INSTRUCTION MANUALS

The Preliminary Installation manual for this base radio is provided. Upon request, final manuals will be sent to the commission and/or telecommunication certification body (TCB) as soon as they become available. All of the descriptions and schematics in this filing are up to date and will be included in the instruction and/or service manuals.

INSTRUCTION MANUALS

Draft copy of the of the front matter of the following instruction manual is enclosed with this submission:

68P81003Y71-O ..... 6.2 First Draft for Simulcast Hardware Installation

Other system and radio / configuration service software manuals are available to support the product and system in operation. They can be provided to the Commission upon request.

6.2 First Draft for Simulcast Hardware Installation

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68P81003Y71-O
November 2002

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Model and Options selection Procedure

GENERAL INFORMATION

- 700 MHz STR 3000 (Tx 764.00625 – 775.99375, Rx 794.00625 – 805.99375)
- 6 Channels per Rack
- 6 Base Radios per Rack, 30 Base Radios per Site
- 100 Watt RF Power Amplifier
- Cabinet Height: 43 RU, 83.5 inches (212 cm)
- Temperature Range: -30° to +60° C (-22°F to 140°F)
- Manual Tuned Cavity Combiners (2, 4 or 6 ports, 150 kHz minimum spacing)
- Antenna Connectors: Receive: N-Female, Transmit: 7/16 Female

Preliminary

700 MHz STR 3000 Ordering Matrix

Super Model and Option Description	Nomenclature
STR 3000 Radio Subsystem	SQM02SUM0011A
Orderable Options: Choose only one required BR option from the following list.	
Add: (1) 100 Watt DC Base Radio	X301AD
Add: (2) 100 Watt DC Base Radios	X302AD
Add: (3) 100 Watt DC Base Radios	X303AD
Add: (4) 100 Watt DC Base Radios	X304AD
Add: (5) 100 Watt DC Base Radios	X305AB
Add: (6) 100 Watt DC Base Radios	X306AB
REQUIRED: Choose a Software Option in the same quantity as BRs ordered above	
Add: ASTRO 25 700 MHz Simulcast Trunking Software	CA00025AB
Add: ASTRO 25 700 MHz ISR Software	CA00158AA
Add: ASTRO 25 700 MHz P25 Limited Digital Conventional Software	CA00242AA
REQUIRED: Choose one Receiver Multicoupler option from the following list:	
Add: Primary Receiver Multicoupler	X679AF
Add: Primary Receiver Multicoupler with Tower Top Amp Capability	X679AG
Add: Expansion Receiver Multicoupler	
REQUIRED: Choose one Hardware/Cabling option from the following list:	
Add: 700 MHz Primary Cabinet Hardware/Cabling	X550BE
Add: 700 MHz Expansion Cabinet Hardware/Cabling	X687AG
Add: 700 MHz TX only Expansion	CA00159AA Need price update
Add: 700 MHz Primary/800 MHz in the field	CA00160AA
REQUIRED: Choose one Transmitter Combiner option from the following list:	
Add: 700 MHz 2 Port Cavity Combiner	CA00161AA
Add: 700 MHz 4 Port Cavity Combiner	CA00162AA
Add: 700 MHz 6 Port Cavity Combiner	CA00163AA
The following options can be used to enhance the basic system:	
Add: Doors, cabinet, four	CA00027AA
Enh: Open cabinet space with tuned combiner port	CA00028AA

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Field Replacement Units (FRUs):	
700 MHz STR 3000 Base Radio	T6724A
Add: ASTRO 25 700 MHz Simulcast Trunking Software	CA00025AB
Add: ASTRO 25 700 MHz ISR Software	CA00158AA
Add: ASTRO 25 700 MHz P25 Limited Digital Conventional Software	CA00242AA
FRU: STR3000 EXCITER MODULE 700 MHZ	DLN6520A
FRU: STR3000 RECEIVER MODULE 700 MHZ	DLN6521A
FRU: 100W 700 MHZ LINEAR PA	DLN6522A
FRU: POWER SUPPLY BOARD	DLN1102B
FRU: SIMULCAST 4 and 6 WAY TRAY	CLF1775A
FRU: SIMULCAST 4 and 6 WAY TRAY w/TTA	CLF1776A
FRU: SIMULCAST 6 WAY TRAY EXPANSION	CLF1777A
FRU: STR 3000 CONTROL MODULE	DLN1269A
FRU: Configuration Service Software	DLN6455A

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PRELIMINARY 700 MHZ STR 3000 SPECIFICATIONS

GENERAL PERFORMANCE

Supermodel Number	SQM02SUM0011A		
Number of Channels	1-6 channels		
Number of Cabinets	1		
Cabinet Height	43 RU, 83 in. (210 cm)		
Footprint * (WxD)	24x24 in. (60 x 60 cm)		
System Weight	795 lbs (361 kg)		
Power Requirements	-48 VDC (43-60 VDC)		
Temperature Range	-30° to +60° C (-22°F to 140°F)		
EBTS thermal loading: (Preliminary)	BRs	Typ. (BTU)	Max.(BTU)
	1	1780	2160
	2	3459	3190
	3	5120	6210
	4	6830	8200
	5	8500	10220
	6	10170	12240
Power Consumption* (Preliminary)	**Typical**	**Maximum**	
	3180W	3840 W est.	
Antenna Connectors			
Transmit	7/16 Female		
Receive	N-Female		

* NOTE: The number of cabinets, footprint and system weights are stated for a 6 channel system including the RFDS without options. Some STR 3000 features require the use of additional equipment.

Preliminary

BASE RADIO	
Dimensions	8.75x19x16.5 in. (222x483x419mm)
Weight	73 lbs
Power Reqts	-48 VDC (42-60 VDC)
# of Frequencies	1
Freq Generation	Synthesized
Digital Channel Spacing	12.5 kHz
Mode of Operation	Duplex
Digital Modulation	
Transmit	Linear Simulcast Modulation, C4FM
Receive	C4FM
Antenna Connectors	
Transmit	SMA Female
Receive	SMA Female

Preliminary

TRANSMITTER	
Frequency Range	764-776 MHZ
Average Power Output (6 Ch Cavity Combiner)	
150 kHz	6W-19W per carrier
250 kHz (Preliminary)	8W-27W per carrier
Occupied Bandwidth	8.7 KHZ
RF Output Impedance	50 Ohm
Frequency Stability	External Reference
Modulation Fidelity	10% maximum error
Spurious and Harmonic Emissions Attenuation	85 dB
Symbol Rate Accuracy	10 PPM

NOTE: These specifications were taken at the sub-system (cabinet) level

Preliminary

RECEIVER	
Frequency Range	794-806 MHz
Sensitivity Static Bit Error Rate (BER) 5%	-121dBm**
Intermodulation Rejection (Per TIA methods of measurement)	80 dB
Adjacent Channel Rejection Digital Reference	60 dB
Spurious and Image Response Rejection	100 dB***
Preselector Bandwidth	30 MHz
Bit Error Rate Floor	
Signal Displacement Bandwidth	0.01%
Frequency Stability	1 kHz
Intermediate Stability	
1st	External Reference Required
2nd	73.35 MHz 450 kHz
RF Input Impedance	50 Ohm

** With Multicoupler Installed

*** 90 dB at +/- 2.1 MHz

NOTE**:** These specifications were taken at the sub-system (cabinet) level

Preliminary

TRANSMIT COMBINER SYSTEM

Transmitter Combiner	700 MHz	
Frequency Range	764-776 MHz	
Insertion Loss (includes isolator)	**Typical**	**Maximum**
2 port Cav Combiner @ 150KHz	4.0 dB	5.1 dB
2 port Cav Combiner @ 250KHz	3.0dB	3.6dB
4 port Cav Combiner @ 150KHz	4.1 dB	5.2 dB
4 port Cav Combiner @ 250KHz	3.1 dB	3.7 dB
6 port Cav Combiner @ 150KHz	4.2 dB	5.3 dB
6 port Cav Combiner @ 250KHz	3.2 dB	3.8 dB
8 port Cav Combiner @ 150KHz		
8 port Cav Combiner @ 250KHz		
10 port Cav Combiner @ 150KHz	Will provide when available	
10 port Cav Combiner @ 250KHz		
12 port Cav Combiner @ 150KHz		
12 port Cav Combiner @ 250KHz (Preliminary)		
RF Connector Type		
Input	N-Female	
Output	7/16 Female	
Tx-Tx Isolation (Preliminary)	32dB	

Note: on 700 MHz STR 3000 TX filter or diplexer is required

Preliminary

RECEIVER MULTICOUPLER

Frequency Range	794-824 MHz	
Noise Figure	**Typical**	**Maximum**
	3.5 dB	4.9 dB
Gain	**Typical**	**Minimum**
	11dB	8 dB
3rd Order Input Intercept	**Typical**	**Minimum**
	14 dBm	13 dBm
Output RF Connector Type	BNC Female	

Chapter

1

Understanding the Installation Process

This chapter provides a general mechanical installation process and some general guidelines when installing an equipment cabinet or rack.

The following topics are included in this chapter:

- "Mechanical Installation Process" on page 1-1
- "Mechanical Installation Guidelines" on page 1-3

Mechanical Installation Process

Process 1-1 provides guidelines for installing hardware components into a rack in a simulcast subsystem.

Process 1-1 Installing Hardware Components

1	Place each piece of equipment carefully in the area designated on the site plan. Verify that the equipment rack is bolted to the floor and ready for equipment installation. See "Verifying Proper Installation of the Equipment Cabinet or Rack" on page 1-5.
2	**NOTE** If your system was racked and tested by Motorola CCSI, continue with step 7.
3	Identify the rack space or Rack Unit (RU) location where the hardware component is to be mounted. **NOTE** An RU is the standard smallest rack panel height. Its standard definition is 4.45 cm (1.75 in.).
4	Locate the hardware component near the rack. **NOTE** Observe all safety precautions when lifting heavy equipment. See "Lifting STR 3000 Simulcast Base Radio Racks" on page 2-3 for more information on these precautions.
5	Lift and slide the component into the rack. See "Installing Equipment in the Equipment Cabinet or Rack" on page 1-6.
6	Attach the chassis to the rack with the recommended type and size screws or bolts.
7	Verify that all boards are properly seated into the chassis, if applicable.
8	Cable the component to the system components. For the installation of each component, see: • Chapter 3,"Installing the Prime Site (10Base-2)." • Chapter 4,"Installing the Prime Site (10Base-T)." • Chapter 5,"Installing the Digital Simulcast Remote Site (10Base-2)." • Chapter 6,"Installing the Digital Simulcast Remote Site (10Base-T)."

Mechanical Installation Guidelines

Hardware components are typically installed into a equipment cabinet or a standard 48.26 cm (19-in) rack. This section provides the following descriptions and guidelines for performing an install with the equipment cabinet:

- "Description of an Equipment Rack" on page 1-3
- "Installing Equipment in the Equipment Cabinet or Rack" on page 1-6

Description of an Equipment Rack

Figure 1-1 shows the front view of the equipment rack and identifies mounting locations for installing components. The cage nut and slide rail location numbers are determined by counting the blank hole locations (starting from the rack bottom). The callouts represent the hole numbers.

Figure 1-1 Front View of the Equipment Cabinet

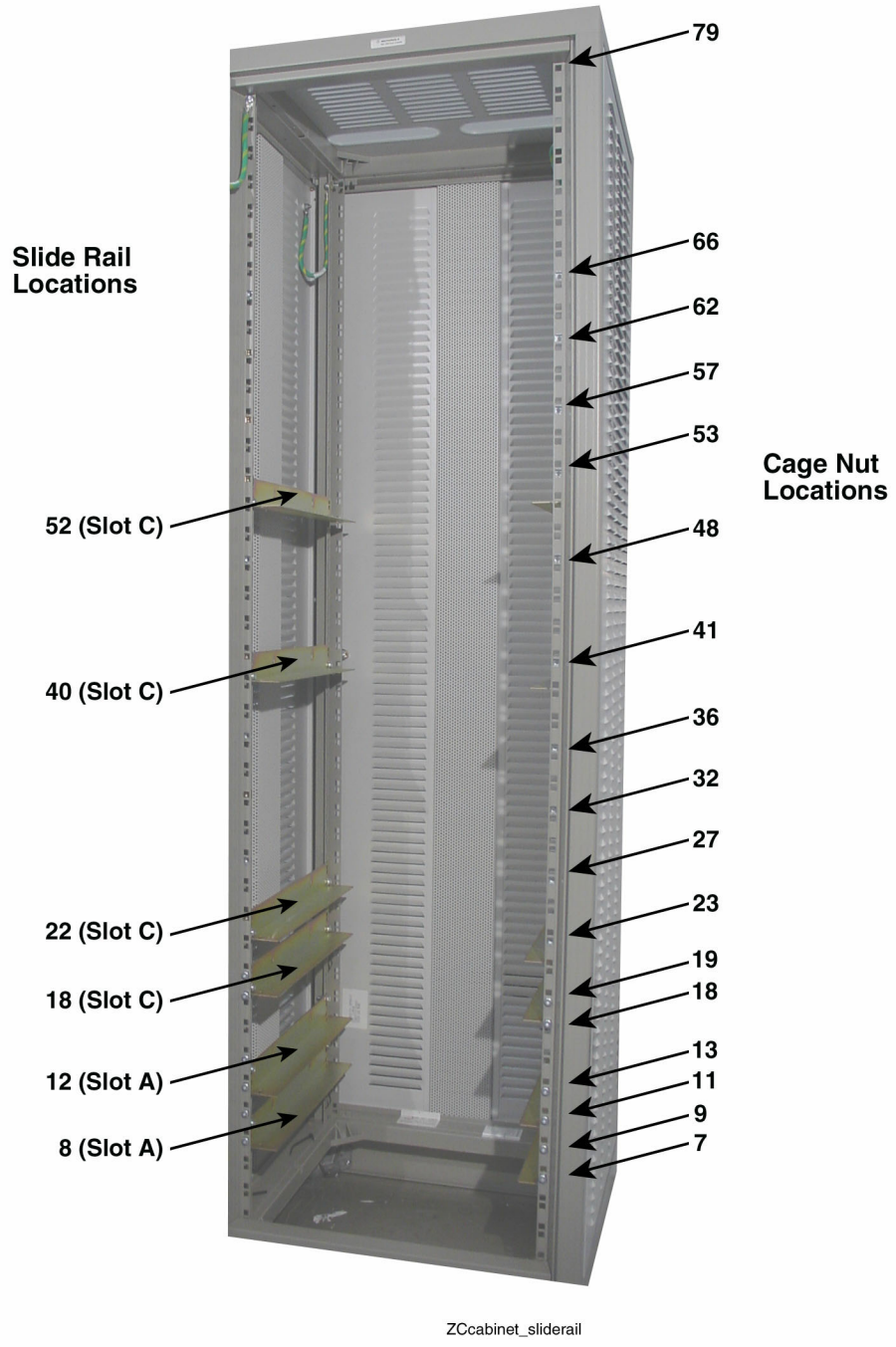
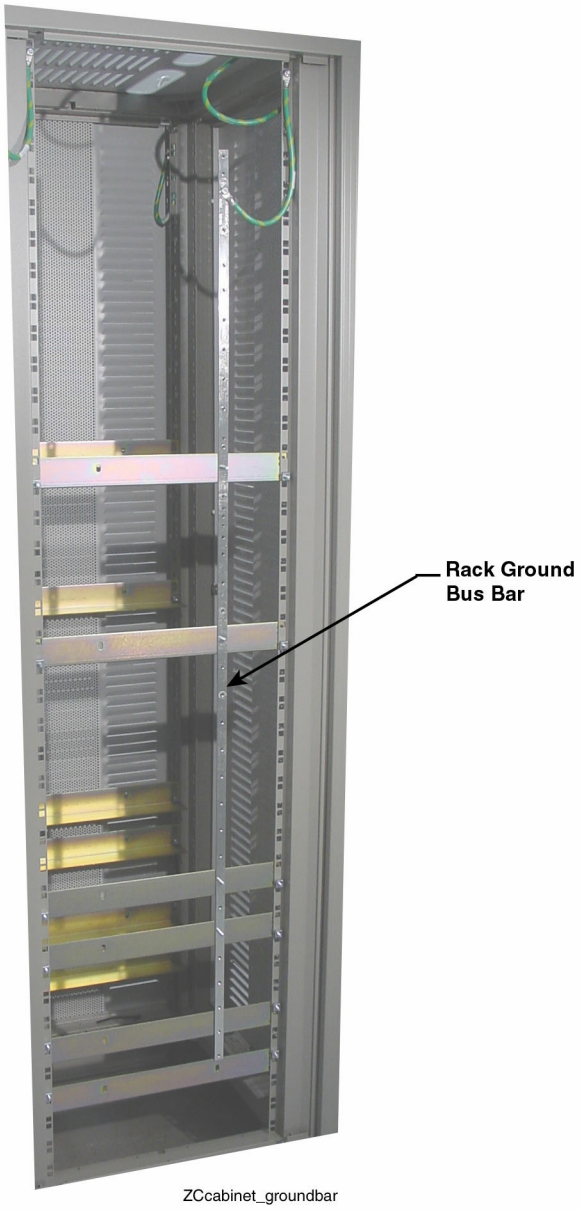


Figure 1-2 shows the Rack Ground Bus (RGB) bar in the equipment cabinet, which is used to ground the components.

Figure 1-2 Rack Ground Bus Bar in the Equipment Cabinet



Verifying Proper Installation of the Equipment Cabinet or Rack

Procedure 1-1 explains how to verify that the equipment cabinet or rack is ready for hardware component installation.

Procedure 1-1 How to Verify Proper Equipment Cabinet or Rack Installation

1	Verify that the equipment cabinet is properly bolted to the floor.
2	Verify that slide rails and cage nut screws on the left and right sides of the cabinet or rack are installed at the proper bracket hole locations, as shown for the equipment cabinet in Figure 1-1.
3	Verify that the grounding straps of all panels are security fastened to the cabinet at bracket hole 78 or 79, as shown in Figure 1-1.

Installing Equipment in the Equipment Cabinet or Rack

Procedure 1-2 explains how to install the components into the equipment cabinet or rack.

Procedure 1-2 How to Install a Component into the Equipment Cabinet or Rack

1	Remove the component from its shipping box and closely inspect it for any physical defects or damage.
2	Affix any front and rear card location decals to their proper place on the chassis.
3	Mark the bracket holes where the component will be attached.
4	Insert the component into the cabinet or rack between the marked bracket holes. **Result:** The chassis should rest on the installed slide rails near the marked bracket holes.
5	Fasten the component to the cabinet or rack using mounting screws through the marked bracket holes. **Result:** This fastens the component securely to the cabinet or rack.
6	Fasten a grounding strap between the component grounding terminal and the rack ground bus bar (RGB).
7	Attach one end of the power cable to the component and the other end to the appropriate AC outlet, or the UPS power supply (if used).

Chapter

2

Installing the Simulcast Subsystem Hardware

This chapter provides general information for installing an ASTRO® 25 digital simulcast subsystem.

The following topics are included in this chapter:

- "General Safety Precautions" on page 2-2
- "Lifting STR 3000 Simulcast Base Radio Racks" on page 2-3
- "Installation Process Overview" on page 2-6
- "Site Preparation" on page 2-7
- "General Installation Guidelines" on page 2-8
- "FCC Requirements" on page 2-14
- "Electromagnetic Safety Requirements" on page 2-14
- "List of Required Tools" on page 2-16
- "Technical Support" on page 2-18

NOTE

The Motorola Customer Center for Solution Integration (CCSI) facility stages most ASTRO® 25 simulcast systems. This staging process ensures that the system is assembled correctly and tested to meet customer specifications. Use this manual in conjunction with Motorola documentation specific to your site.

General Safety Precautions

Observe the following general safety precautions during all phases of operation, service and repair of the equipment described in this manual. The safety precautions listed below represent precautions regarding certain known hazards. Follow these warnings and all other safety precautions necessary for the safe operation of the equipment.

NOTE

The installation process requires preparation and knowledge of the site before installation begins. Review installation procedures and precautions in the *Standards and Guidelines for Communications Sites* (68P81089E50) manual before performing any site or component installation.

Also, all applicable safety procedures, such as Occupational, Safety, and Health Administration (OSHA) requirements, National Electrical Code (NEC) requirements, local code requirements, safe working practices, and good judgment must be used by personnel.

These 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.
- Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications of equipment.
- 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.
- All equipment must be properly grounded in accordance with the *Standards and Guidelines for Communications Sites* (68P81089E50) manual and specified installation instructions for safe operation.
- Slots and openings in the cabinet are provided for ventilation. These slots and openings must not be blocked or covered.
- Only a qualified technician familiar with similar electronic equipment should service equipment.
- Some equipment components can become extremely 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.
- Have personnel call in with their travel routes to help ensure their safety while traveling between remote sites.
- Establish 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.

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 would be work around high voltage sources. A second person may be required to remove power and call for emergency aid if an accident occurs to the first person.
- Use the National Institute of Occupational Safety and Health (NIOSH) lifting equation to determine whether one or two person lift is required when a system component must be removed and replaced in its rack.

Lifting STR 3000 Simulcast Base Radio Racks

Equipment racks should only be lifted without the use of lifting equipment when there are sufficient personnel available to ensure that regulations covering health and safety are not breached.

Motorola recommends the use of an appropriate powered mechanical lifting apparatus for moving and lifting the equipment racks.

In addition to these points, refer to and comply with any local regulations that govern the use of lifting equipment.

WARNING

Crush hazard could result in death, personal injury, or equipment damage. Equipment racks can weigh up to 545kg (1200 lb). Follow the instructions below for proper lifting procedures.

Lifting Equipment Racks

Lifting Equipment Racks Horizontally

In some cases, the equipment racks are laid down horizontal to facilitate the shipping process. Use the appropriate lifting apparatus to lift the racks upright to comply with all applicable health and safety regulations, and any other regulations applicable to lifting heavy equipment.

Do not use the eyenuts mounted on the top of the rack to lift the rack upright from horizontal position. The eyenuts are designed **only** to support and lift equipment in its normal vertical position.

WARNING

Crush hazard could result in death, personal injury, or equipment damage. Do not use the eyenuts mounted on the top of the rack to lift the rack upright from horizontal position. Eyelets could fail, resulting in the equipment dropping.

Lifting Equipment Racks Vertically

Each equipment rack comes with four M10 eyenuts mounted in the top of the rack. Use these eyenuts to lift the equipment rack vertically. Before using these eyenuts, visually check them and the rack hardware for any damage that may have occurred during shipping. If any damage is apparent, **do not use.** Contact Motorola for replacement parts or material.

WARNING

Do not use the eyenuts if damage is apparent. Eyenuts could fail, resulting in the equipment dropping. Contact Motorola for replacements.

Use all four eyenuts when lifting the equipment rack. When lifting from a center point, the distance from each eyenut to the lifting point must be a minimum of 1 m (40 in.) to ensure that the proper lifting angle is maintained. Using a shorter length than that specified could cause the eyenuts to fail. Figure 2-1 shows the minimum lengths and proper 45 degree lifting angles using the eyenuts.

If eyenuts are removed or become loose, install them properly before lifting the equipment rack. Tighten the eyenuts and bolt assembly by hand. Turn the bolt clockwise an additional 45 degrees. Eyenuts must be aligned to point towards the center lifting point of the cabinet and tightened to 10.2 to 13.6 Nm (90 to 120 lb-in.) of torque. Proper eyenut tightness and alignment are crucial to ensure the eyenut assembly performs to its intended lifting capacity.

Figure 2-2 shows the proper alignment of the eyenuts.

Process 2-1 Installing Equipment within a Digital Simulcast Subsystem

1	Prepare each site to comply with the Motorola requirements and specifications for the equipment, as listed in the *Standards and Guidelines for Communication Sites* (68P81089E50) manual. Other codes and guidelines that may apply to the location must also be met.
2	Inspect and inventory all racks, cabinets, cables, and other equipment with a Motorola representative to ensure that the order is complete.
3	Install all equipment using the site drawings and other documents provided by the Field Engineer. Use the installation standards and guidelines for placing and installing equipment.
4	Install all groundings for the racks and cabinets to protect against ground faults, electrical surges, and lightning in accordance with R56 standards..
5	Connect all cables within each rack and between multiple racks (where required). Connect the subsystem to the overall facility system.
6	Run a preliminary check of all sites before applying power and starting the initial software installations.

Site Preparation

Perform the activities listed in Table 2-1 to ensure proper site preparation. The table also references specific chapters in the *Standards and Guidelines for Communication Sites* (68P81089E50) manual for more information.

Table 2-1 Activities for Site Preparation

Activity	Description of Activity	Chapter Reference in the Standards and Guidelines Manual
Review the site plan.	• Prevents potential on-site and off-site interference by local trunked systems. • Minimizes cable lengths between the RF equipment. • Determines the location of telecom equipment.	Chapter 4, “Site Design and Development”
Determine site access and security.	Develop outlines of site access and security measures.	
Review safety considerations.	Develop outlines of general, installation, and environmental safety guidelines and requirements as well as OSHA related considerations.	• Chapter 2, “Safety Summary” • Chapter 5, “Communications Site Building Design and Installation”
Schedule installation of telephone service.	Ensures options and functions of on-site, two-way communications for personnel safety and maintenance.	Chapter 4, “Site Design and Development”
Review grounding specifications.	Ensures the site meets or exceeds the Compliance Audit Checklist in Appendix F as well as the Power and Grounding Checklist (sub-appendix D in Appendix C).	• Chapter 6, “External Grounding” • Chapter 7, “Internal Ground” • Chapter 8, “Power Sources” • Chapter 9, “Transient Voltage Surge Suppression”
Schedule installation of site power.	Provides grounding, power sources, and surge protection.	• Chapter 6, “External Grounding” • Chapter 7, “Internal Ground” • Chapter 8, “Power Sources” • Chapter 9, “Transient Voltage Surge Suppression”

General Installation Guidelines

This section provides several guidelines to ensure a quality install. Review these guidelines before unpacking and installing the system. Review the installation information in the *Standards and Guidelines for Communication Sites* (68P81089E50) for more details.

Equipment Inspection and Inventory

Motorola recommends that an inventory of all equipment is taken with a Motorola representative to ensure that the order is complete. Carefully inspect all equipment and accessories to verify they arrived in good condition. Promptly report any damaged or missing items to a Motorola representative.

Placement Recommendations

The following are recommendations for placing equipment at a site:

- Secure each rack on a firm, and level floor.
- Use the correct mounting hardware to prevent rack movement.
- Use strain relief when installing and positioning cables and cords to help ensure that no interruption of service occurs.
- Allow at least 1 m (3 ft.) of space at the front and rear of the system to allow for proper air flow, cooling, and safe access to equipment. The system components require an ambient air temperature of 0º C to 50º C (32º to 122º F).
- Locate the site racks and other equipment with enough spacing to allow access for service. Service personnel require access to both the front and rear of the racks.
- Locate the system in an area that is free of dust, smoke, and electrostatic discharge (ESD).
- Ground the racks according to the *Standards and Guidelines for Communication Sites* (68P81089E50).

Spacing Requirements

Proper spacing of equipment is essential for ready access to equipment, ease of maintenance, and safety of personnel. Spacing requirements have been established to meet the National Fire Protection Associations (NFPA) Code, and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards. Also, adhere to any local regulations that apply to spacing requirements.

See the *Standards and Guidelines for Communication Sites* (68P81089E50) for details on these space requirements.

Weight Distribution Within a Rack

To avoid hazards or damage from uneven loading of a rack, distribute the weight of equipment evenly in the rack, and consider the limitations of equipment and cables. When possible, mount the heaviest components in the bottom of the rack.

Rack Requirements

Most communications equipment is installed in a standard 48.26 cm (19-in.) EIA rack or enclosed cabinet. Refer to the manufacturer's instructions when installing racks or cabinets, and installing equipment into the rack or cabinet.

Use all supplied bracing hardware when installing a rack or cabinet and secure all equipment within a rack or cabinet.

If additional equipment needs to be installed, refer to the system design document provided by the Field Engineer or consult the Motorola Field Representative.

Bonding and Grounding

Cabinets and equpment racks include a rack grounding bar (RGB) with the capacity to terminate numerous solid or stranded 6 AWG copper ground wires, which are associated with internal metallic or fiber optic cables and external grounding to power company equipment.

You must ground all doors of a metal cabinet by bonding the door to the main cabinet using a 6 AWG (minimum) copper wire.

The RGB is shipped with dual-hole lugs to terminate 2 AWG ground wires. The minimum number of dual-hole attachments is system dependent and is specified by the customer. This bar provides electrical continuity between all bonds and ground wire with a current carrying capacity equal to or exceeding that of a 6 AWG copper wire.

See the *Standards and Guidelines for Communication Sites* (68P81089E50) for more information on proper bonding and ground at a site.

Power Requirements

The *Standards and Guidelines for Communication Sites* (68P81089E50) defines the guidelines and requirements for cabinets, which house equipment that requires AC power input. Some of the guidelines and requirements are as follows:

- The cabinet is designed to accept 120/240 V, single-phase power with an amperage service as required by the electronic equipment.
- Cabinets serviced by commercial power must be equipped with a nationally recognized test laboratory (NRTL) certified power distribution panel that contains a main circuit breaker or individual circuit breakers of the correct size as required for the electronic equipment or specified by the customer.
- A decal showing an electrical schematic of the power wiring must be affixed to the inside surface of the cabinet.
- All AC power equipment and electrical components must conform to National Electrical Manufacturers Association (NEMA) and National Electrical Code (NEC). These must also be listed by an NRTL.

- A surge protector, designed to protect equipment systems from surges at a 120/240 V service and load center, must be placed on the power feed ahead of all individual load center circuit breakers. This protector must be listed by an NRTL for the purpose intended.
- Selection of a surge protector is based on the susceptibility of the equipment powered by the electrical service, with margin provided for locally generated disturbances. See ANSI/IEEE C62.41 for more details.
- At least one 120 VAC, 15 A duplex convenience outlet equipped with ground fault interrupter (GFI) protection must be provided in the electronic equipment compartment.

Table 2-2 lists the required wire gauges for various installations. The "loop length" refers to the combined length of the -48 VDC (hot) lead and the DC return lead. For example, a cabinet installation that needs 16 feet of wire to reach the power supply rack has a total loop length of 32 feet. For a standard installation, the equipment cabinet is located adjacent to the power supply rack with a cable loop length less than 10.6 m (35 ft.).

Wire used for the cabinet power connection to the breaker panel shall not be less than 6 AWG. Total cable loop (from the power supply rack breakers to the STR 3000 cabinet) voltage drop shall not exceed 500 mV for the cabling of the -48 VDC (hot) lead and the DC return leads.

Some sites may require larger sizes than those noted in Table 2-2 to meet local codes. When larger cable is used to run from a power source, the cable shall be "tapped down" to a smaller size for connection to the STR 3000 breaker panel. In accordance with local code requirements, a properly sized electrical box mounted on top of the STR 3000 rack cabinet or commercial tap cover is the point where the cable size transition should take place. The site planner will specify the details of the transition.

When a "tapped down" connection is used, the total voltage drop between the "tapped down" section and the main loop should not exceed 500 mV.

The screws that connect the power cables to the power supply rack are not provided and must be locally procured. Power supply rack breaker panel screw size is 3/8-16 x 3/4.

Table 2-2 Power Connection Wire Gauge

Loop Length	Wire Gauge	Maximum Outer Diameter of Cable
15.3 m (50 ft.) or less	6 AWG	10.2 mm (0.40 in.)
15.3 to 24.4 m (50 to 80 ft.)	4 AWG	10.2 mm (0.40 in.)
24.4 to 36.6 m (80 to 120 ft.)	2 AWG	10.2 mm (0.40 in.)

Antenna Requirements

All antenna feed line installations are to be made through a metal antenna entry plate that is external to the site building. See the *Standards and Guidelines for Communication Sites* (68P81089E50) for details on the requirements for antenna feed lines.

RF Antenna at the Co-Located Site

The RF antenna provides a link between the prime and remote sites without introducing overload, desensitivity, and intermodulation at a co-located site. You may need to install a fixed attenuator to the antenna feed line at the site. The values for these attenuators can vary from site to site.

Transmit Antenna on the STR 3000 Simulcast Base Radio Rack

One transmit cavity combiner can support up to 12 base radios per transmit antenna. It is possible to combine the base radios into as few as two cabinets, if they are adjacent. To increase system reliability and eliminate a single point of failure, use a minimum of two transmit antennas per site.

GPS Requirements

A simulcast subsystem uses two Global Positioning System (GPS) antennas to provide a certain degree of redundancy in case one antenna is damaged or inadvertently shadowing. Mount the two antennas at least 3.05 m (10 ft.) apart with an unrestricted aerial view down to within 10˚ of the horizon in all directions. The antennas must also be mounted high enough to clear the peak of the site roof.

Defining the Correct View for the Location

The hemispheric location of the site also affects installation of the GPS antennas. For systems in the northern hemisphere, mount the antennas to maintain a clear view of the southern sky. For systems in the southern hemisphere, mount the antennas to maintain a clear view of the northern sky.

Avoiding Obstructions

Be careful to avoid adjacent structures (such as trees and buildings), which can obstruct the GPS antennas with their wide and solid profiles. Mount the antennas to clear these types of obstructions. However, an adjacent antenna tower that protrudes into the required view at a prime or remote site does not obstruct the view and only has a minimal effect on reception from the GPS satellite.

Isolate the GPS antennas from any RF interference by mounting the antennas at least 12˚ horizontally from other transmitting antennas.

GPS Antenna Line Loss

The maximum allowable line attenuation between the antenna and the TRAK 9100 GPS receiver is 10 dB. This 10 dB figure includes a 4 dB margin for attenuation from foliage. So, in an installation in which there is interference from foliage, allow for 6 dB line loss and 4 dB foliage attenuation. Installations in which the antenna has an unobstructed view of the sky may have a maximum line attenuation of 10 dB.

In a typical installation using 0.5-in. low density foam coaxial cable, the length of the cable run should never exceed 45.72 m (150 ft.). This is sufficient for most installations.

When considering the use of larger cables, calculate the cable lengths allowing 4.5 dB of loss at 1.5 GHz. The remaining 1.5 dB of attenuation is provided by interior site cabling and connectors.

For more information on installation of the GPS antenna, see "Installing the Global Positioning Satellite Antenna" on page 3-26.

Environmental Requirements

One of the major considerations in designing a site is how to maintain an environment in which the equipment can operate efficiently. A properly designed heating, ventilation, and air conditioning (HVAC) system provides the proper environmental conditions for the communications equipment.

Each manufacturer specifies an operating or ambient temperature for their equipment. These two terms for temperature are defined:

- **Operating temperature** refers to the temperature within the equipment case with the equipment operating at a given capacity or load.
- **Ambient temperature** refers to the environmental temperature as typically measured 152 cm (5 ft.) above the floor in the center of an adjacent aisle.

For the specific environmental requirements for the equipment in a simulcast subsystem, see:

- Chapter 3,"Installing the Prime Site (10Base-2)."
- Chapter 4,"Installing the Prime Site (10Base-T)."
- Chapter 5,"Installing the Digital Simulcast Remote Site (10Base-2)."
- Chapter 6,"Installing the Digital Simulcast Remote Site (10Base-T)."

Expansion Considerations

Expansion cabinets or racks allow equipment to be added to a site. Each type of equipment has its own specific cabinet or rack for installing additional devices. For example, install an expansion rack to add STR 3000 Simulcast Base Radios to a site in the digital simulcast subsystem.

Each expansion cabinet or rack has its own requirements for installation. Detailed information for expansions appear in "Installing the Expansion Cabinets" on page 5-10 and "Installing the Expansion Cabinets" on page 6-11.

Electrostatic Discharge

Electronic components, such as circuit boards and memory modules, can be extremely sensitive to electrostatic discharge (ESD). Motorola recommends that an antistatic wrist strap and a conductive foam pad be used when installing or upgrading the system.

If an ESD station is not available, wear an antistatic wrist strap. Wrap the strap around the wrist and attach the ground end (usually a piece of copper foil or an alligator clip) to an electrical ground. An electrical ground can be a piece of metal that literally runs into the ground (such as an unpainted metal pipe) or the metal part of a grounded electrical appliance. An appliance is grounded if it has a three-prong plug and is plugged into a three-prong grounded outlet.

NOTE

Do not use a computer as a ground, because it is not plugged in during installation.

FCC Requirements

Radio frequency (RF) transmitters installed at sites within the United States must be in compliance with the following FCC regulations:

- Only persons holding a general class commercial radio telephone operator's license or non-licensed persons working under the immediate supervision of licensed operators can make adjustments to radio transmitters.
- The power input to the final RF stage shall not exceed the maximum power specified on the current station authorization.
- The frequency of the transmitter must be checked during initial installation of the transmitter, when replacing modules, or when making adjustments that affect the carrier frequency or modulation characteristics.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If not installed properly and used in accordance with the instruction manuals, the equipment may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user is required to correct the interference.

Electromagnetic Safety Requirements

This section describes information you need to know about working near electromagnetic energy.

OSHA Related Safety Requirements

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act (OSHA) of 1970, has established an electromagnetic energy safety standard that applies to the use of this equipment. Proper use of this equipment will result in exposure below the OSHA limit.

Human Exposure Compliance for RF Energy

STR 3000 Simulcast Base Radios are designed to generate and radiate RF energy by means of an external antenna. When terminated into a non-radiating RF load, the base radio equipment is certified to comply with Federal Communications Commission (FCC) regulations pertaining to human exposure of RF radiation in accordance with the FCC Rules Part 1 section 1.1310 as published in title 47 code of federal regulations and procedures established in *TIA/EIA TSB92, Report on EME Evaluation for RF Cabinet Emissions Under FCC MPE Guidelines*.

Compliance to FCC regulations of the final installation should be assessed and take into account site specific characteristics, such as type and location of antennas, as well as site accessibility of occupational personnel (controlled environment) and general public (uncontrolled environment). This equipment should only be installed and maintained by trained technicians. Licensees of the FCC using this equipment are responsible for ensuring that its installation and operation comply with FCC regulations Part 1 section 1.1310 as published in title 47 code of federal regulations.

Whether a given installation meets FCC limits for human exposure to radio frequency radiation may depend not only on this equipment, but also on whether the “environments” being assessed are being affected by radio frequency fields from other equipment, the effects of which may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee’s equipment is being installed or even by equipment installed later. Therefore, the effect of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

FCC OET Bulletin 65 provides materials to assist in making determinations if a given facility is compliant with the human exposure to RF radiation limits. Determining the compliance of transmitter sites of various complexities may be accomplished by means of computational methods.

In general, observe the following guidelines when working in or around radio transmitter sites:

- Ensure that all personnel have electromagnetic energy awareness training.
- Ensure that all personnel entering the site are authorized.
- Obey all posted signs.
- Assume all antennas are active.
- Before working on antennas, notify owners and disable appropriate transmitters.
- Maintain minimum of 1 m (3 ft.) clearance from all antennas.
- Do not stop in front of antennas.
- Use personal RF monitors while working near antennas.
- Never operate transmitters without shields during normal operation.
- Do not operate base station antennas in equipment rooms.

Installing the STR 3000 Base Radio Rack

The STR 3000 Base Radio rack contains the RF channels and related components for a simulcast remote site.

CAUTION

The cables shipped with your system were sized for a specific racking configuration. Swapping equipment within racks or from one rack to another can put excessive strain on cables and cause cable failures. Do not install additional equipment or devices into the rack as this may have a negative effect on the thermal performance of the equipment and result in reduced safety or reliability.

Overview of the STR 3000 Base Radio Rack

The STR 3000 Base Radio is the RF portion of the 800 MHz, digital-only, simulcast remote site infrastructure. The STR 3000 rack includes from one to six base radios, multicouplers, combiner, isolator, junction panel, circuit breaker panel, and cabling in a single rack. This rack provides the transmit and receive capabilities for the remote site.

The STR 3000 rack forwards digital voice and control packets from the comparator to the transmitter and forwards digital voice and control packets from the receiver to the comparator.

Figure 5-2 shows the STR 3000 Base Radio rack with four base radios.