FLIGHT MANUAL OF WEAPON SYSTEMS F/RF/TF/F-104G/S

USAF SERIES F/RF/TF-104G (MAP) AIRCRAFT
F/RF/TF-104G (CONSORTIUM) SERIES AIRCRAFT

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This publication replaces Operational Supplements -25 thru -44.

Refer to T.O. 0-1-1-4 (or equivalent national index, Consortium) for current status of Flight Manuals, Safety/Operational Supplements, and Flight Crew Checklists.

Commanders are responsible for bringing this manual to the attention of all personnel cleared for operation of the aircraft.

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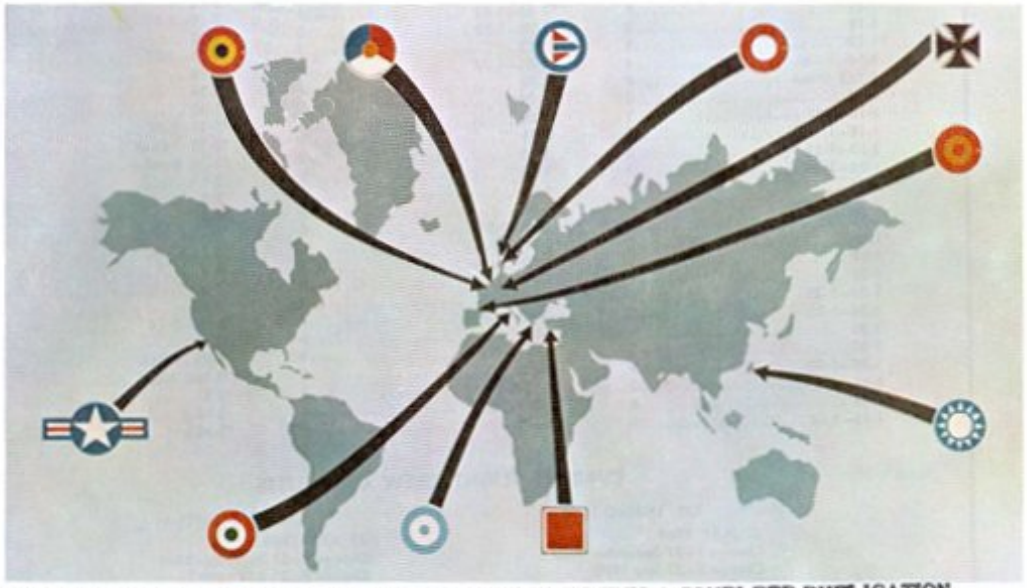

BASIC AND ALL CHANGES HAVE BEEN MERGED TO MAKE THIS A COMPLETE PUBLICATION.

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LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

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31 July 1969

*** WARNING***

This document is not a real flight manual , it cannot be used in real situations

Version 1.0 (May 16th 2010)

List of Abbreviations

A/B	afterburner
ac	alternating current
ADC	air data computer
AGL	above ground level
amp	ampere
amp/hr	ampere-hour
APC	auto-pitch control
avg	average
BLC	boundary layer control
°C	Centigrade degrees
CAS	calibrated airspeed (indicated airspeed corrected for position error)
CDP	compressor discharge pressure
cg	center of gravity
CIT	compressor inlet temperature
cm	centimeter
cps	cycles per second
dc	direct current
EAS	equivalent airspeed (calibrated airspeed corrected for compressibility)
EGT	exhaust gas temperature
°F	Fahrenheit degrees
FFAR	folded fin aerial rocket
FOD	foreign object damage
fpm	feet per minute
ft	foot or feet
G	load factor
gal	gallon or gallons
GCA	ground controlled approach
GCI	ground controlled intercept
gro	gross
GS	ground speed
HW	head wind
IAS	indicated airspeed (uncorrected for instrument error)
IF	intermediate frequency
IFF	identification friend or foe
IGV	inlet guide vane
ILS	instrument landing system
in.	inch
I/P	identification point
IR	infrared
KCAS	knots calibrated airspeed
KEAS	knots equivalent airspeed
KIAS	knots indicated airspeed
KVA	kilovolt-ampere
lb	pound or pounds
lb/hr	pounds per hour
lb-nmi/lb	range factor expressed as pound-nautical miles per pound of fuel
M	one thousand
m	meter
Mach No.	Mach number
mc	megacycle
MEA	minimum enroute altitude
min	minute
mm	millimeter
mph	miles per hour
MSL	mean sea level
nmi	nautical miles
nmi/lb	nautical miles per pound of fuel
PHI	position and homing indicator
PPI	plan position indicator
psi	pounds per square inch
RAT	ram air turbine
rds	rounds (of ammunition)
RF	radio frequency
rpm	revolutions per minute
SIF	selective identification feature
SL	sea level
TACAN	tactical air navigation equipment
TAS	true airspeed
TW	tail wind
UAR	unguided aerial rocket
UHF	ultra high frequency
US	United States
wt	weight

CODING

This Flight Manual covers F-104G(MAP), RF-104G(MAP), TF-104G(MAP), F-104G (Consortium), RF-104G (Consortium), and TF-104G (Consortium) aircraft. A coding system to identify that part of the manual pertaining to each of the individual aircraft is presented below. Text and illustrations applicable to all aircraft will not be coded. Text and illustrations applicable to an individual aircraft only will be coded as follows:

Code	*Aircraft*
F	All F-104G Aircraft
RF	All RF-104G Aircraft
TF	All TF-104G Aircraft
F MAP	F-104G MAP only
RF MAP	RF-104G MAP only
TF MAP	TF-104G MAP only
F Consortium	F 104 G/S Consortium only
RF Consortium	RF-104G Consortium only
TF Consortium	TF-104G Consortium only
MAP	All MAP Aircraft
Consortium	All Consortium Aircraft
C-2	C-2 Ejection Seat
S/R-2	S/R-2 Ejection Seat
MB	*Martin Baker Ejection Seat (GQ-7 and IQ-7)

INACCURATE NOPE Paragraph shows equipment or procedures not operative, inaccurately or not implemented into the sim model, such paragraphs are grayed

In addition to the above codes, there are instances where these codes are combined such as F/RF .

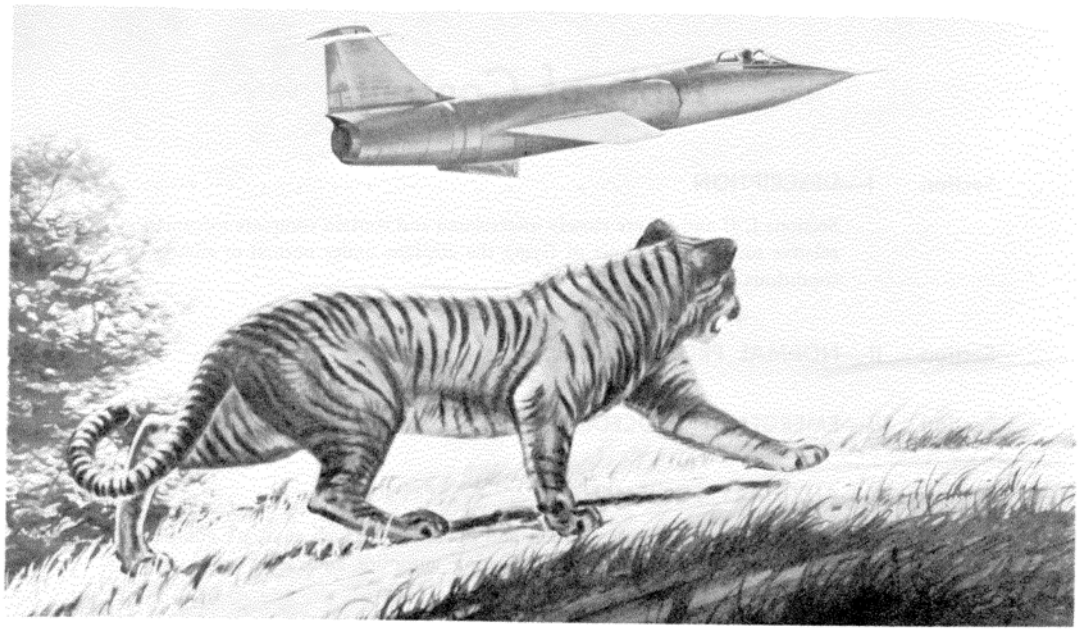
Note

- Illustrations of the cockpit instrument panels and consoles may not necessarily depict your airplane configuration. The text adequately describes the function of all the switches, controls, and indicators for the various airplanes. However, their locations may be different from that shown on the illustrations. In most instances, figure references in the text refer to F Consortium illustrations; however, MAP and TF illustrations will be found on adjacent pages.

- Fighter-bomber aircraft, incorporating L.O. 1-11-7-37 and L.O. 1-11-7-39, are identified as aircraft modified by ECP 2015. Interceptor aircraft, incorporating L.O. 1-11-7-38, are identified as aircraft modified by ECP 2012.

*Martin Baker seat data was developed by the Martin Baker Company and has not been tested or verified by USAF or Lockheed.

- LOCKEED F104-G software model refers to MAP while AERITALIA-LOCKEED F104-S refers to FConsortum



SCOPE. This manual contains the necessary information for safe and efficient operation of the F/RF/TF-104G airplane. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are not discussed.

SOUND JUDGMENT. This manual provides the best possible operating instructions under most circumstances, but it is not a substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS. The flight manual takes a positive approach, and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from SMAMA before any questionable operation, not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA. Refer to T.O. 0-1-1-4 which is issued weekly and devoted solely to the listing of all current Flight Manuals, Safety Supplements, Operational Supplements and Checklists. Its frequency of issue and brevity assures an accurate, up-to-date listing of these publications. Some Consortium countries publish a national index which includes similar information.

STANDARDIZATION AND ARRANGEMENT. Standardization ensures that the scope and arrangement of all flight manuals are identical. The Manual is divided into ten nearly independent sections to simplify using it as a reference manual.

SAFETY SUPPLEMENTS. Information involving safety will be promptly forwarded to you by Safety Supplements. Supplements covering loss of life will get to you in 48 hours by TWX; those concerning serious damage to equipment, within 10 days by mail. The title page of the Flight Manual and the title block of each Safety

Supplement should be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements—current supplements must be complied with but there is no point in restricting your operation by complying with a replaced or rescinded supplement. A current list of Safety and Operational Supplements is included with issuance of each supplement.

CHECKLISTS. The Flight Manual contains normal and emergency procedures. Checklists have been issued as separate technical orders. Refer to the back of the title page for T.O. number and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety or Operational Supplement affects the normal or emergency procedures in the checklist, a change to the checklist will be issued concurrently with the supplement.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, and Checklists. The required quantities should be ordered before you need them to ensure their prompt receipt. Check with your supply personnel; it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Numerical Index and Requirement Table (T.O. 0-1-1-4). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING — Operating procedures, techniques, etc., which will result in personal injury or loss of life if not correctly followed.

CAUTION — Operating procedures, techniques etc., which if not strictly observed will result in damage to or destruction of equipment.

Note — An operating procedure, technique, etc., which it is essential to highlight.

YOUR RESPONSIBILITY — TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports ensure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through command headquarters to SMAMA (MMEAH) McClellan AFB, California 95652. Consortium Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through National Headquarters to: LWG F104G, 505 Porz-Wahn 2, Germany, Post Box 5000/514.

NOTE TO SOFTWARE MODEL USERS.
Despite efforts to make the software model as close as possible to the real has not been possible to replicate or implement all systems. For this reason, several paragraphs are marked with the labels listed below, paragraphs may ot may not be grayed, to let curious reader read how the model was in real, however grayed paragraphs cannot be applied to the software model, inaccurate but not grayed paragraph cannot be applied entirely.

INACCURATE — Inaccurately described, partially compliant, paragraph may or may not be grayed

NOPE — Feature not implemented, paragraph grayed

TABLE OF CONTENTS:

SECTION IV – WEAPON SYSTEMS

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INACCURATE

MISCELLANEOUS EQUIPMENT.

ANTI-G SUIT EQUIPMENT.

The anti-G suit equipment consists of a pressure regulating valve and valve control (3, figure 1-8) on the left console and a pressure hose leading from the valve outlet, through the quick-disconnect to the pilot's anti-G suit tube. When this tube is connected to the pressure hose, air from the engine compressor flows into the pilot's anti-G suit under pressures which vary in accordance with aircraft G forces. Suit pressurization begins at 1.5G and increases at a rate of 1.5 psi per G. A button on top of the valve control can be depressed manually to inflate the anti-G suit when desired. This feature may be used to produce a massaging effect which will help lessen fatigue during prolonged flight. It is possible for the anti-G suit to fail to deflate after completion of a positive-G maneuver. If this occurs disconnect the G-suit hose from the pressure source.

VENTILATED SUIT BLOWER.

The blower supplies cooling air to the pilot's ventilated suit. Flexible ducting carries the cool air from the blower to the suit through a quick-disconnect on the right side of the seat (left side of the seat on Consortium aircraft). The blower receives power from the No. 1 primary ac bus.

Ventilated Suit Blower Switch.

A switch (figure 4-3) located on the right console may be used to energize the ventilated suit blower. The switch positions are labeled FLYING SUIT and OFF.

REAR-VIEW MIRRORS.

Two adjustable rear-view mirrors are installed in the cockpit, one on each side of the forward edge of the canopy. Four mirrors are installed on TF aircraft.

WEAPONS SYSTEM.

The weapons system comprises the aircraft armament and fire-control equipment. An N-9 or KB-3A camera is installed to operate through the optical sight to record effects of forward-firing weapons, as well as for use in practice gunnery. The armament system is capable of operating in the following modes.

NOPE

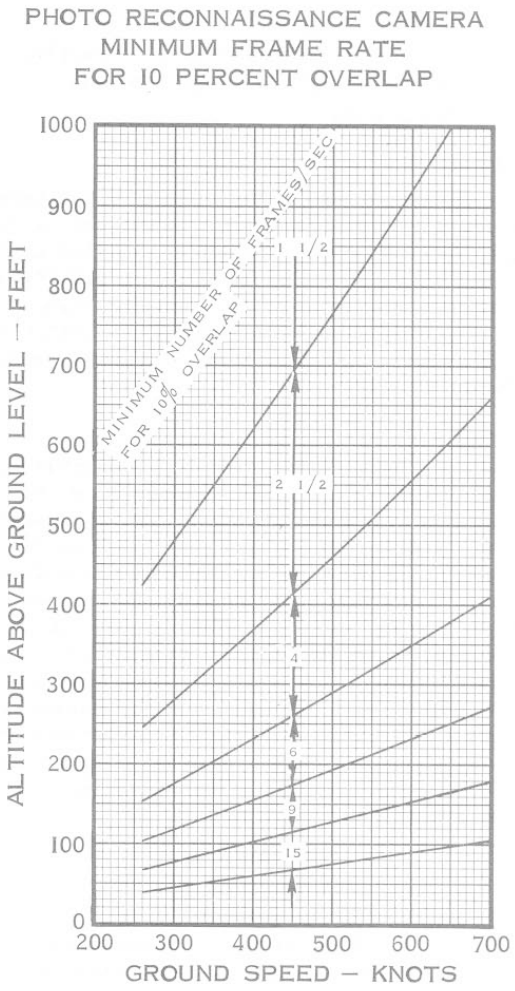


Figure 4-31

Air-To-Air.

a. Radar search, acquisition, lock-on, and automatic antenna track.

b. Blind and visual Sidewinder missile attack.

c. Blind lead-collision rocket attack.

d. Blind and visual lead pursuit gun attack.

e. GCI displays from data link (provisions only).

Ground Mapping.

a. All-weather navigation ground mapping.
b. All-weather navigation terrain contour mapping.
NOPE c. Terrain avoidance for low-level flight safety.
d. Blind bombing.

ARMAMENT.

The armament consists of forward-firing and droppable stores. The forward-firing stores include one 20-mm gun, Sidewinder missiles, 2.75-inch FFAR rockets, UAR rocket, and also provisions for AGM-12B (GAM-83A) missiles on modified aircraft. The droppable stores provisions are for conventional bombs, SUU-21 (MN-1A) practice bombs, and special weapons. A description of the armament follows:

Gun.

The M-61 20-mm Gatling machine gun, located in the lower left side of the forward fuselage, is capable of firing electrically primed cartridges at rates in excess of 4000 rounds per minute. The gun is operated by a double-wound motor, one winding being energized by the No. 1 secondary ac bus, while the other receives its power from the No. 2 ac bus. When the gun is fired, the cases and links are stored in the fuselage or the links are ejected overboard. Gun clearing is automatic when the T-12 feeder is used. The ammunition compartment capacity is 725 rounds. The operable gun provides an alternate configuration of aircraft not employing the extended range fuel tanks or the photoreconnaissance camera installation.

CAUTION

When centerline stores are carried, a maximum of 350 rounds should be loaded if the cases and links are to be retained in the case stowage compartment. If the cases and links are to be ejected overboard, 725 rounds can be loaded. However, the centerline stores must be expended prior to gun firing or damage to the centerline stores will occur from the ejected cases and links.

Sidewinder Missiles.

Necessary controls, wiring, and launchers are provided for firing Sidewinder missiles from the wing tip, pylon, and fuselage centerline station. The missile is a passive, infrared-homing, air-to-air missile.

Rockets.

A UAR high-yield rocket may be carried on an externally mounted launching rail, located on the lower fuselage surface between the nose and main gear wheel wells. A pod encases the launching rail and the two trapeze arms. Two sway braces are provided. At present the aircraft contains only electrical wiring provisions for the UAR rocket installation. Wiring provisions are made for carrying FFAR rockets in pods on the wing pylon attachments. Both pods can be fired or they can be fired individually, as selected by the external stores selector buttons. On modified aircraft equipped with a rocket select switch the FFAR rockets may be used for air-to-ground as well as air-to-air attack. The rocket pods may be jettisoned during flight if desired.

AGM 12B MAP .

Modified aircraft contain electrical provisions for launching the AGM-12B (GAM-83A) missile. The AGM-12B (Bullpup) missile is a guided, command controlled, air to surface missile which carries a 250-pound warhead.

ARMAMENT SYSTEM CONTROLS.

The controls for firing and releasing the weapons are located on the control-stick grip. Selection and arming of weapons are provided for on the armament control panel and the weapons selector panel. Indicator lights for radar lockon and bomb release are located above the instrument panel on the windshield frame. A SPL WPN UNLOCKED indicator light is located below the upper instrument panel on the right side. Programming and monitoring the special store and the MN-1A practice bomb dispenser is provided by the special store monitoring panel.

Aft Cockpit Armament Controls TF .

Emergency release of all external stores is provided by the emergency external-stores jettison button located on the left-forward panel. An emergency armament cutout switch on the armament panel can interrupt forward-firing or normal drop circuits.

Aft Cockpit Armament Control Panel TF .

The aft cockpit armament control panel is located on the lower left side of the instrument panel (see figure 4-33) and consists of an emergency armament cutout switch and stores-selected indicator lights.

Emergency Armament Cutout Switch TF . The emergency armament cutout switch is a two-position guarded toggle switch placarded OFF (down) and ON (up) (see 11, figure 4-33). This switch when in the OFF position, prevents all forward firing and droppable stores from being released. However, the switch does not prevent emergency jettison of all stores. The switch receives power from the primary dc bus.

Armament Control Panel.

The armament control panel (figure 4-33) is located in the cockpit on the lower instrument panel. It consists of the following controls and indicators.

Armament Mode Selector Switch. The armament mode selector switch (1, figure 4-33) is a two position toggle switch located at the center of a decaled rear-end view of the aircraft on the armament control panel. The switch provides individual selection of forward-firing weapons. The two positions are GUN, and ROCKET.

GUN position, selects the M-61 gun, and the ROCKET position selects the FFAR rockets or on F aircraft the AGM-12B. When selecting the UAR rocket with the external stores rotary selector switch, the armament mode selector switch is bypassed. The armament mode selector switch is wired in series with the master arming switch, external stores selector buttons, landing gear cutout switch, and trigger switch. All of these switches must be closed in order to complete the firing circuit for the particular forward-firing weapon selected.

External Stores Selector Buttons and Indicator Lights. Combination external stores selector buttons and indicator lights (figure 4-33) are located at the external stores attachment points of the decaled rear-end view of the aircraft on the armament control panel. There are two for the wing-tip stores, two for the pylon stores, and on F aircraft, two for the lower fuselage Sidewinder stores. These buttons provide individual selection for release of the particular forward-firing or droppable store at its location. When a button is pushed in, a holding coil is energized to hold it and a green light within the button is illuminated to indicate that the external store represented by that button is armed and ready for release. The button will pop out and the indicator light will extinguish when the weapon is released. The button may be manually pulled out to disarm its individual external store release circuit. If there is no external store on the attachment point represented by the button, the holding coil will not be energized and the button will not remain in when depressed nor will the indicator light illuminate. For forward firing, the buttons are connected in series with the master arming switch, armament mode selector switch, landing gear cutout switch, and control stick grip trigger switch. For droppable stores the buttons are connected in series with the external stores rotary selector switch on the weapons selector panel, bomb release switch, and the bomb button.

INACCURATE

Note

When FFAR rockets are fired, depressing a button completes the firing circuit to the rocket pod selected. The light does not extinguish after all rockets in the pod are fired; the light does extinguish, however, when the pod is jettisoned.

Forward Firing Master Arming Switch. The forward firing master arming switch is a three-position guarded toggle switch (figure 4-33). The three positions are ARMT & CAM, OFF, and CAM. The switch in the ARMT & CAM position energizes the missile (including the UAR), gun, rocket, and camera circuits. The switch in the OFF position deenergizes all circuits. The switch in the CAM position energizes the camera circuit only. In the ARMT & CAM position, the switch is connected in series with the armament mode selector switch, external stores selector buttons, landing gear cutout switch, and the trigger switch.

NOPE

Missile Signal Volume Control. The rheostat-type missile signal volume control (figure 4-33) provides audio volume selection of the missile signal tone. Rotating the control clockwise increases signal tone volume.

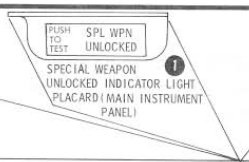
Bomb Release Switch. The bomb release switch (figure 4-33) has two positions, AUTO RELEASE and MANUAL RELEASE. When the switch is in the MANUAL RELEASE position, the bombs drop as selected when the bomb button is depressed momentarily. The dual timer bombing system is energized when the AUTO RELEASE position is selected. For release of normal weapons, the bomb release switch, in the AUTO RELEASE position, is connected in series with the external stores rotary selector switch, external stores selector buttons, and the bomb button. For release of special stores, the bomb release switch, in the AUTO RELEASE position, is connected in series with the droplock switch, external stores rotary selector switch, and the bomb button. When the switch is in the MANUAL RELEASE position it is in series with the bomb button.

Note

When the bomb release switch is in the AUTO RELEASE position, the dual timer motor will run continuously; therefore, to prevent excessive running time, keep the bomb release switch in MANUAL RELEASE position at all times except during bombing runs.

INACCURATE

ARMAMENT SELECTOR CHART



Location	ARMAMENT CONTROL PANEL											SPL WPNS PNL			
Control							ARM NOSE & TAIL / TAIL ONLY	AUTO RELEASE / MANUAL RELEASE	MISSILE / SIG VOL	ARMT & CAM / OFF / CAM	MISSILE / GUN / ROCKET	DROP LOCK / READY / SAFE	EMER JETTISON	PYLON / LOCK RELEASE	HI TOSS / LOW TOSS FUZING
Name	LH TIP SELECT BUTTON	LH PYLON SELECT BUTTON	LH FUS SELECT BUTTON	RH FUS SELECT BUTTON	RH PYLON SELECT BUTTON	RH TIP SELECT BUTTON	BOMB ARMING SWITCH	BOMB RELEASE SWITCH	MISSILE SIGNAL VOL CONT	MASTER ARMING SWITCH	ARMAMENT MODE SELECTOR SWITCH	DROP LOCK SWITCH	SPL WPN EMERGENCY JETT BUTTON	EXTERNAL STORES ROTARY SELECTOR SWITCH	FUZING SWITCH
Purpose	LH tip stores select	LH pylon stores select	LH fus missile select	RH fus missile select	RH pylon stores select	RH tip stores select	Arms selected bombs	Selects bomb release mode	Control missile sig volume	Arms forward-firing weapons and camera	Selects forward-firing weapons	Spl wpn release master arming switch	Emer jett of special stores	Selects special and external stores	Alternate spl store fuzing
FORWARD-FIRING WEAPONS															
GUN										ARMT & CAM	GUN				
SIDEWINDER MISSILES	Press to select	Press to select	Press to select	Press to select	Press to select	Press to select			Adjusted	ARMT & CAM	MISSILE				
ROCKETS		Press to select			Press to select					ARMT & CAM	ROCKET				
UAR										ARMT & CAM		READY		UAR	
AGM-12B		Press to select			Press to select					ARMT & CAM	ROCKET				
EXTERNAL STORES RELEASE															
CENTERLINE GP BOMB							NOSE & TAIL or TAIL ONLY	AUTO or MANUAL				READY		SPL STORES	
SPECIAL STORE								AUTO or MANUAL				READY		SPL STORES	HI TOSS or LOW TOSS
5 PRACTICE BOMBS								AUTO or MANUAL				READY		SPL STORES	
PYLON GP BOMBS		Press to select			Press to select		NOSE & TAIL or TAIL ONLY	AUTO or MANUAL						PYLON BOMBS	
SELECTIVE JETTISONING															
WING TIP TANKS	Press to select					Press to select								TIP STORES	
WING SIDEWINDERS	Press to select	Press to select			Press to select	Press to select								TIP STORES OR PYLON BOMBS	
WING PYLON TANKS		Press to select			Press to select									PYLON TANKS	
WING PYLON BOMBS		Press to select			Press to select		SAFE	MANUAL						PYLON BOMBS	
ROCKET PODS OR AGM-12B		Press to select			Press to select			MANUAL						PYLON BOMBS OR AGM-12B	
SPECIAL STORE OR UAR								MANUAL				READY		SPL STORES	
CENTERLINE GP BOMB							SAFE	MANUAL				READY		SPL STORES	
EMERGENCY JETTISONING 8															
SPECIAL STORES OR UAR												9 READY	PRESS		
CENTERLINE GP STORE							SAFE					READY	PRESS		
BOMB DISPENSER												READY	PRESS		
TIP & PYLON STORES															
C/L MISSILES												READY	PRESS		
PYLONS															

NOTES

1. With the drop lock switch in the READY position during release of a special store, the SPL WPN UNLOCKED indicator light placard will illuminate. After the store is released, the light will flash for 30 seconds and then remain illuminated steadily. The light operates in the same manner when using a centerline G. P. bomb.
2. When performing a UAR mission, the pilot should press the trigger when the FIRE SPL WPN indicator light placard illuminates. Trigger actuation permits launcher lowering, weapon arming, and weapon firing (under control of the F-15A armament system). A malfunction or misfire will illuminate the SPL WPN WARNING light placard. If the launcher fails to retract, the UAR launcher emergency retract switch must be placed in the RETRACT position.
3. When firing Sidewinder missiles, the trigger must be held for approximately one second for a missile to fire. The remaining missiles will be fired as the trigger is re-actuated in the sequence of LH tip, RH tip, LH fuselage and RH fuselage. On aircraft with (530 c/w) a firing circuit lock-in is incorporated which makes it unnecessary to keep the trigger switch depressed when firing wingtip missiles.

CONTROL SWITCH		OFF / ON EMERGENCY ARMAMENT CUTOUT
	EXTERNAL STORES JETTISON	EMERGENCY ARMAMENT CUTOUT
PURPOSE OF SWITCH	EMER TIP & PYLON STORES JETT	INTERRUPT FIRING AND NORMAL DROP CIRCUITRY
EMERGENCY JETTISONING	ACTUATED FOR JETTISONING	

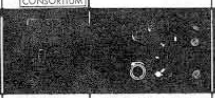
AFT COCKPIT

ARMAMENT INDICATOR				
	LH TIP STORE INDICATOR	LH PYLON STORE INDICATOR	RH PYLON STORE INDICATOR	RH TIP STORE INDICATOR
PURPOSE OF INDICATOR	INDICATES STORE SELECTED	INDICATES STORE SELECTED	INDICATES STORE SELECTED	INDICATES STORE SELECTED

HH 1609
F159-1-4-110

Figure 4-32 (Sheet 1 of 2)

INACCURATE

LEFT CONSOLE	SPECIAL WEAPONS PANEL	RIGHT CONSOLE		LEFT CONSOLE RIGHT CONSOLE [MAP] [CONSORTIUM]	RIGHT CONSOLE	RT CONSOLE [MAP] LFT CONSOLE [CONSORTIUM]	RIGHT CONSOLE	LEFT FWD PANEL	CONTROL STICK GRIP		LEFT CONSOLE
											
AGM-12B POWER SWITCH	UAR LAUNCH-ER EMER RETRACT SW	UAR ROCKET MOTOR HEATER INDICATOR	UAR ROCKET MOTOR TEMP CONTROL	DUAL TIMER	PYLON JETTISON SWITCH	ROCKET SELECT SWITCH	SEE APPROPRIATE PANEL	EXTERNAL STORES JETT BUTTON	TRIGGER SWITCH	BOMB BUTTON	AGM-12B ARMING SWITCH
Controls AGM-12B power	Controls UAR launcher emer retract	Indicates motor heat on	Controls rocket motor temp	Controls release point of GP bombs or special store during auto release	Jettisons pylons	AUTO for air-to-air MANUAL for air to ground	Special store programing	Tip pylon stores & fus missile jett	Fires forward - firing weapons	Drops external stores	Selects AGM-12B arming and guidance
F O R W A R D — F I R I N G W E A P O N S											
									Press to fire		
									③ Press to fire		
						AUTO or MANUAL			④ Press to fire		
	RETRACT for emergency	ON (cyclic)	Set for proper temp						② Press for launcher control and firing		
									Press to fire		ARMED
E X T E R N A L S T O R E S R E L E A S E											
				Set controls to conform to type of release						Press to release	
				Set controls to conform to type of release			GRD or AIR			Press to release	
				Set controls to conform to type of release			Set for practice mission			Press to release	
				Set controls to conform to type of release						Press to release	
S E L E C T I V E J E T T I S O N I N G ⑧											
										Press to jettison	
										Press to jettison	
										Press to jettison	
										Press to jettison	
										Press to jettison	
							OFF for spl store			Press to jettison	
										Press to jettison	
E M E R G E N C Y J E T T I S O N I N G											
							OFF for spl store				
								PRESS			
					ON to jettison						

④ When firing rockets, the trigger must be held until all rockets in the pod are fired.

⑤ When performing an MN-1A practice mission, the special weapon release switch in the ac load center must be placed in the MN-1A PRACTICE position prior to flight.

⑥ If a tip store is inadvertently disengaged in flight, the auto-drop system will jettison the other tip store. A similar system is provided for pylon tanks, but not for pylon bombs or LAU/3A pods.

⑦ A weapon-away switch in each Sidewinder launcher prevents the launcher from being jettisoned, except when the Sidewinder missile is installed on the launcher.

⑧ When emergency jettison of a store is required, the store should be disarmed prior to release. A store can be jettisoned armed, if necessary.

⑨ When emergency jettison of any store from the special store position is required, the drop lock switch must be placed in the READY position prior to pressing the jettison button.

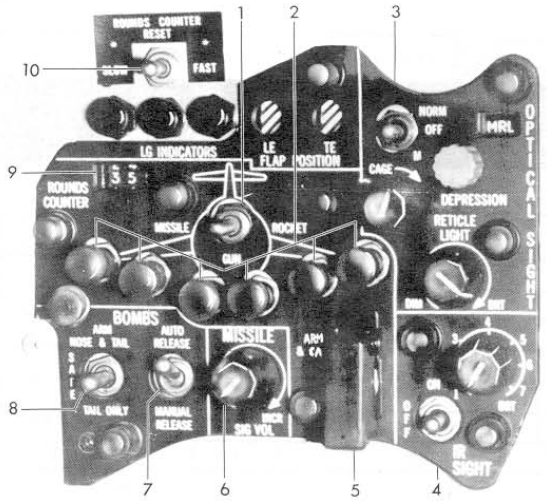
HH 1610
F159-1-4-111

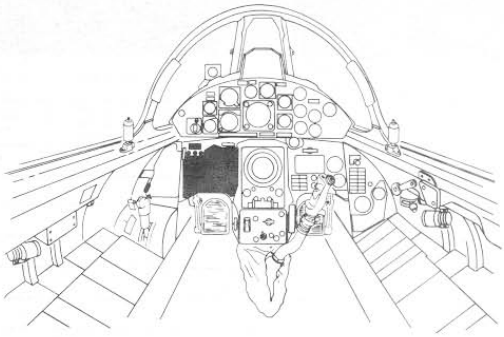
Figure 4-32 (Sheet 2 of 2)

ARMAMENT CONTROL PANELS

(TYPICAL)

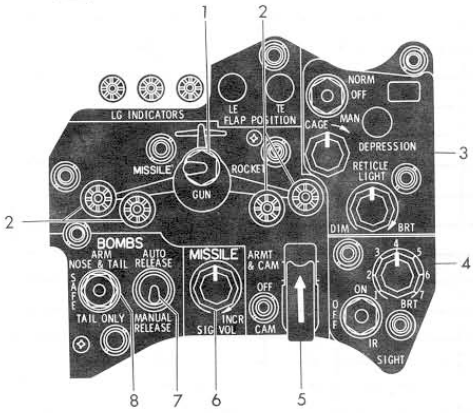
F/RF



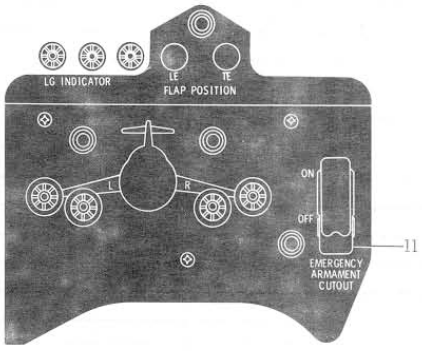


INACCURATE

TF



FORWARD COCKPIT



AFT COCKPIT

INACCURATE

1. ARMAMENT MODE SELECTOR SWITCH
2. EXTERNAL STORES SELECTOR BUTTONS AND INDICATOR LIGHTS
3. OPTICAL SIGHT PANEL
4. IR SIGHT PANEL
5. FORWARD FIRING MASTER ARMING SWITCH
6. MISSILE SIGNAL VOLUME CONTROL
7. BOMB RELEASE SWITCH
8. BOMB ARMING SWITCH
9. AMMUNITION ROUNDS COUNTER
10. AMMUNITION ROUNDS COUNTER RESET SWITCH
11. EMERGENCY ARMAMENT CUTOUT SWITCH

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F159-0-4-112

Figure 4-33

Bomb Arming Switch. The bomb arming switch (figure 4-33) has three positions, NOSE & TAIL, SAFE, and TAIL ONLY. It is used to arm the bomb fuze, the position depending upon where the bomb is fuzed. If the switch is in the SAFE position the bomb fuze is unarmed and will remain unarmed even if the bomb is dropped.

Ammunition Rounds Counter. The ammunition rounds counter (figure 4-33) is provided to indicate the number of unfired rounds remaining after the M-61 gun has been fired. The counter is calibrated in units of 25 from zero through 700 Each time 25 rounds are fired the counter amplifier sends a single pulse to the counter, causing it to indicate a decrease of 25 When a burst is fired the counter will indicate a decrease in multiples of 25 to the last multiple just below the number of actual rounds fired. For example, if a burst of 45 rounds has been fired the counter will indicate a decrease of 50 rounds. The counter should be set before takeoff to indicate the number of rounds available for the mission.

Ammunition Rounds Counter Reset Switch. The rounds counter reset switch (figure 4-33) is provided to set the ammunition rounds counter to indicate the number of rounds carried in the ammunition compartment. The switch has three positions, FAST, neutral (spring loaded), and SLOW. Placing the switch in FAST position operates the rounds counter at a rate of 50 rounds per second. As the counter approaches the desired indication, position the switch to SLOW. Each time the switch is placed to SLOW the counter reading changes 5 rounds.

NOPE

Optical Sight Switch. The optical sight switch (figure 4-33) is provided to turn on the optical sight system. It has two positions, NORM, OFF. When the switch is in the NORM position and sight is uncaged, the sight reticle is illuminated and the reticle position is determined by the position of the armament mode selector switch and by the armament control computer after lockon. When the switch is in the NORMAL position, the sight reticle can be manually elevated or lowered using the manual reticle depression control knob. The switch in the OFF position deenergizes the sight.

Manual Reticle Depression Control Indicator. The manual reticle depression control indicator (figure 4-33) is located adjacent to the optical sight switch. It indicates the manually selected position of the reticle from 172 milliradians below the ADL to the MRL (17.45 milliradians above). The indicator is calibrated in increments of 4 milliradians.

Manual Reticle Depression Control Knob. The manual reticle depression control knob (figure 4-33) permits manual control of the sight reticle position. The reticle can be raised to the missile reference line (MRL), 17.45 milliradians (1 degree) above the ADL, or lowered to 172 milliradians below the ADL. Rotating the knob counterclockwise elevates the reticle position, as indicated by the manual reticle depression control indicator in increments of 4 milliradians. Clockwise rotation lowers the reticle. The optical sight must be uncaged in the MANUAL position and radar on in order to manually adjust reticle position.

Mechanical Cage Knob. The mechanical cage knob (figure 4-33) is provided to cage the optical sight reticle to the ADL. The knob is used when the sight is not in use to protect the sight servos, and when the sight malfunctions. Rotating the knob clockwise cages the sight reticle.

NOPE

Optical Sight Reticle Light Control Knob. The optical sight reticle light control knob (figure 4-33) is provided to adjust the brightness of the optical sight reticle light on the combining glass display. Rotating the knob clockwise increases brightness.

Note

The optical sight may display a double image reticle. This condition usually occurs at high brightness settings.

Infrared Sight Switch. The infrared (IR) sight switch (figure 4-33) is a two position ON-OFF switch provided to energize the IR detection and tracking system.

NOPE

Infrared Brightness Control Knob. The infrared brightness control knob (figure 4-33) is provided to adjust

the brightness of the IR sight presentation on the combining glass display. Rotating the knob clockwise through decaled positions 1 to 8 increases brightness. On modified aircraft, a three-position switch, ON, OFF, and STDBY is installed.

Weapons Selector/Special Weapons Panel.

NOPE

The weapons selector/special weapons panel (figure 4-34) is located in the cockpit, on the lower instrument panel below the radar indicator (front cockpit only for TF aircraft). It consists of the following controls.

Drop Lock Switch F/RF . The drop lock switch is a two-position, guarded toggle switch which can be safetied. It is used to arm the release circuits of the stores carried on the centerline bomb rack. There are two positions, READY and SAFE, for arming and disarming the release circuitry. For automatic release the switch is connected in series with the external stores rotary selector switch, dual timer release circuit, bomb release switch (AUTO RELEASE position), and the bomb button. For manual release the switch is connected in series with the external stores rotary selector switch, bomb release switch (MANUAL position), and the bomb button. For emergency release it is connected in series with the special weapons emergency jettison button.

Special Weapons Emergency Jettison Button F/RF . The special weapons emergency jettison button is provided to jettison the stores carried on the centerline bomb rack in emergency situations. The drop lock switch must be in the READY position prior to actuating the emergency jettison button or the store will not be released. On Consortium aircraft with 554 c/w, the button will also jettison centerline-mounted missiles.

WARNING

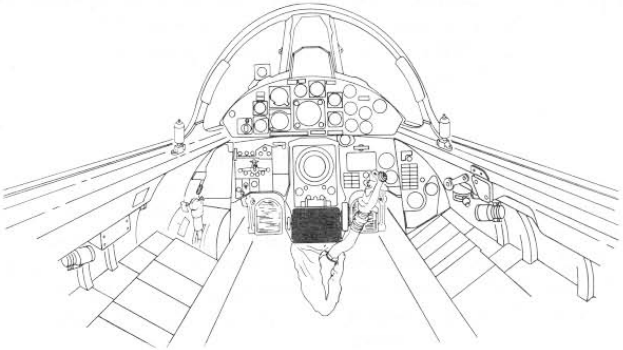
The arming condition of the store depends on the position of the bomb arming switch.

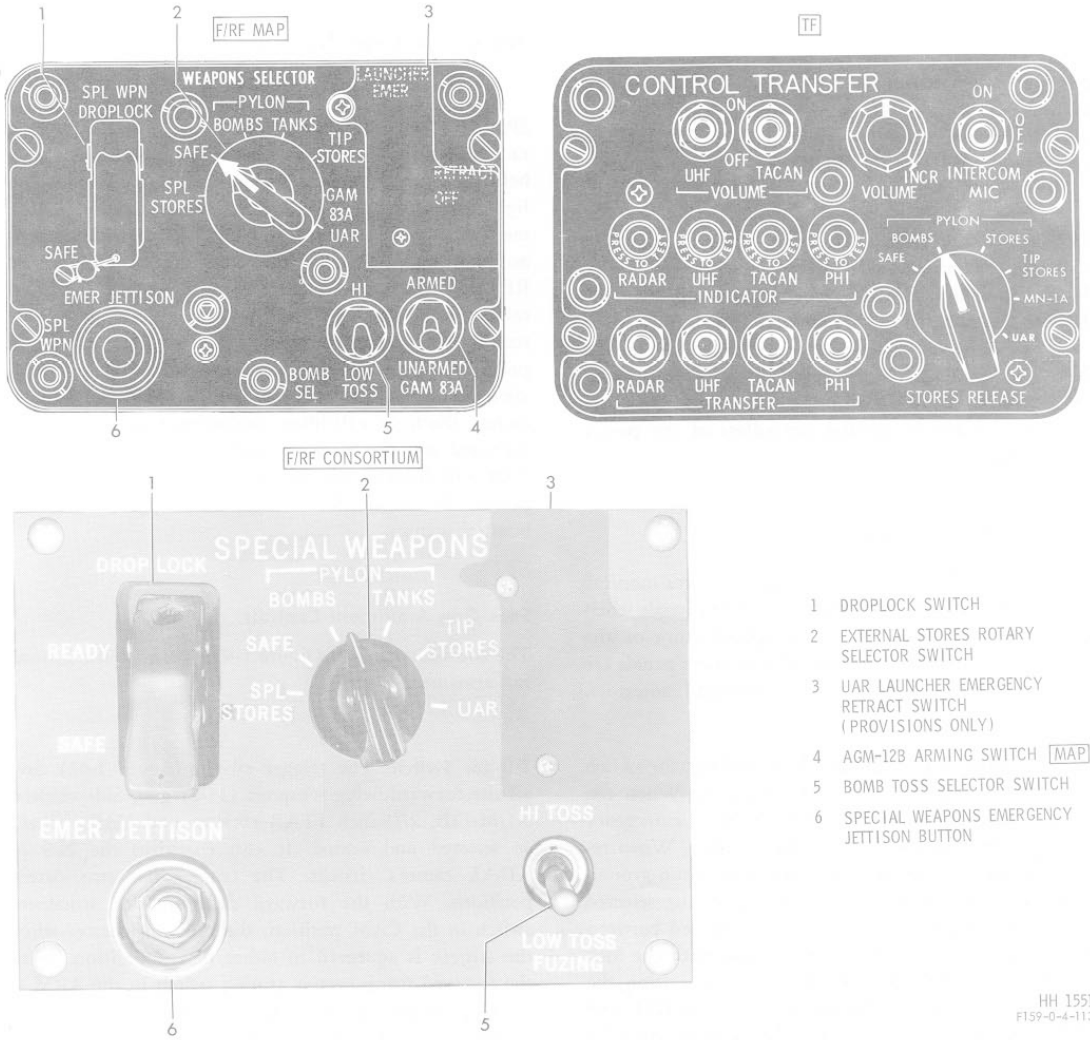
External Stores Rotary Selector Switch. The external stores rotary selector switch is provided for selection of the UAR rocket launch, droppable stores, and selective release of other stores; however, selective drop of catamaran missiles is not possible. The positions clockwise, and functions are as follows:

Position	*Function*
F/RF SPL STORES	Selects stores carried on the lower fuselage attachments. Connects in series with the drop lock switch, dual timer release circuits, bomb release switch, and the bomb button.
SAFE	Disarms the circuitry for release of the UAR rocket, regular droppable and special stores.
PYLON BOMBS	Selects pylon bomb stores. Connects in series with the external stores selector buttons, dual timer release circuits, bomb release switch, and bomb button.
PYLON TANKS	Selects pylon tank and Sidewinder stores. Connects in series with the external stores selector buttons and the bomb buttons.
TIP STORES	Selects wing-tip stores. Connects in series with the external stores selector buttons and the bomb button.
AGM-12B (Modified Aircraft)	Selective jettison of AGM-12B. Connects in series with the external stores selector buttons and the bomb button.
UAR	Selects UAR rocket launching. Connects in series with the master arming switch and trigger switch.
TF MN-1A	Selects MN-1A practice bomblets. This position is connected in series with the external stores selector buttons, bomb release switch, emergency armament cutout switch, and bomb button. The stores release selector switch must be in the PYLON BOMBS position to jettison the MN-1A bomblet dispenser.

NOPE

WEAPONS SELECTOR PANEL





1 DROPLOCK SWITCH
2 EXTERNAL STORES ROTARY SELECTOR SWITCH
3 UAR LAUNCHER EMERGENCY RETRACT SWITCH (PROVISIONS ONLY)
4 AGM-12B ARMING SWITCH MAP
5 BOMB TOSS SELECTOR SWITCH
6 SPECIAL WEAPONS EMERGENCY JETTISON BUTTON

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F159-0-4-113

Figure 4-34

NOPE

Lock Release Button F/RF . The lock release button must be depressed in order to rotate the external stores rotary selector switch counterclockwise from SAFE to SPL STORES position, or clockwise from TIP STORES or AGM-12B to the UAR position. Aircraft with 2083 cw have the lock release button removed.

UAR Launcher Emergency Retract Switch. (Provisions only.) The UAR launcher emergency retract switch is a guarded two-position toggle switch. It is provided for emergency retraction of the UAR launching mechanism if the normal method fails. The RETRACT position initiates the emergency retracting cycle. The switch remains in the OFF position with the guard down for normal retraction.

TOSS SEL Switch. The TOSS SEL switch MAP has two positions, LOW and HI, to provide fuzing of special stores for the mode of delivery selected. On Consortium aircraft this switch is called FUZING.

AGM-12B Arming Switch. The AGM-12B arming switch, located on the weapons selector panel, has two positions, ARMED and UNARMED. When the switch is in the ARMED position the missile is fired armed and can be guided. (The power switch must be on to fire the missile when the ARMED position is selected.) When the switch is in the UNARMED position, the missile is fired unarmed and cannot be guided, regardless of the power switch position.

Special Store Monitor Panel.

The DCU-9/A, T-249, or T-1524 special stores monitor panel (figure 4-35) is installed on the right console when the aircraft is equipped with the special store or the MN-1A practice bomb dispenser. The monitor panels are similar and contain the following controls and indicators.

Selector Switch. The mechanically locked selector switch is placarded OFF, SAFE, GND, and AIR. When the switch is in a position other than OFF, No. 1 emergency dc bus power is supplied to the special store. When released the special store detonates in the air, upon ground contact, or is dropped safe, depending on the selected position. The selector switch may be operated between the AIR, GND, and SAFE positions only with the lock in the SGA position; with the lock in the OS position, the selector switch may be operated between the OFF and SAFE positions. Lock position may be changed only with the selector switch in the SAFE position.

Lamp Test Switch. The lamp test switch is used to check the filament in the WARNING light. If the filament is intact, the WARNING light glows when the switch is depressed, provided the selector switch is not in the OFF position.

WARNING Light. The WARNING light glows when there is a malfunction in the internal mechanism of the special store. If the malfunction-detection circuitry is in order, depressing the WARNING light will cause it to glow. When the MN-1A practice bomb dispenser is carried, illumination of the light indicates doors open. The light will flash while the doors are traveling.

DIM Control Knob. Not connected.

INACCURATE

SPL WPN UNLOCKED Indicator Light. A special weapon rack safety lock mechanism indicator light is installed below the main instrument panel on the right side. The light will illuminate any time the special weapon attachment lock mechanism is unlocked. The mechanism is normally unlocked when the drop lock switch is in the READY position. After the special weapon has been released the light will blink for 30 seconds, then glow steadily. Returning the drop lock switch to the SAFE position will extinguish the light. (On aircraft with 2060 n/c/w the light will not extinguish.) When pushed to test, the light will blink, indicating that the circuit is activated and the blinking mechanism is operable. The light will function in the same manner with centerline bombs. The light does not operate with the MN-1A bomb dispenser.

Stick Grip Armament Controls.

The control-stick grip (figure 1-42) has on it the following armament controls.

INACCURATE

Trigger Switch. The trigger switch (figure 1-42) fires all the forward-firing weapons (M-61 gun, Sidewinders, AGM-12B, 2.75-inch FFAR rockets, and UAR rocket) as selected and armed. It also energizes the N-9 or KB-3A camera circuits. The trigger has two detent positions. With the forward firing master armament switch in the CAM position, the camera operates when the trigger is squeezed to either detent position. With the forward firing master arming switch in the ARM & CAM position, the first detent position operates the camera only. The second detent position fires the selected forward-firing weapons as well as operating the

SPECIAL STORES MONITOR PANEL

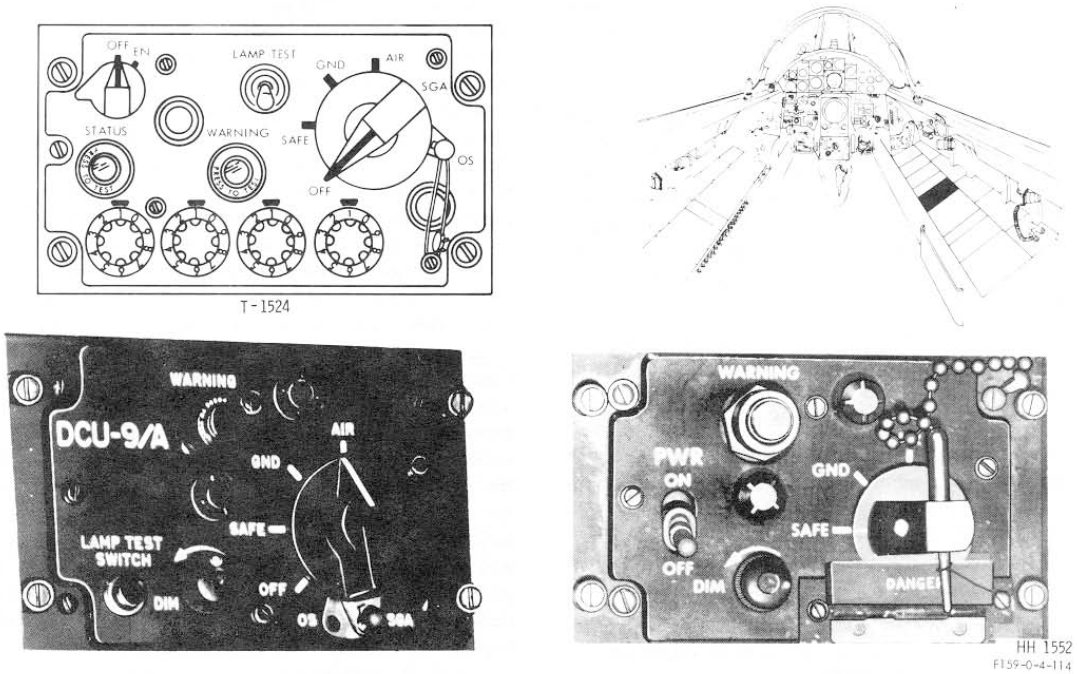


Figure 4-35

NOPE

camera. No. 1 and No. 2 engine ignition is provided during and 10 to 15 seconds after firing of all forward-firing weapons. When the trigger is in the second detent, regardless of the position of the forward firing master arming switch, the inlet guide vanes are energized to close 5 degrees. The 5-degree closure of the guide vanes prevents compressor stall during operation of forward-firing weapons. An indication of vane closure is a slight loss in thrust and a drop in fuel flow.

Note

Vane closure may be checked prior to operation of forward-firing weapons by pressing the trigger switch to the second detent while the master arming switch is in the OFF position.

Droppable Stores Release Button (Bomb Button). The bomb button (figure 1-42), located on the control-stick grip, releases all the droppable stores, bombs, fuel tanks, special stores, etc., as selected and armed. For bomb delivery with the dual timer computing the release point, provided the bomb release switch is in AUTO RELEASE, the bomb button must be depressed and held in until release occurs. When carrying centerline or pylon bombs, and dual timer bombing system is not employed, the bomb release switch must be in MANUAL RELEASE so that release of droppable stores, as selected, will occur when the bomb button is momentarily depressed. The bomb release switch is automatically bypassed when selecting tip or pylon tanks.

Note

Normally bomb release switch is in MANUAL RELEASE position, it automatically reverts in AUTO RELEASE when DUAL BOMBING TIMER unit is energized.

WARNING

Following any attempted release or jettison, any conventional munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing impact. Also, bomblet dispensers and rocket launchers should be considered as still containing one or more bombs and/or rockets. *If visual examination cannot positively confirm a safe condition, jettison prior to landing.*

Action Reject Button. The action reject button (figure 1-42) stops the radar antenna during blind or visual acquisition and, if it is released, it locks on when the

NOPE

NOPE

range gate is over the target and rejects undesirable targets (releases lockon).

Gun Firing Circuit Breaker. As an added precaution against inadvertent firing of the gun and other forward firing weapons, the GUN FIRING circuit breaker (figure 1-20) on the left console may be pulled.

Gun Firing Override Ground Test Switch. A ground test switch (figure 1-20), located on the left console permits gun firing when the aircraft is on the ground. To fire the gun on the ground the switch must be moved from the spring-loaded NEUTRAL position and held in the NORMAL PURGE (engine running) or EXTERNAL PURGE (engine off) position while depressing the trigger switch.

AGM-12B Power Switch (Modified Aircraft). The AGM-12B power switch is located on the left console (figure 1-8). It is used to turn the missile and transmitter standby power ON or OFF as placarded.

Camera Shutter Selector Switch. While in flight, the pilot may readily adjust the camera shutter by positioning the camera shutter selector switch (figure 1-9) to the bright (B), hazy (H), or dull (D) positions. Electrical power for the shutter selector and the camera motor is supplied by the primary dc bus.

Rocket Select Switch. On modified aircraft, a rocket select switch, located on the left console (right console MAP and TF Consortium aircraft) is used to select automatic or manual firing of the 2.75-inch FFAR rockets. In the AUTO position, the armament control computer controls firing of the rockets after the trigger is pressed. In the MANUAL position the armament control computer is bypassed and the rockets are fired immediately when the trigger is pressed. (Normally, the AUTO position is used for air-to-air attack utilizing the radar display and the MANUAL position is used for air-to-ground attack utilizing the manually adjusted optical sight display.)

Bomb Release Light.

The bomb release light is located to the right of the optical sight. When the light extinguishes at the end of a maneuver, weapon release is indicated.

MAP CBU Dispenser Lights.

Two CBU dispenser-empty lights are located, one on each side of the center windshield frame. The lights are green, push-to-test type and indicate the status of the associated dispenser. The lights flash when only three tubes remain unfired and illuminate steadily when the dispenser is empty.

CBU/LAU Selector Switch MAP.

A two-position CBU/LAU selector switch is located on each pylon. The switch is safety-wired in the position corresponding to the store being loaded.

Dual Timer (If Installed).

The dual timer installation consists of a run-in timer (placarded pullup MAP aircraft) and a release timer. When a mission is to be performed using the dual timer system, the attack maneuver must be completely programmed, since the calculated timer settings are dependent upon the I/P-to-target distance, the speed and altitude of approach, the pullup maneuver intended, the desired toss range of the weapon, and the type of store to be delivered. The accuracy of the system is dependent upon the calculated timer settings and the pilot's ability to fly the programmed attack maneuver. The run-in timer is preset to the calculated time required to fly from the selected initial point to the planned pullup point. When the run-in timer cycle is completed, the optical sight reticle goes out and the bomb release light illuminates. The pilot then initiates the pullup maneuver. The release timer automatically starts when the run-in timer cycle is completed. The release timer setting is calculated to release the weapon at a specific point in the programmer pullup to obtain a target hit. When the release timer cycle is completed, the optical sight reticle illuminates, the bomb release light extinguishes, and the weapon is released. Dual timer operation is initiated by pressing the bomb button. If the pilot decides to abort the attack maneuver, releasing the bomb button will prevent weapon release and the timers will automatically recycle to the set-in time. (See figure 4-37.) The dual timers will function only with the bomb release switch in the AUTO RELEASE position.

Note

When the bomb release switch is in the AUTO RELEASE position, the dual timer motor will run continuously; therefore, to prevent excessive running time, keep the bomb release switch in MANUAL RELEASE position at all times except during bombing runs.

INACCURATE

Audio Warning Signal (Fighter-bomber aircraft modified by ECP 2015).

The pilot also receives an audio warning signal in the headset which is calculated by the bombing computer adapter. The characteristic tone is converted in the bombing computer adapter box and is supplied to the UHF receiver. The start and stop of this signal is ordered by the run-in and release-timer. The audio warning signal starts one second prior to expiration of the run-in timer and stops one second prior to expiration of the release timer.

Dual Timer Panel.

The dual timer panel (figure 4-36) is located on the right console (left console MAP aircraft) and consists of two timers operated by one motor, and a power-on light.

DUAL TIMER BOMBING CONTROL PANEL

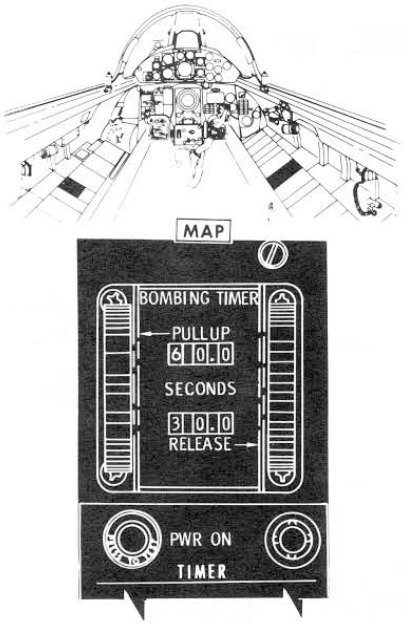


Figure 4-36

MAP Pullup and Release Timers. The two timer controls are placarded PULL UP and RELEASE. The pullup timer can be set for 0.2 to 60.0 seconds and the release timer can be set for 0.2 or 30.0 seconds; both timers are calibrated in 0.1-second intervals.

Consortium Run-in and Release Timers. The two timer controls are placarded RUN-IN and RELEASE. Each can be set from 0.1 to 30.0 seconds in 0.1-second increments.

Consortium Extra Timer.

On modified aircraft, an ex NOPE timer is wired in series with the existing dual e timer is identical to the existing timer and allows run-in time to be increased from 30 to 60 seconds. A switch placarded EXTRA TIMER, located on the right forward panel, permits operation with or without the extra timer. On two-place aircraft, the switch is located in the forward cockpit only.

CAUTION

The timers can be damaged if the controls are set to less than 0.1 or more than 30.0 seconds.

Power-On Light. The power-on light indicates when the timers are energized and ready for operation. Power ito dual timer is provided by activating dual timer power lbutton on dual timer control panel

Emergency Release.

Emergency release of all external stores, except the pylon racks, centerline stores, and on **Consortium** aircraft (G554 c/w) fuselage mounted missiles, is provided by the external stores jettison button on the left forward panel.

Note

The fuselage-mounted Sidewinder missiles and launchers are attached to the aircraft by a rack. The missiles and launchers may be jettisoned together by pressing the external stores jettiso button. The launchers cannot be jettisoned sep arately; the rack cannot be jettisoned. INACCURATE

Emergency release of centerline bombs, MN-1A bomb dispenser, and special stores is provided by the emergency jettison button located on the weapons selector panel. On **Consortium** aircraft with G554 c/w, the button will also jettison centerline-mounted missiles. Controls to operate the weapons delivery equipment are explained individually under that particular system in this section.

INACCURATE SYSTEMS DESCRIPTION FIXING PAGES

AIM-9 IR guided missile

The aircraft model configured for ir defence missions is equipped with 2 AIM9L I/R guided missiles controlled with a dedicated panel that is mounted on ADV version only. (Fig. 4-36a)

Fig. 4-36A

The panel is used to arm and launch AIM9 missile, panel operates only if Air/Ground safety switch is activated, thus aircraft must be airborne and gear up. Panel has a covered switch labeled "**SAFE**" and "**ARMED**".

- **SAFE/ARMED** switch when in ARMED POSITION it allows the missile to be launched.

Note

Missile launch is linked to "CENTER LANDING LIGHT" event, in order to drop or launch one must assign a key/joystick button to that event. Above mentioned event has nothing to do with landing lights on/off, it's generally unused on military fighter aircrafts. We suggest to link that event with joystick BUTTON 2.

DCU-9/A

Special weapon and practice bomblet MK-76 loaded into SUU-21A can be dropped using the DCU-9/A control panel. (Fig. 4-35).
DCU-9/A selector operates only if Air/Ground safety switch is activated. DCU-9/A selector has 4 positions:

- **OFF** control panel is denergized
- **SAFE** control panel receives power and is on safe state
- **GND** Dispenser bay doors are open, MK76 practice bombs ready to be dropped., or special weapon set to a ground burst.
- **AIR** Dispenser bay doors are open, MK76 practice bombs ready to be dropped., special weapon set for an air burst.

Note

- *AIR position will drop special weapon or MK76 practice bomb only when Bombing Timer Unit is energized in special weapon delivery mode.*
- *DCU-9/A can be operated only when SUU 21-A Dispenser is loaded into centerline rack*
- *Only fighter bomber aircraft version has DCU-9/A panel mounted on.*
- *Bombs dropping is linked to "CENTER LANDING LIGHT" event, in order to drop one must assign a key/joystick button to that event.*

USAGE OF DCU 9/A WITH SUU 21-A DISPENSER

DCU-9/A can be used togheter with SUU 21-A Dispenser to practice either conventional or special delivery. SUU 21-A can carry up to 6 MK76 25 lbs practice bombs that can be used to simulate either conventional dragged bombs and special weapon. Special weapon delivery practice is done using BTU (see below) while conventional bomb practice uses DCU-9/A with mode selector set to GROUND position.

Note

SUU 21-A Dispenser cannot be selected to be delivered on weapon panel, SUU 21-A cannot be delivered at all.

BOMBING TIMER UNIT (BTU)

BTU has two timers, named RUN-IN TIMER and RELEASE TIMER respectively.
BTU receives electrical power from PRIMARY DC BUS using the on/off red button. (Fig. 4-36)
Two green lights show when BTU is powered, timers can be set from 0.1 to 30.0 seconds, in 0.1. sec. increment.
Generally RUN-IN timer measures the time from a reference point, either visual or radar, to the beginning of the delivery manouver while RELEASE TIMER measures the time elapsed from manouver beginning to weapon release.
When RUN-IN TIMER expires the "SPECIAL WPN" light located on front panel lights on indicating the beginning of delivery manouver, when RELEASE TIMER expires light goes out.

Note

When BUT is powered bomb release switch is automaticaly set to AUTO RELEASE. bomb delivery is controlled by BTU itself. No direct bomb delivery can be made with BTU energized.

WEAPON CONTROL PANEL

Located on left lower front panel controls almost all weapons: gun, rockets and bombs, it operates gun sight as well. (Fig. 4-33)

OPTICAL SIGHT

Gun sight has an illuminated reticle, sight depression can be set from 0 (ADL) up to154 mils°°, reticle light can be dimmed /enlighted with 4 different positions.

Note

Track-IR users should take in mind that the optical sight position can be affected by paralax error induced by Track-IR itself, so it is worthwhile maintain Track-IR in hold-fixed position when aiming the target trough optical sight.

Gun sight operates also under control of Air Data Computer and radar system both in GM or Air-to-air modes, refer to radar system section for further information
When ground speed error (GSE) redaout is used, gun sight auto reverts to caged position and an analog bar is showed to provide ground speed informations. Refer to fig. 4-39A for further informations.

ROUND COUNTER

A gun ammo counter is provided showing remaining ammonitions into gun store.

WEAPON SELECTION PANEL

Gun/Rockets switch: select either Gun or Rockets to be fired.

Note

Both gun and rockets must be fired using "brakes" button/key, gun and rockets are shoot repetitively as long as "brakes" button/key is hold down.

ARM&CAM: permits gun operations.
Centerline, BL 104 green lights button are on if pressed and corresponding stations are loaded **.**

Note

If rocket launchers are loaded the Gun/Rocket switch in ROCKET position lights also BL104 green lights. Centerline and BL104 green lights cannot be lighted by pressing them if either SUU 21-A or rockets launchers are loaded..

WEAPON DELIVERY PARAMETERS TABLE

WEAPON	2xMK81R	1xMK83R	Orion 2.5"	MK76R	M61VULCAN	1XMK83GP
CONFIG/FLAPS	T/O	T/O	T/O	T/O	T/O	T/O
DIVE ANGLE	15°	15°	25°	15°	10/15°	25°
INDICATED DELIVERY ALT.	555 AGL	600 AGL	1280 AGL	550 AGL	450 AGL	2470 AGL
DEPRESS. °°	128°°	132°°	58°°	128°°	ADL	141°°
KIAS	440	450	450	450	450	450

Note: the postfixed "R" means bombs are retarded/dragged weapons.

Ground Speed Error readout

Aircraft in Fighter Bomber version is equipped with Ground Speed Error readout equipment that shows on-time GS error.

GSE readout is made of two parts: a control panel (Fig. 1-58) and a read out panel (Fig. 1-59).

Control panel is located on right lower console while readout panel on right front panel.

CONTROL PANEL

It provides following functions:

- ON/OFF selector gives/cut power to GSE readout equipment, a little flag on readout panel shows when equipment is not ready to operate (power OFF).
- SPEED selectors, 3 speed selectors are used to set the desired ground speed, they set hundreds, tenths and units of knots.

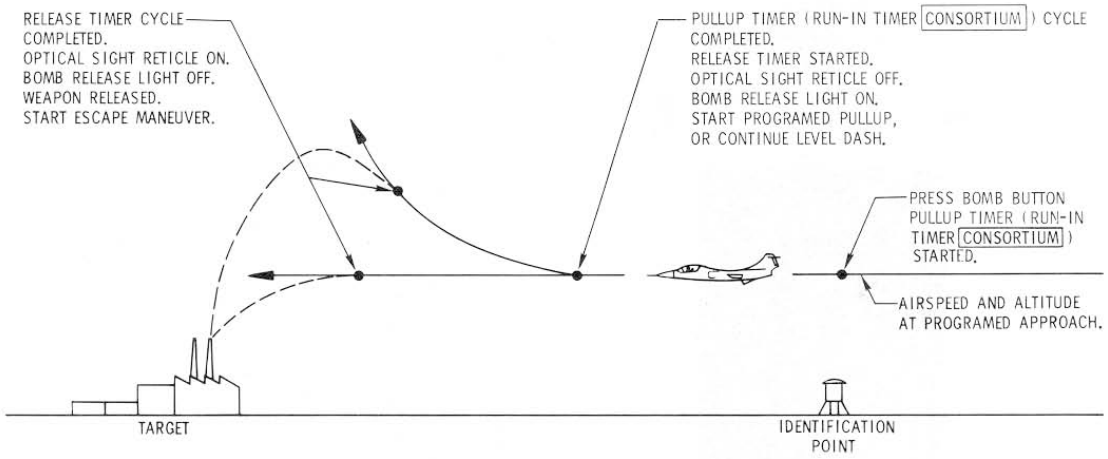
Fig. 1-58

READOUT PANEL

Once powered panel shows the difference between selected and actual ground speed using a white slider that shows the relative error, sliding on left or right of centerline respectively. Left slider means a ground speed less than set, right slider a greater than speed. Error scale goes linearly from -20 to + 20 kts around ground speed set on control panel, higher offsets are not shown, however a window on bottom of readout panel constantly shows actual ground speed.

Fig. 1-59

DUAL TIMER BOMBING METHOD



NOTE

- THE BOMB BUTTON ACTUATION POINT CAN BE DETERMINED IN THREE WAYS:
  1. BY MEANS OF AN IDENTIFICATION POINT A KNOWN DISTANCE FROM THE TARGET.
  2. BY DEPRESSING THE OPTICAL SIGHT RETICLE TO THE PREVIOUSLY CALCULATED ANGLE FOR THE MISSION, AND PRESSING THE BOMB BUTTON WHEN THE RETICLE CENTER DOT IS SUPERIMPOSED ON THE TARGET.
  3. BY USING RADAR IN GROUND MAP MODE, AND ADJUSTING ALTITUDE SET-RANGE GATE THUMBWHEEL TO OBTAIN PRESENTATION IN TRUE GROUND RANGE TO DETERMINE TARGET DISTANCE.
- ON AIRCRAFT MODIFIED BY ECP 2015, THE AUDIO WARNING SIGNAL STARTS ONE SECOND PRIOR TO EXPIRATION OF THE RUN-IN TIMER AND STOPS ONE SECOND PRIOR TO EXPIRATION OF THE RELEASE TIMER. THE TIME-TO-GO AND COMMAND LIGHTS ILLUMINATE AT EXPIRATION OF THE RUN-IN TIMER AND EXTINGUISH AT EXPIRATION OF THE RELEASE TIMER.

HA 3178
F159-1-4-116

Figure 4-37

NOPE

Azimuth Cursor On—Off Switch (Fighter-bomber aircraft modified by ECP 2015).

The azimuth cursor ON-OFF switch located on the left console permits the pilot to use a centered or an off center azimuth cursor. The off-set left or right is selected by means of a switch and the amount of off-set is adjustable with the off-set dial, located in the bombing computer adapter box.

The azimuth off-set cursor serves for parallel displacement of the azimuth. A selection can only be carried out on the ground and provides infinitely variable selection from a 0 to a 40,000 ft range to the left and right. The azimuth off-set cursor indicates to the pilot a flight path, guiding him to a reference target, parallel to the true target (see figures 4-37A and 4-37B).

Range Cursor (Fighter-bomber aircraft modified by ECP 2015).

The range cursor appears on the radar indicator as a reference line. It is designed to aid the pilot during bombing missions as a reference marking for further action depending on the mission. The available ranges: 15,000; 30,000; and 45,000 ft; are pre-selected before flight by means of a switch located in the bombing computer adapter box. See figure 4-69.

NOPE

AZIMUTH OFFSET BOMB DELIVERY

FIGHTER-BOMBER AIRCRAFT
MODIFIED BY ECP 2015

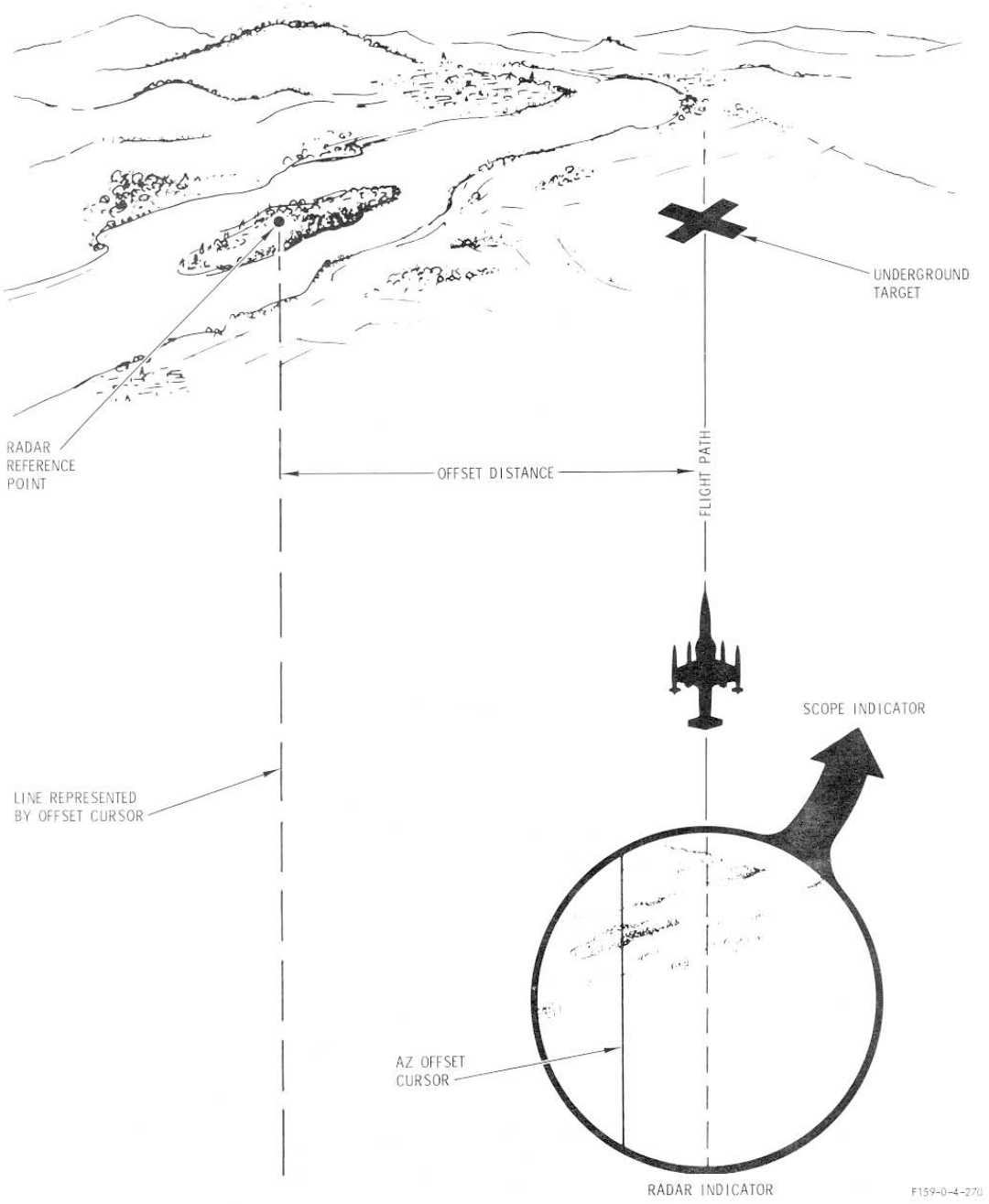


Figure 4-37A

NOPE

AZIMUTH CURSOR SWITCH AND OFFSET DISPLAY

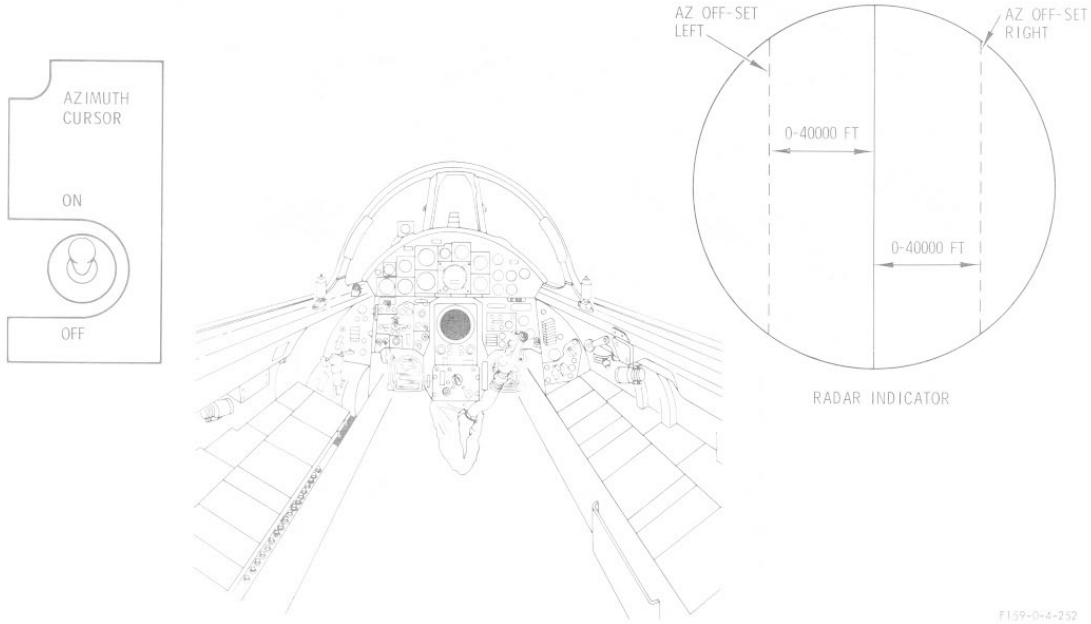


Figure 4-37B

Optical Sight.

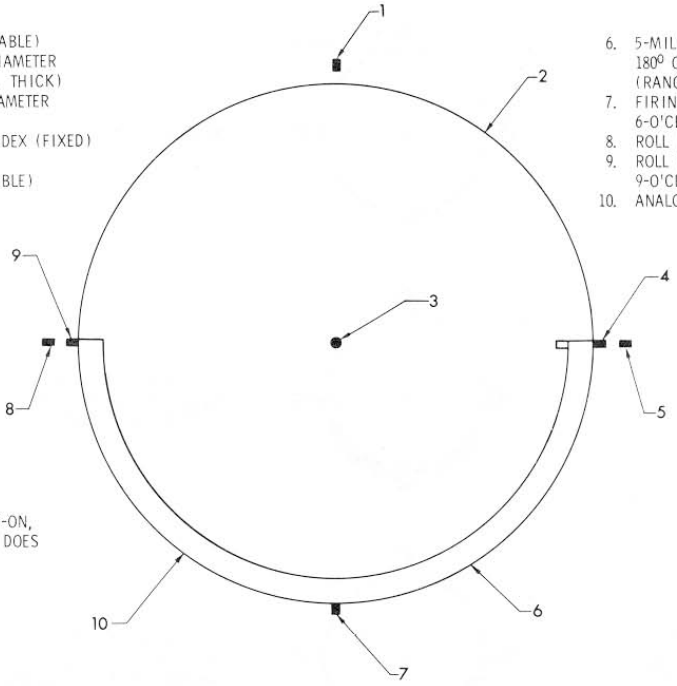
The optical sight comprises an optical display sight (sighthead), optical sight servoamplifier, armament control computer, missile in-range computer, and missile in-range computer accelerometer. The sight provides director type steering in gun mode, after lockon. The optical sight system provides visual aiming and range references for rapid and accurate interpretation of armament position of the aircraft in relation to the target. In addition, the sight provides visual indication of radar lockon, maximum firing range (the range at which the selected armament mode becomes effective), minimum firing range, and a representation of rate of closure. The sight receives variable-frequency ac power from the No. 2 ac bus, fixed-frequency ac power from the radar system, and dc power from the primary dc bus. The display (figure 4-38) is a reticle ring of light with a center dot and both fixed and movable indexes. The fixed indexes at the 3, 6, and 9-o'clock positions are used to indicate the range of the target in conjunction with the range analog bar display. The movable indexes located at 3, 12, and 9-o'clock positions are used to indicate the roll attitude of the aircraft. The traverse, elevation, and roll servomotors position the reticle display in azimuth, elevation, and roll, respectively, on the fixed combining glass when in gun mode. The range analog servomotor positions the range analog bar display, within the reticle display, to visually indicate the minimum and maximum firing range of the particular mode of armament. After radar lockon of a given target, the RANGE ANALOG slews from the 9 to the 3-o'clock position indicating the approximate range of the target. A semicircular bar of light appears on the lower half of the reticle display. This bar of light represents the range of the target with respect to the particular armament selected and is the range analog display which visually depicts the changing range as the aircraft closes on the target. The 3-o'clock fixed index alerts the pilot to anticipate the maximum firing range; the 6 o'clock fixed index indicates a maximum effective firing range

INACCURATE

OPTICAL SIGHT

RETICLE DISPLAY

1. ROLL ZENITH (MOVABLE)
2. 50-MILLIRADIAN DIAMETER RING (1 MILLIRAD. THICK)
3. 2-MILLIRADIAN DIAMETER CENTER DOT
4. ROLL REFERENCE INDEX (FIXED) 3-O'CLOCK
5. ROLL INDEX (MOVABLE)
6. 5-MILLIRADIAN WIDTH BAR 180^0 OF RETICLE (RANGE ANALOG PRESENTATION)
7. FIRING INDEX (FIXED) 6-O'CLOCK
8. ROLL INDEX (MOVABLE)
9. ROLL REFERENCE INDEX (FIXED) 9-O'CLOCK
10. ANALOG RANGE BAR (RED)



NOTE

BEFORE RADAR LOCK-ON, RANGE ANALOG BAR DOES NOT APPEAR

ANALOG RANGE BAR INDICATIONS

CONDITION OF BAR	GUN ATTACK	MISSILE ATTACK
1. COMPLETE BAR FROM 3-O'CLOCK TO 9-O'CLOCK POSITION	RADAR [illegible] PROJECTILE TIME OF FLIGHT TO TARGET, [illegible] SECONDS	RADAR LOCKED ON, RANGE 10 NAUTICAL MILES OR MORE
2. DIMINISHED TO 6-O'CLOCK (BAR EXTENDS FROM 6-O'CLOCK TO 9-O'CLOCK)	PROJECTILE TIME OF FLIGHT TO TARGET, 1.37 SECONDS (MAXIMUM EFFECTIVE RANGE)	RADAR LOCKED ON, RANGE 5 NM, MAX FIRING RANGE
3. DIMINISHED TO 9-O'CLOCK (NO BAR)	PROJECTILE TIME OF FLIGHT TO TARGET, 0.45 SECOND (BREAKAWAY RANGE)	RADAR LOCKED ON, MIN FIRING RANGE

NOPE

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Figure 4-38

OPTICAL SIGHT
GUN AND MISSILE MODE DISPLAYS

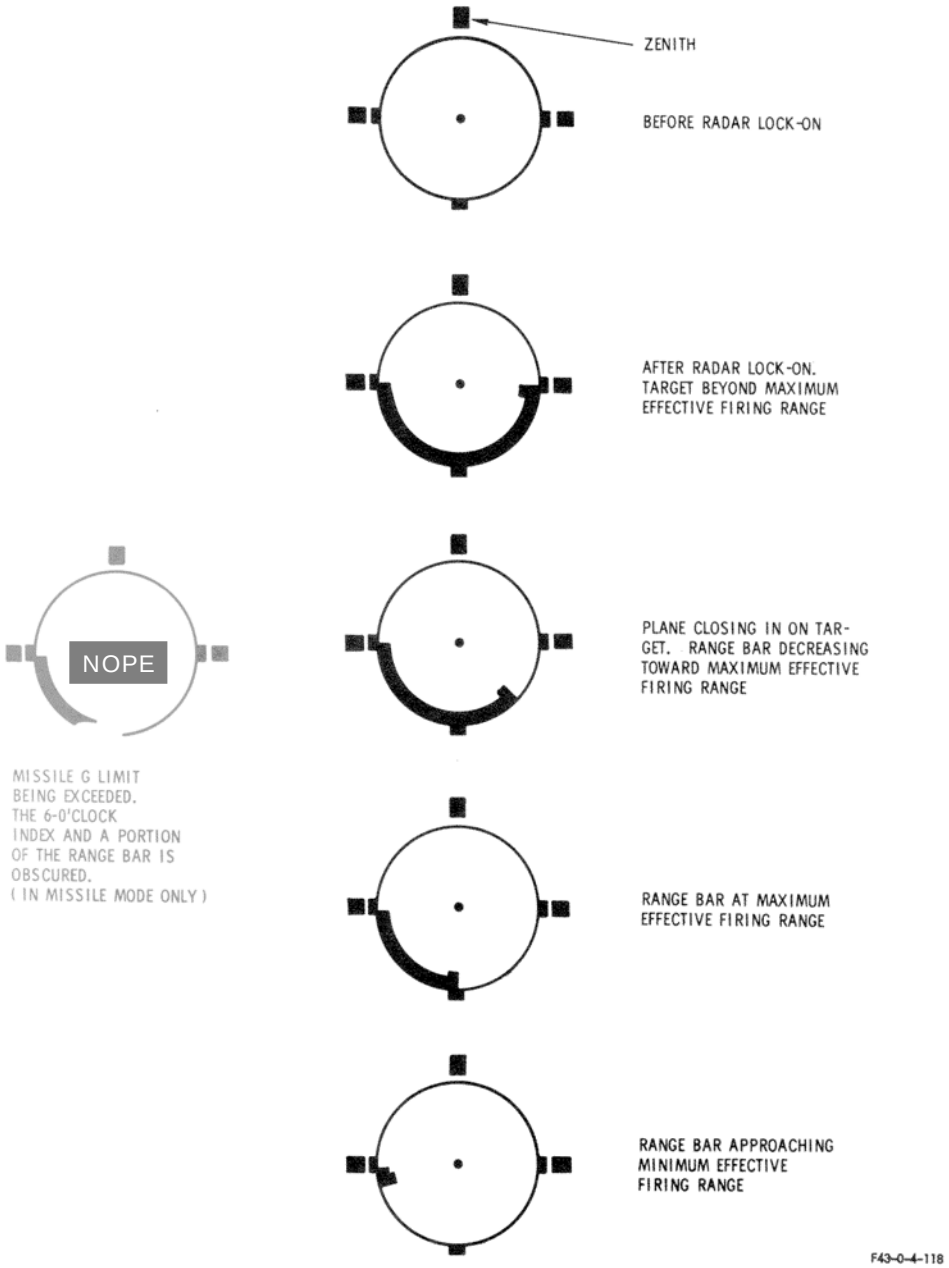


Figure 4-39

in gun mode and maximum range in missile mode, for the armament mode selected; and the 9-o'clock fixed index indicates minimum firing range. The range analog bar decreases in length clockwise as the range or time of flight diminishes. (See figure 4-39 for optical sight displays for gun and missile modes.) The sighthead also provides an attachment which accommodates the gun camera for recording target and reticle position information. The optical sight controls are located on the optical sight control panel. A test button, located on the aft right console, is provided for ground-checking sight operation.

Sighthead. The optical display sighthead is mounted in the cockpit forward of the upper instrument panel. The sight combining glass is positioned in line with the pilot's forward line-of-sight between the pilot and the center section of the windshield. The sighthead consists of a reticle lamp, condensing lenses, boresight mirror, movable mirror, collimating lens, desiccant, combining glass, and four servomotors. The sighthead generates a collimated reticle image display and projects it on the combining glass where, with proper tracking, it appears to the pilot to be superimposed on the target.

Optical Sight Servoamplifier. The optical sight servoamplifier mounts on the lower aft portion of the sighthead. The amplifier consists of the traverse, elevation, roll, and range analog amplifiers. The amplifiers receive inputs from other avionics equipment which operate the servomotors that in turn position the reticle on the sighthead display.

NOPE **Optical Sight Servoamplifier Test Button.** The optical sight servoamplifier test button, located on the right console (figure 1-21) is provided to test operation of the optical sight system. With the radar mode selector switch in the STANDBY position, the armament mode selector switch in the GUN or MISSILE position, and the optical sight switch ON and uncaged with reticle brilliance adjusted, the following will occur when the button is depressed and held:

a. The reticle display will servo up and to the right at approximately 45 degrees from the ADL electrical cage position.

b. The analog range bar appears from the 9-o'clock position and slews to approximately the 7:30 position in GUN position or 4:30 position in MISSILE.

c. The roll indexes will rotate 45 degrees counterclockwise. If the above indications do not appear, the optical sight system has a malfunction and cannot be used.

Note

TF aircraft have a toggle switch labeled OPTICAL SIGHT. It has a spring-loaded OFF position and a TEST position.

Optical Boresight Test Switch (Consortium **2108 c/w,** MAP **2148 c/w).** The boresight test switch is located on the lower left instrument panel below the drag chute handle. The switch is placarded TEST and NORMAL and is spring-loaded to the NORMAL position. The switch provides an inflight means of testing the angle tracking accuracy of the radar and optical sight systems in GUN mode. Actuation of this switch to the TEST position temporarily removes computer lead angle signals from the optic sight. The sight is then positioned only by the antenna position signals and the pipper should be on the target being tracked.

Radar/Sight Boresight Test Procedure. This test is performed during the airborne radar/sight check using the Dart or another aircraft as a target.

1. Radar—AA Mode.
2. Optical sight switch—NORMAL.
3. Sight—Uncaged, Gun Mode.
4. Obtain a lockon in visual acquisition and place pipper near but not on target.
5. Actuate boresight TEST switch. Pipper should move to within 5 milliradians of Dart target or on target aircraft.
6. Notice if tracking error varies with range and position of target to pipper with respect to 6 or 9 o'clock position.

Optical Sight Range Analog Bar (Fighter-bomber aircraft modified by ECP 2015).

The range analog bar on the optical sight is used to indicate ground speed. (See figure 4-39A.) The 6 o'clock position of the range analog bar equals the selected speed. The 3 o'clock position of the range analog bar indicates 50 knots overspeed to the reference selected speed. The 9 o'clock position of the range analog bar indicates 50 knots underspeed in relation to the reference selected speed.

The length of the range analog is directly proportional to the ground speed.

The maximum overspeed or underspeed indication is approximately 50 knots on the indicator.

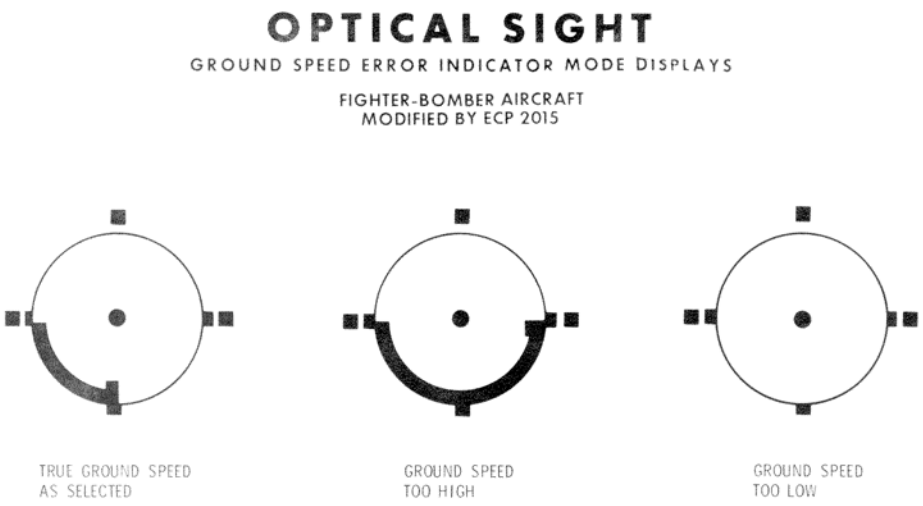


Figure 4-39A

NOPE

INFRARED SIGHT. *(See figure 4-40.)*

The function of the infrared (IR) sight is to detect airborne targets and provide an optical sight display of the target position in either night or daylight situations. The IR sight consists of the IR detection and tracking unit on the forward face of the optical sight. A photoconductive cell sensitive to IR energy supplies a signal to amplifier circuits which trigger a xenon gas lamp. The discharge flashes of the lamp are scanned by slits in a rotating disc to provide a visual indication of the presence of a target within the 17-degree field of view of the IR sight. Optical and mechanical alignments cause the indication to be presented on the optical sight combining glass so the presentation accurately displays the position of the target. The IR sight uses the visual optics of the optical sight for the combining glass presentation. Target range information is not provided by the IR sight. The system receives ac from the secondary fixed-frequency ac bus. The power supply unit of the IR system converts fixed-frequency ac to regulated dc for operation of the amplifier. The IR sight controls are located on the armament control panel (refer to the armament control panel description).

VISUAL DISPLAY.

The visual display of the IR sight is the visual presentation of the IR detection and tracking unit on the optical

NOPE

INFRARED SIGHT DISPLAYS

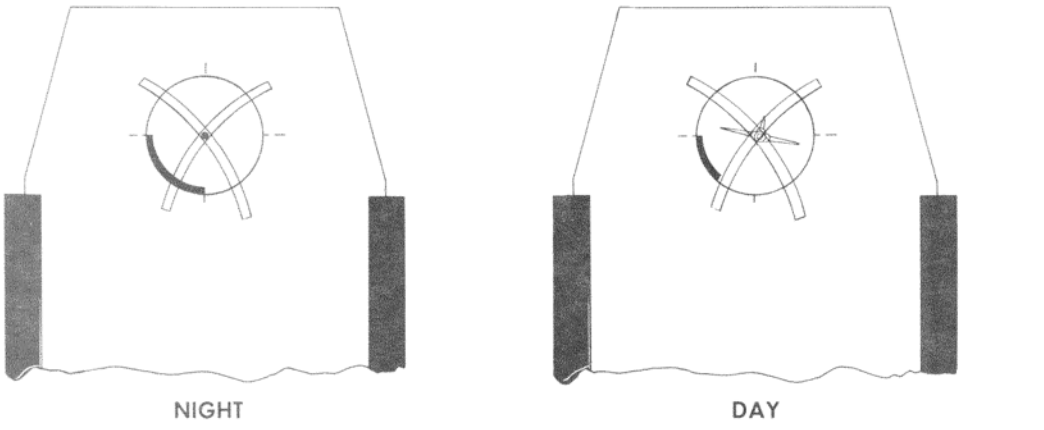


Figure 4-40

sight combining glass. The presentation consists of two intersecting blue-white curved lines. The point of intersection of the curved lines indicates the target position. When the target is visible and the IR sight is being used, the center dot of the optical sight reticle and the IR blue-white cross are superimposed on the target. If the target is obscured because of darkness or haze, the center dot of the optical sight reticle will be superimposed on the IR blue-white cross to indicate the desired track.

MULTIPLE TARGETS.

If more than one target appears in the field of view of the IR sight, the target emitting the most infrared energy is automatically selected for tracking. If targets of equal energy are encountered (resulting in a dual image) the pilot should select one target to pursue and track, maneuvering the aircraft to eliminate the other targets from the field of view.

F15A FIRE CONTROL SYSTEM.

The F15A fire control system consists of radar gear and an armament control computer intergrated with a missile in-range computer, optical sight, data link (provisions only), vertical reference (inertial navigator), and an air data computer to give maximum capabilities in the interceptor and tactical field. The system is designed to provide for pure pursuit launching of the Sidewinder missile, lead pursuit firing of guns, and for lead collision firing of rockets. The components of the system are as follows:

Prime Power, Air-Conditioning, and Pressurization.

The F15A armament control system receives ac power from the No. 2 ac bus and the secondary fixed-frequency ac bus. DC power is supplied from the primary dc bus. The system receives its cooling air from the electronics compartment air-conditioning system; pressurization is supplied by compressor bleed air. Loss of pressurizing air will cause the F15A system to cycle into a transmitter-off condition.

Inertial Navigator.

An inertial navigator (vertical reference) provides aircraft pitch and roll attitude information to the system for stabilization, ballistics computation, prediction computation, and radar display.

Armament Control Computer.

The armament control computer computes the envelope for firing the guns in lead pursuit and the launch point for rocket attack in lead collision in the air-to-air mode. Using the range, relative bearing, elevation, and angular rates from the radar, roll-and-pitch from the vertical

reference, and aircraft flight data from the air data computer, the armament control computer solves automatically the time of firing, provides steering signals, releases the rocket in lead collision attack, and transmits a breakaway signal when minimum collision avoidance range is approached. In the lead pursuit attack, range, steering, and projectile time of flight information is displayed to the pilot, who may fire the guns manually when within range. Minimum-range breakaway is computed and displayed on the radar indicator and a wailing sound is transmitted through the headset.

The fire control system operates in conjunction with the following integrated subsystems to provide maximum aircraft armament capabilities.

Air Data Computer.

The air data computer supplies functions of true airspeed, pressure altitude, Mach number, air density ratio, and aircraft angle of attack to the armament control computer of the armament system for air-to-air attacks, and various functions of pressure altitude and angle of attack to the radar during ground-map and terrain-avoidance modes.

Missile In-Range Computer.

The missile in-range computer is installed in the left aft area of the electronics compartment. The computer receives radar range and range rates from the radar system and altitude and total pressure signal inputs from the air data computer to develop analogs of maximum and minimum launch ranges for firing the missile. The computer also provides a breakaway signal. The output signals of the computer also control the range analog bar presentation on the sight combining glass reticle image display, after the radar has locked onto the target. After missile lockon, a steady tone signal from the missile is channeled through the computer for modulation to indicate the appropriate range areas for releasing the missile. When the maximum missile launch range is attained, the computer causes the steady missile tone to be intermittent (chopped), and heard through the pilot's headphones. When the G launch limit of the missile is exceeded (provided the target is in range) the computer causes the chopped missile tone to revert to a steady tone in the pilot's headphones and a flag blanks out the firing index at the 6-o'clock position of the analog range bar, indicating that the pilot must maneuver the aircraft before releasing the missile. At minimum firing range, the analog bar will disappear. At breakaway range, a wailing siren is heard in the pilot's headphones, indicating an immediate breakaway is necessary to avoid collision with target debris. When radar lockon is broken, the wailing breakaway siren ceases.

Missile In-Range Computer Accelerometer. The missile in-range computer accelerometer, installed on the right side of the electronics compartment aft bulkhead, functions in conjunction with the missile in-range computer to actuate switch closures at two separate G limits which represent the turning capabilities of the missile in two altitude ranges. When the turning capability of the missile has been exceeded (provided the target is in range) the accelerometer actuates a switch that initiates a dc signal in the missile in-range computer. This signal energizes a solenoid-operated flag in the optical display sight which blanks out the 6-o'clock position on the reticle display and range analog bar presentation, and causes the chopped missile tone to change back to a steady tone. The time circle on the radar indicator bezel will simultaneously revert to its original size (3 in. diam.). With the missile G limit flag visible on the optical sight presentation, the airplane must be maneuvered until the flag is removed before the missile can be effectively released.

WARNING

With high rates of closure, the breakaway signal may be received before minimum range is indicated by the analog display bar on the reticle. Whenever the wailing breakaway siren is heard, it is imperative that the pilot immediately execute a maximum-G breakaway maneuver.

RADAR SYSTEM.

Note

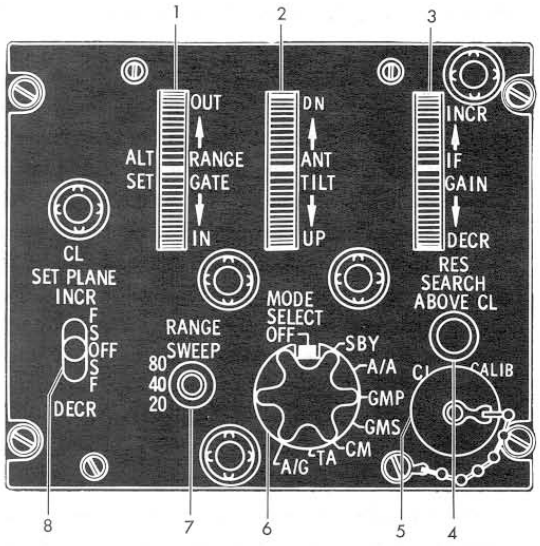
Description data of radar systems modified by ECP 2015 and NOPE be found starting on page 4-110.

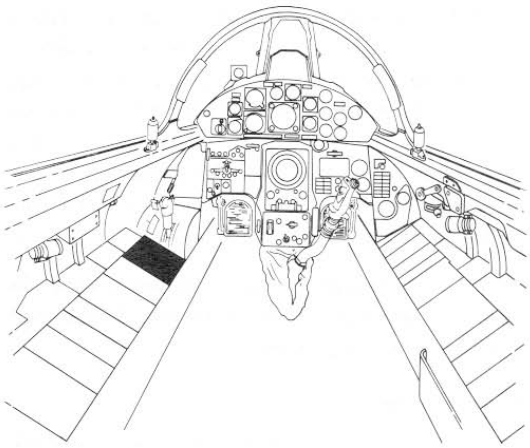
The F15A fire control system radar acquires target data inputs for the armament control computer. The system comprises the radar nose package (containing the antenna), the radar indicator, the clearance plane and antenna tilt indicators, and the radar control panel.

RADAR CONTROL PANEL

(TYPICAL)

MAP





CONSORTIUM

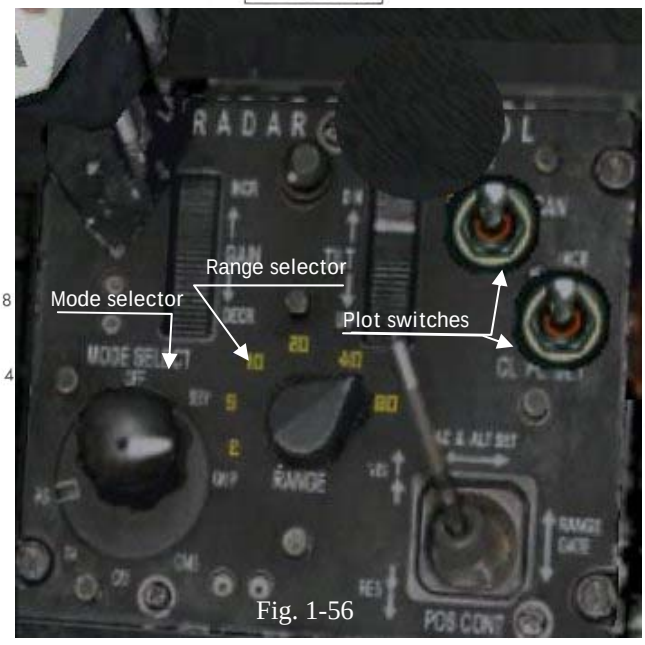


Fig. 1-56

INACCURATE

1 ALTITUDE SET AND RANGE GATE
2 ANTENNA TILT THUMBWHEEL
3 IF GAIN THUMBWHEEL
4 ABOVE CLEARANCE BUTTON
5 CLEARANCE CALIBRATE KNOB
6 MODE SELECT SWITCH
7 RANGE SWEEP SWITCH
8 CLEARANCE SET PLANE SWITCH

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Radar System Control Panel.

The radar system control panel (figure 4-41) is located on the left console, aft of the throttle quadrant. The panel has the following controls and indicators.

NOPE

ALT SET & RANGE GATE Knob. The altitude set and range gate knob has three positions in the air-to-air mode: a detent for visual acquisition, out-of-detent clockwise for controlling range gate position, and out-of-detent counterclockwise (against a spring) for resume search. In the GMP and GMS modes, manual positioning of the knob clockwise provides an altitude delay voltage proportional to height of the aircraft above mean sea level. (Out-of-detent counterclockwise permits measurement of aircraft altitude above terrain.) In addition, bomb release point can be determined by using radar in ground map mode and adjusting altitude set/range gate to obtain presentation in true ground range to determine target distance. In the A/A mode, lockon is broken if rotated to the full out-of-detent counterclockwise position. On modified aircraft the altitude set and range gate control is a thumbwheel. In the A/A mode the thumbwheel is used to manually position the range gate. The thumbwheel functions the same as the knob except for the out-of-detent forward position. The thumbwheel does not incorporate the resume-search function in A/A mode or altitude above terrain measurements in GMP or GMS modes; these functions have been moved to the above-clearance button.

ABOVE CL Button. The momentary type ABOVE CL (above-clearance) puhsbutton is held down to mechanize the clearance plane above the aircraft in the CM and TA modes. When released, the clearance plane returns to below the aircraft.

CAUTION

In both CM and TA modes, the accuracy of the clearance plane above the aircraft is degraded; consequently the above clearance plane should be considered inaccurate and only used during an emergency.

On modified aircraft the button also incorporates the resume-search function and the button is placarded RES SEARCH ABOVE CL. Pressing this button while in the air-to-air mode breaks the lockon phase, the radar returning to the search phase. In the GMP and GMS modes activation of the button permits measurement of aircraft altitude above terrain.

CL CALIB Knob. The CL CALIB (clearance calibrate) knob is used to align the antenna to calibrate the clearance plane. On modified aircraft a plastic cover is installed to prevent inadvertent adjustment of the control.

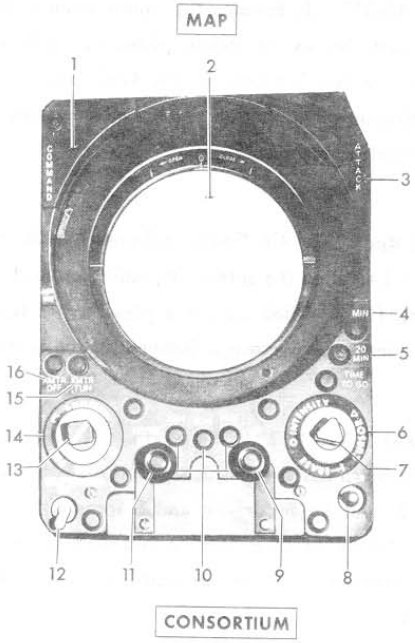
CL SET PLANE Switch. The CL SET PLANE (clearance set plane) switch has five positions, (INCR) F, S, OFF, (DECR) S, and F (F for fast and S for slow). It is spring loaded to the OFF position and used to set the clearance plane to a desired clearance in the CM and TA modes.

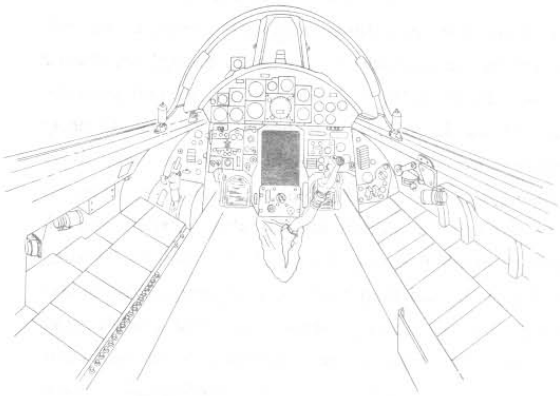
ANT TILT Thumbwheel. The ANT TILT (antenna tilt) thumbwheel positions the antenna scan pattern in elevation during ground map and air-to-air search. Rotating the thumbwheel aft raises the antenna scan. Rotating the thumbwheel forward lowers the antenna scan.

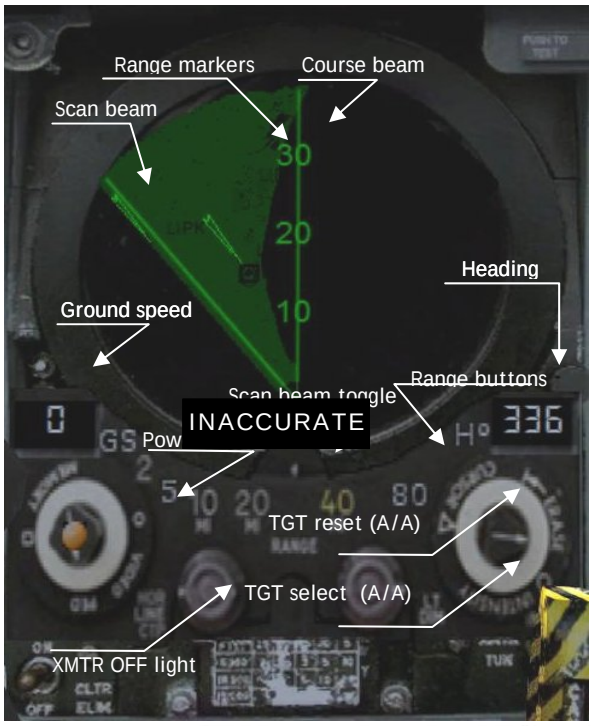
IF GAIN Thumbwheel. The IF gain thumbwheel adjusts receiver gain during ground map (GMP and GMS) and air-to-air (A/A) operations. Rotating the thumbwheel forward increases receiver gain. Rotating the wheel aft decreases the receiver gain.

MODE SELECT Switch. The mode selector switch is an four -position rotary switch used for initial power application to the radar system as well as the selection of the modes of operation. On modified aircraft to rotate the switch counterclockwise from SBY to OFF it is necessary to first lift the switch. The positions of the switch clockwise and functions are as follows:

RADAR INDICATOR







INACCURATE

1 COMMAND LIGHT
2 RADAR SCREEN
3 ATTACK LIGHT
4 TIME-TO-GO 2 - MINUTE LIGHT
5 TIME-TO-GO 20 - MINUTE LIGHT
6 ERASE INTENSITY DIAL
7 CURSOR DIAL
8 TRANSMITTER TUNE SWITCH
9 LIGHT DIM DIAL
10 RANGE LIGHTS (20-40-80)
11 HORIZON LINE CENTER DIAL
12 CLUTTER ELIMINATION SWITCH
13 MEMORY DIAL
14 VIDEO PEDESTIAL DIAL
15 TRANSMITTER TUNE LIGHT
16 TRANSMITTER OFF LIGHT

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Figure 4-42

Position	*Function*
OFF	Deenergizes the radar
SBY	Provides power to the set for warmup
GMP	Selects ground map, pencil beam mode
A/A	Selects air-to-air mode

NOPE

Mode Indicator Lights. The mode indicator lights (figure 1-6), located to the right of the radar indicator, are placarded GM SPOIL, GM PENCIL, AIR-TO-AIR STANDBY, CONTOUR MAP, TERRAIN AVOID, and AIR TO GRD. Each light, when lighted, indicates the radar system is operating in the corresponding mode.

RANGE SWEEP Switch. The range sweep switch has three positions, marked 2,5,10,20,40,80 nautical miles. This switch is used to select the desired indicator range display. The 2,5,80 .n. miles r ange is available only in the ground map modes.

Radar Indicator.

The radar indicator (figure 4-42) is located in the center of the lower instrument panel. The indicator contains the following controls and indicators.

Command Light. The command light (1, figure 4-42) illuminates the letters CMD when GCI information from data link is displayed and the aircraft is operating in the GCI command phase.

Radar Screen. The radar screen (2, figure 4-42) displays radar and GCI information to the pilot. No radar information is displayed in the standby or air-to-ground modes. GCI information (when the data link is installed) may be displayed in either standby or air-to-air modes.

Attack Light. The attack light (figure 4-42) illuminates the letters ATK when GCI information from data link is displayed and the aircraft is operating in the GCI attack phase.

Time to Go–2 Min Light. The time to go–2 minute light (figure 4-42) illuminates at the time the GCI attack phase is entered, and goes out upon radar acquisition.

NOPE

Time to Go–20 Min Light. The time to go–20 minute light (figure 4-42) illuminates 20 minutes before the GCI phases are completed, and goes out when the GCI attack phase is entered.

ERASE INTENSITY Dial. The erase intensity dial (figure 4-42) increases the intensity of the indicator presentations when rotated clockwise. When rotated fully counterclockwise to the ERASE position, it erases the indicator display.

CAUTION

To avoid damage to the scope, the video pedestal dial should be turned fully counterclockwise before erasing the display.

CURSOR Dial. The cursor dial (figure 4-42) is concentric within the ERASE INTENSITY dial. It controls the brilliance of the horizon line and the azimuth cursor. Rotating the dial clockwise increases brilliance.

XMTR TUN Switch. The transmitter tune switch (figure 4-42) is a three-position switch used to increase or decrease transmitter frequency. The positions are INCR, OFF, and DECR. The switch is spring loaded to the OFF position.

Day and Night Visors. Day and night visors provided for use with the radar scope are readily attachable to the indicator face. The day visor aids in preventing

Note

During dusk/night time in GMP mode color revert from light green to light yellow to enhace radar scope visibility

Range Lights. The range lights (figure 4-42) indicate in nautical miles which range 2,5,10,20,40,80 is presented on the display.

NOPE

HORIZ CTR Dial. The horizon line center dial (figure 4-42) positions the artificial horizon line for pitch indications. Rotating the dial clockwise elevates the artificial horizon. The manual setting supplements the movement caused by the vertical reference.

CLUTTER ELIM Switch. The clutter elimination switch (figure 4-42) reduces ground clutter on the radar screen when placed in the ON position. It functions in the air-to-air search mode only.

MEMORY Dial. The memory dial (figure 4-42) is concentric within the VIDEO PED dial. It controls persistence of the indicator display. Rotating the dial clockwise increases display persistence.

VIDEO PED Dial. The video pedestal dial (figure 4-42) controls the amount of signal threshold plus background noise of the range sweep and targets on the indicator. Rotating the dial clockwise increases signal threshold illumination.

XMTR TUN Light. The transmitter tune light (figure 4-42) illuminates when transmitter frequency is being changed and extinguishes when the desired operating point is reached and the pilot releases the tune switch. It will also extinguish when the limit of tuning range in one direction or the other is reached.

XMTR OFF Light. The transmitter off light (figure 4-42) illuminates when the system is not transmitting because of a malfunction, when in test standby, and when the transmitter and waveguide are not pressurized.

CAUTION

If the transmitter light begins to flash, turn the set to standby. Recycle the set to a working mode and if the light continues to flash turn the set off or standby and have the trouble investigated.

Radar Indicator Bezel.

The radar indicator bezel (figure 4-42) is mounted over the face of the radar indicator screen. Reference marks inscribed on the bezel aid in interpreting the radar displays. Figure 4-43 illustrates the location of the following bezel markings.

PPI Sweep Azimuth Position. References the azimuth position of the PPI sweep, and therefore azimuth position of the antenna, at ± 45 degrees.

PPI Sweep Starting Point (Apex). Indicates the point at which the PPI sweep should start. Also provides a reference for adjusting the ALT SET knob during ground map mode and RANGE GATE knob during air-to-air mode.

Closure speed circle (Range rate gap)
Provides informations about closing rates between 0 and 500 knots. On modified airplanes by ECP 2015 the 3-o'clock reference points indicates 250 knots, 6-o'clock indicates 500 knots, and 9-oclock indicates 250 knots negative closure speed.

PPI Sweep ± 30-Degree Azimuth. References ± 30-degree azimuth for position of the PPI sweep.

NOPE

PPI Sweep ± 15-Degree Azimuth. References ± 15-degree azimuth for position of the PPI sweep.

Range Sweep Ranges. Indicates ranges represented by the range sweep as follows:

INACCURATE

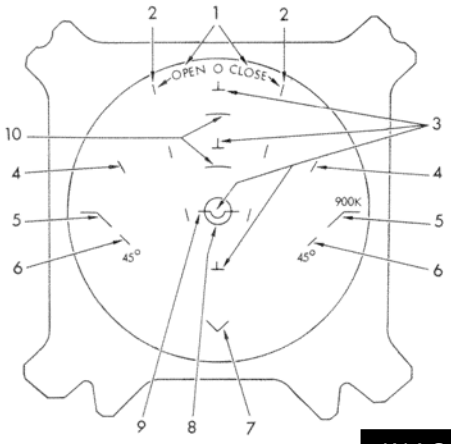
a. In a 20-nautical mile range, the indexes represent 5, 15, and 20 nautical miles.

b. In a 40-nautical mile range, the indexes represent 10, 30, and 40 nautical miles.

c. In an 80-nautical mile range, the indexes represent 20, 60, and 80 nautical miles.

RADAR INDICATOR BEZEL

(TYPICAL)



1. RANGE RATE GAP
2. PPI SWEEP ±15° AZIMUTH
3. RANGE SWEEP RANGES
4. PPI SWEEP ±30° AZIMUTH
5. RANGE RATE GAP REFERENCE POINT
6. PPI SWEEP AZIMUTH POSITION
7. PPI SWEEP STARTING POINT
8. STEERING REFERENCE CIRCLE
9. MINIATURE AIRPLANE
10. TIME REFERENCES

INACCURATE

F43-2-4-99

Figure 4-43

NOPE

The center of the bezel represents the second increment of range in all the ranges (10, 20, and 40 nautical miles in 20, 40, and 80 nautical-mile ranges, respectively).

Range-Rate Gap, Rate Indication Reference. Reference for closing or opening rate indication of the range-rate gap and speed error gap in GCI phases.

Steering Reference. Reference for the steering circle and steering dot.

Miniature Airplane. Represents the wings of the aircraft to show the pilot which direction to roll, using the artificial horizon as an indicator.

Time References. The time reference for the time-to-go circle varies with the weaponry being employed. In Gun mode, the time circle indicates computed time-of-flight of projectile. In Rocket mode, the time circle indicates time-to-go (time remaining before firing the weapon). In Missile mode, the time circle indicates when in-range.

Radar Lockon Indicator Light.

The radar lockon indicator light to the left of the optical sight illuminates when the radar has locked on a target.

Clearance Plane and Antenna Tilt Indicator Panel.

The clearance plane and antenna tilt indicator panel (figure 4-45) is located on the lower right portion of the instrument panel. It indicates clearance in feet between the clearance plane and the aircraft during CM and TA modes and the elevation tilt angle of the antenna in all modes of operation. The panel contains the following indicators and light.

Counter. Indicates, in feet, the amount of clearance selected by the pilot in the CM and TA modes.

ABOVE Light. Illuminates when an above clearance plane has been selected.

BELOW Light. Illuminates when a below clearance plane has been selected.

Antenna-Tilt Indicator. Indicates antenna elevation tilt angle in degrees.

NOPE

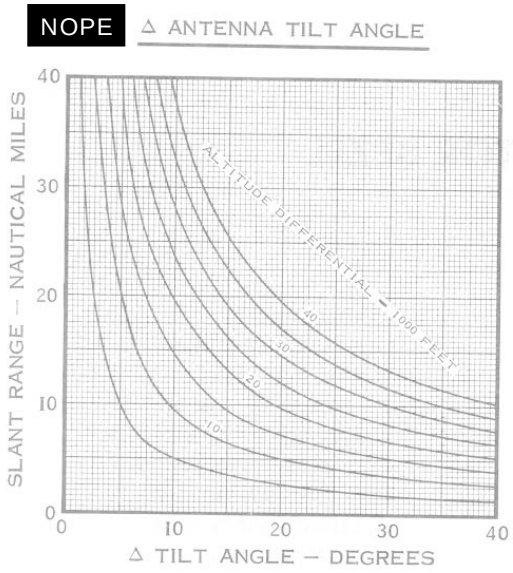


Figure 4-44

A/A Scan Selector Switch MAP

The A/A scan selector switch is located on the left console (figure 1-8) and has two positions, 1 BAR and 2 BAR. When the 1 BAR scan position is selected, the target presentation will appear on each sweep. When the 2 BAR scan position is selected the target presentation may appear on every second sweep, requiring a finer setting of the antenna tilt to obtain a constant target presentation.

MANUAL ANTENNA TILT PROCEDURE. NOPE

In the normal air-to-air search mode, the radar antenna is stabilized parallel to the horizontal. The antenna is stabilized in such a manner that should the aircraft rotate through any pitch angle, the antenna will tilt through an equivalent angle and thus remain aligned to the horizon regardless of the aircraft's pitch attitude with zero manual antenna tilt. The radar beam sweeps in a two-bar scan pattern 90° in azimuth and 10° in elevation.

In the event that radar contact is to be made with a target, it may become necessary to manually tilt the antenna. If the target slant range and altitude differential are known, the tilt angle required (Δ tilt angle) can be obtained from figure 4-44. On MAP aircraft, in 1G flight the antenna-tilt indicator will be oscillating through a 2° range when in 2 BAR position. The midpoint of this oscillation is the search tilt angle along which the antenna is aimed. Add or subtract the tilt angle to search tilt angle as required to correctly position the antenna for radar contact.

RADAR MODES OF OPERATION.

The radar modes of operation are presented in the sequence in which they appear by clockwise rotation of the MODE SELECT switch on the radar control panel. They are as follows:

STANDBY MODE.

In the standby mode the system operates the same as in the air-to-air mode (provided the 3-minute warmup period is over) except that the transmitter is off; therefore, no target display is presented on the radar indicator except for data link (if installed) presentations.

AIR-TO-AIR MODE.

The air-to-air mode is subdivided into the three submodes, or phases: search, acquisition, and track. During search, the target is located (detected) on the radar indicator. The antenna is operated to scan ± 45 degrees looking ahead. If the target is within 20 NM and within antenna gimbal limits the radar automatically locks on the selected target and initiates the track mode.

Search. In air-to-air search, the antenna beam sweeps ahead of the aircraft 90 degrees in azimuth and covers 180 degrees in elevation. Target selection should be done using TGT select button cycling on available targets, a maximum of 10 targets can be selected, but only one can be locked. Once all target have been selected during a selection cycle is recommended to reset target selection using TGT reset button. If a data link with a GCI is available the CMD light indicates that targets are available, selecting a target shows some informations on TGT:

- Target is labeled
- altitude in feet, heading and speed in knots

Range selection of 5, 10, 20, 40 NM are available. In either modes data link equipment (when installed) receives, decodes, and presents GCI information to the armament control system where it is displayed on the radar indicator. The information is used to vector the interceptor to an attack position and facilitate target location. Two vectoring phases are used: a command phase to set up a position advantage, and an attack phase to initiate an

NOPE

CLEARANCE PLANE AND ANTENNA TILT INDICATOR

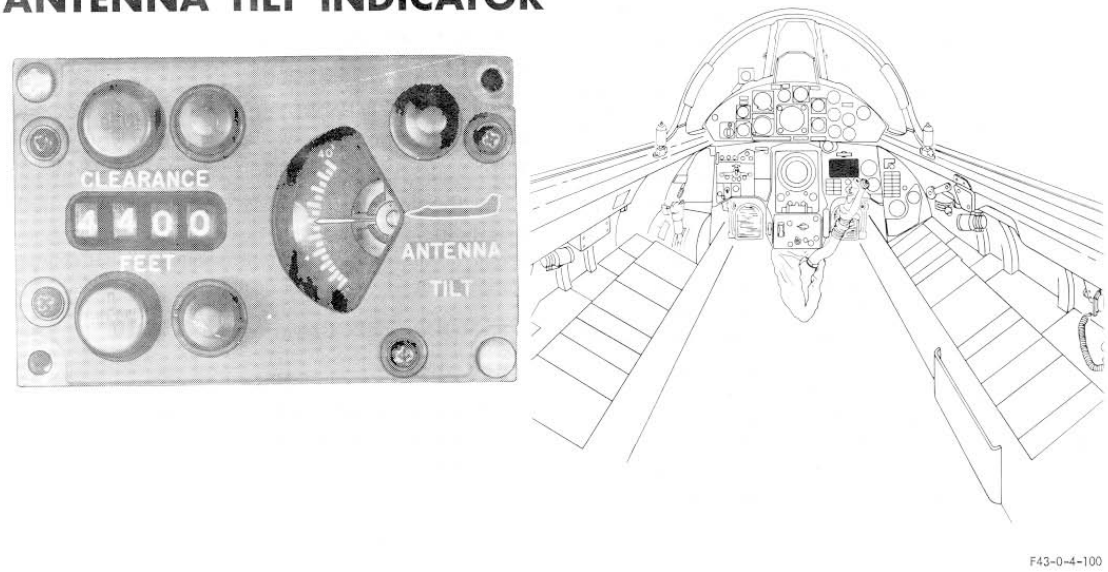


Figure 4-45

attack. Verbal GCI commands may be used to vector the aircraft during search.

Note

NOPE

Full IF gain should be used whenever possible to provide maximum lockon performance and target detection range. At low altitudes, however, ground clutter usually prevents the use of full IF gain. The clutter eliminator can be used with full IF gain or IF gain can be reduced. A combination of clutter eliminator and IF gain setting (or IF gain only, depending on the situation) should produce the best display. Normally, at close range use of the clutter eliminator should not be necessary, and the target can be detected using reduced IF gain only. The clutter elimination switch must be used with discretion, since the target can also be eliminated if within a dense clutter display. An alternate method of eliminating ground clutter (when feasible) is to remain below the target altitude so the radar antenna scans upward. The clutter elimination switch should be placed in the OFF position after lockon to assure proper display of the intensified range gate. On modified aircraft utilization of the A/A scan selector switch in the 1 BAR position tends to alleviate the problem of tracking in clutter at lower altitudes.

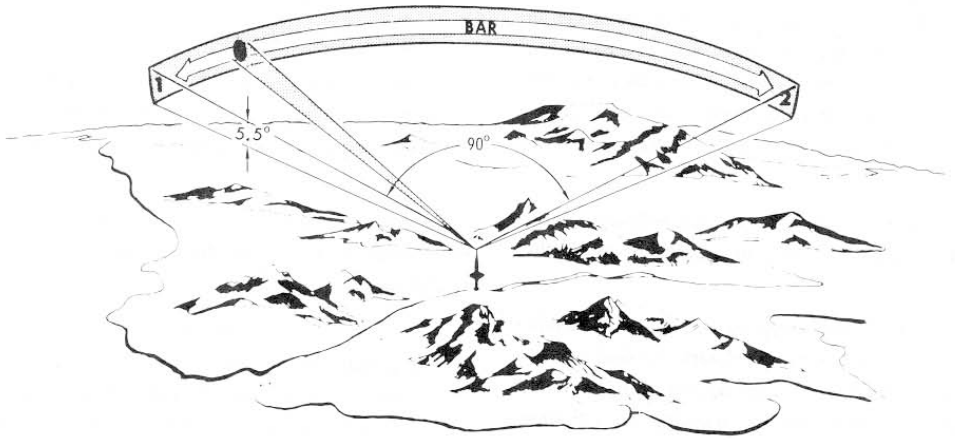
Target Acquisition. Either blind or visual target acquisition can be employed. Blind acquisition consists of acquiring target lockon by using the displays presented on the radar indicator. Visual acquisition consists of acquiring target lockon while observing the target through the optical sight reticle.

Track. During track the system is locked on and tracking the target. The radar provides output signals corresponding to range, range rate, relative bearing and elevation, and line-of-sight rates as analog signals to the armament control computer for solution of the air-to-air armament control problem. Steering information is provided by the radar indicator and optical sight displays to indicate the course on which the aircraft should be flown. The attack course flown depends on the arma-

AIR-TO-AIR SEARCH

ANTENNA 1-BAR SCAN PATTERN AND RADAR B-SCOPE DISPLAY

INTERCEPTOR AIRCRAFT
MODIFIED BY ECP 2012



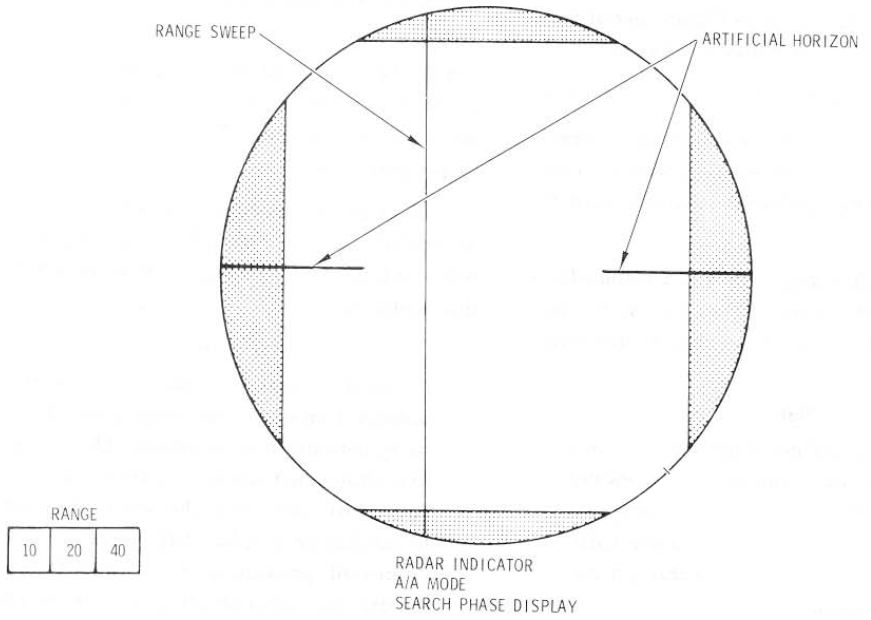


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Figure 4-61 (Sheet 1 of 2)

Air-to-Air Track. Track is the final phase in the completion of an air-to-air attack. The radar system may be used to vector the airplane within range of the target for gun firing, rocket firing, or missile launching. The system may be operated to lock on and track a target at ranges up to 20 miles in blind acquisition regardless of the type of attack. However, the armament computer is limited to certain ranges in which it can compute accurate steering information. Outside these range limits, tracking information is presented on the radar indicator but will not be as accurate; however this tracking information may be used to fly the airplane on a course that will permit a smooth transition into the final phase of attack. Once the radar is locked on and tracking a target, a lead-pursuit type of course is computed. The attack may be completed using either the radar display (figure 4-66 for fighter-bomber aircraft modified by ECP 2015, ~~and figure 4-67 for interceptor aircraft modified by ECP 2012~~) or the optical sight display (figure 4-39). If lockon is achieved at a fairly long range, the track is usually started using the radar display and as range decreases to the point where the target can easily be tracked visually, using the optical sight display. Either a blind or visual attack may be used. Procedures for track in the air-to-air mode for each individual forward-firing weapon follow.

TYPES OF ATTACKS.

Gun Firing.

The sighthead, in the gun mode, provides a moving reticle through which the pilot tracks the target in visual terminal phase of lead pursuit. Movement of the reticle, proportional to signals from the armament control computer, provides the correct lead so that the pilot flies the correct lead course by superimposing the reticle over the target. During visual bombing the sighthead reticle may be used as the tracking reference. In the missile mode, the sighthead reticle is electrically caged to the missile reference line (MRL) for a missile launch reference with sight on norm and uncaged. Firing of the gun above 47,500 feet may result in afterburner blowout or compressor stall, especially when gun firing is accompanied by G forces and maneuvering. However, during gun firing tests, no actual engine flameouts were experienced, even above 50,000 feet. Afterburner blowouts and compressor stalls can be corrected in most instances by reducing speed or altitude; or, in more severe cases, by engine shutdown and restart.

Note

- Engine ignition No. 1 and No. 2 is provided during and 10 to 15 seconds after firing of forward-firing weapons. Also, the inlet guide vanes are closed 5 degrees to minimize inlet distortion effect on the engine.
- Vibration may cause the tachometer needle to fluctuate during gun firing. Normal operation will resume after gun firing has ceased.
- An engine rpm of 80 percent or more is necessary to provide sufficient purge pressure to permit gun firing.
- At engine speeds below 95 percent rpm the generator output may not be sufficient to ensure gun clearing; therefore, maintain engine rpm above 95 percent to preclude live ammunition remaining in the gun breech.

Blind Attack. The indicator display presented in gun blind attack is illustrated in figure 4-66 for fighter-bomber aircraft modified by ECP 2015, and figure 4-67 for interceptor aircraft modified by ECP 2012. The large time circle represents time during which the airplane is in firing range. The range-rate gap represents closure rate or opening rate on the target. The steering circle is accompanied by a steering dot. The range sweep presents a target indication. In flying the blind attack proceed as follows:

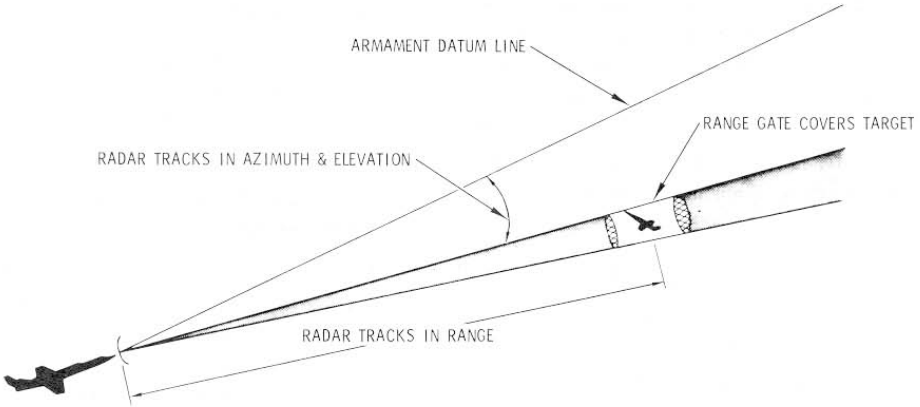
Select the following switches for blind or visual gun firing.

1. Armament mode selector switch—GUN.
2. Forward firing master arming switch—ARMT/CAM.
3. Sight—Normal and uncaged.
4. ~~IR sight—ON.~~
5. Maneuver the airplane to center the steering dot and circle. The circle is a coarse steering error signal and the dot is a fine or sensitive indication. As the steering circle moves toward the center of the screen, the dot moves toward the center of the steering circle. When on course the dot will be centered within the steering circle. The direction of maneuver must follow the indication. Maintain the dot within the steering circle.

TRACK

ANTENNA PATTERN AND RADAR SCOPE DISPLAY

FIGHTER-BOMBER AIRCRAFT
MODIFIED BY ECP 2015



TRACK MODE-ANTENNA BEAM

CLOSURE SPEED CIRCLE
- Range rate gap at 12-o'clock closure at 0 or no target selected
- Range rate gap at 3-o'clock closure 250 knots
- Range rate gap at 6-o'clock closure 500 knots
- Range rate gap at 9-o'clock negative closure -250 knots

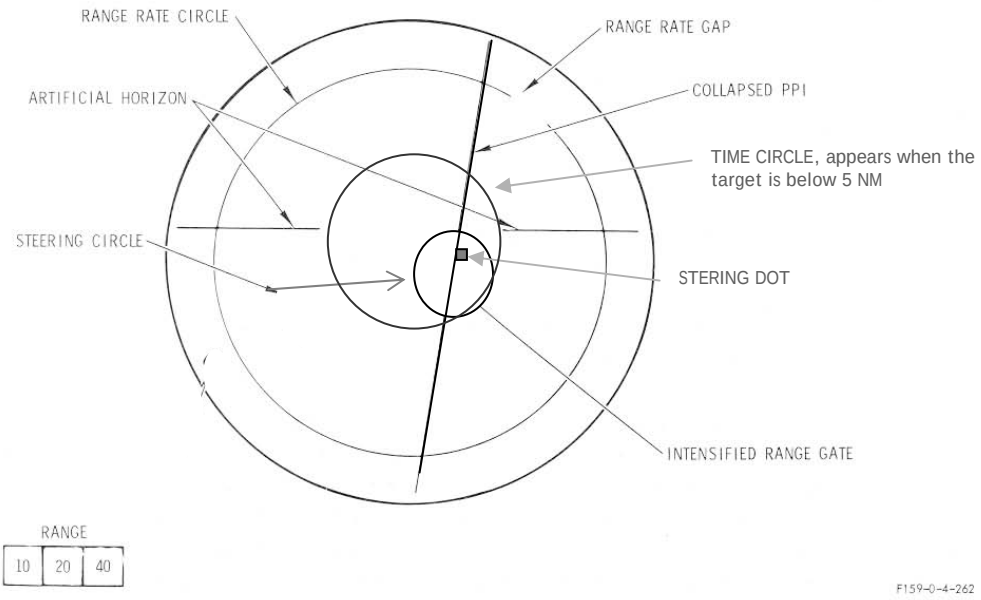


Figure 4-66

6. Trigger switch—To fire the gun depress to second detent when the time circle is within the inner time reference mark on the bezel (figure 4-57). The mark represents maximum firing range.

7. Break off the attack immediately at the breakaway signal, which consists of a wailing breakaway siren in the earphones and a breakaway cross (figure 4-68) appearing at the center of the radar screen.

Visual Attack. The sight reticle is positioned by the steering information to incorporate the proper lead angle. The correct firing course is flown by positioning the reference pipper in the center of the reticle over the target.

1. (Fighter-bomber aircraft modified by ECP 2015). Cage the radar to the armament datum line by placing the altitude set and range gate knob in detent and momentarily depressing the action reject button. The range gate will automatically slew between 1500 and 12,000 feet. Acquisition of the target within this range will result in lockon.

(Interceptor aircraft modified by ECP 2012). Cage the radar to the armament datum line by placing the position control stick in upper detent position and momentarily depressing the action reject button. The range gate will automatically slew between 2250 and 12,000 feet. Acquisition of the target within this range will result in lock on.

2. Maneuver the airplane to position the optical sight pipper on the target. Check the lockon light mounted on the left-hand side of the combining glass. (A lockon display will also be present on the indicator.)

3. At lockon, the red analog bar on the gunsight will slew from the 9-o'clock position to 3-o'clock, or a relative position in relation to the actual range. As range is decreased, the analog bar will decrease to the 6-o'clock position. At 6 o'clock, maximum effectiveness of projectile flight has been reached. Allow at least ⅔ of a second for tracking prior to firing a burst, which will insure proper computation of lead angles, gravity drop, and trajectory shift. Maximum time of projectile flight at the 6-o'clock position is 1.47 seconds, and when 9-o'clock position is reached on the analog bar, 0.45 second projectile flight time remains. At this time, the wailing tone is heard.

4. Lockon within firing distance will indicate immediate fire.

Sidewinder Missile Attack.

After the pilot is in the cockpit and normal prestart operations have been completed, the missiles should be checked. With external power on, the seeker heads should be in operation so the pilot will be able to make an audio check to ascertain satisfactory missile seeker operation. When the missiles are installed on the launchers, protective covers are in place over the missile heads. As the pilot first listens to the audio signal, a very faint signal will be received. Without any weapon selector button pushed the pilot will hear the left tip missile tone. On **Consortium** aircraft incorporating L.O. 1-11-7-35 an automatic audio tone is also provided, without missile selection, from the left fuselage missile. When the pilot pushes the proper selector button for another missile he will then hear that missile. On fuselage installed missiles **F** (L.O. 1-11-7-35 n c/w) and pylon installed missiles **F/TF** the pilot must select the proper button to hear missile tone. The pilot can turn off the left missile tone by operating the missile volume control (the tone can also be turned off by switching to another missile position on the armament control panel). When ground crewmen remove the seeker covers prior to taxiing, a louder signal will be heard as the seeker system picks up the infrared radiations from the surrounding area. A light, directed into the seeker head with a corresponding signal increase in the earphones, will provide a satisfactory check of seeker operation.

CAUTION

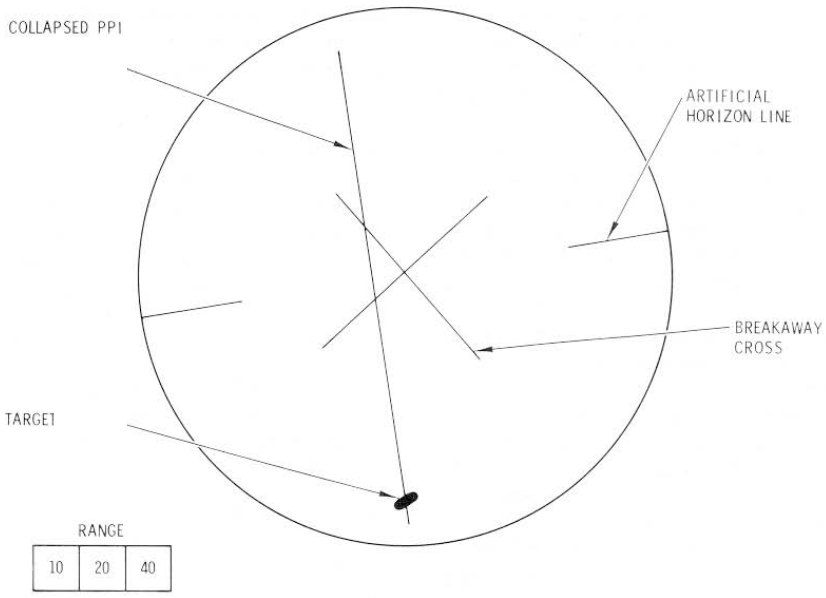
To avoid objects being blown against glass seeker head, do not taxi too closely behind other aircraft.

Blind Attack. The radar display presented in missile attack is similar to that of a gun attack (figure 4-68); however, the display responds differently to provide range indications and an aural tone provides indications of missile-firing conditions. At radar lock-on, the radar display is the same as for the gun attack (the steering

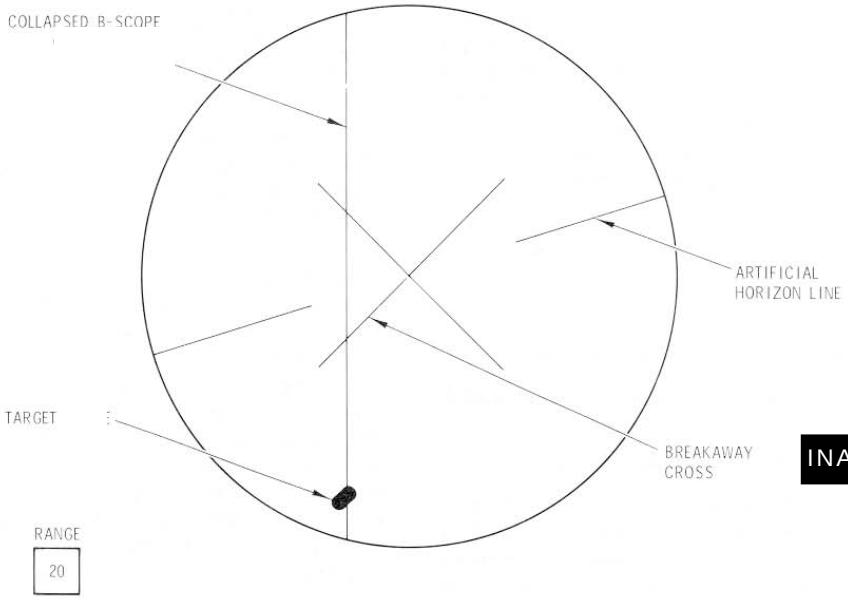
BREAKAWAY

RADAR SCOPE DISPLAY

FIGHTER-BOMBER AIRCRAFT MODIFIED BY ECP 2015



INTERCEPTOR AIRCRAFT MODIFIED BY ECP 2012



INACCURATE

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Figure 4-68

INACCURATE

INACCURATE

dot and circle furnish steering information and the range-rate gap in the time circle indicates rate of closure). The time circle, however, does not diminish steadily as the range decreases, but remains at original size until maximum firing range is reached, at which time it instantly decreases to half size. When the missile is receiving a signal, a steady tone is heard in the earphones. The missile should not be fired until the intermittent tone is heard, even if the in-range signal has been displayed. At maximum firing range the missile lockon tone (steady tone) changes to an intermittent tone simultaneous with the decrease in the time circle. The intermittent tone reverts back to a steady tone if the turn G-load limits of the missile are exceeded. The missile should not be considered infallible. Basically, the two areas (envelopes) in which the aircraft must be before launching the missile are (1) the radiation envelope of the target, and (2) the performance envelope of the missile. The radiation envelope of the target is dependent upon its configuration; that is, prop or jet, number of engines, and altitude. The performance envelope of the missile is determined by the maximum and minimum guidance range of the missile and the maximum G that the missile can pull at a given altitude. When the attacking aircraft is in firing position the pilot should hear missile tone from the target. The pilot should maintain no more than the required G's on his airplane before pressing the trigger on the control stick. Once the missile has been fired the pilot may maneuver to avoid contact, press the attack with another missile, or close to gunfire range. At minimum firing range the time circle instantly increases to full size. At breakaway range, a breakaway cross appears on the radar indicator and a wailing tone is heard. Due to the fact that the missile will maneuver itself into a collision course with the target with no more direction from the attacking aircraft, the pilot is free for further action. The accuracy and reliability of the missile are sufficient to ensure target destruction.

Select the following switches for blind or visual missile attack:

1. Sight—Normal.

2. Armament mode selector switch—Missile.

3. Forward firing master arming switch—ARMT CAM.

4. External stores selector buttons—Press.

5. Trigger switch—Depress to second detent any time after the large range-rate circle is instantly replaced by a half-size circle (coincides with the inner time reference marks), and the steady aural tone changes to a chopped intermittent tone. If the aircraft is in range but the missile is not receiving a signal, no tone will be heard. If missile G-load limits are exceeded the chopped tone reverts back to a steady tone and the 6-o'clock position on the optical sight disappears. The time circle on the radar indicator bezel will simultaneously revert to its original size (3 in. dia.). When G loads are reduced below limits the chopped tone is again heard in the earphones and the 6-o'clock position of the optical sight reappears. The time circle on the radar indicator bezel decreases to half-size (1½ in. diam.).

Note

- It may be necessary to lead the target during high G missile launches in order to obtain an adequate missile firing tone. A lead of approximately 15 to 20 mils will provide the necessary tone to fire the missile. This requires the pilot to coordinate the target lead point in respect to the gunsight pipper in the actual direction of the launching aircraft's yaw and pitch attitude.

- There is a time lag of about one second between the ignition of the servo grains in the missile power generator and the firing of the rocket motor.

- Only one missile will fire each time the trigger switch is actuated. The missile firing sequence is pylon stores before fuselage stores and left-side stores before right-side stores. Only those missiles selected by actuation of the external stores selector button will fire, thus individual selection is available. Do not carry missiles on both the tip and pylon stations simultaneously. With the present circuitry, missiles will not fire from both the tip and pylon stations.

6. Initiate a maximum-G breakaway immediately after missile release, or not later than the minimum launch range, as indicated by the optical sight range analog bar approaching the 9-o'clock position.

Visual Attack. The optical sight display during missile attack is similar to that of a gun attack (figure 4-38); however, the position of the right end of the analog range bar signifies missile firing range rather than time. The analog range bar begins to shorten when the aircraft is within 10 nautical miles of maximum range. The end of the bar is at the 6-o'clock position when maximum range is reached. At the 6-o'clock position ~~the steady tone becomes chopped, or intermittent,~~ and the analog bar continues to shorten toward the 9-o'clock position. To track the target superimpose the reticle center dot over the target.

1. Trigger—Depress to second detent when the range analog bar is between the 6 and 9-o'clock positions, the

firing index is present, and the chopped (intermittent) aural tone is heard. If the missile G limits are exceeded, the tone reverts to a steady tone and the firing index at the 6-o'clock position on the optical sight disappears. The time circle on the radar indicator bezel will simultaneously revert to its original size (3 in. dia.). When the G forces are reduced to below limits, the chopped tone is again heard and the firing index reappears. The time circle on the radar indicator bezel decreases to half-size (1½ in. diam.).

2. Initiate a maximum-G breakaway immediately after missile release, or no later than the minimum launch range, as indicated by the optical sight range analog bar shortened to the 9-o'clock position.

Rocket Attack.

For a rocket attack the steering information furnished is for a lead collision course. The lead collision course requires that the aircraft be positioned considerably ahead and abeam of the target prior to initiating the attack. An attack is then flown that positions the aircraft at close to 90 degrees to the target flight path. (Head-on approaches involving high rates of closure should be avoided.) This type of attack is normally employed when the aircraft is performing an intercept mission and firing 2.75-inch FFAR rockets. Air-to-air rocket attack is always flown using the radar display (figure 4-66 for fighter-bomber aircraft modified by ECP 2015, and figure 4-67 for interceptor aircraft modified by ECP 2012) in blind attack only.

Note

Attack can be flown from 0 to 150 degrees but the desirable range is from 60 to 120 degrees.

Blind Attack. Use the following procedure:

1. Forward firing master armament switch—ARM & CAM.

2. Armament function selector switch—ROCKET.

3. Rocket select switch—AUTO.

4. External stores selector button (pylon)—Press.

5. Maneuver the aircraft to center the steering dot and steering circle.

6. Observe the range-rate gap for rate of closure as indicated by its rotation within the range-rate circle.

7. Trigger switch—Press to second detent and hold in when rate circle begins to diminish. The armament control computer will then compute the correct firing time and fire the rockets automatically when within range.

8. When the rockets are released, the breakaway cross appears on the radar indicator. Release the trigger switch and break off the attack.

After the rockets have been fired the pods may be jettisoned as follows:

1. External stores selector switch—PYLON BOMBS.

2. External stores selector button (pylon) — Depressed.

3. Bomb release switch—MANUAL RELEASE.

4. Bomb button—Press.

GROUND MAPPING.

Three mapping modes are used for navigation to a target area and also as a tactical aid to finding the target. They are ground map, contour map, and terrain avoidance.

Ground Map Pencil and Ground Map Spoiled Modes.

The function of both the ground map pencil (GMP) and ground map spoil (GMS) operating modes is to provide a radar picture of the terrain ahead of the aircraft. This is accomplished by programming the radar antenna to scan 45° either side of the aircraft centerline. ~~Ranges of 10, 20, and 40 nautical miles are available in both modes for fighter-bomber aircraft modified by ECP 2015; and~~ ranges of 2 ,5,10,20,40 and 80 naut. miles are available in both modes for interceptor aircraft modified by ECP 2012.

The purpose of the mapping modes is to continuously assist the pilot with his navigation regardless of weather conditions or time of day. However, dead reckoning (time and distance) remains the primary means of navigation. Any attempt to substitute radar for dead reckoning, especially at the lower altitudes, will some day cause confusion and eventually get the pilot lost.

~~The antenna, as in the air-to-air mode, is manually adjustable from 20° above to 38° below the armament datum line and is adjusted to provide uniform scope presentation or to position the radar on areas of interest.~~ The antenna sweeps horizontally in a one-bar scan which is pitch stabilized and roll corrected. Pitch stabilization is necessary to hold the radar presentation constant as the aircraft changes its pitch attitude. Roll correction is effective up to about 15° of bank at which time the radar picture will begin to narrow. The antenna cannot

GROUND MAP

ANTENNA PATTERN AND RADAR SCOPE DISPLAY

FIGHTER-BOMBER AIRCRAFT
MODIFIED BY ECP 2015

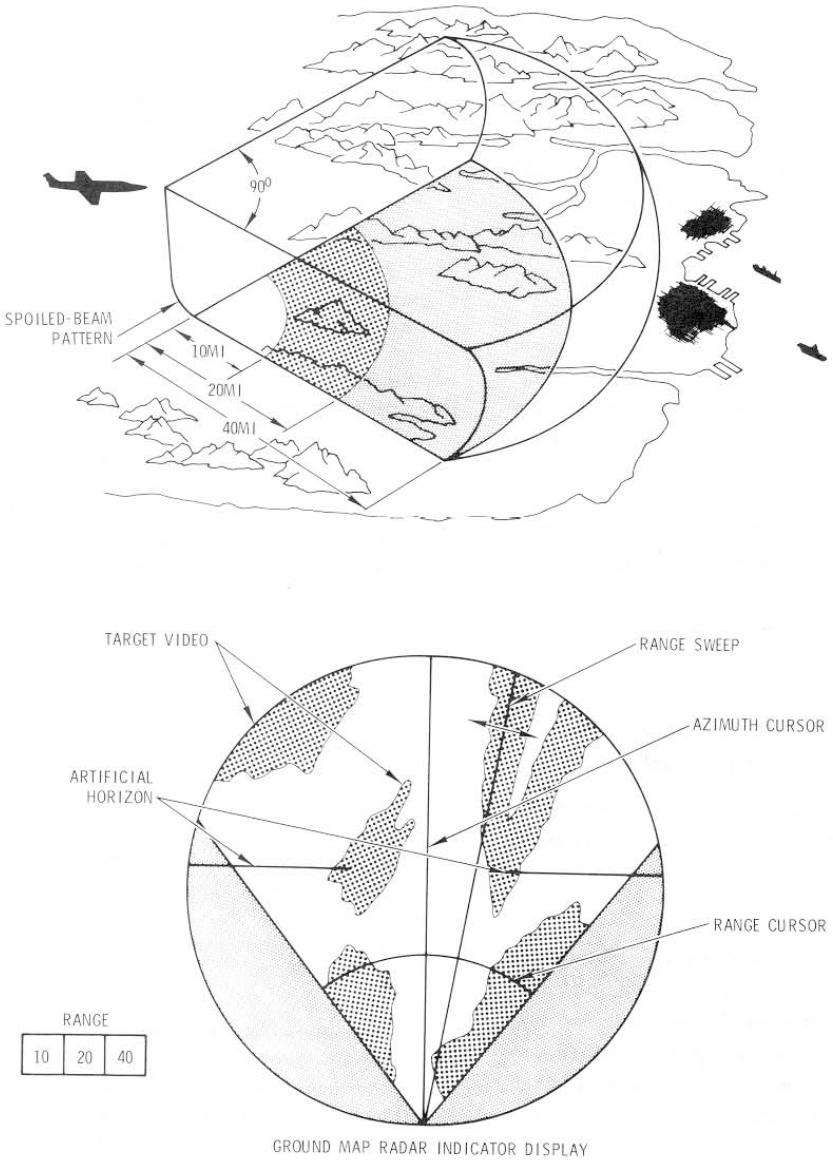


Figure 4-69

clearly displayed.) The orientation of the target to the pointers is established by radar prediction during the flight planning phase.

3. Terrain representation. The terrain is represented with different shades of green depending on the altitude, the higher the altitude lighter the shade, while the water represented with black. Both in GMP and GMS mode informations on airports and nav aids are available, such information can be viewed operating with swicthes in radar control panel.

General GMS Techniques.

INACCURATE

As previously stated, GMS is used most effectively above 3000 feet AGL. Let us assume a level off at 30,000 feet with the controls adjusted as shown in the table on page 4-140.

With this setting, the video returns on the scope should be fairly uniform. If they are not, slowly rotate the antenna down until a uniform video return is obtained. Once the scope is "full," rotate the IF Gain to the desired position. Slowly decrease the IF Gain until a good picture of the terrain is presented. To optimize the display, slowly adjust the intensity and memory. (It may be necessary to adjust the antenna slightly.)

If selection of a target is required, proceed as above. When definite identification of the selected target has been accomplished, continue to decrease the IF Gain until target "breaks out" of the ground returns and clutter. From this point, the selected target may be tracked down the scope.

Since the RF energy is optimized to 40 miles (80 miles, ECP 2012) in the spoiled mode, it will be to your advantage, when at altitude to use the pencil beam when the 80 miles, ECP 2012, check point identification is desired.

When flying at intermediate and low altitude (above 3000 ft AGL), the same technique may be used.

Ground Map Pencil.

The inherent advantage of the pencil beam is realized through clarity of the returns and ability to "break out" targets, even at high altitudes, and distant ranges.

In the Ground Map Pencil mode, the area covered by the transmitted energy is a function of altitude, antenna elevation angle and beam-width height of the transmitted energy. Since the transmitted-beam height remains constant at 6.2 degrees, the primary variables affecting the ground area covered are altitude and the antenna-tilt angle.

In the GMP mode, consider for an example, that the antenna angle is 0 degrees. At an altitude of 3000 feet AGL, the bottom of the beam will contact the ground at about 11 nautical miles. At an altitude of 7200 feet (AGL), the bottom of the beam will contact the ground at about 22 nautical miles. From this, we may establish a rule of thumb for the use of Pencil and Spoil submodes of the GM mode.

When using GMP at higher altitudes (15,000 feet and above) you will notice the narrow beam pattern on the indicator. The gain must be readjusted for optimum display if GMS were being used. It will be necessary to adjust the antenna tilt every few miles in order to track, or map a specific area. The IF Gain must be reduced as range to target is reduced; this is caused by increased antenna gain. GMS is best at intermediate and high altitudes, and close ranges.

At low altitude (below 3000 ft AGL), GMP is inherently superior to GMS. The relative flat dispersion of RF energy causes a uniform display at low altitude. The high concentration of energy may require a low IF Gain setting. Very little movement of the antenna will be necessary. Once a satisfactory gain setting has been achieved, the display is best optimized through use of intensity and memory.

Effect of Bank Angle GMS/P, CM/TA.

Since there is no roll gimbal, the antenna is not truly roll-stabilized. However, roll compensation is computed and permits bank angles up to approximately 15 degrees without an appreciable error affecting the relationship of the target presentation.

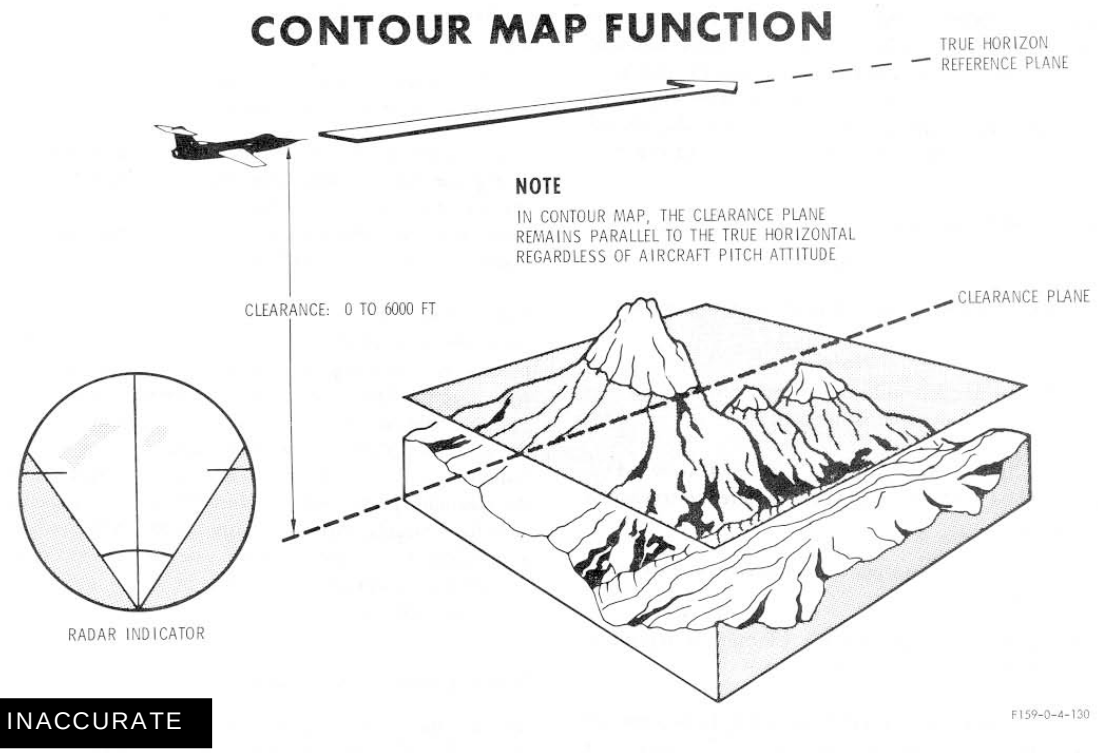
Sector narrowing, in ground map modes, is caused by an effective physical reduction in the azimuth sweep limits, whereas the effects on contour map and terrain avoidance when a bank angle is introduced are caused by a rotation of the transmitted beam (fixed antenna).

Effect of Beam Pattern.

The pencil beam pattern consists of:

1. The main beam.

2. Several secondary beams above, below, and to the sides of the main beam.



INACCURATE

Figure 4-71

The secondary beams are referred to as side lobes. These are due to antenna configuration and radome characteristics. The side lobes have identical characteristics of the main beam except the transmitted power is much lower than that of the main beam, and in CM/TA the phase relationship is reversed. The only side lobe which is of importance is the one appearing immediately below the main beam.

This side lobe is approximately 12 degrees down from the main beam and its phase relationship is inverse to that of the main beam. (Therefore, in CM and TA, if the system sees the return from this side lobe, a false height of the target will usually be computed, and a warning signal will be displayed. This signal from the side lobe will be displayed at any time when the object in the lobe has high reflective characteristics such as mountains, hangars, buildings of concrete and steel, etcetera.

The range at which this side lobe warning will be displayed is a function of altitude.

In contour map and terrain avoidance, the side lobe warning also becomes an inverse function of the clearance plane setting, that is, a reduction of the clearance plane setting will increase the range of the side lobe return. In most cases, this depends on altitude above the terrain, that is, when in excess of 2000 feet above level terrain, the clearance plane set at 1000 feet or less, the side lobe return may show a warning at a range outside of the fail safe cursor.

The pilot must be aware of this characteristic. If the pilot lowers and raises the clearance plane with no apparent, or very little, movement of the suspected side lobes, it can be assumed these are side lobe returns. Always check the map and desired course to help determine the position where side lobes may be expected.

CONTOUR MAP MODE.

The contour map mode provides a display of the terrain contour in the forward quadrant. In contrast to ground mapping (which simply differentiates between surface features), contour mapping differentiates between altitudes of topographic projections above a preset clearance plane. The clearance plane is parallel to true horizontal at all times, at an elevation that is manually adjustable

from 0 to ±6000 feet relative to the altitude of the airplane. Only those surface features that have sufficient height to project into the clearance plane are visible on the contour mapping display. These features appear on the display in a manner similar to the way they would appear on a conventional topographic map of the area.

Contour Map Operation.

1. MODE SELECT switch—CM.

2. Range sweep switch—20 nautical mile position.

Note

The 40 nautical mile range scale can be used but the presentation is not reliable.

3. CL PLANE SET switch (CL PL SET switch, ECP 2012)—Hold at INCR or DECR as required to set desired clearance.

4. Observe clearance plane indicator for the clearance as set in feet.

5. Observe radar display for contour of terrain at intersection with the clearance plane.

6. ABOVE CL button (ECP 2015 only)—Depress and hold. The contour displayed will be that of terrain at the preset clearance but above instead of below the aircraft. This may be desirable when flying in a valley with mountains on either side. As the clearance is being set, the antenna tilt pointer will move in synchronization with antenna movement. When the ABOVE CL button is depressed the pointer will move to an up indication corresponding to the down position previously indicated.

WARNING

In both the CM and TA modes, accuracy of the clearance plane in the above-clearance and the 40-mile range functions are degraded, consequently the above-clearance plane function should be considered inaccurate and only used during an emergency.

Characteristics and Limitations of the Clearance Plane In Contour Map and Terrain Avoidance.

The clearance plane establishes a reference plane below the aircraft for determining unsafe obstructions along the flight path.

1. In contour map the clearance plane remains parallel to the true horizontal regardless of aircraft pitch attitude.

2. In terrain avoidance the clearance plane remains parallel to the aircraft flight path.

3. The distance below the aircraft at which the clearance plane occurs is established by pilot selection, using the clearance plane set control on the radar control panel. Clearance plane altitude is read on the clearance plane and antenna tilt indicator panel.

The system displays a return depending on the computed elevation of the object in relation to the clearance plane. Only objects protruding into the clearance plane will "paint." The radar, through various circuits, will compute whether or not an object is protruding into the clearance plane and thereby paint a return on the indicator, or whether the signal is negative (target below the clearance plane, and therefore not painting). Some very hard targets, such as a large hangar, will produce a warning, or "show," due to side lobe effect, even though that particular target may be below the clearance plane setting.

Effective Antenna Alignment.

The antenna is bore-sighted physically and electronically during the ground calibration procedures so that the centerline is projected 25 milli-radians depressed from the 10 nmi line on the clearance plane. In contour map, the output of the inertial navigator stable platform is used to maintain the antenna sweep parallel to local horizontal and is roll corrected. The clearance plane set switch keeps the antenna "lookdown" angle at the proper declination to maintain the proper crossover point with the horizontal clearance plane.

WARNING

The misalignment of antenna tilt (clearance calibration knob) when airborne will yield a tilted clearance plane which will, in effect, jeopardize the pilot's safety while using contour map or terrain avoidance.

In the terrain avoidance mode, roll correction is maintained but angle of attack information is substituted for pitch stabilization so that the clearance plane is no longer stabilized to the true horizontal but will follow and be parallel to the flight path. Plane reference is taken from the right guide vane and fed through the ADC.

INACCURATE

ANTENNA ELEVATION COVERAGE CHART

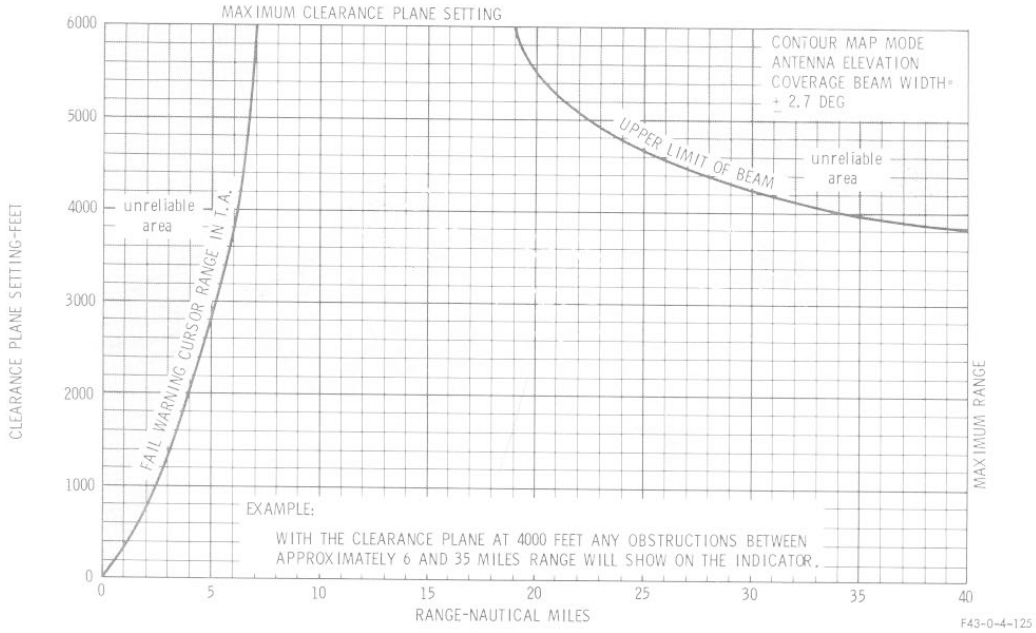


Figure 4-72

Generally ground calibration of the CM/TA plane will be flight checked on each flight if possible. If sufficient flight time is available to air calibrate a misaligned set it would be accomplished and then noted in the A/C forms.

TERRAIN AVOIDANCE MODE.

In the terrain avoidance mode, as in contour mapping, only those objects projecting into a preset clearance plane are displayed on the radar indicator. The clearance plane elevation is adjustable from 0 to ±6000 feet with respect to the airplane. There is one significant difference from the contour map mode, however: in the terrain avoidance mode, the orientation of the clearance plane is maintained parallel to the airplane flight path, rather than to true horizontal as in contour mapping. Indications of obstacles in the flight path will appear on the radar indicator in sufficient time for avoidance of collision. When an obstacle appears on the indicator, the pilot climbs until the obstacle disappears. A fail-safe cursor is also displayed in this mode to indicate satisfactory performance; however, the fail-safe cursor does not appear on the 40 mile range. Target information displayed inside the cursor is unreliable. (See figure 4-72 for reliable target range boundaries as a function of clearance plane in contour map and terrain-avoidance modes of operation.)

Note

Hard targets may show outside the fail-safe cursor with low CL plane setting. These are caused by the side lobes.

Terrain Avoidance Operation.

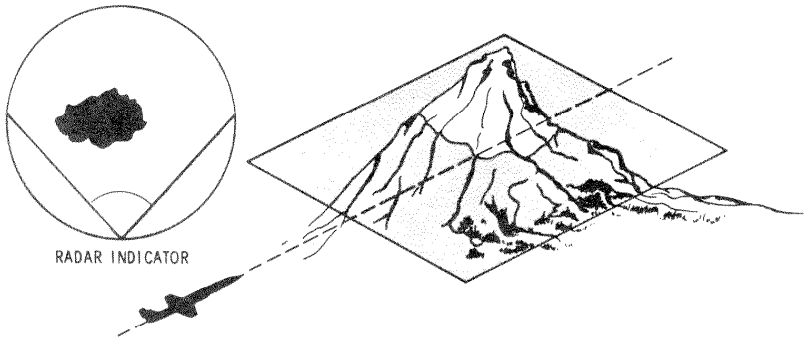
The terrain avoidance (TA) mode is similar to the contour map mode, except that in contour map the clearance plane is always parallel to local horizontal, whereas in terrain avoidance mode the clearance plane is parallel to the aircraft flight path. (See figure 4-73.) The procedure is similar to that for contour map except that the mode select switch is turned to TA. There are two differences in the indicator display: no azimuth cursor is displayed and a fail-warning cursor is presented. Absence of the fail-warning cursor means the terrain avoidance mode is unreliable. Targets that are outside the boundaries of the curves illustrated on figure 4-72 may or may not be displayed. If they *are* displayed, they must be considered unreliable. The range sweep beyond 20 nautical miles is unreliable.

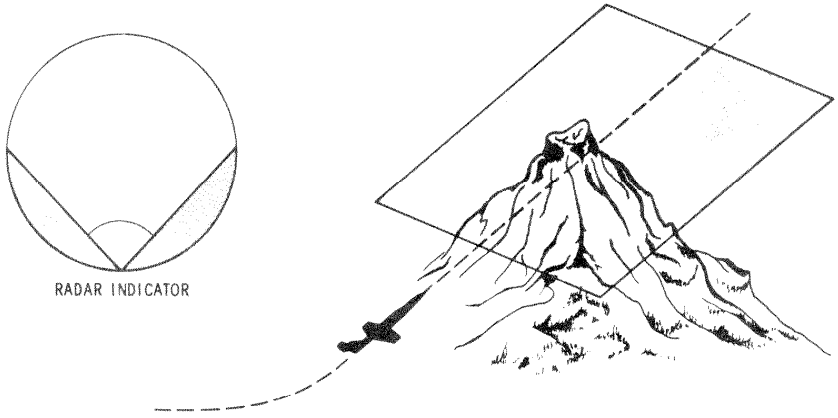
NOPE

INACCURATE

TERRAIN AVOIDANCE FUNCTION

NOPE INACCURATE





HH 1483
F159-0-4-132

Figure 4-73

The RANGE VERSUS CLEARANCE PLANE curve extending from zero nautical mile range to 7 nautical miles corresponds to the fail-warning cursor range displayed in the terrain-avoidance mode. However, a fail-warning cursor is not displayed in contour-map mode and there is no indication of "outside the upper limit of beam" in either contour-map or terrain-avoidance mode.

In the CM/TA mode clutter signals can appear in the form of light noise specks or false targets. This can occur over certain types of terrain with clearance plane settings above 500 ft. The probability of getting the clutter or false targets will increase as the clearance plane setting increases. These clutter specks or false targets can be distinguished from normal terrain targets as follows:

1. The clutter specks or false targets will appear suddenly (generally in the fail-safe cursor) and will be at a lesser range than the real target.

2. These clutter specks do not follow in range with the normal terrain targets, nor change in intensity as range to presented target decreases.

3. By lowering the clearance plane to 500 ft the real targets will increase in size and intensity, while the clutter specks should disappear.

Clearance Plane Accuracy Check.

An accurate check of the clearance plane must be accomplished before either the CM or TA mode is used. Two requirements are necessary to make this check:

1. An accurate terrain elevation point.

2. An accurate altimeter setting for the check area.

If the mission is low level, it is better to make the check as soon as possible after takeoff. The point used to check the clearance plane must be a sufficient distance from the takeoff point to allow for turn level off at the desired altitude, usually between 30 and 40 nmi.

If the mission is high level after takeoff, a forecast altimeter setting and a check point for the CM/TA plane check is necessary in the area of letdown.

The procedures for making the check, either after takeoff or in the letdown area, are the same and are as follows:

1. Assume terrain elevation of 1700 ft MSL for the check point.

2. Assume that an altitude of 500 ft above, or 2200 ft MSL is established. Select contour map mode and lower the clearance plane to 1000 ft. Identify the peak and adjust the clearance plane up until a small return is painted on the indicator. Now, look at the readout on the Antenna Tilt and Clearance Plane Indicator. If the clearance plane is perfect, the readout will be 500 ft.

3. If the readout is not 500 ft, which will probably be the case, note the difference. For instance, 300 ft readout, actual altitude 500 ft. Since the clearance plane has a tolerance of ±125 ft, and calibration readout is normally equal to ±200 ft, the two errors mentioned above are not cumulative. A well-calibrated clearance plane will read out ±200 ft.

4. Track the selected target from 20 nmi down to 5 nmi. At 15, 10, and 5, perform checks of terrain avoidance. Here again, there is an allowance of ±125 ft of readout difference between CM and TA. To check the allowable tolerance, the clearance plane may have to be raised or lowered slightly.

5. If the target return remains approximately the same size on the indicator, all the way to the 5 nmi point, the clearance plane is level. The clearance plane itself is allowed a certain amount of curve This sine/cosine curve may vary the readout slightly. The normal clearance plane tolerance, ±125 ft, should not be exceeded when checking between contour map and terrain avoidance.

Tilted Clearance Plane.

Any time the clearance plane is tilted, it endangers the life of the pilot. By following the same procedures given above, large variances in readout will indicate to the pilot whether the plane is tilted.

For example, at 20 nmi the readout is 000, and a large return pattern is still seen on the indicator. As range to target decreases, the size of the return pattern decreases. As the target comes to within 5 nmi, the clearance plane must be lowered to 500 ft in order to maintain target contact. This indicates a clearance plane error is in excess of 500 ft. This is dangerous.

Note

Clearance plane accuracy in 40 mile scale is degraded.

Check at Co-Altitude. The co-altitude procedure is not recommended for performing the clearance plane check. There is no satisfactory method of checking the errors and clearance plane tolerances.

Level Flight. Level flight is a condition which is chosen by the pilot. He establishes the flight altitude based on MERA's. If the flight is over level terrain, the display will indicate level terrain from minimum range to maximum range selected (20 or 40 nmi). Height of present position is determined by lowering the clearance plane setting and observing terrain display from two miles minimum to five miles.

Once established at Minimum Enroute Radar Altitude over level terrain, the clearance plane should be raised slightly to give a threshold or "just paint" condition on the indicator. If the terrain is rolling and mountainous, MERA may be established from the lowest terrain indicated along the route (and that height held until higher terrain is indicated on the radar).

The higher terrain should not be approached closer than 10 miles if it is on the course line. From this, an action distance is calculated. The action distance is a function of speed and height above the ground (in no case less than 5 miles in the F-104). When the action distance is reached, a climb over or a turn to go around the obstacle must be executed.

If the terrain presents a hard reflective surface to the side lobe, "false" warnings may appear on the scope at a range where the side lobe contacts the surface. The strength and range of this characteristic will vary with individual aircraft, radar system, and clearance plane settings.

Climbs and Level Off. In terrain avoidance, a climb over any obstacle whose height is above the course altitude should also be initiated from the action distance. In mountainous areas, set the clearance plane at a minimum of 700 feet.

When an obstruction is indicated by the radar, check the map to determine the number of feet that must be climbed. When the return reaches the action distance (usually 10 nmi) select TA and a minimum of 700 feet clearance plane setting. Change the pitch attitude slowly and initiate a climb. When the target disappears in the TA mode, hold the established climb attitude on the attitude indicator.

Select the CM mode and continue the climb until the target disappears. As soon as the return fades (it should fade at approximately 5 nmi), level off. The clearance plane may be lowered slightly in order to establish check point, return identification, or a slight descent may be started to re-establish target contact. Check the altimeter —it should read the number of feet set in the clearance plane, above the obstacle. Start timing to determine obstacle passage. When the obstacle passes below the aircraft, establish a descent, if required.

Letdown and Level Off. Select ground map and interrogate the area for a navigational check point and its general features, if necessary. (Pre-plan this.) Select TA mode and push-over until the first returns are at approximately 7 to 8 nmi on the scope. Continue descent, allowing the returns to approach 6 nmi. Hold your vertical speed and Mach number constant during the descent. When the terrain (check point if possible) approaches 6 nmi and letdown angle is 5 to 6 degrees, select CM mode. Do not allow returns to come closer than 5 nmi during the descent. Adjust aircraft pitch to control the range of the returns. Level off in CM mode at the desired clearance plane setting.

Use MERA technique after determining the characteristics of the terrain, and establish the height above ground, the height of your future position, and the action distance (between 5 and 10 miles) until stabilized in level flight at the desired speed.

Terrain Following.

This technique can be used in the F-104G only if the grade of the terrain is shallow and extensive. Flight path clearance may be established in terrain avoidance so long as the terrain characteristics remain fairly constant over a considerable distance.

Frequent use of contour map and the 40 miles scale is required to determine any terrain features which may be beyond the capabilities of the established "action" distance. This will prevent any sudden surprises for the pilot. When following the terrain in terrain avoidance, pull the nose up until the display comes into the fail safe cursor in order to establish a flight path (and clearance plane) that is parallel to the terrain. When the display reaches the fail safe cursor, the flight attitude should be held.

Note

The 40 mile scale is not reliable and should be used only as an indication that an obstacle of undeterminable height is in front of the aircraft.

If the grade of the terrain drops off, which requires a slight descent, the display will indicate this by an absence of painting at the top of the indicator. However, a rise in the terrain may not be noted if the rise of the grade is less than the attenuation slope of the upper half of the radar beam. For this reason, slight changes in flight path (up) are required to obtain a threshold or "just paint" indication of the terrain beyond 5 nmi (using the bottom half of the beam). If the rise of the grade is greater than the attenuation slope of the upper half of the beam, "shadows" will appear.

Fail Safe Warning and Emergency Action.

The TA fail safe cursor position indicates two things:

1. Minimum range of usable information (a function of clearance plane setting).

2. Radar system malfunction (when absent or broken).

When flying contour map, the fail safe cursor should be checked periodically by switching to TA. If the cursor does not appear, or appears "broken," do not use CM/TA modes, since a malfunction has occurred. Further, the range of the cursor should be established when in the terrain avoidance mode, or when changing clearance plane settings in CM mode, switch to TA to establish cursor range.

If, for any reason, the pilot suspects or sees a malfunction indicated by the absent or broken fail safe cursor, the MEA should be immediately adhered to.

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