Claircom℠

Air Terminal
Installation, Operation, and Maintenance Manual

(Model 264 and Model 296 Only)

Document 8018721
May 17, 1993
Version 3

Claircom Communications Group, Inc.
700 Fifth Avenue, Suite 2100
Seattle, Washington 98104

(206) 621-7174

Contents

Figures

Flowcharts

Tables

About this manual

The *Air Terminal Installation, Operation, and Maintenance Manual* contains the information necessary to install the Claircom[SM] Model 264 or Model 296 air terminal equipment on a commercial aircraft. This document describes installing the following hardware portion of the air terminal *only*, all other hardware must already be installed (refer to the as-built documentation for more information):

- Baseband unit
- Power supply unit
- Radio frequency unit
- ECO boxes
- UHF/L-band antennas
- Seatback phone units
- EMI filter
- ISDN terminator

Audience

This manual is written for the Claircom-approved technician. The air terminal equipment is complex and precludes installation by untrained personnel.

Structure

This manual contains the following chapters and appendices:

- Chapter 1 provides a description of the air terminal equipment.
- Chapter 2 covers installation prerequisites, describes the air terminal kit, and contains the installation procedures.
- Chapter 3 describes commissioning the air terminal.
- Chapter 4 describes operating and deactivating the air terminal.
- Chapter 5 covers the theory of operation.
- Chapter 6 describes troubleshooting procedures.
- Chapter 7 covers preventative maintenance, describes measures for protecting personnel and equipment from electrostatic discharge, and contains the procedures for replacing failed equipment.
- Appendix A lists the acronyms used throughout this manual.

Before installing the air terminal hardware, take a few minutes to review the contents of this manual. By doing so, you will become familiar with the basic components that make up the air terminal and how they are to be installed.

Assumptions

Installation and maintenance procedures in this manual are based on the following assumptions:

- All procedures will be performed by qualified service personnel who are familiar with the Claircom architecture and configuration, air terminal hardware elements, and terminology.
- Personnel responsible for equipment installation will have access to the Claircom as-built drawings. This documentation provides information needed to install the air terminal into a particular aircraft.
- The aircraft has been prepared in accordance with the instructions contained in the as-built drawings.
- All equipment to be installed is available at the aircraft.
- All special equipment, tools, and test equipment required for installation and maintenance are available.

Conventions used in this document

Notes, cautions, and warnings, defined as follows, are used throughout this manual to help you become familiar with possible safety or equipment hazards.

Note

Presents additional information or interesting sidelights.

Caution

Indicates a procedure that may result in equipment damage if not strictly observed.

WARNING

Indicates a procedure that may result in personal injury if not strictly observed.

Version record

Version	Date	Description
1	10/08/92	First version released.
2	01/04/93	Second version released
3	05/17/93	Third version released.

Chapter 1

General description

The Claircom[SM] air-to-ground telephony system provides public telephone service to users making calls from commercial aircraft. The passenger initiates a phone call by dialing the desired phone number into the handset (see figure 1-1). The call is transmitted to the nearest ground station via air terminal radio equipment located inside the aircraft. The ground station then routes the call to the public switched telephone network (PSTN) at which point the user operates the system in the same way as a standard pay telephone.

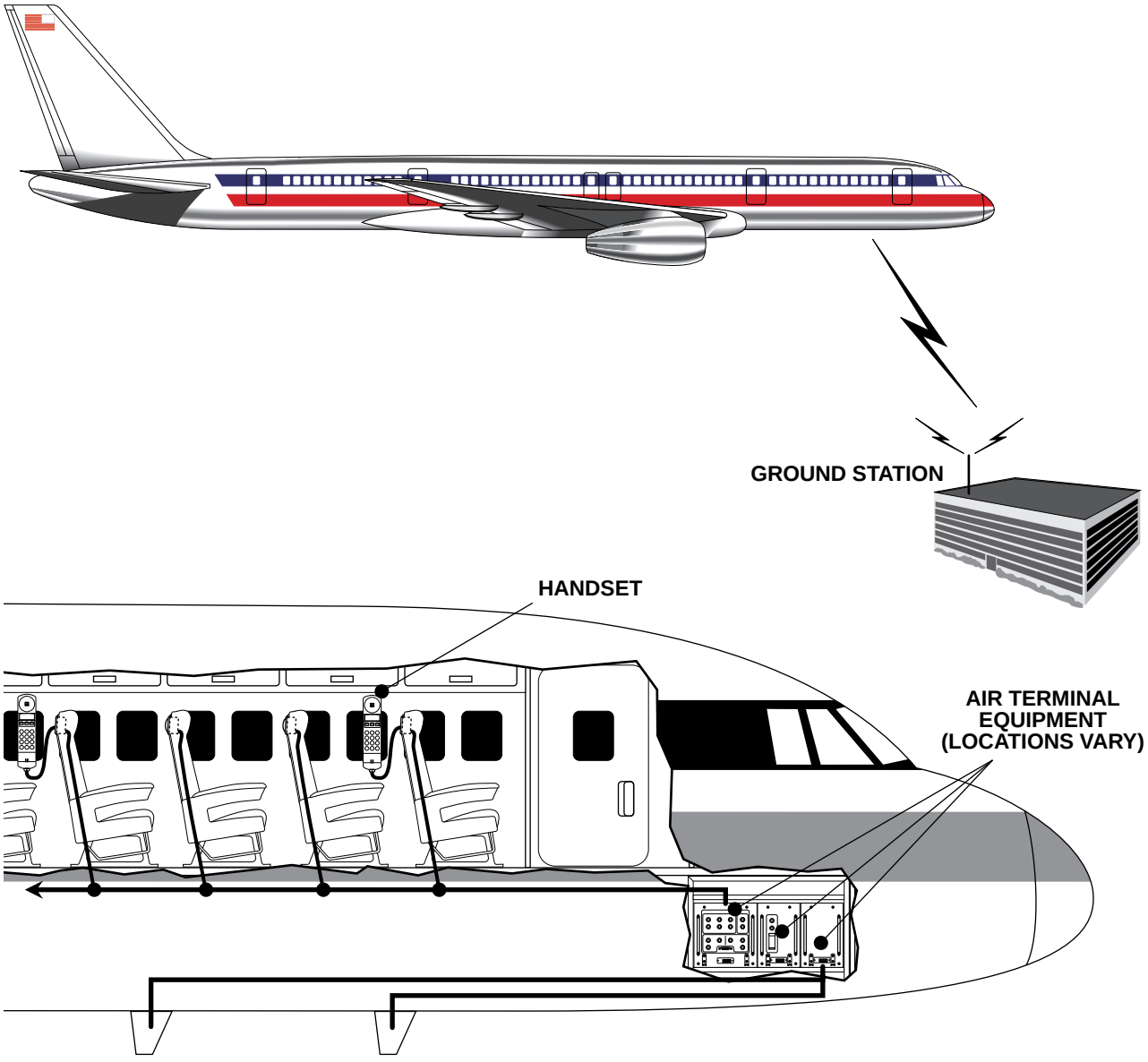


Figure 1-1. The Claircom telephony system

The Claircom air terminal system (see figure 1-2) consists of in-cabin equipment and radio equipment.

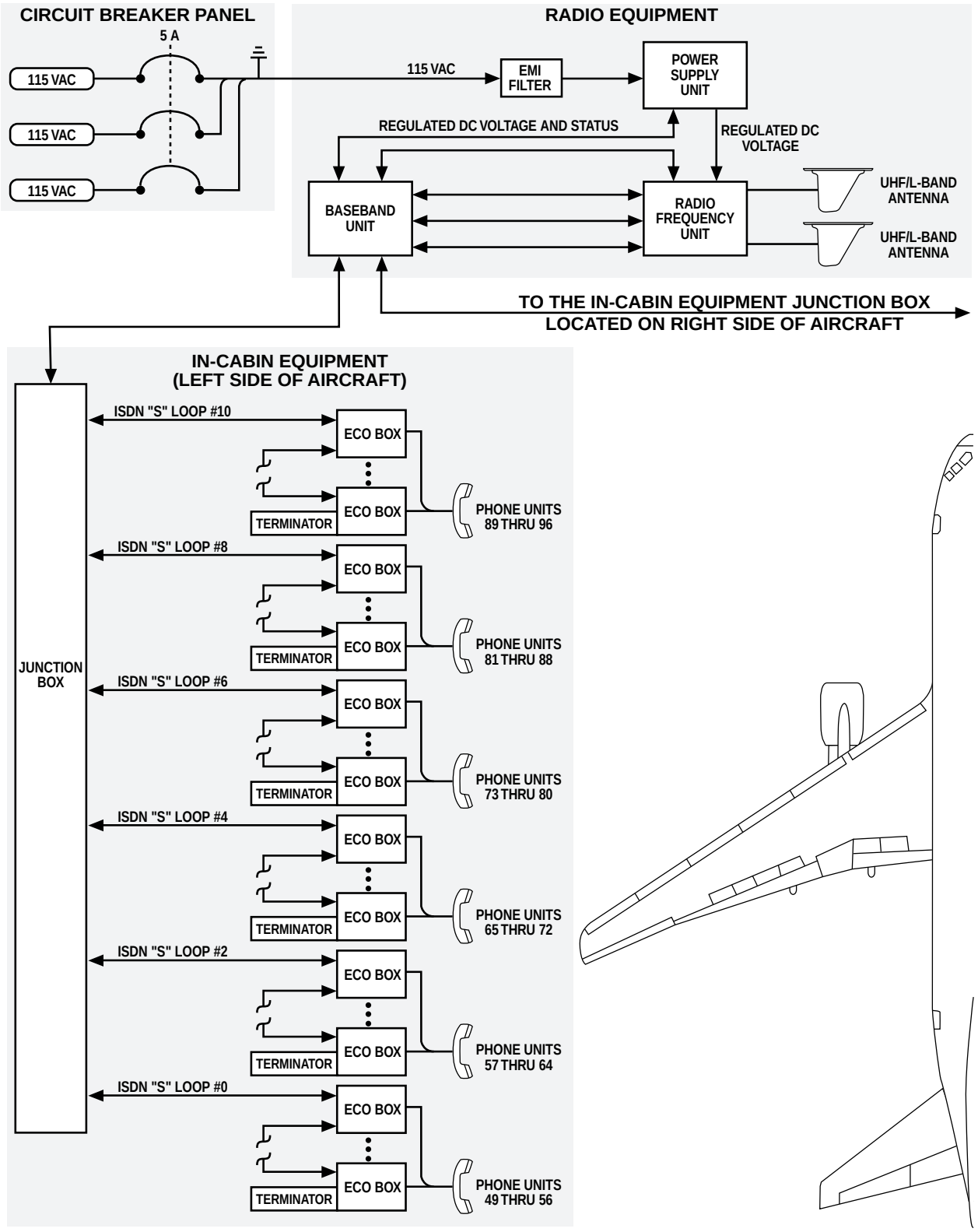


Figure 1-2. Air terminal system (typical Model 296 installation), sheet 1 of 2

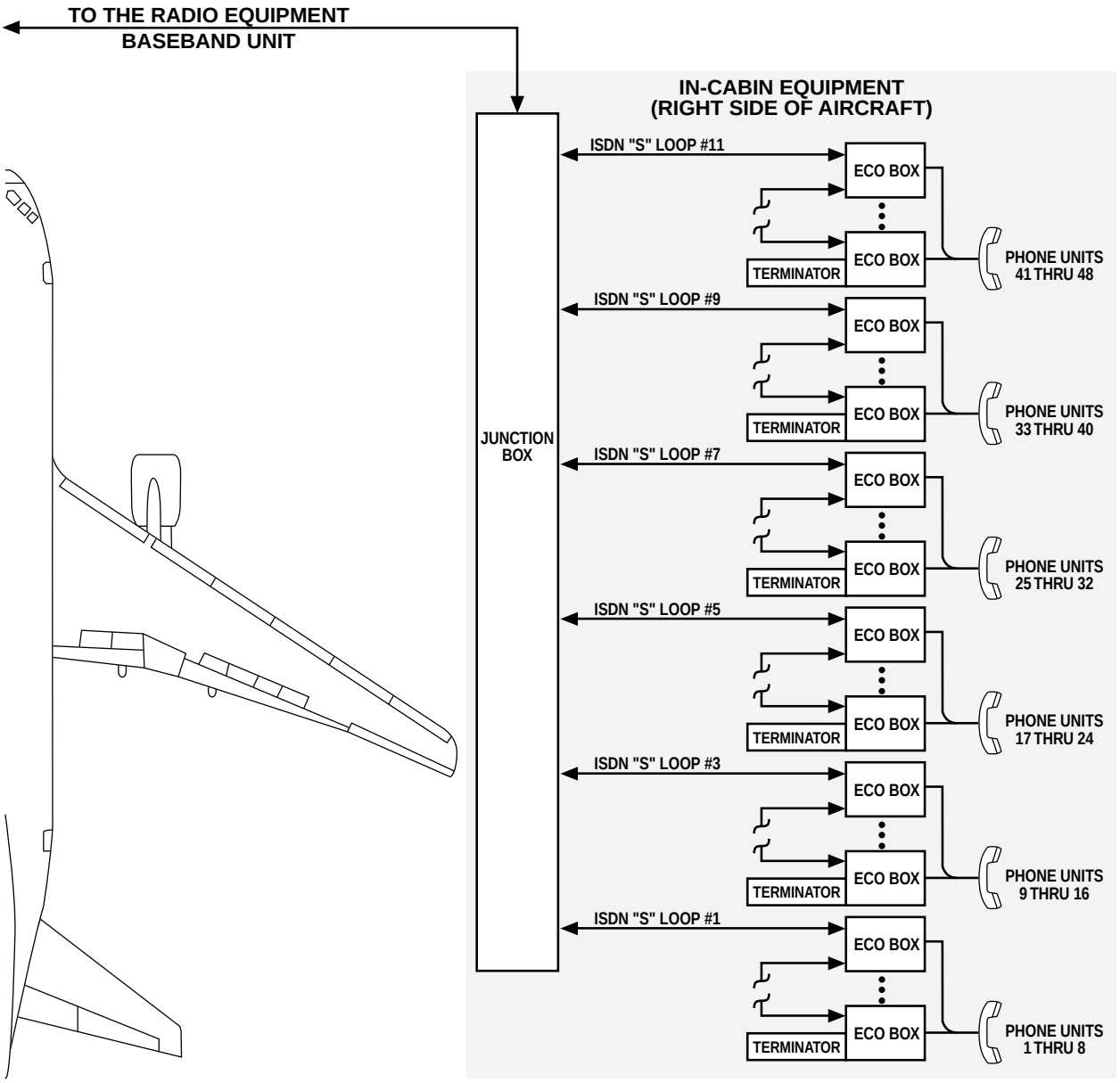


Figure 1-2. Air terminal system (typical Model 296 installation), sheet 2 of 2

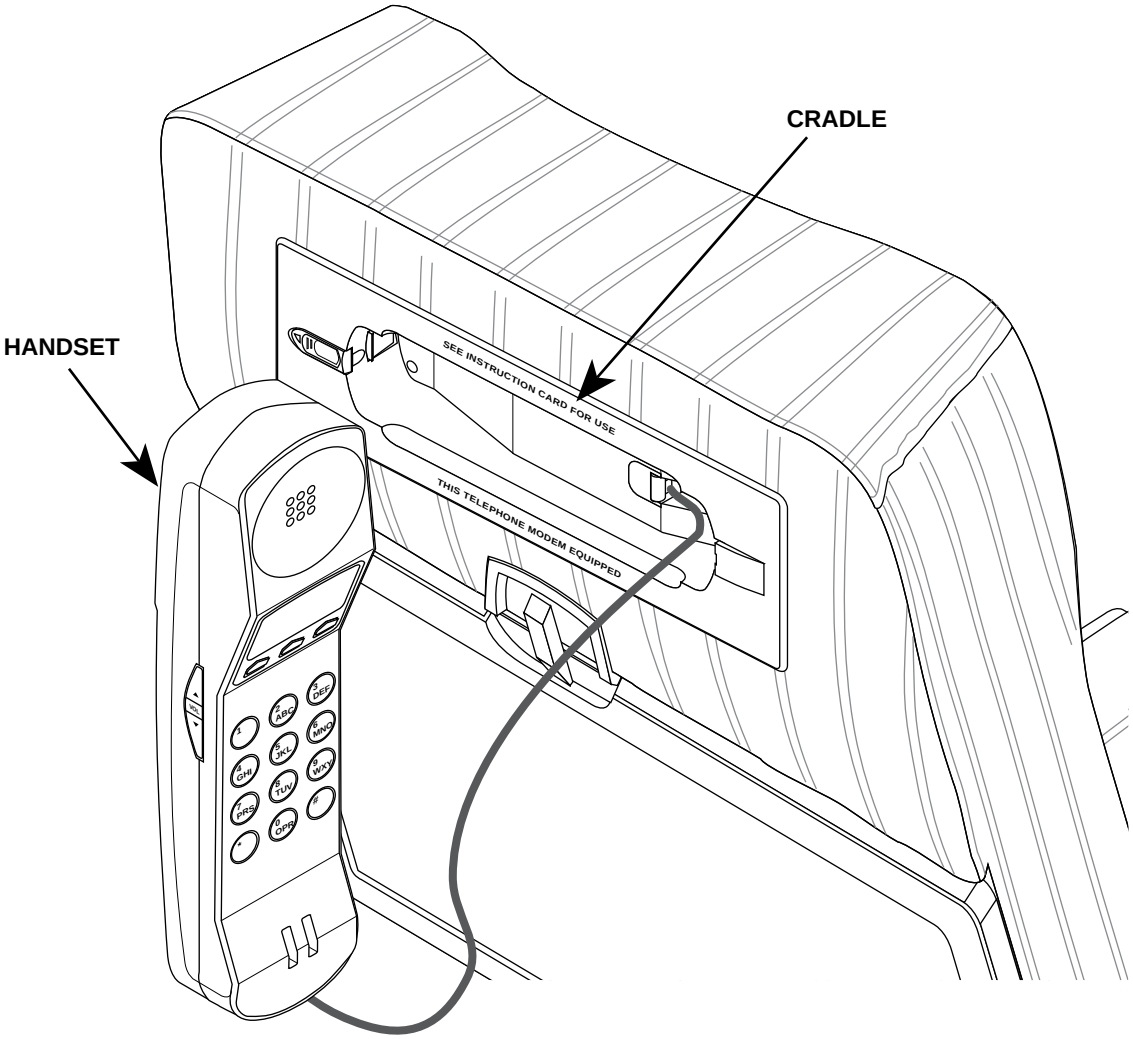


Figure 1-3. Seatback phone unit

1.1

In-cabin equipment

In-cabin equipment includes the seatback phone units and electrical connection boxes.

Seatback phone units

A seatback phone unit (shown in figure 1-3) provides the following functions:

- Voice and modem data services between users and the PSTN.
- A credit card reader for credit card billing.
- A three-line liquid-crystal display (LCD) that displays call progress messages for the user.

- A standard 12-button dual-tone multi-frequency (DTMF) keypad, along with three special-function keys, and a volume control.

Electrical connection boxes

Electrical connection (ECO) boxes (see figure 1-4) convert the phone cable wiring to the integrated services digital network (ISDN) wiring used to communicate with the radio equipment. Typically, one ECO box is installed for each row in the aircraft that will have a phone unit installed (as shown in figure 1-2). ECO boxes are available in one, two, or three registered jack (RJ)-11 jack configurations to accommodate multiple phone units in a seat row (or phones units mounted on a bulkhead).

The phone cable connects between the 6-wire RJ-45 jack on the ECO box and the 6-wire RJ-11 jack on the back of the phone unit.

The ISDN connects the in-cabin equipment to the radio equipment. The ISDN is subdivided into as many as eight “S” interfaces (called “S” loops). Each “S” loop serves up to eight phone units for a total of up to 96 phones. The “S” loop begins at a junction box (see figure 1-2) and connects to the IN connector on the ECO box. Another cable connects the OUT connector of the ECO box to the IN connector of another box (up to the maximum 12 ECO boxes). A terminator (see figure 1-5) is installed on the OUT connector of the last ECO box in the “S” loop.

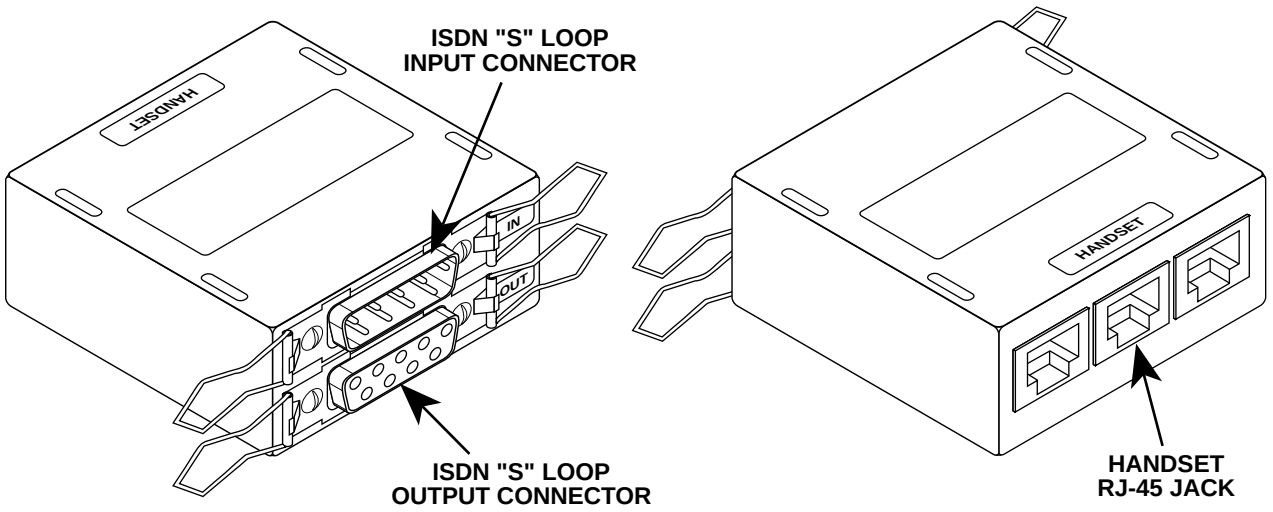


Figure 1-4. Electrical connection box

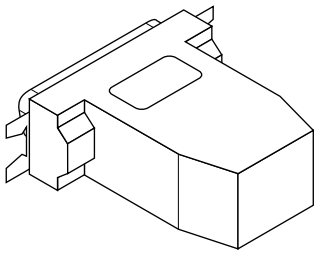


Figure 1-5. ECO box terminator

1.2

Radio equipment

Radio equipment includes the baseband unit, radio frequency unit, power supply unit, an electromagnetic interference (EMI) filter and two ultra-high frequency (UHF)/L-band antennas.

Baseband unit

The baseband unit (BBU) performs the following major functions within the air terminal:

- It controls connecting phone units to the radio channels.
- During transmit operations the BBU selects a channel for transmission to a ground station, performs baseband processing (voice compression and modulation/demodulation) for that channel, and upconverts the signal to radio frequency (RF). The BBU also communicates with the receiving ground station to determine the best power output level.
- During receive operations, the BBU downconverts the received signal and routes the signal via the ISDN “S” interface to the appropriate phone unit. The BBU receives channel availability information on the pilot channel using a channel thread which is not currently occupied by voice traffic. During voice traffic, a low-rate overhead data channel is multiplexed onto the traffic channel by a ground station which carries air terminal transmit power and Doppler frequency adjustment commands.
- The BBU also provides the 10-MHz frequency reference for the air terminal.

The BBU is installed in the BBU aviation electronics (avionics) tray (shown in figure 1-6).

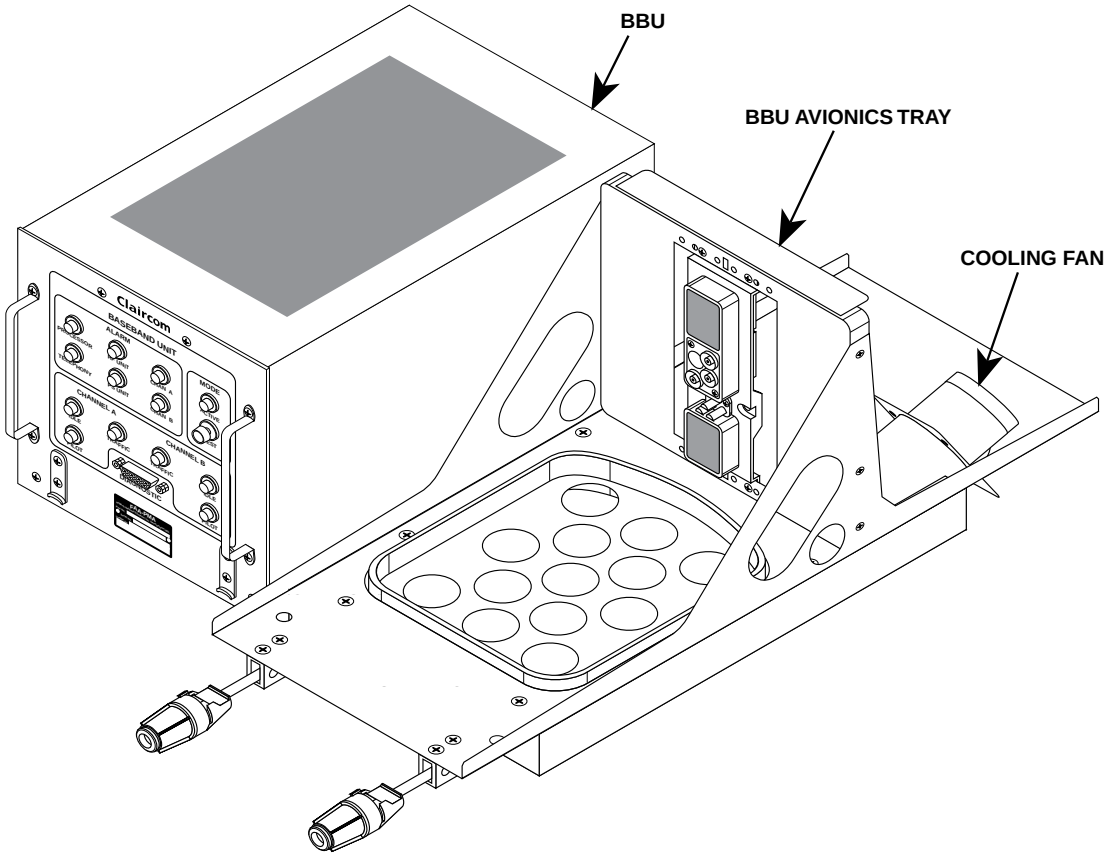


Figure 1-6. Baseband unit and BBU avionics tray

Radio frequency unit

The radio frequency unit (RFU) performs the following functions:

- Obtains the upconverted 895-MHz signal from the BBU and amplifying it in a solid-state power amplifier (SSPA) for transmission at a UHF/L-band antenna.
- Receives the 850-MHz signal transmitted from a ground station and passing the signal first through a low-noise amplifier (LNA) that increases the power level of the received signal. The RFU then outputs the signal to the BBU for down-conversion.
- Provides filtering to protect against radio frequency interference (RFI).

The RFU is installed in the RFU avionics tray (shown in figure 1-7).

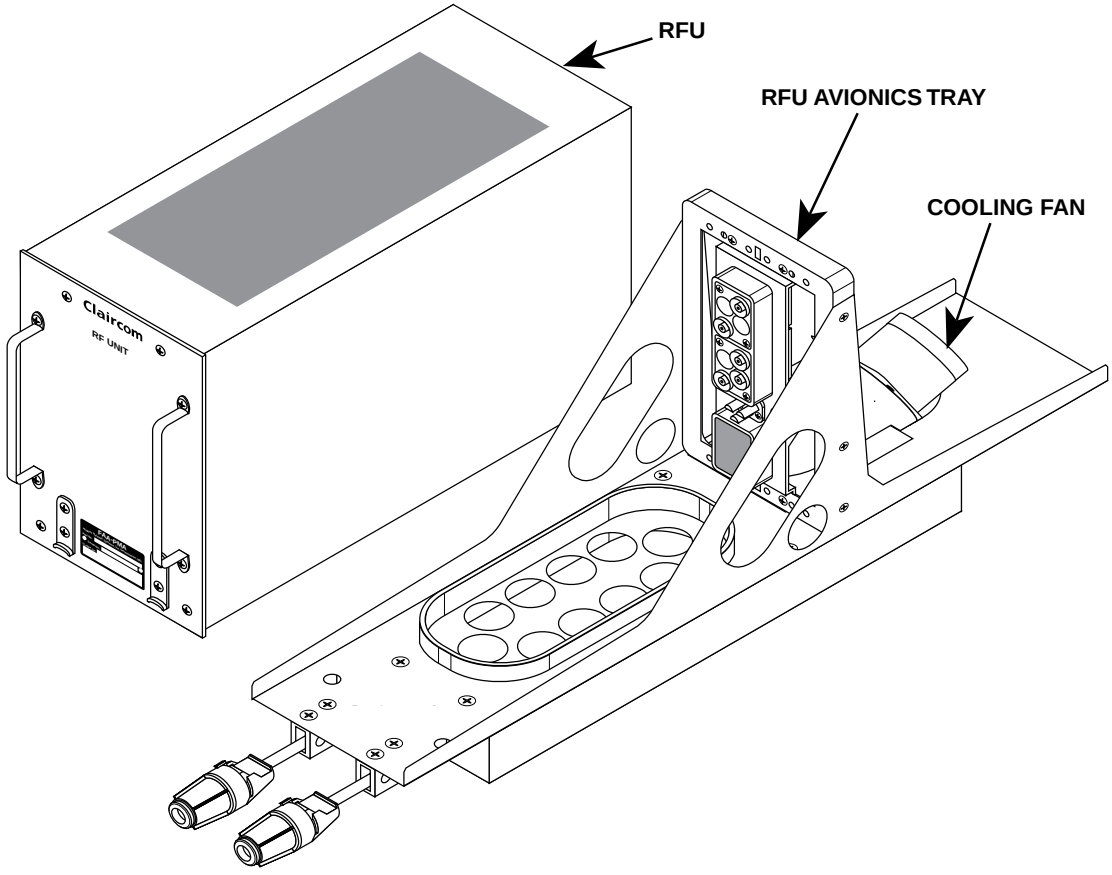


Figure 1-7. Radio frequency unit and RFU avionics tray

Power supply unit

The power supply unit (PSU) supplies regulated direct current (DC) power to the air terminal system. It also provides status monitoring interfaces, fail-safe functions, and voltage transient protection. The regulated power derives from 3-phase, 5-wire, 400-Hz, 115-Volt alternating current (AC).

The PSU provides the following voltages:

- 115 VAC, 3-phase, 400-Hz power to the avionics trays cooling fans.
- +48 VDC to the in-cabin equipment ISDN “S” interfaces (via the BBU).
- +5 VDC, -6.5 VDC, +8 VDC, and +15 VDC to the BBU.
- +15 VDC and +27 VDC to the RFU.

The PSU is installed in the PSU avionics tray (shown in figure 1-8).

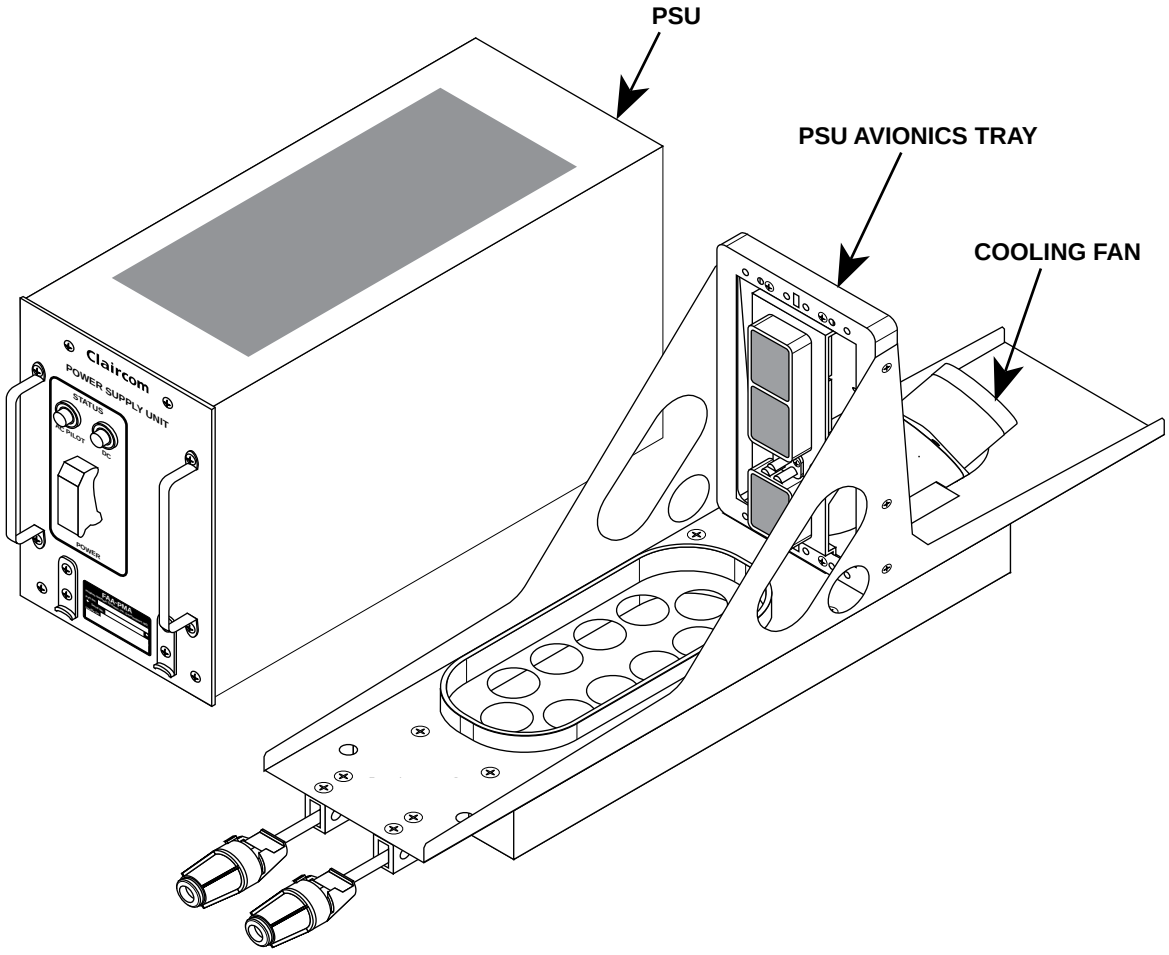


Figure 1-8. Power supply unit and PSU avionics tray

EMI filter

The electromagnetic interference (EMI) filter (shown in figure 1-9) is installed in the 115-VAC line between the circuit breaker panel and the PSU. The filter prevents EMI from entering the PSU via the power input lines.

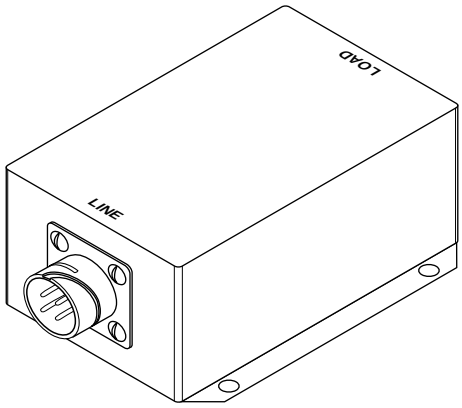


Figure 1-9. EMI filter

UHF/L-band antennas

The UHF/L-band antenna (shown in figure 1-10) is a 3.5-inch tall omnidirectional blade-type antenna. Each air terminal has two antennas, either one of which functions as a receive antenna (operating at 850 MHz) or transmit antenna (operating at 895 MHz).

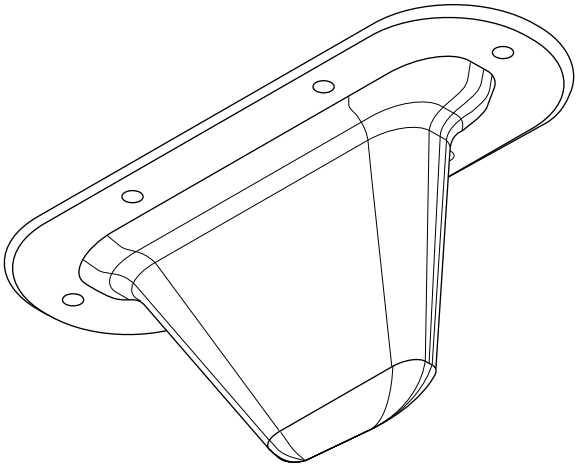


Figure 1-10. UHF/L-band antenna

Chapter 2

Installation

This section describes inspecting, inventorying and installing air terminal hardware.

2.1 Required tools and materials

The following are required:

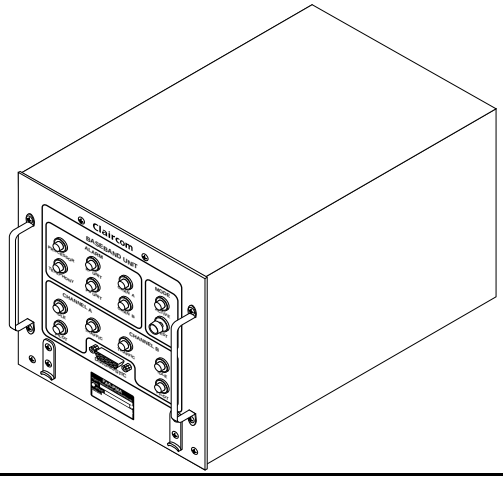
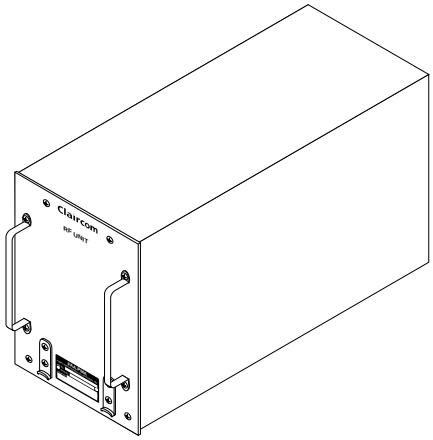
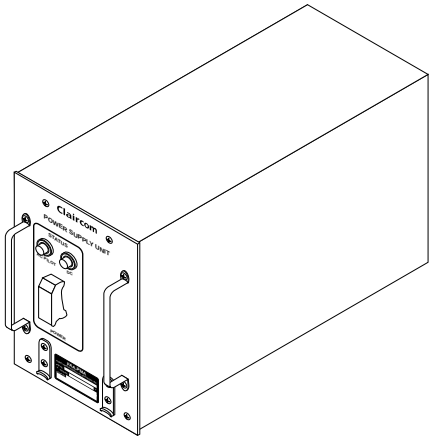
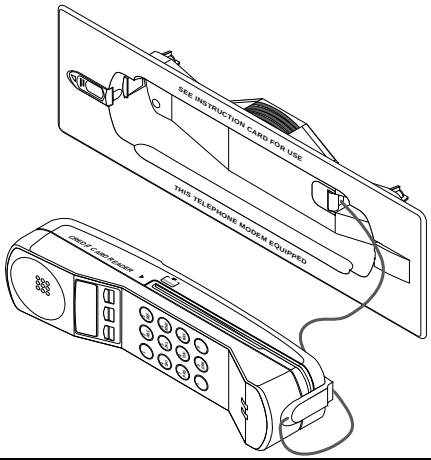
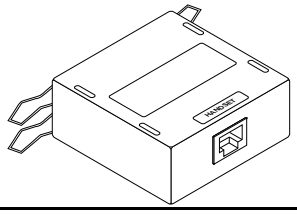
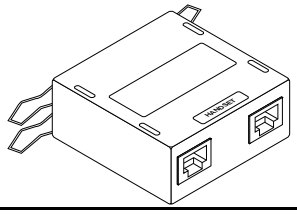
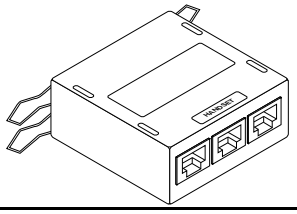
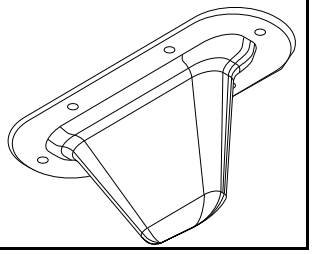
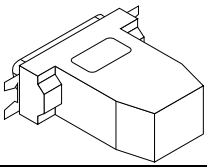
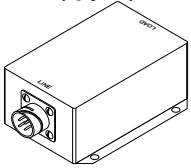
- Hex wrench, #6
- Crosstip torque screwdriver
- Diagonal cutters, small
- Alodine 1200, Irridite, or equivalent (used to treat bare aluminum surfaces to prevent oxidation)
- RTV sealant, or equivalent
- Cable ties, assorted sizes

2.2 Materials inspection and inventory

1. Inspect the shipping containers for external damage. Any damage should be noted before opening the container. Report damaged equipment to the shipping carrier immediately for claim purposes. Save all packing materials until installation has been completed.
2. Each air terminal installation kit contains a documentation package that includes an itemized bill of materials (BOM) which details exactly what that particular kit should contain. Use the BOM as a checklist to inventory the shipment contents and verify that all items are present. Report all shortages to Claircom Communications Group, L.P. for resolution.

   Table 2-1 lists the equipment you will be installing.

Table 2-1. Air terminal installation kit components

Baseband unit C23VB-7100-00 (Qty: 1) 		Radio frequency unit C23VR-7500-00 (Qty: 1) 	
Power supply unit C23VP-7300-00 (Qty: 1) 		Seatback phone unit C23PS-6100-00 (Qty: Variable) 	
ECO box (“S” loop box, 1 RJ) C23CE-4100-01 (Qty: Variable) 	ECO box (“S” loop box, 2 RJ) C23CE-4100-02 (Qty: Variable) 	ECO box (“S” loop box, 3 RJ) C23CE-4100-03 (Qty: Variable) 	UHF/L-band antenna CI-105-15-2 (Qty: 2) 
Terminator C23CE-4200-00 (Qty: Variable) 	RJ-45 blank plug 9006494-0008 (Qty: Variable) 	EMI filter 1015401-0001 (Qty: 1) 	

Installing air terminal equipment

This section describes installing the following air terminal equipment:

- Power supply unit
- Radio frequency unit
- Baseband unit
- Electrical connection (ECO) boxes
- Ultra-high frequency (UHF)/L-band antennas
- Seatback phone units
- The electromagnetic interference (EMI) filter
- Integrated services digital network (ISDN) terminator

Installing the power supply unit

Perform the following procedure to install the power supply unit (PSU) into the PSU avionics tray.

WARNING

Set all air terminal circuit breakers to OFF before continuing with this procedure (refer to the as-built drawings for the locations of the circuit breakers).

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

1. Remove the PSU (see table 2-1) from its shipping container.

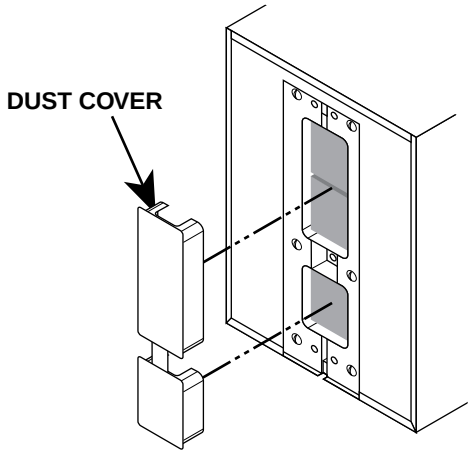


Figure 2-1. Removing the dust cover

2. Remove the ESD-protective dust cover from the rear connectors on the PSU (see figure 2-1). Verify that there are no damaged or bent pins on the connectors.

3. Open the switch cover and verify that the PSU power switch is set to OFF (down position) as shown in figure 2-2. Close the switch cover.

4. Insert the unit into the avionics tray labeled PSU.

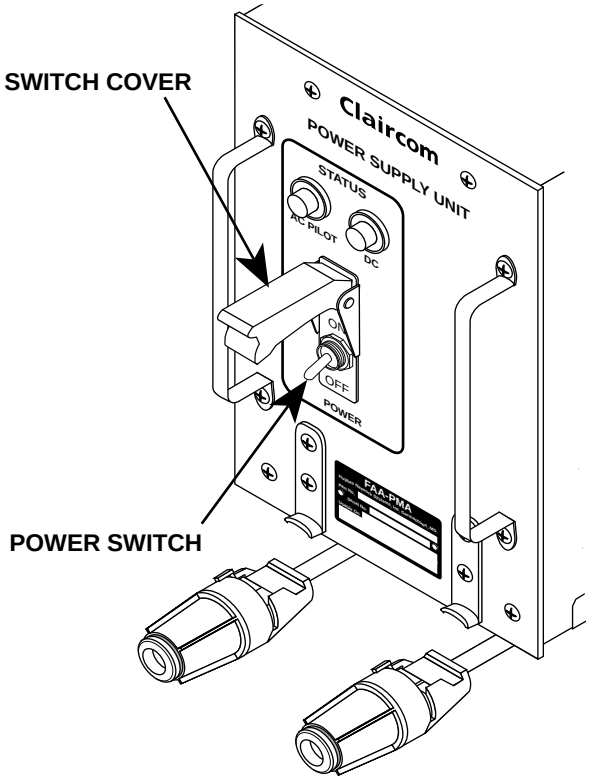


Figure 2-2. PSU power switch

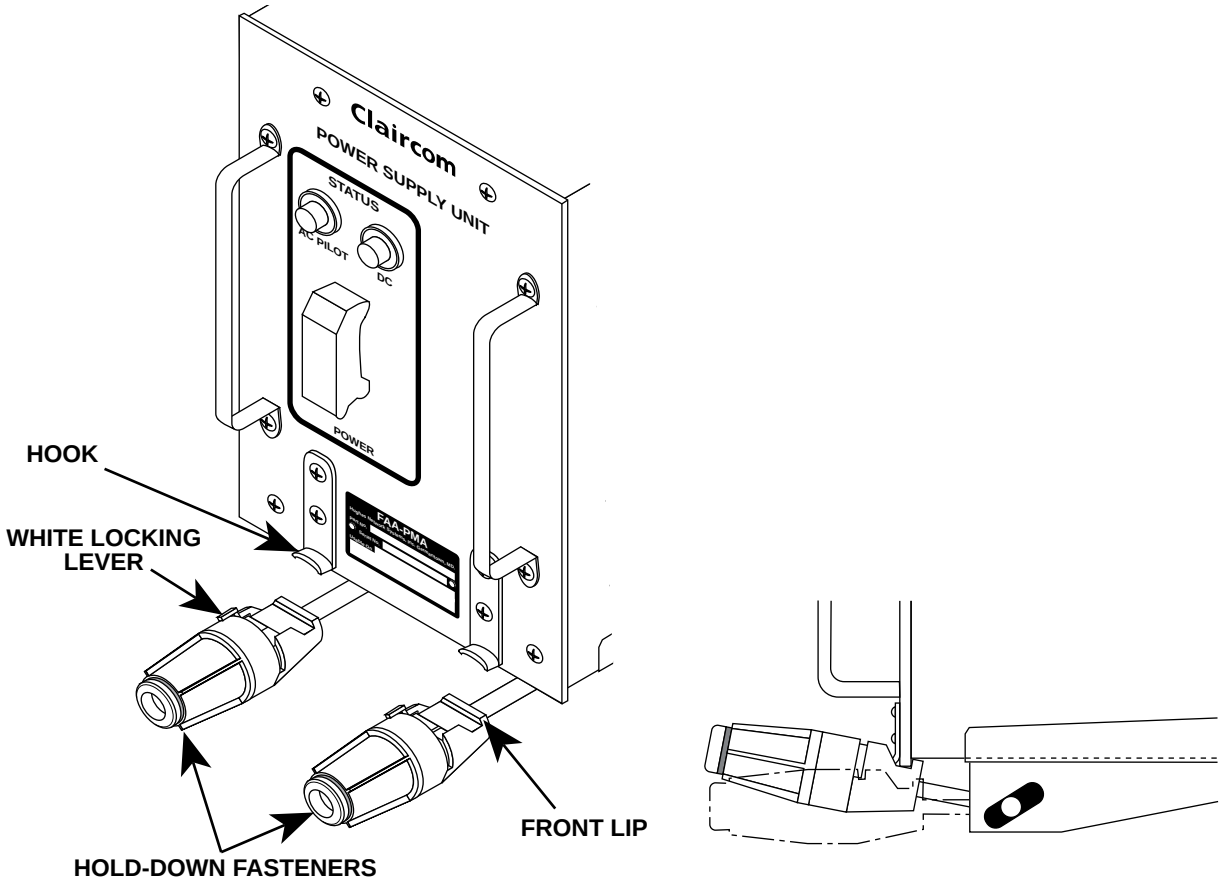


Figure 2-3. Hold-down fastener components

5. Carefully slide the unit into the tray until it makes contact with the connectors.

6. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the PSU (see figure 2-3). Turn the white locking lever (see figure 2-3) clockwise (left to right) as far as it can go, making sure the cup engages the hook. This locks the hold-downs against the PSU (see figure 2-4).

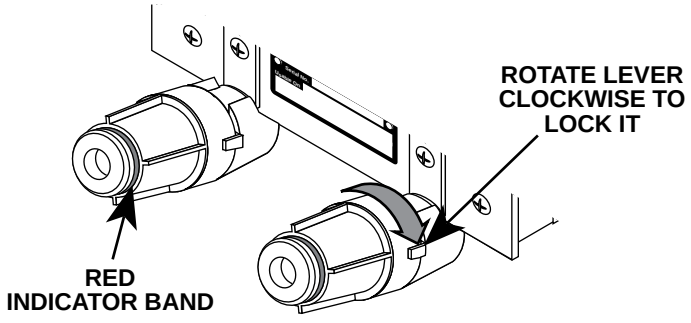


Figure 2-4. Locking and tightening the hold-down fasteners

7. Turn both fluted knobs clockwise until the red indicator bands (see figure 2-4) have disappeared. When that happens, you will feel the fasteners clutching out. That means the full load required for mating has been applied and the PSU is seated securely.

Installing the radio frequency unit

The following procedure describes installing the radio frequency unit (RFU) into the RFU avionics tray.

1. Remove the RFU (see table 2-1) from its shipping container.
2. Remove the ESD-protective dust cover from the rear connectors. Verify that there are no damaged or bent pins on the connectors.
3. Insert the unit into the avionics tray labeled RFU.
4. Carefully slide the unit into the tray until it makes contact with the connector.
5. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the RFU. Turn the white locking lever clockwise as far as it can go, making sure the cup engages the hook.
6. Turn both fluted knobs clockwise until the red indicator bands have disappeared. When that happens, the RFU is seated securely.

Installing the baseband unit

Perform the following procedure to install the baseband unit (BBU) into the BBU avionics tray.

1. Remove the baseband unit (see table 2-1) from its shipping container
2. Remove the ESD-protective dust cover from the rear connectors. Verify that there are no damaged or bent pins on the connectors.
3. Insert the unit into the avionics tray labeled BBU.
4. Carefully slide the unit into the tray until it makes contact with the connector.
5. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the BBU. Turn the white locking lever clockwise as far as it can go, making sure the cup engages the hook.
6. Turn both fluted knobs clockwise until the red indicator bands have disappeared. When that happens, the BBU is seated securely.

Installing the electrical connection boxes

The following procedure describes installing the electrical connection (ECO) boxes. As installations may vary from aircraft to aircraft, refer to the as-built drawings to determine where each ECO box will be located.

1. Remove an ECO box (see table 2-1) from its shipping container.
2. Place the ECO box onto an ECO bracket as shown in figure 2-5.

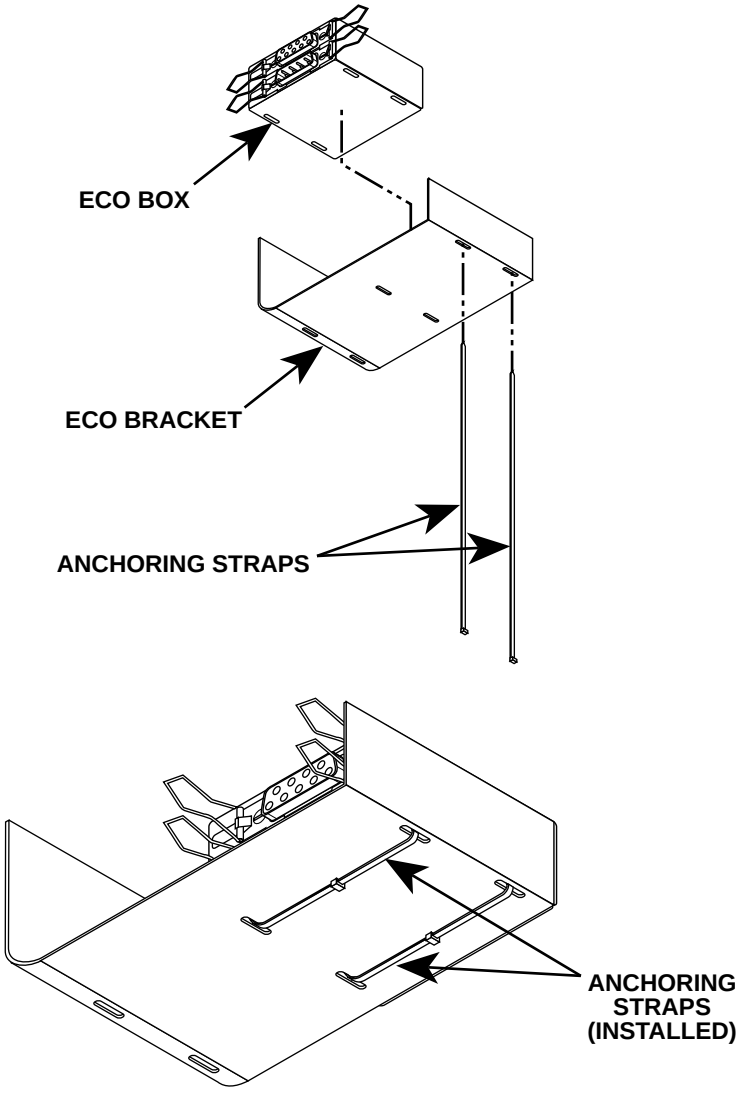


Figure 2-5. Installing an ECO box onto an ECO bracket

3. Insert an anchoring strap through one of the slots in the bracket and the ECO box (see figure 2-5). Bend the strap and insert it through the adjacent slot in the ECO box and bracket as shown in figure 2-5. Slide the tip of the strap into the hole in the head of the strap and pull the tip until any slack in the strap has been removed. Use a pair of diagonal cutters to remove excess strap.

4. Use anchoring straps to install the ECO bracket onto the seat frame as shown in figure 2-6.

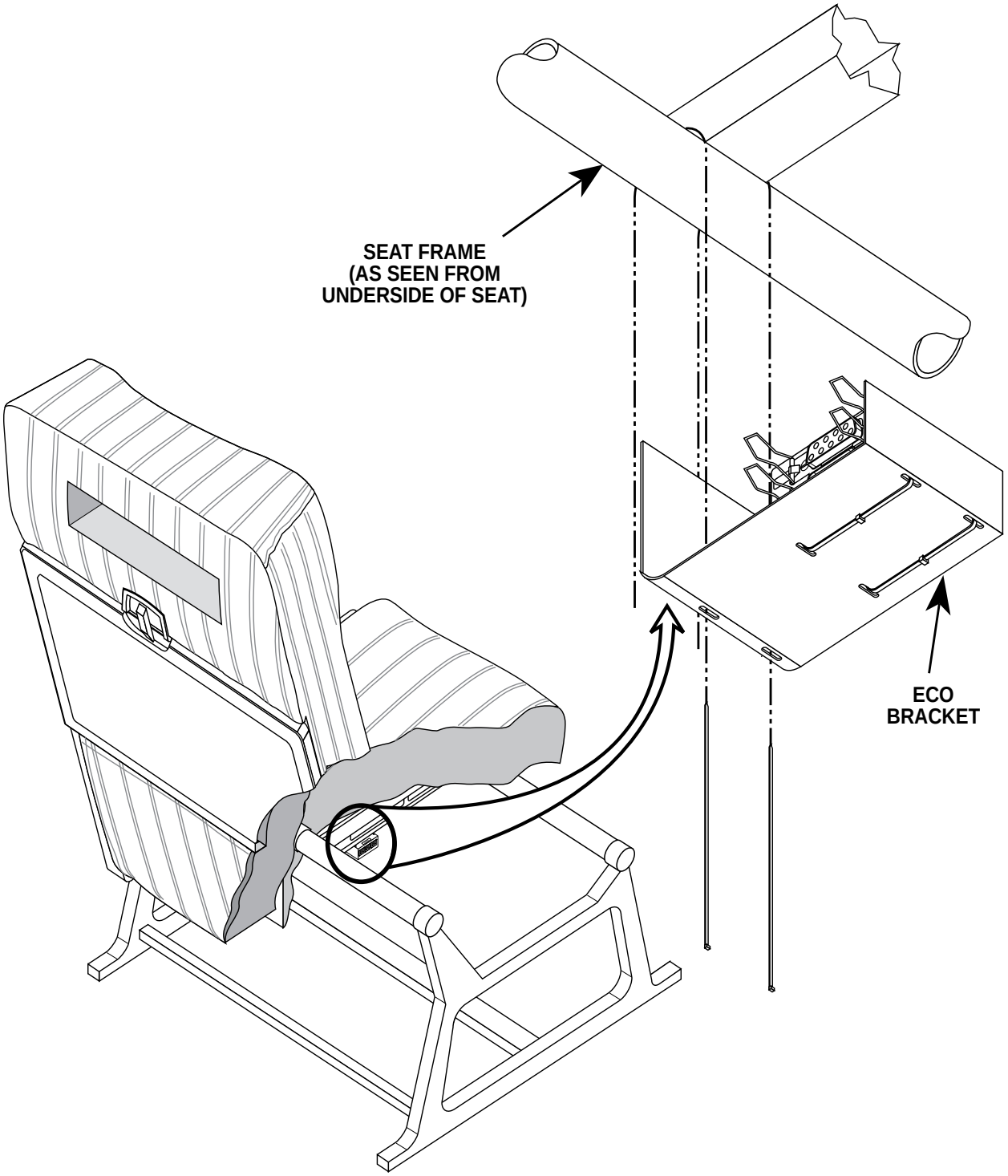


Figure 2-6. Installing an ECO bracket onto a seat frame

5. Install an ISDN “S” loop input cable connector to the ECO box connector labeled IN (see figure 2-7 for locations). Close both spring latches to secure the connector.

6. Install an ISDN “S” loop output cable connector to the ECO box connector labeled OUT (see figure 2-7). Close the spring latches.

7. Install the RJ-45 phone cable connectors to the ECO box connectors labeled HANDSET (see figure 2-7 for locations).

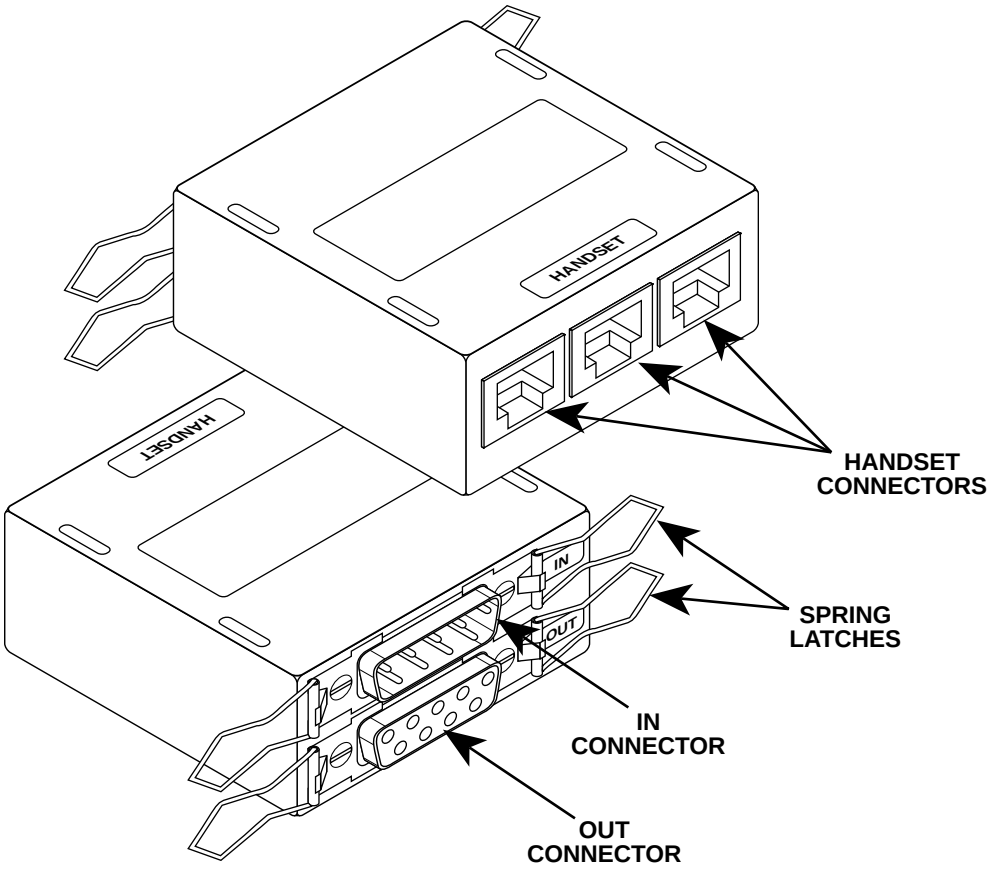


Figure 2-7. Installing phone cables

Note

If the ECO box you are installing will have unused handset jacks, install RJ-45 blank plugs (see table 2-1) into the empty jacks.

8. Repeat steps 1 through 7 to install the remaining ECO boxes in the “S” loop.

9. After installing the last ECO box in the “S” loop, install an ISDN terminator to the ECO box connector labeled OUT (see figure 2-8). Close the spring latches.

10. Repeat steps 1 through 9 to install ECO boxes on remaining “S” loops.

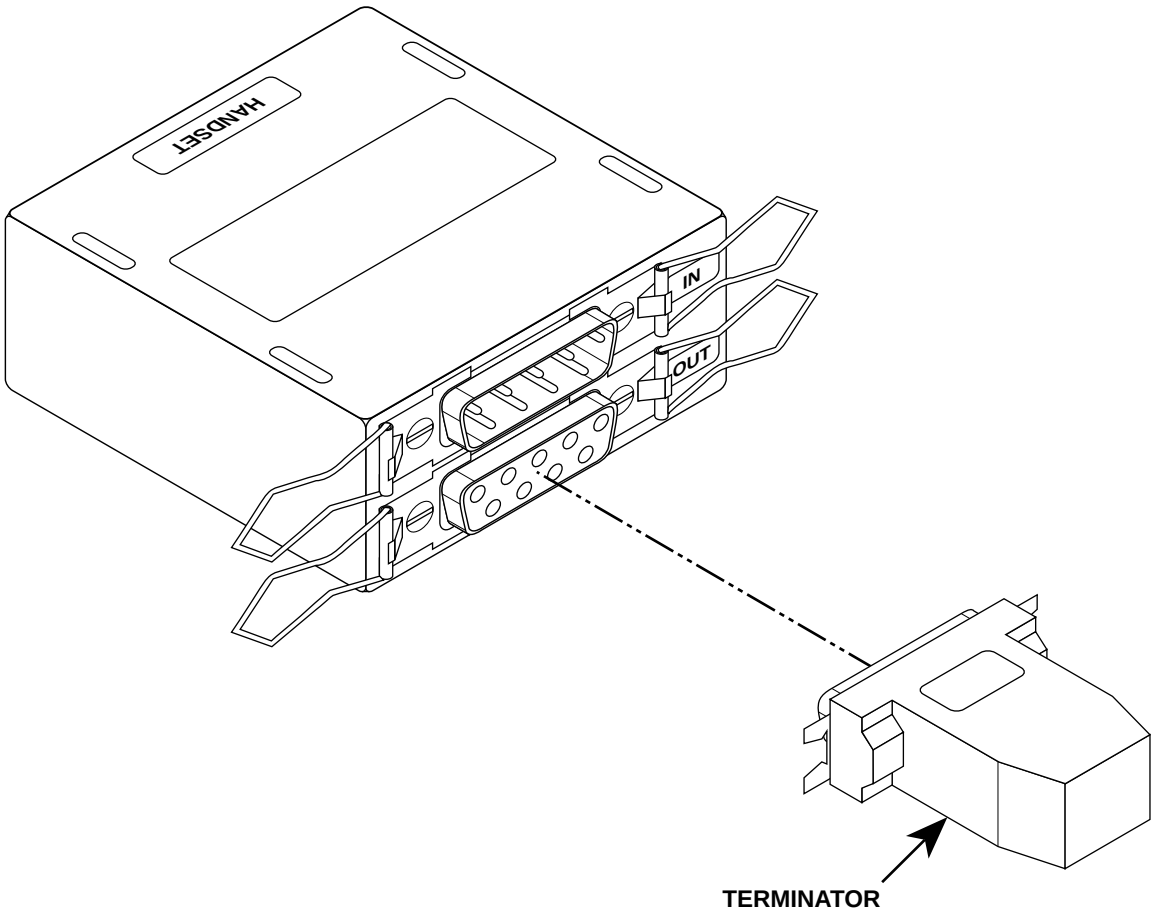


Figure 2-8. Installing the terminator

Installing the UHF/L-band antennas

The following procedure describes installing the two UHF/L-band antennas onto the aircraft. As installations may vary from aircraft to aircraft, refer to the as-built drawings to determine where the cable assemblies that connect to each antenna are located.

Caution

Before proceeding, verify the following:

- That a doubler plate (see figure 2-9) has been installed at each location where an antenna will be mounted
- All paint, primer, etc. has been removed from an area matching the footprint of the antenna on the outside of the aircraft fuselage.
- Bare metal antenna mounting surfaces have been treated with Alodine 1200 or Irridite to prevent aluminum oxidation.

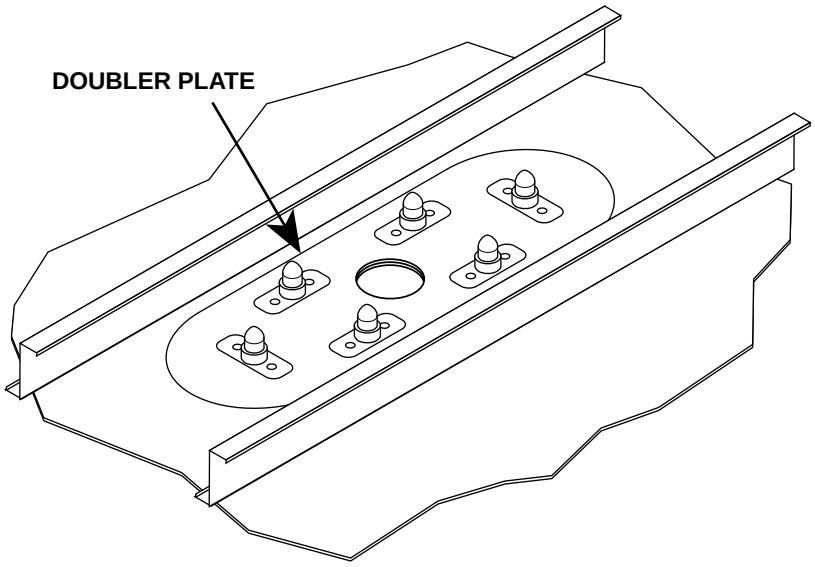


Figure 2-9. Antenna doubler plate

1. Remove a UHF/L-band antenna (see table 2-1) from its shipping container.

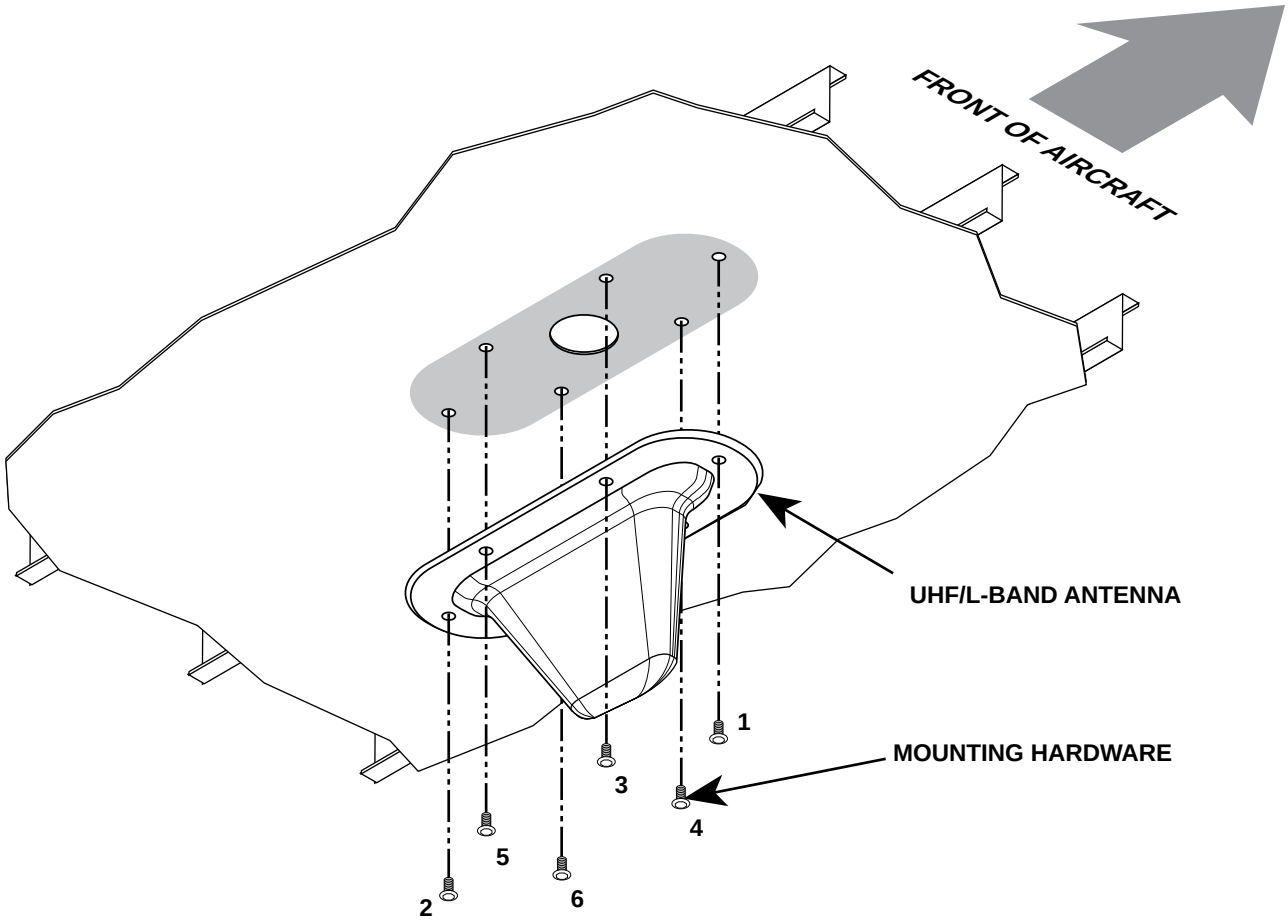


Figure 2-10. Installing the antenna onto the aircraft

2. Using a crosstip torque screwdriver, mount the antenna to the aircraft with six sets of 6-32 screws, as shown in figure 2-10. Tighten screw #1 (see figure 2-10) a small amount, then tighten screw #2 the same amount. Continue tightening the remaining screws a small amount following the sequence shown in figure 2-10. Repeat the sequence again, using the same side-to-side pattern so that uniform stress is placed on the antenna, until the screws have been set to a torque of 8 to 10 inch/pounds.

3. Using RTV sealant, apply a small, smooth fillet along the joint between the antenna and the aircraft fuselage. Also, apply sealant over the mounting hardware heads at the base of the antenna.

⚠ Caution

Allow the sealant to dry for 4 hours before exposing it to water.

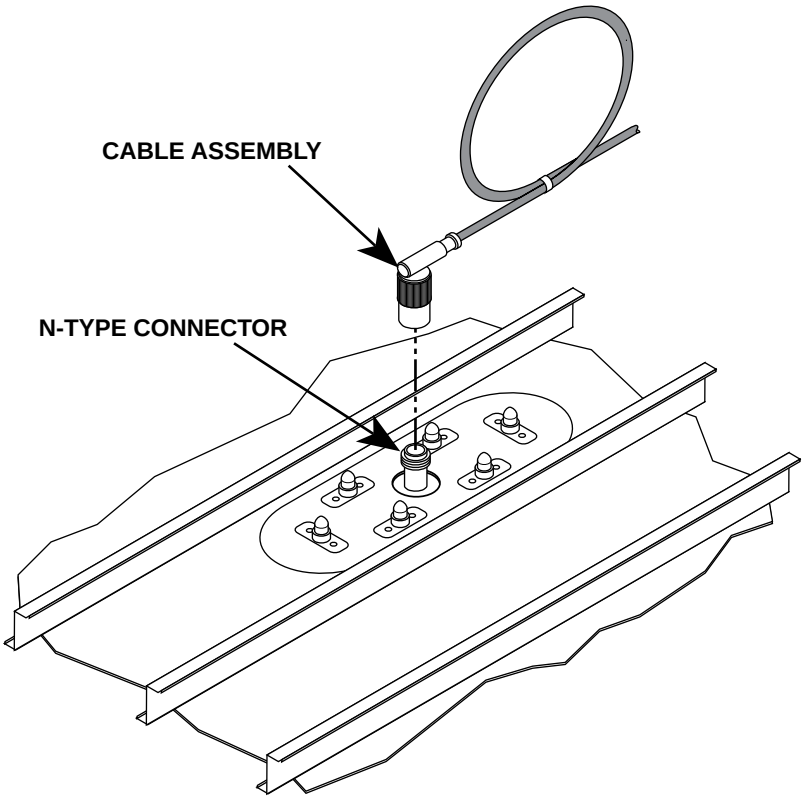


Figure 2-11. Installing the cable assembly onto the antenna

4. Connect the cable assembly to the N-type connector on the antenna as shown in figure 2-11. Hand-tighten the connector to secure it. Create a service loop with the excess cable length and clamp as specified in the aircraft manufacturer's recommendation for antenna installations.

Caution

Be careful when bending the cable that you do not exceed the minimum bend radius of six times the cable's outside diameter. Exceeding the minimum bend radius could result in cable failure.

5. Repeat steps 1 through 4 to install the remaining UHF/L-band antenna.

Installing the seatback phone units

The following procedure describes installing the telephone handsets into the seatback headrests.

1. Remove a seatback phone unit (see table 2-1) from its shipping container.
2. Record the phone unit handset serial number per Claircom's requirements.

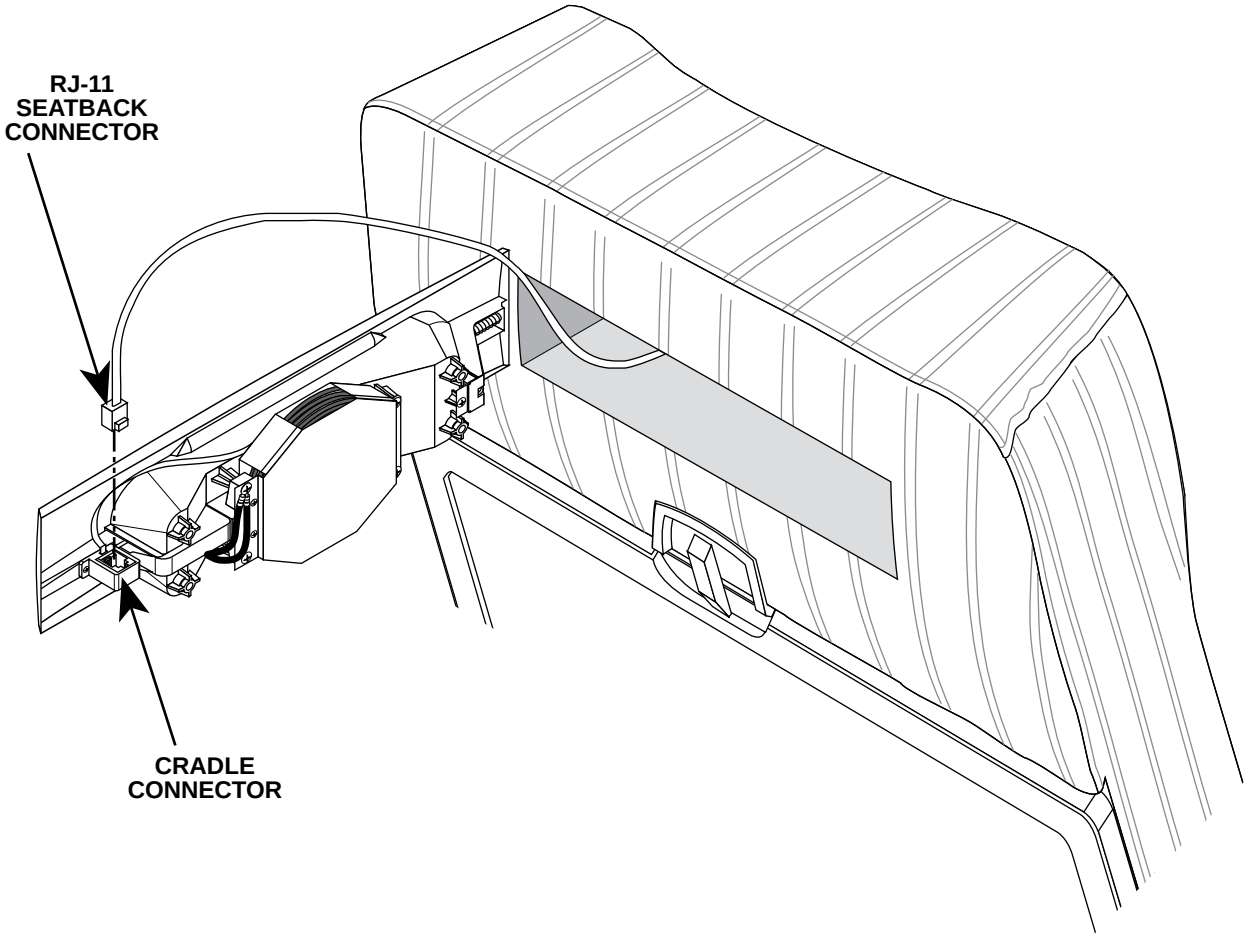


Figure 2-12. Installing the RJ-11 connector onto the seatback phone unit

3. Install the RJ-11 connector (located inside the seatback headrest) into the cradle connector, as shown in figure 2-12.
4. Insert the cradle into the slot in the seatback headrest (see figure 2-12).

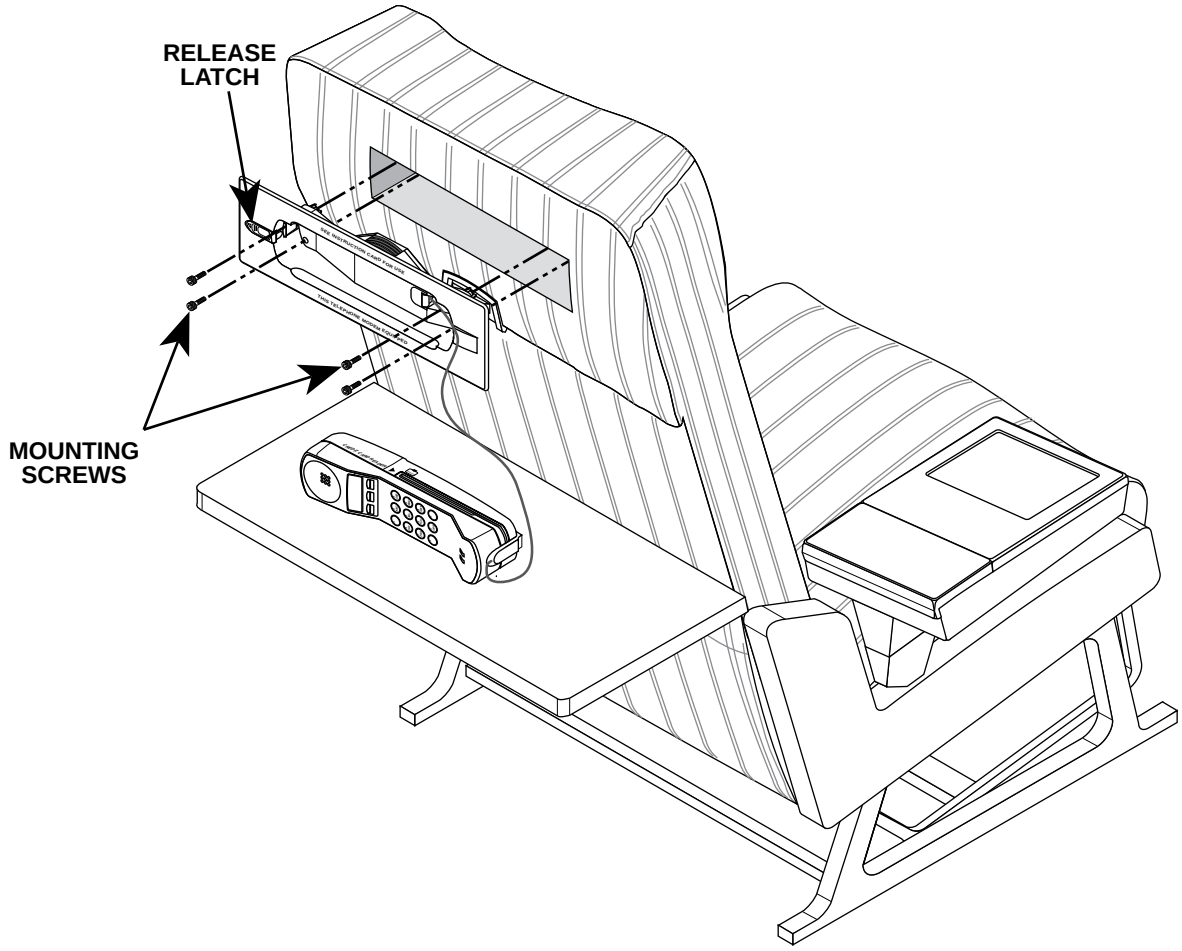


Figure 2-13. Installing phone unit mounting hardware

5. Slide the release latch to the left and remove the handset from the cradle (see figure 2-13). Pull out enough handset cord so that you can install the cradle mounting hardware without the handset or its cord getting in the way.

6. Using the appropriate tool, install the cradle into the seat-back headrest with four mounting screws (see figure 2-13). (Verify that the seat cover material is not buckled and that there are no exposed seams visible after securing the cradle.)

7. Verify proper mechanical operation of the handset (make sure the reel coils the cord properly and that the handset release latch works)

8. Repeat steps 1 through 7 to install remaining phone units.

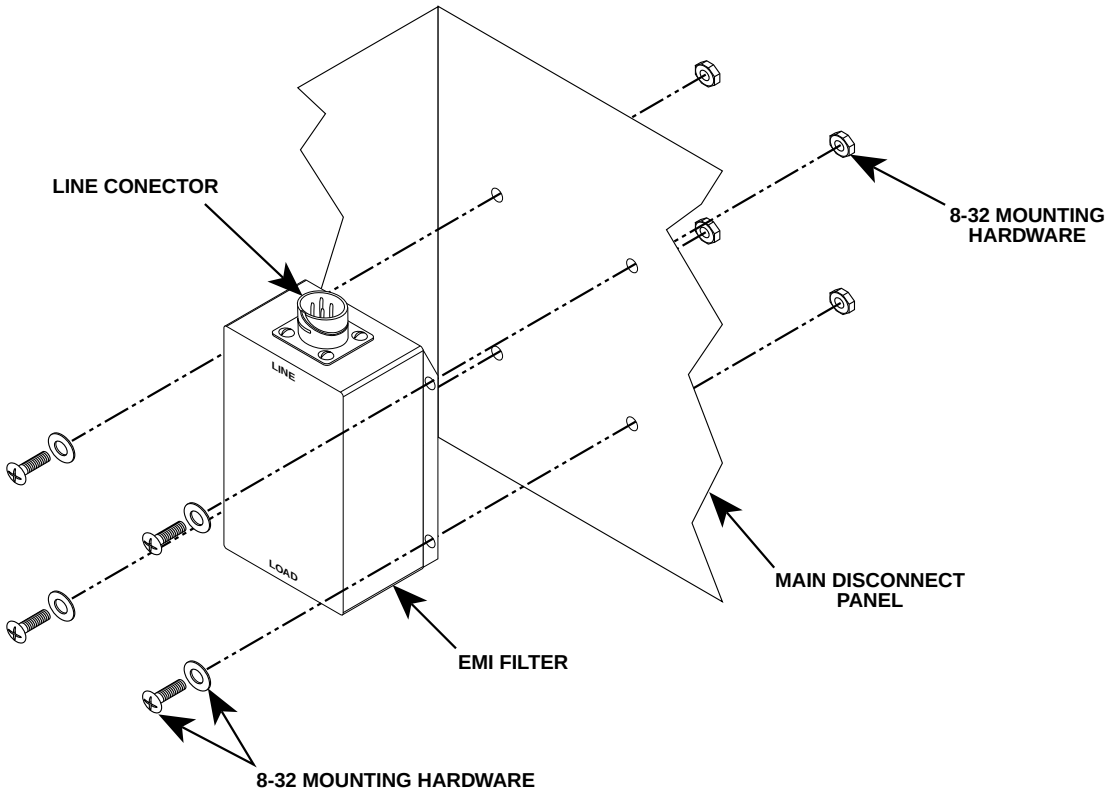


Figure 2-14. Installing the EMI filter

Installing the EMI filter

Perform the following procedure to install the electromagnetic interference (EMI) filter.

1. Remove the EMI filter (see table 2-1) from its shipping container.

2. Using a crosstip torque screwdriver, mount the filter to the main disconnect panel with four sets of 8-32 mounting hardware, as shown in figure 2-14. Torque the screws to 12 to 15 inch/pounds.

Note

The following steps describe installing EMI filter cables. There are two cable connections to the EMI filter. One of them, the LINE connection, is the cable link between the AC voltage source and the EMI filter. The other connection (LOAD) is the cable link between the filter and the PSU.

3. Install the AC voltage source cable connector to the EMI filter connector labeled LINE.

4. Install the PSU cable connector to the EMI filter connector labeled LOAD.

Air terminal installation is now complete. Fill out required documentation. Then refer to chapter 3, “Commissioning” to configure the air terminal for operation in the Claircom network.

This section contains the following procedures for commissioning the air terminal:

- Applying power to the radio equipment and observing as they perform automatic self-tests.
- Using the maintenance console and the RF translator box to run loopback tests of radio equipment and in-cabin equipment.
- Testing the phone units.

3.1 Required test equipment

- Maintenance console in the following minimum configuration:
  - 386 SX IBM or compatible notebook computer
  - 4-Mbytes RAM
  - 3.5-inch disk drive
  - 60-Mbyte disk drive
  - Serial I/O port
- ATC Commissioning Program (version R1.60c, or higher)
- RF translator box (shown in figure 3-1). The translator receives the 895-MHz signal from one UHF/L-band antenna, converts the signal to 850 MHz, and transmits the translated signal to the other UHF/L-band antenna.

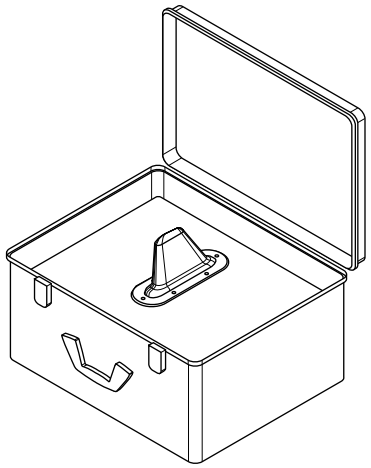


Figure 3-1. RF translator box

- Test card (used to test the credit card readers on the phone units).
- Digital multimeter (Fluke Type 77 or equivalent).

3.2 System power-up and self tests

Perform the following procedure to apply power to the air terminal radio equipment.

1. Set all air terminal circuit breakers to ON.
2. Open the switch cover on the PSU front panel and set the power switch to ON (up position). Close the switch cover. Verify that the AC PILOT and DC status lamps (see figure 3-2 for locations) illuminate and remain lit:

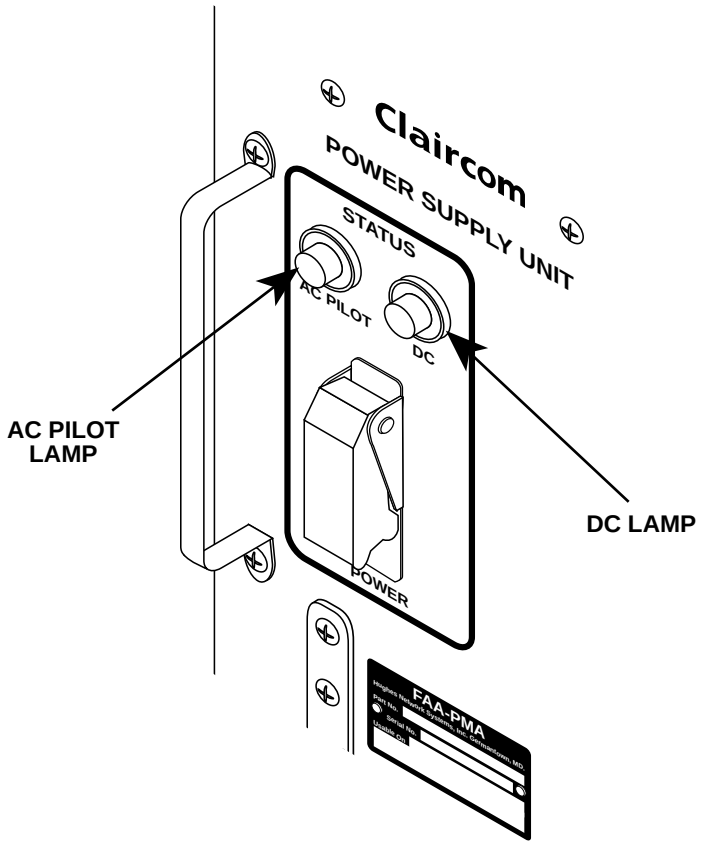


Figure 3-2. PSU status lamps

3. Set the air terminal circuit breakers to OFF. Verify that the AC lamp on the front panel of the PSU extinguishes.

4. Set the air terminal circuit breakers to ON. Verify that the AC lamp on the front panel of the PSU illuminates.

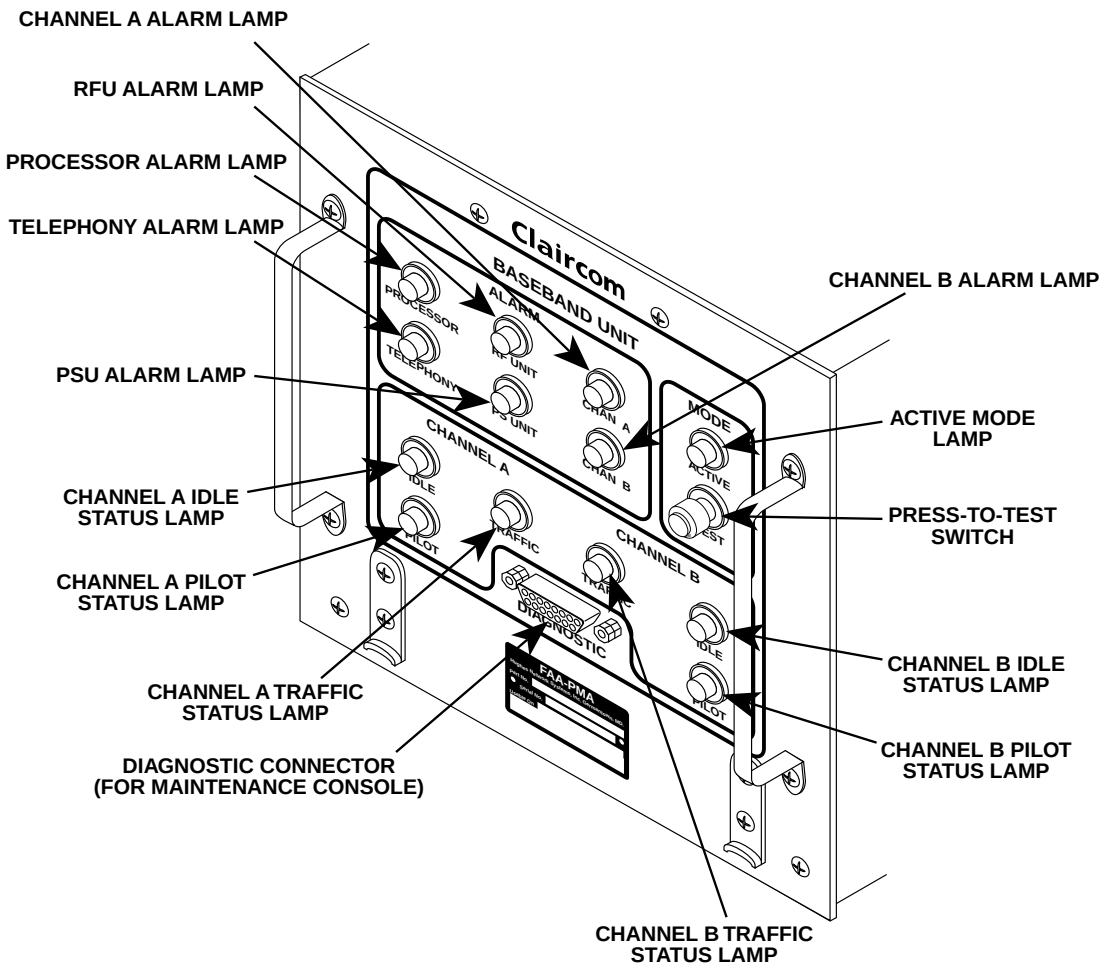


Figure 3-3. BBU indicator lamps

5. Following power up the air terminal will automatically run self-diagnostics tests. This is indicated by all lamps on the PSU and BBU illuminating for approximately one second, then extinguishing, except for the PRESS-TO-TEST lamp (see figure 3-3). The lamp on the PRESS-TO-TEST switch will remain lit until the diagnostics tests are complete.

Note

If the sequence does not terminate with the ACTIVE lamp flashing, the air terminal has failed startup self-tests. Refer to section 6.3, “Troubleshooting flowcharts.”

6. After approximately 30 seconds, the following will occur:
    - The PRESS-TO-TEST lamp will extinguish, indicating that diagnostics test are completed.
    - The PROCESSOR alarm lamp will flash on and off once.
    - The ACTIVE lamp will flash on and off twice, then illuminate for approximately 15 seconds, then begin flashing.
7. Once the diagnostics are complete, the system will test the functioning of the channel threads. The tests last approximately 60 seconds. After the tests are complete, the ACTIVE lamp will be flashing.

Note

If the sequence does not terminate with the ACTIVE lamp flashing, the air terminal has failed startup self-tests. Refer to section 6.3, "Troubleshooting flowcharts."

Air terminal power-up and self-test diagnostics are complete. Refer to the next section to perform system tests.

3.3 System testing

This section describes testing the radio equipment and in-cabin equipment using the maintenance console and RF translator box.

WARNING

To avoid potential health risks caused by RF radiation, do not come within 4 feet of a UHF/L-band antenna while the PSU is activated.

1. Verify that the maintenance console is deactivated.
2. Install the maintenance console/BBU interface cable to the BBU port labeled DIAGNOSTIC (see figure 3-3).

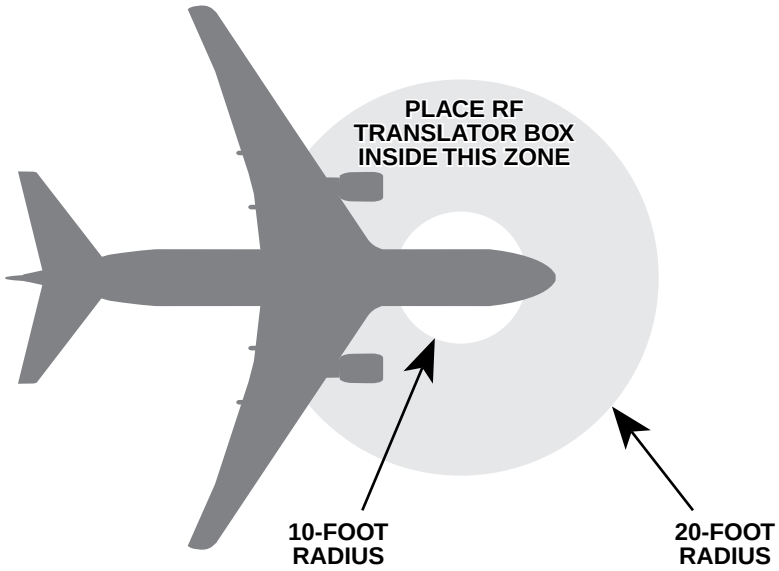


Figure 3-4. Placing the RF translator box

3. Place the RF translator box at a location underneath the UHF/L-band antennas no closer than 10 feet and no farther than 20 feet from the antennas (see figure 3-4).

4. Activate the RF translator box.

5. Activate the maintenance console. Once the console has finished booting up, a prompt resembling the following will be displayed:

```
A:\MC>
```

6. Type *CP*, then press the **[Enter]** key. The Claircom Commissioning Program Application Select Menu will be displayed (see figure 3-5).

Note

If you make a mistake while typing, press the **[Backspace]** key to delete the entry.

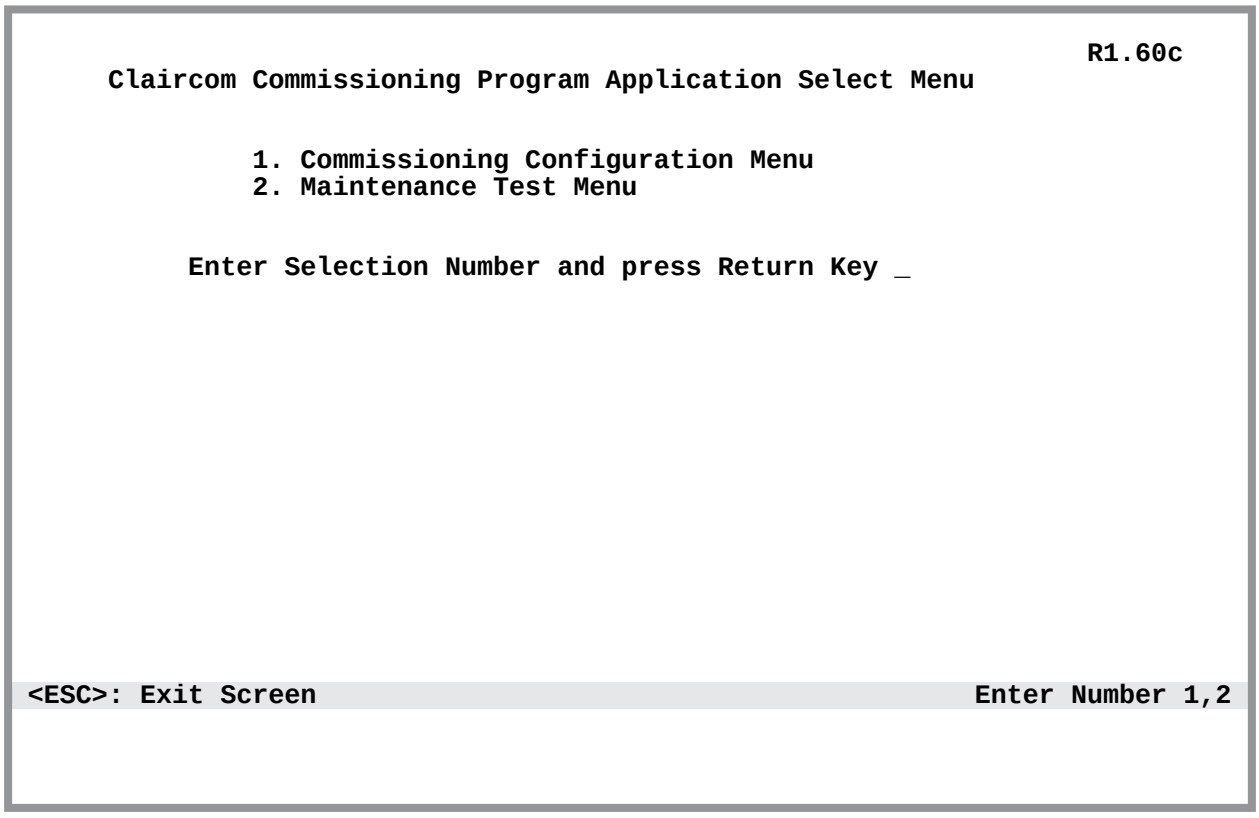


Figure 3-5. Claircom Commissioning Program Application Select Menu

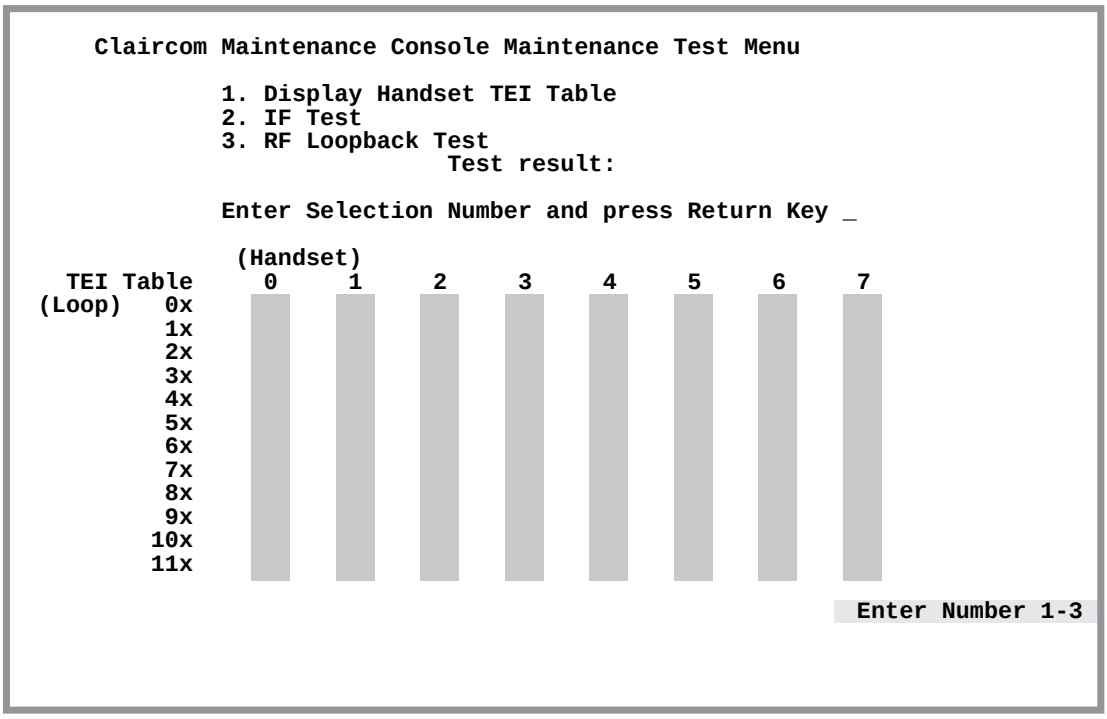


Figure 3-6. Claircom Maintenance Console Maintenance Test Menu

7. Type *2*, then press the **[Enter]** key. The Claircom Maintenance Console Maintenance Test Menu will be displayed (see figure 3-6).

> **Note**
>
> If you are using a version of the ATC Commissioning Program that was released prior to version 1.60c, the Claircom Maintenance Console Maintenance Test Menu will show 8 loops instead of 12.

8. Type *1*, then press the **[Enter]** key to begin the Display Handset TEI (terminal equipment identifier) Table test. This test verifies that each phone unit on each ISDN loop responds to queries from the BBU. *OK* is used to represent phones that respond properly; blank entries in the table indicate that there is either no phone unit present or the phone unit is not responding.

   If TEI table results are correct, go to step 9. Otherwise, verify that phone units are installed in the proper configuration (for instance, too many phones on one “S” loop and not enough phones on another will result in incorrect TEI table listings). If the phone units are installed correctly, refer to section 6.3, “Troubleshooting flowcharts,” flowchart 6-4.

9. Type *2*, then press the **[Enter]** key to begin the IF Test. The system will display *PASS* or *FAIL* at the conclusion of the test. If the result is PASS, continue on to step 10; otherwise, refer to section 6.3, “Troubleshooting flowcharts.”

10. Type *3*, then press the **[Enter]** key to begin the RF Loopback Test. In this loopback test, the BBU transmits a number of signal packets (called RR sequences) through the loopback circuit shown in figure 3-7 and examines the success rate of the arrival of the packets on the receive side. The system will display *PASS* or *FAIL* at the conclusion of the test. If the result is PASS, continue on to step 11; otherwise, refer to section 6.3, “Troubleshooting flowcharts.”

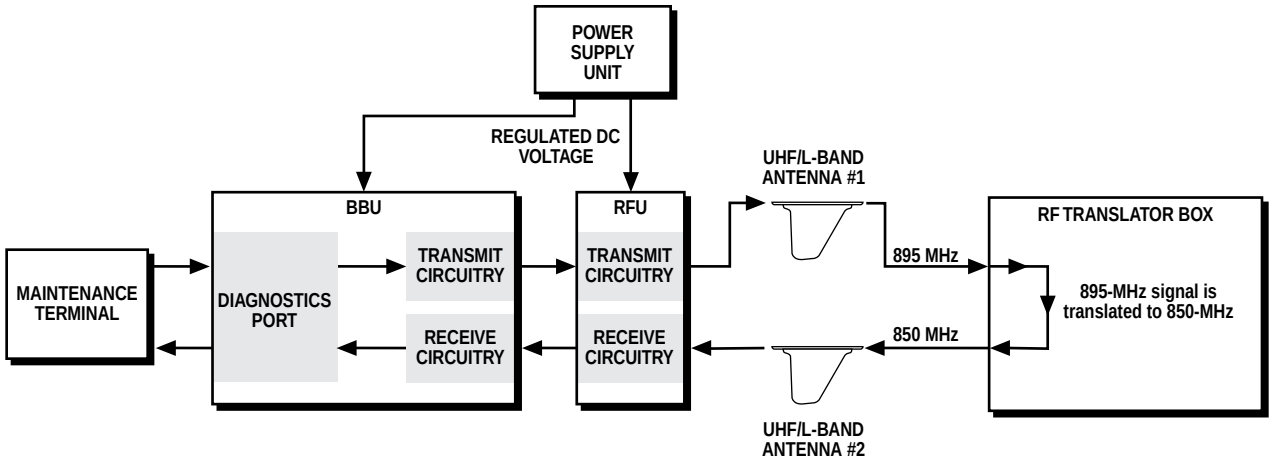


Figure 3-7. RF Loopback Test signal flow

11. Press on the **[Esc]** key to return to the Claircom Commissioning Program Application Select Menu.

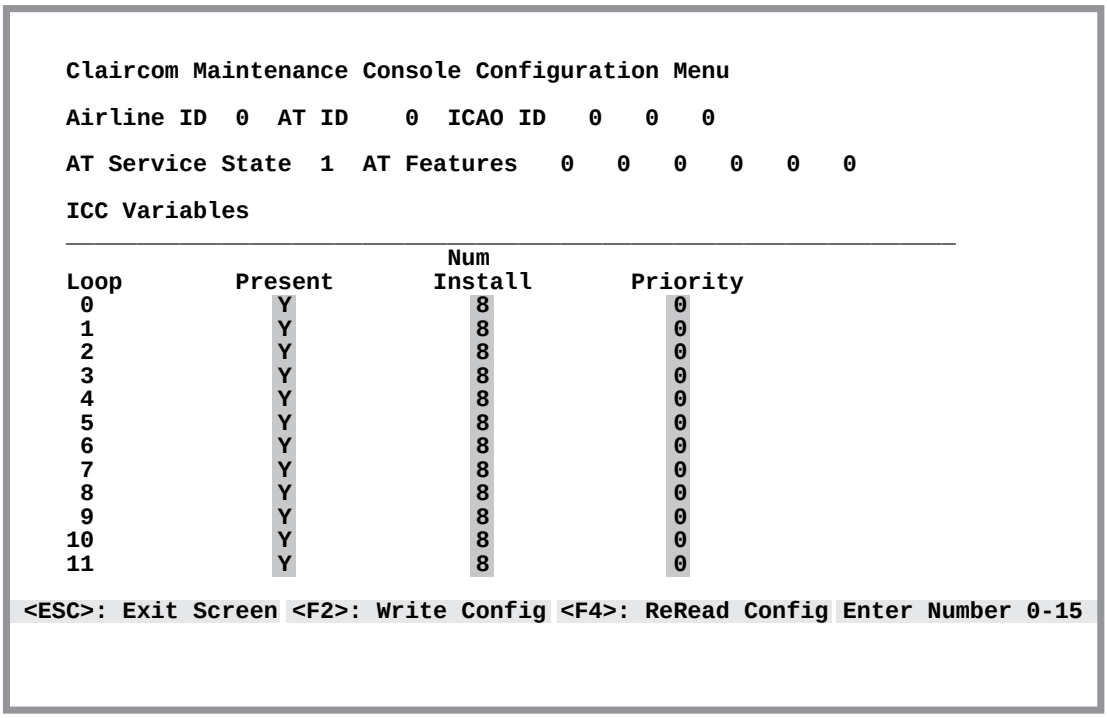


Figure 3-8. Claircom Maintenance Console Configuration Menu

12. Type *1*, then press the **[Enter]** key. The Claircom Maintenance Console Configuration Menu will be displayed (see figure 3-8).

> **Note**
>
> If you are using a version of the ATC Commissioning Program that was released prior to version 1.60c, the Claircom Maintenance Console Configuration Menu will show 8 loops instead of 12.

13. Type in the Airline ID (identification) number (the number must be between 00 and 15), then press **[Enter]**.

> **Note**
>
> If you want to skip a field, or modify one you have already set, press the **[Tab]** key to jump the cursor forward (or press the **[Shift]** + **[Tab]** keys to move the cursor backward) to that field.

14. Type in the AT (air terminal) ID (the number must be between 0 and 1023), then press **[Enter]**.

15. Press the **[Tab]** key to jump the cursor past the ICAO ID, AT Service State, and AT Features fields.

16. Type a *Y* in the Loop 0 Present field if there is a loop present; otherwise, type an *N*. Press the **[Enter]** key to move to the next field

17. Type the number of phone unit handsets installed on "S" loop 0 in the Num Install field, then press **[Enter]**.

18. Type a number from 0 through 3 (0 is the highest level priority, 3 is the lowest) to set the loop priority of "S" loop 0, then press **[Enter]**.

19. Repeat steps 16 through 18 to configure "S" loops 1 through 7. Then continue on to step 20.

20. Press the **[F2]** key to write the configuration changes to the air terminal. After approximately five seconds, press the **[Esc]** key to exit from the ATC Commissioning Program.

21. Deactivate the maintenance console.

22. Disconnect the maintenance console/BBU interface cable from the diagnostics port on the BBU.

23. Set the power switch on the RF translator box to OFF.

24. Open the switch cover on the PSU front panel and set the power switch to OFF. Wait 10 seconds, then set the switch to ON. Close the switch cover.

25. Steps 26 through 35 describe tests that check the following handset features:

    - Keypad operation
    - LCD readout operation
    - Card reader operation
    - Mouthpiece microphone and earpiece speaker operation
    - Volume key operation

    If you find a handset that has an LCD readout displaying error codes, refer to section "Replacing a seatback phone unit" in chapter 7, "Maintenance." If the handset is malfunctioning, but you are unable to determine the cause, refer to section 6.3, "Troubleshooting flowcharts."

Note

You will need a password to perform the following tests. Contact your supervisor to obtain the handset password.

26. Enter the accessing keys into the handset. The handset LCD readout will display the following:

```
1=EMI Mode
2=Auto Dial
3=A-Dial Rst
```

27. Press the **[1]** key on the keypad. The LCD will display the following:

```
Please Enter Password:
```

28. Enter the password into the handset. The LCD readout will display:

```
1=Start EMI
2=Stop EMI
```

29. Press the **[1]** key on the keypad. The LCD will display:

```
  PRESS ON
TO MAKE CALL

ON      HELP
```

30. Press the *ON* key. When the prompt appears on the LCD readout, slide the test card through the card reader slot. If the message *PLEASE SLIDE CARD SLOWLY* appears, slowly slide the test card through the reader slot again. If the *PLEASE SLIDE CARD SLOWLY* message appears again, the handset is defective.

31. Press each key on the keypad; verify that a tone is generated as each key is pressed and that the key's alphanumeric character is displayed on the LCD readout.

32. Press each of the soft keys and verify that the LCD readout display is correct.

33. Talk into the mouthpiece and verify that—after a short delay—you hear your voice in the earpiece. While performing this test, press on the ▲ (increase) volume and ▼ (decrease) volume buttons and verify that the voice volume control operates properly.

34. Verify proper mechanical operation of the handset (make sure the reel coils the cord correctly and that the handset release latch works).

35. Press the *END* key to allow another phone unit to be tested.

36. Repeat steps 30 through 35 to test each remaining phone unit.

37. Press the **[2]** key on a phone unit keypad to return the air terminal to normal operating mode.

38. Open the switch cover on the PSU front panel and set the power switch to OFF. Wait 10 seconds, then set the switch to ON. Close the switch cover.

The air terminal is now operational. Refer to chapter 4, “Operation.”

Chapter 4

Operation and shutdown

This section contains information required to operate, deactivate, or restart the air terminal.

4.1 Operation

Once the air terminal has been installed, tested, and commissioned, no operator action is required under normal conditions; the air terminal is designed for unattended operation. Leave the PSU ON/OFF power switch set to ON at all times (except when the air terminal should have power removed for servicing). Table 4-1 is a summary of air terminal switch positions and indications under normal operating conditions. If your air terminal is not operating as specified, refer to chapter 6, “Troubleshooting.”

Table 4-1. Normal operating configuration for air terminal switches and indicators

Device	Switch/Lamp	Setting/Indication
PSU	ON/OFF switch	ON
PSU	AC PILOT lamp	Lit
PSU	DC lamp	Lit
BBU	ACTIVE lamp	Flashing
BBU	CHANNEL A IDLE	Lit if CHANNEL A TRAFFIC lamp is extinguished
BBU	CHANNEL A TRAFFIC	Lit if CHANNEL A IDLE lamp is extinguished
BBU	CHANNEL A PILOT	Lit if Channel A is being used to search for a pilot signal
BBU	CHANNEL B IDLE	Lit if CHANNEL B TRAFFIC lamp is extinguished
BBU	CHANNEL B TRAFFIC	Lit if CHANNEL B IDLE lamp is extinguished
BBU	CHANNEL B PILOT	Lit if Channel B is being used to search for a pilot signal

4.2

System shutdown

Perform the following procedure to deactivate the air terminal equipment:

1. Open the switch cover on the PSU front panel and set the power switch to OFF (down position). (Refer to figure 4-1 for switch location.) Close the switch cover.

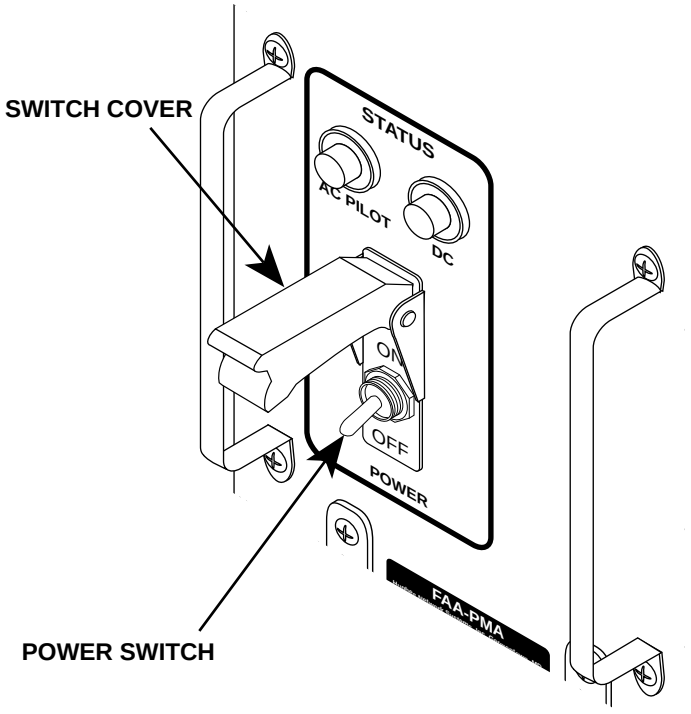


Figure 4-1. PSU power switch

2. Set all air terminal circuit breakers to OFF (refer to the as-built drawings for the locations of the circuit breakers).

3. Verify that the AC PILOT lamp on the PSU is extinguished.

The air terminal is now deactivated. If you need to restart the system, refer to section 4.3, “Restarting the air terminal” to do so.

Restarting the air terminal

Perform the following procedure to apply power to the air terminal radio equipment.

1. Set all air terminal circuit breakers to ON.
2. Open the switch cover on the PSU front panel and set the power switch to ON (up position). Close the switch cover. Verify that the AC PILOT and DC status lamps (see figure 4-2 for locations) illuminate and remain lit.

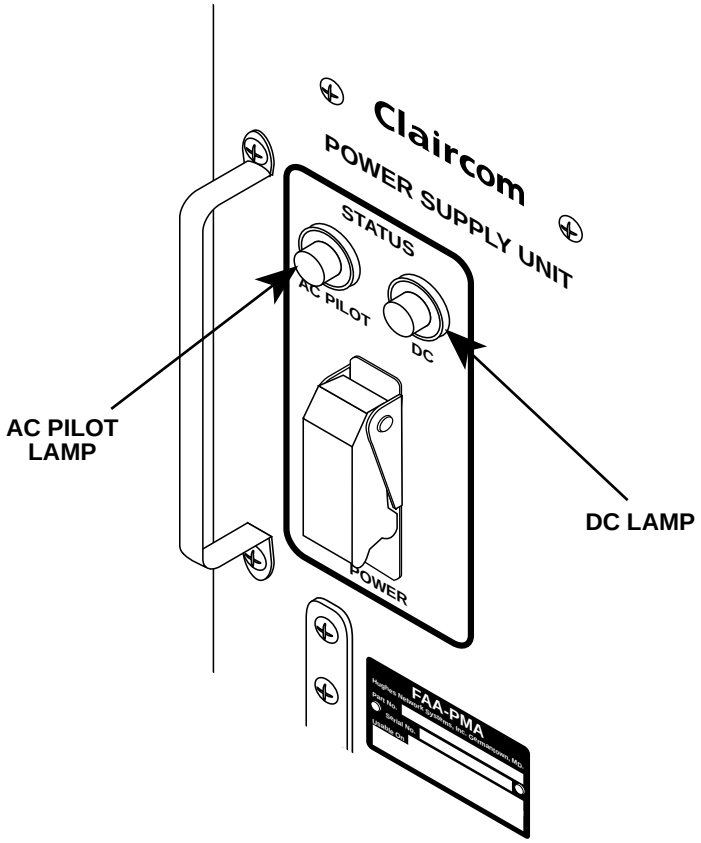


Figure 4-2. PSU status lamps

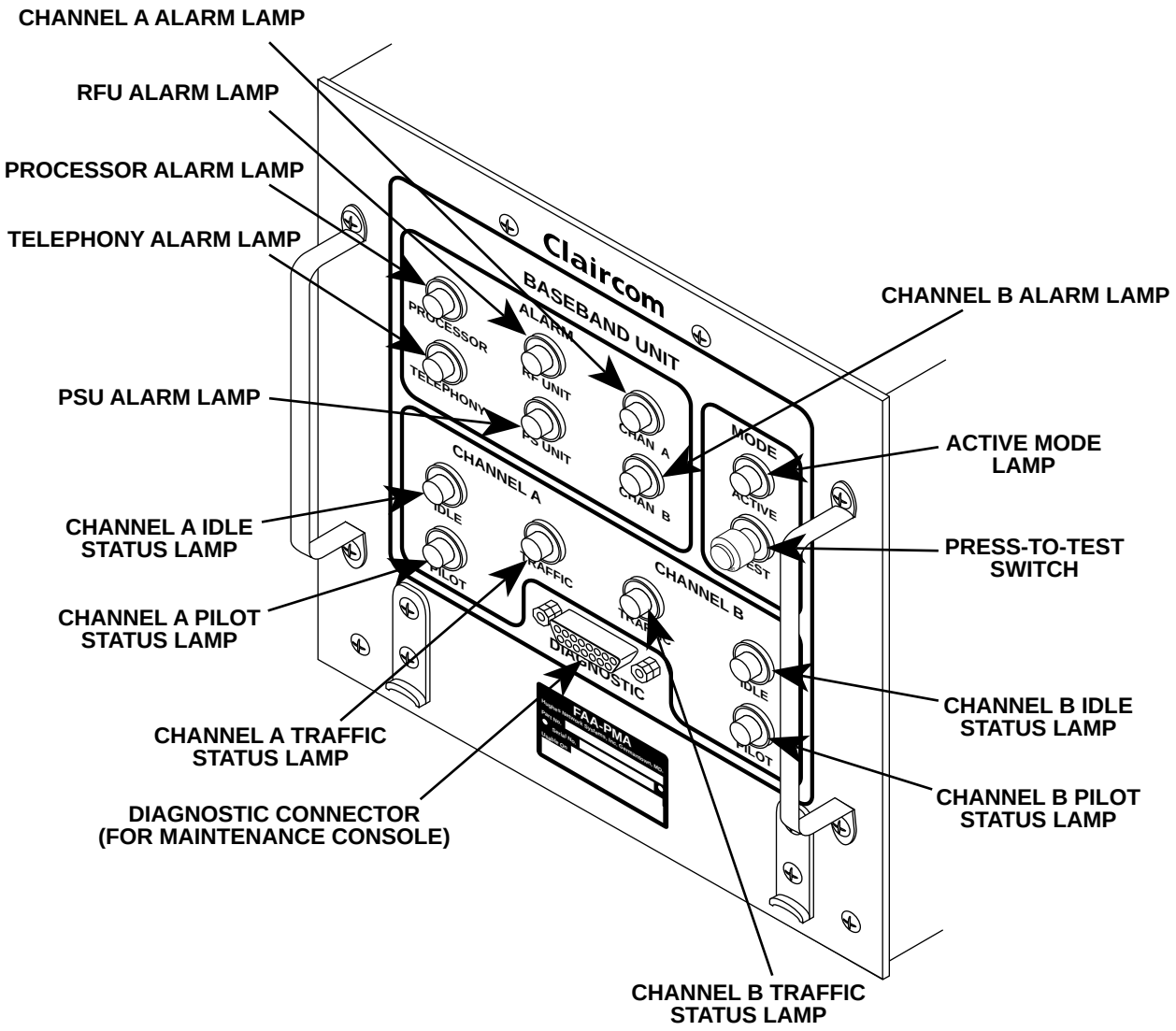


Figure 4-3. BBU indicator lamps

3. Following power up the air terminal will automatically run self-diagnostics tests. This is indicated by all lamps on the PSU and BBU illuminating for approximately one second, then extinguishing, except for the PRESS-TO-TEST lamp (see figure 4-3 for lamp locations). The lamp on the PRESS-TO-TEST switch will remain lit until the diagnostics tests are complete.

Note

If a test fails, the PROCESSOR alarm lamp will illuminate. If that occurs, refer to section 6.3, “Troubleshooting flowcharts.”

4. After approximately 30 seconds, the following will occur:

   - The PRESS-TO-TEST lamp will extinguish, indicating that diagnostics test are completed.
   - The PROCESSOR alarm lamp will flash on and off once.
   - The ACTIVE lamp will flash on and off twice, then illuminate for approximately 15 seconds, then begin flashing.

5. Once the diagnostics are complete, the system will test the functioning of the channel threads. The tests last approximately 60 seconds. When the tests are complete, the ACTIVE lamp will be flashing.

Note

If the sequence does not terminate with the ACTIVE lamp flashing, the air terminal has failed startup self-tests. Refer to section 6.3, “Troubleshooting flowcharts.”

Air terminal power-up and self-test diagnostics are complete.

Chapter 5

Theory of operation

This chapter describes the theory of operation of the major air terminal hardware components (BBU, RFU, PSU, and handsets) and briefly details how phone calls are made.

5.1 BBU description

The baseband unit performs the following functions:

- During transmit operations, the BBU receives ISDN-formatted pulse code modulated (PCM) telephone data from as many as 96 phone units in 12 ISDN “S” loops. The BBU compresses the voice data so that it can be transmitted in a 13.2-Kb/s bandwidth signal. The baseband unit then scrambles, interleaves, and convolutionally encodes the data to prepare it for transmission through a possibly noisy or fading radio link to the nearest ground station. After encoding the data, the BBU modulates the data in BPSK (phase modulation having two possible phase states) or 8-PSK (phase modulation having eight possible phase states) as appropriate to the stage in call setup, at an intermediate frequency (IF) in a band centered at 23.6 MHz. The baseband unit then upconverts the IF carrier to radio frequency (RF) in a band centered at 895 MHz. The RF signal is then passed on to the RFU for final processing and transmission through one of the two radio channels.
- During receive operations, the BBU downconverts the 850-MHz carrier band to an IF frequency centered at 21.4 MHz. The baseband unit then demodulates the received signal in either BPSK or 8-PSK modes; it performs automatic gain control (AGC) and automatic frequency control (AFC) to counter the effects of Doppler caused by aircraft motion and various effects of signal fading and signal blockage. After demodulating the signal, the BBU unscrambles, de-interleaves and performs forward error correction (FEC) to reproduce the original data stream. The baseband unit then synthesizes the voice signal based upon the compressed parameters in the receive data and outputs an ISDN signal for the phone unit receivers in the aircraft cabin. The BBU performs this action for two radio channels and up to 12 ISDN “S” loops.

BBU functions are provided by the following modules:

- *Control processor (CP).* The CP coordinates all in-cabin and BBU activities; monitors the phone units, operates the radio

link, communicates with the control center and keeps records. The CP controls the other modules through a monitor and control (M&C) bus.

- *Circuit switch module (CSM).* The CSM provides the ISDN link to the phone units in the cabin; the circuit switch module directs the data to one of the two channels through a backplane bus.
- *Baseband processor (BSP).* The BSP interchanges voice data with the CSM and analyzes the voice data for compression before transmission. The analysis results in a set of parameters that are used later by the receiving end to decompress the voice signal.
- *Modem module (MOM).* The MOM modulates/demodulates either BPSK data or 8-PSK data.

CP description

The control processor is an i960[1] processor operating under a real-time operating system called Vx960 which is based upon the UNIX[2] operating system. The control processor has dynamic random-access memory (DRAM) and *flash* erasable programmable read-only memory (EPROM) that contain the program firmware used by the CP and the digital signal processors (DSPs) located on the BSP and the MOM. Upon startup, the CP program is loaded from flash EPROM into DRAM. The CP program code then loads the DSP code into the MOM and BSP module.

The CP module's M&C bus controls the BSP module, MOM, and CSM. The CP also has an Ethernet[3] interface that is used during manufacturing to test the module.

The CP has an RS-232 serial port that is used to debug software or to load new software. The serial port provides access to the UNIX-like *shell* of Vx960 (a command line interpreter). The serial port is located on the front panel of the BBU and is labeled DIAGNOSTIC.

The CP communicates with its counterpart CP modules in the ground stations through an overhead channel. The overhead channel is created by the firmware on the BSP module. The BSP firmware can be commanded into overhead mode in which the entire channel bandwidth carries data from the CP or the BSP firmware can be

[1] The terms *i960* and *Vx960* are trademarks of INTEL Corporation.

[2] The term *UNIX* is a registered trademark of AT&T.

[3] The term *Ethernet* is a trademark of Xerox Corporation.

commanded into voice mode in which only a few bits per 120-ms frame are available for overhead data from the CP.

CSM description

The circuit switch module contains all of the ISDN circuitry. There are up to 12 ISDN “S” loops. Each loop is a time-division multiple-access (TDMA) arrangement in which there is a control channel and two traffic channels available per loop. Any phone unit connected to a loop can seize control of one of the traffic channels through appropriate use of the control channel and in cooperation with the CP program monitoring the process. Once two phone units have seized the traffic channels, all others must wait until a channel is released.

Each ISDN “S” loop is a bipolar circuit that requires 48 VDC (supplied by a transformer inside the CSM).

Decoded data sent to the CSM is directed to the selected radio channel on a high-speed serial bus using a time-division multiplexed (TDM) format.

The CP code programs the integrated circuits on the CSM and is responsible for responding to phone unit handset keystrokes during the radio link setup phase of the call. The control processor decides which radio link, if any, is available and programs the CSM to direct the pulse-code modulated (PCM) data from the handset to the appropriate BSP module.

BSP module description

The BSP module has three DSPs and a variety of field-programmable gate array (FPGA) logic circuits. The FPGA logic provides the interface to the M&C bus from the CP as well as interface to the high-speed serial bus from the BSP. The logic also controls the dual-port random-access memory (RAM) used to interface between the DSPs.

The CP program sends commands via the M&C bus that control the operating mode of the BSP module. There are two BSP modes: overhead mode, in which all of the data comes from the air terminal serial controller; or voice mode, in which most of the data comes from the CSM via the high-speed serial bus and only a small percentage comes as overhead data from the CP.

Three DSPs—operating in parallel to share computing tasks—partition the voice compression and pre-transmission data processing so that it is performed in real-time.

The BSP firmware receives the PCM data from the CSM and analyzes the data’s frequency, amplitude, and noise level character-

istics. These characteristics are then expressed as a set of parameters that are then formatted for delivery to the modulator.

Before going to the modulator the data is interleaved and convolutionally encoded to reduce errors.

A synchronous serial line is used to send the data to the MOM. The modem module controls the rate at which the data is output and provides the clock signal used to synchronize the connection.

The BSP firmware synthesizes the voice from the parameters in the receive data and sends it in PCM format (via the high-speed serial bus) to the CSM module.

MOM module description

The MOM primarily uses hardware to perform the modulation function and firmware to perform the demodulation function. The MOM features direct digital synthesis (DDS) of transmit and receive carriers that control synthesizers rated for 1-Hz adjustment. The MOM also has a digital transmit filter (finite impulse response—FIR—implementation). Implemented as a lookup table in DRAM, the filter is loaded by firmware but driven during operation by hardware.

The MOM is controlled by the CP via the monitor and control interface. The CP controls the modes of the MOM and monitors its status in order to manage the radio link.

MOM firmware, besides performing the demodulation function, also manages the interface of the CP with the modulator. The CP has no direct control over the MOM hardware; all operations requested by the CP are overseen by the MOM firmware before actions are taken.

Demodulator firmware provides the following capabilities:

- Continuously tracks the receive frequency as it shifts as much as ±2000 Hz because of the Doppler effect.
- Continuously adjusts the transmit frequency to track the receive Doppler frequency shifts.
- Firmware-controlled hardware AGC with a 70-dB dynamic and numerical AGC with a 70-dB dynamic range for a total of 140dB of dynamic range of the receive signal.
- Automatically selects of the optimal demodulation method

Transmit data from the BSP is not processed by the firmware but passes directly to the modulator hardware. Received data demodulated by the firmware is passed in a synchronous serial stream to the BSP.

5.2

RFU description

The RFU performs the following functions:

- During transmit operations, the RFU receives an RF carrier in the 895-MHz band from the BBU and amplifies it based upon an analog control signal from the baseband unit. The RFU then filters the transmit signal to reduce spurious outputs and sends the signal to one of the two UHF/L-band antennas.
- During receive operations, the RFU uses a low-noise amplifier (LNA) to amplify the signal received from a UHF/L-band antenna. The RFU then outputs the amplified 850-MHz carrier band to the BBU for downconversion.

5.3

PSU description

The PSU supplies regulated direct current (DC) power to the air terminal system. It also provides status monitoring interfaces, fail-safe functions, and voltage transient protection. The regulated power derives from 3-phase, 5-wire, 400-Hz, 115-Volt alternating current (AC).

The PSU provides the following voltages:

- 115 VAC, 3-phase, 400-Hz power to the avionics trays cooling fans.
- +48 VDC to the in-cabin equipment ISDN “S” interfaces (via the BBU).
- +5 VDC, -6.5 VDC, +8 VDC, and +15 VDC to the BBU.
- +15 VDC and +27 VDC to the RFU.

5.4

Phone unit description

The phone unit consists of two major components: the cradle and the handset.

The cradle holds the handset when it is not in use. The cradle contains a reel mechanism for coiling the handset cord and a sliding latch that secures the handset.

The handset has the following components:

- A credit card reader for credit card billing.
- A three-line liquid-crystal display (LCD) that displays call progress messages for the user.

- A volume control switch (see figure 5-1).
- A standard 12-button dual-tone multi-frequency (DTMF) key-pad (see figure 5-1).
- Three special-function keys (called soft keys), shown in figure 5-1. Soft key functions vary depending on where in the call cycle they are used. Table 5-1 lists the different soft key functions.

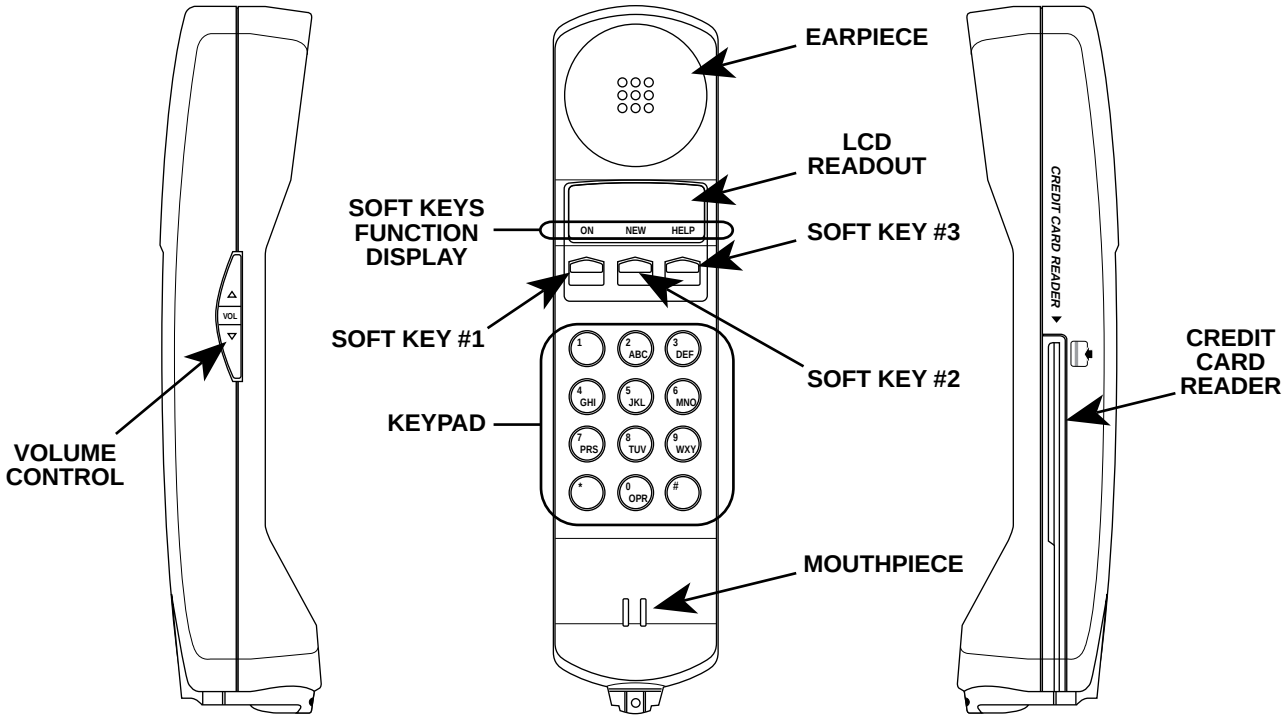


Figure 5-1. Phone unit components

Table 5-1. Soft key functions

Key No.	Key display	Description
1	ON	When displayed, pressing this key activates the handset and begins a new call process.
	END	Pressing this key ends the current call.
2	NEW	When displayed, pressing this key begins a new call process.
3	HELP	Pressing this key displays additional information or instructions pertaining to the current call status.

5.5

AT initialization

The air terminal undergoes an initialization procedure whenever power is interrupted and restored, or when a manually-initiated reset command occurs.

Air terminal initialization consists of the following sequence of events:

1. The CP performs self-initialization.
2. Once the ATC is ready, it loads the computers on the other modules in the AT.
3. Those individual modules that can perform self-diagnostic tests do so.
4. The AT performs a thorough self-check consisting of internal module checks as well as internal loopbacks.
5. If all is well, the AT searches for any Claircom pilot channel and performs a coarse reference frequency calibration using the selected pilot channel.

AT power failure recovery

The air terminal must save its state whenever power is about to be lost to the processor modules so that it may survive short power outages. The random-access memory (RAM) for the processors have a ride-through capability of several milliseconds after the power fails for this purpose. In addition, there is a small quantity of capacitor-backed-up RAM available for saving statistics and other information that should be preserved even if power fails for a long time.

5.6

Call processing

Operation of the in-cabin telephone service is very similar to standard telephone operation. To make a call the user removes a phone unit handset from its cradle on the seatback in front of the user. The caller presses the *ON* button and dials the desired phone number.

Dialing

There are two methods that can be used to dial a call. The difference between them is the way the credit card information is entered into the handset and the point at which you do so.

In the first method, the user removes the handset from the cradle, listens for the dial tone, slides a credit card's magnetic stripe through the handset card reader, listens again for the dial tone, then dials *O* and the area code followed by the standard seven-digit phone

number (*O-XXX-XXX-XXXX*). The user can also access the long-distance operator by dialing *O*.

In the second method, the user removes the handset from the cradle, listens for the dial tone, dials *O* and the area code followed by the standard seven-digit phone number (*O-XXX-XXX-XXXX*), listens for a *bong* tone, then keys the credit card number into the handset using the keypad.

The only difference from a normal phone call is that when the user presses the *ON* button, an air-to-ground channel may not be available. This can be due to the lack of aircraft channels or because the aircraft is out of range of all ground stations. In all of these cases the user will be put into a queue and will be notified (by a *beep*, LED readout, and a message on the LCD readout on the handset) when the channel becomes available.

Ending a call

To terminate a call the user presses the *END* button and returns the handset to the cradle. The user may also press the *NEW* button which disconnects the present call but does not drop the air-to-ground link. The user may then make another call. A call may also be ended by the called party hanging up, which is detected by the GS. When this happens, the voice circuit is converted to data mode and a message is sent to the aircraft. The AT then initiates the hang-up sequence.

In the following cases the user has a set amount of time to begin telephone operation before the air-to-ground link is disconnected:

- 90 seconds after waiting through the queue and being notified of an available air-to-ground link
- 15 seconds after concluding a call and pressing the *NEW* button
- 30 seconds after the called party hangs up.

Follow-on calls

Follow-on calls are calls that the user makes using the *NEW* key to terminate an existing call. This terminates the first call, restores dial tone, and allows the user to dial a new number without having to re-enter a credit card number. This service is provided by the Claircom system; the use of this feature is recorded in the call data record for this call. A user making a follow-on call has priority over a user making a call from scratch.

Call queuing

When the air telephone user requests service, the user will be queued for service if there are no available in-cabin channels, or there are no available air-ground channels, or there are no ground stations within range. The passenger may then replace the handset in the cradle. The handset will beep, illuminate an LED and display a message on the LCD when a dial tone becomes available. The user will then have 90 seconds to begin to operate the telephone before the air-to-ground channel is dropped and the phone is deactivated.

Blocked calls

The interexchange carrier (IEC) can recognize and block certain called numbers. The numbers or number groups (that is, those with a specific area code) are configurable via the carrier that implements the capability.

Blocked calls receive a service signal/message, and are recorded as such in the call data record for the call.

Chapter 6

Troubleshooting

Troubleshooting procedures and tests in this section will help isolate a problem to a specific source for correction. Once you have determined the cause of the malfunction, refer to chapter 7, “Maintenance” for the appropriate repair or replacement procedure. If the problem in the air terminal is intermittent, the most efficient course of action is to sequentially replace equipment in the system. By replacing suspect hardware, the problem can be isolated by carefully observing the long-term effects after swapping out each item. Determining which item in the circuit to start with is mostly a matter of past equipment history and intuition on the part of the technician repairing the equipment.

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

Methods used to troubleshoot hardware failures differ depending on whether you have a maintenance console. If so, there are tests that can be run to diagnose the malfunction (refer to section 3.3, “System testing” for information on running the tests). If you don’t have a maintenance console, rely on the indicator lamps on the front panels of the BBU and PSU, and on the troubleshooting flow charts included in this section.

In addition to any specific troubleshooting at the site, it is a good idea to check out some general items. (This is particularly important if the failure is intermittent rather than solid.)

Verify that:

- The equipment bay where the radio equipment is installed is not being subjected to abnormally hot or cold temperatures. The radio equipment is designed to cease operating automatically during over- or under-temperature conditions. Once those conditions have ended, the equipment begins operating again. This can lead to what appears to be intermittent failures if the temperature problems are continual.
- The antenna casing is undamaged, and that there are no cracks in the sealant that covers the heads of the antenna mounting

hardware and seals the joint between the antenna and the fuselage.

- The equipment bay does not leak, allowing water or other fluids to enter the equipment. If there *are* signs of fluid damage, replace the affected unit because liquids collecting inside electrical equipment will eventually damage the equipment.

6.1 Required troubleshooting equipment

- Maintenance console computer in the following minimum configuration:
  - — 386 SX IBM laptop or compatible notebook computer
  - — 4-Mbytes RAM
  - — 3.5-inch disk drive
  - — 60-Mbyte disk drive
  - — Serial I/O port
- ATC Commissioning Program (version R1.60c, or higher)
- RF translator box.
- Test card (used to test the credit card readers on the phone units).
- Digital multimeter (Fluke Type 77 or equivalent).

6.2 Fault analysis procedure

The following procedures outline steps you should follow when troubleshooting an air terminal system malfunction.

1. If possible, speak with the person who filed the trouble complaint and determine the operational symptoms. Record the symptoms on the appropriate Claircom form.
2. Check the BBU and PSU front panel indicator lamps and note the status of the alarms on the trouble report. Compare the recorded results against those in table 6-1, then refer to the section recommended in the table for the troubleshooting or maintenance procedure. Figure 6-1 shows the locations of the BBU and PSU indicators; table 6-2 describes the functions of items called out in the figures.

Note

If the BBU and PSU front panel indicator lamps are normal, refer to section "Troubleshooting flowcharts."

3. If you have a malfunctioning phone unit, refer to section 6.4 to perform handset self-tests.

Table 6-1. BBU and PSU front panel indicator lamp displays during fault conditions

PSU front panel lamps		BBU alarm lamps						BBU mode lamp	
AC pilot	DC	Processor	RFU	Chan A	Chan B	Telephony	PSU	Active	Refer to…
Off	Off	Off	Off	Off	Off	Off	Off	Off	As-built documentation to troubleshoot aircraft electrical system.
On	Off	Off	Off	Off	Off	Off	Off	Off	Troubleshooting flowchart 6-8, “PSU DC lamp does not illuminate when power switch is set to ON.”
On	On	Off	Off	Off	Off	Off	Off	Off	Section “Replacing the BBU” in chapter 7, “Maintenance.”
On	On	On	Off	Off	Off	Off	Off	Flashing	Section “Replacing the BBU” in chapter 7, “Maintenance.”
On	On	Off	Off	On	Off	Off	Off	Flashing	Section “Replacing the BBU” in chapter 7, “Maintenance.”
On	On	Off	Off	Off	On	Off	Off	Flashing	Section “Replacing the BBU” in chapter 7, “Maintenance.”
On	On	Off	Off	Off	Off	On	Off	Flashing	Section “Replacing the BBU” in chapter 7, “Maintenance.”
On	On	Off	Off	Off	Off	Off	On	Flashing	Section “Replacing the PSU” in chapter 7, “Maintenance.”
On	On	Off	On	On	Off	Off	Off	Flashing	Troubleshooting flowchart 6-3, “RFU alarm lamp lit.”
On	On	Off	On	Off	On	Off	Off	Flashing	Troubleshooting flowchart 6-3, “RFU alarm lamp lit.”

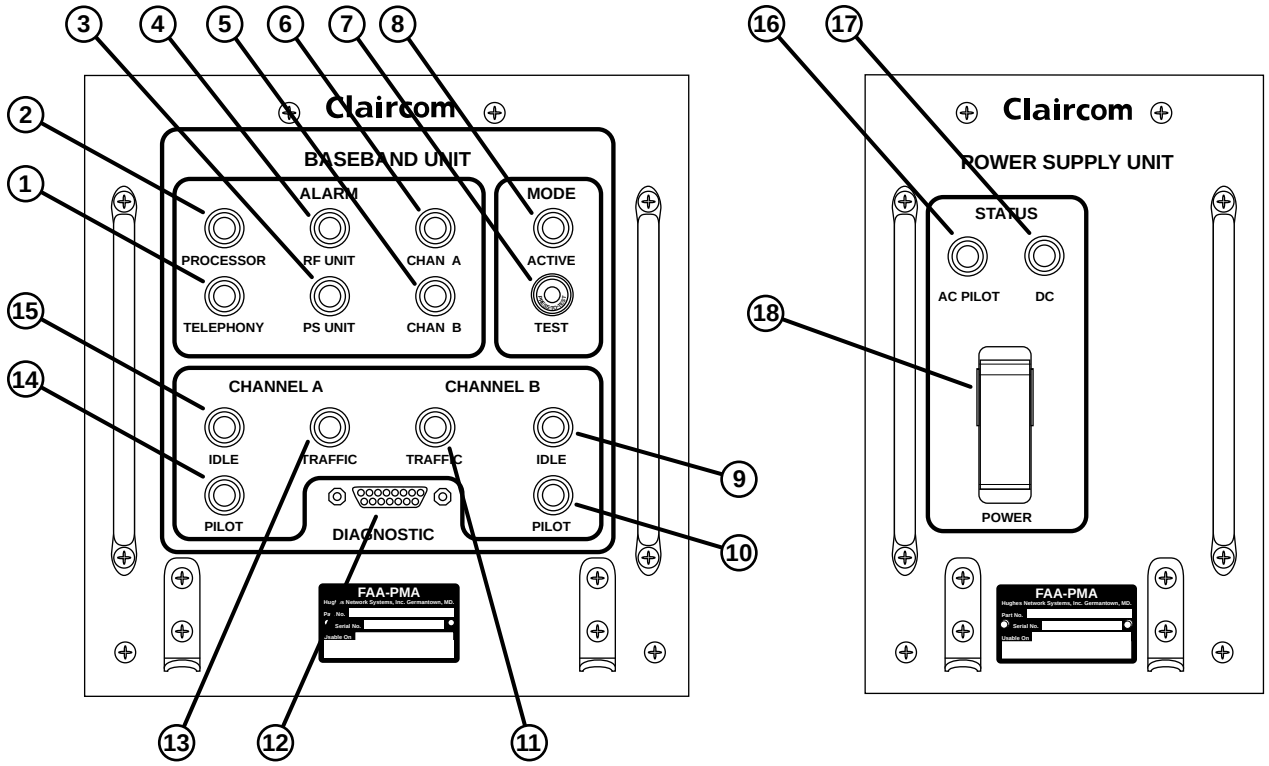


Figure 6-1. BBU and PSU front panel indicator lamps

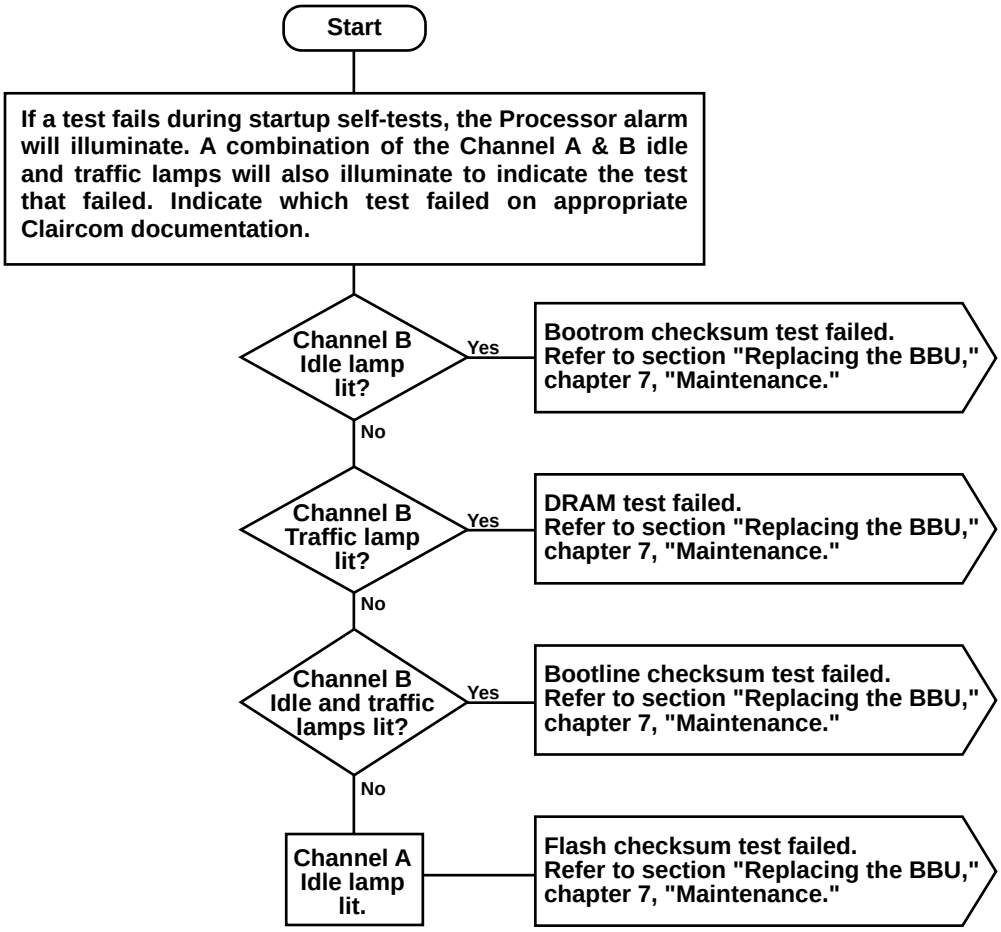
Table 6-2. BBU and PSU controls and indicators

Callout No.	Name	Device	Description
1	Telephony alarm lamp	BBU	When lit, indicates that there is a fault in the BBU.
2	Processor alarm lamp	BBU	When lit, indicates there is a major fault in the BBU.
3	PS unit alarm lamp	BBU	When lit, indicates that there is a fault in the PSU.
4	RF unit alarm lamp	BBU	When lit, indicates that there is a fault in the RFU.
5	Chan B alarm lamp	BBU	When lit, indicates that there is a fault in the Channel B channel thread.
6	Chan A alarm lamp	BBU	When lit, indicates that there is a fault in the Channel A channel thread.
7	Press-to-test switch Test indicator lamp	BBU	When pressed, the Press-to-test switch resets BBU software. When lit, the test lamp indicates that the BBU is running self-tests.
8	Active indicator lamp	BBU	When flashing, indicates that the air terminal is operational.
9	Channel B idle lamp	BBU	When lit, indicates that channel thread B is idle.
10	Channel B pilot lamp	BBU	When lit, indicates that channel thread B is searching for a pilot signal.
11	Channel B traffic lamp	BBU	When lit, indicates that there is traffic on channel thread B.
12	Diagnostic port	BBU	Used to interface with the maintenance console.
13	Channel A traffic lamp	BBU	When lit, indicates that channel thread A is idle.
14	Channel A pilot lamp	BBU	When lit, indicates that channel thread A is searching for a pilot signal.
15	Channel A idle lamp	BBU	When lit, indicates that there is traffic on channel thread A.
16	AC pilot status lamp	PSU	When lit, this lamp indicates that AC power is active.
17	DC status lamp	PSU	When lit, this lamp indicates that DC power is active.
18	Power switch	PSU	When set to on, the PSU is supplying regulated DC power to the AT.

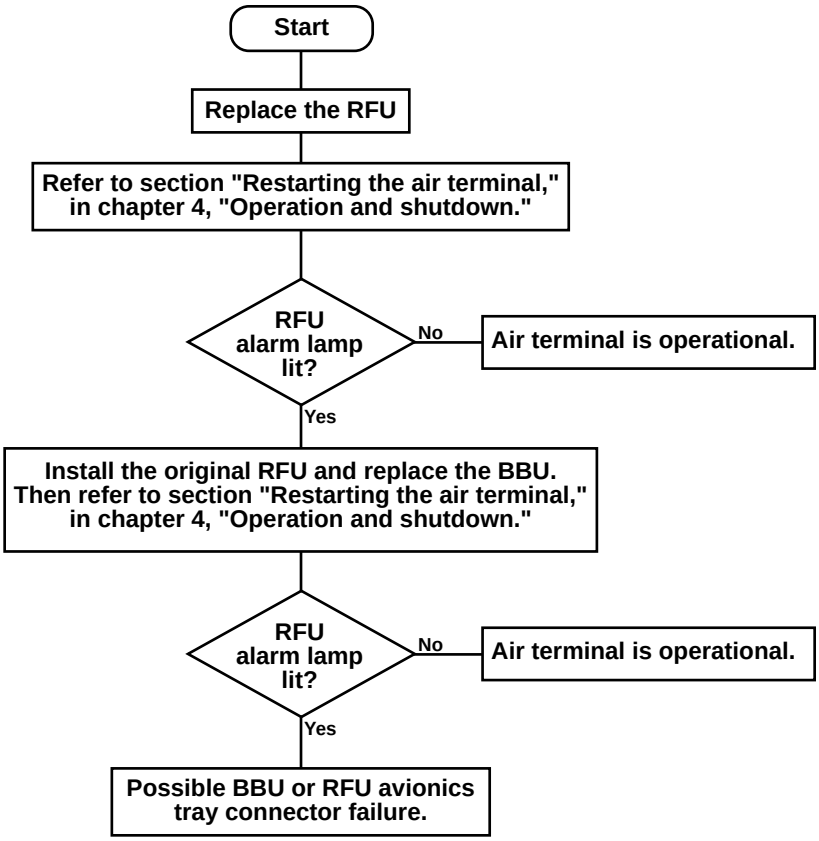
Troubleshooting flowcharts

Review the following symptoms to determine which one most closely resembles the current air terminal failure. Then refer to the flowchart listed to troubleshoot the problem.

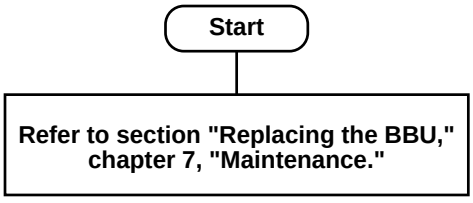
Flowchart 6-1. Air terminal failed startup self-test



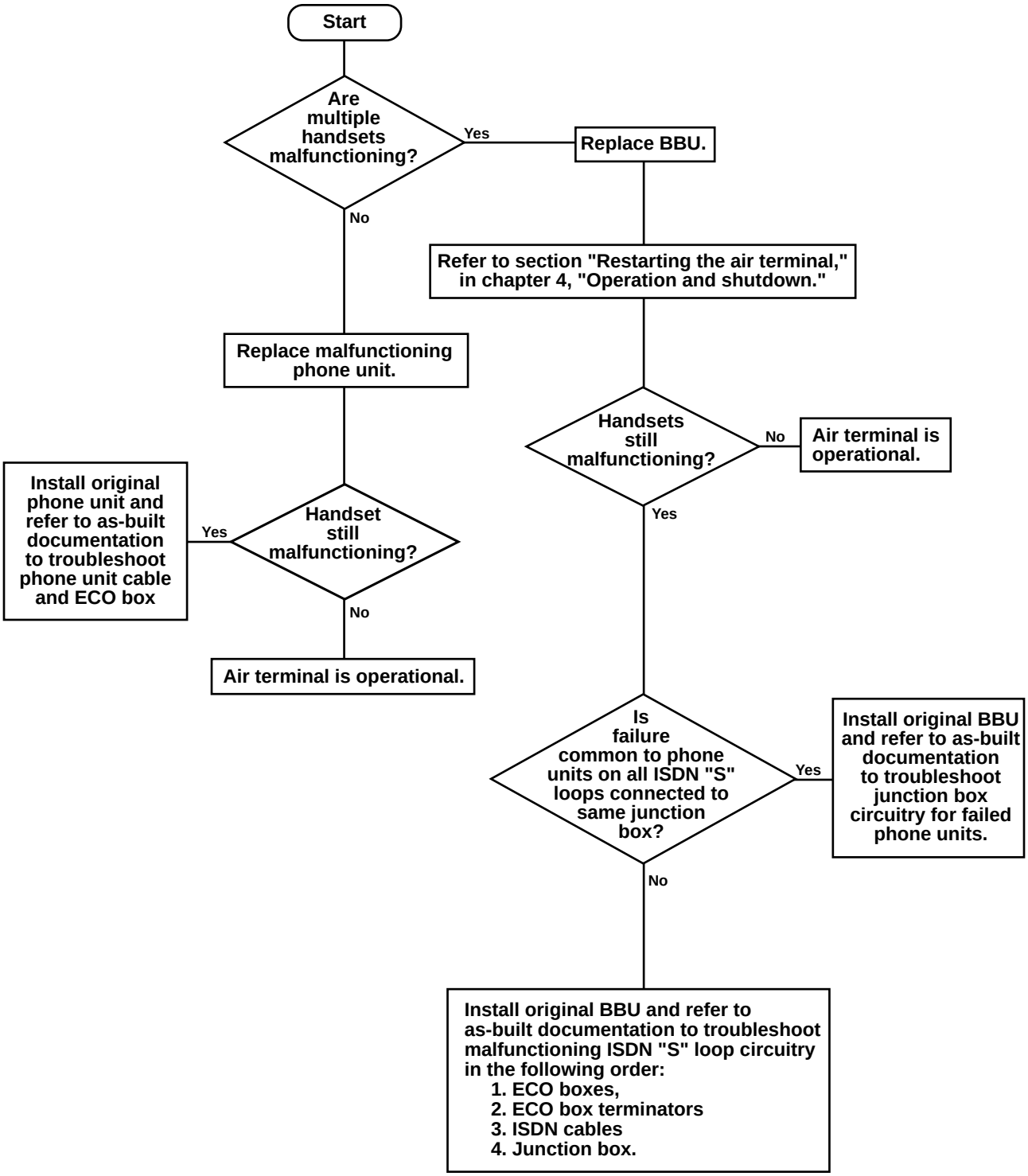
Flowchart 6-2. RFU alarm lamp is lit



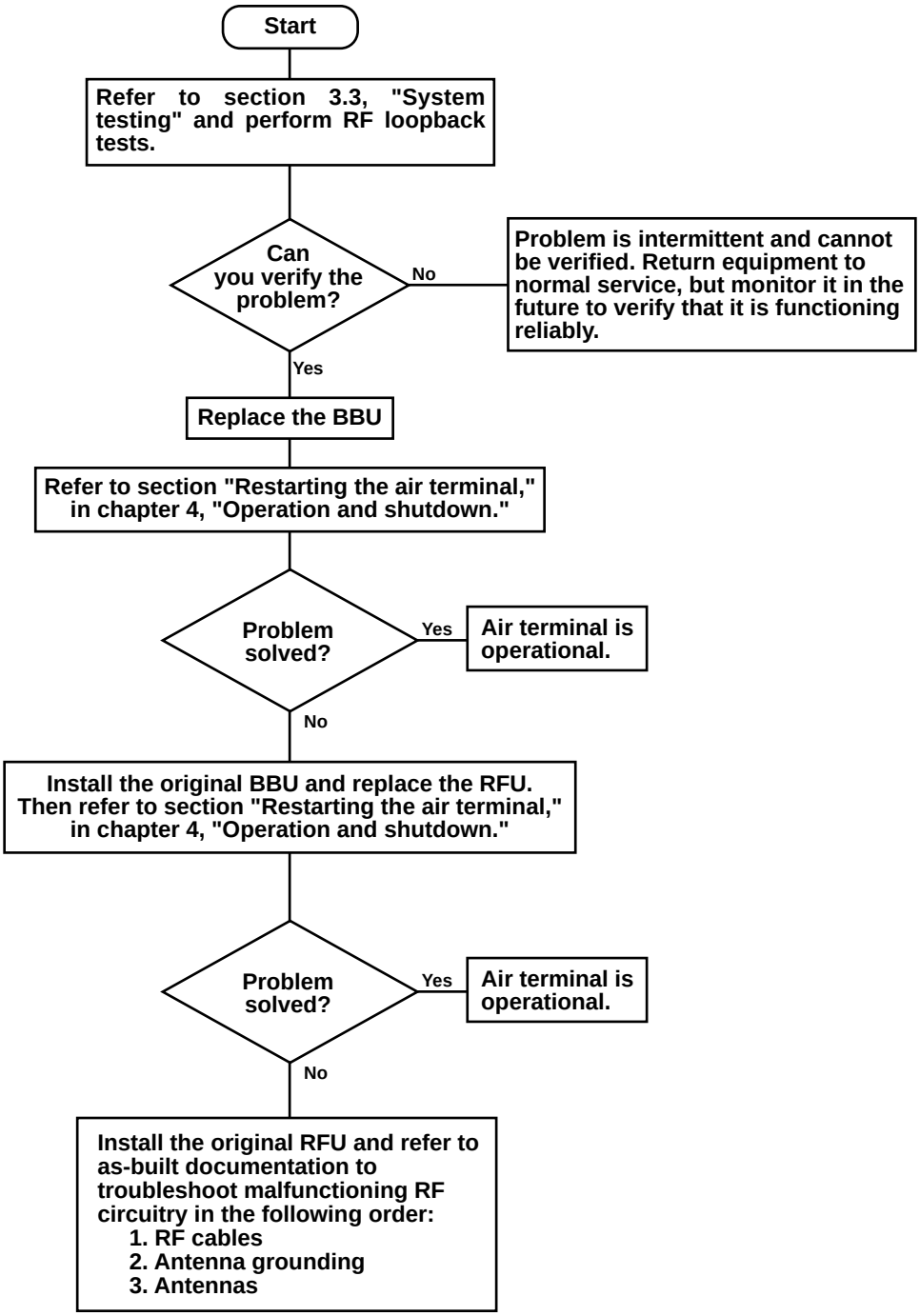
Flowchart 6-3. Channel A or B pilot lamp never illuminates



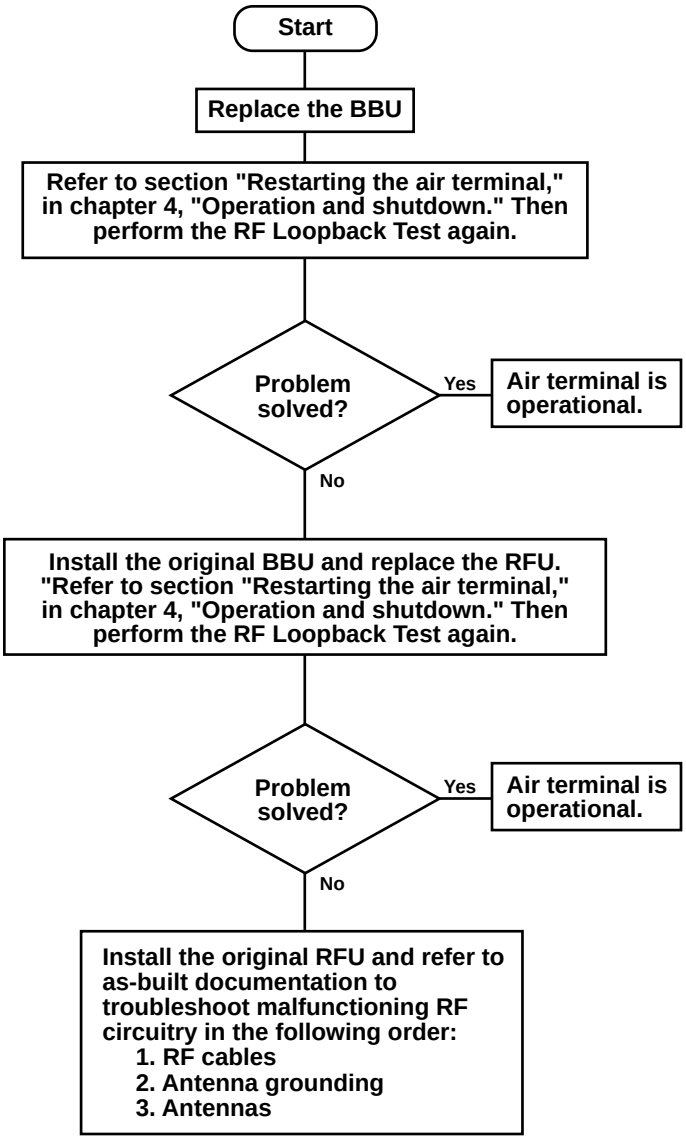
Flowchart 6-4. Phone unit handset LCD readout stays blank



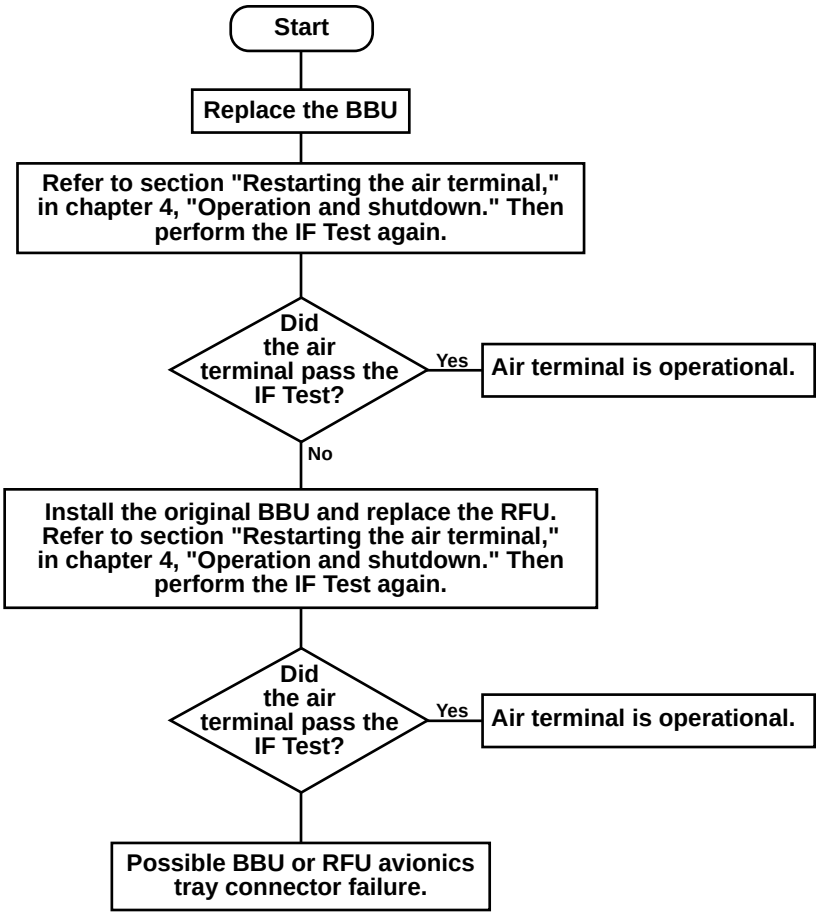
Flowchart 6-5. Call setup is slow or never succeeds



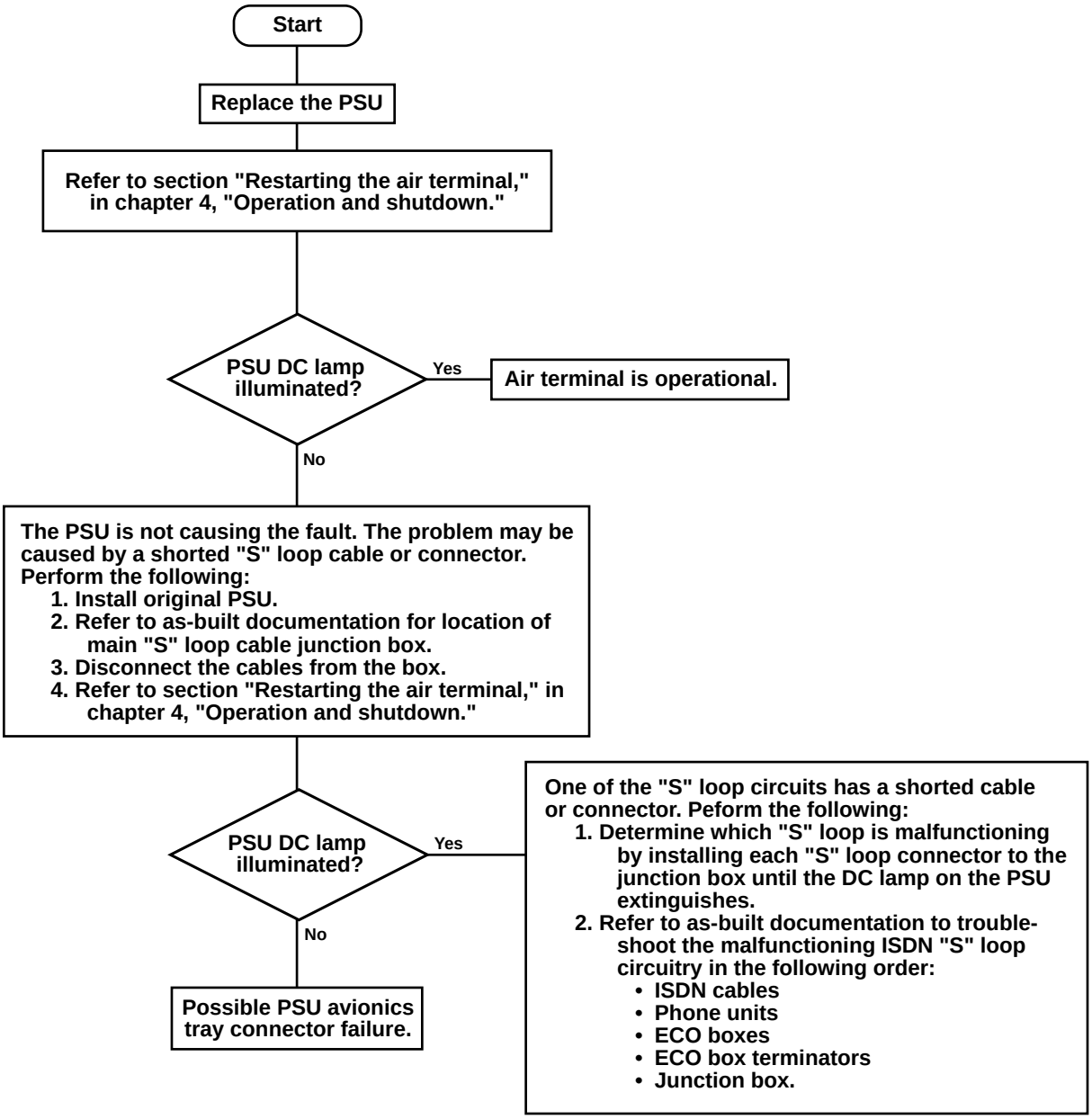
Flowchart 6-6. Air terminal failed RF Loopback Test



Flowchart 6-7. Air terminal failed IF Test



Flowchart 6-8. PSU DC lamp does not illuminate when power switch is set to ON



6.4

Handset self-tests

Perform the following procedures to test a phone unit. If a handset fails a test, refer to section “Replacing a seatback phone unit” in chapter 7, “Maintenance.”

Software cold restart

1. Press the **[*]** and **[#]** at the same time, then release them.
2. Press the **[7]** and **[9]** keys at the same time, then release them.
3. Press the **[8]** key once, then release it.
4. Press the **[0]** key once, then release it.

The handset LCD readout will resemble the following:

```
Serial No.
00000005E712
08/18/92  1156
```

The second line displayed will be the handset’s serial number. The bottom line contains the date and time the software was created and changes with each software version released.

After approximately 10 seconds, the software will reset and the LCD will display the power-up READY message identifying the handset software release number. The LCD will then display the message *PRESS -ON- TO START*.

Sleep mode test

1. Press the **[*]** and **[#]** at the same time, then release them.
2. Press the **[7]** and **[9]** keys at the same time, then release them.
3. Press the **[8]** key once, then release it.
4. Press the **[1]** key once, then release it.

The handset LCD will display the following:

```
Zzz Zzz Zzz
Zzz Zzz Zzz
```

During sleep mode, the computer inside the handset reduces its power demands and the data link portions of the ISDN circuit are disabled. After 60 seconds, a warm restart will begin and the LCD

will display the power-up READY message. The LCD will then display the message *PRESS -ON- TO START*.

Chapter 7

Maintenance

This section describes periodic maintenance procedures for the air terminal and removal and replacement procedures for air terminal line-replaceable units.

Before replacing any air terminal hardware, read the information contained in section “Electrostatic discharge control” for procedures on handling electrostatic discharge sensitive (ESDS) equipment.

7.1 Required tools and materials for maintenance

The following are required:

- Hex wrench, #6
- Crosstip torque screwdriver
- Diagonal cutters, small
- Alodine 1200, Irridite, or equivalent (used to treat bare aluminum surfaces to prevent oxidation)
- RTV sealant, or equivalent
- Cable ties, assorted sizes

7.2 Periodic maintenance

Periodic maintenance procedures consist of cleaning the phone unit handsets according to airline-specified schedules.

Calibration

The air terminal system requires no calibration.

7.3 Electrostatic discharge control

Air terminal equipment electronic assemblies can be damaged by electrostatic discharge (ESD) if they are removed from their chassis enclosures without protective measures. These protective measures include:

- *Grounded wrist straps*—Technicians handling ESDS items in an ESD environment should wear skin-contact wrist straps.

The wrist strap should connect to a labeled ESD connector plug or to the nearest connection to the site's common ground.

WARNING

To avoid the risk of electric shock, the wrist strap should have a resistance in series with ground of at least 250,000 ohms.

- *Grounded tools*—Use grounded power tools and tools with uninsulated handles that can be grounded. If tools with insulated handles are used, the handles should be treated with an antistatic coating. Neutralize hand tools before and during use by contacting with a grounded surface.
- *Conductive tote boxes and shunts*—ESDS assemblies should always be stored in conductive trays, tote boxes, or bags. Shorting bars, clips, or special shunts should be used for grounding component leads. Ground or contact together all conductive tote boxes or containers before transferring ESDS assemblies from one carrier to another.

7.4 Field replacement procedures

The following line-replaceable units (LRUs) can be replaced on-site:

- Baseband unit
- Radio frequency unit
- Power supply unit
- Electrical connection box
- UHF/L-band antenna
- Seatback phone unit
- Avionics tray cooling fan

Instructions replacing failed LRUs are contained in the following procedures.

Replacing the PSU

If you isolate a problem to a PSU, the entire assembly must be replaced as follows:

WARNING

Set all air terminal circuit breakers to OFF before continuing with this procedure (refer to the as-built drawings for the locations of the circuit breakers).

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF. Close the switch cover.
2. Turn both hold-down fastener fluted knobs counter-clockwise (from right to left). *Do not disengage the white locking levers at this time.*
3. Continue to turn the fluted knobs until the PSU extracts and the connectors fully disengage.
4. Disengage the white locking levers by turning them counter-clockwise. The PSU is now free to be removed from the avionics tray.
5. Remove the defective PSU from the tray and place it on an antistatic surface.
6. Remove the replacement PSU from its shipping container and place it on an antistatic surface.
7. Remove the dust cover from the rear connectors on the replacement PSU and install them onto the defective PSU.
8. Place the defective PSU into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom's requirements.
9. Open the switch cover on the replacement PSU front panel and verify that the power switch is set to OFF (down position). Close the switch cover.

10. Insert the unit into the PSU avionics tray.
11. Carefully slide the unit into the tray until it makes contact with the connectors.
12. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the PSU. Turn the white locking lever clockwise (left to right) as far as it can go, making sure the cup engages the hook. This locks the hold-downs against the PSU.
13. Turn both fluted knobs clockwise until the red indicator bands have disappeared. When that happens, you will feel the fasteners clutching out. That means the full load required for mating has been applied and the PSU is seated securely.
14. Refer to section 4.3,"Restarting the air terminal" to verify proper air terminal operation. Next complete required paperwork.

Replacing the RFU

If you isolate a problem to an RFU, the entire assembly must be replaced as follows:

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF (down position). Close the switch cover.
2. Turn both hold-down fastener fluted knobs counter-clockwise (from right to left). *Do not disengage the white locking levers at this time.*
3. Continue to turn the fluted knobs until the RFU extracts and the connectors fully disengage.
4. Disengage the white locking levers by turning them counter-clockwise. The RFU is now free to be removed from the avionics tray.

5. Remove the defective RFU from the tray and place it on an antistatic surface.

6. Remove the replacement RFU from its shipping container and place it on an antistatic surface.

7. Remove the ESD-protective dust cover from the rear connectors on the replacement RFU and install them onto the defective RFU.

8. Place the defective RFU into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom's requirements.

9. Insert the replacement unit into the RFU avionics tray.

10. Carefully slide the unit into the tray until it makes contact with the connectors.

11. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the RFU. Turn the white locking lever clockwise (left to right) as far as it can go, making sure the cup engages the hook. This locks the hold-downs against the RFU.

12. Turn both fluted knobs clockwise until the red indicator bands have disappeared. When that happens, you will feel the fasteners clutching out. That means the full load required for mating has been applied and the RFU is seated securely.

13. Refer to section 4.3,"Restarting the air terminal" to verify proper air terminal operation. Next complete required paperwork.

Replacing the BBU

If you isolate a problem to a BBU, the entire assembly must be replaced as follows:

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF (down position). Close the switch cover.

2. Turn both hold-down fastener fluted knobs counter-clockwise (from right to left). *Do not disengage the white locking levers at this time.*

3. Continue to turn the fluted knobs until the BBU extracts and the connectors fully disengage.

4. Disengage the white locking levers by turning them counter-clockwise. The BBU is now free to be removed from the avionics tray.

5. Remove the defective BBU from the tray and place it on an antistatic surface.

6. Remove the replacement BBU from its shipping container and place it on an antistatic surface.

7. Remove the ESD-protective dust cover from the rear connectors on the replacement BBU and install them onto the defective BBU.

8. Place the defective BBU into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom's requirements.

9. Insert the replacement unit into the BBU avionics tray.

10. Carefully slide the unit into the tray until it makes contact with the connectors.

11. Raise both hold-down fasteners so that the front lip of each fastener rests just behind the lower front panel of the BBU. Turn the white locking lever clockwise (left to right) as far as it can go, making sure the cup engages the hook. This locks the hold-downs against the BBU.

12. Turn both fluted knobs clockwise until the red indicator bands have disappeared. When that happens, you will feel the fasteners clutching out. That means the full load required for mating has been applied and the BBU is seated securely.

13. Refer to section chapter 3,"Commissioning" to verify proper air terminal operation. Next complete required paperwork.

Replacing an ECO box

If you isolate a problem to an ECO box, the entire assembly must be replaced as follows:

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF (down position). Close the switch cover.
2. Release the spring latches attaching the ISDN “S” loop input cable connector to the IN connector of the ECO box. Then disconnect the input cable connector.
3. Release the spring latches attaching the ISDN “S” loop output cable connector (or ISDN terminator) to the OUT connector of the ECO box. Then disconnect the output cable connector (or remove the terminator).
4. Disconnect the RJ-11 phone cable connectors from the jacks labeled HANDSET.
5. While supporting the ECO bracket with one hand, use a pair of diagonal cutters to cut the anchoring straps that secure the bracket to the seat frame.
6. Remove the ECO bracket.
7. Use a pair of diagonal cutters to cut the anchoring straps that secure the ECO box to the ECO bracket.
8. Remove the malfunctioning ECO box from the bracket and use a small flat-tip screwdriver to remove the RJ-45 blank plugs (if any) from the ECO box.
9. Remove the replacement ECO box from its shipping container. Install the RJ-45 blank plugs (if any) into the ECO box handset connectors.
10. Place the defective ECO box in the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom’s requirements.
11. Place the replacement ECO box onto the ECO bracket.
12. Insert an anchoring strap through one of the slots in the bracket and the ECO box. Bend the strap and insert it through the adjacent slot in the ECO box. Slide the tip of the strap into the hole in the head of the strap and pull the tip until any slack in the strap has been removed. Use a pair of diagonal cutters to remove excess strap.

13. Use anchoring straps to install the ECO bracket onto the seat frame.
14. Install the ISDN “S” loop input cable connector to the ECO box connector labeled IN. Close both spring latches to secure the connector.
15. Install the ISDN “S” loop output cable connector (or the ISDN terminator) to the ECO box connector labeled OUT. Close the spring latches.
16. Install the RJ-11 phone cable connectors to the ECO box connectors labeled HANDSET.
17. Refer to section 4.3,“Restarting the air terminal” to verify proper air terminal operation, then continue on to step 18.
18. Remove the handset of a phone unit connected to the ECO box from its cradle and verify that the message *PRESS -ON- TO START* is displayed on the LCD readout. After verifying proper operation, place the handset back in the cradle and complete required paperwork.

Replacing a UHF/L-band antenna

Perform the following procedure to replace a malfunctioning antenna.

Caution

Check aircraft maintenance manual for special requirements before continuing.

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF (down position). Close the switch cover.
2. Disconnect the cable assembly from the N-type connector on the failed antenna.
3. Use a crosstip screwdriver to remove the six sets of 6-32 screws and lower the failed antenna from the aircraft.
4. Remove the replacement UHF/L-band antenna from its shipping container. Place the defective antenna into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom’s requirements.

5. Verify that the mounting surface is free of corrosion and any sealant residue.

6. Using a crosstip torque screwdriver, mount the replacement antenna to the aircraft with six sets of 6-32 screws. Tighten each screw a small amount, then tighten the screw on the opposite side the same way. Continue tightening the screws using this side-to-side pattern so that uniform stress is placed on the antenna. Torque the screws to 8 to 10 inch/pounds.

7. Using RTV sealant, apply a small, smooth fillet along the joint between the antenna and the aircraft fuselage. Also, apply sealant over the mounting hardware heads at the base of the antenna.

Caution

Allow the sealant to dry for 4 hours before exposing it to water.

8. Connect the cable assembly to the N-type connector on the antenna. Hand-tighten the connector to secure it. Create a service loop with the excess cable length and clamp as specified in the aircraft manufacturer's recommendation for antenna installations.

Caution

Be careful when bending the cable that you do not exceed the minimum bend radius of six times the cable's outside diameter. Exceeding the minimum bend radius could result in cable failure.

9. Refer to section 4.3,"Restarting the air terminal" to verify proper air terminal operation. Next complete required paperwork.

Replacing a seatback phone unit

If you isolate a problem to a phone unit, the entire assembly must be replaced as follows:

1. Slide the release latch to the left and remove the handset from the cradle. Pull out enough handset cord so that you

can remove the cradle mounting hardware without the handset or its cord getting in the way.

2. Use the appropriate tool to remove the four mounting screws from the cradle.

3. Remove the malfunctioning phone unit from the seatback and place it on an antistatic surface.

4. Remove the replacement seatback phone unit from its shipping container. Place the defective phone unit into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom's requirements.

5. Record the replacement phone unit handset serial number per Claircom's requirements.

6. Install the RJ-11 connector (located inside the seatback headrest) into the cradle connector.

7. Insert the cradle into the slot in the seatback headrest.

8. Slide the release latch to the left and remove the handset from the cradle. Pull out enough handset cord so that you can install the cradle mounting hardware without the handset or its cord getting in the way.

9. Using the appropriate tool, install the cradle into the seatback headrest with four mounting screws. (Verify that the seat cover material is not buckled and that there are no exposed seams visible after securing the cradle.)

10. Verify proper mechanical operation of the handset (make sure the reel coils the cord properly and that the handset release latch works).

11. Open the switch cover on the PSU front panel and set the power switch to OFF. Wait 10 seconds, then set the switch to ON. Close the switch cover.

12. Remove phone unit handset from its cradle and verify that the message *PRESS ON TO MAKE CALL* is displayed on the LCD readout. After verifying proper operation, place the handset back in the cradle and complete required paperwork.

Replacing an avionics tray cooling fan

If you isolate a problem to a cooling fan, the entire assembly must be replaced as follows:

WARNING

Set all air terminal circuit breakers to OFF before continuing with this procedure (refer to the as-built drawings for the locations of the circuit breakers).

Caution

Wear an electrostatic discharge (ESD) wrist strap at all times while handling air terminal equipment. Connect the wrist strap grounding clip to the grounding connection on any of the avionics trays.

1. Open the switch cover on the PSU front panel and verify that the power switch is set to OFF. Close the switch cover.
2. Disconnect the cooling fan power cable connector from the cooling fan terminal strip (see figure 7-1).

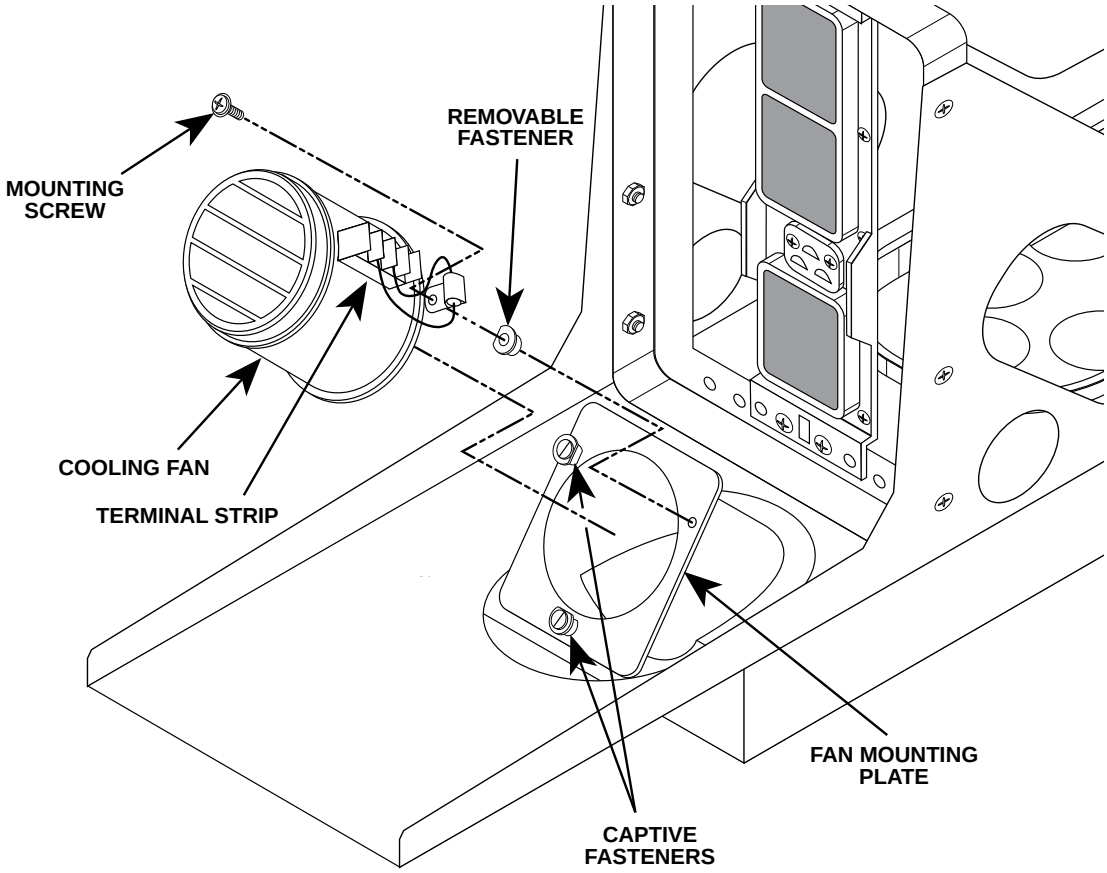


Figure 7-1. Cooling fan replacement

3. Using a flat-tip screwdriver, turn one of the captive fasteners (see figure 7-1) counter-clockwise (right to left) until it stops. Repeat for the other captive fastener.

4. Using a Phillips crosstip screwdriver, remove the mounting screw and removable fastener (see figure 7-1) from the fan assembly. The cooling fan is now free to be removed from the avionics tray.

5. Remove the fan from the tray and place it on an antistatic surface.

6. Remove the replacement fan from its shipping container. Place the defective fan into the shipping container so it can be returned to the Claircom Distribution and Maintenance Center in Seattle, Washington for repair. Complete documentation per Claircom's requirements.

7. Install the replacement fan onto the fan mounting plate.

8. Using a crosstip screwdriver, install the mounting screw as shown in figure 7-1.
9. Using a flat-tip screwdriver, rotate both captive fasteners clockwise to secure the cooling fan.
10. Install the cooling fan power cable connector onto the cooling fan terminal strip.
11. Refer to section 4.3,“Restarting the air terminal” to verify proper air terminal operation. Then complete required paperwork.

Returning failed equipment to the Depot for testing

Return failed equipment to Claircom for disposition per Claircom’s requirements.

Appendix A

List of acronyms

AC	Alternating current
AGC	Automatic gain control
AFC	Automatic frequency control
AT	Air terminal
ATC	Air terminal controller
ASC	Air system manager
AVC	Air view console
BBU	Baseband unit
BOM	Bill of materials
BSP	Baseband signal processor
CP	Control processor
CSM	Circuit switch module
dB	Decibel
DC	Direct current
DRAM	Dynamic random-access memory
DSP	Digital signal processor
DTMF	Dual-tone multi-frequency
ECO	Electrical connection
EMI	Electromagnetic interference
EPROM	Erasable programmable read-only memory
ESD	Electrostatic discharge
ESDS	Electrostatic discharge sensitive
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEC	Forward error correction
FIR	Finite impulse response
FPGA	Field-programmable gate array
LRU	Line-replaceable unit
GS	Ground station
GSC	Ground station controller
GSM	Ground station manager

Continues on next page

Hz	Hertz
IEC	Inter-exchange carrier
IF	Intermediate frequency
ISDN	Integrated services digital network
LCD	Liquid-crystal display
LED	Light-emitting diode
LNA	Low-noise amplifier
M&C	Monitor and control
MHz	Megahertz
MOM	Modem module
MT	Maintenance terminal
NMCC	Network management control center
NMCS	Network management control system
PCM	Pulse-code modulated
PSU	Power supply unit
PSTN	Public switched telephone network
RAM	Random-access memory
RF	Radio frequency
RFI	Radio frequency interference
RFU	Radio frequency unit
RJ	Registered jack
RMA	Return merchandise authorization
SSPA	Solid-state power amplifier
TDM	Time-division multiplexed
TDMA	Time-division multiple-access
UHF	Ultra-high frequency
VAC	Alternating-current voltage
VDC	Direct-current voltage