LANTIRN
AN/AAQ-13 Navigation Pod
AN/AAQ -14 Targeting Pod

Operations Guide
F-16C/D Block 50/52

This guide was written for the Superpak 3 Series of Falcon 4.0 Using a realistic HOTAS setup

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Introduction

Low Altitude Navigation and Targeting Infrared for Night, or LANTIRN, is a system for use on the Air Force's premier fighter aircraft -- the F-15E Eagle and F-16C/D Fighting Falcon, as well as the Navy's F-14 Tomcat. LANTIRN significantly increases the combat effectiveness of these aircraft, allowing them to fly at low altitudes, at night and under-the-weather to attack ground targets with a variety of precision-guided and unguided weapons.
The research and development program, initially conceived as a capabilities upgrade program for the F-16, began in September 1980 with Martin Marietta (now Lockheed Martin) as contractor. Two years later, in 1983, the program was already suspended and reshaped to reduce the technical risks involved with the development of the advanced technology, most notably the Automatic Target Recognizer (ATR) sub-system. The ATR was meant to automatically discriminate between various battlefield targets such as MBT's, SAM's and APC's. Eventually it was decided not to incorporate this functionality from the start of the program on, but instead to add it under a later retrofit program. Ultimately, the ATR never made it into LANTIRN.
Flight trials with the LANTIRN wide-angle HUD began in the summer of 1982. By that time congressional support for the program had all but vanished and the House Armed Services Committee warned that it had seriously considered recommending denial of all 1983 authorization of funding'. Flight testing, using dummy pods (equal to the real pods as far as weight, shape and mass distribution are concerned) started in September 1982. The pods were instrumented so that accurate measurement of vibration and flutter could be performed.
One year after tests with the HUD started, in the summer of 1983, flight tests with fully functional pods started with two F-16B and two A-10A aircraft. By the winter of 1984, LANTIRN had completed operational tests in adverse weather conditions during combined Development, Test and Evaluation (DT&E) and Initial Operational Test & Evaluation (IOT&E) deployments in Europe.
Congressional support declined further when Congress stipulated that, before a production decision could be taken (expected in 1985), LANTIRN had to be tested in competition with the FLIR-pod Ford Aerospace had developed for the F/A-18. The USAF was prohibited to order LANTIRN into production before the testing was done with. By that time, LANTIRN had become a key component of other programs such as the F-15E dual-role fighter program, and as such was no longer regarded as a sub-system of the F-16 but as a program in its own. This in turn led to huge cost overruns, since development costs of LANTIRN could no longer be billed on the F-16 program. In real terms, cost overruns amounted only to some 10%. Ultimately, LANTIRN was

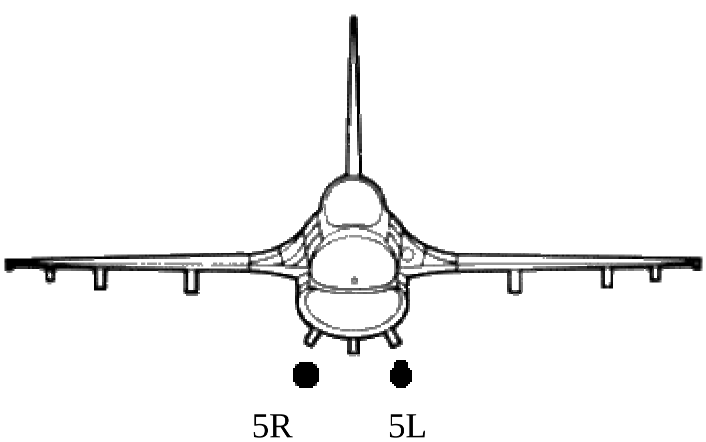
chosen for the F-16C/D and F-15E and has recently been fitted to US Navy F-14 aircraft as well.

The Air Force could finally approve low-rate initial production of the navigation pod in March 1985 and full-rate production in November 1986. The first production pod was delivered to the Air Force March 31, 1987. The initial contract was for 561 navigation and 506 targeting pods and it had a $2.9 value. The complete LANTIRN system adds about $4 million to the cost of the aircraft which is a real bargain for turning day into night.

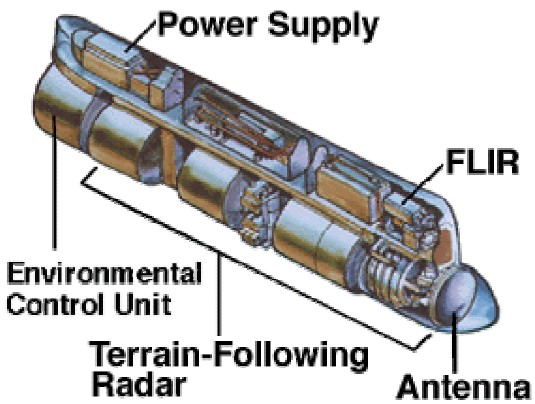
In April 1986, IOT&E of the LANTIRN targeting pod proved that a low-altitude, night, under-the-weather, precision attack mission was feasible. The Air Force approved low-rate initial production in June 1986. Introduction of the LANTIRN revolutionized night warfare by denying enemy forces the sanctuary of darkness.

The LANTIRN system comprises two pods; one AN/AAQ Navigation Pod ***("To Fly")***, and one AN/AAQ-14 Targeting Pod ***("To Fight")***. The pods were conceived in a way that allows them to operate autonomously, so either pod can be used without the other should the need arise. The pods communicate with aircraft systems through a standard 1553B data-bus.

The F-16 carries the LANTIRN pods on its chin stations: the AN/AAQ-13 Navigation Pod on the port station (5L) and the AN/AAQ-13 Targeting Pod on the starboard station (5R). The weight of the pods necessitated strengthening of the internal structure of the F-16 and of the undercarriage. The reinforced landing gear resulted in bulges on the landing gear door, to accommodate the larger tires, and a relocation of the landing gear lights to the edge of the landing gear doors.



AN/AAQ-13 Navigation Pod Mechanisation



The **AN/AAQ-13 navigation** pod provides high-speed penetration and precision attack on tactical targets at night and in adverse weather. The navigation pod also contains a terrain-following radar and a fixed infrared sensor, which provides a visual cue and input to the aircraft's flight control system, enabling it to maintain a preselected altitude above the terrain and avoid obstacles. This sensor displays an infrared image of the terrain in front of the aircraft, to the pilot, on a head-up display. The navigation pod enables the pilot to fly along the general contour of the terrain at high speed, using mountains, valleys and the cover of darkness to avoid detection. The pod houses the first wide-field, forward-looking infrared navigation system for Air Force air-superiority fighters.

The main sub-systems of the navigation pod are a Texas Instruments Ku-band terrain-following radar (AN/APN-237A), a wide field-of-view (WFOV) forward-looking infra-red sensor, and the necessary computers and power supplies.
The FLIR has a 28 degrees field-of-view in azimuth and 21 degrees in elevation. The resulting images are superimposed on the outside scenery by projecting them on the HUD. The image is grainy, but the sense of depth is good enough to fly by in total darkness or the smoke of a battlefield. Rain, fog, or smoke however, degrade the performance of the system, since infra-red energy is greatly absorbed by aerosols or water vapour.

The AN/AAQ navigation Pod (although not fully implemented within SP3) greatly enhances the aircrafts all weather low-level capability, here is a guide on its use and limitations.

AN/AAQ-13 Navigation Pod Power On

Firstly the Navigation Pod which houses the FLIR is mounted on the right fuselage hard point and requires powering up before use, by means of the left/right hard point power on/off switches figure 1.

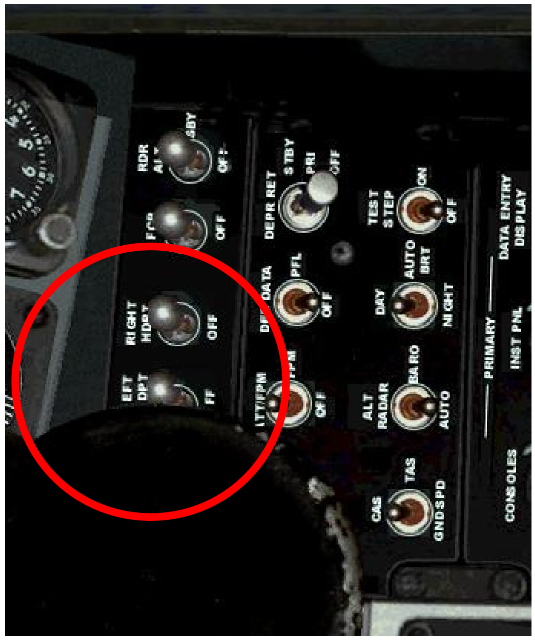


Fig 1

Appling power to the Navigation Pod isn't entirely necessary as this isn't correctly modelled within SP3, it will work even if it isn't activated. Realistically the Pod requires power so that the environmental unit contained inside the unit can lower/raise the temperature to operating conditions to enable the FLIR to differentiate between hot and cold.

AN/AAQ-13 Navigation Pod FLIR

It is important to note that its position on the fuselage being below that of the pilot provides a FOV, which is below that generally seen by the pilot. See figure 2. And thus the image imposed upon the HUD may require some alignment so that it corresponds with the image of the outside world as seen by the pilot.

Fig 2

Accessing the FLIR page on a MFD will enable you to align the FLIR image with your FOV.

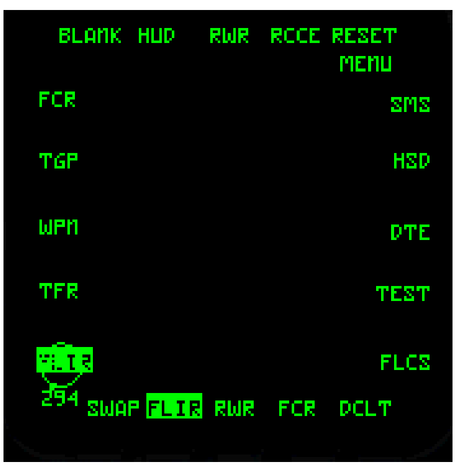
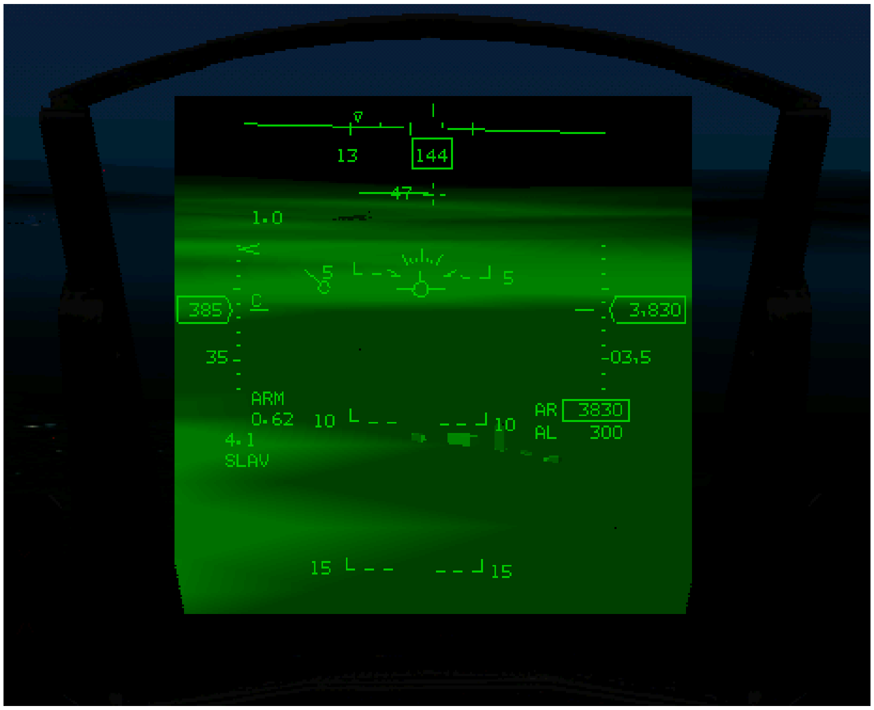


Fig 2a Fig 2b

The Page shown above, figure 2a, is the main menu page; here you will be able to access the FLIR, OSB 16. The FLIR page, figure 2b, is showing the FLIR off, it needs to be activated (shift-H) before any alignment can be made.



Now you be able to see the FLIR image gathered from the Pod superimposed over the HUD and the FLIR page on the MFD will now display some options, which will allow you to bring into line the Pods FOV with that of yours as seen through the HUD.

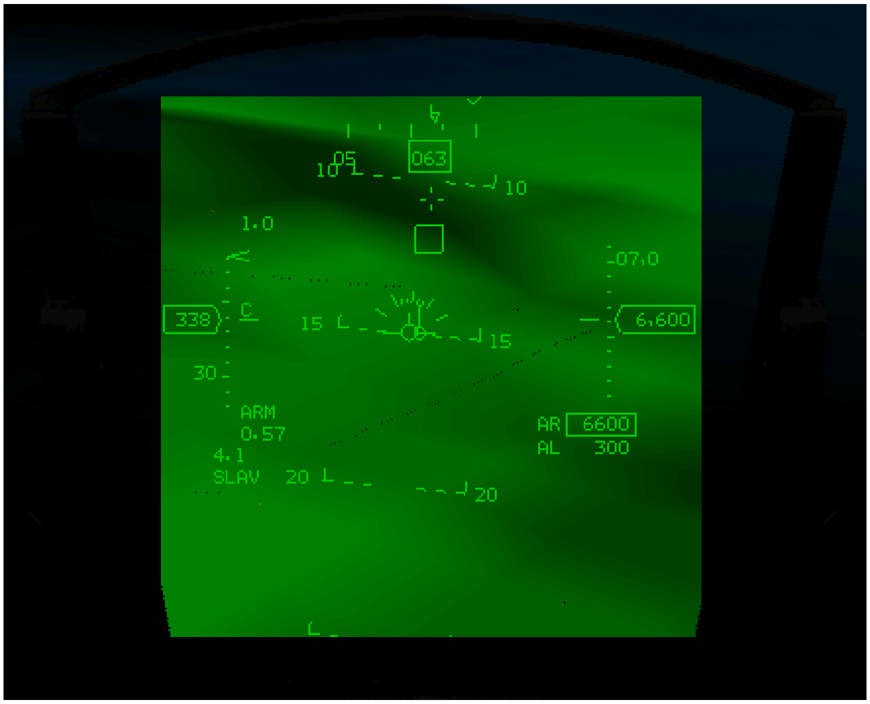
The **Dec Fov** OSB 20 & **Exp Fov** OSB 6 commands will allow you to expand (magnify) or decrease the image displayed. The **Dec Pitch** OSB 19 & **Inc Pitch** OSB 7 will move the FOV either up or down in the HUD, these are of most use when alignment is necessary. The corresponding values for these adjustments are also displayed on this page. Using this function you can reposition the FOV of the Pod to view below and to the front of the aircraft see figure 3. This can be useful; allowing you to scan for hot targets whilst maintaining level flight, even at high altitude, as the image can be expanded considerably. Using the keystrokes for theses OSB commands you could program a rotary on the HOTAS to pitch up and down, or to “snapshot” from forward view to a view 30° nose down and back again.

Fig 3

Now that we have aligned the Image displayed by the Navigation Pod with that of ours lets look at some of its uses and limitations. FLIR is mainly used to facilitate the pilot so that he/she can see directly to the front of the aircraft at night and has partial use under conditions of poor visibility; it can be used in conjunction with NVG's to enhance the all weather capability by allowing the recognition of hot targets at night or when visibility is reduced.

Figure 4 is an image using the FLIR at night; here columns of vehicles made hot by their engines and exhausts are clearly visible displayed as "Black Hot" i.e. the hot areas are shown as dark or black regions.

Compare this to figure 5, which is the same representation this time using only NVG's. Now the vehicles become much harder to spot using this night vision equipment alone which is only engineered to enhance available light. Both the FLIR and NVG's are compatible and can be used simultaneously.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AL 300

Fig 4


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6,600
ARM
0.57
4.1
SLAV
AR 6600
AL 300

Fig 5

AN/AAQ-13 Navigation Pod FLIR Limitations

FLIR has limited use during periods of low visibility and poor weather as cloud and other weather conditions can disrupt the IR picture, also man made obscurants such as smoke, fire and decoys can prevent the use of FLIR. Figures 6 & 7.

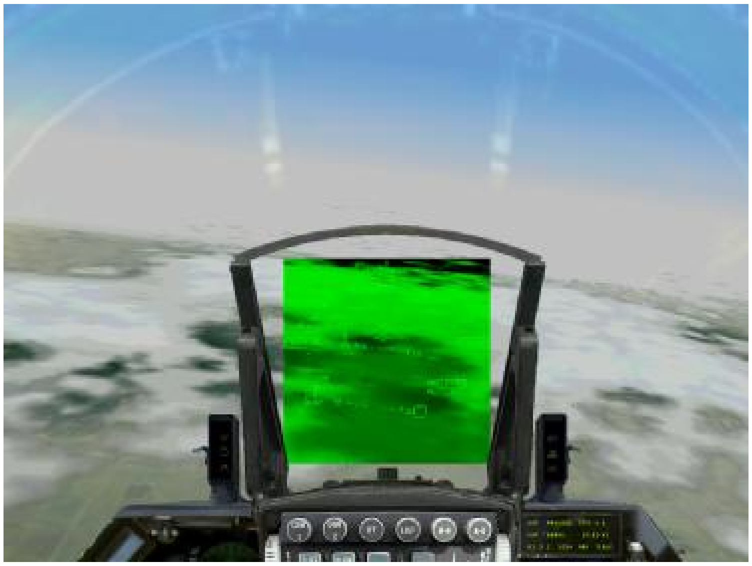


Fig 6

Fig 7

In this case it would be necessary to descend below the weather or cloud base in order to distinguish hot targets, figure 8.

Fig 8

AN/AAQ-13 Navigation Pod Terrain Following Radar

The TFR uses advanced signal processing to provide a wide azimuth coverage, which in turn allows more violent manoeuvring of the carrier aircraft. This is because the system can provide directional inputs to the pilot or the flight control computer, whereas older systems only provided pitch-up commands.
The TFR system is linked directly to the F-16's autopilot. The system uses airspeed, aircraft angle of attack, radar altimeter altitude, and data from its own signal return to ensure that the aircraft flies at the proper altitude.
The TFR significantly enhances the aircraft's chances to survive on the modern battlefield, since it not only allows the pilot to automatically avoid the terrain but also enables to evade air defence systems by manoeuvring in the horizontal plane. The radar can be linked directly to the F-16's autopilot to automatically maintain a preset altitude down to 100 feet while flying over virtually any kind of terrain. It has five modes five modes: Normal, Weather, ECCM, Low Probability of Intercept (LPI), and Very Low Clearance (VLC).

Figure 9 shows the main menu page; from here you are able to access the TFR display, OSB 17.

Fig 9

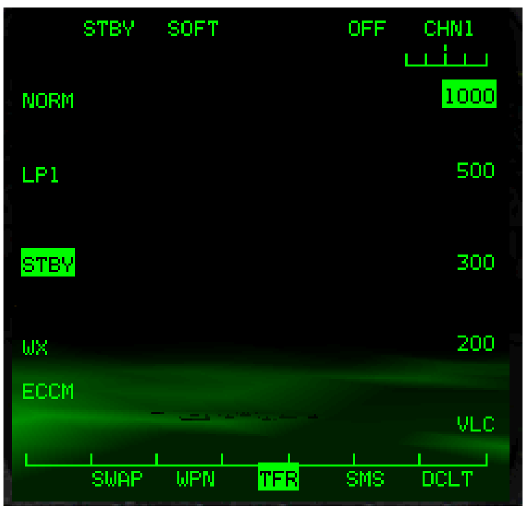


Figure 10 shows the TFR display. The Terrain Following Radar is displayed, controlled and set up from this page.

Fig 10

OSB 1 STBY	Current mode
OSB 2 SOFT	Ride type (SOFT/MED/HARD)
OSB 4 OFF	Toggle ON/OFF to enable or disable the TFR
OSB 5 CHN 1	Set current radar channel (N/I)
OSB 6 1000	Set 1000ft Terrain clearance
OSB 7 500	Set 500ft Terrain clearance
OSB 8 300	Set 300ft Terrain clearance
OSB 9 200	Set 200ft Terrain clearance
OSB 10 VLC	Set Very Low Clearance
OSB 16 ECCM	Emission Control Mode (N/I)
OSB 17 WX	Weather Mode Settings (N/I)
OSB 18 STBY	Select standby mode
OSB 19 LPI	Low probability of intercept mode
OSB 20 NORM	Selects Normal Mode

See Appendix B OSB locations

AN/AAQ-13 Navigation Pod TFR Operation

To activate the TFR after first accessing the TFR page on a MFD first select the desired ground clearance using the OSB's, which correspond to 1000,500,300, and 200ft VLC is used over extremely flat land or over sea.

Next decide on the ride type, OSB2, SOFT/MED/HARD, this determines how many G's the autopilot is allowed to pull when following the terrain, with respect to how strongly the aircraft the will pitch up and down when the TFR is active. After that select, either NORM, OSB 20 or LPI, OSB 19, dependent on the tactical situation. Setting LPI will ensure that the TFR will scan forward of the aircraft and less often, where as NORM will result in the TFR operating in its standard mode with the TFR scanning equally to all sectors.

All that then remains is to toggle the TFR to ON OSB 4. The autopilot will engage (green autopilot ACTIVE indicator to confirm autopilot operating), the aircraft will pitch nose down, the degree of pitch will vary dependent upon altitude and ride type selected. This action is called the "Let Down"

At this point the pilot should remain hands on the controls in the event of a TFR failure, or that the TFR should pitch too aggressively down with a high airspeed from which the aircraft is unable to recover. The TFR can be overridden at any point during flight by use of the AP Override paddle on the HOTAS (see Appendix C). Whilst this is held in the pilot has control but on release the TFR will recommence terrain avoidance on the current heading at the chosen altitude.

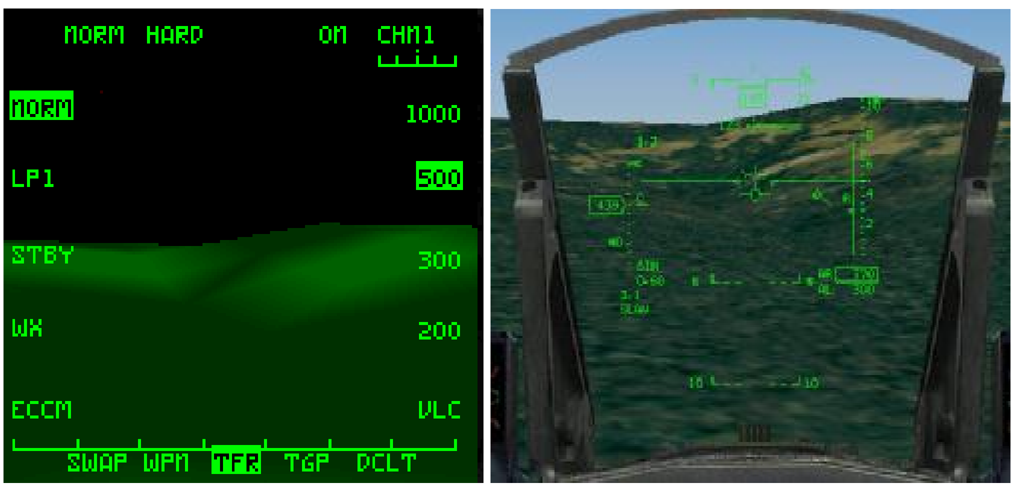
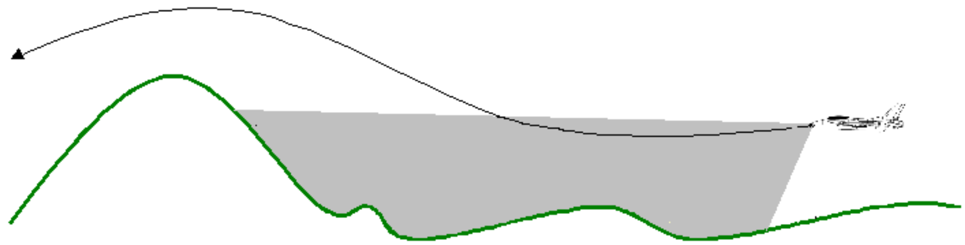


Fig 11

The image displayed (figure 11) will be similar to that projected onto the HUD by the FLIR and is to be closely monitored, particularly at night in case of TFR failure.



Fly ups will occur when the TFR detects a breach in the parameters set in order to maintain the desired ground clearance. When this happens FLY UP will be displayed on both the HUD and MFD and the autopilot should command a pitch up demand. Figure 12. The TFR will function regardless of the position of the HDG SEL and ATT HOLD switches which control the other functions of the autopilot i.e. the upon activation of the TFR the autopilot will continue on the aircrafts present heading and is not dependent on the position of the HDG SEL switch. To physically change the heading of the aircraft the pilot must regain control by way of the AP Override paddle or disconnecting the TFR before turning to the new heading.

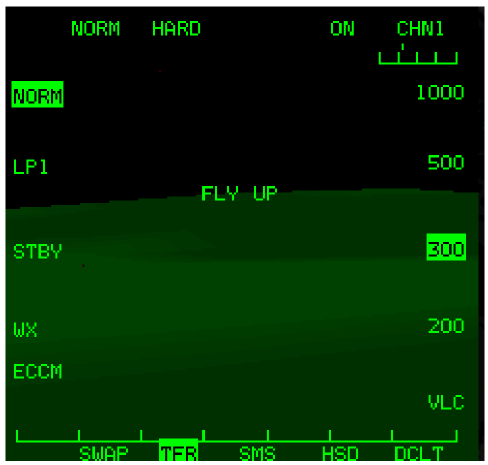


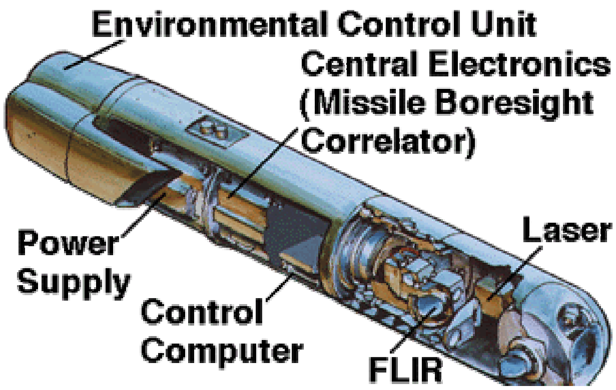
Fig 12

To disconnect the TFR toggle to OFF, OSB 4, regain control and gain altitude especially if extremely low-level flight has been undertaken.

It is important to remember that when the RF Switch is set the SILENT all radar emissions will be silenced, no radar, RALT or TFR. The system will indicate a TF failure and generate a TF FAIL light and WARN indication. Should this happen during TFR operation the TFR will disconnect and you will have to regain control to maintain level flight.

As well as the fault and warning lights, you will also see an indication to show that the autopilot has disengaged in the way of the default amber STBY light.

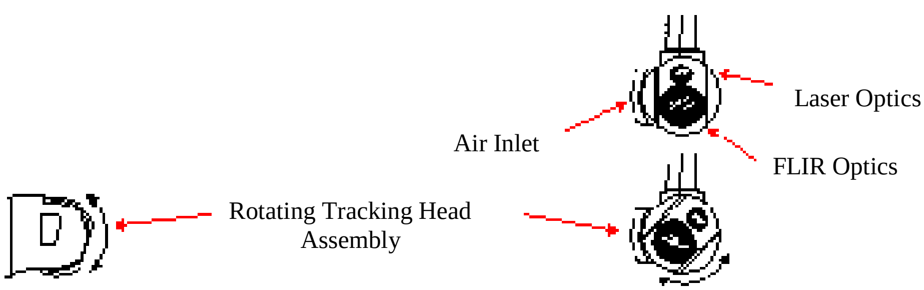
AN/AAQ-14 Targeting Pod Mechanisation



The **AN/AAQ-14 targeting** pod contains a high-resolution, forward-looking infrared sensor (which displays an infrared image of the target to the pilot), a laser designator-rangefinder for precise delivery of laser-guided munitions. The designator is a four-digit PRF-coded laser that can designate for its own weapons or for other acquisition devices or munitions. Main sub-systems of the targeting pod are another FLIR and a laser designator/rangefinder. Both are housed in the movable nose section of the AN/AAQ-14, and are stabilized by a stabilization system which compensates for aircraft movement and vibration. The FLIR that is installed in a two-axis turret operates in two modes: a wide field-of-view (6x6 degrees) for target acquisition or a narrow one (1.7x1.7 degrees) for zooming in.

These features simplify the functions of target detection, recognition and attack and permit pilots of single-seat fighters to attack targets with precision-guided weapons on a single pass.

When LANTIRN is not in operation, the turret or tracking head assembly is turned inwards so that the sensors are not exposed to the elements.



The AN/AAQ –14 Targeting Pod is now almost correctly modelled within SP3 and provides a greatly enhanced precision strike capability, here is a guide on its use and functions.

AN/AAQ-14 Targeting Pod Power On

The Targeting Pod or TGP is mounted on the left fuselage and requires powering up before use; by means of the left/right hard point power on/off switches figure 1.

Fig 1

Figure 2 shows the main menu page selected on either the left or right MFD, from this using OSB 19 you will be able to select the TGP page figure 3, shown here just before the TGP has been powered up.

Fig 2

Fig 3

After switching on the TGP the TGP Page will show NOT TIMED OUT, figure 4, for a period of 7-15 minutes. This is to allow the environmental control unit in the TGP to adjust the temperature and cool the necessary components to operating temperature before and during use. It is important to ensure that the TGP is powered up before take off or as part of a fence-in check to make certain that the TGP is ready for use.

Fig 4

After the TGP has cooled sufficiently it will activate and now become functional, figure 5. There is a substantial amount of information displayed on the TGP page, which will change, dependent upon use. The information immediately important is shown in figure 5.

AN/AAQ-14 Targeting Pod Display Symbols

FOV Indicator

RALT information is displayed if this is enabled

Colour scale indicator (N/I)

Toggles between white and black hot (N/I)

Cross Hairs with NARO FOV box

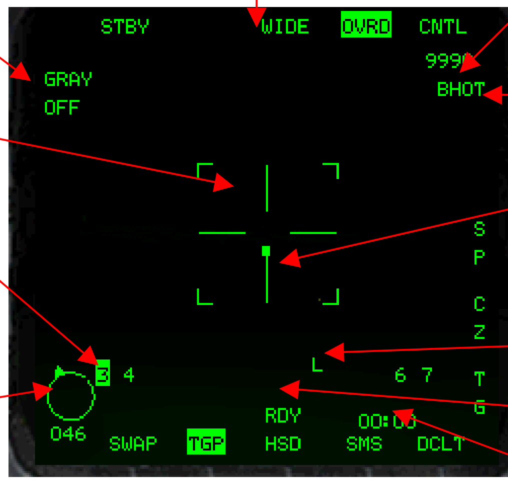
Pointing Dot indicates which direction TGP is pointing relative to the nose of the aircraft see figure 5a

Indicates currently Selected station with ordinance for that type of weapon

L Indicates Laser is currently armed

Bullseye Indicator dependent on format selected

Weapon Ready Indicator



Countdown to impact timer

Fig 5

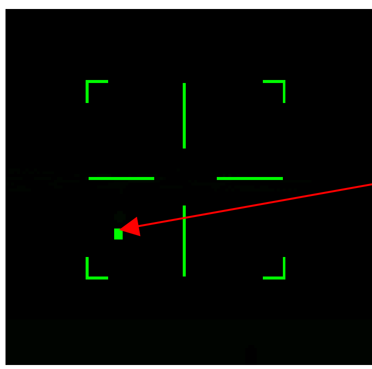


Fig 5a

The pointing dot rotates around the display to show the direction the tracking head assembly is looking, it is an aid to orientate you. It is easy to loose track of where the target is relative to your flight path and prevents you from tracking a target which may become out of gimbal i.e. the TGP will no longer be able to see the target. Here it is looking to the left of the aircraft and slightly nose down.

Fig 6

Before the TGP can be used for the purpose of delivering precision guided ordinance the laser must be armed so that it will fire to guide the weapon. This is done by firstly setting the Master Arm switch to ARM (the TGP will not function at all unless the Master Arm is set to either ARM or SIM, and then the Laser Arm to ARM, figure 6. As well as a L displayed in the HUD when in A-G Master mode, figure 7, an L will also be present on the TGP display to indicate the laser has been armed, and the TGP with consent, now has the ability to fire the laser at the selected time after weapon release, also manual lasing is now possible.

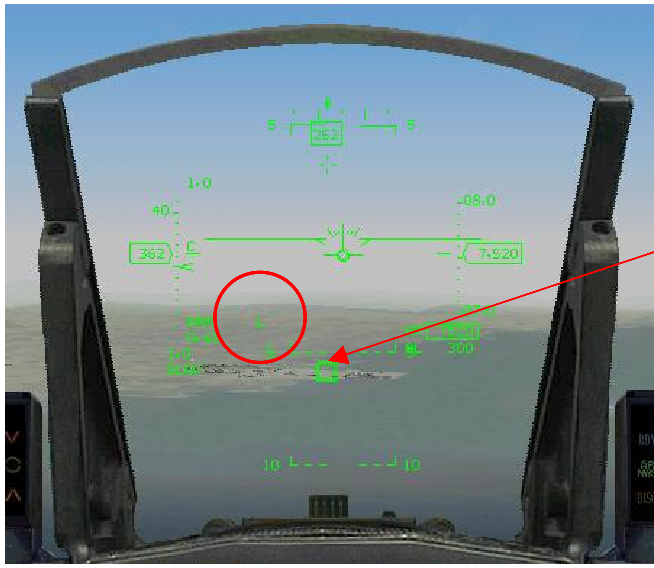


Fig 7

AN/AAQ-14 Targeting Pod Operation

To begin with the TGP is always slaved to the Ground Radar Cursors. With the ground Radar in STP mode the tracking head assembly will look at the location of the selected STP, this is useful as it ensures that the TGP is looking in the right direction with respect to pre-planned targets, which may be marked by a STP. With the Ground Radar in SP (snowplow) mode the tracking head assembly will still be slaved to the radar cursors and look in their direction. A target designator box will be displayed in the HUD, which serves as a visual reference to ensure the tracker head assembly is looking in the required direction.

After expanding the Ground Radars FOV if necessary and selecting the correct target, designating a ground radar contact ground stabilises the tracking head assembly and points the tracking head assembly at the designated target, the TGP display then becomes the SOI indicated in the usual format, figure 8, and is able to be slewed using the Radar Cursor/Enable Switch (see Appendix C). You can also choose without designating a radar contact to transfer the SOI over to the TGP (move the DMS on the HOTAS to the rear/down position which shifts the SOI to the next MFD if you have both the FCR and TGP showing on both left and right MFD's, see Appendix A and Appendix C), you are then able to slew the TGP around with the radar cursors following. It is important to note that only the image displayed on the MFD by the TGP will move during slewing, the cross hairs will remain fixed centrally on the display.

Fig 8

Transferring the SOI to the TGP without first designating a radar contact using the Ground Radar will require that the TGP is ground stabilised to prevent the TGP from slewing across the target area, as the TGP slew speed is determined by the Ground Radar cursors, and as such makes it difficult to position the pointing cross over the desired target. Ground stabilising the TGP will make the tracking head assembly move at significantly reduced speed. With the tracking head assembly pointing in the area of the target push the TMS on the HOTAS up, if you are close to the target or another object it may jump and lock straight away, if this happens and it is not the required target TMS down to return the TGP to its previous state. After ground stabilisation the TGP display will change, figure 9.

Fig 9

Also after ground radar designating or ground stabilisation CCRP steering cues will now be displayed in the HUD. Figure 10.

Fig 10

OSB 8 selects SP (Snowplow) on the TGP display and forces the TGP to ground stabilise without the risk of locking on to an unwanted target, figure 11, but unlike designating a target it will not automatically select the TGP as the SOI, you will have to transfer the SOI using the DMS. In this mode you will still be able lock and unlock targets, and slew the tracking head assembly around independently of the Ground Radar cursors.

SP Highlighted to indicated this mode. SOI has also been transferred to this display Using the DMS

Fig 11

OSB 9 CZ is a cross hair zero function. Depressing OSB 9 after ground radar designation or ground stabilisation will reset the tracking head assembly to the look in the direction of the ground radar cursors.

AN/AAQ-14 Targeting Pod Expanding the FOV

Fig 12a

Using the Pinkie Switch on the HOTAS or OSB 3 you will be able to expand the FOV of the TGP, the first and default FOV is WIDE which has a FOV of 6° shown in figure 12a.

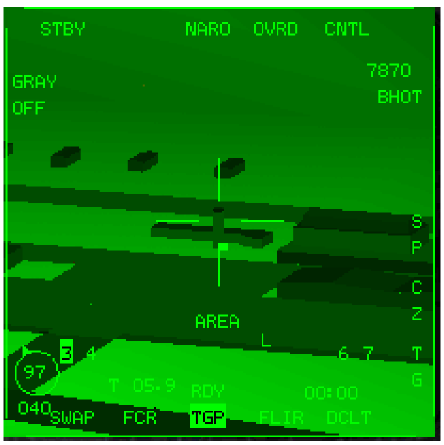


Fig 12b

The next is NARO (short for narrow), which has a FOV of 1.7°, figure 12b. Which will expand the FOV to display the area enclosed within the narrow FOV box, shown in the WIDE FOV.

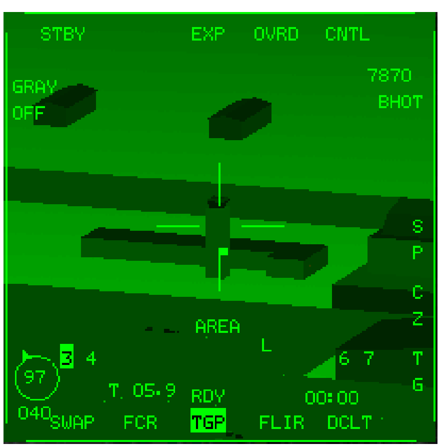


Fig 12c

The third is EXP (short for expanded), which will further expand the FOV to a ratio of 2:1 over NARO, to enable better target selection and identification. Figure 12c.

AN/AAQ-14 Targeting Pod Designate

After slewing the TGP display so that the cross hairs are on the target push the TMS on the HOTAS to the up position to designate. The TGP display will change now to indicate that the TGP has locked onto the target, figure 13. Dependent on range and aspect the TGP may not lock straight away, it may require several attempts.

AREA cue changes to POINT and a tracking box is placed over the target

Fig 13

AN/AAQ-14 Targeting Pod Weapon Release

The FCC will compute a release solution if it is able to. It will only display release cues if the LGB is capable of reaching the target following a ballistic trajectory i.e. it will necessitate the same requirements initially as a free fall dumb bomb of the same weight, figure 14. This is essential as LGB's are guided, not powered and they need to be able to reach the target area using energy imparted on them by the delivering aircraft.

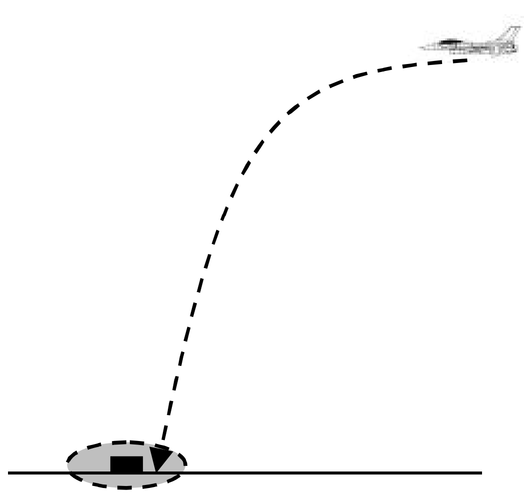


Fig 14

After weapon release the TGP display will change to show a countdown to impact timer, presently showing 00:33 seconds to impact. Figure 15.

Fig 15

The weapon will follow a ballistic path until it is terminally guided by the TGP firing its laser, which it does at a predetermined time before impact. The default setting is 8 seconds but this can be changed through the LASER page in the DED using the ICP up to a maximum of 176 seconds. If the LGB detects reflected laser energy to soon due to the laser being fired too early during a loft or toss delivery the guidance unit attached to the bomb may commence guidance and start to attempt to steer the LGB onto the target, this may result in the LGB being pulled down below a ballistic trajectory which would be essential in order for it to reach the target, meaning a loss of inertial energy for the weapon to a degree that it may drop short and miss the target. For a low-level delivery of LGB’s the minimum altitude should allow for a terminal guidance of about 11 seconds TOF. Manual lasing will override any auto lasing the TGP is programmed to carry out. Once manual lasing has commenced it must be carried out until impact, auto lasing will not recommence once manual lasing is underway. Holding down the trigger at the second detent on the HOTAS preforms manual lasing.

Once the timer reaches the moment to commence auto lasing and if the laser arm is set to arm, the TGP will fire the laser and continue until impact, the L in both the HUD and the TGP display will flash indicating that the laser is now firing. The range estimation is now accurate as the TGP is now using an active laser range finder; the T changing to an L indicates this. Figure 16

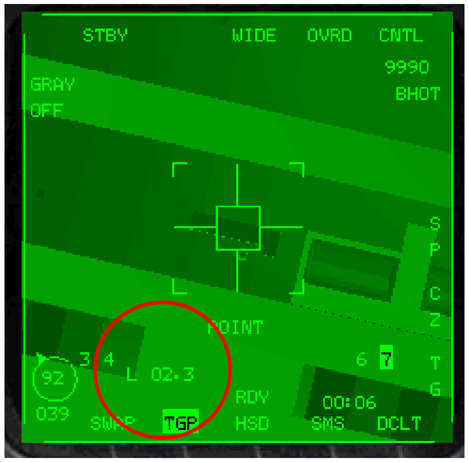
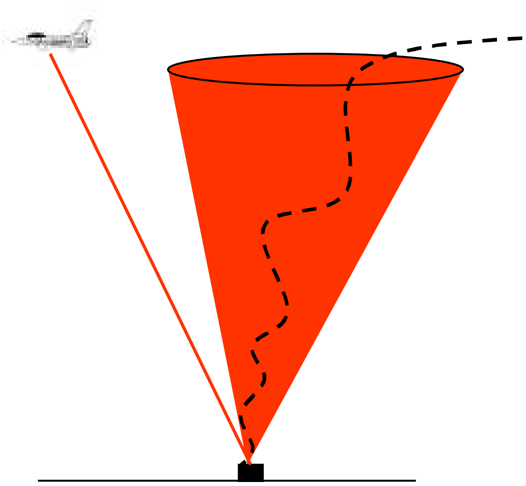


Fig 16



Laser energy will be reflected from the point at which it strikes the target; this will form a cone known as the laser basket. The initial ballistic flight path of the LGB will place it a position where it will be within the laser basket at the time the laser fires. Once the seeker head of the LGB detects this reflected energy it will guide or steer the LGB in an attempt to remain in the bounds of the basket, down to the target. As the cone narrows the closer it is to the target, so the LGB will become more precise, figure 17.

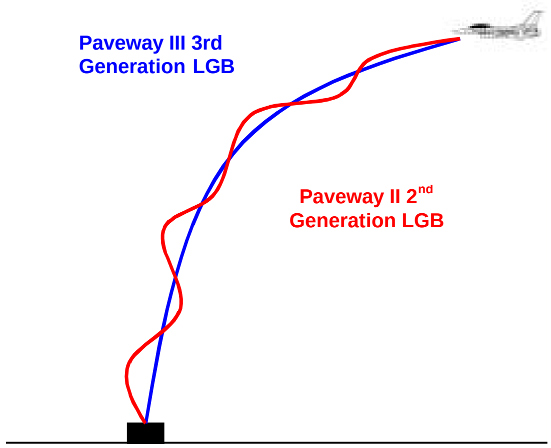
Fig 17

Violent manoeuvring is not advised during the weapons TOF as this may result in the TGP losing its lock on the target, whilst level flight is preferable a toss or loft delivery profile is possible with careful flight path analysis and deployment needed to ensure that the TGP has LOS with the target during the weapons TOF. Tables detailing TOF for LGB can be found in the RP 5 user manual (tables 8-11).

After impact the TGP will remain locked on to the target until a point where it can no longer see it i.e. it reaches it’s gimbal limitations, or TMS down which will remove the TGP lock from the target whilst it remains ground stabilised, a second TMS down will return the TGP to slave mode i.e. the tracking head assembly will follow the ground radar cursors.

AN/AAQ-14 Targeting Pod Accuracy

Designating or locking the target is not necessary as long as you hold the targeting cross over the target for the duration of the weapons TOF and make adjustments manually. The Paveway series of guided weapons can also be reassigned targets whilst in flight should you choose or decide the locked target is not the correct target. The AN/AAQ-14 targeting pod is accurate and capable up to 25,000 feet, at altitudes in excess of this the laser is prohibited from firing, to prevent electrical damage to the laser caused by atmospheric conditions and reduced air density. The TGP is still able to track, lock targets and release LGB's at altitudes above 25,000 feet, but the aircraft must descend and remain below 25,000 feet so that the laser will fire and guide the weapon. In the mid-1990s, Lockheed Martin developed a follow-on targeting pod, named "Sniper", with an updated diode-pumped laser target designator with greater reliability, raising the altitude limit to 40,000 feet. Third Generation Paveway III LGB's will continue on a ballistic flight path to the target, missing only marginally, even if the laser should stop firing during the weapons TOF or the aircraft turns in such a way so that the TGP can no longer see the target. This is because the fins or control surfaces of the Paveway III LGB move only slightly during guidance and it maintains a much smother trajectory. Where as the Second Generation of Paveway LGB's will more than likely miss quite significantly, this is due to the nature of the guidance system attached to the bomb, as the control surfaces of the LGB are continually moving from maximum to minimum deflection during its TOF, creating a snake like trajectory, this is referred to as a bang bang guidance type. The control system on a LGB is irreversible, once the LGB looses its lock its fins will remain at their last know deflection angle. Which will produce a gross over or under steer for Paveway II LGB's, unlike that of the Paveway III series of LGB where the movement of the control surfaces or fins is incremental.



AAQ-14 Targeting Pod Limitations

The TGP tracking head consists of a FLIR camera as well as a laser target designator. The laser target designator is correlated to the bore sight of the FLIR, and as such will aim wherever the TGP's FLIR is looking. The blind zones of the TGP tracker head assembly are illustrated in figure 19. This is the physical gimbal stop on the tracker head assembly. Under particular circumstances the tracker head may be unable to see the target, even thought the tracker head may be outside the blind zone. This may be dependent upon certain combinations of azimuth and elevation of the tracker head, which may cause the line of site to be obscured by parts of the fuselage or any external stores carried such as fuel tanks etc. Figure 18 shows the tracking head assemblies LOS to some extent obscured by a hard point still with remaining ordinance.

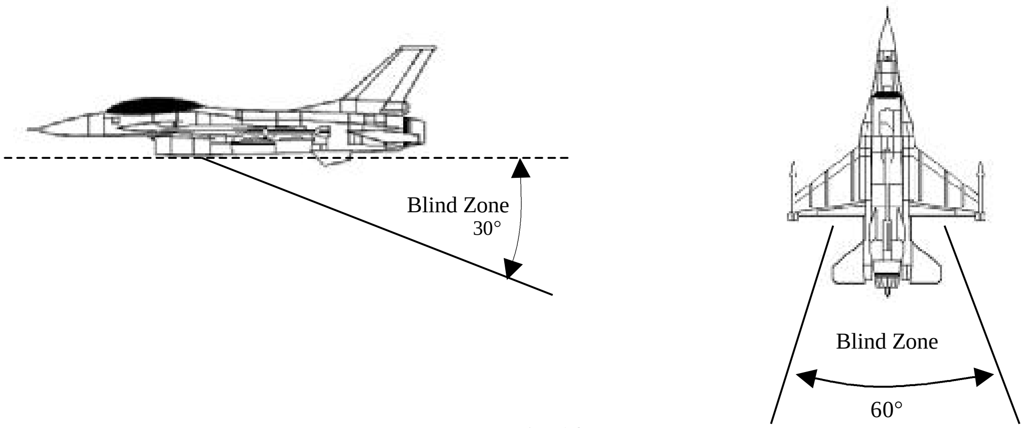


Fig 19

The laser whilst firing can be hindered by low or thick cloud, fog or other weather conditions, also smoke and debris from a previous attack all of which will cause back scatter and prevent reflected laser energy from guiding the weapon. These are considerations, which need to taken into account when planning a proposed attack profile and delivery.

Figure 20 shows a target area covered by low cloud, forcing a low level delivery below the cloud base. Figure 21 shows a target obscured by smoke and debris from a previous attack, both, which would make target identification very difficult.

Fig 20

Fig 21

Appendix A

System Set Up

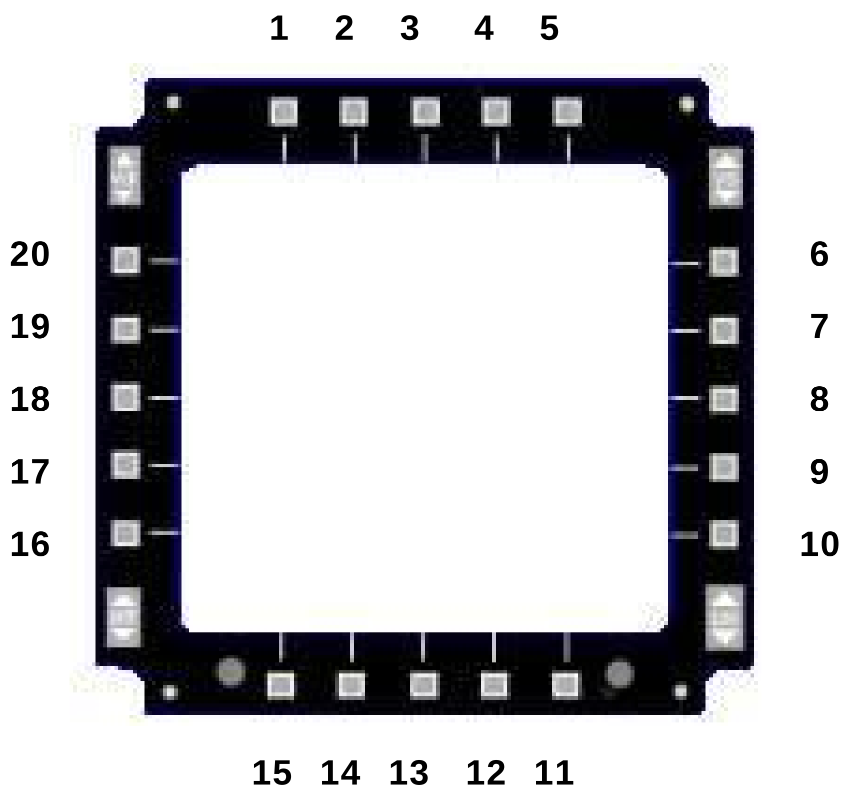
A recommended technique for setting master modes, using OSB's 12, 13 and 14, during LANTIRN operations.

MODE	LEFT MFD	RIGHT MFD
NAV	FCR TGP FLIR	SMS HSD TFR
A-G	FCR TGP FLIR	SMS WPN TFR
A-A	FCR RWR	SMS HSD TFR

The reasoning behind this set up is to have the FCR and TGP on the same MFD. This allows one DMS left to switch from FCR to TGP and the SOI will move as well. With the FCR and TGP on both MFD's it is very easy to loose track of the SOI. You should have the TFR displayed as much as possible; this MFD set up enforces that. The specific order on each MFD is not as important as priority. Ensure that one DMS left or right moves from the primary option to the secondary. If Mavericks are not loaded then the WPN page can be substituted for another. Obviously if there are only two options on the MFD, there isn't a problem. These settings can be saved using Key board commands Alt+C then S then loaded at any time using Alt+C then L.

Appendix B

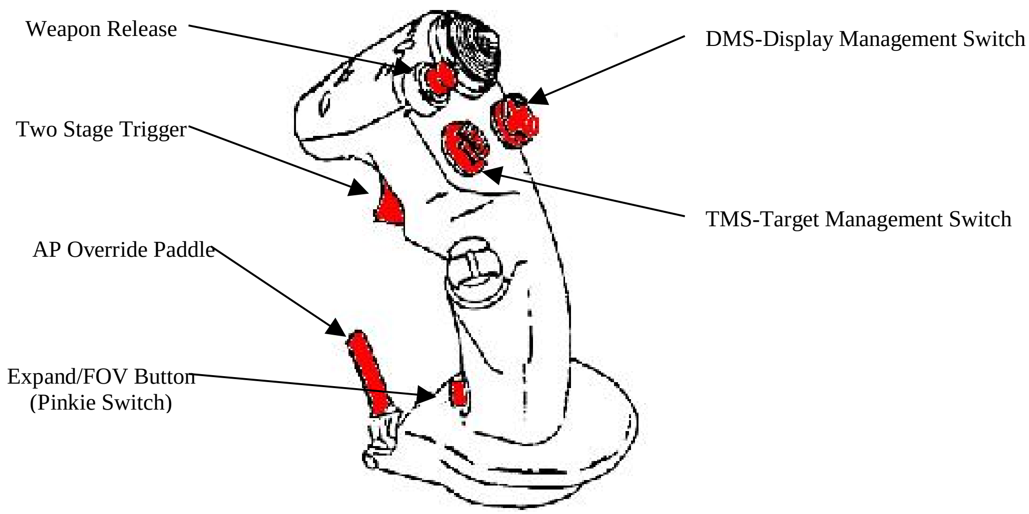
MDF Operation Select Button Locations



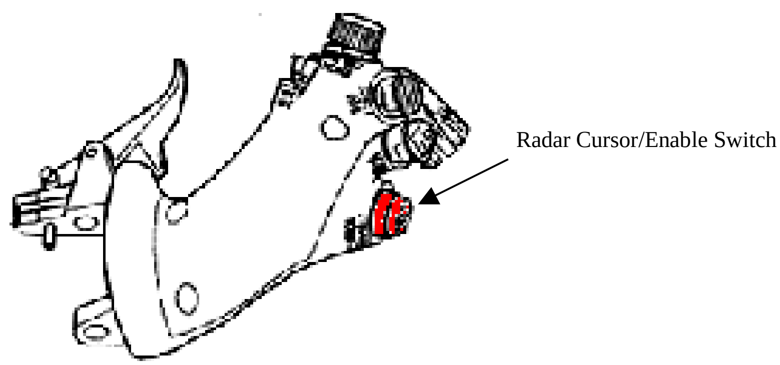
Appendix C

LANTIRN Associated HOTAS controls

FLCS Stick USAF Military (Typical)



TQS Throttle USAF Military (Typical)



Common Acronyms used in this document

CCRP	Computer Controlled Release Point
DED	Data Entry Display
DMS	Display Management Switch
FCC	Fire Control Computer
FCR	Fire Control Radar
FLIR	Forward Looking Infra-Red
FOV	Field Of View
HOTAS	Hands On Throttle And Stick
HUD	Head Up Display
ICP	Intergraded Control Panel (the main keypad console below the HUD)
LGB	Laser Guided Bomb
MFD	Multi Function Display
NVG	Night Vision Goggles
SOI	Sensor Of Interest
OSB	Option Select Buttons
STP	STeerPoint (waypoint)
TFR	Terrain Following Radar
TGP	Targeting Pod
TMS	Target Management Switch
TOF	Time Of Flight

References:

SP3 Manual
RP5 Manual
Falcon 4.0 User Manual
AN/APG-68 (V5) Operating Guide by Stephen"HotDogOne"French
F-16A/B MLU –The Pilots Guide
MCH 11-F 16 Vol5
Federation of American Scientist www.fas.org
Vipers in the Storm by Keith Rosenkranz

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