Spike Technologies, Inc
HighPoint BDS System
(FCC ID MXM–HIGHPOINT200)

Application for Certification

47 CFR Parts 21 and 74

Exhibit M
Users Manual

DRAFT

SPIKE TECHNOLOGIES, INC.

INSTALLATION
and
OPERATION MANUAL

FCC ID: MXM-HighPoint200

Revision 1.0 January 8, 2000
Revision 1.1 April 25, 2000

Warnings and Notes

To assure safety to on site personnel and to avoid damage to equipment the installation personnel should review the following warnings and safety precautions before installation begins.

Electrical Safety

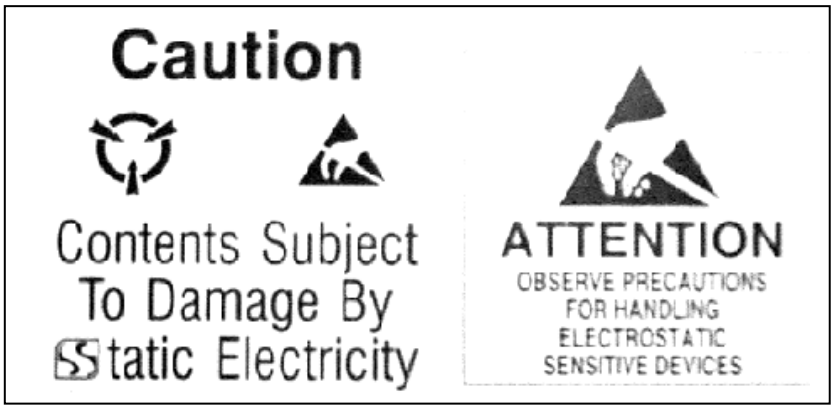
CAUTION: Dangerous voltages exist in the AC power supply. Before installation activity begins, locate the AC power cutoff switch, make certain all on site personnel know the location of the power cut off switch in case of accidental contact. Make certain power is not on when performing the AC power connections. Do not remove the cover, plug or unplug the unit when the surrounding conditions are wet or when it is raining. Failure to follow these recommendations could result in death or serious injury to personnel or damage to the equipment.

Follow all applicable local, regional and national codes when making AC power connections, grounding, and mounting of hardware.

Outdoor mounted equipment, including antennas and cabling should never be installed during or prior to electrical storm activity.

Electro Static Discharge

Any of these symbols may be used to mark a device as being electrostatic sensitive.



WARNING: Use Electrostatic Discharge precautions (ESD). Static electricity can seriously damage this equipment. Damage from static discharges can be prevented with just a few simple precautions:

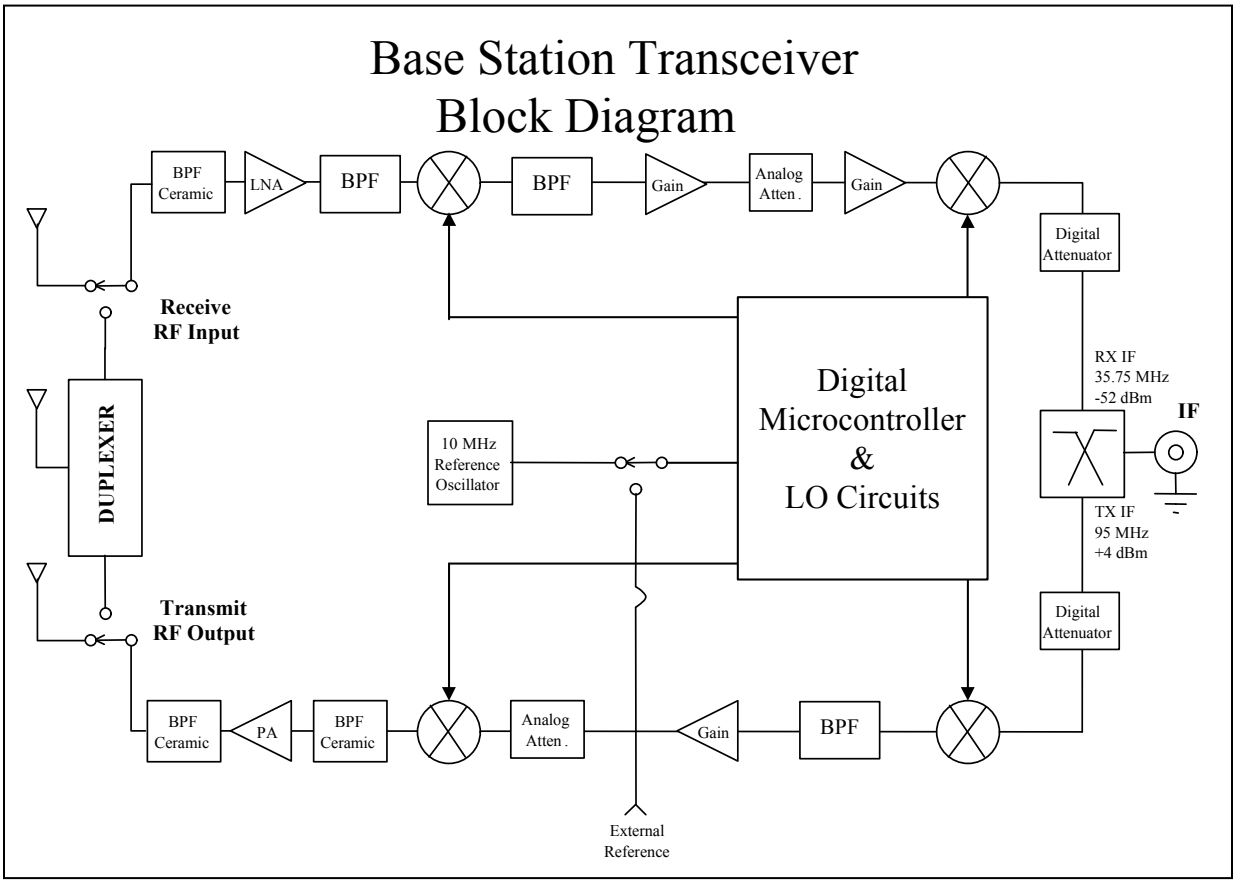
a) Always use properly grounded wrist straps when handling the equipment.
b) Workbenches where equipment is tested should have grounded antistatic mats.
c) For equipment located indoors, tile floors around the equipment should be waxed with a static dissipative wax or grounded antistatic mats should be placed around the equipment racks. Equipment rooms with rugs should be avoided, however if it cannot be avoided, grounded antistatic mats must be placed around the equipment rack.
d) Keep the equipment in the original packing material and sheltered until it is to be installed.
e) Never use white styrofoam, clear plastic bags or paper to pack the units. Cellophane and masking tape should never come in direct contact with the units. Only use approved antistatic bags and styrofoam (pink in color) to pack and store the units (even temporarily or during transportation).
f) Always ground the equipment to prevent static build up, this with also help prevent lightning damage.
g) Do not handle the units unnecessarily.
h) Handle defective modules with the same precautions as good modules.

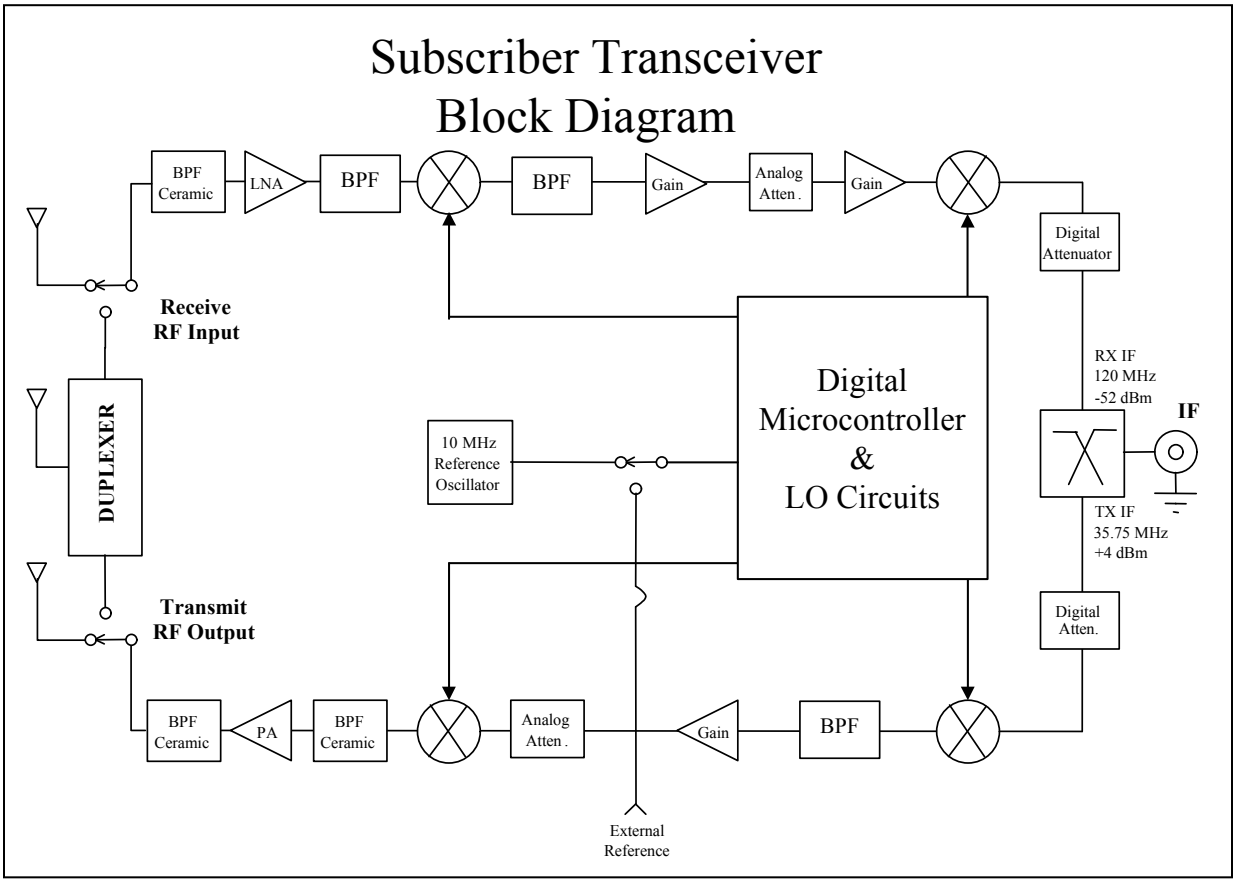
Professional Installation

WARNING: This equipment must be professionally installed. **Instructions for installation are included herein**. Installation personnel should be factory trained and be familiar with setting up microwave communications links and the test equipment required for this purpose.

Transceiver Theory of Operation

Two functional block diagrams representing the headend and subscriber transceivers are presented in fig.5 and fig..6 respectively.





Transceiver Configurations

Each transceiver has frequency coverage of approximately 50 MHz and thus there are two subbands per transceiver. The frequency ranges and transmit-to-receive frequency splits (approximately 100 MHz) are simply guidelines. The design is flexible enough to allow a variety of frequency ranges and Transmit/Receive separations to accommodate almost any channel plan in the 2.5 to 2.7 GHz frequency band.

Differences Between Headend and Subscriber Transceivers

Electrically, the differences between a headend and subscriber transceiver are minimal. They include a transposition of TX and RX frequencies as well as different TX and RX IF frequencies. The results are different local oscillator frequencies used in the conversion process.

From a mechanical point of view, the two transceivers are packaged differently. The headend transceiver slides into a cabinet card rack in the base station cabinet and does not have to be weather tight (the cabinet is). Also the DC power for the headend transceiver is provided by a back-plane connection from a DC power supply located within the base station cabinet.

The subscriber transceiver is mounted outdoors near the antenna and has to be weather tight and have adequate thermal mass for heatsinking purposes. The subscriber transceiver receives DC power through the IF cable, and therefore requires only a single cable to be installed between indoor and outdoor equipment. This requires extra circuitry to be added to the transceiver IF cable diplexer to extract the DC power for the transceiver. There is also a communications channel that is diplexed onto the IF cable at a low carrier frequency (500 kHz). The communications channel allows remote diagnostics and configuration of the transceiver by using a computer running Spike Technologies supplied software. The computer is connected through a serial interface adapter to a communications port on the bias “T”. The DC power for the transceiver is also connected to a port on the Bias “T”. For the sake of simplicity, the communications channel and DC power are not shown in the block diagram.

Both the headend and subscriber transceiver work in the following way:

Receiver Signal Path

Commencing at the antenna in the receive direction, a microwave signal from the opposite end of the link is received. In the case of a single antenna, the signal from the antenna routes through a microwave diplexer. The purpose of the diplexer is to keep the transmitter signal from the receiver to prevent overloading of the receiver. If a separate transmit and separate receive antenna is used, which is generally true of subscriber sites, then the isolation between antennas is sufficient to preclude the use of a diplexer.

The RX signal proceeds through a channel filter to aid out-of-band signal and image noise rejection and TX to RX isolation.

From the RX channel filter, the RX signal is then fed to a low noise amplifier stage, which will determine the receiver noise figure.

The RX signal proceeds through an additional channel filter for additional out-of-band signal and noise rejection.

The received signal is then mixed down through two frequency conversions. A cascade of mixers, filters, and amplifiers ensures proper signal levels and adequate rejection of undesired signals.

Two LO signals support the frequency conversion. These signals are controlled by the transceiver's on-board microprocessor (MCU)

Receive signal levels are adjustable through two independent programmable attenuators. An analog attenuator steps in fine 0.2 dB increments and has a range of approximately 30 dB. The digital attenuator has a range of 40 dB, in 2 dB increments. The attenuators are controlled by the MCU, which contains a calibration table for the attenuators. The MCU handles the RX gain setting programmed into the transceiver during the installation process and translates the date into the proper settings for the programmable attenuators in the receiver.

Transmitter Signal Path

In a similar manner, the Tx IF signal is converter to RF through two frequency conversions. A cascade of mixers, filters, and amplifiers ensures proper signal levels and adequate rejection of undesired signals.

The RF output is passed through a ceramic bandpass filter to a TX power amplifier stage and a second ceramic bandpass filter. The two bandpass filters are used to eliminate out-of-band emissions.

Finally, the TX output signal enters into either a microwave diplexer (single antenna) or into the TX antenna.

The subscriber transceiver can be configured without a microwave diplexer with separate TX and RX ports, or with an internal diplexer where a single antenna port would be provided on the transceiver. Under certain circumstances, such as close TX and RX frequency separation or applications where minimum diplexer loss is required and a single antenna must be used, an external low loss diplexer may be the best solution. In this case, the transceiver would be equipped with separate TX and RX ports.

The headend transceiver will always use a single antenna and always need a diplexer. In some instances, the headend transceiver will be equipped with a low loss external diplexer rather than an onboard diplexer, as is the standard configuration.

Power requirements for both the subscriber and headend transceiver are +13.5 VDC, 20 watts typical, 25 watts maximum. All other voltages required by the transceiver are derived from the +13.5 VDC power source. The headend power supply is mounted inside the base station cabinet and has sufficient power ratings to power up 22 headend transceivers simultaneously. The power supply for the subscriber transceiver has an output voltage of +15 VDC. Extra voltage above the required 13.5 VDC has to be available to compensate for the voltage drop of the IF coax cable since the subscriber transceiver power supply is mounted indoors and supplies DC power for the transceiver through the IF coax cable. The subscriber DC power supply feeds its output into a Bias “T” that is inline on the IF coaxial cable. There is also a port on the Bias “T” to allow a computer to be connected to the MCU inside the transceiver. This interface allows craft personnel to access status and performance data in the transceiver as well as perform configuration changes and input site specific data into the transceiver.

Chapter 2 Installation

Section 2.1

Preparation

Before beginning the installation of HighPoint™ BDS equipment review the following safety advisories. The equipment listed below should be available on site and the installation personnel should be familiar with its use. All personnel involved with the equipment installation and configuration should already be familiar with the procedures outlined in this manual and/or have been through factory training.

Safety Standards

The following safety guidelines should be followed at all times while working with the Spike Technologies HighPoint™ BDS equipment

Remove all jewelry such as rings, watches and bracelets prior to handling equipment. These items may get caught in equipment causing bodily damage. They may also have electrical properties that could contribute to severe injuries.

- Loose clothing should not be worn. It may get caught causing bodily injuries.
- Use extreme caution when working on towers. Always use certified safety equipment.
- Wear eye protection when operating electric power tools.
- Use ESD protective practices when handling electronic devices.
- Do not leave tools lying around. They may cause a tripping hazard.
- Use caution when working with electrical wiring. It can cause severe injuries or even death.

Installation Tool List

- ❑ Electric drill
- ❑ Drill bit (size and type is dependant on mounting surface)
- ❑ Socket set and ratchet
- ❑ Wire / Cable cutters
- ❑ Wire strippers
- ❑ Fish tape
- ❑ Cable ties
- ❑ Hacksaw
- ❑ 5/16 & 5/8 open end wrenches
- ❑ Safety rope
- ❑ Climbing harness
- ❑ **Lanyards**
- ❑ Grounding wrist strap
- ❑ F Connector crimper (RG6 & RG11)
- ❑ TNC connector crimper
- ❑ RJ-45 crimper
- ❑ CAT3 or 5 Cable stripper
- ❑ Coax cable stripper
- ❑ Number one & two flat blade screwdriver
- ❑ Number one & two Phillips (cross, plus) screwdriver
- ❑ Regular all purpose knife
- ❑ System transport harness
- ❑ System lift hooks

Antenna Alignment Tools

- GPS
- Transit
- Level
- Antenna Alignment Plate

Section 2.2

Base Station Outdoor Equipment Installation

The following sections outline the process for installing the base station outdoor equipment in a step by step process.

Basic Requirements

- Before mounting the system to any surface, it must be approved by both the owners of the structure and a qualified engineer.
- The surface must be capable of handling both the weight and wind loading stress of the system.
- The mounting surface must be flat and level.
- The minimum space required for an installation is an **8' x 8'** square area. This area will provide the room necessary for installation and maintenance of the equipment.
- Spike Technologies recommends a 4" diameter hole be provided through the exterior surface of the structure where the Network Operations Center (NOC) will reside. This hole will accommodate the cable run that will exist between the indoor equipment and the outdoor base station equipment.
- Earth grounding (for lightning protection) and AC power that meets system requirements should be available at the selected location.

Wind Loading

The wind loading of the outdoor cabinet with pedestal and antenna assembly is 31.2 sq. ft. flat plate.

System Weight

A fully loaded HighPoint™ BDS (22 Sectors) with pedestal and antenna assembly has a weight of 500 lbs.

Environmental

The following are the environmental limits that the base station outdoor equipment is designed to meet.

Temperature: -33˚ to +55˚C

Humidity: 10 to 100% condensing

Power Requirements

The following are the power requirements for the AC service provided to the base station cabinet.

For Base Station Cabinet

Voltage Range: 100 to 240 VAC

Line Frequency: 50 / 60 Hz

AC Power Consumption: 25 Watts per sector, 550 Watts for 22 sectors

Max AC Current on Accessory Outlet: 5 Amps

Maximum AC Current for 22 Sectors: 6.5 Amps

Step 1

Perform Site Survey

The first step in the installation process is to be properly prepared before installation begins. An important step in pre-installation preparation is to do a site survey from the proposed base station location. From the site survey information, the installer will know the location of the reference site that the antenna is aligned to, the location of cable entries, electric service panel location and how the equipment will be mounted.

Step 2

Determine Location of Outdoor Equipment

Using the information obtained from the site survey identify the actual mounting location of the base station cabinet. Also identify the location of the entry for the power and IF cables. Identify an attachment point to the building lightning ground system. Determine how the base station will be attached to the roof. This involves evaluating the material the roof is made of, usually concrete or steel, and determining the thickness of the roof. If the roof has a water proofing membrane special precautions have to be taken to insure the integrity of the membrane (fig. 4.3), contact the manufacturer of the roof membrane for advice.

Step 3

Inventory Base Station Equipment

A Base Station consists of two groups of equipment. The outdoor mounted Base Station Cabinet / Antenna assembly and the Network Operations Center (NOC) equipment. Do a careful inventory of all the base station equipment to make certain everything is on site before installation begins. When uncrating equipment check the packing list to make sure everything listed is in the container.

Outdoor Equipment List

- ❑ Base station pedestal
- ❑ Base station cabinet, which contains the transceivers, power supply and (optional) external diplexers
- ❑ Hub transceivers (1 per sector)
- ❑ External diplexers (optional) (1 per sector)
- ❑ Antenna / Radome assembly
- ❑ IF cables (RG-6) (1 per sector) (made to length)
- ❑ AC power cable (1) (see power requirements section for size)
- ❑ Cable conduit (sized for number of sectors, recommend 4 inch dia.)
- ❑ Mounting hardware kit
- ❑ TNC crimp connectors (1 per sector)

NOC Equipment List

- 6’ height, 19” equipment racks (Qty 2)
- 19" shelves for equipment racks (Qty 3)
- Cooling Fan Tray
- Modems (1 per sector)
- Modem management software and network management software (SNMPc)
- Modem management station (PC with SNMPc loaded)
- Ethernet switch, bridge or router (usually customer specified and/or provided)
- Ethernet cables (1 per sector) (made to length)
- Un-interruptible power supply (UPS) (optional)
- Male “F” crimp connector (3 per sector)

Step 4

Antenna Alignment Procedure

(Overview) The alignment is accomplished before the system is permanently mounted in place. The pedestal is moved to the proper location and aligned to a reference site, then the mounting hole locations are marked on the surface, the pedestal is then moved out of the way and the mounting hardware is installed. Finally the assembly is leveled and secured.

Determine Antenna Orientation

- Move the pedestal to the mounting location.

- A system alignment plate is then mounted to the pedestal. A surveyor's transit is mounted to the alignment plate. This will be used to properly align the system to the reference point. The reference point is determined during the site survey (see sec. 2.5). The reference point could be a building or other landmark that is easily spotted from the base station location. The base station antenna is pre-aligned for each sector in both azimuth and elevation before being shipped from the factory. The factory uses the site survey information coordinates referenced on the reference site when aligning the antenna.

- Once the transit is mounted to the alignment plate and leveled, it will be calibrated to 0 degrees azimuth while being pointed at the center bolt hole on the pedestal (fig 2.1). The center bolt hole is the zero degree reference used when the antenna is factory aligned. The transit can now be adjusted to the angle that will exist between the system 0˚ reference, (center of sector 1) and the reference point. This angle is determined during the sight survey process. Looking through the transit, the reference point should be visible. If the reference point is not visible, rotated the **pedestal** until the reference point is visible through the transit.

- Once the pedestal is aligned to the reference site, the mounting hole locations are marked on the mounting surface (fig. 2.2), the pedestal is then moved out of the way and the mounting holes are drilled. (see step 5)

Step 5

Install Pedestal Mounting Hardware

The following sections describe two of the more common types of mounting scenarios. All situations are a little different so use the procedures below as a guideline for what is required. If more information is needed call the Spike Technologies Technical Support Department for advice. Consult with the owners of the support structure to determine the best means of mounting the equipment.

Pedestal Mounting Procedure for Concrete

- If mounting to a flat concrete roof. An electric hammer drill with a 1" carbide concrete drill bit will be required. See Threaded Rod Installation Instructions (below).
- Ramset/Red-Head Ceramic 6 Epoxy is recommended for securing the threaded rods into the concrete. If this product is not available hydraulic concrete can be used. See addendum 4 for specifications and manufacturer information.
- Prior to drilling the 4 holes for the threaded rods, the system must be positioned and aligned and the hole locations marked according to the Antenna Orientation Procedure (Step 4).
- Drill holes in the marked locations. These holes should be a minimum of 7 ⅞" deep (assuming a roof thickness of 8 inches or greater) and 1" in Diameter. Consult a structural engineer for roof thickness less than 8 inches; wind loading calculations should be base on a 32.5 sq. ft. flat plate value.

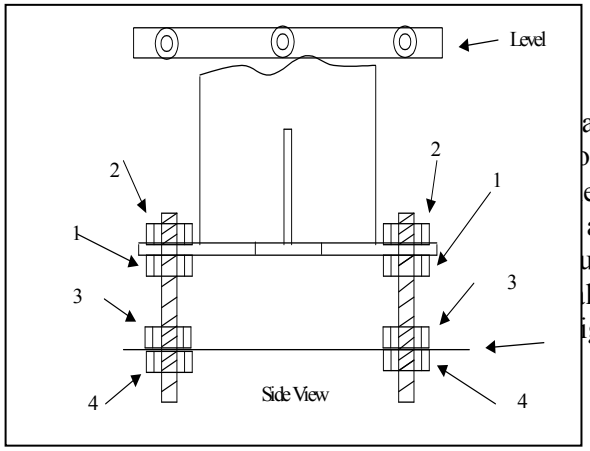
Warning: **Wear safety glasses when using the power drill.**

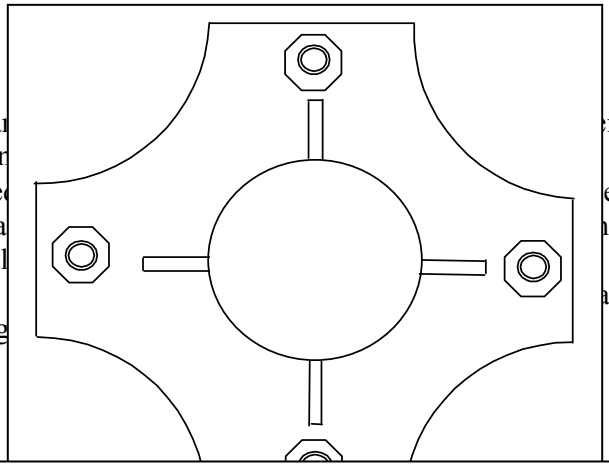
- After drilling clean out hole with forced air. Complete hole preparation (fig. 4.4) with use of a wire brush and repeat cleaning with forced air.
- Dispense enough adhesive into the bottom of the hole to fill to ½ the hole depth.
- Insert the selected threaded rod with a slow twisting motion until it bottoms out in the hole. This insures the adhesive fills voids and crevices and uniformly coats the threaded rod.
- After the suggested cure time is met, install pedestal into place on top of nut #1. See fig. 4.5

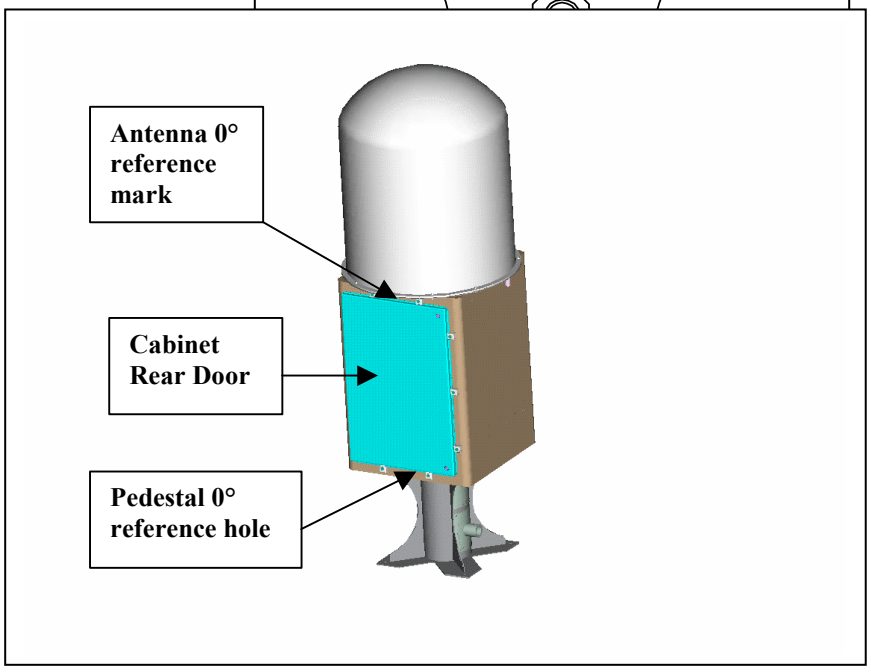
Pedestal Mounting Procedure for Platform or Tower

Mounting of the HighPoint™ BDS using the Pedestal configuration requires (4) 7/8" threaded rods and 4 nuts for each rod. The lengths of these rods will be determined by the thickness of the mounting surface.

- If mounting to a Platform or tower, the surface will be metal. An 8' x 8' minimum surface area is recommended and should have a 4 inch hole in the center of the surface, if a bottom of pedestal cable exit is used. Alternatively a side of pedestal cable exit option (fig. 4.3) is available.
- An electric drill and a 7/8" clearance drill bit will be required for mounting the pedestal.
- Prior to drilling the mounting holes, the Pedestal must be positioned and aligned according to the Antenna Orientation Procedure (Step 4).
- Once alignment has been verified the mounting holes can be marked. See fig. 4.6
- The system can now be removed and the holes drilled in the locations marked in the previous step.
- Install threaded rods and nuts (supplied) as shown in fig. 4.6 and tighten the nuts labeled #3 and #4.







Step 7

The base station cabinet and radome are attached to the pedestal after the pedestal has been aligned and secured to the mounting surface.

Assemble Base Station

Pedestal to Cabinet Assembly

The cabinet is orientated on the pedestal so that the rear door (transceiver back-plane) will be facing out on the same side as the bolt hole on the pedestal used as the 0˚ reference for the transit during the Antenna Alignment Procedure (see Step 4). Fig. 4.7

- Secure the cabinet to the pedestal with the (16) supplied 3/8" bolts, flat and lock-washers. (see fig. 4.2)

Warning:

The transceiver cabinet weighs 150 pounds without transceivers loaded. Use a minimum of 2 people to move the cabinet.

When placing the cabinet on the pedestal, take all necessary precautions to avoid damaging the TNC coax connectors that protrude through the bottom.

Antenna to Cabinet Mounting Procedure

Verify orientation prior to placing the antenna assembly on top of the cabinet. The spot marked on the antenna as the 0˚ alignment mark will be aligned with the center of the rear door on the transceiver cabinet. This should also be aligned with the 0˚ reference bolt hole on the pedestal used in the system alignment procedure (see fig. 4.7).

- Apply a bead of RTV around the outer perimeter of the top of the cabinet, just prior to lowering the antenna assembly onto the cabinet.
- Secure the antenna in place with the (16) supplied 3/8" bolts, flat and lock-washers. See fig. 4.8

Warning:

The antenna and radome assembly weigh 280 pounds. Use a minimum of 4 people to move the assembly.
When placing the assembly on the cabinet, take all necessary precautions to avoid damaging the SMA connectors that protrude through the bottom.

Step 8

AC Wiring, Grounding and IF Cable Installation

The power cable at the NOC end will be wired in such a manner as to connect to the AC Main or a provided uninterruptible power supply (UPS) through a main power disconnect device rated for 40 amps. This cable will be routed up to where the base station cabinet is located. It is recommended that the outside wire be run through conduit. See fig. 4.9

Note:

Qualified personnel or a Licensed Electrician in accordance with the applicable Local and NEC requirements must perform all AC Main connections.

WARNING:

RISK OF ELECTRIC SHOCK. DISCONNECT POWER BEFORE SERVICING.

- There is an internal conduit inside the base station cabinet that goes between the bottom center of the base station cabinet and the AC distribution box (fig. 4.10). It is recommended that the conduit be disconnected from the bottom of the cabinet and from the AC distribution box to make it easier to route the AC power wires. After the wires are routed, reattach the conduit to the cabinet and AC power distribution box.
- The AC power distribution box is located at the bottom backside of the base station cabinet. Connect the AC power cable to the power distribution box (fig. 4.11), wiring will be accomplished according to the chart attached to the inner wall of the distribution box (fig. 4.12). The power conductors should be run in a separate metallic conduit, or use approved armored cable, this should be tied to the main building ground. Spike Technologies recommends the electrical wiring be 12 AWG, 3 conductor wire to comply with the maximum possible current draw scenario. The service should be rated for a minimum of 20 amps. Each installation is unique as far as how the equipment is provisioned and therefore maximum current requirements, for specific wiring recommendations contact the Spike Technologies technical support department.

- Prior to pulling system wiring (IF coax cables and AC power cable) from the NOC to the base station, conduit should be installed for exterior runs. It is recommended that the conduit is made of metal, this will aid in system grounding, and immunity from any possible external interfering signals.
- For a full 22 sectored base station the conduit will need to be 4 inches in diameter. It will connect to the Base Station in one of two ways.
    1. If a pedestal is used the conduit can be mounted horizontally into the side of the pedestal using an optional conduit adapter. The conduit will end at the cable entry in the roof.
    2. The second manner in which the conduit can be fed to the pedestal setup is vertically through the bottom of the pedestal. The conduit will end at the cable entry in the roof. The conduit must be securely fastened in such a manner as to avoid any chance of accidental damage.
- All IF cables and the power can now be pulled from the NOC to the base station cabinet. This is normally accomplished with the aid of a fish tape or small rope. For difficult cable runs it may be necessary to apply cable pulling grease to the cables as they are being pulled. **It is imperative that during this procedure none of the cables get damaged in any way. Damage to the insulation layers could cause problems such as electrical shorts.**
- To avoid cross connects between sectors IF cables should be labeled on both ends with the sector number they are assigned to.
- A grounding terminal located on the bottom corner of the base station cabinet is provided to complete a connection to earth ground for lightning protection. A 6 gauge (min.) wire or suitable ground strap is recommended for optimum protection.

Step 9

Attach IF Cable Coax connectors

The IF cables at the NOC end will be terminated with a Type "F" male connector which will connect to a corresponding loopback module. At the base station cabinet, the cables will be terminated with a TNC male connector, which will connect to the transceiver bulkhead panel. Follow the manufacturers instruction sheet for cable preparation and connector attachment. Crimped on connectors are normally used.

Step 10

Connect IF Cables to Base Station Cabinet

Connect the TNC connector on the end of the IF cable to it's corresponding TNC female connector on the IF connector bulkhead plate on the bottom of the base station cabinet . The IF bulkhead connectors are labeled (inside the cabinet) with their corresponding transceiver slot assignment. Verify the IF bulkhead connector is connected to the correct transceiver, it is easy to accidentally swap cable connections between transceivers. It is recommended that each IF cable has a label marked with its sector number .

Step 11

Install Power Supply Modules

The base station power supply mainframe is installed in the cabinet at the factory, however due to shipping considerations the two power supply modules are shipped separately. It is therefore necessary to install the power supply modules into the power supply mainframe. The power supply modules simply slide into a slot in the mainframe and engage with the mainframe back-plane connector. The modules are secured with a slotted locking fastener located on the right hand side of the module front panel handle. Once the module is installed in the mainframe and engaged into the back-plane connector, rotate the locking fastener clockwise to secure the module. It does not matter which of the two slots the module is inserted into.

Step 12

Install Headend Transceiver

Hub transceivers are installed in a rack that is located in the base station cabinet. Each transceiver is individually mounted for ease of replacement. The cabinet has both front and rear access doors. This will allow for easy access during installation, commissioning and repairs.

On the rear door of the base station cabinet is a chart that will be filled in at the factory prior to shipment. This chart references the location of each transceiver within the cabinet and what sector it will be assigned to.

Caution:

Do not force transceiver into slot

- Slide the transceiver into place and seat it firmly into the back-plane connector that provides DC power. The transceiver front panel should be against the mounting frame. Secure the transceiver to the mounting frame by tightening the two Philips screws on the transceiver front panel.

Each radio should be installed in order, from left to right and top to bottom. If the transceivers have been pre-configured make sure the transceivers are assigned to the slot corresponding to the preset frequency.

The RF and IF connectors will protrude through the back plane where the connections to the modem and antenna or external diplexer will be made. Each transceiver will have two cables attached to it (three if equipped with an external diplexer).

- Connect the transceiver IF Port cable, SMA (male), numbered with the appropriate sector number, to the corresponding SMA (female) connector on the transceiver .

If the base station is to be equipped with an external diplexer proceed to the next section (Step 12 Diplexer Installation) at this point in the procedure.

- Remove the top access panel on the rear rack in the base station cabinet. This panel needs to be removed to gain access to the antenna SMA bulkhead connectors.

- Connect the proper sector antenna feed to the corresponding antenna port on the transceiver. The antenna feed cables should be labeled with the sector number that originates from the SMA bulkhead connectors on the bottom of the antenna assembly that is accessible through the top of the base station cabinet.

- Tighten all connections using a torque wrench if available. **Be careful not to short out the power connector with the wrench when tightening the coax connectors.**

- Replace the access panel when all the antenna connections are completed and route the cables along the cable trough provided on either side of the rear rack

- Tighten all connections using a torque wrench. **Be careful not to short out the power connector with the wrench when tightening the coax connectors.**

- Replace the access panel when all the antenna connections are completed and route the cables along the cable trough provided on either side of the rear rack

Step 13 The external diplexer is an option, if the system is not equipped with this feature please disregard step 12 .

Diplexer Installation

Caution: Do not force diplexer into slot.

The chart on the rear door will identify the location of the external diplexer by serial number and which sector it will operate in. This information will be marked on the chart prior to shipment.

The diplexer will slide into the base station cabinet in the same manner as the transceiver does. Diplexer and transceiver slots are interchangeable, however diplexers do **not** have a DC power connector and thus do not engage with the DC power connector on the backplane.

The transceiver equipped for use with an external diplexer will differ from a transceiver equipped with an internal diplexer. The external diplexer transceiver has a separate TX and RX port that has to be connected to the TX and RX ports on its corresponding diplexer.

- Slide the diplexer into the proper slot using the location chart provided inside the base station cabinet.

- SMA jumper cables will be provided which will be used to connect between the transceiver and the diplexer. Install the SMA to SMA jumper cables between the diplexer and the transceiver being careful not to cross between TX and RX port .

- Remove the top access panel on the rear rack in the base station cabinet. This panel needs to be removed to gain access to the antenna SMA bulkhead connectors.

- Connect the proper sector antenna feed to the corresponding antenna port on the diplexer. The antenna feed cables should be labeled with the sector number that originates from the SMA bulkhead connectors on the bottom plate of the antenna assembly that is accessible through the top of the base station cabinet.
- Tighten all connections using a torque wrench. **Be careful not to short out the power connector with the wrench when tightening the coax connectors.**

- Replace the access panel when all the antenna connections are completed and route the cables along the cable trough provided on either side of the rear rack

Section 4.3

Base Station Indoor Equipment Installation

The following sections outline the process for installing the base station indoor equipment.

Site Requirements

Use the following guidelines for selecting a NOC location.

Cable Access

A cable entry is required that is 4" in diameter to allow cables to be run from the indoor equipment to the base station cabinet. The maximum cable run distance should be kept under 300 feet using RG-6 coaxial cable.

Power Requirements

The following lists typical power requirements for the indoor equipment. This does not take into account any of the requirements for non-Spike Technologies equipment that may be related to the network. This power source should be within the area that the indoor equipment resides.

Modem
Voltage: 100 to 240 VAC
Line Frequency: 50/60 Hz
Power Consumption: 20 Watts

Management Station
Voltage: 100 to 240 VAC
Line Frequency: 50/60 Hz
Power Consumption: 410 Watts

Environmental

All areas where HighPoint™ BDS indoor equipment is located should conform to the following environmental specifications. Due to the close proximity of the devices to each other it is advised that this equipment be operated in an area that is environmentally controlled.

Temperature Range: -5˚ to +45˚ C

Humidity: 10 to 90% non condensing

Space Requirements

A minimum 25 sq. foot area is recommended to comfortably locate the indoor equipment that is specific to the HighPoint™ BDS.

Rack Assembly

A minimum of two 6' tall 19" racks will be required.

Management Station

The management station provides operating files for the system, therefore it is an integral portion of the system. The system is made up of a Pentium Computer and several software packages. The management station is connected to the modems by an Ethernet Switch. The Management Station computer, keyboard and monitor are housed in separate 19 inch rack

mountable industrial enclosures.

Step 14

Rack Mount Indoor Equipment

Rack mounting of equipment depends on the exact configuration of the system. All the indoor equipment for a fully equipped HighPoint™ BDS system could be housed in two 6 feet tall 19 inch relay racks.

Warning: **When installing equipment in a rack a minimum of two people are required, one to hold the item and one to secure the mounting hardware.**

Hint: **When rack mounting equipment put the bottom screw (on each side) in first.**

- Assemble racks using the instructions included with the racks.

Use number 10-32 screws 1/2 inch long for securing the equipment in the rack.

If used, mount AC power strips (customer supplied) on the rack.

It is recommended that the base of the relay rack be fastened to the floor.

Hub Modem Installation

Rack mount the Headend modems. Label the modems with the sector number and IP address that will be assigned to them during the configuration process.

Step 16

Connect Modem to Translator

Each modem will be connected to its assigned translator module by an RG-6 jumper cable with type "F" connectors on each end. (i.e. sector 1 modem will connect to sector 1 translator module.) This connector is located on the front of the modem. Each cable should be labeled with the sector number that the modem is assigned to.

Fabricate quad shield RG-6 jumper cables with type F male connectors on each end. The cables should be long enough to go between the translator and the most distant modem, one cable per headend modem.

Connect one end of each cable to the type F female connector on the modem labeled.

Label each cable with its corresponding sector number.

Connect the other end of each cable to its corresponding translator module.

Step 18

Connect AC Power and Ground

Plug all indoor equipment into AC power outlets that should be provided for during the NOC electrical power installation. Alternatively AC power strips can be mounted on the relay racks as a convenient place to plug in equipment and the strips can plug into a remote AC power outlet. Do not exceed the circuit breaker current rating of the outlet strips.

- An indoor grounding connection should also be provided in the NOC. This ground is an earth ground for lightning protection and is in addition to the AC power ground. There should be a low potential difference between the earth ground and the power ground to avoid ground loops. Using an AC voltmeter, measure the potential difference between the two grounds, if it exceeds 2 VAC, there is a potential for ground loop induced noise. Use proper grounding practices to correct this problem; to avoid ground loops, a single grounding point is best.

Attach the earth ground to a convenient point on each relay rack.

Step 19

Interconnect Ethernet Ports

- Connect the modem Ethernet port to a network hub or switch; use a 10BASE-T cable configured as a straight through cable. The hub or switch will connect all sectors to a common management station. Each cable should be labeled with the sector number that the modem is assigned to.

Specifics of how to connect the Ethernet ports depend on the individual network equipment co-located with the HighPoint™ BDS and therefore is beyond the scope of this manual.

Cabling Specs 10BASE-T

10BASE-T uses pins 1,2,3,6, Cat3 (or better) rated cable with RJ45 connectors.

Use the following pin out at both ends of the straight thru interface cable.

1 - White/Orange

2 - Orange

3 - White/Green

4 - Blue

5 - White/Blue

6 - Green

7 - White/Brown

8 - Brown

Step 20

Setup Management Station

- The management station can be either customer or factory supplied. Follow the setup directions in the management station users manual. If the management station was supplied by Spike Technologies the operating system and management software will already be installed and configured. If the user is supplying the management station and the software is supplied by Spike Technologies follow the software installation and setup procedure in the configuration chapter. Further information can be found in the documentation supplied with the software.

Step 21

Configure Management Station

- The management station configuration procedure can be found in chapter 5, Product Configuration.

Step 22

Power up NOC Equipment

- Power up all the equipment in the NOC. Verify that the power LEDs are illuminated. Ignore the other alarm status indicators at this point, only power is important.

Step 23

Power up Base Station Cabinet

- Turn on AC power to the base station cabinet. This involves turning on the AC power disconnect and the AC circuit breakers on the power distribution panel in the base station cabinet as well as switching on the base station DC power supply and cooling fan. All power LEDs should be illuminated.

Step 24

Load CIT Software

- Refer to the Product Configuration chapter sec. 5.9.1 & 5.9.2 for information on loading the craft interface terminal (CIT) software onto a computer. The CIT is necessary to access the transceiver configuration and alarm reporting software.

Step 25

Configure Transceivers

- Refer to the Product Configuration chapter sec. 5.9.4 for information on how to configure the headend transceivers. The transceivers are normally pre-configured at the factory. Refer to the headend balancing procedure sec. 5.10 for specific information on the proper TX and RX gain to set each transceiver to.

This is the final step of the installation process for the base station. The configuration, balancing, and performance verification portion of the installation process are covered in chapter 5, Product Configuration.

Section 4.4

Install Sub

The following sections outline the process for installing the Subscriber site outdoor equipment.

Step 1

Determine Location of Outdoor Equipment

Site location and preparation is the most critical step for assuring a successful installation. Follow the recommendations in chapter 2 System Design Guidelines; insure the following requirements are met.

- Perform a thorough site survey to insure a clear path between locations. A good site survey should also include a spectrum survey to verify no interference on the chosen channels of operation.
- Locate the antennas so that they have clear line of sight to the antennas at the opposite endpoint of the link.
- There should be no obstructions within ±10 degrees azimuth of the antenna bore sight.
- The elevation of the antennas should be sufficiently high, as to avoid any obstructions within –10 degrees elevation on the lower antenna.
- Mounting the antennas close to the edge of the rooftop (on a flat top roof) helps to avoid problems with the latter requirement.
- Conditions for microwave path design must be considered such as Earth curvature and Fresnel zone clearance.
- Observe local building and electrical codes when running all cables.
- It is necessary to determine how the IF cables will be brought up to the rooftop from inside the building.
- When selecting a location for the outdoor equipment locate it as close to the cable entrance to the building as possible while still maintaining clear line of site to the opposite end of the link.
- When locating the antenna mast it is desirable to have it in close proximity to the building rooftop ground system if present. It then becomes a simple matter to provide a short low resistance connection to the building ground system.
- Other considerations include proximity to the cable run to the rooftop. The maximum allowable IF cable length is 200 feet for RG6 coaxial cable and 500' for RG-11 coaxial cable.

Step 2

Inventory Equipment

Inspect the containers that the equipment is shipped in. Each container will have a packing list, make certain that the material in the container matches the material listed on the packing list. Inspect the goods in the container to insure no shipping damage has occurred. The following is a typical list of the material that would be supplied by Spike Technologies for a subscriber site, the actual equipment may vary depending on equipment configuration and locally sourced materials.

- Subscriber transceiver
- Bias Tee
- Transceiver power supply
- Subscriber modem
- Subscriber modem power supply
- Antenna(s)

Tools and Supplies needed to install Subscriber Equipment but not supplied in standard Installation Kit

- F-Connector Crimper (RG-6 or RG-11)
- Coax cable stripper
- Number two flat blade screwdriver
- Number two Phillips (cross, plus,) screwdriver
- Regular all purpose knife
- An 8" adjustable wrench
- Coax seal & Rubberized tape for waterproofing coax connectors
- Mast minimum 6' long and a 1 ¼" to 1 ½" in diameter
- Coaxial cable RG-6 *maximum* 200' long
- Coaxial cable RG-11 *maximum* 500' long
- Two each F-connectors
- Mount best suited for site to be installed
- Electric drill
- Assorted drill bits
- UV rated tie-wraps
- Lightning arrestors for the IF cable, if required

Step 3

Assemble and Erect Antenna Mast

From the site survey the type of antenna, mast height and mount and its location should already be known. The information described in the following sections gives installation instructions for the two most common types of mast mounts. Follow manufacturers instructions included with the mast mount for assembly and mounting directions.

Warning: All masts that exceed 10' in height must be guyed according to industry standards.

Mount Options

There are two common types of system installations employed. They are non-penetrating roof mount antenna assemblies for use on flat top roofs (Fig. 4.35), and the wall mount assembly for use on existing structures such as chimneys or the sides of a buildings (Fig. 4.36). If the antennas have to be mounted more than about 12 ft. above the rooftop, a climbable tower may be a better solution to allow easier access to the equipment and to prevent antenna movement during high winds.

Non-Penetrating Roof Mount

- For a non-penetrating roof mount assembly a mount made by Rohn, model number FRM125 or equivalent is recommended. This assembly comes with a 1.25 in. outer diameter mast that can be upgraded to a 1.5 in. outer diameter mast for greater stability.
- At least 4 cinder blocks (to be used as ballast) or equivalent, are also required.
- 1 piece of 3 ft. x 3 ft. rubber padding can be placed under the assembly to provide roof protection.
- Allow approximately 6 feet of mast for the mounting of the 2 antennas and outdoor equipment.

Wall mount

For applications where the roof is not flat or strong enough to hold the weight of the non-penetrating roof mount the wall mount is the most effective solution (fig. 4.36).

- This mount is affixed to the side of a building, wall or chimney.
- The structure must be capable of handling the weight of the mast, antennas, and transceiver plus wind loading stress.
- This type of mount requires drilling (4) holes into the structure that it will be mounted to. Size of hole will be dependent on the size of bolt selected to affix bracket to structure.
- When mounting to masonry expansion type bolts or lead anchors should be inserted into the hole drilled as a means of attaching the mounting bracket to the structure.

Step 4

Ground Antenna Mast

It is recommended that the antenna mast be grounded to either the building rooftop lightning ground system or to a separate earth ground system. The mast should be connected to the ground by a low resistance heavy gauge cable #10 stranded copper or larger is recommended. Use suitable ground clamps to attach the cable to the mast and the ground system. Make sure the cable is making a good electrical connection, remove all paint and corrosion from the area the clamp attaches to. Use dielectric grease on the clamp connection to prevent any electrolysis activity due to dissimilar metals.

Ground Loops

Test to make certain that there is a low potential difference between the lightning ground and the electrical ground that the equipment is attached to. This can be verified by using an AC voltmeter and measuring the potential difference between the IF cable shield and the antenna mast before the IF cable is connected to the transceiver. The other end of the IF cable has to be connected to the AC ground, either through the Bias"T" with transceiver power supply (connected to AC power) or by temporary connection to a modem cable port (with modem connected to AC power). The potential difference should be less than 2.0 VAC.

Step 5

Assemble and Mount Subscriber Antenna

There are two types of subscriber antenna presently being offered. The first is a Quasi Log Periodic (QLP) grid reflector antenna, the second is a flat panel patch antenna. The QLP antenna is available in two sizes. The QLP antenna requires assembly, the instructions are given below. The flat panel antenna only requires the attaching of a feed cable and the mast mounting hardware.

Optional Elevation Bracket

If elevation changes on the antenna(s) are required the optional antenna elevation adjustment bracket (Fig. 4.37) should be installed.

- The elevation bracket is used when the subscriber antennas require adjustment in a vertical direction. This is typically required when a subscriber is in close to the Base Station. The antennas will need to be tilted upward to maximize signal strength.
- This bracket will allow the installer to mount a horizontal mast to the existing mast.
- With a horizontal mast in place the antennas can be rotated in the vertical

direction.

Assembling and Mounting of QLP Parabolic Antenna(s)

- To assemble mast, first insert the cable that is attached to the feed through the hole in the center of the reflector (fig. 4.38).
- Turn reflector so that the two slots near the center hole of the reflector are situated so that one is on top of the hole and the other on the bottom.
- Insert the feed camps (2 ea.) labeled #1 into the slots.
- Insert the feed into the clamps verifying that the wide portion of the feed is orientated in the horizontal plane.
- Insert Bolt #2 into the hole provided through clamp #1, feed and second clamp #1.
- Put the nut #3 on the bolt #2 and tighten. The antenna is now assembled and ready for mounting.
- To mount Antenna inset the U-bolts #4 from the front, through the holes as shown in above drawing. The orientation of these U-bolts will vary depending on whether the mast is horizontal or vertical.
- On the backside of the antenna slide a mast cradle (2 ea.) #5 on to each U-bolt.
- Put the antenna on the mast with the mast cradles touching the mast.

WARNING: The antenna must be mounted so that the RF Exposure Warning Label is visible to personnel that may approach the antenna. This label includes the following warning sign .

- Slide the second pair of mast cradles on the U-bolts

- The second antenna, if used should be placed a minimum of 6 in. above or below the first antenna when mounting to a vertical mast.

- When mounting to a horizontal mast a minimum of 1 foot of separation should be maintained.

- Put nuts (4 ea.) #6 on the U-bolts and tighten. Do not over tighten, the antenna will need to be adjusted for alignment.

Verify the required orientation of the antenna prior to assembly.

Position the antenna and insert the mounting studs.

WARNING: The antenna must be mounted so that the RF Exposure Warning Label is visible to personnel that may approach the antenna. This label includes the following warning sign .

Slide one mast cradle over the studs provided with the antenna.

Put the antenna on the mast so that the mast cradle rests on the mast.
Slide second mast cradle over mounting studs.

Thread nuts onto the studs.

Tighten the nuts finger tight. Do not tighten completely, the antenna will need to be moved for alignment purposes.

Step 6 Mount Transceiver to the Mast

- The subscriber transceiver is mounted behind the antenna reflector. Slide the transceiver mounting studs over the mast. Verify that the transceiver is orientated properly.
- The Type “N” connectors should be facing upward. The Craft Interface Port should be facing downward. This will be used in the antenna alignment procedure.
- Slide the provided mast cradles over the studs, thread the nuts on and tighten .

Step 7

Each antenna will connect to the transceiver at the Type “N” connectors on

Connect Antennas to Transceiver

the top of the unit.

When using two antennas the cable from one will connect to the port labeled TX and the other will connect to the port labeled RX.

When using the single antenna option, the antenna cable will connect to the center Type "N" connector.

- Tighten the connectors firmly and protect them from the weather. Wrap the Antenna connector and the first few inches of the coax with rubberized (vulcanized) electrical tape to keep moisture out. This is a very important step to insure equipment reliability.

Step 8

Route the IF Cable

The IF cable provides the connection between the indoor equipment and the outdoor equipment. Multiplexed onto the IF cable are the DC power for the transceiver, the communications channel for configuring and monitoring the transceiver and the TX & RX IF.

Warning: **Observe local building and electrical codes when running power and IF cables. Use licensed contractors to perform electrical wiring.**

Because DC power to the subscriber transceiver is supplied through the IF coaxial cable, it must have a low resistance solid copper conductor with a UV rated jacket, Spike Technologies recommends the following cable types for the Subscriber site IF cable.
Belden 9292 DUOFOIL

Because DC power to the subscriber transceiver is supplied through the IF coaxial cable a DC block should be used with any test equipment connected to the IF cable.

- It is necessary to determine how the IF cables will be brought up to the rooftop from inside the building. In some cases there may be provisions for a cable run to the rooftop.
- If no provisions are available, a hole .5 in. in diameter will need to be drilled to allow the cable to be fed into the building.
- Separate IF coaxial cable from any other cables that may emit radio frequency noise if noise ingress problems are suspected.
- It is recommended that all cabling be run in metal conduit to prevent noise ingress and for cable protection.
- UV rated RG-6 can be used for cable runs that do not exceed 50’
- UV rated RG-11 is required for all cables runs that are longer than 50’ The maximum cable length cannot exceed 500’
- The point that the cable enters the building should be caulked to prevent leakage.

Step 9

Assemble Connectors on IF Cable

The IF cable will have a male Type “F” connector installed on each end. The connector will differ depending on the manufacturer and the type of coaxial cable used; follow the connector manufacturers directions for cable preparation, assembly and required tool.

Step 10 Connect IF Cable to Transceiver

The final step in the installation of the outdoor equipment is to connect the IF cable to the transceiver.

- The transceiver end of the IF cable will be connected to the IF port on the bottom of the transceiver.
- This connection should be sealed from the weather with rubberized tape.

Section 4.5 Subscriber Indoor Equipment installation

The following sections outline the process for installing the subscriber site indoor equipment.

Site Requirements

The following sections list the recommended requirements for the subscriber site indoor equipment.

AC Power Requirements

- AC power must be available in the area where the indoor equipment is to be installed
- A minimum of two AC outlets are required.
- An uninterruptible power supply (UPS) is recommended at all subscriber sites. All subscriber equipment that requires AC power should be attached to this supply.

POWER REQUIREMENTS	Modem	Transceiver	
INPUT VOLTAGE	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz	
POWER CONSUMPTION	20 watts	20 watts (typ.) 25 watts (max.)	

Environmental Requirements

- The radio equipment is designed to operate in the following environmental extremes. Outdoor unit –33˚ C to +50˚ C, 100% humidity.
- The indoor unit is designed to operate in the following environmental extremes -5˚ C to +45˚ C, 70% humidity non-condensing.
- Make sure the indoor equipment is not mounted above equipment that gives off a large amount of heat such as power supplies.
- Providing adequate air circulation around the modem will greatly extend its life.

Space Requirements

- The indoor equipment should be located in a secure area where it cannot be accidentally disturbed or vandalized.
- The space required will be dependent on the type of equipment that is to be used at each subscriber site. For the equipment that is provided

by Spike Technologies an area 2 square feet is required.

- A shelf in a well ventilated area is preferable.

Warning: **Failure to connect the Bias "T" properly can cause damage to the modem and any test equipment that may need to be connected to the cable.**

Step 11 Connect Bias "T" to Modem

- Connect the bias tee type F male connector labeled RF to the modem type F female connector cable port.

Step 12 Connect IF Cable

- Connect the IF cable running from the transceiver to the Bias "T" connector labeled RF/DC.

Step 13 Connect Transceiver Power Supply

- Connect the DC power output cable from the transceiver power supply to the bias tee at the connector labeled DC.
- Due to the AC power cable length, AC power must be located no further than 5 feet from the Bias Tee.

Step 14 Connect Modem Power Supply

For information on AC power source requirements refer to, Site Requirements, AC Power.

Step 15 Power Up Equipment

Power up the modem and the transceiver power supply, monitor pilot lights to verify power is OK. Until the transceiver and modem are properly configured all other visual indicators should be ignored.

Step 16 Configure Subscriber Transceiver

The transceiver can be configured and monitored locally through the craft interface port on the transceiver or remotely through the serial interface adapter that plugs into the port on the Bias "T" labeled CTRL. In addition there is a Bias "T" available that has the serial interface adapter built into the Bias "T" allowing direct connection to a computer serial port. It is recommended that on the initial installation the transceiver be monitored locally so that antenna alignment can be performed while monitoring the received signal strength indicator (RSSI) on the craft terminal.

Configure the transceiver using the instructions covered in sec. 5.9 of the Product Configuration chapter (5).

Step 17 Load Modem Configuration

Configure the modem using the instructions in sec. 5.8 of the configuration chapter. This process must be completed before a subscriber modem is allowed to join the network.

Step 18 Initial Test

Verify equipment is functioning correctly, refer to sec. 5.11 for the initial test and performance verification procedure.

Step 19 Ethernet Connection

Once the subscriber equipment is verified to be functioning properly the final step in the installation process is to connect the Ethernet port on the modem to the customer network.

Connecting to an Ethernet segment using a modem requires a 10BASE-T cable configured as a "straight through" cable when connecting directly to a PC. If connecting to a Hub or switch, a 10BASE-T cable configured as a "cross over" cable is required.

Configuration

Section 5.1

Configuration Process

After equipment installation is completed, the next step in the installation process is equipment configuration. It is the policy of Spike Technologies to pre-configure the headend modems and the management station before the equipment is shipped. The information provided in this chapter assumes that the equipment was not pre-configured before it was shipped, that way the user will understand all the steps necessary to properly configure the HighPoint™ BDS.

Step 4

Configure Headend Transceivers

The next step in the system configuration process is to set up the headend transceivers. In order for this process to begin all NOC equipment has to be installed, properly configured, and fully functional. All cabling between the NOC and the outdoor equipment cabinet has to be connected. The outdoor equipment cabinet has to be powered on and all the transceivers have to be installed in the cabinet. The transceiver configuration process is covered in this chapter in the Transceiver Configuration section.

Step 5

Balance Base Station

After all the headend transceivers are configured it is necessary to set their TX and RX gains to insure TX and RX levels are equal between sectors. This process is cover in this chapter in the Base Station Balancing Procedure section.

Step 6

Configure Subscriber Transceivers

After the headend is fully configured the subscriber transceivers can be configured. It is necessary to have the subscriber modem configuration installed in the provisioning server first. All the subscriber site equipment has to be installed and powered on before the transceiver can be configured. The subscriber transceiver configuration procedure is covered in this chapter in the Transceiver Configuration section. When the subscriber and headend transceivers begin to communicate with each other, the subscriber modem will establish communications with the headend modem and receive it's configuration instructions from the provisioning server, this process may take a few minutes depending on network size and traffic loading.

Transceiver Configuration

Transceiver configuration is accomplished via a Craft Interface Terminal (CIT) which connects to the Craft Interface Terminal Port (CIT Port) via a custom RS232 cable (supplied with the transceiver configuration software). Both the headend (hub) and the subscriber (sub) transceivers have a CIT port available on the front panel of the transceiver. In addition, for subscriber transceivers a bias "T" can be inserted on the IF cable and the serial communications channel, which is multiplexed on the IF line, can be accessed through the use of a serial interface port to allow indoor access to the transceiver utilities. For the base station transceivers a controller card (optional) located in the outdoor cabinet can be used to communicate with all the transceivers within the cabinet. The base station controller card requires a dedicated coax cable to be routed to the indoor access point. The following documentation provides information for the software used to configure the transceiver.

Installation and Management Utilities

The application is a PC based Windows 95/NT application developed specifically to interface to the version 2.0 transceivers and all future Spike Technologies transceiver products. The application allows communication to the transceiver via any standard RS232 interface for configuration and monitoring of all transceiver functions. Additionally, the application will interface to Microsoft Access database for recording and maintenance of all installation activities. The following document illustrates the new capabilities and functions that will be made available to the field installation crew and system manager.

CIT Software Installation

Installation is accomplished by inserting disk 1 into the A: drive on the craft interface terminal PC and clicking on setup.exe. The software will then prompt the installer for any additional steps. Once installed, there will be a program file created on the C: drive called Spike Technologies Utilities. Click on the task bar titled Install Utilities to start the Installation Utilities program.

Section 5.9.3

Installation Utilities Menu

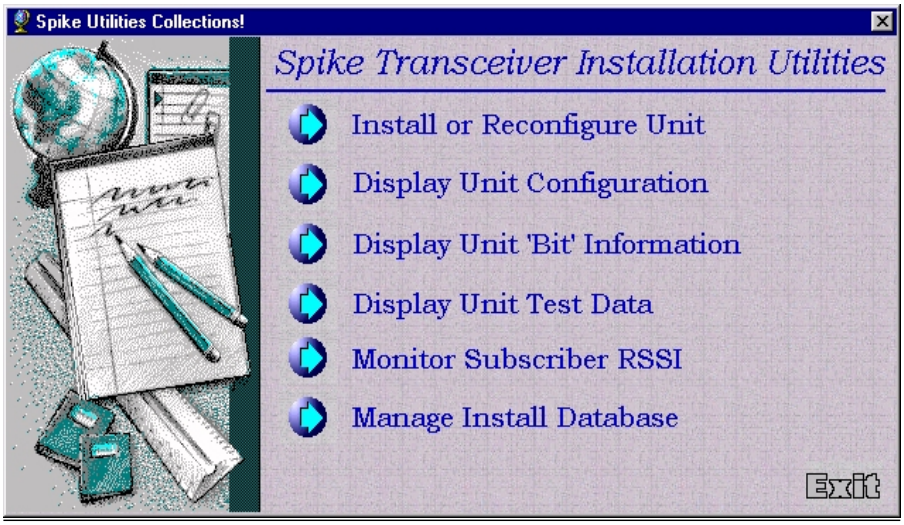


Fig. 5.15

Main screen window from where all installation and management utilities are accessed. The following menu pages will illustrate and describe all of the application items. (see fig. 5.15)

Section 5.9.4

Install or Reconfigure Unit

Select this menu to launch a sub-window that will explain a series of steps to install or reconfigure a transceiver. The procedure for configuring a Hub transceiver is similar to that of configuring a Sub transceiver, there is one additional step in the Sub transceiver configuration process (step 4).

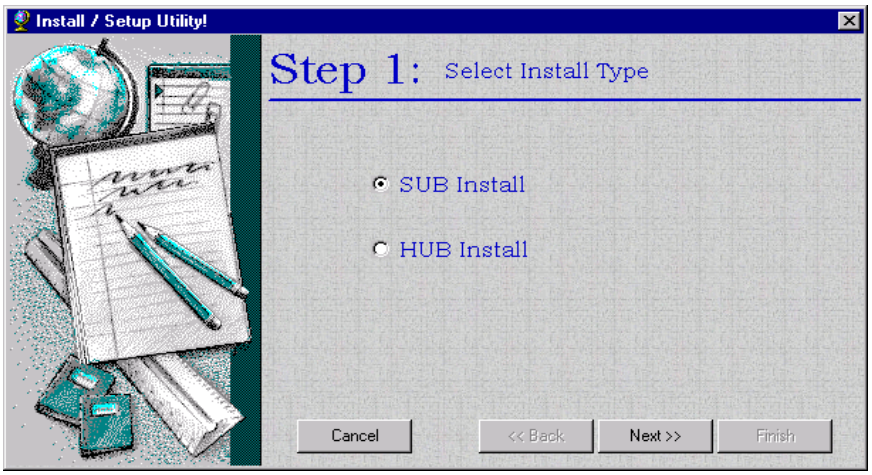


Fig. 5.16

Step 1

Select Install Type

Step 1: select the appropriate installation type, (see fig. 5.16) either subscriber or headend transceiver. After selecting the appropriate installation type, click next to continue the installation process or cancel to abort the installation.

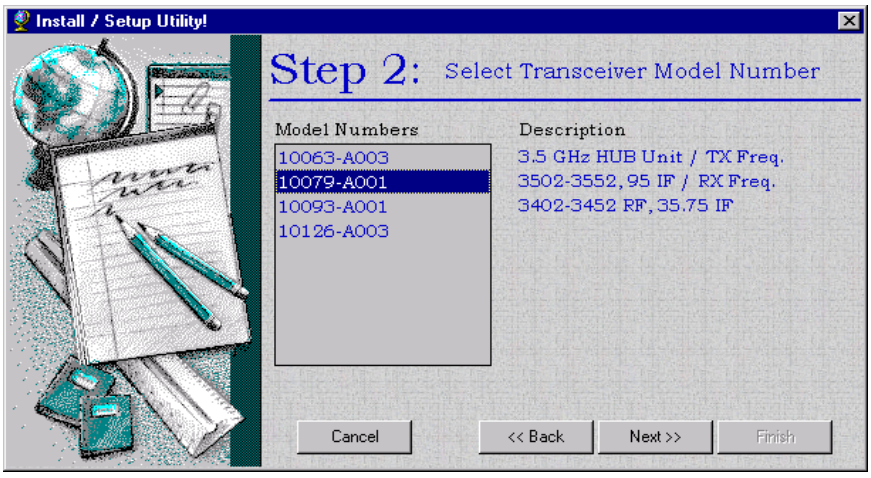


Fig. 5.17

Step 2

Select Model

Step 2 requires user to select the correct model number that identifies the transceiver being installed (see fig. 5.17). Step 2 presents all the available model numbers that have been entered by the system manager and a brief description is presented to the right of the model numbers selected. If the communication channel between the transceiver and the CIT is active the software will poll the transceiver for its model number. If the model number is on the list (installed by the system manager) the model number will be highlighted on the menu. The installer will then select the highlighted model number. The application will signal a warning message if the selected model number does not match the model number programmed into the transceiver.

After choosing the model number, select next to continue the installation process, back to return to step 1, or cancel to abort installation.

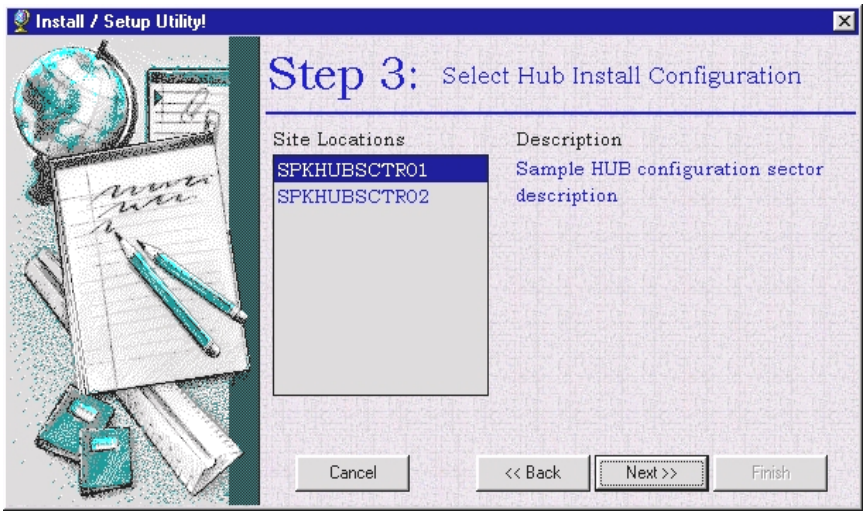


Fig. 5.18

Step 3

Select Hub Installation Configuration

Step 3 requires the correct identifier to be selected for the headend unit transceiver to be installed (see fig. 5.18). It is also necessary to perform this step when installing a subscriber transceiver so that the subscriber can identify which headend transceiver it is communicating with. The items in the list box identify the Hub unit hardware configurations that have been entered by the system manager, and the descriptions to the right are for each sector, or location, as entered by the system manager. When installing a subscriber unit, the information selected will be used to set initial gain settings in the subscriber unit. The information listed under the different site locations will be described in more detail under *Manage Install Database option*, see sec. 5.9.11.

After selecting the correct headend, select next to continue the installation process, back to return to step 2, or cancel to abort installation.

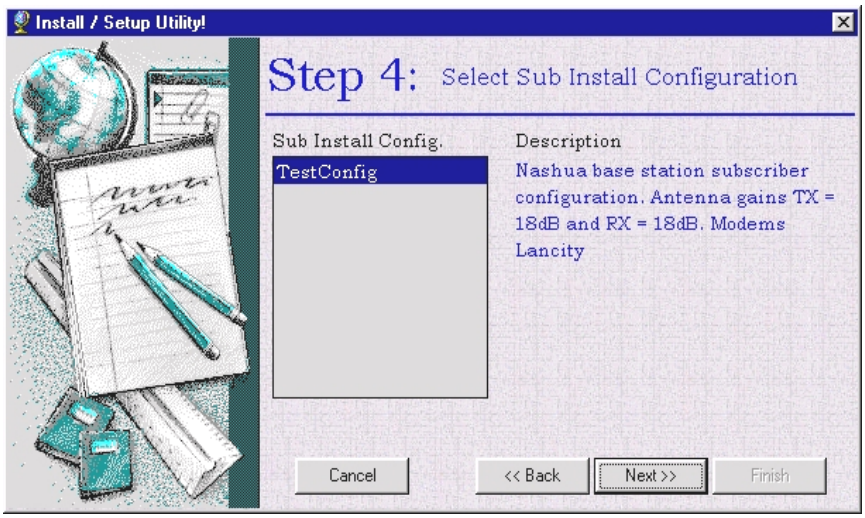


Fig. 5.19

Step 4

Select Sub Installation Configuration

Step 4 requires the user to select the hardware site configuration when installing a subscriber unit (see fig. 5.19). The information entered by the system manager defines the hardware that is being installed at the subscriber location. The descriptions to the right of the menu specify the configuration types entered by the system manager. The information listed under the subscriber hardware configuration will be described in detail later under *Manage Install Database* option. This screen will be by-passed if a hub transceiver installation is selected.

After selecting the correct sub-hardware site configuration, select next to continue the installation process, back to return to step 3, or cancel to abort installation.

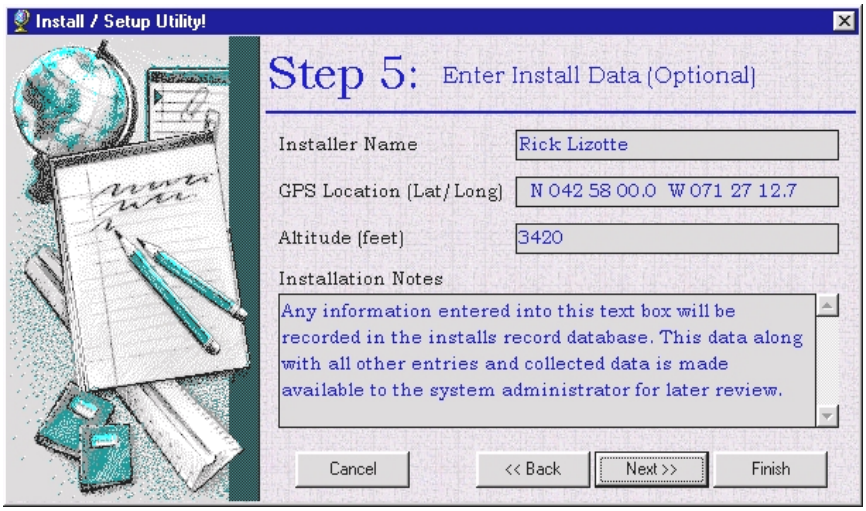


Fig. 5.20

Step 5

Enter Install Data

Step 5: (see fig. 5.20) the installer can optionally enter: □ name, □ GPS location that will be used in calculating initial gain settings, □ altitude at installation site, and □ any installation notes for later review. All information is recorded to the install database and is available for review in the install report.

After entering the appropriate information, select next to continue the installation process, back to return to step 4, or cancel to abort installation.

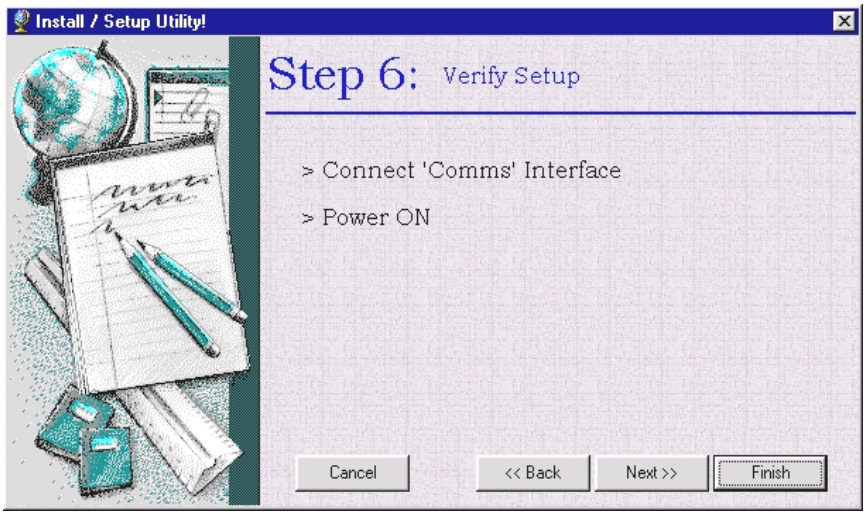


Fig. 5.21

Step 6

Verify Set Up

Step 6 is a reminder to the installer to have power applied to transceiver and have the serial interface connected (see fig. 5.21).

After verifying the setup, select next to continue the installation process, back to return to step 5, or cancel to abort installation.

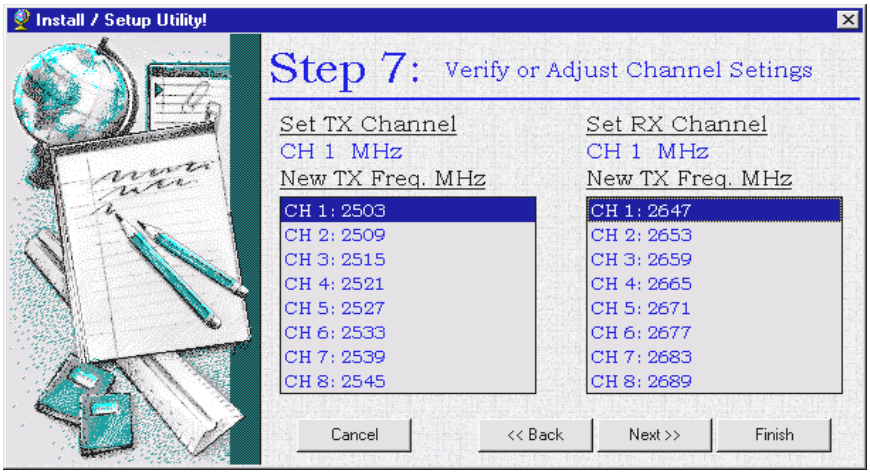


Fig. 5.22

Step 7

Verify Channel Settings

This step allows the installer to over ride the default channel associated with the transceiver model number that was entered in step 2. The default channel will be highlighted when the screen is brought up. Click on the desired channel number to change the default settings.

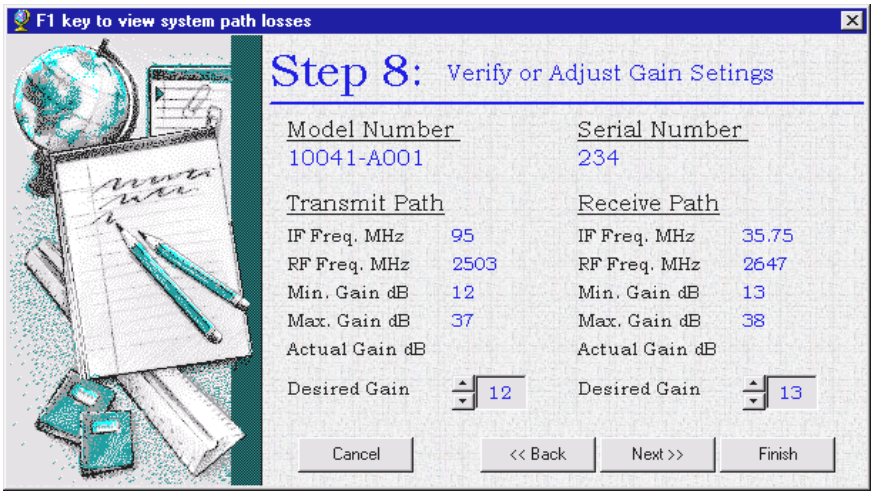


Fig. 5.23

Step 8

Verify Gain Settings

Step 6 must be completed to communicate with the transceiver. If no response is received from the transceiver, the application will generate a warning that will give the installer an opportunity to correct the set-up problem. Once communications is established with the transceiver, the application will run through a series of steps to identify the transceiver it is connected to (see fig. 5.23).

Once the application has made valid communications with the transceiver, it will perform the following steps.

At the onset, the application will read the model number that has been stored in the transceiver's EEPROM during initial configuration. The model number is then compared with the number that was selected during step 2 (*Select Transceiver Model Number*, sec. 5.9.4). If the model numbers do not match, the application will launch a warning dialogue window and allow the installer to continue or return to step 2 to select the correct model number. The application will display the model number, if a match has been made and will continue to the next step.

Once the application has verified the model number through the EEPROM, it will read and display the unit serial number as shown in the figure above.

The configured IF and RF operating frequencies for both transmit and receive chains will be displayed.

The minimum and maximum gain settings that are available on the transmit and receive chains will be read and displayed in the dialogue box. The minimum and maximum values are programmed into the EEPROM during unit calibration at final test.

The current gain settings are read, configured and displayed.

Finally, the application calculates the required gain settings for both transmit and receive chains based on the installer's inputs. The information includes the GPS location (step 5), Hub hardware configuration (step 3), and Sub hardware configuration (step 4). If the calculated gains fall within the minimum and maximum available range, the application will display the calculated values in the desired gain text boxes. If either of the calculated values falls outside of the minimum or maximum values, the application will generate a warning dialogue message and adjust the gain settings to the closest available value.

The installer has the option of accepting the new gain settings that have been calculated by the application, or entering new values. A new value can be entered into the appropriate text box as long as the entered values fall within the minimum and maximum values displayed.

An installer's aid in calculating a distinct gain setting may be activated by keying F1 which will initiate an application to display a spread sheet (see fig. 5.24). The spreadsheet will exhibit the values used to calculate the gain settings. See the figure below for more details. Please note that the spreadsheet is only activated for subscriber transceiver installations.

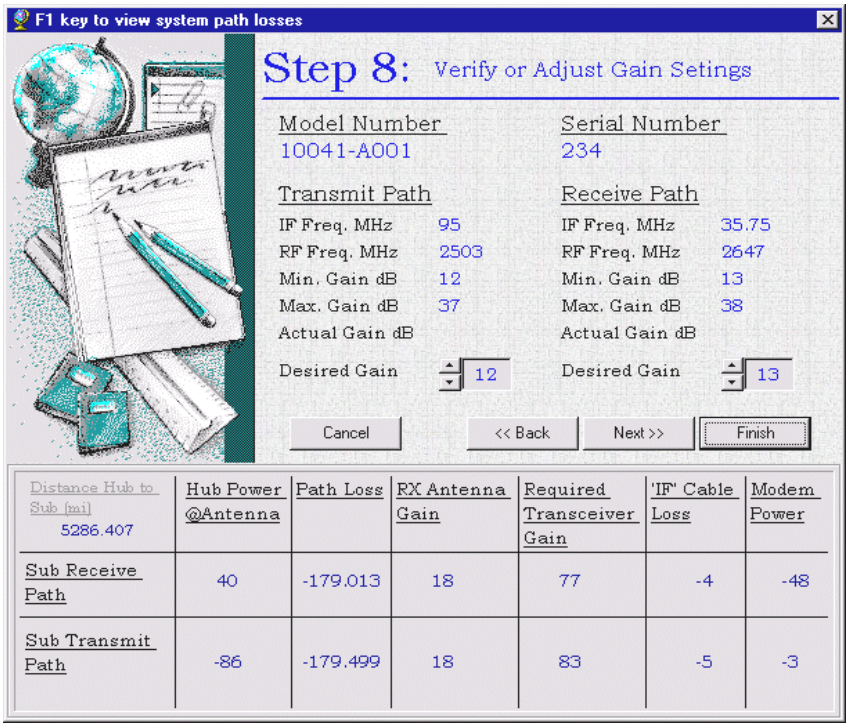


Fig. 5.24

Section 5.9.5

View Parameters

The installer can view the parameters that were used by the application to calculate the required gain settings by toggling the spreadsheet on and off with the F1 key. The IF cable losses or the distance from Hub to Sub can also be adjusted. The distance displayed is the calculated distance from the Hub to Sub using GPS coordinates. When new values are entered for the IF cable losses or distance, the display will update showing the new required gains.

When the desired gains have been entered and calculated, click NEXT to have the application program write the new settings into EEPROM, BACK to return to step 6, or CANCEL to abort installation.

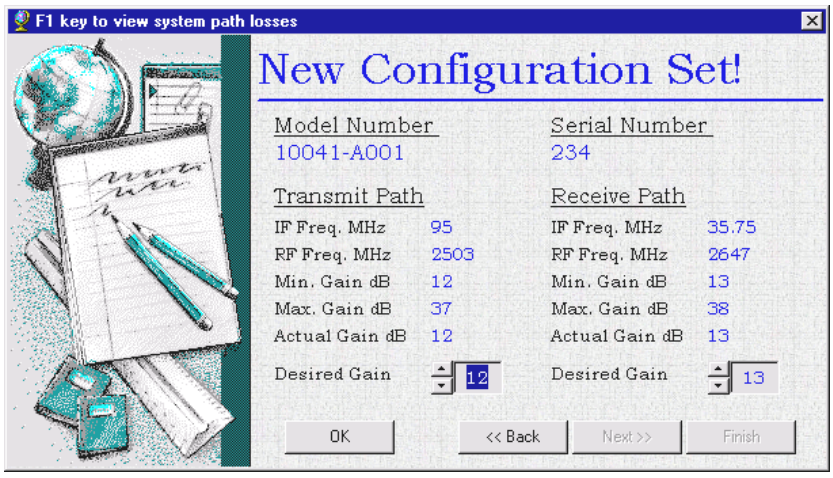


Fig. 5.25

Section 5.9.6

Configuration Set

The application will display NEW CONFIGURATION SET! upon successful completion, both the gain and channel settings will be updated (see fig. 5.25).

The installer has the option of using the back control key (🡐) to enter a different gain or channel setting or select OK to complete the configuration process. Selecting OK will automatically update and store all the information that has been selected during the configuration process, and will return the user to the *Main Utilities* window.

Section 5.9.7

Display Unit Configuration

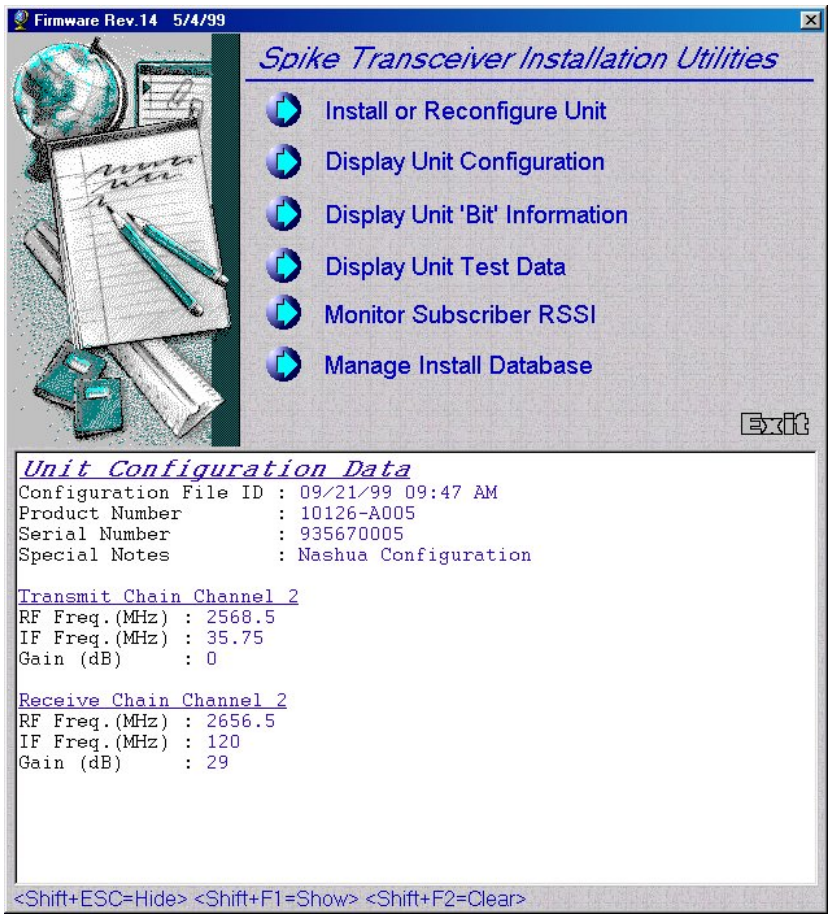


Fig. 5.26

When DISPLAY UNIT CONFIGURATION is selected from the dialogue box in the Main Menu the application will attempt to establish communications with the transceiver. Once communications with the transceiver has been established, the screen will display, the firmware revision number, the transceiver product number, serial number, transmit and receive IF and RF operating frequencies, current gain settings for both the transmit and receive chains, and any special notes that were entered during the initial configuration, (see fig. 5.26). The Configuration File ID field is used to display a unique code that will be assigned by the factory for special product configurations.

Note that the display text box can be toggled on and off using the function keys shown at the bottom of the box.

Section 5.9.8 Display Unit 'Bit' Information

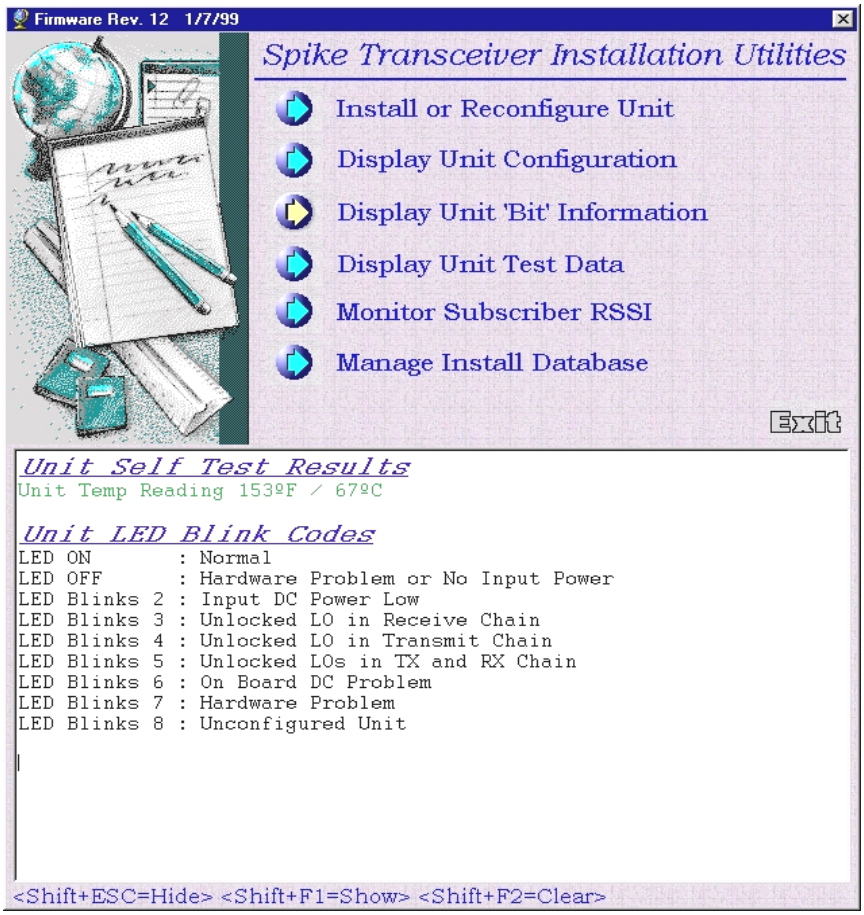


Fig. 5.27

From the main menu selecting 'Displaying Unit 'Bit' Information' will cause the application to open a text box, (see fig. 5.27) then attempt to establish communications with the transceiver. If the application successfully establishes communications with the transceiver, it will first display the firmware revision number of the transceiver and display it in the window title bar. It will then read and display the current 'Bit' status of the unit as shown above. If no errors are detected, the application will simply display the on-board temperature sensor reading and will also always display the unit LED blink codes for reference. If errors do exist, they will be listed and displayed in red.

Selecting DISPLAYING UNIT BIT INFORMATION will open a text box to establish communications with the transceiver. When the application successfully establishes communications with the transceiver, it will display the firmware revision number of the transceiver and display it in the window title bar. It will further display the current BIT status of the unit. The application will display the on-board temperature sensor reading display the unit LED blink codes for reference. Errors will be listed and displayed in red.

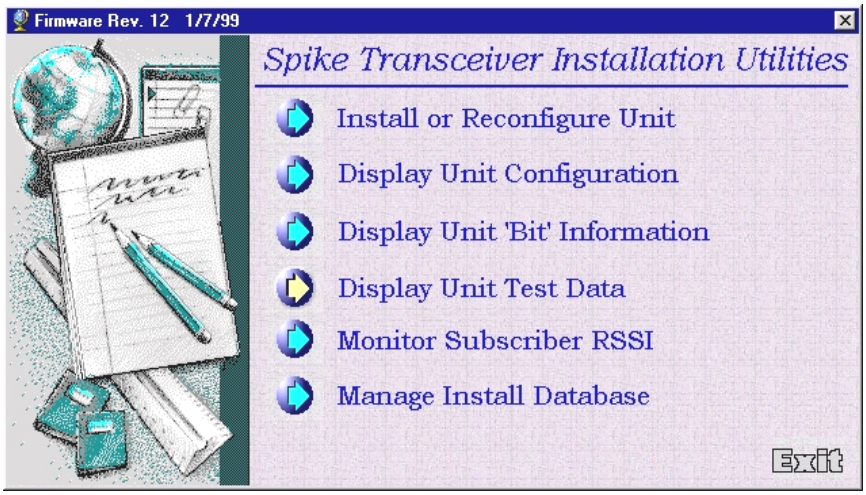


Fig. 5.28

Section 5.9.9 Display Unit Test Data

Not implemented in this current release but intended for future releases which will allow the installer, or system monitor, to view transceiver data that was recorded during final test.

Section 5.9.10 Monitor Subscriber RSSI

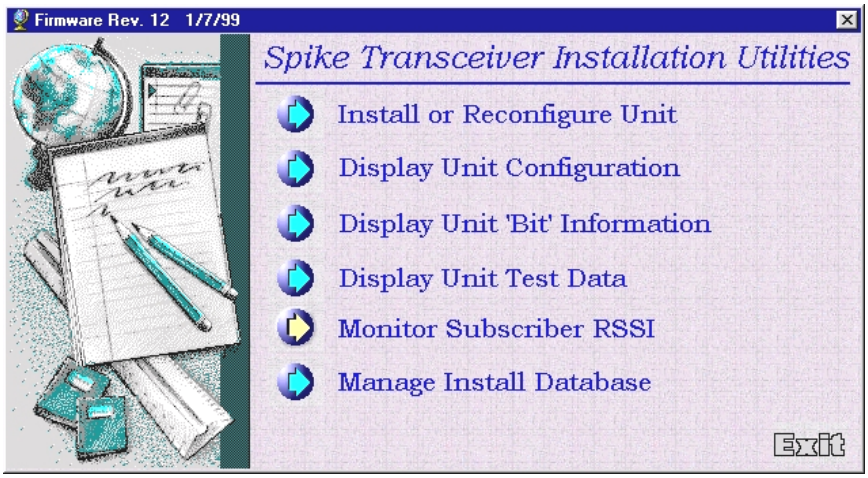


Fig. 5.29

The Monitor Subscriber RSSI option allows the installer, or system monitor, to view the receive signal strength indicator from subscriber units that are equipped to perform this function. Selecting this option (see fig. 5.29) opens a second window for monitoring of data, (see fig. 5.30).

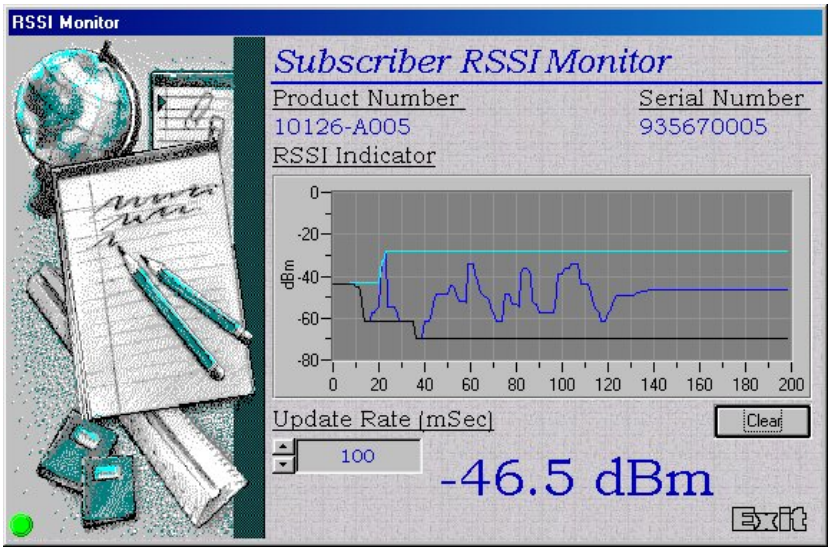


Fig. 5.30

Once the second window has been loaded, the application will attempt to establish communications with the transceiver. If the application successfully establishes contact with the transceiver the indicator in the lower left corner of the screen will be green (red if communications is not established). The application will first read and display the unit model number and serial number. Secondly, the application will continually request RSSI data from the transceiver at the update rate selected and display the data in the grid box. The last two hundred points will be displayed by three traces. The black trace color displays the minimum value detected, the light blue trace color displays the maximum level detected, and the dark blue trace color displays current level detected. The level being measured is the RX IF level out of the receiver. This level is in dBm and has an accuracy of +/- 1.5 dBm and range from -70 to -20 dBm (depending on transceiver gain setting). Also note that the current RX IF level out of the transceiver is displayed at the bottom of the screen.

Note: The displayed power is peak power and not channel power.

Section 5.9.11 Manage Install Database

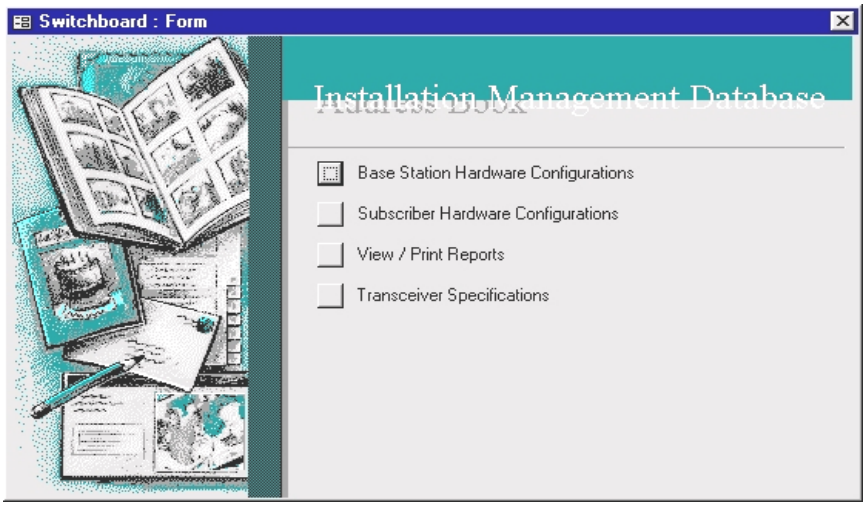


Fig. 5.31

Selecting MANAGE INSTALL DATABASE, from the main menu, will launch Microsoft Access and load the *Installation Management Database*. All system configurations are stored and all installation activities are recorded in the database for system wide retrieval, (see fig. 5.31).

Section 5.9.12 Base Station Hardware Configuration

The system manager has the ability to alter current Hub hardware configurations, add new base station hardware configurations, or delete configurations. The information entered defines the Hub station hardware configurations that are made available to the installer, (see fig. 5.32).

The following window displays the format that is opened for data entry when this option is selected.

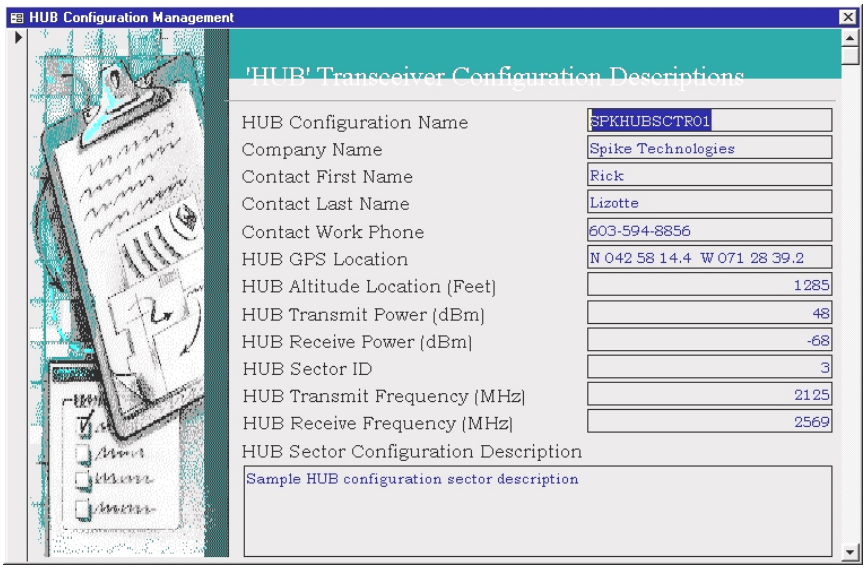


Fig. 5.32

Hub Configuration Name

The Hub CONFIGURATION NAME allows entry of the name that is associated with the hub transceiver. The name is displayed in the list box that appears in the *Select Hub Install Configuration* screen, which was previously described.

Hub Sector Configuration Description

The Hub SECTOR CONFIGURATION DESCRIPTION information is displayed, along with the Hub Configuration Name on the "Select Hub Install Configuration Screen".

Hub GPS Location, TX Power, & RX Power

These entries are used by the installation application when calculating the required gains in the subscriber radios.

Section 5.9.13 Subscriber Hardware Configuration

Using the subscriber hardware configuration option, the system manager has the ability to alter current *sub*-hardware configurations, add new *sub*-hardware configurations, or delete configurations. The information entered with this option defines the sub-hardware configurations that are available to the installer.

The following window (see fig. 5.33) displays the form that is opened for data entry when this option is selected.

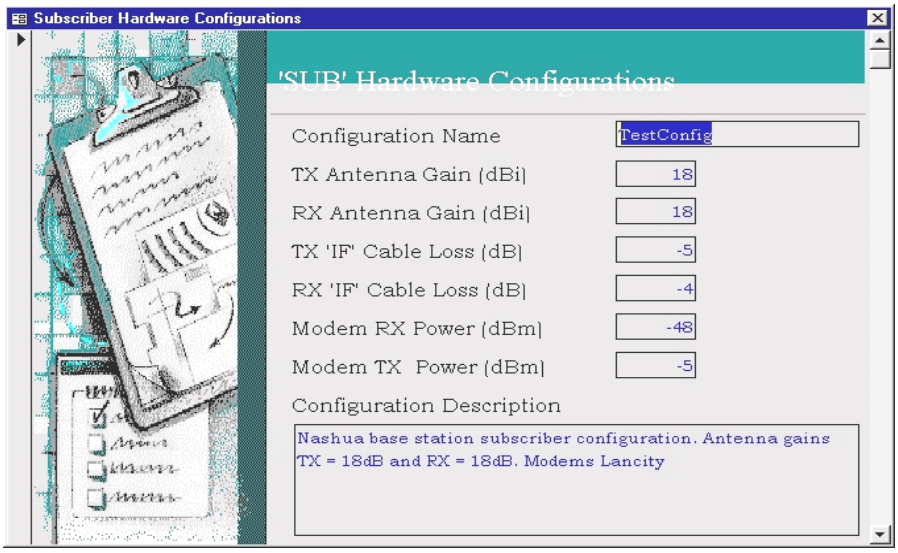


Fig. 5.33

Sub Configuration Name

This entry is the name that is displayed in a list box during unit installs that the installer can select from when asked to select which Subscriber configuration type.

Configuration Description

The information here is what is displayed along with the Sub Configuration Name during unit installs to help the installer in selecting the correct configuration.

Gain Calculation Parameters

TX and RX Antenna, TX and RX Cable Losses, and TX and RX Modem Power are entries used by the installation application when calculating the required gains in the subscriber radios.

Base Station Balancing

The process of setting the base station TX output power and the RX gain, to the proper level is referred to as balancing the base station. The following procedure describes how to balance the base station. Please note that the base station is pre-balanced at the factory and the procedures below are intended as verification tests to identify any installation related problems, minimal readjustment should be expected.

Tools and Equipment Required

Spectrum Analyzer, HP model 8595E or equivalent
Signal Generator, HP model 8648D or equivalent
Test diplexer for frequency band of base station
Low loss 3 ft. RF test cables w/male SMA connectors, qty. 4
Type N male to SMA female coaxial adapter, qty. 2
SMA female to SMA female adapter
50 Ohm SMA female termination
Portable computer with Spike Technologies Installation Utilities installed
Serial interface cable for craft terminal (portable computer) to transceiver communication
5/16” open end torque wrench for SMA connectors
7/16” open end wrench for type "F" connectors
System configuration data spreadsheet

Calibration

Make sure a reasonable warm up time is allowed on all hardware before levels and gains are measured and adjusted, an overnight warm up period is recommended.

Four separate SMA (male) test cables are used for the following measurements and a diplexer that is similar to the diplexer used in the base station. Both the spectrum analyzer (input) and the signal generator (output) should be equipped or adapted to SMA female ports. In addition an SMA female-to-female adapter will be required.
The test cables are named:
Reference cable
Common cable
TX cable
RX cable

The reference cable is used as a convenient means of bringing a reference signal from the signal generator, for the purpose of calibrating the test setup. The reference cable is **not** part of the test setup.

Refer to fig. 5.39, connect one end of the reference cable to the signal generator output port and the other end to the spectrum analyzer input port.

Set the spectrum analyzer as follows:
Center frequency - TX frequency of sector being measured
Span - 10 MHz
Resolution Bandwidth - 100 kHz
Marker - Peak Search.

Set the signal generator output for a CW signal at the transceiver TX output frequency corresponding to the sectors being adjusted. Adjust the signal generator to get a convenient known level at the spectrum analyzer, for example 0 dBm.

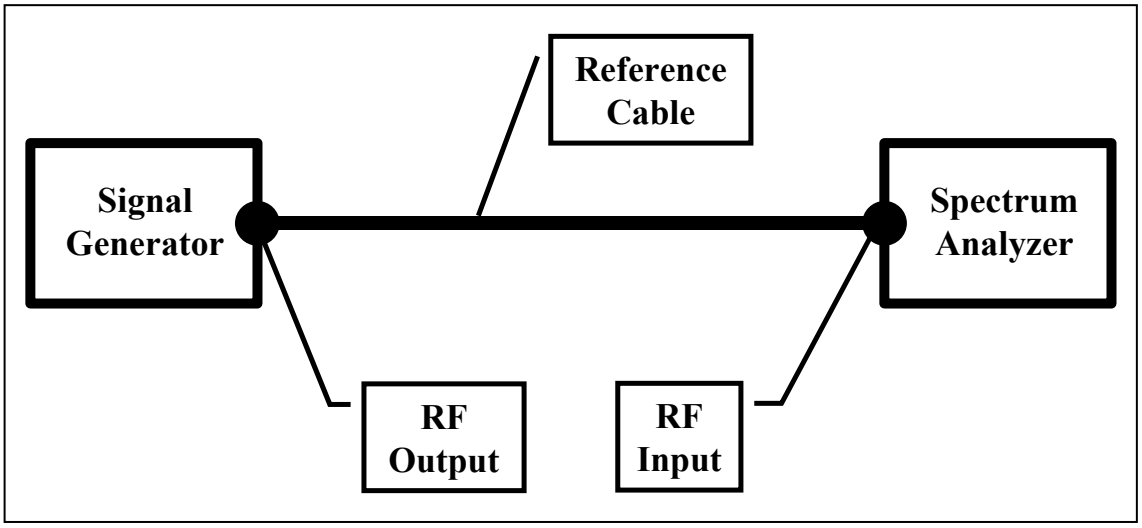


Fig. 5.39 Set Reference Level Set-up

The next step in the calibration process is to record the loss of the TX path through the entire test setup (fig 5.40). The test set-up consists of the diplexer with the common cable attached to the diplexer common port (TX/RX) the TX cable attached to the diplexer TX port and the RX cable attached to the diplexer RX port. Connect the test set-up transmit cable to the reference cable by using an SMA female-to-female adapter. Connected the common cable to the spectrum analyzer. Install a 50 ohm SMA (female) load on the end of the RX cable. The signal level displayed on the spectrum analyzer should be lower than the (previously set) reference level. The difference between the level now displayed on the spectrum analyzer and the reference level is the loss of the transmit path of the test set-up. Record the TX path loss.

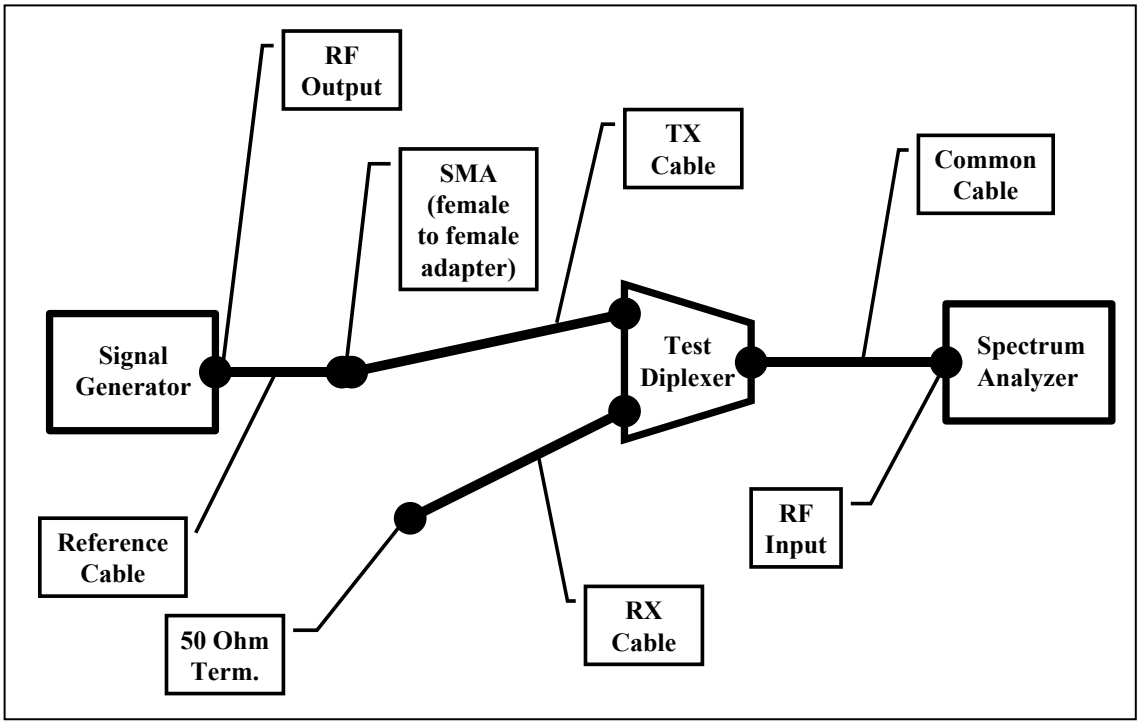


Fig. 5.40 TX Through Path Calibration Set-up

Section 5.11.1

Set TX Output Power

Disconnect the TX cable from the reference cable, (fig. 5.41) connect the TX cable to the antenna port of the transceiver being adjusted. If the transceiver uses an external diplexer connect the TX cable to the antenna port of the external diplexer corresponding to the transceiver being adjusted. The other end of the TX cable should still be connected to the test set-up.
The desired TX output power of the transceiver is determined when the system is being designed and should be known before installation begins, the information is contained in the system configuration data spreadsheet, if the information is lost or circmstances require a change, contact Spike Technologies technical support department for further information.

Adjust the spectrum analyzer to the following settings.

Center Frequency- TX output frequency for the transceiver being adjusted.
Span - 10 MHz
Reference Level - +20 dBm
Resolution Bandwidth - 3 MHz
Trace - Max Hold
Marker - Center Frequency

With the above settings the spectrum analyzer display should show the modulation envelope of the transmitter. The envelope will be approximately 6 MHz wide and should be centered in the middle of the screen. Allow enough time for the envelope to fill in completely on the display. Record the power level being indicated by the marker at the middle of the screen. Add the TX path loss of the test set-up (previously measured) to the level just recorded, this is the TX output power. If the TX output power measured does not correspond (within 1 dB) to the desired TX output power, adjust the TX gain of the transceiver being measured, see section 5.9.4.

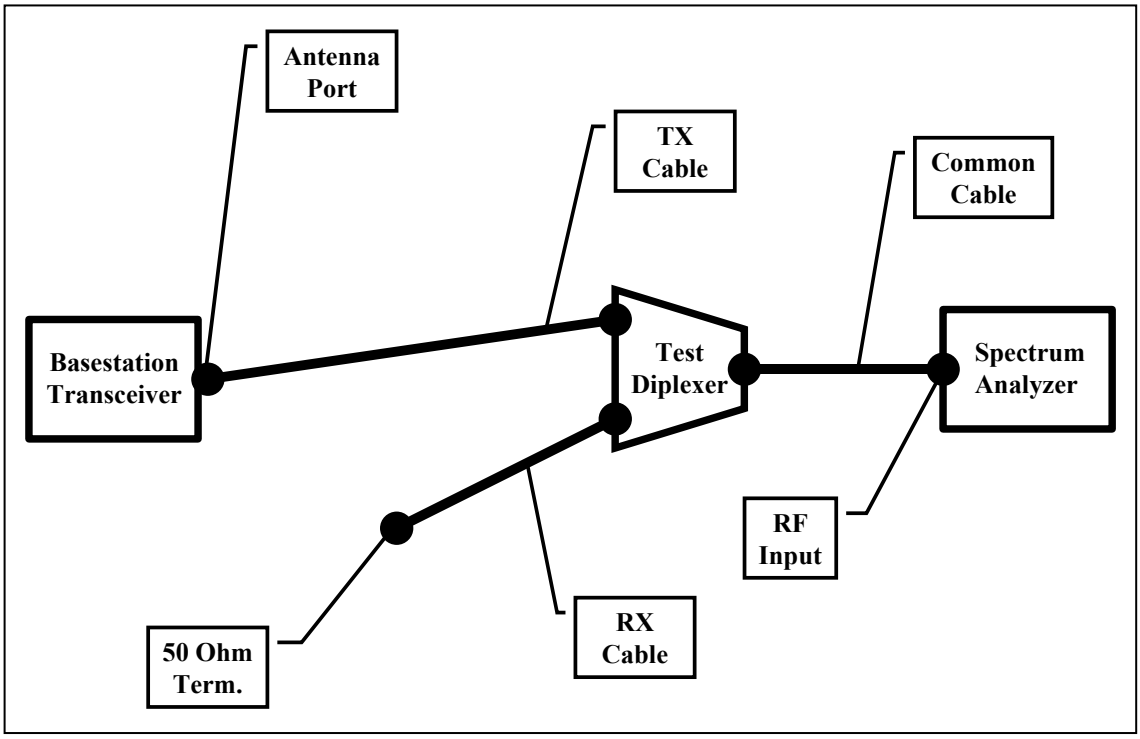


Fig. 5.41 TX Power Measurement Set-up

Section 5.11.2

Set RX Gain

The next step in the base station adjustment process is to set the RX gain of the transceivers. The same test setup used in the TX output power setting procedure is used for the RX gain setting procedure.

The method used to set the RX gain is to inject a test signal (from the signal generator) in through the RX cable, through the diplexer RX path and finally through the common cable which is connected to the antenna port of the transceiver (or external diplexer) see (fig 5.42). The signal generator is set for a level that will present a level at the antenna port that is typical of a subscriber signal. This signal will be down converted by the receiver, go down the IF cable to the modem. The only variable that needs to be adjusted is the RX gain.

The first step in the RX gain setting procedure is to set the reference signal level into the receiver. Connect the RX cable to the signal generator; connect the common cable to the spectrum analyzer (fig. 5.42).

Set the spectrum analyzer as follows:
Center Frequency to the RX frequency of the transceiver being adjusted
Span - 500 kHz
Resolution Bandwidth - 10kHz
Video Avg. - On
Marker - Peak Search
Input Attenuation - 0dB

Set the amplitude on the signal generator such that the CW tone on the spectrum analyzer matches the corresponding level in table 1. Record the amplitude that the signal generator is set to.

RX Reference Power Level Table

	TX/RX Port @	**2.5 GHz System**	**3.5 GHz System**
Internal Diplexer	Radio	-69.5 dBm	-69.0 dBm
External Diplexer	Diplexer	-71 dBm	-70.5 dBm

Refer to the test setup in fig. 5.44, attach the indoor end of the transceiver IF cable to the input of the spectrum analyzer. It is assumed that the transceiver is properly configured except for gain settings. Configure the spectrum analyzer with the following settings:

Center Frequency – 35.75 MHz
Span - 10 MHz
Resolution Bandwidth - 3 MHz
Reference Level - 40 dBm
Trace - Max Hold
Marker - Center Frequency

The spectrum analyzer should be displaying the received, CW tone injected in the receive port. If the display is above the top of the screen raise the reference level by 10 dB and reset the trace. Read the marker on the spectrum analyzer display, the nominal level is -48 dBm, adjust the RX gain of the transceiver to obtain an RX IF level of -48 dBm +/- 1 dB.

Repeat the procedure on the other transceivers, measure all transceivers that share a common channel, then repeat the procedure on the other sector channels, recalibrate the test set-up when changing channels. Should an imbalance be observed, it is best to complete the verification test for all sectors before entering the troubleshooting phase. All sectors should be matched within 1 dB of each other.

Record data for all sectors. Turn off the signal generator.

Turn on all headend modems.

Alignment Troubleshooting Process

The base station transceivers are pre-aligned at the factory so that the TX output power and RX gains are set to the values specified in the system data configuration spreadsheet, within proper tolerances. Since items such as IF cable losses cannot be predicted prior to installation, it is normal for gains to need minor readjustment from their factory settings. If the gains need to be adjusted by more than +/- 3 dB from the factory settings, a hardware or installation problem may be indicated. Most likely causes include the following:
Improperly connected IF cables
IF cables that are swapped to the wrong sector
Poor quality connector installation
Pinched, broken or severed cable
Loose connectors (improperly torqued)
Cards not fully seated in their backplane

If it is found that gains are off by a consistent and excessive amount on all sectors, double check the calibration of the test setup before concluding a problem exists.

Make sure a reasonable warm up time is allowed on all hardware before levels and gains are measured and adjusted, an overnight warm up period is recommended.

Check the obvious things that are installation related first, then break the system down to subsystems and check for proper gains/losses through each subsystem. If a subsystem component is suspected of being at fault such as a transceiver, modem or diplexer, swap it with a similar unit from another (good) sector and see if the problem is resolved. Use the information in chapter 3 & 6 as a guide to system troubleshooting.

Section 5.12

Subscriber Gain Setting Procedure

Once the Base Station is balanced, the subscriber transceivers can be adjusted for the correct TX and RX gains.

Since the subscriber modem TX power is adjusted to give the headend modem a nominal RX level, the subscriber **transceiver** TX gain should be adjusted to center the modem in the middle of the TX AGC range, +45 dBmv.

The subscriber modem also has an RX AGC circuit, the nominal RX level that the modem wants to see is 0 dBmv. Therefore the subscriber **transceiver** RX gain should be adjusted to center the modem in the middle of the RX AGC range.

Tools and Equipment Required

Spectrum Analyzer, HP model 8595E or equivalent
Signal Generator, HP model 8648D or equivalent
Low loss 75 Ohm IF jumper cable, type F male (both ends)
Type N male to F female coaxial adapter
Portable computer (Craft Terminal) with Spike Technologies Inc. Installation Utilities loaded
Serial interface cable for lap-top to radio communication
Bias "T" with serial communications port (optional)
7/16” open end wrench for type "F" connectors

Section 5.12.1

Aim Antennas

Before proceeding with gain adjustment of the subscriber transceiver, make certain that the antennas are aimed exactly at the base station. This is easily accomplished by plugging the craft terminal into the craft interface port on the transceiver. Make sure the transceiver is receiving DC power from the bias "T" located indoors. Transceiver DC power can be verified by observing that the transceiver LED is illuminated solidly. Refer to section 5.9.10, which explains how to monitor the received signal strength on the craft terminal using the Spike Technologies Installation Utilities. PAN the receiver antenna in azimuth and elevation (if equipped with optional elevation bracket) until the received signal is at maximum, aim the transmit antenna in the same direction as the receive antenna. Tighten all clamps.

Section 5.12.2

Subscriber RX Gain Adjustment

Refer to the test setup in fig. 5.44, attach the indoor end of the transceiver IF cable to a bias "T" that has a serial interface port built in. This type of bias "T" is usually used only for transceiver configuration and diagnostics and not left in for normal operation. The IF cable has to be connected to the DC coupled port of the bias "T" or the transceiver will not receive DC power. The other end of the bias "T", the AC coupled port, is connected through a low loss 75 Ohm jumper cable to the input of the spectrum analyzer. The transceiver power supply is connected to the DC power port of the Bias "T" and the craft terminal (portable computer) running the Spike Technologies Installation Utilities software is connected to the craft terminal interface port on the bias "T". It is assumed that the subscriber transceiver is properly configured except for gain settings. Configure the spectrum analyzer with the following settings:

Center Frequency - 120 MHz
Span - 10 MHz
Resolution Bandwidth - 3 MHz
Reference Level - 40 dBm
Trace - Max Hold
Marker - Center Frequency

The spectrum analyzer should be displaying the received, modulated signal from the base station. Allow enough time for the modulated envelope to fill in on the spectrum analyzer display. If the display is above the top of the screen raise the reference level by 10 dB and reset the trace. Read the marker on the spectrum analyzer display, the nominal level is -48 dBm, adjust the RX gain of the transceiver to obtain an RX IF level of -48 dBm +/- 1 dB.

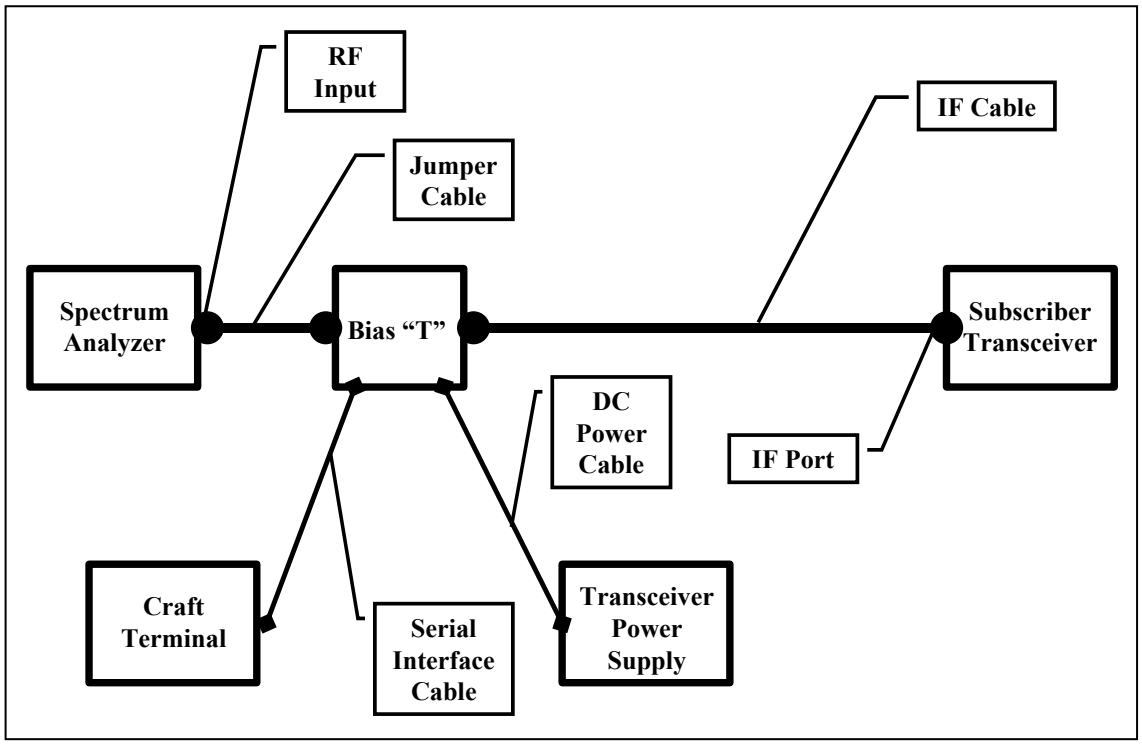


Fig. 5.44 Subscriber RX Gain Adjustment Set-up

Section 5.12.3

Subscriber TX Gain Adjustment

The easiest and safest way to set the subscriber transceiver TX gain is to monitor the subscriber modem TX power level as reported to the management station at the NOC. Refer to section 5.10.1 and go to the section on the Auto Adjust Sub-menu. The screen for the Auto Adjust Sub-menu is shown in fig. 5.37. The parameter TxPwrDbmv specifies the current **modem** transmit power. The modem transmit power is **lowered** by raising the **transceiver** TX gain and raised by lowering the transceiver TX gain. The change between modem gain and transceiver gain corresponds on a dB for dB basis; if the transmitter gain is increased by 1 dB the modem TX power will go down 1dBmv. The nominal modem TX power is +45 dBmv.

Of course it will be necessary to have communications back to the NOC and a person monitoring the management station in order to facilitate Subscriber TX gain adjustment. Allow up to 1/2 hour for the modem to adjust its TX power to the new transceiver TX gain setting.

While monitoring the Auto Adjust Sub-menu check the parameter AvgBSRxLevelDbmv which displays the modem RX input level in dBmv, this level is nominally 0dBmv. If this level needs to be adjusted the procedure is as follows…

To raise the modem RX power, increase the transceiver RX gain. To lower the modem RX power, decrease the transceiver RX gain, there is a dB for dB correspondence between the modem power change and the transceiver gain change.

Section 5.13

System Performance Verification

Upon completion of the installation and balancing of the base station and a number of subscriber sites in each sector, various critical system parameters will need to be monitored to determine whether the equipment is performing within acceptable limits. The parameters of primary concern are those of the subscribers and will be obtained through the management station using SNMPc.