

## **User / Operational Manual**

### *Operational or User's Manual*

The manual should include instruction, installation, operator, or technical manuals with required 'information to the users'. This manual should include a statement that cautions the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The manual shall include RF Hazard warning statements, if applicable.

This product is installed in restricted access locations only, only authorized service personnel access to the product. As such, a high level User's Installation / Operating instruction manual is not published. Copy of some of the manual content has been assembled and is included as part of this filing package.

Upon request, published and/or printed manuals will be sent to the commission and/or telecommunication certification body (TCB). All of the descriptions, block diagrams, and schematics on file with the commissions are believed to be current.

### **EXHIBIT DESCRIPTION**

D1-1	Manual Front Matter
D1-2	Specifications
D1-3	Field Replaceable Units and Orderable Parts
D1-4	Tune-Up Procedure (Draft)
D1-5	Racking Configurations
D1-6	Functional Description / Operation of Modules

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### European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive



The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases).

As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste.

Customers or end-users in EU countries should contact their local equipment supplier representative or service centre for information about the waste collection system in their country.

# About GTR 8000 Base Radio

## What Is Covered In This Manual?

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This manual contains the following chapters:

- *GTR 8000 Base Radio Description on page 35* provides a high-level description of the GTR 8000 Base Radio and the function it serves on your system.
- *GTR 8000 Base Radio Theory of Operation on page 63* explains how the GTR 8000 Base Radio works in the context of your system.
- *GTR 8000 Base Radio Installation on page 85* details installation procedures relating to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio Configuration on page 131* details configuration procedures relating to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio Optimization on page 155* contains optimization procedures and recommended settings relating to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio Maintenance on page 199* describes periodic maintenance procedures relating to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio Operation on page 201* details tasks to perform once the GTR 8000 Base Radio is installed and operational on your system.
- *GTR 8000 Base Radio Troubleshooting on page 205* provides fault management and troubleshooting information relating to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio FRU Procedures on page 213* lists the Field Replaceable Units (FRUs) and Field Replaceable Entities (FREs) and includes replacement procedures applicable to the GTR 8000 Base Radio.
- *GTR 8000 Base Radio Reference on page 251* contains supplemental reference information relating to the GTR 8000 Base Radio indicator LEDs.
- *GTR 8000 Base Radio Disaster Recovery on page 263* provides references and information that enables recovery of a GTR 8000 Base Radio in the event of failure.
- *Conventional GTR 8000 Base Radio Option Kits on page 271* provides the option kits that are available for the conventional GTR 8000 Base Radio.

## Helpful Background Information

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Motorola offers various courses designed to assist in learning about the system. For information, go to <http://www.motorolasolutions.com/training> to view the current course offerings and technology paths.

## Related Information

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In addition to the information in the table, see the Related Information Guide.

Related Information	Purpose
<i>Standards and Guidelines for Communication Sites</i>	Provides standards and guidelines that should be followed when setting up a Motorola communications site.

*Table continued...*

Related Information	Purpose
	This may be purchased on CD 9880384V83, by calling the North America Parts Organization at 800-422-4210 or the international number at 302-444-9842.
<i>System Documentation Overview</i>	<p>For an overview of the ASTRO<sup>®</sup> 25 system documentation, open the graphical user interface for the ASTRO<sup>®</sup> 25 system documentation set and select the <b>System Documentation Overview</b> link. This opens a file that includes:</p> <ul style="list-style-type: none"> <li>• ASTRO<sup>®</sup> 25 system release documentation descriptions</li> <li>• ASTRO<sup>®</sup> 25 system diagrams</li> <li>• ASTRO<sup>®</sup> 25 system glossary</li> </ul> <p>For an additional overview of the system, review the architecture and descriptive information in the manuals that apply to your system configuration.</p>
<i>Dynamic System Resilience</i>	Provides all the information required to understand, operate, maintain, and troubleshoot the Dynamic System Resilience feature.
<i>Conventional Operations</i>	Provides the information required to understand and operate the conventional GTR 8000 Base Radio in a Centralized or Distributed Conventional Architecture.
<i>Quick Guide for Replacing a Conventional QUANTAR with a GTR 8000 Base Radio</i>	Provides instructions for replacing conventional QUANTARs <sup>®</sup> with conventional analog, digital and mixed mode GTR 8000 base radios. Also provides detailed comparisons of the devices.
<i>Trunked IP Simulcast Subsystem Remote Site HPD Standalone System - Infrastructure</i>	Provides the information required to understand and operate the GTR 8000 Base Radio in an ASTRO <sup>®</sup> 25 trunked site.
<i>Quick Guide for Replacing a Trunked 3600 QUANTAR with a GTR 8000 Base Radio</i>	Provides instructions for replacing trunked 3600 QUANTARs <sup>®</sup> with GTR 8000 base radios and GTR 8000 Expandable Site Subsystem. Also provides detailed comparisons of the devices.

- 11 See *Configuring Centralized Authentication on Devices in VoyenceControl on page 152* to program the base radio using UNC.

## General Safety Precautions

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**Warning:** Compliance with FCC guidelines for human exposure to Electromagnetic Energy (EME) at Transmitter Antenna sites generally requires that personnel working at a site must be aware of the potential for exposure to EME, and can exercise control of exposure by appropriate means, such as adhering to warning sign instructions, using standard operating procedures (work practices), wearing personal protective equipment, or limiting the duration of exposure. For more details and specific guidelines, see “Appendix A” of the Motorola *Standards and Guidelines for Communications Sites* manual.

Observe the following general safety precautions during all phases of operation, service, and repair of the equipment described in this manual. Follow the safety precautions listed and all other warnings and cautions necessary for the safe operation of all equipment. See the appropriate section of the product service manual for additional pertinent safety information. Due to the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications of equipment.



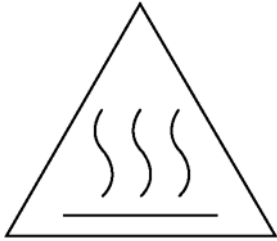
**Note:** The installation process requires preparation and knowledge of the site before installation begins. Review installation procedures and precautions in the Motorola *Standards and Guidelines for Communications Sites* manual before performing any site or component installation.

Always follow all applicable safety procedures, such as Occupational Safety and Health Administration (OSHA) requirements, National Electrical Code (NEC) requirements, local code requirements, and safe working practices. Also, all personnel must practice good judgment. General safety precautions include the following:

- Read and follow all warning notices and instructions marked on the product or included in this manual before installing, servicing, or operating the equipment. Retain these safety instructions for future reference.
- If troubleshooting the equipment while power is on, be aware of the live circuits.
- Do not operate the radio transmitters unless all RF connectors are secure and all connectors are properly terminated.
- Ground all equipment properly in accordance with the Motorola *Standards and Guidelines for Communications Sites* manual and specified installation instructions for safe operation.
- Slots and openings in the cabinet are provided for ventilation. Do not block or cover openings that protect the devices from overheating.
- Only a qualified technician familiar with similar electronic equipment should service equipment.
- Some equipment components can become hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.
- Maintain emergency first aid kits at the site.
- Direct personnel to call in with their travel routes to help ensure their safety while traveling between remote sites.
- Institute a communications routine during certain higher risk procedures where the on-site technician continually updates management or safety personnel of the progress so that help can be dispatched if needed.
- Never store combustible materials in or near equipment racks. The combination of combustible material, heat, and electrical energy increases the risk of a fire safety hazard.
- Equipment installed at the site meeting the requirements of a "restricted access location," per UL60950-1, is defined as follows: "Access can only be gained by service persons or by a user who has been warned about the possible burn hazard on equipment metal housing. Access to the equipment is by using a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location."



**Warning:** Burn hazard. The metal housing of the product may become extremely hot. Use caution when working around the equipment.

**Figure 31: Warning Label on Hot Modules**

warning\_hot



**Warning:** DC input voltage must be no higher than 60 VDC. This maximum voltage includes consideration of the battery charging "float voltage" associated with the intended supply system, regardless of the marked power rating of the equipment. Failure to follow this guideline may result in electric shock.



**Warning:** RF energy burn hazard: disconnect power in the cabinet to prevent injury while disconnecting and connecting antennas.



**Caution:** All Tx and Rx RF cables outer shields must be grounded per Motorola *Standards and Guidelines for Communications Sites* manual requirements.



**Caution:** All Tx and Rx RF cables must be connected to a surge protection device according to the Motorola *Standards and Guidelines for Communications Sites* manual. Do not connect Tx and Rx RF cables directly to an outside antenna.



**Important:** All equipment must be serviced by Motorola-trained personnel.

## GTR 8000 Base Radio Supplemental Safety Installation Requirements

The Supplemental Safety and Installation Requirements include the following:

- The GTR 8000 Base Radio must be installed in a suitable, in-building enclosure. A restricted access location is required when installing this equipment into the end system.
- The base radio contains a Class 1 built-in power supply component. This component is equipped with an appliance inlet for connecting to an AC input, as well as DC input terminals which meet SELV DC circuit requirements.
- When installing the equipment, all requirements of relevant standards and local electrical codes must be fulfilled.
- The maximum operating ambient temperature of this equipment is 60 °C. The maximum operating altitude is 3000 meters above sea level.
- The 28.6 VDC output from the power supply to the PA is at an energy hazard level (exceeds 240 VA). When installing into the end system, care must be taken so as not to touch the output wires.
- When the base radio is used in a DC reverting system, the DC power supply must be located in the same building as the base radio, and it must meet the requirements of a SELV circuit.

## DC Mains Grounding Connections



**Caution:** This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, you must meet all following conditions:

- Connect this equipment directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus in which the DC supply system earthing electrode conductor is connected.
- Locate this equipment in the same immediate area (such as adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor (and also the point of earthing of the DC system). Do not earth the DC system elsewhere.

- Locate the DC supply source within the same premises as the equipment.
- Do not install switching or disconnecting devices in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

## Disconnect Device Permanently Connected

Incorporate a readily accessible disconnect device (circuit breaker or switch) in the building installation wiring.

## Multiple Power Source

This product has multiple power sources. If service requires the removal of a power source, disconnect all inputs (AC and DC powers) to remove power completely to the equipment before servicing.

## Connection to Primary Power

For supply connections, use wires suitable for at least 75 °C.

## Replaceable Batteries



**Warning:** Risk of Explosion if you replace the battery with an incorrect type. Dispose of used batteries according to the instructions.

## Maintenance Requiring Two People

Identify maintenance actions that require two people to perform the repair. Two people are required when:

- A repair has the risk of injury that would require one person to perform first aid or call for emergency support. An example is work around high-voltage sources. If an accident occurs to one person, another person may be required to remove power and call for emergency aid.
- Heavy lifting is involved. Use the National Institute of Occupational Safety and Health (NIOSH) lifting equation to determine whether one or two persons are required to lift a system component when it must be removed and replaced in its rack.

## Equipment Racks

Lift equipment racks without the use of lifting equipment only when sufficient personnel are available to ensure that regulations covering health and safety are not breached. Use an appropriately powered mechanical lifting apparatus for moving and lifting the equipment racks. In addition, comply with any local regulations that govern the use of lifting equipment.

For installation of the cabinet version of the GTR 8000 Base Radio, see [Cabinet Version of the GTR 8000 Base Radio on page 96](#).



**Warning:** Crush Hazard could result in death, personal injury, or equipment damage. Equipment racks can weigh up to 360 kg (800 lb). See the following instructions for proper lifting procedures.

## General Installation Standards and Guidelines

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This section provides guidelines to ensure a quality installation. Review these guidelines before unpacking and installing the system. Additionally, review the installation information in the *Standards and Guidelines for Communication Sites* manual for more details, including:



**Note:** To validate the 35 W standby power consumption specification, wait for the main fans to turn off after the transmitter dekeys. The turn off delay of the main fans is controlled by the fan holdover configuration in the CSS. Single fan operation requires the Tx Power Out in the CSS to be limited to 50 W.

- Transceiver, power amplifier, power supply, fan, and TCXO transceiver option card (internal reference) are all power efficiency package versions



**Note:** The TCXO transceiver option card is available only for non-simulcast conventional systems. The OCXO transceiver option card is available for trunked or simulcast systems, but does not guarantee 35 W.

**Table 2: Standby Power Consumption**

	Conventional Non-Simulcast	Conventional Simulcast	Trunked Non-Simulcast	Trunked Simulcast
Internal Reference Capable	35 W	45 W	35 W	45 W
Not Internal Reference Capable	35 W	35 W	35 W	35 W

## GTR 8000 Base Radio Specifications

The following *G-Series Product Specifications* references the TIA specifications for the base radio. This includes the following Methods and Performance recommendations:

Phase 1 (includes Linear Simulcast):

- Methods: TIA-102.CAAA-C, “Digital C4FM/CQPSK Transceiver Measurements Methods” September 2008
- Performance: TIA-102.CAB-C, “Land Mobile Radio Transceiver Performance Recommendations, Project 25 – Digital Radio Technology, C4FM/CQPSK Modulation” January 2010

Phase 2:

- Methods: TIA-102.CCAA, “Two-Slot Time Division Multiple Access Transceiver Measurement Methods” August 2011
- Performance: TIA 102.CCAB, “Two-Slot Time Division Multiple Access Transceiver Performance Recommendations” October 2011



**Important:** Specifications are subject to change without notice.

## GTR 8000 Base Radio Specifications for Integrated Voice and Data (700/800 MHz)

**Table 3: GTR 8000 Base Radio General Specifications IV&D (700/800 MHz)**

General Specifications	
Model Number	T7039A
Number of Channels (trunked)	1
Number of Channels (conventional)	16
Size (H x W x D)	133mm x 483mm x 457mm (5.25" x 19" x 18")

*Table continued...*



General Specifications	
Weight (Mid-Power)	21 kg (46 lbs)
Weight (High-Power)	22 kg (48 lbs)
Temperature Range	
	Operating: -30 to 60 °C (-22 to 140 °F)
	Storage: -40 to 85 °C (-40 to 185 °F)
Operating Altitude	Up to 1800 meters (5900 feet) above mean sea level Above 1800 meters (5900 feet), the derating is 1.5 °C/km (0.8 °F/1000 feet) Above 3000 meters (9800 feet), the peak power derating for the Tx filter is 1 dB/1km (0.3 dB/1000 feet) Maximum operational altitude is 5000 meters (16900 feet)
Power Requirements	AC: 90-264 VAC, 47-63 Hz DC: 43.2-60 VDC
Power Consumption Transmitting – Mid Power (2–100 W)	
	AC: C4FM, FM: 470 W max, 700/800 MHz H-DQPSK, LSM: 530 W max, 700/800 MHz
	DC: C4FM, FM: 430 W max, 700/800 MHz H-DQPSK, LSM: 490 W max, 700/800 MHz
Power Consumption Transmitting – High Power (15–150 W)	
	AC: C4FM, FM: 725 W max, 800 MHz
	DC: C4FM, FM: 700 W max, 800 MHz
Power Consumption (Standby)	
	AC: 110 W max
	DC: 75 W max
Channel Spacing	12.5/25 kHz
Power Supply Type	Switching
Battery Revert	Included
Input/Output Impedance	50 Ohms
Antenna Connector Types	
	Tx: N female
	Rx: BNC female without preselector N female with preselector

*Table continued...*

General Specifications	
Frequency Stability Internal Reference (transceiver option card)	Aging: 30 ppb/yr 100 ppb/5yr Temperature: 40 ppb
Frequency Stability External Reference	TRAK
Frequency Generation	Synthesized

**Table 4: GTR 8000 Base Radio Transmitter Specifications for IV&D (700/800 MHz)**

Transmitter Specifications	
Frequency Range	769-775, 775-776, 851-870 MHz
Power Output* (Mid-Power, 700/800 MHz)	2-100 W
Power Output* (High-Power, 800 MHz)	15-150 W
Electronic Bandwidth	Full Bandwidth
Modulation (Mid-Power, 700/800 MHz)	C4FM, LSM, H-DQPSK, FM
Modulation (High-Power, 800 MHz)	FM, C4FM
Modulation Fidelity	5%
Spurious and Harmonic Emissions Attenuation	90 dB
Analog FM Hum and Noise	
	12.5 kHz: 45 dB
	25 kHz: 50 dB
Analog Audio Distortion	Less than 2% at 1000 Hz
Emission Designators (Mid-Power, 700/800 MHz)	8K70D1E, 8K70D1D, 8K70D1W 8K10F1E, 8K10F1D, 8K10F1W 9K80D7E, 9K80D7D, 9K80D7W 10K0F1E, 10K0F1D <b>800 W only:</b> 10K0F1W, 16K0F1D, 16K0F3E, 11K0F3E, 14K0F1D, 14K0F3E
Emission Designator (High-Power, 800 MHz)	8K10F1E, 8K10F1D, 8K10F1W, 16K0F1D, 16K0F3E, 11K0F3E, 14K0F10, 14K0F3E, 10K0F1E, 10K0F1E, 10K0F1W
Adjacent Channel Power Ratio	
	12.5 kHz offset, 6 kHz BW: 67 dB
Tx Noise in Rx Band	-145 dBc/Hz
Intermodulation Attenuation (High-Power, 800 MHz)	55 dB
Intermodulation Attenuation (Mid-Power, 700/800 MHz)	80 dB

\*Full transmitter output power is available during battery revert.

# Chapter

# 9

## GTR 8000 Base Radio FRU Procedures

GTR 8000 Base Radios are composed of numerous Field Replaceable Units (FRUs) and field replaceable parts. If you must replace a FRU or part, it is essential to obtain the precise FRU Kit Number or part number, and to review the replacement procedures provided, including all safety precautions and system impact information.

This chapter lists the FRUs and Field Replaceable Entities (FREs), and includes replacement procedures applicable to GTR 8000 Base Radio.

### Field Replaceable Units (FRUs) and Parts

When ordering Field Replaceable Units (FRUs), provide the FRU Kit Number. When ordering field replaceable parts, provide the part number. Contact Motorola Solution Support Center (SSC) as needed for numbers not provided here (for cables internal to a GTR 8000 Base Radio, the part numbers are not listed in this documentation, but you can locate the part number on the cable before contacting Motorola SSC). See [Motorola Solution Support Center on page 211](#).



**Warning:** To guard against personal injury and/or damage to equipment, switch a trunked base radio to Service Mode when performing service. The GTR 8000 Base Radio periodically keys up to pseudo train its linear transmitter autonomously when not assigned by the zone controller. Tx Inhibiting the base radio also prevents the transmitter from keying. Remember to switch the base radio back to Normal Mode when service is complete.

**Table 54: GTR 8000 Base Radio Field Replaceable Units**

Component Type	FRU Kit Number	Replacement Procedure
Transceiver Module (700/800 MHz)**	DLN6885A	
Transceiver Module (UHF R1, 380–435 MHz)**	DLN6888A	
Transceiver Module (UHF R2, 435–524 MHz)**	DLN6884A	
Transceiver Module (VHF, 136–174 MHz)**	DLN6892A	<a href="#">Replacing a Transceiver Module on page 221</a>
Transceiver Module w/OCXO Transceiver Option Card (700/800 MHz)**	DLN6883A	
Transceiver Module w/OCXO Transceiver Option Card (UHF R1, 380–435 MHz)**	DLN6889A	
Transceiver Module w/OCXO Transceiver Option Card (UHF R2, 435–524 MHz)**	DLN6886A	

*Table continued...*

Component Type	FRU Kit Number	Replacement Procedure
Transceiver Module w/OCXO Transceiver Option Card (VHF 136–174 MHz)**	DLN6893A	
Power Efficiency Transceiver Module w/TCXO* Transceiver Option Card (UHF R1, 380–435 MHz)**	DLN6890A	
Power Efficiency Transceiver Module w/TCXO* Transceiver Option Card (UHF R2, 435–524 MHz)**	DLN6887A	
Fan Module	DLN6898A	<i>Replacing the Fan Assembly on page 226</i>
AC/48V DC Power Supply	DLN6781A (0182516W14)	<i>Replacing a Power Supply on page 227</i>
Power Efficiency AC/48V DC Power Supply	DLN6793A (0182516W15)	
Power Amplifier Module (700/800 MHz)	DLN6895A	
Power Amplifier Module (High-Power, 800 MHz)	DLN6935A	
Power Amplifier Module (UHF R1, 380–435 MHz)	DLN6891A	<i>Replacing a Power Amplifier on page 230</i>
Power Amplifier Module (UHF R2, 435–524 MHz)	DLN6896A	
Power Amplifier Module (VHF, 136–174 MHz)	DLN6897A	

\* Available only for non-simulcast conventional systems.

\*\* The transceiver field replacement units are not compatible with ASTRO® 25 base radio software distributed before July 2013. BEFORE installing the replacement transceiver, ensure that all base radios at the site meet the minimum software version requirements listed. Contact Motorola SSC at 800-422-4210 if you do not have access to compatible software. See *Transceiver Software and Feature Compatibilities on page 217* for details.

**Table 55: GTR 8000 Base Radio Field Replaceable Parts**

Component Type	Part Number	Replacement Procedure
Power Supply Fan Module	5985167Y02	<i>Replacing a Power Supply Fan on page 228</i>
GTR 8000 Base Radio Backplane	0180706K30	<i>Replacing a GTR 8000 Base Radio Backplane on page 233</i>
Preselector 700 MHz	0185171Y02	
Preselector 700/800 MHz	0185171Y01	
Preselector Mounting Bracket	0785024Y01	<i>Replacing a Preselector Filter on page 237</i>
Preselector QMA Cable End	3085664Y01	
Preselector BNC to QMA Cable	3085665Y01	
Preselector Mini UHF N-Bulkhead Cable	3085664Y02	

*Table continued...*

Component Type	Part Number	Replacement Procedure
Preselector Mini UHF BNC Cable	3085664Y03	
Preselector UHF 380–433 MHz	CFX1075A	
Preselector UHF 435–470 MHz	TLE5992A	
Preselector UHF 470–524 MHz	TLE5993A	
Preselector VHF 136–154 MHz	TFD6511A	
Preselector VHF 150–174 MHz	TFD6512A	
Transmit Post Filter 700 MHz	9184680Y01	<i>Replacing Transmit Filters (700/800 MHz) on page 238</i>
Transmit Post Filter 800 MHz	9184680Y02	
External Dual Circulator Tray	DLN1317A	<i>Replacing the Dual Circulator/Isolator Modules on page 240</i>
External Dual Circulator Tray UHF 380–435	CLE6203A	
Duplexer 700 MHz	9184718Y01	<i>Replacing a Duplexer (700/800 MHz) on page 244</i>
Duplexer 800 MHz	9184718Y02	
Duplexer UHF 380–403 MHz	0185417U10	<i>Replacing a Duplexer (UHF) on page 246</i>
Duplexer UHF 403–435 MHz	0185417U04	
Duplexer UHF 435–470 MHz	0185417U05	
Duplexer UHF 470–494 MHz	0185417U06	
Duplexer UHF 494–512 MHz	0185417U07	
Duplexer VHF 136–146 MHz	0185417U01	
Duplexer VHF 144–160 MHz	0185417U02	<i>Replacing a Duplexer (VHF) on page 247</i>
Duplexer VHF 158–174 MHz	0185417U03	
Antenna Relay kit including relay, cable, screws	CLN8636A	<i>Replacing an Antenna Relay on page 248</i>
Antenna Relay	40009272002	
External Speaker Kit	HSN1006A	
Microphone Kit	GMMN4063B	

**Table 56: GTR 8000 Base Radio Cabinet Field Replacement Parts**

Component Type	Part Number	Replacement Procedure
Static Rail Bracket	07009411001	
Cabinet, 15 RU, 600D, EIA 19 in.	15009721001	
Cabinet Door, 15 RU	15009728001	<i>Removing/Replacing a Cabinet Door on page 100</i>
Rodent Proof Grommet for 3.5 in. Hole	15009729001	
Cabinet, 24 RU, 600D EIA 19 in.	15009721002	

Table continued...

Component Type	Part Number	Replacement Procedure
Cabinet Door, 24 RU	15009728003	<i>Removing/Replacing a Cabinet Door on page 100</i>
M6 Cage Nut	0285504U05	

**Table 57: Individual Replaceable Parts on External Dual Circulator Tray**

Component Type	Part Number	Replacement Procedure
Dual Circulator 700/800 MHz	0185172Y01	
Dual Circulator UHF 380–435 MHz	0185416U09	
Dual Circulator UHF 435–470 MHz	0185416U05	
Dual Circulator UHF 470–524 MHz	0185416U06	
Dual Circulator VHF 136–146 MHz	0185416U01	
Dual Circulator VHF 144–160 MHz	0185416U02	<i>Replacing the Dual Circulator/Isolator Modules on page 240</i>
Dual Circulator VHF 158–174 MHz	0185416U03	
Circulator Load 700/800 MHz	TLN3391A	
Circulator Load UHF/VHF	TLN3391A	
Low Pass/Harmonic Filter 700/800 MHz	9185202U04	
Low Pass/Harmonic Filter UHF	9185856Y01	
Low Pass/Harmonic Filter VHF	9185856Y03	

**Table 58: GTR 8000 Base Radio Cables**

Component Type	Part Number
System Connector Cable – SCSI2 Base Radio to Champ	30009466002
Antenna Relay Control Cable	30009475001
Antenna Relay Mini UHF Cable	3085664Y04
Antenna Relay QMA Cable	3085664Y05
Antenna Relay BNC Cable	3013943J08
Antenna Relay 75 CM Cable	3013942M23
Antenna Relay 32 CM Cable	3013942M11
Antenna Relay 25 CM Cable	3013943E08
External Speaker Cable	0185180U01
Cable DC Red/Black 2806mm	30009459002
Cable DC Black/Blue 2806mm	30009459004
Battery Temp Sensor 3000mm	30009478001
Cable Battery Temp Extension 15500mm	30009461003
Analog Simulcast Cable	30009398002

*Table continued...*

Component Type	Part Number
V.24 or Wireline Cable	30009455002
Analog Simulcast Cable Assembly	30009467001
Dongle Adapter – Telco to Trunking Control and DSM	30009468001

## Transceiver Hardware Generations

As of July 2013, the GTR 8000 Base Radio and the GPW 8000 Receiver are GTR 8000 Base Radio is shipped with a new generation of transceiver hardware (referred to in this manual as GEN 2). The hardware updates are intended to extend the life of the device as seamlessly as possible. This section details relevant differences and compatibility requirements for GEN 1 and GEN 2 hardware.

## Transceiver Software and Feature Compatibilities

The GEN 2 transceiver hardware is backwards compatible and interchangeable with GEN 1 transceiver hardware on ASTRO<sup>®</sup> 25 7.7 and later systems. GEN 1 transceivers can no longer be ordered; however, spare inventory of GEN 1 transceivers can be used as Field Replaceable Unit (FRU) replacements.

All ASTRO<sup>®</sup> 25 system features are supported on GEN 1 and GEN 2 transceivers, with the following exceptions.

**Table 59: System Feature Exceptions**

Feature	GEN 1 Transceiver	GEN 2 Transceiver
X2 TDMA	Supported	Not Supported
3600 Operation	Not Supported	Supported

GEN 2 transceiver hardware is not compatible with ASTRO<sup>®</sup> 25 GTR 8000 Base Radio software distributed before July 2013. The transfer operation fails if you perform a software download using a SWDL application released before July 2013.

BEFORE installing a FRU replacement or expansion channel at an existing site, ensure that you are using the latest available SWDL application, and that all base radios and receivers at the site meet the minimum software version requirements listed. Contact Motorola Solution Support Center (SSC) at 800-422-4210 if you do not have access to compatible software.

**Table 60: Minimum Software Download Version Requirements**

ASTRO <sup>®</sup> 25 System Release	HPD	Site Repeater	Multi-Site	Conventional	3600
7.6 and earlier	Not Supported			N/A	N/A
7.7	HPDDBR_ R07.7X.023	SiteRptrBR_ R07.7X.031	MsBR_ R07.7X.033	N/A	N/A
7.8	HPDDBR_ R07.8X.033	SiteRptrBR_ R07.8X.038	MsBR_ R07.8X.038	N/A	N/A
7.9	HPDDBR_ R07.9X.049	SiteRptrBR_ R07.9X.050	MsBR_ R07.9X.051	ConvRptrBR_ R07.9X.051	Any Version

*Table continued...*

# Chapter 5

## GTR 8000 Base Radio Optimization

Your Motorola Field Representative or Motorola Solution Support Center (SSC) can advise you on optimization activities required for your system, if any. See [Motorola Solution Support Center on page 211](#).

This chapter contains optimization procedures and recommended settings relating to GTR 8000 Base Radio.

### Aligning the Internal Frequency Reference Oscillator

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The transceiver option card within a base radio provides an internal 10 MHz frequency reference which can be used as the primary or backup frequency reference source for the device. For conventional base radio operation, it also provides the analog interfaces and wildcard I/Os.

After a base radio is installed or after the transceiver option card is replaced, align the internal frequency reference oscillator.

Align the transceiver option card internal frequency reference oscillator to within 1 ppb (parts per billion). The measuring equipment used to make this alignment must be accurate to within 1 ppb. This accuracy typically requires test equipment with a double oven or a Rubidium reference oscillator.



**Note:** The base radio must be turned on for at least one week before the internal frequency reference oscillator is aligned.

Align the internal frequency reference oscillator for an Oven Controlled Crystal Oscillator (OCXO) transceiver option card:

- Upon installation of the base radio for all bands.
- Once every two years after installation for 700/800 MHz systems.
- Once every five years after installation for UHF systems.
- VHF systems do not require alignment after initial installation.

Align the internal frequency reference oscillator for a Temperature Compensated Crystal Oscillator (TCXO) transceiver option card:

- Upon installation of the base radio for UHF.
- Every year after installation for UHF.

The internal frequency reference oscillator can be aligned using two methods: manual alignment or auto alignment.

See “Base Radio Service Help → Service Screens → Alignment Screens” in the *CSS Online Help* for the alignment procedures.

### GTR 8000 Base Radio Time and Frequency Inputs

Various external time and frequency inputs can be provided to the base radio for normal operation or for Internal Frequency Reference Oscillator alignment. The following table provides a list of acceptable input signal types and levels for each input port.



**Table 48: Time and Frequency Inputs**

Input Port	Frequency	Waveform	Level	Impedance	Note
Ext Freq Ref	5 MHz	Sine	2.6–5.3 Vpp	100k ohms	AC coupled
Ext Freq Ref	5 MHz	Square	45–55% duty cycle	100k ohms	AC coupled
Ext Freq Ref	10 MHz	Sine	2.6–5.3 Vpp	100k ohms	AC coupled
Ext Freq Ref	10 MHz	Square	45–55% duty cycle	100k ohms	AC coupled
Ext Freq Ref	20 MHz	Sine	2.6–5.3 Vpp	100k ohms	AC coupled
Ext Freq Ref	20 MHz	Square	45–55% duty cycle	100k ohms	AC coupled
Ext Freq Ref	5 MHz/1PPS*	Square	2.6–5.3 Vpp	100k ohms	AC coupled; 25% modulation 1pps arrives on 75% duty cycle
1 PPS	1 PPS	Pulse	2.6–5.3 Vpp	100k ohms	DC coupled
Front Panel Ext Freq Ref	5 MHz	Sine	2–5 Vpp; 10–18 dBm	50 ohms	AC coupled
Front Panel Ext Freq Ref	5 MHz	Square	45–55% duty cycle	50 ohms	AC coupled
Front Panel Ext Freq Ref	10 MHz	Sine	2–5 Vpp; 10–18 dBm	50 ohms	AC coupled
Front Panel Ext Freq Ref	10 MHz	Square	45–55% duty cycle	50 ohms	AC coupled
Front Panel Ext Freq Ref	5 MHz/1PPS*	Square	2.6–5.3 Vpp	50 ohms	AC coupled; 25% modulation 1pps arrives on 75% duty cycle

\* 25% modulation, 1 PPS arrives on 75% duty cycle.



**Note:** The Front Panel EXT FREQ REF connection is the Frequency Calibrator (BNC connector) on the transceiver module.

**Note:** When two base radios at a site are configured to transmit at frequencies within the same 25 kHz band, the base radios must be connected to a common frequency reference to ensure emissions are contained within regulated limits.

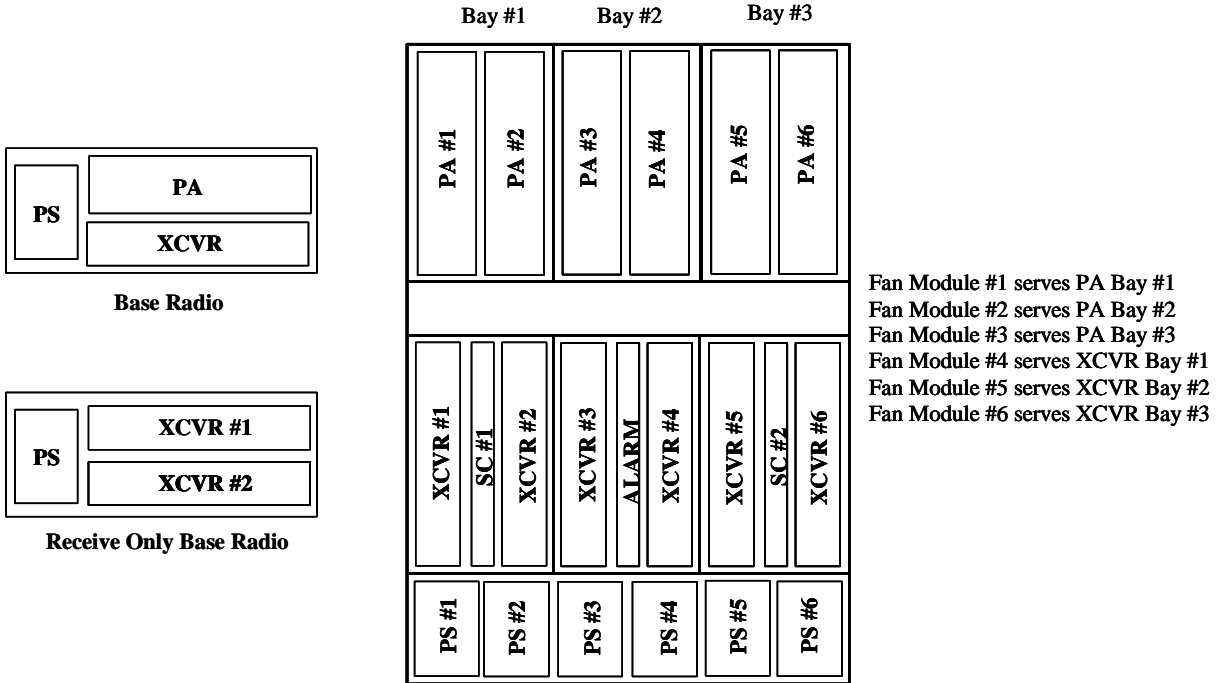
### User / Operational Manual

#### Racking Configurations

There are various equipment racking configurations available to customers. The following section includes sketches which depict many of the racking alternatives.

Note: The drawing below is not from an actual publication. It is included simply to illustrate the various configurations that are available.

### Configuration Layout



GTR 8000 Expandable Site Sub-system Layout

# Chapter 2

## GTR 8000 Base Radio Theory of Operation

For an understanding of the GTR 8000 Base Radio components, review the modules that provide the base radio functionality, the modules that provide RF distribution functionality (RFDS), and the backplane that connects to other modules within the site.

This chapter explains how the GTR 8000 Base Radio works in the context of your system.

### Functions of the GTR 8000 Base Radio Modules

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The following lists GTR 8000 Base Radio modules:

- Transceiver (XCVR) module (with or without a transceiver option card)
- Power amplifier module
- Fan module
- Power supply module

### Function of the Transceiver Module

The transceiver module provides the control, exciter, receiver, and optional transceiver option card for the base radio.

**Figure 5: Transceiver Module (Front View)**



The transceiver generates the station reference, which typically must be locked on to one of many possible external sources. The external source can be either the site controller TDM clocks or the external reference operating at 5 MHz or 10 MHz.

The transceiver SPI bus allows communication with its receiver and exciter circuitry, as well as the power supply module and power amplifier module.

Two or three circuit boards in the transceiver are:

- **Transceiver Control Board:** Performs the control management, digital signal processing, and transmit and receive data formatting for the base radio.
- **Transceiver RF Board:** Contains DC power conversion/regulation and performs receiver and exciter functions.
- **Transceiver Option Card:** An optional board that attaches to the control board. Provides an internal 10 MHz frequency reference. For conventional operation, it also provides the analog interfaces and WildCard I/Os. The transceiver option card requires an internal frequency reference oscillator alignment at different intervals

mandated by its category and frequency band. See Base Radio Service Help > Service Screens > Alignment Screens in the *CSS Online Help* for the alignment procedures and mandated intervals. The transceiver option card is available in two categories:

- **OCXO (Oven Controlled Crystal Oscillator)** – operates at 0.1 ppm and is inclusive to temperature and aging. The OCXO Transceiver Option Card is available in 700/800 MHz, UHF R1/R2, and VHF frequency bands.
- **TCXO (Temperature Compensated Crystal Oscillator)** – operates at 1.5 ppm, of which 0.5 ppm is allocated to temperature, and 1.0 ppm is allocated to aging. Reference precision with the TCXO is traded for lower power consumption. The TCXO mandates shorter maintenance intervals. The TCXO transceiver option card is available in UHF R1/R2 frequency bands. The TXCO is only available for non-simulcast conventional systems.

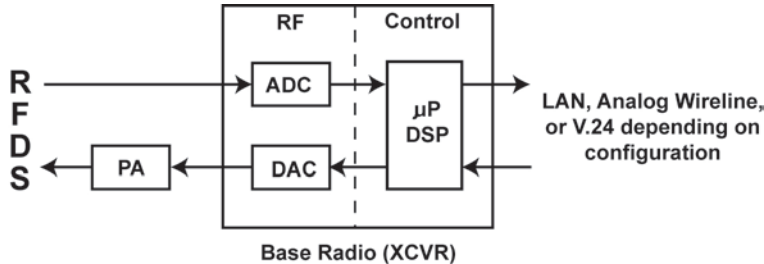
## Transceiver Control Board

The main operating software for the base radio is loaded in the XCVRs control section. As the main manager for the base radio, the XCVR control board provides operational control over the other station modules. It handles three types of information flow, in the following ways:

- Serves as a gateway between the network and RF functionality, by distributing the RF payload to and from the network.
- Supports operational and diagnostic functions with digital control data (for example: site information, channel assignments, and identification numbers for call processing).
- Ensures the flow of other network management configuration information.

*Figure 6: Transceiver Control Board Information Flow on page 64* shows the information flow through the transceiver control and RF sections for trunked and conventional operation.

**Figure 6: Transceiver Control Board Information Flow**



GTR8000\_RF\_Ethernet\_Flow

## Transceiver RF Board

In addition to DC power conversion/regulation, the XCVR RF board provides circuitry for the following exciter and receiver functions.

### Exciter

The exciter on the XCVR RF board provides the transmitter functions for the base radio. The exciter circuitry generates a low-level, modulated RF signal that passes to the power amplifier. It supports various modulation types as well as bandwidths up to 25 kHz, through software programming.

The exciter also provides a controlled output power level to the power amplifier.

## Receiver

The receiver provides either single receiver input or dual (HPD or TDMA) receiver inputs for dual diversity. The receiver also provides enhanced diagnostic capabilities using an on board noise source generator. It includes a wide tuning range (electronic varactor-tuned) preselector. The preselector is electronically tuned to the desired receive frequency anywhere between 792–825 MHz, UHF R1 380–435 MHz, UHF R2 435–524 MHz, or VHF 136–174 MHz.

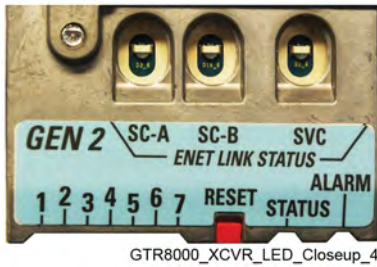
## Transceiver External Interfaces

The transceiver external interfaces include seven external ports, a switch, and LEDs. If a transceiver option card is part of the transceiver, there are four additional external ports. See *Front Connections on page 111* for the port connections. See *LEDs on page 251* for information on the LEDs.

## Transceiver Switch

The multifunction RESET switch on the front of the transceiver module is accessible through the drop-down door to the left of the fans. The RESET switch has two functions:

**Figure 7: Transceiver RESET Switch (viewable through the drop-down door)**



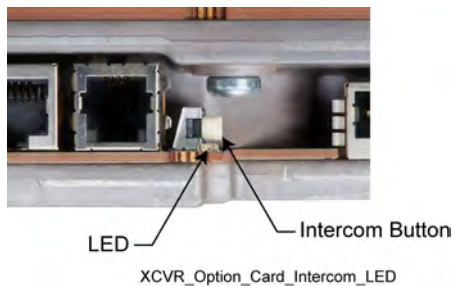
**Table 29: Transceiver Front RESET Switch Functions**

User Action	Result
Press switch for less than 1 second	Service Mode (LED 3 lights amber)
Press switch for more than 3 seconds, then release	Transceiver Control Module Reset

## Transceiver Option Card Intercom Button

The intercom button on the front of the transceiver option card is accessible behind the fan module. Pressing the intercom button toggles the intercom function between the ON and OFF states.

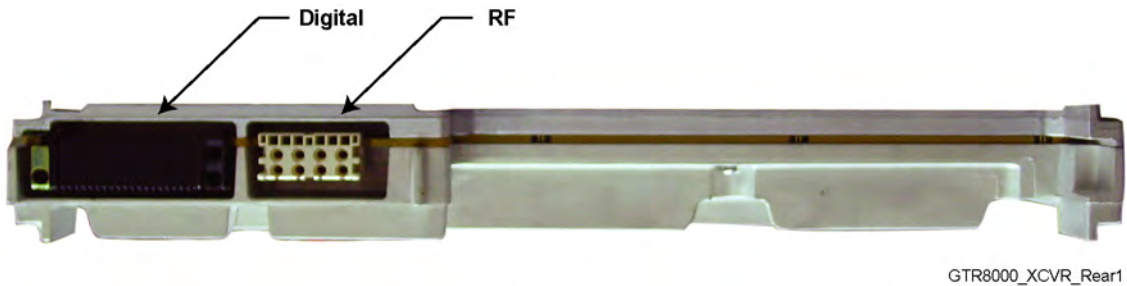
**Figure 8: Transceiver Option Card Intercom Button (behind the fan module)**



## Transceiver Ports (Rear)

The transceiver interconnects to the backplane using a 120-pin HVDML digital connector and 8-pack RF connector, as shown in the figure. These connections handle multiple signals including power supply communications, power amplifier communications, fan interface, and peripheral interface. The digital connection receive alarm data and the site controller Time Division Multiplexer (TDM) signals used to pass reference and control data to the base radio.

**Figure 9: Transceiver Module (Backplane Connections)**



- **Single Receiver Input:** An RJ-45 Ethernet port on the backplane is cabled to a site LAN switch for this channel. The backplane also provides an RF connection to the transceiver for receive (Rx) path A.
- **Dual Receiver Input:** RJ-45 Ethernet ports on the backplane are cabled to corresponding ports on the site controller backplanes (HPD). The backplane also provides RF connections to the transceiver for receive (Rx) paths A and B (HPD and TDMA).

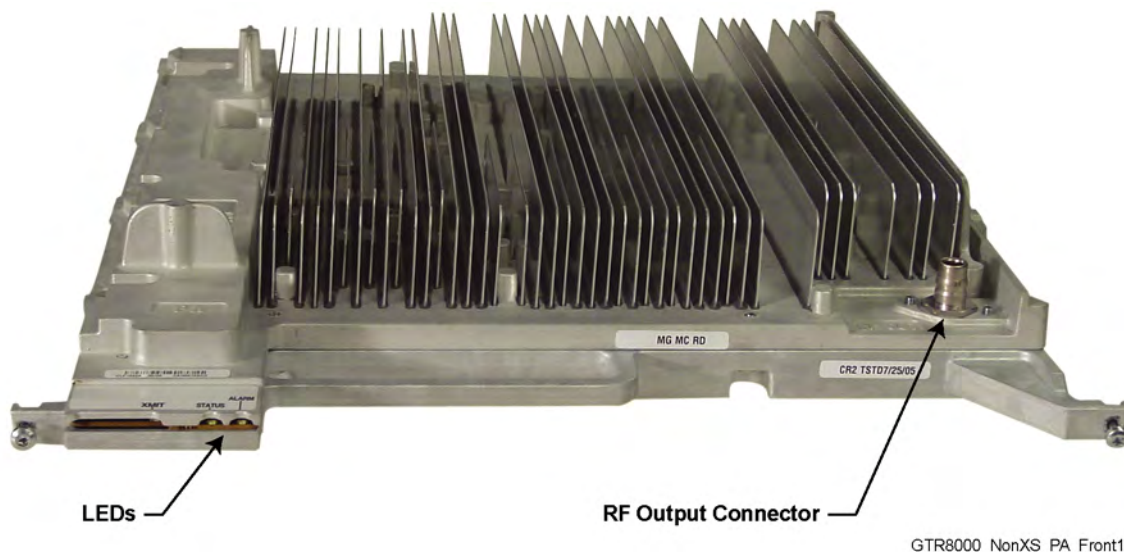
## Function of the Power Amplifier Module

The power amplifier (PA) is a forced convection-cooled RF power amplifier. It accepts a low-level modulated RF signal from the transceiver module, and amplifies it for transmission through the site transmit antenna. Also, to complete the Cartesian correction loop (linearization method), it provides a low-level RF feedback signal to the transceiver module to achieve the required transmitter linearity.

Transmit power output can be set using Configuration/Service Software (CSS). See [Configuring Tx Power Values and Battery Type on page 151](#).

The power amplifier also performs functions related to the fan module, including reporting of the fan module status and supplying power to the fan power bus.

**Figure 10: Power Amplifier Module**





The power amplifier is comprised of six internal modules:

- Core Board
- Converter Board
- Driver Amplifier Board
- Final Amplifier Board
- Distribution Board
- Output Circuitry

## Power Amplifier Input/Output Connections

There are three electrical connection assemblies on the power amplifier:

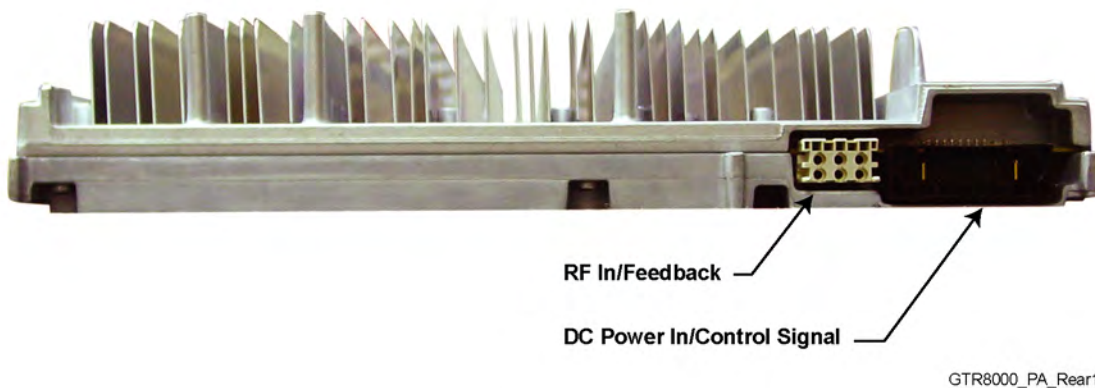
- RF output (front QN "quick-N" connector) on the front of the power amplifier module



**Note:** This is cabled to the N-type female bulkhead connection at the rear of the base radio housing.

- DC power supply/control signal (backplane connection)
- RF input/feedback (backplane connection).

**Figure 11: Power Amplifier (Backplane Connections)**



## Function of the Fan Module

The fan module provides intermittent forced-air cooling for the power amplifier and transceiver modules. The fan module houses two 119 mm axial fans which deliver a total of approximately 160 cubic feet per minute of airflow. Nominal fan speed is 4100 revolutions per minute. A thermostat behind the fan module controls each fan. If the fan speed for either fan falls below 30% of the rated speed, a built-in speed sensor on each fan turns on the red Fan Alarm LED.

If the fan module is used for the Power Efficiency Package, the following must be configured in the Configuration/Service Software (CSS) to take full advantage of the Power Efficiency Package:

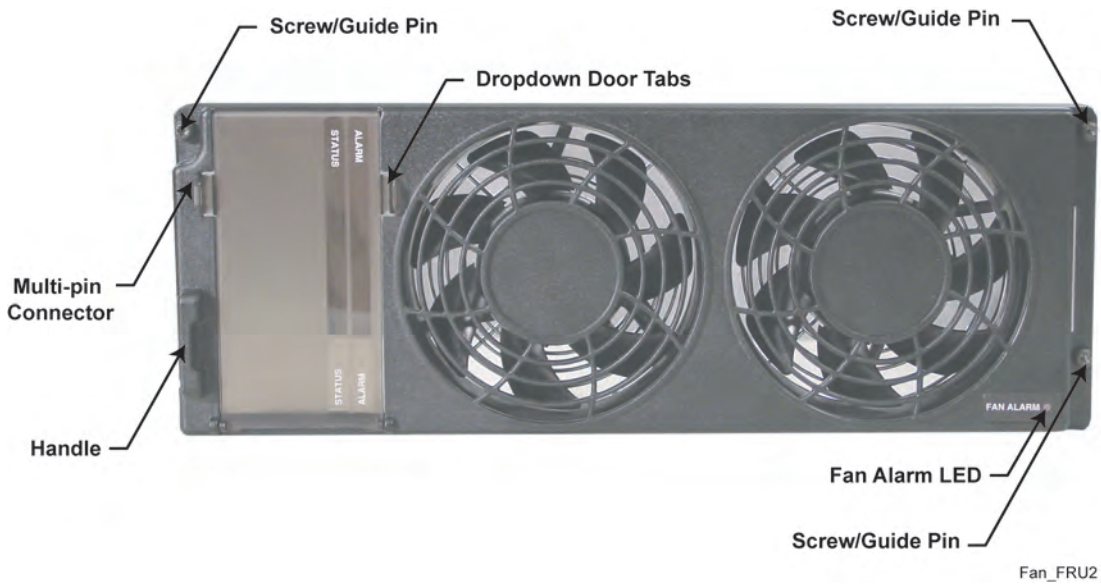
- Optional fan holdover time (length of time the fan stays ON after transmission).
- Disabling one of the fans within the fan module. See [Replacing the Fan Assembly on page 226](#) for instructions on how to disable one of the fans.
- Configuring the base radios Tx Power Out in the CSS should be limited to 50 W.

The fan module connects to the backplane through a 4-pin port on the front of the chassis.



**Note:** The power supply module has its own fan which provides independent airflow.

**Figure 12: Fan Module**



## Function of the Power Supply

The power supply, with front-to-rear airflow, operates from either an AC or DC input and provides the DC operating voltage for the base radio. However the power supply prioritizes an AC source (if present) over a DC source.

**Figure 13: Power Supply**



**Note:** If the power supply module is used for the Power Efficiency Package, the power supply must be used in DC mode to obtain the 35 W standby power consumption performance.



When operating from an AC source (90 to 264 VAC, 47-63 Hz), the supply generates two DC output voltages of 29 V with respect to output ground. The power supply automatically adjusts to AC input ranges and supplies a steady output.

In AC mode, the power supply provides a separate battery charger which can be used to maintain the charge on a 48 VDC nominal system, positive or negative ground, if installed. The supply generates two DC output voltages of 29 V with respect to output ground, when operating from a DC source (43.2 VDC to 60 VDC maximum), positive or negative ground. This voltage limit includes consideration of the battery charging "float voltage" associated with the intended supply system, regardless of the marked power rating of the equipment. Whether in AC, Battery Revert, or DC Only mode, at a voltage of 42 V or lower, the power supply shuts down to not damage any connected battery bank. Once this condition occurs, the power supply starts only after the applied voltage exceeds 45 V.

The battery charger is not usable when operating from a DC input power source. This DC source must be located in the same building as the base radio, and it must meet the requirements of a SELV circuit.

The power supply contains several switching-type power supply circuits as follows:

- Power factor correction circuitry
- Battery charging circuitry
- Diagnostics and monitoring circuitry

The power supply controls its own continuously running fan, changing its speed to fast, or slow as needed.



**Note:**

If the power supply module is used for the Power Efficiency Package, the power supply fan does not run below a 40 °C air inlet temperature in DC mode with the transmitter in a de-keyed state.