# SECTION IV

# AUXILIARY EQUIPMENT

## TABLE OF CONTENTS



## HEATING SYSTEM.

The heating system (figure 4-1) consists of a fan, an internal combustion heater, a plenum chamber, and ducts which run along the left and right-hand sides of the cargo compartment and into the pilot's compartment.

On HH-3E 32▸ or helicopters modified by T.O. 1H-3-575, the heating system (figure 4-2) has been improved to provide more even heat distribution throughout the helicopter. The improvements consist primarily of a variable temperature control switch that allows for a greater selected heat range, a heater switch that permits selection of either automatic or manual modes of operation, four strategically located temperature sensors, and fiberglass ducting with both overhead and floor level diffusers.

**NOTE**

**To obtain the most efficient distribution of heat, when operating in extreme cold weather conditions, the upper right heat diffuser at station 250 should be closed. When ventilating the cabin, this diffuser should remain open.**

The heater has an output of 200,000 BTUs. The heater unit, located overhead in the aft end of the cargo compartment above the aft ramp, operates on fuel pumped from the forward fuel tank to the heater fuel pump and cycling valve to the heater unit where it is ignited by an ignitor plug. The ignitor plug operates electrically on current from the dc essential bus, boosted by the heater ignition unit mounted in the heater compartment. A fan draws air into the heater intake port, located aft of the aft ramp on the bottom of the tail pylon, and

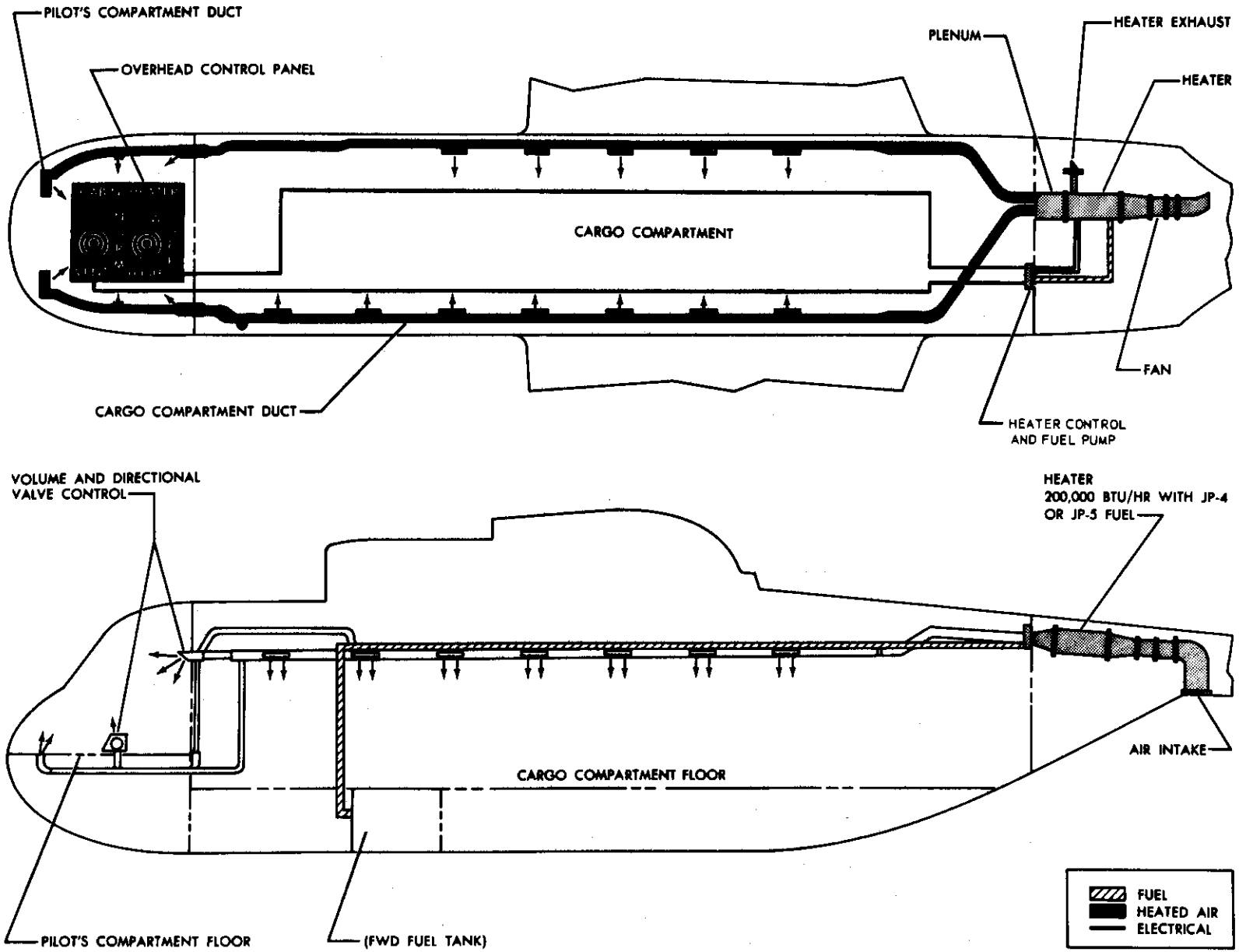



*Figure 4-1. Heating System (Helicopters Prior to HH-3E 32 Not Modified by T.O.1H-3-575)*

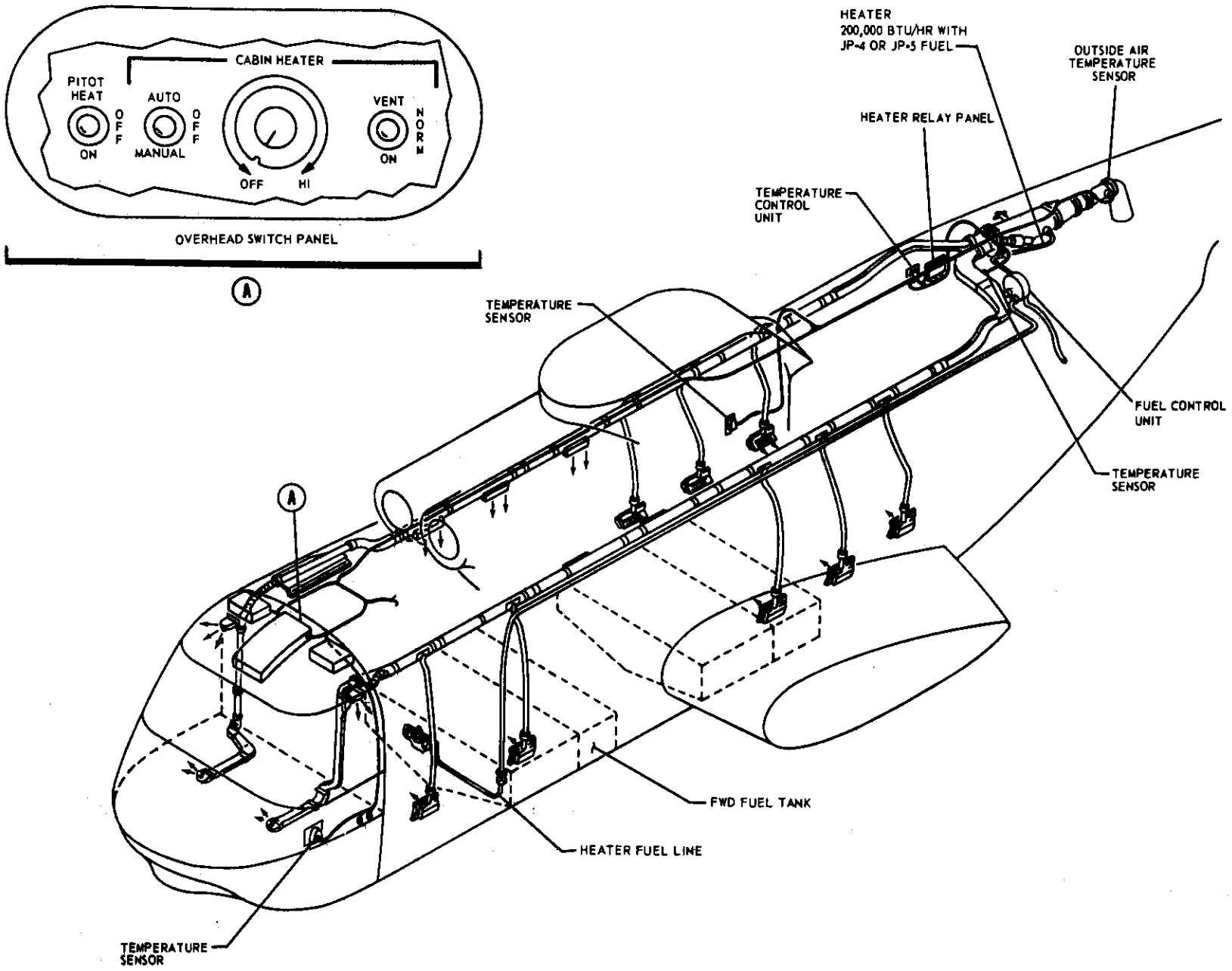



*Figure 4-2. Heating System (HH-3E 32 or Helicopters Modified by T.O. 1H-3-575)*

then through a heat exchanger unit surrounding the combustion unit. Heated air is then forced into the plenum chamber and the heater ducts. The fan also supplies air to the heater combustion chamber. The heating system is energized by the dc essential bus and is protected by a circuit breaker, marked CABIN HEAT CONT, located on the overhead dc circuit breaker panel. Fuel consumption of the heater unit when operating continuously in the HIGH position is 1.2 gallons (8 pounds) per hour.

## HEATER SWITCH.

On helicopters prior to HH-3E 32 not modified by T.O. 1H-3-575, the heating system is operated by a switch, marked CABIN HEATER, with marked positions LOW, OFF, and HIGH, located on the overhead switch panel (figure 1-13). The heater switch controls the heater fuel pump and cycling valve and the ignition unit. When the switch is in the LOW position, the heater will maintain a temperature of approximately 65.6°C in the ducts. When the switch is in the HIGH position, the heater will automatically maintain a temperature of approximately 140.6°C in the ducts. An overheat switch will shut off the heater if for any reason the heat in the plenum chamber rises to 176.7°C.

On HH-3E 32▶ or helicopters modified by T.O. 1H-3-575, the heating system is controlled by a heater switch and a temperature control switch, located on the overhead switch panel under the heading CABIN HEATER. The heater switch, with marked positions AUTO, OFF and MANUAL is used to put the heating system into operation by selecting either the manual or automatic modes of operation. The MANUAL position is used as a backup if the automatic feature should fail. When placed in the MANUAL position, the heater output will increase until a temperature of 176.7°C is realized in the plenum chamber. A cycling switch, located in the plenum chamber, will then maintain the 176.7°C temperature by turning the heater on and off. To maintain lower temperatures, it will be necessary to manually turn the heater on and off by placing the switch in the MANUAL or OFF position. The switch is placed in the AUTO position and used in conjunction with the temperature control switch to select the automatic feature. The temperature control switch, with marked positions OFF and HI is rotated out of the OFF position and toward the HI position to select a desired heat level. When reached, the temperature controller will automatically maintain the selected heat level. An overheat switch will shut off the heater if for any reason the plenum chamber rises to 204.4°C.

On all helicopters, the heater caution light, marked HEATER, located on the caution panel, will illuminate and the heater will automatically shut off if: the heater blower should fail, there is no ignition 45 seconds after the heater has been turned on, the heater flame goes out after ignition, or an overheat condition occurs. The caution light will flash momentarily whenever the heater is turned on.

## CARGO COMPARTMENT HEATER FAN SWITCH.

The cargo compartment heater fan switch, marked CABIN HEATER, located on the overhead switch panel (figure 1-13), has marked positions NORM and VENT. The switch controls a relay connecting power from the ac essential bus to the heater fan (blower) located in the heater air intake duct. The switch and fan control circuit is energized by the dc essential bus and is protected by a circuit breaker, marked CABIN HEAT VENT, located on the overhead dc circuit breaker panel. The fan is protected by circuit breakers marked CABIN HEATER BLOWER, located on the ac essential bus circuit breaker panel. When the heater switch is in the NORM position, the fan operates in conjunction with the heating system. Placing the heater fan switch in the VENT position without operating the heater switch will draw outside air into the heater system and ventilate the pilot and cargo compartments.

On HH-3E 32▶ or those helicopters modified by T.O. 1H-3-575, the heater fan switch is marked VENT and has marked positions NORM and ON. When the switch is in the NORM position, the fan operates in conjunction with the heating system. When placed in the ON position, without operating the heater switch, the fan will force outside air through the heating system and ventilate the helicopter.

### VENTILATING SYSTEM.

Some helicopters are equipped with a vent system that utilizes an adapter tube which replaces the combustion heater during warm weather operation. The adapter tube ventilates the pilot's and cargo compartments. The vent blower will be utilized to defog the pilot's and copilot's windshield panels. The vent blower is powered from the ac essential bus through circuit breakers marked CABIN BLOWER, located on the overhead circuit breaker panel. The vent blower is controlled by a switch on the overhead switch panel, marked CABIN VENT NORM, which is powered from the dc essential bus and protected by a circuit breaker marked CABIN VENT, located on the overhead circuit breaker panel. To turn on the blower, place the switch in the VENT position.

### HEATING AND VENTILATING DIFFUSERS.

Heating and ventilating diffusers and registers are located in each of the heater ducts that extend along the sides of the cargo compartment and into the pilot's compartment. The pilot's compartment has six diffusers. Two are located above and behind the pilot and copilot and two on each side of the compartment near the floor. These four diffusers are of the round, adjustable nozzle, air vent type. The open end of the nozzle has a knurled ring which can be turned to control the flow of air from full open to closed. It is possible to direct the flow of air coming into the pilot's compartment by taking the adjustable nozzle and moving it about. The two remaining diffusers are of the register type and are located on the compartment floor below the tail rotor pedals. There are twelve diffusers in the cargo compartment, seven in the left-hand duct and five in the right-hand duct. Knobs, marked OPEN, are used to regulate the flow of air through the diffusers. The ducts are stenciled with operating instructions above each diffuser. TURN KNOB FOR VOLUME CONTROL and PULL CENTER VANE DOWN FOR DIRECTIONAL CONTROL.

On HH-3E 32▶ or those helicopters modified by T.O. 1H-3-575, there are four diffusers located in the pilot's compartment and thirteen in the cargo compartment. The pilot's compartment has one each located above and behind the pilot and copilot and one each on the floor under and forward of the pilot's and copilot's seats. The cargo compartment has six diffusers from the right-hand heater duct and seven from the left-hand heater duct. Three of the six diffusers from the right-hand heater duct are at head level and the other three are at floor level. Two of the seven diffusers from the left-hand heater duct are at head level and the other five are at floor level.

### HEATER OPERATION (HELICOPTERS PRIOR TO HH-3E 32 NOT MODIFIED BY T.O. 1H-3-575).

1. Heater fan switch — NORM.
2. Heater switch — HIGH OR LOW.
3. Heater diffusers — ADJUST AS DESIRED.

### HEATER OPERATION (HH-3E 32 OR HELICOPTERS MODIFIED BY T.O. 1H-3-575).

1. Heater fan switch — NORM.
2. Heater switch — AUTO.
3. Temperature control switch — ROTATE FOR DESIRED HEAT LEVEL.

**NOTE**

The heater is shut off by moving the heater switch to OFF. The fan will continue to operate after the heater is shut off until the temperature in the plenum chamber drops to 49°C. If the temperature in the plenum chamber should rise to 49°C during hot weather, the fan will begin to operate whenever the ac and dc essential buses are activated.

## ANTI-ICING SYSTEMS.

The anti-icing systems provide anti-ice protection for the engines and engine air inlet ducts, the windshields, and the pitot heads.

**CAUTION**

Icing may be expected when temperature is 10°C or below with high relative humidity, visible moisture, flight in clouds or in close proximity of these phenomena. Ensure the engine and pitot anti-icing systems are turned on before icing conditions are encountered. When operating in these conditions, extreme caution should be exercised to avoid ice buildup, evidenced by icing of windshield wipers, antennas, etc. Failure of the engine anti-ice valve to open will not be indicated by the caution or advisory panel.

**NOTE**

When the outside air temperature is below −18°C, there is no way of determining if the system is working other than the change in $T_5$ and torque.

## ENGINE AIR INLET ANTI-ICING SYSTEM (CH-3E AND HH-3E HELICOPTERS).

The engine air inlet ducts are anti-iced by thermal electrical resistance elements embedded in the epoxy glass lining, and the oil tank mounting ring is anti-iced by a heating element (thermal electric boot) that is interconnected with the inlet duct heating elements. Electrical current is applied to the heating elements to raise the temperature of the affected areas higher than the temperature at which ice will form. The temperature controller will then maintain the duct temperature between approximately 85°C and 90°C, depending on ambient conditions. The engine inlet anti-icing should be turned on when operating under weather conditions which may result in the formation of ice that could be ingested into the compressor with subsequent loss of engine power or engine failure. Anti-icing caution lights, marked NO. 1 INLET ANTI-ICE and NO. 2 INLET ANTI-ICE, respectively, illuminate when the air inlet duct temperature drops to 37.8°C or below with the engine anti-ice switches in the ON position. The engine anti-ice switches, located on the overhead switch panel (figure 1-13), are used to turn the system on. If the free air temperature is −18°C or below, and the engine anti-ice switches have been turned on, the caution lights will illuminate to indicate that electrical heating is not sufficient to raise the inlet temperature at the sensor to 37.8°C which is the temperature necessary to ensure that ice does not form in the inlet duct. If the free air temperature is −18°C or above, and the anti-icing system is on, illumination of the caution lights indicates the possibility of system failure. However, under certain conditions of high speed and high power settings, the caution lights may illuminate when the OAT is as high as −5°C without a malfunction. If the engine inlet anti-ice caution light should illuminate in flight at temperatures above −10°C, reduce engine speed to 80% $N_g$ on the affected engine and airspeed to approximately 70 KIAS or less. If the light does not go out, system failure is indicated. If the system is found to be operational (caution light out during power reduction), reduced power should be maintained to keep the caution light off while operating in icing conditions or icing conditions should be avoided. If the caution light does not go out during power reduction, system failure could be indicated and mission termination should be considered. If the mission is continued with the caution light illuminated, any signs of visible moisture should be avoided. The $T_5$ should also be constantly monitored for an increase as adequate anti-icing capability is not available. At the lower temperatures where this may occur, icing conditions are not usually encountered due to lack of liquid moisture in the air. At temperatures above −18°C the light should not illuminate during ground operation. The system receives power from the ac essential bus through circuit breakers that are marked ENGINE INLET ANTI-ICE and are located on the ac essential bus circuit breaker panel. A thermal switch, located in the air inlet duct, closes to permit power from the dc essential bus to illuminate the anti-ice caution lights.

## ENGINE ANTI-ICING SYSTEM.

The engine starter fairing, the inlet guide vanes, and the top (12 o'clock), right (3 o'clock), and left (9 o'clock) struts of the front frames of each engine are anti-iced by diverting engine tenth-stage compressor air to heat them. The bottom (6 o'clock) strut is continuously heated by scavenge oil from the No. 1 bearing area. The oil tank ring, electrically interconnected with the engine air intake duct contains a heating element. Actuating the engine anti-ice switches, located on the overhead switch panel (figure 1-13), deenergizes the

engine mounted solenoid valve to the open position and allows hot compressor air to flow through the front frame of the engines to the inside of the starter fairing and the inlet guide vanes. When the engine solenoid valves are deenergized, dc power from the essential bus energizes lights on the advisory panel, marked #1 ENG ANTI-ICE ON and #2 ENG ANTI-ICE ON. The engine anti-icing system is turned on simultaneously with the engine air inlet anti-icing system.

**NOTE**

If the anti-ice solenoid valve has opened (deenergized) due to electrical failure, the advisory light will not illuminate and maximum power available will be reduced by approximately 4%.

**Engine Anti-ice Switches (CH-3E and HH-3E Helicopters).**

Two engine anti-ice switches, marked ENGINE ANTI-ICE 1 and 2, with marked positions OFF and ON, are located on the overhead switch panel (figure 1-13). The ON position of the switch energizes the engine air inlet anti-icing system and turns on the engine anti-icing system. The OFF position turns both systems off.

## WINDSHIELD ANTI-ICING SYSTEM.

The pilot's and copilot's windshields are anti-iced by electric current which passes through a transparent electrically resistant film on the inner surface of the outer pane of the windshield. The windshield anti-icing system consists of the special windshields, a windshield anti-ice controller, transformers, and a switch located on the overhead switch panel. The windshield anti-icing system also serves to defog the windshield. The windshield anti-icing system operates on alternating current from the ac essential bus and is protected by circuit breakers, marked WINDSHIELD ANTI-ICE, PILOT, and COPILOT, located on the ac essential circuit breaker panel. The windshield anti-icing control switch operates on direct current from the essential bus and is protected by a circuit breaker, marked WINDSHIELD ANTI-ICE, on the overhead dc circuit breaker panel.

**NOTE**

The windshield anti-ice should be on at all temperatures below 5°C when visible moisture is present. When operating in dry snow, the system should be turned off.

**Windshield Anti-Ice Switch.**

The windshield anti-ice switch, marked WINDSHIELD ANTI-ICE, with marked positions LOW, OFF, and HIGH, is located on the overhead switch panel (figure 1-13). When placed in the LOW position, the windshield controller is energized, current heats the windshield, and the low temperature setting is used for defogging and light icing conditions. When placed in the HIGH position, the windshield is heated and is capable of keeping the windshield ice free in conditions as low as an ambient temperature of −18°C.

**CAUTION**

The windshield anti-ice switches should be placed in the LOW position before going to the HIGH position to avoid the possibility of glass cracking due to sudden change in temperatures. Normally, the use of the HIGH position is not required, except at very low outside temperature when ice cannot be removed by the LOW position.

**Windshield Defogger.**

On model CH-3E/HH-3E helicopters with windshield defogger system installed, the system consists of ducts, defroster units, adapters and attaching clamps which are connected to the ventilation system. When the CABIN fan switch is positioned to VENT, the blower forces air through the ducts to the defroster units to direct air onto the windshield.

## PITOT HEATERS.

A pitot heater switch, marked PITOT HEAT, with marked positions ON and OFF, is located on the overhead switch panel (figure 1-13). When placed in the ON position, an electric heater in each pitot head is turned on to prevent ice formation in the pitot head. Each pitot heater operates from the dc

essential bus and is protected by two circuit breakers, marked PITOT HEAT 1, (for pilot's pitot tube) and PITOT HEAT 2, (for copilot's pitot tube), located on the overhead dc circuit breaker panel.

**NOTE**

Pitot heaters should be turned on when operating in visible moisture.

## COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

The communication equipment, with the exception of a backup UHF command set installed on CH-3E helicopters not modified by T.O. 1H-3(C)C-532 that is designated UHF-2 (AN/ARC-108), is remotely controlled through individual control panels, located on the cockpit console (figures 1-17 and 1-18), and the pilot's and copilot's consoles in the pilot's compartment. The UHF-2 receiver-transmitter, when installed, is mounted on and controlled by a panel on the cockpit console. Figure 4-3 lists the communication and associated electronic equipment installed, together with their operational characteristics and the location of controls. Except for the radio control panels, all radio equipment, including receivers, transmitters, amplifiers and dynamotors, is located in the electronics compartment or on electronic shelves, located behind the copilot. All radios except the HF-103, operate on 28-volt direct current from the dc essential bus. Some associated electronic equipment operates on alternating current from the ac essential bus. Master control over the direct current operating equipment is provided by two circuit breakers, marked RADIO, 1-BUS-2, located on the overhead dc circuit breaker panel. Indicators used in conjunction with the navigation sets are located on the instrument panel. Intercommunication control panels are provided for the crewmember in the cargo compartment at the forward bulkhead and above the ramp. Those helicopters equipped with armament configuration have an additional intercommunication control panel provided on the left forward side of the cargo compartment wall. A HOT MIKE switch, located aft of the personnel door, is used during hoisting operations to allow the crewman freedom of both hands while maintaining continuous conversation with the pilot. Left of the hot mike switch is UHF VOL control knob. The UHF volume control knob permits the crewman to monitor UHF communication. Each crewman's station control panel is provided with a receptacle for a portable cord that contains an ICS button and a headset jack receptacle. The 30-foot portable walk-around cord may also be used in the two external ICS receptacles found on the right-hand side of the helicopter, one located forward of the personnel door, and the other aft. The 30-foot cord allows a crewman to communicate with the pilot during engine starting or while taxiing. The location of all antennas is shown in figure 4-4.

### RADIO CIRCUIT BREAKER PANELS.

The radio circuit breaker panels (figure 1-39) are accessible to the crew during flight operations, and all circuit breakers may be reset by pushing them in. Radio circuit breakers are located on the overhead circuit breaker panels in the pilot's compartment. The direct current operating circuits, each protected by an appropriately marked circuit breaker, are connected to the helicopter's 28-volt direct current power supply system through the radio master circuit breakers. The alternating current operating circuit, each protected by an appropriately marked circuit breaker, are connected directly to the helicopter's alternating current power supply system and are continuously energized. Both power sources must be operating for the communication and associated electronic equipment to be fully operative.

### OPERATING CONTROLS.

A spring-loaded microphone trigger switch, marked ICS-RADIO, located on the pilot's and copilot's cyclic stick grips, connects the respective microphone to the radio transmission circuit when held in the RADIO position, and to the interphone transmission circuit when held in the ICS position. Headset microphones are located at each intercommunication station for reception and transmission over the channels covered at the individual stations. Transmission is accomplished by depressing the ICS button located on the portable cord of the pendant. The individual control panels receive electrical power from the dc essential bus through circuit breakers, under the general heading ICS and marked PILOT, COPILOT, CREW, and RAMP, located on the dc essential bus portion of the ac nonessential circuit breaker panel.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT TABLE

| TYPE | DESIGNATION | FUNCTION | PRIMARY OPERATOR | RANGE | LOCATION OF CONTROL |
|---|---|---|---|---|---|
| Intercommunication system | AN/AIC-18 | Intercommunication of crew and simplified control over communication equipment | Crew-members | Interior of helicopter | (1) Pilot - control and monitor panels on cockpit console (2) Copilot - control and monitor panels on cockpit console (3) Crew - intercommunication station control panels in fwd and aft end of cargo compartment. Left forward cabin compartment wall for armament configuration |
| Public address system | AN/AIC-13 | One-way voice communication | Pilot and copilot | Interior and immediate exterior of helicopter | Pilot's console and intercom control panel |
| Loudhailer system | AN/UIH-5 | One-way voice communication | Pilot co-pilot and crewman | 10 to 5000 feet | Cockpit console, pilot's console and right forward cargo compartment station |
| UHF command set | AN/ARC-34B | Two-way voice communication | Pilot and copilot | Line of sight | UHF panel on cockpit console and intercommunication system control panel |
| UHF command set | AN/ARC-34C | Two-way voice communication | Pilot and copilot | Line of sight | UHF panel on cockpit console and intercommunication system control panel |
| UHF command set | AN/ARC-164(V) aircraft modified by TCTO 1H-3-674) | Two-way voice communication | Pilot and copilot | Line of sight | UHF panel on cockpit console and intercommunication system control panel |
| Backup UHF command set | AN/ARC-108 | Two-way voice communication | Pilot and copilot | Line of sight | Backup UHF panel on cockpit console and intercommunication system control panel |
| FM command set | FM-622A (1) | Two-way voice communication | Pilot and copilot | Line of sight | FM panel on cockpit console and intercommunication system control panel |
| VHF command set | VHF-101 (2) | Two-way voice communication | Pilot and copilot | Line of sight | VHF panel on cockpit console and intercommunication system control panel |
| Direction finder | AN/ARA-25 | Direction finding | Pilot and copilot | Line of sight | UHF or backup UHF panels on cockpit console and intercommunication system control panel |
| Automatic direction finder | AN/ARN-59 | Automatic direction finding | Pilot and copilot | Depends on conditions | ADF panel on cockpit console and intercommunication system monitor panel |
| Radio set (TACAN) | AN/ARN-65 | Bearing and distance of navigation station | Pilot and copilot | Line of sight | Tacan panel on cockpit console and intercommunication system monitor panel |

(1)(2) SEE 1S-161

*Figure 4-3. Communication and Associated Electronic Equipment Table (Typical) (Sheet 1 of 2)*

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT TABLE (Cont)

| TYPE | DESIGNATION | FUNCTION | PRIMARY OPERATOR | RANGE | LOCATION OF CONTROL |
|---|---|---|---|---|---|
| HF communication system | HF-103 | Two-way voice communication | Copilot | Depends on conditions | HF panel on copilot's console and intercommunication system control panel. |
| IFF | AN/APX-46 | Identification | Pilot and copilot | Line of sight | IFF panel on cockpit console |
| IFF | AN/APX-64 | Identification | Pilot and copilot | Line of sight | IFF panel on cockpit console |
| Altimeter, electronic | AN/APN-150 | Altitude over terrain | Pilot and copilot | 0 to 1000 feet | ON/ALT switch on pilot's indicator |
| Altimeter, electronic | AN/APN-171 | Altitude over terrain | Pilot and copilot | 0 to 5000 feet | Switch located on indicator |
| Navigation set, radar | AN/APN-175 (V) | Current position and bearing and distance to destination | Pilot and copilot | 15 to 30,000 feet | Control indicator panel on cockpit console |
| OMNI navigation system | VOR-101 | Select, identify and maintain predetermined fixed course | Pilot and copilot | Line of sight | VHF NAV on cockpit console and VOR/TACAN selector switches on instrument panel |
| Secure speech system | KY-28 | Secure speech | Pilot and copilot | | Control on cockpit console on pilot's console |
| Radar Transponder | AN/UPN-25 | Receive pulsed interrogations and transmit amplified, pulsed replies | Pilot and copilot | Line of sight | Approximate center of cockpit console |
| IS-460 RADAR WARNING SYSTEM | AN/APR-39 (V)-1 | DETECTS RADAR EMITTERS | PILOT AND COPILOT | | CONTROL UNIT ON COCKPIT CONSOLE |

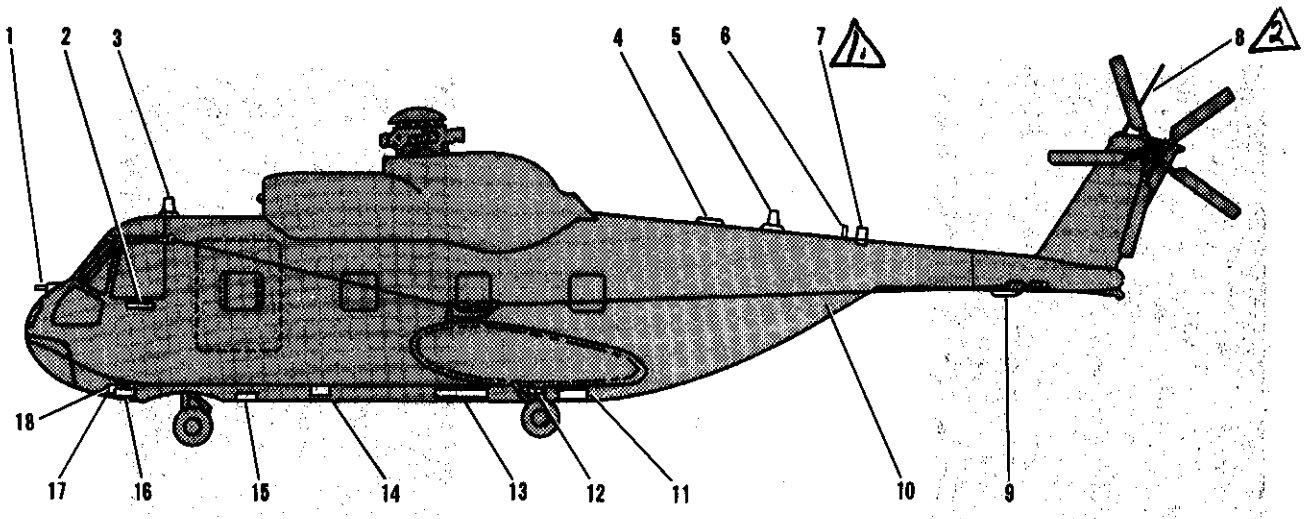
*Figure 4-3. Communication and Associated Electronic Equipment Table (Typical) (Sheet 2 of 2)*

## INTERCOMMUNICATION SYSTEM (AN/AIC-18).

The AN/AIC-18 intercommunication system is installed to provide communication between the various crewmembers. The intercommunication system also ties together the audio channels of the communication and associated electronic equipment to provide simplified control and simultaneous operation. The system is controlled through identical intercommunication system control and monitor panels, provided for the pilot and copilot, and identical intercommunication station control panels provided for the flight engineer and personnel in the cargo compartment. On helicopters equipped with armament configuration, a left gunner's station has been added.

**NOTE**

When connected to respective external ICS receptacle, remote rear ramp operator disables rear ramp operator's ICS station and forward remote operator disables the jump seat ICS station.




1. AN/ARN-58 GLIDE SLOPE
2. AN/ARN-58 LOCALIZER (BOTH SIDES) HELICOPTERS NOT MODIFIED BY T.O. 1H-3-553). VOR-101 OMNI NAVIGATION SYSTEM (BOTH SIDES) CH-3E AND HH-3E HELICOPTERS OR MODIFIED BY T.O. 1H-3-553)
3. AN/ARC-34B UHF COMMAND SET (HELICOPTERS NOT MODIFIED BY T.O. 1H-3-631) AN/APX-64 IFF TRANSPONDER (HELICOPTERS MODIFIED BY T.O. 1H-3-631).
4. AN/ARN-59 LF/ADF RADIO COMPASS (LOOP)
5. AN/ARC-34B UHF COMMAND SET (HELICOPTERS MODIFIED BY T.O. 1H-3-631).
6. AN/UPN-25 RADAR TRANSPONDER
7. VHF-101 VHF RADIO
8. AN/ARC-44 FM ANTENNA AND COUPLER (HELICOPTERS PRIOR TO HH-3E 25 NOT MODIFIED BY T.O. 1H-3-556 FM-662A ANTENNA AND COUPLER (HELICOPTERS HH-3E 25 OR MODIFIED BY T.O. 1H-3-556
9. AN/ARN-58 MARKER BEACON
10. HF-103 SSB HF RADIO
11. AN/APN-175 (V) DOPPLER
12. AN/APX-64 IFF TRANSPONDER (HELICOPTERS MODIFIED BY T.O. 1H-3-631)
13. ARN-59 LF ADF RADIO COMPASS (SENSE)
14. AN/ARN-65 TACAN
15. AN/ARA-25 UHF DIRECTION FINDER GROUP
16. AN/APN-150 (TRANSMITTER) ALTIMETER PRIOR TO HH3E 32 NOT MODIFIED BY T.O. 1H-3-611
17. AN/APN-150 (RECEIVER) ALTIMETER PRIOR TO HH3E NOT MODIFIED BY T.O. 1H-3-611
18. AN/APN-171 RADAR ALTIMETER ANTENNAS (BOTH SIDES) HH-3E 32 ▶ OR MODIFIED BY T.O. 1H-3-611

SEE IS-161

*Figure 4-4. Antennas*

**Intercommunication System Control And Monitor Panels.**

The pilot's intercommunication system (figure 4-5) control and monitor panels are both located on the cockpit console. Both the pilot's and co-pilot's intercommunication system control and monitor panels are identically marked and operate in the same manner. The intercommunication system control panels, marked INTER, contain a transmitter selector switch, eight push-pull type control switches, a momentary press-type CALL switch, and a volume control knob. The transmitter selector switch has marked positions INT, UHF-1, HF, VHF, UHF-2 and PA that selects communication systems through which it is possible to transmit and receive from the helicopter. On those helicopters equipped with the FM-622A radio set in lieu of the AN/ARC-108 backup VHF set, the marked position UHF-2 has been changed to read FM. The two push-pull type switches, marked TALK and LISTEN, under the general marking HOT MIC, permit direct transmission to all other intercommunications stations in the helicopter without operation of the individual microphone switches. Both the LISTEN and TALK switches must be pulled out to transmit and receive over the HOT MIC lines. The HOT MIC position is inoperative when the transmitter selector switch is in the INT or PA position. The momentary press-type switch, marked CALL, provides for emergency call operation by isolating all radio receivers from the intercommunication system and putting all other intercommunication stations in direct contact with the calling station. The volume control, marked VOL, controls the volume level for

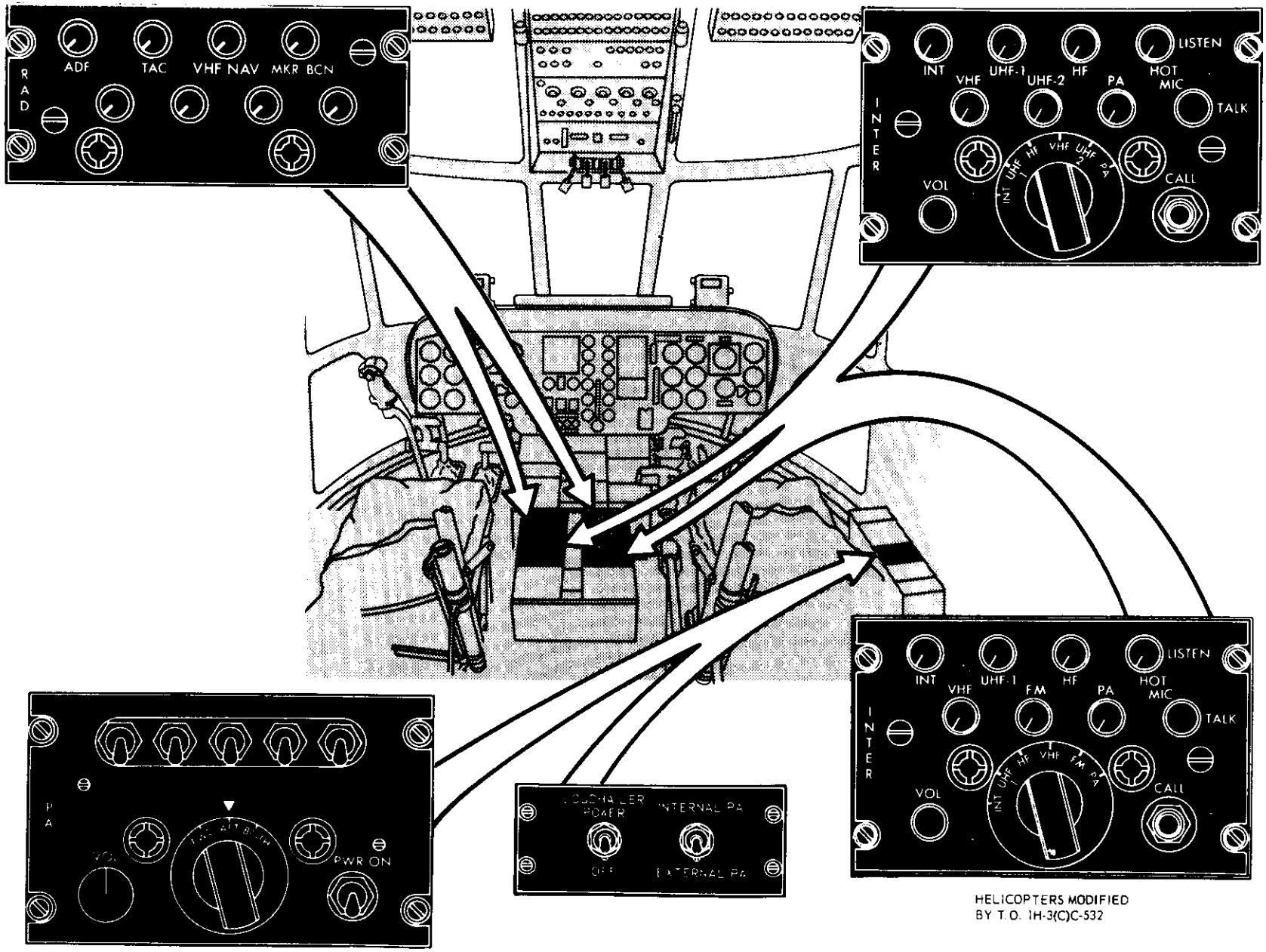



*Figure 4-5. Pilot's and Copilot's Intercommunication System (Typical)*

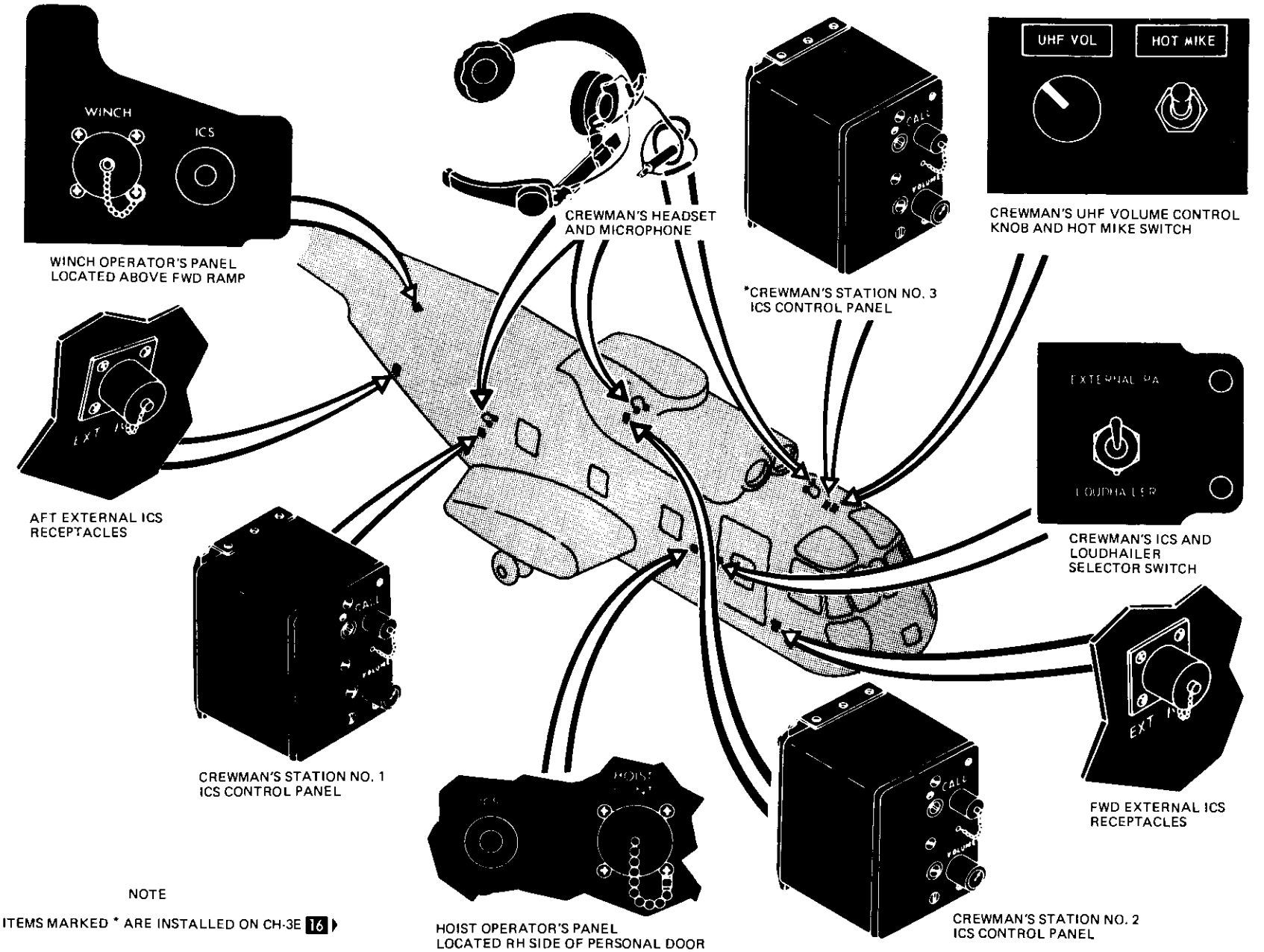
all audio signals that pass through its intercommunication station. The intercommunication system monitor panel, marked RADIO, consists of eight push-pull type switches, but only four are used. The four that are in use, marked ADF, TAC, VHF NAV, and MKR BCN, provide separate volume for each channel to enable the pilot to monitor navigational systems which have output signals in the audio range. Identical intercommunication station control panels (figure 4-6) are located in the forward cargo compartment near the personnel door, in the aft cargo compartment, and the left forward cargo compartment wall for those helicopters equipped with armament configuration. These control panels have only two controls, one marked CALL and the other marked VOL. When the CALL button is depressed, the calling station is placed in direct communication with all other intercommunication stations and all radio receivers are isolated from the intercommunication system. The VOL switch regulates the volume of intercommunication system signals coming into the station. The forward station (station No. 2) has an additional control panel containing a hot mike switch and a UHF volume control knob. The switch, marked HOT MIKE, enables the hoist operator to maintain, as required, continuous conversation with the pilot through the AIC-18 intercommunication system. The hot mike switch allows the hoist operator freedom of both hands for hoist operations and other related necessary functions during rescue hoist employment. The UHF volume control knob, marked UHF VOL, enables the crewmember at station 2 to monitor UHF communications. On HH-3E helicopters Serial Nos. AF69-5811 and subsequent, the three cabin crew interphone stations are equipped with an additional radio monitor panel marked RAD consisting of eight push-pull combination switches, but only four are used. The four switches in use are marked UHF, VHF, HF, and FM and provide volume for each channel to enable the crewmen to monitor pilot - copilot radio communications. On helicopters modified by T.O. 1H-3-610 not equipped with FM radio, the cabin crew interphone stations are equipped with similar radio monitor panels but the four push-pull switches are marked $UHF_1$, $UHF_2$, VHF and HF (see figure 4-6). On those modified helicopters equipped with FM radio, the four push pull switches are marked UHF, VHF, FM, and HF. Those helicopters equipped with a loudhailer system have a selector switch, marked EXTERNAL PA, with marked positions ICS and LOUDHAILER, located forward of the personnel door opening. The switch must be in the ICS position for the crewman at station 2 to use the intercommunication system. There are two outside receptacles for the ground crew to communicate with the pilot or crew inside the helicopter during starting or cargo loading. One receptacle is located below the pilot's window and the other is adjacent to the ramp. It is not possible to monitor radio systems over the intercommunication station control panels. Headset microphones are located at each intercommunication station for reception and transmission over the channels covered at the individual stations. Transmission is accomplished by depressing the ICS button located on the pendant. The individual control panels receive electrical power from the dc essential bus through circuit breakers, under the general heading ICS marked, PILOT, COPILOT, CREW, and RAMP, located on the dc essential circuit breaker panel.

## PUBLIC ADDRESS SYSTEM (AN/AIC-13).

The public address system AN/AIC-13 (figure 4-7) provides transmission to two loudspeakers, one located in the forward cargo compartment and the other under the tail pylon. The system is controlled through a control panel, marked PA, located on the cockpit console. Speech can be supplied to the system through the pilot's and copilot's microphones. Different loudspeaker combinations can be selected by a rotary switch located on the control panel. To transmit on the PA system, select PA on the pilot's or copilot's INTER panel and depress the radio button on the pilot's or copilot's cyclic stick. To receive in the headsets, pull out the button marked PA. There is a loudspeaker gain control switch located at the rear of the cargo compartment on the right side. Placing the switch in the increase or decrease position will cause the VOL knob on the PA panel to rotate and control loudspeaker volume.

### Public Address System Control Panel.

The public address system control panel, located on the pilot's console, contains a speaker-selector switch, a power switch, and a volume control knob. The four mixing switches located on the top half of the control panel are not used. On those




NOTE

ITEMS MARKED * ARE INSTALLED ON CH-3E 16

*Figure 4-6. Crewman's Intercommunication (ICS) Stations (Typical) (Sheet 1 of 3)*

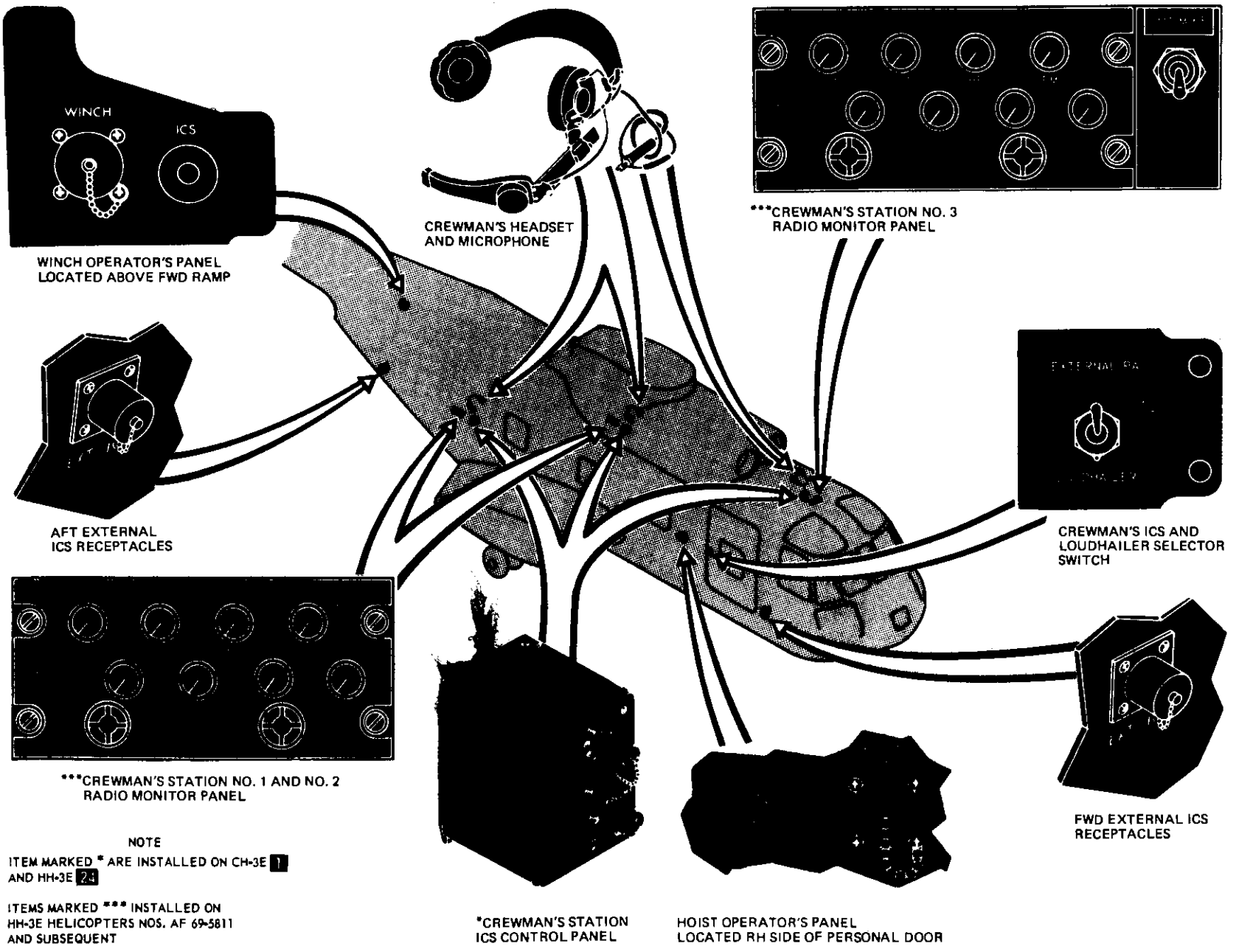



*Figure 4-6. Crewman's Intercommunication (ICS) Stations (Typical) (Sheet 2 of 3)*

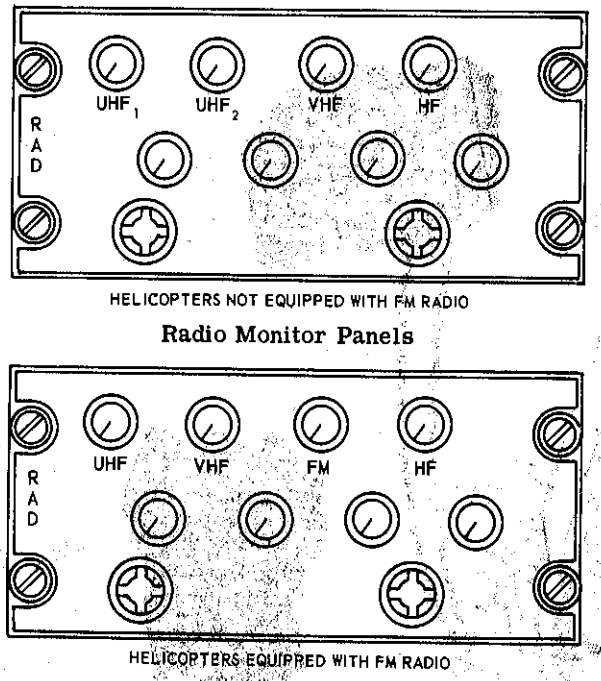



*Figure 4-6. Crewman's Intercommunication (ICS) Stations (Typical) Sheet 3 of 3)*

helicopters equipped with a loudhailer, the mode selector switch on the loudhailer selector switch must be in the INTERNAL PA position when using the public address system. The speaker-selector switch has marked positions FWD, AFT, and BOTH. When the switch is placed in the FWD or AFT position, voice transmission will be heard through the speaker selected. When the switch is placed in the BOTH position, voice transmission is heard through both speakers. The power switch, marked PWR ON, provides power to the public address system. The volume control marked VOL sets the output level of the entire public address system. The public address system receives electrical power from the dc essential bus and is protected by a circuit breaker, marked PA, located on the dc essential bus portion of the ac nonessential circuit breaker panel.

## LOUDHAILER SYSTEM (AN/UIH-5).

The loudhailer system provides one way voice communication from the pilot, copilot, or the forward cabin station to personnel on the ground. The system provides audible transmission from approximately 10 to 5000 feet when the helicopter is hovering and audible transmissions up to 2500 feet lateral distance while at an altitude of 500 feet. The system contains a compact, rotatable bracket-mounted, four-cluster speaker assembly installed on the right side of the cabin forward bulkhead. The rotatable mounting bracket arrangement permits the speaker assembly to be manually rotated to an external position outside the cabin door opening and rotated back inside the cabin to permit closing the cabin door. Locking pins are provided on the speaker mounting bracket to prevent movement of the speakers when in the fully extended or retracted position. A switch is installed at the speaker assembly pivot point to prevent accidental speaker operation when the speaker cluster is in the cabin. The speaker installation is mounted in such a manner as to be readily removed or installed. The system receives power from the dc essential bus and is protected by a circuit breaker, marked LOUDHAILER, located on the overhead circuit breaker panel.

### Loudhailer Controls.

The loudhailer controls consist of a control panel, located on the pilot's console, a switch panel, mounted on the right side of the cargo compartment forward of the personnel door, and an amplifier, mounted on the right side of the entrance to the pilot's compartment. The control panel contains a power switch, marked LOUDHAILER with marked positions POWER and OFF, and a selector switch that has marked positions INTERNAL PA and EXTERNAL PA. Placing the power switch in the POWER position energizes the system. The selector switch is placed in the EXTERNAL PA position to select the loudhailer system and in the INTERNAL PA system to select the AIC-13 public address system. The switch panel, marked EXTERNAL PA, with marked positions ICS and LOUDHAILER, provides operation for the crewman in the cargo compartment. The LOUDHAILER position selects loudhailer system operation and the ICS position selects the intercommunication system. The amplifier contains a volume control, marked GAIN, that controls the volume of recorded or live transmissions. The volume control is rotated through four numbered positions counterclockwise to control the volume of recorded transmissions and clockwise to control the volume of live transmissions.

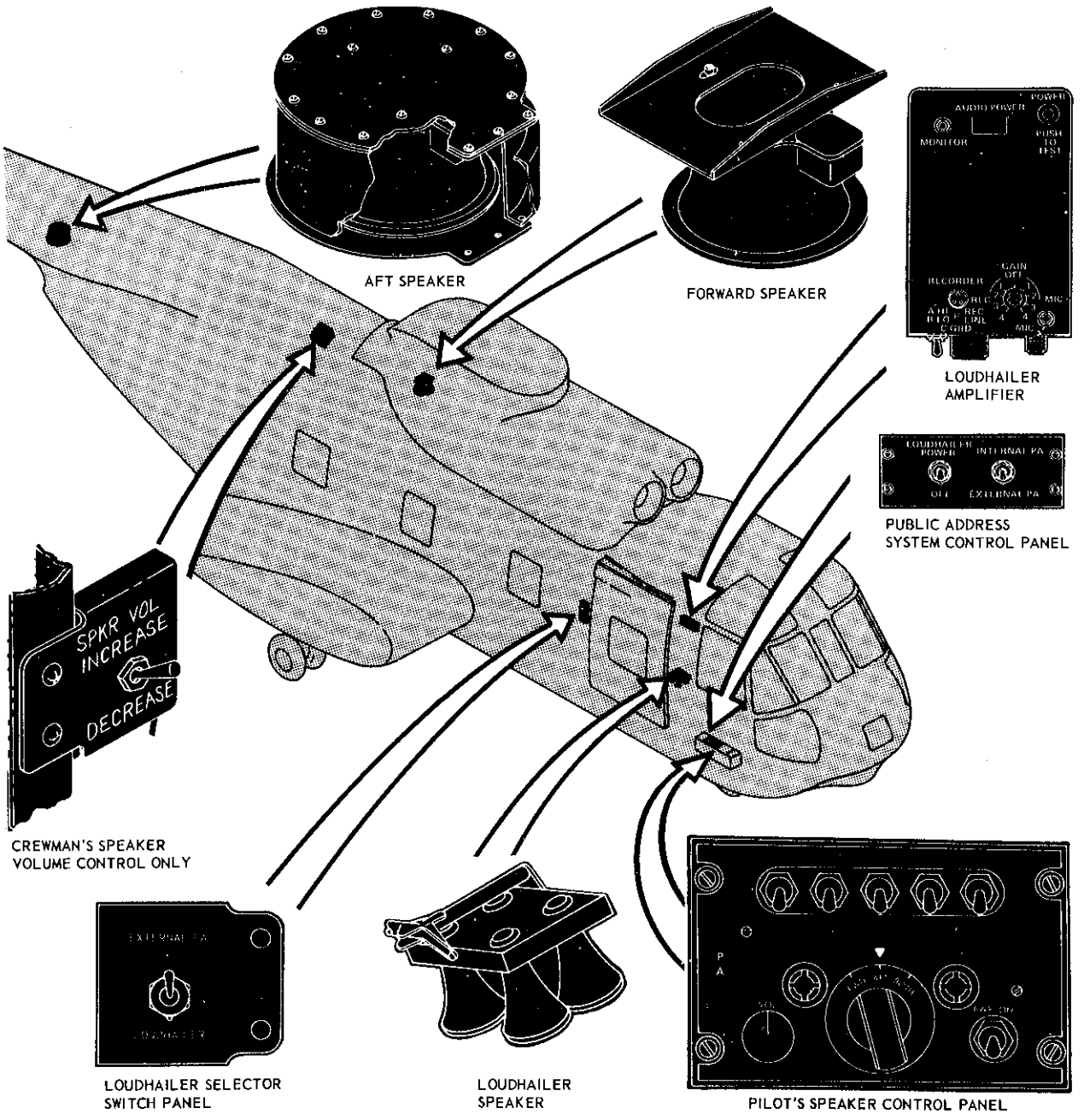



*Figure 4-7. Public Address System (Typical)*

**Loudhailer Operation.**

To transmit on the loudhailer:

1. Transmitter selector switch (ICS control panel) — PA.
2. Volume control marked PA (ICS control panel) — PULL OUT AND ADJUST.
3. Power switch (loudhailer selector switch panel) — POWER.
4. Selector switch (loudhailer selector switch panel) — EXTERNAL PA.
5. Transmission volume (amplifier volume control) — AS DESIRED.
6. Microphone trigger switch (cyclic stick grip) — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

Loudhailer transmission from the forward cargo compartment station may be accomplished by:

1. EXTERNAL PA switch (right side of cargo compartment, forward of personnel door) — LOUDHAILER.
2. Transmission volume (amplifier volume control) — AS DESIRED.
3. Press-to-talk or HOT MIKE switch — DEPRESS.

## UHF COMMAND SYSTEM.

The AN/ARC-34B UHF command set is the primary UHF system, designated UHF-1. On helicopters not modified by T.O. 1H-3(C)C-532, the AN/ARC-108 UHF command set is the backup system, designated UHF-2. The AN/ARC-108 backup system is inoperative until the AN/ARC-34B primary system is turned off by the switch or circuit breaker. On helicopters modified by T.O. 1H-3(C)C-532, an additional AN/ARC-34C UHF command set is added and the AN/ARC-108 backup system removed. All HH-3E helicopters have the AN/ARC-34C UHF command set installed in lieu of the AN/ARC-34B. On helicopters modified by TCTO 1H-3-674, the AN/ARC-34 primary UHF command set has been replaced by the AN/ARC-164(V). Helicopters S/N 63-9683, 63-9688 and 64-14225 have an additional AN/ARC-164 installed, replacing the backup AN/ARC-34 set.

**UHF Command Set (AN/ARC-34B).**

The UHF command set AN/ARC-34B (UHF-1) provides two-way communication between the helicopter and ground, or between aircraft, on any one of 1750 frequency channels in the frequency range of 225.0 to 399.9 megacycles. All reception and transmission is routed through the intercommunication system control panels. A guard receiver, separate from the main receiver, operates on a preset frequency of 243.0 megacycles and provide facilities for reception of emergency messages. The set is remotely controlled from a control panel, marked COMM, located on the main console. Operational controls of the control panel consist of a four-position function switch, a twenty-position channel selector switch, a tone button, and a volume control. The function switch allows for operation as follows: in the OFF position, all of the equipment is off; in the MAIN position, the main receiver and transmitter is operating and the guard receiver is off; in the BOTH position, the main receiver and transmitter is operating and the guard receiver is receiving the guard frequency. The ADF position selects ADF operation from the AN/ARA-25 direction finder. When in the ADF position, reception is still maintained through the UHF channels selected. The channel selector switch permits selection of any of the 20 preset main frequency channels for reception and transmission by simply turning the switch to the desired channel. When the manual-preset-guard switch is in the GUARD position, the main receiver and transmitter tunes to the preset guard frequency. When the manual-preset-guard switch is in the MANUAL position, the main receiver and transmitter may be manually tuned to the desired frequency by means of the four manual selector knobs, and the frequency numbers selected will appear in the four windows above the manual selector knobs. When the manual-preset-guard switch is in the PRESET position, the main receiver and transmitter will operate on the preset channel indicated in the channel-indicator window. The volume control, marked VOL, is used to adjust the receiver signal strength at an understandable and comfortable level. Receiver volume can be further controlled by the master volume control and a control knob on the INTER panel marked UHF-1 to suit the individual

requirements of the pilot and copilot. On helicopters having an additional UHF Command Set AN/ARC-34C installed, the second set is controlled by the master volume control marked UHF-2. The UHF set is protected by a circuit breaker, marked UHF, located on the dc essential portion of the ac nonessential circuit breaker panel. When the tone button is depressed, a 1000 cps tone is transmitted to be used with UHF homing device on the ground or on the aircraft.

**NOTE**

- The GUARD position should not be used except in actual emergencies. When operating under emergency conditions, set the manual-preset-guard switch to the GUARD position and the function switch to the MAIN position. Do not use the BOTH position as the noise from two receivers may make the incoming signal unintelligible.
- It is possible to select frequencies below 225.0 megacycles that are below the operating frequency range. This will cause a relay to turn the set off after two minutes of operation. To restore operation, set up controls for frequency between 225.0 and 399.9 megacycles, turn function switch to OFF position, then to BOTH. Operation will be restored after a one minute warmup period.

**UHF Command Set Operation.**

To turn the set on:

1. Function switch — MAIN OR BOTH.
2. Manual-preset-guard switch — PRESET.
3. Channel selector switch — SELECT DESIRED CHANNEL.
4. Volume control — ADJUST TO DESIRED SIGNAL STRENGTH.

To transmit:

1. Transmitter selector knob (Intercommunication system control panel) — UHF-2. If the second set is installed — Transmitter selector knob — UHF-1 or UHF-2 — AS DESIRED. The pilot can operate from one radio and the copilot from the other.
2. Microphone trigger switch on the cyclic stick grip — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

To turn the set off:

1. Function switch — OFF.

**UHF Command Set (AN/ARC-34C).**

The description and operation of the AN/ARC-34C UHF Command Set is the same as outlined for the AN/ARC-34B UHF Command Set, except as noted herein. The AN/ARC-34C UHF Command Set provides two-way voice communication between the helicopter and ground, or between aircraft, on any one of 3500 frequency channels in the frequency range of 225.0 to 399.9 megacycles. Also, when the manual-preset-guard switch on the AN/ARC-34C is in the MANUAL position, the main receiver and transmitter may be manually tuned to the desired frequency by means of the five manual selector knobs, and the frequency numbers selected will appear in the five windows above the manual selector knobs.

**UHF Command Set (AN/ARC-164(V).**

The UHF command set AN/ARC-164(V) (UHF) provides two-way communication between the helicopter and ground, or between aircraft, on any one of 7000 frequency channels in the frequency range of 225.000 to 339.975 megahertz. (See figure 4-8.) All reception and transmission is routed through the intercommunication system control panels. A guard receiver, separate from the main receiver, operates on a preset frequency of 243.000 megahertz and provides facilities for reception of emergency messages. The set is remotely controlled from a control panel, marked COMM, located on the main console. Operational controls of the control panel consist of a four-point function switch, a manual-preset-guard switch, a twenty-position channel selector switch, five manual frequency select knobs, a tone button, a volume control, and a two-position squelch switch. The function switch allows for operation as follows: in the OFF position, all of the equipment is off; in the MAIN position, the main receiver and transmitter is operating

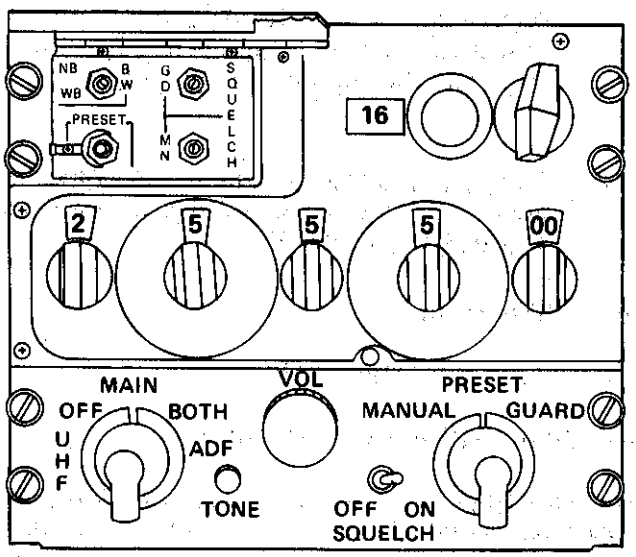



*Figure 4-8. AN/ARC-164(V) Control Panel*

and the guard receiver is off; in the BOTH position, the main receiver and transmitter is operating and the guard receiver is receiving the guard frequency. The ADF position selects ADF operation from the AN/ARA-25 direction finder. When in the ADF position, reception is still maintained through the UHF channels selected. The channel selector switch permits selection of any of the 20 preset main frequency channels for reception and transmission by simply turning the switch to the desired channel. When the manual-preset-guard switch is in the GUARD position, the main receiver and transmitter tunes to the preset guard frequency. When the manual-preset-guard switch is in the MANUAL position, the main receiver and transmitter may be manually tuned to the desired frequency by means of the five manual selector knobs, and the frequency numbers selected will appear in the five windows above the manual selector knobs. When the manual-preset-guard switch is in the PRESET position, the main receiver and transmitter will operate on the preset channel indicated in the channel indicator window. The volume control, marked VOL, is used to adjust the receiver signal strength at an understandable and comfortable level. Receiver volume can be further controlled by the master volume control and a control knob on the INTER panel marked UHF-1 to suit the individual requirements of the pilot and copilot. Squelch switch. This switch (toggle) has two positions identified ON and OFF. When in the ON position, it allows the squelch circuits in both main and guard receivers to operate normally. In the OFF position, the squelch is disabled in the main receiver, allowing receiver noise to be heard in absence of a signal. On helicopters having an additional UHF Command Set AN/ARC-164(V) installed, the second set is controlled by the master volume control marked UHF-2. The UHF set is protected by a circuit breaker, marked UHF, located on the dc essential portion of the ac nonessential circuit breaker panel. When the tone button is depressed a 1020 Hz tone is transmitted to be used with UHF homing device on the ground or on the aircraft.

**NOTE**

The GUARD position should not be used except in actual emergencies. When operating under emergency conditions, set the manual-preset-guard switch to the GUARD position and the function switch to the MAIN position. Do not use the BOTH position as the noise from the two receivers may make the incoming signal unintelligible.

UHF COMMAND SET OPERATION.

To turn the set on:

1. Function switch — MAIN OR BOTH.
2. Manual-preset-guard switch — PRESET.
3. Channel selector switch — SELECT DESIRED CHANNEL.
4. Volume control — ADJUST TO DESIRED SIGNAL STRENGTH.

To transmit:

1. Transmitter selector knob (Intercommunication system control panel) — UHF-2. If the second set is installed: Transmitter selector knob — UHF-1 or UHF-2 — AS DESIRED. The pilot can operate from one radio and the copilot from the other.

2. Microphone trigger switch on the cyclic stick grip — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

To turn the set off:

1. Function switch — OFF.

**UHF Command Set (AN/ARC-164 Modified By TO 1H-3-737).**

The modified AN/ARC-164 set consists of a modification to selected airborne and ground-based radios, providing them with a frequency-hopping capability. Frequency hopping is a technique where the channel or frequency being used for communication on a given link is rapidly changed many times per second.

In the active mode, the radio has the ability to receive and process two simultaneous transmissions on the same net. This conferencing capability is available by selection 00, 50, or 75 with the hundredths/thousands manual frequency selector switch, then operating in the active mode. Conferencing is disabled when the net number ends in 25.

In a conference net, the second transmitting radio will automatically shift its transmission frequency to 25 kilohertz when it monitors a transmission on the primary net frequency. The wide band receiver will read both transmissions without the interference normally associated with two radios transmitting on the same frequency simultaneously. Three simultaneous transmissions will result in garbled reception.

**NOTE**

- When operating in the secure voice mode, conferencing is automatically disabled.
- In the active mode, ADF will function, but accuracy will be degraded depending on the frequency hop rate.

SYSTEM OPERATION.

The usual operating mode for a modified radio will be its normal mode where it uses any one of the 7000 channels available to the UHF communication band. Use and operation of the radio will be just as it is currently done. The two-position switch on the control head is replaced with a four-position switch to provide two new functions. The modified AN/ARC-164 retains the same form/fit as the unmodified radio.

a. All the controls of the modified AN/ARC-164 retain the same functions except as follows:

(1) 200/300 MHz selector knob (A-3-2-T switch).

(a) "A" position selects active (jam-resistant) mode.

(b) Selects 100s digit frequency (either 2 or 3) in normal mode.

(c) "T" position selects input of a new Time Of Day (TOD) for up to one minute after being selected. The "T" position is a momentary, spring-return position. "T" position, in conjunction with simultaneously pressing TONE switch, is used for emergency startup of TOD clock when TOD is not available from external sources. This emergency TOD will not be synchronized to universal coordinated time (UTC).

**NOTE**

The radio will automatically accept the first (TOD) signal it receives after power-up. If the operator requires a new TOD after this initial synchronization, he must momentarily depress this switch to the "T" position. The system will then accept the first TOD received within one minute.

b. Preset Channel Selector Switch. Selects one of 14 to 19 preset channels in normal mode. In active mode, as many as six preset channels (15-20) may be used for loading word of Day (WOD). In the normal mode, the radio will not use the memory contents used for WOD storage as operating frequencies. Any of the preset channels 19-15 not used for the WOD may be used in the normal mode as preset channels.

c. Tone Switch.

(1) Prior to TOD reception, there is no change; it operates as a 1020 Hz tone transmission switch.

(2) After TOD has been received, it will transmit (TOD) followed by the 1020 Hz tone on the selected frequency.

(3) In conjunction with the A-3-2-T switch, starts the TOD clock within the radio. This is done by simultaneously selecting the "T" position and depressing the TONE button.

d. Preset Switch.

Stores selected frequency in selected preset channels in normal mode and WOD in active mode. WOD storage starts in preset 20 and may extend through preset 15. Those presets (19-15) not used for WOD may be used in the normal mode as preset channels.

OPERATIONAL PROCEDURES.

Existing capabilities of modified radios are preserved to the maximum extent possible when the radios are operated in their normal mode and no new procedures are required for normal radio operation.

To operate in the active mode, the radios must first be initialized (primed). This requires setting into the radio three control entries; i.e., Time of Day, Word of Day, and net number.

a. Time of Day (TOD).

(1) Correct TOD may be transmitted to a modified AN/ARC-164 by feeding the receiver with a radio signal carrying the proper time modulation. The signal may be provided by another modified radio which has the correct time or it may be provided by the ground-based clock SG-1192/TRC.

(2) TOD entry must be done after the radio is switched on. The clock inside the radio would lose time when the radio is switched off. TOD entry would normally be done on the ground prior to takeoff, although it can be easily done while in flight. This also permits time corrections in flight, when necessary.

(3) It is possible to transmit and receive timing information in both normal and active modes, by momentarily depressing the TONE button. In normal mode, a complete TOD message is transmitted; while in the active mode, only an updating time-tick is used. The purpose of the active mode time transmission is to allow a time update to take place in the event that a radio is drifting out of synchronization. An operator will know that his radio requires an update when incoming messages from several different radios do not sound as they should. If incoming messages from only one radio sound poor, then it is that radio which requires an update.

TIME OF DAY (TOD) AND TOD UPDATE RECEPTION.

a. Normal Mode. The radio will automatically accept only the first TOD message received after power up, whenever it occurs. Subsequent messages will be ignored unless the operator first selects the "T" position on the A-3-2-T switch. To receive time in normal mode, rotate the A-3-2-T switch to the "T" position and return to a normal channel (either manual or preset) on which TOD is being transmitted.

b. Active Mode. To receive a time update in active mode, rotate the A-3-2-T switch to the "T" position and then back to the "A" position.

**NOTE**

- Depressing the TONE button will send out a TOD update if in the active mode or a complete TOD message if in the normal mode.

- When the "T" position is selected, the radio will accept the next TOD received in either normal or active mode, provided that it arrives within one minute of the time the "T" position has been selected.

WORD OF DAY (WOD).

a. The WOD defines, for the radio, the choice of frequency-hopping pattern for the day. (The choice is a managerial function and the same WOD may be used for one or many days.)

b. WOD entry is normally done on the ground prior to takeoff, although it is possible to enter it while in flight. If the radio is switched off after the entry of WOD, the data will not be lost since it is entered into a nonvolatile memory.

c. The entry of WOD is accomplished by using preset channels 20 through 15. To enter a WOD, the radio is set to the preset mode starting at channel 20. At this point, a single or double beep will be heard indicating that the radio is ready to accept WOD entry. The first segment of the WOD is set with the manual frequency selector switch and the preset button is depressed to enter the WOD in non-volatile memory. The next channel is selected, the next WOD segment is set on the manual frequency selector switches, and the WOD segment is entered in non-volatile memory as before. The process is repeated, using successive channels until WOD entry is complete. Once the entire WOD is entered, it must be transferred to volatile memory. This is accomplished by returning to channel 20. A single or double BEEP will be heard. A single BEEP indicates the next lower channel needs to be selected. The operator continues selecting the next lower channel until the double BEEP is heard. This indicates the transfer has been completed.

d. When the radio is switched off, the WOD is not lost but stored in a non-volatile memory in the switching unit. When the radio is switched on, the WOD must be transferred from the non-volatile memory in the switching unit to the receiver-transmitter. This is done by selecting the preset mode and starting with preset channel 20, rotating the preset channel switch backwards. The operator will hear a single or double BEEP. A single BEEP indicates that entry of WOD is not complete but has been transferred and accepted. After the single BEEP is heard, the operator selects preset 19, 18, etc., and continues transferring WOD until a double BEEP is heard. This double BEEP indicates WOD transfer is complete.

e. Net Number. Once TOD and WOD have been entered, any valid active net number may be selected by using the frequency selector knobs.

OPERATION OF AN/ARC-164 IN THE ACTIVE MODE.

a. Rotate function control switch to the MAIN or BOTH position.

b. Select preset position with the mode control switch.

c. Enter word of day in presets 20 through 15 (starting with preset 20 and working back).

d. Select MANUAL or PRESET position with the mode control switch.

e. Enter TOD by selecting frequency on which TOD is being transmitted or by requesting a TOD transmission.

f. Select active net number on frequency selector knobs or any preset designation for active use.

g. Select "A" on the A-3-2-T switch.

**NOTE**

The radio may now be operated in the normal mode by deselecting the "A" position and selecting the desired frequency. A preset channel may also be selected. To return to the active mode, the operator must select the desired active net and then select "A" on the A-3-2-T switch. An audible tone will be heard in the headset when the active mode is improperly selected. The tone will be heard when the active mode is selected and:

- An invalid active net is selected, or;
- TOD has not been initially received, or;
- WOD has not been entered.

If the function switch is on BOTH and the active mode is selected, any transmission on the GUARD channel will take precedence over the active mode. If GUARD channel is being jammed, operator should then select MAIN on the function switch.

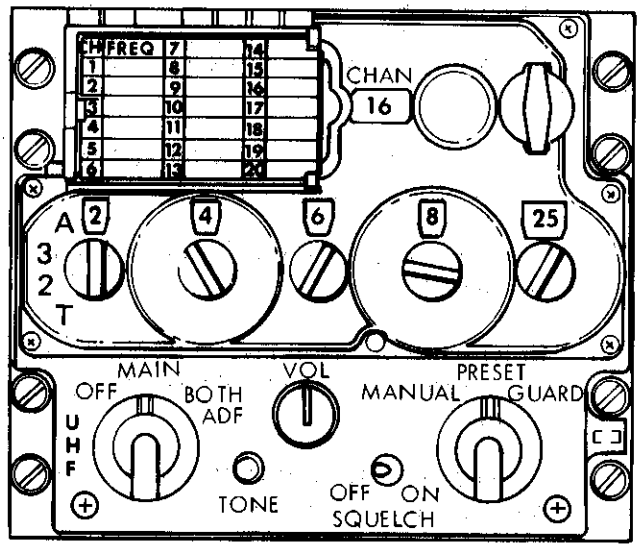



*Figure 4-9. AN/ARC-164(V) Modified Control Panel*

**Backup UHF Command Set (AN/ARC-108).**

CH-3E helicopters prior to [16] not modified by T.O. 1H-3-655 are equipped with the backup UHF command set (AN/ARC-108). The set (UHF-2) provides two-way communication between the helicopter and ground, or between aircraft, when the primary UHF system (AN/ARC-34B) is inoperative. The set operates on any one of three frequency channels in the frequency range of 242.0 to 244.0 megacycles. The UHF-2 receiver-transmitter is mounted on and controlled by a panel on the cockpit console. The control panel, marked UHF AUX, consists of a channel selector switch, with marked positions STANDBY, 1, 2, and GUARD, a volume control marked VOLUME, and a two-position function switch, marked ADV and RCV XMT. When the channel selector is in the STANDBY position, the AN/ARC-108 receives electrical power for standby operation. The AN/ARC-108 is not capable of transmitting with the channel selector switch in the STANDBY position. The GUARD position of the channel selector switch is set at 243.0 megacycles for emergency messages. The 1 and 2 positions of the channel selector switch provide selection of a preset frequency within the 242 to 244 megacycle range. The VOLUME control enables operation of the AN/ARC-108 at the desired audio level. When the function switch is placed in the RCV XMT position, the AN/ARC-108 will receive or transmit. When the switch is placed in the ADF position, the AN/ARC-108 will not transmit but will connect the direction finder (AN/ARA-25) to the AN/ARC-108, to indicate relative bearing from the helicopter to a transmitting UHF station. A power interlock relay will provide electrical power to the AN/ARC-108 in the event of failure of the UHF-1 (AN/ARC-34B), provided that the circuit breaker, marked EMER UHF, located on the dc essential portion of the ac nonessential circuit breaker panel, is depressed.

UHF COMMUNICATION SYSTEM ADDED — SEE 15-163

**Backup UHF Command Set Operation.**

To turn the set on:

1. Function switch (AN/ARC-34B) control panel — OFF.
2. UHF-2 switch (Intercommunication set control panel) — PULL OUT.
3. Function switch (UHF-2 control panel) — RCV XMT.
4. Channel selector (UHF-2 control panel) — 1 OR 2.
5. VOLUME control (UHF-2 control panel) — ADJUST TO DESIRED SIGNAL STRENGTH.

To transmit:

1. Transmitter selector knob (Intercommunication system control panel) — UHF-2.
2. Microphone trigger switch (cyclic stick grip) — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

To turn the set off:

1. Function switch (AN/ARC-34B control panel) — ON.

## FM COMMAND SET (FM-622A).

Helicopters CH-3E [16▸, HH-3E [25▸, or those helicopters modified by T.O. 1H-3-556 are equipped with a FM-622A radio set. The set provides two-way voice communication on any of the 920 channels available in the frequency range of 30.00 to 75.95 mc. All reception and transmission is routed through the intercommunication system control panels. The set is remotely controlled from a control panel located on the cockpit console. The control panel contains four frequency selector knobs, four frequency indicating windows, a squelch control switch, volume control, and a mode selector switch. The mode selector switch has marked positions OFF, T/R, RETRAN, and HOME. However, the RETRAN and HOME positions are not utilized with this installation. The set is turned on by placing the mode selector switch in the T/R (transmit-receive) position. The volume control, marked VOL, adjusts the audio output level of the set. The squelch control switch, marked SQUELCH, with marked positions DIS, CARR, and TONE, is used to select the desired squelch mode. The DIS position disables the squelch circuits. The CARR position provides normal squelch circuit in the presence of any carrier, and the TONE position provides selective calling (tone squelch) only on selected signals (signals containing a 150 cps tone modulation). The four frequency selection knobs are used to select the desired frequency, which will be noted in the frequency indicating windows. The frequency selector knob, located above and to the left of the squelch control switch, selects the tens megacycle digit of the operating frequency. The next frequency selector knob selects the unit megacycle digit of the operating frequency, and the next frequency selector knob selects the tenths megacycle digit. The last frequency selector knob selects the hundredths megacycle digit of the operating frequency. The set receives power from the dc essential bus through a circuit breaker, marked FM, located on the co-pilot's overhead circuit breaker panel.

### FM Radio Set (FM-622A) Operation.

To turn the set on:

1. Mode selector switch — T/R.
2. Frequency selector knobs — SELECT DESIRED FREQUENCY.

**NOTE**

A channel changing tone should be heard in the headset while set is tuning. When the tone stops, the set is tuned.

3. Squelch control switch — AS DESIRED.
4. FM switch (Intercommunication system control panel) — PULL OUT.
5. Volume control — AS DESIRED.

To transmit:

1. Transmitter selector knob (Intercommunication system control panel) — FM.
2. Microphone trigger switch (cyclic stick grip) — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

To turn set off:

1. Mode selector switch — OFF.

**NOTE**

In order to tune the FM set to frequencies higher than 69.95, it is first necessary to reduce the second frequency set knob back to 5 or below. For example, your set would now show 65.95 in the frequency windows. Now, the first frequency set knob can be rotated to show 7, and your set would be tuned to 75.95 megacycles.

## VHF COMMAND SET (VHF-101).

CH-3E helicopters prior to [16] not modified by T.O. 1H-3-655 are equipped with complete provisions for the VHF command set (VHF-101). CH-3E [16▸ helicopters modified by T.O. 1H-3-655 and all HH-3E helicopters are equipped with VHF-101. The set provides two-way voice communication between aircraft, or between the helicopter and the ground, in the frequency ranges of 116.0 to 149.95 megacycles. The system is remotely controlled from a control panel, marked VHF COMM, located on the cockpit console. The VHF command set can provide two modes of operation, the single channel simplex (SCS) and double channel simplex (DCS). However, this installation only uses the single channel simplex (SCS). The double channel simplex

(DSC) is inoperative. In SCS operation, the receiver is disabled during operation of the transmitter. The VHF command set control panel consists of a frequency indicator, a power switch, a mode selector switch, two frequency selector knobs, and a dual squelch and volume control. The set is turned on by placing the power switch, marked POWER with positions ON and OFF, to the ON position. The volume control knob, marked VOL, establishes the audio level of the receiver. A squelch control knob, marked SQ, located concentrically with the volume control knob is used to adjust sensitivity when there is no receiver signal input, and for fine adjustment of objectionable background noise. The frequency selector knob closest to the power switch, selects the frequency in megacycle increments (the numbers to the left of the decimal point), and the other frequency selector knob selects the frequency in 50-kilocycle increments (the numbers to the right of the decimal point). The two-position mode selector switch is labeled SCS and DCS. The DCD lettering on the DCS/DCD position of the switch refers to a mode of operation not utilized on this installation. When the mode selector switch is placed in the SCS position, the transmitter and receiver are tuned to the same frequency, and the receiver is disabled during operation of the transmitter. Operation is thereby restricted to either transmission or reception on the assigned channel. The VHF-101 is protected by two circuit breakers, marked VHF, located on the dc essential bus portion of the ac nonessential bus circuit breaker panel.

### VHF Command Set (VHF-101) Operation.

To turn the set on:

1. Power switch (VHF-COMM control panel) — ON.
2. VHF switch (Intercommunication control panel) — PULL OUT.
3. Mode selector switch — SCS.
4. Volume control — AS DESIRED.
5. Frequency selector knobs — TURN TO DESIRED FREQUENCY.

To transmit:

1. Transmitter selector knob (Intercommunication control panel) — VHF.
2. Microphone trigger switch (cyclic stick grip) — DEPRESS TO RADIO, SPEAK INTO MICROPHONE.

To turn set off:

1. Turn power switch (VHF-COMM control panel) — OFF.

ADDED : VHF/FM COMMAND SET (AN/ARC-186(V)) SEE 1S-16

### DIRECTION FINDER (AN/ARA-25).

The direction finder (UHF), AN/ARA-25, uses signals received by the UHF command set, AN/ARC-34B, AN/ARC-34C, or the UHF backup set on those helicopters so equipped, to indicate the relative bearing of and to home on radio signal sources. When a signal is being received, a 100-cycle-per-second tone is heard regardless of whether the incoming signal is amplitude-modulated or unmodulated. The 100-cycle-per-second tone is produced by a chopper in the antenna installation. The equipment is controllable from the remote control panel of the UHF command set, AN/ARC-34B, AN/ARC-34C, or UHF backup set, located on the cockpit console. Helicopters modified by T.O. 1H-3(C)C-555 are equipped with a pre-amplifier to increase range and sensitivity of weak signals. The pre-amplifier is controlled by a switch, located on the instrument panel, marked DFR RANGE with marked positions LONG and SHORT. When the switch is in the LONG position, the DFR range is increased and the sensitivity of weak signals increased and made more audible. However, it should be noted that when the switch is in the LONG position, the noise level may be increased to the point that it could be uncomfortable. When the switch is in the SHORT position, the set is in its normal operating position. When the direction finder is in operation and a signal is being received the magnetic and/or relative bearing of the transmitting station will be indicated by the No. 1 pointer on the pilot's and copilot's BDHI. The No. 1 pointer of the pilot's and copilot's BDHI also shows the magnetic and/or relative bearing of

transmitting stations as determined by the direction finder set, AN/ARN-59, when the AN/ARA-25 function switch is not in use. The magnetic bearing of the transmitting station will be indicated on the rotating compass card under the pointer. The AN/ARA-25 is protected by a circuit breaker, marked UHF/ADF, located on the dc essential bus portion of the ac nonessential bus circuit breaker panel. The antenna is equipped with a heating system which operates whenever the helicopter's ac electrical system is energized, and is protected by a circuit breaker, marked ARA-25 HEAT, located on the ac essential circuit breaker panel.

**NOTE**

If the AN/ARN-59 is on and in the compass position, and the AN/ARA-25 is in operation, the AN/ARA-25 will take precedence and control the No. 1 pointer. Transmission should not be attempted when in the UHF/DF (No. 1) position.

### Direction Finder (AN/ARA-25) Operation.

To turn the group on:

1. UHF-1 switch (Intercommunication system control panel) — PULL OUT.
2. Function switch (UHF control panel) — MAIN OR BOTH.
3. Channel selector switch (UHF command set control panel) — SELECT DESIRED CHANNEL FOR OPERATION.
4. Function switch (UHF command set control panel) — ADF.
5. DFR range switch — LONG OR SHORT AS REQUIRED.

To turn the group off:

1. DRF range switch — SHORT.
2. UHF control panel function switch — MAIN OR BOTH.

When using backup UHF:

1. Function switch (UHF control panel) — OFF.
2. UHF-2 switch (Intercommunication set control panel) — PULL OUT.
3. Channel selector switch (UHF AUX control panel) — 1 OR 2.
4. Function switch (UHF AUX control panel) — ADF.
5. DFR range switch — LONG OR SHORT AS REQUIRED.

### VHF DIRECTION FINDER (AN/ARA-25) (HELICOPTERS MODIFIED BY T.O. 1H-3-649).

The direction finder (VHF), AN/ARA-25, uses signals received by the VHF command set (VHF-101), (ADDED) to indicate the relative bearing for homing on the radio signal. The equipment is controlled from the UHF/DF VHF/DF switch located on the instrument panel. When the direction finder is in operation and a signal is being received, the No. 1 bearing pointer of the pilot's and copilot's BDHI will indicate relative bearing to the VHF homing signal source. The VHF signal will be heard in the pilot's and copilot's headset. SEE 13-161

To turn the group on:

1. Function switch (UHF control panel) — ADF.
2. Power switch (VHF-COMM control panel) — ON. A. ADDED : DFR-TA-DF SWITCH SEE 13-161
3. Frequency select knobs (VHF-COMM control panel) — SELECT DESIRED FREQUENCY.
4. VHF switch (intercommunication control panel) — PULL OUT.
5. UHF/DF VHF/DF switch — HOLD IN VHF/DF POSITION.

### DIRECTION FINDER SET (AN/ARN-59).

The direction finder set, AN/ARN-59, is an airborne radio compass system designed to automatically provide a visual indication of the direction from which an incoming radio frequency signal is received. It provides for aural reception of amplitude-modulated signals, through the intercommunication system, in the 190 to 1750 kilocycle range. This range is divided into three bands of 190 to

400 kilocycles, 400 to 840 kilocycles, and 840 to 1750 kilocycles. The equipment consists of a receiver, a loop antenna, a sense antenna, a control panel, and a dynamotor. When the AN/ARA-25 set is not in use, the No. 1 pointer on the pilot's and copilot's BDHI will display the magnetic or relative bearing of the station. The direction finder set is controlled from a panel, marked ADF, located on the cockpit console. The control panel includes a band switch, a volume-off control, marked VOL-OFF, a function switch, marked COMP, ANT, and LOOP, tuning control, a beat frequency oscillator switch marked BFO-ON, and a loop switch marked L and R. The volume-off control turns the set on or off and adjusts receiver audio level. When the function switch is placed in the COMP position, the set operates as a direction finder using both the sense and loop antennas. The tuning control is adjusted to give maximum indication on the tuning meter for any given station, and the magnetic bearing is automatically indicated by the No. 1 pointer on the pilot's and copilot's BDHI. When the function switch is placed in the ANT position, the set operates as a communication receiver using the sense antenna only. When the function switch is placed in the LOOP position, the set operates as a receiver using the loop antenna only. The loop switch positions the loop antenna when the function switch is in either the COMP or LOOP position. The BFO switch is used as an aid in the determination of aural nulls on either unmodulated or voice modulated signals. By placing the function switch in the LOOP position, the BFO switch in the ON position, and pressing the loop switch in the desired direction, the aural null can be determined when the tone drops to a minimum. The tuning crank tunes the receiver to the desired frequency within the selected band, and the tuning meter facilitates accurate tuning of the receiver. The AN/ARN-59 is protected by a circuit breaker, marked LF/ADF, located on the dc essential portion of the ac nonessential circuit breaker panel.

**Direction Finder Set Operation.**

To turn the set on:

1. ADF switch (Intercommunication system monitor panel) — PULL OUT.
2. Volume off-on control — ROTATE CLOCKWISE.
3. Function switch — ANT.
4. Band switch — SET DESIRED OPERATING BAND.
5. Tuning control — TUNE DESIRED FREQUENCY.
6. Volume off-on control — ADJUST AS NECESSARY.

To utilize the set as an automatic direction finder:

1. Function switch — COMP.

**Beat Frequency Oscillator Operation (BFO).**

In the event the ADF function is inoperative, use the following procedures for manual direction finding:

1. Function switch — ANT.
2. BFO switch — OFF.
3. Tune desired frequency for best audible signal.
4. Function switch — LOOP.
5. BFO switch — ON.
   Check the loop for maximum reception and retune for high pitch tone. Rotate the LOOP to zero tone and adjust volume for a 5 to 8 degree zero tone width.

The No. 1 pointer of the BDHI will either read the relative bearing of the transmitting station or be 180 degrees out. Check for this ambiguity.

To turn the set off:

1. Volume-off control — OFF.

## AIMS/IFF TRANSPONDER SYSTEM AN/APX-64(V).

The AIMS/IFF (identification friend or foe) transponder system provides automatic radar identification and altitude information of the helicopter to all suitably equipped challenging ground facilities, aircraft, and surface ships within line-of-sight. Mode 1, 2, 3/A, C, or 4 interrogation signals on a frequency of 1030 ± 1.5 megahertz are received by the system and decoded. The received signals are checked for valid code and proper mode, and if the

proper interrogating signal has been received, a coded reply is transmitted on 1090 ± 3.0 megahertz. In addition to these normal identification and altitude reply signals, specially coded identification of position (I/P) and emergency signals may be transmitted in response to interrogating signals. The I/P reply signal is used to distinguish between helicopters displaying identical coding and the emergency reply signal indicates an emergency of distress condition of the helicopter in flight. Normal identification operation, as well as transmission of the I/P emergency reply signals is accomplished in operating modes 1, 2, and 3/A. Mode 1 provides 32 code combinations, any one of which may be selected in flight. Mode 2 provides 4096 possible code combinations, only one of which is normally used in flight, since the code selection dials on the receiver-transmitter are preset before flight. Mode 3/A provides 4096 possible code combinations, any one of which may be selected in flight. Altitude interrogations and replies are accomplished in Mode C operation. The code for mode C is determined by the altitude of the aircraft and is encoded in 100-foot increments. Mode 4 operation provides a secure (encrypted) IFF capability through the use of a transponder computer with the AN/APX-64 transponder. The code for mode 4 must be preset into the computer prior to flight. The AIMS/IFF transponder system includes a test set that provides for go/no-go self-testing of the system in modes 1, 2, 3, and C. System self-testing for mode 4 operation is performed automatically by the transponder computer. The system consists of Radio Receiver-Transmitter RT-727 (APX-64(V), Transponder Control C-6280(P)/APX, Antenna AT-741/A, Antenna Switching Unit SA-1474/A, Altimeter-Encoder AAU-21/A, Altimeter AAU-27/A, Transponder Set Test Set TS-1843/APX, an IFF Antenna Switch, and Mount MT-3949( ) A/U with connector for Transponder Computer KIT-1A/TSEC. Primary power to operate the AIMS/IFF equipment is supplied from the helicopter ac essential bus and the 28-volt dc essential bus. AC electrical power is supplied to the receiver-transmitter and the altimeter encoder from the ac essential bus through the IFF circuit breaker panel. The receiver-transmitter supplies ac power to the antenna switching unit and the transponder computer. DC electrical power is supplied to the altimeter vibrators, the transponder control, and the receiver-transmitter from the dc essential bus through the IFF circuit breaker located on the dc essential portion of the ac nonessential circuit breaker panel.

### Receiver-Transmitter-Radio RT-727/APX-64(V).

The receiver-transmitter contains the primary receiving and transmitting circuits of the AIMS/IFF transponder system. It receives, decodes, and replies to the characteristic interrogation of operational modes 1, 2, 3/A, C, and 4. Absence of the transponder computer and the altimeter-encoder does not affect the operation of the receiver-transmitter except in modes 4 and C, respectively. The mode 2 four-digit reply code selection dials on the front panels select and indicate the mode 2 reply codes. Other than these switches, the receiver-transmitter is controlled by the positions of the switches and controls in the transponder control. The receiver-transmitter responds only to interrogating signals that correspond to the preset modes and codes. A test module enables a quick ground check to be performed in order to determine the operational condition of the receiver-transmitter on a go/no-go basis. The receiver-transmitter is located in the electronics compartment.

### Transponder Computer, KIT-1A/TSEC.

The transponder computer processes mode 4 interrogations and generates appropriate reply signals. These reply signals are then sent to the transponder for transmission. A caution light, marked IFF, located on the caution panel will illuminate when the IFF caution light circuit detects an inoperative mode 4 capability, providing the transponder computer is installed, aircraft power is on, and the IFF MASTER control is not off. Specific discrepancies monitored by the IFF caution light circuit are (1) mode 4 codes zeroized, (2) transponder failure to reply to a proper mode 4 interrogation, or (3) the automatic self-test function of the transponder computer reveals a faulty transponder computer. The transponder computer is located in the electronics compartment.

### Transponder Set Test Set TS-1843/APX.

The test set provides the capability of testing the AIMS/IFF transponder system on a go/no-go basis in all modes except mode 4. The test set is in the radio frequency path between the receiver-transmitter and the antenna switching unit. When one of the mode 1, 2, 3/A, or C switches are placed in the TEST position, interrogation pulse pairs for the selected mode are generated. These interrogations are applied to the receiver-transmitter to check for

proper receiver frequency, sensitivity, and decoding. The test set analyzes the resulting transmitter replies. If all tests are within specified limits, the test set causes the TEST light on the transponder control to illuminate, providing a go indication. Failure of a single test prevents the TEST light from illuminating, providing a no-go indication. The test set is located in the electronics compartment. A bypass cable may be used in lieu of the test set with subsequent loss of go/no-go testing capability for modes 1, 2, 3/A, and C. The bypass cable is mounted in clips near the test set.

### Transponder Control, C-6280(P)/APX.

The transponder control (figure 4-10) is located on the center cockpit console. The transponder control contains all of the controls normally required for operating the AIMS/IFF transponder system except for mode 2 selections as follows:

### Master Switch.

The MASTER switch (figure 4-10) has marked positions OFF, STBY, LOW, NORM, and EMER. In the OFF position, power is removed from the transponder. In the STBY position, the receiver-transmitter is energized and retained in standby condition. The LOW position permits transponder operation with reduced receiver sensitivity. The NORM position permits transponder operation at normal receiver sensitivity. The EMER position permits transponder operation at normal receiver sensitivity and replies with the codes dialed in on modes 1 and 2 plus emergency pulse signals on those modes. Mode 3/A responds with 7700 regardless of the dialed-in setting and mode C responds normally with pressure altitude. In EMER, modes 1, 2, 3/A, and C are operative regardless of the mode control switch positions.

### Mode Control Switches.

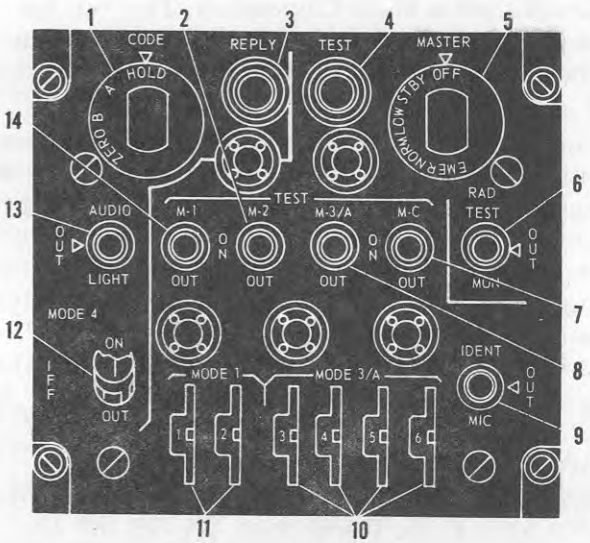
The mode control switches (figure 4-10) marked M-1, M-2, M-3/A and M-C, each have marked positions ON, OUT, and TEST. Placing a switch in the TEST (up) position enables the test set to locally interrogate the receiver-transmitter in that mode. The TEST light will illuminate to indicate the system is operating properly. Placing a mode control switch in the OUT position will deenergize that mode, provided the master control selector is not in the EMER position. With the mode control switches in the ON (center) position, each switch will operate as follows:

1. The M-1 switch (figure 4-10) controls mode 1 transponder operation and allows a code from 00 to 73 to be selected.

2. The M-2 switch (figure 4-10) controls mode 2 transponder operation.

3. The M-3/A switch (figure 4-10) controls mode 3/A transponder operation and allows a code from 0000 to 7777 to be selected.

4. The M-C switch (figure 4-10) controls mode C transponder operation.




1. MODE 4 SELECTOR KNOB
2. MODE 2 CONTROL SWITCH
3. REPLY LIGHT
4. TEST LIGHT
5. MASTER SELECT KNOB
6. RAD/MONITOR SWITCH
7. MODE C CONTROL SWITCH
8. MODE 3/A CONTROL SWITCH
9. I/P-OUT-MIC CONTROL SWITCH
10. MODE 3/A CODE SELECTOR
11. MODE 1 CODE SELECTOR
12. MODE 4 CONTROL SWITCH
13. MODE 4 AUDIO/LIGHT SWITCH
14. MODE 1 CONTROL SWITCH

*Figure 4-10. AN/APX-64 Transponder Control Panel (Transponder Set C-6280 (P)/APX)*

### IDENT-OUT-MIC Control Switch.

The IDENT-OUT-MIC switch (figure 4-10) controls identification of position (I/P) operations, when momentarily placed in the IDENT position (spring-loaded return to OUT), transmission of specially coded I/P reply signals to mode 1, 2, and 3/A interrogations is enabled. When the switch is placed in the MIC position, I/P reply signals are enabled when the UHF command transceiver is keyed by depressing the microphone-trigger switch on the cyclic stick. Either method will enable transmission of I/P reply signals for approximately 20 seconds. The OUT-position prevents triggering I/P signals.

### Mode 4 REPLY Light.

The mode 4 REPLY light (figure 4-10), marked REPLY, will illuminate to indicate valid mode 4 replies when the mode 4 AUDIO-OUT-LIGHT switch (figure 4-10) is in either the AUDIO or LIGHT position. The REPLY light will illuminate when pressed-to-test providing the AUDIO-OUT-LIGHT switch is not in the OUT position.

### TEST Light.

The TEST light (figure 4-10), marked TEST, illuminates when the transponder responds properly to mode 1, 2, 3/A and C test signals. The TEST light also illuminates when pressed-to-test.

### MODE 4 On-Out Switch.

The mode 4 ON-OUT switch (figure 4-10) controls the transponder mode 4 operation. The ON position enables the transponder system to reply to mode 4 interrogations. The OUT position disables mode 4 operation.

### Mode 4 Code Switch.

The Mode 4 CODE switch (figure 4-10) has marked positions HOLD, A, B and ZERO. When momentarily placed in the HOLD position, with the landing gear extended and power applied to the transponder system, the mode 4 code setting will be retained by the transponder computer when electrical power is removed. The mode 4 CODE switch is spring-loaded and will return to the A position when released. The A and B positions enable the transponder system to reply to mode 4 code A or B interrogations, respectively. The ZERO position cancels (zeroizes) the transponder-computer mode 4 codes. To prevent inadvertent mode 4 cancellation, the mode 4 CODE switch knob must be pulled out and then turned to HOLD. The mode 4 codes can also be cancelled by turning the MASTER switch to OFF or by removing power from the helicopters electrical system provided that HOLD has not be initiated.

### RAD/MONITOR Switch.

The RAD/MONITOR switch (figure 4-10) has marked positions RAD, TEST, OUT, and MONITOR. When the switch is placed in the RAD TEST position, it selects a unique mode for test purpose. When the switch is in the MONITOR position, the TS-1843 monitors all replies and illuminates the TEST light if the replies meet the TEST criteria. The OUT position is off.

### Mode 1 Code Selector.

The MODE 1 code selector (figure 4-10) is used to select a desired code from 00 through 73.

### Mode 3/A Code Selector.

The MODE 3/A code selector (figure 4-10) is used to select a desired code from 0000 through 7777.

### Antenna AT-741/A.

Two antennas are required for the AIMS/IFF transponder system. The antennas receive interrogation signals from other stations and radiate the reply signals generated in the receiver-transmitter. The AT-741/A antenna is mounted on the top of the fuselage and an AT-740/A (existing) on the bottom of the fuselage. Either or both antennas may be connected to the receiver-transmitter through the antenna switching unit which is controlled by the IFF antenna switch.

### Antenna Switching Unit SA-1474/A.

The antenna switching unit is connected in the radio frequency path between the antennas and the test set, or between the antennas and the receiver-transmitter when the test set is replaced with the bypass cable. The antenna switching unit is controlled by the IFF antenna switch and is mounted in electronics compartment.

### IFF Antenna Switch.

The IFF antenna switch is a three-position toggle switch with switch positions TOP, BOTH, and BOTTOM. In the TOP position the antenna switching unit connects the receiver-transmitter to the top antenna and to the bottom antenna in the BOTTOM position. When set to BOTH, the antenna switching unit alternately connects the receiver-transmitter to the top and bottom antennas at a rate of approximately 38 times per second. The IFF antenna switch is located on the instrument panel.

NOTE

Set the IFF antenna switch to the BOTH position for normal operation. When operation of the AIMS/IFF system is limited to only the top antenna, sensitivity of the system to interrogators below and to the rear of the aircraft will be reduced.

To place the IFF in operation, proceed as follows:

1. Set the master switch on the IFF panel to STBY for warmup (two minutes for normal ambient temperature or five minutes for extremely low ambient temperature).
2. Select the desired code with the code selectors or the mode control switches.
3. Set the IFF antenna switch to the BOTH position.
4. Set the IDENT-OUT-MIC switch to OUT.
5. For system self test:
   a. Set master switch to NORM.
   b. Set RAD TEST - OUT - MON switch to OUT.
   c. Momentarily hold each mode control switch to test, then return to OUT. Illumination of test light for each mode indicates a system go condition.
   d. The transponder computer automatically tests the mode 4 circuits. The IFF caution light will illuminate when a mode 4 no-go condition is detected.
6. Set mode control switches as required.
7. Perform mode 4 operations as briefed.

To turn the IFF off, pull up on the master switch and rotate to the OFF position.

NOTE

If it is desired to retain the mode 4 codes between flights, it is necessary to lock the codes into the transponder computer before turning the master control to OFF. Turning the master control to OFF, or removing power from the helicopter without first locking the codes into the transponder computer will zeroize the mode 4 codes. To lock the code, momentarily place the code control in the HOLD position after landing, and then proceed with the normal stopping procedure. When power is next applied, the transponder computer will again operate normally. If it is again desired to lock the codes in the transponder computer, it is necessary to repeat the HOLD procedure. The transponder computer will zeroize any time that power is applied and the CODE control is turned to ZERO, even if the HOLD function has been activated. Once the code is zeroized, the code is not available until reset.

To place the IFF in emergency operation, pull up on the master switch and rotate to the EMER position.

### RADAR TRANSPONDER (AN/UPN-25).

Helicopters modified by T.O. 1H-3-582 are equipped with an AN/UPN-25 radar transponder that increases the tracking range of X-band radars by receiving their pulsed interrogations and transmitting pulsed replies of much greater strength in the same frequency band. The system consists of receiver-transmitter RT-855/UPN-25, control 66PA6024, adapter assembly 66PA6025, and antenna AS-2038/UPN. The receiver-transmitter is an encoder-transponder that may be operated in either single pulse reply mode or code spaced double pulse reply mode. The transponder contains a ten-position rotatable switch, marked CODE SEL, that is preset

during ground maintenance. Position 1 places the transponder in single pulse reply mode only. The remaining nine positions place the transponder in double pulse reply mode and select the reply pulse code spacing. The adapter assembly contains a switching circuit to allow remote operation by a control located on the cockpit console. The control, marked AN/UPN-25, contains a selector switch with marked positions OFF, SINGLE PULSE, and DOUBLE PULSE. When the switch is placed in the SINGLE PULSE position, the transponder will transmit one reply pulse for each interrogation pulse received. When the switch is placed in the DOUBLE PULSE position, the transponder will transmit two reply pulses for each interrogation pulse received except when the transponder CODE SEL switch has been preset to position 1. The transponder is protected by a 1-amp circuit breaker, marked AN/UPN-25, on the dc essential bus.

**Transponder System Operation.**

To turn system on:

1. Control selector switch — SINGLE PULSE OR DOUBLE PULSE AS DESIRED.

NOTE

Warmup time is dependent upon temperature conditions. Up to 15 minutes may be required under extreme cold conditions.

To turn system off:

1. Control selector switch — OFF.

## RADIO SET (AN/ARN-65) (TACAN).

The radio set (TACAN) provides both bearing and distance indications to a surface selected navigation station. The magnetic bearing of the selected station is indicated by the No. 2 pointer on the pilot's and copilot's BDHIs and the course deviation indicators. A course to or from the station may be set into the course indicator with the set knob located on the lower left-hand side of the indicator. The course set will appear in an indicating window located on the top part of the indicator. Deviation from the course will be indicated by the course deviation indicators. The To-From indicator on the course indicator shows whether the course selected, if intercepted and flown, will take the helicopter to or from the station. The course indicator switch, located on the course selector panel, must be in the TACAN position for the course indicators to receive information from the AN/ARN-65 radio set. The course indicators also have a flag alarm system that appears when unreliable signals below minimum usage are received from the ground station or when the set is off. The range to the transmitting station is indicated by the distance indicators on the BDHIs. On those helicopters equipped with an OMNI navigation system (VOR-101), the information that is displayed on the BDHIs and course indicators, except for the range indication on the BDHIs, is dependent upon the position of the TACAN/VOR selector switches on the instrument panel. For TACAN information to be displayed on both the pilot's and copilot's BDHIs and course indicators, the copilot's selector switch must be in the TACAN MASTER position and the pilot's selector switch must be in the TACAN SLAVE position. The set is so designed that when the correct bearing or distance cannot be determined, the indicators will search or rotate in a manner that precludes the pilot from deriving improper information from them. The set is controlled from a panel, marked TACAN, located on the cockpit console. Controls include a three-position function switch, marked OFF, REC, and T/R, two channel selector knobs, marked CHAN, and a volume control knob marked VOL. When the function switch is placed in the REC position, only the receiver operates and only bearings are indicated. When the function switch is placed in the T/R position, both the receiver and transmitter operate and both bearings and distances are indicated. The set is turned off when the function switch is placed in the OFF position. The transmitter sends out a pulsed interrogation signal which triggers a reply signal from the selected beacon. The set measures the time lapse between the interrogation signal and the reply and converts this into a range indication. Identification of the selected station is accomplished by listening to the call letters received in International Morse Code through the intercommunication system monitor panel when the push-pull type switch, marked TAC, is pulled out. The strength of the tone signal is adjusted by the volume control knob marked VOL. The outer channel selector knob is used to set the units. Combination of dial settings from 01 to 129 may be made. However, the set only operates on channels 01 to 126, a total of 126 channels. The transmitter operates in a frequency range of 1025 to 1150 megacycles. The receiver operates in the frequency

ranges of 962 to 1024 and 1151 to 1213 megacycles. The radio set is protected by two circuit breakers, marked TACAN, one located on the dc essential portion of the ac nonessential circuit breaker panel and the other on the ac essential circuit breaker panel.

**NOTE**

In flight, crosscheck the TACAN bearing information periodically against other navigation equipment. This is necessary because improperly adjusted or malfunctioning TACAN equipment can result in lock-on to false bearing. The error will probably be plus or minus 40 degrees, but may be any value which is a multiple of 40 degrees, and can be either side of the correct bearing. If a false lock-on occurs, rechanneling from the selected channel number and back (preferably) from the opposite direction than the original setting) sometimes results in a correct lock-on. If this does not correct the error, turn the set off for a few minutes, then turn it back on. When using TACAN for instrument departures, penetrations, or letdowns, utilize ground radar monitor, when possible, to verify TACAN bearing information.

### Radio Set (TACAN) Operation.

To turn the set on:

1. Function switch — REC.

**NOTE**

Five minutes are required for warmup.

2. Channel selector knobs — SELECT CHANNEL.
3. TACAN button (Intercommunication system monitor panel) — PULL OUT.
4. Volume control — ADJUST AS NECESSARY.

**CAUTION**

No attempt should be made at any time to set the CHAN dial below channel 01 or above channel 126.

5. Function switch — T/R.

To turn the set off:

1. Function switch — OFF.

## TACAN AN/ARN-118(V).

The TACAN Navigation Set AN/ARN-118(V) is a polar coordinate navigation system that is used to determine the relative bearing and slant-range distance to a selected TACAN station. The selected TACAN station can be a ground, shipboard, or airborne station. The ground and shipboard TACAN stations are considered surface beacons. An airborne station only supplies slant-range distance information unless the aircraft is specially equipped with a bearing transmitter and rotating antenna. TACAN Navigation Set AN/ARN-118(V) is not capable of transmitting bearing information but does supply slant-range distance replies when interrogated. The TACAN Navigation Set has provisions for 126 X channels and 126 Y channels. The Y channels differ from the X channels in pulse spacing. The maximum operating range of the TACAN Navigation Set is 390 MNI when the selected TACAN station is a surface beacon and 200 NMI when the selected TACAN station is an airborne beacon.

**NOTE**

The Y channels were developed to alleviate congestion of the X channels but have not yet been implemented in AF ground stations. Use of Y channels is encouraged in air-to-air modes.

The AN/ARN-118 TACAN Navigation System is capable of providing a continuous indication of the bearing and distance of the airplane from any selected TACAN surface beacon located within a

line-of-sight distance up to 390 nautical miles. Bearing information is determined by the measurement of the phase difference between a reference bearing signal and a variable signal both transmitted by the surface beacon. The set receives power by two circuit breakers, marked TACAN, one located on the dc essential portion of the ac non-essential circuit breaker panel and the other on the ac essential circuit breaker panel. The determining factor as to whether TACAN information will be displayed on the No. 2 bearing pointers and course indicators is the position of the VOR/TACAN selector switches. The copilot receives TACAN information when the copilot's VOR/TACAN selector switch is in the TACAN MASTER position. The pilot receives TACAN information when the pilot's VOR/TACAN selector switch is in the TACAN SLAVE position. However, the pilot's CDI is slaved to the copilot's CDI. The pilot's TO-FROM indicator will give VOR information only.

## TACAN CONTROLS.

Controls for the TACAN systems are located on the cockpit console (figure 4-11). A five-position (OFF, REC, T/R, A/A, REC, A/A T/R) function switch selects the mode of operation. With the function switch in the REC position, only bearing information is received; with the switch in T/R position, both bearing and range data are received. The A/A T/R positions of the switch are the same as the REC and T/R positions, except that the TACAN system is transmitting and receiving signals to and from a suitably-equipped cooperating airplane rather than a ground station.

**NOTE**

The TACAN system can receive both distance and bearing information from other suitably equipped airplanes but can only transmit distance information.

**CAUTION**

The channel selector switch contains a built-in stop to prevent rotation past the nine (9) position on the units (ones) digit setting. Do not attempt to override the stop. Reverse direction when the stop is reached.

The channel selector tunes the equipment to any of 126 frequency channels. The volume control knob varies the volume of the audio signals received from the surface beacon and heard through the intercommunication system. The manual self-test provides a test of the complete TACAN system except for the antennas.

### Manual Self-Test of TACAN System.

To initiate self-test, select a course of 180 degrees, place the function switch in the T/R position, and allow 90 seconds for warmup. Depress the test button and observe that the indicator illuminates for about one second; and that for about seven seconds, the DME flags come into view and the bearing pointers indicate 270 degrees. For the next fifteen seconds, the flags go out of view, the DMEs indicate 000.0 ($\pm$ 0.5), the bearing pointers indicate 180 ($\pm$ 3) degrees, the course deviation bar centers to within $\pm$ 1/2 dot, and the TO-FROM arrow indicates TO. When the self-test is complete, all indicators return to indications displayed prior to initiation of self-test. A failure is recorded on the indicator light if the light stays on during the test; however, the test can be performed again in the REC mode. If the indicator light does not come on in the REC mode, the malfunction is isolated to the transmitter section and the bearing information is valid.

**CAUTION**

Bearing and/or distance indications may still be present when the TEST lamp is on. Such indications could be either partially usable or grossly inaccurate. They should be crosschecked, using every available means. Be prepared for the possibility of TACAN equipment failure if the TEST lamp illuminates.

### Automatic Self-Test of TACAN System.

An automatic self-test occurs when the receiver signal becomes unreliable or the signal is lost, to ensure that the TACAN system is operating properly. The results of the automatic self-test are the same as for the manual self-test, except that the DME flags and the NAV flags remain in view.

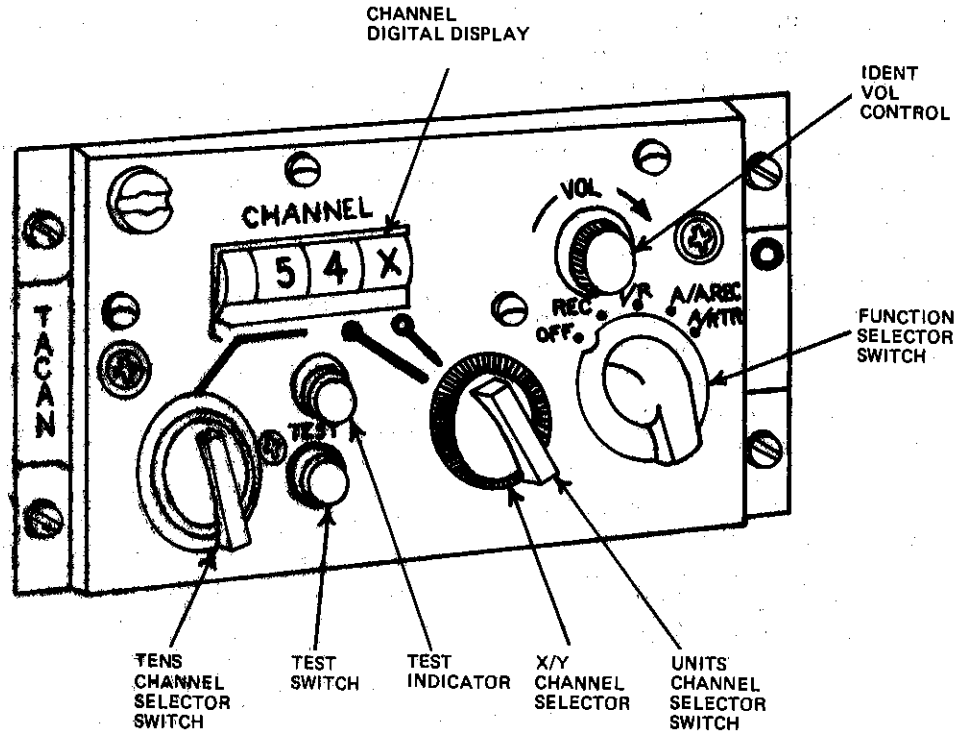



*Figure 4-11. Tacan Control Panel (AN/ARN-118(V)) (Typical)*

**Air-to-Air Modes.**

**A/A T/R Mode.**

In the A/A T/R mode, the AN/ARN-118(V) interrogates a cooperating airplane and receives slant range distance information. If the cooperating airplane has bearing transmitting capabilities, bearing information is also received. Up to five airplanes can receive slant range from one cooperating airplane at one time.

**A/A Rec Mode.**

In the A/A REC mode, only bearing can be received; however, the cooperating aircraft must have bearing transmitting capabilities.

In Air-to-Air modes, the receiving airplane must select a channel 63 channels above or below the cooperating airplane channel. Use of the Y channels is recommended to prevent possible DME interference. Also, to prevent interference from IFF or transponder signals, select Y channels or select X channels between 11 and 58 or 74 and 121.

Normal Operation of the TACAN.

a. Place the VOR/TACAN selector switch to the desired position.

b. Place the function switch to desired position. Allow a 90-second warmup period.

c. Turn the channel selector knobs to the desired channel.

d. TACAN button (Intercommunication System Monitor Panel) — PULL OUT.

e. Volume control — ADJUST AS NECESSARY.

**To Turn The Set Off.**

1. Function switch — OFF.

## HF COMMUNICATION SYSTEM (HF-103).

The HF communication system, HF-103, provides airborne voice communications in the frequency range of 2.0 to 29.999 megacycles. The system is a multi-channel single side band (SSB) transmitting and receiving unit, capable of transmitting or receiving on any one of 28000 selected frequencies. The system is remotely controlled from a control panel, marked HF, located on the copilot's console. The control panel contains a mode selector switch, marked OFF, USB, LSB and AM; four frequency selector knobs; and an r-f gain control knob, marked RF SENS. When the mode selector switch is placed in the USB position, a mechanical filter is selected which allows only the frequencies on the upper side band to pass through the filter. When the mode selector switch is placed in the LSB position, a mechanical filter is selected that filters out the upper side band frequencies and allows only the lower side band frequencies to pass through the filter. When the mode selector switch is in the AM position, only the upper side band frequencies are allowed to pass through the filter and a 500-kc carrier is reinserted at the filter output. The HF button, located on the intercommunication system control panel, must be pulled out to receive voice communications. The r-f gain control knob, marked RF SENS, is used to control the r-f gain of the transmitter-receiver. The HF-103 set is protected by two circuit breakers marked HF. One is located on the DC essential portion of the AC nonessential circuit breaker panel and the other marked AC essential on the AC essential circuit breaker panel.

**HF Communication System Operation.**

To turn the set on:

1. Mode selector switch — AS DESIRED.
2. Frequency selector knob — SELECT FREQUENCY.
3. Transmitter selection (Inter panel) — HF.
4. HF knob (Inter panel) — PULL OUT.
5. Mike switch — MOMENTARILY KEY (wait until tuning tone is no longer heard).
6. Volume control — ADJUST.

To turn the set off:

1. Mode selector switch (HF control panel) — OFF.

**WARNING**

The HF (103) radio must not be used when personnel are on the left sponson.

## RECEIVING SET (AN/ARN-58) (ILS).

The receiving set (ILS) combines the instrument landing and marker beacon receiving systems to provide complete instrument landing system (ILS) reception for the helicopter. The localizer receiver converts signals into usable indications through the pilot's and copilot's course indicators to display the position of the helicopter with respect to the localizer course. The localizer receiver also powers flag indicators on the course indicators to inform the pilot when an unreliable signal is being received. The glide slope receivers give the position of the helicopter with respect to the glide path. The localizer and glide slope receivers indicate position through the course indicators, and the marker beacon indicates passage of the helicopter over a marker beacon transmitter, serving either as an airway marker or runway approach marker, by aural tones and a green marker beacon light on the course indicators. The system receiving sets are remotely controlled by a receiver control, marked ILS, located on the main console. On those helicopters equipped with an OMNI navigation system (VOR-101), the system receiving sets are remotely controlled through the OMNI navigation system control panel, marked VHF NAV, located on the cockpit console. The system is operated by placing the power switch, marked POWER, in the ON position and selecting the proper frequency by use of the frequency selector knobs. The frequency selector knob nearest to the power switch selects the frequency in megacycle increments (the numbers to the left of the decimal point), and the other frequency knob selects the frequency in kilocycle increments (the numbers to the right of the decimal

point). Localizer information is received, and the VOR function is disabled, when a localizer frequency (between 108.1 and 111.9 megacycles) has been selected.

**Receiver Control.**

The receiver control, marked ILS, located on the cockpit console, controls all receivers for the system. The control panel contains a frequency selector knob, marked FREQ; a power switch, marked POWER and OFF; and a volume control knob, marked VOL. The frequency selector knob is used to select the desired localizer frequency. The properly paired glide slope frequency is automatically obtained when the desired localizer frequency is selected. Electrical power is supplied to the system by placing the power switch in the POWER position. When the course indicator switch, located on the course selector panel, is placed in the ILS position, the radio set (TACAN), AN/ARN-65, is disconnected from the course deviation indicator (CDI) of the course indicator. The CDI of the course indicator is utilized by the localizer receiver to display the position of the helicopter with respect to the localizer course. The volume control knob is used to control the volume of the aural output of the receiver. The AN/ARN-58 is protected by a circuit breaker, marked ILS, located on the dc essential portion of the ac nonessential circuit breaker panel.

**Localizer Receiver Operation.**

The localizer receiver operates in the frequency range of 108.1 to 111.9 megacycles arranged into 20 channels. The localizer transmitter, located in proximity to the center of the runway, sends a 150-cps modulated signal to the right of the inbound localizer course and a 90-cps modulated signal of the same frequency to the left of the inbound localizer course. The localizer course is formed along the line of equal strength of the frequency modulated signals and is centered on the instrument runway. When the receiver is set to a desired frequency, the 90-cps and 150-cps signals are detected, amplified, and separated by a filter. The two signals are then differentiated and fed to the (CDI) to show deviation from the localizer course . The push-pull type switch, marked VHF NAV, located on the intercommunication system monitor panel, must be pulled out to receive aural identification.

**Glide Slope Receiver Operetion.**

The glide slope receiver operates in the frequency range of 329.3 to 335.0 megacycles arranged into 20 channels. The glide slope transmitter, located in proximity to the touchdown point on the runway, sends a 90-cps modulated signal above the glide slope course and a 150-cps modulated signal below the glide slope path for a range of approximately 15 miles depending on the condition of the receiver. When the set is receiving a desired frequency, the 90-cps and 150-cps signals are detected, amplified, and separated by a filter. The signal is then fed to the glide slope indicator (GSI) of the course indicator to show deviation from the glide slope path. The inner edges of the localizer and glide slope field pattern coincide and form a vertical and horizontal helicopter flight path to the runway.

**Marker Beacon Receiver Operation.**

The marker beacon set provides a visual and aural indication of the passage of the helicopter over 75-mc beacons. A beacon can be identified by an audio tone, through the intercommunication system, and by visual indication of a green marker beacon light, located in front of the pilot and copilot on the course indicators. The passage over any marker beacon will cause both aural and visual indications to the pilot. The pilot is thus informed of his approximate distance from the end of the runway when making an approach, or is informed of his position on an airway. The push-pull type switch, marked MKR-BCN, located on the intercommunication system monitor panel, must be pulled out to receive aural identification. The marker beacon receiver is on any time the dc essential bus is energized.

**COURSE INDICATOR (TYPICAL).**

Two course indicators (figure 1-17) are mounted on the instrument panel, one in front of the pilot and the other in front of the copilot. The course indicator has a course set knob in the lower left corner, a press-to-test marker beacon light in the upper right-hand corner, a course selector window, a course deviation indicator (CDI), a glide slope indicator (GSI), course and glide slope deviation scales, a heading pointer, and a TO/FROM window. The course set knob is used to set a course in the course selector window. The TO/FROM indicator

indicates whether the course selected, if intercepted and flown, will take the aircraft to or from the navigational facility. The heading pointer indicates the aircraft heading relative to the course in the course selector window. When the OMNI navigation system (VOR-101) is installed, the course indicator will display VOR/ILS or TACAN information. The course indicator will present TACAN information when the VOR/TACAN selector switch is in the TACAN position. The course indicator will present VOR/ILS information when the selector switch is in the VOR position. Regardless of the selector switch position, control of the course set for TACAN operation remains in the copilot's course indicator and control of the course set for OMNI remains with the pilot's course indicator. The heading pointer receives heading information from the J-4 compass, bearing information from the radio set (TACAN), and indicates the number of degrees that the helicopter heading deviates from the course set in the course window. A warning flag, marked OFF, located on the course deviation indicator, will appear when TACAN signals are weak, unreliable, or nonexistent. The GSI, marked GLIDE SLOPE, receives a signal from the glide slope receiver when the course indicator switch is in the VOR MASTER or VOR SLAVED position. The GSI will indicate the position of the helicopter with respect to the ILS glide path. During localizer receiver operation, the CDI of the course indicator displays the position of the helicopter with respect to the ILS course. The light, marked MARKER, will illuminate to provide visual indication of the passage of the helicopter over a marker beacon. The two flag indicators, one on the CDI and one on the GSI, will appear to inform the pilot that an unreliable signal is being received during ILS operations.

**NOTE**

- The TO/FROM indicator on the pilot's course indicator always presents information relative to VOR course selections, and the TO/FROM indicator on the copilot's course indicator presents information relative to the TACAN course selections regardless of the position of the VOR/TACAN selector switches.

- The course set knob on the pilot's course indicator always controls VOR course selection and the course set knob on the copilot's course indicator controls TACAN course selection regardless of the position of the VOR/TACAN selector switches.

- On helicopters CH-3E ▶16◀, HH-3E ▶25◀ and helicopters modified by T.O. 1H-3-640, to have TACAN indications displayed on the pilot's course indicator, the pilot's VOR/TACAN selector switch must be in the TACAN SLAVE position.

## BEARING-DISTANCE-HEADING INDICATOR (BDHI).

The bearing-distance-heading indicators (figure 1-14)), located in front of the pilot and copilot on the instrument panel, provide complete steering and distance information. The instrument consists of an outer azimuth card, numerically marked in 30-degree increments with cardinal headings marked N, E, S, and W, and linear markings at 5-degree increments; a fixed reference index; a pointer, marked No. 1; a pointer, marked No. 2; and a range indicator. The azimuth card, coupled to the J-4 compass system, rotates in the face of the instrument to indicate the magnetic heading of the helicopter on the scale underneath the fixed reference index at the top of the indicator. The No. 1 pointer shows the magnetic and relative bearings of transmitting stations, as determined by the direction finder sets. The No. 2 bearing pointer receives signals from the radio set (TACAN) to indicate the magnetic bearing of the helicopter to the beacon selected on the TACAN set. When the VOR-101 OMNI navigation system is installed, the No. 2 bearing pointer of the pilot's BDHI will indicate the magnetic and relative bearings to the VOR station whenever the pilot's VOR/TACAN selector switch is in the VOR MASTER position, and to the TACAN station whenever the VOR/TACAN selector switch is in the TACAN SLAVE position. The No. 2 bearing pointer of the copilot's BDHI will indicate the relative bearing to the VOR station when the copilot's VOR/TACAN selector switch is in the VOR SLAVE position, and the TACAN station whenever the VOR/TACAN selector switch is in the TACAN MASTER position. The range indicator is connected to the radio set (TACAN) and indicates the distance from the helicopter to the transmitting station.

**NOTE**

On helicopters CH-3E 16▸ , HH-3E 25▸ and those helicopters modified by T.O. 1H-3-640, to have TACAN bearing information displayed on the pilot's No. 2 bearing pointer, the VHF NAV control panel power switch must be in the ON position and the pilot's VOR/TACAN selector switch must be in the TACAN SLAVE position.

## SECURE SPEECH KY-28 SYSTEM.

The secure speech KY-28 system is installed on those helicopters modified by T.O. 1H-3-557 that are equipped with AN/ARC-34B UHF and FM-622A FM command sets. The system is operated from a control panel located on the center cockpit console for CH-3E helicopters and on the aft end of the pilot's console for HH-3E helicopters. The system is operated by placing the master power switch in the ON position and the mode selector switch in the PLAIN position. An amber indicator light on the control panel is illuminated when the mode selector switch is in the PLAIN position. The system receives power from the dc essential bus through a circuit breaker, marked KY-28, located on the copilot's circuit breaker panel.

## OMNI NAVIGATION SYSTEM (VOR-101).

Helicopters CH-3E 15▸ , HH-3E 25▸ , and those helicopters modified by T.O. 1H-3-640 are equipped with an OMNI navigation system (VOR-101) (figure 4-12). The system provides the pilots with the capability to select, identify, and maintain a predetermined fixed course with reference to both a VOR (very high frequency OMNI directional range) and a LCL (localizer) ground station. The system operates in conjunction with the glide slope and marker beacon receiver to provide the helicopter with an instrument landing system (ILS). The system operates in the frequency range of 108.0 to 117.9 megacycles. VOR information is received, and the LCL function is disabled, when a VOR frequency (even tenths of a megacycle) has been selected. LCL information is received, and the VOR function is disabled, when a LCL frequency (odd tenths of a megacycle in the frequency range of 108.1 to 111.9 megacycles) has been selected. The properly paired glide slope frequency is automatically obtained when the desired LCL frequency is obtained, and the marker beacon set is on any time the dc essential bus is energized. Deviation information is reflected on the course deviation indicator. Magnetic and relative bearings are reflected on the No. 2 bearing pointer of the BDHIs, depending on the mode selected.

**NOTE**

The system also has the capability of receiving VHF transmissions, provided a VHF frequency above 117.9 megacycles has been selected on the VOR navigation system control panel.

### OMNI Navigation System Control Panel.

The OMNI navigation system control panel, marked VHF NAV, located on the cockpit console, controls all receivers for the system. The control panel contains a frequency indicator, a power switch, two frequency selector knobs, and a dual squelch and volume control. The system is turned on by placing the power switch, marked POWER, with marked positions ON and OFF, to the ON position. The volume control, marked VOL, establishes the audio level of the receiver. A squelch control knob, marked SQ, located concentrically with the volume control knob, is used to adjust sensitivity when there is no receiver signal input, and for fine adjustment of objectionable background noise. The frequency selector knob closest to the power switch selects the frequency in megacycle increments (the numbers to the left of the decimal point), and the other frequency selector knob selects the frequency in kilocycle increments (the numbers to the right of the decimal point). Even tenths of a megacycle frequency selects VOR operation and the odd tenths of a megacycle frequency selects LCL operation.

### VOR/TACAN Selector Switches.

The VOR/TACAN selector switches (figure 1-14), one each for the pilot and copilot, are located below their respective BDHI. The pilot's switch has marked positions VOR MASTER and TACAN SLAVE, and the copilot's switch is marked TACAN MASTER and VOR SLAVE. When the pilot's switch is in the VOR MASTER position, his CDI and No. 2 bearing pointer (BDHI) will display VOR course information and will display TACAN course information when his switch is in the

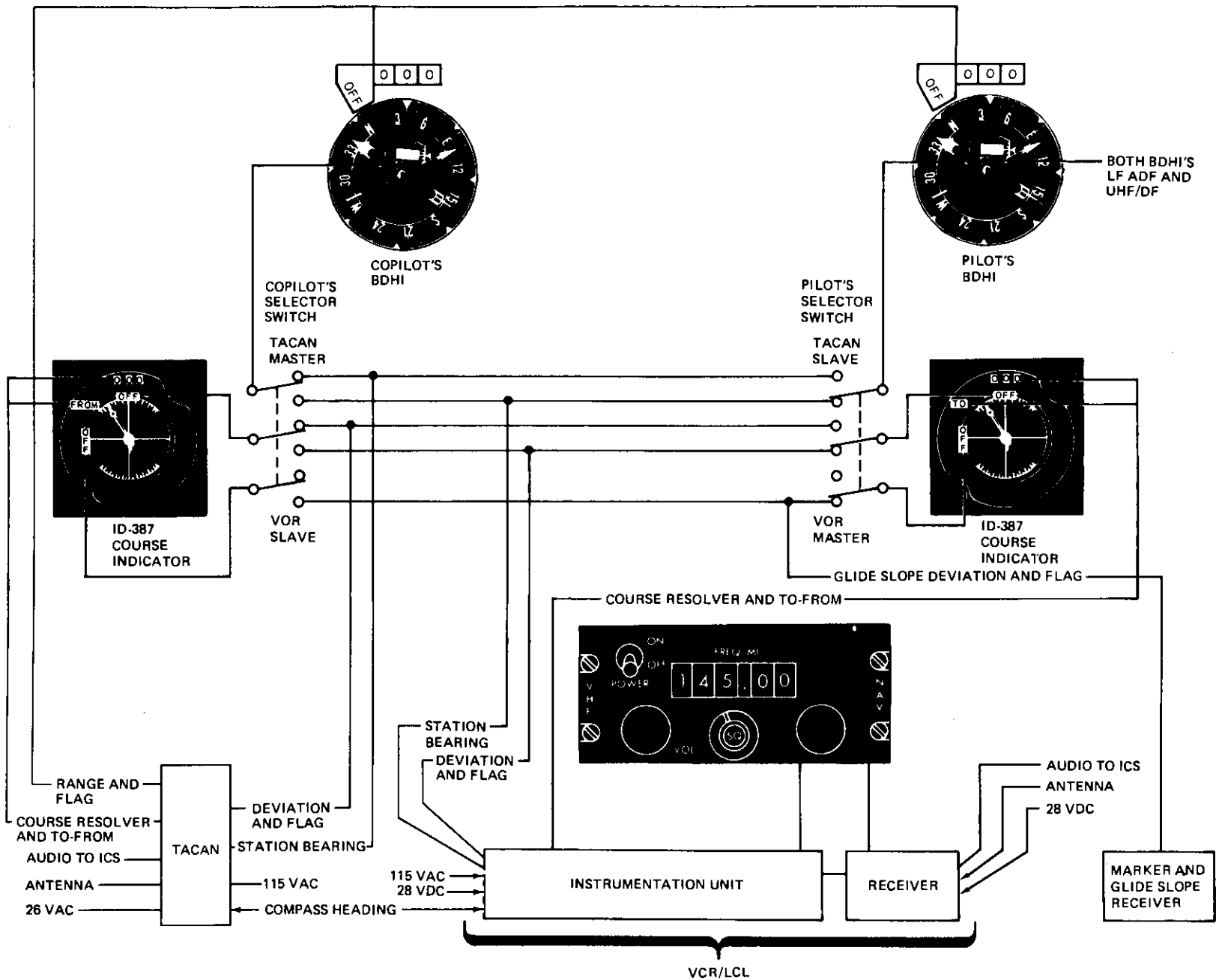



*Figure 4-12. OMNI Navigation System (VOR-101) Block Diagram*

TACAN SLAVE position regardless of the position of the copilot's switch. When the copilot's switch is in the VOR SLAVE position, his CDI and No. 2 bearing pointer (BDHI) will display VOR course information and will display TACAN course information when his switch is in the TACAN MASTER position regardless of the position of the pilot's switch.

NOTE

After completion of TCTO 1H-3-717, the VOR/TACAN selector switches will provide TACAN bearing on the No. 2 needle when ILS is tuned and selected.

## RADAR ALTIMETER SET AN/APN-171(V).

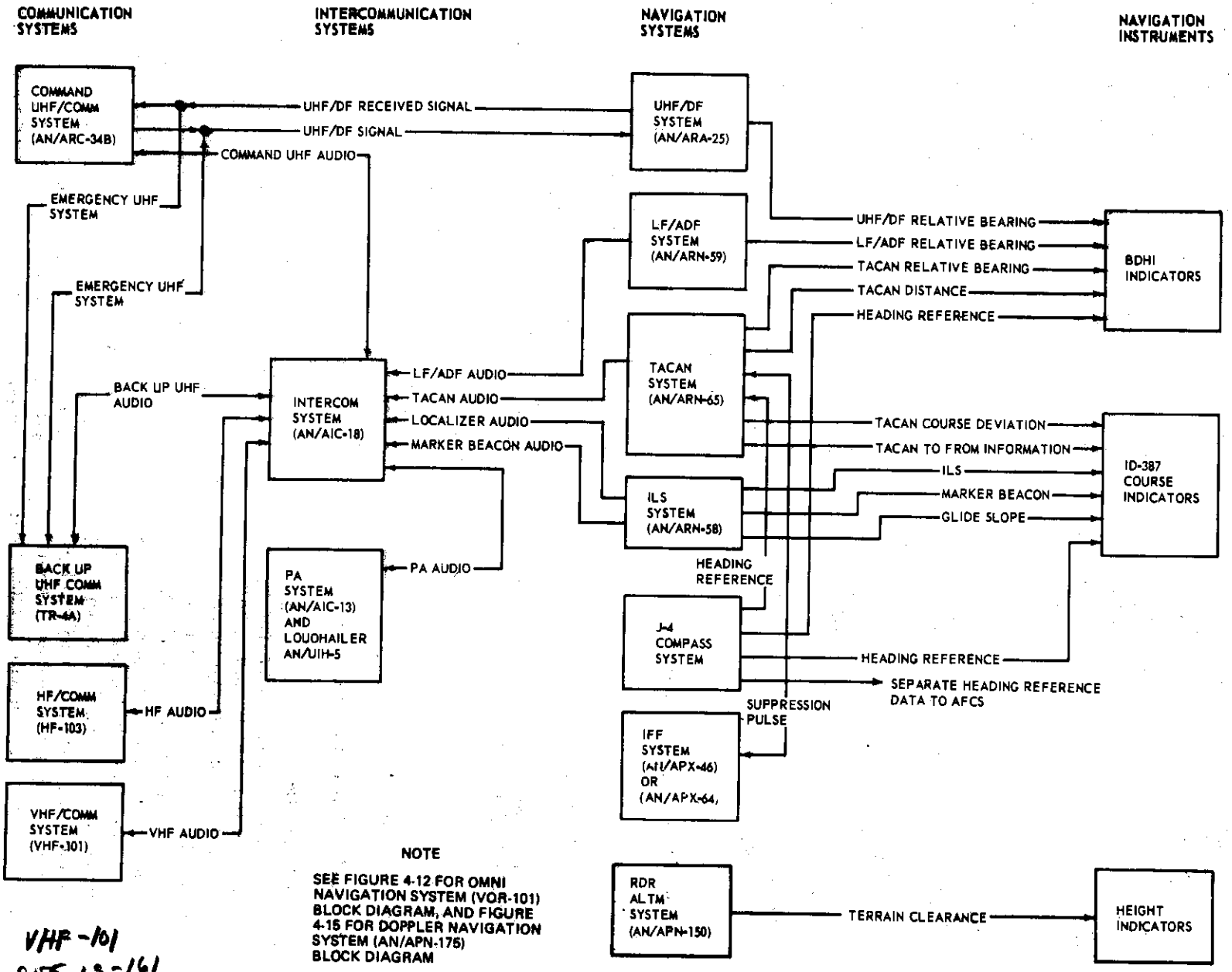
HH-3E helicopters 32▸ or those helicopters modified by T.O. 1H-3-611 are equipped with a Radar Altimeter Set AN/APN-171(V). The altimeter set provides instantaneous terrain clearance between the helicopter and terrain from 0 to 5000 feet. Altitude, in feet, is visually depicted by the two radar altimeter indicators (figure 4-14) located on the instrument panel in front of the pilot and copilot. A control knob on the lower left side of the indicator is a multi-purpose switch. It serves as a test switch, a low level warning index set control and an on/off power switch. The set is turned on by rotating the control knob, marked PUSH-TO-TEST, clockwise from the OFF position. Continued clockwise rotation of the control knob toward the SET position will permit the pilot to select any desired low altitude limit, which will be indicated by the low level index marker on the indicator. Depressing the PUSH-TO-TEST control knob provides a testing feature of the set at any time or altitude, which gives a visual indication of 100 ± 15 feet on the indicator if the set is functioning properly. Releasing the PUSH-TO-TEST control knob restores the set to normal operation. A low level warning light, located on the lower right side of the indicator, will illuminate and show the marking LOW any time the helicopter is at or below the selected altitude. Loss of system power or tracking condition will be indicated by a black and yellow striped flag which appears in the indicator window, located in the lower center portion of the indicator. If the system should become unreliable, the black and yellow striped flag will appear and the pointer will go behind the mask marked NO TRACK. The set is powered by the ac and dc essential buses and is protected by two circuit breakers marked RDR ALTM. One is located on the pilot's ac essential bus circuit breaker panel and the other is located on the copilot's dc essential bus circuit breaker panel. On helicopters modified by TCTO 1H-3-643, the low level warning light is dimmed when the caution and advisory lights are dimmed.

## ALTIMETER SET ELECTRONIC (AN/APN-150).

Helicopter prior to CH-3E 16 not modified by T.O. 1H-3-611 are equipped with an altimeter set electronic (AN/APN-150). The altimeter set provides continuous indication of height (terrain clearance) of the helicopter from 0 to 1000 feet over land and water. Altitude in feet is shown by two altimeter indicators (figure 1-14), located on the instrument panel in front of the pilot and copilot. The altimeters are provided with two controls. However, only the pilot's controls will operate the set. The copilot's control is inoperative. A control knob, marked ON-ALT supplies electrical power for operation of the altimeter and mechanically positions the low altitude limit cursor (BUG) on the indicator dial. A flag indicator, marked either FAIL/ON or OFF/ON, is incorporated in the instrument. A FAIL or OFF flag indicates that either a malfunction exists or that the system has not been turned on. Interruption of power to the flag indicator will display the FAIL (OFF) portion of the flag in the window. When the helicopter is above 1000 feet, the FAIL (OFF) flag will show and the pointer will go behind the mask. A caution light, marked ALTITUDE LOW, comes on whenever the helicopter is below the altitude preselected by the low limit cursor (BUG). The AN/APN-150 set is protected by two circuit breakers, marked RDR ALTM, one located on the ac essential bus circuit breaker panel and the other located on the overhead dc circuit breaker panel.

NOTE

When flying more than 1000 feet above the ground with the APN-150 turned on, the FAIL (or OFF) portion of the FAIL/ON (OFF/ON) indicator will be displayed until the aircraft is at or below 1000 feet above the ground.




VHF-101
SEE 13-161

*Figure 4-13. Navigation Communication System Block Diagram (Typical)*

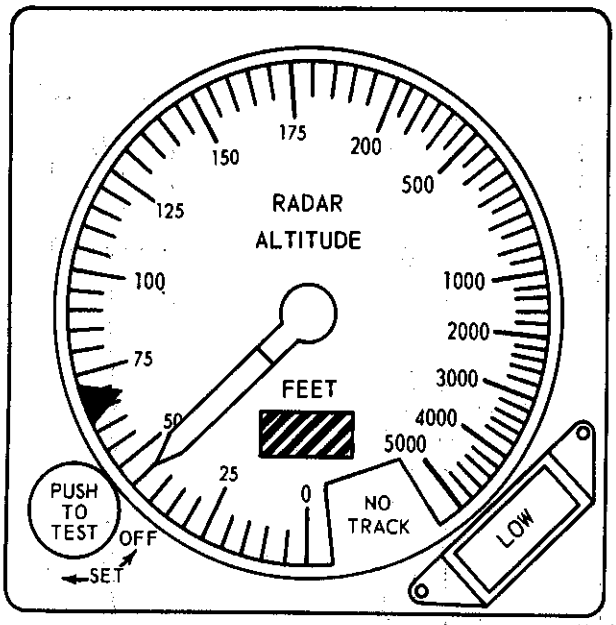



*Figure 4-14. Radar Altimeter Indicator AN/APN-171(V) (HH-3E 32▸ or Helicopters Modified by T.O. 1H-3-611)*

### Altimeter Set Electronic Operation.

To turn the set on:

1. ON - ALT switch — ON.
2. ON - ALT switch — SET (BUG) TO DESIRED ALTITUDE.

To turn the set off:

1. ON - ALT switch — OFF.

## NAVIGATION SET RADAR (AN/APN-175(V).

Helicopters CH-3E 16▸ and HH-3E 25▸ are equipped with a navigation set radar. The navigation set consists of sensor group and a doppler computer group. The system is augmented by magnetic heading information from the J-4 compass system, a true airspeed transducer, and AFCS vertical gyro inputs to stabilize the antenna of the sensor group in pitch and roll (figure 4-15). The AFCS indicators are also utilized to reflect along track, across track, and vertical velocity displays in the hover mode of operation, below 25 knots ground speed. Along track information is displayed by the horizontal bar and across track information is displayed by the vertical bar, each circle representing 5 knots groundspeed. Vertical velocity information is displayed by the left-hand pointer, with each division representing 500 feet per minute. HH-3E helicopters 32▸ or those helicopters modified by T.O. 1H-3-611 are equipped with a radar altimeter set AN/APN-171(V) that eliminates the present altimeter function of the AN/APN-175(V)-2 and the altitude indicators.

HH-3E helicopters 25▸ are equipped to display altitude above the terrain, as determined by the sensor group, on the altitude indicators. The navigation set operates on 115 volts alternating current from the radio ac essential bus and is protected by two circuit breakers, marked DOPPLER COMPT, located on the pilot's overhead circuit breaker panel. The doppler blower operates on 115 volts alternating current from the radio ac essential bus and is protected by three circuit breakers, marked DOPPLER BLOWER, also located on the pilot's overhead circuit breaker panel.

### Sensor Group.

The sensor group is a lightweight airborne group which operates at a frequency of 13,325 megacycles through an altitude range of 2 to 30,000 feet. The set consists of a receiver-transmitter, a frequency tracker, an antenna, and a blower. The blower is provided to cool the operating components and for fume elimination in the doppler compartment. The transistorized receiver transmitter produces a frequency-modulated signal of 13,325 megacycles to the transmitting antenna, which transmits and receives four beams in a square pattern to the land or water below. There are two forward and two backward beams. The signals returned to the antenna by the reflecting surface are received by the frequency-tracker as forward and backward doppler signals from the receiver-transmitter, which produces a single frequency equal to the center frequency of the summed totals of the forward and backward signals, and provides error voltages to align the antenna with the ground track. The horn excited waveguide-type antenna is mounted on the bottom of the lower fuselage. The antenna contains one transmitting and two receiving waveguide assemblies. The antenna will rotate with drift angle changes of the helicopter up to a maximum of 90 degrees, left or right, at a minimum rate of 6 degrees per second. The antenna receives pitch and roll information from either the

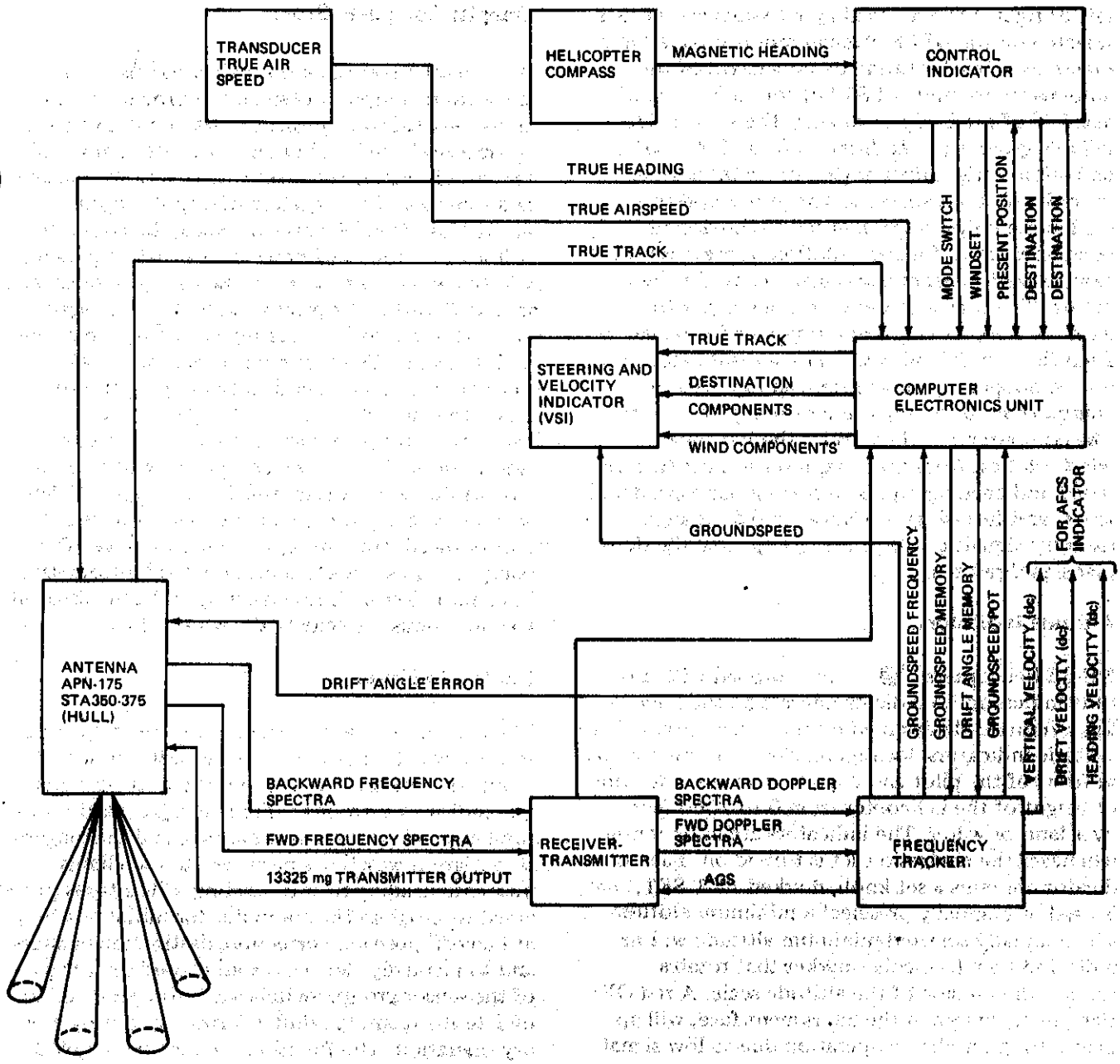



*Figure 4-15. Navigation Set, Radar, System Block Diagram*

left or right AFCS vertical gyro (whichever gyro is selected on the AFCS channel monitor panel) and maintains a level attitude by movement of the antenna up to limits of 35° of roll (left or right) and 10° of pitch (up or down). The set provides reliable groundspeeds, from —50 to +390 knots, and left and right drift angles, up to 90 degrees, over all reflective surfaces. The groundspeed and drift angle outputs are then fed to the doppler computer group for computation of present position, as well as bearing and distance to the destination. The sensor group works in conjunction with the doppler computer group, and is operated from the control indicator. The set will detect any loss of doppler signal and send an input to the computer group to initiate a memory operation. The computer will then utilize the last reliable wind solution from the navigation set, use true airspeed and heading inputs to solve groundspeed and track, and furnish groundspeed and drift angle memory signals to the sensor group until the doppler signal returns.

**Altitude Indicators.**

HH-3E helicopters 25▸ are equipped with altitude indicators to indicate aircraft altitude above the terrain, as determined by the sensor group. The altitude indicators, located on the instrument panel in front of the pilot and copilot, provide indication of height of the helicopter from 0 to 2500 feet over land or water. The indicators are in operation whenever the navigation set is turned on. Each indicator contains a set knob, marked ALT SET, that is used to manually preselect a minimum altitude. The manually selected minimum altitude will be indicated by a triangular marker that rotates around the outside of the altitude scale. A red OFF flag, incorporated in the instrument face, will appear during unreliable operation due to low signal strength, when the altimeter becomes faulty, or upon loss of electrical power. A memory light, marked PRESS-TO-TEST, located on the top right-hand corner of the indicator, will illuminate whenever the navigation set is in memory operation.

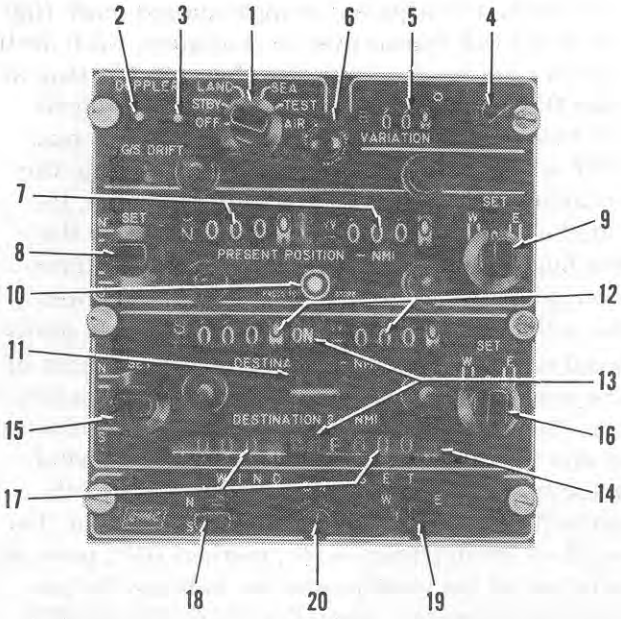
On HH-3E helicopters 32▸ or those helicopters modified by T.O. 1H-3-611, the altitude indicators are removed and replaced with radar altimeter indicators.

**Doppler Computer Group.**

The doppler computer group is a transistorized navigation computer designed to provide continuous calculation of present position relative to an operator-selected grid origin (or center point), distance and bearing to a destination, and windspeed and direction. During a loss of doppler signal or erratic data from the sensor group, the computer will also use the last known or manually updated windspeed and direction to calculate groundspeed and drift angle. The group consists of a navigation computer, a velocity steering indicator, and a control indicator. The group has a memory mode of operation to ensure continuity of computation when tracking information is not available from the sensor group, and an air data mode of operation to permit use of the equipment when operation of the radar transmitter is not desired. Other features of the group include visual displays of groundspeed, true track, and wind velocity. The computer uses track and groundspeed information, in conjunction with true heading and true airspeed, to continuously calculate the wind velocity.

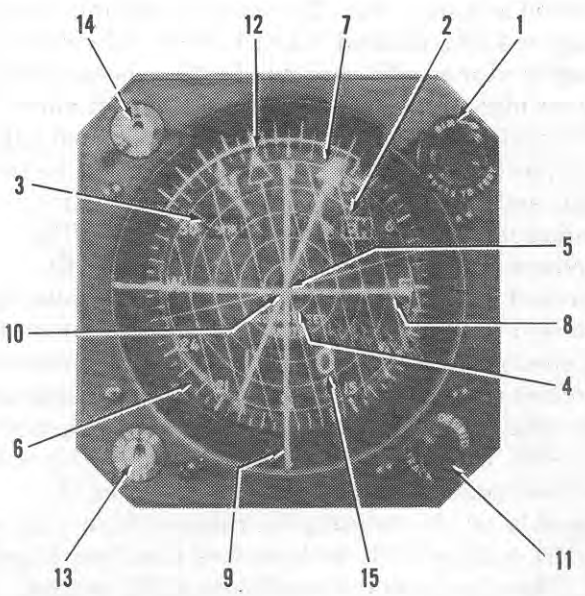
**Control Indicator.**

The control indicator is the master control for the entire navigation set, controlling both the sensor group and the doppler computer group. The control indicator provides a digital counter readout of present position, two destinations, and the magnetic variation which has been inserted to change magnetic heading to true heading. Circuitry is provided to program the computer for initial position at takeoff, position correction, destination changes, and to manually slew the groundspeed drift angle of the sensor group. Switches are also provided to update the memory wind information during memory operation. The function selector switch, with marked positions OFF, STBY, LAND, SEA, TEST, and AIR, (figure 4-16) selects the mode of operation for both the sensor group and the doppler computer group. Placing the function switch in the OFF position turns off both groups. The STBY position places the equipment in a standby mode of operation and allows slewing of the present position and destination readouts. The STBY position is also used for pre-takeoff programming. The velocity steering indicator caution light (figure 4-17)




1. FUNCTION SELECTOR SWITCH
2. DOPPLER SLEW TEST SWITCH
3. DOPPLER DRIFT SWITCH
4. VARIATION SET KNOB
5. VARIATION DIGITAL COUNTER
6. PRESS-TO-TEST COMPUTER MALFUNCTION CAUTION LIGHT
7. PRESENT POSITION DIGITAL COUNTERS
8. PRESENT POSITION N-S SET KNOB
9. PRESENT POSITION W-E SET KNOB
10. PRESS-TO-STORE BUTTON
11. DESTINATION SELECTOR SWITCH
12. DESTINATION 1 DIGITAL COUNTERS
13. DESTINATION ON/OFF FLAGS
14. DESTINATION MASH (ORANGE COLOR)
15. DESTINATION N-S SET KNOB
16. DESTINATION W-E SET KNOB
17. DESTINATION 2 COUNTERS
18. N-S WIND SET KNOB
19. W-E WIND SET KNOB
20. WIND SET KNOB (PRESENT DIRECTION)

*Figure 4-16. Control Indicator (C6586/AYA-3)*




1. VELOCITY STEERING INDICATOR MEMORY CAUTION LIGHT
2. MEMORY FLAG
3. SCALE SELECTED WINDOW
4. CONCENTRIC RANGE CIRCLE
5. CENTER MARKER
6. STATIONARY COMPASS CARD
7. TRACK POINTER
8. HORIZONTAL BAR
9. VERTICAL BAR
10. VERTICAL AND HORIZONTAL BAR INTERSECTION
11. DESIRED TRACK KNOB
12. DESIRED GRID
13. WIND SWITCH (SET/READ)
14. SCALE SWITCH
15. GROUND SPEED DIGITAL COUNTER

*Figure 4-17. Velocity Steering Indicator (ID-1282/AYA-2)*

will illuminate and the memory flag (figure 4-17) will show MEM whenever the function switch is in the STBY position. The LAND position is used for normal operation over land, and the SEA position is used for normal operation over water. The AIR position places the equipment in an air data mode of operation when it is desired to operate the equipment to escape detection by radar transmitter operation. When the switch is placed in the TEST position, the computer will be placed in a self-test mode of operation and the sensor group is placed in a standby mode. The velocity steering indicator caution light (figure 4-17) will illuminate and the memory flag will indicate MEM. The present position counters will change values, and the vertical and horizontal bars of the vertical steering indicator will indicate the relationship between present position and the destination. The doppler slew and test switch (figure 4-16), with marked positions DOPPLER and G/S,is used to manually slew the groundspeed information. Placing the switch in the DOPPLER position will increase groundspeed, and placing the switch in the G/S position will decrease groundspeed (for testing purposes). The doppler drift switch (figure 4-16), marked DRIFT, is used to manually slew the sensor group antenna (for testing purposes). The antenna will slew to the right when the switch is held in the up position, and to the left when held in the down position. The press-to-test memory caution light (figure 4-16), located to the right of the function switch, will be illuminated continuously in the event of a computer malfunction, or intermittently to indicate that the present position counter is being

slewed at a slow rate. The variation digital counter (figure 4-16), marked VARIATION, indicates the degree of magnetic variation that has been manually set into the system by the variation set knob. The variation set knob (figure 4-16), located adjacent to the variation counter, is pulled out to engage and allow manual insertion of magnetic variation up to 99.9 degrees, east or west. The present position digital counter (figure 4-16), marked PRESENT POSITION - NMI, indicates the present position, north or south and east or west, in relation to a selected point. The north or south present position reading is slewed at a variable rate by rotating the rheostat knob (figure 4-16), marked SET, with marked positions N and S. The east or west present position reading is slewed at a variable rate by rotating the rheostat knob (figure 4-16), marked SET, with marked positions W and E. When the push button (figure 4-16), marked PRESS-TO-STORE and located below the present position counter is depressed, the computer will store present position calculations while the pilot corrects the present position counter settings. Depressing the button a second time will cause the computer to update the stored present position information to the present position counters. The PRESS-TO-STORE button will be illuminated when the stored facilities are active. The DESTINATION digital counters (figure 4-16), that are marked DESTINATION 1 and DESTINATION 2, indicate destinations in nautical miles north or south and east or west of an operator designated grid origin (or center point). Both are slewed at a variable rate by rotating the adjacent set knobs. The knob (figure 4-16), marked SET, with marked positions N and S, is used to slew the north or south settings of the destination counter not being used. The knob (figure 4-16), marked SET, with marked positions W and E, is used to slew the west and east settings of the destination counter not being used. The SET rheostats can only be used to slew the counters for the inactive destination. A destination selector switch (figure 4-16), located between the two destination counters, is used to select the desired destination counters and connect the SET rheostat knob to the inactive counters. When the switch is placed in the up position, destination 1 counters are selected and the SET rheostats are connected to the number 2 destination counters. When the switch is placed in the down position, destination 2 counters are selected and the SET rheostats are connected to the number 1 counters. When a destination counter is not in operation, a transparent orange colored mask (figure 4-16) will appear over the counters. Each destination counter also has a flag (figure 4-16) that will read ON, when the counter is active, to indicate the counter cannot be slewed. The flag will read OFF when the counter is inactive to indicate the counter can be slewed. Two wind set knobs, located on the bottom of the indicator under the heading WIND SET, are used to slew wind direction. The knob (figure 4-16), with marked positions N and S, is used to slew the north and south wind velocity, which is shown by displacement of the horizontal bar on the velocity steering indicator. The knob (figure 4-16) with marked positions W and E, is used to slew the east and west wind velocity which is shown by displacement of the vertical bar on the velocity steering indicator. The wind set knob (figure 4-16), marked DIR, permits rotation of the track pointer to indicate the present wind direction when the WIND-READ-SET switch (figure 4-17) on the velocity steering indicator is operated.

**Velocity Steering Indicator (VSI).**
(See figure 4-17.)

The velocity steering indicator, located on the instrument panel, provides a visual display of a selected destination relationship to the present position. The present position is represented by the center mark, which is an etched mark that is in the center marker (figure 4-17) of the concentric rings on the indicator dial. The selected destination is represented by the intersection of horizontal and vertical bar indicators. The horizontal bar (figure 4-17) represents the north or south distance component from present position to the destination, and the vertical bar (figure 4-17) represents the east and west distance component from present position to the destination. The intersection (figure 4-17) of the vertical and horizontal bars indicates destination bearing and the distance to the destination from the present position. The scale markers (figure 4-17) are concentric range circles that provide short, medium, and long distance scales. The scale selected is indicated in a window (figure 4-17) located on the upper left-hand portion of the indicator. The short scale indicates a range of 0 to 10 nautical miles, the medium scale indicates a range of 0 to 100 nautical miles, and the long scale indicates a range of 0 to 1000 nautical miles. Appropriate scales are selected by use of a scale switch, (figure 4-17)

marked X10 SCALE X3, located on the upper left corner of the indicator. The X10 switch position selects the next lower range scale, when the distance to the destination has decreased to within the limits of the lower scale. If the helicopter should overfly the selected range, the scale will automatically change when the limit of the scale in use is reached. The spring loaded X3 position is used to expand the distance-to-go by a factor of three for a five second period, or as long as the switch is held, to make steering easier by allowing the track pointer to be more accurately aligned with the intersection of the horizontal and vertical bars. The track pointer (figure 4-17) rotates around a compass card to indicate true track. True track is maintained to a selected destination by turning the helicopter until the track indicated by the track pointer coincides with the destination bearing indicated by the intersection of the vertical and horizontal bars. The stationary compass card (figure 4-17), calibrated in 5-degree increments from 0 to 360 degrees, is used to facilitate track and wind direction readout. The wind set switch (figure 4-17), marked SET WIND READ, is located on the lower left corner of the indicator. Placing the wind switch in either the SET or READ position, converts the velocity steering indicator from a position indicator to a wind velocity indicator. When used as a wind velocity indicator, the concentric range rings read from 0 to 50 knots, with the space between each ring being equal to 10 knots. The intersection of the vertical and horizontal bars, in relation to the center of the velocity steering indicator, indicates the end of the wind vector. The distance from the center of the velocity steering indicator to the intersection of the vertical and horizontal bars represents wind velocity. The track pointer may be rotated by the DIR knob, located on the control indicator panel, to find the intersection of the cross bars on the VSI to provide readout of wind direction. The wind switch is placed in the SET position to manually program the wind. When the wind is being manually programmed, the N and S and E and W wind set knobs, located on the control indicator, are used to position the vertical and horizontal bars, and the DIR knob, also located on the control indicator, positions the track pointer to correspond to the required wind direction. When the wind has been set, the wind switch is returned to its neutral position. Wind is manually programmed to update the wind velocity when operating in the air data mode and when required to surface wind velocities prior to takeoff. The READ position of the wind switch is spring-loaded to neutral. When the switch is held in the READ position, the velocity steering indicator will display either the wind velocity computer from the sensor group, when operating in the normal mode of operation (the last reliable wind velocity stored in the memory circuits when operating in the memory mode), or the memorized or manually programmed wind velocities when operating in the air data mode. The desired track knob (figure 4-17), marked DESIRED TRACK, located on the lower right hand corner of the indicator, is used to manually rotate the desired track grid. The desired track grid overlay (figure 4-17) contains parallel lines with the center line having an arrowhead. The center line is referred to as the desired track pointer. The track grid is rotated until the desired course for a selected leg is indicated by the desired track pointer on the compass card. A traverse line running through the center of the grid and perpendicular to the desired track pointer is used to determine the distance the helicopter may have deviated from the planned course. This is accomplished by noting the distance measured along the traverse line between the center of the indicator and an imaginary line running parallel to the desired track pointer through the intersection of the vertical and horizontal bars. The groundspeed digital counter (figure 4-17), located in the center of the indicator, indicates groundspeed from 0 to 499 knots. The memory flag, located on the upper right side of the indicator, will show MEM when operating in any mode of operation other than the land or sea modes of operation. The press-to-test memory caution light, located on the upper right corner of the indicator, will illuminate to indicate that the navigation set has lost doppler signal or become unreliable, or that the wind set switch is in the SET position.

**True Airspeed Transmitter.**

The true airspeed transmitter accepts pitot and static pressure from the pilot's pitot tube, and free air temperature from a free air temperature sensor, to produce an electrical signal representative of the true airspeed of the helicopter. True airspeed is applied to the computer to be used in the memory and air data modes of operation and for wind velocity calculation.

**Navigation Set, Radar Sample Problem.**

NORMAL PROCEDURES.

Flight Planning. (See figure 4-18).

Obtain a map upon which grid lines oriented to a true north are drawn, or use a nautical mile grid overlay. On the map to be used, select a convenient origin to be designated as coordinates "zero-zero" on the intersection of the grid lines, or a geographically substantiated and easily identifiable landmark. It is usually desirable to use the helicopter operating base as the origin. Locate the destination or destinations in terms of coordinates north or south and east or west of the origin. Obtain the difference between the latitudinal coordinates of the origin and the destination. One minute of latitude is equal to one nautical mile for the purpose of setting N-S counters. Obtain the difference between the longitudinal coordinates of the origin and the destination. Because of the convergency of the meridians of longitude as they approach the earth's poles, one minute of longitude is equal to one nautical mile only at the equator. In order to obtain nautical miles for purposes of setting the E-W counters, first multiply the difference of the longitudinal coordinates by the cosine of the mid-latitude between the origin and the destination. All destinations selected must be located in reference to the same origin. Using a protractor, determine the desired track for each leg. Obtain the best available wind information for the planned cruise altitude at the point of takeoff. If this is not available, use surface winds.

NOTE

- Mileages for one degree of longitude at any latitude may also be found directly in several navigational texts.
- Because the earth is not a perfect sphere, one degree of latitude varies slightly from 60 miles but is not significant in the use of the doppler navigator.

Before Takeoff.

1. Function switch — STDBY.

   Allow one minute of warmup time for fully reliable doppler operation before takeoff.

2. Variation set knob — PULL TO SET MAGNETIC VARIATION.
3. Wind switch (VSI) — PLACE IN WIND SET POSITION.
4. Wind set DIR knob (control indicator) — ROTATE UNTIL THE TRACK POINTER ON THE VSI INDICATES THE PRESENT WIND DIRECTION.
5. Wind set knobs (control indicator) — SLEW CROSS BARS ON THE VSI TO INTERSECT THE TRACK POINTER AT THE CIRCLE CORRESPONDING TO THE WIND VELOCITY.

   Each circle indicates 10 knots.

6. Wind switch (VSI) — CENTER.
7. Set in present position at this point, if possible.

NOTE

Moving the wind set knobs will insert a different wind whenever the doppler is operating in STANDBY, AIR DATA, or MEMORY modes. The velocity steering indicator will not display this changing wind unless the wind-read-set switch is operated.

8. Function switch — TEST.
   a. VSI MEMORY caution light — ON.
   b. Memory flag — MEM.
   c. Preset position counters — POSITION INCREASES AT APPROXIMATELY 5 MILES PER MINUTE.
   d. VSI cross bars — SLEW TO INDICATE DESTINATION AND PRESENT POSITION RELATIONSHIP.
9. Function switch — STDBY.
10. PRESENT POSITION SET knobs — SLEW PRESENT POSITION TO THE EXACT COORDINATES OF THE BASE (usually zero - zero).