Antenna Alignment

3

3.01 For the Model 9000 radio system to operate properly, the near and far ends must be aligned as accurately as possible. Antenna alignment requires two persons who are able to communicate with each other, one at the near end and the other at the far end.

3.02 You will need these tools to align the antennas:

- Binoculars or the equivalent (if the far end is more than one-half mile distant).
- High-powered (e.g. 600 watt) spotlight for night visibility or a mirror for daytime to flash the path.
- Walkie-talkie portable radios or cellular phones (for communicating with the far end).
- Common wrenches and sockets:

  7/16 inch socket/nut driver
  7/16 inch open-end wrench
  9/16 inch deep socket
  9/16 inch open-end wrench
  3/4 inch socket
  3/4 inch open-end wrench

- Approved and inspected safety equipment for climbing aloft.

DANGER:

Wear approved and inspected safety equipment when climbing aloft on any antenna tower or other antenna-mounting location where there is a risk of falling.

ALWAYS work with a line tender on the ground who can summon aid if you are injured.

Follow these steps to align the near-end and far-end antennas:

Using a local map, determine the proper direction to point the antenna.

2. Check that both feedhorns are horizontally polarized (there is a "zero" indication on the feed that should be turned so that it is on the side of the feed at both ends).

3. Verify that the pseudorandom number (PNS) codes are properly set to ensure communications.

4. Turn on power to both the near-end and far-end systems.

5. If using walkie-talkie radios or cellular phones, establish communication with the far end.

NOTE:

Monitor the automatic gain control (AGC) voltage at the front panel local DB-9 connector. A strong receive level is 1 Vdc, a weak level is 2 Vdc. This is not real time.

6. Observing all safety precautions, including a line tender on the ground, climb to the antenna.

7. Loosen the antenna adjustment bracket just enough to allow the antenna to be swung back and forth in the azimuth plane and elevation plane.

8. Loosen the antenna securing bracket just enough to allow the antenna to be swung up and down (refer to Figure 3-1).

9. Have your assistant at the far end turn on his/her spotlight and aim it toward you (refer to Figure 3-2) or flash the path with a mirror.

10. Aim the antenna as close to the light as possible.

11 Have your assistant check the monitor at the far end for minimum AGC voltage.

TIP:

The beamwidth of the typical Model 9000 antenna is around 8.25° to the 3 dB points on the main lobe. Because the 9000 will not operate if the antenna is aimed more than 4° off "boresight," visually point the antenna as close as possible even after obtaining a minimum voltage reading.

(continued)

12. Instruct the far end to perform the same procedure.

13. Readjust the near-end and far-end antennas for a minimum reading on the voltmeter.

14. Tighten the antenna's securing and adjustment hardware. Make certain that the mounting is sufficiently rigid to assure alignment accuracy under maximum expected wind loading.

The Model 9000 is now ready to be tested for acceptance. Instructions follow in Section 4 and also appear in Larus Practice 80-100-281, the *QuadHopper*™ Model 9000 System Description.

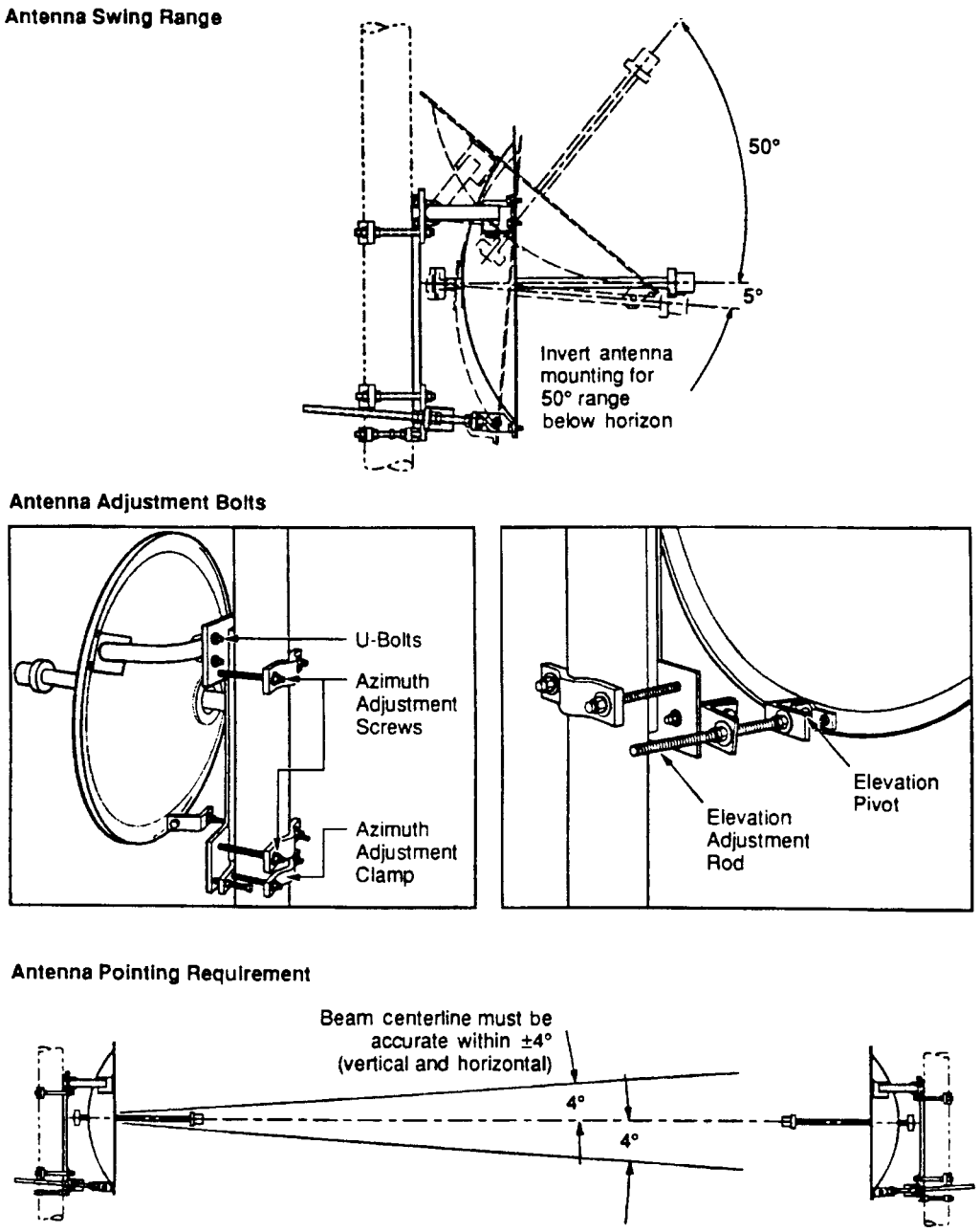

Figure 3-1. Typical Positioning of Parabolic Dish Antenna

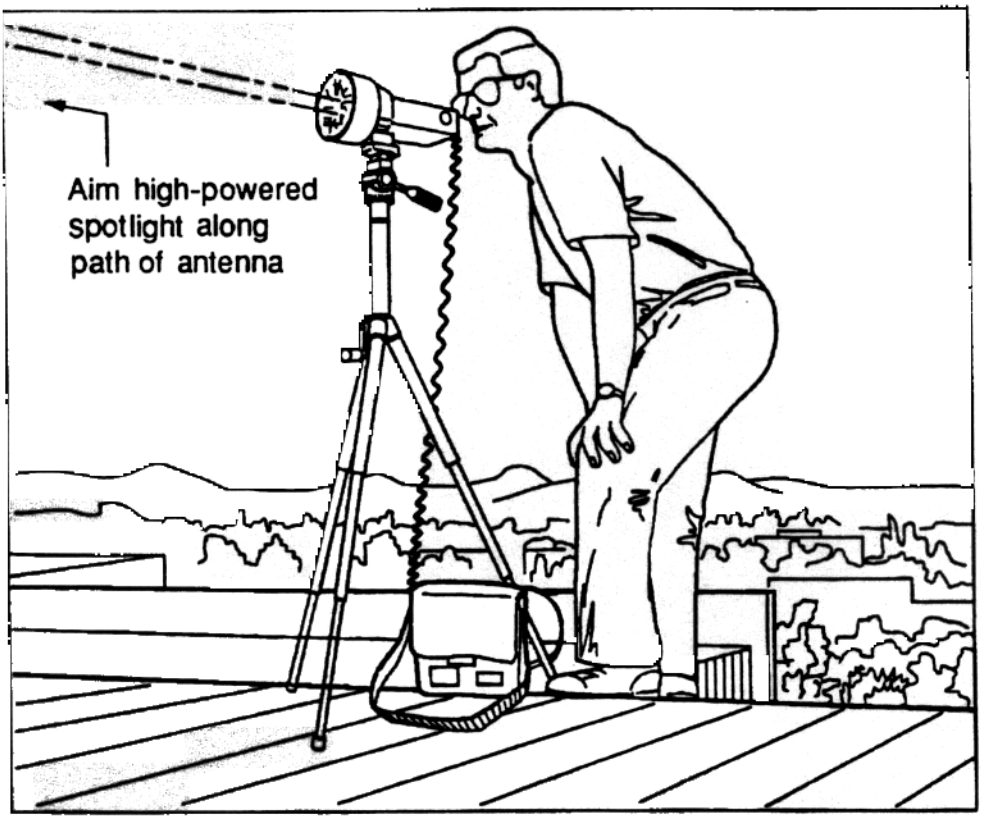

Figure 3-2. Aiming Antenna

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The Model 9000 has two built-in tests which can be run from a terminal connected to the LOCAL port. These tests make installation checkout and acceptance testing easy to do without additional test equipment.

Instructions for running each of the tests follow. Each procedure presumes that a terminal is connected to the local virtual data circuit port on the Control Module.

NOTE:

Call Larus Customer Service if the results from either test indicate a failure. If Test 2 fails, check to make sure the radios have power, the antennas are aligned, and the despreader codes are correctly set at each end. If problems with Test 2 persist, contact Larus Customer Service at 1-800-999-9946.

CAUTION:

Running the field diagnostic tests with live traffic in operation will cause loss of traffic during the test sequence.

Reconfiguring the system while live traffic is up will cause loss of traffic during the reconfiguration sequence.

Test 1: E1/DS1 Loopback

Test 1 verifies the E1 or DS1 connections to the Model 9000 by sending a signal through the circuit to the near-end digital signal crossconnect (DSX), the E1/DS1 interface, and monitoring the return path for the same signal (refer to Figure 4-1). For the test to operate, the E1/DS1 signal at the near end **must** be looped back at the customer's E1 or DS1 equipment. This test can be done at the same time at both the near and far ends.

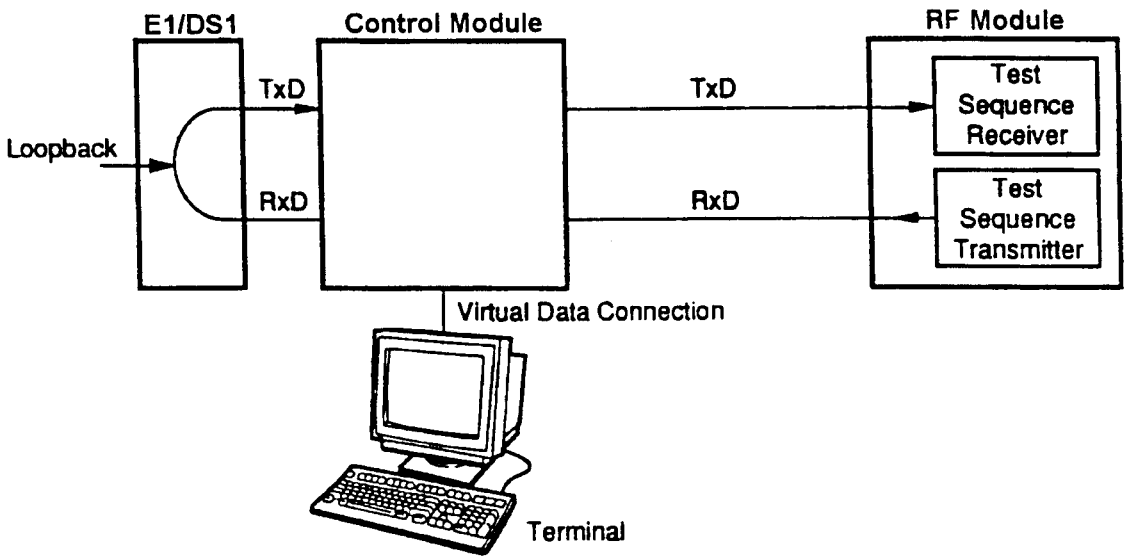

Figure 4-1. E1/DS1 Loopback Test

4.12 To run Test 1 from the VT-100 or compatible terminal connected to one of the local virtual data circuits ports, perform these steps:

1. At the DSX, loop back each of the receive E1 or DS1 lines from the 9000 to the transmit lines to the 9000.

2. Run Test 1. If an error is indicated, check wiring from the Control Module and customer equipment.

Test 2: End-to-End Path Continuity

4.21 Test 2 verifies end-to-end performance of the Model 9000 radios. This test loops the signal through the multiplexer/demultiplexer (muldem) in both the near-end and far-end radios (refer to Figure 4-2). It must be done first from the near end, then from the far end. This procedure does **not** test the E1/DS1 interface at either end.

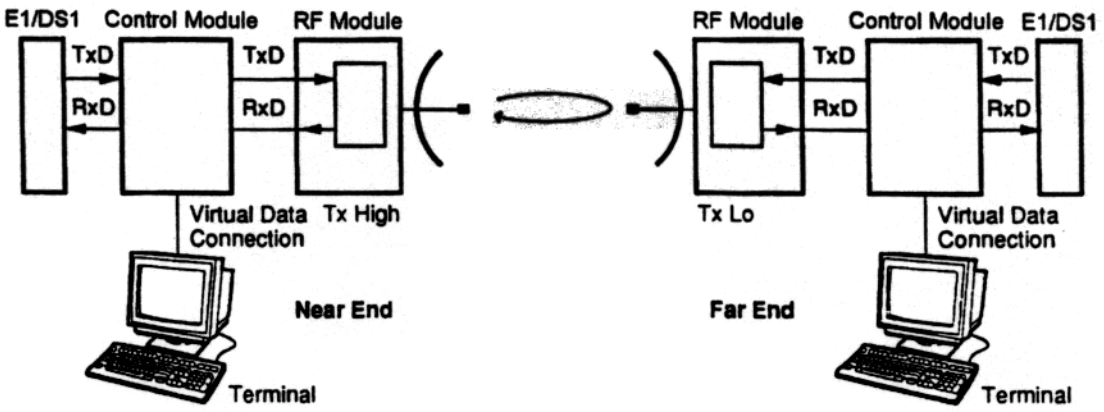

Figure 4-2. Near-end to Far-end Loopback Test

4.22 To run Test 2 from a VT-100 or compatible terminal connected to one of the virtual data circuit ports, perform these steps:

1 At the DSX, loop back each of the receive E1 or DS1 lines from the 9000 to the transmit lines to the 9000.

2. If near-end and far-end DSX loopback is not possible, a Model 9021 E1 or DS1 Test Interface is available for testing (refer to Figure 4-3).

3. Run Test 2. If any errors are reported, check each E1/DS1 line. If all lines are reporting errors, check for interference or other problems.

4. If no errors are reported, the equipment is ready to carry traffic.

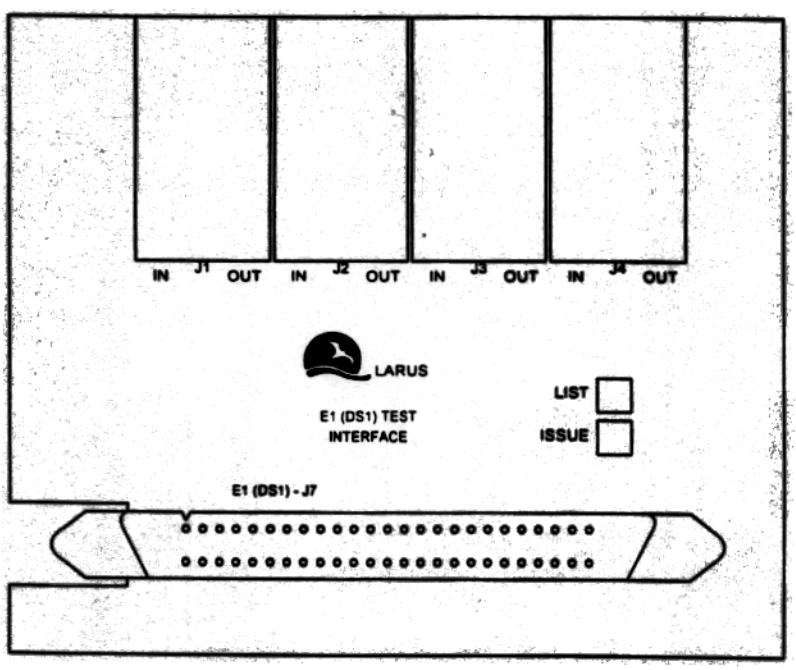

Figure 4-3. Model 9021 E1/DS1 Test Interface

5.01 If you have not completed the Site Planning/Preparation Worksheet in Larus Practice 80-601-281, fill in the following checklist BEFORE installing the Model 9000. If you have already completed the preparation worksheet, continue with the installation checklist beginning on page 5-6.

5.1 Pre-installation Checklist

5.11 Path Survey

Is the path less than 15 miles? ☐ Yes ☐ No

For a given distance, the height of the antenna must be sufficient to clear all obstacles in the path. Consult the table below.

For a path of:	Height at each end for antenna:
☐ 1 mile	☐ 25 feet
☐ 2 miles	☐ 33 feet
☐ 4 miles	☐ 50 feet
☐ 8 miles	☐ 75 feet
☐ 15 miles	☐ 120 feet

NOTE:

Contact Larus Corporation if the distance is greater than 15 miles.

Distance from near end to far end _____

The radio transmission path crosses:

☐ between close buildings ☐ a parking lot

☐ town ☐ residential area ☐ other (describe)

_____

_____

5.12 Interference Survey

- ☐ Within the whole spectrum of operation.
- ☐ High tension lines.
- ☐ Sodium or mercury vapor arc lamps in the first Fresnel zone. (The Fresnel zone is the distance from the transmitter to any point on the shell and on to the receiver.)
- ☐ Industrial area. Watch for high energy sources (e.g. airports, radio pagers, weather radar).
- ☐ Polarization-dependent interference. If present, is it from the low or high part of the band?
- ☐ Other antennas near or in the radiation aperture:
  - frequency
  - power

Path Obstructions Include:	Height:	Distance from Near End:
☐ Deciduous trees		
☐ Evergreen trees		
☐ Radio or electrical line towers		
☐ Tall buildings		
☐ Airport flight path		
☐ Hills		
☐ Valleys		
☐ Water		
☐ Roof obstruction, metal		
☐ Metal roof		
☐ Other (describe)		

5.12 (continued)

How many of the following are in view?

☐ Homes _____ ☐ Factories _____

☐ Businesses _____ ☐ Apartment buildings

(This helps characterize the potential for interference from microwave ovens.)

Any radio or radar signals detected between 5.78 GHz and 5.845 GHz in the proposed Model 9000 path?

Frequencies:

Bandwidth: _ Average power: Peak power:

Signal strength: Measured at: _____

Location: _____

Directivity:

☐ In line with path ☐ Crosses path

Type of Signal:

☐ Intermittent (radar, pager, etc. ☐ Continuous (telemetry, data link, etc.

Location of sources (if known): _____

5.13 Unpacking Model 9000 Equipment

Unpacking location:

☐ Receiving dock ☐ Telephone equipment room

Other: _____

5 4 Equipment Room Requirements

Does the site have power? ☐ Yes ☐ No

Does the site have a place to install the Model 9000 assembly and peripheral equipment? ☐ Yes ☐ No

Access to E1/DS1s within 655 feet? ☐ Yes ☐ No

Adequate air conditioning or ventilation? ☐ Yes ☐ No

Telephone line connection available? ☐ Yes

Electrical support required: ☐ –24/–48 Vdc ☐ 120 Vac

☐ 220 Vac ☐ AC/–24/–48 Vdc converter

☐ Convenience outlets

Cable routes for customer connections to the Model 9000:

☐ Primary power _____

☐ E1/DS1 signals _____

☐ Telephone line _____

Equipment room adequately lighted per local code requirements? ☐ Yes

5.15 Outdoor Requirements

Does the site have power? ☐ Yes

Does the site have a place to mount an antenna? ☐ Yes ☐ No

Does the site have grounding locations, bars, pipes, etc? ☐ Yes ☐ No

Antenna mounting mast fixture:

If not a 3- to 4-inch wide vertical pipe, what is it (angle, etc.)?

_____

5.15 (continued)

Roof mounting:

- Will the roof support the weight? ☐ Yes ☐ No

  Is there legal and physical access to the roof? ☐ Yes

- Permission to be at that location (permits, etc.) or to make modifications? ☐ Yes ☐ No

  Are extra lightning protection measures necessary for the location? ☐ Yes ☐ No

  Clear, unobstructed view of far end? ☐ Yes

- Close to high voltage lines (100 kV)? ☐ Yes ☐ No

- Is this a hostile environment? ☐ Yes ☐ No

Route for the RF unit to antenna cabling:

_____

_____

Route for waveguide when distance from antenna to RF unit is greater than 8 feet (see Figure 2-5):

_____

_____

Cable run bulkhead through holes available for the RF unit to antenna cabling (minimum diameter 3 inches)? ☐ Yes

5.16 CO-to-Customer E1/DS1 Service Link

	Satisfactory	Unsatisfactory
Error-free seconds objective of 98.7%	☐	☐
Availability objective of 99.7%	☐	☐

Installation Checklist

5.201 Use this checklist to check off (✓) each of the installation tasks as you complete it. You can find information and instructions for the tasks as referenced.

Receiving Equipment

Refer to subsection 1.1 for instructions.

- ☐ Carefully check unpacked and inventoried equipment against the packing list(s).
- ☐ Check for damage incurred during shipment.
- ☐ Notify transfer company regarding shipping damage, if any.
- ☐ Save and store packing materials and shipping containers for reuse.

Installing and Connecting Model 9000

- ☐ Collect the required tools (subsection 2.2).
- ☐ Mount the Model 9000 assembly where instructed in the installation plan.
- ☐ Connect plant battery to the Model 9000 shelf (paragraph 2.41). A minimum 14-gauge wire is recommended. Do not install fuses or apply power at this time.
- ☐ Connect Model 9000 shelf alarm outputs to facility alarm equipment (paragraph 2.42).
- ☐ Connect the E1 or DS1 lines to the Model 9000 shelf connector P4 (paragraph 2.43).
- ☐ Ground the Model 9000 (paragraph 2.44).
- ☐ Connect a VT-100 (or compatible) terminal or terminal emulator to the Control Module for local maintenance access to the equipment (subsection 2.6).

5.22 (continued)

- ☐ Connect the interface cable from the controller to the RF unit (paragraph 2.302).
- ☐ Mount the antenna on the mast or tower (paragraph 2.302).
- ☐ Connect the coaxial cable from the RF unit to waveguide and the waveguide, in turn, to the antenna (Figure 2-5).
- ☐ Ground the waveguide (Figure 2-8).
- ☐ Power on the maintenance terminal and set its data parameters, i.e. rate, bits, start, stop, and parity (subsection 2.6).

5.23 Initial Configuration

- ☐ Check –24/–48 Vdc battery plant, wiring, and frame ground before installing fuse in fuse panel or turning power on. A 5 amp fuse is recommended.
- ☐ Check E1/DS1 wiring.
- ☐ Check that the antennas are pointed visually close to the transmission path and that the polarization fiduciary marks are either UP/DOWN (vertical polarization) or RIGHT/LEFT (horizontal polarization).
- ☐ On the LOCAL CONFIGURATION screen at the maintenance terminal, verify that the pseudorandom number (PNS) codes are correct for full-duplex transmission and reception end-to-end.

  The PNS codes are assigned as pairs of DIFFERENT numbers and are SWAPPED from end to end. The near-end station might use 200 as the RECEIVE PNS and 201 as the TRANSMIT PNS. In this case, the far-end settings must be 200 for the TRANSMIT and 201 for the RECEIVE PNS.
- ☐ If the codes must be changed, type HELP PNS and follow the instructions on the screen.
- ☐ Using the LOCAL CONFIGURATION screen at the maintenance terminal, check the E1/DS1 channel programming.

  The LINE EQUALIZE (line buildout) distance and REPORT ALARMS status may need to be changed from the factory defaults of 0 to 133 feet and NO E1/DS1 Alarm Report.

(continued)

(continued)

To change the default setting:

- ☐ Type HELP E1 or HELP DS1
- ☐ Select each of the options for the first E1/DS1 channel.
- ☐ Enter the next E1/DS1 channel and repeat the process for all four channels.

5.24 Power Application

WARNING:

Do not power up unless the antenna system is connected. Extended operation into an unterminated connection can cause damage to the equipment.

- ☐ Apply electrical power.
- ☐ As the system powers up, observe the DESPREADER LOCK alarm condition occurring at both ends. (It may take 2 to 3 minutes for the units to clear this alarm.)
- ☐ Observe the next alarm, UNFRAMED ERROR. Wait for the UNFRAMED ERROR to clear.
- ☐ The final alarm is BER EXCEEDED. After the BER EXCEEDED alarm clears, the units are in operation.
- ☐ Finish pointing the antennas and rotating feeds for LOWEST AGC voltage, as relayed via the PC or modem interface.
- ☐ If the unit will not clear the DESPREADER LOCK condition, check the PNS codes and refer to the PNS verification step in paragraph 5.23 above.

  If the unit still will not lock, contact Larus.

5.24 (continued)

☐ The expected AGC voltage for the path should be part of pre-installation information. (Refer to paragraph 3.03.)

If this is not available, contact Larus for the calibration of these units.

A larger voltage indicates that the antennas may not be pointed correctly, the feeds may be misaligned, or an object may be blocking the path.

If the voltage is lower than expected, a source of interference may be present.

5.25 Configuration of Local and Remote Consoles

☐ Select the desired LOCAL baud rate on the CRT (or PC, laptop, etc.

Set for 8-bit characters, no parity, 1 stop bit.

☐ Connect the terminal to the front panel LOCAL port using the appropriate cable with wiring as shown in Figure 5-1 or Figure 5-2.

☐ Apply power to the terminal and press the ENTER key a few times. There should be a prompt of "->".

☐ If not, check the baud rate settings and verify that the cable is wired correctly.

☐ If the cable is incorrect, try using a null modem adapter on one end of the cable.

If all else fails, contact the factory.

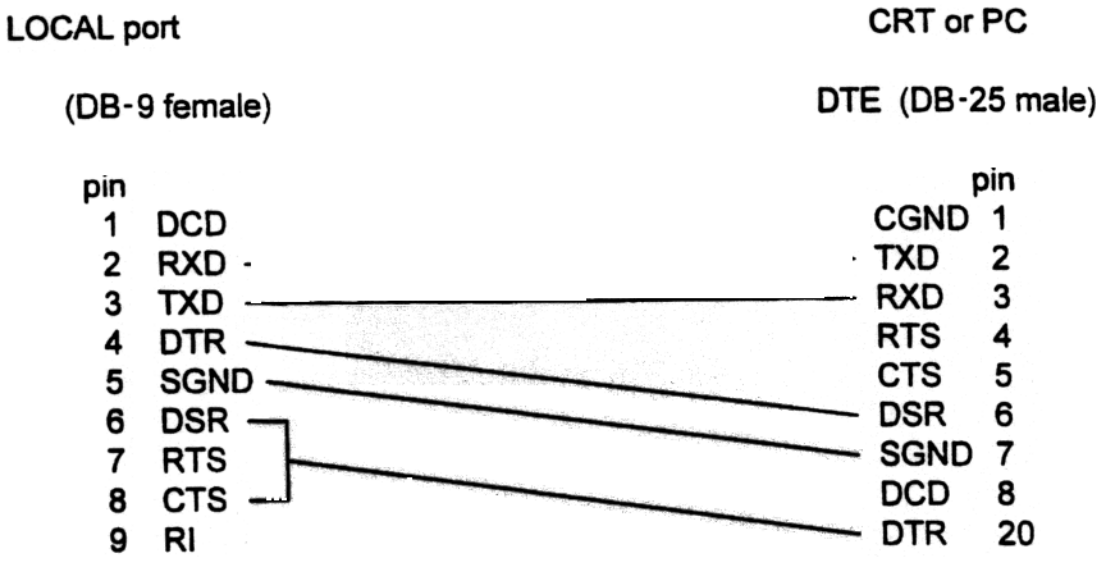

Figure 5-1. LOCAL Port Cable Wiring (9-pin to 25-pin)

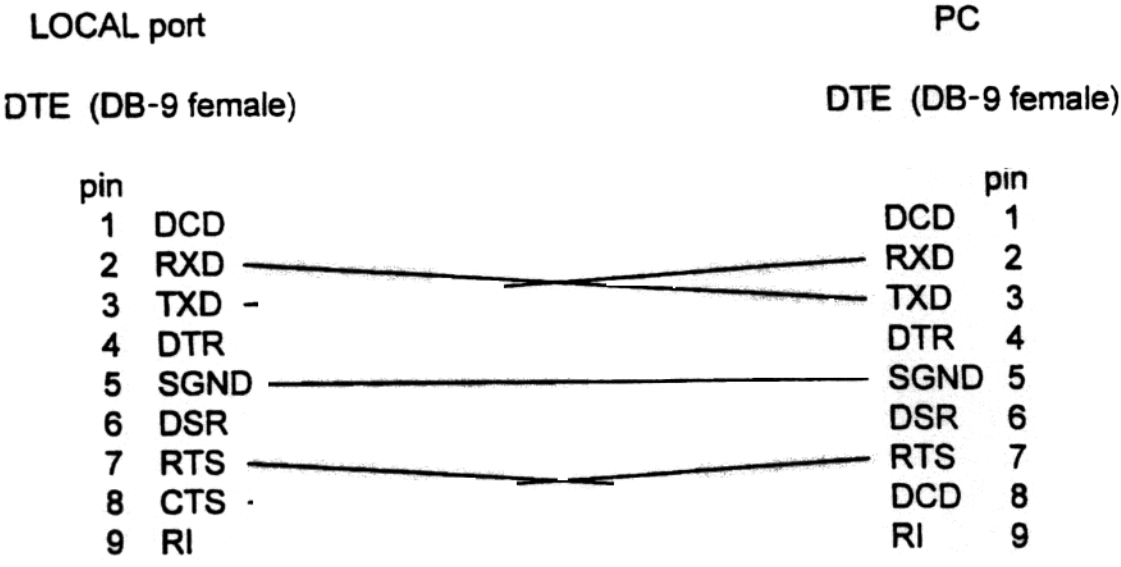

Figure 5-2. LOCAL Port Cable Wiring (9-pin to 9-pin)

5.26 Modem Setup

To set up the modem, you will need to use the system console attached to the LOCAL port (refer to paragraph 5.25).

Because setting up the modem can be a difficult process, it is strongly recommended that this be done BEFORE putting the 9000 system into service.

☐ Select the modem baud rate using the HELP PORT command at the console.

On-line HELP can be accessed if the manual is not available.

NOTE:

The back panel 9-pin RS-232 connector marked REMOTE is wired for DTE connection. It uses the RI, DCD, DTR/DSR, and RTS/CTS modem status signal so a cable with all of these signals is required.

☐ Connect the modem to the REMOTE port using a cable with wiring similar to that depicted in Figure 5-3.

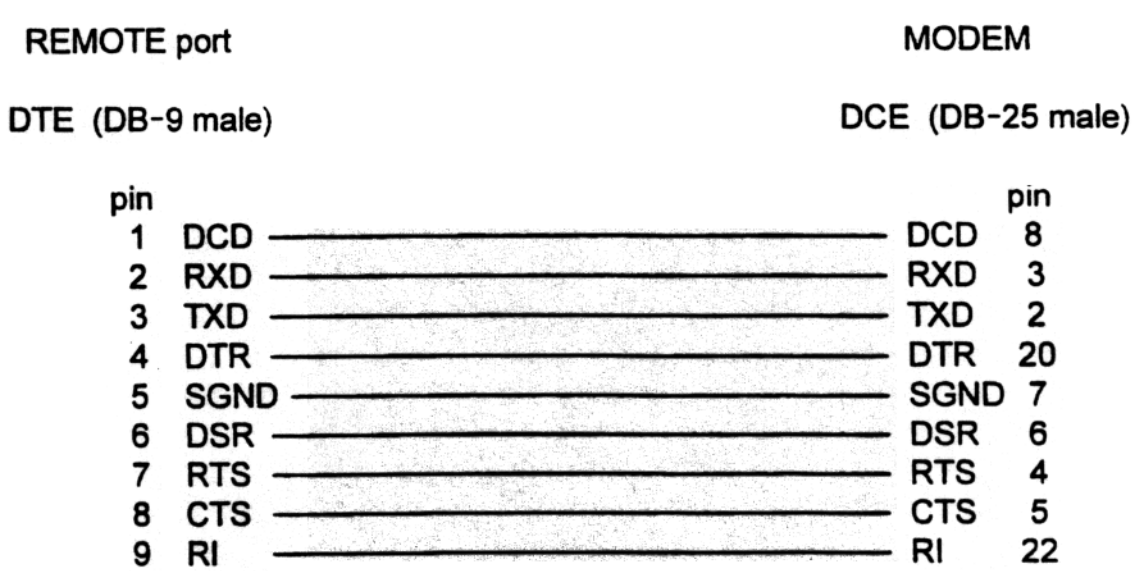

Figure 5-3. REMOTE Port Cable Wiring (9-pin to 25-pin)

(continued)

5.26 (continued)

- ☐ Apply power to the modem.

- ☐ At the LOCAL console, use the XCON command to gain "transparent" access to the modem.

  Anything you type at the console will be sent to the modem and anything received from the modem will be displayed on the screen.

- ☐ Type AT followed by the ENTER or Carriage Return key.

  If the modem responds with "OK", then everything has been done correctly.

NOTE:

The modem must be set for DCD (Data Carrier Detect) to "follow" the state of the telephone carrier. This is necessary so that the beginning and end of a call can be detected.

In addition, the modem must be set to use the DTR/DSR handshake to determine that the modem is plugged in and powered up. The modem must also be set to use the RTS/CTS handshake for flow control.

NOTE:

The Model 9000 does not support XON/OFF protocol. Some modems come with factory defaults set the wrong way.

- ☐ At the LOCAL console, execute the MODEM command and review the default data strings for modem initialization, answer mode, and dial-out.

  Compare them with the documentation for your modem but do not make adjustments at this time. (The default strings should work with a wide variety of modems.)

- ☐ If you wish to use the 9000 to place calls to the far-end 9000, enter the telephone number for the far-end system at this time.

- ☐ If you will be receiving calls to the 9000, you may wish to change the security password using the PASSWD command.

  The next time that power to the 9000 is cycled, the modem should initialize properly and be ready to initiate and receive calls.

5.27 Troubleshooting

☐ If there are problems, try changing the REMOTE port baud rate. Use the XCON command to access the modem as described above.

NOTE:

Some modems come from the factory configured to respond at only one baud rate but may be reconfigured to auto-detect the DTE baud rate.

☐ If this fails, use the DTE command at the LOCAL console to manipulate the RTS and DTR signals at the REMOTE port to try to force the modem to respond.

☐ If the modem has special initialization requirements, enter them into the initiation string using the MODEM command.

☐ If your local telephone company uses pulse dialing instead of tone dialing, you will have to modify the dial-out string.

☐ If all else fails, remove the modem and attach it to a personal computer. Attempt to configure it using any available modem software.

Any modem that conforms to the industry de facto standard Hayes Modem AT Command Set should be able to operate correctly.

NOTE:

The ideal modem for use with the Model 9000 should have some nonvolatile memory so that it will "remember" its configuration. In addition, a modem that supports a DTE baud rate up to 57,600 baud will allow higher throughput at the REMOTE port.

The remote access feature has been tested with the following modems:

Practical Peripherals PM144MT Data/FAX Modem
Telebit TrailBlazer Plus T2000
Telebit WorldBlazer T3000

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(continued)

e. Larus also reserves the right to make product improvements without incurring any obligation or liability to make the same changes in products previously manufactured or purchased. In no event shall Larus be liable for any breach of warranty in an amount exceeding the net selling price of any defective product. No person, including any dealer, agent, or representative of Larus, is authorized to assume for Larus any other liability on its behalf except as set forth herein. Non-payment of any invoice rendered within the stated payment terms automatically cancels any warranty or guarantee stated or implied. If any payment is due Larus for services performed hereunder, it shall be subject to the same payment terms as the original purchase.

f. Except for the express warranties stated herein, Larus disclaims all warranties on products furnished hereunder, including, without limitation, all implied warranties of merchantability and fitness, and the stated express warranties are in lieu of all obligations or liabilities on the part of Larus arising out of or in connection with the performance of the products.

Repaired Products and Repair Parts

Products repaired within the warranty period continue to be warranted to the end of that period or for 90 (ninety) days, whichever is longer. Repair work done on products repaired outside the warranty period is warranted against defects in workmanship and material for a period of 90 (ninety) days.

6.03 Products and Components Manufactured by Others

For products or components not manufactured by Larus, the original manufacturer's warranty shall be assigned to the purchaser to the extent permitted and is in lieu of any other warranty, expressed or implied. For warranty information on a specific product, a written request should be made to Larus.

NOTE: Features and specifications are subject to change without notice

Equipment Issue nformation 7

7.01 Practice 80-600-281, Issue 1 applies to the following equipment:

Description	Part Number	Equipment Issue
RF Module, High Freq Xmt and Low Freq Rcv, plus 4 x E1 Control Module	020-02106-000	
RF Module, Low Freq Xmt and High Freq Rcv, plus 4 x E1 Control Module	020-02107-000	
RF Module, High Freq Xmt and Low Freq Rcv, plus 4 x DS1 Control Module	020-02106-001	(N/A)
RF Module, Low Freq Xmt and High Freq Rcv, plus 4 x DS1 Control Module	020-02107-001	(N/A)
Spare RF Module, High Freq Xmt and Low Freq Rcv	007-02078-000	1
Spare RF Module, Low Freq Xmt and High Freq Rcv	007-02078-001	
Modem Board, 4 x E1	007-01794-000	1
Modem Board, 4 x DS1	007-01794-001	
Power Supply Board	007-02068-000	1
Control Module, 4 x E1	007-02079-000	1
Control Module, 4 x DS1	007-02079-001	1

(continued)

10.01 (continued)

Description	Part/Model Number	Equipment Issue
Installation Kit, RF/Controller Assembly mounted in 19" or 23" rack	007-02109-000	1
Antenna Jumper Cable	041-02110-XXX	
DS1 Single-ended Route Diversity Switch Circuit Pack	5702 List 1	1,2,3,4
RouteSwitch™ 12-slot, 19" shelf	5702 List 3	2
Cable with N-type Connectors, RF Module to Waveguide, 3 feet	7509 List 3	
Frequency Translator, 5.7 GHz	9020 List 0	1
DS1 Test Interface (Test Adapter)	9021 List 0	
E1 Test Interface (Test Adapter)	9021 List 1	

NOTE: Contact Larus Sales for special antenna mounting arrangements, lightning protection, and custom installation.

Extended Service Agreements:

Larus SmartService	7100 List 0
Larus SmartService Plus	7100 List 1
Larus On-Site SmartService	7100 List 2
Larus SmartService Training	7100 List 3