NAVIGATION RADIOS AND SENSORS

DIRECTION FINDER GROUP AN/ARA-25 (UHF/VHF/VHF-FM/ADF) SYSTEM

The direction finder group AN/ARA-25 is employed to indicate the relative bearing of, and to home on, radio signal sources received by the UHF, VHF, and VHF (FM) COMM systems. The relative bearing to the signal source is read as a continuous magnetic bearing by the No. 1 pointer of both pilot's RMIs. When a signal is being received, a 100 cps tone is heard. Some bearing instabilities will be observed in normal maneuvering due to propagation characteristics of the received signal. Good homing service will result under straight and level conditions. Due to antenna losses on the UHF/COMM and VHF/COMM radios in the ADF mode of operation, ranges are considerably less than standard UHF and VHF operation. A radio frequency amplifier has been incorporated in the direction finder group to compensate for the loss in signal for the two bands and thus increase the range of the ADF homing equipment. The antenna for the directon finder group is electrically heated continually while the AN/ARA-25 is in operation. The antenna heater is powered by the No. 2 ac primary bus. The circuit is protected by a circuit breaker on the pilot's circuit breaker panel, marked UHF ANT HEAT ϕA under the general heading No. 2 AC PRI. The direction finder group is powered by the primary bus and 26 volts ac from the radio autotransformer. The direction finder group dc primary circuit is protected by a circuit breaker on the pilot's circuit breaker panel, marked UHF ADF under the general headings DC and PRI.

DIRECTION FINDER GROUP System Controls

The direction finder group can be turned on by turning on UHF, VHF/COMM, or VHF-FM sets. The radio frequency amplifier is controlled by a two-position switch, marked LONG and SHORT under the general headings RANGE and DF MODE, on the VHF/UHF switch panel (figure 4-30). The panel is on the center console. When the switch is at LONG, the radio frequency amplifier is on and the direction finder range is increased. However, it should be noted that when the switch is at LONG, the noise level may be increased to the point it is uncomfortable. When the switch is at SHORT, the amplifier is off and the AN/ARA-25 is operating normally. A RMI selector switch (figure 4-38) on the instrument panel, marked NO. 1 with marked positions LF/ADF and UHF/VHF DF, must be at UHF/VHF DF in order for the No. 1 pointer on the RMI to home on the UHF/VHF/VHF-FM signals.

NOTE

Care must be taken to make sure that at close range the radio frequency amplifier switch is in the SHORT position. If this precaution is not taken, the possibilty exists that homing information will be lost due to excessive RF strength.

DIRECTION FINDER GROUP Operation

To turn set on using UHF/COMM system:

1. Function Switch (UHF/COMM Control Panel) - ADF.

2. ICS Monitor Selector/Volume Control - UHF.

3. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.

4. Mode Selector (UHF/COMM Control Panel) - AS REQUIRED.

5. Frequency Selector (UHF/COMM Control Panel) - AS REQUIRED.

6. Volume Knob (UHF/COMM Control Panel) - AS REQUIRED.

7. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

To secure UHF/COMM homing feature:

1. Function Switch (UHF/COMM Control Panel) - AS REQUIRED.

2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

To turn set on using VHF/COMM system:

1. ICS Monitor Selector/Volume Control - VHF.

2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.

3. VOL OFF Switch (VHF/COMM Control Panel) - ON.

4. Frequency Selectors (VHF/COMM Control Panel) - AS REQUIRED.

5. Squelch Control (VHF/COMM Control Panel) - AS REQUIRED.

6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

7. Momentary ADF Switch (VHF/COMM Control Panel) - DEPRESS.

To secure VHF/COMM homing feature:

1. Momentary ADF Switch (VHF/COMM Control Panel) - RELEASE.

SEE 05-30

To turn set on using VHF-FM/COMM system:

1. ICS Monitor Selector/Volume Control - FM.

2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.

3. Frequency Selector Switches (VHF-FM Control Panel) - AS REQUIRED.

4. Volume Control (VHF-FM Control Panel) - AS REQUIRED.

5. Squelch Control (VHF-FM Control Panel) - AS REQUIRED.

6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

7. Function Selector Switch (VHF-FM Control Panel) - ADF.

To secure VHF-FM/COMM homing feature:

1. Function Selector Switch (VHF-FM Control Panel) - AS REQUIRED.

2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

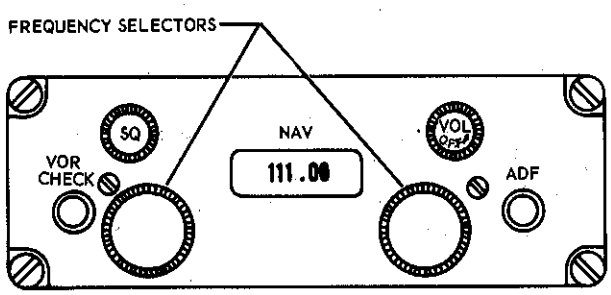


Figure 4-37. VHF/NAV Radio AN/ARN-87

VHF/NAV RADIO SET AN/ARN-87(V)

The VHF/NAV system AN/ARN-87(V) is composed of a receiver, a navigation converter unit, and a control panel. The receiver is designed to operate on crystal controlled channels spaced 50 kHz apart over the 108.00 through 135.95 MHz range. The navigation converter unit accepts navigation signals from the receiver when the receiver is tuned to any omni or localizer channel in the 108.00 to 117.9 MHz range. When a localizer frequency is selected on the control panel, the corresponding glide slope frequency is automatically selected in the GSA-8A-1 glide slope receiver. Visual presentation of the localizer course, VOR (manual) course, and the glide slope is made on both the pilot's and copilot's attitude indicator and course indicators of the AN/AYN-2 flight director. Ambiguity in omni bearing information of a VOR (manual) course is resolved by the to/from arrow. Visual presentation of heading-sensitive (automatic) VOR bearing is presented with the No. 2 pointer of the RMI's. The VHF navigation radio set features a VOR-CHECK circuit that provides a reliable in-flight check on all critical areas of the automatic and manual VOR circuits. The pilot performs the check by pushing the VOR-CHECK button located on the control panel and observing the RMI. A No. 2 pointer indication of zero degrees indicates that the navigation unit is operating accurately. A deviation from zero indicates a bearing error and the amount of error. The VHF/NAV radio set is powered by the dc primary bus and 26 volts ac from the radio autotransformer. The VHF/NAV radio set dc primary circuit is protected by a circuit breaker on the pilot's circuit breaker panel, marked NAV under the general headings DC and PRI.

VHF/NAV Radio Set Control Panel

The operating controls are provided by a control panel (figure 4-37), marked NAV, located on the cockpit center console. The panel consists of two frequency selectors, the frequency display window, the combination off-on/volume control, a squelch control, a VOR momentary check switch, and a momentary ADF homing selector switch.

Frequency Selectors The frequency selectors mechanically select and display frequencies spaced 50 kHz apart over the 108.00 through 135.95 MHz range.

VOL OFF Switch The VOL OFF switch provides power on-off control and volume control.

SQ Control The SQ control eliminates background noise. The squelch is automatically disabled when the receiver is tuned to a VOR or localizer channel.

VOR Check Switch The VOR momentary check switch provides a reliable in-flight check on all critical areas of the automatic and manual VOR circuits.

ADF Switch The momentary ADF homing select switch is inoperative on the VHF/NAV control panel. A two position navaid selector switch (figure 4-38) marked No. 2 with the marked positions VOR and TAC, is located on the instrument panel. This switch selects the navaid that will control the No. 2 pointer on the pilot's RMI's.

VHF/NAV Radio Set AN/ARN-87(V) Operation

To turn set on:

1. VOL OFF Switch (VHF/NAV Control Panel) - ON AND ADJUSTED.

2. ICS Monitor Selector/Volume Control - VHF NAV.

3. VOR-TACAN Selector Switch (Instrument Panel) - VOR.

4. Frequency Selectors (VHF/NAV Control Panel) - AS REQUIRED.

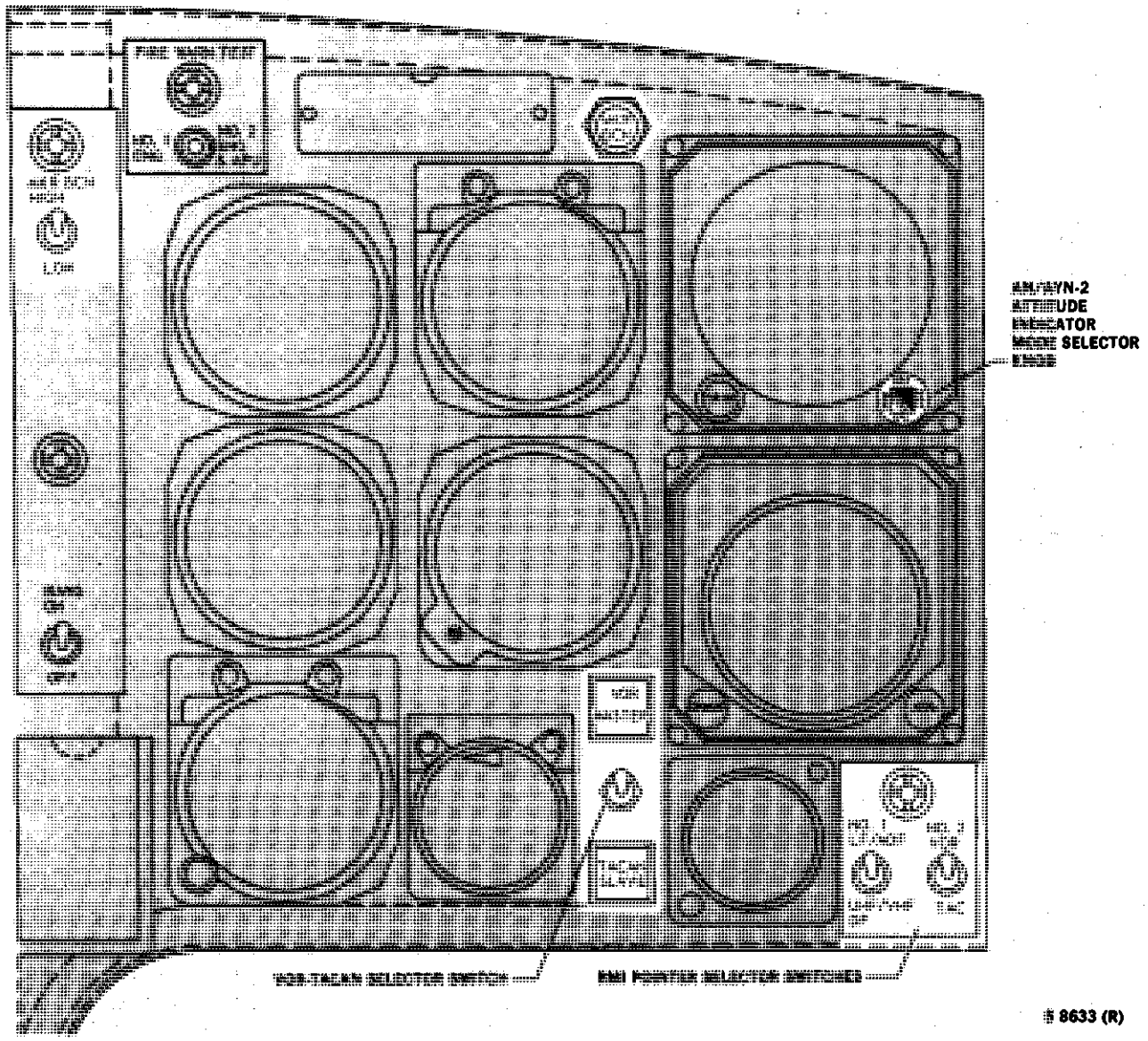


Figure 4-38. Navaid Auxiliary Controls for VOR, ILS, TACAN and ADF

5. RMI Pointer Selector Switch (Instrument Panel) - VOR.

6. AN/AYN-2 Attitude Indicator Mode Selector Knob - AS REQUIRED.

To secure set:

1. VOL OFF Switch (VHF/NAV Control Panel) - OFF.

GLIDE SLOPE RECEIVER GSA-8A-1

The glide slope receiver GSA-8A-1 is a UHF receiver designed to provide twenty operating channels within the frequency range of 329.3 through 335.0 MHz for vertical guidance during ILS approaches. Both the course indicator and the attitude indicator of the AN/AYN-2 flight director have glide slope pointers which are driven by the GSA-8A-1 glide slope receiver. The glide slope receiver is used in conjunction with the VHF navigation radio set AN/ARN-87(V). When a localizer frequency is selected on the VHF navigation control panel, the corresponding glide slope frequency is automatically selected in the glide slope receiver. The glide slope receiver is switched to a standby condition when any frequency other than a localizer frequency is selected. The glide slope receiver is powered by the dc primary bus and is protected by a circuit breaker, marked GLIDE SLOPE, on the copilot's circuit breaker panel, under the general headings DC and PRI.

Glide Slope Receiver Operation

To turn set on:

1. VOL OFF Switch (VHF/NAV Control Panel) - ON.

2. ICS Monitor Selector/Volume Control - VHF NAV.

3. Frequency Selectors (VHF/NAV Control Panel) - AS REQUIRED.

4. AN/AYN-2 Attitude Indicator Mode Selector Knob - AS REQUIRED.

To secure set:

1. VOL OFF Switch (VHF/NAV Control Panel) - OFF.

MARKER BEACON RECEIVER MKA-23A

The marker beacon receiver detects 75 MHz marker beacon signals and indicates this to the pilots through aural and visual indications. The visual signals are presented to both pilots by indicator lights mounted on the instrument panel as well as by characteristic tones and codes heard over the ICS. A two position sensitivity switch, marked MKR BCN, (figure 4-38), is located on the instrument panel so that the pilot may choose a HIGH or LOW setting, according to the altitude of the helicopter in order to shorten or lengthen the indication time over a marker beacon. A standard marker indicator lamp, marked MKR BCN, is located on the instrument panel (figure 4-38) in front of each pilot and illuminates whenever the helicopter is over a beacon. The marker beacon receiver is turned on automatically when the VHF/NAV radio set is turned on. The marker beacon receiver is powered by the dc primary bus and is protected by a circuit breaker, marked MKR BCN, located on the copilot's circuit breaker panel, under the general headings DC and PRI.

Marker Beacon Operation

To turn set on:

1. VOL OFF Switch (VHF/NAV Control Panel) - ON.

2. ICS Monitor Selector/Volume Control - MKR BCN.

3. Sensitivity Switch (Instrument Panel) - AS REQUIRED.

To secure set.

1. VOL OFF Switch (VHF/NAV Control Panel) - OFF.

TACAN RADIO SET AN/ARN-52(V) (TACTICAL AIR NAVIGATION)

The TACAN system AN/ARN-52(V), an airborne navigation set consisting of a receiver-transmitter and control panel, supplies inputs to the flight director, RMI's and the AYN-1 navigation system. It operates in conjunction with a selected, fixed ground station or with another cooperating aircraft equipped with air-to-air TACAN. In the receive mode of operation, the AN/ARN-52(V) provides continuous information of the bearing (azimuth angle) from the helicopter to a selected ground station. In the receive-transmit mode

of operation, the AN/ARN-52(V) provides continuous information on the line of sight distance from the aircraft to a selected ground station in addition to bearing information. In the receive-transmit and receive modes of operation, the selected ground station is identified by the identity tone signal. In the air-to-air mode of operation, the AN/ARN-52(V) provides continuous information of the line of sight distance between two cooperating aircraft that are each equipped with air-to-air TACAN. Although the maximum range of the equipment is governed by line of sight considerations, the maximum indicated range is 300 miles.

Visual presentation of the TACAN course is made on the pilot's and copilot's course indicator of the AN/AYN-2 flight director and the RMI's. Ambiguity in TACAN bearing information of a TACAN (manual) course is resolved by the to/from arrow. Visual presentation of (automatic) TACAN bearing is presented with the No. 2 pointer of both RMI's. The distance to a TACAN or VORTAC station is displayed by the miles counter on tbe course indicator. The distance is read in nautical miles. The TACAN also supplies inputs to the AYN-1 navigation computer set.

The TACAN is powered by the dc primary bus, the No. 1 ac primary bus, and 26 volts ac from the radio autotransformer. The TACAN is protected by two circuit breakers on the copilot's circuit breaker panel. The TACAN's dc primary circuit is protected by a circuit breaker, marked TACAN under the general heading DC PRI. The TACAN's No. 1 ac primary circuit is protected by a circuit breaker, marked TACAN ϕC under the general heading No. 1 AC PRI.

CAUTION

It is possible that improperly adjusted or malfunctioning ground or airborne TACAN equipment may "lock-on" to a false bearing. The error will probably be plus or minus 40°, but can be of any value to either side of the correct bearing in multiples of 40°. This possibility is inherent in the TACAN system and, therefore, the TACAN should be cross-checked with ground radar, airborne radar, VOR, or LF-ADF.

NOTE

Operation in the air-to-air mode requires prearrangement with a cooperating aircraft. The second aircraft must be equipped with an air-to-air TACAN which is set to the air-to-air mode of operation and is set to a channel 63 channels away from the channel setting of the AN/ARN-52(V) in the first aircraft. One aircraft may reply to as many as five others, but it will only display the distance to the nearest aircraft. Bearing information is not provided in the air-to-air mode.

TACAN Operating Controls

The control panel located on the center console (figure 4-39), contains the channel selector, the volume control and the function selector switch.

CHAN Selector Knob The channel selector knob is a rotary switch that provides for selection of 126 TACAN channels.

VOL Control The control allows for adjustment in volume of beacon identity tone signal.

Function Selector The function selector switch is a four-position rotary switch that determines the mode of equipment operation. OFF removes power from the set, and REC turns the receiver on. T/R turns the transmitter and receiver on and A/A enables air-to-air distance measuring. The equipment requires a 3-minute warm-up period regardless of the mode selected. The No. 2 navaid selector switch, with the marked positions VOR and TAC, is located on the instrument panel. This switch selects the navaid that will control the No. 2 pointer on the RMI's.

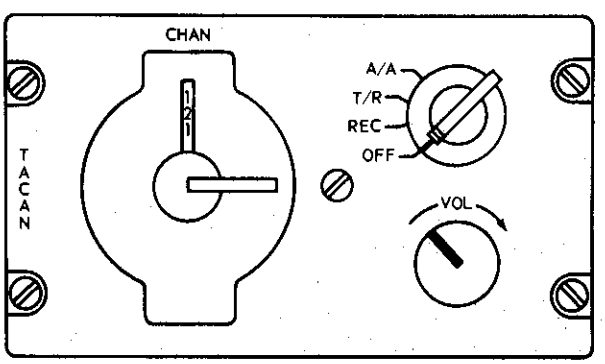


Figure 4-39. TACAN AN/ARN-52(V)

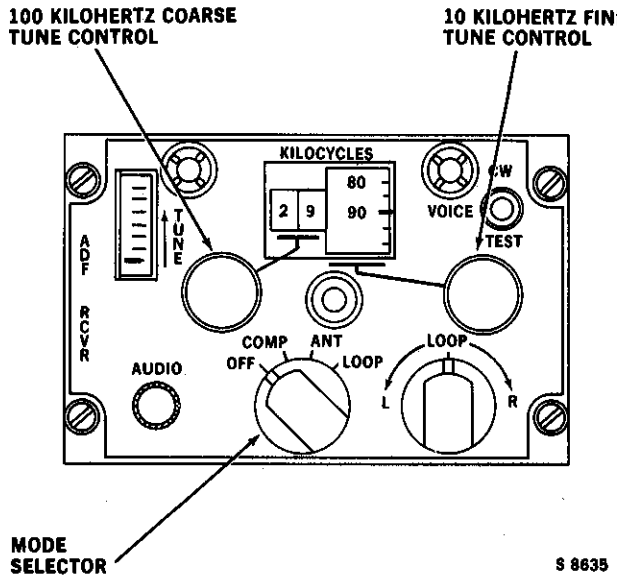


Figure 4-40. LF/ADF Radio AN/ARN-89A

TACAN Operation

To turn set on:

1. Function Selector Switch (TACAN Control Panel) - AS REQUIRED.

2. ICS Monitor Selector/Volume Control - TAC.

3. VOR-TACAN Selector Switch (Instrument Panel) - TACAN.

4. Channel Selector Knob (TACAN Control Panel) - AS REQUIRED.

5. Volume Control - AS REQUIRED.

6. RMI Pointer Selector (Instrument Panel) - TAC.

7. AN/AYN-2 Attitude Indicator Mode Selector Knob - AS REQUIRED.

To secure set:

1. Function Selector Switch (TACAN Control Panel) - OFF.

SEE 05-23

LF AUTOMATIC DIRECTION FINDER SET (LF/ADF) AN/ARN-89A

The LF/ADF set AN/ARN-89A (figure 4-40) is an airborne, transistorized, radio direction finder that provides automatic or manual compass bearings on any radio signal between 100 and 3000 kilohertz. The receiver is tuned by rotating the coarse and fine tune controls to the desired frequency. The system also functions as a low frequency radio communications receiver. The transmitted signal from a ground station is received by an omni-directional sense antenna and directional loop antenna. The loop antenna signal is coupled directly to the receiver while the sense antenna signal is coupled to the sense amplifier and then to the receiver. The receiver interprets the sense and loop antenna signals and supplies a signal output which is coupled to the synchro receivers in the pilot's and copilot's radio magnetic indicators, providing a visual display on the number 1 pointer. A beat frequency oscillator permits identification of keyed CW stations and may be used to obtain improved indications of an aural null during loop operations. The LF/ADF set is powered by the dc primary bus. The LF/ADF set dc primary circuit is protected by a circuit breaker on the pilot's circuit breaker panel, marked LF ADF, under the general headings DC and PRI.

LF/ADF Control Panel The TUNE indicator provides an indication of relative signal strength while tuning the receiver to a specific radio signal.

Tune Controls The coarse tune control tunes the receiver in 100 kHz steps as indicated by the first two digits of the kilohertz indicator. The fine tune control permits continuous tuning of the 10 kHz digits as indicated by the last two digits of the kilohertz indicator.

CW-VOICE-Test Switch The CW-VOICE-TEST switch is a three-position toggle switch (spring-loaded away from the TEST position) that is associated with the operation of the beat frequency oscillator. In the CW position, it enables a 1000 Hz beat frequency oscillator to provide an audible tone null for tuning to a CW station. The VOICE position permits the LF/ADF to function as a standard AM radio receiver. The TEST position is operative only in the COMP mode and is used by holding the toggle switch in the TEST position and observing that the number 1 pointer slews approximately 180°.

AUDIO Control The AUDIO control knob adjusts the audio output when the OFF-COMP-ANT-LOOP switch is in the COMP position. When the switch is in either the ANT or the LOOP position, it functions as a RF gain control.

OFF-COMP-ANT-LOOP Switch The OFF-COMP-ANT-LOOP switch is a four-position, rotary, mode selector switch. The OFF position removes power from the ADF making it inoperative. The COMP position

connects both the loop and sense antennas and the LF/ADF functions as an ADF. In the ANT position, only the sense antenna is connected and the LF/ADF functions as a standard low-frequency receiver. In the LOOP position, only the loop antenna is connected and the LF/ADF may be used for manual direction finding.

LOOP L-R Control The LOOP L-R control provides for manual positioning of the loop antenna when the LF/ADF is operating in the manual direction finding mode.

LF/ADF Operation

To turn set on:

1. ICS Monitor Selector/Volume Control-ADF

2. OFF-COMP-ANT-LOOP Switch to any position except OFF

3. COARSE AND FINE TUNE CONTROLS adjust as necessary to obtain maximum (upward) indication on the TUNE indicator.

4. CW-VOICE-TEST Switch - CW or VOICE as appropriate.

5. Audio Control - Adjust Volume.

6. No. 1 RMI Pointer Selector Switch (Instrument Panel) - LF/ADF

NOTE

Automatic direction finding operation of the LF/ADF can only be accomplished in the COMP mode.

CW Operation

CW operation incorporates a beat frequency oscillator and is used principally to identify CW transmissions occurring within the frequency range of the LF/ADF such as those employed in areas outside of the United States, but may also be used to aid in determining aural nulls. For CW identification and aural null procedures, the OFF-COMP-ANT-LOOP switch is placed in the LOOP position. Operate the LOOP L-R switch to the left (L) or right (R) position to obtain an audio null and a TUNE indicator null. Observe the No. 1 RMI pointer for a display of the bearing to the signal source. Release the switch to its center position.

NOTE

In this mode of operation, two null positions separated by 180° may be obtained.

Operating Limitations and Precautions

The set is subject to the following operating limitations which are imposed by terrain, weather, and general operating conditions.

Night Effect At night radio waves reflected by the ionosphere return to the earth at some point 30 to 60 miles from the station. This night effect may cause the pointer to fluctuate. It is most prevalent during the period just before and after sunrise and sunset. Generally, the greater the distance from the station, the greater the effect. The effect can be minimized by averaging the fluctuations, by flying at a higher altitude, or by selecting a lower-frequency station. Maximum night effect will be present with stations operating in frequency ranges above 1000 kHz. Frequencies below 1000 kHz are generally less subject to night effect.

Mountain Effect Bearings taken in the vicinity of mountainous terrain may be erroneous and the pointer may fluctuate due to magnetic deposits or radio wave reflection.

Shoreline Effect As radio waves pass from land to water, their direction of travel is changed. Because of shoreline effect, a bearing taken on an inland station from an aircraft over water is inaccurate if it makes an angle of less than 30° with the shoreline. At greater angles, bending is negligible. When taking bearings over water, therefore, choose stations which are either right on the shore, or so located that bearings to them make angles greater than 30° with the shoreline.

General Operating Procedures The following operating procedures should be used. Only head-on bearings are entirely dependable. Keep the helicopter in a level attitude when taking side bearings; accurate bearings cannot be taken with the aircraft in a steep bank, especially when close to a station.

RADAR ALTIMETER AN/APN-171(V)

Radar altimeter set, AN/APN-171(V), consists of a receiver-transmitter, two indicators, and two antennas. The set provides instantaneous indication of actual clearance between the helicopter and terrain from 0 to 5000 feet with the following accuracies:

Altitude (ft)	Accuracies
0-200	± (3 ft + 2% of altitude)
200-1000	± (7 ft + 2% of altitude)
1000-5000	±(25 ft + 2% of altitude)

Altitude, in feet, is indicated by the radar altimeter indicators (figure 4-41) located on the pilot's and copilot's instrument panel. The radar altimeter is powered by the dc primary bus and the No. 1 ac primary bus. The altimeter's dc circuit is protected by a circuit breaker marked RDR ALTM, on the copilot's circuit breaker panel, under the general heading DC PRI. The ac circuit is protected by a circuit breaker marked RDR ALTM ϕA, on the copilot's circuit breaker panel, under the general heading NO. 1 AC PRI.

Radar Altimeter Operation

A control knob, located on the lower left corner of the indicator, combines functions to serve as a test switch, a low level warning index set control, and an on/off power switch. The system is turned on by rotating the control knob, marked PUSH-TO-TEST, clockwise from the OFF position and is the only control necessary for equipment operation. Three minutes must be allowed for system warmup. Both control knobs must be in the OFF position to secure the set. Continued clockwise rotation of the control knob toward the SET position will permit each pilot to select any desired low-altitude limit, which will be indicated by the low-level warning index marker (bug) on the indicator. A low-level warning light, located on the lower right-hand corner of the indicator, will illuminate and show the marking LOW any time the helicopter is at or below the low-altitude limit that has been selected. The low limit warning light can be dimmed by using the dimming switch for the Caution/Advisory panel.

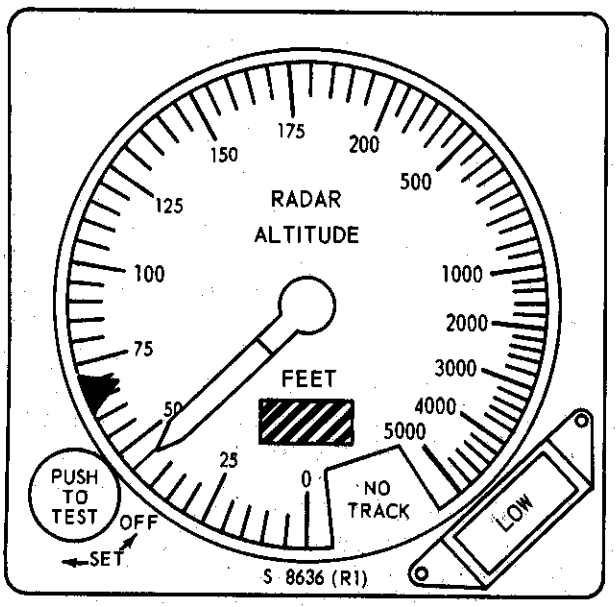


Figure 4-41. Radar Altimeter AN/APN-171(V)

NOTE

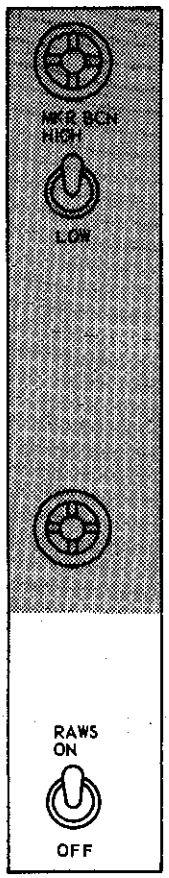
Rheostat marked PILOT FLT INST on the overhead switch panel must be ON to use the bright/dim switch.

Depressing the PUSH-TO-TEST control switch provides a testing feature of the system at any time and altitude, provided the RAD ALT mode of the AFCS is disengaged. When the PUSH-TO-TEST control knob is depressed, a visual indication of 100 ± 15 feet on the indicator is indicative of satisfactory system operation. Releasing the PUSH-TO-TEST control knob restores the system to normal operation. In addition to altitude measurement, the altimeter provides outputs to the coupler for RADALT HOLD operation.

Radar Altimeter Warning System (RAWS)

Three audio warning signals are developed by the altimeter and are fed into the pilot's and copilot's headsets. The first is a 1000 Hz. steady tone which sounds when the altimeter is unreliable. At approximately 200 feet, a 1000 Hz. tone is switched on for 3 seconds and is pulsed at a rate of two pulses per second. At 50 feet, this tone is again switched on for 3 seconds but is pulsed at a rate of four pulses per second. A two-position switch on the instrument panel, marked ON and OFF, under the heading RAWS (figure 4-42) turns the RAWS system on and off. In the OFF position, an amber light on the caution advisory panel, marked RAWS OFF, is illuminated.

Failure Indications Loss of system power or tracking condition will be indicated by a black and yellow striped flag which appears in the indicator window, located on the lower center portion of the indicator. If the system should become unreliable, the black and yellow striped flag will appear, the indicator pointer will go behind a mask, marked NO TRACK, to prevent erroneous readings, and a 1000 Hz. audio tone will sound in both pilots' ICS. If the coupler RAD ALT hold mode is engaged at this time, it will disengage. During normal flight operations, it is not necessary to turn the RAD ALT system off when operating above 5000 feet. The 1000 Hz tone will sound when the altitude is above 5000 feet.



S 8637 (C1)

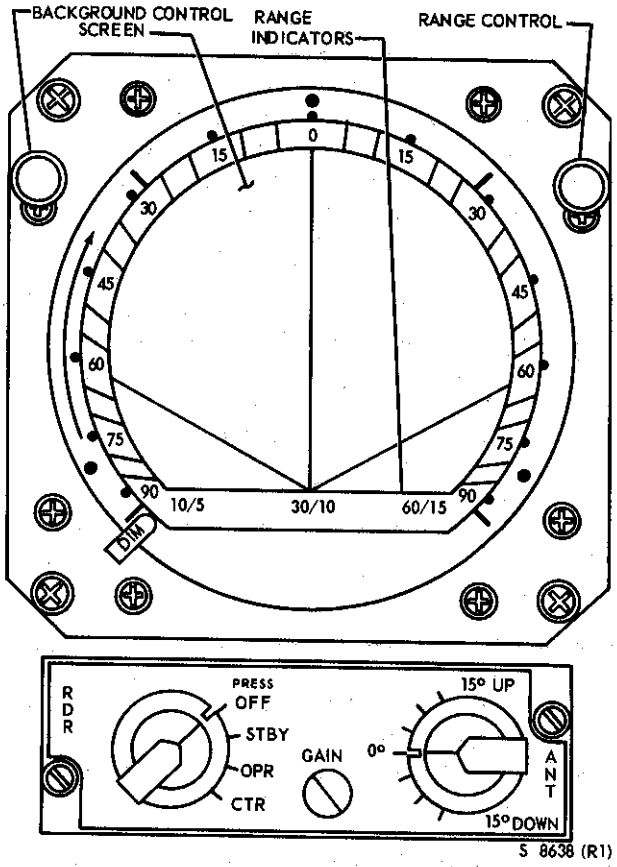
Figure 4-42. Radar Altimeter Warning System (RAWS) Selector Switch

NOTE

If ac power is lost, the pointers freeze in position. An audio warning will be heard on the ICS if ac power is lost and the RAWS switch is ON.

RADAR SET AN/APN-195

The AN/APN-195 radar set is a lightweight, pulse-modulated radar system consisting of a receiver-transmitter, synchronizer, control panel, indicator and antenna. This set provides an accurate and continuous picture of weather conditions (weather map) in the general sky area ahead of the helicopter and is used as a navigation and search aid to extend the vision of the pilot. The AN/APN-195 is powered by the No. 1 ac primary bus and is protected by a circuit breaker, marked SEARCH RADAR on the copilot's circuit breaker panel, under the general heading NO. 1 AC PRI. In addition, pitch and roll inputs from the AN/ASN-50 are necessary to stabilize the antenna.



S 8638 (R1)

Figure 4-43. Radar Set AN/APN-195

Radar Set Control Panel

The control panel and azimuth range indicator (figure 4-43) are centrally located on the instrument panel and are accessible to both pilots. The control panel contains three controls, a mode selector switch, a receiver gain control, and an antenna tilt control.

Mode Selector The mode selector switch is a rotary four-position switch marked OFF-STBY-OPR-CTR. The OFF position disconnects power from the radar set. The STBY position applies voltage to tube filaments and initiates an approximate 4-minute time delay for warm-up. It also holds the equipment in standby conditions after the 4-minute time delay expires. The OPR position applies voltage to all circuits (after elapse of 4-minute time delay) for normal operation. The radar echo from the target area is displayed on the azimuth-range indicator screen as bright spots or areas. In the CTR position, areas of heavy rainfall are displayed on the azimuth range indicator screen as dark areas or black holes surrounded by bright rings which represent areas of lighter rainfall.

CAUTION

There is a detent between the OFF and STBY positions to prevent accidental shutdown of the radar with a subsequent recycled 4-minute delay. To overcome this when shutting off the system, the mode selector switch must be depressed (pushed into the control panel) when going from the STBY to the OFF position. Deviation from this procedure will result in a broken switch which will indicate OFF when actually in the STBY position, STBY when in the OPR position and OPR in the CTR position.

Receiver Gain Control The receiver gain control, marked GAIN, controls the amplification of the radar echo received.

Antenna Tilt Control The antenna tilt control, marked ANT, is a synchro control marked at 5° intervals, UP and DOWN, which varies the tilt of the antenna reflector between 15° above (UP) and 15° below (DOWN) the horizontal reference plane of the helicopter.

Azimuth-Range Indicator The azimuth-range indicator contains a screen that displays target echoes, a range switch, a background control, and a dimming control. The screen indicates the range and azimuth of targets.

The unmarked range switch is located in the upper right side of the indicator and is a three position rotary switch. The range switch, when rotated fully counterclockwise to the first position, will illuminate an indicator, marked 10/5 at the base of the screen. This position provides a 10-mile sweep trace and two 5-mile range circles on the screen. The second clockwise position on the rotary switch will illuminate an indicator, marked 30/10 at the base of the screen. This position provides a 30-mile sweep trace and three 10-mile range circles on the screen. The third clockwise position on the rotary switch will illuminate an indicator at the base of the screen, marked 60/15. This position provides a 60-mile sweep trace and four 15-mile range circles on the screen. All distance references are in nautical miles. The unmarked background control located in the upper left side of the indicator is the minimum intensity position when rotated fully counterclockwise. The background control adjusts the level of background noise to permit very weak echoes to be viewed on the screen. The dimming control, marked DIM, revolves on the periphery of the screen and is used to dim the display for best viewing. The dimming control is off when revolved fully counterclockwise (down).

Radar Operation

Preliminary operating procedures:

1. Mode Selector Switch - STBY.

NOTE

The equipment will not function for 4 minutes because of a built-in automatic time delay.

2. Antenna Tilt Control - CENTERED (O).

3. Receiver Gain Control - FULLY COUNTERCLOCKWISE.

4. Range Switch - AS REQUIRED. N I W

5. Background Control - FULLY COUNTERCLOCKWISE.

6. Dim Control - FULLY COUNTERCLOCKWISE (down).

STARTING

1. Mode Selector Switch - OPR.

2. Range Switch - AS REQUIRED. N I W

3. Background Control - AS REQUIRED.

Adjust background control until scope becomes green. Then turn counterclockwise until green just disappears (range marks will still be visible).

4. Receiver Gain Control - AS REQUIRED.

5. Background Control - AS REQUIRED.

6. Dim Control - AS REQUIRED. N I W

7. Antenna Tilt Control - ADJUST FOR TARGETS.

The tilt control should be turned slowly (approximately 1° per second) when adjusting for small targets, such as ships.

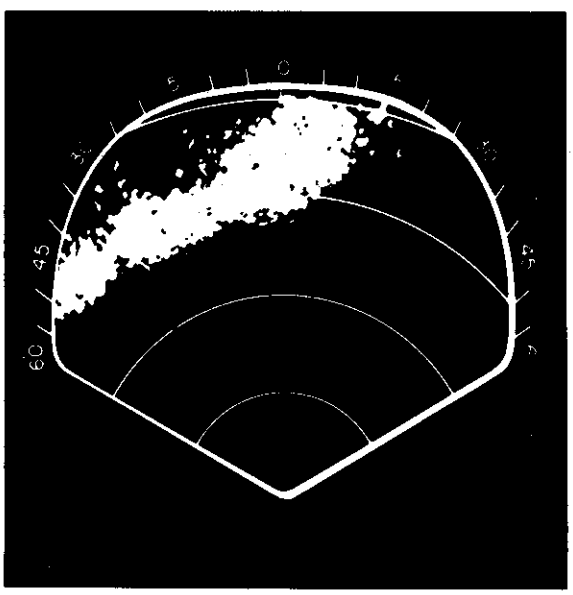
WEATHER OBSERVATIONS

(figures 4-44 and 4-45.)
Perform the preliminary operating procedures:

1. Antenna Tilt Control - AS REQUIRED.
2. Mode Selector Switch - OPR.
3. Receiver Gain Control - AS REQUIRED.
4. Range Switch - AS REQUIRED.
5. Mode Selector Switch - OPR/CTR AS REQUIRED.

DOPPLER RADAR AN/APN-175(V)

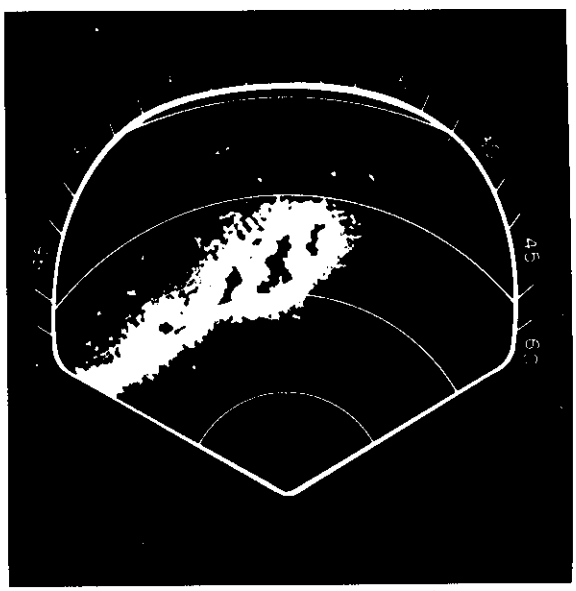
The doppler radar is a navigation system utilizing the doppler effect to determine drift and ground speed. Four beams of pulses microwave energy are beamed toward the earth along the corners of an imaginary pyramid whose peak is at the helicopter. Echoes from the front pointing beams undergo upward doppler shift, while echoes from the rearward beams undergo downward doppler shift. Similarly, drift causes doppler shift of echoes from beams on one side with respect to beams on the other side of the helicopter. The doppler effect is the change in the observed frequency of a wave due to relative motion of source and observer. When the distance between the source and observer is decreasing the observed frequency is higher than the source frequency. When the distance is increasing, the observed frequency is lower. The doppler shift is the amount of the change in the observed frequency of a wave due to doppler effect, expressed in hertz, also called doppler frequency. Doppler navigation information can be obtained from the AN/AYN-1 navigation computer display and map display. In addition,



THE RANGE SWITCH IS NOW IN THE 60 '15 POSITION. THE MASTER SWITCH IS IN THE OPR POSITION. THE CLOSEST PORTION OF THE FRONT IS DISPLAYED APPROXIMATELY 30 DEGREES LEFT OF THE 0-DEGREE REFERENCE AT THE DISTANCE OF APPROXIMATELY 40 NAUTICAL MILES.

THE EXTENT IN AZIMUTH OF AN ACTIVE, TURBULENT STORM IS SHOWN IN THIS DISPLAY. HOWEVER, NO INFORMATION RELATIVE TO AREAS OF HEAVY TURBULENCE OR RAINFALL GRADIENTS IS OBTAINABLE. AN AIRCRAFT MAY BE FLOWN AROUND THIS FRONT BY AVOIDING AREAS OF INTENSE ECHOES. S 8639 (C1)

Figure 4-44. Weather Interpretation (OPR) Position



THE RANGE SWITCH IS STILL IN THE 60 '15 POSITION; HOWEVER, THE MASTER SWITCH IS NOW IN THE CTR POSITION. THIS DISPLAY SHOWS AREAS OF HEAVY TURBULENCE. AN AREA OF HEAVY RAINFALL IS DISPLAYED AT 0 DEGREES ' 35 NAUTICAL MILES. SMALLER AREAS OF LIGHT RAINFALL ARE SHOWN AT 15 DEGREES LEFT OF THE 0-DEGREE REFERENCE AND 35 DEGREES LEFT OF THE 0-DEGREE REFERENCE AT A RANGE OF APPROXIMATELY 30 NAUTICAL MILES.

THE RAPID CHANGE FROM BRIGHT TO DARK AT THE 0-DEGREE REFERENCE POSITION INDICATES EXTREME TURBULENCE IN THE AREA AROUND THE CONTOUR OF THE BLACK HOLE. THE RAIN GRADIENTS AT 15 DEGREES LEFT OF CENTER ARE NOT STEEP TURBULENCE MAY EXIST AT THIS POSITION, BUT IT IS NOT AS EXTREME AS AT THE 0-DEGREE POSITION S 8640 (C1)

Figure 4-45. Weather Interpretation (CTR) Position

the hover indicator in D mode is used to display fore and aft, left and right, and vertical velocity.

Doppler Sensor Group

The doppler sensor group operates at a frequency of 13325 MHz through an altitude range of 15 to 30000 feet. The group consists of a receiver-transmitter, a frequency tracker, an antenna, and a control panel. A blower is provided to cool the operating components and to eliminate fumes in the doppler compartment. The transistorized receiver-transmitter produces a frequency-modulated signal of 13325 MHz to the 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 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°, left or right, at a minimum rate of 6° per second. The antenna receives pitch and roll information from AN/ASN-50 inputs and maintains a level attitude by movement of the antenna up to limits of 45° of roll (left or right) and 25° of pitch (up or down). The set provides reliable groundspeeds, from -50 to +390 knots, and left and right drift angles, up to 90°, over all reflective surfaces. The groundspeed and drift angle outputs are then fed to the navigation computer AN/AYN-1 for computation of present position.

The doppler sensor group is operated from the doppler switch panel (figure 4-46). The set will detect any loss of doppler signal and send an input to the navigation computer. The navigation computer will then utilize the last reliable wind solution from the doppler sensor group, use true airspeed and heading inputs to solve groundspeed and track, and furnish groundspeed and drift angle memory signals to the doppler sensor group until the doppler signal returns. The doppler sensor and the doppler compartment blower are powered by the No. 1 ac primary bus. The sensor group circuit breaker is marked RDR ϕB and the compartment blower is marked COMPT BLO ϕC. Both circuit breakers are on the copilot's circuit breaker panel, under the general headings DOPPLER and NO. 1 AC PRI. The doppler sensor also receives 26 volt ac power from the radio auto transformer.

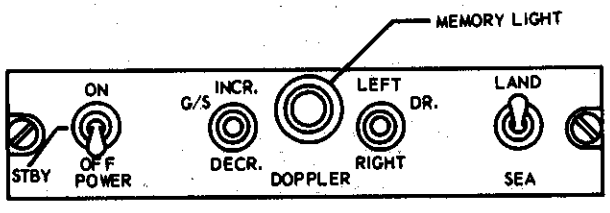


Figure 4-46. Doppler Controls AN/APN -175(V)-1

Hover Indicator

The hover indicator (figure 4-47) in D mode displays information developed by the doppler navigation set, AN/APN-175(V)-1. In D mode, the horizontal pointer and scale are not used. At ground speeds in excess of 23 ± 5 knots only the horizontal bar and warning flag are functional. At ground speeds less than 23 ± 5 knots, the vertical bar will show lateral drift and rate of drift. Each increment of the vertical bar scale represents 5 knots up to a maximum of 20 knots. The vertical pointer above its centerline shows ascent and below descent. Each increment of the vertical pointer scale represents 125 feet per minute up to a 500 foot per minute maximum. The horizontal bar above its centerline shows movement aft and below the centerline movement forward. Each increment of the horizontal bar scale represents 5 knots up to a maximum of 20 knots.

Doppler Control Panel

The doppler control panel, marked DOPPLER, (figure 4-46) consists of four toggle switches and a memory light. It is located on the center console aft of the navigation computer controller. The POWER switch, with marked positions OFF, STBY, and ON, will remove power in the OFF position. The STBY position permits the sensor group to warm up and to be held in a standby status, and the ON position places the sensor group in operation. The G/S (ground speed) switch with marked positions INCR (increase) and DECR (decrease) is used only for test. The memory light is on during a loss of doppler signal. The memory light is also on when the POWER switch is in the STBY position. The DR. (drift) switch with the marked positions LEFT and RIGHT is used only for preflight and test. The LAND-SEA switch is used in the LAND position over land and in the SEA position over water.

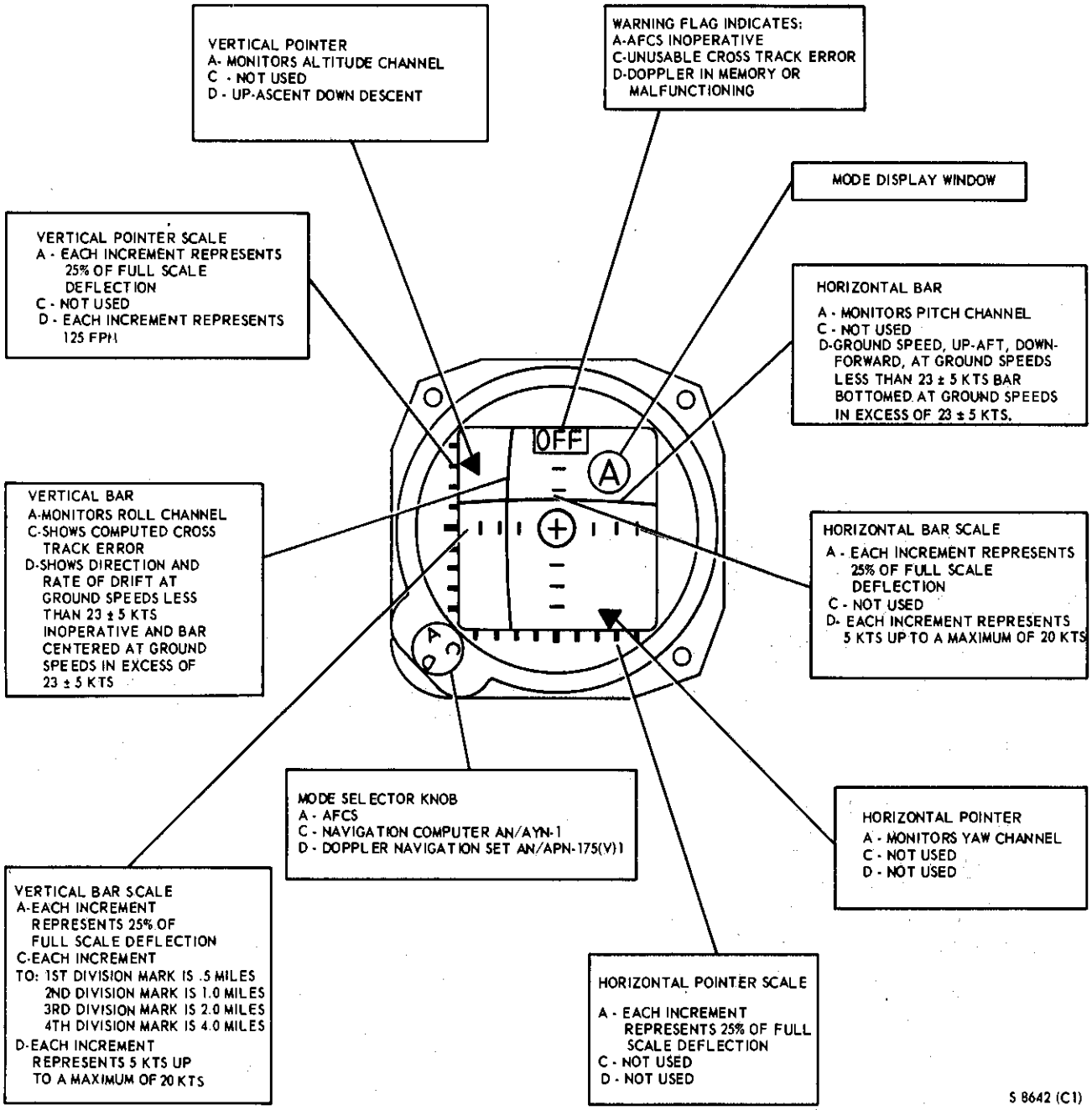


Figure 4-47. Hover Indicator

When the Beaufort sea state is 3 or greater more accurate doppler sensing is obtained with the LAND-SEA switch in the LAND position.

Doppler Preflight

1. Doppler POWER Switch (Doppler Control Panel) - STBY.

2. OFF-STBY-ON Switch (AN/AYN-1 Navigation Computer Controller) - STBY THEN ON.

3. SENSOR Rotary Switch (AN/AYN-1 Navigation Computer Controller) - DOPP.

4. INSERT/DISPLAY Key (Navigation Computer Controller Keyboard) - DISPLAY.

5. E4/GS-TR Key (Navigation Computer Controller Keyboard) - GS-TR.

6. DR. Switch (Doppler Control Panel) - AS REQUIRED.

Observe heading of helicopter on RMI or standby compass. Antenna travel may be checked by turning the antenna 90° left or right of the centerline of the helicopter by holding DR switch left or right approximately 15 seconds. Full antenna deflection can be detected by observing the bottom register of the navigation computer display.

7. OFF-STBY-ON Switch (Doppler Control Panel) - ON.

Observe ground speed lock-on and memory light goes out in a maximum of 30 seconds. Pre-flight complete.

8. ON-STBY-OFF Switch (AN/AYN-1 Navigation Computer Controller) - AS REQUIRED.

9. Doppler POWER Switch (Doppler Control Panel) - STANDBY.

Doppler Sensor Operation

To turn sensor on:

1. POWER Switch (Doppler Control Panel) - STBY.

2. POWER Switch (After 1-Minute Warmup in STBY) - ON.

CAUTION

The doppler power switch should be placed in STBY just prior to landing on the water.

CAUTION

In flight whenever the VERT GYRO switch is OFF, the doppler should be placed in STBY to prevent damage to the antenna.

3. LAND-SEA Switch (Doppler Control Panel) - AS REQUIRED.

LORAN A RECEIVER AN/APN-180

The AN/APN-180 receiver is a microminiaturized, airborne, dual channel, automatic tracking, LORAN A receiving set operating within the frequency range of 1850 to 1950 kHz. The receiver consists of two separate and independent channels, each of which constitutes a complete LORAN A signal receiving and processing system and is used to accurately measure to within 1 microsecond the time difference of any two selected LORAN A station pairs, not necessarily on the same radio frequency, and simultaneously provide this information to the navigation computer. The primary use of the AN/APN-180 receiver is to provide helicopter navigation under all-weather flight conditions when used in conjunction with the navigation computer. After navigator operated manual lock-on to two separate LORAN A rates, the equipment will automatically track, measure, and display the time difference between the master station and slave station of the two selected LORAN A station pairs. The cathode ray tube indicator will display either of the two selected LORAN A signal pairs with the digital readout correspondingly displaying the time difference in microseconds of that particular station pair. Automatic tracking of time difference will occur when the operator has manually positioned the signal pair to within ± 20 microseconds of the actual time difference. The LORAN A receiver is powered from the No. 1 ac primary bus and the dc primary bus. Each circuit is protected by a circuit breaker, marked LORAN A, on the copilot's circuit breaker panel.

Control and Indicator Panel

The control and indicator panel (figure 4-48) is located at the navigator's station. The following controls and indicators are common to the operation of both autotrack channels.

A/B Select Switch Selects either autotrack channel A or B for time difference readout and CRT display presentations. Permits the common controls to operate on the selected autotrack channel.

FUNCT Switch Selects one of the five possible CRT display presentations which are listed below:

Position	Display
1	Dual trace - Master and slave pedestal; master and slave strobe markers; video pulses.
2	Dual trace - Master and slave video; master and slave strobe markers.
3	Single trace - Master and slave video; superimposed; single master/slave strobe marker.
4	Dual trace - Master video with marker on top trace; slave video with marker on bottom trace.

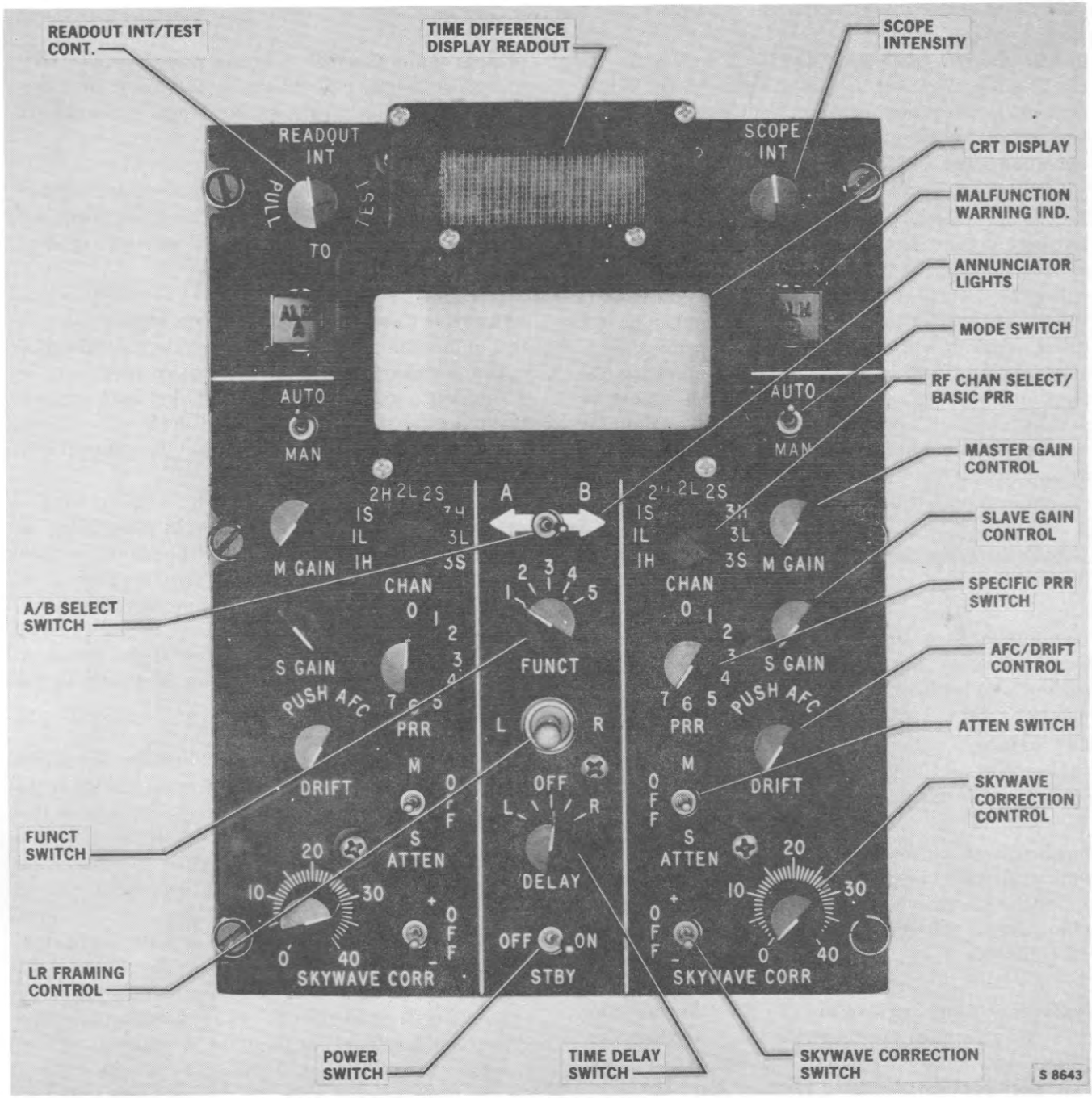


Figure 4-48. LORAN A Control and Indicator Panel

Position	Display
5	Single trace - Master and slave video superimposed; Single master/slave marker; master and slave calibration markers. Controls the speed of video framing when operating in conjunction with the L/R framing control. Controls the slew rate of the slave pedestal when operating in conjunction with the time delay switch.

LR Framing Control Permits positioning of video with respect to pedestals. The video will move to left and right with L and R selection respectively.

Time Delay Switch Permits positioning of slave pedestal as a function of CW or CCW selection and as a function of the position selection of the function switch. This control is inoperative during the auto mode of operation.

Power Switch (OFF-STBY-ON) Provides for the application of power to the system. In the STBY position, power is applied to the CRT filaments and all heaters so that the system is available for immediate operation in the ON position.

Readout Intensity/Test Control Controls the intensity of the time difference display readout and the annunciator light of the selected autotrack channel for either the inward or outward position of this control. When this control is pulled out, the number on the display readout will alternately take the form of 7777 and 16666 in order to provide a self check on the segment lamps in the display readout. It should be noted that the time delay number that appeared on the readout prior to pulling out this control is still retained during the test feature and will reappear as soon as the readout control is depressed.

Scope Intensity Control Controls the intensity of the CRT.

Time Difference Display Readout Displays the time difference in microseconds of the autotrack channel selected by the A/B select switch.

CRT Display Provides for the matching of either station pair of LORAN signals depending on the autotrack channel selected by the A/B select switch.

Annunciator Lights A/B Illuminates the arrow associated with the position of the A/B select switch and identifies the autotrack channel information being presented on the time difference display readout and CRT display.

Individual Channel Controls The following controls and indicators are restricted solely to the operation of one autotrack channel. Identical controls and indicators perform the same function respectively for the other autotrack channel. Consequently, the function of the items described below applies to either of the autotrack channels.

Auto/Manual (Mode) Switch Selects manual or automatic operation of autotrack channel.

RF Chan Select/Basic PRR Selects receiver to operate on RF channel 1-1950 KHz, and simultaneously selects basic station rate H, L, or S.

Specific PRR Switch Selects any one of the correct LORAN A specific pulse repetition rates.

Master Gain Control Provides receiver gain control of the master pulse in the manual mode of operation. This control is inoperative when the autotrack channel is in the AUTO mode.

Slave Gain Control Provides receiver gain control of the slave pulse in the manual mode of operation. This control is inoperative when the autotrack channel is in the AUTO mode.

AFC/Drift Control Synchronizes receiver rate to that of the transmitting station. With the control pulled out, any apparent drift in the master pulse can be controlled manually by adjusting the drift control. With the control pushed in, any drift between the transmitting station and receiver will be automatically controlled by the AFC loop.

Atten Switch Provides for a fixed attenuation of either the master or slave LORAN pulses in order to prevent overdriving the receiver in the presence of excessively strong signals. With the switch in the OFF position, there is no attenuation of the master or slave LORAN pulse. With the switch in either the master or slave position there is an attenuation of 40 dB to the master or slave pulse respectively.

Skywave Correction Control Provides for manual insertion of skywave correction factors in the form of a variable ± 40 microsecond delay. The sign of the delay is determined by the position of the skywave correction switch. The amount of delay is determined by the numerical position setting of this control.

As indicated in figure 4-48, the skywave correction control is calibrated into 40 equal divisions, each division corresponding to one microsecond. Thus in order to skywave correct to + 15 microseconds, the skywave switch should be set to the + position and the skywave correction control should be set to 15. Although skywave correction is a manual operation, it is used only when the receiver channel is in an autotrack mode. With skywave correction operating, the time delay information being fed to the navigation computer will change in accordance with the skywave delay setting, however, the time delay readout will not change its number.

Skywave Correction Switch Selects the sign (+ or -) of the skywave delay.

Malfunction Warning Indicator The purpose of this indicator is to tell the operator that the autotrack channel is not tracking or is tracking outside of a 2:1

signal to noise range. The indicator will illuminate under the following conditions:

1. Manual mode of operation.
2. Display test operative.
3. Excessive track error.
4. Weak signals on either master or slave.
5. Station blink.
6. Excessive noise.
7. Excessive sky wave level in vicinity of ground wave.

LORAN A Pre-Flight

1. Set power switch to STBY and allow the equipment to warm up for 3 to 5 minutes before setting the power switch to ON.

2. Set A-B switch to A and function switch to position 1 and check to see a display on the CRT. Set A-B switch to B and check to see a display on the CRT. If one or both of the displays are not present, reset power switch alternately from STBY to ON until a display is present on both A and B autotrack channels.

3. Pull READOUT INT control. The TIME DELAY READOUT should alternately appear as shown in figure 4-49.

Figure 4-49. Pre-Operational Check Step 3

4. Push READOUT INT control. Adjust SCOPE INT control CCW and CW, CRT display should get dimmer and brighter respectively.

5. A-B Switch to A. Set the following A channel controls to the positions indicated below:

CONTROL	POSITION
AUTO-MAN	MAN
CHAN	1H
PRR	0
M GAIN	Minimum CCW
S GAIN	Minimum CCW

6. With FUNCTION switch in position 1, set DELAY switch either to R-fine or L-fine (midpositions) such that the number 5000 is preset on time difference display readout. When the number 5000 appears, set DELAY switch to OFF. The CRT display should appear as shown in figure 4-50.

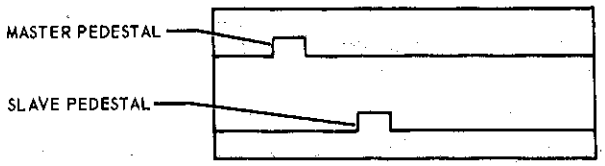


Figure 4-50. Pre-Operational Check Step 6

7. Set DELAY switch to R-course (end position). Check to see that the master pedestal remains fixed in position while the slave pedestal moves to the right at a constant speed. Set DELAY switch to R-fine. The slave pedestal should move to the right at approximately 1/10 the speed.

8. Repeat step 7, for DELAY switch setting of L-COARSE and L-FINE for slave pedestal moving to the left.

9. Set FUNCTION switch to position 2 and DELAY switch to OFF. The CRT display should appear as shown in figure 4-51.

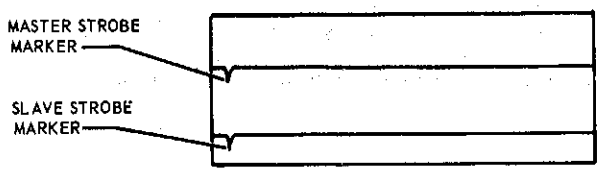


Figure 4-51. Pre-Operational Check Step 9

10. Set FUNCT switch to position 3. The CRT display should appear as shown in figure 4-52.

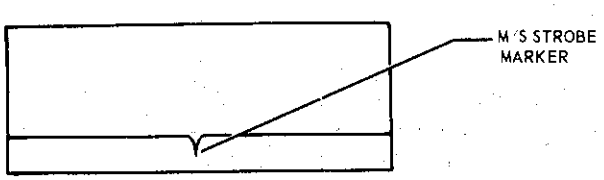


Figure 4-52. Pre-Operational Check Step 10

11. Set FUNCT switch to position 4. The CRT display should appear as shown in figure 4-53.

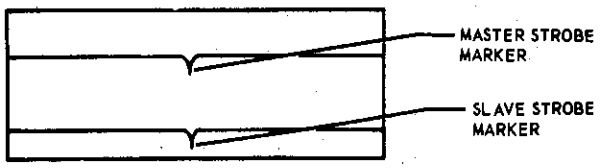


Figure 4-53. Pre-Operational Check Step 11

12. Set FUNCT switch to position 5 and set the DELAY switch such that the number 5000 is preset on the difference display readout. The CRT display should appear as shown in figure 4-54.

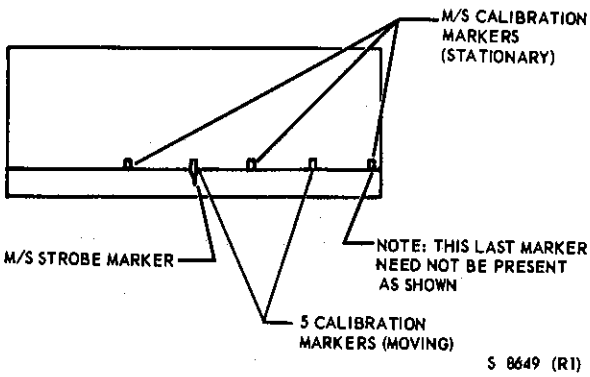


Figure 4-54. Pre-Operational Check Step 12

13. Set DELAY switch to R-fine. The master calibration markers should remain fixed in position, whereas the slave calibration markers should move to the left. When the time difference display readout indicates a number which is an integer multiple of 50 microseconds, the master and slave calibration markers should be coincident.

14. With A-B switch set to A, adjust READOUT INT control CCW and CW and check to see that the time difference display readout and annunciator light A gets dimmer and brighter respectively.

15. Repeat steps 5. through 14. for autotrack channel B.

Operating Procedure for LORAN A Signal Acquisition

1. Set power switch to STBY and allow the equipment to warm up for 3 to 5 minutes before setting the power switch to ON.

2. Consult LORAN A chart for local area and note LORAN A stations within receiving range. Choose two pairs of stations.

3. The following procedure will be used to establish auto tracking operation on autotrack channel A.

All control referred in this procedure that are duplicated for both channels, such as PRR, AUTO-MAN, etc., are to be operated on channel A. Once auto tracking operation has been established for channel A, this procedure should be repeated for channel B.

a. Set A-B switch to A, FUNCT switch to position 1, and AUTO-MAN switch to MAN.

b. Set CHAN switch and PRR switch to RF operating channel and pulse repetition rate respectively, corresponding to one of the station pairs selected in step 2.

c. Observe the CRT display and adjust the M GAIN control until the desired master pulse (top trace) is approximately 1/2 inch in amplitude. Adjust the S GAIN control until the desired slave pulse (bottom trace) is approximately 1/2 inch in amplitude.

d. Place the master pulse on the master pedestal using the L-R framing control. Slew the slave pedestal under the slave pulse by operating the DELAY switch. For the FUNCT switch in position 1, the slave pedestal will move to the right for a DELAY switch setting of either R-coarse or R-fine. Once the master and slave pulses have been placed on their respective pedestals, the CRT display should appear as shown in figure 4-55.

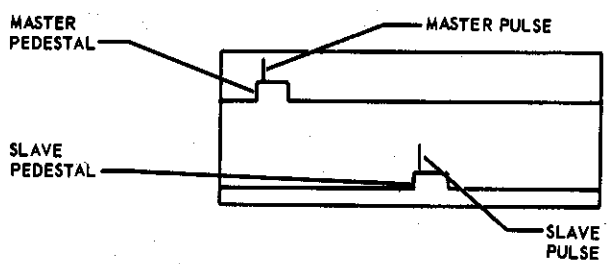


Figure 4-55. Operating Procedure for LORAN A Signal Acquisition Step 3d

e. Set FUNCT switch to position 2. Use DELAY switch to position slave pulse directly under master pulse. For the FUNCT switch in positions 2-5, the slave pulse will move in an opposite direction to the setting indicated on the DELAY switch. For example, a DELAY switch setting of R-coarse or R-fine will cause the slave pulse to move to the left with the FUNCT switch in any position between 2 and 5 inclusive. Under the same conditions, a DELAY switch setting of L-coarse or L-fine will cause the slave pulse to move to the right. Once the slave pulse is positioned under the master pulse, use the framing control to frame both pulses to the left onto the strobe markers as indicated in figure 4-56.

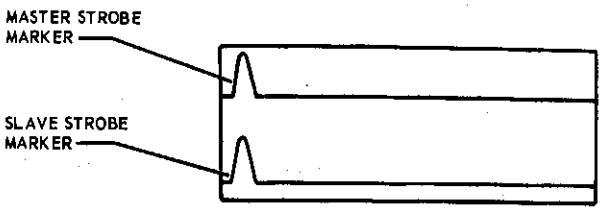


Figure 4-56. Operating Procedure for LORAN A Signal Acquisition Step 3e

f. Set FUNCT switch to position 3. Use the framing control to position the peak of the master pulse under the strobe marker. If it is difficult to identify the master pulse from the slave pulse, turn the slave gain down until the master pulse is present only. When this is done, the CRT display should appear as shown in figure 4-57.

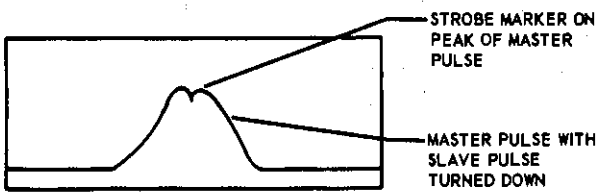


Figure 4-57. Operating Procedure for LORAN A Signal Acquisition Step 3f

g. Pull out AFC/DRIFT control. Adjust drift such that the master pulse does not drift off the marker. A CW rotation of the AFC/DRIFT control will cause the master pulse to move to the right. A CCW rotation will cause the master pulse to move to the left. When there is no more apparent movement of the master pulse, push in AFC/DRIFT control so that the AFC loop will take over control.

h. Increase the slave gain until the slave pulse amplitude equals that of the master pulse. Adjust the DELAY control until the slave pulse is positioned directly over the master pulse. Now use the L-R framing control until the strobe markers lie on the leading edge of both pulses as shown in figure 4-58.

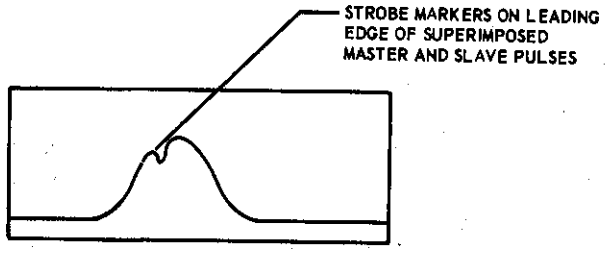


Figure 4-58. Operating Procedure for LORAN A Signal Acquisition Step 3h

i. Set AUTO-MAN switch to AUTO. Channel A is now set for autotracking operation. The A-B switch should now be set to B and the entire acquisition procedure (steps a. through i.) for the second station pair should be repeated for autotrack channel B using corresponding channel B controls.

Automatic Tracking Operation

1. With the system in autotrack operation, the time difference display readout will change automatically as the delay between the selected station pair changes. The operator may obtain instantaneous time delay information for either auto track channel by flipping the A-B display select switch between positions A and B.

2. If the presentation in function 4 and/or 5 is desired, the operator need only select these functions using the FUNCT switch. A typical function 4 and 5 presentation during autotrack operation is shown in figure 4-59.

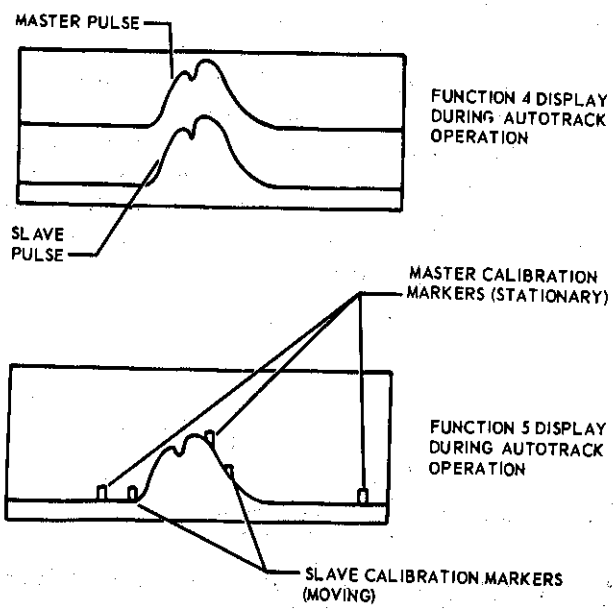


Figure 4-59. Automatic Tracking Operation

3. During autotracking operation, the time delay information on both channels is simultaneously fed to the navigation computer. Each channel's information is valid as long as the malfunction warning indicator for that channel is off. As soon as any channel's indicator is illuminated, a receiver fault signal is sent to the computer telling the computer not to accept any more receiver time delay information until the malfunction warning indicator goes off.

4. As mentioned previously, in the description of the malfunction warning indicator, the malfunction warning indication will be present under different conditions. Once signal acquisition has been performed in the manual mode and the channel set to AUTO, the malfunction warning should go off as soon as the track loop takes control. Frequently when the autotrack channel is tracking under an excessive noise condition or on a groundwave in close proximity to large skywaves, the malfunction warning indicator will be on, yet the channel will remain in track. This is easily noticeable by observing that the time delay information does not radically change, as it does when the channel has lost track. Under this condition of malfunction warning indication present with the channel still in track, the time delay information fed to the computer is valid and thus at the operator's discretion, he may override the fault indication at the navigation computer controller.

Attenuator Operation

1. During autotrack operation it may become necessary to attenuate one of the LORAN pulses due to increased signal strength. An excessively large signal overdriving the receiver can show up in two ways while the channel is in the autotrack mode of operation. One method of detecting signal overdrive is to observe the function 3 display on the CRT and look for a distortion of the strong signal where its trailing edge is misaligned with respect to the normal signal's trailing edge. This is illustrated in figure 4-60.

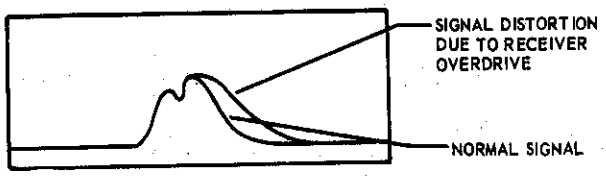


Figure 4-60. Attenuator Operation Overdriven Signal at Matched Gain

Another method of detecting overdrive is to again observe the function 3 display on the CRT and look for a much smaller and narrower signal compared to the normal one. This is illustrated in figure 4-61.

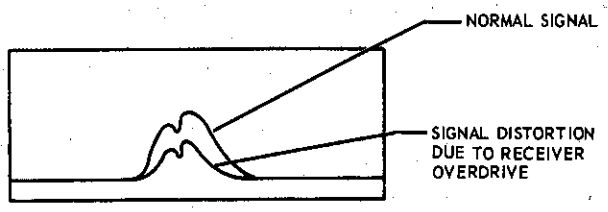


Figure 4-61. Attenuator Operation Overdriven Signal at Reduced Gain

2. In either case cited in step 1. the ATTEN switch should be set to the M or S position corresponding to the signal causing overdrive because the time delay reading is less accurate due to an excessive signal level than it is to a normal signal level. The identification of the excessive signal is easily attainable by observing the function 4 display on the CRT in which the master and slave are separated.

3. Operating the ATTEN switch while the channel is in an autotracking mode should not cause loss of track under most conditions. However, it is possible for the channel to lose track when the ATTEN switch is thrown. If this occurs, set the channel to manual mode and reacquire signals with the ATTEN switch set to either the M or S position.

Skywave Tracking

1. When one or both of the autotrack channels is used for tracking skywaves, perform operation as follows:

a. Consult LORAN A chart for skywave delay for given latitude and longitude.

b. Perform signal acquisition procedure for first-hop skywaves on both master and slave.

c. Once the channel has been set for automatic operation, set SKYWAVE CORR Switch to the polarity of the delay found in step a. Set SKYWAVE CORR control for the amount of delay found in step a.

NAVIGATION COMPUTER SET AN/AYN-1

The navigation computer set (figure 4-62) is a compact, lightweight, computer system that has the capability of solving aircraft navigational problems with information derived from aircraft navigation sensors. The computer also receives:

1. Manual programming inputs from the controller.

2. Power from the No. 1 ac primary bus and the dc primary bus. Both circuits are protected by circuit breakers on the copilot's circuit breaker panel. The ac circuit breaker is under the general heading No. 1 AC PRI and marked NAV COMPUTER. The dc circuit breaker is under the general heading DC PRI and marked NAV CMPTR.

3. Chart scaling and reference coordinates from the navigational map display.

4. Alarm inputs from sensors.

5. Sensor inputs.

Computer outputs are as follows:

1. Navigational coordinates to map display index marker.

2. Navigational readouts to the navigational display indicator.

3. Cross track error signals to hover indicator in C mode.

Navigational Controller

The navigational controller (figure 4-63) supplies manual inputs and controls of the desired computer operation. A detailed description of the controls with their related functions is as follows:

Sensor Switch A six-position rotary switch is used to select various sensors for computer operation. These switch positions and functions are:

1. TEST - Selects the computer self-test program for display.

2. LORAN C-D - Not functional in this installation.

3. LORAN A - Selects the LORAN A receiver as the controlling sensor and prepares the computer for acceptance of these inputs.

4. MAN DR - Selects true airspeed and magnetic heading from the appropriate helicopter systems for the dead reckoning mode of operation and programs the computer for acceptance of these inputs.

NOTE

True airspeed is derived from the helicopter sensor or from a manually inserted value at the controller keyboard.

NOTE

WV-WDR is derived from manually inserted values only when MAN DR is selected as the sensor. MAN DR utilizes the WV-WDR determined by the sensor in use at all other times.

NEW NEW

5. VORTAC - Selects TACAN bearing and distance as sensor and prepares the computer for acceptance of these inputs.

SEE OS-23

6. DOPP - Selects ground speed and drift angle from the doppler and prepares the computer for acceptance of these inputs.

NOTE

Surface Drift (sea current set and drift) may be manually inserted into the computer as a correction to the doppler. Place I/D SELECT switch to PF and insert surface drift as WV-WDR.

NEW NEW

Mode Switch A six-position rotary switch is used to place computer operation in one of six built-in programs. Switch positions and functions are as follows:

1. General navigation.

a. GREAT CIRCLE - Selects great circle course computation.

b. RHUMB LINE - Selects rhumb line course computation.

2. Search pattern navigation.

a. LADDER - Selects ladder search pattern.

b. SQUARE - Selects square search pattern.

c. SECTOR - Selects sector search pattern.

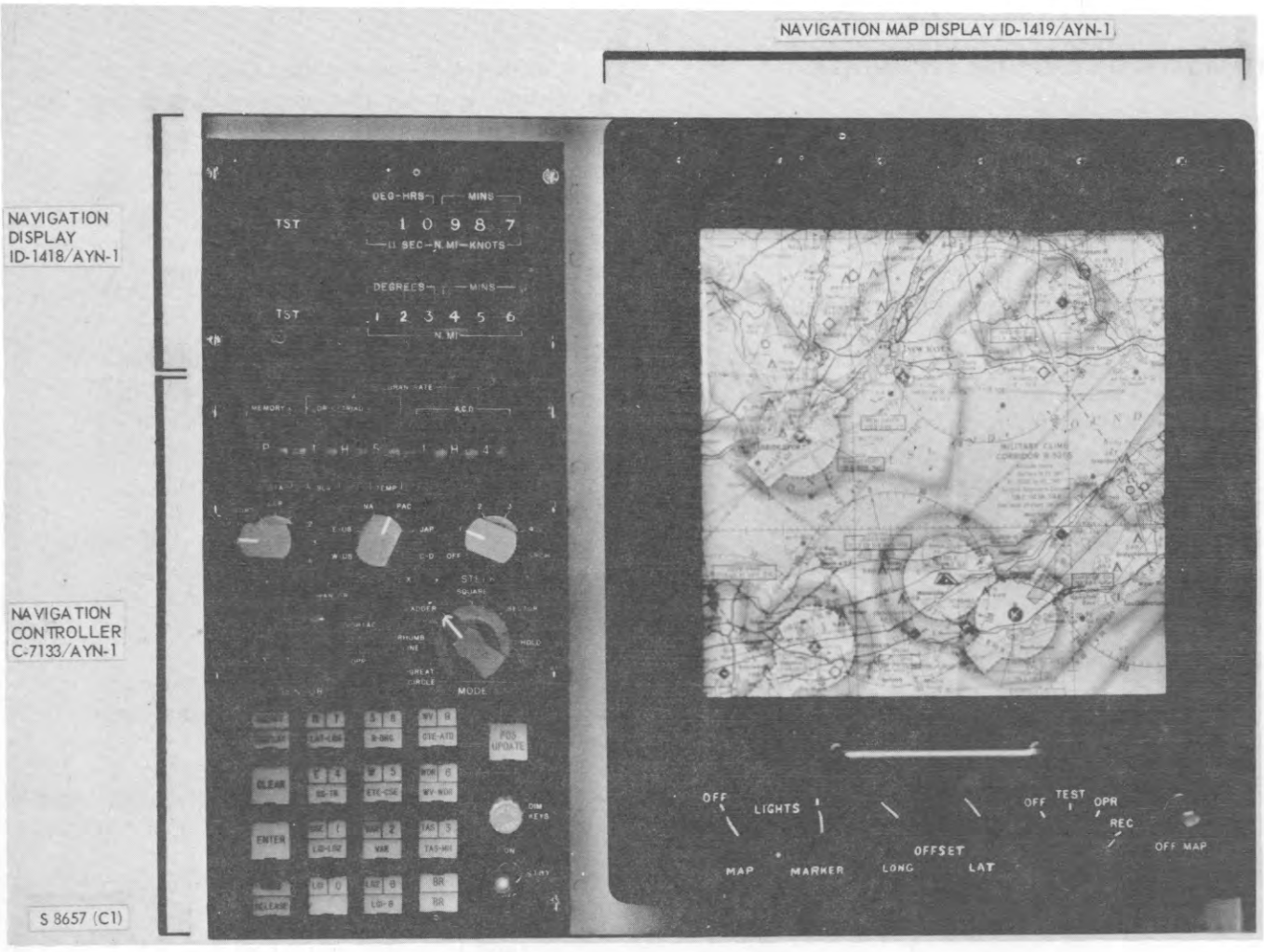


Figure 4-62. Navigation Computer AN/AYN-1

d. HOLD - Selects a holding pattern.

I/D Select Switch A set-position rotary switch is used to control insertion and display of navigation parameters. The available switch positions and associated functions are:

1. PP - Used to insert and display all keyboard parameters related to present position. The displayed parameters are associated with the destination selected on STEER DEST switch, with the exception of present position LAT - LON coordinates and magnetic variation.

2. PF - Used to insert or display coordinates of a selected position. With I/D SELECT switch in PF, all parameters are displayed with respect to this position except for WV-WDR which displays surface drift for the doppler.

3. SRCH - Used to insert or display search parameters, latitude, longitude, and magnetic variation of start search destination, and search pattern initial course.

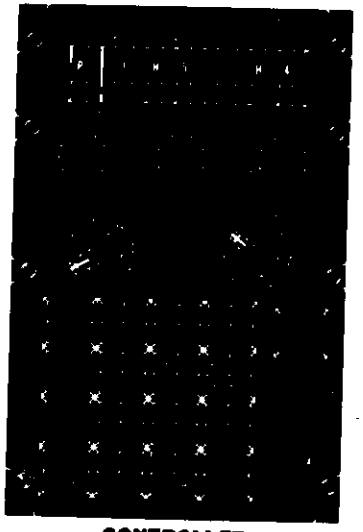
4. VORT - Used to insert and display TACAN station coordinates and magnetic variation. Outputs are displayed with respect to TACAN coordinates.

5. LOR - Used to insert and display latitude, longitude, and a total of base line length plus coding delay of LORAN station. Only LORAN constants inserted into temporary memory can be displayed.

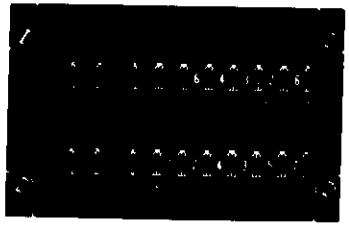
NEW

MANUAL INPUTS

- DESTINATION #1
- DESTINATION #2
- DESTINATION #3
- DESTINATION #4
- SEARCH PATTERN LEG 1
- SEARCH PATTERN LEG 2/Φ
- DESTINATION BEARING
- REFERENCE POSITION (PF)
- TACAN STATION POSITION
- MAGNETIC VARIATION
- WIND VELOCITY
- WIND DIRECTION
- LORAN DATA
- TRUE AIRSPEED



CONTROLLER



DISPLAY INDICATOR

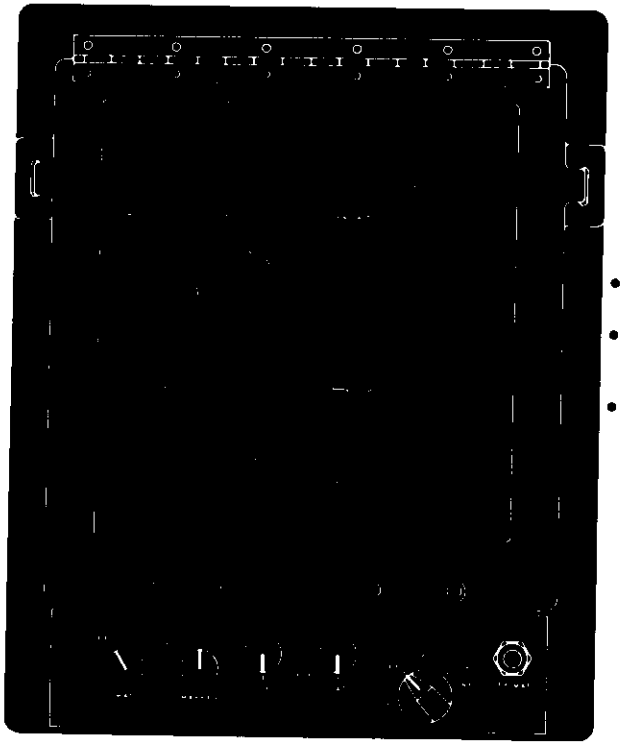
NAVIGATIONAL INFORMATION OUTPUTS

- PRESENT POSITION
- DESTINATION BEARING
- DESTINATION RANGE
- ALONG TRACK DISTANCE
- CROSS TRACK ERROR
- GROUND SPEED
- TRACK ANGLE
- WIND VELOCITY
- WIND DIRECTION
- TRUE AIRSPEED
- MAGNETIC HEADING
- ESTIMATED TIME ENROUTE
- ARRIVE DESTINATION
- SYSTEM FAULT
- SENSOR FAULT
- COURSE

AUTOMATIC INPUTS

- DOPPLER < GROUND SPEED, DRIFT ANGLE
- TACAN < DISTANCE, BEARING
- LORAN "A" AUTOTRACK
- MAGNETIC HEADING
- TRUE AIRSPEED
- TACAN FAULT
- DOPPLER FAULT

COMPUTER



MAP DISPLAY

- PILOT INSERTS STANDARD AIR NAVIGATION CHART
- CONTINUOUS INDICATION OF PRESENT POSITION BY "BUG LIGHT"
- PERMANENT RECORD OF FLIGHT ROUTE BY PIN-PUNCHING OF CHART EVERY 10 SECONDS.

S 8658

Figure 4-63 Navigation Computer Outline AN/AYN-1

NOTE

With the I/D SELECT switch in LOR and LORAN A selected as a sensor, a display of LAT will show the microsecond time delay readout of CHANNEL A. LONG will show the microsecond time delay readout of CHANNEL B. Both of these readouts will already be corrected for the skywave correction selected by the avionicsman and will be different from his readouts unless the SKYWAVE CORR switch is set at zero for both channels.

6. 1, 2, 3, 4 - Used to insert and display up to four destination coordinates. A course is automatically computed between adjacent destinations. This course is stored for computation of cross track errors and may be recalled for display. Autcmatic course computation can be over-ridden by manual keyboard course insertion.

Steer Dest Switch A six-position rotary switch, used to select a destination the computer will use in calculation of steering signals. Switch positions and associated functions are as follows:

1. OFF - Disconnects and removes computer signal from hover indicator in mode C.

2. 1, 2, 3, 4 - Selects destinations that correspond to I/D SELECT switch positions and also delivers signals to the hover indicator in mode C.

3. SRCH - Selects and initiates the automatic search program as selected on the mode switch using parameters inserted in the SRCH position of the I/D SELECT Switch.

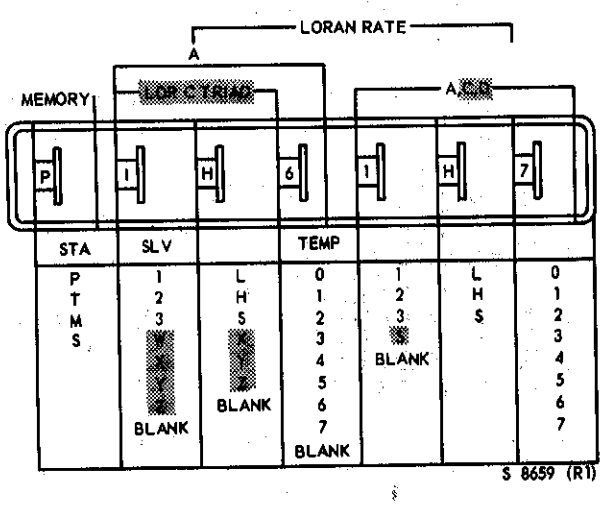


Figure 4-64. LORAN A Selection AN/AYN-1

Complex Switch A six-position rotary switch used to select LORAN A permanent memory complex constants associated with the following geographical areas. Positions available on the switch are as follows:

1. W-US (Western United States)

2. E-US (Eastern United States)

3. NA (North Atlantic)

4. PAC (Pacific)

5. JAP (Japan)

6. C-D (Loran C-D) Not functional in this installation

LORAN Control A series of seven thumbwheel digit switches used to select LORAN A rates for insertion or display. It also aligns the computer to receive inputs from the LORAN set (figure 4-64).

LORAN Rates A/LOR-C Triad A series of three switches used to select a LORAN A station pair. The LOR C TRIAD has no function in this installation.

1. A, C, D - A series of three switches used to select a second LORAN A pair.

2. MEMORY - A single switch used to select either P (permanent memory) or T (temporary memory). Temporary memory may contain up to four LORAN A station pairs.

3. STA - This switch is common with MEMORY switch. It is used to select either M (master) or S (slave) LORAN A station constants for insertion or display.

4. SLV - This switch has no function in this installation.

5. TEMP - This switch selects temporary memory areas for insertion of four LORAN A pairs.

Keyboard Control A keyboard arrangement of 16 pushbutton switches used to insert program information into the computer or to select display outputs from the computer.

1. INSERT/DISPLAY - Determines whether data is to be inserted or displayed. Selection is indicated by illumination of either the upper (INSERT) or lower (DISPLAY) position of keyboard switches.

NOTE

The insert parameter (N, S, E, W typical) is determined by the first keyboard selection. The numerical values of parameters are inserted by succeeding keyboard selections.

2. Keyboard switches allow manual insertion of the following data;

N - North latitude. S - South latitude.
E - East longitude.
W - West longitude.
WV - Wind velocity.
WDR - Wind direction.
TAS - True airspeed.
VAR - Magnetic variation.

NOTE

After VAR is selected, E or W for east or west magnetic variation must be inserted prior to the numeric value of the variation. Example: VAR W 5 00.0.

3. CSE - Magnetic course.

4. LG1 - Length of first leg of search pattern or radius of sector pattern.

5. LG2 - Length of second leg or sector angle. Leg length is inserted when mode switch is in LADDER or HOLD position. Sector angle is inserted when mode switch is in SECTOR position.

6. BR - Value of LORAN baseline length plus coding delay.

7. ENTER - Used to insert data previously selected with the keyboard. Data can be checked for accuracy on display indicator prior to depressing the ENTER switch.

8. CLEAR - Clear display indicator.

NOTE

If incorrect data is inserted into the computer, it may be corrected by reinserting the proper data.

9. Placing the INSERT/DISPLAY switch in the DISPLAY position and depressing the desired keyboard switch allows display of the following parameters:

NOTE

Display selections are provided as indicated on bottom half of each keyboard switch.

LAT-LON - Latitude and longitude.
R-BRG - Range and bearing.
CTE-ATD - Cross track error and along track distance with respect to destination selected on STEER DEST switch.
GS-TR - Ground speed and true track angle.
ETE-CSE - Estimated time enroute and course with respect to destination selected on STEER DEST switch.
WV - WDR - Wind velocity and wind direction or surface drift if I/D select switch is in PF.

NOTE

Wind velocity and direction can be determined only if true airspeed is available from either the true-airspeed sensor or manual input.

LG1-LG2 = Search pattern leg 1 and leg 2 length.
VAR - Magnetic variation.
TAS-MH - True airspeed and magnetic heading.
LGI-ϕ - Sector search pattern radius and angle ϕ.
BR - Value of LORAN base line length plus coding delay.

10. DR Override (Blank Key) - Prevents system from switching to automatic DR when selected sensor fault indication is transmitted to the computer.

NOTE

Automatic DR is a continuing DR plot utilizing the last position and wind as determined by the sensor in use prior to the SENSOR FAULT indication.

11. HOLD/RELEASE - Associated directly with display indicator. In the HOLD position, all navigation parameters are frozen to the same time reference for display purposes. Navigation computation hover indicator mode C and map display remain normal. In the RELEASE position, navigation parameters are free to automatically update with changing computations. Selection is indicated by illumination of upper portion of key for HOLD (green) and lower portion for RELEASE.

Dim Keys Control An adjustable control used for dimming lights in keyboard and for testing system

advisory lights. Rotating the control to full clockwise position illuminates keyboard lights to maximum intensity. Rotating the control to full counterclockwise position causes keyboard lights to extinguish. Depressing the control applies test voltage to ERROR light in controller and SENSOR FAULT, SYSTEM FAULT and ARRIVE DEST indicators in display indicator.

Pos Update Switch A momentary pushbutton switch, used to update present position. It updates MAN DR and DOPP latitude and longitude to computer latitude and longitude values that were inserted in PF, SRCH, VORT, DEST 1-4, or to PP as determined by LORAN or TACAN. Lights in UPDATE switch are controlled in common with keyboard lights.

Power Switch A three position toggle switch used to control the computer power. STBY position provides power to the crystal oven and the ON position provides full power to computer system.

Error Light Provides an indication of an ERROR in the LORAN rate selection process. A rate called from permanent or temporary memory which is not in that memory will create an ERROR condition.

Controller Switch Chart A summary of the purpose and limitations of the controller switches is contained in figure 4-65.

Lighting Controls OFF MAP provides indication when present position is outside of area covered by chart. Light is amber and may be dimmed mechanically.

Navigational Display Indicator

The display indicator provides a visual readout of computer outputs and inputs selected by the controller I/D SELECT switch and keyboard pushbuttons (figure 4-66). The display provides SENSOR FAULT, SYSTEM FAULT, and ARRIVE DEST advisory lights.

Navigational Map Display

The map display receives the following inputs:

1. Computed latitude and longitude data to provide a visual representation of present position.

2. Map and index marker lighting (from computer).

3. OFF map light (from computer).

4. Panel lighting (from helicopter).

5. System fault information (index marker light blinks or extinguishes with system fault).

The map display performs the following functions:

1. Shows present position by moving light (index marker) of the helicopter on Mercator or Lambert Conformal charts that exist in the normal logistics supply. The display is based on computed present position from any of the helicopter sensors (depending on sensor switch selection).

2. A solenoid-operated punch within the marker produces a permanent record of flight path on the chart when REC is selected.

3. Provides chart index coordinates and scale and projection data to the computer in order to maintain coincidence between the chart and computer present position data.

A brief description of controls and indicators found on the map display is given in the following text.

Mode Switch A four position rotary switch to control map display operation.

1. The OFF position renders the map display inoperative.

2. In the TEST position, the servos drive the index marker to center of the map. OFFSET controls are used during this mode to position the index marker to the exact chart index coordinates.

3. In the OPR (operate) position, the index marker is positioned by computed present position information from the computer.

4. In the REC (record) position, the map display operates the same as in the OPR position except that a recording punch makes a permanent flight path record on the chart.

CAUTION

The REC position should not be selected if charts are plastic or plastic laminated as the punch will bind in the chart and damage to the map display will occur.

Offset Controls Two different controls, marked LONG and LAT, are provided for manual adjustment of index marker.

CONTROL OR INDICATOR	PURPOSE	LIMITATIONS
Thumb Wheel Digit Switches	Selects desired LORAN A station pairs from permanent or temporary memory.	T (Temporary Memory) allows storage of four LORAN A station pairs. LORAN A parameters stored in permanent memory can not be displayed.
COMPLEX Switch	Allows operation choice of LORAN A complexes.	Switch should be in proper LORAN A complex position coincident with area and mode of navigation.
ERROR Light (Red)	Indicates erroneous or incompatible LORAN A thumb wheel digit switch setting.	Error conditions can exist which are not guarded by error light.
I/D SELECT Switch	Selects insertion or display of parameters.	None.
STEER DEST Switch	Selects destination for display of CTE and ATD. Applies course information to HOVER indicator in mode C.	None.
SENSOR Switch	Selects sensor used for navigation, or computer test program which validates computer set operation.	None.
MODE Switch	Differentiates between basic modes of system operation; rhumb line, great circle navigation or search.	None.
Keyboard (16 momentary switches)	Provides a means of selecting parameters to be inserted or displayed.	Material must be inserted in precise order. Requires use of display indicator for display and insert function.
POS UPDATE Switch	To update latitude and longitude while operating by Doppler or manual dead reckoning.	Operation requires coordination with I/D SELECT switch. Required for LORAN initialization.
DIM KEYS Control	Controls keyboard lighting intensity	Does not control background lighting.
OFF-STBY-ON Switch	Controls application of computer set power.	STBY (Standby) position prepares system for full operational efficiency by providing clock oven heater power.
Automatic DR Override	Prevents system from switching to automatic dead reckoning when sensor signal is lost. Flashing sensor fault light indicates override condition.	Sensor fault light will not automatically extinguish when faulty condition is corrected.

Figure 4-65. Controller Switch Chart

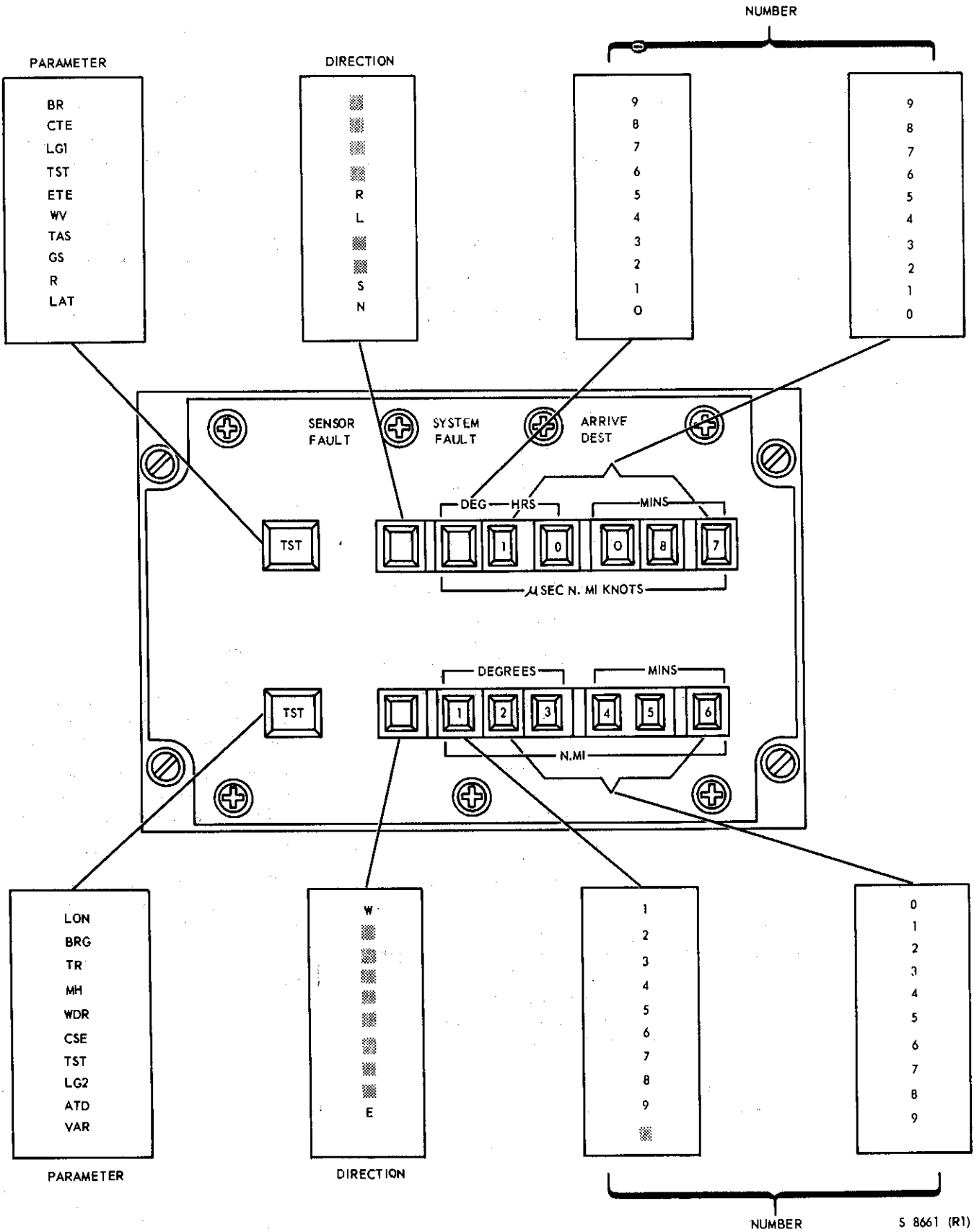


Figure 4-66. Display Indicator Parameters

CONTROL OR INDICATOR	PURPOSE	LIMITATIONS
SENSOR FAULT Light (Amber)	Indicates sensor in use is producing a signal unsatisfactory for computer use. Light will blink continually during auto DR override.	Indicates fault only in sensor selected for navigation parameters by controller SENSOR switch.
SYSTEM FAULT Light (Amber)	To signal computer system failure condition.	Fault isolation is not provided.
ARRIVE DEST Light (Green)	To indicate approach to destination or end of search leg.	
Parameter and numeric displays	To display parameter as selected on controller	Display is updated every two seconds.

Figure 4-67. Display Indicator

1. OFFSET LONG (longitude) - This control provides a means of aligning the index marker in longitude.

2. OFFSET LAT (latitude) - This control provides a means of aligning the index marker in latitude.

3. Index MARKER LIGHTS - Provides a means of varying intensity of chart lighting through peripheral light intensity of marker lights.

4. MAP LIGHTS - Provides a means of varying in right and left sides of map display cover (figure 4-68).

Encoding Switches

The encoding switches (fiqure 4-69), located under the map display cover, supply information relative to latitude, longitude, scale factor, and projection of the chart. The encoding switches consist of 16 thumb wheel digit switches, arranged in two sections on the map display base plate. For easy access to the encoding switches, the map display mode switch should be placed in the TEST position. This action drives the index marker to the center of the map; thus, providing access to both sets of thumb wheel switches.

Map Display Control Chart

A summary of purposes and limitations of the map display controls is contained in figure 4-70.

OPERATIONAL PROCEDURES

Preflight

Map Display Procedures

NOTE

Some operations considered preflight may be done in flight if necessary, but all are normally preparatory to system operation.

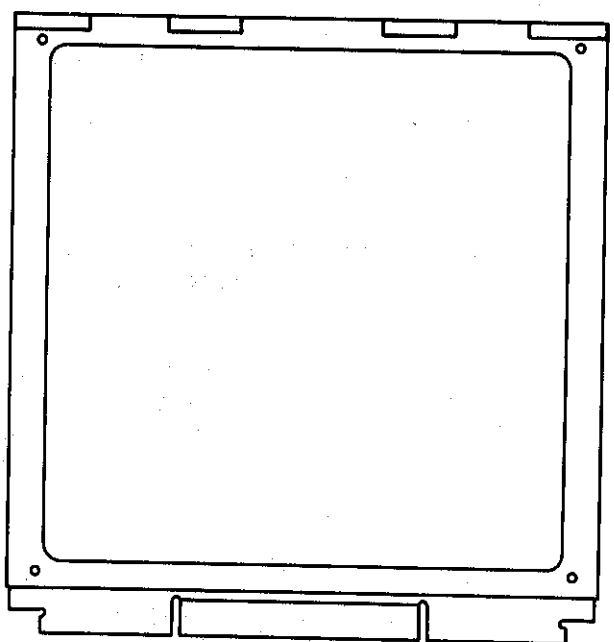


Figure 4-68. Map Display Cover

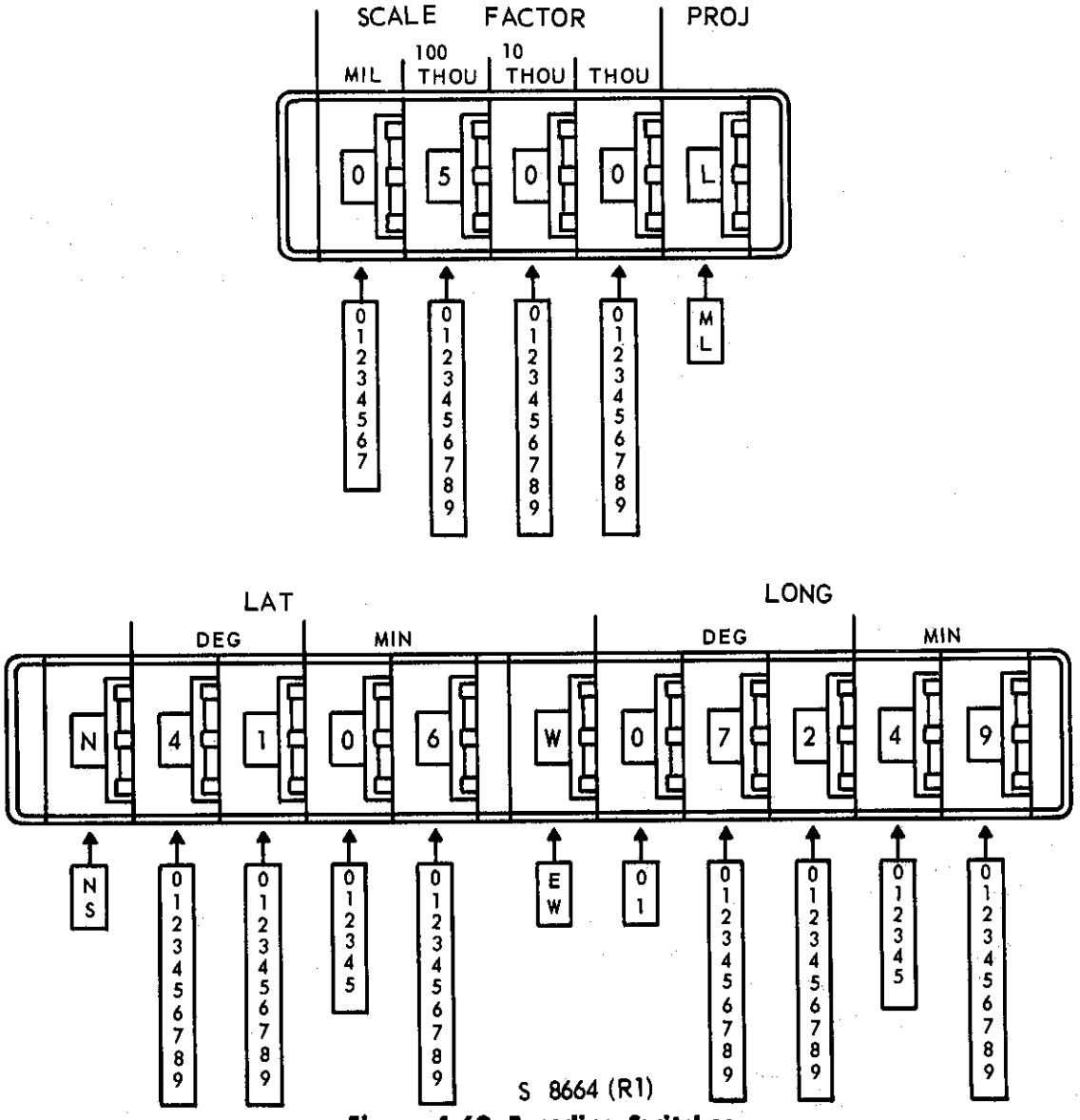


Figure 4-69. Encoding Switches

Chart Preparation

NOTE

Care should be exercised in preparation of charts, as errors could render the chart useless.

1. Select standard aeronautical navigation charts which have the coverage necessary for anticipated area of operation. Either Lambert Conformal or Mercator projection charts with scale factors of 1,000:1 to 7,888,000:1 are acceptable.

NOTE

It is recommended that Lambert charts with a scale factor of over 1:1 million not be used in the map display when accuracy within the diameter of the indicator light is required. If larger area charts are needed, it is recommended that the Mercator chart be used with the correction factor inserted.

2. Choose a center point in selected chart, using one of the following methods which appear in order of preference.

a. An intersection of latitude and longitude lines.

b. A point midway between two medians and any parallel or parallel sub-division.

c. A landmark having known coordinates.

CONTROL OR INDICATOR	PURPOSE	LIMITATIONS
MAP LIGHTS Control	Controls chart lighting.	None.
MARKER LIGHTS Control	Controls brightness of marker.	None.
OFFSET LONG Controls	Provides a means of adjusting marker longitude position	CAUTION Do not operate OFFSET controls with map display OPERATE switch in RECORD position.
OFFSET LAT Controls	Provides a means of adjusting marker latitude position.	
OFF-TEST-OPR-REC Switch	Controls map display operational mode.	None.
OFF MAP Light (Amber)	Indicates marker position is beyond the limits of chart in use or that chart is incompatible with area of flight.	None.
Encoding Switches	Supplies chart latitude and longitude scale factor and chart projection to computer.	Must be changed for each different chart.

Figure 4-70. Map Display Controls

3. Place map-cutting template (figure 4-71), over center point of chart. Rotate cutting template to place reference lines on or parallel with latitude and longitude lines on chart. Mark and cut chart.

4. Center chart section in frame assembly assuring that the chart is smoothly against the glass with no sagging.

NOTE

After chart has been prepared, note latitude and longitude of center point of chart, type of chart (Mercator, Lambert), and scale factor of chart section. This information is necessary to align chart with computer and should be recorded on chart.

Number and coverage of chart(s) prepared for any operation depend entirely upon operating area. Additional charts may be prepared during flight. Map display accuracy is directly related to chart preparation accuracy.

Map Encoding Switch Preparation 1. Place navigation controller OFF-STBY-ON switch to ON position.

2. Place map display OFF-TEST-OPR-REC switch in TEST position. Marker shall drive to approximate center of displayed chart section.

CAUTION

Do not move the index marker assembly by hand, as damage to servo gear train may result.

3. Position the encoding switches, using the following data noted on the selected chart.

a. Position latitude switches to coordinates at center of selected chart (N/S, degrees, minutes).

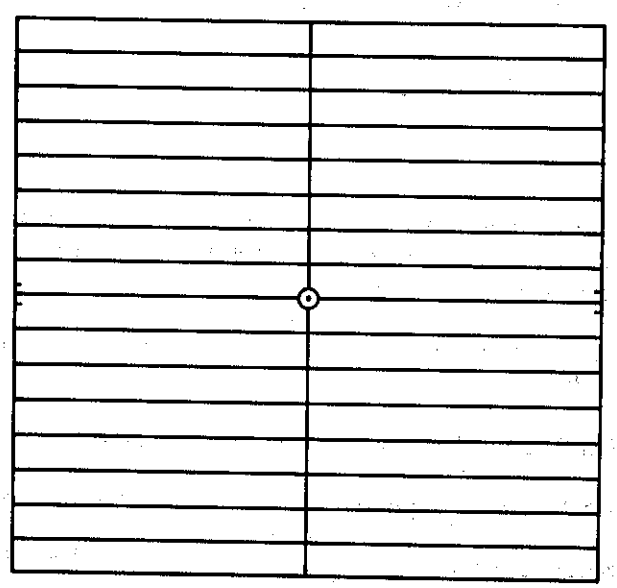


Figure 4-71. Template

b. Position longitude switches to coordinates at center of selected chart (E/W, degrees, minutes).

c. Position projection switch to appropriate chart type: Mercator (M) or Lambert (L).

d. Position scale factor switches to scale factor of selected chart (Mercator chart requires scale factor correction).

NOTE

Separate encoding is required for each different chart section.

NOTE

Mercator chart encoding requires a correction of the scale factor when positioning the encoding switches. The cosine of the chart (Mercator) reference latitude provides this correction factor.

Example:

Chart	VLC 30-22
Scale Factor (S.F.)	1:2,188,800
Reference Latitude	N37°30′
Correction Factor (C.F.)	COS 37°30′

C.F. = COS 37°30′ = 0.7934

S.F. CORRECTED = 1:2,188,800

0.7934

1.2,758, 759.76

The encoding switches can be set only to the nearest thousandth; therefore, the appropriate scale factor for encoding is 1:2,759,000.

Sample Problem of encoding switch selection. (figure 4-69).

Center Point Latitude:	North 41°06′
Center Point Longitude:	West 72°49′
Scale Factor:	500,000
Type Projection:	Lambert Conformal Conic

COORDINATES	
LATITUDE	DECIMAL
N-S	N
Tens (Degrees)	4
Units	1
Tens (Minutes)	0
Units	6
LONGITUDE	
E-W	W
Hundreds (Degrees)	0
Tens	7
Units	2
Tens (Minutes)	4
Units	6
SCALE FACTOR	DECIMAL
Millions	0
100 Thousands	5
10 Thousands	0
Thousands	0
Type Projection Lambert	L

4. Secure frame assembly containing previously prepared chart to map display cover.

5. Make minor adjustments of OFFSET LAT and OFFSET LONG controls to place marker in exact center (reference latitude and longitude) of chart section.

NOTE

Do not operate OFFSET controls in any mode other than TEST. The offset controls add to or subtract from the computer present position.

NOTE

Controls must be zeroed or reset with each chart replacement.

6. Place map display OFF-TEST-OPR-REC switch in OFF position.

7. Place navigation controller OFF-STBY-ON. Switch to OFF position.

Navigation Controller

Preflight

NOTE

The following procedures are the minimum that should be accomplished by the copilot prior to takeoff when cockpit workload permits.

Procedures 1. Place controller OFF-STBY-ON switch in ON position. SYSTEM FAULT light extinguished.

NOTE

Loss of the No. 1 ac primary bus when the computer is on will result in the loss of all temporary memory. If the computer is left on for engine start, information stored in temporary memory may be lost.

NOTE

A built-in test program continually checks the computer and activates the system fault light when an improper operation is sensed.

2. Cancel SENSOR FAULT light by cycling INSERT/DISPLAY switch light to display position.

3. Depress DIM KEYS control. ERROR light, SENSOR FAULT, SYSTEM FAULT, and ARRIVE DEST lights will illuminate.

4. Rotate SENSOR switch to TEST. Observe display indicator. Proper operation is indicated in figure 4-72.

5. a. Rotate SENSOR switch to MAN DR.

b. Rotate ID SELECT switch to VORT.

c. Rotate Map Display function switch to OPR.

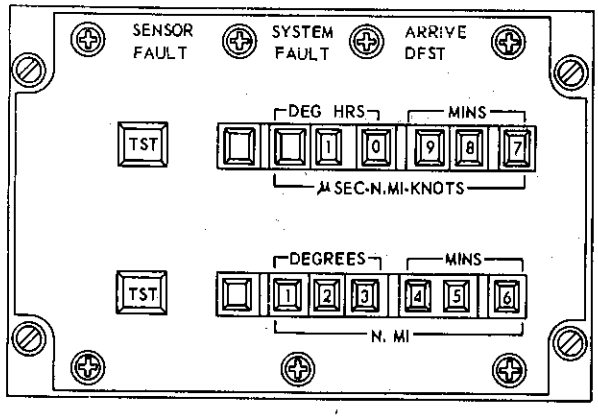


Figure 4-72. Display and Test Parameters

d. Depress POS UPDATE switch light.

e. Marker should move to position of the local VORTAC.

f. Check for correct variation.

g. The marker position may be cross-checked by displaying LAT/LONG.

SEE 05-23

NOTE

It is recommended that each unit establish a policy of always utilizing a local VORTAC station for preflight. If some other VORTAC is used during the flight the LAT/LONG and VAR of the preflight VORTAC should be entered in VORT before the helicopter is secured.

6. a. Rotate I/D SELECT switch to 1.

b. Depress POS UPDATE switch light.

c. Marker should move to position 1.

d. Check for correct variation.

e. The marker may be cross-checked by displaying LAT/LONG.

NOTE

It is recommended that each unit establish a policy of always utilizing the LAT/LONG and VAR of their home unit in position 1. If some other LAT/LONG and VAR are utilized in 1 during flight, the preflight LAT/LONG and VAR should be entered in 1 before the aircraft is secured.

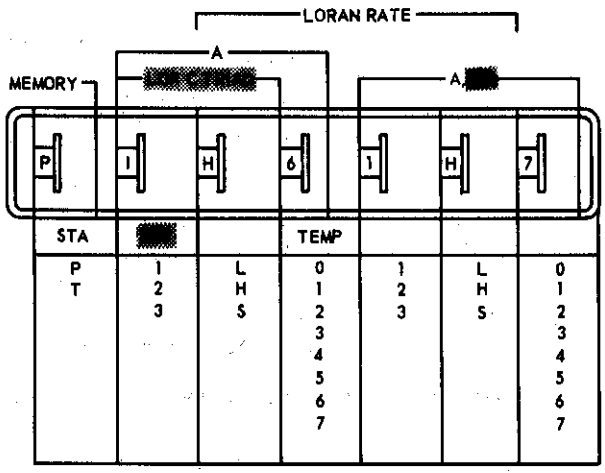


Figure 4-73. LORAN A Permanent Memory Selection AN/AYN-1

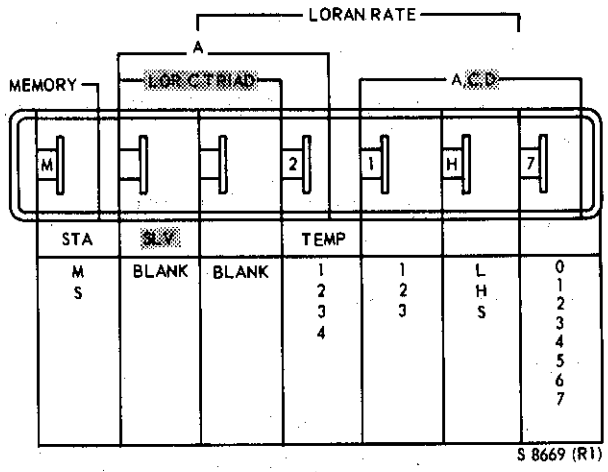


Figure 4-74. LORAN A Temporary Memory Selection AN/AYN-1

7. Rotate I/D SELECT switch to PP (Check for correct VAR).

NOTE

If a local VORTAC has not been inserted in VORT or if position 1 is not the helicopter's location, this information should be inserted before departure.

8. Insert TAS 0 and/or determine that the true airspeed sensor is functioning. If manual TAS is desired, insert desired value.

Sensor Selection

LORAN A Station Selection 1. Place controller SENSOR switch in LORAN A position.

2. Place MEMORY thumb wheel digit switch in either P or T, depending upon whether the desired station constants are in permanant memory or are to be stored in temporary memory.

NOTE

A permanent memory selection requires that the COMPLEX switch be placed in a position that corresponds to the intended area of operation.

3. Select LORAN A complex by using LORAN RATE thumb wheel digit switches. The following table illustrates the combination of thumb wheel digit switch positions that are available for LORAN A selection (figure 4-73).

LORAN C-D Station Selection LORAN C-D station selection is not utilized in this installation.

LORAN Constant Insertion LORAN A station constants for many of the LORAN A stations are placed in the permanent memory at the time of manufacture. These may not be altered or added to by the operator. Additions or changes in LORAN A stations are made only in the temporary memory.

Four LORAN A master-slave pairs may be stored in temporary memory. The following table illustrates the combination of thumb wheel digit switch positions that are utilized for LORAN A temporary memory insertion (figure 4-74).

The following procedure details the manual insertion of LORAN constants into temporary memory.

1. Place controller I/D select switch in LOR position.

2. Depress controller INSERT/DISPLAY key to obtain INSERT indication. (Upper portion of keyboard switches will illuminate.)

3. Place STA thumb wheel digit switch in either M or S position. Selection depends on whether station to be inserted is a master or slave.

4. Select desired temporary memory position (1 to 4) by using the TEMP thumb wheel switch.

NOTE

A temporary memory position will contain one complete set of data pertaining to a particular LORAN A pair. The operator should record position of material stored into temporary memory for future reference.

5. Select LORAN A pair identification.

a. Desired LORAN A pair is selected using the three right-hand LORAN RATE thumb wheel switches.

NOTE

Each change or addition to LORAN A constants requires insertion of complete pair (LORAN A) into temporary memory. Each set of constants involves: Master station latitude and longitude. Slave station latitude and longitude. Base line length plus coding delay.

6. Insert latitude, longitude, and base line length plus coding delay value for each LORAN A pair as follows:

a. Depress N or S key to establish latitude direction. Depress numerical keys to insert latitude. Check display indicator for accuracy and then depress ENTER key.

b. Depress E or W key to establish longitude direction. Depress numerical keys to insert longitude. Check display indicator for accuracy and then depress ENTER key.

Six significant latitude and seven significant longitude digits are required for coordinate accuracy. The arrangement of the display indicator is such that only five latitude and six longitude digits can be displayed.

Therefore, after five latitude or six longitude digits have been inserted and checked for accuracy, an additional digit (least significant hundredths) shall be inserted. Upon insertion of this additional digit, the displayed coordinates will shift one digit to the left thereby removing the most significant longitude digit from view and the most significant latitude digit into the blank area. This arrangement in no way affects the operation or arrangement of the inserted data when the ENTER key is depressed.

7. Repeat insertion process for latitude, longitude, and base line plus coding delay value for each of the remaining stations as shown in figure 4-75.

NOTE

Insertion of LORAN A data into temporary memory position automatically erases data previously placed into the memory position.

8. Each station pair required for LORAN A operation is selected from either temporary or permanent memory. For example, a permanent memory (P) switch setting calls both station pairs from permanent memory, while a temporary memory (T) switch setting calls both station pairs from temporary memory. A station pair from permanent memory cannot be used in conjunction with a station pair from temporary memory.

Manual Dead Reckoning 1. Select MAN DR position on controller SENSOR switch.

2. Depress INSERT/DISPLAY key to obtain INSERT indication.

3. Insert prevailing wind direction and wind velocity using keyboard switches.

TACAN Selection 1. Place controller SENSOR switch in VORTAC position.

2. Place I/D SELECT switch in VORT position.

3. Depress keyboard INSERT/DISPLAY key to obtain INSERT indication.

4. Insert coordinates and magnetic variation of TACAN station in anticipated flight area.

Doppler Selection 1. Place controller SENSOR switch in DOPP position.

2. Place I/D SELECT switch to PF and verify WV-WDR-O.

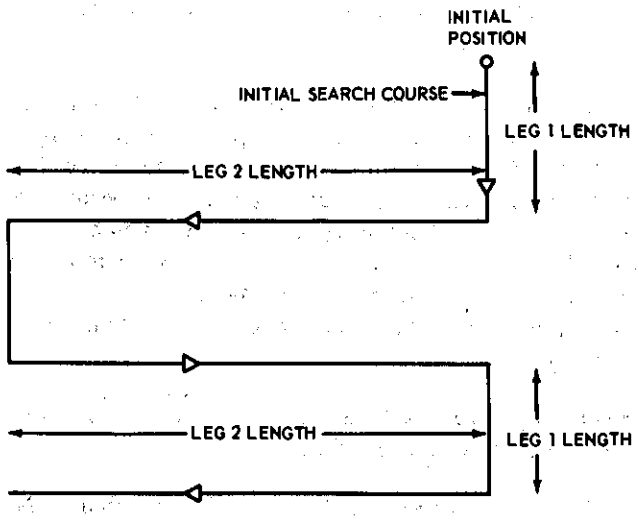
Destination Selection 1. Place controllor MODE switch in either GREAT CIRCLE or RHUMB LINE position.

LORAN A TEMPORARY MEMORY INSERTIONS

STA	TEMP	RATE	LATITUDE	LONGITUDE	BR
M	1	1L0	N70°55.30′	W 8°42.30′	N/A
S	1	1L0	N68°37.90′	E14°27.50′	4080.50
M	2	1L1	N63°49.60′	E 9°25.00′	N/A
S	2	1L1	N68°37.90′	E14°27.50′	2939.96

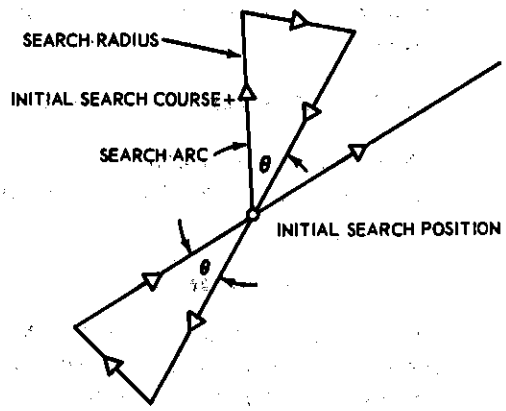
Figure 4-75. LORAN A Temporary Memory Insertions AN/AYN-1

LADDER SEARCH PATTERN



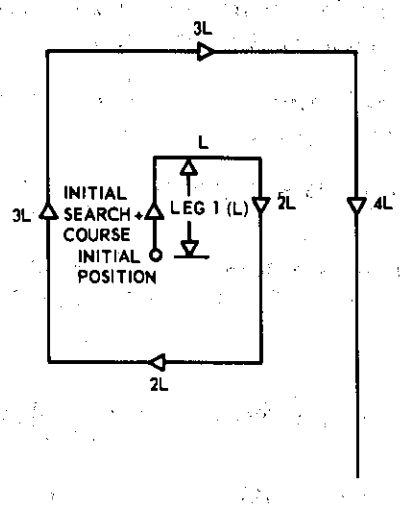
PATTERN IS COMPLETELY DEFINED BY INITIAL POSITION, MAGNETIC VARIATION, INITIAL SEARCH COURSE, LEG ONE AND LEG TWO LENGTHS. FIRST TURN IS 90° TO RIGHT AND NEXT TWO ARE 90° TO LEFT, ETC.

SECTOR SEARCH PATTERN



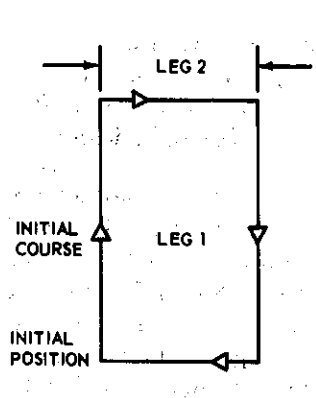
PATTERN IS COMPLETELY DEFINED BY INITIAL POSITION, MAGNETIC VARIATION, INITIAL COURSE, RADIUS AND ARC. ALL TURNS ARE TO THE RIGHT.

SQUARE SEARCH PATTERN



PATTERN IS COMPLETELY DEFINED BY INITIAL POSITION, MAGNETIC VARIATION INITIAL SEARCH COURSE AND INITIAL LEG LENGTH. STARTING FROM INITIAL POSITION PATTERN PROGRESSES ON INITIAL SEARCH COURSE FOR LENGTH OF INITIAL LEG. A 90 DEGREE COURSE CHANGE TO RIGHT IS MADE AT END OF EACH LEG. EVERY OTHER LEG LENGTH IS INCREASED BY LENGTH OF INITIAL LEG. PATTERN MAY CONTINUE INDEFINITELY.

HOLDING PATTERN



PATTERN IS COMPLETELY DEFINED BY INITIAL POSITION, MAGNETIC VARIATION INITIAL SEARCH COURSE, LEG ONE AND LEG TWO. ALL TURNS ARE 90° TO THE RIGHT

5' 8671 (R1)

Figure 4-76. Search Patterns

2. Place I/D SELECT switch in position 1.

3. Depress INSERT/DISPLAY switch to obtain an INSERT indication.

Example:

4. Insert coordinates and magnetic variation of normal base of operations (point of origin) or a selected destination.

5. Place I/D SELECT switch in positions 2 through 4, depending upon the number of destinations required. Insert the coordinates and magnetic variation for each destination.

6. Place I/D SELECT switch in PP position. Insert present position magnetic variation.

7. Depress INSERT/DISPLAY key to obtain DISPLAY indication and verify inserted information.

Automatic Search Selection

NOTE

The procedures described below can be accomplished in flight.

1. Place controller MODE switch in a position which corresponds to type of search pattern that is desired (figure 4-76).

NOTE

The desired search mode must be selected prior to insertion of search parameters.

2. Place I/D SELECT switch in SRCH position.

3. Depress INSERT/DISPLAY key to obtain INSERT indication.

4. Using keyboard switches, insert the following:

a. Latitude, longitude, and magnetic variation of initial position of the search.

b. Initial search course.

c. A selection of LADDER or HOLD pattern requires insertion of leg one length (LG1) and leg two length (LG2).

d. Selection of SQUARE pattern requires insertion of leg one length (LG1). Leg two length is calculated by computer set, using multiples of leg one length.

e. Selection of SECTOR pattern requires insertion of the radius as leg one length (LG1) and search arc (Θ)

5. Depress INSERT/DISPLAY key to obtain DISPLAY indication and verify inserted information.

Initialization

1. Place controller I/D SELECT switch in a destination containing the present position coordinates.

NOTE

If present position is not contained in an I/D SELECT switch position, proceed as follows.

a. Place controller I/D SELECT switch in PF position.

b. INSERT/DISPLAY key to INSERT.

c. Enter present position coordinates.

2. Place I/D switch in DISPLAY.

3. Depress POS UPDATE key to initialize and update computer to present position. Place controller OFF-STBY-ON switch in OFF position if the computer is not going to be used.

Sensor Selection Flow Chart A flow chart summarizing the preflight sensor selection procedures is presented in FO-12.

Automatic Navigation After preflight preparations have been completed, prepare for automatic navigation by completing the following:

1. Place controller ON-STBY-OFF switch to ON.

2. If map display operation is desired, OFF-TEST-OPR-REC switch should be placed on OPR position. REC position shall be chosen if flight path is to be recorded.

CAUTION

Do not operate OFFSET controls with map display OFF-TEST-OPR-REC switch in REC position, as damage to chart may result. If OFFSET controls are inadvertently moved during OPR or REC, present position indication will be invalid. Momentarily place OFF-TEST-OPR-REC switch in TEST position. Use OFFSET controls to recenter marker on chart and then return switch to OPR or REC as desired.

3. Place controller MODE switch in either GREAT CIRCLE or RHUMB LINE position.

4. Place SENSOR switch in position that corresponds to the desired sensor input.

NOTE

Prior to switching to LORAN A as a sensor, update the computer to the best known position to resolve the ambiguity of the LORAN A fix.

NOTE

Should the selected sensor become inoperative or input signal become unreliable, SENSOR FAULT light can be observed. When SENSOR FAULT is lit, system switches to automatic dead reckoning mode. This condition is prevalent during ground operations in which sensors are unreliable. During automatic dead reckoning override, the SENSOR FAULT light blinks continually. The operator may make another sensor selection if desired.

NOTE

If automatic TAS is available, a 0 for TAS must be inserted to obtain the automatic airspeed sensor output.

5. Place I/D SELECT switch to PP.

6. Place STEER DEST switch to position 2. A signal will be sent to the hover indicator in mode C reflecting CROSS TRACK ERROR.

7. Depress INSERT/DISPLAY key to obtain DISPLAY indication. Factors pertaining to flight progress may be selected for display by using the various positions available on the I/D SELECT switch and the keyboard.

8. Depress keyboard switch associated with pair of parameters desired for display. Observe display indicator for readout.

NOTE

Wind velocity and direction can be determined only if an automatic true airspeed is available and a value of 0 is manually inserted or if true airspeed is manually inserted.

9. Controller POS UPDATE switch allows correction of latitude and longitude while using manual dead reckoning or doppler methods of navigation as follows:

a. Determine positive physical position identification at time of position fix passage, destination passage, or from known present position coordinates.

b. Compare actual position to computer calculated position.

c. If position error is evident, depress POS UPDATE key at exact time of position fix passage.

d. Periodic updating of MAN D.R. mode is required to prevent any large disarrangement between sensors.

NOTE

Coordinates of any position inserted on I/D SELECT switch (except LORAN A) may be used to update doppler or manual DR position.

10. The ARRIVE DEST light on the display indicator will illuminate prior to flying over the selected destination (Time ARRIVE DEST light comes on is a function of TAS). The operator may then select the next destination by use of the controller STEER DEST switch. Computer set will automatically direct the helicopter to the new course via the hover indicator in mode C.

NOTE

Manual override provisions remain. Flight path may be changed by altering or adding destinations as required in place of those no longer active in the planned operation. For automatic course computations, both the preceding (flying from) and upcoming (flying to) destinations are required.

NOTE

MAGNETIC VARIATION must be updated in 1° increments during flight progression for accurate navigation.

11. Generally, search operation is a continuation of the navigation process previously discussed. However, some modifications, changes, and additions are required. The following information is intended as an extension of the navigation procedure.

Selection	Functional I/D SELECT Position	Remarks
LAT-LON	PP	Displays computed present position latitude and longitude.
	PF, SRCH VORT, LOR DEST 1-4	Displays inserted latitude and longitude associated with the position selected on the I/D SELECT switch (LOR Position associated with STA and TEMP switches).
R-BRG	PP	Displays computed range and bearing from present position to the position selected on the STEER DEST (next turn point in SRCH) switch.
	PF, SRCH, VORT, DEST 1-4	Displays computed range and bearing from present position to the position selected on the I/D select switch.
CTE-ATD	PP	Displays computed cross track error and along track distance to the position selected on the STEER DEST (next turn point in SRCH) switch with respect to the inserted or computed course.
	DEST 1-4	Displays computed cross track error and along track distance to the destination selected with respect to the inserted or computed course.
GS-TR	ALL	Displays computed ground speed and true ground track.
ETE-CSE	PP	Displays computed estimated time enroute along ATD and inserted or computed course to the position selected on the STEER DEST (next turn point in SRCH) switch.
	DEST 1-4	Displays inserted or computed course to the Destination selected.
WV-WDR	ALL	Displays inserted or computed wind velocity and direction.
LG1-LG2	SRCH	Displays inserted Leg 1 lengths of the ladder, square and hold searches. Displays inserted Leg 2 lengths of the ladder and hold searches.
VAR	ALL	Displays inserted magnetic variation.
TAS-MH	ALL	Displays inserted or computed true airspeed (TAS) and magnetic heading of aircraft.
LG1-0	SRCH	Displays inserted Sector Search search radius and angle theta (θ).
BR	LOR	Displays inserted base line length plus coding delay of LORAN stations in temporary memory.

NOTE

Displays other than those indicated in this table are of no value to the operater.

Figure 4-77. Keyboard Selection Relationships Display Function

12. Upon arrival at initial search position, place MODE switch to the desired search pattern and place STEER DEST switch in SRCH position.

13. As search pattern is started, the computer set provides the necessary guidance information to the hover indicator in mode C for progression of selected pattern.

14. Approximately 45 seconds before completion of a search leg, the ARRIVE DEST light will illuminate, and the navigation computations automatically shift to the next leg.

15. After automatic navigation to destination and/or execution of search pattern, prepare to return to base by completing the following:

a. Return MODE switch to navigational mode.

b. Determine via the I/D SELECT switch and keyboard switches, the BRNG to destination 1 (normal base of operations) or other destination available from the I/D SELECT switch.

c. Insert this bearing as CSE to selected destination.

d. Place SENSOR switch in the desired sensor position.

e. Place controller STEER DEST switch to selected destination. Helicopter will automatically be directed to the destination via hover indicator in mode C.

Inflight Procedures Flow Chart An inflight procedures flow chart summarizing inflight operation is presented in figure FO-13.

Emergency Or Degraded Operation During each computer operation, a programmed system test automatically checks the computer for proper operation. If a failure is detected during this routine the SYSTEM FAULT light will illuminate. An effort should be made to determine the area of failure, as the possibility of total component failure is remote. If the SYSTEM FAULT light cannot be extinguished by cycling the POWER switch to OFF or by other means, place the POWER switch to OFF to prevent further computer damage. A temporary loss of sensor signal (LORAN, TACAN, DOPP) will cause the SENSOR FAULT light to illiminate and the computer set to switch to automatic dead reckoning. The operator may then select another sensor. Also, malfunctions in certain switches may allow operation with limited accuracy. The degree and situation of malfunction should dictate the procedural steps taken. The following are some suggested procedures:

Navigation Controller Malfunction Total failure of controller disables the computer set. Minimize effects of partial failure by changing switch position, inserting new or approximate coordinates, etc. For example, if I/D SELECT DEST 2 position is inoperative, insert DEST 2 coordinates in destination 3 position.

Navigational Map Display Malfunction Turn off map display and continue operation on basis of display indicator flight parameters. Manually record flight course or search pattern parameters if desired.

Display Indicator Malfunction Determine extent of malfunction and continue operation by interpolation and comparison of partially displayed parameters and map display operation.

Navigation Computer Malfunction A failure within a computer functional unit (clock, power supply, read-write or permanent memory units, arithmetic unit) generally disables the entire computer set. However, a malfunction within the MADDAM unit or portions of the INPUT-OUTPUT logic will still allow LORAN operations. Use controller to alternate operational methods if computer malfunctions impairs a particular mode of operation.

FLIGHT DIRECTOR AN/AYN-2

Each pilot is provided with a complete flight director system (figure 4-78). The flight director system provides an easily interpreted pictorial display of the helicopter navigation situation, and it automatically computes the required action necessary to obtain a desired radio track or heading. The information is displayed continuously and any system failure is normally indicated by means of flag circuitry. The copilot's flight director requires attitude and azimuth inputs from the AN/ASN-50. The pilot's flight director requires azimuth inputs from the AN/ASN-50 and attitude inputs from the 1080Y vertical gyro.

The flight director is powered by the No. 1 ac primary bus and is protected by three circuit breakers on the copilot's circuit breaker panel. Two of the circuit breakers, under the general headings NO 1 AC PRI FLT DIR and HEADING, are marked PILOT ϕB and CO-PILOT ϕB respectively. The third circuit breaker is under the general heading NO 1 AC PRI is marked

ATTITUDE CO-PILOT ϕB. The AN/ASN-50 circuit breakers are reviewed in section I. The 1080Y vertical gyro is powered by the No. 2 ac primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel, under the general heading NO 2 AC PRI and marked GYRO.

A flight director system consists of four components; these are the steering computer, the attitude indicator, the course indicator and the instrument amplifier.

Steering Computer

The steering computer provides the pilot with steering information via the attitude indicator. The steering computer computes a horizontal guidance signal from TACAN/VOR or localizer, heading error and bank angle data. The horizontal guidance signal is displayed on the attitude indicator by means of the steering pointer. Necessary corrective measures to the approach, selected heading and radio path are thus provided to the pilot. A steering warning service is provided by flag circuits.

Attitude Indicator

The steering and glide slope pointers of the attitude indicator (figure 4-79) provides guidance in intercepting and following localizer and glide slope beams or for maintaining selected heading or course. Warning flags indicate any malfunction in the glide slope, localizer, VOR, TACAN, attitude display, or steering signal system. The steering computer horizontal guidance signal is displayed by means of the steering pointer. Precise lateral control may be achieved by maneuvering the helicopter to maintain the steering pointer in the centered position. The glide slope pointer indicates displacement of the helicopter from the glide slope path. The position of the glide slope pointer, relative to the pitch indicator, indicates the flight correction required to achieve a smooth approach. The horizontal and vertical guidance indicators described above are superimposed on an artificial horizon. The artificial horizon consists of pitch and bank indicators and provides continuous monitoring of the flight attitude.

Steering Flag Depending on the position of the mode selector switch, failure of the AN/ASN-50 vertical gyro or directional gyro, remote indicating compass, or radio inputs would cause the STEERING flag to be displayed. Loss of steering computer primary power would cause the flag to be displayed regardless of the mode switch position.

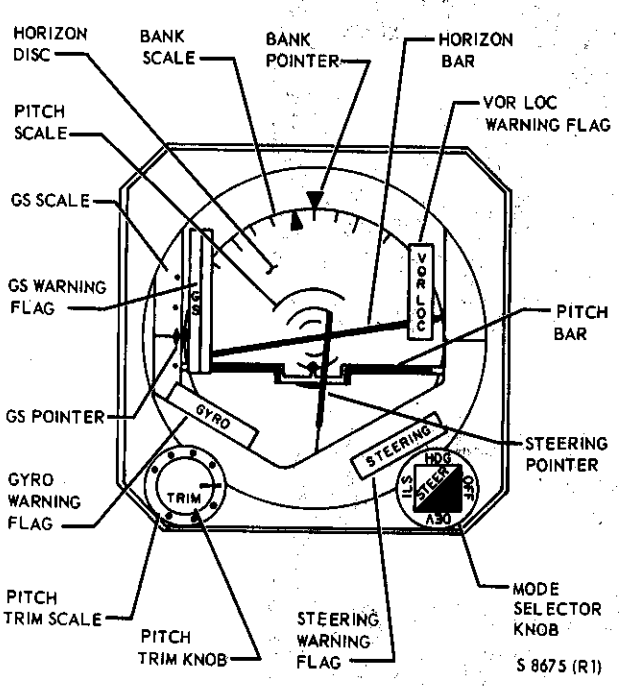


Figure 4-78. AN/AYN-2 Attitude Indicator

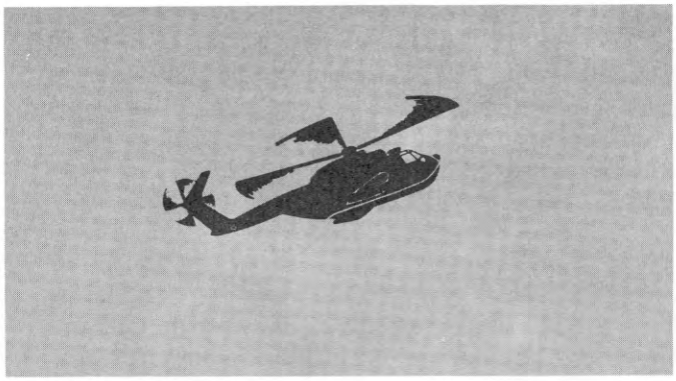
Gyro Flag Failure of the AN/ASN-50 vertical gyro driving the copilot's attitude display, or the 1080Y vertical gyro driving the pilot's attitude display, causes the appropriate GYRO flag to appear. Failure of the AN/ASN-50 vertical gyro also affects the pilot's and copilot's steering circuitry. Set the mode selector to the DEV position and use the pilot's approach indicator as the primary attitude indicator.

VOR LOC Flag The pilot's VOR LOC flag will be in view when the receiver is malfunctioning or turned-off, or not tuned to a sufficiently strong TACAN, VOR, or localizer frequency. The copilot's VOR LOC flag will be in view when the receiver is not tuned to a sufficiently strong TACAN, VOR, or localizer frequency.

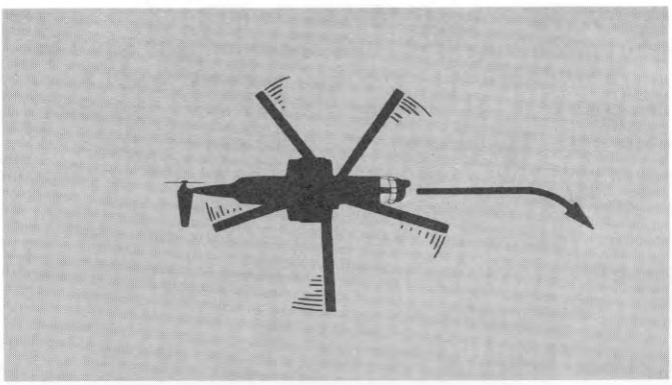
WARNING

Power failure to the VHF NAV receiver will cause TACAN information to be automatically displayed on the copilot's flight director system.

GS Flag The GS flag appears when signals from the glide slope receiver are inadequate for driving the glide slope pointer.

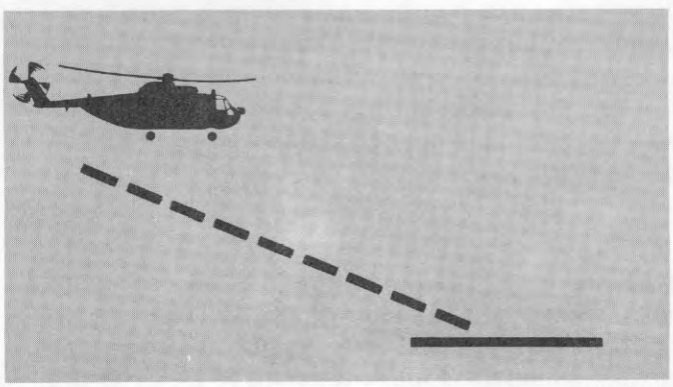


A
PITCH BAR DISPLAY



B
STEERING POINTER

C
HORIZON DISC



D
GLIDE SLOPE POINTER

S 8676 (R1)

Figure 4-79. Attitude Indicator AN/AYN-2

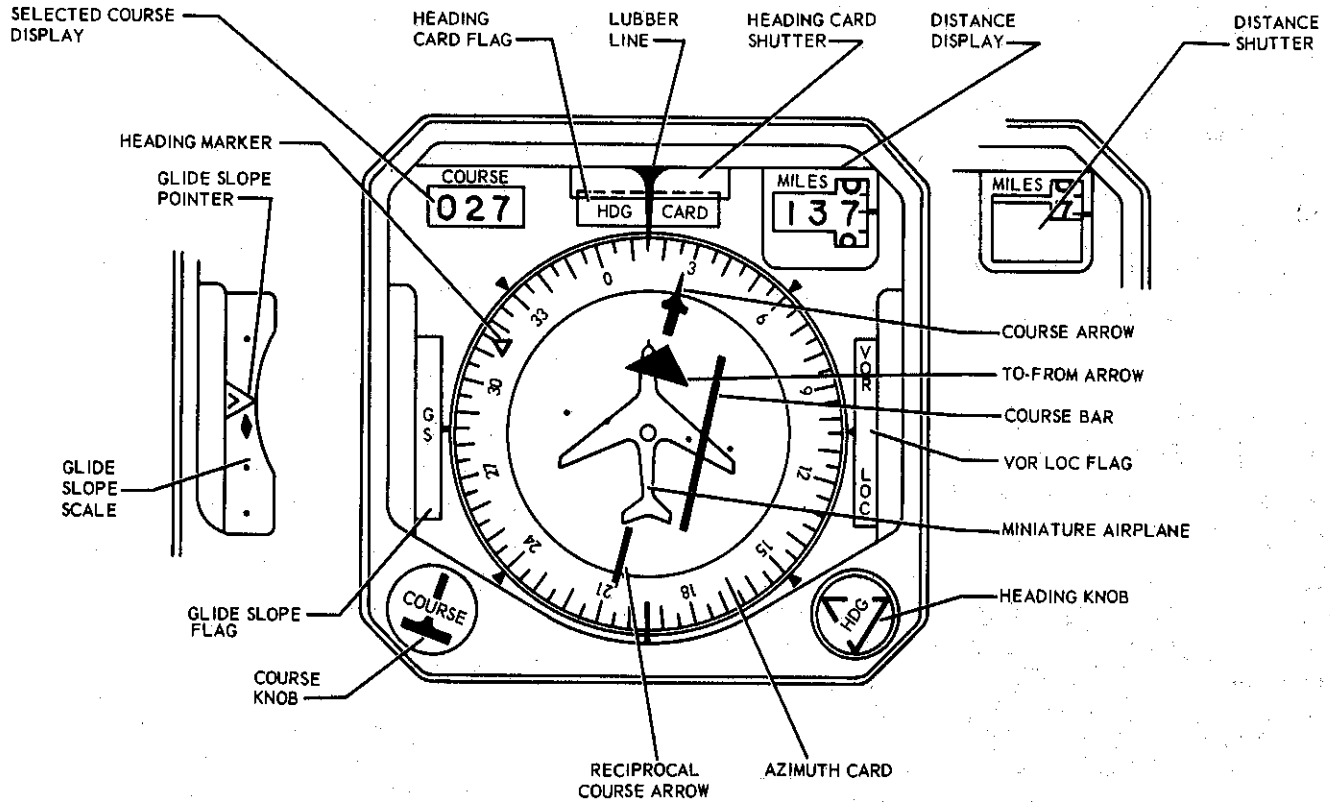


Figure 4-80. AN/AYN-2 Course Indicator

Pitch Bar The pitch bar (A, figure 4-79) represents imaginary wings and moves up and down as helicopter pitch changes. The pitch bar trim knob should be set to the center index prior to flight. The pitch bar trim is preset when the mode selector is in the ILS position.

Steering Pointer Deflections of the steering pointer (B, figure 4-79) are commands to establish a selected course or heading. The pilot always flies the helicopter to bank toward the pointer. Proper bank angle is established when the steering pointer centers. When on course, keeping the steering pointer centered will establish the crab angle required to correct for possible crosswind conditions in the ILS and DEV modes. With the mode switch in DEV position, steering pointer deflections are no longer bank commands. The pointer shows the direction to turn to attain the selected course. Degree of bank is not included in this command since the pointer will center only when the helicopter is actually on the selected course. DEV mode may be used as backup in the event of steering computer failure.

Horizon Bar As seen by the pilot, the horizon bar (C, figure 4-79) tilts in the same sense the real horizon tilts as helicopter bank changes. A pointer at the top of the attitude indicator and index marks on the horizon disc indicate aircraft bank in graduations of 10°, 20°, 30°, and 45°.

Glide Slope Pointer The displacement from the glide path is shown by the glide slope pointer (D, figure 4-79). The glide slope is flown by adjusting power to keep the glide slope pointer and the pitch bar aligned while maintaining a desired airspeed.

Course Indicator

The course indicator (figure 4-80) displays a pictorial plan view of the helicopter with respect to magnetic north, selected course, and selected heading. Heading, heading deviation, selected heading, selected course, and crab angle are read against a servo driven azimuth card. The selected TACAN, VOR or localizer course is displayed pictorially and by means of a digital COURSE counter. A digital distance display is also provided on the course indicator. Meter movements display course deviation, to-from indication, glide slope location and operate warning flags. The warning flags monitor heading, display and radio signals. A stationary symbolic aircraft, located in front of the course deviation pointer, provides the pictorial presentation of helicopter position and heading. The course

indicator requires a remote amplifier for the azimuth servo system. Selected course and heading may be set manually.

VOR LOC Flag See Attitude Indicator, VOR LOC Flag.

GS Flag See Attitude Indicator, GS Flag.

HDG CARD Flag A malfunction in the AN/ASN-50 system will bring the HDG CARD flag into view. The heading circuits also supply data to the steering pointer circuits. Set the mode selector to the DEV position. The steering pointer will show deviation from the selected course. Readings of all other parts of the displays are correct regardless of the condition of the heading circuitry.

Symbolic Aircraft The aircraft outline fixed behind the instrument face is symbolic of the helicopter (A, figure 4-81). Moving portions of the course indicator relate to the symbolic aircraft to provide a map-like display of the actual flight situation.

Azimuth Card and Lubber Line The azimuth card turns as the helicopter turns; the symbolic aircraft is always pointed toward the actual helicopter heading as read on the azimuth card (B, figure 4-81). The helicopter heading may be read accurately under the lubber line at the top of the instrument. A series of index marks are inscribed around the azimuth card for reference at the start of turns.

Course Arrow, Knob, and Counter The TACAN/VOR or localizer course is selected by positioning the course arrow (C, figure 4-81). The course arrow is positioned by the COURSE knob. The arrow setting is read against the azimuth card or on the COURSE counter.

NOTE

The course arrow is always set to the inbound localizer front course even if a back course approach is being flown.

VOR-TACAN Selector Switches A VOR-TACAN selector switch is located in front of each pilot on the instrument panel. These switches select the associated navigation receiver that will supply inputs to the particular pilot's flight director system. The pilot's switch has the marked positions VOR MASTER and TACAN SLAVE. The copilot's switch has marked positions VOR SLAVE and TACAN MASTER. The MASTER/SLAVE markings serve to remind both pilots that only the pilot's course knob controls both flight director system displays when using the VOR or localizer receiver. In addition, only the copilot's course knob controls both flight director displays when using the TACAN receiver-transmitter.

WARNING

Power failure to the VHF NAV receiver will cause TACAN information to be automatically displayed on the copilot's flight director system, if a TACAN station is tuned and being received, regardless of the VOR-TACAN selector switch position.

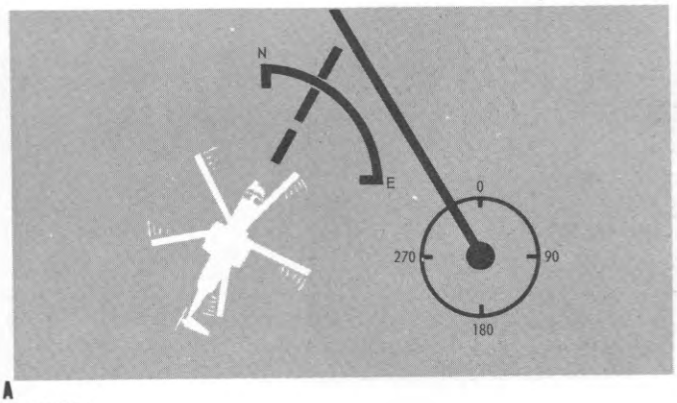
NOTE

When either the pilot's or copilot's VOR-TACAN selector switch is in the MASTER position, steering pointer information (ILS mode) is valid for that particular flight director. If the VOR-TACAN SELECTOR switch is in the SLAVE position, steering pointer information (ILS mode) will not be valid unless the course selected is the same as that course which had been selected on the course indicator of the pilot who controls the flight director display (MASTER position). If the reciprocal of the course is selected, steering pointer information will be invalid.

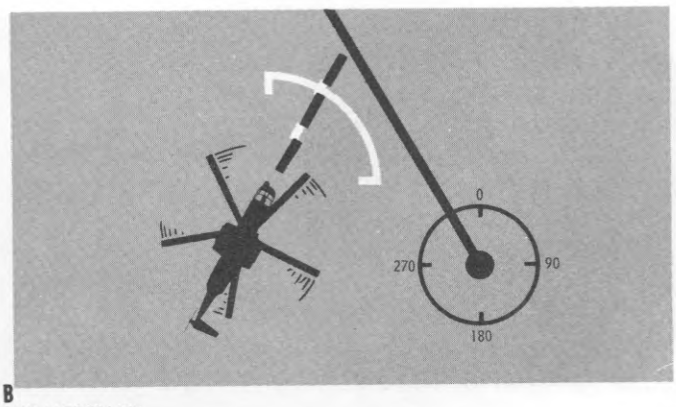
NOTE

It is possible for both pilot and copilot to receive DME information via their respective course indicators whenever the TACAN (AN/ARN-52V) function switch is in the T/R position, regardless of the position of either VOR/TACAN-SELECTOR switch.

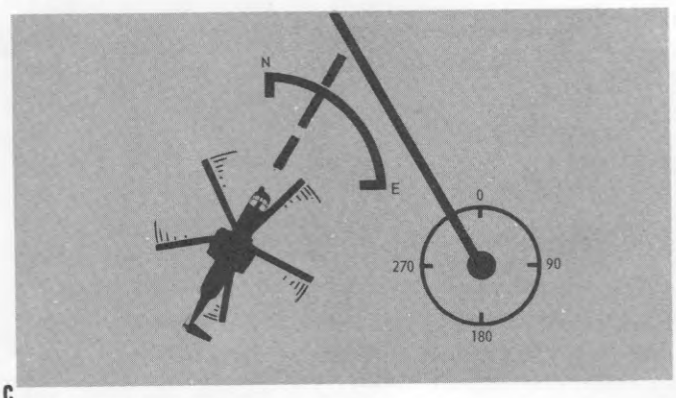
Course Bar The course bar (D, figure 4-81) is symbolic of a segment of the selected TACAN/VOR radial or localizer course. The position of the symbolic aircraft with respect to the course bar is always the same as the position of the pilot's helicopter with respect to the selected course.



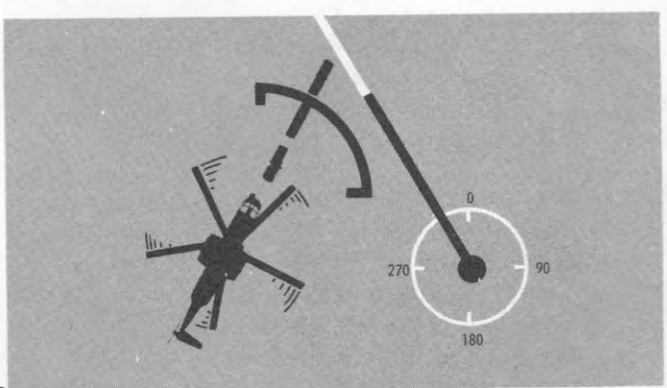
A
SYMBOLIC AIRCRAFT



B
AZIMUTH CARD AND LUBBER LINE



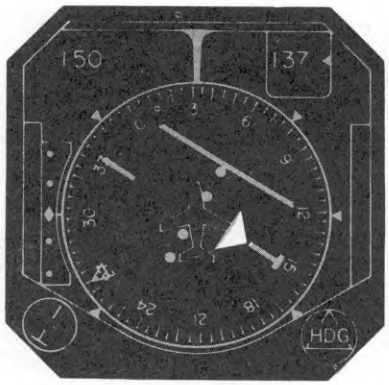
C
COURSE ARROW, KNOB, AND COUNTER

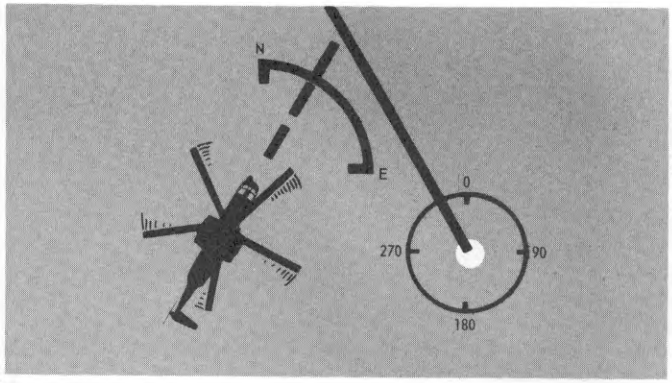


D
COURSE BAR

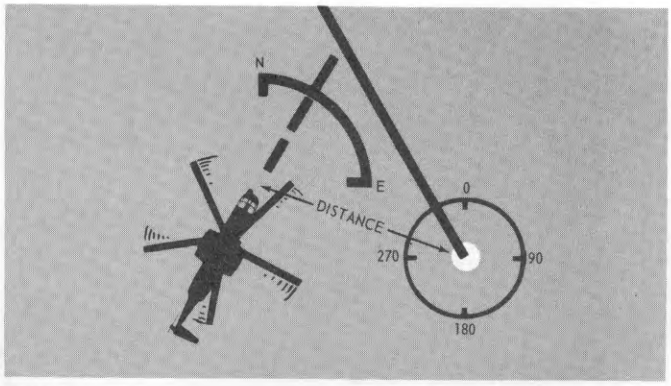
S 8678 (R1)

Figure 4-81. Course Indicator AN/AYN-2

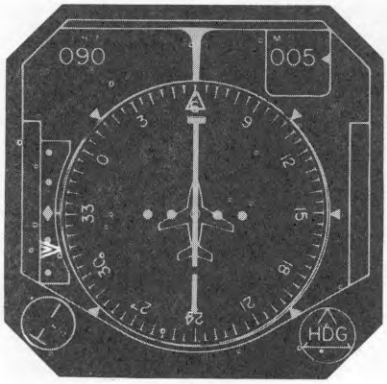


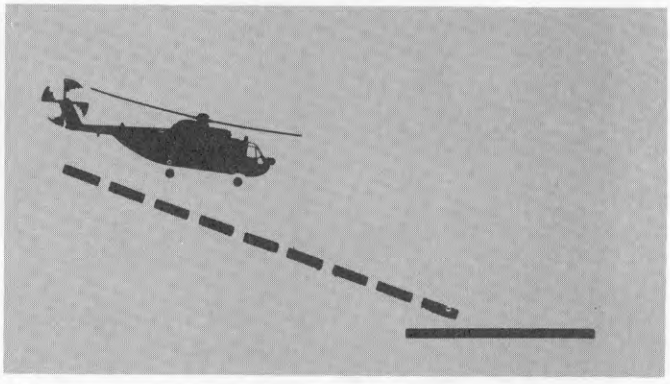


E
TO/FROM ARROW

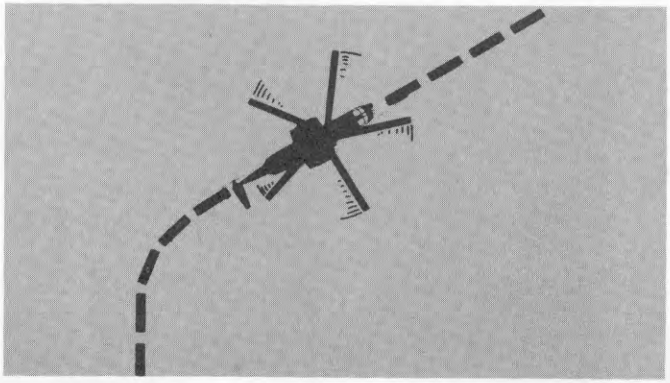


F
MILES COUNTER





G
GLIDE SLOPE POINTER



H
HEADING MARKER

S 8679 (R1)

Figure 4-82. AN/AYN-2 Course Indicator

To/From Arrow Ambiguity in omnibearing information is resolved by the to/from arrow (E, figure 4-82). The arrow will indicate the direction TO the station along the course line selected with the course arrow.

Miles Counter The distance to a VORTAC or TACAN station, measured by the aircraft DME equipment, is displayed by the MILES counter (F, figure 4-82). The distance is slant range and read in nautical miles.

Glide Slope Pointer Both the course indicator and the attitude indicator of the AN/AYN-2 have glide slope pointers (G, figure 4-82). The glide slope pointer on the course indicator also is useful for quick reference when inbound on the localizer to the outer marker; interception of the glide path is readily seen.

Heading Marker The steering pointer guides the pilot to establish the heading read by the heading marker when the mode selector on the attitude indicator is set to the HDG position (H, figure 4-82). The heading marker is read against the azimuth card and is positioned on the card by rotating the HDG knob.

Instrument Amplifier

Compass and gyro warning flag circuitry and servo amplifiers for the approach horizon and the course indicator are contained within the instrument amplifier.

Flight Director Specifications

The following ratios have been established for the flight director.

Glide Slope Pointer A full scale deflection of the glide slope pointer on the vertical glide slope scale corresponds to an aircraft deviation of 0.5° from the glide path.

Pitch Bar A one-unit deflection of the pitch bar, measured on the pitch scale, corresponds to an aircraft pitch angle of 5°.

Course Bar When tuned to a TACAN/VOR radial, a two-dot deflection of the course bar corresponds to an aircraft deviation of 10°. When tuned to a localizer course, a two-dot deflection of the course bar corresponds to an aircraft deviation of 2.5°. The course bar deflection is nonlinear beyond two dots.

Horizon Disc The aircraft bank angle divisions on the horizon disc represent 10°, 20°, 30°, and 45° of bank.

Pitch Trim One division on the pitch TRIM knob represents 5° of pitch.

Steering Pointer The steering pointor will not direct banks in excess of 15° in any mode.

HDG Mode of Operation A selected heading error of 10° is equivalent to a bank error of 15°.

ILS (TACAN/VOR and localizer) Mode of Operation A bank angle of 2.2° is equivalent to 1° of course datum.

Dev Mode of Operation The steering pointer indicates which way to bank in order to intercept or track a selected course.

Flight Director Modes

HDG Mode of Operation The HDG mode of operation is obtained by setting the attitude indicator mode selector knob to the HDG position. A magnetic heading is selected by rotating the course indicator HDG knob until the heading marker is set to the desired magnetic heading as read on the azimuth card. Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of azimuth card with respect to the lubber line. Helicopter position, with respect to the selected heading, is given by the position of the heading marker (representing selected heading) with respect to the lubber line (representing the actual helicopter magnetic heading).

Horizontal guidance steering information is displayed by the steering pointer. The steering pointer deflection indicates the amount and direction of bank required to obtain a selected heading. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made into the magnetic heading. Once the helicopter is on the magnetic heading, minor changes in magnetic heading cause the pointer to deflect in the direction which the helicopter must be turned to correct the error.

ILS Mode of Operation An ILS, TACAN, or VOR mode of operation is obtained by setting the mode selector knob to the ILS position. Align the VOR-TACAN selector switches to desired MASTER/SLAVE positions.

When the navigation receiver is tuned to a localizer frequency, the reference pitch attitude (the pitch attitude required to maintain descent on the glide path) is preset by an adjustment made during test bench adjustments. The pitch bar will be automatically positioned with respect to this reference each time the mode selector knob is set to ILS. The inbound localizer course is obtained by tuning the VOR receiver to the proper localizer frequency. The COURSE knob is rotated until the course counter indicates the heading of the inbound localizer course. Helicopter position, with respect to the localizer course, is presented by the course bar.

The GS warning flags will unmask the glide slope pointers when the glide slope receiver is tuned to a signal of sufficient strength and the glide slope signal is presented. Helicopter position, with respect to the glide path, is presented by the attitude indicator and course indicator glide slope pointers. A TACAN or VOR radial may be selected for use with the course indicator by tuning the associated navigation receiver to the desired TACAN or VOR facility and rotating the COURSE knob until the COURSE counter indicates the desired radial on the azimuth card. It is recommended that TACAN or VOR course intercept be made in the HDG mode. Helicopter position, with respect to the selected TACAN or VOR radial, is presented by the course bar. Helicopter pitch attitude is displayed by the pitch bar. Helicopter bank attitude is displayed by the horizon disc as in the HDG mode of operation. The horizontal guidance steering signal, with crosswind correction, is displayed by the pointer. The steering pointer deflection indicates the amount and direction of bank required to obtain a localizer. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made onto the localizer or selected course. Once the helicopter has obtained the localizer or selected course, minor changes cause the steering pointer to deflect in the direction in which the aircraft must be banked to correct the error.

NOTE

Steering pointer commands, in the ILS mode, are at times erratic, overly sensitive and contradictory to the information displayed by the course indicator. This phenomenon is most prevalent when utilizing the system in proximity to the radio navigational aid. The flight director steering pointer should not be used in the ILS mode during an instrument approach, departure or other conditions of instrument flight requiring high levels of pilot concentration.

NOTE

The VOR-TACAN selector switches must be aligned to desired MASTER/SLAVE positions prior to using the desired navigational aid. In the ILS mode, in order for the pilot to interpret a selected TACAN course with the steering pointer and to provide a correct pictorial plan view, the pilot's and copilot's course counters must display the same selected course.

DEV Mode of Operation The DEV mode of operation is obtained by setting the attitude indicator mode selector knob to the DEV position. A reference pitch attitude is obtained by setting the pitch TRIM knob to the desired pitch attitude. A TACAN or VOR radial is selected by tuning the associated navigation receiver to the desired TACAN or VOR facility, aligning the VOR-TACAN selector switches to desired MASTER/SLAVE positions, and rotating the COURSE knob until the COURSE counter indicates the desired course.

Helicopter pitch attitude, with respect to the reference pitch attitude, is displayed by the pitch bar. Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of the azimuth card with respect to the lubber line. A display of helicopter position, with respect to the selected TACAN or VOR course selected, is presented by the course bar. While in the DEV mode of operation, the steering pointer receives information directly from the selected naviga-

tion receiver and indicates which way to turn in order to intercept or track a selected course. The steering pointer does not indicate the amount of bank required. Warning flag services are provided as in the HDG mode of operation.

OFF Mode of Operation In the OFF mode, the steering computer is deactivated and the steering pointer and steering flag on the attitude indicator are biased out of view.

Flight Director Operation

Preflight Check List 1. Adjust the pitch trim knob to the center index on the pitch trim scale, then check that the positions of the pitch bar and horizon bar correspond to the actual attitude of the helicopter.

2. Check that the helicopter heading corresponds to the heading read on the azimuth card.

3. Tune the helicopter TACAN or VOR receiver to a TACAN or VOR station. Set the mode selector to the DEV position. Set the course arrow to the radial on which the aircraft is located. The course bar and the steering pointer should center.

4. Move the course arrow 10° to the right or left. The course bar and steering pointer should both be deflected in appropriate directions. The course bar should be deflected to the outer dot.

5. Set the mode selector to the ILS position. The steering pointer should call for a bank toward the selected course.

6. Move the course arrow to a position which centers the course bar. The steering pointer should come to rest centered.

7. Tune the helicopter VOR receiver to the localizer. Set the course arrow to the inbound localizer front course. The course bar should be deflected in a direction appropriate to the location of the localizer. The steering pointer should call for a bank toward the localizer.

8. Set the mode selector the OFF position. The STEERING flag and the steering pointer should both be hidden from view.

9. Set the mode selector the the HDG position. Set the heading marker under the lubber line. The steering pointer should come to rest centered.

10. Move the heading marker to the left. The steering pointer should be deflected to the left.