3rd TACTICAL FIGHTER SQ

NEW GUY BOOK

INTRODUCTION: The following booklet is designed to get newly assigned 3TFS aircrews familiar with the F-4E. The ARN-101 system will be briefed separately. Some material may be dated, but together with the -34 it should acquaint you with the F-4E.

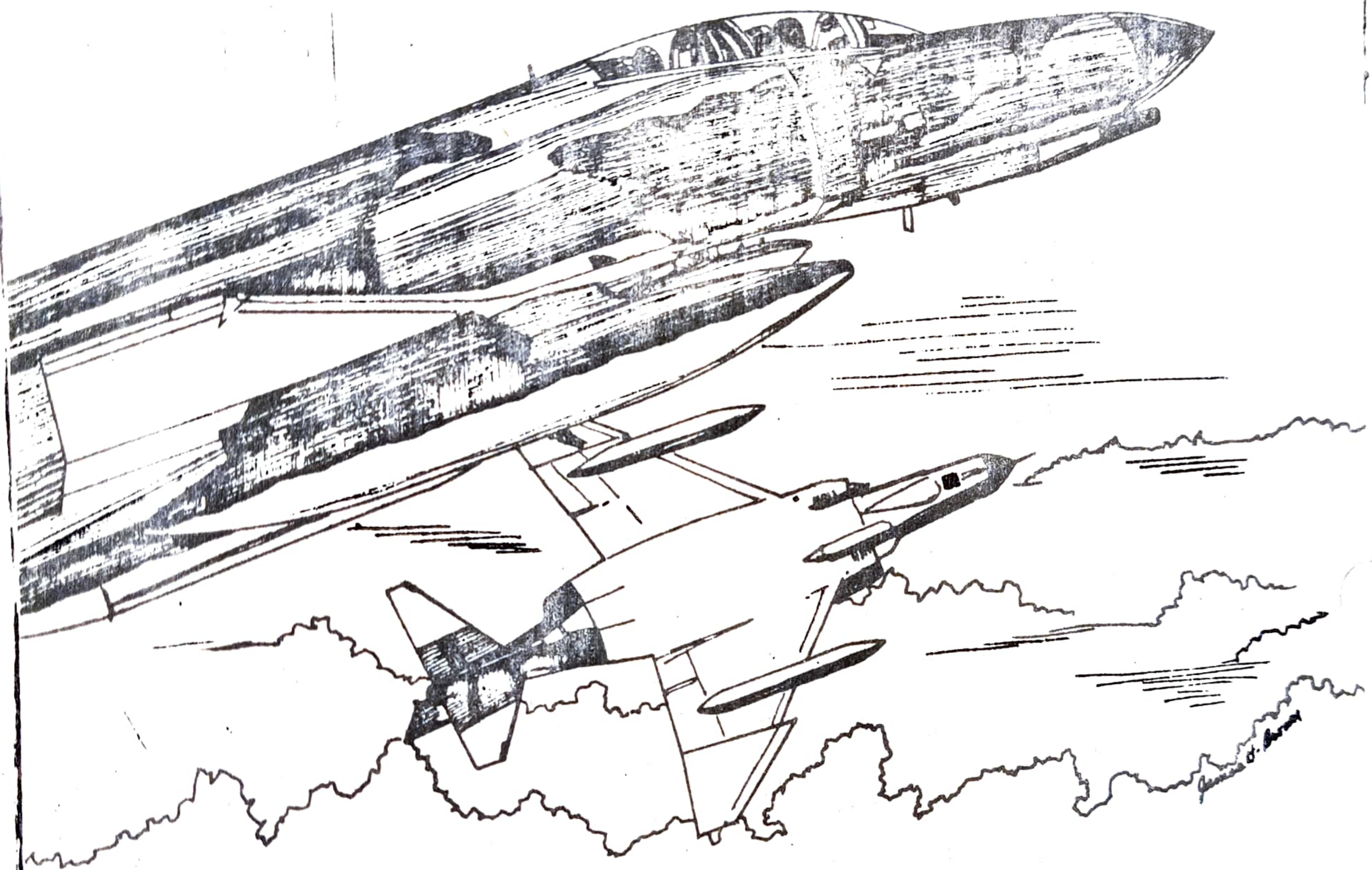
-3TFS

CONTENTS

When the rubble of Man's Folly is being excavated by builders of the next civilization, they will bear witness to the destiny of our plight. On the bottom of the heap will be found the glorious warriors– the ones who died first–knowing nothing of themselves or their enemy. Higher in the debris will be found the bodies of those who lacked not desire, but capability. And beside them, those whose ability lacked determination. And, what of those warriors who knew their enemy and were prepared? Some are atop the rubble; they died leading those below. Some were rejected before the fight and cannot be found. And to the rest........ the Burden of Victory!

I Welcome to the F-4E (LES)

FLYING THE F-4 LEADING EDGE SLAT



By Capt Frank J. Romaglia
35th TTS
35th TFW, George AFB CA

All you F-4 hard-wingers out there getting ready to step up to the soft-wing ... prepare yourself for a pleasant surprise. Also prepare yourself for an aircraft that looks basically the same, but has significantly different and improved handling characteristics. That being the topic of our discussion, we'll dispense with the questions that can be answered by the Dash One and LES Transition Phase Manual, and stick to the slats operation and what to expect when the servo between the stick and throttle yanks and banks.

MECHANICS

Replacing the familiar boundary layer control system (BLC) has brought smiles to the faces of aircrew and maintenance personnel throughout


Capt FRANK J. ROMAGLIA is this month's Fleagle T-shirt winner.

the F-4 community: no more BLC problems. Keeping the system somewhat complicated, however, is a system of linkages, plumbing, wiring, bellcranks, actuating cylinders, ad nauseam. Let's briefly investigate how it works.

The system is electrically selected from the 28 volt DC bus; which means with a double generator failure, the flaps/slats will operate normally providing you have a good battery, a master switch on, and normal utility hydraulic power - not too shabby! Utility hydraulics activate the system. If utility hydraulic pressure is lost, the slats will remain in the position selected because of a mechanical overcenter lock. The flaps will either remain up or, if selected, will retract to a low drag trail position just the same as a hard wing. Check the Dash One, both Sections I and III for a thorough discussion of emergencies.

Where do all these neat things go when the "Yes, little girl, I fly jets" type moves the switch? Flaps are simple: either full up or 30° down; no longer is there a one-half position. The slats are simple too: either extended to a high lift position or retracted to a cruise (outboard) or clean wing (inboard) configuration.

Slat operation is smooth, quick, quiet, and comfortable, the pitch change is insignificant. Unless you're paying close attention or happen to have the aircraft loaded up as AOA increases through 11.5 units (after T.O. IF-4E-603), you won't even notice their movement. The operation takes less than a second (the book allows 3 seconds for slats, 6 for flaps) and the indicator works in unison with the slats.

One nit-noi (Americanized Thai word meaning "something insignificant," e.g., over at Ubon RTAFB, we coined a phrase, "The amount of nit-noi is inversely proportional to the threat. Over the years, it has taken on additional significance .. but I digress ...), one nit-noi to plug into your already overloaded computer: When the flap/slat switch is positioned such that the flaps begin extending, the indicator will immediately show down even though they're still in transit. When retracted, indicator and flap movement are synchronous.

Now for a short blurb directed toward the AOA system. With the gear down or slats in, it's the same as a hard wing. With the gear up and slats out, the AOA range has been shifted upward to reflect the significantly improved maneuvering capabilities. Also, with the gear up, the rudder pedal shaker has been deleted (Hooray! No more worrying whether or nor the left rudder pedal is going to fall off.)

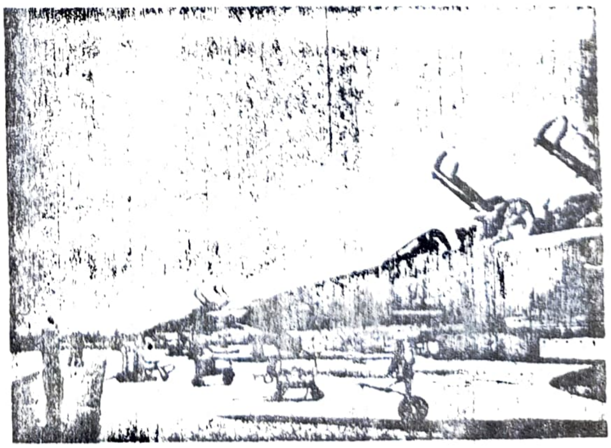
HANDLING CHARACTERISTICS

Now let's examine handling characteristics as we progress through the various aspects of a normal mission (the phrase "normal mission" is often used in conjunction with "the Real Air Force).

TAKEOFF

With a slotted stabilizer, the aircraft will be a good bit more responsive in the longitudinal axis at slower speeds; you can start the nose up by 100 knots. The LES aircraft is more susceptible to jet wash and wind gusts, so watch your T/O attitude. Do not yank it off into a gusty crosswind (by the way, max crosswind component is 25 knots) with both your nose and AOA high - you'll have your hand more full of machine than you want that close to the ground! Gear and flap retraction is normal, and the slats will retract as AOA decreases below 10.5 units.

To backtrack for a second, we all owe McDonnell Douglas a thank you. Humbly, the folks at St Louis have leaped into the breach and prevented



us "one-notch-down-for-takeoff" types from once again validating Murphy's Law. If we were to extend the flap switch to the first detent, we'd get the proper flap configuration (i.e., one-half flaps) for a hard wing T/O. Extending the flaps/slats switch to only the first detent would give us slats - OUT; a potentially dangerous no-flap T/O. Seeing this blatant opening for error, the engineers have wired the system such that when the nose gear is down, placing the flaps/slats switch to the OUT position extends the flaps as well as the slats. This in no way means that the flaps will retract when the nose gear does - they'll still have to be either raised or blown up as per Dash One.

Here's one more nit-noi to file away concerning takeoff. The AOA indexer lights are inoperative with the gear up. If you crack afterburner the second the clock strikes official sunset, by the time you've milked all the night time your JP-4 and SOF will allow, it'll be pretty dark out. Remember to turn down the rheostat on your AOA indexer lights before you lower the gear.

RIG/STAB AUG/SLAT CHECK

Now we add the slat check. Here are some points to ponder: If you pull up too gradually in attaining 11.5 units AOA, your airspeed will bleed off to 300 KCAS or even less. Also, it takes crew coordination to watch slat operation, slat indication, and the AOA gauge all at the same time. This check is accomplished prior to high AOA maneuvering, so pay attention to what it's telling you. Just because all of our 25-ton tricycles look alike doesn't mean they all fly alike - rigging can vary from aircraft to aircraft.

AEROBATICS

The soft-wing will be stable and responsive throughout its envelope, most noticeably at low airspeeds. You can be out of airspeed and flying with all the aerodynamic properties of a rock, and you'll still be able to point the nose wherever you want. Aircraft acceleration is a little slower than you're accustomed to due to slat drag, but once you're up to high calibrated airspeed, it'll feel solid to at least 6-1/2 Gs. Holding 4-5 Gs will produce no perceptible buffet down to about 350-377 KCAS. A good technique for achieving 200 KCAS over-the-top is to begin easing back to 15 units AOA after you get into light buffet.

STALLS

Generally, buffet will be mild to moderate - if at all. Wing rock will occur above 26-28 units AOA - if at all. Here's a warning note from the Dash One's excellent discussion of characteristics: "Aircrews should not depend on wing rock, buffet, directional instability (nose slice) or any classic characteristics for a stall warning. In any configuration or loading, and especially with moderately high pitch change rates, it is possible to increase AOA above 30 units without wing rock or loss of directional stability at which time loss of control may result."

Slats will only smooth out and delay an out-of-control condition - they won't prevent it. 'Nuff said!

ON THE TANKER

After snuggling up to the tanker to get your motion lotion, you may notice you're not the ol' golden hands you used to be if you're phlying a heavyweight phantom. To prevent bobbling around, you may want to go to the "override position" till you've got your onload. It's only a technique, but it could save some embarrassment.

AIR-TO-GROUND GUNNERY

Be aware you'll be able to make tighter turns so you might want to change your roll-in technique to prevent undershooting. Also beware of "slat tuck" or dig-in: You'll get an increase in G without any stick inputs as the slats extend. Its most probable point of occurrence is a stick snatch trying to prevent a low pullout after a press (... Let he who is without sin cast the first stone ...).

AIR-to-AIR COMBAT

Here's where the soft-wing excels. Considering a training arena of 10-15,000' AGL and a 6-1/2 G limit, the corner velocity is about 40-50 knots less than a hard-wing.

The increase in specific excess power (Ps) becomes readily apparent as you match turns with a hard-wing at a reduced power setting. To fully appreciate this Ps advantage, have your wingman override his slats for an engagement and see how fast he becomes the attackee. Enough about F-4 hard-wings; the bad guys aren't flying them yet.

You'll notice an increase in comfort throughout the high AOA envelope due to increased stability and reduced buffet. Adverse yaw is negligible (not nonexistent) and coordinated rudder and aileron are fine, though it's still advisable to maneuver at high AOA with the pole pretty much in the middle. Reason? If you turn with ailerons at high AOA (above 20 units), you'll have to definitely move the stick forward to maintain the same AOA; you might also experience roll hesitations. Wing fences keep the wingtips from stalling as quickly as before, and also improve lateral stability - the aircraft is supposedly slightly more sluggish in roll.

Another nit-noi: going from a high AOA situation - especially when combined with a nose-high condition - to an extension or acceleration maneuver, you'll have the drag of extended slats until the gauge gets below 10.5 units. Some try overriding them as soon as they start unloading; they're quicker than I.

The increased turn capability results in a smaller combat arena - you can start a hi yo-yo 1,000 - 1,500' closer. This increased turn capability, especially at slower airspeeds, also allows you to back yourself into a corner. Pay close attention now: Sustaining maximum performance will result in an airspeed bleedoff so rapid the needle will be a blur. You might get a kill, but your 300 knot tail won't be much competition for the next Mig at your six. This airspeed bleedoff can go unnoticed due to increased stability, pitch responsiveness, lack of buffet, wing rock, and the fact that your fangs are out. The machine gives you fewer clues, so use the aural tone. Once the nose gunner padlocks a bogey, GIBs should pay increased attention to parameters.

TRAFFIC PATTERN

All that we gained in combat capability doesn't come for nothing - handling qualities in the pattern are slightly degraded.

There are two problems in the pitchout phase: The first is losing 200' in the pitch while looking for staff cars at mobile. It's a personal problem ... but a little top rudder might help. The second is that at 300 KCAS, the machine turns beautifully; so well, that if you honk it in you'll practically be going down initial in the opposite direction. But getting ready to come off the perch at 180 KCAS, you'll find the aircraft doesn't turn quite the same - watch tight pitchouts!

The soft-wing approaches about 6-10 knots faster than the hard wing Phantom. The airspeeds for various slat/flap combinations are in your checklist, so there's no need to dwell on them here. You'll notice that the single engine approach AOA is still 17 units; for all other approaches when the slats are out, use 19.2 units; when the slats are in, use 17 units. Reread this paragraph and you'll have it wired. When the slats are extended, it's fairly smooth; with the slats retracted, it's definitely not smooth.

Some people say it's tougher to fly a constant AOA; I don't find that a problem. What is noticeable is the increased stabilator effectiveness ... you can definitely flare the aircraft. By the same token, you can drag the stab tips - especially in a no-flap. Don't forget its susceptibility to jet wash and wind gusts plus reduced lateral control due to wing fences. The Dash One recommends a 17-unit approach in these conditions. Use both aileron and rudder to bring up a dropped wing and be spring-loaded to the go-around position.

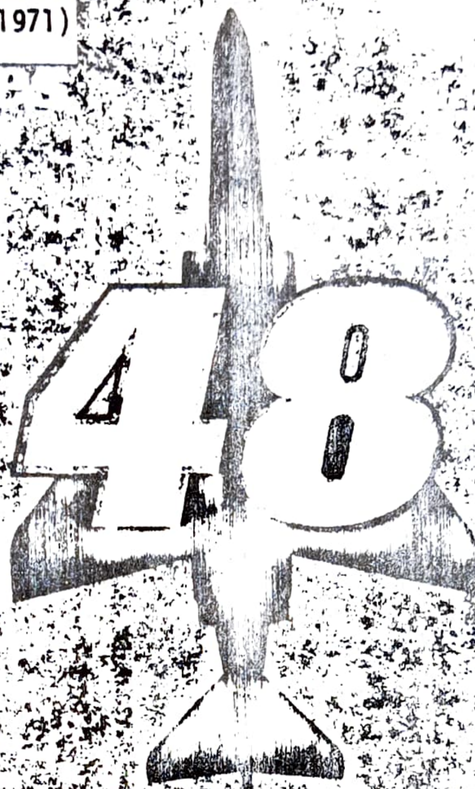
No BLC means very little instant lift by just pushing the throttles forward. To get increased airflow over the wings, you have to increase airspeed - that might mean unloading; and that might mean being unable to salvage an overshoot. Conversely, just by pulling off power doesn't mean you lose lots of lift - your airspeed must bleed off first. This causes two things: a tendency to be hot and a tendency to float - you'll see what I mean at least once. Happy landings, and remember you're not out of a high threat area until you see mobile's grade slips. ➤

(1971)

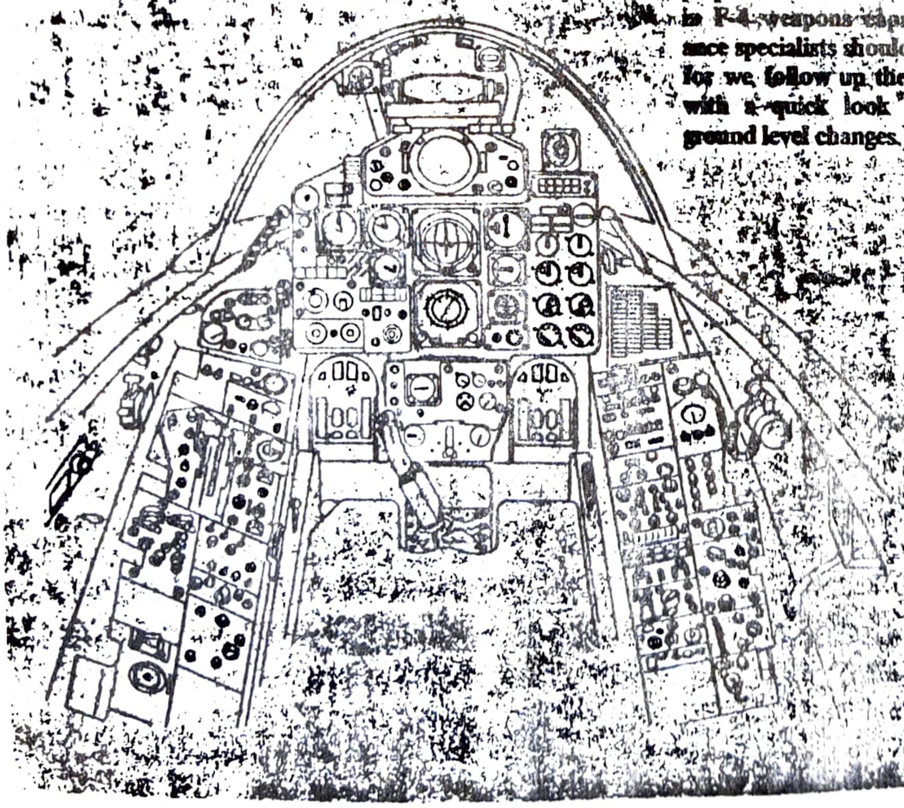
[illegible] Changes

For the first time in several Blocks, we're presenting information "FROM THE READY ROOM" on the latest group of Phantoms. While there were cockpit type changes in Blocks 45, 46, and 47, security limitations would not let us discuss them. Block 48 introduces some really major cockpit changes in the USAF F-4E, and fortunately we are free to give you a little advance word.

These changes apply to the F-4E in both directions - production aircraft from here on out, and eventual retrofit to El. In addition to the conventional weapons system changes you'll read about here, coming up in mid-Block 48 are the maneuvering slats and the electro-optical target identification system (TISEO). However, these two major features are scheduled for airplanes with a delayed delivery, and we're going to put a similar hold on our DIGEST coverage.



So, crewmen suit up now, and prepare to enter "a whole new world" in F-4 weapons capability. (Maintenance specialists should come along too, for we follow up the operational info with a quick look at the Block 48 ground level changes.)



Cockpit Improvements

By STAN McINTIRE/*Engineering Test Pilot*

Starting with F-4E Block 48 deliveries to the U.S. Air Force in December, the first man in the cockpit will take a look at the instrument panel and then probably crawl back out thinking he got in the wrong model aircraft. This little exercise can be attributed to the biggest cockpit changes made in the F-4 since we went from the F-4C to the F-4D.

The philosophy behind the changes can be categorized as follows:

- Get all the weapon controls possible off the pedestal panel and up higher on the instrument panel for better visibility and easier access.
- Give the pilot the ability to go to an air-to-air attack capability from any other mode in a short, one-step motion without taking his hands off the throttles or the stick.
- Simplify the jettison system to prevent inadvertent jettison and assure jettison when you need it.
- Simplify the fuze arming and ready circuits in both air-to-air and air-to-ground weapon modes.
- Provide meaningful AIM-7 select and ready lights.

Now those are big words, and over the next few years the jock in the front seat is going to decide whether the design philosophy has been accomplished. We think it has, but you're the judge and jury.

Before I really get started, I want to give credit to the USAF personnel who were primarily responsible for directing these changes associated with the F-4E cockpit arrangements, armament panels, switch logic, and sight mechanization. Major Al Pruden of the F-4 SPO at ASD was the chief honcho. Al received ideas from such people as Captain Dick Koehnke at Nellis, and Lieutenant Colonel Joe Hutto and Major Charlie Martin at Edwards. Valuable inputs were also made by many McDonnell engineers, plus all the F-4 jocks down through the years who took the time to sit down and document their likes and dislikes about the present system. After you've had a chance to live and work with the new system for awhile, I'm sure Major Pruden and the others would appreciate hearing your reactions.

Front Seat

The photo of the main instrument panel across the page tells better than words where certain controls have been relocated, but I'll take a moment to discuss each item that has changed in capability or location. (Incidentally, the cockpit views we're showing you here are only going to appear exactly like this in the first 13 E's of the Block. Then we're going to slats and TISEO, which will require some minor relocation of gages not associated with the improved conventional weapons system.)

WEAPONS RELEASE MODE SELECTOR

This control, labeled LABS/WPN REL, has the same functions as before and was just relocated to provide better access.

WEAPONS SELECTOR

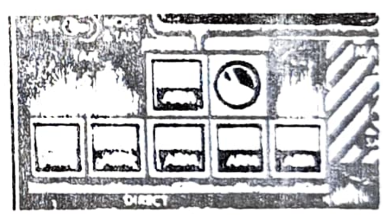
The WPN SEL rotary switch serves the same purpose it did previously, but it has been simplified by removing quantity selections from the control. The gun selector has also been placed on another switch; and the net effect is to open up three positions labeled A, B, and C for growth into new weapons. Actually, that was yesterday's idea. Today, we already have some functions in slots A and B.

Selecting A will give you a continuous 28-volt dc signal to any selected air-to-ground station to be used as desired. The possible uses for this station cannot be discussed here, but the information should be available at your squadron.

Slot B will put the radar, LCOSS and entire armament system back into air-to-ground after you have done a quick one-shot change to air-to-air. That one probably lost several readers - but hang in there and I'll cover more on that in a minute.

STATION SELECTOR SWITCH ASSEMBLY

This set of buttons is now up high and should be easier to set, read, and interpret than on previous models; and



it also has some revised logic. When you depress one of the five station buttons, the top half lights up in green to indicate the station as it always did; but the bottom half will light and indicate ARM only if you have the following five conditions:

- Station loaded and selected
- LABS/WPN REL mode selector not in OFF or TGT FIND
- Proper weapon selected
- Fuze ARM switch armed for bombs
- MASTER ARM/SAFE switch to ARM

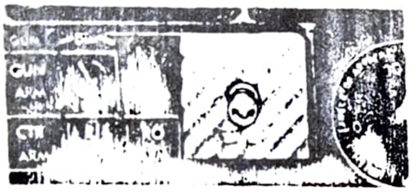
A lighted station ARM indicator assures you that all that's left to do is to sight and pickle.

The switch assembly also has a GUN ARM selector button/light and a rheostat for dimming the station selector lights, missile status lights, centerline tank light, and the four weapon ready lights mounted to the left of the radar scope.

FUZE ARM SWITCH

This item is only a relocation. The ARM switch has the same four positions (NOSE, NOSE & TAIL, TAIL, and SAFE) as used in previous F-4E aircraft.

MASTER ARM/SAFE SWITCH



Located in the middle of the instrument panel on prime real estate, this switch should *NEVER NEVER* be in the wrong position. When it is at ARM (up), the ARM light on the ladder of weapon ready lights to the left of the radar scope will be illuminated. This switch incorporates the air-to-ground and previous missile ARM and SAFE functions into one switch and eliminates a switch on the missiles panel.

MISSILE STATUS PANEL

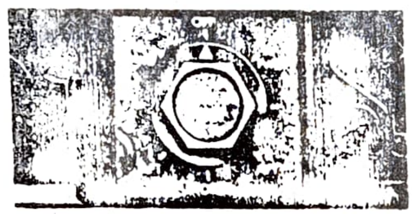
This is strictly to show missile status, using green lights to indicate if Heat missiles are loaded on the stations selected or if a radar missile is tuned. It is possible to have four RDR (radar) lights and one HEAT light on if you have selected HEAT on the air-to-air switch on the throttle and you have a Heat missile loaded on a wing station.

CW (RDR MSL) SWITCH AND INTERLOCK (INTLK) SWITCH

Both switches have the same logic as before, but are relocated. Between these two is an indicator that says 'CL TK in green lights if a tank is onboard. You still can't shoot Sparrows from forward stations with a tank on Station No. 5.

The logic behind the RDR light has also been revised to give a more valid meaning when the missile tunes up. The first missile that tunes will be the first one to launch, providing it doesn't detune in the meantime. There is no capability for selecting the exact radar missile you want to launch because now the selection will be made by an intervalometer when you pull the trigger. If a missile tunes first and then detunes later during flight, the status light will go out and the missile will not launch.

JETTISON SELECTOR SWITCH



If you want to jettison a missile from a station, you select the station and punch the PUSH TO JETT button in the middle of the select knob just like before. What has changed is the position at 6 o'clock which says STORES. By selecting this slot and punching any button on the station selector switch assembly, you can then jettison the MER, TER, bombs, tanks, etc., on the selected stations by pushing the same red button in the middle of the selector. The external fuel tank jettison switches previously located on the fuel panel have been eliminated, and tank jettison will now be accomplished using this method only. The Master ARM switch does not have to be on to jettison any missile or store when using the red jettison button.

AIRCRAFT WEAPONS RELEASE UNIT (AWRU)

Although there are lots of new looks to the weapons panels in Block 48, "AWRU" is the only new abbreviation you've got to learn! It means Aircraft Weapons Release Unit, and it applies to a little panel which offers some very interesting capabilities.

The AWRU panel holds a little gadget called an intervalometer, with continuously variable non-detent selection capability that realistically gives about 400 different release intervals for air-to-ground weapons. Next to the selector dial is a new two-position INTRVL switch that makes a .10 setting on the dial a 1.0 at the intervalometer when the switch is at X10, thereby doubling the approximately 200 settings you can make on the dial.

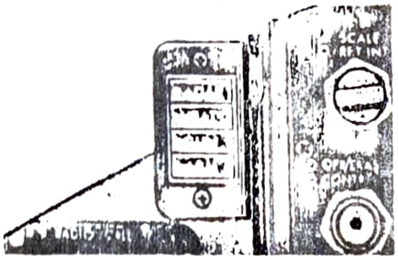
The three-position interval switch used previously was neither adequate in number nor accurate enough to get the proper stick length desired over a wide range of weapons. This new dial arrangement should help solve that problem.

Next to the INTRVL switch is another rotary switch (labeled QTY) that gives you a quantity-set capability previously incorporated in limited fashion on the weapon selector switch. The indicated numbers say you can drop that many bombs by having all of the necessary stations selected and by pushing and holding the pickle button until the required time has elapsed to release that many weapons at the interval selected on the intervalometer. Obviously, the bombs will release alternately from stations selected starting at the left outboard and working across as long as you hold the pickle button down.

The three slots on the QTY switch labeled C, S, and P are short for continuous, salvo, and pairs. If you select C and push the pickle button, one bomb will alternately come off each station selected, at the interval selected, as long as you hold the pickle button. The system will step from left to right if more than one station is selected. The P simply says you get two bombs, one from each wing station, with each pickle push. If you have only the centerline station loaded with bombs, you get just one bomb per pickle push. The S says you get salvo action off all selected stations at the interval selected as long as you hold the pickle button down.

At this moment, I want to point out that I'm not the regular crew-chief-in-charge of writing T.O.'s or procedures and in this operation particularly, as well as all others I've talked about, there are some subtleties I have not discussed (and may not ever know about). So to support the general description I'm giving, please read and initial the appropriate official info before dropping any or all weapons from your Block 48 F-4E aircraft!

WEAPON READY LIGHTS



I've been talking about the "weapon ready" lights for several minutes; so I guess I should explain them. These lights are arranged on a ladder to the left of the radar scope and are designed to give the pilot a semi-heads-up display of what he has selected on the new switch located outboard on the left throttle.

The lights read, in descending order, RADAR, HEAT, GUN, and ARM, and mean just that as far as what is selected for performing the air-to-air job that you are presently involved in or expect to be imminently. Another way to cement this to memory is think of the light that is illuminated as the weapon that will operate when you squeeze the trigger. Of course, you have to have the MASTER ARM/SAFE switch to ARM, and that will illuminate the bottom ARM light.

Let me emphasize that no other switches need be moved to get either of the missile lights on, i.e., RADAR or HEAT. To get guns, you must also push the gun station selector (GUN ARM) button on the instrument panel, but this can be done prior to entering a combat area and it will always be ready for instant selection.

CONTROL STICK GRIP

The big change on the control stick grip is the change in logic for the nose gear steering button. It still steers the aircraft on the ground, but it is also the auto-acquisition button for the radar either on the ground or in the air. The force required to push it has been cut down so it can really be operated with a little finger while holding the control stick in a normal manner.

The heading hold cutout feature previously on this button has been removed and is no longer available. I don't think this deletion will bring too many objections. The air refueling release button still has the AIM-4D cooling function, but the electrical cage function has been relocated to the right throttle. All other buttons or controls on the stick are the same.

THROTTLES

The desirability of selecting an air-to-air mode without taking hands off the throttles or stick required some extensive switchology on the throttles. The electrical cage function was placed on a button to be operated by the left index finger and therefore should be near that finger during normal operation. This little button does more things than an overtemped second lieutenant at Happy Hour, and I guess this is the time to try to explain it.

Assume that you have selected an air-to-ground delivery profile with bombs selected and you get bounced by Charlie Red Star. You want air-to-air right now and you can't take your eyes off Charlie. Assuming you had GUN ARM punched in on the selector prior to the run, you can now select GUNS on the left throttle and press the electrical cage button on the right throttle one time. That action puts the gunsight in a computing air-to-air mode and the radar goes to boresight with a five-mile range.

If you can get Charlie in front and want a lock-up, you can hit the auto-acquisition button on the stick and you should get a lock if he's near boresight. If the weapon selected is RADAR or HEAT, the sight will be at the Radar Boresight Line. With GUNS selected, the sight will compute for two different range values, depending on what you did with the cage button after the first push. If you held it down, the sight will stay at boresight regardless of the weapon selected. If you get an auto-acquisition lock on the radar, it goes to 1000 feet fixed range computation.

Now here comes another hooker. If you released the cage button and did not get radar lock, the range input in the GUNS position is 1000 feet. If the radar is locked up and the button is released, the range input is the real radar range. Again, any time RADAR or HEAT is selected, you get the Radar Boresight Line on the sight. GUNS requires a little more finesse, but it looks to me like the best thing to do is hit the cage button once and then release it. When Charlie gets in front and if you want to lock him up in auto-acquisition, you push the cage down and hold it while you press the auto-acquisition button on the stick. Pressing the cage button down brings the sight to the Radar Boresight Line if the radar is not locked, and you'll have a reference for the boresight lock-on trick.

You probably noticed that I used 1000 feet for a fixed range value above, and that is another item I'll cover in a moment. The first depression of the cage button will also inhibit the flashing reticle you may have had from an air-to-ground weapon drop. It essentially throws the LCOSS and APQ-120 into an air-to-air mode in about one second regardless of any previous switch positions. However, to get back to air-to-ground takes a little more thought. It goes two ways;

- The guy in back has a new lighted button on the instrument panel that says AIR TO AIR when the pilot has thrown things into that mode. If the GIB punches that button, the system goes back to the previous settings on the sight and radar, and he can then use the radar as he desires.
- The front-seater can rotate the weapon selector knob to B at the 6 o'clock position and then back to the previously selected weapon, and he'll be back where he started. Sounds

tricky, eh? That's the price you pay for instant heads-up selection!

The new air-to-air Guns/Missile selector switch is located where the old auto-acquisition switch was on the left throttle, but it has a couple more positions on it plus a little device on the end that lets you move it with your little finger in relative ease. The forward position is RADAR (or Sparrow if you prefer); center is HEAT; and aft is GUNS. (Think of it as selecting long range, medium range, and short range from front to rear.) In the HEAT detent, you can pull the switch up to a momentary position that rejects the selected missile and steps to the next. This function is performed automatically at the RADAR position if one of the missiles doesn't tune. The Heat missile you have selected will be the only one illuminated on the HEAT status lights on the main instrument panel.

LCOSS

We're not done yet, gents, and the next item of attention is the Lead Computing Optical Sight System. After years of using constants for some values in the equations for computing lead angle for the gun solution, the weapons experts now believe that accuracy can be improved at ranges in excess of 1500 feet for air-to-air work by inserting real-time data for some of these parameters.

The lead computing amplifier has been modified to accept additional data signals of true airspeed and aircraft true angle of attack. In addition, a circuit within this amplifier has been added which derives range rate from the radar range signal.

The three new parameters of true airspeed, true angle of attack, and range rate - along with the currently used parameters of normal acceleration, radar range, air density ratio, and aircraft angular rate - are utilized in the explicit computation of projectile time-of-flight and lead-angle required in the gunnery solution. This has been accomplished by redesign of the computation mechanization of the lead computing amplifier and by a wiring change to the lead computing gyro.

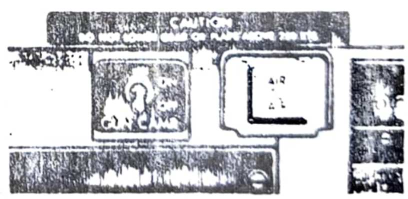
The operational effect of these changes will be an improved solution against non-cospeed targets and during aircraft transitions which cause angle of attack values to be significant. This improved dynamic solution is supposed to give an accurate sight picture that allows the pilot to fire while raking the pipper through the target instead of waiting for a steady state solution. This assumes, of course, that the rate of pipper movement is low in relation to the target.

In addition to computational changes, the tight reticle fixed range computation has been changed from 1500 feet to 1000 feet; and range smoothing circuits have been introduced to eliminate the abrupt reticle jump which takes place during the switching from fixed/radar to radar/fixed range during acquisition/loss of radar lock-on. To do this, a resistance-capacitance (RC) network is switched into the circuit to introduce a time constant in the range voltage during the transition of reticle movement from one position to the other. A time constant of 0.47 second is introduced when going from fixed to radar range computation (lock-on acquired). After 1.0 second, the RC network is switched out of the circuit so that no time lag error is introduced into the radar range signal. When lock-on is lost, a time constant of 1.7 seconds is used in going from radar to fixed range to allow smooth transition of the reticle to the new lead angle position.

All of the changes described above could well go unnoticed by a pilot with average perception, but they should result in a sight that's a bit easier to use and produces more hits at longer ranges.

Back Seat

In addition to the AIR TO AIR reject button on the left side of the instrument panel in the rear cockpit, the nose gear steering button and the "Action" switch on the radar hand control are activated so the GIB can run the range gate in the auto-acquisition mode. Also, complete target tracking can be accomplished if the rear seat locks on in boresight mode at any AI range.

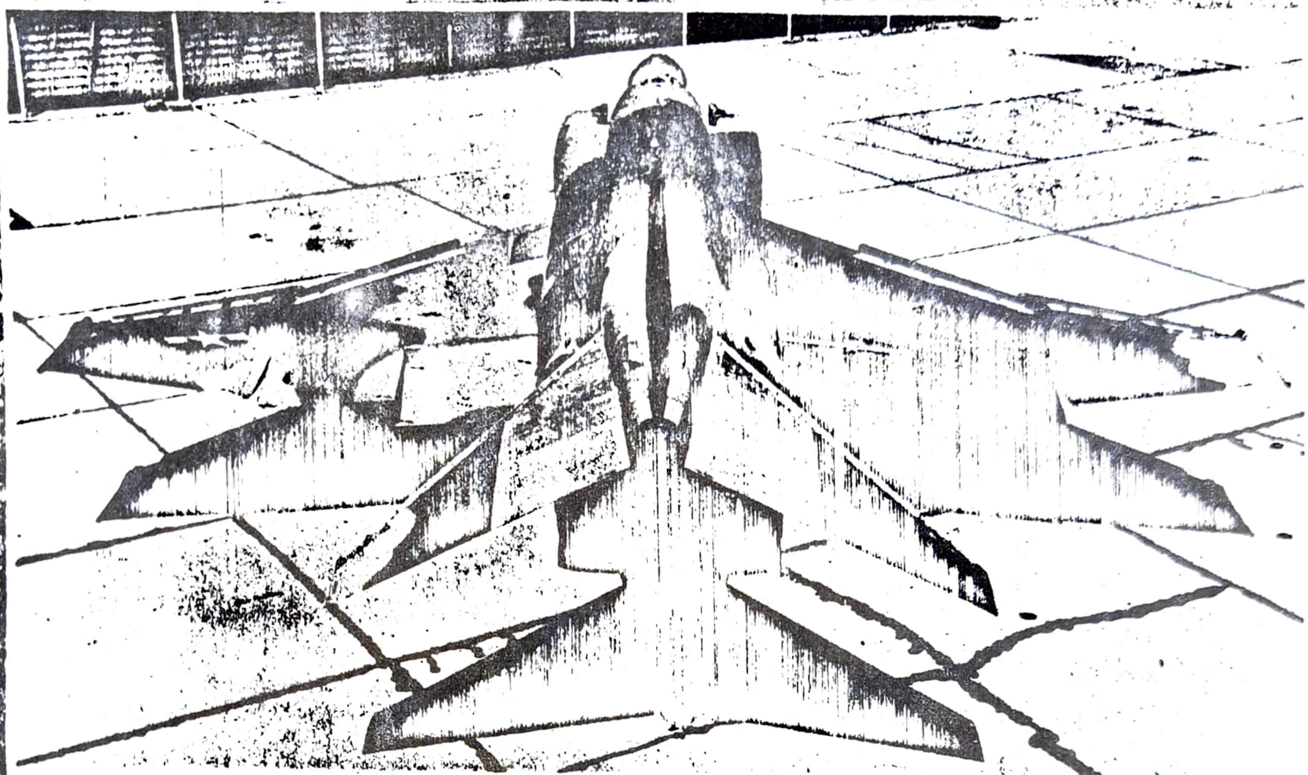


General

Weapons controls which remain on the pedestal, although relocated, are the ROUNDS REMAINING counter, the RATE HIGH/LOW switch, the AUTOCLEAR/NONCLEAR switch, the FILTER RED/CLEAR switch, the TGT REJ/DF REJ switch, and the BAND 1/BAND 2 switch. Also relocated but remaining on the pedestal are the PC 1/2 and UTILITY HYD pressure gages, the PNEUMATIC PRESSURE gage, and the rudder pedal adjustment crank. Two ENG OIL PRESSURE gages now are used instead of a single gage with two needles. In addition, the accelerometer has been moved onto the pedestal to make room for the weapons controls which were relocated onto the left side of the front panel.

Another significant change in the aircraft that should add hours of comfort to both the aircraft commander and the pilot is the moisture separator that is part of the cabin temperature and pressurization package. ~~This unit was written up in the 3rd Quarter 1971 DIGEST (pages 39-40) - so I won't repeat the details.~~ However, the obvious effect you receive is dryer air in the cockpit while running the temperature at humane levels. That one is long overdue.

Block 48/49 Changes (1972)



Operations

Slats are Better!

By IRV BURROWS/*Chief Experimental Test Pilot*

Ready or not, the slats are coming! June delivery F-4E's will be slatted – they'll look and feel different from your average old F-4C through E; and though there ain't nothing in them that'll jump up and bite you, a few words of enlightenment may be in order.

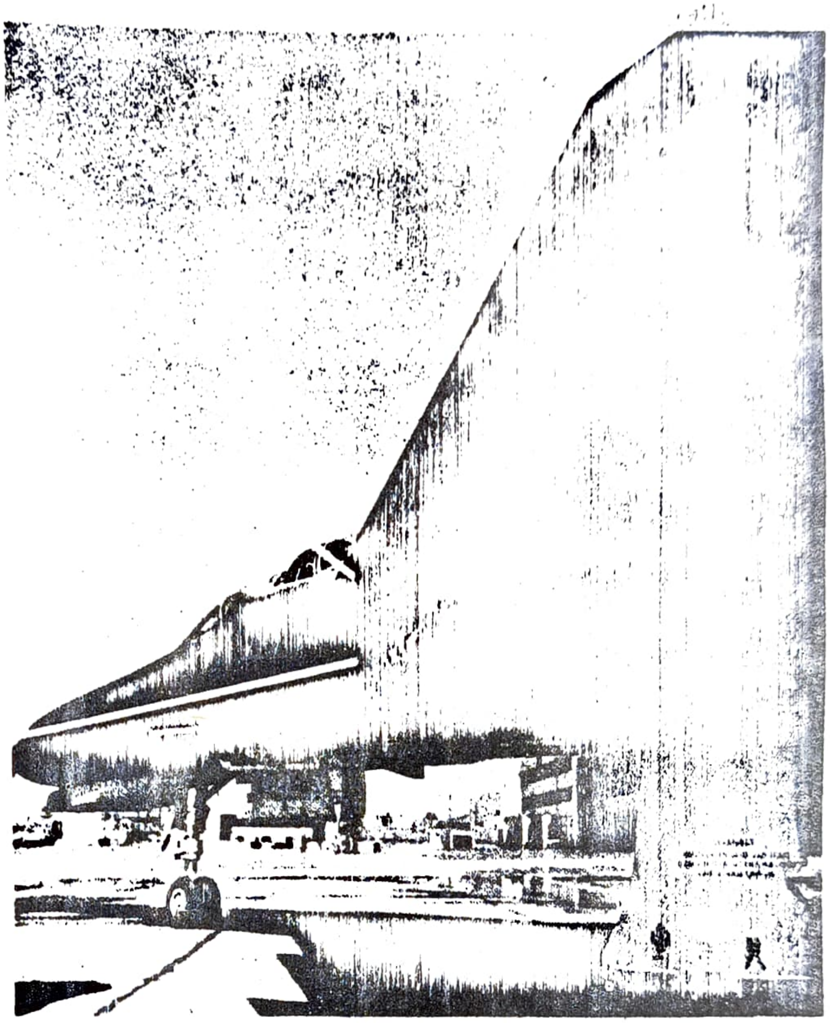
TWO POSITIONS

Let's cover mechanization first. Each wing incorporates two sections of slats – inboard and outboard. Both are hydraulically actuated via the utility hydraulic system. The inboard section moves between the extended (high-lift) position and the retracted (clean) position. The outboard section moves from a high-lift position to a cruise position, which is not retracted but simply rotated ~~(see slats/wing cross-section illustration on page 34)~~.

Both slat sections move in unison, and the total movement is accomplished in about one second. Happily, the movement also takes place very smoothly, relatively quietly, and with almost imperceptible effect on aircraft pitching

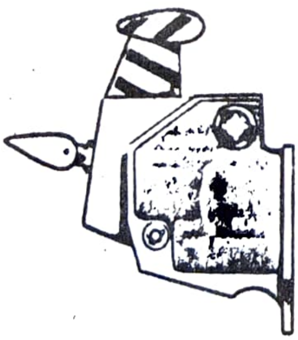
CONTINUED ON PAGE 275

Slats are Better! *continued from page 274*



moment. The net effect is that 90 percent of the time, if you're not watching or listening for them, you won't know when the slats move. Once again for emphasis - they are *two-position* slats - not modulated.

SWITCHOLOGY



A few items have been changed in the cockpit to accommodate this new "toy." The heart of the slats control is the old FLAPS switch which still has three positions but is relabeled from top to bottom as NORM, OUT, and OUT AND DOWN. NORM applies to almost all flying between the take-off and landing phases. In this position, you have a slat system which is automatically positioned as a function of angle of attack. No thinking required - when alpha exceeds 10 units, the slats move out; when it decreases below 8 units, they come back in. Two units hysteresis is built in, of course, to keep them from chattering in and out around cruise. Okay? Auto slats in NORM.

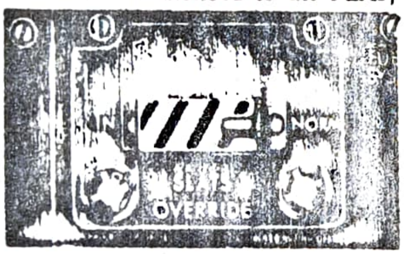
The next position down (OUT) gives you a manual slats-out position - anytime this position is selected, those hummers go to high-lift position *unless* one of two conditions prevails: either the OVERRIDE switch is IN, or airspeed is in excess of 600 knots. Any other time, the OUT position should command just that, thereby providing a manual slats mode.

The bottom position (OUT AND DOWN) can be considered normal landing and takeoff selection. You'll get slats and flaps. (Forget about 1/2 or full flaps - they're now the same; i.e., 30° flaps is the *only* flaps-down position.) Now, right here, we felt we saw a Murphy. F-4 drivers the world over have been moving that flap switch one notch down for takeoff. With our original slat mechanism, this position would give you a no-flap, slats-out takeoff - not necessarily a problem, but potentially one if the pilot isn't on his toes (possible overrotation). Our solution here is to interlock the flaps and gear so that if the gear is down (specifically, if the nose gear is down), the OUT position will also run the flaps down. This does not mean that as soon as the gear is retracted after takeoff, the flaps will come up too. The circuitry is designed so that the flap switch must be placed in NORM (or the flap blow-up speed exceeded) before flaps will retract. This eliminates premature flap retractions after a heavy takeoff.

How about a quick review of that: Flaps are lowered whenever OUT or OUT AND DOWN positions are selected with the gear down; with gear up only the OUT AND DOWN notch gives you flaps. Thus, if you've selected OUT with gear up, you'll get no flaps until the gear is lowered - then, down they come. Flaps are raised *only* by placing the switch in NORM.

If I haven't lost you yet, hang in there and I'll try harder.

Earlier I mentioned the SLATS OVERRIDE switch. This is a new addition to the cockpit: a two-position switch guarded to the NORM position with the other selection being IN. If it, in fact, is positioned to NORM, the functions I've ascribed to the FLAP/

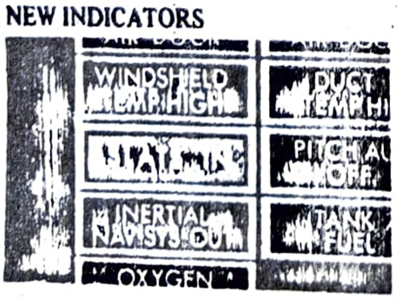


SLAT switch will prevail. However, if you move it to IN, all other slat selections are overridden, and the slats should come in. The logic here was to provide a capability to retract everything rather than have an asymmetric slat extension due to battle damage or malfunction.

Pneumatic emergency flap extension will give you what you'd normally want under those conditions - flaps and slats - the landing configuration.

So that's it for controls. All the options are available: automatic slats (which I will consider the normal case); plus manual in and out.

NEW INDICATORS



In our slats-equipped F-4E's some new and different indications are presented. The old leading-edge flap indicator is now a *slat* indicator which moves from IN to barber pole to OUT as the slats move. A new SLATS IN light has been added to the telepanel; it will come on whenever the override IN position is selected. And the old WHEELS light logic has been changed so that it now flashes whenever you're below flap blow-up switch speed (approximately 230 knots) and the gear isn't down.

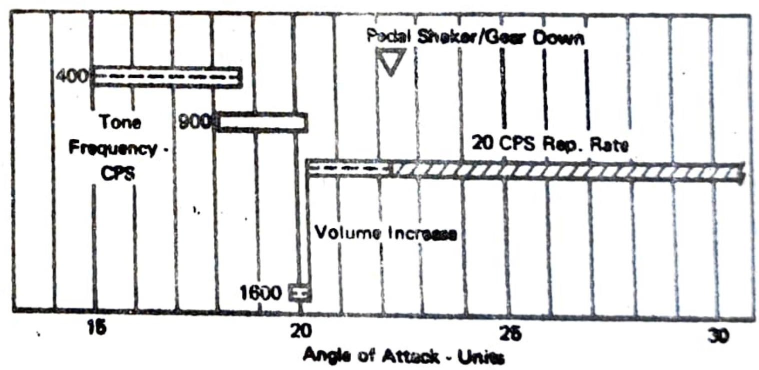
MORE AURAL TONES

As you'll soon see, the maneuvering handling qualities with slats out are significantly improved. This being the case, it was quite obvious that a change was required in the aural tone pattern. Now we have an airplane which maneuvers at 25 AOA with slats out but which still approaches at 19.2. By the same token, should slats not extend for any reason when scheduled, we're back to a basic F-4 for maneuvering. So what we really need are two tone patterns - one for slats out and one for otherwise. Accordingly, the new schedule (see below) was developed to go along with the old basic schedule, with slats-out logic being obtained from the four limit switches in series. Thus, the familiar old F-4 aural tone pattern will apply anytime one or more slats are still in, *or* for the landing configuration. When slats are out for clean maneuvering, the new tone schedule will be heard.

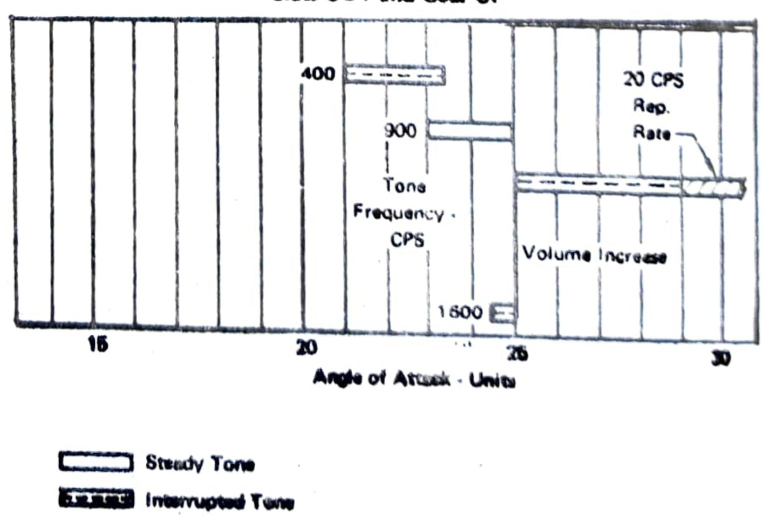
Your representatives and our guys agreed on the new pattern, feeling

AURAL TONES

Slats IN or Slats OUT and Gear DOWN



Slats OUT and Gear UP



that: (a) anticipatory tone below 23 units really wasn't required and would only be bothersome; (b) 23 to 25 was probably going to be the prime maneuvering range; (c) above 25, volume should be at a level that couldn't be turned off; and (d) 29 was a good point for stall warning. Rudder shaker at 22.3 is retained only for the landing configuration – for a 25 unit maneuvering airplane it's obviously undesirable and hence has been deleted.

So much for mechanization. The obvious question now is: How does it fly?

UP AND AWAY

Let's go through the normal flight sequence, which, all other things being equal, requires takeoff to occur first.

The airplane is longitudinally more responsive at low speeds – a fact which will be obvious when full aft stick starts the old nose coming up at something less than 100 knots. Takeoff techniques remain the same as in the non-slat aircraft, but you should be prepared to stop the pitch attitude change a little earlier. We've found that the 3 units nose-down trim previously recommended for the basic F-4E is still okay. Of course, if the slat switch is left up (NORM) for takeoff, it'll be the same as a clean F-4 takeoff. (With weight on the wheels, slats are driven to the cruise position on the ground.) However, as soon as weight is off the wheels, the slats will come out (AOA higher than 10 just after takeoff). This transient is insignificant and won't be a problem.

CHARACTERISTICS

A rundown on handling characteristics will show some which are consistent and repeatable. There are other subtle quirks that, as in all airplanes, will vary from F-4 to F-4, or from pilot to pilot. Generally, this is what happens:

CLEAN – Buffet is less at all angles of attack. I think this will be quite obvious to you the first time you honk it in, particularly at high altitude. Next, I think you'll notice an increase in "comfort" at high alpha – maneuvering from 20 to 25 units is routine. In fact, optimum maneuvering is (at this time) recommended at 23 to 25; and the aural tone will so state.

Aileron effectiveness diminishes above 20, but good roll rates are available with rudder. Above 25, some wing rock will generally start to develop. The exact point it starts, the rate it builds up, the associated yaw, etc., are all variable; and I think it's sufficient to say that anything above 25 units is not considered optimum for maneuvering. The aural volume increase will start here (25); and if perchance you should miss that but begin to feel wing rock and yaw, I would suggest moving the stick forward smartly to decrease alpha below 25. I don't intend to sound an alarm here – we've spent a lot of time above 25 (in fact, above 30). We've encountered some departures (generally between 30 and 35 which we classify as very gentle), but there is absolutely no point in flirting with out of control, and slats, friends, are *not* advertised to prevent out of control. Forestall it, yes; pacify it, yes – but not prevent it. Incidentally, the AOA indicator will still read 0-30, and 30 units will constitute an upper maneuvering placard.

Of course, the obvious capability to pull more g's (or alpha) for a given airspeed/altitude combination is there. Likewise, specific excess thrust is improved – you can fly formation with a non-slat F-4 in high AOA turns using considerably less power.

One g flight (clean) is also characterized by increased comfort. The airplane can be one g (clean) stalled with only mild buffet and sometimes little or no wing rock. I've seen cases of stick back on the stop, and alpha well above 30 for several seconds, while the airplane simply drops like a rock, but does little else – similar to a delta-wing stall. They're not always this stable, and increasing wing rock from 25 to 30 units is more often the case, but it is significantly more comfortable than the basic F-4.

DIRTY – If we have to tone down our bragging a little bit, it's in the landing configuration arena. We've traded a little here to gain a lot of combat capability. Basically, the aircraft approaches about 8 to 10 knots faster than a full-flap no-slats F-4E at the same alpha. While it's doing this, the roll response is just a tad less than you're used to, and maybe it's a little tougher to track a constant AOA. On the other hand, there is more stabilator effectiveness, which allows the airplane to be flared a bit before touchdown. Thus some of that extra speed can be bled off and actual ground roll is not excessively lengthened.

A power approach stall is not greatly different from the basic airplane. Buffet is greater, and perhaps so is wing rock (starting at about 25 units). Neither of these detracts from the approach, but they do provide stall warning that is probably more noticeable. There is an area of almost neutral stick force stability (i.e., increased alpha for very slight increased stick) between 23 and 25 units, but we do not feel this is of serious concern since it's very slight and well above normal approach alpha.

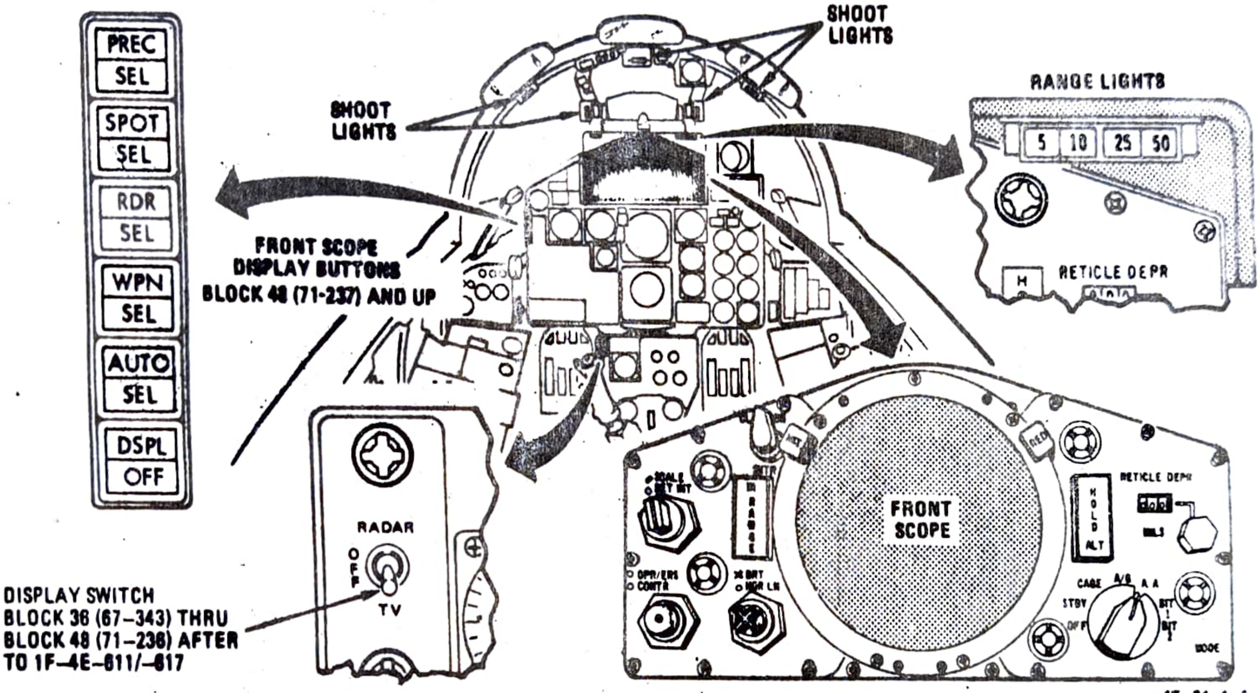
THE BEST F-4 YET

So that's it, guys! As of this writing the slats program is still underway, and all the returns are not in yet. An upcoming Air Force evaluation, plus some of our own thoughts, may revise a few of the items I've mentioned. For example, the 8 to 10 unit actuation point is up for grabs. It was designed this way based on analysis; it works, but may not be optimum. Other things are under consideration, but won't be determined by the time this DIGEST goes to press; so we'll have to cover any changes later if necessary. In the meantime, the slats are coming. Whatever changes may occur from what I've said here should be for the better, and they'll just make it more pleasant for you to fly what we consider to be the *best F-4 yet!*

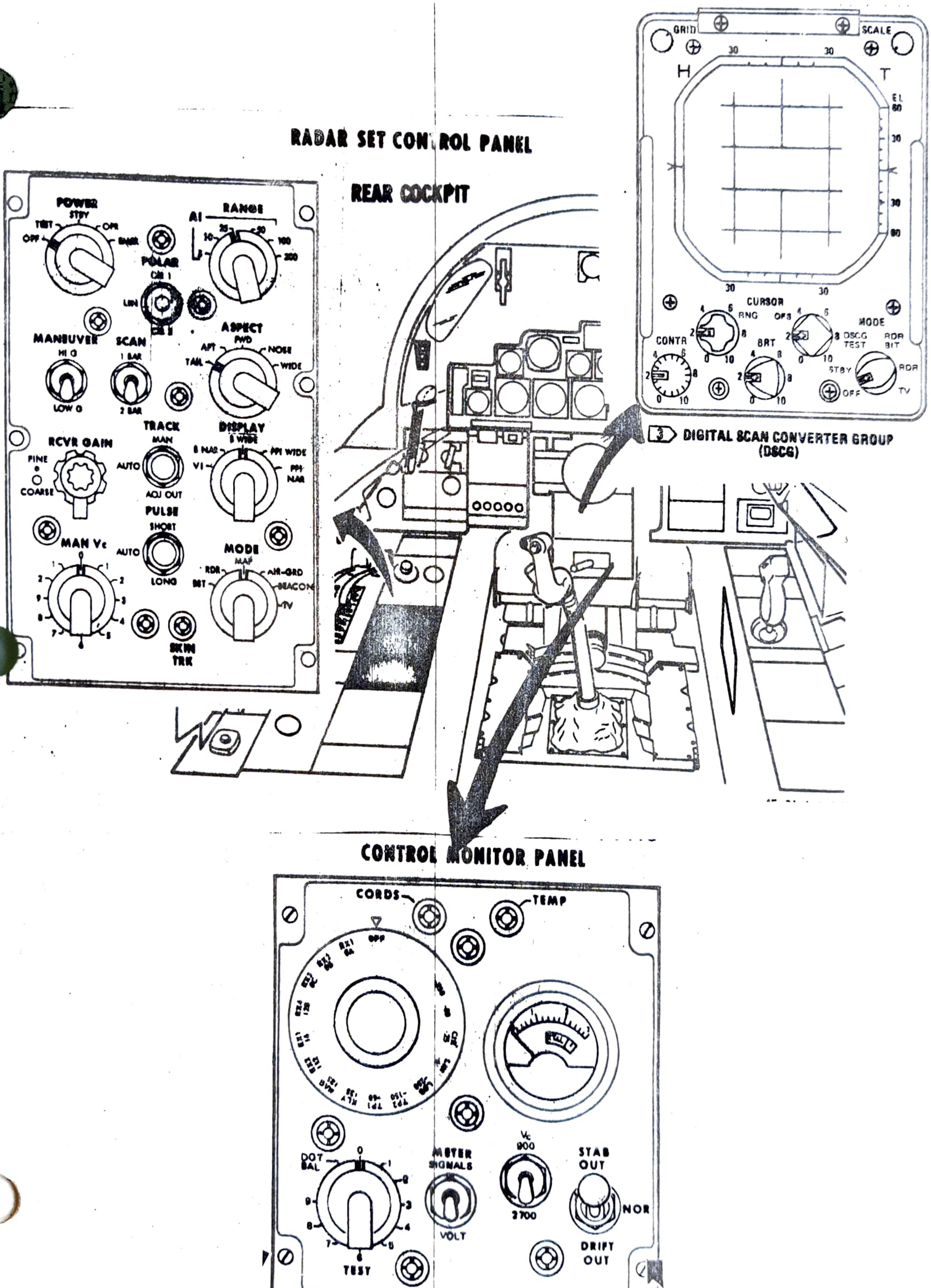
II DSCG RADAR

FCS CONTROLS & INDICATORS

FRONT COCKPIT



4E-34-1-1-(28) B


RADAR SET CONTROL PANEL
REAR COCKPIT
DIGITAL SCAN CONVERTER GROUP (DSCG)
CONTROL MONITOR PANEL
POWER
RANGE
POLAR
MANEUVER
SCAN
ASPECT
TRACK
DISPLAY
RCVR GAIN
PULSE
MAN Vc
MODE
SKIN TRK
GRID
SCALE
CURSOR
CONTR
BRT
CORDS
TEMP
METER SIGNALS
VOLT
STAB OUT
NOR
DRIFT OUT
TEST
DOT BAL

DSCG DISPLAY SYMBOLS.

NOTE: *The number references shown in Figure 2-14 correspond with the following paragraph sequencing.*

(1) HORIZON LINE. The horizon line is a straight line consisting of two segments. Each segment is 1 ± 1/8 inch in length separated by 13/16 ± ¼ inch gap. The horizon line is displayed at all times provided that STAB OUT is not selected on the Control Monitor Panel. The horizon line constantly indicates the antenna reference plane with respect to the aircraft attitude. During normal radar operations the horizon line is parallel to the horizon. The exception is during certain BIT functions. An Horizon Line (HOR LN) adjust knob is provided on the front indicator which is used for zero pitch adjustment of the horizon line on both scopes.

(2) ELEVATION STROBE. The elevation strobe is displayed as a short (¼ ± 1/16 inch in length) horizontal line on the right side of the scope. The primary function of the elevation strobe, which is displayed at all times, is to indicate antenna position. Manual elevation control is commanded in search operations by rotating the elevation thumbwheel control on the antenna hand control. The strobe may be positioned anywhere within the elevation limits (at least ± 50°) marked on the right side of the scopes. The vertical position of the strobe indicates antenna elevation angle with respect to the horizontal plane, assuming that the stabilization switch on the control monitor panel is in the NOR position. In the STAB OUT position, the elevation strobe represents the antenna angle with respect to the aircraft.

(3) ACQUISITION SYMBOL. The acquisition symbol is displayed as two short (¼ ± 1/16 inch long) vertical lines which are ¼ ± 1/16 inch apart. The position of the acquisition symbol represents the azimuth position that the range strobe and antenna will assume when half action is initiated. Horizontally, the acquisition symbol tracks the B-sweep within 1/16 inch when the Antenna Hand Control is moved from left to right. Fore and aft movement of the Antenna Hand Control controls the vertical movement of the acquisition symbol which is limited to the top of the scope in range scales of 5, 10, 25 and 50. The acquisition symbol is displayed in all AI ranges during search and acquisition except in VI, MAP-PPI or BEACON-PPI modes.

(4) B-SWEEP. The B-sweep is a 3½ ± 1/8 inch vertical line moving in synchronization with the antenna azimuth scan. Horizontal

displacement of the B-sweep from the center of the scope indicates the angular position of the antenna in azimuth. During search operations, the antenna azimuth scan is controlled by the display knob to provide either a 120° (WIDE) or 45° (NAR) scan. With WIDE scan selected, the B-sweep horizontal scan fills the unmasked scope area within 1/8 inch. The B-sweep scans 1 5/16 ± 1/8 inch horizontal segment when NAR scan is selected. The center of the narrow scan is positionable at least ± 32.5° from 0° azimuth by the Antenna Hand Control. The length of the B-sweep represents range using the vertical scope axis. Zero range is the bottom of the scope and the top of the scope represents the range selected.

(5) RANGE STROBE. A range strobe appears in the B-sweep as an intensified portion of the sweep when half action is initiated and is aligned in the center of the acquisition symbol. When a target appears in the B-sweep, the range strobe can be manually positioned over the target prior to initiating (full action) track operation. After lockon is achieved, the range strobe is automatically positioned to indicate target range.

(6) ASE CIRCLE. The allowable steering error (ASE) circle is displayed in the center of the radar scope to indicate the computed allowable steering error. With AIM-7 missile selected, the diameter of the circle is variable from 0.2 to 1.2 inches. With heat missile selected (AIM-4 or AIM-9), the diameter is a constant 0.4 inch. In AOJ, VI and AIR-GRD operations, the circle also is fixed at 0.4 inch. During BIT 3 testing, the circle is 1.9 ± 1 inch in diameter and is used for checking the angle track function.

(7) AIM DOT. The aim dot is a 1/16 inch square symbol that appears on the scope after lockon is achieved. Dot displacement indicates the deviation from the computed attack course and the direction in which the aircraft must be maneuvered to assume the computed attack course. This steering function is provided by the radar computer.

(8) RANGE RATE. On the DSCG scopes, range rate is presented as numerical read outs in the upper right corner of each scope. Closing velocities are indicated by the digits while opening velocities are preceded by a minus character. During track operations, the range rate is constantly updated to provide the aircrew with accurate opening or closing rates. The maximum and minimum rates that can be displayed is limited to the radar computer parameters. However, since the range rate is digitally represented, the 900 position of the V_c switch is not used.

(9) R_a STROBE. The R_a strobe appears as a short horizontal line to the left of the B-sweep during track operation. The strobe represents the missile aerodynamic range for the existing launch conditions with either AIM-7 or AIM-4D missiles selected.

(10) R_{min} STROBE. The R_{min} Strobe appears as a short horizontal line below the R_a strobe during track operations. Minimum launch range is indicated by the R_{min} strobe with either AIM-7 or AIM-4D missile selected. The R_{min} and the R_a strobe is displayed in all range tracking modes except air-to-ground and VI modes.

(11) BREAK X. The Break X is displayed at minimum launch range to indicate that the attack mode should be discontinued. Break X indications, in conjunction with the front scope In-Range light, are a function of the radar computer. The Break X is not displayed in the air-to-ground or VI modes. The computed break X does not reflect the minimum range of the AIM-7E-2 dogfight missile.

(12) T SYMBOL. The T (track) symbol is engraved in the upper right portion of the rear scope face plate. The T symbol is a light that illuminates to indicate that the radar is in a track condition. When the T symbol is illuminated, so is the SKIN TRK light on the radar set control. The same parameters that affect the SKIN TRK light also affect the T symbol except for BIT 6 testing. In BIT 6, the T symbol is illuminated but the SKIN TRK light remains off.

(13) H SYMBOL. The H symbol is engraved in the upper left portion of the rear scope plate. The H symbol also is a light that illuminates to indicate when the radar system switches to Home-ON-JAM (HOJ) operation. In addition to the H symbol, both scope range rate digits begin flashing at a 4 Hz rate and the last digit (which is always a zero) is replaced with the letter H.

(14) RADAR RANGE. During all operating modes, the selected radar range scale is numerically presented in the upper left corner of both scopes.

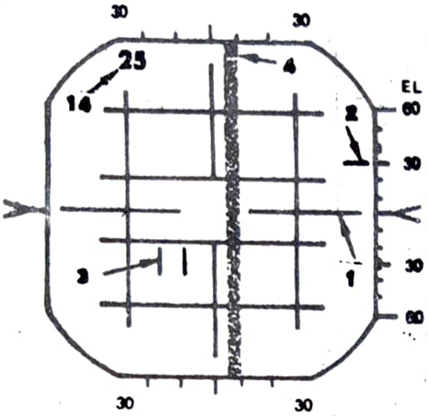
(15) BOMBING RANGE STROBE. The bombing range strobe appears in the PPI sweep as an intensified spot in the MAP-PPI or BEACON-PPI modes provided that AI 5 miles is not selected on the radar range knob. The bombing strobe is used to display steering information for bombing computation and is positioned by the

Weapon Release Computer in the TARGET FIND and OFFSET bombing modes, or when HOLD is selected on the Weapon Delivery Panel. The above condition is available provided the delivery mode knob is not in the DT, DL, L, or AGM-45 position, otherwise the bombing strobe position is controlled by the manual range strobe adjust on the antenna hand control panel.

(16) OFFSET CURSOR. The offset cursor is displayed as a straight line in the 10-, 25- or 50- mile ranges only and is used as a bombing reference in the MAP-PPI or BEACON-PPI modes. Display of the offset cursor is controlled by the Weapon Release Computer as described in item (15).

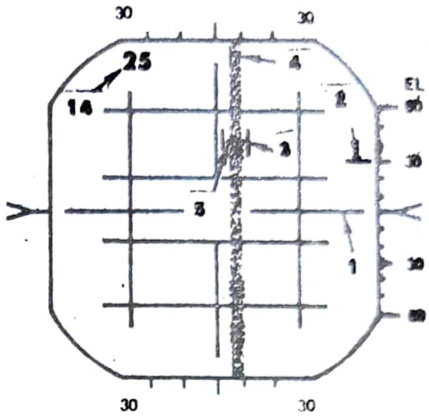
DSCG SYMBOLS

SEARCH



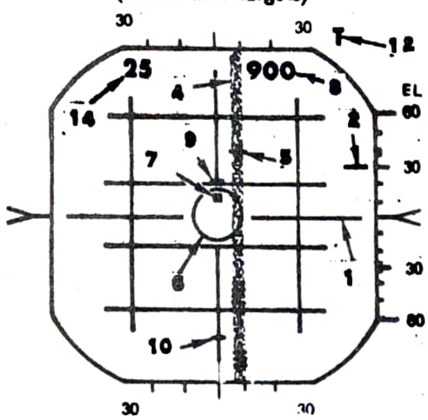
SEARCH IS OBTAINED IN A NO ACTION CONDITION WITH A CHOICE OF WIDE OR NARROW SCAN AVAILABLE.

ACQUISITION
(shown with targets)



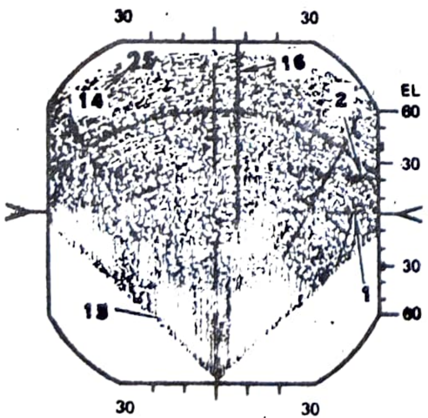
ACQUISITION IS ACCOMPLISHED BY BRACKETING THE TARGET WITH THE ACQUISITION SYMBOL, INITIATING HALF ACTION, AND POSITIONING THE RANGE STROBE OVER THE TARGET

TRACK
(shown with targets)



AFTER ACQUISITION, TRACK IS OBTAINED BY DEPRESSING THE ACTION SWITCH TO FULL ACTION AND HOLDING UNTIL LOCKON IS ACHIEVED. THE ACTION SWITCH IS RELEASED AFTER THE TRACK DISPLAY IS OBTAINED.

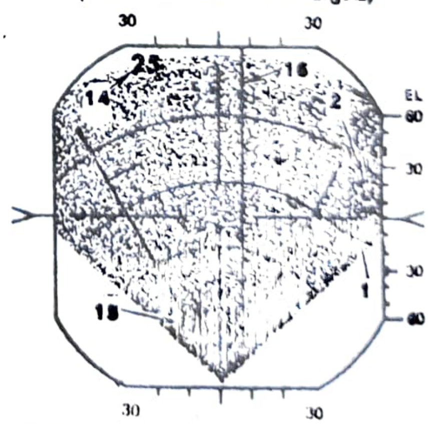
MAP-PPI SEARCH
(wide scan shown)



MAP PPI SEARCH CAN BE SELECTED WITH A CHOICE OF WIDE OR NARROW SCAN. ACQUISITION AND TRACK CAN NOT BE OBTAINED AS THE ACTION SWITCH IS DISABLED. WITH AI 5 RANGE SELECTED THE DISPLAY REVERTS TO A B-SCAN FORMAT.

FIGURE 2-14

BEACON-PPI
(wide scan shown with targets)



THE BEACON SEARCH PATTERN IS IDENTICAL TO THE MAP PPI SEARCH DISPLAY. BEACON NAVIGATIONAL INFORMATION IS RECEIVED IN SEARCH OPERATION ONLY BUT MAY BE DISPLAYED IN THE B-SCAN FORMAT.

Introduction

The LRU-1 is the latest modification to the F-4E radar. Its primary purpose is to eliminate the guesswork associated with estimating air-to-air weapons parameters, and is accomplished through the LRU-1 computer and its corresponding software. Another important feature of this mod is the Computer Aided Acquisition Mode which gives the aircrew an automatic off-boresight capability.

The purpose of this outline is to familiarize aircrews with the operational aspects of the LRU-1 modification and how this mod enhances the F-4E's weapon system capabilities. The following items will be covered in this discussion:

LRU-1 Computer Software
Long Range Intercept Mode (LRI)
Air Combat Maneuvering Mode (ACM)
Computer Aided Acquisition Mode (CAA)

LRU-1 Computer Software

The target intercept computer receives its inputs from three sources: the CADC, INS, and on board radar. From this information, the computer determines target aspect, altitude, direction, velocity, and turn rate. The computer then compares this current data with the missile launch envelope stored in its memory and determines missile capability at that instant. The displays which depict this launch envelope will be discussed later.

After T.O.-1167, the target intercept computer now computes launch paramters for a wider range of air-to-air weapons. The LRU-1's computer software now gives valid launch indications for the following weapons: AIM-7E/F, and the AIM-9P-2-3. Figure 1 depicts the flow of information in and out of the LRU-1 computer.

Long Range Intercept Mode (LRI)

The long range intercept mode is automatically selected anytime the radar is locked on, and the targets range is greater that 5NM or the fighters altitude is greater than 32,000 feet.

The radar displays in the LRI mode are identical to the current analog display with the exception of RA which now becomes R max and represents the true maximum range for a non-maneuvering target. A 1 G target is still assumed, however, the computer now has aspect angle and velocity information available. This allows a more accurate determination of missile performance which produces a wider tolerance for steering commands. The aim dot programs a lead collision course beyond R max with a smooth transition to lead pursuit course at R max. The lead pursuit course generates the correct lead from which the missile can fly a collision course to the target without any additional course corrections after launch. There is no noticeable perception of a course change from lead collision to lead pursuit.

Air Combat Maneuvering Mode (ACM)

The air combat maneuvering mode is automatically selected any time the radar is locked on, the target is inside 5 NM, and the fighter is below 32,000 feet. The following paragraphs will discuss only those displays that differ from the all analog computer. The displays will be discussed separately for AIM-7 and AIM-9.

AIM-7 Displays

ASE Circle: With RADAR selected in the ACM Mode, the ASE circle is fixed at .56 inches in diameter and represents the angular limits of the computed launch envelope. The center of the circle represents the fighters velocity vector. When the dot is within the circle, the angular launch limits have been satisfied and the shoot lights should illuminate.

R max and R min: After the -1167 mod the Ra strobe now becomes R max. The displayed R max is limited to 5 NM in the ACM mode. The R min strobe represents the minimum range capabilities that the missile possesses under current measured conditions.

Shoot/In Range Lights: After -1167 there are now five SHOOT Lights in the front cockpit and one in the near cockpit (see figure 2). With a valid lock on, the IN RANGE light and SHOOT Lights indicate that missile launch parameters are satisfied and the missile may be launched. The high intensity and flashing operation of the SHOOT Lights improve daylight visibility. When the instrument panel dimming control is used for night operations, however, the SHOOT lights are off but the In Range light operates at reduced intensity.

Aim Dot: The aim dot represents the center of the instantaneously available missile envelope. The position of the aim dot with respect to the center of the ASE circle indicates the relative angle which the fighter velocity vector must change in order to point to the center of the launch envelope. If, for example, the aim dot was in the upper right hand corner of the scope, the aircraft would have to be banked right and pulled to get within valid launch parameters.

Break X: When in the ACM mode, the Break X is inhibited and will not appear except to indicate a computer malfunction. The only indication of min range will be when the targets return is inside the min range strobe.

Aim-9 Display

Shoot/In Range Lights: When in the ACM Mode with HEAT selected, the missile envelope is computed for a boresighted missile unless the ARR button is depressed. If the missile is allowed to self track, the envelope computed is for this off-boresight situation. Again, SHOOT light operation is determined by a computer decision of whether or not the fighter is within the missile launch envelope.

Aim Dot: When HEAT is selected in the ACM Mode and the missile seeker head is caged, the aim dot indicates a boresight pursuit course. When the missile seeker head is uncaged the aim dot represents the missile pointing vector (see Aim-7 dot).

ASE Circle: Like the Aim-7 circle, the Aim-9 circle does not convey steering information but is a depiction of missile launch envelope. With HEAT selected and the missile seeker head caged, the ASE circle is fixed at 0.2 inches in diameter. When the missile seeker head is uncaged, the circle is fixed at 0.56 inches.

Rmax/Rmin: With the old analog computer, max and min range with HEAT selected was programmed for the old Aim-4D. With the LRU-1, the Aim-9P2-3 is now being used to determine max and min range. The Rmax and Rmin strobes are based on missile envelope determination for a boresighted missile when the Aim-9 head is caged. The Rmax and Rmin values will change as the target maneuvers or the seeker head is uncaged.

Computer Aided Acquisition (CAA)

The CAA mode gives the F-4 aircrew a tactical advantage not previously available with the old radar. This mode gives the aircraft commander the capability to achieve an off-boresight lock on without calling the WSO into the cockpit. This allows the F-4 to take full advantage of its all aspect capability while allowing the WSO to continue checking six, keeping a visual or tally, etc. The following paragraphs describe the operation and performance envelope of the CAA mode.

CAA is initiated by pressing the cage button on the throttle and then pressing the auto-acquisition button (nose gear steering button) in either cockpit. When automatic acquisition is initiated, the range strobe automatically rests to 1000 feet in range and the antenna is driven to 0° azimuth and -21° in elevation. Only after the antenna reaches this angle ± 21° in elevation. Only after the antenna reaches this angle ±2° does the automatic acquisition made start. The antenna scans in elevation at approximately 120° per second to facilitate target detection. The antenna is positioned 2° left during the upward scan and 2° right during the down ward scan. Although the antenna scans from +57° to -21° in elevation and ±2° in azimuth (see figure 3), actual lock on capabilities are limited by computer software. Because of a necessary buffer zone at the extremes of the scan, lock on is limited to +45° to -9° in elevation and ±5° in azimuth (see figure 3 and 4).

The valid lock on range for CAA is dependent on look-up or look-down angle. Above the radar boreline (0° in elevation), the entire 5NM range is available. Below RBL, this range decreases down to 6000 feet in range at -9° elevation (see figure 5). To take full advantage of the CAA's range capability, a level to look-up angle is recommended by the Dash-34.

The ACM computer is programmed to enhance the acquisition of valid target returns while minimizing spurious lockons. It should be noted, however, that aircraft attitudes which minimize radar clutter returns (look-up aspects) also minimize spurious automatic acquisitions. If the CAA mode attempts to lockon a return that either the radar or the aircrew determines to be undesireable, the range of the undesireable return is memorized and any further acquisition at that range ±200 feet is banked out for three half-scans of the scan pattern. This feature permits the CAA mode to look for additional targets during the three half-scans without interference from the previously rejected return. Additionally, whenever loss of lock occurs on a return originally acquired with CAA, the range at which lock was broken (±200 feet) is memorized and blanked out for three half-scans.

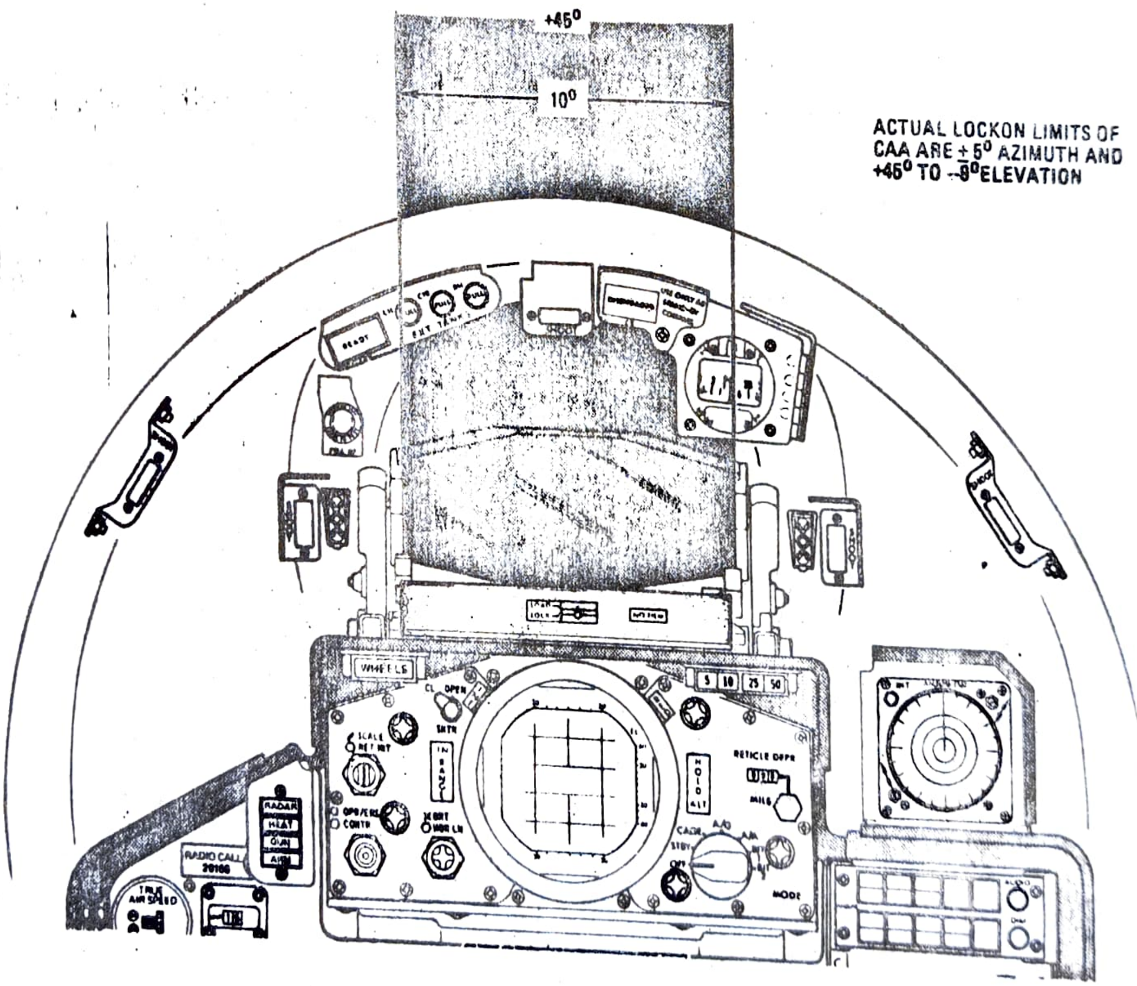
When CAA is initiated, Hi-G maneuvering and stab-out are automatically selected, regardless of switch positions. Even though the radar is stab-out, the horizon line remains if stab-in was selected when CAA was initiated. Once CAA achieves a lock or is deselected, the stab switch operates normally. Prior to T.O. -1167, stab-in was supposed to be selected prior to launching on Aim-7 to achieve proper altitude switching. After T.O. -1168, this is no longer necessary.

Conclusion

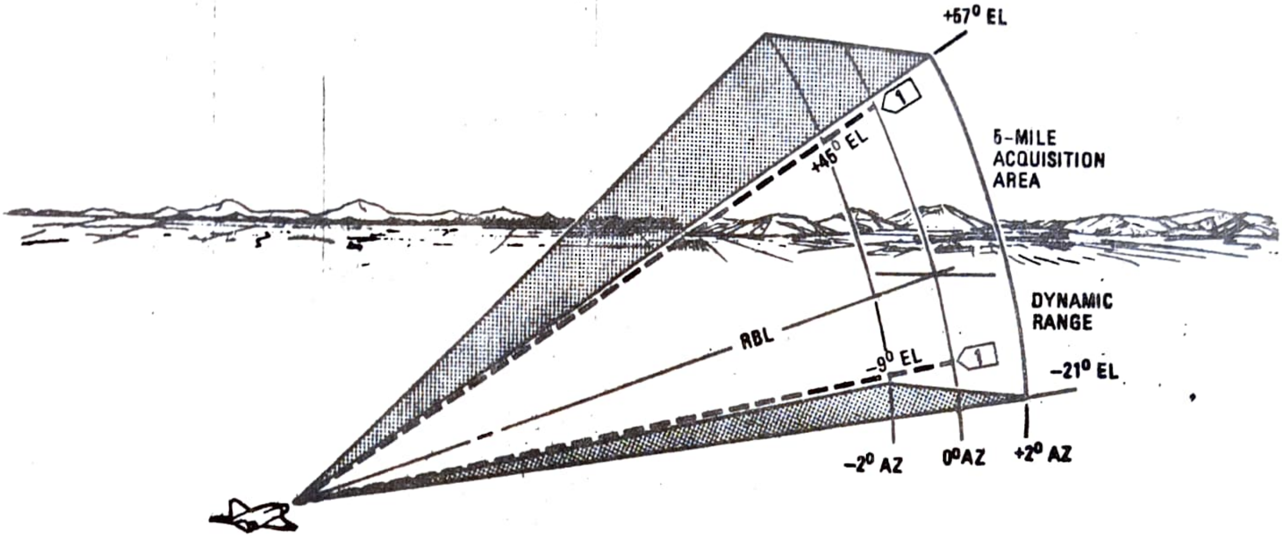
One Final Operational Note: Do not turn on radars with the LRU-1 modification until the engines are above 85% (i.e. takeoff roll) or the computer will burn up. Also, the radar Bit check indications for this modified system are substantially different than for the old computer so refer to the Dash -34 check list for proper Bit check indications.

For a more thorough discussion of this modification, refer to the F-4E-34-1-1.

CAA LOCKON LIMITS

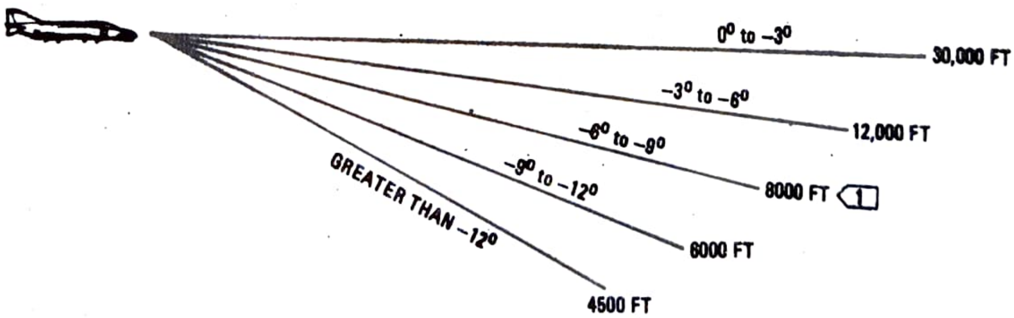


CAA SCAN PATTERN



NOTE

SCAN IS STABILIZED TO AIRCRAFT COORDINATES. 5-MILE ACQUISITION AREA IS FROM 0° TO +57° EL. DYNAMIC RANGE, LIMITED BY ACM COMPUTER, IS FROM 0° TO -21° EL.



CAA MAXIMUM ALLOWABLE TARGET DETECTOR RANGES AS A FUNCTION OF RADAR ELEVATION.

1 DUE TO COMPUTER SOFTWARE LIMITATIONS, ACTUAL LOCK ON CAPABILITY IS LIMITED TO +45° TO -9° IN ELEVATION AND ±5° IN AZIMUTH (NUTATING BEAM).

Figure 1-12A

4E-34-1-1-(30-8)

The following are problems/recommendations found out at George AFB where the factory tech rep for this radar mod is trying to work with the aircrews to get the bugs out of the systems.

T.O. 1166/1167 LRU-1 Modification

1. George is the only Wing in TAC with LRU-1 equiped aircraft. Clark is also modifying aircraft at this time.

2. The LRU-1 Modification is done locally by a field contract team during Phase. We have 19 aircraft with the modification now installed.

3. The LRU-1 Mod effectively changes all radar functions/capabilities. It is a digital computer system, with an intercept computer incorporated, completely different from the old computer.

4. The Intercept Computer
   a. This component is extremely heat sensitive.
   b. There is no heat sensor/auto shut off incorporated in the Computer component.
   c. The computer operates at its maximum temperature with little or no higher tolerance capability due to a high voltage requirement.
   d. The radar over-temp light indicates a high temperature in the radar bay and not any radar component. The computer could overheat and be destroyed with no cockput indication.
   e. There is a parts problem currently. No "get well" date in sight.
   f. If the computer fails or is removed, the radar is totally non mission capable.

5. In the interim, crews will adhere to the following:

   a. Maximum time for radar operation on the ground is 5 minutes.

   b. If the overheat light illuminates, the radar will be shut down immediatately.

   c. Any BIT fault/inflight malfunction will be debriefed to a radar specialist via telephone if necessary.

   d. During the airborne weapons system check, with a full system lock-on, the R-max strobe should remain relatively constant in range. Erratic behavior (fluctuations in range) and/or "noise" on the scope is an indication of an improperly gyro stabilized feed horn and requires the immediate attention of maintenance.

We've had our new digital LRU-1 radars for a while now and the odds are good that it has frustrated you in some way as you tried to use it. There are some things that you can do to eliminate that sense of frustration.

First, strictly follow the BITs as discussed on pages 1-41 through 1-46 and 2-53 through 2-63 in the -34. Second, strictly adhere to the operating limitations on pages 2-51 and 2-52 in the -34. Last, perform all weapon system checks while airborne.

Some things to remember about the LRU-1 are that missile computations come in two modes: the Long-Range Intercept mode and the ACM mode. In addition, HEAT steering is now pure pursuit with the AIM 9 missile caged. ACM and LRI computations may be found on pages 1-81 through 1-84 of the -34.

While airborne add one more step to your weapon system check. At 6000 feet after checking your heat tone, perform an unloaded roll of approximately . R max should remain stabilized at its present range. If it fluctuates, "breathes", or does a scissors action with R min write it up in the 781. You have one of two problems: First, and most likely, the radar antenna gyro stabilization may be bad or second, the digital processor may not be rec ving proper inputs from the target intercept computer.

The LRU-1 system is cosmic and a great improvement over the conventional APQ-120 D radar we have been using so write them up when they don't work properly and we all will benefit.

Recommendations for Aircrew Operations of LRU-1 modified radars

a. Do not turn LRU-1 modified radars on more than 3 minutes prior to take-off. This would necessitate BIT checks be done in flight and could cause some operational problems, i.e. radar look-out/trail departures.

OR

b. When equiped with an LRU-1 modified radar, one engine will be run-up to 85% momentarily, immediately after turning the radar on. This will insure the radar package cooling valve is opened. Maximum ground time allowable is 10 minutes if this procedure is followed.

NOTE: 1) If ambient temperature is over 90 F do not turn radar on more than 3 minutes before take-off.

2) If radar over-temp light illuminates turn radar off immediately.

III TISEO

TISEO CONTROLS

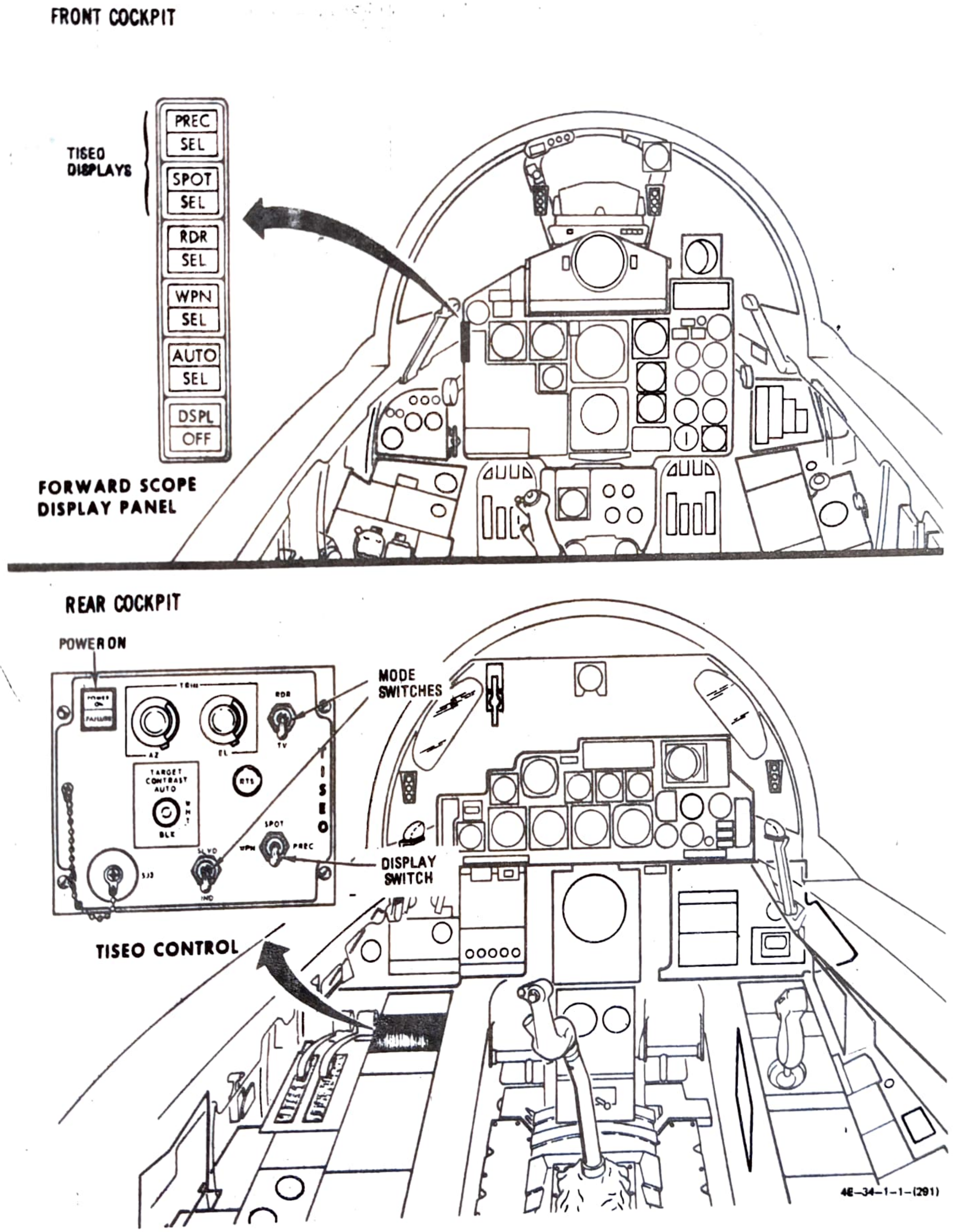


Figure 1-49

TARGET IDENTIFICATION SYSTEM

ELECTRO OPTICAL (TISEO)

CHAPTER 2

INTRODUCTION TO TISEO

INSTRUCTIONAL OUTLINE

1. (U) INTRODUCTION:

a. MOTIVATION: The F-4 as an air superiority weapon has been limited in the past by visual identification criteria. With the advent of TISEO, a gimbal-mounted, high-resolution, close-circuit TV system with a dual field of view (FOV); this requirement can be fulfilled at sparrow head-on missile ranges, thus allowing a successful intercept and kill on the first pass. The success of the tactical mission is directly dependent upon the function of the system and the aircrew's knowledge of TISEO and its operating procedures.

b. OVERVIEW:

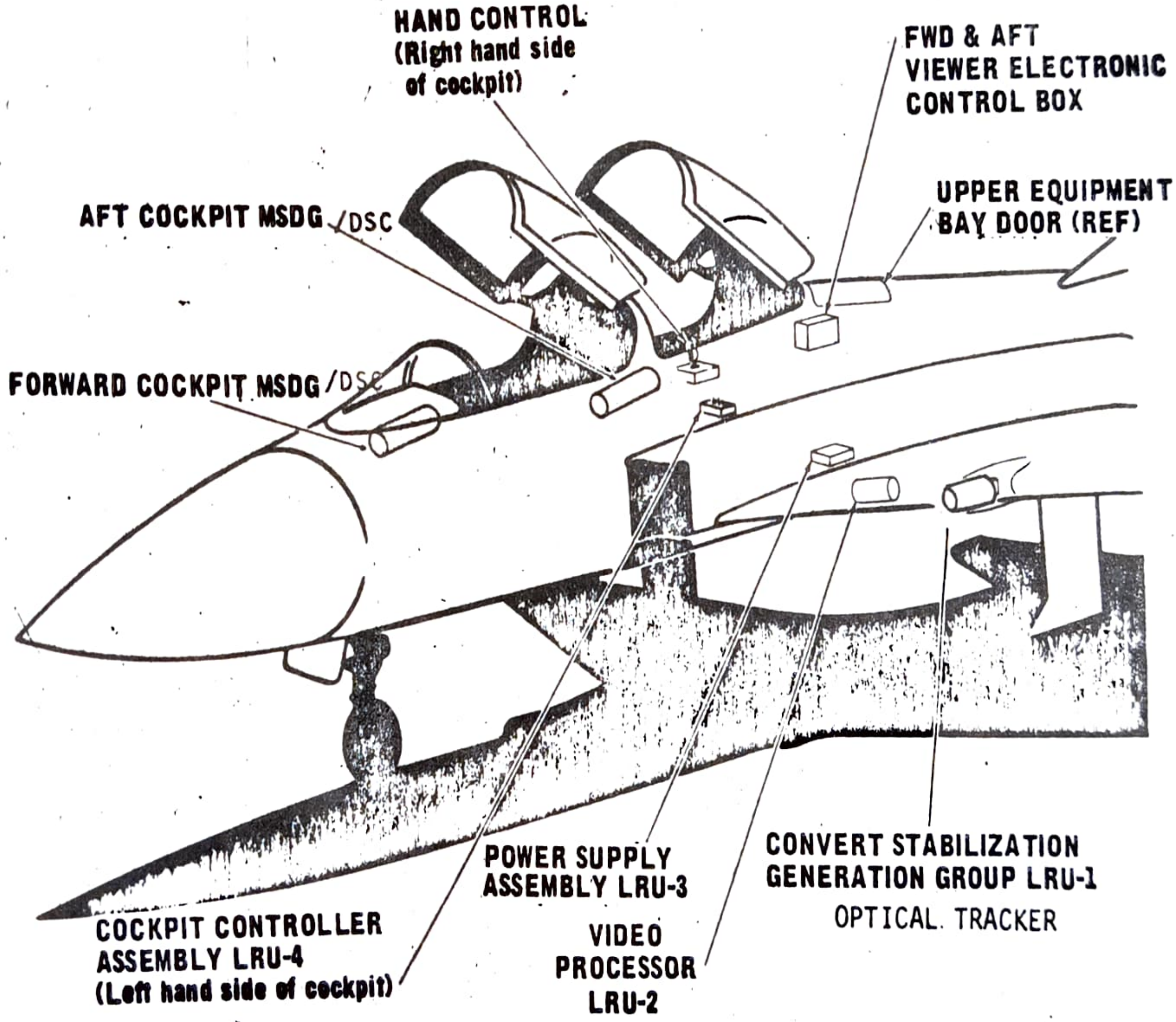
(1) The location of TISEO and general description.

(2) Description of components.

2. (U) DIRECTIONS AND EXPLANATIONS:

a. (U) The TISEO system consists of the following components: telescope, sensor electronics, and a combined RDR/TV viewing scope. The optical sensor is a gyro-stabilized dual telescope-vidicon system mounted in the leading edge of USAF Block 48 and above F-4E aircraft (approximately 185 aircraft). (Figure 2-1). The dual optical system contains a long focal length precision telescope with a narrow field-of-view and an integrally-mounted spotting telescope having a wider FOV. The gimbaled telescope system is pointed by the Radar/TV hand control (which also retains its normal radar function) and is capable of slaved, manual, and automatic EO tracking.

b. (U) The precision telescope FOV provides a narrower area of coverage and a magnified (10:1) center area of the spotting field of view. (Refer to T.O. 1F-4C-34-1-1-1 (C) - "Classified Dash 34" for the exact SFOV and PFOV mil sizes).



TISEO EQUIPMENT LOCATIONS

FIGURE 2-1

c. (U) When caged, the TISEO is aligned at the radar boresight line (RBL) and can be pointed with a caged gunsight pipper. The TISEO can also be slaved to the radar, the radar slaved to the TISEO, or either operated independently.

d. (U) TISEO COMPONENTS:

(1) (U) Converter Stabilization Generation Group, LRU-1: The optical tracker (located in the leading edge of the left wing, Figure 1-1) consists of the optical tracker and the tracker control. The optical tracker subassembly contains the dual FOV telescope and two vidicon cameras. The optical images from the telescope are focused onto the vidicons, converted into video signals (US Standard Format), and displayed on the viewing monitors. Servo torquers mounted on a two-axis gimbal system allow positioning of the optical tracker subassembly within a 50° cone. The specific azimuth limits are 25° left and right, while the elevation limits are 20° up and 30° down. Although the TISEO Gimbal limits are 25° right, the aircraft radome blanks out any video after approximately 17° of azimuth movement. The video processor subassembly contains the electronics required to operate the telescope servo torquers and the vidicons as well as additional electronics used to generate display symbols for the TISEO video through the Multi Sensor Display Group (MSDG)/or digital scan converter (DSC).

(2) (U) Video Processor, LRU-2: The video processor contains electronics for video processing to the cockpit displays. During video operations, synchronizing signals and special system operational status signals (symbols) are added to the spotting and precision video signals from the optical tracker. This operation develops the spotting and precision composite video signals which are then applied to the MSDG/DSC for display.

(a) (U) During optical tracking operations, a desired object (target) in the precision field-of-view is selected by the TISEO operator. The tracking control develops telescope azimuth and elevation positioning signals from the selected target information contained in the precision video signal. Telescope positioning signals are then applied to the servo system in the optical tracker and cause the telescope to continuously change position so that the target is maintained within the center of the precision field-of-view display (TV optical lock-on). In addition, the tracking control also contains mode control electronics which direct and control TISEO operation in response to inputs from other system LRUs. Operation of the tracking control (and optical tracker) is initiated at the controller.

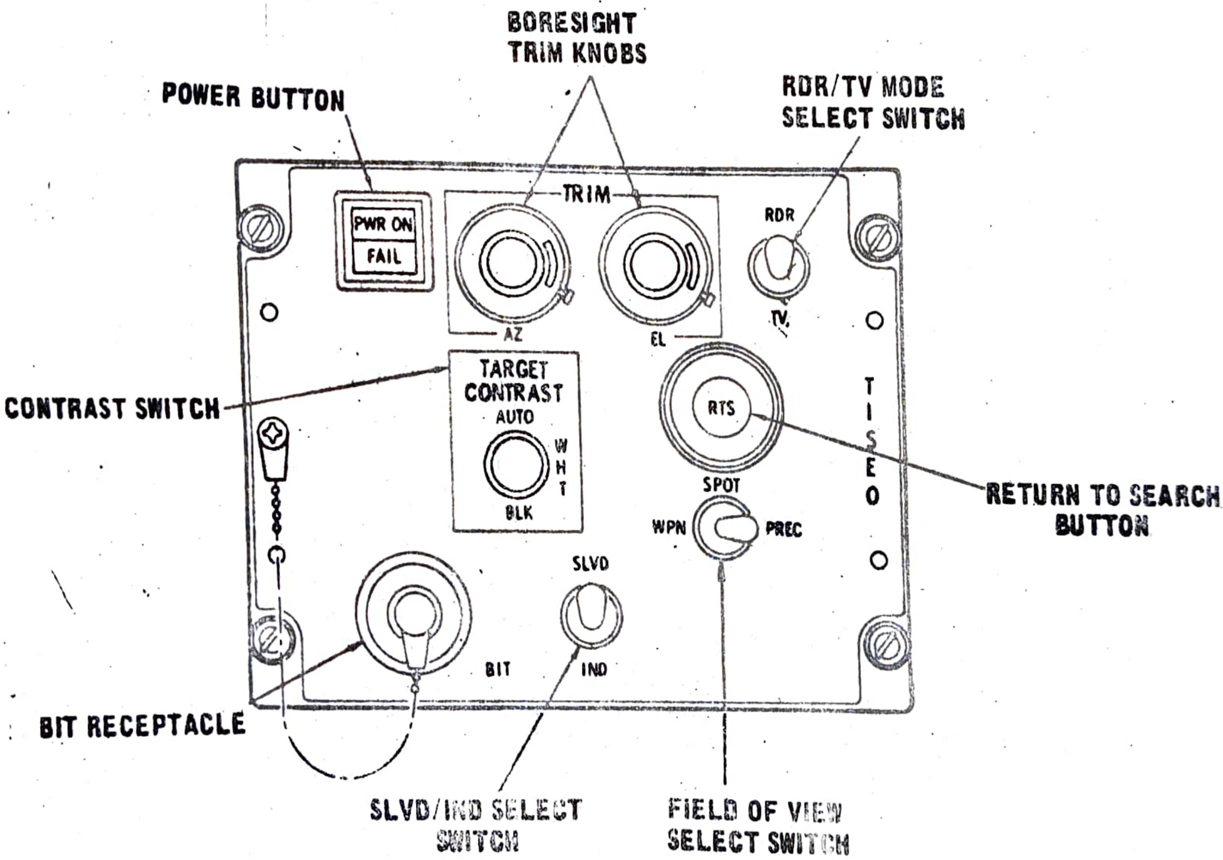
(3) (U) Power Supply, LRU-3: The power supply (located in the left side of the forward fuselage) converts 115V/400 Hertz (delta Y) three-phase aircraft power into AC and DC voltages required for TISEO operations. Power supply outputs are applied to the video processor for regulation and distribution to various units in the video processor (LRU-2) and converter stabilization generator group (LRU-1).

(4) (U) TISEO Control Panel, LRU-4: The TISEO control panel, in conjunction with the radar/TV hand control (Figure 2-2) contains all the switchology necessary to operate and control the TISEO system. The controls and their functions are:

(a) (U) Power Switch. This push-to-operate button applies power to the TISEO system.

(b) (U) Radar/TV Switch. This switch controls the video that is selected and displayed on the rear cockpit MSDG/DSC. Either radar on TV video may be viewed (the aircraft commander will view what is selected by the WSO in the rear cockpit if AUTO is selected on the sensor select buttons, located on the upper left corner of the glare shield.) If TV is selected on the control panel the antenna hand control belongs to TISEO or Maverick depending upon the position of the Display Select Switch. When the trigger is depressed to the first detent, the hand control directs the movement of the TISEO head throughout its 50° field-of-view, if PREC or SPOTTING is selected or slews the Maverick head if WPN is selected.

(c) (U) The Slaved/Independent Switch. This switch controls the slaving commands to either system. If TV and SLVD are selected the radar will be slaved to the TISEO throughout the 50° gimbal limit when TISEO is in rate mode or locked on. If RDR and SLVD are selected, the TISEO will receive slaving commands from the RDR after radar lock-on and second order track. Since the radar has larger gimbal limits than the TISEO, the TISEO will only slave to the radar within its gimbal design limits. If IND is selected, no slaving commands are present and each system remains in whatever state it was in prior to selection of IND.



TISEO CONTROLLER

FIGURE 2-2

(d) (U) Display Select Switch. This switch is located in both the front and rear cockpits. In the front cockpit the Sensor Select Panel allows the aircraft commander to independently select either weapon, precision or spotting video, or radar. If AUTO is selected, the aircraft commander will view whatever the WSO has selected. The aft cockpit TISEO controller has a three-position toggle switch which allows for selection of spotting FOV, precision FOV, or a third option (WPN) whereby Maverick or other EO weapons can be selected and the weapon video viewed on the displays. If an EO weapon is loaded and selected, video will therefore be displayed. If a Maverick is loaded and selected, the hand control for controlling the Maverick head will be active in addition to the Maverick video being displayed. After the Maverick or other EO weapon has been released or deselected, the monitors are blank as long as WPN is selected on the Display Select Switch. Without a Maverick or other EO weapon on board, if the WPN position is selected the display will be blank or a white band will cover approximately the top 1/4 of the displays indicating loss of video.

(e) (U) Target Contrast Switch. This is a three-position switch designed to optimize target contrast for the TISEO tracker. The positions are white on black, black on white, or automatic. You should normally use the AUTO contrast for all modes of operation, except when discrimination between black and white targets for lock-on is difficult. When you select BLACK on WHITE, the tracker locks on the selected contrast target and rejects targets of opposite contrast. An example of this might be a dark-colored tank near a large light-colored building. Selection of BLACK provides lock-on to the tank instead of the large building which appears as a prime target to the TISEO tracker when AUTO contrast is used.

NOTE: There are separate target contrast switches for Maverick in each cockpit and should not be confused with the TISEO contrast switch.

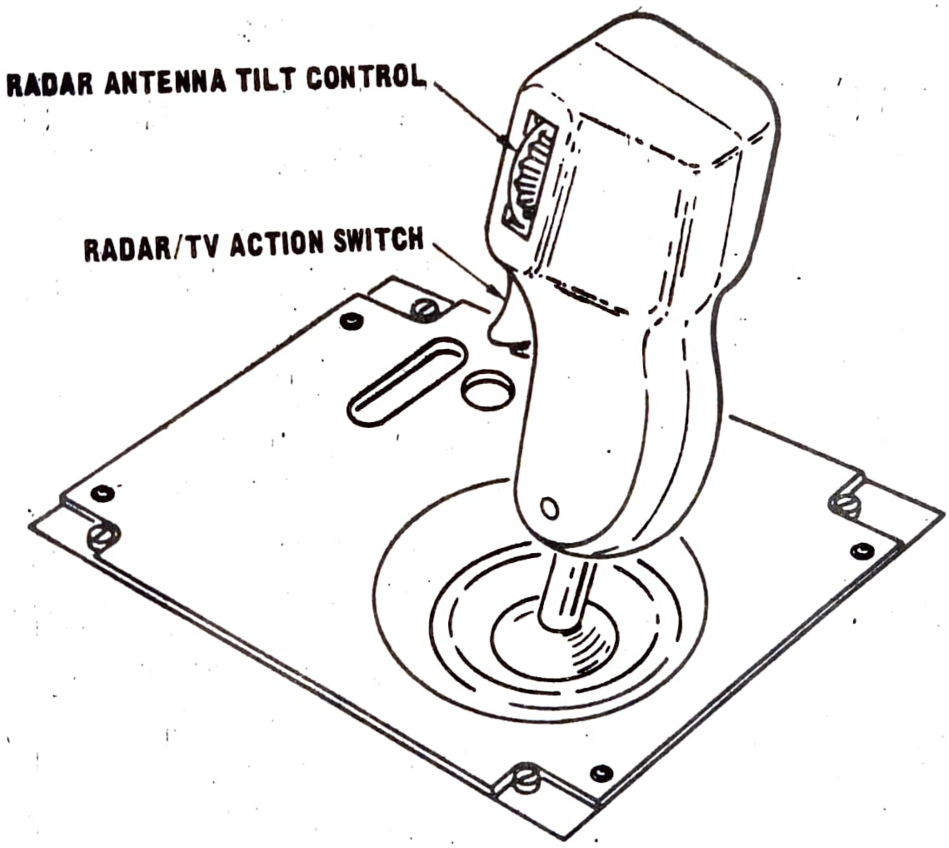
(f) (U) Boresight Tri Control. Two trim knobs are provided for boresighting the TISEO in azimuth and elevation to the radar line of sight (LOS), the caged pipper, or an EO weapon. These knobs are graduated in units and have a locking device to ensure trim stability. By turning the trim knobs clockwise, the TISEO head will move upward in elevation and right in azimuth. One complete turn of the knob equals 100 units or 10 mils movement. The boresight values are read on the trim knobs at the 3 o'clock position. Initial settings on the dials should be at a specified number if the system had been boresighted previously. The boresight values, in azimuth and elevation, should be posted in the aircraft 781 forms or in an appropriate place in the squadron. These boresight values might enable the aircrew to achieve a quick boresight of the TISEO system if there is not time for a full air-to-air or air-to-ground boresight.

(g) (U) RTS Button. Depressing the return to search button automatically breaks the radar lock if TV is selected. This feature allows the operator to maintain a TV lock while returning the radar to search provided the system is in the independent condition. If system is in slaved condition, the radar antenna returns to TISEO line-of-sight if TISEO is in a tracking operation.

(5) (U) Radar Logic Unit.

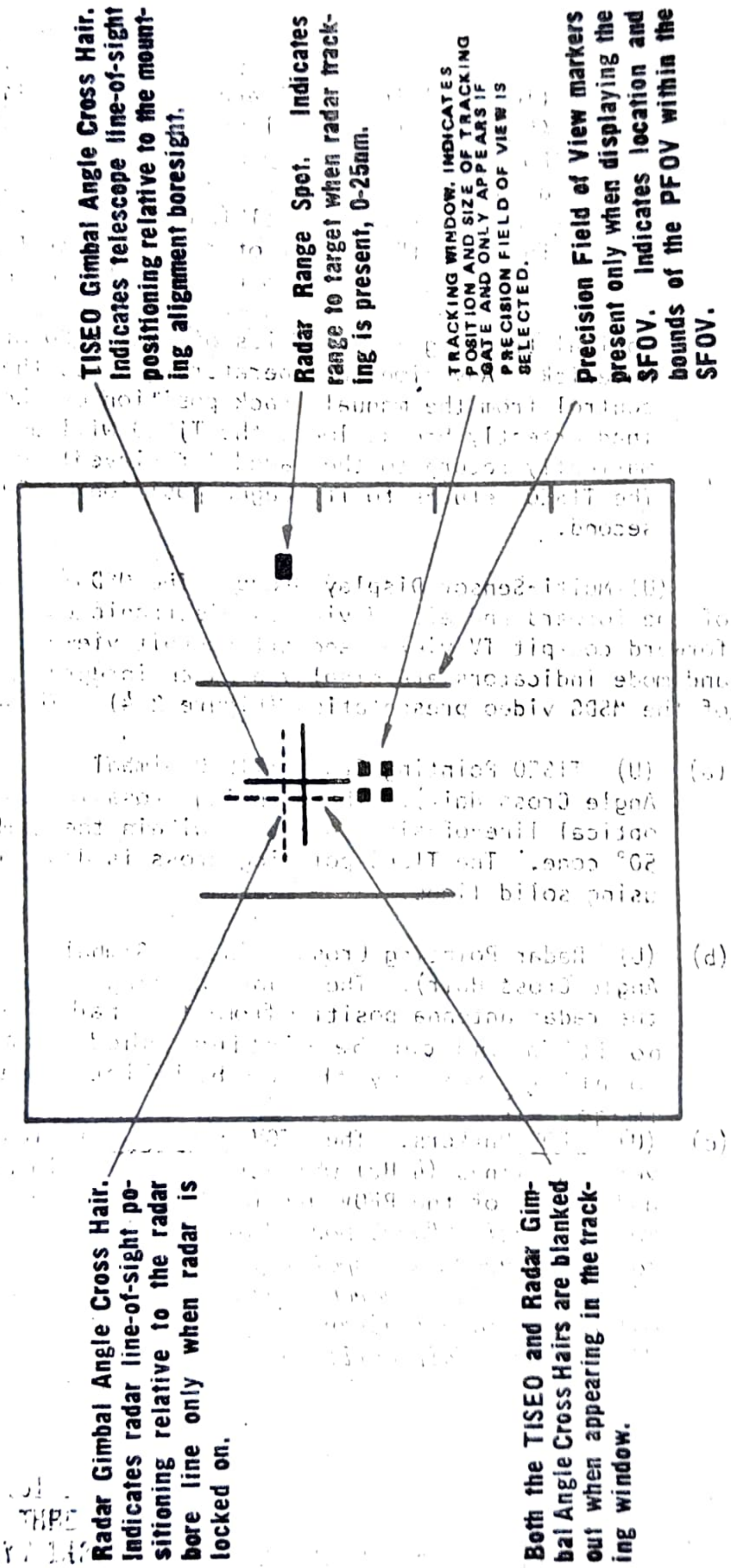
(a) (U) The radar provides TISEO with radar antenna azimuth and elevation angles along with radar range SOT signals. TISEO optical tracker azimuth and elevation angles are provided to the radar as well as a follow-optics command signal.

(b) (U) The hand control (Figure 2-3) incorporates time sharing between the TV and radar systems. These commands are applied to the radar logic unit, depending on the mode selected on the TISEO control panel. When in a radar mode, half-action (HA) and



RADAR/TV HAND CONTROL

FIGURE 2-3



TISEO MSOG SYMBOLOGY

FIGURE 2-4

full-action (FA) functions are the same as for a normal APQ-120 fire control system. When slaved to the TISEO, the radar can be used to spotlight and lockup a target. In the TV mode, the hand control provides manual rate control (HA of TISEO or Maverick proportional to the amount of displacement from the null position, to a maximum rate of 9°/sec for TISEO. FA allows the operator to engage the electro-optical tracking capabilities of the TISEO or Maverick. Any time the operator releases the hand control from the manual track position or the system inadvertently breaks lock, the TISEO will automatically return to the caged (or slaved) position. The TISEO returns to its caged position at 30° per second.

(6) (U) Multi-Sensor Display Group. The MSDG/DSC consists of the forward and aft TV viewers electronic control box, forward cockpit TV viewer and aft cockpit viewer. Status and mode indicators are displayed as an integral portion of the MSDG video presentation (Figure 2-4). These are:

(a) (U) TISEO Pointing Cross (TISEO Gimbal Angle Cross Hair). The pointing cross indicates the optical line-of-sight position within the gimballed 50° cone. The TISEO pointing cross is depicted by using solid lines.

(b) (U) Radar Pointing Cross. (Radar Gimbal Angle Cross Hair). The radar pointing cross indicates the radar antenna position from the radar boresight position and can be distinguished from the TISEO pointing cross by the dashed lines that form the image.

(c) (U) PFOV Markers. The PFOV markers are flashing vertical lines (4 Hz) which indicate the location and bounds of the PFOV within the SFOV. *Note: These flashing "goal posts" also serve as a warning to the aircrew that spotting field of view is being viewed. If the aircrew should become engrossed in watching a target aircraft "grow" on the spotting display, a midair collision could result.*

(d) (U) Radar Range Marker. A small white block illuminates on the right side of the TISEO display unit whenever the radar is locked on, the TV is selected, and range to the target is between 0-25 NM.

(7) (U) The Radar Logic Unit controls assignment of the antenna hand control to either TISEO, Maverick, or the radar according to the various switch setups on the TISEO control panel.

(8) (U) The following paragraphs provide a general description of overall TISEO operation when integrated with radar and the antenna hand control.

(a) TISEO operation is initiated at the cockpit controller in the R/C/P by selection of one of the modes of operation: TV/IND, TV/SLVD, RDR/IND, or RDR/SLVD. For the following discussion, assume the TV/SLVD mode is selected and the radar is in a search mode.

(b) The controller applies the TV/SLVD mode selection command to the tracking control (and also applies the power-on-signal to the aircraft power distribution circuits) to start TISEO operation. A resultant TV/SLVD mode selection command is then applied to the Radar logic unit. This command causes the logic unit to assign the hand control HA and FA commands to TISEO.

(c) The HA and FA commands then direct TISEO operation such that when the hand control action switch is engaged to HA, the hand control AZ and EL signals applied to TISEO control azimuth and elevation positioning of the telescope at a rate proportional to the amount of antenna hand control displacement.

(d) If the hand control action switch is engaged to FA, the hand control AZ and EL signals continue to cause the azimuth and elevation position of the telescope to change at a rate proportional to the amount of stick displacement from center position.

TISEO optical lock-on operations are initiated when a contrasting portion of a desired target is in the center of the precision display and the action switch is engaged to FA. If optical lock-on does not occur, the rate mode is maintained.

(e) When TISEO achieves optical lock-on, the follow-optics-antenna command is applied to the radar. This command causes the radar to respond to the TISEO AZ and EL signals and, in turn, the radar antenna is positioned to the telescope azimuth and elevation position (TISEO line-of-sight (LOS)).

(f) Operations are different if the radar is tracking a target when the TV/SLVD mode is selected. During this condition, the radar applies a second-order-track command (radar track) to TISEO to indicate that the radar is tracking a target. This command causes TISEO to respond to the radar antenna AZ and EL signals and position the optical telescope to the radar LOS. The hand control can then be used to rate the telescope about the radar LOS for TISEO target acquisition and optical lock-on operations. Also, the radar range voltage from the radar provides a radar range display on the TV viewers.

(g) The preceding simplified description of TISEO operation when in the SLVD mode, as well as a simplified description of operations performed for the other TISEO modes of operation, are summarized in Figure 2-5. A TISEO interface flow diagram (Figure 2-6) is included here for a more explicit explanation of the radar/TISEO interface.

3. (U) SUMMARY:

CONTROLLER MODE	ACTION SWITCH	TISEO	RADAR
TV/IND	NA HA FA	CAGED RATE & TCI UNTIL OLO OLO	SEARCH SEARCH SEARCH
TV/SLVD	NA HA FA	CAGED RATE & TCI UNTIL OLO OLO	SEARCH [redacted] SEARCH SLAVED TO TV LOS
RDR/SLVD	NA HA FA	CAGED CAGED SLVD TO RLOS	SEARCH SLAVED TO TGT AZ TRACK
RDR/IND	NA HA FA	CAGED CAGED CAGED	SEARCH SLVD TO TGT AZ TRACK

KEY:
FA - FULL ACTION
HA - HALF ACTION
NA - NO ACTION
OLO - OPTICAL LOCK-ON
TCI - TRACK CONTROL INITIALIZE
SOT - SECOND ORDER TRACK
LOS - LINE OF SIGHT
RLOS - RADAR LINE OF SIGHT

FIGURE 2-5

TISEO INTERFACE FLOW DIAGRAM

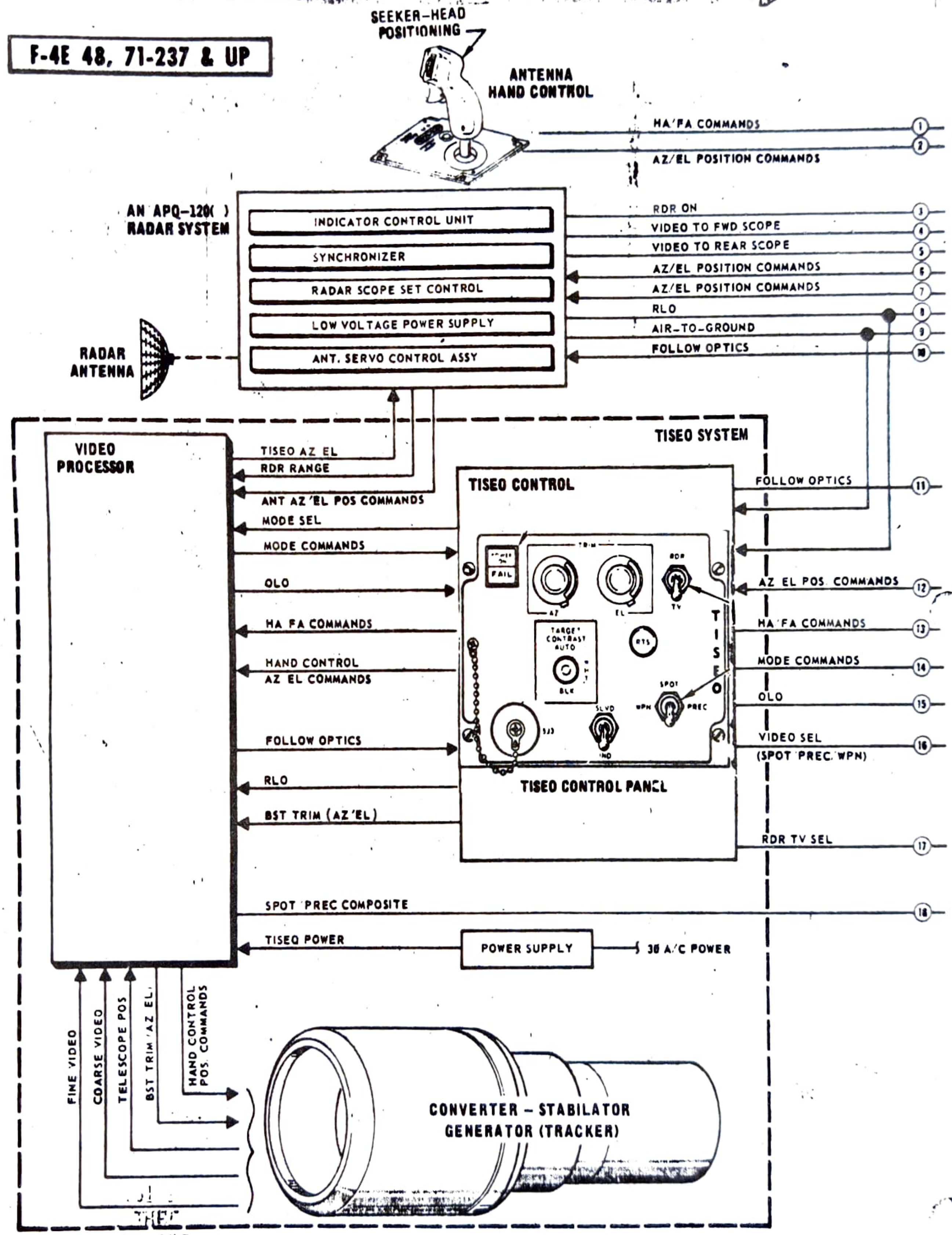


FIGURE 2-6

TISEO INTERFACE FLOW DIAGRAM (CONTINUED)

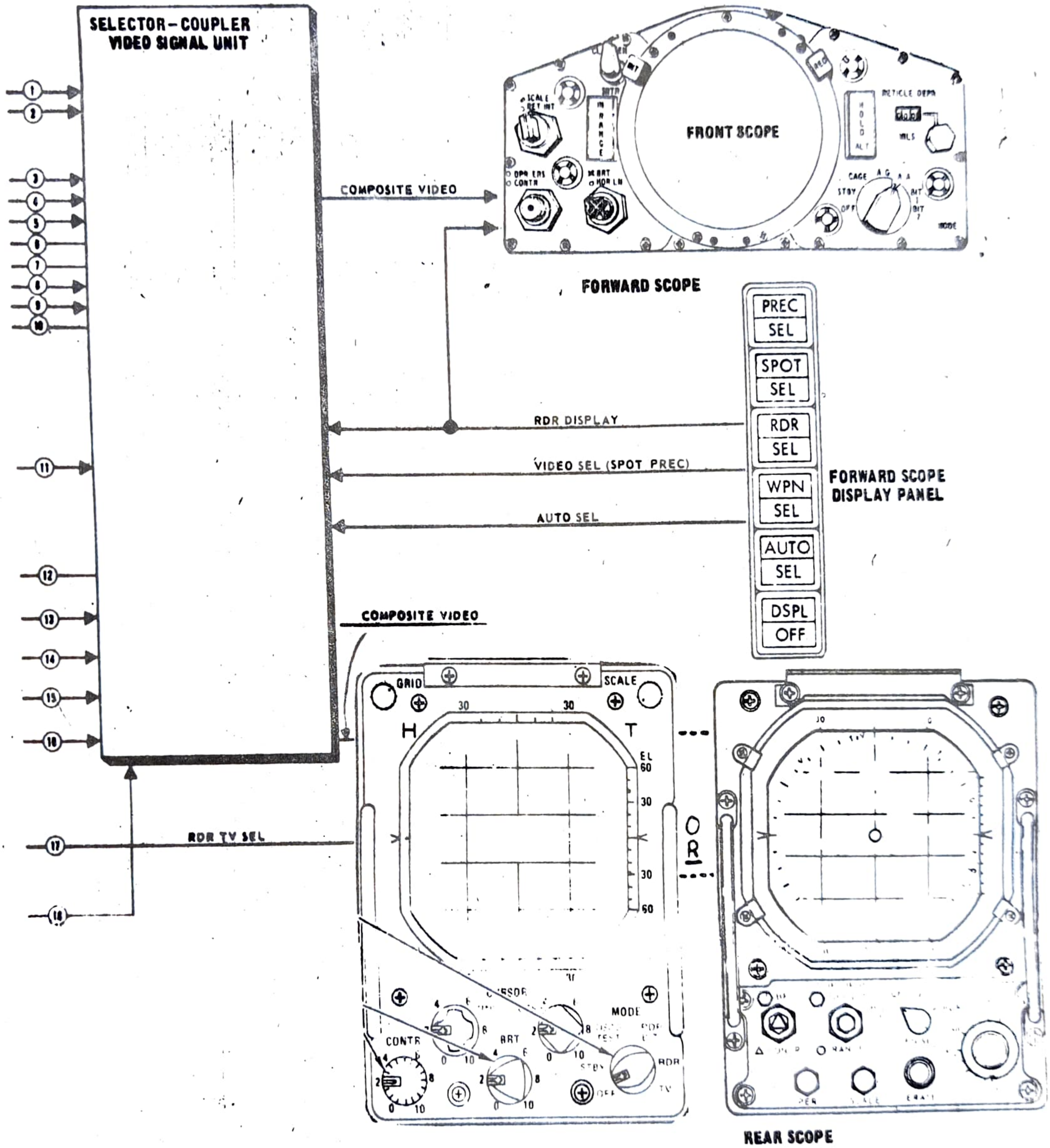


FIGURE 2-6 (Cont)

TISEO-F4-PT-2 1 Feb,77

TARGET IDENTIFICATION SYSTEM - ELECTRO OPTICAL

CHAPTER 3

BASIC TISEO OPERATION

INSTRUCTIONAL OUTLINE

1. (U) INTRODUCTION:

a. MOTIVATION: The addition of TISEO enhances the attack capabilities of the F-4 significantly. Both the air-to-air and air-to-ground roles are afforded new advantages not realized before. An extensive background in the different modes available for TISEO use is mandatory for the qualified operator. Knowledge of system operation and techniques recommended herein is considered essential if the aircrew is to effectively use this weapons system in all environments.

b. OVERVIEW:

(1) Controls and indicators.

(2) Preflight.

(3) Displays.

(4) System operation.

(5) Modes.

(6) Search.

(7) Track.

(8) Lock-on.

2. (U) DIRECTIONS AND EXPLANATIONS:

a. This section contains preflight and mission (flight) operating instructions and preflight performance tests for the TISEO system. Included are functional descriptions of the operational controls and indicators, [illegible] displays, and system operations and performance options available to the TISEO operator during different modes of TISEO operation.

(1) Preflight Procedures. The following paragraphs furnish general preflight operating instructions for TISEO. Included are instructions for performing preflight checks, system turn-on, and system performance tests. Note that the following procedures may also be used to perform ground checkout of TISEO and the MSDG by selecting appropriate aircraft power at the aircraft generator panel.

(a) Preflight Check. Prior to placing the TISEO system into operation, it is necessary to ascertain that the flightline window cover has been removed from the TISEO optical window and that the window is clean and free of foreign matter.

(b) System Turn-on and Turn-off. On the TISEO controller, place the following switches in the indicated positions.

SWITCH	POSITION
TV/RDR	TV
IND/SLVD	IND
SPOT/PREC/WPN	PREC
TARGET CONTRAST	AUTO

(c) After the aircraft is on internal power, TISEO may be placed into operation by performing the following steps:

1. Verify that the panel and indicator lamps on the TISEO controller are working by using the aircraft lamp test circuits. Panel lamps, RTS, PWR ON and FAIL indicators should all be red.

2. Turn the MSDG/DSC sensor select knob to the ON position (note - do not select TV or Radar on the MSDG - since the ON position applies a warming voltage to the MSDG and there is a possibility of blowing a cold scope tube with TV or Radar Selected immediately.)

3. Radar power switch - TEST.

4. TISEO power button - PUSH ON. Power on indicator should light, FAIL indicator should be OFF. If the FAIL light is on, push the button again to turn TISEO off and check circuit breakers. If a circuit breaker was out (No. 4 circuit breaker panel), reset (ensure that the MSDG/DSC is in OFF position) and turn TISEO on again. If the FAIL light comes on again turn TISEO off and leave it off.

5. Observe that a video scene and symbol display appears on both the forward and aft TV scopes. If necessary, adjust the aft TV screen controls for a stable display. Adjust the brightness (BRIGHT) and contrast (CONT) controls for optimum viewing.

6. Perform preflight tests (Refer to 34-1-1CL-1 TISEO).

(d) TISEO may be turned off by depressing the PWR switch on the controller panel.

(2) Flight Procedures. Before the TISEO can be employed successfully as an aerial attack and/or as an air-to-ground aid the TISEO head must be boresighted to the radar line of sight, the caged pipper, or an EO weapon. The primary reason for an accurate boresighting of the TISEO is to give the operator confidence in the Precision Field of View (PFOV) since if there is more than 4mils error between the radar line of sight and PFOV the target will not appear in the MSDG /DSC when TV and Slaved are selected. The TISEO should be boresighted to the particular system (i.e., radar, caged pipper, or EO weapon) that that will be used to accomplish the specific mission.

(a) Radar Boresight Procedures:

1. AC/WSO - Achieve a radar lock-on on a cooperating target in trail in any radar mode.

2. WSO - select TV, SLVD, and SFOV on TISEO.

3. WSO - adjust trim knobs to put target within goalposts.

4. WSO - select PFOV and refine adjustments to put target under tracking gate of TISEO.

5. WSO - lock trim knobs to ensure boresight stability.

6. The TISEO boresight procedure is often complicated by the fact that the desired bore sight reference does not appear in the TISEO SFOV during the initial phase of the boresight. In this situation a common reference must first be established before the TISEO can be boresighted. The following procedures are recommended to acquire the radar boresight reference.

   a. Achieve a radar lockon in the trail position.

   b. Select TISEO, TV, SLVD, SFOV.

   c. If the target does not appear in the SFOV, select IND on the TISEO and track the target with the caged pipper.

   d. Select SLVD on the TISEO and note the direction the target disappears on the TISEO scope. Rotate the TISEO boresight knobs in the proper direction to bring the target into the SFOV in the SLVD Mode. (*NOTE: This may require alternating between SLVD and IND to see the target.*)

   e. When the target appears in the SFOV, continue with steps 4 and 5 above.

(b) When attempting to boresight to a reference mil setting

1. Select TISEO, TV, IND, SFOV.

2. Set desired mil reference

3. Put pipper on a prominent ground reference point on the horizon.

4. Rotate the TISEO EL knob until the horizon is centered in the SFOV.

5. The Azimuth boresight can be corrected by putting the caged pipper on a prominent ground return. The AC can correlate what is in the MSDG/DSC and what the pipper is on outside the cockpit. The AC should tell the WSO the proper direction to rotate the TISEO Azimuth knob until the ground return is centered in the MSDG picture.

6. When the target appears in the SFOV, continue with steps 4 and 5 above.

(c) EO Weapon Boresight Procedures: (Maverick-Hobo)

1. AC - select WPN on Sensor select panel.

2. AC - track a prominent ground target (hill, mountain, ground object) with the EO weapons gate (or another air-to-air target with the EO weapons gate).

3. WSO - select TV, IND, and SFOV on TISEO.

4. WSO - adjust trim knobs to put target within goalposts.

5. WSO - select PFOV and refine adjustments on target.

6. WSO - lock trim knobs.

(d) Aerial Flight Procedures. The purpose of performing flight procedures to acquire and ID a tactical target with TISEO. The flight procedures that must be performed to accomplish this task consist of target search, target acquisition, and TISEO track (manual or automatic).

1. Target search is the process of "looking" for a target with TISEO. Target acquisition consists of performing the operations necessary to manually hold the target on the display or to position the target within the tracking window. Track control initially is the condition that exists when the optical tracking electronics are enabled by engaging hand control action switch to FA. TISEO optical lock-on automatically follows TISEO track if the tracking electronics determine that the target is suitable for development of proper TISEO telescope pointing commands.

2. Except for optical lock-on, all flight procedures are performed by use of the antenna hand control, with additional aid being provided by the radar when in certain modes of operation. The following paragraphs provide a general outline for performing each of the flight procedures.

3. TISEO Track. TISEO track is initiated immediately upon engaging the action switch to FA with a target in the track window, and is indicated by the track window enlarging to envelop the target. During the TISEO track stage, the optical tracking electronics measure specific parameters of the contrast change to determine if the target is suitable for developing accurate pointing error commands for the telescope. If proper, optical lock-on immediately follows TISEO track.

4. Optical Lock-On. When optical lock-on occurs, the antenna hand control is disconnected from TISEO (note that although disconnected, it may remain assigned to TISEO) and TISEO automatically follows target azimuth and elevation changes to maintain the target centered in the precision FOV.

(e) Typical Air-to-Air Operation using Radar/TISEO:

1. TISEO Control Panel - SET.

a. Mode Switches - RDR/SLVD.

b. Display Switch - PREC.

c. Contrast Switch - AUTO.

2. Radar Set Controls - As required for maximum radar contact.

3. (AC) Display Panel -

4. (AC) Missile Switches - As required.

5. Radar Contact - Accomplish.

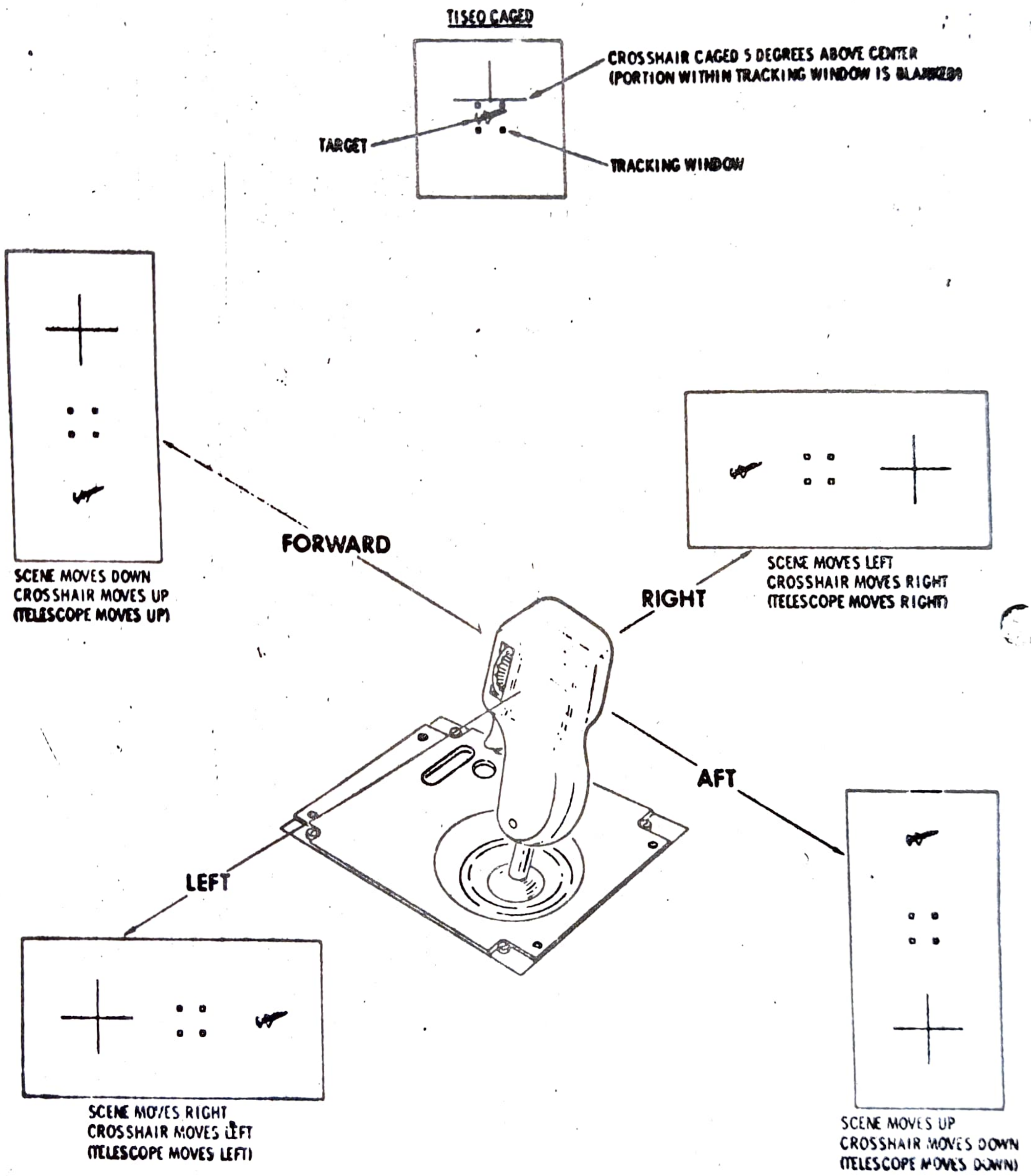
6. Radar lock-on - Accomplish and observe good radar track before proceeding to next step.

7. TISEO Mode - TV.

8. TISEO Acquisition - Accomplish.

a. Watch for the target on the precision display. (NOTE: Pre-selection of PREC in 1. b. above facilitates the longest possible target acquisition at this time. With good harmonization between TISEO and radar, the target aircraft will be visible on the precision display as a tiny speck with apparent random motion as soon as TV is selected. Of course, the size of the "speck" depends on range to the target and viewing aspect. It is important to acquire the target on TISEO at the longest possible range for several reasons:

(1) Target evasive maneuvering can be detected at long range.



RADAR/TV HAND CONTROL SENSING

FIGURE 3-1

(2) When the target maneuvers, long range identification is greatly enhanced.

(3) ~~If the radar should break lock, simply lock-on with TISEO, switch back to RDR and re-lock the radar (which will be slaved to TISEO and already pointing at the target), and switch back to TV.~~ PRS

b. Once the target is detected, go to rate control (HA) to stop the motion and maintain the target on the precision display. NOTE: If the target jumps off the display when HA action is depressed, release to NA, attempt to null out the hand control position, and again attempt to capture the target with rate control (HA). Continue rate control or obtain an optical lock-on. If the target does not appear on the precision display at the expected range, it is possible that the boresight is bad. In this case, switch to Spotting, ~~observe~~ ATTEMPT TO FIND the target, go to rate control to place the target within the flashing "goal posts" and switch to precision.

9. Optical Lock-on - Accomplish.

a. Place tracking window over target.

b. Squeeze to FA.

NOTE: *After Optical Lock-on on (OLO), the action switch can be released to No Action (NA). If you desire to regain rate control, simply depress again to HA. This breaks the OLO and gives you rate control immediately).*

10. WSO-ID accomplish (Call TISEO ID)

11. WSO - Return to RDR in order to keep track of bogeys azimuth and range.

12. Missile Firing - Accomplish when within parameters.

(f) Typical Air-to-Air Operation using Pipper/TISEO. If the AC detects a glint or speck in the sky, he calls "Pipper" and proceeds to put the pipper on the target. The WSO immediately selects TV/ SLVD, releases the action switch to NA, and selects spotting. When the AC calls "Tracking", the target should be visible on the spotting display. The WSO goes to rate control (HA), places the target between the goal posts, selects precision and manually tracks or obtains an OLO. AUTO/ACQ is hot with TV/SLVD and OLO. If AC depresses the cage button, the radar goes to boresight, not slaved. If not within auto-acquisition range, the WSO can obtain an OLO, switch to RDR, observe the target in the B sweep and lock-on, and switch back to TV.

(g) Typical Air-to-Ground Operations:

1. Air-to-Ground operation for the case where the AC puts the pipper on a potential target is the same as air-to-air using Pipper/ TISEO. After OLO, the WSO can switch to RDR and, by adjusting the radar gain, obtain a rough range to target.

2. When air-to-ground search is being used, the WSO normally selects TV/IND and uses spotting or precision as required. For example, spotting would be used to locate a road and precision to search along the road.

IV AN/APX80A

AN/APX-80/A

IFF INTERROGATOR

1. INTRODUCTION:

a. The AN/APX-80A can be quite useful during combat and training operations. Positive ID through use of part of this system led to some BVR and night MIG Kills in SEA. Red Flag operations have proved the value of the APX-76 portion of the APX-80A by allowing crew members to sort out players/threats without requiring a radar skin paint (skin paints don't tell you what you need to know anyway). This allowed them to anticipate or avoid the threat. The AN/APX-81A portion is not installed in 347TFW aircraft for training missions.

b. The AN/APX-80 is useful during training for:

1. Intercept training.

2. Tanker rendezvous

3. Positive ID.

4. ACBT/DACT training. (The real war will be multi-bogey and multi-bandit).

5. Mid-air collision avoidance.

6. Determination of threat positioning during low altitude ingress (The real war will be multi-bogey and multi-bandit). Primary air-to-ground units can not expect to carry out their mission unopposed by enemy air. To assume no or low opposition, ignores the realities of aircraft numbers and types available to enemy Air Forces. Air-to-ground units must not only be configured with air-to-air munitions for self-defense, but also trained to survive against the air threat.

c. WE PREFERABLY WOULD HAVE THE AN/APX-81 PORTION INSTALLED FOR COMBAT OPERATIONS.

2. REFERENCES: (For more detailed info)

a. T.O. 1F-4E-34-1-1-2. (Classified)

b. FWS Text, "Aerial Attack-APX-81A Appendix". (Classified)

3. MAINTENANCE of the system is related to the manning of the CRS/COM-NAV shop, training of maintenance personnel, availability of parts, time available to work on the aircraft/system and the quality of aircrew writeups.

4. AIRCREW WRITEUPS AND TROUBLE SHOOTING (AN/APX-76).

a. Did the Loop check work? It is possible for the Loop check to work properly due to the close proximity of the on board IFF; and the system still may not work when airborne. This could be because of a bad cable in the system.

b. Did the system work properly against known airborne squawks? The Loop check could be bad, but the system could still work properly when airborne if your on board IFF was bad (i.e., didn't trip the Loop check).

c. Did green CHAL light illuminate when you attempted to interrogate? With the interrogate button? With the TEST/CHAL switch in TEST? ...in CHAL?

d. It is possible to receive APX targets even though a fault condition exists (i.e., no green CHAL light when interrogating) in both the APX TEST position and in normal operation. Be sure to note this during system debrief.

e. If there is no radar video (with radar in Operate) and all other functions of the radar appear normal, it is probable that there will be no APX targets since radar video and APX video are mixed. (Note that the AN/APX-76 is designed to work properly with the radar in the STBY mode. Interrogating with the radar in Standby removes clutter from the scope).

f. What was the position of the RCP Video Select Button and the FCP Scope Display Select Switch, if there was a PAVE SPIKE pod loaded and connected to the aircraft? See Note 3 on page 12.

5. THE SYSTEM:

a. The AN/APX-80A is an IFF Interrogator capable of interrogating friendly IFF systems. This system has combined the best qualities and versatile capabilities of its predecessor the AN/APX-76 to enhance reliability and aircrew tasking. It also controls the AN/APX-81A. The capabilities of the AN/APX-81A are classified (see T.O. 1F-4E-34-1-1-2).

b. Overview

(1) Switch Functions

(2) AN/APX-80A Displays

(3) AN/APX-80A Bits

(4) AN/APX-80A Tactical Application (for detail see your weapons officer).

(5) AN/APX-81A (Ref -34-1-1-2 and FWS Text)

6. AN/APX-80A SWITCHOLOGY: Figures 1 & 2 show the Interrogator Set Control Panel used to select modes and codes, monitor system performance, and self test. The AN/APX-80A control panel is used to select modes and codes for MK-X SIF/MK-X11 Mode 4 transponder reception.

a. Mode Select Switch. This button switch, located in the upper left corner of the control set, selects the AN/APX-76A MK-X or MK-X11 modes to be interrogated/received. It has six selectable positions: 1, 2, 3, 4a, 4b, and Blank (white square). Positions 1, 2, 3 select the MK-X mode and positions 4a/4b select the secure mode 4 of the MK-X11. Mode 4a selects the code of the day at launch time and 4b selects the immediate follow-on code. The blank position turns the AN/APX 76A to Standby. The different modes are selected by depressing

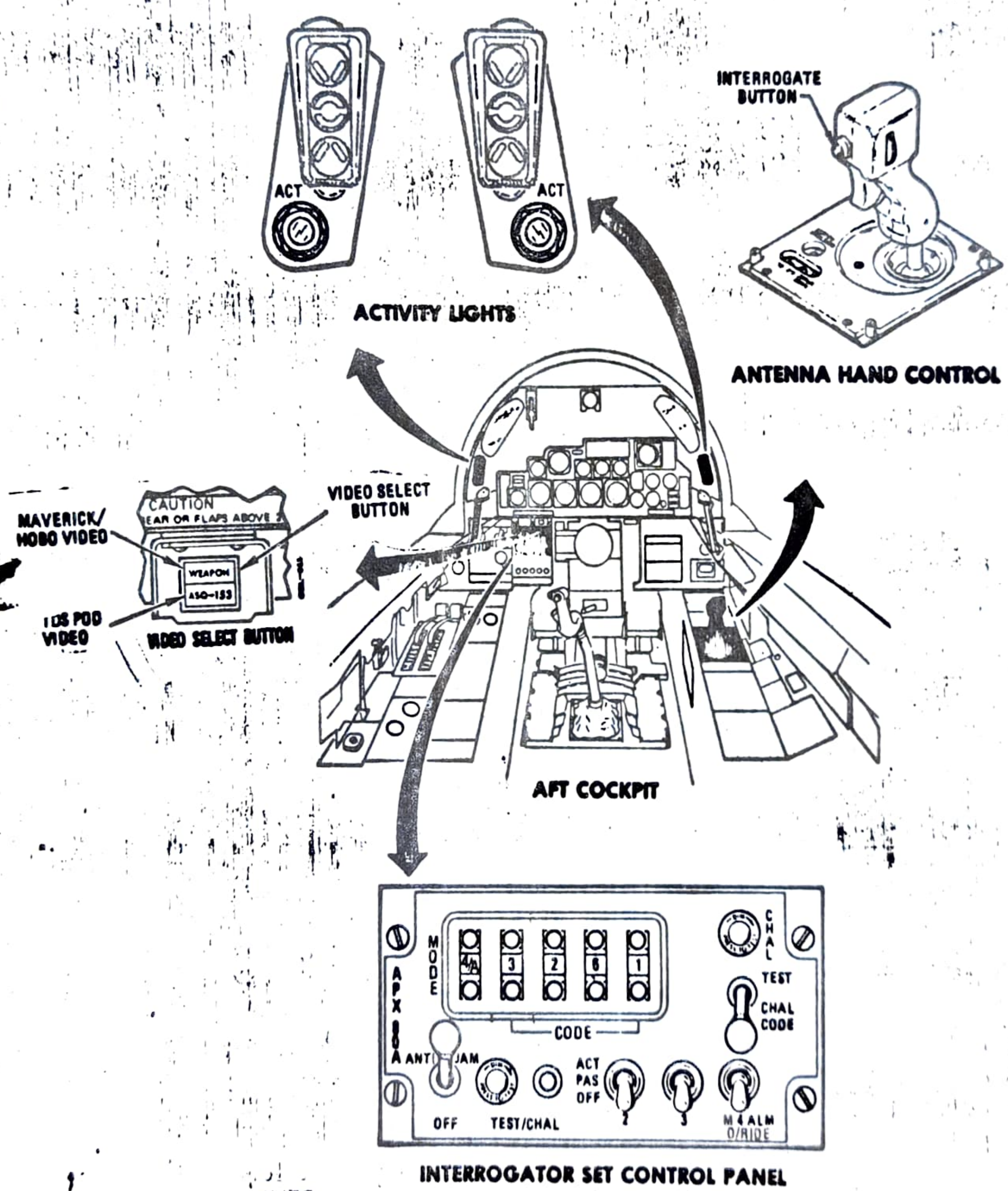


Figure 1 AN/APX-80A Controls and Indicators

the buttons located above and below the display window. The upper button advances the mode selector and the lower button reverses the mode selector. When position 4b is selected, the mode cannot be advanced further; therefore, to go from 4b to the Blank position, the lower button has to be pressed and the modes cycled through to Blank (white square in view in the window = Standby).

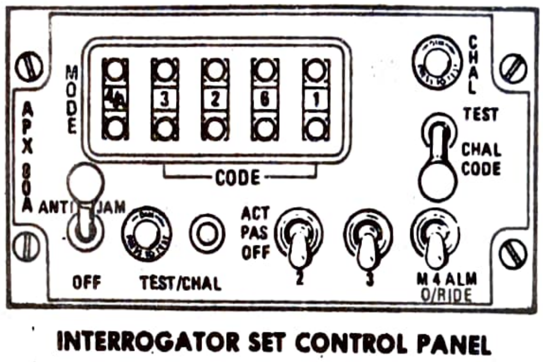


Figure 2 AN/APX-80A Control Panel

b. Code Select Switches. These button switches, located adjacent to the mode select switch, control the 4 digit codes which can be set in modes 1, 2, or 3. They serve no function for modes 4a/4b (modes 4a/4b must be set on the ground by avionics personnel). Each window displays digits 0 through 7 and codes are selected by depressing the buttons above and below the window. The upper button advances the numbers and the lower button reverses the numbers.

c. Challenge Light. The Challenge Light (Labeled CHAL), located in the upper right corner of the control panel, is illuminated during AN/APX-76A Interrogations and during AN/APX-76A Self Test Interrogations.

d. TEST/CHAL Code Switch. This 3 position switch, located on the right side of the control panel under the CHAL Light, accomplishes two functions. The upper portion, labeled TEST, is used to initiate the loop test function of the AN/APX-76A, using the onboard MK-X11 Kit Transponder. The lower position, labeled CHAL CODE, interrogates for a specific mode and code only. (Responses different from the selected mode and code are not displayed on the AN/APQ-120 Radar Scope). The center position disables both the TEST and the CHAL CODE functions described above.

e. Antijam Switch. Located in the extreme lower left hand corner of the control panel, this switch was designed for ANTIJAM CONTROL. It is not electrically connected.

f. Mode 4 Alarm Override Switch. Is not connected/functional in 347TFW aircraft.

g. TEST/CHAL LIGHT and BUTTON SWITCH. These controls, located in the lower left on the control panel adjacent to the Antijam Switch, serve to bit check the AN/APX-81A system.

h. AN/APX-81A type 2 and 3 Interrogator Control Switches. Due to classification, these control switches and their function will not be discussed in this WIP. Refer to -34-1-1-2 for information pertaining to the APX-81A.

i. AN/APX-80A Interrogate Button. Located on the top front of the radar antenna hand control (Figure 3), this button when depressed transmits interrogation pulses from the AN/APX-76A. The AN/APX-76A will interrogate 5 to 10 seconds with the button held depressed. At the end of the interrogation cycle the button has to be released and depressed again to start each interrogation cycle. See Note 3 on page 12.

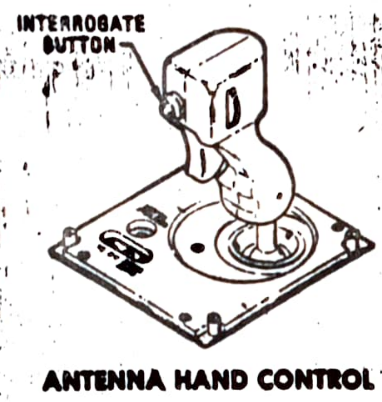


Figure 3 Antenna Hand Control and AN/APX-80A Interrogate Button

j. AN/APX-81A Activity Lights. The Activity Lights are located under the angle of attack indexer lights in the rear cockpit of the F-4E. Their operation pertains to the AN/APX-81A and will not be discussed in this text. See T.O. 1F-4E-34-1-1-2 and FWS text.

k. Control Transponder Set. This unit (Figure 4), although not part of the AN/APX-80A, includes numerous switches and indicators associated with the control of the On-Board MK-X/X11 Transponder. The operation of the AN/APX-80A is not directly effected by the Transponder Control, however the loop test operation of the AN/APX-76A requires that the Transponder be enabled and that the Transponder modes and codes be compatible. The controls affecting the AN/APX-76A Loop Test are:

(1) IFF-Mode 4 ON-OFF: Place in ON

(2) Code-Hold-A-B-Zero: Place in A

(3) Master-OFF-STBY-LOW-Norm-Emerg: Place in Low (Squawk Low)

1. The KIT-1A/TSEC and KIR-1A/TSEC installed as part of TCTO 1F-4E-551 and TCTO 1F-4E-587, provides the MARK X11 secure IFF for the F-4. Both units are located in the lower equipment bay and are coded before flight. The KIT, which receives and responds to Mode 4 interrogations from other stations, is used to check AN/APX-76A Mode 4 capability. (The KIT is in turn checked for proper operation if the IFF is not replying to Mode 4 interrogations, the cockpit MASTER CAUTION light and the IFF Warning Light on the telelight panel will illuminate.) The KIR contains the Mode 4 interrogation code which enables the AN/APX-76A to trigger other Mode 4 equipped transponders.

IDENTIFICATION SYSTEM CONTROL PANEL

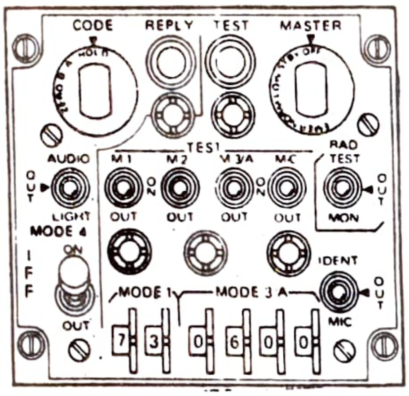


Figure 4 Control Transponder Set

7. SCOPE DISPLAYS: A multitude of radarscope displays and Indicator Lights occur depending upon the circumstances and whether the AN/APX 76-A, AN/APX-81A or both are activated. Operation Displays are presented here for the AN/APX-76A only; Refer to -34-1-1-2 for AN/APX-81A Displays. For simplicity and ease of interpretation of the various displays, illustrations of the radarscope, AN/APX-80A control panel, and activity lights will be used.

a. AN/APX-76A Displays

(1) Interrogation of Mode Responses from Two Aircraft. When Interrogation is initiated, by using the interrogator button on the hand control, MK-X/X11 replies are displayed from any transponder within range. With Mode 1, 2, or 3 selected, and without regard to code selection, a single line is displayed and the CHAL Light is illuminated. The mode line is Ø.5NM nearer in range than actual target position except for 100 and 200 NM scope ranges. At these ranges it is displayed 1NM nearer. Figure 5 illustrates a Mode only response from two targets.

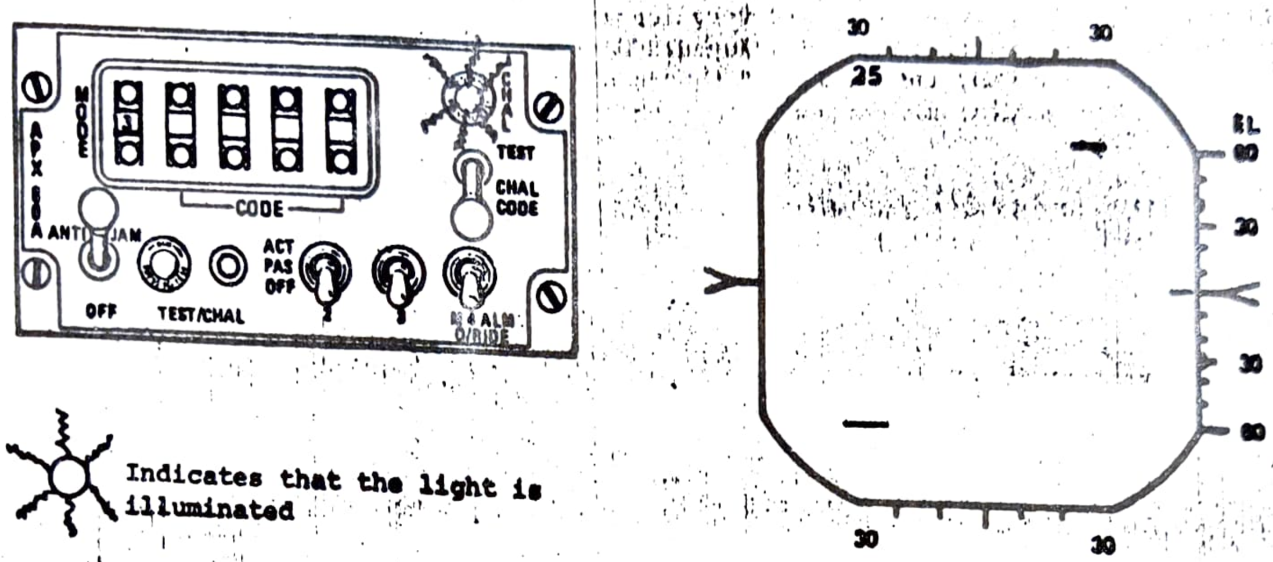


Figure 5 AN/APX-76A Interrogation With Mode Only Responses from 2 Aircraft (no skin paints)

(2) Interrogation of Both Mode and Code Responses. When the four digit code of the target transponder is selected, as well as the mode, an additional line appears on the display Ø.5NM farther in range than the target (1NM in 100 and 200 NM scope ranges). Note: To receive a Mode 1 correct code reply, the last two digits in the code window must be zero. Figure 6 shows the display with both mode and code selected on the AN/APX-80A control panel.

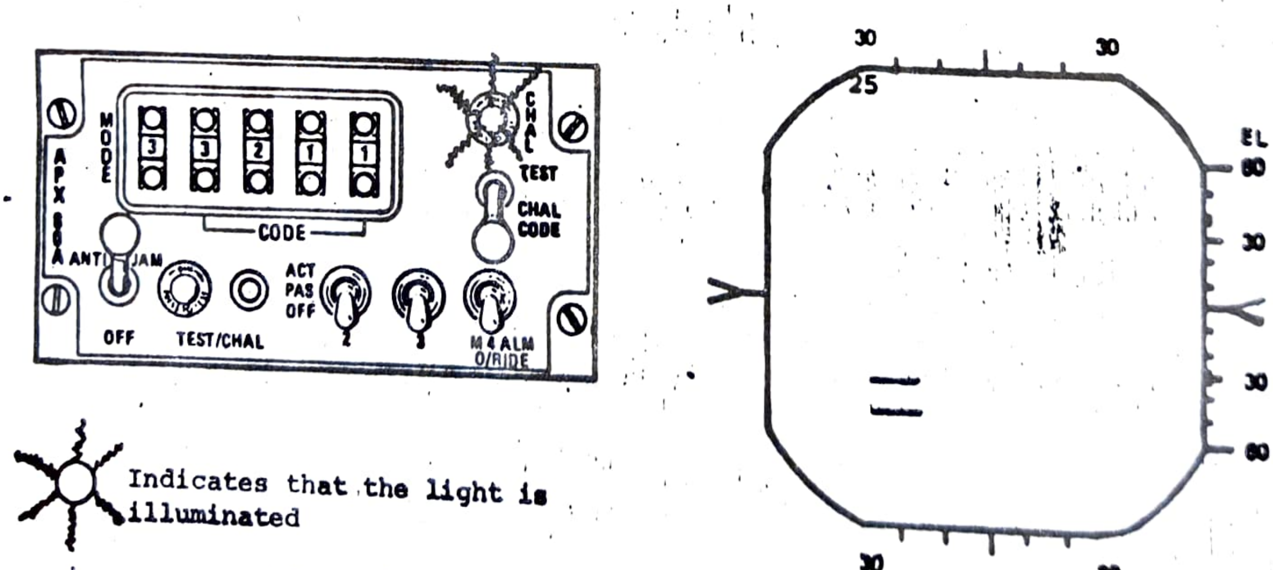
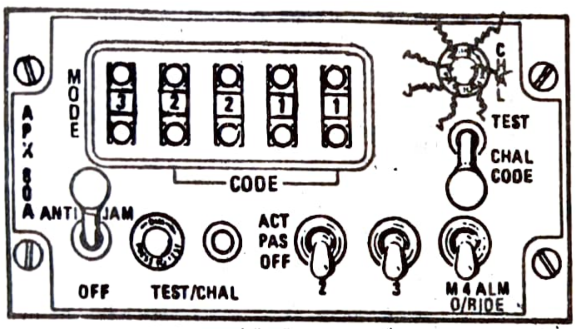


Figure 6 AN/APX-76A Interrogation: Shows Mode Plus Code Response from 1 aircraft (No skin paint)

(a) Note that activation of the CHAL Code switch eliminates all target responses that are not the same code as that selected on the AN/APX-80A control panel. In some cases, at very long ranges, even with the correct code selected, only a mode line is displayed due to weak signal strength. In Mode 4 (4a or 4b) selection, regardless of the code selection, or even if no code is selected, the display always contains both mode and code lines from a target response.

(3) AN/APX/76A and AN/APQ-120 simultaneous displays. When the radar is used in conjunction with the AN/APX-76A, the radar skin paint appears in between the Mode and Code lines, as shown in Figure 7.



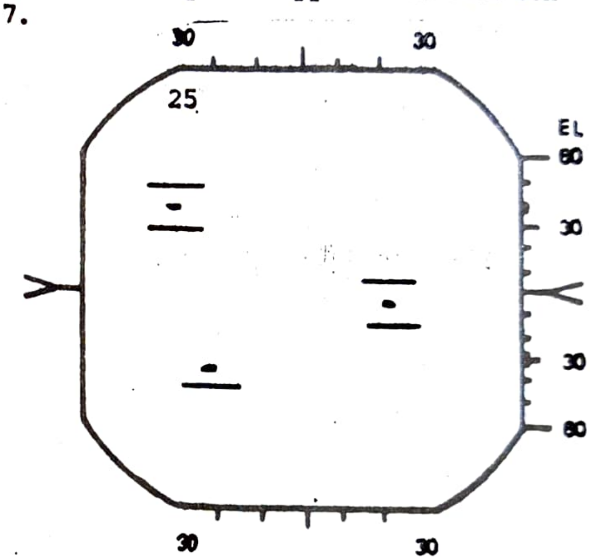


Figure 7 AN/APX-76A Interrogation: Two Mode and Code Responses with Radar Skin Paints; one Mode only response with Radar Skin Paint (Here interrogating with Interrogate button on Radar Antenna Control Handle; 2 Aircraft squawking 3-2211 and 1 aircraft squawking 3 but with a different code).

(4) Displays associated with the MK-X11 IFF/SIF AND/OR Emergency Squawk. Various unusual displays are encountered when the AN/APX-76A receives an IDENTIFICATION (IDENT) or EMERGENCY Squawk. Generally, they consist of one or more additional lines (up to three pairs) depending on which AN/APX-76A mode or code is being interrogated. Normal displays should occur when receiving a Mode 2 or Mode 3 IDENT. Multiple displays will occur for Mode 1 IDENT and Emergency. Figure 8 shows an example of a possible IDENT display. If the aircraft being interrogated is transmitting in EMERGENCY, various multiple line displays are possible depending on the mode and code selections on the AN/APX-80A control panel and on the IFF/SIF switch selection in the target aircraft.

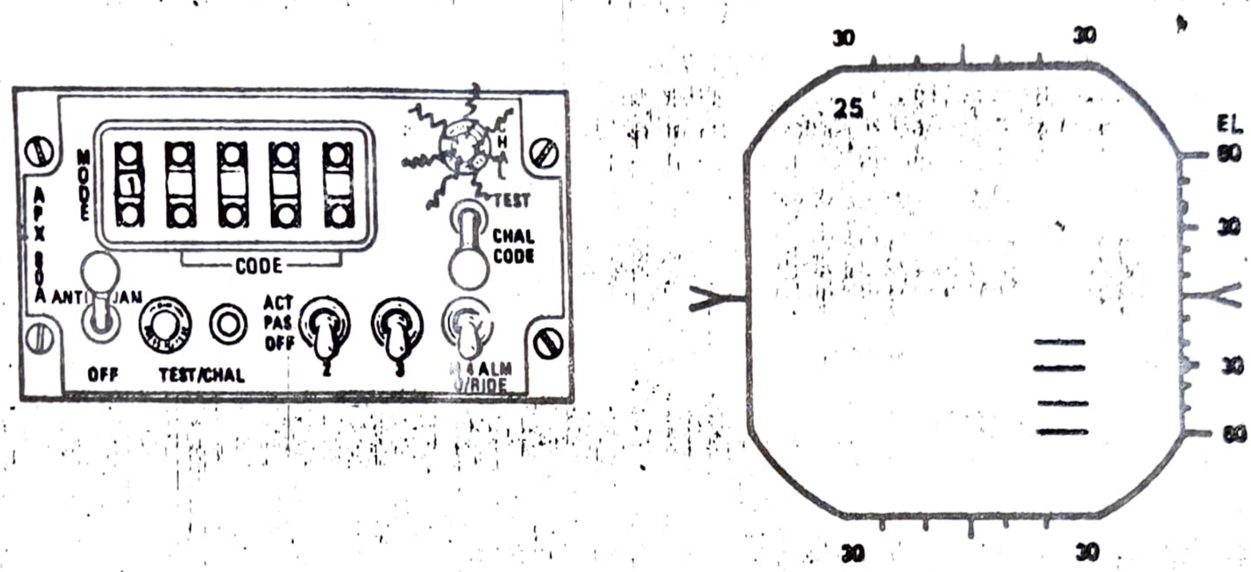


Figure 8 Possible AN/APX-76A Interrogation of Target Transmitting Ident with the mark X11 IFF/SIF

8. AN/APX-80A DISPLAYS WITH RADAR LOCK ON. All AN/APX-76A modes are usable with an AN/APQ-120 Radar Lock on. Responses are displayed in the B-sweep. Figure 9 depicts an AN/APX-76A interrogation with a Radar Lock on.

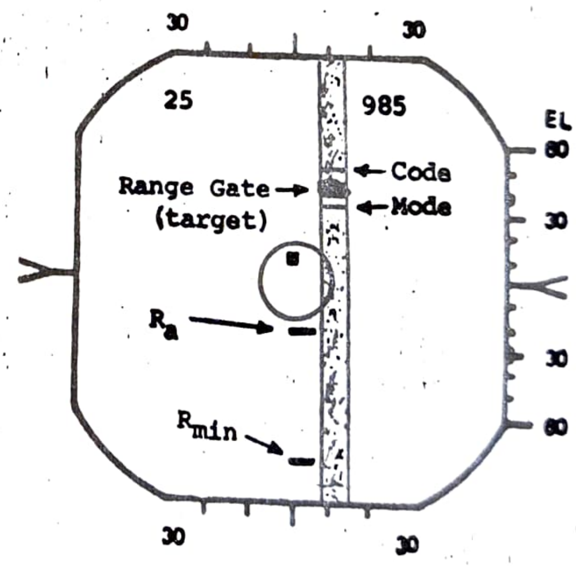


Figure 9 AN/APX-76A Interrogation of Target after Lock-On

8. **LOOP CHECK:**

a. The check out of the AN/APX-76A is accomplished through the use of a loop check. Basically, the AN/APX-76A interrogates the aircraft's On-Board IFF/SIF through Back-Lobe Radiation, and if the AN/APX-76A and Transponder are operational, a mode and code line is displayed on the radar scope at 3.5NM and 4.5NM respectively. The proper procedures are (after engine start and on internal power):

(1) (WSO) Radar-Stby

(2) (WSO) Radar Mode - MAP-B/Radar

(3) (WSO) Radar Range - 10

(4) (WSO) DSCG Scope - RDR

(5) (WSO) AN/APX-76A-Mode-Set (As Desired)

(6) (WSO) AN/APX-76A-Code-Set (As Desired)

(7) (AC) Mode 4-4a (If Required)

(8) (AC) Mode 4 Tone/Light-Set (As Desired)

(9) (AC) IFF/SIF Master Switch-Stby

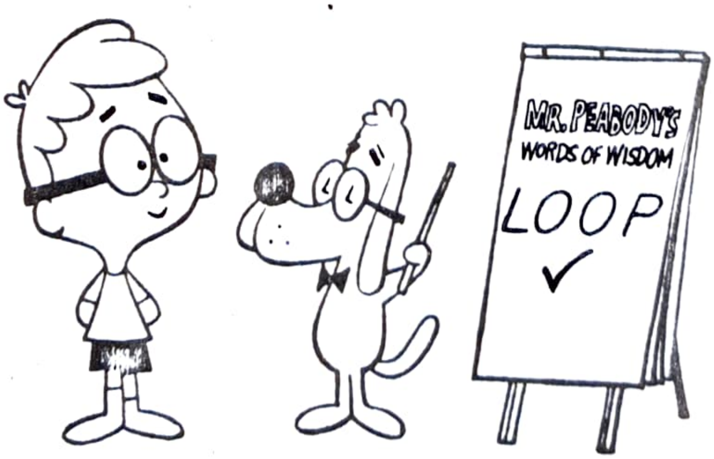
(10) (AC) IFF/SIF Mode-Enabled (Proper mode selected)

(11) (AC) IFF/SIF Code-Set (As Desired)

(12) (AC) IFF/SIF Master Switch - Low

(13) (WSO) CHAL Code/Test Switch - TEST

b. The WSO should note an AN/APX-76A interrogate light (green CHAL light) plus two IFF markers extending completely across the scope at 4NM, (one line at 3.5NM and the other line at 4.5NM) as shown in Figure 10. The test period will last a maximum of 10 seconds. Note that you will receive two lines if testing correct Mode and Code. You will receive only the bottom (near) line if the correct Code is not set. In the Loop Check, a third target (line) may appear; usually below (nearer than) the Mode line. This is known as a "Phantom Pulse". This pulse may also occur for any returns within 1 mile of the aircraft.



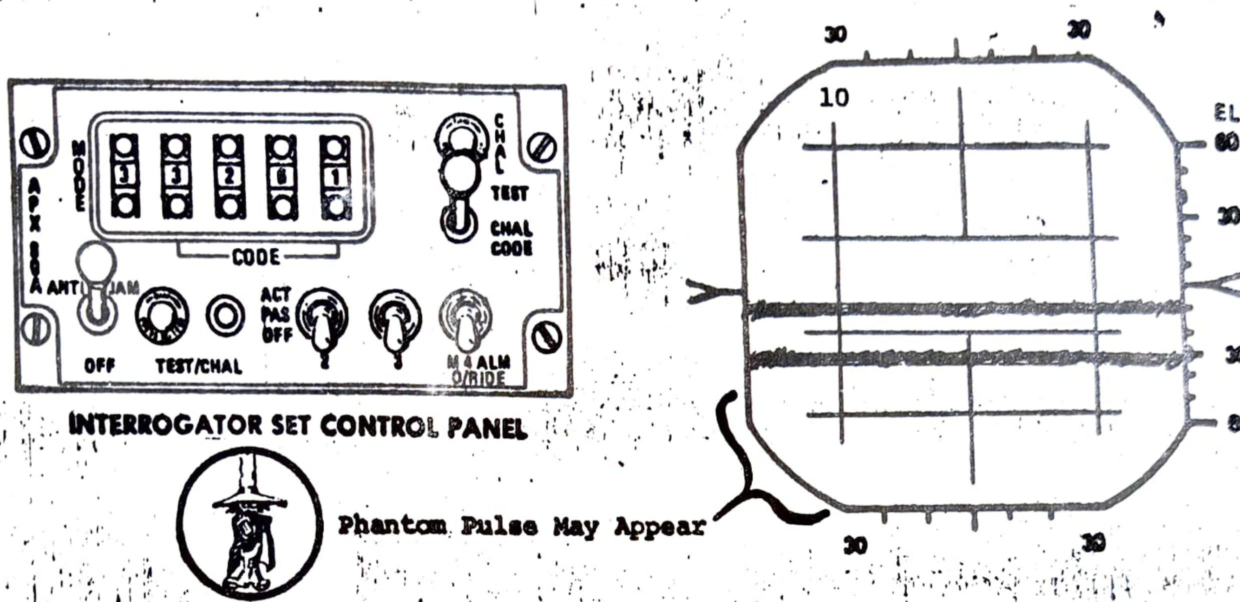


Figure 10 AN/APX-76A Loop Check Display

c. There is a 90-120 second warmup time for the MK-X11 IFF/SIF and the AN/APX-76A.

d. <u>Mode 4</u>

(1) If the KIT (IFF) is not properly keyed, the IFF light on the Telelight Panel will remain illuminated any time the IFF is turned on.

(2) If the KIR (APX-76) is not properly keyed, the green CHAL light will not illuminate when attempting to interrogate Mode 4A or 4B.

(3) If the KIT and KIR are properly keyed and there is an IFF malfunction; the MASTER CAUTION light and the IFF light on the Telelight Panel will illuminate when the Loop check or Mode 4 interrogation is attempted.

(4) When there is an IFF failure in Mode 4, the IFF light and MASTER CAUTION light will illuminate when a ground station (threat or friendly) interrogates Mode 4. This has tactical implications - one of them is spelled H-A-W-K.

e. The Loop check display occassionally breaks up during ground checks, especially in Mode 4, due to ground reflections from nearby equipment or aircraft shelters. A positive Loop check may be difficult if the aircraft is in a revetment or hangarette.

9. CONSIDERATIONS IN AN/APX-80A UTILIZATION:

a. The cueing provided by the AN/APX-80A is a definite aid in acquiring a radar skin paint. Subsequent to AN/APX-80A detection of a target return, the most efficient means of obtaining a radar contact is to select narrow scan, concentrate the search pattern on the desired azimuth, and scan the vertical sector. The large vertical beam width ($\pm$ 30°) of the AN/APX-80A is a disadvantage in determining target elevation at long ranges. In a flight of two, the aircraft with the operable AN/APX-80A might select B-narrow while the wingman stays in B-wide to sanitize the arena.

b. Because of the myriad of information available to the AN/APX-80A equipped F-4E aircrew, care must be taken to prevent a delay in taking the required actions to attack or avoid a threat, in expectation of solving the entire battle situation.

c. AN/APX-80A displays are always visible through ground clutter, but scope presentation can be cleared of clutter by selecting radar STANDBY. The AN/APX-80A functions fully with the radar in STANDBY.

d. The AN/APX-80A is beneficial during reattacks, or after a defensive separation if the aircrew decides to reenter the engagement. The threat locations are easily determined by turning towards the general area of the previous threat indications and depressing the interrogate button.

e. The AN/APX-80A can be quite valuable as an aid to determining airborne threat and threat positioning during your low altitude ingress.

NOTE 1: The above AN/APX-80 applications can be utilized in training scenarios by assigning your friendly fighters discrete mode 1 Squawks.

NOTE 2: The AN/APX-80A is intended to be used as an aid to aircrews. Therefore aircrews should be cautious of structuring their tactics around the AN/APX-80A, but should incorporate the AN/APX-80A into existing tactics.

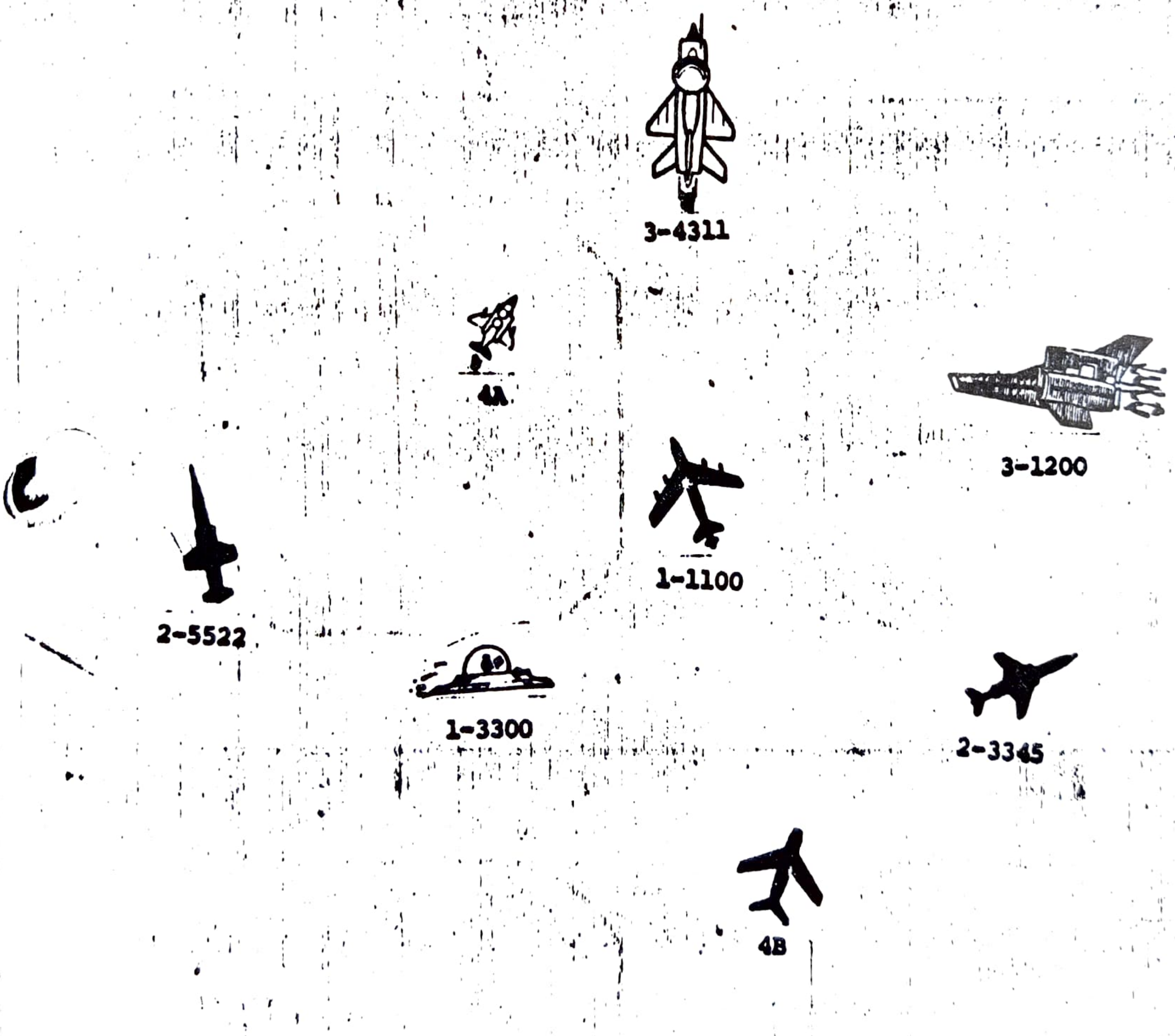
NOTE 3: APX-80A use with a PAVE SPIKE pod loaded. In order to initiate IFF interrogation and display it on the RCP scope, the WSO must select RDR on the RCP DSCG scope mode knob and press the interrogate button on the antenna control handle (or use the TEST/CHAL CODE switch). However, if the pilot has TV selected for display (on his scope display select switch) the WSO must also deselect PAVE SPIKE (i.e., ASQ-153) on the RCP video select button prior to interrogation in order to allow display of APX markers on the radar scope. (The WSO does not have to deselect ASQ-153 if the pilot has RDR selected on his scope display select switch). Also note that APX markers may be displayed on only the FCP radar scope if the pilot has RDR selected on his scope display select switch and the WSO uses the TEST/CHAL Code switch to initiate interrogation (In this case, the WSO is using the PAVE SPIKE pod and has a TV picture; the antenna control handle is functioning in the PAVE SPIKE mode and cannot be used for interrogation).

NOTE 4: Depending on your source, some people contend that the AN/APX-80 should be in STBY (white square visible in the Mode window) before power is applied to the radar in order to avoid transient voltage damage during radar TURN ON; The people in the Com NAV shop say this has no effect on the system.

Note 5: AN/APX 76 markers are also visible in MAP PPI mode of Radar operation turn on. 347TFW CRS/COMM-NAV experts say that this will have no effect (ill or good) on the functioning of the system.

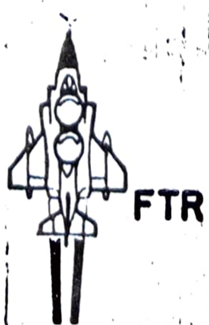
NOTE 5: AN/APX-76 markers are also visible in the MAP-PPI mode of radar operation.

B I G P I C T U R E



Assumptions:

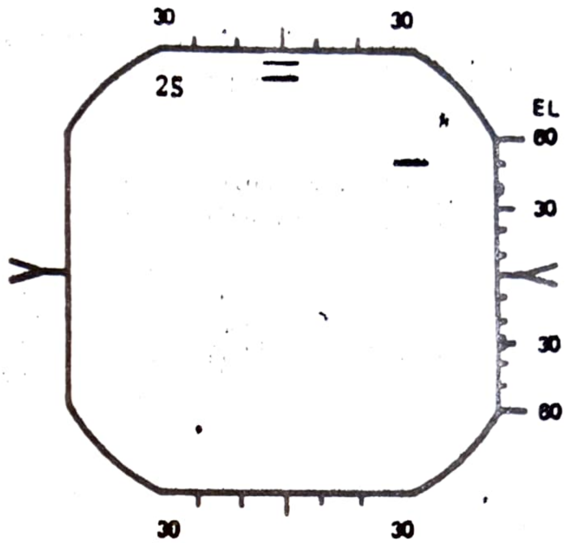
1. These are the only aircraft in the area.
2. [illegible] aircraft are squawking only th[illegible]s and codes shown.



Several Situations are shown on the following pages based on this Big Picture.

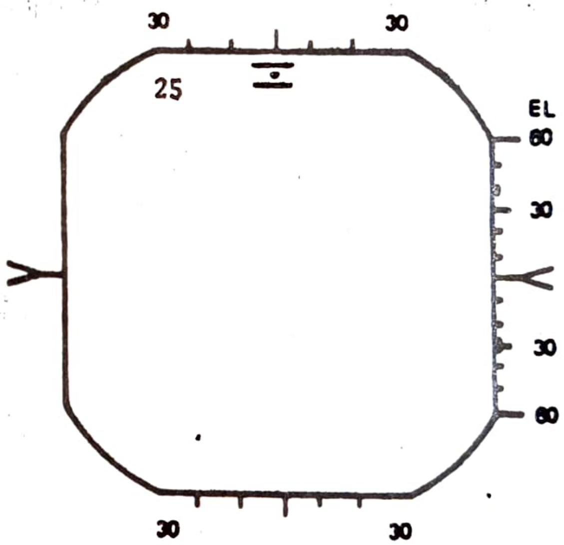
SITUATION #1

You are interrogating 3-4311 with the interrogation button on the Radar Hand Control.



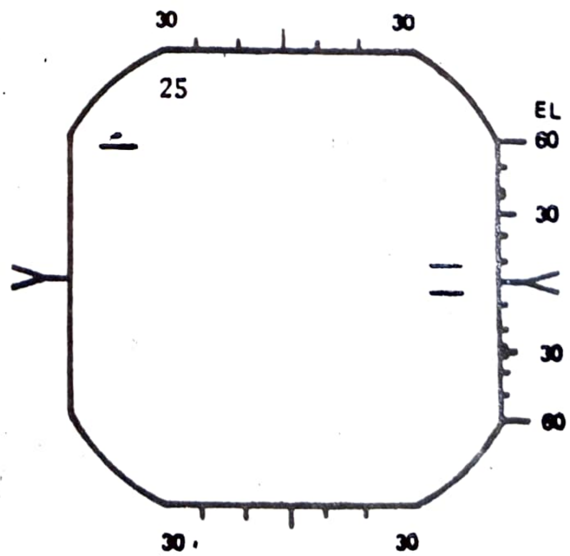
SITUATION #2

You are interrogating 3-4311 with the TEST/ CHAL code switch (You also have a skin paint on the aircraft squawking 3-4311).



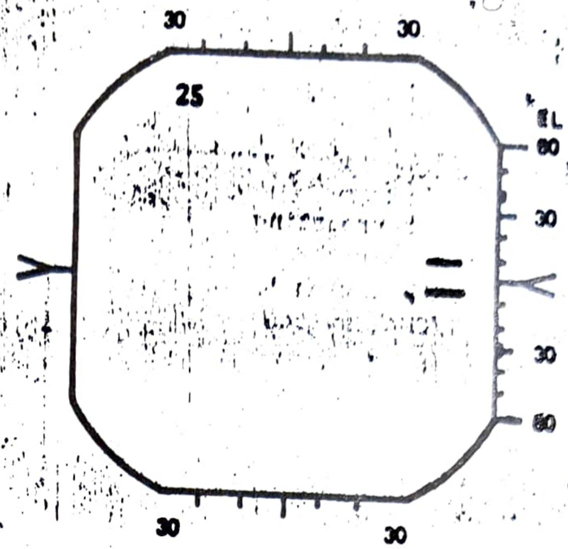
SITUATION #3

You are interrogating 2-3345 with the interrogate button. (You also have a skin paint on the aircraft squawking 2-5522).



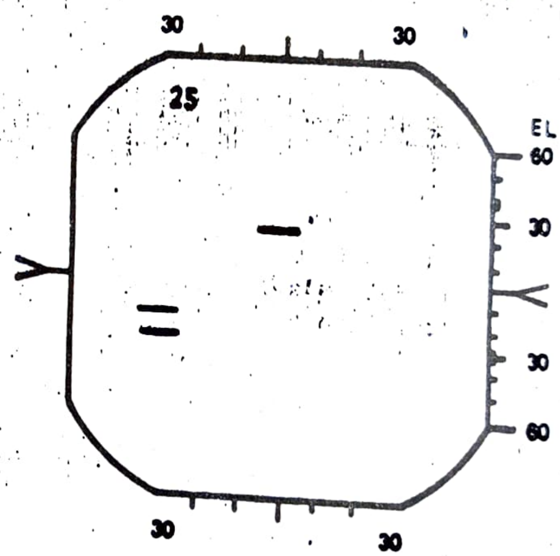
SITUATION #4

You are interrogating 2-3345 with the TEST/CHAL code switch.



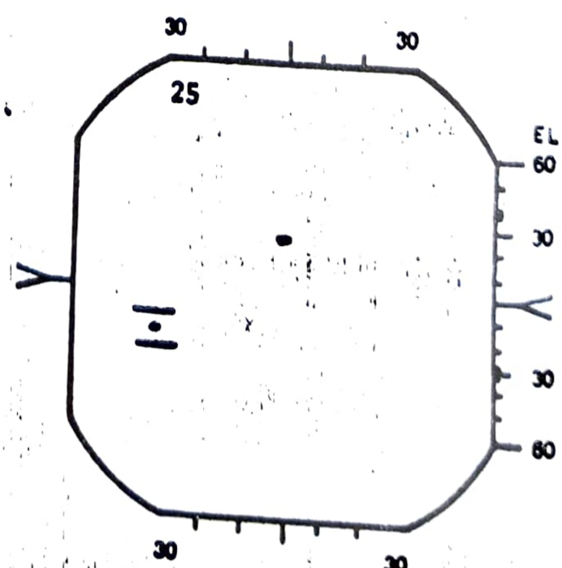
SITUATION #5

You are interrogating 1-3300 with the interrogate button.



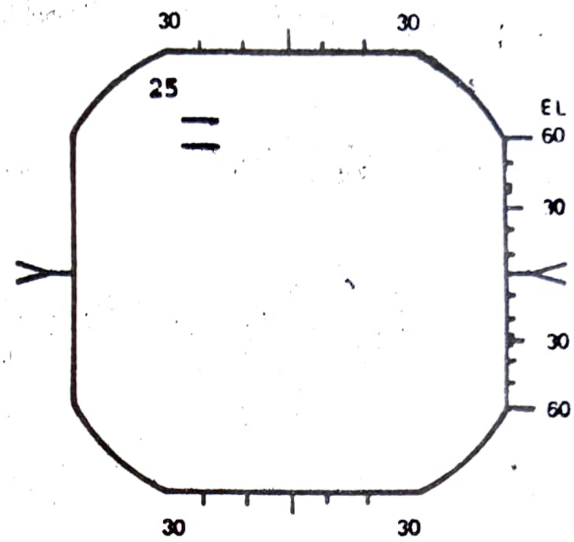
SITUATION #6

You are interrogating 1-3300 with the TEST/CHAL code switch (You have a skin paint on both aircraft squawking mode 1).



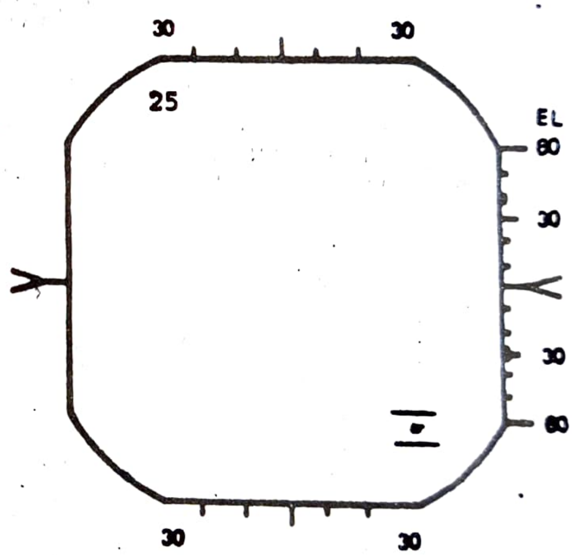
SITUATION #7

You are interrogating 4A with either the interrogate button or the TEST/CHAL switch.



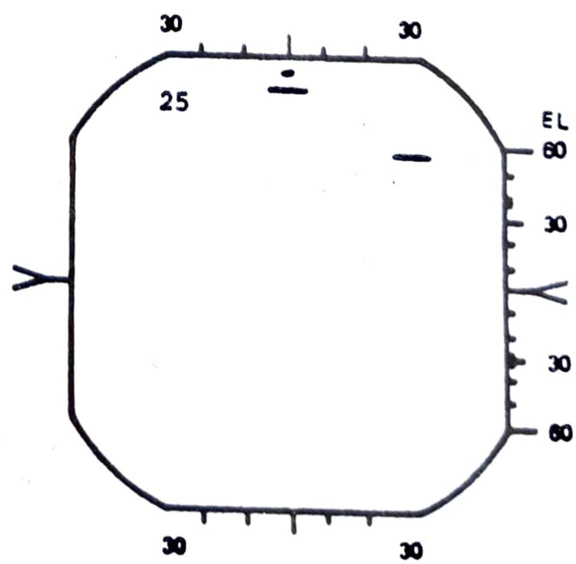
SITUATION #8

You are interrogating 4B with either the interrogate button or the TEST/CHAL code switch (You have a skin paint)



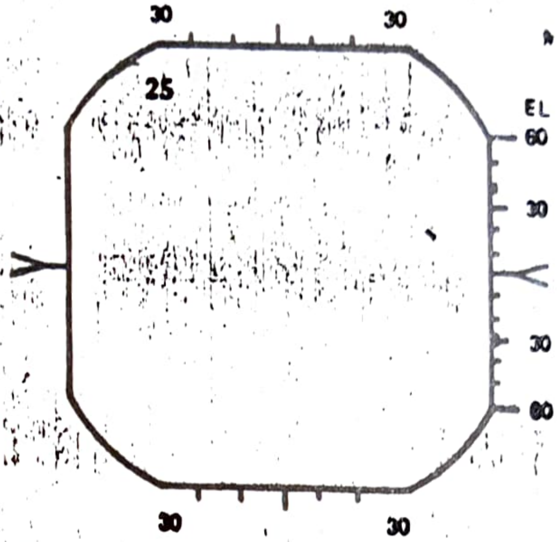
SITUATION #9

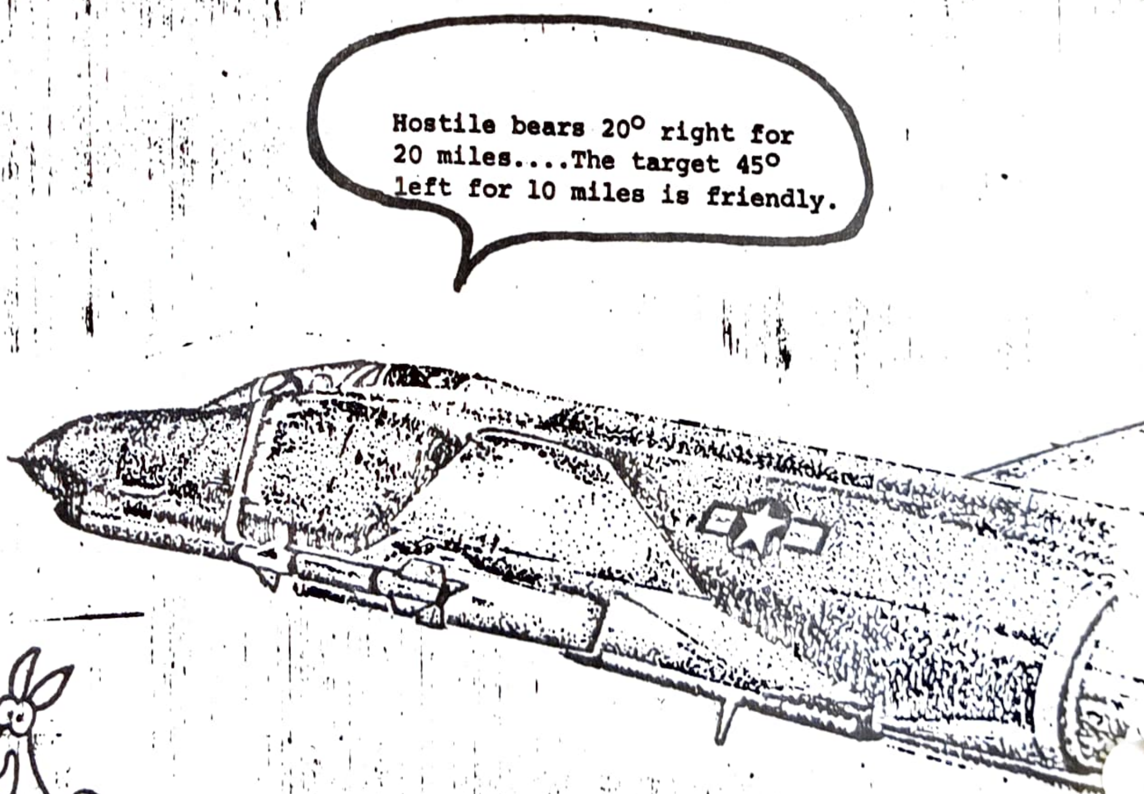
You are interrogating 3-1400 with the interrogate button (You have a skin paint on the aircraft squawking 3-4311)



SITUATION #10

You are interrogating 3-1400 with the TEST/ CHAL switch.





V ALE 40 Countermeasures Set

AN/ALE-40 CONTROLS & INDICATORS

(AFTER TO 1F-4E-614)

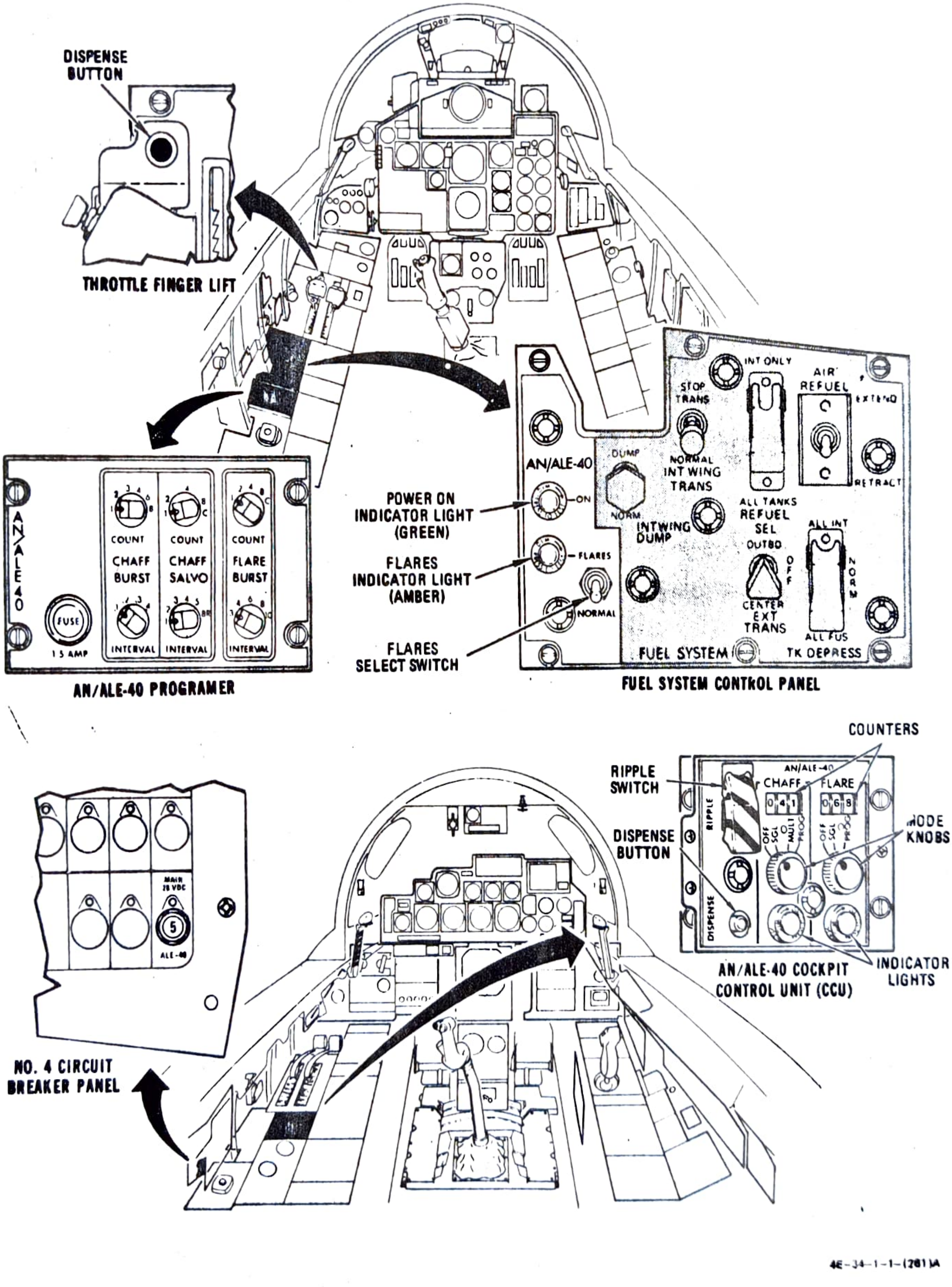


Figure 1-44

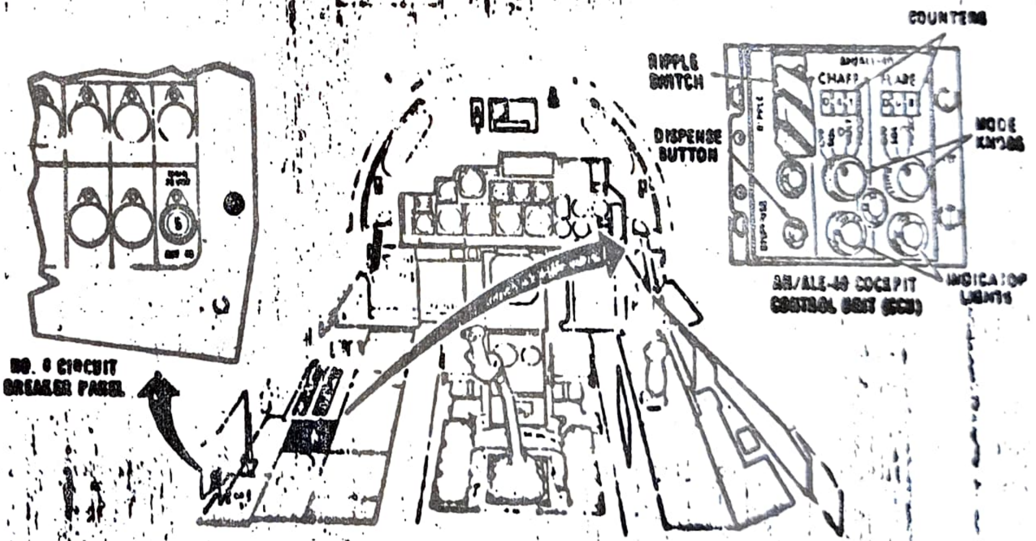
ALE-40 COUNTERMEASURES DISPENSING SET

The ALE-40 is a lightweight, aerodynamically configured (i.e., low drag) dispensing system designed to provide self protection for high-performance aircraft against radar-controlled or infrared homing threats. The system consists of four dispensers mounted on both sides of the inboard pylons of the F-4. Each dispenser has a capacity of 30 chaff cartridges for a total capacity of 120 cartridges. The flare carriage is restricted to the outboard dispensers and each dispenser can carry 15 flares for a total capacity of 30 flares. When configured in this manner, the flare dispensers are canted down 25° and aft to insure aircraft clearance during dispensing. A mixed chaff/flare loading of either 90 chaff cartridges and 15 flare cartridges, or 60 chaff cartridges and 30 flare cartridges is possible. The ALE-40 system, is controlled by a cockpit control unit (CCU) in conjunction with a programmer that allows the aircrew to select the number of flares/chaff cartridges to be dispensed; the interval between each burst, and in the case of chaff, the number of times and the intervals at which the dispensing sequence will be repeated. The system incorporates interlock circuitry, which prevents dispensing any payload when the flaps and/or speed brakes are down.

The ALE-40 does not limit the weapon carriage or delivery capability of the pylon. It does, however, add drag to your aircraft.

CONFIGURATION	WT	DRAG INDEX
4 - Chaff Modules	112.6 lbs	5.5 units
2 - Chaff/2 - Flare Modules	130.4 lbs	6.2 units

The flare modules canted down at 25° to the horizontal, account for the increased drag index. The flare module has been canted for the express purpose of insuring flare/stabilator clearance on the F-4 aircraft.



CCU:

The CCU contains the chaff and flare operating mode control switches, a dispense button, a shielded flare ripple switch, two subtraction counters (one for chaff and one for flares), and two power lights (one each per system). The CCU is mounted in the left console aft of the throttles in the rear cockpit. The primary function of the ripple switch is to jettison all flares loaded in the ALE-40 dispensers (in approximately 3 seconds) during emergency situations.

When the ripple switch is engaged, a 10-Hz flare fire command signal is routed by the programmer to the dispensers. This action overrides all other mode settings including the OFF positions.

The dispense switch allows the WSO to dispense flares or chaff, depending upon the positions of the operating mode switches on the CCU, the flare/normal switch, and the programmer located in the front cockpit.

The counters are subtraction counters, which record the number of firing pulses sent to either the chaff or flare dispensers. The counters are set by maintenance when the dispensers are loaded, and should indicate the number of chaff and flare cartrides loaded on the aircraft.

The green power lights for each system illuminate when the operating mode switch is out of the off position.

The operating mode switches of the CCU, in combination with the programmer determine the type, number, and interval of the dispensed countermeasures.

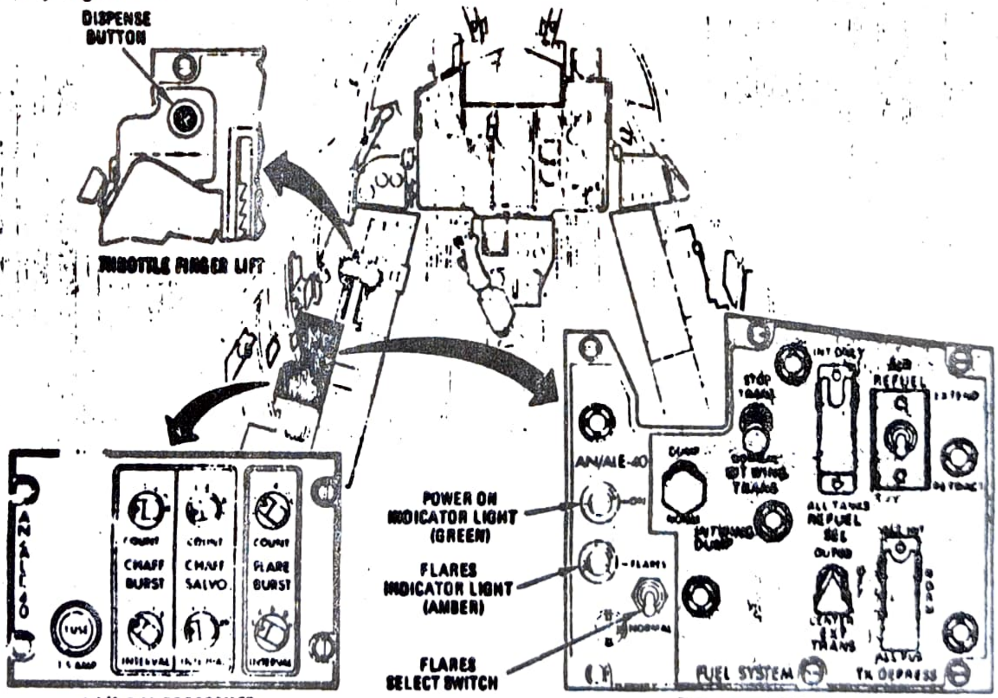
CHAFF:

The single position of the chaff mode switch allows one chaff cartridge to be fired each time a dispense button is actuated. The multiple position selects the chaff burst program on the programmer. The program position selects the chaff burst program and will repeat that operation for the number of times and intervals selected on the chaff salvo selector.

FLARES:

The single position of the flare mode switch allows one flare cartridge to be fired when a dispense button is depressed. The program position selects the flare burst program on the programmers.

All of the possible combinations of the two control switches are available to the aircrew. If both chaff and flare single are selected, one cartridge will be dispensed each time a dispense button is actuated. Other combinations such as chaff single and flare program, chaff multiple and flare program or chaff program and flare program will dispense the number of flare and chaff cartridges as selected on the programmer.



AN/ALE-40 PROGRAMER

FUEL SYSTEM CONTROL PANEL

PROGRAMMER:

The ALE-40 programmer gives the pilot the capability to select multiple releases and the interval between these releases for both flares and chaff. The programmer is located on the front cockpit left hand console in the vicinity of the fuel control panel.

CHAFF BURST:

When the WSO selects multiple with the chaff control switch on the CCU, the program selection on the chaff burst section of the programmer is selected. The pilot has the option of dispensing 1, 2, 3, 4, 6, or 8 cartridges of chaff at 0.1, 0.2, 0.3, or 0.4 - second intervals. The appropriate number of firing-pulses are automatically sent to the dispensers, and the counter on the CCU is reduced by the correct number of pulses.

The counters are subtraction counters, which record the number of firing pulses sent to either the chaff or flare dispensers. The counters are set by maintenance when the dispensers are loaded, and should indicate the number of chaff and flare cartridges loaded on the aircraft.

The green power lights for each system illuminate when the operating mode switch is out of the off position.

The operating mode switches of the CCU, in combination with the programmer determine the type, number, and interval of the dispensed countermeasures.

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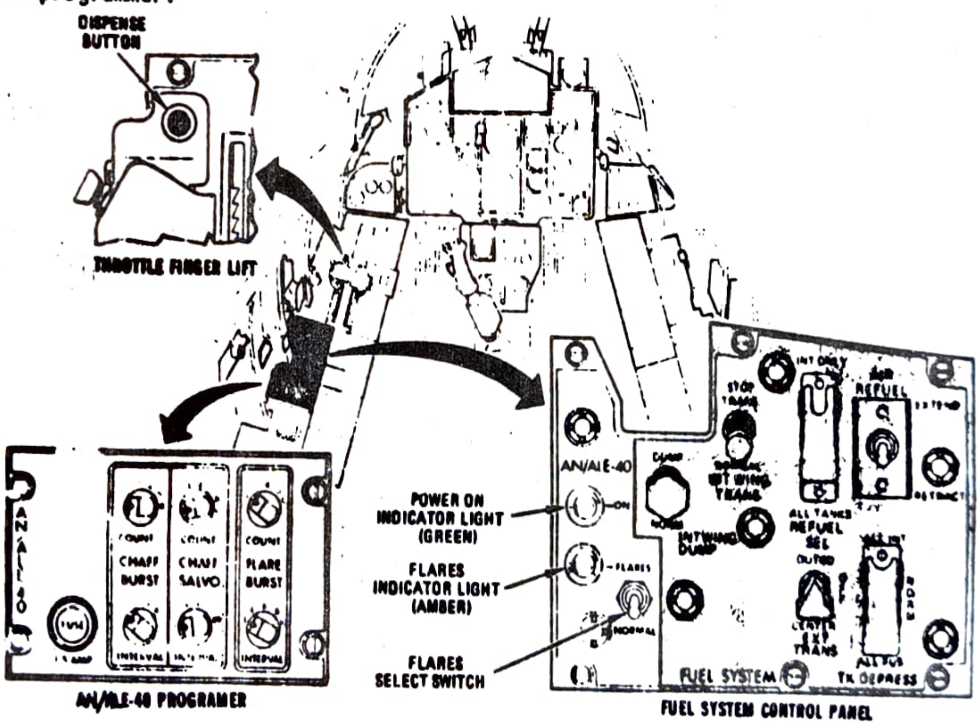
FLARES:

The single position of the flare mode switch allows one flare cartridge to be fired when a dispense button is depressed. The program position selects the flare burst program on the programmers.

All of the possible combinations of the two control switches are available to the aircrew. If both chaff and flare single are selected, one cartridge will be dispensed each time a dispense button is actuated. Other combinations such as chaff single and flare program, chaff multiple and flare program or chaff program and flare program will dispense the number of flare and chaff cartridges as selected on the programmer.



PROGRAMMER:

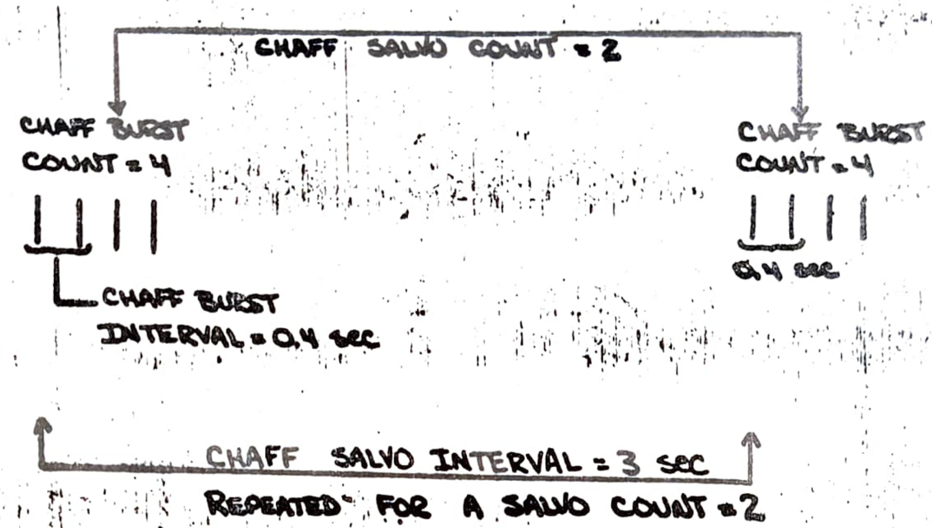
The ALE-40 programmer gives the pilot the capability to select multiple releases and the interval between these releases for both flares and chaff. The programmer is located on the front cockpit left hand console in the vicinity of the fuel control panel.

CHAFF BURST:

When the WSO selects multiple with the chaff control switch on the CCU, the program selection on the chaff burst section of the programmer is selected. The pilot has the option of dispensing 1, 2, 3, 4, 6, or 8 cartridges of chaff at 0.1, 0.2, 0.3, or 0.4 - second intervals. The appropriate number of firing pulses are automatically sent to the dispensers, and the counter on the CCU is reduced by the correct number of pulses.

CHAFF SALVO:

The chaff salvo portion of the programmer is activated when the WSO selects the program position of the chaff control switch on the CCU. The count switch salvo section allows the pilot to select the number of times that the chaff burst program will be repeated. The pilot can select 1, 2, 4, or 8 repititions. If C (continuous) is selected the chaff burst program will be repeated continuously until all chaff cartridges are expended. The interval switch on the chaff SALVO section controls the time between repititions. The pilot can select 1, 2, 3, 4, 5, or 8 second intervals. If R (random) is selected the interval will vary 3, 5, 2, or 4 seconds. For example, if the pilot selects the following chaff program would be dispensed (assuming other switches are set properly).



FLARE BURST:

The function of the flare burst portion of the programmer is identical to that of the chaff burst portion except that flares are dispensed. There are no provisions in the ALE-40 for a flare salvo program. The pilot can select 1, 2, 4, or 8 flares to be dispensed. The C (continuous) position on the flare burst count switch will continuously dispense flares until the flare supply is exhausted. The pilot may select a 3, 4, 6, 8, or 10 second interval between the flares.

FRONT COCKPIT DISPENSE SWITCH:

The front cockpit dispense switch is located on the top of the left throttle fingerlift. It's function is identical to that of the rear cockpit dispense switch. Depressing the button either dispenses the countermeasures or initiates the program selected on the CCU and programmer.

FLARE NORMAL SWITCH:

The flare normal switch is a two-position toggle switch located on the left hand console in the front cockpit adjacent to the fuel control panel. When this switch is in the Normal position it has no effect on the system and the ALE-40 operates as programmed. If the switch is in the flare position, and the front cockpit dispense switch is depressed, one flare will be dispensed from the aircraft regardless of what is set on the CCU and the programmer. If the rear cockpit dispense switch is depressed, chaff and flares will be dispensed based upon what is selected on the CCU and programmer.

347TFW OPERATIONS:

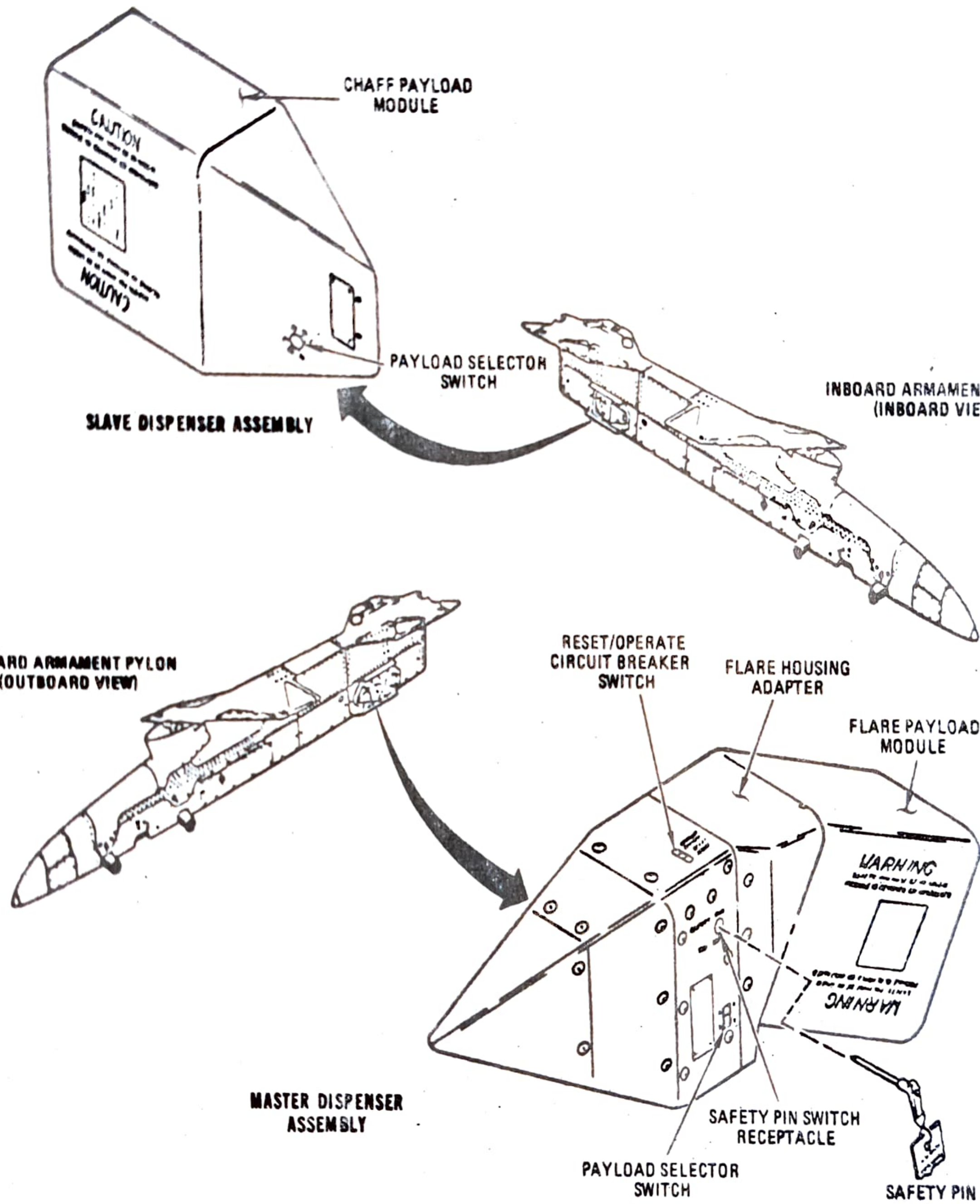
ALE-40's are likely to be used on range rides to Pinecastle, Lake George, Avon Park, or other ranges with collocated EW simulators.

ALE-40's should be used in all phases of tactical missions. Tactics should be consistent with threat that are likely to be encountered in the target area or on ingress to or egress from the target. Programming of the ALE-40 should not become standardized and must be tailored to meet the needs of your mission that day. Of course, the ALE-40 is just a supplement to a viable tactical plan and should not be used in place of good tactics. The briefing should cover the use of chaff and flares in certain key phases of the mission. Leave the briefing with a clear concept of ALE-40 employment for that After stepping to the airplane preflight the ALE-40's IAW the -34 checklist. Make sure that the payload selector switches are the same as what is loaded in that module i.e., chaff selected with chaff loaded. Insure that the RCP guarded flare ripple switch is down. Have the front seater set up the programmer according to premission planning. In the RCP set up the CCU as you plan to use it in the first phase of flight. Turn on of the system should be done with the rest of the fence check. Thereafter, when a threat is detected on RWR or visually, employ the ALE-40 in order to negate the threat. Tactics will vary depending on the threat. Use the ALE-40 throughout the mission and turn it off prior to landing.

The actual programming of the dispensers, and the tactics that are most viable should be discussed with your squadron weapons shop or with Wing Weapons. Currently, OT & E is still going on with the ALE-40. Further classified information is available in your squadron weapons safe.

AN/ALE-40 DISPENSERS AND PAYLOAD MODULES

(AFTER TO 1F-4-1072)



COMPONENT	LENGTH (INCHES)	WIDTH (INCHES)	HEIGHT (INCHES)	WEIGHT (POUNDS)
CHAFF PAYLOAD MODULE	8.2	9.5	4.8	6.3
FLARE PAYLOAD MODULE	8.2	7.5	5.7	7.4
RR-170 A/AL CARTRIDGE	1.0	1.0	8.0	0.41
MJU-7 CARTRIDGE	1.0	2.0	8.0	0.67

4E-34-1-1-(282)

Figure 1-45

PREFLIGHT AN/ALE-40 COUNTERMEASURES DISPENSER

1. MASTER DISPENSER SAFETY PINS - INSTALLED
2. CHAFF/FLARE DISPENSERS - SECURE
3. RESET/OPERATE SWITCHES - RESET
4. MASTER DISPENSER PAYLOAD SELECTOR SWITCHES - SET PER MISSION REQUIREMENTS
5. SLAVE DISPENSER PAYLOAD SELECTOR - SET PER MISSION REQUIREMENTS
6. CHAFF/FLARE PAYLOAD MODULES - CONFIGURED PER MISSION REQUIREMENTS

Pg 2-23 -34-1-1

VI Training for the threat

Training For The Threat

When Jack Nicklaus starts preparing for the British Open, he begins by hitting about a thousand balls on the driving range. He video tapes his shots to analyze and improve his swing, stance, and grip.

When he is satisfied with the basics, he goes to the U.K. and practices on the course, learns the geography, sand traps, and water hazards, and hits a few balls out of the heather. His caddy studies the course, and learns to the nearest yard distances to each hole from any fairway position. He knows Jack's game well enough to select the appropriate club for different combinations of wind, terrain, and lie.

After each practice round, Jack will probably be found back at the driving range, ironing out the rough spots in what will become his tactical approach to eighteen holes of tournament golf.

On opening day Jack is ready. He has blended the event oriented training of the driving range with the tactical practice rounds to optimize his combat capability for the engagement

Of course, Jack is not resource limited. He and his caddy can practice together every day; he can afford all the buckets of balls he needs, and there are any number of courses he can choose to hone his skills. But, even if the PGA limited Jack to ten buckets of balls and four practice rounds per tournament, his adversaries would be foolish to discount him as a threat. Jack is a competitor and would squeeze every ounce of training he could from what he had.

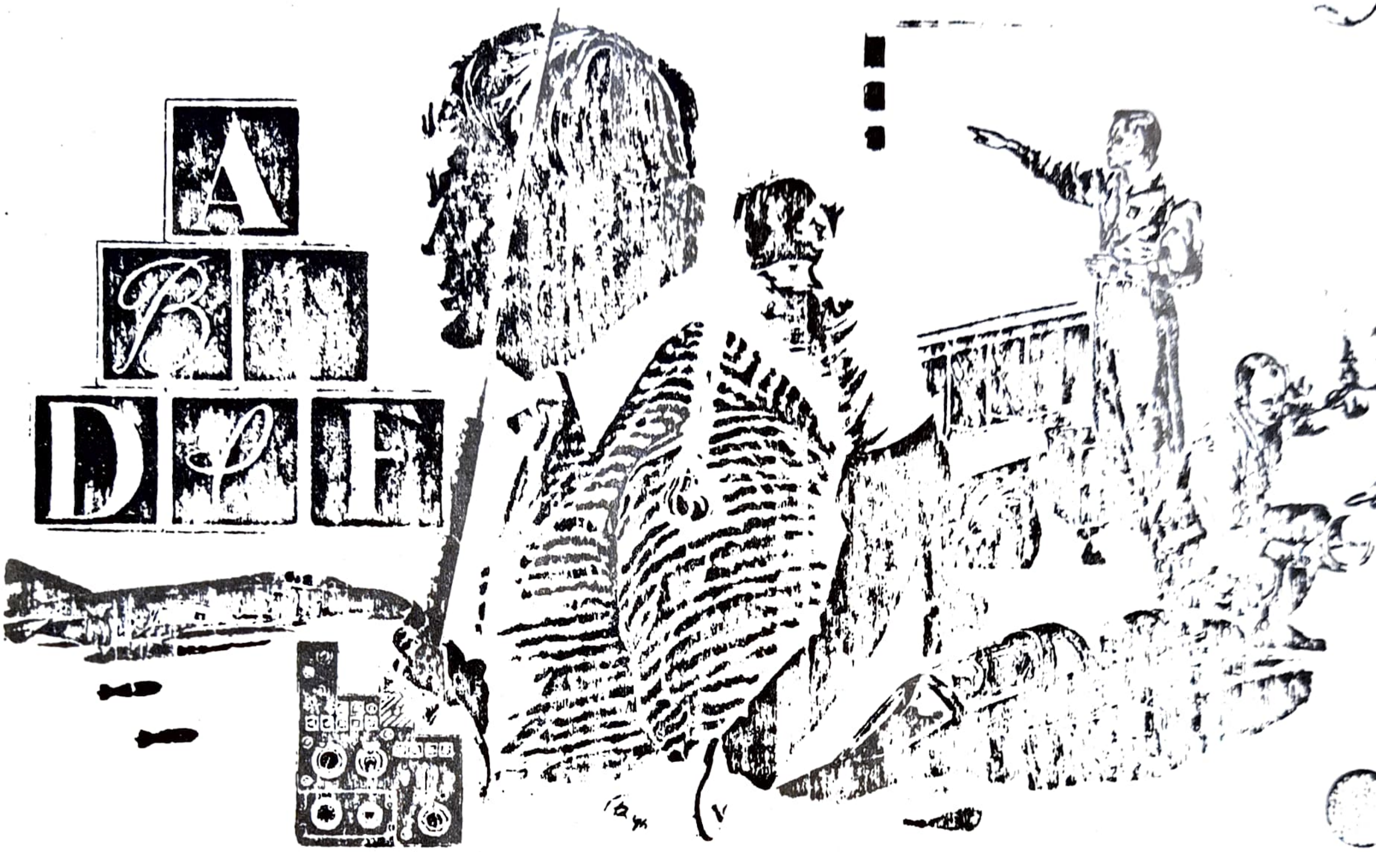
Our problem is that there are only a few tactical courses available to take us beyond the box pattern and RBS. Let's analyze the interface between event and tactical training to provide combat capability.

We will use Maverick training as an example (the principle applies to any training in any aircraft). If we were given sorties to go out and train in Maverick as an event, we would fly out to the tactical range, lock-on to various type targets, and generally develop the motor skills required to get the missile off the aircraft. It could be that our training program allows us to combine this with other training on the same sortie. After a few sorties of this type, what would we have? Obviously, the ability to lock-on and launch a Maverick. Is that combat capability? We could probably be Blue 16 in a low threat environment, but we are not combat capable in today's projected threat (the same analogy would apply to the relation of BFM to combat capability in a multi-bogey environment).

A better word for the product of event-training is lethality. In the above example we could definitely hurt something with a Maverick, given the right conditions. The question we must ask ourselves when tasked to "train with Maverick" is, "Train to do <u>what</u> with Maverick?" The answer: train to fight in today's threat scenarios.

If our goal is to train to fight, then we have defined the need for tactical training and intensified the goals of event-training. We cannot discount the importance of event oriented skills developed on the conventional range, in ECM training, and all that, but these must be placed in perspective with the ultimate goal: learning how to fight. Too often we are satisfied with minimum event performance, or worse, any performance to fill the square.

Beyond lethality, as stated before, is the need for training to confront the tactical problems imposed by the threat: communication jamming, multi-bogey, multiple passes, etc. In today's training programs there is no emphasis on these skills because they cannot be qualified or evaluated. You can sometimes see the effects of this in an advanced training scenario such as Red Flag. We may be able to bomb their eyes out in the target area, but how prepared are we to effectively fight our way in and out, reorient our navigation after a break into the Aggressors, use the terrain to mask ourselves, etc., etc. These skills are the product of tactical training at home, where we challenge ourselves to "put it all together" to the limits available. It is tactical training which makes the difference between lethality and combat capability .... and another thing we can do for ourselves.



One proven method of preparing to put it all together is the building block approach. We will see in later pages examples of this technique, used to build specific training programs. Let's turn our attention now to the effective use of this technique on a daily basis, and how we can begin early on to develop the skills required to prog ress to tactical training.

An important consideration in the efficient integration of event and tactical training is the recognition of transition points. At what point in a training cycle is a guy ready to progress? When will he be able to put it all together sufficiently well to benefit from a tactical scenario? When can he be safe and effective in an advanced scenario such as Red Flag? Let's examine these transition points.

Any new guy entering an operational squadron will probably receive several indoctrination rides. These rides are his first exposure to the disciplines and esprit of his new unit. Over and above the basic requirements of new guy ground schools, weapon certification, and so forth, what challenges do we issue him in preparation for his first rides? Do we lead him by the hand and summarily expect him to absorb as much as possible, or do we define items of responsibility requisite to advancement?

If we lead him by the hand, then there must be an established transition point somewhere down the line where the guy is expected to start doing things for himself. We all know that this point is usually implied rather than established. Most new guys are able to challenge themselves to learn the local area, ATC filing procedures, and all the other more or less standard squadron and wing procedural items.

Conversely, consider the effect of establishing squadron standards of performance requisite to advancement. For example, on the first ride the instructor may brief everything. On the second ride the new guy will be required to brief ground operations, departure and recovery, and be familiar with the expanded sight check and TISEO boresight. On the third ride items A and B are briefed as "standard," with the new guy briefing items C and D and being familiar with E and F. Consider the benefits of this technique. We have established a required squadron level of performance from the outset. The new guy is an active participant in his training, vice being a passive receiver. Instructors will know exactly when they can progress to higher goals and, more importantly, we have set the pace for training with the technique which will be used in each phase of progression. As the new guy advances, the squadron will require second-nature compliance with increasingly demanding standards.

The next level of progression for a new guy is usually some form of mission qualification training. This phase is designed to develop technical skills in those events which will be used later in putting it all together for tactical training. For purposes of illustration we will list events which would be appropriate for a conventional air-to-surface capability: BFM, low level navigation, RWR/ECM, and required weapons qualification. Using the same technique described earlier we would take care not to teach these skills as an end in themselves. The new guy must understand that each of these listed events are but one ingredient necessary to enter tactical training and requisite to the ultimate training goal of combat capability.

Most qualification training is also the time to begin developing those skills of discipline, awareness, and reaction previously discussed. Here again, the existence of squadron standards is the method to implement this training. A weapon systems check on departure is one standard which builds and maintains switchology proficiency while insuring daily practice of stab-out radar locks, crew coordination, etc. This daily use of air-to-air switchology—regardless of the mission—will allow rapid transition to this mode when required on a tactical or combat mission.

Another important standard is the use of tactical formations. We should be in tactical formation whenever possible during the mission. This not only builds awareness of flight path relationships and proper wingman positioning, but also gives us the opportunity to practice visual scan patterns, radar and visual search coordination, and formation turns. Initial use of tactical formations with the new guy should emphasize the basic disciplines of precise positioning, throttle technique, and all the other mechanical aspects that make it work. As proficiency builds, we should transition to comm-out turns where the new guy must add awareness of his leader's signals to his list of responsibilities. The next step is to build reaction with such exercises as an initial move call on the way home from the range to see how well our new guy moves his airplane, transitions to air-to-air switchology, and so forth.

These examples of daily drills are proven, valuable techniques to build those skills that we can't score on a range, but which will be vital to our combat capability. In addition, exercises such as comm-out turns are directly related to techniques used in a jamming environment.

We are at a major transition point. We have a good start on combat capability by (1) getting the new guy involved with his own training, (2) setting standards of performance from the beginning, and (3) integrating training to develop tactical skills with regular mission qualification event training. The transition to a tactical training program will be greatly simplified.

These techniques can be employed in most of our training environments and are implemented by those who want to improve things they "can do." A logical fallout from this type of training is increased flying safety. After all, awareness we seek for combat capability is the same awareness which allows us to anticipate and avoid dangerous situations. In addition, tactical formations are designed for optimum lookout, be it friendly or enemy

Beyond A Training Aid

The success or failure of any combat mission ultimately rests upon weapons delivery accuracy. Each time we fly, we must be able to quickly and accurately assess weapons system operation and pinpoint degradations. Thorough checklist BITs are usually a standard in every unit. Therefore the emphasis here will be placed on a discussion of the expanded sight check and on methods for quickly completing an after-takeoff systems check for the F-4E (LES) with TISEO. While this does not accommodate every iteration of the F-4, it can be used as a point of departure to insure that a preferred standard weapons system check is safely and correctly accomplished on each flight, despite mission, weather, ATC, or training restrictions. The F-4 is a fighter—let's be ready to use it.

Expanded Sight Check

Upon arrival at the aircraft (External Electrical Power On):

1 (AC) Sight Shutter - Open

2 (AC) Sight Mode Knob - Cage. Insure that the LCOSS bulb is good since it may take specialists 15 minutes to replace the bulb after arrival at the aircraft.

3 (AC) Sight Mode Knob - Standby or Cage. The sight must not be returned to the OFF position because this will remove electrical power from the gyro and preamplifier. A five-minute warmup of these components is required to accomplish a valid LCOSS check.

Anytime after switching to internal power the following checks may be accomplished (provided you have had the Sight Mode Knob in Standby or Cage for five minutes). The initial switch setup is:

AC

Sight Mode Knob - Cage

Guns/Missile Switch - Radar or Heat

Reticle Depression - 0 mils

WSO

Radar Power Knob - Test (must be out of OFF for 30 seconds to supply 250 VDC to LCOSS)

Radar Range Knob - 5NM

Radar Mode Switch - Boresight

Test Knob - BIT 5

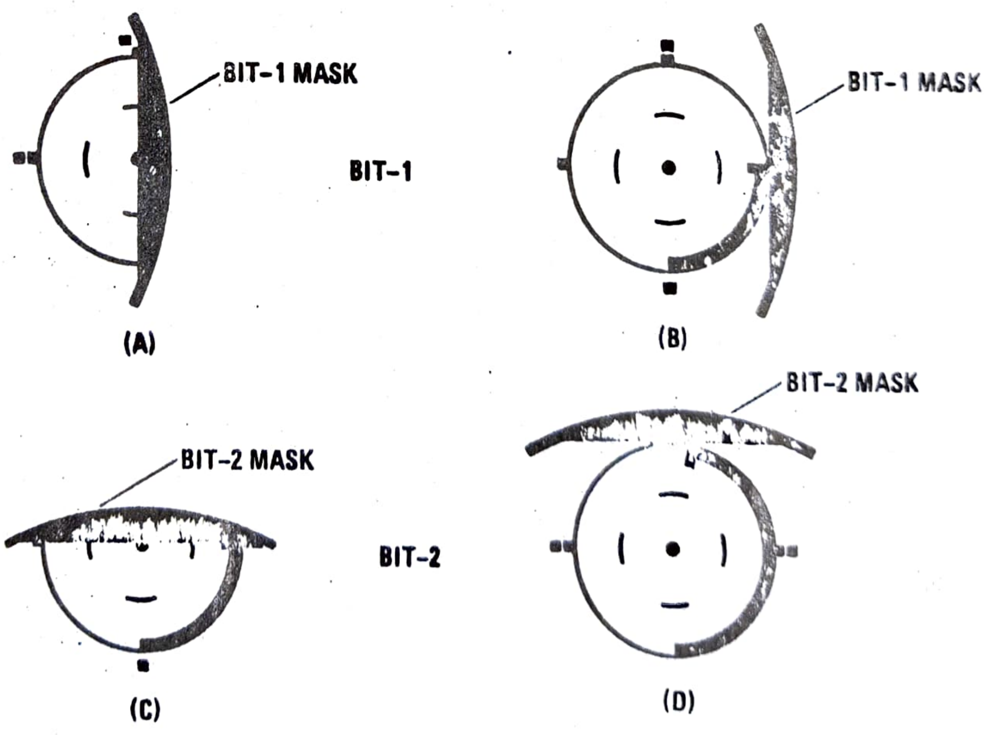


FIGURE 1

1 (AC) Sight Mode Switch - Cage, A/G, A/A. Pipper remains within ± 2 mils of the cage position.

2 (AC) Reticle Depression - 10 mils.

3 (AC) BIT 1: The aircraft commander moves his head to the right to obtain a reticle presentation similar to that shown in Figure 1(a). When the mode switch is positioned in BIT 1, the reticle will move 25 ± 4 mils in traverse and appear as shown in Figure 1(b). The roll tab will rotate 90° clockwise and the analog bar will slew to the three o'clock position.

c (WSO) VI meter reads 6,000'

9 (AC) Guns/Missile Select Guns.

a Head-up Gun Light - on

b Range Bar - 6,000' (one o'clock).

c Pipper slowly depresses (37 - AOA) mils Figure 2(b).

10 (AC) Reticle Cage Button - Depress and Hold.

Pipper moves to within 4 mils of the

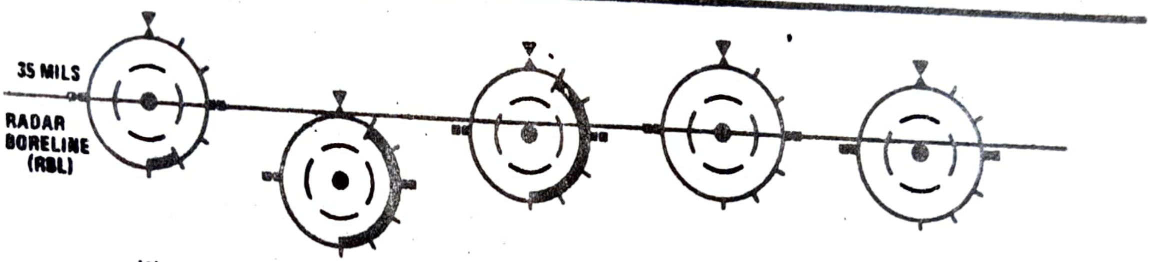


FIGURE 2

4 (AC) BIT 2: With the Mode Switch in BIT 1, the aircraft commander moves his head up to obtain the reticle presentation shown in Figure 1(c). When the mode switch is positioned to BIT 2, the reticle will depress 25 ± 4 mils and appear as shown in Figure 1(d). The roll tabs should rotate back to the wings level attitude and the analog bar slew to the 12:40 position

5 (AC) Sight Mode - A/A.

6 (AC) Armament Safety Over-ride Button - Depress.

7 (AC) Guns/Missile Select - Radar or Heat (appropriate light illuminated on head-up display).

8 Auto-acquisition Switch - Depress and Release.

a Radar locks onto first target.

b (AC) Range Bar indicates 6,000' (five o'clock). Figure 2(a).

Radar Bore Line (Computing for 1,000' range/zero overtake. Pipper should be about 37 mils for a 2-mil gravity drop computation). Figure 2(c).

11 (WSO) Action Switch - Half Action and Release.

a Radar Breaks Lock.

b Pipper - Moves up to Radar Bore Line Figure 2(d).

12 (AC) Reticle Cage Button - Release

Reticle drops to position 2(e) (again computing for 1,000' range/zero overtake.

13 Sight Mode Switch - Cage or Standby for takeoff.

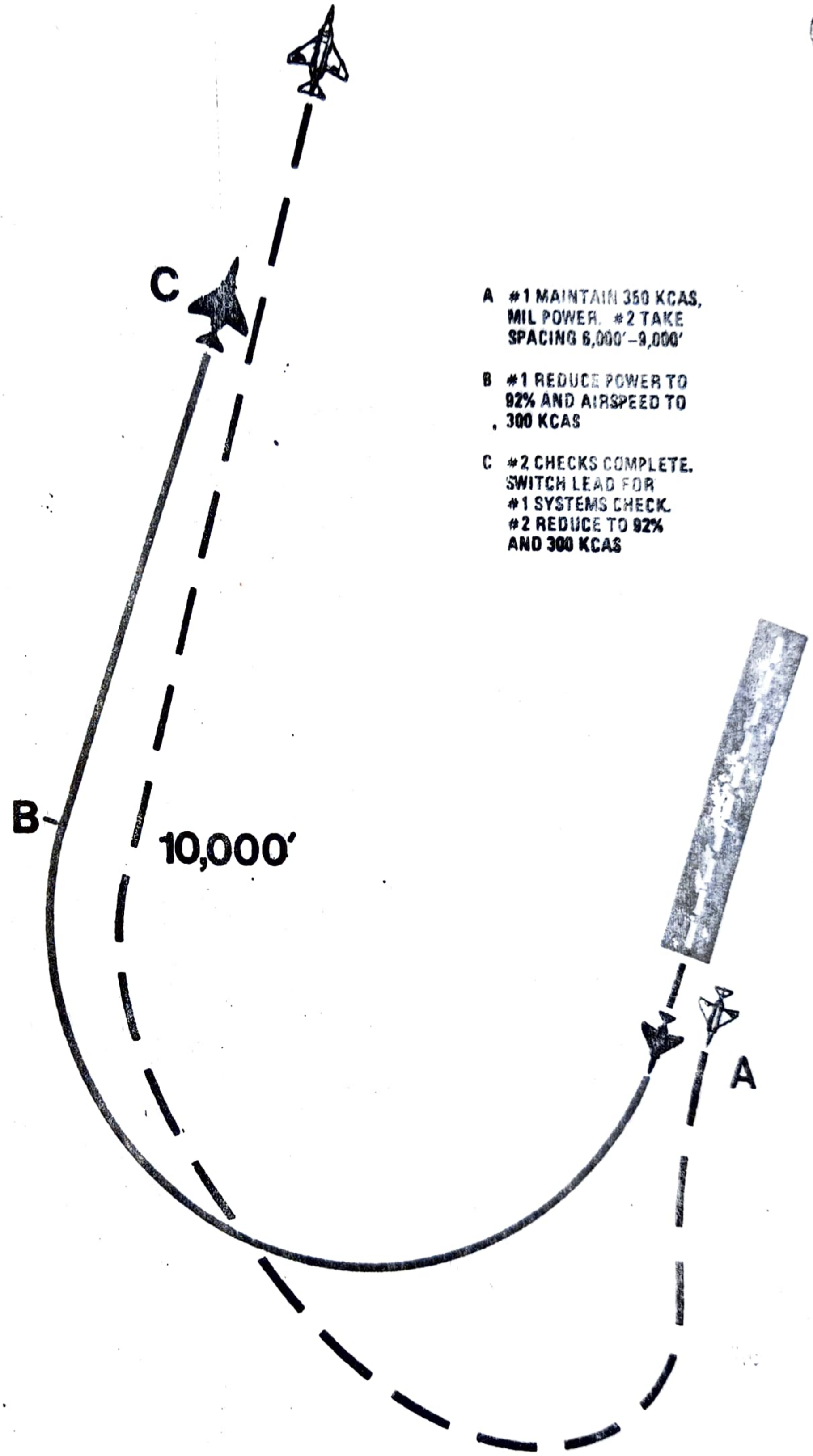

C
A #1 MAINTAIN 350 KCAS, MIL POWER. #2 TAKE SPACING 6,000'–9,000'
B #1 REDUCE POWER TO 92% AND AIRSPEED TO 300 KCAS
C #2 CHECKS COMPLETE. SWITCH LEAD FOR #1 SYSTEMS CHECK. #2 REDUCE TO 92% AND 300 KCAS
B
10,000'
A

FIGURE 3

SYSTEMS CHECK

The goal of the systems check is to determine the airborne capability of the radar, LCOSS, TISEO, and APX 80. When the check is initiated from a formation takeoff, the wingman should maneuver to a position 6,000' to 9,000' in trail, with closure. When initiated from a trail departure, normal closure will provide adequate time to complete all checks. Figure 3 illustrates a typical departure with suggested airspeeds and power settings to maintain closure. The following table shows a condensed list of switches and crew actions during a typical formation takeoff and systems check.

	AC	WSO
After Takeoff	SIGHT - Cage or A/G Guns/msl select SW-MSL	RADAR - Stby or normal sweep, 25 mile scope. RWR on
	Cage Button Depress - observe sight goes A/A	Observe - Radar goes 5 mile boresight
		A/A Button Depress. Radar - Power on, 5 mile, short pulse, stab-out
When Taking Spacing	Call position of lead aircraft for stab-out lock (See Note 1)	Lock-on lead aircraft, check accuracy of AC's calls
	Note Range Analog Position	Compare Sight Range Analog with VI readout
When in Trail Closing	Guns/MSL select SW - Guns Observe LCOSS travels in azimuth and elevation. (Can be done while WSO is checking TISEO)	TISEO - TV/SLVD, SFOV Note Lead aircraft in field of view and correct symbology (See Note 2) Select PFOV, obtain OLO select IND, depress RTS button, observe radar returns to search
		TISEO - RDR/SLVD Radar - BST
	Depress auto acq button. Note speed of range gate	Observe B-sweep slaved to OLO and radar lock from auto acq
	Observe single ranging on analog. Compare with stadiametric ranging during closure	Observe VI Range and closure, compare with AC Range calls. Select VI Mode - compare DOT with azimuth and elevation of lead
	Switch Leads for #1's System check or assume briefed formation position. Guns/MSL select SW - as desired. Notify lead of malfunction. Complete RIG/STAB AUG check as applicable.	Radar - Stab normal - Search as desired TISEO - SFOV

NOTE 1: The radar lock can be obtained in any way the crew desires; however, proficiency in stab-out coordination will probably be most useful. Approximate reference points in the front cockpit are provided in Figure 4.

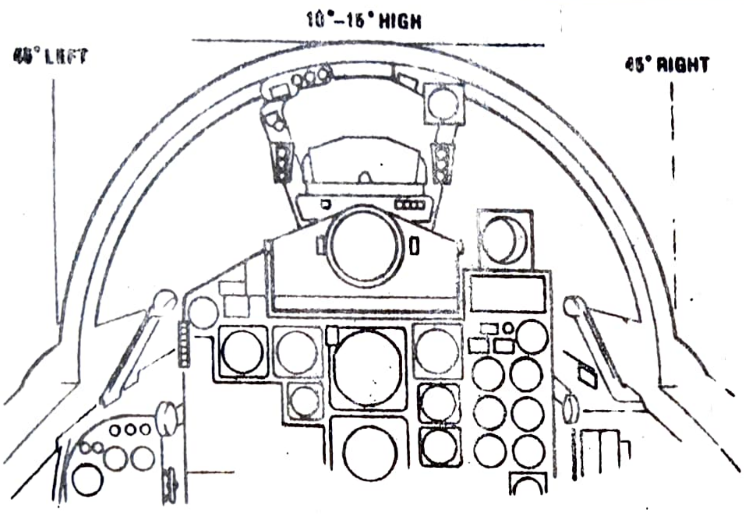


FIGURE 4

NOTE 2: If, after selecting TV/SLVD with a radar lock-on, the target aircraft is not in SFOV, the following procedures apply:

1 TISEO IND/SLVD SW - IND.

2 AC - with 35-mil pipper, track horizon or any line of demarkation between sky and ground, such as clouds, water, etc

3 WSO - unlock TISEO boresight knobs. Adjust elevation knob until horizon splits field of view as shown in Figure 5. This eliminates elevation error.

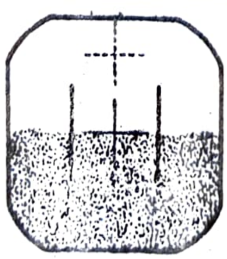


FIGURE 5

4 AC - retrack target aircraft with 35-mil pipper.

5 WSO - adjust azimuth knob until target becomes visible in field of view. Refine as necessary to center target. Relock boresight knobs. This step eliminates azimuth error. Return IND/SLVD switch to SLVD (assuming radar lock has been maintained). Target should be in FOV.

The above procedure assumes that the 35-mil pipper is accurately aligned to the radar boreline. Obviously, steps 2, 3, and 4 can be used to boresight on any discernable target. In situations where no boresight target is available, a rough boresight can be accomplished using the following procedure:

1 AC - Track horizon in 45° bank.

2 WSO - Select TV, IND, SFOV. Unlock boresight knobs. Rotate either boresight knob until horizon splits the field of view as shown in Figure 6

FIGURE 6

AC - Roll to 45° bank in opposite direction and retrack horizon.

WSO - Rotate other boresight knob to split the screen diagonally as shown in Figure 7.

FIGURE 7

This procedure should yield a boresight accuracy of approximately 5 mils. Now that we have determined the operability of our air-to-air systems, let's depart from the mechanics of checklists, and enter the esoteric world of air-to-air combat.

VII Wounded Bird

have a sick bird deep over enemy territory. To get home or at reach a less hostile ejection area, every mile you can get you is as precious as an oxygen tent is to a heart patient!"

Five years ago, Bill Brinks used those two sentences to start off a DIGEST Ready Room article which offered some pilot techniques for possible emergency use when primary hydraulic power had been lost. These were techniques our crews had discovered as part of F-4 flight testing, and were described by Bill as "long shots." However, when a long shot pays off, the rewards are great - and we know of at least two combat episodes in which stricken aircraft were controlled as suggested by Bill to a point of safe ejection, and where the rewards were the recovery of all four crewmen. No higher rewards are possible, so we are recounting here the stories of the two Navy crews involved, and reprinting the original Brinks article, just in case someone else suddenly needs some advice in a similar situation.

(1972)

"Thank God for Sea Stories..."

The tenth of May, 1972 dawned much the same as any other day for the men of the USS Constellation, steaming slowly on station in the Gulf of Tonkin. Engineers and boilermen went about their work deep inside the ship. Maintenance crews pressed ahead getting aircraft ready for flight. Ordnancemen wrestled bombs aboard planes, destined for flight later in the day to the inner reaches of North Vietnam. And in the ready rooms of this huge carrier, pilots and radar intercept officers compared notes, strike data, and plans for the day's missions.

Among these people - five thousand of them - were two men, Lt Randy Cunningham, a VF-96 Phantom pilot, and Ltjg Bill Driscoll, his radar intercept officer. Little did they realize, as this day began, that they would bag three Migs, becoming the first air aces of the Vietnam conflict. Even further from their minds was the manner in which they would return to the ship.

For Cunningham and Driscoll, the story began on January 19th, 1972. It was on this date that they bagged their first Mig, a Mig-21. Unwilling to let this kill stand alone, they got their second, a Mig-17, on May eighth. And it was two days later, on the tenth of May, that they bagged three more, earning them both the title of "Ace."

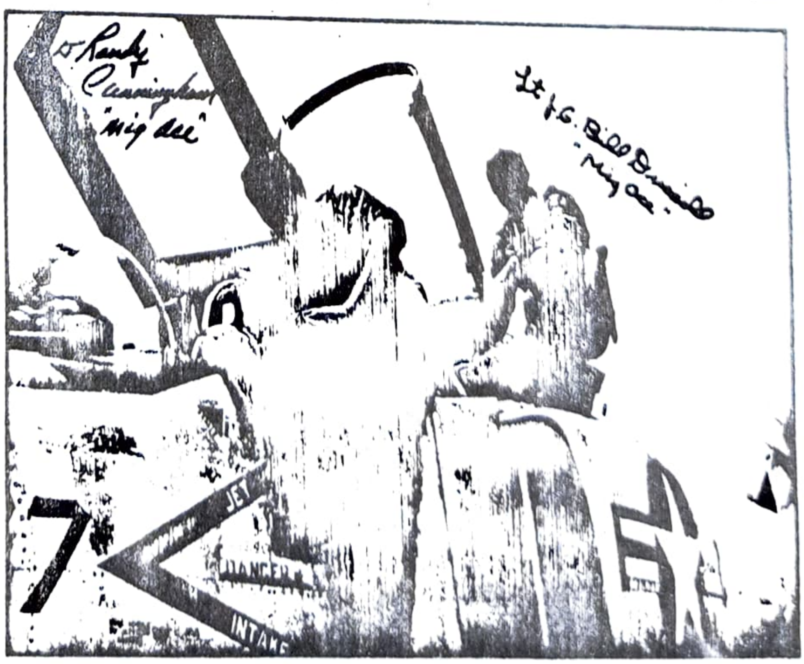
Lt Cunningham had been assigned as a section leader of a thirty plane "Alpha Strike" against a major railroad center. This railroad storage area was linked up with a supply system delivering arms into South Vietnam and Laos. Their mission was to strike at any gun or missile emplacement that shot at the strike group. After delivering ordnance, they were to become air superiority fighters, warding off any enemy Migs that might appear. It was with this goal in mind that the strike force launched from the Constellation, flying deep into North Vietnam.

The mission progressed according to plan; ordnance was released on schedule. However, after the ordnance delivery and immediately after pulling off the target, Cunningham's wingman, Lt Brian Grant, called out, "Duke, you have Mig-17's at seven o'clock!"

A quick maneuver brought the Migs ahead of the Phantom, and the first missile was launched. Cunningham and Driscoll had bagged their first Mig-17 of the day.

Now they spotted their VF-96 Executive Officer, Cdr Dwight Timm, being chased by two Mig-17's and a Mig-21. The Cunningham/Driscoll F-4J was placed in hot pursuit. In the process, they had to ward off four Mig-17's behind them, two Mig-19's strafing their starboard side, and four Migs at the nine o'clock position. The tactical advantage shifted from side to side until suddenly the team of Driscoll and Cunningham found themselves aiming straight for another Mig-17. A second missile left the F-4J, and the score for the day had risen to two.

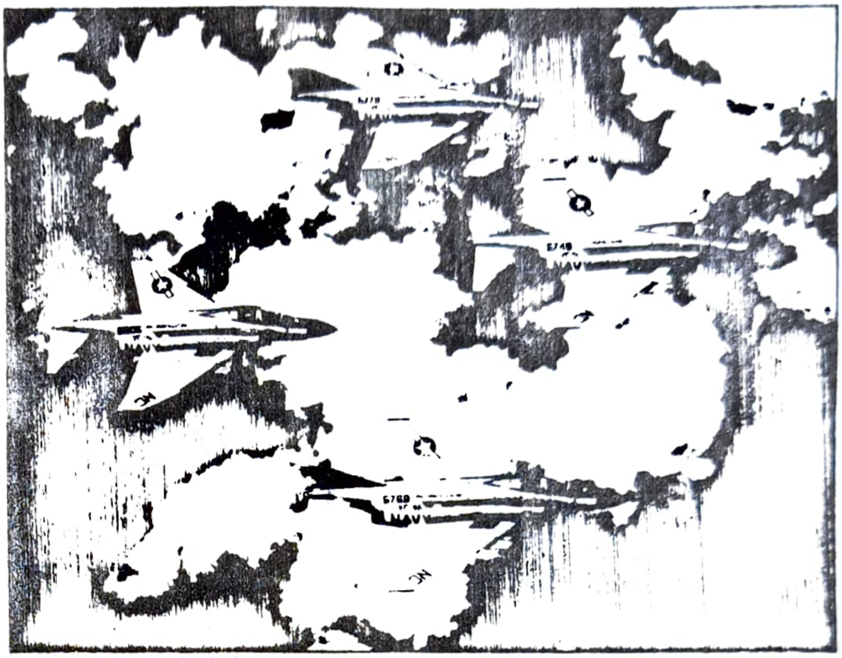
It was time to leave the scene, yet action continued unabated. In an al-



With a record of four MIG-17's and one MIG-21 shot down, Lt Randy Cunningham and Ltjg Bill Driscoll became the first air aces of the Vietnam conflict.

most fatal action, Lt Cunningham locked onto his third Mig. The first two Mig's had been easy scores, but this one was not to be as simple. According to those on the scene, this was a five minute conflict, unprecedented in jet warfare. On two occasions, the Mig forced the F-4J to disengage and reattack. After five minutes of high-g maneuvering, the Mig attempted to disengage. Lt Cunningham reversed, let loose a third missile, and another Mig went down in flames. An attempt was made to engage yet a fourth Mig, but action was broken off when squadron-mates Mat Connelly and Tom Blonski warned of four more Migs that were on a tail chase. Lt Connelly fired a missile into the group of Migs, forcing them to break off their attack.

Cunningham and Driscoll started the long haul back to the Constellation, not realizing that they still faced their biggest test of all. Leaving the target area, some eighty miles over the North, and pursued by four Mig-21's, they had sixty miles to go to reach the coastline and the safety of the Gulf of Tonkin. The last third of that trip was made in a burning aircraft controlled only by the rudder and engine power. The story, from this point on, is told by Lt Cunningham:



Four Phantoms from VF-96 pass in review. Aces Cunningham and Driscoll were members of this Constellation-based squadron at the time they earned their title.

"Bill and I had varied emotions after shooting down the three Migs. We knew that the day's tally had given us a total of five, making us the first aces; however, we still had a lot of work to do because of the Triple-A and surface-to-air missiles we were having to evade. I remember looking over my left shoulder and telling Bill to keep an eye on the Mig-21's, which were about three miles in trail of us.

"We heard a SAM call over our receiver, and I looked to starboard just in time to see an SA-2 heading for us. Before I could maneuver, it went off about 400 feet away from the aircraft. The resultant concussion was mild, and we had had other SAM's pass closer. To this point, there appeared to be no damage. Following the near miss, I immediately went right to the gages and checked for any system malfunction; but everything was normal, so we continued the climb watching out for other possible SAM's.

"About 45 seconds later, the aircraft yawed violently to the left, and my first reaction was that of steadying the F-4. A re-check of instruments showed the PC-1 hydraulic system indicating zero, PC-2 and Utility systems fluctuating. Thank God for sea stories, for from somewhere out of the memory bank came a recollection of 'Duke' Hernandez, a Navy pilot who had rolled his aircraft to safety after having lost primary hydraulics. Sure enough, when PC-2 went to zero, the nose of the F-4 went straight up, just as had happened to Hernandez.

"I pushed full right rudder, forcing the nose to yaw right and down. The aircraft rolled to the right, and as the nose passed just below the horizon, I pushed in the speed brakes and selected full afterburner to start a climbing roll. Each time the nose reached the top of the up-swing, I had to bring it down so as not to stall. On the down-swing, I tried not to let the nose get too low, or it would have been impossible to get it back up with rudder alone. We rolled the F-4 fifteen miles in this manner, starting at 27,000 feet, and ending up at 17,000 feet.

"We had just cleared the coast when the Utility system went to zero. I don't know who was watching over us, but if this had happened thirty seconds earlier we would have come down over land and become residents of the Hanoi Hilton.

"The F-4 went into a spin and I told Bill to wait two more turns so that I could try and get one more mile over the water to give us a better chance of evading capture by the North Vietnamese. I deployed the drag chute to no avail, and further attempts to pull the F-4 out of the spin were useless.

"Our call to eject is: 'WILL EJECT, EJECT, EJECT.' But I only got out 'WILL E. . .,' and Bill punched out. Earlier I had told him to put in the select handle so that he alone would go, but he agreed to stay with the plane until I told him to get out because Bill, like myself, took the chance of the F-4 exploding rather than become POW's as a result of premature ejection. Bill was later asked by a group of newsmen what his thoughts were while hanging in the chute. His response: 'He thought, at that moment, he had made an incorrect decision when he left the Army

Reserve in Boston.

"We, as fighter pilots, used to make jokes about the funny little airplanes that chugged along at under 200 knots, but our view of them has changed. We were in the water fifteen minutes pending on fifteen days when three Marine helo's from the USS Okinawa pulled us up. To say we were glad to see them is an understatement.

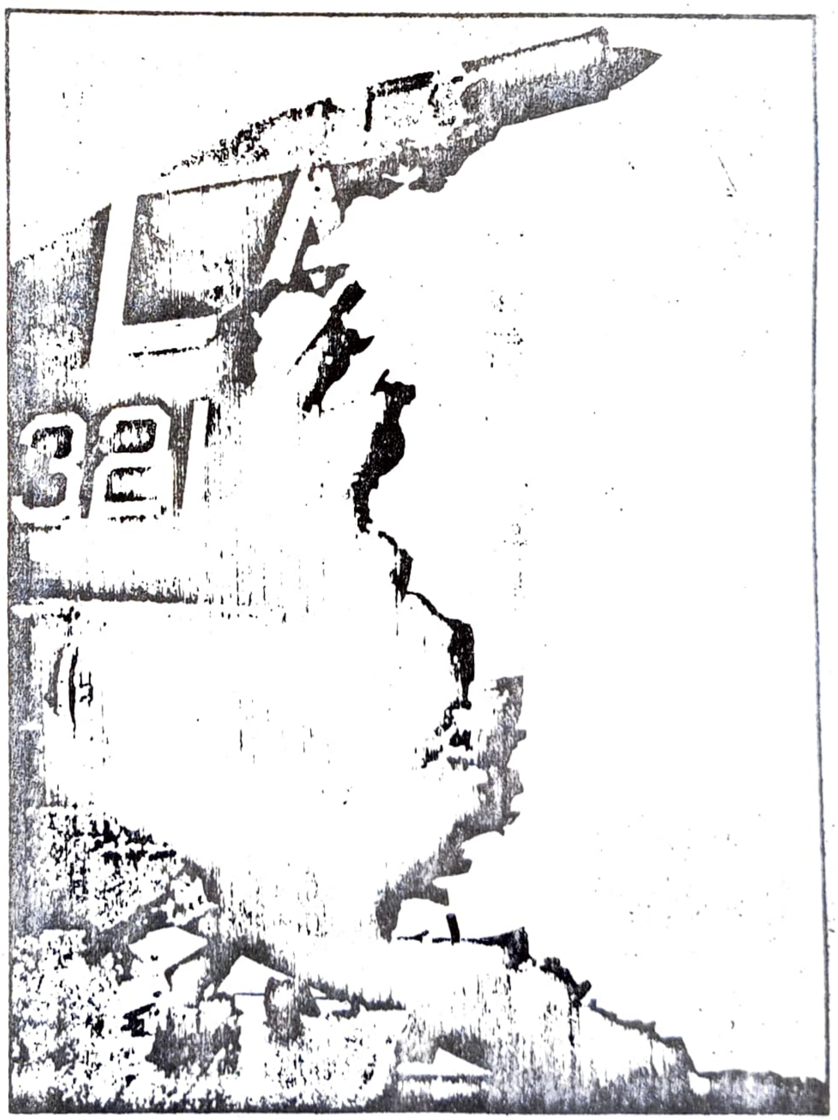
'When we were returned to the 'Connie,' five thousand men were waiting for us on her decks. One of the troopers walked up and said, 'Mr. Cunningham, we are glad you shot down three Migs today and became aces, but we're even happier that you are back with us,' and that's the same sentiment Bill and I have. The best thing that happened to us was getting out alive.

"Bill and I are aces, but we deserve only one five thousandth of each Mig because each of the guys on the 'Connie' contributed, and deserves credit. We were only the instruments of their effort."

Three crews from Fighter Squadron 96 distinguished themselves in the skies of North Vietnam that day. Lt Steve Shoemaker, a pilot, and his RIO, Lt Keith Crenshaw bagged one Mig. Lt Mat Connelly and RIO Tom Blonski knocked down two Migs. These were over and above the three shot down by the team of Cunningham and Driscoll.

Six F-4's took on twelve Mig-17's, four Mig-19's, and six Mig-21's, downing six of the Migs, and suffering no losses of their own. Lt Cunningham and the others attributed their success to the training they received in the Navy Fighter Weapons School at NAS Miramar where pilots learn to fight against dissimilar aircraft simulating Mig aircraft. Lt Cunningham stated that the weapons school is largely responsible for the eleven to one kill ratio enjoyed by the Navy, and is directly responsible for his being alive today.

A testimony to the durability of an aircraft; the combat damage on these pages, though severe, was not enough to keep the Phantoms involved from making their way back to safety.



Five years ago, in December 1967, LCdr (now Commander) Diego "Duke" Hernandez was returning from a mission over Vietnam. His F-4 had been damaged in the action, resulting in the loss of PC-1 and PC-2 hydraulic pressures. It was the recovery techniques used by Cdr Hernandez during this flight that were recalled by Randy Cunningham and used to advantage in reaching the safety of the Gulf of Tonkin. (Commander Hernandez currently is C.O. of Navy Fighter Squadron 84, a part of Carrier Air Wing 6, presently deployed to the Mediterranean Sea aboard the attack carrier, Franklin D. Roosevelt.)

Here's the Duke Hernandez story, as recalled by Jim Frayser, McDonnell Field Service Engineer at NAS Miramar, who was assigned to VF-21 along with Hernandez at the time the action took place. Jim, by the way, lays claim to being a "plank-owner" in VF-96, having joined them early in 1962 when they were still designated VF-142. He later made their maiden F-4B cruise with them.

The Duke Hernandez Story

"To begin with, the first indication of trouble was when, at 7,000 feet altitude, the aircraft suddenly pitched violently up, and rolled to the right. Duke immediately pushed the control stick forward, against the stop, and started rolling in full nose-down trim.

"Just prior to stall, he kicked in top rudder, and as the aircraft rolled inverted, the nose fell through. With rudder control only, he managed to keep the aircraft under some semblance of control, performing what might be called a huge barrel-roll, or something like a corkscrew. There was, at this time, no aileron control.

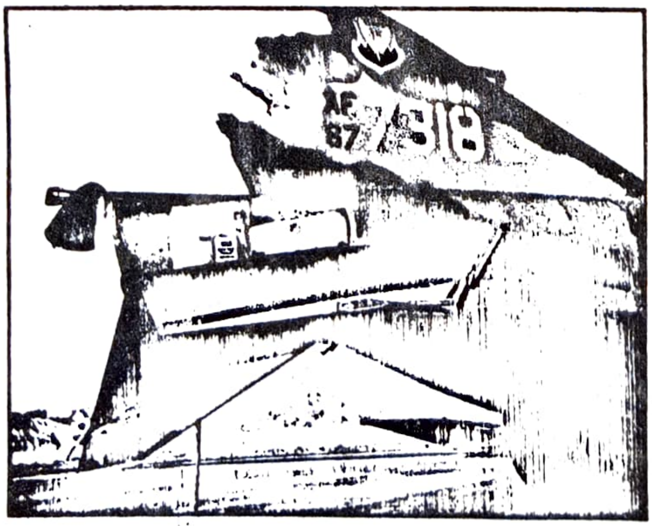
"After the third roll, Duke figured he could handle the aircraft, so he proceeded to check instruments. There was no loss of engine or electrical power, or utility hydraulic pressure. Both PC-1 and PC-2 hydraulic systems read zero.

"Afterburner was required to maintain speed and whatever attitude that could be held. At one point, he deselected afterburner, but airspeed fell too low to maintain the escape maneuver. During that portion of the flight after being hit, the aircraft travelled approximately fifteen miles under a constant load of 5 to 6 g at 19 to 20 units of angle of attack.

"Ltjg Steve Van Buren was in the back seat. He switched to Sea Air Rescue (SAR) and by the time of ejection, two helo's were in the air waiting for them. The aircraft had actually gained altitude during this portion of the flight, and as the wings rolled level at 9,000 feet Steve ejected. After the next rotation, again as the wings rolled level at Duke ejected. All this time he had been holding the stick full forward, moving the rudder pedals as required. He pulled the face curtain with his left hand. Because of the position, he suffered a compression fracture of the T-12 vertebra.

"The RIO was picked up while the pilot was still descending. Within a few minutes of water entry, the pilot was picked up by the second helo.

"After the entire thing was over, Duke remarked that he did not know where the plane had been hit, but that he had read an article in the PRODUCT SUPPORT DIGEST pertaining to longitudinal controls and loss of PC systems. He credited that article with helping him get the aircraft out far enough to eject over water. He also said that without utility hydraulic pressure, he might not have been able to control the aircraft because of airloads."



Little did Bill Brinks realize, in writing an article five years ago, that two aircrews would be able to credit their lives to what he had to say. But, as you've just read, its value has been proven twice; and since the ideas in his story are just as good today as in 1967, here it is again.

(1967)/(1972)

AIRCRAFT CONTROL in Combat Emergencies

By BILL BRINKS / *Experimental Test Pilot*

You have a sick bird deep over enemy territory. To get home or at least reach a less hostile ejection area, every mile you can get behind you is as precious as an oxygen tent is to a heart patient. Here are some pointers for controlling your bird in combat emergencies. We've discovered these only recently. While these procedures *have not* been fully flight tested and are meant for limited control in extreme cases, they may get you those precious extra few miles.

PC-1 and PC-2 pressure is lost because of damage to parts of the hydraulic system. Do you have any *pitch control?** You might, if the stabilator power control cylinder is undamaged. It may be possible to "lock" the stabilator hydraulically in a fixed position and thereby conceivably maintain a reasonable flight attitude. But - and this is important - it depends largely on the techniques you employ.

Before we suggest some techniques we feel will help get things going your way, let's lay a little background. Thanks to Perry Hoffman (one of McDonnell's autopilot and F-4 flight control experts, and well-known for his series of DIGEST articles on flight control), a number of ground tests were performed to validate the stabilator control theory. These ground tests showed that the minimum pressure required to actuate the stabilator power control cylinder varies from 500 to 1500 psi. We also know that if forward pressure is held on the control stick below this minimum actuation pressure, a hydraulic lock may form between the stabilator power control cylinder and the one-way check valves just upstream from the actuator in the PC-1 and PC-2 lines.

Now back to techniques. Position the stabilator to the attitude you desire as PC-1 and -2 fall to the 500-1500 psi level. PC-1 and PC-2 pressure is now gone but the stabilator power control cylinder is okay. We suggest you position the stabilator with forward stick pressure as soon as possible after the stabilator ceases responding to the stick. Maintain forward stick pressure to hold the hydraulic lock. *Don't relax forward pressure on the stick.* Aft stick after hydraulic lock will vent fluid and you'll have no more lock.

How long can you hold the lock? There is no fixed answer but we know it depends largely on holding forward stick pressure. It also depends on system leakage, the integrity of mechanical linkage, and the condition of the one-way check valves. Therefore, you can see that this technique may not work every time. We can sum it up this way. As PC-1 and PC-2 pressure falls below minimum required, apply forward stick pressure. The stabilator will probably remain fixed until forward stick pressure is relaxed or until leakage will no longer hold the hydraulic lock. Loss of the hydraulic lock will be characterized by an increasing nose rise, since aerodynamic force will pull the stabilator leading edge down. Let's get the record straight on one point here before we go on. Do not consider this information as a "cure-all." The technique as suggested should be regarded as just one more possibility you have - nothing more. It might be a big one, though.

Now, what about *lateral control?** Some degree of lateral control is available as long as PC-1, PC-2, or Utility hydraulic systems are operating, and the aileron/spoiler actuators work. Lateral control following complete hydraulic failure (PC-1, PC-2, and Utility) can possibly be maintained with manual rudder control. In Air Force aircraft, of course, with two people (two people and two sets of pedals plus adrenaline) pushing on the rudder, the task is reasonable.

In Navy aircraft, F-4B and J troops will have to work harder. Only the pilot has rudder pedals. Directional control by using differential power settings is a possibility also.

We'll wind this up now. Although these procedures may seem like a long shot, there is always a chance that they will prolong a flight just long enough to make the difference between winning and losing. It won't hurt to have them in mind.

***Editor's Note: Since this article was written in 1967, there have been some aircraft changes that may affect your particular situation. For instance, the lateral controls have been modified on all aircraft so that they now operate on utility hydraulic pressure as well as on PC-1 and PC-2 systems (Navy AFC-400, UK AFC-43, USAF T.O. 1F-4-780). With this triple-redundant system, you will have varying degrees of lateral (aileron/spoiler) control with loss of any one or two hydraulic systems. Loss of all three systems still produces the lateral control situation Bill analyzes in his article (including the try for manual rudder control).**

On the Air Force side of the flight line only, a stabilator auxiliary power unit (APU) has been added to F-4E and RF-4C aircraft, Block 40 and up (T.O. 1F-4-903). If the stabilator power cylinder is still serviceable, the APU provides adequate longitudinal control even with loss of both PC systems (Utility system does not power the stabilator).