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NAVAIR 01-45HHF-1A

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AIRCRAFT 1

WEAPON  
SYSTEMS 8

## Supplemental NATOPS Flight Manual (U)

NAVY MODEL

F-8J

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS NAVAIR 01-45HHF-1,  
NATOPS FLIGHT MANUAL FOR MODEL F-8J AIRCRAFT.



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1 December 1969  
Changed 15 March 1971

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## LIST OF APPLICABLE CHANGE DIRECTIVES

Following is a list of change directives which apply to this manual but which may not be incorporated in the aircraft. The change directive is briefly described and, where applicable, information is given for visual determination of incorporation.

<i>Type Change and Change Number</i>	<i>Description</i>	<i>Visual Identification</i>
Airframe Change No. 490 (Parts I, II and III)	Adds Shoehorn equipment to aircraft.	Adds ECM control panel to right-hand console.
Airframe Change No. 499	Provides protective armor in fuselage and vertical tail. Protects critical flight control components, engine and pilot.	
Airframe Change No. 502	Adds speech security equipment to aircraft.	Adds speech security equipment controls to LH longeron switch panel.
Airframe Change No. 504	Modifies radar set to include the BAT mode of operation.	Range strobe potentiometer near the throttle quadrant. Range meter on RH side of the azimuth-range indicator.
Airframe Change No. 512	Adds ALQ-100 ECM system to Shoehorn equipment.	Presence of external receptacle near right-hand gun bay for insertion of destruct disable safety pin.
Airframe Change No. 525	Removes AN/AAS-15 infrared system.	Refer to aircraft logbook.
Airframe Change No. 535	Provides for an additional SEAM indicator light which is electrically parallel with the SEAM indicator light on the armament panel.	By the presence of a third push-to-test type light located on the Sidewinder-ranging indicator (ID-1485/APQ).
Airframe Change No. 553	Provides for an additional SEAM lock-on button which is electrically parallel with the SEAM lock-on button on top of the radar control stick.	By the presence of a second SEAM lock-on button, located on the throttle.
Airframe Change No. 571	Modifies the aircraft to accept BAT/ALE modified radar and a modified SEAM system	Presence of range meter and a light across the top of the radar scope.

## SECURITY CLASSIFICATION

Classified material contained in this manual is identified as follows:

- a. Descriptive text is classified by paragraphs. The security classification is enclosed in parentheses at the beginning of the paragraph, eg (C-GP 4).
- b. Procedural text is classified by individual steps. The security classification is enclosed in parentheses at the beginning of the step as follows: (C)
- c. Descriptive and procedural text which is not marked as described above is unclassified.



## RADAR SET AN/APQ-124

### INTRODUCTION

(C-Gp 4) The AN/APQ-124/-124A radar set is an airborne intercept radar utilizing normal pulse radar target detection techniques. The primary purpose of the set is to locate and track targets. The set provides the information necessary to maneuver the fighter within the attack range of airborne targets, and also provides an indication of fighter roll and pitch attitudes. Antijam provisions and a coastal mapping capability are included.

The pulse Doppler (PD) mode is not incorporated in the AN/APQ-124/-124A radar. If the function switch is placed in the PD position, the radar set transmits energy but there are no indications on the azimuth-range indicator (scope). The antenna goes to a 1-bar spin operation regardless of the position of the antenna switch.

(C-Gp 4) The radar set computes and displays launching information for the AIM-9 series Sidewinder missiles for air-to-air coalitude and differential altitude attacks. It also supplies target range and range rate information to the Mk 101 Mod 0 computer of the AFCS EX-16. For additional operating instructions, refer to Deviated Pursuit Computer CP-742A/APQ and the Sidewinder Expanded Acquisition Mode (SEAM) ASA-63A in this section of the manual.

### COMPONENTS

The components of the AN/APQ-124/-124A (figure 8-1) are interconnected and connected to other equipment in the fighter by an aircraft wiring harness.

Radar set group OY-12A/APQ-124 houses the radar antenna and the receiving and transmitting system. The housing is a metallic cylinder with a hemispherical pressure cover. The set is mounted with provisions for shock and vibration isolation.

The OY-12A/APQ-124 radar set is pressurized to permit operation at high altitudes and requires a source of cooling air for continuous operation. The waveguide in the radar is also pressurized.

The OY-12A/APQ-124 radar set is controlled by a C-7326A/APQ-124 control panel on the left console, by controls on the IP-869A/APQ-124 azimuth-range indicator, and by controls on the radar antenna control grip.

The CP-473A/APQ-83 missile release computer performs the computing function for the radar set.

The SN-411/APQ-124 electrical synchronizer provides a crystal-controlled synchronizing source for the radar set and the AIM-9C missile.

The CN-529/APQ-83 displacement gyroscope provides a target sight line reference during the radar track mode.

The OG-39A/APQ-124 amplifier control group contains the circuitry used to control antenna position and to switch the antenna between the search, acquisition and track modes. The amplifier control group contains an elapsed time indicator.

A detachable night viewing hood is provided and stored in the cockpit. After AFC 571, a detachable, adjustable folding hood for daylight use has been installed. The antireflective coated lens within the day view hood filters reflective light of the radar scope. When the day view hood is not in use it shall be closed to protect the filter lens from fingerprints.

### CAPABILITIES

#### Search Capability

(C-Gp 3) The radar set searches either a wide or a narrow forward sector as selected by the pilot. The wide sector extends a minimum of 43 degrees on each side of the aircraft boresight line. The narrow sector is approximately 50 degrees wide and can be centered on the boresight line or to the left or right. In all cases, the scanned volume is stabilized against roll and pitch motions of the fighter. The volume of the radar beam in elevation depends upon the function selected and on the position of the antenna switch located on the radar set control panel. The centroid of elevation volume may be controlled between 45 degrees up and 30 degrees below the boresight line. The frame time (time to sweep across the wide sector and return) is 2.4 seconds.

#### Detection Capability

(C-Gp 3) The radar set detects and displays radar targets up to 60 miles in range. Before AFC 571, three display ranges may be selected: 0 to 15 miles, 0 to 30 miles, and 0 to 60 miles. After AFC 571, 0 to 5 miles is an additional selectable range. Noise jamming signals can be detected and are displayed at the azimuth and elevation of the noise jamming source.

#### Ground Mapping Capability

A coastal mapping capability exists in all ranges when used in conjunction with the 1 BAR NO SPIN option of the antenna switch.

#### Note

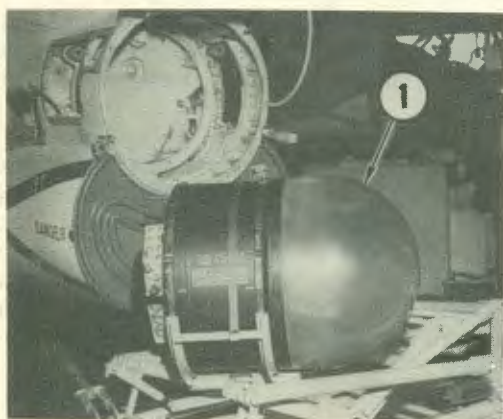
With the radar operating with either IR or BAT modes selected, the antenna will spin regardless of the position of the antenna switch.

#### Range Lock-On Capability

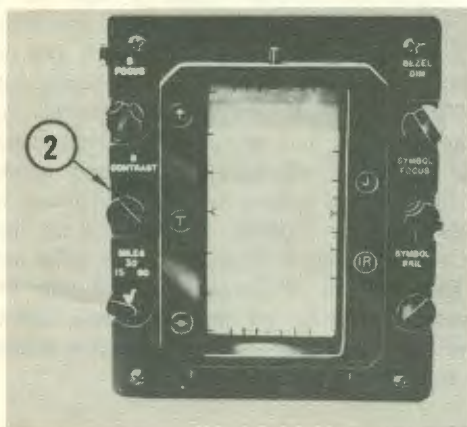
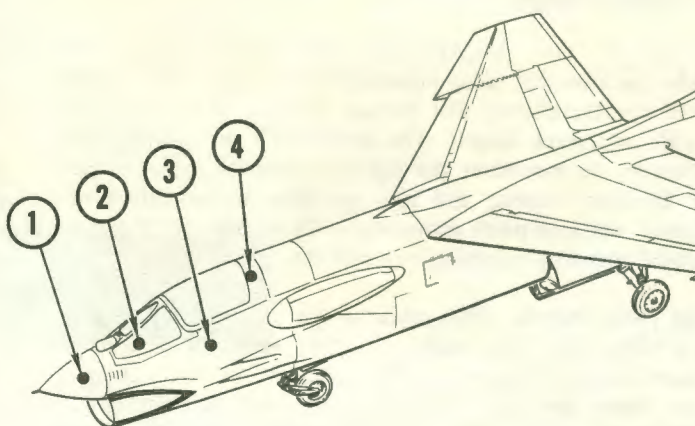
(C-Gp 4) The radar set locks on and tracks radar targets up to 25 miles in all range scales. The minimum lock-on



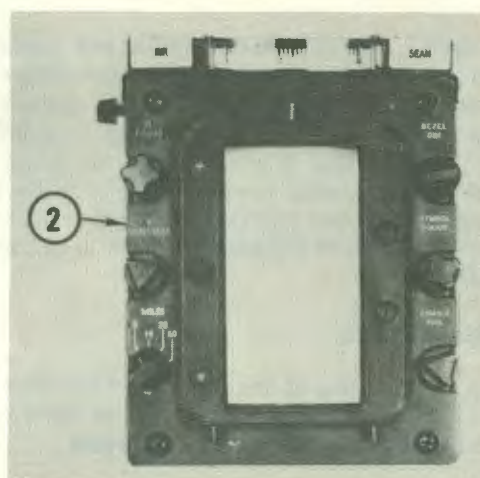
# AN/APQ-124 COMPONENTS



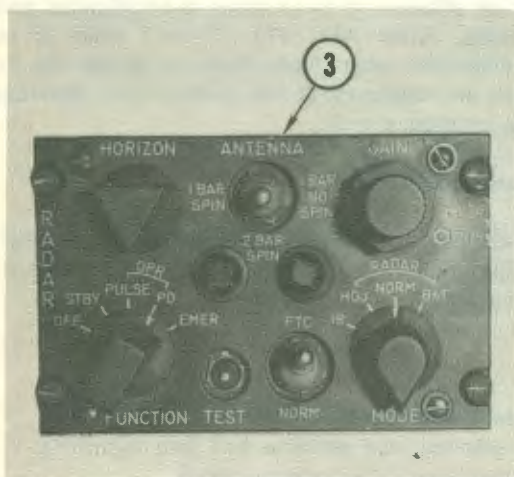
OY-12A/APQ-124



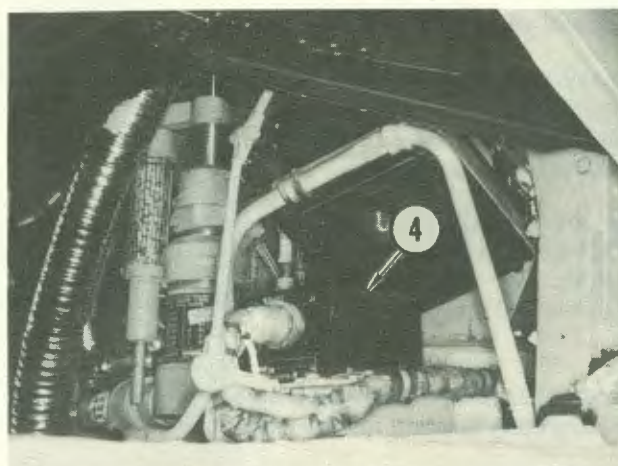
AZIMUTH-RANGE INDICATOR  
IP-869/APQ-124 (Before AFC 571)



AZIMUTH-RANGE INDICATOR  
IP-869A/APQ-124 (After AFC 571)



RADAR SET CONTROL C-7326A/APQ-124

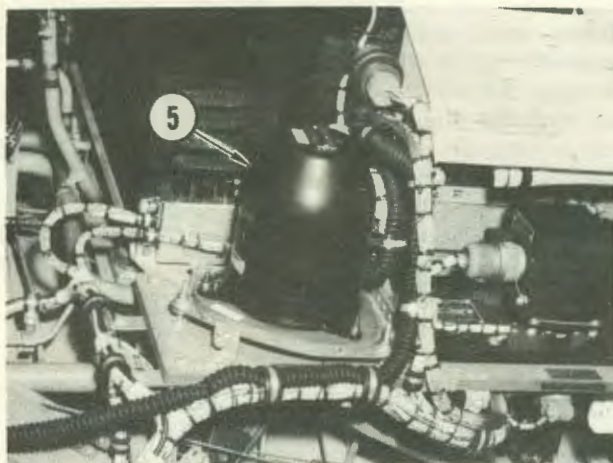


ELECTRICAL SYNCHRONIZER SN-411/APQ-124

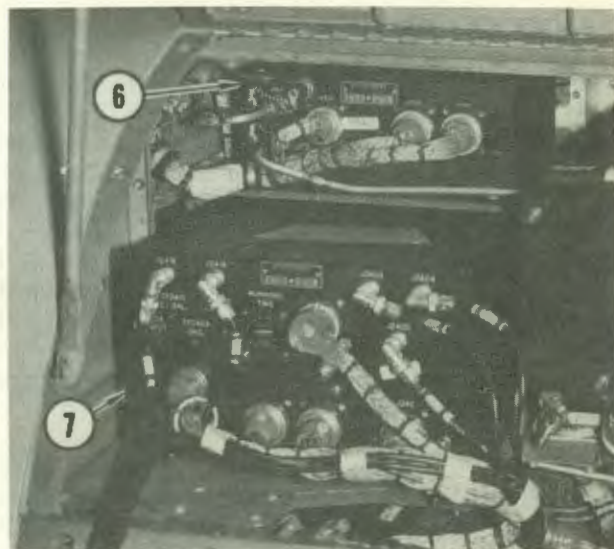
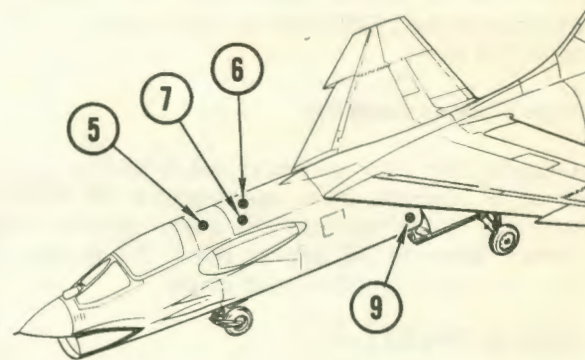
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Figure 8-1. (U) (Sheet 1)

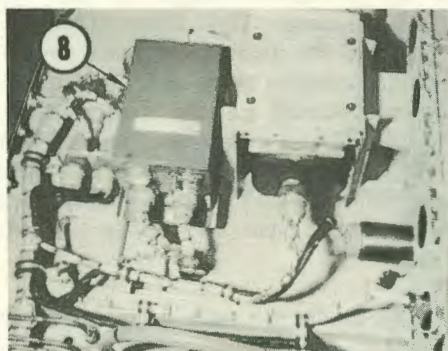
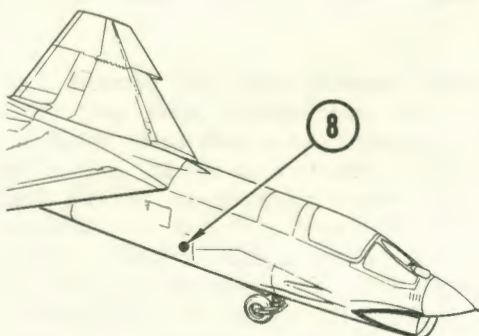
## AN/APQ-124 COMPONENTS



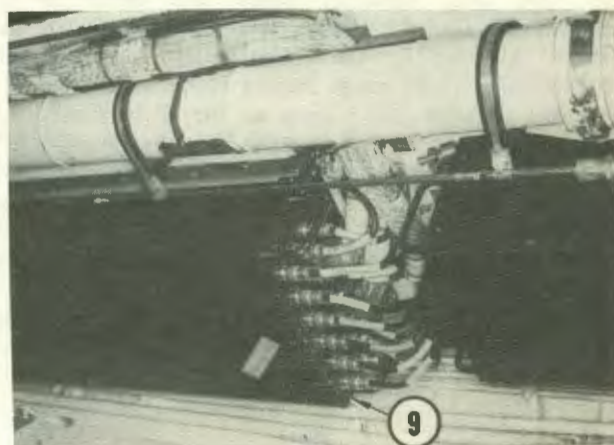
DISPLACEMENT GYROSCOPE CN-529/APQ-83  
GYROSCOPE MOUNT MT-2093/APQ-83



6. MISSILE RELEASE COMPUTER CP-473A/APQ-124  
7. AMPLIFIER CONTROL GROUP OG-39A/APQ-124



DEVIATED PURSUIT COMPUTER  
CP-742A/APQ



ELECTRICAL SYNCHRONIZER SN-412A/APQ-124

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Figure 8-1. (U) (Sheet 2)

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range is 600 yards. Targets that are in a relatively clutter-free (look-up) background can be detected and tracked in the normal pulse mode with relative closing velocities up to 2,000 knots or relative opening velocities up to 100 knots.

#### Angle Tracking Capability

(C-Gp 3) The radar set tracks targets and noise jamming signals in azimuth up to approximately 45 degrees left and right of the boresight line and in elevation from 45 degrees above to 30 degrees below the boresight line. Angle tracking is possible in all ranges.

### NORMAL OPERATION

#### Modes of Operation

##### Radar Modes

(C-Gp 3) The radar modes of search, acquisition, and track are available when operating in PULSE. In the radar search mode, the radar antenna scans the selected sector of the forward hemisphere. Targets in the selected sector are displayed on the azimuth-range indicator. The acquisition mode is entered using controls located on the radar control grip to designate the target echo to be tracked and to order the set to acquire and lock on the desired target. The set locks on the target and enters the radar track mode automatically. Thereafter, the set tracks the target and displays range and angle information on the azimuth-range indicator.

In the radar track mode, the radar set also displays missile launching information based on the operational capabilities of the type missile selected and supplies target range and range rate information to the aircraft guns computer. The radar set compares the present target range and range rate with the computer quantities in the missile release computer. When missile launching requirements are met, the large diameter range rate circle on the azimuth-range indicator snaps down to a smaller size and, before AFC 571, the in-envelope lamp on the ID-1485/APQ (BAT range meter) illuminates; after AFC 571, the in-range (INR) lamp on the IP-869A/APQ-124 indicator illuminates. Before AFC 571, the ID-1485/APQ range meter is located to the right of the azimuth-range indicator. After AFC 571, the range meter is located above the radar scope indicator between the INR and SEAM lamps. If the target range becomes less than the minimum range capability of the missile, a missile breakaway indication is displayed on the azimuth-range indicator and the heads-up in-envelope or INR lamp goes out.

#### Note

Computed minimum ranges are approximate at best. Pilots must have a thorough knowledge of Sidewinder minimum ranges and decide whether the aircraft is within the effective envelope by using the BAT range meter.

#### HOJ Modes

(C-Gp 4) The HOJ mode of operation includes all the functions of the normal radar modes when conventional radar target echos are received. The use of HOJ mode in clutter environment (look down) can increase the probability of target detection. In the presence of noise jamming, the HOJ mode enables the radar set to acquire and track the noise jamming source. Range information is not determinable from a noise jamming signal until target "burn through" at a range of approximately 4 to 6 miles, depending on target size and jamming intensity. Additionally, whenever the mode switch is in the HOJ position, the range strobe of the acquisition mode becomes fixed rather than sweeping.

#### BAT Mode

(C-Gp 3) Before AFC 571, Boresight-Acquisition-Track (BAT) is activated any time the radar mode switch is placed in the BAT position regardless of the position of the range scale switch. If the antenna switch is in the 1 BAR NO SPIN position, the antenna will automatically start to spin. When used in conjunction with the three-position gun switches, BAT provides a method of heads-up target acquisition and full angle tracking after lock-on. The BAT range meter is installed in the aircraft to provide target range and Sidewinder envelope information.

BAT system cockpit controls are the BAT position of the mode switch on the radar control panel and a BAT RANGING potentiometer located immediately aft of the landing gear position indicators on the left side of the cockpit. The range strobe potentiometer (labeled BAT RANGING, figure 8-4) is used to control the 1,400-yard sweeping range strobe within a distance from 600 yards to 5 miles (30,000 feet). The range of the 1,400-yard sweeping range strobe can be preset to a fixed distance within the 600-yard to 5-mile spectrum or can be varied as necessary to obtain lock-on. The BAT range meter has two needles and two lights which display information used in missile firing. The upper (S/W MAX RANGE) needle indicates the maximum range of the type Sidewinder missile selected. The lower (TARGET RANGE) needle indicates the distance the range strobe is sweeping while in the acquisition mode and, after lock-on, indicates target range. Distances are read from a dial face that is graduated in 5,000-foot increments. The left-hand (TRACK) lamp on the range meter illuminates to indicate lock-on. The right-hand (IN-ENV) lamp illuminates at missile maximum range and goes out at the computer missile minimum range.

(C-Gp 3) In the BAT mode, the radar beam is centered in azimuth and elevation on the aircraft boresight line. It is necessary to visually bring targets within the 50-mil ring of the gunsight to effect lock-on. After radar lock-on is accomplished, the S/W MAX RANGE needle on the BAT range meter displays Sidewinder maximum range for the type missile selected. After closing to within Sidewinder maximum capability, the missile may be fired provided



other Sidewinder firing criteria are met. (Sidewinder Rmax indications on the BAT range meter prior to radar lock-on are erroneous and should be ignored.)

#### BAT/ALE Mode

(C-Gp 3) After AFC 571, Boresight-Acquisition-Track (BAT) with Altitude-Line-Elimination (ALE) is a semiautomatic method of heads-up target acquisition and full angle track after lock-on. A range meter and an in-range (INR) light are provided on top of the radar indicator to display range to target and Sidewinder missile envelope information.

(C-Gp 4) To use BAT/ALE, the radar must be in the PULSE position and the mode selector must be positioned in either the IR or BAT positions. Selection of BAT or IR generates a BAT enable order which causes the antenna to spin regardless of the position of the antenna switch. The BAT enable order also will disengage the autopilot if it is engaged and complete the logic to allow the autopilot/BAT/nose gear steering button on the stick grip to control the BAT command. If IR is selected the radar transmitter is inhibited until the BAT command is initiated by depressing the autopilot/BAT/nose gear steering button. Once BAT command has been initiated, the transmitter fires and the BAT/ALE sequence begins. With BAT selected, the radar presentation will be the normal search mode. The antenna switch of the radar set control still selects the elevation coverage desired (one-bar or two-bar scan) but the antenna will spin regardless of the switch position.

(C-Gp 3) Upon actuation of the BAT command button, the radar antenna is programmed to zero tilt. The ALE gate is then swept out in range from 0 to 30,000 feet while the antenna continues to scan in azimuth. The ALE gate will sweep the 0- to 30,000-foot range interval twice or for 5 seconds, whichever is shorter. The ALE gate analyzes all radar targets, but point source targets are modulated and do not satisfy the ALE lock-on logic criteria. If a radar target is not scan modulated in a 1-second period, the ALE assumes it to be the altitude line and acquires that target. A blanking pulse eliminates all radar returns from the 1,500-foot interval, starting at the altitude line leading edge.

(C-Gp 3) At altitude line acquisition or after 5 seconds of ALE gate sweeping, whichever occurs first, the range scale switches to 0 to 5 miles and the antenna slews to

boresight. The radar range tracker begins sweeping the 0- to 30,000-foot interval continuously as long as the BAT button is depressed or until a radar target is acquired. The sequence can be interrupted any time up to full autotrack by releasing the BAT button. Upon acquisition, the radar goes into full system track, altitude line elimination is removed, and the range meter atop the indicator will indicate the range to the target. After full system lock-on, radar lock can be broken by momentarily depressing the BAT button or by depressing the acquisition switch on the radar hand control.

(C-Gp 4) The radar range meter will not be activated until radar lock-on and will present range to the target after full system lock-on. The INR lamp, left of the range meter, will illuminate when the target being tracked is within the range boundaries of the Sidewinder missile being carried. Between Rmax +10% and Rmax the INR lamp will flash as a warning that in-range condition is being approached.

A polarized radar display filter and hood assembly allows the radar presentation to be viewed in ambient light conditions by a normally positioned pilot. This filter and hood assembly in conjunction with the head-up range meter/lamp assembly and daylight viewable radar scope increases the aircraft's effectiveness in a combat environment. When in BAT mode and a lock-on occurs with the flight instrument light switch in BRT, the INR and SEAM lights will illuminate in full brightness.

When the radar is operating in any mode other than BAT, the brilliance of the INR and SEAM light is determined by the setting of the radar bezel dim control knob. The intensity of the light in the BAT meter is controlled by the noninstrument light dimmer and activates when lock-on occurs.

#### BANNER BAT Mode

The BANNER BAT (formerly GARO) mode permits the acquiring and automatic range lock-on of a towed gunnery target. The BANNER BAT mode is entered by selecting BAT on the radar control panel and having a ground selected switch on the OG-39A/APQ-124 antenna control amplifier preset to the BANNER BAT position.

BANNER BAT is utilized only for air-to-air gunnery practice and is recommended because angle-tracking is





inhibited and retention of a tow aircraft lock-on is highly unlikely. BANNER BAT provides acquisition and track modes only. In this mode the radar beam is depressed from the boresight line approximately 4 degrees and the angle-tracking feature is disabled. No Altitude Line Elimination (ALE) is provided.

#### IR Modes

#### CAUTION

When operating with the function switch in PULSE, and the mode switch in IR, extreme power is concentrated into the aiming dot symbology. Turn gun 1 bias knob to the full down position to prevent damage to the scope face.

The Infrared Detection System AAS-15 is not utilized in F-8J aircraft; however provisions for the system will remain. The IR position on the radar mode switch will still secure the radar transmitter without securing power to the radar equipment. Use of the IR mode to remain passive is recommended over the use of the standby function. After AFC 571, the IR position is a BAT enable position and provides BAT/ALE function when commanded by the pilot.

#### Operating Controls

##### Radar Control Grip

Range control is provided by fore and aft movement of the radar control grip (figure 8-2). The grip is spring loaded so that it returns to aft (zero range) position when released. In the search modes, the grip positions the acquisition bar in range and in azimuth on the azimuth-range indicator display. In the acquisition modes (except BAT modes), the grip locates the starting position of the range strobe in range and azimuth. The range strobe may be either sweeping or stationary (HOJ selected).

Azimuth control is provided by side-to-side movement of the radar control grip. It is also spring-loaded to the center position when released.

In all search modes, azimuth control determines which of the narrow scans is selected when the sector scan button is depressed. If the wide scan is being used and the sector scan switch is depressed, the scan changes to either left, center, or right narrow scan, depending on the position of the radar control grip in azimuth. The range and azimuth movements of the radar control grip have no effect on BAT modes. Range and azimuth movement is not effective in any track mode.

The elevation control knob (tilt thumbwheel) controls the elevation angle of the search scan pattern in all search

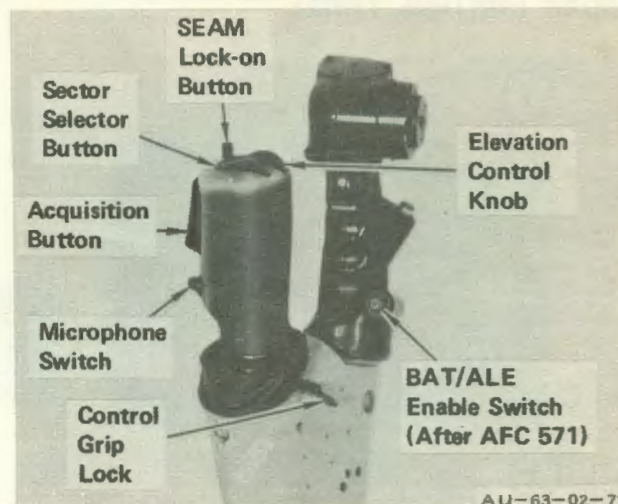


Figure 8-2. (U) Radar Control Grip

modes. In the acquisition modes, except BAT and BANNER BAT, the tilt thumbwheel controls elevation angle of the radar antenna.

The acquisition (action) button is used to enter an acquisition mode and thereby obtain manual control of the radar antenna and the target range designation capability.

Pressing the action button initiates an acquisition mode regardless of the previous operating mode (either search or track).

The sector select button is used to select either the wide scan or one of the narrow scans. The wide scan covers a search sector approximately 43 degrees to the right and left of the boresight line. Each of the narrow scans covers a search area approximately 50 degrees wide. The left and right narrow scans overlap in the center of the indicator. The narrow scan selected when the selector button is depressed depends on the left, center, or right position of the radar control grip. When a narrow scan is in use, pressing the sector selector button returns the search coverage to the wide scan.

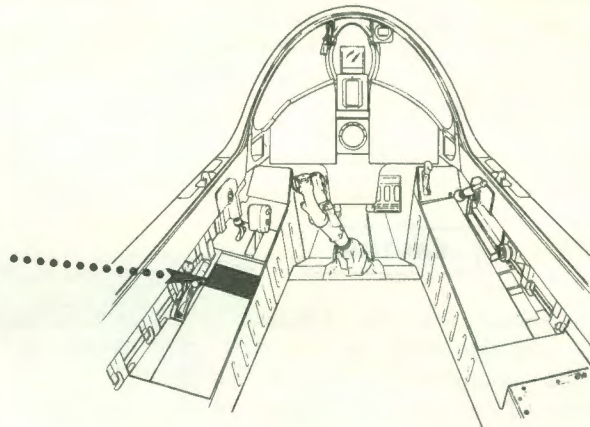
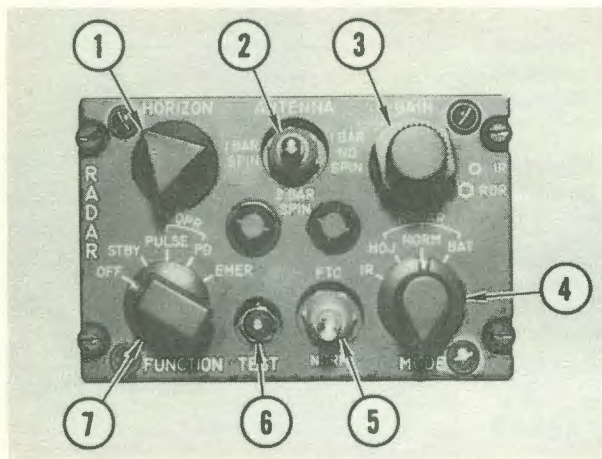
The radar control grip also has a butterfly lock switch to lock the grip while not in use, an auxiliary microphone switch to facilitate voice transmissions while using the control, and a SEAM lock-on switch.

##### Radar Control Panel

The radar control panel is illustrated in figure 8-3. The illustration also contains a functional description of the various controls on the panel.



## RADAR CONTROL PANEL



Nomenclature	Function
1. Horizon knob	Controls vertical centering of the artificial horizon bar on the display; effective only in the search and acquisition modes.
2. Antenna switch	Controls sweep-spin options of the antenna in PULSE function search mode only. Whenever the one bar no spin condition exists in the normal pulse search mode, and acquisition (NORM, HOJ) is selected, the antenna spin motor automatically starts. The antenna also starts spinning automatically when BAT or IR is selected.
3. Gain knob	Controls receiver gain in the search modes. Gain is controlled automatically in the acquisition and track modes. The IR knob concentric with the GAIN knob is inoperative.
4. Mode switch	Operations on the MODE switch and their relationship to operations on the FUNCTION switch are shown below.
5. FTC switch	FTC – activates fast-time constant circuitry to reduce effects of ground clutter on the display during PULSE search mode only. FTC circuits are automatically activated in the PULSE acquisition and track modes. After AFC 571, FTC circuits are also automatically activated if the IR or BAT modes are selected. NOR – normal ground clutter returns are displayed in the PULSE search mode.
6. Test button	When depressed, provides targets at 1,000-yard intervals on the indicator for operational check.
7. Function switch	Operations of the FUNCTION switch and their relationship to operations of the MODE switch are shown below.

### RELATIONSHIP OF FUNCTION AND MODE SWITCH OPERATION

Switch Name and Position		System Operation
Function	Mode	
OFF	IR RADAR-NORM RADAR-HOJ RADAR-BAT	The radar set is inoperative with no power to any of the components.
STBY	IR RADAR-NORM RADAR-HOJ RADAR-BAT	Radar set is in standby condition. This position of the FUNCTION switch is used to reset the radar set whenever it drops off the line. OPR-IR is used for a non-transmitting standby condition and accomplishes the same as standby.

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Figure 8-3. (C)(U) (Sheet 1)



# RADAR CONTROL PANEL

RELATIONSHIP OF FUNCTION AND MODE SWITCH OPERATION (Continued)

Switch Name and Position		System Operation
Function	Mode	
OPR-PULSE	IR	Used to maintain the radar set in a standby condition with filament power to all radar components. Artificial symbols will be displayed. After AFC 571, this is a BAT enable position providing the BAT/ALE sequence upon pilot command.
OPR-PULSE	NORM	The radar set operates in the normal PULSE modulation mode. The range strobe sweeps (1,400–1,500 yards) in this mode.
OPR-PULSE	HOJ	The radar set operates in the normal PULSE modulation mode and has the capability to angle track noise jamming sources. The range strobe is stationary (non-sweeping).
OPR-PULSE	BAT	Before AFC 571 the radar set operates in the normal BAT or BANNER BAT mode depending upon the position of the generator compartment selector switch on the antenna control package. The range strobe sweeps (1,400–1,500 yards) in this mode and is positioned by the BAT RANGING control. After AFC 571, if BAT is selected the set operates in normal search until the pilot commands the BAT/ALE sequence.
EMERG	RADAR-NORM RADAR-HOJ RADAR-BAT	The EMERG position of the FUNCTION switch is a momentary operation. Whenever the FUNCTION switch is placed to EMERG, a mechanical-electrical latch is picked up that overrides all radar set safety sensors. The switch must then be repositioned to PULSE. This position is ONLY TO BE USED FOR COMBAT NECESSITY AS IRREPARABLE DAMAGE COULD RESULT. To recycle a lost display, always attempt to utilize STBY. In STBY, radar set safety sensors are not bypassed.

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Figure 8-3. (C/U) (Sheet 2)

## Azimuth-Range Indicator

The azimuth-range indicator is illustrated in figure 8-4. The illustration also contains a functional description of the various controls on the indicator. Circuit breaker CB4901 supplies power to the azimuth-range indicator and is located behind the ejection seat on the port side. If display on azimuth-range indicator is lost, the pilot can attempt to regain it by resetting the circuit breaker.

## BAT Range Meter (Before AFC 571)

The BAT Range Meter is illustrated in figure 8-4. The illustration contains a functional description of the lamps and needles associated with this device.

## Operation Before Use

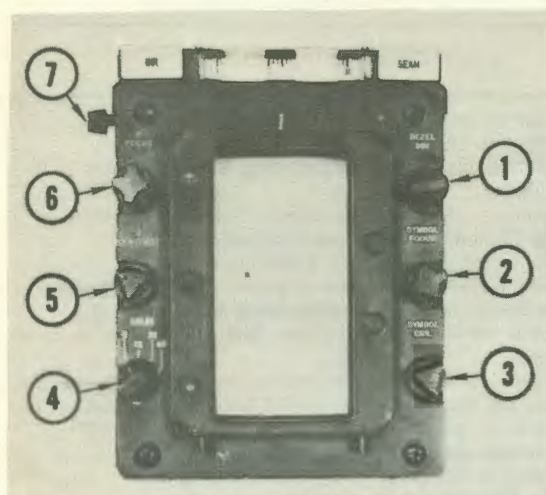
### Warmup

With the engine operating, electrical power and hydraulic power are available to the radar set. The following procedure warms up the set and provides a check for normal operation.

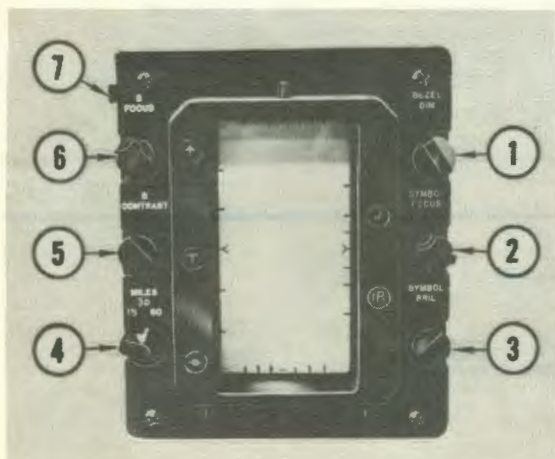
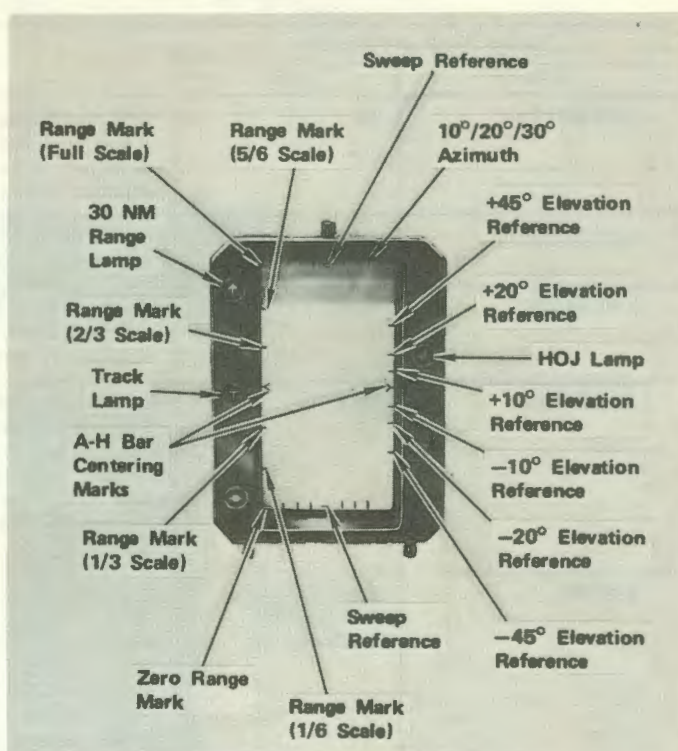
### CAUTION

With cockpit pressurization on, limited cooling is provided at idle power settings. Do not operate the set for more than 15 minutes, including warmup time, without external cooling air.

# AZIMUTH-RANGE INDICATOR AND BAT RANGING CONTROLS



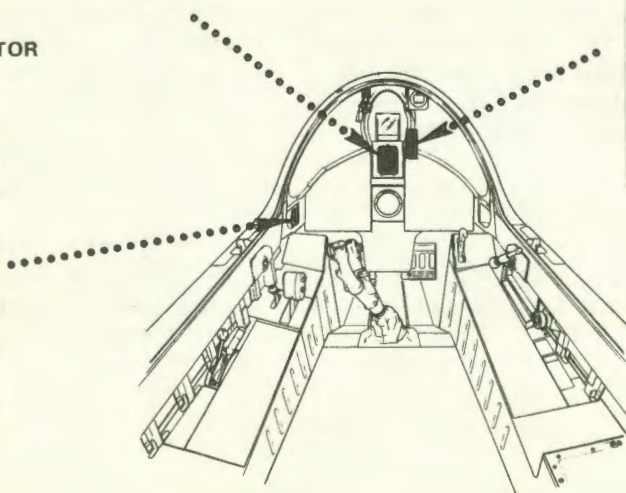
AZIMUTH-RANGE INDICATOR  
(After AFC 571)



AZIMUTH-RANGE INDICATOR  
(Before AFC 571)



BAT RANGING CONTROL  
(Before AFC 571)



SIDEWINDER  
RANGING METER  
(Before AFC 571)

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Figure 8-4. (C)(U) (Sheet 1)



## AZIMUTH - RANGE INDICATOR AND BAT RANGING CONTROLS

<i>Nomenclature</i>	<i>Function</i>
1. Bezel dim knob	Controls intensity of the indicating lamps and the scope bezel illumination lamps.
2. Symbol focus knob	Controls focus of the A-H bar, calibrated vertical, aiming dot, tilt mark, steering circle, and range rate circle.
3. Symbol brilliance knob	Controls brilliance of the A-H bar, calibrated vertical, aiming dot, tilt mark, steering circle, and range rate circle.
4. Miles switch	Selects 5-mile, 15-mile, 30-mile, or 60-mile scales. AFC 571 adds 5-mile scale.
5. B contrast knob	Controls B sweep intensity.
6. B focus knob	Controls focus of the B sweep, the narrow B sweep, the acquisition bar, the range strobe, and the missile maximum range mark.
7. Gun 1 bias knob	Controls the bias on gun 1 of the indicator. A good adjustment is obtained by moving this control until the acquisition bar is neither too dim nor has excessive grass that appears to attach to the B trace.
8. BAT ranging control	Positions range strobe out to 30,000 feet while operating in the BAT mode. When in the BAT mode, the range strobe control of the radar hand control is disabled.

### RADAR INDICATOR LAMP INDICATIONS

Track lamp	On when a target echo is being tracked in range.
30NM range lamp	On when the miles switch is in 30.
HOJ lamp	On when a noise jamming signal is being tracked in angle.
IR lamp	Before AFC 571, not used. After AFC 571, on indicates SEAM lock-on.
INR lamp (IP-869/APQ-124A)	After AFC 571, on when target is within computed range boundaries for Sidewinder missile being carried.
Range meter (IP-869/APQ-124A)	After AFC 571, illuminates and indicates range when lock-on occurs. Range scale of 0 to 30,000 feet.
SEAM lamp (IP-869/APQ-124A)	After AFC 571, on when IR target is being tracked by Sidewinder missile in the SEAM mode.

### BAT RANGING METER INDICATIONS (Before AFC 571)

Auxiliary track lamp	On when a target echo is being tracked in range.
In-envelope lamp	On when the fighter is in the missile launching envelope.
S/W max needle	Not locked on Locked on - computed S/W maximum range for missile selected.
Range needle	Not Locked on - position that sweeping range strobe is sweeping (0-5NM). Locked on - range of the target to a maximum of 30,000 feet.

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Figure 8-4. (CXU) (Sheet 2)

Changed 15 March 1971

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8-11



## 1. MODE SWITCH - IR

The IR position makes possible nonradiating radar operation before the switch is placed in HOJ, NORM, or BAT. After AFC 571, the IR position serves as a BAT/ALE enable position.

### CAUTION

When operating with the function switch in PULSE and the mode switch in IR, extreme power is concentrated into the aiming dot symbology. Turn the gun 1 bias knob to the full position to prevent damage to the scope face.

## 2. FUNCTION SWITCH - PULSE

After an equipment warmup time of approximately four minutes, the system is ready for use and will come on the line. Adjust the BEZEL DIM knob to obtain the desired illumination of the cathode-ray tube bezel. The BEZEL DIM knob also controls the brilliance of the indicating lamps when they are lighted during actual operation. If no display appears, it is possible that the circuit breaker has opened. Reset the circuit breaker a maximum of three times in an attempt to gain a display.

### CAUTION

Do not leave the function switch in PULSE for more than six minutes if the display does not appear. Leaving the switch in one of these positions with no display may result in equipment damage.

After normal operation is obtained, leave the FUNCTION switch in one of the OPR positions at all times unless turned OFF due to abnormal scope presentations. If a continuing requirement exists for non-radiating operation, leave the MODE switch in IR and the FUNCTION switch in OPR to ensure that artificial symbols are displayed. Monitor the scope for abnormal artificial symbol presentations at not less than six minute intervals while operating under this condition.

If radar transmission is desired (after warmup) make sure that an area at least 150 feet forward and 45 degrees to the right and left of the aircraft centerline is clear of all personnel, fuel trucks, ammunition carts, and other equipment before placing the MODE switch in HOJ, NORM, or BAT. Observe all the preceding restrictions, and monitor the presentation at least once every six minutes for abnormal presentation.

### Abnormal or No Display

If no display appears, cycle the FUNCTION switch between STBY and one of the OPR positions within the six minute restriction. Turn the FUNCTION switch to

OFF if the display is not obtained within the six minute time limit.

If abnormal presentation of artificial symbols appears (intermittent, absent, or permanent shrinking of symbols), turn the FUNCTION switch OFF.

If presentations appear and disappear three times within a three-minute time period, turn the FUNCTION switch OFF. (This is caused by actuation of overload circuits and requires resetting to STBY, then to OPR.)

## Radar Search Mode

After system warmup is complete, the radar is placed in search mode by placing the MODE switch in RADAR-NORM or RADAR-HOJ.

Adjust the azimuth-range indicator for operation as follows:

1. Set the MILES switch on the indicator to 15.
2. Adjust the B CONTRAST control on the indicator full clockwise.
3. Turn the GAIN control knob on the radar control panel full counterclockwise.
4. Adjust the GUN 1 BIAS control on the indicator clockwise until the video pedestal appears and then counterclockwise slowly until the video pedestal is just extinguished.
5. Readjust GAIN control knob on the radar control panel full clockwise.
6. Adjust the B CONTRAST and B FOCUS control on the indicator for best contrast and focus.
7. Set the SYMBOL BRIL control on the indicator for acceptable brightness of the A-H BAR.
8. Set the SYMBOL FOCUS control on the indicator for best definition.
9. Adjust the side sighting and edge-symbol lamp brilliance with the BEZEL DIM control on the indicator for acceptable illumination.

## Scan Coverage in Radar Search Modes

(C-Gp 4) The antenna scan coverage in the radar search modes is shown in figure 8-5. As indicated, the radar antenna has three possible search scan patterns in PULSE search. The basic sweep occurs at a rate of 72 degrees per second. The wide scan or the left, center, or right narrow scan can be selected by the pilot. In elevation, the basic antenna beam width is approximately 5.5 degrees for the one-bar no-spin sweep pattern. In the one-bar spin sweep pattern, the beam width increases to approximately 7.5 degrees due to the added antenna nutation. Whenever the two-bar spin sweep pattern is utilized, beam coverage increases to approximately 9.5 degrees due to the



sweep outward to a distance of 1,400 to 1,500 yards greater than its quiescent position and return. In RADAR NORM, the range strobe sweeps across the target blip. When the range strobe and the target are coincident in range, range lock-on occurs and the TRACK lamps illuminate. Thereafter, the range strobe remains coincident with the target and the TRACK lamps remain lighted. During acquisition, the displacement gyroscope slews to the azimuth and elevation of the antenna (position that radar control grip was being held to acquire the target blip). When the displacement gyro reaches the antenna angular position and if range lock-on has been achieved, the radar will enter the angle track mode. In this mode, the radar antenna is space stabilized (yaw, roll and pitch) to the displacement gyro. The scale factors on the radar acquisition displays are the same as on the radar search displays. Also, the A-H bar is positioned on the radar acquisition displays in the same manner as in the radar search displays.

#### Operating Procedure In Radar Acquisition Modes

If the acquisition bar and the tilt mark are accurately positioned in the radar search mode, no operating procedures are required in the acquisition mode, except as follows:

1. Hold the radar control grip in the position established in the search mode.
2. Hold the action button depressed.

Normally, the radar set sequences to the radar track mode within 3.5 seconds after the action button is depressed. If the radar set remains in the acquisition mode, the setting of the radar control grip may require refinement. Adjust the radar control grip in range so that the range strobe is coincident with or sweeps through the target blip. Manipulate the radar control grip in azimuth and tilt to obtain the maximum brightness of the target blip. In HOJ manually sweep the stationary range strobe through the target blip until lock-on occurs.

#### Radar Track Modes

The radar set automatically enters radar track from the radar acquisition mode as described in the preceding paragraph. In radar track, the control grip has no effect on the control or display of the radar set except for the action button. The action button can be released with no effect on the operation. If the action button is pressed after having been released, the radar set reenters the acquisition mode. When the action button is again released, the radar reenters the search mode.

In the radar track modes, the radar set tracks the target in range, azimuth, and elevation, and presents maneuvering information on the display to enable the fighter to arrive at a missile firing position. Also, the maximum

launching range requirement for the missile that is selected is displayed.

The antenna of the radar set follows the apparent direction of the target throughout changes in the target relative position, and throughout pitch, roll, and heading changes of the fighter. Also, antenna position information (azimuth and elevation) referenced to the aircraft boresight and the artificial horizon is generated.

#### Radar Track Display

Typical indicator displays in the radar track mode are shown in figure 8-10. The TRACK lamp lights in the radar acquisition mode when range lock-on occurs and remains lighted in the radar track mode. The steering circle is positioned to the azimuth and elevation of the target being tracked (referenced to the aircraft boresight line and the artificial horizon).

(C-Gp 3) On the indicator, the narrow B-scan is positioned to the azimuth of the target being tracked and, thus, is superimposed on the steering circle. The track gate and target video are positioned on the narrow B-scan at the target range, where the range scale is, before AFC 571, either 15 miles, 30 miles, or 60 miles as selected by the MILES switch. After AFC 571, 5, 15, 30, and 60 mile range may be selected. The missile maximum range mark is positioned on the left side of the narrow B-scan and indicates the computed maximum range capability of the missile type in use on the same range scale as the track gate.

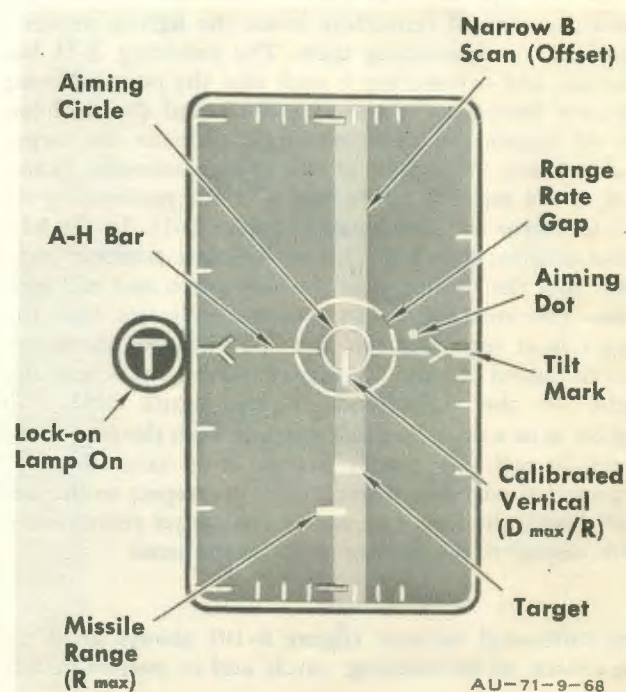


Figure 8-10. (C/U) Radar Track Display



The aiming dot indicates the target angle on a magnified scale. The scale multiplier is approximately 5 (4.92); thus, the aiming dot appears at the edge of the azimuth scale ( $\pm 1$  inch in azimuth) for a target angle of 9 degrees. When the aiming dot is coincident with the steering circle edge the target is within 2 degrees of boresight. The aiming dot will only displace one inch from the center of the indicator. Whenever the dot is displaced one inch in any direction, reference to target position should be made from the steering circle.

Target range rate is read from a gap in the larger stationary range rate circle. The reference point on the gap is the CCW edge. For a target with zero range rate, the reference point is at the 12 o'clock position on the range rate circle. The scale factor is 600 knots per quadrant (90 degrees) with closing range rates indicated by positions in the CW direction from the zero rate position. In figure 8-10, the indicated range rate is 400 knots closing. Whenever the pilot flies to within missile maximum range, the range rate circle snaps down to a smaller size to draw attention to the in-envelope condition.

The A-H bar is positioned and orientated on the radar track display to indicate the pitch and roll attitude of the aircraft, and to indicate as well the elevation angle between the target and the horizon. The A-H bar location is similar to that of the search and acquisition displays but with two differences: (1) on the track display, the horizon control is not effective, and the vertical position of the A-H bar represents the true pitch of the fighter with respect to the horizon; and (2) on the track display, the A-H bar is deflected horizontally from the vertical centerline when the fighter makes a climbing or descending turn. The resulting A-H bar position and orientation is such that the perpendicular distance between the steering circle and the A-H bar always equals the elevation angle between the target and horizon, regardless of the fighter attitude. Examples of the steering circle and A-H bar positioning on the indicator are illustrated in figure 8-11. In the left-hand display, figure 8-11, the A-H bar position indicates that the fighter is in the zero pitch and roll attitude. The steering circle position indicates that the target is at zero azimuth and  $+20$  degrees elevation, as referenced to the 20-degree scribe mark on the right. In the right-hand display, figure 8-11, the fighter is in a nose-up pitch attitude with the ring wing down in roll. The target is now at an azimuth of 15 degrees left and zero degrees up with respect to the aircraft boresight line, but notice the target relationship with respect to the horizon remains the same.

The calibrated vertical (figure 8-10) always starts at the center of the steering circle and is perpendicular

to the A-H bar. The length of the calibrated vertical represents the angle subtended by the quantity  $D_{\max}$ , as viewed by the fighter; that is,  $D_{\max}/R$ , where  $R$  is the present target (slant) range. The quantity  $D_{\max}$  equals the missile climb capability. In use, the end of the calibrated vertical is compared with the position of the A-H bar to determine if the target altitude advantage is more or less than  $D_{\max}$ . Another example of calibrated vertical interpretation is presented in figure 8-12.

#### In-Range Indication

(C-Gp 3) In-range indications are threefold: (1) target inside the missile maximum range indication along the narrow B-scan, (2) a noticeable snapping down in size of the range rate circle, and (3) illumination of the in-range lamp on the S/W firing indicator (BAT range meter). In addition to these indications, the lower (target range) needle of the S/W firing indicator will be displaced to the left of the upper (S/W MAX RANGE) needle before AFC 571. After AFC 571, the INR lamp atop the radar scope will flash between  $R_{\max} + 10\%$  and  $R_{\max}$ . At minimum computed missile range the track mode remains but a breakaway display is presented and the heads-up in-range lamp goes out. Whenever an AIM-9B missile is carried the in-range lamp goes out whenever within range but in excess of 2.0 g's (an AIM-9B firing limitation).

(C-Gp 4) The Sidewinder firing limits are computed in the missile release computer using target range and range rate, fighter altitude and speed and aircraft acceleration (g).

#### Coaltitude Attack

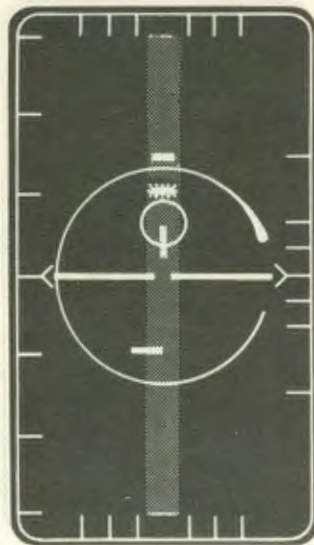
(C-Gp 4) In a coaltitude attack, the effective launching envelope is a horizontal cross section of the cone-shaped volume at the target's altitude (figure 8-13). As seen, the missile  $R_{\max}$  and  $R_{\min}$  limits define the outer and inner boundaries of the envelope. The missile envelope is further bounded in azimuth by the angle off limitations of the missile type selected ( $A_{\max}$ ). The missile release computer does not compute the angle off missile boundaries except for the 2-g firing thumb rule for the AIM-9B. Furthermore, the minimum missile range computation is rough at best.

#### Note

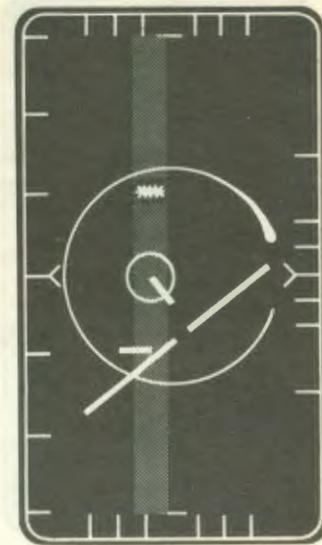
(C-Gp 4) The maximum range for AIM-9 missiles as computed by the missile release computer is very accurate and is only 10 to 15% conservative out to 60 degrees angle off. However, the minimum range/angle off limitations must be memorized.



## INTERPRETATION OF STEERING CIRCLE AND A-H BAR POSITIONING



Fighter in straight and level flight.  
Target at zero azimuth and +20 degrees  
elevation with respect to boresight line.  
Target range = 10 miles.  
Target altitude advantage = 20,000 feet  
( $\frac{1}{2}$  inch = 20,000 feet at 10 miles).  
Missile  $R_{max}$  = 5 miles.



Fighter in climbing right turn.  
Target at -15 degrees azimuth and zero  
elevation with respect to boresight line.  
Target range = 10 miles.  
Target altitude advantage = 20,000 feet.  
Missile  $R_{max}$  = 5 miles.

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Figure 8-11. (C)(U)

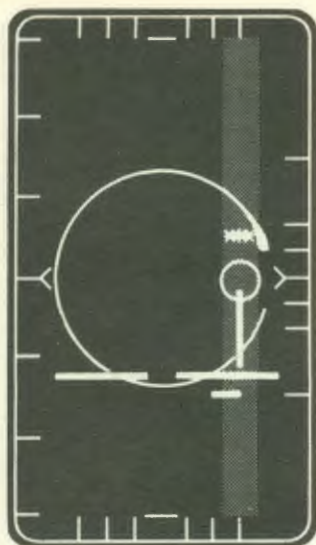
### Differential Altitude Attack

In a differential altitude attack (target higher than fighter), the permissible altitude differential is limited by the missile climb capability. The relationship between the climb capability and the target altitude advantage is represented by the distance between the calibrated vertical and the A-H bar, as shown in figure 8-12. In a differential altitude attack, the effective launching envelope is a vertical cross section of the cone shaped volume, as shown in figure 8-14. In the case shown, the fighter is outside and below the launching envelope. Accordingly, the target range indication on the display is much greater than missile  $R_{max}$ , and the calibrated vertical does not reach the A-H bar. When the fighter has closed on the target and has gained sufficient altitude to enter the launching envelope, the calibrated vertical meets the A-H bar.

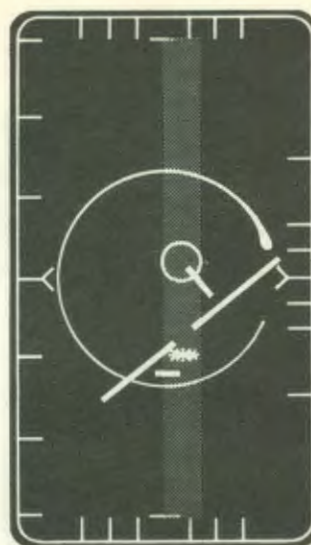
### Loss of Target In Radar Track Mode

(C-Gp 4) The tracking circuitry of the radar set includes memory functions which maintain the previously established range and angle tracking rates during short periods of target fading. Thus, if the target echo disappears and reappears a few moments later, the range and angle tracking functions continue without interruption provided the range or angle rate does not change markedly during the period in which the target is absent. Since the validity of the remembered range and angle rates decrease with elapsed time, a cut-off point of approximately 6 to 8 seconds is established in the radar set. As a result, if the target echo disappears and does not reappear within the time limit, the radar set assumes the target is lost and returns to the search mode. Except when an AIM-9C missile is fired, the radar set returns to the search mode when the target is

## INTERPRETATION OF CALIBRATED VERTICAL



Fighter in nose-up, zero-roll attitude.  
Target at +30 degrees azimuth and zero elevation with respect to boresight line.  
Target altitude advantage is greater than missile  $D_{max}$ .  
Target range = 8 miles.  
Required interceptor climb (distance between end of calibrated vertical and A-H bar) = 4,000 feet ( $\frac{1}{16}$  inch = 4,000 feet at 8 miles).



Fighter in climbing right turn.  
Target at +8 degrees azimuth and +8 degrees elevation with respect to boresight line.  
Target altitude advantage is greater than missile  $D_{max}$ .  
Target range = 5 miles.  
Required interceptor climb = 1,250 feet ( $\frac{1}{16}$  inch = 1,250 feet at 5 miles).

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Figure 8-12. (C)(U)

lost. When an AIM-9C is fired, the radar set remains in the track mode after missile firing even though the target is lost. If the next missile on the pylon is an AIM-9C, the radar track mode continues indefinitely, or until the pilot presses the action button. If the next missile on the pylon is not an AIM-9C, the radar track mode continues for 60 seconds after AIM-9C missile firing, then changes to the radar search mode. In either case, the TRACK lamps go out when the target is lost.

### Unlock Procedures in the Radar Track Mode

The radar set can be switched from the radar track mode to the radar acquisition mode by pressing the

action button. If the range strobe then sweeps across or comes in coincidence with a target echo, the radar set locks on to that target echo and reenters the radar track mode. If the range strobe does not sweep across or come into coincidence with a target, the radar set remains in the acquisition mode as long as the action button is held down. When the action button is released, for this case, the radar set goes to the radar search mode.

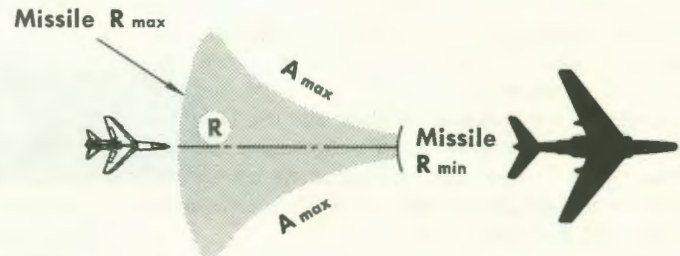
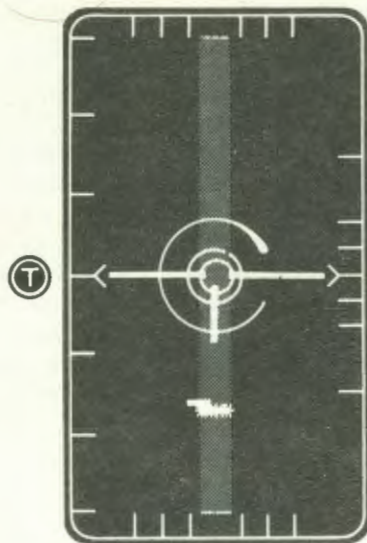
### Breakaway Display

The breakaway display appears in the radar track mode when the present target range becomes less than



# CROSS SECTION OF COALTITUDE LAUNCHING ENVELOPE

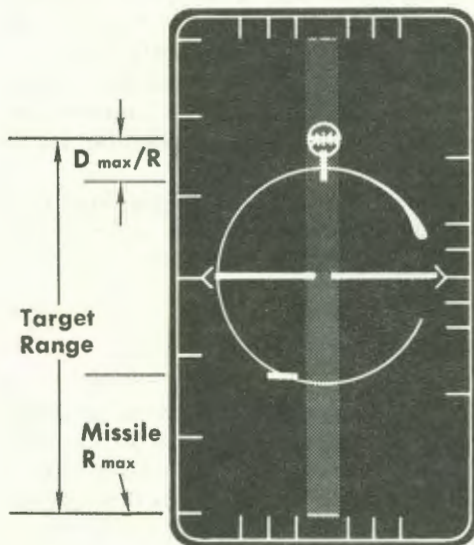
INR



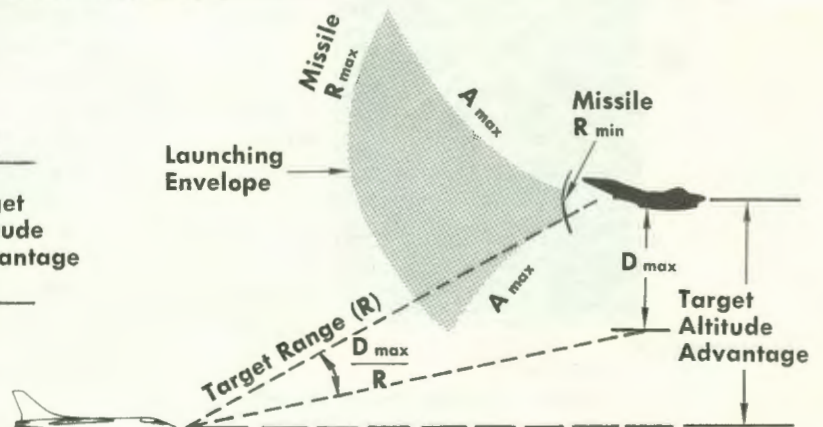
AU-74-02-71

Figure 8-13. (C)(U)

# VERTICAL CROSS SECTION OF LAUNCHING ENVELOPE



Target  
Altitude  
Advantage



Missile  $R_{max}$  = Missile Maximum Range  
Missile  $R_{min}$  = Missile Minimum Range  
 $A_{max}$  = Maximum Angle Off Due to  
Missile Limitations  
 $D_{max}$  = Missile Climb Capability  
 $D_{max}/R$  = Angle Subtended by  $D_{max}$   
As Viewed From Fighter

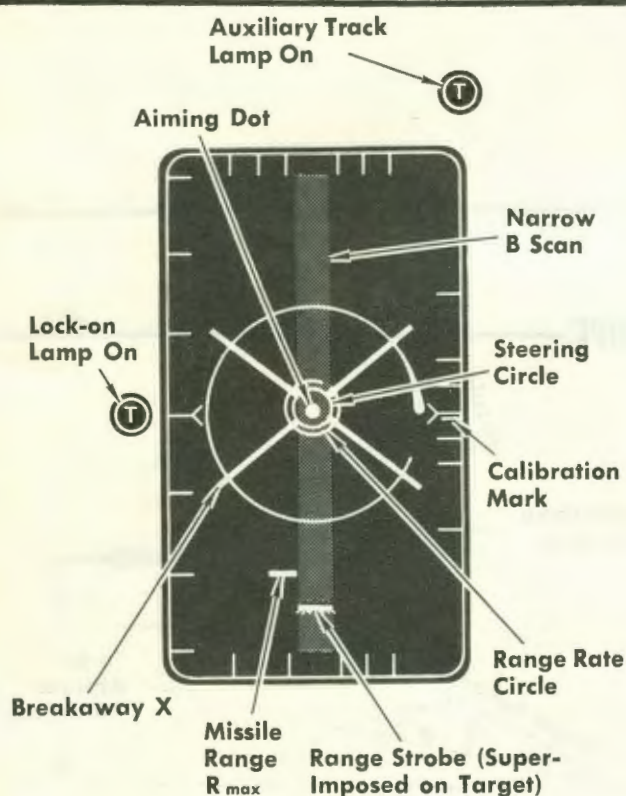
AU-75-02-71

Figure 8-14. (C)(U)



the computed minimum range for the missile ( $R_{min}$ ). The breakaway display is shown in figure 8-15. On the indicator, the breakaway cross is centered on the display. Also, the TRACK lamp remains lighted and the heads-up in-envelope lamp goes out.

The narrow B-scan appears at the target azimuth and includes the track gate, received video, and the missile  $R_{max}$  mark, as in the normal radar track display. The steering circle and aiming dot continue to mark the target's azimuth and elevation angle. The range rate circle continues to show range rate. The A-H bar and calibrated vertical are missing as they are the symbols that make up the breakaway X. A calibration dot appears at the right side of the indicator denoting the boresight elevation (ADL) angle. This dot represents zero tilt along the elevation scale.



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Figure 8-15. (C/U) Breakway Display

#### HOJ Modes

(C-Gp 3) Where only target echos are received, the HOJ modes are identical in all respects with the corresponding radar modes (search, acquisition or track). In addition a noise jamming signal has the same appearance in the HOJ

search display as in the NORM search display. A noise jamming signal, however, can be acquired in angle in the HOJ acquisition modes and angle-tracked in the HOJ track modes. This capability does not exist in the NORM radar modes. It is noted that the capability of tracking a noise jamming signal applies to azimuth and elevation only (angle tracking only), range information is not determinable from a noise jamming signal. A noise jamming signal appears on the search display as one or more vertical stripes, where multiple stripes indicate reception on antenna side lobes. The azimuth of the signal source can be identified by turning the gain control counterclockwise (down) to eliminate display of the side lobe reception. The tilt setting which results in the brightest stripe represents the elevation of the signal source. Where the noise jamming signal is very strong it is displayed as one or more dark vertical stripes because of receiver overloading. In this case, turning the gain counterclockwise eliminates the overloading and produces bright stripes as described. The noise jamming signal can be acquired from the HOJ mode but not in the NORM mode.

#### Acquisition of a Noise Jamming Signal

The operating procedures to acquire a noise jamming signal are as follows:

1. Enter the HOJ mode by turning the MODE switch to HOJ and the FUNCTION switch to PULSE.
2. A noise jamming signal may be pinpointed in azimuth by reducing gain. It is desirable to adjust the tilt thumbwheel for maximum signal brightness.
3. Adjust the radar control grip to locate the acquisition bar at the center azimuth of the jamming signal. The range position of the acquisition bar is immaterial.
4. Press the action button. At this point, the HOJ search display changes to the HOJ acquisition display, and the radar set enters the HOJ acquisition mode with a jamming signal.

#### Operation In HOJ Acquisition Mode

In the HOJ acquisition mode with a noise jamming signal, the narrow B-scan is illuminated by the jamming signal over its entire length and the HOJ lamp is lighted. Normally, the radar set sequences through the HOJ acquisition mode to the HOJ track mode within one second after the action button is pressed. If the radar set should fail to sequence to the HOJ track mode, the setting of the radar control grip and the tilt thumbwheel may require refinement. Adjust for maximum brightness of the narrow B-scan. In the HOJ acquisition mode, the range strobe is stationary and does not sweep as in NORM acquisition.



### Operation in the HOJ Track Mode

The HOJ track mode is defined as a track mode with the FUNCTION switch in PULSE and the MODE switch in HOJ. When only target echoes are present, the indicator displays and interpretation for the HOJ track modes and the NORM radar track modes are identical. If a noise jamming signal is acquired in the HOJ acquisition mode, it is tracked in angle in the HOJ track mode.

(C-Gp 3) The HOJ display, when tracking a noise jamming signal, is shown in figure 8-16. The HOJ lamp is lighted and the TRACK lamps are not lighted. The steering circle and aiming dot are positioned in the same manner as in the NORM radar track displays. The position of the A-H bar represents the pitch and roll attitude of the fighter as in the NORM radar track modes. The narrow B-scan is offset to the left edge of the display. The target echo and the track gate are on the offset B-scan but may be masked by the jamming signal. If the jamming signal stops, normal radar echoes will be displayed on the offset B-scan. Three seconds of angle track memory is provided after loss of the jamming signal. The calibrated vertical and the  $R_{max}$  mark are not presented when tracking a noise jamming signal (no range information). Also, there is no range rate circle, and the breakaway display does not appear. When the range to a large target gets sufficiently close, the target will "burn through" and be seen in the narrow B-scan; however, there is no way to enter a NORM radar track (range lock-on) from a

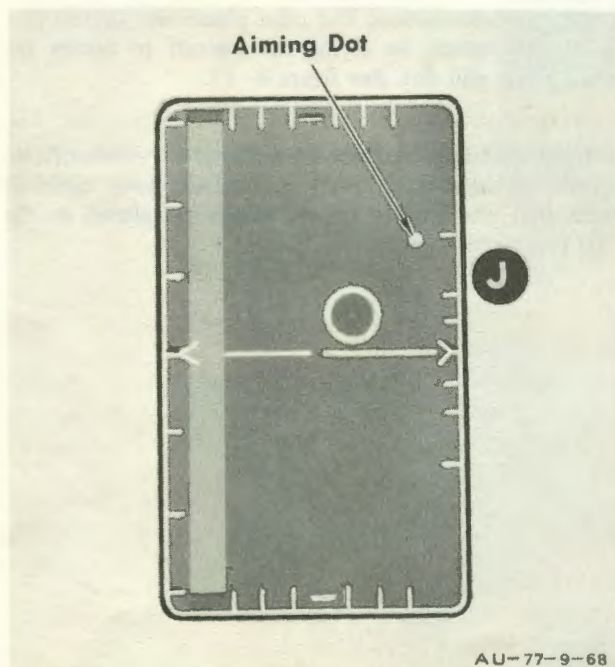


Figure 8-16. (C)(U) HOJ Display When Tracking Jamming Signal

HOJ track mode without going back through acquisition to position the range strobe over the target echo.

### BAT Modes

Before AFC 571, the BAT modes consist of Boresight-Acquisition-Track (BAT) or BANNER BAT. After AFC 571, the Boresight-Acquisition-Track (BAT) modes consist of the BAT/ALE or BANNER BAT. The choice of which BAT mode will be available is made on the ground by placing a two-position switch on the antenna control group (generator compartment) to the appropriate position. Normally BANNER BAT is only used for banner gunnery practice. Before AFC 571, the BAT modes are automatic heads-up modes and as such do not require use of the azimuth-range indicator. After AFC 571, the BAT modes require cross-checking of the azimuth-range indicator.

### BAT Operation

Before AFC 571, to enter the BAT mode place the MODE switch to BAT and the FUNCTION switch to PULSE.

(C-Gp 3) Before AFC 571, when BAT is selected the radar set automatically enters an acquisition condition with the radar beam coincident with the boresight line. The radar control grip is disabled except that the action button will break a lock-on. Control over the sweeping range strobe is accomplished by using the BAT RANGING control on the port side of the aircraft above the throttle. The BAT RANGING control will position the sweeping range strobe within the limits of 600 yards and 5 miles (30,000 feet). Position of the sweeping strobe may be noted on the lower needle of the BAT indicator. To acquire a lock-on, it is necessary to visually bring the target within the 50-mil ring of the gunsight and manipulate the BAT RANGING control (this is done by estimation of target range and is quite easy as the ranging control can be positioned from MAX to MIN with one wrist-twist) or by presetting the BAT RANGING control and flying into the preset range. Whenever the target is within the 50-mil ring visually and the sweeping range strobe is caused to sweep through the target, a normal radar track mode is entered with full range and angle tracking. The auxiliary TRACK lamp lights at lock-on and the in-envelope lamp illuminates when in-range conditions have been satisfied.

(C-Gp 4) After AFC 571, to enter the BAT/ALE mode place the MODE switch to either BAT or IR and the FUNCTION switch to PULSE. This provides a BAT enable order to the radar and causes the FTC circuits to be activated and the radar antenna to spin, as well as disengaging the autopilot and changing the function of the autopilot/BAT/nosewheel steering button to a BAT command button. The radar set will be in normal search if BAT is selected, and the transmitter dormant if IR is selected. To acquire a lock-on it is necessary to visually



bring the target within the 50-mil ring of the gunsight and depress the BAT command button.

**Note**

(C-Gp 4) The BAT command button may be depressed prior to placing the target in the 50-mil ring of the gunsight. This action can save valuable time by allowing the ALE circuit to blank out the altitude line, and have the radar range gate already sweeping when the target is boresighted. Care must be exercised using this technique to prevent false target lock-on. A cross-check of the range meter and azimuth-range indicator will be necessary to verify target lock-on.

**Banner BAT Operation**

Whenever the MODE switch is placed in BAT with the BANNER BAT position selected in the generator compartment, and the FUNCTION switch is in OPR the radar set enters the Banner BAT mode. Banner BAT is also an acquisition mode. The radar beam is centered in azimuth but, unlike BAT, is depressed about 4 degrees in elevation. Acquiring a lock-on is identical to BAT except the visual placement of the target banner must be displaced about 4 degrees down the fixed reticle of the gunsight (about -70 mils is the center of the radar lobe). The lock-on in Banner BAT is in range only. No angle tracking takes place and the radar beam is physically inhibited from moving. This technique prevents tow aircraft lock-on retention as the gunnery run progresses. Since fixed guns must be fired relatively close to a boresight line of sight to the target, there is no need for angle tracking as the Banner BAT antenna lobe includes all the possible amounts of lead that might be used in gunnery. The Banner BAT display is the same as a boresight acquisition display except the TRACK lamps are illuminated. There are no other symbols in the Banner BAT track display and this fact makes a good verification as to which position the generator compartment switch is in. The radar control grip is again inoperative except that lock-on can be broken by pressing the action button.

**Operation With A Guns Order**

When an aircraft guns order is originated (one gun selector switch in the full forward position), the radar set operates in search and acquisition modes as if there were no guns order present. Set operation in search and acquisition is exactly identical whether guns or missiles are selected for firing. In the track modes with a gun order, the calibrated vertical and  $R_{max}$  are not displayed. The heads-up in-envelope lamp continues to operate, illuminating at  $R_{max}$  and going out at  $R_{min}$ . There is no breakaway X with a guns order. Even though simultaneous hot guns and missiles are a capability of the F-8, there can be no missile tones for valid firing when operating with a guns order. To reestablish missile tones, the gun selector switches would have to be positioned aft to the center-on position, thus taking away the guns order and allowing missile tones in lieu of gun tones and the reappearance of missile symbols upon the display. If a gun order is present while tracking a jamming signal, the narrow B-scan follows the azimuth of the jamming source as in the normal radar track mode instead of displacing to the left edge of the radar indicator.

**Deviated Pursuit Computer CP-742A/APQ**

(C-Gp 4) The computer provides the pilot with two conditions of fixed lead when used with the AN/APQ-124 radar set. A 20° lead angle provides an enlarged aerodynamic missile launch envelope. A 9° lead angle is used for attack with an AIM-9C on a launcher station shadowed by the aircraft's nose. The computed lead is displayed on the radarscope by offset of the circle and dot steering information. The pilot places the aircraft in a lead pursuit attack by flying the aircraft to center the steering circle and dot. See figure 8-17.

The fixed lead approach can be initiated by either of two methods, automatic or pilot command. Both methods require that the missile tuning switch be placed in the LEAD (centered) position.



### Search Operation

The procedure for checking search operation of the radar set is as follows:

1. Operate the radar set in the radar search mode, normal range.
2. With the aircraft in level flight, note the sweep area of the B-scan. Operate the range and azimuth controls to move the acquisition bar to each of the four corners of the B-scan. This step checks the range of the range and azimuth controls.
3. Operate the tilt thumbwheel to check that the position of the tilt mark is adjustable. Observe that the tilt mark nods up or down as the range sweep reverses direction.
4. Press and hold the test switch of the radar control panel. The test targets should appear on the vertical sweep. Turn the gain control back and forth and check that the number of visible test targets and the background noise are controlled accordingly. Release the test switch.

#### Note

The normal setting for the gain control is approximately  $\frac{3}{4}$  of full CW rotation.

Set the miles switch to the extended range. The extended range lamp should light. The acquisition bar should be positionable to 25 miles range by operation of the range control. Set the miles switch to the map range. The extended range lamp should go out.

Turn the mode switch to its BAT position. Before AFC 571, the narrow B-scan should be positioned at the center of the display regardless of the position of the azimuth control. The tilt mark should not nod and should be centered on the display. Range strobe should be sweeping and can be positioned by the BAT RANGING control. After AFC 571, the radar should remain in the normal search pattern. Upon actuation of the BAT command button on the flight control stick, the ALE sequence should occur, resulting in altitude line lock-on. Then the scale will switch to 5 miles, the scan will collapse to a narrow B, and the tilt mark should not nod and should be centered on the display. Turn the mode switch to the IR position and verify similar operation after the BAT command button is depressed.

### Sector Scan Test

The procedure for checking the scan coverage of the radar set is given in the following:

1. Operate the radar set in the radar search mode.
2. Hold the hand control to the left and press the sector selector button. The B-scan coverage should be on the left side of the display and should overlap the center by about 8 degrees (refer to figure 8-5).

Press the sector selector button. The B-scan coverage should return to normal.

3. Repeat step 2, except hold the hand control to the right. The B-scan coverage should be on the right side of the display and should overlap the center about 8 degrees.
4. Repeat step 2, except hold the hand control in the center position. The B-scan coverage should be about 23 degrees on each side of the display center.

### Test Target Lock-On

The procedure for checking the lock-on capability of the radar set using a test target is as follows:

1. Operate the radar set in the radar search mode, normal range.
2. With the aircraft in level flight, press and hold the test switch on the radar control panel. The test targets should appear on the display. The appearance of the test targets on the IP-869A/APQ-124 is shown in figure 8-26.

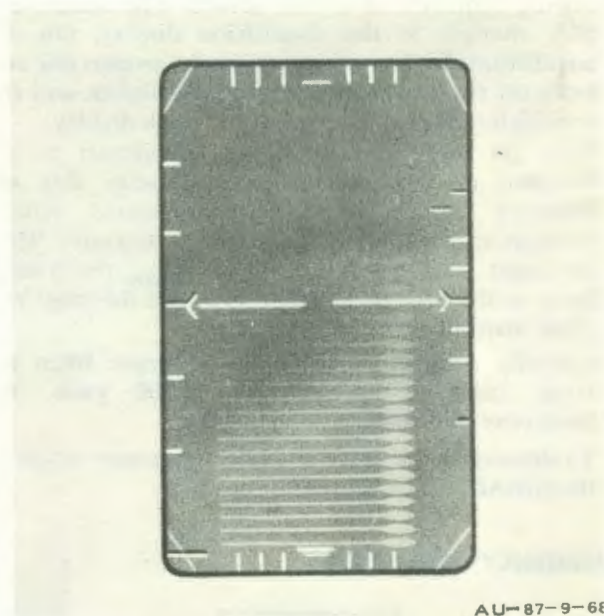


Figure 8-26. (C/U) Test Targets

3. Position the tilt thumbwheel to set the tilt mark to zero elevation. Position the azimuth control to position the acquisition bar to zero azimuth. Acquire and lock on a test target at about 10,000 yards range. The track lamp should light at range lock-on, and the display should change from search to acquisition to track. The steering circle, aiming dot, missile  $R_{max}$  mark, A-H bar, and calibrated vertical should appear on the display. The aiming dot can be expected to wander about the display, since the radar set is not locked on in angle. If



the wander is excessive, that is, if the steering circle drifts off the display, the capability of locking on an airborne target is questionable and should be verified by the airborne target lock-on procedure.

4. Make climbing turns to the left and right. The A-H bar should rotate inversely about the steering circle center. Return to level flight.
5. Release the test switch of the AN/APQ-124A. After approximately 6 seconds, the track lamp should go out and the search display should appear.

#### Airborne Target Lock-On

(C-Gp 4) The procedure for checking the AN/APQ-124A using an airborne target is as follows:

1. Operate the radar set in the NORM radar search mode. When a target blip appears on the display, position the acquisition bar approximately 1/16 inch or less below the target. Adjust the tilt control to obtain equal brightness of the target blip on the left-to-right and right-to-left sweeps of the B-scan.
2. Press the action button and observe that the following sequence of events occurs: The search display changes to the acquisition display. On the acquisition display, the range strobe sweeps out and locks on the target. The track lamp lights, and the acquisition display changes to the track display.
3. Close on the target by flying the aircraft in the direction of the steering circle. Observe that the following events occur: The calibrated vertical increases in length as the target range decreases. When the target range is less than missile  $R_{max}$ , the in-range lamp on the BAT range meter lights and the range rate circle snaps to a smaller size.
4. Carefully continue to close on the target. When the target range is approximately 2,000 yards, the breakaway presentation should appear.
5. To deenergize the radar set, turn the power switch of the AN/APQ-124A to its OFF position.

#### EMERGENCY OPERATION

##### CAUTION

The emergency (EMER) position on the FUNCTION switch on the control panel should not be used except under combat or last resort conditions. Placement of the switch to the EMER position could cause damage to the radar.

The following are emergency procedures for operating Radar Set AN/APQ-124A in the event of failure of one or more of the normal functions. There are no equipment repairs that can be performed during an emergency.

#### Loss of Indicator Displays

If all indicator displays are lost, the malfunction is probably an overload in the power supplies. The overload may clear automatically in a few seconds, in which case, the displays will return. If the displays do not return in 10 seconds or less, perform this step: Turn the power switch to its STBY position. Then return it to its former operating position. If this step does not restore normal operation, the overload is permanent and cannot be rectified in flight. Attempt to reset the circuit breaker behind the left side of the ejection seat to restore power to the indicator. Do not reset more than three times.

##### CAUTION

A repetition of the overload condition indicates a serious malfunction in the AN/APQ-124A power system. Exercise caution to avoid damage to the equipment.

#### Loss of Search Display

If the search display is lost but the acquisition display is normal, limited operation can be obtained by performing the search function in an acquisition mode; that is, by use of the azimuth control and the tilt thumbwheel to direct the antenna to the angles at which searching is desired. Detected targets will appear on the narrow B-scan. It is likely that normal track operation will be obtained.

#### Failure of Azimuth Control

If the azimuth control fails to control the azimuth position of the acquisition bar (NORM radar and HOJ search modes), operation in the BAT modes may be entirely normal.

#### Failure of Range Control

If the range control fails to control the range position of the acquisition bar (NORM search and acquisition modes), it will be necessary to fly the aircraft so as to bring the target blip to the stationary position of the acquisition bar. If the target is acquired, it is likely that track operation will be normal. Before AFC 571, it may be possible to position the range strobe by switching to BAT mode and using BAT RANGING. After AFC 571, the BAT/ALE mode may or may not be effected.

#### Loss of Track Display

If the track display is lost, it will be necessary to operate in a search mode and rely on visual sighting of the target.



## SEAM SYSTEM — AN/ASA-63A

### DESCRIPTION

(C-Gp 3) The Sidewinder Expanded Acquisition Mode (SEAM) provides two additional modes of operation (SLAVE and SCAN) for the Sidewinder AIM-9G missile which considerably enhance its employment in a maneuvering environment. Both modes of operation allow the missile to be fired with lead on the target. Before SEAM, only the AIM-9C (radar) missile could be launched with lead as computed by the CP-742/APQ deviated pursuit computer. In addition to permitting the AIM-9G to be launched with lead, SEAM also improves the missile's field of view from 2.5 degrees to 7.5 degrees in both SCAN and SLAVE before AFC 571; after AFC 571, the field of view is increased from 2.5 degrees to 4.6 degrees in SCAN and 7.5 degrees in SLAVE. This is accomplished by scanning of the usually boresighted field of view. Before AFC 571, this scan pattern was a back-to-back double D for both the SCAN and SLAVE positions. After AFC 571, the scan pattern is a 4.6-degree circular pattern in the SCAN position and the 7.5-degree double D in the SLAVE position. The patterns are displayed in figure 8-27. The displays of the radar scope during SEAM operation are illustrated in figure 8-27A. Due to these electrically induced scan patterns, the audio tones transmitted to the pilot are quite unique and require a thorough knowledge of them to be able to interpret them properly.

(C-Gp 3) The SEAM system consists of a missile acquisition programmer, a mode select switch, an advisory light, and a lock-on button. The missile acquisition programmer is located in the speed brake well and the mode select switch is located to the right of the instrument panel on the right longeron. The mode select switch has three positions, SCAN, OFF, and SLAVE. Before AFC 571, the advisory light is located on the armament panel and, after AFC 535, an additional advisory light is located on the Sidewinder ranging indicator (ID-1485/APQ). After AFC 571, the advisory light is located on top of the radar scope. The lock-on button is located on the top of the radar control stick

and, after AFC 553, an additional lock-on button is located on the inner aft side of the throttle. Controls are illustrated and described in figure 8-28.

### WARNING

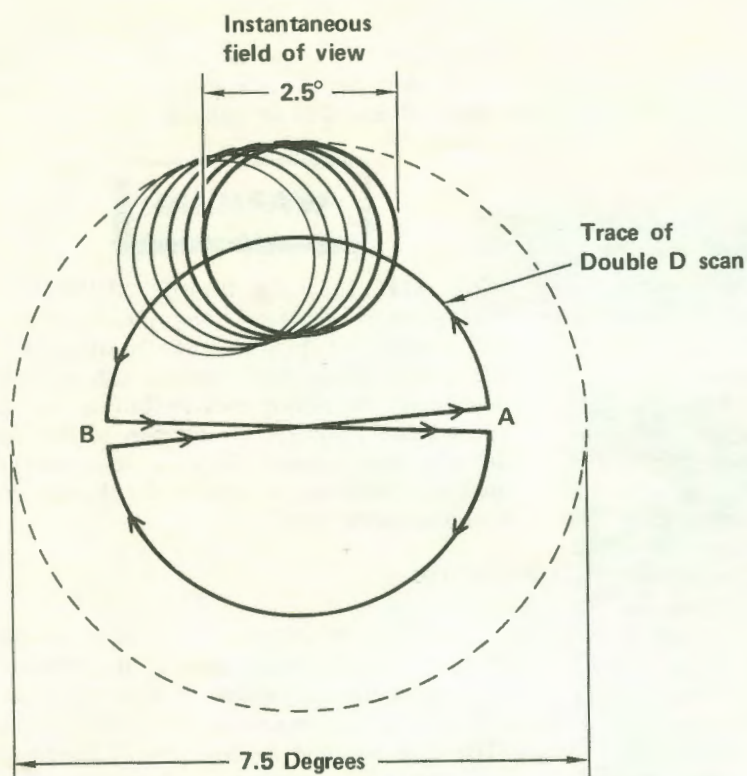
After AFC 553, the throttle SEAM lock-on button can be depressed using the thumb or the heel of the hand. In a maneuvering situation with the cruise droop down and a high g loading, depressing the SEAM lock-on button too hard could cause inadvertent retraction of the cruise droop. Pilots should adapt a technique that applies a minimum of force to the throttle cruise droop actuating grip.

### OPERATION

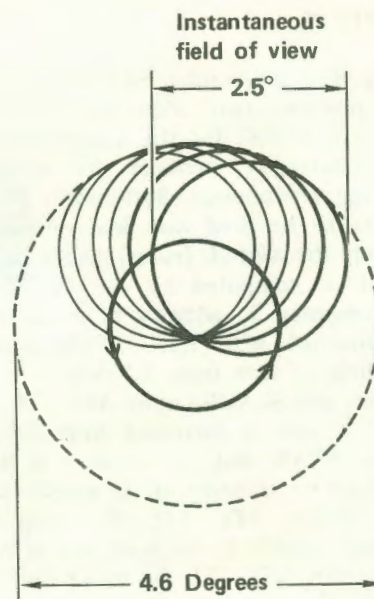
(C-Gp 3) In the SCAN position or mode of operation, before AFC 571, the seeker head of the AIM-9G missile begins its back-to-back double D scanning pattern and, after AFC 571, its circular pattern about its boresight axis. The time required to cover the 7.5-degree field of view in 2.5-degree increments is about 4 seconds and 2 seconds to cover the 4.6-degree field of view. Therefore, peculiarities arise in the audio received by the pilot when the missile sees a target. There is no steady tone as with a standard AIM-9D, but more of a chopped tone every time the seeker head glimpses the point of IR energy (target) as it travels its scan pattern. When the antenna is scanning in the double D pattern a tone is heard each 4 seconds and each 2 seconds in the circular pattern. However, before AFC 571, a tone could be heard in the SCAN mode each 2 seconds if, in fact, the point source of IR energy were located along the horizontal axis of the scan pattern as from A to B, depicted in figure 8-27. In the SCAN mode before AFC 571, lock-on to the target being scanned is achieved by depressing the SEAM lock-on button. It could take as long as 4 seconds for the seeker head to actually lock on to the target because it must



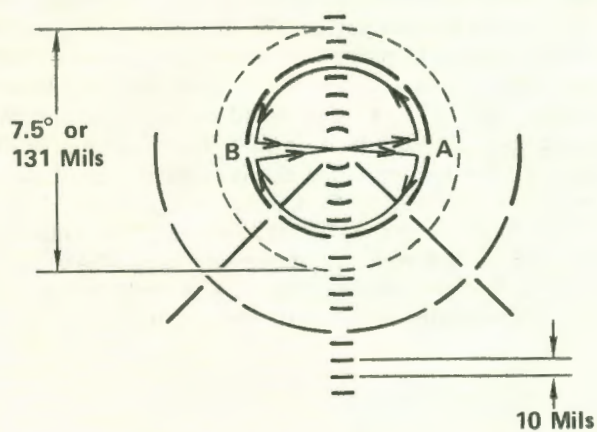
# SEAM SCAN PATTERN



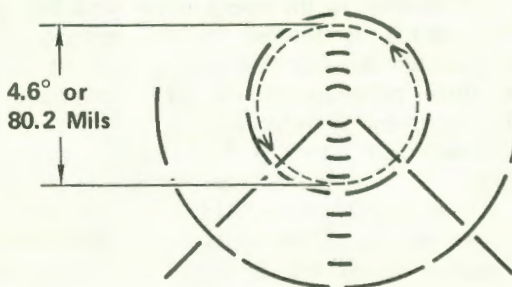
Before AFC 571, scans entire 7.5° field of view in approximately 4 seconds in both SCAN and SLAVE positions. After AFC 571, scan only in SLAVE position.



After AFC 571, scans 4.6° field of view in SCAN position in 2 seconds.



Relationship of 7.5° double 'D' scan pattern to gunsight full-fixed reticle.



Relationship of 4.6° circular scan pattern to gunsight full-fixed reticle.

## NOTE

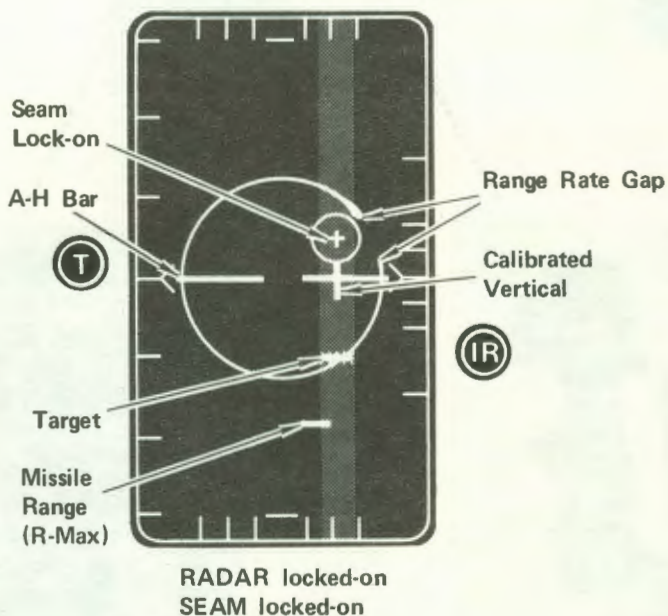
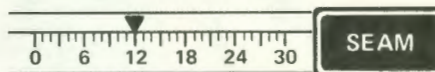
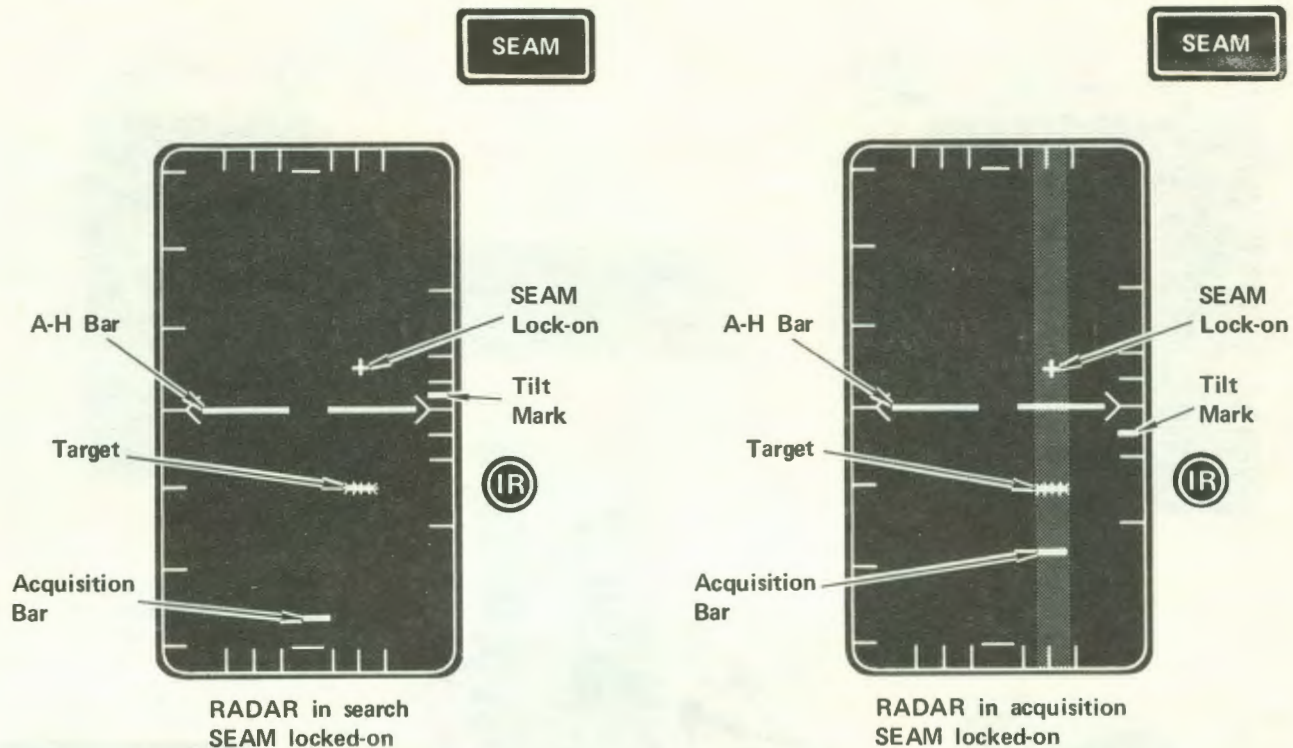
The trace line between A and B is common, but has been separated to amplify the double D scan pattern.

AU-88-02-71

Figure 8-27. (C)(U)



# SEAM DISPLAYS



**NOTE**

These displays reflect incorporation of AFC 571.

AU-89-02-71

Figure 8-27A. (C)(U)

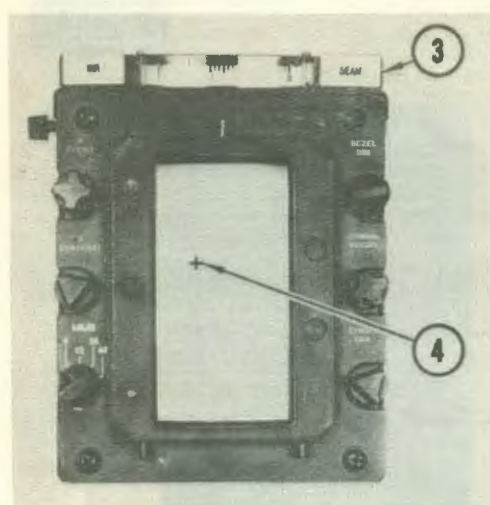
Changed 15 March 1971

CONFIDENTIAL

8-32A



# SEAM SYSTEM CONTROLS



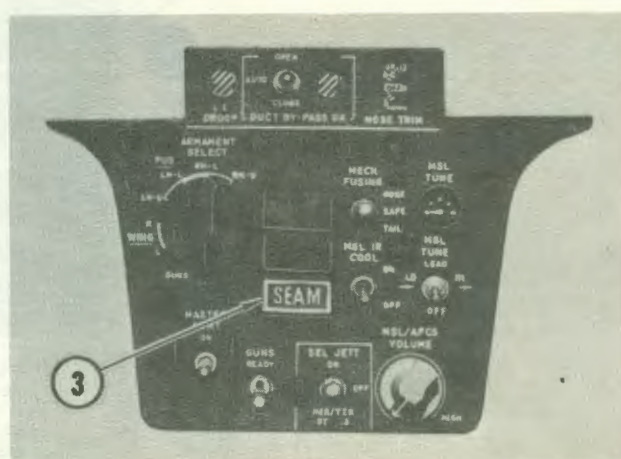
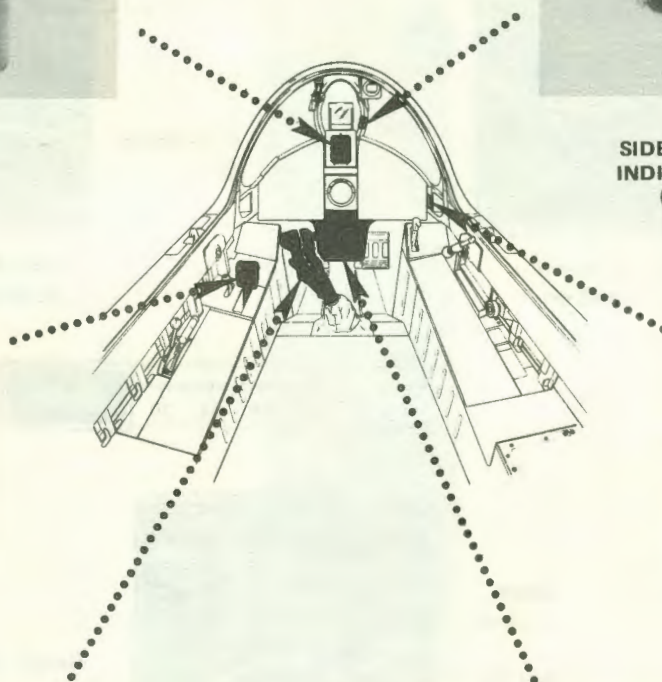
After AFC 571



SIDEWINDER RANGING  
INDICATOR ID-1485/APQ  
(Before AFC 571)



After AFC 553



AU-54(1)-02-71

Figure 8-28. (C)(U) (Sheet 1)



# SEAM SYSTEM CONTROLS

Nomenclature	Function
1. SEAM lock-on button	DEPRESSED — before AFC 571, locks/unlocks AIM-9G seeker head when operating in SCAN mode only. Inoperative when in SLAVE mode. After AFC 571, locks/unlocks AIM-9G seeker head in both SCAN and SLAVE modes.
2. SEAM select switch	SCAN — before AFC 571, enables AIM-9G seeker head to increase its field of view from 2.5 to 7.5 degrees about the boresight line. After AFC 571 enables AIM-9G seeker head to increase its field of view from 2.5 to 4.6 degrees about the boresight line. OFF — deenergizes SEAM system. SLAVE — slaves AIM-9G seeker head to radar antenna when radar is in TRACK mode. Enables AIM-9G to increase its field of view from 2.5 to 7.5 degrees.
3. SEAM advisory light	LIGHTED (SEAM) — indicates AIM-9G seeker has locked on target, when either mode of SEAM operation is selected.
4. SEAM missile head position symbol (after AFC 571)	A plus (+) — presented on the azimuth-range indicator any time SEAM is selected. Displays the missile seeker head position in azimuth and elevation with a 1:1 scaling ratio.

AU-54 (2) - 02-71

Figure 8-28. (C) (Sheet 2)

traverse around the pattern before it sees the point source of IR energy again to lock on. Depressing the SEAM lock-on button activates the lock-on circuitry for a period of 4 seconds. If lock-on is not achieved within this time period, the SEAM lock-on button must be depressed again.

## CAUTION

It should be determined as accurately as possible by the pilot that the target the missile is locked on is, in fact, the target desired. The missile seeker head locks on to any source of IR energy that has a signal strength ratio of greater than 3:1 over the ambient background noise level.

(C-Gp 3) After AFC 571, lock-on is not automatic in the SLAVE mode and, like SCAN mode, the lock-on enable switch must be held until lock-on occurs. The best technique for achieving a SEAM lock-on is to anticipate the chopped audio tone heard every time the missile seeker head passes through the IR source and to depress the SEAM lock-on button just prior to the seeker looking at the target. Depressing the SEAM lock-on button does not interrupt the SEAM scan pattern; therefore it is possible to depress the button and wait for a lock-on.

## CAUTION

It should be determined as accurately as possible by the pilot that the target the missile is locked on is, in fact, the target desired. The missile seeker head locks on to any source of IR energy that has a signal strength ratio of greater than 1.5:1 over the ambient background noise level. A cross-check of the SEAM head position symbol on the azimuth-range indicator can assist the pilot in determining the target being tracked by the missile. The scaling of the missile head position symbol is 1:1 in both azimuth and elevation.

(C-Gp 3) Lock-on tone as received by the pilot is again quite peculiar to SEAM. Logically speaking, if the AIM-9G seeker head were locked on to a target and physically boresighted on it, it would center itself right in the middle of its 2.5-degree field of view and therefore right in the middle of the AIM-9G's null, giving no tone at all. This has been compensated for, however, by an electrical circuit which drives the seeker head off boresight just enough to put it out of the null once each second. The so-called "chirping" sound of the SEAM lock-on is an indication to the pilot that his missile is locked on to a point source target. A missile lock-on lacking a distinct "chirping" should indicate to the pilot that his missile has locked on a broad IR source such as a cloud. The pilot is now free to maneuver his aircraft to the gimbal limits of the uncaged seeker head (40 degrees) and still retain lock-on. The implications that the missile may be fired with lead are obvious. An operating radar is not a requirement for SEAM operations in the SCAN



mode. The SEAM advisory lights perform an advisory service only, that one of the two modes has been selected and that the missile has locked-on a target. Depressing the SEAM lock-on button again will break the lock-on.

(C-Gp 3) In the SLAVE position or mode of operation, the AIM-9G seeker head is slaved to the radar antenna when the radar is in the track mode. This capability allows off-boresight lock-on of the AIM-9G out to approximately 25 degrees and off-boresight tracking out to the gimbal limits of the seeker head. After AFC 571, the 7.5-degree double D scan pattern in the SLAVE mode was retained to account for slaving inaccuracies between the radar antenna and missile seeker head. The missile head position display on the azimuth-range indicator is presented when SEAM missile locks-on and provides a good cross-check reference for target identification/verification. SEAM lock-on from the SLAVE mode is the same as for the SCAN mode and controlled by the pilot through the SEAM lock-on

button. Before AFC 571 in the SLAVE mode, the pilot's lock-on button is inoperative.

(C-Gp 3) The SEAM missile system becomes extremely compatible with the BAT mode of radar operation because it automatically locks on as soon as the seeker head sees the target before AFC 571. The SEAM missile system gives the F-8 a greater degree of flexibility. The capability to fire a missile with lead or lag expands the available missile envelope. The pilot must become very familiar with the system and the Sidewinder missile to be effective in a combat environment. The same restrictions as to "on-side/off-side" missiles are mandatory in the use of SEAM missile tracking as are published for the CP-742/APQ deviated pursuit computer. The missile will transfer its lock to any available IR source as its original target source is removed. With the SEAM switch in the OFF position, the AIM-9G functions the same as a standard AIM-9D missile.

## ELECTRONIC COUNTERMEASURES SYSTEMS

The primary equipment of the Electronic Countermeasures Systems consists of the AN/APR-27 Launch/Alert System, the AN/ALQ-51A ECM System, and the AN/ALE-29A, Chaff Dispenser.

AFC 512, Part I, installs the AN/ALQ-100 ECM system. Aircraft with this AFC incorporated can also use the AN/ALQ-51 Mod II ECM system on an interchange basis. The function of the AN/APR-27 is identical with either set.

AFC 490, Part III, installs the AN/APR-30(V) ECM warning and vector system.

### AN/APR-27 LAUNCH/ALERT SYSTEM

#### Note

Refer to Unclassified NATOPS Flight Manual and the (Secret) Supplement of the F-8 Tactical Manual (U) NAVAIR 01-45HHA-1T (A) for further information.

F-8 Airframe Change 490, Parts I and II, expands the operational capability of the F-8J aircraft by adding electronic warning and countermeasures equipment.

#### Description

(C-Gp 3) The launch/alert system provides warning of SAM threats and consists primarily of an antenna, a receiver, controls and warning lights. Dual tones are fed into the pilot's headset for warning. Controls are located on an ECM control panel which also provides control of the AN/ALQ-51A ECM set. The control panel is mounted in the right-hand console. One SAM

warning light is mounted on the right-hand instrument cowl and another is on the ECM control panel; these lights operate in parallel. System electrical power is supplied from the secondary dc bus.

#### ECM Systems

(C-Gp 3) The system antenna is a blade-type antenna attached to the lower fuselage and serves a dual purpose. During system operation the antenna is connected to the APR-27, and when the APR-27 is turned off, the antenna becomes part of the TACAN system. During APR-27 operation the TACAN receives and transmits through an antenna located on top of the fuselage only. The system receiver (R-1412/APR-27) is installed in the left-hand gun bay (for further information on the receiver, refer to the (Confidential) Handbook of Operation and Service Instructions for Radar Receiver R-1412/APR-27, NAVAIR 16-30APR 27-1 (U) and to its supplement, (Secret) NAVAIR 16-30APR27-1A (U).

System controls are illustrated and their functions described in figure 8-35.

#### Operation

(C-Gp 3) The launch/alert system is in operation when the launch/alert switch is ON. When appropriate signals are received, the two SAM lights come on, a warning tone is heard in the headset, and a ground circuit is completed to the AN/ALQ-51A. If the ALQ-51A is operating in the receive mode, the ALQ-51A is automatically switched to the repeat mode. Transmission of signals cannot occur, however, unless the

Figures 8-29 through 8-34 deleted.



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