DIGITAL COMBAT SIMULATOR

F-15E

User Manual

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Manual for the F-15E Strike Eagle for DCS World

Written & designed by

BALTIC DRAGON

Special Thanks To:

Firesilver for proofreading and grammar corrections.

Techie | Nighthawk 2-1 - Nighthawk Squadron XO for aircraft history and introduction.

NOTE: this is an Early Access version of the manual and does not represent the final version of the product. Everything is subject to change. It may contain typos and omissions.

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SECTION 1

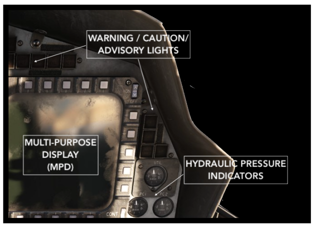
AIRCRAFT DESCRIPTION
AND
SYSTEMS

Manual Introduction

This manual attempts to create an easy to use, interactive document that is best viewed in electronic format (e.g PC, iPad or Phone) - it can also be printed and used as a reference manual.

Bookmarks

Throughout this manual, you will find many bookmarked sections allowing you to quickly navigate the manual's sections to find specific information, and also be able to find it later quickly without having to navigate entire sections.



As a rule, whenever a screen or part of the cockpit are described in this way, it is possible to click directly on the button / display etc. to which the arrow points to (or directly beneath the white text box in some cases). Doing so will immediately make the manual to jump to the specific system, for instance Hydraulic Pressure Indications in this case:

Hydraulic Pressure Indicators

1. Utility Hydraulic System Pressure Gauge monitors the operation of two pumps: left with pressure of 3000 psi and right with pressure of 2775 psi.

2. PC1 Hydraulic System Pressure Gauge. The PC1 pump operate at a pressure of 3000 psi.

3. PC2 Hydraulic System Pressure Gauge. The PC2 pump operate at a pressure of 3000 psi.

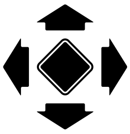
Pressing on the diagram in the description (i.e any part of the screenshot with the gauges) will return you back to the overview of the
front panel.

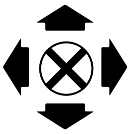
Furthermore, in sections that deal with several larger subsystems, at the beginning there will be an easy graphical presentation of later parts that one can easily jump to by clicking on them, like seen below:

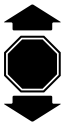


HOTAS Symbols

When describing the HOTAS functions, graphical representation of different types of switches is used for quick recognition of the button type. These are:


A four - way button (FWD - AFT - LEFT - RIGHT) with additional DOWN (press) function.

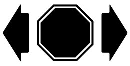

A four - way switch (FWD - AFT - LEFT - RIGHT) spring-loaded to center (neutral) position.


A three - way button (FWD - CTR - AFT) with center being a selection (so it does not need to be pressed).

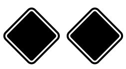

A two - way button (FWD - AFT) with center OFF or neutral position.

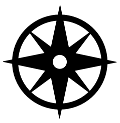

A two - way button (LEFT - RIGHT or FWD - AFT if mounted on the side of the stick / throttle) with center OFF / neutral position.


A two-way button with additional DOWN (press) function.


A three-way button (LEFT - CTR - RIGHT) with center being a selection (so it does not need to be pressed)

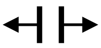

A button with only DOWN (press) function.


Trigger with two detents (half pressed and then fully pressed)


A multidirectional switch that includes a depressible action position, used for slewing the cursor / seeker head on the MPCD or MPD.


A rotary knob.


Acquisition Symbol (Acq Sym)


Azimuth Bump

Additional Symbols

NOTE: A note containing additional useful information or things which should be memorised.

Red symbols indicate that this system, button or function is not used in this simulation of the F-15E.

Black symbols indicate that this system, button or function is not simulated within DCS, and therefore cannot be used. These features will likely not be added at a later stage due to complexity.

Yellow symbols indicate that the system, button or function is not available or functional in the current version of the simulated F-15E, but are likely to be added at a later stage.

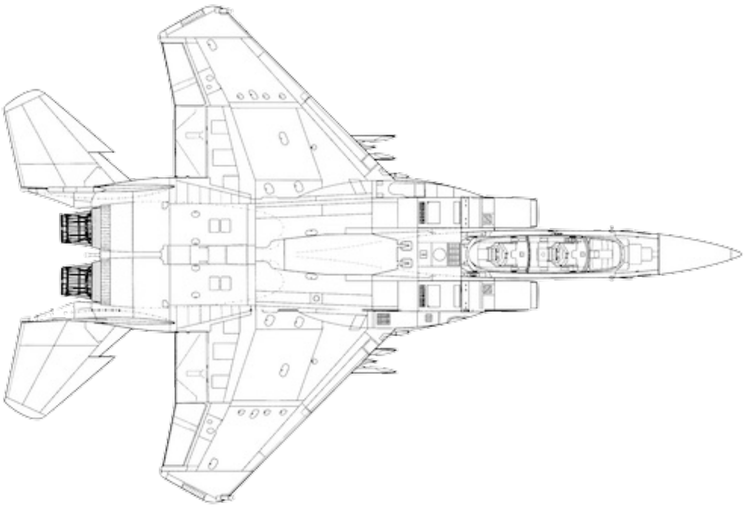
A video symbol will contain a link to a YouTube video with instructions or other information relevant for the given part of the manual.

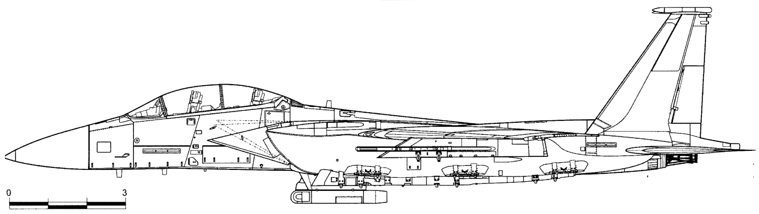
A checklist symbol will contain a link to relevant checklist available in the Appendixes at the end of the manual.

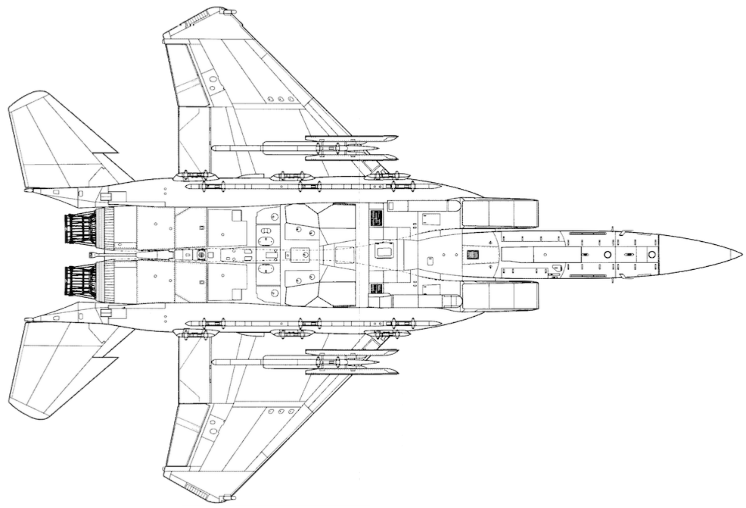
Click this symbol to return to the parent chapter / main description in the manual.

CHAPTER 1: INTRODUCTION

1.1 AIRCRAFT DESCRIPTION







CREW
2 (pilot and WSO)

LENGTH
63 ft 9.6 in (19.446 m)

WINGSPAN
42 ft 9.6 in (13.045 m)

HEIGHT
18 ft 6 in (5.64 m)

EMPTY WEIGHT
31 700 lbs (14 379 kg)

MAX T/O WEIGHT
81 000 lbs (36 741 kg)

MAX SPEED (HIGH ALT)
1 434 kn (2 656 km/h)

MAX SPEED (LOW ALT)
782 kn (1 448 km/h)

COMBAT RANGE
687 NM (1 272 km)

SERVICE CEILING
60 000 ft (18 000 m)

RATE OF CLIMB
50 000 ft / min

POWER PLANT
2x P&W F100-PW-229
Dry thrust: 17 800 lbs each
AB thrust: 29 160 lbs each

THRUST TO WEIGHT
0.93

The F-15E Strike Eagle was initially developed by McDonnell Douglas, later taken over by Boeing. It is an all-weather multirole strike fighter built on the basis of the McDonnell Douglas F-15 Eagle in the 1980s.

Its main task was long-range, high-speed interdiction with self - escort capability. United States Air Force (USAF) F-15E Strike Eagles can be generally distinguished from other US Eagle variants by a tandem - seat cockpit, darker aircraft camouflage, as well as conformal fuel tanks (CFTs) mounted along the engine intakes and fuselage.

The F-15E is a high - performance, supersonic, all-weather dual role (air to air and interdiction) fighter.

1.2 AIRCRAFT HISTORY

Originally, the Strike Eagle was introduced by the USAF to replace the ageing F-4 Phantom II, which was in service since 1964. However, McDonnell Douglas started to work on air to ground version of their F-15A and C models with a thought of the need to find a substitute for the General Dynamics F-111, as well as the F-4s.

In 1978 the USAF initiated the Tactical All-Weather Requirement Study, which looked at McDonnell Douglas's proposal and other options such as the purchase of additional F-111Fs. The study recommended the F-15E as the USAF's future strike platform. In 1981 USAF announced the Enhanced Tactical Fighter program procurement aiming to indeed replace the F-111s, as envisaged by McDonnell Douglas. The main candidates presented by the industry were F-16XL by General Dynamics, F-15E and Panavia Tornado (although the latter due to lack of serious air to air capabilities, was never seriously considered).

First prototype, known as the Advanced Fighter Capability Demonstrator flew on 8 July 1980. Between 1981 and 1983 the modified F-15B that later was to become the -E variant logged more than 200 flights, validating 16 different weapons - carrying configurations. On 24 February 1984 the USAF finally chose the Strike Eagle, due to its lower development costs and two engine redundancy.

The first production F-15E was delivered to the 405th Tactical Training Wing at Luke Airforce Base in April 1988.

1.2.1 DESIGN

While the progenitor of the F-15E was designed purely for air superiority (in line with the known motto “not a pound for air to ground”) the designers quickly found out that the airframe was sturdy enough to also produce a potent ground attack platform, while retaining the exceptional air to air capabilities of the F-15C. This meant that the Strike Eagle not only was able to engage surface targets, but also had a significant self-escort ability. The back seat was equipped with multiple screens allowing the Weapons Systems Officer (WSO, pronounced “wizzo”) to work the air to ground avionics, as well as operate the radar, electronic warfare suites, weapons and moving map in order to navigate. Moreover, the back seater in the F-15E also has his own stick and throttle and can have full control over the aircraft. Moreover, the division of responsibilities between the front and back seat is much different than in other platforms and both crew members have control over 90% of Strike Eagle’s capabilities.

The F-15E carries the most air-to-ground weapons of any fighter aircraft in the USAF inventory. It is also armed with AIM-9 Sidewinders, AIM-7 Sparrows and AIM-120 AMRAAMs, retaining the counter-air capabilities of its Eagle lineage, being fully capable of Offensive-Counter-Air operations. Like the F-15C, it also carries an internally mounted General Electric M61A1 20 mm cannon with 500 rounds, which is effective against enemy aircraft and "soft" ground targets.

1.2.2 Operational History

First combat deployment of the F-15E was in 1990 in response to Iraq's invasion of Kuwait in August 1990 for Operation Desert Shield. The 336th Tactical Fighter Squadron flew first to Seeb Air Base in Oman and then together with 335th squadron relocated to Prince Sultan Air Base in Saudi Arabia, closer to Iraq's border. On 17 January 1991 the Strike Eagles spearheaded the attack with strikes on fixed Scud installations in western Iraq.

Famous USAF photo of F-15Es flying with F-15Cs and F-16s over burning Kuwaiti oil wells (source: Wikipedia)

F-15Es destroyed numerous enemy aircraft on the ground, as well as tanks and Scud launchers. They also undertook missions aimed at killing the Iraqi president Saddam Hussein. The only air to air kill was a Mi-24 helicopter with the use of a GBU-10 bomb. Strike Eagles engaged a MiG-29 in the opening night of the war, but failed to hit and destroy it.

Following Desert Storm, F-15Es took part in overseeing the two no-flight zones over Iraq. The most notable incident was when a flight witnessed attacks by Iraqi helicopters against a large group of Kurdish refugees at Chamchamal. With very restrictive ROE in place, the pilots performed several low high-speed passes very close to the Iraqi aircraft, creating severe wake turbulence, at the same time aiming lasers at their cockpits trying to blind their crews, which led to one of the Hinds to crash.

In 1998 during the operation Desert Fox the F-15Es debuted in their SEAD role, destroying an SA-3 site using GBU-12 bombs, and in the following weeks attacking other SAM sites near Mosul using guided bombs and AGM-130 missiles.

Simultaneously, the F-15E was heavily used in various Balkans conflicts. In 1993, the 492nd and 494th fighter squadrons deployed to Aviano Airbase, Italy to take part in Operation Deny Flight, a U.N. no fly zone over Bosnia and Herzegovina, flying over 2500 sorties together. As the situation escalated, they began striking missions, the first being a retaliatory strike on an SA-2 battery. With the advent of Operation Deliberate Force, strike missions became the norm for Strike Eagles based at Aviano. Targets for these missions were armor and logistics around Sarajevo, the Bosnian capital. This was soon followed up by Operation Allied Force, in which Aviano and RAF Lakenheath based Strike Eagles struck more strategic targets, such as SAMs and EWRs. They also conducted grueling 7.5-hour CAS missions, which, despite the Strike Eagle's large fuel tanks, consisted of at least 2 ariel refuelings. During this operation, hybrid loadouts (air to air and air to ground) became the norm.

Additionally, to counter mobile SAM systems like the SA-6, standoff weapons such as the AGM-130 were frequently carried and employed.

After the 9/11 terrorist attacks, Strike Eagles saw extensive use in Afghanistan. They were used non-stop from the opening night of the conflict to the very last day U.S. forces departed the country on August 30, 2021. During the air campaign, common targets included military facilities, terrorist training camps, supply depots, and portions of the Afghan mountain's extensive network of caves. These targets were serviced by GBU-15s and AGM-130s, and in the event of reinforced targets, GBU-24s and GBU-28s were used. Afghanistan proved to be a very low threat environment, and there was a shortage of targets within a few weeks of the air campaign. With the arrival of ground forces, the Strike Eagles transitioned to CAS missions. Loadouts for these missions consisted of mostly GBUs, with the occasional Mk-82 unguided bomb. During this time, the record for the longest fighter mission in history was set by the 391st Fighter Squadron: 15.5 hours, including 12 aerial refuelings. During battles such as Robert's Ridge, Strike Eagles demonstrated their CAS capabilities, dropping about 20 GBUs on Taliban positions, along with many strafing passes in support of Navy SEALs rescuing occupants of a downed Chinook helicopter. The Strike Eagles provided invaluable support to the SEALs. Additionally, after 9/11, Air National

Guard Strike Eagles have stood alert in the continental United States as part of Operation Noble Eagle.

By late 2002, Strike Eagles from the 336th fighter squadron were deployed to Al Udeid Airbase, Qatar. Strike Eagles were once again performing combat missions in Iraq, first under Operation Southern Watch, and later Operation Iraqi freedom. High profile missions include the destruction of the Baath Party HQ and an Air Defense Sector HQ on the same night by Strike Eagles carrying GBU-24s and GBU-10s respectively. A few months later, the 336th was joined by the 335th, and together conducted an air campaign to prepare the skies for large numbers of aircraft conducting strike missions, striking air defense, command and control, communication facilities, and airbases. During this phase, they attacked critical targets, such as the H3 airbase complex. Strike Eagles are credited with destroying 60% of the Iraqi Medina Republican Guard and 65 MiGs on the ground. During Operation Odyssey Dawn, 18 American Strike Eagles were deployed to participate in the conflict.

Strike Eagles have also played a critical role in the fight against ISIS. They were involved in September 23, 2014's joint strike against IS fighters, training compounds, headquarters and command and control facilities, storage facilities, a finance center, supply trucks, and armed vehicles in Syria. USAF Strike Eagles flew 37% of all USAF sorties between August 2014 and January 2015. A pair of Strike Eagles conducted a strike on Darnah, Libya on November 13th, 2015, killing Abu Nabil al-Anbari, the leader of ISIS Iraq and Levant Libya, along with many IS fighters. On June 8th and 17th, Strike Eagles shot down pro-Syrian regime drones near Al Tanf, Syria. The drones are believed to have been Shahed 129s and were engaged after they deployed weapons near coalition personnel. Another drone was shot down by a Strike Eagle on August 21, 2021 with an AIM-9X as the drone approached American forces in eastern Syria.

1.2.3 Foreign operators

Israel

Inducted: 1998
Number: 25

South Korea

Inducted: 2005
Number: 59

QATAR

Inducted: N/A
Number: 36 on order

Saudi Arabia

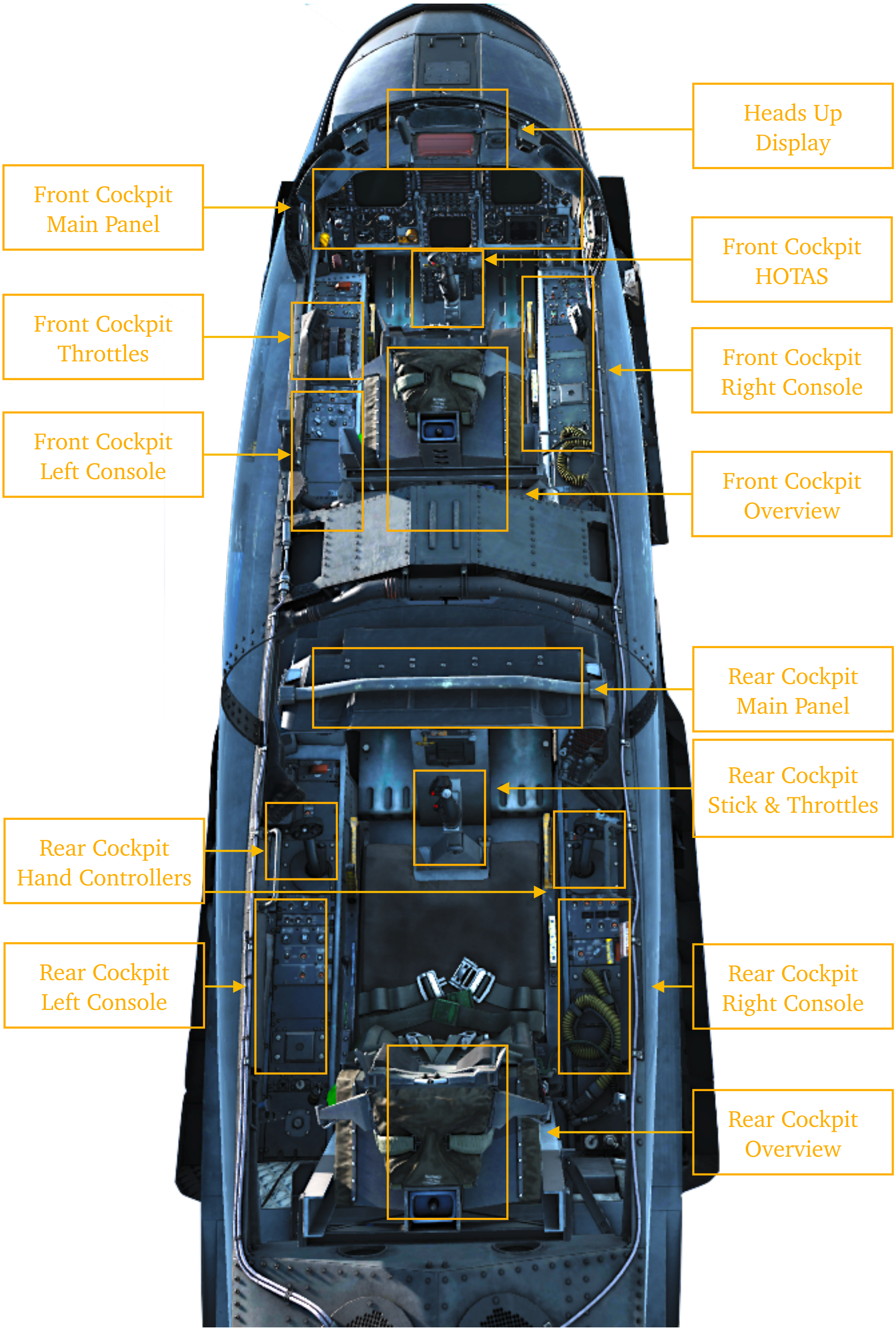
Inducted: 1996
Number: 70 -S/84 -SA on order

Singapore

Inducted: 2009
Number: 40

1.3 COCKPIT SHORTCUTS

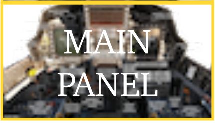
The picture below is designed to grant you quick access to relevant chapter or part of the manual. Simply click on the area that interest you.



CHAPTER 2: FRONT COCKPIT

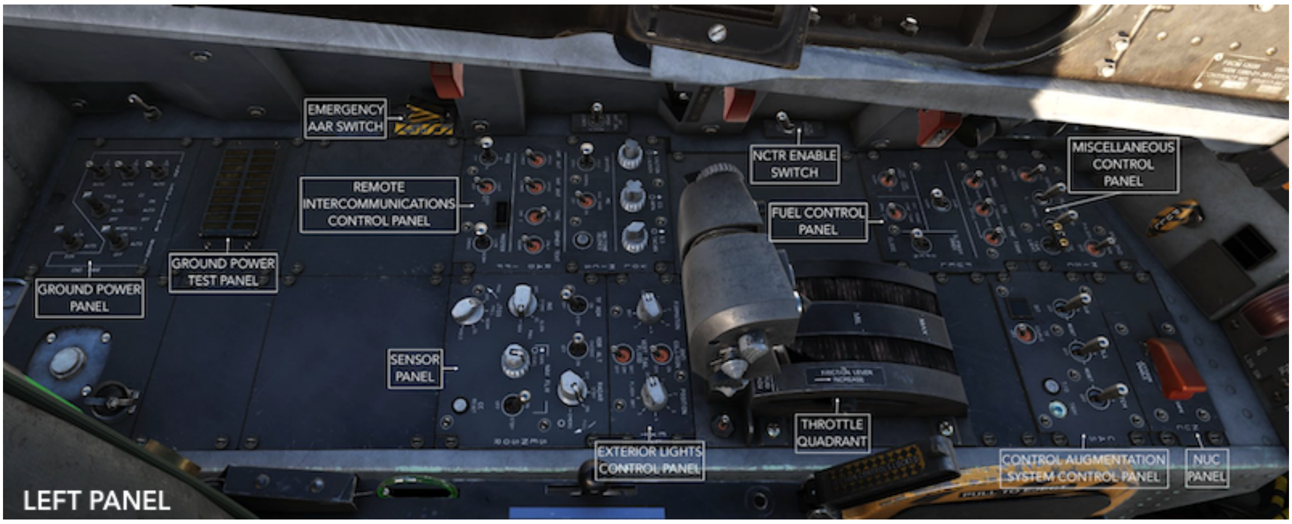
2.1 Front Cockpit Overview

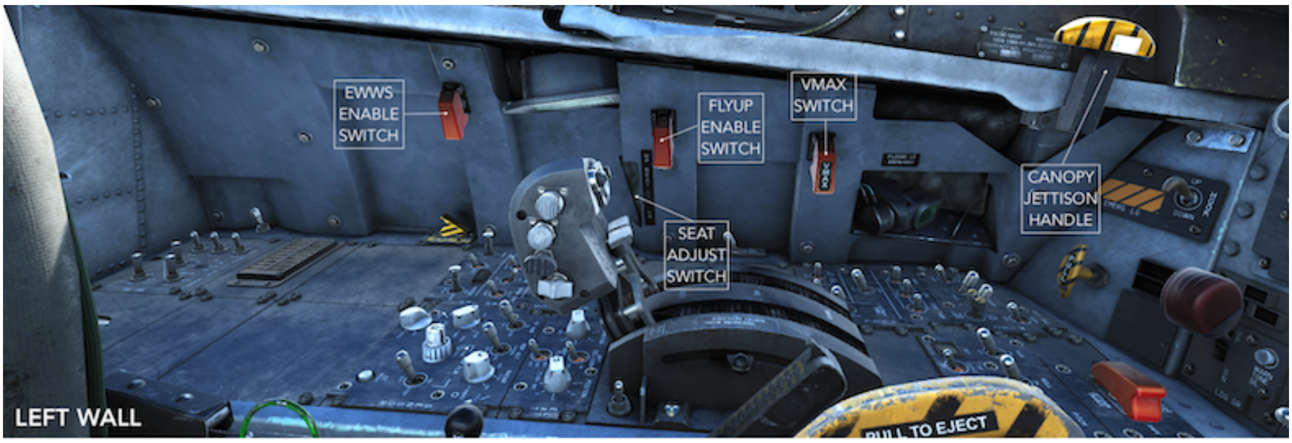
The cockpit of the F-15E is equipped with two seats: the front one for the pilot and the back one for the Weapons Systems Officer (or WSO). Both stations contain the flight stick and throttle, with additional controls in the back seat. Going from left to right, below is the overview of the front office.




2.2 Left console and wall overview

The left side of the front cockpit contains the throttle quadrant, together with external lights controls, sensor panel, control augmentation system, IFF and volume knobs, fuel switches, as well as ground power panel and annunciators. You can click at any of the panels below to move directly to the page containing a more in-depth description of each of the systems.



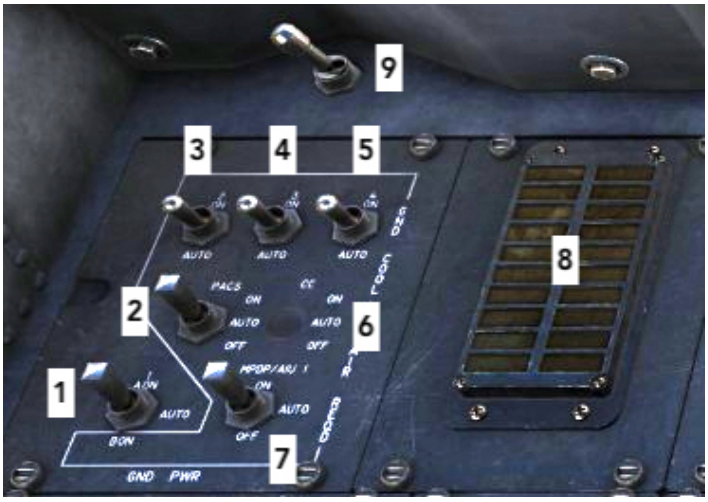


2.2.1 LEFT CONSOLE INSTRUMENTS AND SWITCHES

GROUND POWER PANEL

Consists of seven switches, each of them controlling a group of systems and / or instruments and preventing unnecessary operation. External electrical power can be connected to the aircraft and is governed by External Power Control Switch on the engine control panel.

In general, the following rule applies: if set to ON, the governed systems can be energized by external power; if set to AUTO, systems can only be energized by aircraft generator power.



1. Controls hydraulic pressure, fuel flow, engine monitor, fuel quantity indicator, flaps, speed brakes and AFCS. In position A, all systems except AFCS can be energised by external power. In position B, also AFCS can be energised.
2. Controls PACS. In OFF position, PACS is de-energized regardless of power source.
3. Controls AHRS, Standby Attitude Indicator, MAD and EGI (if equipped).
4. Controls ADC, EAIC, AOA, VVI, IBS and VTRS.
5. Controls ILSR, TACAN, RMR and DMS.
6. Controls the Central Computer (CC). In OFF position, CC is de-energized regardless of power source.
7. Controls the MPDP/A1U. In OFF position, MPDP/A1U is de-energized regardless of power source.
8. Ground maintenance diagnostic panel, a caution panel that has some of the display-only cautions working jointly with the Ground Power Panel switches.
9. Armament Safety Override Switch. Allows the use of jettison controls even when landing handle is in DOWN position.

EMERGENCY AIR TO AIR REFUELING SWITCH

It can be used to open the AAR slipway door by the means of pyrotechnic devices. However, that means that the door cannot be then closed in flight. However, if set to “CLOSE”, it will still restore the pressurization of the external fuel tank.

REMOTE INTERCOMMUNICATIONS CONTROL PANEL

Contains controls for the IFF transponder set, VHF, UHF and Intercom controls as well as volume knobs for different systems.

1. Mode 4 selector switch for the IFF. A enables mode 4/A reply, B enables mode 4/B reply, OUT disables all mode 4 replies.

2. Mode 4 reply switch. In LIGHT when the mode 4 system replies to valid interrogation, causes the REPLY light **(3)** to illuminate. In AUDIO REC allows audio tone and REPLY light to illuminate. OFF turns the system off.

3. REPLY light

4. IFF Master Switch. In LOW system operates in reduced sensitivity. In NORM full system sensitivity is enabled. EMERG enables response to interrogations in modes 1, 2, 3A, C and 4.

5. UHF Antenna Selector Switch. Chooses whether UPPER or LOWER antenna is used for UHF 1 radio transmissions. AUTO makes the UHF 1 radio to always choose the antenna with the stronger signal. UHF 2 radio uses only the lower antenna.

6. VHF Antenna Selector Switch. Chooses whether UPPER or LOWER antenna is used for VHF radio transmissions. Same as UHF.

7. Tone Selector Switch. Chooses which radio (UHF 1 or UHF 2) will be used to transmit the tone.

8. Cipher Text Selector Switch. In ONLY the radio can only receive the ciphered text and not clear text communications. In NORM both types are allowed.

9. Mode 4 Crypto Switch. Chooses between HOLD (stores the codes in memory), NORM (normal operation, zeroing the codes at power shutdown) and ZERO (zeroing the codes).

10. Intercom Function Selector Switch. It is spring-loaded to ON position. RAD ORIDE overrides the radio comms in favour of the intercom. In ON it provides direct

communications between crew members. OFF turns off the microphone for intercom purposes (but not for radio).

11. Voice / Tone Silence Switch. Can be used to silence any voice or tone warning for up to one minute.

12. Tactical Electronic Warfare System Volume Knob. The top knob is used to set the volume of caution sounds, the bottom (larger) one controls the launch warning volume.

13. Intercom / Weapons Volume Knob controls the audio volume of the Intercom system (top one) and the weapons lockon tone (bottom one).

14. ILS / TACAN Volume Knob controls the volume of ILS audio (top one) and TACAN beacon sounds (bottom one).

15. IFF Antenna Select Switch. Chooses which antenna will the IFF use (UPPER, LOWER or BOTH).

Sensor Panel

Contains switches for different onboard sensors and systems, such as radar, NAV FLIR and INS.

1. Master control for the Joint Tactical Information Distribution Sytem (JTIDS).

2. Central Computer Reset Button. If pressed resets the Central Computer. To be used only in case of suspected problem with the computer.

3. INS Mode Knob controls main functions of the INS. See INS/Navigation section for more information.

4. Navigation FLIR gain and level knob. Used to adjust the quality contrast / brightness of the Nav FLIR video output in manual mode. See NAV FLIR section for more information.

5. Navigation FLIR power switch. Can be set to OFF, STBY and ON. See NAV FLIR section for more information.

6. Terrain Following Radar power switch. Can be set to OFF, STBY and ON. See Terrain Following Radar section for more information.

7. Radar Altimeter Switch. Can be set to OFF (which also disables LAW warnings if LAW is enabled at the same time), ON and OVERRIDE (which deactivates the radar altimeter, but leaves the LAW and TF warning ON).

8. Radar Power Knob. See Radar section for more information.

External Lights Control Panel

1. Formation Lights Knob control the brightness of six position lights (two on wingtips, one on each side of fuselage forward of the cockpit, one on aft fuselage behind the wing. Available options are OFF, 1-5 (increasing the brightness) and BRT (the full brightness position).

2. Anti-Collision Lights Switch. Turns ON or OFF three red anti-collision lights, one on each wing and one on right vertical tail fin.

3. Vertical Tail Flood Switch. Two tail flood lights are used during night - time ops and formation flying. The switch has three position: BRIGHT, DIM and OFF.

4. Position Lights Switch. There are three position lights: green on the right wingtip, red on the left wingtip and white on the left vertical tail fin. Available options are OFF, 1-5 (increasing the brightness), BRT (the full brightness position) and FLASH (flashing at full brightness). With the anti-collision lights on, the position lights automatically go to steady full brilliance, regardless of the position of the position lights knob.

NCTR Enable Switch

NCTR Auto Enable Switch in ON position enables the auto NTCR entry.

Throttle Quadrant

The front throttle quadrant contains the front throttles, finger lifts, friction adjusting lever, rudder trim switch and flap switch. Additionally, the throttle grips contain switches to provide various system controls without moving the left hand from the grips.

1. Rudder Trim Switch. As the name implies, it is used to adjust the trim setting for the rudders.

2. Flap Switch. Controls the position of the flaps. It only has two positions (UP or DOWN).

3. Finger Lifts (left and right). Each couple the JFS to the respective engine during starting. Moreover, they need to be lifted to move the throttles from OFF to IDLE.

4. Throttle friction adjusting lever (not applicable in the sim).

NOTE: It is advised to bind the finger lifts to buttons on the HOTAS, as they are indispensable part of the startup procedure.

FUEL CONTROL PANEL

Contains switches governing the fuel system and external tanks. These are:

1. Wing fuel control switch with three positions: NORM (provides normal transfer and refuel of the external wing tanks), STOP TRANS (stops any transfer from the external wing tanks, unless the FUEL LOW light is ON) and STOP REFUEL (prevents filling the external wing tanks during air to air refueling and during ground refueling as well).

2. Centerline tank fuel control switch. Works in exactly the same way as Wing Switch, but for the centerline external tank.

3. Conformal tanks fuel control switch. Works in exactly the same way as Wing and Centerline switches, but for the conformal tanks.

4. Fuel dump switch. Used for dumping fuel from all but engine feed tank.

5. Conformal tanks emergency transfer switch with three positions: NORM (normal, which should be selected even if conformal tanks are not installed), L (left) or R (right). The two latter - provided emergency generator is operating - deactivate all pitot heaters and enable the selected conformal tank center sump transfer pump.

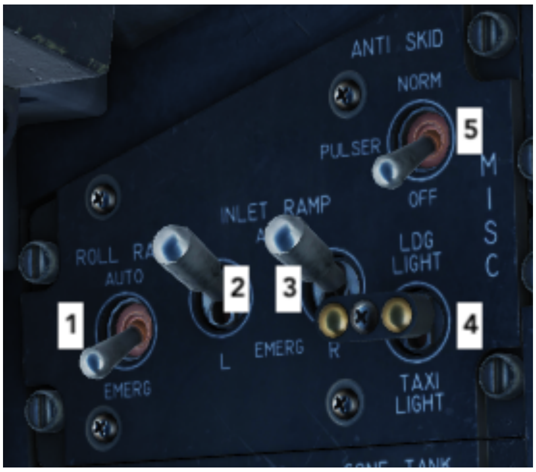
6. External transfer switch. Selects the priority for the fuel transfer to the internal system between conformal tanks (CONF TANK) and external wing and centerline tanks (WING/CTR).

7. Slipway switch. Controls the slipway door during air to air refueling. It has three positions: CLOSE (slipway doors are closed), OPEN (slipway doors are open) and ORIDE (override, which allows boom locking and forces the receiver to initiate all disconnects).

NUC PANEL

This guarded switch allowing pilot to release or jettison nuclear weapons onboard. Three positions: SAFE, RELEASE and JETTISON ENABLE. The functions of this switch are not implemented.

MISCELLANEOUS CONTROL PANEL



Contains various controls and switches.

1. Roll Ratio Switch. In AUTO mode it provides normal system functions. In EMERG mode, it removes hydraulic pressure from roll control system, causing the roll ratio to lock at midrange.

2. Left Inlet Ramp Switch. In AUTO mode, air inlet system is automatically controlled by AIC. In EMERG mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position.

3. Right Inlet Ramp Switch. Performs the same function as (**2**), but for the right ramp.

4. Landing / Taxi light. Control intensity of the landing light (LDG / OFF / TAXI).

5. Anti-Skid Switch. It has three positions: NORM (anti-skid is on when the gear is down, it also automatically provides pulser function), PULSER (turns off normal anti-skid protection and activates the brake pulser), OFF (turns off the normal anti-skid and brake pulser systems).

CAS CONTROL PANEL

Contains switches responsible for the Control Augmentation System (CAS).

1. YAW CAS 3-position switch. ON allows normal operation after engagement, RESET engages disconnected axis after the fault that caused the disconnect no longer exists (it is spring loaded back to ON), OFF disengages the applicable axis.

2. Roll CAS 3-position switch. Works the same as YAW and PITCH.

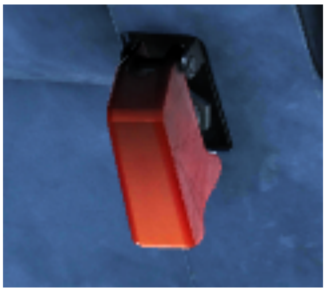
3. Pitch CAS 3-position switch. Works the same as YAW and ROLL.

4. Terrain Following Couple Switch. When engaged, it couples the terrain following system to the autopilot.

5. Take Off Trim Button and Light. When pressed, it drives the stick and rudder pedals to the takeoff position which, in turn, drives the aileron, rudder and stabilator actuators to the takeoff position. The T/O trim light then comes on.

2.2.2 LEFT WALL SWITCHES

EWWS ENABLE SWITCH

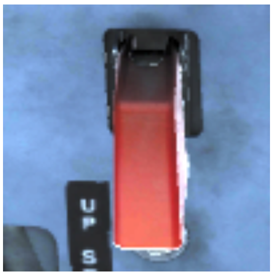


Electronic Warfare Warning Switch. EWWS is part of the jet's defensive suite. The functions of the switch are not implemented.

SEAT ADJUST SWITCH

The switch has the three positions of UP and DN and is spring- loaded to the centre OFF position. Maximum vertical seat travel is 5 inches. The seat adjustment actuator does not cut off power to the electric motor at either limit of travel. Release the seat adjust switch when the seat reaches an upper or lower limit to prevent damage to the actuator motor.

FLYUP ENABLE SWITCH



This switch is part of the Terrain Following system and in most situations should be kept in ON (guarded) position. Refer to Terrain Following system for more information.

VMAX SWITCH

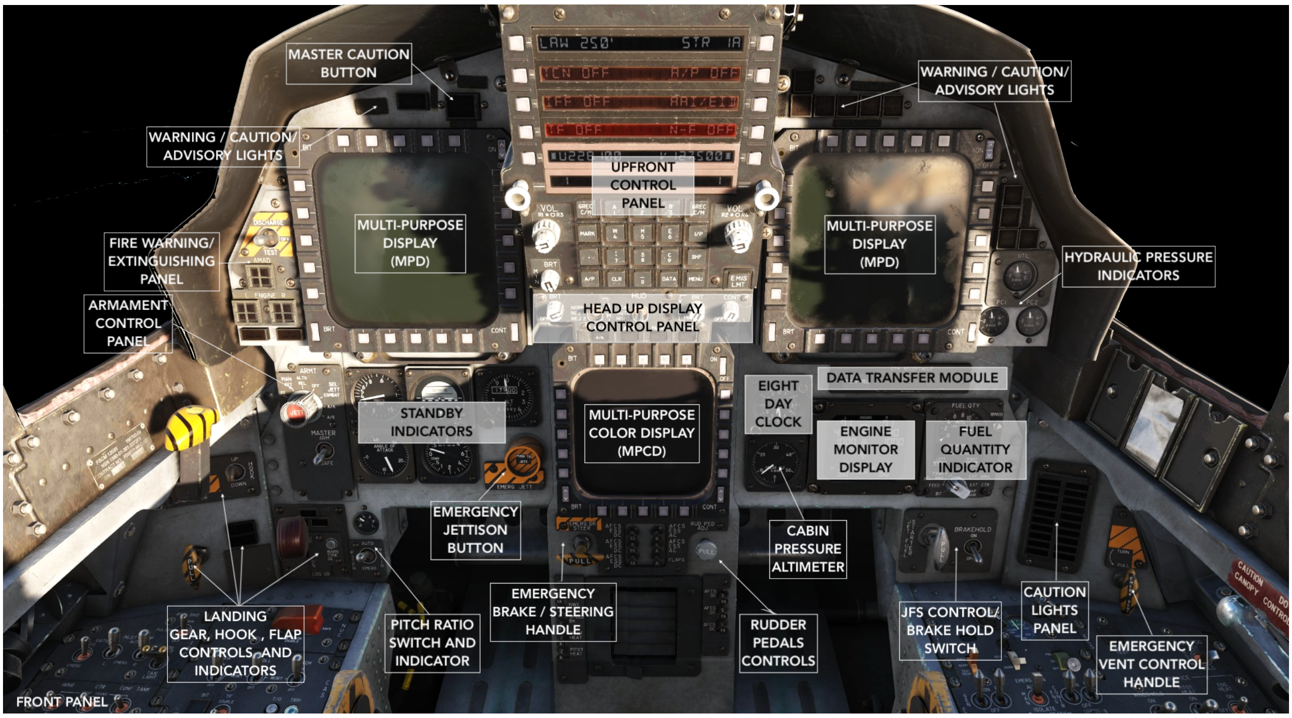
This switch was used in the F-15E with PW-220 engines and has no function with the PW-229.

Canopy Jettison Handle

A black and yellow striped canopy jettison handle is located under the left canopy sill just aft of the instrument panel in both cockpits. Pressing an unlock button on the inboard side of the handle and pulling the handle aft fires the canopy jettison system. The handle, once pulled to the fired position, is locked in the fired position where it remains locked until the handle and initiator are replaced.

2.3 MAIN PANEL OVERVIEW

The main panel consists mainly of two MPDs (Multi-Purpose Displays), one MPCD (Multi-Purpose Colour Display) and Upfront Control Panel (UFC). In addition, it contains the engine monitor indicator, landing gear controls and indications, warning, caution and advisory lights, as well as an array of standby instruments.

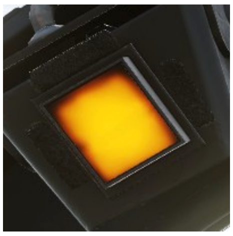


2.3.1 HUD and Canopy Rail

Head Up Display Combining Glass

The holographic combiner displays projected raster (video) and stroke (symbols) imagery in a total field of view which measures 21° in elevation and 28° in azimuth. The HUD displays navigation, FLIR video, flight control and weapon delivery information. See Chapter X: Head Up Display for more information.

Lock / Shoot Lights



The left and right annunciator lights on the canopy rail indicate the radar lock on target. When all conditions for a missile shot are met, then SHOOT light appears.

Air Refueling Ready Light

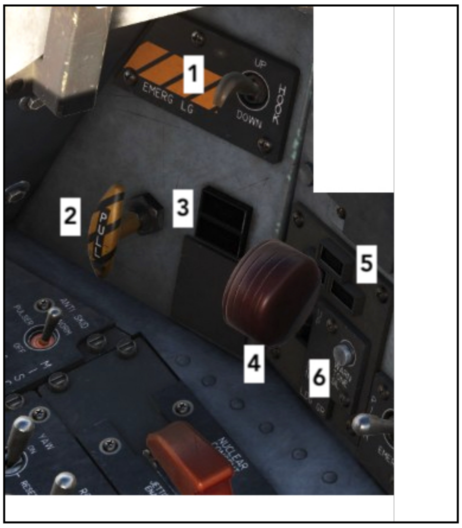
Tha AR Ready Light indicates that the system is ready for boom engagement. It then goes off once the boom connects and refuelling starts.

Standby Magnetic Compass

A conventional magnetic compass mounted on the canopy arch. It is available only in the front cockpit.

2.3.2 MAIN PANEL

LANDING GEAR PANEL



This panel contains numerous indicators and switches, which mostly are connected with the takeoff and landing.

1. The arresting hook control switch is located on the front and rear cockpit left sub panels. In UP position the hook is retracted. In DOWN position the hook is lowered.

2. Emergency Landing Gear Handle is used to lower the landing gear bypassing the normal hydraulic and electrical controls. The Emergency Landing Gear Handle in the front cockpit can be reset by rotating the handle 45 deg. clockwise and pushing it forward.

3. Flap Position Indicator shows the status of the flaps. If the lights are off, that means the flaps are fully retracted. YELLOW light indicates that the flaps are in transit. A GREEN light indicates that the flaps are down.

4. Landing Gear Control Handle. Placing it in down (DN) position extends the landing gear. Moving it to UP retracts the landing gear. It also has a red warning light, which lights up if any landing gear is not locked in the commanded position.

5. Landing Gear Position Lights just above the handle are marked NOSE, LEFT and RIGHT. Each of the lights illuminates when when its respective gear strut is down and locked.

6. Warning Tone Silence Button can be used to turn off the landing gear warning which goes off whenever the following conditions exist simultaneously: aircraft altitude is below 10,000 feet MSL, airspeed is below 200 KCAS, rate of descent greater than 250 fpm and the gear handle is not down.

PITCH RATIO SELECT SWITCH AND INDICATOR

Pitch Ratio Select Switch and Indicator. The switch has two positions: AUTO, which provides normal system functions and EMERG, which removes hydraulic pressure from the hydromechanical pitch control system and causes the pitch ratio and the PTC to drive to a midrange position and lock.

The Pitch Ratio Indicator, positioned just above the switch, shows the ratio of the motion of the stabilator compared to the up and down stick motion. This ratio should be 1.0 at slow speeds and close to 0 at Mach 0.9

close to sea level.

ARMAMENT CONTROL PANEL

1.Master Arm Switch with two positions. When SAFE is selected, no weapons can be employed. In ARM (up) position, power is applied to the master arm switch, which in turn provides power for weapons release / launch and gun firing.

NOTE: Power will not be supplied to the Master Arm Switch if the Landing Gear Handle is down or the Armament Safety Switch is not in the override position.

2. Jettison Select Knob. When pressed, the button jettisons stores depending on the knob position: OFF (removes power from the selective jettison button), COMBAT (first press initiates program 1, second press initiates program 2), A/A (selects air to air selective jettison), A/G (selects air to ground selective jettison). See Stores Jettison System section for more information.

To the left from the OFF position is an alternate release mechanism, which technically is not part of the jettison system. MANUAL FF (free fall, selects an ARMED manual (ripple) release mode with nose fuze only), MAN RET (manual retard, selects the manual weapon release mode and tail fuze only) and ALTN RET (backup nuclear release mode).

EMERGENCY JETTISON BUTTON

The emergency jettison button is located on the center of the front instrument panel to the left of the MPCD. When pressed, it causes a sequenced jettison of all carted pylons. The button will work as soon as electrical power is on the aircraft, even on the ground. .

Instruments and Standby Indicators

Standby Airspeed Indicator shows current indicated airspeed in knots. It has a fixed scale from 60 to 850 knots and a rotation pointer.

Velocity Vector Indicator (VVI) displays the vertical speed of the aircraft in feet per second (10-100 in 10 feet marks, then from 100 to 600 in 50 feet marks) for both climb and descent. An OFF flag is displayed if electrical power is lost and instrument readouts are not valid.

Standby Attitude Indicator is a self-contained, electrically driven gyro-horizon type instrument. If there is no power or the gyro is caged, the OFF flag appears. In order to uncage the gyro, the pilot should pull the knob, rotate and then release. The indicator displays rolls through 360 degrees, climb up to 90 and descend down to 78 degrees.

NOTE: Power should be supplied for at least one minute before uncaging the gyro.

Standby Altimeter operates directly from the static pressure source. The rotating pointer shows hundreds of feet. Current altitude is displayed on the dials in the top window, while the bottom one shows currently selected barometric pressure in inches of mercury.

Angle of Attack Indicator is only available in the front cockpit and displays indicated AoA in units from 0 to 45. A T shaped index mark show optimum landing approach AoA (between 20 and 22 units). An OFF flag is displayed is there is no power supply for the indicator.

FIRE WARNING / EXTINGUISHING PANEL

1. Fire Test / Extinguisher Switch has three positions:

OFF (middle) provides normal fire warning.

TEST (down) turns on three fire lights below and two Afterburner Burn Thru lights indicating that the fire sensors are working properly.

DISCHARGE (up) momentarily releases the extinguisher into the selected compartment.

NOTE: If JFS is providing the electrical power, only AMAD light will illuminate.

2. AMAD (Airframe Mounted Accessory Drive) / Left Engine / Right Engine Fire Push lights come up when the fire condition exists in the corresponding engine or AMAD.

After lifting metal guard, pressing the AMAD FIRE PUSH button arms the extinguisher bottle for release into the AMAD / JFS compartment (though it will not prevent normal JFS operation). If the fire light is pressed again, it de-arms the extinguisher and restores normal operation of the system.

After lifting metal guard, pressing L ENGINE or R ENGINE lights shuts off bleed air from and fuel flow to respective engine. It also arms the extinguisher bottle. The engine will decelerate but could continue to run for up to two minutes until it runs of fuel. If the fire light is pressed again, it de-arms the extinguisher and restores normal operation of the system.

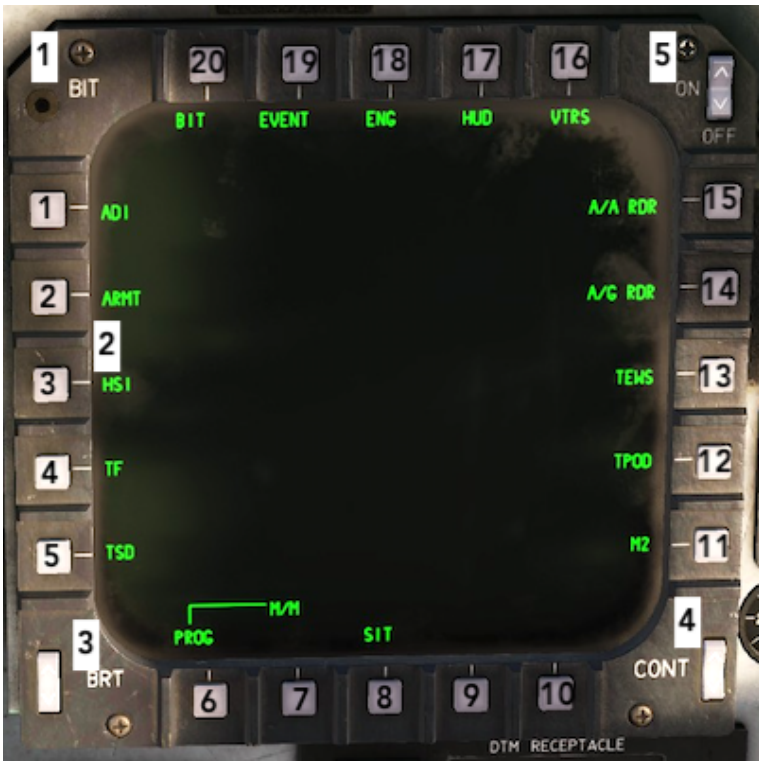
3. Afterburner Burn Thru warning lights indicate burn through or overtemperature condition in the respective afterburner section.

The fire condition is accompanied by the repeated voice warning (WARNING, ENGINE FIRE LEFT, WARNING, ENGINE FIRE RIGHT or WARNING, AMAD FIRE).

A special voice warning is played when the overtemperature is detected in either engine (WARNING, OVERTEMP LEFT or WARNING, OVERTEMP RIGHT) or in the afterburner section (AB BURN THRU LEFT or AB BURN THRU RIGHT).

MULTIPURPOSE MENU DISPLAYS (MPDS)

There are two MPDs in the front cockpit. They display system data, sensor video, and weapon information in monochromatic format.



1. BIT Indicator. A magnetically controlled BIT ball rolls over to indicate white when an MPD / MPCD has failed.

2. Pushbuttons 1-20, numbered counterclockwise from the upper button on the left side of the display to the left button on the top of the display. Legends are positioned adjacent to each pushbutton to advise the crew of the modes and options selectable for operation of the onboard systems.

3. MPD Brightness Switch is a two-position rocker switch that adjusts the black level on the selected MPD.

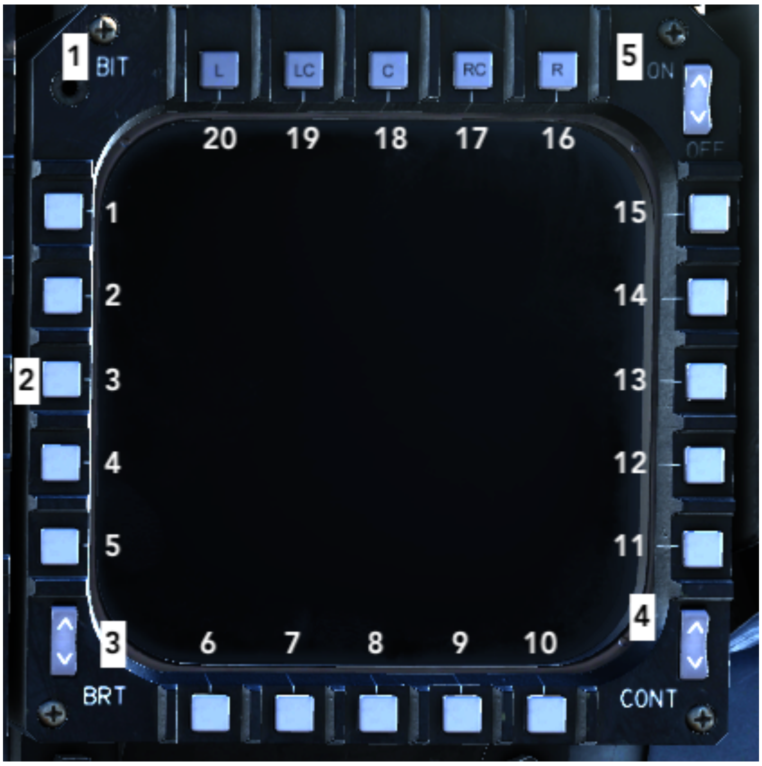
4. MPD Contrast Switch is a two-position rocker switch that controls the raster contrast (shades of grey) and stroke brightness.

5. MPD Power Switch is a two-position rocker switch that provide electrical power to the MPD. The MPDs do not turn on automatically and have to be manually switched on.

For more information about the available menu displays refer to the chapter Multipurpose Menu Displays.

Multipurpose Color Display (MPCD)

There is one MCPD in the front cockpit, capable of displaying system data, sensor video, and weapon information in monochromatic or multicolour format.



1. BIT Indicator. A magnetically controlled BIT ball rolls over to indicate white when an MPD / MPCD has failed.

2. Pushbuttons 1-20, numbered counterclockwise from the upper button on the left side of the display to the left button on the top of the display. Legends are positioned adjacent to each pushbutton to advise the crew of the modes and options selectable for operation of the onboard systems.

NOTE: The A/G radar display is not available on the MPCD.

3. MPCD Brightness Switch is a two-position rocker switch that adjusts the brightness and raster contrast on the selected MPCD.

4. MPCD Contrast Switch is a two-position rocker switch that controls the raster contrast (shades of grey) and stroke brightness.

5. MPCD Power Switch is a two-position rocker switch that provide electrical power to the MPCD. The MPCDs do not turn on automatically and have to be manually switched on.

For more information about the available menu displays refer to the chapter Multipurpose Menu Displays.

WARNING / CAUTION / ADVISORY LIGHTS

The red warning lights provide indications of system malfunctions that require immediate crew attention.

The amber caution lights indicate system malfunctions that require less than immediate attention. Some of the cautions are only displayed on the MPDs and MPCDs.

Caution and warning lights are spread across the front panel, with majority set in the caution lights panel located in the lower - right part of it.

Top - Left Caution Lights

1. Master Caution Light come on simultaneously with any MPD/MPCD caution, as well as all yellow caution lights except PROGRAM, MINIMUM, CHAFF, FLARE, LOCK/ SHOOT, AV BIT (Avionics BIT), LASER ARMED, EMIS LMT and UNARMED/NO ATF (Automatic Terrain Following). Pressing the Master Caution makes the MASTER CAUTION lights in both cockpits go out, except for the AUTO PLT caution (it remains on until the malfunction is corrected).

2. EMS LMT caution light comes on whenever the EMIS LMT key is pressed.

Top - Right Warning Lights

1. AI / SAM light up when Air Intercept Threat or Surface to Air Missile threat is detected by aircraft onboard defensive systems.

2. Low Altitude Warning Light turns on whenever aircraft descends below the LAW (Law Altitude Warning) altitude set in UFC or descend below 75% of the set clearance value.

3. Spare light

4. Terrain Following Failure light means that the TF system is not operating normally. Pilot is advised not to rely on terrain following indications.

5. Canopy Unlocked warning light turns on whenever the canopy is unlocked or the canopy actuated initiator lanyard is disconnected.

Center - Right Warning / Caution Lights

1, 2. Spare lights

3. Laser Armed informs pilot that the targeting pod laser has been armed.

4. Green advisory light informing that the autopilot is engaged.

Main Caution Lights Panel

1. Green PROGRAM advisory light informs the pilot that countermeasure dispenser is in semi-auto mode and that pre-selected program is ready to be deployed.

2. Yellow CHAFF informs that the chaff are being dispensed (flashing) or that the dispenser is empty (steady)

3. Yellow EMER BST ON lights up when the emergency boost pump is supplying pressure.

4. Yellow NUCLEAR light signifies nuclear armament malfunction.

5. Yellow L GEN light turns on when failure of the left generator is detected.

6. Yellow ENGINE light signifies engine systems failure. More information can be found on MPD/MPCD cautions.

7. Yellow HYD signifies hydraulic systems failure. More information can be found on MPD/MPCD cautions.

8. Yellow DSP FLO LO caution warns about inadequate cooling air flow to cockpit displays.

9. Yellow MINIMUM light comes on whenever the dispensable stores reach a predetermined level.

10. Yellow FLARE informs that the flares are being dispensed (flashing) or that the dispenser is empty (steady).

11. Yellow BST SYS MAL implies emergency boost pump malfunction.

12. Yellow FUEL LOW comes up whenever left feed tank drops below 600 pounds or / and right feed tank drops below 1000 pounds of fuel.

13. Yellow R GEN light turns on when failure of the right generator is detected.

14. Yellow FLT CONTR caution light indicates flight controls failure. More information can be found on MPD/MPCD cautions.

15. Yellow AV BIT light indicates avionics BIT failure. More information can be found on BIT display on MPD / MPCD.

16. Yellow OXYGEN light turns on when onboard oxygen system failure is detected.

17. Spare lights.

UPFRONT CONTROL PANEL (UFC)

1. Ten function buttons used to control the menus, numbered from top left (1-5) and then from bottom right up (6-10)

2. Six 20-character rows of display

3. Left radio channel select knob

4. Right radio channel select knob

5. Radio 1 / 3 volume control

6. Radio 2 / 4 volume control

7. Brightness control, also used to turn on and off the UFC

8. Alphanumeric and menu pushbutton keys

9. Emissions Limit key reduces electronic emissions from the aircraft for passive operations. The low probability of intercept terrain following radar mode is automatically selected if TF radar is active, the Fighter Data Link (FDL) terminal is placed in receive only mode, and other electronic emitters are switched to standby, except CARA which continues to transmit and has to be turned off to terminate transmission. The EMIS LMT light comes on when first selected. When the pushbutton is pressed again, the emission light is deselected and affected systems are returned to their previous state of operation.

Please refer to Upfront Control Panel chapter for more information.

HEADS UP DISPLAY CONTROL PANEL

1. Symbol Brightness knob controls the brightness of the HUD stroke symbology. Rotating it clockwise applies power to HUD.

2. Symbol Declutter Switch is a three position switch which removes and restores symbol information from the HUD. REJ 1 and REJ 2 positions are programmable.

3. DAY / AUTO / NIGHT switch provides the pilot with a means to select appropriate raster and stroke imagery brightness levels for daytime or nighttime missions. In AUTO position the symbology brightness is adjusted depending on the ambient brightness.

4. Video Brightness and Contrast knobs adjust the intensity and contrast of the raster - generated video. They also affect the NAVFLIR image brightness and contrast when the FLIR image is presented in the HUD.

5. Air to Air Mode Master Mode Button

6. Air to Ground Mode Master Mode Button

7. Navigation Mode Master Mode Button

8. Instrument Mode Master Mode Button

For more information about the master modes, refer to Head Up Display chapter.

EIGHT DAY CLOCK

A standard clock with stopwatch function that can be controlled using the pushbutton on the bottom - left. The clock by default is set to display the local time.

CABIN PRESSURE ALTIMETER

Displays the pressure altitude of the cockpit on a 0-50,000 foot scale. On the ground the displayed value should be equal to the actual field elevation.

ENGINE MONITOR DISPLAY

This display is the primary source of engine data, although additional information can be found on the MPD / MPCD in Engine menu. The data displayed for the Left and Right engine is as follows:

1. Displays compressor RPM in increments of 1 from 0 to 110%

2. Displays FTIT (Fan Turbine Inlet Temperature) from 200 to 1400 degrees in 10 degree increments

3. Displays main engine fuel flow from 0 to 99,900 Pounds Per Hour in 100 PPH increments

4. Displays exhaust nozzle position from 0% (fully closed) to 100% (fully open) in 10% increments

5. Displays oil pressure from 0 to 100 Pounds Per Square Inch (PSI) in 5-PSI increments.

DATA TRANSFER MODULE

The DTM consists of the DTM Receptacle (DTMR) on the main instrument panel and the Data Transfer Module (DTM). Mission data is loaded, by the aircrew or operations personnel, on the ground and stored in the module. The module is carried to the aircraft and inserted by the pilot into the DTM receptacle to initialize mission data.

This data is then transferred to the Central Computer and consist of waypoints, bullseye, GPS data for the EGI, IFF modes, weapon data, countermeasures programming etc.

HYDRAULIC PRESSURE INDICATORS

1. Utility Hydraulic System Pressure Gauge monitors the operation of two pumps: left with pressure of 3000 psi and right with pressure of 2775 psi.

2. PC1 Hydraulic System Pressure Gauge. The PC1 pump operate at a pressure of 3000 psi.

3. PC2 Hydraulic System Pressure Gauge. The PC2 pump operate at a pressure of 3000 psi.

FUEL QUANTITY INDICATOR

1. Internal Fuel Gauge shows total internal fuel with readings multiplied by 1000.

2. Bingo knob can be used to set the desired Bingo fuel level. This value is is shown by the white adjustable bug ("Bingo Bug") on the face of the indicator (visible just above the OFF flag).

3. Total Fuel Counter shows total internal fuel plus conformal and external tanks. An OFF flag is displayed if no electrical power is available.

4. Left and Right Fuel Counters in conjunction with the selector switch, are used to monitor fuel remaining in individual tanks based on the position of the Fuel Quantity Selector Knob.

5. Fuel Quantity Selector Knob has the following positions:

BIT: A spring-loaded position that drives the internal pointer and total counter to 6000 pounds, and the LEFT and RIGHT counters to 600 pounds indicating the fuel quantity indicator is operating normally.

FEED: displays the fuel available in the respective engine feed tank.

INTL WING: displays the fuel available in the respective internal wing tank.

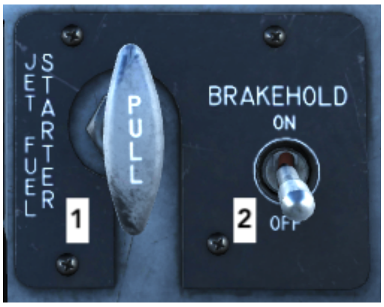
TANK 1: displays the fuel available in Tank 1 (using the LEFT counter)

EXT WING: displays the fuel available in respective external wing tank.

EXT CTR: displays the fuel available in the external centerline tank (using the LEFT counter)

CONF TANK: displays the fuel available in respective conformal tank.

JFS CONTROL / BRAKE HOLD SWITCH



1. Jet Fuel Starter Handle turns on the JFS, which is a self-contained small jet engine mounted on the central gearbox. JFS together with AMAD provide rotation and electrical power necessary to start the engines.

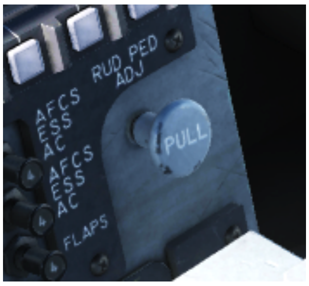
2. Holding Brake Switch. When set to ON, hydraulic system pressure (3000 psi) is applied to brakes. When set to OFF, normal system brake operation is restored.

NOTE: The Holding Brake ON signal is used by the INS to enter re-alignment after interrupted alignment takes place.

EMERGENCY VENT HANDLE

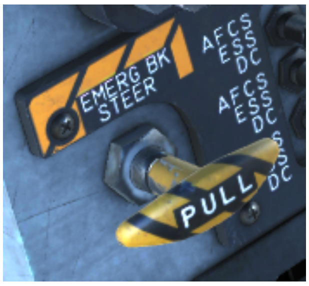
The emergency vent handle electrically dumps cabin pressure when turned 45 degrees counterclockwise. When extended, it shuts off ECS air to the cockpit and allows ram air to enter.

Rudder Pedal Adjust Release Knob



When pulled, this knob releases the rudder pedals and allows the pilot to either force them out or push them forward for better comfort.

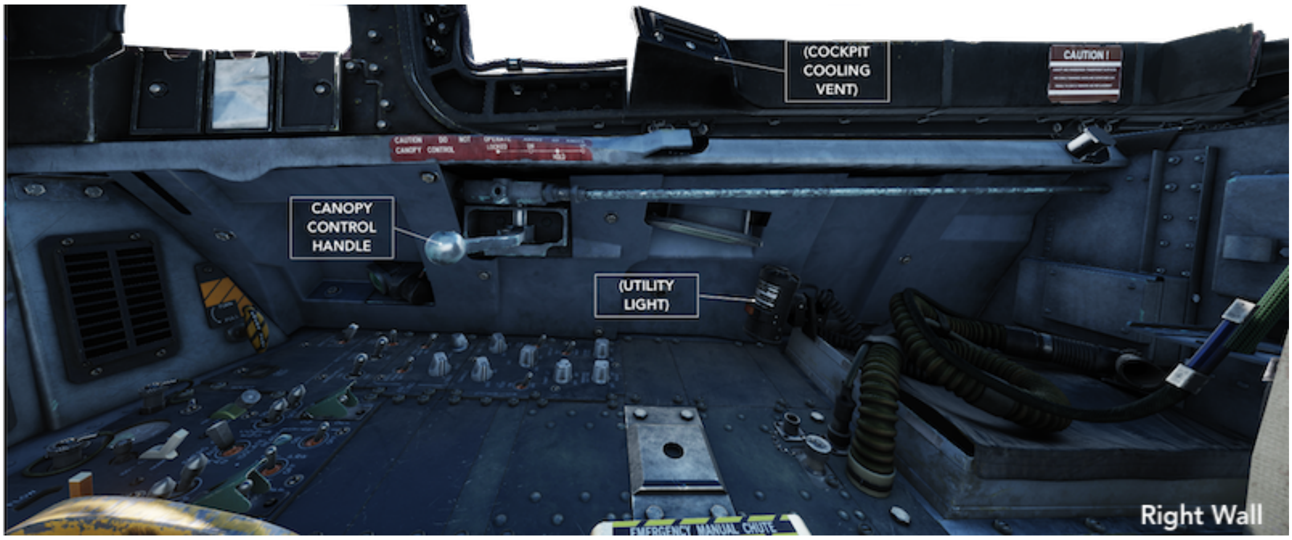
Emergency Brake / Steering Handle



When pulled, this handle provide additional power from JFS hydraulic accumulator to the brake system and for the nose gear steering. In case of brakes failure, sufficient power is provided to safely stop the aircraft.

2.4 Right console and wall overview

The right panel in the front cockpit of the F-15E contains engine controls, oxygen regulator, ECS panel, interior lights controls as well as stowage compartment.



2.4.1 RIGHT CONSOLE SWITCHES

OXYGEN REGULATOR

Control panel for the Molecular Sieve Oxygen Generating System (MSOGS). The MSOGS provides a continuously available supply of breathing gas for the aircrew.

MSOGS performs a power-up self BIT when electrical power is on aircraft and the front cockpit regulator is turned on.

1. Supply Mode Control Level has three positions: OFF (electrical power removed from the system), ON (supplies breathing gas to the crew with positive pressure breathing as function of altitude) and PBG (same as ON, but with positive pressure breathing as function of G).

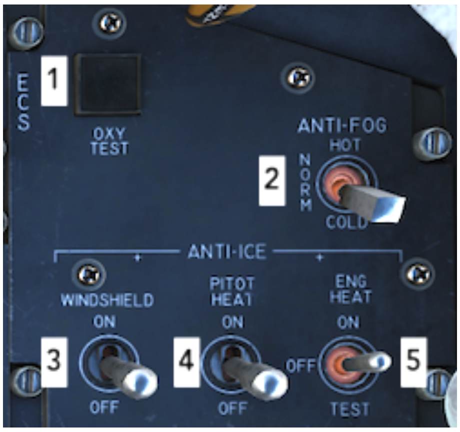
2. Diluter Switch with two positions: 100% (with no dilution of breathing gas, providing pure oxygen) and NORM (MSOGS gas and cabin air are mixed as a function of altitude).

3. Emergency Lever with three positions: EMERGENCY (provides continuous positive pressure to the mask plus all the functions of NORM mode), NORMAL (provides normal breathing gas on demand) and TEST MASK (spring-loaded, used for testing the mask).

4. Flow Indicator. Shows white for flow and black for no-flow with each breath.

5. Pressure Gauge. Indicates the inlet supply pressure to the regulator.

ECS Control Panel



1. Oxygen Test / BIT Light. It turns on after successful MSOGS bit test. Pressing the light resets it.

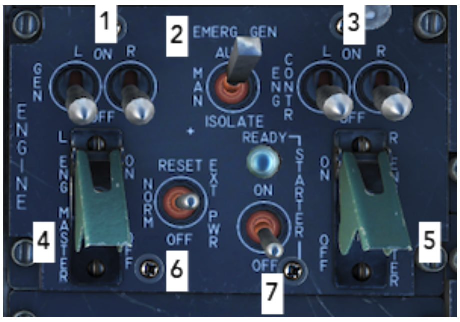
2. Anti - Fog Switch allows pilot to choose the temperature of the air used to defog the canopy. It has three positions: HOT (anti-fog is hotter than normal), NORM (standard temperature) or COLD (anti-fog air is controlled by cockpit temperature control knob and can be cooler or hotter than normal, depending on the setting of the knob).

3. Windshield Anti - Ice Switch controls the flow of the hot airflow to the exterior anti-ice nozzle. It has two positions: ON and OFF.

4. Pitot Heat Switch turns ON or OFF heating elements for all four pitot-static probes.

5. Engine Anti-Ice Heat Switch is responsible for removing the ice building up in engine inlets. It has three positions: ON, OFF and TEST (checks detector operation and turns the INLET ICE caution).

Engine Control Panel



1. Left / Right Generator Control Switches are two position toggle switches with ON (up) and OFF (down) positions.

2. Emergency Generator Switch controls the utility hydraulic motor-driven emergency AC/DC generator, which is separate from the primary electrical system. AUTO position provides automatic activation of emergency generator whenever such necessity arise and allows for automatic shutdown of emergency generator 30s after the first main generator comes online. MAN provides manual activation of the emergency generator. ISOLATE Restricts the emergency generator to powering the emergency fuel boost pump, the arresting hook and provides power from the emergency/ essential 28 volt DC bus to the emergency air refueling switch to open the slipway door.

3. Left / Right Engine Control Switches with two positions: ON (DEEC provides normal engine control) and OFF (where engine control mode is transferred to secondary mode, inhibiting the use of afterburner and limiting power to MIL).

4. Left Engine Master Switch. A guarded switch which, when set to ON, opens left engine fuel shutoff valve and enables fuel transfer pumps.

5. Right Engine Master Switch. The same function as (4), but for the right engine.

6. External Power Control Switch controls application of external power to the aircraft electrical buses. In NORM position it allows them to be energized without any external power. RESET position is spring-loaded to NORM, and establishes external power if it is not in line. OFF disconnects external power to the aircraft.

7. JFS Starter Switch and Light. Used to enable the JFS. When JFS is ready, the green ready light turns on. JFS is automatically shut down after both engines are started.

AIR CONDITION CONTROL PANEL

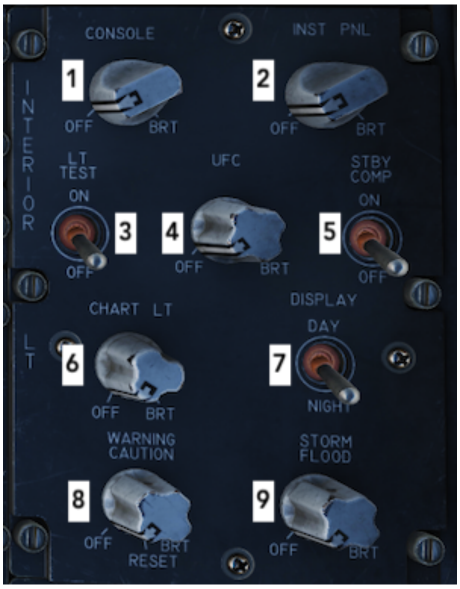
1. Cockpit Temperature Switch. Controls internal temperature. Three positions: AUTO, MANUAL and OFF.

2. Air Flow Selector Switch allows three cockpit flow selections: MAX, NORM or MIN.

3. Cockpit Temperature Control Knob. Used to regulate the temperature in MANUAL mode of Cockpit Temperature Switch.

4. Air Source Knob selects the engine bleed air source for the ECS system. Possible options include BOTH (both engines), L ENG (only left engine), R ENG (only right engine) or OFF.

INTERIOR LIGHTS CONTROL PANEL



The names of different knobs are mostly self-explanatory and do not need further details. All the knobs offer varied lighting intensity from OFF to BRIGHT.

1. Console Lighting Knob

2. Instrument Panel Lighting Knob

3. Lights Test Switch. Spring - loaded to OFF position. When set to ON, all serviceable warning / caution / advisory lights (but not TO TRIM) come on.

4. Upfront Control Display Lighting Knob.

5. Standby Compass Light. When set to ON, brightness of light depends on the position of the Instrument Panel Knob.

6. Chart Lights Knob. The chart light is used to illuminate maps and other documents.

7. Display Lighting Switch. It has two positions: DAY and NIGHT, which control the maximum illumination level for the MPDs / MPCDs.

8. Warning / Caution Lights Control Knob.

9. Storm / Flood Lighting Knob. Controls the intensity of four flood lights which are mounted in the front cockpit.

2.4.2 RIGHT WALL SWITCHES

CANOPY CONTROL HANDLE

Internal Canopy Control Handles in both cockpits are interconnected to follow each other whenever one handle is moved. There are four positions:

1. LOCKED: causes a hydraulic block, therefore it is necessary to have the canopy down against the windscreen before placing the handle in LOCKED position.

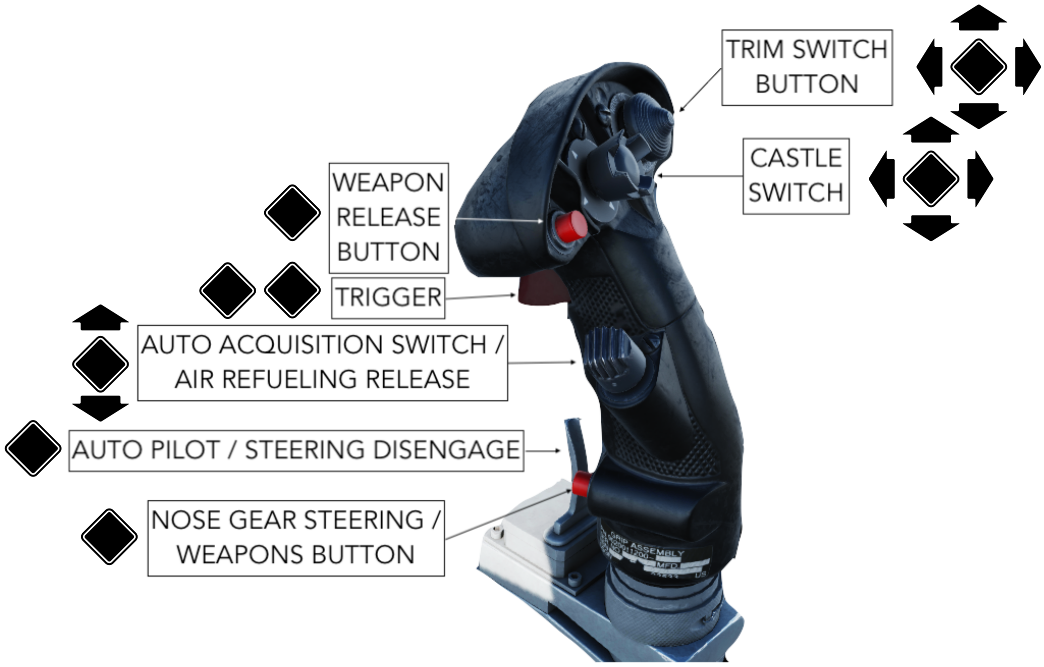
2. UP: raises canopy to maximum open position. When selected from the LOCKED position, the canopy first unlocks, then moves back before opening.

3. DOWN: lowers the canopy fully then pushes it forward against the windscreen.

4. HOLD: Creates a hydraulic lock and stops the canopy at any point in the open or close cycle.

2.5 FRONT COCKPIT STICK

The front cockpit control stick consists of a stick grip and force transducer, and contains seven controls as described below.



All of these buttons have different functions depending on the current situation (weight-on-wheels / airborne) or selected display, master mode, sensor or weapon. Moreover, in some instances in order to perform a specific function it is necessary to press another button simultaneously, which makes proper description of all of the uses of all the switches in one place a daunting task with overload of information. Therefore where relevant in further chapters there always will be a specific section devoted to HOTAS use in the context of the given system. Below description of the most basic functions.

Trim Switch Button

A five-way switch with mostly one basic function, which is trimming the aircraft in flight. Pushing it forward will cause the aircraft's nose to go down, left - left wing will go down etc., as described on the chart above. Pressing it releases countermeasures in MAN 1.

Castle Switch

A five-way switch that has many different functions depending on the situation and selected sensors. It is mainly responsible for switching between and taking command of different sensors, as well as controlling the Nav Pod and moving back and forth between master modes.

Weapons Release Button

Also called a PICKLE BUTTON, responsible for A/A missile and A/G weapons release as well as operation of the VTRS.

Trigger

The trigger has two detents, first one turns on the VTRS, second fires the gun while keeping the VTRS running.

Auto Acquisition Switch / Air Refueling Release

A three - way switch used mostly for sensor control, with the down position additionally used for disengaging the Air Refueling Probe. Details will be described in relevant sensor sections of the manual.

Paddle Switch

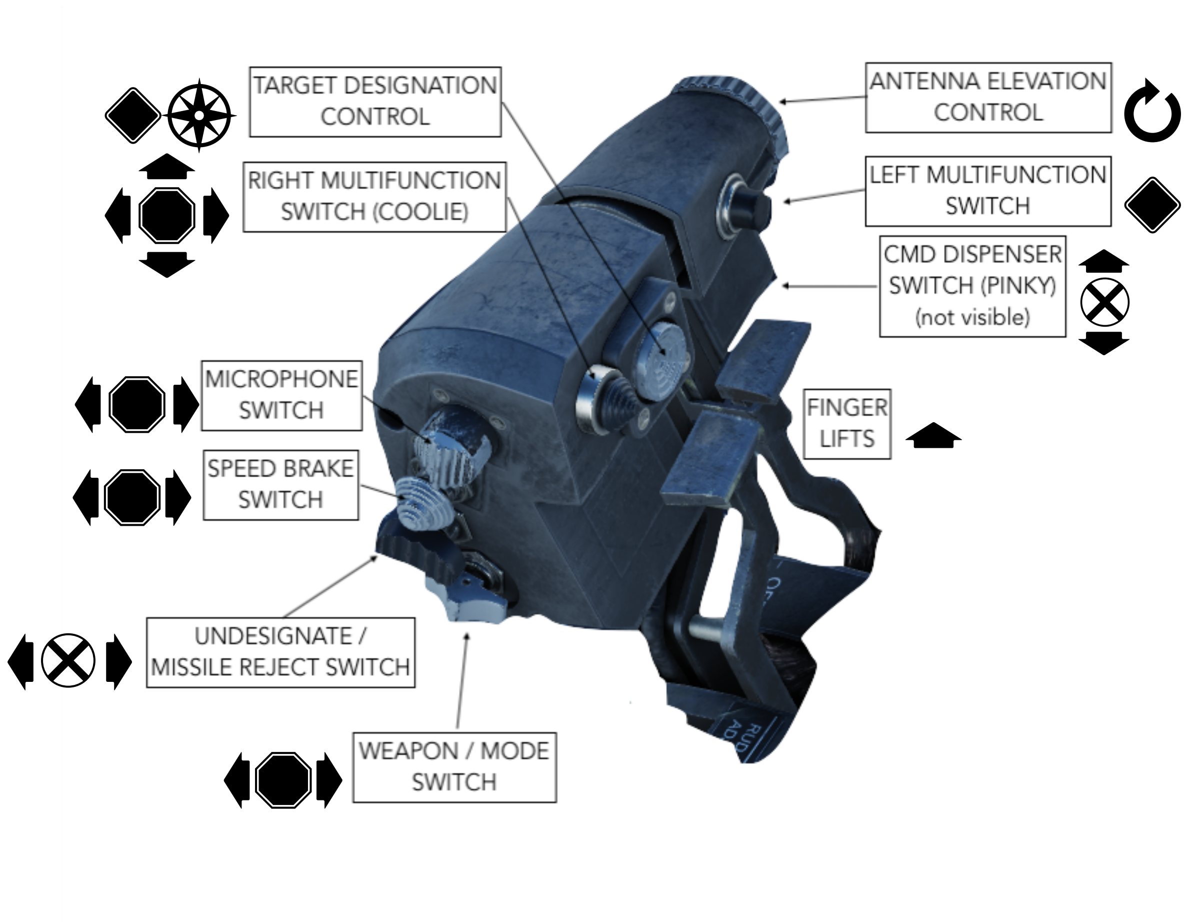
The paddle switch located in front of the stick is mainly used to disengage the autopilot. On the ground it terminates the AFCS BIT (on short press) or disengages the nose gear steering (pressed and held). It also has additional functions in Terrain Following mode.

Nose Gear Steering Button

On the ground, this button enables the maneuver mode (high rate) of the nose gear steering. However, it also has its functions in Air to Air and Air to Ground mode, depending on the weapon selected.

2.6 FRONT COCKPIT THROTTLES

The front throttle quadrant contains the front throttles, finger lifts, friction adjusting lever, rudder trim switch and flap switch. Additionally, the throttle grips contain switches to provide various system controls without moving the left hand from the grips. These switches will be briefly described below, with more information provided in relevant sections of this manual.



Just like with the stick, many of the switches and buttons have many functions, so below one can find the most basic ones, with more advanced covered in relevant chapters and sections of the manual.

Finger Lifts

Left and Right Finger Lift are used to couple the JFS to the respective engine during startup process. Moreover, they need to be lifted to move the throttles from IDLE to OFF position.

Antenna Elevation Control

Used to increase or decrease the antenna elevation in the air to air and air to ground radar.

Countermeasures Dispenser Switch (Pinky, not shown)

A two-way switch used to release the countermeasures MAN 1 (down) and MAN 2 (up) program. More information can be found in the Countermeasures section.

Left Multifunction Switch

In NAV and INST Master Mode this button cages / uncages the Velocity Vector. But as its name implies it also has additional functions when using the TGP, A/G Guided Weapons, TSD and other systems.

Target Designation Control (TDC)

TDC is an axis slew / cursor controller for different sensors and displays (TGP, radar, HUD etc.), with additional function whenever it is pressed.

Right Multifunction Switch (Coolie)

Coolie is a 4-way switch (up, down, right or inboard and left or outboard) controlling numerous instruments and sensors (TGP, A/A Radar, Nav Pod, A/A Gun, A/G guided weapons)

Microphone Switch

A 2-way switch used to transmit on radios 1 and 3 (in forward position) and radios 2 and 4 (in aft position). Center position enables receive mode.

Speed Brake Switch

Speed Brake has three positions: forward (retracting the speed brake), center (hold the brake in current position) and aft (extending the speed brake).

Undesignate / Missile Reject Switch (Boat Switch)

Boat switch also has three positions: forward, center (off) and aft. It is mainly used with A/A Radar as missile reject / target undesignate button, but has more functions with other sensors and weapons.

Weapon Select Switch

Weapon / Mode Switch also has three positions: Forward (Medium Range Missile), Center (Short Range Missile) and Aft (Auto Guns / A/A mode command).

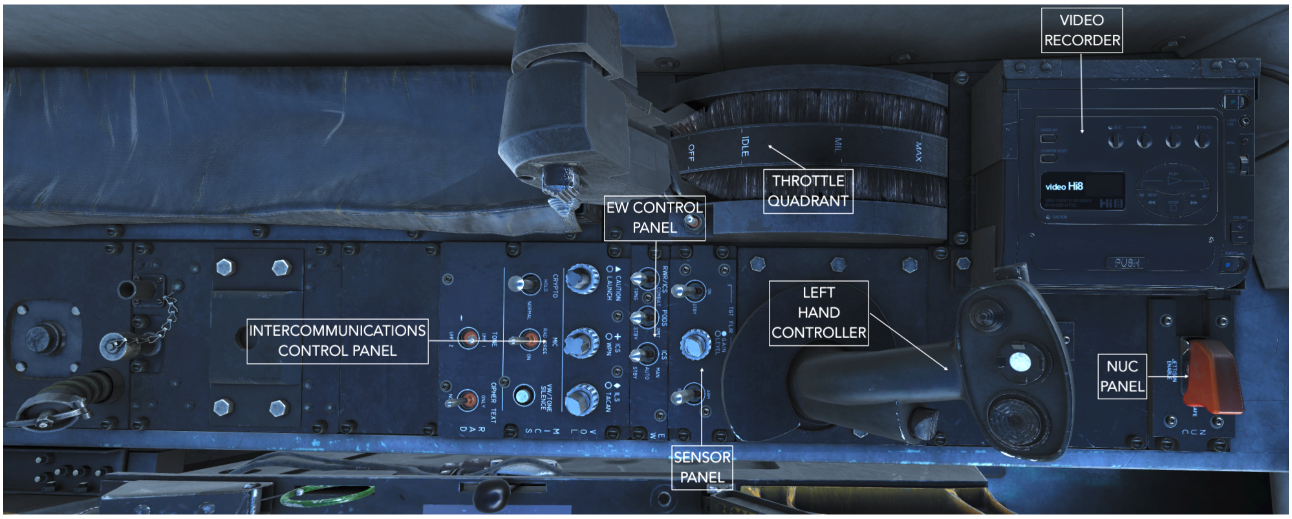
CHAPTER 3: REAR COCKPIT

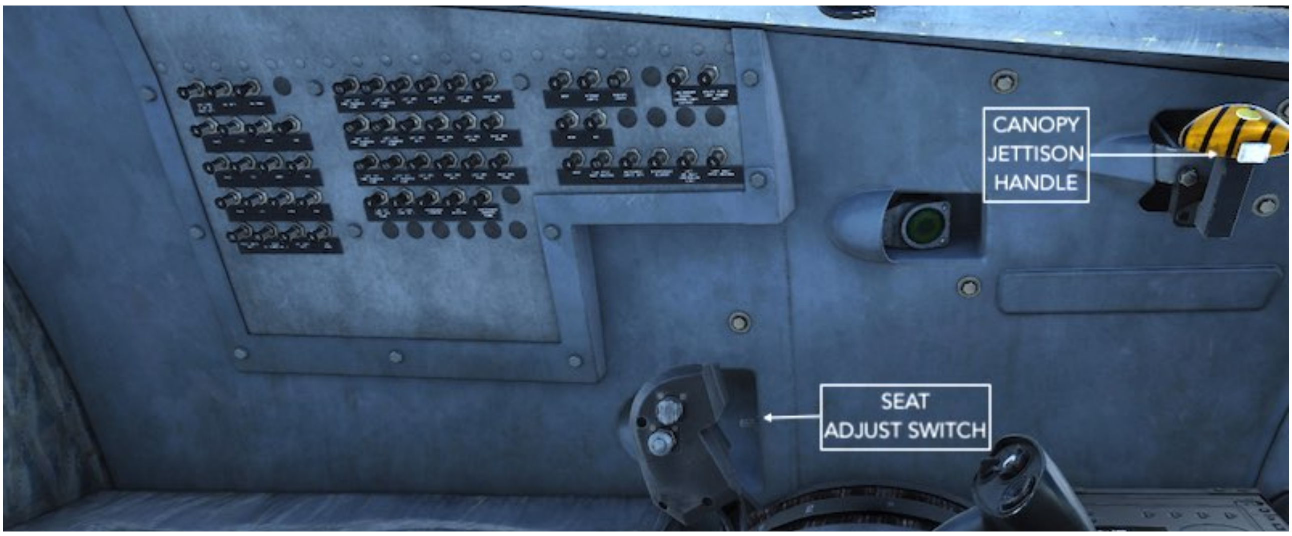
3.1 Rear Cockpit Overview

The rear office in the F-15E belongs to the Weapons Systems Officer (or WSO, often pronounced as '*wizzo*'). In addition to a flight stick and throttle - which are pretty rudimentary but can be used by the WSO to fly the plane as a backup if need arises - there are two additional hand controllers, to which most of the switches were moved. This allows the back seater to use his own HOTAS system without interfering with the pilot's flight controls.

3.1.1 Rear Left console and wall overview

On the left side, the WSO has switches and buttons for sensors, electronic warfare and intercommunications, as well as throttle and one of the two controllers.





NUC PANEL

This guarded switch is exactly the same is in front cockpit. It allows the crew to release or jettison nuclear weapons onboard. Three positions: SAFE, RELEASE and JETTISON ENABLE. Both switches have to enabled for RELEASE or JETTISON.

8MM VIDEO TAPE RECORDER

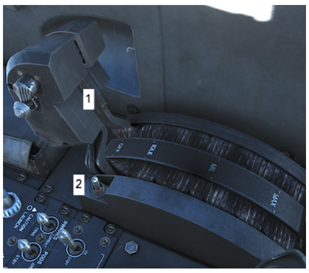
1. The 8mm colour video recorder is capable of recording up to 5 hours of MPD, MPCD and HUD video, together with audio communication to and from the air crew.

2. Power Switch Panel for the recorder has three positions: PLAYBACK (not used), ON and OFF.

LEFT HAND CONTROLLER

The left and right hand controllers are used to provide sensor/ display control for the WSO. Each has a number of switches and buttons that have different functions depending on the currently used sensor / weapon or display. Refer to later section of this chapter for more information and to specific sensor / weapon parts for detailed description.

THROTTLE QUADRANT



The throttle in the back seat has many less options than the one in the front, because most of the switches have been moved to the Hand Controllers. More information about the functions of the buttons on the throttle **(1)** can be found in later section of this chapter.

2. Rudder trim switch, which works exactly the same as the one in the front seat.

SENSOR CONTROL PANEL

The Sensor Control Panel in the back seat is used for TGP operation.

1. TGT FLIR Power Switch with three positions: OFF, STANDBY (initiates the cool down process) and ON.

2. Set Level / Gain Knob. Used to manually adjust the image quality on the MPD / MPCD and fine - tune it to pilot's liking if Auto Level Gain is not satisfactory.

3. Laser Arm Switch with two positions: SAFE and ARM.

NOTE: If the Laser Arm Switch is in SAFE mode, it is impossible to use the targeting laser, but laser marker functions will work normally.

ELECTRONIC WARFARE CONTROL PANEL

1. RWR / ICS mode switch changes between TRAINING and COMBAT modes.

2. Pods switch is not functional.

3. ICS switch has three positions: MAN, AUTO and OFF (turns off the system).

INTERCOMMUNICATIONS CONTROL PANEL

1. Tactical Electronic Warfare System Volume Knob. The top knob is used to set the volume of caution sounds, the bottom (larger) one controls the launch warning volume.

2. Intercom / Weapons Volume Knob controls the audio volume of the Intercom system (top one) and the weapons lockon tone (bottom one).

3. ILS / TACAN Volume Knob controls the volume of ILS audio (outer) and TACAN beacon sounds (inner).

4. Mode 4 Crypto Switch. Chooses between HOLD (stores the codes in memory), NORM (normal operation, zeroing the codes at power shutdown) and ZERO (zeroing the codes).

5. Intercom Function Selector Switch. It is spring-loaded to ON position. RAD ORIDE overrides the radio comms in favour of the intercom. In ON it provides direct communications between crew members. OFF turns off the microphone for intercom purposes (but not for radio).

6. Voice / Tone Silence Switch. Can be used to silence any voice or tone warning for up to one minute.

7. Tone Selector Switch. Chooses which radio (UHF 1 or UHF 2) will be used to transmit the tone.

8. Cipher Text Selector Switch. In ONLY the radio can only receive the ciphered text and not clear text communications. In NORM both types are allowed.

SEAT ADJUST SWITCH

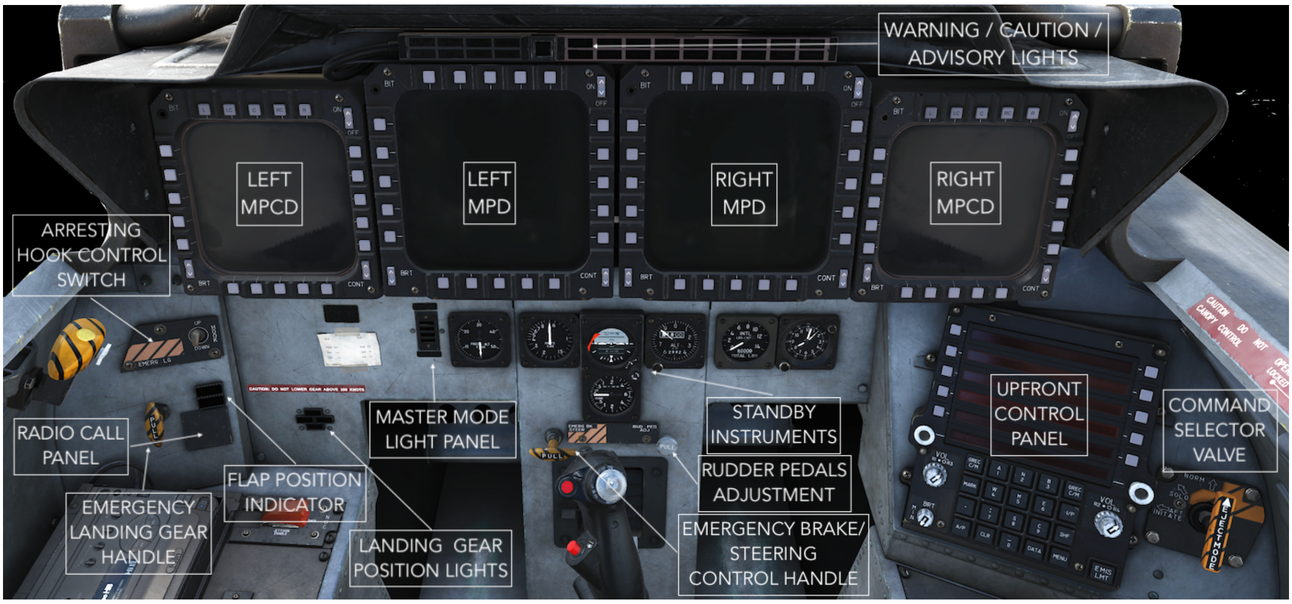
The switch has the three positions of UP and DN and is spring-loaded to the centre OFF position. Maximum vertical seat travel is 5 inches. The seat adjustment actuator does not cut off power to the electric motor at either limit of travel. Release the seat adjust switch when the seat reaches an upper or lower limit to prevent damage to the actuator motor.

CANOPY JETTISON HANDLE

A black and yellow striped canopy jettison handle is located under the left canopy sill just aft of the instrument panel in both cockpits. Pressing an unlock button on the inboard side of the handle and pulling the handle aft fires the canopy jettison system. The handle, once pulled to the fired position, is locked in the fired position where it remains locked until the handle and initiator are replaced.

3.1.2 REAR MAIN PANEL OVERVIEW

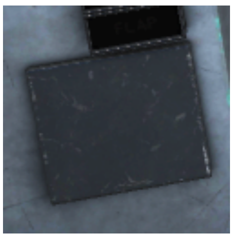
The main panel in the back office contains four displays (two MPCDs and two MPDs), set of caution and warning lights, as well as many standby instruments and indicators.



EMERGENCY LANDING HANDLE

Emergency Landing Gear Handle is used to lower the landing gear bypassing the normal hydraulic and electrical controls. The Emergency Landing Gear Handle in the front cockpit can be reset by rotating the handle 45 degrees clockwise and pushing it forward.

RADIO CALL PANEL



A simple placard with the aircraft tail number on it.

ARRESTING HOOK SWITCH

The arresting hook control switch is located on the front and rear cockpit left sub panels. In UP position the hook is retracted. In DOWN position the hook is lowered.

FLAP POSITION INDICATOR

Flap Position Indicator shows the status of the flaps. If the lights are off, that means the flaps are fully retracted. YELLOW light indicates that the flaps are in transit. A GREEN light indicates that the flaps are down.

LANDING GEAR POSITION LIGHTS

Landing Gear Position Lights are marked NOSE, LEFT and RIGHT. Each of the lights illuminates when when its respective gear strut is down and locked. There also is an UNSAFE indication, which lights up whenever any landing gear is not locked in the commanded position.

MASTER MODE LIGHT PANEL

Indicates the currently selected Master Mode:

A/A: Air to Air

A/G: Air to Ground

NAV: Navigation

INST: Instruments

STANDBY INSTRUMENTS

Similarly to the front cockpit, there are gauges for the WSO to monitor current airspeed, altitude, attitude, fuel, vertical velocity, cabin pressure and time.

Cabin Pressure Altimeter displays the pressure altitude of the cockpit on a 0-50,000 foot scale. On the ground the displayed value should be equal to the actual field elevation.

Standby Airspeed Indicator shows current indicated airspeed in knots. It has a fixed scale from 60 to 850 degrees and a rotation pointer.

Standby Attitude Indicator is a self-contained, electrically driven gyro-horizon type instrument. If there is no power or the gyro is caged, the OFF flag appears. In order to uncage the gyro, the pilot should pull the knob. The indicator displays rolls through 360 degrees, climb up to 90 and descend down to 78 degrees.

Standby Altimeter operates directly from the static pressure source. The rotating pointer shows hundreds of feet. Current altitude is displayed on the dials in the top window, while the bottom one shows currently selected barometric pressure in inches of mercury.

Fuel Quantity Indicator

Internal Fuel Gauge shows total internal fuel with readings multiplied by 1000, while the total Fuel Counter shows total internal fuel plus conformal and external tanks. An OFF flag is displayed if no electrical power is available.

Eight Day Clock is a standard clock with stopwatch function that can be controlled using the pushbutton on the bottom - left. The clock by default is set to display the local time.

Velocity Vector Indicator (VVI) displays the vertical speed of the aircraft in feet per second (10-100 in 10 feet marks, then from 100 to 600 in 50 feet marks) for both climb and descent. An OFF flag is displayed if electrical power is lost and instrument readouts are not valid.

Emergency Brake / Steering Handle

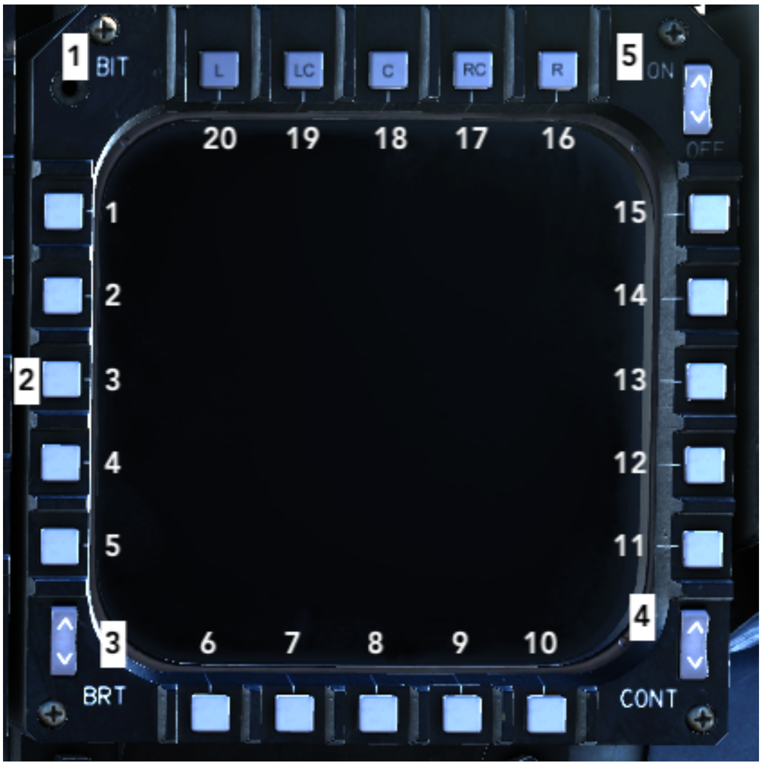
When pulled, this handle provide additional power from JFS hydraulic accumulator to the brake system and for the nose gear steering. In case of brakes failure, sufficient power is provided to safely stop the aircraft.

Rudder Pedal Adjust Release Knob

When this knob is pulled, the rudder pedals are released and can be moved back or forward to increase comfort for the operator.

MULTIPURPOSE COLOR DISPLAY (MPCD)

There are two MCPDs in the back cockpit, each capable of displaying system data, sensor video, and weapon information in monochromatic or multicolour format.



1. BIT Indicator. A magnetically controlled BIT ball rolls over to indicate white when an MPD / MPCD has failed.

2. Pushbuttons 1-20, numbered counterclockwise from the upper button on the left side of the display to the left button on the top of the display. Legends are positioned adjacent to each pushbutton to advise the crew of the modes and options selectable for operation of the onboard systems.

NOTE: The A/G radar display is not available on the MPCD.

3. MPCD Brightness Switch is a two-position rocker switch that adjusts the brightness and raster contrast on the selected MPCD.

4. MPCD Contrast Switch is a two-position rocker switch that controls the raster contrast (shades of grey) and stroke brightness.

5. MPCD Power Switch is a two-position rocker switch that provide electrical power to the MPCD. The MPCDs do not turn on automatically and have to be manually switched on.

For more information about the available menu displays refer to the chapter Multipurpose Menu Displays chapter.

MULTIPURPOSE MENU DISPLAYS (MPDS)

There are two MPDs in the back cockpit. They display system data, sensor video, and weapon information in monochromatic format.

1. BIT Indicator. A magnetically controlled BIT ball rolls over to indicate white when an MPD / MPCD has failed.

2. Pushbuttons 1-20, numbered counterclockwise from the upper button on the left side of the display to the left button on the top of the display. Legends are positioned adjacent to each pushbutton to advise the crew of the modes and options selectable for operation of the onboard systems.

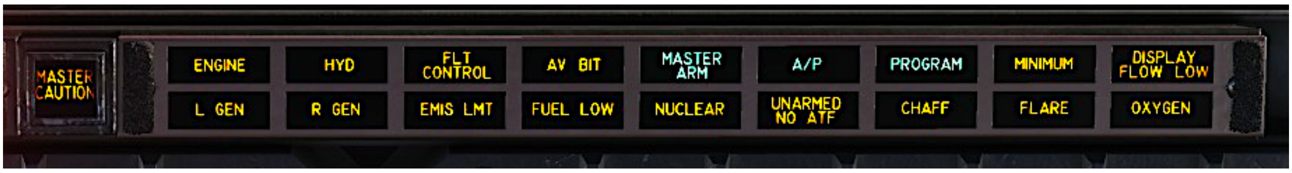
3. MPD Brightness Switch is a two-position rocker switch that adjusts the black level on the selected MPD.

4. MPD Contrast Switch is a two-position rocker switch that controls the raster contrast (shades of grey) and stroke brightness.

5. MPD Power Switch is a two-position rocker switch that provide electrical power to the MPD. The MPDs do not turn on automatically and have to be manually switched on.

For more information about the available menu displays refer to the Multipurpose Menu Displays chapter.

WARNING / CAUTION / ADVISORY LIGHTS



MASTER CAUTION: Master Caution Light come simultaneously with any MPD/ MPCD caution, as well as all yellow caution lights except PROGRAM, MINIMUM, CHAFF, FLARE, LOCK/SHOOT, AV BIT, LASER ARMED, EMIS LMT and UNARMED/ NO ATF. Pressing the Master Caution makes the MASTER CAUTION lights in both cockpits go out, except for the AUTO PLT caution (it remains on until the malfunction is corrected).

ENGINE light signifies engine systems failure. More information can be found on MPD/MPCD cautions.

L GEN light turns on when failure of the left generator is detected.

R GEN light turns on when failure of the right generator is detected.

HYD signifies hydraulic systems failure. More information can be found on MPD/ MPCD cautions.

FLT CONTROL caution light indicates flight controls failure. More information can be found on MPD/MPCD cautions.

EMIS LMT caution light comes on whenever the EMIS LMT key is pressed.

AV BIT light indicates avionics BIT failure. More information can be found on BIT display on MPD / MPCD.

FUEL LOW comes up whenever left feed tank drops below 600 pounds or / and right feed tank drops below 1000 pounds of fuel.

MASTER ARM advisory light lights up whenever the Master Arm switch is in ON position.

NUCLEAR light signifies nuclear armament malfunction.

A/P advisory light informs the WSO that the autopilot is engaged.

UNARMED - NO ATF UNARMED means malfunctions which preclude auto flyup; NO ATF means that Auto Terrain Following system is not available.

PROGRAM advisory light informs the pilot that countermeasure dispenser is in semi-auto mode and that pre-selected program is ready to be deployed.

CHAFF informs that the chaff are being dispensed (flashing) or that the dispenser is empty (steady)

FLARE informs that the flares are being dispensed (flashing) or that the dispenser is empty (steady).
DISPLAY FLOW LOW caution warns about inadequate cooling air flow to cockpit displays.

OXYGEN light turns on when onboard oxygen system failure is detected.

ENGINE FIRE LEFT indicates fire condition detected in the left engine. The WSO has no access to fire extinguishing system.

ENGINE FIRE RIGHT indicates fire condition detected in the left engine. The WSO has no access to fire extinguishing system.

CANOPY UNLOCKED warning light turns on whenever the canopy is unlocked or the canopy actuated initiator lanyard is disconnected.

LOW ALT warning light turns on whenever aircraft descends below the LAW altitude set in UFC or descend below 75% of the set clearance value.
AI lights up when Air Intercept Threat is detected by aircraft onboard defensive systems.

SAM lights up when Surface to Air Missile threat is detected by aircraft onboard defensive systems.

OBSTACLE indicates that an obstacle requiring more than 2.0g is in aircraft flight path. It is advised to climb or turn away from obstacle.
TF FAIL means that the TF system is not operating normally. Pilot is advised not to rely on terrain following indications.

Upfront Control Panel (UFC)

1. Ten function buttons used to control the menus, numbered from top left (1-5) and then from bottom right up (6-10)

2. Six 20-character rows of display

3. Left radio channel select knob

4. Right radio channel select knob

5. Radio 1 / 3 volume control

6. Radio 2 / 4 volume control

7. Brightness control, also used to turn on and off the UFC

8. Alphanumeric and menu pushbutton keys

9. Emissions Limit key reduces electronic emissions from the aircraft for passive operations. The low probability of intercept terrain following radar mode is automatically selected if TF radar is active, the Fighter Data Link (FDL) terminal is placed in receive only mode, and other electronic emitters are switched to standby, except CARA which continues to transmit and has to be turned off to terminate transmission. The EMIS LMT light comes on when first selected. When the pushbutton is pressed again, the emission light is deselected and affected systems are returned to their previous state of operation.

Please refer to Upfront Control Panel for more information.

COMMAND SELECTOR VALVE

Available only in the rear cockpit, allows operator to select the desired ejection sequence to be initiated from the rear cockpit, or provide for single ejection for solo flight. Positioning is accomplished by pulling full aft then turning to the desired position.

NORM (VERTICAL): single rear seat ejection when initiated from the rear cockpit. Dual ejection (rear seat first) when initiated from the front cockpit. If initiated from the WSO seat, only he / she goes and the pilot stays in the jet until he pulls his own handles.

AFT INITIATION (HORIZONTAL): Dual ejection (rear seat first) when initiated fromeither front or back seat. This is the expected setting for almost all flights.

SOLO – Meant for Pilot only Ferry. Pilot pulls the handles and only they are ejected. Rear seat is disabled.

3.1.3 REAR RIGHT CONSOLE AND WALL OVERVIEW

On the right side of their office, the WSO has the right controller, oxygen panel, countermeasures dispenser, tactical electronic warfare system and interior lights control. On the wall, there is the canopy control handle, which moves in unison with the handle in the front cockpit.

OXYGEN REGULATOR

Control panel for the Molecular Sieve Oxygen Generating System (MSOGS) is exactly the same in the back seat as in the front. The MSOGS provides a continuously available supply of breathing gas for the aircrew.

MSOGS performs a power-up self BIT when electrical power is on aircraft and the front cockpit regulator is turned on.

1. Supply Mode Control Level has three positions: OFF (electrical power removed from the system), ON (supplies breathing gas to the crew with positive pressure breathing as function of altitude) and PBG (same as ON, but with positive pressure breathing as function of G).

2. Diluter Switch with two positions: 100% (with no dilution of breathing gas, providing pure oxygen) and NORM (MSOGS gas and cabin air are mixed as a function of altitude).

3. Emergency Lever with three positions: EMERGENCY (provides continuous positive pressure to the mask plus all the functions of NORM mode), NORMAL (provides normal breathing gas on demand) and TEST MASK (spring-loaded, used for testing the mask).

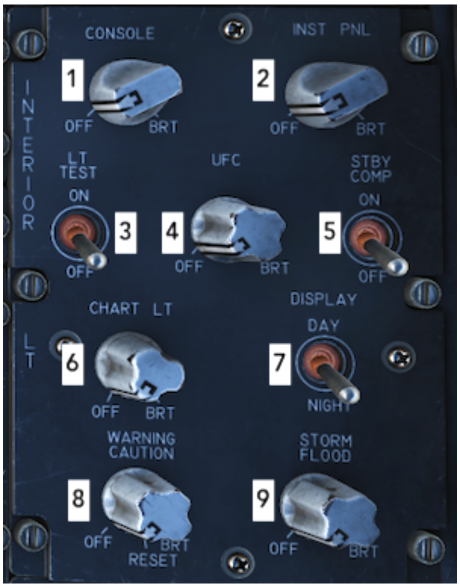
4. Flow Indicator. Shows white for flow and black for no-flow with each breath.

5. Pressure Gauge. Indicates the inlet supply pressure to the regulator.

RIGHT HAND CONTROLLER

The left and right hand controllers are used to provide sensor/ display control for the WSO. Each has a number of switches and buttons that have different functions depending on the currently used sensor / weapon or display. Refer to later section of this chapter for more information and to specific sensor / weapon parts for detailed description.

INTERIOR LIGHTS CONTROL PANEL



The names of different knobs are mostly self-explanatory and do not need further details. All the knobs offer varied lighting intensity between OFF and BRIGHT.

1. Console Lighting Knob

2. Instrument Panel Lighting Knob

3. Lights Test Switch. Spring - loaded to OFF position. When set to ON, all serviceable warning / caution / advisory lights (but not TO TRIM) come on.

4. Upfront Control Display Lighting Knob.

5. Standby Compass Light. When set to ON, brightness of light depends on the position of the Instrument Panel Knob.

6. Chart Lights Knob. The chart light is used to illuminate maps and other documents.

7. Display Lighting Switch. It has two positions: DAY and NIGHT, which control the maximum illumination level for the MPDs / MPCDs.

8. Warning / Caution Lights Control Knob.

9. Storm / Flood Lighting Knob. Controls the intensity of four flood lights which are mounted in the front cockpit.

TACTICAL ELECTRONIC WARNING SYSTEM (TEWS)

The TEWS is an integrated suite consisting of four subsystems: Radar Warning Receiver (RWR), the Internal Countermeasures Set (ICS), the Electronic Warfare Warning Set (EWWS), and the Countermeasures Dispenser (CMD) Set.

1. TONE / DEFEAT switch: not simulated

2. Electronic Warfare Warning Set power switch. Turns ON or OFF the EWWS.

3. Radar Warning Receiver power switch. Turns ON or OFF the RWR.

4. Internal Countermeasures Set (ICS) power switch. Turns ON or OFF the ICS.

5. SET-1, SET-2, SET-3 switches and status windows. Different modes for the jammer.

For more information refer to TEWS chapter.

COUNTERMEASURES DISPENSER

The CMD control panel applies CMD operations power, selection of payload dispensing modes, and selection of flare jettison.

1. Dispense Select Switch. Whenever the CMD Mode knob is in different position than OFF, the three position of the switch (CHAFF / BOTH / FLARE) provides different dispensing for the MAN 1 and MAN 2 programs. Refer to TEWS chapter for more information.

2. Mode Select Switch. It has following positions:

OFF: CMD is not operational.

STBY: Standby mode. Enables warm up of the system and full BIT with weight on wheels.

MAN ONLY: System accepts dispense inputs via MAN 1 and MAN 2.

SEMI AUTO: the CMD relies on the data provided by the RWR to prepare the best dispensing program against specific threat. Pilot can still use MAN 1 or MAN 2 to use different programs and has to manually initiate dispensing countermeasures.

AUTO: CMD relies on the data provided by the RWR to prepare the best dispensing program and automatically initiates dispensing countermeasures.

NOTE: SEMI AUTO and AUTO modes are hardly ever used because they can use up all the available countermeasures very quickly. Therefore it is advised to stick to MANUAL mode.

3. Flare Jettison Switch. The jettison switch is a guarded, two-position switch with the following functions: NORM (where CMD operates normally in line with the current position of the Mode Select Switch) and JETT (overrides the position of the Mode Select Switch - even if it is in OFF - and dispenses all the onboard flares ignited).

CANOPY CONTROL HANDLE

Internal Canopy Control Handles in both cockpits are interconnected to follow each other whenever one handle is moved. There are four positions:

1. LOCKED: causes a hydraulic block, therefore it is necessary to have the canopy down against the windscreen before placing the handle in LOCKED position.

2. UP: raises canopy to maximum open position. When selected from the LOCKED position, the canopy first unlocks, then moves back before opening.

3. DOWN: lowers the canopy fully then pushes it forward against the windscreen.

4. HOLD: Creates a hydraulic lock and stops the canopy at any point in the open or close cycle.

3.2 Rear Cockpit Stick

The rear cockpit control stick consists of a stick grip and force transducer, and contains five controls as described below.

Trim Switch Button

A four-way switch with one basic function, which is trimming the aircraft in flight. Pushing it forward will cause the aircraft's nose to go down, left - left wing will go down etc., as described on the chart above.

Weapon Release Button

Also called a PICKLE BUTTON, responsible for A/G weapons release as well as operation of the VTRS.

Trigger

The trigger in the back seat is not functional - it is actually melded into the stick and does not move at all.

Paddle Switch

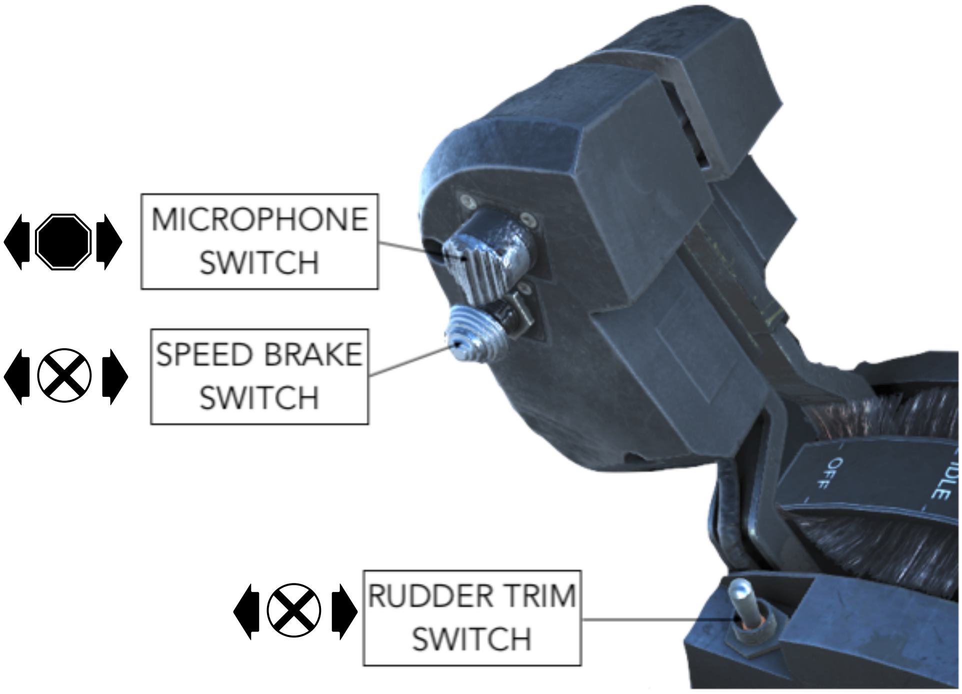
The paddle switch located in front of the stick is mainly used to disengage the autopilot. On the ground it terminates the AFCS BIT (on short press) or disengages the nose gear steering (pressed and held). It also has additional functions in Terrain Following mode.

Air Refueling Release Switch

Causes the Air Refueling Probe to disengage.

3.3 Rear Cockpit Throttle

The rear cockpit throttle has only three controls. Microphone Switch, Speed Brake and Rudder Trim.



Microphone Switch

A 2-way switch used to transmit on radios 1 and 3 (in forward position) and radios 2 and 4 (in aft position). Set to receive in middle position.

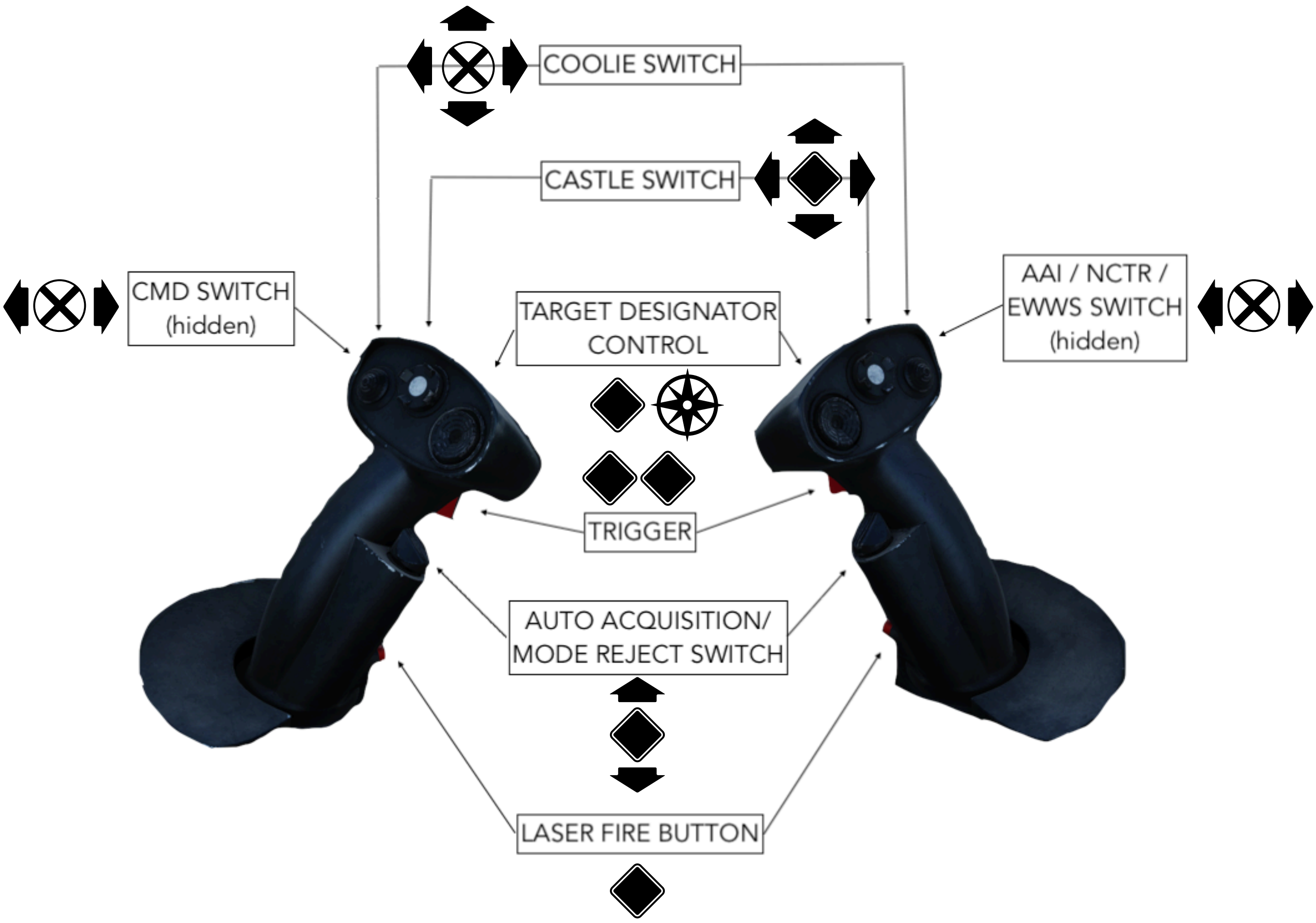
Speed Brake Switch

Speed Brake has three positions: forward (retracting the speed brake), center (hold the brake in current position) and aft (extending the speed brake).

3.4 REAR COCKPIT HAND CONTROLLERS

Two Hand Controllers in the rear cockpit constitute the WSO's HOTAS - as opposed to flight stick and throttle, which solely play the role of flight controls. As both stick and throttle move in unison in both cockpits, placing different buttons and hat switches in the back - especially on the stick - could create problems for the pilot flying the aircraft. Hence the decision to install separate controllers for the WSO.

Left HC is responsible for the left MPD / MPCD plus for countermeasures. Right controls the right MPD and MPCD plus the AAI/ NCTR / EWWS.



Coolie Switch

The coolie switch is a four-way, momentary toggle switch with center off. Moving the switch forward cycles through the programmed displays on the MPD; aft cycles through the programmed displays on the MPCD; left is the take command function for the left display; right is the take command function for the right display. If Master Caution Reset switch is held simultaneously, pressing the Coolie Switch aft will declutter cautions from the display. Pressing it again brings them back. Left / Right actuation moves the cautions between displays.

Castle Switch

A 5-way Castle Switch has many different uses depending on the currently selected sensor, weapon or page on the MPD/MPCD. Detailed description will be provided in the relevant chapters of this manual.

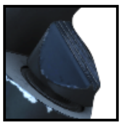
Target Designator Control (TDC)

The TDC is a multidirectional switch that includes a depressible action position. It is mostly used to move around the cursor for the radar and other sensors like the TGP and A/G missile seekers. Detailed description will be provided in the relevant chapters of this manual.

Trigger

Trigger in both hand controllers has two detents. It performs different functions depending on the selected sensor / mode / weapon. Detailed description will be provided in the relevant chapters of this manual.

Auto Acquisition / Mode Reject Switch



The auto acquisition switch is a four-position switch: forward, aft, center OFF, and down, spring-loaded to the center OFF position. It has different functions depending on the selected sensor / mode or weapon. Detailed description will be provided in the relevant chapters of this manual.

Laser Fire Button

This button has many different uses depending on the currently selected sensor, weapon or page on the MPD/MPCD. Detailed description will be provided in the relevant chapters of this manual.

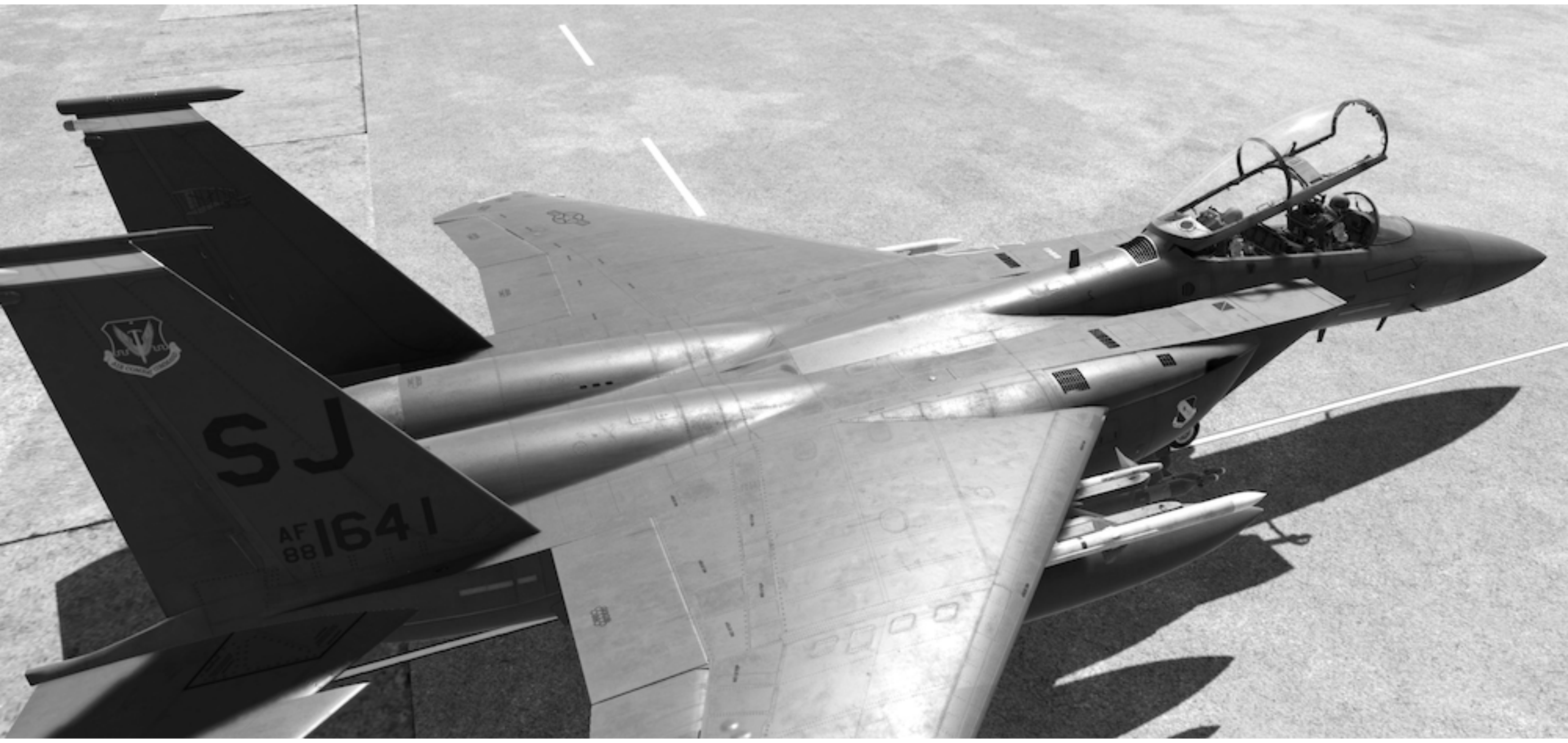
CMD

The three-position momentary slide switch is available only on the Left Hand Controller. It controls manual countermeasures dispensing. The switch returns to OFF when released. FWD selects MAN1 program, aft selects MAN2 program.

AAI / NCTR / EWWS / EID Switch

This switch is only available on the Right Hand Controller with three positions: FWD, center (OFF) and AFT. It is mainly used for air to air interrogation and will be described in depth in other parts of the manual.

CHAPTER 4: NORMAL PROCEDURES



4.1 INTRODUCTION

This chapter will cover normal procedures, focusing mostly on the front cockpit. These will cover the following sub-sections:


Aircraft startup (front cockpit)


Aircraft startup (rear cockpit)


Taxiing and takeoff


Landing


Shutdown

Each of the sections described above has separate checklists available at the end of this manual in Appendixes.

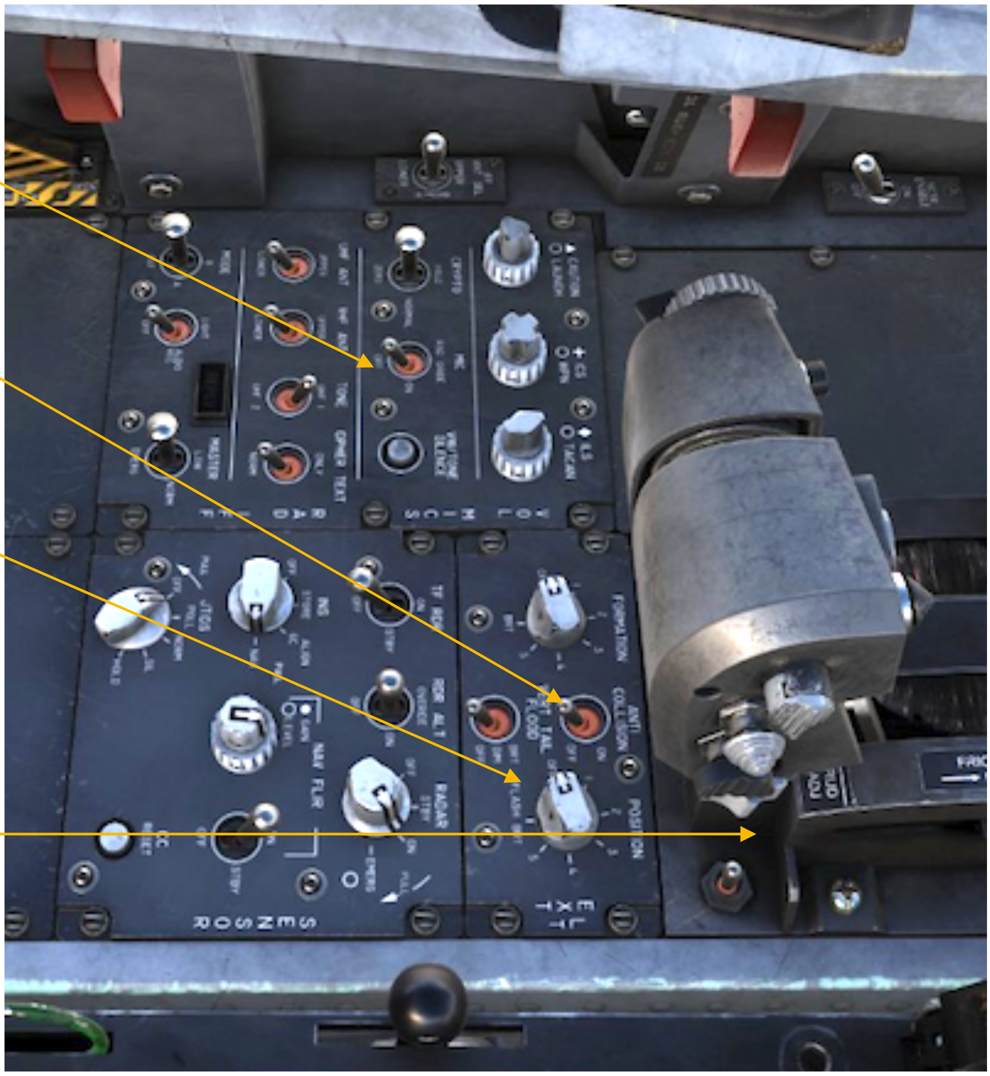
4.2 Aircraft startup - front cockpit

F-15E is a relatively easy aircraft to prepare for flight, and the whole procedure, including full INS alignment, can take between 10 minutes with only necessary actions performed to 20-30 minutes with all BIT and system checks.

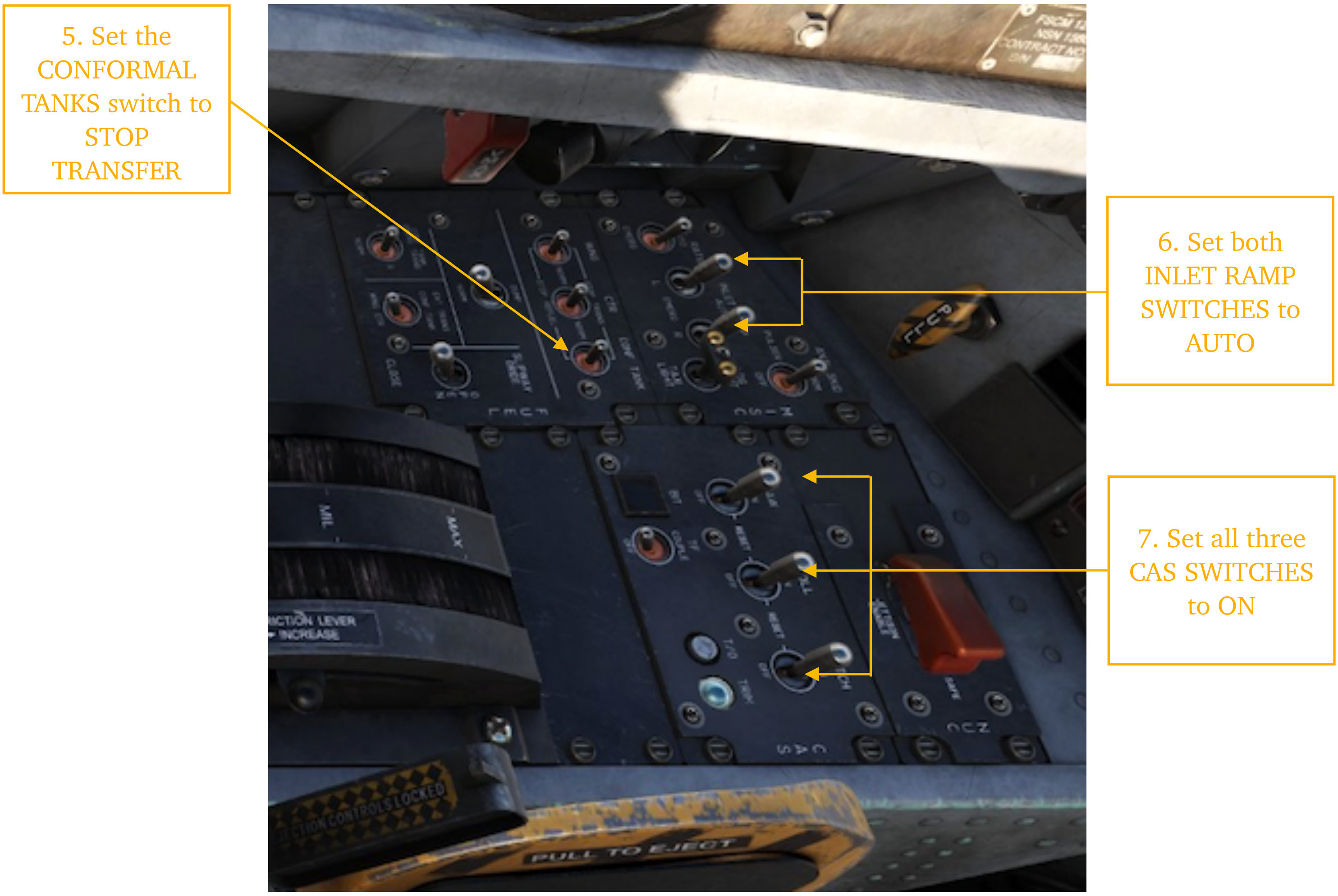
Relevant checklist for this part of the manual can be found in the Appendixes.

4.2.1 Before Engine Start

LEFT PANEL #1

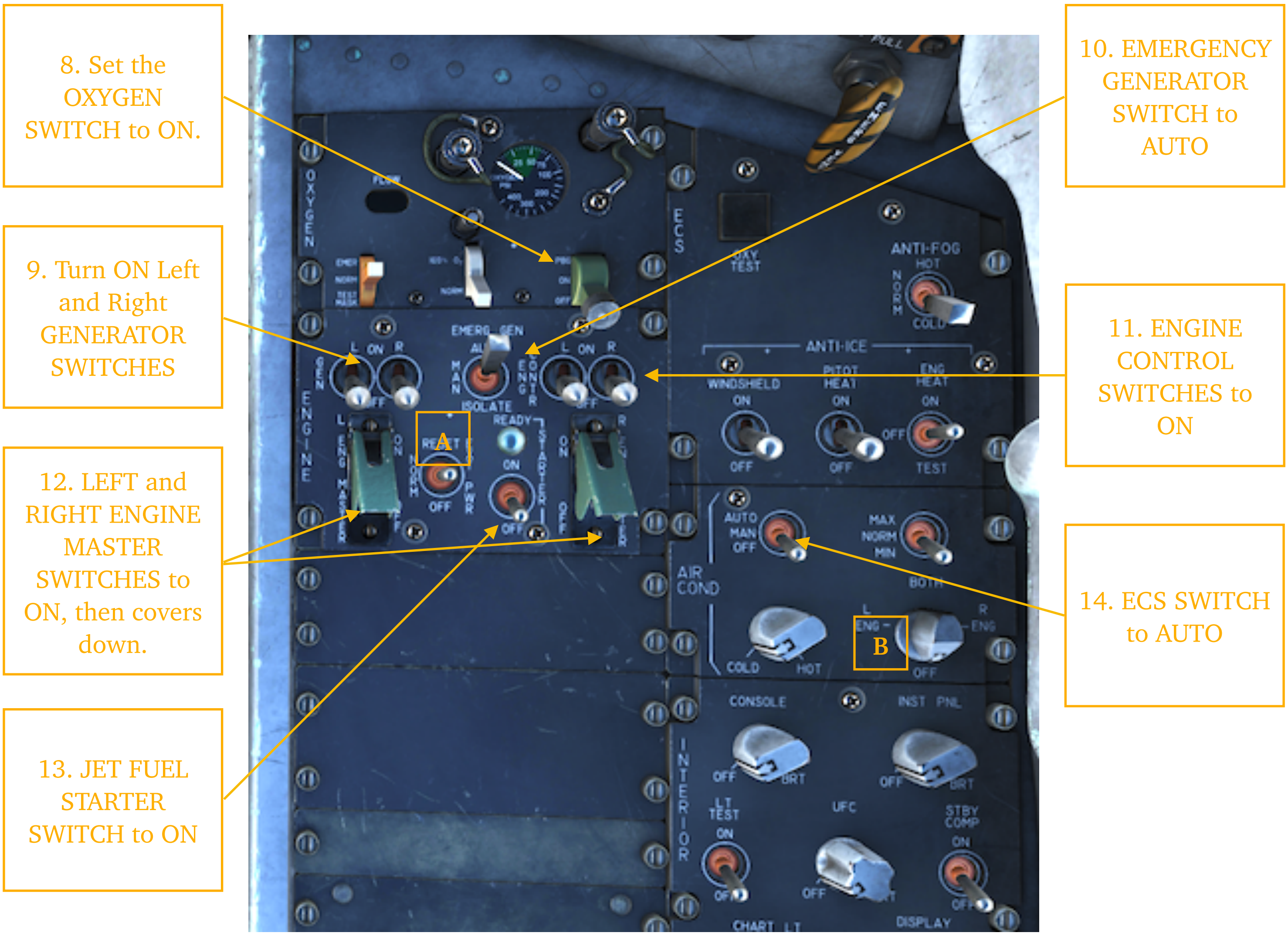


LEFT PANEL #2



Setting INLET RAMP SWITCHES allows the ramps to drop down once the necessary RPM is reached (around 60%). Below example of right ramp being already down.

RIGHT PANEL #1



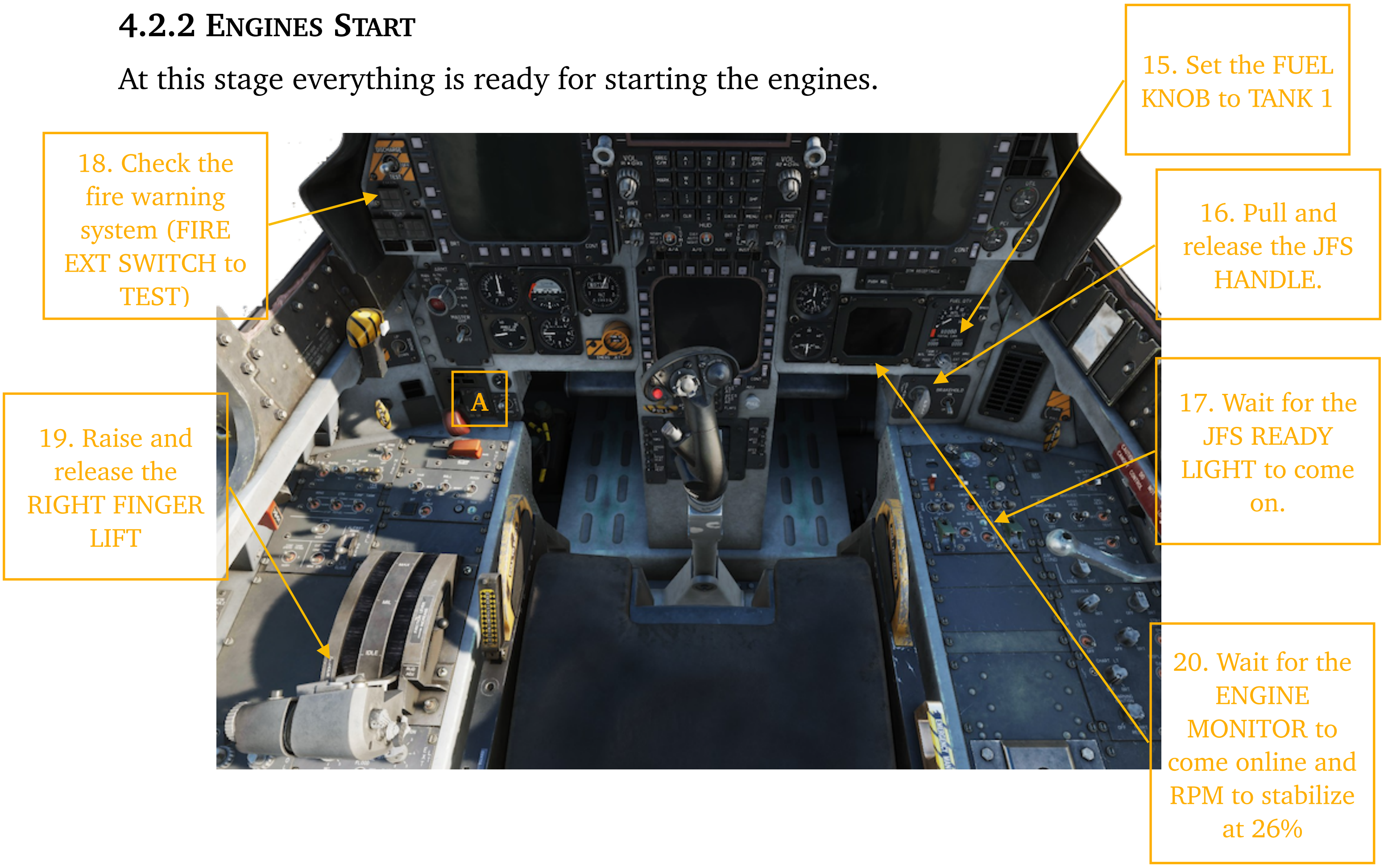
External Power Switch (**A**) should not be used until external power is connected to the aircraft, in which case it should be set to NORM.

ECS Switch (14) is important, as without setting it up the avionics will not receive proper cooling and may shut down or even get damaged.

The BLEED VALVES (**B**) should be set to BOTH already upon entering the cockpit, but their position should be verified before engine start.

4.2.2 ENGINES START

At this stage everything is ready for starting the engines.



The JFS Handle has two positions in which it can be actuated. Pulling it in vertical (default) position discharges one JFS accumulator. If it is rotated 45 degrees counter-clockwise and then pulled, it will discharge both JFS accumulators.

The JFS Ready Light comes on up to 10 seconds after the JFS Handle is pulled and remains on until the JFS shuts down.

The first Fire Warning Check is performed once the JFS is on but before spinning up the engine. At this stage the AMAD FIRE light should come on and an audible warning should be heard. The warning can be silenced using the VW / Tone Silence Switch (**A**) on the left side of the main panel.

Once the first Fire Warning Check is complete, the Finger Lift on the RIGHT Throttle should be pulled up and released, which will initiate the spooling up of the right engine. Do not move the throttle itself to IDLE at this point!

The Engine Monitor should come up when the RPM reach around 15%. The RPM will stabilize at 26%.

Right Engine Start #2

The second Fire Warning Check is performed after the RPM stabilises at 26% and before moving the right throttle to IDLE. This time AMAD FIRE and both ENGINE FIRE lights should come on with the accompanying audio warnings.

After the test, Right Throttle should be moved beyond the detent and then back to the idle position. This opens the fuel flow to the engine and after approximately 10 seconds the right engine RPM should start to rise.

At around 52-55% RPM, the JFS spools down. The ready light goes out during the engagement while the engine is starting. It comes back on upon the JFS returning to idle, indicating that it is ready to be used again.

At 57% the Right Generator should come online and the right ramp should fall down (provided that the Right Ramp Switch is set to AUTO).

Left Engine Start

The third Fire Warning Check is performed after the right engine is fully spooled up. This time AMAD FIRE, both ENGINE FIRE and LEFT and RIGHT BURN THRU lights should come on with the accompanying audio warnings.

To close the canopy, move the lever to DOWN position. Wait for it to close and then few seconds later push the lever forward to LOCK it.

With the canopy down and locked, the Finger Lift on the LEFT Throttle should be pulled up and released, which will initiate the spooling up of the left engine.

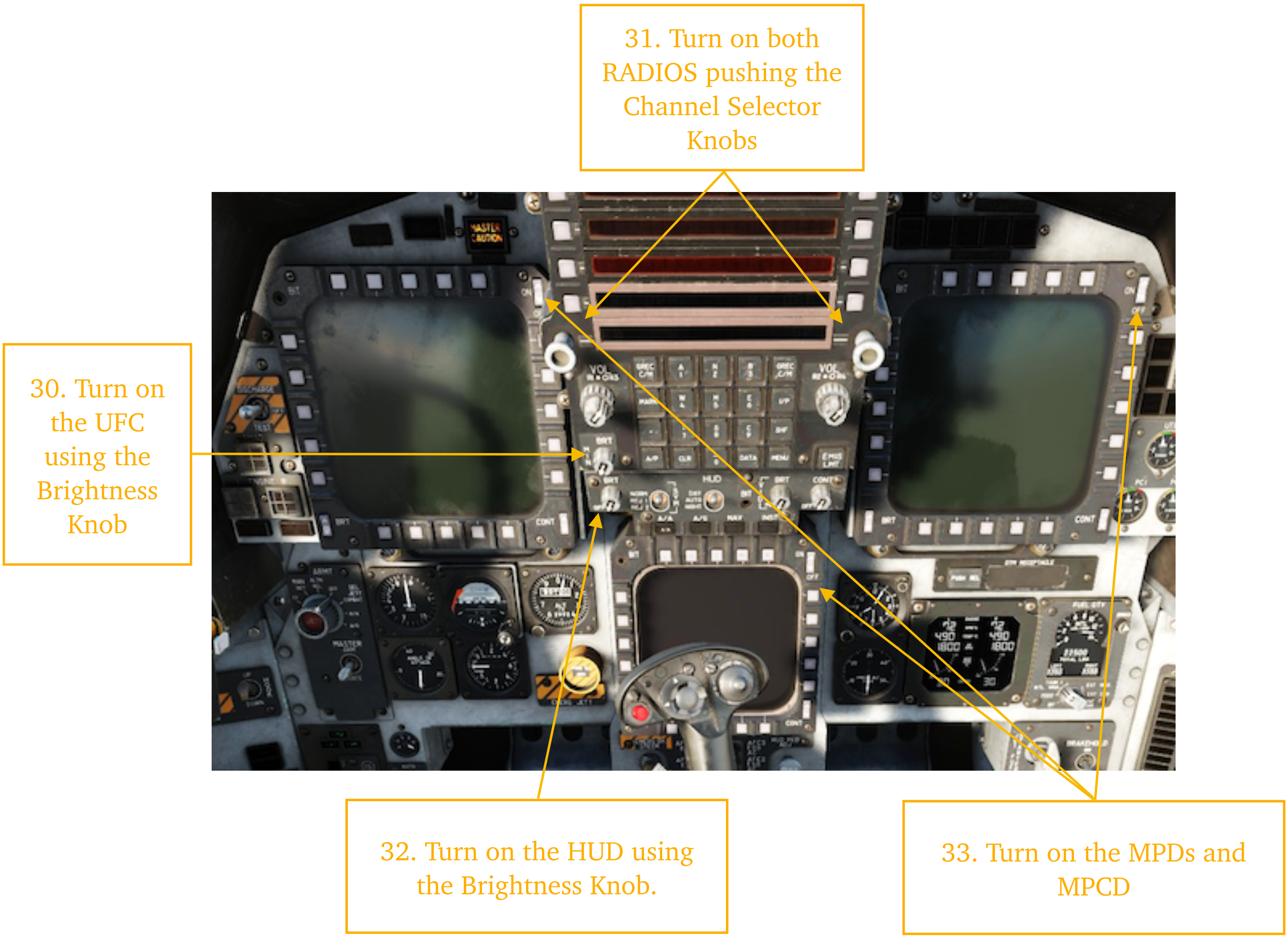
The RPM for the left engine will rise and stabilize at 26%.

At 57% the Left Generator should come online and the left ramp should fall down (provided that the Left Ramp Switch is set to AUTO).

The JFS shuts down and the JFS Ready Light goes off.

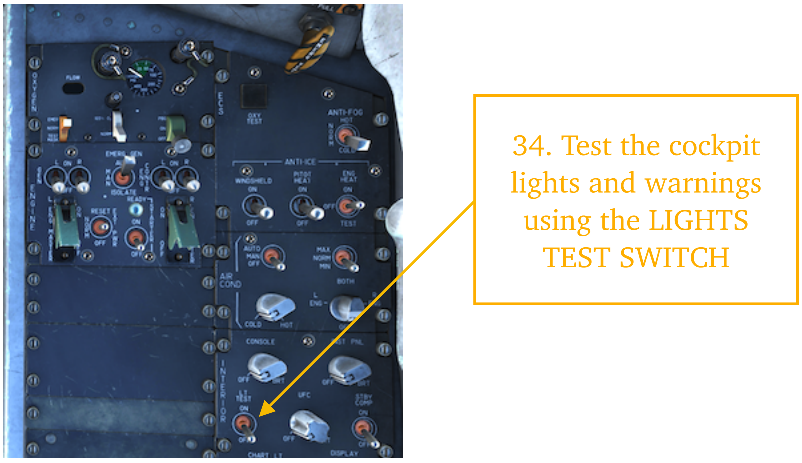
4.2.3 Systems and Sensors

With both engines running, it is time to initialise the displays and sensors.

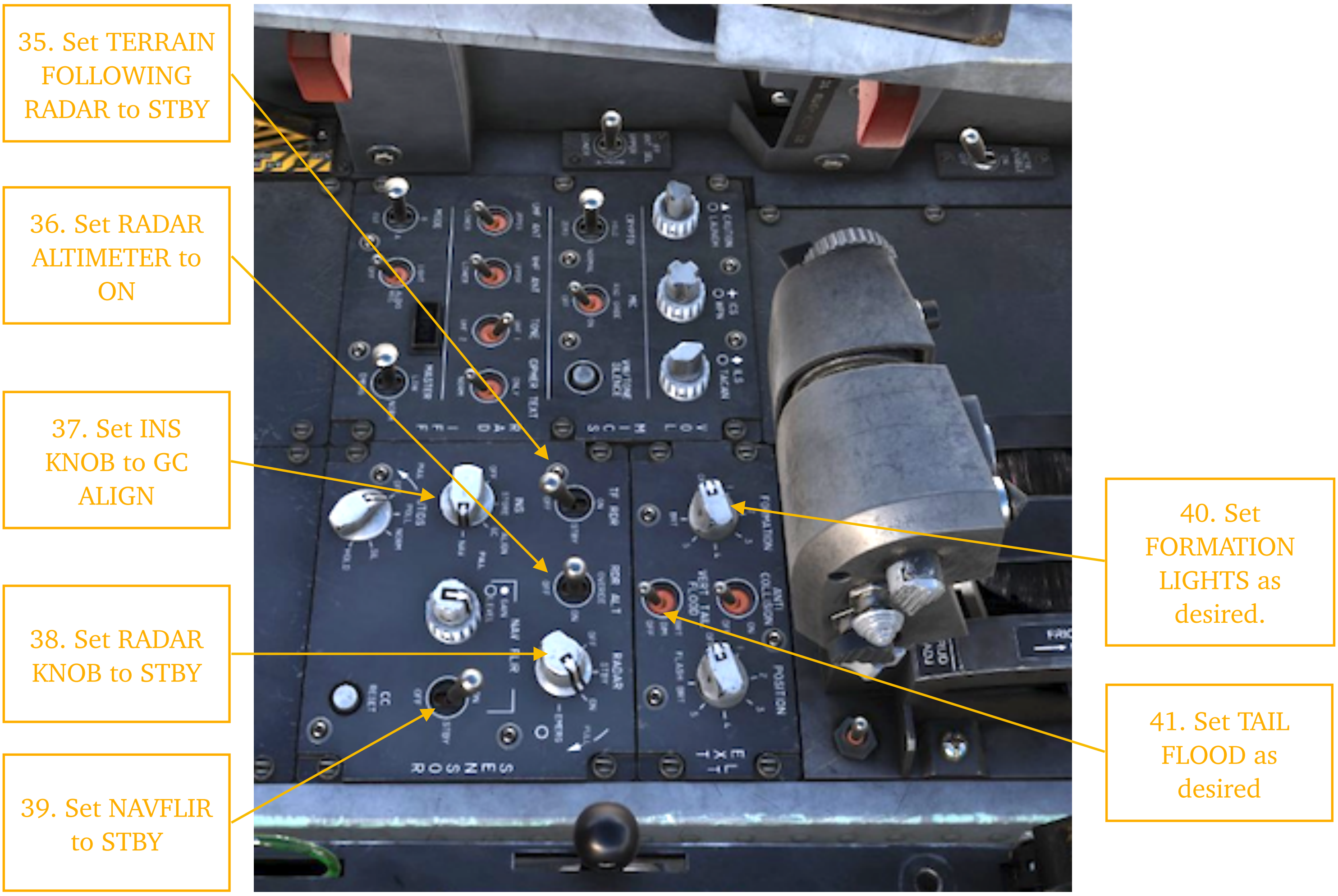


Set the brightness of the UFC and the HUD as desired depending on the conditions.

After turning on the radios it is also a good moment to set up the desired frequencies for both.



On the left panel set up the following:



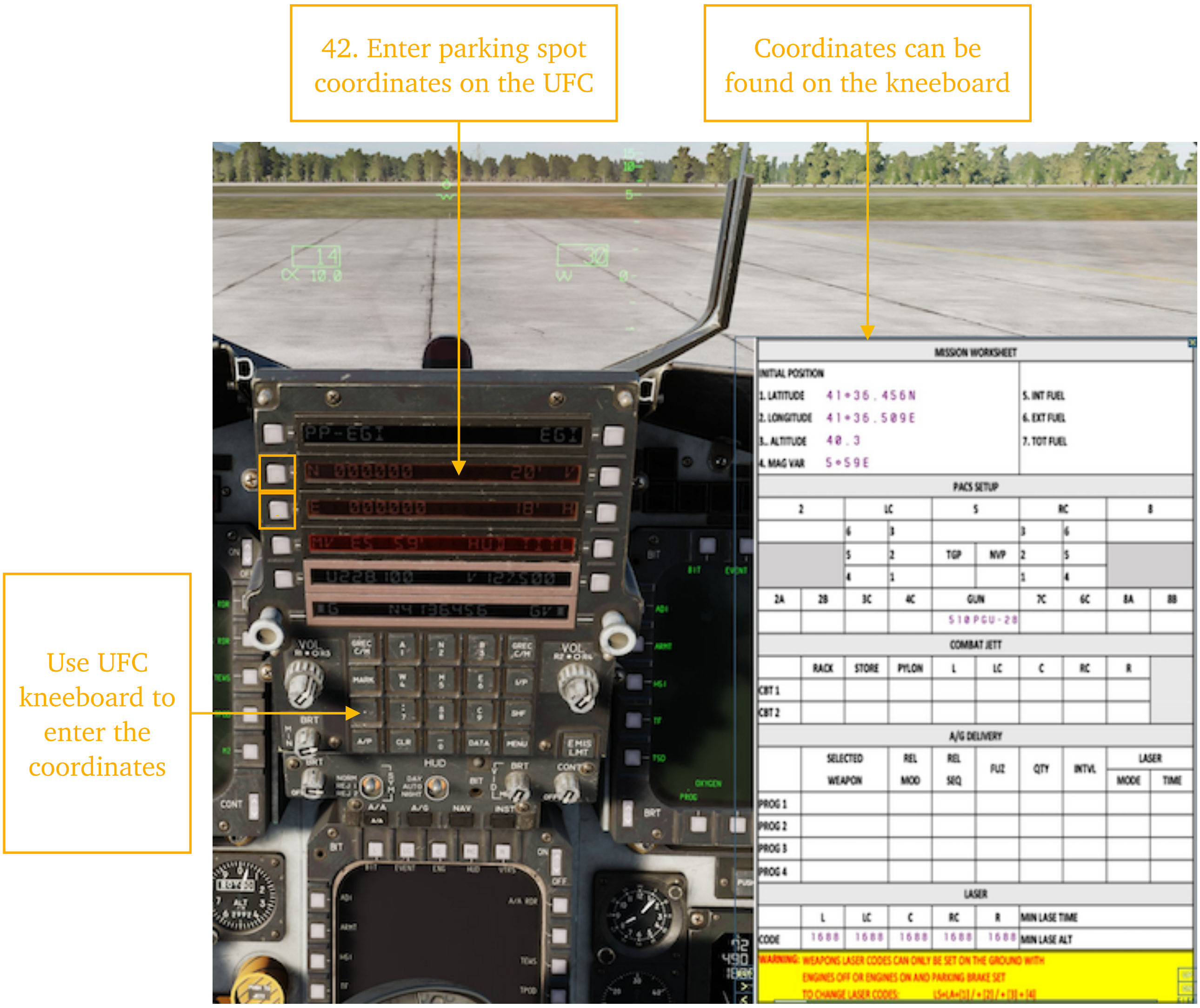
Set the Sensors in any order you like.

The Terrain Following Radar is not available at this stage of Early Access.

Lights should be set as briefed / as desired, depending on the time of day / night and meteorological conditions.

4.2.4 INS Alignment

When the INS Knob is moved to GC ALIGN position, the alignment process can start.



For proper alignment, it is necessary to introduce the parking spot coordinates into the system. These can be found on the kneeboard page.

In the example above, press SHF on the keyboard, followed by 2 for N. Then type 4 - 1 - 3 - 6 - 4 - 5 - 6 (the decimal point is not necessary) and press menu button 2 on the UFC.

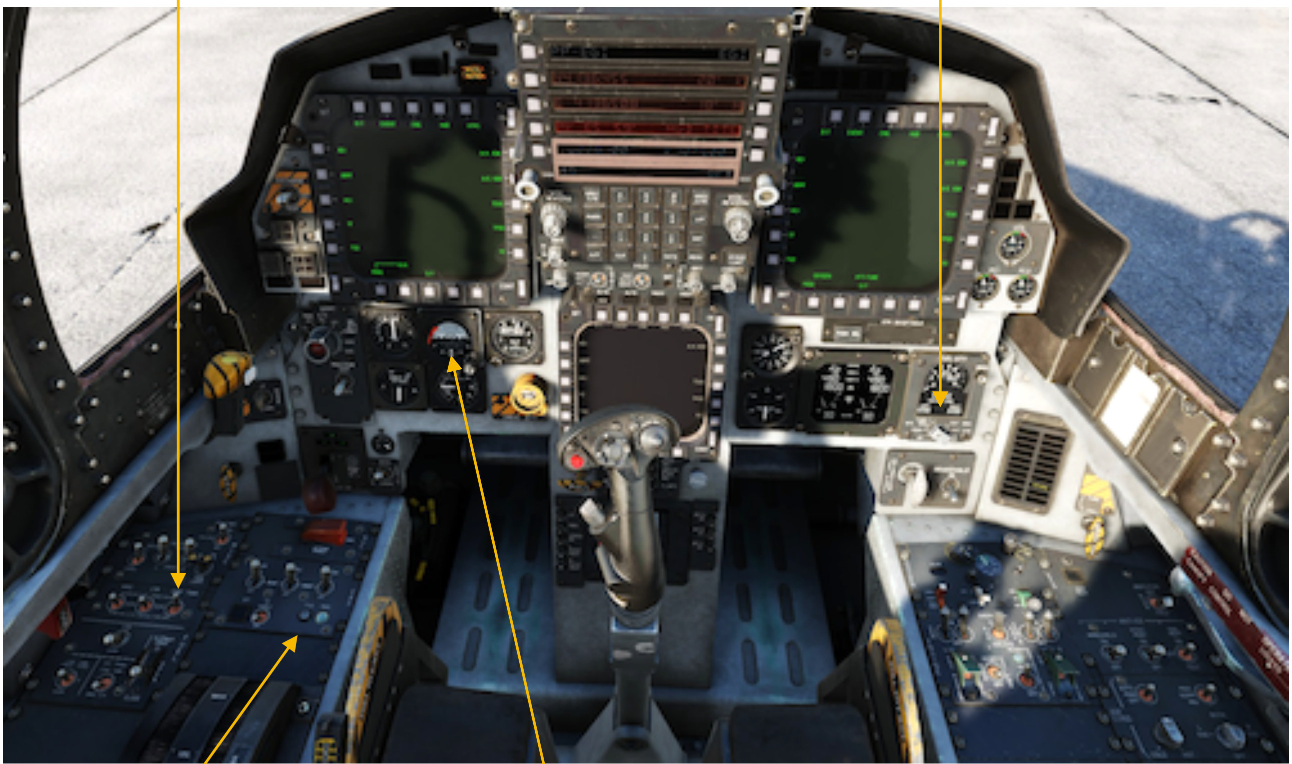
Next, press SHF again, followed by 6 for E. Then type 0 - 4 - 1 - 3 - 8 - 5 - 0 - 9 (the decimal point is not necessary, however leading '0' is) and press menu button 3 on the UFC.

Once this is done, a GC NO TAXI legend will be shown on the HUD, which will change to a decreasing alignment accuracy, until a GC OK is displayed on the HUD after more or less four minutes.

NOTE: in current version of the module it is not needed to enter the coordinates.

4.2.5 Other steps

While the INS is aligning, it is a good time to prepare the displays, including sequence programming (see this section for more details), setting up the master modes, as well as PACS programs. Other steps that should be followed include:



The T/O TRIM button should be pressed and held until the audible warning is heard and the light turns on.

Once GC OK is displayed on the HUD, set the INS KNOB to NAV.

4.3 AIRCRAFT STARTUP - REAR COCKPIT

These checks should be performed after entering the cockpit. Switch position designated AS DESIRED allows the aircrew to set it accordingly to their preferences. AS REQUIRED means that the switches should be set in accordance with the circumstances and the mission to be flown.

Relevant checklist for this part of the manual can be found in the Appendixes.

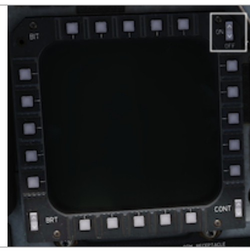
4.3.1 BEFORE TAXIING (REAR COCKPIT)

1

Press the Lights Test switch (3) and check if all the warning and caution lights function properly.

2

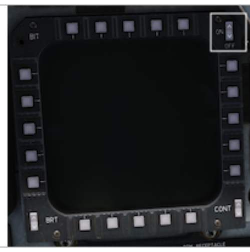
Turn on the left and right MPCDs and MPDs.



3

Confirm the INS / EGI is aligning.

Usually the WSO does the alignment steps once the pilot turns on the INS knob to GC align.



4

Set the Sensor Panel.

1. TGT FLIR switch to STBY.
2. Make sure that the LASER switch is SAFE.

5

Program the radar according to briefing / mission parameters.

6

Set up the armament on the PACS page according to briefing / mission parameters.

7

Set up / check the oxygen system. Set the Oxygen Flow Lever to ON. Check that the FLOW window functions normally.

8

Uncage the Standby Attitude Indicator.

9

Set the altimeter to match the pressure at the airport.

Also check that all the warning and caution lights are off.

4.4 Taxiing and Takeoff

This part will be covered for both front and rear cockpit, although the majority of tasks is performed from the front seat, with the WSO acting as backup and making sure that some of the checklists items are performed. Where applicable, (P) will indicate pilot, (W) will indicate the WSO and (B) will mean both cockpits.

1 Release the Holding Brake and as the aircraft starts to roll, apply the brakes and check if they work properly. When clear, actuate nose gear steering in both directions to ensure proper operation. Both aircrew should also check the flight instruments and warning lights. You may want to close the canopy at this stage.

2 Advance the throttle enough to start moving again and taxi via the assigned taxiways to the designated runway. During taxi, check all the flight instruments. At high gross weights, make sure to perform all turns at minimum practicable speeds and maximum practicable radius. At low gross weight, closely monitor your taxi speed, as there may be excess thrust at idle throttle position.

Stop short of the designated runway and perform the following steps:

1. (P) Set the HOLDING BRAKE.
2. (P) Confirm that Inlet Ramp Switches are in AUTO
3. (B) Check that the Ejection Control Safety Lever is ARMED.
4. (W) Set the Command Select Valve AS BRIEFED
5. (B) Check for free flight controls movements.
6. (B) Check that the flaps are DOWN.
7. (P) Check / press the T/O Trim button.
8. (B) Check that the canopy is CLOSED and LOCKED.
9. (W) Turn on the IFF.
10. (P) Set the CFT Switch to NORM.
11. (P) Set the RADAR to ON.
12. (W) Confirm TGT POD switch is set to STBY, confirm the TGP is stowed.
13. (P) Set the PITOT HEAT and ENGINE HEAT switches as required.
14. (B) Check there are no warning, cautions or BIT lights on.
15. (P) Make sure INS is in NAV.

3

NOTE: The ENG HEAT switch should not be enabled unless flying in conditions where icing is possible. Once clear of icing conditions, it should be set back to OFF.

4 Release the HOLDING BRAKE and enter the runway. Set up in the middle and stop the aircraft by applying and holding the toe brakes.

5 Advance engines to 82% and check the instruments and caution / warning lights. When ready for takeoff, release brakes and advanced the throttles to MIL or MAX power (as desired).

6 After reaching the rotation speed, smoothly move the stick to around 1/2 aft position to establish a 10º pitch attitude. Retract gear and flaps when airborne. Usually 1-2 clicks of nose down trim is required after liftoff to compensate for the T/O trim nose up attitude.

7 Climb out keeping 350 KCAS (with heavy loadout / high drag index 300 KCAS) to 0.90 Mach in MIL power. Then maintain 0.90 Mach until cruise altitude.

Climb out keeping 350 KCAS to 0.95 Mach in MAX power (with heavy loadout / high drag index to 0.90 Mach). Maintain the Mach utnil cruise altitude.

Relevant checklist for this part of the manual can be found in the Appendixes.

4.5 LANDING

The landing procedure will start with a descent check, the landing itself (using the overhead break), before landing checklist and the after landing checklist. Special situations, like high crosswind landing or no flap landing will also be covered.

4.5.1 DESCENT CHECK

Perform the following steps during the descent to the airfield:

1. (P) Make sure that the Master Arm Switch is SAFE.
2. (W) Set the CMD Mode Knob to OFF.
3. 1 (B) Set up and check standby altimeters.
4. (W) Set the Targeting Pod Switch to STBY.
5. (P) Set the TF Radar Power Switch AS REQUIRED.
6. (P) Set the PITOT HEAT / ENG HEAT Switches AS REQUIRED.
7. (P) Set up external lights.

4.5.2 LANDING USING AN OVERHEAD BREAK

2 After contacting the Tower, fly over the runway at set altitude (the standard USAF overhead pattern is 1600 feet AGL) and speed (minimum 300 knots).

When you reach the desired break point, break left or right. You may need to extend the airbrake if going too fast. Roll out on the reciprocal heading and put the wingtip
3 on the runway (a perfect position is putting the runway between the wingtip and the outside missile rails).

4 On downwind (flying parallel to the runway, around 1.5 NM away from it) your speed should fall to 250 knots. Extend flaps and gear.

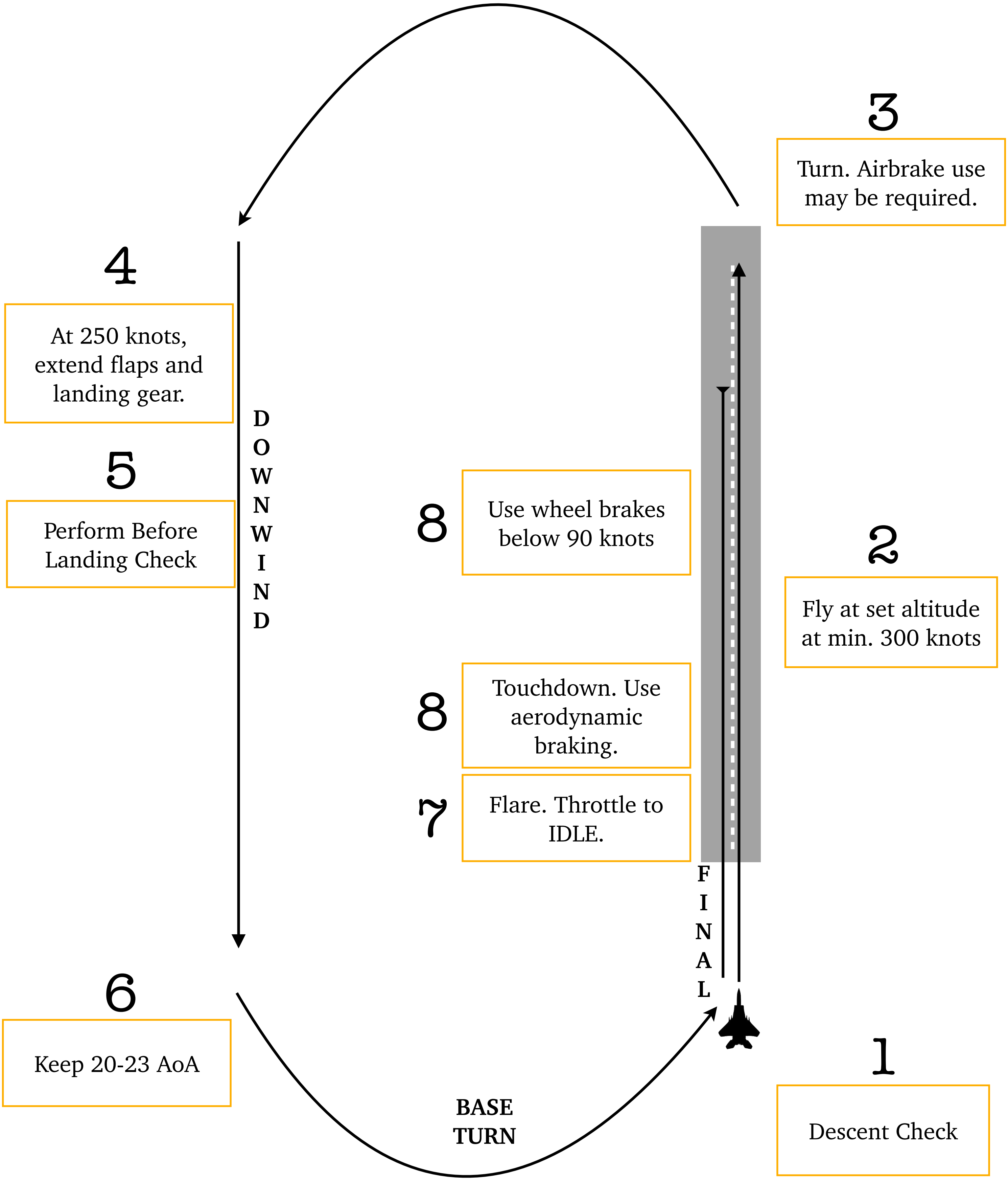
5 Perform Before Landing Checks.

6 On base turn, reduce the speed further to arrive on final with on-speed AOA of 20-22 units.

7 When you reach the flare point, retard the throttle to idle and reduce the rate of descent. Do not raise the nose too high, as this may lead to tail or engine ground contact.

8 After touchdown, keep the nose at 12° for best aerodynamic braking. Use wheel brakes once the nose wheel is on the ground.

OVERHEAD BREAK



4.5.3 Before Landing Checks

Perform the following steps on downwind:

1. (B) Verify that the landing gear is down and locked.
2. (B) Verify that the flaps are down.
3. (P) Check the hydraulics gauges.
4. (P) Turn on the landing light.
5. (P) Set the Anti-Skid to NORM position.
6. (P) Verify that the Holding Brake is set to OFF.

4.5.4 Crosswind Landing

It is not recommended to land if the crosswind exceeds 30 knots. A normal pattern should be flown having in mind the need to adjust it in such a way so as to avoid excessively shallow or steep base turns.

On final, using the rudders establish a wings-level crab into the wind in order to counteract the drift. Hold the crab through the touchdown, maintain the ground track with the rudder and use aileron into the wind to stay wings-level. Be careful when performing the aerodynamic braking, avoid pitch attitude higher than 10 degrees. If the crosswind is above 25 knots, use maximum anti-skid braking.

4.5.5 After Landing

Perform the following steps after leaving the active runway:

1. (B) Check that he ejection controls safety levers are LOCKED.
2. (W) Set Command Selector Valve to NORMAL.
3. (P) Retract the Speed Brake.
4. (P) Retract the flaps.
5. (W) Turn of the IFF.
6. (P) Set Radar Power Knob to STBY.
7. (P) Set Terrain Following Radar to OFF.
8. (W) Turn OFF the TACAN.
9. (P) Set JTIDS Mode Knob to OFF.
10. (P) Press and hold the T/O Trim Button.
11. (P) Switch from Landing to Taxi light.
12. (P) Turn OFF the formation lights.
13. (P) Turn OFF the Pitot Switch and Windshield Switches.

14. (P) Set Engine Heat switch AS REQUIRED.
15. (P) Set Radar Power knob to OFF.

4.5.6 Shutdown

After taxiing to the assigned parking spot, the following steps should be performed:

1. (P) Set Holding Brake to ON.
2. (P) Turn off the Video Recorder.
3. (B) Turn of the LANTIRN pods.
4. (W) Turn off TEWS.
5. (B) Turn all avionics systems OFF (AAI, ILS, Sensors, HUD, INS) before engine shutdown to avoid false BIT warnings.
6. (B) Turn MSOGS (oxygen system) OFF.
7. (P) Set both throttles to OFF.

NOTE: It is advised to keep the engines at IDLE at least for 5 minutes before shutting them down to reduce the likelihood of post-shutdown auto ignition.

Relevant checklist for this part of the manual can be found in the Appendixes.

CHAPTER 5: UPFRONT CONTROLS (UFC)

5.1 INTRODUCTION

The upfront controls in the front and rear cockpit are the major interface units for control of avionics subsystems. The UFC consists of 10 function buttons, six 20-character rows of display, four radio volume controls, two rotary switches, a 20-key data entry keyboard, a rotary brightness control knob, and an EMIS LMT pushbutton.

This chapter will cover the following items (click on the pictures to move directly to selected section):


UFC Overview: General description of the UFC, the LCD lines and buttons / keyboard.


MENU 1 Display: Allows the aircrew to control numerous systems, such as IFF, TACAN, NAVFLIR, Law Altitude Warning, Terrain Following Radar and autopilot.


MENU 2 Display: Controls another set of systems, including INS and EGI, ILS, JTIDS (Joint Tactical Information Distribution System) and bullseye point.


DATA 1 Display: Used mostly for information purposes, it contains data related to true and ground airspeed, aircraft position in relation to selected steer point, wind, time and altitude.


DATA 2 Display: This display contains NAV data functions which provide the capability to determine look ahead information such as remaining fuel, ETE and ETA.


UHF and V/UHF Radios: Contains information about different functions and modes of functioning of the onboard radios.

5.2 UPFRONT CONTROL OVERVIEW

The Upfront Control in front and rear cockpit look and work exactly the same. Moreover, any data entry in either cockpit is visible on the display in the other one. UFC provides control of numerous systems, including the INS and navigation, TACAN, Auto pilot, Terrain Following, IFF (Identification Friend or Foe), ILS (Instrument Landing System), NAV FLIR and GCWS (Ground Collision Warning System). Press on the relevant knob / button to go to more detailed description.

Six Row Liquid Crystal Display (LCD) each with maximum 20 characters it can display. Rows 5 and 6 (with brown frame) are exclusively used for the radios. Pushbuttons 1 to 10 (going counter-clockwise from top left to top right) are used to select / interact with menu items displayed in each row.

Left / Right Channel Select Knobs are used to turn on the radios and select preset radio frequencies.

R1 / R3 and R2 / R4 Volume Knobs control the volume for the selected radio. Outer knobs are used for R1 / R2 and the inner, larger ones for R3 / R4 respectively.

NOTE: Only R1 and R2 are simulated in current version of the module.

Brightness Knob controls brightness of the LCDs.

Emission Limit Key limits electronic emissions from the aircraft for passive operations.

Guard Receiver (GREC), Channel / Manual Key enables guard monitoring for left or right radio or switches between manual frequency and preset channel mode of operation. See UHF and V/UHF Radios section for more information.

0 - 9 / Letter / Symbol Keys are used to enter digits into the scratchpad. When shift (SHF) key is pressed, the upper case functions for each key are enabled, allowing to enter the following letters: A, N, B, W, M, E, S, C, as well as colon (:) and and dash (-).

Mark Key marks and selects marked point for display.

Decimal Point (.) Key enters decimal point into scratchpad.

NOTE: For input of most of the data use of Decimal Point key is not necessary, as the system enters it automatically.

Autopilot Key selects autopilot format and couples the autopilot.

Clear Key performs different functions depending on the UFC condition:

> If the scratchpad is empty, pressing CLR will blank the four top LCD rows.
>
> If the scratchpad is empty and four top LCD rows are blank, pressing CLR will also blank the two bottom rows.
>
> If there is one digit entered in the scratchpad, pressing CLR will clear the selection.
>
> If there is more than one digit entered in the scratchpad, pressing CLR will clear the last digit entered. Pressing it again will clear all the digits.

I/P Key initiates IFF identification of position.

Shift (SHF) Key enables upper case function of the next key pressed.

Data Key selects data display format (DATA 1 or DATA 2, see below). Data pages mostly present the aircrew with reference / information and generally do not allow additional inputs or edits.

Menu Key selects menu format (MENU 1 or MENU 2, see below). Menu pages allow the aircrew to introduce new or change existing data.

5.3 UFC MENU 1 DISPLAY

Pressing MENU Key once brings up the following display on the UFC. Press the associated pushbutton to move to the detailed description of each of the functions.

5.3.1 LOW ALTITUDE WARNING (PB 1)

If a number is shown, it indicates the low altitude warning system (LAWS) has been enabled and the voice warning and light are activated if the aircraft first climbs above and then descends below the altitude (AGL) displayed. The LAW altitude is changed by keyboard entry into the scratchpad and pressing the pushbutton next to LAW (based on CARA). The LAW is turned off by pressing PB 1 with a blank scratchpad.

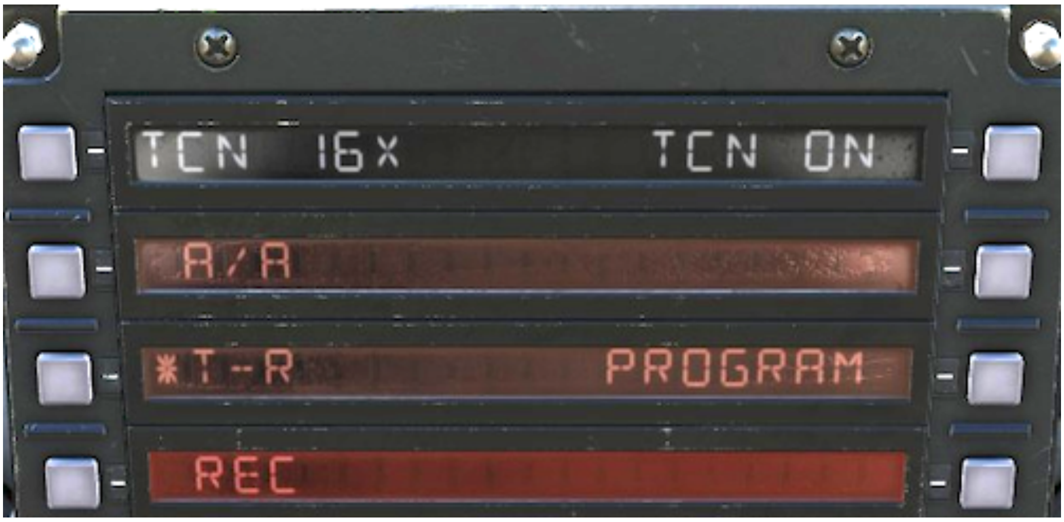
NOTE: It is currently not possible to choose the altitude using the scratchpad. The system can only be set to ON (250 feet) or OFF.

5.3.2 TACAN (PB 2)

Pressing PB 2 brings up the TACAN menu.

Info next to PB 1 shows the currently selected TACAN channel. To change it, a new number should be entered in the scratchpad. After pressing PB 1, this channel will be set and the TACAN will automatically enter into the T-R mode (marked with asterisk next to it), with TCN ON information displayed next to PB 10.

Pressing PB 1 in this view switches between the X and Y modes.



Pressing the PB 8 (PROGRAM) opens another page which allows to enter additional data for the TACAN station.

NOTE: The PROGRAM page for TACAN is currently not functional.

5.3.3 IFF (IDENTIFICATION FRIEND OR FOE, PB 3)

Pressing PB 3 brings up the IFF page.

This page allows crew member to select the appropriate mode of operation, as well as the code for Mode 3.

NOTE: The IFF system is not fully modelled in DCS and the options for different modes are not implemented in the current version of the module.

5.3.4 TERRAIN FOLLOWING (PB 4)

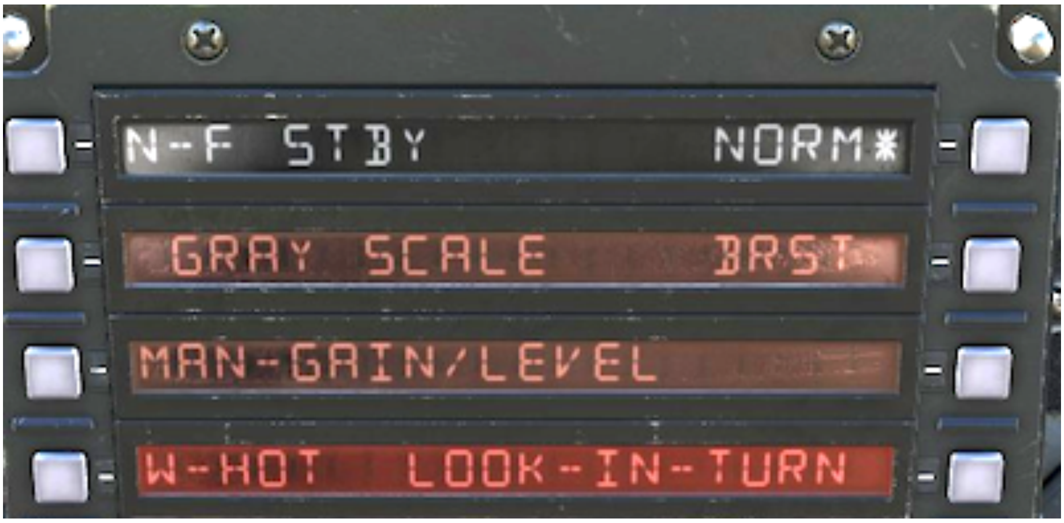
Data next to PB 4 shows the status of the Terrain Following radar.

NOTE: The Terrain Following radar is not available in the current version of the module.

5.3.5 NAV FLIR (PB 7)

Data next to PB 7 indicates the current status mode of the LANTIRN navigation FLIR: OFF, N/R (not ready), STBY (standby), NORM (normal) or BRST (boresight).

When pressed with empty scratchpad, the following menu appears:



N-F (PB 1): indicates the current status of the LANTIRN navigation FLIR as described above.

GRAY SCALE (PB 2): when selected, displays the gray scale across the bottom of the HUD in order to adjust the HUD contrast / brightness.

MAN - AUTO GAIN / LEVEL (PB 3): switches between manual and auto gain / level of the navigation FLIR display.

W-HOT / B-HOT (PB 4): switches between white hot and black hot polarity of the FLIR video.

LOOK-IN-TURN (PB 7): enables selection of the look into turn function, where the pod automatically positions its line of sight 6° in the direction of turn when the bank angle is greater than 33°.

BORESIGHT (PB 9): used to boresight the pod to align with the nose of the aircraft / real world image through the HUD.

Refer to the NAV FLIR section in HUD Chapter for more information.

5.3.6 AAI / EID (IFF MODES, PB 8)

Indicates the radar interrogation modes. Refer to AAI section for more information.

NOTE: Only Mode 4A/B is fully simulated in DCS.

5.3.7 AUTOPILOT (PB 9)

Indicates if the autopilot is engaged and current steer mode. If pressed with empty scratchpad, it displays the autopilot submenu.

The autopilot submenu provides the means of coupling the current aircraft steer mode and altitude mode. When the autopilot is engaged the autopilot status (same as menu 1) is displayed centered on the top line. If A/P is not engaged, A/P OFF is displayed instead.

The autopilot can be engaged in the basic mode by pressing the A/P Key on the UFC. It can also be coupled with one of the five steer modes: heading select, navigation, ground track, course or tacan, which is done by selecting the appropriate mode from HSI display format.

For more information, please refer to Autopilot section in Navigation chapter.

5.3.8 SEQUENCE POINT (PB 10)

Text next to PB 1 indicates the currently selected sequence point (which can be a steer point, aim point, target point, offset point, mark point, base point, bullseye point or avoidance point). Steering to a new point is selected by typing the desired point in the scratchpad and pressing this pushbutton. If PB 1 is selected with a blank scratchpad, it displays the point - data submenu.

Selected Sequence Point (PB 1): displays the currently selected sequence point.

LAT / LONG Coordinates (PB 2-3): shows the latitude and longitude of the currently selected sequence point.

UTM (PB 4): when pressed, opens the separate UTM sub-menu, which displays the sequence point coordinates as grid.

Elevation (PB 7): displays the elevation of the selected sequence point in feet.

Minimum Enroute Altitude (MEA, PB 8): only applies to steer points and target points and is a function of the terrain following radar.

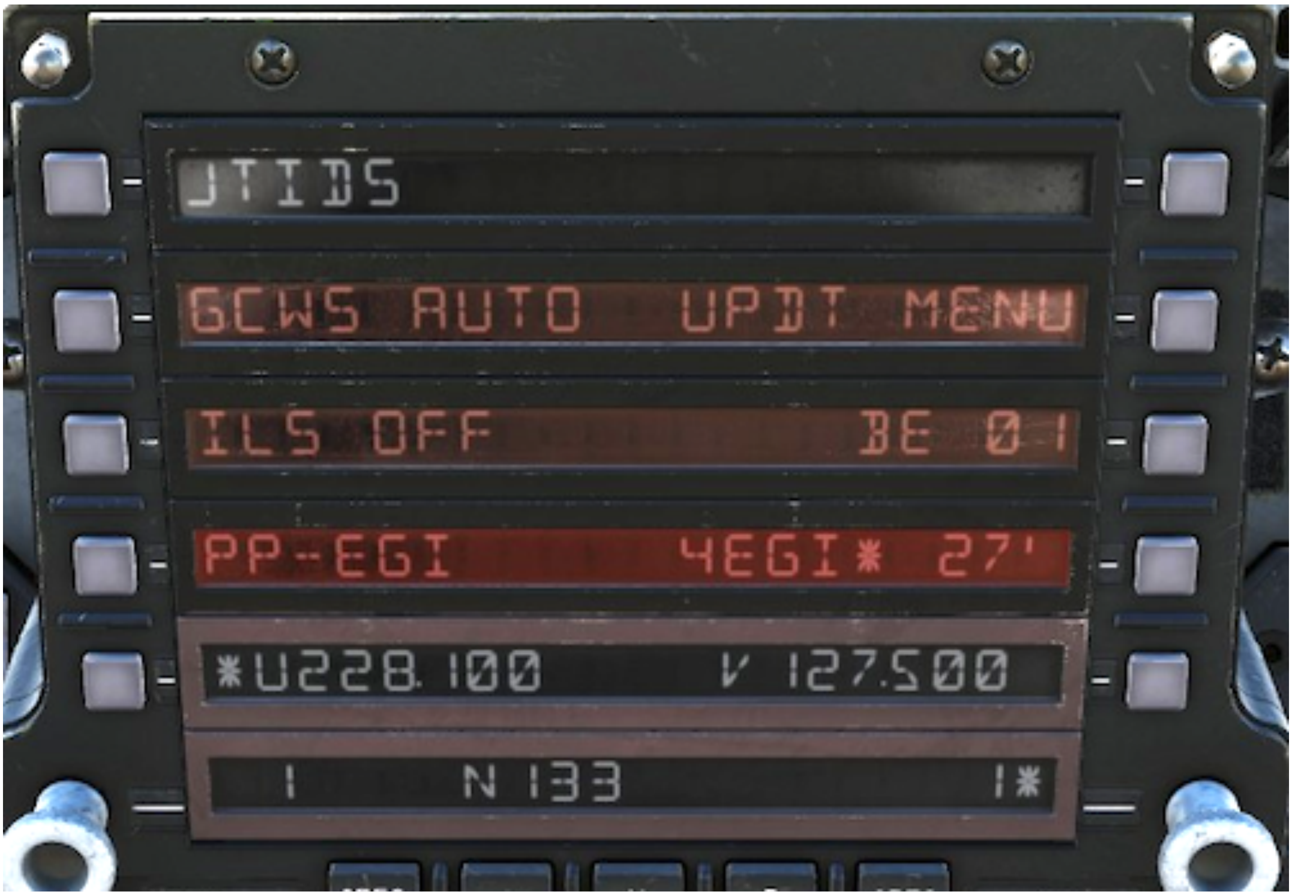
Time on Target (PB 9): displays the set Time on Target for each steer point and target point.

List (PB 10): a list point can be married to sequence point at PB 1 by typing the list point into the scratchpad and pressing PB 10.

More information about sequence point can be found in the Navigation chapter.

5.4 UFC Menu 2 Display

Pressing MENU Key for the second time brings up the following display on the UFC. Press the associated pushbutton to move to the detailed description of each of the functions.



5.4.1 Joint Tactical Information Distribution System (PB 1)

Pressing this pushbutton selects the JTIDS submenu.

NOTE: the JTIDS is not available in current version of the module.

5.4.2 Ground Collision Warning System (PB 2)

Indicates the status of the ground collision warning system as follows:

ON: GCWS warnings are enabled.

AUTO: GWCS warnings are enabled if not in INST master mode and operating between 5000 feet and 400 feet AGL.

ADV: GWCS warnings are disabled and an advisory is displayed only on the HUD.

OFF: GWCS warnings are disabled and no advisory is displayed.

Pressing PB 2 switches between the modes mentioned above.

5.4.3 INSTRUMENT LANDING SYSTEM (PB 3)

Pressing this PB with empty scratchpad powers up the ILS system and enters the last used ILS frequency. In order to change the frequency, crew member should type the new value into the scratchpad (with or without the decimal point) and then press the PB 3 again. Another press of PB 3 disables the ILS.

More information about using the ILS can be found in the ILS section of the Navigation chapter.

5.4.4 PRESENT POSITION KEEPING SOURCE (PPKS, PB 4)

Indicates the current position keeping source. Refer to Navigation section for more information.

5.4.5 EMBEDDED GPS / INS (EGI) STATUS (PB 7)

Indicates the status of the EGI. The digit before EGI indicates the number of satellite measurements being incorporated into the EGI blended solution (between 0 and 4). The digit after 'EGI' is the spherical position error in feet. Other indications include types of alignment: Gyro Compass Align (GCA), Stored Heading Align (SHA) or In Motion Align (IMA).

5.4.6 BULLSEYE (BE, PB 8)

Shows current Bullseye point. Also allows the crew members to choose another BE using the scratchpad (between 1 and 10) or choosing current steer point (in which BE STR is displayed next to PB 8).

5.4.7 UPDATE MENU (BE, PB 9)

When pressed, selects the INS update submenu. Current position can be updated using different methods: by comparison with EGI data, visual position (overfly or HUD updates), radar ground target position or targeting pod line of sight.

NOTE: INS update is not implemented in the current version of the module.

5.5 UFC DATA 1 DISPLAY

Pressing DATA Key once brings up the following display on the UFC. You may press the associated pushbutton to move to the detailed description of each of the functions.

5.5.1 BEARING / RANGE TO STEER POINT (PB 1)

Shows magnetic bearing and range (in Nm) to currently selected steer point. This point is shown next to PB 10 (steer 1A in this case).

5.5.2 ESTIMATED TIME OF ARRIVAL / ENROUTE (PB 2)

Pressing PB 2 switches between Estimated Time of Arrival display (which shows exact time when aircraft will arrive over currently selected steer point provided that speed remains unchanged) and Estimated Time Enroute (time left before aircraft arrives over currently selected steer point).

NOTE: the time format not displayed on the UFC will be shown on the HUD, HSI and the TEWS displays. So if ETA is selected in UFC, ETE will be visible on other displays.

5.5.3 TRUE SPEED (PB 3)

This field shows the true speed of the aircraft in knots. The asterisk next to it indicates that true airspeed is also enabled in HUD. Pushing PB 3 again disables the HUD true airspeed display.

5.5.4 GROUND SPEED (PB 4)

This field shows the ground speed of the aircraft in knots. The asterisk next to it indicates that ground airspeed is also enabled in HUD. Pushing PB 4 again disables the HUD ground airspeed display.

NOTE: true and ground airspeeds cannot be simultaneously displayed on the HUD and ADI. Selecting the speed that is not currently displayed automatically deselects the displayed one. In addition, if you deselect the currently '' selection, it will remove that speed display from the HUD.*

5.5.5 WIND DIRECTION AND SPEED (PB 7)

Indicates the magnetic wind direction and speed, measured in real time.

5.5.6 TIME (PB 8)

Shows current time. The default time loaded at CC (Central Computer) power up is the GPS time, but it can also be introduced manually be the crew members by typing correct time into the scratchpad and pressing PB 8.

For ZULU time, the entry should be preceded by M (so: M 133000 will introduce the Z time of 13:30:00).

NOTE: manual time entry is not enabled in this version of the module.

5.5.7 CARA ALTITUDE (PB 9)

Indicates the CARA altitude. The asterisk indicates the CARA altitude is also enabled on the HUD and ADI displays.

NOTE: The AN/APN-232 CARA (Combined Altitude Radar Altimeter) is the standard US Air Force Radar Altimeter, used in C-5, C-17, C-130, OC-135, C-141, F-111, F-15, F-16, MH-53, T-43 and UH-1N aircraft.

5.5.8 CURRENT STEER POINT (PB 10)

Indicates currently selected steer point. To change it, type the new steer point into the scratchpad and press PB 10. Pressing PB 10 with a blank scratchpad accesses the point data submenus

More information about sequence point can be found in the Navigation chapter.

5.6 UFC DATA 2 DISPLAY

Pressing DATA Key for the second time brings up the DATA 2 display on the UFC. It mostly contains NAV data functions which provide the capability to determine look ahead information such as remaining fuel, ETE and ETA etc.

These calculations are based on the following assumptions:

A. The aircraft is flown from the present position to the steer point / target point displayed next to PB 1.

B. The aircraft is then flown to all subsequent steer points / target points between PB 1 and PB 3's sequence points.

C. All turns are made at 45° bank angle.

D. Ground speed remains constant.

E. Fuel flow remains constant.

You may press the associated pushbutton to move to the detailed description of each of the functions.

NOTE: DATA 2 page functions are mostly not implemented in current version of the module.

5.6.1 Selected Sequence Point (PB 1)

Displays a steer or target point chosen by the aircrew, which has to be equal or greater than the one the aircraft is currently flying towards. They are identified with SP preceding the steer / target point number. The information which is displayed next to PB 9 (ETA) and PB 10 (fuel remaining / range and bearing) relates to the PB 1 sequence point.

5.6.2 Ground Speed (PB 2)

Shows the current ground speed of the aircraft.

5.6.3 Selected Look Ahead Point (PB 3)

Displays a steer or target point chosen by the aircrew, which - as in case of PB 1 - needs to be equal or greater than the one the aircraft is currently flying towards. The information which is displayed next to PB 4 (Commanded Ground Speed), PB 7 (Time of Arrival / Time on Target) and PB 8 (fuel remaining) relates to the PB 3 sequence point.

The relation between PB 1 / 3 and 7-10 is shown in the picture below:

5.6.4 COMMANDED GROUND SPEED (PB 4)

If there is a Time on Target (TOT, PB 7) set for the sequence point displayed next to PB 3, this display is asterisked and displays the ground speed required to arrive on set time at sequence point at PB 3. If there is no associated TOT, OFF is displayed instead.

5.6.5 TIME OF ARRIVAL / TIME ON TARGET (PB 7)

The Time of Arrival (ToA) shows the time at which the aircraft will arrive over sequence point at PB 3, provided that the assumptions listed in the beginning of this section are true. If they are not, the ToA will be constantly changing to accommodate to new conditions.

The Time on Target (ToT) can be set by the aircrew and remains constant. It also used to determine the required ground speed displayed next to PB 4. The ToT can be changed by typing the new value in the scratchpad and pushing PB 7.

NOTE: unlike ToT changes done in the point data submenu, changing the ToT in PB 7 on DATA 2 menu does not affect the ToT of any other sequence points.

5.6.6 FUEL REMAINING AT PB 3 (PB 8)

Displays the amount of fuel remaining (in lbs) upon arrival at sequence point displayed next to PB 3.

5.6.7 ESTIMATED TIME OF ARRIVAL / ESTIMATED TIME ENROUTE (PB 9)

Toggles between the ETE or ETA to the PB 1 sequence point from the aircraft's present position.

5.6.8 FUEL REMAINING / RANGE AND BEARING TO PB 1 (PB 10)

Toggles between the fuel remaining at the sequence point displayed at PB 1 and the aircraft's range and bearing from present position to PB 1.

5.7 UHF AND V/UHF RADIOS

The V/UHF communications system provides air-to-air and air-to-ground communications and monitoring of guard (emergency frequency).

NOTE: the ADF is no longer used in the simulated suite of the aircraft.

The aircraft is equipped with 2 radios:

Radio 1 is ARC-164, capable of operating on UHF frequency in range between 225.000 and 399.975 MHz.

Radio 2 is the newer ARC-210, capable of operating in the following ranges:

- From 30.000 to 87.975 MHz (FM)
- From 108.000 to 115.975 MHz (AM, VHF)
- From 118.000 to 173.975 MHz (AM, VHF)
- From 225.000 to 399.975 MHz (AM, UHF)

Both radios can operate on up to 20 preset frequencies or manually selected ones in ranges listed above.

NOTE: A third radio (another -210 type) will be added to the module at the later stage. Fourth radio was never added to the aircraft and therefore will also not be simulated in DCS.

Radios are mostly controlled via the UFC buttons and menu. There are a few switches on the Remote Intercommunications Control Panel in the front cockpit that are related to the radios (namely, the UHF and VHF Antenna Selector Switches and the Tone Selector Switch), however they have no effect in DCS.

5.7.1 RADIO HOTAS CONTROLS

A three-position Microphone Switch on the right throttle in each cockpit governs the UHF and V/UHF transmission. It is spring-loaded to the center (receive) position.

Pushing the switch forward enables transmission on Radio 1 (UHF).

Pushing the switch aft enables transmission on Radio 2 (V/UHF).

NOTE: Make sure to bind this switch to your HOTAS setup in order to be able to bring up communications menu in the sim.

5.7.2 TURNING ON THE RADIOS

When Radio 1 and / or Radio 2 is OFF, this is indicated next to PBs 4 and 7, as seen below:

In order to turn on the radios the aircrew can:

A. Turn the Channel Select Knob clockwise or counterclockwise. Changing the channel turns on the respective radio.

B. Enter manual frequency in the scratchpad and press PB 5 or 6.

C. Enter a preset channel number (between 1 and 20) in the scratchpad and press the respective Channel Select Knob.

D. Enter UHF (L) or V/UHF (R) submenu and press PB 1 to enable selected radio.

5.7.3 RADIO OPERATION

The following controls are used to operate the radios via the UFC:

LCD Display

LCD Line 5 displays the manually entered frequency for the UHF radio on the left and the V/UHF radio on the right. The G behind the the frequency indicates that Guard monitoring is enabled.

LCD Line 6 displays the preset channel for the UHF radio on the left and the V/UHF radio on the right (5 and 3, respectively).

The mode in use is indicated by the presence of an asterisk next to manual frequency or the preset channel number (Radio 1 on the left in this case). In the picture below, Radio 1 is operating in preset channel mode, while Radio 2 is working in manual frequency mode.

Channel Selector Knobs

The left and right Channel Selector Knobs are used to increment or decrement the preset channel by turning them clockwise or counter-clockwise.

It is also possible to type in the desired channel (between 1 and 20) and then press the Channel Selector Knob for the respective radio.

With power removed from the UHF and V/UHF, turning the knob or entering channel number via the scratchpad powers on given radio.

Volume Knobs

The left Volume Knob controls the volume of UHF radio (R1) with the outer (smaller) knob. The inner (larger) one is used for the second V/UHF radio (R3).

NOTE: R3 is not modelled in the current version of the aircraft.

The right Volume Knob controls the volume of the V/UHF radio (R2) with the outer (smaller) knob. The inner (larger) one is not used, as R4 was never added to the F-15E Strike Eagle.

GREC C/M Buttons

These buttons have two main functions.

Each press of the left or right GREC C/M button switches the mode of operation of respective radio between Channel and Manual. The currently selected mode is indicated by an asterisk on either line 5 or 6 on the LCD.

Another important function is enabling or disabling GUARD monitoring for selected radio. In order to do so, press and release the SHF key and then press the respective GREC pushbutton. Letter G will appear next to the frequency at PB5 or PB6, indicating that GUARD monitoring is on. In order to disable it, repeat the whole procedure.

5.7.4 Frequency Selection

With preset channels, use the Channel Selector Knob to select the desired preset channel for left or right radio. Alternatively, you can type the desired channel in the scratchpad and then press the Channel Selector Knob.

With manual frequency mode, type the required frequency into the scratchpad (a decimal is not required) and then press PB5 for Radio 1 and / or PB6 for Radio 2.

It is important to note that whenever a new channel or frequency is entered via scratchpad and then fed into the radio by pressing PB5 / 6 or Channel Selector Knob, the previously used channel / frequency is displayed on the scratchpad, which makes it easy to bring it back into the system.

If wrong frequency or channel is entered, the digits will flash.

5.7.5 Guard Monitoring

Whenever letter G is visible next to manual frequency (PB5 or 6), it means that the given radio is listening on the Guard frequency of 243.000. This is a passive system which allows to receive all the communications on that bandwidth, but does not allow to actively transmit.

In order to transmit on Guard, either Channel Selector Knob should be rotated until letter G appears next to the channel selector, as indicated on picture below. The 243.0 frequency can also be manually typed in on either radio (or 121.5 for VHF .

5.7.6 UHF SUBMENU

A separate UHF submenu can be entered by pressing PB5 with a blank scratchpad:

R1 CHAN - 1 (PB 1): Indicates the currently selected radio (R1 = UHF, R2 = V/UHF) as well as the preset channel (1 in this case), which can be changed via the scratchpad.

HQ (PB 3): Have Quick system. Not modelled in DCS.

KY-58 (PB 4): Pressing this PB opens KY-58 submenu on the UFC. Not modelled in DCS.

R1 - R2 TX (PB 7): Enables simultaneous transmission on both radios (if enabled, asterisk is displayed next to the PB)

HQ TOD (PB 8): Have Quick option. Not modelled in DCS

NB / WB (PB 9): Changes between narrow band and wide band. Not modelled in DCS.

Frequency (PB 10): Displays frequency preset to channel displayed next to PB 1. It can be changed via a scratchpad entry.

5.7.7 V/UHF SUBMENU

A separate V/UHF submenu can be entered by pressing PB6 with a blank scratchpad:

R2 - 1 (PB 1): Indicates the currently selected radio (R1 = UHF, R2 = V/UHF) as well as the preset channel (1 in this case), which can be changed via the scratchpad.

Maritime (PB 2): Not modelled in DCS.

HQ (PB 3): Have Quick system. Not modelled in DCS.

KY-58 (PB 4): Pressing this PB opens KY-58 submenu on the UFC. Not modelled in DCS.

SQUELCH (PB 7): Provides suppression of weak radio signals in order to remove white noise. When enabled, asterisk is displayed next to PB 7.

AJ PROGRAM (PB 8): Anti - Jam function of the radio. Not modelled in DCS.

MAN AM / MAN FM (PB 9): Changes between AM and FM bands. FM mode allows the aircrew to use the frequencies between 30.000 to 87.975 MHz.

Frequency (PB 10): Displays freqency preset to channel displayed next to PB 1. It can be changed via a scratchpad entry. Depending on the selected frequency it will either display AM (for UHF and VHF bands) or FM (for the FM band).

CHAPTER 6: HEADS UP DISPLAY

6.1 INTRODUCTION

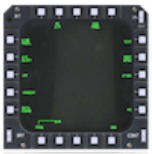
The Heads Up Display holographic combiner displays projected raster (video) and stroke (symbols) imagery in a total field of view which measures 21° in elevation and 28° in azimuth. The HUD displays navigation, FLIR video, flight control and weapon delivery information. It is installed only in the front cockpit, but can be mirrored in any MPCD/MPD in either front and rear pit.

This chapter will include the following sections:

HUD Control Panel used to adjust the brightness of the HUD display, elements shown on the HUD and quality of the NAV FLIR video.

HUD HOTAS controls, describing HOTAS buttons used when Heads Up Display is commanded by the pilot.

HUD Basic Symbols, which are common for different Master Modes and / or weapons.



HUD Display Programming, which allows the pilot to choose what will be displayed on the HUD (not available in Early Access)

NAV FLIR, which provides infrared, forward terrain video on a HUD display in support of the Terrain Following Radar operation.

6.2 Heads Up Control Panel

The HUD Control Panel is located just below the UFC in the front cockpit only.

1. Symbol Brightness knob controls the brightness of the HUD stroke symbology. Rotating it clockwise applies power to the HUD.

2. Symbol Declutter Switch is a three position switch which removes and restores symbol information from the HUD. REJ 1 and REJ 2 positions are programmable.

NOTE: REJ 1 and REJ 2 functions are not implemented in current version of the module.

3. DAY / AUTO / NIGHT switch provides the pilot with a means to select appropriate raster and stroke imagery brightness levels for daytime or nighttime missions. In AUTO position the symbology brightness is adjusted depending on the ambient brightness.

4. Video Brightness and Contrast knobs adjust the intensity and contrast of the raster - generated video. They also affect the NAVFLIR image brightness and contrast when the FLIR image is presented in the HUD.

5. Air to Air Mode Master Mode Button

6. Air to Ground Mode Master Mode Button

7. Navigation Mode Master Mode Button

8. Instrument Mode Master Mode Button

The Master Modes will be described in more detail in MPCD / MPD chapter of the manual.

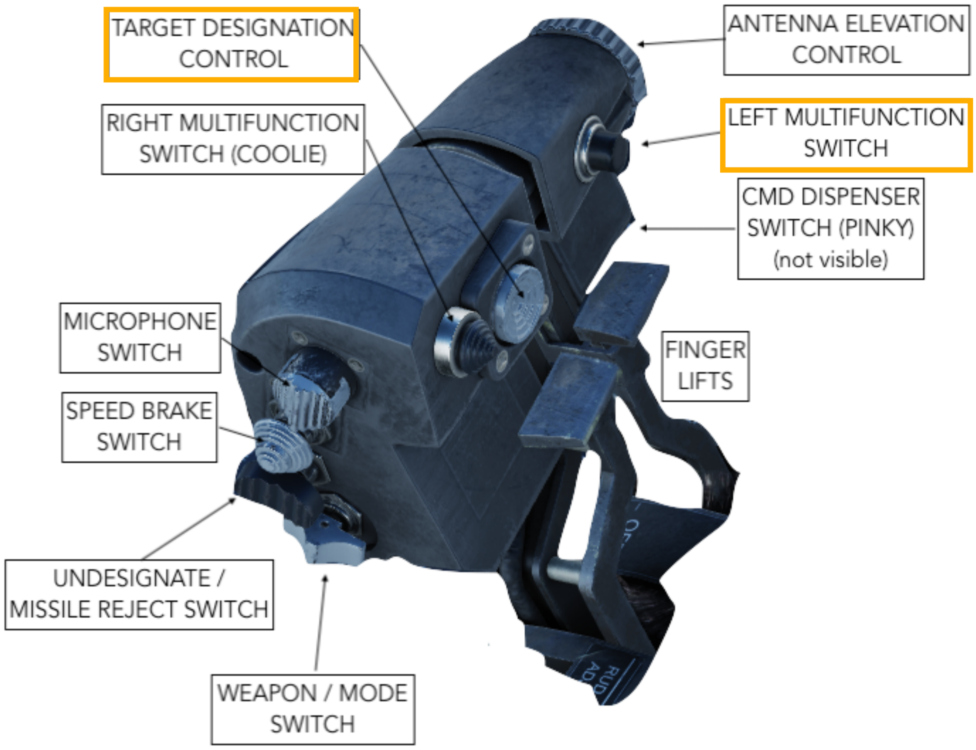
6.3 HUD HOTAS Controls

Following HOTAS functions are relevant for HUD display:

Castle Switch: if pressed and released first, pushing it FWD will take command of the HUD as the main display.

Auto Acquisition Switch: In A/G mode placing it in the AFT position enables the AUTO / CDIP mode. See Air to Ground Bombing for more information.

Nose Gear Steering / Weapons Button: in A/G mode pressing it cages the auto reticle to velocity vector. See Air to Ground Bombing for more information.



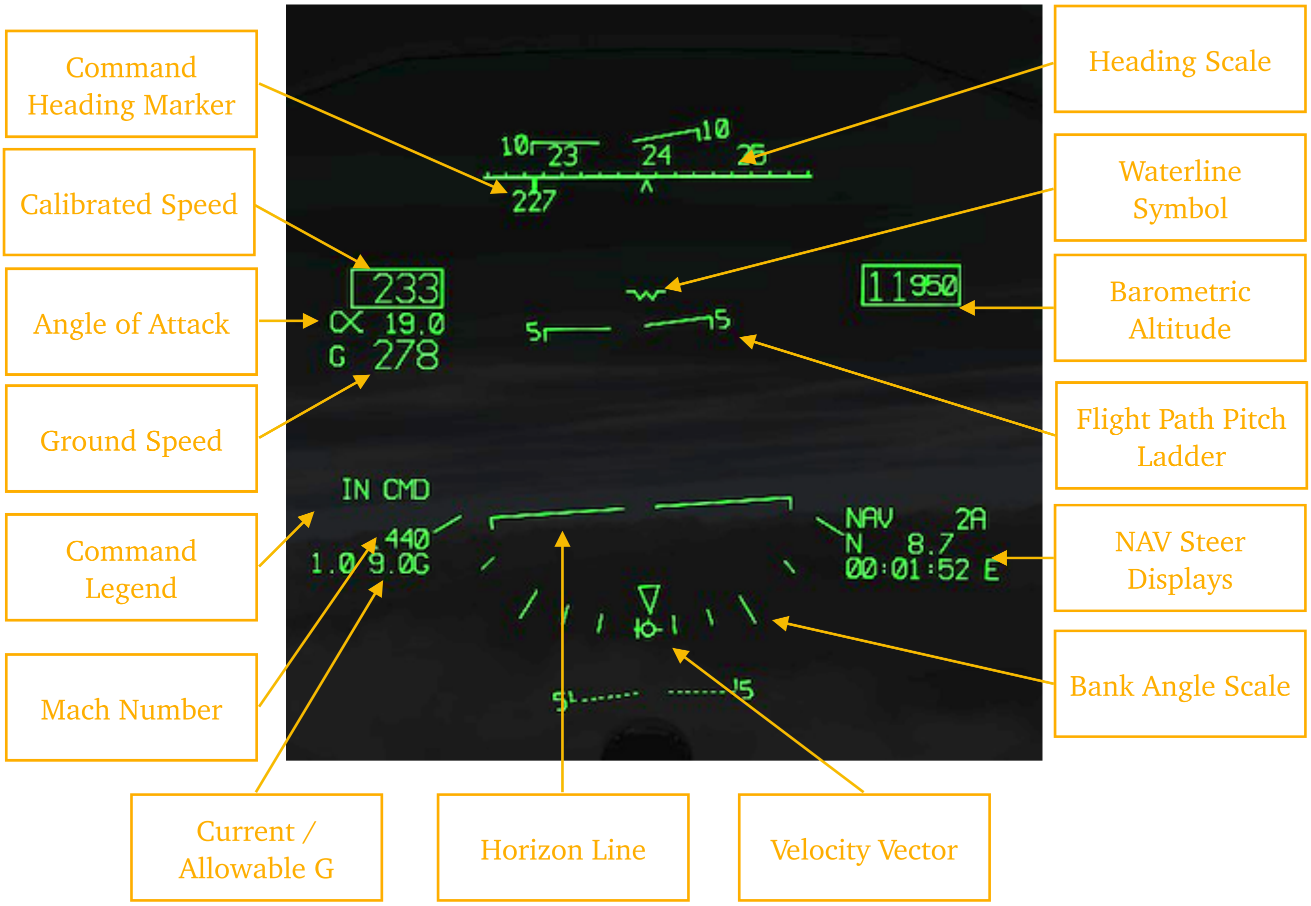
Target Designation Control : In NAV and INST Master Mode it provides the SP symbol line of sight control.

In A/G Master Mode it allows for HUD stabilized AUTO reticle line of sight control. When pressed, it designates the spot at the pipper line of sight. When it is held and moved, it controls the Target Designator diamond line of sight, while releasing it will designate the target under current diamonds position. Refer to XXX chapter for more information.

Left Multifunction Switch: In NAV and INST Master Modes pressing it will cage or uncage the Velocity Vector.

6.4 HUD Basic Symbols

When NAV Master Mode is selected, following symbols are displayed on the HUD:



Heading Scale: the heading scale at the top of the HUD moves horizontally against a fixed caret index, indicating aircraft's magnetic heading from 0° through 360°. The digits above the scale should be multiplied x10 to get the exact heading.

Command Heading Marker: is displayed when a steer point is selected. It moves against the scale and also shows a digital readout of magnetic heading towards the currently selected point.

Waterline Symbol: indicates the aircraft's waterline position. The pitch ladder provides aircraft pitch attitude information when it is compared with the waterline symbol.

Flight Path Pitch Ladder: indicates the vertical path angle of the aircraft in 5° scale between 5 and 85°. Positive pitch lines are solid and negative pitch lines are dashed. The dash next to the number at the end of each line point towards the horizon.

Horizon Line: it is longer than other lines on the pitch scale and has tabs at each end pointing towards the ground.

BANK ANGLE SCALE: the triangle in the middle shows current bank angle of the aircraft. The tic marks represent 0°, 10°, 20°, 30° (double length), 45° and 60° (double length).

VELOCITY VECTOR (VV): The velocity vector displays the instantaneous aircraft flight path with respect to the earth. The wings of the symbol always remain paralel to the wings of the aircraft.

The vertical distance between the VV and the Waterline Symbol indicate the true Angle of Attack (AoA).

The horizontal distance between the VV and the HUD centerline indicates the drift (or the crab angle) of the aircraft.

Velocity Vector can be caged to the center of the HUD by pressing the Left Multifunction Switch on the throttle. When it is caged, a ghost VV is displayed at the true VV position.

NAV STEER DISPLAYS: show the information relevant for the navigation:

NAV indicates that NAV Master Mode is selected.

2A is the currently selected steer point.

N 8.7 shows the distance to the steer point.

00:01:52 E shows the estimated time to reach the selected steer point.

BAROMETRIC ALTITUDE: aircraft's barometric altitude. The thousands and ten thousands digits are larger than the hundreds, tens, and units digits, except below 1000 feet, when all the digits are the large size.

CALIBRATED SPEED: displays aircraft's calibrated speed in knots.

ANGLE OF ATTACK (AOA): aircraft AOA to the nearest tenth of a unit is displayed below the aircraft calibrated airspeed readout at all times.

GROUND SPEED / TRUE SPEED: shows aircraft's ground (G) or true (T) speed in knots. The type of speed depends on the setting chosen on the UFC Data 1 display.

COMMAND LEGEND: IN CMD is displayed here whenever pilot has command of the HUD. Command of the HUD is taken by pressing and releasing the Castle Switch and then pushing it forward.

MACH NUMBER: aircraft Mach number is displayed in all modes when the landing gear is up.

CURRENT G / ALLOWABLE G: shows the instantaneous g-force applicable to the aircraft on the left and the maximum allowable G (depending on many factors, like conditions, jet configuration, gross weight etc.) on the right.

NOTE: the F-15E HUD is capable of displaying much more information that will be covered in other chapters and sections of this manual as necessary.

6.5 HUD DISPLAY PROGRAMMING

Programming the HUD symbology can be done using menu 2 on the MPD/MPCD.

NOTE: REJ 1 and REJ 2 functions are not implemented in current version of the module.

6.6 NAV FLIR

The NAV FLIR capabilities are delivered by the AN/AAQ-13 Navigation Pod. It provides infrared, forward terrain video on a HUD display in support of the Terrain Following Radar operation (not available in Early Access).

NOTE: the AN/AAQ-13 Navigation Pod has to be installed on the jet in order for the pilot to be able to use the NAV FLIR capabilities.

6.6.1 NAV FLIR CONTROLS

The primary means to control the NAV FLIR are located on:

Sensor Control Panel

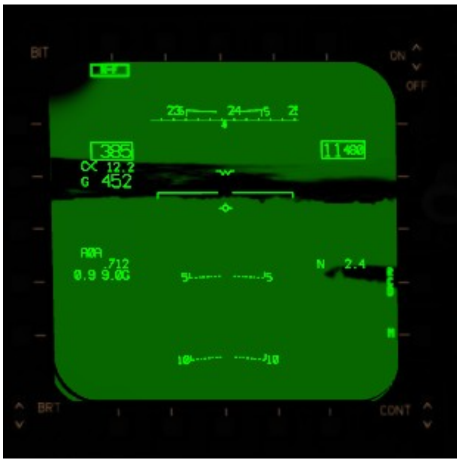
NAV FLIR Power Switch (5) needs to be set to ON position for the NAV FLIR option to be used.

NAV FLIR Gain (smaller, outer knob) and **Level** (larger, bottom knob) control the pod settings itself and as such can be used to adjust the image displayed on HUD repeater on MPD / MPCD (independently from the controls for the HUD).

MPCD / MPD

The HUD repeater can be enabled on any MPCD / MPD in front or rear cockpit.

In order to display the NAV FLIR image on the repeater, pilot or the WSO need to press OSB 20 labeled N-F and box the legend.



With the N-F boxed, the NAV FLIR image is now displayed on the MPCD or MPD.

It is possible to have the NAV FLIR displayed only on the HUD, only on the MPCD / MPD or on both.

Please note that different sets of knobs are responsible for the control of image quality. The ones on Sensor Control Panel will affect the image displayed on MPCD / MPD, which the ones on HUD Control Panel will be responsible for adjusting the image on the HUD.

NOTE: There are additional MPCD / MPD pages for NAV POD I-BIT (built - in test) and status, however these are not simulated in the current version of the module.

HUD Control Panel

There are two knobs on the HUD Control Panel responsible for the NAV FLIR image displayed on the HUD, namely the **Video Brightness** and **Contrast** (4).

These knobs control the brightness and contrast level of the NAV FLIR video in the HUD, but have no impact on the one displayed on HUD repeater in one of the MPCDs / MPDs (with the exception that the VID BRT knob on the left (#4) cannot be in OFF or the FLIR image will not be displayed at all on the HUD repeater).

Position of other switches (i.e. REJECT or DAY/AUTO/NIGHT) have no impact on NAV FLIR display in the HUD.

Upfront Control Panel (UFC)

NAV FLIR status is displayed in MENU 1 next to PB 7. The possible options are:

OFF: no power supplied or no LANTIRT installed;

N/R: not ready

STBY: standby;

NORM: normal operation;

BRST: boresight mode, see below.

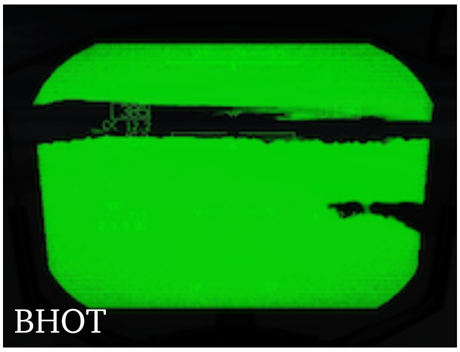
When PB 7 is pressed it opens a separate NAV FLIR menu:

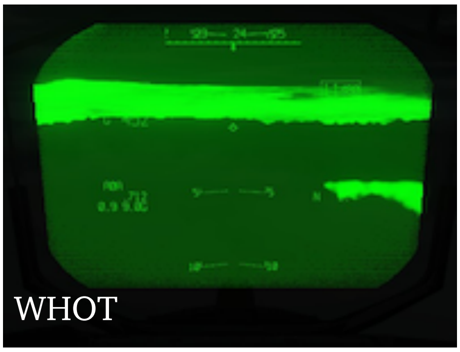
N-F (PB 1): Indicates the current status of the LANTIRN navigation FLIR as described above (OFF, N/R, STBY, NORM, BRST).

GRAY SCALE (PB 2): When selected, displays the gray scale across the bottom of the HUD in order to adjust the HUD contrast / brightness.

MAN - AUTO GAIN / LEVEL (PB 3): Switches between manual and auto gain / level of the navigation FLIR display.

W-HOT / B-HOT (PB 4): Switches between white hot and black hot polarity of the FLIR video.





LOOK-IN-TURN (PB 7): Enables selection of the look into turn function. When this function is selected, the pod automatically positions its line of sight 6° in the direction of turn when the bank angle is greater than 33°. It can also work in manual mode with Coolie switch pressed.

BORESIGHT (PB 9): Used to boresight the pod to align with the nose of the aircraft / real world image through the HUD. Pressing this PB brings up the Boresight menu.

NORM (PB 10): Selecting this PB returns NAV FLIR to NORMAL mode.

6.6.2 NAV FLIR BORESIGHT

When PB 9 is pressed from within the NAV FLIR submenu, asterisk appears next to BRST legend and the following options appear on the UFC:

In the real aircraft, the values indicated next to YAW (**PB 2**), PITCH (**PB 3**) and ROLL (**PB 4**) should agree with the unique mechanical boresight numbers stored in CC and also listed on a special form available to the aircrew.

It is possible to adjust these numbers using the scratchpad. They can have positive or negative values (for introducing negative, SHFT and then (-) buttons should be pressed).

Adjusting PITCH moves the point of view up or down. Adjusting YAW moves it left and right. ROLL correction is currently not implemented.

ELEC (PB 7): allows for the boresight to be electrically slewed using the TDC in order to align the NAV FLIR image with the real world image visible through the HUD.

6.6.4 NAV FLIR Operation

The pilot has primary control of the navigation pod. The WSO has access to NAV FLIR video by selecting HUD from the main menu for the desired display and then pressing PB 20 to box the N-F legend on the HUD repeater.

Apart from projecting the infrared image of the terrain ahead of the aircraft directly into the HUD (for the pilot) and / or the HUD repeater (for both), the LANTRIN pod additionally allows the aircrew to be able to check the terrain features in any of the four directions: up, down, left and right by utilising a **snap look** function, shifting the line of sight of the pod to 25° to the sides and to 9° up or down. The other option is by enabling the **look-in-turn**, which can be commanded manually or by enabling the PB 7 option on the NAF FLIR menu in the UFC.

In order to be able to use the NAV FLIR, following steps should be followed:

1. NAV FLIR Power Switch on the Sensor Control Panel should be set to ON.

2. PB 1 N-F menu on the UFC should indicate NORM.

3. The Video and Contrast knobs on the HUD Control Panel should be set as desired.

4. Optionally, NAF FLIR video can also be enabled on the HUD repeater. The gain and level is controlled by the knobs on the Sensor Control Panel.

6.6.5 NAV FLIR HOTAS Commands

The NAV FLIR HOTAS commands are mainly used for controlling the Look - In - Turn capability and slewing the pod in ELEC mode. These functions are not enabled in the current version of the module.

CHAPTER 7: MULTI PURPOSE DISPLAY PAGES

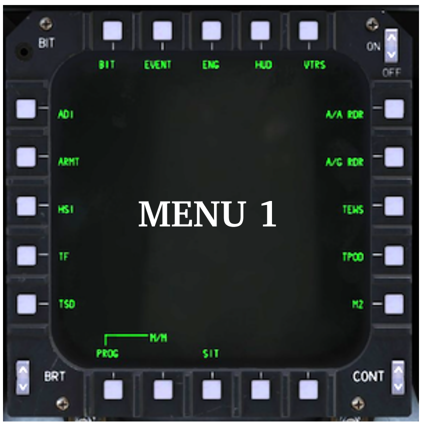
7.1 MPCD / MPD INTRODUCTION

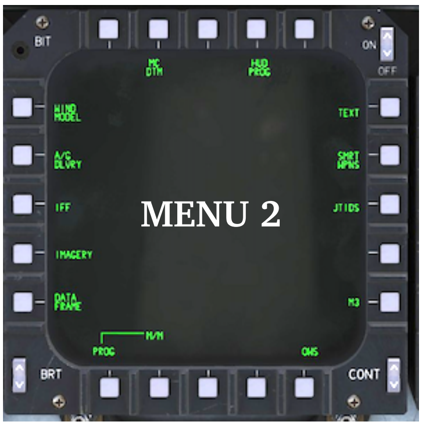
There are two MPDs and one MPCD in the front cockpit and two more MPDs and two MPCDs in the rear. All the displays have the same controls described in relevant section in front and rear cockpit description.

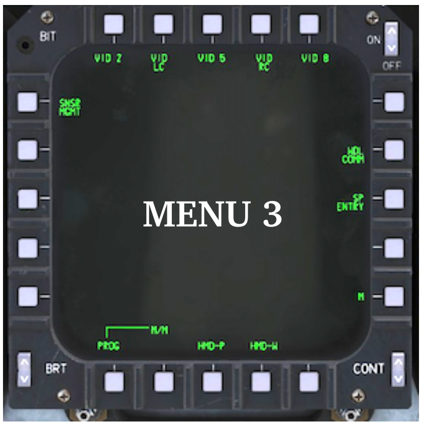
All displays have pushbuttons (PBs) numbered as on the picture below:

7.2 MPCD / MPD MENUS

There are three main menu pages available on each MPCD / MPD (Menu 1 to 3 next to PB 11). Additionally, a PROG legend is available above PB 6, which is used for Master Mode programming.



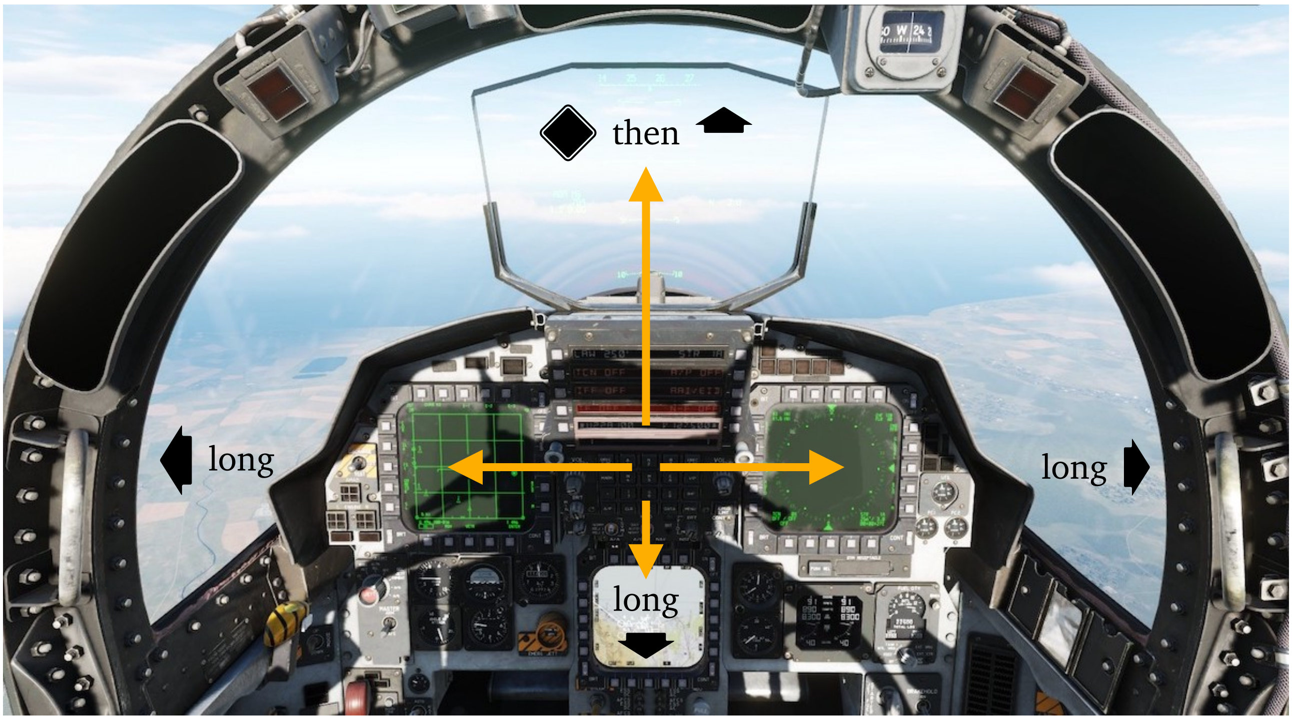




7.3 TAKING COMMAND OF A SENSOR IN DISPLAY

In order to be able to properly use different systems, it is crucial for the air crew to be able to take command of displays, including HUD and some pages on the MPDs and MPCDs (currently: A/A and A/G Radar and TPOD)

Front Cockpit



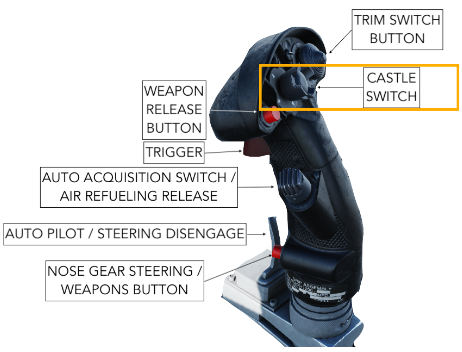
In the front seat, use the CASTLE SWITCH on the stick to take control of sensor (AA Radar, AG Radar, TGP and HUD).

For the HUD, short press the CASTLE SWITCH down, and then short press it forward towards the HUD. A IN CMD cue should appear just above the Mach number.

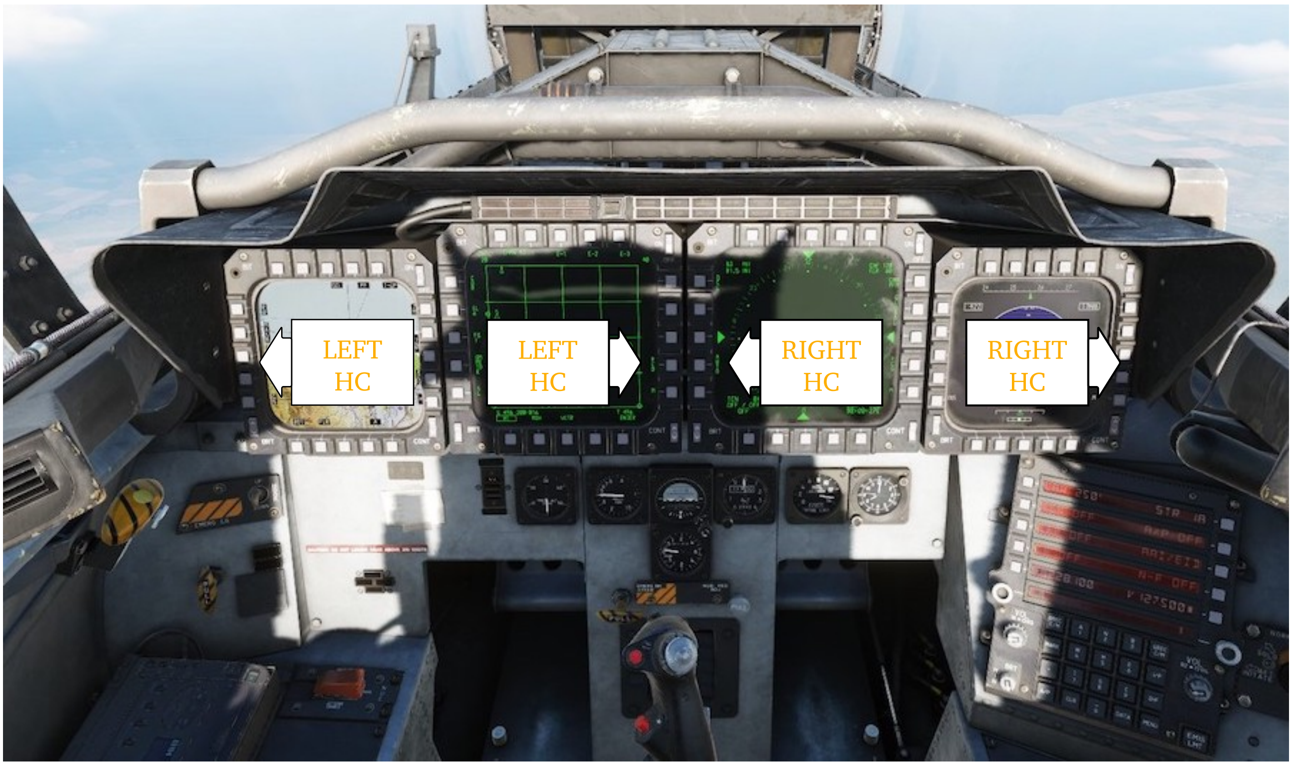
For the sensor in the left MPD, long press the CASTLE SWITCH left.

For the sensor in the right MPD, long press the CASTLE SWITCH right.

For the sensor in the MPCD, long press the CASTLE SWITCH down.



Rear Cockpit



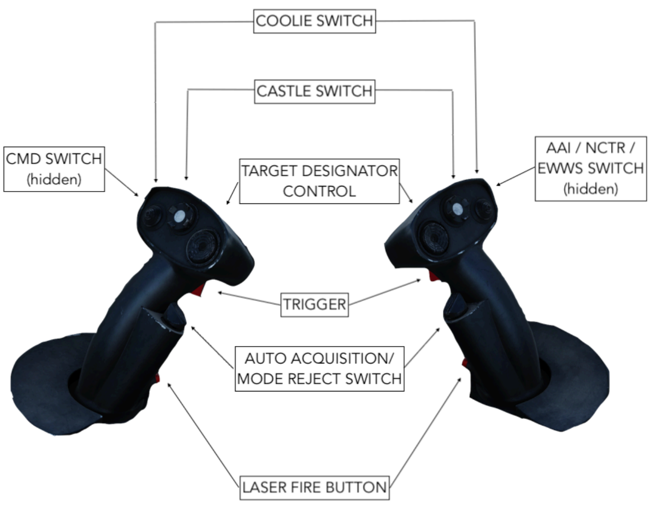
In the back seat, use the COOLIE SWITCH on the left and right hand controllers. Left hand controller controls the left MCPD and left MPD. Right hand controller controls the right MPCD and right MPD.

To take control of left MPCD, push the COOLIE SWITCH on left HC left.

To take control of the left MPD, push the COOLIE SWITCH on left HC right.

To take control of right MPCD, push the COOLIE SWITCH of the right HC right.

To take control of the right MPD, push the COOLIE SWITCH on the right HC left.

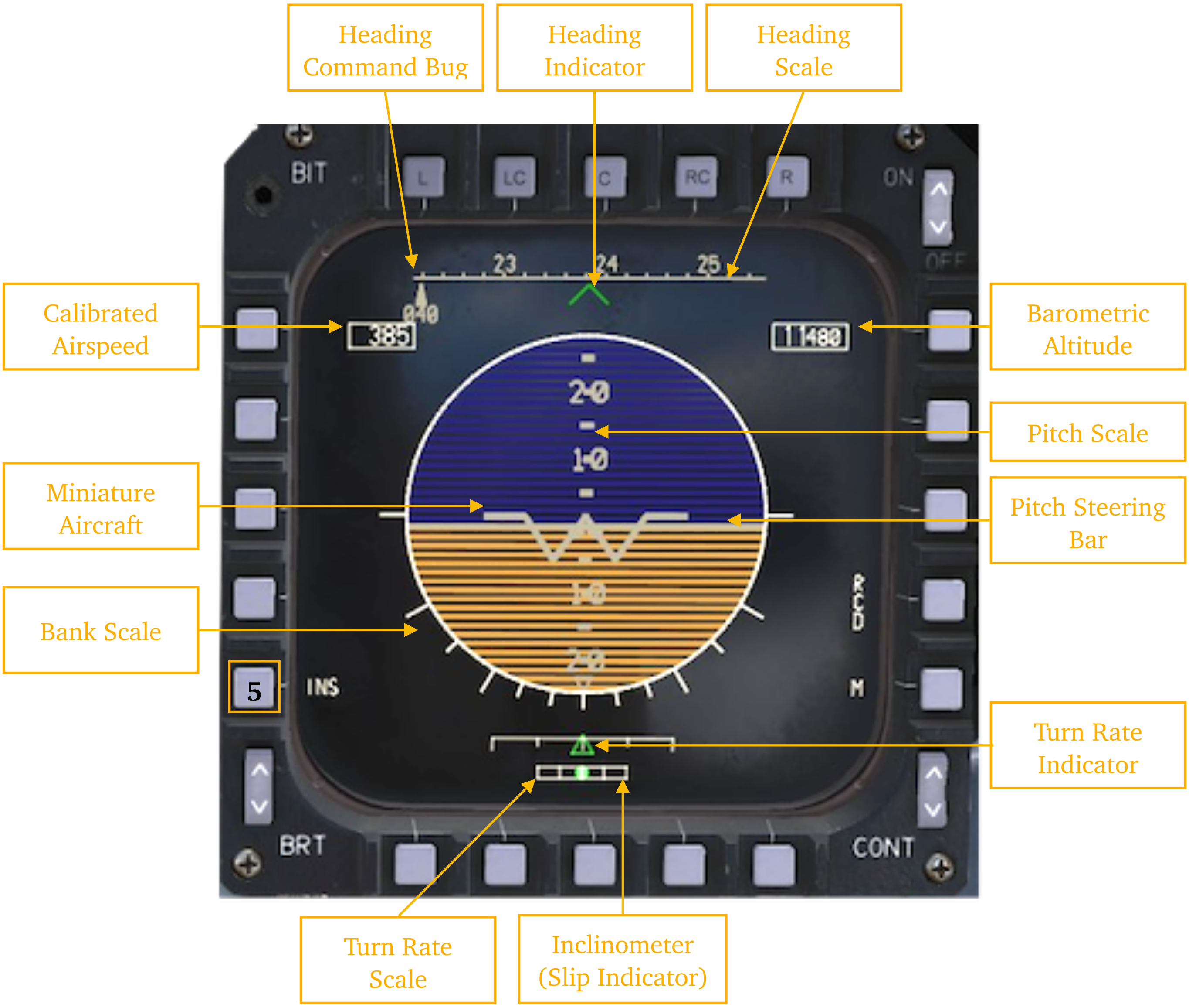


7.4 MENU 1

This menu is the default display for the MPD / MPCD after the power is turned on.

Click on the P/B number to go directly to the description of each separate page. Please note that some pages will only be introduced in general in this chapter, with more in-depth description in other relevant parts of the manual.

7.3.1 ATTITUDE DIRECTOR INDICATOR (ADI)



Heading Bug, Heading Indicator and Heading Scale are mirrored from the HUD, as are the Calibrater Airspeed and Barometric Altitude readouts.

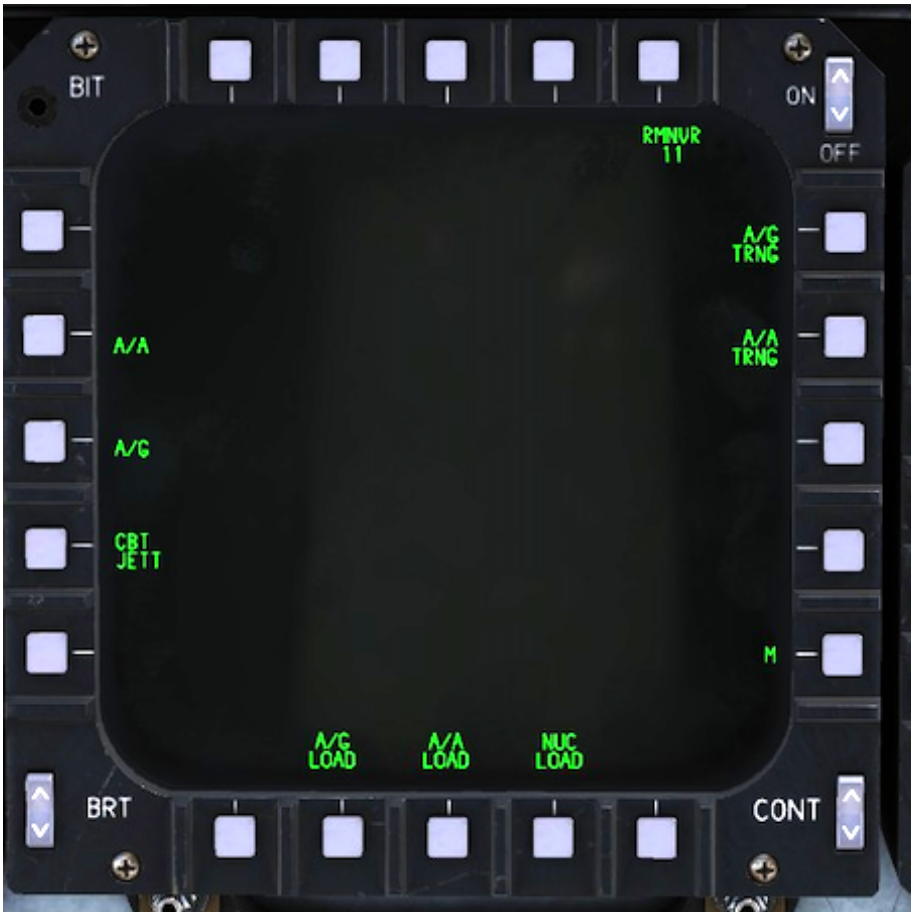
NOTE: the speed units are KCAS, unless True Airspeed or Ground Airspeed are selected on UFC Data 1 page.

The attitude sphere in the middle displays pitch and bank, with pitch markings in graduation of 5° and bank markings beginning at 10° increments between 10 and 30°, and then 45° and 60°.

ADI is also capable of displaying the ILS data, please refer to ILS Section for more information. ADI will also be covered in greater detail in the Navigation chapter.

Pushbutton 5 can be used to select the primary attitude source between INS and EGI. INS is the default and preferred source, but it can be cycled between the two.

7.3.2 PROGRAMMABLE ARMAMENT CONTROL SET (PACS)



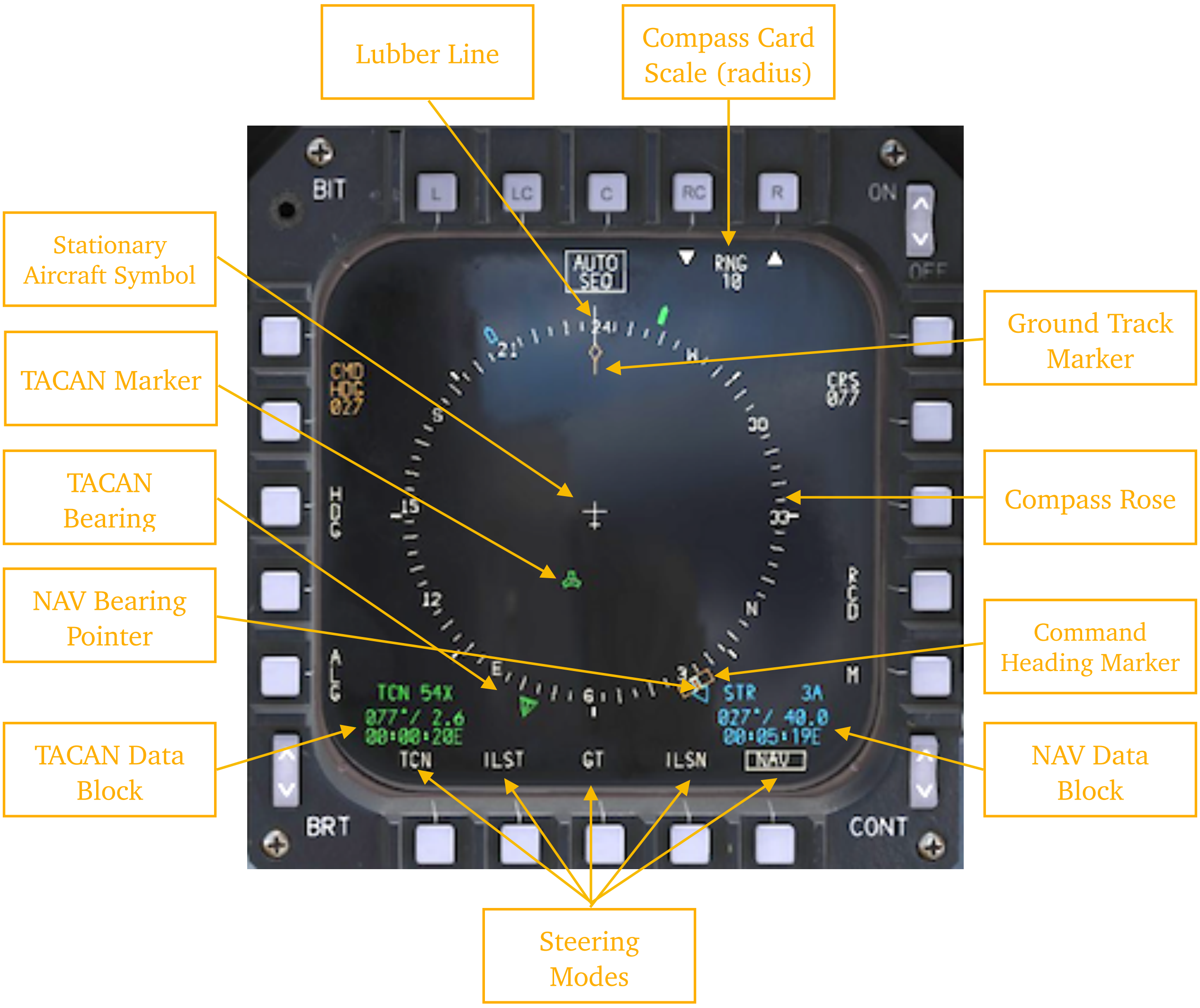
PACS provides weapon monitoring and weapon display / management capabilities. The main four modes of operation for PACS are:

- A/A combat and A/G combat
- A/A combat and A/G training
- A/A training and A/G training
- A/A training and A/G combat

PACS will be described in depth in the Programmable Armament Control Set section in the later part of the manual.

7.3.3 HORIZONTAL SITUATION INDICATOR (HSI)

The HSI provides a horizontal or plan view of the aircraft with respect to the navigation situation. The aircraft symbol is in the center of the HSI, superimposed on the compass rose.



The eight steering modes listed on the HSI are: Heading Select (HDG), Autonomous Landing Guidance (ALG), tacan (TCN), Course (CRS), Instrument Landing (ILST / ILSN), Ground Track (GT) and Navigation (NAV).

The Range Scale can be displayed in five different values: 10, 20, 40, 80 and 160 Nautical Miles. The range represents the distance between the aircraft symbol in the middle and the perimeter of the compass rose.

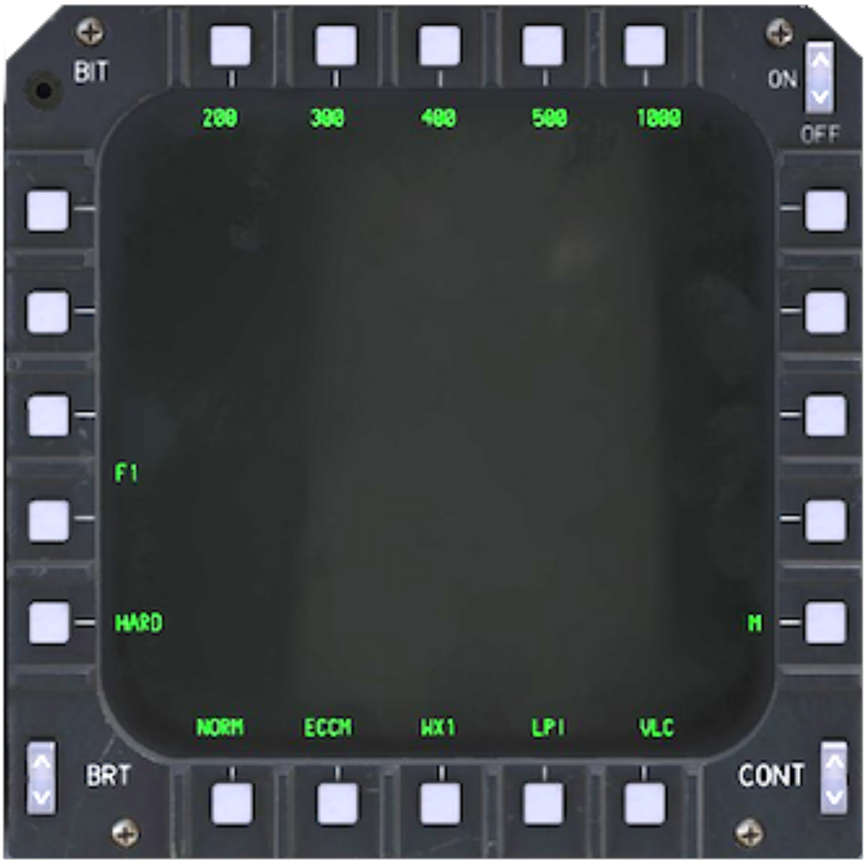
The TACAN and NAV data blocks provide bearing, distance and ETE / ETA information for the selected tacan or NAV sequence point.

The Heading Marker can be moved around the compass rose by command heading selections made by the operator in all modes except NAV and GT.

HSI will be covered in greater detail in the Navigation chapter.

7.3.4 TERRAIN FOLLOWING (TF)

The Terrain Following radar capabilities are delivered by the AN/AAQ-13 Navigation Pod. TF radar provides an aircraft flight control system for vertical terrain following. It uses radar ground return to allow flying at specific, preselected altitudes.

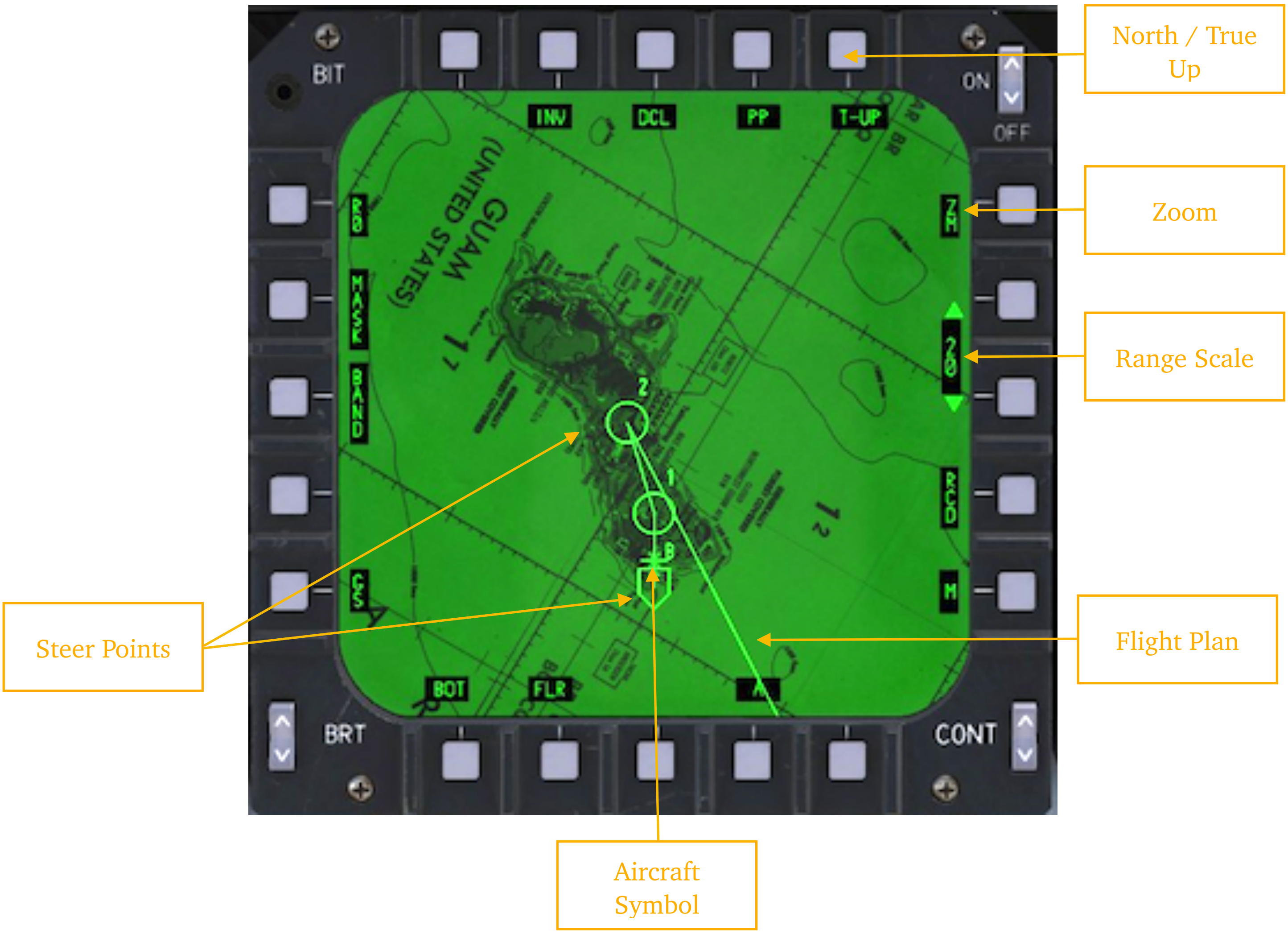


Terrain Following radar will be covered in greater detail in the Navigation chapter.

NOTE: the TF is a very advanced and complicated system and therefore will be simulated after initial release in later stages of the Early Access.

7.3.5 TACTICAL SITUATION DISPLAY (TSD)

The TSD is a presentation of the aircraft position superimposed over the digital moving map.



Tactical Situation Display will be covered in greater detail in the Navigation chapter.

7.3.6 SITUATION PAGE

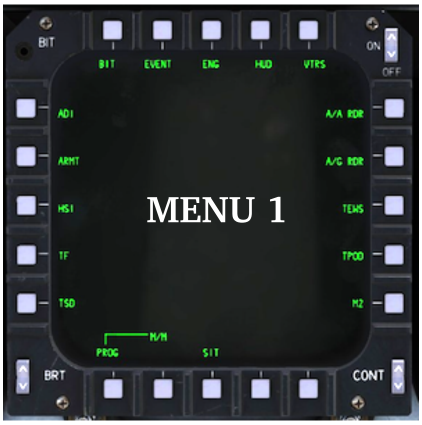
Displays the situation page on the MPD / MPCD.

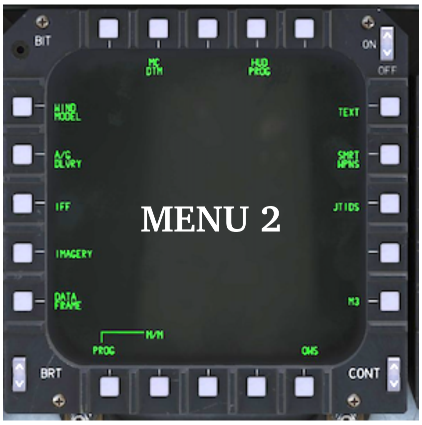
NOTE: the SIT page is not available at the Early Access Stage.

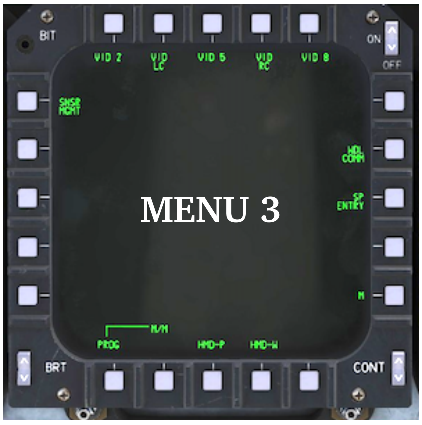
7.3.7 M1/M2/M3 PAGE

PB 11 switches between Menu views. If M2 is displayed, it means that M1 is currently active. If M3 is displayed, it means that M2 is currently active. If M1 is displayed, it means that M3 is currently active.

M is displayed next to PB 11 in all display pages.

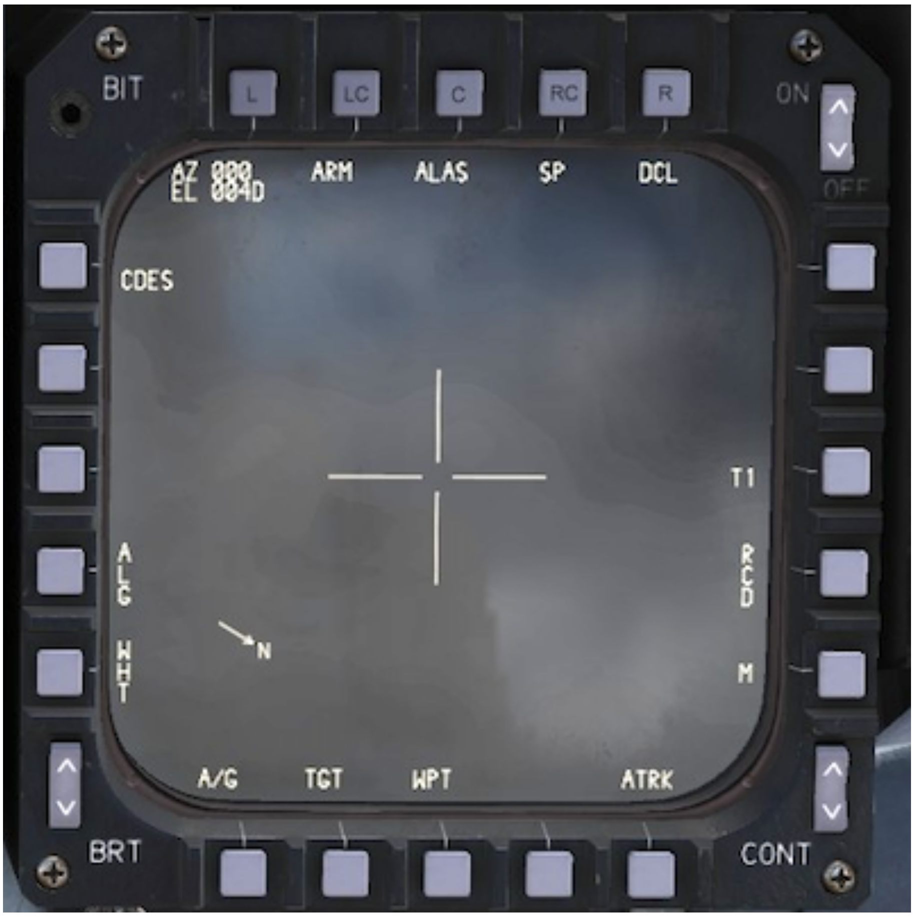






7.3.8 TPOD (TARGETING POD)

Selects the display for the targeting pod.

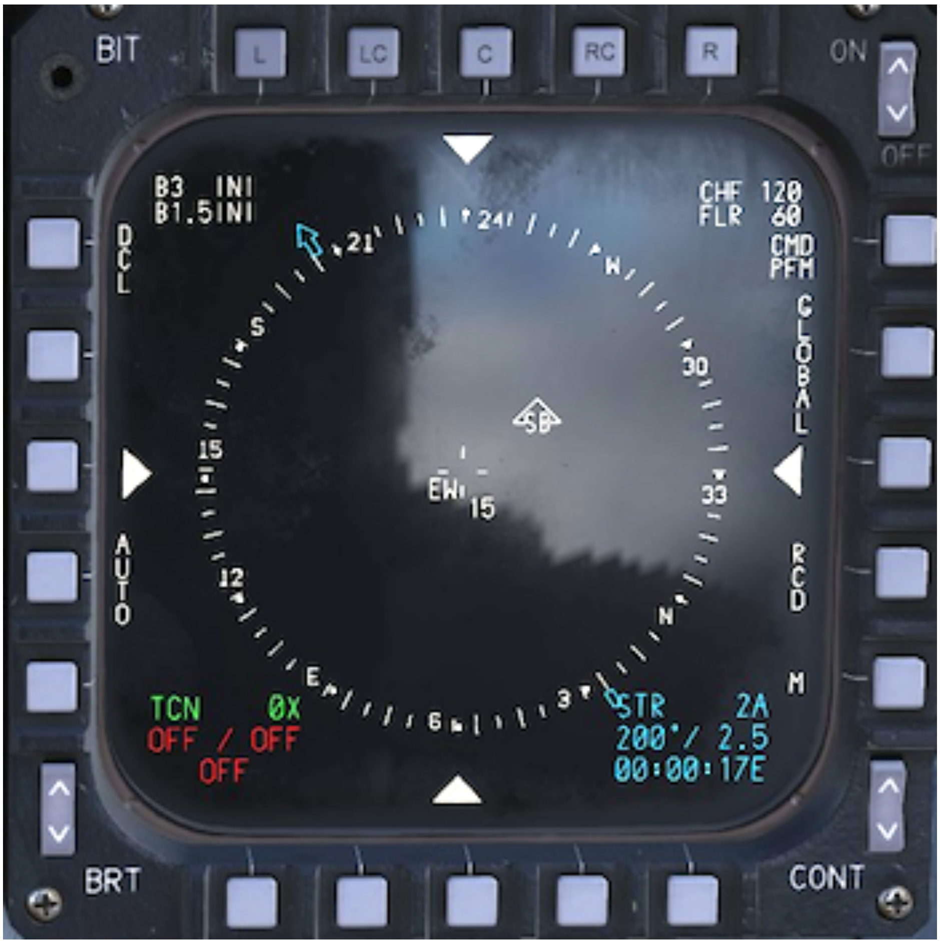


NOTE: the first targeting pod available in Early Access will the be LANTIRN. LITENING and SNIPER pods will be added at a later stage of development.

Please refer to LANTIRN targeting pod, LITENING targeting pod and SNIPER targeting pod for more information.

7.3.9 TEWS (TACTICAL ELECTRONIC WARFARE SYSTEM)

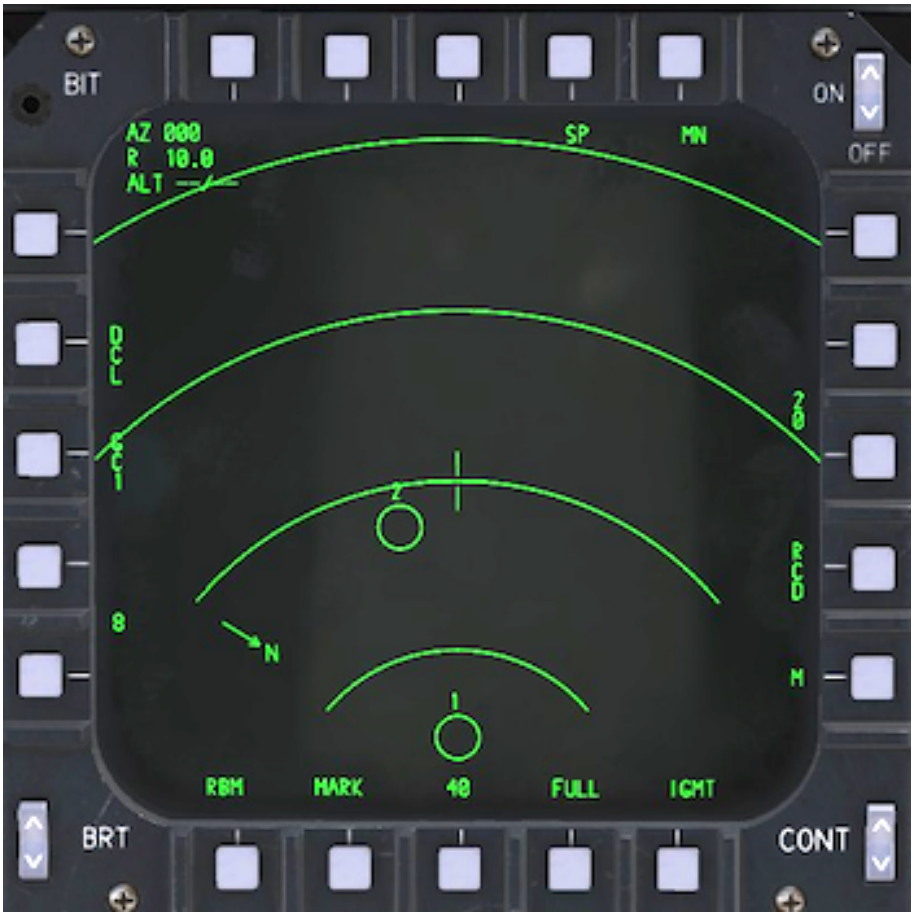
The TEWS screen includes the RWR (Radar Warning Receiver) display, including the RWR and EWWS threat identification, location and CMD status data.



The TEWS system will be described in detail in Tactical Electronic Warfare System chapter.

7.3.10 A/G RDR (AIR TO GROUND RADAR)

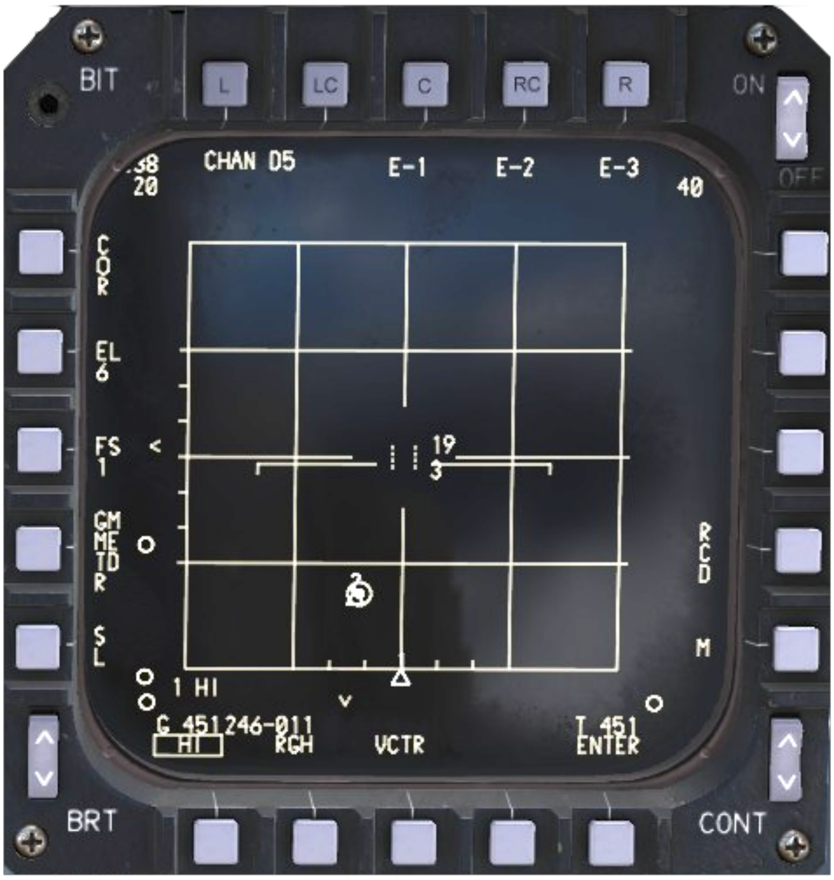
The Air to Ground Radar display is selected from the main menu with PB 14.



Air to Ground radar and its modes of operation will be described in detail in the Air to Ground Radar section of the manual.

7.3.11 A/A RDR (AIR TO AIR RADAR)

The Air to Air Radar display is selected from the main menu with PB 15.



Air to Air radar and its modes of operation will be described in detail in the [Air to Air Radar](#) section of the manual.

7.3.12 VTRS (Video Tape Recorder Set)

The VTRS is installed to record individual MPCD, MPD and HUD displays.

NOTE: the VTRS page is not available at the Early Access Stage.

7.3.13 HUD (HUD REPEATER)

The HUD repeater mirrors the HUD display from the front cockpit. It is also capable of display the NAV FLIR view, which is controlled separately from the one on the HUD.

Please refer to the Heads Up Display chapter for description of the HUD and NAV FLIR section.

7.3.14 ENG (ENGINE PAGE)

The ENG page on MPD/MPCD is an alternate source of information than Engine Monitor Display, also providing the cruise data.

The central data block contains following information for left (L) and right (R) engine:

RPM % is the compressor RPM from 0 to 110% (in 1% increments)

TEMP° C displays FTIT (Fan Turbine Inlet Temperature) from 200° to 1375° in 1° C increments.

FF / FPH displays main engine Fuel Flow from 0 to 150,000 Pounds per Hour in 10 PPH increments.

NOZ POS% shows exhaust nozzle position from 0 to 100% in 1% increments.

OIL PSI displays oil pressure from 0 to 100 Pounds per Square Inch (PSI) in 1 PSI increments.

NOTE: the difference between the data displayed in EMD and on ENG page is that the latter is much more detailed (especially the TEMP, FF and NOZ POS).

RCD (PB 12): allows recording of the display for future review.

ATDP TEST (PB 20): this feature is not implemented.

Cruise data is displayed in the lower part of the ENG page. END FUEL (PB 12) is part of cruise data information.

7.3.15 EVENT (AIR TO GROUND EVENT PAGE)

The A/G event page displays delivery parameters and other information for the different weapons.

NOTE: the EVENT page is not available at the initial EA Stage.

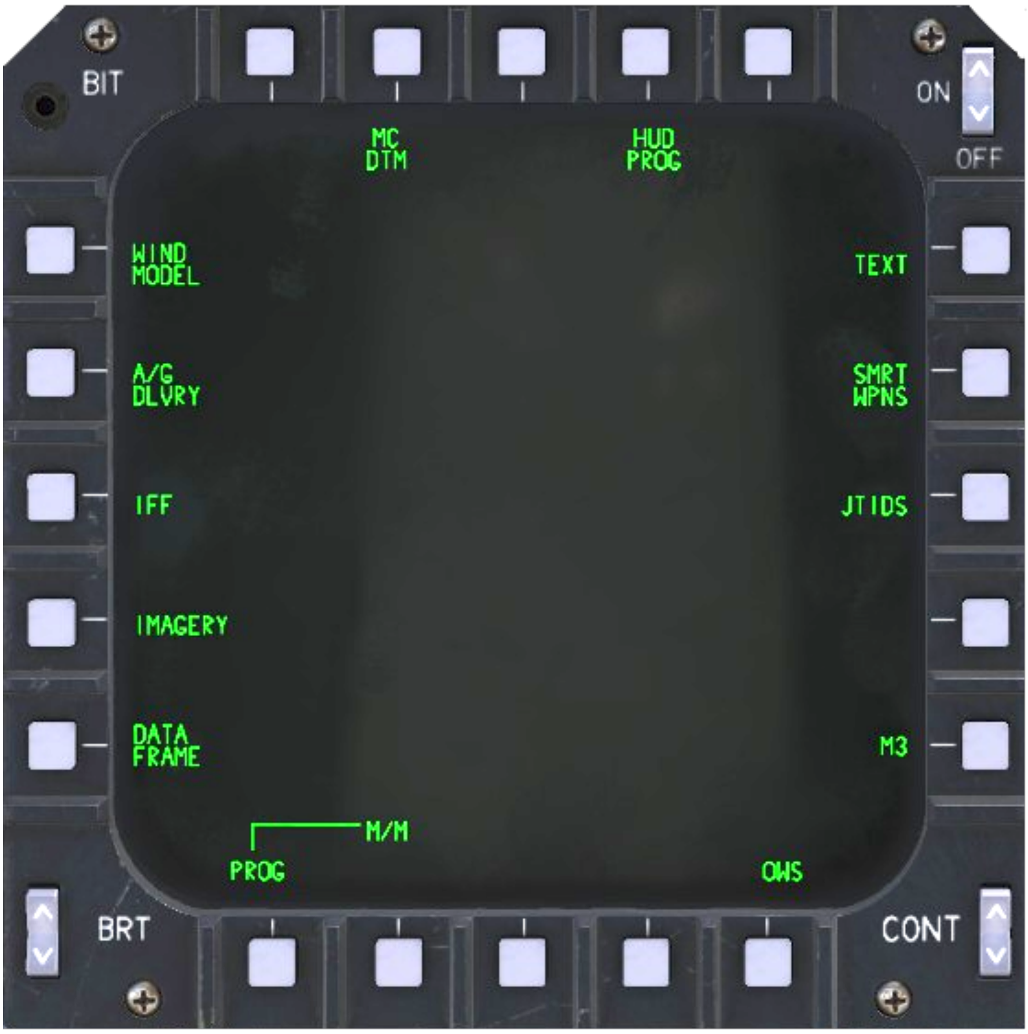
7.3.16 BIT (Built - In Test System)

The BIT pages (BIT1 and BIT2) contains the status of all BIT tested systems.

NOTE: the BIT page is not available at the initial EA Stage.

7.4 MENU 2

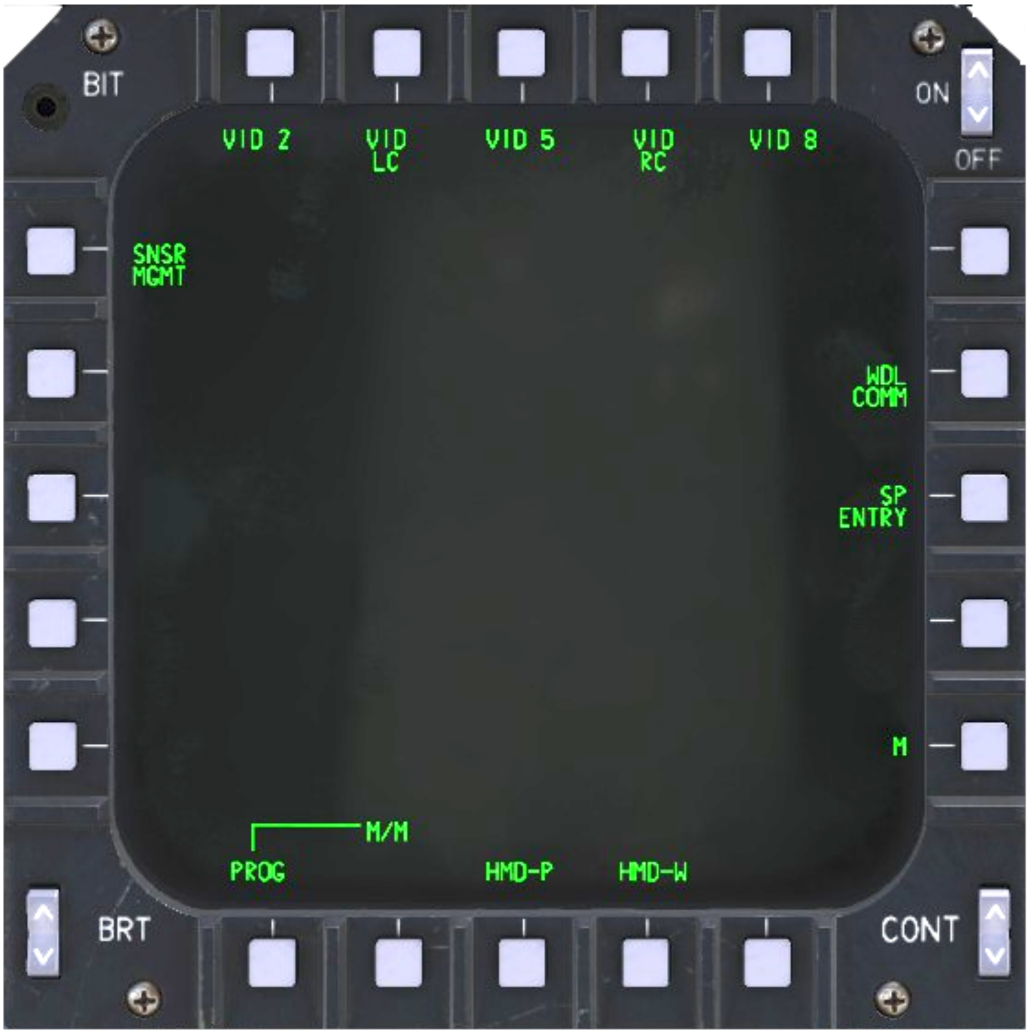
This menu is accessed when M (PB 11) is pressed while in Menu 1.



Menu 2 displays are largely not implemented at the Early Access stage, with the exception of the **A/G DLVRY** page (please see Air to Ground Delivery section for more information). Menu 2 pages will be gradually added after the release.

7.5 MENU 3

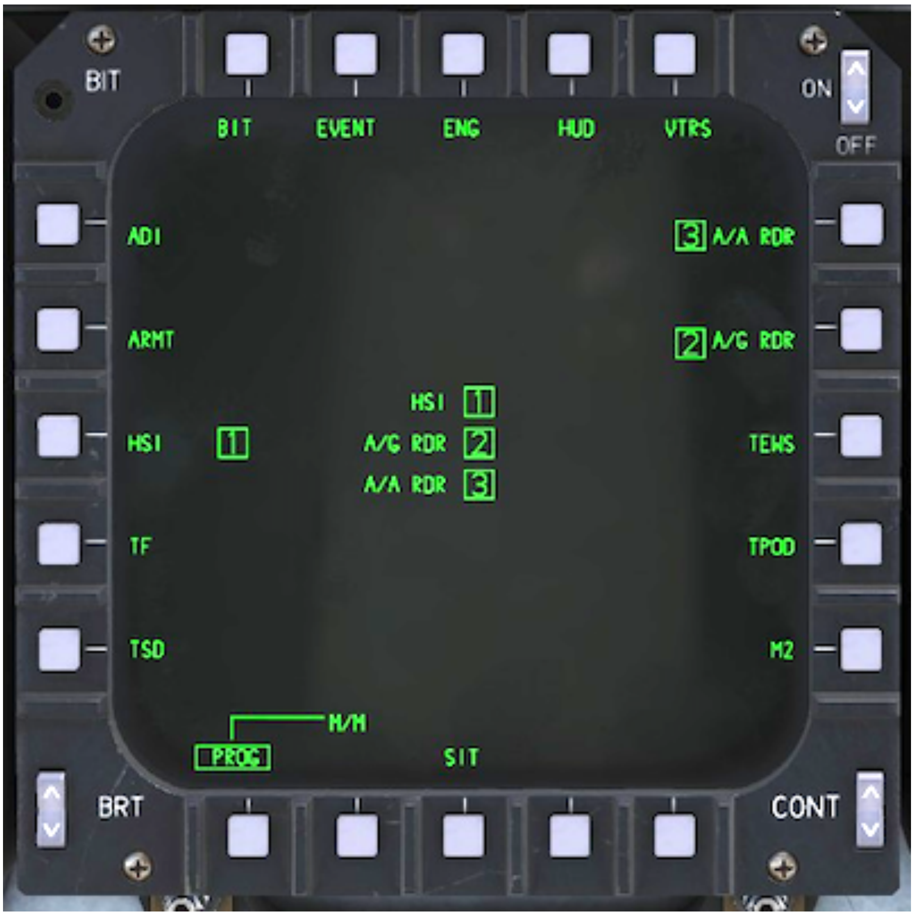
This menu is accessed when M (PB 11) is pressed while in Menu 2.



Menu 3 displays are not implemented at the initial Early Access stage. Additional pages will be gradually added after the release.

7.6 Display Sequence Programming

Each of the MPCDs / MPDs can be programmed to provide easy access to up to three different display formats. When pressed, the PROG legend becomes boxed.



The pilot / WSO can then choose the order of three of the displays by sequentially pushing the PBs next to each legend. In the example above, PB 3 (HSI) was pressed first , PB 9 (A/G RDR) was pushed second and PB 10 (A/A RDR) was pressed third. The respective sequence numbers are also displayed next to the given PB.

To change the order, it is enough to unselect the undesired program and then press PB next to another one that needs to be added.

To exit the program mode, PB 6 (PROG) should be pressed again or pilot / WSO can scroll to one of the programmed displays.

NOTE: you can program displays across all three Menu pages this way.

Scrolling through programmed displays: Front Cockpit

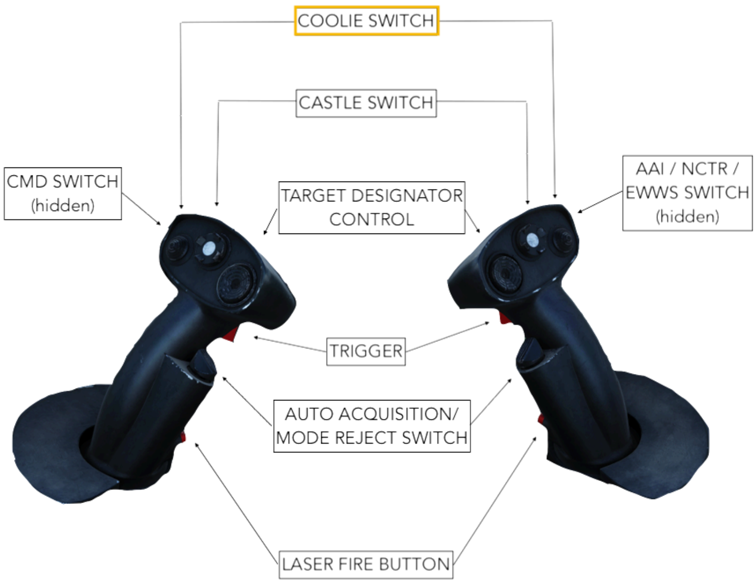
In the front cockpit, the pilot uses LONG PRESS Castle Switch to take command of MPD and SHORT PRESS towards the desired display to scroll between the programmed display formats.

Each time the switch is toggled (Castle short press) towards the left, it scrolls to the next format on the left MPD (in sequence introduced earlier, 1-2-3).

Each time the switch is toggled (Castle short press) towards the right, it first brings up the TEWS page. Then each subsequent toggle right scrolls to the next format on the right MPD (in sequence introduced earlier, 1-2-3).

When the Castle switch is toggled towards the MPCD, it presents the ADI. Subsequent toggles scrolls through the programmed formats as long as the next press is within 5 seconds.

Scrolling through preprogrammed displays: Rear Cockpit

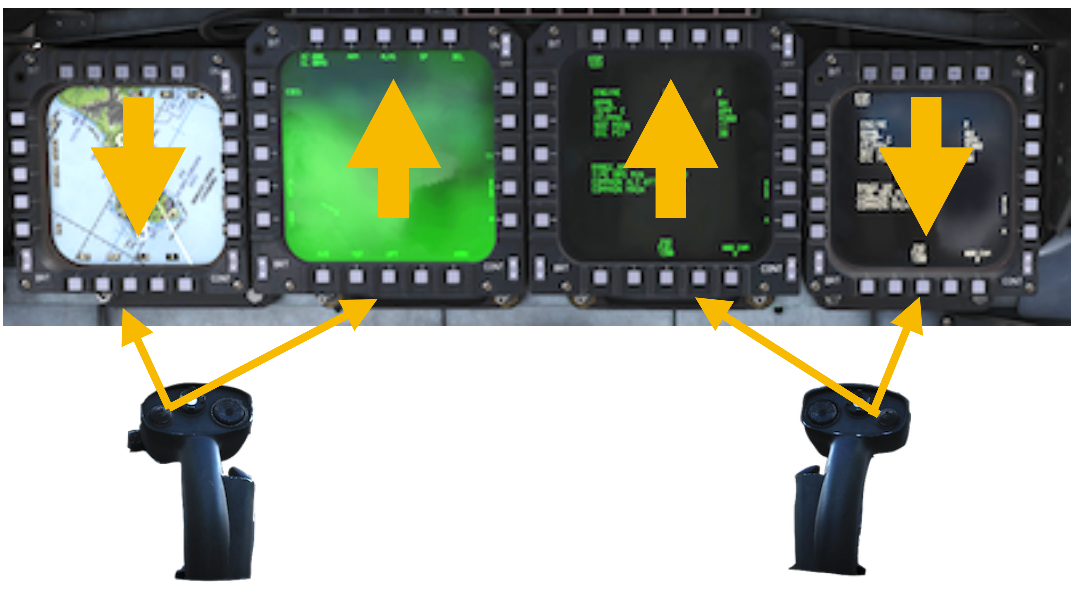


In the rear cockpit, the WSO uses the Coolie Switch to scroll between the programmed display formats.

The Left Coolie Switch is used to take command the left outboard MPCD by and left inboard MPD.

Right Coolie Switch is used to take command of the right outboard MPCD and right inboard MPD.

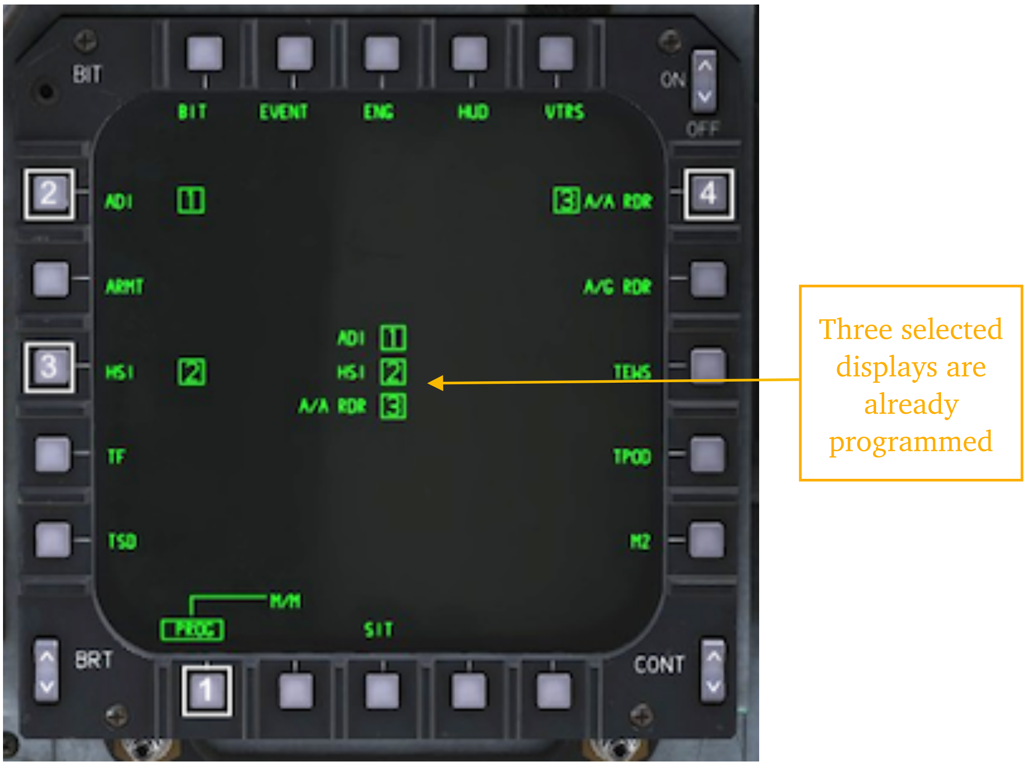
Pressing the respective switch forward scrolls through displays on the inboard MPD, pulling it aft scrolls through displays on outboard MPCD (see below).



7.7 Master Mode Programming

On top of being able to sequence the display formats, it is also possible to assign them to specific master modes, with one specific format attached per screen to the given master mode.

To set it up, crew members should follow the steps described below:

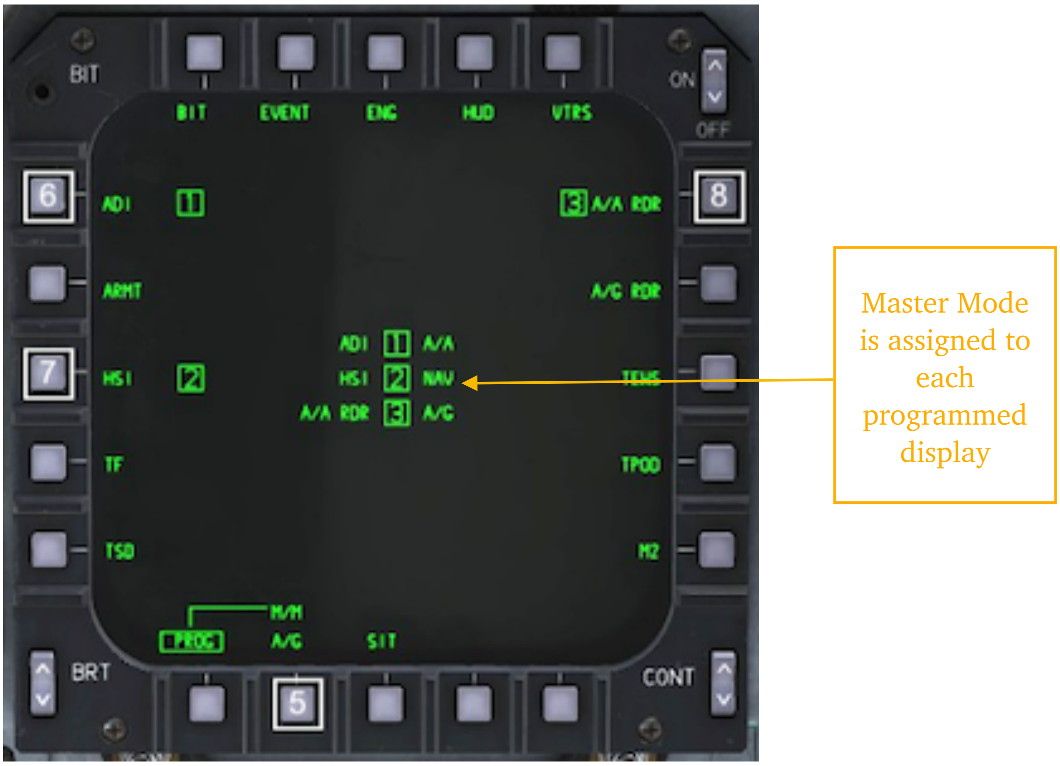


Program the displays for the selected MPD / MPCD as described in previous section.

1. When three displays are selected and assigned numbers (in the example above: ADI, HSI and A/A RDR) press the PB 6 labeled PROG.
2. Choose first desired display to be assigned to a master mode, in this example ADI.
3. Select second desired display, in this example HSI.
4. Choose third desired display, in this example A/A RDR.

NOTE: it is not possible to program displays for the Master Modes without first setting up three main pages for each display.

The three chosen displays will be now shown at the center of the MPD / MPCD.



5. Press PB 6 (with MM legend). A master mode should show up directly above. Continue pressing the PB until the desired MM is displayed. The default order is A/A - A/G - NAV.

6. With the desired MM shown above PB 7, select the PB next to display you want to assign. In this example for the A/A master mode it is ADI (PB 1). You will notice A/A legend appearing next to ADI in the middle of the screen.

7. Next switch to a different MM using PB 7 and then push the PB next to the second display you want to assign to the selected master mode. In this case A/A RDR was assigned to A/G.

8. Repeat the process for the third display, in this example HSI is assigned to NAV master mode.

9. When satisfied, press PB 6 again to exit the programming mode.

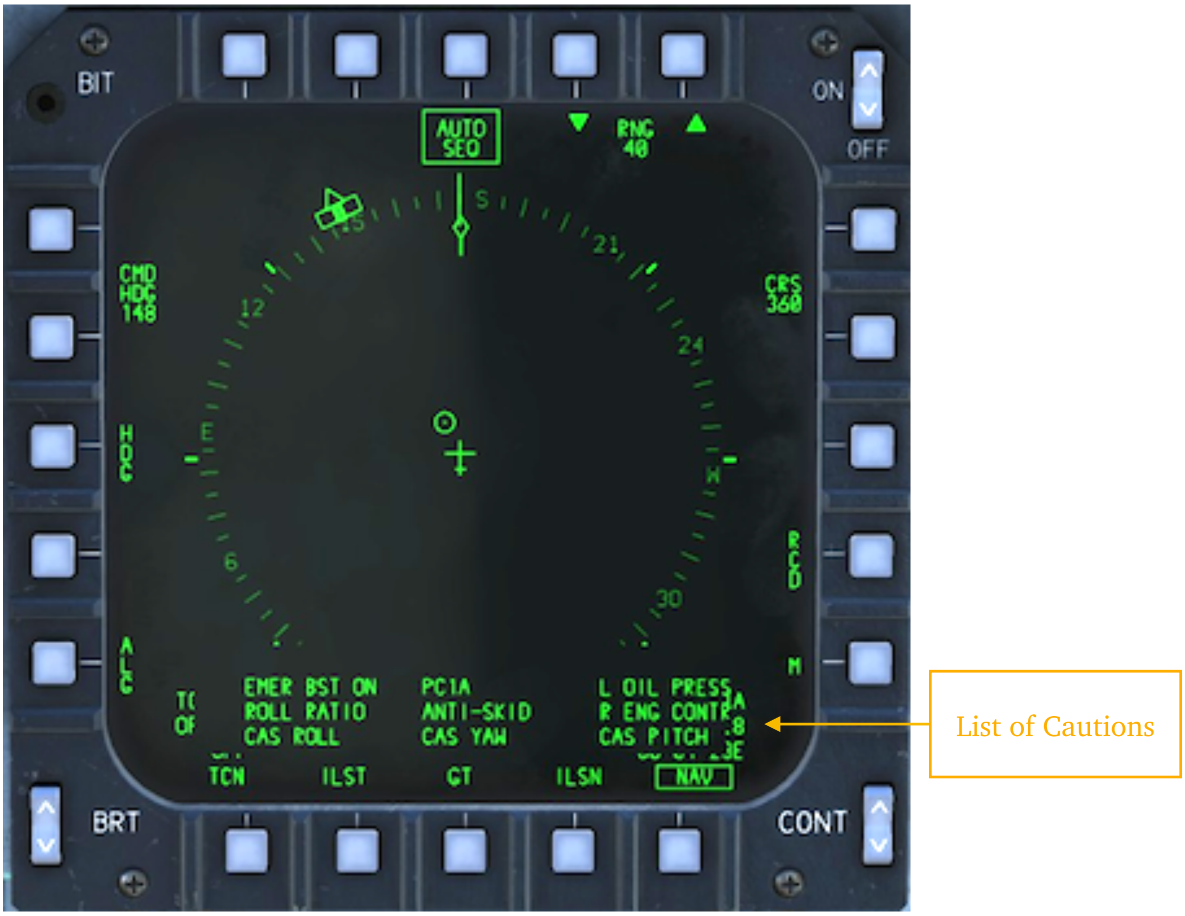
Note that to have specific pages shown on all three (or four for rear cockpit) displays, the crew members have to program each MPD / MPCD separately. So in the example above, whenever A/A master mode is selected, ADI will be shown on this particular display; in NAV - HSI will be visible and so on.

The master modes are selected with the switches below the Hud Control Panel.

7.8 MPD / MPCD CAUTIONS

Apart from the red warning and yellow caution lights in the front and rear cockpit, a number of additional warnings that are displayed on the MPDs and MPCDs in both cockpits. Only two of them appear both as yellow caution lights and MPD / MPCD cautions: EMER BST ON and BST SYS MAL.

Cautions are initially displayed on the right MPD in the front cockpit and on the right MPCD in the rear cockpit.



The cautions can be moved between displays if need be.

In front cockpit, this is done by short pressing the **Castle Switch** towards the desired display while simultaneously holding the MASTER CAUTION light. Pressing the **Castle Switch** down declutters the display.

In the rear cockpit, the **Coolie Switch** on the appropriate HC while simultaneously holding the MASTER CAUTION light. Pressing the **Coolie Switch** aft on any controller while holding the MASTER CAUTION light declutters the display.

When the display is decluttered, only a boxed CAUT legend remains.

All the cautions are displayed in the time order, with the most recent ones on the top of the list from right to left.

The full list of cautions that can be displayed is as follows:

ANTI-SKID: anti-skid is inoperative or turned OFF.

ATTITUDE: unreliable attitude source.

BINGO FUEL: fuel at preset bingo amount.

L BLEED AIR: left bleed air leak.

R BLEED AIR: right bleed air leak.

BST SYS MAL: emergency boost pump malfunction.

L BST PUMP: left boost pump failure.

R BST PUMP: right boost pump failure.

CAS PITCH: pitch control augmentation system inoperative or disengaged.

CAS ROLL: roll control augmentation system inoperative or disengaged.

CAS YAW: yaw control augmentation system inoperative or disengaged.

ECS: environmental control system flow low or high temperature.

L ENG CONTR: left DEEC failure, afterburner fully or partially inhibited.

R ENG CONTR: right DEEC failure, afterburner fully or partially inhibited.

EMER BST ON: emergency boost pump supplying pressure.

FIRE SENSOR: failed fire / temperature sensor.

FUEL HOT: engine fuel temperature above 210°F (99°C).

HI AOA: AFCS degraded.

HOOK: hook unlocked.

IFF MODE 4: mode 4 zeroized or not responding.

INLET ICE: ice buildup in left engine inlet.

L INLET: left engine inlet control failure.

R INLET: right engine inlet control failure.

JFS LOW: JFS accumulator pressure low.

LAT STK LMT: AFCS failure.

NAV POD HOT: navigation pod overtemperature.

OXY LOW: oxygen reserves low.

L OIL PRESS: left oil pressure at or below 8 PSI.

R OIL PRESS: right oil pressure at or below 8 PSI.

PITCH RATIO: pitch ratio failure or pitch ratio switch EMERG selected.

PC1 A: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

PC1 B: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

PC2 A: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

PC2 B: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

L PUMP: left utility pump pressure low.

R PUMP: right utility pump pressure low.

ROLL RATIO: roll ratio incorrect or roll ratio switch EMERG selected.

RUR LMTR: rudder limiter not scheduling properly.

SPIN RECOVERY: spin condition detected.

RECOVER: spin ceased.

TGT POD HOT: target pod overtemperature.

TOT TEMP HI: critical inlet temperature.

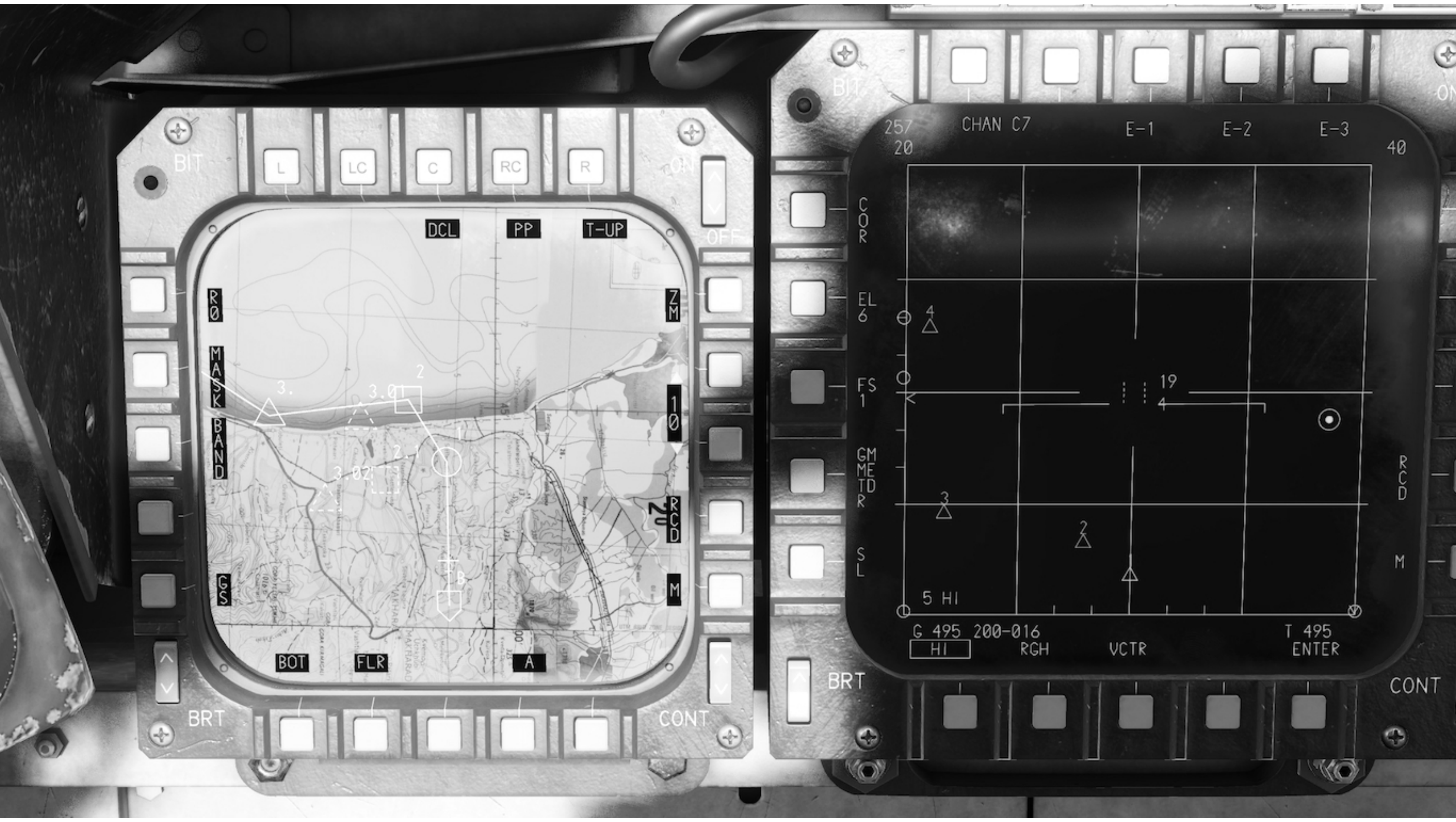
UTL A: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

UTL B: designated RLS (Reservoir Level Sensing) valve has actuated to shut off subsystem.

WNDSHLD HOT: anti-ice air hot.

XFER PUMP: wing or CFT fuel Xfer pump inoperative.

CHAPTER 8: NAVIGATION



8.1 INTRODUCTION

Navigation chapter will cover many different systems and tools that are at disposal of the F-15E Strike Eagle crew members. Following topics will be covered in detail in separate sections:

Navigation Aids: describes the role and functions of different instruments and displays, including HOTAS, HUD, UFC, MPDs and MPCDs.

Navigation HOTAS Controls: describes functions of HOTAS in the front and rear seat.

TSD Display: describes symbology shown on the Tactical Situation Display.

ADI: describes the Attitude Direction Indicator.

HUD: describes the common NAV symbology on the HUD.

UFC: describes basic functions of the UFC used in navigation.

NAV Steering Mode: describes the Navigation steering mode.

HDG Steering Mode: describes the Heading steering mode.

GT Steering Mode: describes the Ground Track steering mode.

TACAN Steering Mode: describes the TACAN steering mode, including two submodes.

CRS Steering Mode: describes the Course steering mode, including two submodes.

ILS Steering Mode: describes two types of Instrument Landing System mode.

ALG Steering Mode: describes the Autonomous Guidance System mode.

ALG Steering Mode: describes different modes of the autopilot.

Cruise Mode: describes the Cruise Mode used for max endurance flights.

Sequence Points: talks about the sequence points and their attributes, including editing existing ones and creating new ones.

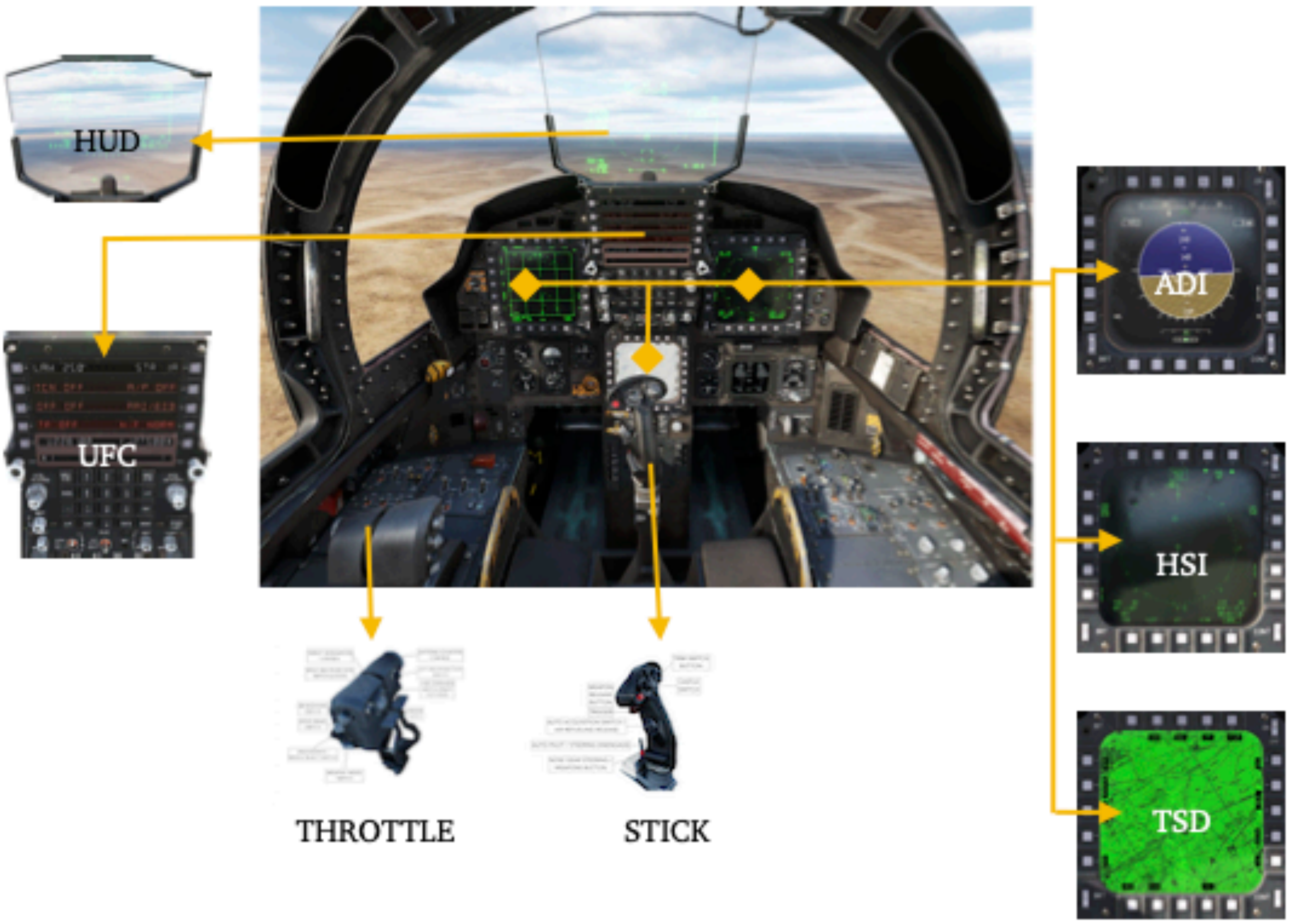
PPKS: describes the Present Position Keeping System, including INS updates and EGI.

Terrain Following: describes the Terrain Following system.

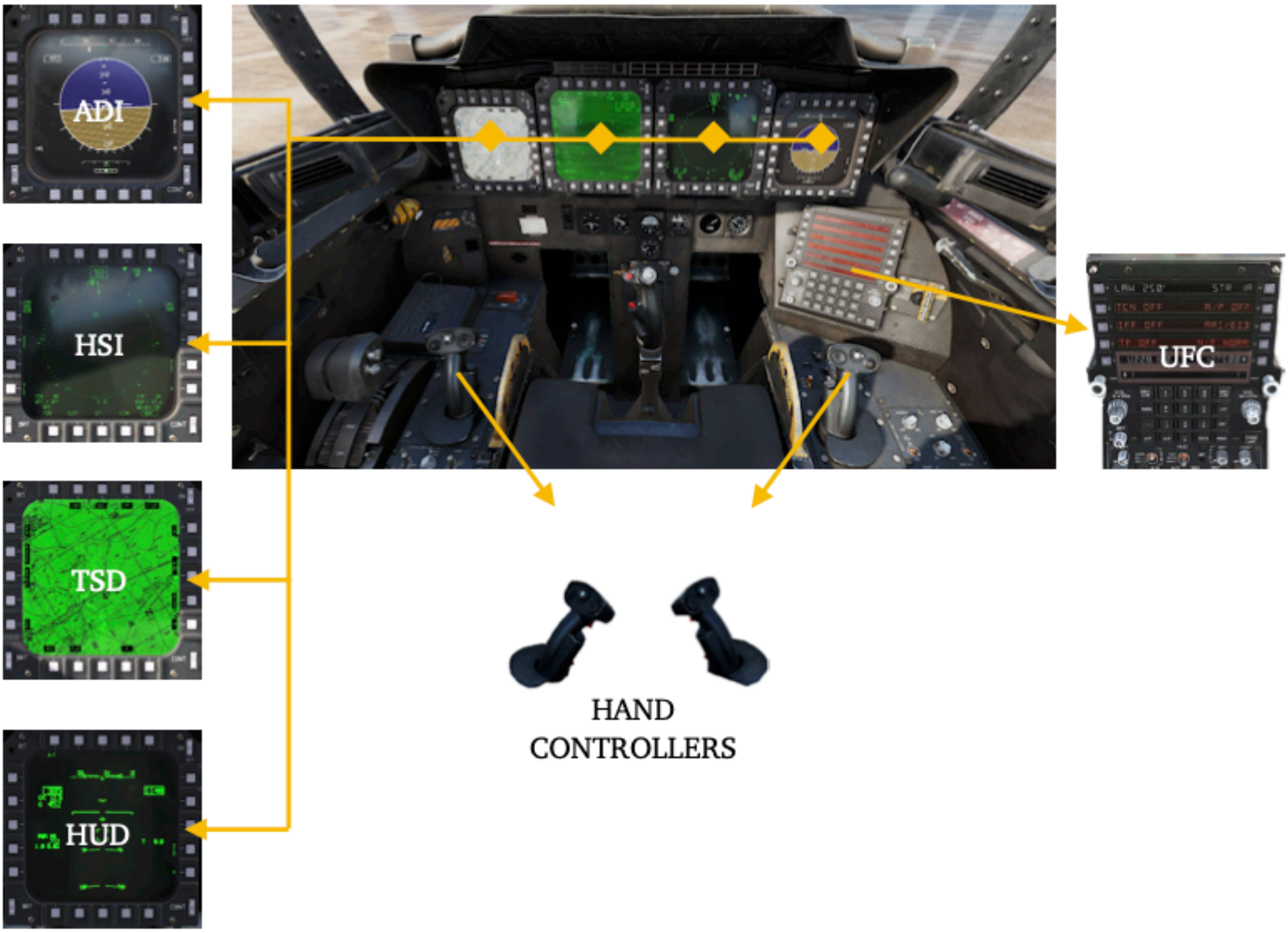
8.2 NAVIGATION AIDS

Both pilot and WSO have a number of instruments they can use during the flight to navigate. These will be described in more detail in the subsequent sections of this chapter. Please click on the image below to move to the corresponding part of the NAV chapter.

Front Cockpit



Rear Cockpit



8.3 NAVIGATION HOTAS CONTROLS

There is relatively little functionality when it comes to using HOTAS system for navigation purposes.

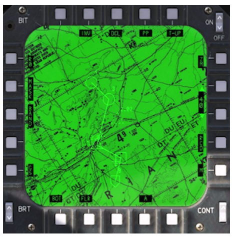
8.3.1 FRONT COCKPIT - STICK

In the front cockpit pilot uses following buttons and switches:

Castle Switch is used to take command of HUD, MPDs and MPCD and to scroll between pre-programmed displays set for each of them (see Display Sequence Programming section for details).

To take control of the HUD, first the pilot should press ( ) the Castle Switch, and then shortly push it up.

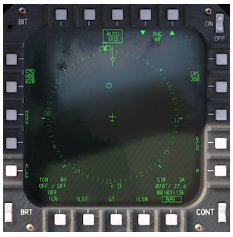
(press and release), then short to take control.



To take control of the sensor in left MPD, long press

To switch between pre-programmed displays, short press

Each press scrolls through one screen in order 1-2-3.



To take control of the sensor in the right MPD, long press

To switch between pre-programmed displays, short press

Each press scrolls through one screen in order 1-2-3. First press always brings up the TEWS page.

To take control of the sensor int he MCPD, long press

To switch between pre-programmed displays, short press

Each press scrolls through one screen in order 1-2-3. First press always brings up the ADI.

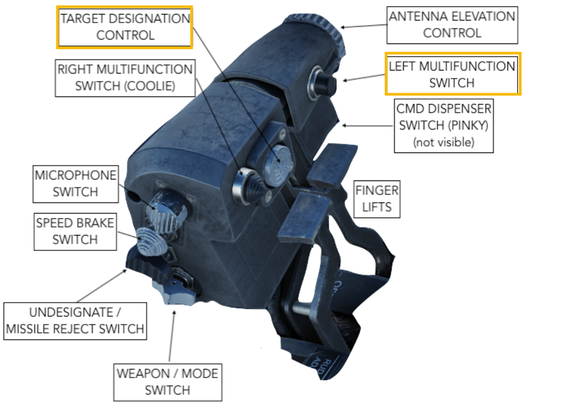
Auto Acquisition Switch is responsible for CUE footprint size on TSD.

NOTE: the TSD page and its HOTAS controls for it are not available at the Early Access stage.

Paddle Switch is used to disable the currently - selected mode of the autopilot.

NOTE: inflight the Paddle Switch also performs certain function for the Terrain Following mode of the autopilot, which is not available at the the Early Access stage.

8.3.2 FRONT COCKPIT - THROTTLE



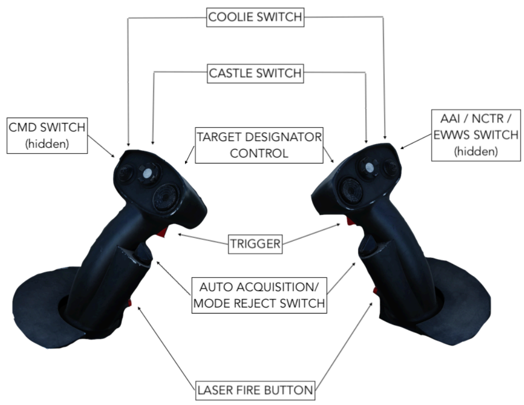
Only two throttle controls are used for the NAV purposes.

Target Designation Control is used on TSD page for range and bearing control (using the transducer) and for cue command (press).

Left Multifunction Switch press is used to toggle the track on or off on TSD page.

Note: the TSD page and HOTAS controls for it are not available at the Early Access stage.

8.2.3 REAR COCKPIT - HAND CONTROLLERS



Target Designation Control is used on TSD page for range and bearing control.

Trigger is used on TSD page to track / untrack (half action) and for cue command (full action).

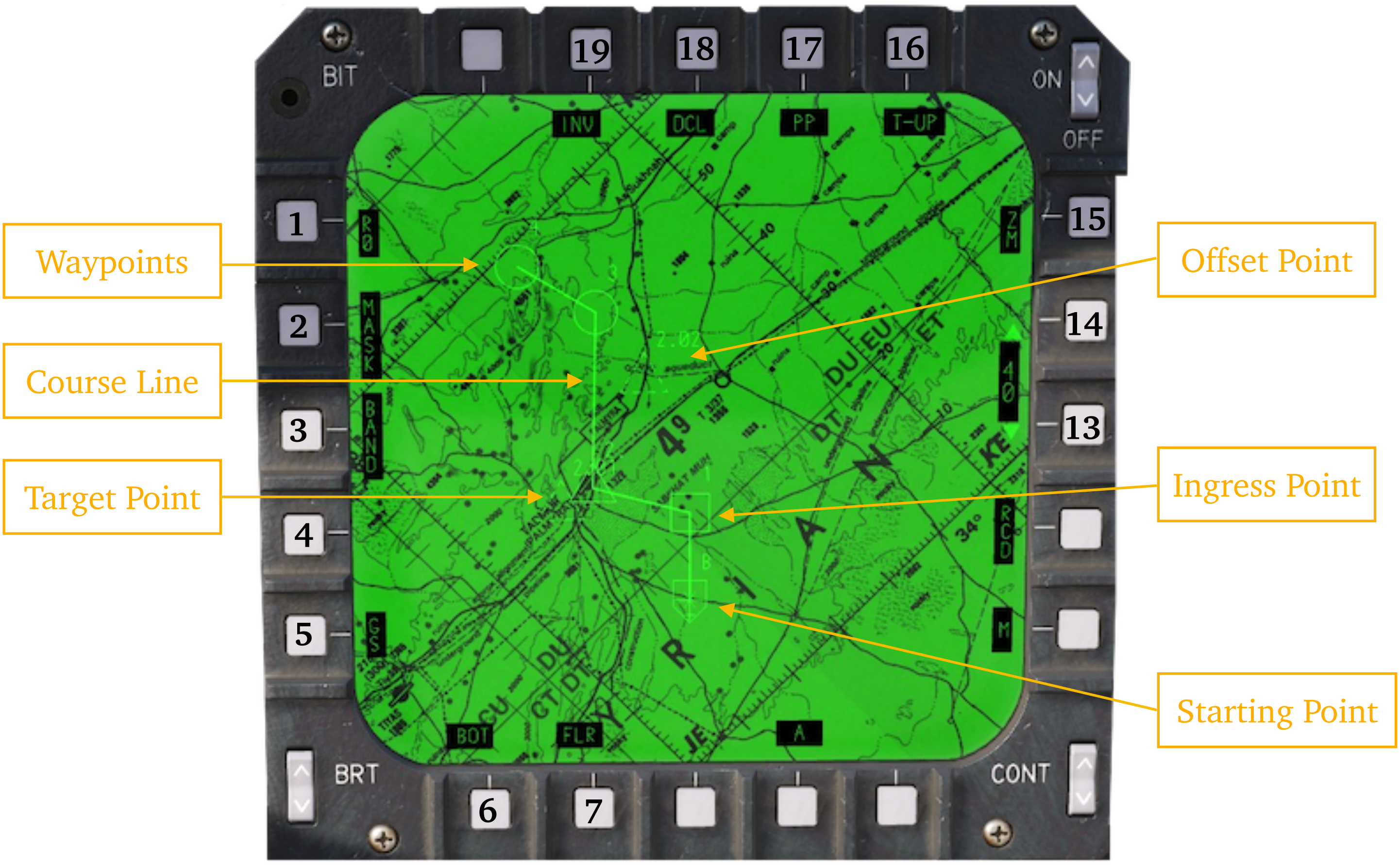
Mode Reject Switch is responsible for CUE footprint size on the TSD.

Castle Switch decreases and increases the map scale on the TSD.

NOTE: the TSD page and its HOTAS controls for it are not available at the Early Access stage.

8.4 Tactical Situation Display (TSD)

The TSD display is part of the Digital Map System, which provides a color or monochromatic map image, which can be manipulated by the crew (by changing map's scale and orientation). It also is capable of displaying additional data, such as threat rings, sensors line of sight, as well as basic navigation data.



PB 1 (Ring): enables a ring (R1 to R4) around the selected threat point, indicating area of avoidance. Up to four rings can be selected for a given point.

PB 2 (Mask): transparent overlay representing areas where the aircraft is visible to a defined threat.

PB 3 (Band): provides dynamic elevation banding (current aircraft MSL altitude vs the surrounding terrain).

PB 4 (Bank): only visible with GS (PB 5) value other than zero. Pressing PB 4 cycles between 30°, 45°, and 60° bank angle. It changes the straight route lines into the curved ones representing actual ground track based on the chosen bank angle and ground speed.

PB 5 (Ground Speed): cycles through ground speed selections (0, 420, 450, 480, 510, 540, 570, and 600 knots).

PB 6 (Bottom or Center): changes between centered and decentered aircraft symbol display. With CTR, the ownship symbol is centered vertically and horizontally on the display. With BOT, the ownship symbol is at the bottom of the display, centered horizontally.

PB 7 (FLR / RDR / EDIT / LOS): cycles between different sensor cues.

PB 9 (Navigation Route Select): switches between three available navigation routes (A, B and C)

PB 12 (Record): records the selected display.

PB 13 and 14 (Map Scale): switches between the following available map scales:

10 NM; JOG, 1:50,000
20 NM; TPC, 1:500,000
40 NM; ONC,1:1,000,000
80 NM; JNC, 1:3,000,000
160 NM; GNC, 1:.5,000,000

Pressing PB 13 decreases the map scale, while PB 14 increases it. Currently selected scale is displayed between PB 13 and 14. The number also gives the distance in Nautical Miles between the ownship symbol and the edge of the screen.

PB 15 (Zoom): each major maps scale offers three additional levels of zoom , as shown in the table below.

Major Map Scale	Zoom 1	Zoom 2	Zoom 3
160	140	112	100
80	70	56	50
40	35	28	25
20	18	14	12
10	10	7	6

PB 16 (True UP / North UP): With track up selected, the top of the map image corresponds to the aircraft ground track. With north up selected, the top of the map image corresponds to true north regardless of the aircraft ground track.

PB 17 (Present Position, PP): pressing this PB sequences through the programmed steer points and target points.

PB 18 (Declutter, DCL): declutters the TSD display, with three available levels.

OFF: all the information is displayed on TSD.

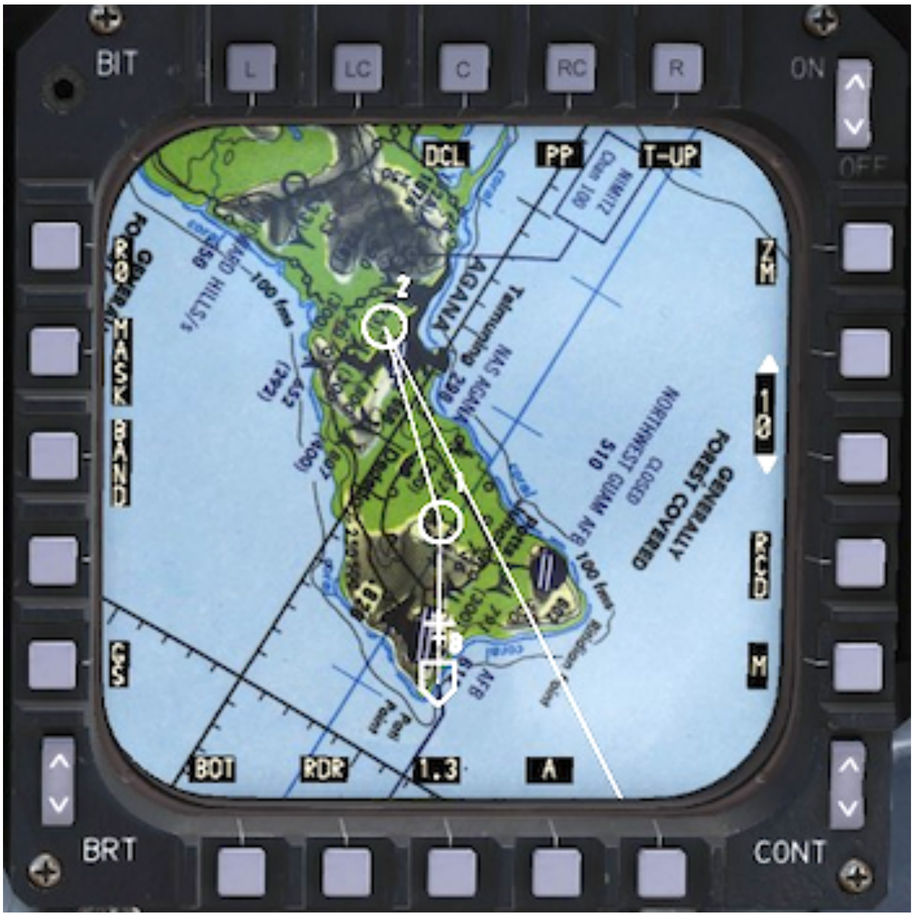
DCL 1 (boxed): removes route lines, sequence point symbols, bank angle selection, ground speed selection, horizontal and vertical range scales.

DCL 2 (boxed): as DCL 1 plus ring options, dynamic threat masking, threat symbols, dynamic elevation banding.

NOTE: DCL button will be fully functional only after all the options it removes from view are added to the module. Not available in EA.

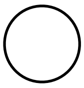
PB 19 (Inverse Video, INV): available only on MPD (monochrome display). It provides improved viewing of the map during night operations and improves the readability of the may by reversing the gray scale from light to dark of normal image.

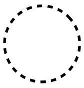
The TSD can also be displayed on the MPCD, potentially offering a clearer and better picture.

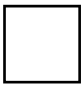


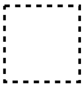
8.4.1 TSD SYMBOLS

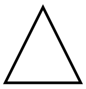
During a typical mission, a plethora of symbols will be displayed on the TAD related to navigation, as well as sensors, threats etc. These are briefly described below:

 Steer Point. The number in the top - right is the steer point number.

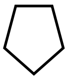
 Aim Point associated with steer point. The number in the top - right shows the steer point number and then aim point number (1.1, 1.3, 2.1 etc).

 Initial Point (IP), which is always the steer point before the target point.

 Aim Point associated with the initial point. The number in the top - right shows the initial point number and then aim point number (1.1, 1.3, 2.1 etc).

 Target. The number in the top - right is the target number.

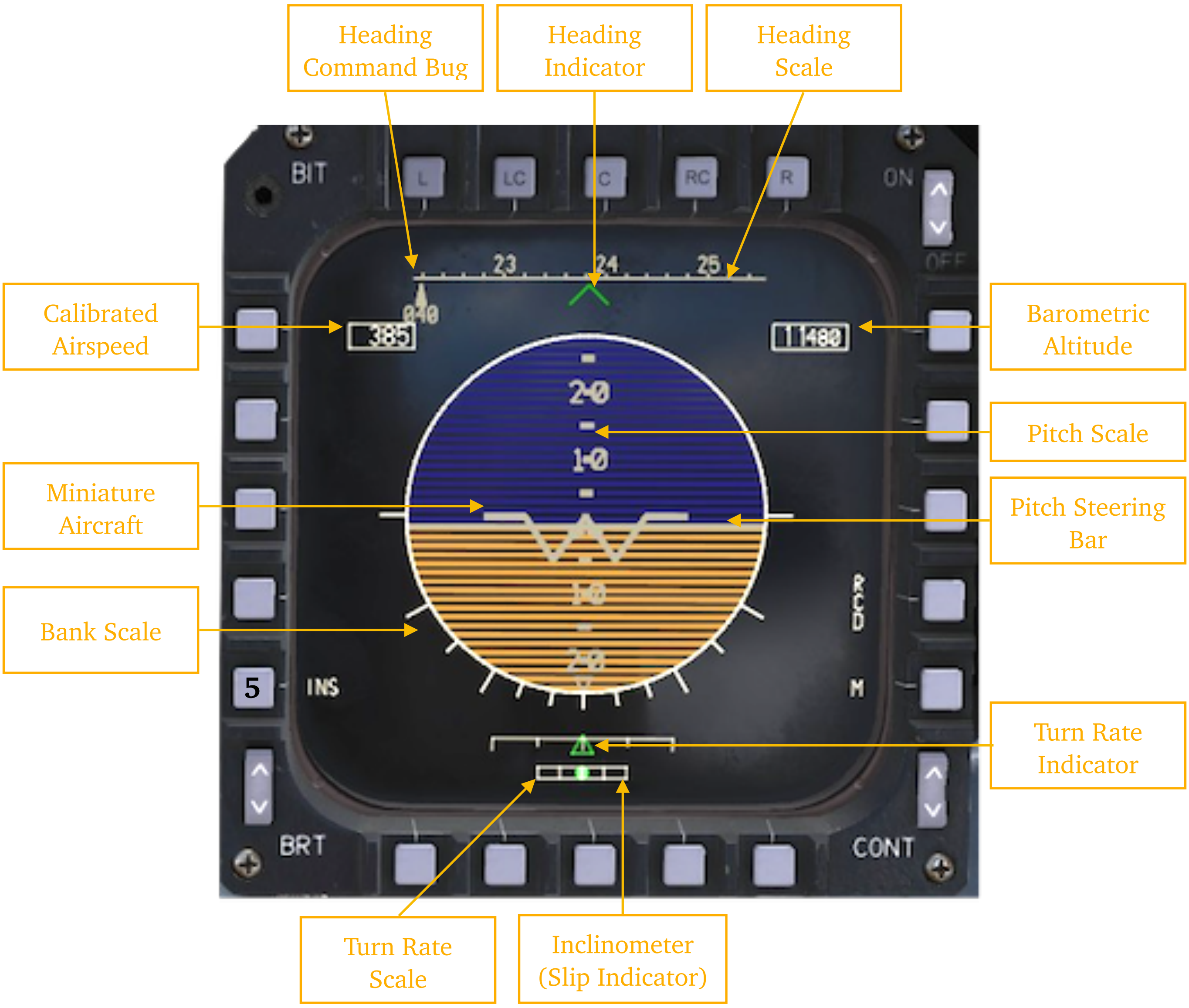
 Offset Point, associated with the target. The number in the top - right shows the target point number and then offset point number in two - digit format (1.01, 1.03 etc).

 Base. Point of origin of the current mission / flight.

NOTE: other TSD symbols (threats, rings etc.) will be added after the initial EA stage.

8.5 ATTITUDE DIRECTOR INDICATOR (ADI)

The Attitude Director Indicator (AI), formerly known as the gyro horizon or artificial horizon, is a flight instrument that informs the pilot of the aircraft orientation relative to Earth's horizon, and gives an immediate indication of the smallest orientation change. It can be brought up in any MPD / MPCD.



Heading Scale the heading scale at the top of the ADI moves horizontally against a fixed caret index, indicating aircraft's magnetic heading from 0° through 360°. The digits above the scale should be multiplied x10 to get the exact heading.

Heading Indicator shows the current heading against the heading scale.

Heading Command Bug is displayed when a steer point is selected. It moves against the scale and also shows a digital readout of magnetic heading towards the currently selected point.

Calibrated Airspeed displays the KCAS value, unless True Airspeed or Ground Airspeed are selected on UFC Data 1 page.

Miniature Aircraft is a representation of the airplane visually showing the bank and the pitch against the pitch and bank scales.

Bank Scale the triangle in the middle shows current bank angle of the aircraft. The tic marks represent 0°, 10°, 20°, 30° (double length), 45° and 60° (double length).

Turn Rate Indicator / Scale shows the rate at which the aircraft is turning.

Inclinometer gives an indication of whether the aircraft is slipping (green dot on the wing down side), skidding (green dot on the wing up side) or in coordinated flight (green dot is in the center).

Pitch Steering Bar / Pitch Scale indicates the vertical path angle of the aircraft in 5° scale between 5 and 85°. Positive pitch lines are solid and negative pitch lines are dashed. The dash next to the number at the end of each line point towards the horizon.

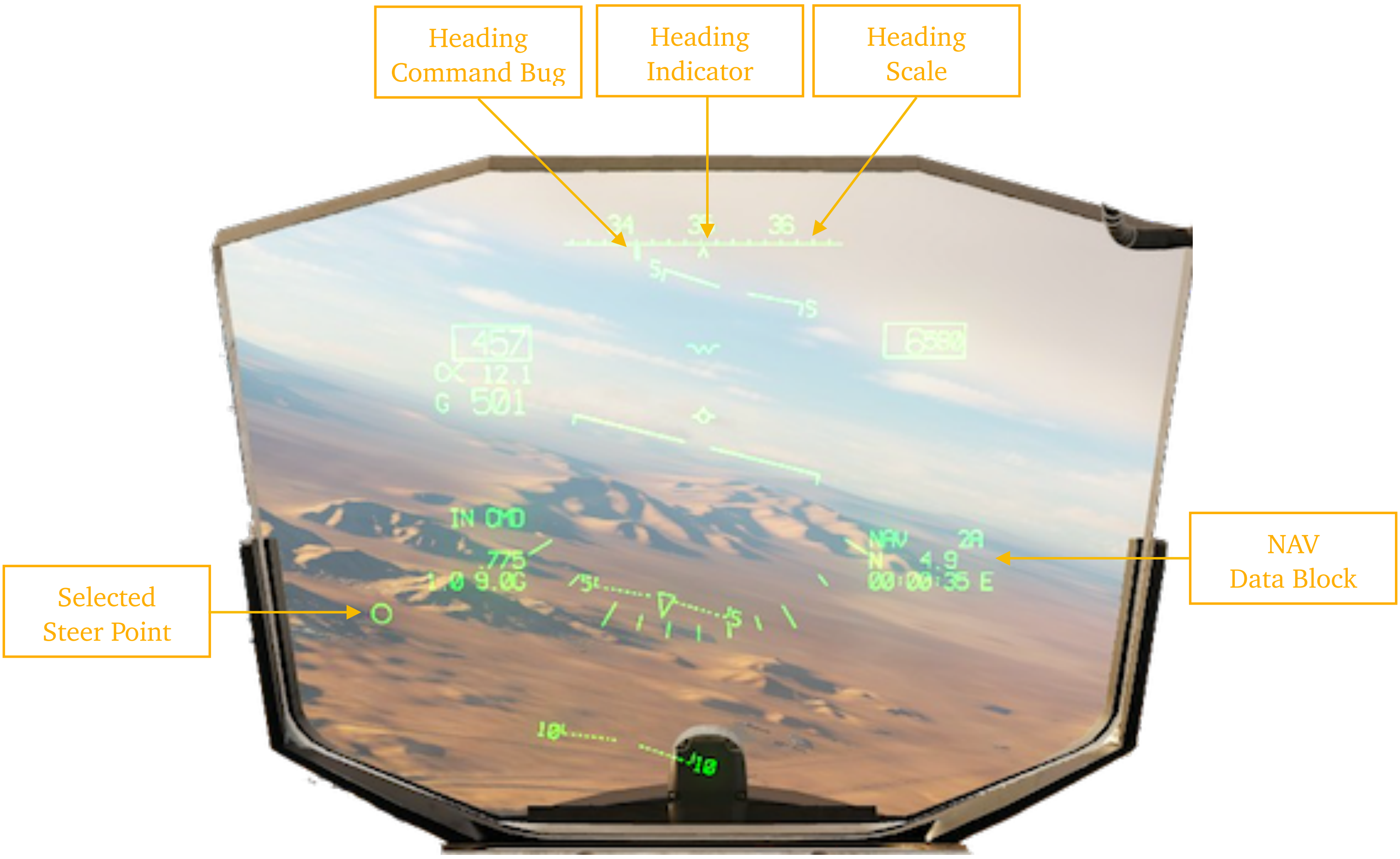
Barometric Altitude shows current MSL altitude in feet.

PB 5 (Current Attitude Source): switches between INS and EGI as the attitude source for the ADI, with INS being the default selection.

The ADI is also capable of displaying the ILS data, as well as other navigation information, all of which will be described in greater detail in later sections of this chapter.

8.6 HEADS UP DISPLAY (HUD)

The basics of the HUD operation are covered in the Heads Up Display chapter earlier in this manual. This section will focus more on indications specific for navigating the aircraft. Please note that many of these are the same as the ones described above for the ADI.



Heading Scale at the top of the HUD moves horizontally against a fixed caret index, indicating aircraft's magnetic heading from 0° through 360°. The digits above the scale should be multiplied x10 to get the exact heading.

Heading Indicator shows the current heading against the heading scale.

Heading Command Bug is displayed when a steer point is selected. It moves against the scale and also shows a digital readout of magnetic heading towards the currently selected point provided that it is outside the heading range visible in HUD.

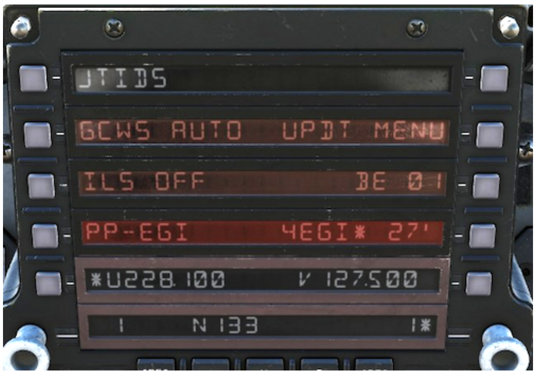
Selected Steer Point is visible in the HUD at the altitude specified in its attributes, ie. it can be set on the ground or at specific elevation.

NAV Data Block shows currently selected steer point, distance in nautical miles and estimated time to target (E) or time of arrival (A), depending on the setting chosen on the UFC.

8.7 UP FRONT CONTROLLER

The UFC is an important tool when it comes to navigation, as it controls many different systems available on MENU 1, MENU 2, DATA 1 and DATA 2 pages:

MENU 1 allows to bring up the Steer Point Menu (PB 10), Auto Pilot Menu (PB 9), Low Altitude Warning (PB 1), TACAN (PB 2) and Terrain Following (PB 4).



MENU 2 is responsible for the Ground Collision Warning System (PB 2), ILS (PB 3), EGI status (PB 4), INS Update (PB 8) and Bullseye information (PB 7).

DATA 1 is used mostly for information purposes and provides crew members with intel about bearing and distance (PB 1) to current steer point (PB 10), estimated time of arrival or time to go (PB 2), selection between True (PB 3) and Ground (PB 4) speed and current winds.

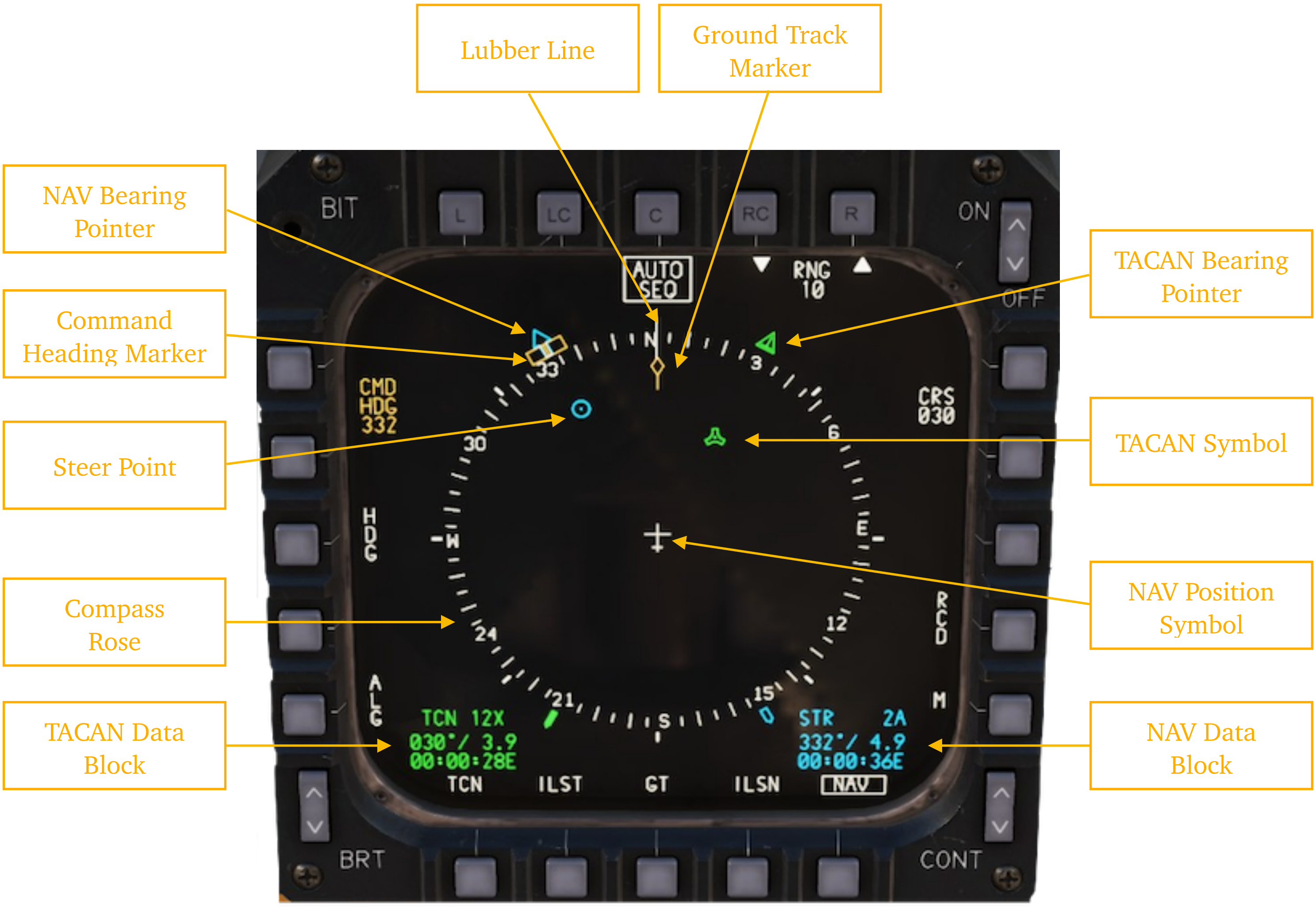
DATA 2 is also used mostly for information purposes and provides crew members with selected sequence point (PB 1), look - ahead point (PB 3) and relevant information connected with both.

Some of the more advanced functions of the UFC will be described later in this chapter.

8.8 HORIZONTAL SITUATION INDICATOR (HSI)

The HSI provides a plan view of the aircraft with respect to the navigation situation. It is also used to choose between the eight main steering modes, all listed on the HSI display. These will be described in detail below.

8.8.1 HSI SYMBOLS



Different data blocks are colour - coded for easier reference. TACAN Data Block, TACAN Bearing pointer and TACAN symbol are marked green, while NAV information (ie. Steer Point, NAV Bearing Pointer and NAV Data block) are blue. Command Heading and Command Heading Marker are orange.

NOTE: only one, currently selected Steer Point is visible on the HSI. Therefore it is not possible to display the whole route (unlike on TSD).

8.8.2 HSI PUSHBUTTONS

PB 1 - 2, CMD HDG: used to move around the command heading marker. PB 1 increases the value by one with each press, PB 2 decreases it. Desired heading can also be typed in the scratchpad and then entered by pressing either of the two PBs. In NAV mode the marker is coupled with the NAV bearing pointer, and the CMD HDG field displays the heading towards the selected Steer Point (which corresponds to information visible in the second line of the NAV Data Block).

PB 3, HDG: enters the Heading Select (HDG) Steering Mode.

PB 5, ALG: enters the Autonomous Landing Guidance (ALG) Steering Mode.

PB 6, TACAN: enters the TACAN (TCN) Steering Mode or Course (CRS) Steering Mode (each press of PB 6 switches between the modes).

PB 7, ILST: enters the Instrument Landing System (ILS) Steering Mode with TACAN distance as main reference.

PB 8, GT: enters the Ground Track (GT) Steering Mode.

PB 9, ILSN: enters the Instrument Landing System (ILS) Steering Mode with distance to airfield Steer Point as main reference.

PB 10, NAV: enters the Navigation (NAV) Steering Mode, which is the default one.

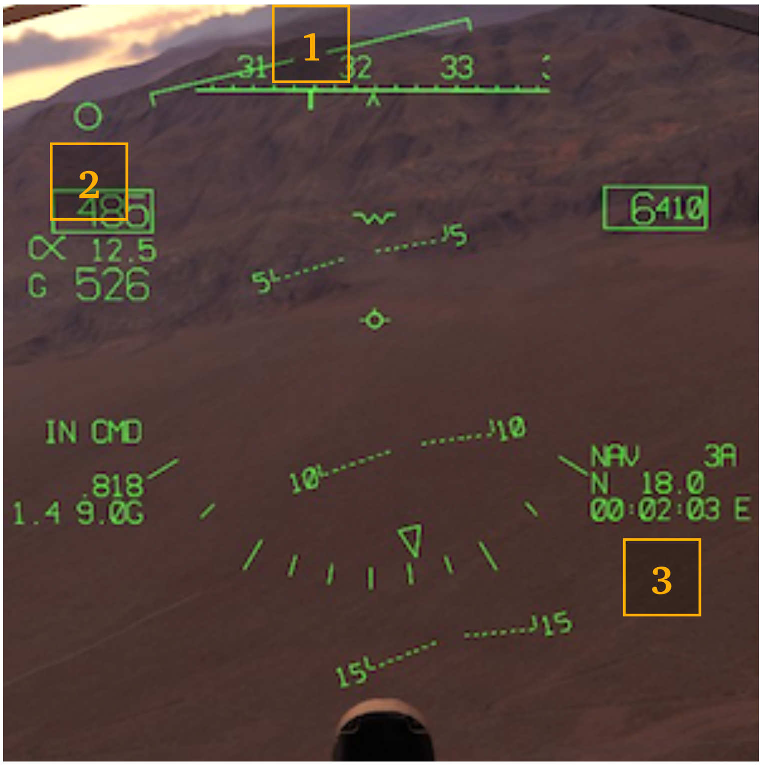
PB 14 - 15, CRS: these pushbuttons are used to select the desired course. PB 14 decreases the value by one, PB 15 increases it. In NAV steering mode changing the course with PBs is inhibited, while in most others this setting is used to align the aircraft with the runway or selected course towards Steer Point / TACAN.

PB 16 - 17, RNG: these pushbuttons change the range scale of the HSI display up (PB 16) or down (PB 17). There are five range scales: 10, 20, 40, 80 and 160 NM. The range represents distance from the aircraft symbol to the perimeter of the compass rose.

PB 18, AUTO SEQ: enables or disables automatic sequencing between the Steer Points. When enabled (boxed), Steer Point switches to the next one once the aircraft flies over the currently selected one or crosses its 3-9 line while being within 2 NM miles laterally from it.

8.9 NAVIGATION (NAV) STEERING MODE

The NAV Mode is the most commonly used of all Steering Modes. In this mode the bearing and heading to fly to selected Steer Point is displayed. It is possible to follow a sequence of waypoints, especially if AUTO SEQ option is enabled.

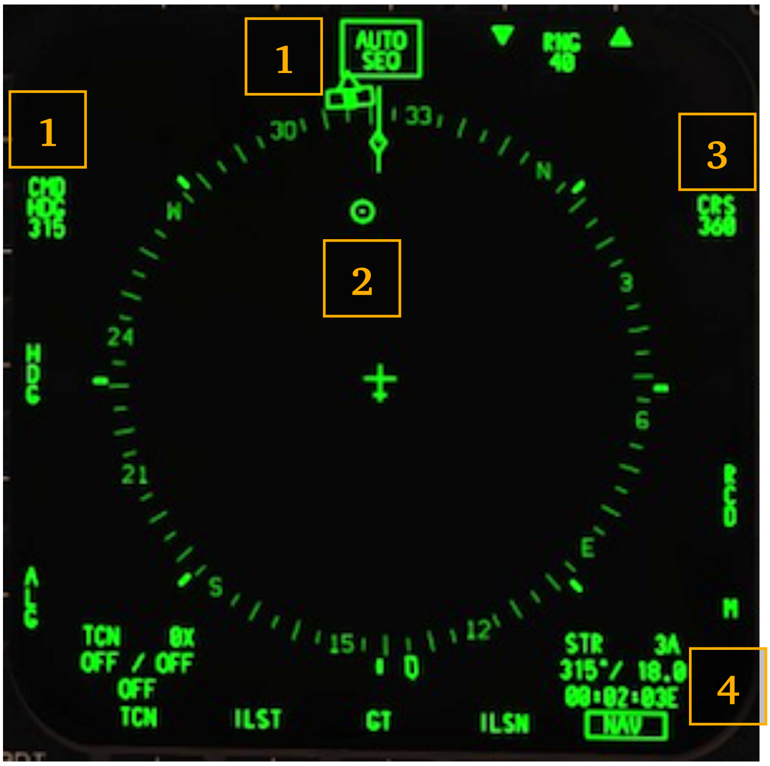


1. The Command Heading Bug on the Heading Scale indicates the heading towards the currently selected Steer Point.

2. Currently selected Steer Point is visible above the calibrated air speed (provided that it remains within the HUD FOV).

3. The NAV Data Block shows the currently selected Steer Point (3A), distance from aircraft's position in Nautical Miles and either Time-To-Go (marked with E in HH:MM:SS) or Estimated Time of Arrival (marked with A), depending on the setting on the UFC (see below).

HSI



1. Command Heading is displayed next to PB 1 and 2, as well as on the compass rose.

2. Currently selected Steer Point is shown in relation to the aircraft.

3. The Course information shows the ground track and cannot be altered.

4. The NAV Data Block shows the currently selected Steer Point (3A), distance from aircraft's position in Nautical Miles and either Time-To-Go (marked with E in HH:MM:SS) or Estimated Time of Arrival (marked with A), depending on the setting on the UFC.

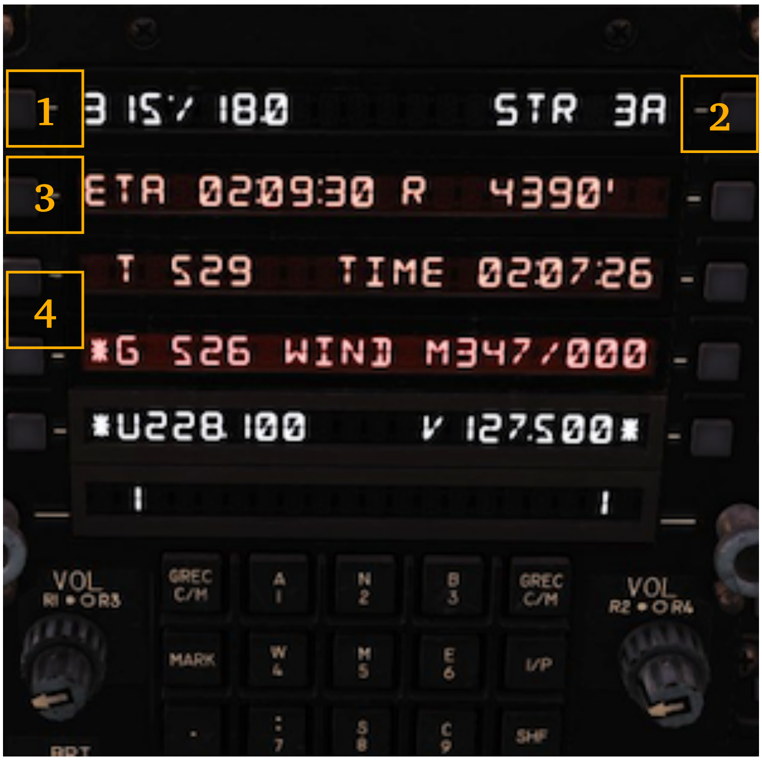
Note that in NAV mode it is not possible to change the command heading nor the course using the pushbuttons. The CMD HDG is tied to the currently selected Steer Point, while CRS shows the ground track of the aircraft.

ADI

1. Information on the ADI largely mirrors the one shown on the HUD, with Command Heading displayed on the heading scale.

It also shows the indicated airspeed, barometric altitude, as well as aircraft's pitch and bank.

UFC: Data 1 Page



1. Part of the DATA page on the UFC mirrors some of the information from the other displays, namely bearing and range to the selected Steer Point (2).

3. If ETA is selected on UFC, then ETE is displayed in the NAV Data Block on the HUD and in HSI and vice versa.

4. The True Airspeed (T) or Ground Speed (G) is selected on the UFC, then this selection is mirrored on the HUD. Deselecting both means that neither T or G speed will be shown on the HUD.

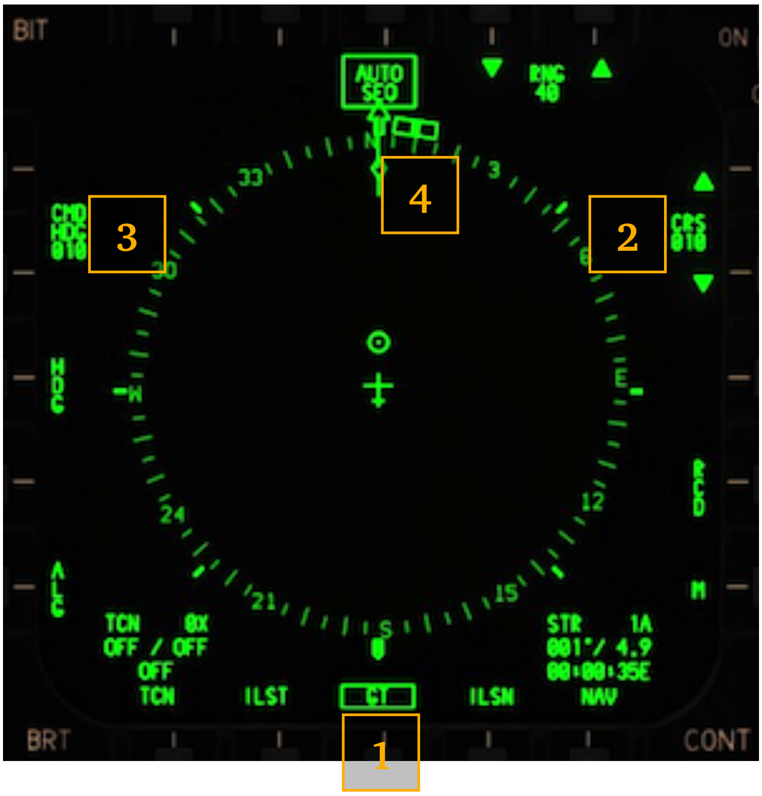
8.10 HEADING (HDG) SELECT STEERING MODE

The HDG steer mode is mutually exclusive with all the other steering modes. Coupled with the autopilot, it allows the air crew to enter a desired heading which will be intercepted and held by the aircraft.

NOTE: The HDG Steering Mode is a blended mode and it is not fully operational in Early Access.

8.11 GROUND TRACK (GT) STEERING MODE

The Ground Track Steering Mode is used to set up a wind - corrected heading using the UFC controls and the HSI (in other words, it is basically a crabbed flight director based on winds).



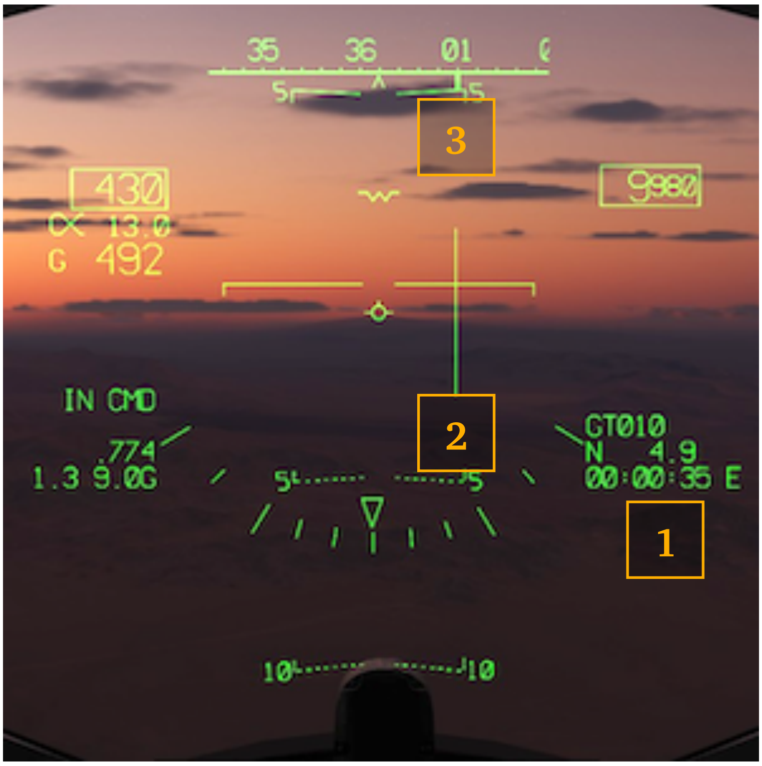
1. To enable GT mode, the PB 8 (GT) should be pressed and becomes boxed.

2. Desired course is selected by either typing the value in UFC and pressing PB 14 or 15 or by increasing / decreasing the value by one using the same pushbuttons.

3. CMD HDG is whatever heading is required to fly the desired course. With a crosswind, the CMD heading will be different than the course in order for the aircraft to maintain the course. For instance, if the desired course is 360 and there is 25 knots winds from 270 (left to right crosswind), then the command heading might be around 300 to hold that course over the ground.

4. The Command Heading bug shows the heading which should be flown on the compass rose.

HUD

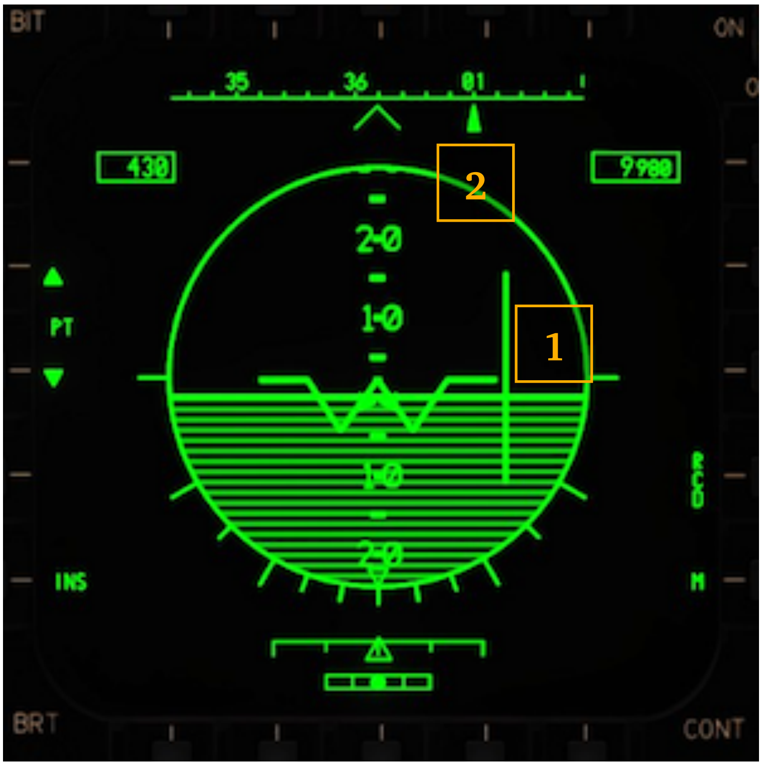


1. On the HUD, GT legend is displayed in NAV data block, followed by the value selected in CRS field on the HSI. Note that the info below still indicates the distance and Time Enroute (or of Arrival) to the currently selected Steer Point.

2. A Bank Steering Bar is shown giving the pilot visual designation for intercepting the selected Ground Track.

3. The Command Heading Bug on the Heading Scale indicates the heading that is required to intercept and then maintain the desired course that should be flown to intercept the selected Ground Track.

ADI

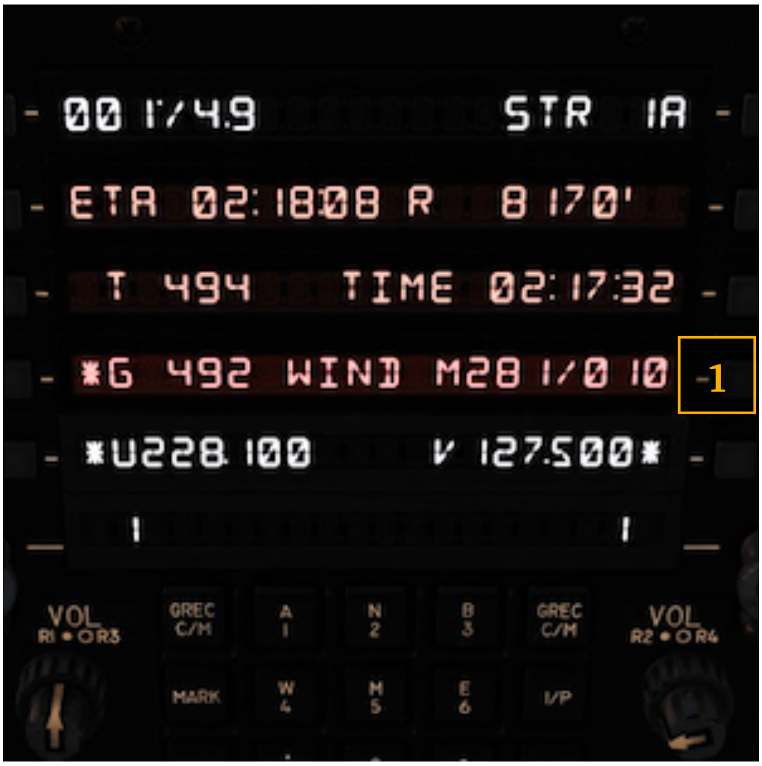


The information displayed on the ADI largely mirrors the HUD indications.

1. A Bank Steering Bar is shown giving the pilot visual designation for intercepting the selected Ground Track.

2. The Command Heading Bug on the Heading Scale indicates the course that should be flown to intercept the selected Ground Track.

UFC

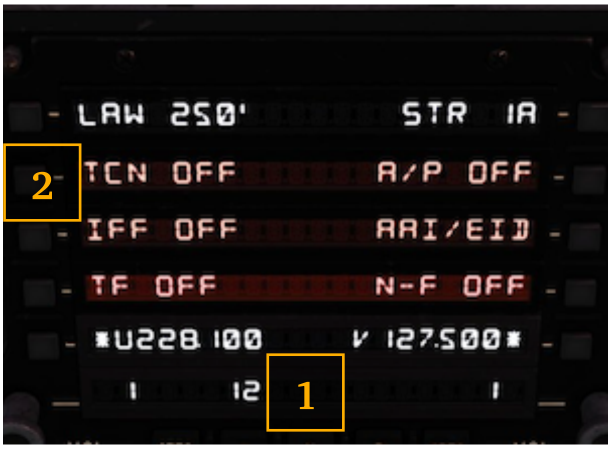


In the UFC, the DATA 1 display contains usual information with relation to the selected Steer Point.

1. It is important to note the wind data next to PB 7, which is taken into account by the system when setting the Ground Track on a specified heading.

8.12 TACAN (TCN) STEERING MODE

The TACAN Steering Mode uses a tactical air navigation station, typically for guidance to the airfield (although fully functional TACAN can also be mounted on larger airborne platforms, like tankers).



In order to for it to work, first the onboard TACAN should be set up and turned on.

The easiest way to do this is by:

1. typing the correct channel in the scratchpad using the UFC and then

2. pressing PB , which automatically enables the system and puts in in T/R mode.

Subsequent actuation of PB 2 opens the UFC TACAN menu with the following options:

PB 1: TCN channel. Pressing this PB switches between X and Y modes.

PN 2-4: switches the modes of operation between air to air (2), transmit - receive (3) and receive only (4).

PB 8: TACAN program (not functional).

PB 10: indicates that the TACAN is turned on.

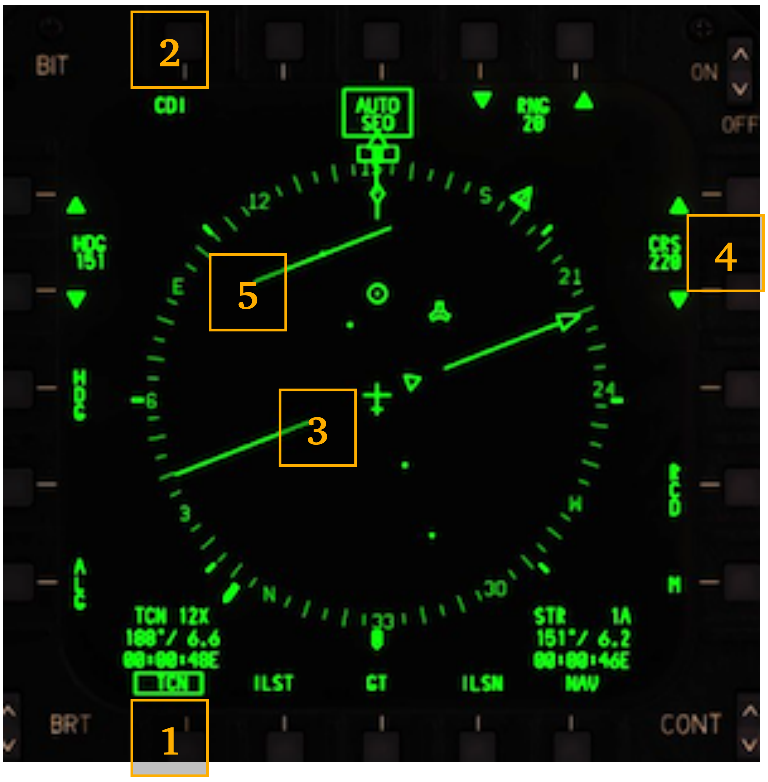
As soon as the TACAN is functional, it will appear in HSI even if the TCN Steering Mode is not selected, and is represented by the symbol visible to the left.

The TCN Data Block will also be displayed with information about the selected channel, bearing, distance and time enroute (or time of arrival). If TACAN is disabled or out of range, the respective fields of the TCN Data Block will show OFF.

There are two display options available for TACAN: course deviation indicator (CDI) or PLAN. Both will be described below.

8.12.1 TACAN WITH CDI

In this mode, a set course pointer with Course Deviation Indicator is drawn through the center of the aircraft.



1. In order to enable the TCN Steering Mode, PB 6 should be pressed once. TCN legend becomes boxed.

2. Display defaults to CDI (PB 20).

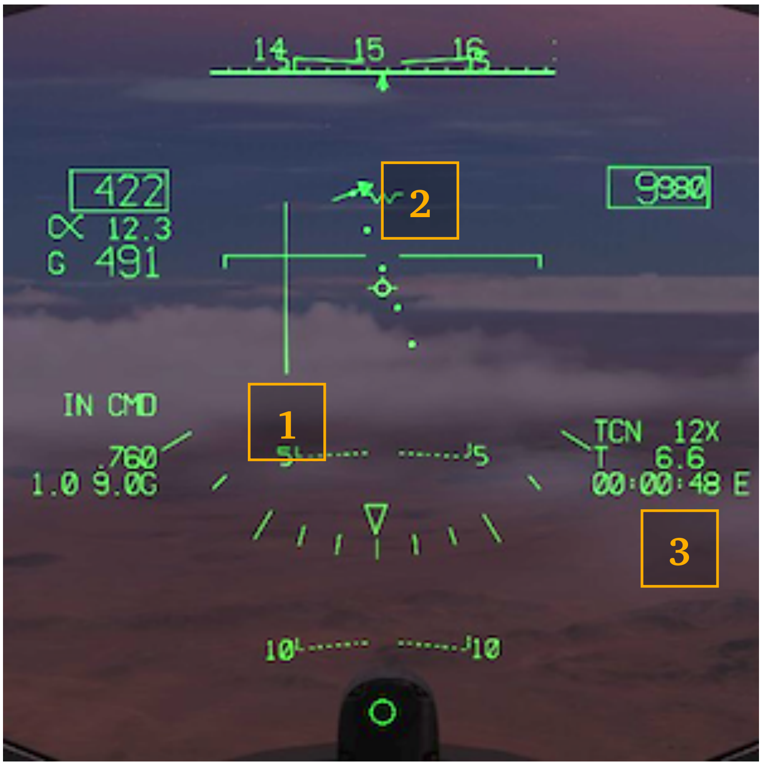
3. Set course pointer goes through the middle of the aircraft, with the TO/FROM indicator adjacent to it. It corresponds to the CRS setting **(4)**, which can be set via the scratchpad on the UFC or by pressing PB 14 and 15 to decrease / increase its value.

5. Course Deviation Indicator moves away from the set course pointer the further aircraft is from the desired course. The dots to the left and right from the set course pointer signify a 5° deviation each. If CDI is aligned with the set course pointer, the aircraft has intercepted the desired course.

In practical terms the CRS setting is the selected TACAN radial on which the aircraft should be approaching of flying from the station. The CDI shows how many degrees off of the radial the aircraft is. As the aircraft gets closer to the radial, the CDI will start moving towards the set course pointer and vice versa.

The TACAN Data Block shows the direct course and distance to the TACAN station.

HUD

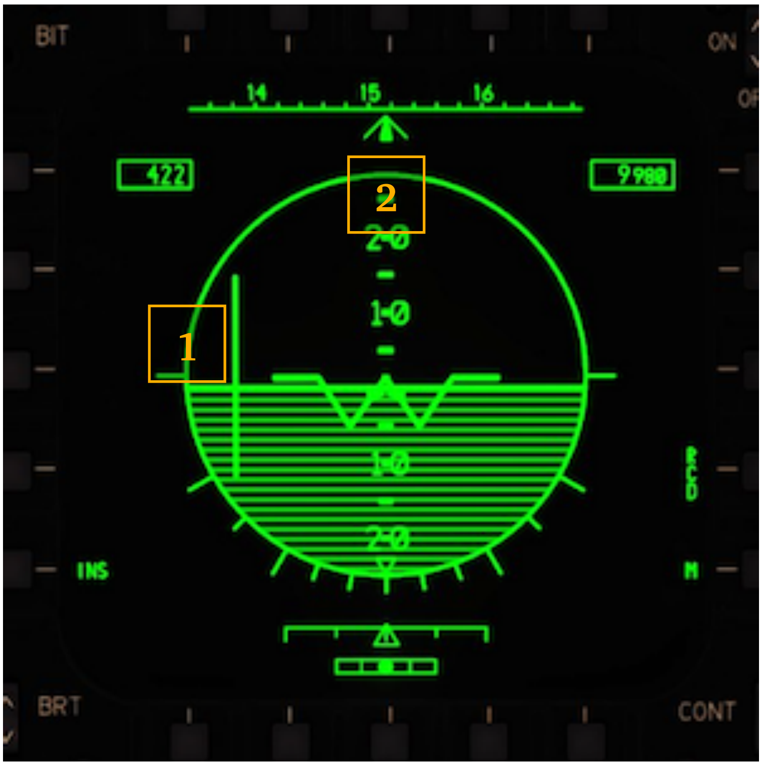


1. On the HUD, a vertical Bank Steering Bar is displayed just like in the GT mode.

2. TACAN Deviation Arrow mirrors the CDI position on the HSI, together with five dots, the middle one corresponding with the position of the aircraft.

3. The TACAN Data Block shows the channel, distance from TACAN station and time enroute / time of arrival.

ADI

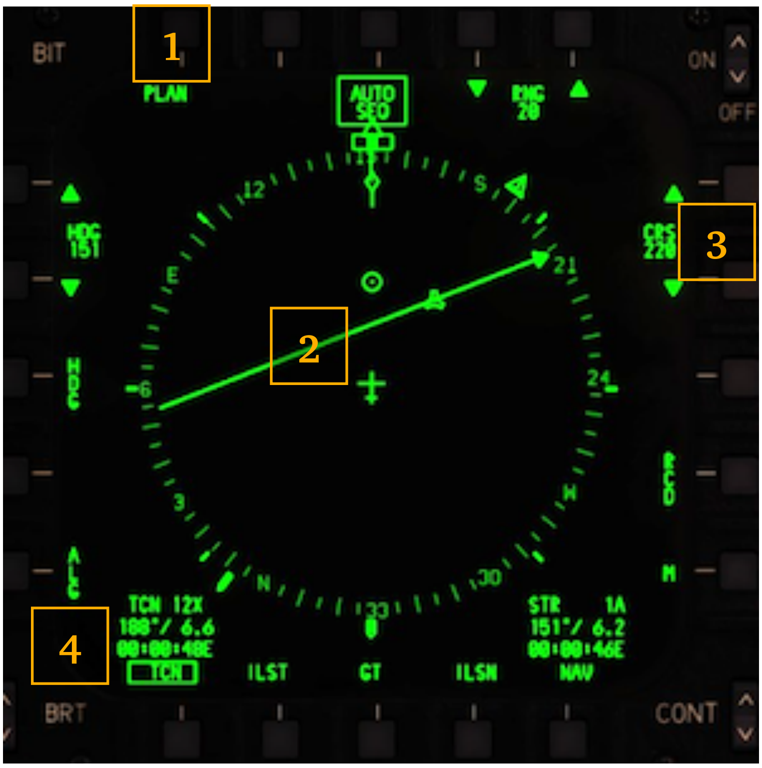


1. On the ADI data from the HUD is mirrored, with vertical Bank Steering Bar.

2. However, even in the TCN Steering Mode, the Command Heading marker shows bearing to the currently selected Steer Point.

8.12.2 TACAN WITH PLAN

In this mode, a set course arrow is drawn through the center of the TACAN station symbol.



1. In order to enable the PLAN mode, with TCN boxed press PB 20.

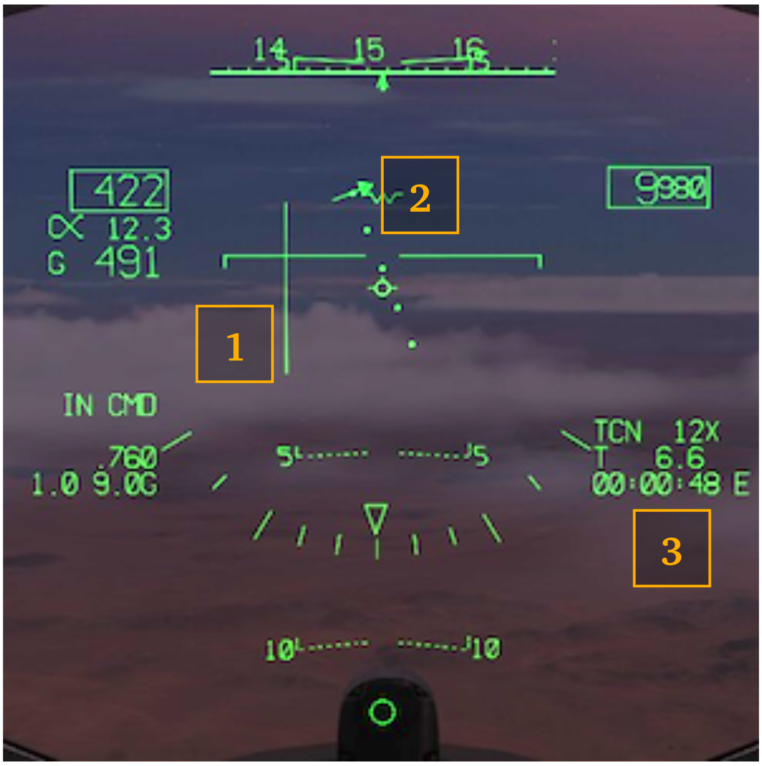
2. The set course arrow runs through the middle of the TACAN symbol. As with CDI mode, it corresponds to the CRS setting (3), which can be set via the scratchpad on the UFC or by pressing PB 14 and 15 to decrease / increase its value.

There is no CDI and TO / FROM indication in this mode.

4. The TACAN Data Block shows the direct course and distance to the TACAN station.

PLAN mode gives a more straightforward representation of aircraft's position in relation to the TACAN station and the desired course that needs to be intercepted with less "moving elements" on the screen.

HUD

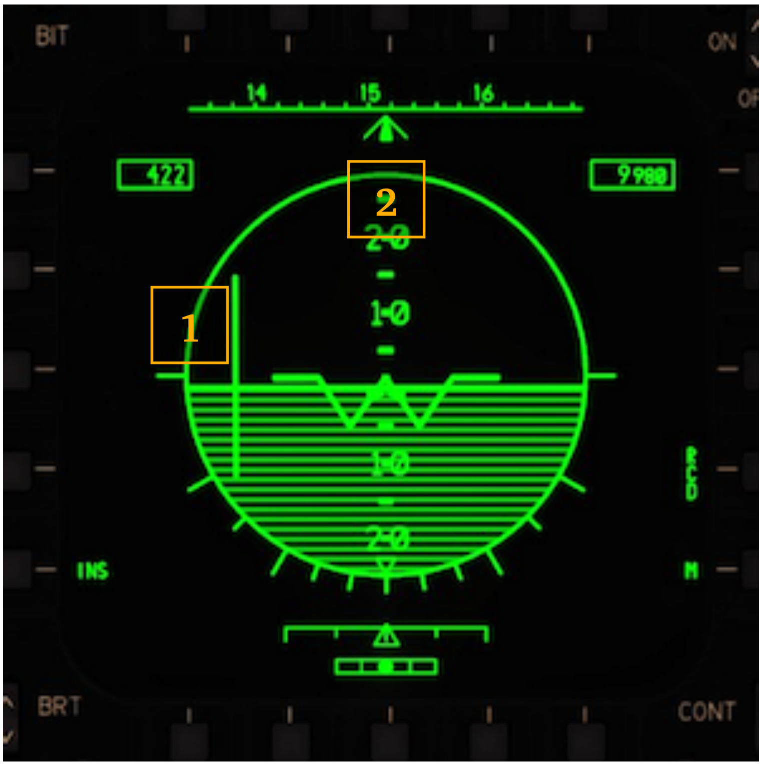


1. On the HUD, a vertical Bank Steering Bar is displayed just like in the GT mode.

2. TACAN Deviation Arrow mirrors the CDI position on the HSI, together with five dots, the middle one corresponding with the position of the aircraft.

3. The TACAN Data Block shows the channel, distance from TACAN station and time enroute / time of arrival.

ADI



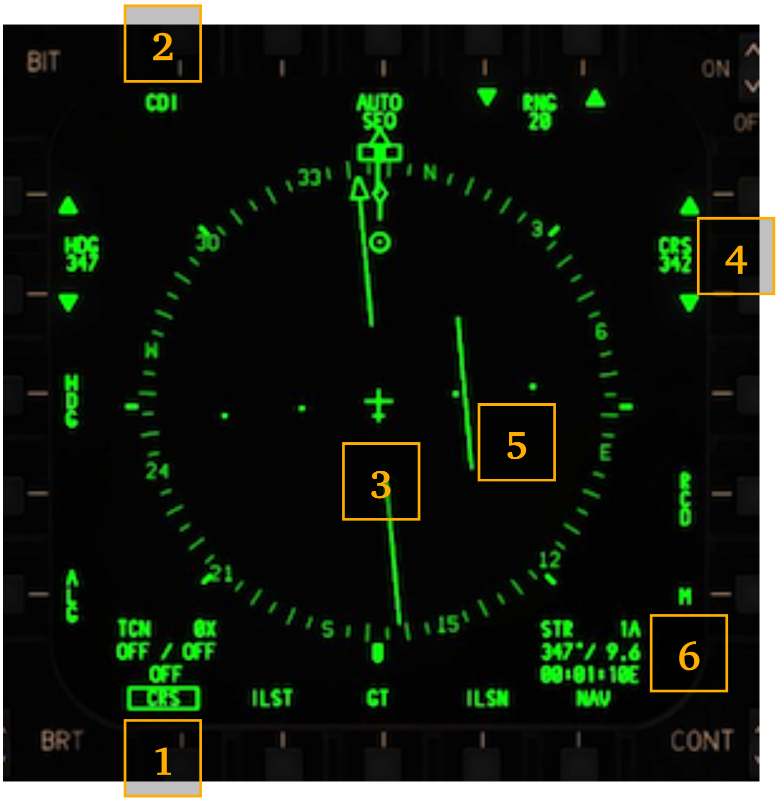
1. On the ADI data from the HUD is mirrored, with vertical Bank Steering Bar.

2. The Heading is no longer a "COMMAND" HDG. It is a user selectable heading where you can input a heading from the UFC into PB 1 or 2, or use the up/down arrows at PB1/2 to change the heading to the desired HDG.

8.13 COURSE (CRS) STEERING MODE

The Course Steering Mode works basically in the same way as TCN Steering Mode, with the difference that the reference point is currently selected Steer Point instead of a TACAN station. As such, there is no need to have the TACAN enabled. CRS works both in CDI and PLAN modes.

8.13.1 CRS WITH CDI



1. In order to enable the CRS mode, press PB 6 twice. First actuation will box the TCN legend, second will enable and box CRS.

2. Display defaults to CDI (PB 20).

3. Set course pointer goes through the middle of the aircraft, but there is no TO/ FROM indicator as in TCN mode. The pointer corresponds to the CRS setting (4), which can be set via the scratchpad on the UFC or by pressing PB 14 and 15 to decrease / increase its value.

5. Course Deviation Indicator moves away from the set course pointer the further aircraft is from the desired course. The dots to the left and right from the set course pointer signify a 5° deviation each. If in straight flight the CDI is aligned with the set course pointer, the aircraft is flying on the desired course, ie. if in this example CRS was set to 347° (corresponding to the direct course to Steer Point 1A, as shown in the NAV Data Block, **6**), then the CDI would go through the aircraft symbol and align with the course pointer (and the course pointer would intersect the Steer Point marker).

Just like for the TACAN, the CRS setting allows the air crew to choose and easily intercept a desired course on which the aircraft should approach the selected Steer Point, while the CDI shows how many degrees away it is from intercepting it..

The NAV Data Block shows the direct course and distance to the selected Steer Point.

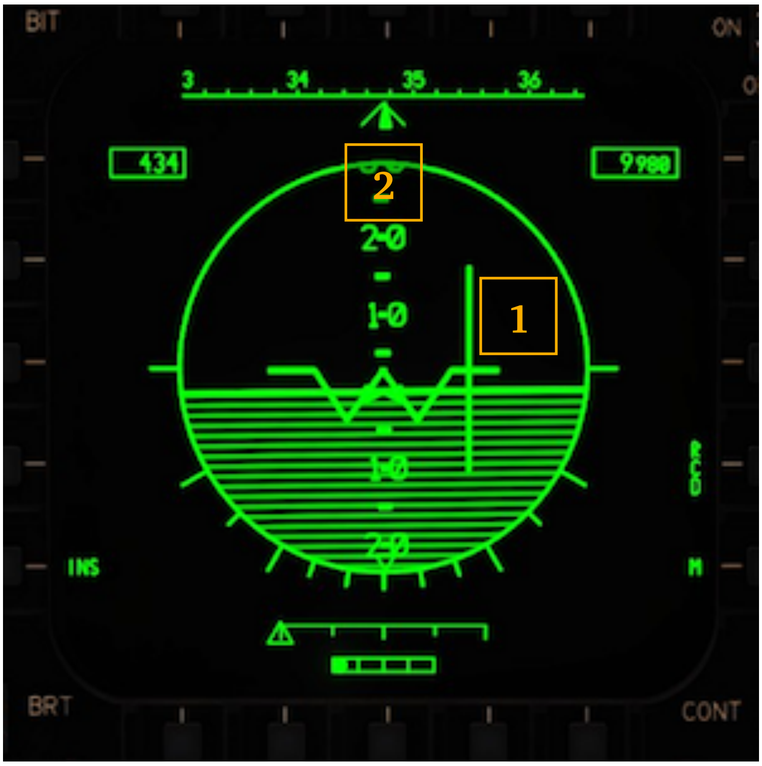
HUD

1. On the HUD, a vertical Bank Steering Bar is displayed just like in the GT mode.

2. TACAN Deviation Arrow mirrors the CDI position on the HSI, together with five dots, the middle one corresponding with the position of the aircraft.

3. The NAV Data Block shows the channel, distance from selected Sequence Point and time enroute / time of arrival.

ADI

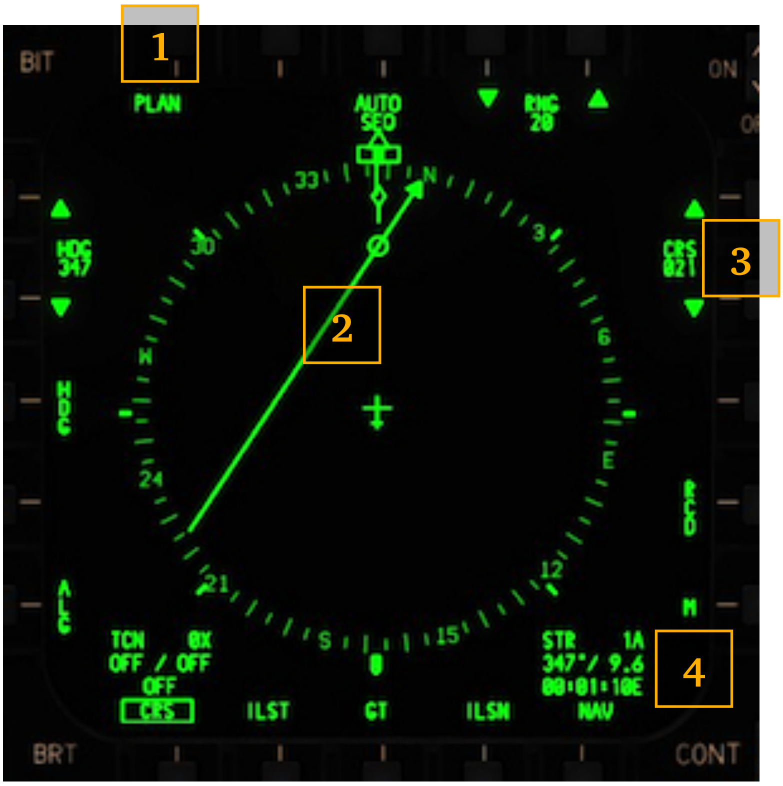


1. On the ADI data from the HUD is mirrored, with vertical Bank Steering Bar.

2. The Command Heading marker shows bearing to the currently selected Steer Point.

8.13.2 CRS WITH PLAN

This mode works in exactly the same way as similar TACAN option, although currently selected Steer Point is used as a reference for all navigation calculations.



1. In order to enable the PLAN mode, with CRS boxed press PB 20.

2. The set course arrow runs through the middle of the Steer Point symbol. As with CDI mode, it corresponds to the CRS setting (3), which can be set via the scratchpad on the UFC or by pressing PB 14 and 15 to decrease / increase its value.

There is no CDI and TO / FROM indication in this mode.

4. The NAV Data Block shows the direct course and distance to the selected Steer Point.

PLAN mode gives a more straightforward representation of aircraft's position and provides better awareness about its whereabouts in relation to the selected Steer Point. It should be used when an approach on a specific course is necessary - typically for landing, but not exclusively.

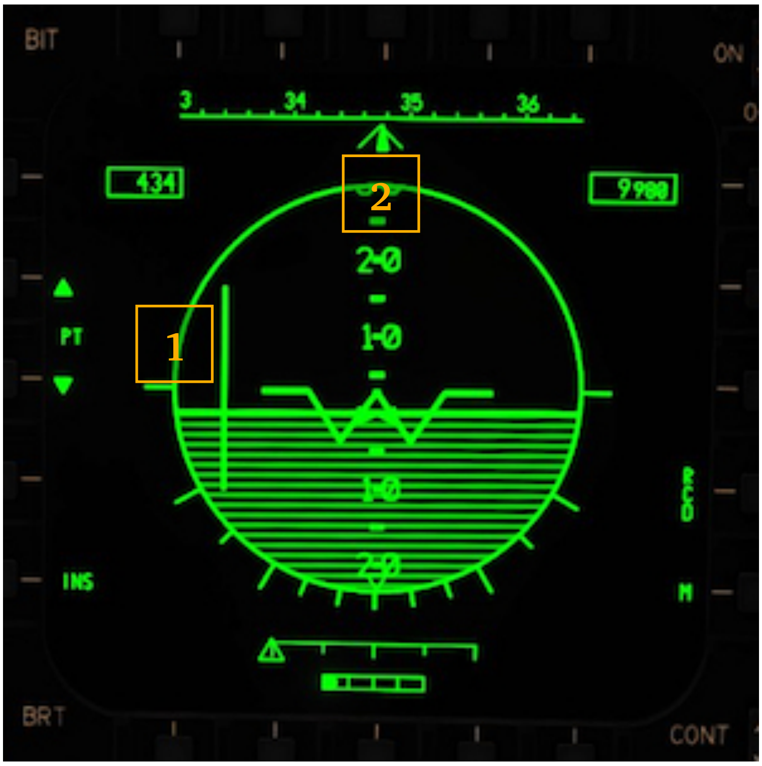
HUD

1. On the HUD, a vertical Bank Steering Bar is displayed just like in the GT mode.

2. Course Deviation Arrow mirrors the set course arrow position on the HSI. Next to it are five dots, the middle one corresponding with the position of the aircraft.

3. The NAV Data Block shows the currently selected Steer Point, distance to it and time enroute / time of arrival.

ADI



1. On the ADI data from the HUD is mirrored, with vertical Bank Steering Bar.

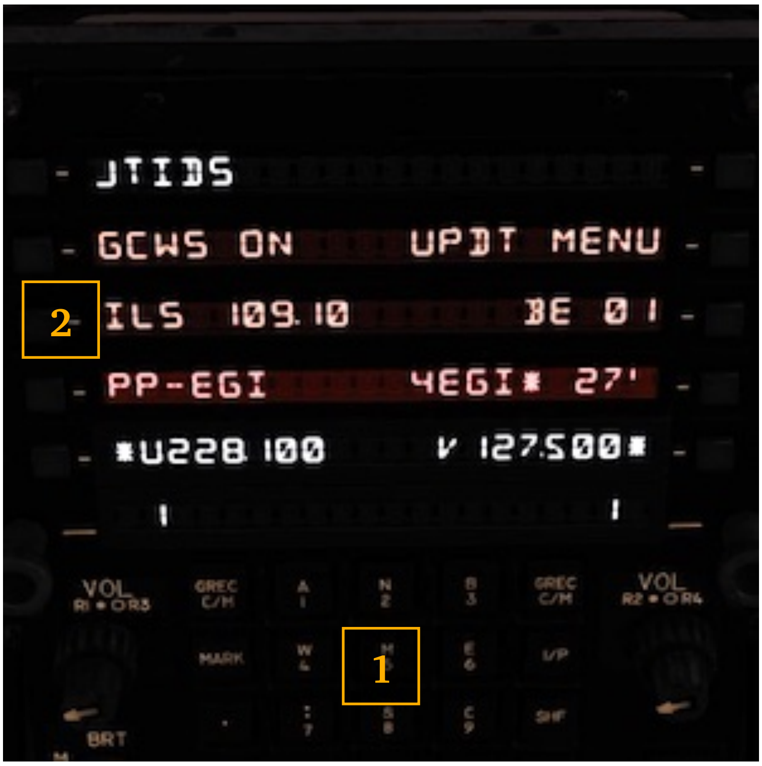
2. The Heading is no longer a "COMMAND" HDG. It is a user selectable heading where you can input a heading from the UFC into PB 1 or 2, or use the up/down arrows at PB1/2 to change the heading to the desired HDG.

8.14 INSTRUMENT LANDING SYSTEM (ILS) STEERING MODE

The Instrument Landing System (ILS) is a precision radio navigation system that provides short-range guidance to aircraft to allow them to approach a runway at night or in bad weather.

The F-15E has two different variants of the ILS using either TACAN or NAV as source for all inbound course calculations. Both share the indications and symbols and therefore will be described together.

Note that for ILST mode, TACAN should first be enabled and set up, as described here. Moreover, for the ILS steering mode to work also ILS has to be turned on and properly set up.



1. To do so, the ILS frequency should be typed using the scratchpad. There is no need to introduce decimal points, as the system will recognise the input and format it accordingly.

2. In this example, the ILS for Nellis AFB (109.10) was used. It is enough to type 1091 in the scratchpad and then press PB 3 next to ILS legend to enable the system (you don't need a decimal point, but the system will accept it).

1. In order to enable the ILST or ILSN mode, PB 7 or PB 9 should be pressed, respectively. The selected steering mode becomes boxed.

2. The course pointer goes through the middle of the aircraft. The pointer corresponds to the Inbound CRS setting (3), which can be set via the scratchpad on the UFC or by pressing PB 14 and 15 to decrease / increase its value.

4. Bearing to TACAN station (4) is shown at the compass rose (in both modes, as long as TACAN is set up properly).

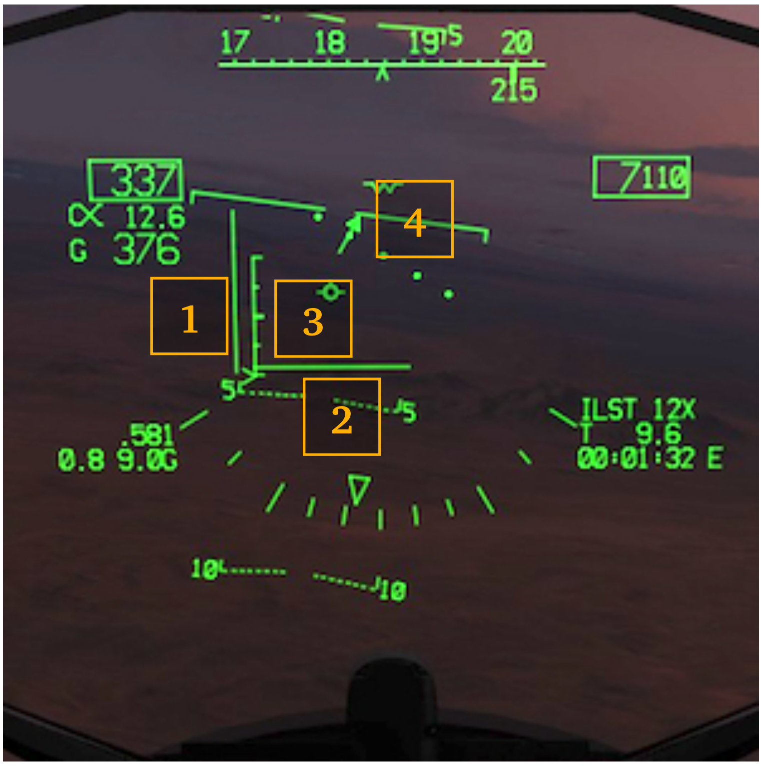
5. The Heading Bug can be moved around the compass rose using PB 1 and 2.

6. The Course Deviation Indicator (CDI) indicates if the aircraft is aligned with the desired course. If it is too far to the right, the CDI will be to the left from the aircraft symbol. If it is too far to the left, the opposite will be true. Each dot on the scale represents a 5° deviation.

On the picture below, the aircraft is perfectly aligned with the runway and the ILS (the CDI is in the straight line with the course pointer). However, the introduced CRS setting is 8° to the right, which results in misalignment between the course pointer and NAV pointer.

HUD

The following indications are displayed in the HUD in both modes:



1. The ILS localiser vertical and horizontal (**2**) bars indicate the position of the aircraft in relation to the glideslope. They are not tied to the TACAN or Steer Point, but are based on the indications from the ILS localiser.

If the vertical bar is positioned to the left from the VV, it means that the pilot should turn left in order to intercept it (ie. the jet is too far to the right from the runway's centerline). If it is positioned to the right, the opposite is true.

If the horizontal bar is below the TVV, that means that the aircraft is too high and the pilot should increase the pitch. If it is above, then the opposite is true.

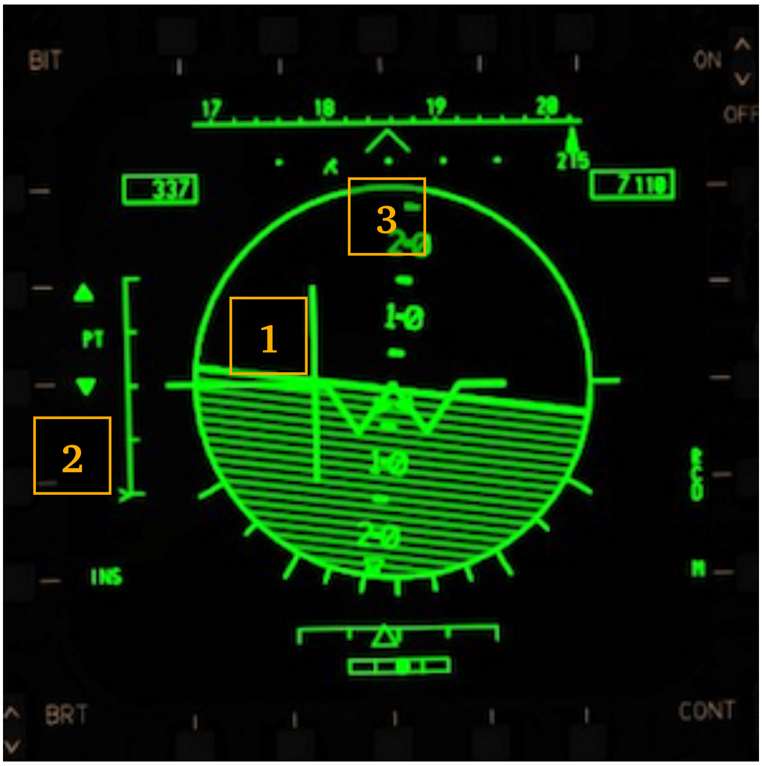
With perfect alignment, both bars should form a perfect cross.

3. The glideslope indicator and deviation scale shows the vertical discrepancy between the position of the aircraft and the glideslope. The indicator (>) travels through the scale. If it is in the middle (next to the longest horizontal bar), it means that the vertical glideslope was intercepted. If it is below, the aircraft is too high. If it is above, then the aircraft is too low.

4. Course Deviation Indicator and localizer deviation scale perform the same function as the glideslope indicator, but in relation to the aircraft's alignment with the runway. The small arrow mirrors the course pointer on the HSI and with perfect alignment should be vertical (pointing up) and crossing through the middle dot of the localizer deviation scale. Each dot represents a 5° deviation.

The below picture shows correct horizontal alignment with the runway. However, the aircraft is still too high, as the glideslope indicator which is at the bottom of the scale and the horizontal ILS bar is way below the TVV.

On the ADI, the symbology looks as follows:



1. The vertical and horizontal bars are superimposed over the artificial horizon and mirror the indications from the HUD.

2. The glideslope indicator and deviation scale shows the vertical discrepancy between the position of the aircraft and the glideslope. The indicator (>) travels through the scale. If it is in the middle (next to the longest horizontal bar), it means that the vertical glideslope was intercepted. If it is below, the aircraft is too high. If it is above, then the aircraft is too low.

3. Course Deviation Indicator and localizer deviation scale perform the same function as the glideslope indicator, but in relation to the aircraft's alignment with the runway. The small carret (^) mirrors the course pointer on the HSI and with perfect alignment it should be pointing at the middle dot of the localizer deviation scale. Each dot represents a 5° deviation.

8.15 AUTONOMOUS LANDING GUIDANCE (ALG) STEERING MODE

The ALG Steering Mode provides an independent capability for instrumented approaches and landings at any location.

NOTE: The ALG Steering Mode is not implemented in Early Access.

8.16 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The AFCS provides roll, pitch, and yaw control augmentation, autopilot modes in roll and pitch axes, terrain following in the pitch axis and a Direct Electric Link (DEL) mode in a spin. This section will describe the following items:

Control Augmentation System: description of the three - channel, three - axis control augmentation system for yaw, pitch and roll.

Spin Recovery Display: not enabled in early access.

Autopilot Controls: describes different options available in the Autopilot Submenu on the UFC.

Autopilot Basic Modes: description of the two basic autopilot mode - heading hold and attitude hold.

Autopilot Altitude Hold Mode: description of the basic autopilot mode used to maintain the altitude of the aircraft when the mode is enabled.

Autopilot Altitude Select Mode: description of the autopilot mode allowing the air crew to select desired altitude to which the aircraft will then automatically climb or descend.

Autopilot Blended Modes: not all blended modes are available in early access.

8.16.1 CONTROL AUGMENTATION SYSTEM (CAS)

CAS is a three-channel, three-axis (pitch, roll and yaw) control augmentation system. In short, it modifies movements of the stick and rudder made by the pilot and adjusts the resulting control surface deflections to provide the desired flying qualities.

CAS CONTROL PANEL

Contains switches responsible for the Control Augmentation System (CAS).

1. YAW CAS 3-position switch. ON allows normal operation after engagement, RESET engages disconnected axis after the fault that caused the disconnect no longer exists (it is spring loaded back to ON), OFF disengages the applicable axis.

2. Roll CAS 3-position switch. Works the same as YAW and PITCH.

3. Pitch CAS 3-position switch. Works the same as YAW and ROLL.

4. Terrain Following Couple Switch. When engaged, it couples the terrain following system to the autopilot.

5. Take Off Trim Button and Light. When pressed, it drives the stick and rudder pedals to the takeoff position which, in turn, drives the aileron, rudder and stabilator actuators to the takeoff position. The T/O trim light then comes on.

CAS CAUTION DISPLAY

CAS caution displays come up on MPDs / MPCDs.

NOTE: MPD cautions are not enabled in the Early Access stage.

8.16.2 SPIN RECOVERY DISPLAY

The purpose of the SRD is to provide information to help the aircrew recover from an up-right or inverted spin and verify the out of control condition is a _spin and not an auto-roll.

NOTE: Spin Recovery Display is not enabled in the Early Access stage.

8.16.3 AUTOPILOT CONTROLS

For the autopilot to work it is necessary that all three CAS switches are set to ON.

The UFC is the primary autopilot mode selection and engagement controller.

A/P button on the UFC enables or disables the autopilot. Mode entered upon pressing the button depends on several factors, as described below. It also brings up the A/P menu displayed above.

PB 1: A/P engagement status line shows currently selected mode of the autopilot. These include:

A/P OFF: autopilot is disengaged.

A/P HDG: autopilot is engaged in Heading Hold basic mode.

A/P ATT: autopilot is engaged in Attitude Hold basic mode.

A/P ALT: autopilot is engaged in Altitude Hold or Altitude Select basic mode.

HDG / NAV / GT / CRS / TCN: autopilot is engaged in one of the blended modes, described in later part of this section.

PB 2: Steer Mode coupling pushbutton and display enables one of the blended modes linked to Steer Mode currently selected on the HSI.

PB 3: Altitude Mode coupling pushbutton and display enables the Altitude Hold or Altitude Select mode of the autopilot.

PB 4: Altitude Source pushbutton and display is used to switch between BARO and RADAR altitude as a basis for the Altitude Hold mode.

PB 8: Altitude Mode select pushbutton and display works in conjunction with PB 3 and allows the air crew to introduce the desired altitude for Altitude Select mode.

Currently selected mode of the autopilot is also displayed next to PB 9 on the UFC MENU 1 page:

8.16.3.1 AUTOPILOT BASIC MODES

This is a basic function of the autopilot, selected by pressing the A/P key on UFC keyboard. Depending on current pitch and roll, the A/P will engage different modes of the autopilot, as described below.

Autopilot will automatically enable the **pitch attitude hold mode** if the pitch is between 0° and 45° when the A/P button is pressed. A/P HDG will be displayed on the UFC.

Autopilot will also enable **heading hold mode** if the bank angle is less than 7° when the A/P button is pressed. A/P HDG will be displayed on the UFC.

Autopilot will enable **attitude hold mode** if the the bank angle is between 7° and 60° when the A/P button is pressed. A/P ATT will be displayed on the UFC.

In all three modes the autopilot will try to maintain selected flight parameters (pitch and / or heading or bank angle).

The currently selected mode will be displayed in the top line of the UFC with A/P submenu or on MENU 1 page next to PB 9. Additionally, a green A/P light will come on on the caution panel next to the right MPD.

8.16.3.2 AUTOPILOT ALTITUDE HOLD MODE

This is a separate function of the autopilot, allowing the pilot to hold current altitude.

1. In order to enable this mode, ALT HOLD legend has to be marked by pressing the PB 3, which will cause an asterisk to appear next to it. The press of A/P button activates it.

2. Barometric or Radar altitude selection has no function for altitude hold mode.

3. A/P ALT legend in the first row indicates, that the altitude hold is active. Additionally, a green A/P light will come on on the caution panel next to the right MPD.

NOTE: the ALT HOLD selection will not disengage on its own and remains selected even if autopilot mode changes. It is therefore a good habit to check its status before switching the autopilot modes.

8.16.3.3 Autopilot Altitude Select mode

This functions provides the capability to automatically climb or descend to selected radar or barometric altitude.

1. First step is to type the desired altitude in the scratchpad and then enter it into the system by pushing PB 8. The altitude value may be between 1000 and 50,000 feet. If the entry is between 10 and 50, it will get multiplied by the system x100.

2. Either barometric or radar altitude can be used as basis for system calculations. These can be switched by pressing PB 4 without the need to disengage the mode.

NOTE: if the air crew tries to switch from RDR to BARO altitude, a comparison of the selected altitude to the ground level is made. If the selected altitude is at least 1000 feet above the ground, BARO is engaged. If the selected altitude puts the aircraft below 1000 feet AGL, the altitude source (PB 4) momentarily displays BARO and then reverts to RDR.

3. The Altitude Select mode is enabled by pressing the PB 3. An asterisk appears next to ALT SELECT and A/P ALT is displayed on the top line of UFC (4). Additionally, a green A/P light will come on on the caution panel next to the right MPD.

5. Constant airspeed switching to constant mach number will be the climb schedule. It is displayed next to PB 7. In descent, only airspeed is displayed. The climb or descent rate is controlled with the throttle.

To disengage the Altitude Select mode the air crew has to press the A/P button or press PB 8 with an empty scratchpad, which will revert it to normal A/P Hold.

8.16.4 AUTOPILOT COUPLED WITH STEER MODES

Autopilot can be coupled with any of the five steer modes:

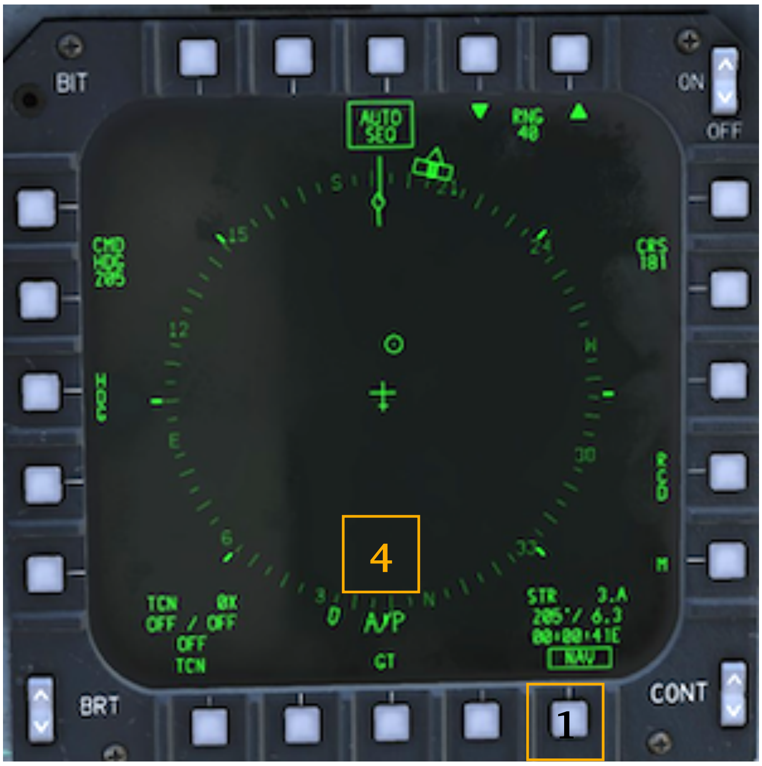
1. Navigation (NAV)
2. Heading Select (HDG)
3. Ground Track (GT)
4. Course (CRS)
5. Tacan (TCN)

*NOTE: for any of the coupled modes to work, the aircraft **has to be** in the NAV Master Mode.*

8.16.4.1 NAV COUPLED MODE

In NAV coupled mode the autopilot will fly currently selected route, following the Sequence Points in order.

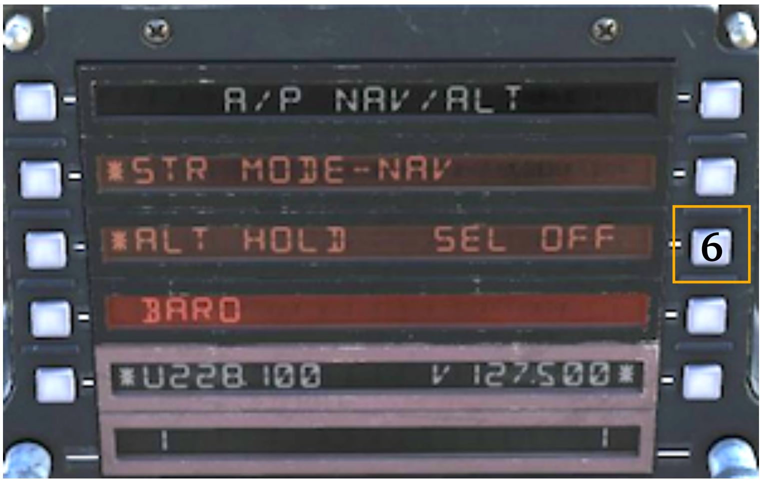
In order to enter the NAV coupled mode, NAV steering mode has to be selected (boxed) on the HSI (**1**).



Second line of display on the UFC will show STR MODE-NAV legend with an asterisk next to it (**2**). When the A/P button is pushed on the UFC, A/P NAV shows in the first line of display (**3**), with additional A/P information on the HSI (**4**).

The aircraft will now turn to intercept the currently selected Sequence Point. It will maintain the pitch angle the aircraft had when the autopilot was engaged.

It is possible to command the aircraft to maintain altitude by pressing PB 3 on the UHF. Asterisk appears next to ALT HOLD legend (5) and first line of display shows A/P NAV / ALT.



It is also possible to choose the desired altitude by pressing PB 8 and introducing value in feet via the scratchpad in the same manner as if using basic Altitude Select Mode. (6)

ANAV legend will also be displayed in the NAV data block on the HUD to signify that the NAV coupled mode is active (**7**).

8.16.4.2 HEADING SELECT COUPLED MODE

The heading select steer mode allows the aircrew to enter a selected heading for the aircraft to acquire and hold. Once the desired heading is entered and coupled, the aircraft rolls to the selected heading (using standard turn rate of 30° bank angle or 3°/second max turn rate). Once the heading is achieved, the heading select mode remains selected.

On the HSI, HDG should be boxed by pressing PB 3 (1). Desired heading should be selected by using PBs 1 and 2 or by typing the value in the scratchpad and pressing either of these PBs (2).

On the UFC, STR MODE-HDG will be shown in second display line, with the asterisk next to it as soon as the A/P button is pressed (3).

If altitude hold is not selected, first display line shows A/P AHDG and the autopilot will hold pitch angle of the aircraft from the moment when HDG steer mode was enabled.

Once altitude hold is on (signified by an asterisk in third display line) (4), first line shows A/P AHDG/ALT.

It is also possible to choose the desired altitude by pressing PB 8 and introducing value in feet via the scratchpad in the same manner as if using basic Altitude Select Mode. (5)

On the HUD, AHDG legend will also be displayed in the NAV data block to signify that the HDG coupled mode is active (6). A vertical steering line will also be shown (7).

8.17 CRUISE MODE

The cruise mode provides the air crew with recommended max range profile. It is displayed on the engine monitor format.

NOTE: Cruise mode mode is not available in the Early Access stage.

8.18 SEQUENCE POINTS

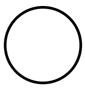
The sequence points are geographical points that are described by latitude, longitude and elevation.

Three sets of sequence points (or routes) can be stored in the aircraft's computer, labelled with letters A, B and C.

Note: only A route is enabled in the Early Access stage, with other two bound to be added later in the module development.

There are different types of sequence points:

Steer Points

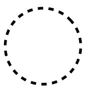


Steer Point define the basic route of flight.

They are displayed with a number followed by the route letter (1A, 2B etc.)

NOTE: the letter next to the SP is only shown on the UFC, HSI and HUD (so not visible on TSD, RDR, TGP or other sensors).

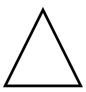
Aim Points



Aim points are always associated with a steer point. Up to seven aim points can be assigned to a single steer point.

They are displayed as the number of the assigned steer point followed by a decimal point, tenth digit and a route letter sometimes (1.1A etc.)

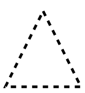
Target Points



These are specialized points for attack, which when selected in A/G master mode automatically become designated.

They are displayed with a number, followed by decimal point and sometimes a letter (1.A etc.)

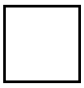
Offset Points



Offset points are visually associated with a target point. Each target point can have up to seven offset points assigned to it.

They are displayed as the number of the assigned target point plus a decimal point, followed by a hundredth point and sometimes a route letter (1.01A etc.)

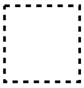
Initial Points



The initial point is the last steer point before the given target point.

Their numbering is the same a for the normal steer points.

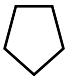
Aim Points for IP



These aim points are always associated with a given initial Point. Up to seven aim points can be assigned to a single initial point.

They are displayed as the number of the assigned initial point followed by a decimal point, tenth digit and a route letter (1.1A etc.)

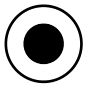
Base Point



The base point is a single point common to all three routes which is normally the place where the INS was aligned (home plate).

It is displayed as the letter B.

Bullseye Point



Used as reference points for all the assets in a given mission for providing bearing and range from that point to target or selected position.

8.18.1 CHANGING STEER POINTS

Currently selected Steer point can be changed using the UFC Menu 1 or UFC Data 1. To do so, desired sequence point number should be typed in the scratchpad, followed by pressing PB 10.

If only a number is typed, the system will select a steer point with a given number within the currently selected route.

To enter a steer point from a different route, its number should be followed by the route letter.

If invalid number is typed, the scratchpad selection will blink.

NOTE: current Steer Point selection can only be made using PB10 on UFC Menu 1 and / or UFC Data 1 pages. Switching through sequence points in Point Data Submenu does not alter the currently selected Steer Point.

Using this method the air crew can also set aim points, offset point, target points etc. as currently selected Steer Point.

8.18.2 UFC POINT DATA SUBMENU

The UFC point data submenus are used to input and display the coordinates, elevation and other data that is associated with sequence points.

Point Data Submenu is accessed by pressing PB 10 on the UFC Menu 1 page or UFC Data 1 page with an empty scratchpad.

PB 1 (Selected Sequence Point (PB 1): displays the currently selected sequence point, described with its number and route letter.

Repeatedly pressing **PB 1** with an empty scratchpad switches through the all the available waypoints in current route.

NOTE: as mentioned above, switching between sequence points in this mode does not change the currently selected Steer Point and allows to adjust the data for a given sequence point / points.

Entering a number in the scratchpad and pressing **PB 1** jumps to that point within the route.

If there is no waypoint with the typed number, pressing PB 1 creates a new waypoint with default coordinates (N0000000, E0000000, 99999FT). See more information about this below.

A steer point can be changed to a target point by entering the sequence point number followed by a decimal point and pressing **PB 1** and vice versa - entering the number without a decimal point will change the target point to normal steer point.

NOTE: a target point cannot be changed to steer point if the target is currently designated.

PB 2 and 3 (LAT / LONG Coordinates): for each selected sequence point, its coordinates are displayed as latitude and longitude.

It is possible to change the coordinates by entering new value using the scratchpad.

For N - S, first press the SHF button on the UFC keyboard, then select 2 for North or 8 for South. Follow that with the coordinates and press PB 2 to introduce them into the system. If less than seven digits after N or S are typed, system will automatically fill the remaining ones with zeros.

For W - E, first press the SHF button on the UFC keyboard, then select 4 for West or 6 for East. Follow that with the coordinates and press PB 3 to introduce them into the system. If less than eight digits after N or S are typed, system will automatically fill the remaining ones with zeros.

If the first digit is a '0' and it is not introduced properly, the system will not accept the selection and the typed number will blink.

NOTE: it is not possible to change the coordinates for the currently selected Steer Point.

UTM (PB 4): when pressed, opens the separate UTM sub-menu, which displays the sequence point coordinates as UTM grid.

NOTE: UTM coordinates introduction is not available until later in Early Access stage.

Elevation (PB 7): displays the elevation of the selected sequence point in feet.

It is possible to change the elevation by entering new value using the scratchpad and pressing PB 7 to introduce it. The value typed should be between 1 and 59 999 feet.

If wrong value is entered, it will not be accepted by the system and the number in the scratchpad will blink.

Positive elevations do not require a '+', but negative elevations require a '-' to be entered first.

Minimum Enroute Altitude (MEA, PB 8): only applies to steer points and target points and is a function of the terrain following radar.

Time on Target (PB 9): allows the air crew to set a desired Time on Target for each steer and target point. If none is assigned, TOT OFF is displayed.

List (PB 10): a list point can be married to sequence point at PB 1 by typing the list point into the scratchpad and pressing PB 10. This will change this sequence point's latitude, longitude and elevation to values for the list point.

8.18.3 UFC DATA 1 DISPLAY

Pressing DATA Key once brings up the following display on the UFC. You may press the associated pushbutton to move to the detailed description of each of the functions.

Bearing / Range to steer point (PB 1)

Shows magnetic bearing and range (in Nm) to currently selected steer point. This point is shown next to PB 10 (steer 1A in this case).

Estimated Time of Arrival / Enroute (PB 2)

Pressing PB 2 switches between Estimated Time of Arrival display (which shows exact time when aircraft will arrive over currently selected steer point provided that speed remains unchanged) and Estimated Time Enroute (time left before aircraft arrives over currently selected steer point).

NOTE: the time format not displayed on the UFC will be shown on the HUD, HSI and the TEWS displays. So if ETA is selected in UFC, ETE will be visible on other displays.

True Speed (PB 3)

This field shows the true speed of the aircraft in knots. The asterisk next to it indicates that true airspeed is also enabled in HUD. Pushing PB 3 again disables the HUD true airspeed display.

Ground Speed (PB 4)

This field shows the ground speed of the aircraft in knots. The asterisk next to it indicates that ground airspeed is also enabled in HUD. Pushing PB 4 again disables the HUD ground airspeed display.

NOTE: true and ground airspeeds cannot be simultaneously displayed on the HUD and ADI. Selecting the speed that is not currently displayed automatically deselects the displayed one.

Wind Direction and Speed (PB 7)

Indicates the magnetic wind direction and speed, measured in real time by the INS or EGI.

Time (PB 8)

Shows current time. The default time loaded at CC (Central Computer) power up is the GPS time, but it can also be introduced manually be the crew members by typing correct time into the scratchpad and pressing PB 8.

For ZULU time, the entry should be preceded by M (so: M 133000 will introduce the Z time of 13:30:00).

NOTE: manual time entry is not enabled in this version of the module.

CARA Altitude (PB 9)

Indicates the CARA altitude. The asterisk indicates the CARA altitude is also enabled on the HUD and ADI displays.

NOTE: The AN/APN-232 CARA (Combined Altitude Radar Altimeter) is the standard US Air Force Radar Altimeter, used in C-5, C-17, C-130, OC-135, C-141, F-111, F-15, F-16, MH-53, T-43 and UH-1N aircraft.

Current Steer point (PB 10)

Indicates currently selected steer point. To change it, type the new steer point into the scratchpad and press PB 10. Pressing PB 10 with a blank scratchpad accesses the point data submenus

8.18.4 UFC DATA 2 DISPLAY

Pressing DATA Key for the second time brings up the DATA 2 display on the UFC. It mostly contains NAV data functions which provide the capability to determine look ahead information such as remaining fuel, ETE and ETA etc.

These calculations are based on the following assumptions:

A. The aircraft is flown from the present position to the steer point / target point displayed next to PB 1.

B. The aircraft is then flown to all subsequent steer points / target points between PB 1 and PB 3's sequence points.

C. All turns are made at 45° bank angle.

D. Ground speed remains constant.

E. Fuel flow remains constant.

You may press the associated pushbutton to move to the detailed description of each of the functions.

NOTE: DATA 2 page functions are mostly not implemented in current version of the module.

Selected Sequence Point (PB 1)

Displays a steer or target point chosen by the aircrew, which has to be equal or greater than the one the aircraft is currently flying towards. They are identified with SP preceding the steer / target point number. The information which is displayed next to PB 9 (ETA) and PB 10 (fuel remaining / range and bearing) relates to the PB 1 sequence point.

Ground Speed (PB 2)

Shows the current ground speed of the aircraft.

Selected Look Ahead Point (PB 3)

Displays a steer or target point chosen by the aircrew, which - as in case of PB 1 - needs to be equal or greater than the one the aircraft is currently flying towards. The information which is displayed next to PB 4 (Commanded Ground Speed), PB 7 (Time of Arrival / Time on Target) and PB 8 (fuel remaining) relates to the PB 3 sequence point.

The relation between PB 1 / 3 and 7-10 is shown in the picture below:

Commanded Ground Speed (PB 4)

If there is a Time on Target (TOT, PB 7) set for the sequence point displayed next to PB 3, this display is asterisked and displays the ground speed required to arrive on set time at sequence point at PB 3. If there is no associated TOT, OFF is displayed instead.

Time of Arrival / Time on Target (PB 7)

The Time of Arrival (ToA) shows the time at which the aircraft will arrive over sequence point at PB 3, provided that the assumptions listed in the beginning of this section are true. If they are not, the ToA will be constantly changing to accommodate to new conditions.

The Time on Target (ToT) can be set by the aircrew and remains constant. It also used to determine the required ground speed displayed next to PB 4. The ToT can be changed by typing the new value in the scratchpad and pushing PB 7.

NOTE: unlike ToT changes done in the point data submenu, changing the ToT in PB 7 on DATA 2 menu does not affect the ToT of any other sequence points.

Fuel Remaining at PB 3 (PB 8)

Displays the amount of fuel remaining (in lbs) upon arrival at sequence point displayed next to PB 3.

Estimated Time of Arrival / Estimated Time Enroute (PB 9)

Toggles between the ETE or ETA to the PB 1 sequence point from the aircraft's present position.

Fuel Remaining / Range and Bearing to PB 1 (PB 10)

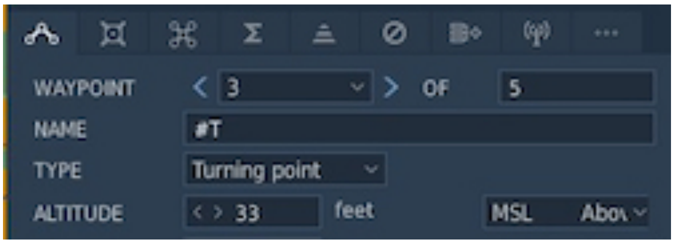
Toggles between the fuel remaining at the sequence point displayed at PB 1 and the aircraft's range and bearing from present position to PB 1.

8.18.5 INTRODUCING SEQUENCE POINTS IN MISSION EDITOR

Certain sequence points, namely target points, offset points and aim points can be set up when building the mission at the Mission Editor level.

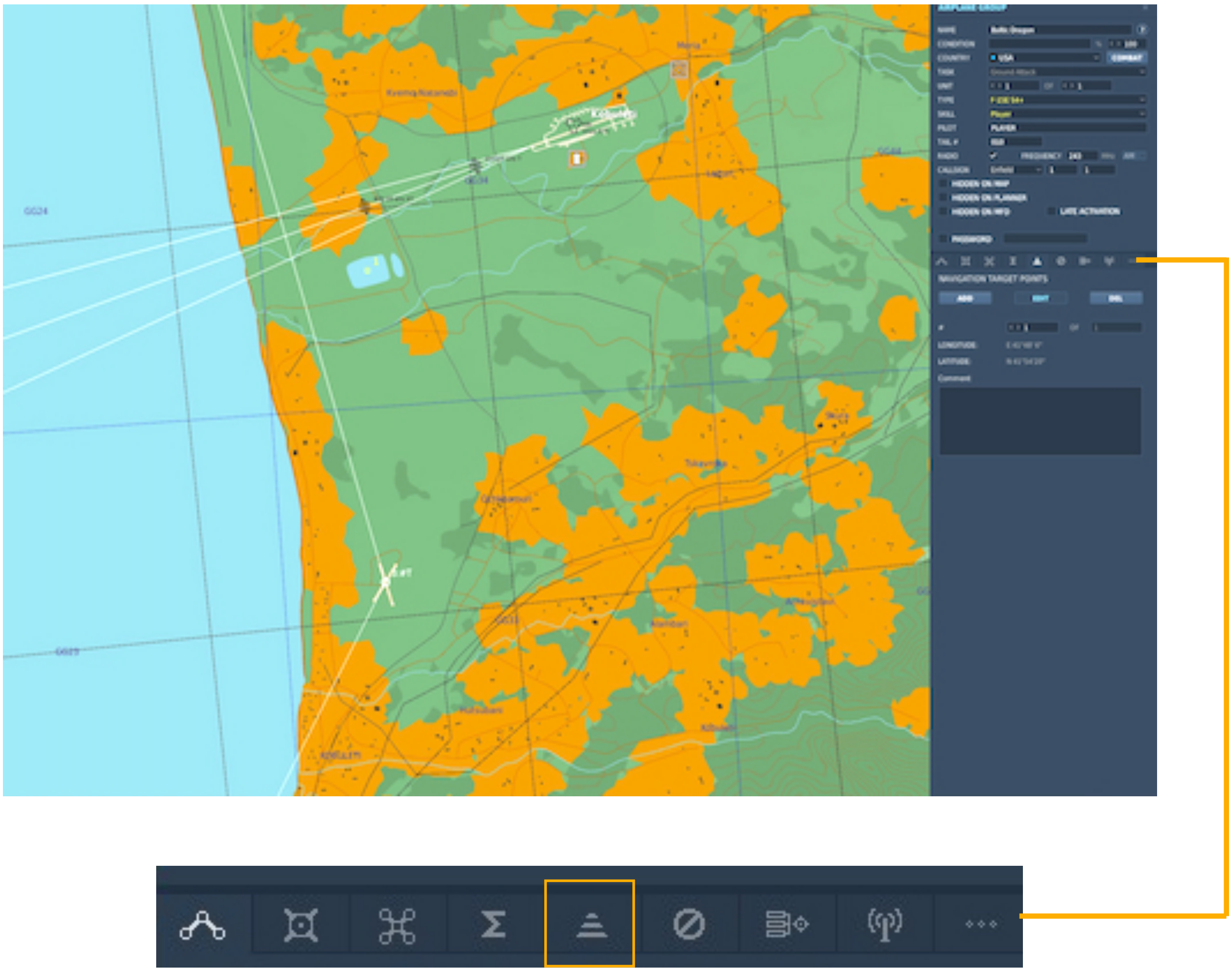
Set up the flight plan as you normally would, placing waypoints. Make sure that the aircraft is set to “Client” or “Player” for the whole operation to work.

To set the desired waypoints as **Target Points**, add #T next to their NAME:



More than one target point can be set up using this method. It is worth noting that the waypoint immediately before the target point will show up as Ingress Point on the TSD.

To add any offset or aim points, you will need to open the NAVIGATION TARGET FIX POINTS submenu:



To create **target offset points**, first select the desired target point.

Press ADD button and place the offset point where you want it.

Next, in the Comment section type the name of the new offset as follows: X.0Y, where 'X' is the target point number and 'Y' is the offset point number. So for example first offset for target point 3. should be named 3.01 etc.

To create **aim points**, use any of the regular steer points and follow the same pattern:

Press ADD button and place the aim point where you want it.

Next, in the Comment section type the name of the new offset as follows: X.Y, where 'X' is the target point number and 'Y' is the offset point number. So for example, first offset for waypoint 4. should be named 4.1 etc.

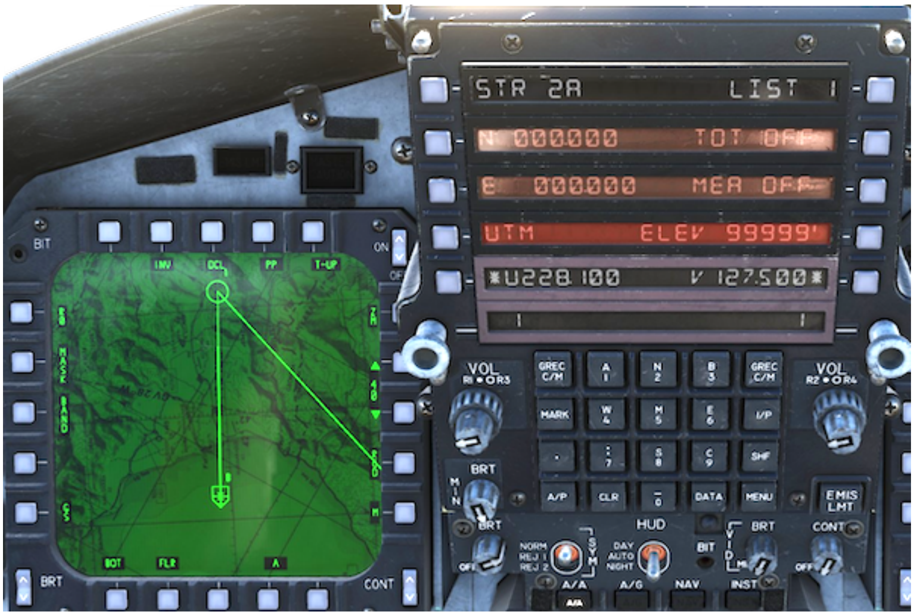
Note that if you choose steer point directly before the target point, it will be create an IP aim point. If you perform all the steps correctly, this is what you fill wind on the TSD:

8.18.6 CREATING NEW SEQUENCE POINTS IN THE COCKPIT

It is also possible to create new Steer Points, Target Points, Offset Points and Aim Points from the cockpit using the UFC.

To do so, the pilot or WSO should enter the Steer Point Submenu pressing PB 10 in Menu 1 or Data 1 page.

In the example above, there is only one Steer Point (1A) in the current flight plan. To add a new Steer Point, type the number higher than the number of points currently stored in the system and press PB 1 on the UFC.



New Steer Point will be created with coordinates equaling to 0N and 0E. It will also be added to the flight plan with the line extending all the way to the Null Island where the prime meridian and the equator intersect.

Correct coordinates should be now set by entering new values using the scratchpad.

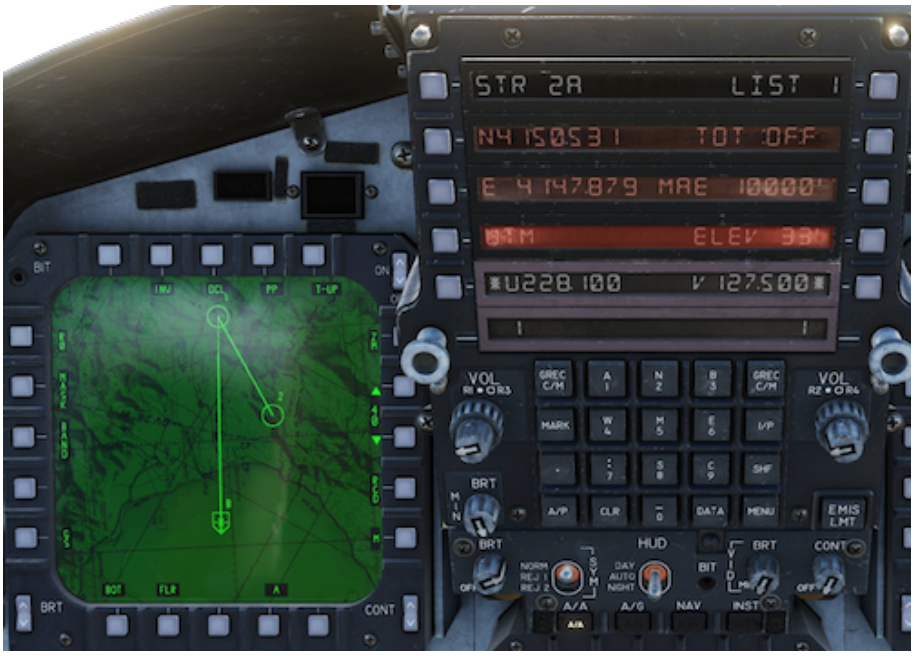
For N - S, first press the SHF button on the UFC keyboard, then select 2 for North or 8 for South. Follow that with the coordinates and press PB 2 to introduce them into the system. If less than seven digits after N or S are typed, system will automatically fill the remaining ones with zeros.

For W - E, first press the SHF button on the UFC keyboard, then select 4 for West or 6 for East. Follow that with the coordinates and press PB 3 to introduce them into the system. If less than eight digits after N or S are typed, system will automatically fill the remaining ones with zeros.

If the first digit is a '0' and it is not introduced properly, the system will not accept the selection and the typed number will blink.

EXAMPLE: E 36 41.690 should be entered as: SHF *E 0364169, then press PB3.*

If everything was done properly, a new Steer Point should be visible on the TSD.



NOTE: if new Steer Point number typed is higher by 2 or more than the highest SP currently stored in the system, the CC will create the SP with the entered number and not default to next available one. In the case above, if aircrew types 23 as new Steer Point number, it will create SP 23 and not SP 3.

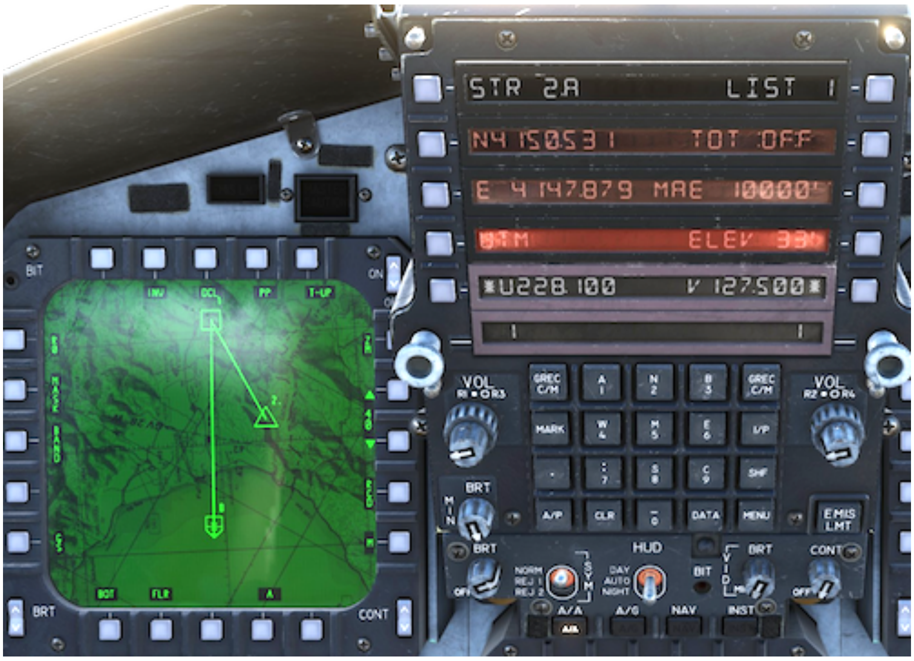
Creating Steer Points using UTM Grid

NOTE: UTM waypoint creation is not available in Early Access and will be added at a later stage.

Creating Target Points

The aircrew has an option to either create a completely new Target Point or change any of the existing Steer Points into a Target Point.

To change the existing Steer Point into a Target Point, it should be selected in the Sequence Point Submenu (ie. displayed next to PB 1). Typing the Steer Point number followed by a decimal (.) will automatically assign it a Target Point status.



Note that in the example above, the change of SP 2 into a Target Point automatically changed SP 1 into the Ingress Point.

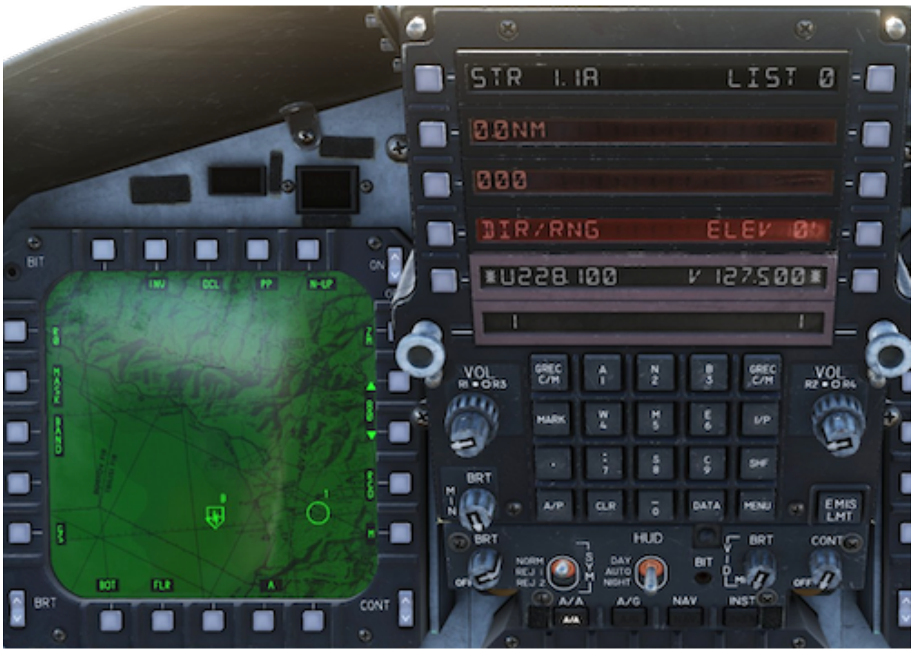
In order to create a completely new Target Point, the procedure described for creating Steer Points should be followed, but the number of the Target Point should always include a decimal (.) behind it.

Creating Aim Points and Offset Points

In order to create Aim Points or Offset Points, first an existing Steer Point or Target Point should be chosen, respectively.

Next step is to type the number, which would be X.Y for an Aim Point (Aim Points are created for Steer Points) or X.0Y for the Offset Points (Offset Points are created for Target Points).

It is possible to create Offset / Aim Points by entering the Lat - Long or UTM coordinates in exactly the same way as for the Steer Points. However, there is additional option available after pressing the PB 4 when in UTM sub-menu (marked RNG / BRG):



This menu allows the aircrew to create an Offset or Aim Point using range (in NM) and magnetic bearing from the mother Target Point or Steer Point.

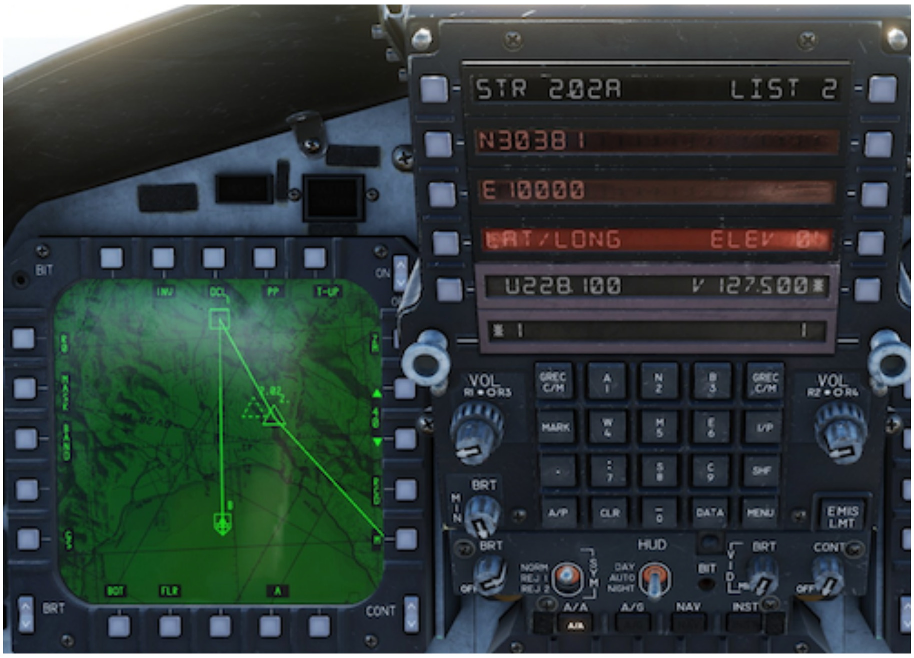
In order to do so, the desired range should be typed on the UFC (the minimal value is 0.1, the system only accepts one digit after the decimal point) and accepted using PB 2.

Then the bearing from the Steer Point or Target Point should be introduced and entered by pushing PB 3. If this is done correctly, new Target Point (or Offset Point) will be visible on the TSD.

NOTE: creating wrong type of offset point will also change the type of mother Steer Point or Target Point. For example adding an Aim Point (X.Y) for Target Point (X.) will change that Target Point to a Steer Point (X) and vice versa.

The last option for creating the Offset or Aim Points via the UFC is to use another sub-menu, which is Direction / Range (DIR/RNG) next to PB 4, available while on the Range / Bearing page.

This sub-menu allows the aircrew to introduce new Offset Point or Aim Point by providing cardinal direction and distance in feet.



To create a new Offset / Aim Point using this system, a cardinal N-S and E-W direction should be determined first.

For N - S, first press the SHF button on the UFC keyboard, then select 2 for North or 8 for South. Follow that with the distance in feet to the desired location.

Then the second, W - E part. First press the SHF button on the UFC keyboard, then select 4 for West or 6 for East. Follow that with the distance in feet.

In the example above, Offset Point 2.02 is 30381 feet to the north and 10000 feet to the east from Target point 2.

NOTE: creating Offset or Aim Point using the Range / Bearing automatically fills in data for the or Direction / Range, but does not work the other way around. Therefore if the aircrew adjusts the position of the point using DIR/RNG, the values in RNG/BRG submenu will not be affected.

8.19 PRESENT POSITION KEEPING SOURCE (PPKS) / INS UPDATE

The PPKS submenu allows selection of the source of navigation data used to drive / update the navigation displays and is used to enter the INS alignment coordinates.

PPKS defines the best available source for aircraft's position and velocity, which is used for navigation, steering and weapon delivery. These sources, in the order of precision and reliability are:

Relative Navigation [REALNAV], which is based on free inertial data inputs from the EGI as a primary source and INS as secondary one. It also relies on precision data from the EGI blended solution as well as information sent by other members of the FDL (Fighter Data Link) network.

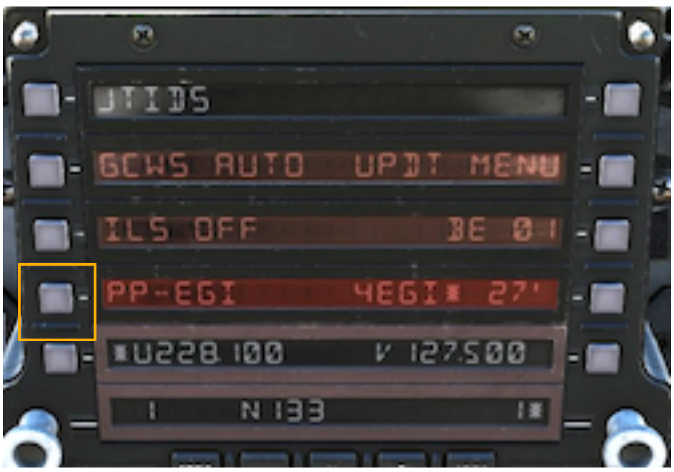
Embedded Global Positioning System (GPS)/ Inertial Navigation System (INS) [EGI], which provides a blended solution from an internal INS aided with embedded GPS data.

NOTE: EGI will not be available for missions set prior to 1998, in which case only INS / MN will work (see INS drift section below)

Mission Navigator [MN]: this is a system that integrates PVU (Precision Velocity Update) corrected velocities for use in weapon delivery modes. It also provides relative target ranges and platform coordinates and allows position updates independent of the INS. Its advantage, however, is the ease with which it can be updated using the PVU mode of the Ground Radar. Another advantage is that you can fully update the MN and if you make a mistake can reset it back to the INS position.

Inertial Navigation System [INS]: The INS is a self-contained, fully automatic Ring Laser Gyro (RLG) system which supplies the primary attitude reference for the aircraft and provides continuous PP monitoring. In addition, the INS provides aircraft attitude, heading, velocity, and acceleration information to the LANTIRN, radar, AFCS and CC.

The PPKS submenu is entered by pressing PB 4 in UFC Menu 2:



8.19.1 PPKS SUBMENU

PB 1, PPKS CURRENTLY USED BY CC. The options available after PP- are:

RLN (relative navigation)

EGI (embedded global positioning system)

MN (mission navigator)

INS (inertial navigation system)

A/D (air data; no PPKS available)

Information listed next to PB 1 may be different from the one displayed next to PB 10 if CC for any reason defaults to lower priority PPKS.

PB 2, PRESENT POSITION LATITUDE. Shows the current latitude of the aircraft. This field is also used for entering the latitude during INS alignment.

PB 3, PRESENT POSITION LONGITUDE. Shows the current longitude of the aircraft. This field is also used for entering the longitude during INS alignment.

PB 4, MAGNETIC VARIATION. It is automatically updated through the look-up table stored in the EGI (or INS if EGI fails).

PB 7, HUD TITLING.

PB 8, EGI OR RLN HORIZONTAL POSITION ERROR. With EGI or RLN selected as PPKS, it indicates the blended estimated horizontal error from the EGI, followed by 'H' (for horizontal).

PB 9, EGI VERTICAL POSITION ERROR. With EGI selected as PPKS, it indicates the blended estimated vertical error from the EGI, followed by 'V' (for vertical).

PB 10, PPKS SELECTION. Allows the aircrew to selected the preferred PPKS source. The available options are the same as listed next to PB 1. Bear in mind, that CC may default to lower priority PPKS if the need arises.

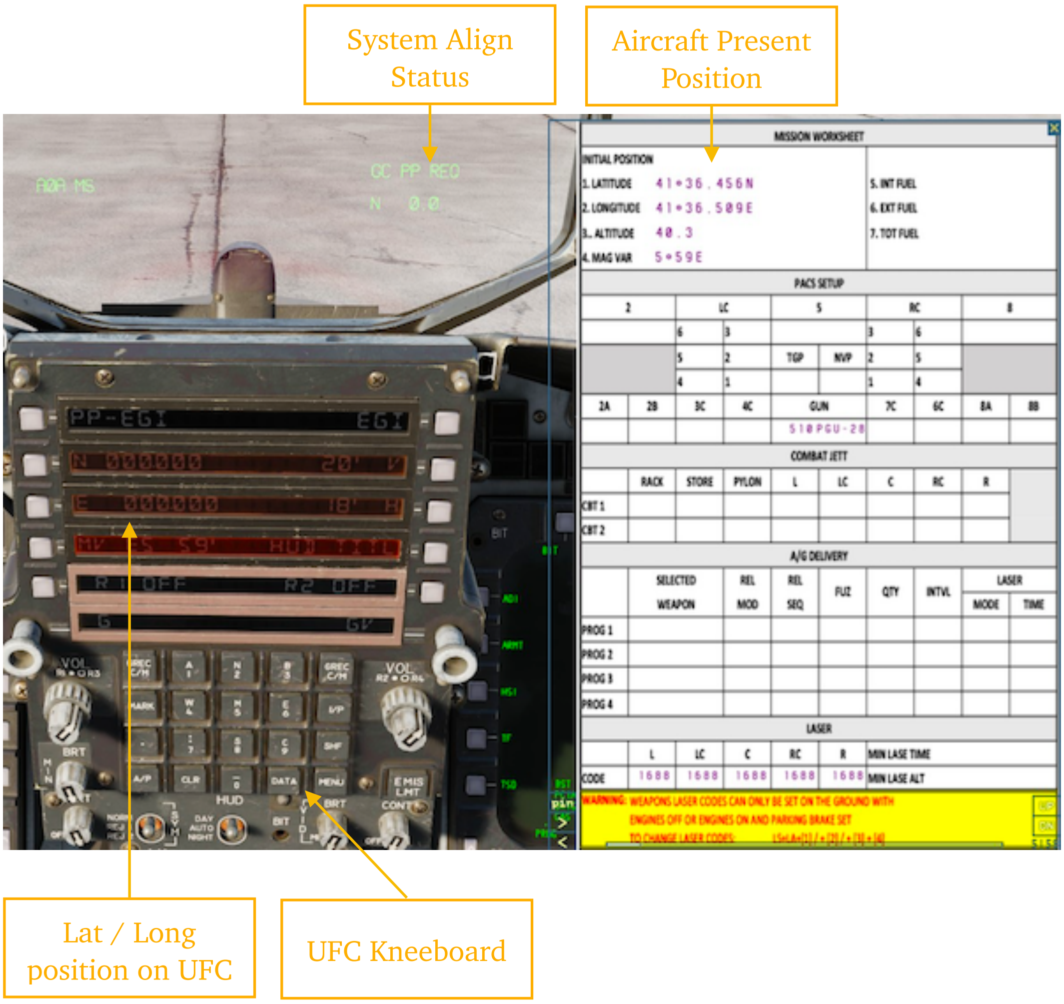
8.19.2 INS ALIGNMENT

For the correct INS alignment several steps have to be followed. Alignment mode is entered by using the INS Mode Knob with two different positions for separate alignment modes:

STORE: Selects the stored heading (SH) alignment mode and uses gyrocompass alignment parameters which were stored at the time of the last system shutoff for rapid INS alignment. PP source submenu is called up on the pilot's UFC when SH is selected. The aircraft must not have been moved since the last shutdown. SH alignment is complete approximately 40 seconds after turn-on and should achieve approximately GC align accuracy.

GC: Selects the gyrocompass (GC) mode which is the most accurate mode of INS alignment. PP source submenu is called up on pilot's UFC when GC selected. Full GC alignment requires approximately 4 minutes. Alignment complete is indicated by GC OK in the HUD and on the PVU display.

In both cases, after the INS Mode Knob is set to either STORE or GC position, a SH PP REQ or GC PP REQ is displayed on the HUD, indicating that that the system requires present position update. The pilot or the WSO must must insert current Lat / Long coordinates on UFC PP source submenu.



Aircraft's present position can be found on the kneeboard. The LAT / LONG coordinates should be introduced into the system by:

1. Pressing SHF button on the UFC Keypad
2. Pressing '2' for N
3. Entering coordinates (in this case: 4 1 3 6 4 5 6)
4. Pressing PB 2 on the UFC to introduce the coordinates
5. Pressing SHF button again.
6. Pressing '6' for E
7. Entering coordinates (int his case: 0 4 1 3 6 5 8 9)
8. Pressing PB 3 on the UFC to introduce the coordinates

Once this is done, the legend on the HUD will change to GC / SH NO TAXI and remain there until the INS attitude is valid. Aircraft should not be moved during this process - if it is, the alignment process will have to be restarted.

After approximately 60 seconds, the legend will change again to GC / SH / IFA 15.9, where number indicates the alignment quality. The higher the number, the less accurate the alignment. It will gradually decrease until the legend says GC / SH OK.

At this stage the pilot should move the INS Mode knob to NAV position. The alignment is complete.

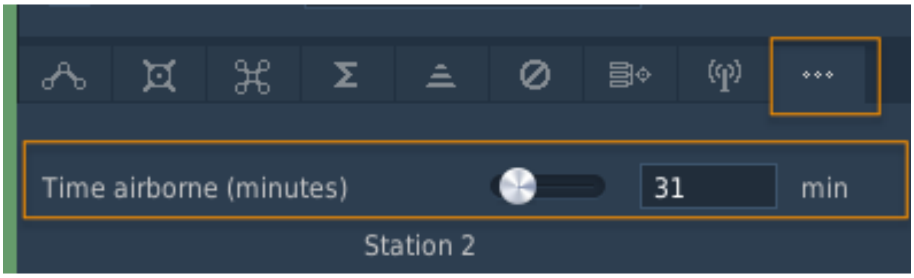
NOTE: In the current version of the module initial coordinates are already stored in the system, so their introduction during the startup is not necessary. Therefore it is enough to just place the knob in GC ALIGN position.

8.19.3 INS Drift and Update

The INS is a very delicate and complicated tool, however it accumulates errors over time, which results in growing drift and increasingly degraded representation of the aircraft's, waypoints, targets etc. position in relation to real world.

With full alignment done at startup, the drift equals to around 0.8 NM per one hour of flying.

With missions starting in the air, players are able to select the already accumulated INS drift using "Additional properties for aircraft" tab in Mission Editor:



This applies only to aircraft that has no functional EGI (due to damage taken, mission conditions or other circumstances), as EGI constantly checks for and updates INS readouts, thus negating any drift. Note that EGI will not be available for any missions flown before 1998.

In longer flights it will therefore be important to perform INS update from time to time, which can be done in several ways.

The most precise option is to use the A/G Radar, the TGP or the Link-16 to preform an update to the INS or the MN.

8.20 TERRAIN FOLLOWING

Note: terrain following functions are not available in the Early Access stage

SECTION 2

AIR TO AIR RADAR AND WEAPONS

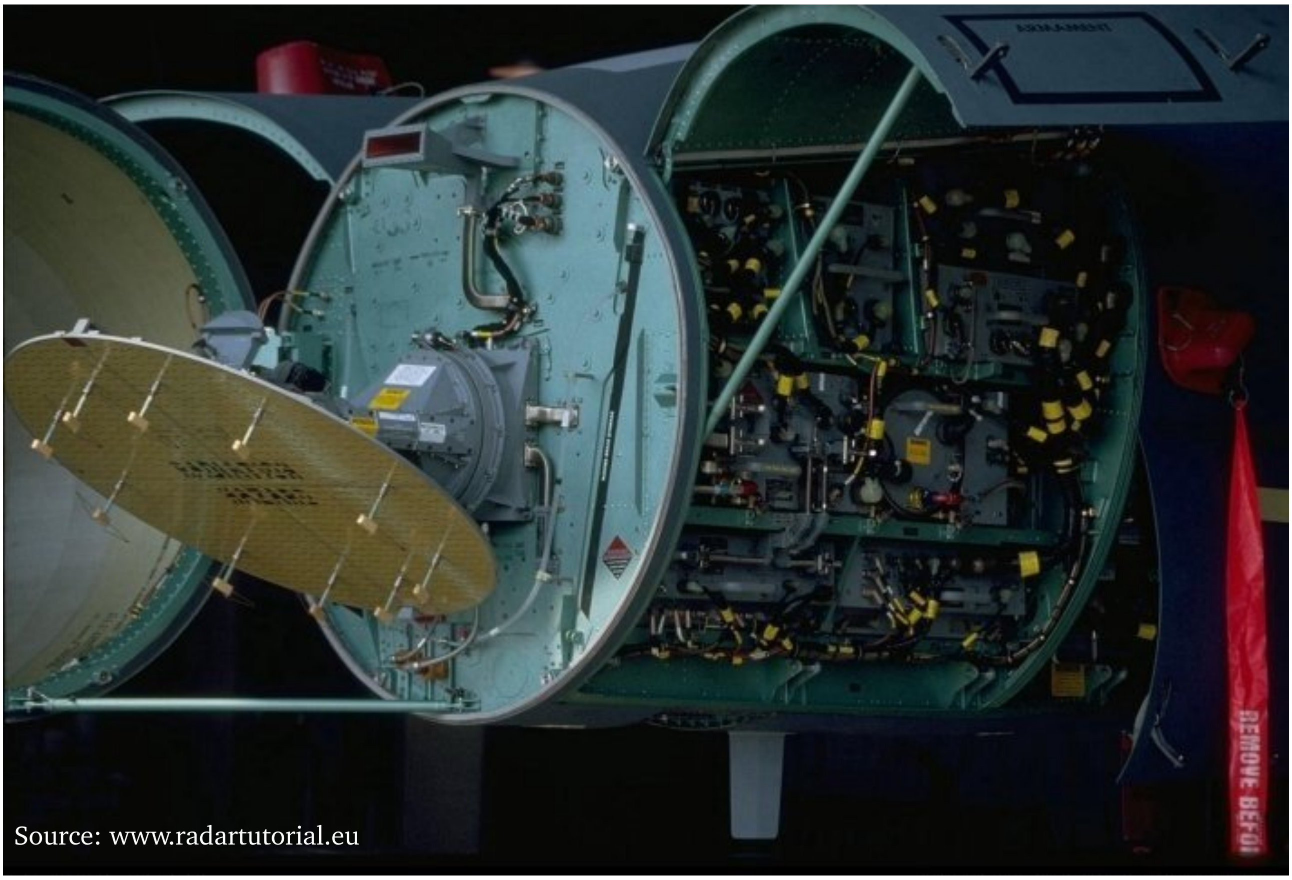
CHAPTER 9: Air to Air Radar

9.1 INTRODUCTION

F-15E Strike Eagle is equipped with the AN/APG-70, which is a high frequency, Pulse Doppler radar capable of operating both in air to air (A/A) and air to ground (A/G) mode. It allows for limited A/G actions to be performed at the same time as the A/A operations. The radar is in many ways similar to the AN/APG-63 installed on the F-15C, belonging to the same family.

The APG-70 radar system allows aircrews to detect ground targets from long ranges. This means that after a sweep of a target area, the crew can freeze the air-to-ground map, go back into air-to-air mode to check and engage any air threats. Then when they continue to their target, the pilot is capable of detecting, targeting and engaging enemy aircraft, while the WSO designates and works on the ground target.

The AN/APG-70 can detect and track aircraft and small high-speed targets at distances beyond visual range down to close range, and at altitudes down to treetop level.

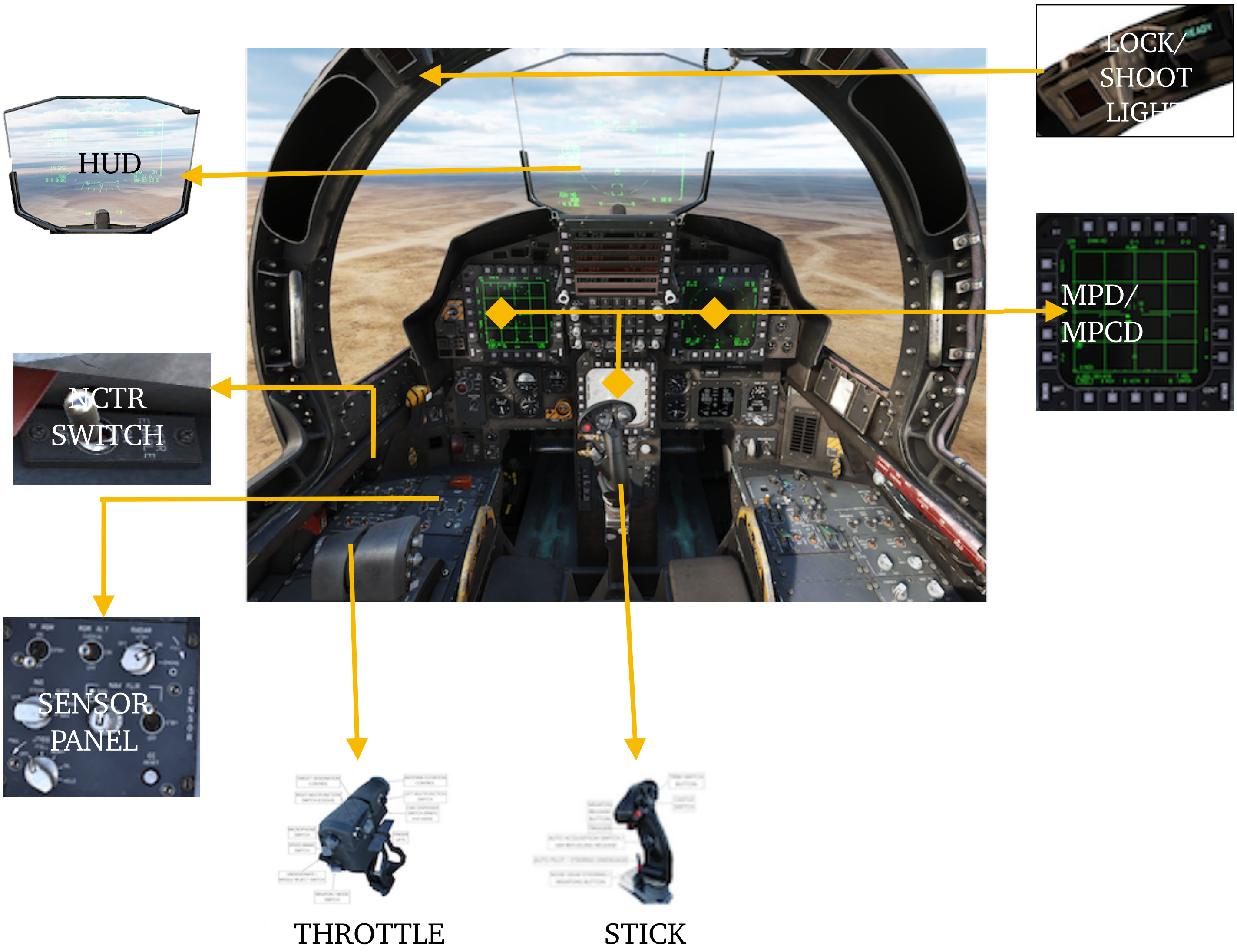


Source: www.radartutorial.eu

9.2 AIR TO AIR RADAR CONTROLS

The following instruments and panels are used for controlling and using the radar in air to air mode.

Front Cockpit



Rear Cockpit

9.2.1 SENSOR PANEL (SCP)

The Radar Power Knob on the sensor control panel has the following functions:

OFF: no power is coming to the radar. It is completely deenergized.

STBY: standby mode. In this mode BIT checks can be performed and the radar is warming up, which takes around 3 minutes. After that time, it can be placed in full operation.

ON: the radar is in full operation unless the aircraft is on the ground (weight-on-wheels [W-o-W] interlock). If the knob is moved directly to ON position, the 3-minute warm-up just as in STBY position is initiated.

EMERG: emergency mode. It bypasses all the protective interlocks (apart from W-o-W) and places the radar in full operating mode. It still requires a 3-minute warm-up. E is displayed on the HUD.

NOTE: It is forbidden to use the radar in Emergency mode during peace time training missions.

9.2.2 AUTO NCTR ENABLE SWITCH

When in ON position it enables the auto NCTR (Non-Cooperative Target Recognition) entry. Otherwise manual entry is possible.

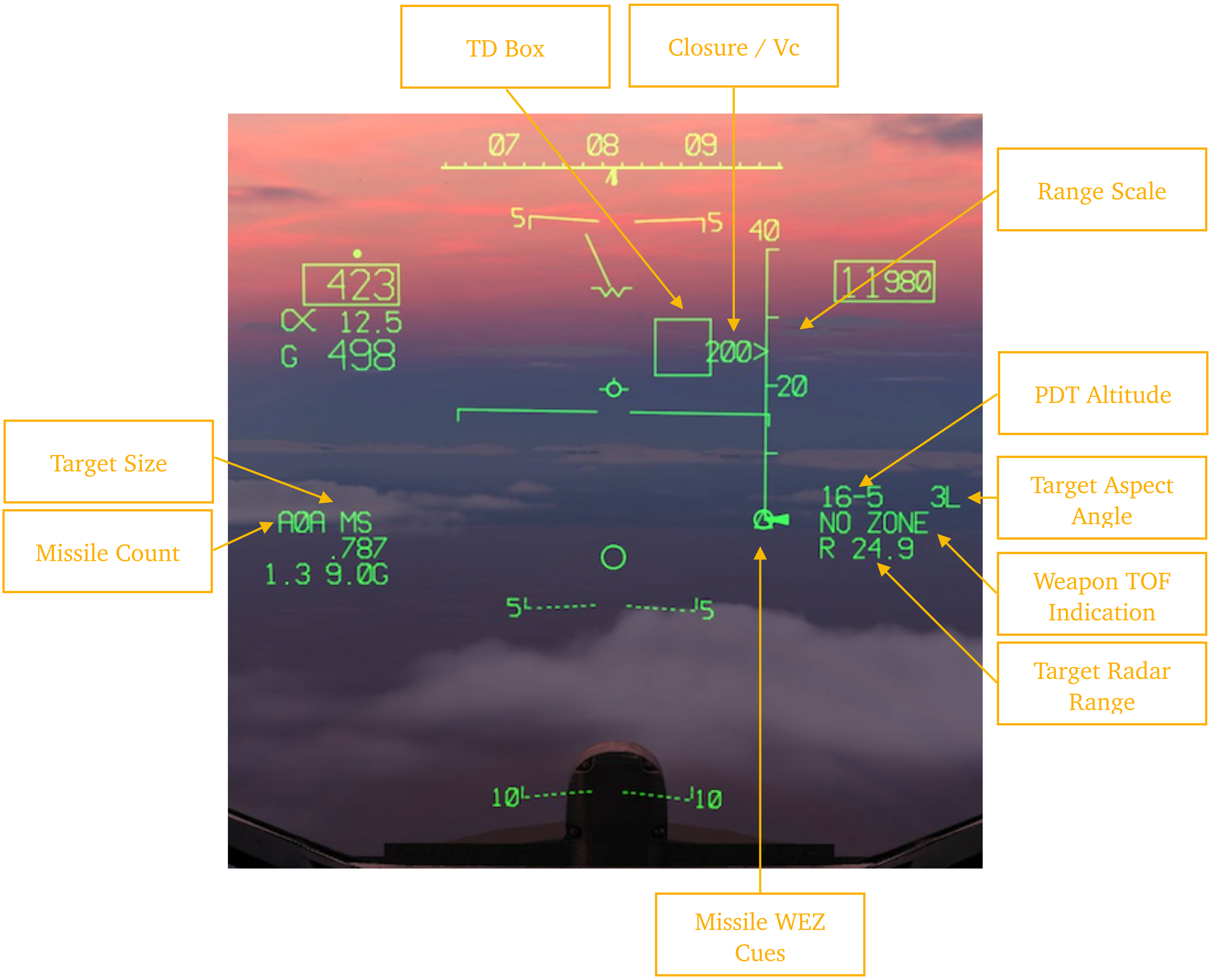
9.2.3 LOCK / SHOOT LIGHTS

The lock / shoot lights are mounted on the canopy rail in the front cockpit. They are operative only if A/A Master Mode is selected. These lights will be steady or flash depending on the selected weapon and target range - more information will be found in the description of employment of different air to air missiles.

Intensity of the lights can be adjusted using the warning caution lights knob. These lights are disabled when low intensity mode for night operations is selected.

9.2.3 HUD

When a target is locked by the radar, HUD mirrors certain information from the RDR display and provides a representation of the target in real world, provided that it is within the Radar field of view.



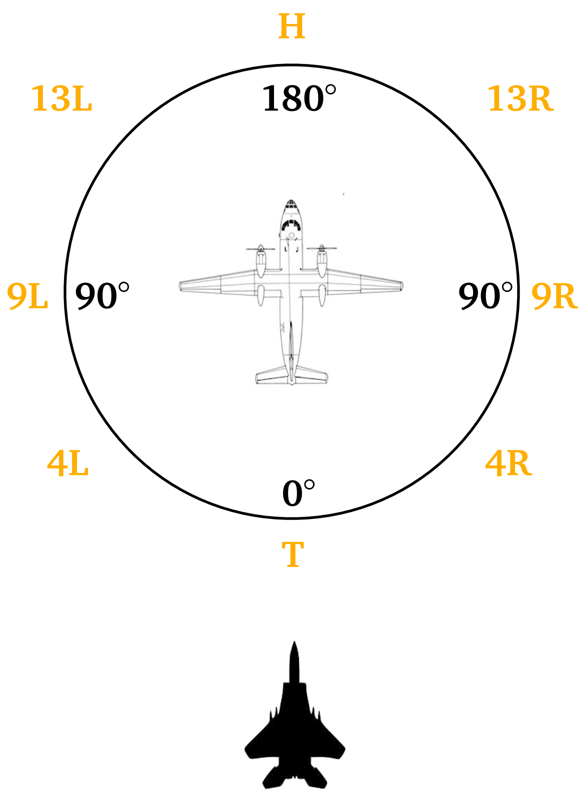
Target Designator Box: visual representation of the locked target. If it is outside the HUD FOV, the box starts to flash, and the azimuth in degrees is displayed next to it.

Closure Rate: rate of closure (also called Radial closure or "Vc") between the aircraft and the locked target in knots per hour. It can be positive if both aircraft are flying towards each other, or the chasing aircraft is gaining on the target. It can also be negative, when the opposite is true and the distance between both is increasing.

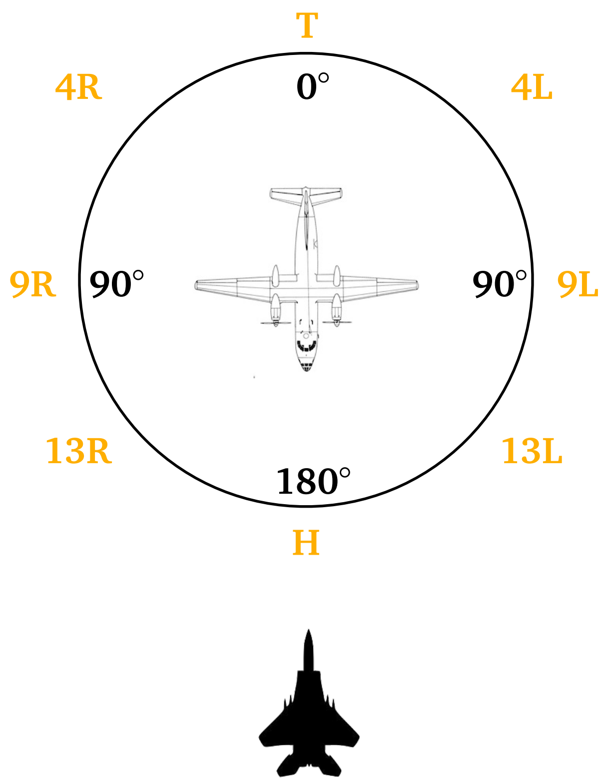
Range Scale: appears on the HUD whenever the lockon occurs. The uppermost number is the currently selected radar range. The caret (**>**) next to the Range Rate indicates the range on the scale.

Primary Designated Target (PDT) Altitude: in XX - Y format, where (**XX**) is altitude of the currently designated target in thousands of feet and (**Y**) indicates the hundreds of feet.

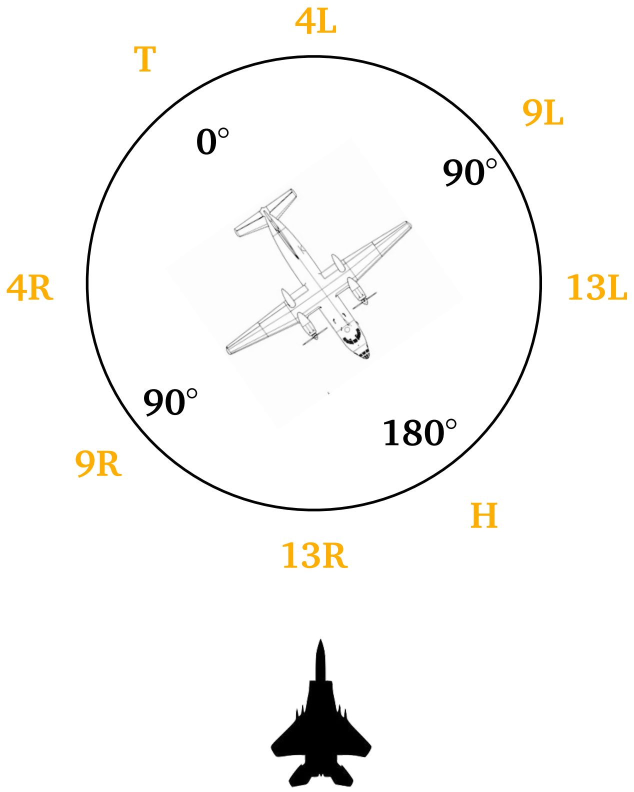
Target Aspect Angle: it is the horizontal angular difference between the target longitudinal axis and the F-15 to target LOS, as shown in the picture below. The L or R next to the number tells if the F-15 is looking at the left or right side of the target. Below are several examples to better understand the concept.



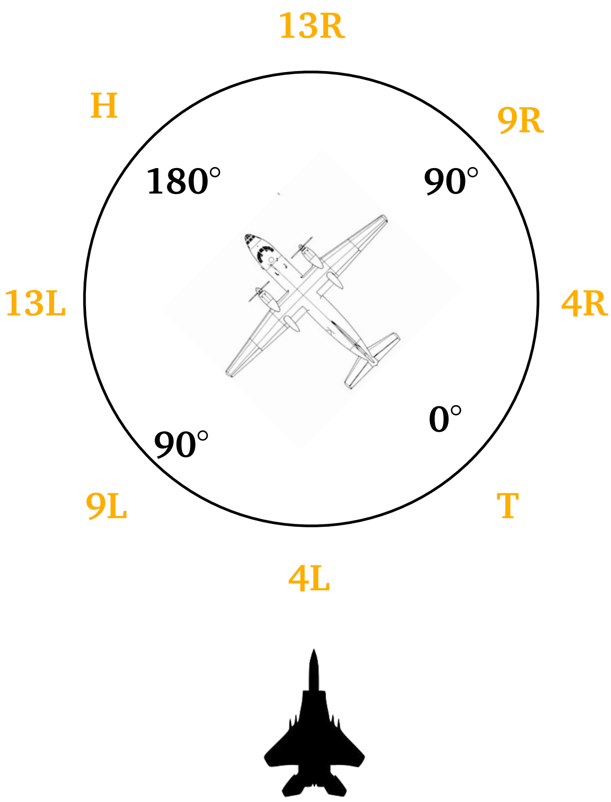
T(ail) Aspect Target



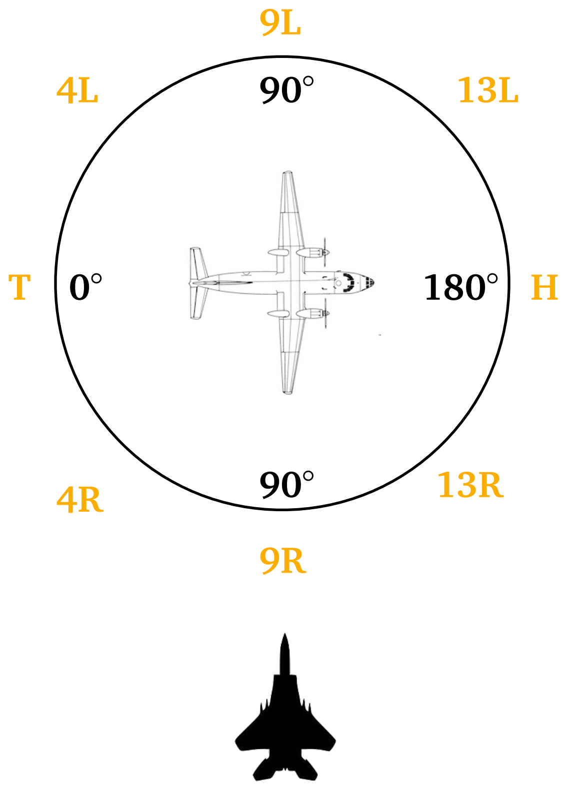
H(ot) Aspect Target



13R Aspect



4L Aspect Target



9R Aspect Target

Missile Time of Flight Indication: refer to specific weapon types for more information. NO ZONE is displayed if the jet can't calculate the time.

Target Radar Range: range to the designated target in Nautical Miles.

Range Cues: normally these would be positioned on the Range Scale in different places of the scale, depending on the selected weapon. They will be described in greater detail in sections dedicated to separate missiles, but general information on each of them can also be found below:

Raero Cue (Max Aerodynamic Range): indicated by a triangle, this is the absolute maximum missile launch range. It assumes that the target is not maneuvering and it does not accelerate.

Rpi Cue (Range Probability of Intercept): is a maximum launch range with current steering that assures a high likelihood of success. It also assumes no maneuvers from the target.

Ropt Cue (Range Optimum): indicated by a circle, it is a special case of Rpi calculated assuming the steering dot is centered in the ASE circle (optimal steering). Assumes no maneuvers from the target.

Rmnvr Cue (Maneuver): indicated by a sideways golf tee, represents maximum range against a target executing at launch a constant speed, level 4-G turn towards the tail.

Rtr Cue (Range Turn and Run): indicates a maximum launch range against a target that is executing an evasive turn.

Rmin Cue (Minimum Range): indicates the minimum launch range that assures any likelihood of success.

Missile Count: shows the type and count of of the current missile type in priority. Note that it does not show all missiles and inventory.

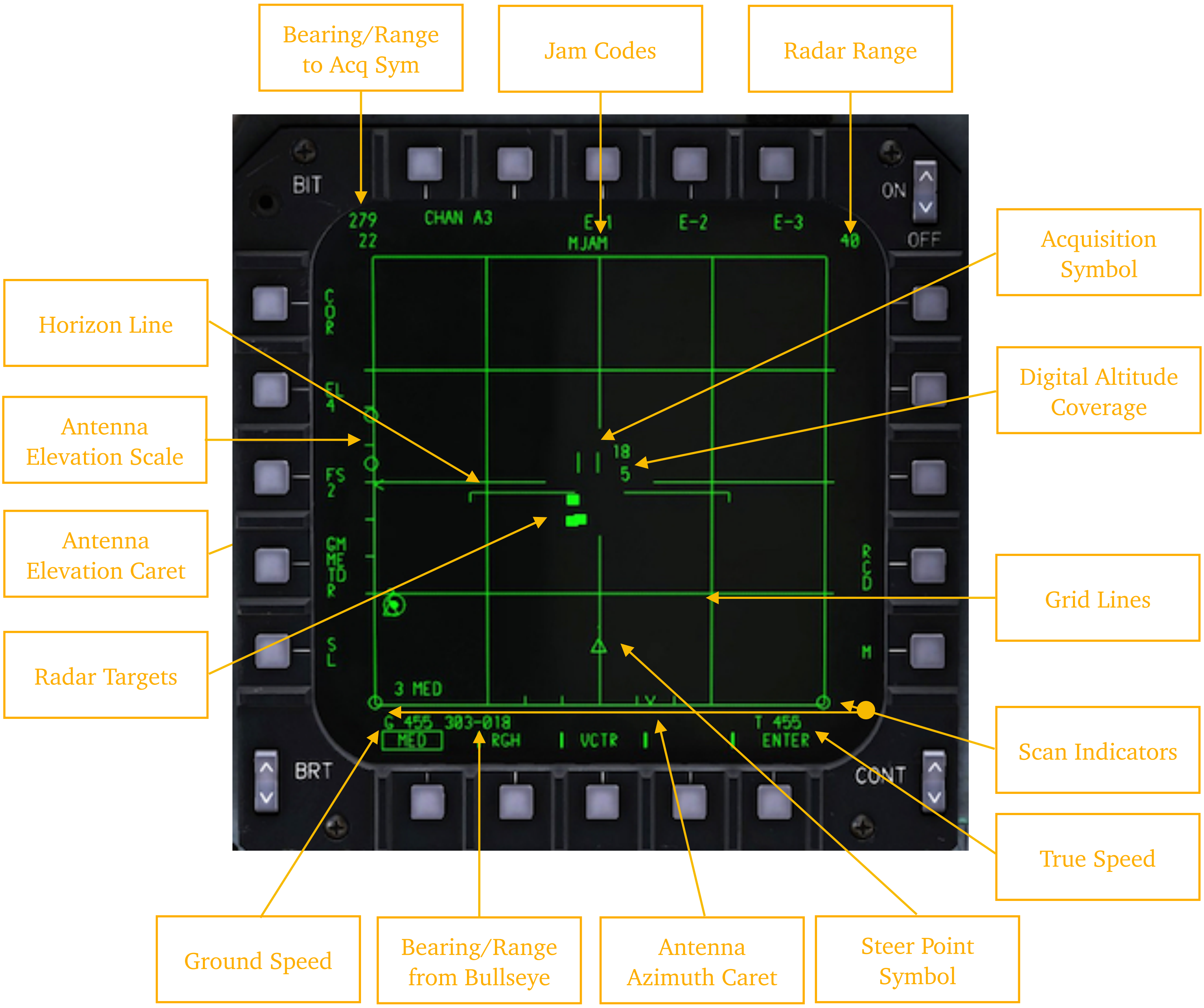
Target Size: in the A/A master mode and when using an AIM-7 or AIM-120, the target size and its radar-cross section is displayed next to the missile count. This tells when the missile is likely to detect the target and when to fuze based on proximity. Not implemented in DCS.

9.2.4 Multi - Purpose Displays (MPD/MPCD)

MPDs and MPCDs in both cockpits provide the main source of information provided by the radar and also allow the air crew to control many aspects of its work. The basic symbols and functions of the radar in air to air mode are described in the pictures below.

The basics of the functioning of the radar as well as options described in this section are explained by Notso in the video on Razbam Simulations channel.

Radar Screen symbols (part 1)



Bearing / Range to Acquisition Symbol (Acq Sym): this digital readout shows the magnetic bearing and distance in NM between the aircraft's nose and the position of the Acquisition Symbol on the display.

Radar Range: shows currently selected range, which can be set to one of the following figures: 10, 20, 40, 80 and 160 nautical miles.

To increase the range, slew the Acq Sym using the TDC to the top of the display. Conversely, to decrease it, slew the Acq Sym to the bottom.

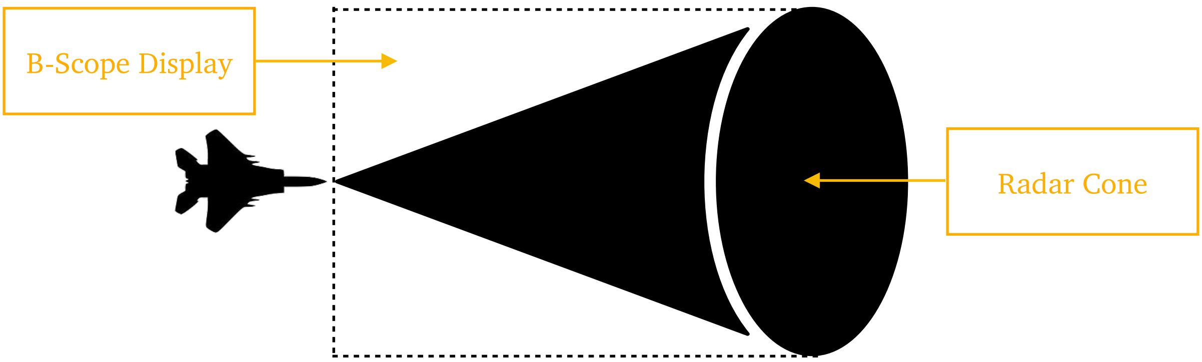
Jam Codes: jam codes are displayed when jamming conditions are detected.

Acquisition Symbol (Acq Sym): it is displayed in all search modes and is used to change the radar range, enable azimuth bumping, sampling and target designation.

Acq Sym is slewed around the display using the TDC on the throttle in the front cockpit and on the hand controllers in the rear one.

Digital Altitude Coverage: shows the maximum and minimum scan altitudes which the radar is covering in search (or in TWS). The numbers indicate thousands of feet MSL (at the example above, the radar is "looking" at altitudes between 5 and 18 thousand feet). Maximum altitude is 99 thousand, and minimum is -9 thousand.

Digital Altitude Coverage depends on three factors: the antenna elevation, number of bars set (see below) and the point of the Acq Sym on the display - the further it is from the aircraft, the wider the scan will be, as radar search zone essentially is a cone that gets bigger the further it goes from the aircraft. The B-Scope radar display figuratively stretches the bottom of the display to be in full azimuth.



Grid Lines: the grid lines are range and azimuth references. Vertical spacing between horizontal lines represent 1/4 of the currently selected range (so in the example above, each horizontal line is separated by 10 nautical miles, because the selected range is set to 40).

The horizontal spacing between the vertical lines normally represent 30° in azimuth (as the total horizontal coverage of the radar is 120°, unless in AZ Bump, when the total coverage is 60°, in which case spacing between the lines drops to 15°).

Scan Indicators: small circles positioned on the antenna AZ scale to provide a quick reference of the present antenna scan in progress.

True Speed: aircraft's true speed in knots.

Steer Point Symbol: represents the currently selected Steer Point in relation to the aircraft's nose (if within radar range).

Antenna Azimuth Caret: in search mode, the AZ caret indicates the current antenna scan position. At lockon, it shows the azimuth angle to the target.

Bearing / Range from Bullseye: displays the bearing and range from bullseye to the position of the Acq Sym on the display in format bearing (XXX) - range (YYY). So in the example above, the Acq Sym is over a point at bullseye 303 / 018.

Ground Speed: aircraft's ground speed in knots.

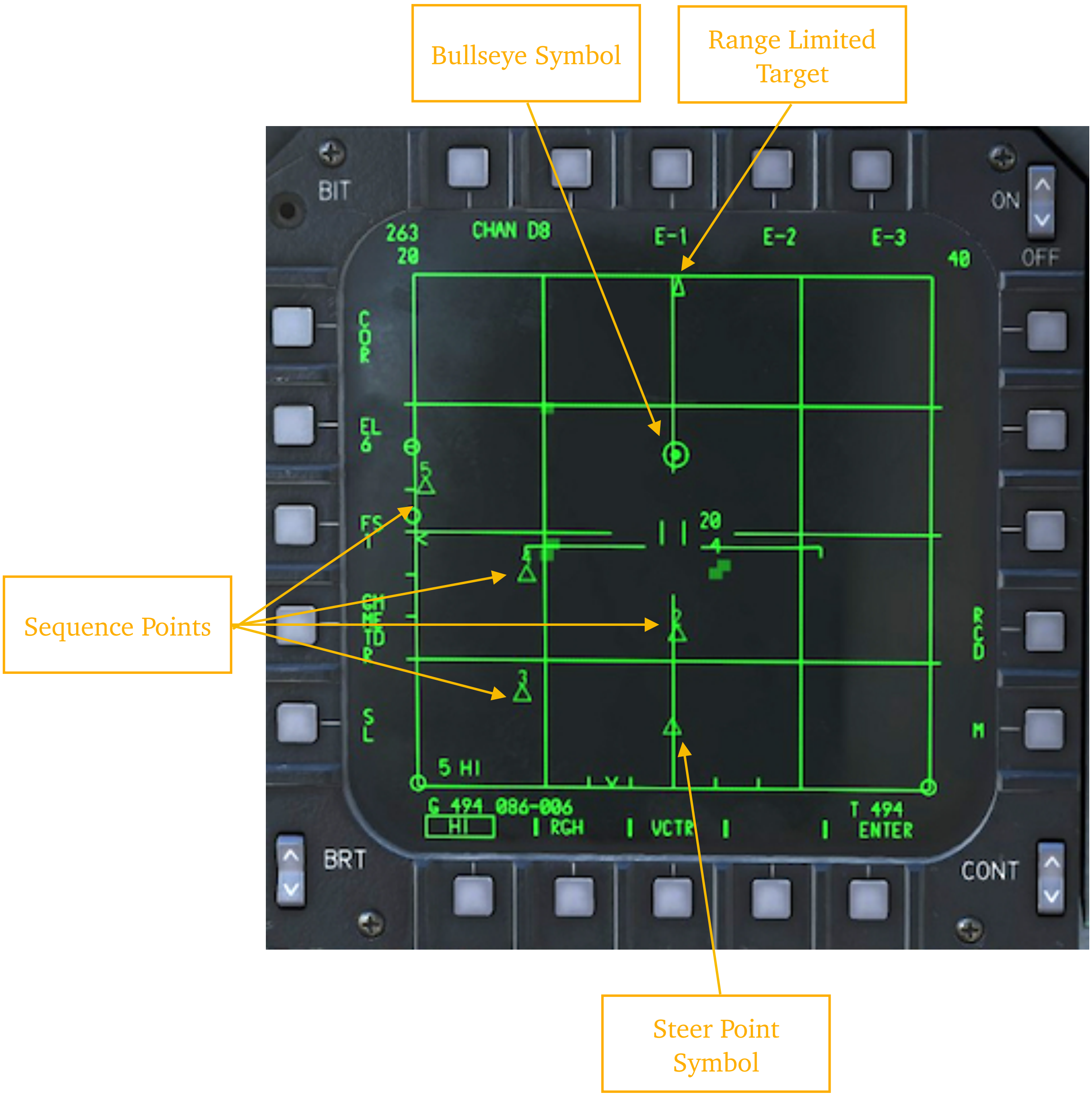
Radar Targets: target symbols will look differently depending on the current mode. Whenever the target is painted by the radar, it turns bright green. After that it turns to dark green and stays on screen for the number of scan cycles depending on the setting next to PB 3.

If there is enough data about the target, hovering the Acq Sym over it should display its elevation on the left side of the symbol.

Antenna Elevation Caret: moves along the antenna elevation scale and depicts the angle of the antenna.

Antenna Elevation Scale and Altitude Coverage Circles: radar beam altitude coverage circles are displayed against the antenna elevation scale on the left side of the radar display. The circles represent beam altitude coverage at the acquisition symbol position (also mirrored on the Digital Altitude Coverage scale next to it).

Radar screen symbols - part 2

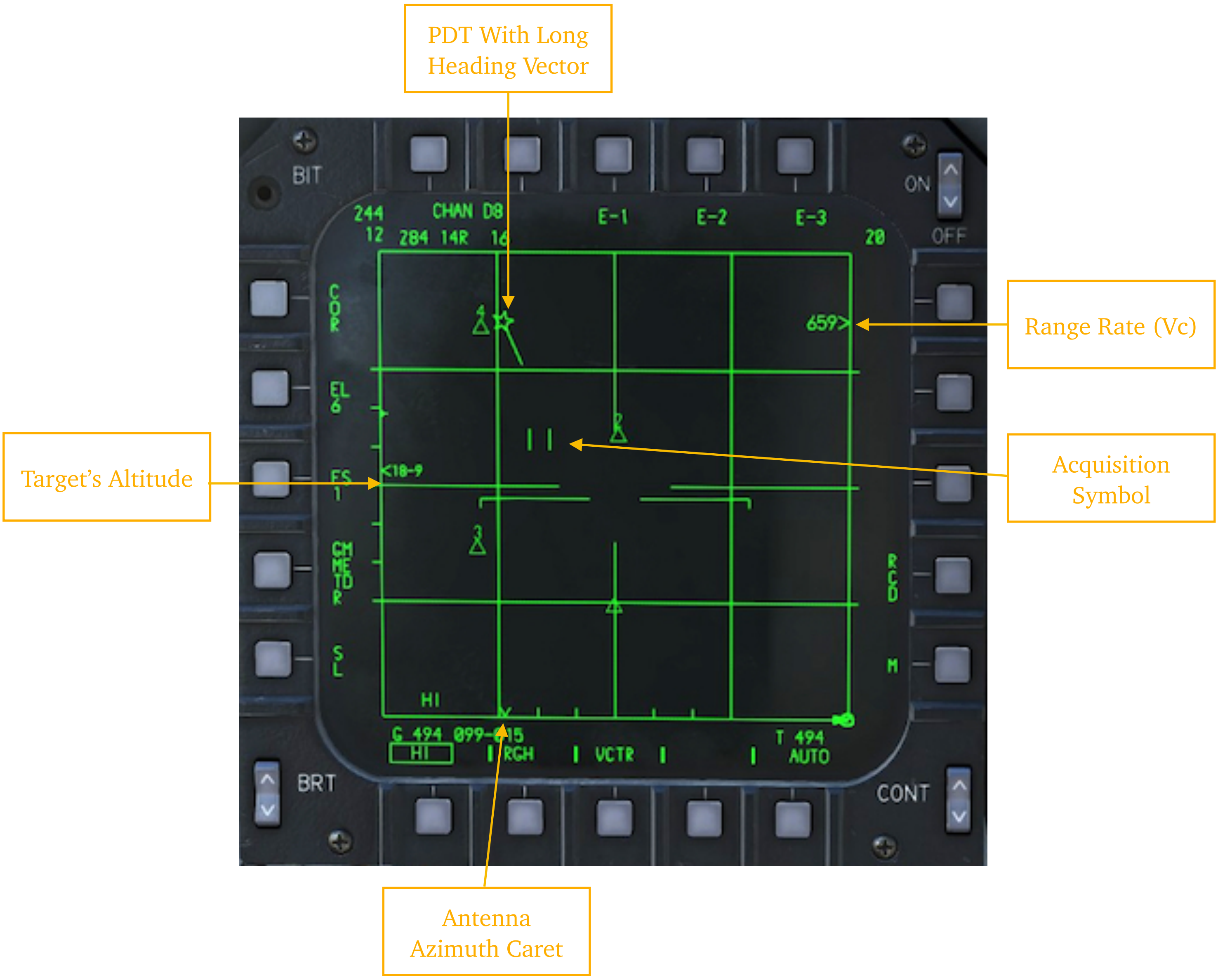


Bullseye Symbol: displays the position of the bullseye in relation to the aircraft's nose. Judging by the AZ lines, in this case it is directly ahead off the nose, around 26 NM away. The Acq Sym is at bearing 086, 6 NM away.

Range Limited Target: each symbol like this signifies that there is a target (one for each symbol) detected that is outside the currently displayed radar range (so above 40 NM in this case).

Sequence Points: all sequence points that are within radar's range and field of view are displayed as small triangles with a number above. Steer point is a triangle without the number.

Radar screen symbols - Single Target Track, no weapon selected



PDT With Long Heading Vector: target locked in Single Target Track (STT) turns into a star with a vector, which represents the relative heading between the target and the F-15.

Range Rate (Vc): rate of closure between the aircraft and the locked target in knots per hour.

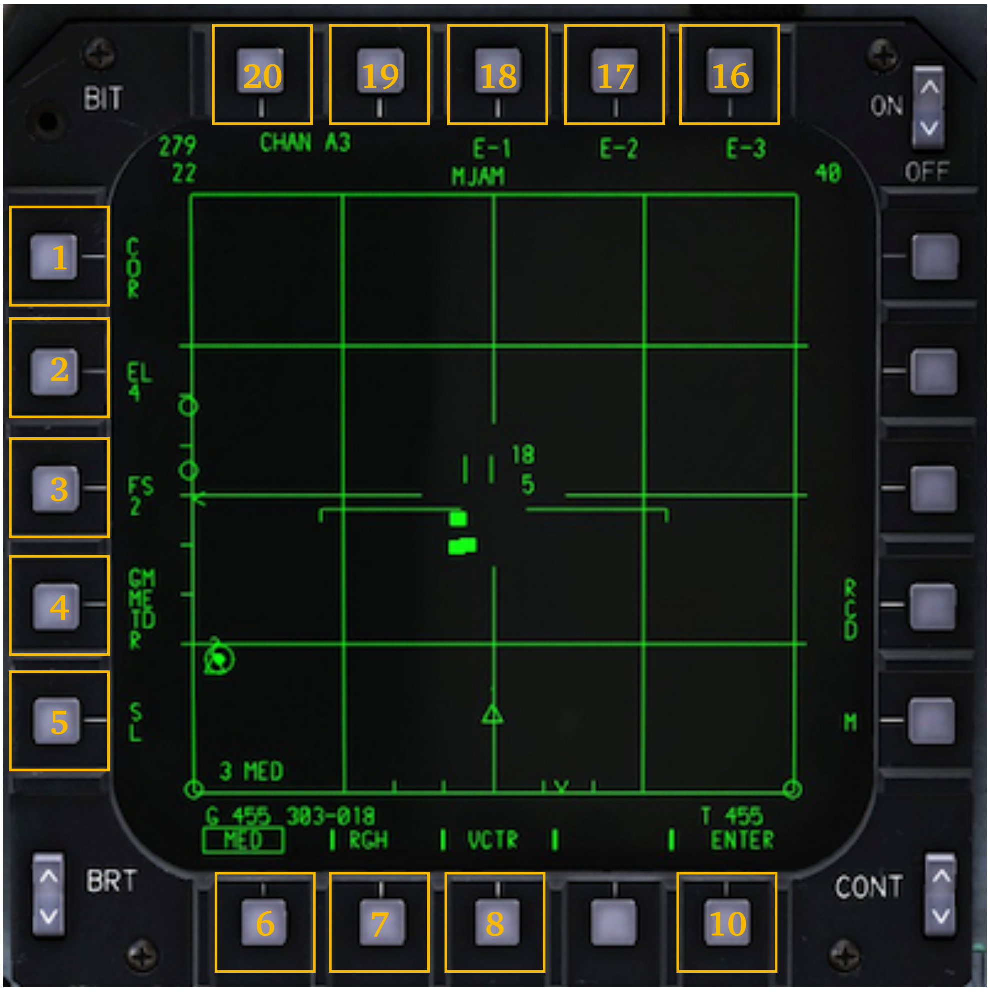
Acquisition Symbol: in STT mode Digital Altitude Coverage is no longer displayed.

Antenna Azimuth Caret: in STT mode it moves to the position of the locked target.

Targets Altitude: replaces the Antenna Elevation Scale and displays the MSL altitude of the locked target in thousands (XX) - hundred (Y) feet, 18 900 in the example above.

9.2.4.1 Radar Display Controls

Once the radar is in full operation, it is controlled by HOTAS controls as described above and pushbutton options around the display shown below.



PB 1 (COR): not functional.

PB 2 (EL): Elevation scan. Pressing this PB changes the number of elevation scan patterns between 1, 2, 4, 6 or 8, with the currently selected pattern displayed below the EL legend. See A/A Radar Search Modes part for more information.

PB 3 (FS): Frame Store. It allows the air crew to manually select the length of time a target return is visible on the display, measured in frames. One frame equals to the full sweep in current bar scan selection, so if a six bar EL scan is selected, target return will be visible for a little over than 10 seconds (one bar sweep takes around 1.6 second to complete).

With 0 selected, target data is displayed only on the current bar. With 1 or 2, target history information is displayed for chosen number of frames. For current bar it is displayed with maximum brightness, and the stored return has reduced intensity.

PB 4 (GMTR): Ground Moving Target Rejection. Allows the air crew to select the level of GMT rejection and airborne beam notch, changing the radar's sensitivity to slow moving targets, but also increasing the chance of ground clutter and false targets appearing on the screen. LOW is best at detecting targets such as helicopters or ground moving targets, but will also provide highest level of ground clutter. The GMT rejection is linked with target velocities: targets closing or opening with speed lower than the value listed in the table below for the give setting will be rejected by the radar. The values are as follows:

GMTR Selection	Airborne Notch
LO	45 knots
MED	63 knots
HI	87 knots
CHAF	95 knots

PB 5 (SL): not functional.

PB 6 (PRF radar operation): each actuation of this button switches between High , Medium and Interleaved Pulse Radar Frequency (HPRF, MPRF, H/MPRF). In a nutshell, this setting determines the number of pulses the radar produces in a specified period of time. After sending the pulse and while waiting for it to return, the transmitter is turned off in order to “hear” the reflections of that pulse off the distant targets. This means that by sending less pulses, it will be able to wait longer for the return, which in turn means ability to work at a longer range (more time = longer distance the pulse can travel). Conversely, higher PRF produce shorter maximum ranges, but can detect smaller targets and better track them.

HPRF works on all radar scales and is best used at long ranges and to search for bigger targets (like tankers, bombers etc). It also works best for front aspect targets.

MPRF is most efficient at shorter ranges, also against low altitude and tail aspect targets. While in MPRF, 160NM scale cannot be selected on the radar.

INLV (H/MPRF) constantly switches between high and medium pulse frequency with every scanned bar. It works best at ranges of 20, 40 and 80NM. If in INLV and 10NM scale is selected, it will automatically use MPRF. This is the go-to mode for most tactical situations.

PB 7 (RGH): a Range Gated High mode, which employs an intermediate PRF falling between medium and high frequency over all range scales.

PB 8 (VCTR): selects vector scan that uses only HPRF and can be used in all range scales. The scan rate slows down by half. This mode is used to search for small Radar Cross Section (RCS) targets like cruise missiles.

PB 10 (ENTER): this button allows the aircrew to reprogram the MRM / SRM default parameters. See Programming MRM / SRM section for more details.

PB 16-18 (Special Modes): electronic protection modes of the radar. Not functional.

PB 19 (channel number) and 20 (frequency band): allows to choose between different available frequency bands and then different channels within each band.

There are five available frequency bands (A to E). D is a limited automatic frequency band, while E is an emergency band that should only be used in combat.

Within each band there are 8 numbers that can be chosen. Typically each flight member would stay at the same band but choose different channels.

Different bands and channels are used to deconflict / avoid interference between operating radars.

9.2.4.2 AZIMUTH BUMPING

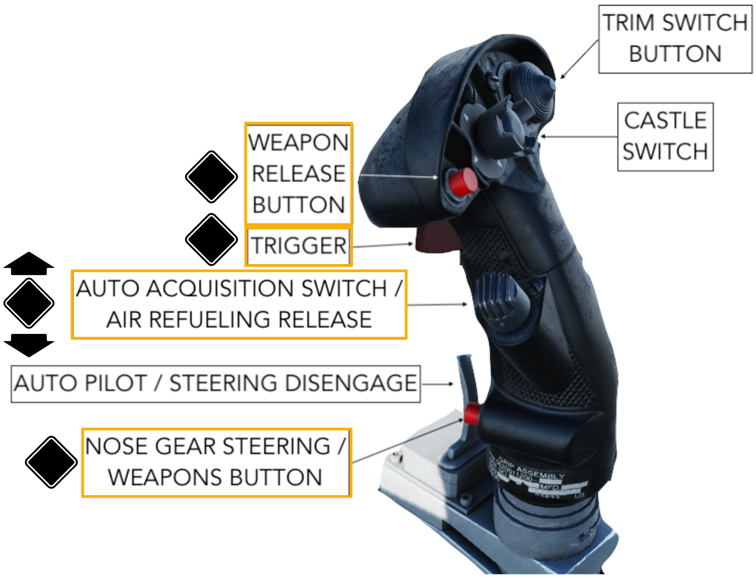
In MRM or SRM weapon modes, if the Acq Sym is moved to left or right edge of the display, it changes the AZ scan. The default scan switches to 60°, but can be narrowed down further to 30° by pressing the TDC on the front stick (or squeezing the trigger to first detent in the rear) for more than 1 second.

To return to full scan (120°), the Acq Sym should be moved once again to the extreme of the display.

The basics of radar search modes are explained by Notso in the video on Razbam Simulations channel.

9.2.5 STICK (FRONT COCKPIT)

Following controls on the stick are used for radar operation in Air to Air mode:



Automatic Acquisition (Auto Acq) Switch has different functions depending on the current operating mode of the radar.

FROM SEARCH

Short press forward (<1s) switches between Supersearch (SS) or Boresight (BST) auto acquisition mode.

Short pull aft (<1s) enters Vertical Scan (VTS) mode.

Long press forward (>1s) selects Long Range Boresight (LR BST) mode.

FROM SINGLE TARGET TRACK (STT)

Short pull aft (<1s) selects Designated Track - While-Scan (DTWS) mode.

Short press forward (<1s) selects High Data Rate TWS (HD TWS) mode.

Long press forward (>1s) with AIM-7 inflight selects Velocity Search Boresight (VS BST) mode.

Long pulling aft (>1s) with AIM-7 inflight selects HPRF flood mode.

Pressing down (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

Nose Wheel Steering Button

- With AIM-9 selected, pressing NWS cages / uncages the missile seeker.

Weapon Release Button

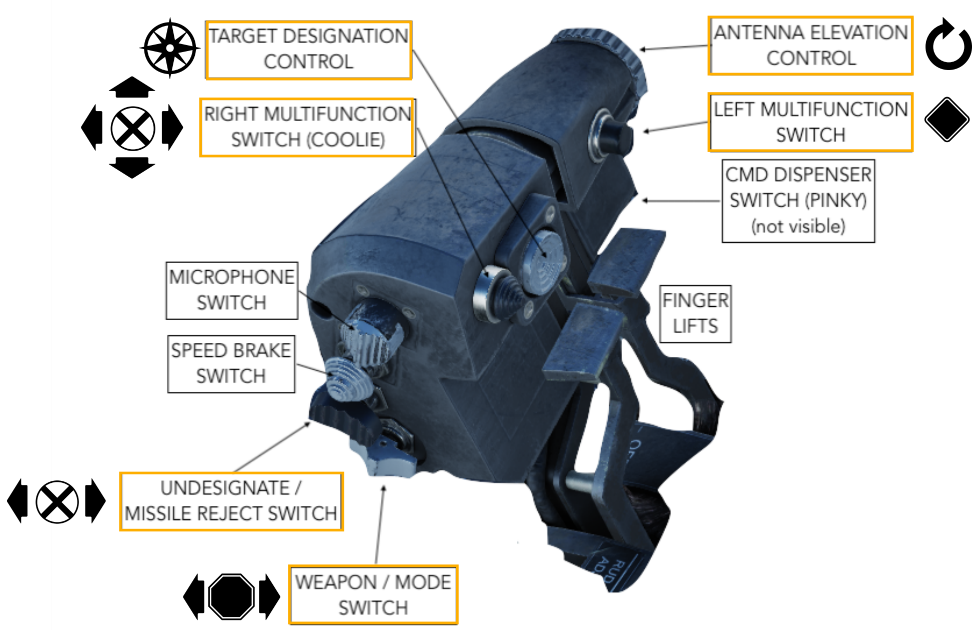
- Pressing and holding the pickle button with Master Arm set to ARM and MRM or SRM selected releases the missile.

Trigger

- Pressing only the first detent enables VTR recording. Pressing the second detent fires the gun.

9.2.5 THROTTLE (FRONT COCKPIT)

Following controls on the throttle are used for radar operation in Air to Air mode (note that weapons employment will be described in separate chapters):



<u>**Weapon Mode Switch**</u> is directly linked with master modes and selecting air to air missiles, but is also related with A/A radar display.

If set to forward (MRM), it places the MRM missiles in launch priority and provides steering on HUD and Radar display (note that steering is provided <u>only</u> in A/A Master Mode). Also sets the radar to operating parameters programmed previously for MRM.

If set to center (SRM), it places the SRM missiles in launch priority and provides steering on HUD and Radar display (note that steering is provided <u>only</u> in A/A Master Mode). Also sets the radar to operating parameters programmed previously for SRM.

If set to aft (GUN) it selects the A/A master mode and selects the GUNS auto acq mode of the radar. It also places the GUNS RDR screen on the FCP Left MPD.

NOTE: Guns mode is hard coded to display that RDR page on the LMPD and you cannot change it until you exit guns mode.

Coolie Switch:

Pulling up short (< 1 sec) while in TWS MODE first "latches" the Acq Sym to the PDT. Subsequent Coolie up < 1 sec steps the PDT to the next SDT in range. This is called “QUICKSTEP".

When in Combined Mode pulling it up short (<1s) cycles between the GDS and FNL gunsight modes.

With GUNS selected, pulling it up short (<1s) cycles between the funnel and GDS gun modes.

When in Search with SRM selected, pulling it up long (>1s) enables the Combined Mode. If already in Combined Mode, the same actions exits it.

With caged AIM-9 in priority and a valid PDT, pressing and holding it down together with the Weapon Release Button to command a launch from missile boresight.

With MRM selected and AIM-120 in priority and a valid PDT, pressing and holding it down together with the Weapon Release Button commands visual launch.

Antenna Elevation Control:

It controls position of the center of the selected bar scan pattern and moves the antenna UP or DOWN in elevation. This movement can be observed on the elevation scale on the left border of the display, as well as by changing altitude coverage data next to the radar acquisition symbol.

Target Designator Control (TDC):

When not pressed and in control of the radar, it is used to move the A/A radar acquisition symbol.

When pressed short (<1s) in A/A search, the radar antenna is slaved to the acquisition symbol and enters a miniraster scan.

When pressed long (>1s) in A/A search, the radar enters search sort at the acquisition symbol position, which is followed by lockon in any radar search mode.

When pressed (<1s) in TWS mode while sampling a designated target, that target becomes the Priority Designated Target (PDT).

Undesignate / Missile Reject Switch (Boat Switch)

- In A/A radar or in A/A PACS page, short pressing forward (<1s) rejects the priority missile type and chooses another active missile type.

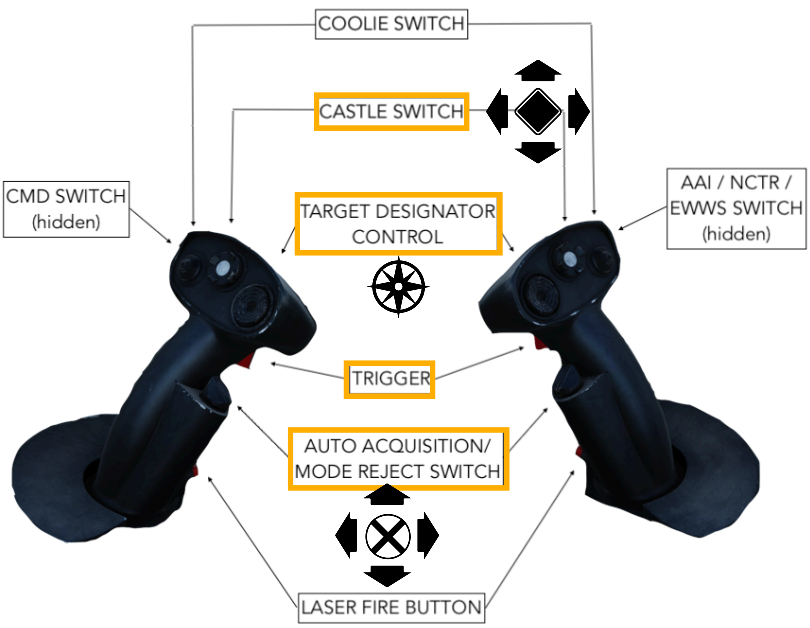
If there are different types of AIM-120s, it would cycle through the types (AIM-120V, then B). If there are both AIM-120s and AIM-7s, each Each BOAT FWD would go back and forth between AIM-7 and AIM-120.

Left Multifunction Switch

- In SRM / Combined mode, pressing it short (<1s) enables manual SBR mode for the AIM 9M or L.

9.2.6 HAND CONTROLLERS (REAR COCKPIT)

The right hand controller (RHC) controls the right MPD and MPCD, and the left hand controller (LHC) does the same for the left MPD and MPCD. The switches on both are mirrored, with the exception of the AAI / EWWS / NCTR on the RHC and the CMD switch on LHC.



<u>Castle Switch</u>:

- Pressing it forward commands MRM radar search mode programmed parameters.
- Pulling it aft commands SRM radar search mode programmed parameters.
- Pressing it left commands undesignate of the target under the acquisition symbol in TWS mode.
- Pressing it down commands TWS quick step.
- In A/A radar or in A/A PACS page, short pressing right (<1s) rejects the priority missile and chooses another active missile.

Trigger:

Squeezing the trigger to half action enables radar scan elevation control by the TDC.

- Squeezing the trigger to second detent (full action) commands the miniraster scan centered on the acquisition symbol.
- When pressed long (>1s) in A/A search, the radar enters search sort at the acquisition symbol position. Releasing the TDC commands lockon in any radar search mode.
- When pressed (<1s) in TWS mode while sampling a designated target, that target becomes the Priority Designated Target (PDT).

Auto Acquisition Switch:

FROM SINGLE TARGET TRACK (STT)

- Short pull aft (<1s) selects Designated Track - While-Scan (DTWS) mode.
- Short press forward (<1s) selects High Data Rate TWS - 3 bar (3HDT) mode.
- Long press forward (>1s) selects High Data Rate TWS - 2 bar (2HDT).

FROM TRACK WHILE SCAN (TWS)

- Short press forward (<1s) switches between Designated Track - While - Scan (DTWS) and High Data Rate TWS (HD TWS) mode.
- If target is locked, short pull aft (<1s) commands STT on the PDT.

OTHER

- Long press forward (>1s) with AIM-7 inflight selects Velocity Search Boresight (VS BST) mode.
- Long pulling aft (>1s) with AIM-7 inflight selects HPRF flood mode.

Laser Fire Button

- In SRM / Combined mode, pressing it short (<1s) enables manual SBR mode for the AIM 9M or L.

<table>
<tr><th colspan="7">STICK - FRONT COCKPIT</th></tr>
<tr><th>SWITCH</th><th>CONDITION</th><th colspan="5">ACTION</th></tr>
<tr><td rowspan="8">AUTO ACQ SWITCH</td><td>Search Mode</td><td>FWD Short
SS or BST</td><td>FWD Long
LR BST</td><td>AFT Short
VTS</td><td>-</td><td>-</td></tr>
<tr><td>Single Target Track</td><td>FWD Short
HD TWS</td><td>FWD Long
2HDT</td><td>AFT Short
2TWSH</td><td colspan="2">DOWN
Return to Search</td></tr>
<tr><td>TWS Wide Pattern
(2TWSH)</td><td>FWD Short
3HDT</td><td>FWD Long
2HDT</td><td>AFT Short
STT</td><td colspan="2">DOWN
Return to Search</td></tr>
<tr><td>TWS Medium Pattern
(4TWSH)</td><td>FWD Short
3HDT</td><td>FWD Long
2HDT</td><td>AFT Short
STT</td><td colspan="2">DOWN
Return to Search</td></tr>
<tr><td>TWS Narrow Pattern</td><td colspan="2">AFT Short
STT</td><td colspan="2">DOWN
Return to Search</td><td>-</td></tr>
<tr><td>TWS High Data Rate 3 Bar
(3HDT)</td><td colspan="2">FWD Short
4TWSH - 3HDT</td><td>FWD Long
2HDT</td><td>AFT Short
STT</td><td>DOWN
Return to Search</td></tr>
<tr><td>TWS High Data Rate 2 Bar
(2HDT)</td><td colspan="2">FWD Short
3HDT - 4TWSH</td><td>AFT Short
STT</td><td colspan="2">DOWN
Return to Search</td></tr>
<tr><td>AIM-7 in Flight</td><td colspan="2">FWD Long
VS BST</td><td colspan="3">AFT Long
HPRF Flood</td></tr>
<tr><td>NOSE WHEEL STEERING</td><td>AIM-9 Selected</td><td colspan="2">DOWN
Cage / Uncage the Seeker</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>PICKLE BUTTON</td><td>MRM or SRM Selected
Master Arm ON</td><td colspan="2">DOWN AND HOLD
Fire the Missile</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>TRIGGER</td><td>Master Arm ON</td><td colspan="2">FIRST DETENT
VTR</td><td colspan="2">SECOND DETENT
Fire the Gun</td><td>-</td></tr>
</table>

THROTTLE - FRONT COCKPIT			
WEAPON MODE SWITCH	Set to FORWARD (MRM)	Places the MRM missiles in launch priority and provides steering on HUD and Radar display	
	Set to CENTER (SRM)	Places the SRM missiles in launch priority and provides steering on HUD and Radar display	
	Set AFT (GUNS)	Selects the **A/A master mode** and selects the **GUNS auto acq mode** of the radar.	
COOLIE SWITCH	Radar in TWS Mode	FWD Short: latches **Acq Sym** to **PDT**; next press **QUICKSTEP**	
	Combined Mode	FWD Short: cycles between **GDS** and **FNL** gunsight	
	Search with SRM selected	FWD Long: enables **COMBINED MODE**	
	Caged AIM-9 and valid PDT	DOWN Long + Pickle Button: launch from missile boresight	
	MRM selected, valid PDT	DOWN Long + Pickle Button: visual launch	
ANTENNA ELEVATION CONTROL	Radar in command	Controls position of the center of the selected bar scan pattern and moves the antenna UP or DOWN in elevation.	
TARGET DESIGNATOR CONTROL	Radar in command	Controls the movement of the A/A radar acquisition symbol	
	Search mode	DOWN Short Enters miniraster scan	DOWN Long Search sort at the acquisition symbol position, followed by lockon
	TWS mode over target	DOWN Short: target becomes the Priority Designated Target (**PDT**).	
	TWS Wide Pattern (2TWSH)	AZ BUMP: **4TWSH**	
	TWS Medium Pattern (4TWSH)	AZ BUMP: **2TWSH**	ACQ SYM over 4TWSH and DOWN: **NARROW**
	TWS Narrow Pattern	AZ BUMP: **4TWSH**	
	TWS High Data 3 bar (3HDT)	AZ BUMP: **2TWSH**	
	TWS High Data 2 bar (2HDT)	AZ BUMP: **2TWSH**	
BOAT SWITCH	A/A Radar in Command or A/A PACS Page	FWD Short: rejects priority missile type and chooses another active type.	
LEFT MULTI-FUNCTION SWITCH	SRM or Combined Mode	DOWN Short: manual SBR mode for the AIM 9M or L.	

<table>
<tr><th colspan="7">HAND CONTROLLERS - REAR COCKPIT</th></tr>
<tr><th>SWITCH</th><th>CONDITION</th><th colspan="5">ACTION</th></tr>
<tr><td>CASTLE SWITCH</td><td>A/A Radar in Command</td><td>FWD Short
MRM program</td><td>AFT Short
SRM program</td><td>LEFT Short
Undesignate</td><td>RIGHT Short
Missile Reject</td><td>DOWN
TWS Quick Step</td></tr>
<tr><td rowspan="3">TRIGGER</td><td>A/A Radar in Command</td><td colspan="2">Half Action
Enables radar scan elevation control</td><td colspan="2">Full Action
Commands the miniraster scan</td><td>-</td></tr>
<tr><td>A/A Search</td><td colspan="5">DOWN Long
Search sort at Acq Symb position</td></tr>
<tr><td>TWS Mode</td><td colspan="5">DOWN Short
When sampling a designated target, it becomes a PDT</td></tr>
<tr><td rowspan="3">AUTO ACQUISIT-ION SWITCH</td><td>Single. Target Track</td><td>FWD Short
3HDT</td><td>FWD Long
2HDT</td><td>AFT Short
DTWS</td><td>DOWN</td><td>-</td></tr>
<tr><td>Track While Scan</td><td colspan="2">FWD Short
Toggles between DTWS and HD TWS</td><td colspan="2">AFT Short
If locked target, toggles STT</td><td>-</td></tr>
<tr><td>AIM-7 In Flight</td><td colspan="2">FWD Long
Toggles VS BST</td><td colspan="2">AFT Long
Toggles HPRF Flood</td><td>-</td></tr>
<tr><td>LASER FIRE BUTTON</td><td>SRM / Combined Mode</td><td colspan="5">DOWN Short
Manual SBR Mode for AIM-9</td></tr>
</table>

9.3 AIR TO AIR RADAR SEARCH MODES

The main search modes are Range While Search (RWS) or Track While Scan (TWS).

RWS offers a general picture in the range of the radar without focusing on any single target. It offers a much broader view with any combination of azimuth and elevation (bars).

TWS allows to focus on one or more targets, while maintaining limited scan capability (offering certain pre-set azimuth and bar settings).

Different options are described in the table below:

A/A SEARCH MODE	RANGE SCALES AVAILABLE	ANTENNA SCAN (AZIMUTH)	ANTENNA SCAN (ELEVATION)	NOTES
RWS INLV RWS HPRF	10, 20, 40, 80, 160	120°, 60°, 30°	1,2,4,6,8	See below
VCTR (HPRF)	10, 20, 40, 80, 160	60°, 30°, 12°	1,2,4,6,8	
RWS MPRF	10, 20, 40, 80	120°, 60°, 30°	1,2,4,6,8	Track possible in all range scales
TWS H/MPRF	10, 20, 40, 80, 160	60° 30° 15°	2 4 6	Number of bars linked with AZ
HDTWS	10, 20, 40, 80, 160	30°	3 or 4	

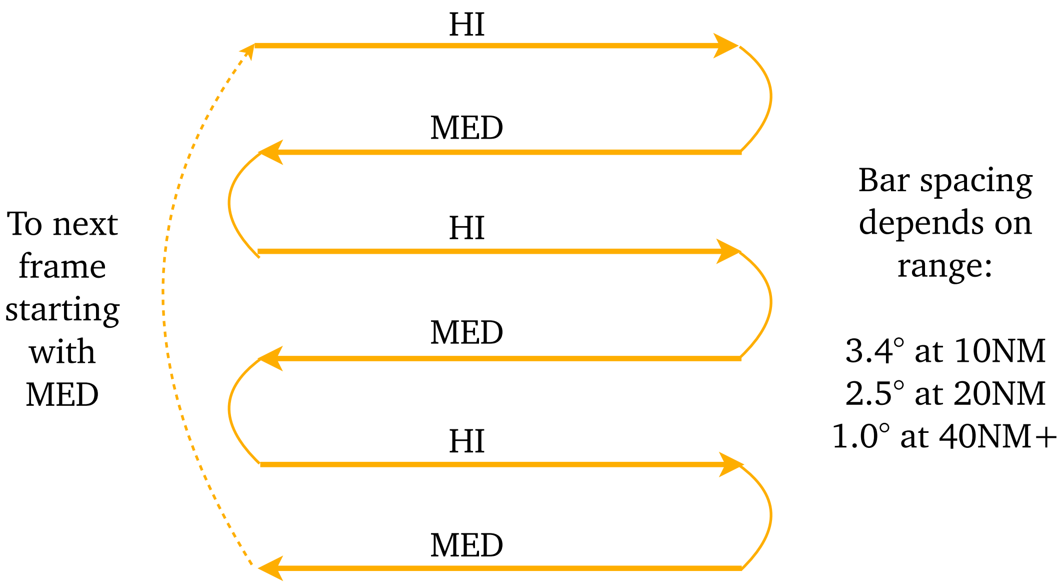
9.3.1 RANGE WHILE SEARCH INTERLEAVED MODE

This is the most common mode for long range radar search. Radar alternates between MPRF and HPRF with each bar scan in all scales apart from the 10NM, where only MPRF is used (as it is optimal for short range) and 160NM, which only uses HPRF.

Mixing two pulse repetition frequencies maximise the chance of detecting targets irrespective of their radar cross section, aspect and altitude.

Currently employed PRF is listed in the bottom - left corner of the radar display for each bar, where the number is the elevation bar currently scanned from top to bottom (i.e. 1 HI, 2 MED, 3 HI etc.).

The graphical example of the 6 bar INLV scan would look as follows:



Example of 6-bar INLV scan

9.3.2 Range While Search HPRF Mode

Using High Pulse Repetition Frequency allow longer range detection than INLV or MPRF, however when targets move to medium and short range it is much less effective. In practice it works in the same way as the INLV described above, with the sole difference of HI being used for every bar.

9.3.3 Vector Scan

Works similarly to RWS HI mode, but the antenna horizontal scan range is reduced from 70° per second to 35° per second. This significantly increases the radar sensitivity for detecting small RCS targets, such as cruise missiles.

9.3.3 Range While Search MPRF Mode

Using Medium Pulse Repetition Frequency is optimised for short - range, high - maneuvering targets and using primarily short range missiles and guns. It also works better against targets at low altitude.

9.3.4 Range-Gated High Mode

This mode provides a middle ground between MPRF and HPRF. It works quite well against targets in frontal aspect (closing), is less effective against targets in tail aspect (opening) and limited against targets in tail aspect which are at the same speed or closing.

9.3.5 Track While Scan Modes

These modes will be described fully in the TWS Section of this chapter.

9.4 Target Acquisition

There are two ways to lock a target on the radar, either manually or using one of five available auto acquisition modes: **Supersearch** (SS), **Boresight** (BST), **Long Range Boresight** (LR BST), **VTS** (Vertical Scan) and **Guns**.

9.4.1 Manual Acquisition

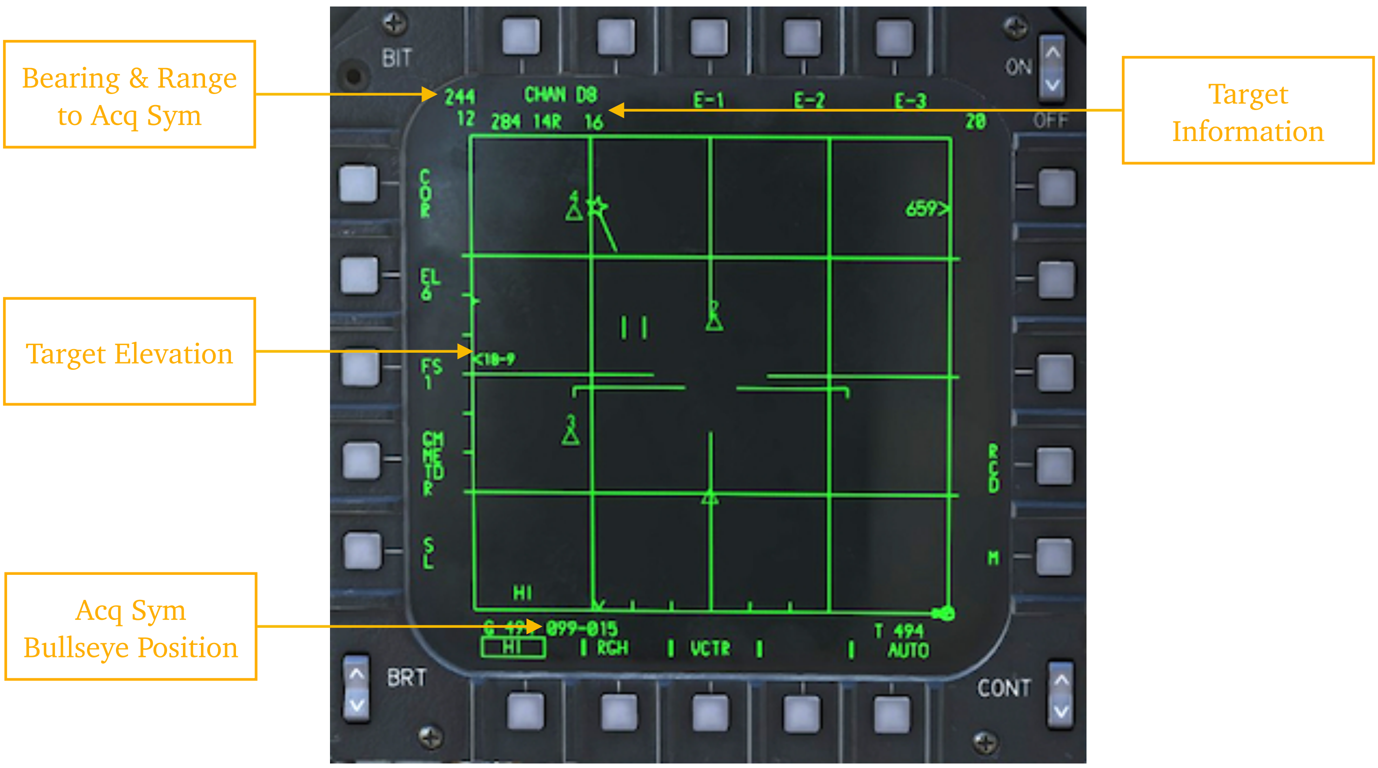
In this mode, the pilot or WSO use the TDC to superimpose the Acq Sym over the intended target. Then they command the radar to enter the acquisition scan centered on the Acq Sym position, also called a miniraster.

To command mini raster, pilot has to depress and hold the TDC. Releasing the TDC commands radar lockon.

For the WSO, the procedure is the same with the exception that miniraster is achieved by pressing the HC trigger to full action and then releasing it.

In practice, the radar tries to correlate any returns with the position of the Acq Sym, and when it succeeds, it enters a two-bar, 3° scan at the target. If there are two target hits within 1.5 second, the lockon is accomplished.

The target then turns into a star symbol with long heading vector, and new information in relation to the target is displayed.



Bearing and Range to Acquisition Symbol: as described before, this window shows the bearing an range from aircraft's nose to the Acquisition Symbol position. When acquiring a lockon, the Acq Sym is superimposed over the locked target and thus the information in the window shows the BRA (without the altitude) to the PDT. However, it is possible to move the Acq Sym away using the TDC.

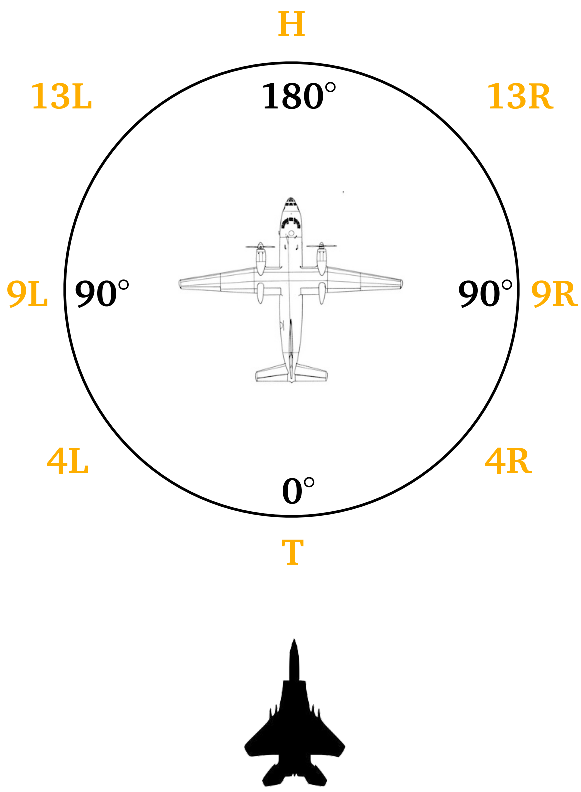
In order to quickly attach the Acq Sym back to the PDT, the pilot can short press the Coolie switch UP.

Target Elevation: displays the altitude of the PDT in thousands of feet - hundreds of feet MSL (in the example above: 18 900 feet MSL).

Acquisition Symbol Bullseye Position: shows the bearing and range from bullseye to the current position of the Acq Sym. As with bearing and range, during lockon the Acq Sym is superimposed over the locked target and thus provides its bullseye position. However, it can be moved using the TDC in order to check other targets in TWS mode.

Target Information: this line provides target's ground speed (284), its aspect angle (14R) and magnetic bearing to target from aircraft's nose (16).

Target Aspect Angle is the horizontal angular difference between the target longitudinal axis and the F-15 to target LOS, as shown in the picture below. The L or R next to the number tells if the F-15 is looking at the left or right side of the target.



Dropping lock: to unlock the target, the pilot should depress the **Automatic Acquisition Switch** to command Return to Search (RTS).

9.4.2 AUTO ACQUISITION

There are five available auto acquisition modes: **Supersearch** (SS), **Boresight** (BST), **Long Range Boresight** (LR BST), **VTS** (Vertical Scan) and **Guns**.

These modes are only available from the front cockpit, as most of them are using HUD indications for target acquisition. As most of them are designed for short range, they work in Medium PRF, with the exception of LR BST, which utilises High PRF.

Auto Acquisition modes can only be entered from search mode or other auto acquisition modes and are inhibited when in STT or TWS.

Supersearch Mode (SS) scans a 20° by 20° area in 6-bar scan pattern in front of the aircraft up to 10 NM.

Boresight Mode (BST) the acquisition scan is in the 4° circle visible on the HUD with the maximum range of 10 NM.

Long Range Boresight Mode (LR BST) works similarly to BST, but at a distance of up to 40 NM.

Vertical Scan Mode (VTS) sets the the antenna to scan vertically from +5° to +55° above the waterline with the maximum range of 10 NM.

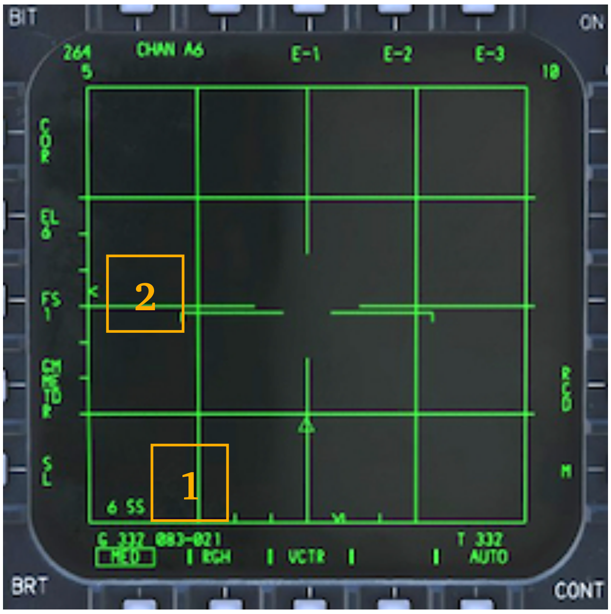
Guns Mode (GUNS) provides a positionable scan pattern with the auto acquisition capability between 0.5 and 15 NM

More information about the auto acquisition modes can be found in Notso's video on Razbam Simulations channel.

9.4.2.1 SUPERSEARCH MODE (SS)

In this mode the radar automatically scans a 20° by 20° area in 6-bar scan pattern until a lockon is achieved or pilot selects return to search by depressing **Castle Switch**. Search range is between 500 feet and 10 NM.

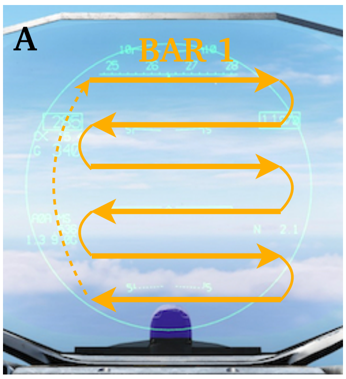
To enter the Supersearch Mode, pilot should short (<1s) press the **Auto Acquisition Switch** forward once when in search mode.

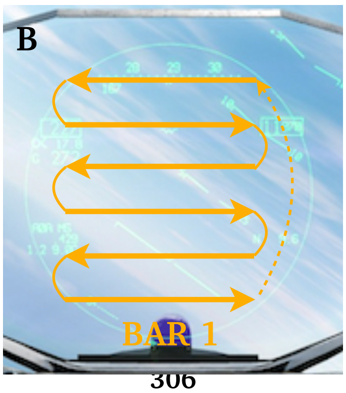


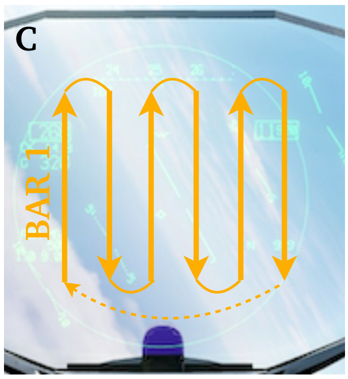
On the radar display, SS legend in the bottom - left part (**1**) indicates that the radar is in supersearch. The number before it shows current bar (between 1 and 6), mirrored by the movement of the caret on the elevation scale (**2**).

On the HUD, a large scan circle is shown, indicating area painted by the radar. As soon as the target is locked, radar enters STT.

In level flight, the scan pattern is parallel to the wings, with first bar at the top of the HUD FOV and going down (**A**). When it turn with bank angle less than 45°, scan pattern is is still parallel to the wings, but the scan begins from the bottom of the HUD FOV and going up (**B**). When in turn with bank angle of 45° or more, scan pattern changes and goes from one side of the HUD to the other (**C**).





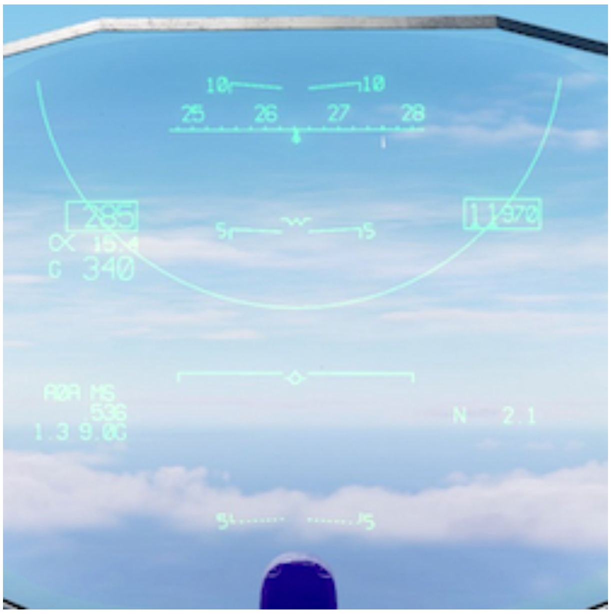


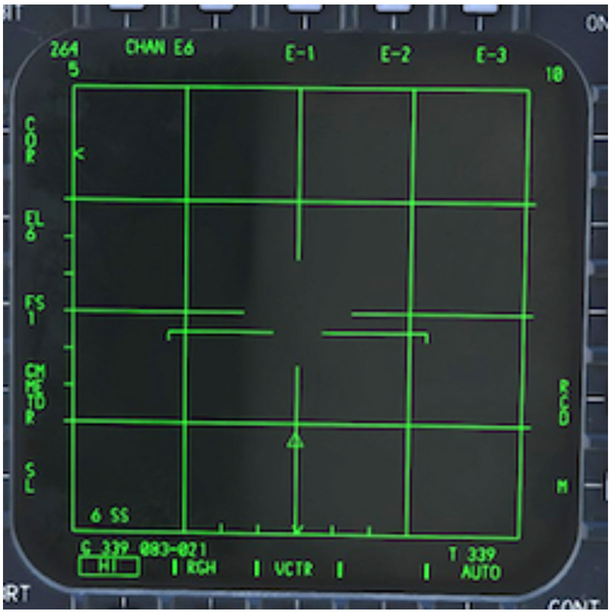
Positionable supersearch

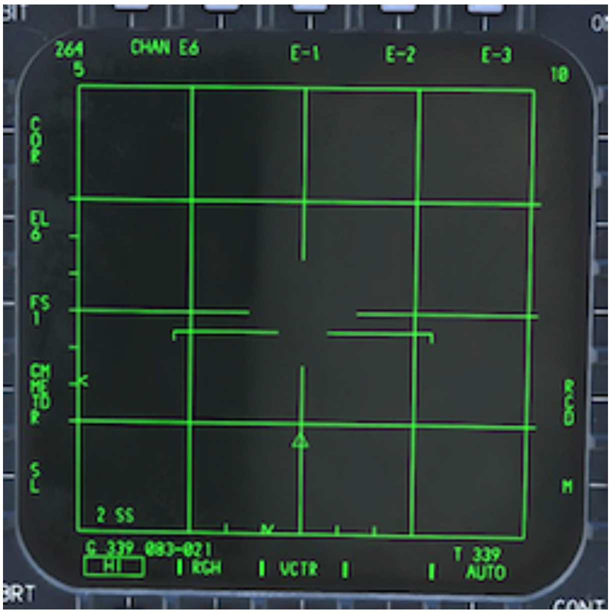
The pilot can move the antenna up or down in vertical plane using the TDC.

- Full **up** motion of the TDC places the center of the scan at +28°.
- Full **down** motion of the TDC brings it to -19°.

This is indicated by the HUD circle and elevation caret on the radar display.



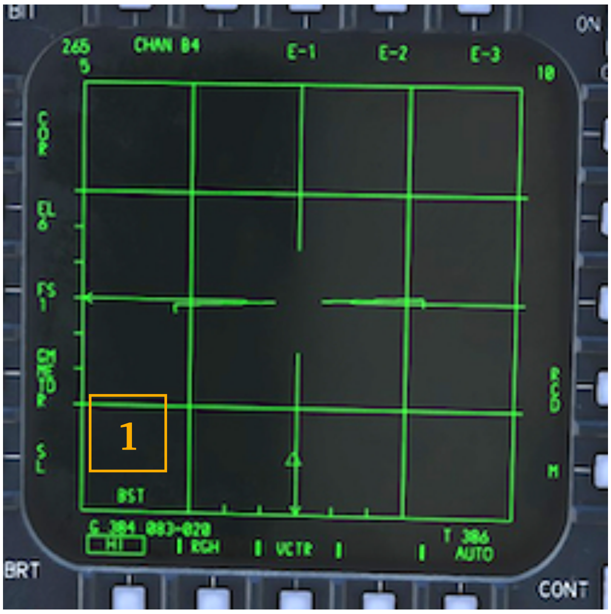




9.4.2.2 BORESIGHT (BST)

In Boresight mode radar antenna is slaved to the Radar Boresight Line (RBL), with the acquisition scan in the 4° circle visible on the HUD. Radar remains in this mode until a lockon is achieved or pilot selects return to search by depressing **Castle Switch**. Search range is between 500 feet and 10 NM.

To enter the Boresight mode, pilot should short (<1s) press the **Auto Acquisition Switch** forward once when in SS mode (or twice from search).



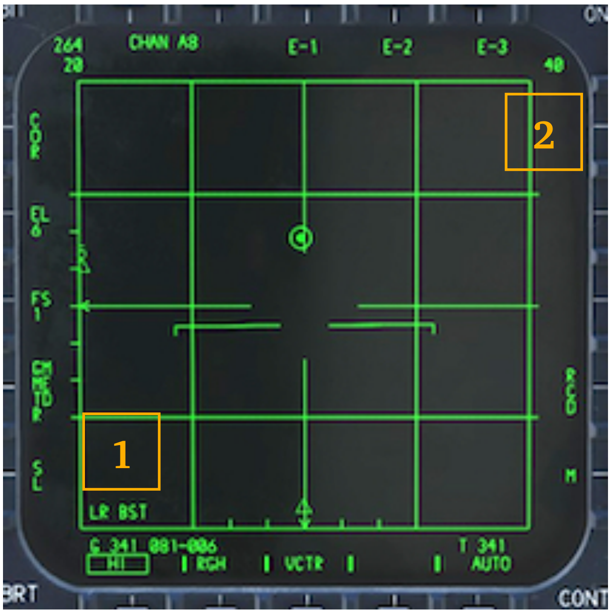
On the radar display, BST legend in the bottom - left part (**1**) indicates that the radar is in Boresight mode. On the HUD, target should be placed in the scan circle to achieve an automatic lockon (**2**), upon which the radar enters normal STT.

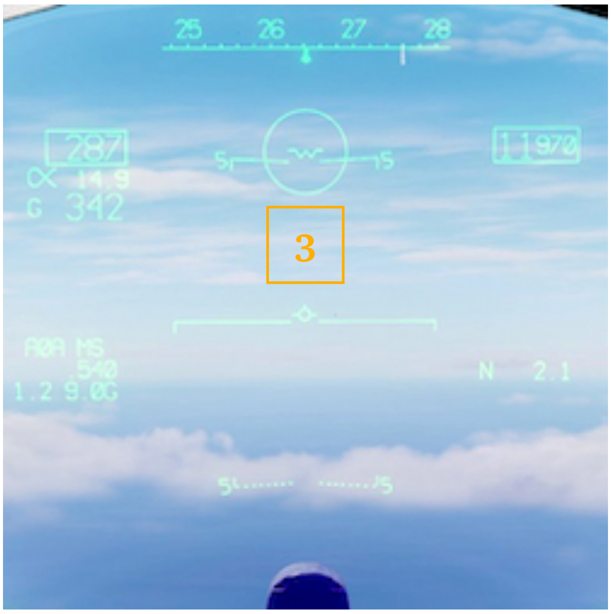
The BST is the most reliable and rapid acquisition mode in the visual, short range and high maneuvering target situation. Using this mode the pilot can remain heads up during the course of engagement.

9.4.2.3 LONG RANGE BORESIGHT (LR BST)

In Long Range Boresight, the radar antenna is also slaved to Radar Boresight Line (RBL), however in this mode the search is extended to 40 NM (with minimum distance of 3000 feet). A 2.5° circle is displayed on the HUD.

To enter LR BST mode, pilot should long press (>1s) the **Auto Acquisition Switch** forward. LR BST is available from Search, BST, VTS, SS or Guns.





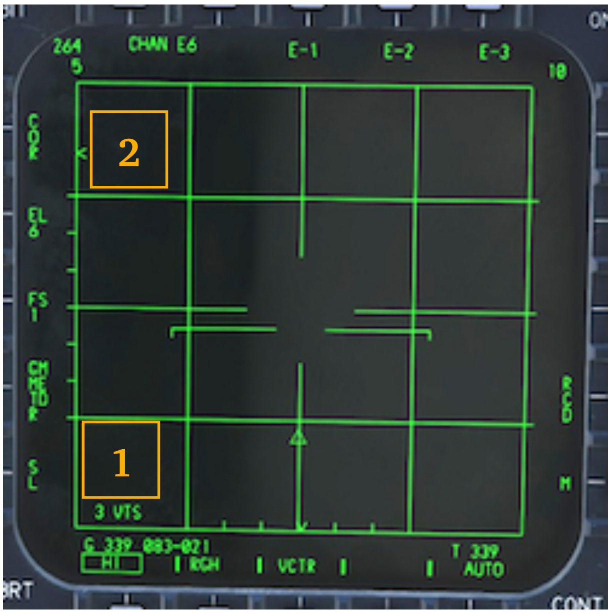
On the radar display, LR BST is displayed in the bottom - left part (**1**). The range of the scan is set to 40 NM (**2**). On the HUD, target should be placed in the scan circle to achieve an automatic lockon (**3**), upon which the radar enters normal STT.

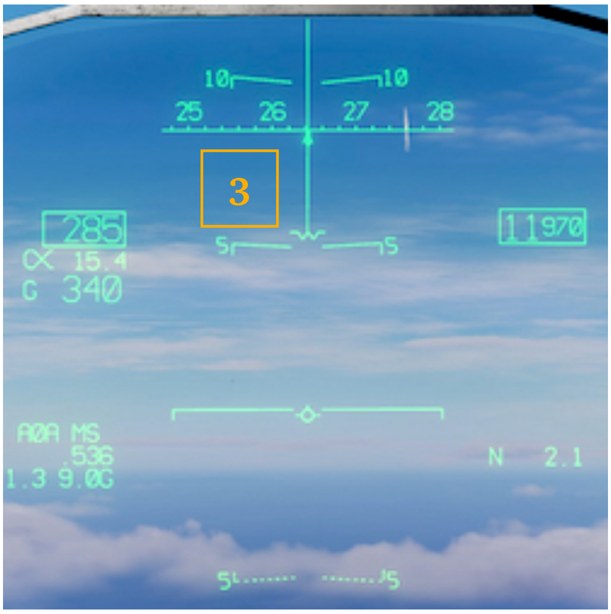
In practice this mode is most useful against distant targets leaving contrails or visible against weather / clouds background. Another advantage, as with normal BST is that pilot can remain heads up during the hole acquisition process.

9.4.2.4 VERTICAL SCAN (VTS)

In this short range mode, the antenna scans vertically from +5° to +55° above the Fuselage Reference Line (FSR). The horizontal scan is 7.5°. Search range is between 500 feet and 10 NM. The scan is aircraft stabilized.

To enter VTS, pilot should short press (<1s) the **Auto Acquisition Switch** aft. VTS is available from Search, BST, VTS, SS or Guns.





Just like in SS, VTS legend in the bottom - left part of radar display (**1**) indicates that the radar is in vertical scan. The number before it shows current bar (between 1 and 6), mirrored by the movement of the caret on the elevation scale (**2**). On the HUD, a vertical line extends from the Waterline Symbol to signify that the radar is in VTS.

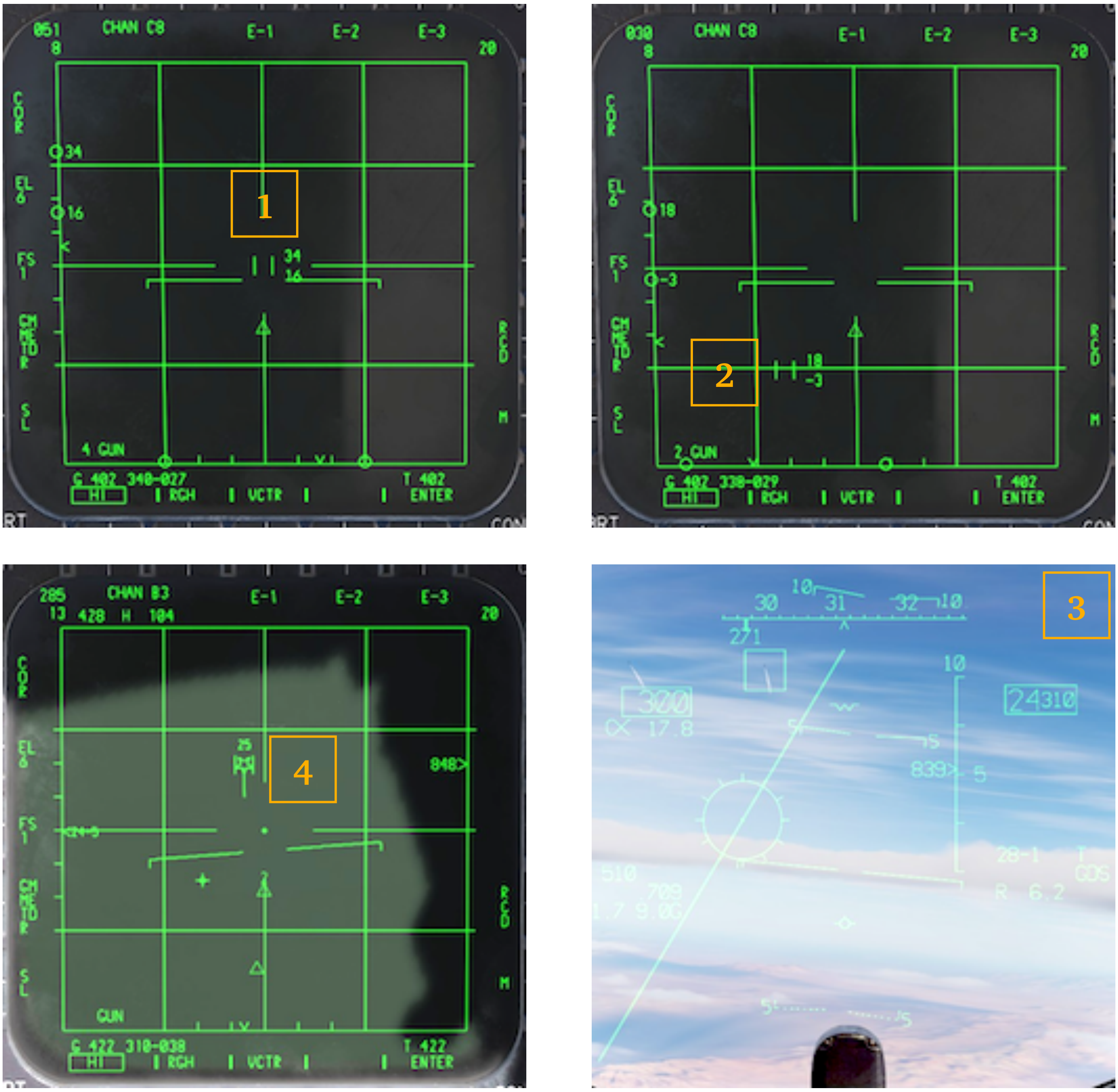
This mode is best used against visual, look - up aspect targets. The lock / shoot lights are particularly useful here to indicate radar lockon or the missile launch - ready condition.

9.4.2.5 Guns Mode

The GUNS mode provides a positionable scan pattern with the auto acquisition capability between 0.5 and 15 NM. The scan pattern is 60° in azimuth, 20° (six-bar, 3.4° bar spacing) in elevation, and is space stabilized.

To enter GUNS (**1**), pilot should place the Weapons Select Switch in **GUNS** position.

The center of the pattern, indicated by the acquisition symbol, can be positioned in AZ and EL using the TDC **(2)**. Radar vertical and horizontal coverage has changed.



After lockon, the HUD GUNS steering display is provided (**3**) and the A/A RDR display shows target track data (**4**).

NOTE: with GUNS selected it is not possible to exit the radar screen or use PB 11.

9.5 TRACK WHILE SCAN MODES

Track while scan mode provides multi - target detection and track capability within a selected area. It allows to track single target, while giving the aircrew good situational awareness. In TWS, radar maintains track files on up to 10 targets (and all of them can be designated) on top of additional 20 observation files (displayed as half intensity symbols). There are several different TWS sub-modes that should be used depending on tactical situation:

Wide Pattern Mode (2TWSH), a 2-bar and 60° in azimuth, best used when facing multiple targets at similar altitude but separated horizontally.

Medium Pattern Mode (4TWSH), a 4-bar and 30° in azimuth, best used for general surveillance of targets separated both in azimuth and elevation.

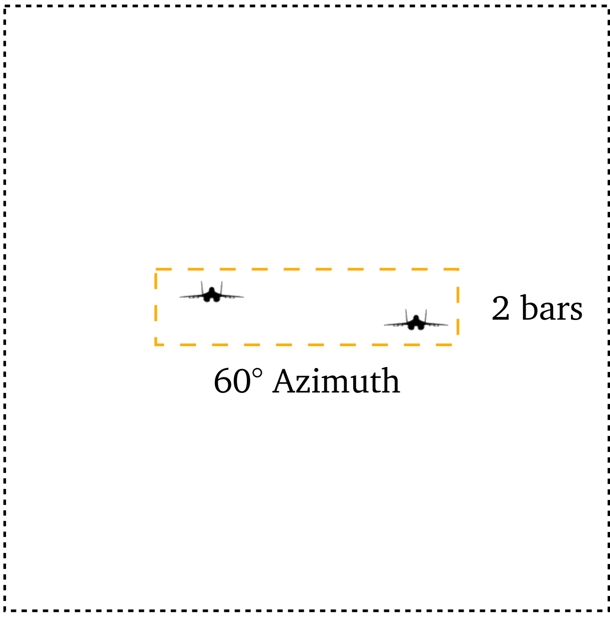
Narrow Pattern Mode, a 6-bar and 15° in azimuth, best used when facing targets which are stacked vertically.

High Data Pattern Mode (3HDT), a 3-bar and 30° in azimuth, best used when facing targets maneuvering vertically.

High Data Pattern Mode (2HDT), a 2-bar and 30° in azimuth, best used when facing maneuvering co-altitude targets.

Wide Pattern (2TWSH)

Normal TWS can be entered from STT mode by short-pressing the Auto Acquisition Switch AFT (in both seats). It brings up the following display:



The wide pattern TWS mode should be used when faced with targets flying at roughly the same altitude and with wide separation in azimuth. In this mode the elevation bar spacing is 1.5° with a frame time of approximately 2 seconds.

It is also possible to enter 2TWSH in non-designated version (NDTWS) directly from search mode. It is done by designating desired space with TDC (commanding miniraster) and then short (<1s) pressing **Auto Aquisition Switch** aft.

Performing an AZ Bump switches into the Medium Pattern TWS scan.

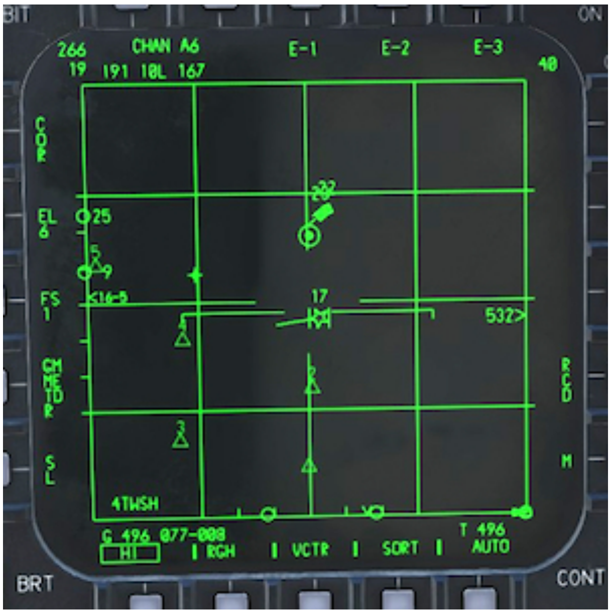
Once in 2TWSH, pressing the Auto Acquisition Switch forward short (<1s) switches to High Data Rate Scan (3HDT).

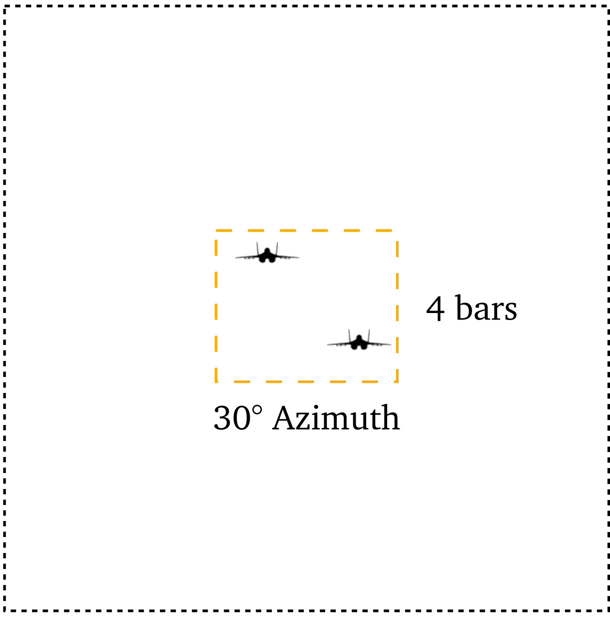
Once in 2TWSH, long pressing (>1s) the **Auto Acquisition Switch** forward brings up the 2 bar High Data Rate Pattern (2HDT).

Once in 2TWSH, pressing the **Auto Acquisition Switch** aft short (<1s) returns to Single Target Track.

Pressing down **Auto Acquisition Switch** (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

Medium Pattern (4TWSH)





The medium pattern TWS mode should be used for general surveillance of targets separated in azimuth and elevation. In this mode the elevation bar spacing is 1.5° with a frame time of approximately 2 seconds.

It is entered by performing AZ bump when in Wide Pattern.

Performing the AZ bump switches back to Medoum Pattern.

Moving the Acq Sym over the 4TWSH legend in the bottom - left of the screen and momentarily pressing the TDC enters the Narrow Pattern.

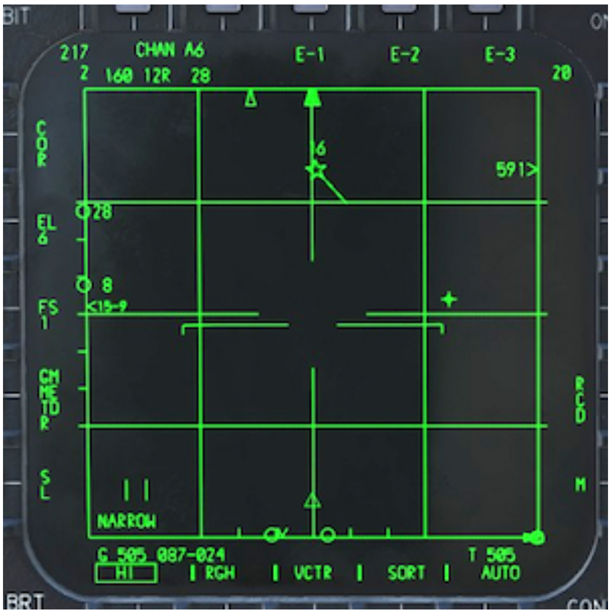
Once in 4TWSH, pressing the Auto Acquisition Switch forward short (<1s) switches to High Data Rate Scan (3HDT).

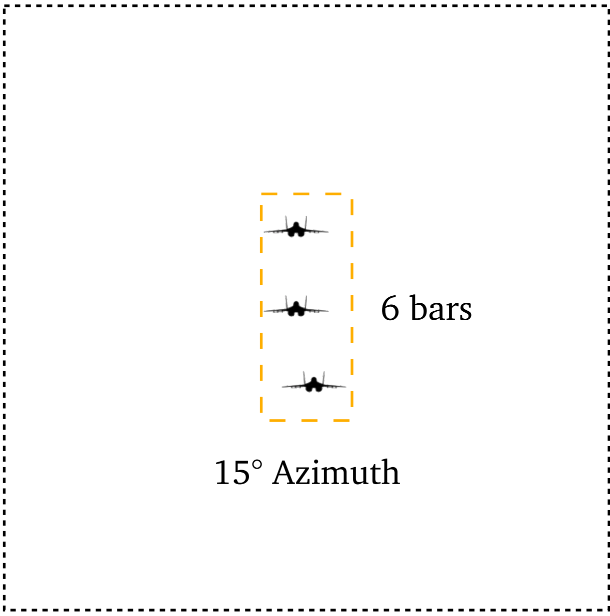
Once in 4TWSH, long pressing (>1s) the **Auto Acquisition Switch** forward brings up the 2 bar High Data Rate Pattern (2HDT).

Pressing the Auto Acquisition Switch aft short (<1s) returns to Single Target Track.

Pressing down **Auto Acquisition Switch** (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

Narrow Pattern (NARROW)





The narrow pattern TWS mode should be used when facing vertically stacked targets.

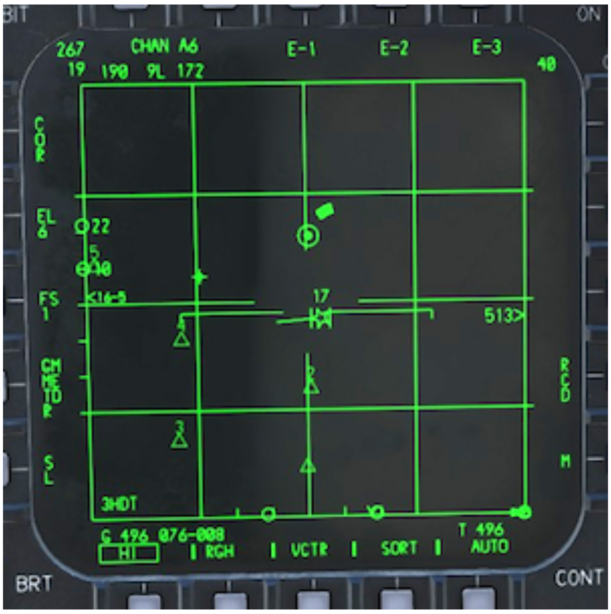
It is entered by Moving the Acq Sym over the 2 TWSH or 4TWSH legend in the bottom - left of the screen and momentarily pressing the TDC.

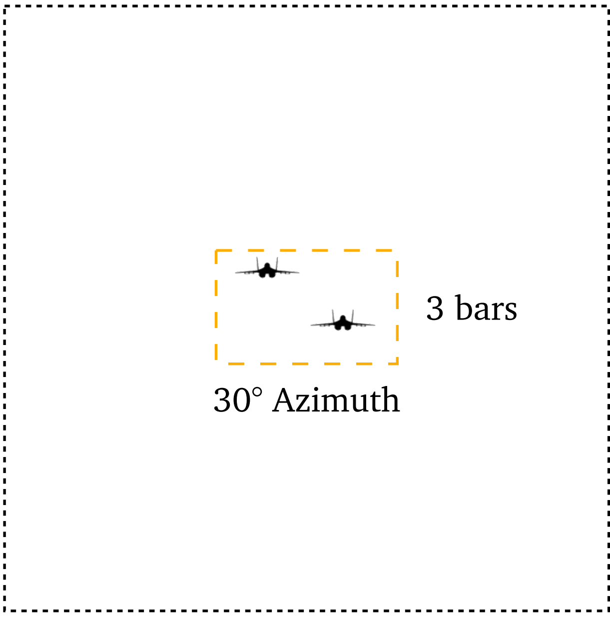
Once in Narrow Pattern, performing AZ bump switches to Medium Pattern.

Pressing the **Auto Acquisition Switch** aft short (<1s) returns to Single Target Track.

Pressing down **Auto Acquisition Switch** (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

High Data Rate Pattern - 3 bar (3HDT)





The three bar high data rate pattern should be used to track targets maneuvering in elevation. In this mode the elevation bar spacing is 1° with a frame time of approximately 1.5 seconds.

It is entered by short (<1s) pressing the **Auto Acquisition Switch** forward when in STT or TWS.

It is also possible to enter 3HDT in non-designated version (ND/HDTWS) directly from search mode. It is done by designating desired space with TDC (commanding miniraster) and then short (<1s) pressing Auto Acquisition Switch forward.

Once in 3HDT, long pressing (>1s) the **Auto Acquisition Switch** forward brings up the 2 bar High Data Rate Pattern (2HDT).

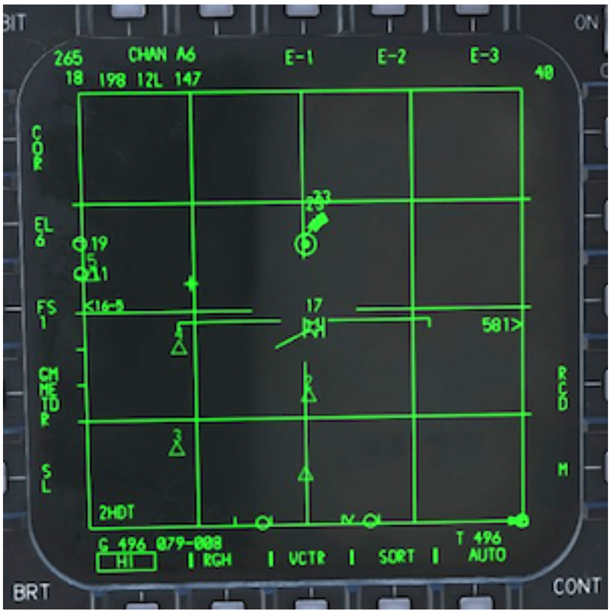
Once in 3HDT, short pressing (<1s) the **Auto Acquisition Switch** alternates between Wide Pattern 4TWSH and 3HDT.

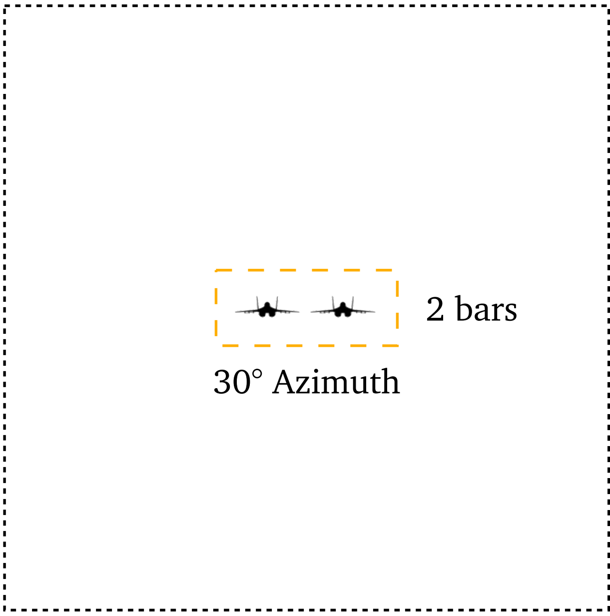
Once in 3HDT, Performing AZ Bump switches to Medium Pattern 2TWSH.

Pressing the **Auto Acquisition Switch** aft short (<1s) returns to Single Target Track.

Pressing down **Auto Acquisition Switch** (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

High Data Rate Pattern - 2 bar (2HDT)





The two bar high data rate pattern should be used to track co-altitude maneuvering targets. In this mode the elevation bar spacing is 1° with a frame time of approximately 1.5 seconds.

It is entered by long pressing (>1s) the **Auto Acquisition Switch** forward when in STT, in 2TWSH, 4TWSH or 3HDT.

It is also possible to enter 2HDT in non-designated version (ND/HDTWS) directly from search mode. It is done by designating desired space with TDC (commanding miniraster) and then long (>1s) pressing Auto Acquisition Switch forward.

Once in 2HDT, short pressing (<1s) the **Auto Acquisition Switch** changes to 3HDT. Subsequent presses switch between 3HDT and 4TWSH.

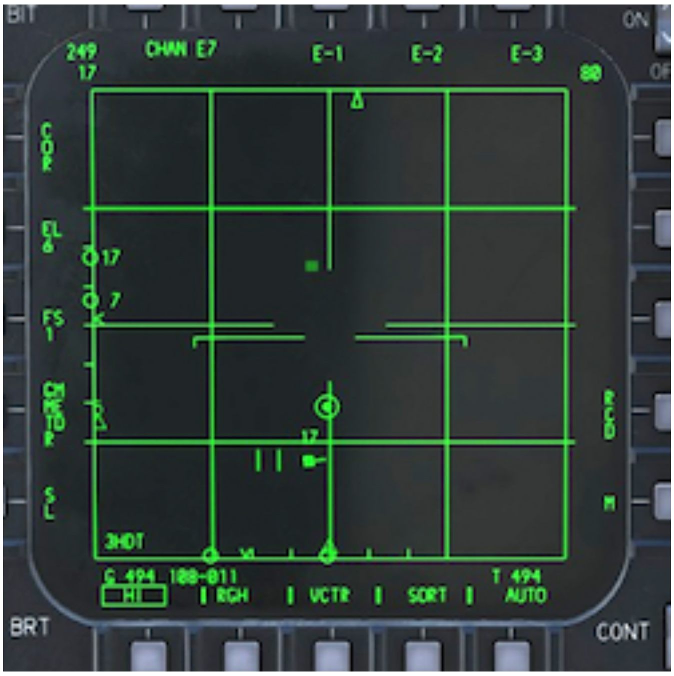
Once in 2HDT, Performing AZ Bump switches to Medium Pattern 2TWSH.

Pressing the **Auto Acquisition Switch** aft short (<1s) returns to Single Target Track.

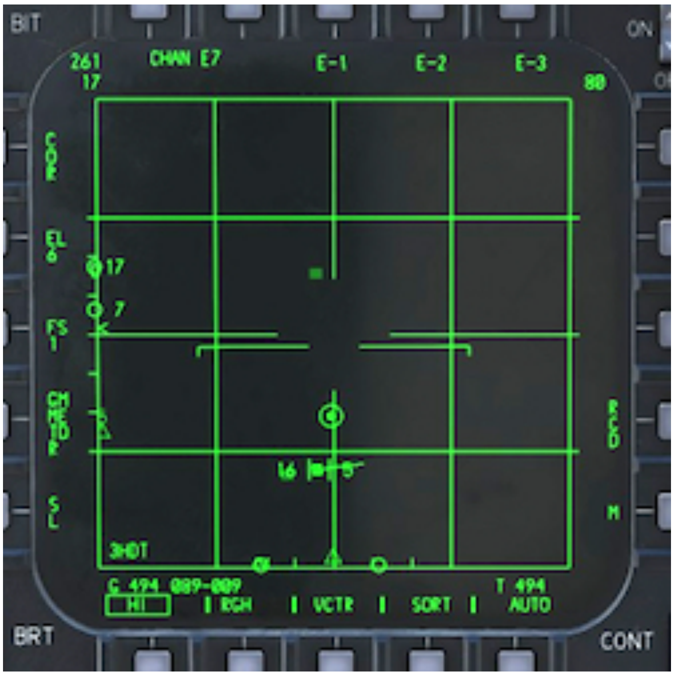
Pressing down **Auto Acquisition Switch** (REJECT position) in any mode except GUNS commands the radar to Return to Search (RTS).

9.5.1 TARGET SAMPLING

Target sampling allows the aircrew to obtain additional information about detected targets without locking them up. To sample a contact, the aircrew needs to hover the Acq Sym over the short vector target symbol. Once this is done, its symbol is changed to long vector and its altitude is shown to the left (in X,000 of feet, so 10 indicates 10,000). The number to the right is target's speed in Mach.



A short vector target symbol flying around 18 NM in front of the aircraft.

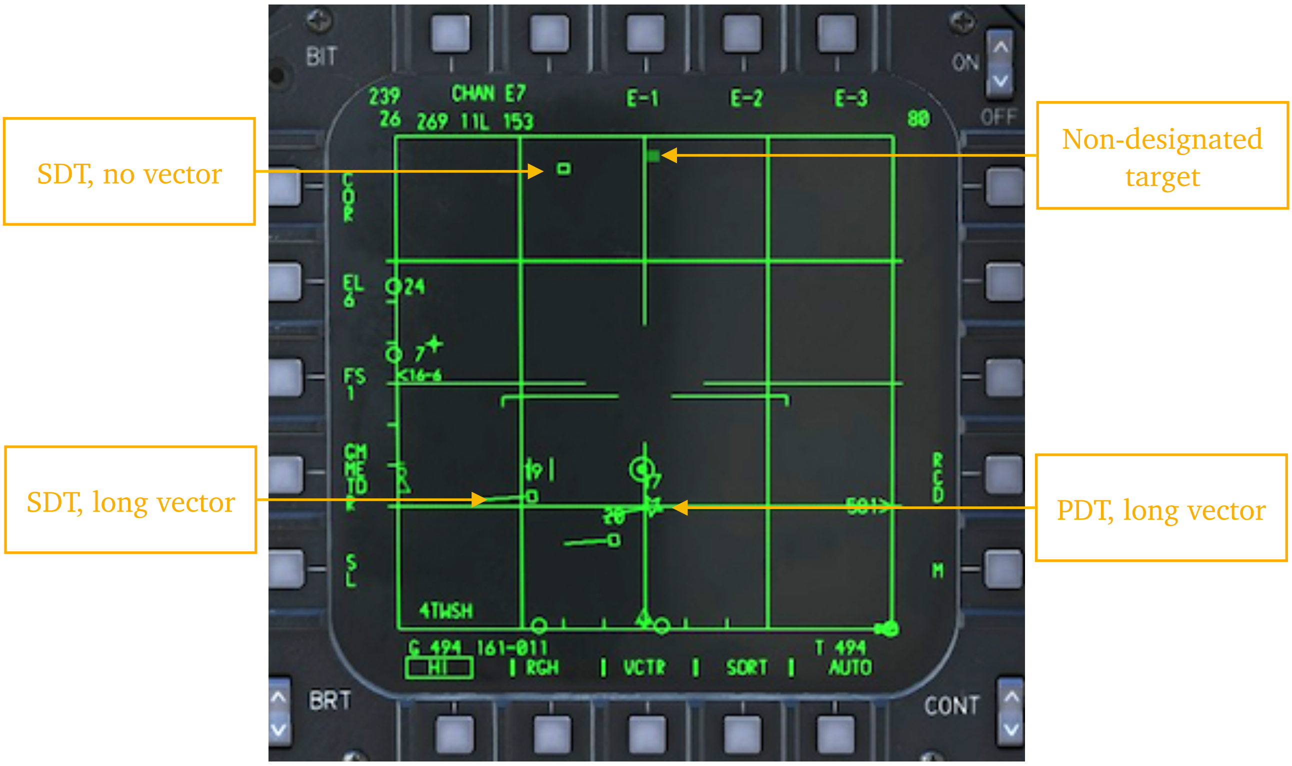


After superimposing the Acq Sym using the TDC target's altitude is displayed to the left and Mach is shown on the right.

9.5.2 MULTITARGET DESIGNATION

Up to nine additional targets can be designated in addition to the PDT. These are called SDTs (Secondary Designated Targets). To designate a SDT, TDC should be used to put the Acq Sym over the target and then pressed short (in rear cockpit, HC trigger should be pressed to second detent).

The screenshot below shows different types of designated and undesignated targets.



Long vector is shown when relative heading information is available (more than four radar hits). If there are less than four hits, no vector is shown.

To undesignate the SDT or PDT, pilot should press the **Boat Switch** aft short (<1s). WSO should short press (<1s) the **Castle Switch** left.

Quick Step

Allows the aircrew to quickly change the PDT to the next SDT in range. The order of switching is from left to right in azimuth.

In front cockpit, quick step is achieved by pulling the **Coolie Switch** up short (<1s).

In rear cockpit, quick step is achieved by pressing the **Castle Switch** down.

Quick Pick

Any designated target can be selected as the PDT via a Quick Pick. Short pressing TDC (pilot) or trigger to full actuation (WSO) when sampling a SDT turns it into PDT.

TWS Auto Designation

When in TWS, aircrew has option to enable auto designation of the SDTs. If AUTO legend next to PB10 is boxed, up to nine targets with vector status are automatically designated. Manual designation is still available. Likewise, manually undesignated targets will not be eligible for automatic designation again.

TWS Sort Mode

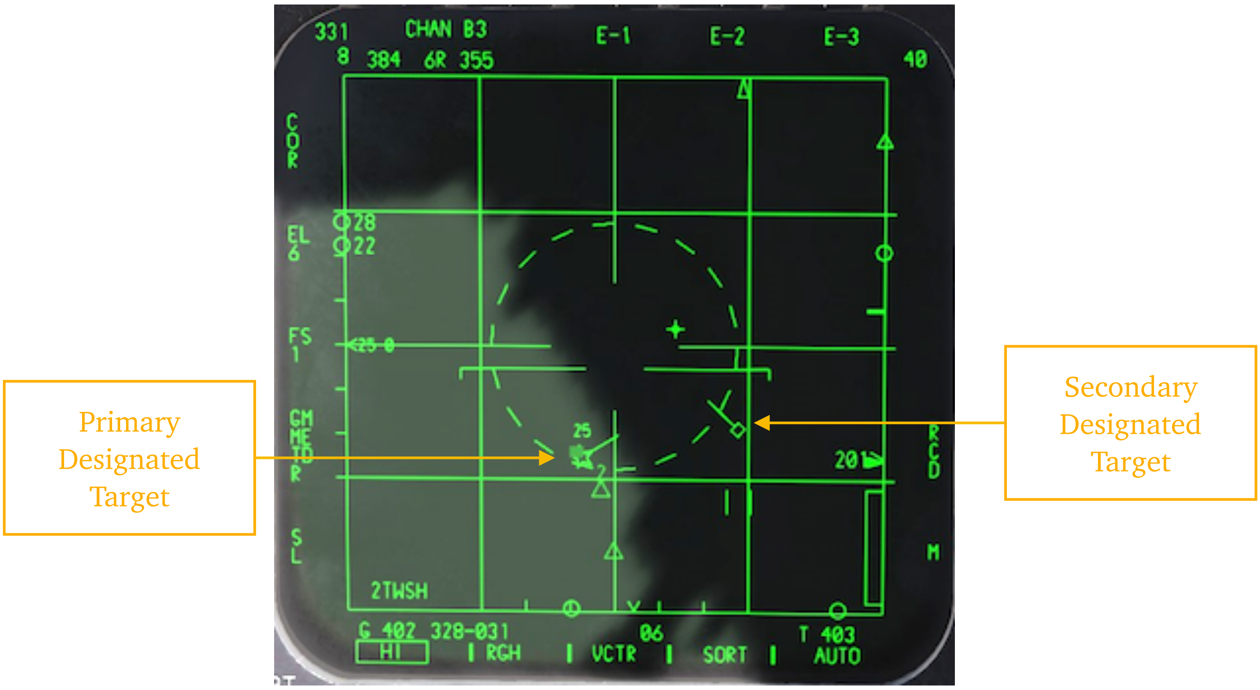
Note: TWS Sort Mode is not functional in the Early Access stage.

Dual Target Track (DTT)

The DTT TWS submode provides a two-target track capability of widely spaced targets; a PDT (Priority Designated Track) and an SDT (Secondary Designated Track).

Dual Target Track can be entered from DTWS, DTWS sort or HDTWS modes by re-designating a secondary designated target for longer then 1s (using >1s **TDC press** in front cockpit or **HC Trigger** in the rear cockpit.

NOTE: It is advised to disable the AUTO option (PB 10) before attempting the DTT to avoid automatic designation of additional targets.



Pressing Mode Reject exits the DTT and returns to search. Undesignating the PDT or SDT returns to DTWS. Pressing **Auto Acquisition Switch** forward (<1s) when in DTT switches the mode to HDTWS. Pressing it aft (<1s) changes to STT.

9.6 RADAR SPECIAL MODES

These include additional radar modes, including:

Hot / Cold Search Symbology. Hot and cold target symbology is provided in RWS, RGH, VCTR, and TWS.

Electronic Protection Modes, which provide the capability of detecting the presence and location of Electronic Attack (EA) devices, most notably jammers.

Sort Mode *(not available in EA)*.

Highlight Search Mode *(not available in EA)*.

9.6.1 HOT / COLD SEARCH SYMBOLOGY

Hot and cold target symbology is provided in RWS, RGH, VCTR, and TWS. (Hot/cold symbology is not provided in TWS sort.)

Basic hot (nose) target symbology is a filled in triangle pointed toward the bottom of the display;

Basic cold (tail) target symbology is a filled in triangle pointed toward the top of the display.

Targets for which a nose or tail determination can not be made or that do not meet GS requirements are displayed with a filled in rectangle.

In HPRF (High Pulse Repetition Frequency) search, the search hit is displayed as a hot target if it is beyond 10 NM and its ground speed along the LOS is greater than +300 knots. If the hit is inside 10 NM or it has a GS along the LOS less than 300 knots, it is displayed as a filled in rectangle.

In RGH (Range Gate High), MPRF (Medium Pulse Repetition Frequency) or Range while Search with MRM selected, the target is displayed as a hot or cold target, as appropriate, if the target GS along the LOS is greater than 200 knots.

In TWS (Track while Scan) the radar displays hot/cold triangles for developing track files (prior to vector status); hot/cold triangles are not displayed in TWS sort.

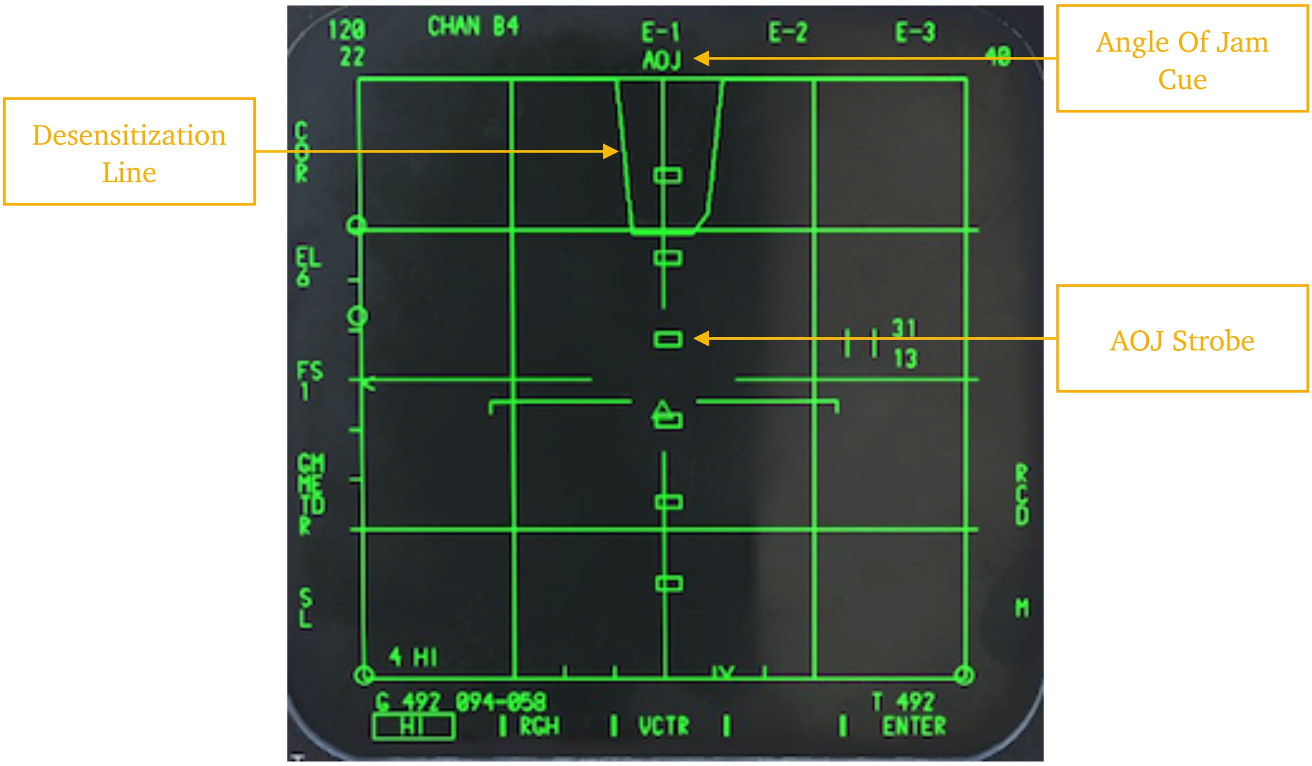
9.6.2 RADAR ELECTRONIC PROTECTION MODES

The radar Electronic Protection features provide the capability of detecting the presence and location of Electronic Attack (EA) devices, most notably jammers. Special circuits automatically configure the radar for optimum search, acquisition, and track performance against jamming devices such as repeater or noise jammers.

There are three different cues that can be displayed.

9.6.2.1 AOJ - ANGLE OF JAM.

The AOJ cue identifies the EA threat as a noise jammer and is displayed only during search operations. The relative bearing of the jammer is indicated by the AOJ strobe, which consists of a row of six open symbols. The symbols are evenly spaced in range at the azimuth position of the jammer.

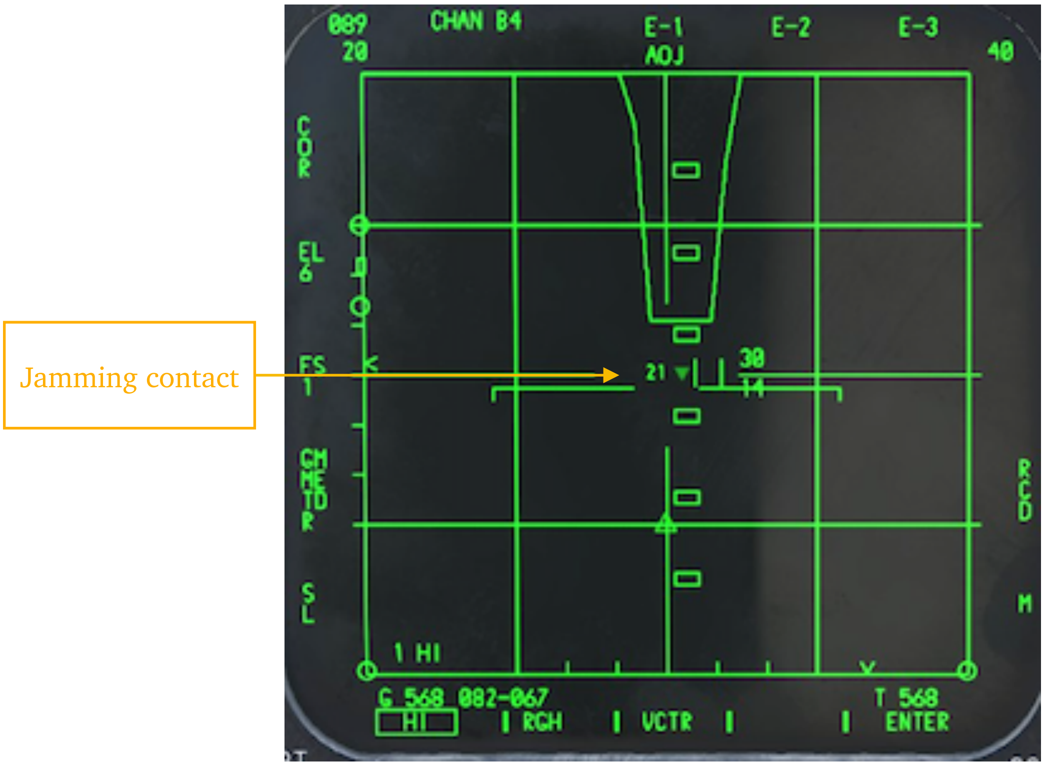


The AOJ legend is displayed at the top of the display.

The desensitization line is the estimated range at which aircraft's radar is blind for a target with 5 square meters radar cross section (which is equal to the RCS of as Su-30).

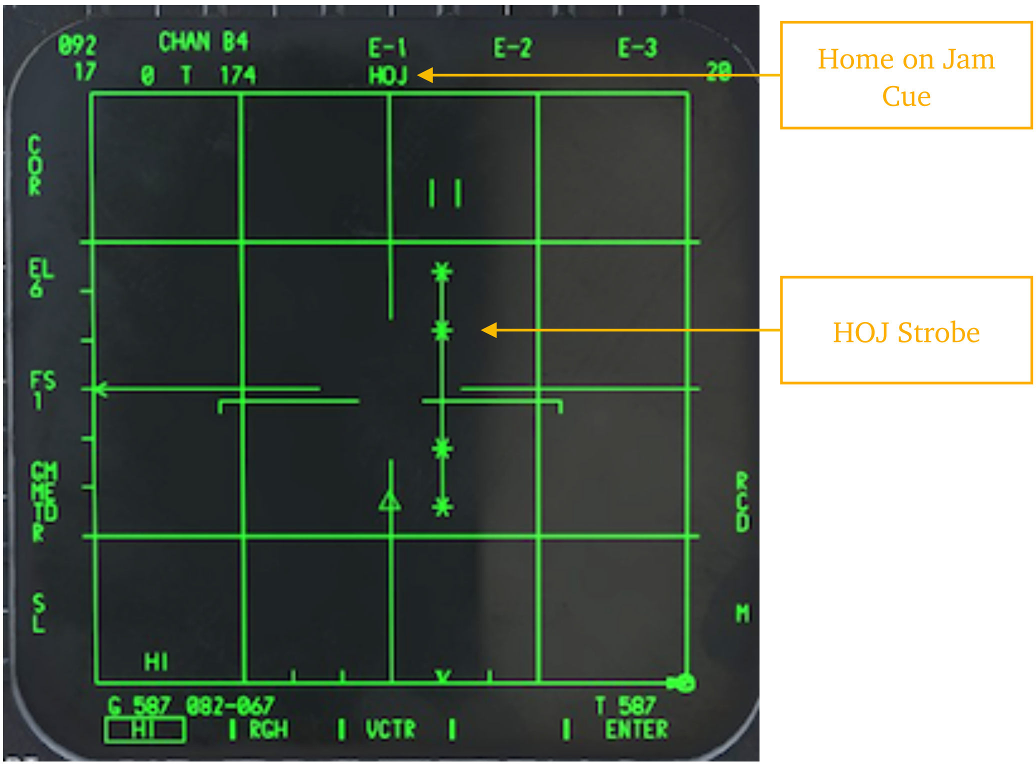
Until the burn-through is achieved, only relative bearing of the jamming aircraft is available, with no range nor altitude displayed.

As the range decreases, the contact will be displayed below the AOJ Strobe.

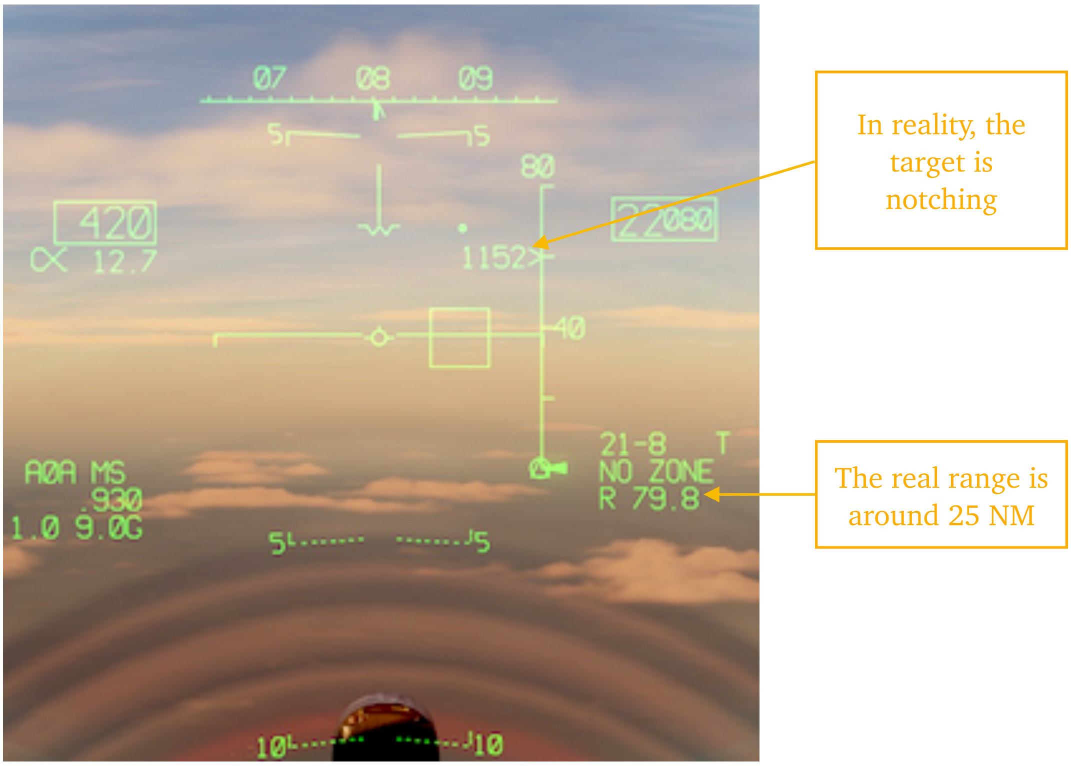


9.6.2.2 HOJ - HOME ON JAM

The Home on Jam is a track mode in which the radar locks on the source of the jamming. The HOJ cue is displayed at the top of the display.

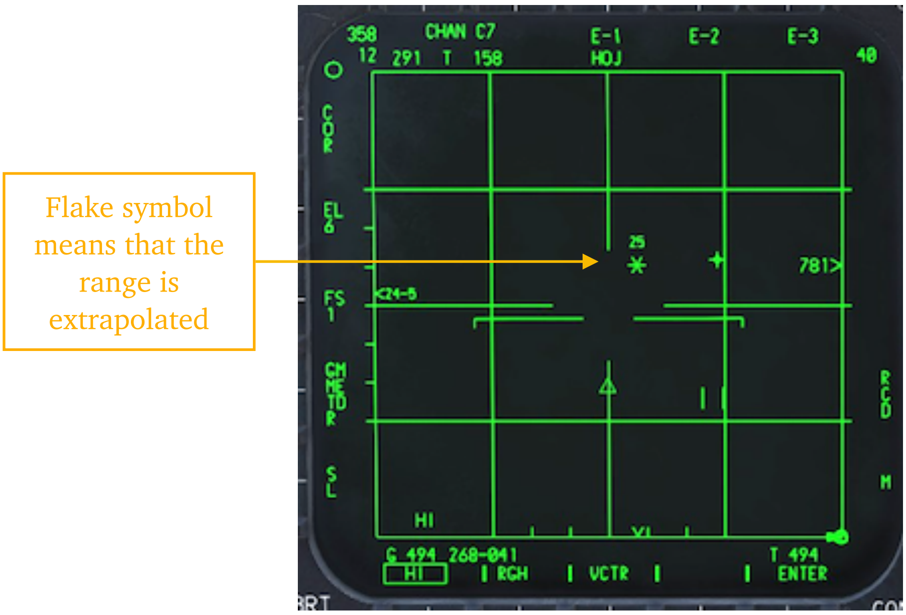


After lock-on, contact's position is displayed on the HUD, but the range, closure and altitude data will be constantly changing until the burn-through occurs.



9.6.2.3 JAM

The last track mode is JAM, which indicates that some jamming is detected by the antenna and that the data provided to the system may be corrupted. If the locked target is shown as a single flake symbol, then the range to the target is unknown and extrapolated by the radar.



9.7 AIR TO AIR INTERROGATOR (AAI)

The AAI set, in conjunction with the radar set, provides A/A target identification capabilities. The interrogator set transmits challenge signals and receives target AAI replies through the L-band antennas mounted on the main radar antenna.

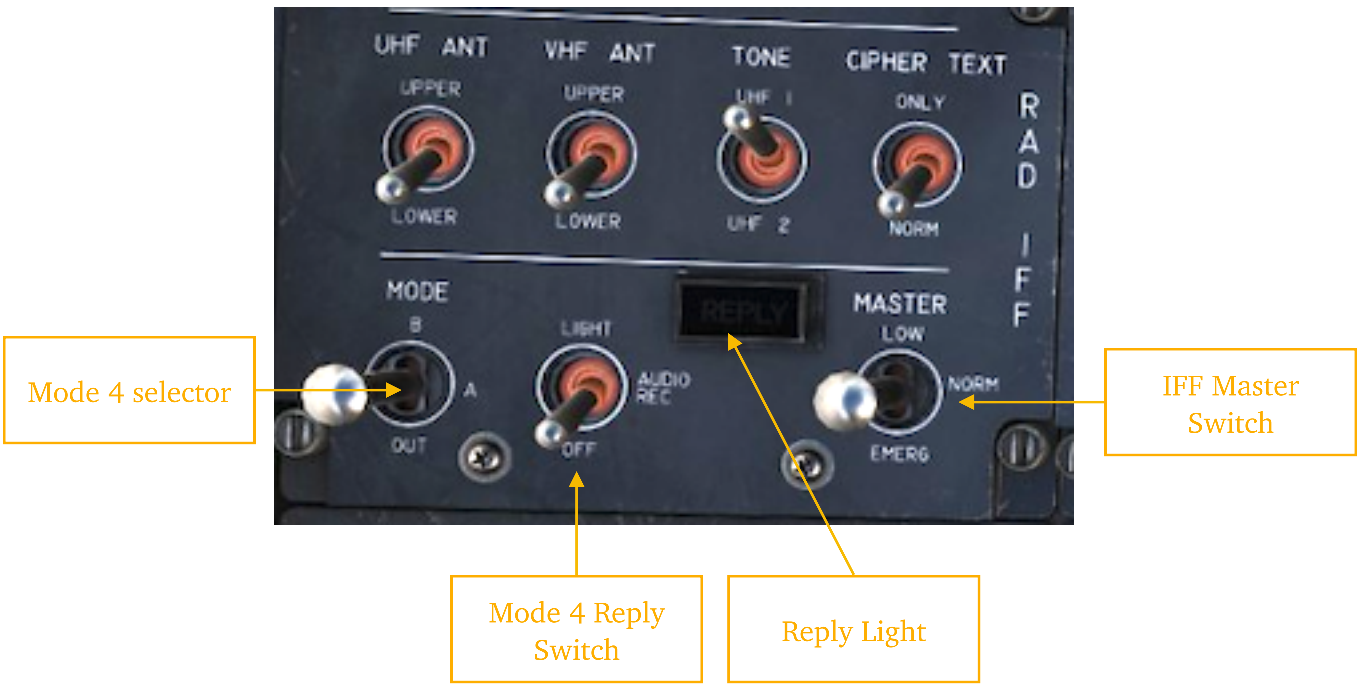
AAI interrogation can be selected from either the AAI or Enhanced Identification (EID)UFC submenu. Within each submenu there are multiple modes of AAI interrogations. The AAI interrogations can be slaved to the aircraft IFF settings.

9.7.1 AAI CONTROLS

The AAI is controlled using the following controls:

1. IFF Controls on Remote Intercommunications Control Panel.
2. UFC AAI submenu (entered from MENU 1 by pressing PB X)
3. **Coolie Switch** on the throttle in the Front Cockpit or **AAI Switch** on RHC in the Rear Cockpit.

IFF Controls



Mode 4 selector switch for the IFF has three positions:

- A enables mode 4/A reply
- B enables mode 4/B reply
- OUT disables all mode 4 replies.

Mode 4 reply switch. In LIGHT when the mode 4 system replies to valid interrogation, causes the **REPLY light** to illuminate. AUDIO REC allows audio tone and REPLY light to illuminate. OFF turns the system off.

IFF Master Switch. In LOW system operates in reduced sensitivity. In NORM full system sensitivity is enabled. EMERG enables response to interrogations in modes 1, 2, 3A, C and 4.

NOTE: In DCS, only Mode 4A and B are fully simulated.

UFC AAI Submenu

To enter the AAI submenu, the aircrew should press PB 8 from the MENU 1 level.

NOTE: AAI Submenu is not functional in Early Access.

Interrogation

To start interrogating contacts, **Coolie Switch** should be pressed outboard (right) for more than 1 second in the front cockpit. In the rear cockpit, **AAI switch** should be pressed forward (>1 second).

NOTE: currently, the interrogation is largely automated and it is impossible to set the proper settings. After EA, different options (like length of interrogation, number of bars etc) will be enabled.

The interrogation can be stopped by pressing the respective control once again or by pressing **Auto Acq / Mode Reject Switch**.

9.7.2 AAI DISPLAYS

AAI information is displayed on the HUD, A/A RDR display, and A/G RDR display.

9.7.2.1 HUD AAI CUES

NOTE: HUD AAI Cues are not enabled in this stage of Early Access.

9.7.2.2 A/A RADAR AAI CUES

Radar is the main sensor capable of displaying the outcome of interrogation of contacts within its FOV. For Mode 4 (A and B) there are two possible symbols that can be shown:

A diamond (either open or filled in) indicates a **low confidence (LC)** AAI return.

A circle (either open or filled in) indicates a **high confidence (HC)** AAI return.

A **High Confidence** return means that the interrogated contact is - with high degree of probability - a friendly aircraft.

A **Low Confidence** return means that the interrogated contact is not squawking correct code to be classified by friendly, but that does not make it automatically a hostile. Such classification would require additional data or positive visual identification.

In STT, the AAI symbol mipples with the PDT Star for the length of interrogation plus 2 seconds for TWS and 5 seconds for STT. Also, the HC status of the PDT is displayed in the top - left corner of the radar display (nothing is shown there for the LC return).

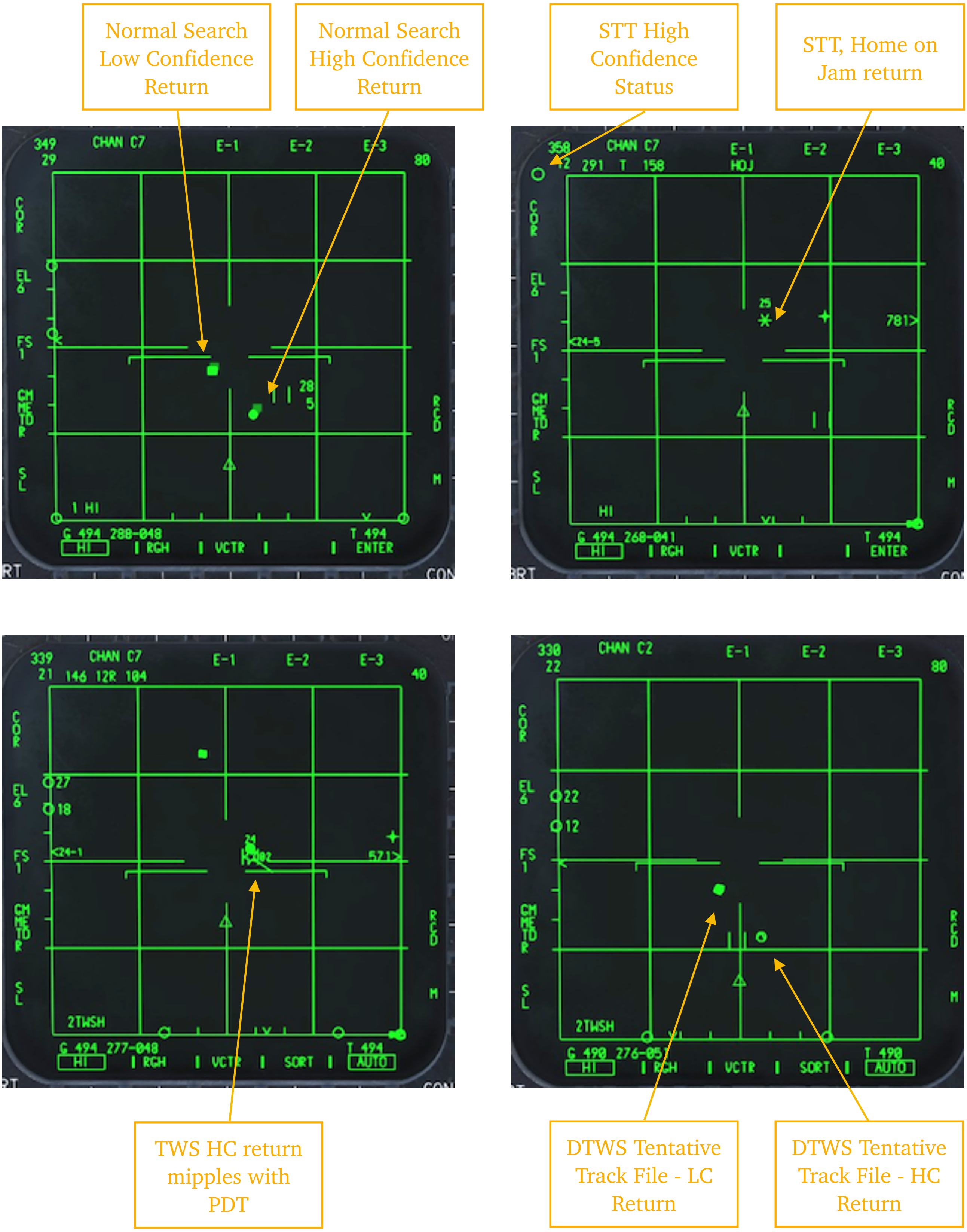
NORMAL SEARCH SYMBOLOGY					
	Regular search		Hot / Cold Search		Upgraded hot / cold target
SEARCH - AAI SYMBOLOGY CORRELATED WITH RADAR TARGET					
	Regular search (LC top, HC bottom)		Hot / Cold Search (LC top, HC bottom)		Upgraded hot / cold target (LC up, HC bottom)
SEARCH - AAI SYMBOLOGY - NO CORRELATION WITH RADAR TARGET					
	Regular search (LC top, HC bottom)		Hot / Cold Search (LC top, HC bottom)		Upgraded hot / cold target (LC top, HC bottom)

NDTWS - NORMAL SYMBOLOGY					
	Observations (top), tentative track files		Vectored track files		Radar Priority Target
NDTWS - AAI SYMBOLOGY CORRELATED WITH RADAR TARGET					
	Observations, tentative track files		Vectored track files (LC top, HC bottom)		Mipple Radar PT with AAI symbols
NDTWS - AAI SYMBOLOGY NOT CORRELATED WITH RADAR TARGET					
	Observations, tentative track files		Vectored track files (LC top, HC bottom)		Radar Priority Target

DTWS - NORMAL SYMBOLOGY					
	Tentative track file		Vectored track file		Priority Designated Target
DTWS - AAI SYMBOLOGY CORRELATED WITH RADAR TARGET					
	Tentative track files		Vectored track files		Mipple PDT with AAI symbology
DTWS - AAI SYMBOLOGY NOT CORRELATED WITH RADAR TARGET					
	Tentative track files		Vectored track files		

SINGLE TARGET TRACK - NORMAL SYMBOLOGY					
	Initial Track		Established Track		HOJ Extrapolate
STT - AAI SYMBOLOGY CORRELATED WITH RADAR TARGET					
	Mipple Initial Track with AAI Symbology		Mipple Established Trck with AAI Symbology		Mipple HOJ with AAI symbology

Below some examples of radar screen before and during AAI interrogation.



CHAPTER 10: AIR TO AIR COMBAT

10.1 MASTER MODES

The selection of Master Modes (MM) establishes the operational status of the PACS and HUD avionics equipment. While there are separate modes for Navigation, Air to Ground, Air to Air and Instruments, they will all be described here as there are certain limitations to weapons use when in different MM.

Master Mode buttons are located on the HUD control panel and are only installed in the front cockpit. Master Modes are mutually exclusive, and the applicable button illuminates to indicate which master mode is currently selected.

Air to Air (A/A) Master Mode

The system will default to A/A on startup. Alternatively, it can also be entered by selecting GUN on the **Weapon Select Switch** on the throttle. The HUD attack display is selected using the the same switch with three available options: GUN, SRM (short range missile) and MRM (medium range missile) and these weapons can immediately be placed in fire - ready status (provided that the Master Arm Switch is set to armed (up) position).

Air to Ground (A/G) Master Mode

Pressing the A/G MM button enables the PACS (Programmable Armament Control Set) air to ground weapon circuitry and changes the HUD to display information specific for air to ground deliveries. See Air to Ground Combat chapter for more information.

Navigation (NAV) Master Mode

Selecting the NAV MM changes the HUD display to show navigation - related information. GUN, MRM and SRM circuits are still operational and the radar can be used in any mode. However, A/G weapons cannot be used. See Navigation chapter for more information.

Instrument (INST) Master Mode

Choosing this MM selects a canned display program on the MPDs/MPCDs in both cockpits. The gun and A/A missiles can be fired, but use of A/G weapons is inhibited.

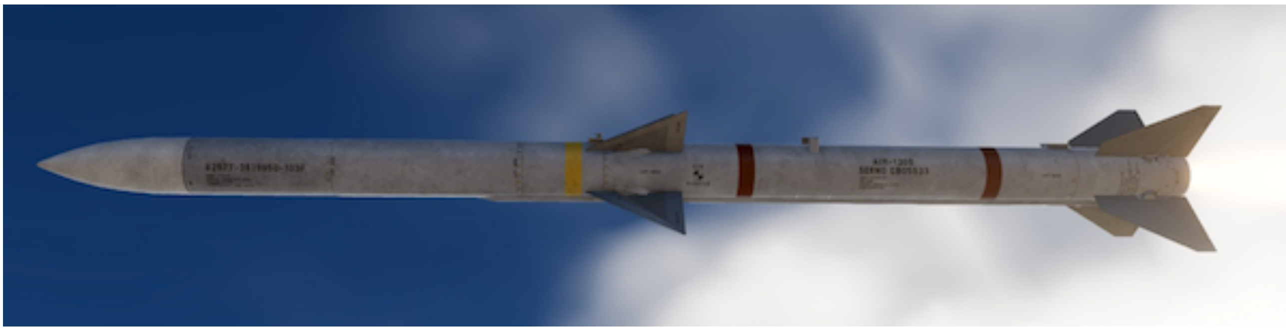
10.2 AIR TO AIR WEAPONS

The simulated version of F-15E is capable of employing most short and medium range missiles used by the US Air Force for the time of its service described below, as well as its gun in air to air mode.

10.2.1 MEDIUM RANGE MISSILES

AIM-120B AMRAAM

AMRAAM stands for Advanced Medium-Range Air-to-Air Missile and is a beyond-visual-range missile capable of all weather day-and-night operation.



Guidance	Active Radar	Warhead (size)	49 lb (22 kg)
Mass	348 lb (158 kg)	Length	12 ft (3.65 m)
G-limit	22	Range	27 NM (50 km)

AIM-120C AMRAAM

This version received a redesigned warhead, improvements to the rocket motor, guidance algorithms as well as fuzing and ECCM logic.

Guidance	Active Radar	Warhead (size)	44 lb (20 kg)
Mass	348 lb (158 kg)	Length	12 ft (3.65 m)
G-limit	22	Range	27 NM (50 km)

AIM-7M Sparrow

The Sparrow was the first medium range missile introduced by the Western allies in 1952. It uses a mono-pulse seeker, giving it significant advantage over the F version.

Guidance	Semi-Active Radar	Warhead (size)	86 lb (39 kg)
Mass	510 lb (231 kg)	Length	12 ft (3.66 m)
G-limit	20	Range	24 NM (45 km)

AIM-7MH Sparrow

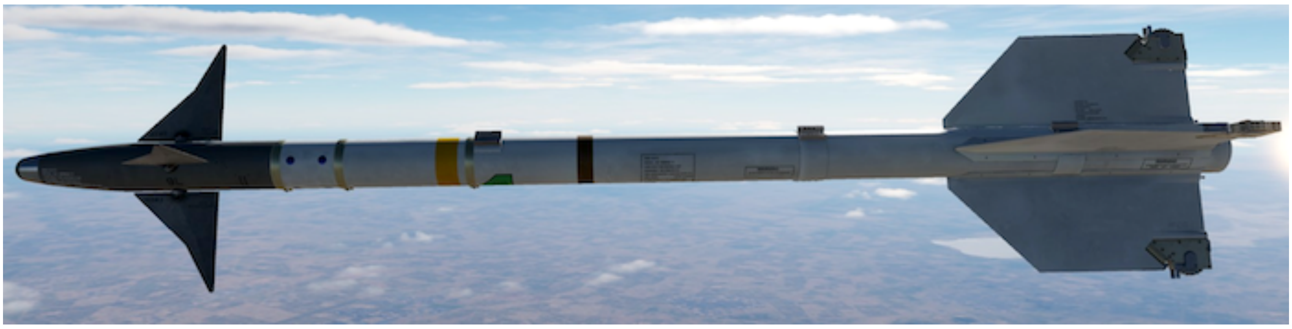
This version of the Sparrow received minor seeker enhancements, better chaff resistance and ability to loft, increasing its kinematic performance at range.

Guidance	Semi-Active Radar	Warhead (size)	86 lb (39 kg)
Mass	510 lb (231 kg)	Length	12 ft (3.66 m)
G-limit	20	Range	24 NM (45 km)

10.2.2 SHORT RANGE MISSILES

AIM-9L Sidewinder

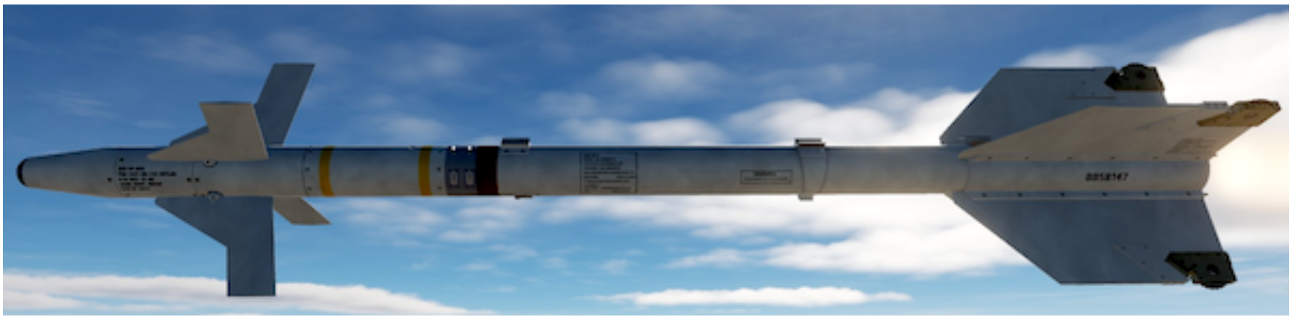
Short range, infrared homing missile initially introduced in 1956. The L variant is a first all-aspect version that can be launched at up to 9G.



Guidance	Infrared	Warhead (size)	21 lb (9.4 kg)
Mass	190 lb (86 kg)	Length	9.5 ft (2.89 m)
G-limit	22	Range	9.8 NM (18 km)

AIM-9P Sidewinder

Short range, infrared homing missile initially introduced in 1956. The P variant is a heavily improved USAF model.



Guidance	Infrared	Warhead (size)	21 lb (9.4 kg)
Mass	190 lb (86 kg)	Length	9.5 ft (2.89 m)
G-limit	22	Range	9.8 NM (18 km)

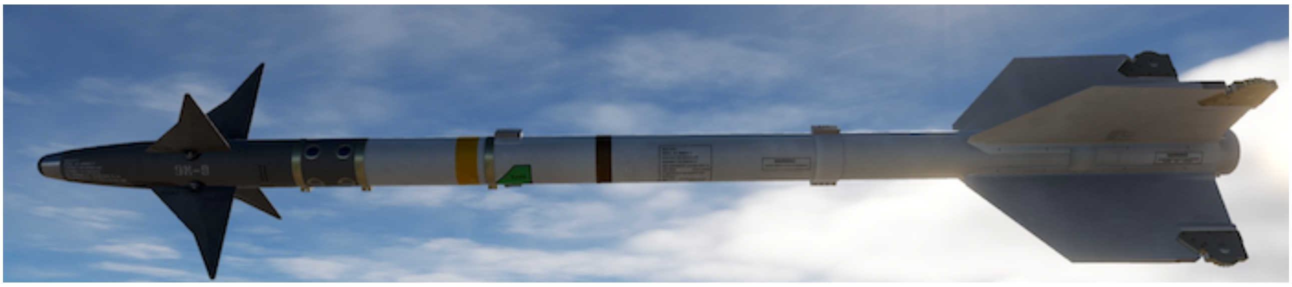
AIM-9P5 Sidewinder

This version has a smaller P5 motor and slightly upgraded seeker.

Guidance	Infrared	Warhead (size)	21 lb (9.4 kg)
Mass	190 lb (86 kg)	Length	9.5 ft (2.89 m)
G-limit	22	Range	9.8 NM (18 km)

AIM-9M Sidewinder

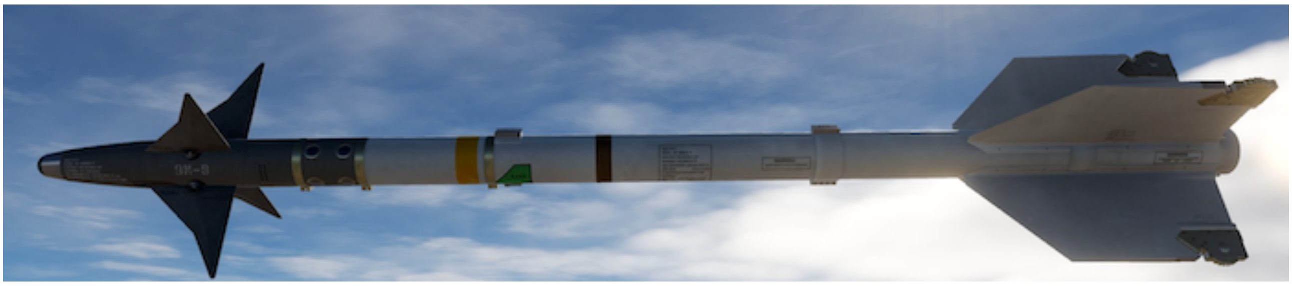
A slightly improved version of the L variant of the missile, introduced in 1980s.



Guidance	Infrared	Warhead (size)	21 lb (9.4 kg)
Mass	190 lb (86 kg)	Length	9.5 ft (2.89 m)
G-limit	22	Range	9.8 NM (18 km)

AIM-9J Sidewinder

An improved version of the earlier E variant, with with hybrid electronics using a mix of solid state and tube technology, and an improved control system using a longer burning gas generator for a 40 sec flight time



Guidance	Infrared	Warhead (size)	21 lb (9.4 kg)
Mass	190 lb (86 kg)	Length	9.5 ft (2.89 m)
G-limit	20	Range	9.8 NM (18 km)

Captive AIM-9M Sidewinder

A inert version of the missile used for training purposes.

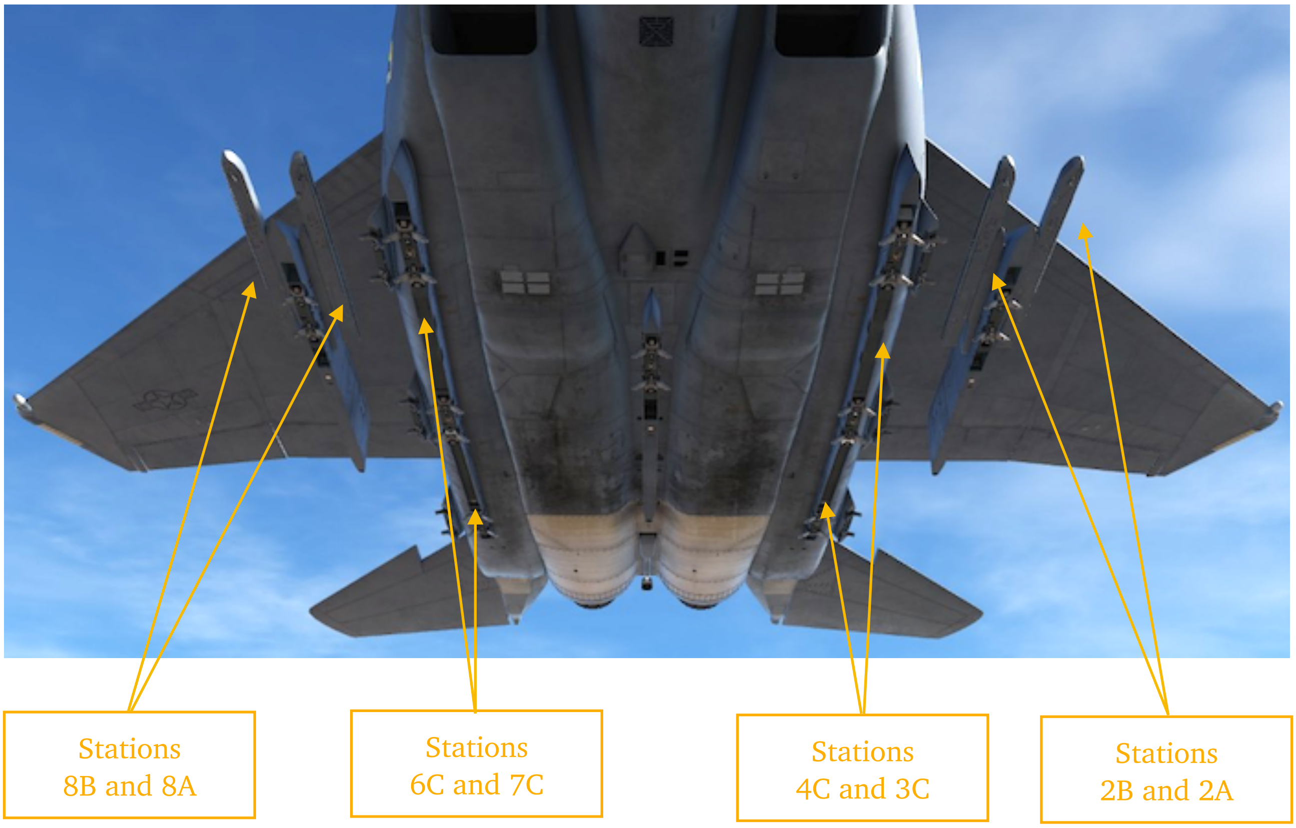
10.2.3 Gun

The F-15E uses a 20mm M61A1 Vulcan gatling cannon mounted in the aircraft's starboard wing root behind the engine inlet.

Caliber	20mm	Rate of Fire	4000 / 6000 rpm
Total Mass	769 lb (349 kg)	Drive System	Hydraulic
Rounds	500	Effective Range	2000 ft (600 m)

10.3 Air to Air Loadout

F-15E is capable of carrying an air to air missile on a total of four underwing and four underbelly stations. Each station can hold one missile and they can be mounted in any of the combinations listed below.



8B	8A	7C	6C	4C	3C	2B	2A
AIM-120B	AIM-120B	AIM-120B	AIM-120B	AIM-120B	AIM-120B	AIM-120B	AIM-120B
AIM-120C	AIM-120C	AIM-120C	AIM-120C	AIM-120C	AIM-120C	AIM-120C	AIM-120C
AIM-9L	AIM-9L	AIM-7M	AIM-7M	AIM-7M	AIM-7M	AIM-9L	AIM-9L
AIM-9M	AIM-9M	AIM-7MH	AIM-7MH	AIM-7MH	AIM-7MH	AIM-9M	AIM-9M
AIM-9P	AIM-9P					AIM-9P	AIM-9P
AIM-9P5	AIM-9P5					AIM-9P5	AIM-9P5
AIM-9J	AIM-9J					AIM-9J	AIM-9J
C AIM-9M	C AIM-9M					C AIM-9M	C AIM-9M

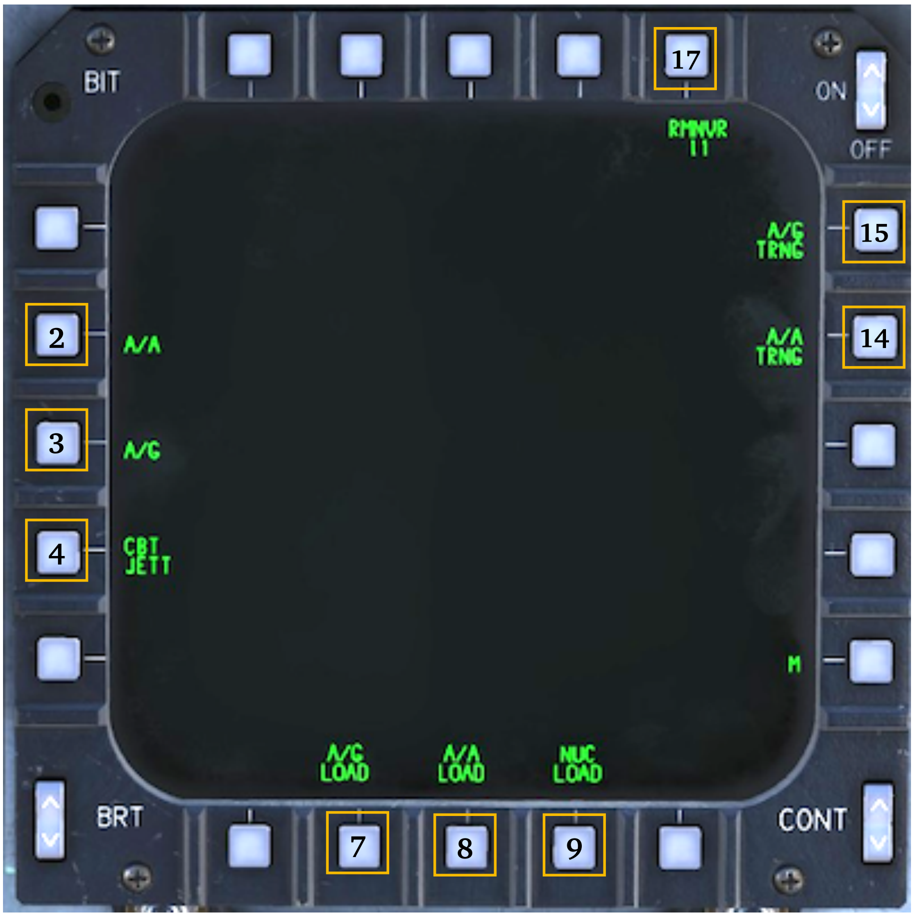
10.4 Programmable Armament Control Set (PACS)

The PACS provides weapons monitoring, as well as display / management capabilities. It is used for selection, pre-launch preparation, launch and jettison of both air to air and air to ground munitions.. Both aspects will be covered separately in A/A and A/G chapters, with additional functions as selective jettisoning with separate section at the end of A/G part.

There are two main modes of PACS operation for A/A and A/G domains: combat (CMBT) and training (TRNG), and these can be enabled independently between the domains. In other words the aircraft can operate in A/A CMBT and A/G TRNG etc.

In training mode, munitions cannot be expended for as long as A/A TRNG is boxed on the PACS page. However, the jet behaves as if real ordnance was used and weapon inventory tracks all missiles "fired" in training.

The PACS menu can be accessed from Menu 1 on any MPD / MPCD by pressing pushbutton 2 (ARMT).



These pushbutton functions are briefly described on the next page. Clicking on the PBs above will bring the reader directly to the selected display.

PB 2, A/A (AIR TO AIR) DISPLAY: enters the Air to Air display on the MPD / MPCD with additional set of options. See A/A Display section in this chapter for more information.

PB 3, A/G (AIR TO GROUND) DISPLAY: enters the Air to Ground display on the MPD / MPCD with additional set of options. See A/G Display section in the next chapter for more information.

PB 4, CBT JETT (COMBAT JETTISON) DISPLAY: enters the Combat Jettison display, also called a two-push jettison capability. See Combat Jettison section in the next chapter for more information.

PB 7, A/G LOAD (AIR TO GROUND LOADOUT) DISPLAY: enters the Air to Ground Loadout display. Refer to A/G Load Display in the next chapter for more information.

PB 8, A/A LOAD (AIR TO AIR LOADOUT) DISPLAY: enters the Air to Air Loadout display. See A/A Load Display section in this chapter for details.

PB 9, NUC (NUCLEAR LOADOUT) DISPLAY: not functional.

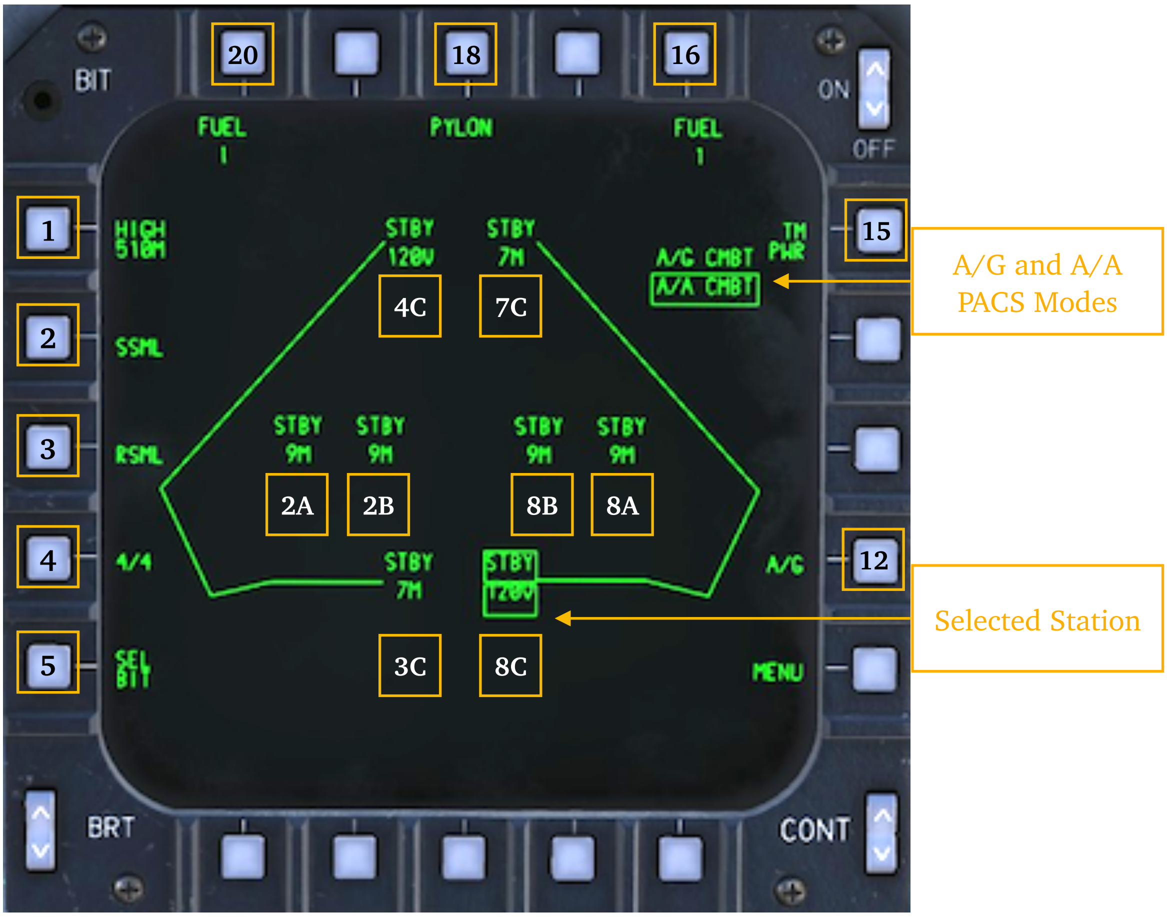
PB 14, A/A (AIR TO AIR) TRAINING: pressing this PB boxes the A/A TRNG legend. See Air to Air Training section for more details.

PB 15, A/G (AIR TO GROUND) TRAINING: pressing this PB boxes the A/G TRNG legend. See Air to Ground Training section in next chapter for more details.

PB 17, RMNVR (MRM MANEUVERING RANGE): pressing this PB changes the designated aspect angle value used to calculate and display the Rmnvr cue on the A/A radar display. Each press of the button increases the value from 0° to 170°.

10.4.1 PACS AIR TO AIR DISPLAY (AIM-120)

The picture below shows the A/A page in typical AIM-120 configuration (as AMRAAM is the currently selected missile).

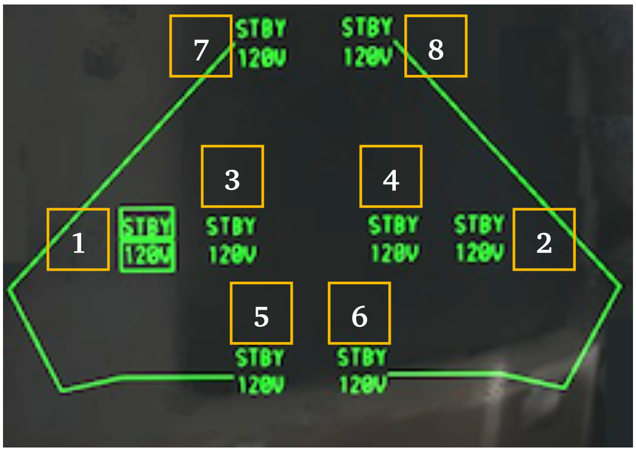


CURRENTLY SELECTED PACS MODE: displays current PACS mode for both A/G and A/A, with the following options: A/G CMBT, A/G TRNG, A/A CMBT, A/A TRNG. Currently selected Master Mode is boxed (either A/A or A/G).

SELECTED STATION: Boxes the station and weapon loaded on it. Depending on the status of the missile, different legends can be displayed for AIM-120:

MRM 120C	AIM-120 onboard, BIT not complete	STBY 120C	AIM-120 onboard, BIT complete, missile not in priority
STBY 120C (boxed)	AIM-120 onboard, BIT complete, selected as priority, MRM on throttle with MA SAFE or SRM on throttle with MA ARM, A/G not selected	RDY 120C (boxed)	AIM-120 onboard, BIT complete, missile selected, MRM on throttle, MA ARM, A/G not selected
FAIL 120C	Missile fails BIT	(blank)	No AIM-120 onboard

Missile Launch Sequence: provided that only AIM-120s would be installed on all available stations, the default launch sequence would be as follows:



PB 1, Gun Rate and Rounds Remaining: pressing this pushbutton switches between two gun firing rates: HIGH (6000 shots per minute) and LOW (4000 shots per minute). The number below indicates the number of remaining rounds (in increments of 10). If training mode is selected, letter T is visible next to the round count.

PB 2, MRM Target Size: pressing this button manually changes the target size, which is then used by AIM-120 for fuze timing and flight correction.

PB 3, MRM Target Radar Cross Section: allows the aircrew to choose the RCS estimate for the target.

PB 4, Flight Member Identification: allows the aircrew to enter a flight member identification for deconfliction purposes. The options are: 1/1 (single ship), 1-2/2 (lead or wingman in flight of two), 1-4/4 (lead, wingman, element lead or element wingman in the flight of four).

PB 5, AIM-120 Selective BIT: with AIM-120 loaded, **Weapon Switch** in MRM, training not selected and Master Arm switch in SAFE, pressing this pushbutton allows a BIT of individual missiles.

PB 12, A/G Mode: enters the Air to Ground display on the MPD / MPCD with additional set of options. See A/G Display section in the next chapter for more information.

PB 15, TM Power (Telemetry Power): sends telemetry power to instrumented missiles.

PB 16, 18, 20 Fuel / Pylon: shows current loadout on pylons 2, 5 and 8 that are capable of carrying external tanks or A/G weapons.

10.4.2 PACS Air to Air Display (AIM-7)

The A/A page in a typical AIM-7 configuration does not differ from the AIM-120 one, with the exception of TM PWR legend next to PB 15 not being displayed.

Selected Station: Boxes the station and weapon loaded on it. Depending on the status of the missile, different legends can be displayed for AIM-7:

MRM 7M	7M onboard, missile not tuned	STBY 7M	7M onboard, missile tuned but not in priority
STBY $\boxed{\text{7M}}$	7M onboard and tuned, selected as priority; MRM on throttle with MA OFF or SRM on throttle with MA ARM, A/G not selected	$\boxed{\text{RDY}}$ $\boxed{\text{7M}}$	7M onboard and tuned, selected, MRM on throttle with MA ARM
HUNG 7M	7M onboard after launch or jettison command	(blank)	No 7M onboard

Missile Launch Sequence: The AIM-7 Sparrow can be loaded on four stations with the default launch sequence shown below.

10.4.3 PACS Air to Air Display (AIM-9)

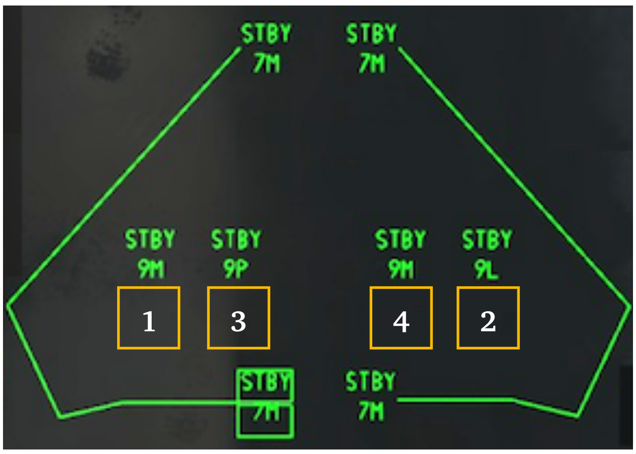
The A/A page in AIM-9 configuration is similar to the AIM-120 one, but there is no TM PWR legend next to PB 15 and no target size and flight member identification on the left side of the display (2-5).

Additional COOL button appears next to PB 15 and is automatically selected whenever Master Arm switch is set to ARM, irrespective of which missile is currently selected on the throttle.

Selected Station: Boxes the station and weapon loaded on it. Depending on the status of the missile, different legends can be displayed for AIM-9 (note that the display will show M, L or P depending on the type of missile loaded):

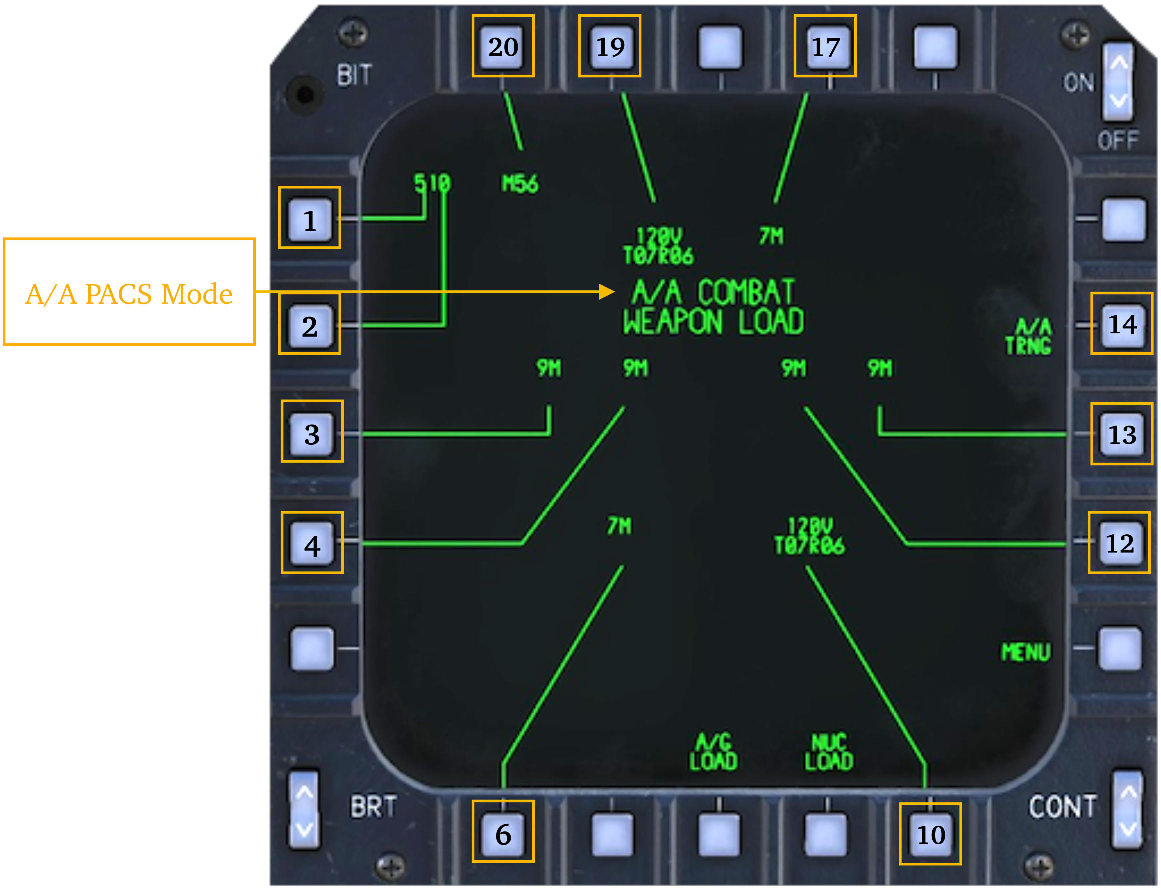
SRM 9M	AIM-9 onboard, station not in priority	STBY 9M	AIM-9 onboard, station in priority, SRM on throttle with MA SAFE, A/G not selected
SRM 9M	AIM-9 onboard, station in priority, SRM on throttle with MA SAFE or MRM/GUN on throttle with MA ARM	RDY 9M	AIM-9 onboard and tuned, selected, SRM on throttle with MA ARM, A/G not selected
HUNG 9M	AIM-9 onboard after launch or jettison command	(blank)	No AIM-9 onboard

Missile Launch Sequence: The AIM-9 Sidewinder can be loaded on four stations with the default launch sequence shown below.



10.4.4 PACS Air to Air Weapon Load Display

The weapon load display is selected by pressing PB 8 on the top level ARMT menu.



A/A Pacs Mode: displays the current mode of A/A PACS (A/A COMBAT or A/A TRAINING). These can be cycled by using PB 14.

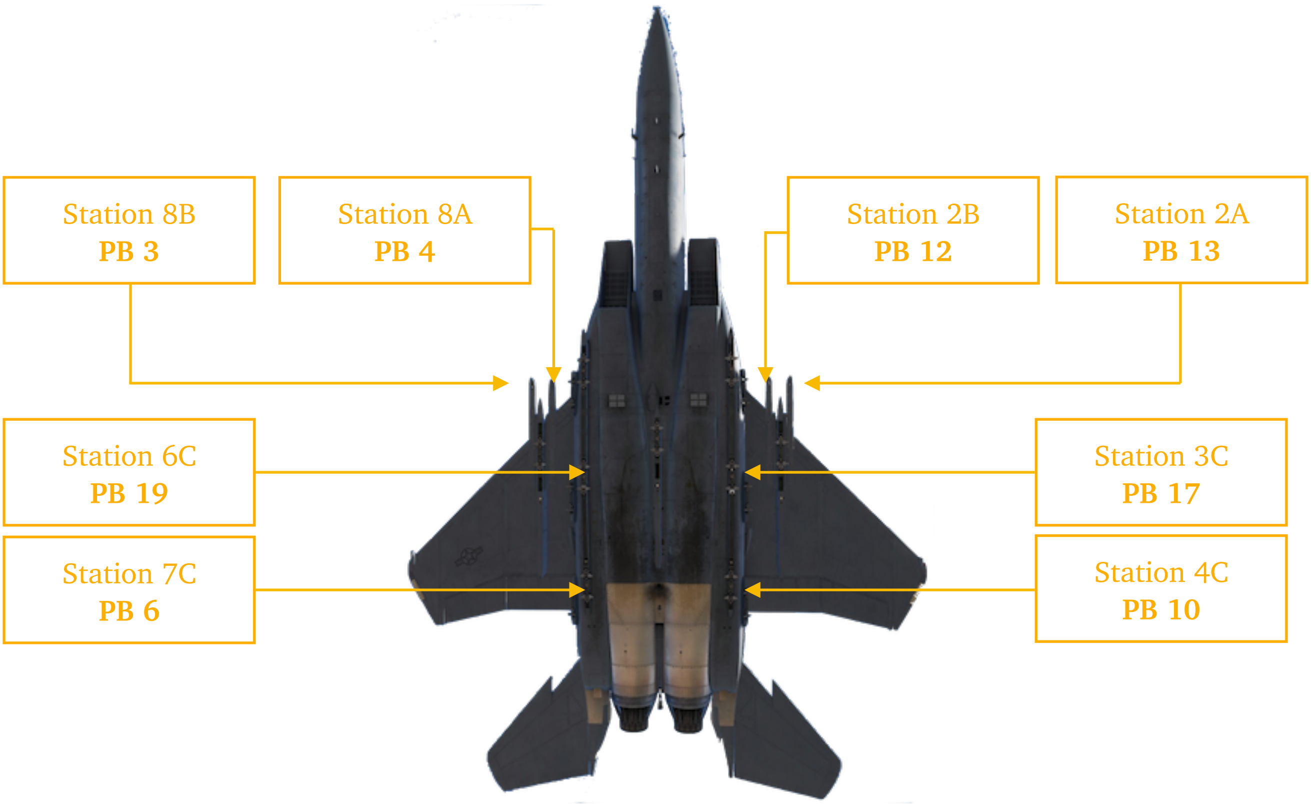
Gun

PB 1 and 2, Gun Rounds Buttons: pressing them changes the rounds remaining by either 100 or 10.

PB 20, Gun Ammo Type: this PB cycles between two types of bullets, PGU28 and M56.

Stations

Pushbuttons 3,4, 6, 10, 12, 13, 17 and 19 control the missiles on specific stations. While AIM-120 is automatically detected (with newer version of 120C being displayed as 120V), the system cannot differentiate between AIM-7M and AIM-7MH nor between AIM-9 L, P and M models. Therefore it is necessary for the aircrew to cycle each station so that it correctly reflects the ordnance loaded there. In training mode it is also possible to set up a desired set of missiles for training that can completely differ from what is really mounted on the jet. The relation between stations and pushbuttons is shown in the picture below.



10.4.5 PACS AIR TO AIR TRAINING MODE

The training mode is designed as a weapon safe mode - which means that no missiles can physically be expended as long as the A/A TRNG is boxed (and A/A TRAINING is displayed on the A/A Load Display and in the top - right corner of the Air to Air display).

The aircraft will normally react to all inputs and system changes, display targeting symbology, tones etc. However, it won't release any weapons - although those expanded will disappear from the A/A Load and A/A PAC Displays.

It is possible to select any loadout by using the A/A Load Display and pressing P/B responsible for each station util it shows the desired weapon.

In training mode additional reset (RESET) option is available next to PB 14, which reinitializes the entire training load.

If NAV, INST or A/A Master Mode is selected and A/A Training is enabled, TRNG is also displayed in the HUD.

To exit the A/A Training mode, the A A/A TRNG legend should be unboxed.

10.5 AIM-120 Employment

The AIM-120 AMRAAM is an active radar homing medium- range air-to-air missile. It was first introduced in 1982 as a replacement for the AIM-7 Sparrow.

The AIM-120 uses both command guidance and radar homing to reach its target. Its integral radar has a comparatively short range, and so until the missile is within that range, it is guided by datalink commands sent automatically from the launching aircraft. The AMRAAM has a maximum speed around Mach 4.

10.5.1 AIM-120 Built In Test (BIT)

As soon as the radar knob is moved out of the 'OFF' position, automatic AIM-120 BIT is performed in sequence to all stations with the missile installed (unless Master Arm switch is already in ARM or training mode is selected). As described above, after successful BIT, the station legend changes to STBY (or FAIL if it is unsuccessful). The BIT can also be selectively applied to the currently selected station (changing the station using **Missile Reject Switch**).

10.5.2 AIM-120 Launch Modes

There are two launch modes for the AIM-120: normal mode and visual mode.

Normal Mode

In normal mode the missile is launched on the target locked by the aircraft's radar. For most part of the missile's flight target information is fed to the missile via the datalink combined with the missiles INS guidance. Once it reaches certain points it uses its own seeker for terminal acquisition and tracking.

If the radar locked is lost after launch (or radar starts supporting an AIM-7 Sparrow), *inertial active mode* is activated, where the missile uses only its own onboard INS guidance to reach the active phase.

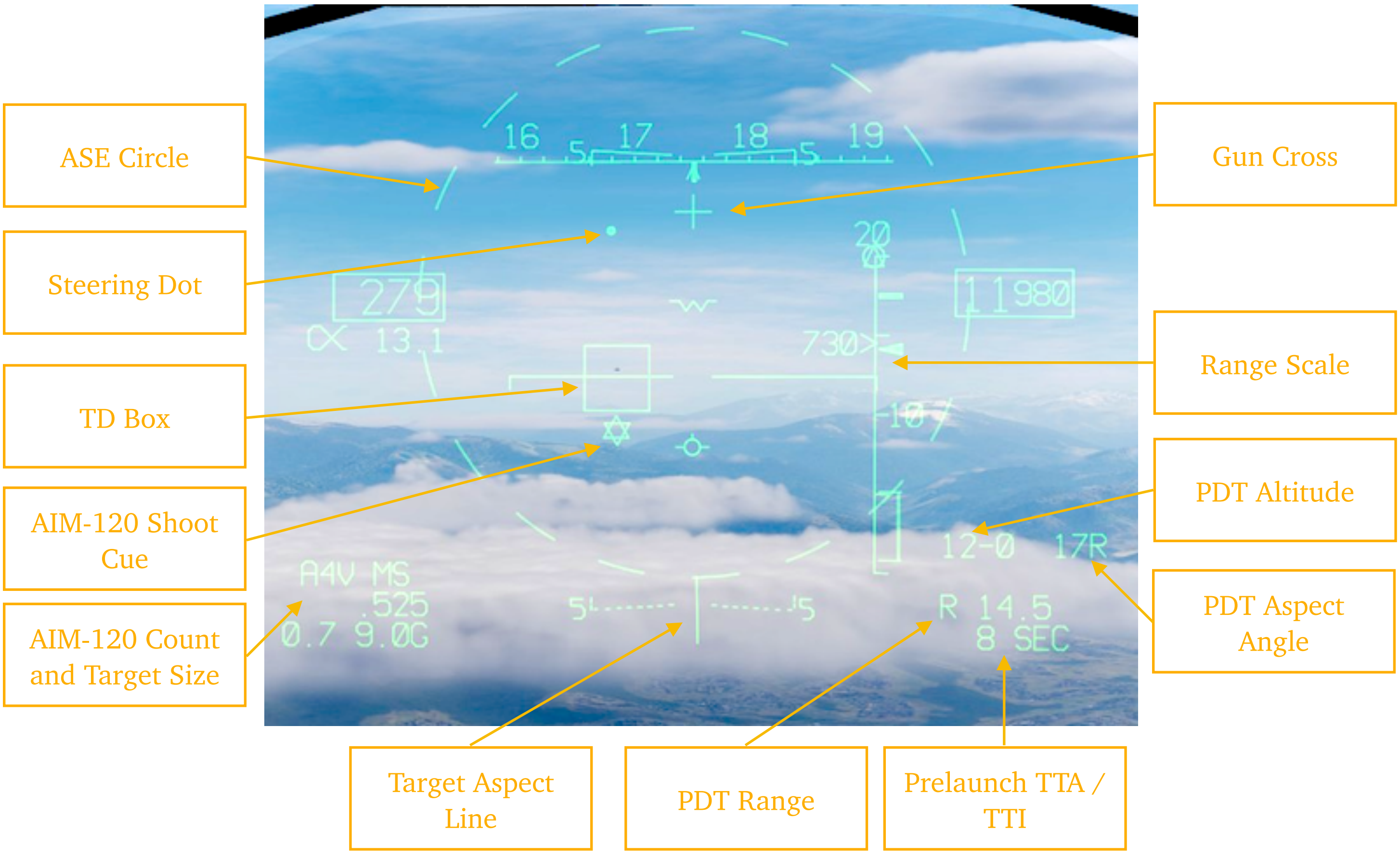
Visual Mode

Used only for visual range encounters. It allows to shoot the AIM-120 while maintaining radar support for an AIM-7 against another target or while having a different target locked by the radar.

10.5.3 AIM-120 HUD SYMBOLOGY

In normal mode, the AIM-120 can be launched at a single target using the STT lock or at up to 8 different targets in Track While Scan mode. The following symbols appear on the HUD and Radar Screen.

HUD display, target within FOV



ASE CIRCLE: ASE stands for "Allowable Steering Error". The size of this circle depends on the radar line of sight to the target and missile gimbal limits, which means that it will change depending on these two factors.

The pilot should put the **STEERING DOT** inside the ASE circle for missile launch.

TARGET DESIGNATION BOX: the box appears around the PTD (Priority Designated Target). If the target is outside HUD FOV, the box flashes at low rate and a number indicates the off-boresight angle.

AIM-120 SHOOT CUE: this 6-pointed cue appears below the TD Box when the following launch conditions exist:

a) The selected mode is MRM and the AIM-120 is in priority and ready

b) Master Arm Switch is set to ARM

c) Radar is in STT, DTT or DTWS

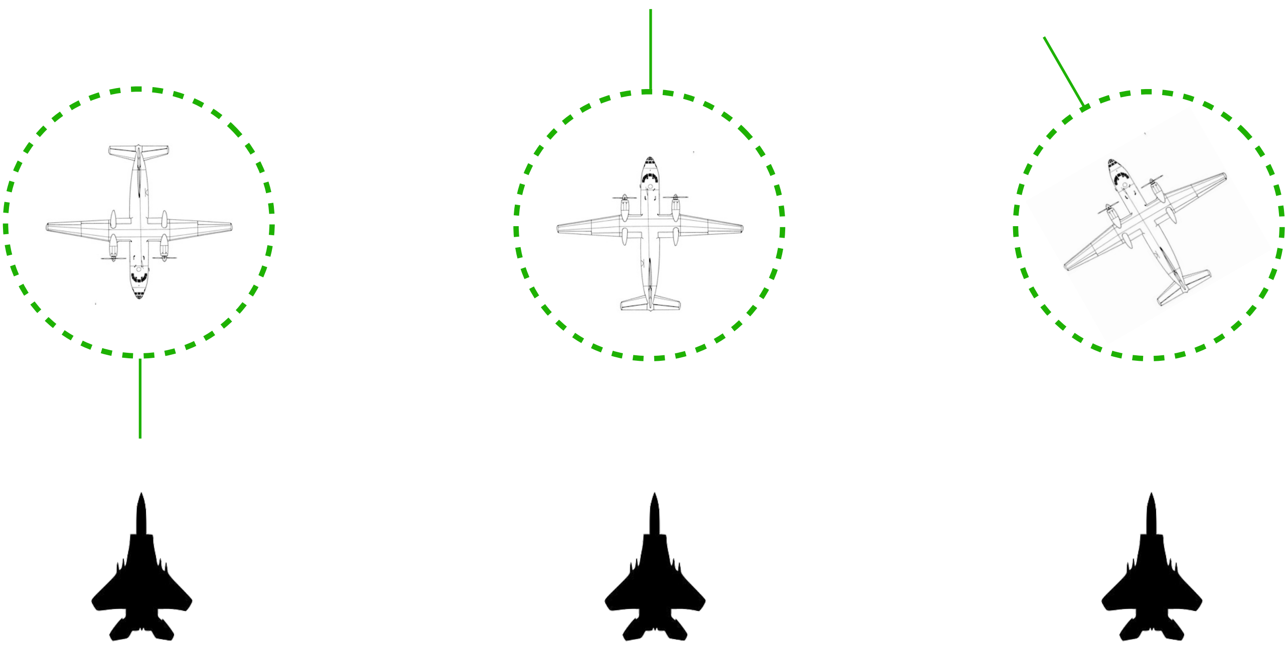
d) Steering Dot is inside the ASE circle

e) Target is between Raero and Rmin range.

AIM-120 COUNT: Indicates the number and type of AIM-120 missiles available. First letter A denotes missile type, 4 indicates the number of missiles left, letter V denotes the missile variant (A, B, C or V - which is the newer version of C).

Target Size and RCS (radar cross section) are displayed next to the missile count. The options are from smallest to largest: S, M, L, SS, SM, SL, MS, MM, ML, LS, LM, LL. These have no effect in game.

TARGET ASPECT LINE: this radial line is displayed outward from the ASE circle and indicates the target aspect as shown below.

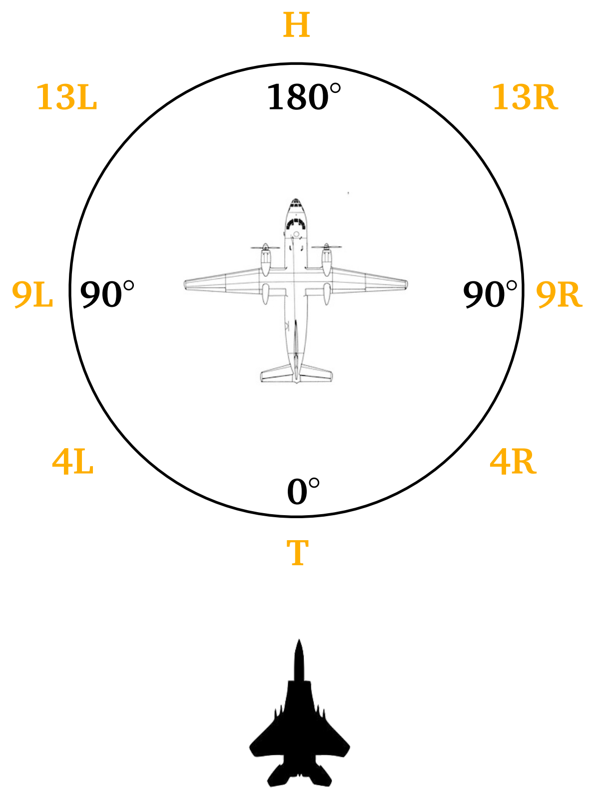


A line on 6 o'clock indicates nose aspect, a line on 12 o'clock indicates the tail aspect. Any other position reflects the target aspect angle readout displayed next to target's altitude (see below).

PDT RANGE: shows the range to Priority Designated Target in Nautical Miles.

PRELAUNCH TTA / TTI: the TTA (time to active) is the predicted missile time of flight to range at which the priority AIM-120 goes active. It is constantly updated depending on many different factors. The TTI (time to intercept) is the predicted time of flight between the missile going active and hitting the target. When the target is in missile active range, TTI is displayed with M or H prefix to indicate that the missile will enter its active phase (MPRF or HPRF) immediately after launch.

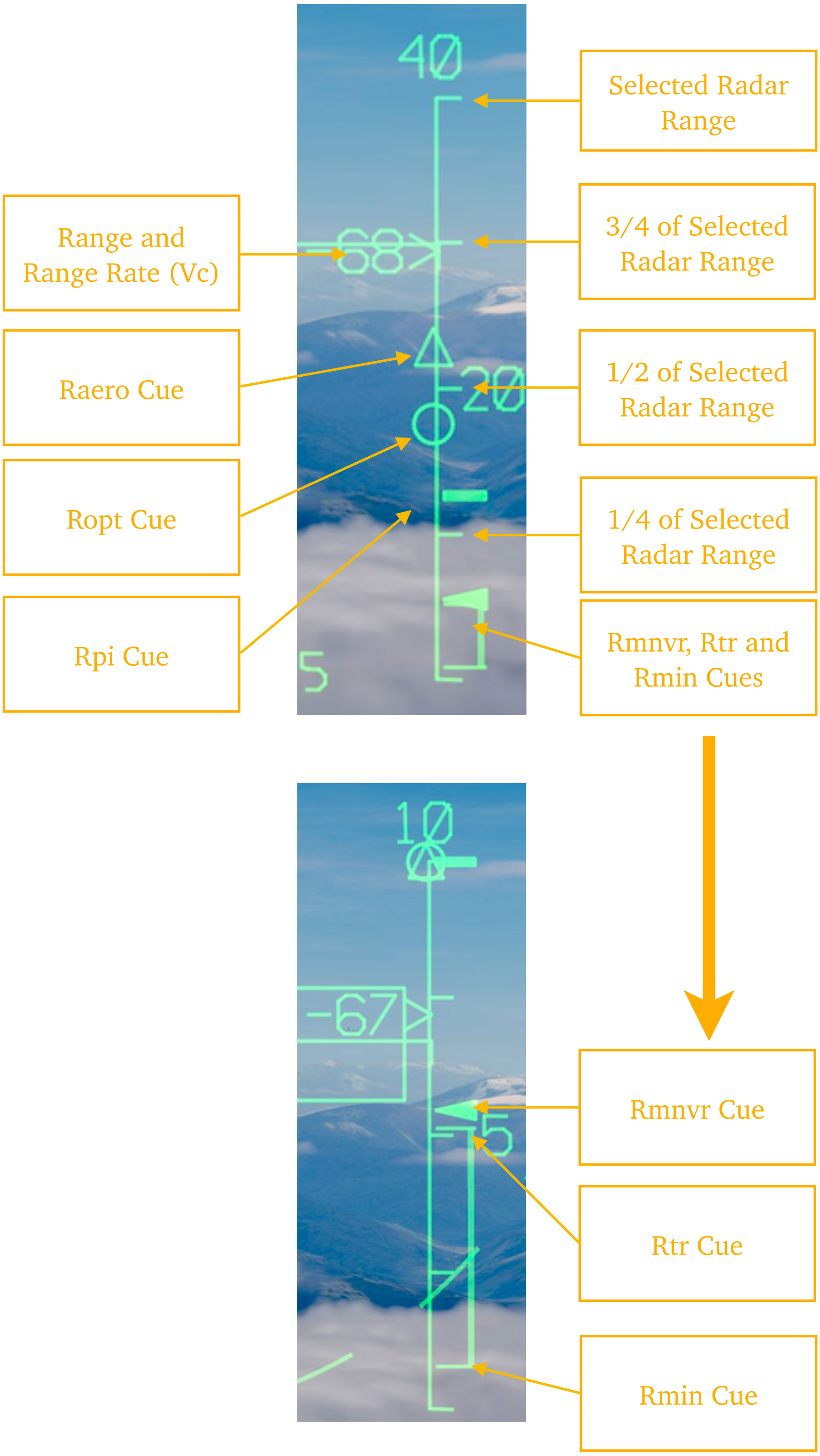
PDT ASPECT ANGLE: Priority Designated Target Aspect Angle is the horizontal angular difference between the target longitudinal axis and the F-15 to target LOS, as shown in the picture below. The L or R next to the number tells if the F-15 is looking at the left or right side of the target.

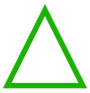


PDT ALTITUDE: displays the altitude of the locked target in thousands(large digits before the dash) and then hundreds (smaller digit after the dash) of feet.

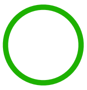
GUN CROSS: displayed with the Master Arm in ARM position.

RANGE SCALE: appears on the HUD and Radar display as soon as the lockon is achieved. The uppermost number on the scale is the currently selected radar range.



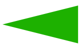


Raero Cue (Maximum Aerodynamic Range) is the absolute maximum missile launch range. It assumes that the target is not maneuvering and does not accelerate. It is calculated using the optimal ownship steering, meaning the Steering Dot is centered on the ASE.

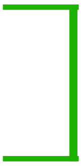


Ropt Cue (Maximum Range Probability of Intercept with Optimum Steering) is a special case of **Rpi Cue** calculated assuming the steering dot is centered in the ASE circle (optimal steering). Assumes no maneuvers from the target, but in all other aspects is the same as **Rpi Cue** described below.

Rpi Cue (Maximum Range Probability of Intercept With Current Steering) is a maximum launch range with current steering that assures a high likelihood of success. It also assumes no maneuvers from the target, ie. that it maintains its current velocity with no acceleration. With the Steering Dot centered in the ASE, **Rpi** is the same as **Ropt**.



Rmnvr Cue (Maximum Launch Range Against A Maneuvering Target) represents maximum range against a target executing at launch a constant speed, level 4-G turn towards the tail at missile launch.



Rtr Cue (Range Turn and Run) indicates a maximum launch range against a target that is executing an evasive turn and run maneuver at launch.

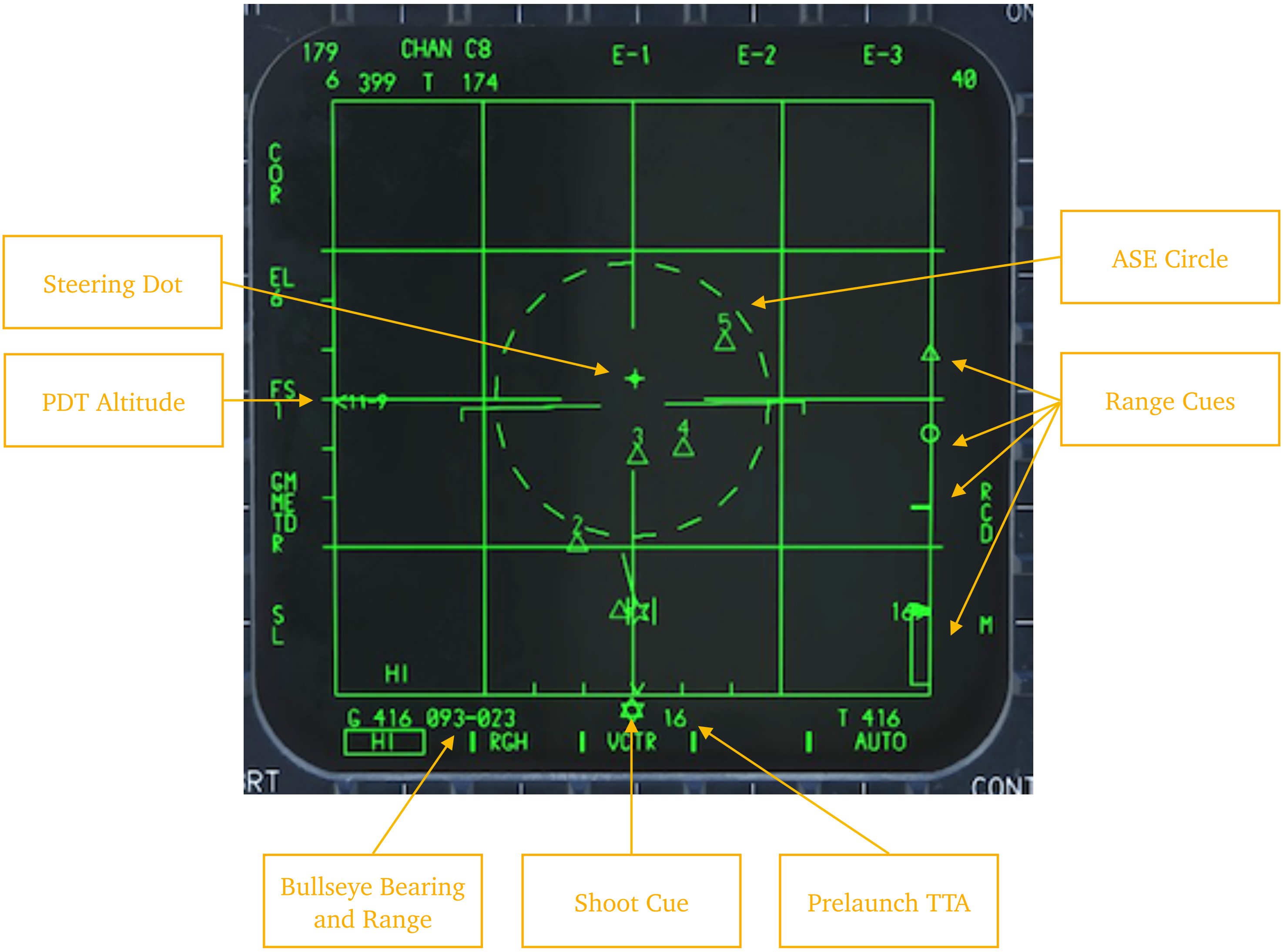
Rmin Cue (Minimum Launch Range) indicates the minimum launch range that assures any likelihood of success. These two Cues are connected by a vertical line.

Range and Range Rate (Vc): the caret on the right side of the number moves up and down the scale, visually showing the distance that is also displayed in PDT range box and also making it easier for the pilot to understand within which range (as marked by the cues) the target currently is.

The number next to it show the combined closing speed (if the number is positive) or departure speed (if the number is negative) in knots.

10.5.4 AIM-120 RADAR SYMBOLOGY

The majority of the symbols appearing on the radar during AIM-120 employment are the same as those described above from the HUD or were already covered in the A/A Radar Chapter.



The range scale and cues mirror the ones described above for the HUD. The Shoot Cue is displayed at the bottom of the display, together with the prelaunch TTA.

Additional symbols, like missile fly-out cue and other data to track post-launch information will be added at later stage.

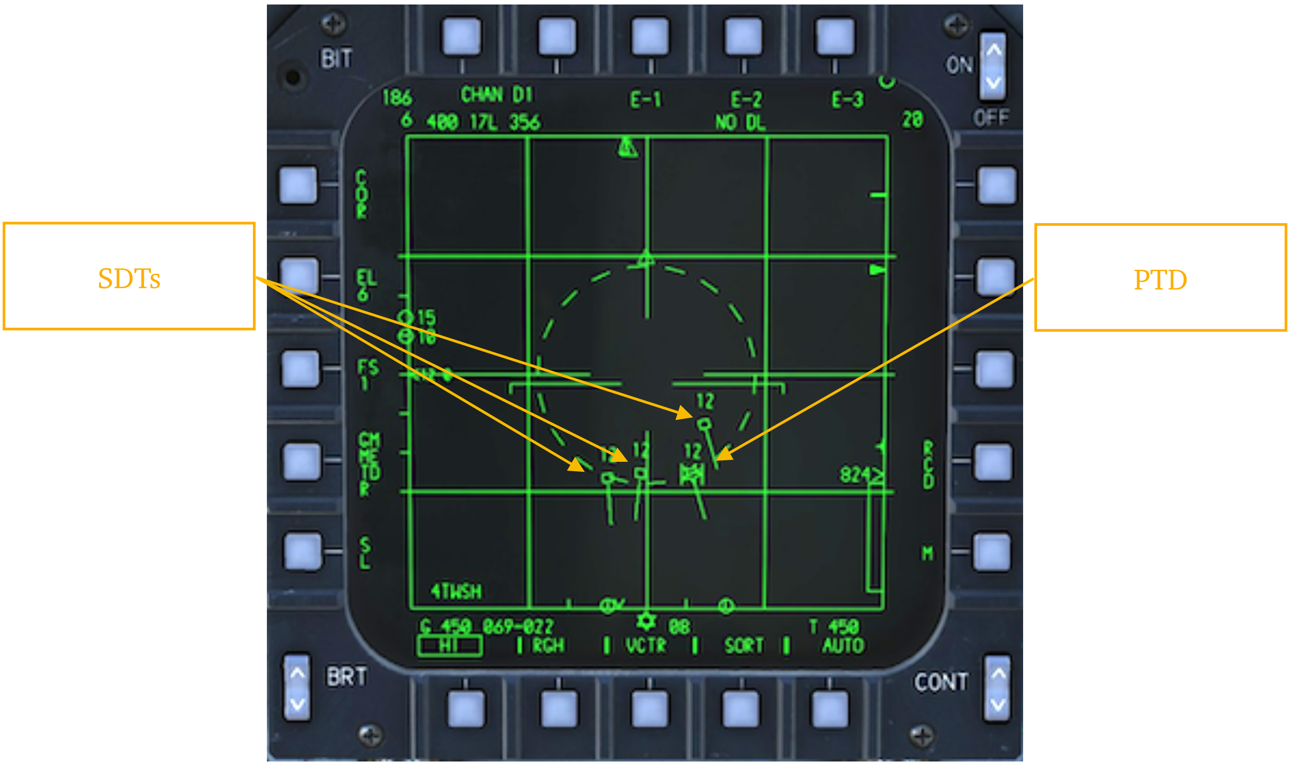
10.5.5 AIM-120 Attack

To shoot the AIM-120C at a locked target, pilot should press and hold the **Pickle Button** on the flight stick until the missile is released.

The post-launch data for the HUD and Radar screen is not yet fully implemented.

10.5.6 AIM-120 Attack Against Multiple Targets

It is possible to simultaneously shoot all eight AIM-120 missiles the F-15E is capable of carrying at eight different targets by using the Multitarget Designation. The procedure should be as follows:



A. Aircrew should set the PTD and up to seven STDs (Secondary Designated Targets).

B. Master Arm should be switched to ARM.

C. First missile should be shot at the current PTD.

D. Next STD should be designated as PTD using Quickstep function.

E. Second missile should be shot at the newly designated PTD.

(to be repeated until all missiles are released).

10.6 AIM-7 EMPLOYMENT

The AIM-7 Sparrow is is a semi-active medium-range air-to-air missile. It has a maximum speed of Mach 4 and an operational range of up to 53 nautical miles, though the performance will vary depending on many factors. As a semi-active guided missile, the launching aircraft must maintain a continuous radar lock on the target until impact.

AIM-7 Steering Modes

There are two steering modes: radar track (which is the desired one for best effects) and flood (when there is no STT).

In **radar track mode**, when the Master Arm is in ARM position and AIM-7 is selected and ready, the radar attempts a Medium to High Track Transfer (MHTT) when the target is in range.

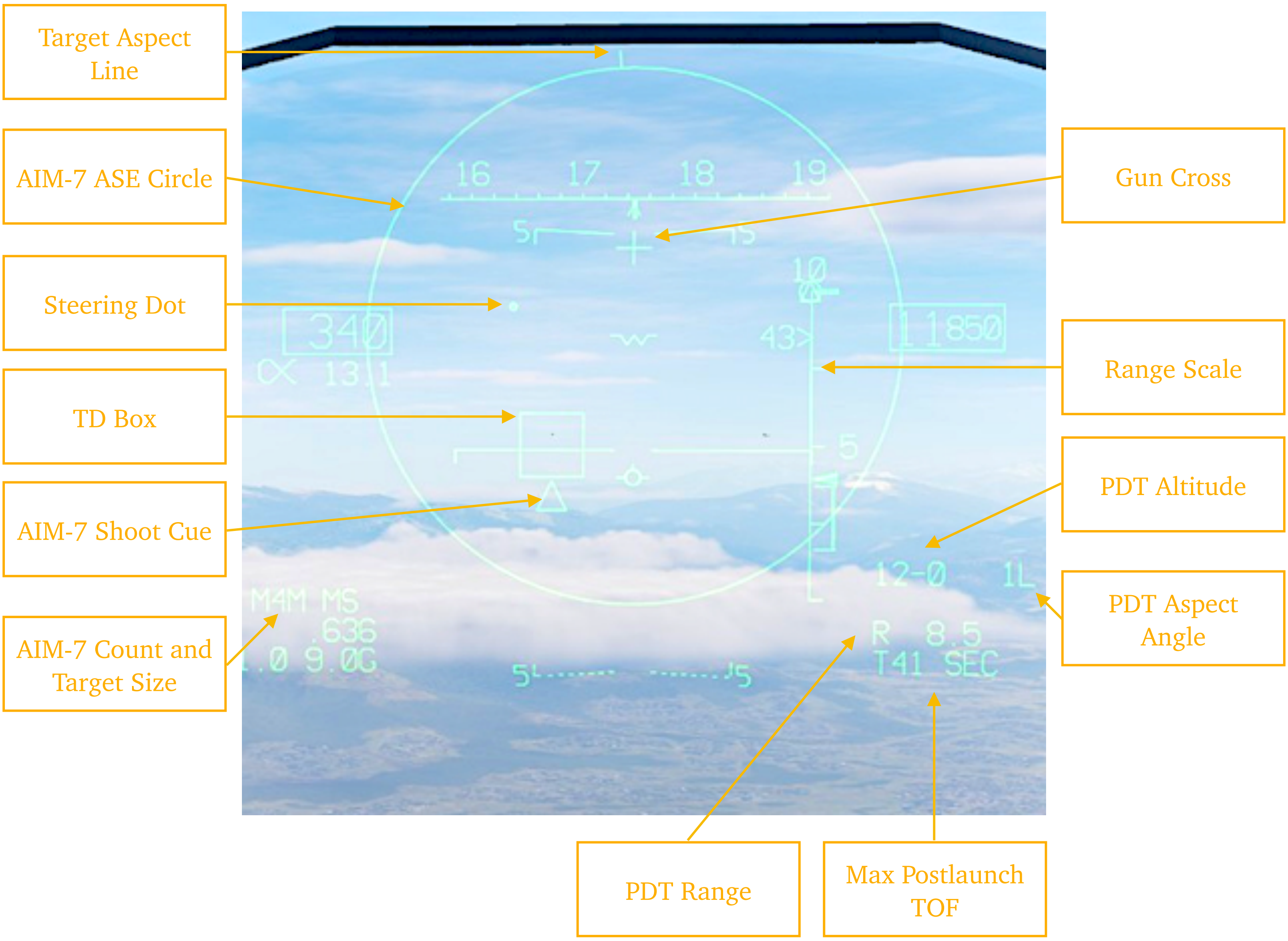
If the target range is available, all the range cues are computed and displayed, just as for the AIM-120. When the range parameters are satisfied, a shoot cue appears on HUD and on the radar screen, and lock / shoot lights are on.

If target enters minimum range, a flashing break X is displayed on the HUD and radar to indicate that the attack should be terminated.

The **flood** mode is not available in Early Access.

10.6.1 AIM-7 HUD Symbology

The HUD symbology for AIM-7 is very similar to the AIM-120, with several minor differences described below.



The Target Aspect Line, ASE Circle, Steering Dot, TD Box, Target Size, Gun Cross, Range Scale, DPT Altitude and Aspect Angle are the same as described in previous section for the AIM-120C.

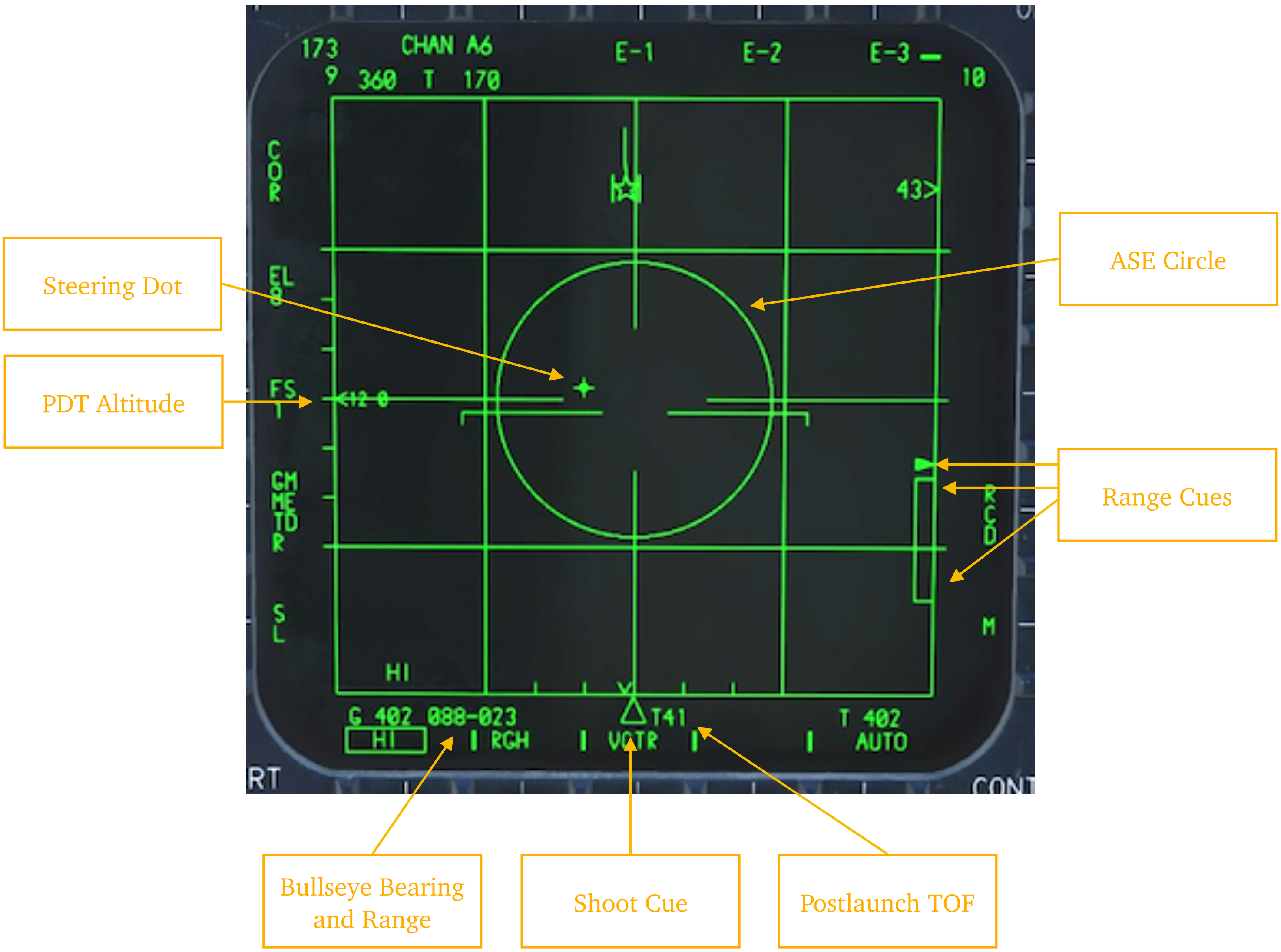
The Shoot Cue has the same function, but the symbol is different - a triangle is displayed for the AIM-7.

In the AIM-7 count window, MXM will be displayed for AIM-7M, where X denotes the number of missiles remaining. If MXH is shown, that means AIM-7MH is loaded.

The post-launch TOF shows the maximum missile time time of flight.

10.6.2 AIM-7 RADAR SYMBOLOGY

The Radar symbology largely reflects what is shown in the HUD. For detailed description please refer to the AIM-120 section above.



Additional symbols, like missile fly-out cue and other data to track post-launch information will be added at later stage.

10.6.3 AIM-7 ATTACK

◆ To shoot the AIM-7 at a locked target, pilot should press and hold the **Pickle Button** on the flight stick until the missile is released.

The radar should maintain the lock throughout the whole time of flight of the missile. If the lock is lost, it should be reacquired ASAP, otherwise the missile is likely to miss.

Also, missile launch should not be attempted when the steering dot is outside the ASE circle, as it represents the missile gimbal limits.

10.7 AIM-9 EMPLOYMENT

The AIM-9 Sidewinder is a heat-seeking, infrared-guided short-range air- to-air missile. The AIM-9 uses an array of up to five scanning infrared sensors, cooled in the L and M modes by an internal argon bottle. The Sidewinder has a maximum speed of over Mach 2.5 and a maximum range of around 10 miles.

Seeker Cool

In order to be able to acquire and track targets, the AIM-9 seeker should be cooled at least 25 seconds before the launch. Cooling is automatically initiated as soon as Master Arm switch is placed to ARM. It can also be manually initiated by boxing the COOL legend by pressing PB 15 on the A/A PACS page.

Selecting the AIM-9

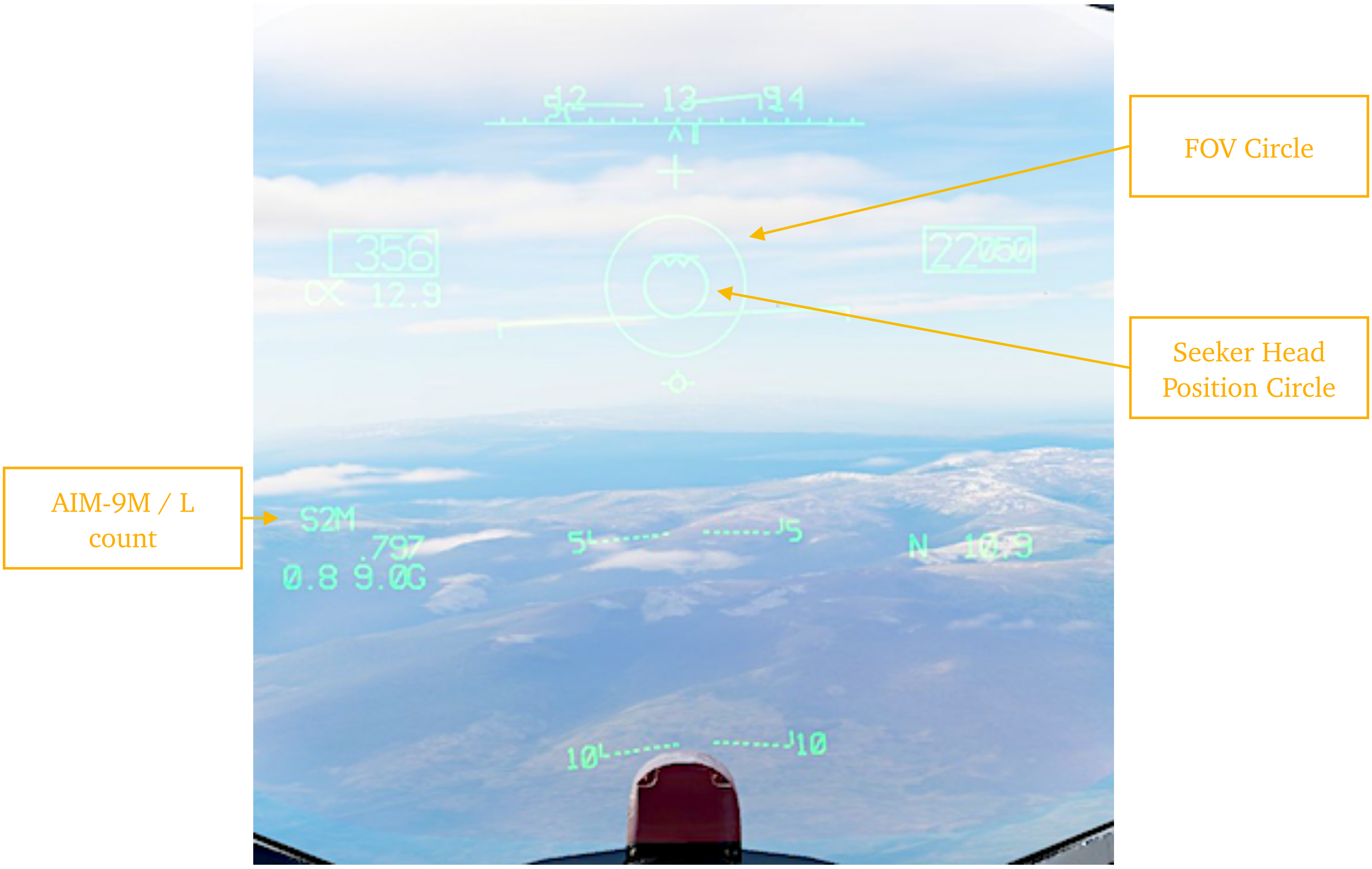
To switch to AIM-9, the pilot should place the **Weapon Select Switch** to SRM position while in A/A Master Mode.

AIM-9 Tracking

AIM-9 can be used either with the radar lock (which slaves the seeker to the currently locked target) or without it (using only the onboard sensors of the missile to detect and lock the target). However, after release the missile uses only its own seeker head and is not dependant on the radar in any way.

10.7.1 AIM-9 EMPLOYMENT WITHOUT RADAR TRACK

When the radar is in search and SRM is selected with AIM-9 onboard, missile seeker heads are aligned to the missile boresight position, with the seeker head position centered in the FOV circle.



FOV (FIELD OF VIEW) CIRCLE remains centered on the HUD. It is removed when the seeker is uncaged and tracking target or when radar is in angle track.

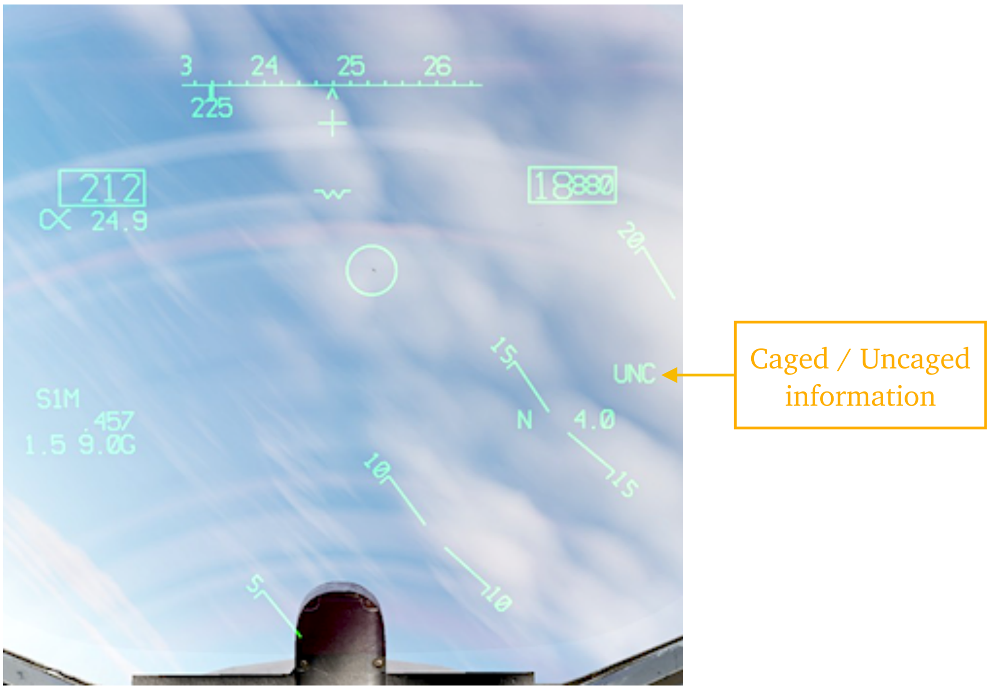
SEEKER HEAD POSITION CIRCLE indicates the line of sight of the currently selected AIM-9 missile. When the seeker position exceeds the HUD field of view, it is displayed as half circle and flashes.

AIM-9 COUNT displays the number of remaining M or L missiles in launch priority (which means that if both M and L models are selected, this HUD window will show the type of currently selected missile).

To acquire a lock, pilot should maneuver the aircraft in order to center the target within the FOV Circle. As soon as missile detects it, the seeker detection tone rises to a higher pitch. The pilot may launch immediately or attempt to achieve the seeker self track (lockon) by uncaging it.

◆ To uncage or cage the AIM-9 seeker, pilot should press the **Nose Wheel Steering (NWS)** button.

The picture below shows successful lockon. The FOV circle disappeared and the Seeker Head Position Circle is superimposed on the target and following it in the HUD FOV. High - pitched tone can be heard. If Master Arm is in ARM position, the missile could be launched.



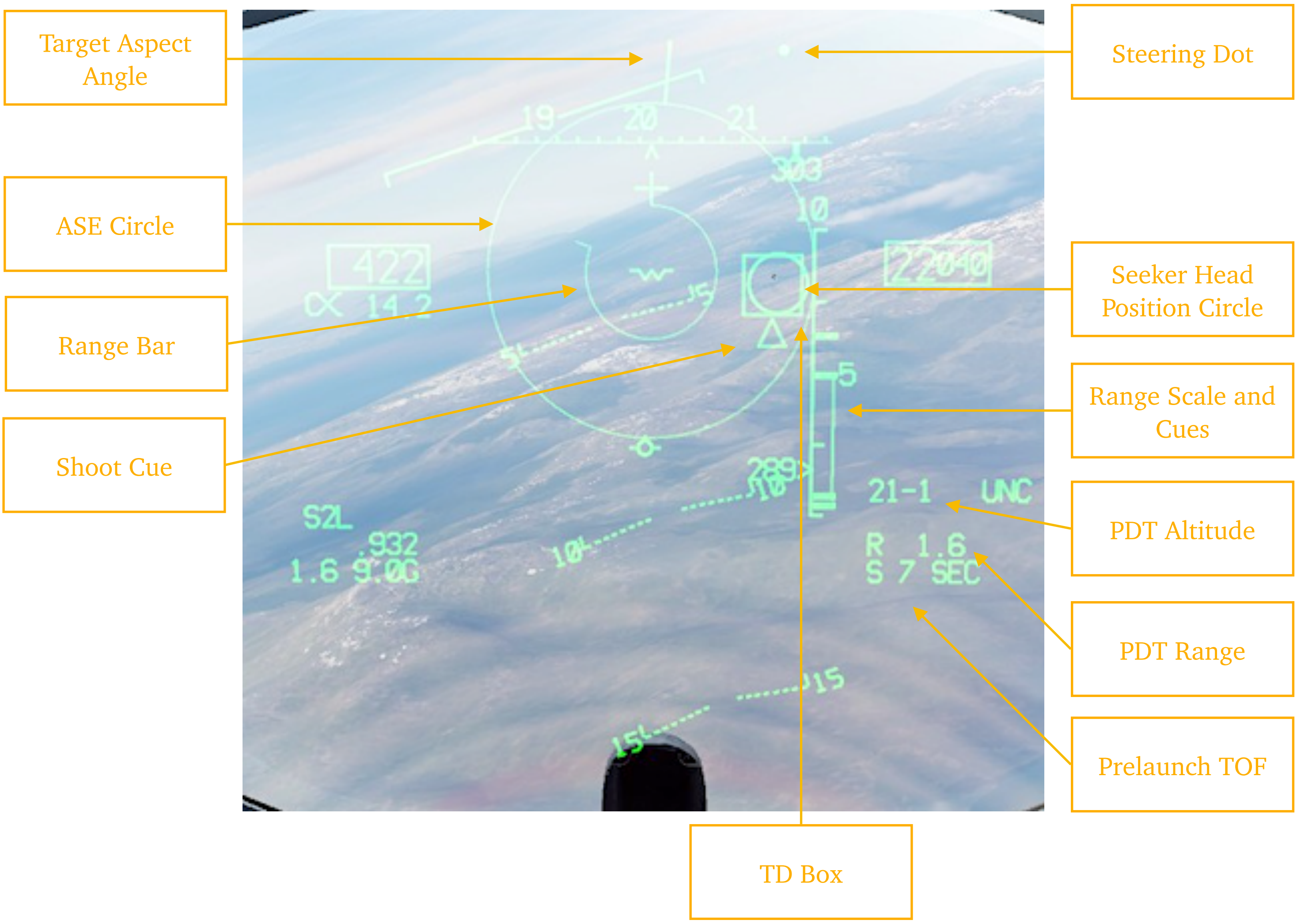
It is also possible to uncage the seeker without any target in the FOV circle. The UNC legend will be displayed on the right side of the HUD and Seeker Head Position Circle will wander around the HUD FOV until it is caged again using the **NWS** button.

10.7.2 AIM-9 SPECIAL BURST RANGING

Special Burst Ranging (SBR) allows to determine the range to target in FOV circle without having to command STT.

10.7.3 AIM-9 EMPLOYMENT WITH RADAR TRACK

When AIM-9 is selected and the target is locked by the radar, the display changes and is very similar to the one used for the AIM-120 or AIM-7.



Most of the functions of displayed information are exactly the same as for the AIM-120 and do not need additional description. The Seeker Head Position Circle is superimposed on the TD Box.

The **ASE Circle** doubles its size if seeker lockon (uncage) is accomplished.

Circular **Range Bar** appears when range to target is less than 12 000 feet. It unwinds as the target gets closer. The range follows the clock indications, i.e 9 o'clock position is 9 000 feet, 6 o'clock is 6 000 feet etc.

Prelaunch Time of Flight is displayed on the HUD, preceded by letter S.

Pilot should try to place the Steering Dot in the middle of the ASE circle. When the detection tone is heard and the flashing Shoot Cue is displayed, missile can be launched or seeker self track can be attempted by pressing the **Nose Wheel Steering** button.

NOTE: the Shoot Cue is a reliable indication that the missile will track correctly and uncaging (achieving seeker self track) is not necessary. However, it may be useful to validate missile track on specific target, particularly when other IR sources exist.

10.7.4 AIM-9 MANUAL BORESIGHT

Manual boresight allows to shoot an AIM-9 at a second target, while the radar is committed to tracking the first one.

10.8 GUN EMPLOYMENT

The internal gun system is an electrically controlled, hydraulically powered, air-cooled, 6-barrelled Gatling gun. Each barrel's caliber is 20mm. It is capable of firing up to 6000 round per minute. Gun's dispersion forms an approximate 8-mil cone.

Ammo

The gun can carry up to 500 rounds and use two types of ammunition:

PGU-28 bullet: better for air to air gunnery, as it offers increased maximum range and decreased lead angle requirement.

M-56 bullet: it has a slightly lower muzzle velocity than the PGU-28.

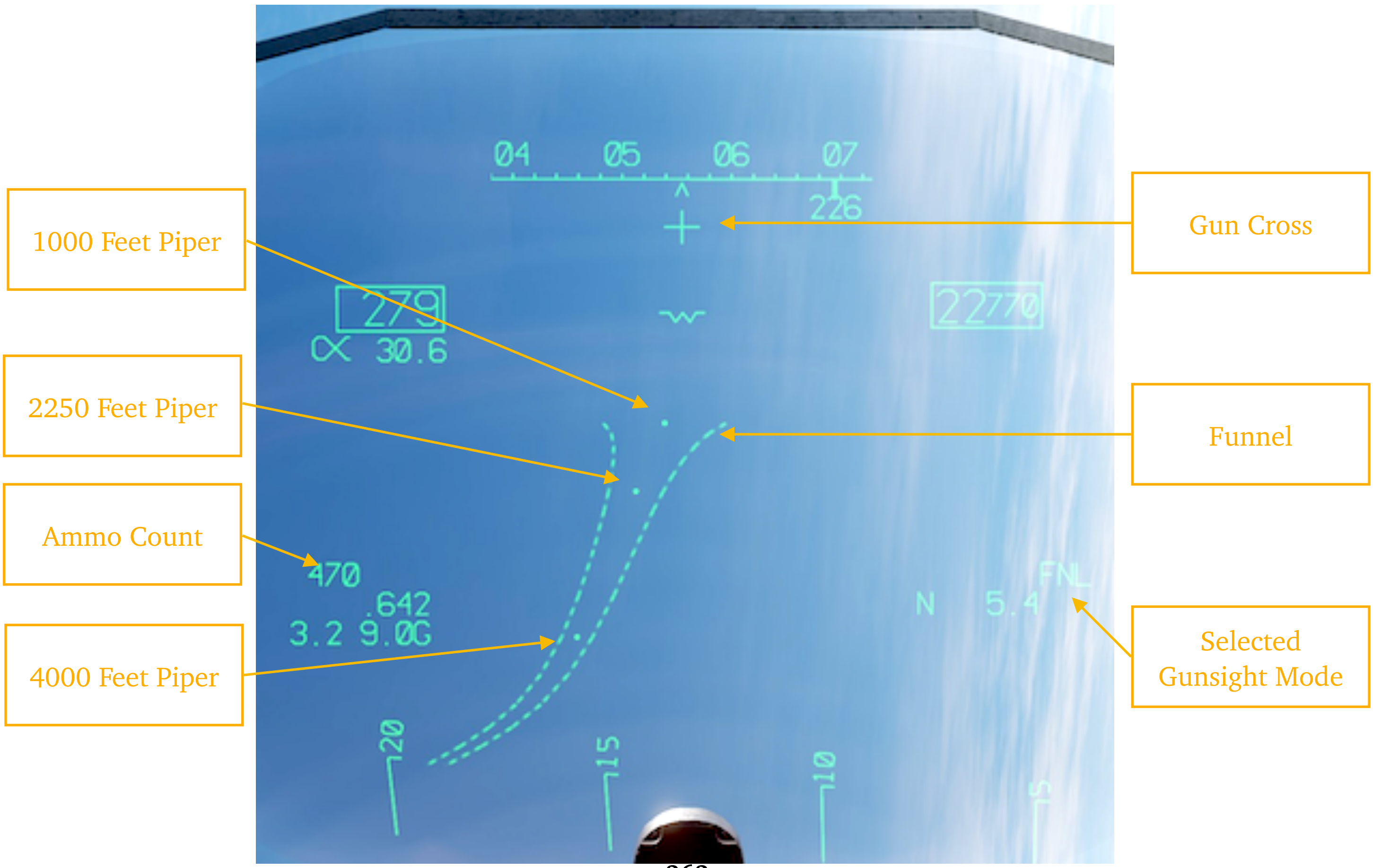
10.8.1 GUNSIGHT MODES

There are two gunsight modes with GUN selected on the **Weapon Select Switch**: Funnel (FNL) and Gun Director Sight (GDS).

Pilot can switch between the two modes by pulling up short (<1s) on the **Coolie Switch**.

Without the radar track, only Funnel can be used. With radar track, the pilot can choose between FNL and GDS as described below.

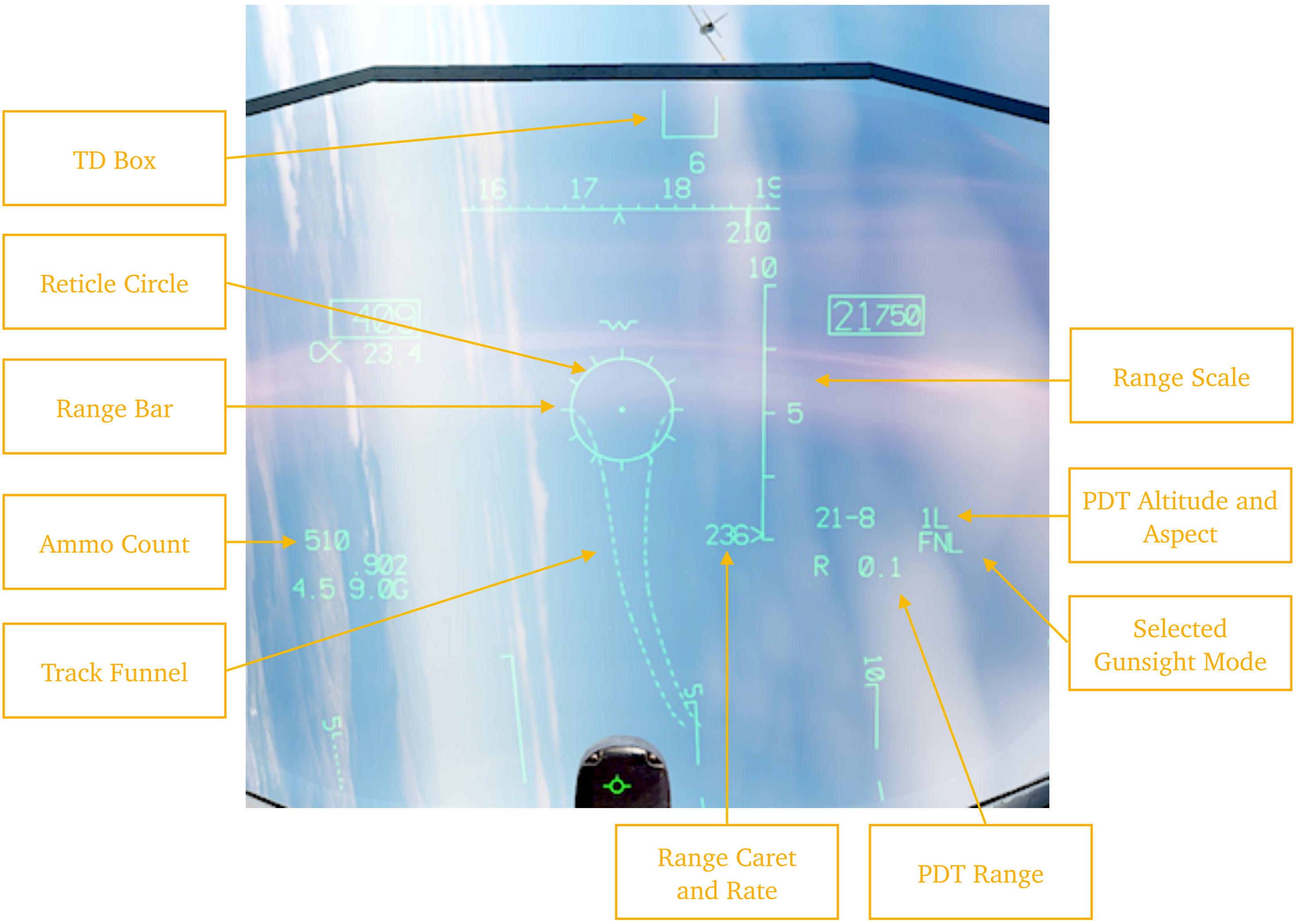
Search Funnel (no radar track)



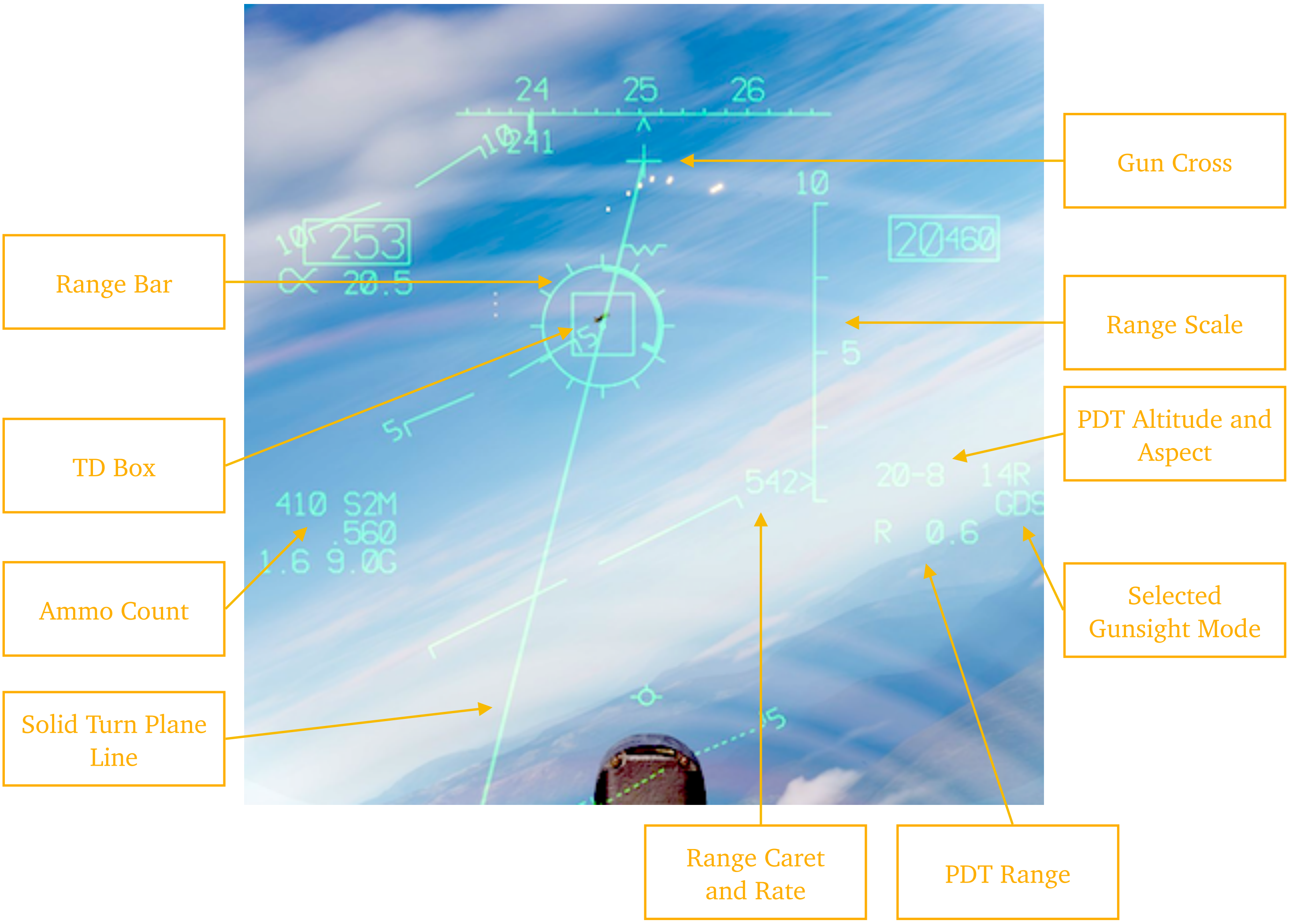
The end of the funnel is limited to the bullet maximum range when less than 5000 feet. The three pipers set to 1000, 2250 and 4000 feet are provided if there is no radar lock. Funnel width corresponds to a 40-foot target wingspan at a selected range.

The **Search Funnel** is calculated using the LCOS algorithm and only ownship data. The only exception to this is that radar range and/or range rate are used when available. The funnel is based on the LCOS assumption that the target is performing the same maneuvers as the F-15 shooter. Thus, the funnel responds to changes in F-15 acceleration.

Track Funnel (with radar track)



Gun Director Sight, radar track



The **Track Funnel** appears when the target range or range rate is valid. New data appears on the HUD, including the radar range scale, TD box, target altitude, range and aspect, as well as the 25-mil reticle circle. The latter disappears if target is in maximum firing range (around 3000 feet) and the circle would be superimposed over the TD box.

The **Director Reticle** provides an all-aspect gunsight which in theory eliminates the requirement to obtain a steady- state tracking condition. Coincidence of the director reticle and the target represents a correct solution; there is no need for the pilot to manually track the target or to anticipate bullet TOF. However, with higher range and manoeuvring target the probability of a hit decreases, especially without a valid radar lock.

Many of the indications in both modes are the same as described in earlier sections of the manual and do not need additional explanations. Notable differences are:

RANGE BAR indicates range in feet. Each tick mark on the gunsight represents 1000 feet, to a total of 12 000. The thicker portion represents the current range (in the example above, target is at around 4 000 feet.

SOLID TURN PLANE LINE shows the "plane of motion" (POM) of the target jet as the pursuing aircraft is turning. The goal for a tracking gun shot is to align your POM with the bandits POM, so you can pull lead in front of their jet and allow the bullets to arc down that line. The GDS piper will slide up and down that line based on the amount of G's being pulled. At low G's the piper will be up towards the top of the line, with a lot of G's it will be way down towards the bottom of the line, because the bullets will fall aft.

For both the funnel and director reticle it is important to remember that they work better and are more accurate with some G's on the aircraft and in the turn. If in level flight at or close to 1G, it is better to use the gun cross than rely on the reticle circle for accurate shots, as shown at the screenshot below.

Even though in theory the reticle should be aligned with the gun cross, the bullets are flying to where the gun cross is pointing, so above the target.

10.9 COMBINED MODE

Combined mode uses both GUN / SRM mode, with the gun symbology dominating the HUD and some extra SRM symbology added. It is not yet fully implemented at EA stage.

SECTION 3

AIR TO GROUND RADAR AND WEAPONS

CHAPTER 11: Air to Ground Radar

11.1 INTRODUCTION

The AN/APG-70 radar gives the Strike Eagle a very potent capabilities in air to ground domain. This chapter will cover the symbology and use of all the radar modes, as well as HOTAS bindings specific for each of them.

Common Symbols of the Air to Ground Radar Display

Air to Ground Radar HOTAS functions.

Real Beam Map (RBM) Mode, which provides a ground mapping mode for navigation, but also target designation.

Ground Moving Targets (GMT) Mode, designed to detect and display moving targets.

High Resolution Map (HRM) Mode providing increased map resolution for very accurate position updates, better target detection and long range designation.

Precision Velocity Update (PVU) Mode which is used to velocity update the Mission Navigator and the INS.

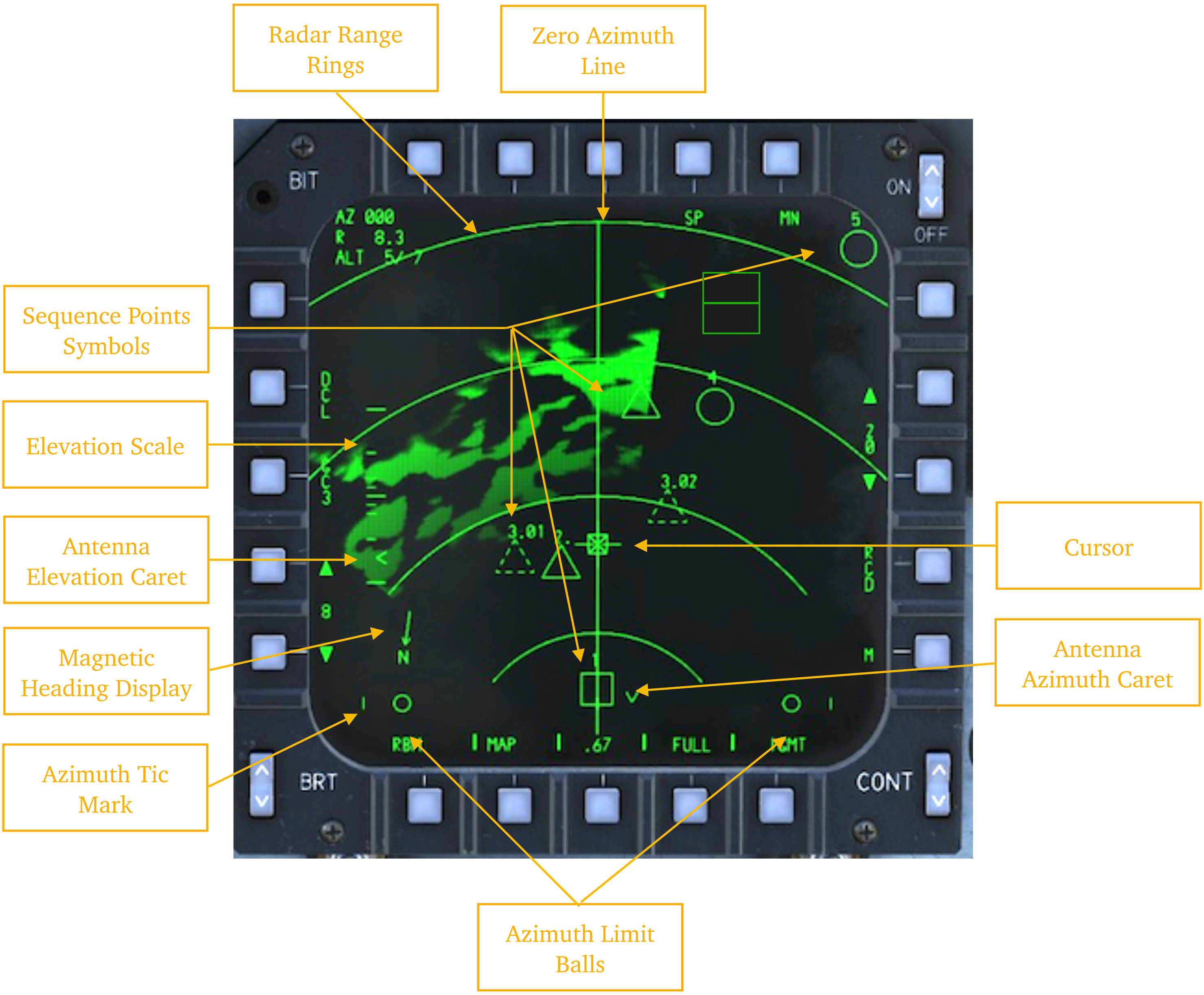
Air to Ground Ranging Mode (AGR) provides a slant range measurement used to update position and determine target terrain altitude before delivering weapons.

11.2 AIR TO GROUND RADAR: COMMON SYMBOLS

For the Air to Ground radar to function, the Radar Knob on the Sensor Panel must be in the ON position.

The aircrew should also take the command of the display with the AG Radar.

Air to Ground Radar page is accessed from Menu 1 on any MPD/MPCD by pressing PB 14 marked A/G RDR.



SEQUENCE POINTS SYMBOLS are the same as the ones displayed on TAD:

Steer Point. The number in the top - right is the steer point number.

Aim Point associated with steer point. The number in the top - right shows the steer point number and then aim point number (1.1, 1.3, 2.1 etc).

Initial Point (IP), which is always the steer point before the target point.

Aim Point associated with the initial point. The number in the top - right shows the initial point number and then aim point number (1.1, 1.3, 2.1 etc).

Target Point. It uses a whole number and a decimal (1., 2. etc).

Offset Point, associated with the target. The number in the top - right shows the target point number and then offset point number in two - digit format (1.01, 1.03 etc).

Base. Point of origin of the current mission / flight.

Bullseye. Used as reference points for all the assets in a given mission for providing bearing and range from that point to target or selected position.

1

Mark Points are marked as small triangle and identified by a number from 1 - 10.

Selecting Sequence Points can be done in a number of ways:

A. by pressing PB 17 (marked with SP legend)

B. by using using HOTAS command:

pulling **Coolie Switch** up short in the front cockpit

pressing **Castle Switch** in the rear cockpit

C. introducing the desired SP number via the UFC and pressing PB 17. This causes the new SP number to be displayed under the PB 17 and positions the cursor over the new SP.

The example of the A/G Radar Screen with Target Point 2. selected is on the next page. The cursor is inside the Target Point triangle, and the legend below PB 17 shows 2., which is the Target Point number.

If the selected SP is beyond the radar range the cursor will be limited to the edge of display along the radial from the aircraft to the reference sequence point.

ELEVATION SCALE allows to determine vertical antenna position.The tic marks are at +10°, +5°, +2°, +1°, 0, -1°, -2°, -5° and -10°.

ELEVATION CARET reflects the current antenna position against the Elevation Scale.

MAGNETIC HEADING / DIRECTION DISPLAY constantly shows the magnetic north in relation to the sensor line of sight.

Azimuth Tic Marks provide a reference for determining antenna position.

Azimuth Limit Balls are only displayed in HRM and GMT modes. They aid the aircrew to determine the antenna azimuth scan in relation to the blind zone, which extends 8° around the aircraft ground track.

Antenna Azimuth Caret reflect the current antenna position.

A/G Cursor Symbol is an open plus symbol that can be slewed by the aircrew around the radar display using the **TDC**. More information will be provided in detailed description of all the modes.

Zero Azimuth Line is displayed in RBM and GMT modes. The line is drift stabilized up to ±10° of drift.

Radar Range Rings represent the 25%, 50%, 75% and 100% of the selected range scale (displayed next to PBs 13 and 14).

11.3 AIR TO GROUND RADAR HOTAS

Front Cockpit Stick

<u>Auto Acquisition Switch</u>

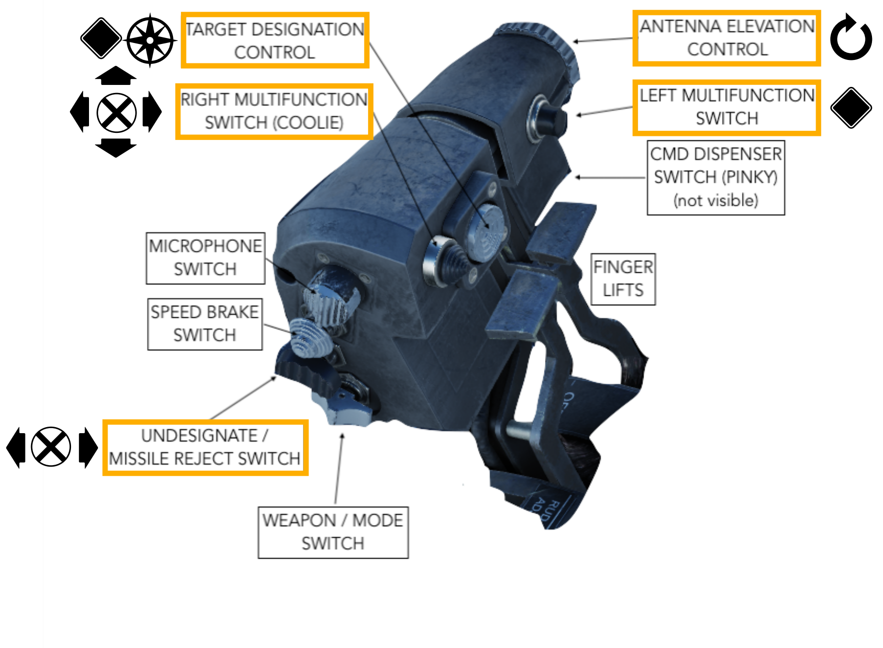
Pressing forward decreases the size of the Display Window (DW) in Map Cursor Mode

Pulling aft increases the size of the Display Window (DW) in Map Cursor Mode

Pressing down (in) with MAP rejects to PVU mode.

With TGT cursor selected and designated target, pulling aft alternately enables / disables PSL slewing.

Front Cockpit - Throttle



Target Designation Control (TDC)

Slews the cursor on the A/G Radar Display or positions the PSL.

After placing the cursor in the desired spot, pressing the TDC performs the selected function depending on the selected cursor mode.

In PVU mode, pressing the TDC accepts the errors displayed for MN velocity update. The values are frozen on the display for 4 seconds. If the INS is boxed, it begins the INS update process.

Undesignate (Boat) Switch

Pulling aft undesignates the selected target or the designated PSL.

Antenna Elevation Control Wheel

Commands the RBM antenna elevation.

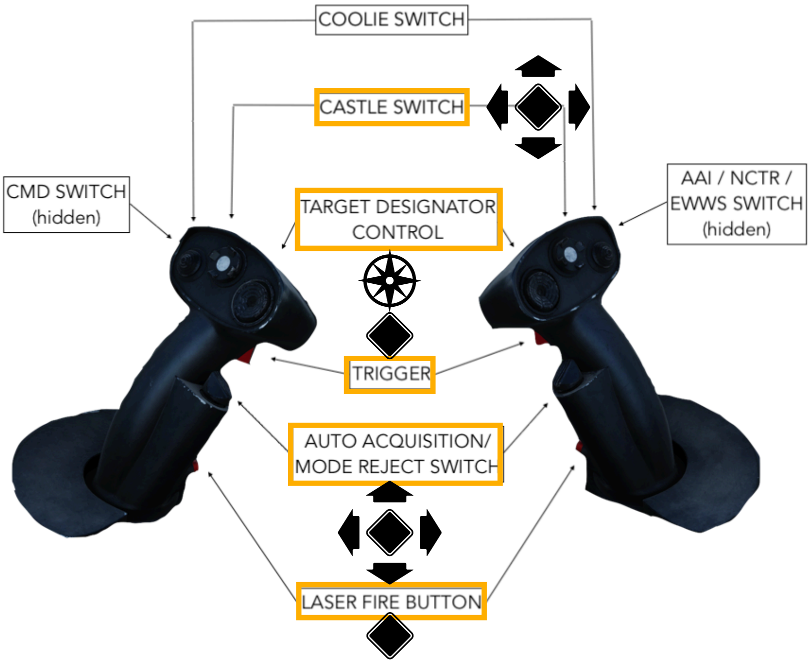
Left Multifunction Switch

Pressing this button selects or deselects FREEZE in RBM, which halts continuous mapping and allows for current sweep to finish. After that it displays the current RBM display indefinitely.

Coolie Switch

Pulling up short (<1s) on this switch - called a quickstep - selects next Sequence Point (or a blank one).

Rear Cockpit



Target Designator Control (TDC)

Slews the cursor on the A/G Radar Display.

When pressed up or down with **HC Trigger** depressed at half action it controls RBM antenna elevation.

Auto Acquisition Switch

Pressing forward decreases the size of the Display Window (DW) in Map Cursor Mode

Pressing aft increases the size of the Display Window (DW) in Map Cursor Mode

Pressing down (in) with MAP rejects to PVU mode.

Pressing Auto Acq Switch forward with **HC Trigger** at half action increases the range scale by one step in IGMT mode.

Pressing Auto Acq Switch aft with **HC Trigger** at half action decreases the range scale by one step in IGMT mode.

Pressing down in TGT cursor mode undesignates current target or designated PSL.

Trigger

◆ After placing the cursor in the desired spot, pressing the HC Trigger (full action) performs the selected function depending on the selected cursor mode.

◆ In PVU mode, pressing the trigger to full action accepts the errors displayed for MN velocity update. The values are frozen on the display for 4 seconds. If the INS is boxed, it begins the INS update process.

It also has additional functions when pressed to half action in conjunction with **Auto Acquisition Switch** and **TDC.**

Laser Fire Button

◆ Pressing this button selects or deselects FREEZE in RBM, which halts continuous mapping and allows for current sweep to finish. After that it displays the current RBM display indefinitely.

Castle Switch

The WSO can also use **HC Castle Switch** to select the cursor function:

Pressing forward short selects the MAP function.

Pressing aft short selects the TGT function.

Pressing right short selects the UPDATE function.

Pressing left short selects the CUE/MARK function.

◆ Pressing **Castle Switch** in the rear cockpit performs a quickstep between the Sequence Points.

AG RADAR HOTAS
Front Cockpit

STICK - FRONT COCKPIT				
SWITCH	**CONDITION**	**ACTION**		
AUTO ACQ SWITCH	Map Cursor Mode (HRM/RGM/GMT)	FWD Short **Decreases DW size**	AFT Short **Increases DW size**	DOWN **Rejects PVU mode**
	TGT cursor selected & designated target	AFT Short **Enable / disable PSL slewing**		
	PVU	DOWN **Rejects PVU mode**		

THROTTLE - FRONT COCKPIT		
COOLIE SWITCH	HRM / RBM / PVU / GMT	UP Short: **Sequence Point select**
ANTENNA ELEVATION CONTROL	A/G Radar in command	UP / DOWN: **Commands the RBM antenna elevation**
TARGET DESIGNATOR CONTROL	A/G Radar in command	**Controls the movement of the currently selected A/G radar cursor**
	Designate Cursor	PRESS short: **designate spot under the cursor**
	Mark Cursor	PRESS short: **create markpoint under the cursor**
	CUE Cursor	PRESS short: **cue sensors to the selected location**
	Position Update Cursor	PRESS short: **update position**
BOAT SWITCH	HRM / RBM / GMT	AFT Short: **undesignates current designation**
LEFT MULTI-FUNCTION SWITCH	HRM / RBM / GMT	DOWN Short: **Freeze / Unfreeze**
	GMT	DOWN Short: **stops GMT processing**

AG RADAR HOTAS
Rear Cockpit

HAND CONTROLLERS - REAR COCKPIT						
SWITCH	**CONDITION**	**ACTION**				
TARGET DESIGNATOR CONTROL	RBM / GMT	**Controls the movement of the currently selected A/G radar cursor**				
	PSL Designated	**Controls the PSL movement**				
	HC Trigger at Half Action	**Controls RBM antenna elevation**				
CASTLE SWITCH	A/G Radar in Command	FWD Short **MAP**	AFT Short **TGT**	LEFT Short **CUE / MARK**	RIGHT Short **UPDATE**	DOWN **Quick Step**
TRIGGER	Designate Cursor	FULL ACTION: **designate spot under the cursor**				
	Mark Cursor	FULL ACTION: **create markpoint under the cursor**				
	CUE Cursor	FULL ACTION: **cue sensors to the selected location**				
	Position Update Cursor	FULL ACTION: **update position**				
	HRM	HALF ACTION: **enables HRM expand**		FULL ACTION: Commands HRM Map		
	With TDC	HALF ACTION: **enables RBM antenna elevation control**				
	With Auto Acq Switch	HALF ACTION: **enables increase / decrease of range scaler in IGMT**				
AUTO ACQUISIT-ION SWITCH	Map Cursor Mode (HRM/RGM/GMT)	FWD Short **Decreases DW size**		AFT Short **Increases DW size**		DOWN **Rejects PVU mode**
	HC Trigger at Half Action IGMT Mode	FWD Short: **increases the range scale by one step**		AFT Short: **decreases the range scale by one step**		
	TGT Cursor Mode	DOWN Short: **undesignate current target or designated PSL**				
LASER FIRE BUTTON	RBM	PRESS Short **Freeze / Unfreeze**				

11.4 REAL BEAM MAP (RBM) MODE

The RBM mode provides low resolution ground mapping and weather detection capability. It can also include a GMT (Ground Moving Target) overlay.

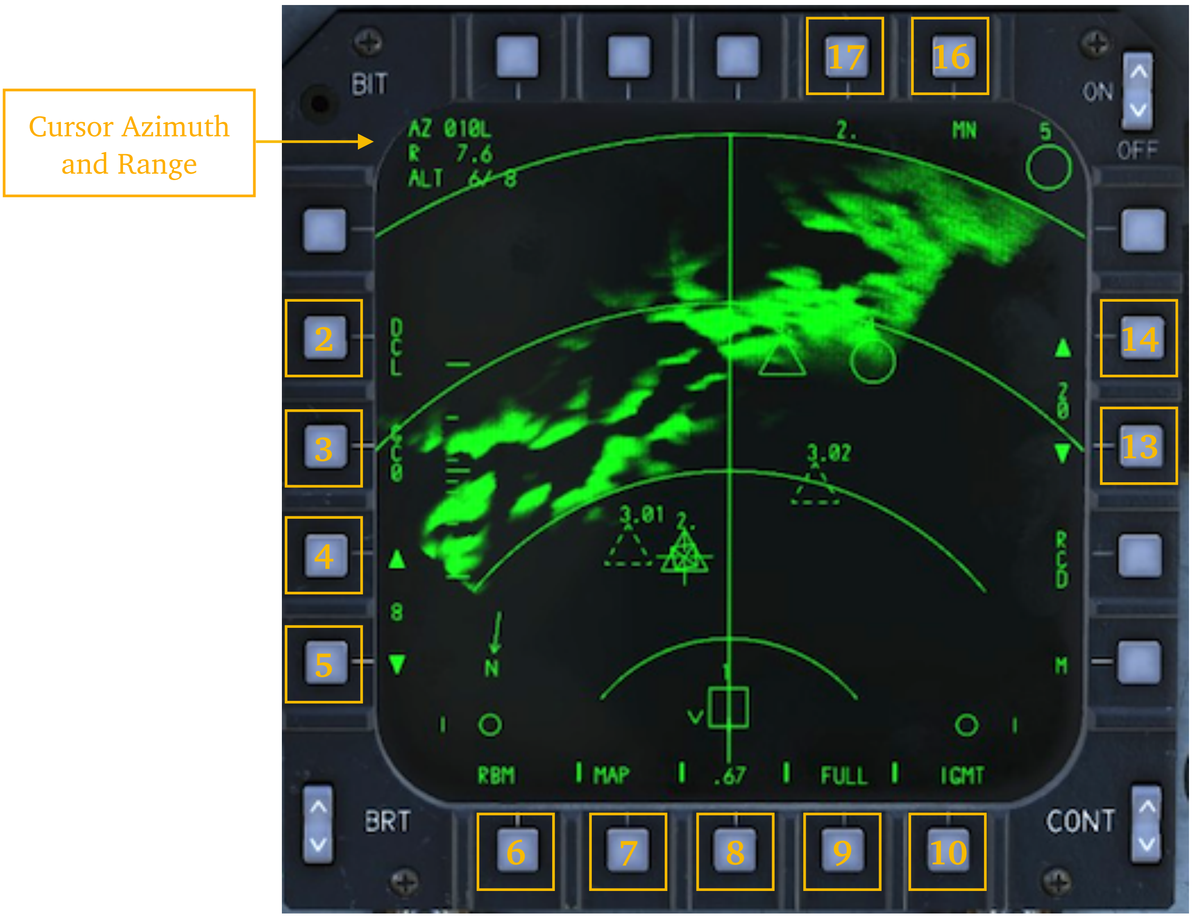
RBM is usually used to improve the situational awareness of the aircrew by mapping the approaching terrain features and for ground target inspection. It is also capable of detecting large cloud formations and adverse weather. Additional advantage of the RBM is that it can map aircraft's ground track, something that HRM (High Resolution Map) is not able do.

RBM uses a single bar azimuth sweep, with the full azimuth scan of 100° taking roughly 1.2 second.

NOTE: ranges displayed in RBM format are slant ranges, ie. distance measured in straight line from aircraft's nose to the selected point. That means that the range will increase with altitude. Conversely, ranges on the map are ground ranges.

11.4.1 RBM MPD CONTROLS

RBM is controlled via the MPD / MPCD pushbuttons and HOTAS.



PB 2, DECLUTTER (DCL): when pressed (DCL becomes boxed), it removes the following data and symbols from the display:

- Magnetic Heading / Direction Display
- Sequence points and their numbers
- Pattern Steering Line (PSL) and attack heading number

Declutter will remain on even if the radar mode is switched between RBM, HRM and GMT.

PB 3, RADAR GAIN (GC0-GC3): controls the intensity of radar returns through the receiver, which changes the gain (brightness) of the display. Four selections are available that can be cycled through by repeated pressing of PB 3. GC3 is recommended for normal operations.

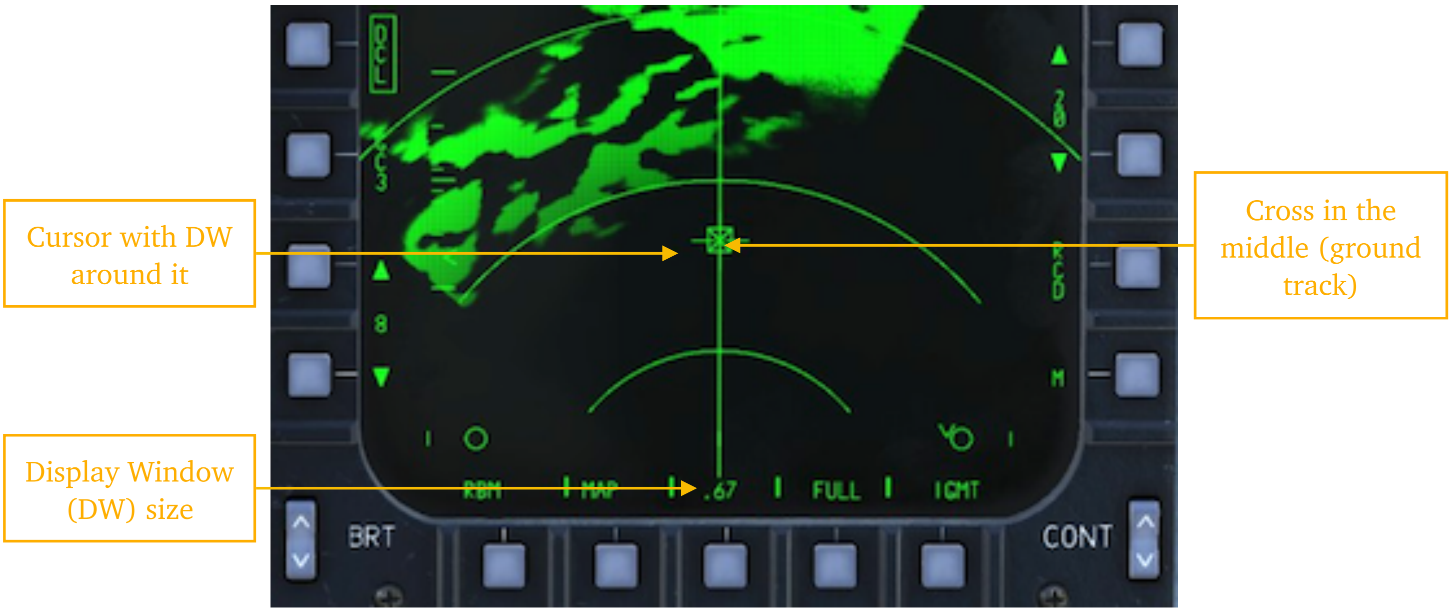
PB 4 - 5, DISPLAY BRIGHTNESS ADJUST (DBA): controls the brightness of the map display with 16 available levels (0 thru 15). Separate values of this setting are kept for RBM and HRM modes.

PB 6, RADAR MODE SELECT: this PB is used to switch between the four A/G radar modes: RBM, GMT, HRM and PVU. Currently selected mode is displayed above this PB.

PB 7, CURSOR FUNCTIONS: there are five distinct cursor functions, chosen by subsequent actuation of PB 7.

<u>**Map Cursor Function (MAP)**</u>

This is used to prepare the system for commanding HRM patch maps or to enable mode rejecting into PVU. When this function is selected, a special Display Window (DW) appears around the cursor. This DW equals the size of the patch map that would be commanded and can be changed pressing the **Auto Acq Switch** fwd and aft. Currently selected DW size is displayed above PB 8 (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80NM).



To command the HRM patch map, the pilot should press and release the **TDC**. The WSO should perform a full action on the **HC trigger** and then release it.

When this is done, MAP becomes boxed and time to go clock counts down in the bottom - right corner of the display. After it gets to zero, a map of the desired area is displayed and MAP is unboxed.

Position Update Cursor Function (UPDT)

This cursor is selected when the aircrew needs to perform a position update to either the MN (Mission Navigator) or INS from the real beam map.

NOTE: this function is not available in this stage of the Early Access.

Target Cursor Function (TGT)

With this cursor active, the aircrew is able to designate a point on a real beam map for weapons delivery. To do so, the pilot should press and release the **TDC**. The WSO should perform a full action on the **HC trigger** and then release it.

NOTE: selecting TGT does not pause the RBM scan, therefore selecting FREEZE is necessary to stop the continuous scanning.

Refer to Designating Targets section for more information.

Cue Cursor Function (CUE)

This cursor is used to direct or command an imaging supporting sensor (like LANTIRN) to a selected point on the RBM. The aircrew needs to first FREEZE the RBM to stop continuous mapping, and then command the designation in the normal way (press and release the **TDC** in the front cockpit, fully press and release the **HC Trigger** in the rear).

Mark Cursor Function (MARK)

This function allows the aircrew to mark a specific point on the RBM for future reference. After the cursor is positioned over selected point, the pilot should press and release the **TDC** to create a mark. The WSO should perform a full action on the **HC trigger** and then release it.

1 △ The mark symbol appears on the display underneath the cursor and its assigned mark number is shown next to the cursor.

A maximum of 10 mark points can be designated (any mark above the tenth overwrites the first one, then the second and so on). A maximum of 5 mark points can be displayed at the same time.

NOTE: selecting TGT will not pause the RBM scan, therefore selecting FREEZE is necessary to stop the continuous scanning.

PB 8, DISPLAY WINDOW SIZE shows currently selected DW size, with the following available options: 0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80NM. These values can be changed by pressing the **Auto Acq Switch** fwd and aft**.**

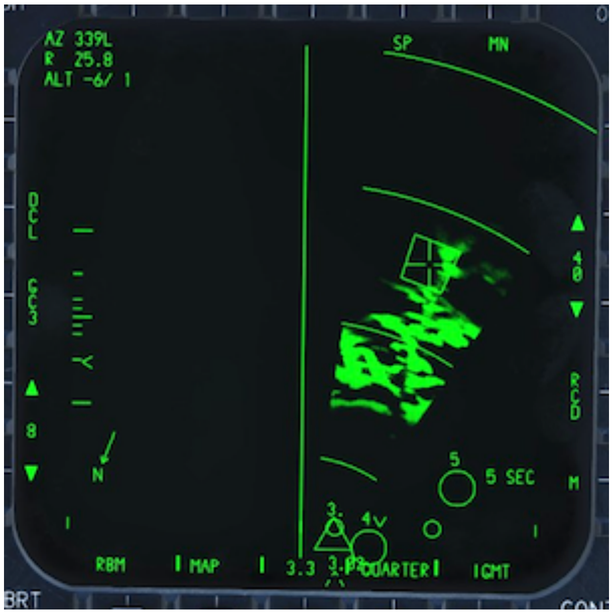
PB 9, ANTENNA AZIMUTH SCAN SELECT allows the aircrew to choose between three selectable PPI (Plan Position Indicator) scan widths:

FULL with the azimuth scan of 100°.

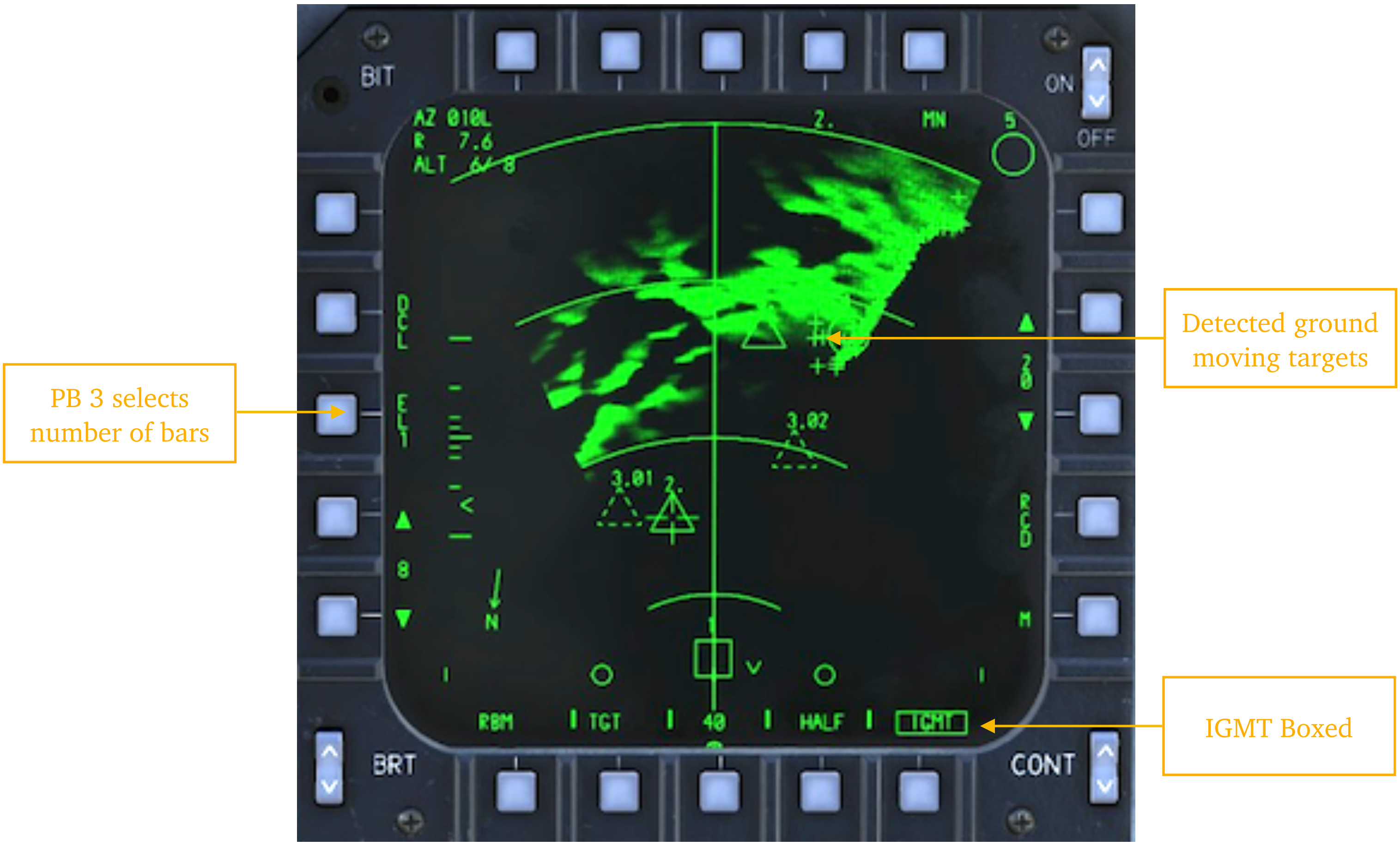
HALF with the azimuth scan of 50°.

QTR (quarter) with the azimuth scan of 25°.

With HALF or QTR selected, the azimuth scan is positioned on the cursor and the PPI can be moved to the either side of the velocity vector, as shown below.



PB 10, INTERLEAVED GROUND MOVING TARGET: This mode allows the aircrew to superimpose detected GMT (Ground Moving Targets) over the RBM display. It is only possible to do so if the selected map scale is 40NM or less (ie. with 80 or 160NM selected, there will be no legend above the PB10 and entering IGMT is inhibited).



Pressing PB 3 allows selection of elevation bars for the GMT scan, with the value between 1 and 4 (displayed next to the PB). Refer to Ground Moving Target section for more information.

PB 13-14, RBM RANGE SCALE: Actuation of PB 13 decreases, and of PB 14 increases the range scale. The available ranges are: 4.7, 10, 20, 40, 80 and 160 NM.

The WSO can can change the range scale by pressing **HC Auto Acquisition Switch** fwd or aft with the **HC Trigger** in half action.

PB 16, INTERLEAVED POSITION VELOCITY UPDATE: When boxed, the radar automatically updates the Mission Navigator velocities every 60 seconds. Please see Precision Velocity Update (PVU) Mode section for more details.

BP 17, SEQUENCE POINT INDICATOR SELECTOR displays the currently selected Sequence Point on the radar beneath the pushbutton.

Pressing the PB 17 jumps to next SP in sequence (or to the blank SP).

Desired SP number can also be typed into the scratchpad, and then selected by pressing the PB 17.

PB 19-20, CHANNEL / BAND SELECT: Works in exactly the same way as for the air to air radar.

NOTE: this function is not available in the current version of Early Access.

CURSOR AZIMUTH AND RANGE indicates the azimuth and range from the aircraft to the A/G radar cursor.

The ALT line displays the minimum and maximum altitude (in thousands of feet) covered by current RBM, with the assumed 1 bar scan and 2.5° beamwidth.

11.5 GROUND MOVING TARGET (GMT) MODE

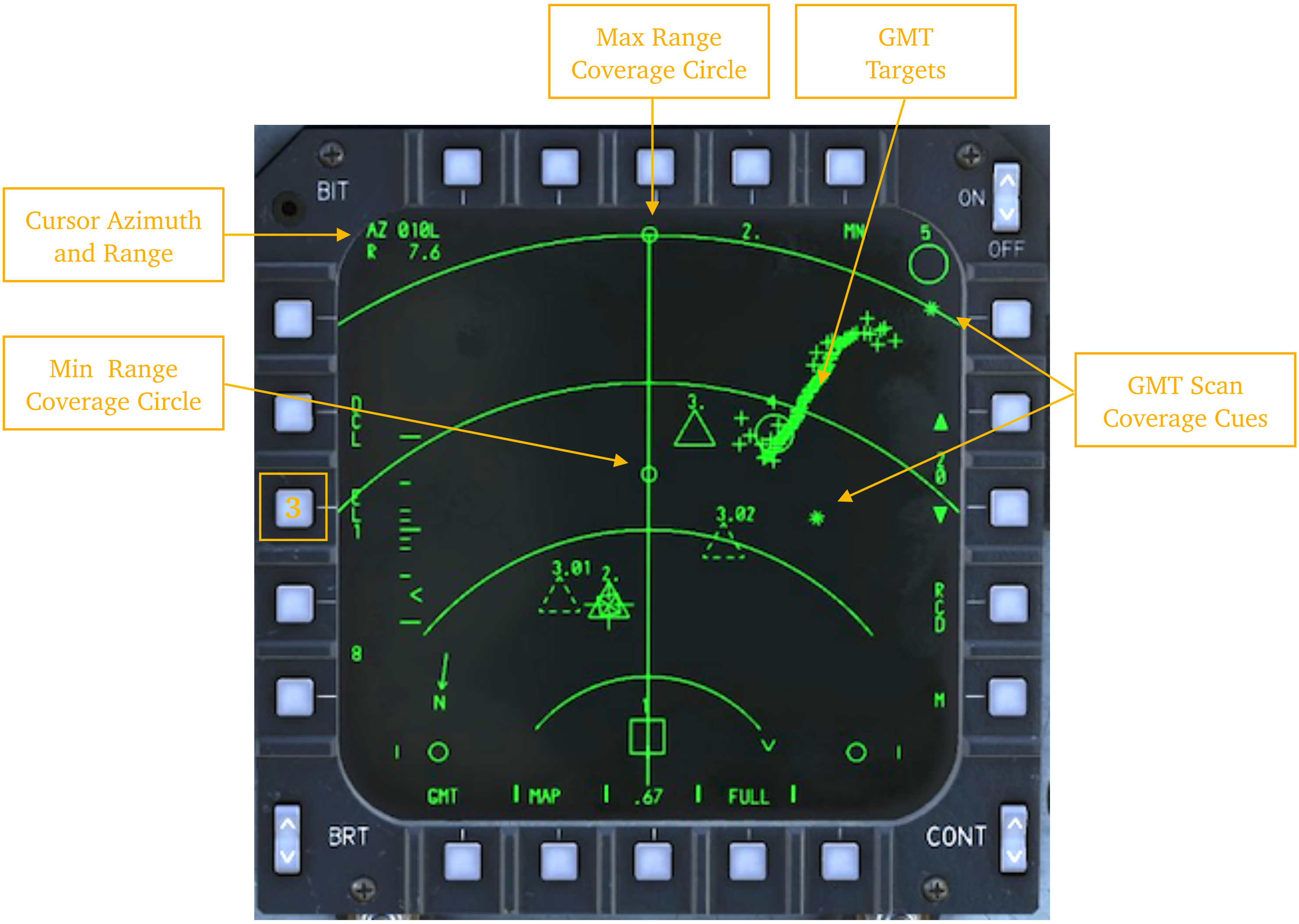
The GMT mode allows the aircrew to detect the moving targets on the ground (such as truck convoys, tanks etc) and facilitate targeting them using the TPOD.

Maximum range for target detection in GMT is 32 NM - with the maximum selectable scan range of 40 NM.

GMT can work as a dedicated mode, without the background map information or interleaved with RBM. It is entered using PB 6 from other A/G radar mode or as IGMT by pushing PB 10 when in RBM.

11.5.1 GMT DISPLAY AND CONTROLS

The controls for GMT are almost the same as for RBM - only differing information will be described below.



PB 3, ELEVATION BAR SELECTION changes the number of scan bars. Pressing this PB switches between 1, 2, 3 and 4 bars and takes effect at the beginning of the next GMT frame.

The radar takes into account the EL BAR setting commanded by the aircrew and the terrain altitude to determine the desired EL coverage and updates the range coverage cues accordingly. This means that EL BAR setting will not always be respected if some of the bars do not provide additional coverage.

The EL beam width is 4.6° in 4.7 and 10 NM range scales and 3.55° in 20 and 40 NM.

MIN AND MAX RANGE COVERAGE CIRCLES show the minimal and maximal range coverage in PPI format. They constantly shift, taking into account aircraft position, EL BAR setting, antenna slewing and terrain altitude. In GMT mode with more than one bar the radar scans from the nearest to the farthest range, which means that the closest targets are observed first.

GMT SCAN COVERAGE CUES provide additional information about the GMT scan coverage on the current bar. They move left and right to reflect the current horizontal position of the antenna. The lower asterisk shows the minimum scan coverage for the frame, and the upper one always represents the maximum range of the current bar.

GMT TARGETS show those targets that qualify as GMTs as plus (+) symbols. The maximum number of targets that can be displayed during one frame is 100. Detected targets are correctly positioned relative to the map video during the first scan and remain on the display during the next one, but are then mispositioned. They are subsequently erased on the third GMT frame.

11.6 HIGH RESOLUTION MAP (HRM) MODE

The HRM mode was designed to build radar maps in high resolution. Resolution of the display is measured in feet, with the best being 8.5 feet. Building HR maps takes time (usually between 2-12 seconds). Up to five mark points and sequence points can be overlayed on HRM video. Antenna elevation is controlled automatically and does not require any input from the aircrew.

There are several restrictions that have to be taken into account when building a HRM:

1. HRM is not available in aircraft's blind zone, which extends 8° around the aircraft ground track.

2. HRM is not available if the aircrew is trying to map the area too close to the gimbal limit.

3. HRM is not available if the aircrew is trying to map a patch with size too large for current range (so, for instance, 20 NM patch at range scale set to 10 NM etc).

Two types of HRM can be generated: HRM PPI Map and HRM Patch Map.

11.6.1 HRM PPI Map

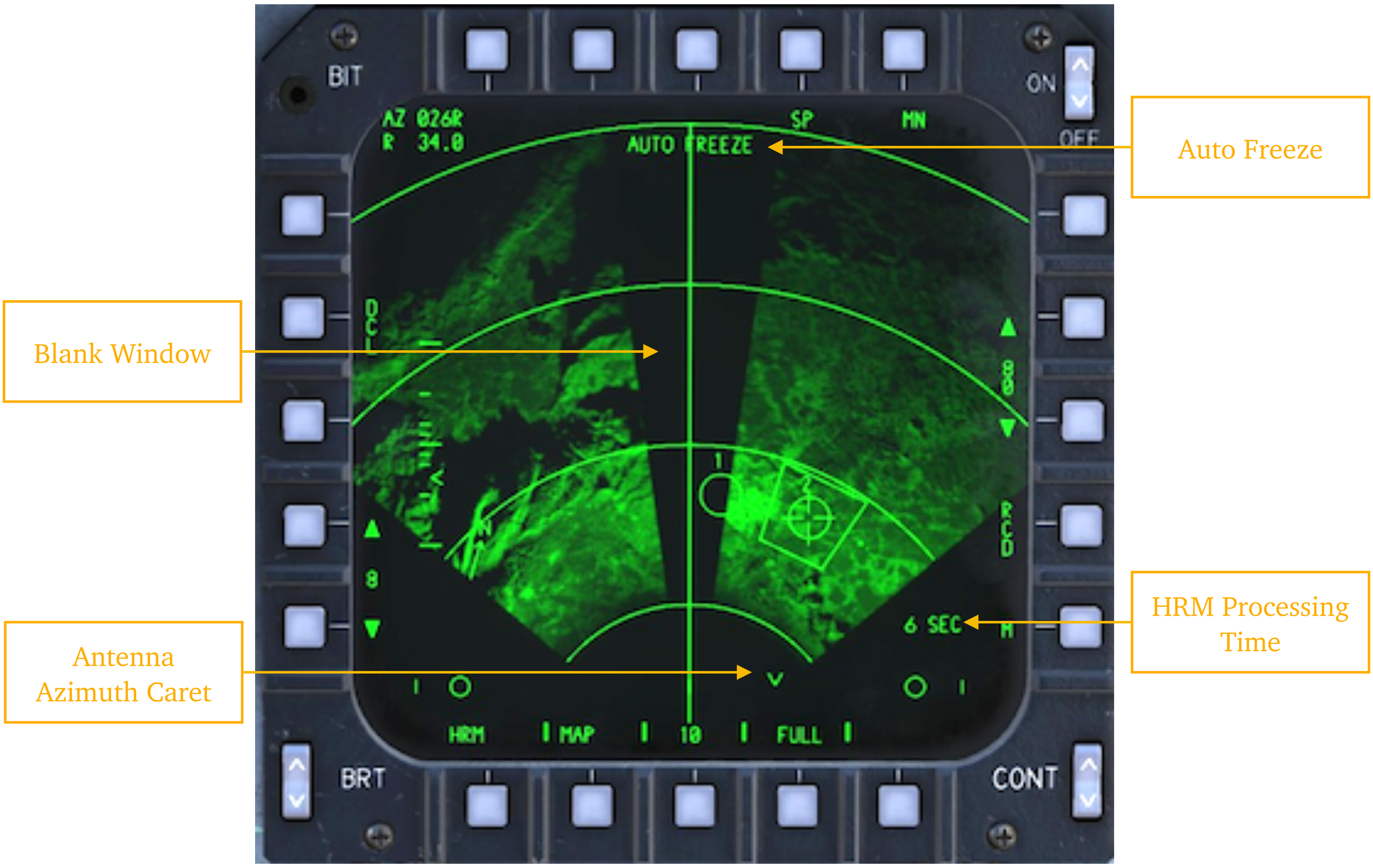
High resolution map can be displayed in a PPI presentation, which is similar to RBM. It covers a relatively large area and is useful for terrain surveillance and situation awareness.

To enter HRM in PPI mode, the air crew should press PB 6 until HRM legend is displayed above it.

The selectable range scales for the PPI mode are 4.7, 10, 20, 40, 80 and 160 NM.

Depending on aircraft speed, it takes some time (typically 7 - 10 seconds) to build the HRM.

Half and quarter azimuth widths are selectable and require less time to construct. They can be chosen by pressing **PB 9**.



The **Blank Window** is a blind zone of roughly 8° on each side of aircraft's ground track (so 16° in total). Mapping is not allowed in this zone due to prohibitive time of area map construction stemming from very low squint angle (angle off the ground track). The **Antenna Azimuth Caret**, which moves slower in HRM mode than in RBM, slides over the Blank Window.

The HRM processing time in the lower - right corner depends on the size of the Display Window and shows how long it will take the radar to process the new image if commanded at the current position of the cursor.

Auto Freeze is displayed if the mapping operation is required outside certain limits (such as that less than 75% of the scan area is mappable). Refer to the list in the HRM Mode section.

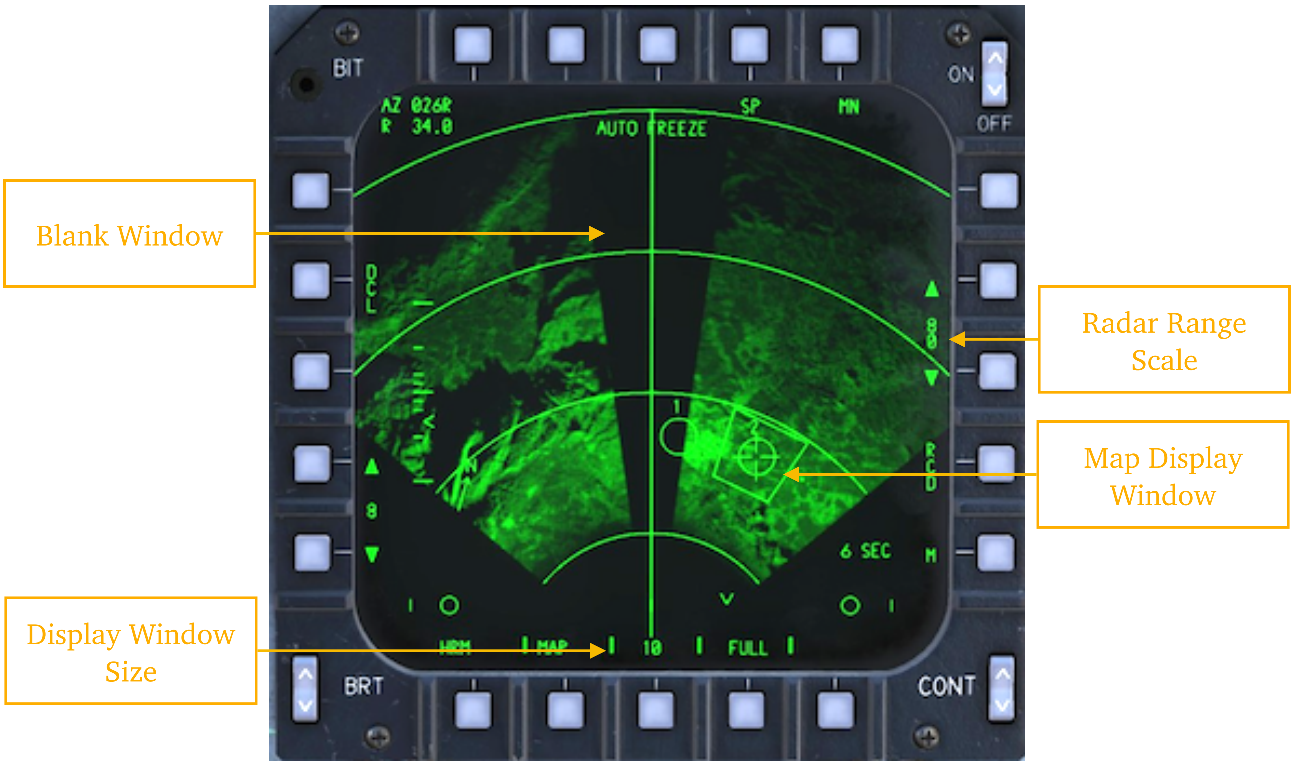
Pushbuttons in PPI mode have the same functions as those described in the RBM Mode section.

11.6.2 HRM Patch Map

A HRM patch provides a smaller, area - specific and higher resolution map than the PPI.

HRM patch can be selected from almost any A/G radar mode: HRM PPI, RBM, GMT and PVU.

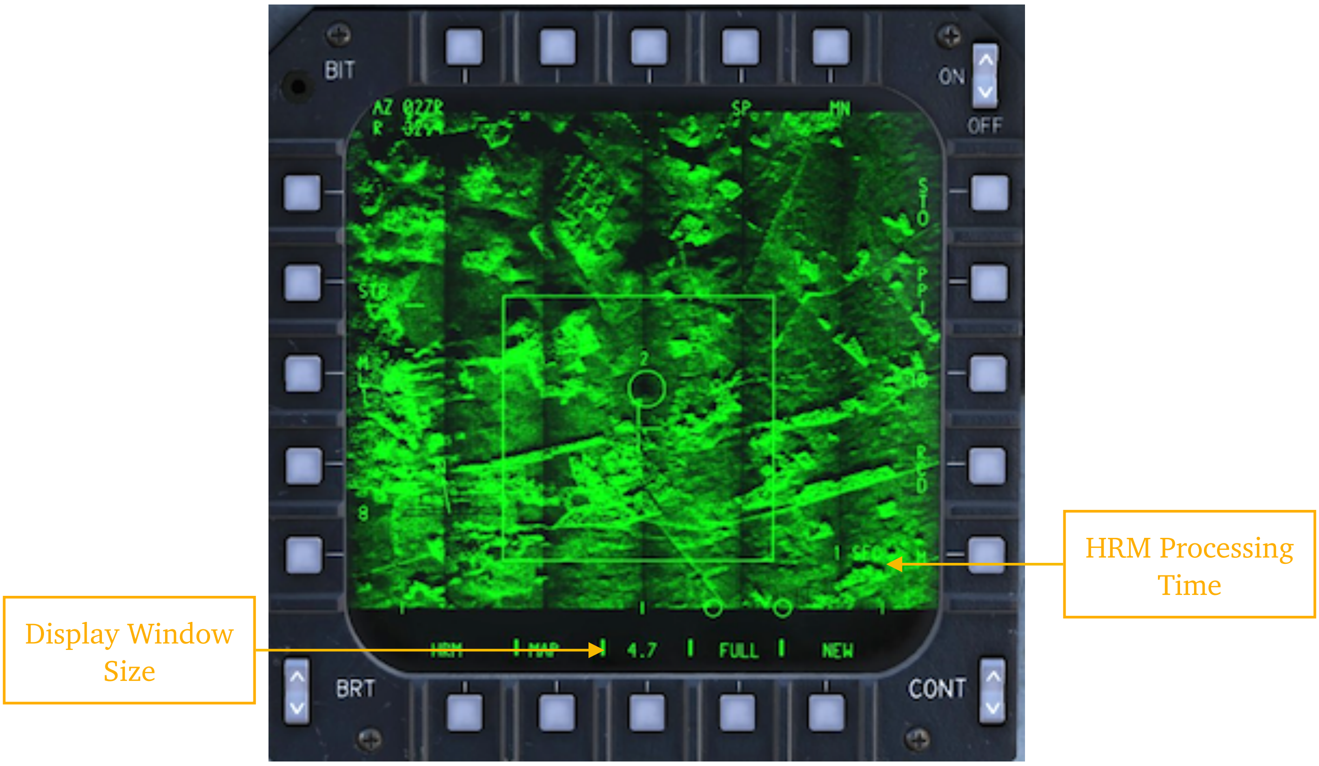
To command a patch mode, the aircrew should select the MAP cursor function using **PB 6**. When this function is selected, a special Display Window (DW) appears around the cursor. This DW equals the size of the patch map that would be commanded and can be changed pressing the **Auto Acq Switch** fwd and aft. Currently selected DW size is displayed above PB 8 (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80NM).



In the example above, the size of the patch map is 10 NM, as indicated by Display Window Size. The range scale is 80 NM. Should the DW size be too large to properly map, large X would be displayed superimposed over the Map Display Window:

To command the HRM patch map, the pilot should press and release the **TDC**. The WSO should perform a full action on the **HC trigger** and then release it.

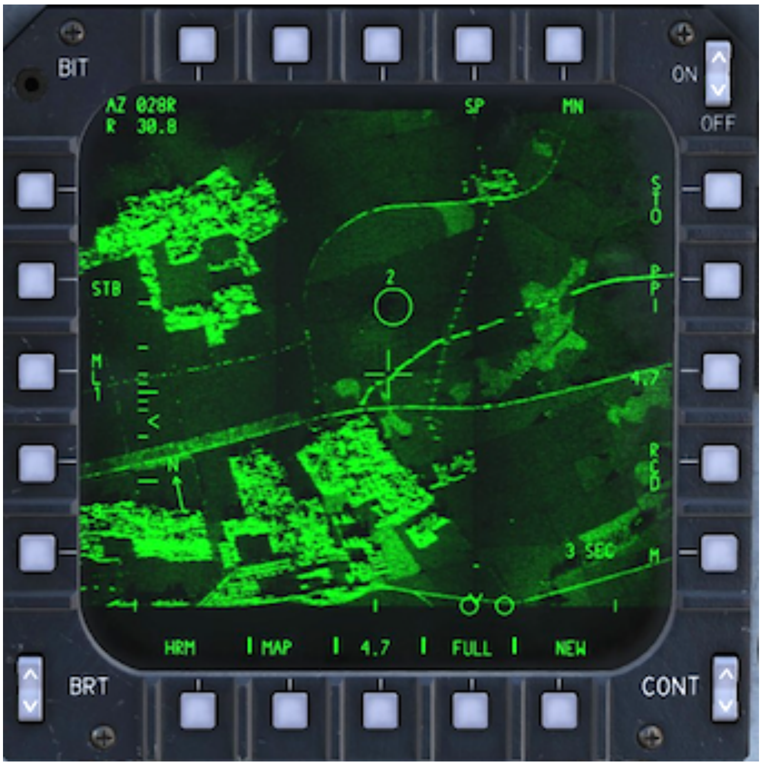
When this is done, MAP becomes boxed and time to go clock counts down in the bottom - right corner of the display. After it gets to zero, a map of the desired area is displayed and MAP is unboxed.



Once this is done, it is possible to select a smaller DW (4.7 NM in this case) and generate a more detailed map of the selected area.

To do so, the pilot should again press and release the **TDC**. The WSO should perform a full action on the **HC trigger** and then release it.

The **HRM Processing Time** counter will again go down, and new radar picture will be displayed.



The picture should be further refined using smaller DW sizes (in the example above, 3.3, 1.3 and 0.67 NM are still available).

Relation between the DW, cursor range and max range displayed can be found in the table below:

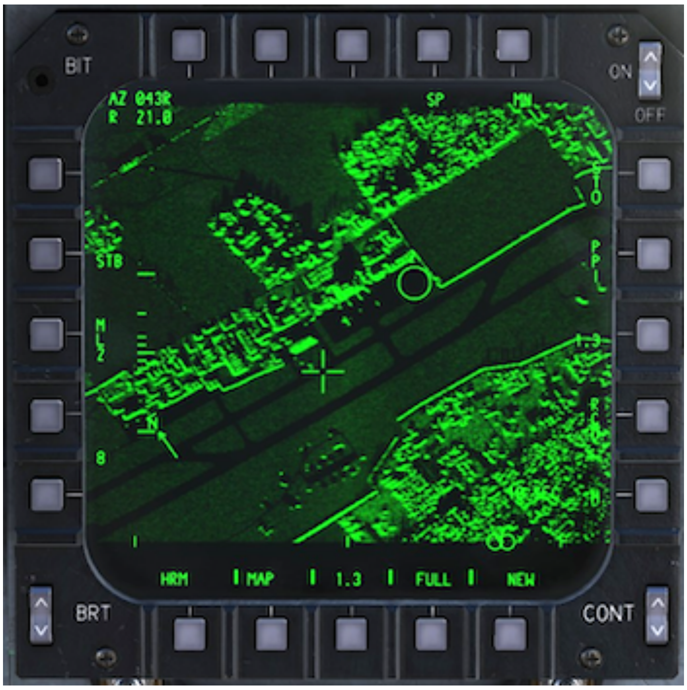
DW Size (NM)	Min Cursor Range	Max Cursor Range	Max Range Displayed
0.67	3.0 NM	39.33 NM	40 NM
1.3	3.4 NM	39.33 NM	40 NM
3.3	4.4 NM	48.65 NM	50 NM
4.7	5.2 NM	77.65 NM	80 NM
10	11 NM	155 NM	160 NM
20	22 NM	150 NM	160 NM
40	44 NM	140 NM	160 NM
80	88 NM	120 NM	160 NM

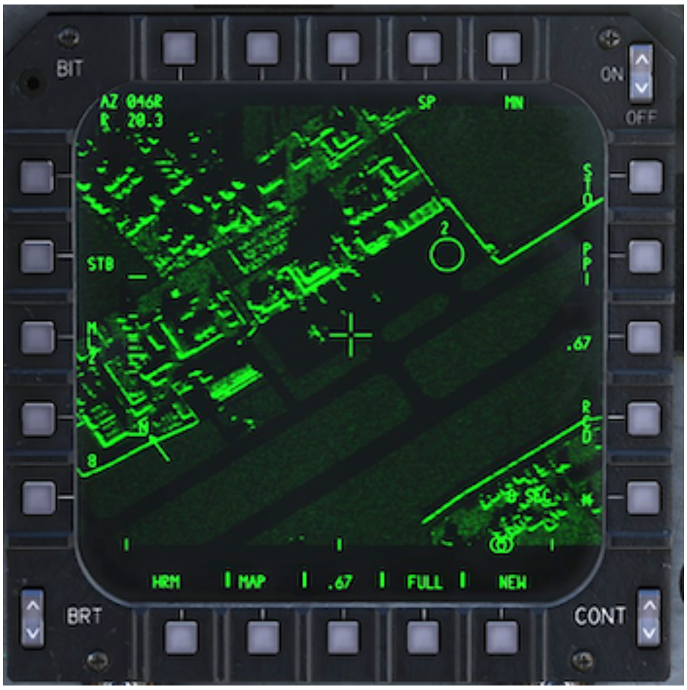
NOTE: For DCS, best results can be achieved using newer maps (like Sinai or Marianas), where there is higher density of objects. Older ones, like Caucasus, will never produce the same results.

With a bit of practice and proper use of options described in the next section (such as multilook), it is possible to build accurate, high quality maps at ranges vastly exceeding capabilities of the targeting pod's.

One important factor is the angle at which the radar paints the area - it cannot be too steep or too shallow, therefore at longer ranges being at higher altitude helps.

Below are two examples of a HRM patch map built for the Aleppo airport from over 20 NM away.

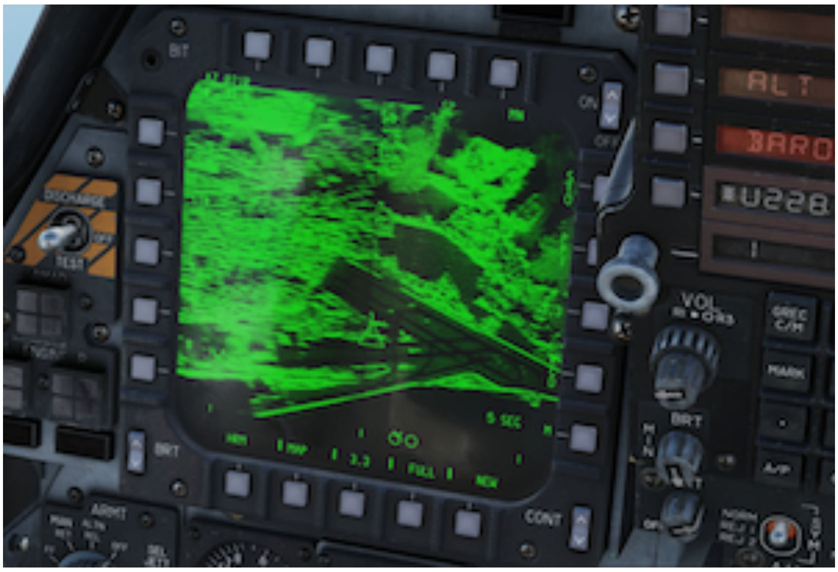


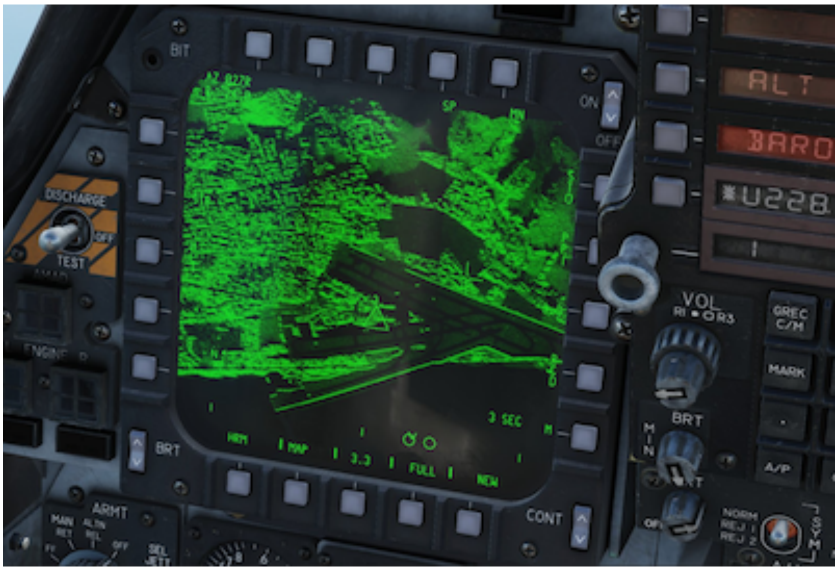


There are three aircraft clearly visible on the ramp, even from this distance (for reference: C-17, AH-64 and C-130).

It is also important to remember that for aircraft without EGI it is crucial to perform a Precision Velocity Update prior to building a HRM patch map, as without it the results may be severely degraded, as presented below.

The same area HRM patch map built before and after PVU update:





11.6.3 HRM DISPLAY PUSHBUTTONS

When in patch mapping mode, additional pushbuttons and options are available for the HRM.

PB 2, STABILIZED / PROGRESSIVE: Two patch map stabilisation options.

Stabilized patch map remains centered on the fixed point on the ground, so the refreshed picture will always be based on the same spot, only rotate as the aircraft changes position relative to it.

Progressive patch maps are constructed at a fixed range and angle off the velocity vector and will follow the aircraft movement.

PB 3, MULTILOOK OPTION: Two options are available, ML 1 and ML 2. With either option, the radar map is generated by dividing the selected map into certain arrays for video processing.

With ML 1, the arrays have very little overlap and are processed independently to generate a complete radar map. This generally is a faster way of building a map.

With ML 2, each array oversteps its two neighbor arrays by 50% each. This generally improves the video quality, but takes roughly 1.5x more time than ML 1.

PB 10, RECALL (NEW / OLD) allows the aircrew to show the current map (NEW) or recall the previous map displayed (OLD). If a new map is constructed, it overwrites whichever map is not currently displayed and the previously displayed map becomes an old map.

PB 13, HRM DISPLAYED MAP SIZE displays the size of the currently displayed map (in NM). This PB is not functional.

PB 14, PPI SELECT: During the HRM patch mapping pressing this PB will tell the radar to immediately return to HRM PPI mode with the last selected PPI range scale and full azimuth scan.

PB 15, STORE: This option allows the aircrew to save a specific high resolution map so that it can be recalled later. With STO selected, radar will save the stored map and the most recent one and pressing PB 10 cycles between these two (as opposed to current and one before it without PB 15 selected).

Store selection is only possible when FREEZE is commanded (STO becomes boxed).

Map cueing errors

The main reason for low radar map quality are errors in current aircraft position and velocity. While with EGI equipped jets this shouldn't be a problem, as it constantly sends the updated data to the radar, without EGI a PVU update should be performed before attempting to build a HRM map.

Map resolution

There are 480 by 480 range and azimuth cells (pixels) making up the displayed map. Therefore for each range radar has to set up cells with the size equal to 1/480 of the given map size, which is the resolution in feet:

DW Size (NM)	Resolution Cell Size (feet)
0.67	8.5
1.3	17
3.3	42
4.7	59
10	127
20	254
40	508
80	1016
160	2030

11.7 PRECISION VELOCITY UPDATE (PVU) MODE

In this mode, the radar provides an estimate of velocity error for updating the MN or the INS. Irrespective of the version, radar antenna is positioned to a fixed point relative to jet's velocity vector and the system calculates the doppler range rate for the piece of terrain illuminated by the antenna boresight. There are three different versions available to the aircrew.

Mission Navigator PVU updates to the Mission Navigator, offering the accurate short term system velocity without affecting the INS. First, the radar performs a coarse doppler estimate to detect potentially large velocity errors. Once valid coarse data for two successive positions is obtained, the radar proceeds with determining the PVU error. This usually takes around 10 seconds. The aircrew then updates the MN by accepting the errors, which causes the display to freeze for four seconds and the word UPDATE to be displayed.

INS PVU uses radar antenna for in flight update of the INS, which is a much longer process, but is likely to achieve better long-term iNS performance. To do so, the aircrew needs to enter the dedicated PVU mode and box the INS to prepare for an update. Once valid errors are displayed, they have to be accepted for the INS PVU to begin.

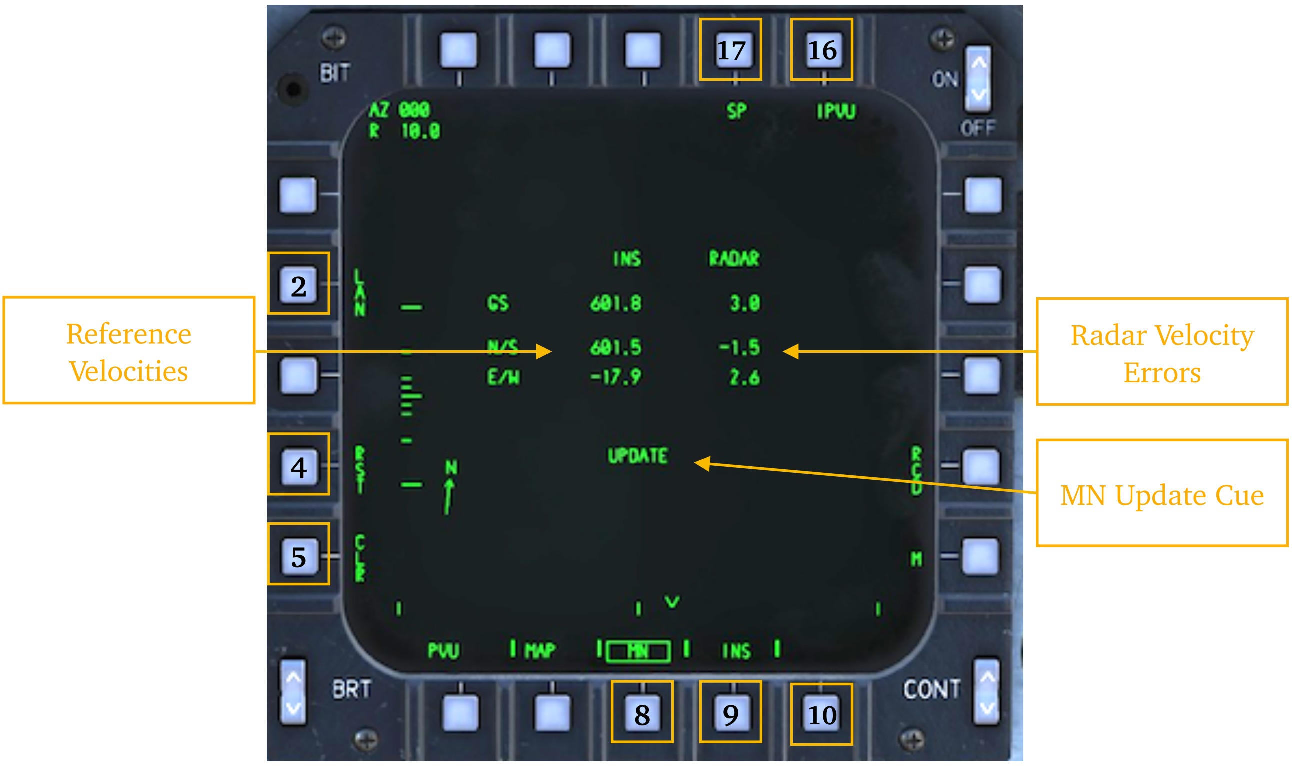
This is an ongoing process that will last until it is stopped by the aircrew. Theoretically, the longer the update, the better the results, but in practice 3-6 minute updates should be sufficient. The best update profile should include 90° to 180° heading changes, as well as climbs, dives, accelerations and decelerations.

Interleaved PVU (IPVU): Automated version of PVU available in HRM and RBM modes. This mode configures the radar to enter the PVU mode once a minute, which keeps the system accurate with minimum aircrew attention. However, this mode will not be as accurate as manually commended PVU, which should be performed with MN as PPKS before building the first HRM map.

The PVU mode is entered via PB 6 from any A/G Radar mode or via mode reject from the RBM.

11.7.1 PVU Display and Pushbuttons

The following pushbuttons and display options are available in PVU mode.



PB 2, Land / Sea: for the majority of updates, LAN option should be selected. However, when in need to perform an update while flying over large water areas, the SEA option is available - however, due to measurement corruption by water currents, even in this mode velocity errors may still exist.

PB 4, Reset: This button allows the aircrew to reinitialize the PVU, deleting the current data and starting the averaging process anew.

PB 5, Clear: This PB allows the aircrew to set to zero any prior MN velocity update. It is worth noting that clear command is sent to radar and MN automatically 5 minutes after any MN data accept.

PB 8, Mission Navigator: It is boxed by default upon entering the PVU mode. Allows updating the MN velocities once the aircrew accepts the PVU errors.

PB 9, INS: This PB has to be selected to perform the INS velocity update. Once the errors are displayed, the aircrew has to accept them to begin the update process.

PB 10, IFA: The in flight alignment legend appears only if the INS has been cycled from OFF to NAV during flight.

PB 16, IPVU: When boxed, it enables the interleaved PVU update, as described above.

PB 17, SEQUENCE POINT: This displays the currently selected Sequence Point. If a SP is chosen while in PVU and REJECT button is pressed on **Aut Acq Switch**, it returns the radar to HRM patch of the given SP.

Reference Velocities: Display ground speed components as provided by INS.

Radar Velocity Errors: Show the difference between the Reference Velocities and the computations made by the radar.

MN Update Cue: This cue is displayed for 5 seconds below the PVU data display when the aircrew has commanded an update.

11.7 A/G RANGING (AGR) MODE

The AGR mode provides slant range measurement for target altitude determination, target designation or position updates. This mode cannot be selected and is commanded automatically every time the CC determines that a slant range is necessary for proper designation or weapons delivery.

It is worth noting that AGR mode interrupts other radar mode operations in progress and should be carefully monitored by the aircrew. These will be described in other sections of this manual, however below one can find a list of such instances:

1. During MAP / NAV AUTO weapon delivery in A/G Master Mode, slant range measurement is required for the last 15 seconds prior to weapon release.

2. During targeting pod designation when laser is not armed or not operational, the CC will use AGR provided that the radar was cued to the targeting pod LOS.

To manually exit the AGR mode, the aircrew needs to take command of A/A or A/G radar display. However, this is not possible when slant range is being measured in AUTO weapon delivery asdescribed in point 1.

CHAPTER 12: LANTIRN TARGETING POD

12.1 INTRODUCTION

The AN/AAQ-14 targeting pod provides a high resolution IR display in conjunction with accurate pointing and laser range information. It can be positioned manually or cued to a spot designated using other onboard sensors, such as the A/G radar. The AN/AAQ-14 pod weighs 575 pounds.

Powering up

Power to the LANTIRN pod can be initiated only from the back cockpit, using a switch on the Sensor Control Panel (**1**). The same panel governs the gain / level (**2**), as well as arming the laser (**3**).

With the power switch set to OFF, the targeting pod is stowed. Placing the switch to STBY starts the sensor head cooldown period, which normally takes between 5 to 8 minutes.

Targeting Pod Boresight

Aircrew has an option to perform mechanical or electrical boresight of the targeting pod. These, however, are not relevant for DCS and will not be implemented.

FLIR tuning and focus

There are several options available under setup mode (T2) to fine - tune the level, gain and focus for better IR video sharpness and clarity. These can be set to manual or automatic (default mode).

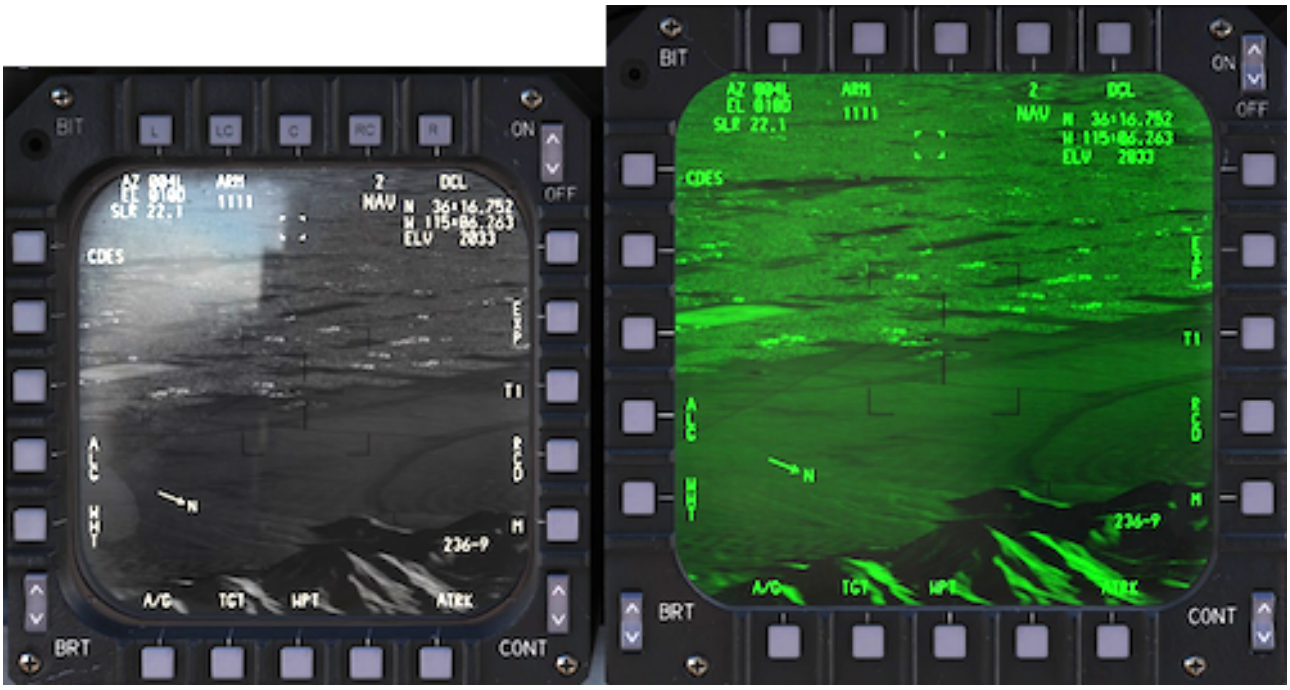
NOTE: manual mode is not available in Early Access.

12.2 TARGETING POD DISPLAY

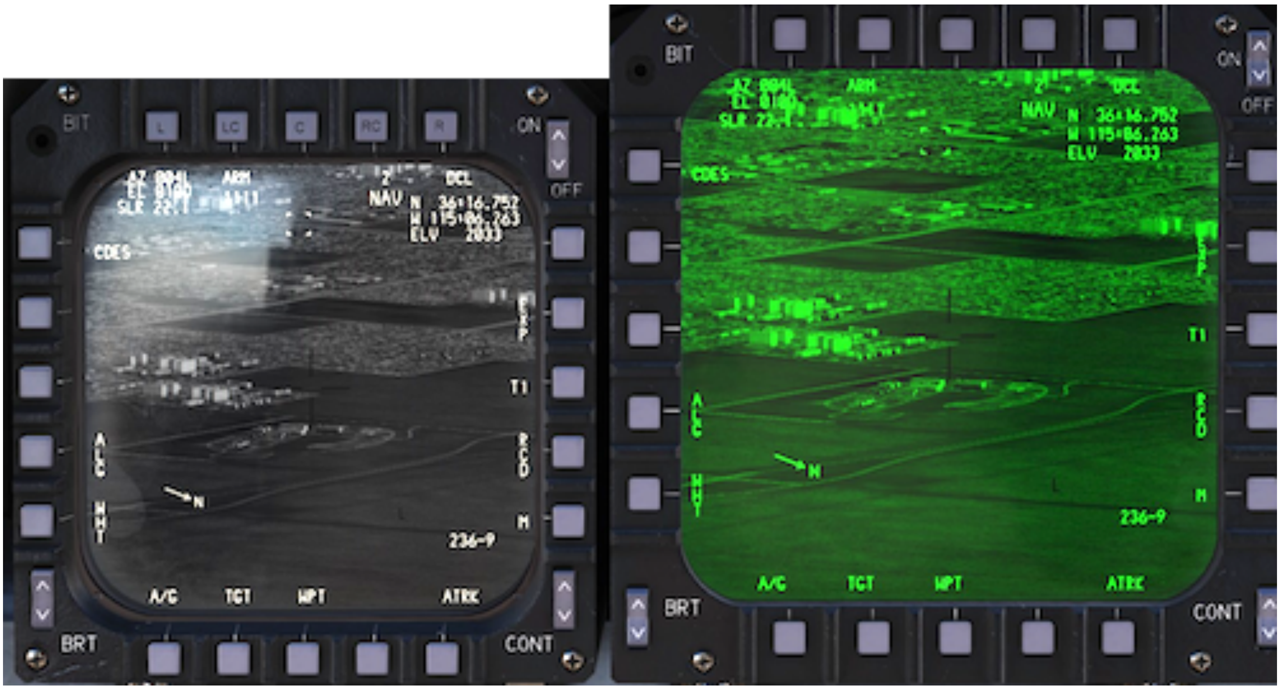
The targeting pod provides three seeker Field of Views (FOV), depending on the cockpit screen which is being used and the magnification level. Three options are available: Wide (WFOV), Narrow (NFOV) and Expanded Narrow (ENFOV).

FOV	Video Dimension	MPD Magnification	MPCD Magnification
WFOV	5.87° x 5.87°	2.3x	1.9x
NFOV	1.65° x 1.65°	8x	6.7x
ENFOV	0.825° x 0.825°	16x	13.4x

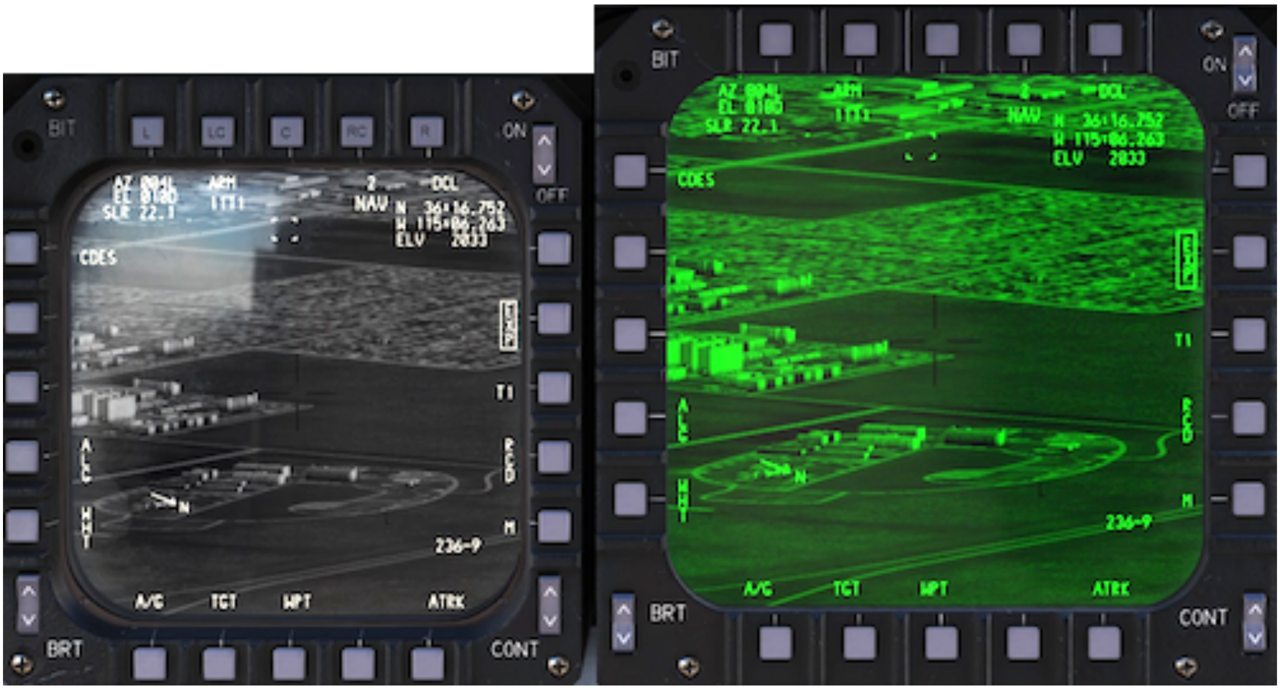
In practice the difference between displays and FOVs looking at the same spot will be as follows:



Wide Field of View



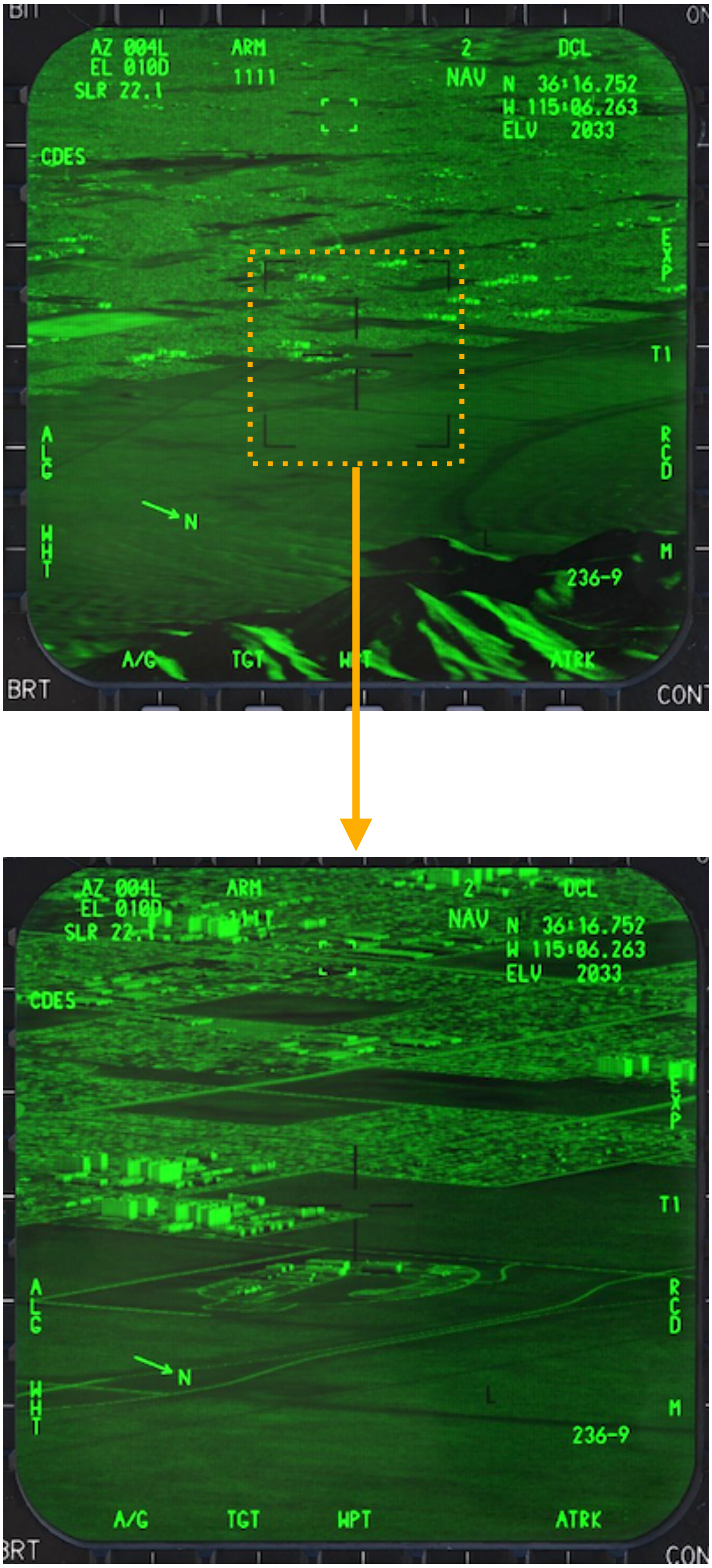
Narrow Field of View



Expanded Narrow Field of View

Expanded NFOV is only available if EXP legend next to PB 14 is boxed.

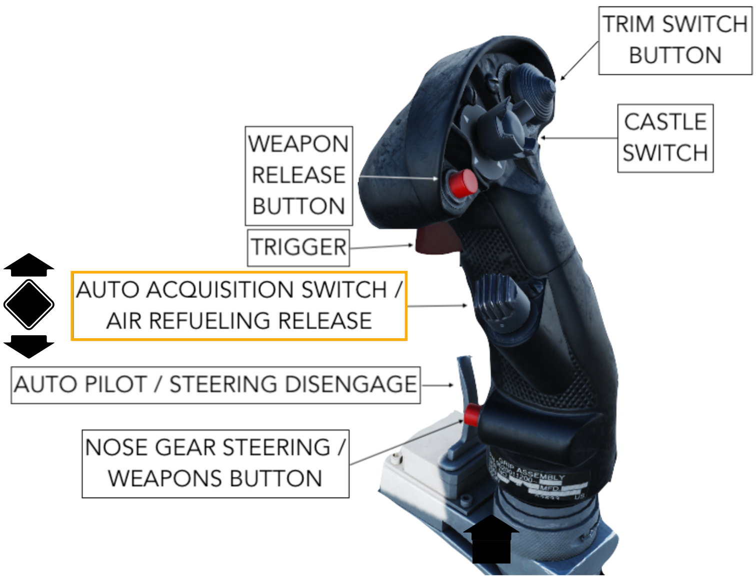
Four corner markers within the WFOV and NFOW (if EXP is boxed) outline part of the screen which will be visible if next smaller FOV is commanded.



12.3 TARGETING POD HOTAS

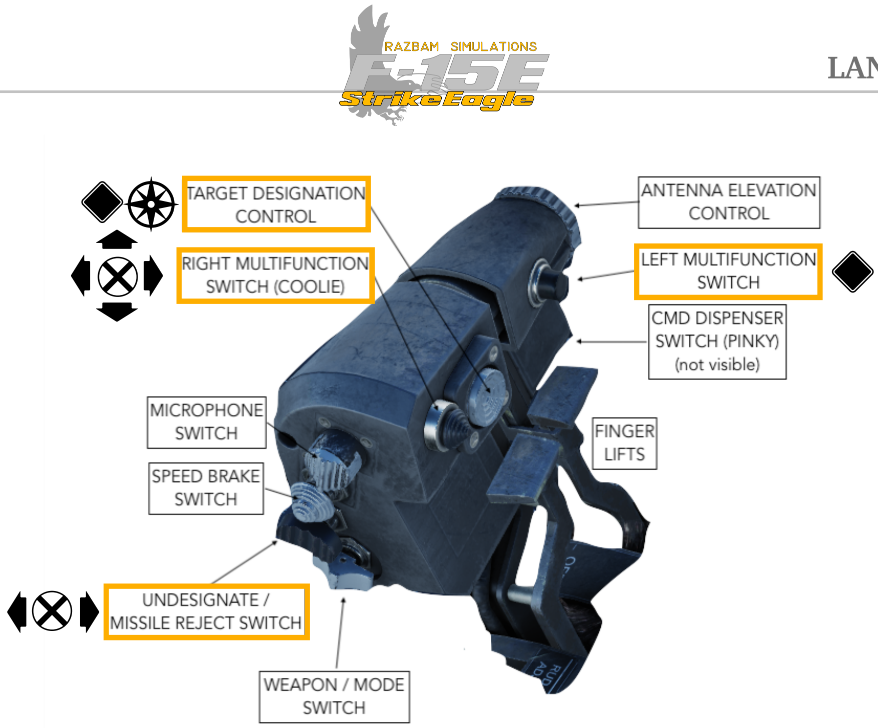
12.3.1 FRONT COCKPIT

The following HOTAS commands for LANTIRN are available in the front cockpit.



Auto Acquisition Switch

- Pushing forward short (<1s) changes the FOV (WFOV -> NFOV -> ENFOV -> WFOW)
- Pushing forward long (>1s) enables Snowplow mode
- Pulling aft short (<1s) commands return to cue.
- Pulling aft long (>1s) selects / deselects space stabilization.
- Pressing down commands track / untrack.



Left Multifunction Switch

◆ Pressing it enables the laser fire.

Target Designation Control

Slew control for the targeting pod.

◆ Pressing TDC performs the special cursor function (designate, mark, cue or update)

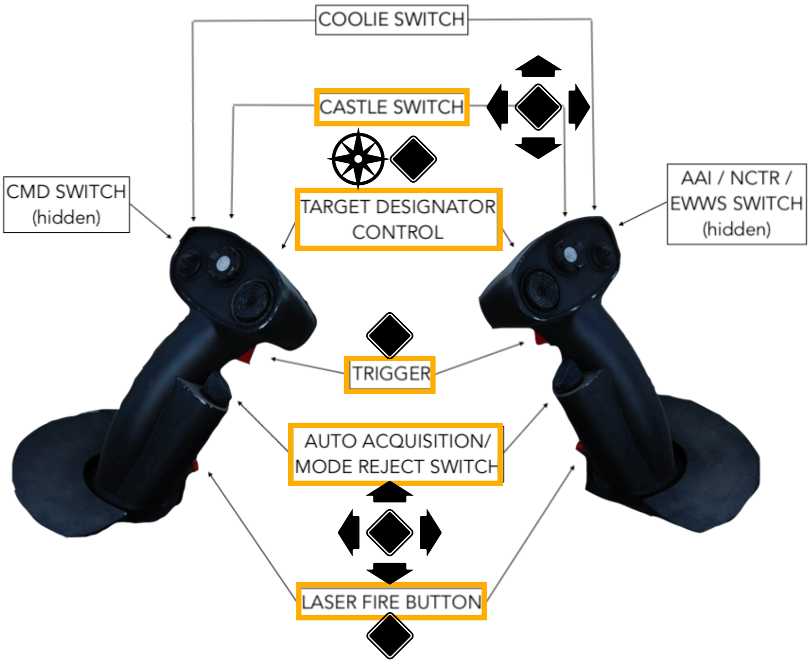
Coolie Switch

Pulling it up selects next Sequence Point.

Undesignate / Missile Reject Switch

Pulling it aft undesignates the target.

12.3.2 REAR COCKPIT



Target Designator Control (TDC)

Slews the cursor on the A/G Radar Display.

Pressing switches between PTRK / ATRK

Castle Switch

Pushing forward short (<1s) switches changes the tracker polarity.

Pushing forward long (>1s) changes video polarity selection (WHT or BHT).

Pulling aft short (<1s) selects cursor target function.

Pressing left short (<1s) selects cursor cue / mark function.

Pressing left long (>1s) initiates station 2 handoff (for Maverick use)

Pressing right short (<1s) causes cursor update function.

Pressing right long (>1s) initiates station 8 handoff (for Maverick use)

Pressing down select next Sequence Point.

Auto Acquisition / Mode Reject Switch

Pushing forward short (<1s) changes the FOV (WFOV -> NFOV -> ENFOV -> WFOW)

Pushing forward long (>1s) enables Snowplow mode

Pulling aft short (<1s) commands return to cue.

Pulling aft long (>1s) selects / deselects space stabilization.

Pressing down undesignates current target.

Laser Fire Button

Pressing it enables the laser fire.

Trigger

Half action commands track / untrack.

Full action performs the special cursor function (designate, mark, cue or update).

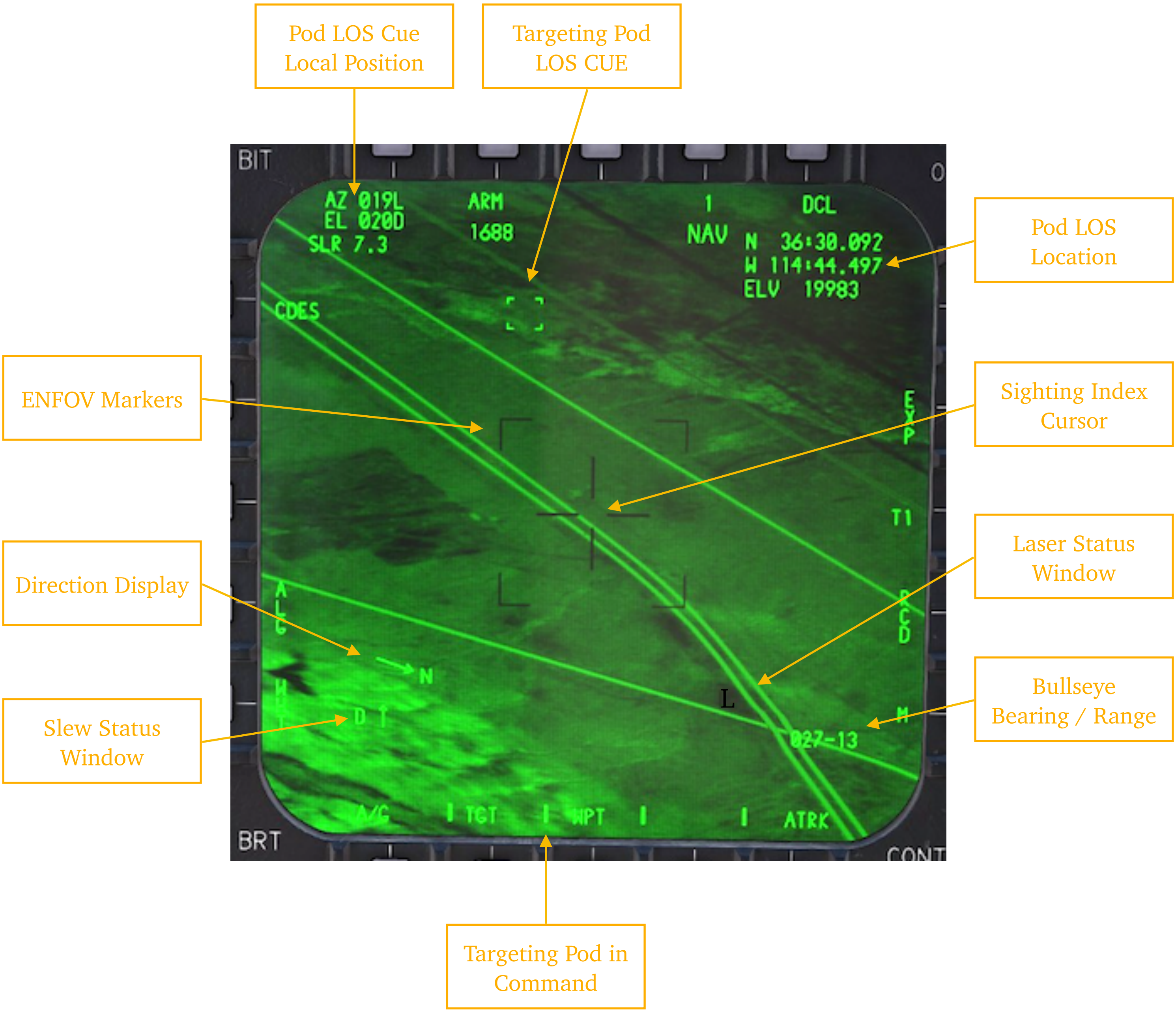
STICK - FRONT COCKPIT						
SWITCH	CONDITION	ACTION				
AUTO ACQ SWITCH	TGP in Command	FWD Short **Change FOV**	FWD Long **Snowplow**	AFT Short **Return to cue**	AFT Long **Space Stabilize**	Press DOWN **Track / Untrack**

THROTTLE - FRONT COCKPIT		
SWITCH	CONDITION	ACTION
LEFT MULTI-FUNCTION SWITCH	TGP in Command	DOWN Press **Laser Fire / Stop Fire**
TARGET DESIGNATOR CONTROL	TGP in Command	**Controls the movement of the targeting pod**
	Designate Cursor	DOWN Press: **Designate the selected spot**
	Mark Cursor	DOWN Press: **Create markpoint**
	CUE Cursor	DOWN Press: **Cue sensors to selected location**
	Position Update Cursor	DOWN Press: **Update position**
COOLIE SWITCH	TGP in Command	UP Short: **Sequence Point select**
BOAT SWITCH	TGP in Command	AFT Short: **Undesignate**

<table>
<tr><th colspan="7">HAND CONTROLLERS - REAR COCKPIT</th></tr>
<tr><th>SWITCH</th><th>CONDITION</th><th colspan="5">ACTION</th></tr>
<tr><td>TARGET DESIGNATOR CONTROL</td><td>TGP in Command</td><td colspan="3">Movement: Controls the movement of the targeting pod</td><td colspan="2">Press DOWN
Switches between PTRK / ATRK</td></tr>
<tr><td rowspan="2">CASTLE SWITCH</td><td>TGP in Command</td><td>FWD Short
Tracker Polarity</td><td>AFT Short
Cursor target</td><td>LEFT Short
CUE / MARK</td><td>RIGHT Short
UPDATE</td><td>DOWN
Quick Step</td></tr>
<tr><td>TGP in Command</td><td>FWD Long
WHT / BHT</td><td colspan="2">LEFT Long
Station 2 handoff (Mav)</td><td colspan="2">RIGHT Long
Station 8 handoff (Mav)</td></tr>
<tr><td rowspan="5">TRIGGER</td><td>TGP in Command</td><td colspan="5">HALF Action: Track / Untrack</td></tr>
<tr><td>Designate Cursor</td><td colspan="5">FULL Action: Designate the selected spot</td></tr>
<tr><td>Mark Cursor</td><td colspan="5">FULL Action: Create markpoint</td></tr>
<tr><td>CUE Cursor</td><td colspan="5">FULL Action: Cue sensors to selected location</td></tr>
<tr><td>Position Update Cursor</td><td colspan="5">FULL Action: Update position</td></tr>
<tr><td>AUTO ACQUISIT-ION SWITCH</td><td>TGP in Command</td><td>FWD Short
Change FOV</td><td>FWD Long
Snowplow</td><td>AFT Short
Return to cue</td><td>AFT Long
Space Stabilize</td><td>Press DOWN
Track / Untrack</td></tr>
<tr><td>LASER FIRE BUTTON</td><td>TGP in Command</td><td colspan="5">DOWN Press
Laser Fire / Stop Fire</td></tr>
</table>

12.4 Targeting Pod Displays

To enter the TPOD display, PB12 (marked TPOD) should be pressed from the level of Menu 1.



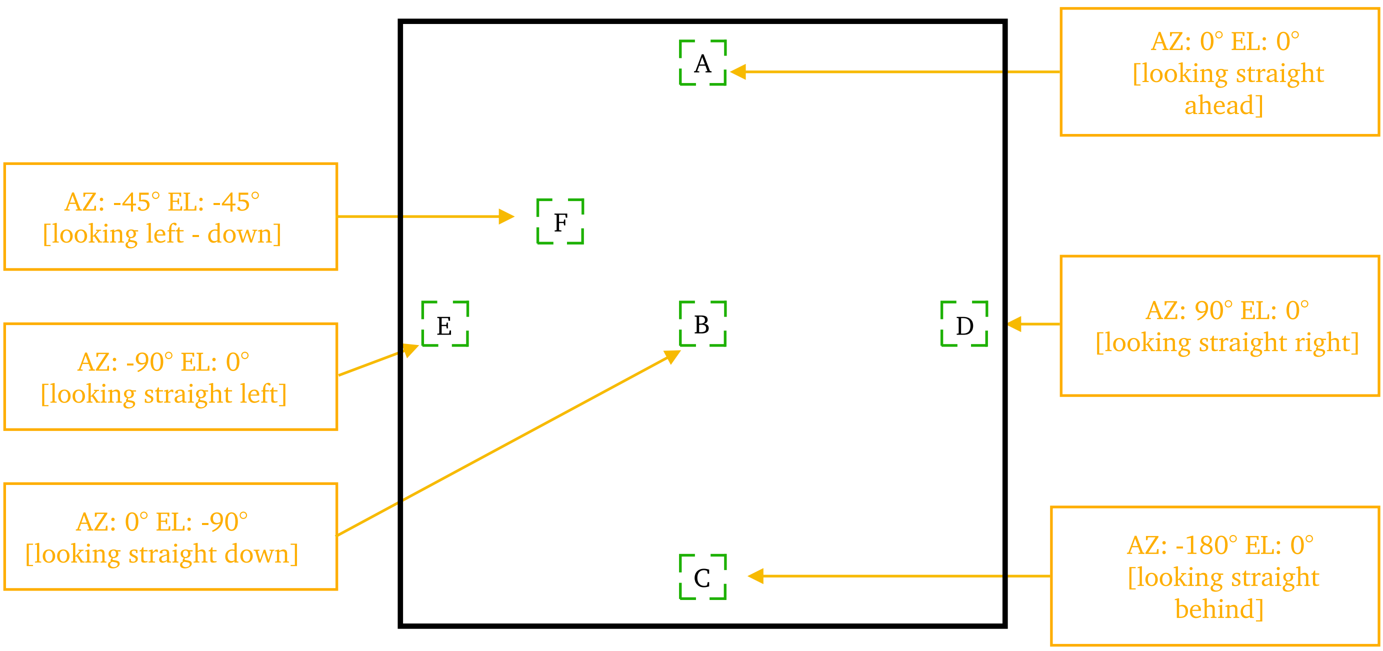
POD LOS CUE LOCAL POSITION: Shows the azimuth and elevation of the targeting pod's line of sight with respect to the aircraft. The three values displayed are:

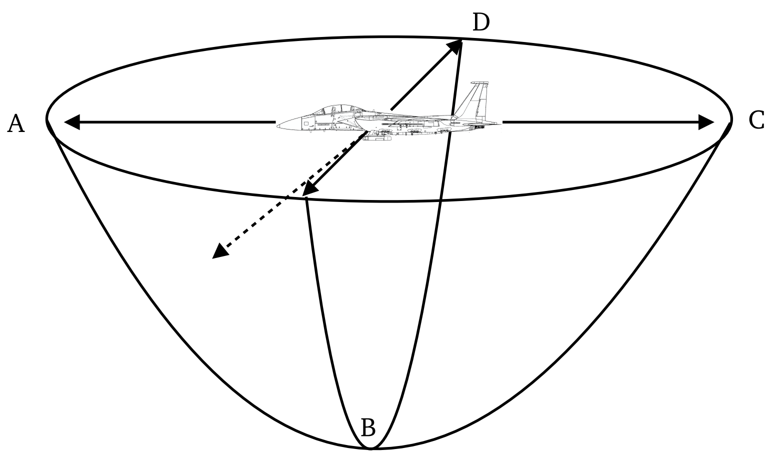
AZ (azimuth): From 0° to 180° left (L) or right (R).

EL (elevation): Between 90° up (U) and 90° down (D).

SLR (slant range): Distance in nautical miles to the point on the ground the pod is currently looking at.

Targeting Pod LOS Cue: Visual representation of the pod's line of sight relative to the aircraft. It moves around the display providing a rapid means to identify the approximate azimuth and elevation of the targeting pod.





POD LOS LOCATION: Displays Latitude / Longitude and elevation of the point the targeting pod under the sighting index cursor.

SIGHTING INDEX CURSOR: Indicates the targeting point FLIR / laser line of sight (place at which the pod is currently "looking"). It always remains at the center of the display.

LASER STATUS WINDOW: A L, T or M indicates current laser status. See Laser Operation section for more information.

BULLSEYE BEARING / RANGE: Shows the bearing and range from the bullseye to the targeting pod's LOS in the standard degrees / distance in NM format.

TPOD COMMAND: The four short vertical bars indicate that the targeting pod is in command.

SLEW STATUS WINDOW: Provides the aircrew with indication of active slewing action magnitude and direction.

The four arrows (up, down, left, right) indicate the direction that the LOS is being commanded by the TDC input.

The letters indicate the magnitude of the slew LOS rate in the increments of 5%, starting with A. Therefore B means 10%, C means 15%, D is 20% etc.

MAGNETIC HEADING / DIRECTION DISPLAY: An indication of magnetic north is displayed on the targeting FLIR as well as on the radar in air to ground mode. It is always set in relation to the sensor's line of sight and rotates in order to always point towards the magnetic north.

FOV MARKERS: As described earlier in the chapter, the four corner markers within the WFOV and NFOW (if EXP is boxed) outline part of the screen which will be visible if next smaller FOV is commanded.

12.4.1 HUD TARGETING POD LOS CUE

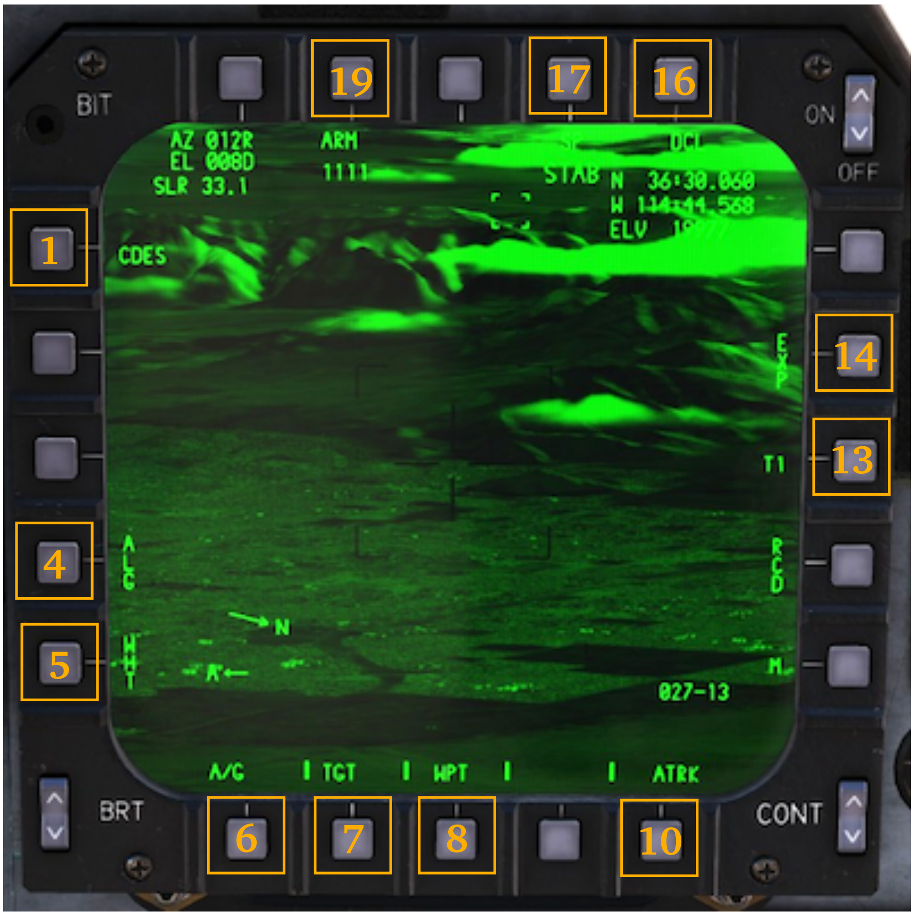
HUD LOS Cue

The targeting pod LOS is displayed on the HUD as a segmented box, representing what is displayed on the targeting pod NFOV (1.65°). This symbol is displayed in all Master Modes.

12.5 TARGETING POD CONTROLS

There are two display options for the targeting pod, primary (T1) and setup (T2), and they differ when it comes to pushbuttons and functions the perform.

12.5.1 PRIMARY MODE

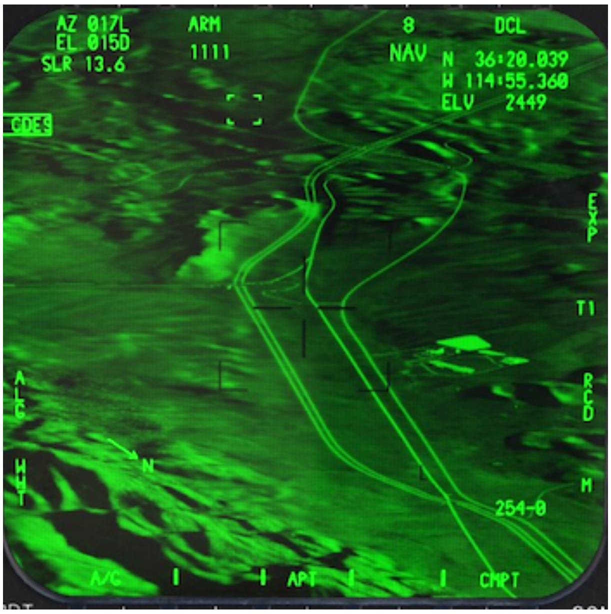


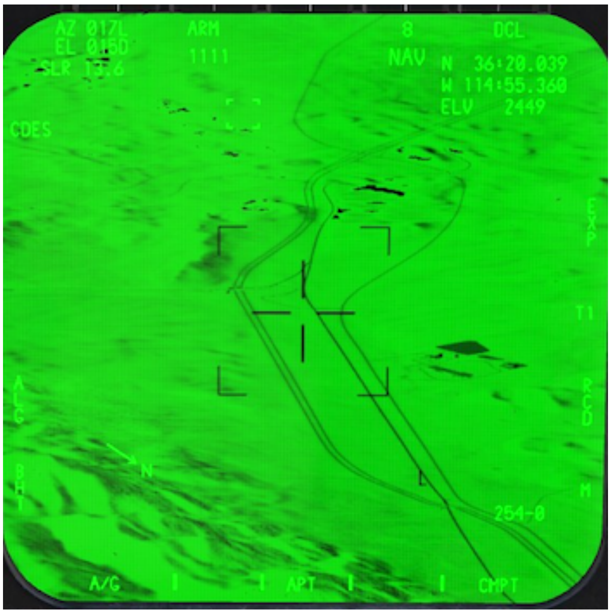
PB 1, CDES (Continuous Designation): When boxed, enables continuous designation of the target.

PB 4, ALG (Auto / Manual Level Gain Select): Selects between manual and auto gain levels.

PB 5, WHT / BHT (Video Polarity Selection): Pressing this pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.

In WHT hot areas are displayed as green (MPD) or white (MPCD). In BHT this is reversed (hot areas are displayed as black on both MPD and MPCD).





The same area with BHT polarity selected on the left and WHT on the right.

Pushing the **Castle Switch** forward long (>1s) on the HC in the rear cockpit switches between BHT / WHT.

PB 6, A/G - A/A (Air to Ground / Air to Air Mode): this pushbutton switches between the air to ground and air to air modes.

PB 8, WPT - PBT - APT (Tracker Polarity): three options are available to choose from:

WPT - White Polarity Track: targeting pod tracks white / green targets. All targeting pod embedded symbology is black.

BPT - Black Polarity Track: targeting pod tracks black targets and all embedded symbology is white.

APT - Auto Polarity Track: targeting pod tracks either white / green or black targets, depending on the color of the target at the centre of the crosshairs when point track is initiated.

Pushing the Castle Switch forward short (<1s) on the HC in the rear cockpit cycles through each of the polarity track options.

PB 10, ATRK - PTRK - CMPT (Track Modes): two primary track modes can be selected by pressing PB 10: Area Track (ATRK) and Point Track (PTRK). The third mode, Computed Track (CMPT) is a non-active track mode that uses LOS and LOS rate extrapolation techniques. More information about the track modes can be found in Targeting Pod A/G Operation section later in this chapter.

PB 11, T1 - T2 (primary and setup display): Pressing this PB switches between the primary mode and setup display for the targeting pod. See Setup Mode for more information.

PB 14, EXP (expanded mode): When boxed, enables the use of ENFOV (Expanded Narrow Field of View) zoom mode. See Targeting Pod Display part for more information.

PB 16, DCL (declutter): This option is only available in T1 and allows the aircrew to remove specific display items from all A/G and A/A displays. When DCL is boxed, the following items are removed:

a) BBR

b) Weapon launch zones and range scale

c) Weapon status and delivery data

d) Targeting pod LOS lat / long data

e) Magnetic heading / direction display.

PB 17, Targeting Pod Cue Source: Indicates the source of the cue of the targeting pod. The possible options are:

RDR - targeting pod cued from A/G Radar Display.

TSD - targeting pod cued from the TSD.

NAV - targeting pod cued from NAV designation or quick step. Pressing PB 17 cycles through all available Sequence Points and cues the LOS to them.

◆ Pressing down **Castle Switch** on HC in rear cockpit selects next Sequence Point.

SIT - targeting pod cued from SIT.

HUD - targeting pod cued from the HUD diamond.

RET - targeting pod slaved to the A/G reticle or a ground stabilized by offset from that point by TDC input.

STAB - targeting pod commanded to space stabilized cue mode.

SP - targeting pod commanded to ground stabilized cue mode.

POD - targeting pod designation on the TGT IR display (if SP # is displayed above) or without a sequence point (if SP above)

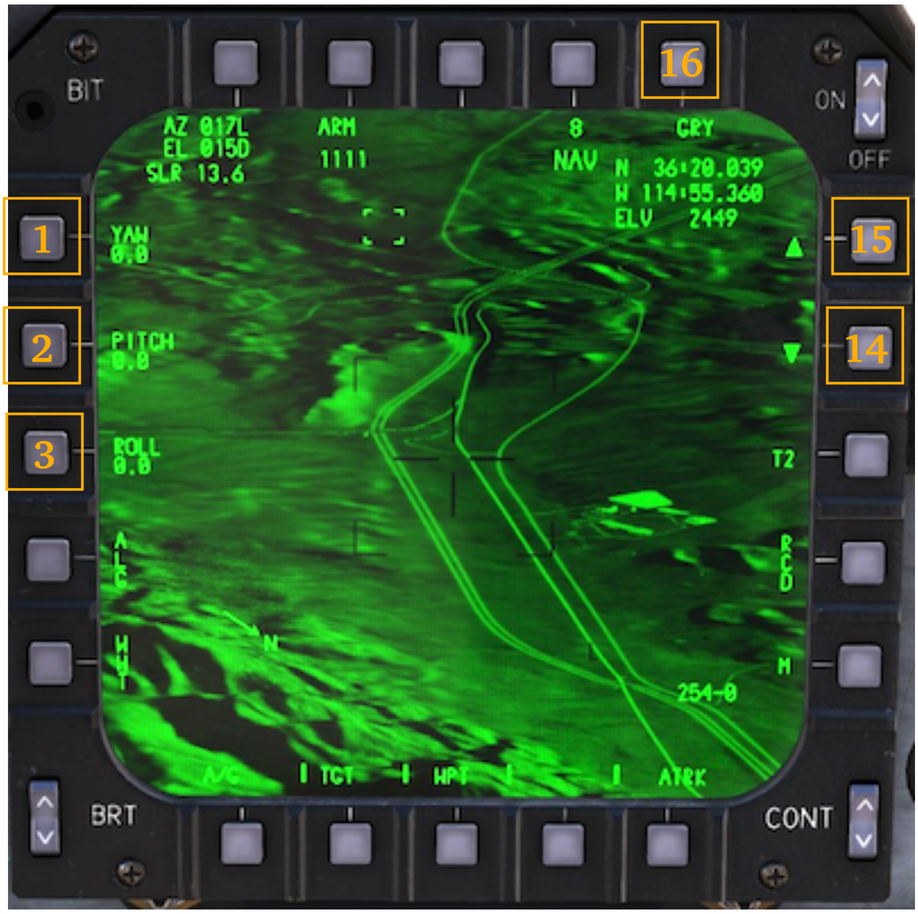
Blank - targeting pod not cued.

For more information, see Targeting Pod A/G Operation section later in this chapter.

PB 19, laser status: Indicates currently introduced laser code and status of the laser. See Laser Operation section for more information.

12.5.2 SETUP MODE

Pressing PB 13 enters the Setup Mode of the targeting pod, which enables the aircrew to boresight the pod and tune the FLIR and focus.



PB 1-3 (yaw, pitch, roll): Used during mechanical boresight of the targeting pod.

PB 14-15 (Manual Focus Control): Enables the aircrew to adjust the IR video sharpness and clarity.

PB 16 (Gray Scale): Enables a gray scale used to adjust the gain / level of the targeting pod.

12.6 LASER OPERATION

The AN/AAQ-14 targeting pod is equipped with two types of laser - tactical one and eyesafe training version. As one or the other has to be selected by the ground crew before the flight, only the tactical version will be simulated in DCS.

The maximum range of the tactical laser is up to 13.2 NM (but may be shorter depending on weather conditions and visibility).

There are four conditions that has to be simultaneously fulfilled for using the laser:

1. Laser arm switch should be set to ARM.
2. Valid laser code must be entered.
3. Weight Off Wheels and gear handle up.
4. Altitude is below 25 000 feet.

Arming the laser

Laser Arm Switch is on the right side of the Sensor Control Panel in the rear cockpit (**3**).

When the laser is armed, appropriate red warning light will be visible on the top-left caution lights panel (**3**) in the front cockpit.

Laser code

A laser code is displayed under PB 19 on the TPOD page. If invalid code is introduced, it will flash. Valid laser codes are 1111 thru 1788.

To enter a code, it should be introduced by using the UFC keyboard, verified and then sent to the targeting pod by pressing the PB 19. If invalid number is entered, it will flash on the UFC.

Laser Status

Laser status is also displayed under PB 19. It can be one of the four states:

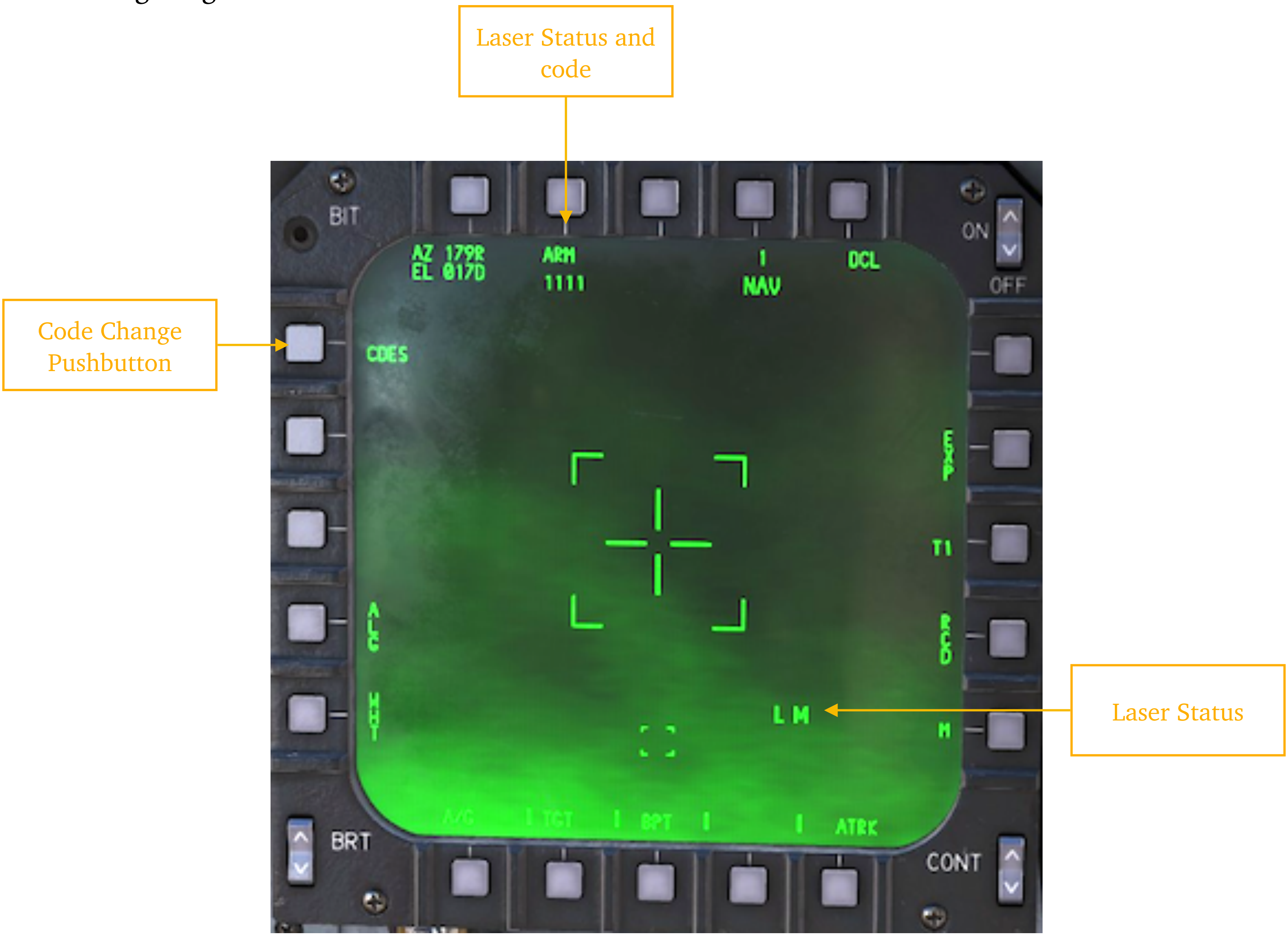
SAFE: the Laser Arm Switch is set to OFF.

ARM: the Laser Arm Switch is set to ON and valid laser code has been entered.

LASE: the legend flashes when the laser is firing.

MASKED: TPOD LOS is masked by the airframe or stores.

Current status is also mirrored on the TPOD display below and to the left from the Sighting Index Cursor.



The Laser Status window is blank when the laser is in SAFE.

L appears when targeting pod arms the laser. As soon as the laser is fired, the legend flashes.

M indicates that the targeting pod LOS may be obscured by the aircraft structure and the laser is inhibited from firing.

12.7 TARGETING POD A/G OPERATION

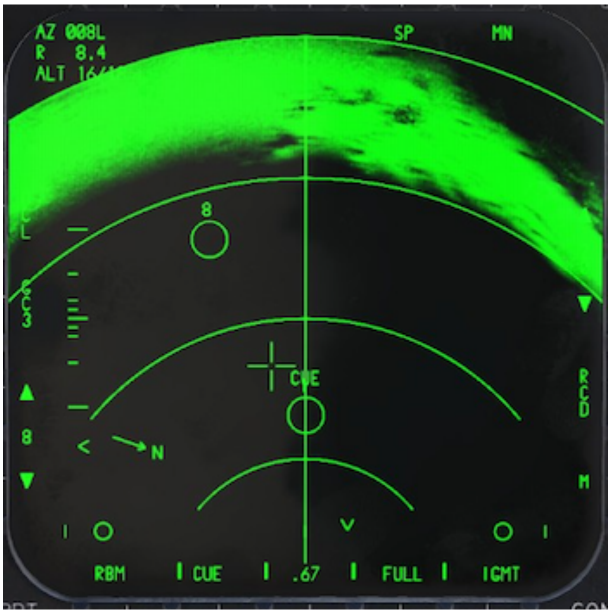
When in A/G mode (default, selected by PB 6), the targeting pod LOS can be controlled in two submodes: cue and track.

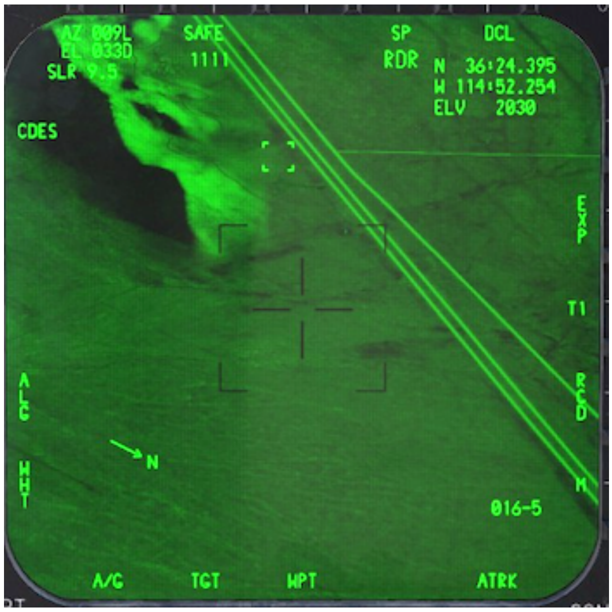
12.7.1 CUE MODE

The cue mode is in operation at any time the targeting pod is not commanded to track a target. Cue mode is essentially a slave mode and the LOS movement may be generated manually be the aircrew using the TDC to slew it or automatically from another onboard sensor or a navigation sequence point.

12.7.1.1 A/G RADAR CUE (RDR)

The radar cue is commanded from the A/G mode using the CUE Cursor function. The aircrew has to place the cursor over the desired area on the radar display and perform the cursor command that will automatically cue the targeting pod LOS to that point.





The picture on the left shows the A/G radar in RBM mode. The CUE cursor was selected and spot underneath it was designated (indicated by the CUE legend next to it).

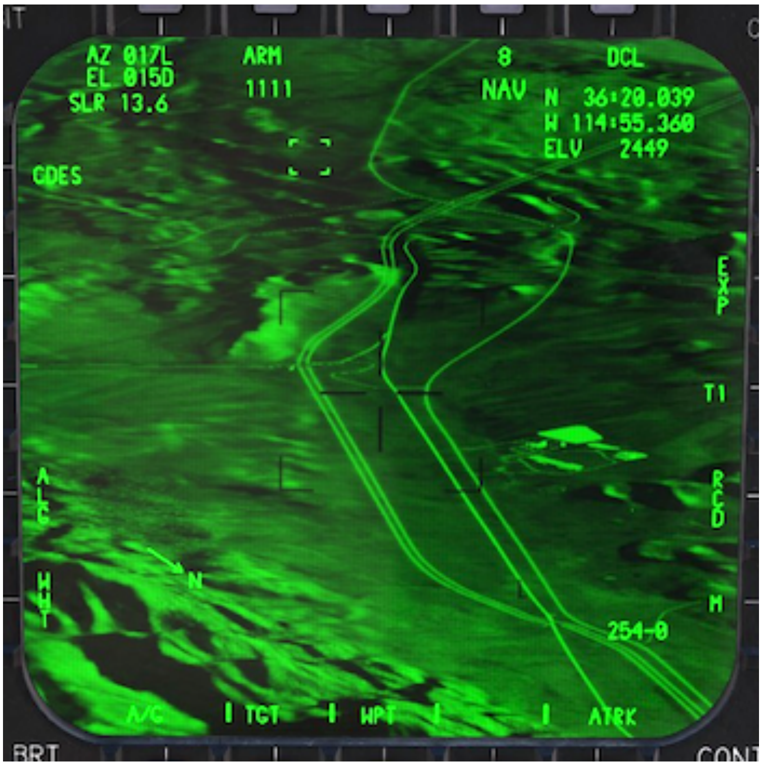
The picture on the right shows the targeting pod display with SP and RDR legend below PB 19. The first one indicates that the pod is ground stabilised and the other one that it was cued from (or slaved to) the A/G Radar.

12.7.1.2 TACTICAL SITUATION DISPLAY CUE (TSD)

TSD cue is not implemented in EA version of the module.

12.7.1.3 NAVIGATION DESIGNATION / QUICK STEP CUE (NAV)

Targeting pod's LOS can be cued directly to each Sequence Point which is included in the current flight plan. Upon selection of a SP via quick step, the LOS will immediately move to the given waypoint's coordinates and point to the surface at that location.



In the example above, NAV legend is displayed below the PB 17. The number above is currently selected Sequence Point. Pressing PB 17 cycles through all available Sequence Points (meaning steer points, target points, offset points and aim points). The SP can also be selected by typing it in UFC and pressing PB 17.

Pulling **Coolie Switch** up in front cockpit selects next Sequence Point.

Pressing down **Castle Switch** in rear cockpit selects next Sequence Point.

12.7.1.4 SITUATION DISPLAY CUE (SIT)

SIT cue is not implemented in EA version of the module.

12.7.1.5 HEADS UP DISPLAY CUE (HUD)

HUD cue is not implemented in EA version of the module.

12.7.1.6 A/G TARGETING RETICLE (RET)

RET cue is not implemented in EA version of the module.

12.7.1.7 SPACE STABILIZED (STAB) AND GROUND STABILIZED (SP) CUES

These should be treated differently then other modes, because the pod will always be either space or ground stabilized.

When ground stabilized, the ground motion is automatically compensated for and any TDC inputs are independent of aircraft motion relative to the ground. This effectively mean that once ground stabilized, the LOS will maintain on the point it has been stabilized at.

When space stabilized, the LOS is no longer tied to the ground and will point at the space at angle azimuth and elevation it had when space stabilization was initialised.

A special version of that is Snowplow mode, where the LOS is continuously cued below the horizon, along the heading vector. It is a default cueing mode on initial power up.

Pulling aft long (>1s) on **Auto Acquisition Switch** in both cockpits selects or deselects space stabilization.

In both modes, TDC inputs can be made to modify the LOS location in space. When switching between STAB and SP, the current LOS is maintained.

STAB can be entered by:

1. Entering 0 on the UFC and pressing PB 17 on the targeting pod display.
2. Entering the Snowplow mode by:

pressing forward long (>1s) **Auto Acquisition Switch** in the both cockpits

3. Pulling aft long (>1s) on **Auto Acquisition Switch** in both cockpits.

STAB is exited when:

1. Targeting pod is commanded to track;
2. Targeting pod is cued by another source;
3. Designate (CUE or MARK) is commanded;
4. Ground stabilization is commanded by the aircrew.

Snowplow Mode

Snowplow is basically a default mode of STAB, with LOS set to a point below the horizon along the heading vector. Therefore when Snowplow is commanded, the targeting pod's LOS will automatically switch to that point.

12.7.2 TRACK MODE

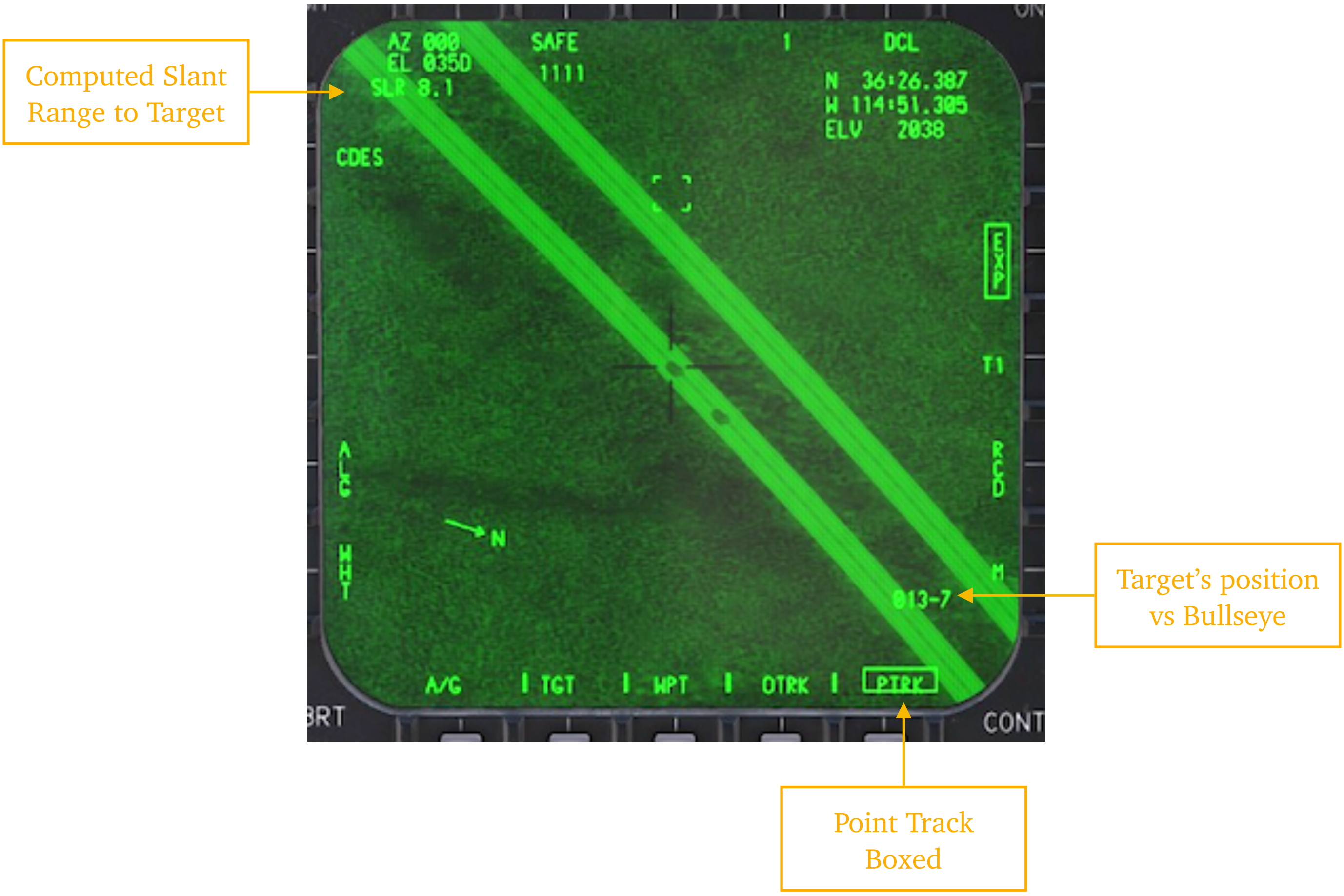
There are two primary track modes that can be selected from the targeting pod display using PB 10: PTRK (point track) and ATRK (area track). Additionally, there is a CMPT (computed), non-active track mode which is using LOS and LOS rate extrapolation techniques that the system reverts to if PTRK or ATRK are not available.

12.7.2.1 INITIATING TRACK

First the aircrew should select the desired track mode, either point or area, using PB 10. The WSO can also do so by pressing and releasing the HC TDC. Once this is done, the track can be initiated.

- By pressing the **Auto Acquisition Switch** in the front cockpit.
- By pressing and releasing the **HC Trigger** to half action in the rear cockpit.

PTRK or ATRK becomes boxed when the targeting pod is tracking the target.



12.7.2.2 Area Track (ATRK)

In Area Track, the targeting pod tracks the video scene using an area correlation tracker. ATRK is preferable to use for the stationary targets, such as buildings or unbounded ones, like roads or bridges. If ATRK cannot be maintained or is broken, the pod defaults to CMPT.

12.7.2.3 Point Track (PTRK)

In this mode, the pod tracks a target using a point contrast video tracker, looking for IR transitions on each side of the target.

When PTRK has been achieved, the target is bounded with a rectangular box on the display.

This mode works well against targets that are well defined against the background. It should also be used to track moving targets. If PTRK cannot be maintained or is broken, the pod defaults to ATRK.

12.7.2.4 Offset Track (OTRK)

NOTE: Offset track in not functional in the Early Access.

12.7.2.5 Computed Mode Track (CMPT)

This mode is automatically enabled when PTRK and ATRK are impossible to maintain. The pod stops attempting to track the previous target, attempting to keep the LOS pointed at the position that last was tracked. As soon as aircrew initiates a slew when in CMPT mode, the pod tries to reenter PTRK or ATRK at the termination of the slew.

12.7.3 DISPLAY CURSOR FUNCTIONS

Special cursor functions in TGP can be used in both cockpit by pressing the PB 7.The WSO can additionally select them by pressing the PB 7 or by moving the **Castle Switch** (see Rear Cockpit HOTAS functions earlier in this chapter). To perform the special cursor function:

- In the front cockpit, **TDC** should be pressed.
- In the rear cockpit, **HC Trigger** should be pressed to full action.

The possible options are: blank (no function selected), TGT (target), UPDT (update), CUE and MARK.

NOTE: Only TGT and MARK functions are currently fully implemented.

12.7.3.1 BLANK

When nothing is displayed above PB 7, this means a cursor function has not been selected. In this state pressing the designation switch has no impact on the system.

12.7.3.2 TGT CURSOR FUNCTION

TGT function allows the aircrew to identify a specific point within the targeting pod FOV as a designated A/G target.

To designate a target using this method, the crosshairs should be placed over the desired spot (which can already be tracked by the pod) and the special cursor function should be performed as described above (ie. pressing TD or HC Trigger to full action).

Once the target is designated, normal attack symbology is displayed on the HUD and TGT IR display for A/G weapon deliveries. A DESIGNATE legend is shown below the crosshairs on the display for 5 seconds.

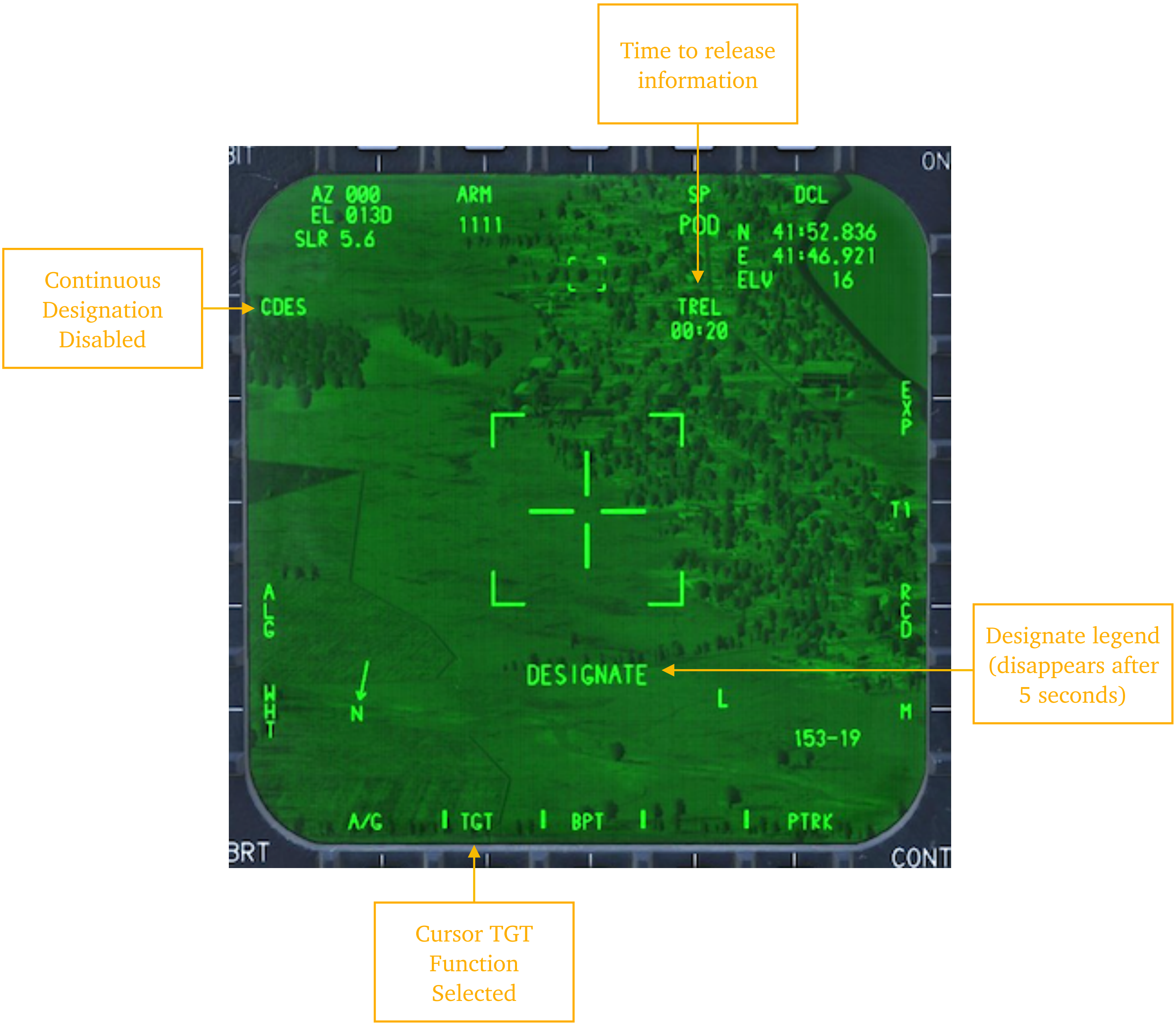
Aircrew has an option to choose between one time or continuous designation, which can be toggled by boxing the CDES legend with PB 2.

One time designation

If a one time designation is performed, current range and LOS information is used at the moment of initiating the process. If the pod is moved to another location, previously designated spot remains valid for the system until designation action is performed again.

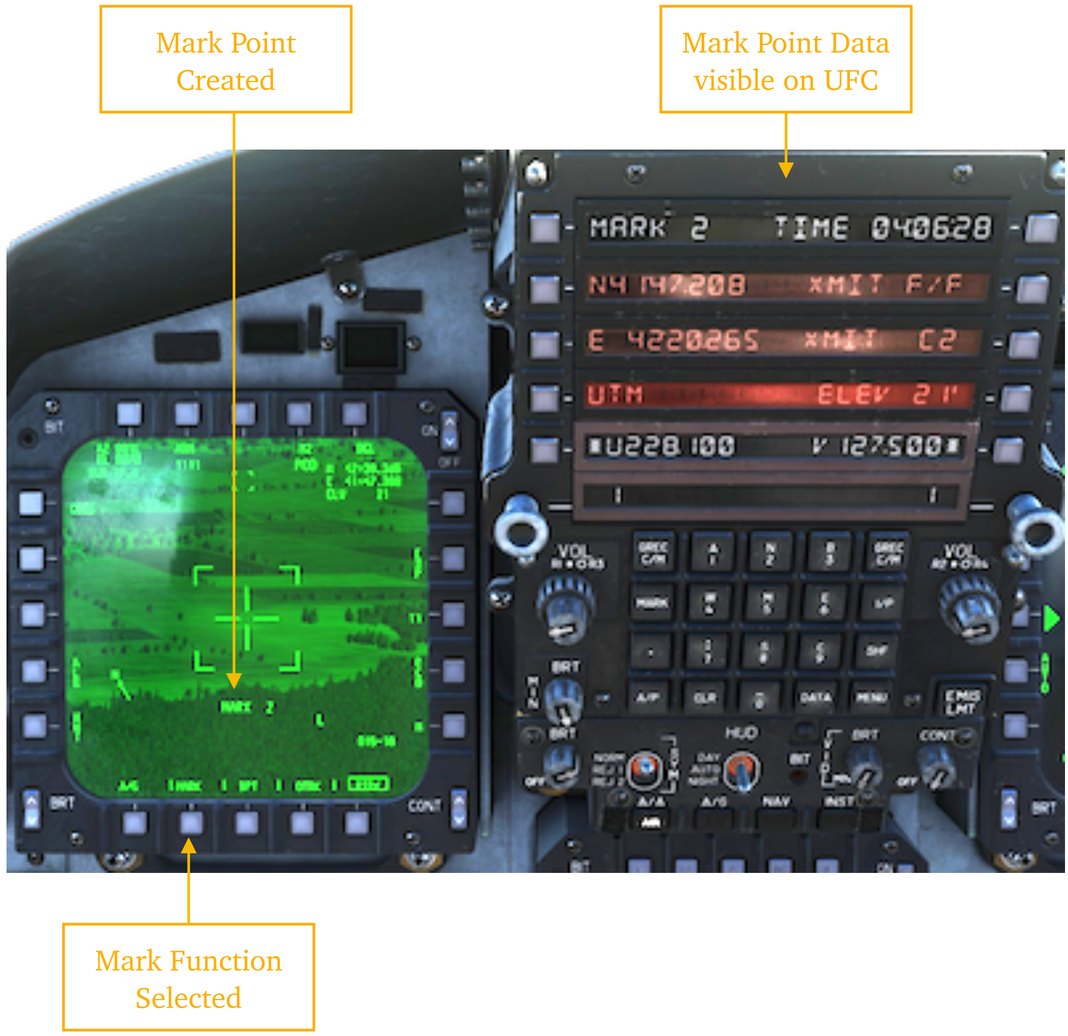
Continuous designation

If continuous designation was selected (CDES is boxed), the designation is updated continuously with new range and LOS information. This means that designation follows pod's LOS and changes to the spot the crosshairs are pointing to as soon as the slewing stops. CDES is only available if LAS, HRM or PASS is programmed as active sensor in manual mode (in AUTO, only LAS can be used).



12.7.3.2 Mark Function

Allows the aircrew to create a Mark Point using the targeting pod's LOS. To do so, | MRK | function should be selected using PB 7. Freshly created Mark Point is added to the point data submenu. MARK X legend is shown on the targeting pod display for 5 seconds, where X is a Mark Point number. UFC displays coordinates of the freshly created Mark Point and the time when it was taken.



12.7.4 RANGE

The range source for the range displayed in the top-left corner of the display can be based on laser (LAS), radar (RAD) or computed slant range (SLR), based on CARA / system altitude above the SP.

Range is displayed in feet, except when SLR is used as range source and the range is greater than 0.5 NM - in which case nautical miles are displayed.

In order to obtain a valid laser range, the laser needs to be armed and firing.

NOTE: laser ranging will not function if performed outside the maximum range of the laser (which depends on the visibility and weather conditions). If laser is not within range, the slant range will be displayed instead.

12.8 Targeting Pod Air to AIr Operations

NOTE: Lantirn pod A/A functions are not available in the current build of Early Access.

CHAPTER 13: Air to Ground Weapons

13.1 Introduction

The F-15E Strike Eagle was designed with the air to ground as its primary role, and while she can be a dangerous opponent in aerial combat, ground attack is the domain where she absolutely excels. Capable of using most of the weapons available in the USAF inventory (with the exception of those reserved for SEAD), she is a very potent and versatile aircraft.

13.2 Air to Ground Weapons

DCS F-15E in Early Access is capable of using almost all of the types of dumb bombs and laser-guided munitions. Other types, such as AGM-65 Maverick, AGM-130 as well as JDAMs will be available at the later stage.

13.2.1 Unguided Bombs

Mark-82 Bomb

A general purpose, low drag, free fall bomb widely used by NATO forces.

Type	Low Drag	Warhead (size)	192 lb (39 kg)
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

Mark-82 Air Bomb

Version of Mark-82 with air inflatable retarder, slowing down the descend rate and allowing more time for the delivering aircraft for safe escape.

Type	High / Low Drag	Warhead (size)	192 lb (39 kg)
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

Mark-82 Snakeye Bomb

Another, older version of Mark-82 with extending four retarding fins slowing down the descend rate and allowing more time for the delivering aircraft for safe escape.

Type	High / Low Drag	Warhead (size)	192 lb (39 kg)
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

Mark-84 Bomb

General purpose, low drag, free fall bomb. Largest of the Mark 80 series of weapons.

Type	Low Drag	Warhead (size)	945 lb (429kg)
Mass	2039 lb (925 kg)	Length	10ft 9in (3.28 m)

Mark-84 Air

Version of Mark-84 with air inflatable retarder, slowing down the descend rate and allowing more time for the delivering aircraft for safe escape.

Type	High / Low Drag	Warhead (size)	945 lb (429kg)
Mass	2039 lb (925 kg)	Length	10ft 9in (3.28 m)

BDU-108 "DURANDAL"

An anti-runway penetration bomb developed by the French company Matra (now MBDA), designed to destroy airport runways. It can be dropped from altitudes as low as 200 feet.

The initial phase of flight is retarded by a parachute. Once the bomb reaches a 40° angle, the parachute is discarded and a rocket booster initialises, driving the bomb into the runway surface. The primary charge then explodes, sending the smaller, secondary charge with delayed fuse even deeper.

Type	High Drag	Warhead (size)	220 lb (100kg) 33lb (15kg)
Mass	440 lb (200 kg)	Length	8ft 10in (2.7 m)

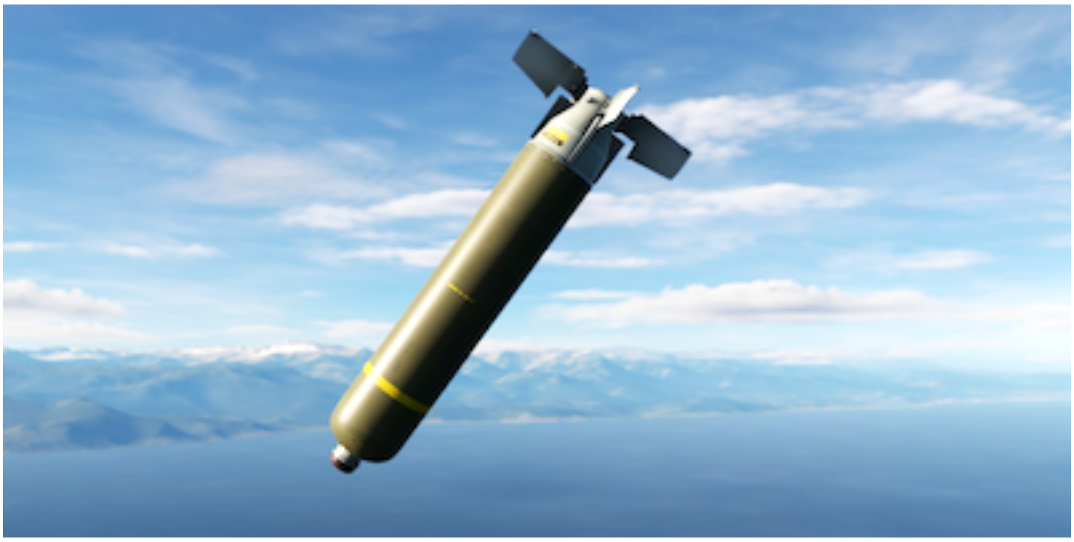
CBU-87 Combined Effects Munition

Each CBU-87 holds 202 bomblets. It can be dropped at any altitude and any air speed, and after drop it begins to spin. At preset altitude the canister breaks open and the submunitions are released, covering large area.

Type	Cluster	Warhead (size)	202 bomblets
Mass	951 lb (431 kg)	Length	7ft 7in (2.31 m)

CBU-97 Combined Effects Munition

Works similarly to the CBU-87, but instead of bomblets each CBU-97 holds 40 skeets capable of detecting tanks and vehicles and guiding into them.



Type	Cluster	Warhead (size)	40 skeets
Mass	927 lb (420 kg)	Length	7ft 8in (2.34 m)

BDU-50 LD

Training, inert version of the Mk-82 bomb.

Type	Low Drag	Warhead (size)	Inert
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

BDU-50 HD

Training, inert version of the Mk-82 Air bomb.

Type	High / Low Drag	Warhead (size)	Inert
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

MARK-84 AIR TP

Inert, training version of Mark-84 with air inflatable retarder.

Type	High / Low Drag	Warhead (size)	Inert
Mass	2039 lb (925 kg)	Length	10ft 9in (3.28 m)

13.2.2 Laser - Guided Bombs

GBU-12 Paveway II

GBU-12 is a Mark 82 general purpose bomb with the addition of a nose-mounted laser seeker and fins for guidance.

Type	Laser Guided	High Explosives	192 lb (39 kg)
Mass	510 lb (230 kg)	Length	10ft 7in (3.27 m)

GBU-10 Paveway II

GBU-10 is a Mark 84

general purpose bomb with the addition of a nose-mounted laser seeker and fins for guidance.

GBU-24 Paveway III

Similar to GBU-10, but with better guiding capabilities and therefore increased range.

Type	Laser Guided	High Explosives	945 lb (429 kg)
Mass	2315 lb (1050 kg)	Length	14ft 5in (4.39 m)

GBU-27 Paveway III

A version of GBU-24 redesigned for bunker-busting capabilities. During the Gulf War it was nicknamed "Hammer" by the pilots due to its destructive power.

Type	Laser Guided	High Explosives	550 lb (250 kg)
Mass	2315 lb (1050 kg)	Length	14ft (4.2 m)

GBU-28

A 5000 pound, bunker busting bomb designed during Operation Desert Storm to enable the allied forces to penetrate hardened Iraqi command centers.

Type	Laser Guided	High Explosives	630 lb (286 kg)
Mass	5000 lb (2268 kg)	Length	18 ft 8 in (5.7 m)

BDU-50 LGB

Inert version of GBU-12.

Type	Laser Guided	Warhead (size)	Inert
Mass	500 lb (227 kg)	Length	7ft 3in (2.22 m)

13.2.3 JDAMs

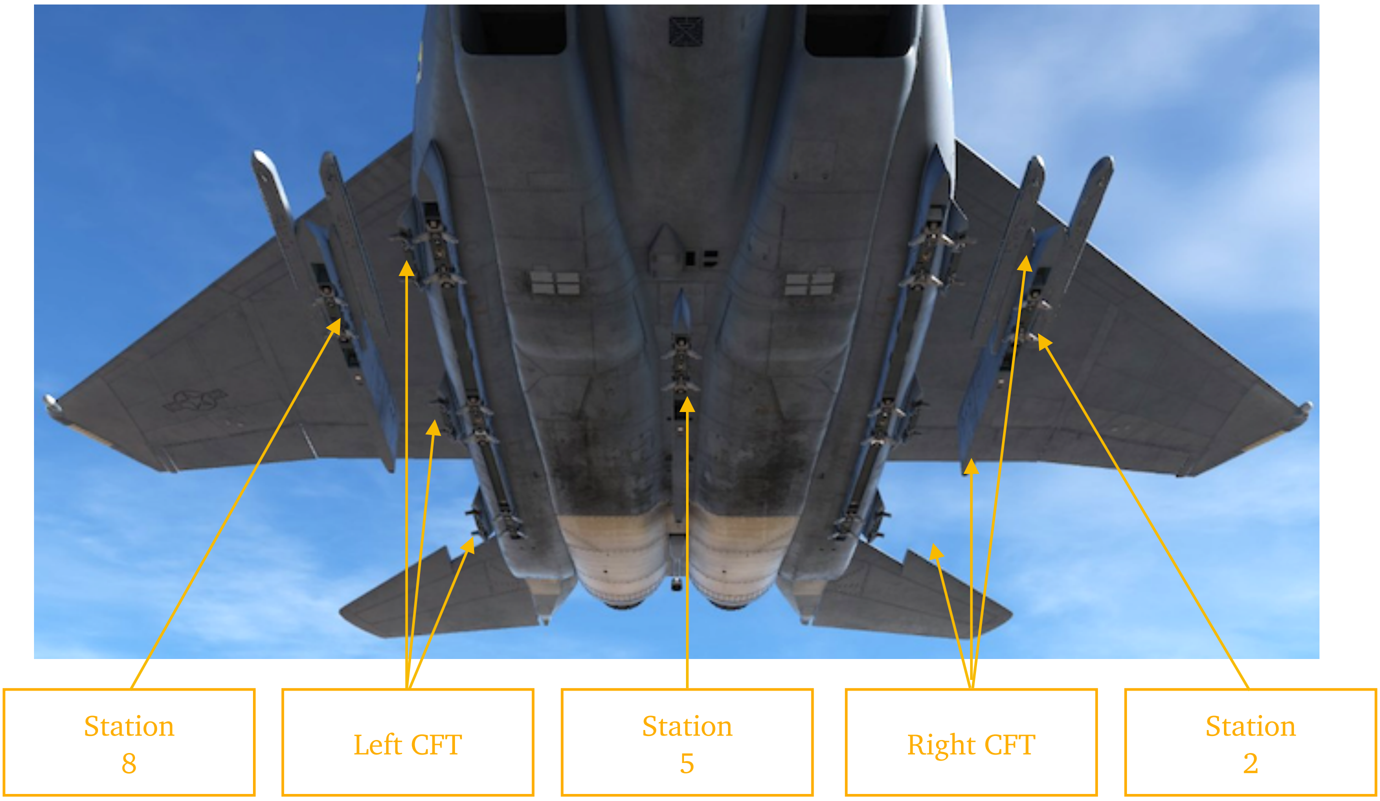
NOTE: JDAMs are not available in Early Access.

13.2.4 Guided Missiles

NOTE: Guided missiles are not available in Early Access.

13.3 Air to Ground Loadouts

F-15E is capable of carrying a mix of air-to-air and air-to-ground in different configurations. It can also have up to three fuel tanks and can use travel pods.



STA 8	LEFT CFT	STA 5	RIGHT CFT	STA 2
Mk-82 (1x)	Mk-82*	Mk-82 (1x)	Mk-82*	Mk-82 (1x)
Mk-82SE (1x)	Mk-82SE*	Mk-82SE (1x)	Mk-82SE*	Mk-82SE (1x)
Mk-82AIR (1x)	Mk-82AIR*	Mk-82AIR (1x)	Mk-82AIR*	Mk-82AIR (1x)
Mk-84 (1x)	Mk-84**	Mk-84 (1x)	Mk-84**	Mk-84 (1x)
Mk-84AIR (1x)	Mk-84AIR**	Mk-84AIR (1x)	Mk-84AIR**	Mk-84AIR (1x)
CBU-87 (1x)	BLU-107***	CBU-87 (1x)	BLU-107***	CBU-87 (1x)
CBU-97 (1x)	CBU-87***	CBU-97 (1x)	CBU-87***	CBU-97 (1x)
GBU-10 (1x)	CBU-97***	GBU-10 (1x)	CBU-97***	GBU-10 (1x)
GBU-12 (1x)	GBU-10**	GBU-12 (1x)	GBU-10**	GBU-12 (1x)

STA 8	LEFT CFT	STA 5	RIGHT CFT	STA 2
GBU-24 (1x)	GBU-12****	GBU-24 (1x)	GBU-12****	GBU-24 (1x)
GBU-27 (1x)	GBU-24 (1x)	GBU-27 (1x)	GBU-24 (1x)	GBU-27 (1x)
GBU-28 (1x)	GBU-27**	GBU-28 (1x)	GBU-27**	GBU-28 (1x)
MXU 648 (1x)	BDU-50HD*	MXU 648 (1x)	BDU-50HD*	MXU 648 (1x)
Fuel Tank (1x)	BDU-50 LD*	Fuel Tank (1x)	BDU-50 LD*	Fuel Tank (1x)
BDU-50HD (1x)	BDU-50LGB****	AN/AXQ-14	BDU-50LGB****	BDU-50HD (1x)
BDU-50LD (1x)	Mk-84AIR**	MXU 648 (1x)	Mk-84AIR**	BDU-50LD (1x)
	MXU 648 (1x)		MXU 648 (1x)	
NOTES	*: 1, 2, 3 or 6 can be loaded		**: 1 or 2 can be loaded	
NOTES	***: 3 or 6 can be loaded		****: 1, 2 or 4 can be loaded	

13.3.1 Loaudout restrictions

It is possible to mix air to air and air to ground ordnance, however there are many restrictions linked to the shape and proximity of certain weapons. As a rule, A-A missiles cannot be loaded on stations 2A-B and 8A-B next to some GBUs. Also, if bombs are present on L and R CFT, no missiles can be added to stations 3C, 4C, 6C and 7C. The DCS load out restrictions were put in place to best duplicate the loadout restrictions of the real thing, but can't possibly match all of them.

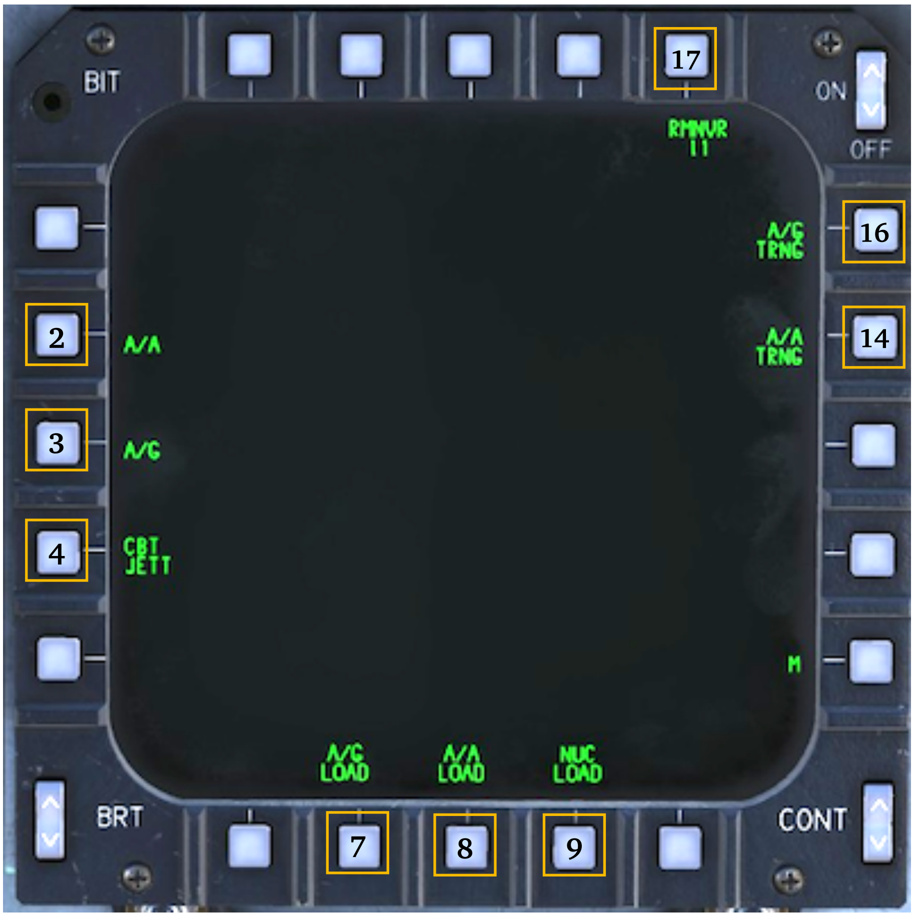
13.4 PROGRAMMABLE ARMAMENT CONTROL SET (PACS)

The PACS provides weapons monitoring, as well as display / management capabilities. It is used for selection, pre-launch preparation, launch and jettison of air to air, as well as air to ground weapons. Both aspects will be covered separately in A/A and A/G chapters, with additional functions as selective jettisoning with separate section at the end of A/G part.

There are two main modes of PACS operation for A/A and A/G domains: Combat (CMBT) and Training (TRNG), and these can be enabled independently between the domains. In other works the aircraft can operate in A/A CMBT and A/G TRNG etc.

In training mode, munitions cannot be expended for as long as A/G TRNG is boxed on the PACS page. However, the jet behaves as if real ordnance was used and weapon inventory tracks all missiles "fired" in training.

PACS menu can be accessed from Menu 1 on any MPD / MPCD by pressing pushbutton 2 (ARMT).



The pushbutton functions are briefly described on the next page. Clicking on the PBs above will bring the reader directly to the selected display.

PB 2, A/A (AIR TO AIR) DISPLAY: Enters the Air to Air display on the MPD / MPCD with additional set of options. See A/A Display section in this chapter for more information.

PB 3, A/G (AIR TO GROUND) DISPLAY: Enters the Air to Ground display on the MPD / MPCD with additional set of options.

PB 4, CBT JETT (COMBAT JETTISON) DISPLAY: Enters the Combat Jettison display, also called a two-push jettison capability. See Combat Jettison section for more information.

PB 7, A/G LOAD (AIR TO GROUND LOADOUT) DISPLAY: Enters the Air to Ground Loadout display. Refer to A/G Load Display in the next chapter for more information.

PB 8, A/A LOAD (AIR TO AIR LOADOUT) DISPLAY: Enters the Air to Air Loadout display. See A/A Load Display section in this chapter for details.

PB 9, NUC (NUCLEAR LOADOUT) DISPLAY: Not functional.

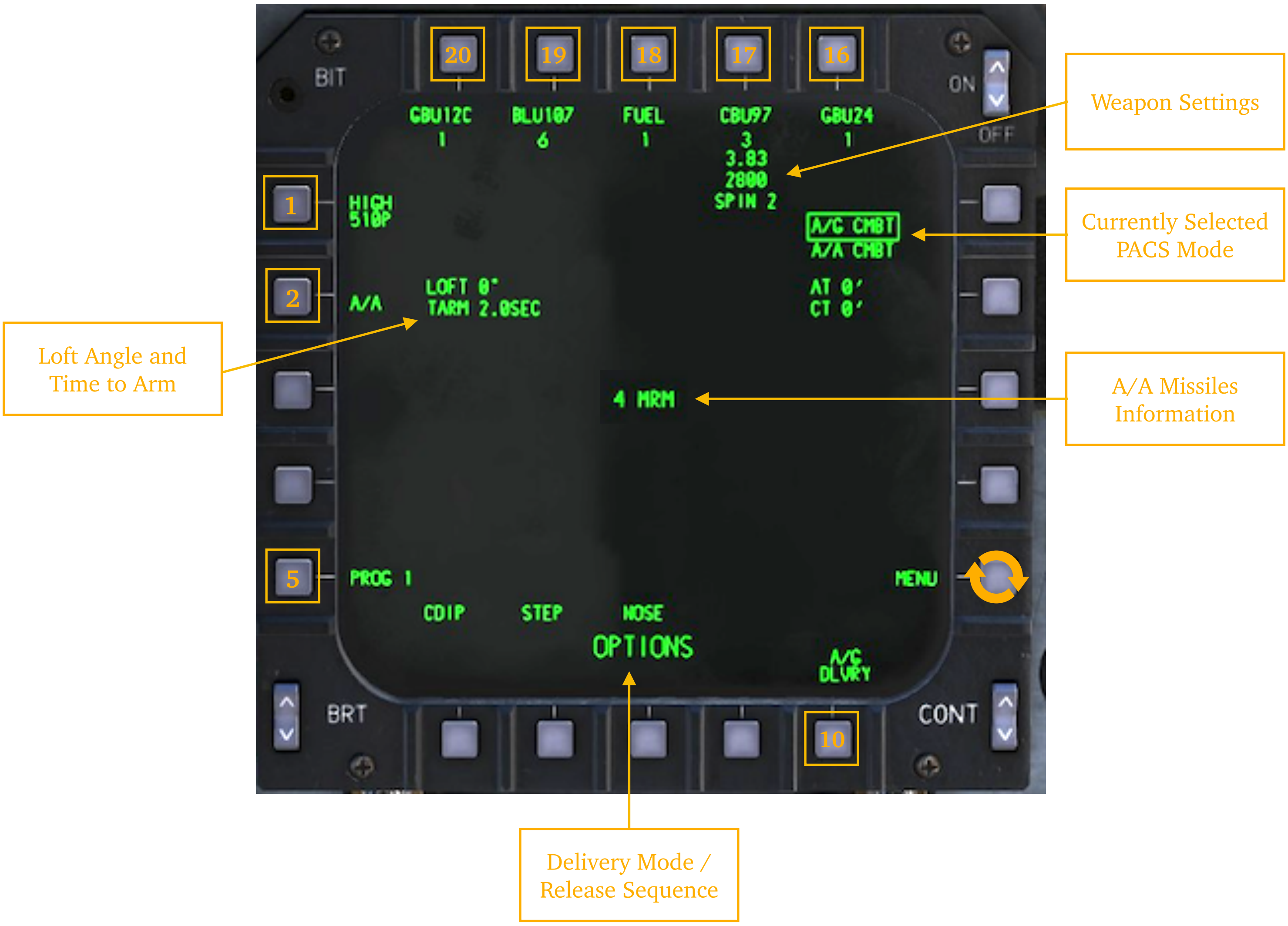
PB 14, A/A (AIR TO AIR) TRAINING: Pressing this PB boxes the A/A TRNG legend. See Air to Air Training section for more details.

PB 15, A/G (AIR TO GROUND) TRAINING: Pressing this PB boxes the A/G TRNG legend. See Air to Ground Training section for more details.

PB 17, RMNVR (MRM MANEUVERING RANGE): Pressing this PB changes the designated aspect angle value used to calculate and display the Rmnvr cue on the A/A radar display. Each press of the button increases the value from 0° to 170°.

13.4.2 PACS AIR TO GROUND DISPLAY

The picture below shows the A/G display of PACS page (accessible by pressing PB 2 - ARMT - under M1, and then PB 3 - A/G).



PB 1, GUN RATE AND ROUNDS REMAINING: Pressing this PB changes the gun rate of fire (ROF) between HIGH (6000 shots per minute) and LOW (4000 shots per minute). For air to ground, low setting is generally used. The number below the ROF shows remaining rounds.

PB 2, AIR TO AIR MODE: Pressing this button opens Air to Air PACS display.

LOFT ANGLE AND TIME TO ARM: Specific data which can be set using the A/G Delivery display.

PB 5, PROGRAM NUMBER: Pressing this button switches through four available programs (1 - 4) and allows to set up a specific delivery mode and release sequence pattern for selected station / stations. See A/G Programming section below.

DELIVERY MODE / RELEASE SEQUENCE: Pushbuttons 6 to 9 are used to determine the desired delivery options. See A/G Programming section below.

PB 10, A/G DELIVERY: Pressing this PB opens separate display used to input various weapon delivery parameters and to display ARMT and system data. See A/G Delivery section below.

A/A MISSILES INFORMATION: Gives the aircrew general information about the number and type of missiles loaded / remaining on the jet (SRM or MRM). For details, it is necessary to enter the A/A display.

CURRENTLY SELECTED PACS MODE: Displays current PACS mode for both A/G and A/A, with the following options: A/G CMBT, A/G TRNG, A/A CMBT, A/A TRNG. Currently selected Master Mode is boxed (either A/A or A/G).

WEAPON SETTINGS: Shows weapon - specific settings (in this case for CBU) under the legend for a given pylon.

PB 16, STATION 8: Shows type, quantity and additional information for weapon loaded on station 8.

PB 17, RIGHT CTF: Shows type, quantity and additional information for weapons loaded on right Tangential Conformal Fuel Tank (CTF).

PB 18, STATION 5: Shows type, quantity and additional information for weapon loaded on station 5.

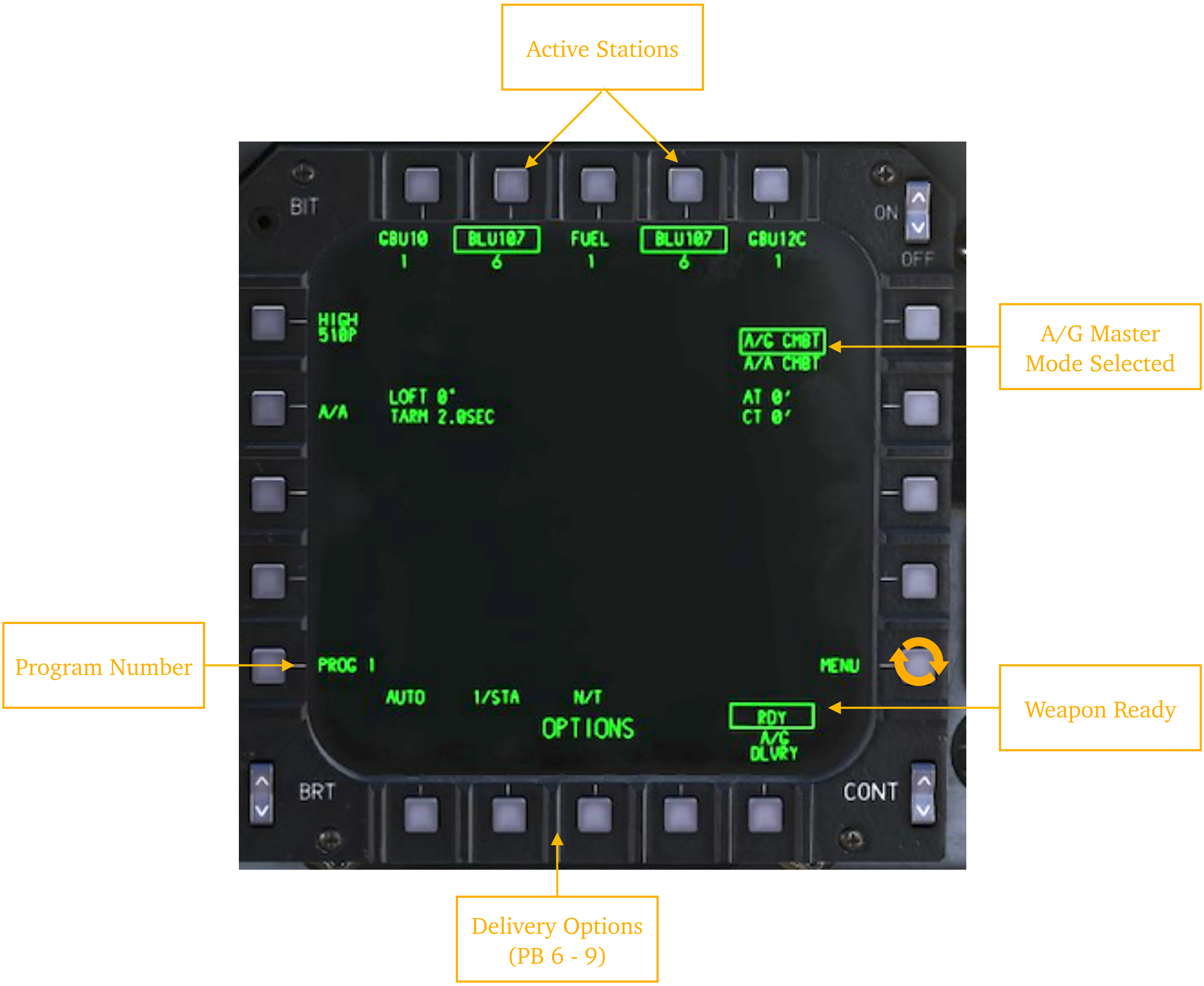
PB 19, LEFT CTF: Shows type, quantity and additional information for weapons loaded on left Tangential Conformal Fuel Tank (CTF).

PB 20, STATION 2: Shows type, quantity and additional information for weapon loaded on station 2.

When pressed, PB 16 to 20 box the legend for selected station and enable programming delivery mode and release sequence for the specific weapon.

13.4.3 AIR TO GROUND PROGRAMMING

A/G programming is achieved using the A/G display. The program can be changed at any time without selecting the A/G Master Mode.

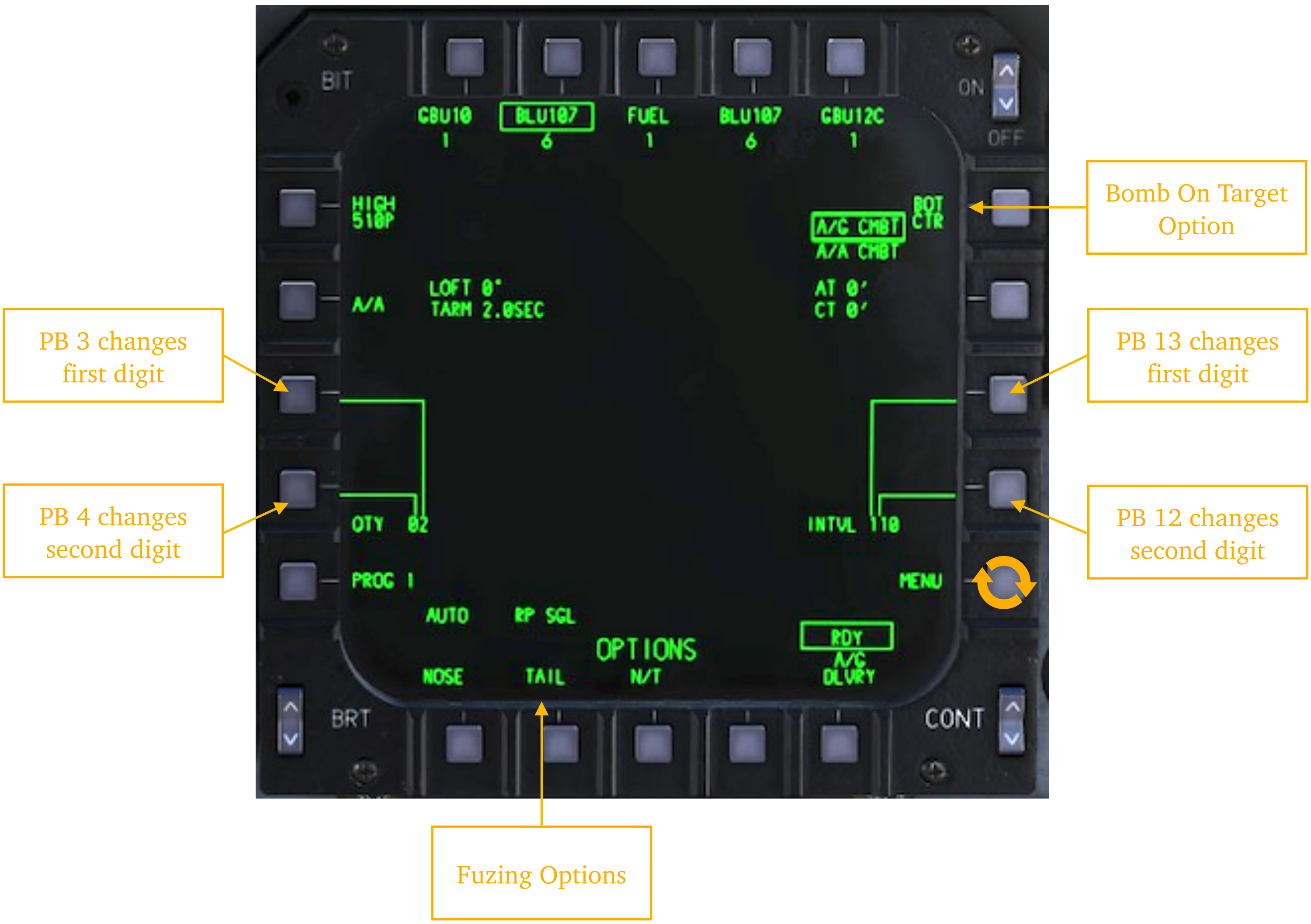


It is important to remember that the selected **Program** (from 1 to 4) will always save the latest introduced delivery options. Therefore, if aircrew sets up the BLU-107 profile with PROG 1 selected, but then switches to GBU-12 without changing the Program number, these new settings will overwrite what was previously programmed for the BLU.

Another thing to bear in mind is that essentially programming is done for stations, and not weapon types. Therefore with the loadout from the example above, it is possible to create three different programs for BLU107: one for R CTF, one for L CTF and one for both CTFs. If selecting more than one station for a given program, all stations should have the same weapon loaded on them.

To program a station, aircrew has to perform the following steps:

1. Press PB 5 to choose the desired PROG number (1 thru 4).
2. Select a station / stations to program. The legend becomes boxed.
3. Select desired Delivery Mode using PB 6 - 9 (options depend on the weapon type, see below).
4. Select Release Sequence using PB 6 - 9 (options depend on the weapon type, see below).
5. Select desired Release Quantity (01 - 29) and Interval (010 - 990 feet) using PB 3 and 4 / 12 and 13, as described below.



Quantity determines how many bombs in total will be dropped in the given programme. Interval determines how far from one another they should hit, which is achieved by programming necessary delay between releasing each weapon.

6. Choose required Fuze options using PB 6 - 9 (these also depend on the weapon type, see below).

Once all the parameters is set, the aircraft is in Air to Ground mode and Master On is switched to ON, a boxed RDY legend will appear above PB 10, signifying that the weapons is ready to be released.

To program another station / stations, simply choose another program number and repeat the whole process.

To recall previously saved program, it is enough to select it using PB 5. The programmed stations will become boxed and delivery options chosen earlier will be displayed in the bottom line.

13.4.3.1 AIR TO GROUND DELIVERY OPTIONS

As was stated before, delivery options depend on the weapon type loaded on the given station. The table below sums up all the possibilities.

DELIVERY MODE	RELEASE SEQUENCE	FUZING
CDIP	1/STA	NOSE
AUTO	STEP	TAIL
DIRECT	RP SINGLE	N/T
	RP MPL	PRIMARY
		OPTION
		TIME
		HEIGHT

Delivery Modes

CDIP, Continuously Displayed Impact Point: displays a continuously updated pipper on the HUD to determine the weapon impact point based on aircaft speed, altitude, pitch and bank angle.

Auto: after the target is designated, displays a TD diamond on its location and a steering line guiding the aircraft to optimal release point.

Direct: the direct mode is mostly used for smart weapons that require lock on target.

Release Sequence

1/STA: one weapon per selected station will be dropped simultaneously with each press of the pickle button. So if two stations are programmed, one bomb will fall from each of them etc.

Step: one weapon will be dropped with each press of the pickle button, alternating between the stations to maintain best possible balance.

Ripple Single: allows to drop a string of weapons for as long as the pickle button is pressed. They will be dropping alternating between the selected stations until the set Quantity is reached. The timing between each drop will depend on the Interval setting.

Ripple Multiple: works similarly to Ripple Single, but one bomb will drop from each selected station simultaneously (so in pairs for two stations, threes if three stations are selected etc) until the set Quantity is reached. The timing between each drop will depend on the Interval setting.

Fuzing

Ejector racks have three fuze arming wire units (nose, center and tail). With **Nose** arming, both nose and center wire units are energized. With **Tail** selected, only the tail unit is energized. With **Nose/Tail (NT)** chosen, all three units are armed.

In practical terms this choice will matter for Mk-82 Air and Mk-82 Snakeye bombs, where **Nose** only setting will inhibit deployment of ballot / fins and mean low drag delivery; the **Tail** or **N/T** will enable the high drag delivery.

Primary, Option, Time and Height settings are specific for the cluster bomb units and will be described in another part of the manual when delivery of these kinds of weapons will be discussed.

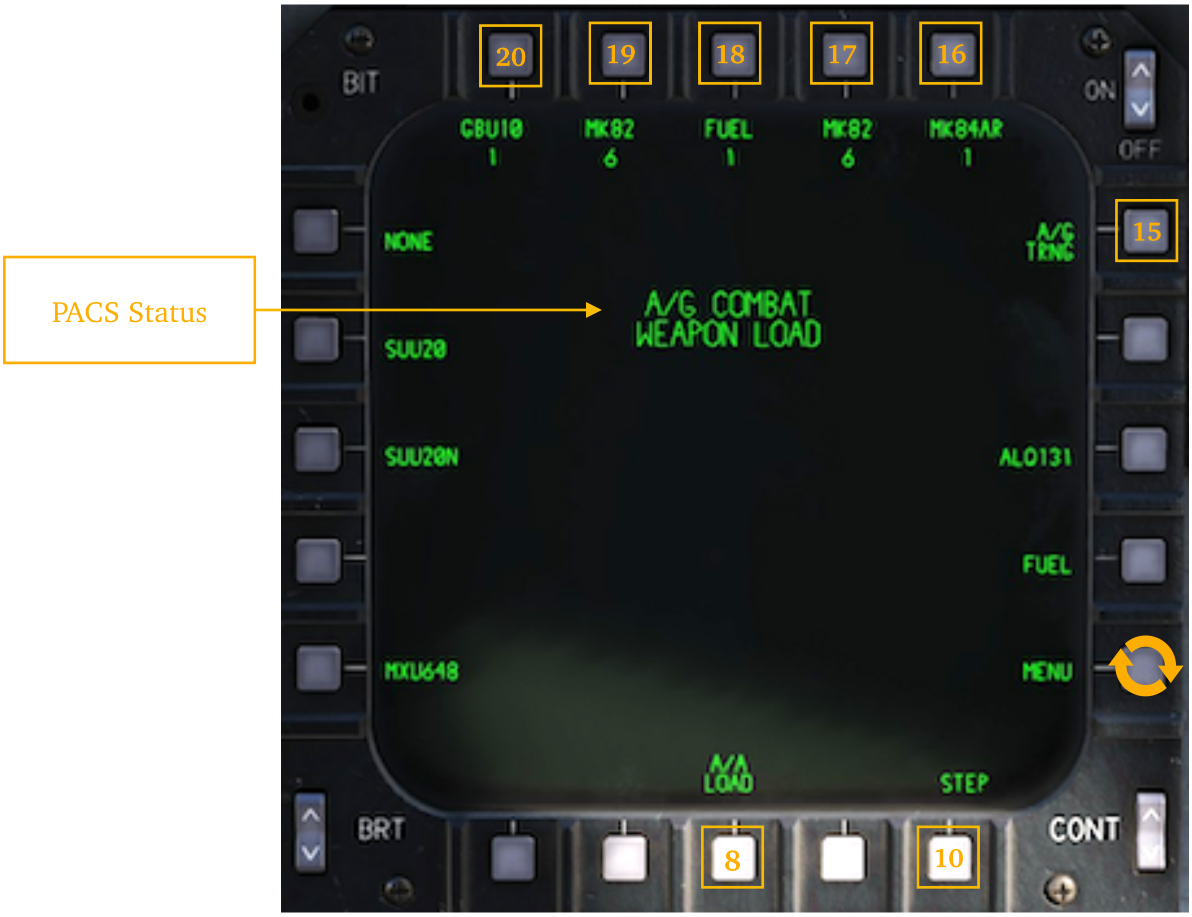
Bomb on Target Option

This setting appears next to pushbutton 15 whenever ripple option is selected and set to greater than 1. It determines, which bomb in the string during the along attack will hit the designated target / spot under the pipper. BOT defaults to CTR (Centrer) and can be changed by repeatedly pressing PB 15. The selected number indicates the bomb in the string that will fall on the target (1 being the first bomb dropped).

Bot can also be set up by typing the desired number on the UFC and then pressing pushbutton 15.

13.4.4 AIR TO GROUND LOAD

Pressing PB 7 from the PACS main display opens the A/G Load page.



In this mode, various weapon choices are listed next to most pushbuttons on six different pages. Other important options are:

PB 8, Air to Air Load: Pressing this PB switches to Air to Air load display.

PB 10, Step: Each press brings up another page with additional weapon choices. See pictures below for the sequence.

PB 15, A/G Training: Pressing this PB enables A/G training mode. Legend on the middle of the screen changes from A/G COMBAT to A/G TRAINING. More information can be found in Air to Ground Training section.

PB 16, STATION 8: Shows type and quantity of weapon loaded on station 8.

PB 17, RIGHT CTF: Shows type and quantity of weapons loaded on right Tangential Conformal Fuel Tank (CTF).

PB 18, STATION 5: Shows type and quantity of weapon loaded on station 5.

PB 19, LEFT CTF: Shows type and quantity of weapons loaded on left Tangential Conformal Fuel Tank (CTF).

PB 20, STATION 2: Shows type and quantity of weapon loaded on station 2.

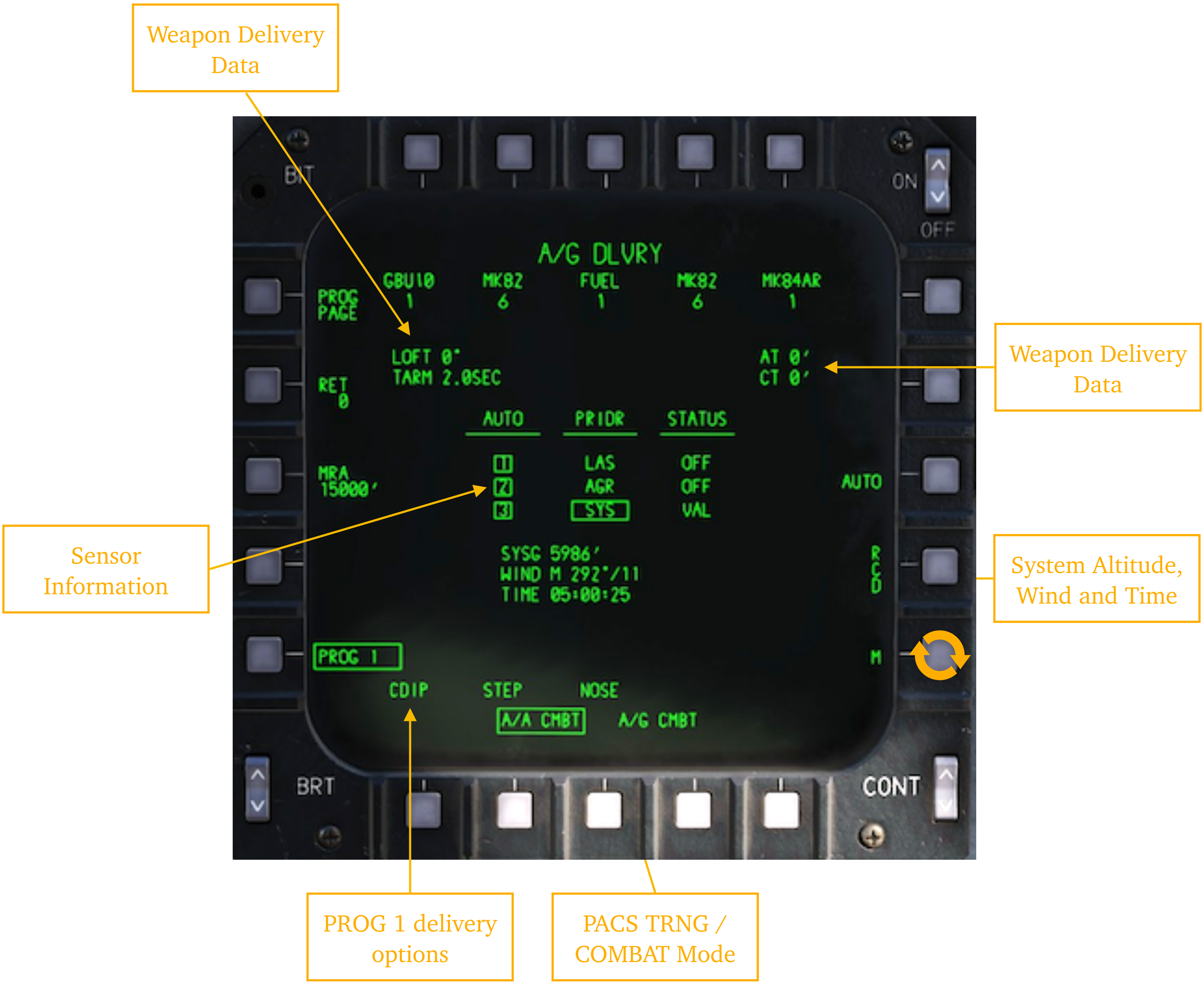
Air to ground pages sequence

To change loadout on any of the stations, simply press the PB next to the desired weapon type. Its legend will become boxed. Next, press the PB for the station you would like to assign the given weapon to. The aircrew will want to utilise this option mostly for the A/G training, where delivery of any kind of weapon can be simulated even if the stores are empty on the real jet.

NOTE: also, in the real jet PACS is capable of recognizing only smart weapons loaded on different stations, but can't do the same for dumb bombs which have to be manually added using the cartridge or A/G load page. Unfortunately, this is not simulated in the DCS.

13.4.5 AIR TO GROUND DELIVERY PAGE

Pressing PB 2 from MPD/MPCD Menu 2 or PB 7 from PACS A/G display brings up the Air to Ground Delivery Page. This page is used to input various weapon delivery parameters and to display PACS and system data.



PB 1, PROG (PROGRAM) PAGE: Opens a separate PROG page (see below or click on PB 1 above to jump directly to its description), which allows programming of specific weapon delivery data and parameters.

PB 2, RET (RETICLE) DEPRESSION: Allows entry of reticle depression angle from flight path data (between 0 and 250 mils) via the UFC scratchpad.

PB 4, MRA (Minimum Recovery Altitude): The minimum recovery altitude which can be entered using the UFC scratchpad.

PB 5, PROG #: Pushing this PB cycles through the PACS A/G programs. Options specific for the given program are displayed below together with PACS mode (either A/A or A/G and CMBT or TRNG).

System Altitude, Current Winds and Time of Day (TOD): This information is provided for display purposes only.

PB 13, AUTO / MANUAL: Pressing this PB toggles between manual and auto sensor hierarchy (AUTO being the default one). This hierarchy can be set up using the A/G Delivery Program Page.

PB 16, Station 8: Shows type and quantity of weapon loaded on station 8.

PB 17, Right CTF: Shows type and quantity of weapons loaded on right Tangential Conformal Fuel Tank (CTF).

PB 18, Station 5: Shows type and quantity of weapon loaded on station 5.

PB 19, Left CTF: Shows type and quantity of weapons loaded on left Tangential Conformal Fuel Tank (CTF).

PB 20, Station 2: Shows type and quantity of weapon loaded on station 2.

NOTE: it is not possible to select a station using A/G Delivery Page. Station should be selected in the PACS A/G Display.

Weapon Delivery Data: Four items are displayed for information purposes only: loft setting, Time to Arm, Along Track and Cross Track adjustments. See A/G Delivery Program Page for more details.

Sensor Information: Provides information about the availability and hierarchy of sensors for A/G operations. Please refer to A/G Delivery Program Page for more details.

13.4.5.1 A/G DELIVERY PROGRAM PAGE

In order to use all the options available on this page, a station or program should first be selected in PACS A/G Display. Depending on type of weapon different options will be shown. The right and top rows of PBs will be covered in the next subsection on sensors hierarchy.

PB 1, PROG (PROGRAM) PAGE: When Program page is active, legend next to PB 1 is boxed.

PB 2, LOFT ANGLE: Using this PB, the aircrew can introduce the desired loft angle (between 0° and 45°) via the scratchpad. If the scratchpad is empty and this PB is pressed, LOFT MAX is displayed, indicating that the CC will compute the maximum loft delivery profile.

PB 3, AT (ALONG TRACK) BIAS: This option enables the aircrew to adjust the impact point for unguided weapons during dive, level or loft deliveries along the line of attack.

This is done via the scratchpad by introducing positive (+) or negative (-) values, Positive AT will move the impact point long to correct for short errors. Negative AT does the opposite and moves the impact point short to correct for long errors. To enter negative value, a minus (-) sign should by selected first.

The value entered is the desired long or short bias in feet and can be anywhere between -9999 and 9999.

If PB3 is pressed with blank scratchpad, the unit will be changed from feet into miliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.

PB 4,CT (CROSS TRACK) BIAS: Works in the same way as the AT bias, but for adjusting the impact point for unguided weapons during dive, level or loft deliveries and moving it to the left or right from the line of attack.

This is done via the scratchpad by introducing positive (+) or negative (-) values, Positive AT will move the impact point right to correct for left errors. Negative AT does the opposite and moves the impact point left to correct for right errors. To enter negative value, a minus (-) sign should by selected first.

The value entered is the desired long or short bias in feet and can be anywhere between -9999 and 9999.

Pressing PB4 with blank scratchpad changes the unit from feet to miliradians. The legend now shows CT XX MIL. The possible value for bias here is between -50 and 50.

PB 5, PROGRAM: Pushing it cycles trough the A/G PACS programs.

PB 6, TARM (TIME TO ARM): Allows entry of weapon time to arm after release. This is done via the scratchpad (the valid time is between 0 to 99.9 seconds) and pushing PB 6. If decimal is not manually entered, the system adds it before the right most digit.

PB 8, AUTO AND MANUAL LASE (GBU ONLY): PB 8 allows the entry of automatic or manual lase time.

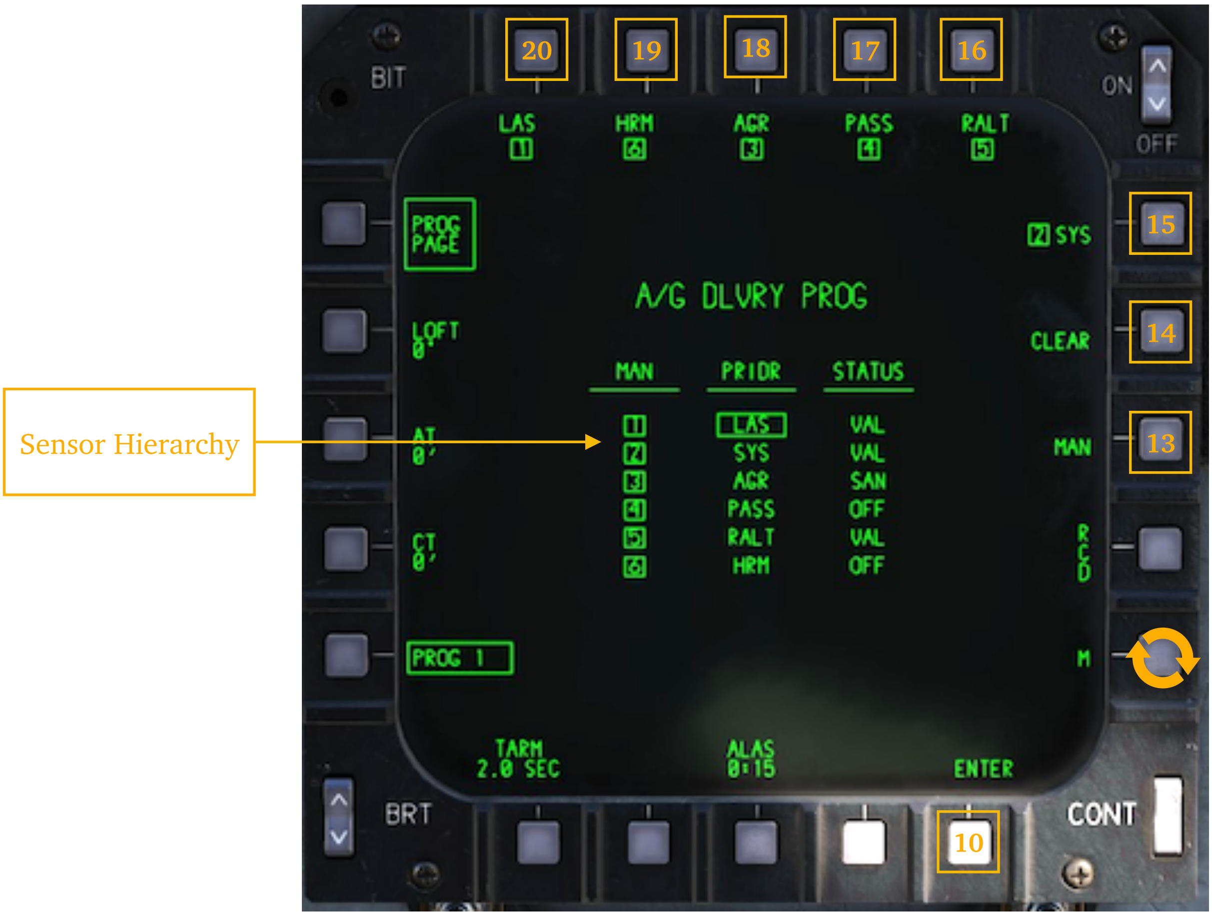
If scratchpad is blank, pushing PB 8 toggles between MLAS and ALAS (the first being manual lasing, the other automatic). Below either CONT or time will be displayed. To enter a desired lase time scratchpad should be used (valid entries are 0:01 thru 0:31).

With AUTO and CONT selected, laser will continuously paint the target as soon as the bomb is dropped. With AUTO and TIME set it will only fire for the given amount of time before impact.

In MANUAL mode, the laser will fire only after appropriate HOTAS command is issued.

13.4.5.2 A/G Sensor Hierarchy

Onboard sensor hierarchy is an important part of A/G Delivery program functionality and therefore will be covered separately, even if it uses the same menu page.

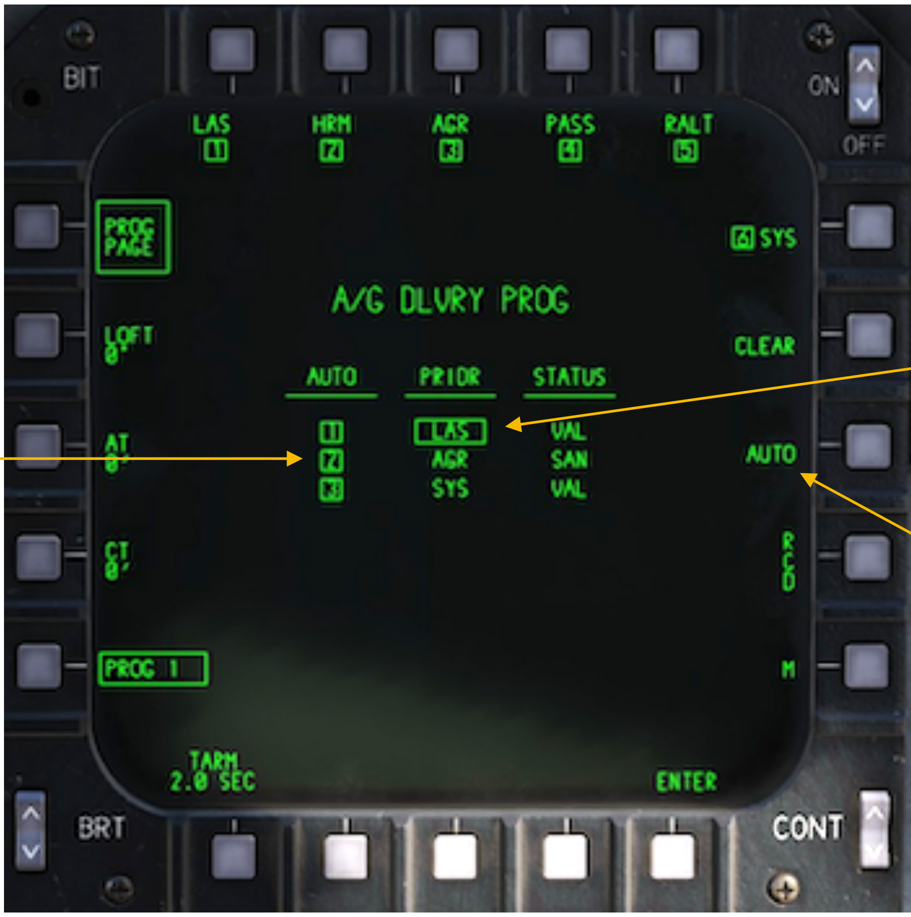


PB 10, Enter: pressing this PB enters the sensors selected at PBs 15 thru to 20 into the manual sensor hierarchy. The selected sensors are then positioned accordingly to the number assigned to each of them (see examples below).

PB 13, Manual / Auto Sensor Hierarchy: System initialises with AUTO enabled. Pressing this PB switches between the automatic mode of setting sensor hierarchy or allows the aircrew to determine it manually.

With MAN selected, all the sensor which are manually assigned a number will be displayed in the middle of the display in the order decided by the aircrew. With AUTO, only three will be shown: LAS, AGR and SYS. The sensor which is going to be used to calculate Height Above Target (HAT) or Height Above Ground (HAG) is boxed. If the system is not given a number, it will not appear in the hierarchy / status displays. SYS is always part of the manual program and is placed on the bottom of the list unless manually programmed to a higher priority.

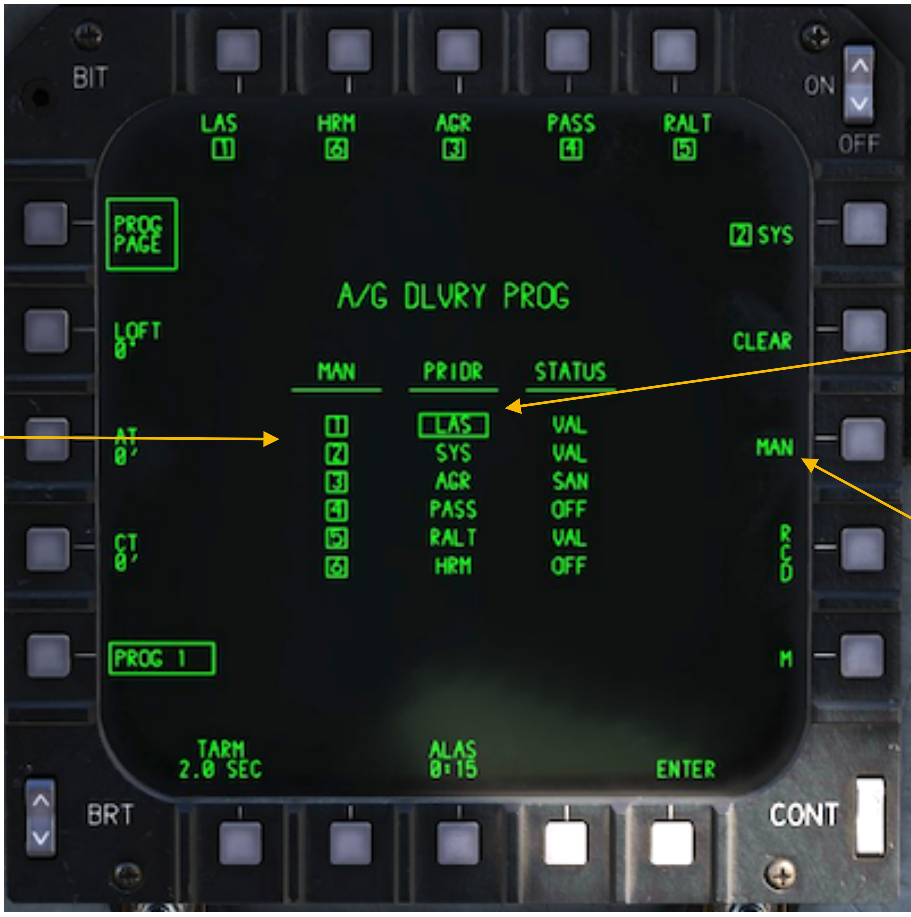
In Auto Mode only 3 sensors are shown



Currently selected sensor is boxed

AUTO selected

In Manual Mode all sensors assigned a number will be shown in hierarchy set by aircrew



Currently selected sensor is boxed

MAN selected

The set sensor hierarchy is used 15 seconds before release to increase accuracy. If first sensor on the list becomes unavailable, the system switches to the next one.

The three columns on the display are as follows:

MAN or AUTO: displays currently selected mode and numbers assigned to systems in sequence.

PRIOR: shows the systems accordingly to their numbers (these will always be the same in AUTO). The currently selected sensor (the one given the highest priority and which is available) will be boxed.

STATUS: displays the readiness of the given sensor. These can be:

VAL: sensor is passing validity and HUD sanity checks

SAN: sensor is not passing the HUD sanity checks

OFF: sensor cannot be used

PB 14,CLEAR: pressing it removes all sequence numbers next to sensor legend at PB 15 thru 20.

Selecting sensors in MAN mode

The sensors under PBs 15 - 20 will be assigned numbers from one to six. If PB 14 was pressed and there is no number displayed under any sensor, each press of the PB will assign the lowest available number to the selected sensor. If number is already assigned, pressing the associated PB will remove the number. Once all numbers are distributed, PB 10 (ENTER) should be pressed to validate them. The options are:

PB 15, SYS: Selects system altitude as active sensor.

PB 16, RALT: Selects Radar Altimeter as active sensor.

PB 17, PASS: Selects passive ranging from targetiing pod Line of Sight and LOS rate.

PB 18, AGR: Selects Air to Ground radar as active sensor. The AGR grazing angle must be ket at or greater than 1.25°, designated target must be within the radar antenna gimbal limits and the computed range from AGR must be within -10,000 to +15 000 feet of the designated yeah target position.

PB 19, HRM: Uses ground range to the target designated from the patch map, along with slant range and depresssion angle from the pod designation to calculate the HAT.

PB 20, LAS: Selects laser as active sensor. The targeting pod has to be installed, and the laser has to be armed and firing.

13.4.6 A/G Training Mode

A/G training mode can be enabled pressing PB 15 on the top level PACS display page or on A/G load display. This mode is designed as a weapon safe mode, which means that no A/G munitions can be expended for as long as A/G TRNG is boxed.

NOTE: A/G Training Mode is only partially functional during EA stage.

13.5 STORES JETTISON SYSTEM

There are three main options when it comes to jettisoning ordnance from the jet: the emergency jettison, selective jettison or combat jettison. All three will be described below.

Regardless of Master Arm switch position, when either the emergency jettison or select jettison button is pressed, all arming solenoids are automatically deenergized and all stores are jetissoned unarmed.

Also, the selective jetisson controls are deenergized if the landing gear handle is in the down position (note that emergency jettison still works).

The landing gear handle interlock can be bypassed by placing the Armament Safety Switch to OVERRIDE position.

13.5.1 EMERGENCY JETTISON

The Emergency Jettison button is hot at all time as long as the aircraft is on internal or external power.

When pressed for approximately 1 second, the contents of all CFT stations and stations 2, 5 and 8 pylons are jettisoned.

13.5.2 SELECT JETTISON KNOB / BUTTON

The select jettison knob / button is located on the ACP. When pressed and held for at least one second, the button jettisons stores depending on the knob position.

NOTE: there are positions which are not jettison positions and allow to drop live ordnance.

The <u>non - selective jettison</u> options are:

MANUAL FREE FALL: selects an ARMED manual (ripple) release mode with nose fuze only. Pressing and holding the weapon release button releases weapons continuously from each selected station until all weapons are gone or the button is released.

MANUAL RETARD: this option selects the manual weapon release mode and tail fuze only. Each release pulse releases one weapon from each selected aircraft station while the weapon reelase button is pressed.

ALTN REL: Nuclear release mode.

The <u>selective jettison</u> options are:

OFF: removes power from the selective jettison button. Pressing it will not have any effect.

COMBAT: selective jettison button first press initiates combat jettison program 1. Second press initiates combat jettison program 2.

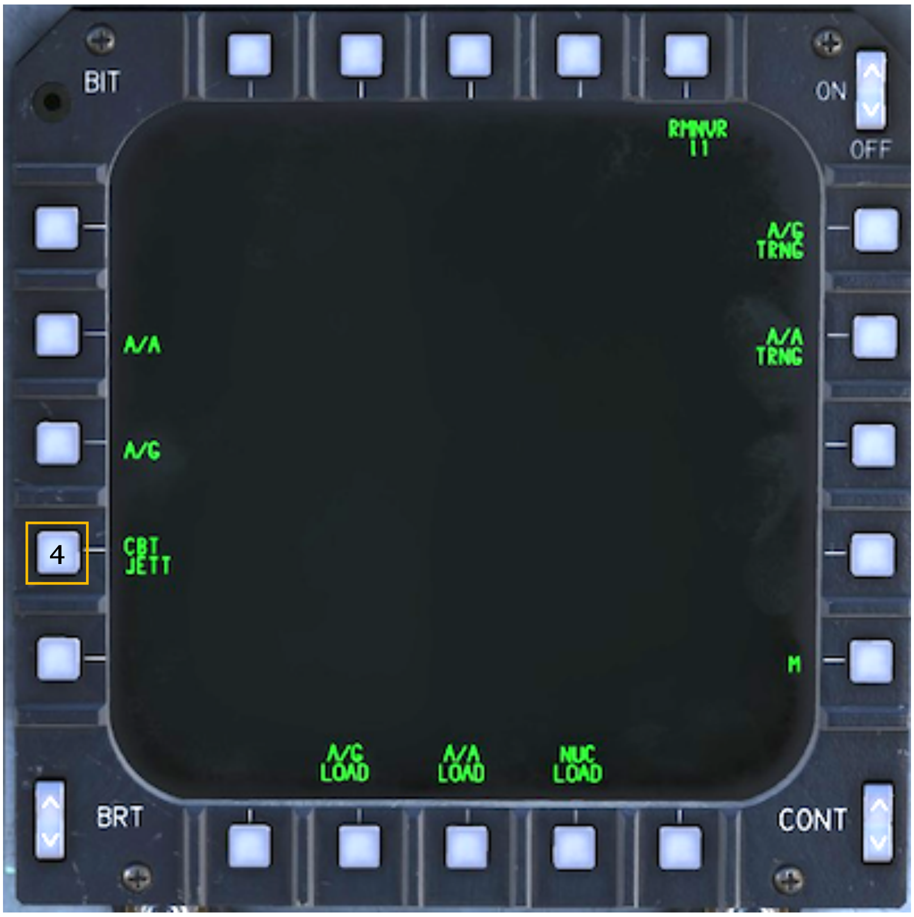
AIR TO AIR (A/A): selects air to air selective jettison.

AIR TO GROUND (A/G): selects air to ground selective jettison.

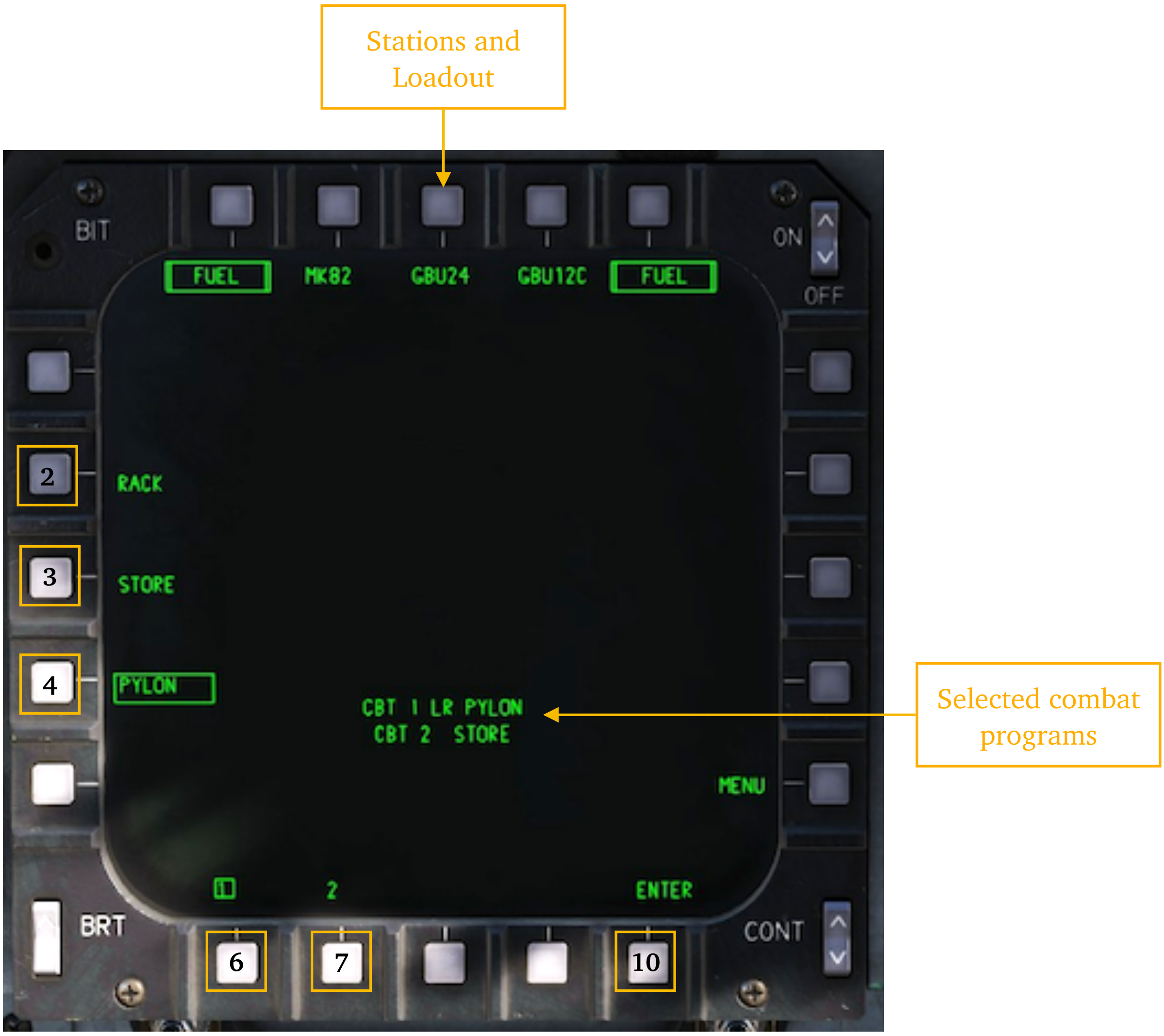
13.5.3 COMBAT JETTISON

Combat jettison is also called a two-push jettison capability. The aircrew can set up two separate programs for stores and each of them will be jettisoned with one press of the button.

The combat jettison programming page can be entered from the top A/G PACS display by pressing P/B 4.



The Select Jettison knob can be either in OFF or in COMBAT position. Once in the CBT JETT page, a number of new options appear: available loadout and stations are listed at the top of the display. Other functions include:



Stations and loadout: Top of the screen represent (from left to right) Station 2, left CTF, Station 5, right CTF and Station 8 and loaded weapons.

PB 2 RACK: When boxed, it programs jettison function for the rack mounted on the given station.

PB 3 STORE: When boxed, it programs jettison function for the store mounted on the given station. The pylon will remain attached to the jet. This is the default selection when initialising the CBT JETT page.

PB 4 PYLON: When boxed, it programs jettison function for the whole pylon mounted on the given station, which means that not only weapons, but also the pylon itself will be detached from the jet. This also means that any A/A missiles on stations 2A and 2B and / or 8A and 8B will be jettisoned as well.

PB 6 (1): This indicates that selection / programming is being made for first program.

PB 7 (2): This indicates that selection / programming is being made for second program.

PB 10 (ENTER): Used to validate selection made for the currently active program (1 or 2).

Selected Combat Programs: Displays the summary of selection made for the given program (1 or 2). There are three columns and the possible options are:

COLUMN 1	COLUMN 2	COLUMN 3
CBT 1	L (left)	RACK
CBT 2	LC (left conformal tank)	STORE
	C (center)	PYLON
	RC (right conformal tank)	
	R (right)	

As one, two or all stations can be selected for each program, there may be different variations seen in column 2, for instance:

CBT 1 LRC PYLON means that for program 1 left + right conformal tank stations were selected and pylon will be jettisoned.

CBT 1 LLCRC STORE means that for program 1 left + left conformal tank + right conformal tank stations were selected and stores will be jettisoned.

CBT 2 LLCCRCR RACK means that for program 2 all stations were selected and racks will be jettisoned etc.

Setting up combat jettison program

1. Enter the CBT JETT page.
2. Select the desired program (1 by default) pressing PB 5 or 6.
3. Select the stations you want to program to jettison by pressing PBs 16 thru 20. Mark stations will become boxed.
4. When happy, select rack / store or pylon option using PBs 2 thru 4.
5. Validate the selection by pressing ENTER (PB 10).

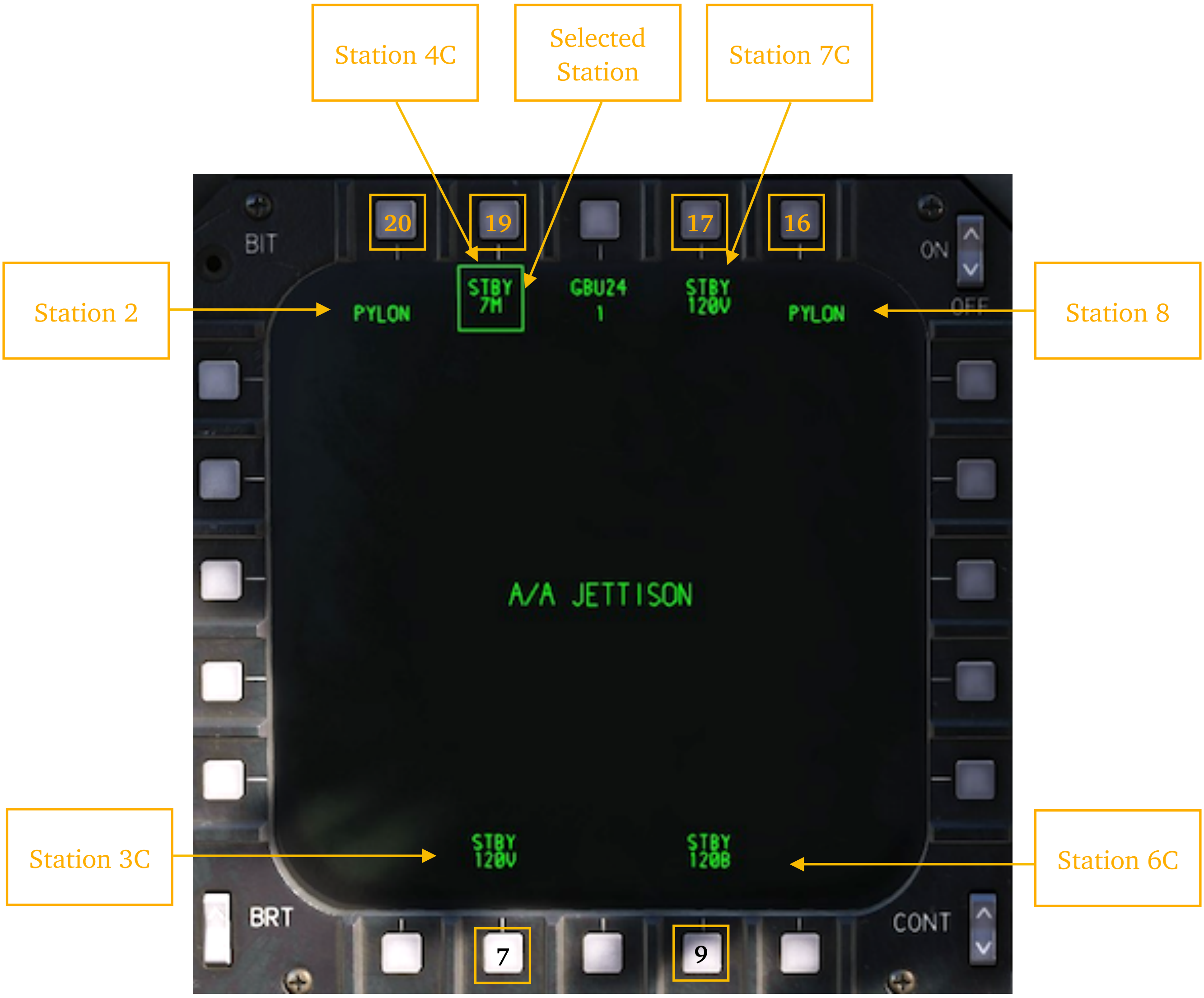
Executing combat jettison programs

1. Set the Selective Jettison Knob to COMBAT.
2. Press and hold the red JETT button for at least one second. Stations selected under program 1 will be jettisoned.
3. To jettison stations selected under program 2, press and hold the red JETT button for at least one second again.

NOTE: you can execute only two programs of the combat jettison, meaning that changing programs afterwards will not enable you to jettison extra stores.

13.5.4 AIR TO AIR JETTISON

Selecting Air to Air Jettison position of the Selective Jettison Knob automatically brings up the dedicated A/A Jettison page on the MPCD in the front cockpit (it can also be entered on any of the MPDs by selecting ARMT page).



Loaded A/A weapons and their status are shown next to the following pushbuttons:

PB 7 (station 3C)

PB 9 (station 6C)

PB 16 (station 8A and 8B)

PB 17 (station 7C)

PB 19 (station 4C)

PB 20 (station 2A and 2B)

Note that for the pylons no additional information about A/A weapons loaded there (if any) is provided.

To select the station to be jettisoned, press the associated PB. The legend will become boxed. The selections are mutually exclusive, which means that only one station can be selected at any given time.

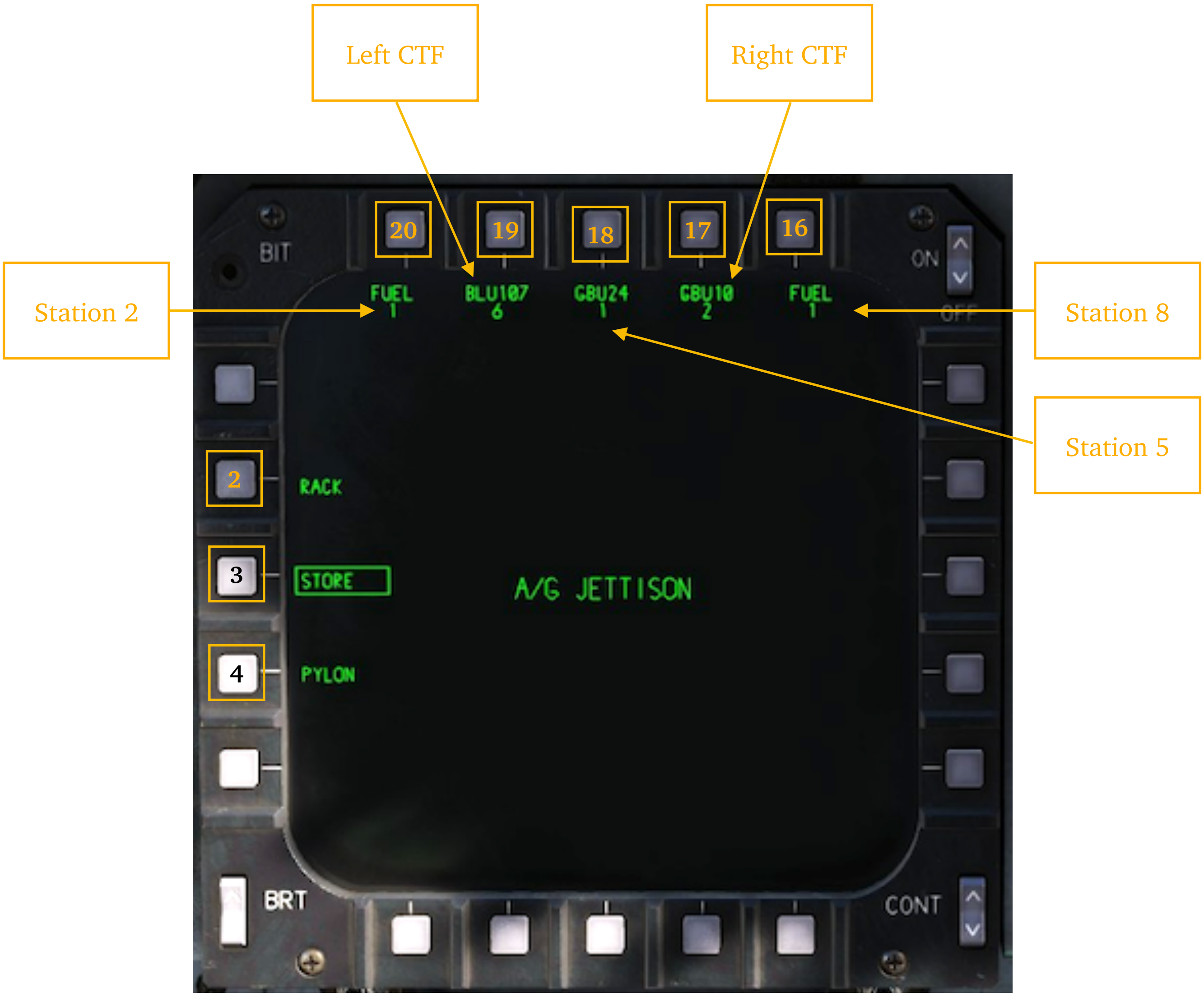
In order to jettison weapons from the selected station, press and hold the red JETT button for at least one second.

Note that stations 2 and 8 mean jettisoning the whole pylon, including the fuel tank or any A/G weapon mounted there.

To exit the A/A jettison mode, change the Selective Jettison Knob position.

13.5.5 AIR TO GROUND JETTISON

Selecting Air to Ground Jettison position of the Selective Jettison Knob automatically brings up the dedicated A/G Jettison page on the MPCD in the front cockpit (it can also be entered on any of the MPDs by selecting ARMT page).



Loaded A/G weapons and their status are shown next to the following pushbuttons:

PB 16 (station 8)

PB 17 (right CTF)

PB 18 (station 5)

PB 19 (left CTF)

PB 20 (station 2)

Moreover, on the left side of the screen, following selections are available:

PB 2 RACK: When boxed, it programs jettison function for the rack mounted on the given station.

PB 3 STORE: When boxed, it programs jettison function for the store mounted on the given station. The pylon will remain attached to the jet. This is the default selection when initialising the CBT JETT page.

PB 4 PYLON: When boxed, it programs jettison function for the whole pylon mounted on the given station, which means that not only weapons, but also the pylon itself will be detached from the jet. This also means that any A/A missiles on stations 2A and 2B and / or 8A and 8B will be jettisoned as well.

Note that for the pylons no additional information about A/A weapons loaded there (if any) is provided.

A/G Jettison procedure

To select the station to be jettisoned, press the associated PB. The legend will become boxed. The selections are mutually exclusive, which means that only one station can be selected at any given time.

In order to jettison weapons from the selected station, press and hold the red JETT button for at least one second.

Note that for stations 2 and 8 if PYLON is selected, it will also jettison any air to air weapons loaded on stations 2A-B and 8A-B.

To exit the A/G jettison mode, change the Selective Jettison Knob position.

NOTE: the Selective Jettison Knob as well as Emergency Jettison Button - and therefore any jettison options - are only available in the front cockpit.

13.6 Designating Targets

Target designation is the aircrew procedure for obtaining target position data in relation to the aircraft's present position and storing it for the air to ground attack purpose. F-15E offers a number of different ways to do that:

A. NAV designation

B. Radar in A/G mode

C. HUD (either Target Designator or CDIP pipper)

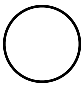
D. Targeting Pod

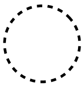
All of these methods will be described in greater detail below.

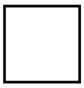
13.6.1 NAV Designation

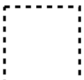
NAV designation is basically creating a Target Point or turning a Sequence Point into a Target Point using the UFC menu. Any Sequence Point that is a Target Point is automatically treated as designation for the A/G attack.

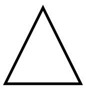
As a reminder, a list of different Sequence Point types:

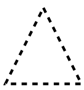
 Steer Point. The number in the top - right is the steer point number.

 Aim Point associated with steer point. The number in the top - right shows the steer point number and then aim point number (1.1, 1.3, 2.1 etc).

 Initial Point (IP), which is always the steer point before the target point.

 Aim Point associated with the initial point. The number in the top - right shows the initial point number and then aim point number (1.1, 1.3, 2.1 etc).

 Target. The number in the top - right is the target number.

 Offset Point, associated with the target. The number in the top - right shows the target point number and then offset point number in two - digit format (1.01, 1.03 etc).

It is possible to create a set of Target Points (and Offset Points) during mission preparation in the Mission Editor level - the process was described here.

It is also possible to quickly change any Steer Point into a Target Point using the UFC. In order to do so:

1. Enter MENU 1 on the UFC.

2. Press PB10 to enter the Steer Point menu

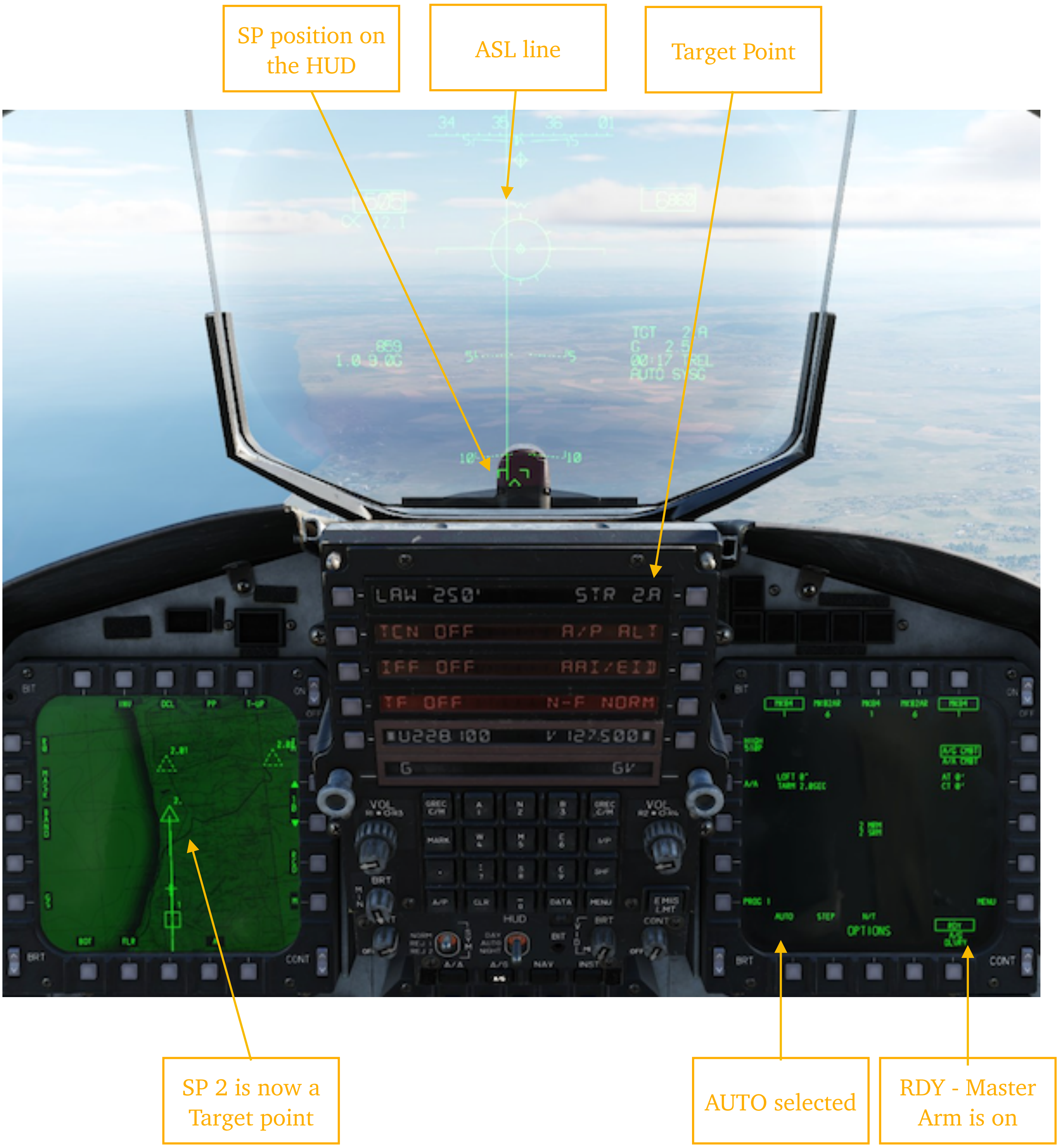
3. Type desired Sequence Point number and press PB1 to select it.

4. Now type the same Sequence Point and add a dot (.) to its name.

5. If the weapons are selected and set up for AUTO delivery and the Target Point is within the HUD LOS, the target and the ASL line will appear.

Normal Sequence Point (2) selected

Sequence Point (2) converted to Target Point (2.)



Only Target Points are designated by the system - even if Offset Point (1.01, 1.02 etc) is selected, the main Target Point will be used by the CC to compute delivery data.

NOTE: changing the Offset Point (dotted triangle on the TSD) to other type (Aim Point associated with SP or IP) will also change the main Target Point accordingly (into a normal SP or IP if next point in the route is a Target Point).

13.6.2 Radar Designation

Target can be designated in any mode except PVU (so: in RBM, HRM or GMT) using the TGT cursor function. Steps to be followed:

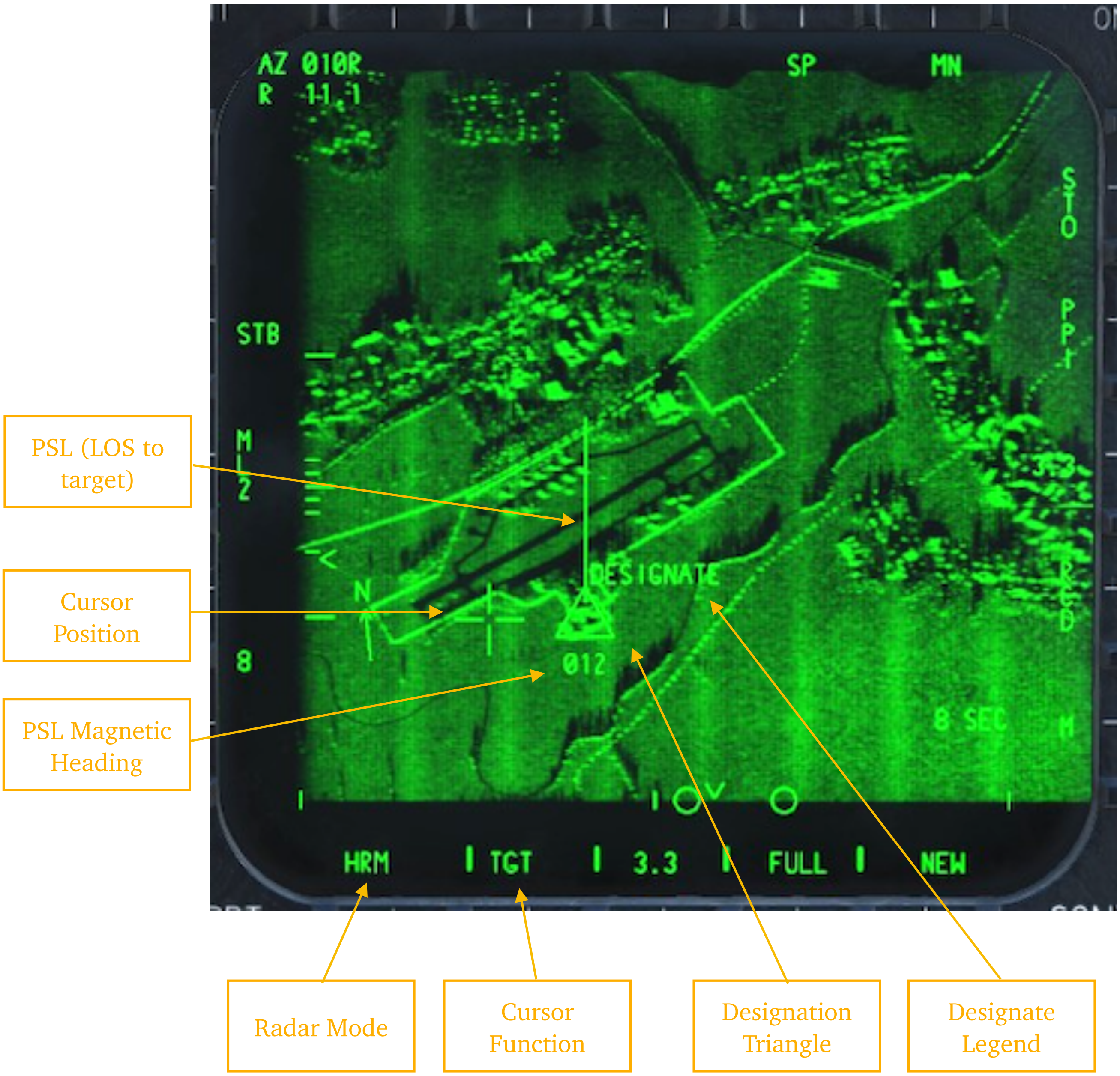
1. Enter the A/G page and take command of the radar.

2. Select the desired A/G radar mode using the PB 6. When using the HRM map patch, build the picture of the required area, as described in the A/G Radar chapter.

3. When ready to designate, switch the cursor function by pressing PB 7 until TGT appears (in the rear cockpit you can also press **Castle Switch Aft** short).

4. Using the TDC, place the cursor over the object or area you want to designate. Press the **TDC** (in the front cockpit) or **HC Trigger full action** (in the rear cockpit).

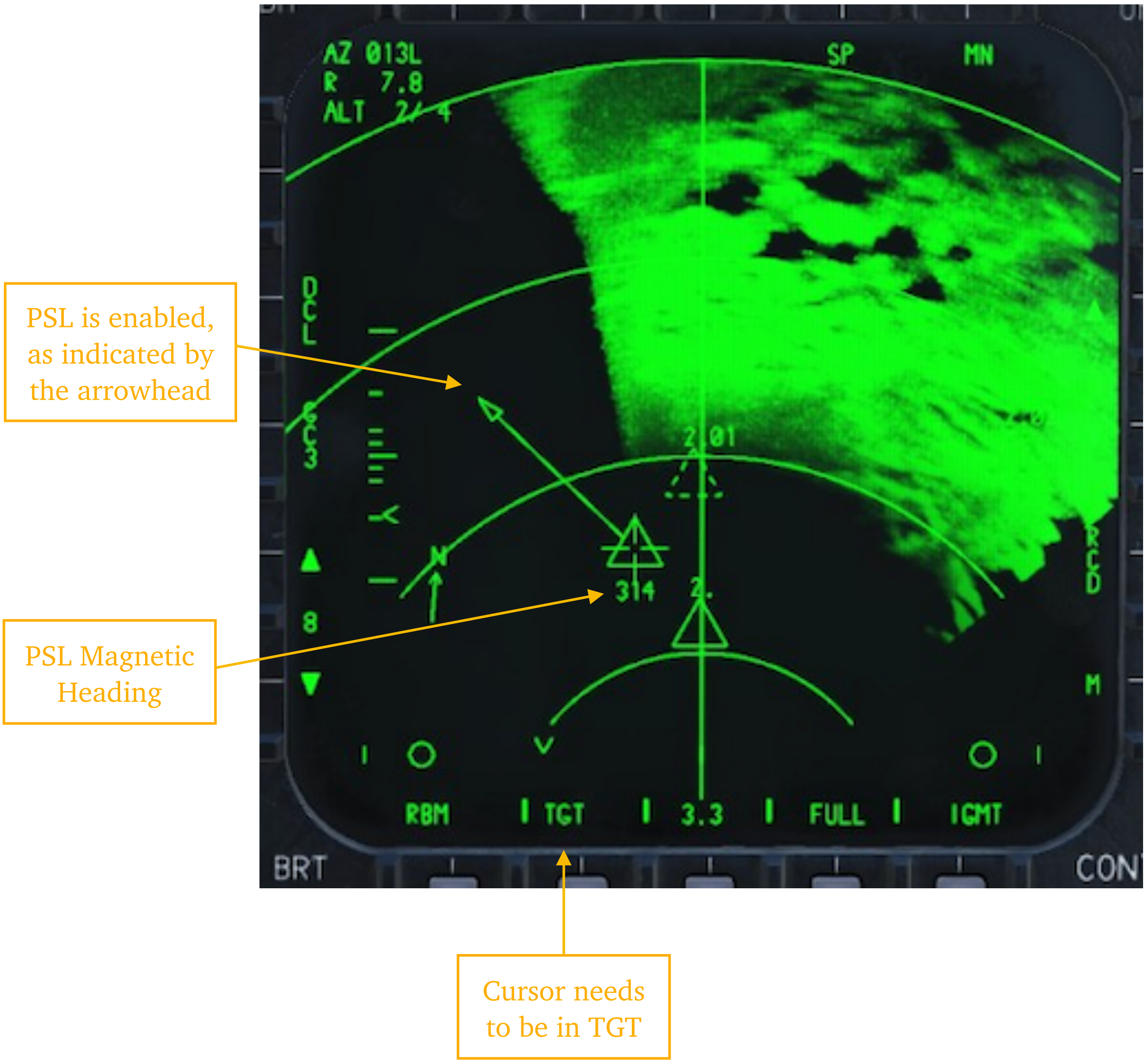
The radar screen itself in greater detail:



PATTERN STEERING LINE (PSL): PSL appears on the radar display screen when a target has been designated. It is indicating the LOS from the aircraft to the target at the moment of designation, but it can be slewed around should there be a need to approach the target at a different heading.

In order to slew the PSL around, TGT cursor function should remain selected and aircrew member currently operating the radar should pull the **Auto Acquisition Switch** aft (in both cockpits). This enables the PSL and an arrowhead appears on its end. Using the **TDC**, PSL can then be slewed left or right around the designation triangle to the desired run in heading. Current magnetic heading of the PSL is displayed below the triangle.

PSL enabled, RBM mode



13.6.2 HUD DESIGNATION

Targets can be designated using the HUD Target Designator (TD) or a pipper both in Auto and CCIP modes.

13.6.2.1 HUD TARGET DESIGNATOR

HUD TD is not available at the Early Access stage.

13.6.2.2 HUD PIPPER

Designation using the HUD is possible from AUTO mode with or without prior designation and from CDIP mode.

Auto Mode - Target Designated

If a target has previously been designated by any method, attack steering is to a release point from which weapons will impact the HUD TD diamond position.

With HUD in command, it is possible to move the TD diamond by pressing **TDC**, slewing it to new position and releasing the TDC. The new point is designated in this way.

It is also possible to maneuver to aircraft in order to place the pipper over desired location and press **TDC** in order to designate this new spot.

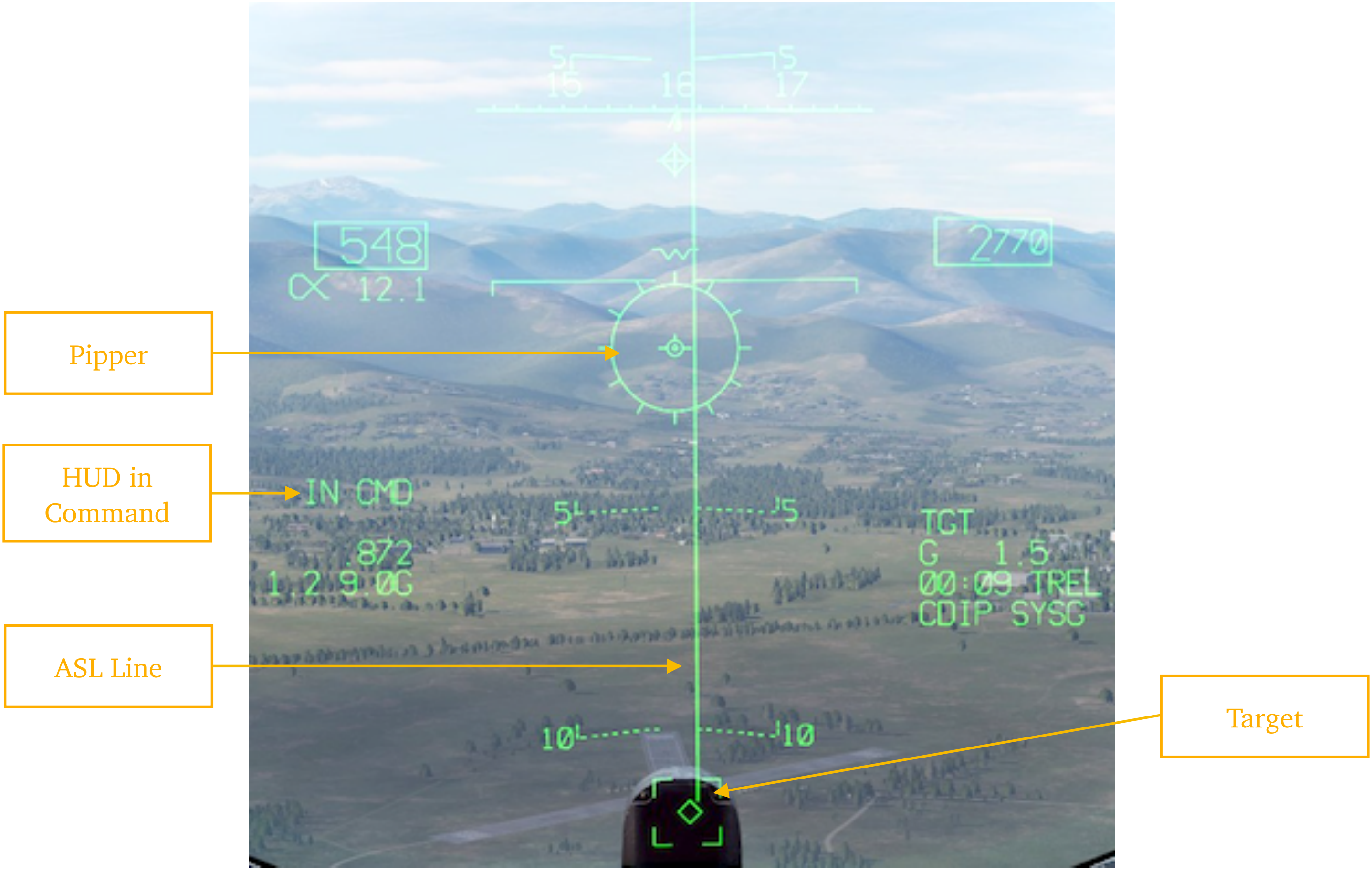
Auto Mode - No Target Designated

Works exactly the same as in the example above. If there is no target designated, it is still possible to designate a location directly under a pipper by pressing **TDC**.

CDIP Mode

The target may be designated if desired prior to release also in CDIP mode. To do so, put the target under the line connecting the velocity vector and the pipper (DIL). Fly to keep the target on the DIL. Press and hold the **Pickle Button** when the pipper is on target, which will bring up the AUTO display. Hold the pickle button pressed until the weapon is released.

CDIP Mode - Target Designated



NOTE: it is important to remember to take command of the HUD when designating target using pipper, as not doing so may cause premature release of the bomb when pressing the pickle button.

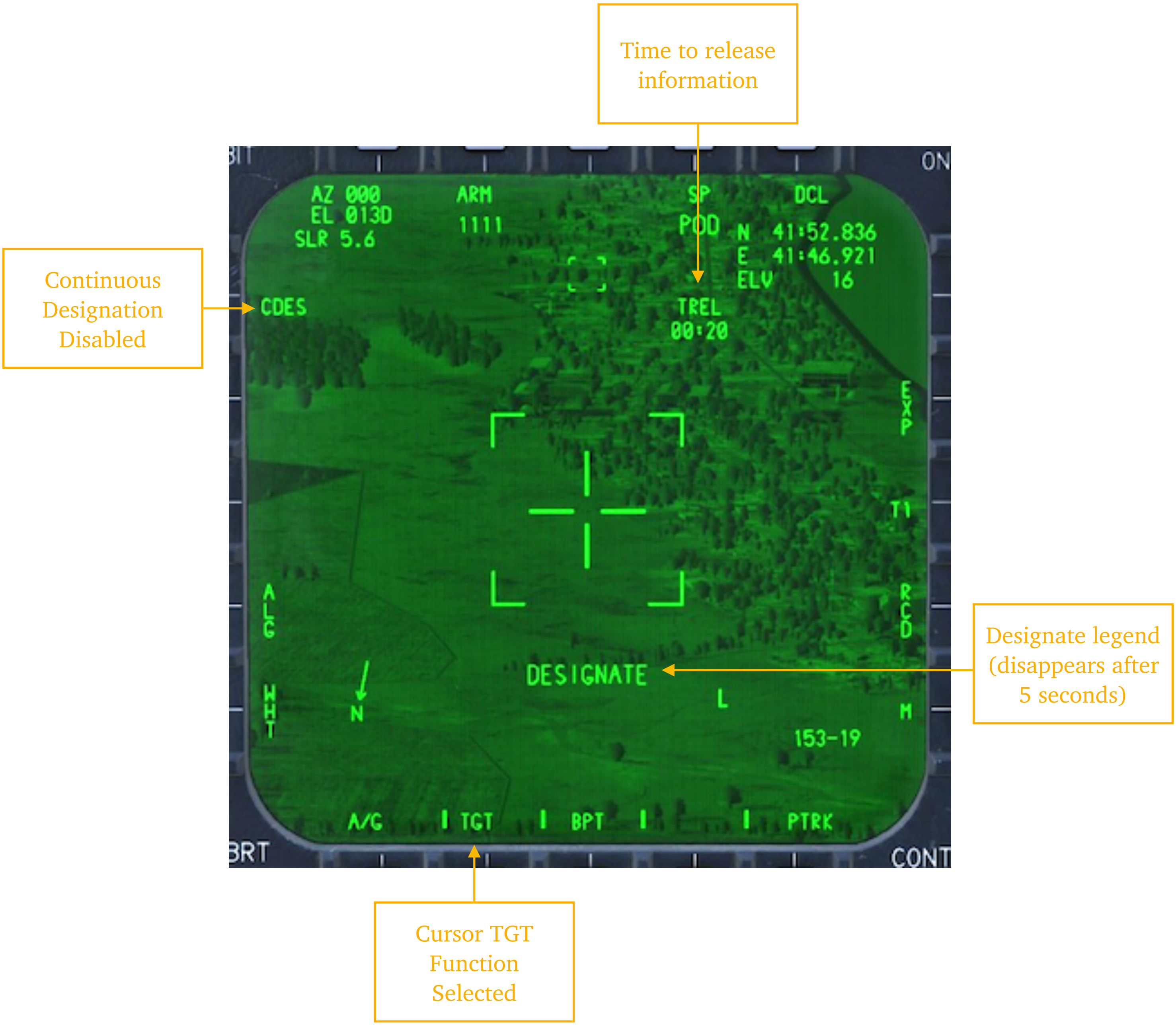
13.6.3 TPOD DESIGNATION

Targets can be designated using the targeting pod using the TGT cursor function.

To designate a target using this method, the crosshairs should be placed over the desired spot (which can already be tracked by the pod) and the special cursor function should be performed as described above (ie. pressing TD or HC Trigger to full action).

Once the target is designated, normal attack symbology is displayed on the HUD and TGT IR display for A/G weapon deliveries. A DESIGNATE legend is shown below the crosshairs on the display for 5 seconds.

Aircrew has an option to choose between one time or continuous designation, which can be toggled by boxing the CDES legend with PB 2.



One time designation

If one time designation is performed, current range and LOS information is used at the moment of initiating the process. If the pod is moved to another location, previously designated spot remains valid for the system until designation action is performed again.

Continuous designation

If continuous designation was selected (CDES is boxed), the designation is updated continuously with new range and LOS information. This means that designation follows pod's LOS and changes to the spot the crosshairs are pointing to as soon as the slewing stops. CDES is only available if LAS, HRM or PASS is programmed as active sensor in manual mode (in AUTO, only LAS can be used).

13.7 AIR TO GROUND BOMBING

The ways in which different types of bombs are dropped depend on the type of ordnance used as well as the tactical considerations (low, level and fast delivery for retarded munitions versus high level attack on designated target in auto mode using guided bombs). Still, when it comes to delivery modes, there are three primary ways of doing it: Auto, CDIP and Direct plus one backup: Manual mode.

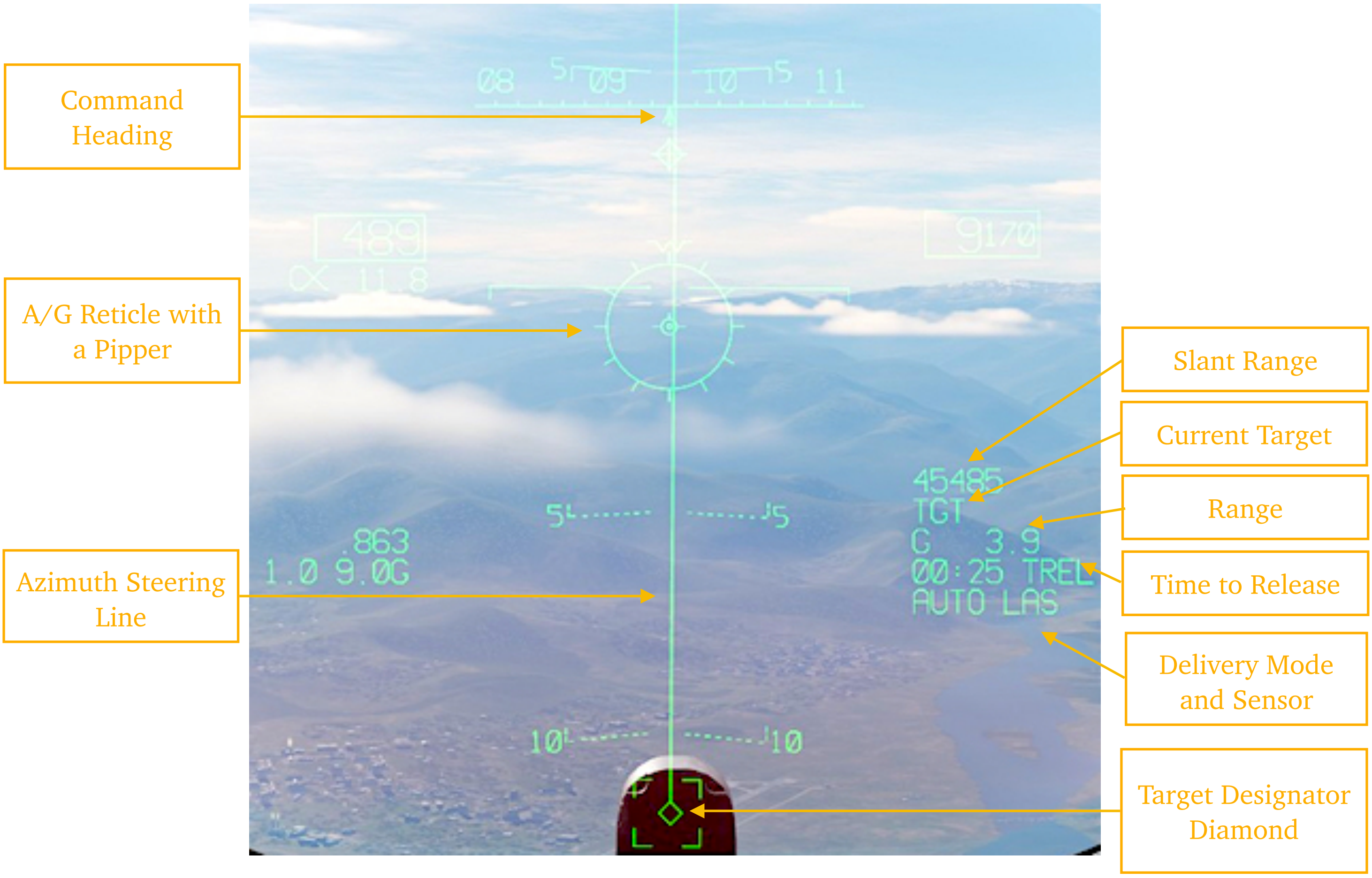
13.7.1 AUTO BOMBING MODE

For the AUTO mode, the aircrew must first designate the target - it is not possible to use this mode without a designation. However, the pilot can employ various techniques to drop the bombs, be it level, loft or dive flight path, as the delivery mode is not restricted to a specific set of release parameters.

In order to bring up attack symbology and perform a successful bombing run, the steps below should be followed:

1. Designate the target.
2. Select the A/G Master Mode.
3. Set up your weapon of choice using PACS / select the desired AUTO program.
4. Set the Master Arm Switch to ARM.

As soon as successful designation occurs, target is marked with a HUD TD diamond and attack symbology is displayed, as shown on the picture on the next page.



A/G RETICLE WITH A PIPPER: the primary A/G reticle consists of a 50-mil circle with a 2-mil pipper (aim dot). The reticle is displayed in all air to ground attack modes. In AUTO mode the pipper is remains fixed in the center of the velocity vector.

AZIMUTH STEERING LINE (ASL): this line provides an azimuth steering reference relative to the velocity vector. It extends vertically from the Target Designator Diamond and always remain perpendicular to the horizon.

During the AUTO delivery pilot should steer the aircraft in order to keep the ASL in the middle of the pipper. It may be displaced left or right on the HUD in crosswind conditions. The command heading on the HUD heading scale must be used for steering to the weapon release point.

TARGET DESIGNATOR DIAMOND: this is a line of sight reference to the designated target. It flashes at the appropriate edge of the HUD when the target is within 1.5° of a vertical or horizontal edge of the HUD and continues to be displayed as long as the target is within 60° of the nose.

DELIVERY MODE AND ACTIVE SENSOR: this line shows the delivery mode set up for currently selected weapon (AUTO, CDIP or DIRECT) and the sensor currently used for delivery (see A/G Sensor Hierarchy part for more information).

TIME TO RELEASE: TREL indicates time remaining to weapon release. If TREL reaches 0 and pickle button is not pressed, it is replaced with TTGT (time to target). TREL is not displayed if steering error is greater than 20°.

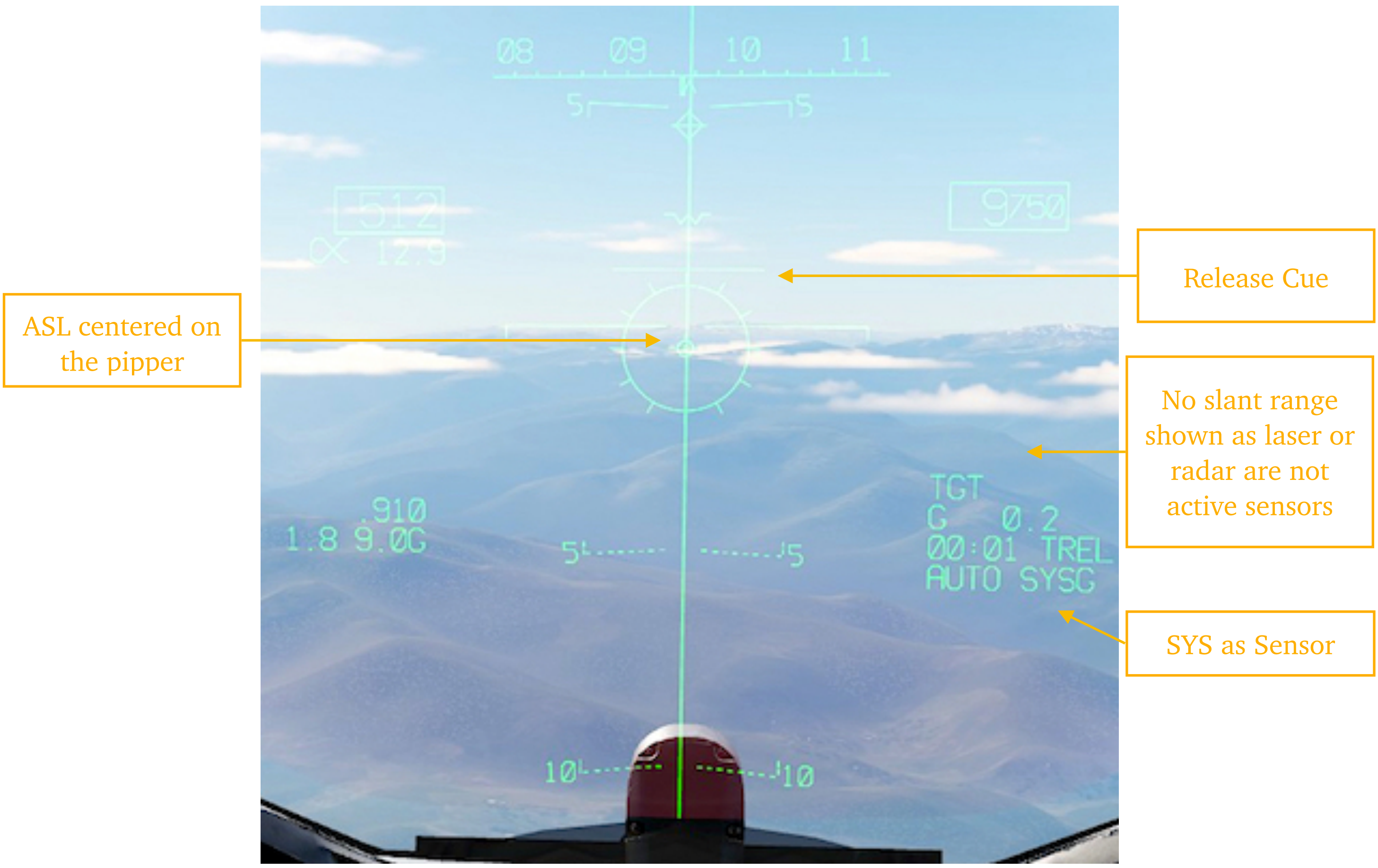
RANGE TO TARGET: shows range to target in nautical miles.

CURRENT TARGET: provides additional information about the target. If only TGT is displayed, it means that the target was designated using one of the means described in previous section except for NAV. If Target Point is designated, then its number will be shown next to TGT.

SLANT RANGE: the digital slant range in feet to the designated point is shown when valid radar or laser ranging is available.

Attack Phase

As long as the steering error is less than 20° and when TREL reaches 10 seconds the release cue is displayed on the ASL 5° above the velocity vector. The main task of the pilot now is to keep the ASL centered on the pipper.



The CC computes the steering to the weapon release point from the position of the designated target (marked with HUD TD diamond), regardless of the sensor used to define it. Therefore it is advisable to update the target position by re-designating if necessary.

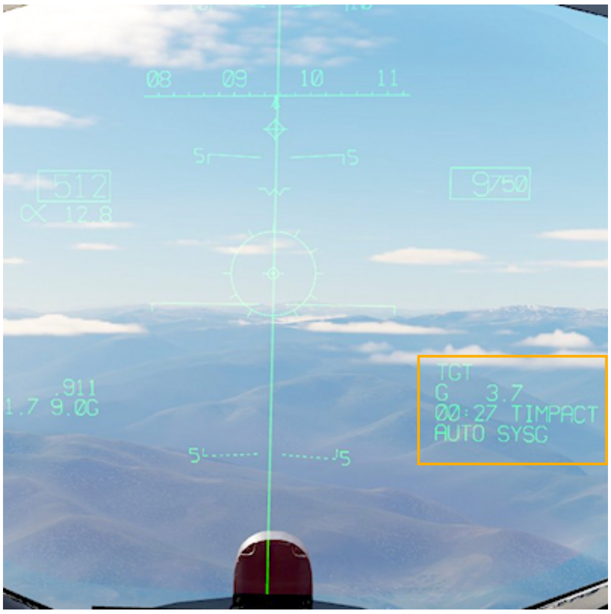
The aircraft aimpoint is continuously computed as long as the time to reach the aimpoint is greater than 2 seconds or of the pickle button is not pressed after that. If less than 2 seconds remain and the pickle button is pressed, the aimpoint is held in memory for as long as it remains pressed. This is important for ripple delivery in order to keep the ASL visible on the HUD for as long as the bombs are released to allow the pilot to maintain stable track (and desired impact locations). If the aimpoint was continuously computed even when the pickle button was pressed, it is likely that the ASL would swing “behind" the aircraft and out of HUD FOV, which could affect the accuracy of the ordnance released after passing the aimpoint.

As the release cue travels down the ASL, pickle button should be pressed and held. As soon as it passes the velocity vector, release command is sent to PACS. During the release, the reticle flashes until the last weapon release command is issued.

Reattack Phase

Reattack phase is entered when the designated target is overflown and the pickle button is released. The HSI command heading marker, HUD steering pointer and the HUD azimuth steering line rotate left or right to indicate that the target is left or right of the aircraft respectively.

A TIMPCT (time to impact) legend replaces the TREL on the HUD and shows time to weapon impact in MM:SS format. It is also displayed on the Targeting Pod display, on TEWS display and om the HSI display in the time block.



13.7.1.1 LOFT DELIVERY

Loft delivery is not enabled in the Early Access.

13.7.2 CDIP BOMBING MODE

CDIP stands for Continuously Displayed Impact Point (being just a different name for CCIP mode that can be found on many other aircraft). The point on the ground where the weapon will impact is continuously shown at the HUD reticle LOS. It is not necessary to designate the target beforehand, but it could aid the pilot in target identification and will stabilize the pipper over rough terrain.

The CDIP can be used with a level or dive delivery and would mostly be employed against unplanned targets.

In order to bring up the CDIP attack symbology and perform a successful bombing run, the steps below should be followed:

1. Select the A/G Master Mode.
2. Set up your weapon of choice using PACS / select the desired CDIP program.
3. Take command of HUD.
4. Set the Master Arm Switch to ARM.

Displayed Impact Line: the DIL provides an azimuth steering reference to aid in positioning the reticle on the target. It is limited to the edge of the reticle to allow clearer viewing of objects in the reticle.

Impact Point: continuously computed point where the bombs will hit.

Delivery Mode and Active Sensor: this line shows the delivery mode set up for currently selected weapon (AUTO, CDIP or DIRECT) and the sensor currently used for delivery (see A/G Sensor Hierarchy part for more information).

To have laser ranging from the target, the aircrew should first take command of the targeting pod and enable the laser by pressing the **Left Multifunction Switch**. Then command of the HUD should be taken again.

Time to Release: TREL indicates time remaining to weapon release. If TREL reaches 0 and pickle button is not pressed, it is replaced with TTGT (time to target). TREL is not displayed if steering error is greater than 20°.

Slant Range: the digital slant range in feet to the designated point is shown when valid radar or laser ranging is available.

CDIP Attack Phase

The DIL is provided to aid the pilot in flying a course line projected through the target. This is accomplished when the target appears to be moving down the DIL toward the center of the sight reticle. When the target is in the center of the sight reticle, the pilot presses the pickle button to obtain immediate weapon release. The radar antenna and the FLIR are slaved to the sight reticle to provide a continuous display of the slant range to the impact point. If a ripple release is programmed, the sight reticle LOS is for the center of the bomb pattern on target.

If the pilot presses the button earlier, ie. at the moment the pipper crosses the target, AUTO display is initialized. Target becomes designated and the TD box appears on the HUD. The system then begins to operate the same as AUTO mode - it computes and displays TREL and ASL, and the pilot retains weapon release steering in the event multiple weapons are being released.

After release, the TREL legend changes into TIMPCT showing weapon time to impact on the HUD, targeting pod display, as well as TEWS and HSI.

13.7.3 Direct Bombing Mode

Direct mode is not enabled in the Early Access.

13.7.4 Manual Bombing Mode

Manual bombing mode is a backup mode for use when PACS and / or MPDP have failed. It is used by placing the selective jettison knob in MAN FF or MAN RET position.

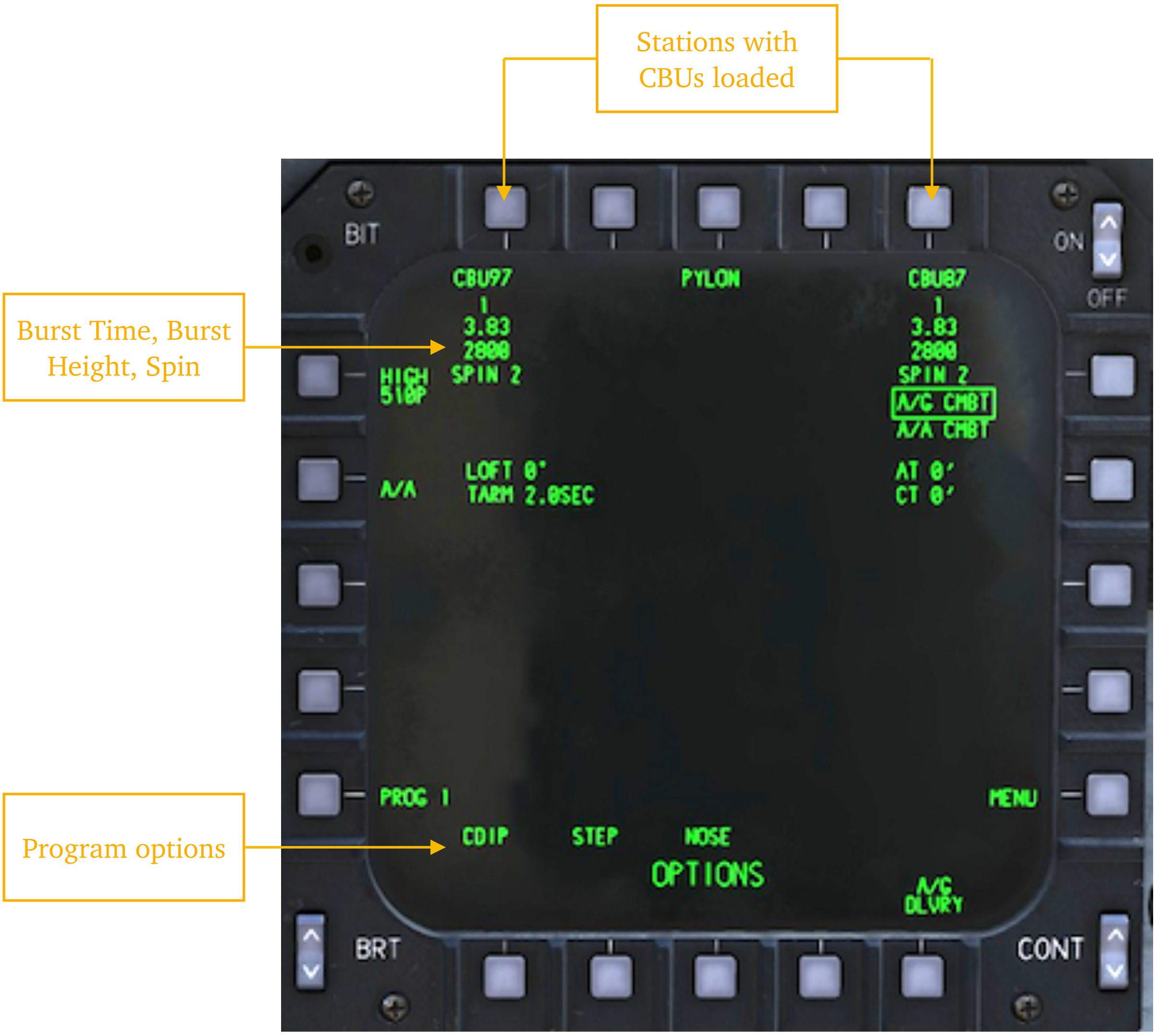
Manual mode is not enabled in the Early Access.

13.8 CBU Employment

While the Cluster Bomb Units (CBU) use the same delivery method as iron bombs, the main difference is in their programming due to the way in which they operate. Each CBU carries a number of smaller bomblets that are spread over certain area, depending on the various settings which can be altered from the PACS page.

13.8.1 Dispenser Weapon Programming

On the PACS page, the following information is displayed beneath each station containing CBUs:



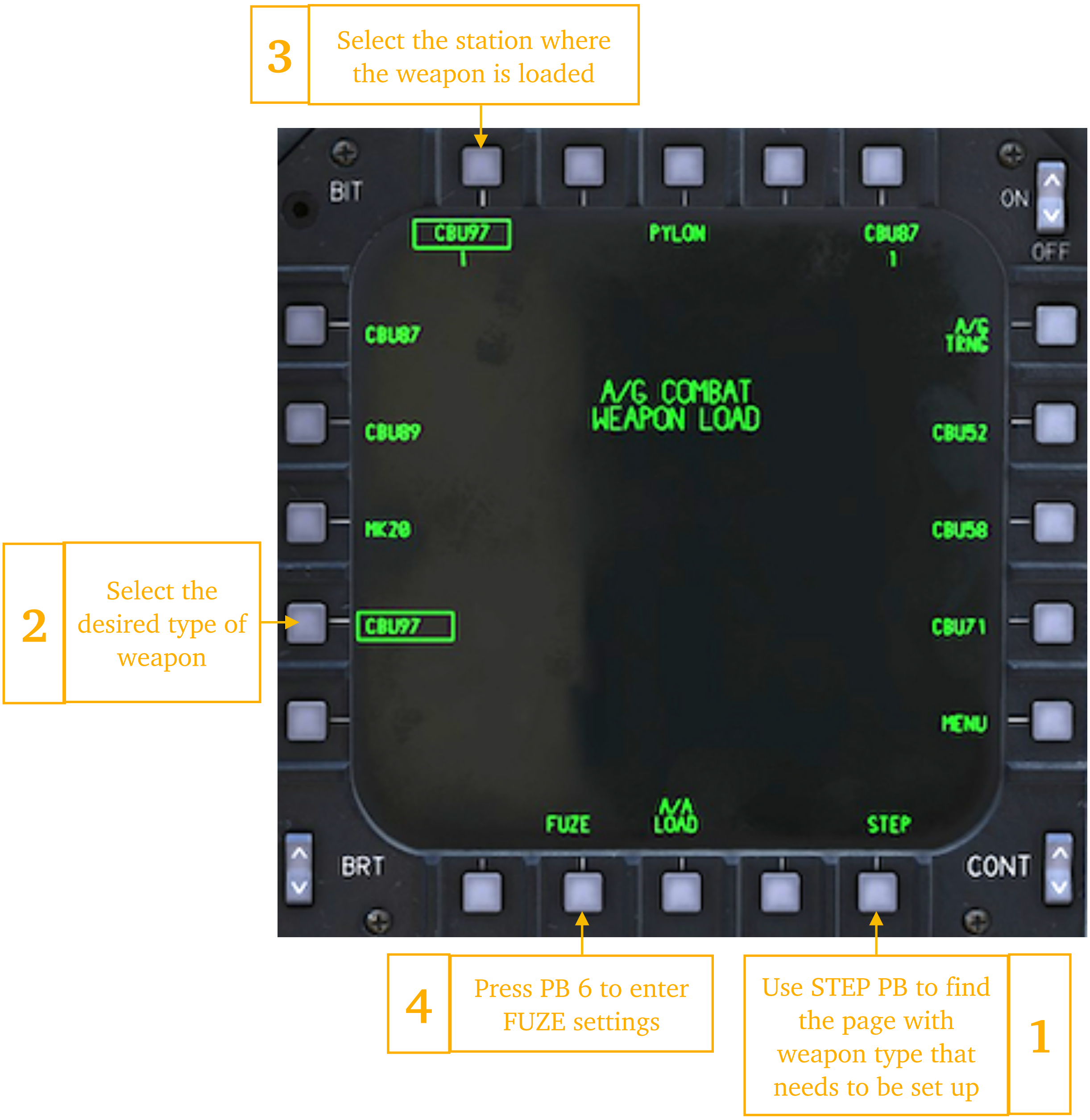
Burst Time and **Height** both determine when the canister will open and release the bomblets. Both modes are mutually exclusive, ie. only one of them can be selected. Burst Time is time in seconds since the bomb is dropped. Height determines altitude in feet MSL at which the bomblets are released.

SPIN sets the rotation speed of the canister when it is releasing the bomblets, set in rounds per minute. The higher the spin, the larger are the bomblets will cover, but also their density (and thus lethality) will diminish.

Program Options should be set up as for normal bombs: either AUTO or CDIP delivery mode, release quantity etc. The only difference is with the fuzing, as two new options are available: TIME and HEIGHT, which correspond to the ones described above.

Dispenser settings can be changed in A/G Load page. After entering it from the main PACS menu, use STEP option (PB 10) to find the desired weapon, and then select it - its legend will become boxed.

Next choose the station where corresponding bomb is loaded and box it again. New option - FUZE - will appear above PB 7. Press it to open next page with settings.



After opening the FUZE submenu, following options will become available:

PB 2-3, BURST TIME: sets the time from bomb drop in seconds after which the bomblets will be released. There are 11 options available:

N	O	P	R	S	T	U	V	X	Y	Z
0.95	1.28	1.60	1.92	2.23	2.55	2.87	3.19	3.51	3.83	4.15

Pressing the pushbuttons alternates between all the available programs. To save the selected setting, ENTER (PB 10) has to be pressed.

PB 4, SELECT FUZE: pressing this PB alternates between integral fuze and additional one, allowing also to select the burst height.

PB 10, ENTER: after all the options are selected, this PB has to be pressed to save them in memory.

PB 12, SPIN: chooses the speed (in RPM) with which the canister will rotate while releasing the bomblets. The higher the speed, the larger area will be covered, but at the expense of density. There are 6 different spin options:

1	2	3	4	5	6
0	500	1000	1500	2000	2500

To save the selected setting, ENTER (PB 10) has to be pressed.

PB 13-14, BURST HEIGHT: determines the altitude (in feet MSL) at which the bomblets will be released. Similarly to spin, the higher the altitude, the larger the bomblet coverage, but smaller the density. There are 10 available options:

A	B	C	D	E	F	G	H	J	K
300	500	700	900	1200	1500	1800	2200	2600	3000

To save the selected setting, ENTER (PB 10) has to be pressed.

13.9 LGB EMPLOYMENT

Most of the available Laser Guided Bombs (LGB) use the same delivery methods as the dumb bombs (with the exception of GBU-28, which can be also dropped in direct mode).

NOTE: Direct mode for the GBU-28 is not enabled in the Early Access.

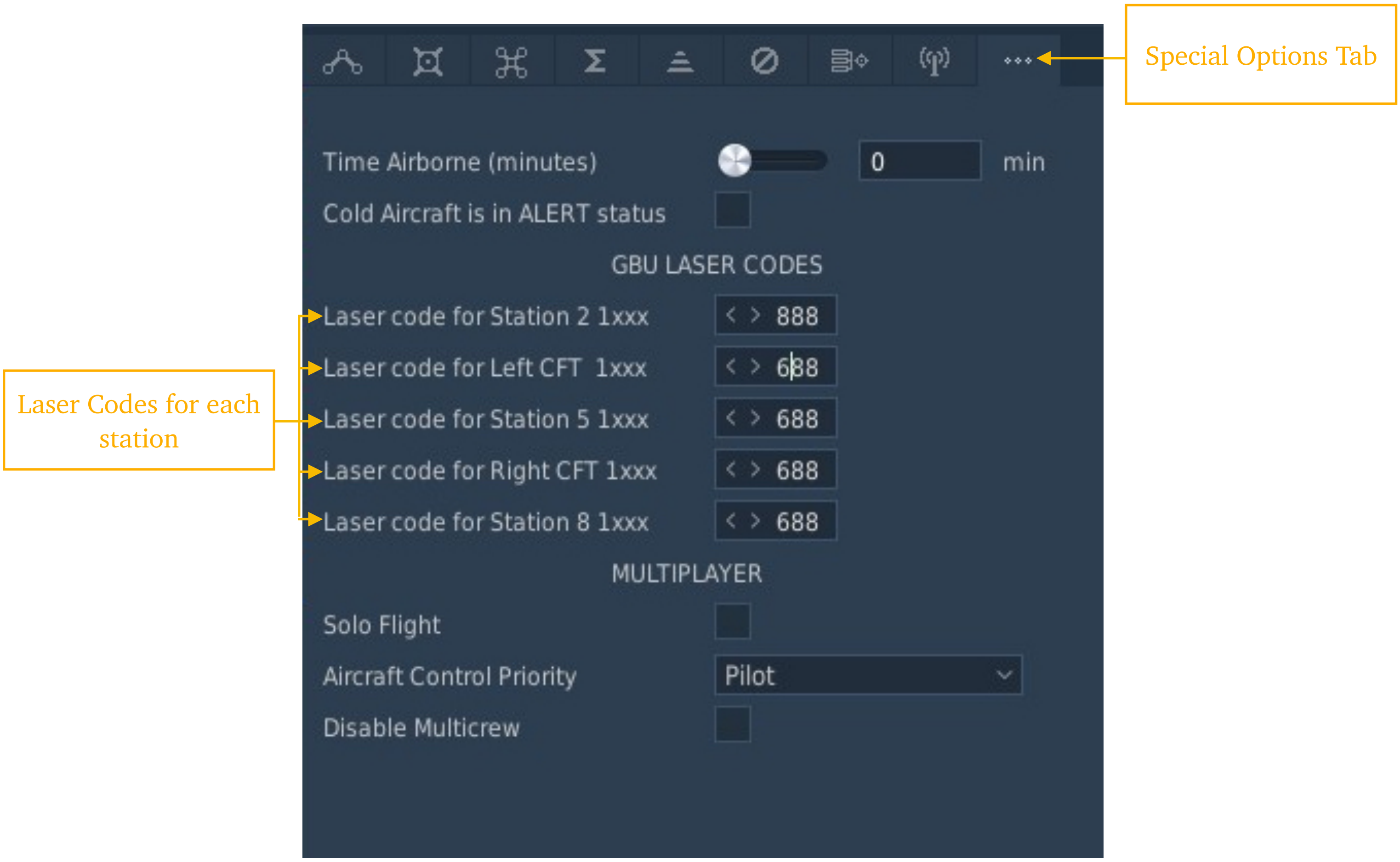
The main difference is the use of specific laser code on the targeting pod that would match the code set up for specific station (or bomb dropped by another aircraft but guided from player's jet - which is called "buddy lasing").

13.9.1 LASER CODE

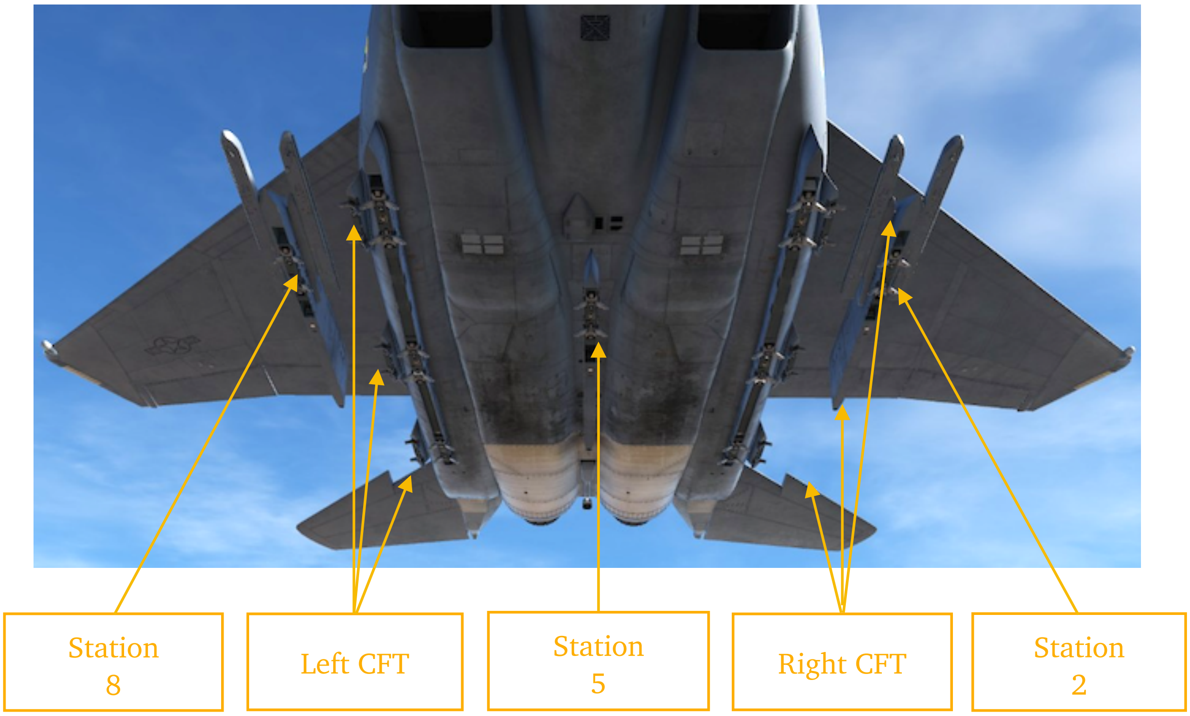
The laser code is set up for specific station on the ground and cannot be changed after takeoff. This can be done either via a mission editor or from inside the cockpit via the kneeboard page.

Mission Editor

Laser codes for each station can be set up in the special options tab for player's aircraft:

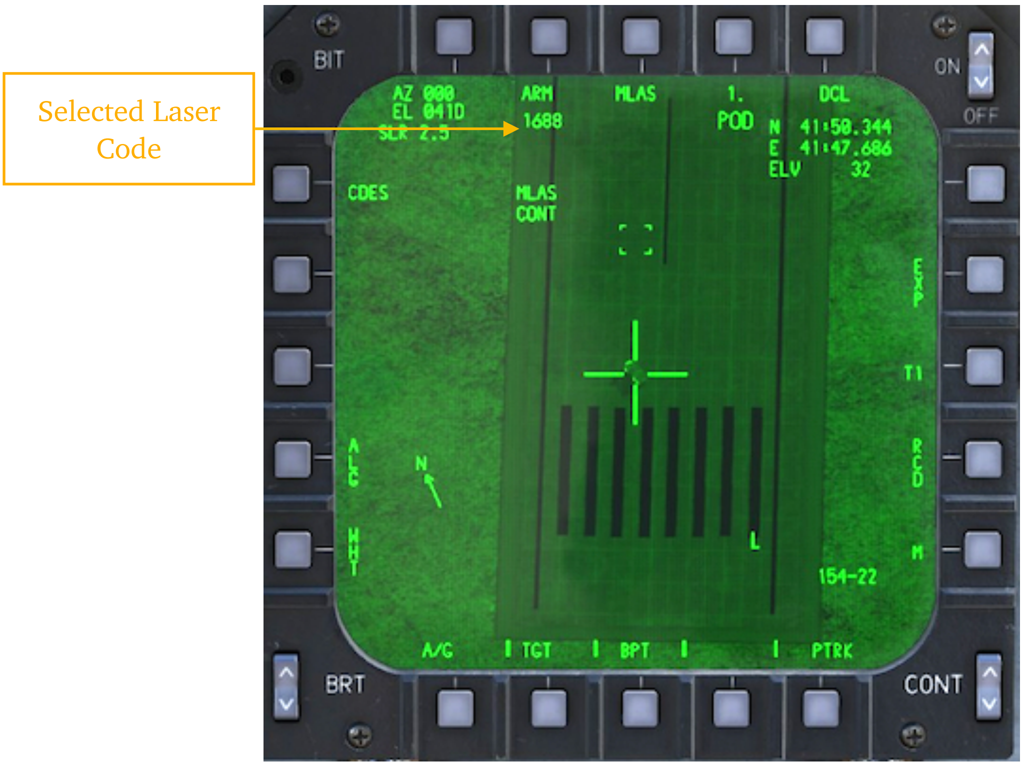


As a reminder, the stations are as follows:



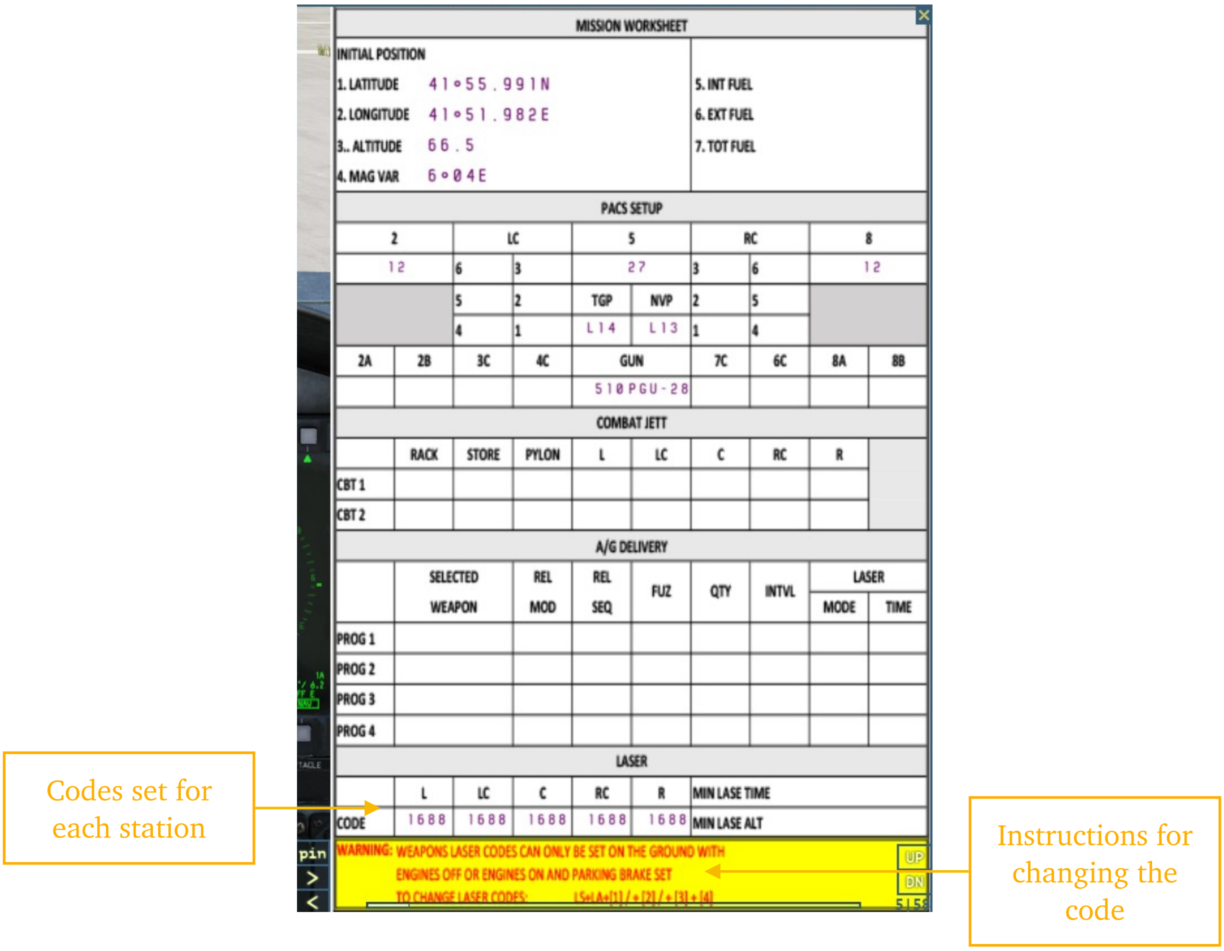
The value for each laser code has to be between 1111 and 1888. The standard code is 1688, and the game will default to it for each station (ie. this code should be used if it is not changed before the mission).

The code set in the Targeting Pod should match the one set up for the currently used station.



In the cockpit

It is also possible to set up the laser codes from inside the cockpit using the kneeboard page. This can be done only with engines OFF or with engines ON and parking brake set.



To change the code, the following combination of keys should be used:

Left Shift + Left Alt + 1 / 2 / 3 /4.

13.9.2 STEPS FOR GBU DELIVERY

Successful attack using the GBU requires more preparation than for the iron bomb delivery, although first steps are the same.

1. Select the A/G Master Mode.

2. Set up your weapon of choice using PACS / select the desired program (AUTO is strongly recommended for GBUs)

3. Set up the Auto / Manual laser mode and time using A/G Delivery Programing page (see below for more details).

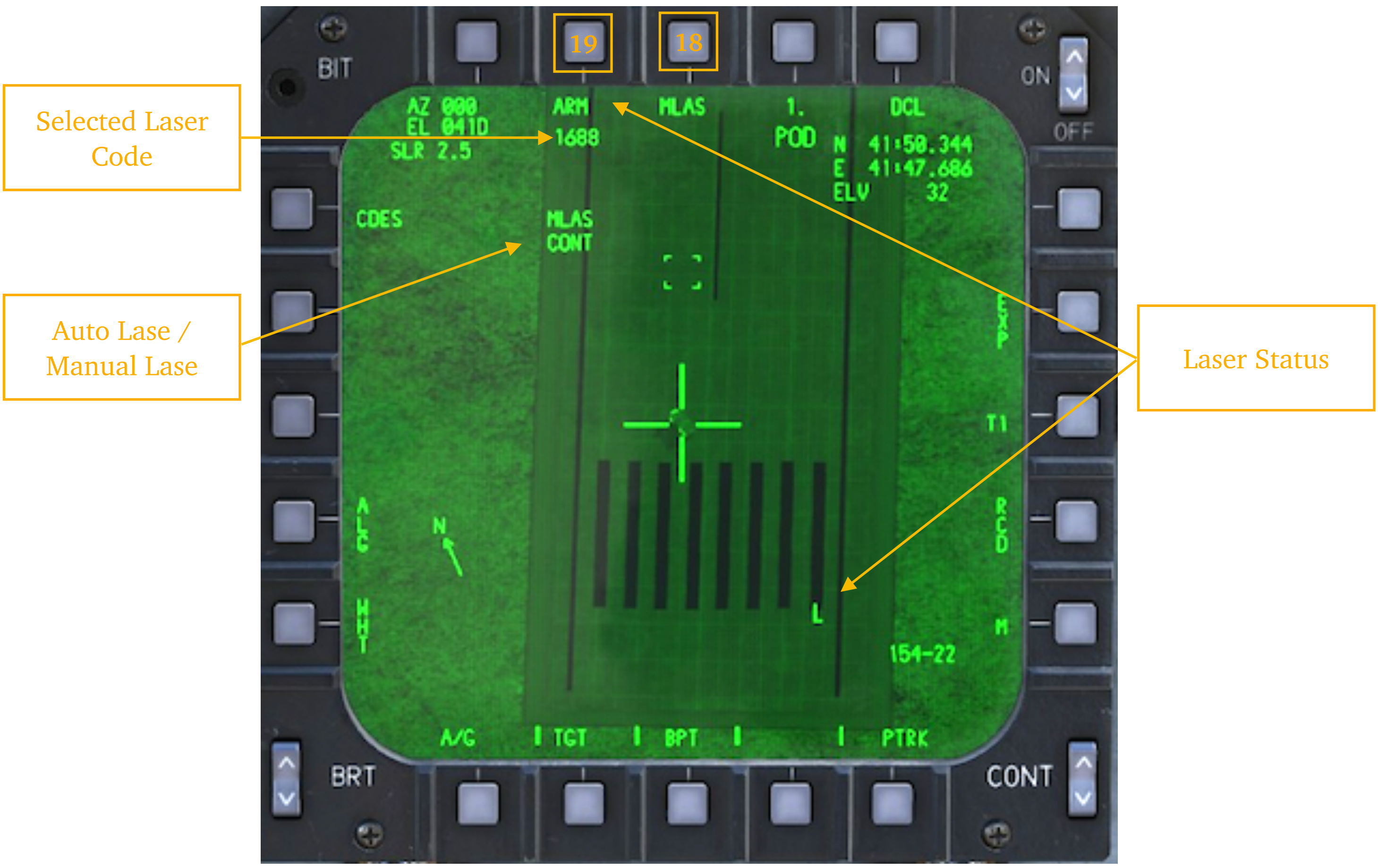
4. Bring up the Targeting Pod page and make sure that correct laser code is set up (see below for more details).

5. Designate the Target and place Targeting Pod's crosshairs over it.

6. Set Master Arm to ON.

7. Perform normal bombing using AUTO mode.

13.9.3 USING THE LASER



UFC keyboard is used to enter a desired code, which then is introduced into the targeting pod by pressing PB 19. It is then displayed below the laser status legend beneath the PB.

If invalid code is entered, it will still be displayed there, but the status will change to SAFE.

LASER STATUS: the laser status window in the bottom - right of the screen is blank when the laser is in SAFE. When it is in ARM, following legend appears:

L is shown when targeting pod arms the laser. As soon as the laser is fired, the legend flashes.

M indicates that the targeting pod LOS may be obscured by the aircraft structure and the laser is inhibited from firing.

PB 18, AUTO / MANUAL LASE: Auto / Manual Lase can be set up for the selected station on A/G Delivery Programing page using PB 8.

If scratchpad is blank, pushing PB 8 toggles between MLAS and ALAS (the first being manual lasing, the other automatic). Below either CONT (continuous) or time will be displayed. To enter a desired lase time scratchpad should be used (valid entries are 0:01 thru 0:31).

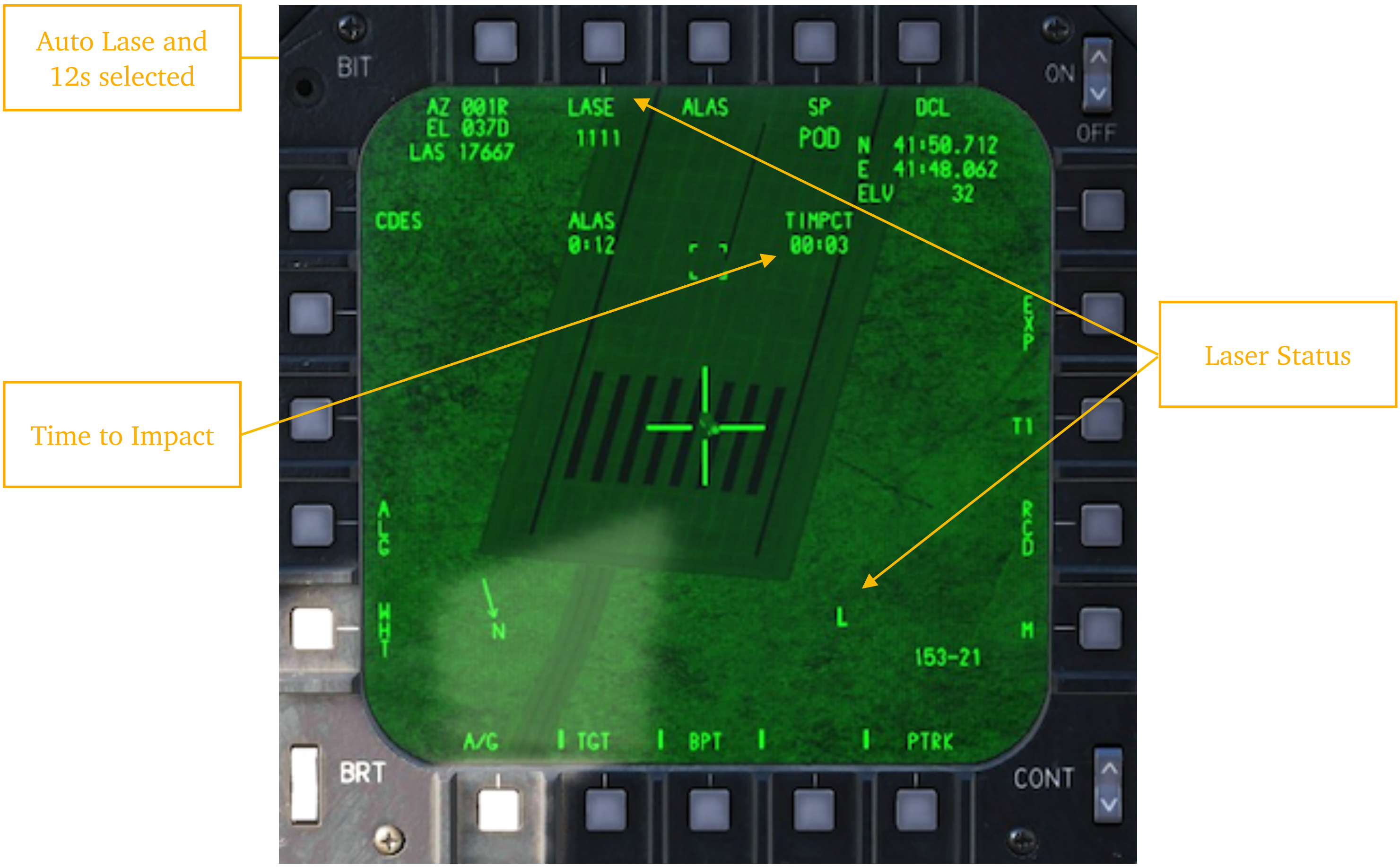
With ALAS and CONT selected, laser will continuously paint the target from the moment the bomb is released. The laser then has to manually turned off using the HOTAS command.

With ALAS and time set, the laser will only fire for the given amount of time before impact. The recommended time varies depending on the circumstances.

In MLAS mode, the laser will fire only after appropriate HOTAS command is issued.

This information is mirrored on the targeting pod display below the selected laser code. The aircrew can change between ALAS and MLAS using PB 18 directly from this page without having to go back to PACS.

Before the bomb is released, TREL (Time to Release) legend is shown on the targeting pod display. After the drop, it changes to TIMPCT (Time to Impact), as illustrated below.



In this example auto lase is selected and timer set to 12 seconds. As soon as the bomb is released, TREL changes to TIMPCT. When the latter is equal to ALAS time, the laser is fired automatically (both LASE and L legend flashes to indicate it is active).

Aircrew can make corrections to the desired impact points until the very last moment, provided they are not too rapid. Thanks to this it is possible to hit moving targets followed by the targeting pod in point track.

13.10 A/G GUN EMPLOYMENT

There are two gunsights available to the pilot for the air to gun strafe runs: a CDIP gun and MANUAL mode.

CDIP gun offers a radar and computer driven CDIP reticle which includes the range bar on the HUD.

NOTE: range bar is not enabled in current version of Early Access.

Manual gun mode provides a fixed depressible sight.

13.10.1 CDIP GUN

To obtain the CDIP gun reticle, the following steps should be followed:

1. Select the A/G Master Mode.
2. Make sure that PACS A/G Program has all stations deselected.
3. Take command of the HUD.
4. Press the **Auto Acq Switch** AFT short (<1s).

Master Mode switch should be in ARM position to fire the gun, using the **Trigger** on the stick in the front cockpit.

The AGL Altitude Bar shows whenever the aircraft gets below 1500 feet AGL (as measured by the radar altimeter) and disappears when it gets back above 2000 feet.

The slant range is shown as a digital readout and also as an analog bar show on the reticle.

13.10.2 MANUAL GUN

The MANUAL gun mode for A/G strafe can be used when the PACS or CDIP reticle is not functioning properly.

NOTE: MANUAL AG mode is not enabled in current version of Early Access.

CHAPTER 14: TACTICAL ELECTRONIC WARFARE SYSTEM

14.1 Introduction

Tactical Electronic Warfare System is an integrated defensive suite which consists of four separate subsystems:

1. AN/ALR-56C Radar Warning Receiver (RWR), which displays threat identification and location information to the aircrew on any selected MPD or MPCD.

2. AN/ALQ-135 Internal Countermeasures Set (ICS), which is a software controlled self-protection jammer.

3. AN/ALQ-128 Electronic Warfare Warning Set (EWWS) using array of antennas to detect and display various threats and other information.

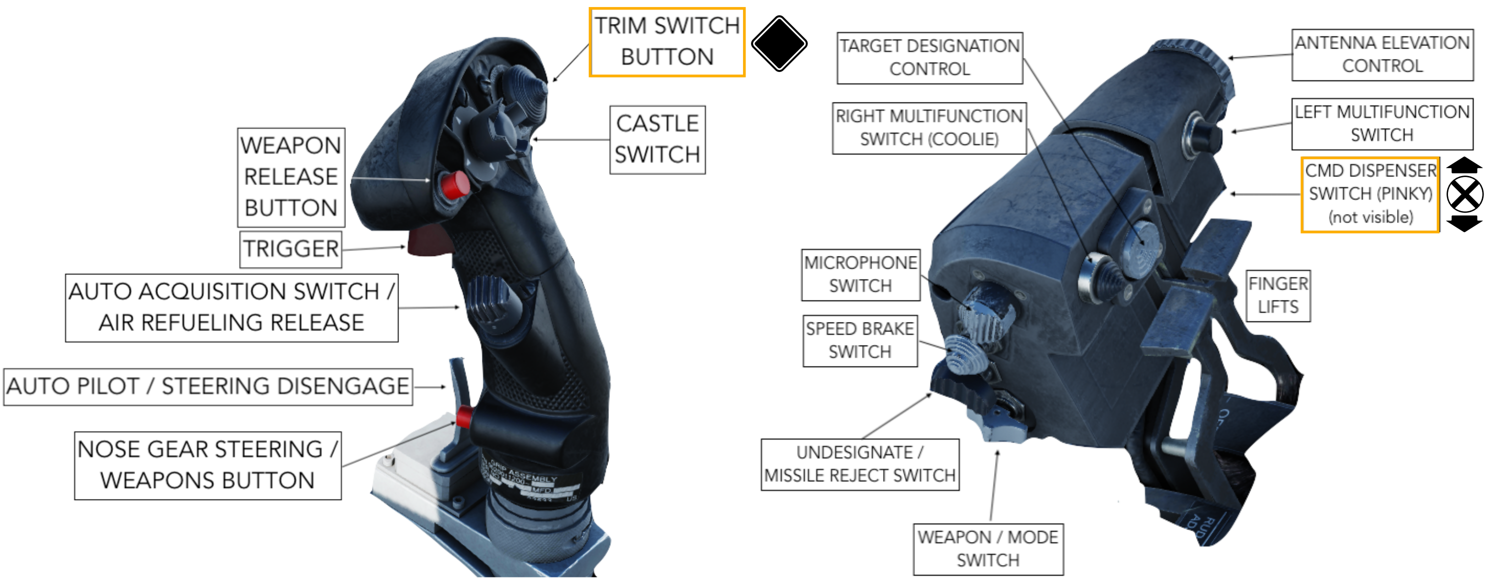
4. AN/ALE-45 Countermeasures Dispenser Set (CMD), which is a computer driven, internally mounted chaff and flare dispenser.

More detailed description of the systems can be found in the next sections of the manual.

14.2 Controls

Most of the controls for TEWS are located in the rear cockpit, with the exception of dispenser switches which can be found on the throttle and stick in the front cockpit, as well as LHC in the rear.

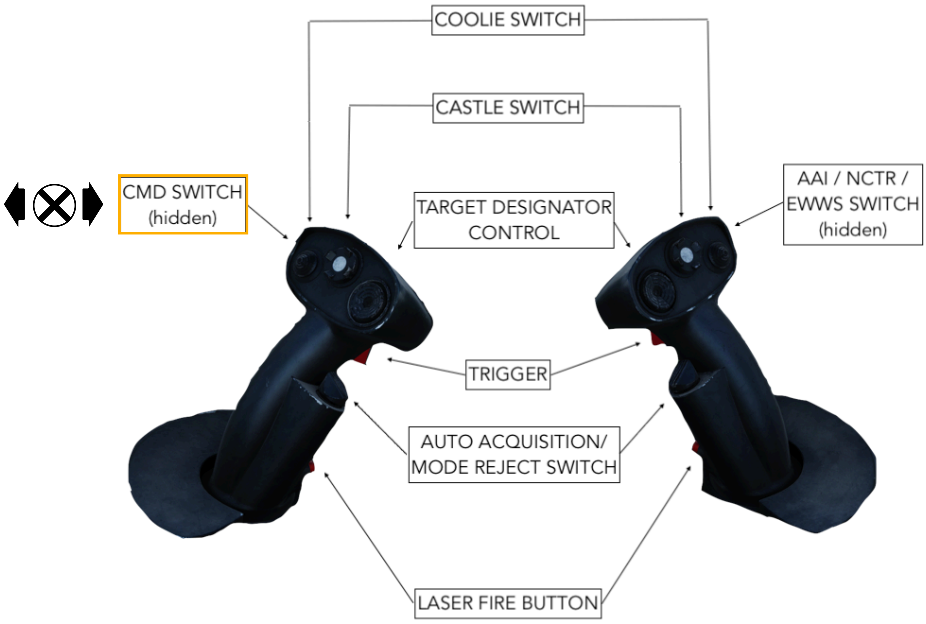
Front Cockpit



Trim Button Switch, when pressed (not pulled) down, dispenses MAN 1 program.

CMD Dispenser Switch, also called a pinky switch on the throttle is spring-loaded to center / OFF position. If pulled up, it releases MAN 2 program. If pushed down, it releases MAN 1 program.

Rear Cockpit



Countermeasures Dispenser Switch on left Hand Controller is spring-loaded to center, OFF position. If pushed forward, it releases MAN 1 program. If pulled back, it releases MAN 2 program.

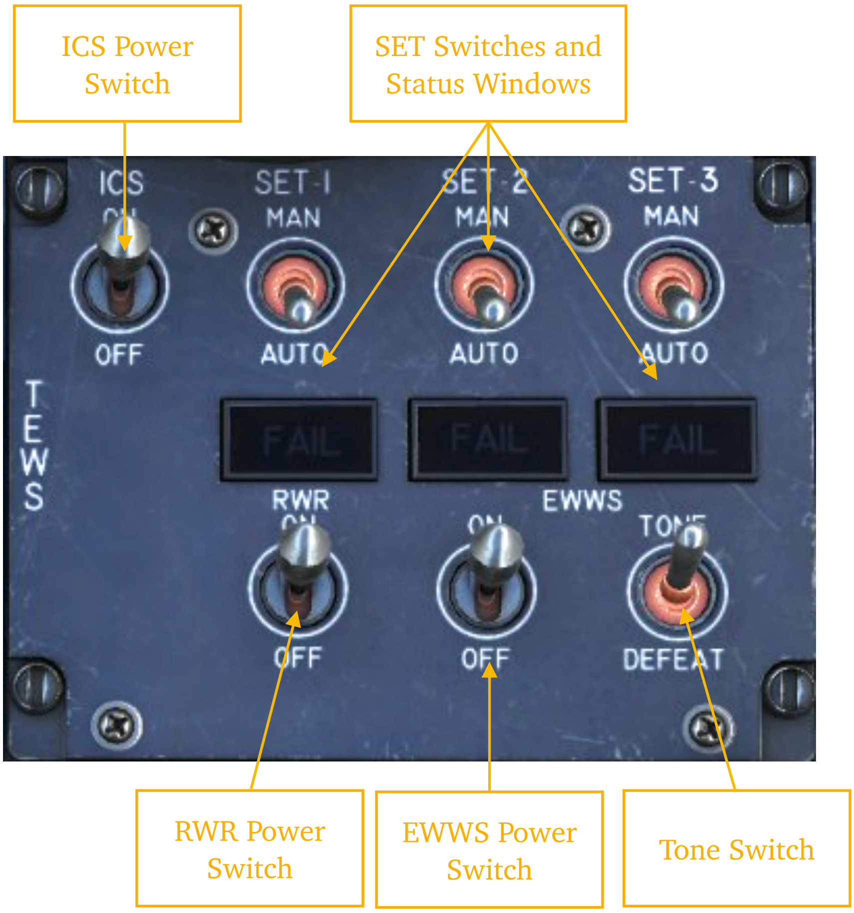
Electronic Warfare panel is located on the left console in the rear cockpit and consists of three switches.

RWR / ICS OPERATIONAL SWITCH swaps between the COMBAT and TRAINING operational mode of the RWR and ICS.

PODS SWITCH is not functional.

ICS SWITCH turns the ICS on and off. Since ICS works in bands 1.5 or 3 and neither have manual mode, setting the switch to either MAN or AUTO position results in automatic operation. Setting it to STBY terminates any transmission from the ICS.

TEWS Control Panel is located on the right console in the rear cockpit.



Internal Countermeasures Set (ICS) power switch. Turns ON or OFF the ICS.

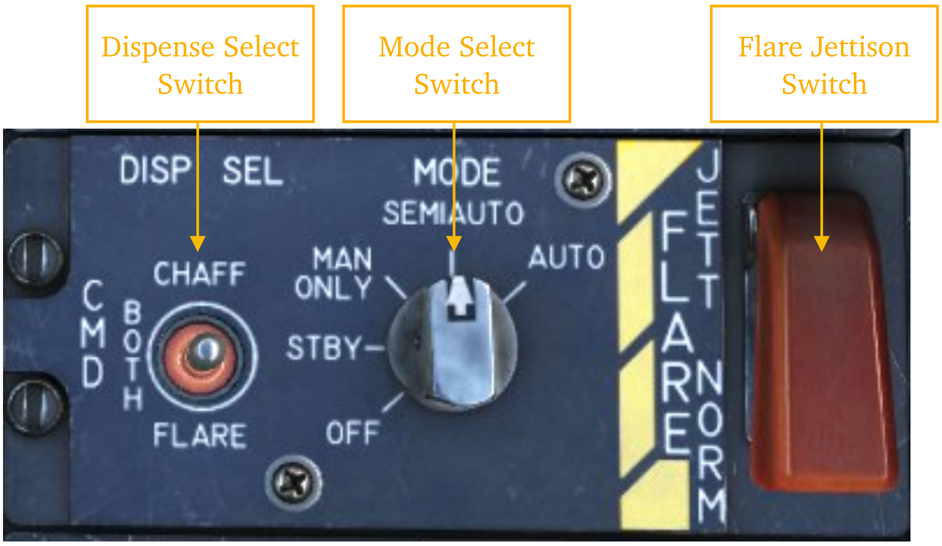
SET-1, SET-2, SET-3 switches and status windows. Different modes for the jammer.

Radar Warning Receiver power switch. Turns ON or OFF the RWR.

Electronic Warfare Warning Set power switch. Turns ON or OFF the EWWS.

TONE / DEFEAT switch: not simulated.

Countermeasures Dispenser Set Control Panel is located in the rear cockpit just below the TEWS Control Panel.



The CMD control panel applies CMD operations power, selection of payload dispensing modes, and selection of flare jettison.

Dispense Select Switch. Whenever the CMD Mode knob is in different position than OFF, the three position of the switch (CHAFF / BOTH / FLARE) provides different dispensing for the MAN 1 and MAN 2 programs. Refer to XXXX for more information.

Mode Select Switch. It has following positions:

OFF: CMD is not operational.

STBY: standby mode. Enables warm up of the system and full BIT with weight on wheels.

MAN ONLY: System accepts dispense inputs via MAN 1 and MAN 2.

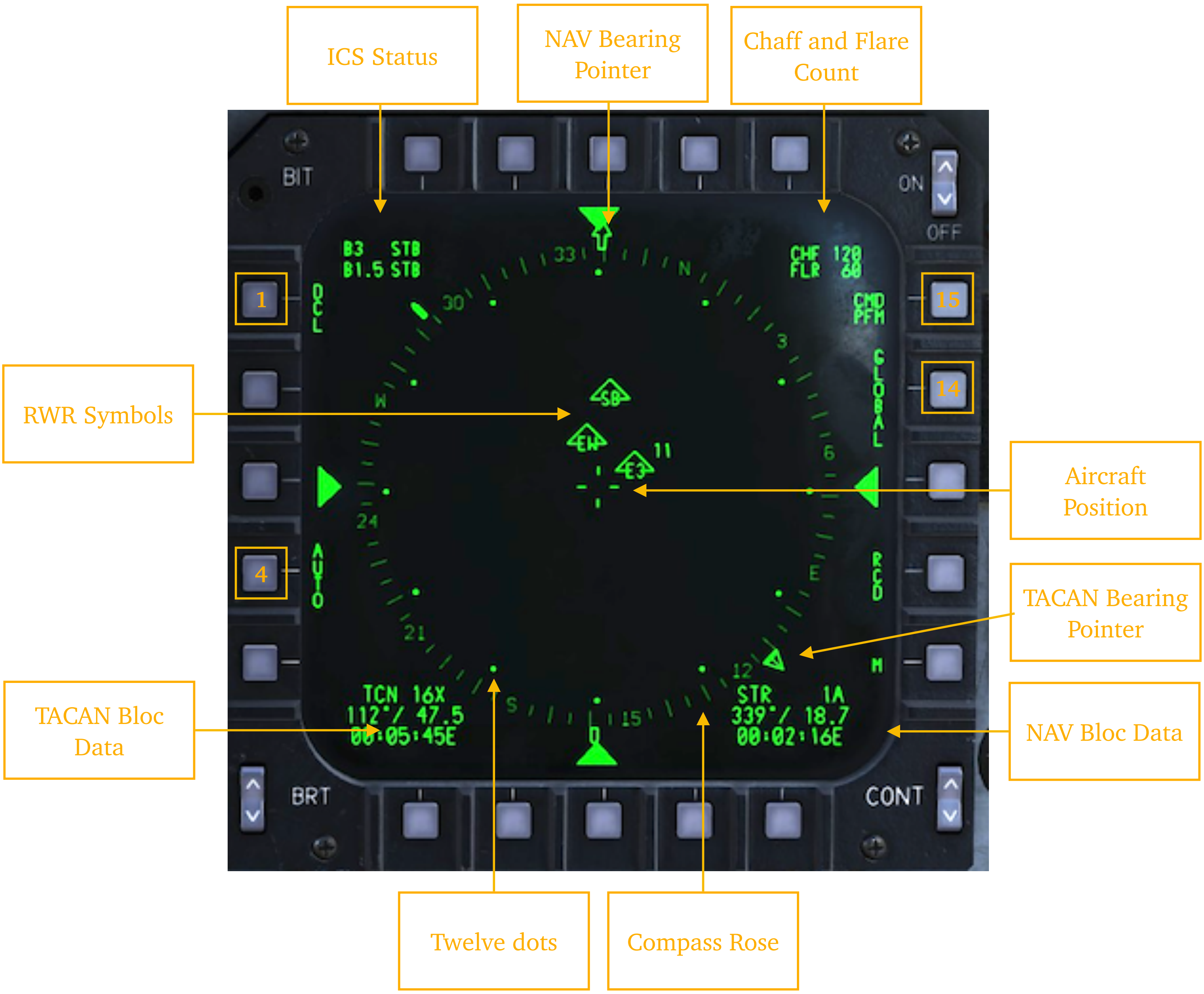
SEMI AUTO: the CMD relies on the data provided by the RWR to prepare the best dispensing program against specific threat. Pilot can still use MAN 1 or MAN 2 to use different programs and has to manually initiate dispensing countermeasures.

AUTO: CMD relies on the data provided by the RWR to prepare the best dispensing program and automatically initiates dispensing countermeasures.

FLARE JETTISON SWITCH. The jettison switch is a guarded, two-position switch with the following functions: NORM (where CMD operates normally in line with the current position of the Mode Select Switch) and JETT (overrides the position of the Mode Select Switch - even if it is in OFF - and dispenses all the onboard flares ignited).

14.3 TEWS Display

Tactical Electronic Warfare System display can be brought up on any MPD or MPCD. In the front cockpit, pressing **Castle Switch** right short (<1s) will by default switch to TEWS before moving to the first programmed display.



PB 1, Declutter: when pressed, DCL legend becomes boxed and the compass rose is removed from display.

PB 4, ICS Priority Control Set: pressing this PB switches between AUTO, ATAK and DEFNS modes.

PB 14, MISSIONIZED PREFLIGHT MESSAGE: the ALR-56C allows the aircrew to prioritize the types of threat for display with three available options:

GLOBAL, which displays all threats detected.

WFO, which prioritizes airborne threats.

AIRGND, which prioritizes ground threats.

PB 15, MISSION SPECIFIC CMD PROGRAMMING: two different main programs with specific sub-routines are available for chaff and flare dispenser quantities and intervals. *Not available in Early Access.*

RWR SYMBOLS: show radar sources detected by the RWR in relation to the aircraft (represented by the cross in the middle). Full list of symbols can be found in next section.

TACAN BLOC DATA: mirrors the TACAN information displayed also on the HSI: channel of the currently selected station, bearing, distance and time to go.

TWELVE DOTS: arranged as on the clock, these dots help the aircrew in communicating detected threats in relation to the aircraft.

COMPASS ROSE: with longer lines representing 10 degrees mark and shorter ones every 5 degrees. Compass rose can be disabled and re-enabled using PB 1.

NAV BLOC DATA: mirrors the NAV information displayed also on the HSI: number of the currently selected sequence point, bearing, distance and time to go.

TACANA BEARING POINTER: shows bearing to the selected TACAN station.

AIRCRAFT POSITION: the cross always stays in the center of the TEWS display.

CHAFF AND FLARE COUNT: displays number of remaining chaff and flares.

NAV BEARING POINTER: shows bearing to the selected Sequence Point.

ICS STATUS: displays ICS bands 1.5 and 3 status.

14.3.1 RADAR WARNING RECEIVER

When a radar emitter is detected, it is shown on the TEWS display with a coded symbol, indicating the type of emitter (airborne, ground or naval) and its position in relation to the F-15E. Each type of radar has a specific code, consisting of letters and numbers for easier identification (full list of the codes can be found below).

Note: RWR is largely WiP and many things may still be changed or added at a later stage.

Detected emitters are displayed according to their signal strength. The stronger the signal, the closer it will be to the center of display. In general, it can be divided into three zones, as indicated in the picture above: the inner ring (0-20nM), middle ring (20-40nM), outer ring (40-60nM) and outside the compass rose (above 60nM).

Note: The ranges are just estimates and can vary from the indications. Also the azimuth can be off by up to 15°.

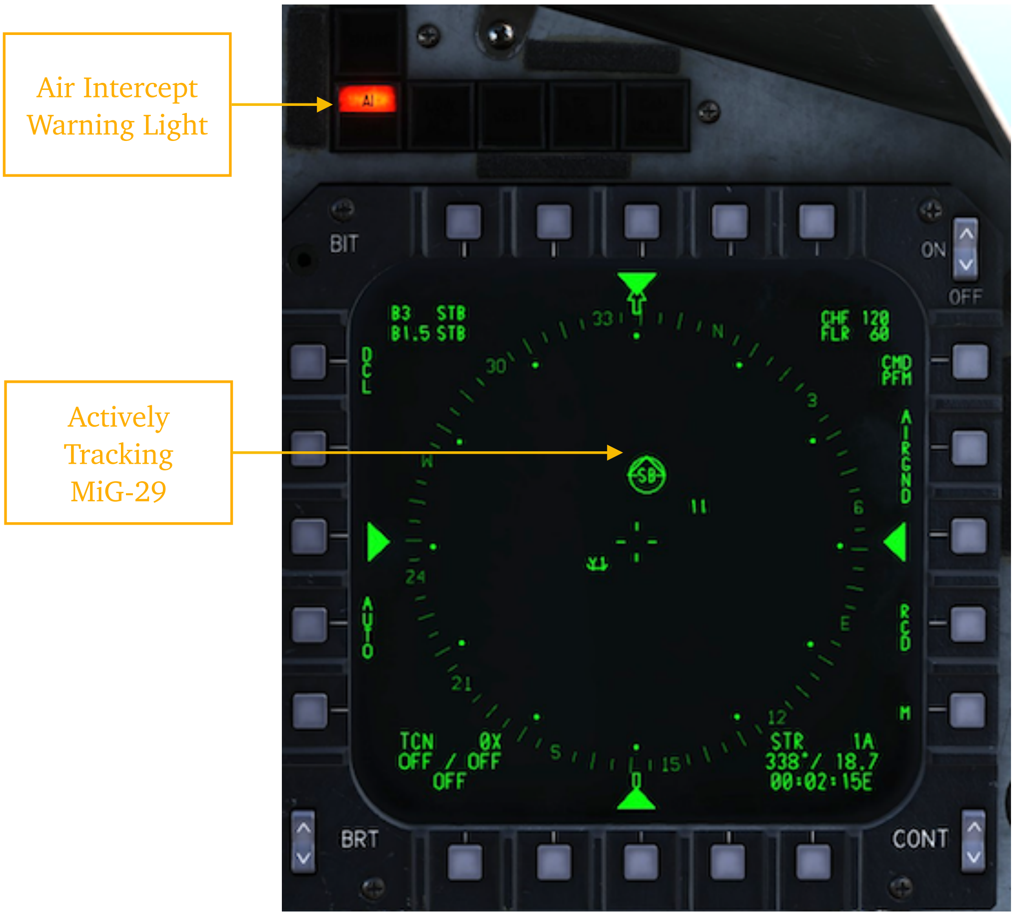
Ground radars have no additional marking, only their code is shown.

 Surface (shipborne) radars are underlined with a boat symbol.

 Airborne radars are marked with a triangle.

Additional symbols are shown if the emitter is actively tracking or guiding a missile on the aircraft.

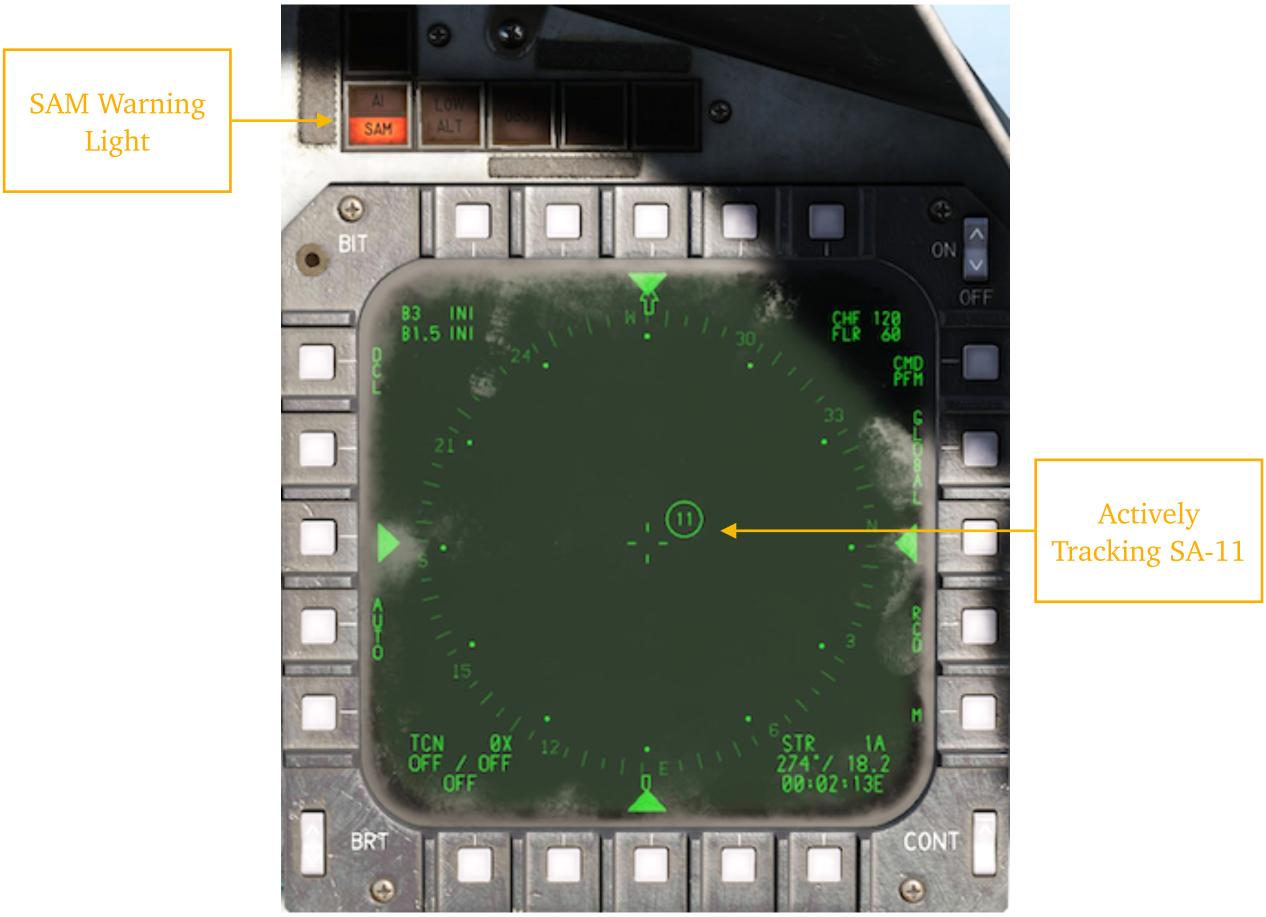
When the radar is actively guiding a missile, the wingform flashes.



The new symbology is accompanied by a special sound in the headset as soon as the enemy achieves a lock. It changes again into a chirping sound when the contact is guiding a missile.

The same happens if a ground or surface radar locks up the player's aircraft. SAM warning light turns on and the green circle is displayed around the emitter.

When the radar is actively guiding a missile, the circle flashes.



The new symbology is accompanied by a special sound in the headset as soon as the enemy achieves a lock. It changes again into a chirping sound when the contact is guiding a missile.

14.3.2 Radar Warning Receiver Symbols

Below is a full list of RWR symbols.

Blue Coalition Aircraft			
RWR Code	**Aircraft**	**RWR Code**	**Aircraft**
F4	F-4	51	B-1B
F5	F-5E, F-5E-3	52	B-52H
14	F-14 A/B	S3	S-3B
15	F-15 C/E	E2	E-2C
16	F-16 A/C	E3	E-3A
18	F-18 A/C	M1	Mirage F1 (all variants)
18	AV-8B+		
TO	TORNADO		
M2	M-2000C / -5		
37	AJS-37		

Red Coalition Aircraft			
RWR Code	**Aircraft**	**RWR Code**	**Aircraft**
FT	Su-17	62	Tu-22
19	MiG-19	65	Tu-95, Tu-142, Tu-160
21	MiG-21	EW	A-50, KJ-2000
23	MiG-23, MiG-27		
24	Su-24		
25	MiG-25		
SB	MiG-29, Su-27		
SB	Su-30, Su-33, J-11A		
31	MiG-31		
34	Su-34		

Blue Coalition SAM			
RWR Code	**Aircraft**	**RWR Code**	**Aircraft**
HK	Hawk		
PT	Patriot		
GP	Gepard		
VL	Vulcan		
RD	Roland		
NS	NASAMS		
77	AN/FPS-117		
RA	Rapier		

Red Coalition SAM			
RWR Code	**Aircraft**	**RWR Code**	**Aircraft**
2	SA-2 / P-19	AA	ZSU-23 Shilka
3	SA-3	H7	HQ-7
5	SA-5	FC	SON-9
6	SA-6	EW	1L13 / 55G6
8	SA-8		
10	SA-10 / SA-12		
11	SA-11		
13	SA-13		
15	SA-15		
S9	Tunguska		

Blue Coalition Surface Vessels			
RWR Code	Aircraft	RWR Code	Aircraft
CT	La Combattante		
Y1	Ticonderoga		
Y1	Arleigh Burke		
49	Perry Class		
48	Vinson / Stennis		
48	CVN 71 -75		
48	Tarawa		

Red Coalition Surface Vessels			
RWR Code	Aircraft	RWR Code	Aircraft
N4	Albatros / Kuznecov		
N4	Rezky		
NS	Molniya		
N3	Moscow		
N9	Neustrashimy		
N9	Peter the Great		
H2	Type-052B		
H9	Type-052C		
H6	Type-054A		
HS	Type-071, 093		

14.3 INTERNAL COUNTERMEASURES SET (ICS)

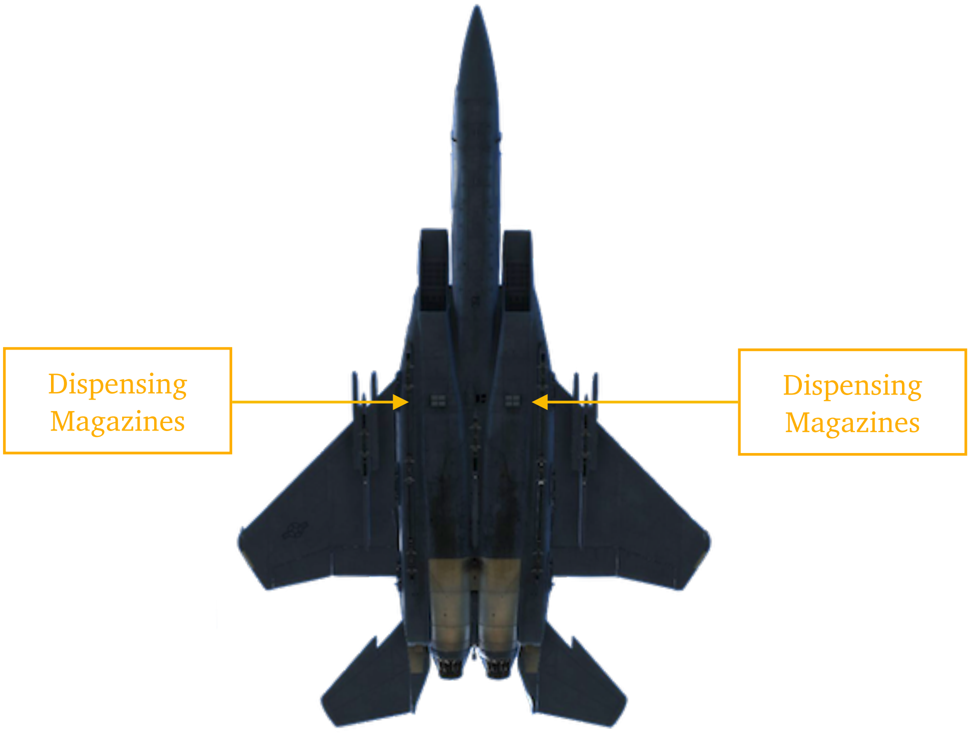
The ICS is a software controlled self protection jammer consisting of the RWR antennas, transmit antennas, amplifiers and control oscillators.

The jammer is not fully functional in Early Access version of the module.

14.4 Countermeasures Dispenser Set

The CMD is a computer driven, internally mounted chaff and flare dispenser. It can work in a manual mode, or in semi-automatic / automatic modes, where it uses data sent from the RWR in 12 different categories, sorted by threat radar pulse and beam widths to select chaff dispensing programs.

The aircraft has a total of four dispensing magazines capable of loading chaff of flares.



The possible chaff / flare ratio is as follows:

CHAFF	240	210	180	150	120	90	60	30	0
FLARE	0	15	30	45	60	75	90	105	120

These setting can be altered in the Paint and Loadout tab in the mission editor.

Number of remaining chaff and flares is displayed in the top-right corner of the TEWS page.

The mode of operation for the CMD can be selected using the Countermeasures Dispenser Set Control Panel.

14.4.1 Mission Specific Programming

The programs used are not programmable from inside the aircraft.

Note: they can only be edited using the ALE45_PRG.lua file. Option to alter the programs from the mission editor level will be added after the EA.

Flare and chaff are dispensed using MAN1 or MAN2 program in both front and rear cockpit.

MAN 1 always releases a programmed number of flares and chaff (8 of each by default, in two bursts of 1-2-1 within four seconds).

MAN 2 releases a variable program, depending on the RWR threat estimate and provided that the Mode Select Switch on the Countermeasures Dispenser Set Control Panel in the rear cockpit is in Semi Auto position. If there are no threats detected, MAN 2 follows program set for MAN 1.

Note: threat-based programs for MAN 2 dispensing are not available in Early Access.

PFM and MSS Option

Note: PFM and MSS advanced options are not available in Early Access.

14.4.2 Warning / Caution / Advisory Lights

The following caution / advisory lights are associated with the countermeasures.

PROGRAM: the green light comes ON when CMD threat programs from the RWR are present in the semi-automatic mode and the required expendables are present.

MINIMUM: lights up when any expendable store reaches a low quantity level (turns off when they reach zero).

CHAFF / FLARE: flash during dispensing of the indicated payload. Turns ON when all magazines of the indicated payload are empty.

APPENDIX A: GLOSSARY

ABBREVIATIONS USED IN THE MANUAL

A

A/A - Air-to-Air

AAI - Air-to-Air Interrogator

ACCEL - Acceleration

ACM - Air Combat Maneuvering

ACP - Armament Control Panel

ACQ - Acquisition

AID - Air Data

ADC - Air Data Computer

ADI - Attitude Director Indicator

ADL - Aircraft Data Link

ADU - Adapter Unit

AFCS - Automatic Flight Control System

AFMSS - Air Force Mission Support System

A/G - Air-to-Ground

AGC - Automatic Gain Control

AGL - Above Ground Level

AGM - Air-to-Ground Missile

AGR - Air-to-Ground Ranging

AHRS - Attitude Heading Reference System

AIM - Air Intercept Missile

AIR - Air Inflatable Retard

AIS - Airborne Instrumentation System

AIU - Avionics Interface Unit

AJ - Anti-Jam

ALAS - Automatic Lasing

ALG - Automatic Level/Gain

ALM - Almanac

ALT - Altitude

ALTN REL - Alternate Release

AMRAAM - Advanced Medium Range Air-to-Air Missile

AO - Angle Only

AOA - Angle of Attack

AOJ - Angle of Jam

APCC - Advanced Pod Control Computer

A/P - Auto Pilot

APPLD - Applied

APT - Automatic Polarity Track

ARMT - Armament

ASC - Analog Signal Converter

ASE - Allowable Steering Error

ASL - Azimuth Steering Line

ASP - Avionics Status Panel

AT - Along Track

ATF - Automatic Terrain Following

ATL - Above Target Level

ATM - Air Training Munition

ATRK - Area Track

AUTO - Automatic AZ - Azimuth

B

B - Barometric (altitude)

BARO - Barometric

BATT - Battery

BBR - Bulls Eye Bearing and Range

BE - Bulls Eye

BH - Burst Height

BHT - Black-hot FLIR polarity

BIT - Built-In Test

BLK- Black

BOC - Bomb On Coordinates

BOT - Bomb On Target

BPT - Black Polarity Track

BRG - Bearing

BRST - Boresight

BRT - Brightness

BRU - Bomb Rack Unit

BST - Boresight

BUF - Buffer

C

CARA - Combined Altitude Radar Altimeter

CAS - Calibrated Airspeed; Control Augmentation System

CATM - Captive Air Training Misaile

CBT- Combat

CBU - Cluster Bomb Unit

CC - Central Computer; Correct Code

CDES - Continuous Designation

CDIP - Continuously Displayed Impact Point

CFRS - Computerized Fault Reporting System

CFT - Conformal Fuel Tank CHAN - Channel

CHF - Chaff

CHRM - Continuous High Resolution Map

CL - Centerline

CLAS - Continuous Lasing

CLM - Climb

CLMB - Climb

CLR- Clear

CM-BIT - Continuous Monitor BIT

CMBT - Combat

CMD - Countermeasures Dispenser; Command

CMPT - Computed Rate Track

CNX - Cancel

COMM - Communication

CONT - Contrast; Continuous

CORR - Correlate (AGM-65 tracking mode)

CPASS - Continuous Passive Ranging

CPU - Central Processor Unit

CRS - Course

CSO - Control Stick Override

CSS - Control Stick Steering

CT - Cross Track

CTR - Center

D

D-Dud

DAIS - Digital Airborne Instrumentation System

DBA - Display Brightness Adjust

DCL - Declutter

DCLTR - Declutter

DCY - Decoy

DECR - Decrease; Decrement

DEGRD - Degraded

DEP - Design Eye Point

DES - Designation

DGR - Desired Ground Range

DGRD - Degraded

DIL - Displayed Impact Line

DIR - Direct

DISP - Dispense; Dispenser

DL - Data Link

DLM - Data Logging Module

DLP - Data Link Pod

DLVRY - Delivery

DMC - Digital Maneuvering Cue

DMP - Digital Map Processor

DMS - Digital Map System

DPLR - Doppler

DRSP - Digital Radar Signal Processor

DSA - Dispensing Switch Assembly

DSCH - Discharge

DSR - Dynamic Seeker Ranger

DTM - Data Transfer Module

DTMR - Data Transfer Module Receptacle

DTT- Dual Target Track

DTWS - Designated Track-While-Scan

DW - Display Window

E

EA - Electronic Attack
ECCM - Electronic Counter Countermeasures
ECM - Electronic Countermeasures
EEPROM - Electrically Erasable Programmable Read Only Memory
EOG - Edge
EFAIL - Failure in a Mass Data Transfer
EGBU - Enhanced Guided Bomb Unit
EGI - Embedded Global Positioning System (GPS)/ Inertial Navigation System (INS)
EL - Elevation
EID - Enhanced Identification
EMER - Emergency
EMERG - Emergency
EMIS LMT - Emissions Limit
ENAB - Enable
ENFOV - Expanded Narrow Field Of View
ENTR - Enter
EO - Electro-Optical
EOB - End Of Bar
EOF - End Of Frame
EP - Electronic Protection
ES - Electronic Warfare Support
ESL - Elevation Steering Line
ESU - Electronic Sequencing Unit
ETI - Elapsed Time Indicator
EU - Electronic Unit
EW - Electronic Warfare
EWWS - Electronic Warfare Warning Set
EXP- Expand
EXPND - Expand

F

F - Frag

FA - Full Action

FCC - Flight Control Computer

FCP - Front Cockpit

FDL - Fighter Data Link

FF - Free Fall (delivery mode)

FIF - Fighter- to - Fighter

FLIR - Forward Looking Infrared

FLR - Flare

FNL- Funnel

FOV - Field of View

FPA - Flight Path Angle

FPS - Feet Per Second

FREQ - Frequency

FRL - Fuselage Reference Line

FS - Frame Store

FTS BATT - Flight Termination System Battery

G

g - Gravity force

G - Ground speed

G-BIT - Ground BIT

GAINS - GPS Aided Inertial Navigation System

GBU - Guided Bomb Unit, a conventional bomb with self-contained guidance system

GCS - Guidance/Control Set

GCU - Guidance/Control Unit

GDS - Gun Director Sight

GMTR - Ground Moving Target Reject

GND - Ground

GP - General Processor

GPS - Global Positioning System

GRY -Gray

GS - Ground Speed

GT - Ground Track

H

HA - Half Action
HAG - Height Above Ground
HAT - Height Above Target
HC - Hand Controller; High Confidence
H/C - Hot/Cold
HD - High Drag (retarded bomb)
HDT - High Data Rate Track-While-Scan
HDTWS - High Data Rate Track-While-Scan
HI - High
HOB - Height Of Burst
HOJ - Home On Jam
HOJext - Extrapolated HOJ
HOTAS - Hands On Throttle And Stick
HPRF - High Pulse Repetition Frequency
HRM - High Resolution Map
HSI - Horizontal Situation Indicator
HSTT - High Pulse Repetition Frequency Single Target Track
HUD - Head-Up Display
HVPS - High Voltage Power Supply Hz - Hertz, cycles per second

I

IA - Inboard Aft (weapon station location)
IAM - Internal Allocation Module
I-BIT - Initiated BIT
IC - Inboard Center (weapon station location)
ICCP - Integrated Communications Control Panel
JCS - Internal Countermeasures Set
IDL - Improved Data Link
IDLP - Improved Data Link Pod
IF - Inboard Forward (weapon station location)
IFA - Inflight Alignment
IFF - Identification Friend or Foe
IFL - Inflight Lockout
IMI - Imaging Infrared

IMIRS - Improved Modular Infrared Sensor

IMU - Inertial Measurement Unit

INC - Increase; Increment

IND - Indirect

INLV - Interleaved

INS - Inertial Navigation System

INST - Instrument

INTVL - Interval

INV - Invalid

INVARM - Invalid Armament

IP - Identification Point, visual or sensor established prominent location

IPVU - Interleaved Precision Velocity Update

IR - Infrared

J

JDAM - Joint Direct Attack Munition

JEM - Jet Engine Modulation

JETT - Jettison

JH - Jam High

JL - Jam Low

JPF - Joint Programmable Fuze

JSOW - Joint Stand-Off Weapon

JTIDS - Joint Tactical Information Distribution Sys- tem

K

KCAS - Calibrated Airspeed in Knots

KTAS - True Airspeed in Knots

L

LADD - Low Altitude Drogue Delivery

LAE - Lead Angle Error

LAN - Land

LANT - LANTIRN

LANTIRN - Low Altitude Navigation and Targeting Infrared for Night

LAR - Launch Acceptable Region LAS - Laser
Lat - Latitude
LAU - Launcher Adapter Unit LAW - Low Altitude Warning
LC - Left Conformal fuel tank; Low Confidence
LCFT - Left Conformal Fuel Tank
LCOS - Lead Computing Optical Sight
LCW - Long Chord Wing
LDGP - Low Drag General Purpose
LGB - Laser Guided Bomb
LHC - Left Hand Controller
LI - Left Inboard (munition rack/pylon location)
LIT - Look-Into-Turn
LO - Left Outboard (wing pylon location)
Low LOD - Line of Departure, initial path of projectile,
LOS - Line Of Sight
LP - Launch Point
LPI - Low Probability of Intercept
LPRF - Low Pulse Repetition Frequency
LR BST - Long Range Boresight
LRDT - Long Range Dive Toss
LRG- Large
LRS - Long Range Search
LRU - Line Replaceable Unit
LSG - Losing
LST - Level Straight Through
LVL- Level
LVPS - Low Voltage Power Supply

M

M - Menu; Minimum recovery altitude
MAINT - Maintenance
MAN - Manual
MAR - Missile Active Range
MAU - Miscellaneous Arming Unit
MAX - Maximum
MC - Mission Cartridge u MDT - Mass Data Transfer

MEA - Minimum Enroute Altitude

MED-Medium

MEM - Memory

MHTI - Medium to High PRF Track Transfer

MI - Mutual Interference

MIL - Milliradian, I mil= 0.0573", 1 degree=17.45 mils; 1 mil subtends approximately I foot at a 1000-foot range

MIN - Minimum

MK - Mark (a designation preceding model numbers)

ML - Multilook

MLAS - Manual Lasing

MLC - Main Lobe Clutter

MLG - Manual Level/Gain

MM - Master Mode; Millimeter

MN - Mission Navigator

MPCD - Multi-Purpose Color Display

MPD - Multi-Purpose Display

MPFM - Missionized Preflight Message

MPDP · Multi-Purpose Display Processor

MPRF - Medium Pulse Repetition Frequency

MRA - Minimum Release Altitude; Minimum Recovery Altitude

MRI - Minimum Release Interval MRM • Medium Range Missile

MSEC - Millisecond, 1 MSEC = 0.001 second; also MS

MS - Millisecond, 1 ms =0.001 second

MSL - Mean Sea Level

MSN - Mission

MSTT - Medium Pulse Repetition Frequency Single Target Track

MTF - Manual Terrain Following

N

NAV - Navigation

NDTWS - Non-Designated Track-While-Scan

N-F - Navigation FLIR

NFOV - Narrow Field of View

NGS - Nose Gear Steering

NIM - Nose Index Marker

NM - Nautical Mile (6080 feet)
NML - Normal
NORM - Normal
NRDY - Not Ready

O

OA - Outboard Aft (weapon station location)
O-BIT - Operational BIT
OBST - Obstacle
OC - Outboard Center (weapon station location)
OEP - Operational Eye Position
OF - Outboard Forward (weapon station location)
OFP - Operational Flight Program
OFS5 - Operational Flight Software Verison 5
OPS - Operations
O/S - Offset
OTRK - Offset Track
OWL - Obstruction Warning Line
OWS - Overload Warning System

P

PACS - Programmable Armament Control Set
PASS - Passive (ranging)
PB - Pushbutton
P-BIT - Periodic Built-In Test
PCO - Power Change Over
PD - Pulse Doppler
PDT · Primary Designated Target
PERS - Persistence
PFM - Preflight Message
Pickle - Act of pressing weapon release button
PIM - Pulse Interval Modulation
Pipper - HUD gun reticle aim dot
PLGR - Precision Lightweight GPS Receiver
PP - Present Position
PPI - Plan Position Indicator

PPKS - Present Position Keeping Source

PPLI - Precision Position Location Identification

Pressure Altitude, altimeter reading when set at 29.92 inches Hg

PRF - Pulse Repetition Frequency,

PRG - Progressive

PROG - Program

PSA - Phased Scanned Array

PSL - Pattern Steering Line

PSP - Programmable Signal Processor

PTRK - Point Track

PVC - Position Velocity Consistency filter

PVU - Precision Velocity Update

PWR- Power

Q

QTR - Quarter

QTY - Quantity

R

R - Radar Altimeter

Radar Mile, 6000 feet, or time required for one pulse of energy to be transmitted 6000 feet and reflected back to receiver (12.4 microseconds)

Raero - Maximum aerodynamic range

RALT - Radar Altimeter

RAM - Random Access Memory

Raster, horizontal scan of electron beam in a fixed TV format, used in low PRF radar modes

RATR - Round At Target Range

RBL - Radar Boresight Line, position of radar antenna when in boresight. Zero's with the fuselage reference line.

RBM - Real Beam Map u RC - Right Conformal fuel tank

RCD - Record

RCFT - Right Conformal Fuel Tank

RCL - Recall

RCP - Rear Cockpit

RCS - Radar Cross Section

RDP - Radar Display Processor
RDR - Radar
ROY - Ready
RE - Receiver/Exciter
REL - Release
RELNAV - Relative Navigation
RET - Reticle; Retard (delivery mode)
RF - Radio Frequency
RFA - Radio Frequency Amplifier
RGH - Range Gated High
RHC - Right Hand Controller
RI - Right Inboard (wing pylon station)
RICP - Remote Intercommunications Control Panel
RIFL - Reversible Inflight Lockout
RLG - Ring Laser Gyro
Rmin - Minimum range
Rmax - Maximum range
RNG - Ranging; Range
RO - Right Outboard (wing pylon station)
Ropt - Maximum range probability of steering with optimum steering
Rpi - Maximum range probability of steering with current steering
RP MPL - Ripple Multiple
RP SGL - Ripple Single
RST - Reset
RT - Receiver/Transmitter
Rtr - Range Tum and Run
RTS - Return To Search
RWR - Radar Warning Receiver
RWS - Range While Search
RWS-H - Range While Search - High
RWS-I - Range While Search - Interleaved
RWS-M - Range While Search - Medium

S

SA - Situation Awareness
SAN - Sanity
SC - Set Clearance
SCP - Sensor Control Panel
SCW - Short Chord Wing
SOT - Secondary Designated Target
SEL - Select
SHF - Shift
S INT - Set Interval
SLC - Side Lobe Clutter
SLR - Slant Range
SLV - Slave
SML - Small
SMT WPN - Smart Weapon
SNF - Sniff
SNR - Signal to Noise Ration
SP - Sequence Point; Snow Plow
SPD - Speed
SPM - Shots Per Minute
S QTY - Set Quantity
SRM - Short Range Missile
SS - Supersearch
SSC - Summary of Significant Changes
ST - Self - Targeting
STA - Station
STAB - Stabilized
STB - Stabilized (HRM map stabilization)
STBY - Standby
STO - Store
STT - Single Target Track
SUU - Stores suspension and release unit
SUW - Smart Unknown Weapon
SW - Smart Weapon; Switch
SWMSN - Smart Weapon Mission
SYS - System

SYSB - System (barometric)

SYSG - System (EGI)

T

TACAN - Tactical Air Navigation

TARM - Time to Arm

TAS - True Airspeed, calibrated airspeed corrected for temperature and pressure

TBL - Timed Barrel Line, a line extending from center of a timed gun barrel bore to infinity, used as a reference in harmonization; Table

TCFT - Tangential Conformal Fuel Tank

TCN - Tacan

TD - Target Designator

TOA - Target Density Altitude

TDC - Target Designator Control

TERM - Terminal

TEWS - Tactical Electronic Warfare System

TF - Terrain Following

TGBU - Training Guided Bomb Unit

TGM - Training Guided Missile

TGT - Target

THDG - True Heading

TIK - Test Instrumentation Kit TIMPCT - Time to Impact

TK - Track

TLAS - Time to Lase

TLM - Target Location Marker

TM - Target Mach; Telemetry

TMR - Time to Max Range

TOD - Time of Day

TOF - Time of Flight

TOO - Target of Opportunity

TOT - Time on Target

TPUL - Time to Pull

TPULL - Time to Pull

TREL - Time to Release

TRNG - Training

TRSN - Transition

TSO - Tactical Situation Display
TT - Track Test
TTA - Time To Active
TTGT - Time to Target
TTI - Time To Intercept
TVGS - Television Guidance Section
TWS - Track-While-Scan
TXA - Transfer Alignment

U

UFC - Upfront Control
UJDAM -Unknown Weapon Using the JDAM Interface
UJSOW - Unknown Weapon Using the JSOW Interface
UWCMD - Unknown Weapon Using the WCMD Interface
UNC- Uncage
UNKWN - Unknown
UPDT - Update
UTM - Universal Transverse Mercator

V

VAL - Valid
Vc - Closing velocity
VCTR - Vector Scan
VHSIC - Very High Speed Integrated Circuit
VID - Video
VLC - Very Low Clearance
VS BST - Velocity Search Boresight
VT - Release velocity
VTR - Video Tape Recorder
VTS - Vertical Scan

W

W - Wind

WCDT - Weapon Control Data Terminal

WCMD - Wind Corrected Muntions Dispenser WDL - Weapon Data Link
WFOV - Wide Field of View
WHT - White-hot FLIR polarity; White

WL - Waterline, a plane of horizontal reference on an aircraft, usually in inches

W-OFF-W - Weight Off Wheels

WON - Weapon Operating Number

W-ON-W - Weight On Wheels

WOW - Weight On Wheels

WP - Waypoint

WPN-Weapon

WPT - White Polarity Track

WSO - Weapon Systems Officer

WX - Weather

X

XFAIL - Transfer Failure

XFER - Transfer

XMIT - Transmit

XMTR - Transmitter

Z

ZCL - Zero Command Line (TF radar)

ZSL - Zero Sight Line, pipper LOS when optical sight is set on O mils depression, 2 degrees above fuselage reference line on this aircraft

APPENDIX B-F: CHECKLISTS

Mic Switch	LEFT PANEL	**ON**
Anti-Col Lights	LEFT PANEL	**ON**
Position Lights	LEFT PANEL	**AS DES.**
Throttles	LEFT PANEL	**IDLE**
Conform Tanks	LEFT PANEL	**STOP TR.**
L Inlet Ramp Sw.	LEFT PANEL	**AUTO**
R Inlet Ramp Sw.	LEFT PANEL	**AUTO**
Yaw CAS Sw.	LEFT PANEL	**ON**
Roll CAS Sw.	LEFT PANEL	**ON**
Pitch CAS Sw.	LEFT PANEL	**ON**
Oxygen Sw.	RIGHT PANEL	**ON**
L GEN Sw.	RIGHT PANEL	**ON**
R GEN Sw.	RIGHT PANEL	**ON**
Emer. GEN Sw.	RIGHT PANEL	**ON**
L Engine Con. Sw.	RIGHT PANEL	**ON**
R Engine Con. Sw.	RIGHT PANEL	**ON**
L Engine Mas. Sw.	RIGHT PANEL	**ON**
R Engine Mas. Sw	RIGHT PANEL	**ON**
JFS Sw.	RIGHT PANEL	**ON**
ECS Sw.	RIGHT PANEL	**AUTO**
Fuel Knob	MAIN PANEL	**TANK 1**
JFS Handle	MAIN PANEL	**PULL**
JFS ready light	RIGHT PANEL	**ON**
Fire Ext Switch	MAIN PANEL	**TEST**
Right Finger Lift	THROTTLE	**PULL**
RPM (L Eng)	ENGINE MON.	**26%**
Fire Ext Switch	MAIN PANEL	**TEST**
Right Throttle	LEFT PANEL	**IDLE**
R Gen Caution	RIGHT PANEL	**OFF**
Fire Ext Switch	MAIN PANEL	**TEST**
Canopy	RIGHT WALL	**CLOSE**
Right Finger Lift	THROTTLE	**PULL**
RPM (R Eng)	ENGINE MON.	**26%**
UFC	MAIN PANEL	**ON**
L and R Radio	MAIN PANEL	**ON**
HUD	MAIN PANEL	**ON**

MPDs and MPCD	MAIN PANEL	**ON**
Light Test Sw.	RIGHT PANEL	**TEST**
Terrain Fol. Radar	LEFT PANEL	**STBY**
Radar Altimeter	LEFT PANEL	**ON**
INS Knob	LEFT PANEL	**GC ALIGN**
Radar Knob	LEFT PANEL	**STBY**
NAVFLIR Sw.	LEFT PANEL	**STBY**
Formation Lights	LEFT PANEL	**AS DES.**
Tail Flood Light	LEFT PANEL	**AS DES.**
Parking coord.	UFC	**ENTER**
Conform Tanks	LEFT PANEL	**TRANSF.**
Fuel Knob	MAIN PANEL	**CONF. T.**
Bingo Value	MAIN PANEL	**SET**
T/O Trim Button	LEFT PANEL	**HOLD**
Stby Attitude Ind.	MAIN PANEL	**UNCAGE**

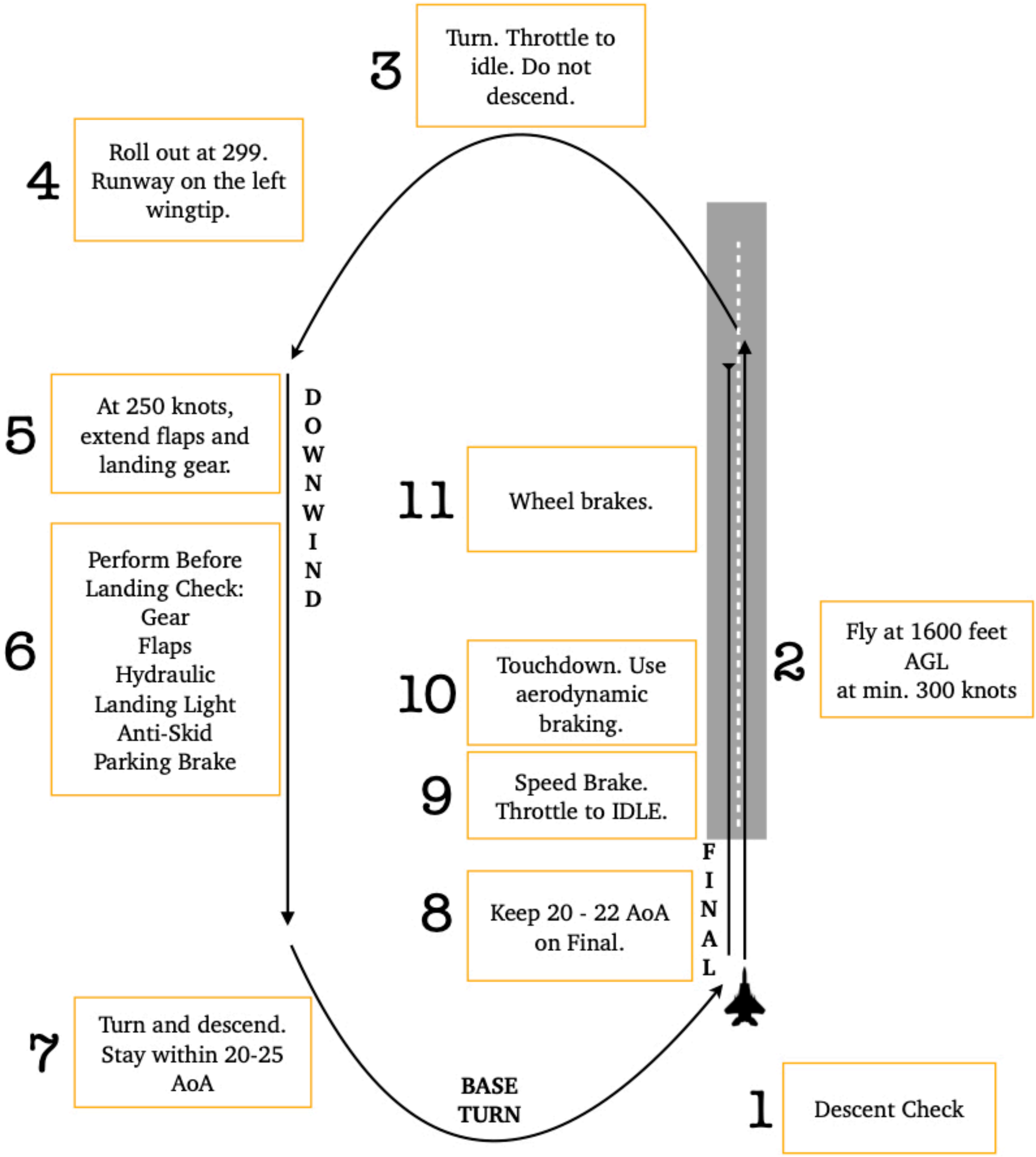
Volume Knobs	LEFT PANEL	**AS DES.**
Crypto Switch	LEFT PANEL	**NORM**
Mic Switch	LEFT PANEL	**ON**
Cipher Txt Sw.	LEFT PANEL	**AS REQ.**
Tone Sw.	LEFT PANEL	**OFF**
TGT FLIR Power	LEFT PANEL	**OFF**
Laser Sw.	LEFT PANEL	**OFF**
Nuclear Consent	LEFT PANEL	**SAFE**
Emer. Landing Gear	MAIN PANEL	**IN**
Arresting Hook	MAIN PANEL	**UP**
Emer. Brake	MAIN PANEL	**IN**
Command Sel. V.	RIGHT PANEL	**NORM**
Oxygen system	RIGHT PANEL	**SET**
ICS Sw.	RIGHT PANEL	**OFF**
RWR Sw.	RIGHT PANEL	**OFF**
EWWS Sw.	RIGHT PANEL	**OFF**
CMS Mode Sw.	RIGHT PANEL	**OFF**
Flare Sw.	RIGHT PANEL	**NORM**
Interior Lights	RIGHT PANEL	**AS DES.**
Lights Test	LEFT PANEL	**TEST**
MPDs & MPCDs	MAIN PANEL	**ON**
INS / EGI align	MAIN PANEL	**CONFIRM**
TGT FLIR POWER	LEFT PANEL	**SBY**
PACS Page	MPD	**SET UP**
Oxygen Flow Lev.	RIGHT PANEL	**ON**
Stby Attitude Ind.	MAIN PANEL	**UNCAGE**
Altimeter	MAIN PANEL	**SET**

Holding Brake	PILOT	OFF
Wheel Chocks		REMOVE
Brakes	PILOT	CHECK
Nose Gear Steer.	PILOT	CHECK
Flight Instruments	BOTH	CHECK

<u>BEFORE TAKEOFF</u>

Holding Brake	PILOT	ON
Inlet Ramp Sw.	PILOT	AUTO
Ejection Safety Lev.	BOTH	ARMED
Command Sel. V.	WSO	AS BRIEF.
Flight Controls	BOTH	CHECK
Flaps	BOTH	DOWN
T/O Trim	PILOT	CHECK
Canopy	BOTH	CLOSED
IFF	WSO	ON
CFT Switch	PILOT	NORM
Radar	PILOT	ON
TGT Pod	WSO	STBY
Pitot / Eng. Heat	PILOT	AS REQ.
Warnings / Caut.	BOTH	CHECK
INS	PILOT	NAV
Holding brake	PILOT	OFF

OVERHEAD BREAK



DESCENT CHECKS

Master Arm Switch	PILOT	SAFE
CMD Mode Knob	WSO	OFF
Altimeter	BOTH	SET AND CHECK
TGT Pod Switch	WSO	OFF
TF Radar Power Switch	PILOT	OFF
PITOT Heat / ENG Heat	PILOT	ON AS REQUIRED
External Lights	PILOT	ON AS REQUIRED

BEFORE LANDING CHECKS

Landing Gear	BOTH	VERIFY DOWN AND LOCKED
Flaps	BOTH	DOWN
Hydraulics	PILOT	CHECK
Landing Light	PILOT	ON
ANTI-SKID	PILOT	NORM
Holding Brake	PILOT	OFF

AFTER LANDING CHECKS

Ejection Seat Safety Lever	BOTH	LOCKED
Command Selector Valve	WSO	NORMAL
Speed Brake	PILOT	IN
Flaps	PILOT	UP
IFF Modes	WSO	DESELECT
Radar Power Knob	PILOT	STBY
TF Radar	PILOT	OFF
TACAN	WSO	OFF
JTIDS Mode Knob	PILOT	HOLD / OFF
Trim	PILOT	T/O
Landing / Taxi Light	PILOT	TAXI
Formation Lights	PILOT	OFF
Pitot Heat / Windshield Switches	PILOT	OFF
ENG Heat	PILOT	AS REQUIRED
Radar Power Knob	PILOT	OFF

SHUTDOWN

Holding Brake	PILOT	ON
Video Recorder	PILOT	OFF
LANTIRN Pods	BOTH	OFF
TEWS	WSO	OFF
AAI	BOTH	OFF
Sensors	BOTH	OFF
ILS	BOTH	OFF
HUD	PILOT	OFF
INS	PILOT	OFF
MSOGS	BOTH	OFF
Throttles	PILOT	OFF