System Release 7.17
ASTRO® 25
INTEGRATED VOICE AND DATA

ASTRO 25 Express Standalone Infrastructure

NOVEMBER 2016

MN003228A01-A

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* Before any software reload.

* To confirm troubleshooting results and analysis before removing and replacing a Field Replaceable Unit (FRU) and Field Replaceable Entity (FRE) to repair the system.

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	302-444-9842 (International Orders)
	Includes help for identifying an item or part number and for translation as needed.
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Document History

Version	Description	Date
MN003228A01-A	Original release of *ASTRO 25 Express Stand-alone - Infrastructure* manual.	November 2016

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Contents

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List of Figures

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List of Tables

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List of Processes

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List of Procedures

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About ASTRO 25 Express Standalone Infrastructure

This manual provides an introduction to the ASTRO® 25 Express Standalone System Infrastructure with GTR 8000 Expandable Site Subsystem, and includes information for installing, configuring, and maintaining the site.

What Is Covered In This Manual?

This manual contains the following chapters:

- ASTRO 25 Express Standalone Infrastructure Description on page 23 – This chapter provides a description of the ASTRO® 25 Express System Infrastructure.

- ASTRO 25 Express Standalone Infrastructure Theory of Operation on page 27 – This chapter describes the interactions between ASTRO® 25 Express System components.

- ASTRO 25 Express Standalone Infrastructure Installation on page 33 – This chapter provides installation information for the ASTRO® 25 Express System.

- ASTRO 25 Express Standalone Infrastructure Configuration and Optimization on page 45 – This chapter provides information on configuring and optimizing the ASTRO® 25 Express System.

- ASTRO 25 Express Standalone Infrastructure Operation on page 57 – This chapter provides information on operational modes for the ASTRO® 25 Express System.

- ASTRO 25 Express Standalone Infrastructure Maintenance on page 59 — This chapter provides maintenance for the ASTRO® 25 Express System.

- ASTRO 25 Express Standalone Infrastructure Troubleshooting on page 61 – This chapter provides the methodology, suggested tools, and related references for troubleshooting the ASTRO® 25 Express System.

- ASTRO 25 Express Standalone Infrastructure Field Replaceable Units and Entities on page 65 – This chapter lists the site ordering information and individual hardware and component replacement information for equipment at the ASTRO® 25 Express System.

Helpful Background Information

Motorola Solutions 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

See the following documents for associated information about the radio system.

Related Information	Purpose
Standards and Guidelines for Communication Sites	Provides standards and guidelines that should be followed when setting up a Motorola Solutions communications site.
	This manual may be purchased on CD 9880384V83, by calling the North America Parts

Table continued…

Related Information	Purpose
	Organization at 800-422-4210 (or the international number: 302-444-9842).
System Overview and Documentation	Provides an overview of the ASTRO® 25 new system features, documentation set, technical illustrations, and system-level disaster recovery that support the ASTRO® 25 radio communication system.

Send Feedback

Chapter 1

ASTRO 25 Express Standalone Infrastructure Description

This chapter provides a high-level description of the site and its components.

1.1
ASTRO 25 Express System Site Overview

An ASTRO® 25 Express System with a GTR 8000 Expandable Site Subsystem is a single site, standalone P25 Phase 1 compliant (FDMA) trunking system that supports up to 18 channels. This type of site is designed to optimize channel capacity requirements operating in the 700 MHz, 800 MHz, 900 MHz, UHF R1 (380–435 MHz), UHF R2 (435–524 MHz), and VHF (136–174 MHz) bands.

> **NOTICE:** An ASTRO® 25 Express System supports Phase 2 TDMA operation in the Single-Site standalone system. TDMA operation is not supported.

The GTR 8000 Expandable Site Subsystem in this configuration is set up in a single trunked site, with one active control channel and a number of voice channels. Figure 1: ASTRO 25 Express System Overview Diagram on page 23 is a system overview diagram of the ASTRO® 25 Express System.

Figure 1: ASTRO 25 Express System Overview Diagram

A25_EXP_site
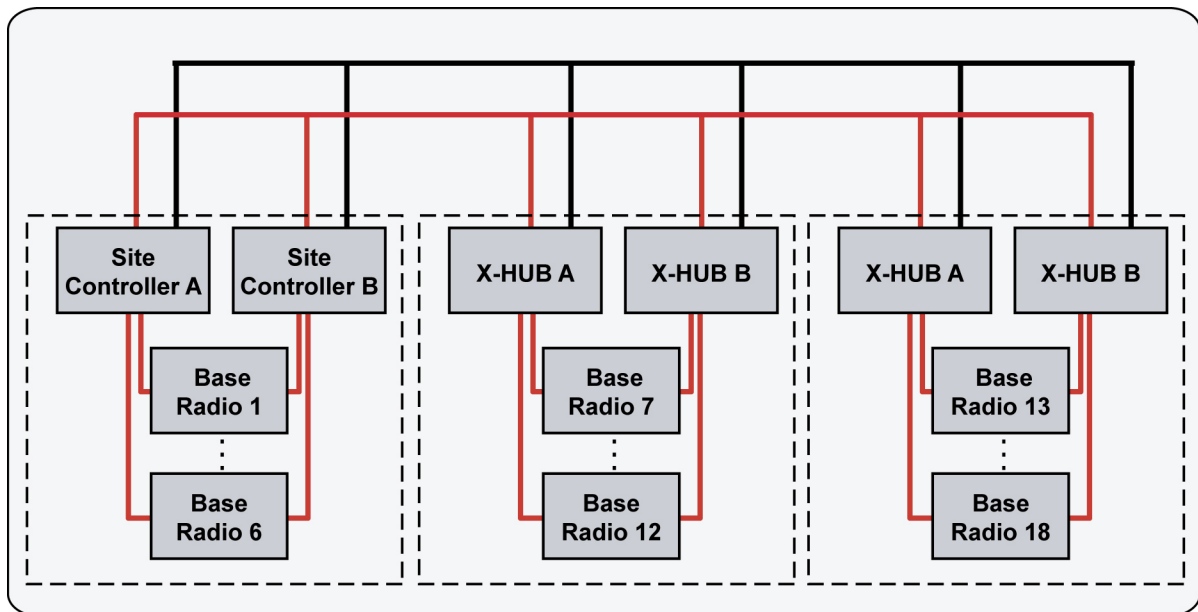
1.2
Hardware Components

This section introduces the hardware components in an ASTRO® 25 Express System.

1.2.1
GTR 8000 Expandable Site Subsystem for ASTRO 25 Express System

The GTR 8000 primary rack or cabinet includes the following components:

- Redundant site controller modules

- Up to six transceiver modules

- Up to six power amplifier modules

- Up to six power supply modules

- RFDS equipment for the transmit (Tx) and receive (Rx) paths only (700-800 MHz and UHF R2 (435-524 MHz) only)

- Junction panel, for connection to other devices at the site

A maximum of six transceivers, power amplifiers, and power supplies may be installed in the cabinet/ rack with a maximum of three cabinets/racks, supporting up to 18 channels. The following diagrams show the front and rear view of a GTR 8000 Expandable Subsystem.

Figure 2: GTR 8000 Expandable Subsystem Front View

Figure 3: GTR 8000 Expandable Subsystem Rear View

A bank of power supplies along the bottom of the cabinet/rack supply power to the modules. The cabinet/rack is supplied with up to six AC power connections. DC power or backup batteries can also be connected. The cabinet/rack can run on a combination of AC power and backup battery power, while continuing to charge the backup batteries. Installation and replacement for all the modules in the cabinet/rack is accessible through the front of the cabinet/rack.

The GTR 8000 Expandable Site Subsystem can be ordered in an 8' cabinet (Option CA00293AA) or a 7.5' open rack (Option X882AH) or a 7' open rack (Option CA01402AA).

1.3
Software Components

This section introduces the software components in an ASTRO® 25 Express System. The following software components are supported.

- Configuration Manager – Trunking (optional)
- Software Download Manager (SWDL)
- Configuration/Service Software (CSS)

1.3.1
Configuration Manager

The Configuration Manager enables customers to configure their single-site small systems on ASTRO® 25 Express Trunking System without the additional cost of zone core equipment. Additionally, the operator is able to configure many of the features and capabilities found in ASTRO® 25 Trunking systems that have a zone core. See Configuration Manager Trunking on page 54.

For detailed information on Configuration Manager, see the *Configuration Manager for Trunking Systems User Guide*.

1.3.2
Software Download Manager

Software Download Manager (SWDL) transfers and installs new firmware in RF site components (base radios and site controllers).

For detailed information on uploading firmware to the base radios and site controllers, see the *Software Download Manager* manual.

1.3.3
Configuration/Service Software (CSS)

The Configuration/Service Software (CSS) is a Windows-based application installed on a laptop or desktop PC used to perform configurations, status reporting, and servicing tasks for infrastructure devices in a system. For more details, see Configuration/Service Software on page 46.

Chapter 2

ASTRO 25 Express Standalone Infrastructure Theory of Operation

This chapter briefly explains the interactions between site components and also includes some theory explaining subscriber radios operation and call processing theory. More information on these topics is available in the training available from Motorola Solutions.

2.1
Site Hardware Theory

A GTR 8000 Expandable Site Subsystem (ESS) contains two redundant GCP 8000 Site Controllers which provide protection against a single point of failure. Each site controller is programmed with a set of rules that determine which one of the two assumes the role of active site controller initially and when it is necessary for the standby site controller to take over the operation of the subsystem. If the active site controller fails, the standby site controller automatically takes control of the site.

> **NOTICE:** In configurations with more than one cabinet/rack, it is not necessary to include site controllers in every cabinet/rack. In add-on cabinets/racks, Expansion Hubs (XHubs) are used instead of site controllers to provide network and reference connections between cabinets/racks.

A GTR 8000 Expandable Site Subsystem can contain Radio Frequency Distribution System (RFDS) equipment which provides the interface between the base radios and the site antennas. Radio frequency distribution at a GTR 8000 Expandable Site Subsystem is accomplished through equipment that includes the receive and transmit antennas, isolators, multicouplers, and combiners.

The RFDS equipment is structured to be an optional part of the GTR 8000 Expandable Site Subsystem for 800 MHz and UHF R2 (435–524 MHz) systems. However for 700 MHz systems, the Motorola Solutions RFDS equipment is mandatory.

2.1.1
Site Controller

The site controller processes inbound and outbound data traffic, assigns base radios for voice channel access, and generally monitors and maintains order in the system. The controller maintains a database that tracks each subscriber radios Unit ID and the current talkgroup to radio affiliation.

The controller in a single site system performs the following call processing functions:

- Services call requests
- Recovers and decodes inbound signal requests
- Maintains a database of active radios and their system permissions
- Receives group affiliations
- Checks call access privileges
- Issues call grants
- Monitors and controls each call sequence
- Maintains a list of subscriber radios that are waiting for repeater assignments
- Selects and assigns voice channels as required

- Selects the control channel

2.1.2
Base Radios

A base radio or repeater is an RF station that serves as the RF link between the system and the mobiles and portables. Base radios in an ASTRO® 25 Express trunked system are connected in a site configuration with a minimum of two and a maximum of 18 base radios.

Base radios in a trunked system have two primary interfaces:

- A receiver to pick up the RF signal from the subscriber radios
- A transmitter to send RF signals to the subscriber radios

Antenna systems for the base radios are on top of high structures such as buildings, hills, or towers. The base radios are normally located close to their antennas to minimize the losses inherent in the cables connecting the base radios to the antennas.

In a single site system, the signal that comes in at the receiver is immediately passed to the transmitter for transmission to the subscriber radios that are within the coverage area.

Standard trunked base radios can operate in one of two modes:

- Control channel:

  - The site controller controls and monitors the operation of the system and makes channel assignments. The controller must be able to communicate with all radios in the system to receive call requests and send channel assignments to the radios in the field and is the role of the control channel. Each system has one of its channels assigned to function as a control channel. The other channels are used for voice communication.

  - The control channel is the RF interface between the central controller and the radios. It is always active, and transmits and receives the data traffic required to monitor and control the operation of the subscriber radios. The subscriber radios are in communication with the control channel as long as they are not involved in a call.

  - A radio uses the control channel to send in call requests or to receive call assignments. A radio always tunes to the control channel except when it is assigned to a call on a voice channel. When a call is completed, the radios involved in the call switch back to the active control channel.

  - To make a talkgroup call on a trunked system, a radio operator presses the push-to-talk (PTT) button on the radio. A call request is sent over the control channel to the controller. The controller assigns a channel to the radio operator talkgroup and sends out an assignment message over the control channel telling all radios that have that particular talkgroup selected to switch to a specific voice channel.

  - All active radios in that talkgroup automatically switch to the assigned voice channel. When the radio user initiating the call begins speaking, the transmission is received from the repeater at the site and transmitted back out. Subscriber radios in the talkgroup receive the radio signal, process the signal to separate the audio from the RF and send the audio signal to the local speaker so the radio operators can hear the message.

  - Subscriber radios in the system send a signal to the controller, through the control channel, indicating their unique identification and talkgroup selection. This signal is sent whenever a subscriber radio is powered up or the radio operator changes the position of the talkgroup selector. This process is known as affiliation.

- Voice Channel:

  - The voice channel is the name applied to the base radios assigned to transmit and receive voice information. When one of the members of a talkgroup requests voice channel service, the

talkgroup is assigned its own voice channel for the duration of the call. A talkgroup assigned to channel 3 cannot be heard from members of a talkgroup assigned to channel 9.

2.2
Subscriber Radios

Subscriber radios are the mobile or portable radios and desktop units with multiple frequency capability. They provide radio operators with the ability to communicate in the system. The subscriber radio unit contains the logic circuitry necessary to perform the following functions:

- Generate and transmit requests for service in the form of data words used to modulate the carrier frequency.
- Interpret the data messages sent from the site controller.
- Generate the frequency of the assigned voice channel.
- Generate tones to advise the radio user about the status of the call request.

Customer Programming Software (CPS) is used to configure each radio with a system ID, the radios unique individual ID, and as many talkgroup IDs as needed.

> **NOTICE:** For more details, see your subscriber radio user guide and *Customer Programming Software Online Help*.

2.2.1
Individual IDs

Each subscriber radio unit is assigned a unique ID assigned that serves to identify the radio to the controller.

2.2.2
Talkgroup Membership

A talkgroup is the basic unit of communication in a trunked system. In most organizations, radio operators work in groups that are based on their functions and responsibilities. In a trunked radio system, these groups of radio operators are assigned to communication talkgroups that reflect their function or responsibilities. Programming of talkgroups in a radio is based on the communication needs of radio users. A radio is programmed with only one or with several talkgroups. Radio users selecting a particular talkgroup on their radios are assigned a voice channel when someone in the group requests talkgroup call services. Group privacy during conversations is provided since only one talkgroup is assigned to each voice channel.

Talkgroups are identified in the system by a unique six-digit ID that ranges between 800000 and 804094.

2.2.3
Voice Security Through Encryption

Once voice information is transmitted over an RF channel, it is susceptible to interception by almost anyone with an inexpensive scanner, as well as other radio operator on the same frequencies. A radio user transmitting sensitive information must accept the risks: avoid using the radio system (not always practical) or encrypt the message.

The encryption solution sends a voice message as an encrypted, digital signal. The encryption system uses an electronic code key to encrypt or encode the digital signal.

Receiving radios should be programmed with the same key that was used for encoding the audio. Once the signal is received, it is decoded to the receiving radio speaker. No other radios or devices without the proper code can receive intelligible information.

2.3

Call Processing and Mobility Management

Call processing is the sequence of events that the system goes through to process a call request. A trunked system enables people to communicate with one another whenever required and from wherever they are in the coverage area. All communications within the system are processed as a call. A call is a specific instance of the system providing a call service to a properly configured, registered, and affiliated user of the system. The basics of call processing cover the hardware components that are used to facilitate the call, the types of calls available, and the flow a call takes as it makes its way through the system.

Individual radios must register at the site to make and receive individual-based call services. In addition, radios affiliate with a talkgroup (that they are programmed to be part of) to participate in talkgroup calls and utilize other group-based call services. The site determines whether to accept or deny a request for registration/affiliation based on the configuration settings programmed in the radio and also parameters configured by Configuration Manager.

2.3.1

Call Types

The ASTRO® 25 Express System call types are as follows:

Table 1: Types of Calls

Call Type	Description
Talkgroup calls	The basic method of communication in a trunked radio system. Most of the conversations that a radio user participates in are talkgroup calls.
Multigroup Calls	A specialized version of a talkgroup call involving multiple talkgroups at the same time. Multigroup calls can be initiated from a properly authorized radio. The talkgroups that are addressed in the call are pre-programmed within the radio units and are configured in the Site Controller via the Configuration Manager. The advantage of Multigroup Call is the ability to simultaneously communicate important information to multiple talkgroups quickly and efficiently. A single Multigroup Call transmission utilizes fewer channel resources and airtime than multiple, separate talkgroup calls.
Emergency calls	A specialized, high-priority version of a talkgroup. Emergency calls always have the highest priority in the system. When an emergency call request is made during a period when all voice channels are busy, the request takes a priority over any other type of non-emergency call request. The emergency call is transmitted on each radio's currently selected talkgroup. Emergency calls are processed by the system in one of two ways: • Top of Queue: During the top of queue processing, the controller places the incoming emergency call request at the top of the busy queue. No other group in the busy queue or new channel requester grants a voice channel until the emergency caller is assigned to a voice channel. In addition, the central controller monitors the voice channels for a

Table continued…

Call Type	Description
	disconnect signal. Upon detection of a disconnect signal on one of the voice channels, the controller assigns that channel to the unit in emergency mode. • Ruthless Preemption: With Configuration Manager, it is possible to configure a talkgroup for perform "ruthless preemption". During ruthless preemption processing, the controller preempts active non-emergency calls to get resources for the call.
Private Calls	Allows properly configured radios in the same system to enter into one-to-one conversations. The sender enters into the private conversation mode, selects a target radio by dialing an ID on a keypad, and presses the PTT to initiate the call. Based on the model of the radio, the target radio emits two beeps or telephone type ringing to indicate that a private conversation request is received. Radios can be programmed to receive calls only, make calls from a programmed list only, or with the capability to call radios from a list or through the keypad.
Call Alert	Allows an authorized caller to leave a notification in an unattended radio. This is done to indicate that a system user wishes to communicate with another user of the alerted radio. The radio continues to emit call-received tones until the alert is acknowledged manually by the target radio user. There is no voice communication involved in the Call Alert.

2.3.2
Subscriber Radios Affiliation

The radio constantly monitors its RF environment and automatically switches to the best site available, based on received signal strength, internal programming, and responses to registration and affiliation requests sent to the site equipment. When a newly programmed radio comes on the system, it references a preprogramming list of control channels to find a valid channel. If the radio cannot find a valid control channel on the preprogramming list, it resorts to a full spectrum scanning, if enabled, to find a channel.

When a valid control channel is found, the unit goes through a registration/affiliation request sequence. This sequence registers the radio with the system and also affiliates the radio with the selected talkgroup. The site accepts the registration/affiliation request if the radio is programmed with the correct system ID, also parameters configured by Configuration Manager and is now ready to make and receive calls.

If the registration/affiliation request is not accepted by the RF site equipment, the radio continues to search for a valid site and system, repeating the registration/affiliation request sequence each time a control channel with the correct frequency and acceptable signal strength is found. If a subscriber radio is in a coverage area where the radio can receive outbound communication (system to radio) but inbound communication (radio to system) is not possible, the subscriber radios cannot request services. The subscriber radios can provide notification of this condition to the radio operator with a tone, the radio display, or a combination of tone and display.

2.3.3
Call Processing Flow

This section covers the call processing flow.

2.3.3.1
Group Call Flow

The following is a description of Group Call audio flow, call continuation, and call teardown:

1 When the radio operator presses the PTT, the radio sends a data signal in the form of an Inbound Signal Packet (ISP) to the control channel. The ISP contains the radio unit ID and the talkgroup ID on which the radio wants to communicate and an indication of the type of call being made. The ISP is a request for allocation of a voice channel for the call.

2 The control channel forwards the received ISP to the site controller. The site controller searches its database for a unit ID match. The ISP contains the selected talkgroup information. The site controller updates the database to reflect the current talkgroup affiliation.

3 The site controller processes the ISP and assigns one of the idle base radios to the radio operators talkgroup. The central controller then sends an Outbound Signal Packet (OSP) over the control channel. The OSP contains the talkgroup ID and unit ID of the requesting radio, as well as voice channel assignment information.

4 All radios monitoring the control channel receive the transmitted OSP and examine the talkgroup ID contained in the OSP.

5 When the call is completed, the radios in the talkgroup switch back to the control channel frequency. The previously assigned voice channel now becomes available for other calls.

2.3.3.2
Unit-to-Unit Call Flow

The following is a description of Unit-to-Unit Call audio flow:

1 The sender enters into the private conversation mode.

2 The sender selects a target radio by dialing a User ID on a keypad, or selects one from a pre-existing list and presses the PTT to initiate the call.

3 The target radio rings to indicate that a private conversation request has been received and accepts the unit-to-unit call.

Chapter 3

ASTRO 25 Express Standalone Infrastructure Installation

This chapter describes the process of installing hardware components at the site.

3.1
Hardware Installation

This section covers how to install the ASTRO® 25 Express System site.

3.1.1
Site Installation Overview

Standards and Guidelines for Communication Sites includes guidelines and details for designing and installing equipment at an RF site. See the document for the following guidelines on the site installation:

- Safety guidelines
- Site selection, design, and development
- Site building design and installation
- External/internal grounding
- Power sources
- Transient voltage surge suppression
- Minimizing site interference
- Equipment installation
- Antenna installation

3.1.2
Required Installation Process Overview

When and where to use: Follow this process to install racks, cabinets, and devices at the site.

Process:

1 Prepare each site to comply with the Motorola Solutions requirements and specifications for the equipment, as listed in the *Standards and Guidelines for Communication Sites* manual. Other codes and guidelines that may apply to the location must also be met. Be sure to review the specific safety guidelines included in the Installation chapter of the *GTR 8000 Expandable Site Subsystem* manual.

2 Inspect and inventory all racks, cabinets, cables, and other equipment to ensure that the order is complete.

3 Install all equipment using the site drawings and other documents provided for your site. Use the installation standards and guidelines for placing and installing equipment. This and other information is included in the *GTR 8000 Expandable Site Subsystem* manual.

4 Install all groundings for the racks and cabinets to protect against ground faults, electrical surges, and lightning in accordance with R56 standards.

MN003228A01-A
Chapter 3: ASTRO 25 Express Standalone Infrastructure Installation

5 Connect all cables within each cabinet/rack and between multiple cabinets/racks (where required) as described in the *GTR 8000 Expandable Site Subsystem* manual.

6 Run a preliminary check of all sites before applying power and starting initial software installation.

7 Install the firmware on the site controllers and base radios using the Software Download Manager application installed on the service laptop and the software options purchased with your equipment.

3.1.3
Required Tools for Hardware Installation

Various tools are required to install, optimize, and service the equipment. If information is needed regarding where to obtain any of the equipment and tools listed, contact the Motorola Solutions Support Center (SSC). The following is a list of general recommended tools for installing and servicing site equipment:

Service Monitor: Aeroflex 3900 Series Service Monitor with P25 Options installed (plus TDMA options as required)

- Aeroflex 3900 Series Service Monitor with P25 Options installed

The general recommended tools are:

- 150 MHz 4-channel digital storage oscilloscope
- Transmission test set (TIMS Set)
- 50 Ohm terminated load
- Digital multimeter (DMM)
- Antenna tester
- Terminal emulation software
- DB-9 straight through serial cable
- RS-232 cables with connectors
- Punch block impact tool
- MODAPT RJ-45 breakout box
- Remote RJ-11/RJ-45 cable tester (1,200 ft length maximum)
- PC cable tester with RG58, 59, 62, BNC, RJ-45, RJ11, DB-9, DB15, DB25, and Centronics 36-pin connectors
- Electrostatic discharge (ESD) field service kit
- Amprobe Instruments GP-1 earth tester
- AEMC 3730 clamp-on ground resistance tester
- General Dynamics R2670 w/P25

The following is a list of recommended networking tools for installing and servicing the network:

- Fluke® OneTouch Assistant LAN tester
- NiMH rechargeable battery for Fluke
- T1/E1 or E1 test set
- Serialtest® software with ComProbe® and SerialBERT option

Send Feedback

3.1.4
Power Requirements

The GTR 8000 Base Radios have automatic battery revert capabilities and can charge batteries from the AC power supply. The power supply includes an integrated charging system that eliminates the need for UPS and that provides battery equalization. For the GTR 8000 platform, the integrated distributed site rectifier provides 3A charging per power supply module. The battery charge and temperature conditions are monitored by the base radio and may be viewed through CSS.

Follow the guidelines in *Standards and Guidelines for Communication Sites* for information on providing electrical service, power budgeting, selecting batteries, and other topics for supplying power at the site.

3.1.5
GTR 8000 Expandable Site Subsystem Configurations

The ASTRO® 25 Express System is installed in the configurations shown in the following sections:

- Operating Configurations (700/800/900 MHz) on page 35
- Operating Configurations for UHF R1 (380–435 MHz) on page 37
- Operating Configurations for UHF R2 (435–524 MHz) on page 39
- Operating Configurations for VHF (136–174 MHz) on page 41

Connections are made between the cabinets or racks using the junction panel connections provided in this documentation.

3.1.5.1
Operating Configurations (700/800/900 MHz)

For a GTR 8000 Expandable Site Subsystem, the GTR 8000 Base Radio can operate as a trunked 700/800 MHz station. For the trunked station, each individual base radio has an Ethernet connection and a frequency reference connection to the site controller.

Figure 4: GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (700/800/900 MHz)
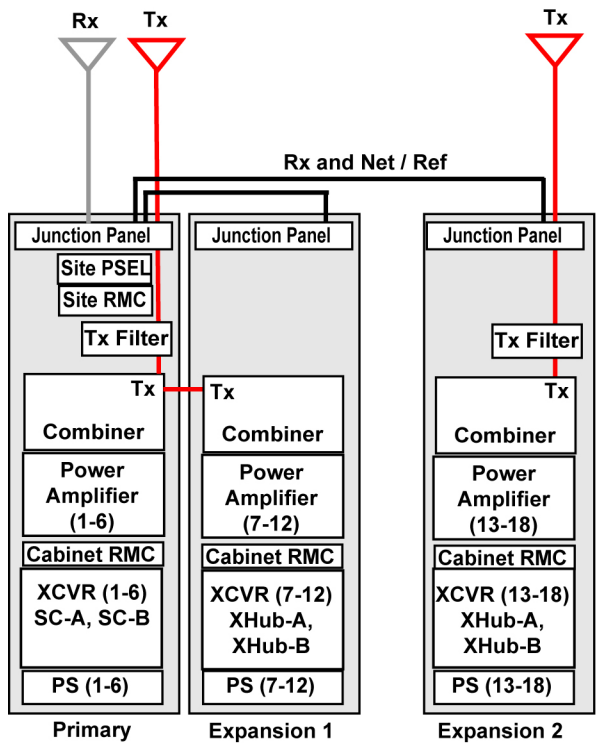
EXP_GTR_8000_Expansion_Diagram_Site

✏️ **NOTICE:**

- The expansion cabinets or racks shown in these diagrams are used only if the site supports more than the six channels (base radios) included in the primary cabinet.

- For an ASTRO® 25 Express System using Phase 2 TDMA operation, a second antenna branch may be required. See Appendix B in the *Dynamic Dual Mode for TDMA Operation Feature Guide* for details.

3.1.5.1.1
ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for 700/800/900 MHz

Table 2: ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for 700/800/900 MHz

Connection	Description
Transmit	A maximum of 12 base radios per antenna can be combined. So two cabinets/racks (6 base radios in each) can be combined per transmit antenna. The cabinets/racks must be located next to each other. No doors can be installed on the sides that face each other.

Table continued…

Send Feedback

Connection	Description
	The cabinet/rack connected to the transmit antenna must be configured with a Tx filter (if both cabinets/racks are the same band) or diplexer (if a different band than other cabinet/rack).
	The other cabinet/rack must be configured with a phasing harness (if both cabinets/racks are the same band) or diplexer extension cable (if a different band than other cabinet/rack). Cabinets/racks connected by a phasing harness or a diplexer extension cable must be 1 inch apart or less.
	All necessary Tx RF interconnect cables (critical length) are provided in these options. The interconnect cable goes directly between RFDS components of the two cabinets/racks without using the junction panel. The output Tx antenna connection is a 7/16 DIN on the junction panel.
Receive	All three cabinets/racks (18 radios) can be connected to a single receive antenna. A connection point is provided on the junction panel with output for the other cabinets/racks. Cables that connect the cabinets/racks are NOT provided. There is a Site Preselector labeled Site PSEL in Figure 4: GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (700/800/900 MHz) on page 36 in cabinets/racks that connect to the Rx antenna.
Ethernet	The Ethernet connection supports CSS connections. Ethernet also supports Configuration Manager connections. Each Expansion Hub in the expansion cabinets/racks contains an incremental 8–port Ethernet switch which augments, in a hierarchical fashion, the main switch in the site controller, and later supports 6 additional base radios.
700 MHz cabinet/rack connected to an 800 MHz cabinet/rack	For side-by-side dual band cabinets/racks (a 700 MHz cabinet/rack connected to an 800 MHz cabinet/rack), the following is required, in addition to the transmit configuration requirements previously listed: • Only one Tx antenna is needed. • Only one Rx antenna is needed. • A diplexer is used instead of a transmit filter in one of the cabinets/racks. • The Tx connection between combiners is a diplexer extension cable instead of the phasing harness used for single band cabinets/racks.

3.1.5.2

Operating Configurations for UHF R1 (380–435 MHz)

For a GTR 8000 Expandable Site Subsystem, the GTR 8000 Base Radio can operate as a trunked UHF R1 (380–435 MHz) station. For the trunked station, each individual base radio has an Ethernet connection and a frequency reference connection to the GCP 8000 Site Controller.

Figure 5: GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (UHF Range 1)
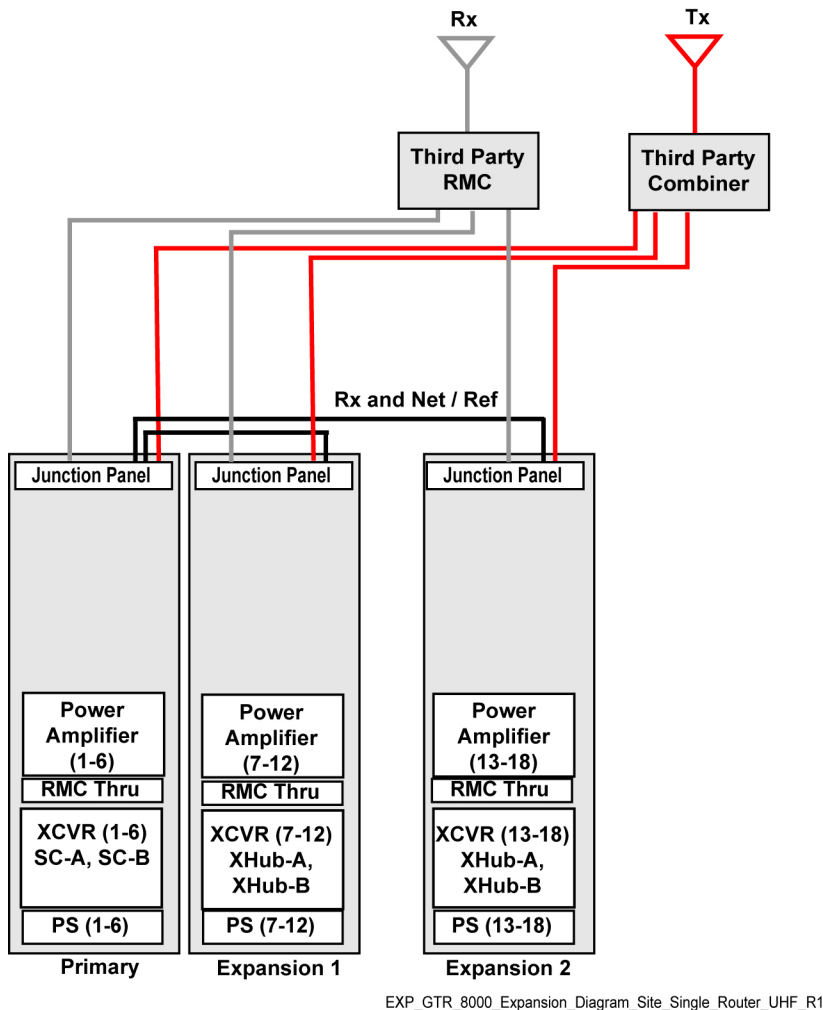
EXP_GTR_8000_Expansion_Diagram_Site_Single_Router_UHF_R1

NOTICE:

- The expansion cabinets or racks shown in these diagrams are used only if the site supports more than the six channels (base radios) included in the primary cabinet.
- For an ASTRO® 25 Express System using Phase 2 TDMA operation, a second antenna branch may be required. See Appendix B in the *Dynamic Dual Mode for TDMA Operation Feature Guide* for details.

3.1.5.2.1
ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for UHF R1 (380–435 MHz)

Table 3: ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for UHF R1 (380–435 MHz)

Connection	Description
Transmit	The Power Amplifier output of each base radio is connected to the QN to N jumper cable to the external Third-Party

Table continued…

Connection	Description
	Combiner inputs, through the junction panel on top of the cabinet/rack. All cabinets/racks can be combined into a third-party supplied combiner that feeds into one transmit antenna.
	The output Tx antenna connection is a 6-N female inside the cabinet/rack.
	See the third-party customer documentation.
Receive	The external Third-Party RMC outputs are connected to six BNC Receive Inputs on the junction panel in each cabinet/rack. All cabinets/racks can be combined into a third-party supplied RMC that feeds into one receive antenna.
	See the third-party customer documentation.
Ethernet	The Ethernet link CSS connections. Ethernet also supports Configuration Manager connections. Each Expansion Hub in the expansion cabinets/racks contains an incremental 8–port Ethernet switch which augments, in a hierarchical fashion, the main switch in the site controller, and later supports six additional base radios.

3.1.5.3
Operating Configurations for UHF R2 (435–524 MHz)

For a GTR 8000 Expandable Site Subsystem, the GTR 8000 Base Radio can operate as a trunked UHF R2 (435–524 MHz) station. For the trunked station, each individual base radio has an Ethernet connection and a frequency reference connection to the GCP 8000 Site Controller.

Figure 6: GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (UHF Range 2)
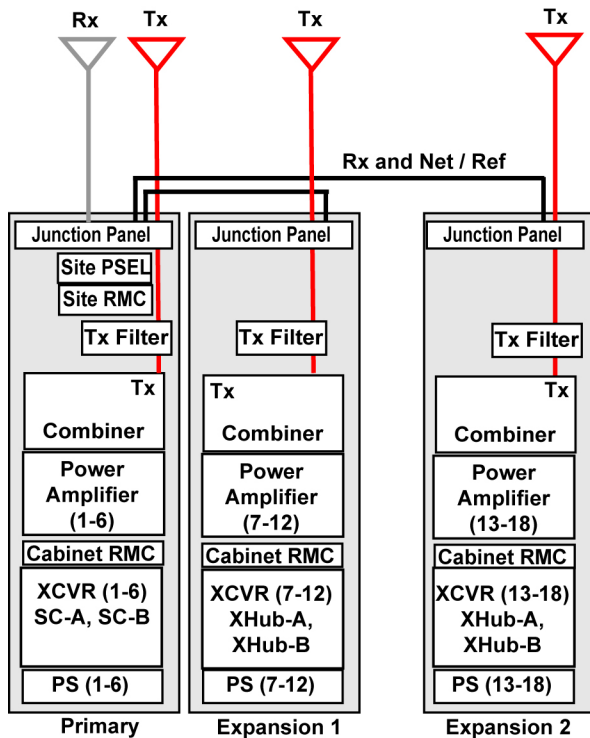
EXP_GTR_8000_Expansion_Diagram_Site_Single_Router_UHF_R2

NOTICE:

- The expansion cabinets or racks shown in these diagrams are used only if the site supports more than the six channels (base radios) included in the primary cabinet.
- For an ASTRO® 25 Express System using Phase 2 TDMA operation, a second antenna branch may be required. See Appendix B in the *Dynamic Dual Mode for TDMA Operation Feature Guide* for details.

3.1.5.3.1
ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for UHF R2 (435–524 MHz)

Table 4: ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for UHF R2 (435–524 MHz)

Connection	Description
Transmit	A maximum of six base radios can be combined. So no more than one cabinet/rack (six base radios in each) can be combined per transmit antenna. The cabinet/rack that connects to the transmit antenna must be configured with a Tx filter. The output Tx antenna connection is a 7/16 DIN on the junction panel.

Table continued…

Connection	Description
Receive	Up to three cabinets/racks (18 radios) can use a single receive antenna. A connection point is provided on the junction panel with output for the other cabinets/racks. Cables that connect the cabinets/racks are NOT provided. There is a Site Preselector labeled Site PSEL in "GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (UHF Range 2)" in cabinets/racks that connect to the Rx antenna.
Ethernet	The Ethernet link supports software downloads and CSS connections. Ethernet also supports Configuration Manager connections. Each Expansion Hub in the expansion cabinets/racks contains an incremental 8–port Ethernet switch which augments, in a hierarchical fashion, the main switch in the site controller, and later supports 6 additional base radios.

3.1.5.4
Operating Configurations for VHF (136–174 MHz)

For a GTR 8000 Expandable Site Subsystem, the GTR 8000 Base Radio can operate as a trunked VHF (136–174 MHz) station. For the trunked station, each individual base radio has an Ethernet connection and a frequency reference connection to the GCP 8000 Site Controller.

Figure 7: GTR 8000 Expandable Site Subsystem Operating Configuration with Expansion Units (VHF)
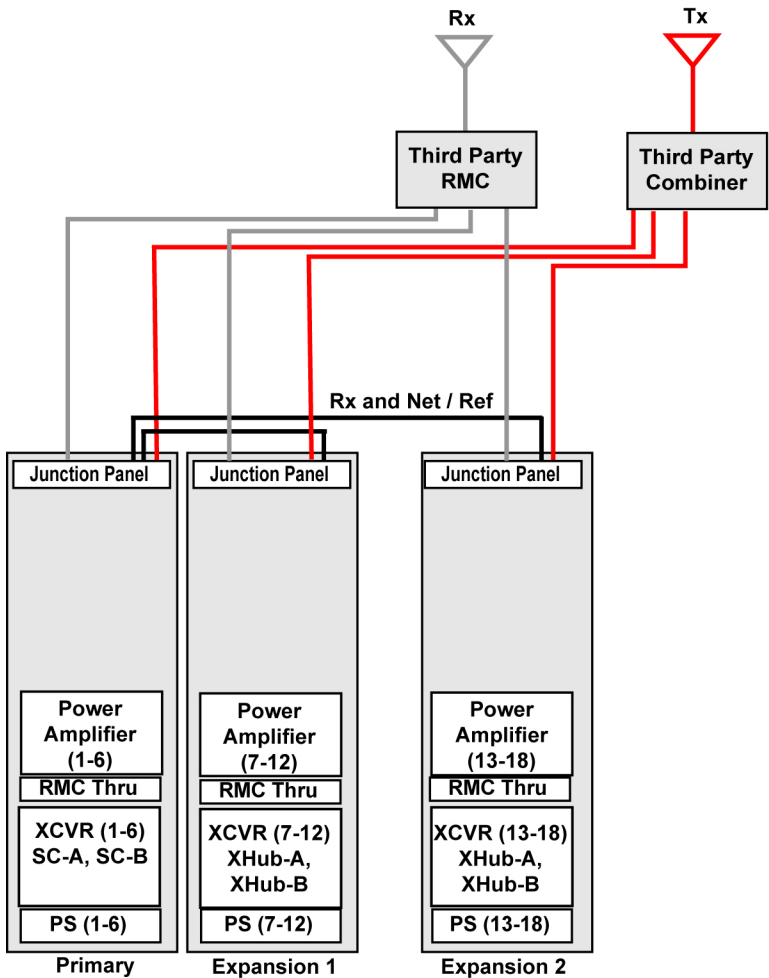
EXP_GTR_8000_Expansion_Diagram_Site_Single_Router_VHF

> **NOTICE:**
>
> - The expansion cabinets or racks shown in these diagrams are used only if the site supports more than the six channels (base radios) included in the primary cabinet.
> - For an ASTRO® 25 Express System using Phase 2 TDMA operation, a second antenna branch may be required. See Appendix B in the *Dynamic Dual Mode for TDMA Operation Feature Guide* for details.

3.1.5.4.1
ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for VHF (136–174 MHz)

Table 5: ASTRO 25 Repeater Site GTR 8000 Base Radio Configurations for VHF (136–174 MHz)

Connection	Description
Transmit	All cabinets can be combined into a third-party supplied combiner that feeds into one transmit antenna. The output Tx antenna connection is a 6-N female inside the cabinet. See the third-party customer documentation.
Receive	All cabinets can be combined into a third-party supplied RMC that feeds into one receive antenna. The input Rx antenna connection is a six BNC female connector on the junction panel. See the third-party customer documentation.
Ethernet	Each trunked base radio at the site has Ethernet connection to the site LAN. The Ethernet connection provides an interface for voice or control traffic for the individual base radio. The transceiver (XCVR) in each base radio provides conversion between the inbound and outbound IP packets and the control or voice traffic. The Ethernet link supports fault reporting, software downloads, and CSS connections. Each Expansion Hub in the expansion cabinets contains an incremental 8–port Ethernet switch which augments, in a hierarchical fashion, the main switch in the site controller, and later supports six additional base radios. Ethernet also supports Configuration Manager connections.

3.2
Junction Panel Connections

The junction panel for the GTR 8000 Expandable Site Subsystem provides locations for all the connections to external devices for the standard configuration. Cables provided from Motorola Solutions include the specific connectors required by the junction panel on one end and the subsystem equipment on the other end.

See the Installation chapter in the *GTR 8000 Expandable Site Subsystem* manual for the junction panel connections for an ASTRO® 25 Express system.

3.3
RFDS Modules

The Radio Frequency Distribution System (RFDS) equipment included in your system depends on what options were purchased from Motorola Solutions. See the *GTR 8000 Expandable Site Subsystem* manual for a list of all RFDS equipment available.

3.4
Site Channel Capacity Expansion

This section covers how to add channels to an existing site.

3.4.1
Adding Channels (700/800/900 MHz)

The GTR 8000 Expandable Site Subsystem configuration can be ordered with two to six base radios for the primary cabinet, and one to six base radios per expansion cabinet. Open slots can be filled later to add more base radios.

To add 700 MHz base radios to an 800 MHz GTR 8000 Expandable Site Subsystem or 800 MHz base radios to a 700 MHz GTR 8000 Expandable Site Subsystem, add another cabinet containing the other band base radios. This cabinet must be connected to the existing cabinet with a diplexer extension cable (the cabinets must not be more than 1 inch apart). In this situation, a diplexer is used instead of a transmit filter to combine the transmitters of the two cabinets. The diplexer is only installed in the cabinet which connects to the antenna. The diplexer can be located either in the cabinet with the 700 MHz base radios or the cabinet with the 800 MHz base radios. Add at least two base radios when adding in another band.

To add base radios in the same frequency band (700 MHz base radios to a 700 MHz GTR 8000 Expandable Site Subsystem or 800 MHz base radios to an 800 MHz GTR 8000 Expandable Site Subsystem), you can add from one to four base radios to a cabinet with open slots or you can add another cabinet with at least two base radios. The cabinets in the same band must be connected with a phasing harness (the cabinets must not be more than 1 inch apart).

> **IMPORTANT:**
> - If you are adding a cabinet or cabinets with 700 MHz GTR 8000 Base Radios to an existing 800 MHz GTR 8000 Expandable Site Subsystem, check your band plan configurations.
> - When you add new base radios, load them with the same version of the software currently running at the site. You cannot mix software versions.
> - The cavity combiner must be tuned to the correct transmit frequency.

3.4.2
Adding Channels for UHF R1 (380–435 MHz)

The GTR 8000 Expandable Site Subsystem configuration can be ordered with up to six radios per cabinet. Open slots can be filled later to add more base radios.

> **IMPORTANT:**
> - If you are adding a cabinet or cabinets UHF R1 (380–435 MHz) GTR 8000 Base Radios to an existing UHF R1 (380–435 MHz) GTR 8000 Expandable Site Subsystem, check your band plan configurations.
> - When you add new base radios, load them with the same version of the software currently running at the site. You cannot mix software versions.

3.4.3
Adding Channels for UHF R2 (435–524 MHz)

The GTR 8000 Expandable Site Subsystem configuration can be ordered with up to six radios per cabinet. Open slots can be filled later to add more base radios.

> **IMPORTANT:**
> - If you are adding a cabinet or cabinets UHF R2 (435–524 MHz) GTR 8000 Base Radios to an existing UHF R2 (435–524 MHz) GTR 8000 Expandable Site Subsystem, check your band plan configurations.
> - If you are adding a cabinet or cabinets UHF R2 (435–524 MHz) GTR 8000 Base Radios to an existing UHF R2 (435–524 MHz) GTR 8000 Expandable Site Subsystem, check your band plan configurations.
> - When you add new base radios, load them with the same version of the software currently running at the site. You cannot mix software versions.
> - The cavity combiner must be tuned to the correct transmit frequency.

3.4.4
Adding Channels for VHF (136–174 MHz)

The GTR 8000 Expandable Site Subsystem configuration can be ordered with up to six radios per cabinet. Open slots can be filled later to add more base radios.

> **IMPORTANT:**
> - If you are adding a VHF (136–174 MHz) GTR 8000 Base Radios to an existing VHF (136–174 MHz) GTR 8000 Expandable Site Subsystem, check your band plan configurations. You may need to update CSS information.
> - When you add new base radios, load them with the same version of the software currently running at the site. You cannot mix software versions.

Chapter 4

ASTRO 25 Express Standalone Infrastructure Configuration and Optimization

This chapter contains configuration and optimization procedures for the site equipment.

4.1
Prepare Support and Test Equipment

This section introduces the tools used to manage the hardware at the site.

4.1.1
Service Laptop

The Service Laptop or a laptop computer is a valuable tool for most troubleshooting. You can use it to obtain information about the functioning of system components and the transport architecture between sites.

Primary uses of Service Laptop include:

- Quick checking of component status, configuration, and reconsideration.
- Saving hard and soft copies of all configuration information for a system.
- Configuring and servicing base radios with CSS application.
- CPS is used to program subscriber radios.
- Local configuration and troubleshooting of SDM3000 Network Translator (SNT) and SDM3000 RTU devices using the SDM3000 Builder application.

4.1.1.1
Laptop Requirements

A laptop computer may be required to directly troubleshoot, configure, and read local alarm logs for devices in the radio network. The laptop computer can be used to check the local status of a device, program radios, and base stations, and save a backup of device configurations. The laptop computer should have the following minimum specifications:

- 1 GHz or higher Pentium grade processor
- 1 GB RAM recommended for Windows 7 32-bit
- 2 GB RAM recommended for Windows 7 64-bit
- 2 GB RAM recommended for Windows 10 64-bit
- 2 GB RAM recommended for Windows 10 64-bit
- 40 GB Hard drive with 3 GB free space
- CD-ROM
- Serial COM port
- Ethernet port

- 2 USB Ports

- DB-9 straight through serial cable

- Ethernet standard and crossover cables

> **NOTICE:** For computers that are not equipped with a serial port, radio communications may be possible with the use of an off-the-shelf USB to RS–232 converter.

The laptop should have one of the following operating systems:

- Windows 7 32- and 64-bit

- Windows 10 32- and 64-bit

Load the laptop with the following software:

- Configuration/Service Software (CSS) and Software Download Manager (SWDL)

- Customer Programming Software (CPS)

- Radio Service Software (RSS)

- pcAnywhere

- PuTTY

- Third-party Telnet client

4.1.2
Configuration/Service Software

The Configuration/Service Software (CSS) is a Windows-based application installed on a laptop or desktop PC used to perform configurations, status reporting, and servicing tasks for infrastructure devices in the system. The CSS application allows a service technician to:

- Configure operating parameters for infrastructure devices.

- Retrieve status and operational information from a device.

- Perform alignment procedures for the infrastructure devices that can use the CSS.

- Set the IP Address for specified devices, which requires a local serial connection.

- Perform most device configuration and servicing tasks either through a serial connection to the device or over the LAN.

Use the CSS to configure and service the parameters for the site devices in your system. The devices that are configured using the CSS are:

- Base radio

- Site controller

> **NOTICE:** For Phase 2 TDMA configuration and related parameters for the base radio and site controller, see the *Dynamic Dual Mode for TDMA Operation Feature Guide*.

The CSS is used to configure the parameters on the GTR 8000 Base Radios and on the GCP 8000 Site Controller. CSS can access each device over the local LAN, or individually through the Ethernet service port. The DB-9 serial port connection is used to set the IP address for the GTR 8000 Base Radio and on the GCP 8000 Site Controller. CSS also can be used to view status information, equalize batteries, and check internal logs of the equipment at the site.

4.1.2.1
Installing and Upgrading the Software Using Configuration/Service Software

When and where to use: The Configuration/Service Software CSS is used to configure the parameters on the GTR 8000 Base Radios and on the GCP 8000 Site Controller.

Table 6: Installing and Upgrading the Software

Activity	Description	Reference
Install CSS	Install the Configuration/Service Software (CSS) on the service laptop. The Software Download Manager (SWDL) application is included on the same CD. After installation, two icons will appear on the desktop: • CSS icon: Launches the CSS application • SWDL icon: Launches the SWDL application	CSS Getting Started, booklet is inside the CSS CD case.

4.1.2.2
Configuration/Service Software Usage Guidelines

The Configuration/Service Software (CSS) application enables you to use a laptop or other client computer to configure, service, and maintain various Motorola Solutions devices in an ASTRO® 25 radio system. Devices supported by CSS include the base radio and site controller equipment.

To install CSS, see the *Configuration/Service Software (CSS) Getting Started Instructions* provided with the software media. These instructions also include a procedure for Configuring the CSS PC Network Connection

To access the online help, select **Help → CSS Help** from the menu. Before performing any procedure or process established in the online help, review the following *Core CSS Online Help* topics to ensure that you are familiar with and have access to the appropriate topics:

• CSS Main Window - To become familiar with the CSS elements and navigation components.

• Overview of CSS - To become familiar with using CSS locally or through the network management subsystem.

• CSS Help Links - For specific online help supporting base radio configuration and site controller configuration.

4.1.2.2.1
Configuring Read/Write Files From/To a Device

When and where to use:

When Configuration/Service Software (CSS) is installed, the online help feature provides information, and instructional procedures to read/write a configuration file from/to a device.

Procedure:

1 Open CSS.

2 Select **Help** → **CSS Help** from the menu.

3 From the list of CSS Online Help topics, expand **CSS Procedures** (list of procedures).

4 Select the appropriate help topic.

   a Connecting to a Device Through an Ethernet Connection

   b Connecting to a Device Through a Serial Connection

   c Reading the Configuration File from a Device

   d Writing the Configuration File to a Device

5 Follow the instructions provided to perform the task selected from the online help.

4.1.3
Software Download Manager

Software Download Manager (SWDL) transfers and installs new firmware in RF site components (base radios and site controllers).

> **NOTICE:** For detailed information on uploading firmware to the base radios and site controller, see the *Software Download Manager* manual.

The SWDL allows you to perform the following tasks:

- Download software to site devices.
- Download software to an instance of a device (such as one base station) that has been disconnected from the radio network.
- Update the software on newly added channels or subsites.
- Determine software and hardware versions on target devices.
- Purge (delete) a software version from selected target devices.
- Obtain device IP information.
- Query the site controller for the number of channels and/or subsites in the system.
- Audit a session using historical information recorded by Software Download Manager.

To download software to an ASTRO® 25 System, you can do one of the following:

- Software download to the entire site – site controllers and base radios.
- Software download to either of the device types in the system – base radios or site controllers.

4.1.3.1
Installing and Upgrading the Software

When and where to use: Software Download Manager (SWDL) transfers and installs new firmware in RF site components (base radios and site controllers).

Table 7: Installing and Upgrading the Software

Activity	Description	Reference
Upgrade factory-installed software	Launch the Software Download Manager (SWDL) application and upgrade the factory-installed software on the equipment to the latest version. All base radios and all site controllers must have consistent versions of software.	*Software Download Manager* manual
	After installation, the SWDL icon appears.	

4.1.4
Customer Programming Software

Subscriber radios are configured through Customer Programming Software (CPS). A computer running CPS is directly connected to the universal connection port on the subscriber radio and the codeplug is loaded. The configuration settings in CPS are categorized into different types, such as Radio-Wide settings, Controls, Display and Menu settings, and Secure settings. Parameters must be set according to the services used from the radio. Customer Programming Software (CPS) is used to configure each radio with a system ID, the radios unique individual ID, and as many talkgroup IDs as needed.

For subscriber radio programming details, see your subscriber radio user guide and *Customer Programming Software* Online Help.

4.2
Configuring Site Hardware

After installing the hardware at the site and completing the cable connections, install the latest version of firmware on the device using Software Download Manager (if needed). For detailed firmware download procedures, see the *Software Download Manager* manual. When this step is completed, follow the instructions in the *CSS Online Help* to configure the site controller and base radios using Configuration/Service Software (CSS).

> **IMPORTANT:** Creating and managing device passwords is an important part of site hardware configuration. This step helps ensure system integrity. See the *CSS Online Help* for information on creating and changing passwords for the site controller and base radios. The password for the CSS should also be changed periodically.

4.3
Configuring Subscriber Radios

Subscriber radios are configured through Customer Programming Software (CPS). A computer running CPS is directly connected to the universal connection port on the subscriber radio and the codeplug is loaded. The configuration settings in CPS are categorized into different types, such as Radio-Wide settings, Controls, Display and Menu settings, and Secure settings. Parameters must be set according to the services used from the radio.

4.3.1
Basic Parameters to Make a Radio Work in The System

The XTS5000 and XTL5000 subscriber radios used in these systems are programmed with the ASTRO® 25 Customer Programming Software (CPS). There are separate CPS applications for the Portable (XTS5000) and Mobile (XTL5000) radios. The CPS includes hundreds of parameters. For a detailed explanation, consult the online help included with the application. As a starting point, the following table lists the essential parameters to make a radio work in the system.

Table 8: Basic Parameters to Make a Radio Work in The System

Parameters	Description
Trunking	Trunking configuration:

- SmartZone
  - Display Site Trunking = **unchecked**
  - Alert Site Trunking = **unchecked**

Trunking system:

- General
  - Type: **ASTRO25**
  - Home System ID: **customer specific**
  - Home WACN ID: **customer specific**
  - Unit ID
  - Coverage Type: **Disabled**
- ASTRO25 Channel ID: Entire band plan as defined in site controller
- ASTRO25 Control Channels: Frequencies of possible control channels

Trunking personality

- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: **Unchecked**
- Talkgroup
  - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: **Unchecked**
- Talkgroup

Table continued…

Parameters	Description

    - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)

- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: **Unchecked**
- Talkgroup
  - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: Unchecked
- Talkgroup
  - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: **Unchecked**
- Talkgroup
  - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency
  - Console ACK Required: **Unchecked**
- Talkgroup
  - Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
- General
  - Protocol Type: **ASTRO25**
  - System & ID: pointer to the Trunking System you created
- Emergency

Table continued…

Parameters	Description
	- Console ACK Required: **Unchecked**
	• Talkgroup
	- Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, type **F**)
	• General
	- Protocol Type: **ASTRO25**
	- System & ID: pointer to the Trunking System you created
	• Emergency
	- Console ACK Required: **Unchecked**
	• Talkgroup
	- Enter the list of talkgroups, with the IDs in hexadecimal (example: to enter talkgroup 800015, simply type **F**)
Channel Assignment	Channels • Enter names for the selector positions and associate them with the personalities and talkgroups created in previous steps.

4.3.2
Basic Parameters to Support Radio-to-Radio Encryption

The Secure Configuration window contains all the fields and settings specific to secure voice operation. Key assignment slots are assigned for the radio by the Secure Hardware Encryption Multikey records in the CPS. Keys are defined with two slots per Common Key Reference "(CKR)" to support two TEKs (or Traffic Encryption Keys) per "CKR". See *CPS Online Help* to determine the appropriate secure settings for your subscriber radios.

To implement radio-to-radio encryption, use the settings specified in Table 9: Basic Parameters to Support Radio-to-Radio Encryption on page 52.

Table 9: Basic Parameters to Support Radio-to-Radio Encryption

Parameters	Description

Radio Configuration	Secure
	 • Secure Configuration
	    - General
	       + Secure equipped: **checked**
	       + Secure type: **Hardware** for most algorithms. **Advanced Digital Privacy** only for ADP radios.
	 • Secure Multikey List
	    - Enter CKR (Common Key Reference) numbers and aliases (names of encryption keys that you assign later to talkgroups)

Trunking	Trunking System • Multikey

Parameters	Description

	- Failsoft Key select: Key from the Secure Multikey List that radios use to transmit during Failsoft.
	- Private Call Key select: Key from the Secure Multikey List that radios use to transmit in a Private Call.
	
	Trunking Personality
	• Talkgroup
	  - Secure/Clear strapping: Choose if this talkgroup permits only encrypted calls, only secure calls, or if the radio user is able to select between clear and secure.
	  - Key Select: if the talkgroup is not set to be always Clear, in this parameter you decide which key from the Secure Multikey List used by the radio to transmit calls for the talkgroup.

4.3.3
Key Parameters for ASTRO 25 Express System

The XTS5000 and XTL5000 radios can operate in various systems. Some of the features in the Customer Programming Software are intended for large systems with multiple sites that the radio can roam to. Some of these features must be turned off in the programming of the radios to avoid confusion for the radio user of a standalone system.

Table 10: Key Parameters for ASTRO 25 Express System

Parameters	Description

Trunking	Trunking configuration
	• SmartZone
	  - Display Site Trunking = **unchecked**
	  - Alert Site Trunking = **unchecked**
	  - Display Site Trunking = **unchecked**
	  - Alert Site Trunking = **unchecked**
	  - Display Site Trunking = **unchecked**
	  - Alert Site Trunking = **unchecked**
	
	NOTICE: Since the site operates in Site Trunking, display indications or sounds alerting the user of this condition should be suspended using these settings.
	
	  - Display Site Trunking = **unchecked**
	  - Alert Site Trunking = **unchecked**
	
	NOTICE: Since the site operates in Site Trunking, display indications or sounds alerting the user of this condition should be suspended using these settings.
	
	  - Display Site Trunking = **unchecked**
	  - Alert Site Trunking = **unchecked**

Parameters	Description

NOTICE: Since the site operates in Site Trunking, display indications or sounds alerting the user of this condition should be suspended using these settings.

Trunking system

- General

    - Coverage Type: **Disabled**

    NOTICE: This setting prevents the radio from roaming to other sites.

Trunking personality

- Emergency

    - Console ACK Required: **unchecked**

    NOTICE: This setting allows the radio to send an Emergency Call without participation of a console, which is not part of the basic architecture of standalone systems.

4.4
Configuration Manager Trunking

The Configuration Manager software is an ASTRO® 25 software application that supports installation, configuration, and optimization of your system. The Configuration Manager enables customers to configure an ASTRO® 25 Express Trunking system without the additional cost of zone core equipment. Additionally, the operator is able to configure many of the features and capabilities found in ASTRO® 25 Trunking systems that have a zone core.

Capabilities that are supported in the system with or without the Configuration Manager include the following:

- Group calls
- Unit-to-unit calls
- Emergency Calls
- Emergency Alarms
- Call Alert

The Configuration Manager provides the capability for a system manager to configure radio users and talkgroups in a Subscriber Access Control Database in the system site controller. In an ASTRO® 25 Express system, the integrated GCP 8000 Site Controller functions as the system site controller.

Capabilities enabled by the Configuration Manager include the following:

- Authorization of radio operators (individuals and groups)
- Transmission vs. Message Trunking
- Service Mode
- Sub-band channel selection
- Voice enable/disable
- Talkgroup/Multigroup enable/disable
- Unit to Unit enable/disable
- Transmission Interrupt

- Call alert enable/disable
- Emergency call enable/disable
- Priority Monitor enable/disable
- Audio Interrupt enable/disable
- Priority Queuing
- Ruthless Preemption for Emergency Calls

Figure 8: Configuration Manager — Architecture
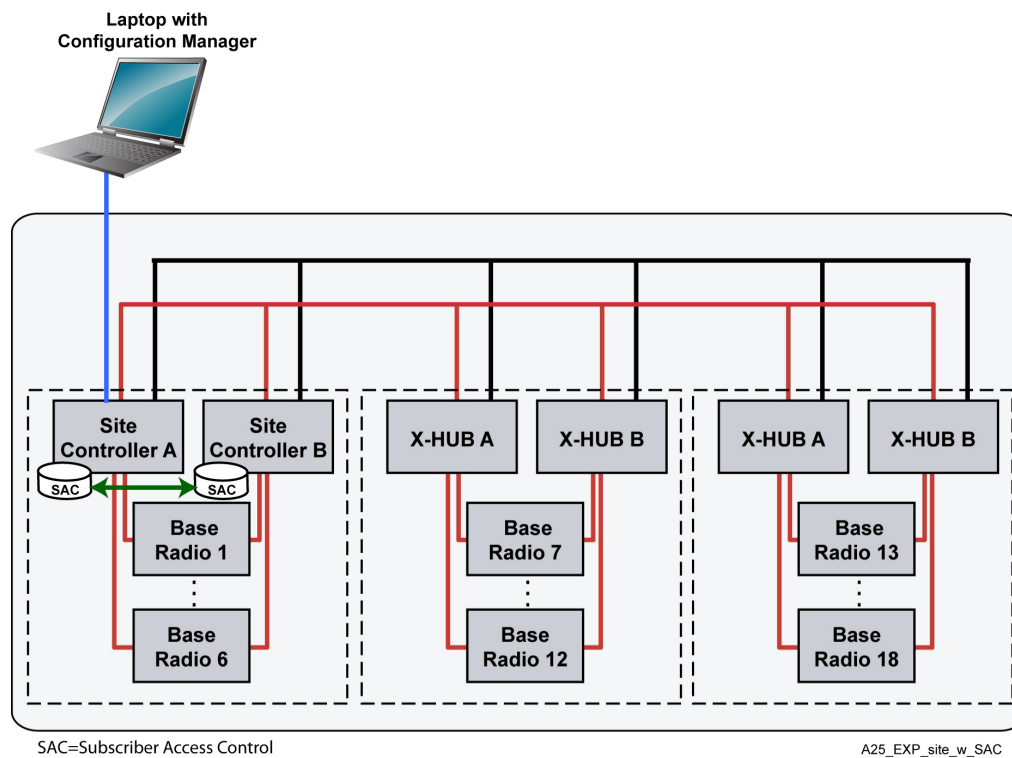
Configuration Manager can be deployed on a dedicated workstation or on a service laptop. For more details on Configuration Manager, see the *Configuration Manager for Trunking Systems User Guide*.

4.5
Optimizing the Performance of Site Equipment

Once the site equipment is installed and configured, optimize the performance of the site. For detailed optimization procedures, see the "Optimization" chapter in the *GTR 8000 Expandable Site Subsystem* manual.

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Chapter 5

ASTRO 25 Express Standalone Infrastructure Operation

This chapter details tasks to perform once the GTR 8000 Expandable Site Subsystem is installed and operational on your system.

5.1
Operational Modes

The operational modes for an ASTRO® 25 Express System are the following:

Table 11: ASTRO 25 Express System Operating Modes

Mode	Description
Site trunking	This is the normal mode of operation for the ASTRO® 25 Express System. Conditions required to maintain site trunking include: • At least one voice channel • One Control Channel • A site controller • Connectivity between the various site components. If a site controller switchover occurs during site trunking, all active calls at the site are transmission trunked.
Failsoft	Losing all site controllers or losing all the Control Channel capable base radios at a site forces the site into Failsoft mode. Basically, there is no trunking functionality. In this mode, and if programmed with Failsoft capability, the individual base radios become active (bring up their carrier) continuously. The radios receive a data word from their repeater that instructs them to generate a tone at fixed intervals to indicate to the users that the system is in Failsoft. A radio can communicate only with other radios programmed for and operating on the same failsoft channel. In failsoft mode, the radio checks the last active Control Channel in its list for the site. If it does not find that channel, it attempts to find the second Control Channel. If that channel is unavailable, the radio displays Out of Range until a Control Channel is available. When the conditions needed for either site trunking are restored, the site automatically returns to the available state.
Site Off	An operational mode in which the system is not available to the subscriber radios.

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Chapter 6

ASTRO 25 Express Standalone Infrastructure Maintenance

This chapter describes periodic maintenance procedures relating to the ASTRO® 25 Express System.

6.1
Site Equipment Maintenance

Periodic inspection of site equipment is recommended. This inspection helps identify and prevent potential problems.

Follow these guidelines:

- If the station equipment is installed in a dusty environment, precautions must be taken to filter the air used for forced cooling of the station. Excessive dust drawn across and into the station circuit modules by the cooling fans adversely affects the heat dissipation and circuit operation. In such installation, ensure to clean or replace external filtering devices periodically.

- Clean the grills periodically. When cleaning, verify that dust is not pulled into the modules. Use a damp cloth to wipe the front of the fan grills.

- If there is a need to remove a power supply, make sure that the unit is turned off before proceeding.

- Create a schedule for regular monitoring of device LEDs, preferably at least once daily. Learn to identify various LED states on the equipment and what they represent.

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Chapter 7

ASTRO 25 Express Standalone Infrastructure Troubleshooting

This chapter provides fault management and troubleshooting information relating to the GTR 8000 Expandable Site Subsystem.

7.1
Prerequisites for Troubleshooting

Before troubleshooting a site with GTR 8000 Expandable Site Subsystem, develop a thorough understanding of the following:

* Various call-processing scenarios
* How packets flow through the system
* Equipment operational theory

7.2
Troubleshooting Methodology

This process describes a methodology you can use to isolate faults to the FRU level.

Process:

1 Visually inspect the equipment LEDs.

2 Use the CSS to isolate a fault.

3 Escalate the problem to the Solutions Support Center (SSC) if you are unable to diagnose the cause of the problem.

7.3
Failure Scenarios

Typical causes of failure are as follows:

* Faulty or failed Ethernet switches (integrated with the site controllers)
* Improper configuration (hardware and software)
* Interference due to extreme weather conditions
* Intermittent loss of carrier service
* Physical obstructions in communications paths (for example, buildings, trees, and trains)
* Physical damage to cables

7.3.1
Site Failure Indicators and Causes

The following is a table of possible indicators of link failure in an ASTRO® 25 Express System.

Table 12: Site Failure Indicators and Causes

Symptom	Possible Cause	Corrective Action
Fault LEDs light up	Device or communication path failure	Determine and address the problem cause.
Site enters the Failsoft mode	Failure of both site controllers	Use hardware LEDs to confirm cause of failure.
Subscriber radio is unable to complete a call	• Indicative of channel or site controller failure, or capacity overloading on the channel. • Improper programming at the radio • Improper configuration of radio or talkgroup records in the database.	• Use hardware LEDs to confirm cause of failure. • Configure radio or talkgroup records using Configuration Manager. • Distribute the configuration changes to the Site Controller.
User is disconnected from the other users	• Failed subscriber radio unit. In this case, there is no impact to the rest of the system. • Subscriber radio unit moved out of the coverage area • Failed RF infrastructure component such as a base station • Incorrect key usage • Lack of keys in subscriber radio unit • Improper user manipulation of key sets	Determine and address the problem cause.
Poor audio quality	• Users speaking too close to the microphone • Users not enunciating clearly • Poor line characterization • Poor optimization • Degradation of an audio circuit, such as excessive thermal noise due to a failing component • Intermittent failure of a device, module, or link • Total failure of a device, module, or link	Determine and address the problem cause.

Table continued…

Send Feedback

Symptom	Possible Cause	Corrective Action
Subscriber radio displays Site Trunking indicator	Site Trunking not turned off in subscriber radios.	Using CPS, uncheck **Display Site Trunking** parameter in the subscribers codeplug.
Subscriber radio that indicates no acknowledgment received to emergency call	Subscriber radios emergency call ACK not programmed to Off in the subscriber radios.	Using CPS, uncheck Emergency **Console Ack required** parameter in the subscribers codeplug.

7.4
Troubleshooting Tools

The overall methodology for diagnosing and troubleshooting a GTR 8000 Expandable Site Subsystem includes the following:

- Using software and hardware tools to monitor site devices.

- Isolating problems to a FRU level and correcting them.

7.4.1
Troubleshooting Tools for a GTR 8000 Expandable Site Subsystem

Table 13: Troubleshooting Tools for a GTR 8000 Expandable Site Subsystem

Troubleshooting Tool	Links	Switch (Integrated with Site Controller)	Channels (Base Radios)	Site Controllers
LED indicators and physical connections	X	X	X	X
Networking Troubleshooting Commands (such as ping)	X	X	X	X
Configuration/Service Software (CSS)		X	X	X

7.4.2
Using Configuration/Service Software for Troubleshooting

Several of the devices you can configure and service with Configuration/Service Software (CSS) generate log files to track their status and operational information. The Status Report Screen available through the CSS service menu allows you to manage these log files. The log files include the following:

- Technicians logs – Contain time-stamped status and alarm messages. These logs are useful in troubleshooting the device and isolating faulty modules.

- Engineering Log – Provides a highly detailed account of device operation. This information describes data in the internal registers, data communications between components on the circuit boards, and other internal software processes. Motorola Solutions uses this information to troubleshoot the devices software processes.

CSS also has a service port mirroring function used for advanced diagnostics. The Status Panel window can be used to review base radio configuration, hardware status, station (base radio) configuration, and operational status. For more details, see the *CSS Online Help*.

7.5
Troubleshooting Individual Site Components

For additional information for troubleshooting individual components at the site with GTR 8000 Expandable Site Subsystem, see the *Core CSS Online Help* and the following manuals:

* *GTR 8000 Expandable Site Subsystem*
* *GCP 8000 Site Controller*

If your system features a firewall, contact your service representative for assistance.

7.6
Motorola Solutions Support Center Contact Information

The Motorola Solutions Support Center (SSC) provides technical support, Return Material Authorization (RMA) numbers for FRUs and FREs, and confirmations for troubleshooting results. Call the Motorola Solutions Support Center (SSC) for information about returning faulty equipment or ordering advance exchanges.

North America: 1-800-221-7144

International: 001-847-576-7300

ASTRO 25 Express Standalone Infrastructure Field Replaceable Units and Entities

This chapter lists the Field Replaceable Units (FRUs) and Field Replaceable Entities (FREs), and includes information on how to order parts from Motorola Solutions.

8.1
Ordering Replacement Parts

For a list of replacement units and parts that can be ordered for your site equipment, see the FRU/FRE chapters in the *GTR 8000 Expandable Site Subsystem* manual.

8.2
Ordering Configuration/Service Software

Table 14: Ordering CSS and Related Parts Number

Item	Kit Number
Configuration/Service Software (CSS)	DLN6455

> **NOTICE:** The CSS Serial Programming cable for use with a GTR 8000 in an ASTRO® Express system is a straight through DB-9 Male to DB-9 Female RS-232 cable.

8.3
Placing an Order

To place an order, contact Motorola Solutions at:

- Phone: 1-800-422-4210 ext. 6883
- TTY Phone: 1-866-522-5210
- Motorola Online users: https://businessonline.motorolsolutions.com
- Fax: 1-800-622-6210

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