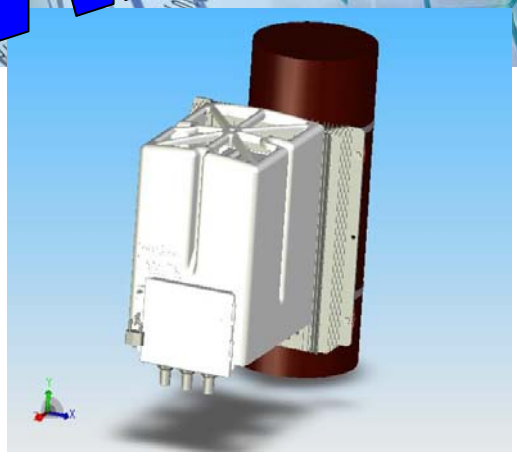
Appendix M: Manual

Please refer to the following pages for the installation manual.

OpenSky®

700 MHz
Cell Site Base Station
Model MACS-MC700

PRELIMINARY



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MA-COM

MANUAL REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
—	April 2006	Preliminary manual.

M/A-COM Technical Publications would particularly appreciate feedback on any errors found in this document and suggestions on how the document could be improved. Submit your comments and suggestions to:

Wireless Systems Business Unit
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or e-mail us at: techpubs@tycoelectronics.com

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The voice coding technology embodied in this product is protected by intellectual property rights including patent rights, copyrights, and trade secrets of Digital Voice Systems, Inc. The user of this technology is explicitly prohibited from attempting to decompile, reverse engineer, or disassemble the Object Code, or in any way convert the Object Code into human-readable form.

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NOTICE!

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitutions of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

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TABLES

1. SAFETY AND REGULATORY INFORMATION

1.1 SAFETY SYMBOL CONVENTIONS

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

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

The electrical hazard symbol indicates there is an electrical shock hazard present!

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

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

The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of **E**lectro-**S**tatic **D**ischarge. Proper precautions must be taken to prevent ESD when handling circuit modules.

1.2 MAXIMUM PERMISSIBLE EXPOSURE LIMITS

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

FAILURE TO OBSERVE THESE LIMITS MAY ALLOW ALL PERSONS WITHIN THE MPE RADIUS TO EXPERIENCE RF RADIATION ABSORPTION, WHICH EXCEEDS THE FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE) LIMIT. IT IS THE RESPONSIBILITY OF THE BASE STATION OPERATOR TO ENSURE THAT THE MAXIMUM PERMISSIBLE EXPOSURE LIMITS ARE OBSERVED AT ALL TIMES DURING BASE STATION TRANSMISSION. THE BASE STATION OPERATOR MUST ENSURE NO BYSTANDERS ARE WITHIN THE MPE RADIUS LIMITS WHEN THE STATION IS TRANSMITTING.

1.3 DETERMINING MPE RADIUS

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

1.4 SAFETY TRAINING INFORMATION

THIS BASE STATION GENERATES RADIO FREQUENCY (RF) ELECTRO-MAGNETIC ENERGY WHEN IT IS TRANSMITTING. THIS BASE STATION IS DESIGNED FOR AND CLASSIFIED AS "OCCUPATIONAL USE ONLY," MEANING IT MUST BE USED ONLY IN THE COURSE OF EMPLOYMENT BY INDIVIDUALS AWARE OF THE HAZARDS AND THE WAYS TO MINIMIZE SUCH HAZARDS. THIS BASE STATION IS NOT INTENDED FOR USE BY THE "GENERAL POPULATION" IN AN UNCONTROLLED ENVIRONMENT. IT IS THE RESPONSIBILITY OF THE BASE STATION OPERATOR TO ENSURE THE MAXIMUM PERMISSIBLE EXPOSURE LIMITS ARE OBSERVED AT ALL TIMES DURING STATION TRANSMISSIONS. THE BASE STATION OPERATOR IS TO ENSURE THAT NO BYSTANDERS COME WITHIN THE RADIUS OF THE MAXIMUM PERMISSIBLE EXPOSURE LIMITS.

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

- **FCC OET Bulletin 65 Edition 97-01 Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.**

- **American National Standards Institute (C95.1 – 1992), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.**
- **American National Standards Institute (C95.3 – 1992), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.**

TO ENSURE HUMAN EXPOSURE TO RF ELECTROMAGNETIC ENERGY IS WITHIN THE FCC ALLOWABLE LIMITS FOR OCCUPATIONAL USE, **DO NOT** OPERATE THE BASE STATION IN A MANNER THAT WOULD CREATE AN MPE RADIUS IN EXCESS OF THAT ALLOWED BY THE FCC.

Changes or modifications not expressly approved by M/A-COM Inc. could void the user's authority to operate the equipment.

1.5 IMPORTANT SAFETY INFORMATION

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. M/A-COM® Inc. assumes no liability for the customer's failure to comply with these standards.

SAVE THIS MANUAL — It contains important safety, installation, and operating instructions.

1. **BEFORE USING THIS EQUIPMENT**, please follow and adhere to all warnings, safety and operating instructions located on the product and in this manual.
2. **GROUNDING AND POWER CONNECTION** — To reduce risk of electrical shock and to minimize exposure to radio frequency (RF) energy, connect the equipment to a properly grounded power source and site ground point as described in this manual.
3. **MAXIMUM PERMISSIBLE RF EXPOSURE LIMITS** —This equipment generates and uses RF energy. Any changes or modifications to this equipment not expressly approved by M/A-COM may cause harmful interference and could void the user's authority to operate the equipment.
4. **ELECTROSTATIC DISCHARGE SENSITIVE COMPONENTS** — This equipment contains electronic components that may be damaged by electrostatic discharge. Proper precaution must be taken when handling circuit modules. As a minimum, grounded wrist straps should be used at all times when handling circuit modules.
5. Care should be taken so objects do not fall onto or liquids do not spill into the interior of the equipment.
6. **DO NOT** connect auxiliary equipment not recommended or sold by M/A-COM. To do so may result in the risk of fire, electric shock or injury to persons.
7. **DO NOT** attempt to operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

8. To reduce risk of electric shock, isolate the unit and disconnect electrical power before attempting any maintenance or interior cleaning.

9. Use only fuses of the correct type, voltage rating and current rating as specified in the parts list. Failure to do so can result in fire hazard.

2. SPECIFICATIONS

2.1 GENERAL

Dimensions, Less Mounting Bracket: 21.5 x 18 x 22 inches (546 x 457 x 559 millimeters)
(Height x Width x Depth)

Weight, Less Mounting Bracket
Packed for Shipment: < 100 pounds (45 kilograms)
Unpacked: < 90 pounds (40 kilograms)

Operating Temperature Range: -22 to +122° Fahrenheit (-30 to +50° Celsius)

Storage Temperature Range: -40 to +158° Fahrenheit (-40 to +70° Celsius)

Humidity: 95% maximum relative humidity @ 122° F (50° C)

Altitude:
Operating: 15,000 feet (4572 meters) maximum
Non-Operating: 30,000 feet (9144 meters) maximum

DC Supply Voltage
Nominal Operating Input Voltage: 27 Vdc (negative ground system)
Acceptable Input Voltage Range: 21 to 27.75 Vdc (for full specifications)
Maximum Input Ripple Voltage: 200 millivolts peak-to-peak at 7 amps

DC Supply Current:
700 MHz Base Station Only: 6.75 amps maximum at 27 Vdc
700 MHz Base Station & T1/FT1 Router: 7.0 amps maximum at 27 Vdc

AC Supply/Charger Volts/Amps: (See SkyCharger documentation)

2.2 700 MHZ TRANSCEIVER

2.2.1 General

Frequency Ranges
Transmit (Narrowband Channels Only): 764 to 767 MHz and 773 to 776 MHz
Receive (Narrowband Channels Only): 794 to 797 MHz and 803 to 806 MHz

RF Channel Bandwidth: 25 kHz

RF Channel Available Step Size: 6.25 kHz

RF Transmit-to-Receive Frequency Offset: 30 MHz (typical)

Modulation Type: 4-Level GFSK[1] (9600 sym./sec. for 19.2 kbps/channel)

Data Communications Mode: Full-Duplex

Voice Communications Mode: Half-Duplex (per voice path)

Reference Oscillator Stability: 0.1 ppm

Antenna Ports' Impedances: 50 ohms

Digital Data Transmission/Reception
Aggregate Forward Channel Rate: 19.2 kbps
Aggregate Reverse Channel Rate: 2 x 9.6 kbps (2 time slots)

Voice/Data DSP[2] Compression Technique: Advanced Multi-Band Excitation (AMBE™)

Compressed Voice Relative Data Rate: 2400 bps

2.2.2 Transmitter

Output Power at Tx Antenna Port
With Duplex Antenna Option: 3 to 25 watts (35 to 44 dBm)
With Simplex Antenna Option: 3 to 31.5 watts (35 to 45 dBm)

Duty Cycle Rating: Continuous (100%) at 25 watts

FM Hum and Noise: > 37 dB per TIA-603 test method

Adjacent Channel Power Ratio (ACPR): Per FCC Part 90.543

2.2.3 Receiver

Sensitivity: -111 dBm minimum for 1% Block Error Rate

Intermodulation Rejection: > 85 dB per TIA-603 test method

Adjacent Channel Rejection: > 80 dB per TIA-603 test method

Spurious Response Rejection: > 90 dB per TIA-603 test method

Conducted Spurious Emission: No spurious emissions from antenna output ports exceeding -57 dBm (FCC Part 15)

2.2.4 Regulatory

FCC Type Acceptance ID Number: BV8CS700

Applicable FCC Rules: Part 90 and Part 15

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[1] Gaussian Frequency-Shift Keying (GFSK) is a modulation format that employs Gaussian filters for spectral efficiency, and carrier frequency-shift modulation techniques.

[2] Digital Signal Processing/Processor (DSP)

Industry Canada Certification Number: 3670A-CS700

2.3 SITE-TO-SITE (BACKHAUL) COMMUNICATIONS

2.3.1 T1/FT1 Frame-Relay Router Option MACS-NDF1Y

Protocol Utilized: RFC 1490 encapsulation (multi-protocol over frame relay)

LMI Type: LMI, ANSI (Annex D), CCITT (Annex A) and static

Data Throughput Rate: 64 kbps to approximately 1.5 Mbps

BSC-to-Router Communication Link

Local Area Network (LAN) Interface: 10/100-Base-T Ethernet (10/100 Mbps)

LAN Port Connections: RJ-45 modular jacks provided on internal side of Customer Interface Board; surge-protected interface

T1 Line Connection Port: RJ-45 modular jack provided on external side of Customer Interface Board; surge-protected interface

Applicable FCC Rules: Part 68

Industry Canada Certification Number: CS03

2.3.2 56 Kbps DDS Modem Router Option MACS-NDF1Z

Protocol: Synchronous Digital Data Service (DDS)

Data Throughput Rate: 56 kbps maximum

BSC-to-Router Communication Link

Local Area Network (LAN) Interface: 10/100-Base-T Ethernet (10/100 Mbps)

LAN Port Connections: RJ-45 modular jacks provided on internal side of Customer Interface Board; surge-protected interface

Telco Line Connection Port: RJ-45 modular jack provided on external side of Customer Interface Board; surge-protected interface

Dial Backup (DBU) Port: RJ-45 modular jack provided on external side of Customer Interface Board; surge-protected interface

Applicable FCC Rules: Part 68

3. INTRODUCTION

3.1 ABOUT THIS MANUAL

This manual contains installation instructions, configuration and test procedures for the OpenSky® 700 MHz Cell Site base station equipment. It is intended for use by M/A-COM and/or M/A-COM-contracted personnel responsible for supervising or conducting the equipment installation process. Before attempting to install or test this equipment, familiarity with the contents of this manual is recommended. This manual is divided into the following sections:

1. **SAFETY AND REGULATORY INFORMATION** — This section includes safety information which must be observed at all times!

2. **SPECIFICATIONS** — This section includes general specifications for the equipment.

3. **INTRODUCTION** — This section introduces the reader to the contents of this manual, provides a brief overview of the equipment, and includes a list of related documentation. It also includes lists of recommended tools and test equipment.

4. **SITE PREPARATION** — This section includes general antenna system installation information and general facility requirements such as AC/DC electrical power requirements. It also includes instructions for unpacking the base station equipment upon receipt.

5. **MECHANICAL INSTALLATION** — This section includes cabinet mechanical installation instructions. Instructions for pole-mount, tower-mount, and in-building installations is included.

6. **ELECTRICAL INSTALLATION** — This section includes electrical installation instructions such as antenna connections, AC/DC electrical power connections, and backhaul link connections.

7. **POWER-UP PROCEDURE** — The recommended power-up procedure is included in this section.

8. **CONFIGURATION** — This section provides instructions for setting-up the equipment for operations on an OpenSky radio network.

3.2 GENERAL INFORMATION

M/A-COM's OpenSky® 700 MHz Cell Site base station is a stand-alone fully-digital trunked base station for 700 MHz OpenSky trunked radio networks. Housed in a compact and easy-to-install weather-resistant cabinet, it can be pole mounted, tower mounted or wall mounted. The Cell Site base station requires a co-located continuous-duty 24-volt DC power source, a 700 MHz antenna system, and site-to-site backhaul communication equipment to link it to the high-power SkyMASTR base station/tower site.

OpenSky employs Time-Division Multiple-Access (TDMA) digital modulation technology. TDMA allows multiple users to share a single RF channel. Each channel can support simultaneous digital voice and data communications, in either a 2-slot or 4-slot format.

The Cell Site base station operates in the OpenSky Trunking Protocol (OTP) mode on a single 25 kHz wide 700 MHz RF channel. A key advantage of OTP mode is its internet protocol (IP) based communication capability. The station has a RF transmit output power range that is configurable between 15 and 37 watts (35 to 45.7 dBm), with a 25-watt continuous-duty rating.

The Cell Site base station complements the wide area coverage of a high-power SkyMASTR base station/tower site by providing a cost-effective RF coverage solution for problem areas. It provides consistent RF coverage to low-traffic areas that require only a single (2-slot or 4-slot TDMA) channel for voice and data communications. Cell Site base stations are typically employed in areas that are problem coverage areas for the respective high-power tower site(s). In other words, those areas hard-to-reach from an RF standpoint via the high-power tower site(s) due to difficult terrain or other geographic or man-made RF obstructions. In essence, a Cell Site base station is an extension of a high-power tower site's network of OpenSky base stations. A Cell Site base station can typically be deployed for one-tenth the cost of a tower site with an equipment shelter.

NOTE

OpenSky system software up to release 4 utilizes 2-slot TDMA technology.

OpenSky system software release 5 and later utilizes 4-slot TDMA technology.

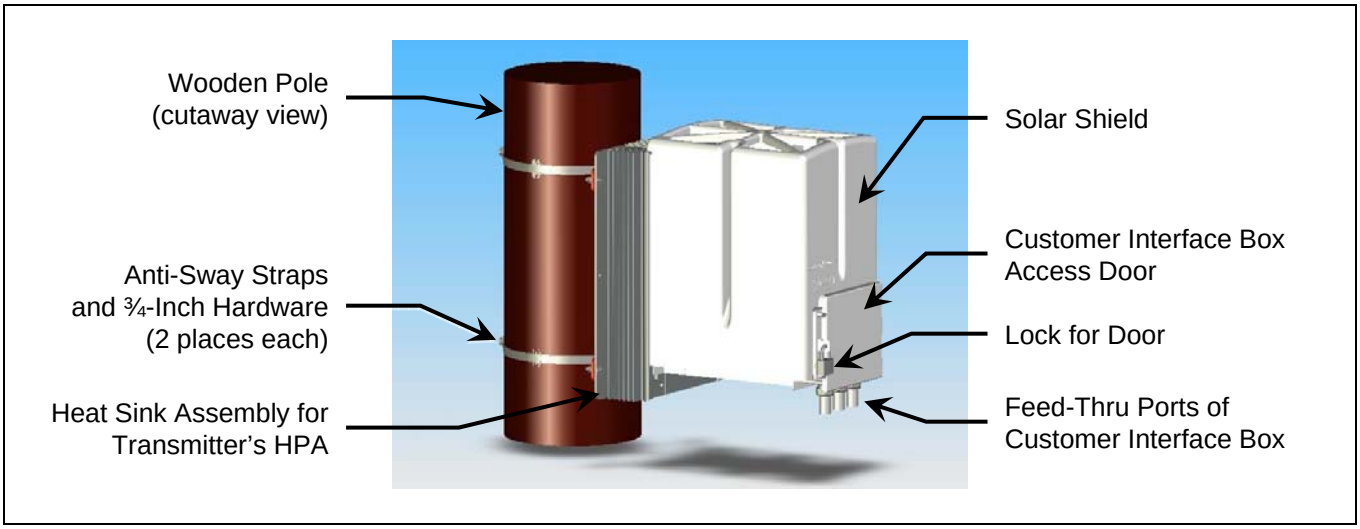

Figure 3-1: Cell Site Base Station — Mounted on a 12-Inch Diameter Wooden Pole (Cabling Not Shown)

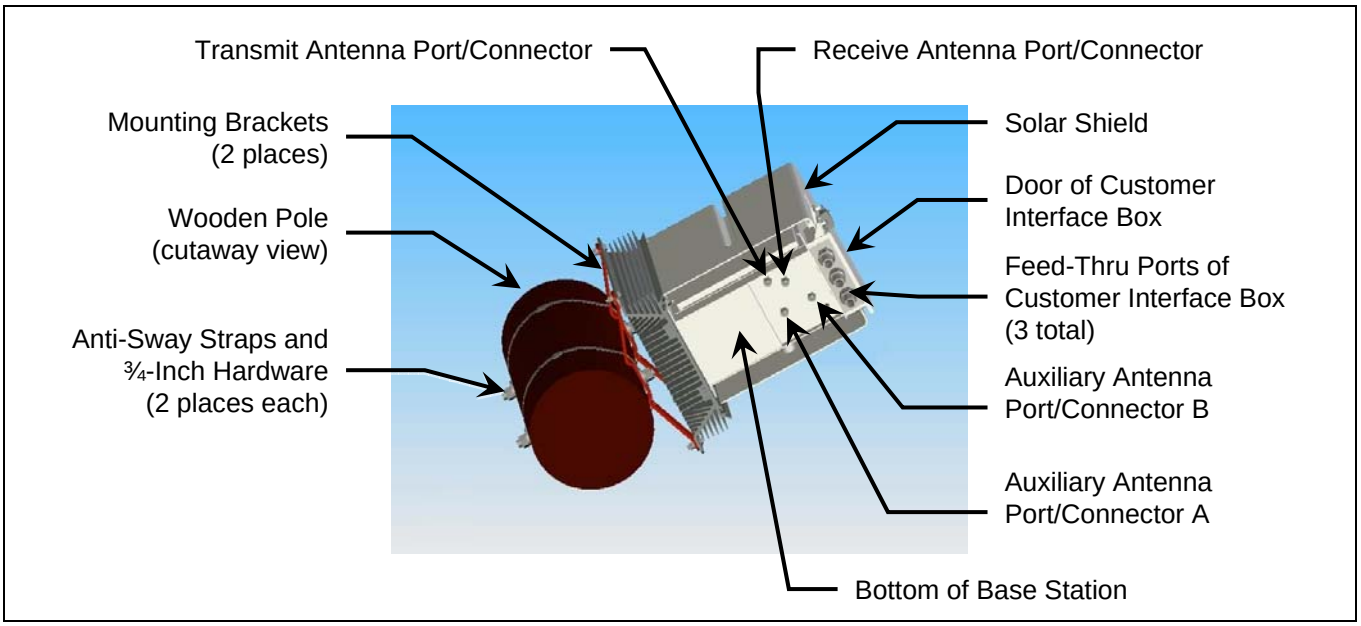

Figure 3-2: Cell Site Base Station — Bottom View (Cabling Not Shown)

Each Cell Site base station in an OpenSky trunked radio network is assigned to a SkyMASTR base station/tower site within the trunked radio network. The Cell Site base station gains network connectivity via a site-to-site backhaul communication link between itself and the main station/tower site. This is accomplished using IP-based protocols over either a T1/Fractional T1 (FT1) frame-relay landline link, or a 56 kbps Digital Data Service (DDS) landline modem link.

T1/FT1 frame-relay and DDS modem landline links are implemented via a router installed inside the base station cabinet. For a T1/FT1 site-to-site communication link, the router is equipped with a T1/FT1 frame-relay option. For a DDS site-to-site communication link, the router is equipped with a DDS modem option.

In an OpenSky trunked radio network, each SkyMASTR base station/tower site is assigned a block of Class C internet protocol (IP) addresses. From these addresses, one address is used for the site-to-site backhaul communication link.

Site-specific configuration parameters such as site ID, channel ID and site IP address, MDIS IP address, VNIC IP address, etc. are typically loaded into the Cell Site's Base Station Controller (BSC) before the equipment ships from the factory. The BSC is a part of the station's Digital Controller/Transceiver (DCX) which is located inside the Cell Site base station cabinet.

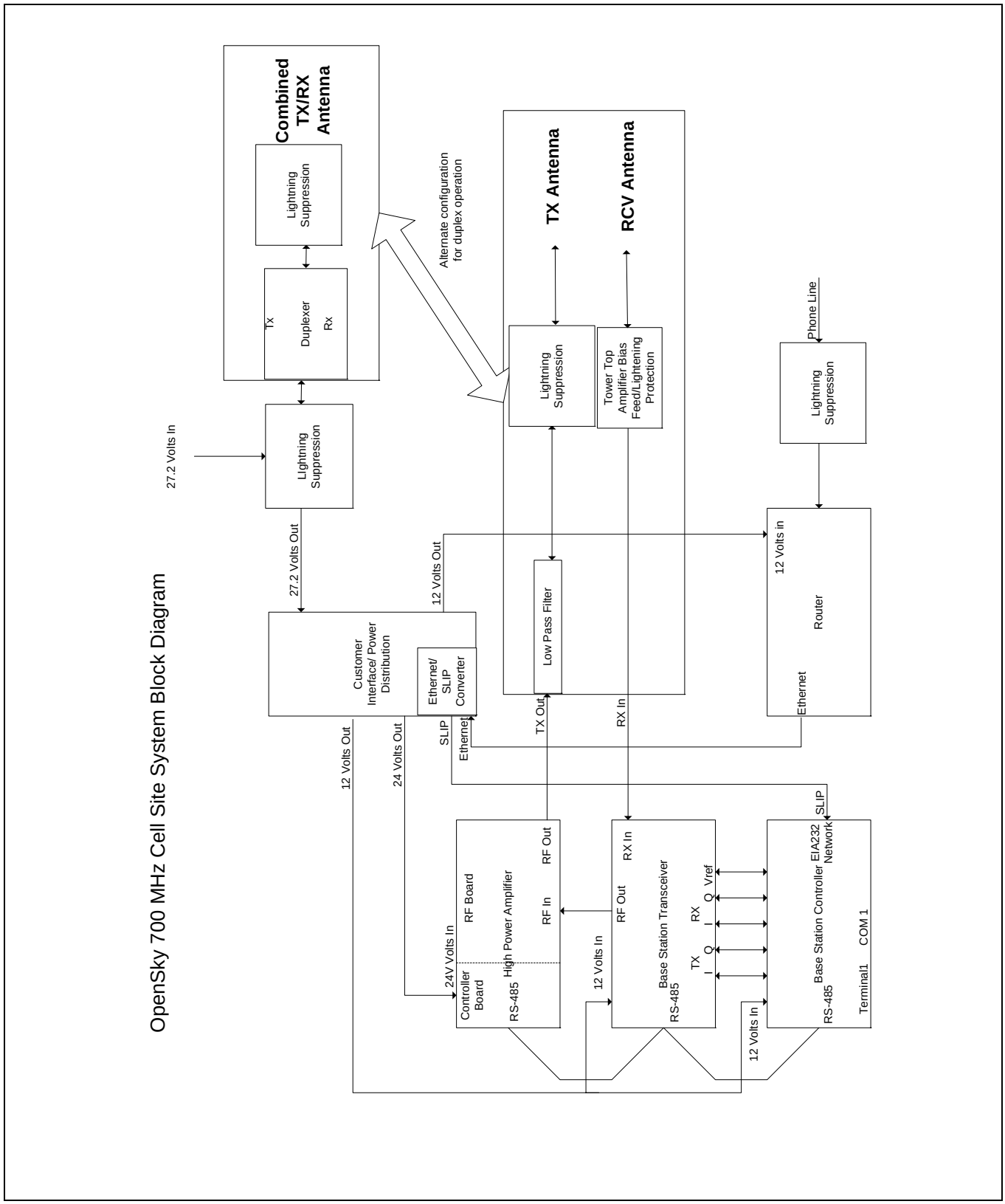

Figure 3-3: Cell Site Base Station — System Block Diagram

3.3 EQUIPMENT MODEL AND PART NUMBERS

Model and part numbers for this equipment and the related options are listed in the follow table:

Table 3-1: 700 MHz Cell Site Base Station Equipment Model and Part Numbers (Major Assemblies and Options Only)

ASSEMBLY DESCRIPTION	MODEL/PART NUMBER	
OpenSky 700 MHz Cell Site Base Station; Includes:	MACS-MC700	
• 700 MHz DCX; Includes:	IA-008104-001	
• Base Station Controller (BSC) Board Assembly (Does not include enclosure)	BG01049	
• BSC Enclosure (Does not include board assembly)	FM-008100	
• 700 MHz Base Station Transceiver (BSX) Board Assembly (Does not include enclosure)	1000011224	
• BSX Enclosure (Does not include board assembly)	FM-008102	
• 700 MHz 40-Watt HPA & Controller; Includes:	1000022909-0001	
• 700 MHz 40-Watt HPA	1000022937-0001	
• HPA Digital Controller	CB-008852	
• Customer Interface Board	1000023295-0001	
Kit, Heat Sink & Solar Shield Pole-Mount	MACS-NCK1G	
Option, Wooden Pole-Mount Kit	MACS-NMA6D	
Option, Metal Pole-Mount Kit	MACS-NMA6E	
Option, 700 MHz Simplex Antenna	MACS-NDU1W	
Option, 700 MHz Duplex Antenna	MACS-NDU1X	
Option, T1/FT1 Router	MACS-NDF1Y	
Option, 56 kbps DDS Modem Router with DSU and DBU Connectivity	MACS NDF1Z	
Option, SkyCharger Battery Backup System	MACBOS0003	

4. RECOMMENDED TOOLS, TEST EQUIPMENT AND SOFTWARE

Lists of recommended tools, test equipment, and programming software are included in the tables in this section. Other test equipment may be substituted providing it is equivalent in accuracy and performance to the listed test equipment.

Table 4-1: Recommended Tools

DESCRIPTION	USE/COMMENTS
½-Inch Drive Racket	Used with below listed socket
½-Inch Drive, 1-¼-Inch Socket	Needed only for wooded pole installations.
1-¼-Inch Wrench	Needed only for wooded pole installations.
3/8-Inch Drive Racket	Used with below listed socket
3/8-Inch Drive, 1/2-Inch Socket	For securing ground to bus bar
12-Inch Nylon Wire Ties	General cable/wire securing.
Assorted Hand Tools	As needed for cabinet installation
Tape Measure, 25-Foot	For making general distance measurements.
2 or 4-Foot Bubble Level and/or Electronic Laser Level	For marking reference lines on mounting surfaces and verifying mounted components are level.
Drill with ½-inch Chuck	For drilling holes in pole, etc.
Heavy-Duty (Industrial-Type) Drill with 1-inch Chuck	Needed for wooden pole installations. Used for drilling 7/8-inch holes in the pole.
7/8-Inch Drill Bit	Needed for wooden pole installations. Used for drilling 7/8-inch holes in the pole.
Set of Standard Drill Bits	For drilling holes in pole, etc.
Set of Masonry Drill Bits	Needed if the base station is mounted to a concrete or cinder block wall.
Center Punch	Used to punch hole centers prior to drilling holes.
Ground Cable (6 AWG green)	For grounding equipment cabinets
Crimp-On 1-hole lugs	For attaching cabinet ground cables to grounded surface
Crimp-On 2-hole lugs	For attaching cabinet ground cables to grounded surface
Crimpers	For crimping lugs to ground wire and power leads
Crowbar	For opening shipping crates
Equipment Cart with 1,200 pound minimum lift capacity	For moving equipment cabinets

Table 4-1: Recommended Tools

DESCRIPTION	USE/COMMENTS
Heat Gun	For shrink tubing with control cable connector
Knife or Shears	For cutting strapping around cabinet packaging
Labeling System	Recommended Type: P-Touch Labeling System, Model PT-330
Denatured Alcohol	For cleaning heat transfer surfaces prior to applying heat transfer compound.
Heat Transfer Compound	Used between base station cabinet and Heat Sink Assembly.
Soft-Jaw Connector Pliers	For tightening and loosening N-type connectors. Recommended Type: M/A-COM Part Number 529-10 or Tessco Part Number 83040
Soldering Gun	For soldering leads of control cable connector
T1 Crimper	Recommended Type: AMP Hand Tool Part Number 2-231652-0

Table 4-2: Recommended Test Equipment and Programming Software

DESCRIPTION	MODEL/PART NUMBER	USE
RF Communication Test Set (Service Monitor)	Agilent ESG-D with option UND (or equivalent) with cables	RF signal source for test and alignment.
RF Power Meter	Agilent 437 with 8481H power sensor	Used for measuring RF power levels.
50-Ohm RF Load(s)	Bird 8135	Test and alignment.
True-RMS Digital Multimeter (DMM)	Fluke 87-Series	Test and alignment.
OpenSky Portable Radios	M/A-COM P801 or P7200 Series (Use customer's radios if available)[3]	Test and alignment.
Personal Computer (PC)	(laptop-type recommended; see Table 4-3 for minimum requirements)	Test and alignment.

Table 4-3: Personal Computer Minimum Requirements (PC Used for Local Configuration and Testing)

PARAMETER	WINDOWS® NT 4.0 (Service Pack 4)	WINDOWS 2000	WINDOWS XP
Processor Speed:	Pentium II 90 MHz	Pentium II 133 MHz	Pentium II 233 MHz
RAM:	128 Megabytes	128 Megabytes	128 Megabytes
Hard Drive Free Space:	160 Megabytes	160 Megabytes	160 Megabytes
Other Drives:	CD-ROM	CD-ROM	CD-ROM
Ports:	1 Serial or Ethernet	1 Serial or Ethernet	1 Serial or Ethernet
Microsoft Internet Explorer:	Version 5.01 or higher	Version 5.01 or higher	Version 5.01 or higher
Network:	LAN	LAN	LAN

[3] If the system supports digital encryption, radios capable of the same digital voice mode are required. For example, if 128-bit AES encryption is utilized in the system, radios capable of 128-bit AES encryption are required for complete testing.

5. SITE PREPARATION

5.1 BEFORE BEGINNING THE INSTALLATION

Before beginning an installation, collect information from the Site Deployment Order (SDO) specific to the site access such as:

- Permission to access the site.
- Important contact names and telephone numbers.
- Location of and directions to the site.
- Keys and/or lock combinations to access the site and equipment shelter (if any), or points of contact to obtain them.
- Site entry alarm system pass-codes and/or disable keys.
- Information about work practices needed to work safely at the site.

Other important information that may or may not be included on the SDO includes:

- Type of mounting—metal pole, wooden pole, tower base, exterior wall, etc.
- Drawing or description of each site showing how the equipment is to be installed.
- Applicable inspections completed (pole installation, electrical, local build code, etc.)

Keep the working environment clean!
Control dust, dirt, and shavings for safety, and to protect the equipment.
Be sure to follow installation procedures carefully!

5.2 POLE-MOUNT INSTALLATIONS

Contact a local utility company and arrange for installation of the required pole type. Refer to the Site Deployment Order (SDO) and other applicable site installation information as necessary. Typically, a 60- or 70-foot tall 12-inch diameter pole is employed, with at least 10 feet of the pole buried in the ground.

5.3 ELECTRICAL POWER

5.3.1 AC Power

A Cell Site base station site equipped with a SkyCharger battery backup system requires 100-amp AC electrical service:

- Contact the local electrical utility company and arrange for installation of 100-amp electrical service at the site (to the pole/pad/wall/etc.) Either over-head or under-ground service may be used; however, under-ground service is recommended for improved safety. If over-head service is used, it can be either 100 or 200-amp rated to the base of the power meter. However, if under-ground service is used, it must be 200-amp rated (minimum) to the base of the power meter.

- The installed power meter must be rated at 200 amps minimum. For pole-mount installations, the meter is normally installed 90 degrees from the Cell Site base station cabinet, and 90 degrees from the SkyCharger battery backup system cabinet. When facing the pole with the Cell Site cabinet on the left and the SkyCharger cabinet on the right, the power meter is located on the far side of the pole. Power meter egress conduit type, size and related wiring should meet all local building codes.
- An AC circuit breaker box must be installed. Typically, a 6-breaker load center box is used. For pole-mount installations, the breaker box is normally installed on the pole 180 degrees from the power meter. In other words, when facing the pole with the Cell Site cabinet on the left and the SkyCharger cabinet on the right, the circuit breaker box is located on the near side of the pole. All breaker box egress conduit and related wiring should meet all local building codes. Typically, ¾-inch GRS-type conduit is employed.
- A 20-amp Ground Fault Interrupt (GFI) duplex AC receptacle box should be installed just under or beside the AC circuit breaker box. This receptacle is for auxiliary use by installation and service personnel. It should be connected to an independent breaker located in the AC circuit breaker box. This breaker should remain in the OFF position when installation/service personnel are not using it. Box installation, conduit and wiring servicing this box should meet all local building codes. Typically, ¾-inch GRS-type conduit is employed.

All AC circuit breakers for site equipment must remain OFF during equipment installation. The circuit breaker for the auxiliary duplex AC receptacle (if any) can remain on as needed by installation and service personnel.

AC power installation methods must conform to all applicable local installation regulations and/or local building codes, including but not limited to the utilization of the proper AC receptacle and circuit breaker combination.

If the SkyCharger battery backup system is not used, refer to the sections 5.3.3 and 5.3.4 for additional information.

5.3.2 Generator Power

Some systems require emergency generators with automatic switchover systems. The generators must be connected to the external site grounding system and should be located in an outdoor location. There should only be one neutral/ground bond at the site per NEC code. Automatic switchover systems must be disabled during installation.

5.3.3 DC Power

The Cell Site base station requires a 27-volt (nominal) DC power source. This source must have a continuous-duty current rating of at least 10 amps, with a ripple of less than 200 mV peak-to-peak at 7 amps, or 250 mV peak-to-peak at 10 amps. Refer to the specifications section on page 9 for additional information.

Typically, the SkyCharger battery backup system is employed to supply DC power to the Cell Site base station, both during normal operating periods and on a temporary backup basis when the site loses AC power. Battery hold-up time may be specified in the equipment contract and/or on the SDO. Refer to the SkyCharger installation manual (MM20963) included with this manual set.

Like AC power installations methods, a DC power installation methods must conform to all applicable local installation regulations and/or local building codes.

5.3.4 If the SkyCharger Battery Backup Power System is Not Used

Some systems require battery backup power connected to the supply system in case of an AC power failure. Preferably, the battery bank should be in a room separate from the radio equipment. If located in the same room as the radio equipment, the battery bank should be at a point furthest from the equipment room entrance/door. In either case, it should have a separate fume extraction system or it should be located directly below the air extraction system for the site.

If the SkyCharger battery backup system is not employed, consult the site's SDO and/or the respective vendor's DC power supply system installation instructions for additional information or special instructions that may apply. In any case, as previously stated, the DC supply system powering the Cell Site cabinet must have a 10-amp (minimum) continuous-duty current rating. Battery hold-up time may be specified in the equipment contract and/or on the SDO.

NEVER locate batteries near the air intake(s) of an air conditioning or air circulation system!

Always minimize the risk of contact between lead-acid batteries and aluminum alloys!

5.4 GROUNDING THE EQUIPMENT

Ensure all equipment and facilities meet the requirements for grounding and lightning protection. *Site Grounding and Lightning Protection Guidelines* manual AE/LZT 123 4618/1 provides proper grounding procedures. These guidelines must be observed in order to protect the equipment and service personnel from lightning and other sources of electrical surges. See section 7.1 in this manual for additional information.

Proper grounding also ensures the MPE radius of the radio frequency (RF) antenna is maintained. The MPE radius is the minimum distance from the antenna axis that ALL persons should maintain in order to avoid RF exposure higher than the allowable MPE level set by the FCC. Refer to section 1 which begins on page 5 for additional information.

5.5 ANTENNA SYSTEM

This section is an overview of the antenna system installation. It includes general antenna installation guidelines and installation information for the respective antenna RF coaxial cables.

Antenna systems are generally installed by crews specially-trained and equipped for working on antenna towers and/or pole-type installations. As a result, this manual assumes skilled personnel of this type will be working on the towers/poles, and installing the antennas and antenna cables. However, it may be necessary for the system installer to provide information and directions to the crew, and to verify proper installation.

5.5.1 Antenna Mounting

5.5.1.1 Simplex Antennas

If the installation utilizes simplex antennas (i.e., separate transmit and receive antennas), the Cell Site base station must be equipped with M/A-COM option MACS-NDU1W. With simplex antennas, antenna installation/mounting locations must provide least 25 dB of isolation between the TX and RX antennas. This is necessary to avoid interference in the receiver caused by the transmitter. An isolation of greater than 25 dB is easily obtained by mounting the transmit antenna at least ten (10) feet above the receive antenna.

5.5.1.2 Duplex Antenna

If the installation utilizes a duplex antenna system (i.e., one antenna for both transmit and receive), the Cell Site base station must be equipped with M/A-COM option MACS-NDU1X. In installations of this type, the respective antenna is normally mounted at the top of the pole.

5.5.2 RF Coaxial Cables

When installing antenna RF coaxial cables, refer to the applicable antenna assembly drawing(s) shown in *Antenna Systems* manual LBI-38983, which is included with this set of manuals.

5.5.2.1 Cable Length

The length of the main coaxial cable for each antenna should be a continuous run with no connectors or splices. Smaller diameter, more flexible coaxial cable is typically used at cabinet end of the main coaxial cable to facilitate cable connection and disconnection, formation of drip loops, etc.

5.5.2.2 Cable Minimum-Bend Radius

Always adhere to the cable manufacturer's minimum-bend radius specification. For Andrew cable, the values are listed in the following table. For another cable brand, consult the respective manufacture's recommendations.

Table 5-1: Minimum-Bend Radius for Andrew HELIAX® 50-Ohm Foam Dielectric Coax Cable

CABLE SIZE	TYPE	ANDREW PART NUMBER	MINIMUM-BEND RADIUS
1/4-inch	Super-flexible	FSJ1-50A	1 inch (25 mm)
3/8-inch	Super-flexible	FSJ2-50	1 inch (25 mm)
1/2-inch	Super-flexible	FSJ4-50B	1.25 inches (32 mm)
1/2-inch	Hard-line	LDF4-50A	5.0 inches (125 mm)
7/8-inch	Hard-line	LDF5-50A	10 inches (250 mm)
1-1/4-inch	Hard-line	LDF6-50	15 inches (380 mm)
1-5/8-inch	Hard-line	LDF7-50A	20 inches (510 mm)

5.5.2.3 Hoisting Grips

Hoisting grips provide the means to attach a lifting mechanism to the coaxial cable without damaging it. Typically, each hoisting grip is capable of safely lifting 200 feet of cable without causing cable damage. Therefore, one hoisting grip is required for every 200-foot cable section. Grips may be left attached to the cable after the cable installation is completed.

Some situations may require more hoisting grips, such as:

- An installation on a tower which is on top of another structure; or,
- Any installation where the lengths of cable that must be lifted is greater than the height of the tower/pole.

In these situations, additional hoisting grips should be ordered and used as needed.

Never attach lifting ropes or hoisting grips to an RF connector on the end of a coax cable.

5.5.2.4 Hangers and Adapters

Coaxial cables on the tower/pole should be secured at 3-foot intervals (maximum distance). Securing 7/8-inch and 1-5/8-inch diameter coaxial cables is accomplished by using either hangers or hanger-adapter combinations. The hangers secure the cables to the tower/pole structure by using pre-punched holes or attachment adapters.

- For wooden poles, shelf-thread lag bolts should be used.
- When a tower structure is pre-punched with 3/4-inch holes, snap-in hangers should be used.
- When a tower structure is pre-punched with 3/8-inch holes, each hanger should be secured with a 3/8-inch bolt.
- For towers without pre-punched holes, hangers and adapters are available for either angle tower members or round tower members.

Adapters for each antenna system are selected when ordering the system. If antenna coaxial cable must be attached to a structure that is not compatible with any of the previously described hangers or adapters, additional materials or other special considerations may be required.

To secure 1/4-inch or 1/2-inch vertical or horizontal coaxial cables of any size, the use of heavy-duty nylon cable ties is recommended.

5.5.2.5 Weatherproofing Connectors

A kit of weatherproof tape is normally provided to protect coaxial connectors from the outside elements. Follow all cable manufacturer weatherproofing guidelines.

5.5.2.6 RF Entry Point (Wall Feed-Thrus)

If the Cell Site base station cabinet is located inside an equipment room, the room's RF entry point (wall feed-thrus) should be installed and the respective bulkhead grounded in accordance with the procedures presented in *Site Grounding and Lightning Protection Guidelines* manual AE/LZT 123 4618/1 (manual include with this manual set).

5.5.2.7 Grounding Transmission Lines and Surge Protection Devices (SPDs)

All RF transmission lines and surge protection devices (SPDs) should be grounded in accordance with procedures presented in *Site Grounding and Lightning Protection Guidelines* manual AE/LZT 123 4618/1. AE/LZT 123 4618/1 is include with this set of installation manuals.

5.6 SITE-TO-SITE (BACKHAUL) COMMUNICATION LINKS

If the Cell Site base station will employ a landline backhaul communications link (i.e., the router with the T1/FT1 frame relay option or the router with the 56 kbps DDS modem option) for the site-to-site backhaul communication link, suitable lines should be in-place before beginning site installation. Typically, lines are ordered from and supplied by the local telephone company. Interfaces will be agreed demarcation points to which the customer/installer will make connections.

- For pole-mount installations, the Telco connection box is normally mounted on the same side of the pole as the Cell Site cabinet. Some installations use a NEMA (Type 12, 13, 4) box such as Hammond Manufacturing's EJ12126.
- For other type installations, the Telco connection box can be mounted at any nearby approved mounting surface such as the exterior wall of an equipment building.

5.7 UNPACKING THE BASE STATION EQUIPMENT

Cell Site base station equipment is generally packed in mini-pallets approximately 36 inches deep by 32 inches wide. These pallets can generally be moved with a medium-duty hand-truck. A crowbar and hammer will be useful for opening the crates. Wrenches will be needed to unbolt the cabinets from the pallets.

Carefully examine each carton upon receipt. If any packaging damage is detected, note the damage on the Bill of Lading.

Before unpacking a pallet or crate, move it as close as possible to the installation location.

Carefully unpack the equipment and examine each item for damage. If any, contact the carrier immediately and have their representative verify the damage. Failure to report shipping damage immediately may cause forfeiture of any claim against the carrier.

When unpacking the equipment, check the contents against the packing list. Contact your M/A-COM representative and the carrier if any discrepancies are noted.

After unpacking, carefully open each cabinet and inspect its contents to ensure the enclosed equipment has not been damaged during delivery. If damage has occurred, note details of the damage and, if necessary, contact the carrier immediately and have their representative verify the damage. Contact your M/A-COM representative if the damage is such that installation cannot proceed.

6. MECHANICAL INSTALLATION

This section includes mechanical installation procedures for the 700 MHz Cell Site base station and the related equipment. Because of the wide variety of installation conditions and configurations, many installations will require unique mechanical installation planning processes which must be accomplished on a site-by-site basis. For example, installers typically encounter several different types of mechanical installation scenarios such as wooden pole or metal pole mounting, optional cabinets that must be installed on the same pole as the Cell Site base station, if the battery cabinet is installed on the same side of the pole or the opposite side of the pole, etc.

The Site Deployment Order (SDO) should include an accurate site layout map, information to designate equipment locations, and other necessary installation information.

Unless otherwise stated, all installation procedures presented in this section should be performed in the order presented.

6.1 MOUNTING THE CELL SITE BASE STATION

Mounting the Cell Site base station typically involves attaching its mounting brackets to the mounting surface (i.e., wooden pole, metal pole, tower base), attaching the base station's Heat Sink Assembly to the mounting brackets, lifting the base station cabinet and bolting it to the Heat Sink Assembly, and attaching the cabinet's solar shield. However, if the base station is mounted to a flat surface, no bracket is required since the Heat Sink Assembly is simply bolted directly to the mounting surface.

Cell Site base station installations typically employ 60 or 70-foot-tall 12-inch-diameter wooden or metal poles, with at least 10 feet of the pole buried into the ground. Two pole-mount installation kits are available—one for wooden poles and one for metal poles. Each kit contains two (2) mounting brackets and hardware for attaching the brackets to the pole. See Table 6-1 and Table 6-2 for kit contents.

6.1.1 Attaching the Mounting Brackets to a Wooden Pole

The following procedure is recommended for wooden pole installations. It is assumed the pole is already planted, and that it is vertically level to within 2 degrees:

1. Consult the SDO for the required height above ground specification, and any other mounting-related instructions/requirements. Most installations require the bottom of the base station cabinet at a distance of at least eight (8) feet from the surface of the ground.

2. On the base station cabinet-side of the pole, mark a drill-point location for the lower mounting bracket's bolt hole. The bottom of the cabinet will be at approximately this same level above ground. However, the bottom edge of the Heat Sink Assembly will be approximately 3.5 inches lower than this point after it is attached to the brackets. See Figure 6-1.

3. Using a bubble or a laser-type level for an accurate vertical reference line, mark a drill-point location for the upper mounting bracket's bolt hole exactly 16-¾ inches above the mark for the lower bracket's bolt hole. This mark must be directly above the mark for the lower bracket's bolt hole. As

illustrated in Figure 6-1, the two end holes in one of the brackets may be used as a measuring tool, as these holes are exactly 16-¾ inches apart.

4. Using a centering-type gauge/tool, a level-equipped drill, and a 7/8-inch (0.875-inch) drill bit, drill two 7/8-inch holes at the marked locations. These holes must pass through the pole's diameter-line (within approximately 5 degrees) and they must be perpendicular to the length of the pole (also within approximately 5 degrees).

5. Attach the two (2) mounting brackets to the pole using the ¾-inch hardware included in Pole-Mount Installation Kit MACS-NMA6D (for wooden poles). See Figure 6-1 and refer to Table 6-1 for kit contents. **Do <u>not</u> torque this hardware until <u>after</u> the Heat Sink Assembly has been attached to the brackets (as described in a later section).**

6. Advance to section 6.1.3, Attaching the Heat Sink Assembly to the Mounting Brackets (on page 30).

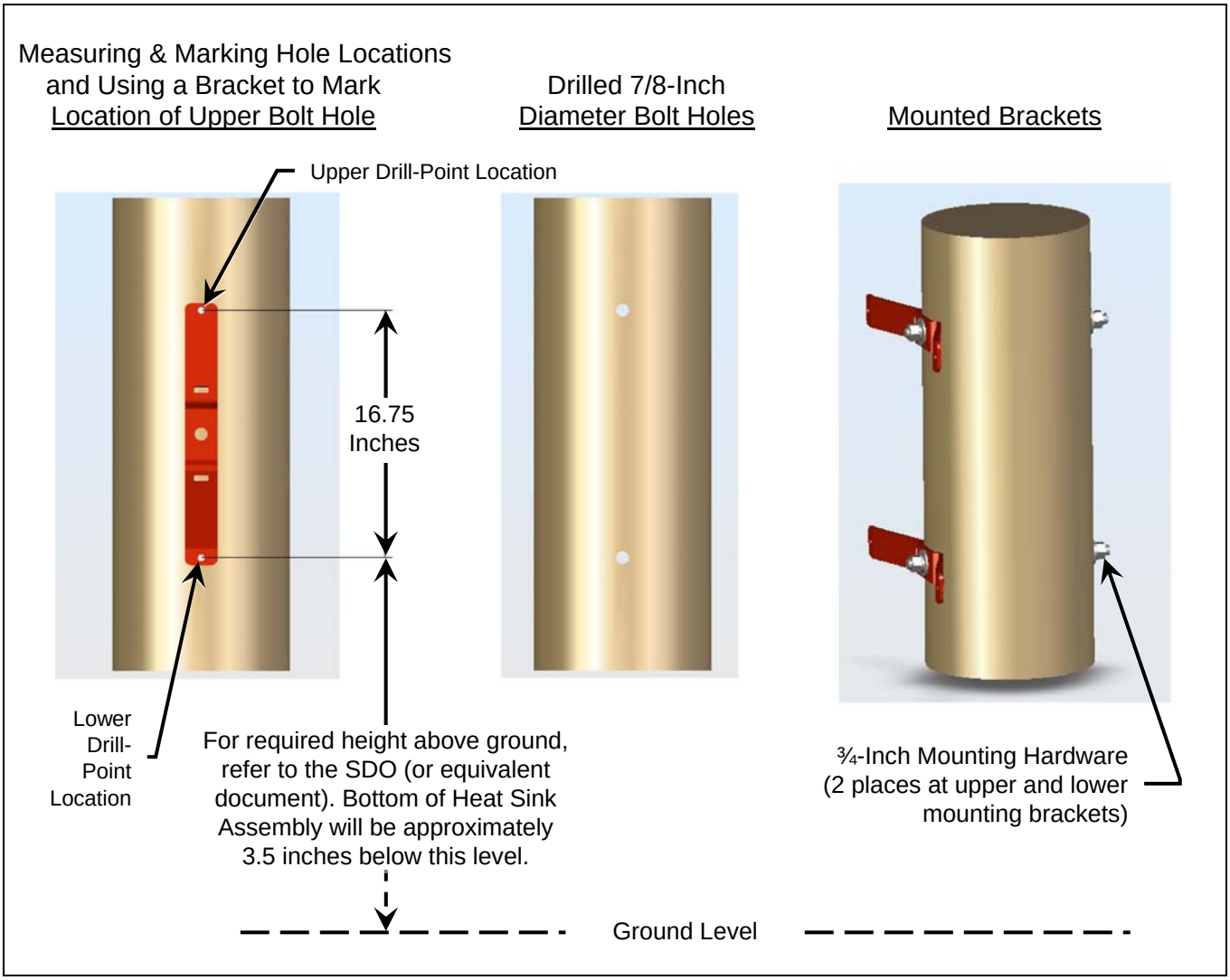

Figure 6-1: Attaching the Mounting Brackets to a 12-Inch Wooden Pole

Table 6-1: Contents of Pole-Mount Installation Kit MACS-NMA6D for 12-Inch Diameter Wooden Poles

PART NUMBER	QTY. PER KIT	DESCRIPTION	NOTES
1000023950	2	Bracket, Mounting	Used to mount Heat Sink Assembly to a wooden or metal pole.
TBD	2	Bolt, Hex-Head: ¾-Inch Stainless-Steel, 14 inches long)	Used to attach brackets to a wooden pole.
TBD	4	Washer, Flat: ¾-Inch Stainless-Steel	Used with above bolts.
TBD	4	Washer, Split-Lock: ¾-Inch Stainless-Steel	Used with above bolts.
TBD	2	Anti-Sway Straps	Used to prevent side-to-side movement during strong winds, etc.

6.1.2 Attaching the Mounting Brackets to a Metal Pole

The following procedure is recommended for metal pole installations. It is assumed the pole is already planted and it is vertically level to within 2 degrees:

1. Consult the SDO for the required height above ground specification, and any other mounting-related instructions/requirements. Most installations require the bottom of the base station cabinet at a distance of at least eight (8) feet from the surface of the ground.

2. On the base station cabinet-side of the pole, mark a location for the lower mounting bracket's bolt hole. The bottom of the cabinet will be at approximately this same level above ground. However, the bottom edge of the Heat Sink Assembly will be approximately 3.5 inches lower than this point after it is attached to the brackets.

3. Using a bubble or a laser-type level for an accurate vertical reference line, mark a location for the upper mounting bracket exactly 16-¾ inches above the mark for the lower bracket. As illustrated in Figure 6-1, the two end holes in one of the brackets may be used as a measuring tool, as these holes are exactly 16-¾ inches apart.

4. Using the two (2) stainless-steel straps included in Pole-Mount Installation Kit MACS-NMA6E (for metal poles), attach the two brackets to the pole. Refer to Table 6-2 for kit contents. Tighten the straps in accordance with the installations instructions included with the straps.

5. Add the anti-sway straps to the brackets in accordance with the included installation instructions.

6. Advance to section 6.1.3, Attaching the Heat Sink Assembly to the Mounting Brackets (on page 30).

Table 6-2: Contents of Pole-Mount Installation Kit MACS-NMA6E for 12-Inch Diameter Metal Poles

PART NUMBER	QTY. PER KIT	DESCRIPTION	NOTES
1000023950	2	Bracket, Mounting	Used to mount Heat Sink Assembly to a wooden or metal pole.
TBD	2	Straps, Stainless-Steel	Used to mount bracket to metal pole.
TBD	2	Anti-Sway Straps	Used to prevent side-to-side movement during strong winds, etc.

6.1.3 Attaching the Heat Sink Assembly to the Mounting Brackets

For pole-mount installations, Heat Sink Assembly MA-007498 must be attached to the mounting brackets before the Cell Site base station cabinet is attached to it. This assembly is a part of Heat Sink & Solar Shield Pole-Mount Kit MACS-NCK1G. Contents of this kit are listed in Table 6-3 on page 31. The Heat Sink Assembly is mounted to the pole via Mounting Brackets 1000023950 and 3/8-inch stainless-steel hardware. The following procedure is recommended:

If mounting the base station to a flat surface, mounting brackets are **not** required. In this case, advance to section 6.1.4 on page 32 for installation information.

1. Loosely attach the Heat Sink Assembly to the two mounting brackets using the 1-3/8-inch long (1.375-inch) 3/8-inch hex-head bolts, nuts, and washers included in the respective installation kit. Start all hardware bolts before tightening any one bolt/washers/nut combination. See Figure 6-2.

2. Torque all of this 3/8-inch hardware to (TBD) pound-inches.

3. For wooden pole-mount installations, torque the ¾-inch bolts securing the two mounting brackets to the pole to (TBD) pound-inches.

Table 6-3: Contents of Heat Sink and Solar Shield Pole-Mount Kit MACS-NCK1G

PART NUMBER	QTY. PER KIT	DESCRIPTION	NOTES
MA-007498	1	Heat Sink Assembly	The finned aluminum assembly external of the base station cabinet.
HT-008474	1	Thermal Gasket	Used between the Heat Sink Assembly and the back of the station cabinet.
TBD	4	Bolts, Hex-Head: 3/8-Inch Stainless-Steel, 1-3/8-inches long	Used for securing Heat Sink Assembly to the mounting brackets.
TBD	4	Nuts, Hex: 3/8-Inch Stainless-Steel	Used with above bolts.
92240A622	6	Bolts, Hex-Head: 3/8-Inch Stainless-Steel, 3/4 inches long	Used for securing base station cabinet to Heat Sink Assembly.
92141A031	TBD	Washers, Flat: 3/8-Inch Stainless-Steel	Used with above bolts.
92146A031	TBD	Washers, Split-Lock: 3/8-Inch Stainless-Steel	Used with above bolts.
FM-008077	1	Shield, Solar	Shields base station cabinet from the sun to help maintain temperature inside the cabinet.

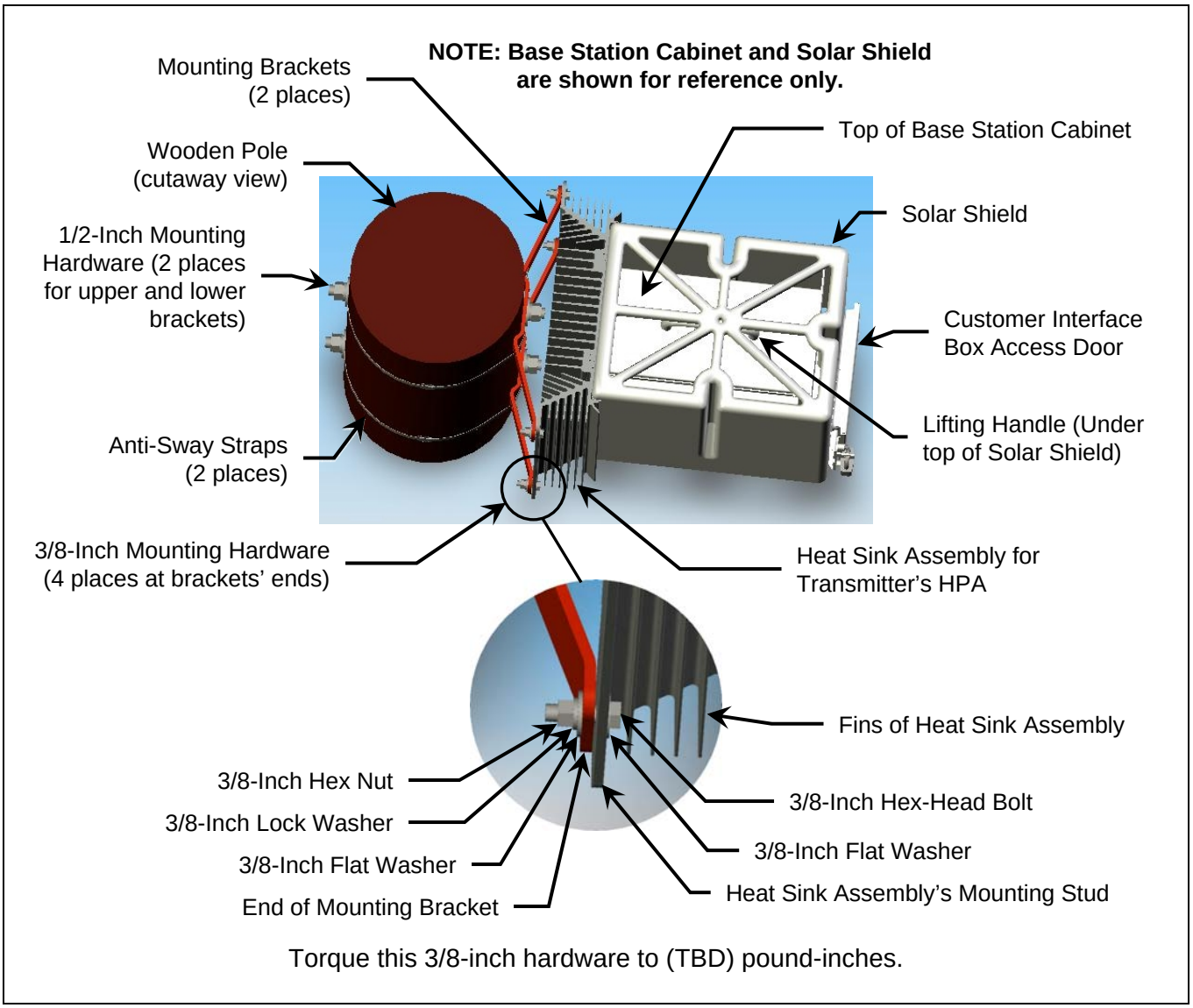

Figure 6-2: Attaching the Heat Sink Assembly to the Mounting Brackets (Top View; Wooden Pole Installation Shown)

6.1.4 Attaching the Heat Sink Assembly to a Flat Surface

Instead of pole or tower base mounting, the Cell Site base station may be mounted directly to a flat surface such as the interior or exterior wall of an equipment shelter. This is accomplished by attaching its Heat Sink Assembly directly to the flat surface. Six (6) 3/8-inch bolts are used to secure the Heat Sink Assembly to the surface (not supplied). The following procedure is recommended:

1. Consult the SDO for the required height above ground specification, and any other mounting-related instructions/requirements. Most installations require the bottom of the base station cabinet at a distance of at least eight (8) feet from the surface of the ground.

2. Obtain 3/8-inch hardware appropriate for the mounting surface. For example, if mounting to a concrete wall, expandable concrete anchors with appropriate 3/8-inch bolts and washers are normally used. Use of stainless-steel bolts and washers is recommended. For a flat surface that is less than approximately ¾-inch thick, the 3/8-inch stainless-steel hardware in Pole-Mount Installation Kit MACS-NMA6D (includes 1-3/8-inch long stainless-steel bolts) may be used if the opposite side of the mounting surface is accessible. In this case, the two brackets in the kit are not be used and they can be returned to stock or discarded.

A steel mounting surface must be grounded by ground wires/cables that are separate from the wires/cables used to ground the base station cabinet.

Verify the mounting surface has no embedded electrical wires, water pipes, etc., or other items on the opposite side such as fuel tanks, batteries, or equipment cabinets. If so, adjust the location of the mounting surface as required so any drilled holes and/or mounting bolts do not interfere with or penetrate items of this type.

3. Using a bubble or a laser-type level for an accurate vertical reference line, mark a vertical centerline for the Heat Sink Assembly.

4. From this centerline, mark two (2) parallel lines exactly 8-3/8 inches (8.375 inches) from the centerline. One line exactly 8-3/8 inches to the left of the centerline and one line exactly 8-3/8 inches to the right of the centerline.

5. On the two (2) parallel lines, mark drill-points for the two *bottom* bolt holes. The bottom edge of the Heat Sink Assembly will be approximately 3.5 inches lower than these points after it is attached to the mounting surface. However, the bottom of the base station cabinet will be at approximately the same level (height above ground) as these two bolt holes.

6. On the two parallel lines, mark drill-points for the two *center* bolt holes exactly 8-3/8 inches (8.375 inches) above the bottom holes.

7. On the two parallel lines, mark drill-points for the two *top* bolt holes exactly 8-3/8 inches (8.375 inches) above the center holes.

8. To verify the locations of the marked drill-points, position the Heat Sink Assembly over the points. Adjust marks if they are incorrect.

9. Center-punch these six (6) drill-points and then drill pilot holes at the six drill-point locations. An 1/8-inch pilot hole is recommended.

10. Re-drill the six pilot holes to the required diameter according to utilized mounting hardware. Hole diameter is typically 3/8-inch, unless anchor or toggle-type hardware is used which will typically require larger holes.

11. Position the Heat Sink Assembly over the bolt holes and install the mounting hardware as required. A flat washer must be used between the head of the each bolt and each mounting hole in the Heat Sink

Assembly, and between each mounting hole in the Heat Sink Assembly and the mounting surface. If the mounting surface is not nearly completely flat, additional flat washers should be used as required to prevent bending of the Heat Sink Assembly when the bolts are torqued.

12. Torque the six (6) bolts as required per utilized hardware. Torque the two (2) center bolts (left and right sides) first, then torque the four (4) corner bolts. **Do not exceed (TBD) pound/inches.** Exceeding this torque spec could cause the Heat Sink Assembly to immediately crack, or crack later during temperature cycles.

6.1.5 Attaching the Cabinet to the Heat Sink Assembly

After the Heat Sink Assembly is attached to its mounting surface, the Cell Site base station cabinet must be attached to it per the following procedure:

1. Using a lint-free cloth dipped in denatured alcohol, clean the machined heat transfer surface at the back of the base station cabinet and the corresponding surface on the Heat Sink Assembly. The machined surface at the back of the cabinet is the portion of the station's RF High-Power Amplifier (HPA) heat sink and casting that is visible on the outside of the cabinet. This surface transfers heat to the Heat Sink Assembly via a special thermal interface material applied later.

2. After cleaning, allow several minutes for the alcohol to evaporate.

Observe and follow all recommended safety procedures, warnings, etc. listed by the alcohol's manufacturer and/or respective Material Safety Data Sheet (MSDS).

3. At the back of the base station cabinet, apply Thermal Interface Material HT-008474 (included with installation kit) to the HPA's machined heat transfer surface. This material has an adhesive side to adhere to the machined surface, and a foil side which contacts the Heat Sink Assembly when the two are joined together in the next step. Visually center the material parallel to the machined surface, then lay it flat against the surface and use a gentle top-to-bottom sweeping motion to smoothly adhere the material to the surface.

4. Using the cabinet's lifting handle, carefully lift the cabinet and hang it on the Heat Sink Assembly by the two (2) hooks at the top rear corners of the cabinet.

5. Slightly reposition the cabinet left or right as necessary to align the six (6) holes in the its rear panel to the six corresponding threaded holes in the Heat Sink Assembly.

6. Start 3/8-inch mounting hardware in all six locations. Use a lock washer and a flat washer on each bolt, with the lock washer adjacent to bolt head and the flat washer adjacent to rear panel hole. Do not tighten any one bolt until all hardware has been started.

7. Torque all of the 3/8-inch mounting bolts to (TBD) pound-inches.

6.1.6 Install the Solar Shield Over the Cabinet

If not already, Solar Shield FM-008077 must be installed over the base station cabinet by attaching it to the Heat Sink Assembly. This shield improves heat dissipation characteristics of the cabinet during

daylight hours compared to an unshielded cabinet, and it helps to reduce build-up of foreign material on the top of the cabinet. The Solar Shield is a part of Heat Sink & Solar Shield Pole Mount Kit option MACS-NCK1G. Attach the shield to the cabinet in accordance with this procedure:

1. Position the Solar Shield directly above the Cell Site base station cabinet's lifting handle so the shield's vent slots (on the top of the shield) are up/sky-facing, and its back with the tracked edges are directly above the two vertical grooves in top-front edge of the Heat Sink Assembly.

2. Slide the Solar Shield's tracked edges down through the respective vertical grooves in the Heat Sink Assembly until the shield is all the down on the assembly.

6.2 MOUNTING THE SKYCHARGER CABINET

Mounting the SkyCharger cabinet includes attaching mounting brackets to the mounting surface (i.e., wooden pole, metal pole, flat surface), lifting the cabinet and attaching it to the brackets. For complete installation details, refer to the SkyCharger installation manual (MM20963) included with this manual set.

7. ELECTRICAL INSTALLATION

7.1 PROTECTIVE GROUND CONNECTIONS

All Cell Site base station related equipment must be grounded in accordance with the instructions presented in the *Site Grounding and Lightning Protection Guidelines Manual* AE/LZT 123 4618/1 (included with this installation manual set). This includes all metal (electrically conductive) items mounted to or in the near vicinity of the pole/mounting surface.

Pole-mount installations must employ at least two ¾-inch diameter 8- to 10-foot long copper-clad ground rods near the base of the pole. These rods are driven into the ground to at or below grade-level, and the top of one rod is considered the site's common ground point. Bentonite can be used to improve the rod grounding performance. Refer to the *Site Grounding and Lightning Protection Guidelines Manual* for additional information.

To ground the site's antenna(s), a single conductor of 2 AWG solid copper wire (minimum) or of 28 strands of 14 AWG copper wire (minimum) must be run up the pole to the base of the antenna(s). This conductor must be installed inside PVC type conduit secured to the opposite side of the pole from other conductors as much as possible to minimize the risk of flashover during a lightning strike. Make connections to the antenna(s) in accordance with the instructions provided by the antenna's manufacturer. Primary ground conductors must be exothermically welded (e.g., using Cadweld® process or equivalent) at the top of each ground rod. High-compression type connectors should not be used at the ground rods.

Ground the Cell Site base station, SkyCharger battery charger system, and other equipment using separate ground conductors to the common ground point. These conductors must also be installed inside PVC type conduit that is secured to the pole. Refer to the *Site Grounding and Lightning Protection Guidelines Manual* for additional information.

The Cell Site base station cabinet has a stainless-steel 3/8-inch ground stud located at the bottom of the cabinet, near the bottom of the Customer Interface Box. Secure a ground conductor to this ¾-inch-long stud using a 3/8-inch 16-threads-per-inch (UNC) stainless-steel nut, a stainless-steel 3/8-inch flat washer and a 3/8-inch lock washer.

For grounding instructions on the SkyCharger battery backup system, refer to the SkyCharger installation manual (MM20963) included with this manual set.

7.2 POWER CONNECTIONS

To prevent damage to equipment, ensure power is not accidentally applied at this time. Make sure all equipment circuit breakers are **OFF**. **DO NOT** apply power at this time! **Temporarily label all applicable circuit breakers accordingly to avoid accidental turn-on!**

Refer to the SkyCharger's installation manual (MM20963) included with this manual set for general instructions on making AC and DC power connections. DC power connections to the Cell Site base station are accomplished at the +24-volt terminal block in the Customer Interface Box. The DC power wires from the SkyCharger's cabinet to the Cell Site cabinet must be routed inside conduit.

7.3 ANTENNA CABLE CONNECTIONS

Antenna cable connections are made at the N-type RF connectors located on the bottom of the Cell Site base station cabinet. For simplex antennas, two cable connections are required. For duplex antenna, only one cable connection is required.

7.3.1 Simplex Antennas

If the site employs simplex antennas (separate transmit and receive antennas), follow this procedure to make RF antenna cable connections to the base station. It is assumed both antennas and associated antenna feedlines (i.e., coaxial cables) are already secured to the pole/tower, and they have been tested for proper performance:

1. Determine which cable is the receive antenna cable and which cable is the transmit antenna cable. Mark each cable accordingly. If the site has a Tower-Top Amplifier (TTA), the receive antenna cable connects to it.

2. Verify the antenna system is properly grounded.

3. Cut each cable to the required length, leaving length for a 180-degree 8- to-10-inch diameter drip-loop at the bottom of the cabinet. For best results when cutting the cable, use an Andrew EASIAX® coaxial cable cutting tool (or equivalent). This tool will cut the cable properly for easy connector attachment.

4. Install N-type male RF connectors onto each coaxial cable.

5. At the bottom of the cabinet, connect the receive antenna cable to the receive antenna port and connect the transmit antenna cable to the transmit antenna port. Refer to Figure 3-2.

6. Using soft-jaw pliers, tighten both RF connectors securely.

7. Tie and stow the cables as necessary to prevent cable movement in strong winds.

7.3.2 Duplex Antenna

If the site employs a duplex antenna, follow this procedure to make the RF antenna cable connection to the base station. It is assumed the antenna and the associated antenna feedline (i.e., coaxial cable) are already secured to the pole/tower, and both have been tested for proper performance:

1. Verify the antenna system is properly grounded.

2. Cut the antenna cable to the required length, leaving length for a 180-degree 8- to-10-inch diameter drip-loop at the bottom of the cabinet. For best results when cutting the cable, use an Andrew EASIAX® coaxial cable cutting tool (or equivalent). This tool will cut the cable properly for easy connector attachment.

3. Install N-type male RF connectors onto each coaxial cable.

4. Connect the antenna cable to the duplex antenna port at the bottom of the cabinet.

5. Using soft-jaw pliers, tighten the RF connector securely.

6. Tie and stow the cable as necessary to prevent cable movement in strong winds.

8. POWER-UP PROCEDURE

The following power-up procedure is recommended:

1. **In the site's main AC circuit breaker box, verify the AC circuit breaker for the SkyCharger battery backup system is OFF and verify the respective DC load (output) circuit breaker is OFF.**

   If the SkyCharger system is not employed at the site, verify the corresponding AC circuit breaker for the site's 24-volt DC power source/battery charger is OFF and verify the respective DC load (output) circuit breaker is OFF.

2. **Verify all mechanical and electrical installations are complete.**

3. **Verify all equipment is properly grounded.**

4. **Open the access door of the Cell Site base station's Customer Interface Box and set both the main DC circuit breaker (labeled BREAKER) and the DCX power switch (labeled DCX POWER) to their OFF positions, if not already.**

5. If the SkyCharger battery backup system is employed, perform all SkyCharger system AC power-up and DC voltage checks in accordance with the instructions provided in the SkyCharger's installation manual (publication number MM20963). After completing these checks, leave its AC circuit breaker and the DC load (output) circuit breaker that powers the Cell Site base station cabinet both ON .

   If the SkyCharger system is not employed, perform site battery charger AC power-up and DC voltage checks in accordance with the instructions provided with the vendor equipment. After completing these checks, leave its AC circuit breaker and the DC load (output) circuit breaker that powers the Cell Site base station cabinet both ON.

6. **In the Cell Site base station's Customer Interface Box, verify the DC supply voltage at the main DC input terminal block is between 24.0 and 28.5 Vdc. (+ with respect to ground). The nominal DC voltage level is 27.5 Vdc. Also verify correct polarity! Do not proceed until the DC voltage and polarity are verified!**

The TVS protection diodes on the Customer Interface Board's DC input begin to conduct at approximately 31.1 Vdc (+ with respect to ground). Therefore, exceeding this approximate DC supply power input voltage potential will cause the main DC circuit breaker to trip off if it is on. Reversed polarity connections (at any DC voltage) will also cause the breaker to trip off.

7. In the Customer Interface Box, turn on the main DC circuit breaker (labeled **BREAKER**) while observing the HPA's power indicator (labeled **POWER ON** in the HPA section). The HPA in the cabinet is "hot-wired" (i.e., its power is not switched on and off by the main DC power switch). Therefore, this indicator will light when the HPA is powered-up, even when the DCX power switch is off.

8. In the Customer Interface Box, turn on the DCX power switch (labeled **DCX POWER**) while observing the DCX's power indicator (labeled **POWER ON** in the DCX section). This indicator will light when the DCX is powered up.

9. In the Customer Interface Box, verify the DC supply voltage at the main DC input terminal block remains 24.0 and 28.5 Vdc. (+ with respect to ground). The nominal DC voltage level is 27.5 Vdc. If the DC supply voltage is not with this range, refer the battery backup system's installation manual for troubleshooting information.

10. Continue with the configuration procedures presented in the next section.

Several Light-Emitting Diode (LED) status indicators are located at the front panel of the Customer Interface Box. Indicator operation is summarized in the following table:

Table 8-1: LED Status Indicators at Customer Interface Box's Front Panel

FRONT PANEL DESIGNATION	INDICATOR COLOR	INDICATOR OPERATION
DCX Section:		
POWER ON	Green	This indicator lights to indicate the DCX is powered-up. The DCX consists of the BSC and BSX assemblies.
SELF TEST	Red	This indicator blinks to indicate the DCX's BSC is in a self test mode. The BSC executes a self test just after it is powered-up or reset.
RX DATA	Green	This indicator blinks to indicate the DCX's BSC is receiving data from the Ethernet or SLIP interface.
TX DATA	Green	This indicator blinks to indicate the DCX's BSC is transmitting data to the Ethernet or SLIP interface.
HPA Section:		
POWER ON	Green	This indicator lights to indicate DC operating power (24 volts nominal) is applied to the Cell Site base station and the station's HPA is powered-up. Since the HPA is "hot-wired," it remains powered-up even when the DCX power switch on the front panel is in the OFF position.
TX ON	Red	This indicator lights when the HPA is transmitting RF power to the 700 MHz antenna system.
RF DISABLED	Amber	This indicator lights to indicate the HPA transceiver has been disabled. This is accomplished by placing the RF ENABLE/DISABLE rocker switch in the RF DISABLE position.

9. CONFIGURATION

9.1 GENERAL INFORMATION

Cell Site base station configuration is performed during final equipment tests at the factory in accordance with the customer's order. Most configurations are programmed into the BSC section of the Cell Site's DCX. These factory configurations include but are not limited to:

- Site ID number
- Site color
- Area color
- Channel ID number
- Wide Area Network (WAN) IP addresses
- RF operating frequencies (transmit and receive)
- Service Provider Network Identifier (SPNI) number
- Wide Area Service Identifiers (WASI) number
- Site adjacency data

Optional configurations programmed into the optional equipment include:

- Router parameters (if so equipped)

The Cell Site base station requires very little configuration in the field. Once the mechanical and electrical installations are completed, the equipment is powered-up, and the site-to-site backhaul communication link is established, configuration must be performed at the network level.

Each Cell Site base station in an OpenSky trunked radio network is assigned to a SkyMASTR base station/tower site within the trunked radio network. The Cell Site base station gains network connectivity via a site-to-site backhaul communication link between itself and the main station/tower site. This is accomplished using IP-based protocols over either a T1/Fractional T1 (FT1) frame-relay landline link, or a 56 kbps Digital Data Service (DDS) landline modem link. Therefore, the site-to-site backhaul communication link must be operational before configuration can be performed.

9.2 CELL SITE ALARMS

9.2.1 AC/DC Power Source Alarms

The SkyCharger battery backup system is configured at the factory to generate alarms based upon any one of the following conditions:

- Loss of AC input power
- Door open (or low battery voltage)
- Charger rectifier failure

Alarm logic states are transferred from the SkyCharger cabinet to the Cell Site cabinet via the modular cable that interconnects between terminal block TB3 in the SkyCharger cabinet and the **ALARM** modular jack at the front panel of the Cell Site cabinet Customer Interface Box. Inside the Cell Site cabinet, these alarm logic states are then passed to the BSC in the DCX for processing.

For remote alarm monitoring purposes, after processing by the BSC, the alarm states are transferred over the IP-based network to the radio system's Network Switching Center (NSC)[4] and Centralized Network Manager (CNM)[5].

9.2.2 HPA Alarms

Cell Site base station HPA-related alarms are preset at the factory and require no configuration. These alarms include:

- Loss of "heartbeat"
- Loss of Automatic Level Control (ALC)
- Low DC input voltage condition
- Over current condition (of HPA DC input power)
- Over temperature condition

Like the power source alarms, these alarms are processed by the BSC and then transferred over the IP-based network to the radio system's NSC and CNM for remote monitoring purposes.

9.2.3 Cabinet Door Alarm

The Cell Site base station's cabinet door alarm disables the HPA from transmitting when the Customer Interface Box's door is open, activating the alarm. No field configuration is necessary.

[4] The NSC was formerly referred to as the Regional Operation Center (ROC).

[5] The CNM was formerly referred to as the Network Operations Center (NOC).

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