## 1.34 VHF/UHF RADIO SYSTEM.

The VHF/UHF radio system uses an ARC-210 radio mounted in the aircraft to provide voice communications. Secure voice communications are provided by a KY-100 communications encryption device working in conjunction with the airborne ARC-210. The communications system is integrated with the GCS intercom, so the flight crew can use PTT buttons to transmit. Selection of Plain Text (PT) or Cipher Text (CT) communications is accomplished via the ARC-210 Control window Graphical User Interface (GUI) on the GCS tracker display and the KY-100 front panel controls.

### CAUTION

Limit use of the airborne ARC-210 above 2000 feet AGL and do not use the airborne ARC-210 below 2000 feet AGL. The aircraft may perform slight uncommanded pitch adjustments if the airborne ARC-210 push-to-talk is activated when airspeed or altitude hold modes or Nav modes are enabled. Additionally, when the airborne ARC-210 push-to-talk is activated, the HUD may indicate incorrect airspeed, altitude, or vertical speed values.

The secure voice communications system can be used in digital LOS datalink mode (C-Band datalink), or in SATCOM mode (Ku-band datalink). Standard LOS datalink mode does not support the VHF/UHF radio system.

## 1.35 ARC-210 RADIO FUNCTIONAL DESCRIPTION.

The AN/ARC-210 is a 30 to 400 megahertz VHF/UHF radio unit. Figure 1-112 provides a functional diagram of the system. The radio frequency bands and features are described in Figure 1-113.

The PPDM supplies 28 VDC power to the ARC-210 radio. The radio has an internal on/off relay for power switching. The flight crew controls power to the unit using the ARC-210 Control window GUI.

The ARC-210 radio has:

- 25 simplex frequencies (non-EP mode) that can be filled using a Data Transfer Device (DTD). This feature is not used on the airborne ARC-210. All Presets are configured from the ARC-210 Control window on the tracker display.
- 25 EP nets (Have Quick and/or Single Channel Ground and Airborne Radio System (SINCGARS)) that can be loaded via a Data Transfer Device (DTD).
- 1 SINCGARS-V cue channel.

- 57 maritime channels (1 thru 28 and 60 thru 88).
- Built-in emergency guard channels at 121.5 and 243 MHz.
- 8.33 kHz channel spacing for air traffic control frequencies.
- Tuning increments of 25, 5, and 2.5 kHz.

### 1.35.1 TRANSMIT.

When the operator presses the PTT button on the joystick, the transmitter is turned on. Audio from the headset microphone is routed through the KY-100 to the Link Manager Assembly (LMA) in the GCS to be encoded with the command link command data. If the Digital Line Of Sight (DLOS) datalink is being used, the LMA passes the encoded data to the PSO workstation processor for transmission to the aircraft via the C-band GDT/PGDT. If the Ku-band SATCOM datalink is being used, the LMA sends the encoded data to the Ku-band SATCOM terminal for transmission.

In the aircraft, if the C-band digital LOS uplink is being used, the RCM passes uplink data to the Sensor Processor Modem Assembly (SPMA) for decoding, and the SPMA passes the decoded audio to the ARC-210 radio. If the Ku-band SATCOM datalink is being used, the SPMA decodes the audio from the uplink data and routes it to the ARC-210 radio. In either case, the ARC-210 then transmits the signal through either the upper or lower aircraft antenna as selected from the ARC-210 Control GUI in the GCS.

### 1.35.2 RECEIVE.

The ARC-210 radio in the aircraft receives signals from its antenna and passes an audio stream to the SPMA. The SPMA converts the analog audio stream to a compressed digital format and incorporates it into the return link stream. If the C-band datalink is being used, the SPMA passes the encoded return link data to the RCM for transmission.

In the GCS, if the Ku-band datalink is being used, the return link is routed to the LMA. If the C-band digital datalink is being used, the PSO workstation processor sends the return link signal to the LMA for decoding. The LMA then decodes the compressed digital audio from the return link serial stream and converts it back to analog audio. The analog audio is then passed through the KY-100 into the GCS intercom system.

### 1.35.2.1 Guard Receiver.

The ARC-210 unit contains a complete stand-alone AM receiver capable of monitoring emergency transmissions on the emergency guard channels of 121.500 or 243.000.

### NOTE

Guard receiver is not functional.

## Airborne ARC-210 Functional Diagram
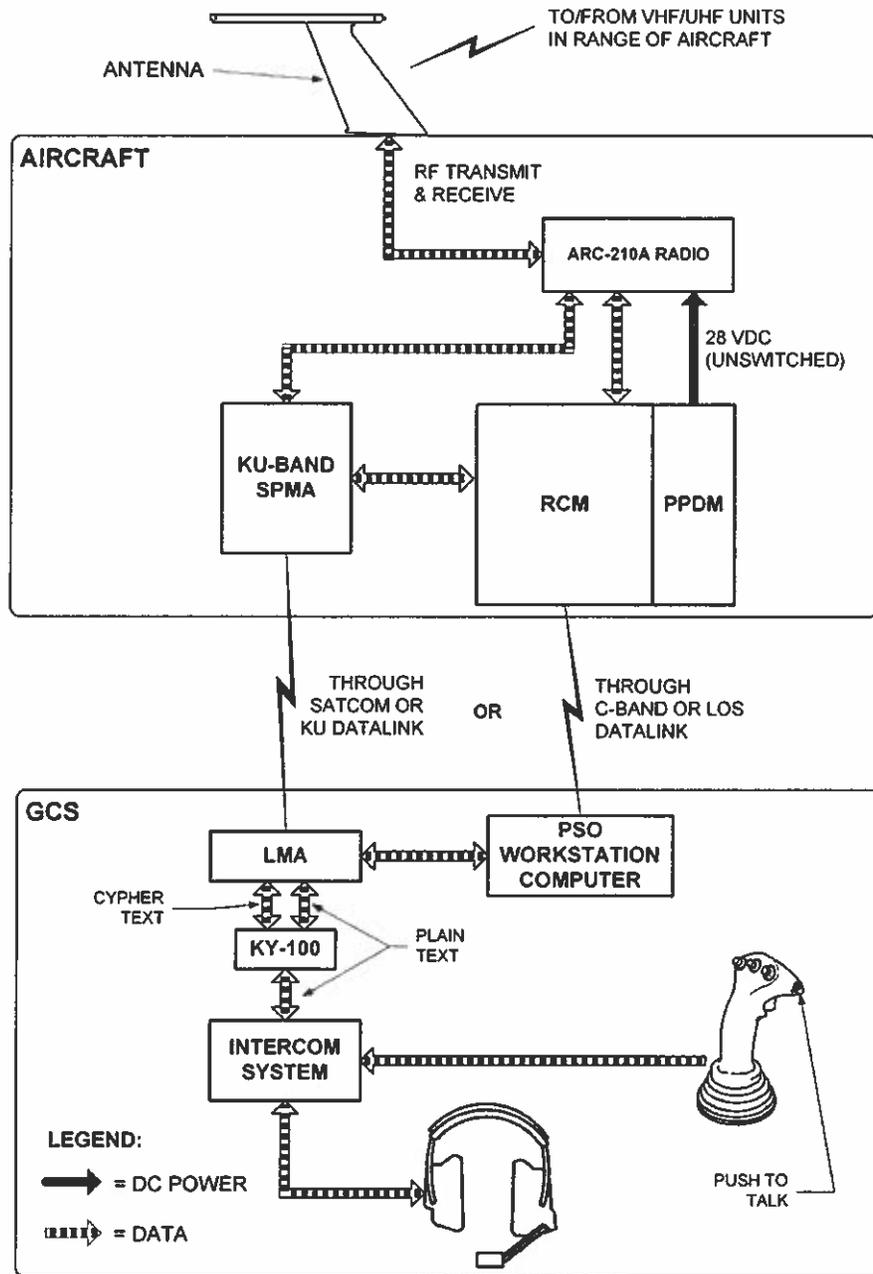


Figure 1-112.

# ARC-210A Features

| Frequency Band | Mode | Application |
|---|---|---|
| 30 – 87.985 MHz FM | • Normal/secure voice/data<br>• 150 Hz squelch tone<br>• SINCGARS-V– (not supported) | Tactical/close air support |
| 108 – 117.985 MHz AM | Receive only | Navigation |
| 118 – 135.985 MHz AM | • Normal/secure voice/data<br>• 1020 Hz tone transmission<br>• ADF<br>• 8.33 kHz channel spacing | Air traffic control 121.5 MHz guard channel |
| 136 – 155.985 MHz AM/FM | • Normal/secure voice/data<br>• 1020 Hz tone transmission<br>• ADF | Land mobile |
| 156 – 173.985 MHz FM | • Normal/secure voice/data<br>• 1020 Hz tone transmission<br>• ADF | Maritime |
| 225 – 399.985 MHz AM/FM | • Normal/secure voice/data<br>• ADF<br>• 1020 Hz tone transmission<br>• Have Quick/Have Quick II – (not supported) | • Military/NATO<br>• 243 MHz guard channel<br>• CASS/DICASS command |

**Figure 1-113.**

## 1.36   KY-100 OVERVIEW.

A KY-100 encryption device is capable of transmitting and receiving secure, half-duplex voice, analog data, digital data, and remote keying over narrowband or wideband radio.

### NOTE

- G20 When equipped, GCSs will each have two LMAs and three KY-100s, one KY-100 for each LMA and one for the GCS ARC-210 radio.

- G1 G10 When equipped, GCSs will have one KY-100 each, which is used in conjunction with the airborne ARC-210 radio.

KY-100 locations are shown in Figure 1-114 and Figure 1-115.

### 1.36.1   KY-100 OPERATION.

In conjunction with the ARC-210, the KY-100 provides secure voice communications over the VHF/UHF radio system. Figure 1-116 shows the signal flow through the KY-100 to and from the airborne radio.

The operator can select between Plain Text (PT) mode and Cipher Text (CT) mode using the rotary Mode switch on the face of the unit. Plain Text (PT) mode allows analog voice input to bypass the digitized COMSEC function and provides plain analog transmission. When running in Cipher Text (CT) mode, the unit automatically encodes and decodes secure voice. When not processing a CT reception, plain text reception is supported in CT mode.

## G1 G10 *KY-100 Location*

BULKHEAD

PILOT
CONTROL
CONSOLE
ASSEMBLY

PILOT
SEAT
ASSEMBLY

GCS00900-61.1CH6
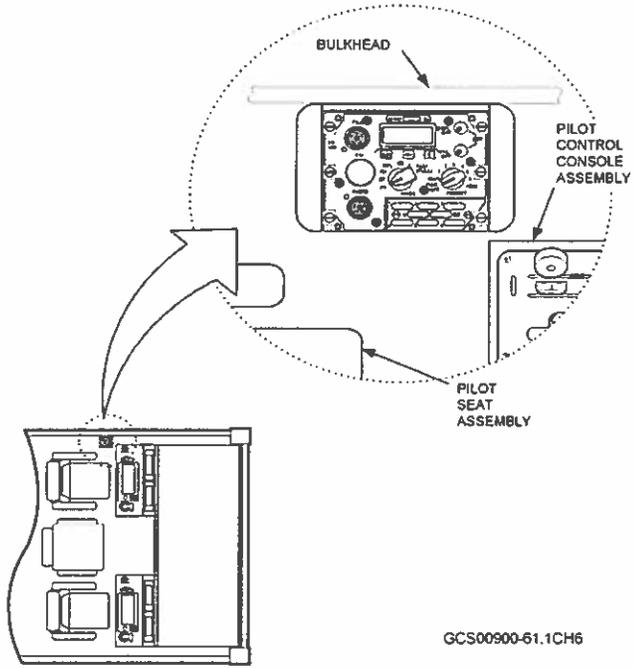
Figure 1-114.

## G20 *KY-100 Location*

AIR1 KY-100

AIR2 KY-100

GND1 KY-100

AIR1 KY-100
(CONNECTED
TO LMA 1)

AIR2 KY-100
(CONNECTED
TO LMA 2)

MFW 4          WS0579
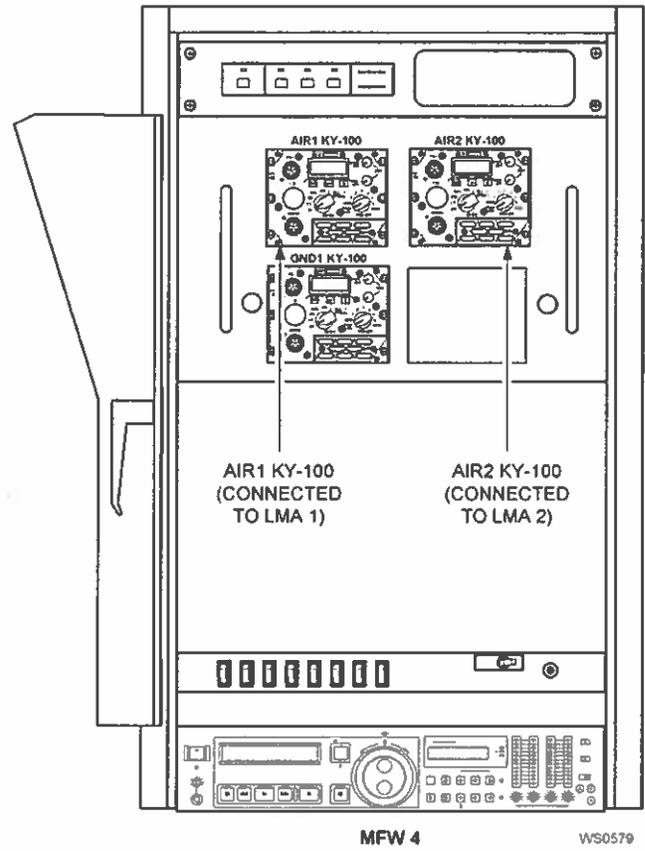
Figure 1-115.

## *Airborne Secure Voice Diagram*
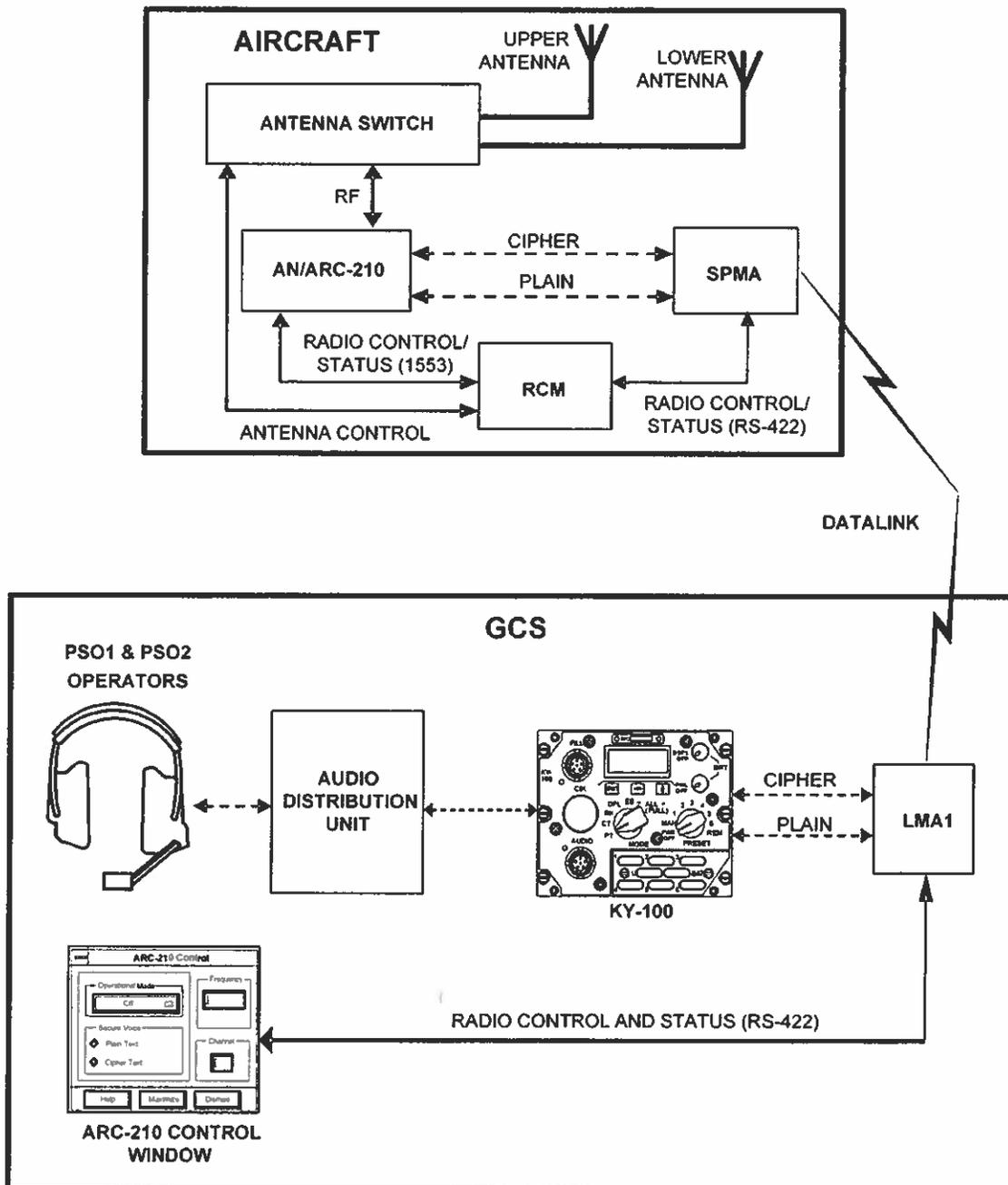


Figure 1-116.

## 1.37 ARC-210 RADIO CONTROLS AND INDICATORS.

### 1.37.1 GRAPHICAL USER INTERFACE.

**NOTE**

The ARC-210 Control window graphical user interface (GUI) is the same for all combinations of GCS and aircraft. If a function is not available, it is grayed out on the GUI.

The operator can control various features of the airborne ARC-210 radio via a window on the tracker display. The ARC-210 Control window is accessed from the Tools menu on the HUD. The window can be displayed in either a minimized or maximized state. When minimized, the window provides quick access to selection of essential operational modes and functions. When maximized, the window provides access to five panels for additional operational settings and information. Figure 1-117 shows the window minimized.

In its minimized state the ARC-210 Control window displays four functional areas:

1. Operational Mode – Allows selection of 10 operational modes.
2. Frequency – Allows entry of the desired frequency for operation, or, if grayed out, displays the operating frequency without allowing entry.
3. Secure Voice – Allows selection of plain text or cipher text voice transmission. If Cipher text is selected, the KY-100 must be in cipher text operation, too.
4. Channel – Either allows entry of the desired channel for operation, or, if grayed out, displays the operational channel without allowing entry. In Scan mode, the channels being scanned are displayed in sequence.

At the bottom of the minimized window are three buttons:

1. Help – Provides help information.
2. Maximize/Minimize – Maximize expands the window and displays selectable function tabs. Minimize closes the tab panels and returns the window to its minimized state. The text on the button changes in sync with the state of the GUI window.
3. Dismiss – Closes the ARC-210 GUI window.

## ARC-210 Control Window (Minimized)
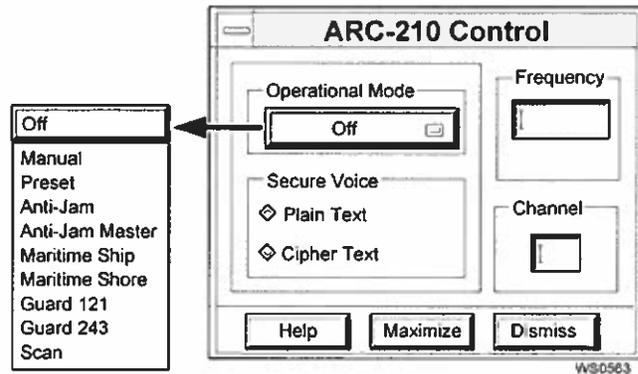


**Figure 1-117.**

### 1.37.2 OPERATIONAL MODES.

**NOTE**

Pressing the Enter key completes all text entries and enables the setting. If the Enter key is not pressed, any text entry is ignored and the prior value (frequency, channel, etc.) is retained for operation.

The ARC-210 has ten mutually exclusive operational modes:

1. Off
2. Manual
3. Preset
4. Anti-Jam
5. Anti-Jam Master
6. Maritime Ship
7. Maritime Shore
8. Guard 121
9. Guard 243
10. Scan

The following describes the ten operational modes.

### 1.37.2.1 Manual.

Allows direct selection of desired frequency and AM or FM operation. The operator types in a desired frequency, presses the Enter key, and for frequencies available as AM or FM, selects AM or FM operation via the AM/FM button on the Utility tab.

The operator may select any of the operating frequencies in the VHF and UHF bands. See Figure 1-113 for operational frequencies.

### 1.37.2.2  Preset.

**NOTE**

Preset frequencies are NOT loaded into the ARC-210. When the Save button on the Presets tab is clicked, the preset frequencies are saved in a file at the GCS. The Preset frequencies are recalled from the file if the GCS computer is rebooted.

Allows selection of preset channels. The operator may select up to 25 (channels 1 through 25) preset operating channels. The frequency associated with the channel is displayed in the Frequency entry field.

### 1.37.2.3  Anti-Jam.

Department of Defense (DoD) standard Electronic Protection (EP) Anti-Jam (AJ) waveforms are embedded in the radio receiver-transmitter. The operator may select up to 25 AJ preset networks, either Have Quick and/or SINCGARS EP nets. Synchronization parameters are entered using the Have Quick and SINCGARS tabs on the ARC-210 Control window as appropriate.

For SINCGARS operation, the SINCGARS tab provides a Cue Freq entry field. The Cue Freq entry field establishes the frequency to be used for SINCGARS Cue communication. Maintenance personnel may use a DTD to data fill EP operating channel information.

### 1.37.2.4  Anti-Jam Master.

Provides the same capabilities as Anti-Jam mode plus the added functions associated with a SINCGARS master net controller.

### 1.37.2.5  Maritime Ship/Maritime Shore.

Allows selection of any one of the 57 preset maritime station channels (channels 1 through 28 and 60 through 88). Maritime channel and transmit frequency are displayed in the Frequency and Channel entry fields. Maritime channel and frequency assignment are shown in Figure 1-118.

## Maritime Channels/Frequencies

| Channel | Transmitting Frequency (MHz) | |
| | AC-Xmit Coast-Rcv | Coast-Xmit AC-Rcv |
|---|---|---|
| 01 | 156.050 | 160.650 |
| 02 | 156.100 | 160.700 |
| 03 | 156.150 | 160.750 |
| 04 | 156.200 | 160.800 |
| 05 | 156.250 | 160.850 |
| 06 | 156.300 | |
| 07 | 156.350 | 160.950 |
| 08 | 156.400 | |

**Figure 1-118.**

## Maritime Channels/Frequencies – Continued.

| Channel | Transmitting Frequency (MHz) | |
| | AC-Xmit Coast-Rcv | Coast-Xmit AC-Rcv |
|---|---|---|
| 09 | 156.450 | 156.450 |
| 10 | 156.500 | 156.500 |
| 11 | 156.550 | 156.550 |
| 12 | 156.600 | 156.600 |
| 13 | 156.650 | 156.650 |
| 14 | 156.700 | 156.700 |
| 15 (1 W max) | 156.750 | 156.750 |
| 16 (distress) | 156.800 | 156.800 |
| 17 (1 W max) | 156.850 | 156.850 |
| 18 | 156.900 | 161.500 |
| 19 | 156.950 | 161.550 |
| 20 | 157.000 | 161.600 |
| 21 | 157.050 | 161.650 |
| 22 | 157.100 | 161.700 |
| 23 | 157.150 | 161.750 |
| 24 | 157.200 | 161.800 |
| 25 | 157.250 | 161.850 |
| 26 | 157.300 | 161.900 |
| 27 | 157.350 | 161.950 |
| 28 | 157.400 | 162.000 |
| 61 | 156.075 | 160.675 |
| 62 | 156.125 | 160.725 |
| 63 | 156.175 | 160.775 |
| 64 | 156.225 | 160.825 |
| 65 | 156.275 | 160.875 |
| 66 | 156.325 | 160.925 |
| 67 | 156.375 | 156.375 |
| 68 | 156.425 | 156.425 |

## Maritime Channels/Frequencies – Continued.

| Channel | Transmitting Frequency (MHz) | |
| --- | --- | --- |
| | AC-Xmit Coast-Rcv | Coast-Xmit AC-Rcv |
| 69 | 156.475 | 156.475 |
| 70 | 156.525 | 156.525 |
| 71 | 156.575 | 156.575 |
| 72 | 156.625 | |
| 73 | 156.650 | 156.675 |
| 74 | 156.725 | 156.725 |
| 76 (guard band) | 156.8125 to 156.8375 | |
| 75 (guard band) | 156.7625 to 156.7875 | |
| 77 | 156.875 | |
| 78 | 156.925 | 161.525 |
| 79 | 156.975 | 161.575 |
| 80 | 157.025 | 161.625 |
| 81 | 157.075 | 161.675 |
| 82 | 157.125 | 161.725 |
| 83 | 157.175 | 161.775 |
| 84 | 157.225 | 161.825 |
| 85 | 157.275 | 161.875 |
| 86 | 157.325 | 161.925 |
| 87 | 157.375 | 161.975 |
| 88 | 157.425 | 162.025 |

**Figure 1-118.**

### 1.37.2.6  Guard 121.

Tunes the transmitter and guard receivers to the 121.500 MHz (AM) guard channel.

### 1.37.2.7  Guard 243.

Tunes the transmitter and guard receivers to the 243.000 MHz (AM) guard channel. This mode has precedence over all other modes except transmit, and causes other controls to be inoperative.

### 1.37.2.8  Scan.

Provides continuous scanning of four preset channels. The ARC-210 radio will scan the four preset channels in the following sequence: channel 22, 23, 22, 24, 22, 25. Channel 22 is the Control channel. This channel has the highest priority and will be sampled on alternated scans. If the operator presses Push To Talk (PTT) while scanning, the radio will broadcast on channel 22.

If the radio picks up a broadcast or "hit" while scanning, the radio will remain on the channel until the broadcast ends. The radio will then continue to scan unless the operator presses the PTT switch within 3 seconds of the broadcast ending. If the PPT was pressed within 3 seconds, the radio locks on to the last broadcast channel. The channel number is displayed in the Channel entry field, and the frequency in the Frequency entry field.

The operator can enter Scan Recall Mode if it is necessary to access a scan channel that has passed. The right-most green button on the center rack auxiliary control panel is used as follows to access Scan Recall:

1. Press ON and catch most recent broadcast channel.
2. Press ON-OFF ON to return to the second most recent broadcast channel.
3. Press ON-OFF ON-OFF ON to return to the third most recent broadcast channel.
4. Press ON-OFF ON-OFF ON-OFF ON to resume scanning.

### 1.37.3  FREQUENCY.

The Frequency entry field serves two functions: frequency entry or frequency display. If the entry field is not grayed out, the operator enters the desired frequency, and presses the Enter key to establish the operational frequency. If the Frequency entry field is grayed out, the operational frequency is displayed but cannot be changed.

### 1.37.4  SECURE VOICE.

#### NOTE

The KY-100 cipher text or plain text setting must match the Secure Voice selection on the ARC-210 Control window GUI. If Cipher Text is selected under Secure Voice, the KY-100 must be switched to cipher operation. If Plain Text is selected, the KY-100 must be in plain text operation.

Selecting Plain Text results in unencrypted (red) voice communications from the airborne ARC-210. Selecting Cipher Text

results in encrypted (green) voice communications via the airborne ARC-210.

CAUTION

A software anomaly requires that the aircrew does not use both PSO-1 and PSO-2 to control the ARC-210 secure voice selection. The ARC-210 control window should be open on only one PSO at a time. If both PSO stations are used to control the secure voice selection, the system may lose synchronization, causing both secure voice and plain text communication to be partially scrambled and unreadable. An indication this has occurred, besides lack of communication, is that the secure voice selection symbol (a diamond in the control window) will disappear. If this occurs, close one of the PSO station ARC-210 control windows. Reselecting plain text on the ARC-210 control window of the other PSO station will return the secure voice selection button. Next, cycle between plain text and secure voice at least 3 times, pausing momentarily between each switch. This will return the system back into an operational state by re-syncing all the secure voice/plain text system components.

If the ARC-210 Control window Secure Voice area is grayed out, the GCS is set up to work with an airborne radio on an RS-422 bus and is not capable of supporting cipher text. If the Secure Voice area is not grayed out, the GCS is set up to work with an airborne radio on a MIL-STD-1553B bus and can support secure voice operation.

### 1.37.5  CHANNEL.

The Channel entry field serves two functions: channel entry or channel display. If the entry field is not grayed out, the operator enters the desired channel, and presses the Enter key. If the Channel entry field is grayed out, the operational channel is displayed but cannot be changed.

### 1.37.6  ARC-210 CONTROL WINDOW (MAXIMIZED).

When the GUI window is maximized, by clicking the Maximize button, five selectable tabs provide access to additional operational settings and information. The five tabs are:

1. Have Quick – Allows setting of TOD and Operational Date for Have Quick EP AJ operation (Figure 1-119).
2. SINCGARS – Allows setting of Net Time and Cue Frequency for SINCGARS EP AJ operation (Figure 1-120).

3. Presets – Allows setting of 25 preset channels. Frequencies set on channels 22-25 are used for scan mode with the channel scan pattern being: 22, 23, 22, 24, 22, 25 (Figure 1-121).
4. Utility – Allows selection of operational states (Figure 1-122).
5. Status – Displays radio status, operational mode, as well as other operational parameters (Figure 1-124).

The following describes the five tabs and their associated operational settings and information.

### 1.37.6.1  Have Quick Tab.

The ARC-210 can store up to 25 preset channels, one Word Of Day (WOD) and six Multiple Word Of Day (MWOD), for operation on the Have Quick EP AJ network. Have Quick operation is established when a valid, loaded, Have Quick channel number is entered in the Channel entry field, and the Enter key is pressed.

### 1.37.6.2  Synchronization.

There are four sources for Time-Of-Day (TOD) synchronization to the Have Quick AJ network. The operator selects a source by clicking on one of the momentary buttons under the Have Quick tab. The selections are:

1. Emergency Start – Initializes the radio's internal clock for use as a TOD reference.
2. GPS Receive – If a GPS receiver is hardwired to the radio, this selection synchronizes the radio's internal clock to UTC.
3. RF Send – Transmits TOD on the RF link so the distant end radio can synchronize.
4. RF Receive – Receives TOD on the RF link to synchronize the radio's internal clock to that of the transmitting radio.

### NOTE

If mission operations dictate use of both Have Quick and SINCGARS channels, it is advisable to synchronize using the GPS Receive button on the SINCGARS tab. Syncing in this fashion will support both Have Quick and SINCGARS net operations.

### 1.37.6.2.1  WOD / MWOD.

To establish WOD or MWOD operation, the operator enters a two digit operational date. For MWOD, 01 thru 31 is entered. For WOD operation, 00 is entered.

# ARC-210 Have Quick Control
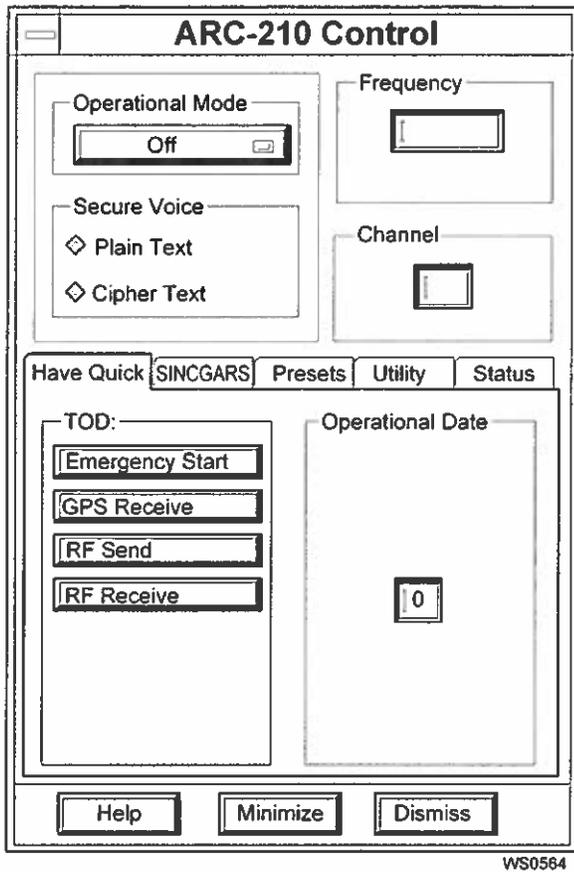


**Figure 1-119.**

# ARC-210 SINCGARS Control
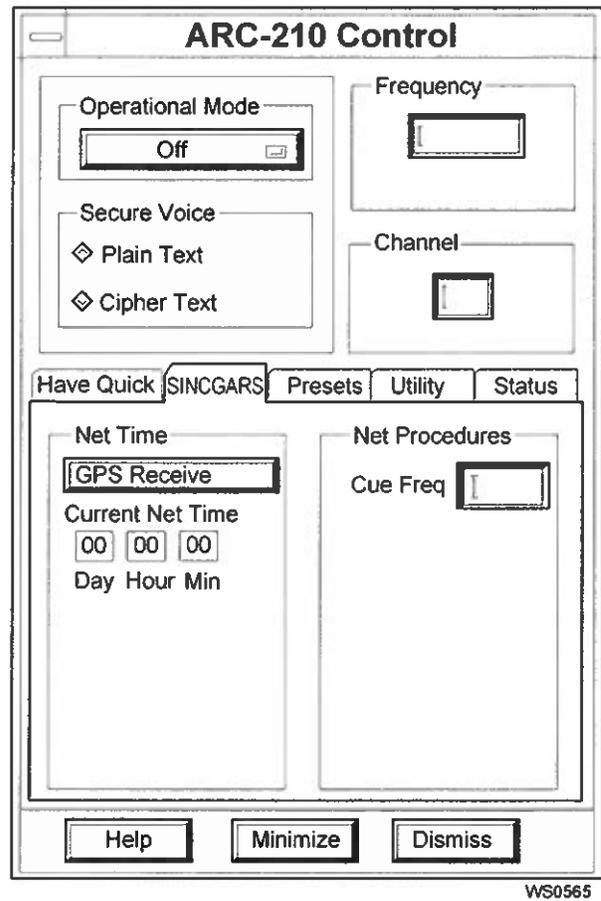


**Figure 1-120.**

### 1.37.6.3   SINCGARS Tab.

The operator clicks the GPS Receive button to establish SINC-GARS base time (including the mission day) via GPS.

**NOTE**

> If mission operations dictate use of both Have Quick and SINCGARS channels, it is advisable to synchronize using the GPS Receive button on the SINCGARS tab. Syncing in this fashion will support both Have Quick and SINCGARS net operations.

The Current Net Time field is display-only and shows network time.