Appendix K: User Manual

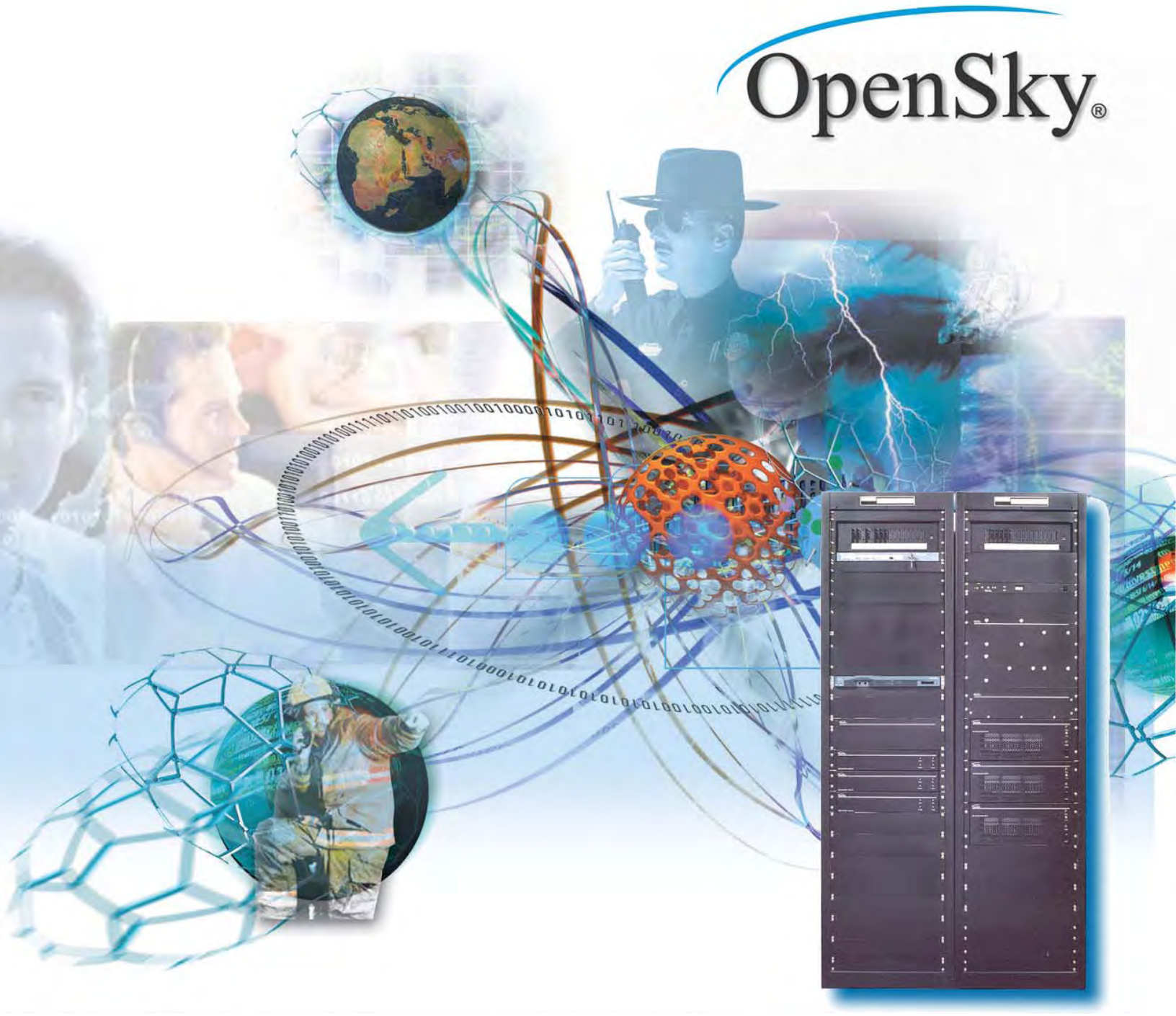
Please refer to the following pages.

Installation Manual

MM102225V1

Rev. B, Jul-05

OpenSky®



Base Station/Tower Site

tyco Electronics

M/A-COM

MANUAL REVISION HISTORY

REV	DATE	REASON FOR CHANGE
A	2003	Initial release.
B	Jul. 2005	Changed Accuracy Test, Step 7, added Caution added footnote.

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

Wireless Systems Business Unit
M/A-COM, Inc.
Technical Publications
221 Jefferson Ridge Parkway
Lynchburg, VA 24501

fax (434) 455-6851

techpubs@tycoelectronics.com

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1.0 GENERAL INFORMATION[1]

1.1. INTRODUCTION

This manual specifies procedures for installing and testing OpenSky® Base Station/Tower equipment racks at a communication site. This manual is intended for M/A-COM and contracted personnel responsible for supervising or conducting the equipment rack installation process.

Before attempting to install or checkout this equipment, become familiar with the contents of this manual. This manual is divided into the following sections:

General Information - includes a list of related reference material, a list of test equipment required for testing, aligning and maintaining radio equipment, safety information and OpenSky Base Station equipment specifications.

Site Preparation - identifies antenna system installation practices for the antenna/tower, transmissions lines connected to the equipment shelter, site requirements and facility preparation, site requirements and an antenna system audit.

Base Station Installation - provides instructions for unpacking and physically installing the Base Station equipment cabinets and interrack cabling.

Site Test Procedures - provides verification testing, equipment configuration, compliance testing, performance testing, operational testing, network connectivity and final operating capability.

System Configuration - provides detailed instructions for setting up the equipment prior to applying power.

System Functional Checkout Procedures - provides detailed instructions for verifying the overall operation of the equipment as a system.

Table of Common Terms - identifies and defines common terms used throughout this manual.

1.2. REFERENCE MATERIAL

It may be necessary to consult one or more of the following manuals. These manuals will also provide additional guidance if you encounter technical difficulties during the installation or testing processes.

Title	Publication Number
• Digital Base Station Controller/Transceiver (DCX) Maintenance Manual	MM102425V1
• High Power Amplifier (HPA-75) Maintenance Manual	MM102445V1
• Antenna System Maintenance Manual.....	LBI-38983
• Standard For Site Grounding and Protection	AE/LZT 123 4618/1

[1] Taken from M/A-COM Drawing, No. AP7079, Rev.-

Title	Publication Number
• OE-100 Outdoor Enclosure.....	MM102226V1
• M/A-COM, Inc. Quality Standards Manual.....	GQM0221
• Rack Breaker Panel Maintenance Manual	*(Not Available)*
• RX Amplifier Maintenance Manual	*(Not Available)*
• Duplexer and Power Sensor Maintenance Manual	*(Not Available)*
• TX Combiner Maintenance Manual	*(Not Available)*

1.3. TOOLS AND TEST EQUIPMENT

The items listed in Table 1-1: Tools and Test Equipment are the tools and test equipment needed during installation, alignment, testing, and maintenance of the OpenSky Base Station/Tower equipment racks. Test equipment other than that recommended may be substituted, providing it is electrically equivalent in accuracy and operating range, and capable of maintaining the tolerances specified for the recommended test equipment.

Table 1-1: Tools and Test Equipment

NAME OF TOOL	USE/COMMENTS
Assorted Cabling Hardware (lugs, bolts, connectors, clamps, and so on)	As needed for rack installation
Assorted Hand Tools	As needed for rack installation
Assorted Power Tools	As needed for rack installation
Bolting Template	Template for bolt placement on enclosure floor for rack fasteners
DC Power Cable	For bringing power to equipment racks
Equipment Cart (1,200 pound recommended capacity)	Moving equipment racks
Ground Cable (#6, green)	For grounding equipment racks
Insulating Bushings	Used to insulate equipment racks from the bolts securing the racks to cement and raised floors
Knife, Shears, and so on	Cutting strapping around rack packaging
Lag Bolts	Bolting equipment racks to wood enclosure floor
One (3/4") inch Drop-Down Expanding Anchors	Bolting equipment racks to enclosure floor
Permanent Marker	Marking locations on enclosure floor for rack fasteners
Shim Material	Leveling equipment racks

NAME OF TOOL	USE/COMMENTS
Soft Jaw Connector Pliers	Tightening or loosening N-type connectors Crescent Pliers: M/A-COM Part Number 529-10 or Tessco Part Number 83040
Superflex Antenna Cable	To convey antenna signals to equipment racks within a shelter
Torque Wrench	Tightening SMA connectors Preset to 5/16-inch, 8 inch-pounds of torque: M/A-COM Part Number 1055419-1 (2098-5065-54) or Tessco Part Number 14682, 1 Newton/Meter torque
Trash Bags	For removal of debris from site
Hammer Drill, ½" chuck	Used to drill holes for anchors in concrete floor
Set tool	Used to expand anchors in the floor
Basic hammer	Used with set tool to expand anchors in the floor
Crimpers	Used to crimp on lugs to ground wire and power leads
Greenlee Knock-Out tool	Used to punch out hole on top of rack for entry of ground wire
9/16" Socket	Used to secure rack to the floor and power leads to bus bar on rack
½" Socket	Used to secure ground to bus bar
7/16" Socket	Used to bolt racks together
Tape measure	Used to measure proper distance from wall to rack
Soldering gun	Used to solder leads of control cable connector
Heat gun	For shrink tubing with control cable connector
12" wire ties	
¾" anchors (tapcon)	
1" bolts	
Crimp on 1 hole lugs	
Crimp on 2 hole lugs	
T1 Crimper	AMP Hand Tool, Part Number 2-231652-0
Labeling System for field use	Recommended unit: P-Touch Labeling System, Model PT-330
Insulating washers	Between floor and bottom of rack between anchor bolts and rack
Service Monitor	HP 8920
Network Analyzer	HP 8752C (Used in conjunction with HP 8920 for Tower Top Amplifier)

1.4. TOOLS REQUIRED FOR SPECIFIC TASK

Generally, professional judgment can be used about the fitness of a tool for a given purpose. In some cases, however, specific tools must be used to complete installation steps properly. Failing to use the correct tool in these cases could damage equipment or leave crucial assembly steps incomplete. The tools for specific steps in base station installation are as follows:

Table 1-2: Tool for Specific Tasks

ASSEMBLY STEP	TOOL REQUIRED
Tightening SMA-Type connector	**Eight Inch-Pound Torque Wrench** M/A-COM Part Number 1055419-1 (2098-5065-54) or Tessco Part Number 14682, 1 Newton/Meter torque
Loosening SMA-type connectors	**5/16" (8mm) Open-End Wrench**
Tightening or loosening N-Type connectors	**SoftJaw Connector Pliers** Crescent Pliers, M/A-COM Part Number 529-10 or Tessco Part Number 83040

Look for notes and cautions in the installation procedures that remind the installer when these tools must be used to complete an installation step properly.

1.5. SAFETY INFORMATION

Personnel installing OpenSky rack-mounted components at a communication site should be aware of a number of potential hazards. These hazards may be associated with OpenSky electronic and **R**adio **F**requency (**RF**) equipment, radio antennas used with these components, or with the environments in which components are housed. Keep in mind that when working in the field, hazards associated with equipment, antennas, or environmental conditions that are part of applications other than OpenSky radio may also present risks.

Hazards you may encounter include the following:

- RF emissions
- Electrical shock
- Lifting of heavy objects
- Falling objects
- Falls
- Poor ergonomic design
- Chemical exposure

Working around the hazards listed above does not necessarily pose any outstanding risk to health or safety - however, knowledge of these possible hazards is vital to working safely.

The safety guidelines and precautions presented in this manual do not replace M/A-COM's specific requirements. The primary responsibility for health and safety standards, practices and guides lines in a M/A-COM project lies with the **E**nvironmental, **H**ealth & **S**afety (**EHS**) department.

All M/A-COM managers, supervisors, or subcontractors responsible for work associated with OpenSky equipment must be completely familiar with and prepared to comply with all applicable EHS guidelines and requirements. Although M/A-COM's policy requires that all contractors and visitors must be adequately trained prior to working on any M/A-COM project, this does not mean M/A-COM is responsible for conducting or providing this training.

The following 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 assumes no liability for the customer's failure to comply with these standards.

1. SAVE THIS MANUAL - It contains important safety and operating instructions.
2. Before using this equipment, please follow and adhere to all warnings, safety and operating instructions located on the product and in the manual.
3. **DO NOT** expose equipment to rain, snow or other type of moisture.
4. Care should be taken so objects do not fall or liquids do not spill into the equipment.
5. **DO NOT** expose equipment to extreme temperatures.
6. **DO NOT** use auxiliary equipment not recommended or sold by M/A-COM. To do so may result in a risk of fire, electric shock or injury to persons.
7. **GROUND THE EQUIPMENT**-To minimize shock hazard, the station equipment cabinet must be connected to an electrical ground.

   IF the equipment supplied is equipped with three-conductor AC power cords, these power cords must be plugged into approved three-contact electrical outlets with the grounding wires firmly connected to an electrical ground (safety ground) at the power outlet. The power cords must also meet **I**nternational **E**nergy **C**ommission **(IEC)** safety standards.
8. To reduce risk of damage to electrical cords, pull by plug rather than cord when disconnecting a unit.
9. Make sure all power cords are located so they will not be stepped on, tripped over or otherwise subjected to damage or stress.
10. An extension cord should not be used unless absolutely necessary. Use of an improper extension cord could result in a risk of fire and electric shock. If an extension cord must be used, ensure:

    a. The pins on the plug of the extension cord are the same number, size, and shape as those of the plug on the power supply.

    b. The extension cord is properly wired, in good condition, and

    c. The wire size is large enough for the AC ampere rating of unit.

11. **DO NOT** operate equipment with damaged power cords or plugs - replace them immediately.
12. **DO NOT** operate this product in an explosive atmosphere.
13. To reduce risk of electric shock, unplug unit from outlet before attempting any maintenance or cleaning.
14. **DO NOT** operate this product with covers or panels removed. Refer all servicing to qualified service personnel.
15. 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.
16. **GROUNDING AND AC POWER CORD CONNECTION** - To reduce risk of electrical shock use only a properly grounded outlet. The system components are equipped with electric cords having an equipment grounding conductor and a grounding plug. Be sure all outlets are properly installed and grounded in accordance with all local codes and ordinances.
17. **DANGER** - Never alter the AC cord or plug. Plug into an outlet properly wired by a qualified electrician. Improper connection or loss of ground connection can result in risk of an electrical shock.
18. **ELECTROSTATIC DISCHARGE SENSITIVE COMPONENTS** - This station contains CMOS and other circuit components, which 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.

1.6. SAFETY SYMBOLS

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

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

1.7. OpenSky BASE STATION EQUIPMENT SPECIFICATION (General)

Type:	Indoor Cabinet 83 Inch Floor Mount
Size:	
Height:	83 inches (77 inches usable)
Width:	22 inches
Depth:	24 inches
Number of Rack Units (RU):	44 RU available
Weight (Approximate)	Depending on the number of RF channels installed, the weight could range from 350 to 500 LBS for the rack with the HPA's. Usually Rack #2 is the HPA rack.
Operating Temperature (Full spec performance per EIA/TIA603)	-30ºC to +50ºC (-22ºF to +122ºF)
Note: Some third party equipment is only rated for 0ºC to +50ºC	
Input Power Source:	120 VAC (±20%), 60 Hz Or -48 VDC

2.0 SITE PREPARATION

2.1 INTRODUCTION

This section provides instructions for preparing the site and other installation items, which must be completed prior to installing OpenSky Communication equipment. The areas covered include the following:

Antenna System - This includes installation of the antenna tower, receive and transmit antennas, tower top amplifier and the installation of the transmission lines from the antenna to the tower top amplifier to the equipment shelter.

Site Requirements - Information is provided concerning various factors, which may affect the physical location of the equipment facility.

Facility Preparation - This section provides information for preparing the facility prior to installing the equipment. This information includes proposed equipment layout, environment, electrical power, equipment room grounding and telephone line installation.

2.2 ANTENNA SYSTEM

This section covers installation of the antenna system, including RF cables from the antennas to the equipment room wall feedthrough.

Antenna systems are generally installed by crews trained and equipped for working on antenna towers. As a result, this manual assumes the Antenna systems are installed by crews with the specialized equipment and skills required for working on towers and installing the antenna cables. However, it may be necessary for the system installer to provide information and directions to the crew installing the antenna system and to verify proper installation.

2.2.1 Antenna Mounting

The antenna tower must allow antenna mounting that provides isolation of at least 25 dB between the TX and RX antennas. This is necessary to avoid interference in the trunked receivers caused by the trunked transmitters. An isolation of greater than 25 dB is easily obtained by placing one antenna directly above the other on the tower (minimum 10-foot separation).

2.2.2 Transmission Lines

When installing the transmissions lines, refer to the diagrams contained in Antenna System Maintenance Manual LBI-38983.

2.2.2.1 Length

The length of the main coaxial cable for each antenna is planned as a continuous run with no connectors or splices between the antenna and the equipment room. Each cable includes a 50-foot allowance for the distance from the bottom of the tower to the equipment room. Smaller diameter, more flexible coaxial cables are used at both ends of the main coaxial cable to facilitate installation.

2.2.2.2 Minimum Bending Radius

Always adhere to the minimum bending requirements provided by the manufacturer. For Andrew Products, the values are:

CABLE SIZE	BENDING RADIUS	
1/4-inch	1-inch	(25 mm)
1/2-inch	1.25-inch	(32 mm)
7/8-inch	10-inches	(250 mm)
1-5/8-inch	20-inches	(510 mm)

2.2.2.3 Hoisting Grips

Hoisting grips provide the means to attach a lifting mechanism to the coaxial cable without damaging the cable. Each hoisting grip is capable of safely lifting 200 feet of cable without causing damage. Therefore, one hoisting grip is required for every 200-foot section of cable. The 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 to a tower which is on top of another structure.
- Any installation where the length of cable that must be lifted is greater than the height of the tower.

In these situations, additional hoisting grips should be ordered.

Under **NO** conditions should RF connectors be used to attach a rope or cable.

2.2.2.4 Hangers and Adapters

Coaxial cables on the tower should be secured at intervals of 3 feet (maximum).

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 structure by using prepunched holes or attachment adapters.

When the tower structure is prepunched with 3/4-inch holes, snap-in hangers are used (preferred method).

When the tower is prepunched with 3/8-inch holes, the hanger is secured by a 3/8-inch bolt.

For towers without prepunched holes, the hangers are attached with adapters. The type of adapter depends on the type of tower structure. Adapters are available for either angle tower members or round tower members.

Adapters for each antenna system are selected when ordering the system. If the coaxial cable must be attached to a structure that is not compatible with any of the above hangers or adapters, then 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, use UV resistant, black nylon cable ties.

2.2.2.5 Weatherproofing

A kit of weatherproof tape is provided to protect coaxial connectors from the outside elements. One roll of tape is sufficient to weatherproof four exposed outside connector joints (More than four are required with a Top Tower Antenna).

2.2.2.6 Antenna Grounding

Grounding kits are installed to prevent the radio system from being damaged by lightning. A grounding point should be installed at the top end of each coaxial cable run on the tower. A second grounding point should be installed on each cable at the bottom of the tower and a third grounding point on the cable at the point where the cable enters the building, if the tower-to-building length is greater than 20 feet. For cable runs on the tower greater than 200 feet, additional grounding points should be installed at each 200-foot interval. Grounding points should be installed at the Tower Top Amplifier as well.

2.3 TOWER TOP AMPLIFIER

The **T**ower **T**op **A**mplifier (**TTA**) should be installed near the receive antenna in order to improve the receive (inbound) channel performance. The amplifier should be mounted to the tower structure with corrosion resistant hardware and grounded to the tower structure with a #6 AWG solid or stranded copper conductor. All TTA ground connections, whether to tower frame (angular or circular) or a tower ground buss, should be made with corrosion resistant hardware.

For the TTA a ***"drip loop"*** in the RF cable from the antenna is recommended.

2.4 SITE REQUIREMENTS

This section provides information for preparing the facility prior to installing the equipment. This information includes proposed equipment layout, environment, electrical power and telephone line installation.

2.4.1 Floor Plan

Direct access to the area (for antenna cables and personnel) between the tower and the equipment room is necessary. Standard floor plans for the equipment cabinets are side-by-side cabinets. Lengths of interconnect cables supplied are based on these standard floor plans. If a floor plan other than a standard floor plan is used, longer interconnect cables may be required.

2.4.2 Operating Environment

The equipment room where the base station equipment is installed must meet the environmental conditions listed in the Station Specifications section of this manual.

Although the temperature requirements for individual pieces of trunked equipment may be broader, when several units are assembled together in a cabinet more heat is generated. Because of this condition, the ambient room temperature outside the cabinet must be lowered to ensure the temperature inside the cabinet does not exceed the limits for the equipment.

2.4.3 Electrical Power

Normally, OpenSky equipment is powered by –48 VDC. If the OpenSky cabinet is equipped with an AC power supply and an AC power cord, a 20-amp circuit breaker for each AC supply is recommended.

Receptacles must be installed within reach of the power cord(s). This can be on the wall behind the cabinets, in the floor under the cabinets, or in the cabinet top cable ducts. Each station power supply power cord is about 3 meters (9.8 feet) long, starting at the back of each power supply (two or three different heights) within the rear of each station cabinet. Each cord plugs into an AC Outlet which has a cord length of about 3 meters (9.8 feet) long.

When required, the AC power supplies are omitted from the station cabinet. In this case, DC power must be supplied to the base stations from an external -48 VDC power source through a separate 30-amp circuit breaker for each base station.

Additional equipment may be required if other types of power sources are used, or if the power source is not within reach of the individual AC power cords.

2.4.4 Equipment Room Grounding

Ensure all equipment and facilities meet the requirements for grounding and lightning protection.

Installation Manual AE/LZT 123 4618/1 - Standard For Site Grounding and Protection provides instructions for proper grounding of sites and radio equipment. These procedures should be observed in order to protect the equipment and service personnel from lightning and other sources of electrical surges. This manual is included as part of system documentation.

2.5 ANTENNA SYSTEM QUALITY AUDIT

Before installation of the antenna begins fill out APPENDIX J- INSTALLER PROFILE DATA SHEET. After the Antenna System is installed it should be inspected before the installers leave. A checklist of tasks performed on the antenna system is provided in APPENDIX K - ANTENNA SYSTEM INSTALLATION CHECKLIST. Be sure to complete this visual inspection before the installers leave, so any obvious errors can be corrected.

1. Using field glasses (if necessary) view the Antenna System from various positions on the ground. Using copies of the Antenna System Installation Checklist found in APPENDIX K, fill out a checklist for each antenna as you go through the following inspection procedure. This will provide a record of the inspection, and of some antenna information for future reference.
2. Record the make of antenna.
3. Record the type of antenna (omni or directional).

4. Record the design gain of the antenna.
5. If the antenna is directional, record the bearing of the main lobe, using the magnetic declination for True North. If it is Omni, write "Omni" in the data entry line.
6. Record the height of the antenna above ground.
7. Confirm that cable-hoisting grips were installed as required to prevent damage to the coaxial cable. Hoisting grips should have been installed at the antenna end of the cable plus one for each 200 feet of cable length.
8. Confirm the cable is secured to the tower at intervals, which do not exceed 3 feet.
9. Confirm the cable is grounded at the top of the tower.
10. Confirm the cable is grounded at the point where it leaves the tower.
11. Confirm the cable is grounded at the point where it enters the building.
12. Confirm the coaxial cable run looks OK. The cable must be tight (nothing to flap in the breeze), have no dings or kinks, be one continuous run (no connectors or splices), and not exceeding the minimum bending radius on any bend.
13. Confirm the cable weather tight feedthrough is properly installed where the cable enters the building.
14. Confirm the coaxial connectors have been properly weather sealed.
15. Confirm the cable entrance to the building has been properly weather sealed.

3.0 BASE STATION INSTALLATION

The following sections present the steps required for installation of populated OpenSky base station equipment racks at a communications site.

To a certain extent, installations must be planned site-by-site, because of the wide variety of installation conditions and configurations. Installers will encounter many types of equipment enclosures and tower site equipment configurations. The **S**ite **D**eployment **O**rder (**SDO**) should include an accurate site layout map, information to designate rack locations, and other necessary installation information.

3.1 BEFORE INSTALLATION OCCURS

Before the antenna installation date, collect the information from the Site Deployment Order specific to site access. Site-specific information includes the following:

- Permission to access the site
- Directions to the site
- Keys and lock combinations to access the site and equipment shelter, or points of contact to obtain them
- A drawing or description of each site showing where the equipment is to be installed inside the enclosure
- Information about work practices needed to work safely at the site

The installation procedure below assumes that the installation team has secured permission to access the communications site and has obtained the necessary keys or lock combinations.

Keep working environment clean!

Control dust, dirt, and shavings for safety, and to protect equipment.

Be sure to follow installation procedures carefully!

3.2 BASICS

Generally, the OpenSky base station fits into two or more equipment racks. Each rack is nominally seven feet high and twenty-four inches wide. The populated racks must be installed inside a weatherproof enclosure near the base of a communications tower. If an OE-100 Outdoor Enclosure is used, the OpenSky equipment is mounted to the mounting rails provided within the enclosure (Refer to OE-100 Outdoor Enclosure Maintenance Manual MM102226V1). The Base Station installation procedure addresses the following:

- Installing the equipment racks after they have been transported to the communications site and moved into the equipment shelter
- Making inter-rack cabling connections

- Connecting the power supply and site subsystems external to the OpenSky equipment racks

3.3 SECURING EQUIPMENT RACKS TO THE FLOOR

Move the racks into the designated positions and prepare to bolt them to the floor. In rare cases, bolting to the floor may be prohibited. In those cases, bolt the racks to each other for stability.

Procedure:

1. Using a template, mark bolt locations for each equipment rack to be installed.
2. Drill pilot holes (Drill any required pilot holes to the specified depth of 1-1/2").
3. Drill 1/2" diameter holes for wood and concrete floors.
4. Move racks into position over bolt marks. In general, racks are placed side-by-side in numerical order, with Rack #1 leftmost when viewed from the front.
5. If necessary, level the racks. The racks should be, at a minimum, approximately level. If necessary, shim the racks so they are level by eye (use of an actual level is better).
6. Align the front of the racks.
7. Bolt equipment racks to the floor. Follow the procedure below corresponding to the type of floor in the shelter. In general, equipment installers will encounter four types of floor: concrete, concrete covered with linoleum, wood, and raised floors. The procedure for each type is as follows:
   - For **concrete floors**, use 1/2" drop-in expanding anchors with an insulating nylon washer under the fastener head to anchor the racks (see Figure 3-1: Bolt Assembly Hardware and Figure 3-2: Nylon Washer and Bolt Assembly).
     1. Drill pilot holes for the anchors using the appropriate-sized carbide-tipped drill bit. The pilot holes must not exceed 1-1/2" in depth.
     2. Insert the anchors into the pilot holes.
     3. Place insulating phenolic strip(s)[2] and under the cabinets/racks before bolting them in place.
     4. Place the cabinet/rack over the holes.
     5. Assembly the bolts, fender washers and nylon washers.
     6. Insert the bolt and washer assemblies into the pilot holes.
     7. Tighten the bolts until firmly set (see Figure 3-3: Concrete Floor Mounting and Figure 3-4: Bolt Assembly Used to Bolt Rack to Concrete Floor).

Be careful not to over tighten bolts to avoid breaking the phenolic bushings.

[2] Phenolic strips are only required if the floor is pure concrete. Concrete floors covered with linoleum **do not** require phenolic strips.

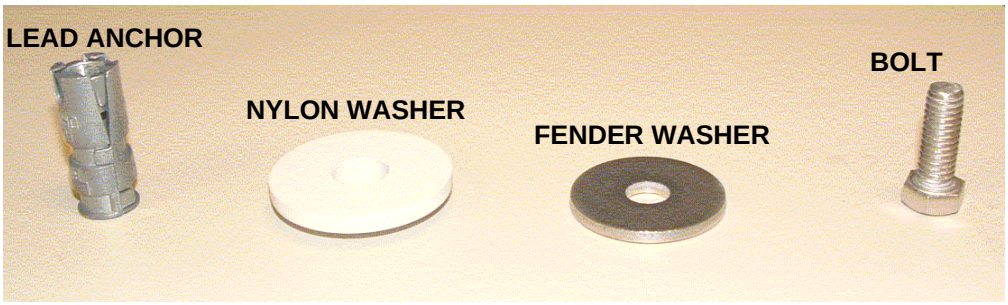


Figure 3-1: Bolt Assembly Hardware


Top View


Side View


Bottom View


Bolt Assembly

Figure 3-2: Nylon Washer and Bolt Assembly

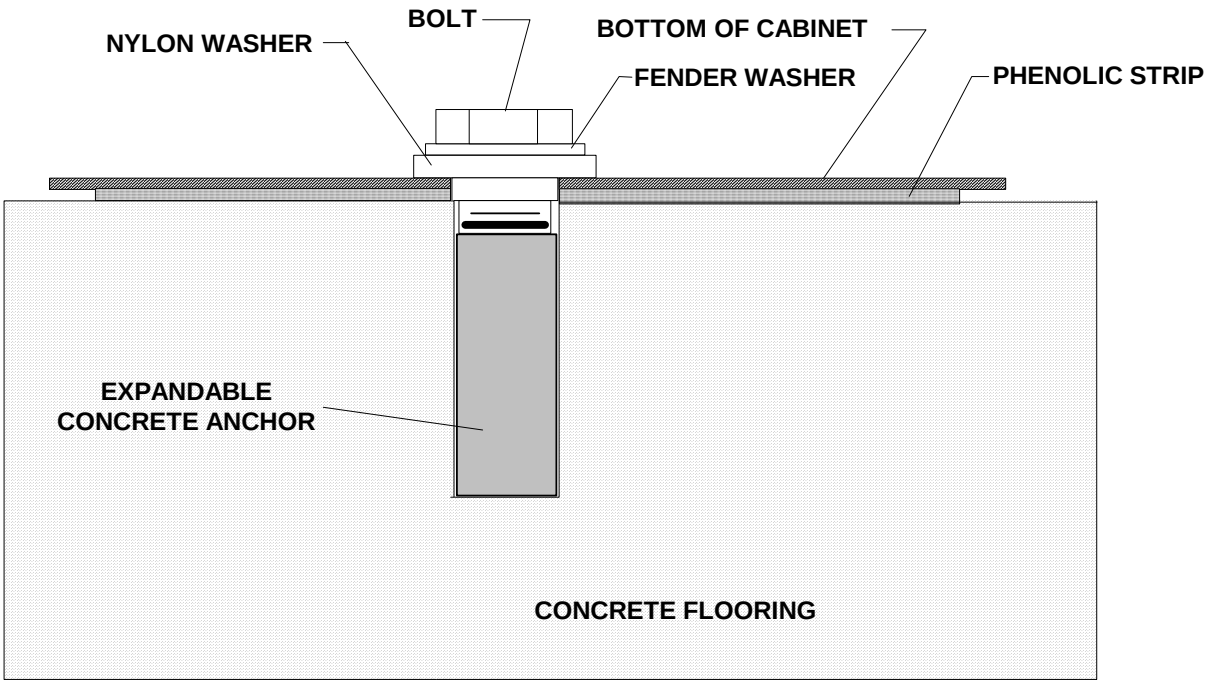


Figure 3-3: Concrete Floor Mounting

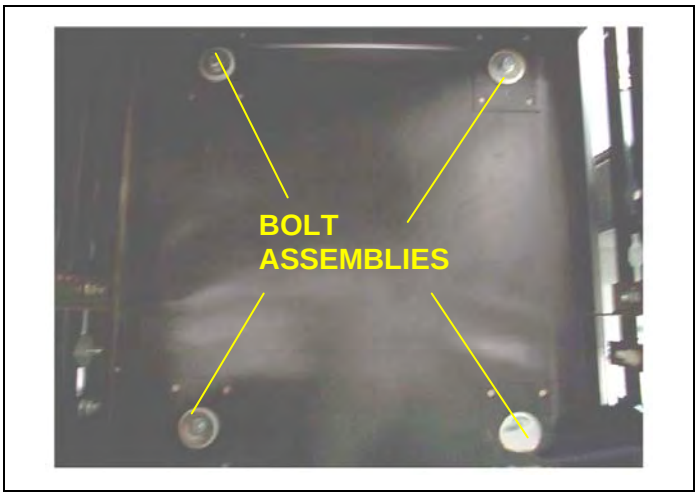


Figure 3-4: Bolt Assembly Used to Bolt Rack to Concrete Floor

- For **wood floors**, use a lag bolt with an insulating nylon washer under the head to bolt the racks to the floor. Insulating phenolic strips under the racks are **not** required. **No** pilot hole is needed on wood floors.
- For **raised floors**, the rack attachment procedure is quite different. The first and last racks in the row are bolted to the sub-floor as shown below. The remaining racks are bolted to the end racks, to each other, or both. Insulating phenolic strips **must** be placed under each rack (see Figure 3-5: Raised Floor Rack Attachment).

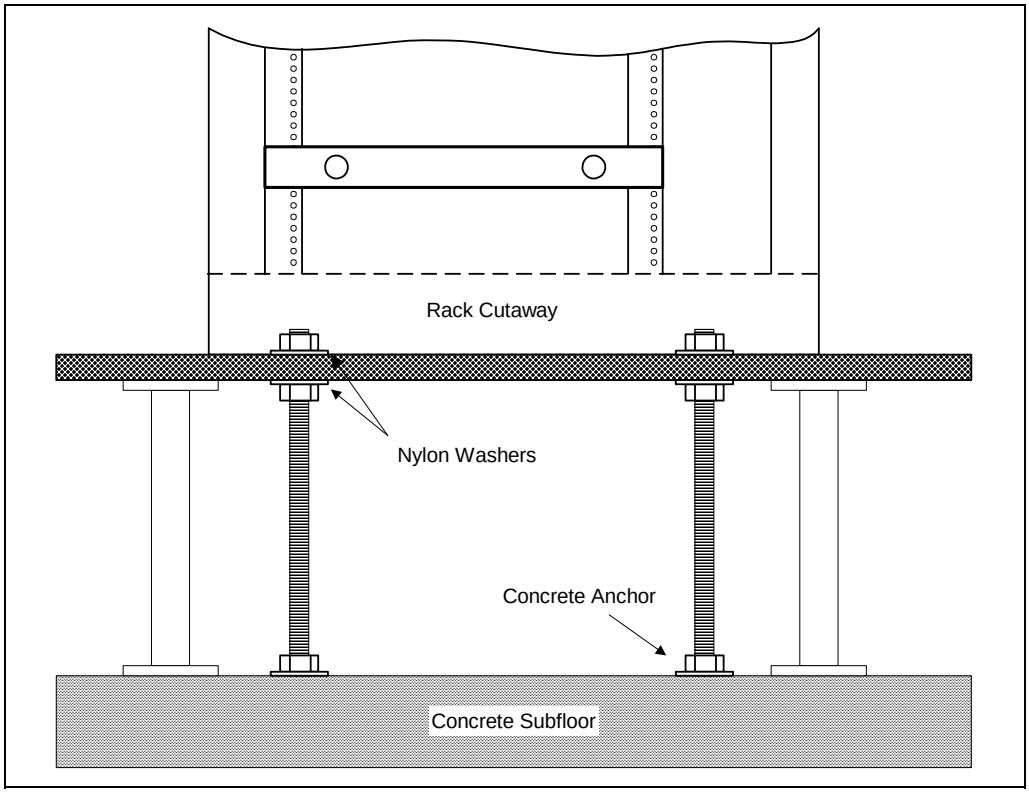


Figure 3-5: Raised Floor Rack Attachment

3.4 CABLING EQUIPMENT RACK COMPONENTS

Once the racks have been installed, interrack cable connections must be made, and racks must be connected to a power source and grounded, as well as connected to external communications sub-systems such as antennas. Follow this procedure in accordance with M/A-COM, Inc. Quality Standards Manual GQM0221. Possible rack-ups of equipment cabinets are shown in Figures 6 and 7.

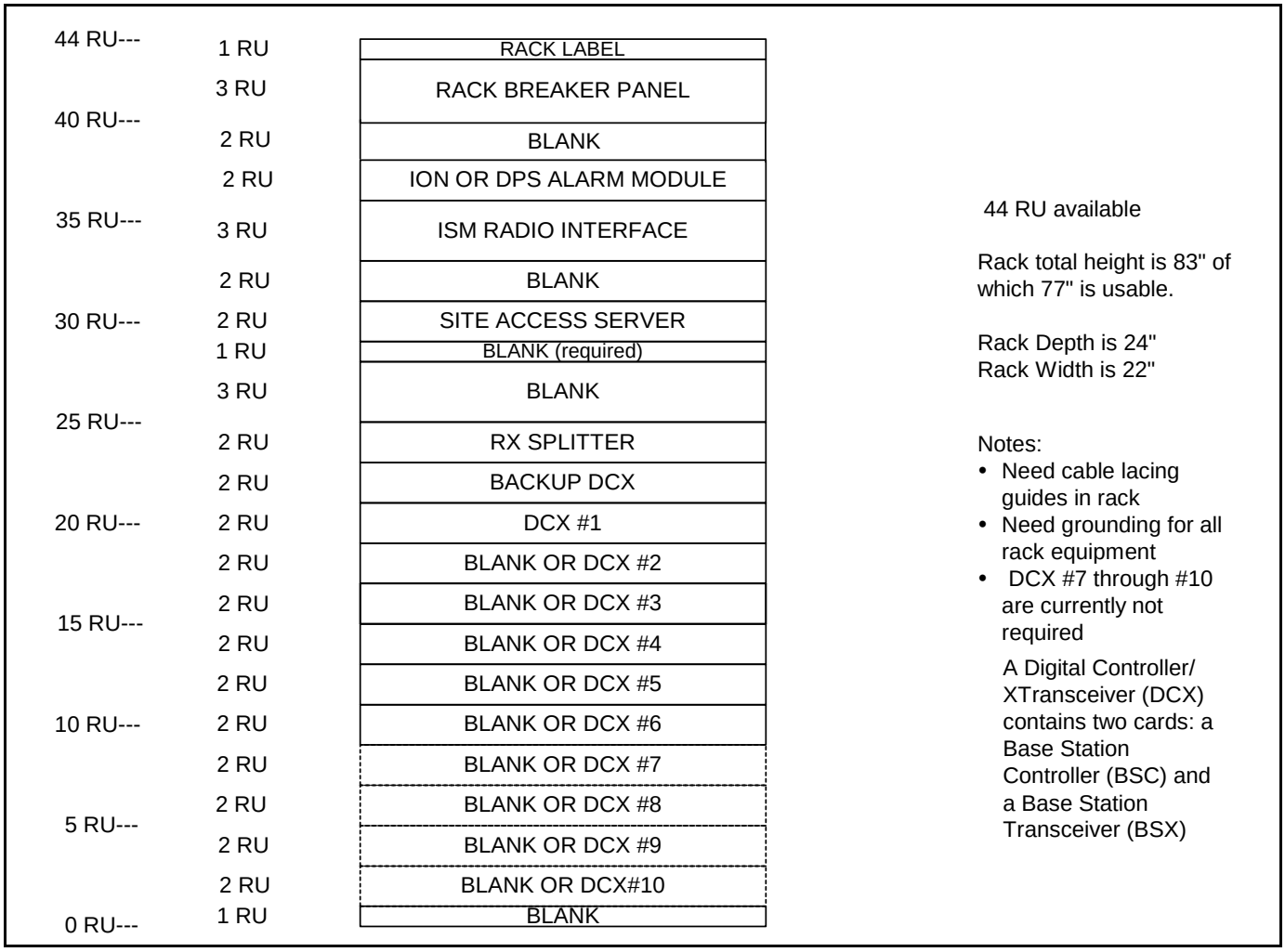


Figure 3-6: Possible Rack-Up of Tower Site Rack #1
For One To Ten Base Stations Plus Backup And ISM Radio Options

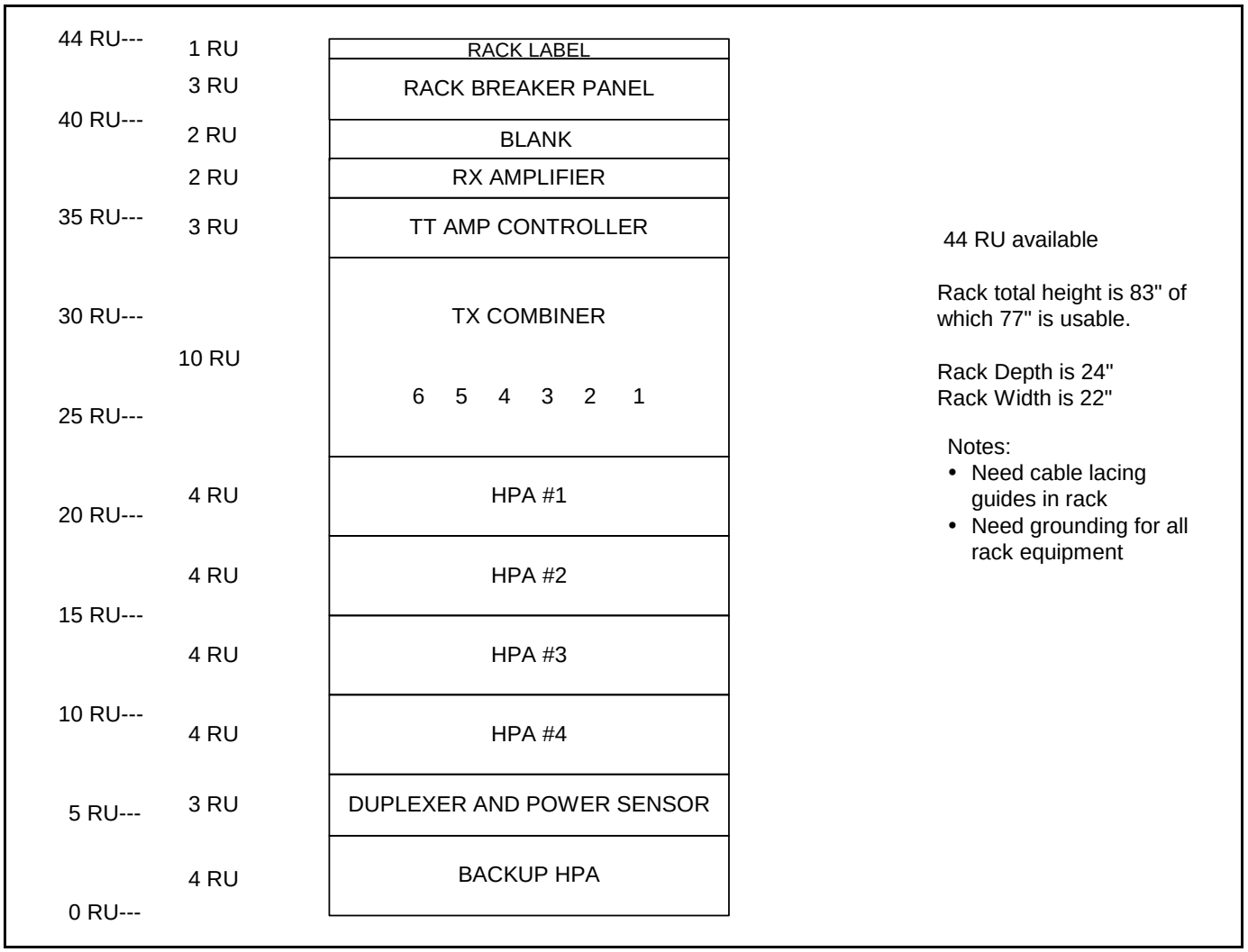


Figure 3-7: Possible Rack-Up of Tower Site Rack #2
With Separate TX/RX Antenna Option For Base Stations #1 To #4 Of Six Maximum Plus Backup Option

Use the right tool for the job!

Eight Inch-Pound Torque Wrench or Newton/Meter Wrench for SMA-Type connectors

Soft Jaw Connector Pliers for N-Type connectors

3.4.1 Interrack Cable Connections

1. On the back of each **H**igh-**P**ower **A**mplifier (**HPA**) is an RF cable attached to the RF Input port. Attach each of these cables to the RF Output port on the companion **D**igital **C**ontroller/(X)Transceiver[3] (**DCX**) (see Figure 3-8: HPA RF Input Connection and Figure 3-9: DCX RF Output Connection).

[3] **D**igital **C**ontroller/(**X**) Transceiver (**DCX)** contains two cards: a **B**ase **S**tation **C**ontroller (**BSC**) and as **B**ase **S**tation (**X**)Transceiver (**BSX**).

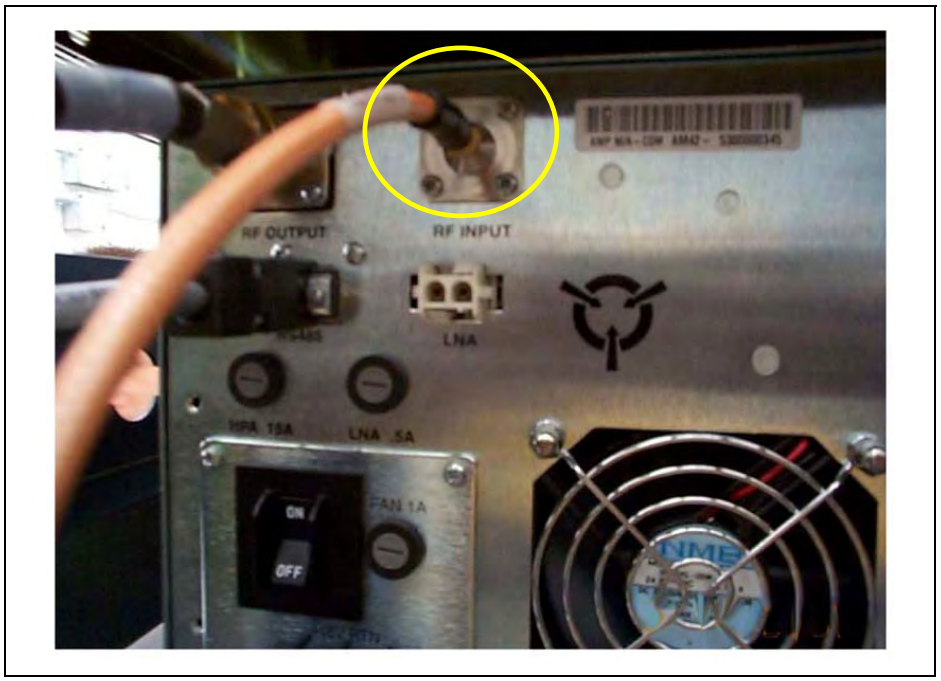


Figure 3-8: HPA RF Input Connection

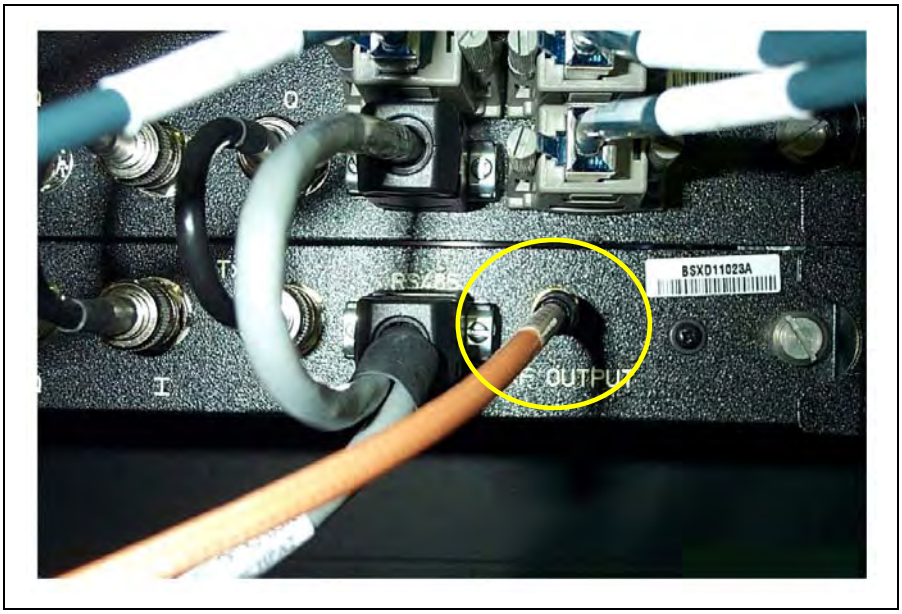


Figure 3-9: DCX RF Output Connection

2. Racks that hold the HPA's have two large unconnected wire bundles covered with a split loom. Pull these bundles to the adjacent rack, which contains the DCXs and the Base Station Alarm Module[4] (see Figure 3-10: Wire Bundles with DCX and Base Station Alarm Wiring).

[4] The Base Station Alarm Module can be an ION Alarm manufactured by Sentinel or a NetGuardian Alarm, model D-PK-NETGD-12053 manufactured by DPS Telecom.

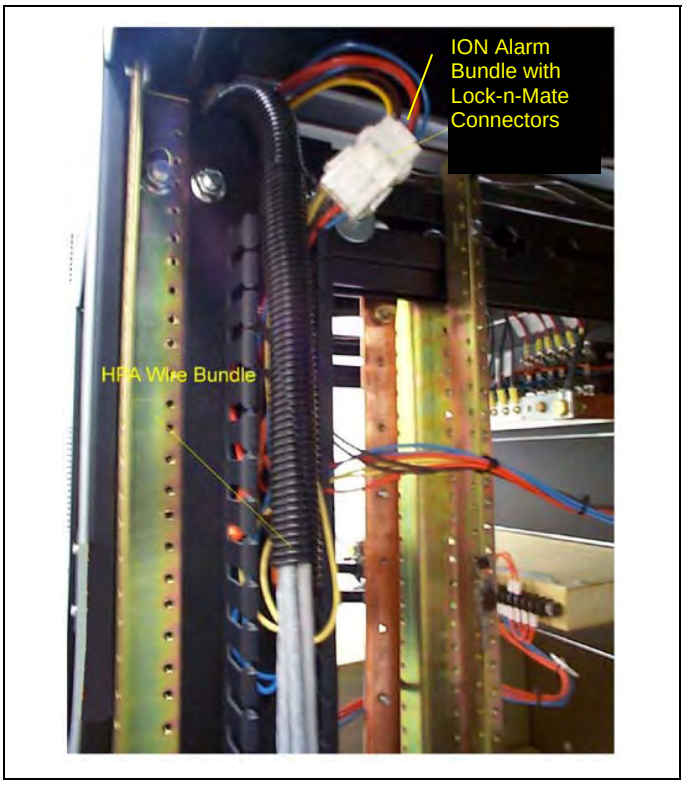


Figure 3-10: Wire Bundles with DCX and Base Station Alarm Wiring

(This figure is for the ION Alarm only. The DPS Alarm uses punchblock connections.)

3. Included in the wire bundle above, is a wiring harness with the female half of a MATE-N-LOK® connector. Locate the male half (it connects to the harness that runs to the Contact Closure Inputs plug on the Base Station Alarm Module) and connect the MATE-N-LOK connectors (see Figure 3-11: DPS Alarm Punchblock Connector).

Figure 3-11: DPS Alarm Punchblock Connector

4. The remaining cables in this wiring bundle are data cables that attach to each DCX. Dress these cables into the cable tray. Each data cable terminates in a pigtail with an RS-485 connector on both the main cable and its pigtail. Following the labels on each data cable, plug the main cable and its pigtail into the two RS-485 ports on each DCX. The main cable plugs into the bottom (RF) half of the DCX (BSX) and the pigtail plugs into the top (digital) half of the DCX (BSC) (see Figure 3-12: RS-485 Main Cable and Pigtail Plug Connected to DCX).

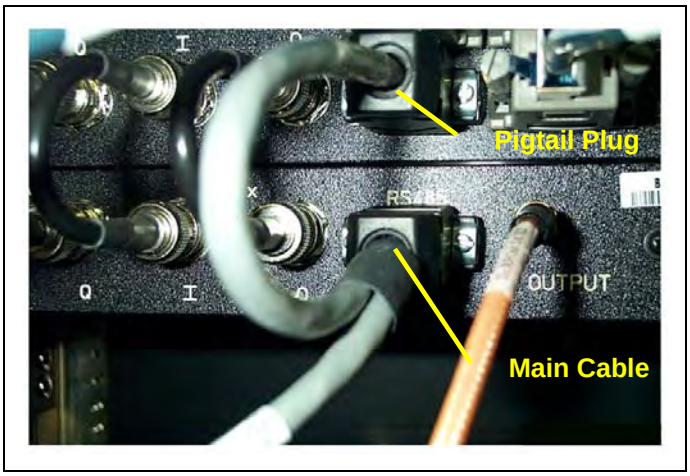


Figure 3-12: RS-485 Main Cable and Pigtail Plug Connected to DCX

5. Locate the cable attached to one of the host ports on the Alarm Module that has an RS-232 connector on the free end. Plug this connector into the RS-232 port on the Bird Electronic Corporation Power Monitor (VSWR) in the adjacent rack (see Figure 3-13: RS-232 Connector from Alarm Module to Bird Power Monitor (VSWR).

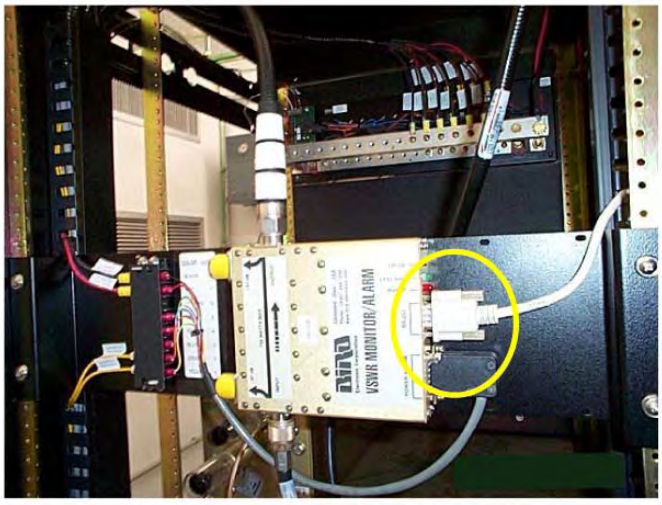


Figure 3-13: RS-232 Connector from Alarm Module to Bird Power Monitor (VSWR)

6. For Sites with a dual antenna, locate the Tower-Top Amplifier Control Box. In the adjacent rack, locate the cable attached to the Input port of the TX/RX multi-coupler. Connect the free end of that cable to the Tower-Top Amplifier Controller's Receiver

Multi-Coupler port (see Figure 3-14: Cable Connecting the Tower-Top Amplifier Control Box to the Input port of the Multi-Coupler).

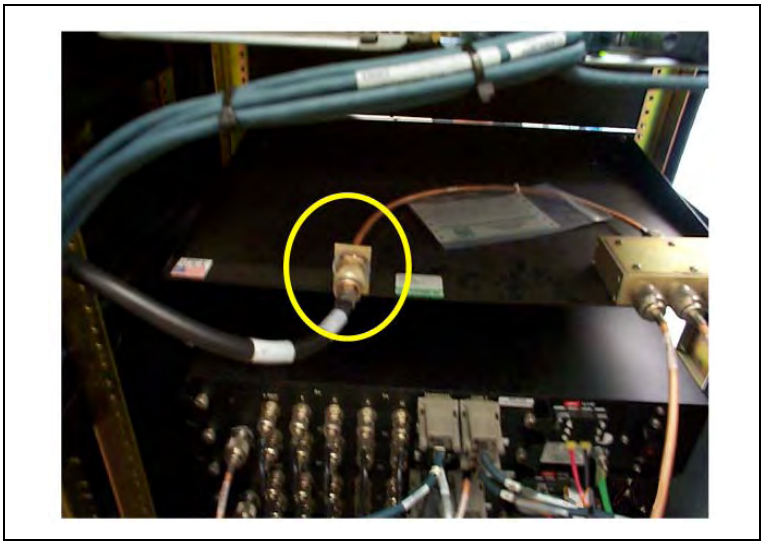


Figure 3-14: Cable Connecting the Tower-Top Amplifier Control Box to the Input port of the Multi-Coupler

3.4.2 Connecting Power Source and External Equipment

Once rack-to-rack cables have been connected, the racked equipment in the enclosure must be connected to external equipment and to the power source. For a layout of the cable tray refer to Figure 3-15: Cable Tray Layout.

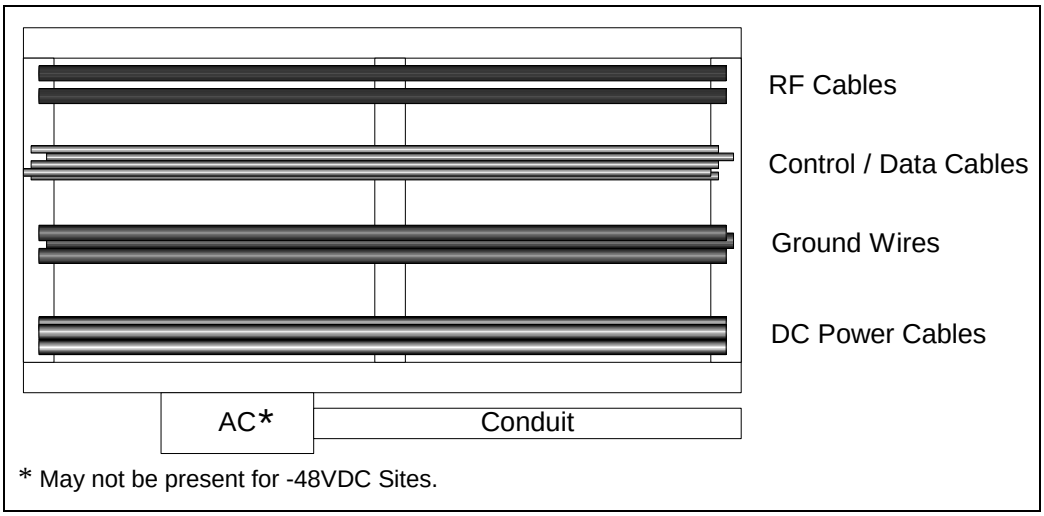


Figure 3-15: Cable Tray Layout

3.4.3 Connect Cabling for the Power Source

1. Run two DC power cables (#6 insulated red connected to -48 volts) and ground (DC return insulated black) from the site's -48VDC Distribution Panel (see Figure 3-17: -48 Volt Breaker Distribution Panel of the DC Power Supply - Red Wire[5] and Figure 3-18: DC Return Distribution Bar - Black Wires) to each rack, attaching the cables to the racks.

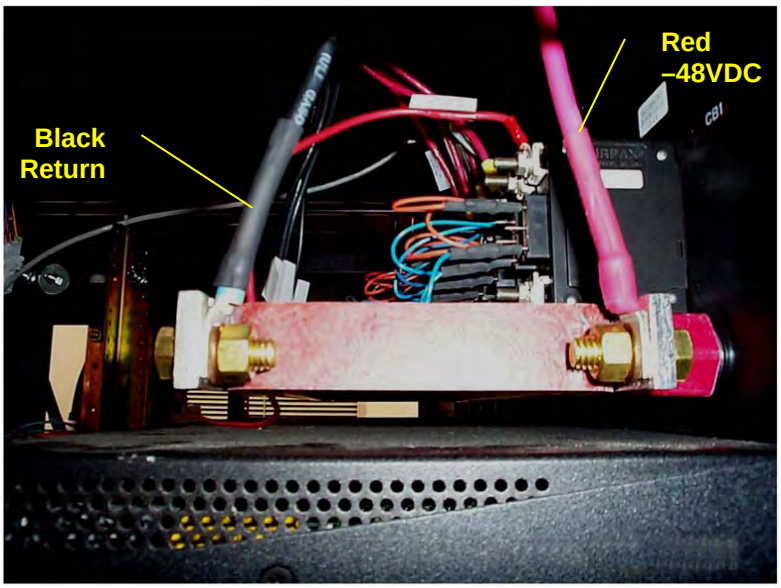


Figure 3-16: DC Power Connection Found in Each Rack - Black (DC Return) and Red (-48 Volt) wires

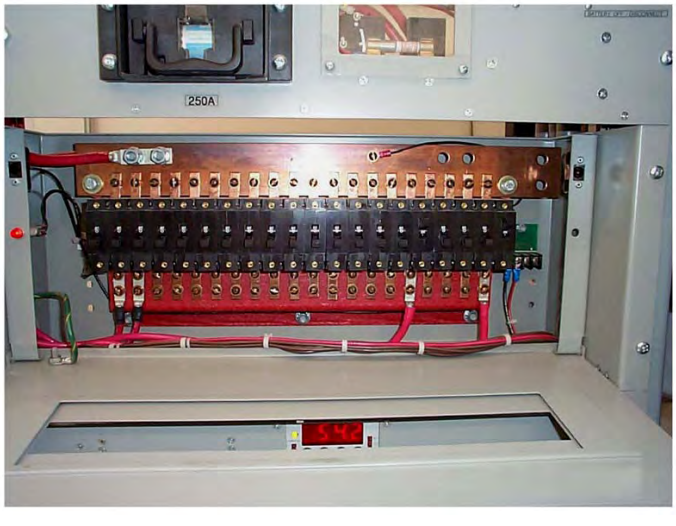


Figure 3-17: -48 Volt Breaker Distribution Panel of the DC Power Supply - Red Wire

[5] The DC supply may not be the make shown here.

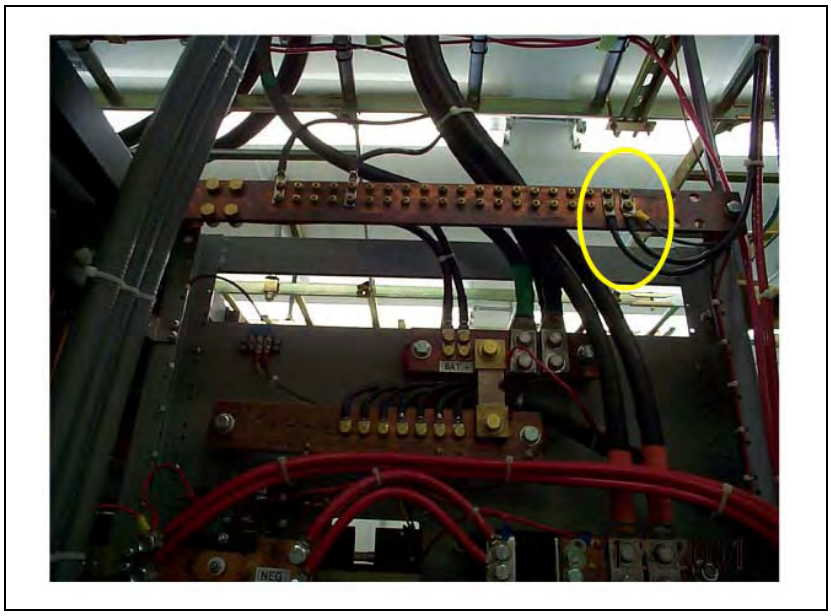


Figure 3-18: DC Return Distribution Bar - Black Wires

2. If not already labeled, label OpenSky circuits in the breaker panel to identify each rack (see Figure 3-19: Properly Labeled OpenSky Circuit Breakers in the Distribution Panel - OpenSky Rack 1, OpenSky Rack 2, etc.)

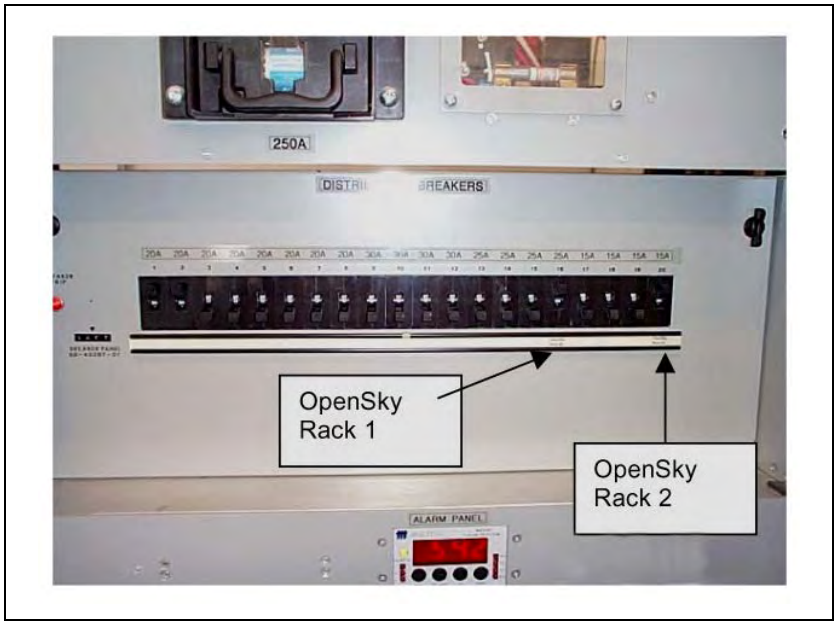


Figure 3-19: Properly Labeled OpenSky Circuit Breakers in the Distribution Panel

3. Route cables as specified by the installation procedure, using existing cable trays and overhead ladders, routing cables under raised floors, and so on.
4. Route DC power cables together and maintain at least two inches (2") spacing between the DC power cable bundle and other types of cables.

3.4.4 Connect Grounding Cables to Equipment Racks

Attach a ground cable to each rack.

1. Run #6 Green grounding cable (stranded copper) from each rack ground directly to the single-point ground bar in each enclosure.

CAUTION

All bends in the grounding cables must be < 70-degrees.

All bends in the grounding cables must have minimum bend radius of 8 inches.

See the M/A-COM Quality Standards Manual (GQM0221) for more information.

2. At a single point cabinet ground, use a two-hole lug to attach the ground cable. Route the cables as specified by the installation procedure, using existing cable trays and overhead ladders, routing cables under raised floors, and so on (see Figure 3-20: Single Point Ground That is Found on Each Rack and Figure 3-21: Ground Bar).

Figure 3-20: Single Point Ground That is Found on Each Rack

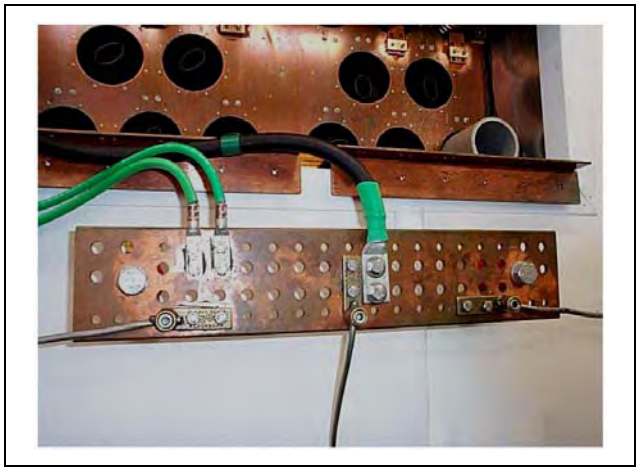


Figure 3-21: Ground Bar

3. Route the ground cables together and maintain at least two inches (2") spacing between the ground cable bundle and other types of cables.

3.4.5 Connect Antenna Cables to Equipment Racks

Attach the antenna cables to the communications equipment.

1. Prior to the communications equipment installation, one or two antennas will have been installed at the site. The antenna cables will have been terminated inside the enclosure onto a metal plate (ground plane).
   - For **single antenna sites**, the incoming antenna cable terminates in a PolyPhaser® (surge protector) attached to the ground plane.
   - For dual antenna sites, both the transmission and receiving antennas' incoming cables terminate in a PolyPhaser (surge protector). Systems with tower-top amplifiers require a special DC Injection/DC Path Protector (PolyPhaser #DC50LNZ+30-MA). The 1-5/8" cable is the TX cable and the 7/8" cable is the RX cable when used with a Tower Top Receive Amplifier.

Figure 3-22: Dual Antenna PolyPhasers (Surge Protectors)

2. Attach drop cables from the PolyPhaser to the appropriate antenna connection points in the OpenSky equipment racks.
3. Route the cables appropriately, or as specified by the installation procedure, using existing cable trays and overhead ladders, routing cables under raised floors, and so on.
4. Maintain at least two inches (2") spacing between the antenna cables and other cables.

3.4.6 Connect the T1 Network

Connect the high-speed digital T1 (telephone) network Interface to the Site Access Server as defined by the Site Deployment Order.

NOTE

In most installations, this connection goes to microwave equipment.

3.4.7 Site Clean Up

Before leaving, remove any debris, such as wire clippings, metal shavings, dust mounds, etc. from the site.

3.5 COMPLETING THE INSTALLATION

Once the OpenSky equipment has been installed, perform field testing as detailed in Section 4.0 SITE TEST PROCEDURES to verify operation according to specifications of installed equipment racks with externally connected subsystems such as antennas.

Procedures:

1. Perform testing to verify correct operation and performance of the installed equipment racks, following the procedures specified in Section 4.0 SITE TEST PROCEDURES.
2. Set HPA transmission power level, following the procedure specified in Section 7.06.7 -TX POWER CALIBRATION (MANDATORY).
3. If problems occur during installation, describe them and detail how they were resolved. If the installation could not be completed, describe the obstacles and clearly explain what was done and what remains to be done.

4.0 SITE TEST PROCEDURES

4.1 PURPOSE AND SCOPE

This section describes post installation tests required for compliance testing of the M/A-COM Wireless Systems OpenSky Digital Base Station. This section defines and details the test plan and methodology for each test.

Objective: This test confirms a base site receive channel is not corrupted by site specific noise or interference. Site installation and site gain optimization should be completed before this test is performed. The NIMCAS site optimization program provides an expected difference between terminated and antenna connected quieting tests. Measured results should be within 2 dB of this value.

This section covers tests that perform two functions:

- Verify that all contractual requirements as detailed in the system **R**equirements **T**raceability **V**erification **M**atrix, (**RTVM**), are met. These tests are identified as mandatory and are linked to the relevant section for the RTVM.
- Ensure that the site, as installed, is operating at optimum performance. These tests are not mandatory but clearly have impact on some of those that are.

To ensure that the system is installed and configured correctly, the following procedures must be performed. In addition, several tests are performed to validate the RF performance of the station and to ensure compliance with the station FCC license.

This section is therefore divided into the following areas:

- Verification Testing
- Equipment Configuration
- Compliance Testing
- Performance Testing
- Operational Testing
- Network Connectivity
- Final Operating Capability
- Appendices: Supplemental information on equipment configuration and control access.

  ⇒ Base Site Configuration Procedure should also be consulted for configuration questions (see APPENDIX F - TYPICAL BASE STATION CONFIGURATION).

  ⇒ Installed Site Cavity Tuning Procedure should also be consulted for Filter Tuning (see APPENDIX H - VERIFICATION TESTING – TRANSMIT FILTER TUNING).

4.2 OVERVIEW OF OPENSKY BASE SITE EQUIPMENT

An OpenSky base station consists of a variety of products and includes radio transmitting and receiving equipment, RF distribution equipment and network communications system interface equipment.

OpenSky is a digital system and has some significant differences in terms of fixed network connectivity to that commonly seen with conventional analog systems. In particular, base station controllers (BSCs) communicate via an access server and are connected back to a central office or dispatch center via digital circuits.

OpenSky base station equipment is available in five primary RF configurations. This document covers Types 1, 2, 3, and 4 listed below. Type 5 is covered separately.

1. Primary site with separate transmit and receive antennas: Referred to as a Tower Top Site.
2. Primary site with a single antenna for transmit and receive: Referred to as a Duplexed Site.
3. Outdoor Enclosure with separate transmit and receive antenna.
4. Outdoor Enclosure with a single antenna for transmit and receive.
5. Low profile site providing coverage fill: Referred to as a Cell Site.

4.3 TEST METHODOLOGY

Equipment configuration and testing must be performed in accordance with the instruction given in this document. Tests must also be conducted in the order given in this document as adjustments made during certain procedures may affect the results of other tests.

Testing an installed base site comprises performing standard forward and reverse channel tests to ensure correct operation of the entire installation. Testing also verifies physical and application layer connectivity to the Regional Operations Center serving the site under test via a communications link.

Required specifications are verified using one of the following methods:

1. **Inspection:** An observation or examination of an item against the applicable documentation to confirm compliance with the requirements.
2. **Analysis:** Interpretation, interpolation, or extrapolation of analytical or empirical data under defined conditions of reasoning to show theoretical compliance with stated requirements.
3. **Demonstration:** Verification of an operational or functional capability by one or more performances before qualified witnesses, as designated by the customer. Instrumentation or data recording beyond that provided indigenously by the elements to be verified shall generally not be required.
4. **Objective Test:** Performance of a functional operation under specific conditions involving the use of instrumentation, special test software, and/or special test equipment to generate, acquire, and/or record data. This method may include an analysis of test data.

4.4 PREPARATION

To prepare for the start of testing, it is important that all test equipment be powered up now and allowed to thermally stabilize. Begin by powering up the Communications Test Set HP 8920.

Record the specifics of each of the system components.

Before testing the complete system, verify that the system is cabled correctly. The tower-mounted receive amplifier will not power up until it senses that the indoor control panel has been connected via the RF feed cable and the multi-conductor control cable. The initial sections of this procedure describe how to check for correct installation, particularly those areas that were disturbed as part of the shipping process.

4.5 RECORDING TEST RESULTS

The main body of this document provides space for the recording of all test results and equipment configuration parameters. These must be supplemented where indicated by equipment configuration hardcopy printouts taken for each RF channel being tested.

4.6 BASE SITE BLOCK DIAGRAM

Figure 4-1: 3-Channel Base Station with Tower Top Amplifier Block Diagram, shows the Block Diagram for a three-channel site installation.

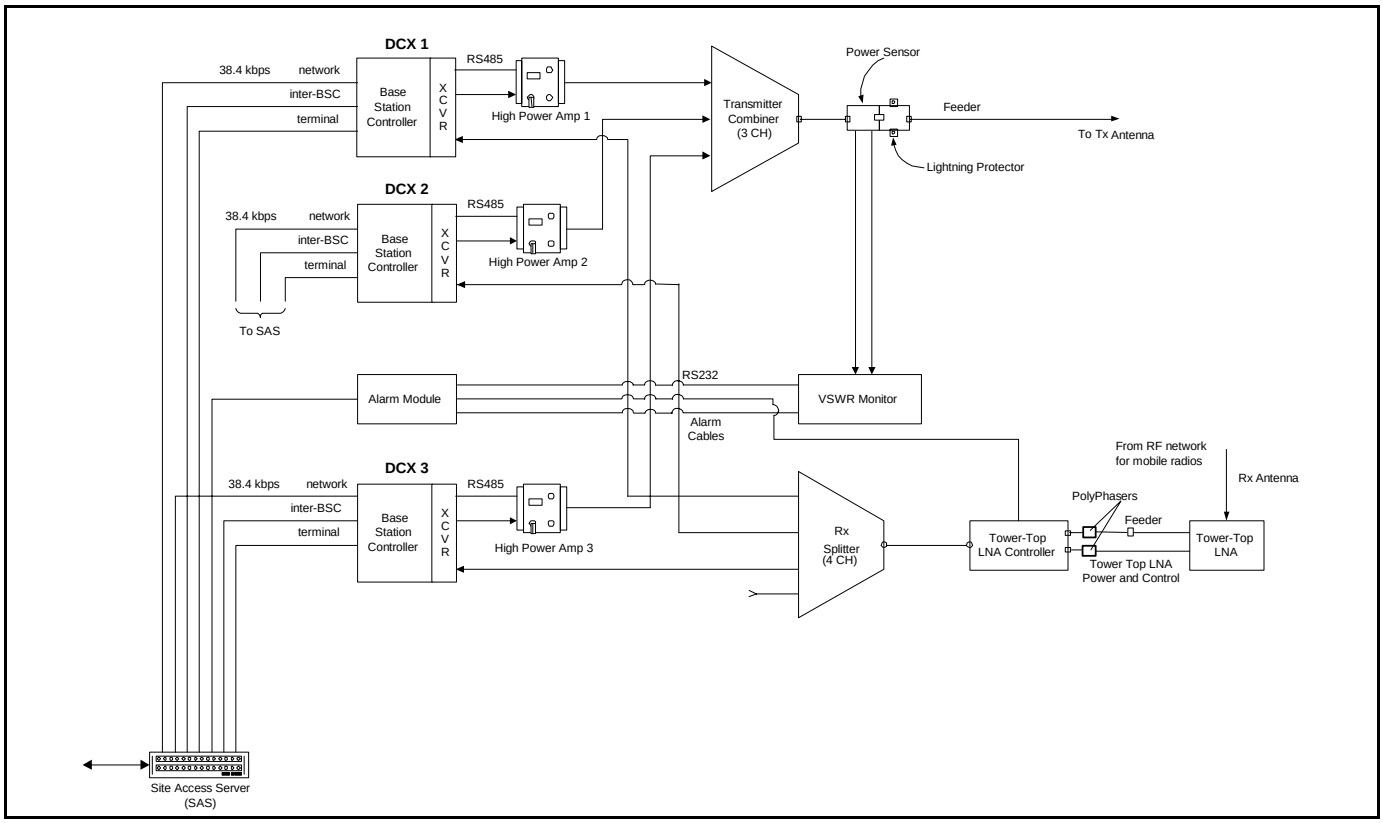


Figure 4-1: 3-Channel Base Station with Tower Top Amplifier Block Diagram

4.7 INSPECTION

In this section, the location of the installation is recorded and equipment configuration parameters are verified against the As Built. In addition, general workmanship and quality of assembly and installation are inspected

NOTE

Only selected parameters are checked against the recorded factory configuration as all parameters are programmed into equipment before leaving the factory and hence should not require to be modified.

4.7.1 Pre-test Inspection

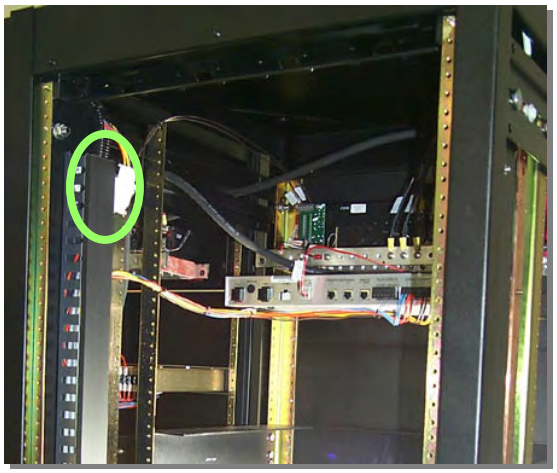
Objective: To verify that the site installation has been satisfactorily completed and that newly installed cable interfaces have been correctly connected, especially inter-rack cabling disconnected during shipment.

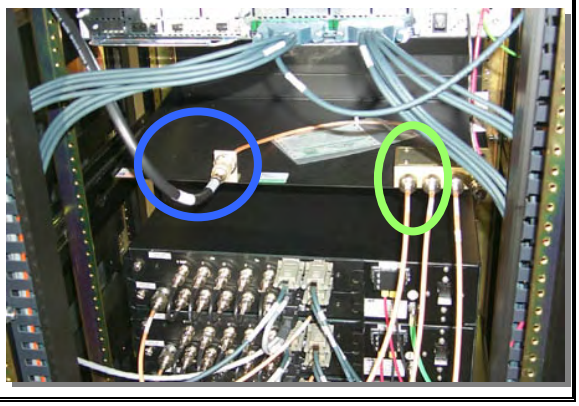
NOTE

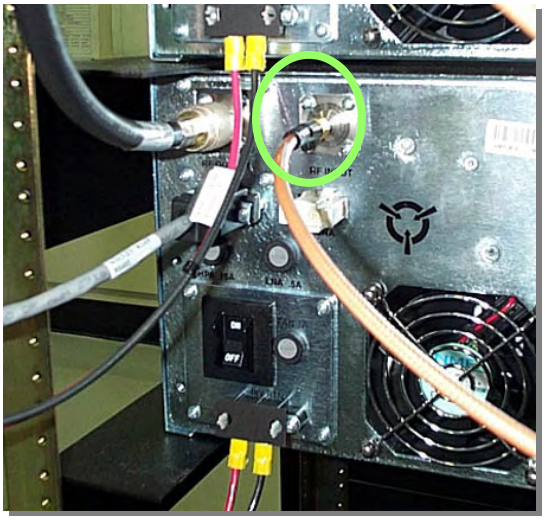
Before commencing this section of tests, **ENSURE THAT ALL RACK CIRCUIT BREAKERS ARE IN THE OFF POSITION.**

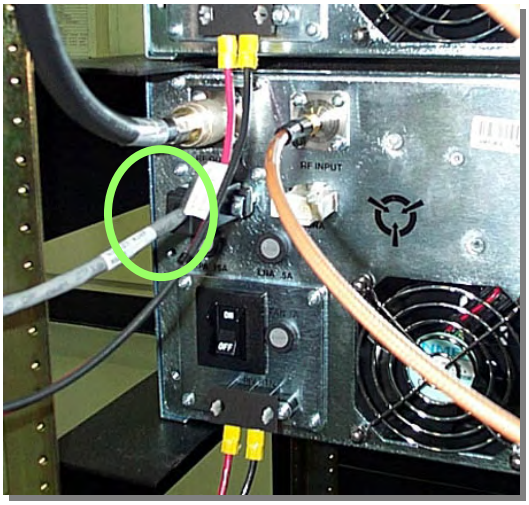
PRE-TEST INSPECTION	ACTION	MISCELLANEOUS
1.	A two rack three channel base station is as shown in the figure to the right. Rack 1 (on left) contains system transceivers, communication interfaces and control and monitoring equipment; Rack 2 (on right) contains transmit path RF power amplifiers and combining equipment.	

4.7.2 Interrack Cabling

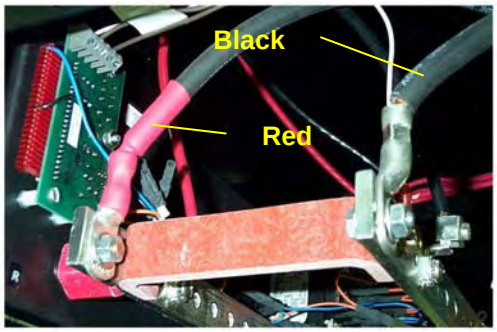
ALARM CABLING	ACTION	MISCELLANEOUS
2.	The photograph to the right shows the location of the inter-rack alarm interconnect cable. Verify that it has been connected as shown where the circle is located.	

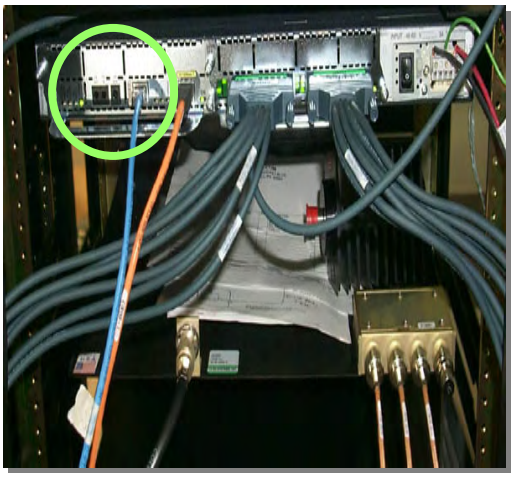
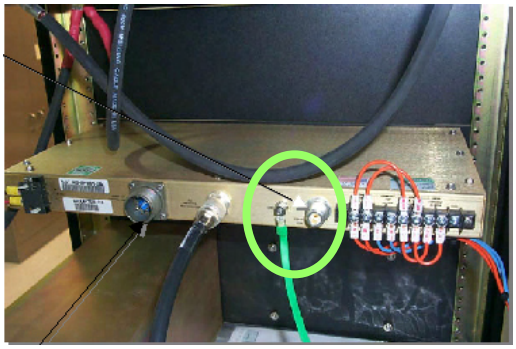
RECEIVE MULTICOUPLER INPUT	ACTION	MISCELLANEOUS
3.	The photograph to the right shows the source and destination points for the receive Multicoupler feed. Verify that it is connected as shown. Also, verify that unused output ports are terminated with a 50-Ohm terminator.	

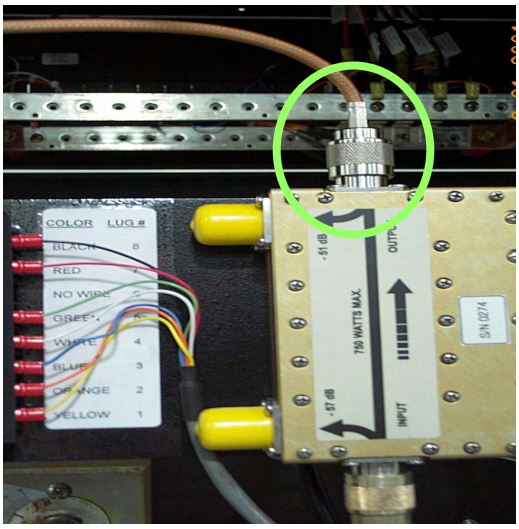
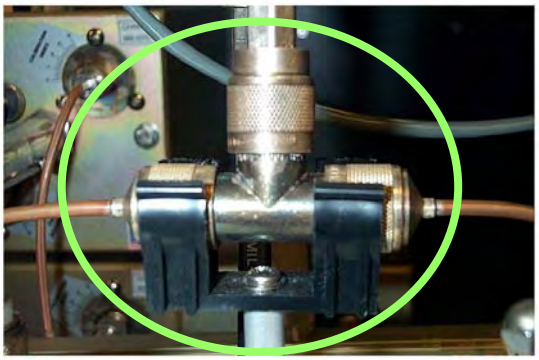
HPA RF INPUT	ACTION	MISCELLANEOUS
4.	The photograph to the right shows the destination point for the HPA RF Input. Verify that they are connected as shown.	

HPA CONTROL CONNECTION	ACTION	MISCELLANEOUS
5.	The photograph to the right shows the destination point for the HPA control cable. Verify that they are connected as shown.	

4.7.3 New Cabling

RACK POWER CONNECTION	ACTION	MISCELLANEOUS
6.	The photograph to the right shows the connection points and polarity of the DC power connection to each power distribution panel. Verify that they are connected as shown. **Note:** The red cable is the most negative, i.e. -48VDC. The black cable is the return.	
RACK GROUNDING	**ACTION**	**MISCELLANEOUS**
7.	The photograph to the right shows the connection point for rack to halo grounding. The halo is located inside the shelter and is part of the shelter grounding system that is fed to an earth ground. Connect a black ground cable from the halo to the two hole lug shown here.	

SYSTEM COMMUNI-CATIONS	ACTION	MISCELLANEOUS
8.	The photograph to the right shows the in-rack connection point for T1 communications. The destination of this connection will vary by site; however, verify that a modular style plug wired (T568B) is used to connect the site communications interface with the base site T1. If equipped with ISM Backhaul, the Orange cable is the 10BaseT connection to the ISM Backhaul Router. **Note:** Actual cables may be different colors.	
RECEIVE ANTENNA CONNECTION	**ACTION**	**MISCELLANEOUS**
9.	The photograph to the right shows the in-rack connection point for the system receive antenna. Verify that the jumper cable to the receive antenna is present and *disconnect it from the receive input.* **Note:** This is only for Tower Top Amplifier sites.	
TTA CONTROL CABLE	**ACTION**	**MISCELLANEOUS**
10.	Ensure that the 5-conductor Tower Top Amplifier control cable is connected as shown in the photo to the right. **Note:** The connector is installed in the field. To solder the connector to the cable, refer to APPENDIX A.	

TRANSMIT ANTENNA CONNECTION	ACTION	MISCELLANEOUS
11.	The photograph to the right shows the in-rack connection point for the system transmit antenna. Verify that the jumper cable is present and *disconnect it from the Bird Power Monitor output.*	
DUPLEX ANTENNA CONNECTION	**ACTION**	**MISCELLANEOUS**
12.	The photograph to the right shows the in-rack connection point for a duplexed system. Verify that the jumper cable is present and *disconnect it from the "T" shaped connection.*	

5.0 EQUIPMENT CONFIGURATION

The objective of this procedure is to verify that base station equipment has been correctly programmed for the site at which it is installed. Testing involves connecting a laptop computer to each piece of equipment and interrogating and recording configuration files.

A record of the configuration files **will** be shipped with the radio rack. Compare the pertinent parameters with the highlighted parameters as indicated on the final configuration documents from staging.

Required Test Equipment:

- Laptop with Floppy Disk Drive
- PC operating system and HyperTerminal
- Blank floppy disk
- Cisco® "Black Connection Cable"
- Cisco 9-pin "D" shell to RJ-45 adapter
- Or, 9-Pin Male to 9-Pin Female w/Null Adapter

6.0 PERFORMANCE TESTING[6]

This series of tests characterizes the receive performance of the Base Station in terms of its absolute sensitivity and its sensitivity relative to the local noise floor at the installed site.

The base station is capable of providing a raw discriminated output to support analog receive testing. The output is provided on the "Q" Transmitter output of the BSC when the base station is in output mode 0.

Required Test Equipment:

- PC running suitable console application
- Cisco “Black” cable
- Cisco RJ-45 to DB9 (F) adapter
- Or, 9-Pin Male to 9-Pin Female w/null adaptor
- HP 8920 Communications Analyzer
- 30dB Directional Coupler
- Parallel Printer & Cable

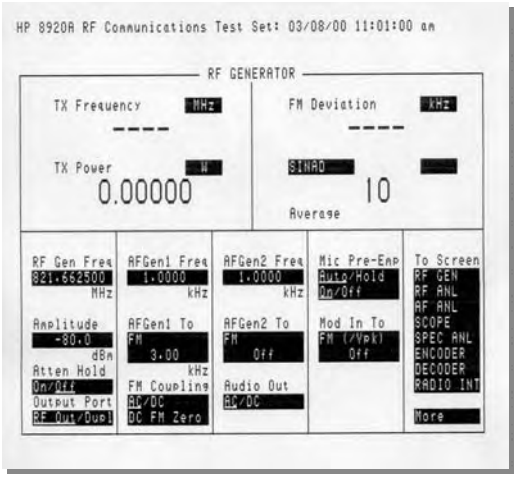
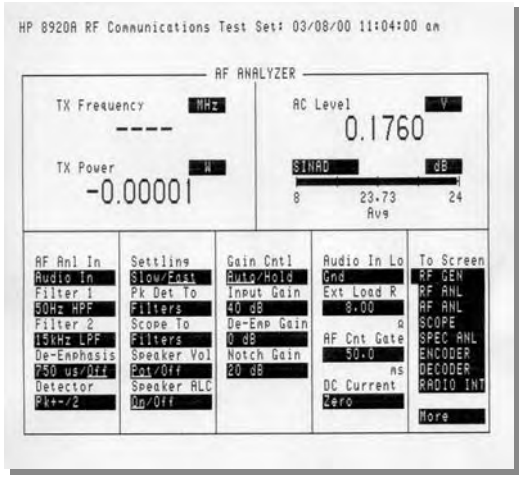
6.1 ANALOG RECEIVE TESTS (MANDATORY)

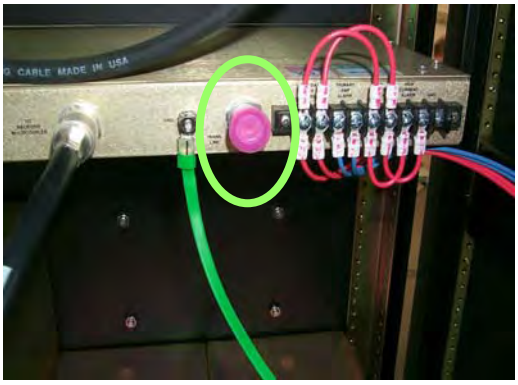
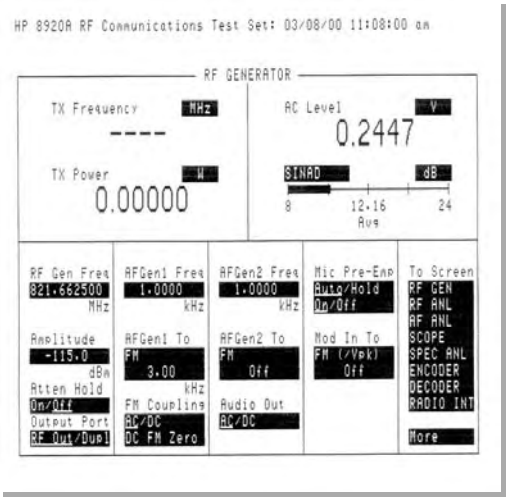
6.1.1 12dB SINAD Receiver Sensitivity

Objective: The 12dB SINAD test measures the effective receive sensitivity and signal to noise ratio of the RF Channel. This test is performed at the RF input connection, on the BSX. Compare the results with the staging area data.

STEPS	ACTION	MISCELLANEOUS
1.	Connect the PC to the Terminal port of the DCX of the base station under test. **Note:** Requires Black Cisco cable & adapter and a communications data rate of 19,200 bps.	
2.	Ensure that the Disable/Enable switches on all HPA’s are DISABLED.	

[6] Taken from M/A-COM, Inc - Drawing No. GTP-0296, Rev. A

STEPS	ACTION	MISCELLANEOUS
3.	To place the DCX in Analog Mode, enter the sequence of commands indicated by bold script in the example seen to the right.	**Offline** [CR] *;<Various status messages>* **at@outmode0** [CR] OK **save_config** [CR] OK **Reboot** [CR] *; < The Base Station Reboots>*
4.	Repeat Steps 1 and 2 for all other DCX units.	
5.	Ensure that the DCX and HPA under test are powered up and the HPA is offline.	
6.	On the HP 8920, select the **RF GEN** screen and set the following configuration, (see adjacent photo): **RF Gen Freq:** Set for the receive frequency of the RF path under test (45MHz below the Transmit Frequency) . **Amplitude:** -80 dBm **Output Port:** RF Out **AFGen1 Freq:** 1kHz **AFGen1 To:** FM 3kHz **AFGen2 To:** Off **AC Level:** Set to dBm plus 10 sample averaging **SINAD dB:** Set for an averaging value of 10 samples	
7.	Select the **AFANL** screen and set the following configuration: **AF Anl In:** Audio In **Filter 1:** 300Hz HPF **Filter 2:** 3kHz LPF **De-Emphasis:** 750 µsec **Detector:** rms	

STEPS	ACTION	MISCELLANEOUS
8.	Select the **RF GEN** screen and place the cursor on the **Amplitude** field.	
9.	Configure test as follows: • Verify HP 8920 RF IN/OUT port is connected to the antenna port of the TTA Controller. • Disconnect the TX Q cable from the DCX under test. • Connect a Test Cable between the TX Q port under test and the Audio In Hi port of the HP 8920.	
10.	Adjust the volume control on the HP 8920 until the 1kHz test tone is audible.	
11.	On the RF GENERATOR screen, reduce the Amplitude of the generated signal until the indicated value for SINAD stabilizes at a nominal value of 12dB.	
12.	Record the amplitude on worksheet and record the results on the data sheet[7].	-122 dBm
13.	Repeat for all other DCX's.	

[7] Refer to APPENDIX L - RECORDED DATA SHEET.

6.2 ANALOG PERFORMANCE TESTING OF TOWER TOP AMPLIFIERS

This single channel measurement is performed using external antenna coupling between the transmit and receive antennas to deliver a test signal to the TTA. A SINAD System level test is performed with the TTA "On" and "Off" to measure the receive system improvement provided by the TTA. This is a relative measurement the difference between the "On" and "Off" measured value represents the system improvement provided by the TTA. Log the results on the site Test Data Form.

Required Test Equipment:

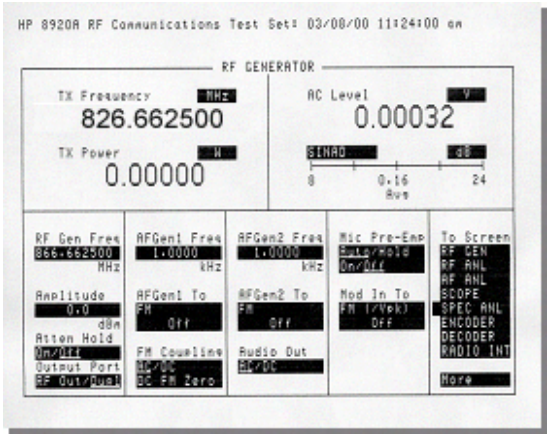
- PC running suitable console application
- Cisco “Black” cable
- Cisco RJ45 to DB9 (F) adapter
- HP 8920 Communications Analyzer
- 30 dB Coupler

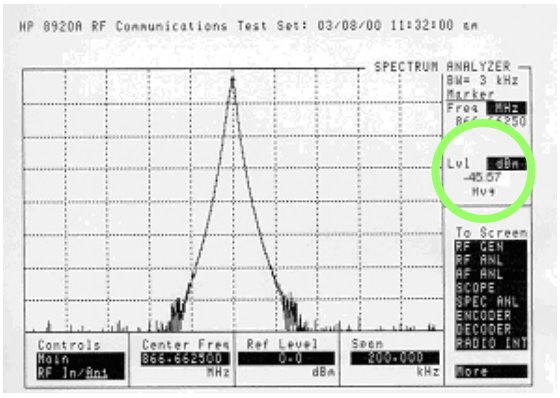
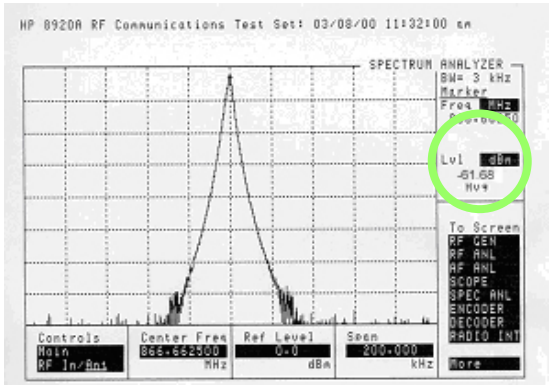
6.2.1 Tower Top Amplifier Performance Test

Objective: The 12dB SINAD test is performed to give a relative indication of the receive system improvement provided by the TTA by measuring the effective receive sensitivity and signal noise ratio of any assigned site receive channel.

6.3 TOWER TOP LOW NOISE AMPLIFIER (TTA) GAIN MEASUREMENT (REQUIRED)

The purpose of this test is to measure the gain of the TTA. The method will be to inject a test signal into the transmit jumper cable using a **receive channel frequency**. This signal will be coupled from the transmit antenna to the receive antenna and a reference power level measurement will be made with the TTA "On" and a second measurement will be made with the TTA "Off". This is a relative measurement and the difference will be the TTA gain value.

STEPS	ACTION	MISCELLANEOUS
1.	Select the RF GEN screen and configure the following: RF Gen Freq: Set as appropriate for any assigned receive frequency per SDO (TX Freq –45 MHz). Amplitude: 0dBm Output Port: Dupl AF Gen 1 & 2: Off	
2.	Verify a test cable is still connected from the transmit jumper cable (normally connected to the Bird Power Monitor output port) and the Duplex out port on the HP 8920.	
3.	Disconnect the Jumper at the TTA Control Panel RF output labeled " TO RECEIVER MULTICOUPLER".	
4.	Connect a test cable between the TTA Control Panel RF out port labeled "To RECEIVER MULTICOUPLER" and the Antenna In port of the HP 8920.	
5.	Verify that the Power Switch on the front of the TTA Control Panel is in the "On" position.	

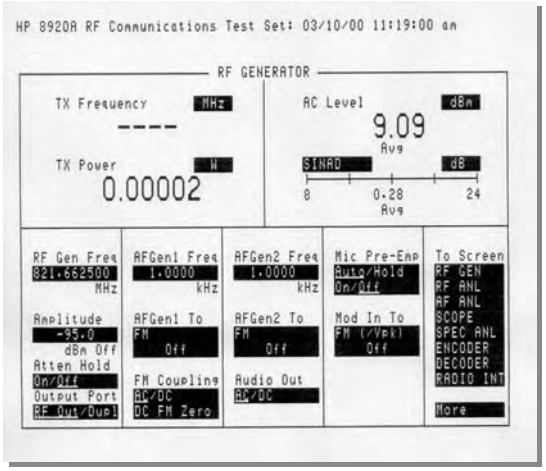
STEPS	ACTION	MISCELLANEOUS
6.	Record the power level as indicated in the HP 8920 Spectrum Analyzer Lvl field. Enter this value in the TTA Gain table, column 2 for TTA "On"[8].	
7.	Turn the Power Switch on the front of the TTA Control Panel to the "Off" position.	
8.	Record the power level as indicated in the HP 8920 Spectrum Analyzer Lvl field. Enter this value in the TTA Amplifier Gain table, column 2 for TTA "Off".	
9.	Subtract the recorded "Off" Lvl from the "On" Lvl.	
10.	Record the result (gain) in the table.	
11.	Reconnect the Jumper disconnected in Step 3 that goes to the TTA "To RECEIVE MULTICOUPLER" port.	

[8] Refer APPENDIX L- RECORDED DATA SHEET

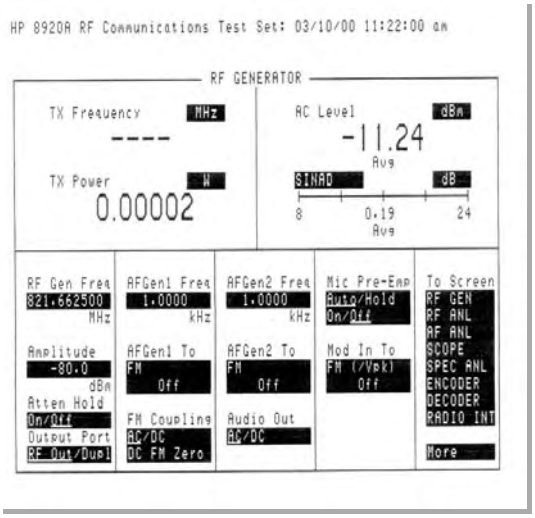
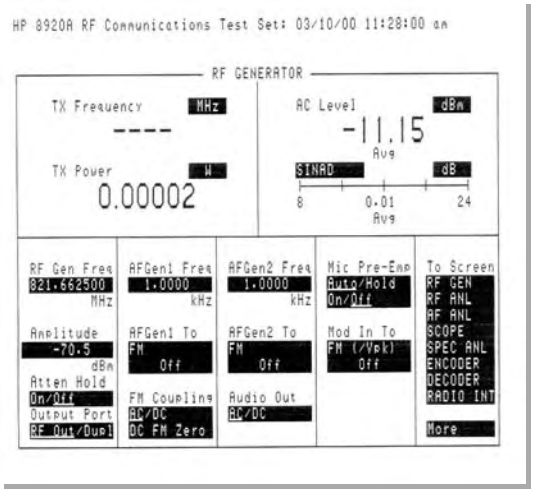
6.4 ANTENNA 20DB QUIETING TEST (MANDATORY)

Objective: This test measures the susceptibility of the site to de-sense resulting from site-specific interference.

STEPS	ACTION	MISCELLANEOUS
1.	On the HP 8920, select the RF GEN screen and set the following configuration: **RF Gen Freq:** Set for the receive frequency of the RF path under test. (45MHz below the Transmit Frequency recorded in data collection sheet. The set frequency will be in the range from 806-824 MHz. **Amplitude:** Off **Output Port:** RF Out **AFGen1 To:** Off **AFGen2 To:** Off **AC Level:** Set to dBm plus 10 sample averaging	
2.	Select the **AFANL** screen and set the following configuration: **AF Anl In:** Audio In **Filter 1:** 50Hz HPF **Filter 2:** 15kHz LPF **De-Emphasis:** Off **Detector:** Pk+-/2	
3.	Select the RF GEN screen and place the cursor on the Amplitude field.	

STEPS	ACTION	MISCELLANEOUS
4.	Configure test as follows: • Connect the 30dB Directional Coupler to the input of the receive multicoupler. • Connect the **RF IN/OUT** connector of the HP 8920 to the coupler port labeled as **TO ANALY**. • Connect the 50-Ohm terminator to the **ANT/TERM** port of the coupler. • Connect **Duplx/SPL** port to Multicoupler Input. • Disconnect the **Tx Q** cable from the controller module of the DCX. • Connect a Test Cable between the **Tx Q** port and the **Audio In Hi** port of the HP 8920.	
5.	Adjust the volume control on the HP 8920 to a comfortable level. White noise should be audible.	
6.	Record the measured **AC Level** as displayed on the RF Generator screen and record this on the worksheet and record the results on the datasheet[9].	
7.	Enable the RF output **Amplitude** and raise the signal level until the measured AC level of demodulated channel noise decreases by 20dB.	

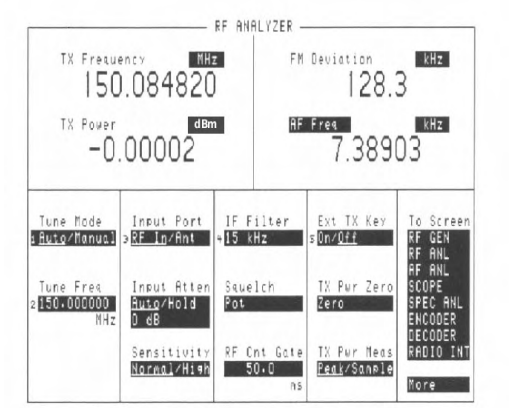
[9] Refer to APPENDIX L - RECORDED DATA SHEET

STEPS	ACTION	MISCELLANEOUS
8.	Record the new 20dB quiet value of AC Level on worksheet together with its associated RF input level[10].	
9.	Replace the 50-Ohm Terminator with the main receive antenna feed. The indicated value of AC Level will increase.	
10.	Increase the RF input Amplitude to recover the reading recorded on the worksheet.	
11.	Calculate the difference between readings obtained with Antenna versus the 50-ohm Terminator to obtain the 20dB de-sense value. Record this on the worksheet and record the results on the datasheet.	
12.	Repeat for all other channels.	
	If the Site Noise on all RX Channels exceeds 5 dB or if a single channel exceeds 5 dB contact M/A-COM Engineering.	

[10] Refer to APPENDIX L- RECORDED DATA SHEET.

6.5 BASE STATION TRANSMIT (BSX) FREQUENCY ACCURACY TEST (MANDATORY)

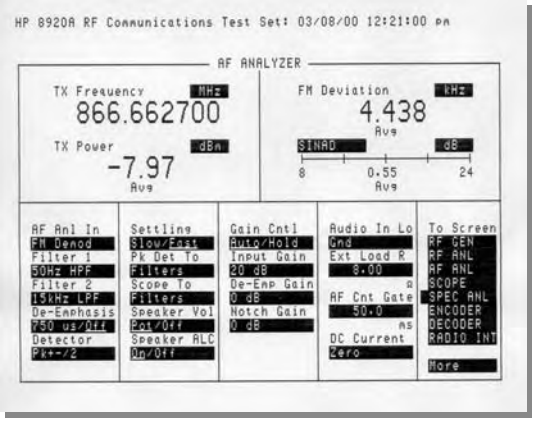
Objective: The purpose of the Base Station Frequency Test is to verify that the DCX is operating on the allocated frequency and compliant with the FCC specifications.

STEPS	ACTION	MISCELLANEOUS
1.	Connect the PC to the DCX TERMINAL port.	
2.	Using a suitable console application, enter the sequence of commands indicated by the bold script in the example on the right to return the base station to digital mode.	**offline** *; <Various Shutdown Text is Displayed>* **at@outmode1** OK **save_config** OK **reboot** *; < The Base Station Reboots >*
3.	Repeat Steps 1 and 2 for all other DCX units.	
4.	Select the **RF GEN** screen of the HP 8920 and turn off the generator function by selecting the **Amplitude** and pressing the **ON/OFF /(YES)** key.	
5.	Select the **RF ANALYZER** function of the HP 8920 and set the following parameters: • **Tune Mode: Auto** • **Input Port: RF In** • **Disconnect the I/Q cables to remove modulation.** • **Connect the HP 8920 RF/IN Port to Bird Power Monitor TX Output Port.**	
6.	Enable an HPA.	
7.	Record TX Frequency shown on Analyzer[11].	TOL: Must be ± 86Hz. **CAUTION:** Lock the frequency counter/service monitor to a GPS standard and then set the station frequency ± 86Hz.[12]
8.	Disable the HPA.	
9.	Repeat on all other DCX units.	
10.	Replace I/Q Cables.	

[11] Refer to APPENDIX L - RECORDED DATA SHEET.
[12] Ensure the GPS standard is better than 0.01ppm (about 1E-8 or better).

6.6 TRANSMIT DEVIATION (MANDATORY)

Objective: The objective of this test is to ensure that the transmit deviation is correctly adjusted.

STEPS	ACTION	MISCELLANEOUS
1.	Verify that the HPA transmit Enable/ Disable switch is set to the Disable position for all HPA's.	
2.	Select the **RF GEN** screen and set the **Amplitude** field to **Off** by pressing the **ON/OFF / (YES)** key.	
3.	Select the AF Analyzer Screen on the HP 8920 and configure the following parameters: • Set AF Analyzer to "FM Demod" • Set the Detector to "Pk+ - /2" • Set FM Deviation to Ave 10 Samples.	
4.	Set the following configuration parameters on the RF Analyzer screen: Tune Mode: Auto Tune Frequency: Set for the RF path under test. Input Port: RF In Sensitivity: Normal IF Filter: 230KHz	
5.	Set the HPA Enable/Disable switch to the Enable position.	
6.	The measured value of FM Deviation should be 3.0 kHz ±150 Hz for the channel under test. Measure and record the indicated **FM Deviation** on the recorded data sheet[13].	
7.	Disable the HPA.	
8.	Repeat for each RF path.	

[13] Refer to APPENDIX L - RECORDED DATA SHEET.

6.7 TX POWER CALIBRATION (MANDATORY)

Objective: The following procedure sets the output power level at the final rack RF transmit port based on the transmit Antenna/Feedline Gains and Losses shown in the following examples.

STEPS	ACTION	MISCELLANEOUS
1.	Calculate the required HPA TX Power setting based on the required site ERP. HPA TX Level may be calculated as seen on the right.	Example of Calculating and Setting an ERP of 50dBm: Ant Gain in dB 10dB Feed Line Loss in dB -3dB Net Gain 7dB Output Power 43dBm Net Gain +7dB ERP 50dBm
Setup Procedure	**Verify that ALL of the HPA disable/enable switches are in the Disable position.**	
2.	Select the RF Analyzer screen • Set the correct channel frequency • Set the TX Power to read dBm • Set the Input Port to "RF Input" • Set the Input Attenuation to "Auto" (Default)	
3.	Set the Sensitivity to "Normal" (Default).	
4.	Connect the Bird Power Monitor TX Output Port to the HP 8920 RF In Port using calibrated test cables and suitable adapters as required.	
5.	Connect the Laptop PC to the DCX serving the HPA under test using the black "Cisco" cable and the DB-9 to RJ-45 Converter between the laptop "COM" port and the DCX port.	
6.	Turn on the Laptop PC and launch the Hyper Terminal.	
7.	With the PC connected to the DCX serving the channel under test and running a VT-100 Emulation.	
8.	The purpose of this test is to adjust the HPA transmit power level into the RF transmission line to provide the site specified ERP.	

STEPS	ACTION	MISCELLANEOUS
9.	Press the Enter key on the laptop keyboard. The status information on the right will be displayed on the PC console application. **Similar** to the text found on the right.	**Example:** buck40:[14] buck40-bs1>
Setting the HPA TX Power		
10.	Enter the command: **at@hpapower*N*** [CR]	Example: Where ***N*** is the desired HPA power setting to overcome rack losses.
11.	Set the HPA Disable/Enable switch to **Enable**.	
12.	The HPA will send the message shown on the right via the DCX to the console display and start transmitting.	HPA> RF enabled by front panel switch.
13.	Compare the measured value **TX Power** on the HP 8920 to the desired level, repeating steps 10-12 as necessary to fine-tune the measured level to set the prescribed Site ERP.	**Note:** There may be a slight variation between the commanded and measured power levels. This may be due to test cable losses. Be sure to factor these into the measurement process. Example: Output Power 43dBm Test Cable Loss -.8dB HP 8920 Reading 42.2dBm
14.	When the final value for **TX Power** is achieved, enter the commands on the right.	**save_config** [CR] **reboot** [CR]
15.	After the DCX has completed its boot cycle record the final measured HPA **TX Power** level on the collection sheet and data sheet[15].	
16.	Set the tested HPA Enable/Disable switch to the **Disable** position.	
17.	Repeat for each RF channel, leaving tested HPA's in the **DISABLED** mode.	

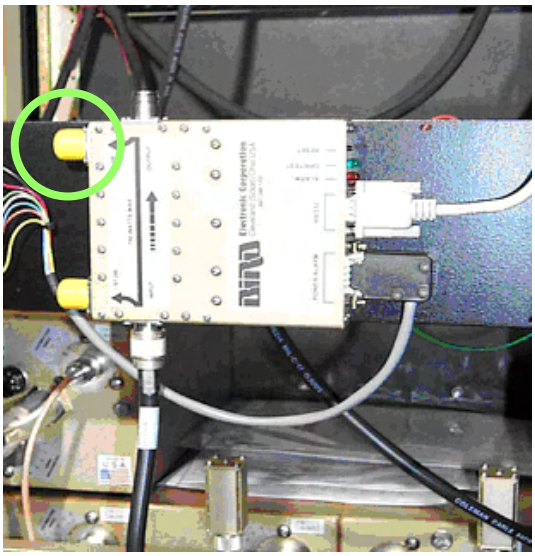
[14] "**Buck40**", where used in this manual, is only an example of the applicable code.

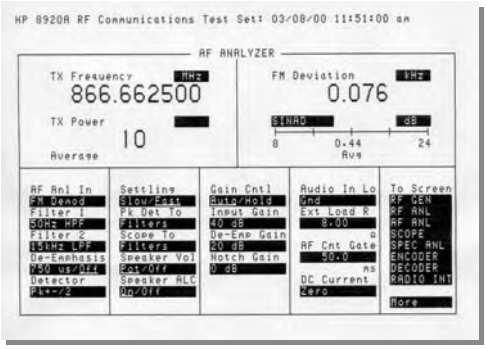
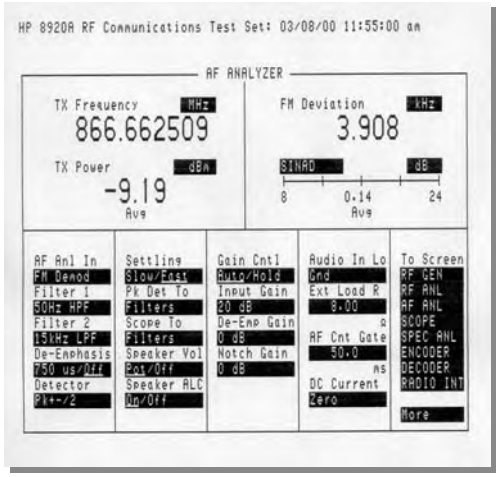
[15] Refer to APPENDIX L - RECORDED DATA SHEET.

STEPS	ACTION	MISCELLANEOUS
18.	Complete the summary acceptance table confirming that the HPA transmit power for each channel was set to provide the site specified ERP.	

6.8 HPA TX POWER BENCHMARKS – BIRD VSWR –57DBM PORT (REQUIRED)

Objective: The objective of this test is to provide a reference power measurement for each transmitter at the Bird Power Monitor (VSWR) –57dBm Port with the Bird Power Monitor Output Port connected to the TX Antenna. This is a test port that can be used for non-interfering measurement of transmitted power from all base stations.

STEPS	ACTION	MISCELLANEOUS
1.	**DISABLE ALL OF THE HPA OUTPUTS BEFORE PROCEEDING:** Set all of the HPA Enable/Disable switches to the **Disable** position.	
2.	Remove the HP 8920 test cable from the Bird Power Monitor **OUTPUT** port and connect it to the **–57dB** input coupler port.	
3.	Connect the TX antenna jumper to the Bird Power Monitor Output Port.	

STEPS	ACTION	MISCELLANEOUS
4.	Select the **AF ANL** screen and configure the following settings: • **TX Power:** dBm (Average 10) • **AF Anl In:** FM Demod • **De-Emphasis:** Off • **Detector:** Pk+-/2	
5.	Set the HPA Enable/Disable switch to the **Enable** position.	
6.	Measure and record the **TX Power** from the HP 8920 **AF Analyzer** screen on the data collection sheet, factoring in the additional loss of the test cable[16].	
7.	**DISABLE THE HPA OUTPUT BEFORE PROCEEDING:** Set the HPA Enable/Disable switch to the **Disable** position.	
8.	Repeat for each RF path.	
9.	Record[17] the data on the work collection sheet.	
10.	Measure and record the TX power with channels 1 and 2 transmitting and sequentially any additional channels at the same time.	For example: Channel 1 and 2 = -8 dBm Channel 1, 2, and 3 = -6 dBm Channel 1, 2, 3, and 4 = -4 dBm Channel 1, 2, 3, 4, and 5 = -2 dBm

[16] Refer to APPENDIX L - RECORDED DATA SHEET.

[17] Refer to APPENDIX L - RECORDED DATA SHEET.

STEPS	ACTION	MISCELLANEOUS
11.	Record[18] the results in table provided with the data worksheet.	

[18] Refer to APPENDIX L - RECORDED DATA SHEET

7.0 OPERATIONAL TESTING

7.1 STANDALONE SITE ACCEPTANCE (MANDATORY)

Objective: To verify correct functionality of the site in a standalone mode of operation. Successful completion of this series of tests together with all preceding mandatory tests will allow full operation of the site in standalone or repeater mode. This stage of site certification permits its use in the event that backhaul communications are not available.

7.1.1 Preparation - Remove ALL Network Connectivity

STEPS	ACTION	MISCELLANEOUS
1.	Ensure that all cables removed for testing are re-connected for normal site operation.	
2.	Disconnect cable from SAS CTRL 0 Port.	Removes the T1 Network connectivity.
3.	Disconnect the ISM Ethernet connection if the site has an ISM option.	

7.1.2 Procedure for Single Site Trunking

STEPS	ACTION	MISCELLANEOUS
1.	Set all HPA **ENABLE/DISABLE** switches to the **ENABLE** position.	
2.	Configure two **mobile or portable** radios using the station parameters of the site under test.	Radios should be set to factory default configurations by removing record for current OTP mode. ie: ATZ-1 **ERASERECORDMODE9
3.	Power cycle the radios using their front panel power switch and perform a unit-to-unit test transmission.	
4.	Confirm *default* talk groups are configured in the radios.	*6# via DTMF M-803, P801.
5.	Enable all HPA's. Select the same RF channel and different talk groups for both radios. Key the radio transmitters simultaneously and verify one of the radios trunks to a different RF channel. Repeat for all RF channels allocated to site.	

STEPS	ACTION	MISCELLANEOUS
6.	Disable all HPA's except RF channel under test. Select the RF channel under test (C. U. T.) and different talk group for both radios. Key the radio transmitters simultaneously and verify both stay on the same RF channel. Repeat for all RF channels allocated to site.	
7.	Enable all HPA's. Select different RF channels and the same talk group for both radios. Key the primary radio transmitter and verify the secondary mobile radio trunks to the same RF channel as the primary radio. Key the secondary radio transmitter and verify it stays on the same RF channel it just trunked to. Repeat for all RF channels allocated to site.	

7.2 NETWORK CONNECTIVITY - BACKBONE COMMUNICATIONS (REQUIRED)

Objective: These tests verify the quality of the T1 link feeding the site and connectivity to the Regional Operations Center serving the base site under test.

Required Test Equipment:

- PC running a suitable console emulation program
- Cisco "Black" test cable
- Cisco RJ45 to DB-9 terminal adapter

STEPS	ACTION	MISCELLANEOUS
1.	Check the front panel of the Cisco 3600 access server and observe whether the READY LED's are illuminated.	
2.	Check the front panel of the Cisco 3600 access server and observe whether the ACTIVE LED's are flashing.	

STEPS	ACTION	MISCELLANEOUS
3.	Check the rear panel of the Cisco 3600 access server and observe whether the **Carrier Detect** LED is lit and the **LOCAL** and **REMOTE ALARM** LED's are off.	
4.	Connect the PC to the **CON** port of the Cisco 3600 access server. This connector is located on its front panel.	
5.	Using address information given in the regional IP Address Excel spreadsheet, ping the MIS1 and MIS2 servers located in the ROC. Commands and responses are shown to the right.	buck40sas>ping 10.136.10.21[19] Sending 5, 100-byte ICMP Echoes to 10.136.8.10, timeout is 2 seconds: !!!!! Success rate is 100 percent (5/5), round-trip min/avg/max = 8/8/12 ms buck40sas>ping 10.136.10.21 Sending 5, 100-byte ICMP Echoes to 10.136.8.11, timeout is 2 seconds: !!!!! Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/24 ms buck40sas>
6.	Record the success or failure on worksheet[20].	

[19] "**Buck40**", where used in this manual, is only an example of the applicable code.

[20] Refer to APPENDIX L - RECORDED DATA SHEET.

7.3 T1 QUALITY LINK

Objective: The Cisco 3600 provides comprehensive monitoring capabilities for the T1 port that carries data traffic over the communications backbone. The **showcontroller** command accumulates statistics over sixteen 15-minute intervals. This test does not form part of the site acceptance testing but is included as a diagnostic tool to aid resolution of link related issues.

STEPS	ACTION	MISCELLANEOUS
1.	Allow the Unit to operate with the T1 connected for at least 5 minutes.	
2.	Using a PC connected to the Cisco CONSOLE port, enter the following command from the enabled prompt: **buck40sas# show contr t1 1/0** [CR][21] The 3600 will respond with the Status Information on the right.	T1 1/0 is up Applique type is Channelized T1 Cable length is long gain36 0db No alarms detected Framing is ESF, Line Code is B8ZS, Clock Source is Line Data in current interval (741 seconds elapsed): 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs Data in Interval 1: 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs Data in Interval 2: 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs

Continued

[21] "**Buck40**", where used in this manual, is only an example of the applicable code.

Continued

STEPS	ACTION	MISCELLANEOUS
		Data in Interval 14: 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs Data in Interval 15: 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs Data in Interval 16: 35361 Line Code Violations, 46606 Path Code Violations 1 Slip Secs, 13 Fr Loss Secs, 1 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 13 Unavail Secs Total Data (last 16 15 minute intervals): 35361 Line Code Violations, 46606 Path Code Violations, 1 Slip Secs, 13 Fr Loss Secs, 1 Line Err Secs, 0 Degraded Mins, 0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 13 Unavail Secs buck40sas#

7.4 FINAL DEPARTURE CHECK

Objective: To ensure that the site is ready for on-line operation and that it can recover automatically from a catastrophic power failure.

Required Test Equipment:

- PC with suitable console application
- Cisco “Black” Cable
- Cisco RJ45 to DB-9 adapter

7.4.1 Power Failure

STEPS	ACTION	MISCELLANEOUS
1.	Connect the PC to the **TERMINAL** port of the DCX.	
2.	Type the command: **opred** ? [CR]	
3.	The DCX will respond with the information on the right.	Manadabs2> opred? OPRED: BssN Status: Socket: 7 MCAddr: 225.1.2.35[6801] Cond: 1 OPRED: SasN Status: Socket: 8 MCAddr: 225.1.1.32[6802] Cond: 1 OPRED: Device Status: **BSC:Up HPA:Keyed BSX:Up** BSIB:Undef OPRED: **Expected/Actual Peers - Normal: 1/1 Standbys: 0/0** MCD: 2 OPRED: Operating State: Normal Mode: 0x3e Does Standby: 0 OPRED: SCI CHN CDS BSC HPA BSX BSS_Address SAS_Address Reach OPRED: 2 2 68 Up Keyed Up 172.18.16.168 172.18.112.202 0xb OPRED: 1 1 68 Up Keyed Up 172.18.16.167 172.18.112.201 0xb OPRED: ------- OPRED: OK
4.	Verify that the items shown in bold are indicated.	
5.	Turn off all circuit breakers feeding both racks of equipment.	
6.	Wait for 30 seconds before reverting all breakers to the ON position.	
7.	Verify that all equipment powers up.	
8.	Verify MES registration.	
9.	Repeat Steps 2 and 3 to verify the data once more.	

7.4.2 Multi Site Trunking

STEPS	ACTION	MISCELLANEOUS
1.	Verify all HPA **ENABLE/DISABLE** switches to the **ENABLE** position.	
2.	Configure two mobile radios using the station parameters of the site under test.	
3.	Power cycle the radios using their front panel power switch.	
4.	Unit to Unit Call	
5.	Trunk Call to another site.	
6.	Multi Site Trunking	

8.0 COMMON TERMS

The following brief explanations describe OpenSky Base Station rack components and define other common terms:

Table 8-1: Common Terms

TERM	ACRONYM OR ALIAS	DEFINITION
Alarm Module	ION	Environment and equipment monitor with network or pager alarm capability, providing detection of out-of-specification conditions. Device used initially: *ION Networks, Inc.: Sentinel 2000 Slimline*
Antenna		Device that transmits or receives electromagnetic radiation at radio frequencies.
Antenna cable (Feedline)		Coaxial cable used to connect a transmitter and/or receiver to its antenna.
Base Station Controller	BSC	The BSC is part of the **D**igital **C**ontroller/(**X**)transceiver (**DCX**).
Base Station Transceiver	BSX	The BSX is part of the **D**igital **C**ontroller/(**X**)transceiver (**DCX**).
Bus		That part of a circuit used in common by several units or modules. The main power lead in a rack or cabinet of equipment.
Cisco Router	Network Access Server	TCP/IP internetworking router connecting base site to the OpenSky Network.
Control Cable (Tower Top Amplifier)		Five-conductor cable connected between TTA and Control Unit. Provides voltage/current read out of TTA, alarm status, and switching between primary and secondary amps.
Combiner		Device to combine transmission signals from base site transmitters before sending to the antenna for transmission.
Duplexer		Used for single-antenna sites, a device to allow simultaneous transmission and reception over a single antenna.
Feedline		Transmission line that delivers RF power to an antenna or between an antenna and a radio transmitter or receiver.
High-Power Amplifier	**HPA**	Device to amplify the frequency-modulated signal for transmission.
InterModulation	**IM**	The production, in a nonlinear element of a system, of frequencies corresponding to the sum and difference frequencies of the fundamentals and harmonics thereof that are transmitted through the element.

TERM	ACRONYM OR ALIAS	DEFINITION
InterModulation Rejection	**IMR**	The reject to the production, in a nonlinear element of a system, of frequencies corresponding to the sum and difference frequencies of the fundamentals and harmonics thereof that are transmitted through the element.
ISM Controller (BackHaul Router)		Control unit used to process data from the tower-top-mounted Industrial, Scientific, and Medical (ISM) transceiver. *(ISM is a license-free RF communications band; 2.4 GHz and 5.8 GHz.)*
Lightning Arrester		Protective device that provides a low impedance path to ground for surge protection against dangerous voltages such as lightning.
Low Noise Amplifier	LNA	See Tower Top Amplifier.
Multicoupler		Device to amplify and separate signals, used for single-antenna sites.
Reception Signal Splitter	RX Splitter	Passive device used with multiple receivers.
Network Access Server	Cisco Router	TCP/IP internetworking router connecting base site to the OpenSky Network. Device used initially: *Cisco Router, Model 3600*
Noise and InterModulation Cascade Analysis System	**NIMCAS**	Program used to predict the expected difference in 20 dB quieting measurements for terminated and feedline connected results.
PolyPhaser®		Producer of lightning arrester devices for surge protection.
Radio Frequency	RF	That portion of the electromagnetic energy spectrum used for radio signal transmission and reception.
Receive; Reception	RX	The action or process of selecting and decoding transmitted RF signals using particular frequencies to reconstruct the information transmitted.
Site Access Server	SAS	
Tower-Top Amplifier Low Noise Amplifier	TTA or TTLNA	Used with receive only antenna installations (TX/RX Systems, Inc.).
Transmit; Transmission	TX	The action or process of coding information in the form of RF signals, using particular frequencies to make it available for reception.
TX/RX Hybrid Power Divider		An amplifier installed in conjunction with a Tower Top Amp to feed additional receivers.

TERM	ACRONYM OR ALIAS	DEFINITION
TX/RX Isolator		Prevents reflection of RF energy back into the RF source (the transmitter).
Voltage Standing Wave Ratio Monitor	VSWR Monitor	Placed in the antenna feed circuit, it continuously monitors the forward and reverse power using a directional coupler.

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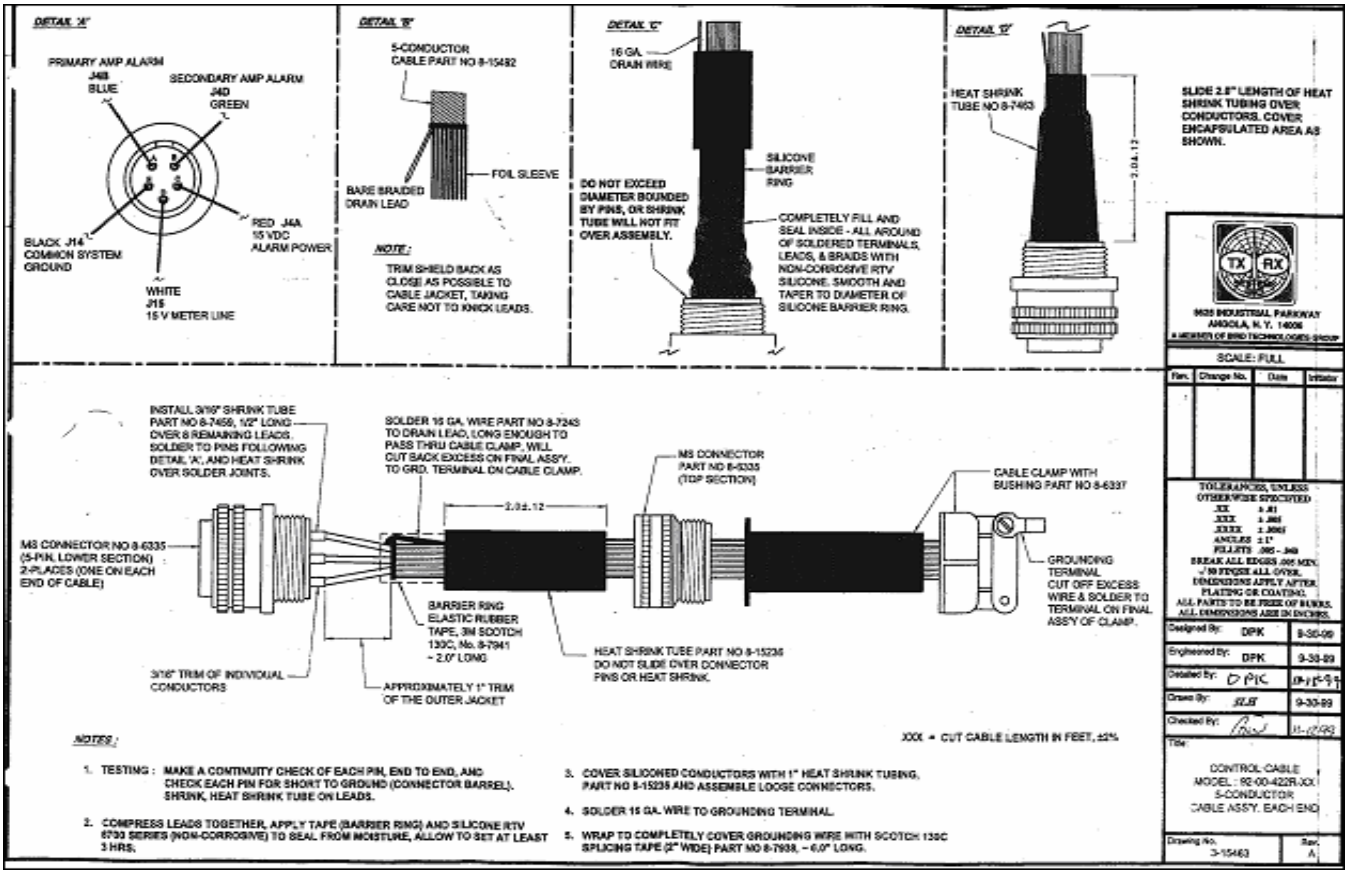
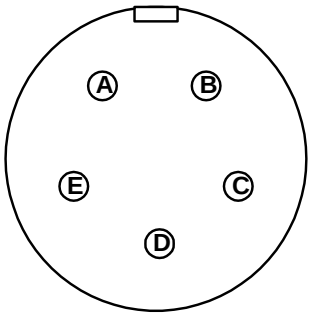
APPENDIX A

ATTACHING MIL-SPEC (MS) CONNECTOR TO END OF CONTROL CABLE/SOLDERING TOWER TOP AMPLIFIER CONTROL CABLE[22]



Detail "A"



A – PRI ALARM (Blue)

B – SEC. ALARM (Green)

C – ALM POWER (Red)

D – METER LINE (White)

E - GROUND

[22] Taken from M/A-COM, Inc. Drawing No. GTP-0296

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APPENDIX B

CONNECTING A PC TO A BASE STATION[23]

There are three ways to connect a personal computer to OpenSky Base Station equipment:

1. Direct connection to the RS-232 port of the device under test.
2. Direct connection to the Console Port of the Access Server and telnet to the device under test.
3. Direct connection to the Ethernet port of the Access Server and telnet to other devices.

Direct connection to any device is the simplest approach, but requires cables to be swapped and various configurations for the terminal emulation application used as the PC user interface. The table below provides connection details for all rack equipment.

EQUIPMENT	SERIAL/ PORT	RATE	CABLE	TELNET AVAILABLE
DCX/BSC	Yes/ Terminal DB9	19200	Null/or Cisco Black Cable	Yes Via Cisco
Cisco Router	Yes/ CON(sole) RJ45	9600	Cisco Black Cable with RJ45 to DB9 Female adapter for PC end.	Yes
DPS Alarm	Yes/ Aux DB9	9600	DB9 F-M	Yes Via Cisco
ION Alarm	Yes/ Aux DB9	9600	DB9 F-M	Yes Via Cisco
Bird Power Mon	Yes/ RS-232 DB9 via Front Panel Connector on DPS or ION Alarm.	9600	DB9 F-M	Yes available on ION Box

[23] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

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APPENDIX C

EQUIPMENT SERIAL NUMBERS[24]

RACK	EQUIPMENT	SERIAL NUMBER
1	Alarm	
1	DCX 1	
1	DCX 2	
1	DCX 3	
1	Cisco	
2	Bird Power Mon	
2	TTA Controller	
2	HPA 1	
2	HPA 2	
2	HPA 3	
1	RCVR Multicoupler	

[24] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

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APPENDIX D

SITE ACCESS SERVER CONFIGURATION[25]

PARAMETER & VALUE	EXPLANATION
buck40sas#show run	
Building configuration	
Current configuration:	
!	
version 12.0	
service timestamps debug uptime	
service timestamps log uptime	
no service password-encryption	
!	
hostname buck40sas	
!	
enable secret 5 1ZKEn$1ZY/cQ0ILIKvSDh/sODJT0	
!	
!	
!	
!	
!	
ip subnet-zero	
no ip domain-lookup	
!	
ip multicast-routing	
ip dvmrp route-limit 20000	
!	
!	
controller T1 1/0	
framing esf	
linecode b8zs	
channel-group 0 timeslots 1-4 speed 64	

[25] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

PARAMETER & VALUE	EXPLANATION
!	
process-max-time 200	
!	
interface Loopback0	
ip address 10.136.24.158 255.255.255.224	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
!	
interface Loopback1	
ip address 10.136.24.190 255.255.255.224	
no ip directed-broadcast	
!	
interface FastEthernet1/0	
ip address 10.136.24.222 255.255.255.224	
no ip directed-broadcast	
!	
interface Serial1/0:0	
ip unnumbered Loopback0	
no ip directed-broadcast	
fair-queue 64 256 0	
!	
interface Async1	
ip unnumbered Loopback0	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	
!	
interface Async2	
ip unnumbered Loopback0	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	

PARAMETER & VALUE	EXPLANATION
!	
interface Async3	
ip unnumbered Loopback0	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	
!	
interface Async6	
ip unnumbered Loopback1	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	
!	
interface Async7	
ip unnumbered Loopback1	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	
!	
interface Async8	
ip unnumbered Loopback1	
no ip directed-broadcast	
ip pim dense-mode	
no ip mroute-cache	
async mode dedicated	
!	
interface Async11	
no ip address	
no ip directed-broadcast	
async mode interactive	
!	
interface Async12	

PARAMETER & VALUE	EXPLANATION
no ip address	
no ip directed-broadcast	
async mode interactive	
!	
interface Async13	
no ip address	
no ip directed-broadcast	
async mode interactive	
!	
interface Async15	
ip unnumbered Loopback1	
no ip directed-broadcast	
async mode dedicated	
!	
interface Async16	
ip unnumbered Loopback1	
no ip directed-broadcast	
encapsulation ppp	
shutdown	
async mode dedicated	
!	
ip classless	
ip route 10.136.8.0 255.255.252.0 Serial1/0:0	
ip route 10.136.24.129 255.255.255.255 Async1	
ip route 10.136.24.130 255.255.255.255 Async2	
ip route 10.136.24.131 255.255.255.255 Async3	
ip route 10.136.24.161 255.255.255.255 Async6	
ip route 10.136.24.162 255.255.255.255 Async7	
ip route 10.136.24.163 255.255.255.255 Async8	
ip route 10.136.24.188 255.255.255.255 Async15	
ip route 10.136.24.189 255.255.255.255 Async16	
no ip http server	
!	
dialer-list 1 protocol ip permit	
dialer-list 1 protocol ipx permit	

PARAMETER & VALUE	EXPLANATION
snmp-server engineID local 000000090200003080C45CA0	
snmp-server community public RO	
!	
line con 0	
exec-timeout 0 0	
transport input none	
stopbits 1	
flowcontrol hardware	
line 1 10	
stopbits 1	
speed 38400	
line 11 14	
transport preferred telnet	
transport input telnet	
transport output none	
telnet speed 19200 19200	
stopbits 1	
line 15	
transport preferred telnet	
transport output none	
stopbits 1	
speed 38400	
line 16	
autoselect ppp	
stopbits 1	
flowcontrol software	
line aux 0	
exec-timeout 0 0	
transport preferred telnet	
transport input all	
stopbits 1	
speed 38400	
flowcontrol hardware	
line vty 0 4	

PARAMETER & VALUE	EXPLANATION
password cisco	
login	
!	
end	
buck40sas#	

APPENDIX E

TYPICAL MOBILE CONFIGURATION[26]

AVAILABLE CHANNEL:	**OT400:s400,601 OT460:s460,102**
AVAILABLE CHANNEL:	**OT500:s500,602 OT560:s560,603**
AVAILABLE CHANNEL:	**TYCO9:s708,202**
CURRENT CHANNEL:	**OT560:s560,603**
HOME CHANNEL:	**OT400:s400,601**
TUNING MODE:	0
ECHO:	1
SIDE TONE:	1
SAVE CONTROL:	2
CALIBRATION VALUES: FACTORY:	1100,300,31076,32676,32767,100
CALIBRATION VALUES: USER:	1100,300,31076,32676,32767,100
TRANSMIT_POWER:	45
VOLUME:	9
BRIGHTNESS:	1
CONTRAST:	1
IP ADDRESS:	**148.174.106.4**
BROADCAST IP ADDRESS:	**148.174.106.254**
SERVICE ADDRESS:	**199.81.106.100**
SERVICE PORT:	6425
MODE:	9
SHUTDOWN TIMER:	120
User ID:	**2**
Station ID:	
AutoRegistration:	1
AutoProvisioning:	0
Auto-Online Command:	ato
Delay Host Ready:	0
Side Tone Level:	16384
Roam Tone Level:	1500
Grant Tone Level:	1500
Enable Secondary Registration:	1
TNIC ADDRESS:	**148.174.104.71**

[26] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

TNIC PORT:	5766
DIPP Format:	0
USE DTR/DSR:	1
AUDIO INPUT:	0
AUDIO OUTPUT:	0
SCAN MODE:	0
Enable Data Registration:	1
Voice Re-registration Timer:	40
Voice Re-registration Count:	2
Enable Voice Registration:	1
Queue Timer:	10
Emergency Timer:	5
Start Profile Number:	0
VCO Calibration(CF_ADJUSTMENT):	0
Save VCO Calibration:	0
Fix the voice AGC gain:	0
Sync loss report mark:	17
VERBOSITY:	1

OK

APPENDIX F

TYPICAL BASE STATION CONFIGURATION[27]

manadabs2> at&v	
BSC INFORMATION: S/N:	000000010005
BSC INFORMATION: BSC S/W Version:	BSC-1000 Version OTP 4.00 Sep 28 1999 14:58:02
BSC INFORMATION: BSC H/W Version:	50 MHz NGP Rev B with 1M of Memory
BSC INFORMATION: M/A-COM HPA Version:	0.01e
BSC INFORMATION: M/A-COM HPA Product String:	13-09-99 (0x01, 0x02)
BSC INFORMATION: M/A-COM HPA Serial Number:	00000101
BSC INFORMATION: MACOM BSX Version:	802: 19 09/03/99
BSC INFORMATION: MACOM BSX Serial Number:	000000010004
Switch to Another Process:	
BSC I/P Address:	172.18.16.168
MDIS I/P Address:	172.18.16.200
MDIS PORT:	16962[4242]
Voice Grant Timeout:	0[0]
Null Voice Frame Limit (missed end):	15[f]
Null Voice Frame Limit (after grant):	15[f]
Null Voice Frame Limit (after trunk):	20[14]
MSF Pause Interval:	3600[e10]
MSF Pause Duration:	0[0]
Set Channel Characteristics:	MANA2[0 698]: Col:[1 4]/4/2 402 2 0 (0.0000,0.0000)
Change Slip Interface Rate:	38400[9600]
RSSI Hysteresis Value:	8[8]
RSSI Scan Time:	90[5a]
RSSI Scan Delta:	8[8]
RSSI Average Time:	5[5]
BLER Threshold:	10[a]
BLER Average Time:	5[5]
CBLER Threshold:	20[14]
CBLER Average Time:	10[a]
RRM CSI Epoch:	60[3c]

[27] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

RRM Cell Configuration Epoch:	30[1e]
RRM Quality Parameters Epoch:	120[78]
RRM RC Roaming Epoch:	10[a]
RRM RC Roaming Parameters:	80[50] 40[28] 2[2] 25[19] 10[a]
RRM RC Utilization Epoch:	0[0]
RRM Utilization Roaming Parameters:	10[a] 40[28] 0[0] 60[3c] 30[1e]
RRM Deactivation Roaming Parameters:	4[4]
NMS Port:	6100[17d4]
Deviation Scale Factor:	1.000
Output Mode:	1[1]
I/Q Max Deviation:	4000[fa0]
I/Q Offsets:	70[46] -130[ffffff7e]
I/Q Vector: 0[0]	32767[7fff] 32067[7d43] 32767[7fff]
I/Q Amplitude:	16384[4000]
BSC TYPE: 2[2]	
BSX oven oscillator warm-up time:	5[5]
RPS I/P Address:	0.0.0.0
RPS PORT:	6222[184e]
Tracking Receive (net->bs) PORT:	6667[1a0b]
HPA Power Level:	44.900 [Current: 44.800]
Reset RRM Parameters to Defaults:	
Show Adjacent Channels:	MANA1[0 794]: Col:[1 4]/4/1 401 2 0 (0.0000,0.0000)
Add Adjacent Channel:	
Remove All Adjacent Channels:	
Remove Specific Adjacent Channels:	
TNIC I/P Address:	172.18.16.200
TNIC Receive/Send PORT:	5762[1682]
OpenSky NMS Port:	6102[17d6]
Define NMS Trap Target: 0:	172.18.16.205,4000,0xffff
Define NMS Trap Target: 1:	0.0.0.0,0,0xffff
Define NMS Trap Target: 2:	0.0.0.0,0,0xffff
Define NMS Trap Target: 3:	0.0.0.0,0,0xffff
Define NMS Trap Target: 4:	0.0.0.0,0,0xffff
Set NMS Operating Mode:	62 [0x3e]
BSC Local Network I/P Address:	172.18.112.202
BSC Local Network Netmask:	255.255.240.0

Dispatch Network Netmask:	255.255.240.0
Peer Port:	6800[1a90]
Redundancy SAS Multicast Address:	225.1.1.32
Redundancy SAS Multicast Port:	6802[1a92]
Redundancy BSS Multicast Address:	225.1.2.35
Redundancy BSS Multicast Port:	6801[1a91]
Redundancy Peers:	1[1]
Redundancy Standbys:	0[0]
Redundancy Peer Heartbeat Timeout:	10[a]
Redundancy Peer Query Timeout:	5[5]
Redundancy Discovery Timeout:	90[5a]
Redundancy Device Query Timeout:	10[a]
Channel ID:	2[2]
Site Component ID:	2[2]
BSC Does Standby:	0[0]
Both network links fail option:	0[0]
Terminal prompt:	manadabs2>
Over the network download port:	6425[1919]
Private Voice Group Boundary:	2000
Emergency Priority Boundary:	4
Default Voice Group info:	private VG PRI:14, HT:0 sec. public VG PRI:16, HT:0.
Voice Group Delete:	
Voice Group Add:	0: 101 2 30
Voice Group Add:	1: 102 4 30
Voice Group Add:	2: 201 6 10
Voice Group Add:	3: 301 6 0
Voice Group Add	4: 302 6 0
Voice Group Add:	5: 303 6 0
Voice Group Add:	6: 304 6 0
Voice Group Add:	7: 305 6 0
Voice Group Add:	8: 401 8 0
Voice Group Add:	9: 402 8 0
Voice Group Add:	10: 403 8 0
Voice Group Add:	11: 404 8 0
Voice Group Add:	12: 405 8 0
Voice Group Add:	13: 501 10 0
Voice Group Add:	14: 502 10 0
Voice Group Add:	15: 503 10 0

Voice Group Add:	16: 504 10 0
Voice Group Add:	17: 505 10 0
BSIB is present:	0[0]
BSIB should key:	0[0]
** NOT USED **:	0[0]
BSIB VSWR Alarm Levels:	0.000 1.200 0.000 0.000 0.000 1.200
BSIB power Alarm Levels:	0.000 0.000 0.000 0.000 0.000 0.000
RX I/F Eq Tap:	7000[1b58]
Dataflow Mark:	60[3c]
Redundancy disable:	0[0]
MAC continuity sum:	15[f]
VERBOSITY :	1[1]

OK

APPENDIX G

TVARB STATUS[28]

TVARB show the status of the **T**ransmit **V**oice Channel **ARB**itration (**TVARB**) process. Returned parameters provide useful insight to voice channel access information allowing system problems to be readily diagnosed.

```
manadabs2> tvarbstate
************************************************************
num BSCs this site:                    2    snooping: OFF
bsc_info[0]=                           sci:2  chid:2  free_rev:2  free_fwd:2
bsc_info[1]=                           sci:1  chid:1  free_rev:2  free_fwd:2
free_rev_slots_site:                   4
free_fwd_slots_site:                   4
************************************************************
OK
manadabs2> tvarbvg2
************************************************************
current number of queued requests:     0     max. number of queued requests: 0
state->next_rev_res_ctl entries:       0
state->new_tams_ctl entries:           0
state->active_tams_ctl entries:        0
state->deleted_tams_ctl entries:       0
bsc[0]                                 {chnid:2   nports:2   free_fwd:2   free_rev:2}
bsc[1]                                 {chnid:1   nports:2   free_fwd:2   free_rev:2}
TVARB: current calls:
private_public_group_boundary:         2000
emergency_priority_boundary:           4
default PRIVATE_VG priority:           14
default PRIVATE_VG hang time:          0 sec.
default PUBLIC_VG priority:            16
default PUBLIC_VG hang time:           0 sec.
maximum_grant_time:                    0 sec.
************************************************************
OK
Test Cables:
```

[28] Taken from M/A-COM, Inc. Drawing No. GTP-0296, Rev. A.

Cable 1
Cisco black RJ45 to RJ45 Modular
Cisco Terminal Adapter RJ45 to 9-Pin D Shell (F)
Cables 2 & 3
Qty 2 BNC to N for in rack distribution losses.
Qty1 N-N (F/F) barrel for in rack distribution losses
HPA output power
Cables 2 & 3
SMA (F) to N (M) to attach to HPA
N F-F Barrel to attach to high power side of load.
BNC to N to attach cable 3 to RF input of HP 8920

APPENDIX H

VERIFICATION TESTING – TRANSMIT FILTER TUNING[29]

Installed Site Cavity Tuning Procedure should also be consulted for Filter Tuning.

1. Installed Site Cavity Tuning Procedure.
2. Power on Agilent® 8920. Select **RF GEN** from TO **SCREEN**.
3. Set **RF Gen Freq** to frequency cavity is to be tuned to.
4. Set **AMPLITUDE** to -10 dBm.
5. Set **Output** Port to RF Out.
6. Set **AF Gen1** to Off.
7. Select **SPEC ANL** from **TO SCREEN**.
8. Select **ANT** from **CONTROLS**.
9. Set **REFERENCE LEVEL** to 0.0 dBm.
10. Keep **SPAN** at 0.200000 MHz.
11. Set **LVL AVG** to 20.
12. Connect RF cable from Agilent 8920 RF OUT port to combiner Isolator Input port and connect an RF cable from the combiner Airline Output port to the Agilent 8920 ANTENNA IN port. Use calibrated RF cables from the service monitor pack.
13. If signal is not seen at this span set in step 9, widen span to 5 MHz and a coarse tune adjustment will need to be made.
14. Remove protective sleeve from coarse tune plunger and loosen setscrew. Loosen lock nut for fine tune plunger. (**NOTE:** Use only the fine tune plunger if checking cavity for a drift.)
15. Position fine tune plunger mid-range before adjusting coarse tune plunger. Position coarse tune plunger to generate maximum spectrum amplitude on display. If plunger refuses to move, tap on it with handle end of screwdriver.
16. Tighten setscrew on coarse plunger and reinstall protective sleeve.
17. Position fine tune plunger to maximize spectrum amplitude on display.
18. Tighten fine tune plunger lock nut.
19. Reconnect all cables.
20. Finished.

[29] Taken from M/A-COM, Inc. Drawing No. GTP-0301, Rev. - .

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APPENDIX J

INSTALLER PROFILE DATA SHEET

(One sheet per Installer if multiple Installers used)

INSTALLER PROFILE

Installer's Company Name: _____

Installer's Telephone Number: _____

Installer's Name (s): _____

_____

Technician's Name (s): _____

_____

Date of Testing Complete: _____

Test Equipment Used,
Model, Serial Number
and Calibration Date: _____

_____

_____

_____

_____

_____

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APPENDIX K

ANTENNA SYSTEM INSTALLATION CHECKLIST

(One sheet per antenna per site)

SITE _____

ANTENNA _____

INSPECTED BY _____

DATE _____

CHECKLIST:

1.	Is this antenna for Transmit, Receive or GPS?	❒ TX ❒ RX ❒ GPS	
2.	What is the make and model of antenna?	❒ OMNI ❒ DIRECTIONAL	
3.	What is the type of antenna?	_____	
4.	What is the design gain of antenna?	_____	dB
5.	What is the bearing of antenna relative to True North?	_____	deg
6.	What is the height of antenna above ground?	_____	ft
7.	What is the feedline make and type?	_____	
8.	What is the installed feedline length from antenna to building entrance?	_____	ft
9.	Are hoisting grips installed as specified?	❒ YES ❒ NO	
10.	Is feedline secured to tower at specified intervals?	❒ YES ❒ NO	
11.	Is feedline grounded at top of tower?	❒ YES ❒ NO	
12.	Is feedline grounded at bottom of tower?	❒ YES ❒ NO	
13.	Is feedline grounded at point where it enters building?	❒ YES ❒ NO	
14.	Is feedline feed-through properly installed?	❒ YES ❒ NO	
15.	Are coaxial connectors weather-sealed?	❒ YES ❒ NO	
16.	Is feedline entrance weather-sealed?	❒ YES ❒ NO	
17.	Is the feedine connected to a surge protector inside the building?	❒ YES ❒ NO	
18.	Is the TTA control cable connected to a surge protector at the entrance port?	❒ YES ❒ NO	

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APPENDIX L

RECORDED DATA SHEET

(A separate data sheet is required for each channel)

Channel # _____

Passive Antenna Sites

RMS audio voltage coming from the radio receiver
("Un-quieted" audio output level) _____
Signal generator level at the 20dB quieting level
with the antenna ***not*** attached _____

20dB quieting level with the antenna attached _____

Analog Receive Tests

12dB SINAD Receiver Sensitivity

RF Signal Generator Amplitude (For 12dB SINAD) _____

Tower Top Amplifier Low Noise Amplifier (TTALNA) Gain Measurement

Power level as indicated in the HP 8920 Spectrum Analyzer
Lvl field (On) _____ (Off)_____

Resulting Gain _____ (On minus Off)

Antenna 20dB Quieting Test

AC Level _____

New 20dB quieting AC Level with associated
RF input level._____

20dB de-sense value:
Channel___ _____

TX Frequency shown on Analyzer (Total must be ± 200 Hz):
Channel___ _____

Transmit Deviation

FM Deviation _____

Final HPA TX Power level _____

TX Power from the HP 8920
AF Analyzer screen _____

TX Power with channels 1 and 2 transmitting and sequentially any additional channels at the same time _____

Network Connectivity

Ping the MIS1 and MIS2 servers located in the ROC.

Success_____ Failure _____

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M/A-COM Wireless Systems
221 Jefferson Ridge Parkway
Lynchburg, Virginia 24501
(Outside USA, 434-385-2400) Toll Free 800-528-7711
www.macom-wireless.com

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