 122°F (50°C) Non-condensing                                                            |
| AC Power Supply:                          |                                                                                               |
| Input Power Source:                       | 90-240 VAC (nominal), 47~63 Hz                                                                |
| Source Power Drain:                       | 1000 watts per channel (max.) @ 120 VAC<br>600 watts per channel (typical) @ 120 VAC          |
| Input Power Efficiency:                   | >85% at full load (120 VAC)<br>>82.5% at full Load (<100 VAC)                                 |
| Power Supply Outputs:                     | +28.0 VDC ± 0.2V at 25.0 Amps<br>+12.0 VDC ± 0.2V at 2.8 Amps<br>+5.0 VDC ± 0.2V at 28.0 Amps |
| Antenna Connection:                       |                                                                                               |
| Transmitter:                              | Type N Female                                                                                 |
| Receiver:                                 | SMA Female                                                                                    |
| Altitude:                                 |                                                                                               |
| Operating:                                | Up to 15,000 ft (4,570 m)                                                                     |
| Shippable:                                | Up to 50,000 ft (15,250 m)                                                                    |

---

\* These specifications are intended primarily for the use of the service technician. Refer to the product data sheet for the complete specifications.

---

### **2.1.1 Transmitter**

|                                            |                                  |
|--------------------------------------------|----------------------------------|
| Frequency Range:                           | 150-174 MHz                      |
| RMS RF Output Power*:                      | 10 - 100 Watts                   |
| RF Output Impedance:                       | 50 ohms                          |
| Power control accuracy:                    | -0/+0.79 dB                      |
| Frequency Stability:                       | < 0.15 ppm                       |
| Frequency Step Size:                       | 6.25 kHz                         |
| Tuning Range:                              | ± 1 MHz (min)                    |
| Nominal TX Deviation:                      | 2.544 to 3.111 kHz (per TIA-102) |
| Modes of Modulation:                       | C4FM, WC-QPSK, HD-QPSK           |
| Modulation Emission Spectrum:              | Per FCC Part 90                  |
| Incidental AM / AM Hum & Noise:            | > 50 dBc                         |
| Radiated and Conducted Spurious Emissions: | < -70 dBc                        |

\* Rated power output is measured at the transmitter's power amplifier output connector. Optional items such as power measuring devices and/or duplexers will introduce loss between the transmitter output connector and the station cabinet output connector. This loss will reduce the available power at the station connector.

### **2.1.2 Receiver**

|                                |                                              |
|--------------------------------|----------------------------------------------|
| Frequency Range:               | 150 – 174 MHz                                |
| RF Input Impedance:            | 50 ohms                                      |
| Channel Spacing:               | 12.5 kHz                                     |
| Sensitivity:                   | ≥ -119 dBm (5% BER) static, -111 faded (EIA) |
| Selectivity:                   | ≥ 60 dB Per TIA-102                          |
| Frequency Stability:           | <0.15 ppm external freq. std.                |
| Signal Displacement Bandwidth: | ±1.0 kHz Per TIA-102                         |
| Spurious and Image Rejection:  | ≥ 90 dB                                      |

### 3 INTRODUCTION

The MASTR V Base Station is a P25 Phase I capable transceiver. The station is fully upgradable to P25 Phase II. The MASTR V Base Station is a digital, IP based, LMR communications base station operating within a compact shelf design. It supports IP-based remote code uploads and configuration. IP-based programming may be accomplished using the *Device Manager* programming tool. A built-In Self Test (BIST) feature provides improved performance through remote diagnosis which minimizes down time.

The MASTR V Base Station uses a 14-slot modular multi-channel T/R shelf assembly (refer to Figure 3-1) and a 2-slot High Power Amplifier/Power Supply (HPA/PS) shelf assembly. Modules may include BaseBand Processors, Traffic Controllers, TX, and RX modules. Blank panels for the main module slots (MA-555413) and for the E-Switch slots (MA-555417) are installed in unused slots.

The TX module uses a factory programmable IQ modulator circuit capable of generating most any LMR modulation format into a Direct Digital Synthesis (DDS) TX exciter circuit. Additionally, the HPA may be equipped with a Linearizer module for improved amplitude and phase noise characteristics in S-C4FM or similar modulation modes.

The RX module includes integrated front end and IF circuitry. The RX module also uses IQ demodulation circuitry. The IQ demodulator is factory programmable and can decode most any amplitude and phase modulation characteristic making it capable of receiving most any analog or digital LMR modulation format.

The Multi-channel T/R shelf requires +12 VDC and +5 VDC. The HPA requires +28 VDC. The station may be equipped with a 120/240 VAC switching power supply. The T/R Shelf occupies 5-RU spaces. The HPA/PS shelf occupies 2-RU spaces (per TX channel).

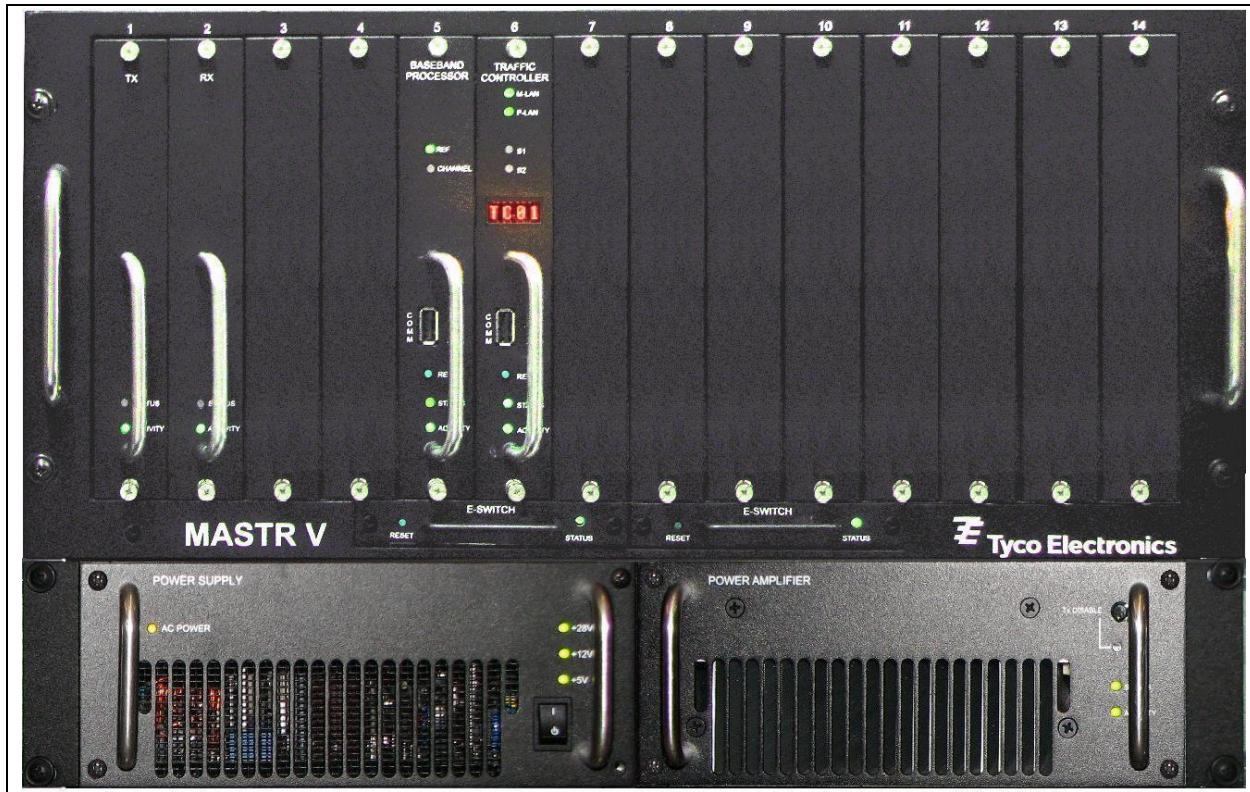


Figure 3-1: MASTR V Multi-Channel Base Station Equipped with One (1) RF Channel

## 4 MASTR V BASE STATION OVERVIEW

### 4.1 MULTI-CHANNEL BASE STATION SHELF ASSEMBLY

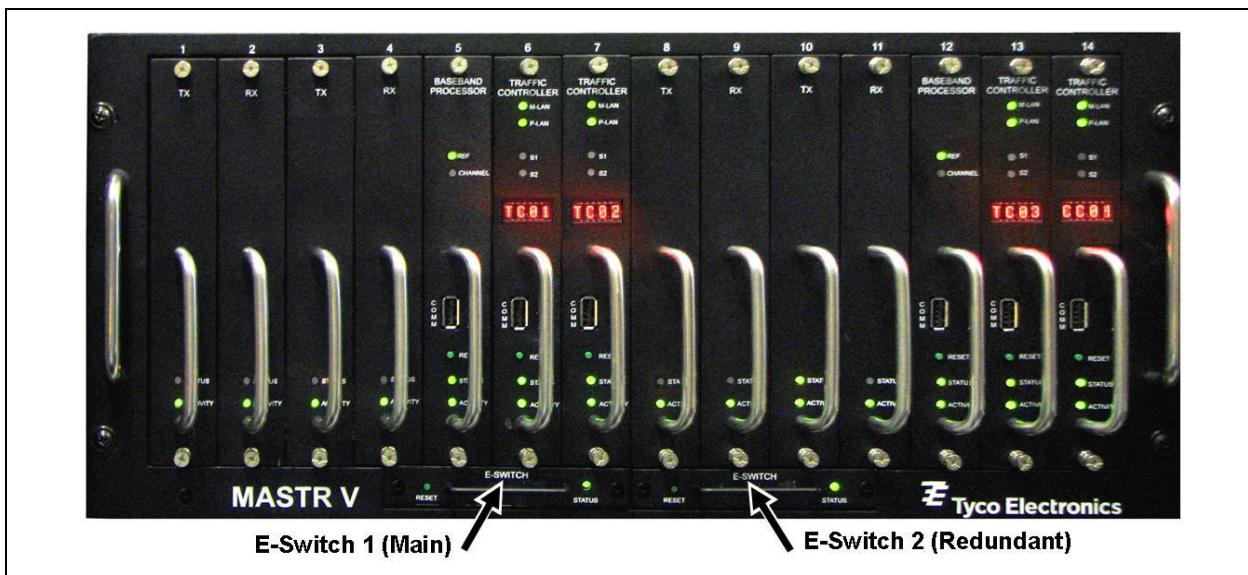
The MASTR V multi-channel base station shelf assembly is a unified subrack design providing 14 identical vertical module slots. Also included are two (2) horizontal slots located under the 14 vertical slots, and used to connect the built-in main and redundant Ethernet Switch modules.

A backplane assembly (refer to Figure 4-2) provides data and DC power connections to each vertical slot, and the two Ethernet Switch module slots. The multi-channel base station shelf, and each module, is equipped with a pull handle for improved handling of the equipment.

When equipped for multiple channel VHF, 150-174 MHz operation, the 14-slots may be populated as shown in Figure 4-1 with the modules listed in Table 4-1. Other module combinations and slot assignments are possible depending on the specific LMR application and system requirements.

**Table 4-1: Typical Module Slot Assignments for 700/800 MHz MASTR V Base Stations**

| SLOT # | MODULE                          | SLOT # | MODULE                          |
|--------|---------------------------------|--------|---------------------------------|
| 1      | Transmitter Module (Channel 1)  | 8      | Transmitter Module (Channel 3)  |
| 2      | Receiver Module (Channel 1)     | 9      | Receiver Module (Channel 3)     |
| 3      | Transmitter Module (Channel 2)  | 10     | Transmitter Module (Channel 4)  |
| 4      | Receiver Module (Channel 2)     | 11     | Receiver Module (Channel 4)     |
| 5      | Baseband Module (Channel 1 / 2) | 12     | Baseband Module (Channel 3 / 4) |
| 6      | Traffic Controller (Channel 1)  | 13     | Traffic Controller (Channel 3)  |
| 7      | Traffic Controller (Channel 2)  | 14     | Traffic Controller (Channel 4)  |
| E1     | E-Switch # 1 (Main)             | E2     | E-Switch #2 (Redundant)         |



**Figure 4-1: MASTR V 150-174 MHz Base Station Shelf equipped with Four (4) RF Channels**

## Multi-Channel Base Station Shelf

The MASTR V Multi-channel Base Station shelf model EA-555002-001 (refer to Figure 4-2) is a 14-slot, 5-RU, shelf assembly. The shelf provides a modular environment supporting most any combination of MASTR V modules.

Assembled to the rear of the shelf is a unified backplane assembly. The backplane interfaces all data, frequency reference, and DC power connections from the 14 module slots, to the two (2) horizontally positioned Ethernet switch modules.

Two (2) connector assemblies are provided for each module slot, a 3-pin connector for DC power (J101 through J114), and a 95-pin connector for data/small signals (J1 through J14). The DC power connector pinout is provided in Table 4-2. Each E-Switch module slot uses a 120-pin signal connector (40 balanced signal pairs, each with an individual shield) for optimal signal performance. Additionally, two (2) guide pins are used in each module slot, one at each end of every connector row. The guide pins properly align the module with the backplane connectors as they slide together.

### 4.1.1.1 DC Power Input Connections

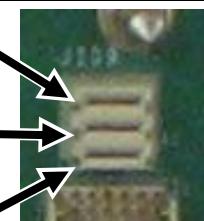
The backplane's DC power distribution may be configured to use one or both DC power input connections, J30 and J31. DC power input to slots 1 through 7 is primarily connected to J30. DC power input to slots 8 through 14 is primarily connected to J31. Removing the two fuses (F1 and F2) from the backplane allows independent DC operation of slots 1 through 7, and slots 8 through 14. This configuration is commonly used for one or more of the following reasons:

- To minimize channel failure (multi-channel configurations) in the event one of the supporting power supplies fail, or a module failure unexpectedly loads the DC input.
- To distribute current loading between power supply modules.

Alternately, if the combined current drain of each module installed in the shelf does not exceed the power supply's maximum current ratings, then the backplane may be configured for a common DC input. Installing 30 amp fuses into fuse locations F1 and F2 will parallel the +5 VDC and +12 VDC input connections. This configuration allows either J30 or J31 to act as a common DC power source for slots 1 through 14.

It is important to understand that when F1 and F2 are installed, DC input connectors J30 and J31 are not isolated; therefore, connecting DC power sources to each connector simultaneously is not recommended in this configuration. Also, fuses F1 and F2 are not used as safety devices, but rather as high current (low resistance) jumpers.

**Table 4-2: Module Slot 1 through 14 – DC Power Connector Pinout**

| CONNECTOR   | PIN | DESCRIPTION | DIAGRAM                                                                               |
|-------------|-----|-------------|---------------------------------------------------------------------------------------|
| J101 – J114 | 1   | + 5 VDC     |  |
|             | 2   | – Ground    |                                                                                       |
|             | 3   | + 12 VDC    |                                                                                       |

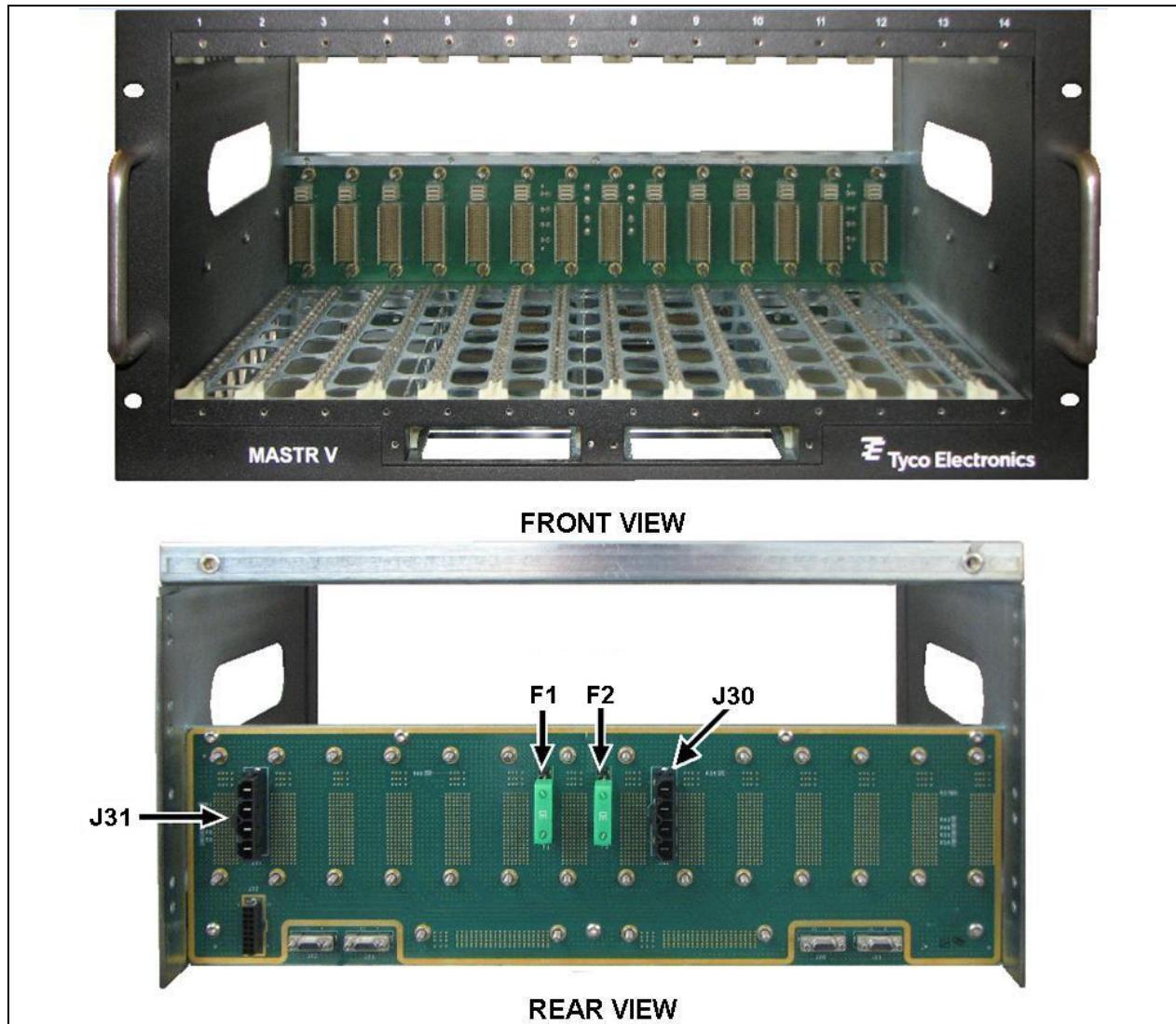


Figure 4-2: 14-Slot Base Station Shelf

## 4.2 HIGH POWER AMPLIFIER/POWER SUPPLY SHELF ASSEMBLY

The High Power Amplifier (HPA) (refer to Section 4.3.6) and the Power Supply (PS) (refer to Section 4.3.6.1) are installed in a 19" rack mountable, 2-slot metal shelf, model MA-555003 (refer to Figure 4-3). The HPA/PS shelf is a mechanical-only assembly with no electrical components.

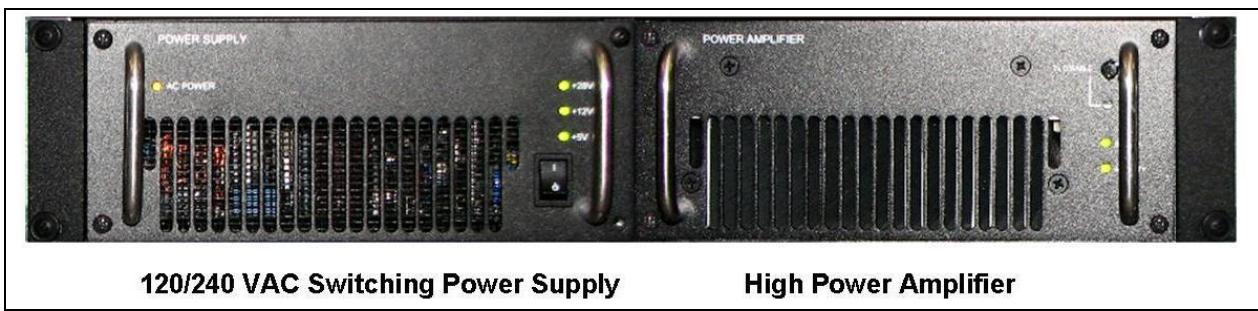


Figure 4-3: MASTR V HPA/PS Shelf Assembly (shown with HPA and PS installed)

## 4.3 MASTR V MODULES

For P25 Trunked Simulcast, the following station modules may be installed in the MASTR V Base Station shelf:

- TX module
- RX module
- Baseband Processor Module
- Traffic Controller Module
- High Power Amplifier Module
- Power Supply Module
- Ethernet Switch

### 4.3.1 Ethernet Switch (E-SWITCH)

Communications with the MASTR V base station modules is provided by a built-in Ethernet Switch module EA-555012-001 located under main module shelf. A second position under the main module shelf is provided for a redundant Ethernet Switch module.

Ethernet communications are utilized to pass voice and data transmissions, management, and control data between the Traffic Controller and supporting MASTR V modules via the Ethernet Switches.

**Table 4-3: E-Switch Module Connections**

| LOCATION             | CONNECTOR | DESCRIPTION                             |
|----------------------|-----------|-----------------------------------------|
| Circuit Board (side) | RJ-45     | Factory Service Communications Port     |
|                      | 4-Pin     | Factory Service DC Power                |
| Rear Panel           | 120-Pin   | Backplane Connection (40 pair w/Shield) |
|                      | 3-Pin     | Backplane DC Power (refer to Table 4-2) |

**Table 4-4: Ethernet Switch – Front Panel Indicators and Controls**

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION         |
|-------------------|-----------------|---------------------|
| Status LED        | OFF             | No Status           |
|                   | GREEN SOLID     | Active Switch       |
|                   | GREEN FLASHING  | Standby Switch      |
|                   | RED SOLID       | Major Fault         |
|                   | RED FLASHING    | Minor Fault         |
|                   | YELLOW SOLID    | Flash Write         |
|                   | YELLOW FLASHING | Program Downloading |
| Reset Switch      | N/A             | Soft Module Reset   |

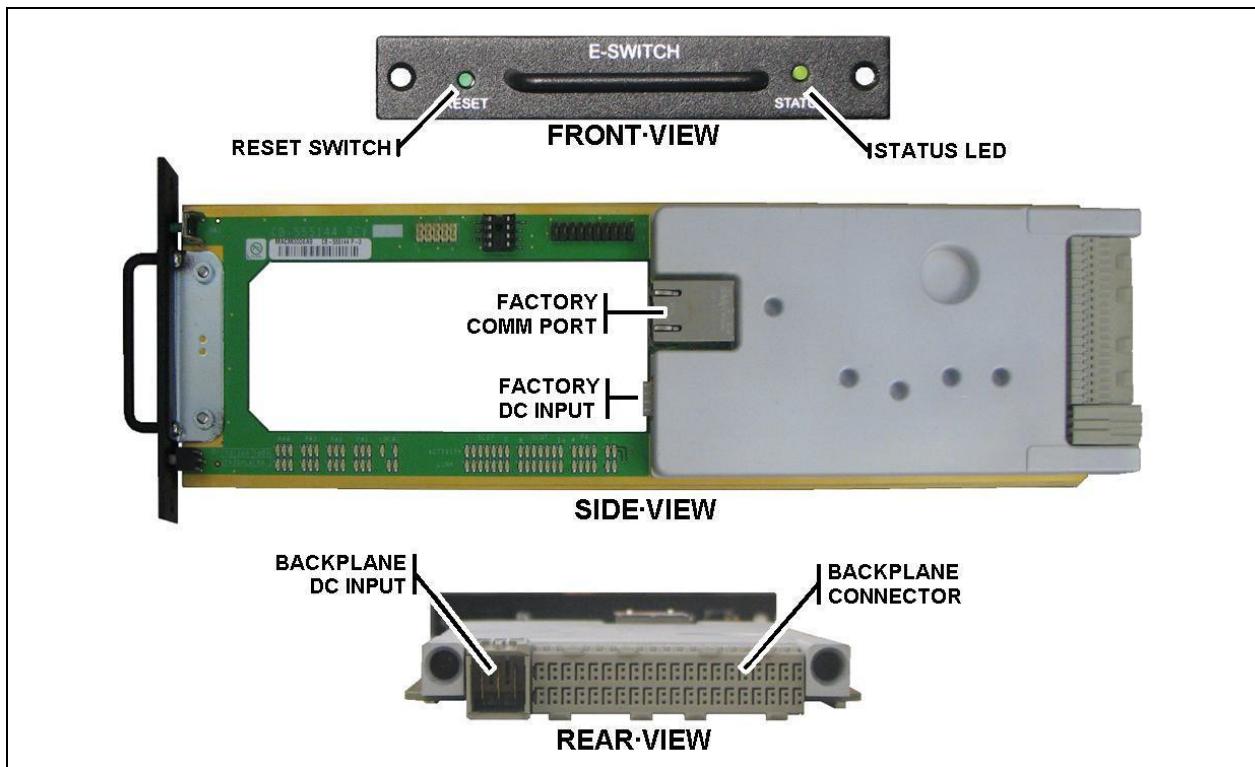


Figure 4-4: Ethernet Switch Module

#### 4.3.2 Transmitter Module (TX)

The MASTR V TX module series EA-555008 provide a highly stable -1 dBm RF output to drive the High Power Amplifier module. The MASTR V TX module uses a Direct Digital Synthesizer (DSS) which optimizes the modulation characteristics of the TX module. DSS can digitally create a precision waveform or modulation scheme from a single on-board oscillator. This capability makes the MASTR V TX module one of the most versatile transmitter modules in the North American Land Mobile Radio (LMR) and European Professional Mobile Radio (PMR) marketplace.

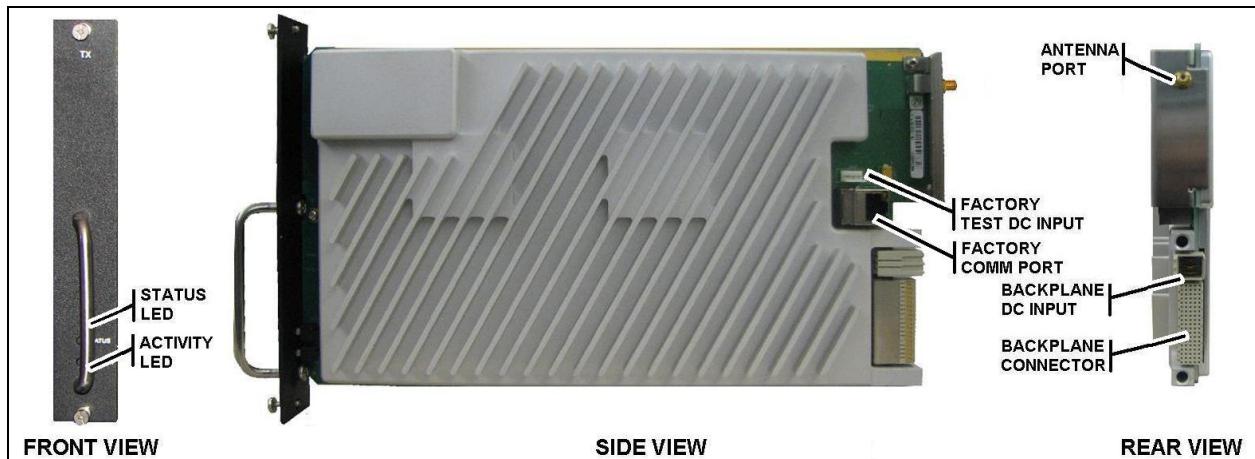


Figure 4-5: TX Module

All electrical connections used during normal operation are located on the rear panel (refer to Figure 4-5). Control, data, small signal, and DC power connections mate with the unified backplane. A low level TX exciter output connector is located on the rear panel.

**Table 4-5: TX Module Connections**

| LOCATION             | CONNECTOR | DESCRIPTION                             |
|----------------------|-----------|-----------------------------------------|
| Rear Panel           | SMA       | Transmitter Exciter Output              |
|                      | 95-Pin    | Backplane Small Signal Connector (5X19) |
|                      | 3-Pin     | Backplane DC Power (refer to Table 4-2) |
| Circuit Board (side) | RJ-45     | Factory Service Communications Port     |
|                      | 4-Pin     | Factory Service DC Power                |

**Table 4-6: TX Module – Front Panel Indicators and Controls**

| INDICATOR/CONTROL       | INDICATOR COLOR | DESCRIPTION            |
|-------------------------|-----------------|------------------------|
| Status LED              | OFF             | No Status              |
|                         | GREEN SOLID     | Transmitting           |
|                         | GREEN FLASHING  | Undefined (future use) |
|                         | RED SOLID       | Major Fault            |
|                         | RED FLASHING    | Minor Fault            |
|                         | YELLOW SOLID    | Flash Write            |
|                         | YELLOW FLASHING | Program Downloading    |
| Activity LED (Ethernet) | OFF             | No Activity            |
|                         | GREEN SOLID     | Ethernet Activity      |
|                         | GREEN FLASHING  | Undefined (future use) |
|                         | RED SOLID       | Major Fault            |
|                         | RED FLASHING    | Minor Fault            |
|                         | YELLOW SOLID    | Undefined (future use) |
|                         | YELLOW FLASHING | Undefined (future use) |

### **4.3.3 Receiver Module (RX)**

The MASTR V Receiver (RX) modules, model EA-555007, are dual-IF conversion receivers. The RX modules are currently available in the 700/800 dual band, model EA-555007-011, with EA-555007-002 covering the 150-174MHz VHF band split.

The receiver uses a Sigma-Delta analog to digital converter to process the incoming IF signal. The output of the analog-to-digital converter is a complex pair of I/Q baseband digital signals. The MASTR V RX module supports a wide range of modulation waveforms required for current and next generation public safety two-way radio communications.

After IF filtering and down-conversion, received signals are digitized into I and Q information and sent to the Baseband Processor module via the backplane Ethernet. The Baseband Processor module provides the narrow channel filtering and demodulation. The narrow channel filters and digital demodulation is

performed by the system DSP, giving the MASTR V receiver the flexibility needed in current and future LMR communications systems.

All bands of MASTR V RX modules share common design features and meet stringent receiver specifications including the following:

- High intercept point.
- Low noise figure.
- 110.2 MHz IF chosen for all bands of the MASTR V.
- Automatic Level Control.
- Built-in 10 MHz reference; switchable to external reference derived from the baseband module (which is compatible with an external frequency standard used for Simulcast).
- High side LO injection for superior noise performance .
- Built-in hardware diagnostics (voltage supplies, PLL Lock).
- Built-in analog FM test mode.
- Raw IQ data is sent to the BaseBand Processor module for demodulation.

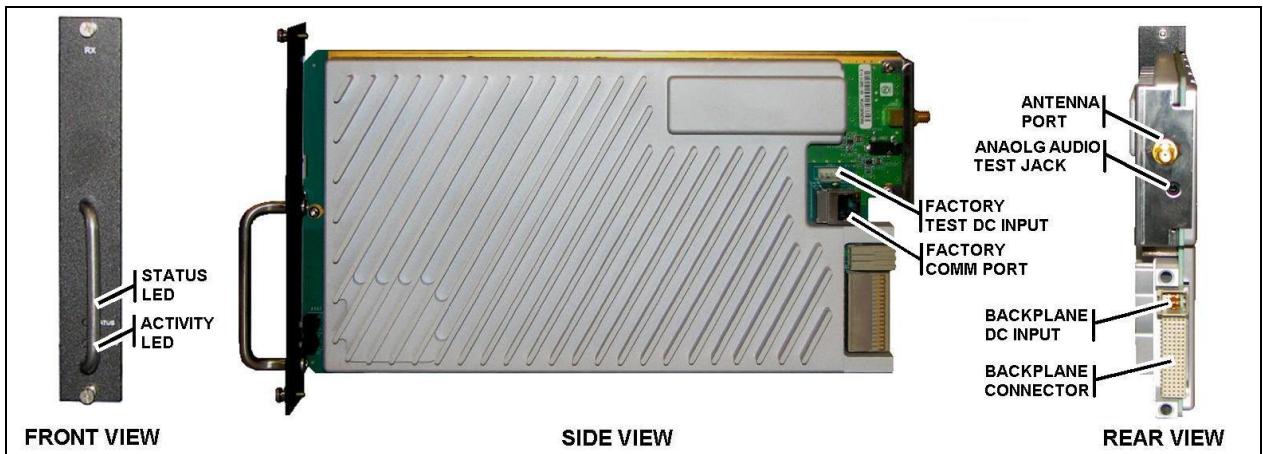


Figure 4-6: RX Module

Table 4-7: RX Module Connections

| LOCATION             | CONNECTOR                | DESCRIPTION                             |
|----------------------|--------------------------|-----------------------------------------|
| Rear Panel           | SMA                      | Receiver Antenna Input                  |
|                      | 3.5 mm Stereo Phone Jack | Analog Receiver Audio (Test mode only)  |
|                      | 95-Pin                   | Backplane Small Signal Connector (5X19) |
|                      | 3-Pin                    | Backplane DC Power (refer to Table 4-2) |
| Circuit Board (side) | RJ-45                    | Factory Service Communications Port     |
|                      | 4-Pin                    | Factory Service Port (DC Power)         |

**Table 4-8: RX Module – Front Panel Indicators and Controls**

| INDICATOR/CONTROL       | INDICATOR COLOR | DESCRIPTION            |
|-------------------------|-----------------|------------------------|
| Status LED              | Off             | No Status              |
|                         | Green Solid     | Receiving              |
|                         | Green Flashing  | Undefined (future use) |
|                         | Red Solid       | Major Fault            |
|                         | Red Flashing    | Minor Fault            |
|                         | Yellow Solid    | Flash Write            |
|                         | Yellow Flashing | Program Downloading    |
| Activity LED (Ethernet) | Off             | No Activity            |
|                         | Green Solid     | Ethernet Activity      |
|                         | Green Flashing  | Undefined (future use) |
|                         | Red Solid       | Major Fault            |
|                         | Red Flashing    | Minor Fault            |
|                         | Yellow Solid    | Undefined (future use) |
|                         | Yellow Flashing | Undefined (future use) |

#### **4.3.4 Baseband Processor Module (BBP)**

The Baseband Processor (BBP) module model EA-555005-001 provides several functions within the MASTR V P25 Simulcast Base Station:

- Generates all RX, TX, and Control Processing for one or more RF channels.
- Provides a data interface between the Traffic Controller the TX and RX modules.
- Interface between the Simulcast T1 multiplexer and the base station.
- Generates a heartbeat message used to monitor the health of the base station modules.
- Performs resynchronization of transmitted data packets.

When a MASTR V Base Station is powered up, the TX, RX, and HPA modules will perform a discovery period where they await a software request message from the BBP module assigned to manage that slot. When the message is received, the module will respond with a software response message that prompts the BBP to send the modules a personality message.

The personality message will contain all personality data (default initialization parameters). The modules respond with an acknowledgement for the personality message, and then initialize themselves according to the personality data in the personality message. The BBP module sends the modules a message to go operational. Once operational, the discovery and initialization phase is complete. The BBP module periodically monitors the modules through heartbeat messages.

##### **4.3.4.1 Base Station TX Interface and Control**

The BBP module performs a vital role during all modes of operation, especially during P25 Simulcast TX site's transmit operations. During P25 simulcast, the BBP module receives the transmit packet timing and

re-synchronization data from the Control Point via the MUX. This information, along with the voice packets routed through the Ethernet Switch's MLAN connection, is reunited to form the P25 transmitter messages. Final synchronization of the P25 transmitter packets, relative to the required system/site timing, is performed and the data is sent to the TX module(s). The BBP module manages only the control operations for the TX modules. Inbound receiver communications from mobile and portables is processed in the associated channel's Traffic Controller and sent to the Control Point via the MLAN connection to the Cisco® switch.

#### 4.3.4.2 Heartbeat Messaging

Heartbeat messaging is used to monitor the condition of the TX, RX, and HPA modules. Once operational, the BBP module sends out *heartbeat* messages to each module. When a heartbeat message is received by a module, the receiving module then sends a heartbeat message back to the BBP module.

The heartbeat monitor task keeps track of the time-stamps of the received heartbeat messages. A fault is registered if a heartbeat message is not received within a predetermined time-frame. The heartbeat monitor also keeps track of certain fault conditions.

#### 4.3.4.3 Resynchronization

In P25 Simulcast mode of operation, the MASTR V BBP module performs timing and resynchronization of data packets sent to the TX module. A predetermined time delay is applied to the packets relative to a precision world time clock signal provided by an external, centre highly stable, GPS based time clock. A GPS receiver is installed at each Simulcast TX Site and Control Point to provide the best possible synchronization between all TX sites.

**Table 4-9: BBP Module Connections**

| LOCATION             | CONNECTOR | DESCRIPTION                             |
|----------------------|-----------|-----------------------------------------|
| Rear Panel           | SMA       | 10 MHz Time Base Input                  |
|                      | DB-15HD   | Simulcast Channel 1                     |
|                      | DB-15-HD  | Simulcast Channel 2                     |
|                      | RJ-45     | Ethernet MLAN                           |
|                      | 95-Pin    | Backplane Small Signal Connector (5X19) |
|                      | 3-Pin     | Backplane DC Power (refer to Table 4-2) |
| Circuit Board (side) | RJ-45     | Factory Service Port (Signaling)        |
|                      | 4-Pin     | Factory Service Port (DC Power)         |
| Front Panel          | USB       | Field Service Communications Port       |

**Table 4-10: BBP Module – Front Panel Indicators and Controls**

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION               |
|-------------------|-----------------|---------------------------|
| Reference LED     | Off             | No Power                  |
|                   | Green Solid     | BP Clock Controller       |
|                   | Green Flashing  | BP Clock Standby          |
|                   | Red Solid       | External Reference Failed |

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION               |
|-------------------|-----------------|---------------------------|
|                   | Red Flashing    | Internal Reference Failed |
|                   | Yellow Solid    | Undefined (future use)    |
|                   | Yellow Flashing | Undefined (future use)    |
| Channel LED       | Off             | No Activity               |
|                   | Green Solid     | Channel Active            |
|                   | Green Flashing  | Undefined (future use)    |
|                   | Red Solid       | Major Fault               |
|                   | Red Flashing    | Minor Fault               |
|                   | Yellow Solid    | Undefined (future use)    |
|                   | Yellow Flashing | Undefined (future use)    |
| Status LED        | Off             | No Status                 |
|                   | Green Solid     | OK Status                 |
|                   | Green Flashing  | Undefined (future use)    |
|                   | Red Solid       | Major Fault               |
|                   | Red Flashing    | Minor Fault               |
|                   | Yellow Solid    | Flash Write               |
|                   | Yellow Flashing | Program Downloading       |
| Activity LED      | Off             | No Activity               |
|                   | Green Solid     | Ethernet Activity         |
|                   | Green Flashing  | Undefined (future use)    |
|                   | Red Solid       | Major Fault               |
|                   | Red Flashing    | Minor Fault               |
|                   | Yellow Solid    | Undefined (future use)    |
|                   | Yellow Flashing | Undefined (future use)    |
| Reset Switch      | N/A             | Software Reset            |

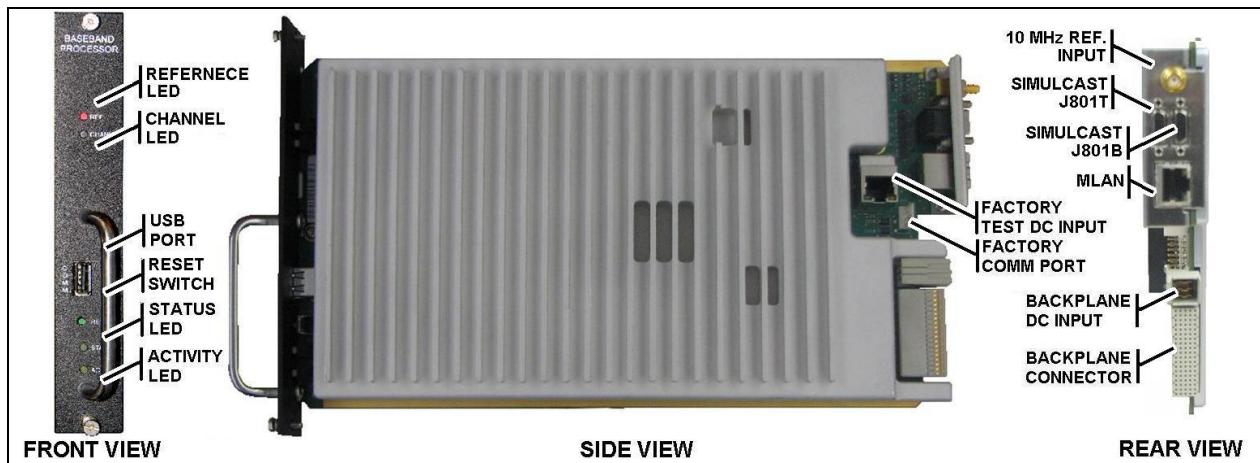


Figure 4-7: BaseBand Processor Module

#### 4.3.5 Traffic Controller Module (TC)

The Traffic Controller (TC) module model EA-555004-001 performs interfacing for one (1) MASTR V P25 RF channel. The TC module provides the following services:

- Data and control information for one (1) TX module.
- Data and control information for one (1) RX module
- Generates the P25-formatted TX messages for over-the-air transmission.
- Provides VoIP interfacing to other P25 sites.

The TC module manages data and control information for one (1) TX and one (1) RX channel module. Incoming data from dispatch points is processed into over-the-air P25-formatted TX messages. The TC module processes decoded radio information received from the BBP module, and handles all aspects of trunking (subscriber unit validation, assigned channels, queuing, etc.).

During P25 Trunked Simulcast operation, the TC module interprets and directs inbound calls. It issues appropriate control commands to and from the TX and RX modules, including how to handle data between the base station and the Control Point.

The TC module also handles VoIP interfacing to other P25 sites. Receiver packets are formatted into a VoIP-capable protocol and sent to other predefined P25 sites for retransmission.

Table 4-11: TC Module Connections

| LABEL                | CONNECTOR | DESCRIPTION                             |
|----------------------|-----------|-----------------------------------------|
| Rear Panel           | RJ-45     | Ethernet MLAN                           |
|                      | RJ-45     | Ethernet PLAN                           |
|                      | 95-Pin    | Backplane Small Signal Connector (5X19) |
|                      | 3-Pin     | Backplane DC Power (refer to Table 4-2) |
| Circuit Board (side) | RJ-45     | Factory Service Communications Port     |
|                      | 4-Pin     | Factory Service DC Power                |
| Front Panel          | USB       | Service Communications Port             |

Table 4-12: TC Module – Front Panel Indicators and Controls

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION            |
|-------------------|-----------------|------------------------|
| Status LED        | Off             | No Status              |
|                   | Green Solid     | RX/TX C-LAN            |
|                   | Green Flashing  | Undefined (future use) |
|                   | Red Solid       | Major Fault            |
|                   | Red Flashing    | Minor Fault            |
|                   | Yellow Solid    | Flash Write            |
|                   | Yellow Flashing | Program Downloading    |
| Activity LED      | Off             | No Activity            |
|                   | Green Solid     | Ethernet Activity      |
|                   | Green Flashing  | Undefined (future use) |
|                   | Red Solid       | Major Fault            |
|                   | Red Flashing    | Minor Fault            |
|                   | Yellow Solid    | Undefined (future use) |
|                   | Yellow Flashing | Undefined (future use) |

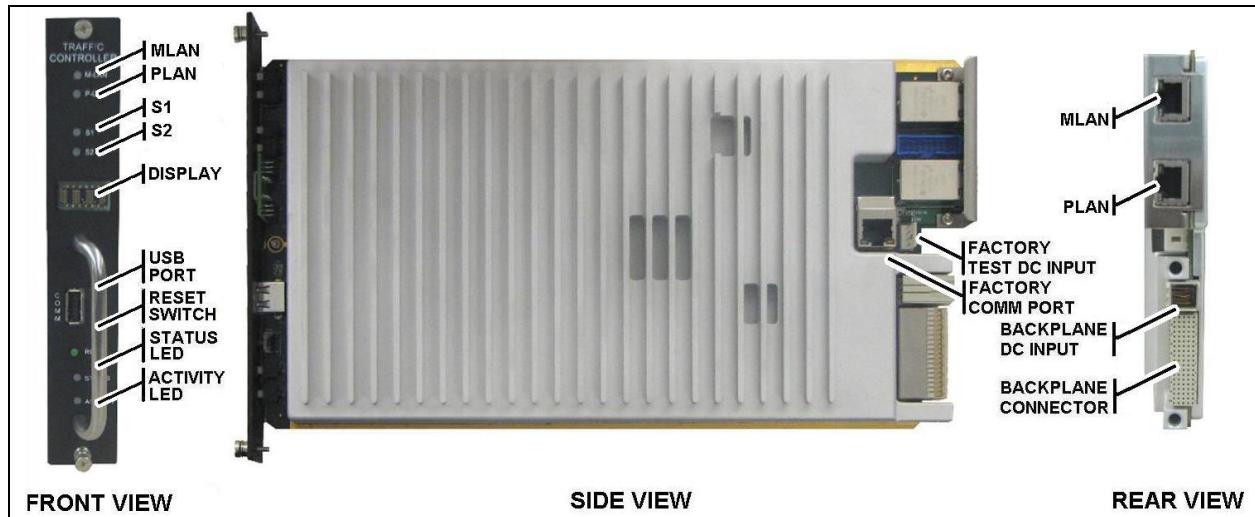


Figure 4-8: Traffic Controller Module

#### 4.3.6 High Power RF Power Amplifier Module (HPA)

The RF High Power Amplifier (HPA) assembly EA-555009-002 (shown in Figure 4-9), amplifies the exciter output to rated station output power level for 150-174MHz operation. This module contains a power module, amplifier drivers and power control circuitry required for power amplification. The Power Amplifier assembly is a continuous duty, solid state, wide-band RF power amplifier. Its main function is to amplify the 0 dBm signal from the TX module to the rated RF output at the antenna port. The RF

output of the Power Amplifier Assembly is typically 100 Watts for VHF (adjustable from 10 to 100 Watts).

The MASTR V HPAs are also equipped with a RF linearizer circuit to improve RF performance. The RF linearizer samples the RF output of the HPA, and provides waveform correction to the RF input signal relative to its RF output characteristics. This improves waveform distortion.

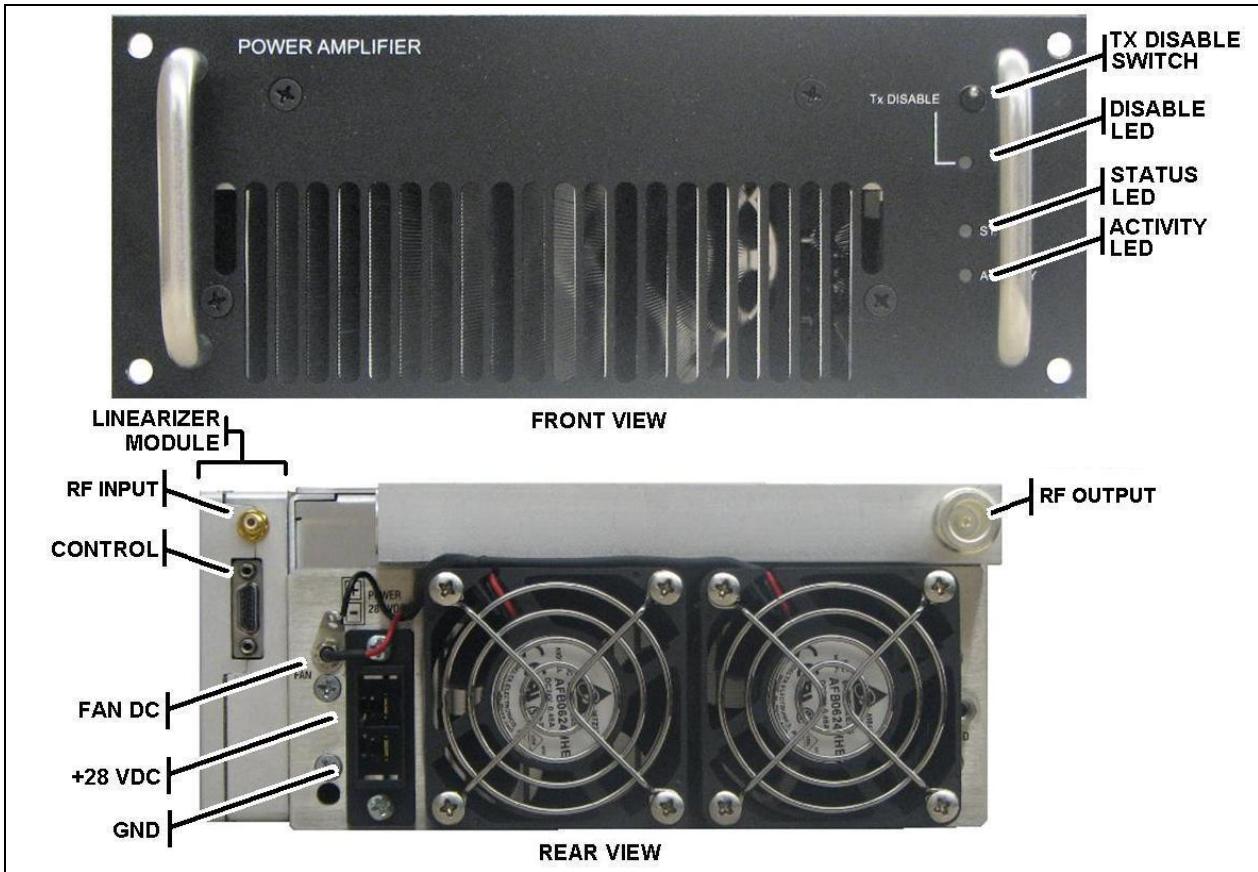


Figure 4-9: High Power Amplifier Module with Integrated Linearizer

Table 4-13: HPA Front Panel Indicators and Switches

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION                                                                                                 |
|-------------------|-----------------|-------------------------------------------------------------------------------------------------------------|
| TX Disable LED    | Off             |                                                                                                             |
|                   | Yellow          |  TX Disabled              |
| Status LED        | Off             |  No Status                |
|                   | Green Solid     |  Pa Active                |
|                   | Green Flashing  |  TX Inhibit               |
|                   | Red Solid       |  Major Fault              |
|                   | Red Flashing    |  Minor Fault              |
|                   | Yellow Solid    |  Flash Write              |
|                   | Yellow Flashing |  Program Downloading      |
| Activity LED      | Off             |  No Activity              |
|                   | Green Solid     |  Ethernet Activity       |
|                   | Green Flashing  |  Undefined (future use) |
|                   | Red Solid       |  Major Fault            |
|                   | Red Flashing    |  Minor Fault            |
|                   | Yellow Solid    |  Undefined (future use) |
|                   | Yellow Flashing |  Undefined (future use) |
| TX Disable Switch | N/A             | Hard TX Disable                                                                                             |

#### 4.3.6.1 Power Supply Module (PS)

The MASTR V Power Supply (PS) module EA-555011-001 (refer to Figure 4-9) is a continuous duty switching power supply. It operates from an input of 85 VAC to 265 VAC at 47 Hz to 63 Hz (1000 Watts maximum). The PSU provides a maximum of 875 Watts total output power divided among the following three (3) DC outputs:

- +28 VDC at 25 Amps.
- +12 VDC at 2.8 Amps.
- +5.0 VDC at 28 Amps.

The MASTR V PS includes front panel LED status indicators for each DC output, an AC Power input LED, and a front panel ON/OFF switch used to disable the power supply and built-in cooling fan.

Three (3) DC power output connections are provided; one (1) to provide DC current to the MASTR V multi-channel shelf, another to provide DC current to the HPA module, and a spare DC connection.

The MASTR V PS is a negative ground power supply (the negative lead of each DC output is tied to chassis ground). Over voltage, under voltage, and over current protection is built-into the AC input, and each DC output. In the event one of the protection circuits is triggered, only the affected DC output is shut down until the protection circuit is reset.

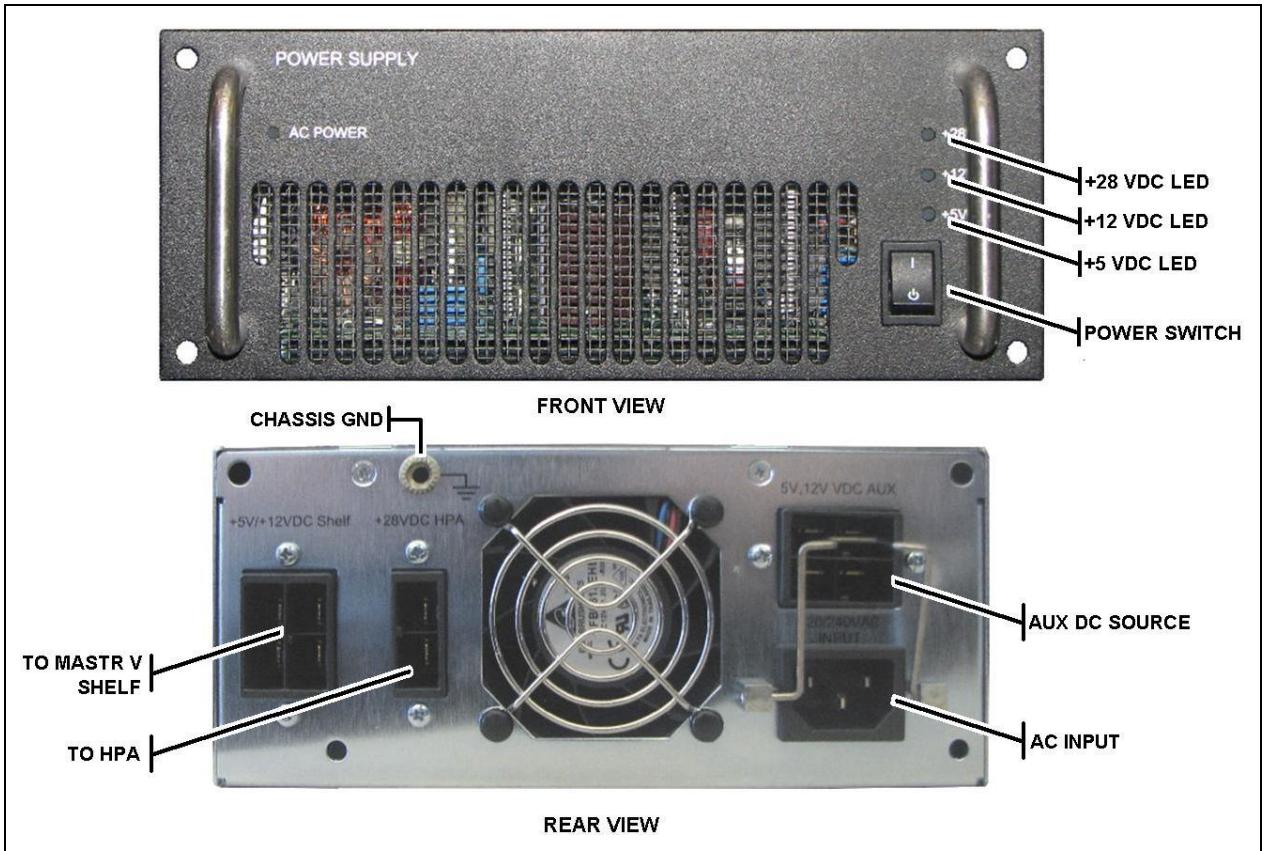


Figure 4-10: Power Supply Module

Table 4-14: Backplane – Module DC Power Connector Pinout

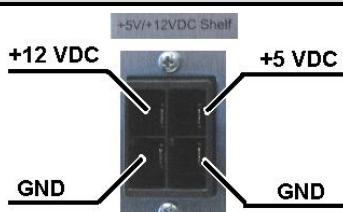
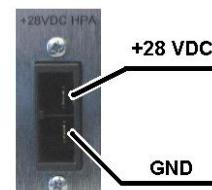
| CONNECTOR LABEL  | DESCRIPTION          | DIAGRAM<br>(As viewed when facing the rear of the PS)                               |
|------------------|----------------------|-------------------------------------------------------------------------------------|
| +5V/+12VDC Shelf | To MASTR V T/R Shelf |   |
| +28VDC HPA       | To HPA Module        |  |
| 5V,12V VDC AUX   | Auxiliary/Spare      |   |

Table 4-15: PS Front Panel Indicators and Switches

| INDICATOR/CONTROL | INDICATOR COLOR | DESCRIPTION            |
|-------------------|-----------------|------------------------|
| +28 VDC LED       | Off             | OFF or not operational |
|                   | Green Solid     | Operational            |
| +12 VDC LED       | Off             | OFF or not operational |
|                   | Green Solid     | Operational            |
| +5 VDC LED        | Off             | OFF or not operational |
|                   | Green Solid     | Operational            |
| AC Power LED      | Off             | OFF or not operational |
|                   | Green Solid     | Operational            |
| ON/OFF Switch     | N/A             | AC Power ON/OFF        |

## 5 PROGRAMMING, TEST AND DIAGNOSTICS

### 5.1 DEVICE MANAGER

Setup, configuration, and programming of a MASTR V P25 Trunked base station is accomplished through the use of Tyco Electronics Device Manager programming software tool. Device Manager is an easy-to-use programming tool designed around a Windows-based file management system that permits users to configure and manage devices within their system. The user can save/open personalities using the Windows file system.

The opening screen, known as the Device Management Console (DMC), allows users to configure and manage IP-accessible devices in their MASTR V radio system. It allows users to edit device Personalities and permits users to perform actions such as the following:

- Reset
- Read Version
- Load Code
- Read Personality
- Write Personality

The DMC stores device connection information and all personalities (by default) for the supported devices within the radio system. The information stored includes device definitions, device plug-ins, device Client plug-ins, device personalities, device code, device connections, and device details. The Repository provides an interface to access, modify, and create the information.



Figure 5-1: Device Manager

## 5.2 TEST AND DIAGNOSTICS

The MASTR V base station has built-in self diagnostics and fault reporting. Station faults may be remotely monitored via fault reporting from one or more of the following resources:

- Via the VIDA Network through the Regional Network Manager.
- By telnet session while connected locally to a MASTR V base station.

The TC module and BBP modules are capable of reporting fault information via the VIDA Network to the Regional Network Manager (RNM). The RNM has the ability to “Poll” the status of certain equipment, and “Trap” responses to log files. For more information regarding RNM *polling* and *trapping*, refer to the Regional Network Manager User Manual: MM1000018633.

## **6 REFERENCE MANUALS**

The following table provides a listing of individual manuals that may be useful when installing and maintaining a MASTR V P25 Simulcast System.

**Table 6-1: Reference Manuals**

| <b>REFERENCES AND STANDARDS MANUALS</b>             | <b>MANUAL NUMBER</b> |
|-----------------------------------------------------|----------------------|
| Standard For Site Grounding and Protection Manual   | AE/LZT 123 4618/1    |
| Electrostatic Discharge Protection Manual           | LBI-38737            |
| Specification, Guidelines & Practices Manual        | LBI-39185            |
| Antenna Systems Manual                              | LBI-38983            |
| MASTR V P25 Simulcast TX Site Installation Manual   | MM-015040-001        |
| VIDA Device Manager User's Manual                   | MM-016371-001        |
| VIDA Network Regional Network Manager User's Manual | MM1000018633         |

## **7 CUSTOMER SERVICE**

### **7.1.1 Technical Support**

Tyco Electronics' Technical Assistance Center (TAC) resources are available to help you with overall system operation, maintenance, upgrades, and product support. TAC is your point of contact when you need technical questions answered.

Product specialists, with detailed knowledge of product operation, maintenance, and repair, provide technical support via a toll-free telephone number (in North America). Support is also available through mail, fax, and e-mail.

For more information about technical assistance services, contact your sales representative, or call the Technical Assistance Center directly at:

|                |                                                                      |
|----------------|----------------------------------------------------------------------|
| North America: | 1-800-528-7711                                                       |
| International: | 1-434-385-2400                                                       |
| Fax Number:    | 1-434-455-6712                                                       |
| E-mail:        | <a href="mailto:tac@tycoelectronics.com">tac@tycoelectronics.com</a> |

### **7.1.2 Customer Resource Center**

If any part of the system equipment is damaged on arrival, contact the shipper to conduct an inspection and prepare a damage report. Save the shipping container and all packing materials until the inspection and the damage report are completed. In addition, contact the Customer Resource Center to make arrangements for replacement equipment. Do not return any part of the shipment until you receive detailed instructions from a Tyco Electronics representative.

Contact the Customer Resource Center at:

US & Canada:

|                            |                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------|
| Toll Free Domestic Number: | 1-800-368-3277 (toll free)                                                               |
| Fax Number:                | 1-800-833-7592 (toll free)                                                               |
| E-mail:                    | <a href="mailto:customerfocus@tycoelectronics.com">customerfocus@tycoelectronics.com</a> |

International:

|               |                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------|
| Phone Number: | 1-434-455-6403                                                                                                     |
| Fax Number:   | 1-434-455-6676                                                                                                     |
| E-mail:       | <a href="mailto:InternationalCustomerFocus@tycoelectronics.com">InternationalCustomerFocus@tycoelectronics.com</a> |

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## **WARRANTY**

- A. HARRIS, Inc. (hereinafter "Seller") warrants to the original purchaser for use (hereinafter "Buyer") that Equipment manufactured by or for the Seller shall be free from defects in material and workmanship, and shall conform to its published specifications. With respect to all non-HARRIS Equipment, Seller gives no warranty, and only the warranty, if any, given by the manufacturer shall apply. Rechargeable batteries are excluded from this warranty but are warranted under a separate Rechargeable Battery Warranty (ECR-7048).
- B. Seller's obligations set forth in Paragraph C below shall apply only to failures to meet the above warranties occurring within the following periods of time from date of sale to the Buyer and are conditioned on Buyer's giving written notice to Seller within thirty (30) days of such occurrence:
  1. for fuses and non-rechargeable batteries, operable on arrival only.
  2. for parts and accessories (except as noted in B.1) sold by Seller's Service Parts Operation, ninety (90) days.
  3. for P7200, P7100<sup>IP</sup>, P5400, P5300, P5200, P5100, P3300, PANTHER™ 405P and 605P, M7300, M7200 (including V-TAC), M7100<sup>IP</sup>, M5300 and M3300 radios, two (2) years, effective 10/01/2007.
  4. for all other equipment of Seller's manufacture, one (1) year.
- C. If any Equipment fails to meet the foregoing warranties, Seller shall correct the failure at its option (i) by repairing any defective or damaged part or parts thereof, (ii) by making available at Seller's factory any necessary repaired or replacement parts, or (iii) by replacing the failed Equipment with equivalent new or refurbished Equipment. Any repaired or replacement part furnished hereunder shall be warranted for the remainder of the warranty period of the Equipment in which it is installed. Where such failure cannot be corrected by Seller's reasonable efforts, the parties will negotiate an equitable adjustment in price. Labor to perform warranty service will be provided at no charge during the warranty period only for the Equipment covered under Paragraph B.3 and B.4. To be eligible for no-charge labor, service must be performed at a HARRIS factory, by an Authorized Service Center (ASC) or other Servicer approved for these purposes either at its place of business during normal business hours, for mobile or personal equipment, or at the Buyer's location, for fixed location equipment. Service on fixed location equipment more than thirty (30) miles from the Service Center or other approved Servicer's place of business will include a charge for transportation.
- D. Seller's obligations under Paragraph C shall not apply to any Equipment, or part thereof, which (i) has been modified or otherwise altered other than pursuant to Seller's written instructions or written approval or, (ii) is normally consumed in operation or, (iii) has a normal life inherently shorter than the warranty periods specified in Paragraph B, or (iv) is not properly stored, installed, used, maintained or repaired, or, (v) has been subjected to any other kind of misuse or detrimental exposure, or has been involved in an accident.
- E. The preceding paragraphs set forth the exclusive remedies for claims based upon defects in or nonconformity of the Equipment, whether the claim is in contract, warranty, tort (including negligence), strict liability or otherwise, and however instituted. Upon the expiration of the warranty period, all such liability shall terminate. The foregoing warranties are exclusive and in lieu of all other warranties, whether oral, written, expressed, implied or statutory. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES.

This warranty applies only within the United States.

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