DCS GUIDE

F-15E STRIKE EAGLE

SUITE 4E+

BY CHUCK

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DISCLAIMER

This document has been created for recreational purposes only. Do not use for training or real life flying.

The author of this document has never had access to restricted or classified documentation on the F-15E Strike Eagle. The author has never had access to OEM (Original Equipment Manufacturer) data related to the F-15, its armament systems nor its defensive systems. All the information within this document is taken from public documentation (i.e. F-15E Early Access Manual by RAZBAM) and non-official tutorials (player-made videos on Youtube).

The procedures listed in this document are deliberately simplified for gameplay purposes due to the limitations of the DCS World simulation environment and the limitations of the DCS F-15E Strike Eagle module by RAZBAM.

This document is merely a free, personal project that is used for entertainment. This document is not meant nor designed to teach someone to fly a real F-15.

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Special thanks to Paul "Goldwolf" Whittingham for creating the guide icons.

The McDonnell Douglas F-15 Eagle is an American twin-engine, all-weather fighter aircraft designed by McDonnell Douglas (now part of Boeing). Following reviews of proposals, the United States Air Force (USAF) selected McDonnell Douglas's design in 1969 to meet the service's need for a dedicated air superiority fighter.

The Eagle first flew in July 1972, and entered service in 1976. It is among the most successful modern fighters, with over 100 victories and no losses in aerial combat, with the majority of the kills by the Israeli Air Force. The F-15 has an almost mythical reputation among air forces around the world due to its stellar combat record. Although the F-15 was originally envisioned as a pure air superiority fighter, its design included a secondary ground-attack capability that was largely unused. It proved flexible enough that an improved all-weather strike derivative, the F-15E Strike Eagle, was later developed, entered service in 1989. The Eagle has been exported in multiple variants to many countries including Israel, Japan, and Saudi Arabia.

The F-15 can trace its origins to the early Vietnam War, when the U.S. Air Force and U.S. Navy fought each other over future tactical aircraft. Defense Secretary Robert McNamara was pressing for both services to use as many common aircraft as possible, even if performance compromises were involved. In July 1967, the Soviet Union unveiled a new generation of combat aircraft during an air show at Domodedovo civil airport south of Moscow. The MiG-25 Foxbat, featuring two engines, twin vertical stabilizers, and an estimated speed greater than Mach 2, was the most formidable aircraft in this new air armada. It was designed as a high-speed, high-altitude interceptor aircraft, and made many performance tradeoffs to excel in this role. The twin-tailed fighter alarmed Air Force planners and highlighted the need for a new fighter designed to fill the air superiority role-a role that had not been fulfilled since development of the F-86 Sabre in the late 1940s.

General Dynamics and McDonnell Douglas were awarded concept exploration contracts in December 1967 for "FX Air Superiority“, a fighter superior in air combat to any present or projected Soviet fighters. The contracts resulted in an Air Force request for proposal for preliminary designs of the F-15 in September 1968. These requirements called for single-seat fighter having a maximum take-off weight of 40,000 pounds for the air-to-air role with a maximum speed of Mach 2.5 and a thrust-to-weight ratio of nearly 1:1 at mission weight. Fairchild-Republic, McDonnell Douglas, and North American Rockwell won design contracts for the F-15 in December 1968. In an effort to reduce development time and costs, the Air Force awarded McDonnell Douglas the F-15 contract on 23 December 1969 without a competitive fly-off, which was deemed a controversial decision at the time.

The Eagle's initial versions were the F-15 single-seat variant and TF-15 twin-seat variant. (After the F-15C was first flown, the designations were changed to "F-15A" and "F-15B"). These versions would be powered by new Pratt & Whitney F100 engines to achieve a combat thrust-to-weight ratio in excess of 1:1. A proposed 25-mm Ford-Philco GAU-7 cannon with caseless ammunition suffered development problems. It was dropped in favor of the standard M61 Vulcan gun. The F-15 used conformal carriage of four Sparrow missiles like the Phantom. The fixed wing was put onto a flat, wide fuselage that also provided an effective lifting surface. The airframe was designed with a 4,000 hour service life, although this was later increased through testing and extension modifications to 8,000 hours and some would fly beyond that. The first F-15A flight was made on 27 July 1972, with the first flight of the two-seat F-15B following in July 1973.

The single-seat F-15C and two-seat F-15D models entered production in 1978 and conducted their first flights in February and June of that year. These models were fitted with the Production Eagle Package (PEP 2000), which included 2,000 pounds of additional internal fuel, provisions for exterior conformal fuel tanks (CFT), and an increased maximum takeoff weight up to 68,000 pounds. The increased takeoff weight allows internal fuel, a full weapons load, conformal fuel tanks, and three external fuel tanks to be carried. The APG-63 radar uses a programmable signal processor (PSP), enabling the radar to be reprogrammable for additional purposes such as the addition of new armaments and equipment. The PSP was the first of its kind in the world, and the upgraded APG-63 radar was the first radar to use it. Other improvements included strengthened landing gear, a new digital central computer, and an overload warning system, which allows the pilot to fly up to 9 g at all weights. The F-15 Multistage Improvement Program (MSIP) was initiated in February 1983 with the first production MSIP F-15C produced in 1985. Improvements included an upgraded central computer; a Programmable Armament Control Set, allowing for advanced versions of the AIM-7, AIM-9, and AIM-120A missiles; and an expanded Tactical Electronic Warfare System that provides improvements to the ALR-56C radar warning receiver and ALQ-135 countermeasure set.

In 1979, McDonnell Douglas and F-15 radar manufacturer, Hughes, teamed to privately develop a strike fighter version of the F-15. This version competed in the Air Force's Dual-Role Fighter competition starting in 1982. The F-15E ”Strike Eagle” variant was selected for production in 1984 as a two-seat, dual-role, totally integrated fighter for all-weather, air-to-air, and deep interdiction missions. The rear cockpit is upgraded to include four multipurpose cathode ray tube (CRT) displays for aircraft systems and weapons management. The digital, triple-redundant Lear Siegler aircraft flight control system permits coupled automatic terrain following, enhanced by a ring-laser gyro inertial navigation system. For low-altitude, high-speed penetration and precision attack on tactical targets at night or in adverse weather, the F-15E carries a high-resolution APG-70 radar and LANTIRN pods to provide thermography.

The USAF introduced the F-15 as "the first dedicated USAF air-superiority fighter since the North American F-86 Sabre". Interestingly, criticism from the ”fighter mafia” that the F-15 was too large to be a dedicated dogfighter and too expensive to procure in large numbers, led to the Lightweight Fighter (LWF) program, which led to the USAF General Dynamics F-16 Fighting Falcon and the middle-weight Navy McDonnell Douglas F/A-18 Hornet.

The USAF began deploying F-15C, D, and E model aircraft to the Persian Gulf region in August 1990 for Operations Desert Shield and Desert Storm. During the Gulf War, the F-15 accounted for 36 of the 39 air-to-air victories by the U.S. Air Force against Iraqi forces. Iraq has confirmed the loss of 23 of its aircraft in air-to-air combat. The F-15C and D fighters were used in the air-superiority role, while F-15E Strike Eagles were used in air-to-ground attacks mainly at night, hunting modified Scud missile launchers and artillery sites using the LANTIRN system. The F-15 had a combined air-to-air combat record of 104 kills to no losses through 2008. The F-15's air superiority versions, the A/B/C/D models, have not suffered any losses to enemy action. Over half of F-15 kills have been achieved by Israeli Air Force pilots.

The F-15’s "look-down/shoot-down" radar can distinguish low-flying moving targets from ground clutter. As you fly missions in the Strike Eagle (also nicknamed “Mudhen” by its pilots), you will realize how powerful its capabilities are, especially when integrated with other sensors like the LANTIRN targeting pod and navigation pod. The F-15E is an incredibly versatile aircraft and it can perform its missions in any weather.

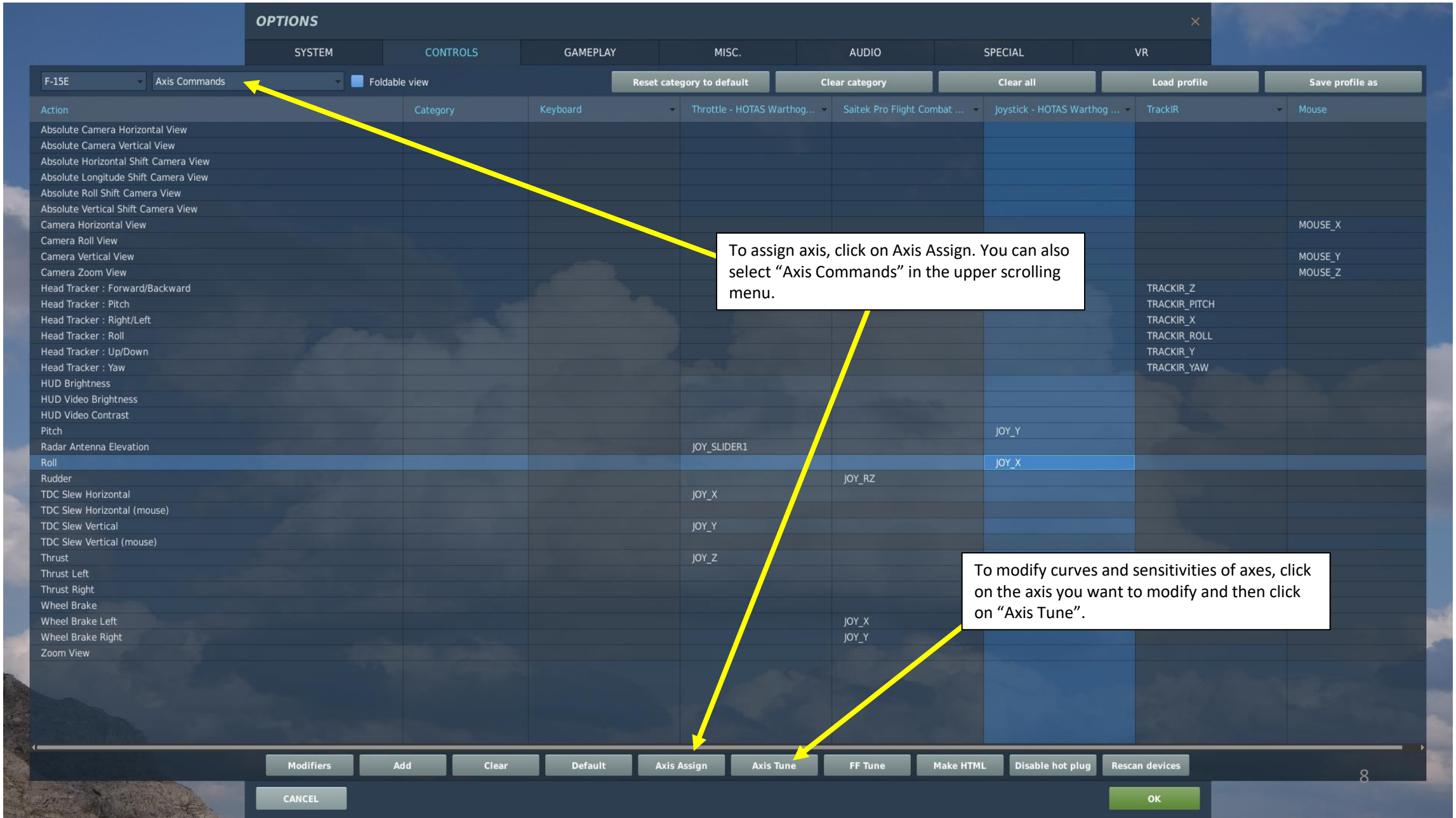
This impressive array of sensors can technically be operated by a single crew member, but operationally speaking, it pretty much requires a crew of two to avoid task saturation. The pilot and the WSO (Weapon Systems Officer) must work as a team to ensure the aircraft can perform its mission and survive.

Overall, the DCS F-15E truly is an incredible aircraft to fly. It carries enormous amounts of fuel, bombs and missiles… and it has plenty of tools at its disposal to deliver its ordnance, even in highly contested areas. Once the afterburners kick in, the Strike Eagle climbs like a rocket heading to space. If you like modern fast jets brimming with fancy schmancy ~~gizmos~~ sensors, you will be right at home with the Mudhen.

Note: As of April 4th 2024, RAZBAM is currently not supporting the DCS F-15E module anymore. Instead of letting this project go to waste, I preferred to complete it instead in case support from the developer is resumed. This means that some sections described in this guide may not work due to regressions caused by subsequent DCS updates or existing bugs.

PART 2 – CONTROLS SETUP

Note: In your controls, make sure you check your “Trim” controls since the default version of the game has your trim hat set to changing your view rather than trim the aircraft. Since most of you are probably equipped with a TRACKIR already, I suggest you make sure the Trim Hat Switch is set up properly.




OPTIONS
SYSTEM
CONTROLS
GAMEPLAY
MISC.
AUDIO
SPECIAL
VR
F-15E
F-16C
F-4E-45MC
F-5E
F-86F
F-14
F/A-18C
Fw 190 A-8
Fw 190 D-9
FC3
I-16
JF-17
Ka-50
Ka-50 III
L-39
M-2000C
MB-339
MiG-21bis
Mi-24P
F-15E S4+
Control Customization
Linear and realistic stick pitch range and limits
Throttle cutoff detent
10
Throttle afterburner detent
75
Force Feedback Pitch Gain (%)
65
Force Feedback Roll Gain (%)
65
Force Feedback Enable Trim Offset
Radar
Randomize radar channel at spawn
View Customization
VR eyepoint offset
5
Monitor eyepoint offset
0
Enable Ghost Controls
Performance Customization
Radar threads
4
Experimental SAR scintillation
High quality radar altimeter
Cockpit Textures Quality
Default
CANCEL
OK

PILOT CONTROL SETUP

- ↑ Trim Nose Down
- → Trim Right Wing Down
- ↓ Trim Nose Up
- ← Trim Left Wing Down

- ↑ Castle Switch – FWD
- → Castle Switch – RIGHT
- ↓ Castle Switch – AFT
- ← Castle Switch – LEFT

- ↑ ZOOM IN SLOW
- → TDC – PRESS
- ↓ ZOOM OUT SLOW
- ← Castle Switch – PRESS

Weapon Release (Pickle)
(RALT+Space)

Trigger (First Detent)
Trigger (Second Detent, Space)

- ↑ Auto Acquisition Switch – FWD
- →
- ↓ Auto Acquisition Switch – AFT
- ←
- P Auto Acquisition Switch – PRESS

NWS (Nosewheel Steering) / Weapons Button

Paddle Switch

+ Wheel (Toe) Brakes (mapped on pedals)

PILOT CONTROL SETUP

↑
→ MIC Switch – FWD
↓
← MIC Switch – AFT

← Speed Brake (Extend) – AFT

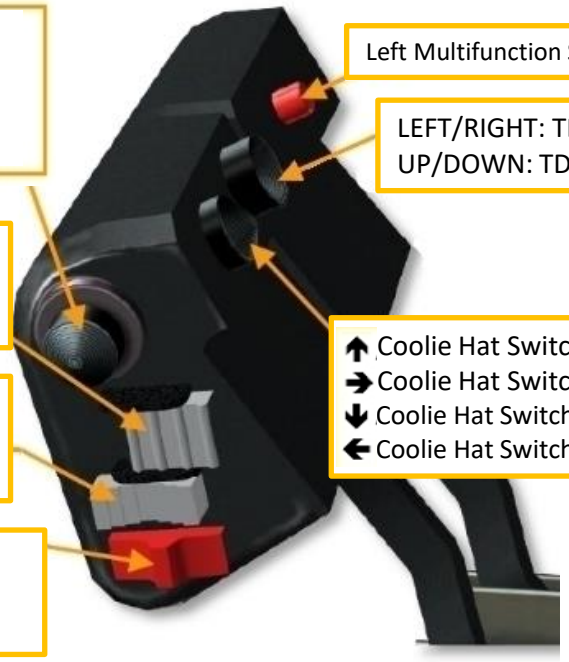
→ Speed Brake (Retract) – FWD

← Boat Switch (Undesignate / Missile Reject) – AFT

→ Boat Switch (Undesignate / Missile Reject) – FWD

← Weapons / Mode Switch Cycle – AFT

→ Weapons / Mode Switch Cycle – FWD



Left Multifunction Switch

LEFT/RIGHT: TDC Slew Axis – Horizontal (JOY X)
UP/DOWN: TDC Slew Axis – Vertical (JOY Y)

↑ Coolie Hat Switch – UP
→ Coolie Hat Switch – RIGHT
↓ Coolie Hat Switch – DOWN
← Coolie Hat Switch – LEFT

← CMD Switch – DOWN (Manual 1 Dispense)

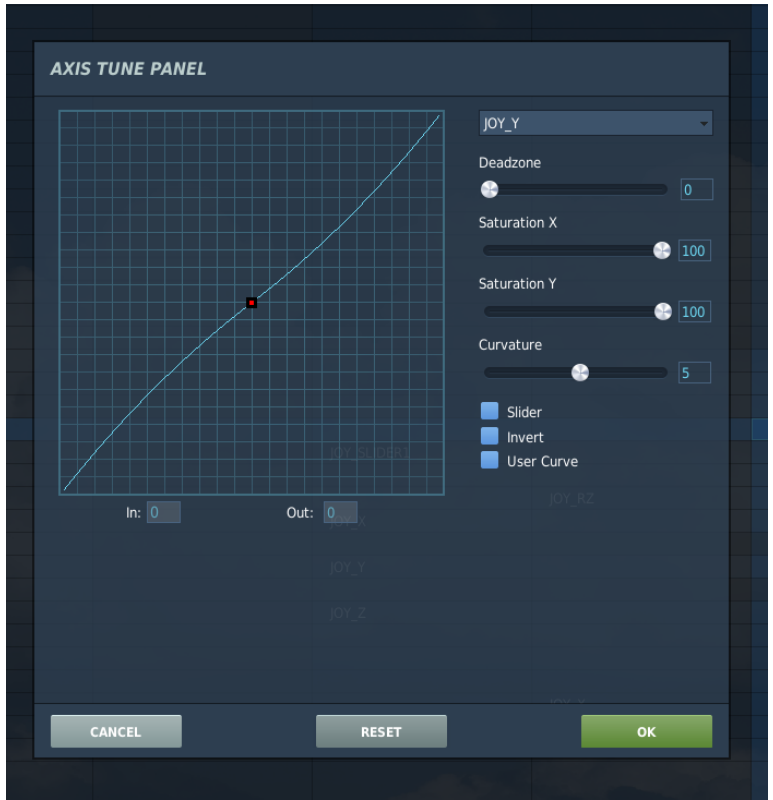
→ CMD Switch – UP (Manual 2 Dispense)

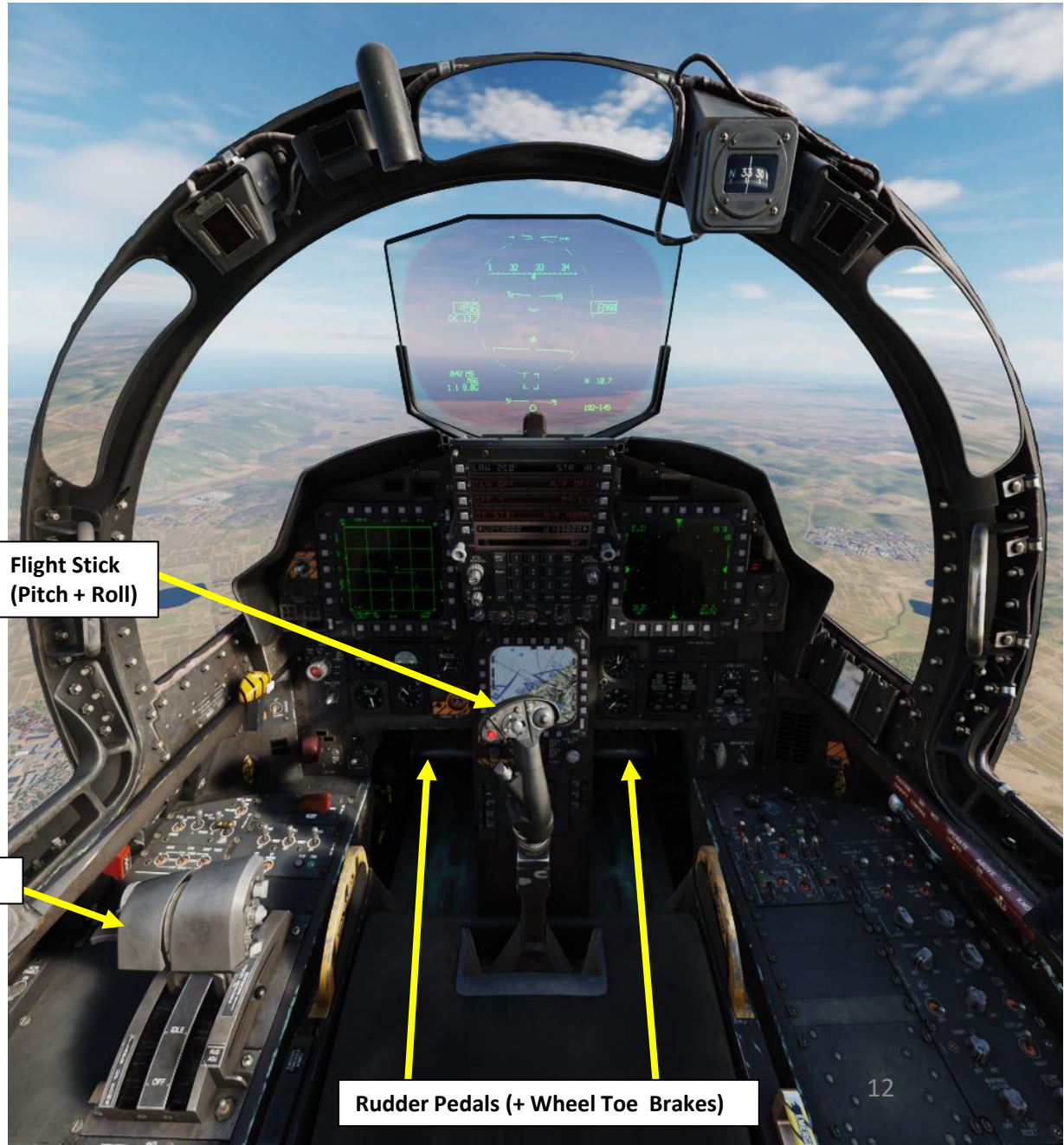
Radar Antenna Elevation (JOY SLIDER)

PILOT AXIS COMMANDS

Bind the following axes:

- PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 5)
- ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 5)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- THRUST – CONTROLS ENGINE RPM (THROTTLE)
- TDC (TARGET DESIGNATION CONTROL) SLEW – HORIZONTAL & VERTICAL AXIS
- RADAR ANTENNA ELEVATION
- WHEEL BRAKE LEFT / RIGHT





WSO (WEAPON SYSTEMS OFFICER) CONTROL SETUP

Note: Controls in Red use the LSHIFT Modifier. This simulates using the right hand controller (RHC) instead of the left hand controller (LHC).

- ↑ Trim Nose Down
- → Trim Right Wing Down
- ↓ Trim Nose Up
- ← Trim Left Wing Down

- ↑ LHC / **RHC** Castle Switch – FWD
- → LHC / **RHC** Castle Switch – RIGHT
- ↓ LHC / **RHC** Castle Switch – AFT
- ← LHC / **RHC** Castle Switch – LEFT

- ↑ ZOOM IN SLOW
- → LHC / **RHC** TDC – PRESS
- ↓ ZOOM OUT SLOW
- ← LHC / **RHC** Castle Switch – PRESS

Weapon Release (Pickle)
(RALT+Space)

LHC / **RHC** Trigger (HA, Half-Action Detent)
LHC / **RHC** Trigger (FA, Full-Action Detent)

- ↑ LHC / **RHC** Auto Acquisition Switch – FWD
- → RHC – AAI Switch – FWD
- ↓ LHC / **RHC** Auto Acquisition Switch – AFT
- ← RHC – AAI Switch – AFT
- P LHC / **RHC** Auto Acquisition Switch – PRESS

LHC / **RHC** – Laser Fire

Paddle Switch

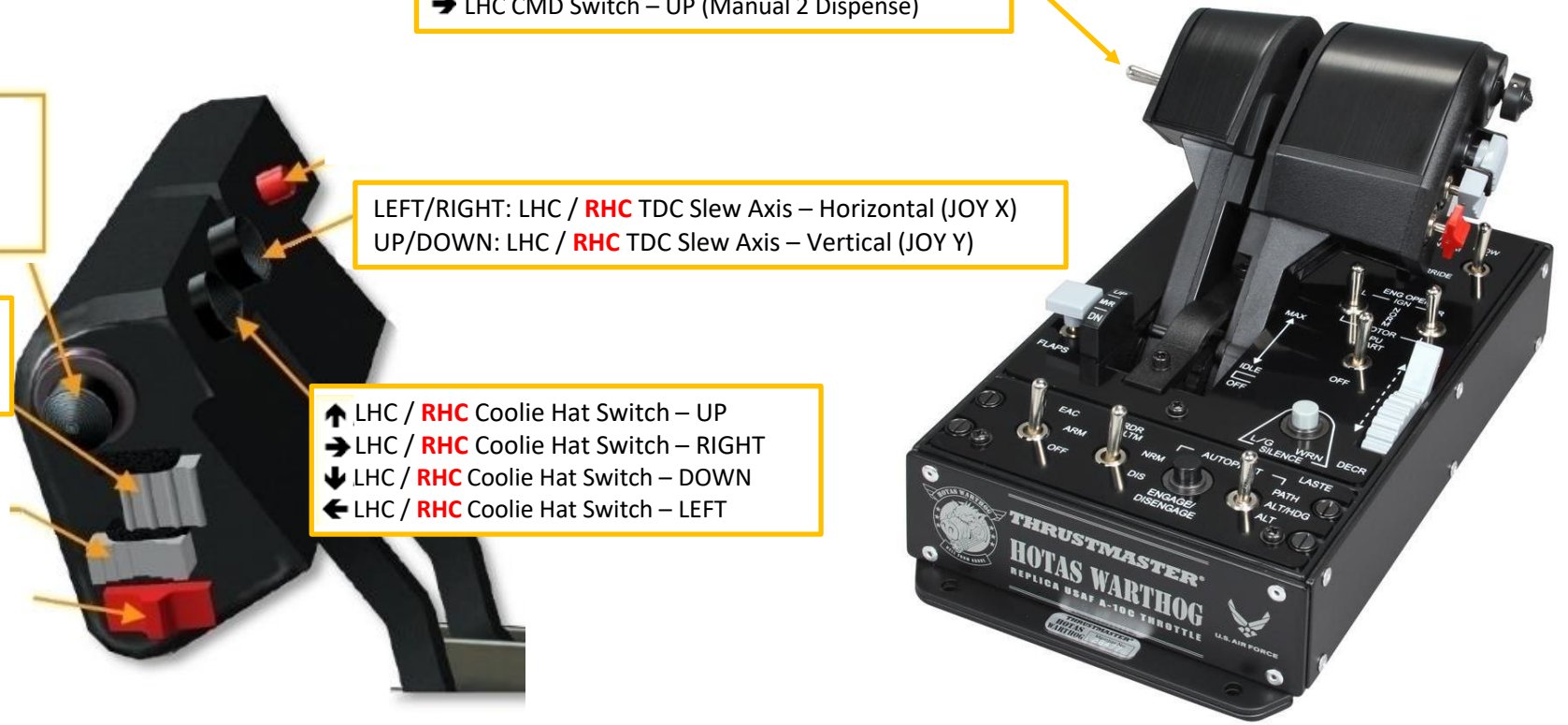
+ Wheel (Toe) Brakes (mapped on pedals)

WSO (WEAPON SYSTEMS OFFICER) CONTROL SETUP

Note: Controls in Red use the LSHIFT Modifier. This simulates using the right hand controller (RHC) instead of the left hand controller (LHC).

LHC CMD Switch – DOWN (Manual 1 Dispense)

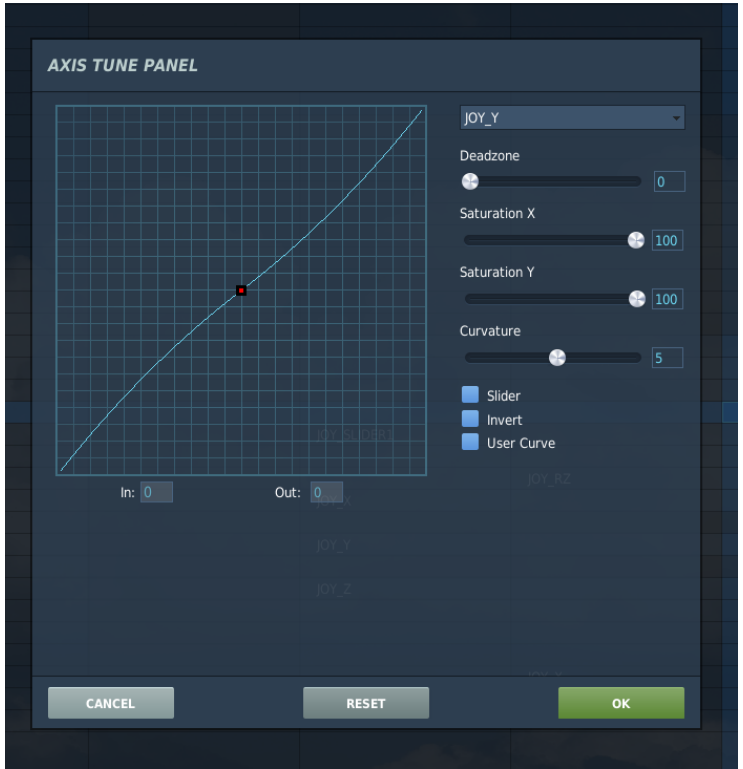
LHC CMD Switch – UP (Manual 2 Dispense)

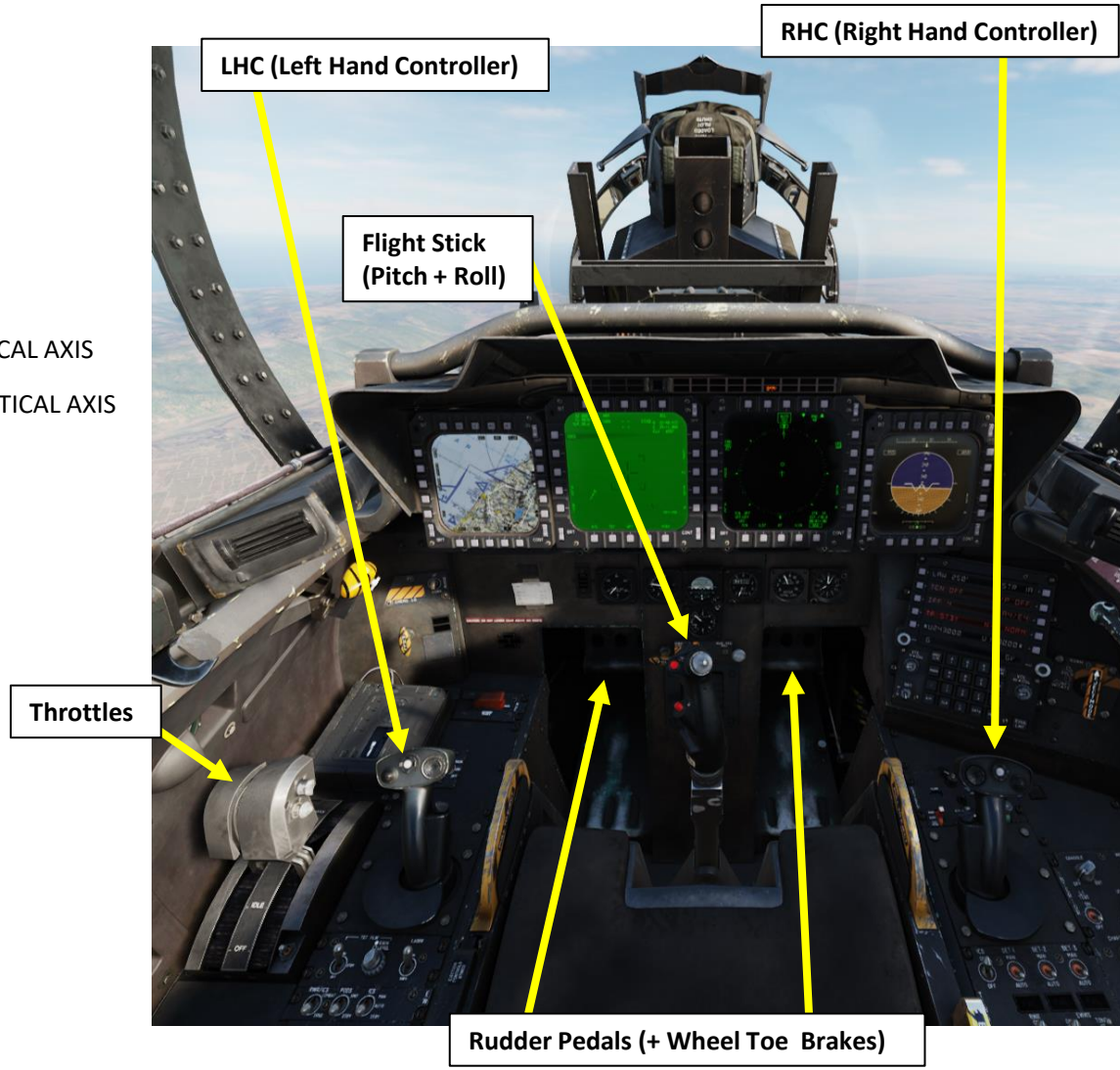


WSO (WEAPON SYSTEMS OFFICER) AXIS COMMANDS

Bind the following axes:

- PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 5)
- ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 5)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- THRUST – CONTROLS ENGINE RPM (THROTTLE)
- LHC (LEFT HAND CONTROLLER) TDC (TARGET DESIGNATION CONTROL) SLEW – HORIZONTAL & VERTICAL AXIS
- RHC (RIGHT HAND CONTROLLER) TDC (TARGET DESIGNATION CONTROL) SLEW – HORIZONTAL & VERTICAL AXIS
- WHEEL BRAKE LEFT / RIGHT

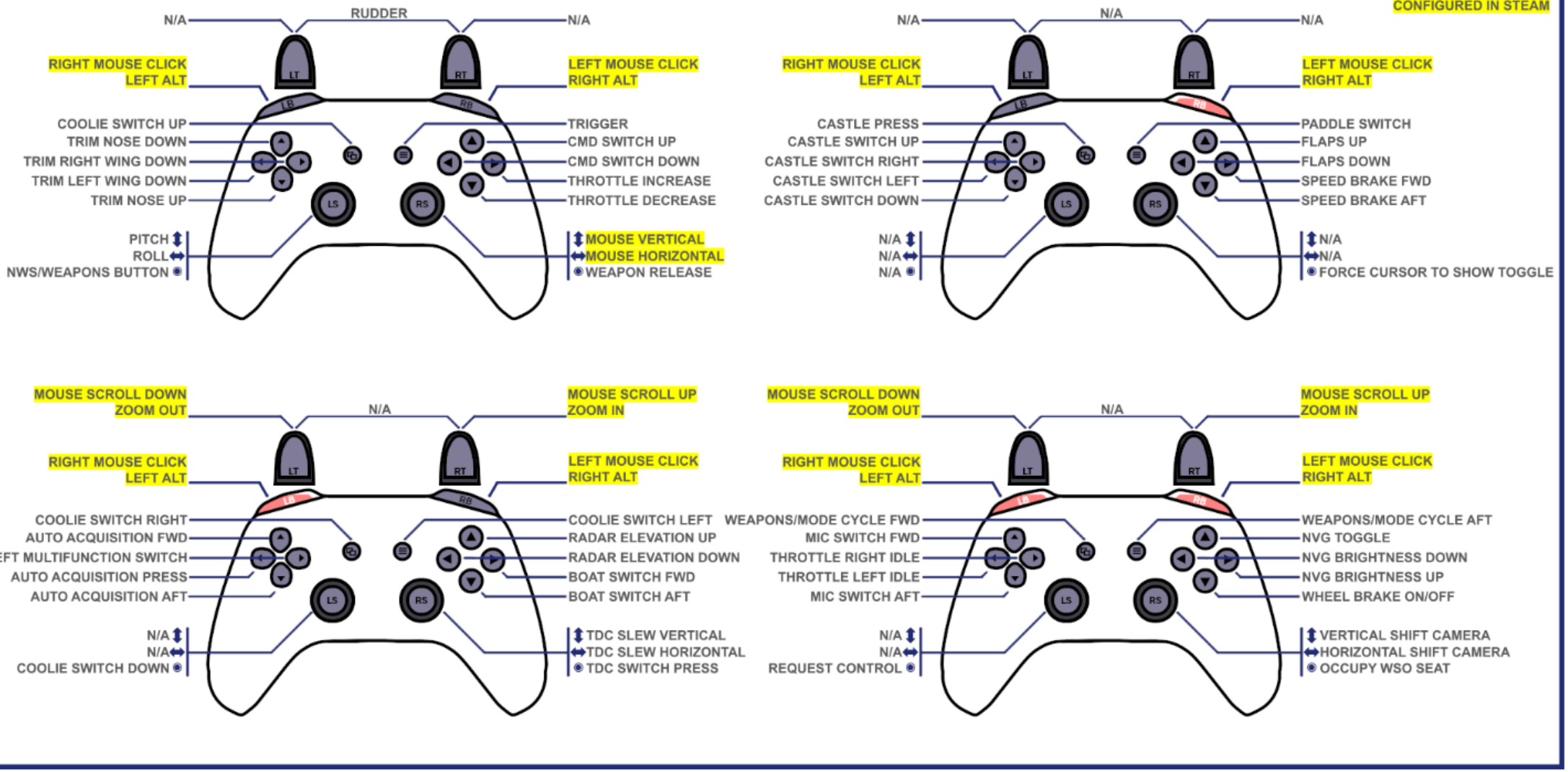




GAMEPAD CONTROLLER PROFILE

(BY TUUVAS, GAMEPAD GURU)

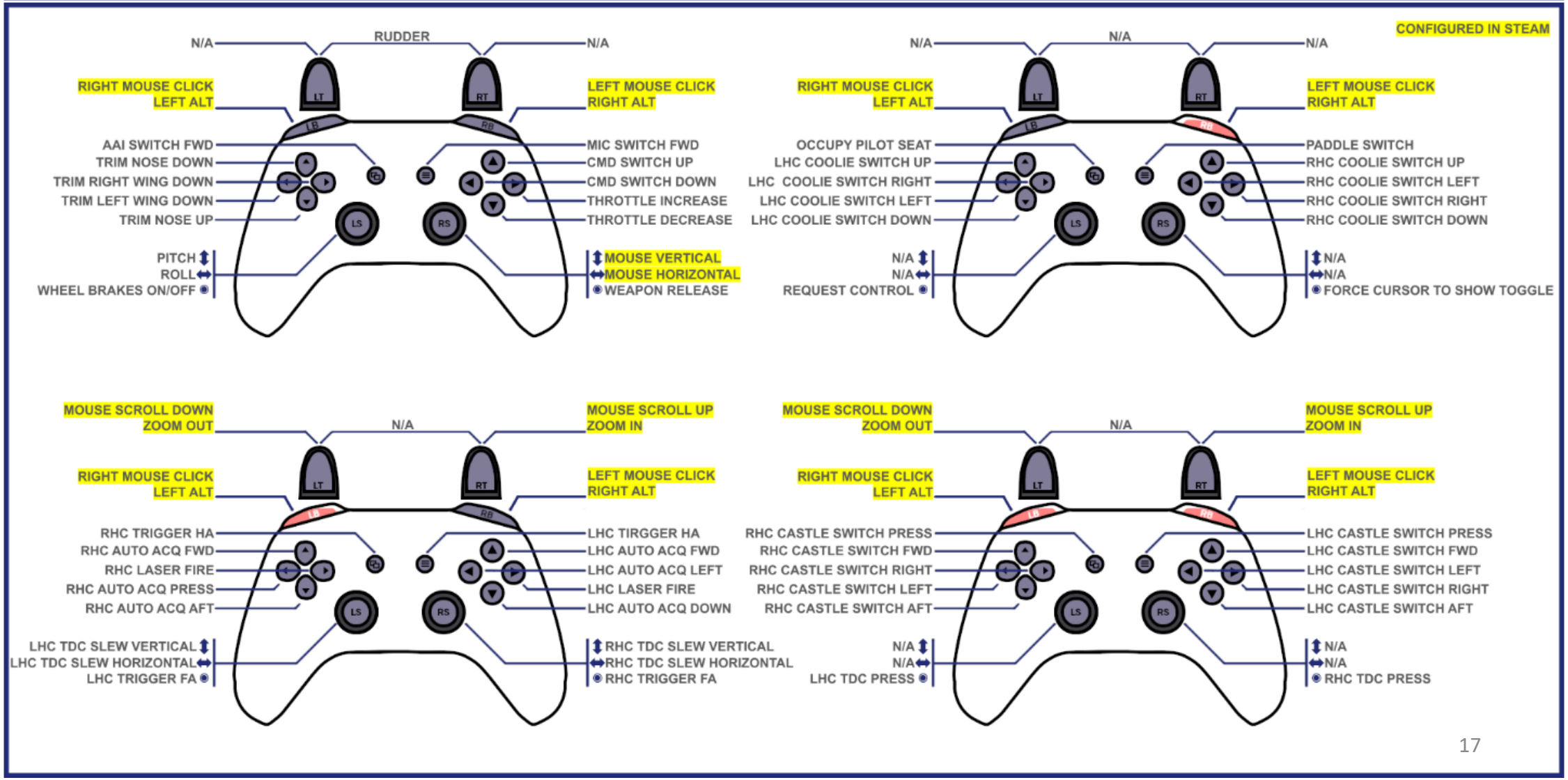
DCS WORLD: F-15E STRIKE EAGLE (PILOT)



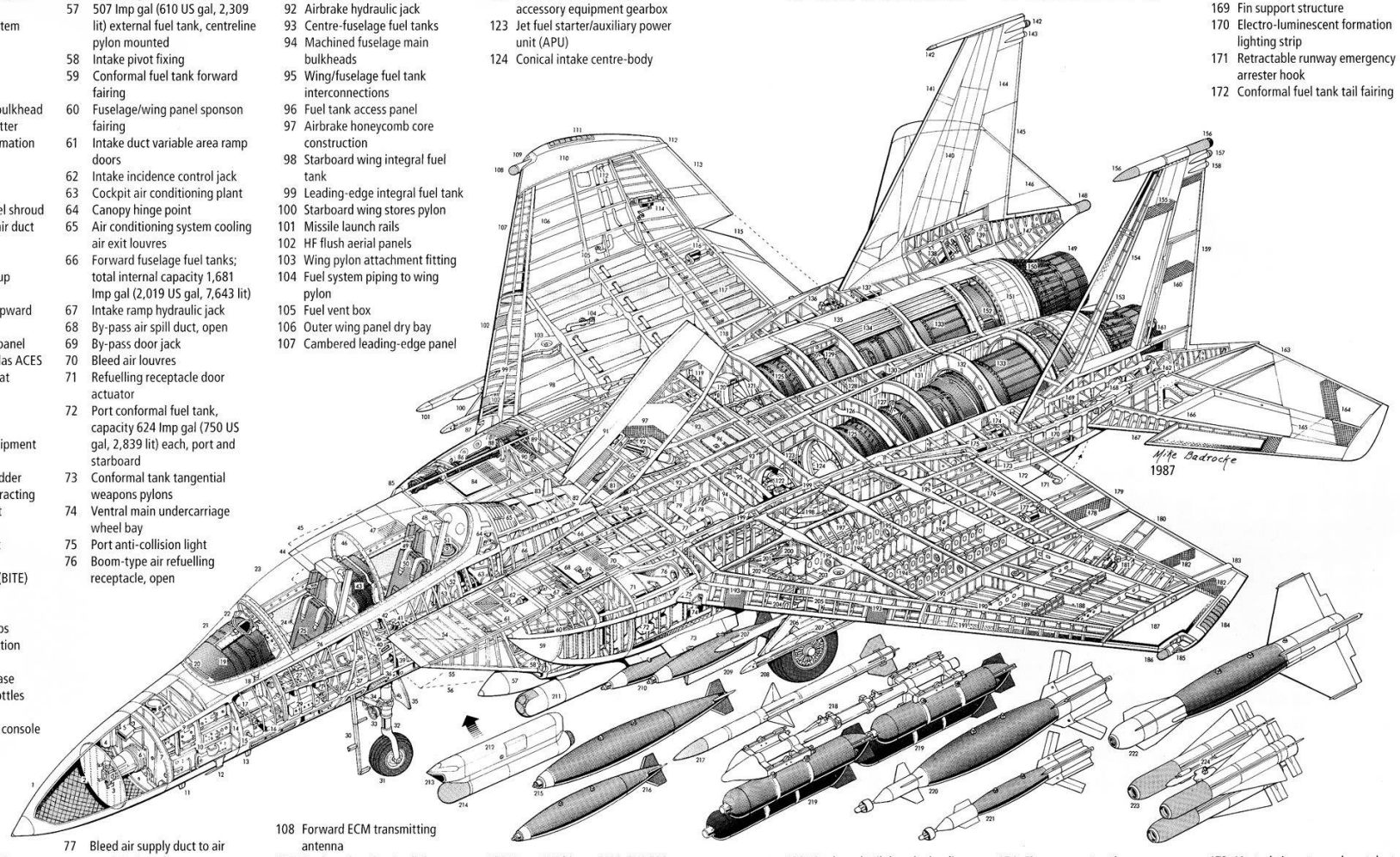
GAMEPAD CONTROLLER PROFILE

(BY TUUVAS, GAMEPAD GURU)

DCS WORLD: F-15E STRIKE EAGLE (WSO)



BOEING (McDONNELL DOUGLAS) F-15E STRIKE EAGLE



1 Glassfibre radome
2 Hughes APG-70 pulse-Doppler radar scanner
3 Scanner tracking mechanism
4 Radome hinge
5 Wide band radar Flood Horn
6 Scanner mounting
7 Radome bulkhead
8 ADF sense aerial
9 Avionics equipment bay, port and starboard
10 APG-70 multi-mode system equipment
11 UHF aerial
12 Pitot head
13 TACAN aerial
14 Cockpit front pressure bulkhead
15 Angle of attack transmitter
16 Electro-luminescent formation lighting strip
17 Rudder pedals
18 Control column
19 Instrument/display panel shroud
20 Windscreen demisting air duct
21 Single piece frameless windscreen panel
22 Pilot's wide-field head-up display (HUD)
23 Cockpit canopy cover, upward hingeing
24 Starboard side console panel
25 Pilot's McDonnell Douglas ACES II 'zero-zero' ejection seat
26 Cockpit coaming
27 Engine throttle levers
28 Port side console panel
29 Underfloor avionics equipment bay
30 Retractable boarding ladder
31 Nosewheel, forward retracting
32 Shock absorber leg strut
33 Landing/taxying lamps
34 Retraction/breaker strut
35 Nosewheel leg door
36 Built-in test equipment (BITE) panel
37 Underfloor control runs
38 Boarding steps/handgrips
39 Flight control augmentation system equipment
40 Canopy emergency release
41 Rear cockpit engine throttles
42 Radar hand controller
43 Rear instrument/display console
44 Starboard intake external compression lip
45 Intake negative incidence position
46 Canopy centre arch
47 Boundary layer bleed air spill duct
48 Ejection seat headrest
49 Seat safety handle/arming lever
50 Weapons System's Officer's ACES II ejection seat
51 Cockpit pressurisation valves
52 Rear pressure bulkhead
53 Canopy jack
54 Port engine air intake box construction
55 Variable capture area 'nodding' air intake
56 Intake high incidence position
57 507 Imp gal (610 US gal, 2,309 lit) external fuel tank, centreline pylon mounted
58 Intake pivot fixing
59 Conformal fuel tank forward fairing
60 Fuselage/wing panel sponson fairing
61 Intake duct variable area ramp doors
62 Intake incidence control jack
63 Cockpit air conditioning plant
64 Canopy hinge point
65 Air conditioning system cooling air exit louvres
66 Forward fuselage fuel tanks; total internal capacity 1,681 Imp gal (2,019 US gal, 7,643 lit)
67 Intake ramp hydraulic jack
68 By-pass air spill duct, open
69 By-pass door jack
70 Bleed air louvres
71 Refuelling receptacle door actuator
72 Port conformal fuel tank, capacity 624 Imp gal (750 US gal, 2,839 lit) each, port and starboard
73 Conformal tank tangential weapons pylons
74 Ventral main undercarriage wheel bay
75 Port anti-collision light
76 Boom-type air refuelling receptacle, open
77 Bleed air supply duct to air conditioning plant
78 Intake ducting
79 Air refuelling feed pipe
80 AN/ALQ-135 ECM system equipment bay
81 Ammunition magazine, 940 rounds
82 Airbrake hinge point
83 Upper UHF aerial
84 Starboard intake bleed air spill door
85 Cannon muzzle aperture
86 Cannon barrels
87 Starboard anti-collision light
88 M61A-1 Vulcan 20mm cannon
89 Hydraulic rotary cannon drive unit
90 Ammunition feed chute
91 Dorsal airbrake, open
92 Airbrake hydraulic jack
93 Centre-fuselage fuel tanks
94 Machined fuselage main bulkheads
95 Wing/fuselage fuel tank interconnections
96 Fuel tank access panel
97 Airbrake honeycomb core construction
98 Starboard wing integral fuel tank
99 Leading-edge integral fuel tank
100 Starboard wing stores pylon
101 Missile launch rails
102 HF flush aerial panels
103 Wing pylon attachment fitting
104 Fuel system piping to wing pylon
105 Fuel vent box
106 Outer wing panel dry bay
107 Cambered leading-edge panel
108 Forward ECM transmitting antenna
109 Starboard navigation light
110 Wing-tip fairing
111 Electro-luminescent formation lighting panel
112 Fuel jettison pipe
113 Starboard aileron
114 Aileron hydraulic actuator
115 Starboard plain flap, down position
116 Flap hydraulic actuator
117 Trailing-edge box integral fuel tank
118 Aileron control run
119 Hydraulically-driven emergency generator
120 Cooling system intake/bleed air spill duct
121 Intake compressor face
122 Airframe mounted engine accessory equipment gearbox
123 Jet fuel starter/auxiliary power unit (APU)
124 Conical intake centre-body
125 Pratt & Whitney F100-PW-220 afterburning turbofan engine (General Electric F110 alternative fit)
126 Engine bleed air ducting
127 Forward engine support link
128 All-titanium rear fuselage/engine bay construction
129 Forward engine mounting
130 Fire extinguisher bottle
131 Engine bay dividing firewall
132 Main engine mounting 'spectacle' frame
133 Afterburner ducting
134 Corrugated inner skin doubler
135 Titanium skin panelling
136 Starboard air system equipment bay
137 AN/ALQ-135 system amplifier
138 Starboard tailplane hydraulic actuator
139 Tailplane hinge arm
140 Boron fibre fin skin panelling
141 Fin leading edge, titanium
142 Starboard fin tip ECM aerials
143 Anti-collision light
144 Fixed portion of trailing edge
145 Starboard rudder
146 Starboard tailplane
147 Tailboom fairing construction
148 Aft ECM transmitting antenna
149 Variable area afterburner exit nozzle
150 Nozzle actuating linkages
151 Nozzle shroud fairing
152 Fueldraulic afterburner nozzle actuators
153 Jet pipe central tail fairing
154 Fin spar construction
155 Boron fibre skin/honeycomb core construction
156 Radar warning antennae
157 Port rear ECM aerial
158 Tail navigation light
159 Port rudder
160 Rudder honeycomb core construction
161 Rudder hydraulic rotary actuator
162 Tailplane pivot fixing
163 Port all-moving tailplane
164 Tailplane honeycomb core construction
165 Boron fibre skin panelling
166 Tailplane spars
167 Leading-edge dog tooth
168 Port tailplane hydraulic actuator
169 Fin support structure
170 Electro-luminescent formation lighting strip
171 Retractable runway emergency arrester hook
172 Conformal fuel tank tail fairing
173 Ventral air system exhaust duct
174 Port air system equipment bay
175 Engine bleed air primary heat exchanger
176 Port wing trailing-edge box integral fuel tank
177 Flap hydraulic actuator
178 Flap honeycomb core construction
179 Port plain flap
180 Port aileron
181 Aileron hydraulic actuator
182 Honeycomb core construction
183 Fuel jettison pipe
184 Port electro-luminescent
185 Port navigation light
186 Forward ECM antenna
187 Port wing-tip fairing
188 Outer wing panel rib construction
189 Machined wing skin/stringer panels
190 Front spar
191 Cambered leading-edge ribs
192 Wing fuel tank outboard sealing rib
193 HF flush aerial panels
194 Machined wing ribs
195 Titanium wing spars
196 Port wing integral fuel tank
197 Wing root rib support struts
198 Fuel system piping
199 Wing spar/fuselage attachment pin joints
200 Main undercarriage leg pivot fixing
201 Hydraulic retraction jack
202 Forward breaker strut
203 Port wing pylon attachment hardpoint
204 Torque scissor links
205 Port leading-edge integral fuel tank
206 Port wing stores pylon
207 Missile launch rails
208 Port mainwheel, forward retracting
209 Mainwheel door
210 Mk 82, 500lb (227kg) HE bombs (26)
211 Low Altitude Navigation and Targeting Infra-red for Night (LANTIRN) targeting pod
212 LANTIRN navigation pod, starboard side
213 Litton forward-looking infra-red (FLIR) aperture
214 Texas instruments terrain following radar
215 Mk 84, 2,000lb (908kg) HE bomb (seven)
216 Mk 83, 1,000lb (454kg) HE bomb (15)
217 AIM-120 Advanced Medium Range Air-To-Air Missile (AMRAAM) (six)
218 Multiple ejector rack
219 Mk 20 Rockeye cluster bombs (26)
220 GBU-10 Paveway II 2,000lb laser guided bomb (seven)
221 GBU-12 Paveway II 500lb laser guided bomb (15)
222 GBU-15 (V) 2,000lb cruciform wing weapon (CWW) (seven)
223 AGM-65 Maverick air-to-surface missiles (six)
224 Triple launch rail unit


Pilot
• Press “1” to select
WSO (Weapon Systems Officer)
• Press “2” to select
KRAKEN
DANGER
EJECTION SEAT & CANOPY
DANGER
DANGER
DANGER
UP
HOLD
DOWN
LOCK
NO STEP
NO STEP
RESCUE
PUSH "T" HANDLE EXTEND CABLE 8 FT & PULL TO JETTISON CANOPY

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit

Tip: Pilot body can be toggled on/off by pressing “RSHIFT+P”

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit

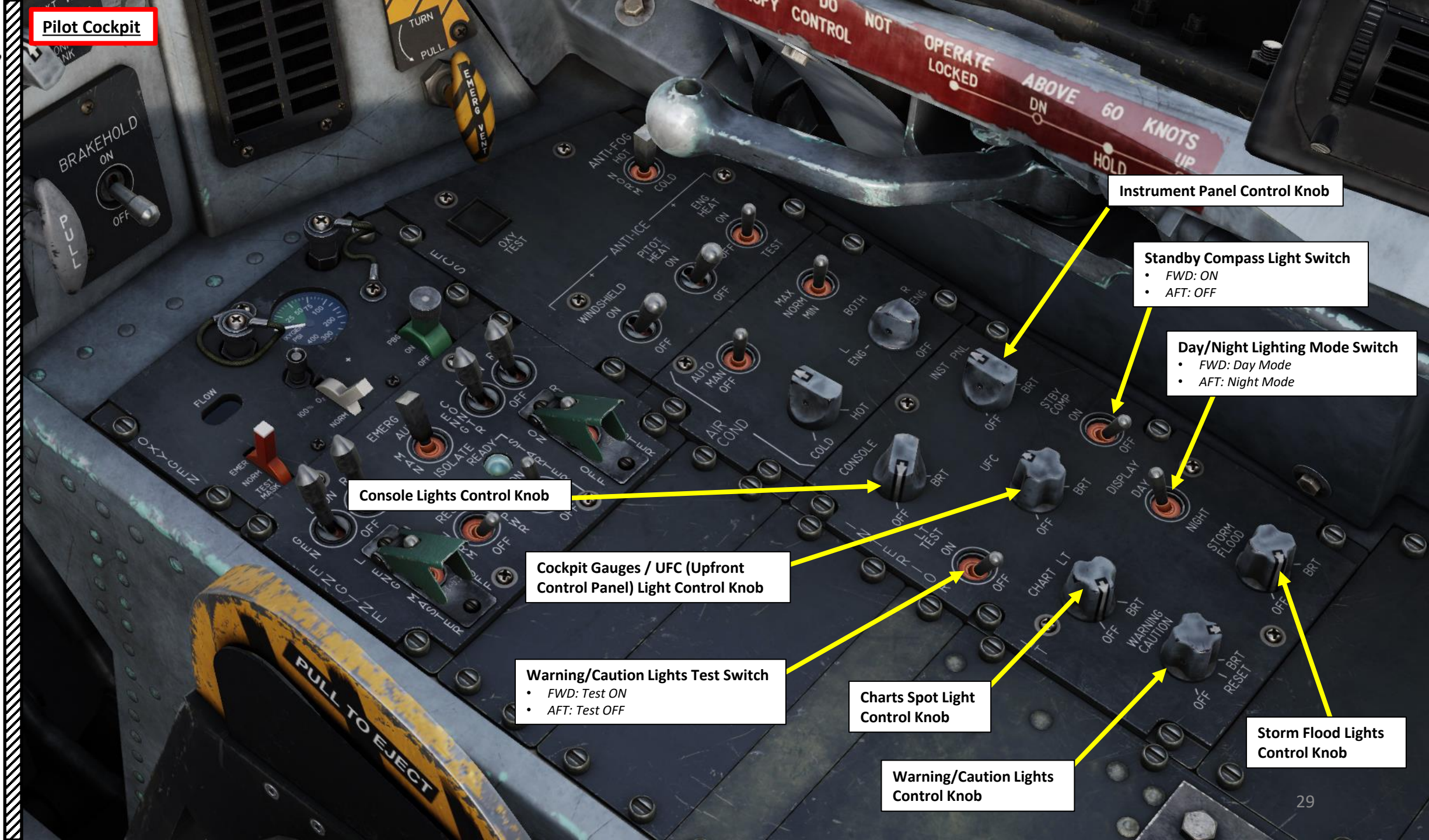
Cockpit Utility Light

Ejection Seat Handle (Pull to Eject)

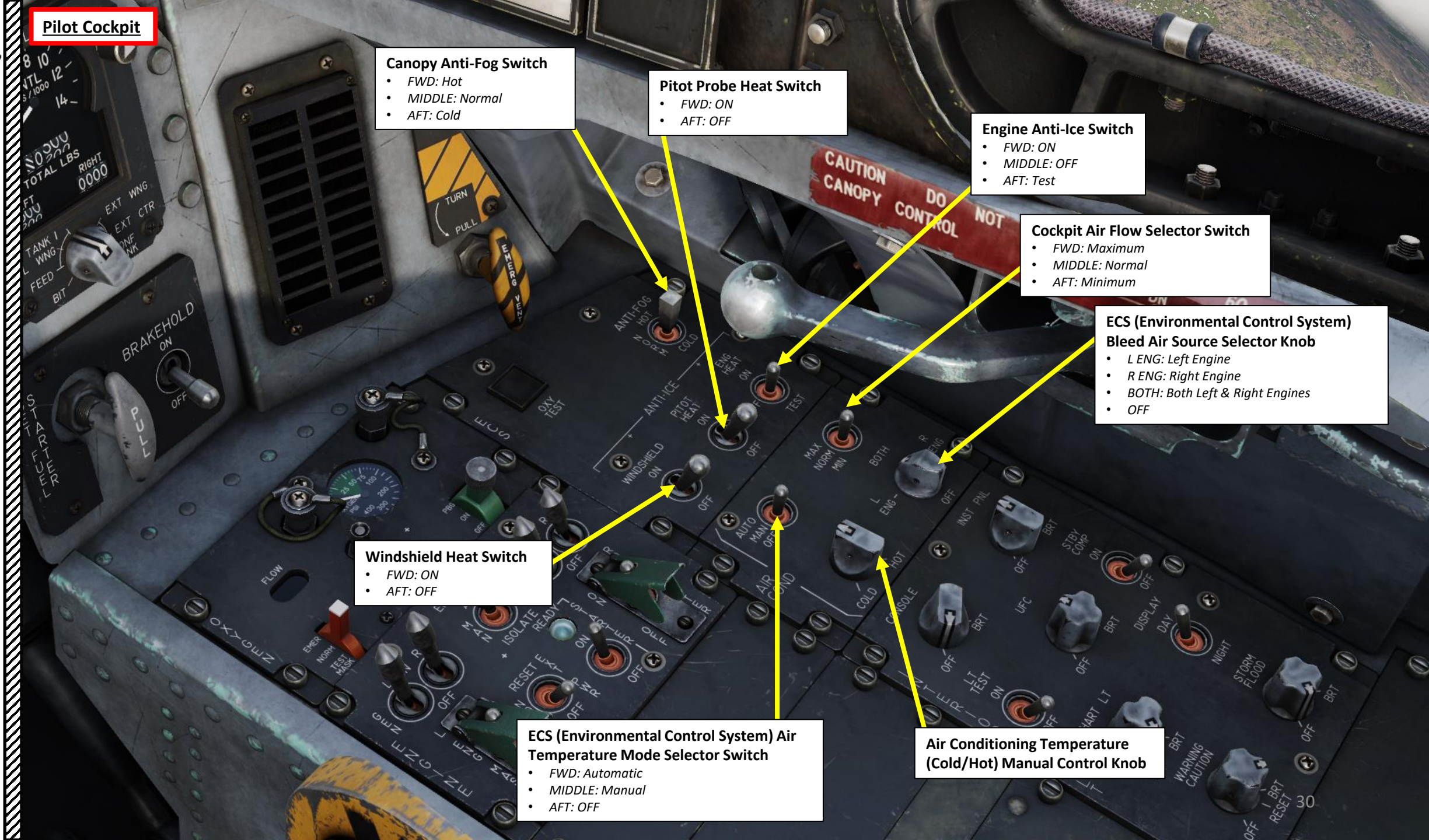
Emergency Manual Chute Control Handle

Pilot Cockpit

Pilot Cockpit



Pilot Cockpit



Canopy Anti-Fog Switch
- *FWD: Hot*
- *MIDDLE: Normal*
- *AFT: Cold*

Pitot Probe Heat Switch
- *FWD: ON*
- *AFT: OFF*

Engine Anti-Ice Switch
- *FWD: ON*
- *MIDDLE: OFF*
- *AFT: Test*

Cockpit Air Flow Selector Switch
- *FWD: Maximum*
- *MIDDLE: Normal*
- *AFT: Minimum*

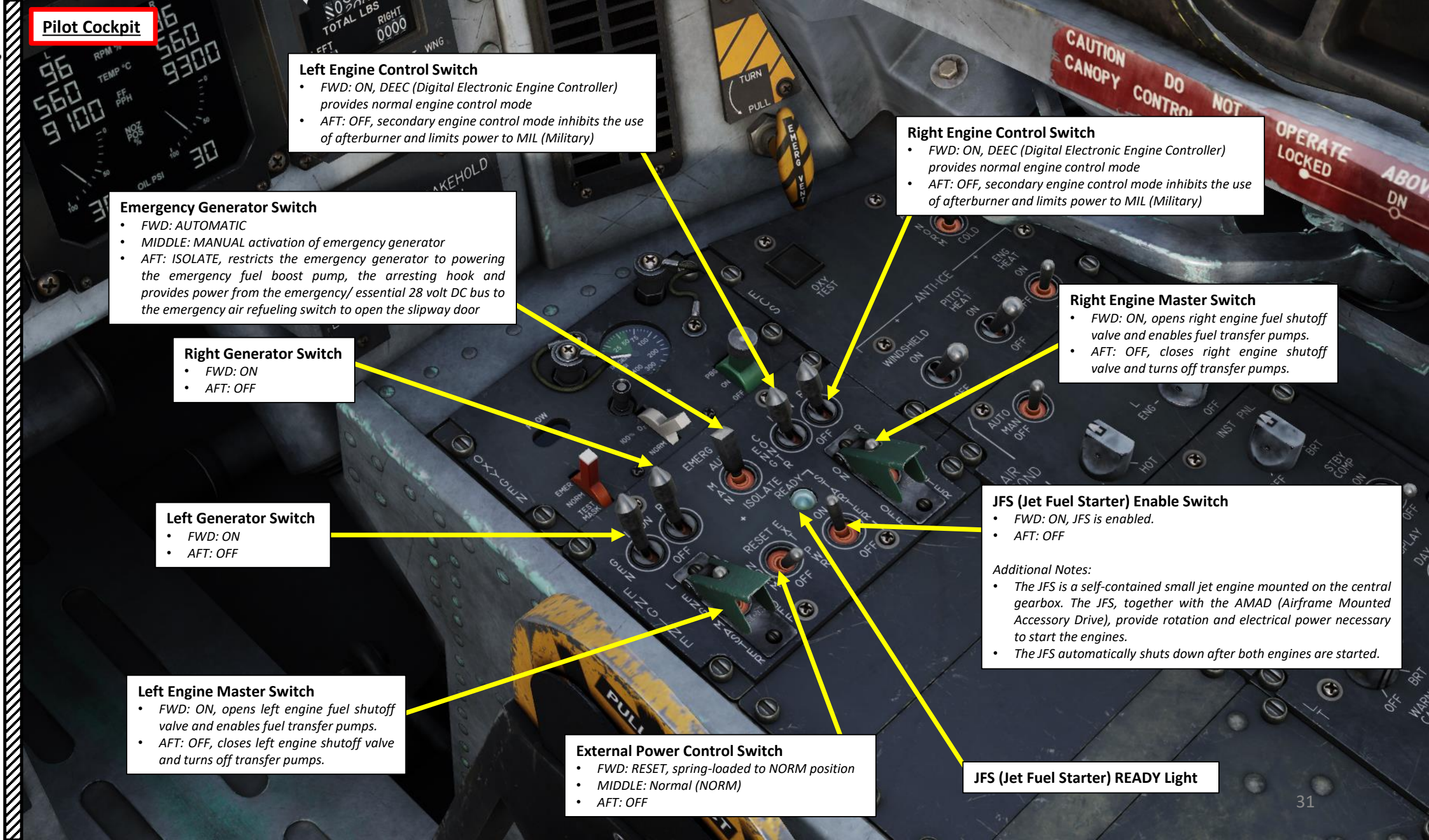
ECS (Environmental Control System) Bleed Air Source Selector Knob
- *L ENG: Left Engine*
- *R ENG: Right Engine*
- *BOTH: Both Left & Right Engines*
- *OFF*

Windshield Heat Switch
- *FWD: ON*
- *AFT: OFF*

ECS (Environmental Control System) Air Temperature Mode Selector Switch
- *FWD: Automatic*
- *MIDDLE: Manual*
- *AFT: OFF*

Air Conditioning Temperature (Cold/Hot) Manual Control Knob

Pilot Cockpit



Left Engine Control Switch
- *FWD: ON, DEEC (Digital Electronic Engine Controller) provides normal engine control mode*
- *AFT: OFF, secondary engine control mode inhibits the use of afterburner and limits power to MIL (Military)*

Right Engine Control Switch
- *FWD: ON, DEEC (Digital Electronic Engine Controller) provides normal engine control mode*
- *AFT: OFF, secondary engine control mode inhibits the use of afterburner and limits power to MIL (Military)*

Emergency Generator Switch
- *FWD: AUTOMATIC*
- *MIDDLE: MANUAL activation of emergency generator*
- *AFT: 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*

Right Engine Master Switch
- *FWD: ON, opens right engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes right engine shutoff valve and turns off transfer pumps.*

Right Generator Switch
- *FWD: ON*
- *AFT: OFF*

Left Generator Switch
- *FWD: ON*
- *AFT: OFF*

JFS (Jet Fuel Starter) Enable Switch
- *FWD: ON, JFS is enabled.*
- *AFT: OFF*

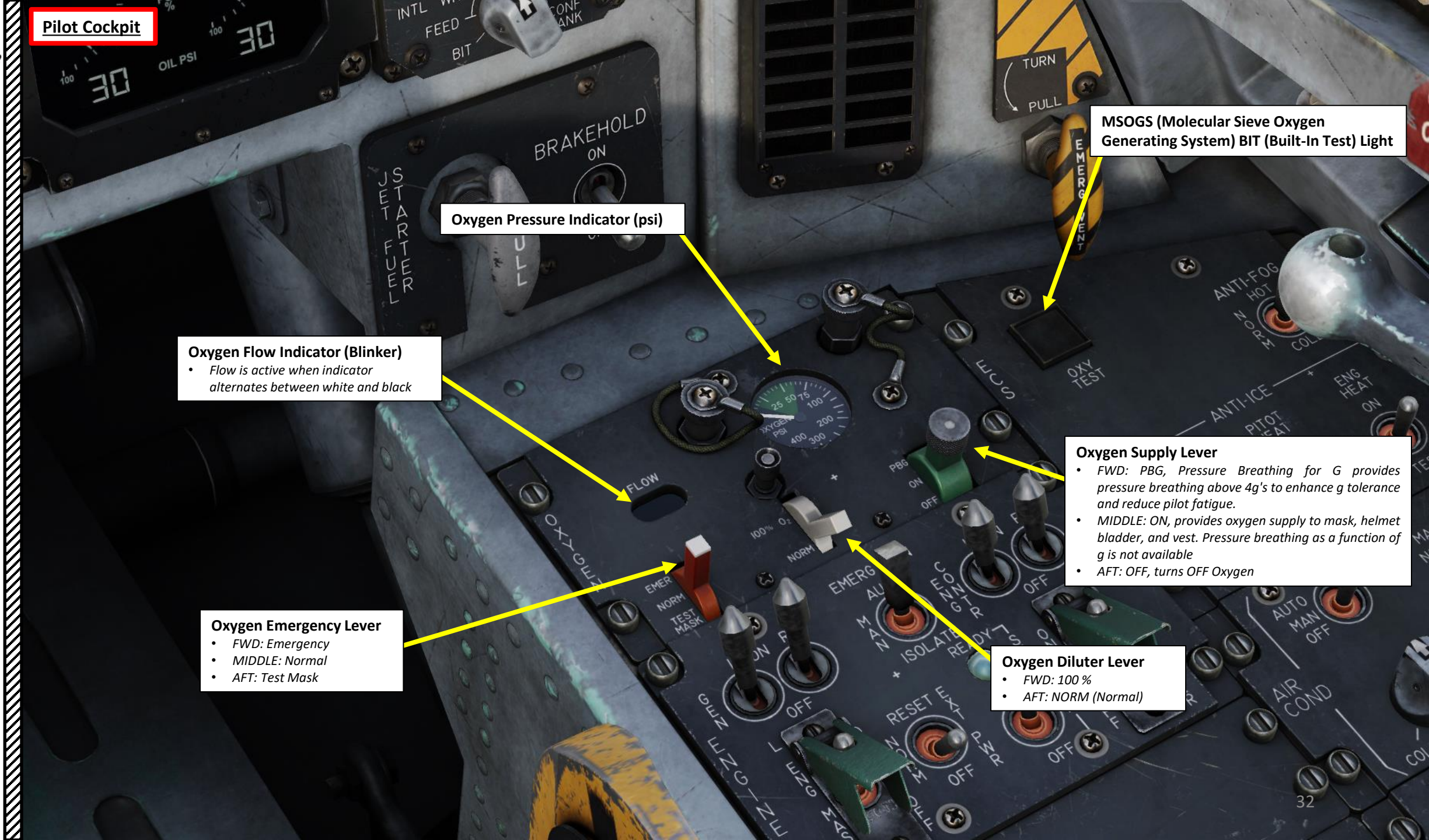
Additional Notes:
- *The JFS is a self-contained small jet engine mounted on the central gearbox. The JFS, together with the AMAD (Airframe Mounted Accessory Drive), provide rotation and electrical power necessary to start the engines.*
- *The JFS automatically shuts down after both engines are started.*

Left Engine Master Switch
- *FWD: ON, opens left engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes left engine shutoff valve and turns off transfer pumps.*

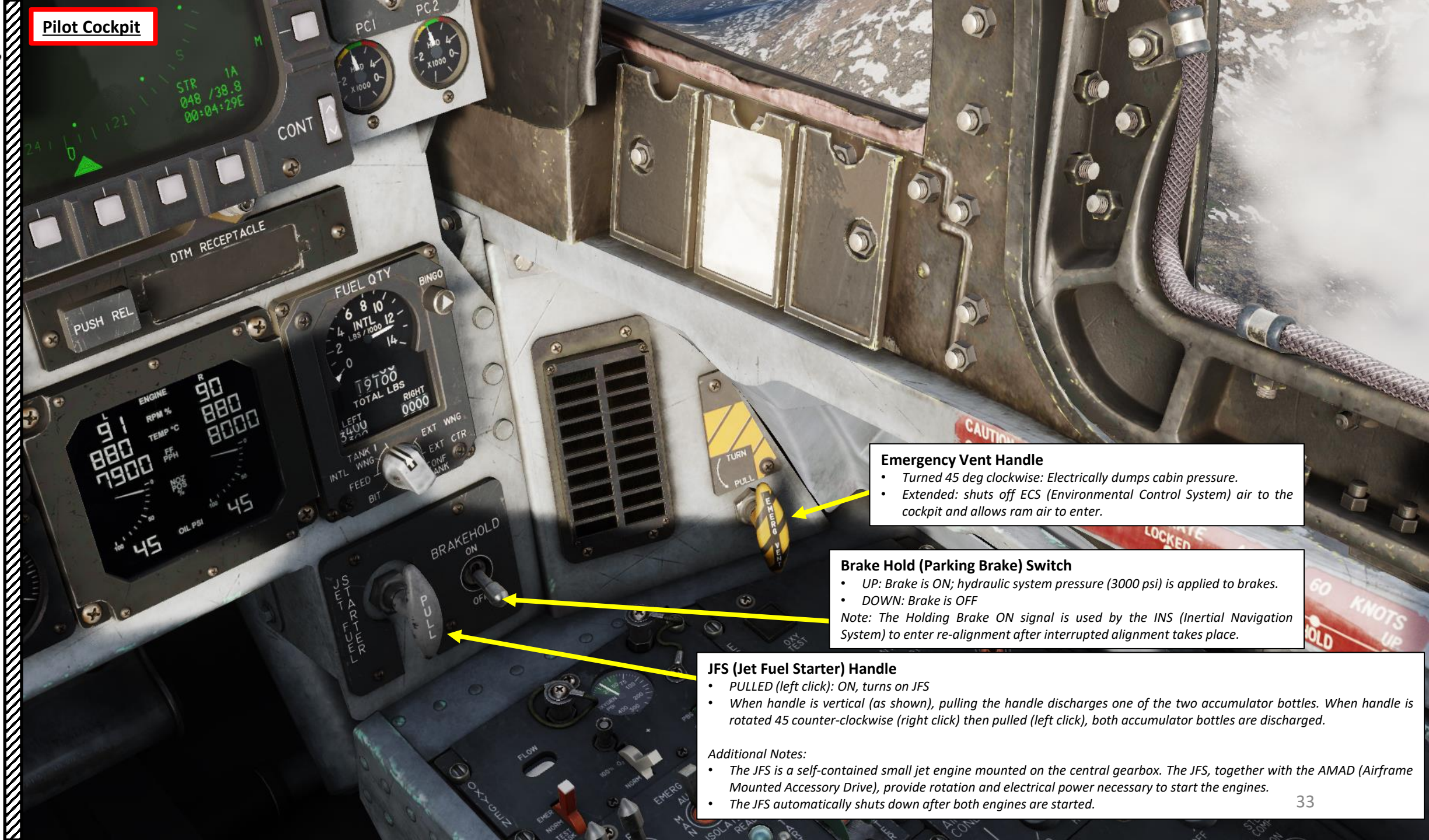
External Power Control Switch
- *FWD: RESET, spring-loaded to NORM position*
- *MIDDLE: Normal (NORM)*
- *AFT: OFF*

JFS (Jet Fuel Starter) READY Light

Pilot Cockpit



Pilot Cockpit



Emergency Vent Handle

- *Turned 45 deg clockwise: Electrically dumps cabin pressure.*
- *Extended: shuts off ECS (Environmental Control System) air to the cockpit and allows ram air to enter.*

Brake Hold (Parking Brake) Switch

- *UP: Brake is ON; hydraulic system pressure (3000 psi) is applied to brakes.*
- *DOWN: Brake is OFF*

Note: The Holding Brake ON signal is used by the INS (Inertial Navigation System) to enter re-alignment after interrupted alignment takes place.

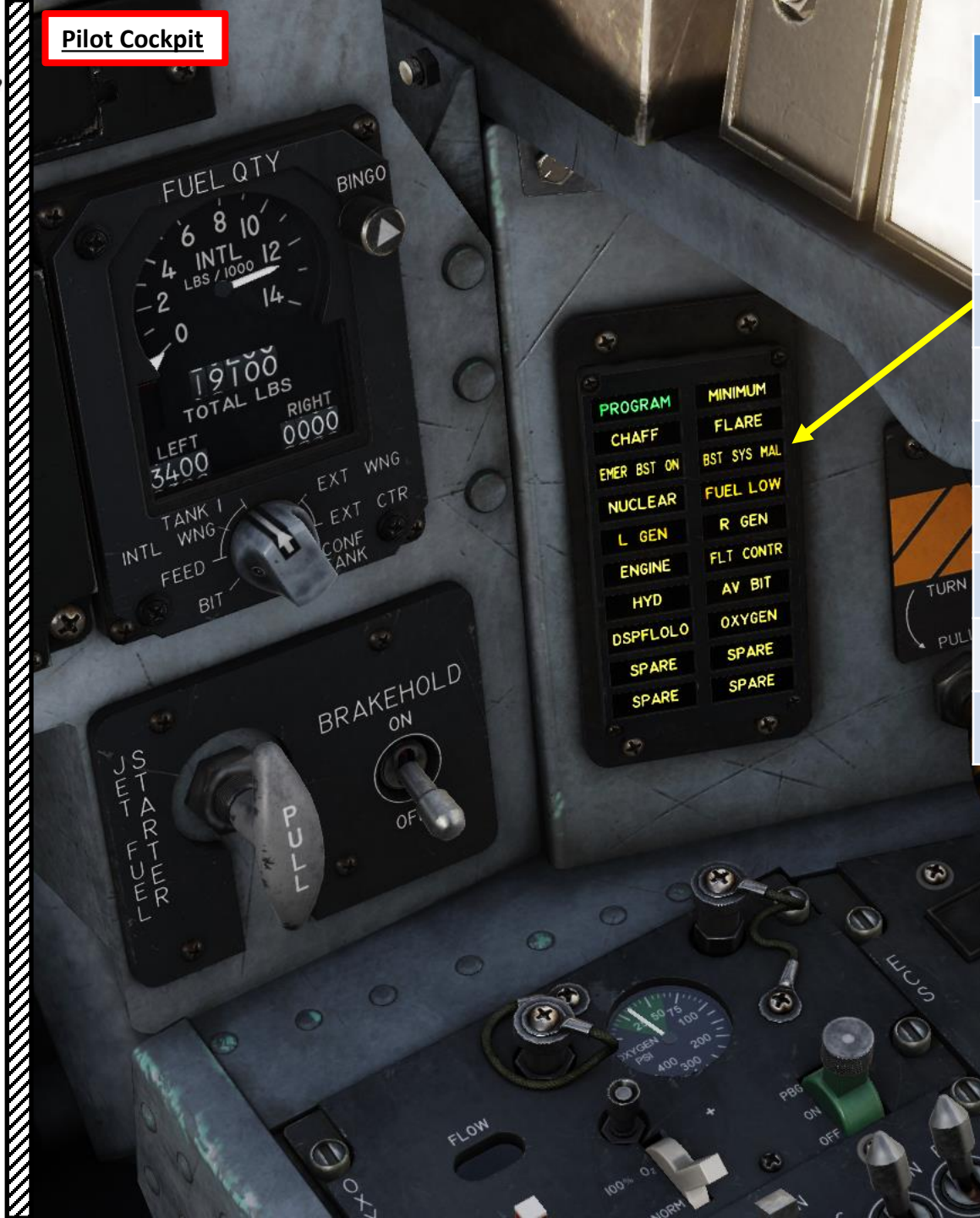
JFS (Jet Fuel Starter) Handle

- *PULLED (left click): ON, turns on JFS*
- *When handle is vertical (as shown), pulling the handle discharges one of the two accumulator bottles. When handle is rotated 45 counter-clockwise (right click) then pulled (left click), both accumulator bottles are discharged.*

Additional Notes:

- *The JFS is a self-contained small jet engine mounted on the central gearbox. The JFS, together with the AMAD (Airframe Mounted Accessory Drive), provide rotation and electrical power necessary to start the engines.*
- *The JFS automatically shuts down after both engines are started.*

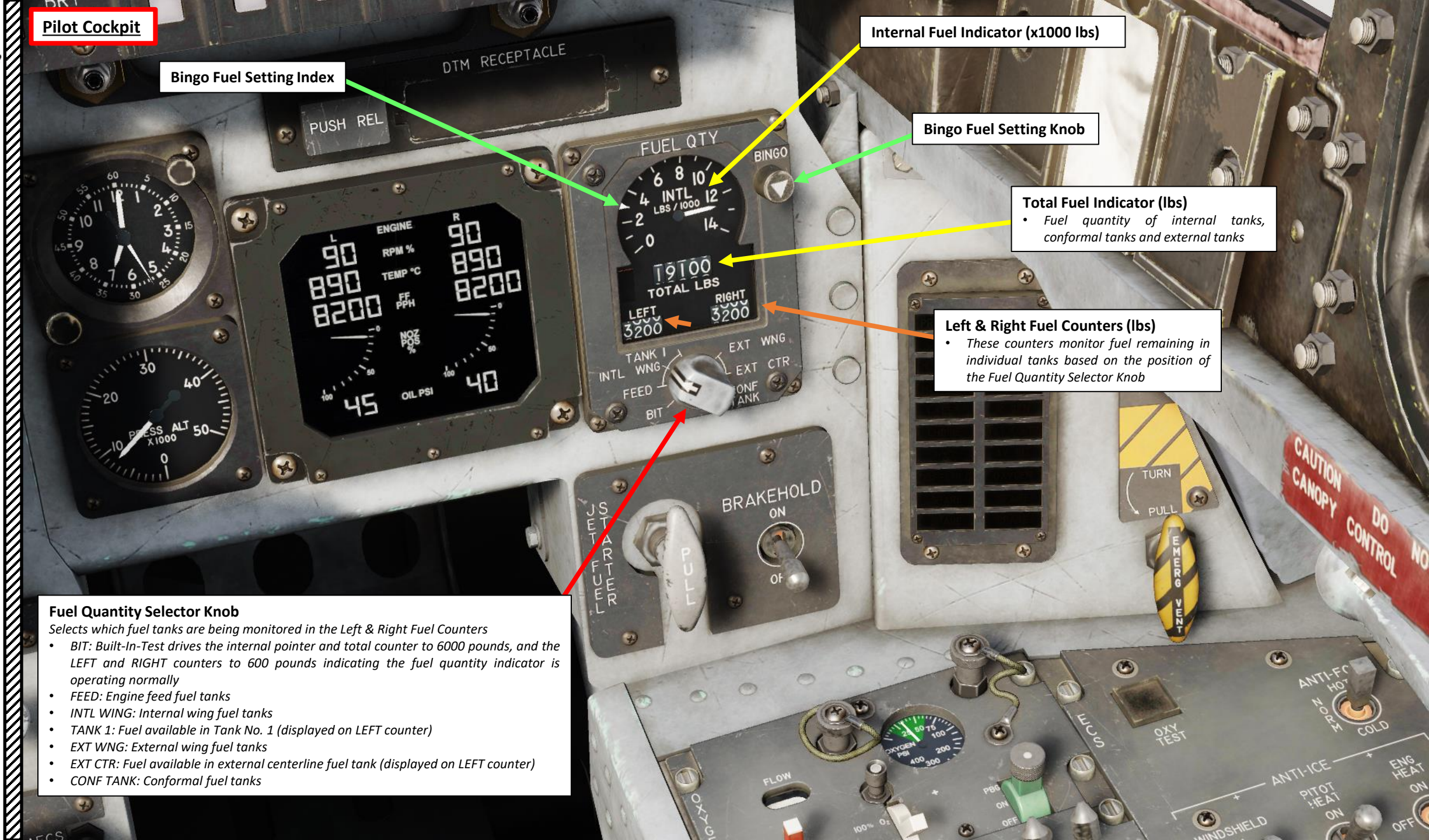
Pilot Cockpit



Main Caution Lights Panel

PROGRAM: Countermeasure dispenser is in semi-auto mode and pre-selected program is ready to be deployed/dispensed	**MINIMUM**: Dispensable stores reach pre-determined level.
CHAFF: Chaff are being dispensed when flashing, dispenser is empty when steady.	**FLARE**: Flares are being dispensed when flashing, dispenser is empty when steady.
EMER BST ON: Emergency boost pump is supplying pressure.	**BST SYS MAL**: Emergency boost pump system malfunction.
NUCLEAR: Nuclear armament malfunction.	**FUEL LOW**: Left feed tank drops below 600 lbs or / and right feed tank drops below 1000 lbs of fuel.
L GEN: Left generator failure is detected.	**R GEN**: Right generator failure is detected.
ENGINE: Engine systems failure.	**FLT CONTR**: Flight controls failure.
HYD: Hydraulic systems failure.	**AV BIT**: Avionics built-in-test failure.
DSP FLO LO: Inadequate cooling air flow to cockpit displays.	**OXYGEN**: Onboard oxygen system failure is detected.
SPARE: These lights are not used in this specific F-15E variant.	

Pilot Cockpit



Bingo Fuel Setting Index

Internal Fuel Indicator (x1000 lbs)

Bingo Fuel Setting Knob

Total Fuel Indicator (lbs)

- *Fuel quantity of internal tanks, conformal tanks and external tanks*

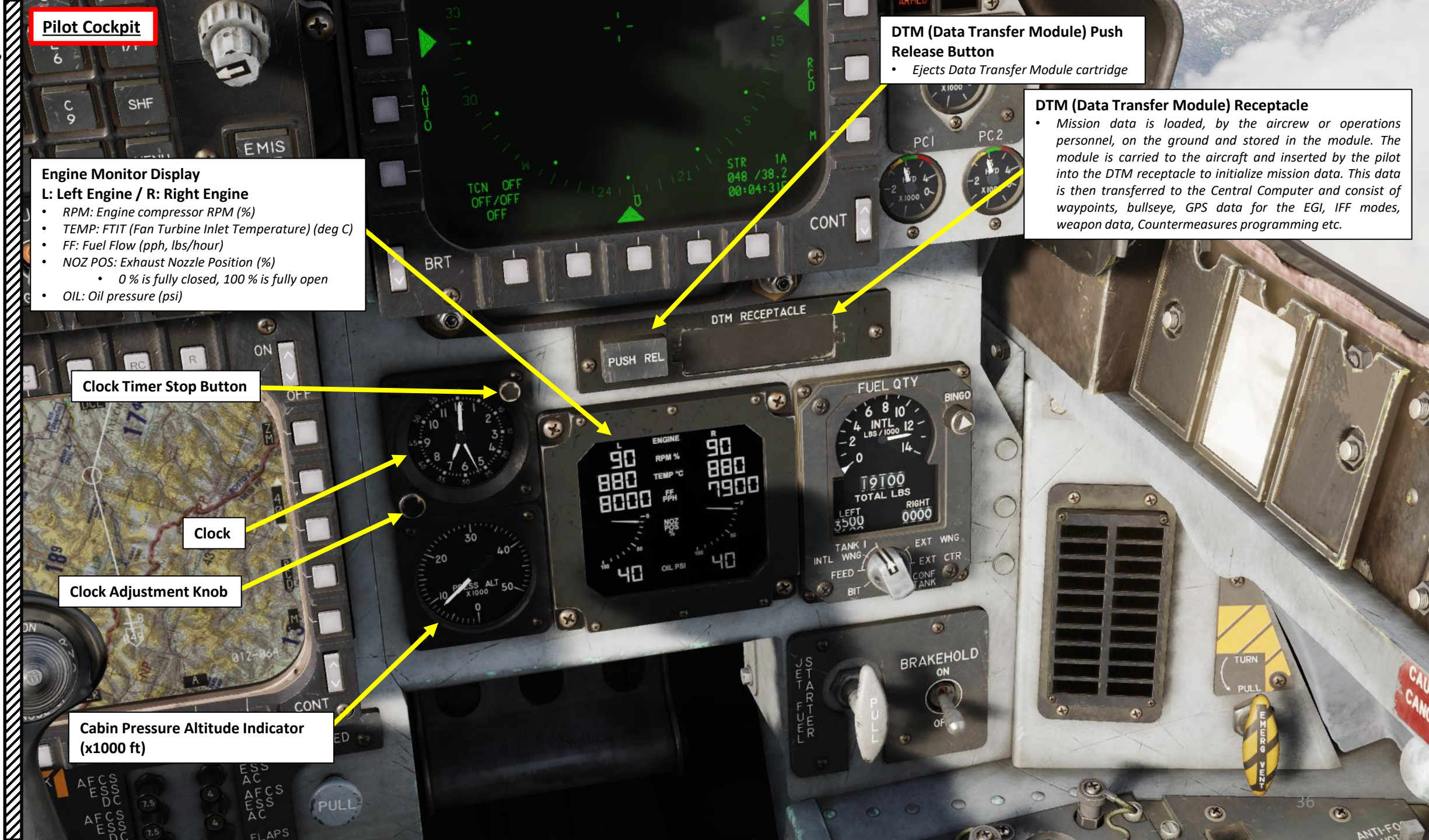
Left & Right Fuel Counters (lbs)

- *These counters monitor fuel remaining in individual tanks based on the position of the Fuel Quantity Selector Knob*

Fuel Quantity Selector Knob

Selects which fuel tanks are being monitored in the Left & Right Fuel Counters

- *BIT: Built-In-Test 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: Engine feed fuel tanks*
- *INTL WING: Internal wing fuel tanks*
- *TANK 1: Fuel available in Tank No. 1 (displayed on LEFT counter)*
- *EXT WNG: External wing fuel tanks*
- *EXT CTR: Fuel available in external centerline fuel tank (displayed on LEFT counter)*
- *CONF TANK: Conformal fuel tanks*


Pilot Cockpit
DTM (Data Transfer Module) Push Release Button
• Ejects Data Transfer Module cartridge
DTM (Data Transfer Module) Receptacle
• 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.
Engine Monitor Display
L: Left Engine / R: Right Engine
• RPM: Engine compressor RPM (%)
• TEMP: FTIT (Fan Turbine Inlet Temperature) (deg C)
• FF: Fuel Flow (pph, lbs/hour)
• NOZ POS: Exhaust Nozzle Position (%)
• 0 % is fully closed, 100 % is fully open
• OIL: Oil pressure (psi)
Clock Timer Stop Button
Clock
Clock Adjustment Knob
Cabin Pressure Altitude Indicator (x1000 ft)
DTM RECEPTACLE
PUSH REL
ENGINE
RPM %
TEMP °C
FF PPH
NOZ POS %
OIL PSI
FUEL QTY
TOTAL LBS
BRAKEHOLD
JET FUEL STARTER
EMERG VENT
TURN
PULL

Pilot Cockpit

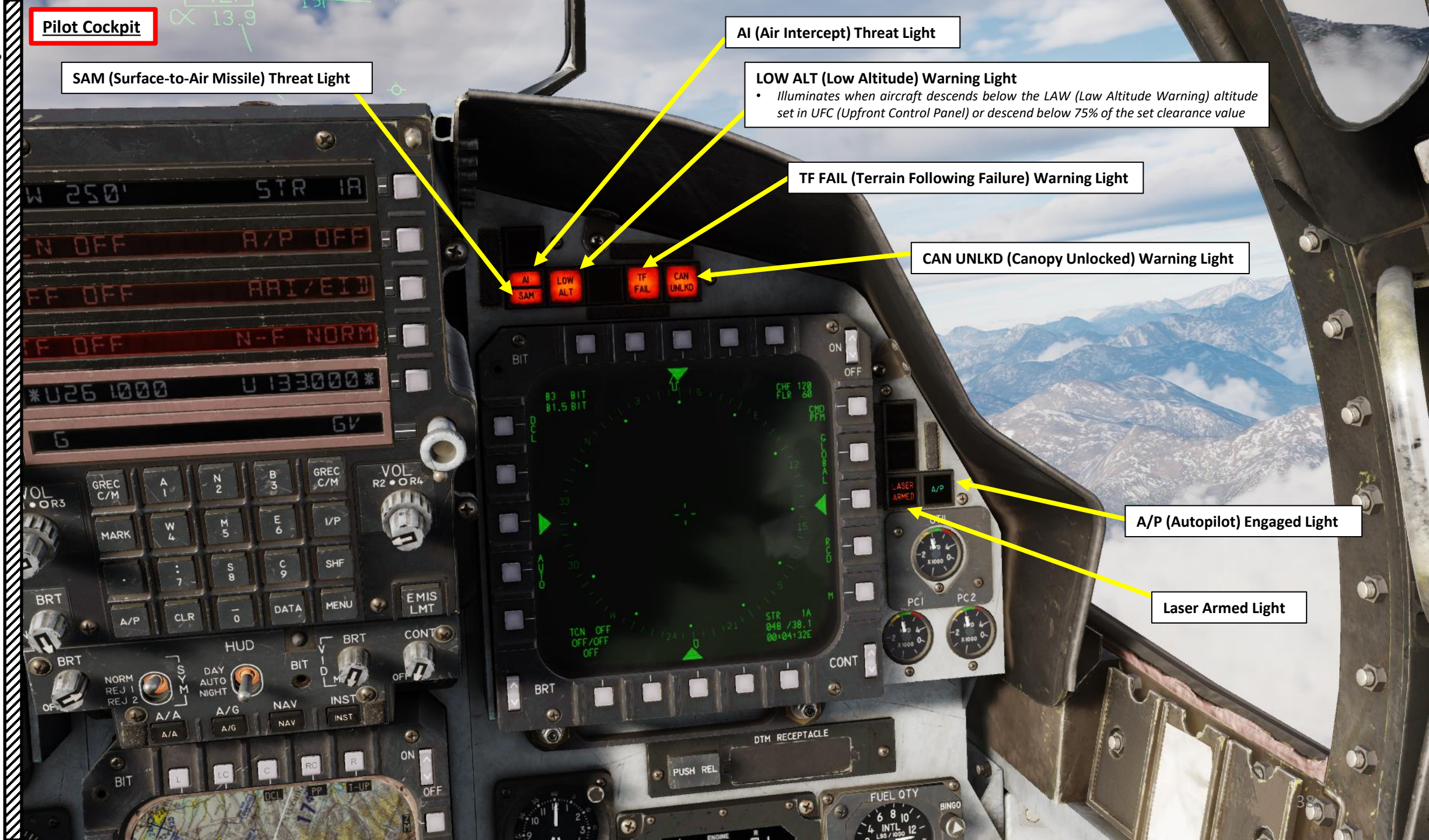
Utility Hydraulic System Pressure Gauge Indicator (x1000 psi)

- *Monitors the operation of two pumps: left with pressure of 3000 psi and right with pressure of 2775 psi.*

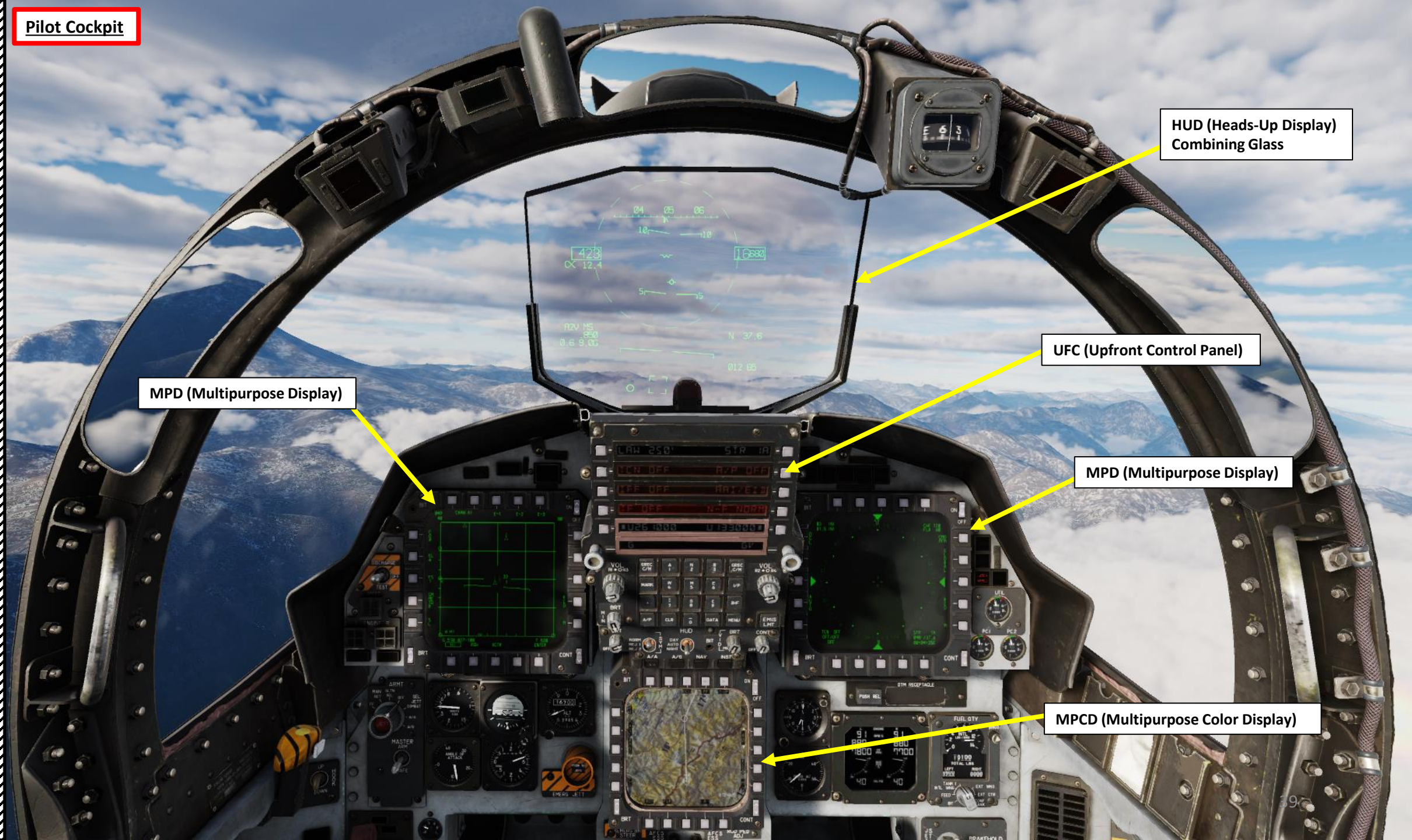
PC1 (Power Control 1) Hydraulic System Pressure Indicator (x1000 psi)

PC2 (Power Control 2) Hydraulic System Pressure Indicator (x1000 psi)

Pilot Cockpit

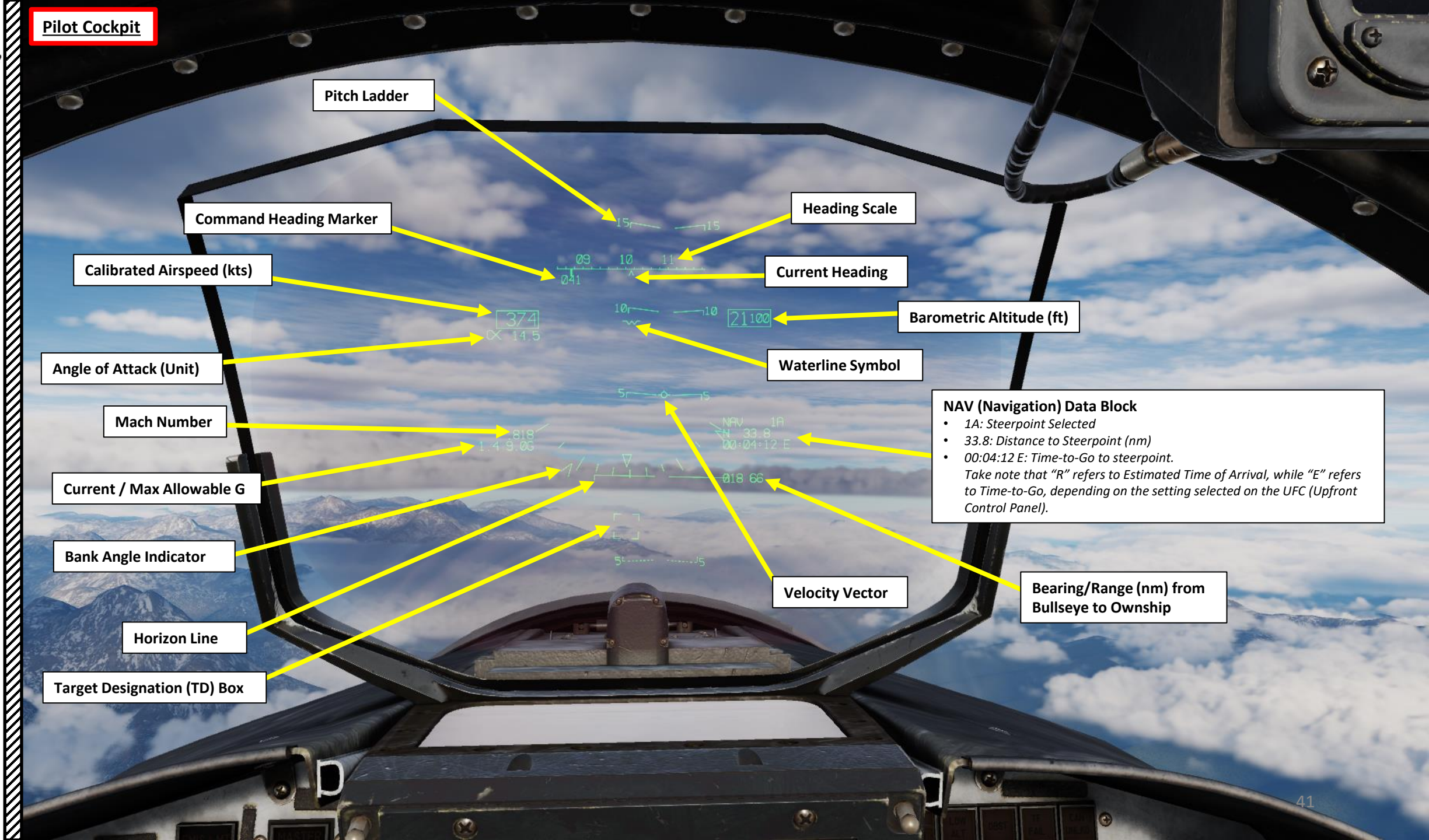


Pilot Cockpit

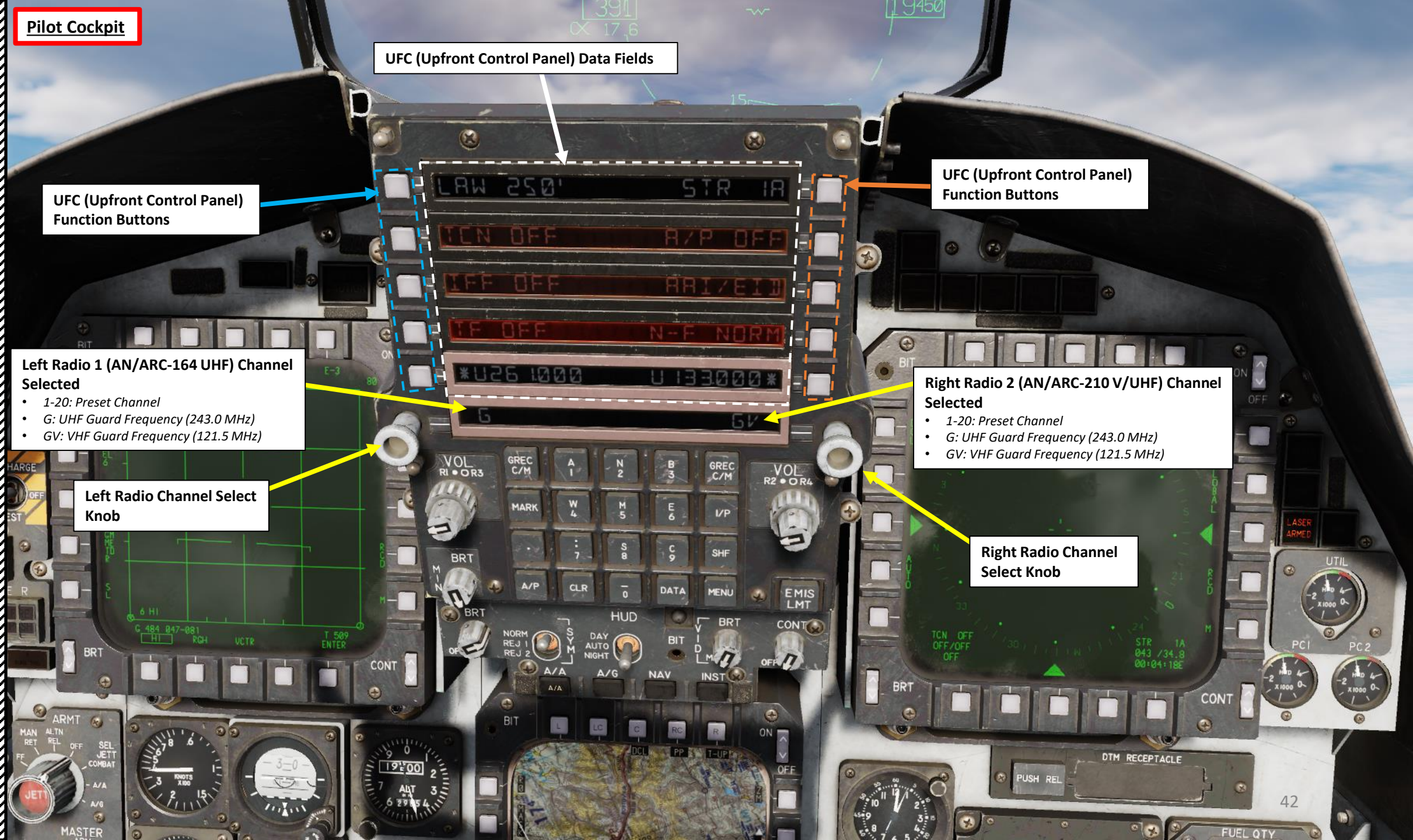


Pilot Cockpit

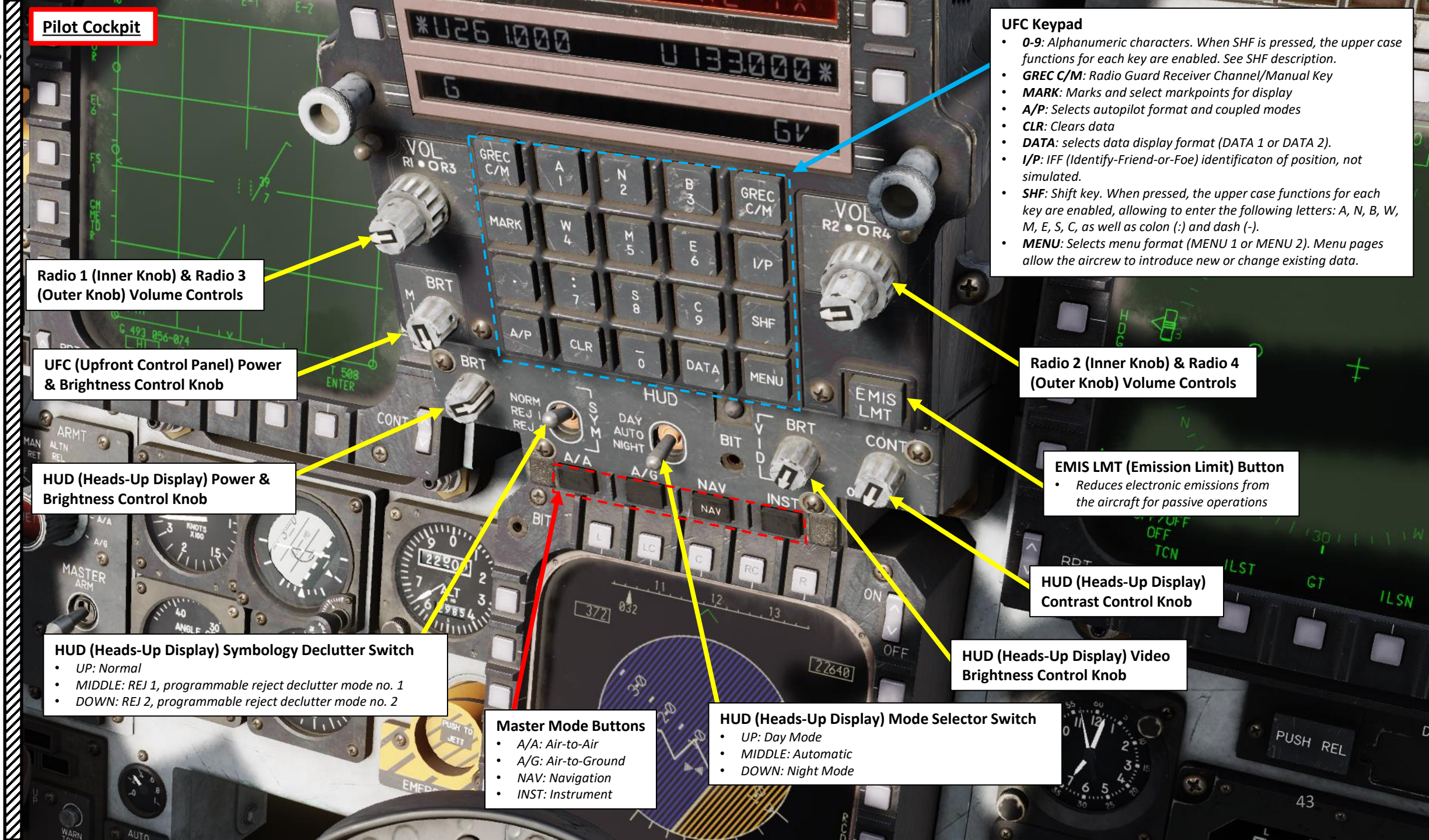
Pilot Cockpit



Pilot Cockpit



Pilot Cockpit



UFC Keypad

- ***0-9****: Alphanumeric characters. When SHF is pressed, the upper case functions for each key are enabled. See SHF description.*
- ***GREC C/M****: Radio Guard Receiver Channel/Manual Key*
- ***MARK****: Marks and select markpoints for display*
- ***A/P****: Selects autopilot format and coupled modes*
- ***CLR****: Clears data*
- ***DATA****: selects data display format (DATA 1 or DATA 2).*
- ***I/P****: IFF (Identify-Friend-or-Foe) identificaton of position, not simulated.*
- ***SHF****: Shift key. When 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 dash (-).*
- ***MENU****: Selects menu format (MENU 1 or MENU 2). Menu pages allow the aircrew to introduce new or change existing data.*

Radio 1 (Inner Knob) & Radio 3 (Outer Knob) Volume Controls

UFC (Upfront Control Panel) Power & Brightness Control Knob

HUD (Heads-Up Display) Power & Brightness Control Knob

HUD (Heads-Up Display) Symbology Declutter Switch

- *UP: Normal*
- *MIDDLE: REJ 1, programmable reject declutter mode no. 1*
- *DOWN: REJ 2, programmable reject declutter mode no. 2*

Master Mode Buttons

- *A/A: Air-to-Air*
- *A/G: Air-to-Ground*
- *NAV: Navigation*
- *INST: Instrument*

HUD (Heads-Up Display) Mode Selector Switch

- *UP: Day Mode*
- *MIDDLE: Automatic*
- *DOWN: Night Mode*

HUD (Heads-Up Display) Video Brightness Control Knob

HUD (Heads-Up Display) Contrast Control Knob

EMIS LMT (Emission Limit) Button

- *Reduces electronic emissions from the aircraft for passive operations*

Radio 2 (Inner Knob) & Radio 4 (Outer Knob) Volume Controls

Pilot Cockpit

Pressing the MENU button toggles UFC (Upfront Control Panel) MENU 1 and MENU 2 pages

MENU 1

Left Sub-Menus
- **LAW:** Low Altitude Warning Setting (ft)
- **TCN:** TACAN Station Selection
- **IFF:** Identify-Friend-or-Foe Settings
- **TF:** Terrain Following Radar Settings

Right Sub-Menus
- **STR:** Sequence/Steering Point Selected
- **A/P:** Autopilot Settings
- **AAI/EID:** Air-to-Air Interrogation/ Enhanced Identification Settings
- **N-F:** LANTIRN Pod NAV FLIR (Navigation Forward-Looking Infrared) System Settings

MENU 2

Left Sub-Menus
- **JTIDS:** Joint Tactical Information Distribution System Settings
- **GCWS:** Ground Collision Warning System Settings
- **ILS:** Instrument Landing System Settings
- **PP:** Present Position Keeping Source (PPKS)

Right Sub-Menus
- **UPDT:** INS (Inertial Navigation System) Update Menu
- **BE:** Current Bullseye Point
- **EGI:** Embedded GPS/INS Status Menu. The digit before EGI indicates the number of satellite measurements being incorporated into the EGI blended solution (between 0 and 4)

Pilot Cockpit

Pressing the DATA button toggles UFC (Upfront Control Panel) DATA 1 and DATA 2 pages

DATA 1

Left Sub-Menus

- **XXX/YY.Y:** Bearing/Range (nm) to selected steerpoint
- **ETA/ETE:** Estimated Time-of-Arrival / Enroute to selected steerpoint. 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.
- **T:** True Airspeed (kts)
- **G:** Ground Speeds (kts)

Right Sub-Menus

- **STR:** Sequence/Steering Point Selected
- **R:** CARA (Combined Altitude Radar Altitude) Setting (ft)
- **TIME:** Shows current time
- **WIND:** Wind Direction (Magnetic or True) & Speed (kts)

DATA 2

Left Sub-Menus

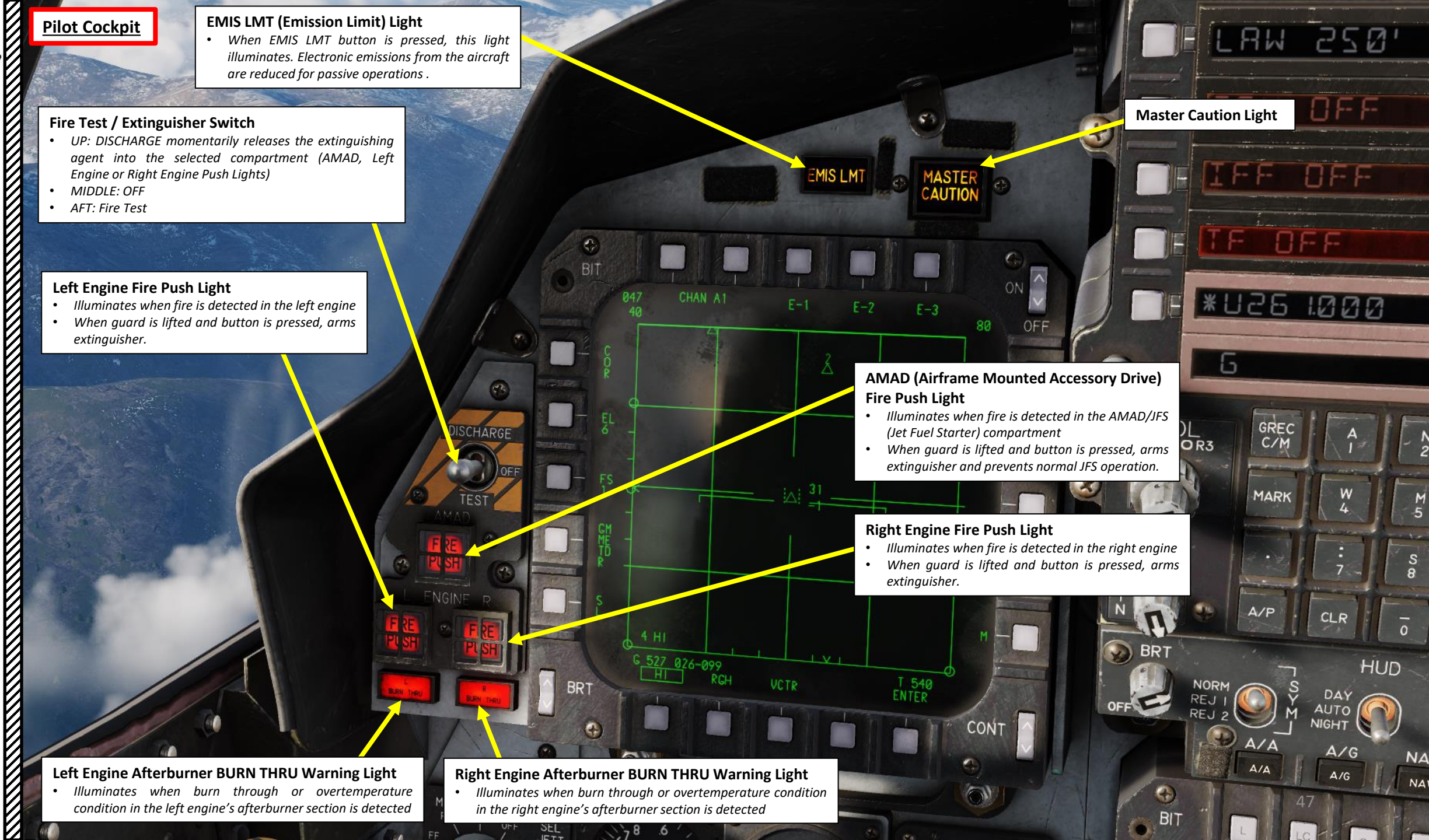
- **SP (Row 1):** Sequence/Steering Point Selected
- **G:** Ground Speeds (kts)
- **SP (Row 3):** Selected Look-Ahead Point
- **GC:** Commanded Ground Speed (kts)

Right Sub-Menus

- **XXX/YY.Y or Z LBS:** Bearing/Range (X/Y) to Selected Sequence/Steering Point or Fuel Remaining (Z) at this point. Press button to toggle between data
- **ETE/ETA:** Estimated Time-of-Arrival / Enroute to selected steerpoint.
- **X LBS:** Fuel Remaining at Selected Look-Ahead Point
- **TOA/TOT:** Time-of-Arrival/Time-On-Target

Pilot Cockpit

Pilot Cockpit



EMIS LMT (Emission Limit) Light
- *When EMIS LMT button is pressed, this light illuminates. Electronic emissions from the aircraft are reduced for passive operations .*

Master Caution Light

Fire Test / Extinguisher Switch
- *UP: DISCHARGE momentarily releases the extinguishing agent into the selected compartment (AMAD, Left Engine or Right Engine Push Lights)*
- *MIDDLE: OFF*
- *AFT: Fire Test*

Left Engine Fire Push Light
- *Illuminates when fire is detected in the left engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

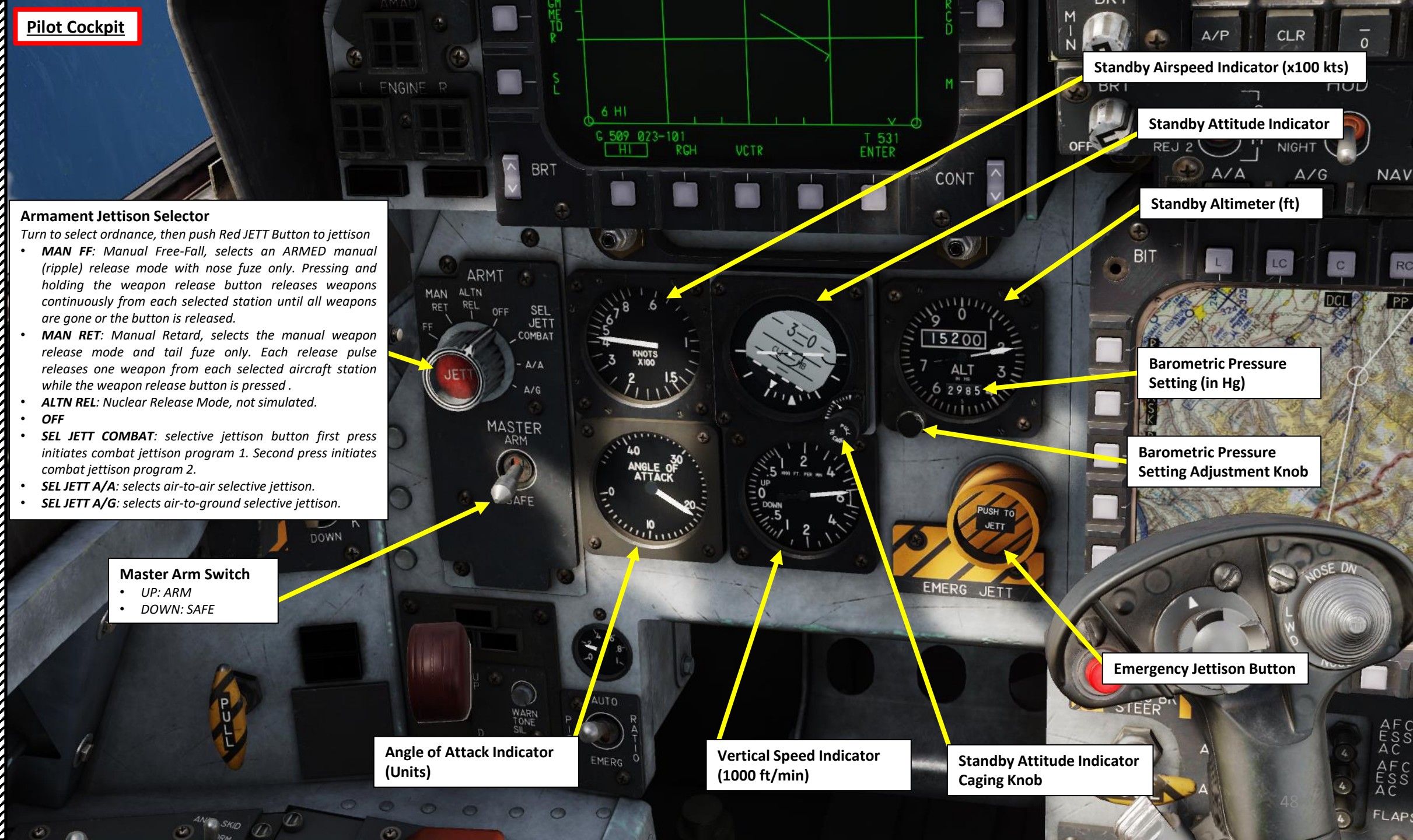
AMAD (Airframe Mounted Accessory Drive) Fire Push Light
- *Illuminates when fire is detected in the AMAD/JFS (Jet Fuel Starter) compartment*
- *When guard is lifted and button is pressed, arms extinguisher and prevents normal JFS operation.*

Right Engine Fire Push Light
- *Illuminates when fire is detected in the right engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

Left Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the left engine's afterburner section is detected*

Right Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the right engine's afterburner section is detected*

Pilot Cockpit



Armament Jettison Selector

Turn to select ordnance, then push Red JETT Button to jettison

- ***MAN FF**: 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.*
- ***MAN RET**: Manual Retard, selects the manual weapon release mode and tail fuze only. Each release pulse releases one weapon from each selected aircraft station while the weapon release button is pressed .*
- ***ALTN REL**: Nuclear Release Mode, not simulated.*
- ***OFF***
- ***SEL JETT COMBAT**: selective jettison button first press initiates combat jettison program 1. Second press initiates combat jettison program 2.*
- ***SEL JETT A/A**: selects air-to-air selective jettison.*
- ***SEL JETT A/G**: selects air-to-ground selective jettison.*

Master Arm Switch

- *UP: ARM*
- *DOWN: SAFE*

Standby Airspeed Indicator (x100 kts)

Standby Attitude Indicator

Standby Altimeter (ft)

Barometric Pressure Setting (in Hg)

Barometric Pressure Setting Adjustment Knob

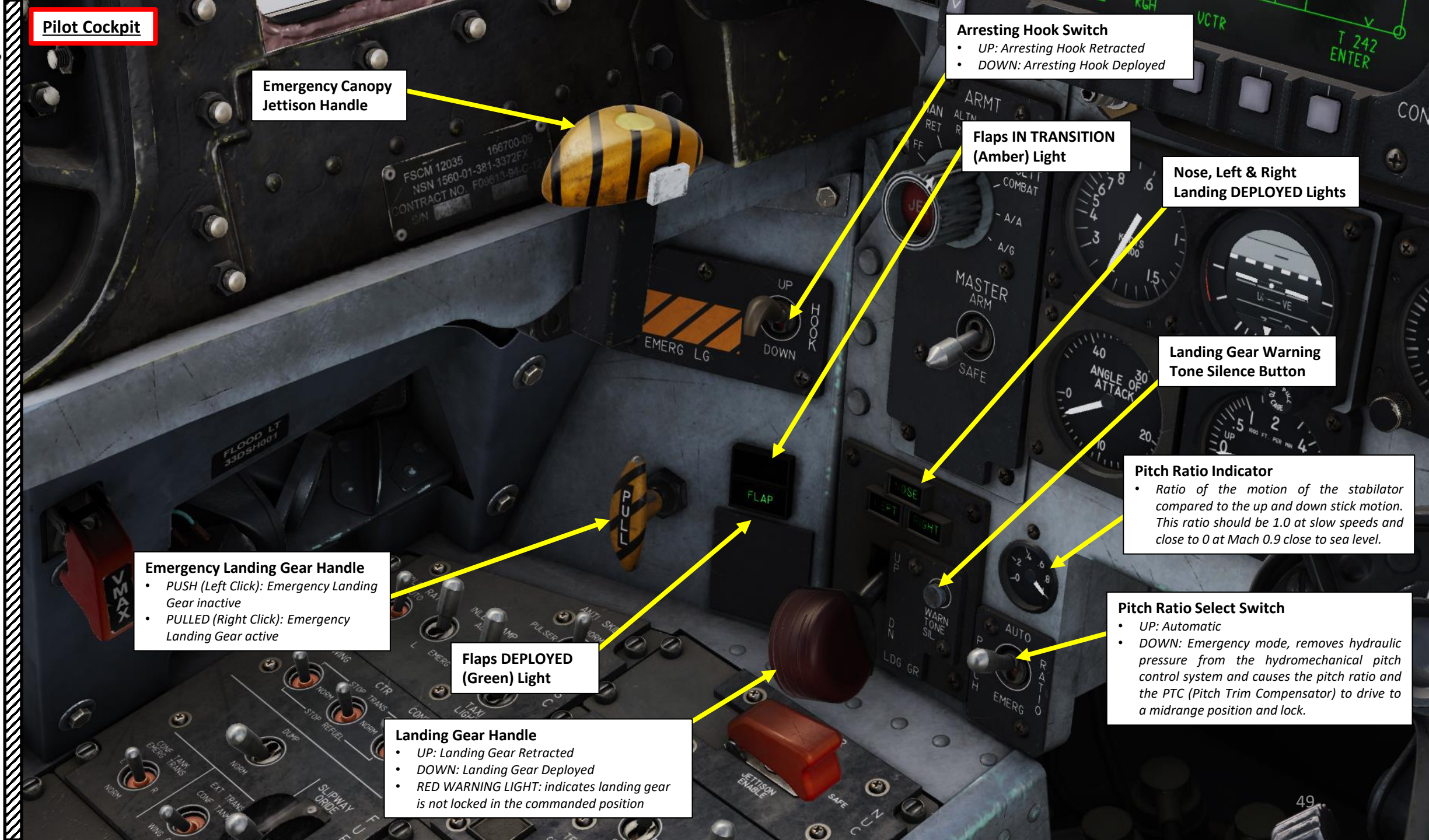
Emergency Jettison Button

Angle of Attack Indicator (Units)

Vertical Speed Indicator (1000 ft/min)

Standby Attitude Indicator Caging Knob

Pilot Cockpit



Emergency Canopy Jettison Handle

Arresting Hook Switch
- *UP: Arresting Hook Retracted*
- *DOWN: Arresting Hook Deployed*

Flaps IN TRANSITION (Amber) Light

Nose, Left & Right Landing DEPLOYED Lights

Landing Gear Warning Tone Silence Button

Pitch Ratio Indicator
- *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.*

Emergency Landing Gear Handle
- *PUSH (Left Click): Emergency Landing Gear inactive*
- *PULLED (Right Click): Emergency Landing Gear active*

Flaps DEPLOYED (Green) Light

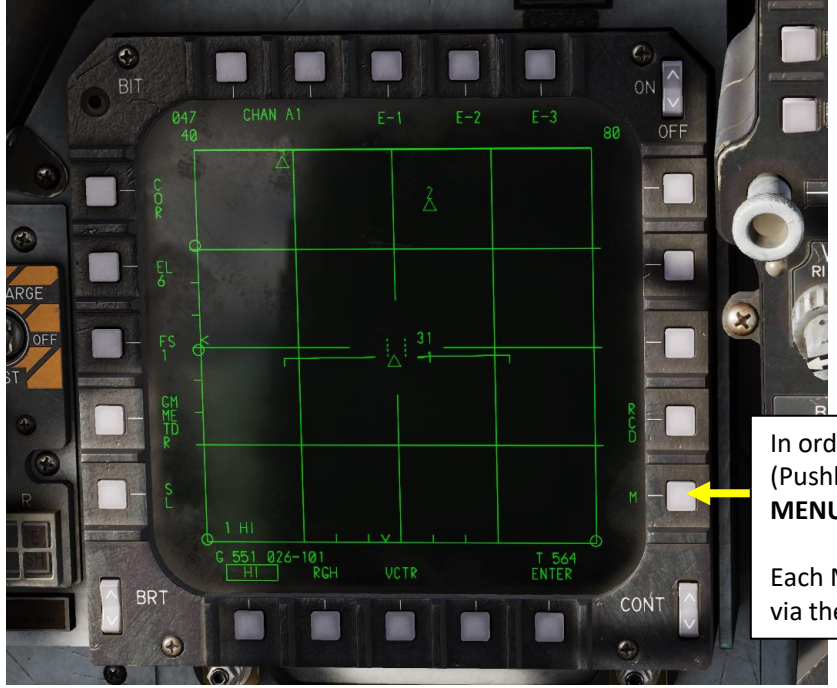
Pitch Ratio Select Switch
- *UP: Automatic*
- *DOWN: Emergency mode, removes hydraulic pressure from the hydromechanical pitch control system and causes the pitch ratio and the PTC (Pitch Trim Compensator) to drive to a midrange position and lock.*

Landing Gear Handle
- *UP: Landing Gear Retracted*
- *DOWN: Landing Gear Deployed*
- *RED WARNING LIGHT: indicates landing gear is not locked in the commanded position*

Pilot Cockpit

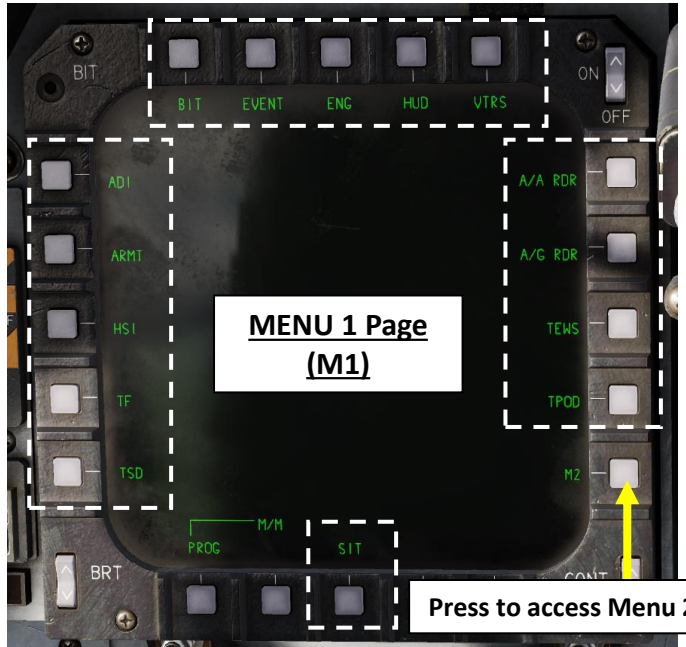

Pilot Cockpit
MPD (Multipurpose Display)
MPD ON/OFF Rocker Switch
MPD BIT (Built-In Test) Indicator
MPD (Multipurpose Display)
MPD ON/OFF Rocker Switch
MPD BIT (Built-In Test) Indicator
MPD Brightness Rocker Switch
MPD Brightness Rocker Switch
MPD Contrast Rocker Switch
MPD Contrast Rocker Switch
MPCD BIT (Built-In Test) Indicator
MPCD ON/OFF Rocker Switch
MPCD (Multipurpose Color Display)
MPCD Brightness Rocker Switch
MPCD Contrast Rocker Switch

Pilot Cockpit



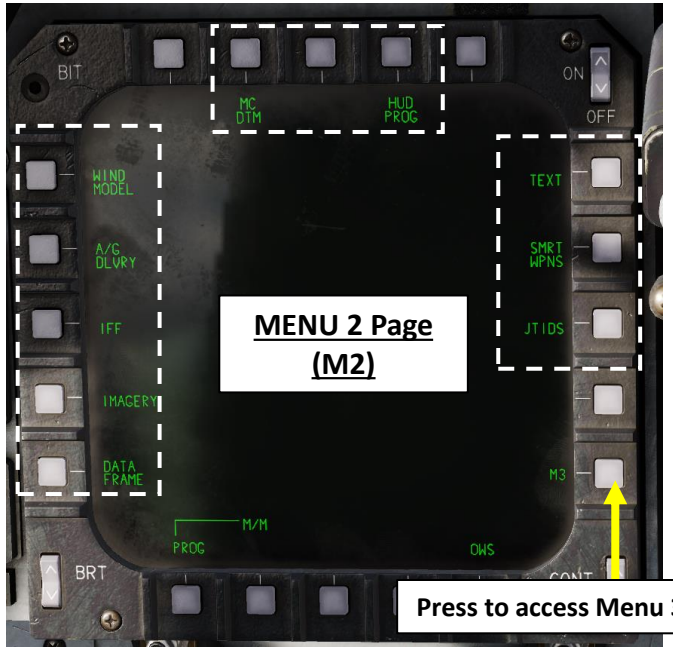
In order to **select a desired MPD page**, press the **Menu Selection PB** (Pushbutton) to toggle between **MENU 1 (M), MENU 2 (M2),** and **MENU 3 (M3).**

Each MENU page contains programmable pages that can be accessed via their respective Pushbuttons.



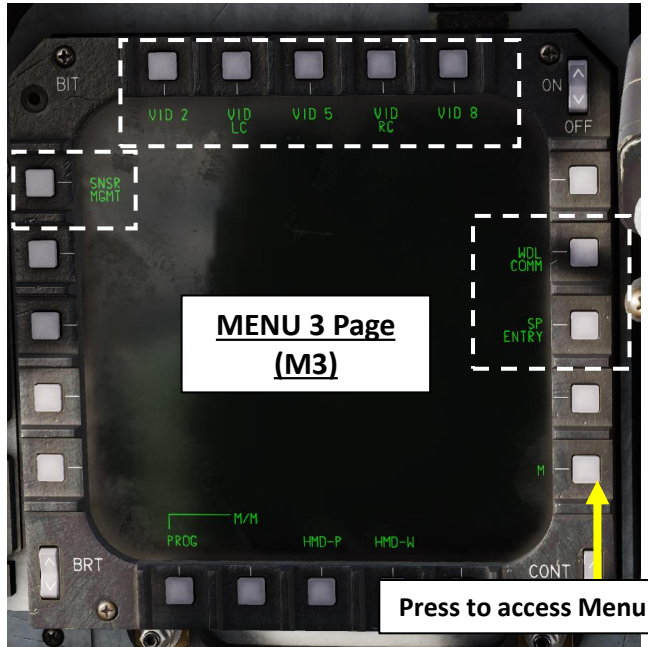
MENU 1 Page (M1)

Press to access Menu 2



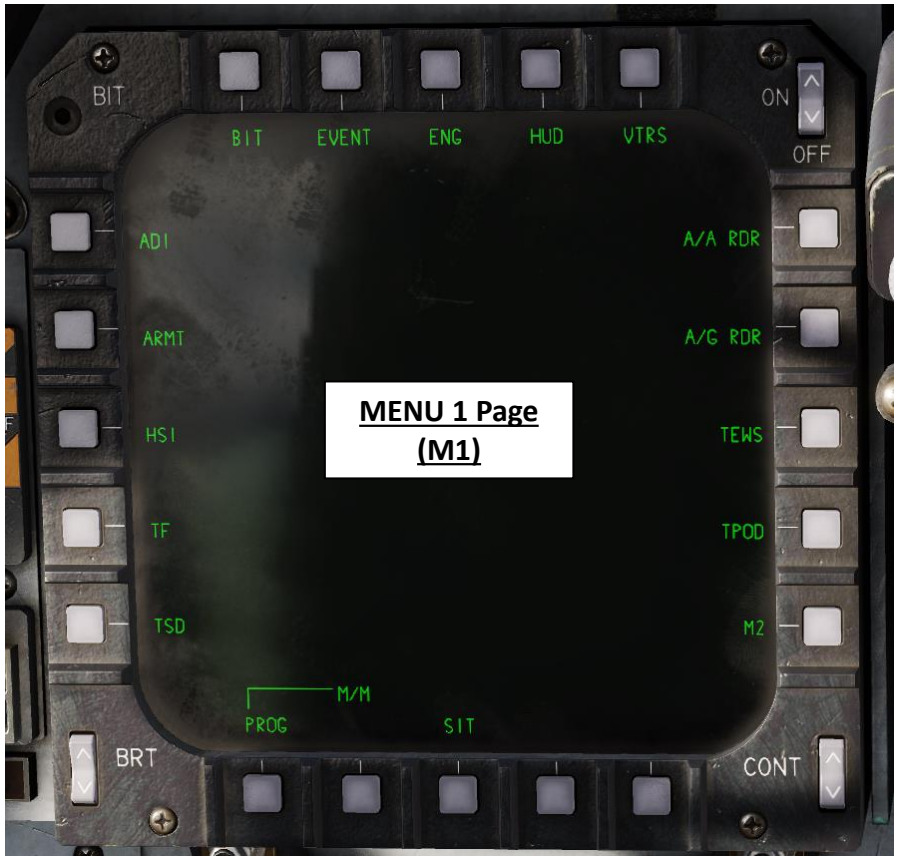
MENU 2 Page (M2)

Press to access Menu 3



MENU 3 Page (M3)

Press to access Menu 1



MENU 1 Page (M1)

MPD (Multipurpose Display) Pages: Menu 1

ADI: Attitude Director Indicator page.	**ENG**: Engine parameters page. Alternate source of information than Engine Monitor Display, also providing cruise flight data.
ARMT: Armament page, also known as the PACS (Programmable Armament Control Set). 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	**HUD**: Heads-Up Display repeater page.
HSI: Horizontal Situation Indicator page. Provides a horizontal or plan view of the aircraft with respect to the navigation situation	**VTRS**: Video Tape Recorder Set page. Not simulated.
TF: Terrain Following Radar page. TF is only available on F-15s carrying an AN/AAQ-13 LANTIRN navigation pod. The TF is a short range (36000 ft) forward and down radar that allows you to follow the terrain at very low altitude with automatic fly up protection.	**A/A RDR**: Air-to-Air radar page.
TSD: Tactical Situation Display page. The TSD is a presentation of the aircraft position superimposed over the digital moving map.	**A/G RDR**: Air-to-Ground radar page.
SIT: Situation page. Not simulated.	**TEWS**: Tactical Electronic Warfare System page. Includes the RWR (Radar Warning Receiver) display, EWWS (Electronic Warfare Warning Set) threat identification, location and CMD (Countermeasure Dispenser Set) status data.
BIT: Built-In Test page. Not simulated.	**TPOD**: Targeting Pod page. This page is only available on F-15s carrying an AN/AAQ-14 LANTIRN targeting pod.
EVENT: Recorded air-to-ground events page. Not simulated.	**M2 Pushbutton**: Access Menu 2 for additional pages.

Pilot Cockpit | **MENU 1 (M1) Pages**

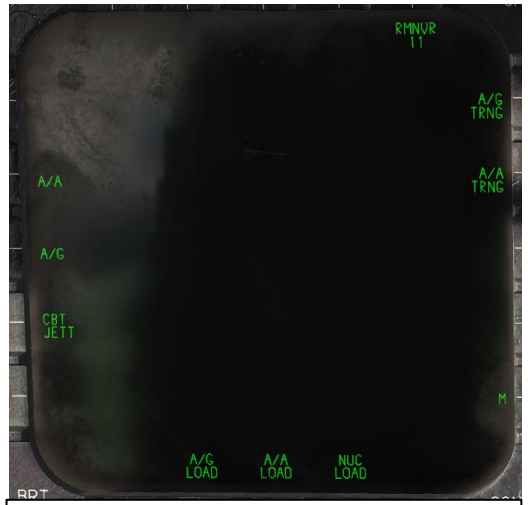
ADI (Attitude Director Indicator)

HSI (Horizontal Situation Indicator)

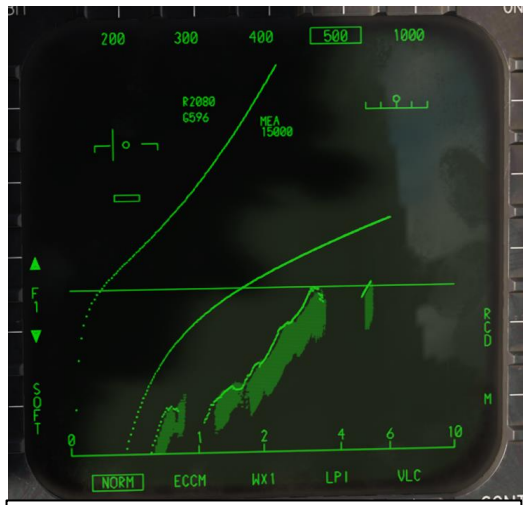
TSD (Tactical Situation Display)

Not Simulated

BIT (Built-In Test)



ARMT (Armament/PACS)



TF (Terrain Following Radar)

Not Simulated

SIT (Situation)

Not Simulated

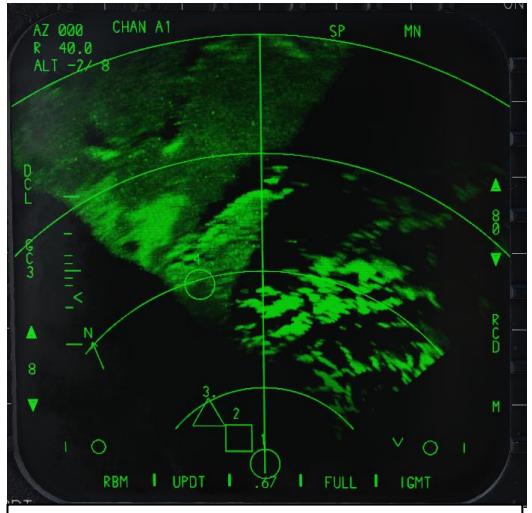
EVENT (Recorded Events)

Pilot Cockpit | **MENU 1 (M1) Pages**

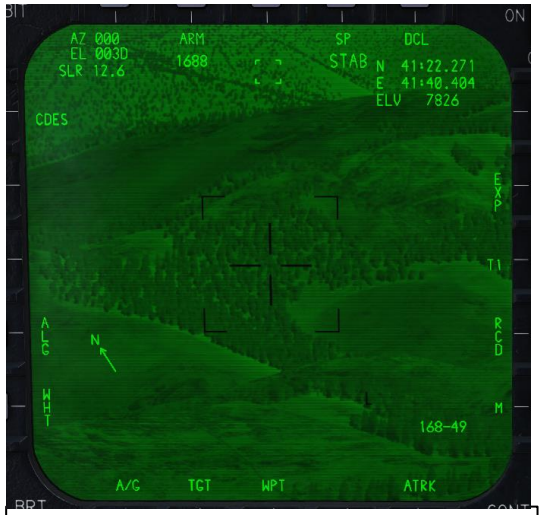
ENG (Engine Parameters)

Not Simulated

VTRS (Video Tape Recorder Set)

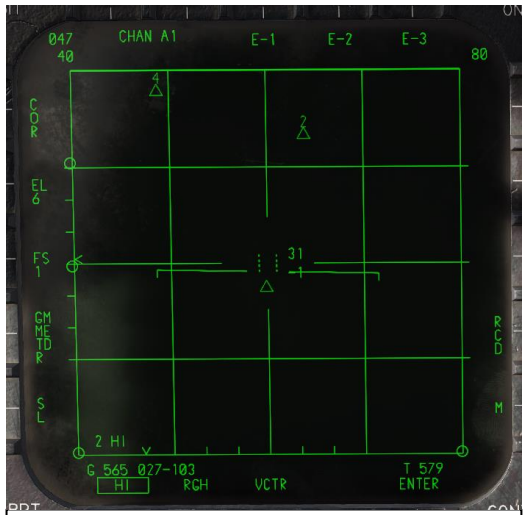


A/G RDR (Air-to-Ground Radar)



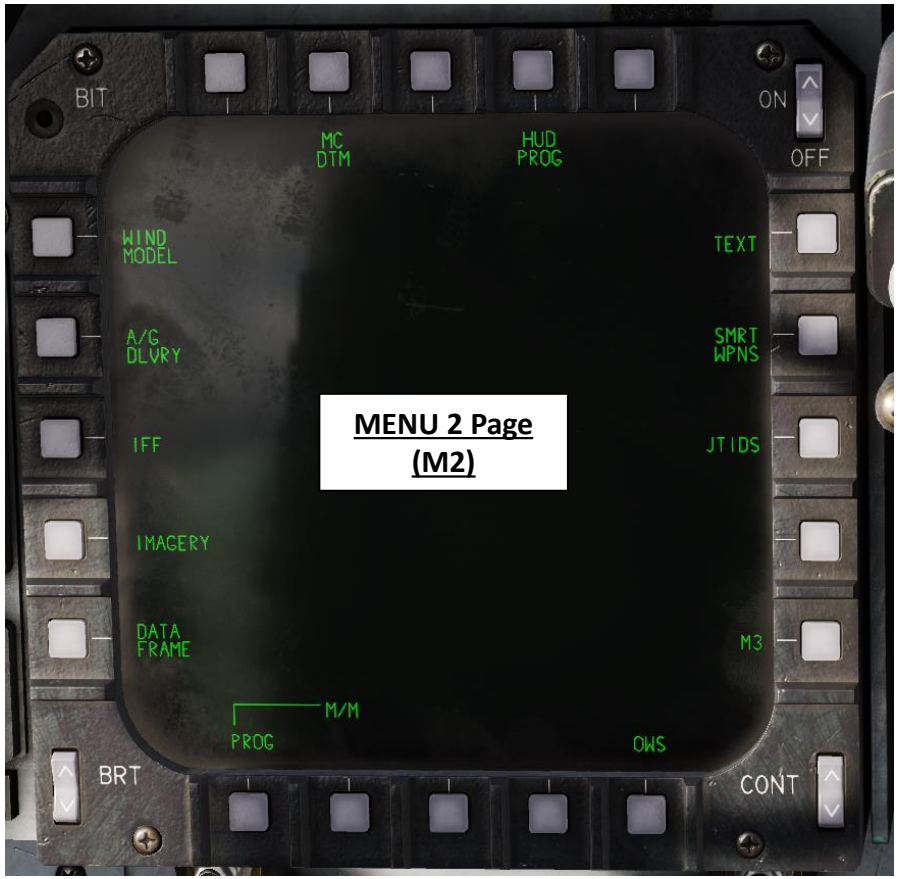
TPOD (Targeting Pod)

HUD (Heads-Up Display Repeater)



A/A RDR (Air-to-Air Radar)

TEWS (Tactical Electronic Warfare System)



MENU 2 Page (M2)

MPD (Multipurpose Display) Pages: Menu 2

WIND MODEL: Not simulated.	**HUD PROG**: Heads-Up Display Program. Not simulated.
A/G DLVRY: Air-to-Ground Delivery page. This page is used to input various weapon delivery parameters and to display PACS and system data.	**TEXT**: Not simulated.
IFF: Identify-Friend-or-Foe system page. Not simulated.	**SMRT WPNS**: Smart Weapons page, used for GPS-guided munitions like JDAMs.
IMAGERY: Not simulated.	**JTIDS**: Joint Tactical Information Distribution System page. Not simulated.
DATA FRAME: Not simulated.	**OWS**: Overload Warning System page. Not simulated.
MC DTM: Mission Computer Data Transfer Module page. Not simulated.	**M3 Pushbutton**: Access Menu 3 for additional pages.

Pilot Cockpit | **MENU 2 (M2) Pages**

Not Simulated Yet

WIND MODEL

A/G DLVRY (Air-to-Ground Delivery)

Not Simulated Yet

IFF (Identify-Friend-or-Foe)

Not Simulated Yet

IMAGERY

Not Simulated Yet

DATA FRAME

Not Simulated Yet

MC DTM (Mission Computer Data Transfer Module)

Not Simulated Yet

HUD PROG (Heads-Up Display Program)

Not Simulated Yet

TEXT

Pilot Cockpit | **MENU 2 (M2) Pages**

SMRT WPNS (Smart Weapons)

Not Simulated Yet

JTIDS (Joint Tactical Information Distribution System)

Not Simulated Yet

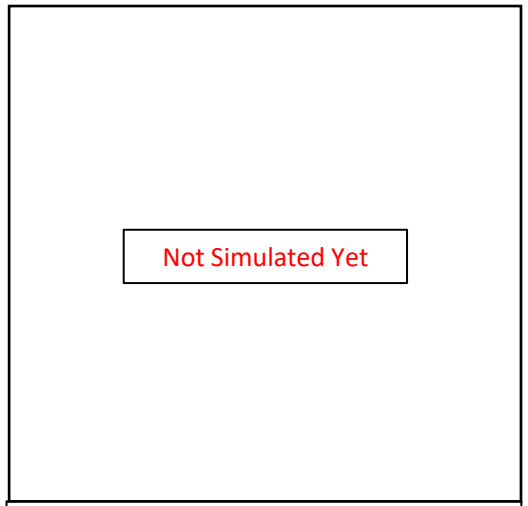
OWS (Overload Warning System)

MENU 3 Page (M3)

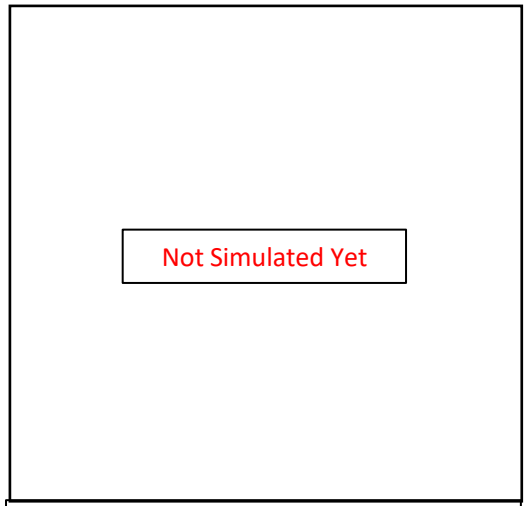
MPD (Multipurpose Display) Pages: Menu 3

SNSR MGMT: Sensor Management page. Not simulated.	**WDL COMM**: Weapon Data Link Communications page. Not simulated.
VID 2: Not simulated.	**SP ENTRY**: Not simulated.
VID 5: Not simulated.	**HMD-P**: Not simulated.
VID RC: Not simulated.	**HMD-W**: Not simulated.
VID 8: Not simulated.	**M Pushbutton**: Access Menu 1 for additional pages.

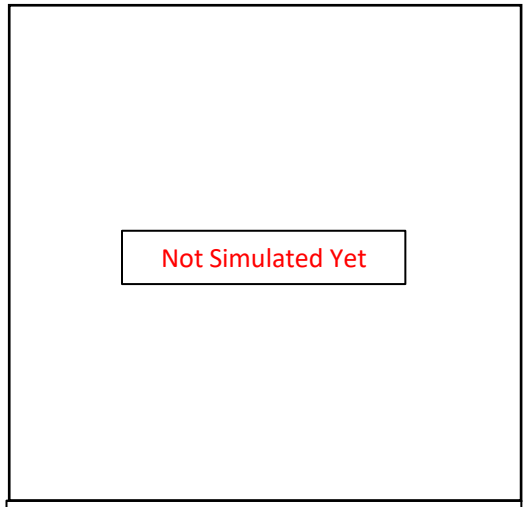
Pilot Cockpit | **MENU 3 (M3) Pages**



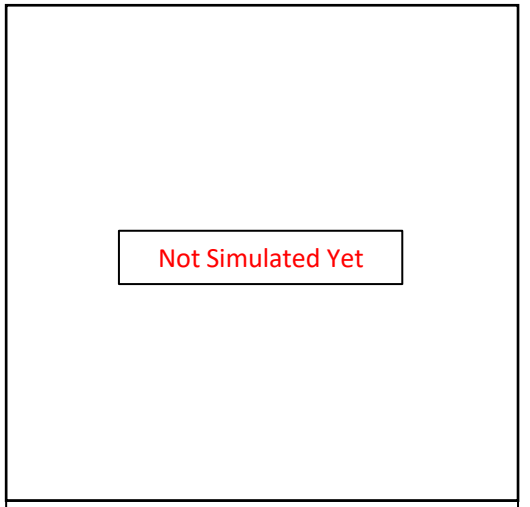
SNSR MGMT (Sensor Management)



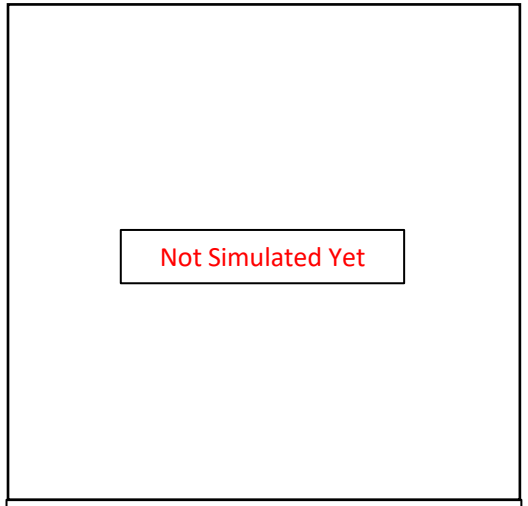
VID 2



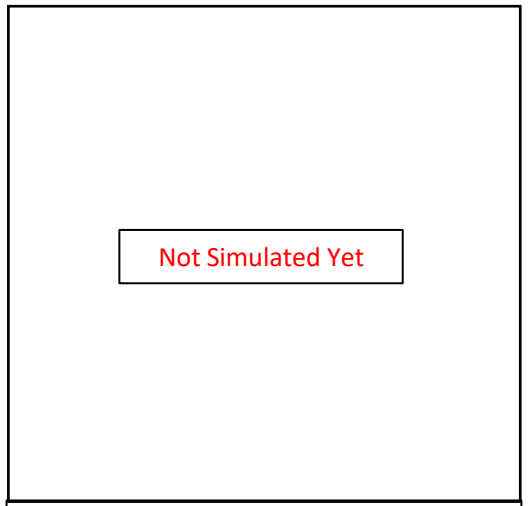
VID 5



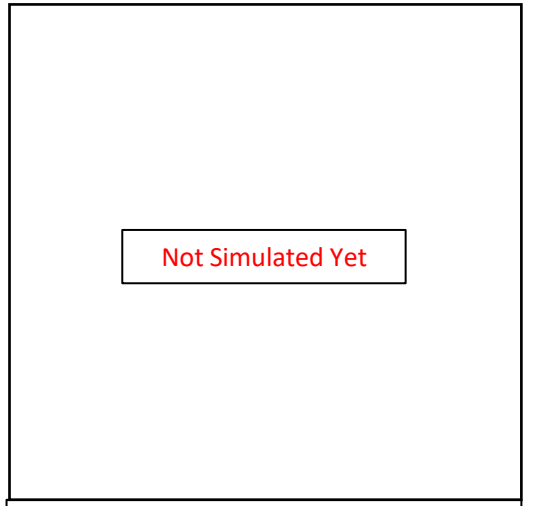
VID RC



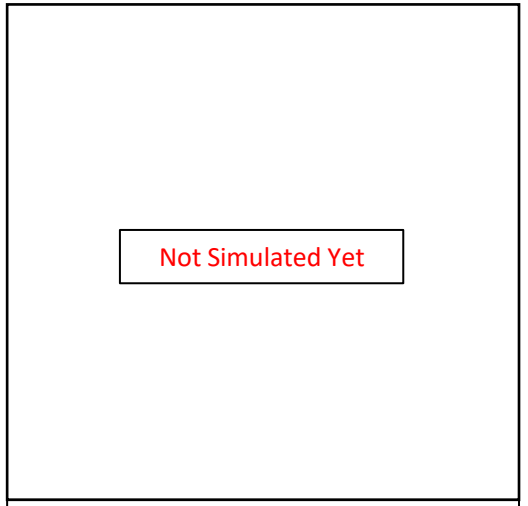
WDL COMM (Weapon Data Link Communications)



SP ENTRY



HMD-P

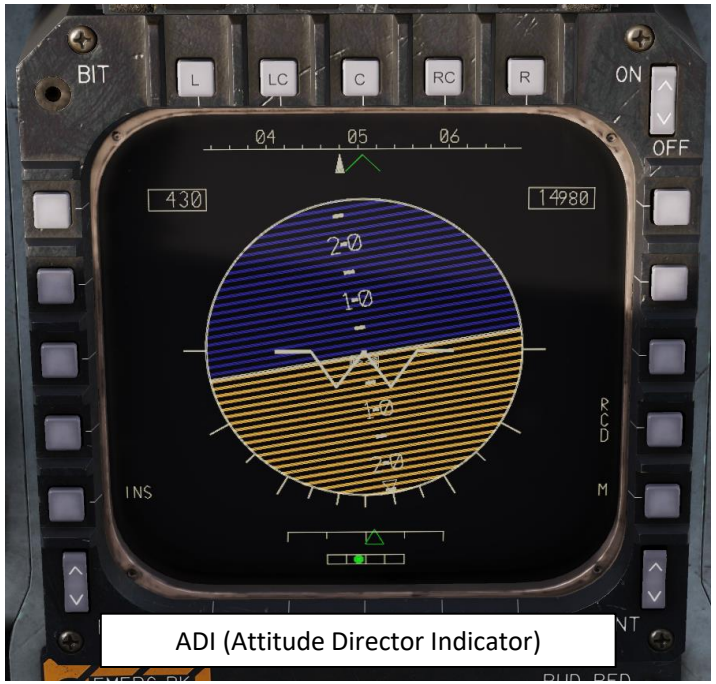


HMD-W

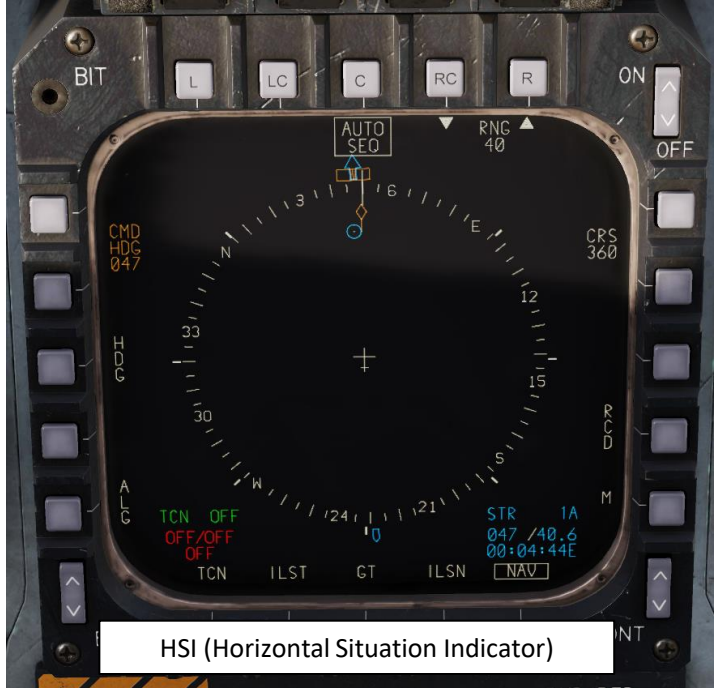
Pilot Cockpit

MPCD (Multipurpose Color Display) Pages

- *MPCD pages are basically the same as MPD (Multipurpose Display) pages, but some of them are colorized.*

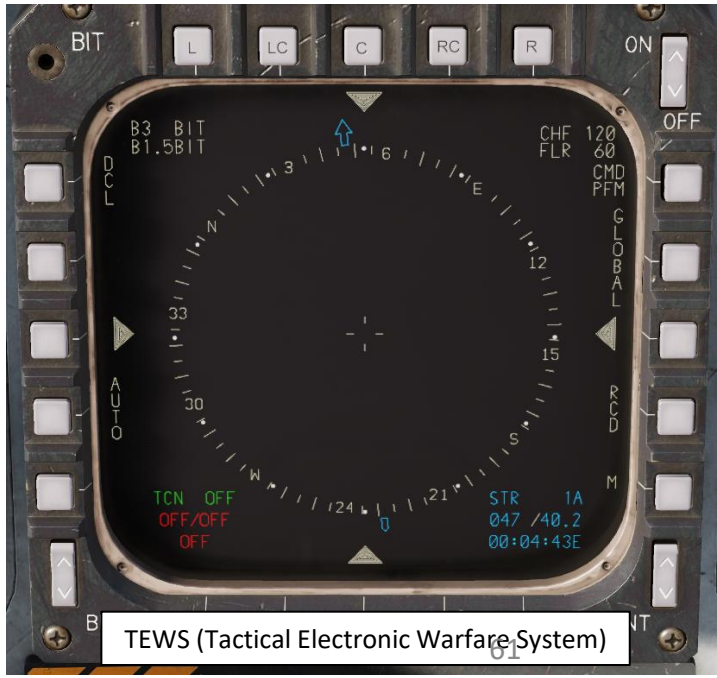


ADI (Attitude Director Indicator)



HSI (Horizontal Situation Indicator)

TSD (Tactical Situation Display)



TEWS (Tactical Electronic Warfare System)

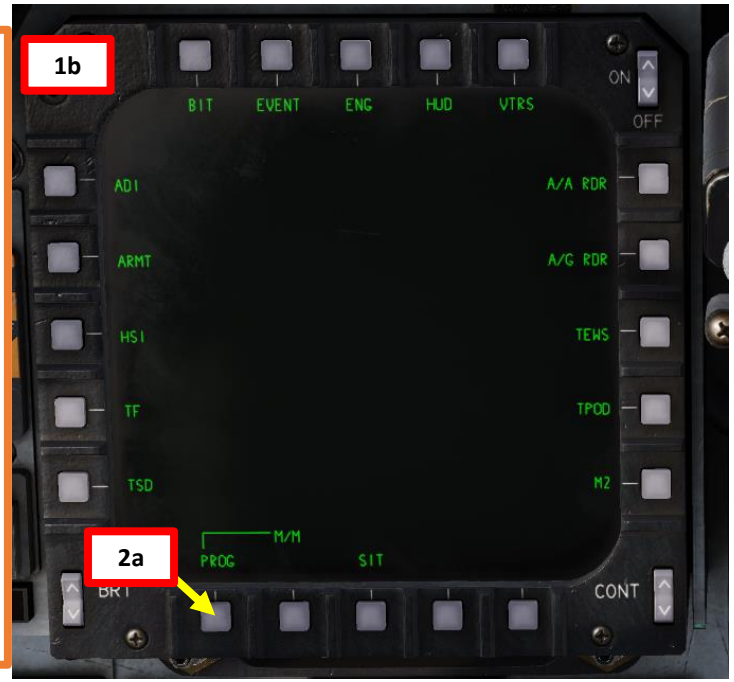
Pilot Cockpit

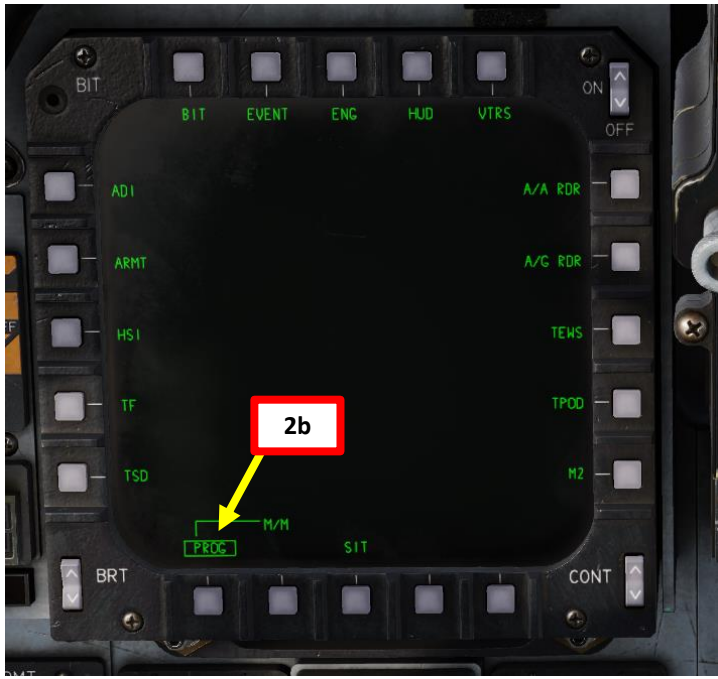
Display Sequence Programming Concept

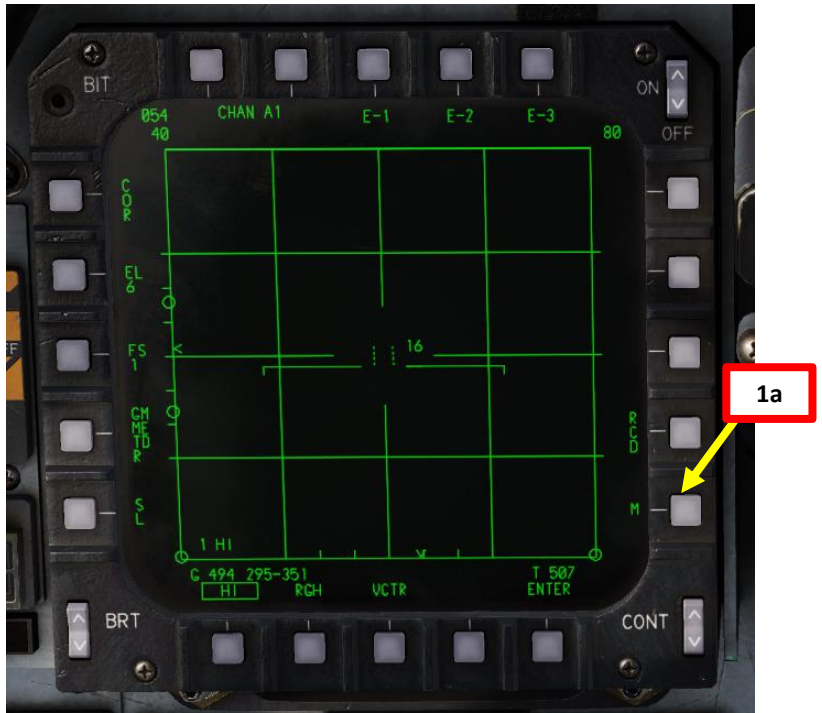
- *Each MPD/MPCD can be programmed individually to quickly change between a set of three different pages using the Castle Switch (see next page).*

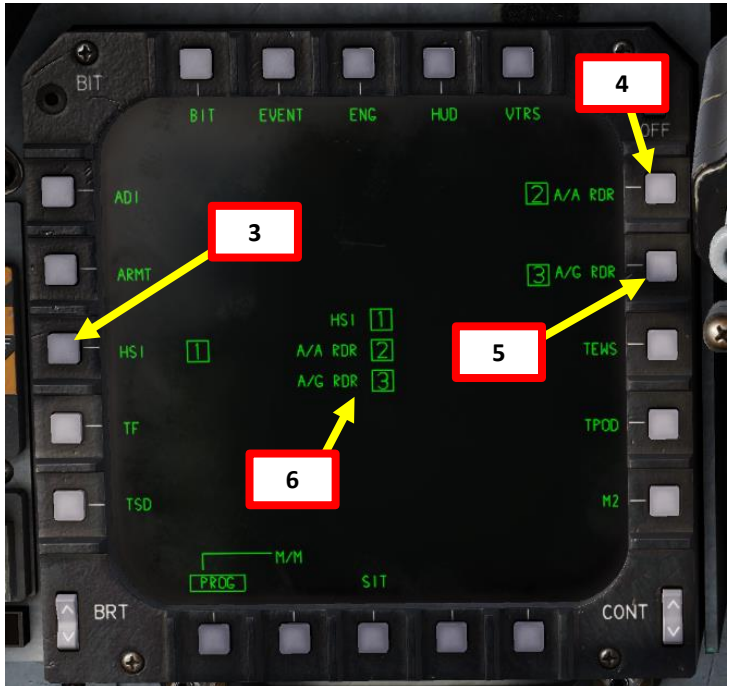
How to Program Display Sequence

1. *Access desired Menu page using the Pushbutton next to M/M2/M3.*
2. *Press Pushbutton (PB) next to PROG to select display programming function. PROG becomes boxed when selected.*
3. *Press PB next to the first page you want to set in the sequence. We will select the HSI (Horizontal Situation Indicator) as the first page.*
4. *Press PB next to the second page you want in the sequence; we will select A/A RDR (Air-to-Air Radar).*
5. *Press PB next to the third page you want in the sequence; we will select A/G RDR (Air-to-Ground Radar).*
6. *The display sequence is indicated with the "1", "2", and "3" numbers.*
7. *Press PB next to PROG to unselect display programming. PROG becomes unboxed when unselected.*









Pilot Cockpit

Left MPD (Multipurpose Display)
- Display Sequence Page 1: HSI
- Display Sequence Page 2: A/A RDR
- Display Sequence Page 3: A/G RDR

Right MPD (Multipurpose Display)
- Display Sequence Page 1: ENG
- Display Sequence Page 2: TPOD
- Display Sequence Page 3: HSI

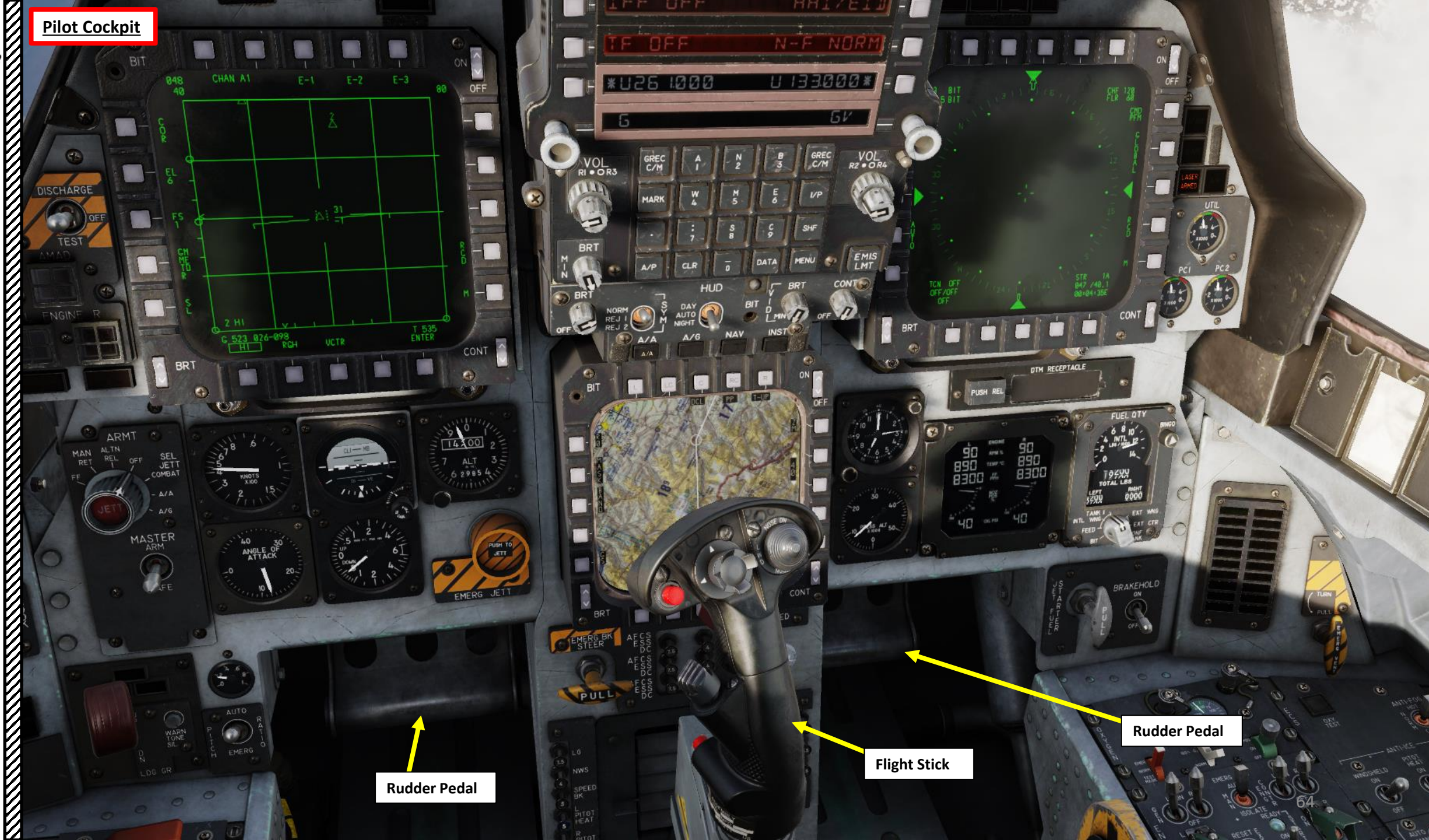
MPCD (Multipurpose Color Display)
- Display Sequence Page 1: TSD
- Display Sequence Page 2: ADI
- Display Sequence Page 3: TEWS

Castle Switch (Front Cockpit)
- *Each time the switch is **toggled (short press) LEFT**, it scrolls to the **next format** on the **left MPD** programmed in the display sequence.*
- *Each time the switch is **toggled (short press) RIGHT**, it first brings up the **TEWS (Tactical Electronic Warfare System)** page. Each **subsequent toggle RIGHT** scrolls to the **next format** on the **right MPD** programmed in the display sequence.*
- *When the Castle switch is **toggled AFT** towards the **MPCD**, it first brings up the **ADI (Attitude Director Indicator)**. Each **subsequent toggle DOWN within 5 seconds** scrolls through the **next format** on the **MPCD** programmed in the display sequence.*

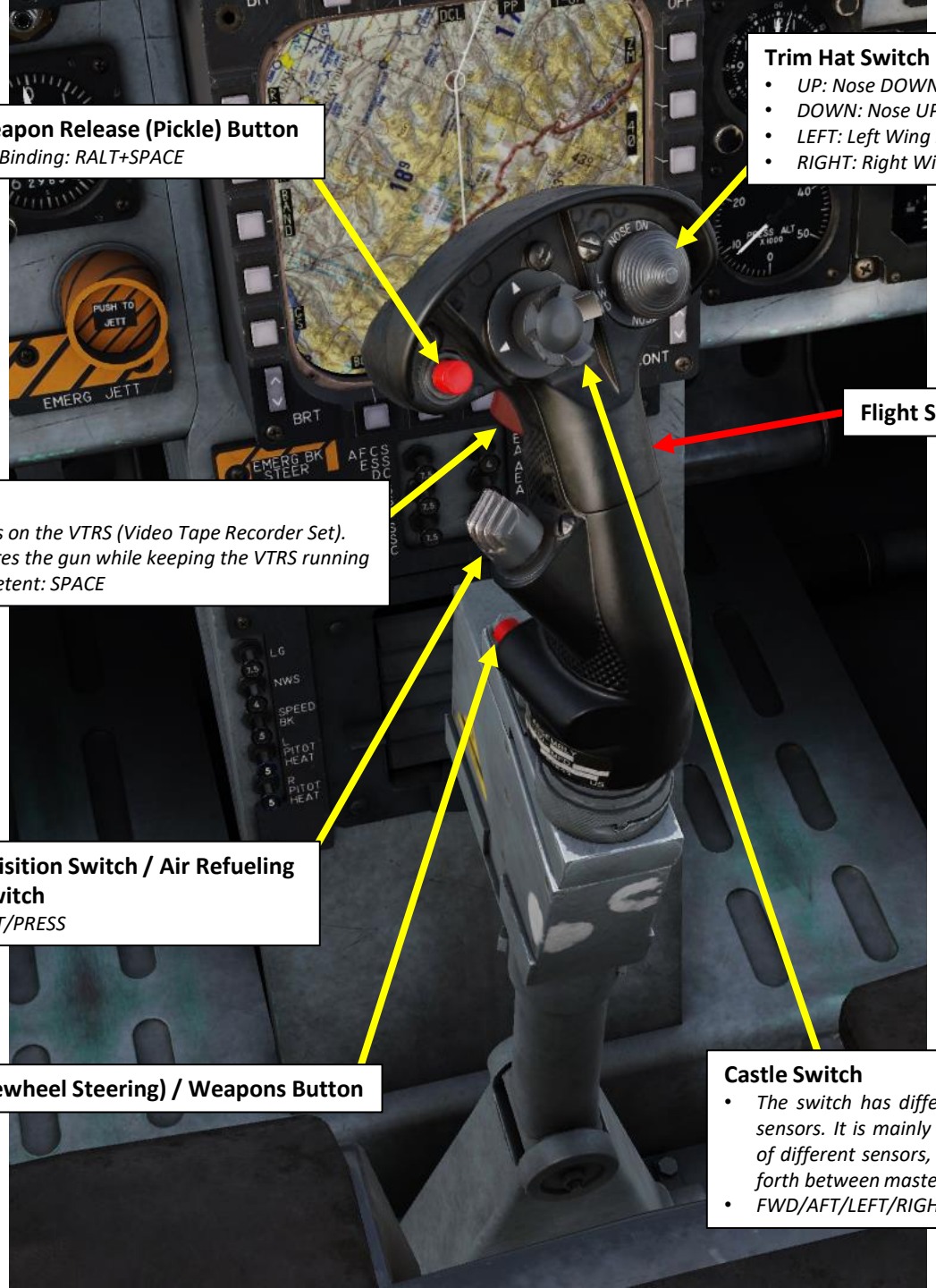
How to Scroll through Display Sequence Pages (Front Cockpit)

1. *Make sure the display sequence is programmed properly.*
2. *Press the Castle Switch SHORT in the direction of the display you want to scroll pages through.*
   - *Press LEFT for left MPD*
   - *Press RIGHT for right MPD*
   - *Press AFT for MPCD*
3. *As an example, pressing Castle Switch LEFT SHORT (less than 1 sec) cycles through the three pages programmed in the left MPD display sequence (see previous slide for programming procedure).*

Pilot Cockpit



Pilot Cockpit



Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

Trim Hat Switch
- *UP: Nose DOWN*
- *DOWN: Nose UP*
- *LEFT: Left Wing DOWN*
- *RIGHT: Right Wing DOWN*

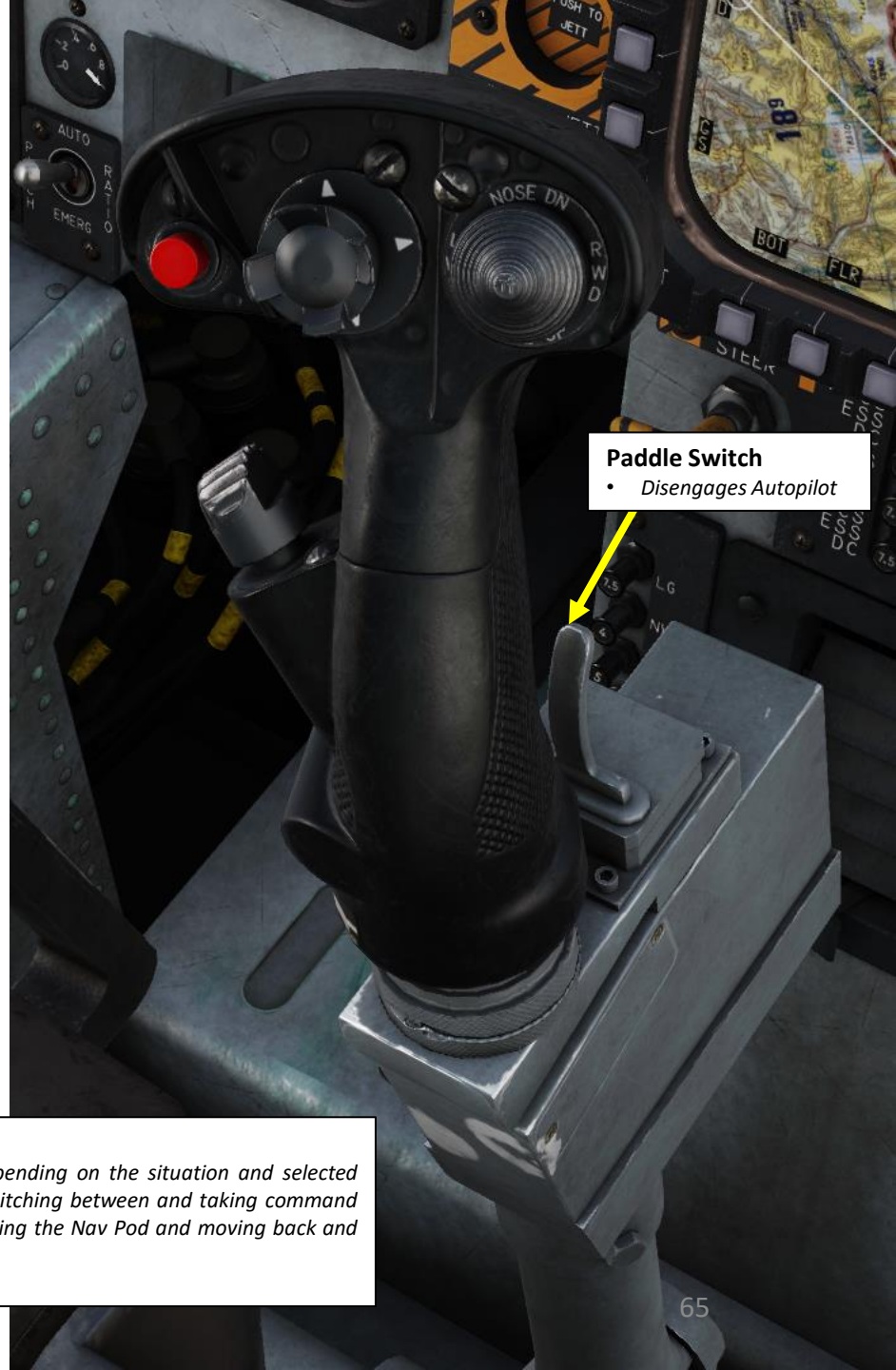
Flight Stick

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

NWS (Nosewheel Steering) / Weapons Button

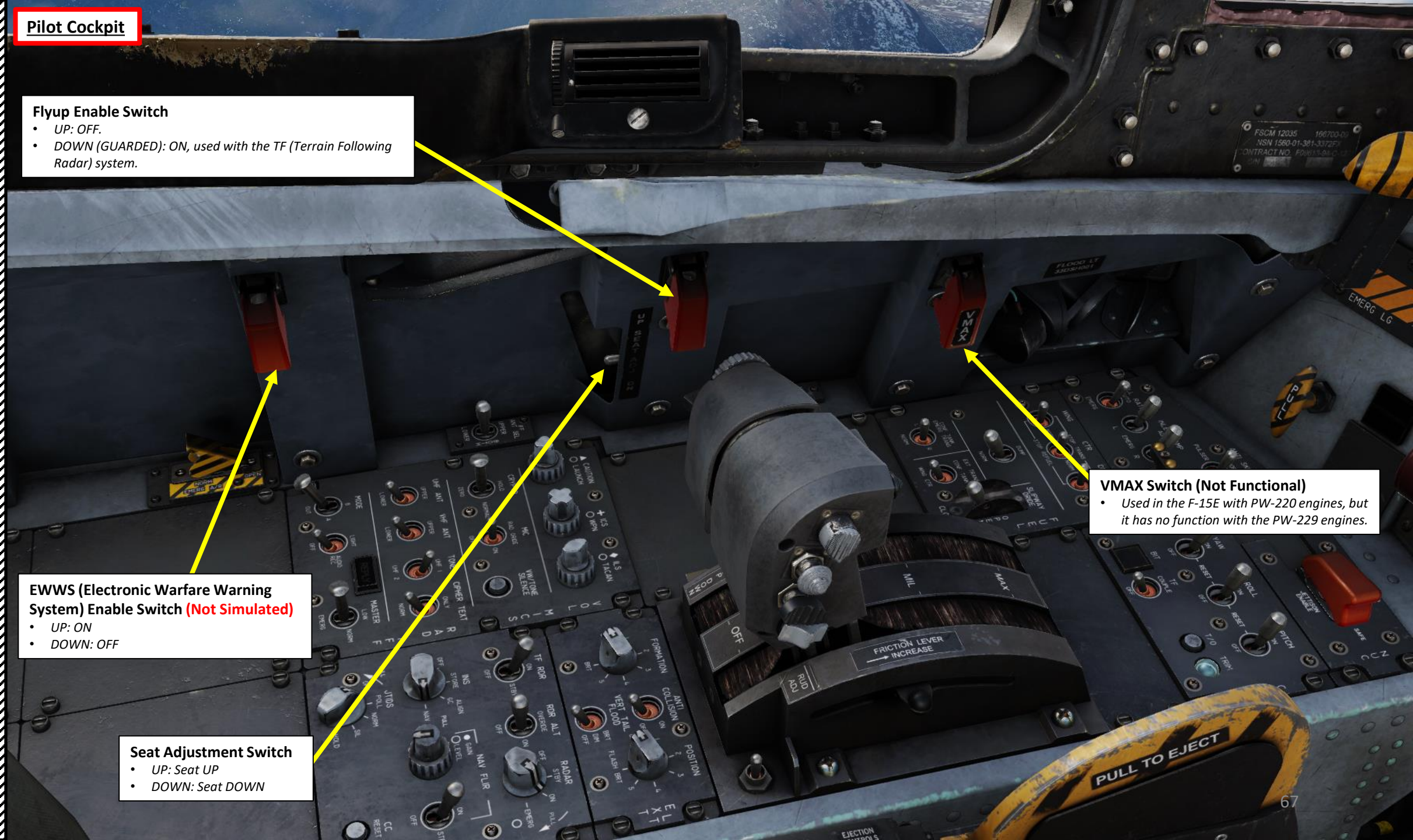
Castle Switch
- *The switch has different functions depending on the situation and selected sensors. It is mainly responsible for switching between and taking command of different sensors, as well as controlling the Nav Pod and moving back and forth between master modes.*
- *FWD/AFT/LEFT/RIGHT/DEPRESS*



Paddle Switch
- *Disengages Autopilot*

Pilot Cockpit

Pilot Cockpit



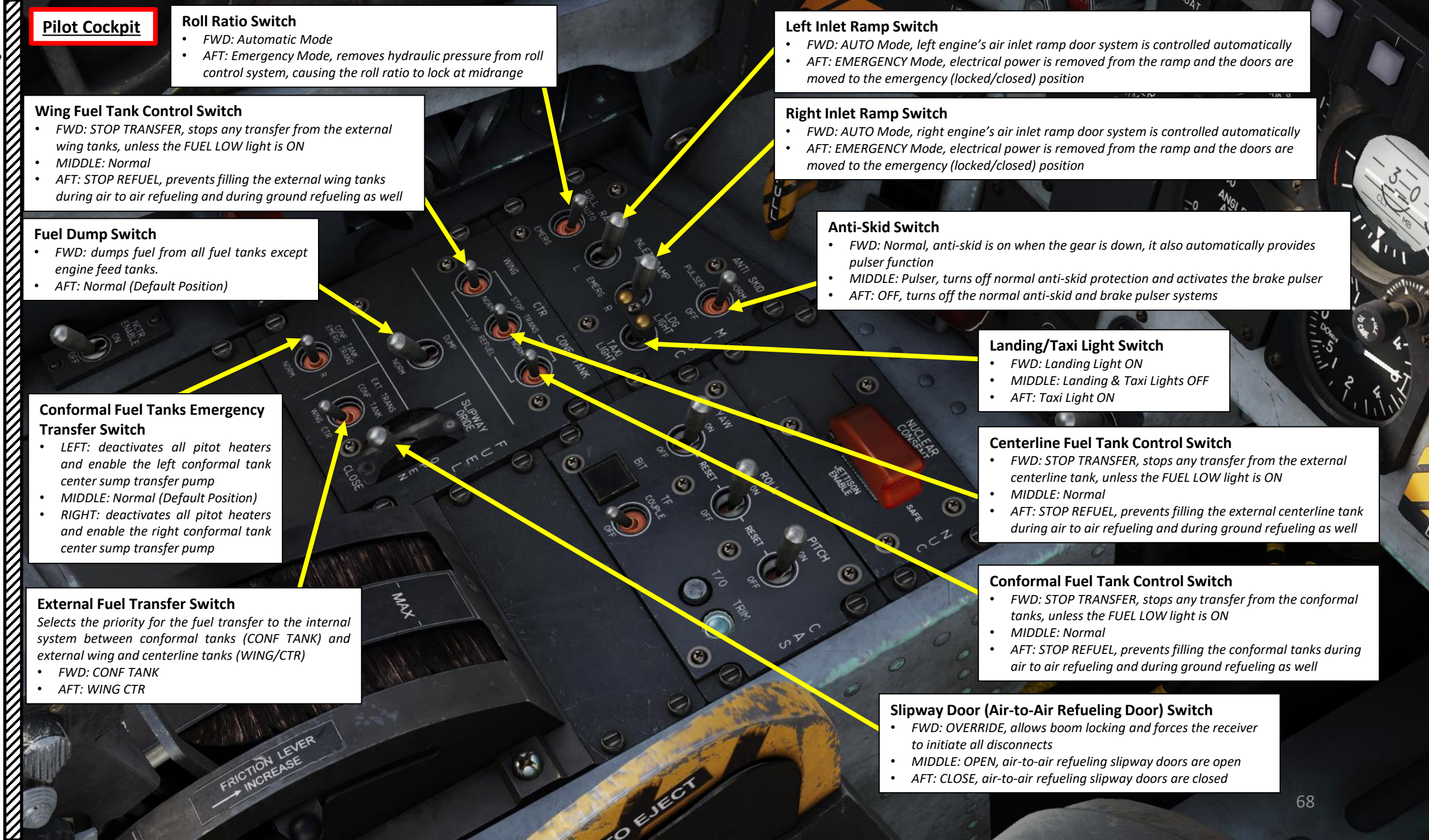
Flyup Enable Switch
- *UP: OFF.*
- *DOWN (GUARDED): ON, used with the TF (Terrain Following Radar) system.*

EWWS (Electronic Warfare Warning System) Enable Switch (Not Simulated)
- *UP: ON*
- *DOWN: OFF*

Seat Adjustment Switch
- *UP: Seat UP*
- *DOWN: Seat DOWN*

VMAX Switch (Not Functional)
- *Used in the F-15E with PW-220 engines, but it has no function with the PW-229 engines.*

Pilot Cockpit



Roll Ratio Switch
- *FWD: Automatic Mode*
- *AFT: Emergency Mode, removes hydraulic pressure from roll control system, causing the roll ratio to lock at midrange*

Left Inlet Ramp Switch
- *FWD: AUTO Mode, left engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*

Right Inlet Ramp Switch
- *FWD: AUTO Mode, right engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*

Wing Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external wing tanks, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external wing tanks during air to air refueling and during ground refueling as well*

Anti-Skid Switch
- *FWD: Normal, anti-skid is on when the gear is down, it also automatically provides pulser function*
- *MIDDLE: Pulser, turns off normal anti-skid protection and activates the brake pulser*
- *AFT: OFF, turns off the normal anti-skid and brake pulser systems*

Fuel Dump Switch
- *FWD: dumps fuel from all fuel tanks except engine feed tanks.*
- *AFT: Normal (Default Position)*

Landing/Taxi Light Switch
- *FWD: Landing Light ON*
- *MIDDLE: Landing & Taxi Lights OFF*
- *AFT: Taxi Light ON*

Conformal Fuel Tanks Emergency Transfer Switch
- *LEFT: deactivates all pitot heaters and enable the left conformal tank center sump transfer pump*
- *MIDDLE: Normal (Default Position)*
- *RIGHT: deactivates all pitot heaters and enable the right conformal tank center sump transfer pump*

Centerline Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external centerline tank, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external centerline tank during air to air refueling and during ground refueling as well*

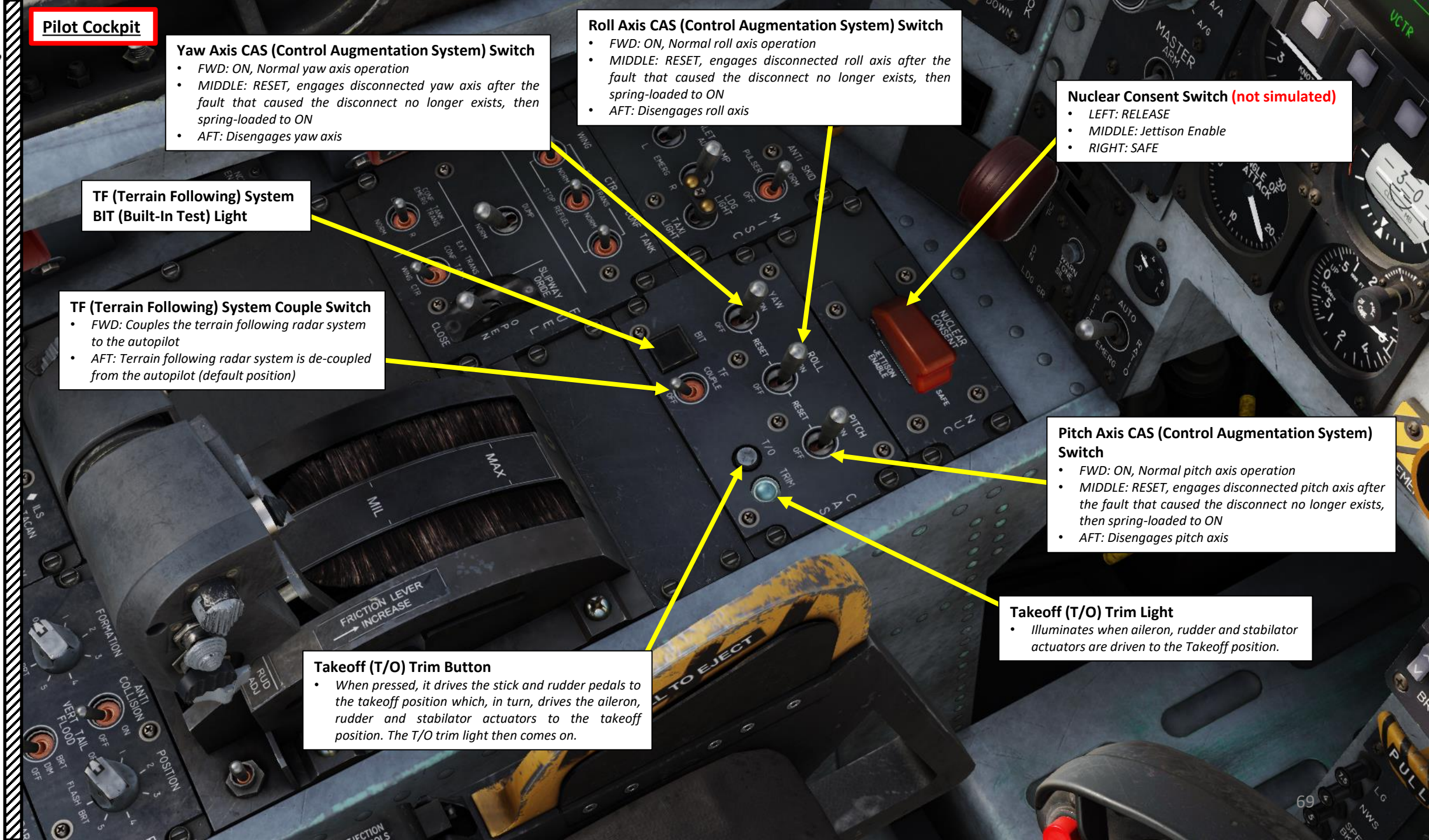
External Fuel Transfer Switch

Selects the priority for the fuel transfer to the internal system between conformal tanks (CONF TANK) and external wing and centerline tanks (WING/CTR)
- *FWD: CONF TANK*
- *AFT: WING CTR*

Conformal Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the conformal tanks, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the conformal tanks during air to air refueling and during ground refueling as well*

Slipway Door (Air-to-Air Refueling Door) Switch
- *FWD: OVERRIDE, allows boom locking and forces the receiver to initiate all disconnects*
- *MIDDLE: OPEN, air-to-air refueling slipway doors are open*
- *AFT: CLOSE, air-to-air refueling slipway doors are closed*

Pilot Cockpit



Yaw Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal yaw axis operation*
- *MIDDLE: RESET, engages disconnected yaw axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages yaw axis*

Roll Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal roll axis operation*
- *MIDDLE: RESET, engages disconnected roll axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages roll axis*

Nuclear Consent Switch (not simulated)
- *LEFT: RELEASE*
- *MIDDLE: Jettison Enable*
- *RIGHT: SAFE*

TF (Terrain Following) System BIT (Built-In Test) Light

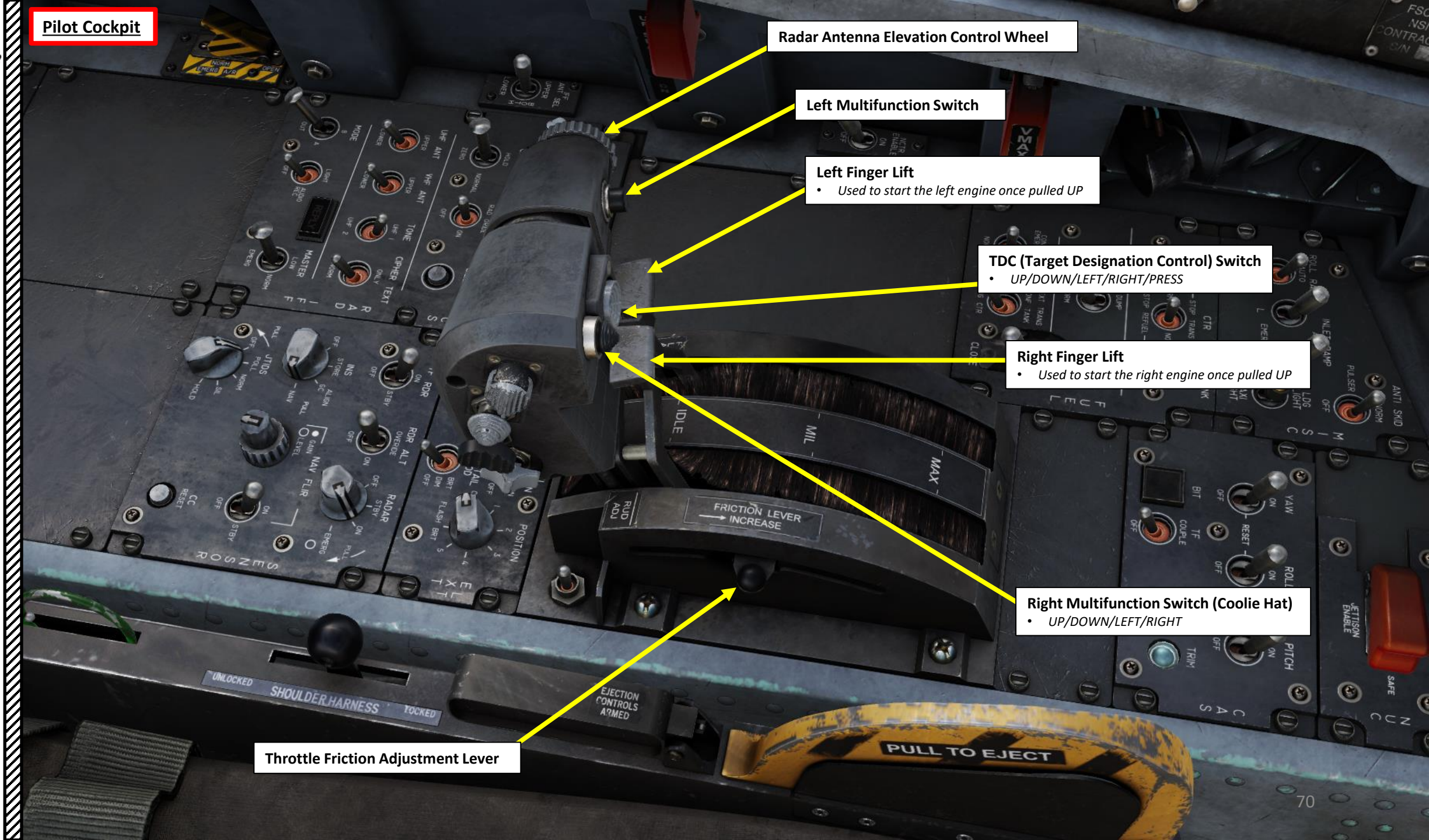
TF (Terrain Following) System Couple Switch
- *FWD: Couples the terrain following radar system to the autopilot*
- *AFT: Terrain following radar system is de-coupled from the autopilot (default position)*

Pitch Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal pitch axis operation*
- *MIDDLE: RESET, engages disconnected pitch axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages pitch axis*

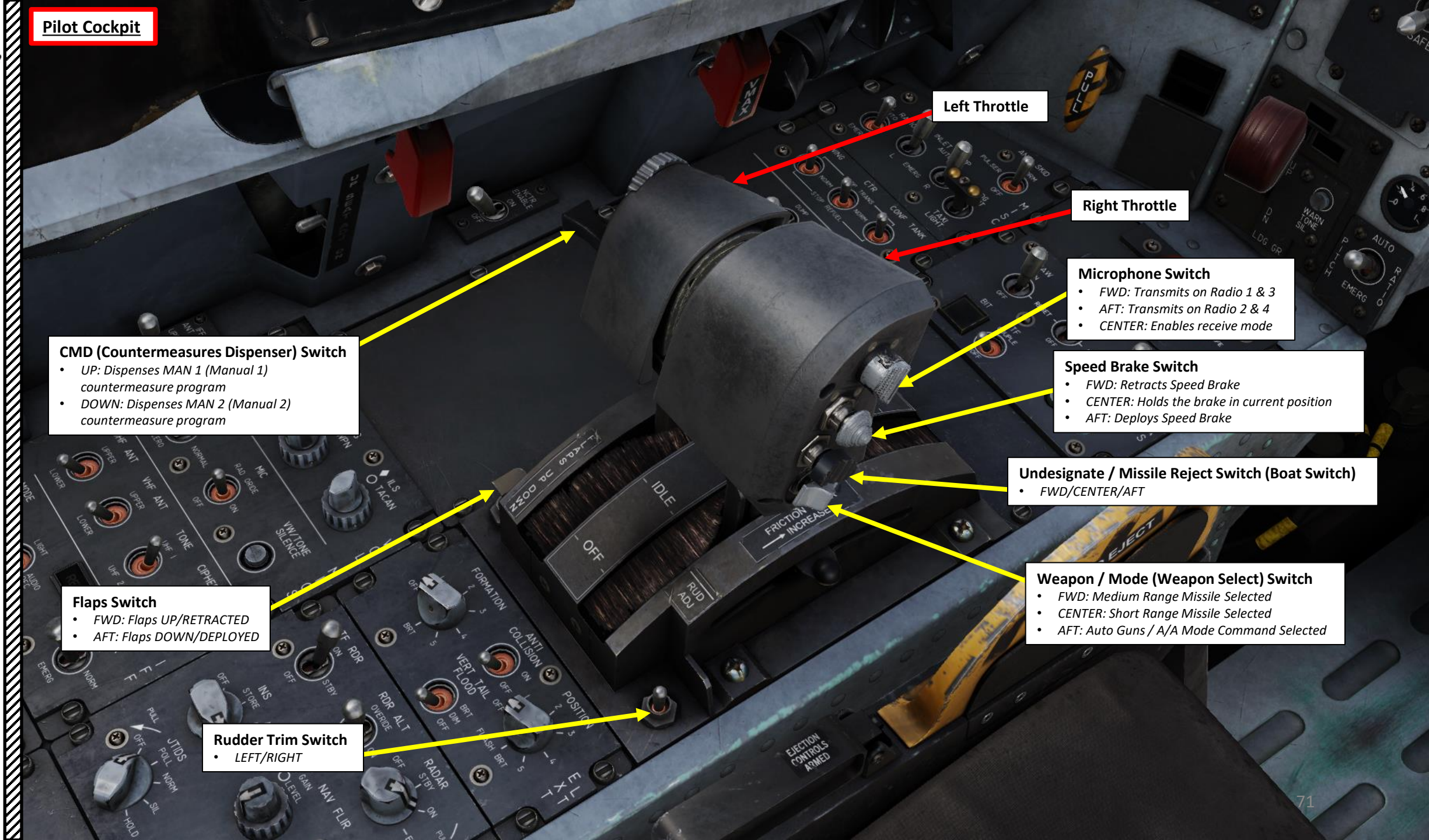
Takeoff (T/O) Trim Light
- *Illuminates when aileron, rudder and stabilator actuators are driven to the Takeoff position.*

Takeoff (T/O) Trim Button
- *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.*

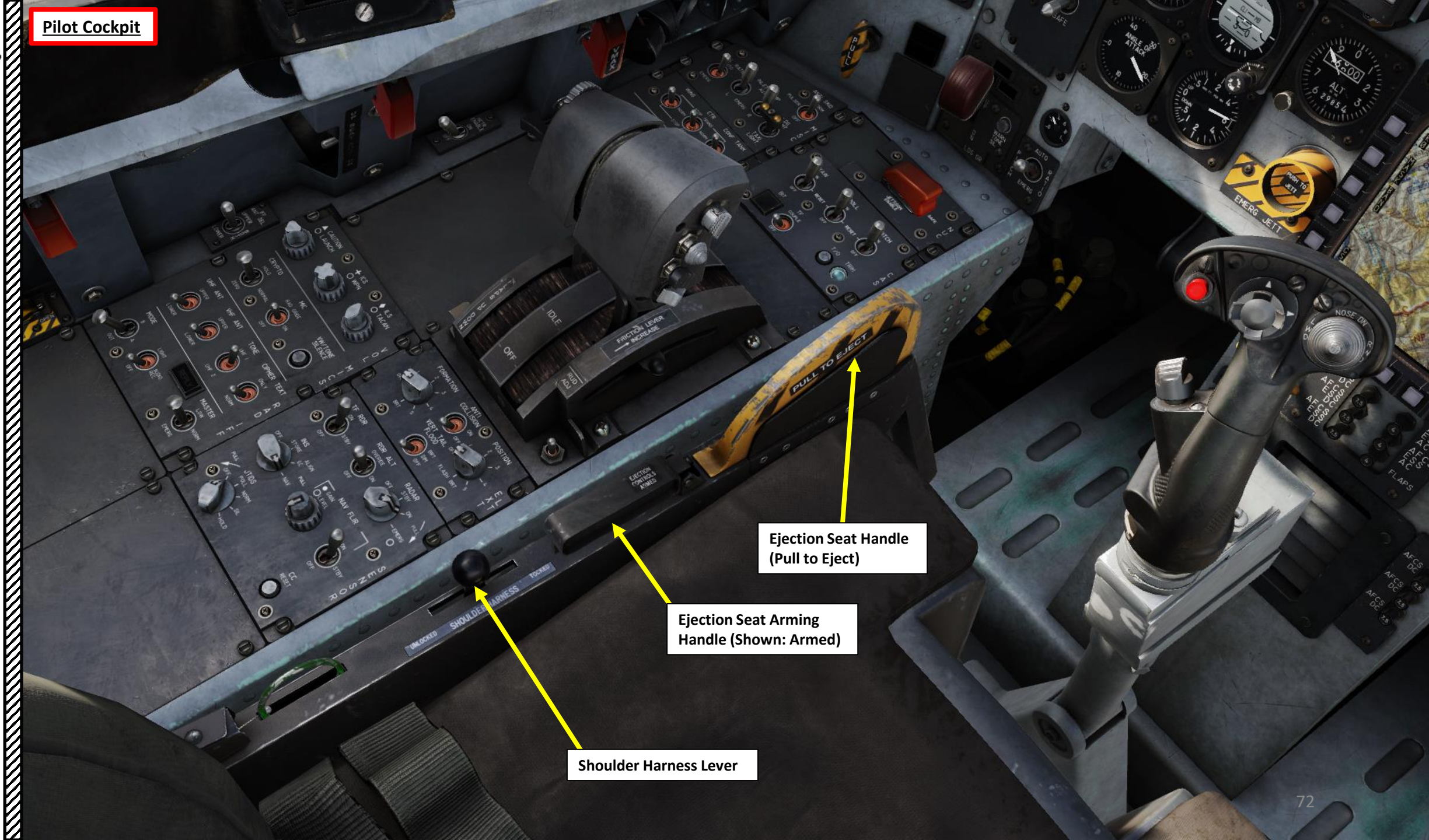
Pilot Cockpit



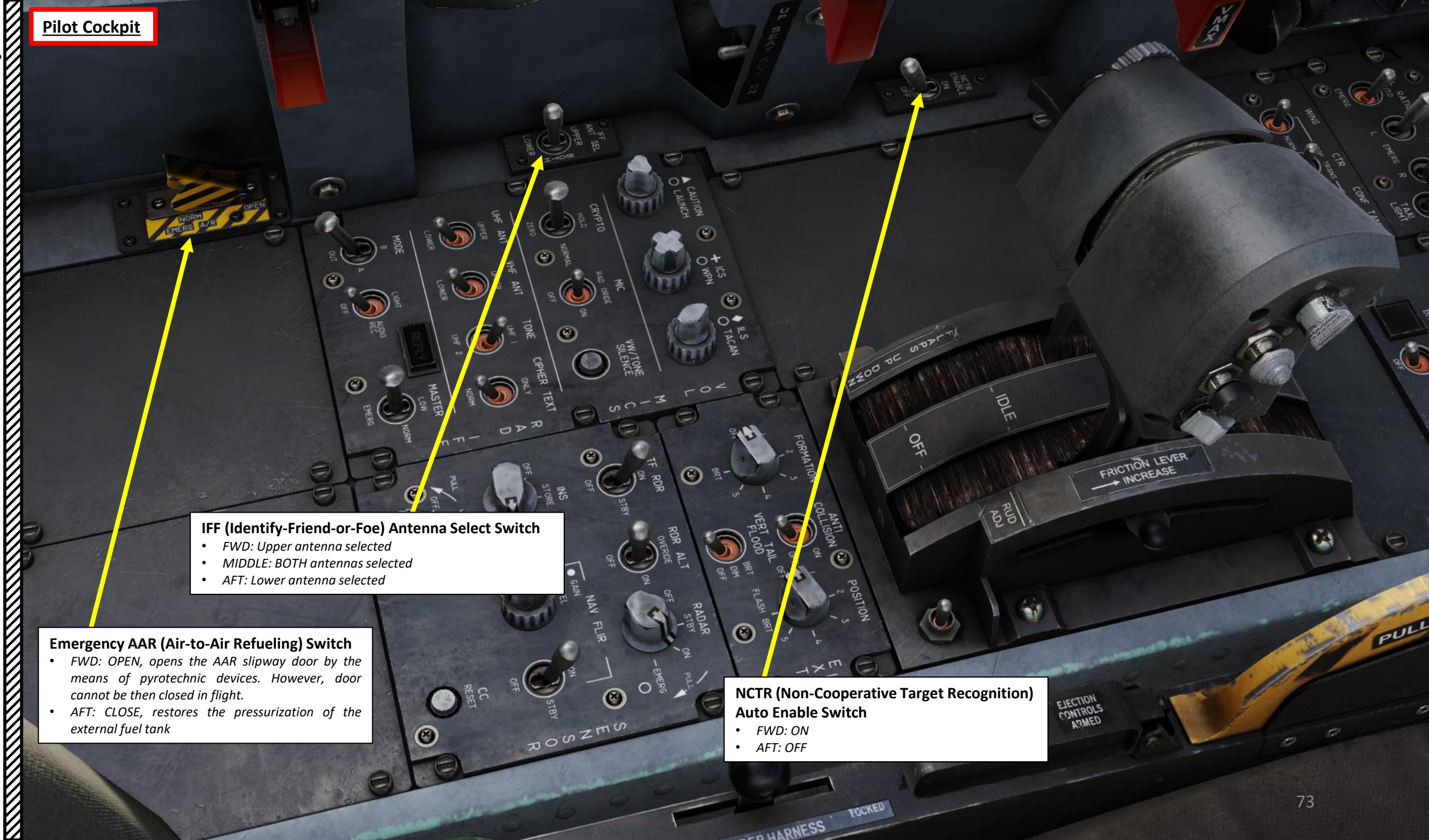
Pilot Cockpit



Pilot Cockpit



Pilot Cockpit



IFF (Identify-Friend-or-Foe) Antenna Select Switch

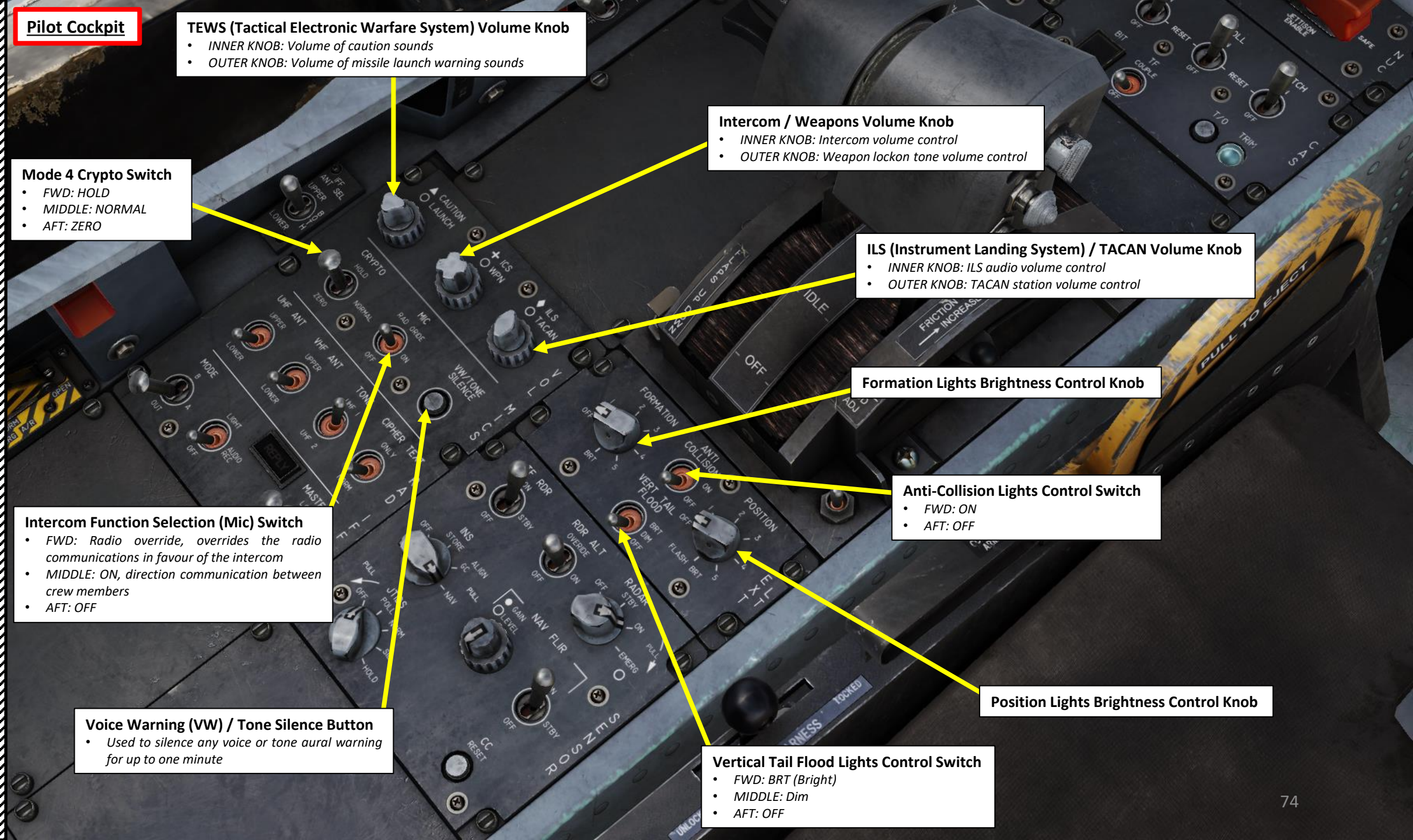
- *FWD: Upper antenna selected*
- *MIDDLE: BOTH antennas selected*
- *AFT: Lower antenna selected*

Emergency AAR (Air-to-Air Refueling) Switch

- *FWD: OPEN, opens the AAR slipway door by the means of pyrotechnic devices. However, door cannot be then closed in flight.*
- *AFT: CLOSE, restores the pressurization of the external fuel tank*

NCTR (Non-Cooperative Target Recognition) Auto Enable Switch

- *FWD: ON*
- *AFT: OFF*



Pilot Cockpit

TEWS (Tactical Electronic Warfare System) Volume Knob
- *INNER KNOB: Volume of caution sounds*
- *OUTER KNOB: Volume of missile launch warning sounds*

Intercom / Weapons Volume Knob
- *INNER KNOB: Intercom volume control*
- *OUTER KNOB: Weapon lockon tone volume control*

Mode 4 Crypto Switch
- *FWD: HOLD*
- *MIDDLE: NORMAL*
- *AFT: ZERO*

ILS (Instrument Landing System) / TACAN Volume Knob
- *INNER KNOB: ILS audio volume control*
- *OUTER KNOB: TACAN station volume control*

Formation Lights Brightness Control Knob

Anti-Collision Lights Control Switch
- *FWD: ON*
- *AFT: OFF*

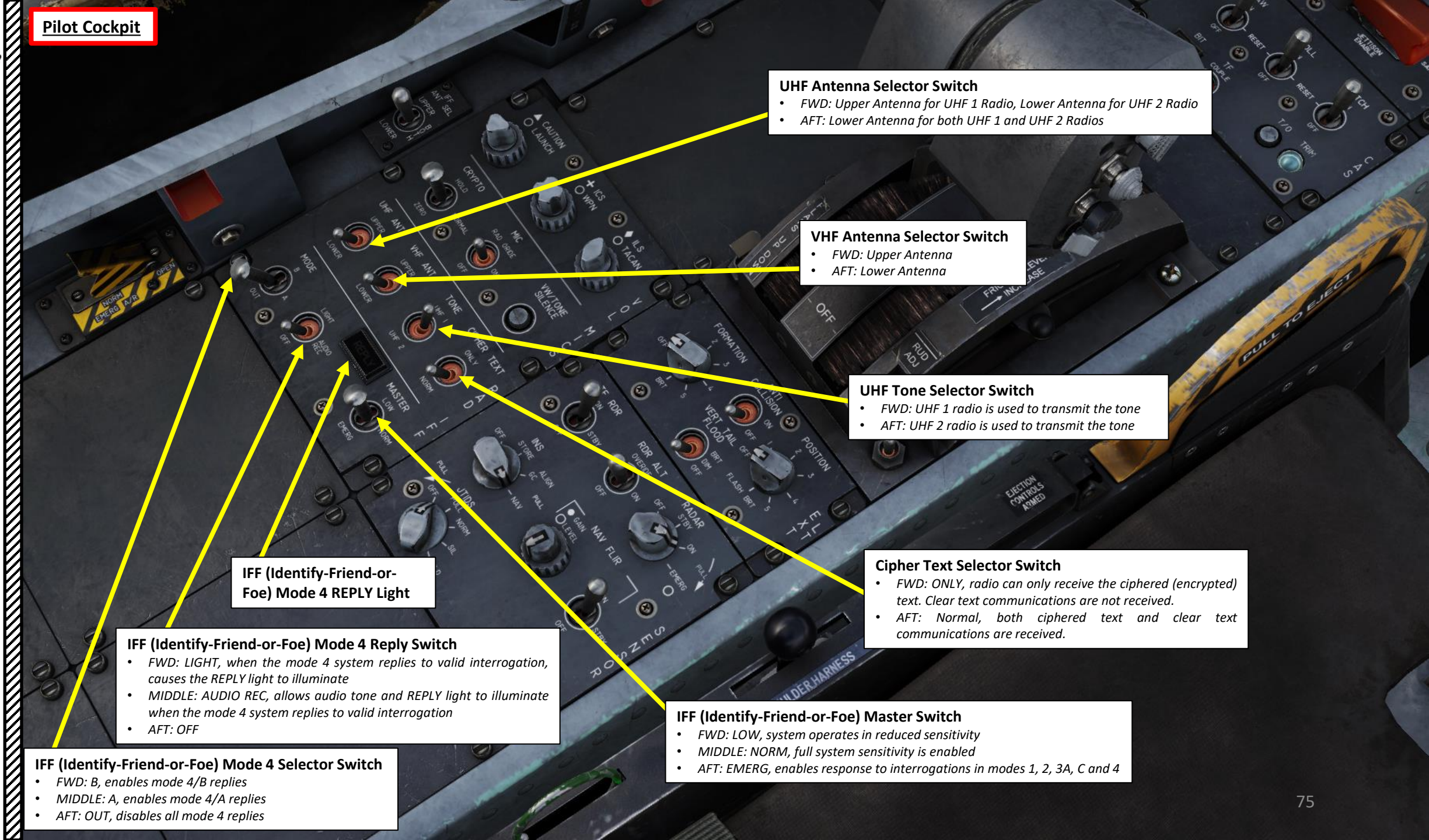
Intercom Function Selection (Mic) Switch
- *FWD: Radio override, overrides the radio communications in favour of the intercom*
- *MIDDLE: ON, direction communication between crew members*
- *AFT: OFF*

Position Lights Brightness Control Knob

Voice Warning (VW) / Tone Silence Button
- *Used to silence any voice or tone aural warning for up to one minute*

Vertical Tail Flood Lights Control Switch
- *FWD: BRT (Bright)*
- *MIDDLE: Dim*
- *AFT: OFF*

Pilot Cockpit



UHF Antenna Selector Switch
- *FWD: Upper Antenna for UHF 1 Radio, Lower Antenna for UHF 2 Radio*
- *AFT: Lower Antenna for both UHF 1 and UHF 2 Radios*

VHF Antenna Selector Switch
- *FWD: Upper Antenna*
- *AFT: Lower Antenna*

UHF Tone Selector Switch
- *FWD: UHF 1 radio is used to transmit the tone*
- *AFT: UHF 2 radio is used to transmit the tone*

Cipher Text Selector Switch
- *FWD: ONLY, radio can only receive the ciphered (encrypted) text. Clear text communications are not received.*
- *AFT: Normal, both ciphered text and clear text communications are received.*

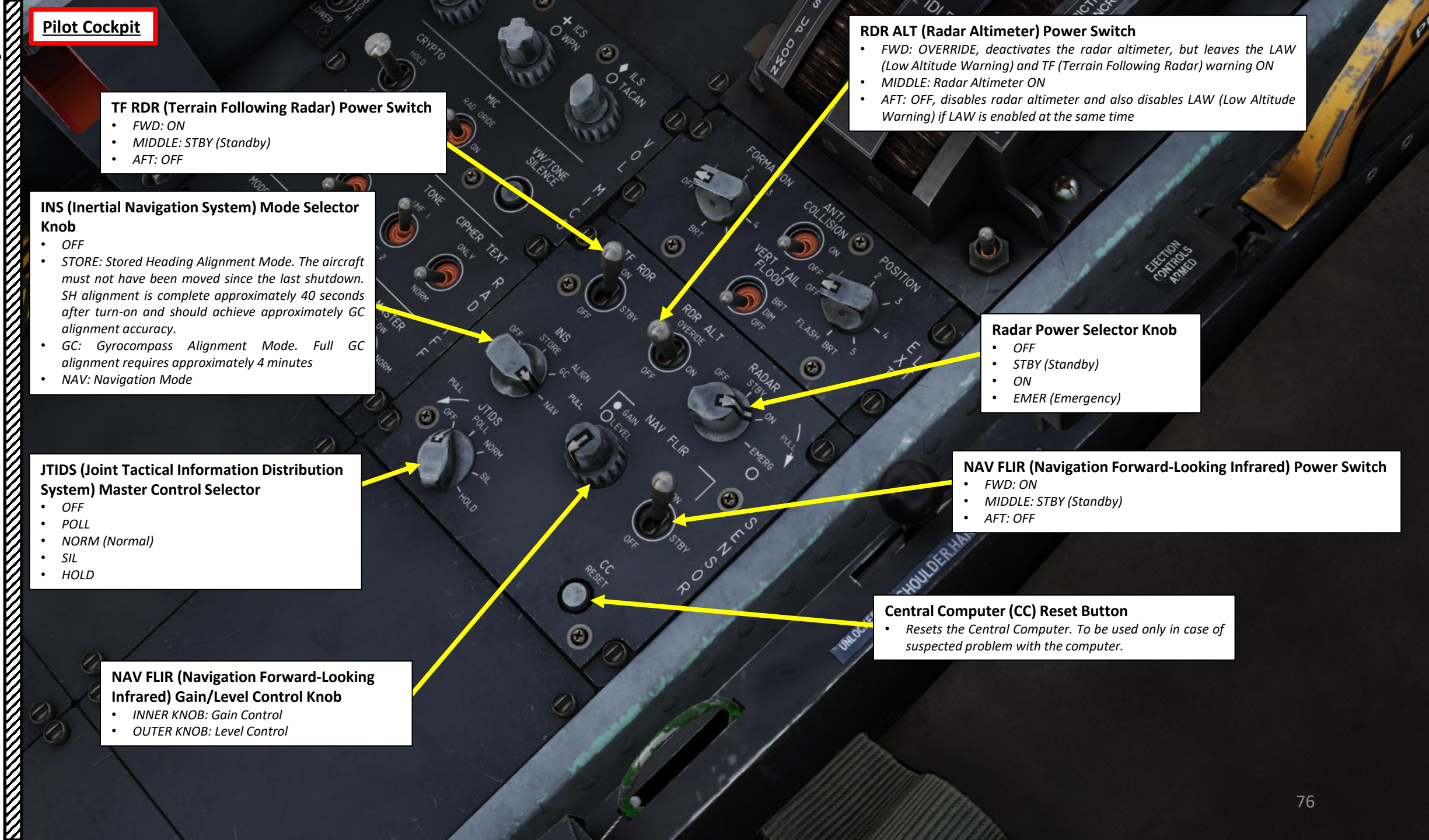
IFF (Identify-Friend-or-Foe) Master Switch
- *FWD: LOW, system operates in reduced sensitivity*
- *MIDDLE: NORM, full system sensitivity is enabled*
- *AFT: EMERG, enables response to interrogations in modes 1, 2, 3A, C and 4*

IFF (Identify-Friend-or-Foe) Mode 4 Reply Switch
- *FWD: LIGHT, when the mode 4 system replies to valid interrogation, causes the REPLY light to illuminate*
- *MIDDLE: AUDIO REC, allows audio tone and REPLY light to illuminate when the mode 4 system replies to valid interrogation*
- *AFT: OFF*

IFF (Identify-Friend-or-Foe) Mode 4 REPLY Light

IFF (Identify-Friend-or-Foe) Mode 4 Selector Switch
- *FWD: B, enables mode 4/B replies*
- *MIDDLE: A, enables mode 4/A replies*
- *AFT: OUT, disables all mode 4 replies*

Pilot Cockpit



TF RDR (Terrain Following Radar) Power Switch
- *FWD: ON*
- *MIDDLE: STBY (Standby)*
- *AFT: OFF*

INS (Inertial Navigation System) Mode Selector Knob
- *OFF*
- *STORE: Stored Heading Alignment Mode. 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 alignment accuracy.*
- *GC: Gyrocompass Alignment Mode. Full GC alignment requires approximately 4 minutes*
- *NAV: Navigation Mode*

JTIDS (Joint Tactical Information Distribution System) Master Control Selector
- *OFF*
- *POLL*
- *NORM (Normal)*
- *SIL*
- *HOLD*

NAV FLIR (Navigation Forward-Looking Infrared) Gain/Level Control Knob
- *INNER KNOB: Gain Control*
- *OUTER KNOB: Level Control*

RDR ALT (Radar Altimeter) Power Switch
- *FWD: OVERRIDE, deactivates the radar altimeter, but leaves the LAW (Low Altitude Warning) and TF (Terrain Following Radar) warning ON*
- *MIDDLE: Radar Altimeter ON*
- *AFT: OFF, disables radar altimeter and also disables LAW (Low Altitude Warning) if LAW is enabled at the same time*

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

NAV FLIR (Navigation Forward-Looking Infrared) Power Switch
- *FWD: ON*
- *MIDDLE: STBY (Standby)*
- *AFT: OFF*

Central Computer (CC) Reset Button
- *Resets the Central Computer. To be used only in case of suspected problem with the computer.*


Pilot Cockpit

Pilot Cockpit

Armament Safety Override Switch
- *AFT: Override OFF (Default Position)*
- *FWD: Override ON, allows the use of jettison controls even when landing handle is in DOWN position.*

Ground Power Switch No. 3
- *Controls ADC, EAIC, AOA, VVI, IBS and VTRS*
- *ON: the governed systems can be energized by external power*
- *AUTO: systems can only be energized by aircraft generator power.*

Ground Power Switch No. 2
- *Controls AHRS, Standby Attitude Indicator, MAD and EGI (if equipped).*
- *ON: the governed systems can be energized by external power*
- *AUTO: systems can only be energized by aircraft generator power.*

Ground Power Switch No. 4
- *Controls ILSR, TACAN, RMR and DMS*
- *ON: the governed systems can be energized by external power*
- *AUTO: systems can only be energized by aircraft generator power.*

PACS (Programmable Armament Control Set) Ground Power Switch
- *ON: the governed systems can be energized by external power*
- *AUTO: systems can only be energized by aircraft generator power.*
- *OFF: PACS is de-energized regardless of power source*

Ground Power Test Panel
- *Ground maintenance diagnostics*

Ground Power Switch No. 1
- *Controls hydraulic pressure, fuel flow, engine monitor, fuel quantity indicator, flaps, speed brakes and AFCS (Automatic Flight Control System).*
- *A ON: all systems except AFCS can be energized by external power*
- *B ON: all systems can be energized by external power (including AFCS)*
- *AUTO: systems can only be energized by aircraft generator power.*

MPDP/A1U (Multi-Purpose Display Processor) Ground Power Switch
- *ON: the governed systems can be energized by external power*
- *AUTO: systems can only be energized by aircraft generator power.*
- *OFF: MPDP/A1U is de-energized regardless of power source*

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit

Environmental Sensor Pitot

- In an emergency situation during the pilot escape initiation, the seat moves up the rails leaving the aircraft. Pitot tubes on the top of the seat near the parachute container are exposed to the airstream. Pitot and Static pressure inputs to the environmental sensing unit act on the speed and altitude transducers to establish the safest mode for the pilot involved, based on the speed and altitude environment

Magnetic Transmitter Unit

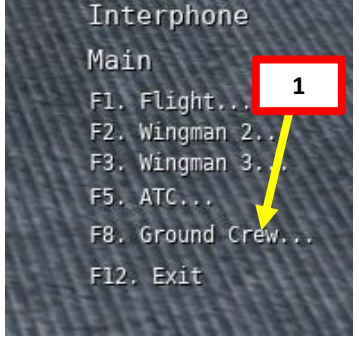
- Used to generate a magnetic field used to determine HMD (Helmet-Mounted Display) position/orientation, which is used by the JHMCS (Joint Helmet-Mounted Cueing System).

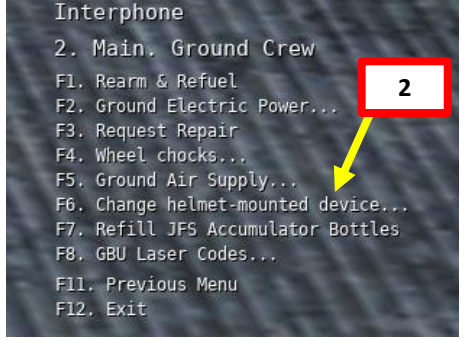
Pilot Cockpit

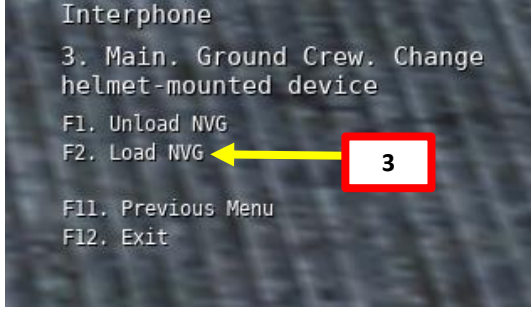
Pilot Cockpit

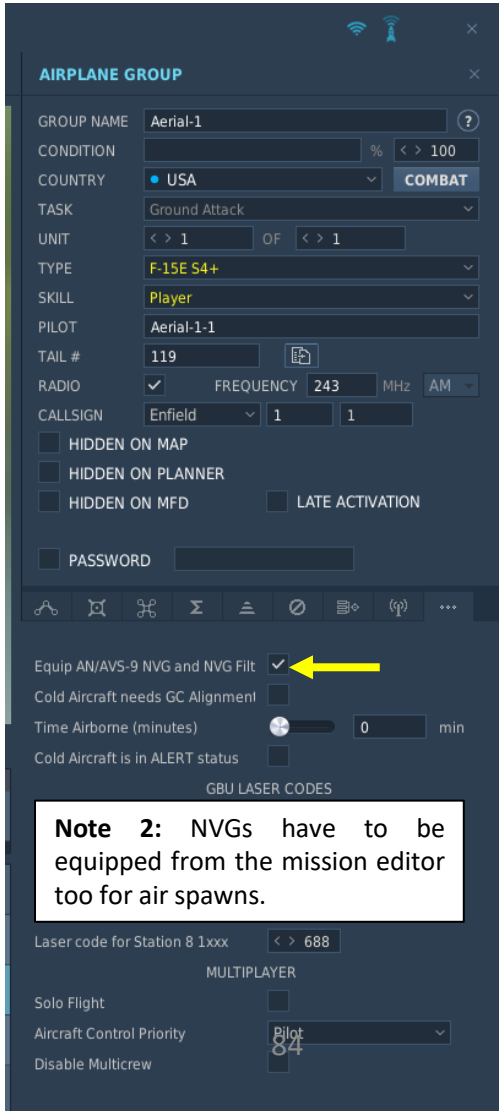
Pilot Cockpit

Note 1: You must contact the ground crew to equip either the Helmet Visor or Night Vision Goggles (NVGs). Using "\", then F8 (Ground Crew), then F6 (Change helmet-mounted device) then either F1 or F2 for your desired helmet type.



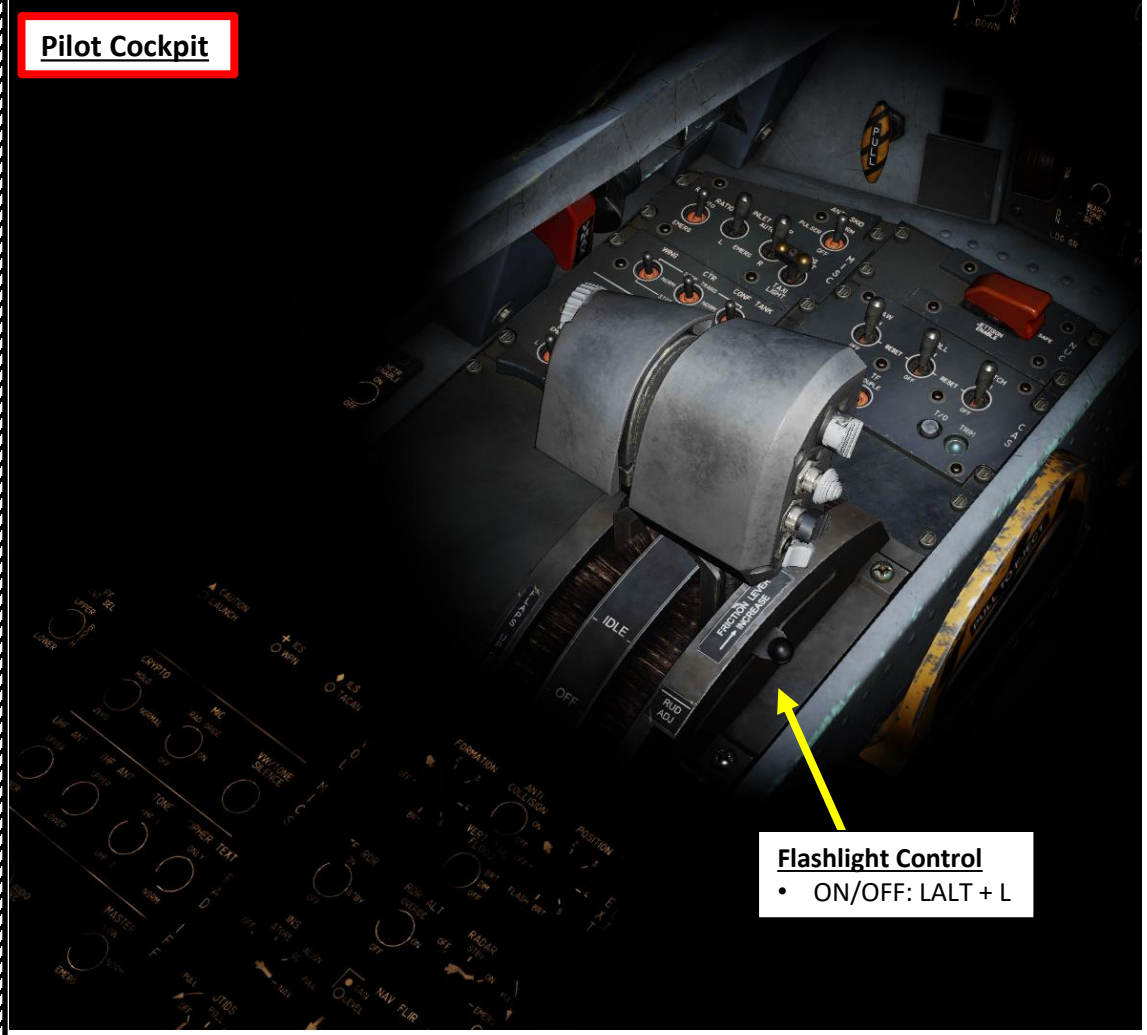




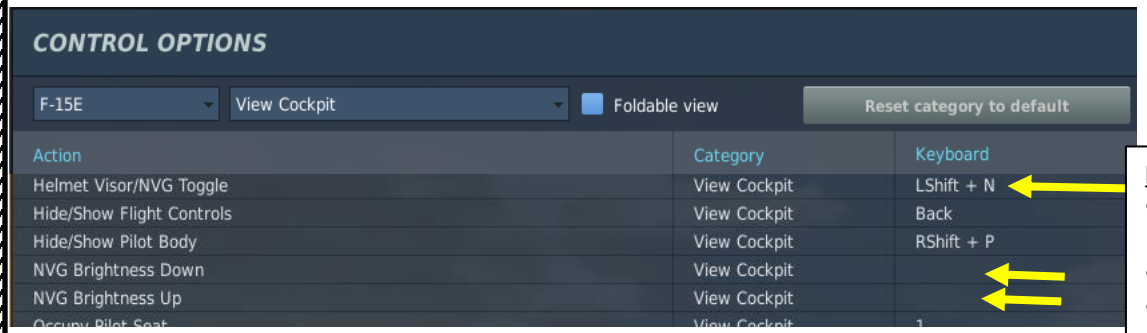


Note 2: NVGs have to be equipped from the mission editor too for air spawns.

Pilot Cockpit



Flashlight Control
- ON/OFF: LALT + L



Night Vision Goggles
- ON/OFF: LSHIFT + N (Helmet Visor/NVG Toggle)
- NVG BRIGHTNESS DOWN: Custom Binding
- NVG BRIGHTNESS UP: Custom Binding

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit

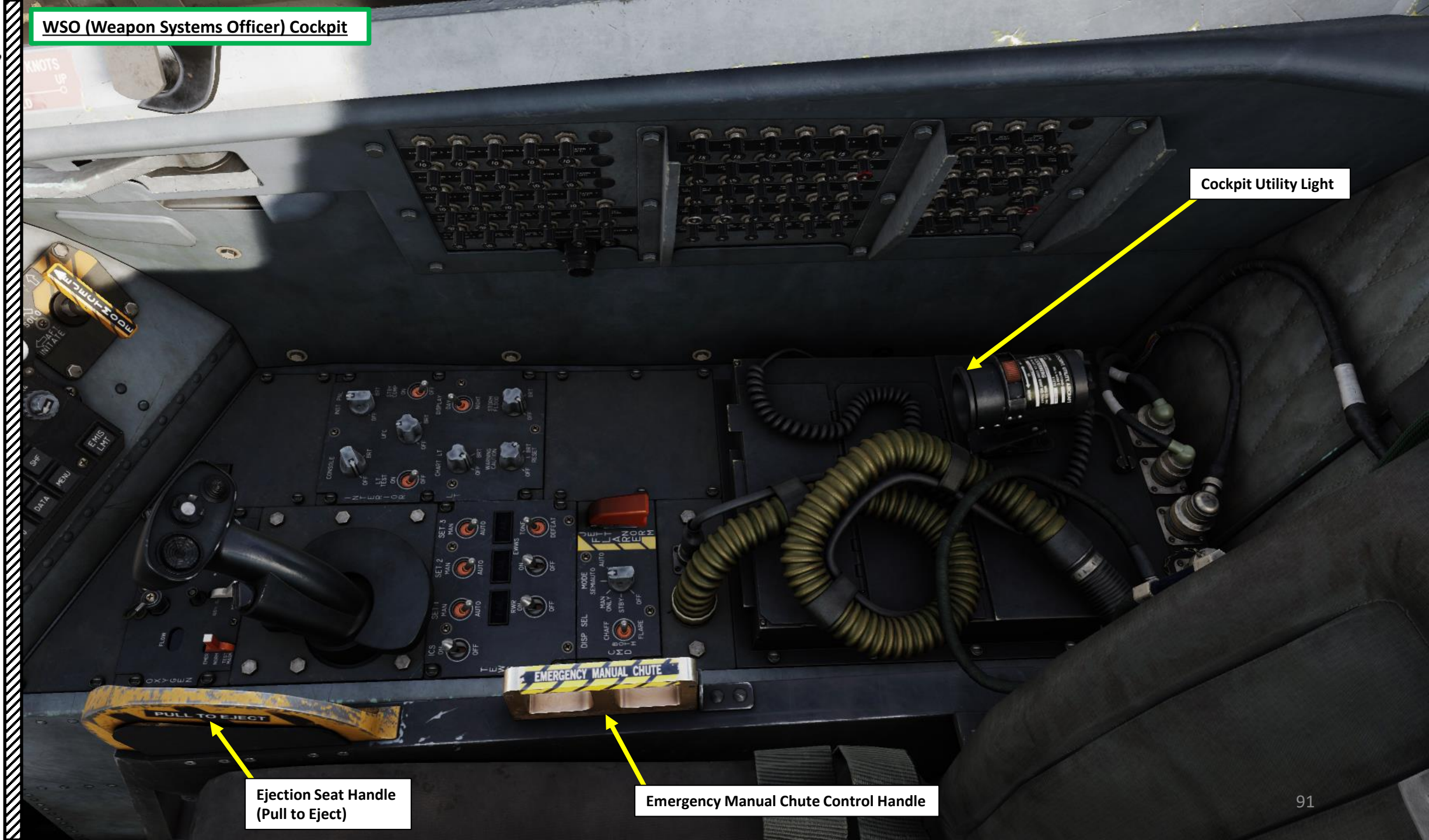
WSO (Weapon Systems Officer) Cockpit

Tip: WSO body can be toggled on/off by pressing “RSHIFT+P”

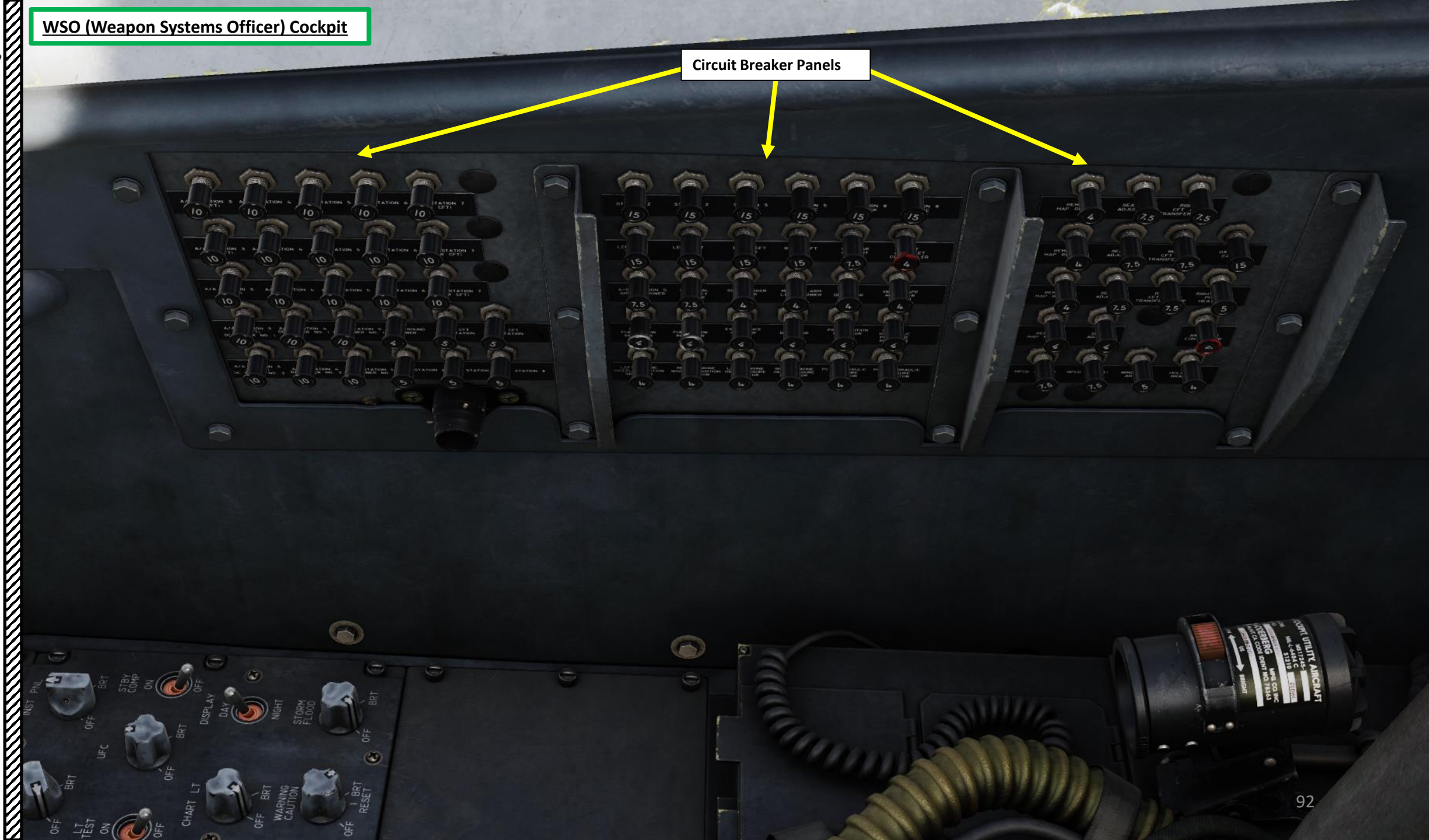
WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit

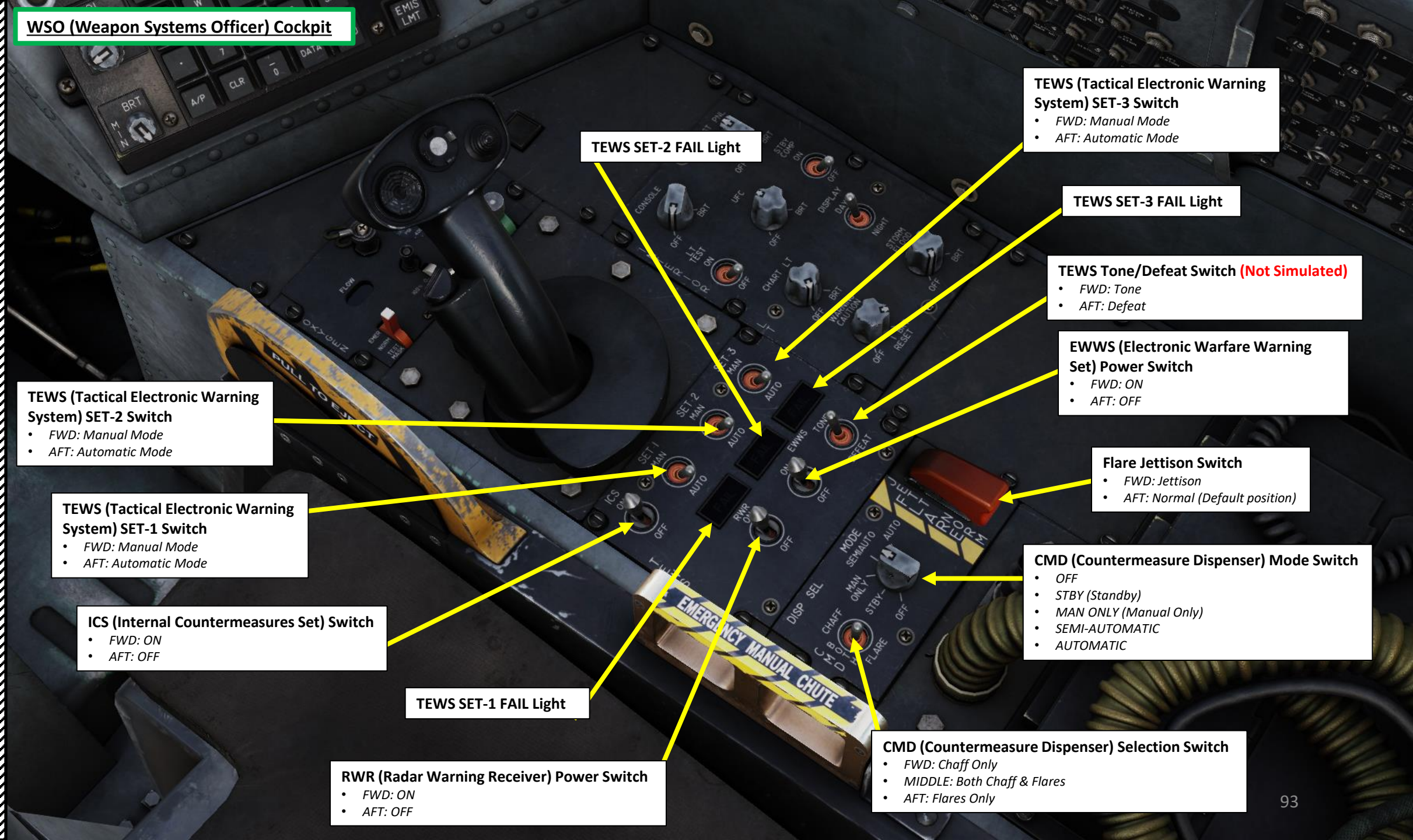
WSO (Weapon Systems Officer) Cockpit



WSO (Weapon Systems Officer) Cockpit



WSO (Weapon Systems Officer) Cockpit



TEWS (Tactical Electronic Warning System) SET-3 Switch
- *FWD: Manual Mode*
- *AFT: Automatic Mode*

TEWS SET-2 FAIL Light

TEWS SET-3 FAIL Light

TEWS Tone/Defeat Switch (Not Simulated)
- *FWD: Tone*
- *AFT: Defeat*

EWWS (Electronic Warfare Warning Set) Power Switch
- *FWD: ON*
- *AFT: OFF*

TEWS (Tactical Electronic Warning System) SET-2 Switch
- *FWD: Manual Mode*
- *AFT: Automatic Mode*

Flare Jettison Switch
- *FWD: Jettison*
- *AFT: Normal (Default position)*

TEWS (Tactical Electronic Warning System) SET-1 Switch
- *FWD: Manual Mode*
- *AFT: Automatic Mode*

CMD (Countermeasure Dispenser) Mode Switch
- *OFF*
- *STBY (Standby)*
- *MAN ONLY (Manual Only)*
- *SEMI-AUTOMATIC*
- *AUTOMATIC*

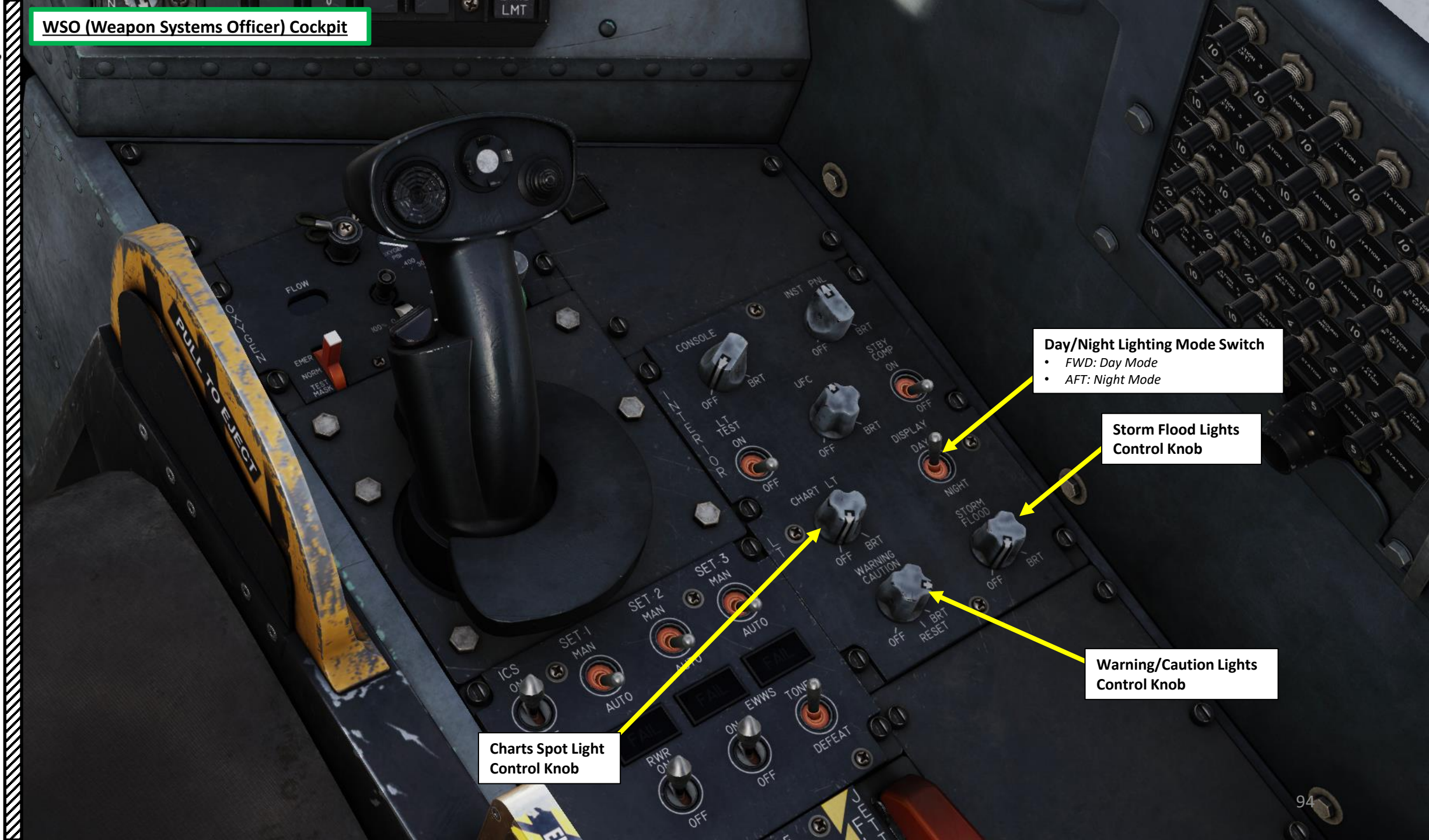
ICS (Internal Countermeasures Set) Switch
- *FWD: ON*
- *AFT: OFF*

TEWS SET-1 FAIL Light

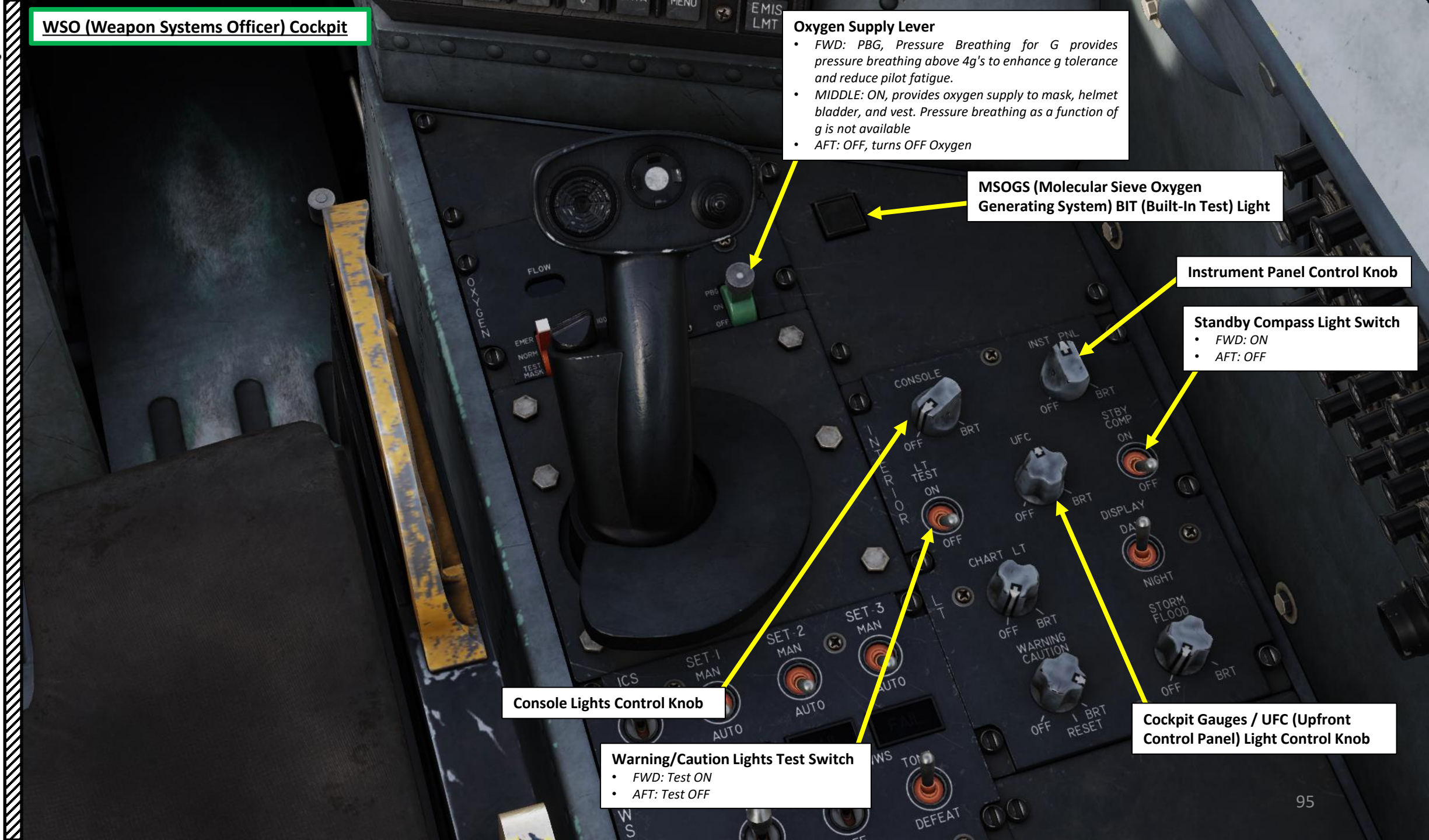
RWR (Radar Warning Receiver) Power Switch
- *FWD: ON*
- *AFT: OFF*

CMD (Countermeasure Dispenser) Selection Switch
- *FWD: Chaff Only*
- *MIDDLE: Both Chaff & Flares*
- *AFT: Flares Only*

WSO (Weapon Systems Officer) Cockpit



WSO (Weapon Systems Officer) Cockpit



Oxygen Supply Lever
- *FWD: PBG, Pressure Breathing for G provides pressure breathing above 4g's to enhance g tolerance and reduce pilot fatigue.*
- *MIDDLE: ON, provides oxygen supply to mask, helmet bladder, and vest. Pressure breathing as a function of g is not available*
- *AFT: OFF, turns OFF Oxygen*

MSOGS (Molecular Sieve Oxygen Generating System) BIT (Built-In Test) Light

Instrument Panel Control Knob

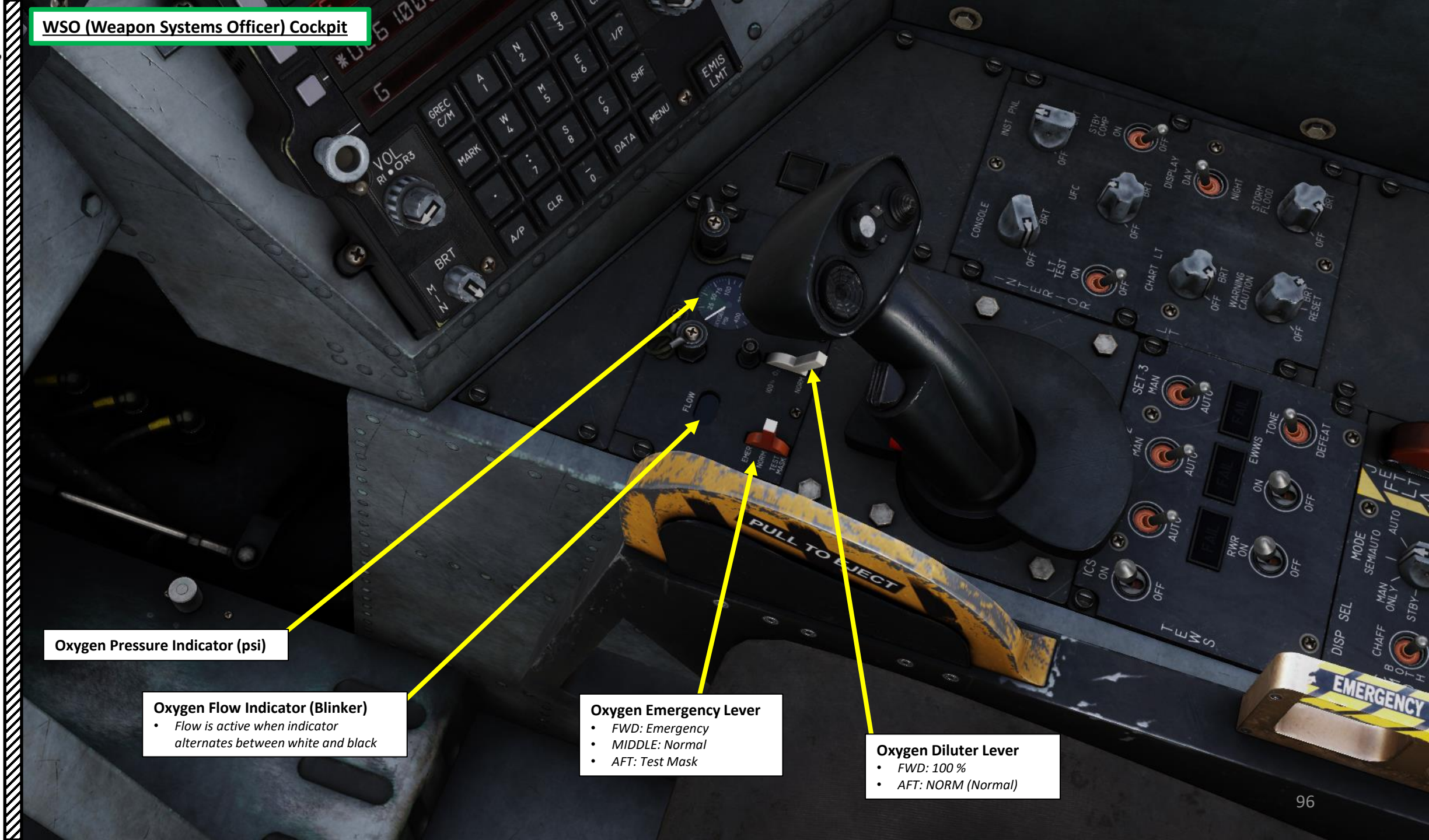
Standby Compass Light Switch
- *FWD: ON*
- *AFT: OFF*

Console Lights Control Knob

Warning/Caution Lights Test Switch
- *FWD: Test ON*
- *AFT: Test OFF*

Cockpit Gauges / UFC (Upfront Control Panel) Light Control Knob

WSO (Weapon Systems Officer) Cockpit



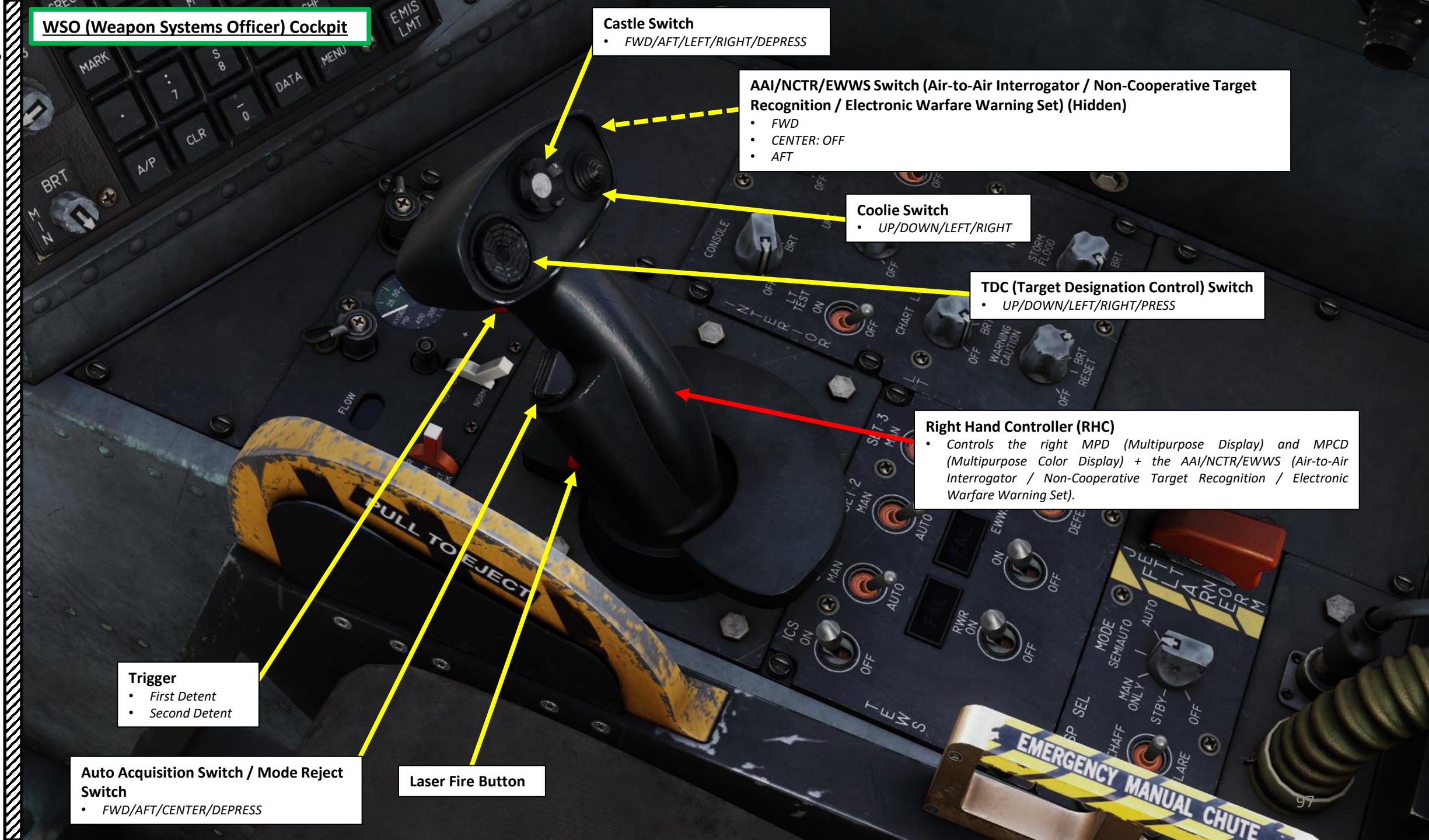
Oxygen Pressure Indicator (psi)

Oxygen Flow Indicator (Blinker)
- *Flow is active when indicator alternates between white and black*

Oxygen Emergency Lever
- *FWD: Emergency*
- *MIDDLE: Normal*
- *AFT: Test Mask*

Oxygen Diluter Lever
- *FWD: 100 %*
- *AFT: NORM (Normal)*

WSO (Weapon Systems Officer) Cockpit



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

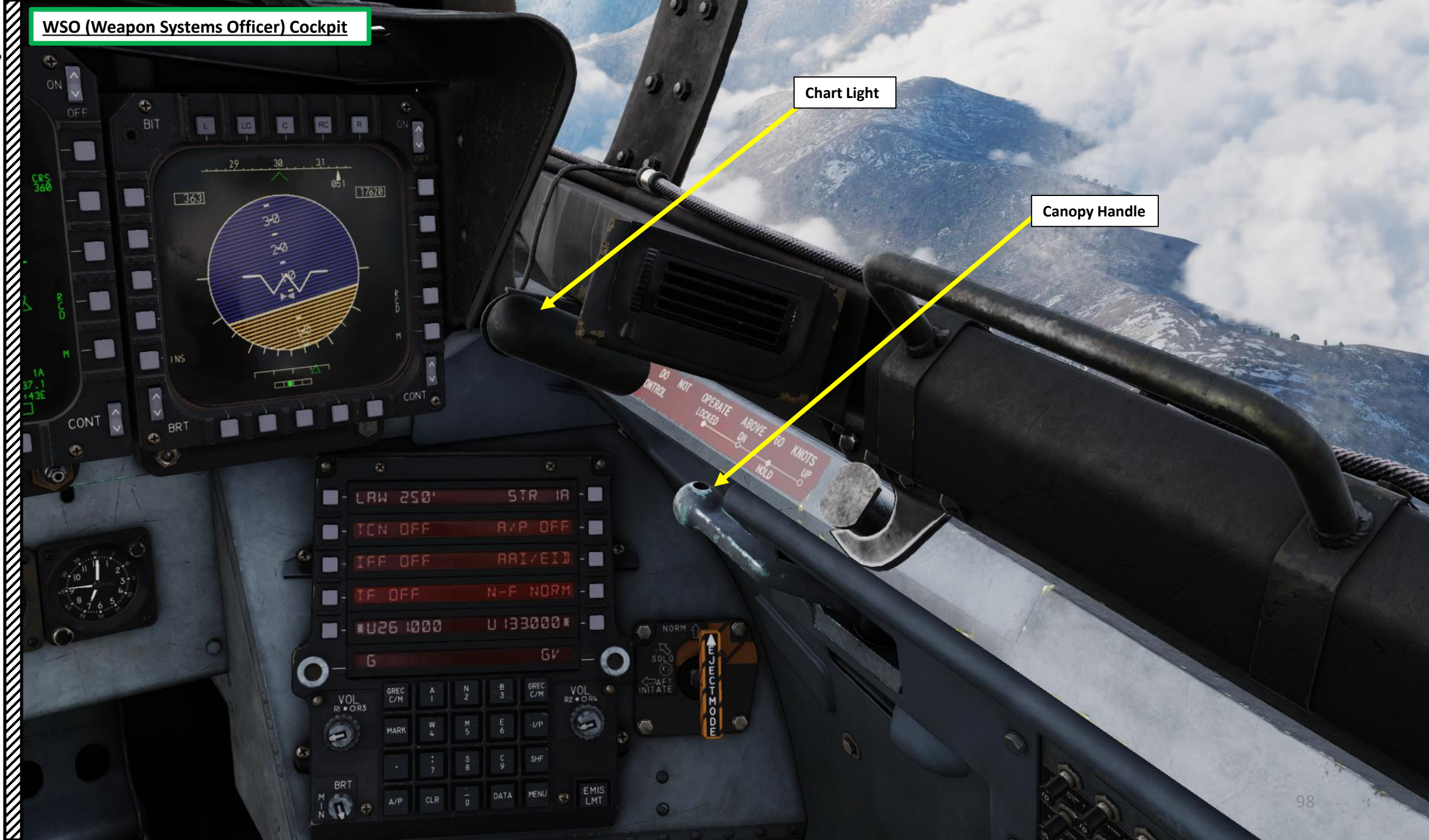
Right Hand Controller (RHC)
- *Controls the right MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + the AAI/NCTR/EWWS (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set).*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

WSO (Weapon Systems Officer) Cockpit



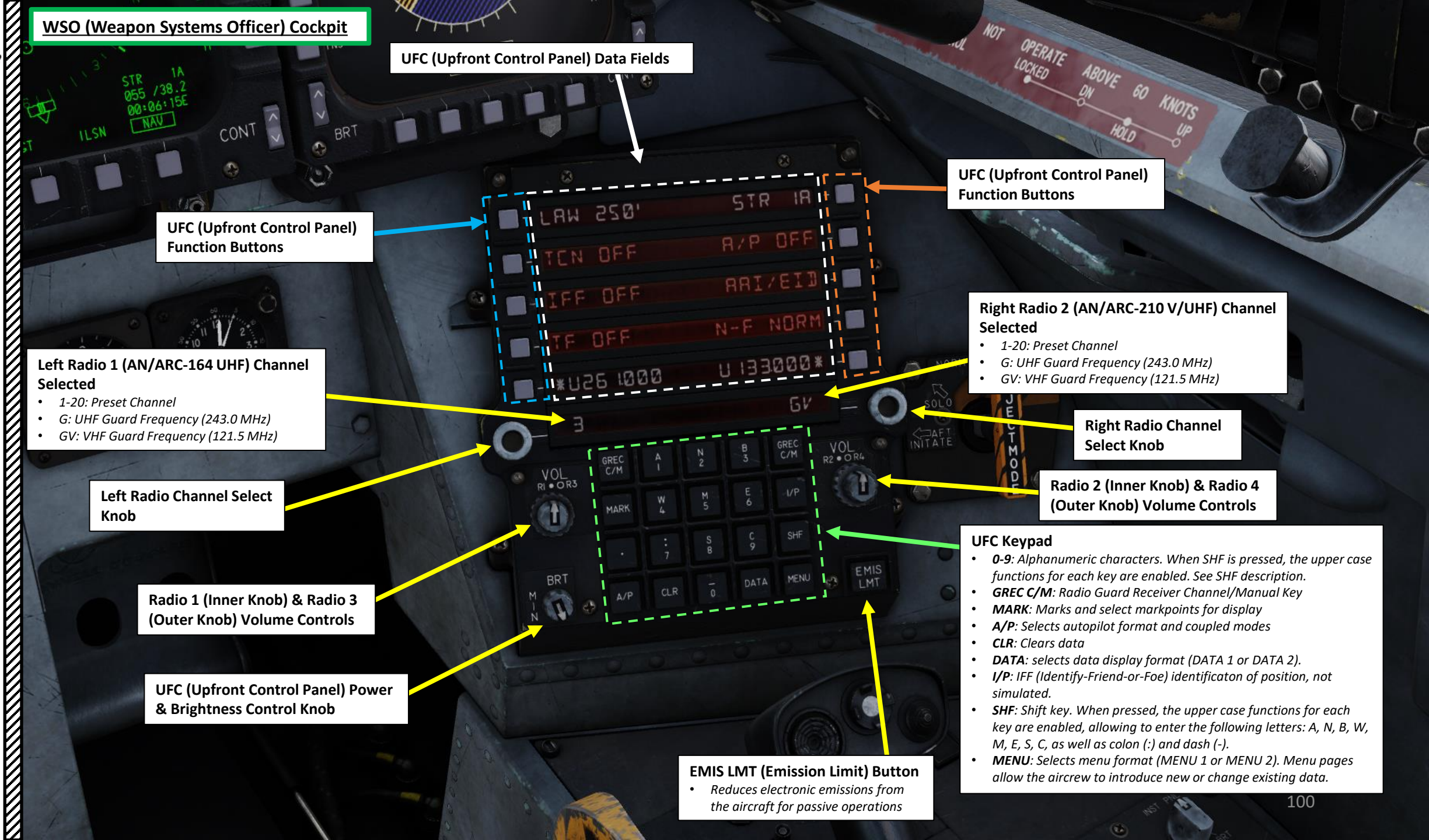
WSO (Weapon Systems Officer) Cockpit

Command Selector Valve

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 the WSO goes and the pilot stays in the jet until he pulls his own handles.*
- *AFT INITIATION (Horizontal): Dual ejection (rear seat first) when initiated from either 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.*

WSO (Weapon Systems Officer) Cockpit



UFC (Upfront Control Panel) Data Fields

UFC (Upfront Control Panel) Function Buttons

UFC (Upfront Control Panel) Function Buttons

Left Radio 1 (AN/ARC-164 UHF) Channel Selected
- *1-20: Preset Channel*
- *G: UHF Guard Frequency (243.0 MHz)*
- *GV: VHF Guard Frequency (121.5 MHz)*

Left Radio Channel Select Knob

Radio 1 (Inner Knob) & Radio 3 (Outer Knob) Volume Controls

UFC (Upfront Control Panel) Power & Brightness Control Knob

Right Radio 2 (AN/ARC-210 V/UHF) Channel Selected
- *1-20: Preset Channel*
- *G: UHF Guard Frequency (243.0 MHz)*
- *GV: VHF Guard Frequency (121.5 MHz)*

Right Radio Channel Select Knob

Radio 2 (Inner Knob) & Radio 4 (Outer Knob) Volume Controls

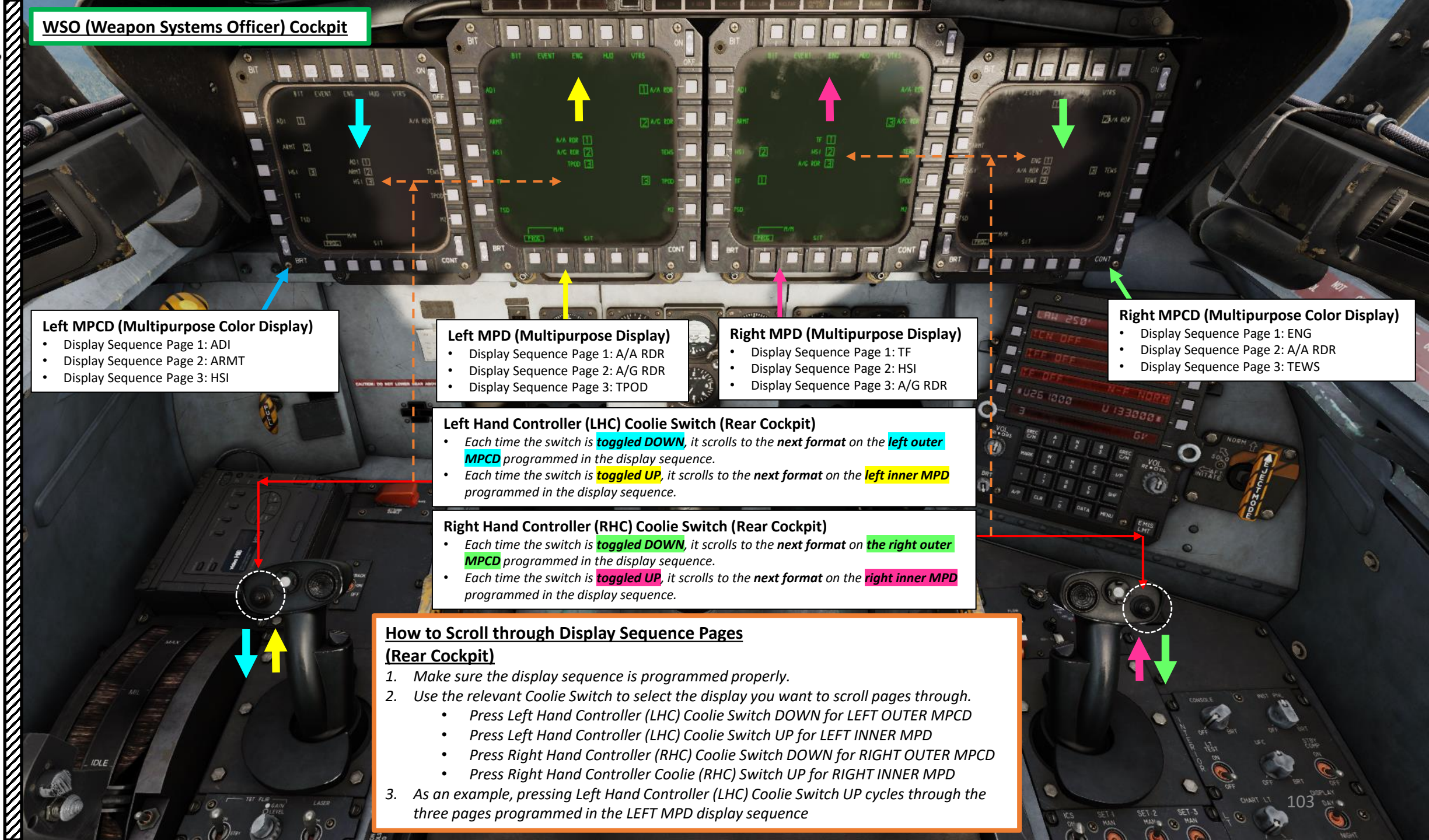
UFC Keypad
- ***0-9**: Alphanumeric characters. When SHF is pressed, the upper case functions for each key are enabled. See SHF description.*
- ***GREC C/M**: Radio Guard Receiver Channel/Manual Key*
- ***MARK**: Marks and select markpoints for display*
- ***A/P**: Selects autopilot format and coupled modes*
- ***CLR**: Clears data*
- ***DATA**: selects data display format (DATA 1 or DATA 2).*
- ***I/P**: IFF (Identify-Friend-or-Foe) identificaton of position, not simulated.*
- ***SHF**: Shift key. When 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 dash (-).*
- ***MENU**: Selects menu format (MENU 1 or MENU 2). Menu pages allow the aircrew to introduce new or change existing data.*

EMIS LMT (Emission Limit) Button
- *Reduces electronic emissions from the aircraft for passive operations*

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit



Left MPCD (Multipurpose Color Display)
- Display Sequence Page 1: ADI
- Display Sequence Page 2: ARMT
- Display Sequence Page 3: HSI

Left MPD (Multipurpose Display)
- Display Sequence Page 1: A/A RDR
- Display Sequence Page 2: A/G RDR
- Display Sequence Page 3: TPOD

Right MPD (Multipurpose Display)
- Display Sequence Page 1: TF
- Display Sequence Page 2: HSI
- Display Sequence Page 3: A/G RDR

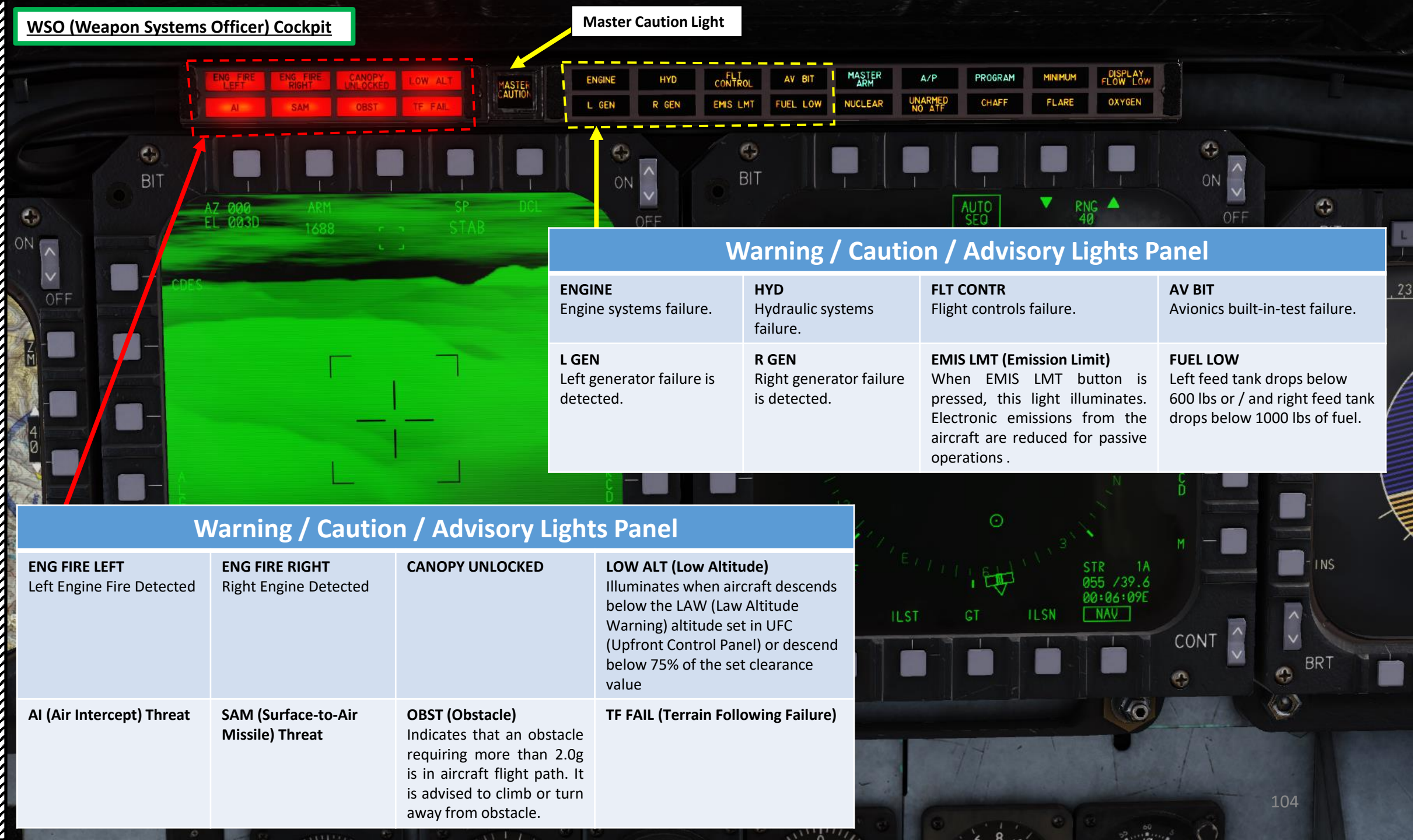
Right MPCD (Multipurpose Color Display)
- Display Sequence Page 1: ENG
- Display Sequence Page 2: A/A RDR
- Display Sequence Page 3: TEWS

Left Hand Controller (LHC) Coolie Switch (Rear Cockpit)
- *Each time the switch is **toggled DOWN**, it scrolls to the **next format** on the **left outer MPCD** programmed in the display sequence.*
- *Each time the switch is **toggled UP**, it scrolls to the **next format** on the **left inner MPD** programmed in the display sequence.*

Right Hand Controller (RHC) Coolie Switch (Rear Cockpit)
- *Each time the switch is **toggled DOWN**, it scrolls to the **next format** on **the right outer MPCD** programmed in the display sequence.*
- *Each time the switch is **toggled UP**, it scrolls to the **next format** on the **right inner MPD** programmed in the display sequence.*

How to Scroll through Display Sequence Pages (Rear Cockpit)

1. *Make sure the display sequence is programmed properly.*
2. *Use the relevant Coolie Switch to select the display you want to scroll pages through.*
   - *Press Left Hand Controller (LHC) Coolie Switch DOWN for LEFT OUTER MPCD*
   - *Press Left Hand Controller (LHC) Coolie Switch UP for LEFT INNER MPD*
   - *Press Right Hand Controller (RHC) Coolie Switch DOWN for RIGHT OUTER MPCD*
   - *Press Right Hand Controller Coolie (RHC) Switch UP for RIGHT INNER MPD*
3. *As an example, pressing Left Hand Controller (LHC) Coolie Switch UP cycles through the three pages programmed in the LEFT MPD display sequence*



Warning / Caution / Advisory Lights Panel

ENGINE Engine systems failure.	**HYD** Hydraulic systems failure.	**FLT CONTR** Flight controls failure.	**AV BIT** Avionics built-in-test failure.
L GEN Left generator failure is detected.	**R GEN** Right generator failure is detected.	**EMIS LMT (Emission Limit)** When EMIS LMT button is pressed, this light illuminates. Electronic emissions from the aircraft are reduced for passive operations .	**FUEL LOW** Left feed tank drops below 600 lbs or / and right feed tank drops below 1000 lbs of fuel.

Warning / Caution / Advisory Lights Panel

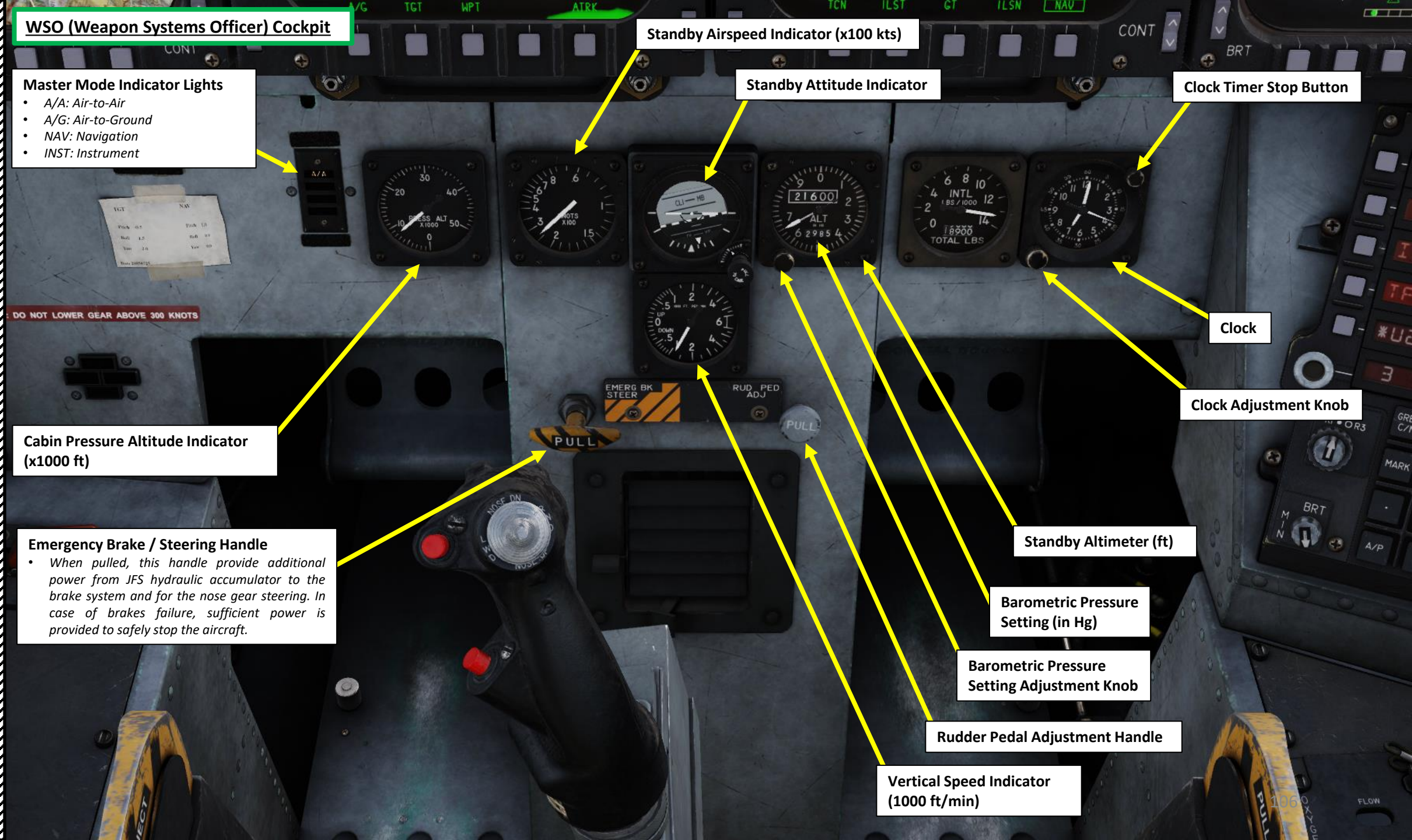
ENG FIRE LEFT Left Engine Fire Detected	**ENG FIRE RIGHT** Right Engine Detected	**CANOPY UNLOCKED**	**LOW ALT (Low Altitude)** Illuminates when aircraft descends below the LAW (Law Altitude Warning) altitude set in UFC (Upfront Control Panel) or descend below 75% of the set clearance value
AI (Air Intercept) Threat	**SAM (Surface-to-Air Missile) Threat**	**OBST (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 (Terrain Following Failure)**

WSO (Weapon Systems Officer) Cockpit

Warning / Caution / Advisory Lights Panel

MASTER ARM Master Arm switch is in ON position	**A/P** Autopilot is Engaged	**PROGRAM** Countermeasure dispenser is in semi-auto mode and that pre-selected program is ready to be deployed.	**MINIMUM** **D**ispensable stores reach pre-determined level.	**DISPLAY FLOW LOW** Inadequate cooling air flow to cockpit displays.
NUCLEAR: Nuclear armament malfunction.	**UNARMED NO ATF** UNARMED means malfunctions which preclude auto flyup; NO ATF means that Auto Terrain Following system is not available.	**CHAFF** Chaff are being dispensed when flashing, dispenser is empty when steady.	**FLARE** Flares are being dispensed when flashing, dispenser is empty when steady.	**OXYGEN** Onboard oxygen system failure is detected.

WSO (Weapon Systems Officer) Cockpit



Master Mode Indicator Lights
- *A/A: Air-to-Air*
- *A/G: Air-to-Ground*
- *NAV: Navigation*
- *INST: Instrument*

Standby Airspeed Indicator (x100 kts)

Standby Attitude Indicator

Clock Timer Stop Button

Clock

Clock Adjustment Knob

Cabin Pressure Altitude Indicator (x1000 ft)

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.*

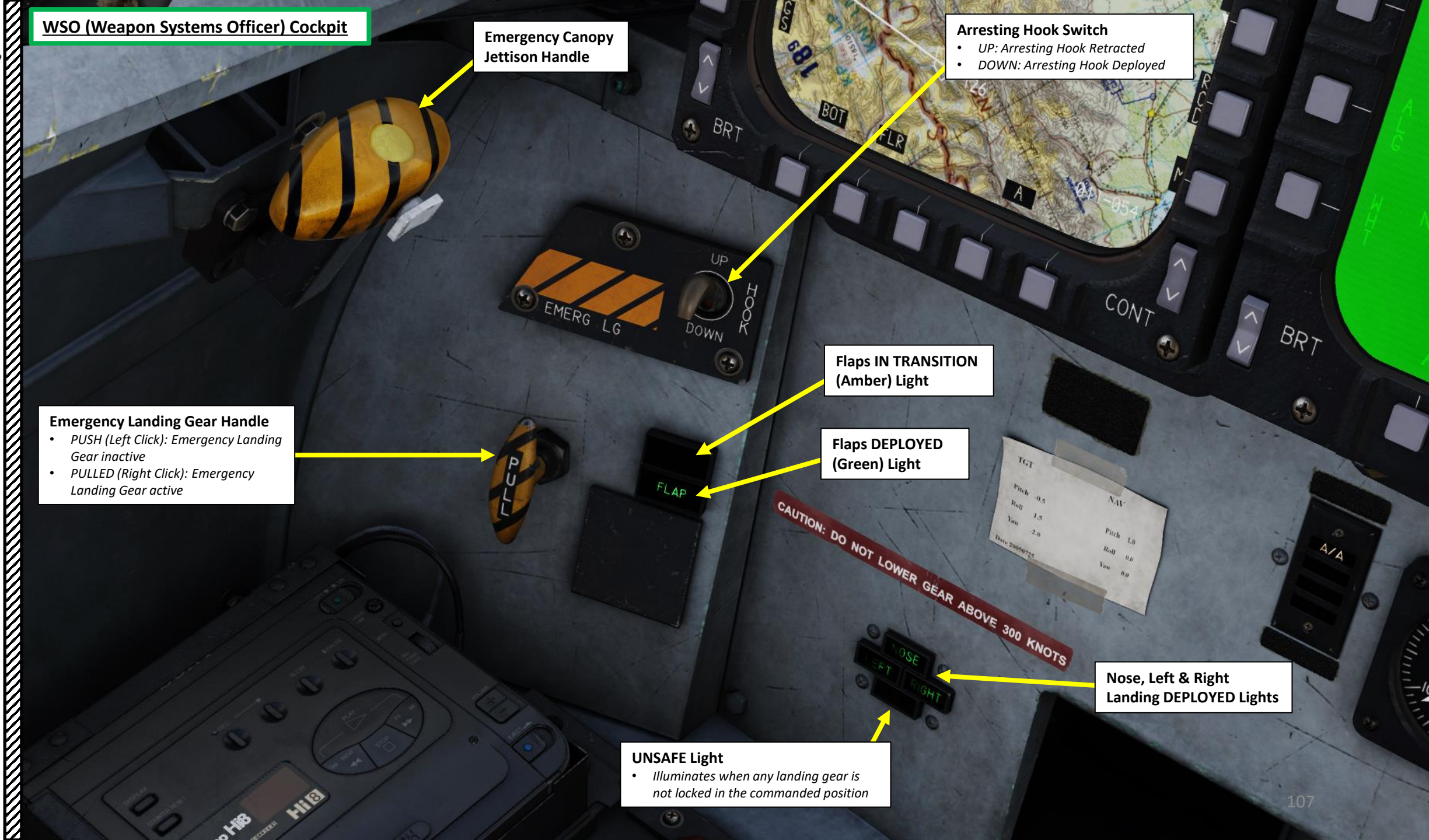
Standby Altimeter (ft)

Barometric Pressure Setting (in Hg)

Barometric Pressure Setting Adjustment Knob

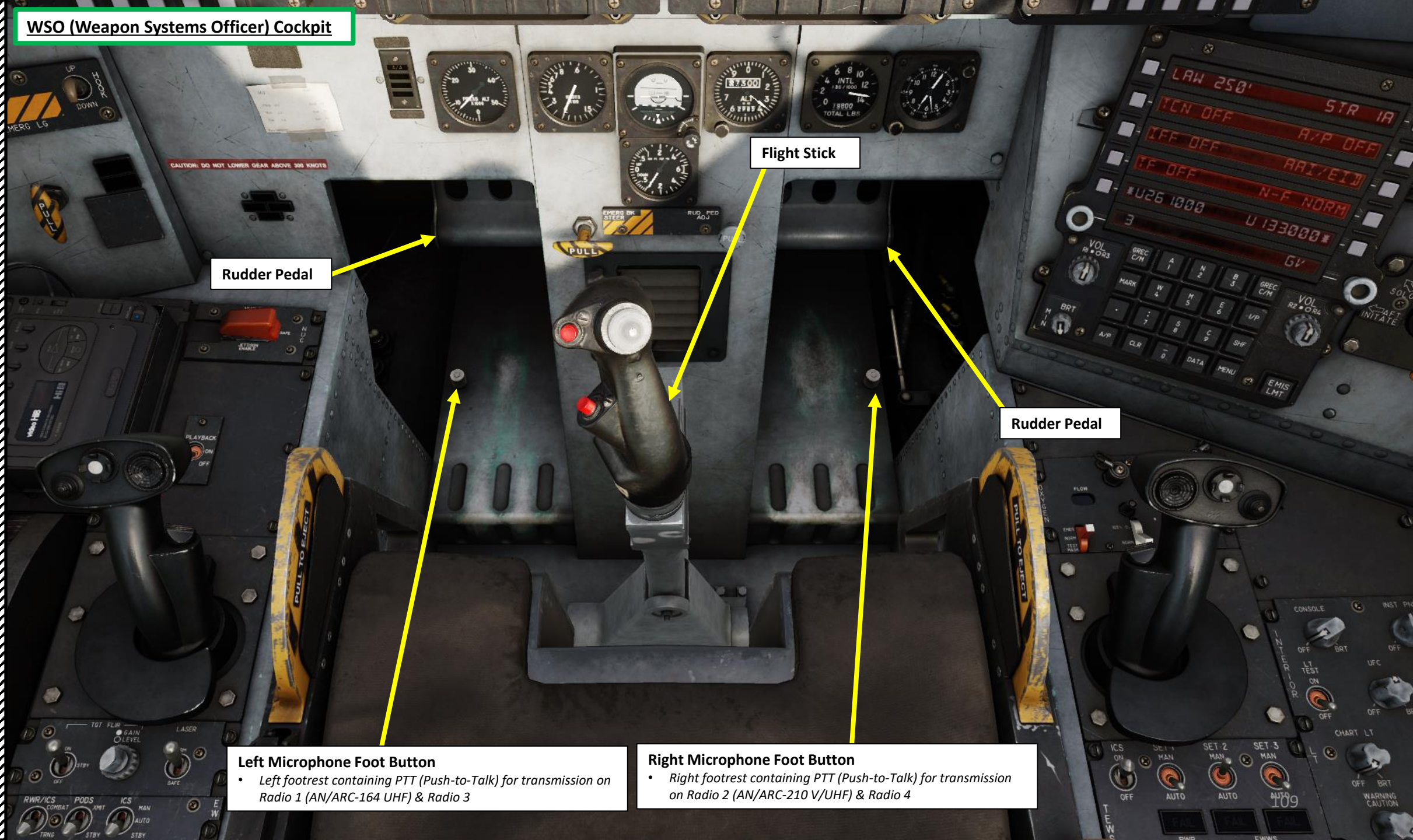
Rudder Pedal Adjustment Handle

Vertical Speed Indicator (1000 ft/min)

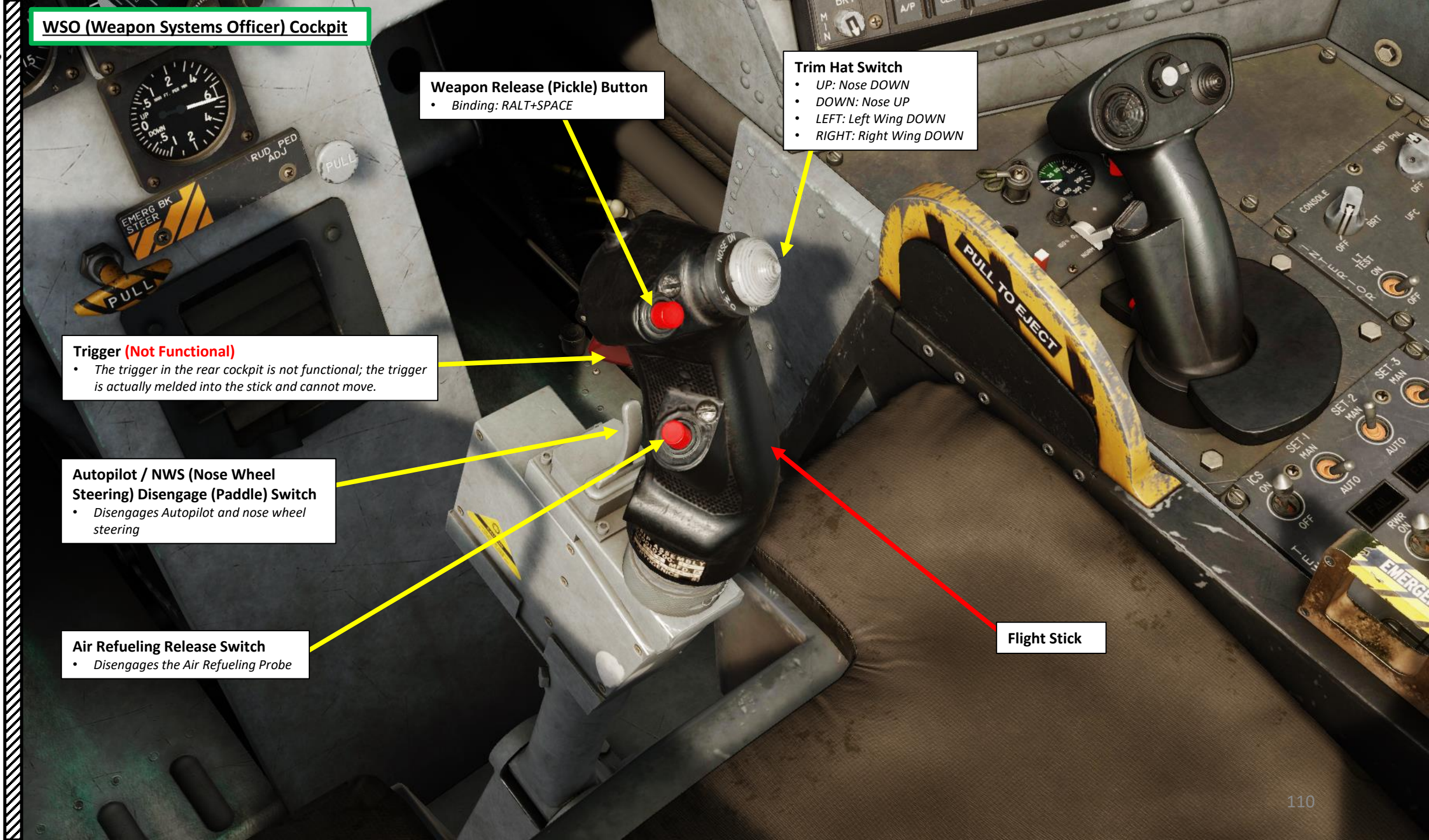

WSO (Weapon Systems Officer) Cockpit
Emergency Canopy Jettison Handle
Arresting Hook Switch
• UP: Arresting Hook Retracted
• DOWN: Arresting Hook Deployed
EMERG LG
UP
DOWN
HOOK
BRT
BOT
FLR
CONT
Flaps IN TRANSITION (Amber) Light
Flaps DEPLOYED (Green) Light
FLAP
Emergency Landing Gear Handle
• PUSH (Left Click): Emergency Landing Gear inactive
• PULLED (Right Click): Emergency Landing Gear active
PULL
CAUTION: DO NOT LOWER GEAR ABOVE 300 KNOTS
NOSE
LEFT
RIGHT
Nose, Left & Right Landing DEPLOYED Lights
UNSAFE Light
• Illuminates when any landing gear is not locked in the commanded position

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit



WSO (Weapon Systems Officer) Cockpit



Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

Trim Hat Switch
- *UP: Nose DOWN*
- *DOWN: Nose UP*
- *LEFT: Left Wing DOWN*
- *RIGHT: Right Wing DOWN*

Trigger (Not Functional)
- *The trigger in the rear cockpit is not functional; the trigger is actually melded into the stick and cannot move.*

Autopilot / NWS (Nose Wheel Steering) Disengage (Paddle) Switch
- *Disengages Autopilot and nose wheel steering*

Air Refueling Release Switch
- *Disengages the Air Refueling Probe*

Flight Stick

WSO (Weapon Systems Officer) Cockpit

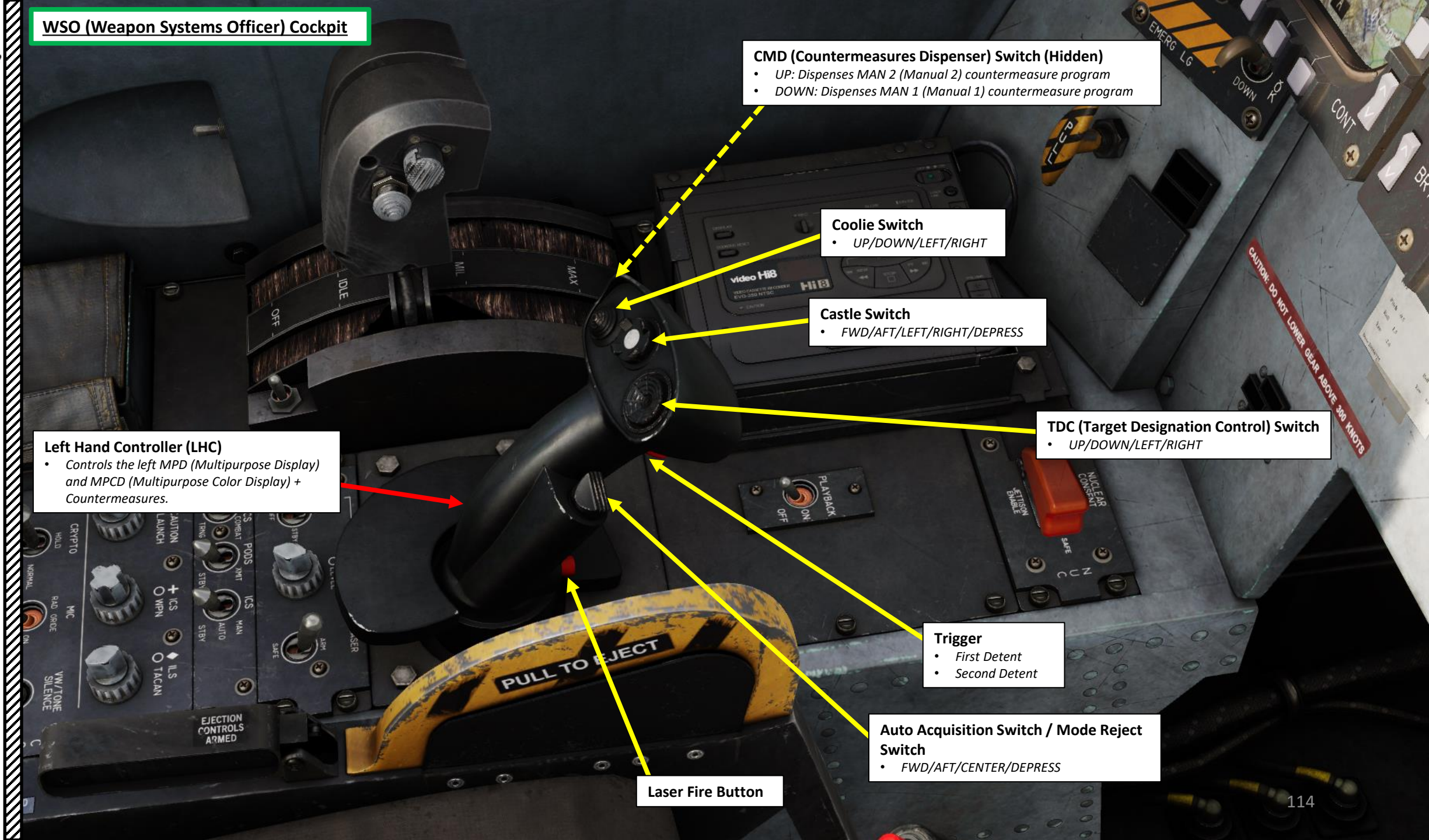
WSO (Weapon Systems Officer) Cockpit

Nuclear Consent Switch (not simulated)

- *LEFT: RELEASE*
- *MIDDLE: Jettison Enable*
- *RIGHT: SAFE*

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit



CMD (Countermeasures Dispenser) Switch (Hidden)
- *UP: Dispenses MAN 2 (Manual 2) countermeasure program*
- *DOWN: Dispenses MAN 1 (Manual 1) countermeasure program*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT*

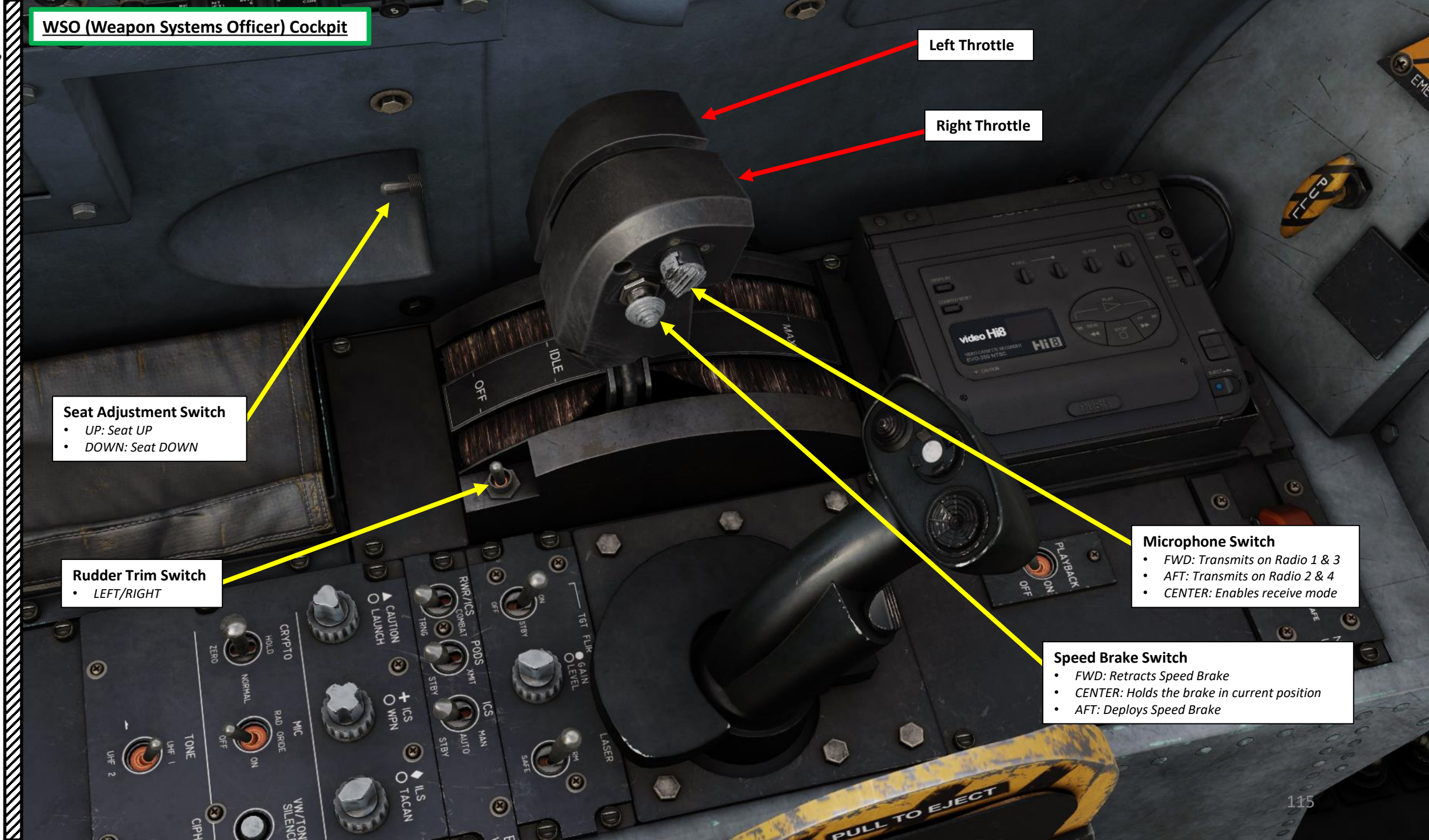
Left Hand Controller (LHC)
- *Controls the left MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + Countermeasures.*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

WSO (Weapon Systems Officer) Cockpit



WSO (Weapon Systems Officer) Cockpit

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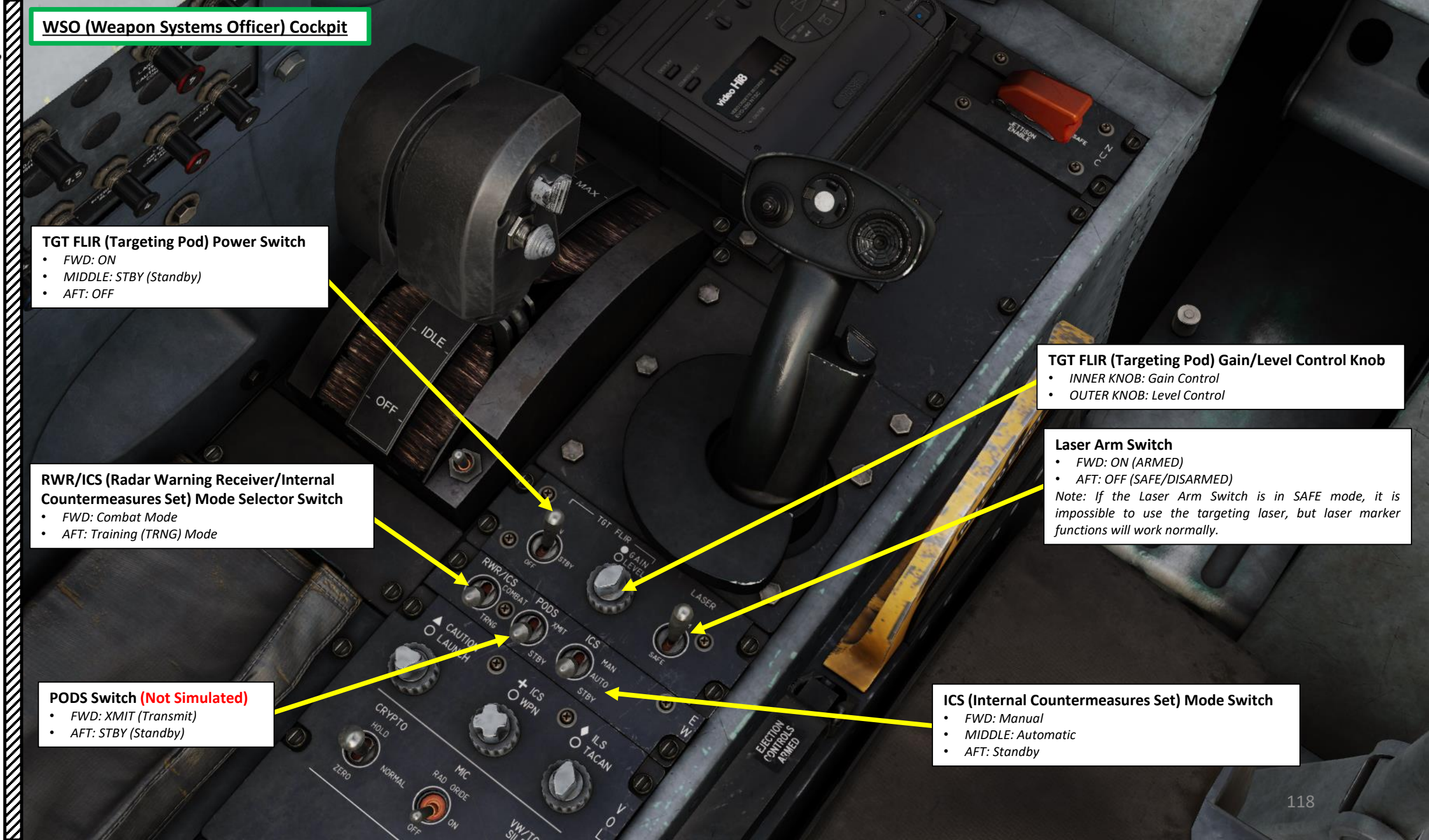


TGT FLIR (Targeting Pod) Power Switch
- *FWD: ON*
- *MIDDLE: STBY (Standby)*
- *AFT: OFF*

RWR/ICS (Radar Warning Receiver/Internal Countermeasures Set) Mode Selector Switch
- *FWD: Combat Mode*
- *AFT: Training (TRNG) Mode*

PODS Switch (Not Simulated)
- *FWD: XMIT (Transmit)*
- *AFT: STBY (Standby)*

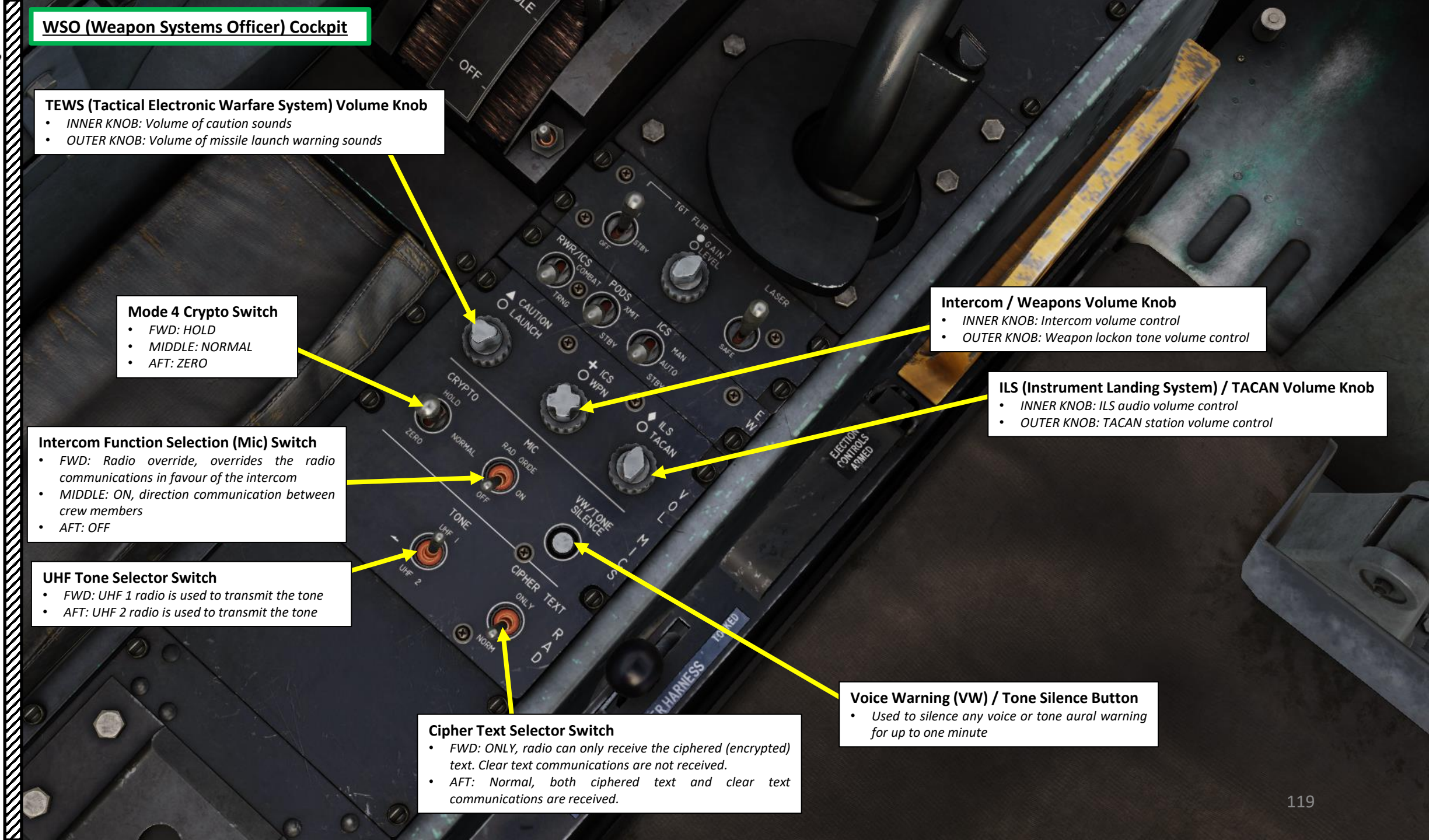
TGT FLIR (Targeting Pod) Gain/Level Control Knob
- *INNER KNOB: Gain Control*
- *OUTER KNOB: Level Control*

Laser Arm Switch
- *FWD: ON (ARMED)*
- *AFT: OFF (SAFE/DISARMED)*

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.

ICS (Internal Countermeasures Set) Mode Switch
- *FWD: Manual*
- *MIDDLE: Automatic*
- *AFT: Standby*

WSO (Weapon Systems Officer) Cockpit



TEWS (Tactical Electronic Warfare System) Volume Knob
- *INNER KNOB: Volume of caution sounds*
- *OUTER KNOB: Volume of missile launch warning sounds*

Mode 4 Crypto Switch
- *FWD: HOLD*
- *MIDDLE: NORMAL*
- *AFT: ZERO*

Intercom Function Selection (Mic) Switch
- *FWD: Radio override, overrides the radio communications in favour of the intercom*
- *MIDDLE: ON, direction communication between crew members*
- *AFT: OFF*

UHF Tone Selector Switch
- *FWD: UHF 1 radio is used to transmit the tone*
- *AFT: UHF 2 radio is used to transmit the tone*

Intercom / Weapons Volume Knob
- *INNER KNOB: Intercom volume control*
- *OUTER KNOB: Weapon lockon tone volume control*

ILS (Instrument Landing System) / TACAN Volume Knob
- *INNER KNOB: ILS audio volume control*
- *OUTER KNOB: TACAN station volume control*

Voice Warning (VW) / Tone Silence Button
- *Used to silence any voice or tone aural warning for up to one minute*

Cipher Text Selector Switch
- *FWD: ONLY, radio can only receive the ciphered (encrypted) text. Clear text communications are not received.*
- *AFT: Normal, both ciphered text and clear text communications are received.*

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit

WSO (Weapon Systems Officer) Cockpit

Environmental Sensor Pitot

- In an emergency situation during the pilot escape initiation, the seat moves up the rails leaving the aircraft. Pitot tubes on the top of the seat near the parachute container are exposed to the airstream. Pitot and Static pressure inputs to the environmental sensing unit act on the speed and altitude transducers to establish the safest mode for the pilot involved, based on the speed and altitude environment


LAW 250'
ICEN OFF
IFF OFF
TF STBY
N-F NORM

PART 3 – COCKPIT & EQUIPMENT

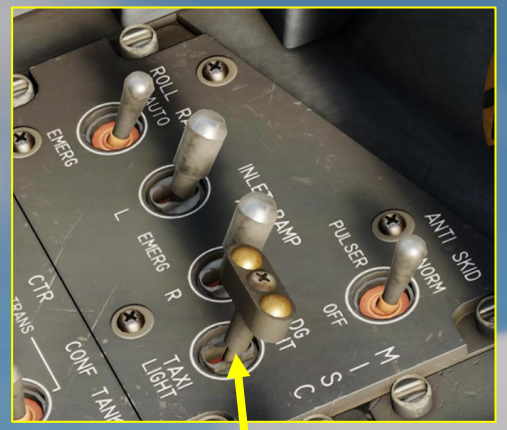

AN/APG-70 Radar Radome
AN/AAQ-14 LANTIRN (Low Altitude Navigation & Targeting Infrared for Night) Targeting Pod (TGP)
AN/AAQ-13 LANTIRN (Low Altitude Navigation & Targeting Infrared for Night) Navigation Pod (NVP)


Position Light
Position Light
Position Light
POSITION
2
3
4
5
OFF
EXT LT
FLASH BRT
Position Lights Brightness Control Knob


Formation Lights
Formation Lights
Formation Lights
Formation Lights
FORMATION
OFF
BRT
Formation Lights Brightness Control Knob

Anti-Collision Lights Control Switch
- *FWD: ON*
- *AFT: OFF*

Vertical Tail Flood Lights Control Switch
- *FWD: BRT (Bright)*
- *MIDDLE: Dim*
- *AFT: OFF*



Landing/Taxi Light Switch

- *FWD: Landing Light ON*
- *MIDDLE: Landing & Taxi Lights OFF*
- *AFT: Taxi Light ON*

Taxi Light

Landing Light


Aileron
• Hydraulically actuated
Rudder
• Hydraulically actuated
Rudder
• Hydraulically actuated
Stabilator
• Hydraulically actuated
Stabilator
• Hydraulically actuated
Aileron
• Hydraulically actuated


Nose Landing Gear
• Hydraulically actuated
Main Landing Gear
• Hydraulically actuated
Main Landing Gear
• Hydraulically actuated

Flaps Switch
- *FWD: Flaps UP/RETRACTED*
- *AFT: Flaps DOWN/DEPLOYED*

Flaps
- *Hydraulically actuated*

Flaps
- *Hydraulically actuated*

Speed Brake
- *Hydraulically actuated*

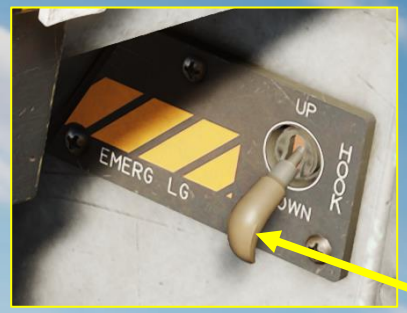
Speed Brake Switch
- *FWD: Retracts Speed Brake*
- *CENTER: Holds the brake in current position*
- *AFT: Deploys Speed Brake*


UHF Radio Antenna
Angle of Attack Sensor
Pitot Head / Air Data Probe
KRAKEN
TACAN Antenna
Combined V/UHF Antenna
Combined UHF/IFF Antenna

Engine Inlet Ramp

- *The position of the ramp is controlled automatically. This rectangular, plate-like device within the air intake of the engine is designed to generate a number of shock waves to aid the inlet compression process at supersonic speeds. The ramp sits at an acute angle to deflect the intake air from the longitudinal direction. At supersonic flight speeds, the deflection of the air stream creates a number of oblique shock waves at each change of gradient along at the ramp. Air crossing each shock wave suddenly slows to a lower Mach number, thus increasing pressure.*

PART 3 – COCKPIT & EQUIPMENT



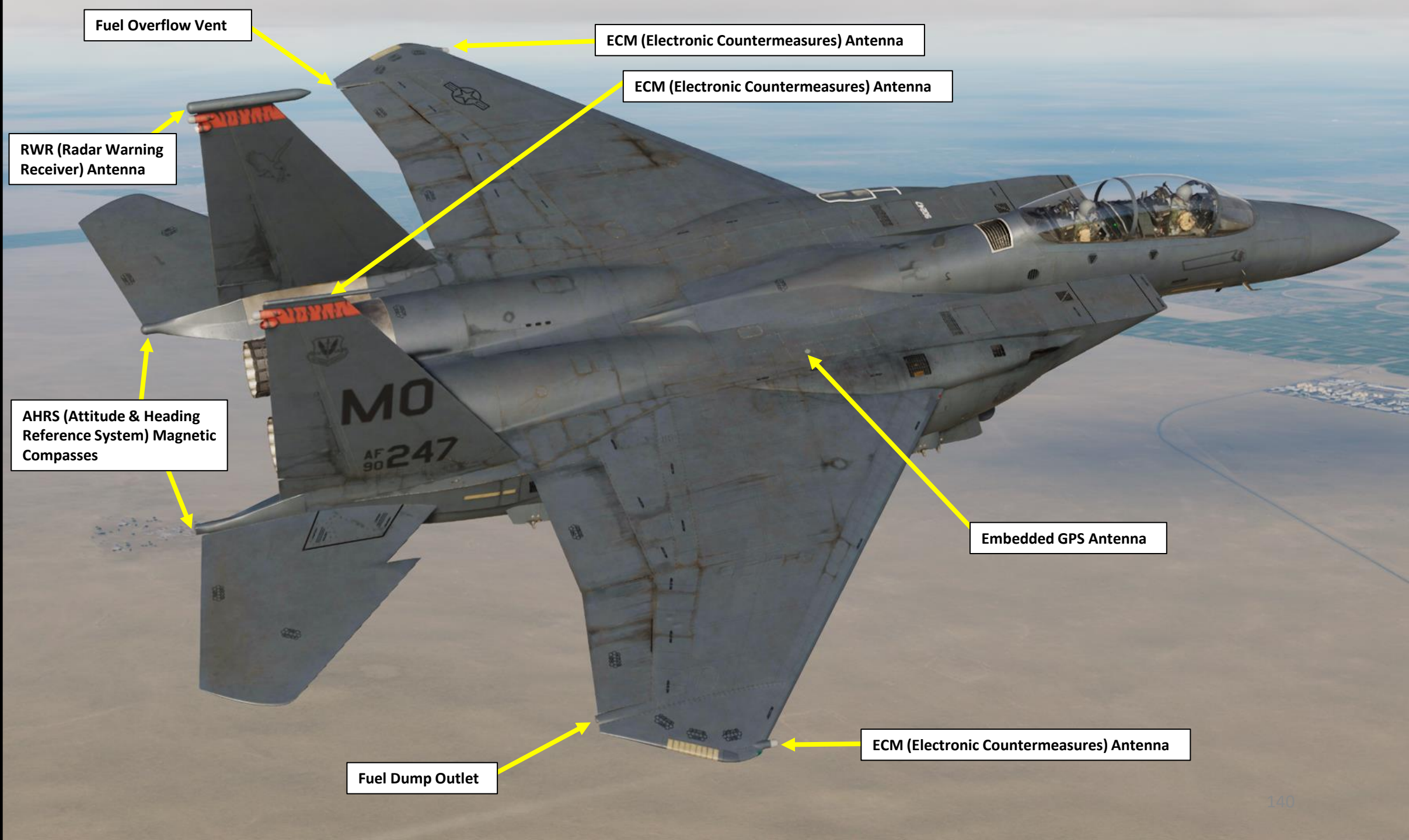
Arresting Hook Switch
- *UP: Arresting Hook Retracted*
- *DOWN: Arresting Hook Deployed*

Ram Air Exhaust

Ram Air Exhaust

Arresting Hook
- *The hook is used to achieve rapid deceleration during routine landings during emergency landings or aborted takeoffs at airports equipped with an arresting wire/cable.*


M61A1 Vulcan Gatling Cannon
(20 mm)
NO STEP


Fuel Overflow Vent
ECM (Electronic Countermeasures) Antenna
ECM (Electronic Countermeasures) Antenna
RWR (Radar Warning Receiver) Antenna
AHRS (Attitude & Heading Reference System) Magnetic Compasses
Embedded GPS Antenna
ECM (Electronic Countermeasures) Antenna
Fuel Dump Outlet
MO
AF 90 247


Countermeasure Dispensers
Countermeasure Dispensers


JFS (Jet Fuel Starter) Intake
JFS (Jet Fuel Starter) Exhaust

PART 4 – START-UP PROCEDURE

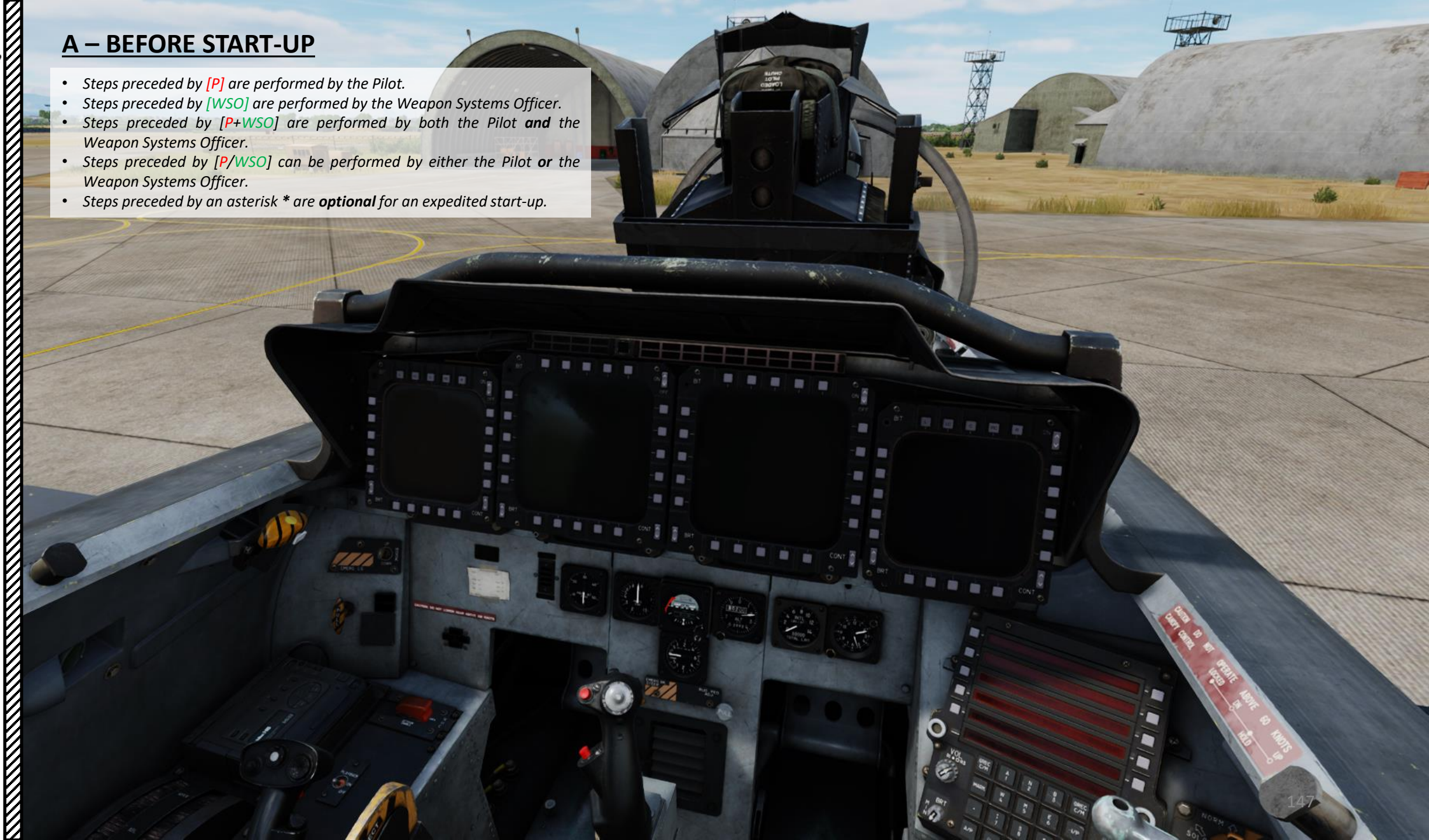
COLD START PROCEDURE OVERVIEW

- A – Before Start-Up
- B – Engine Start
- C – Avionics & Sensors Setup
- D – INS (Inertial Navigation System) Alignment
- E – Datalink Setup
- F – IFF (Identify-Friend-or-Foe) Setup
- G – PACS (Programmable Armament Control Set) Setup
- H – Display Setup
- I – Complete Aircraft Setup

A – BEFORE START-UP

A – BEFORE START-UP

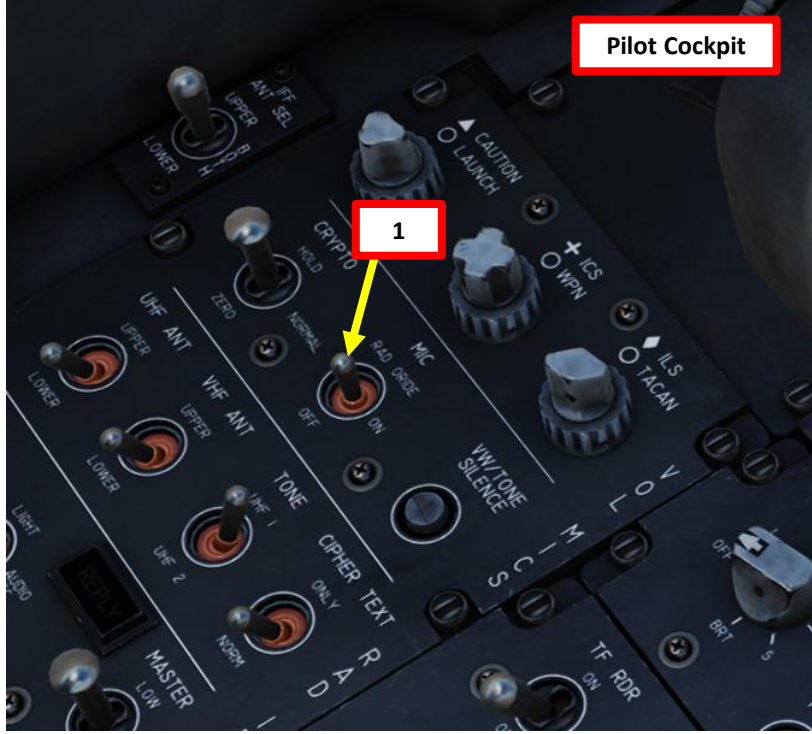
- *Steps preceded by [P] are performed by the Pilot.*
- *Steps preceded by [WSO] are performed by the Weapon Systems Officer.*
- *Steps preceded by [P+WSO] are performed by both the Pilot **and** the Weapon Systems Officer.*
- *Steps preceded by [P/WSO] can be performed by either the Pilot **or** the Weapon Systems Officer.*
- *Steps preceded by an asterisk ***** are **optional** for an expedited start-up.*

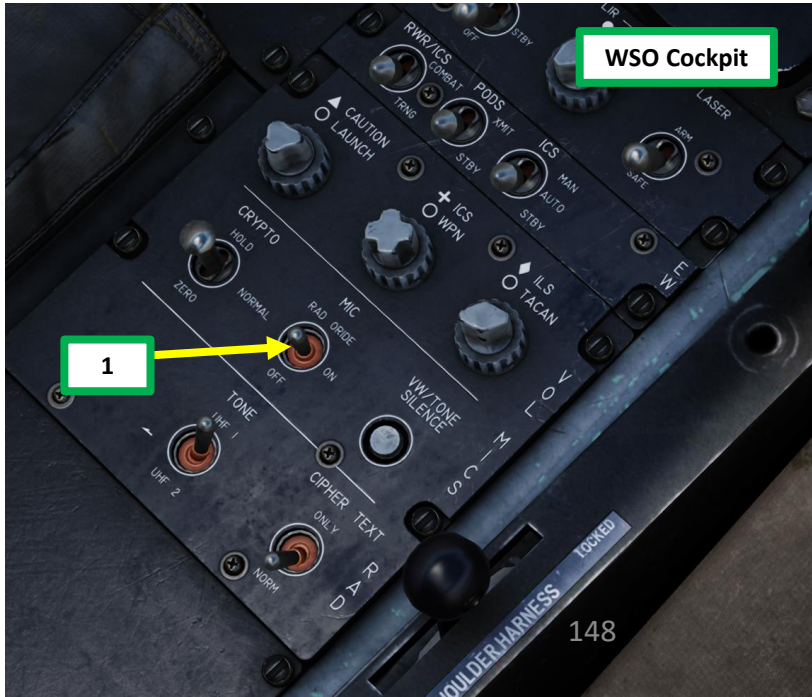


A – BEFORE START-UP

- *Note: Some steps will be omitted to keep the procedure concise and practical. We will assume that the jet is in pristine condition and that the ground crew did their job properly.*

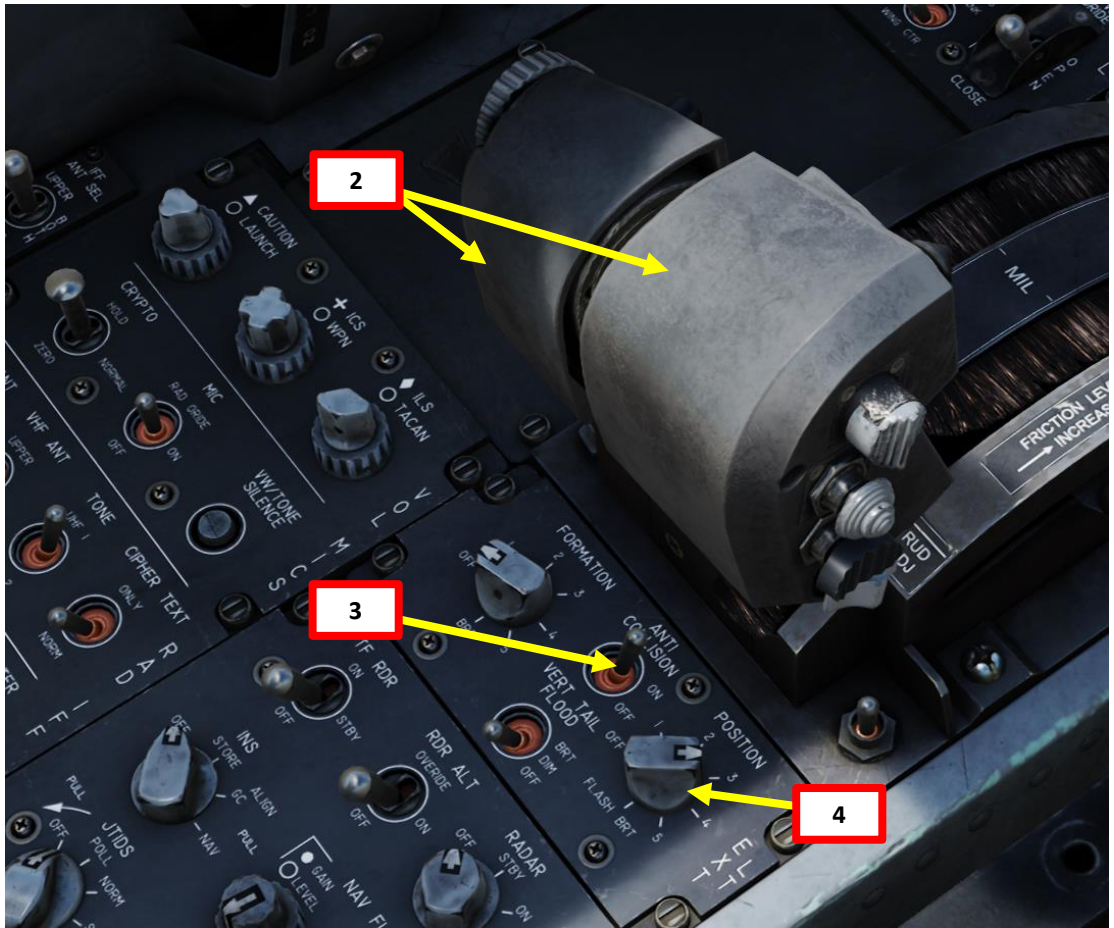
1. *[P+WSO]* Set Intercom Function Selection (Mic) Switch – ON (MIDDLE). This will allow communication between the pilot and WSO (Weapon Systems Officer) with the intercom once aircraft power is provided.

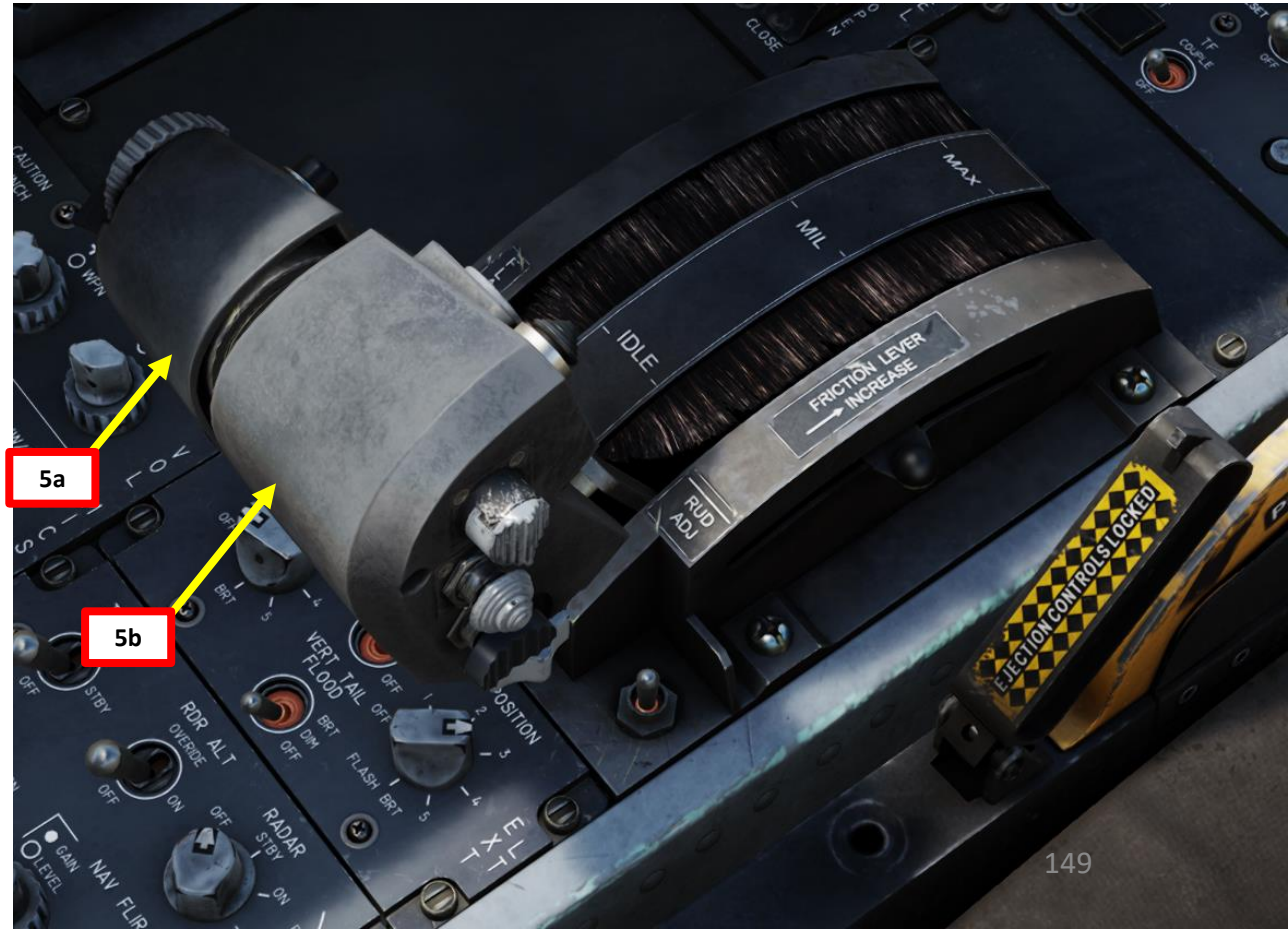




A – BEFORE START-UP

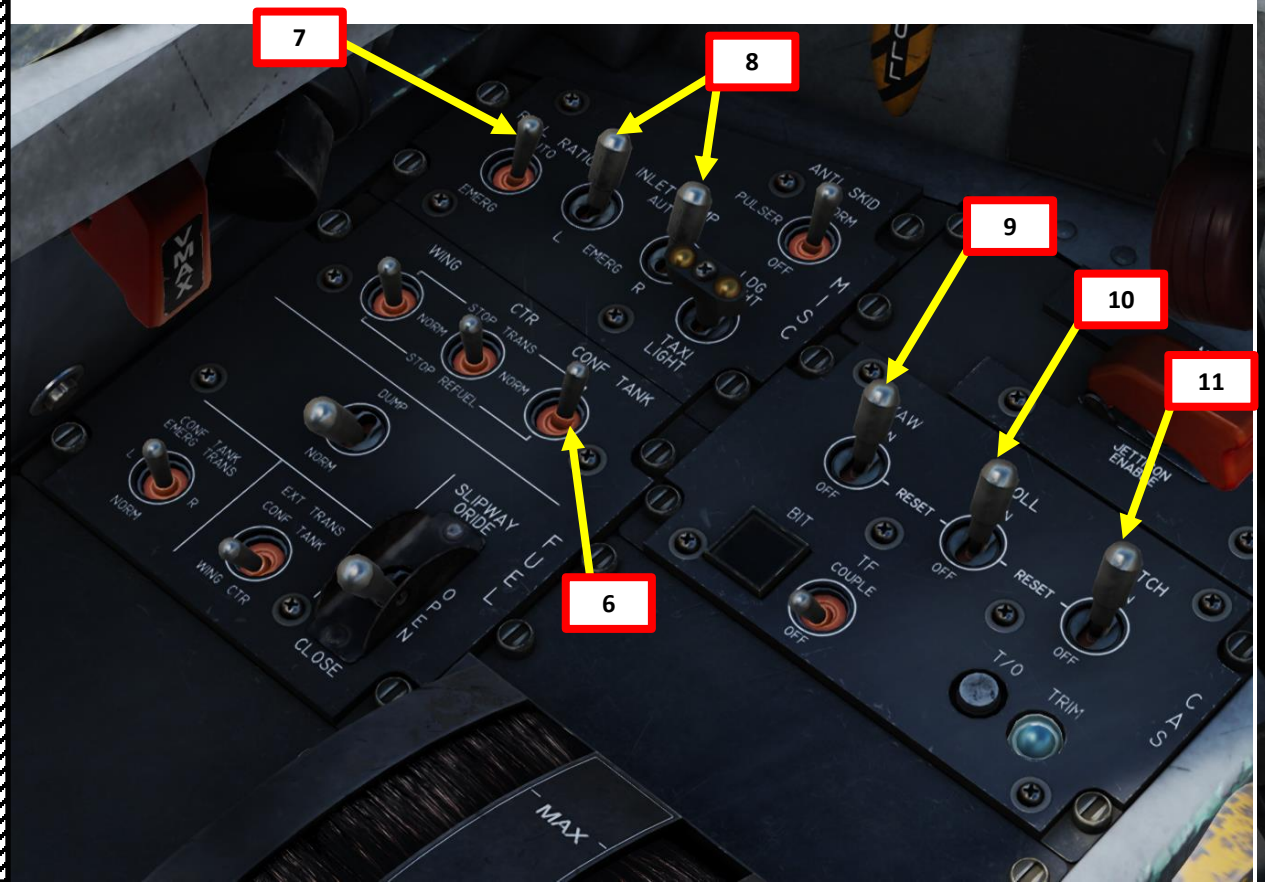
2. *[P]* If needed, move throttles forward in order to better see the external lighting panel.
3. **[P]* Set Anti-Collision Lights Control Switch – ON (FWD).
4. **[P]* Set Position Lights Brightness Control Knob – As desired. We will select a brightness setting of "3".
5. *[P]* Move throttles to OFF detent.
    a) Left Throttle to OFF: "RALT+END" binding.
    b) Right Throttle to OFF: "RSHIFT+END" binding.

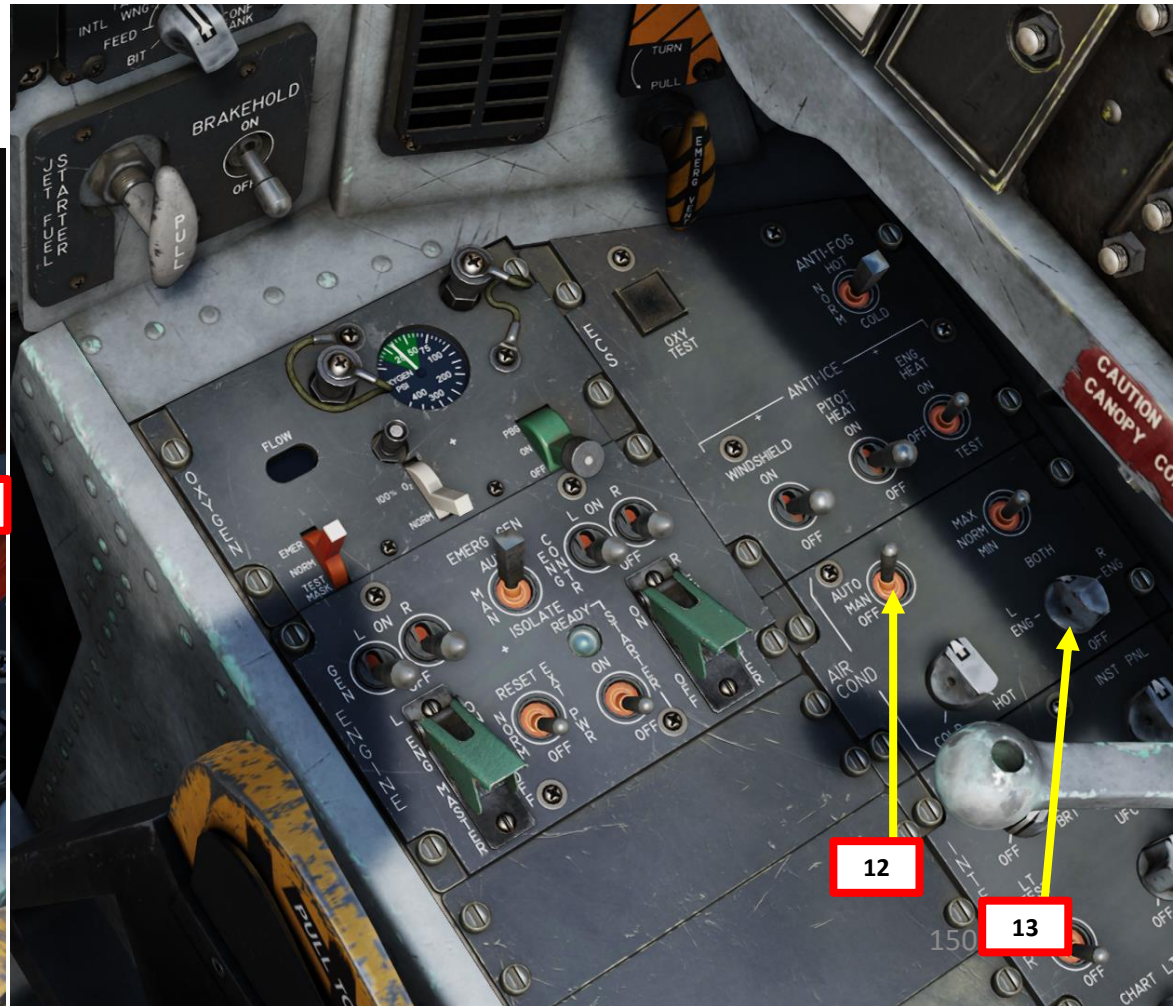




A – BEFORE START-UP

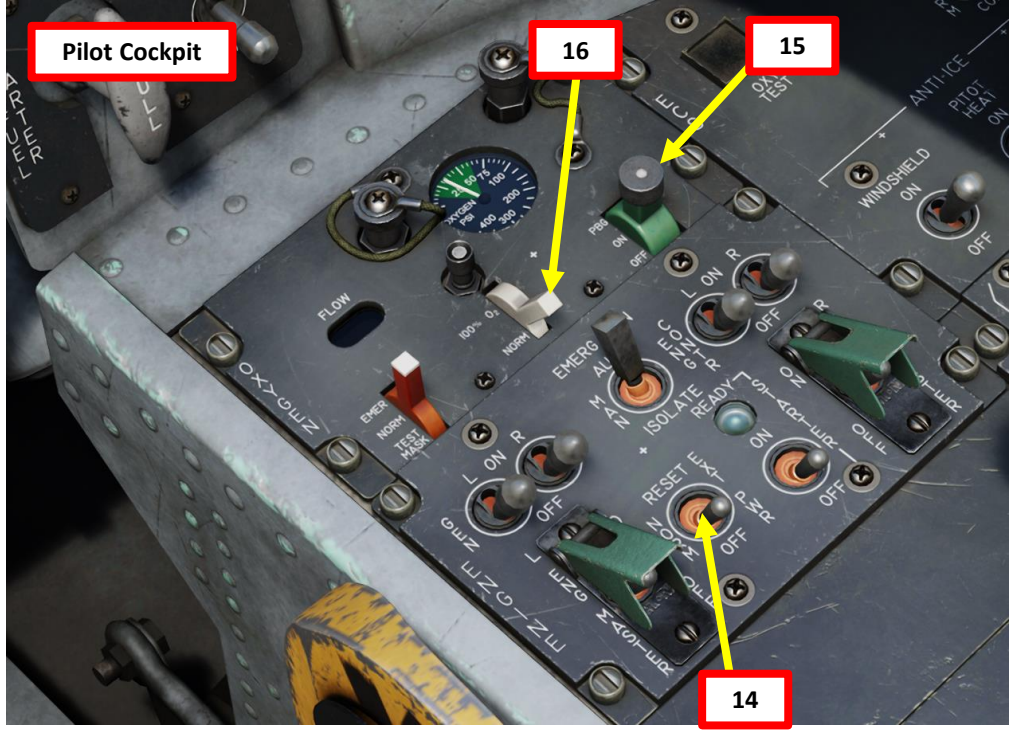
6. *[P] Set Conformal Fuel Tank Control Switch – STOP TRANSFER (FWD).
   - This step is optional and is used to check that Fuel Tank No. 1 is feeding correctly.
7. [P] Set Roll Ratio Switch – AUTO (FWD).
8. [P] Set Left & Right Inlet Ramp Switches – AUTO (FWD).
   - When in AUTO mode, engine inlet ramps will drop down once engine RPM is above 60 %.
9. [P] Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
10. [P] Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
11. [P] Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
12. [P] Set ECS (Environmental Control System) Air Temperature Mode Selector Switch – AUTO (FWD). This will open the engine bleed air valves when engine is spooled up, which sets automatic air temperature control, cockpit pressure regulation, and avionic systems cooling.
13. [P] Set ECS (Environmental Control System) Bleed Air Source Selector Knob – BOTH.

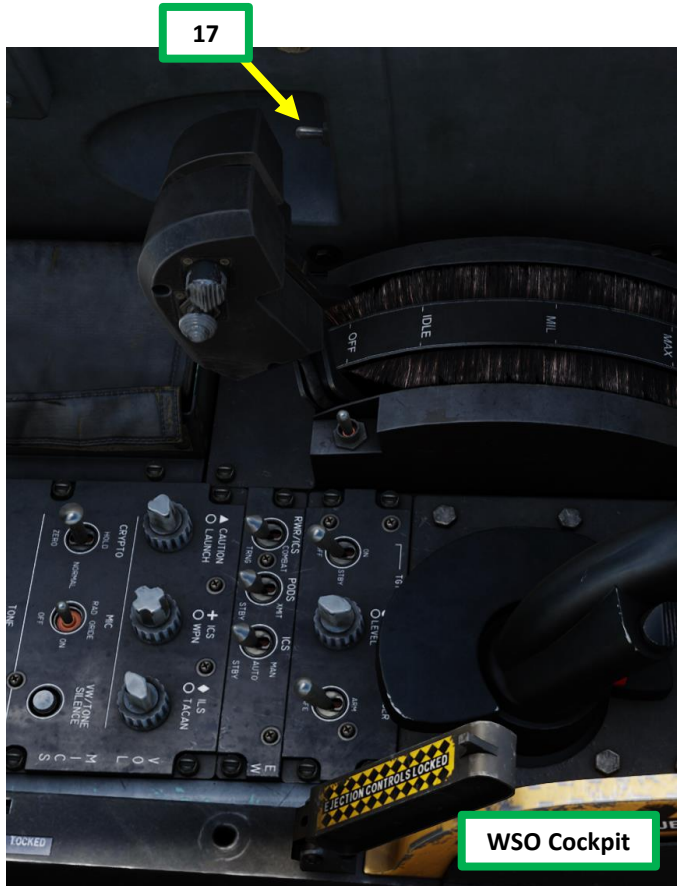


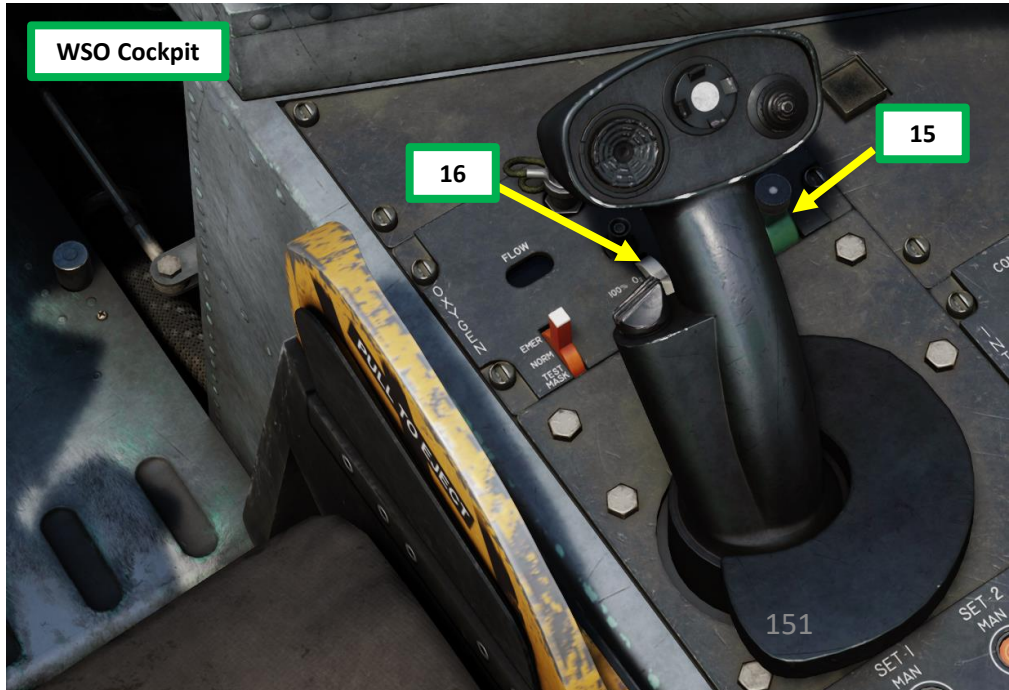


A – BEFORE START-UP

14. *[P]* If you want to use ground power to perform system checks, request the ground crew to connect the ground power unit ("/" –> F8 –> F2 –> F1). In that case, the External Power Control Switch needs to be set to NORM (MIDDLE).
    - In this tutorial, we will NOT use ground power. Therefore, the External Power Control Switch has to be set to OFF (AFT).
15. *[P+WSO]* Set Oxygen Supply Lever – ON (MIDDLE).
16. *[P+WSO]* Set Oxygen Dilute Lever – NORM (AFT).
17. **[P+WSO]* Adjust Seat position as required using the Set Adjustment Switch.

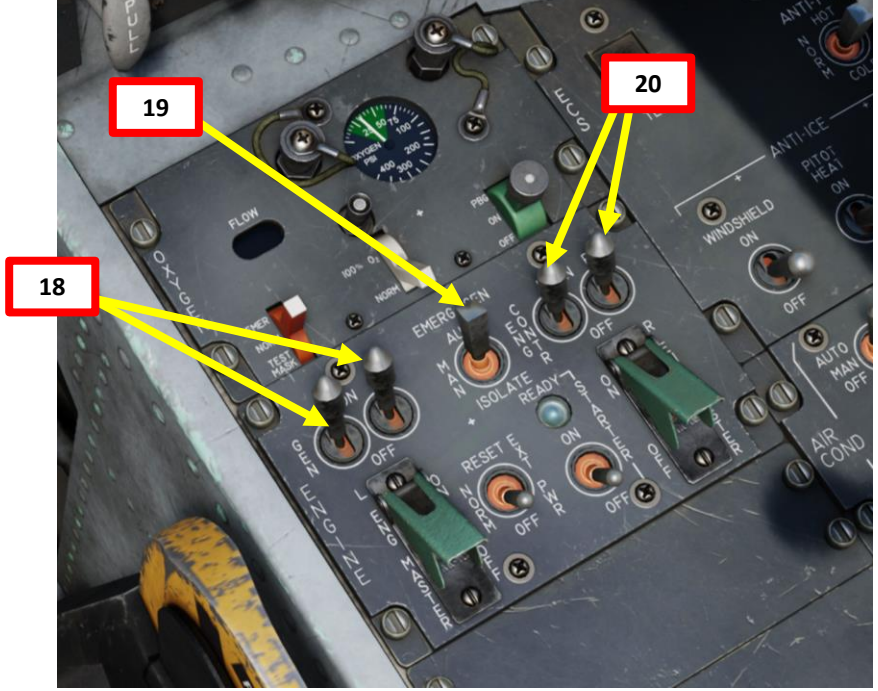


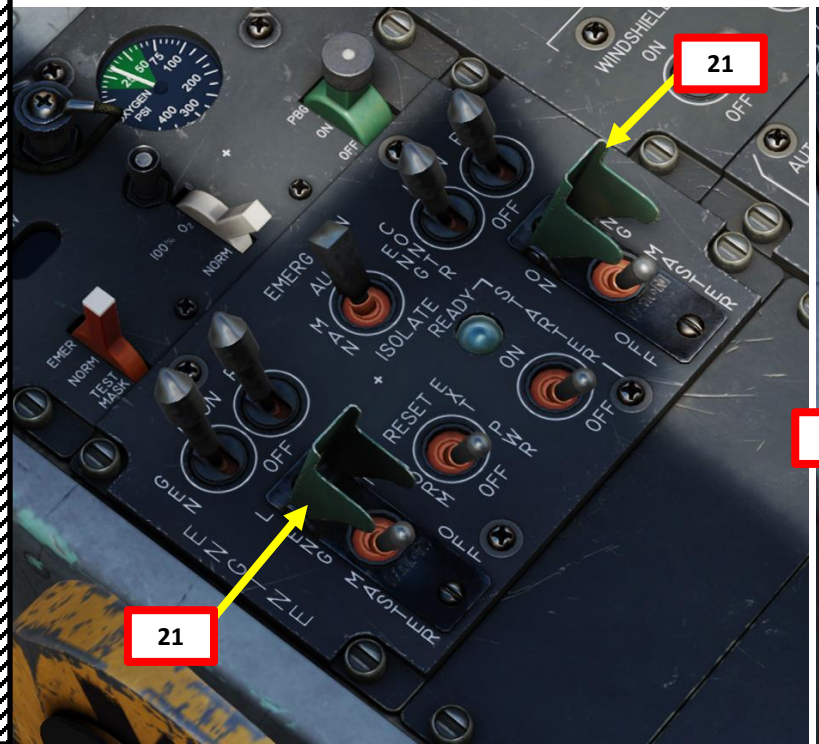


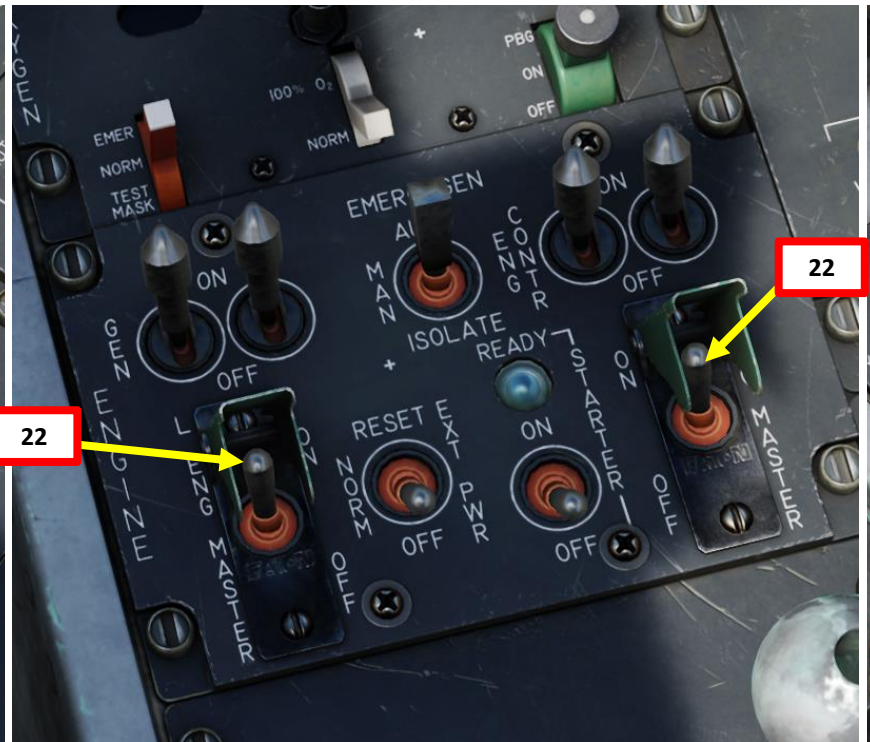


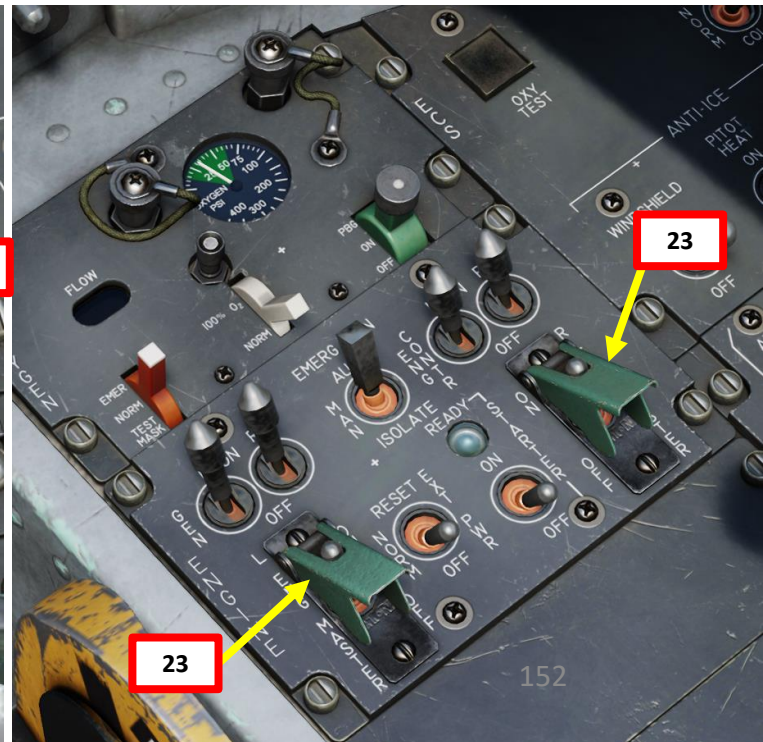
B – ENGINE START

18. *[P]* Set Left & Right Generator Switches – ON (FWD).
19. *[P]* Set Emergency Generator Switch – AUTO (FWD).
20. *[P]* Set Left & Right Engine Control Switches – ON (FWD).
21. *[P]* Flip Left & Right Engine Master Switch Covers – UP.
22. *[P]* Set Left & Right Engine Master Switches – ON (FWD).
23. *[P]* Flip Left & Right Engine Master Switch Covers – DOWN.



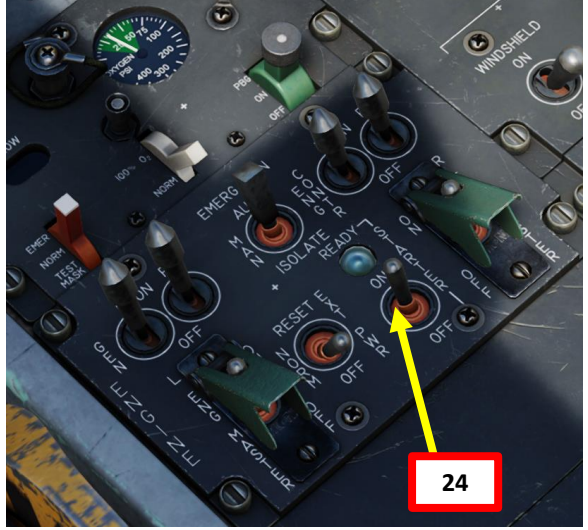


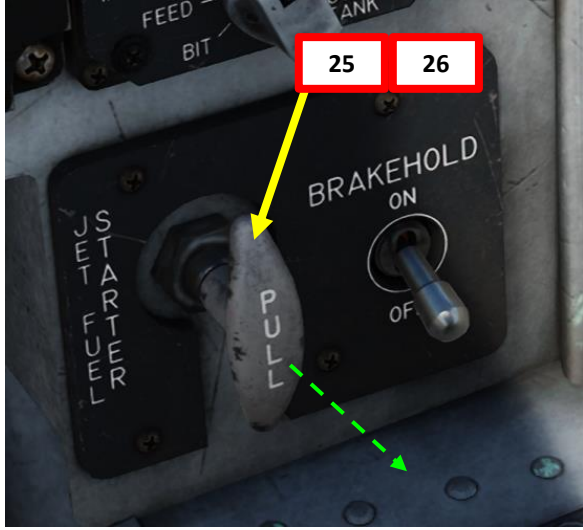


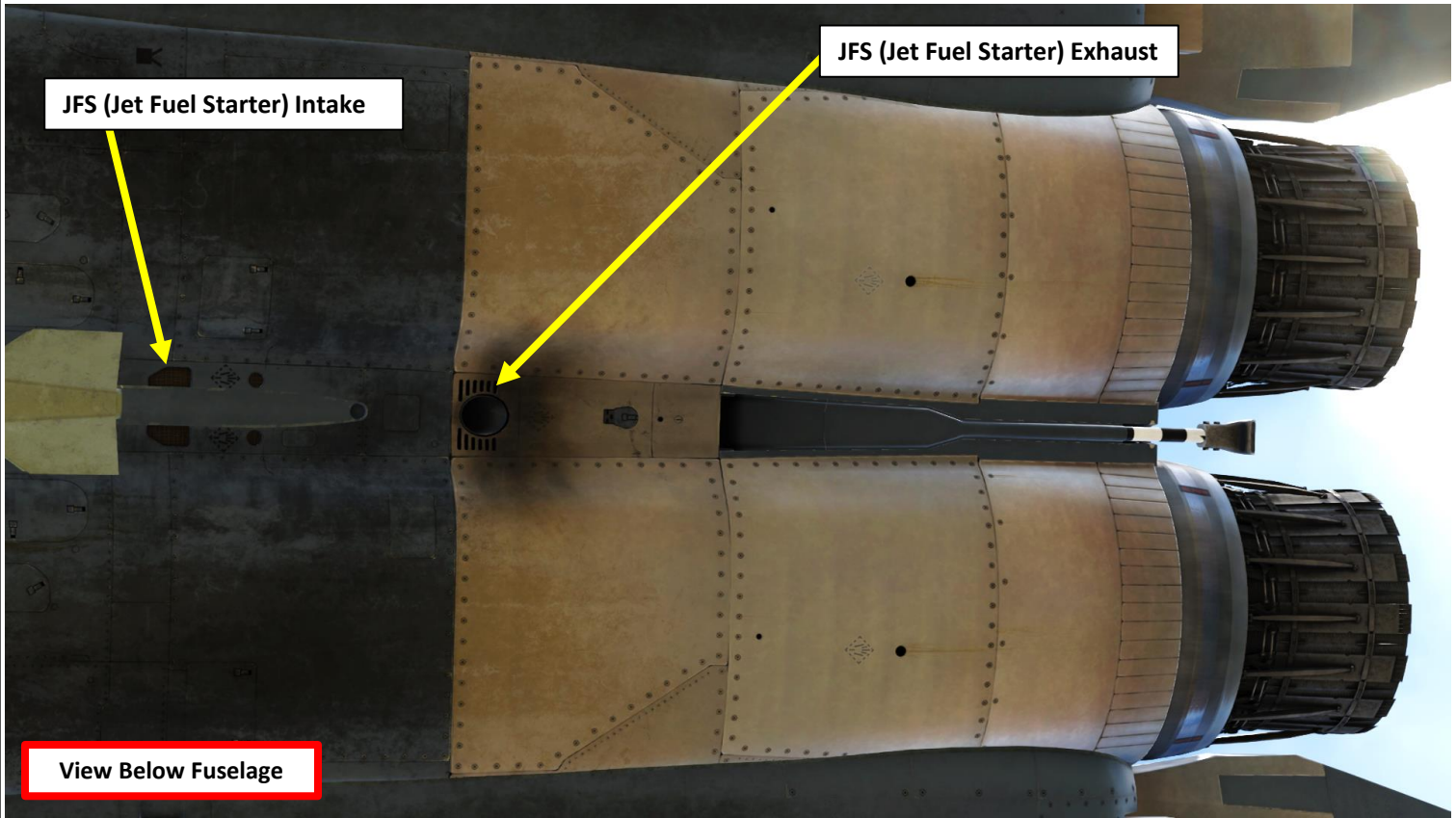


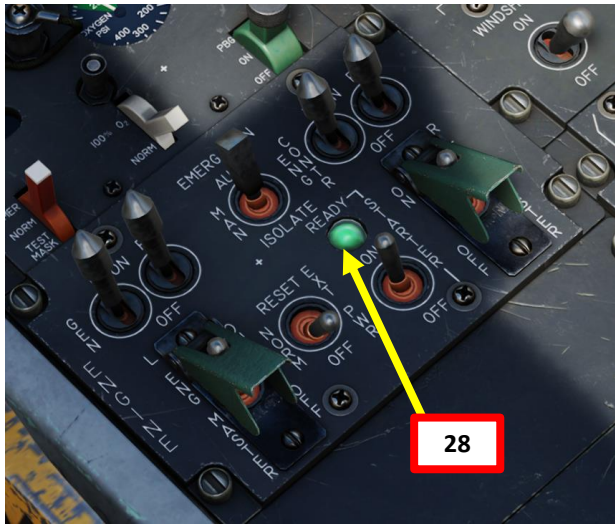
B – ENGINE START

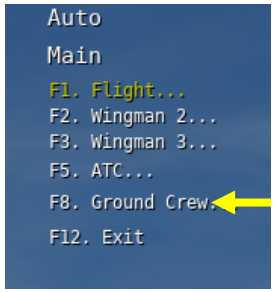
24. *[P]* Set JFS (Jet Fuel Starter) Enable Switch – ON (FWD).
25. *[P]* There are two compressed air bottles (accumulators) that can be used to start the JFS.
    - To use the first compressor air bottle, leave the handle in the vertical position. This is what we will do for this tutorial.
    - In case of a failed JFS (Jet Fuel Starter) start, you can use the second compressor air bottle by rotating the JFS (Jet Fuel Starter) Handle 45 deg counter-clockwise by right-clicking on it.
    - If compressor air bottles have already been expended during previous failed engine starts, you can request the ground crew to refill JFS Accumulator bottles ("/" –> F8 –> F7).
26. *[P]* Pull JFS (Jet Fuel Starter) Handle (left click) to initiate the JFS start-up sequence.
27. *[P]* As the JFS start-up sequence initiates, you will hear it spool up.
28. *[P]* When JFS reaches IDLE RPM (within 10 seconds), the JFS READY Light illuminates. A mechanical clutch between the JFS and the engine will be used to drive the engine starter.

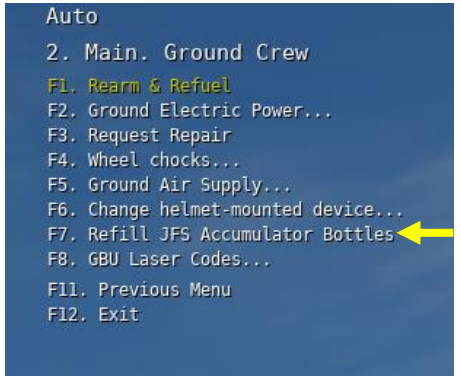






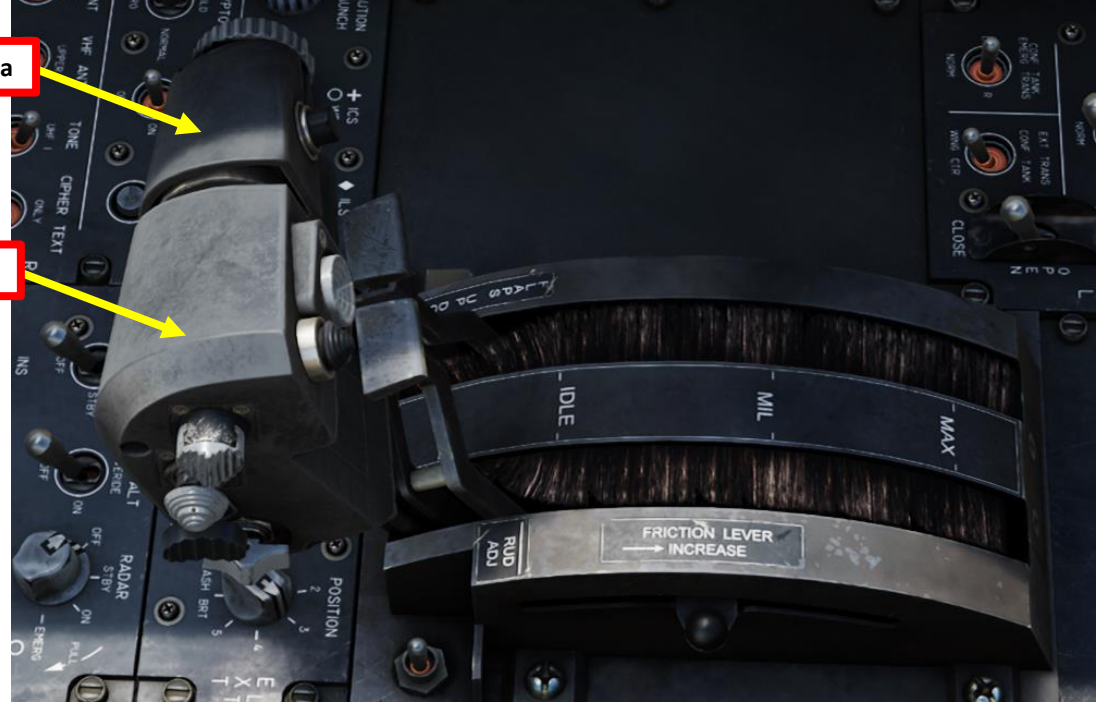






B – ENGINE START

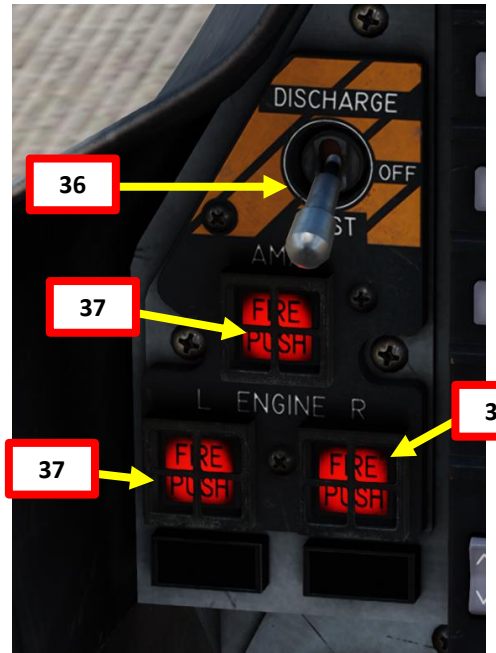
29. *[P] Set Fire Test / Extinguisher Switch – TEST (DOWN).
30. *[P] Confirm that the AMAD FIRE (Airframe Mounted Accessory Drive) light illuminates and an audible warning is heard (“WARNING AMAD FIRE”). This will indicate that fire detection system for the AMAD is functioning correctly.
31. *[P] If desired, press the Voice Warning (VW) / Tone Silence Button to silence the warning sound.
32. [P] Verify both throttles are set to OFF detent.
    a) Left Throttle to OFF: “RALT+END” binding.
    b) Right Throttle to OFF: “RSHIFT+END” binding.

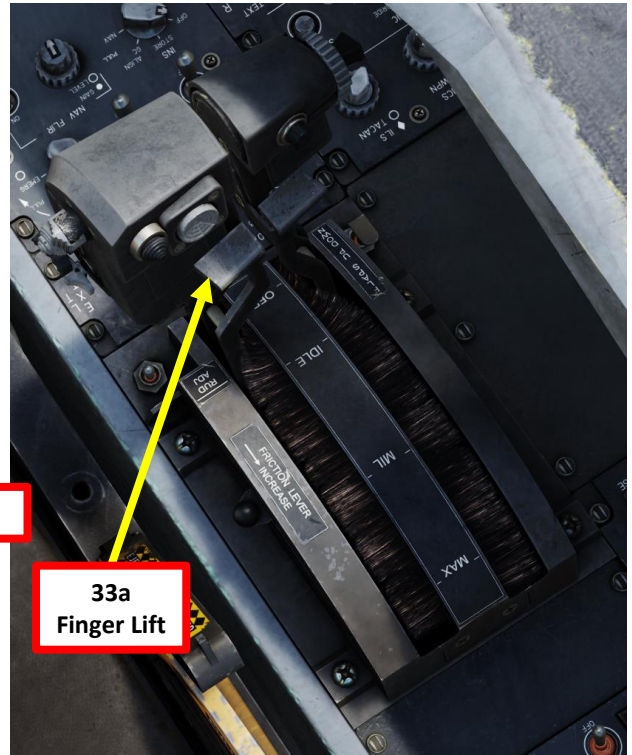


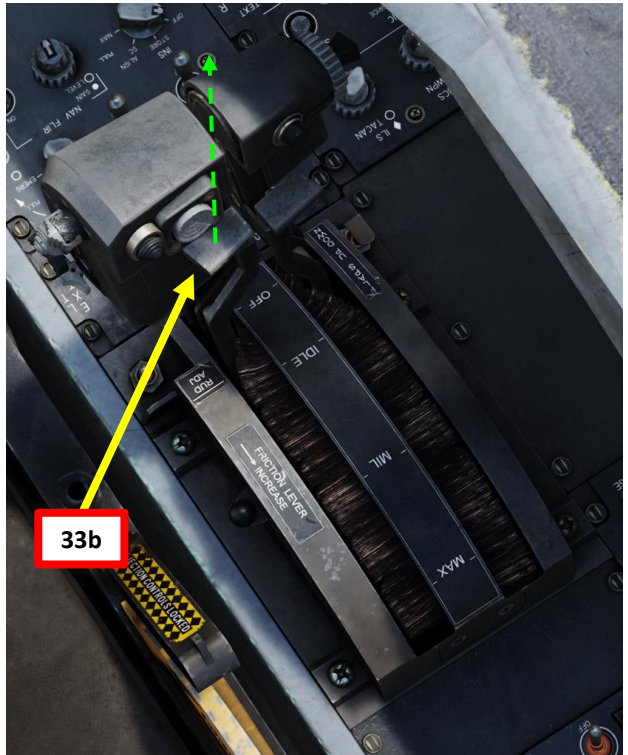
B – ENGINE START

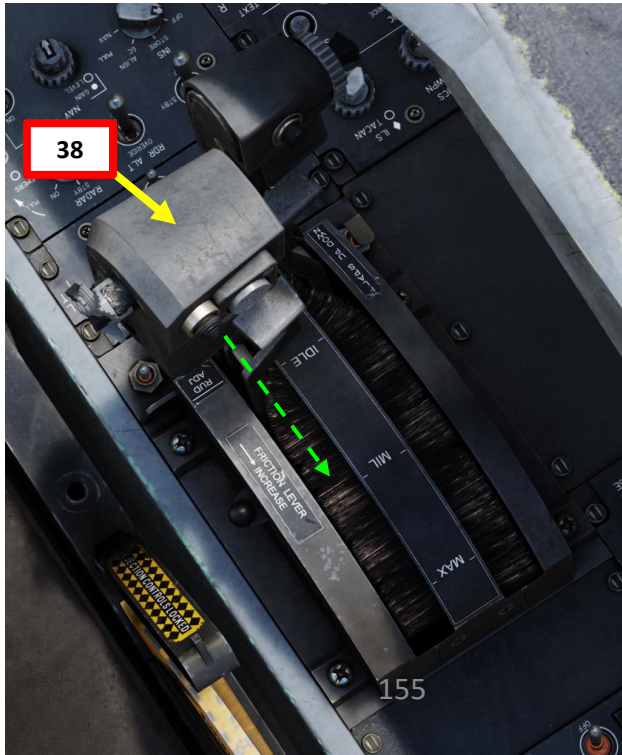
33. *[P]* Pull UP and release the Finger Lift on the RIGHT throttle. This will initiate right engine cranking. The engine starter is driven by a mechanical clutch between the JFS (Jet Fuel Starter) and the engine.
34. *[P]* Once right engine RPM increases to 15 %, the Engine Monitor Display will power up.
35. *[P]* Wait until right engine RPM has stabilized to 26 %.
36. **[P]* Set Fire Test / Extinguisher Switch – TEST (DOWN).
37. **[P]* Confirm that the AMAD FIRE (Airframe Mounted Accessory Drive), LEFT ENGINE FIRE and RIGHT ENGINE FIRE lights illuminate and audible warnings are heard ("WARNING AMAD FIRE", "WARNING ENGINE FIRE LEFT", and "WARNING ENGINE FIRE RIGHT"). This will indicate that fire detection systems for the AMAD and engines are functioning correctly.
38. *[P]* Move RIGHT throttle from OFF detent to IDLE detent.
    - Right Throttle to IDLE: "RSHIFT+HOME" binding.
39. *[P]* Once throttle is set to IDLE, engine RPM should increase within 10 seconds. Fuel flow is introduced to the right engine and lightoff sequence is initiated. Monitor RPM, TEMP/FTIT (Fan Inlet Turbine Temperature), FF (Fuel Flow) and OIL (Oil Pressure) indications. FTIT should not exceed 800 deg C, and oil pressure should stabilize between 15 and 95 psi.
40. *[P]* Right engine parameters should stabilize around the following:
    - Engine compressor RPM: 72 %
    - FTIT (Fan Inlet Turbine Temperature): 480 deg C
    - Fuel Flow: 1800 pph
    - Oil Pressure: 30 psi

Note: *The right engine is normally started first to permit checking utility hydraulic pressure with only the right pump operating.*



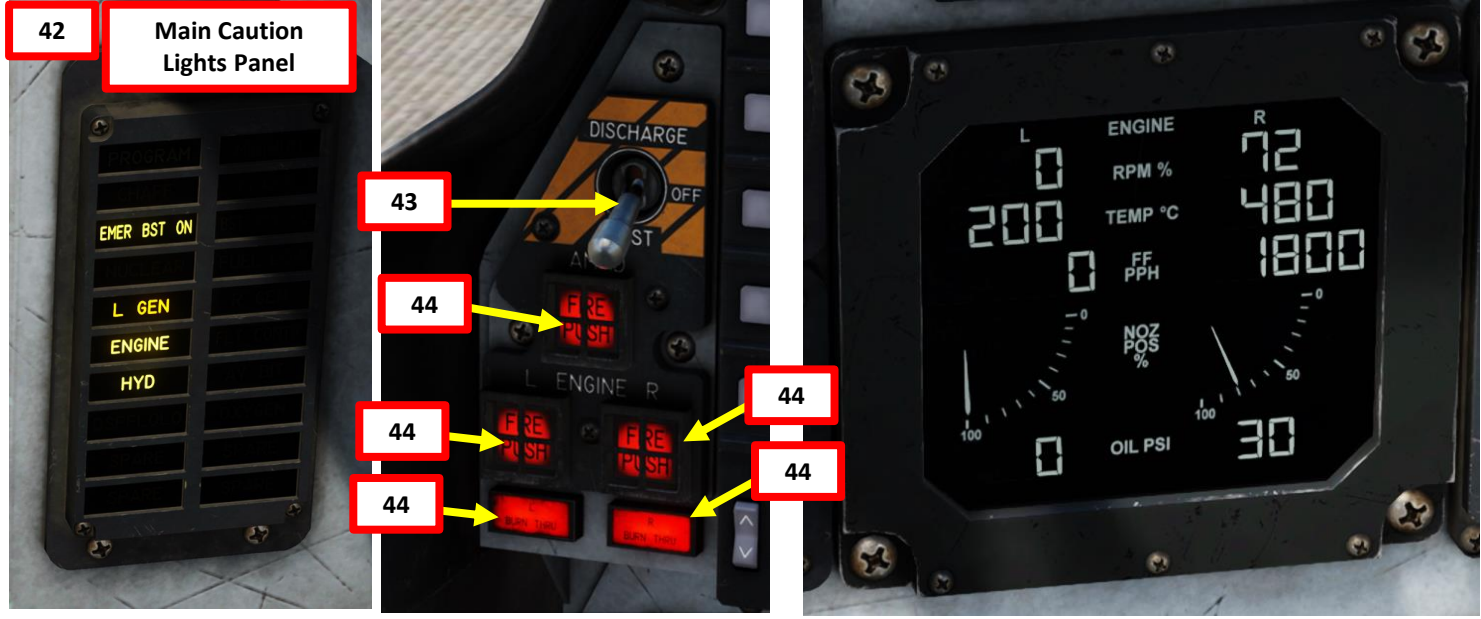


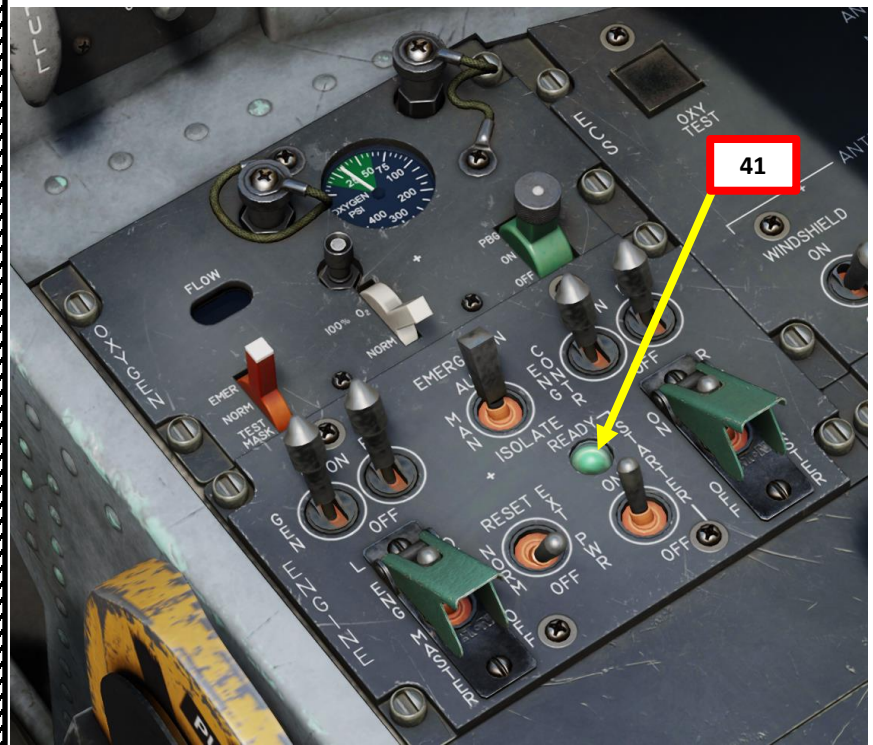




B – ENGINE START

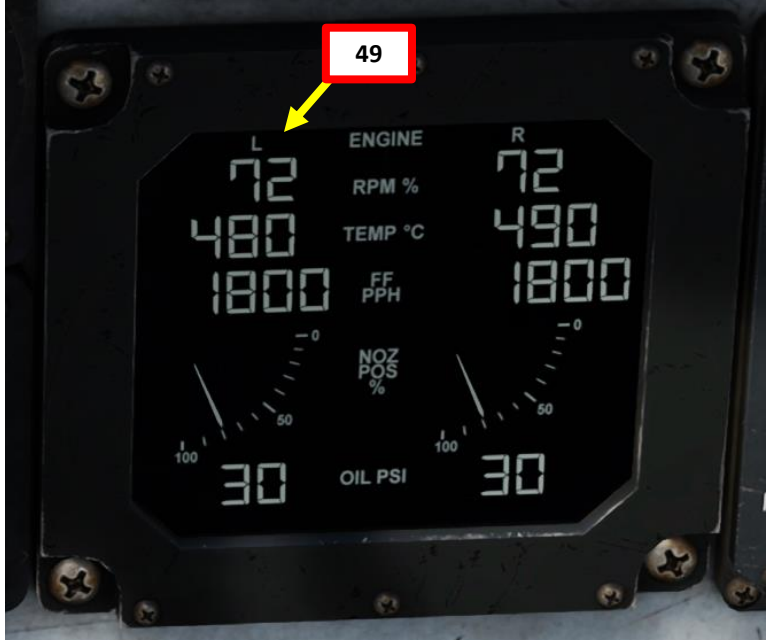
41. *[P]* When engine RPM is around 52-55%, the JFS (Jet Fuel Starter) spools down. The JFS READY Light goes out during the engagement while the engine is starting. It comes back on upon the JFS returning to idle, indicating that it is ready to be used again.
42. *[P]* When right engine RPM is around 57%, the Right Generator should come online. The Main Caution Lights panel will power on. Also, the right ramp should fall down (provided that the Right Ramp Switch is set to AUTO).
43. **[P]* Set Fire Test / Extinguisher Switch – TEST (DOWN).
44. **[P]* Confirm that the AMAD FIRE (Airframe Mounted Accessory Drive), LEFT ENGINE FIRE, RIGHT ENGINE FIRE, L BURN THRU and R BURN THRU lights illuminate and audible warnings are heard ("WARNING AMAD FIRE", "WARNING ENGINE FIRE LEFT", "WARNING ENGINE FIRE RIGHT", "AB BURN THROUGH LEFT", and "AB BURN THROUGH RIGHT"). This will indicate that fire detection systems for the AMAD, engines and afterburner chambers are functioning correctly.

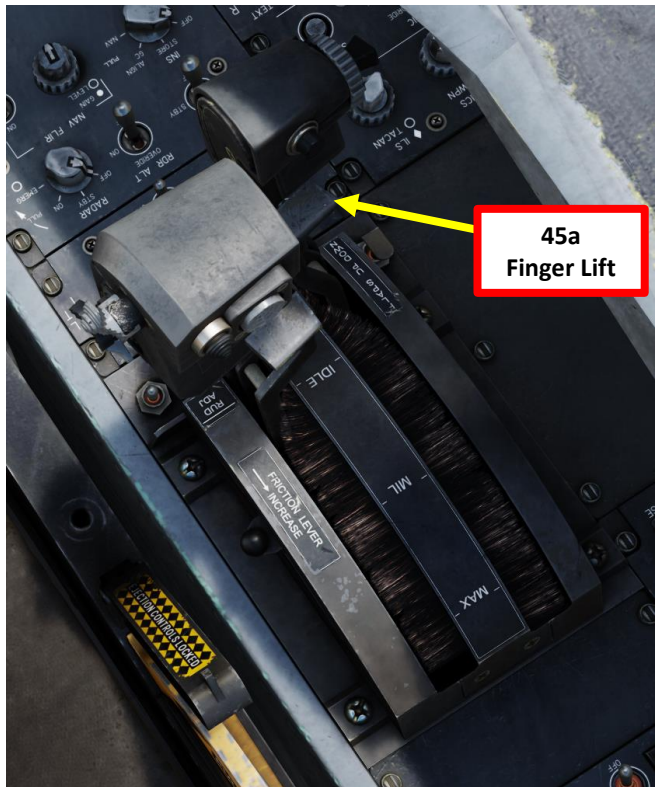


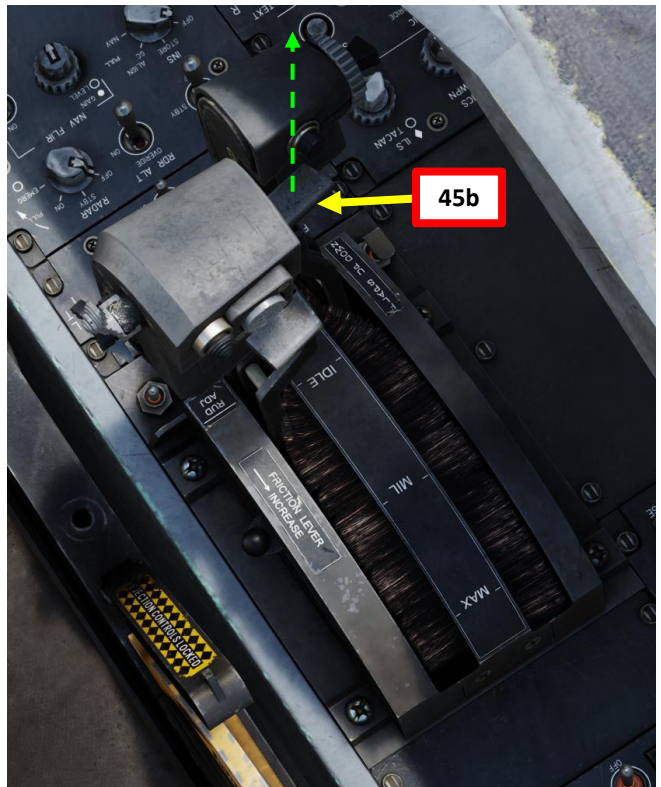


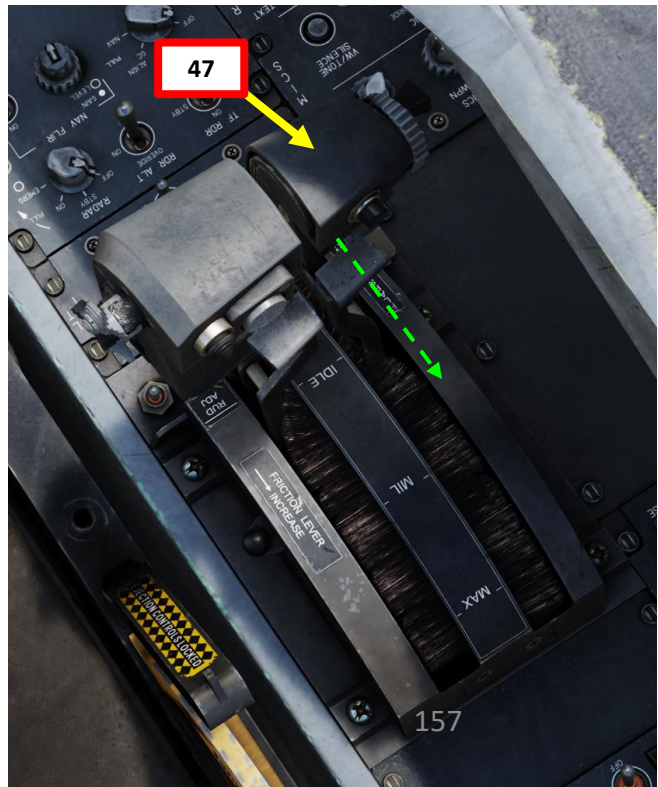
B – ENGINE START

45. *[P]* Once the right engine RPM is stabilized to Idle (72 %), pull UP and release the Finger Lift on the LEFT throttle. This will initiate left engine cranking. The engine starter is driven by a mechanical clutch between the JFS (Jet Fuel Starter) and the engine.
46. *[P]* Wait until left engine RPM has stabilized to 26 %.
47. *[P]* Move LEFT throttle from OFF detent to IDLE detent.
    - Left Throttle to IDLE: "RALT+HOME" binding.
48. *[P]* Once throttle is set to IDLE, engine RPM should increase within 10 seconds. Fuel flow is introduced to the left engine and lightoff sequence is initiated. Monitor RPM, TEMP/FTIT (Fan Inlet Turbine Temperature), FF (Fuel Flow) and OIL (Oil Pressure) indications. FTIT should not exceed 800 deg C, and oil pressure should stabilize between 15 and 95 psi.
49. *[P]* Left engine parameters should stabilize around the following:
    - Engine compressor RPM: 72 %
    - FTIT (Fan Inlet Turbine Temperature): 480 deg C
    - Fuel Flow: 1800 pph
    - Oil Pressure: 30 psi







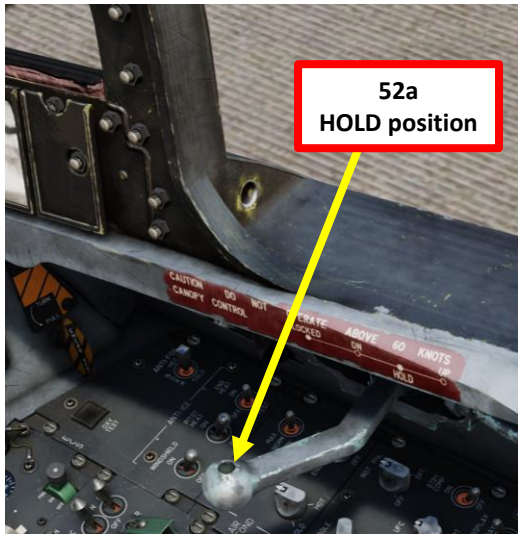


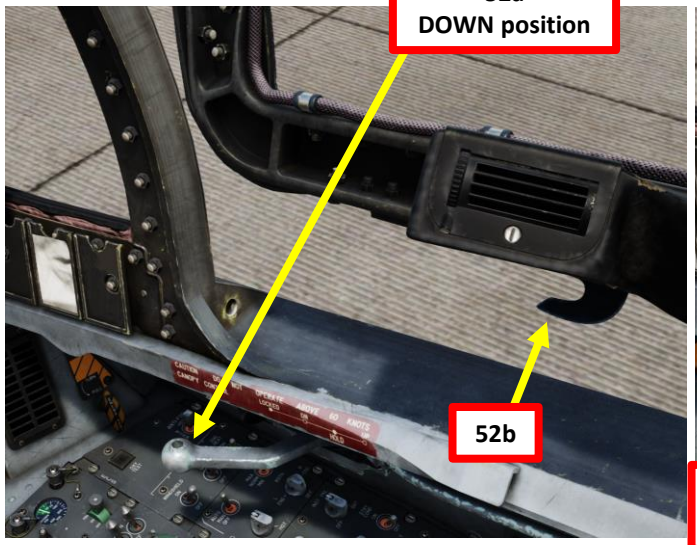
B – ENGINE START

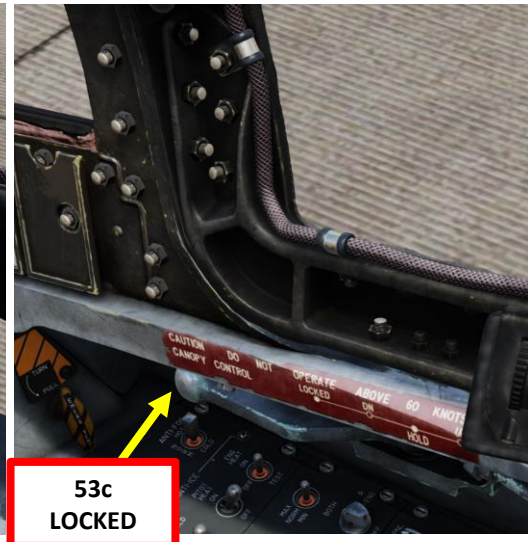
50. *[P]* When left engine RPM is around 52-55%, the JFS (Jet Fuel Starter) spools down automatically and the JFS READY Light goes out.
51. *[P]* When engine RPM is around 57%, the Left Generator should come online and the left ramp should fall down (provided that the Left Ramp Switch is set to AUTO).

B – ENGINE START

52. *[P]* Close Canopy
    a) Move canopy lever to DOWN position.
    b) Wait for the canopy to close.
    c) Push the canopy lever forward to lock and pressurize the canopy.
    d) Confirm CAN UNLKD light is extinguished.
53. *[P]* Press the Master Caution button to clear (extinguish) the caution light.

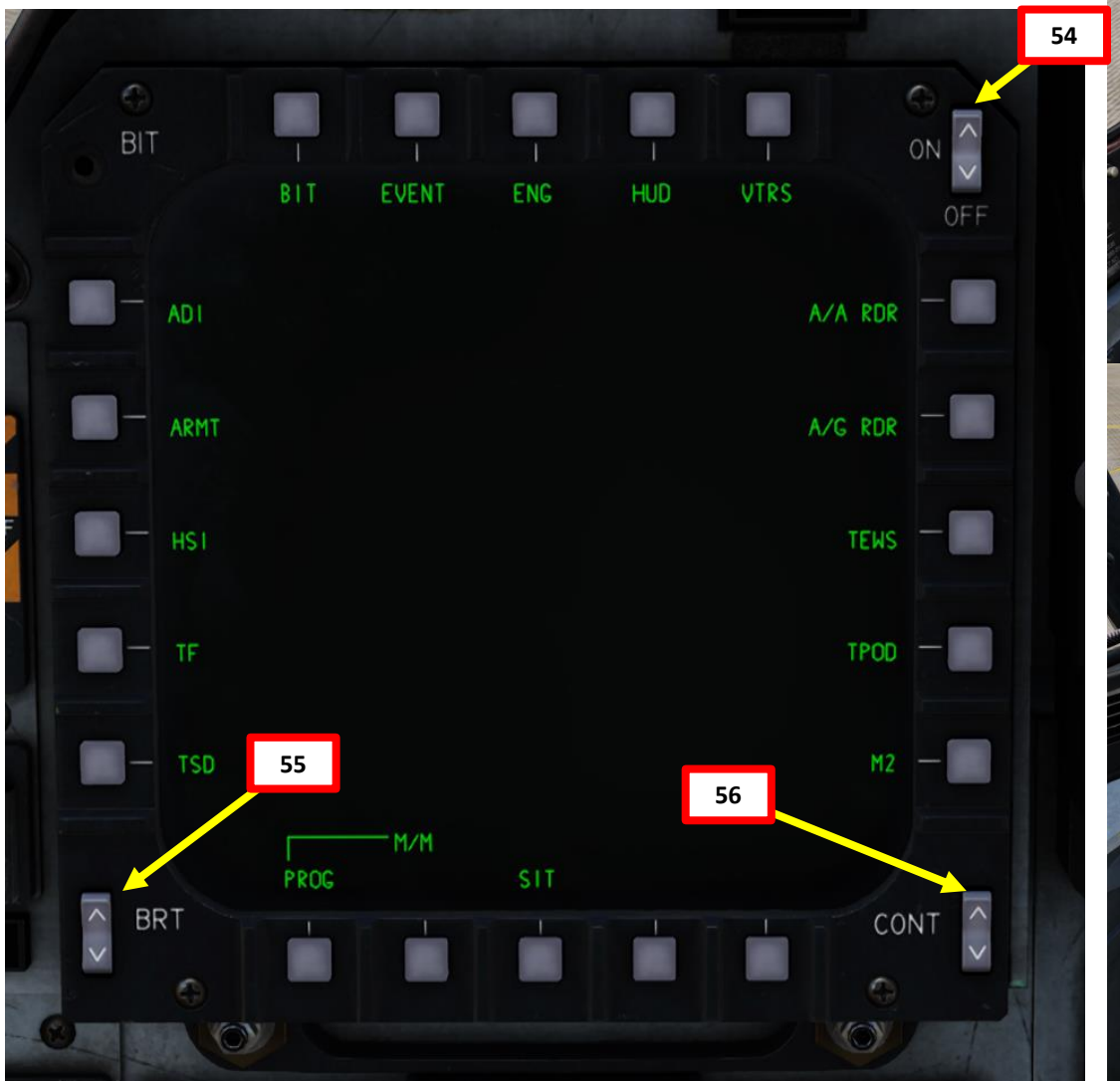


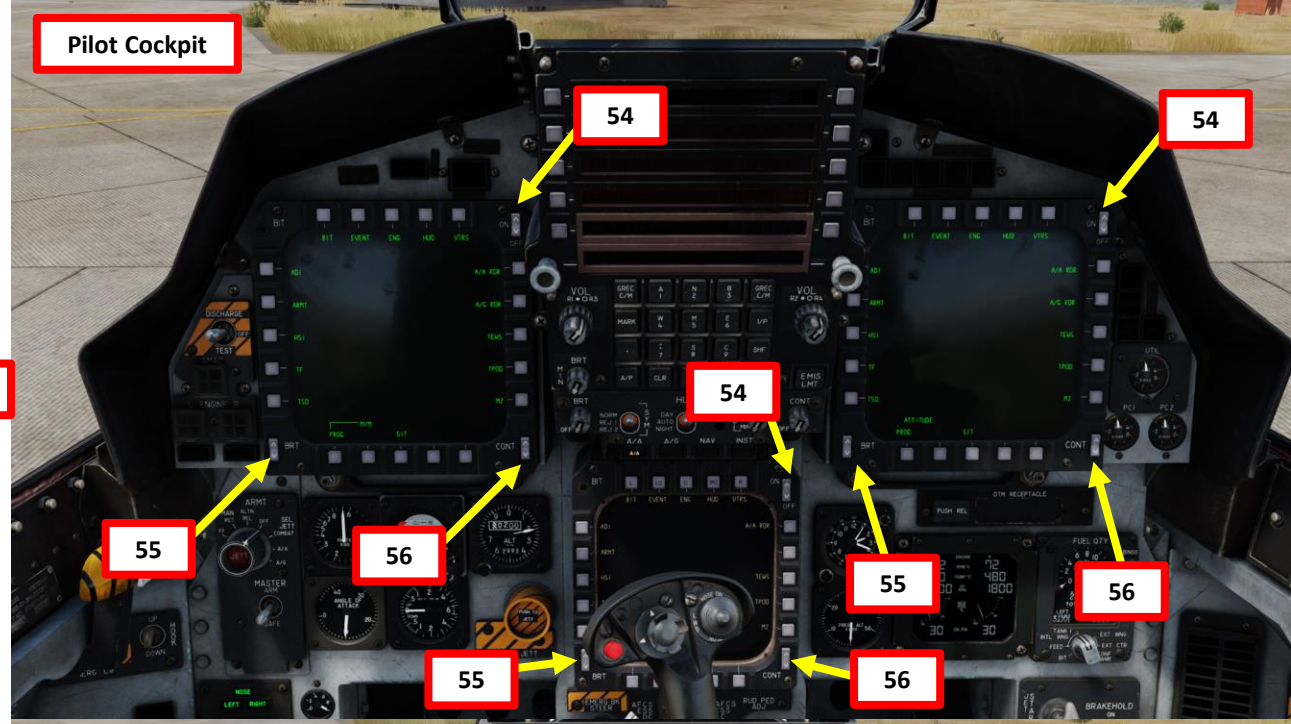


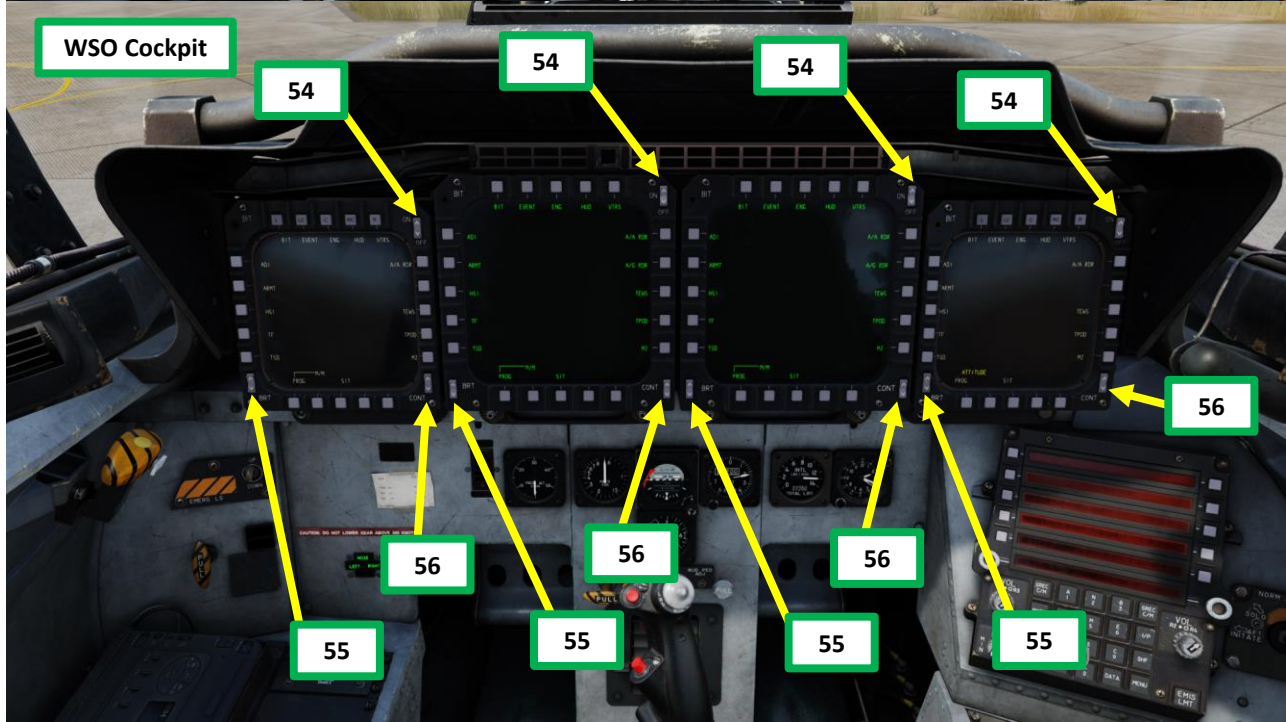


C – AVIONICS & SENSORS SETUP

54. *[P+WSO] Turn on MPDs (Multipurpose Displays) and MPCDs (Multipurpose Color Displays).*
55. *[P+WSO]* Adjust Brightness of MPDs and MPCDs – As desired.
56. *[P+WSO]* Adjust Contrast of MPDs and MPCDs – As desired.

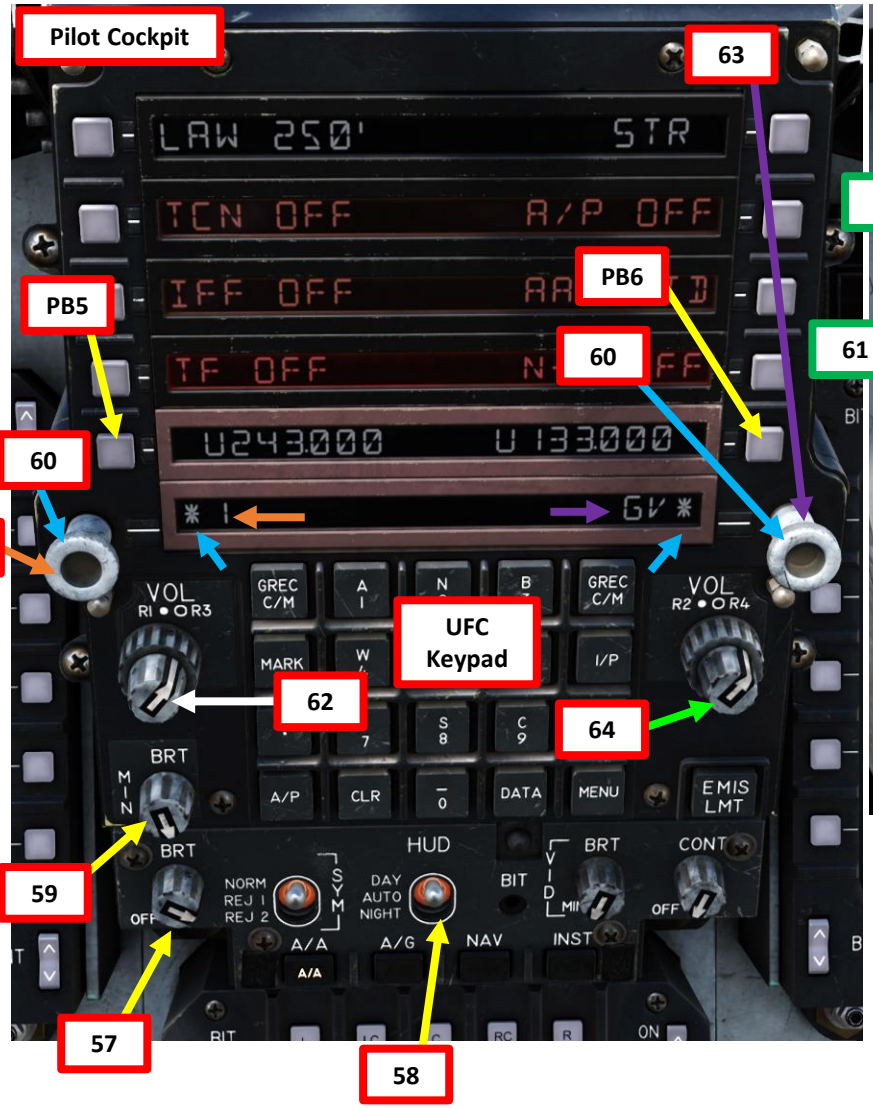


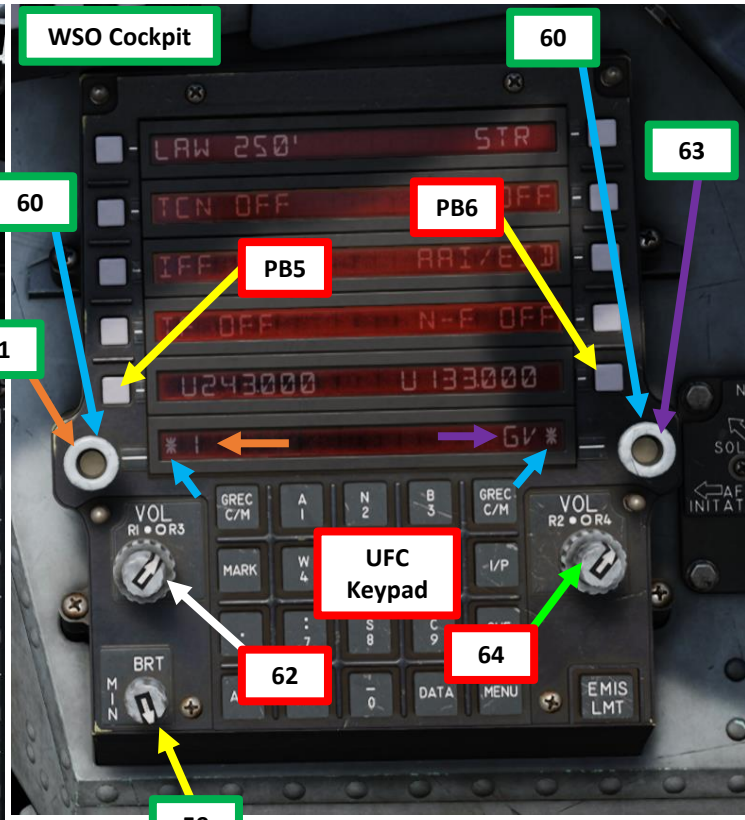




C – AVIONICS & SENSORS SETUP

57. *[P]* Set HUD (Heads-Up Display) Power & Brightness Control Knob – BRT (Bright).
58. *[P]* Set HUD Mode Selector Switch – AUTO (MIDDLE).
59. *[P+WSO]* Set UFC (Upfront Control Panel) Power & Brightness Control Knob – BRT (Bright).
60. *[P/WSO]* Turn on radios 1 and 2 by pressing IN (left click) the LEFT and RIGHT Radio Channel Selector knobs. Asterisks on the UFC indicate that radios are powered.
61. *[P/WSO]* Select desired radio channel for Radio 1 (AN/ARC-164 UHF) by turning the LEFT Radio Channel Selector knob.
    - Alternatively, you can also enter the frequency manually with the UFC (Upfront Control Panel) keypad and then press the Pushbutton No. 5 (PB5).
62. *[P/WSO]* Adjust volume for Radio by turning the Radio 1 Volume Control (Left Inner Knob).
63. *[P/WSO]* Select desired radio channel for Radio 2 (AN/ARC-210 V/UHF) by turning the RIGHT Radio Channel Selector knob.
    - Alternatively, you can also enter the frequency manually with the UFC (Upfront Control Panel) keypad and then press the Pushbutton No. 5 (PB6).
64. *[P/WSO]* Adjust volume for Radio 2 by turning the Radio 2 Volume Control (Right Inner Knob).





C – AVIONICS & SENSORS SETUP

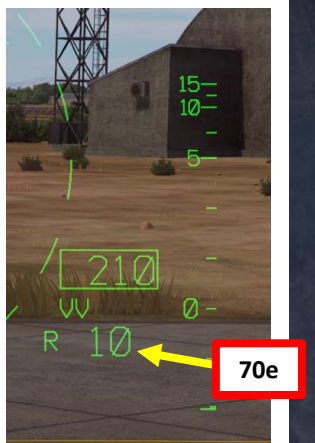
65. *[P+WSO] Momentarily set Warning/Caution Lights Test Switch – ON (FWD). Confirm that warning and caution lights illuminate accordingly, then release switch.

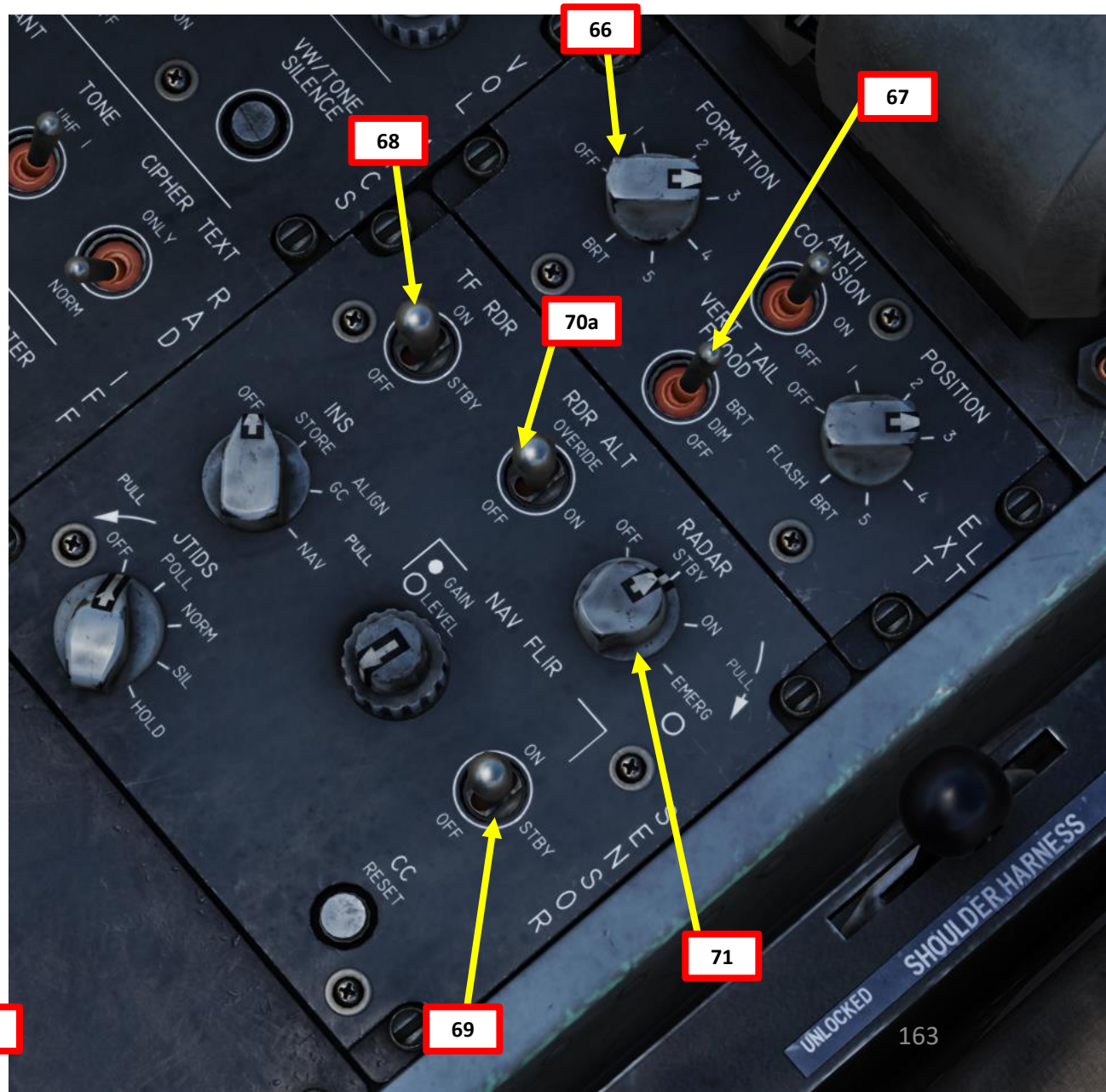
Pilot Cockpit

WSO Cockpit

C – AVIONICS & SENSORS SETUP

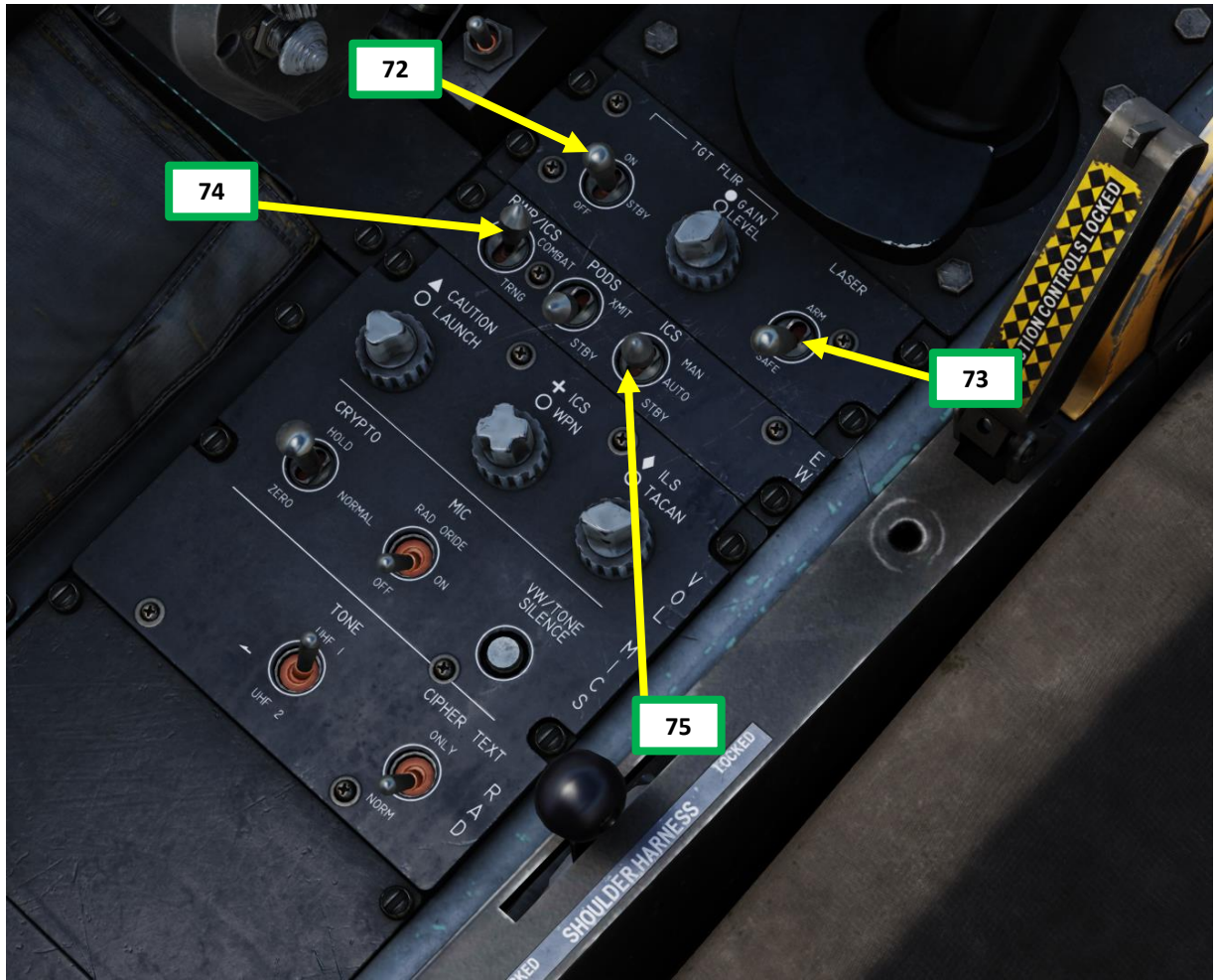
66. *[P] Set Formation Lights Brightness Control Knob – As desired. We will select a brightness setting of "3".
67. *[P] Set Vertical Tail Flood Lights Control Switch – As desired. We will select BRT (Bright, FWD).
68. [P] If AN/AAQ-13 LANTIRN Navigation Pod (NVP) is installed, set TF RDR (Terrain Following Radar) Power Switch – STANDBY (MIDDLE). Otherwise, leave switch to OFF (AFT).
69. [P] If AN/AAQ-13 LANTIRN Navigation Pod (NVP) is installed, set NAV FLIR (Navigation Forward-Looking Infrared) Power Switch – STANDBY (MIDDLE). Otherwise, leave switch to OFF (AFT).
70. [P] Set RDR ALT (Radar Altimeter) Power Switch – ON (MIDDLE).
    - Note: If you want to display Radar Altitude on the Heads-Up Display, press "DATA" button on the UFC (Upfront Control Panel), then press on UFC button next to "R". Once button is pressed, an asterisk (*) indicates that radar altitude data is displayed on the HUD.
71. [P] Set Radar Power Selector Knob – STANDBY.

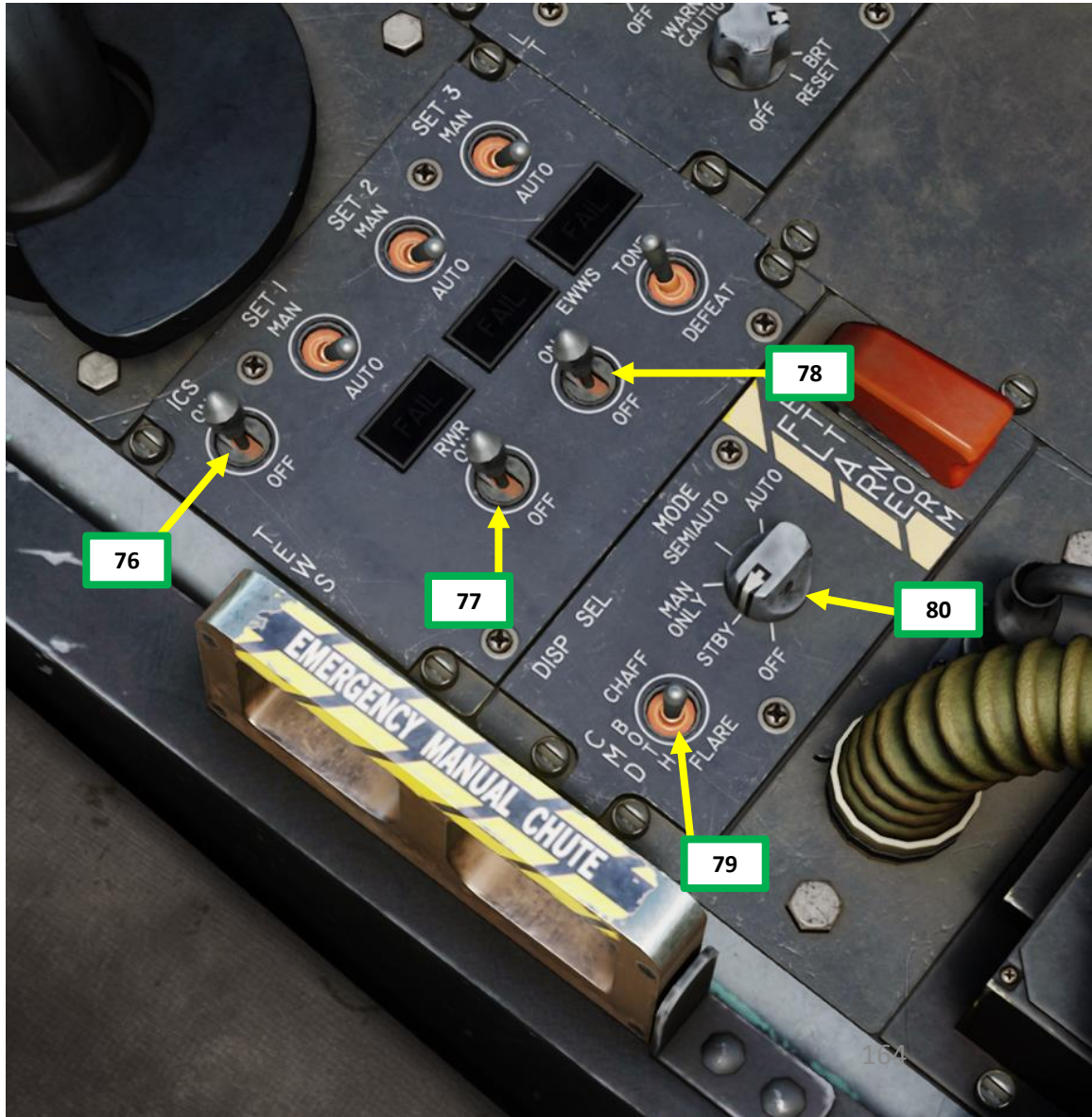




C – AVIONICS & SENSORS SETUP

72. *[WSO]* If AN/AAQ-14 LANTIRN Targeting Pod (TGP) is installed, set TGT FLIR (Targeting Pod) Power Switch – STANDBY (MIDDLE). Otherwise, leave switch to OFF (AFT).
73. *[WSO]* If AN/AAQ-14 LANTIRN Targeting Pod (TGP) is installed, verify that Laser Arm Switch is set to SAFE (AFT).
74. *[WSO]* Set RWR/ICS (Radar Warning Receiver/Internal Countermeasures Set) Mode Selector Switch – COMBAT (FWD).
75. *[WSO]* Set ICS (Internal Countermeasures Set) Mode Switch – AUTO (MIDDLE).
76. *[WSO]* Set ICS (Internal Countermeasures Set) Switch – ON (FWD).
77. *[WSO]* Set RWR (Radar Warning Receiver) Power Switch – ON (FWD).
78. *[WSO]* Set EWWS (Electronic Warfare Warning Set) Power Switch – ON (FWD).
79. *[WSO]* Set CMD (Countermeasure Dispenser) Selection Switch – BOTH (MIDDLE).
80. *[WSO]* Set CMD (Countermeasure Dispenser) Mode Switch – STBY (Standby).

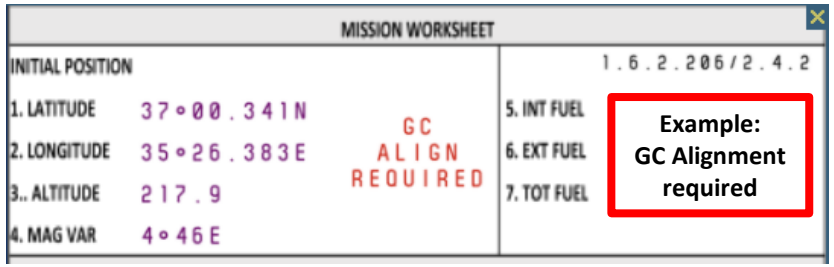


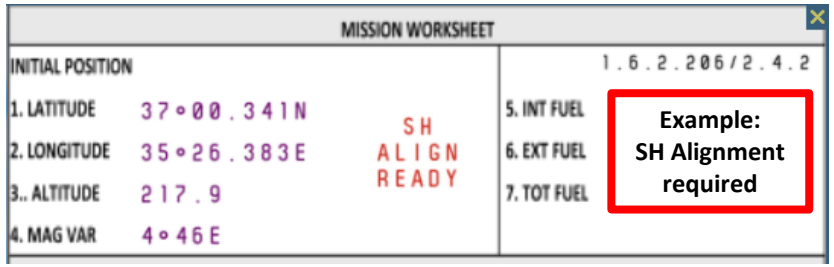


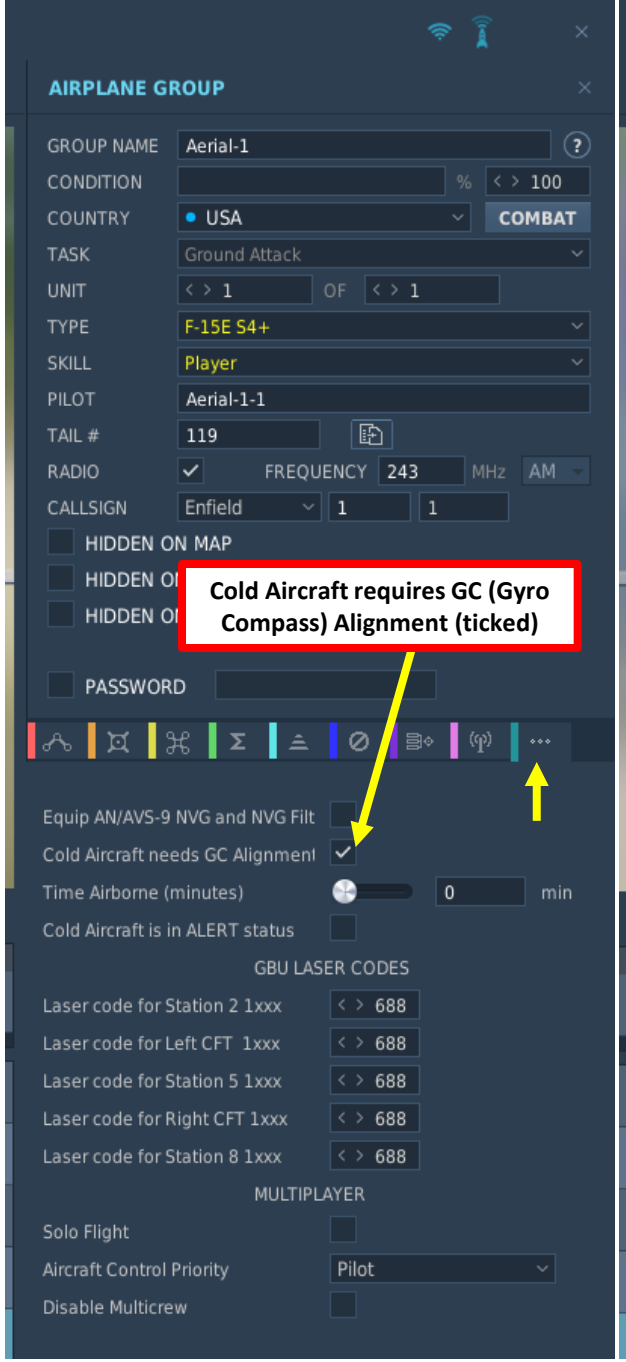
D – INS (INERTIAL NAVIGATION SYSTEM) ALIGNMENT

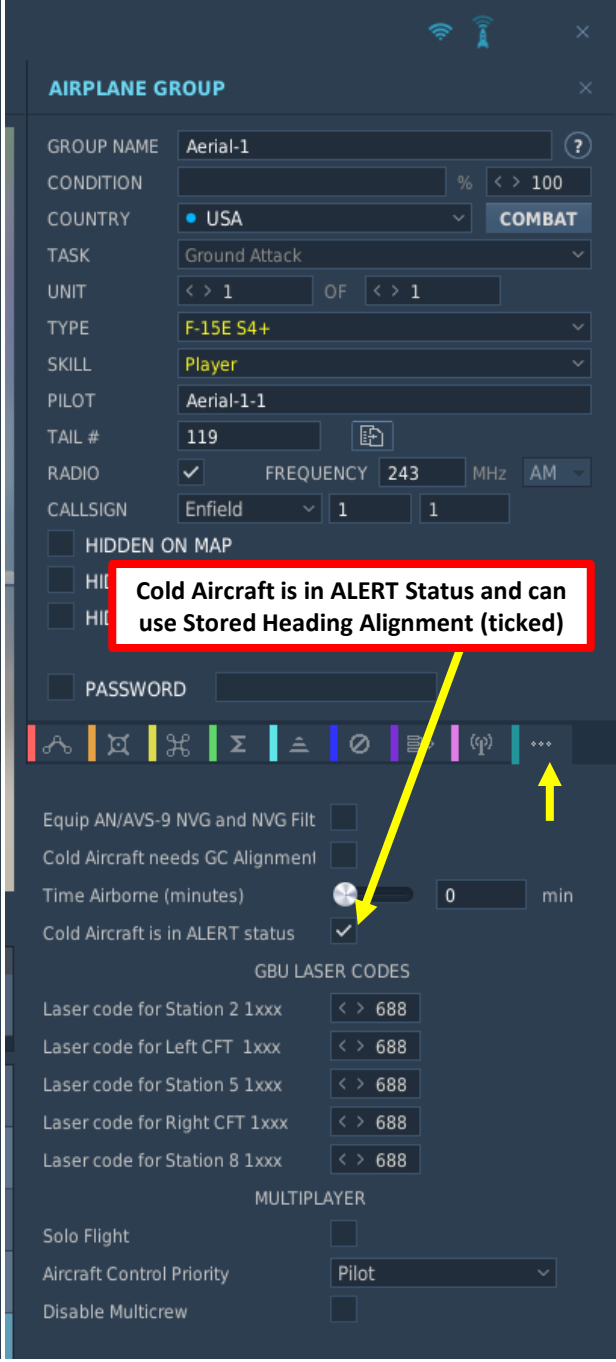
You can either use a **Gyro Compass (normal) alignment** (takes roughly 4 minutes) or a **Stored Heading alignment** (takes roughly 40 seconds), which is quicker but accumulates drift error more rapidly and can only be used if the aircraft has been set up specifically for this alignment beforehand.

- **GYRO COMPASS ALIGNMENT (GC)** is done with the INS Mode Selector set to ALIGN GC. Aircraft coordinates need to be confirmed. PP (present position) source submenu is called up on pilot's UFC (Upfront Control Panel) when GC selected.
    - GC Alignment is required if the “Cold Aircraft needs GC Alignment” option is set in the Mission Editor.
- **STORED HEADING ALIGNMENT (SH)** is done with the INS Mode Selector set to ALIGN STORE. Aircraft coordinates do not need to be confirmed since they are already entered in the system. Stored heading alignment uses gyrocompass alignment parameters which were stored at the time of the last system shutoff for rapid INS alignment. PP (Present Position) source submenu is called up on the pilot's UFC (Upfront Control Panel) when SH is selected. The aircraft must not have been moved since the last shutdown.
    - Stored Heading Alignment can be used if the “Cold Aircraft is in ALERT Status” option is set in the Mission Editor, which means that the ground crew has already aligned the INS prior to the mission.



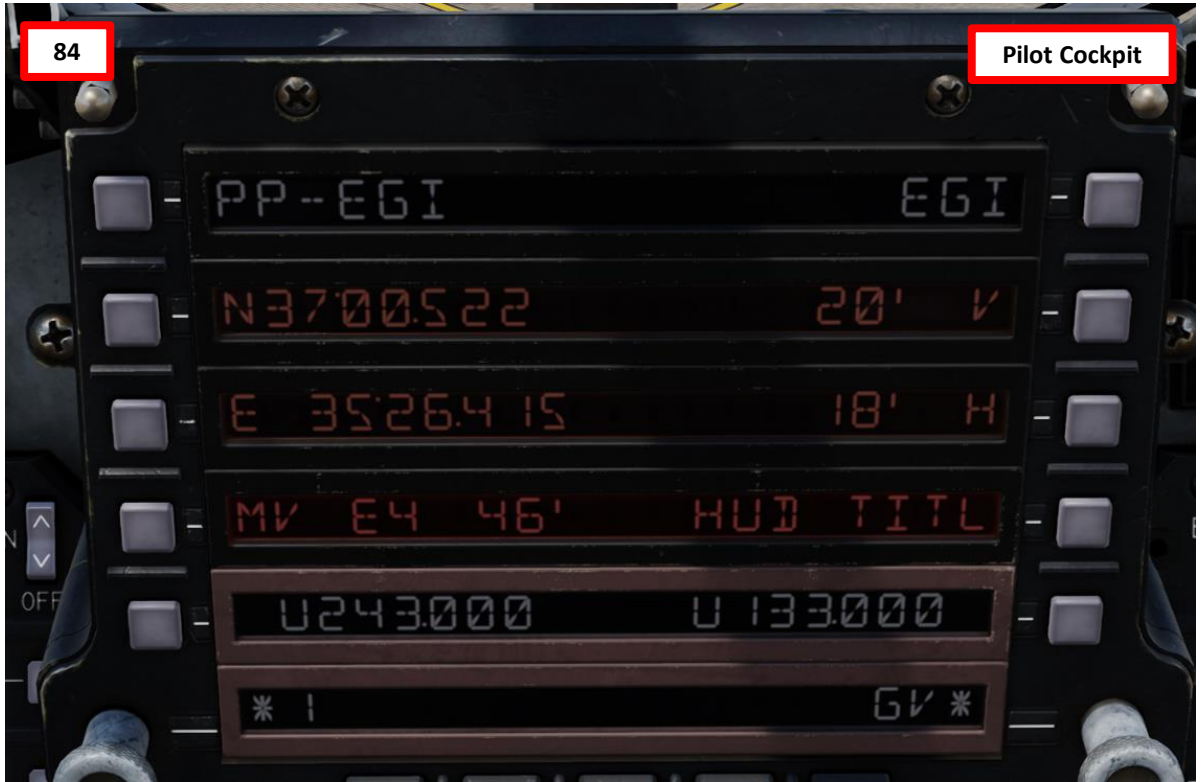


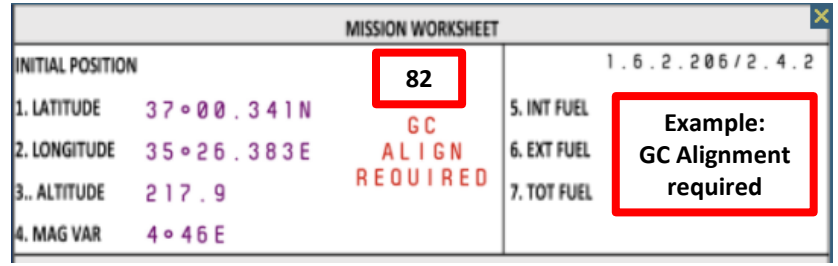


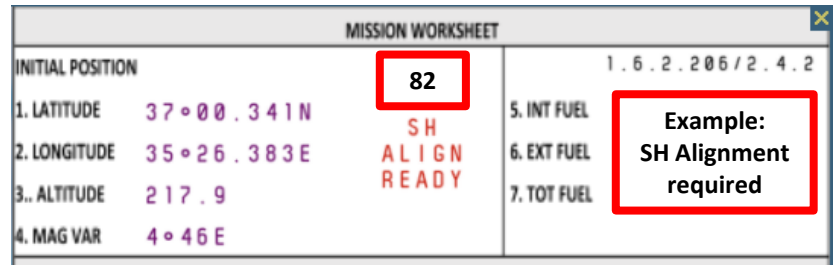


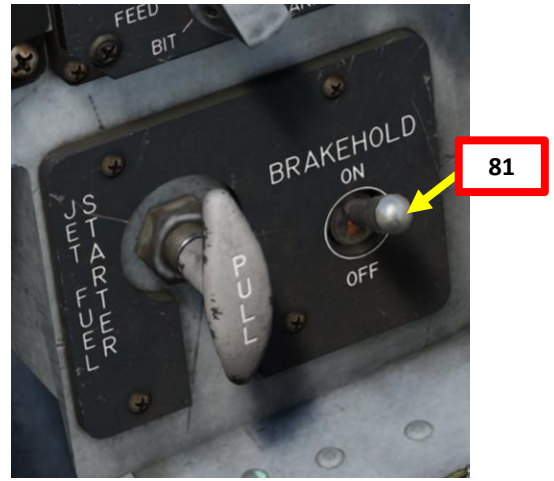
D – INS (INERTIAL NAVIGATION SYSTEM) ALIGNMENT

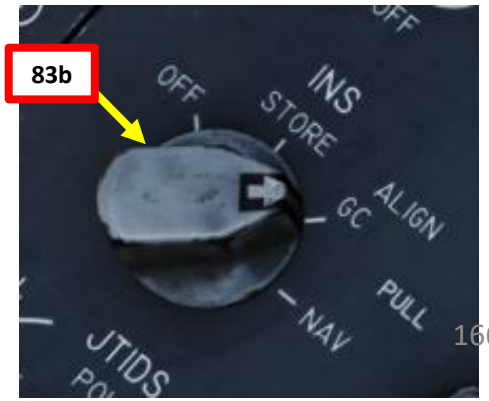
81. *[P]* Set Brake Hold (Parking Brake) Switch – ON (UP). This step isn't mandatory since we already have wheel chocks set up to keep the aircraft in place.
82. *[P]* Press « RSHIFT+K » to open up kneeboard and check your Mission Worksheet. It will indicate whether you need to perform a Gyco Compass (GC) alignment or if the Stored Heading (SH) alignment is available to speed up the INS alignment procedure.
83. *[P]* Set INS Mode Selector Knob for the alignment dictated by the Mission Worksheet. We will select GC.
    a) STORE for Stored Heading Alignment
    b) GC for Gyro Compass Alignment
84. *[P/WSO]* When INS Mode Selector is set to either STORE or GC, the UFC (Upfront Control Panel) will display the PPKS (Present Position Keeping Source) sub-menu.
    - *[WSO]* note: the WSO can also access the PPKS page by pressing the UFC MENU button twice to access MENU 2, then pressing the PB (Pushbutton) next to "PP".
85. *[P/WSO]* On the UFC, compare Latitude (North/South) and Longitude (East/West) coordinates with the coordinates listed on the Initial Position field of the Mission Worksheet. In this example, we will re-enter aircraft coordinates.
    - If coordinates are correct, you can wait until the alignment procedure completes.
    - If coordinates are incorrect, you need to re-enter the coordinates listed in the Initial Position field.











D – INS (INERTIAL NAVIGATION SYSTEM) ALIGNMENT

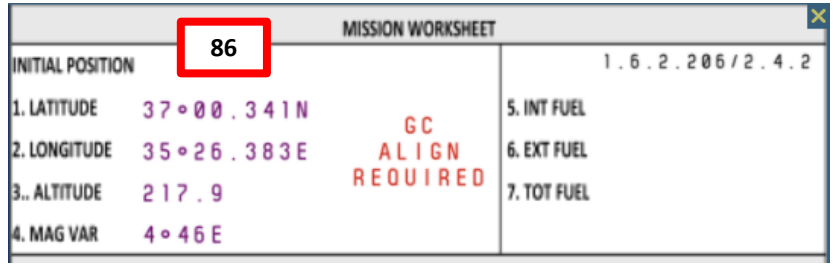
86. *[P/WSO]* From the Mission Worksheet, check what the real Initial Position of the aircraft is. Write down your coordinates (i.e. **37°00.341 North 035°26.383 East** in deg, min, decimal-minutes) and magnetic variation (**4.46 deg East**).

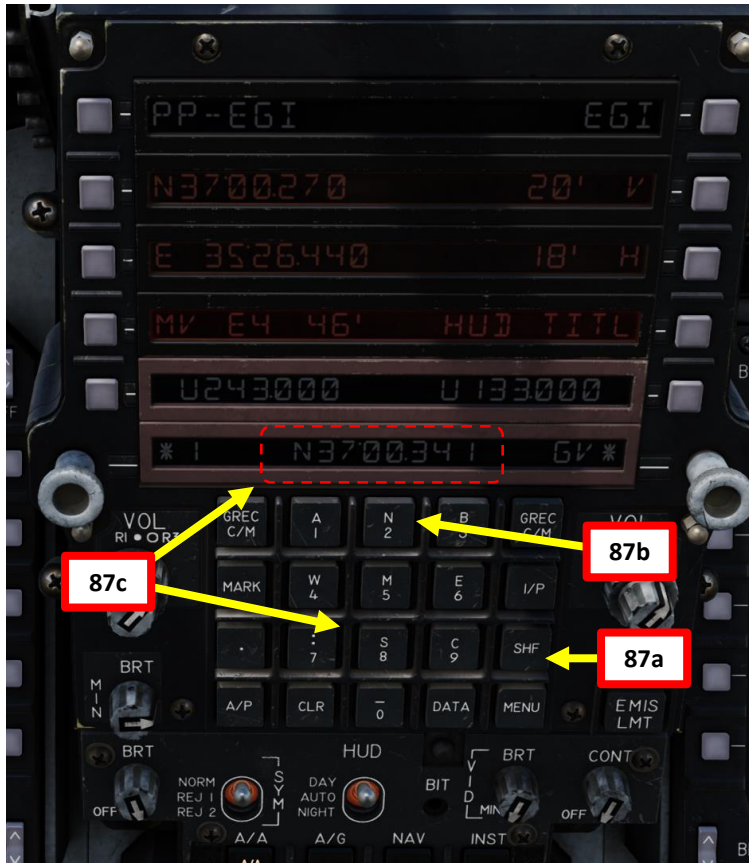
87. *[P/WSO]* Enter Latitude Coordinates **37°00.341 North:**

a) Press SHF (Shift) Button on UFC Keypad
b) Press "2" button for North Latitude (or "8" for South if required)
c) Press "3700314" on the keypad to enter **37°00.341** coordinates.
   - A single press of the CLR button can be used as a "backspace" key. Pressing CLR twice erases the whole line.
d) Press PB (Pushbutton) next to Latitude data field to enter coordinates.

88. *[P/WSO]* Enter Longitude Coordinates **035°26.383 East:**

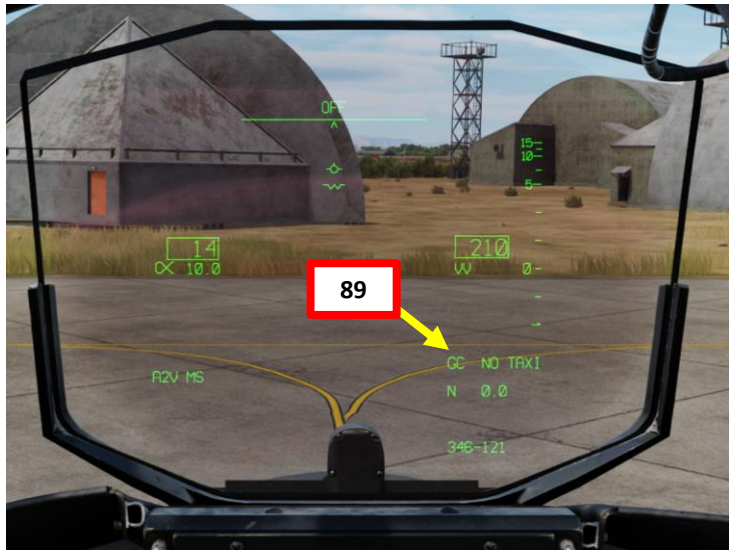
a) Press SHF (Shift) Button on UFC Keypad
b) Press "6" button for East Longitude (or "4" for West if required)
c) Press "03526383" on the keypad to enter **035°26.383** coordinates.
   - A single press of the CLR button can be used as a "backspace" key. Pressing CLR twice erases the whole line.
d) Press PB (Pushbutton) next to Longitude data field to enter coordinates.

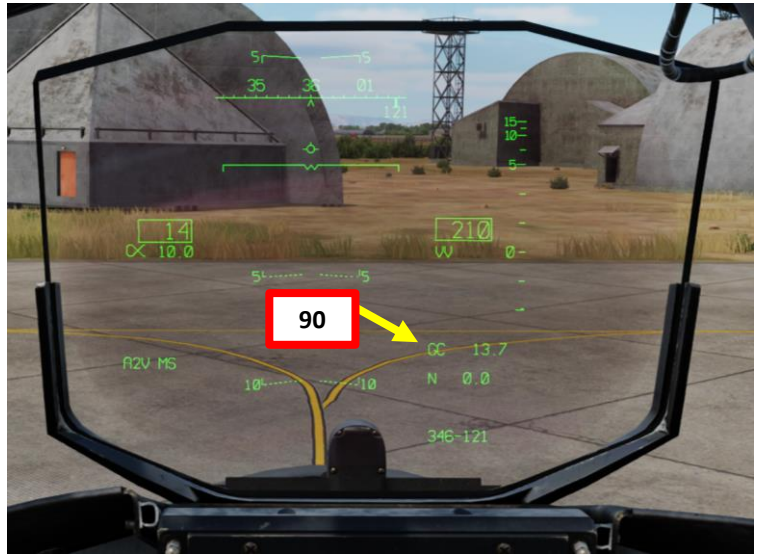


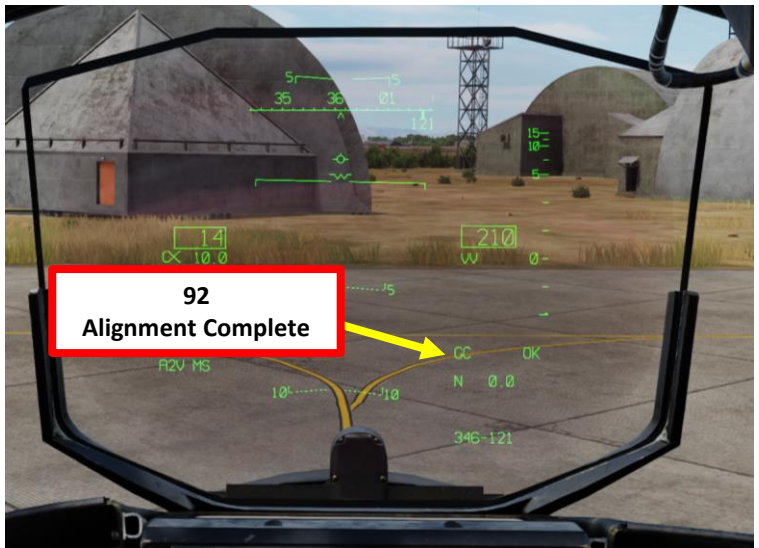


D – INS (INERTIAL NAVIGATION SYSTEM) ALIGNMENT

89. *[P]* When INS Mode Selector Knob is first set to ALIGN GC and coordinates are entered, the HUD (Heads-Up Display) will first display **GC NO TAXI** (or SH NO TAXI if using Stored Heading Mode).
90. *[P]* Approximately 60 seconds later, the GC/SH NO TAXI indication will change to **GC 15.9** (or SH 15.9). The "15.9" number will decrease as INS alignment sequence is progressing.
91. *[P]* Alignment time **takes about 4 minutes** for Gyro Compass alignment or 40 seconds for Stored Heading alignment.
92. *[P]* Once alignment is complete, the HUD will indicate **GC OK** (or SH OK for stored heading).
93. *[P]* Set INS Mode Selector Knob to NAV.





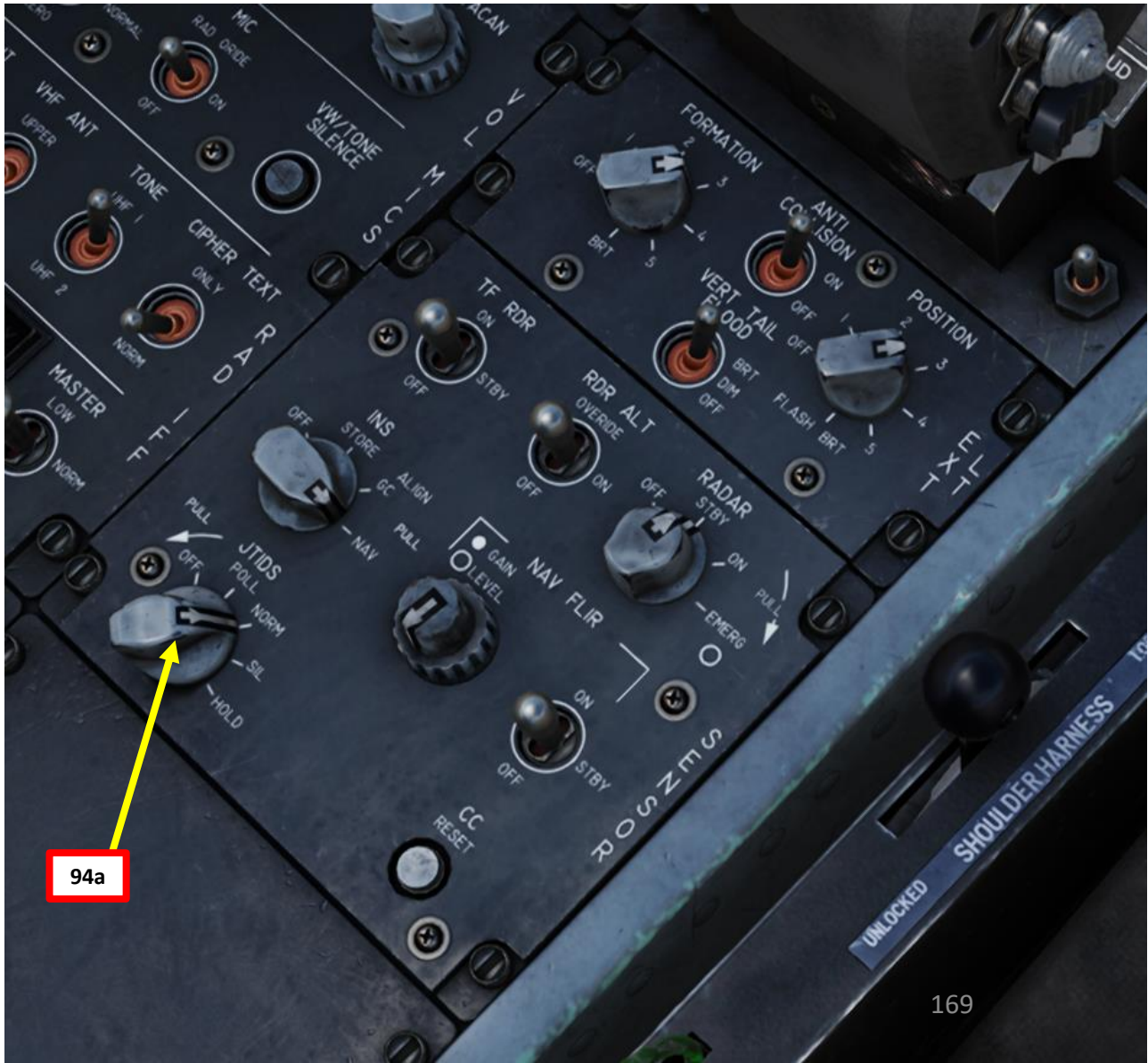


E – DATALINK SETUP

94. [P] Set up Datalink – As required per mission briefing.

a) Set JTIDS (Joint Tactical Information Distribution System, also known as "Link 16") Master Control Selector – NORM (Normal).

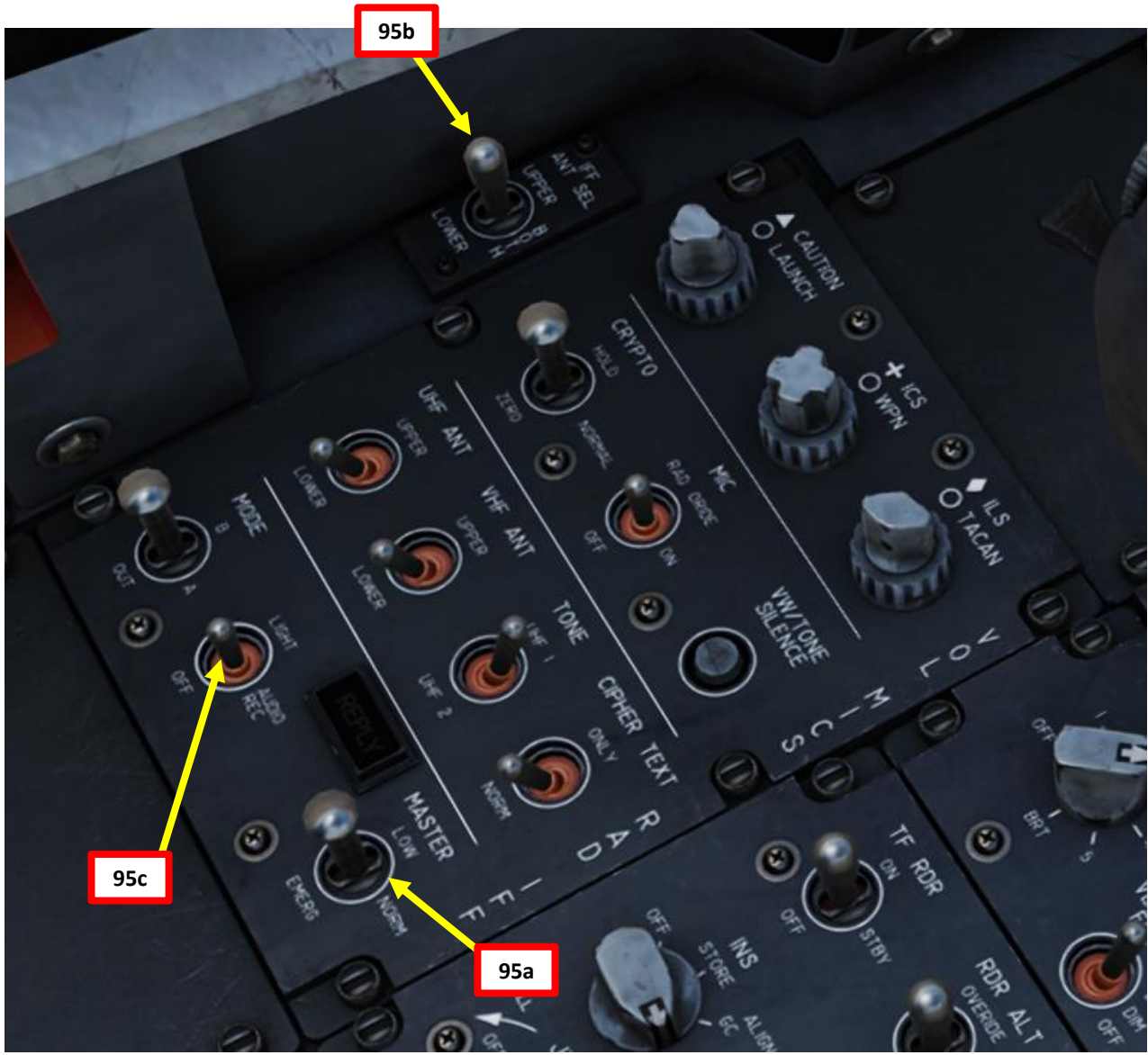
- **Note: Datalink is not implemented yet for the DCS F-15E.**



F – IFF (IDENTIFY-FRIEND-OR-FOE) SETUP

95. [P] Set up IFF (Identify-Friend-or-Foe) System – As required per mission briefing.

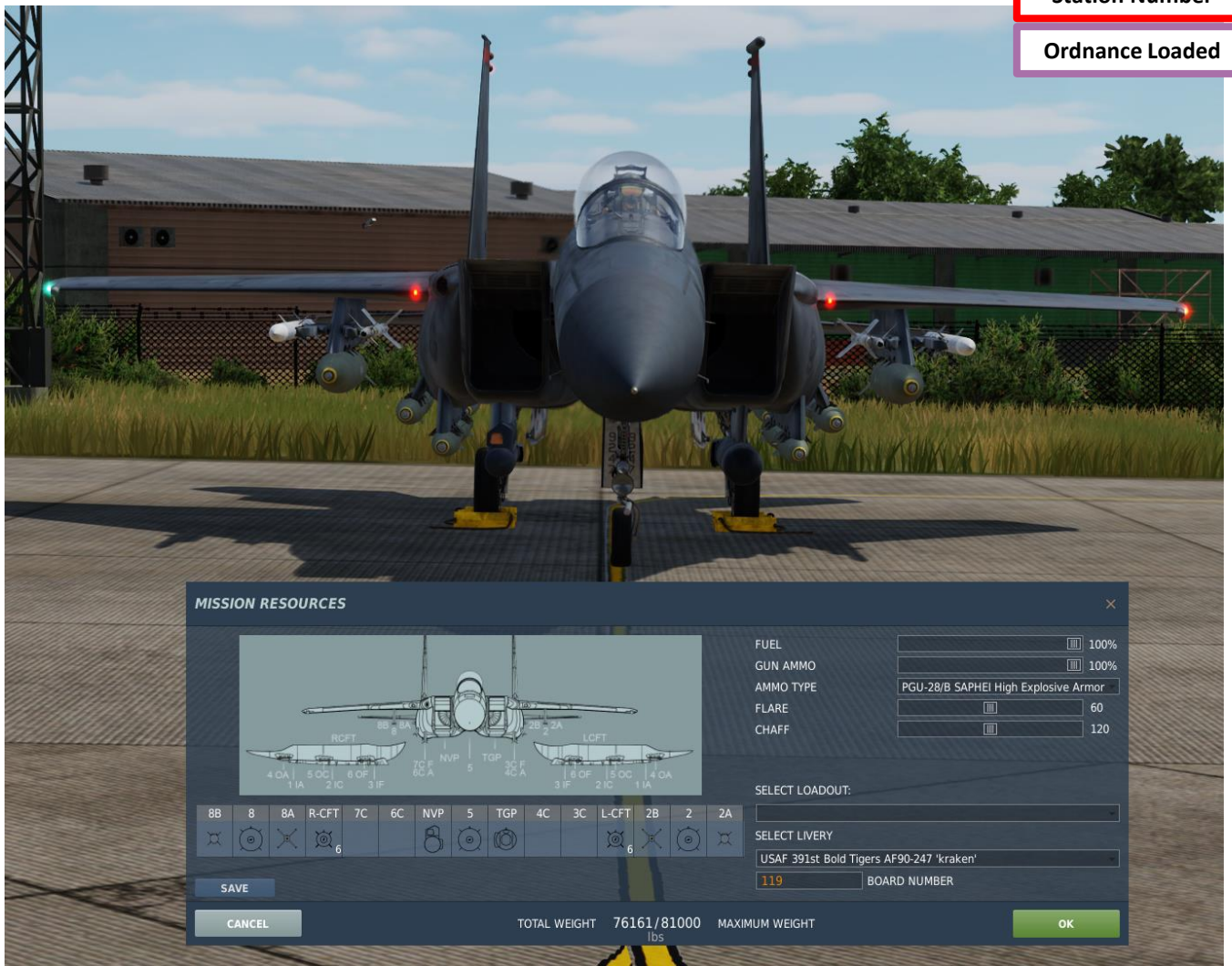
a) Set IFF Master Switch – NORMAL (MIDDLE).
b) Set IFF Antenna Select Switch – BOTH (MIDDLE).
c) Set IFF Mode 4 Reply Switch – AUDIO REC (MIDDLE).



G – PACS (PROGRAMMABLE ARMAMENT CONTROL SET) SETUP

When rearming the aircraft, the PACS (Programmable Armament Control Set) **does not automatically recognize every type of ordnance installed on the pylons**. Therefore, it is necessary to **program manually** in the PACS ARMT (Armament) page what the ground crew has installed. Some weapons like AIM-120 AMRAAMS, JDAMs or External Fuel Tanks are detected automatically by the aircraft, while other weapon types like MK-82 dumb bombs need to be programmed.

96. *[P/WSO]* Press « RSHIFT+K » to open up kneeboard and check your Mission Worksheet. The PACS SETUP field indicates what is loaded on which pylon, and the LASER section what laser codes are programmed on which laser-guided bombs.



MISSION WORKSHEET

INITIAL POSITION			1.6.2.206/2.4.2
1. LATITUDE	37°00.341N	GC ALIGN REQUIRED	5. INT FUEL
2. LONGITUDE	35°26.383E		6. EXT FUEL
3.. ALTITUDE	217.9		7. TOT FUEL
4. MAG VAR	4°46E		

PACS SETUP

2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V

COMBAT JETT

	RACK	STORE	PYLON	L	LC	C	RC	R
CBT 1								
CBT 2								

A/G DELIVERY

	SELECTED WEAPON	REL MOD	REL SEQ	FUZ	QTY	INTVL	LASER MODE	LASER TIME
PROG 1								
PROG 2								
PROG 3								
PROG 4								

LASER

	L	LC	C	RC	R	MIN LASE TIME
CODE	1688	1688	1688	1688	1688	MIN LASE ALT

WARNING: WEAPONS LASER CODES CAN ONLY BE SET BY THE GROUND CREW

UP DN

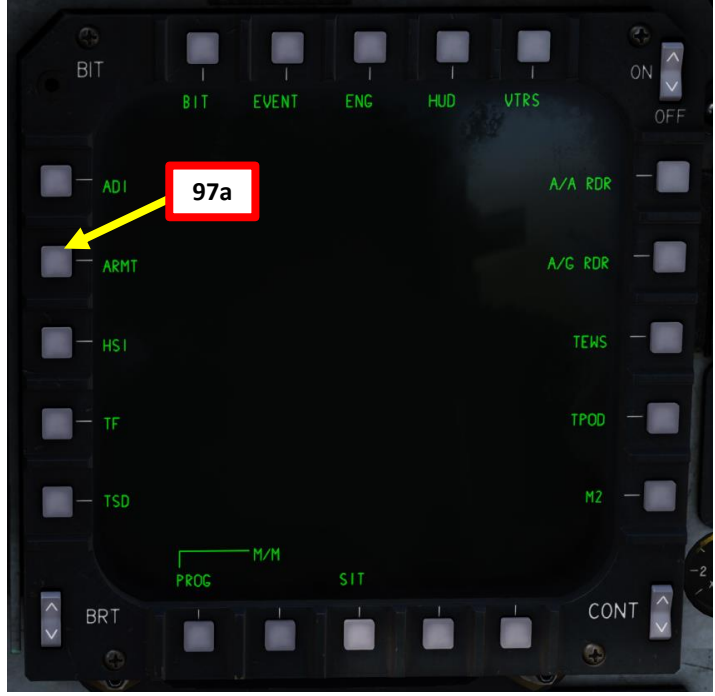
518

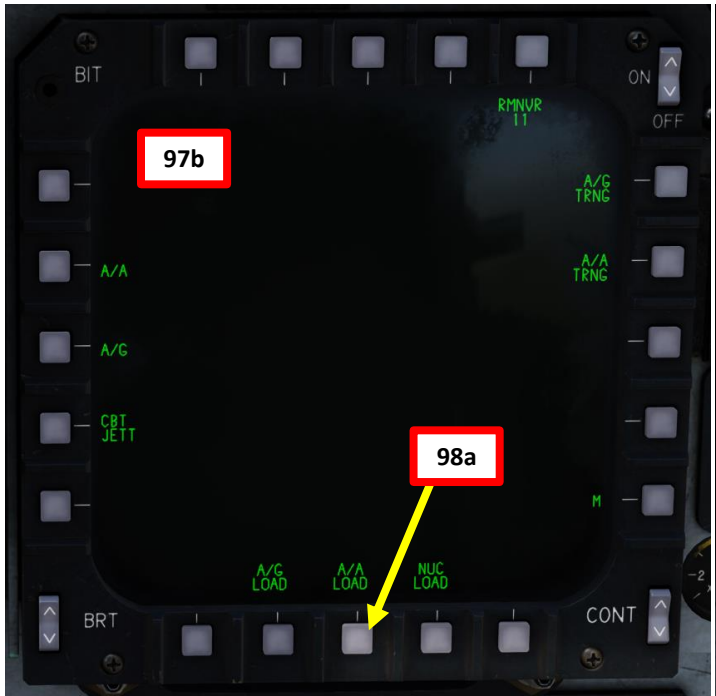
G – PACS (PROGRAMMABLE ARMAMENT CONTROL SET) SETUP

97. [P/WSO] On any display, press PB (Pushbutton) next to ARMT (Armament) to select PACS (Programmable Armament Control Set) page.
98. [P/WSO] We will check air-to-air weapons first. Press PB next to A/A LOAD to display the A/A COMBAT WEAPON LOAD page.

Smart weapons like the AIM-120 air-to-air missile are automatically detected (with the newer version of AIM-120Cs being displayed as 120V). However, the PACS 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.

For simplicity's sake, the loadout we have is comprised of AIM-120Cs and AIM-9Ms, which are already detected by the aircraft and loaded in the PACS.





PACS SETUP								
2		LC		5		RC		8
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR	
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR	
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V

G – PACS (PROGRAMMABLE ARMAMENT CONTROL SET) SETUP

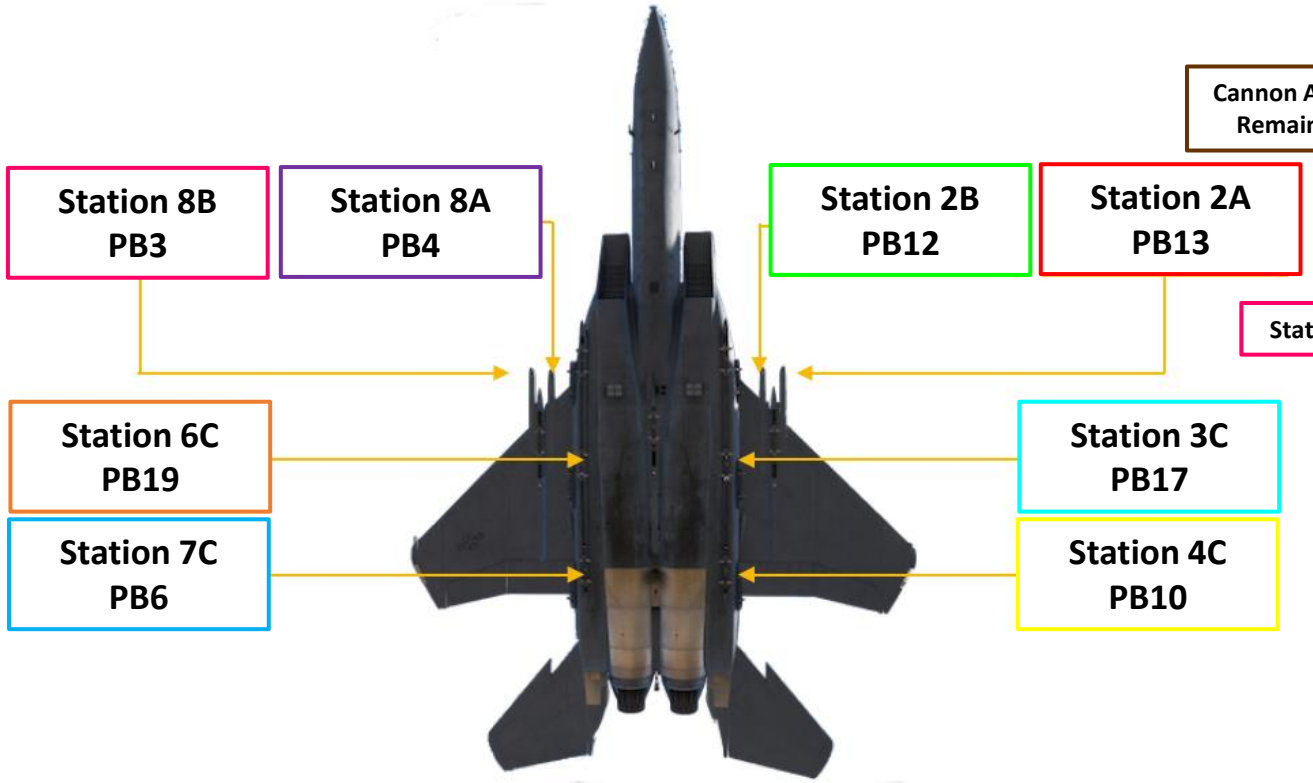
99. *[P/WSO]* Compare Mission Worksheet PACS SETUP with the A/A COMBAT WEAPON LOAD page. Verify that the configuration matches what is displayed on the PACS A/A COMBAT WEAPON LOAD page.

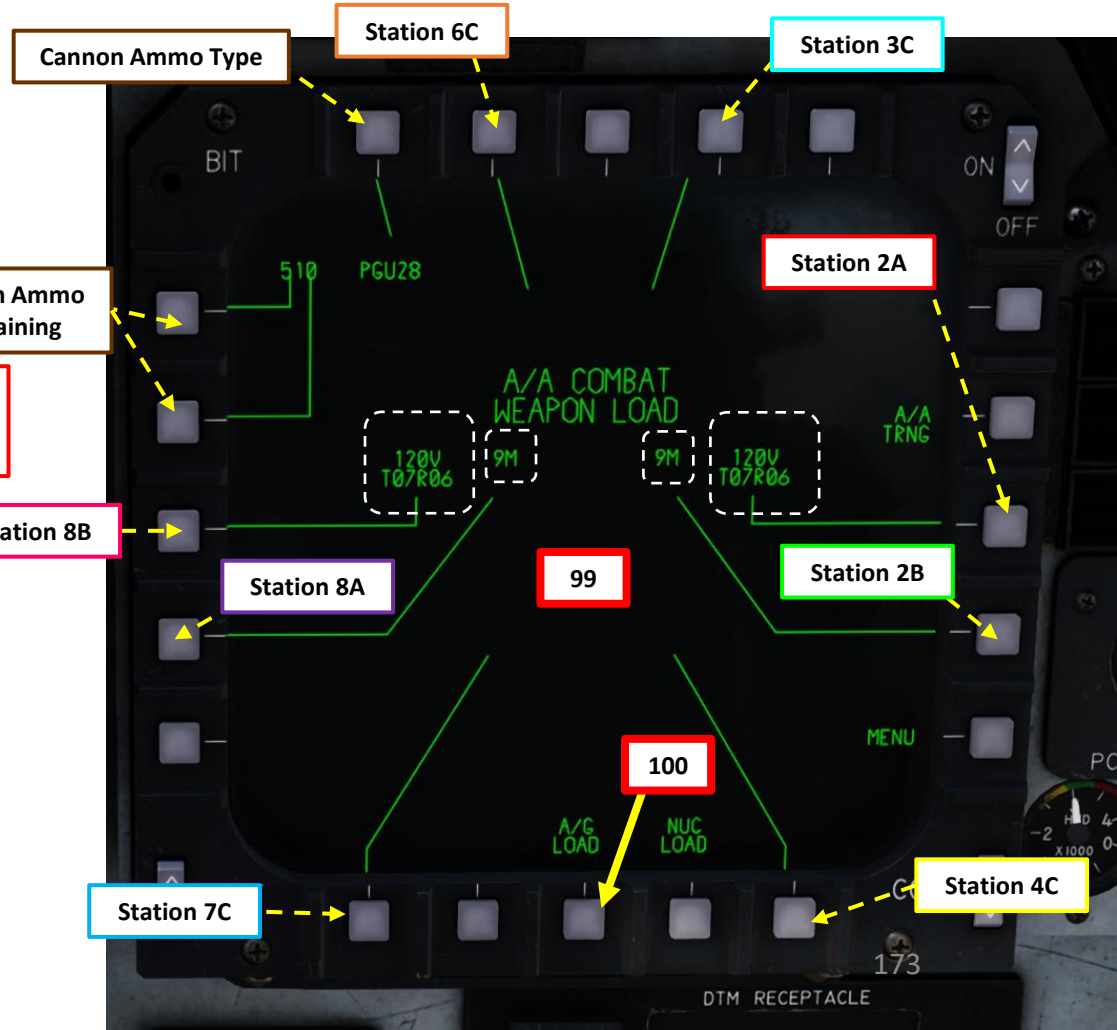
100. *[P/WSO]* Let's check air-to-ground weapons. Press the PB (Pushbutton) next to A/G LOAD to display the A/G COMBAT WEAPON LOAD page.

- Alternatively, you can press the PB next to MENU to return back to the PACS MENU page and select the A/G LOAD page from there.

99

PACS SETUP									
2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510 PGU-28				9M	120V





G – PACS (PROGRAMMABLE ARMAMENT CONTROL SET) SETUP

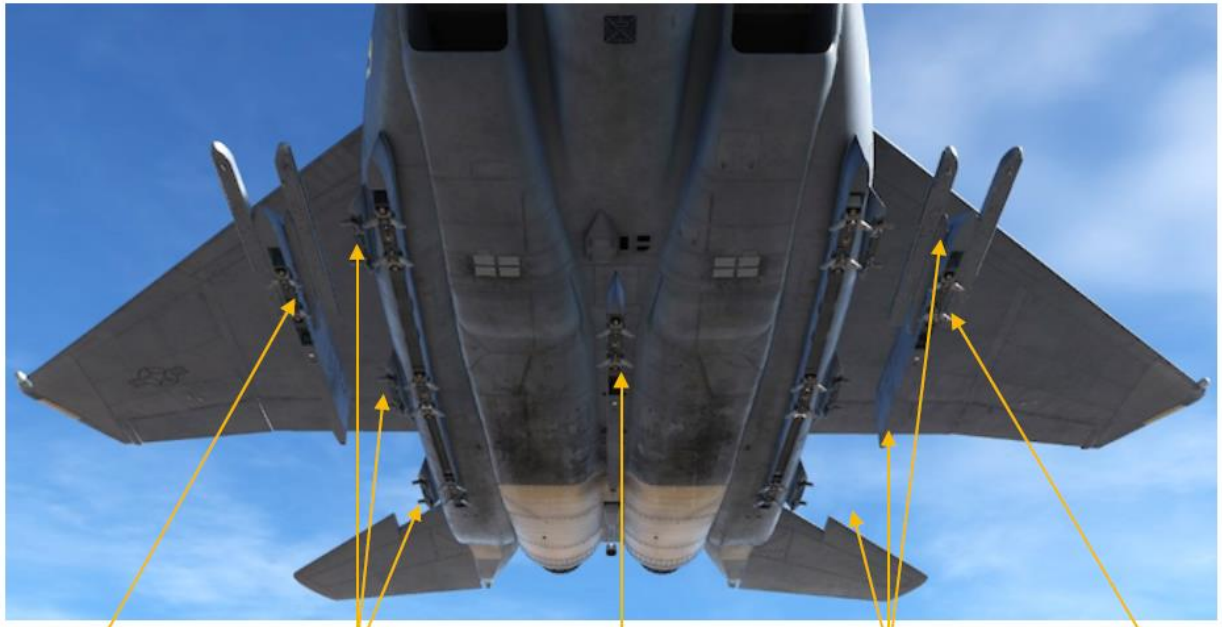
101.[P/WSO] Compare Mission Worksheet PACS SETUP with the A/G COMBAT WEAPON LOAD page. As we can see, the configuration does not match what is displayed on the PACS A/G COMBAT WEAPON LOAD page since no ordnance types are visible.

102.[P/WSO] We have to manually program in the PACS what weapons we have installed while using the Mission Worksheet as a reference.

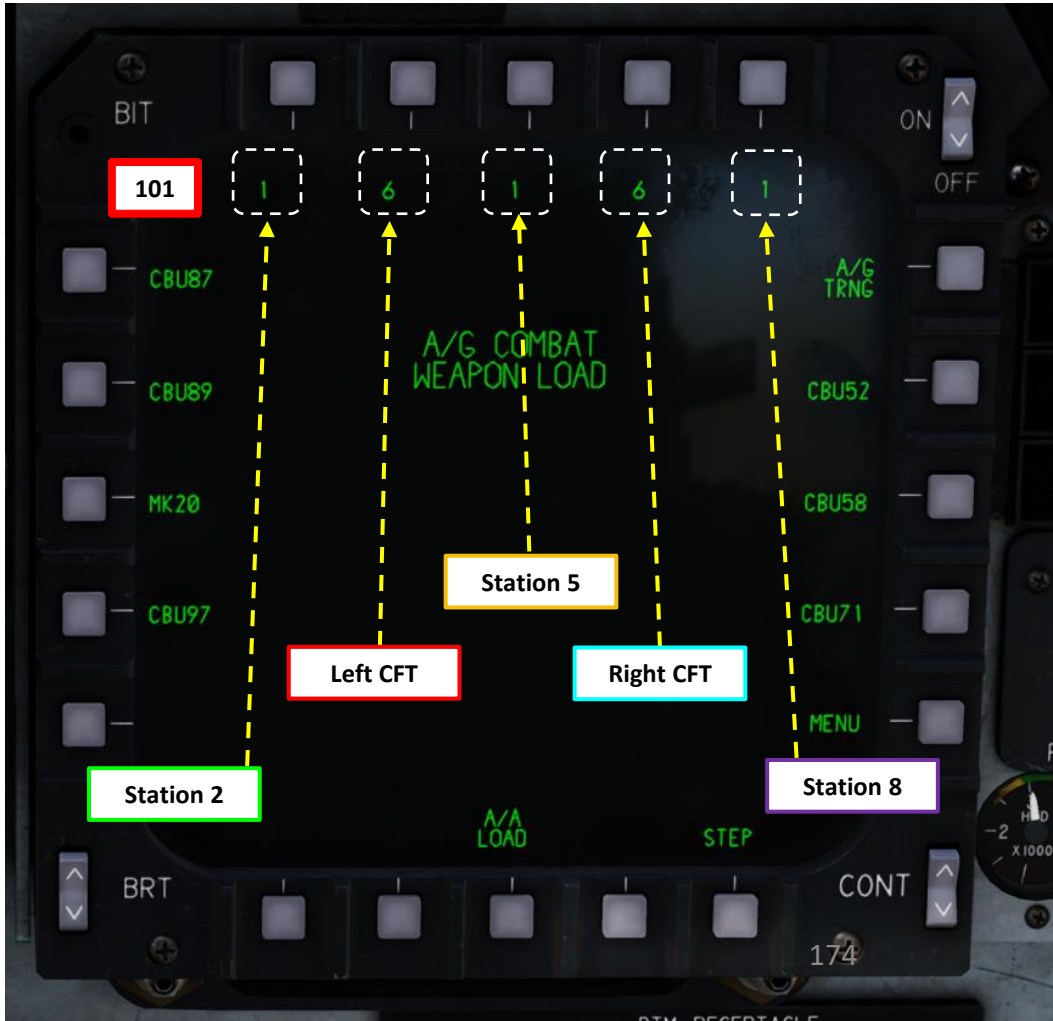
- Note: smart weapons like JDAMs or External Fuel Tanks (FUEL) are automatically detected.

101

PACS SETUP									
2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V



Station 8 PB16	Right CFT PB17	Station 5 PB18	Left CFT PB19	Station 2 PB20

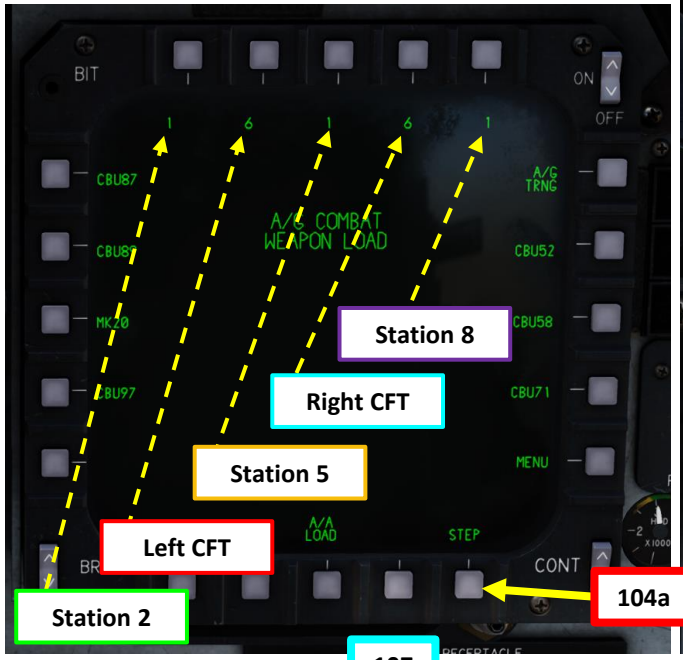


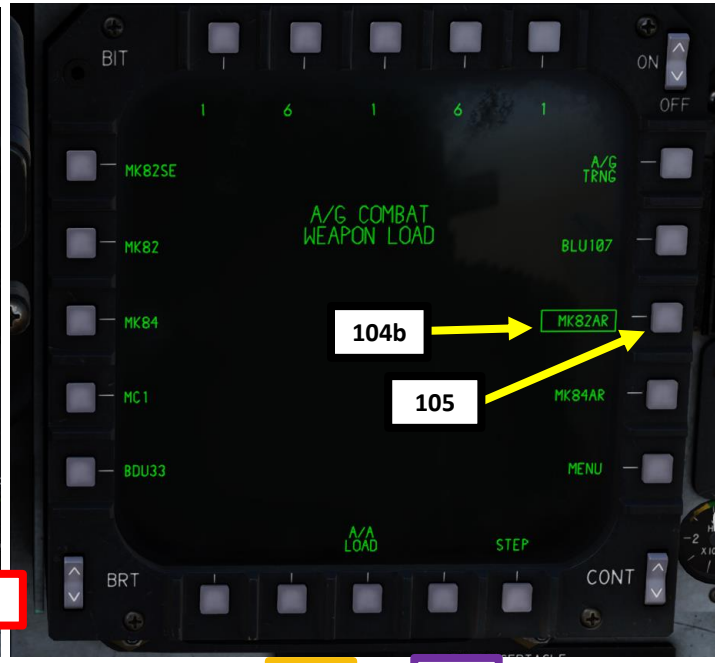
G – PACS (PROGRAMMABLE ARMAMENT CONTROL SET) SETUP

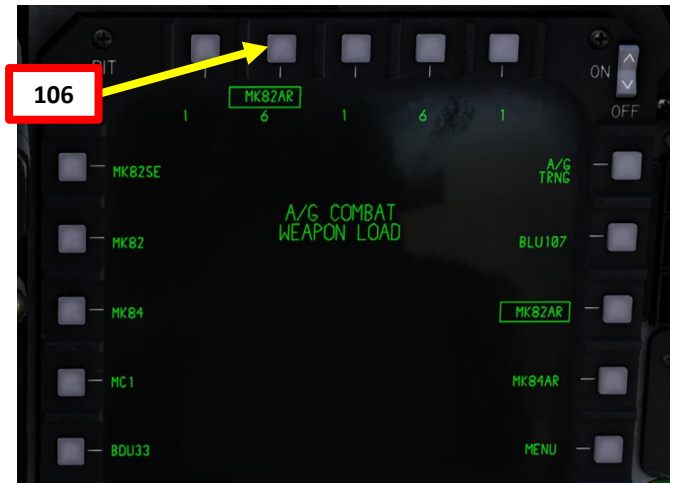
Note: This section does not include weapon delivery/profile programming since the subject is too extensive to be included in the start-up procedure. See the Weapons & Armament section for more information.

103.[P/WSO] Let's start by programming the Left CFT (Conformal Fuel Tank) station. The Mission Worksheet indicates that MK-82 Air Retarded Bombs (2AR) are installed.
104.[P/WSO] Press PB (Pushbutton) next to STEP to cycle between weapon types until you find "2AR" (MK-82 Air Bomb).
105.[P/WSO] Press PB next to "MK82AR" to box (select) MK-82 Air Bomb Weapon Type.
106.[P/WSO] Press PB next to the Left CFT station, which will change to "MK82AR".
107.[P/WSO] Repeat previous step, but for Right CFT Station.
108.[P/WSO] Now, let's program Station 2, Station 5 and Station 8, which all have a MK-84 bomb installed. If needed, press PB next to STEP until you find the "MK-84" type.
109.[P/WSO] Press PB next to "MK84" to box (select) MI-84 Bomb Weapon Type.
110.[P/WSO] Press PB next to Station 2, which will change to "MK84".
111.[P/WSO] Repeat previous step, but for Stations 5 and 8 as well.
112.And that's it! The aircraft now recognizes our air-to-ground weapons.

PACS SETUP								
2		LC		5		RC		8
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR	
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR	
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V







H – DISPLAY SETUP

113.*[P]* Exit the PACS ARMT page by pressing the PB (Pushbutton) next to MENU, then press PB next to M to reach main menu.

114.**[P]* Program the display sequence to easily switch between pages during flight. This isn't mandatory but it will make your life much easier. As an example, we will program the left display.

115.**[P]* Press Pushbutton (PB) next to PROG to select display programming function. PROG becomes boxed when selected.

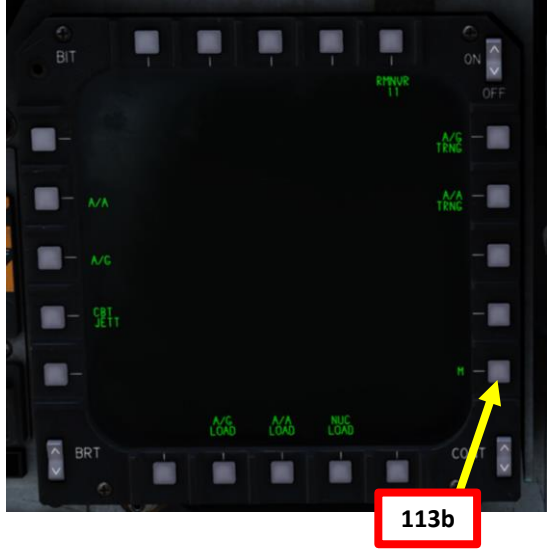
116.**[P]* Press PB next to the first page you want to set in the sequence. We will select the A/A RDR (Air-to-Air Radar) as the first page.

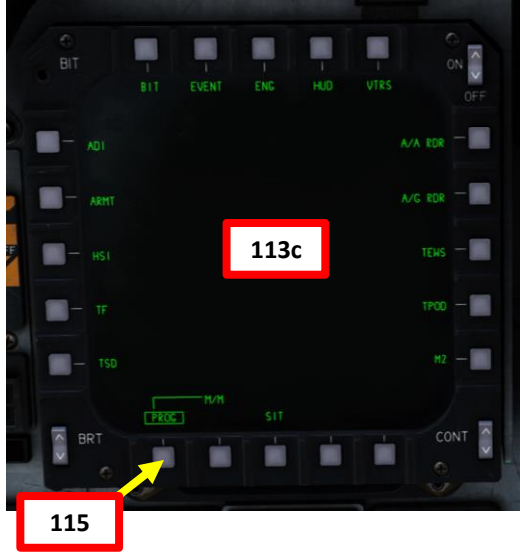
117.**[P]* Press PB next to the second page you want in the sequence; we will select A/G RDR (Air-to-Ground Radar).

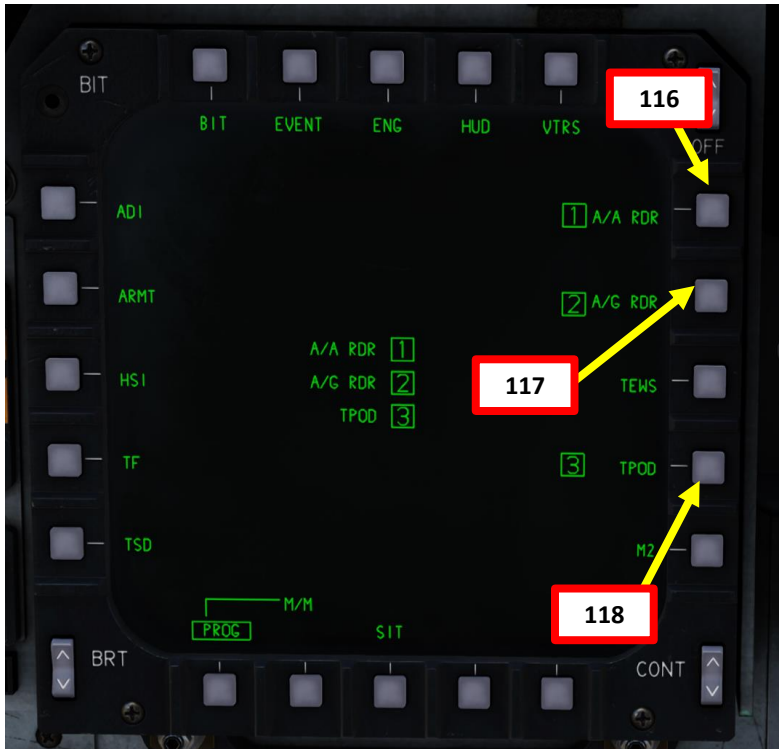
118.**[P]* Press PB next to the third page you want in the sequence; we will select TPOD (Targeting Pod).

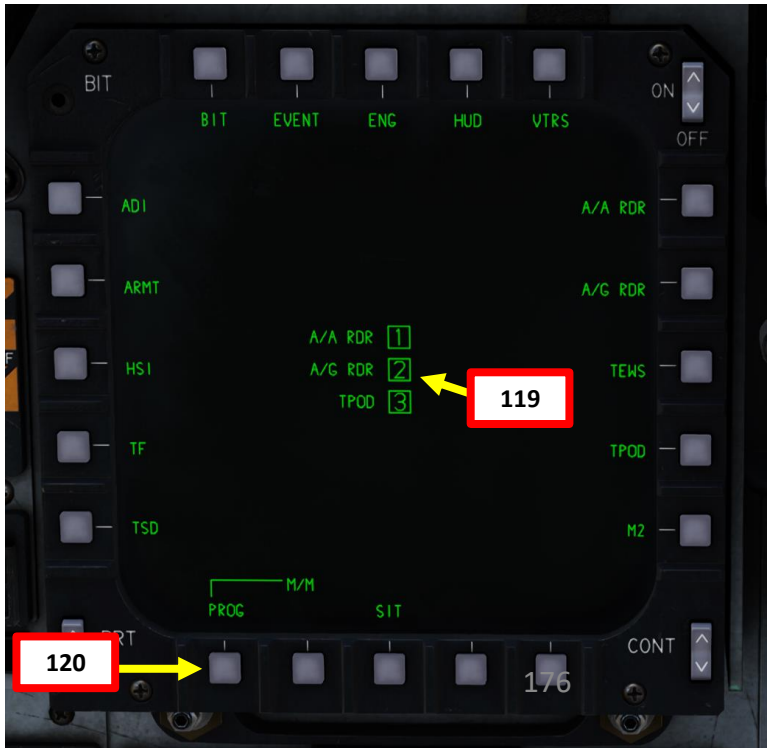
119.**[P]* The display sequence is indicated with the "1", "2", and "3" numbers.

120.**[P]* Press PB next to PROG to unselect display programming.PROG becomes unboxed when unselected.









H – DISPLAY SETUP

121.[P]* Program other displays as shown previously. Ultimately, the setup should depend on your own preference for the mission.

H – DISPLAY SETUP

122.[P] Select displays as desired for takeoff. Make sure PROG (Display Programming Function) is not selected (not boxed).

a) Front Left display: A/A RDR page.
b) Front Right display: TEWS (Tactical Electronic Warfare System) page
c) Front Bottom display: TSD (Tactical Situation Display)

H – DISPLAY SETUP

123.[WSO]* Program other displays as shown previously. You can put all the "DO" screens (actively using HOTAS) on the right side and the “WATCH" screens (i.e. mainly used for monitoring) on the left.

H – DISPLAY SETUP

124.[WSO] Select displays as desired for takeoff as shown previously. Make sure PROG (Display Programming Function) is not selected (not boxed).

a) Rear Outer Left display: TSD (Tactical Situation Display)
b) Rear Inner Left display: TPOD (Targeting Pod) page
c) Rear Inner Right display: HSI (Horizontal Situation Indicator) page
d) Rear Outer Right display: ADI (Attitude Director Indicator) page

I – COMPLETE AIRCRAFT SETUP

125.[P+WSO] Uncage the Standby ADI (Attitude Director Indicator):

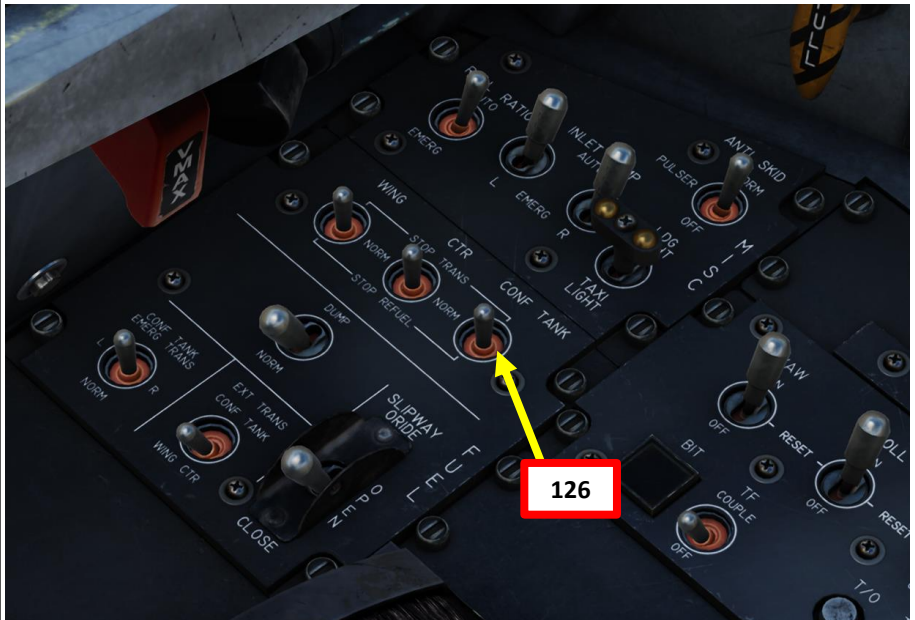
a) Pull the caging knob by left clicking and holding it.
b) Turn caging knob by scrolling mousewheel until the horizon line is centered.
c) Release caging knob by releasing left mouse button. Once the Standby ADI is uncaged, the orange flag will disappear.

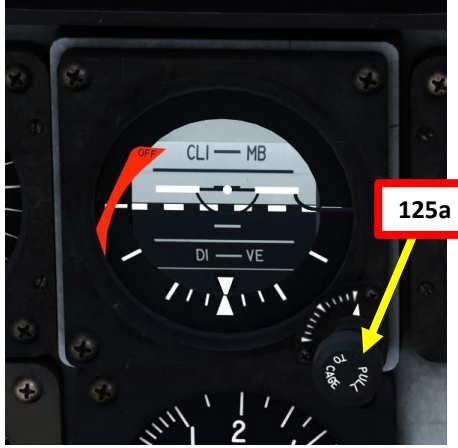
126.[P] Set Conformal Fuel Tank Control Switch – NORMAL (MIDDLE).

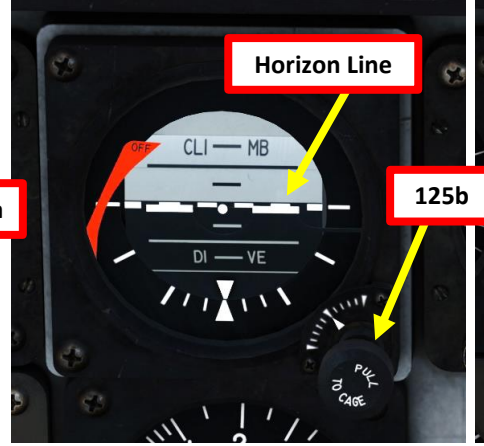
127.[P] Set Fuel Quantity Selector – As required by aircraft loadout. We will set it to CONF TANK in this example.

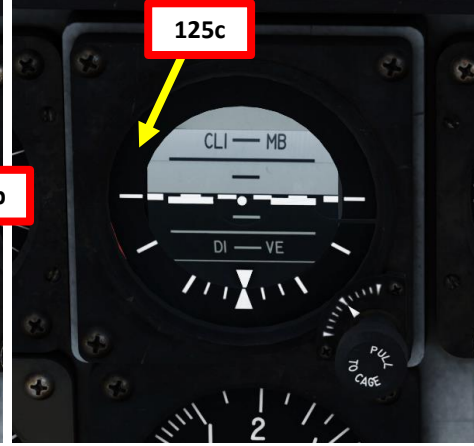
- If **no external fuel tanks are equipped**, set to **CONF TANK** (Conformal Fuel Tanks). The left and right fuel counters will display the fuel amount stored in the conformal tanks.
- If **external fuel tanks are equipped**, set to either **EXT WNG** (External Wing Fuel Tanks) **or EXT CTR** (External Centerline Fuel Tank) depending on what you have loaded. External fuel tanks will feed the engines first before the conformal tanks.
- If **both external wing fuel tanks and an external centerline fuel tank are loaded**, set to **EXT CTR** first.

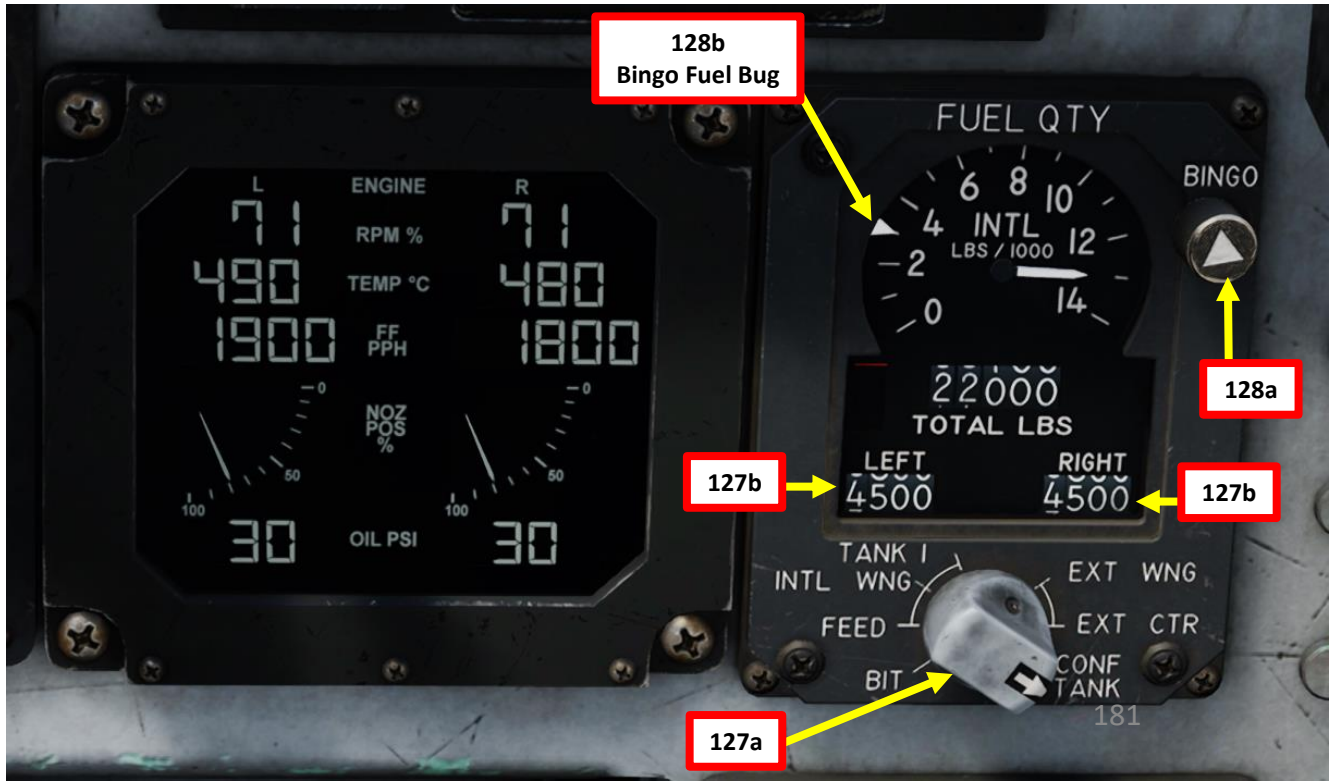
128.[P] Set Bingo Fuel (minimum fuel quantity required to reach the closest airfield) by turning the BINGO knob. We will set 3000 lbs, but keep in mind that this value may vary based on mission profile and selected loadout.











I – COMPLETE AIRCRAFT SETUP

129.[P+WSO] Equip either JHMCS (Joint Helmet-Mounted Cueing System) helmet or NVGs (Night Vision Goggles) as required.

a) Press "****" (communication menu binding) to contact ground crew
b) Press "**F8**" to select "**Ground Crew"**
c) Press "**F6**" to "**Change helmet-mounted device**".
d) Press "F2" to load NVGs. **Take note that JHMCS is not available yet.**

129a

Auto
Main
F1. Flight...
F2. Wingman 2...
F3. Wingman 3...
F5. ATC...
F8. Ground Crew...
F12. Exit

129b

Auto
2. Main. Ground Crew
F1. Rearm & Refuel
F2. Ground Electric Power...
F3. Request Repair
F4. Wheel chocks...
F5. Ground Air Supply...
F6. Change helmet-mounted device...
F7. Refill JFS Accumulator Bottles
F8. GBU Laser Codes...
F11. Previous Menu
F12. Exit

129c

Auto
3. Main. Ground Crew. Change helmet-mounted device
F1. Unload NVG
F2. Load NVG
F11. Previous Menu
F12. Exit

129d

I – COMPLETE AIRCRAFT SETUP

130.[P]* Perform the AFCS (Automatic Flight Control System) BIT (Built-In Test). 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.

- **Note: this function is not simulated yet.**

131.[P]* Perform a control wipeout to check flight controls.

- Stick Full Forward
- Stick Full Aft
- Stick Full Left
- Stick Full Right
- Rudder Full Left
- Rudder Full Right

132.[P] Press the Takeoff (T/O) Trim Button until the Takeoff (T/O) Trim Light illuminates and the "YAW RATE YAW RATE" aural warning is audible. When pressed, the T/O TRIM button drives the stick and rudder pedals to the takeoff position which, in turn, drives the aileron, rudder and stabilator actuators to the takeoff position.

133.[P] Set Anti-Skid Switch – NORMAL (FWD)

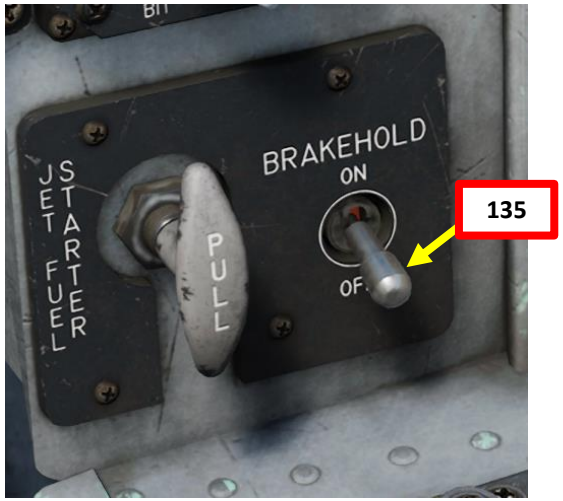
I – COMPLETE AIRCRAFT SETUP

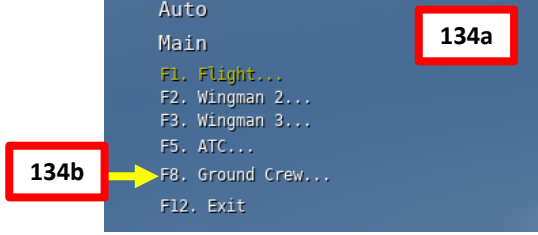
134.[P/WSO] Request the ground crew to remove wheel chocks.

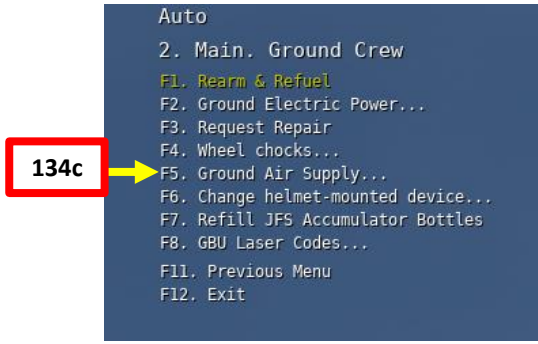
a) Press "****" (communication menu binding) to contact ground crew
b) Press "**F8**" to select "**Ground Crew"**
c) Press "**F4**" to "**Wheel chocks**".
d) Press **"F2"** to **"Remove Wheel Chocks"**.

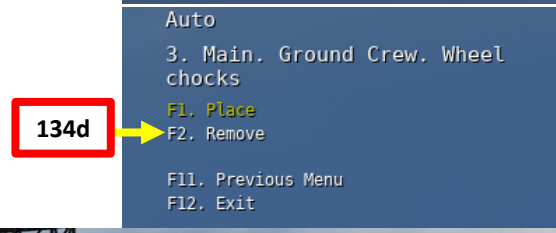
- *Note: If you have no answer from the ground crew, make sure that the Intercom Function Selection (Mic) Switch is set to ON (MIDDLE), which is at the beginning of the start-up procedure.*

135.[P] Release parking brake by setting Brake Hold (Parking Brake) Switch – OFF (DOWN).





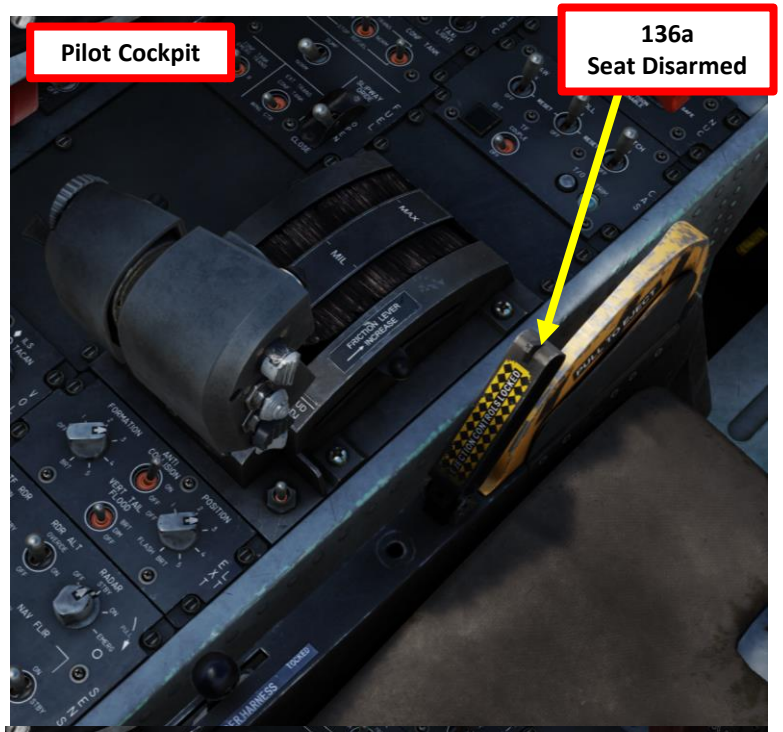


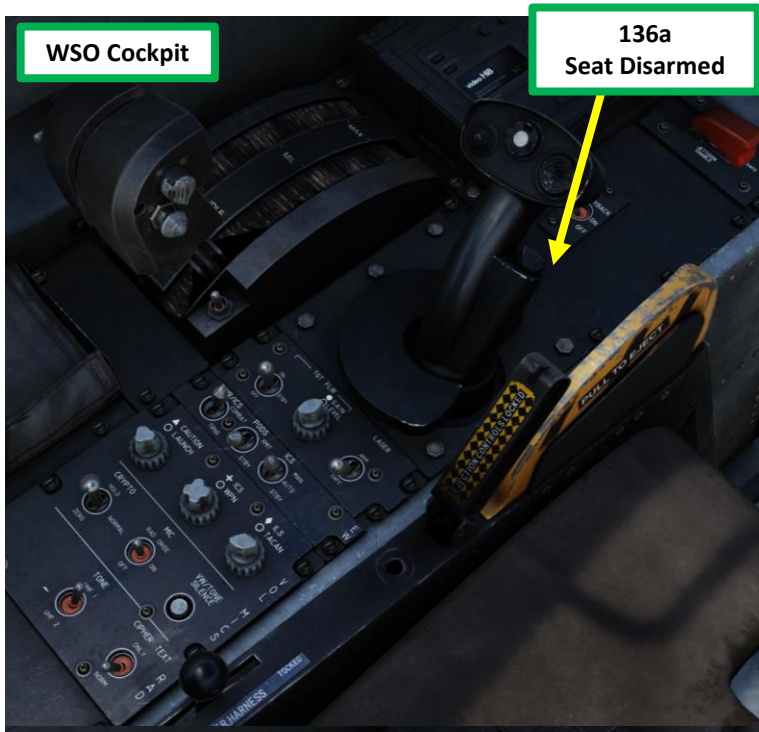


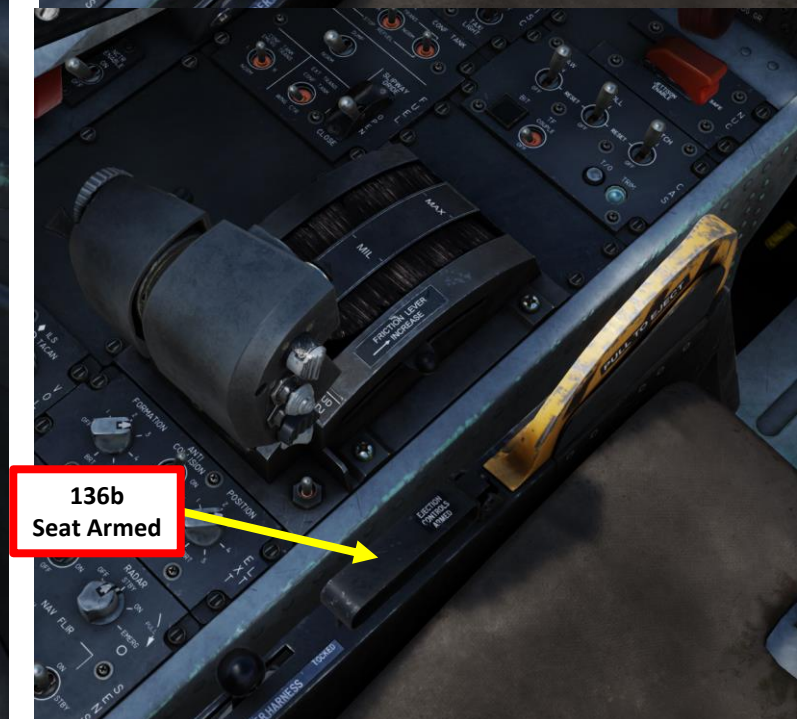
I – COMPLETE AIRCRAFT SETUP

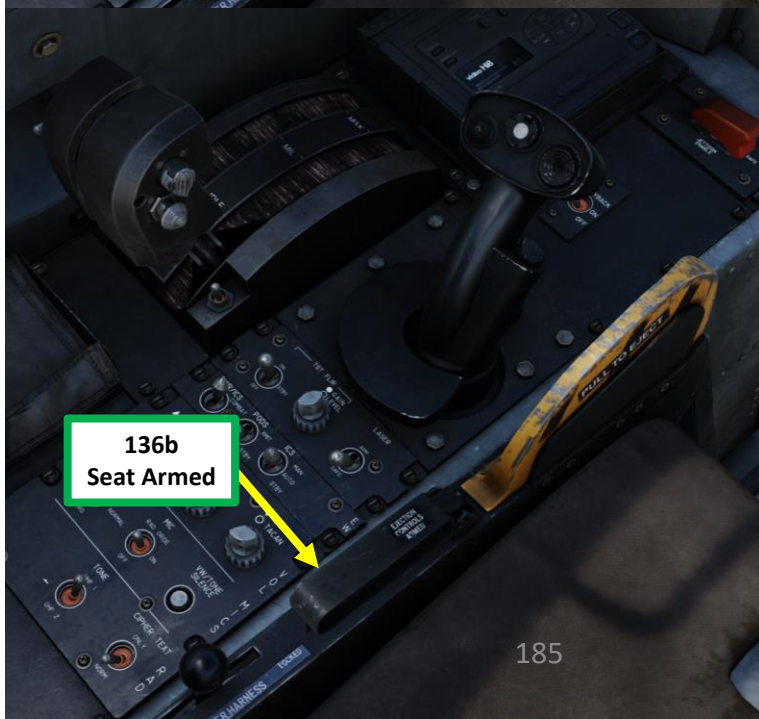
136.[P+WSO] Arm ejection seat.
- Note: this step is usually performed just before takeoff.

137.[WSO] Set Command Selector Valve – AFT INITIATION (Horizontal position). This will ensure that when ejection sequence is initiated, the WSO seat will eject first, followed by the pilot seat.
- NORMAL (Vertical position) is also an acceptable setting in most situations.









I – COMPLETE AIRCRAFT SETUP

138.[P/WSO] And that's it! We are now ready for taxi. Call the tower and request clearance to start taxiing.

ABBREVIATED START-UP CHECKLIST (SOURCE: RAZBAM MANUAL)

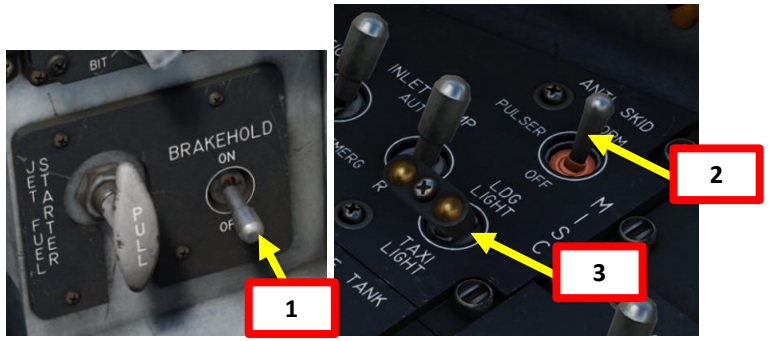
Mic Switch	LEFT PANEL	ON
Anti-Col Lights	LEFT PANEL	ON
Position Lights	LEFT PANEL	As DES.
Throttles	LEFT PANEL	OFF
Conform Tanks	LEFT PANEL	STOP Tr.
L Inlet Ramp Sw.	LEFT PANEL	AUTO
R Inlet Ramp Sw.	LEFT PANEL	AUTO
Yaw CAS Sw.	LEFT PANEL	ON
Roll CAS Sw.	LEFT PANEL	ON
Pitch CAS Sw.	LEFT PANEL	ON
Oxygen 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 (R 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
Left Finger Lift	THROTTLE	PULL
RPM (L Eng)	ENGINE MON.	26%
Left Throttle	LEFT PANEL	IDLE
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

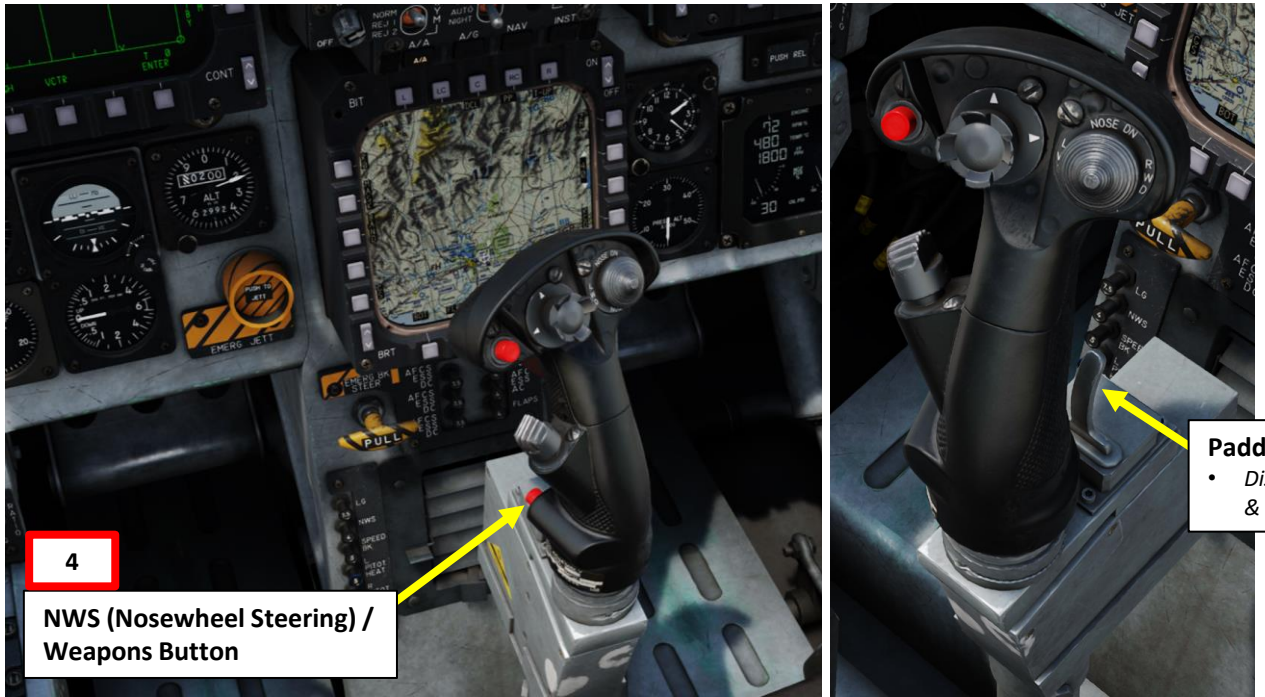
Volume Knobs	LEFT PANEL	As Des.
Crypto Switch	LEFT PANEL	NORM
Mic Switch	LEFT PANEL	ON
Cipher Txt Sw.	LEFT PANEL	As Req.
Tone Sw.	LEFT PANEL	OFF
TGT FLIR Power	LEFT PANEL	OFF
Laser Sw.	LEFT PANEL	OFF
Nuclear Consent	LEFT PANEL	SAFE
Emer. Landing Gear	MAIN PANEL	IN
Arresting Hook	MAIN PANEL	UP
Emer. Brake	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

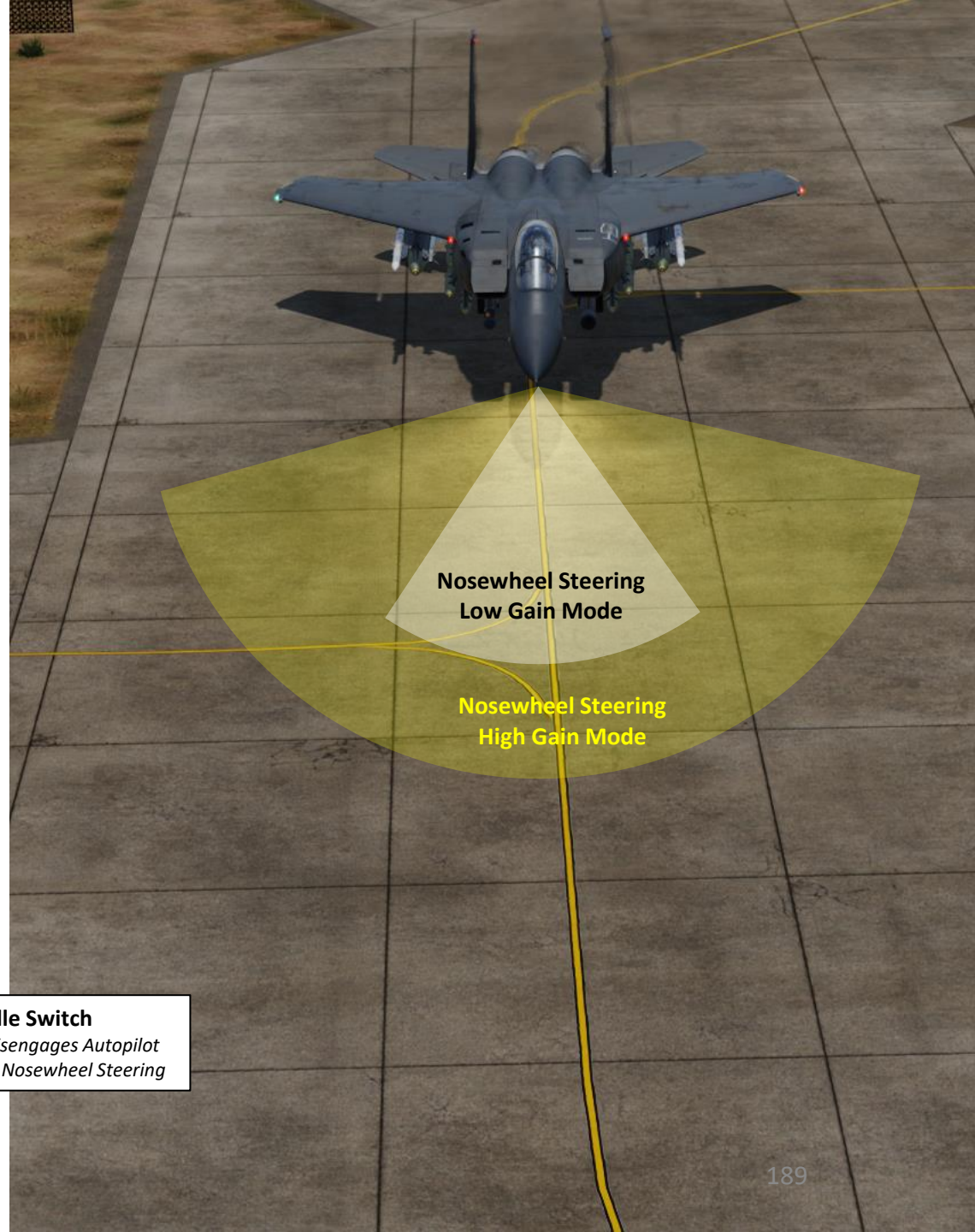
PART 5 – TAXI & TAKEOFF

TAXI

1. *[P]* Ensure wheel chocks are removed and that parking brake is released. Brake Hold (Parking Brake) Switch should be set to OFF (DOWN).
2. *[P]* Make sure Anti-Skid Switch is set to NORMAL (FWD)
3. *[P]* Set Landing/Taxi Light Switch – TAXI (AFT)
4. *[P]* By default, nosewheel steering is engaged in LOW GAIN steering mode. To perform tighter turns, press and hold the NWS (Nosewheel Steering) / Weapons Button on the stick to engage HIGH GAIN steering mode, which allows the aircraft to turn in a tighter radius. The aircraft is steered on the ground using the rudder pedals.
    - Note: If you want to disengage nosewheel steering, press and hold the Paddle Switch to momentarily disengage it.





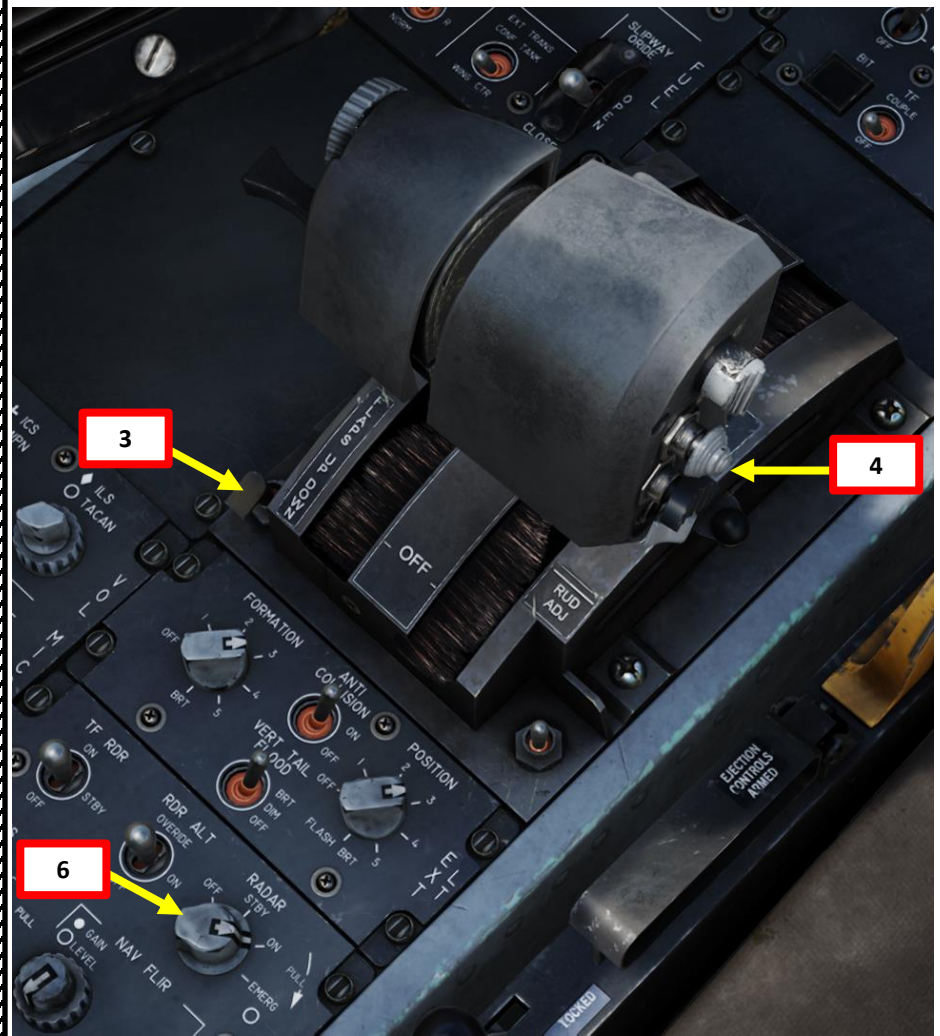


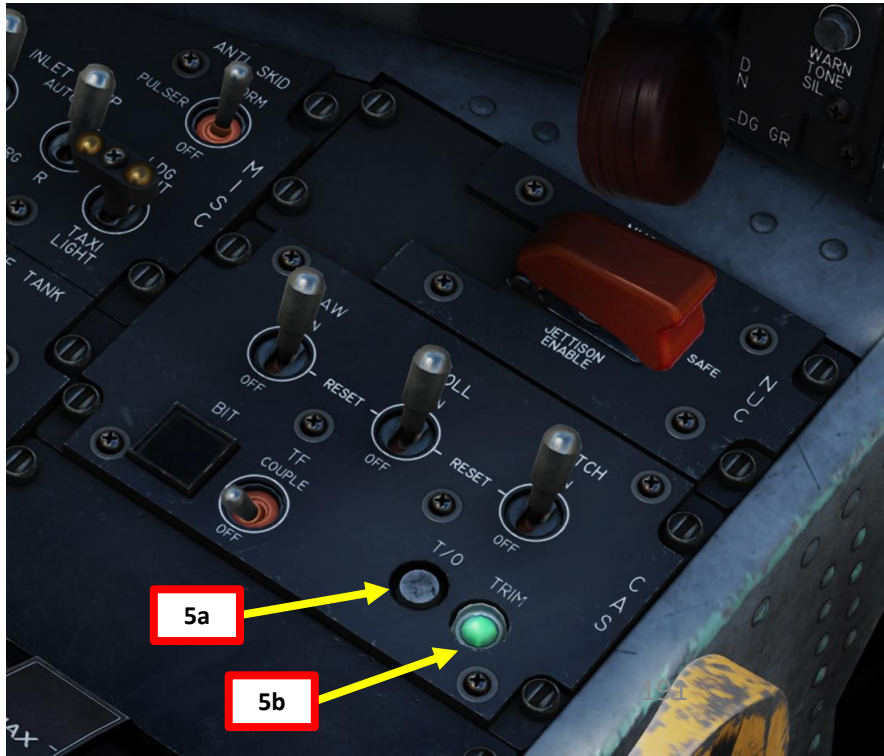
TAXI

5. *[P]* Throttle up slightly above IDLE to start taxiing. Perform a quick brake check before taking the taxiway.
6. *[P]* Steer aircraft using rudder pedals. Use toe brakes if you need to decelerate or bring the aircraft to a stop.
7. *[P]* Try to aim for a taxi speed no faster than 20 kts. Perform taxi turns at 10 kts or less.

TAKEOFF

1. *[P]* Line up on the runway.
2. *[P]* Set Landing/Taxi Light Switch – OFF (MIDDLE)
3. *[P]* Set Flaps Lever – DOWN (AFT).
4. *[P]* Verify Speed Brake is Retracted (Speed Brake Switch FWD).
5. *[P]* Ensure Takeoff Trim is set by checking that the Takeoff (T/O) Trim Light is illuminated. If the light is extinguished, press the Takeoff (T/O) Trim Button until the Takeoff (T/O) Trim Light illuminates and the "YAW RATE YAW RATE" aural warning is audible.
6. *[P]* Set Radar Power Selector Knob – ON.
7. *[WSO]* Set CMD (Countermeasure Dispenser) Mode Switch – MAN ONLY or SEMI-AUTO, as desired.





TAKEOFF

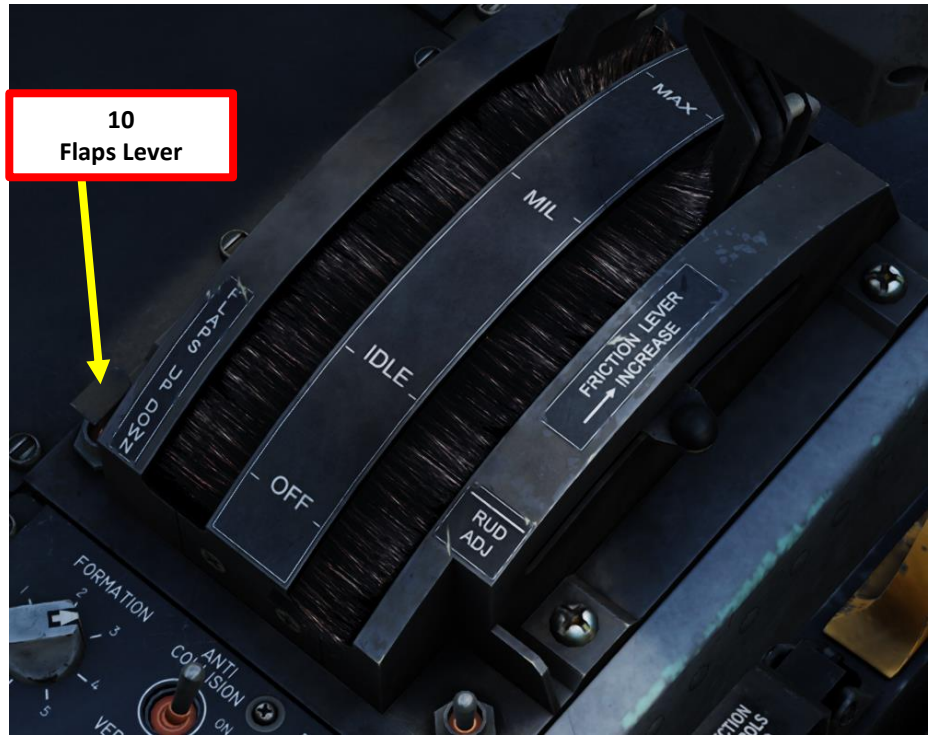
8. *[P]* Advance engines to 82% and check the instruments and caution / warning lights. When ready for takeoff, release brakes and advance the throttles to MIL or MAX power.

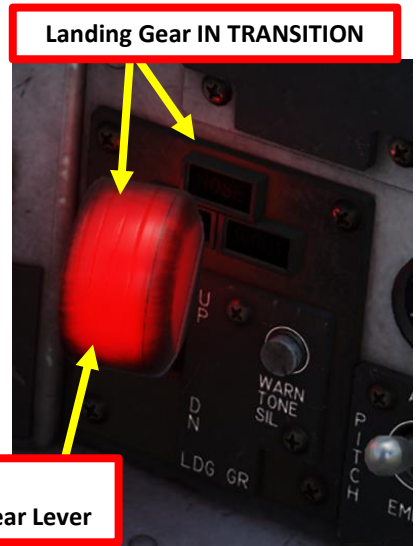
TAKEOFF

9. *[P]* After reaching the rotation speed, smoothly move the stick to around halfway aft position to establish a 10 deg pitch attitude.

TAKEOFF

10. *[P]* Retract gear (Landing Gear Lever UP) and flaps (Flaps Lever FWD) when airborne.
11. *[P]* Set 1-2 clicks of nose down trim after liftoff to compensate for the T/ O trim nose up attitude.





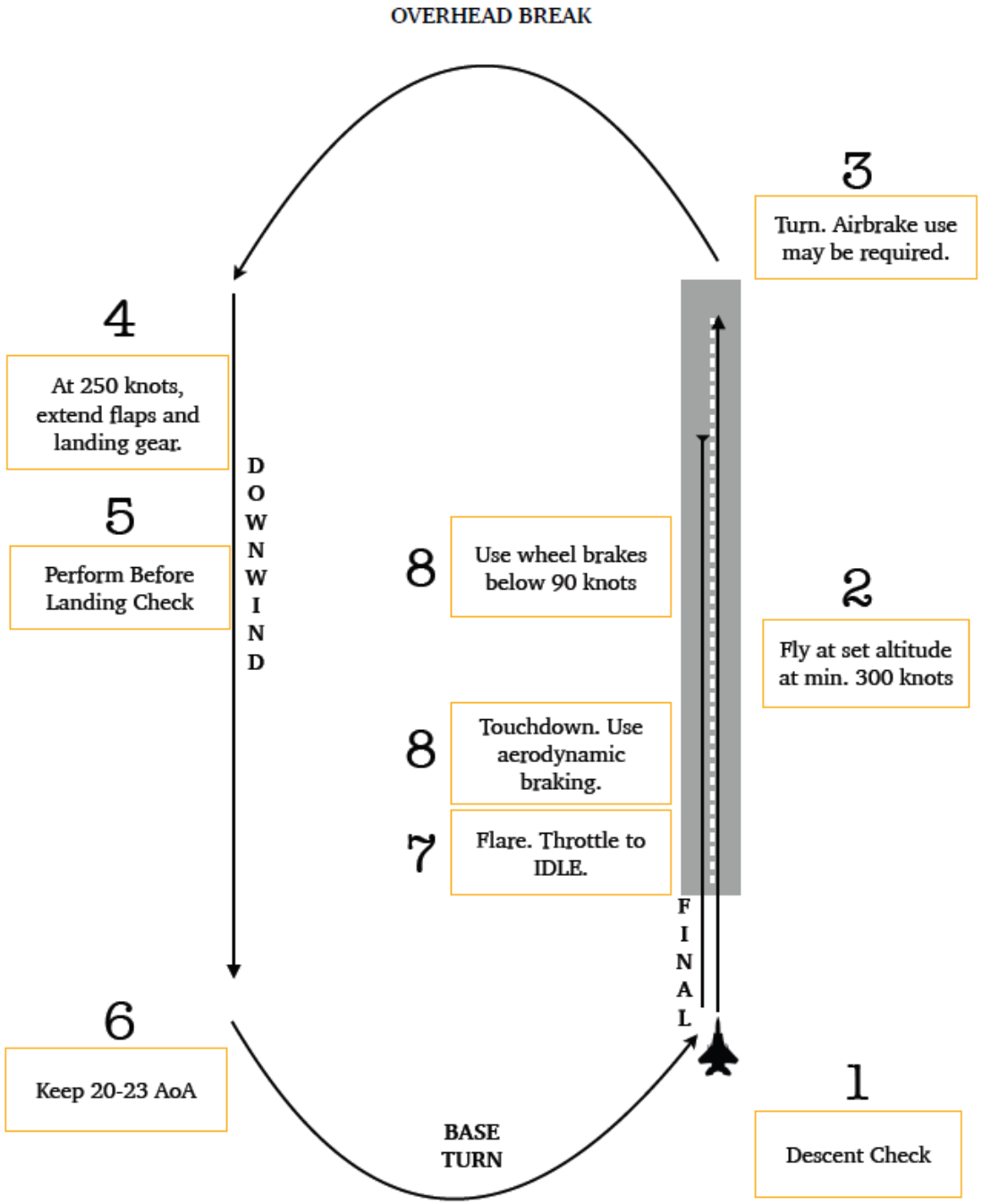
TAKEOFF

12. *[P]* Climb out with the desired power setting.
    - **In MIL power setting**: Maintain 350 KCAS to 0.90 Mach with light loadout (300 KCAS with heavy loadout / high drag index). Maintain this airspeed until reaching cruise altitude.
    - **In MAX power setting**: Maintain 350 KCAS to 0.95 Mach with light loadout (0.90 Mach with heavy loadout / high drag index). Maintain this airspeed until reaching cruise altitude.

PART 6 – LANDING

LANDING PATTERN

1. Descent Check
2. Initial Approach
3. Overhead Break
4. Downwind Leg
5. Before Landing Checks
6. Base Turn
7. Short Final & Flare
8. Touchdown & Roll-Out



THE IMPORTANCE OF WEIGHT

Weight & Fuel Considerations

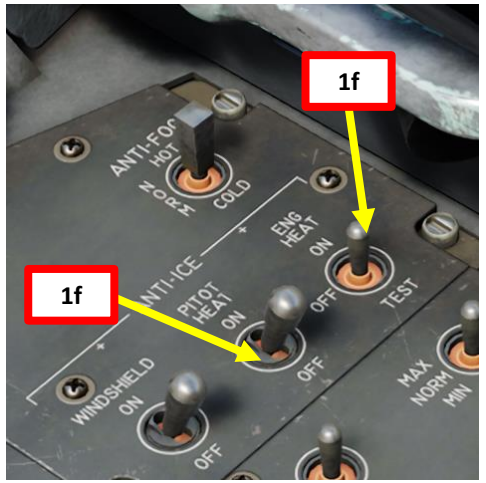
- The F-15E can carry an impressive fuel quantity. However, keep in mind that attempting to land with a nearly fully fuelled (read: very heavy) aircraft means that you may not have enough runway length to come to a full stop.
- I would normally recommend landing with 5000 lbs of fuel or less. If you have too much fuel, you can use the **Fuel Dump Switch** to jettison fuel through the right wingtip's fuel dump outlet.
- Note: The left wingtip only vents fuel when an overpressure or overfuelled condition exists.

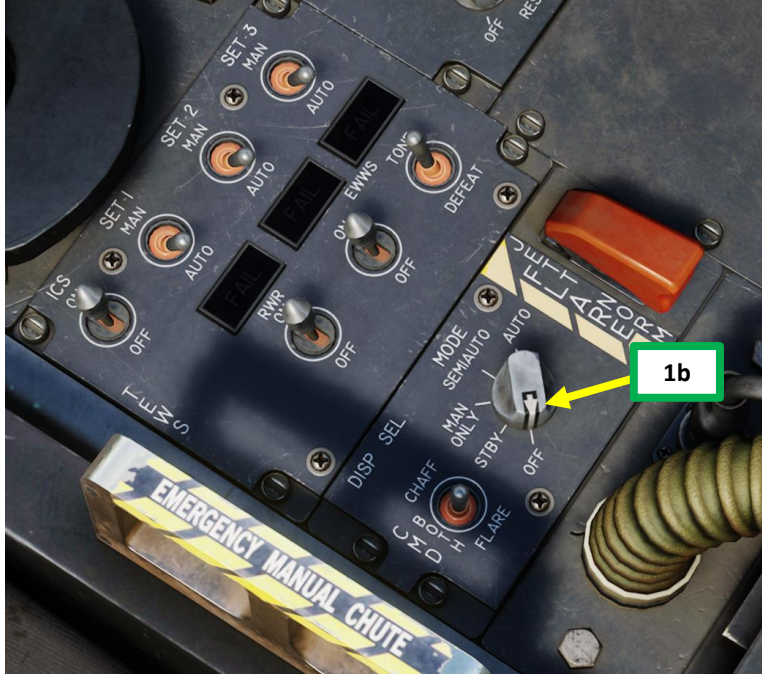
Fuel Dump Switch

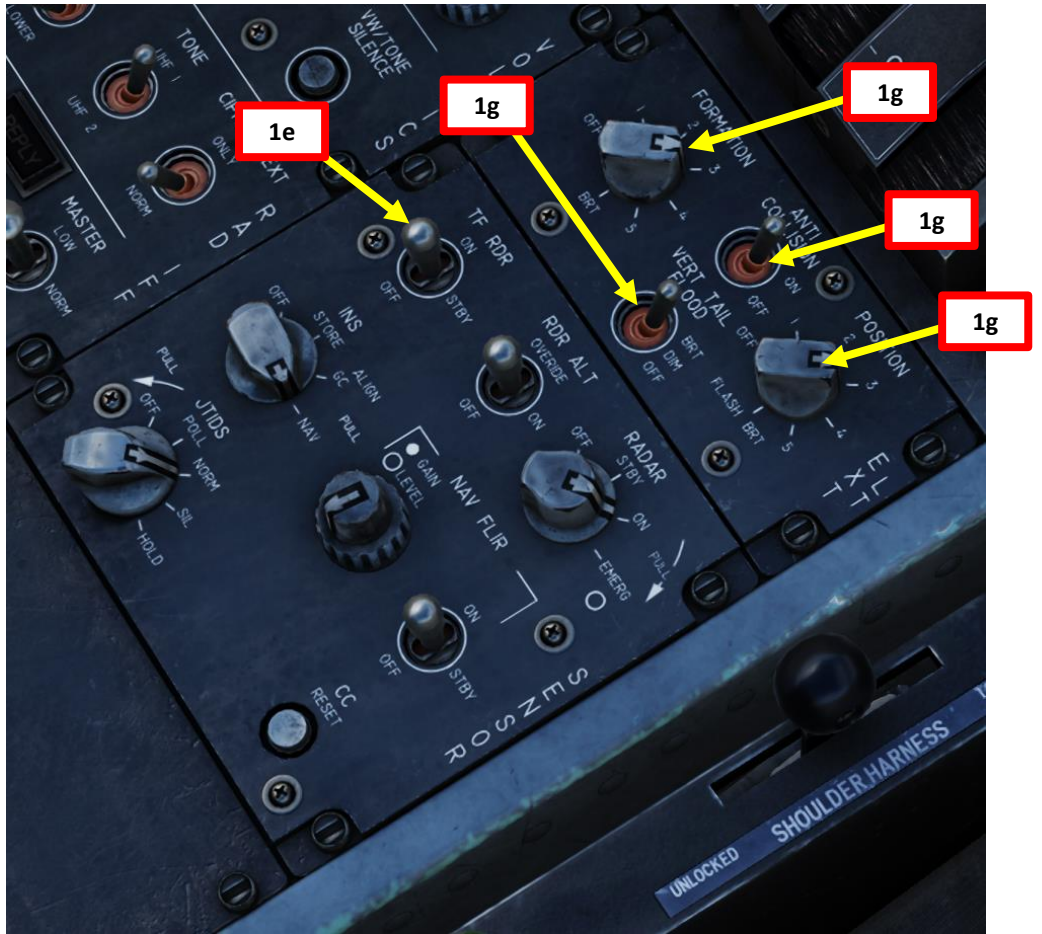
- *FWD: dumps fuel from all fuel tanks except engine feed tanks.*
- *AFT: Normal (Default Position)*

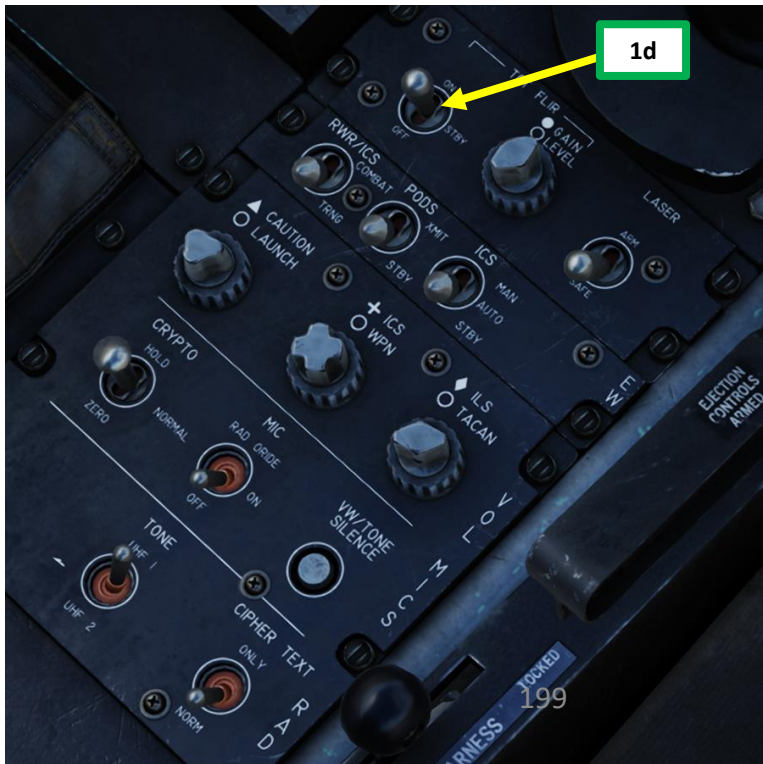
LANDING PROCEDURE

1. **Descent Check**
   - *a)* *[P]* Set Master Arm Switch – SAFE (DOWN).
   - *b)* *[WSO]* Set CMD (Countermeasure Dispenser) Mode Switch – OFF.
   - *c)* *[P+WSO]* Set up and check standby altimeters
   - *d)* *[WSO]* If AN/AAQ-14 LANTIRN Targeting Pod (TGP) is installed, set TGT FLIR (Targeting Pod) Power Switch – STANDBY (MIDDLE).
   - *e)* *[P]* If AN/AAQ-13 LANTIRN Navigation Pod (NVP) is installed, set TF RDR (Terrain Following Radar) Power Switch – STANDBY (MIDDLE).
   - *f)* *[P]* Set Pitot Probe Heat Switch & Engine Anti-Ice Switch – As required
   - *g)* *[P]* Set up External Lights





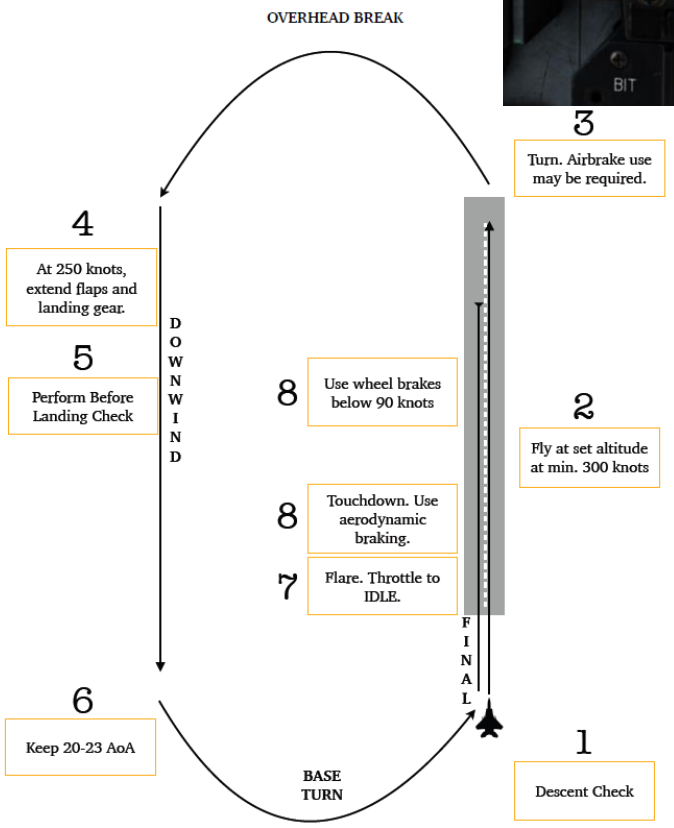




LANDING PROCEDURE

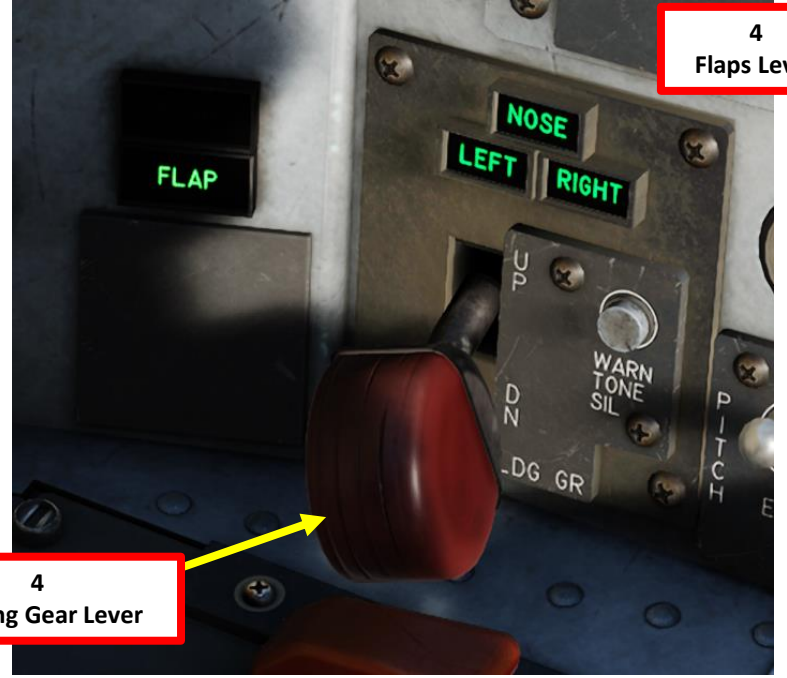
2. **Initial Approach**
   a) Set Master Mode to NAV (Navigation).
   b) After contacting the Tower, fly over the runway at set altitude and speed. The standard USAF overhead pattern is 1600 feet AGL (Above Ground Level) and with a minimum airspeed of 300 kts.

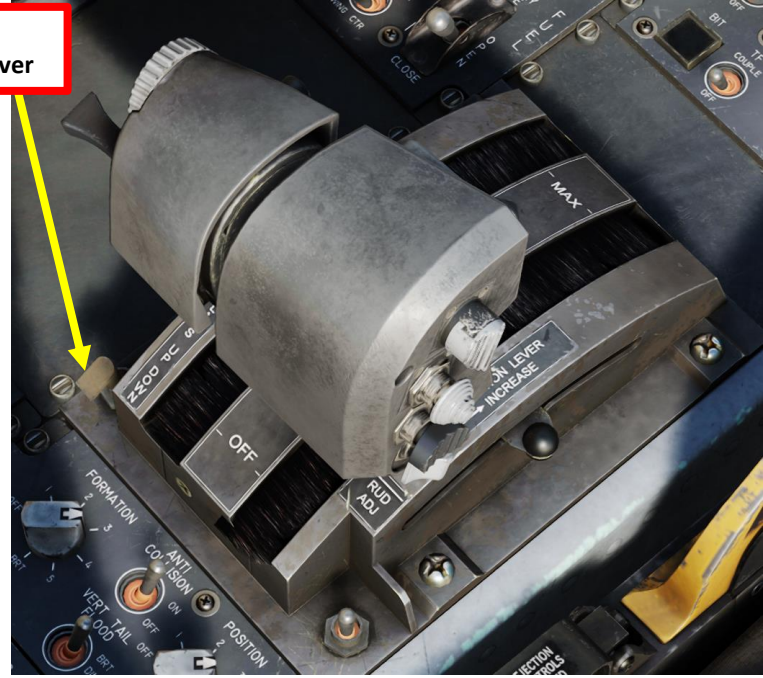
3. **Overhead Break**
   - When you reach the desired break point, set throttle to IDLE, then break left or right. You may need to extend the airbrake if going too fast. Roll out on the reciprocal heading and put the wingtip on the runway (a perfect position is putting the runway between the wingtip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

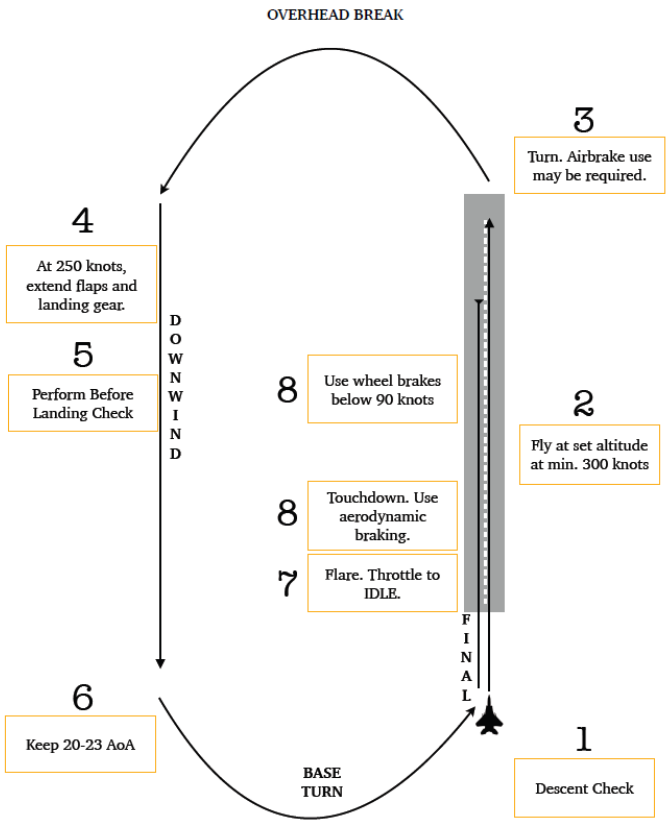


LANDING PROCEDURE

4. **Downwind Break**
   - On downwind, you should be flying parallel to the runway, around 1.5 nm away from it. Decrease airspeed to 250 kts.
   - Extend flaps (Flaps Lever AFT) and landing gear (Landing Gear Lever DOWN).

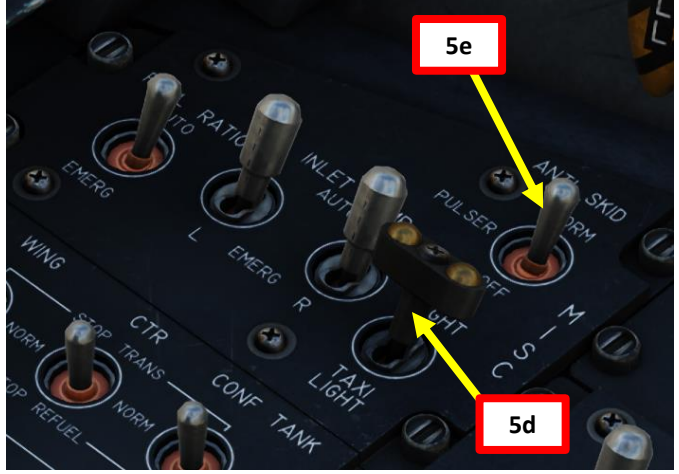


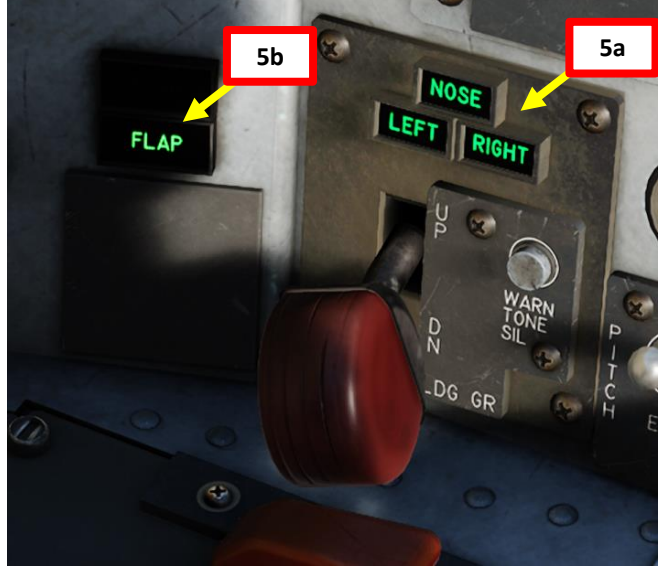


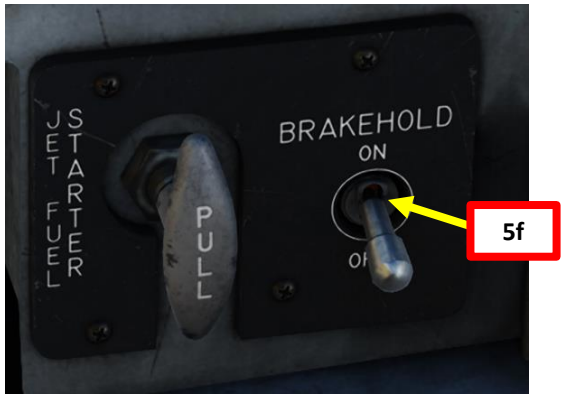


LANDING PROCEDURE

5. **Before Landing Checks**
   - *a)* *[P+WSO]* Verify that landing gear is down and locked.
   - *b)* *[P+WSO]* Verify that flaps are down.
   - *c)* *[P]* Check hydraulic gauges are in the green (nominal pressure).
   - *d)* *[P]* Set Landing/Taxi Light Switch – LANDING (FWD)
   - *e)* *[P]* Set Anti-Skid Switch – NORMAL (FWD)
   - *f)* *[P]* Verify that Brake Hold (Parking Brake) Switch is set to OFF (DOWN).



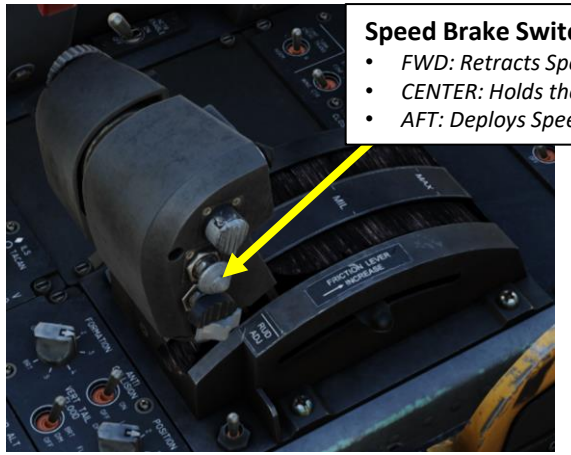


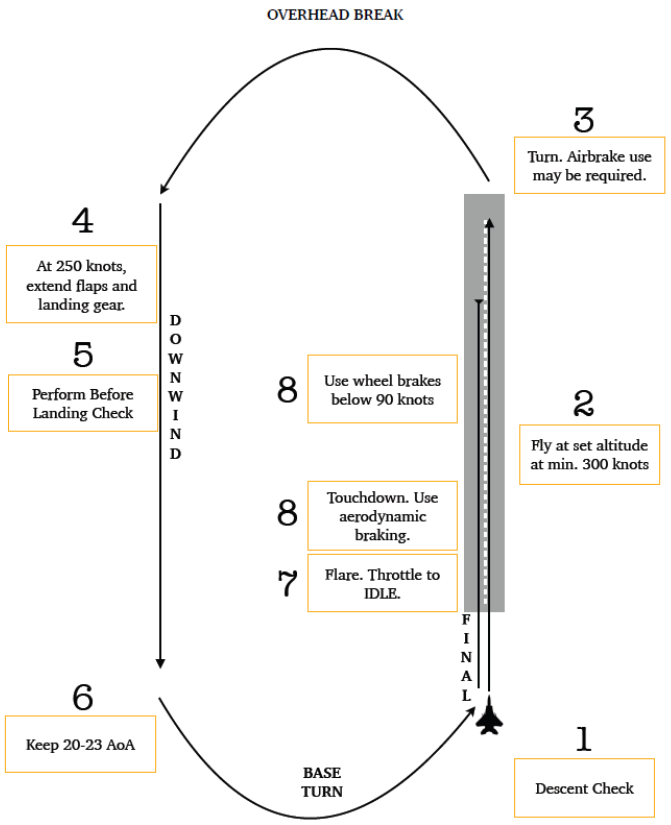


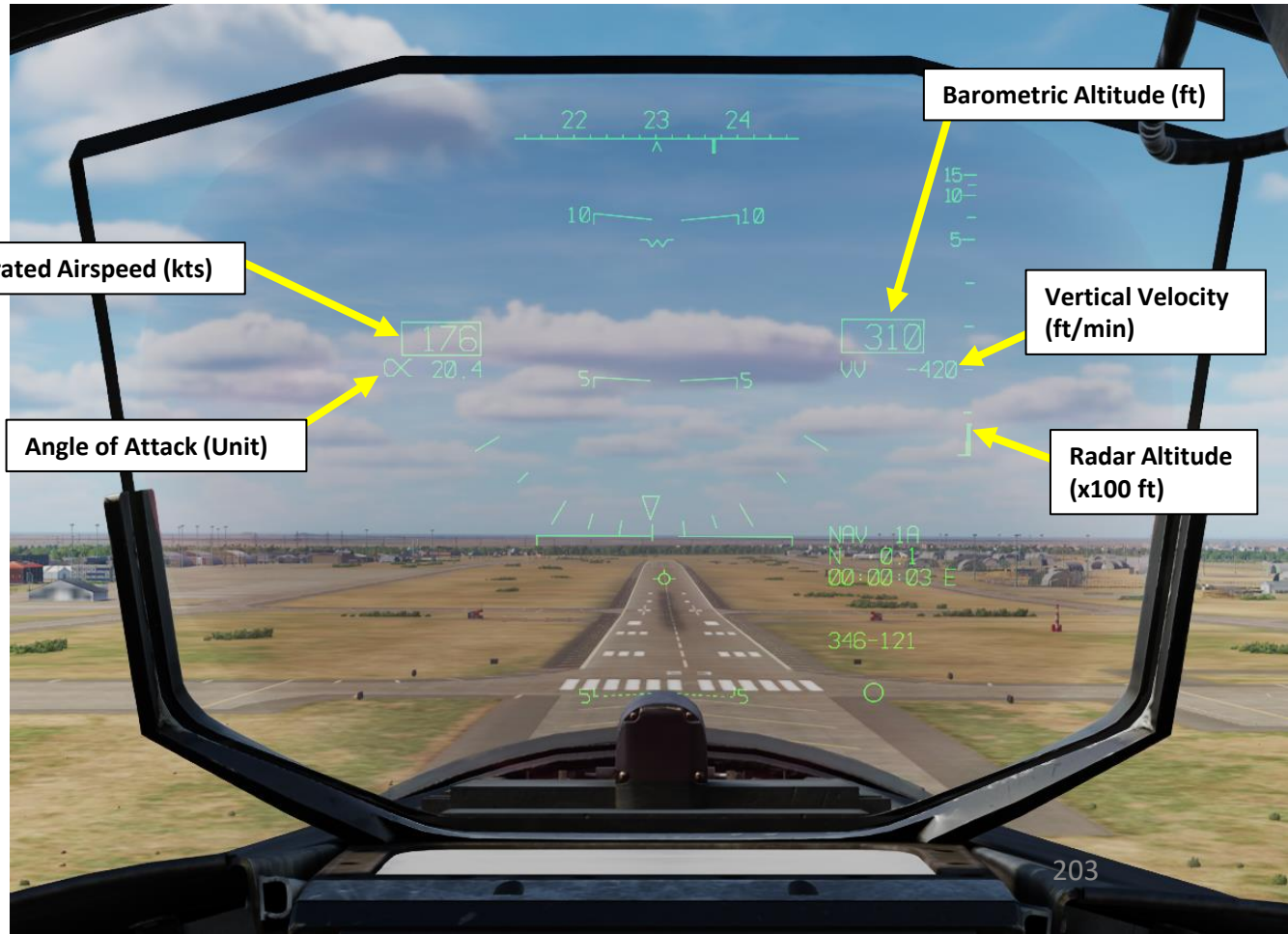
LANDING PROCEDURE

6. **Base Turn**
   - *a) [P]* On base turn, reduce the speed further to arrive on final with on-speed AOA (Angle of Attack) of 20-22 units. The aircraft's nose should be 5-10 deg down.
   - *b) [P]* Extend Speed Brake (Speed Brake Switch AFT).

- Note: Adjust aircraft **pitch angle to control airspeed**, and adjust power with the **throttle to control glide slope & altitude**.
  - Adjust aircraft pitch with the stick and trim controls in order to control aircraft AoA (Angle of Attack). Coming in too fast generally induces a low AoA, which requires the pilot to increase aircraft pitch. Coming in too slow? Your AoA is too high; decrease aircraft pitch.
  - Once you are On Speed (the AoA is between 20 and 22 units), control altitude and glide slope with throttle input.
  - Generally, after you make a pitch adjustment you will likely have to make a throttle adjustment.



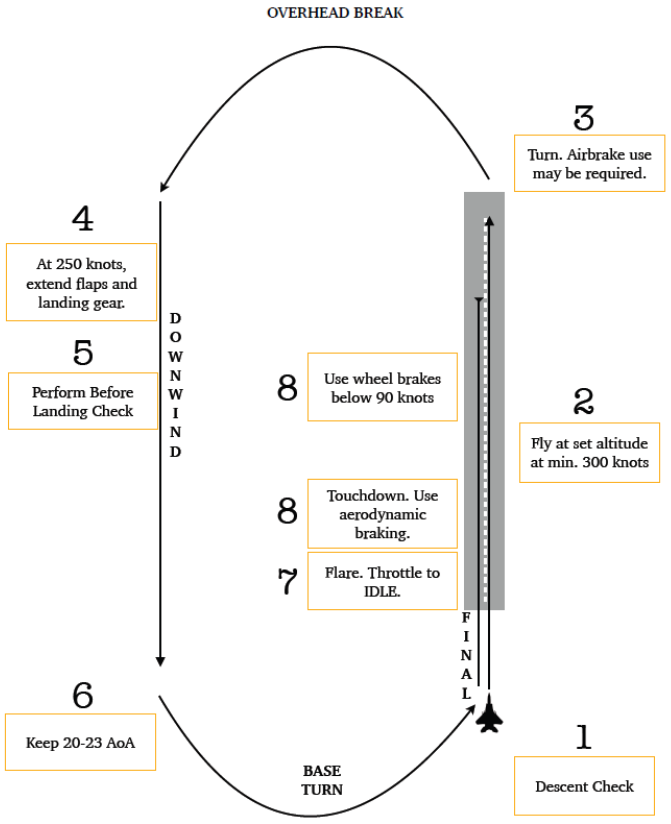




LANDING PROCEDURE

7. **Short Final & Flare**
   - *a) [P]* When flying over the "overrun" (also referred as "flare point", the overrun is the portion of the runway before the primary surface starts), gently pull back on the stick to flare and reduce the descent rate. Do NOT level off. Aim to touchdown at the runway threshold.
   - *b) [P]* 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.

Note about Crosswind Landing:
It is not recommended to land if the crosswind exceeds 30 kts. 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 kts, use maximum anti-skid braking.



LANDING PROCEDURE

8. **Touchdown & Roll-Out**
   a) *[P]* Let the wheels touch the ground once the aircraft has lost enough lift.
   b) *[P]* After touchdown, keep the nose at 12 deg of pitch for best aerodynamic braking.
   c) *[P]* Use toe brakes once the nose wheel is on the ground and aircraft speed is below 90 kts.
   d) *[P]* Taxi off the runway.
   e) *[P]* Retract speed brake and retract flaps.

LANDING PROCEDURE

SECTION STRUCTURE

- **1 – POWERPLANT**
  - 1.1 – Pratt & Whitney F100-PW-229 Engines
  - 1.2 – Engine Instruments & Parameters
  - 1.3 – Engine Controls
  - 1.4 – Engine Control Modes
  - 1.5 – Engine Inlet Ramps
  - 1.6 – Afterburners / Augmentors
  - 1.7 – Engine Relight Procedure
  - 1.8 – Engine Fire Detection & Suppression

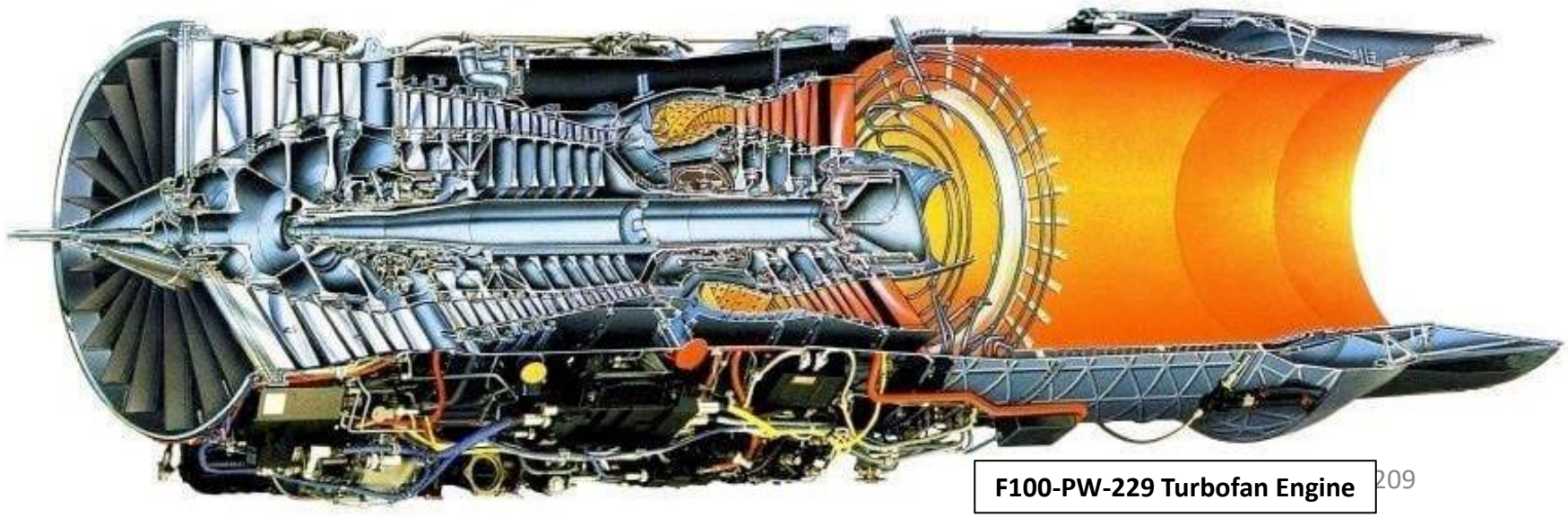
- **2 – FUEL**
  - 2.1 – Fuel System Overview
  - 2.2 – External Drop Tanks
  - 2.3 – Bingo Fuel
  - 2.4 – Fuel Dumping

1 – POWERPLANT
1.1 – Pratt & Whitney F100-PW-229 Engines

The F-15E modelled in DCS is powered by two Pratt & Whitney F100-PW-229 afterburning turbofan engines. The F100 is a twin spool, axial flow, afterburning turbofan engine. It has a 3-stage fan driven by a two-stage low-pressure turbine and a 10-stage compressor driven by a two-stage high-pressure turbine.

The F100-PW-229 and its competitor, the General Electric F110-GE-129, were the result of the USAF seeking greater power for its tactical aircraft through the Improved Performance Engine (IPE) program in the 1980s. It was developed under company designation PW1128; in addition to greater thrust, the -229 incorporates the reliability and durability improvements of the -220 as well as an enhanced DEEC (Digital Electronic Engine Controller).

Compared to earlier variants, the -229 has a higher turbine inlet temperature, higher airflow of 248 lb/s, and lower bypass ratio. The first engine was flown in 1989 and produced thrust of 17,800 lbf (79.2 kN) (dry/intermediate thrust) and 29,160 lbf (129.7 kN) with afterburner. The -229 powers late model F-16C/D Block 52s and F-15Es.

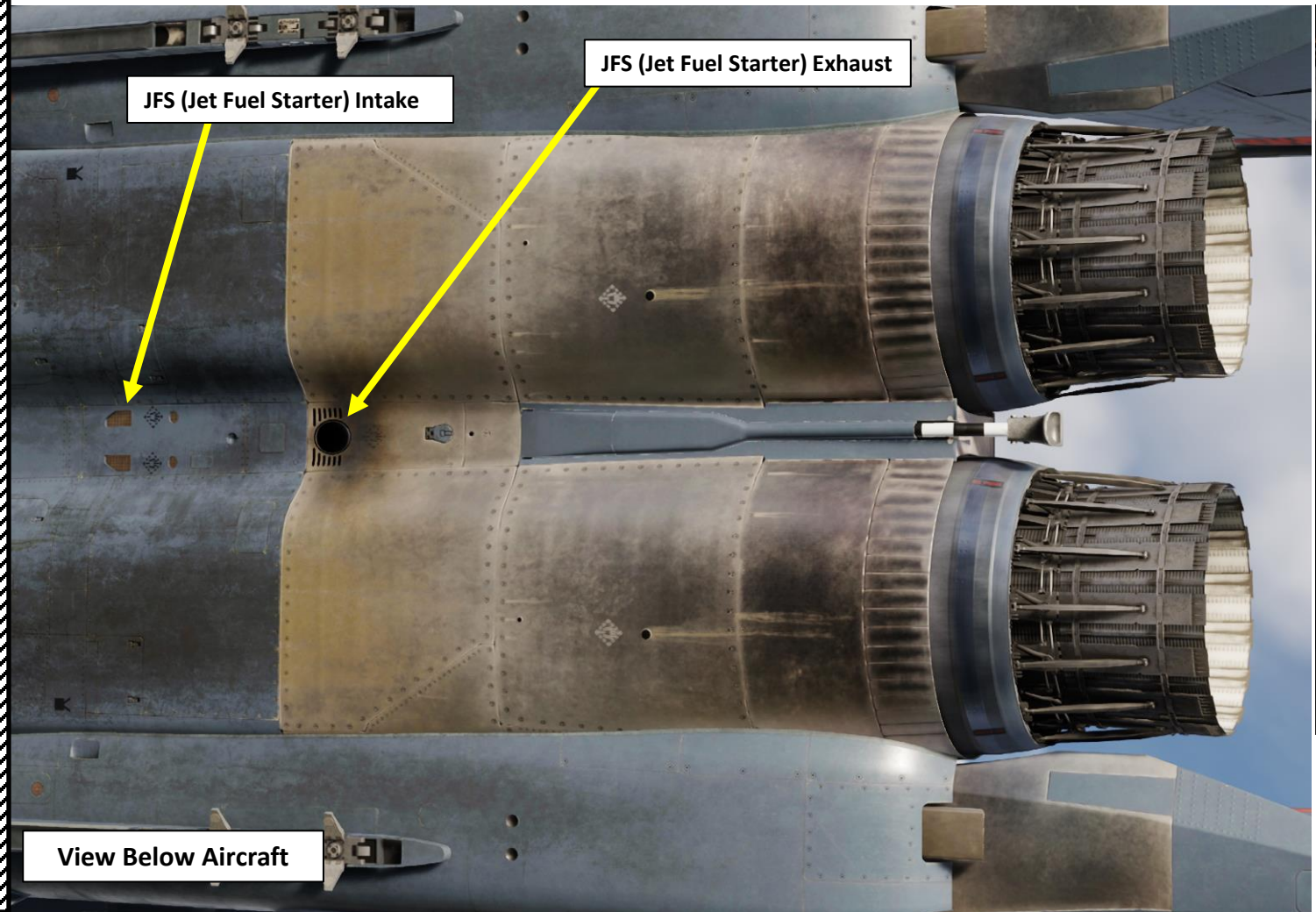


F100-PW-229 Turbofan Engine

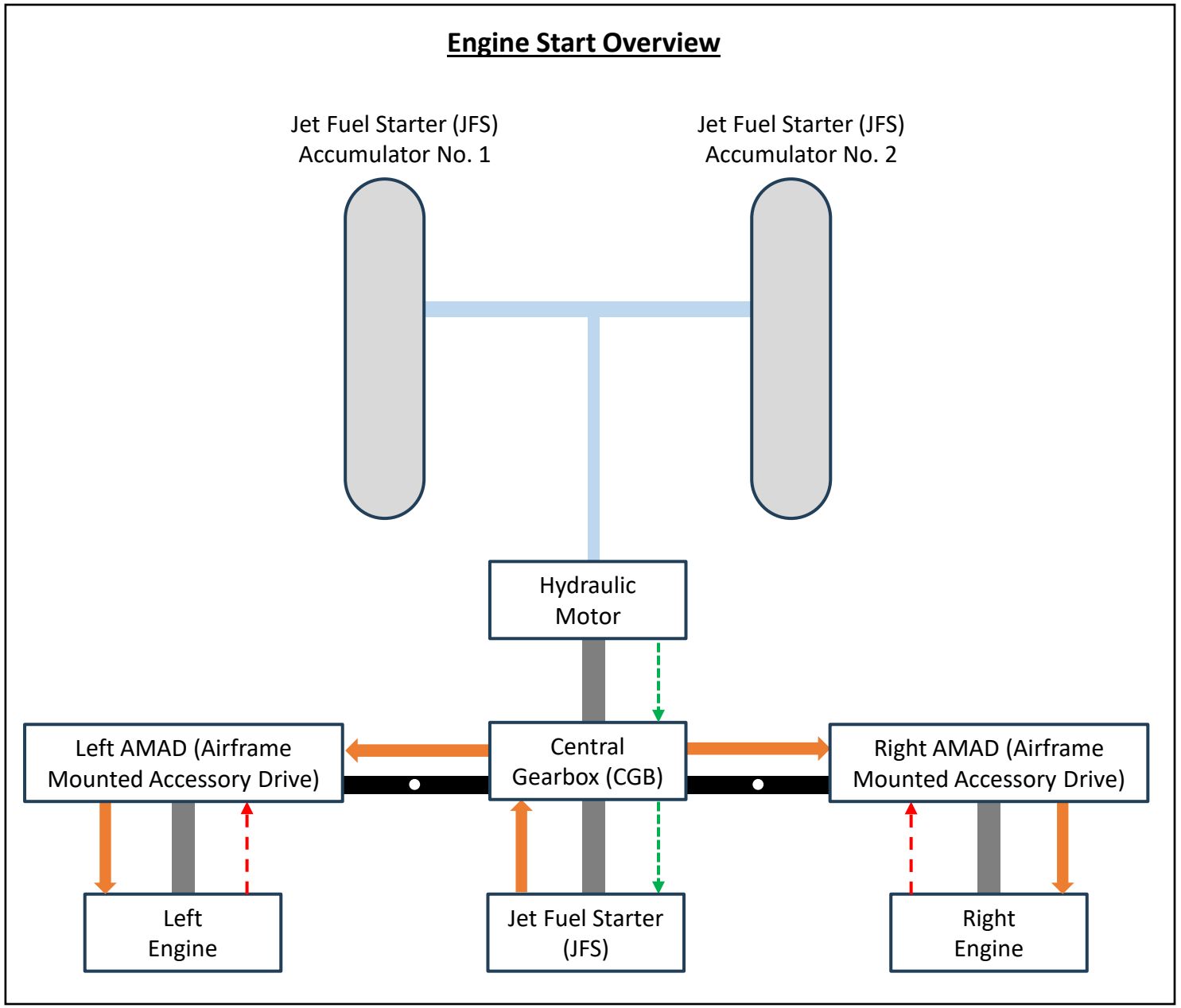
1 – POWERPLANT
1.1 – Pratt & Whitney F100-PW-229 Engines

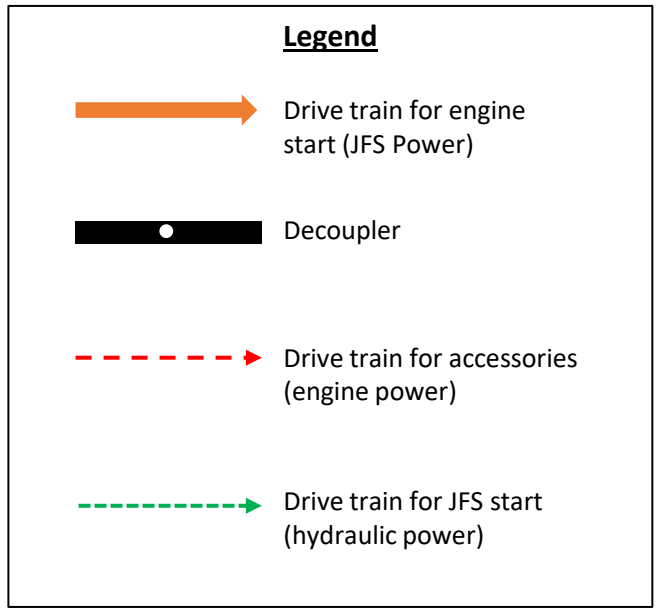
In order to start the engines, the pilot has to use the JFS (Jet Fuel Starter), which is a self-contained small jet engine mounted on the central gearbox. The JFS, together with the AMAD (Airframe Mounted Accessory Drive), provide rotation (through a mechanical clutch) and electrical power necessary to start the engines. The JFS automatically shuts down after both engines are started.
There are two compressed air bottles (accumulators) that can be used to start the JFS.

- To use the first compressor air bottle, leave the JFS handle in the vertical position.
- In case of a failed JFS (Jet Fuel Starter) start, you can use the second compressor air bottle by rotating the JFS Handle 45 deg counter-clockwise by right-clicking on it.
- If compressor air bottles have already been expended during previous failed engine starts, you can request the ground crew to refill JFS Accumulator bottles.



1 – POWERPLANT
1.1 – Pratt & Whitney F100-PW-229 Engines





1 – POWERPLANT
1.2 – Engine Instruments & Parameters

Pilot Cockpit

Engine Monitor Display
L: Left Engine / R: Right Engine

RPM: Engine compressor RPM (%)

TEMP: FTIT (Fan Turbine Inlet Temperature) (deg C)

FF: Fuel Flow (pph, lbs/hour)

NOZ POS: Exhaust Nozzle Position (%)
- **0 % is fully closed, 100 % is fully open**

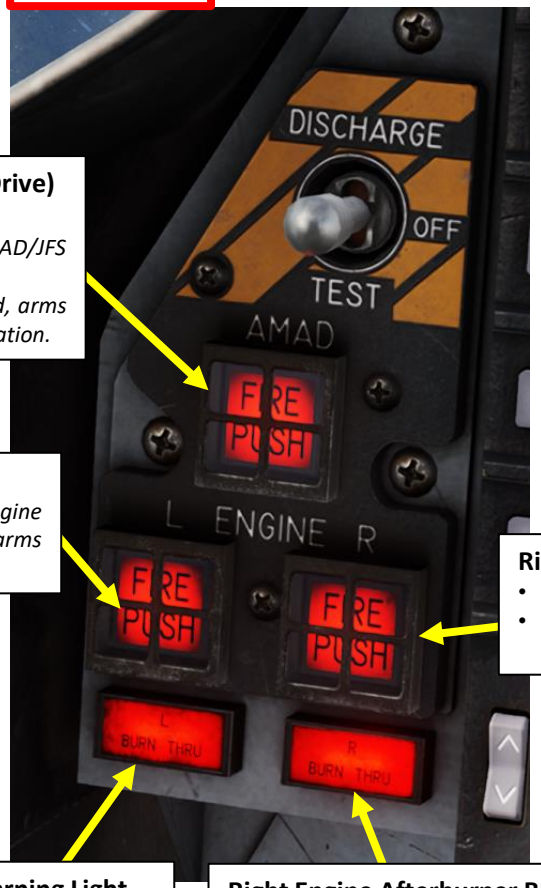
OIL: Oil pressure (psi)

Pilot Cockpit

ENG (Engine Parameters) MENU Page
L: Left Engine / R: Right Engine

1 – POWERPLANT
1.2 – Engine Instruments & Parameters

Pilot Cockpit



AMAD (Airframe Mounted Accessory Drive) Fire Push Light
- *Illuminates when fire is detected in the AMAD/JFS (Jet Fuel Starter) compartment*
- *When guard is lifted and button is pressed, arms extinguisher and prevents normal JFS operation.*

Left Engine Fire Push Light
- *Illuminates when fire is detected in the left engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

Right Engine Fire Push Light
- *Illuminates when fire is detected in the right engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

Left Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the left engine's afterburner section is detected*

Right Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the right engine's afterburner section is detected*

Pilot Cockpit

ENGINE Caution
- *Illuminates when engine system failure is detected*

1 – POWERPLANT
1.2 – Engine Instruments & Parameters

Left Engine Fire Light

Right Engine Fire Light

ENGINE Caution
- *Illuminates when engine system failure is detected*

1 – POWERPLANT
1.2 – Engine Instruments & Parameters

F100-PW-229 Engine Limitations (Aircraft On Ground)

Condition	FTIT (Fan Turbine Inlet Temperature) (deg C)	RPM (%)	Oil Pressure (psi)
Engine Start	800	-	-
Idle Power	625	-	Min 15 Max 80
Military/Afterburner (MIL/AB)	1070	97	Min 30 Max 80
Transient	1090	98	Min 30 Max 80
Fluctuation	+/- 10	+1	At or Below Idle: +/- 5 Above Idle: +/- 10

F100-PW-229 Engine Limitations (Aircraft In Flight)

Condition	FTIT (Fan Turbine Inlet Temperature) (deg C)	RPM (%)	Oil Pressure (psi)
Engine Air Start	870	-	-
Idle Power	-	-	Min 15 Max 80
Military/Afterburner (MIL/AB)	1070	97	Min 30 Max 80
Transient	1090	98	Min 30 Max 80
Fluctuation	+/- 10	+1	At or Below Idle: +/- 5 Above Idle: +/- 10

Additional Notes

- FTIT and RPM limitations include fluctuations.
- Excessive engine parameter fluctuations accompanied by thrust surges indicate engine control problems.
- Nozzle fluctuations are limited to +/- 2 % at MIL power and above. Fluctuations are not permitted below military power.
- Any oil pressure from 0 to 100 psi is acceptable during engine start and initial operation for a period not exceeding 1 minute after reaching idle.
- Oil pressure fluctuations of +/- 10 psi are acceptable if the average is within limits.
- At less than 0 G, oil pressure may drop as low as 0 psi.
- For engine operation at MIL power or above, oil pressure must increase 15 psi minimum above idle oil pressure.
- Engine nozzle position is limited to 30 % open or less at military power.
- Negative G flight is limited to 10 seconds at all power settings. Exceeding this limit can potentially cause fuel starvation and engine flameout.

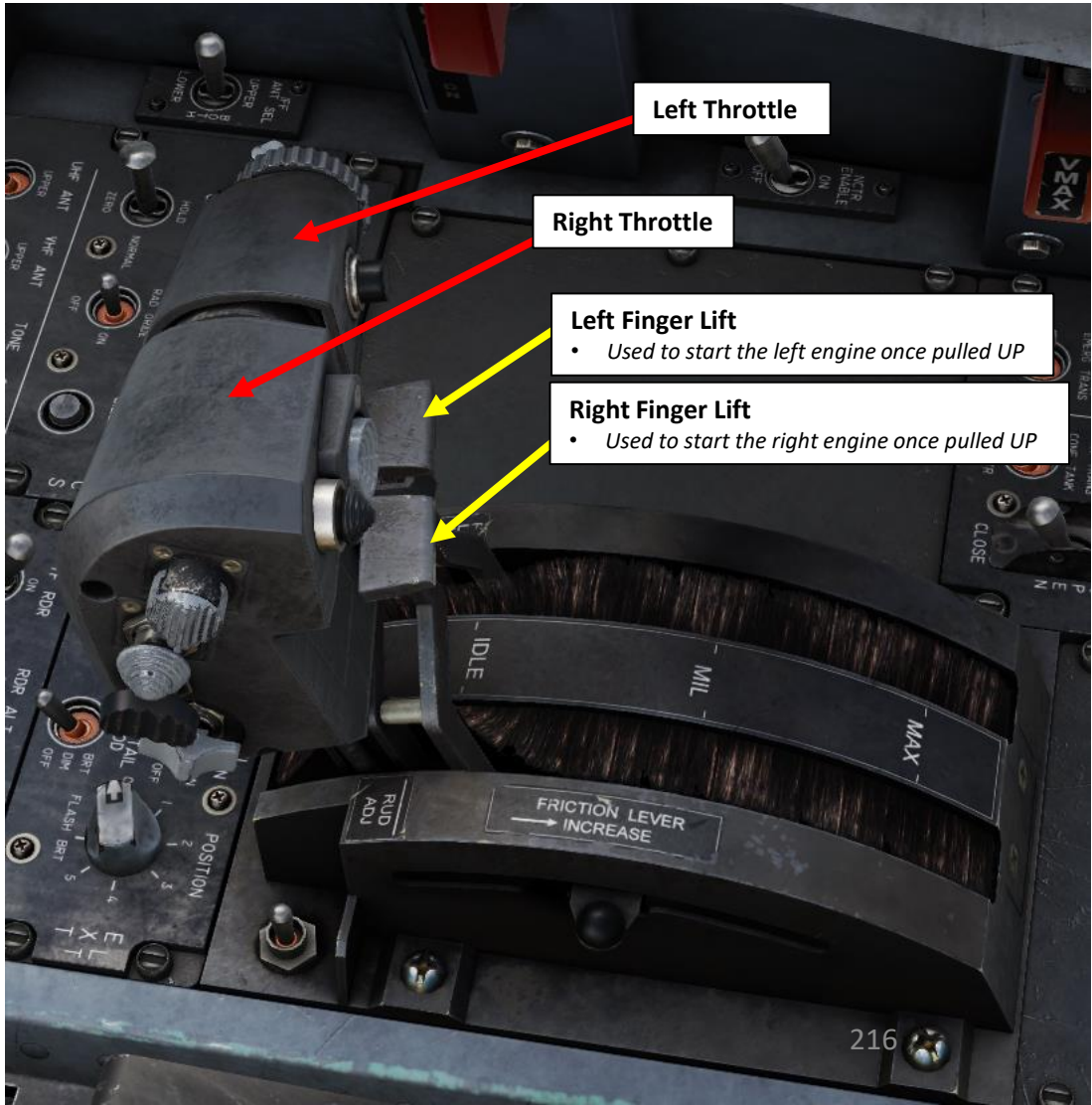
1 – POWERPLANT
1.3 – Engine Controls

The engine is primarily controlled with the left and right throttles. The DEEC (Digital Electronic Engine Controller) automatically controls fuel flow based on throttle position and required power setting. There are throttles in both the front and rear cockpit; they are mechanically linked.

There are four throttle detents:

- **OFF**
  - Left Throttle to OFF: “RALT+END” binding.
  - Right Throttle to OFF: “RSHIFT+END” binding.
- **IDLE**
  - Left Throttle to IDLE: “RALT+HOME” binding.
  - Right Throttle to IDLE: “RSHIFT+HOME” binding.
- **MIL (Military Power)**
- **MAX (Maximum Power)**

Finger lifts are used to start the engine, as shown in the Start-Up Procedure section.



1 – POWERPLANT
1.3 – Engine Controls

JFS (Jet Fuel Starter) Handle
- *PULLED (left click): ON, turns on JFS*
- *When handle is vertical (as shown), pulling the handle discharges one of the two accumulator bottles. When handle is rotated 45 counter-clockwise (right click) then pulled (left click), both accumulator bottles are discharged.*

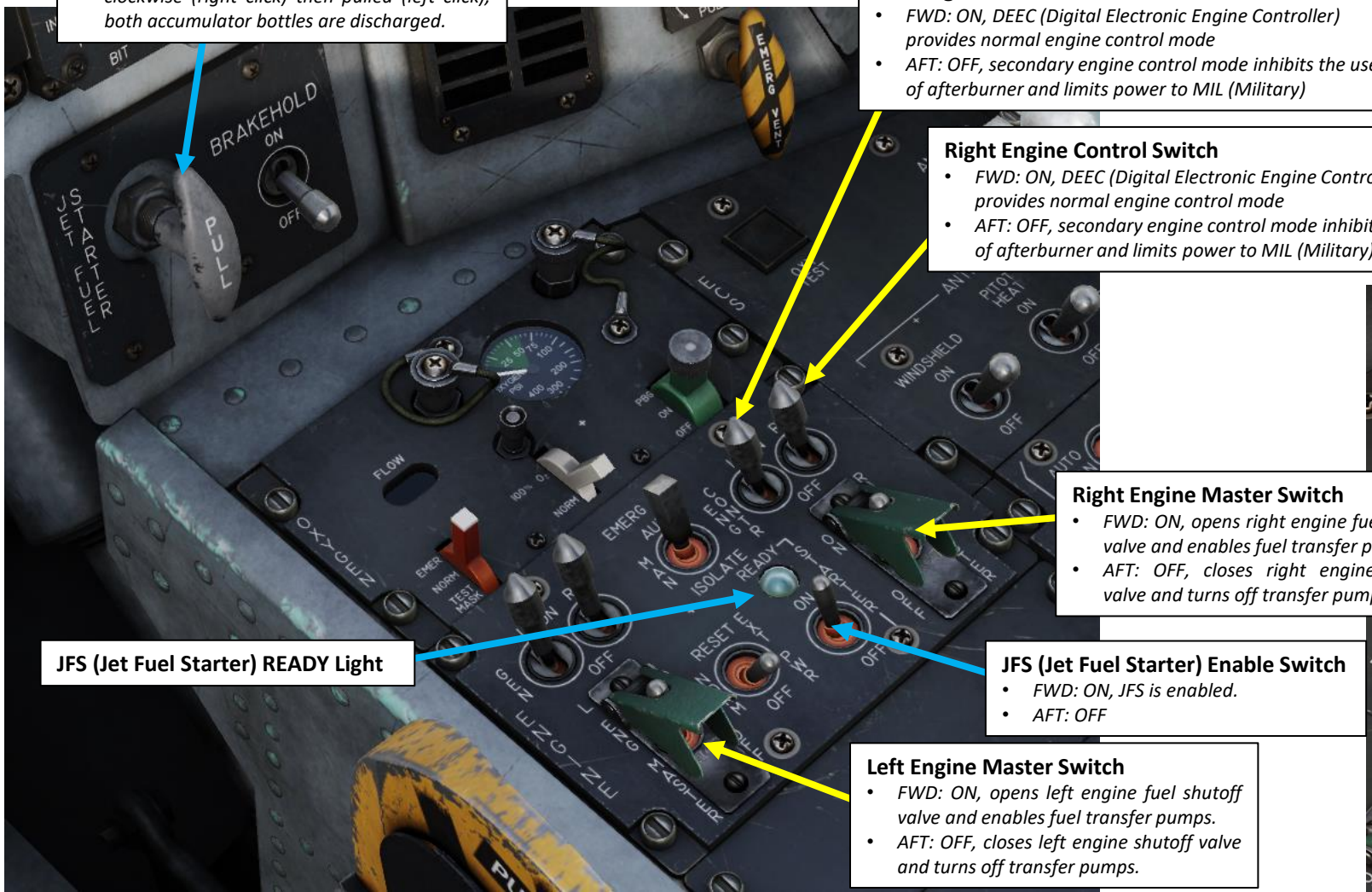
Left Inlet Ramp Switch
- *FWD: AUTO Mode, left engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*

Right Inlet Ramp Switch
- *FWD: AUTO Mode, right engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*

Left Engine Control Switch
- *FWD: ON, DEEC (Digital Electronic Engine Controller) provides normal engine control mode*
- *AFT: OFF, secondary engine control mode inhibits the use of afterburner and limits power to MIL (Military)*

Right Engine Control Switch
- *FWD: ON, DEEC (Digital Electronic Engine Controller) provides normal engine control mode*
- *AFT: OFF, secondary engine control mode inhibits the use of afterburner and limits power to MIL (Military)*

Engine Anti-Ice Switch
- *FWD: ON*
- *MIDDLE: OFF*
- *AFT: Test*



Right Engine Master Switch
- *FWD: ON, opens right engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes right engine shutoff valve and turns off transfer pumps.*

JFS (Jet Fuel Starter) READY Light

JFS (Jet Fuel Starter) Enable Switch
- *FWD: ON, JFS is enabled.*
- *AFT: OFF*

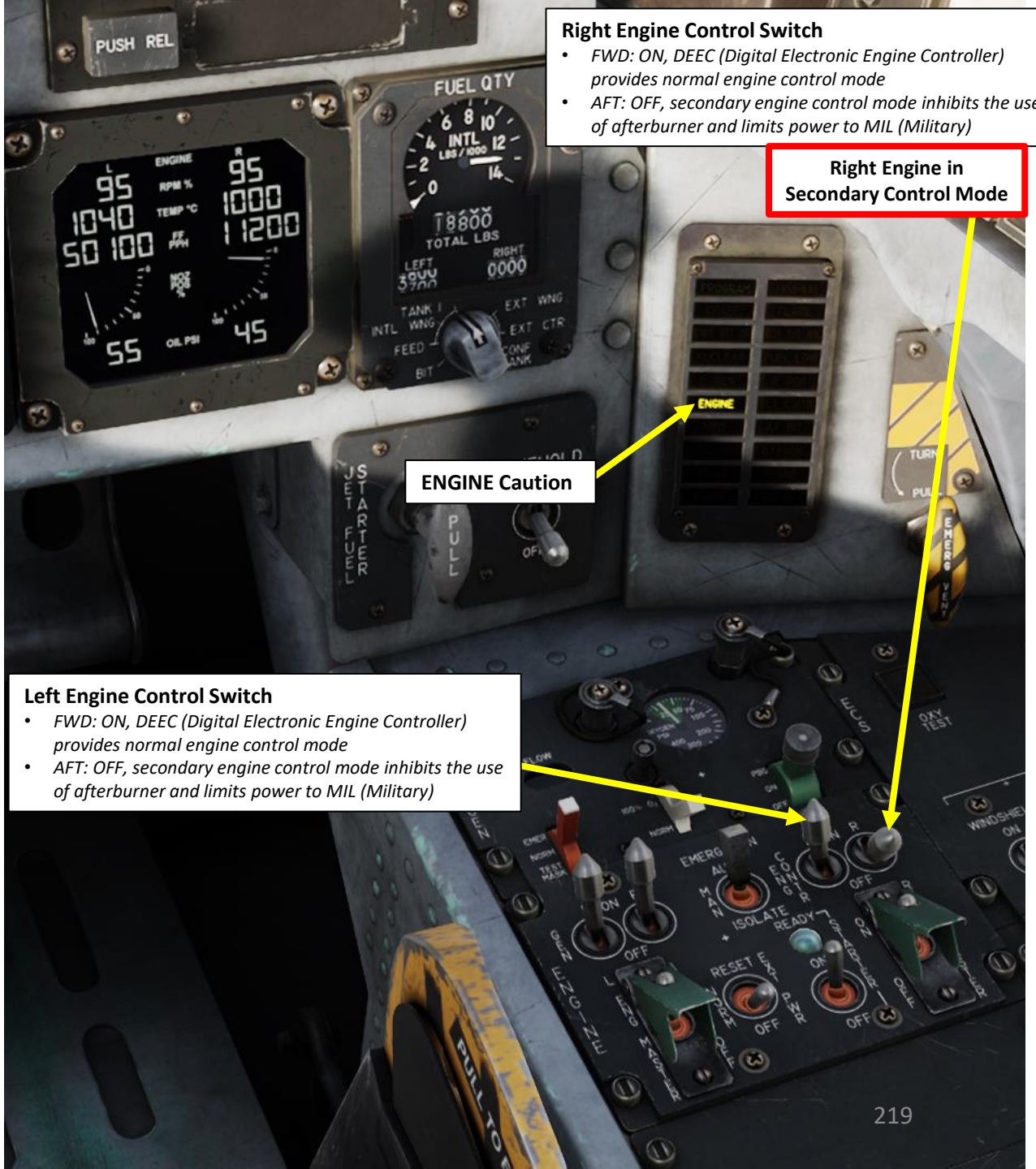
Left Engine Master Switch
- *FWD: ON, opens left engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes left engine shutoff valve and turns off transfer pumps.*

1 – POWERPLANT
1.3 – Engine Controls

1 – POWERPLANT
1.4 – Engine Control Modes

During normal operation, both Left and Right Engine Control Switches should be set to ON (FWD) position. In this **primary operation mode**, the DEEC (Digital Electronic Engine Controller) manages fuel scheduling as per throttle input.

If an engine malfunction is detected (as an example, fuel flow fluctuations), the affected engine can be set to the **Secondary Operation Mode**. In this control mode, the DEEC is powered OFF and fuel flow is controlled by a HMU (Hydromechanical Unit), which inhibits afterburner and restricts maximum available thrust below MIL power.



1 – POWERPLANT
1.5 – Engine Inlet Ramps

The F-15E has variable engine inlet ramps, which are rectangular plate-like devices within the air intake of the engine designed to generate a number of shock waves to aid the inlet compression process at supersonic speeds. The ramp sits at an acute angle to deflect the intake air from the longitudinal direction. At supersonic flight speeds, the deflection of the air stream creates a number of oblique shock waves at each change of gradient along at the ramp. Air crossing each shock wave suddenly slows to a lower Mach number, thus increasing pressure.

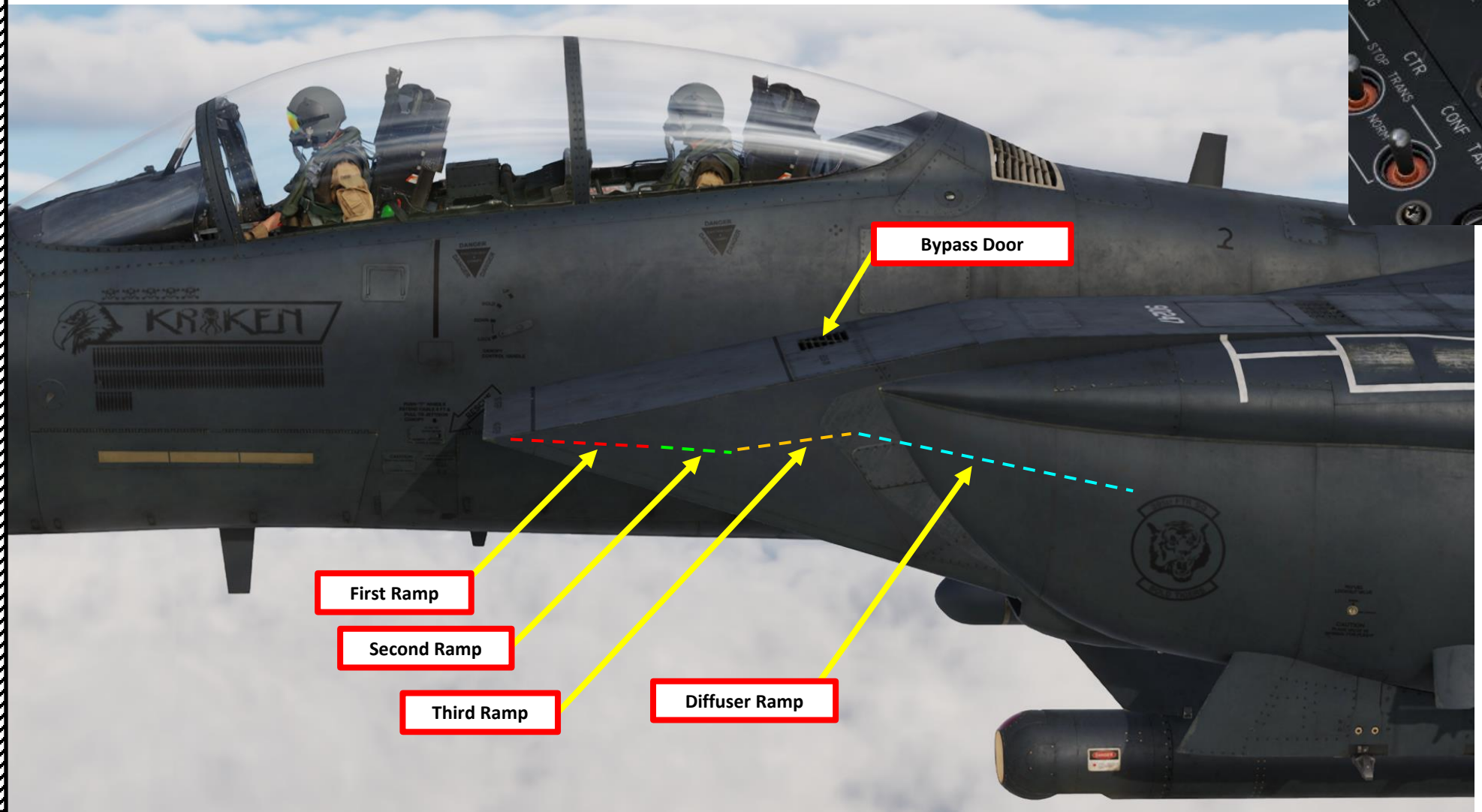
1 – POWERPLANT
1.5 – Engine Inlet Ramps

The AIC (Air Inlet Controller) system controls position of the ramp automatically based on aircraft angle of attack, Mach number and air sensor data. The bypass door automatically opens when the system needs to relieve excess pressure in the engine inlet duct.

Inlet Ramp Switches allow an Automatic or an Emergency Control mode.

Left Inlet Ramp Switch
- *FWD: AUTO Mode, left engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*

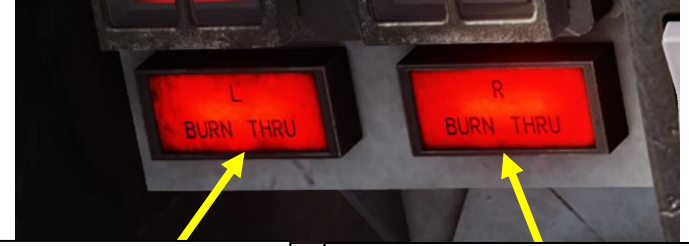
Right Inlet Ramp Switch
- *FWD: AUTO Mode, right engine's air inlet ramp door system is controlled automatically*
- *AFT: EMERGENCY Mode, electrical power is removed from the ramp and the doors are moved to the emergency (locked/closed) position*



1 – POWERPLANT
1.6 – Afterburners / Augmentors

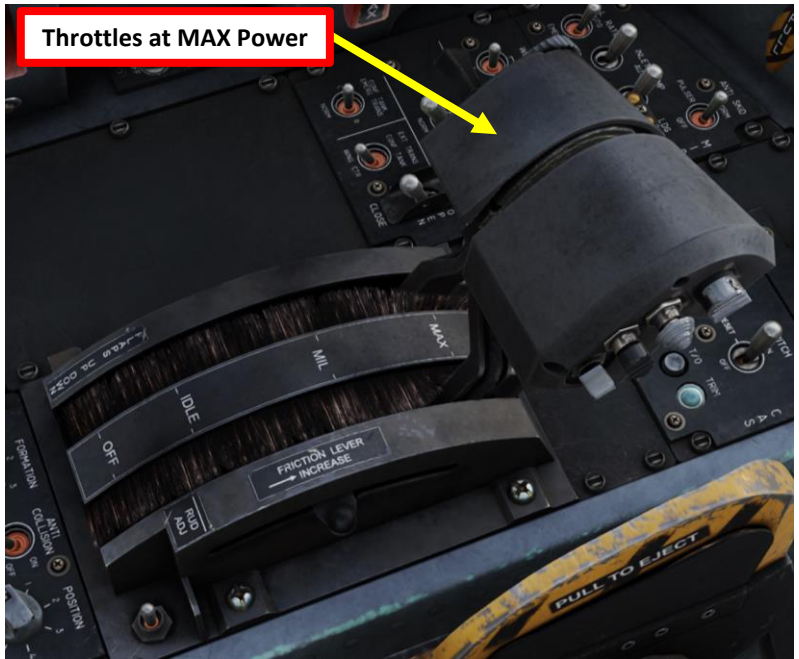
Afterburners are engaged by throttling past the MIL (Military Power) detent. Afterburner intensity varies progressively as the throttle is pushed forward within the afterburner operation envelope.

Note: Afterburners are inhibited when engines are in Secondary Mode, which is set with the Engine Control Switches in the OFF position.



Left Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the left engine's afterburner section is detected*

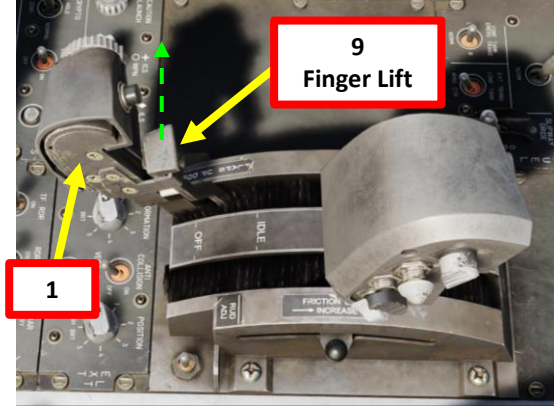
Right Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the right engine's afterburner section is detected*

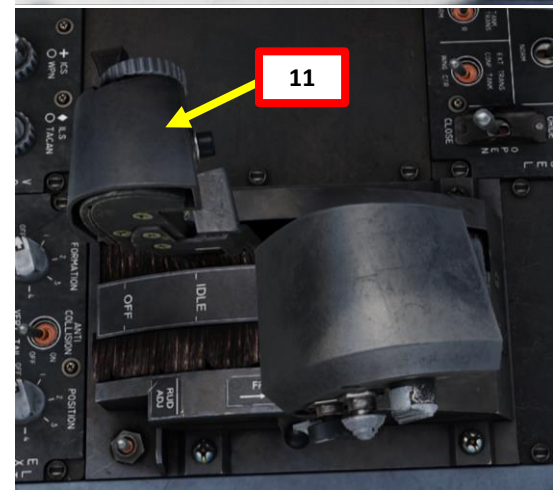


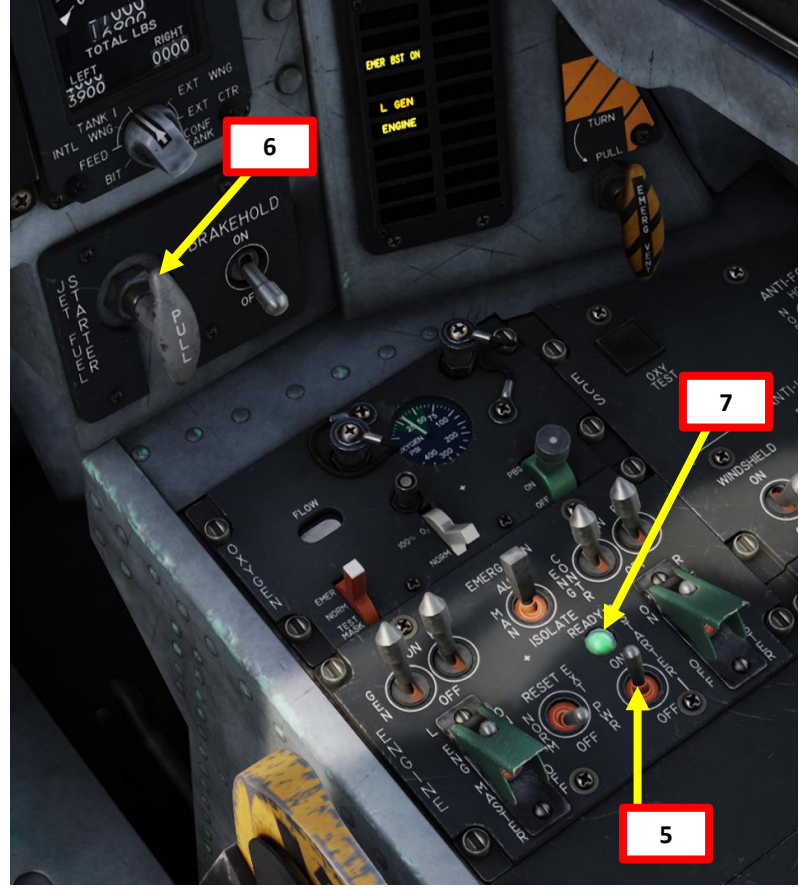
1 – POWERPLANT
1.7 – Engine Relight Procedure (JFS-Assisted)

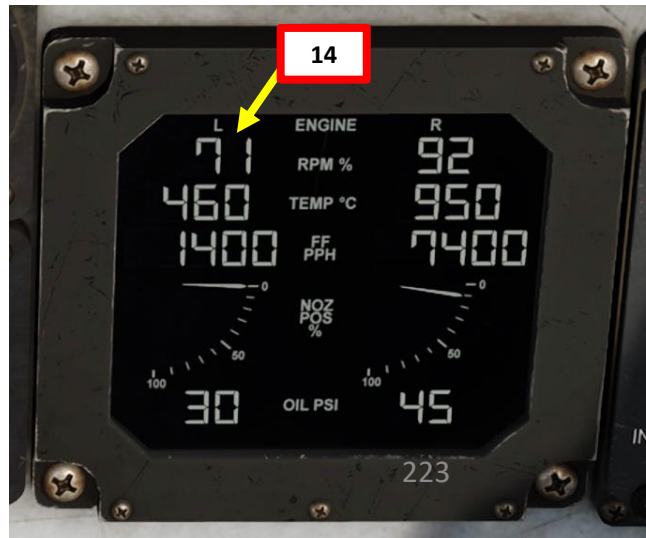
If one of your engines happens to flame out during flight, you can restart it using the JFS (Jet Fuel Starter).

1. Retard throttle of flamed out engine throttle IDLE, then to OFF detent.
   - Left Throttle to OFF: “RALT+END” binding.
   - Right Throttle to OFF: “RSHIFT+END” binding.
2. Adjust aircraft airspeed to 350 kts or more. Maintaining a high airspeed will allow windmilling (air flow driving the engine compressor blades) to facilitate engine start.
3. I recommend flying below 25000 ft and above 275 kts.
4. Let the engine RPM of the flamed out **engine spool down below 40 % RPM** (**very important!**). The reason for doing this is that during an engine start sequence, the Jet Fuel Starter automatically shuts down when engine RPM is above 40 %.
5. Set JFS (Jet Fuel Starter) Enable Switch – ON (FWD).
6. Pull JFS (Jet Fuel Starter) Handle (left click) to initiate the JFS start-up sequence.
7. When JFS reaches IDLE RPM (within 10 seconds), the JFS READY Light illuminates. A mechanical clutch between the JFS and the engine will be used to drive the engine starter.
8. Verify that **engine RPM is below 30 % RPM** (**very important!**). Attempts to engage the JFS above this RPM may shear the central gearbox shaft.
9. Pull UP and release the Finger Lift on the flamed out engine’s throttle. This will initiate engine cranking. The engine starter is driven by a mechanical clutch between the JFS (Jet Fuel Starter) and the engine.
10. Wait until cranking engine RPM has stabilized to 26 %.
11. Move cranking engine’s throttle from OFF detent to IDLE detent.
    - Left Throttle to IDLE: “RALT+HOME” binding.
    - Right Throttle to IDLE: “RSHIFT+HOME” binding.
12. Once throttle is set to IDLE, engine RPM should increase within 10 seconds. Fuel flow is introduced to the right engine and lightoff sequence is initiated.
13. When cranking engine RPM is around 52-55%, the JFS (Jet Fuel Starter) spools down automatically and the JFS READY Light goes out.
14. Resume normal engine operation once engine parameters have stabilized (Engine compressor RPM increases to 72 %).









1 – POWERPLANT
1.8 – Engine Fire Detection & Suppression

The fire detection and suppression system of the Strike Eagle is pretty straightforward:

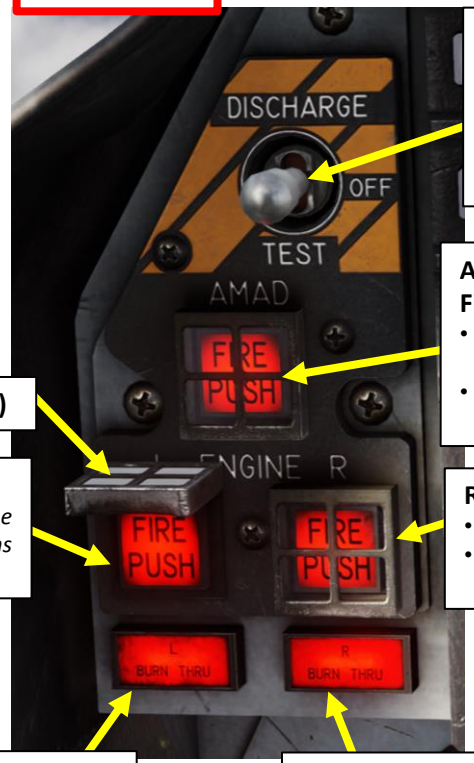
- When fire is detected, the FIRE Warning lights for the affected engine (or AMAD, Airframe Mounted Accessory Drive) will illuminate.
- The FIRE Warning lights are also pushlights as well. When pressing a FIRE pushlight, the corresponding engine feed shutoff valve at the feed tanks closes, the crossfeed valve closes and the system arms the corresponding engine fire or AMAD extinguisher system.
- When fuel shutoff valves are closed, set the Fire Test / Extinguisher Discharge Switch UP to the DISCHARGE position. This will discharge a chemical agent to extinguish the fire.

WSO Cockpit

Left Engine Fire Light

Right Engine Fire Light

Pilot Cockpit



Fire Test / Extinguisher Switch
- *UP: DISCHARGE momentarily releases the extinguishing agent into the selected compartment (AMAD, Left Engine or Right Engine Push Lights)*
- *MIDDLE: OFF*
- *AFT: Fire Test*

AMAD (Airframe Mounted Accessory Drive) Fire Push Light
- *Illuminates when fire is detected in the AMAD/JFS (Jet Fuel Starter) compartment*
- *When guard is lifted and button is pressed, arms extinguisher and prevents normal JFS operation.*

Guard (Right Click to flip)

Left Engine Fire Push Light
- *Illuminates when fire is detected in the left engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

Right Engine Fire Push Light
- *Illuminates when fire is detected in the right engine*
- *When guard is lifted and button is pressed, arms extinguisher.*

Left Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the left engine's afterburner section is detected*

Right Engine Afterburner BURN THRU Warning Light
- *Illuminates when burn through or overtemperature condition in the right engine's afterburner section is detected*

2 – FUEL
2.1 – Fuel System Overview

The F-15E's fuel system consists of interconnected fuel tanks. By design, all internal fuel can be transferred even in the eventuality that the fuel transfer pump fails.

Internal Fuel Tanks:

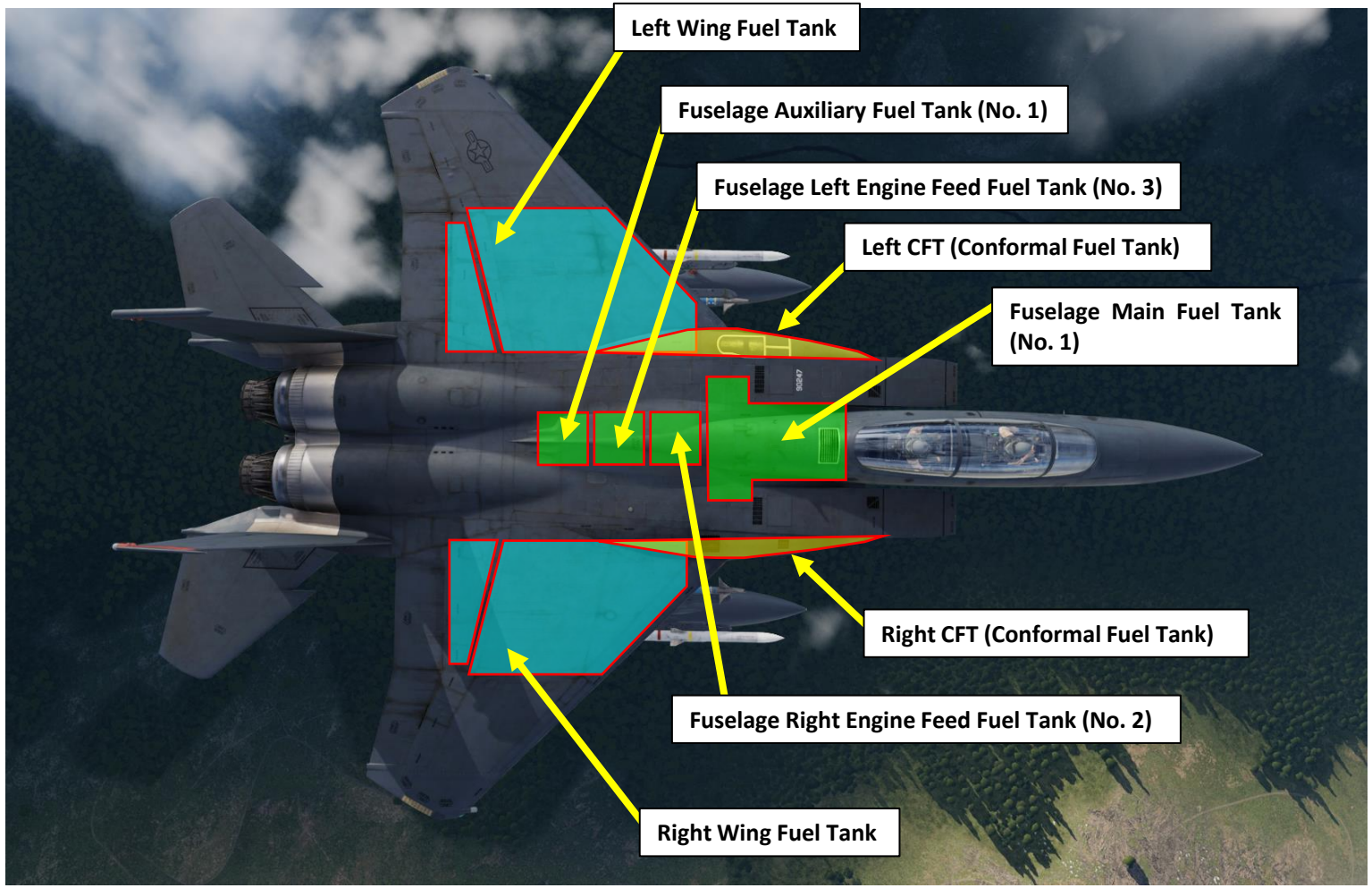
- ***Fuselage Fuel Tanks***
  - Main Fuel Tank + Auxiliary (No. 1) Quantity: 604 gal
  - Left Engine Feed Tank (No. 3): 189 gal
  - Right Engine Feed Tank (No. 2): 234 gal
- ***Wing Fuel Tanks***
  - Left Wing Fuel Tank: 496 gal
  - Right Wing Fuel Tank: 496 gal
- ***Conformal Fuel Tanks (CFTs)***
  - Left Conformal Fuel Tank: 728 gal
  - Right Conformal Fuel Tank: 728 gal

Total Fuel Quantity (Internal + CFTs): 3475 gal

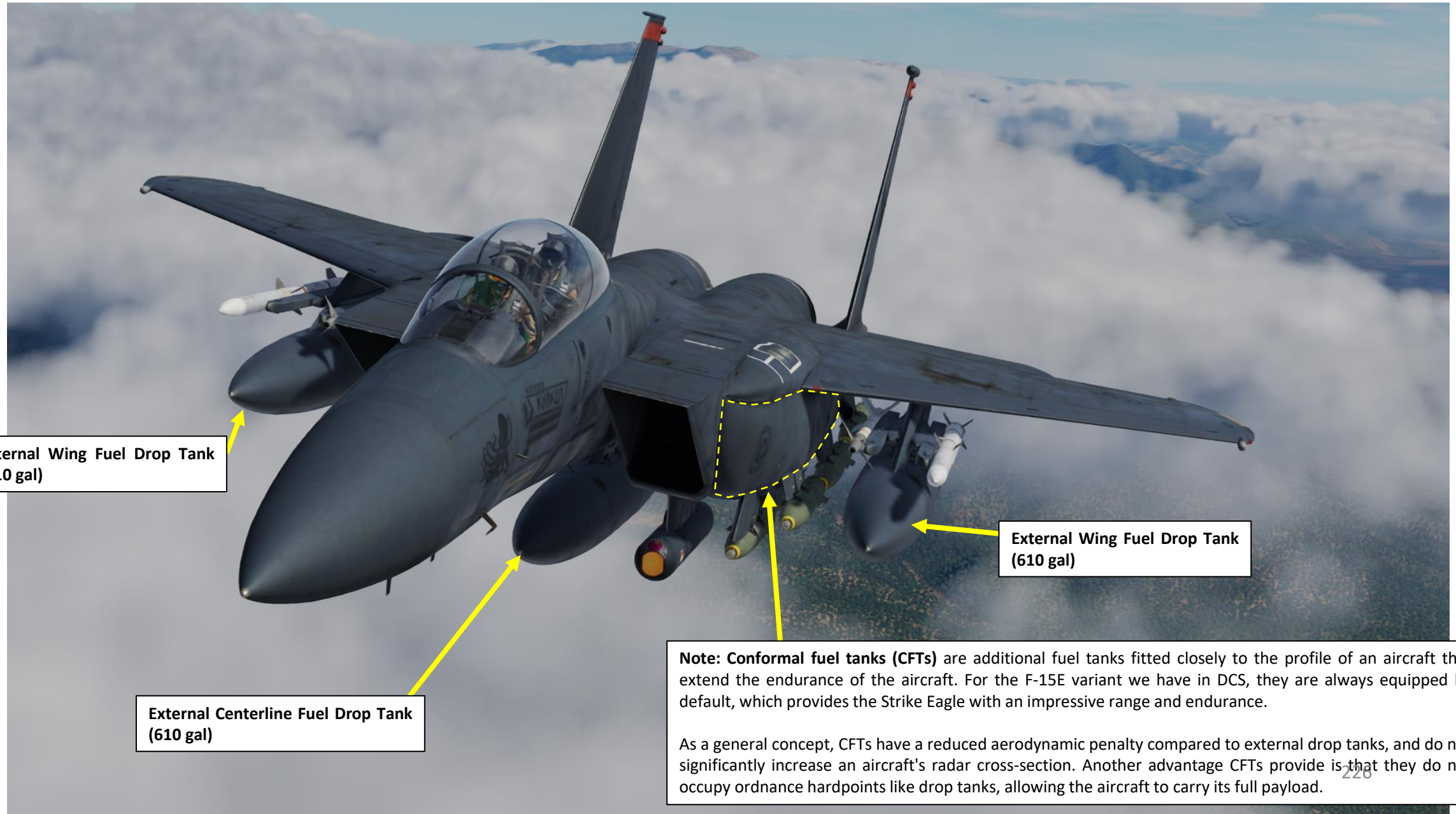
External Fuel Tanks

- ***Drop Tanks***
  - Centerline External Fuel Tank Quantity: 610 gal
  - Wing External Fuel Tank Quantity: 610 gal

Total Fuel Quantity (Internal + CFTs + 3x External): 5305 gal



2 – FUEL
2.1 – Fuel System Overview



Note: Conformal fuel tanks (CFTs) are additional fuel tanks fitted closely to the profile of an aircraft that extend the endurance of the aircraft. For the F-15E variant we have in DCS, they are always equipped by default, which provides the Strike Eagle with an impressive range and endurance.

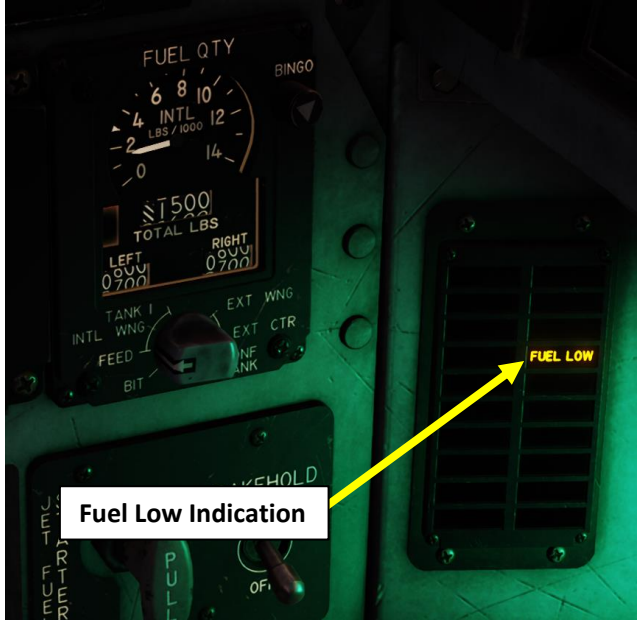
As a general concept, CFTs have a reduced aerodynamic penalty compared to external drop tanks, and do not significantly increase an aircraft's radar cross-section. Another advantage CFTs provide is that they do not occupy ordnance hardpoints like drop tanks, allowing the aircraft to carry its full payload.

2 – FUEL
2.1 – Fuel System Overview

Fuel quantity can be monitored on the FUEL QTY panel.

You can see quantity for specific fuel tanks by rotating the Fuel Quantity Selector Knob as desired and consulting the Left & Right Fuel Counters.

The FUEL LOW indication illuminates (accompanied with a "WARNING, FUEL LOW" aural warning) when Left feed tank drops below 600 lbs or / and right feed tank drops below 1000 lbs of fuel.



FEED Quantity

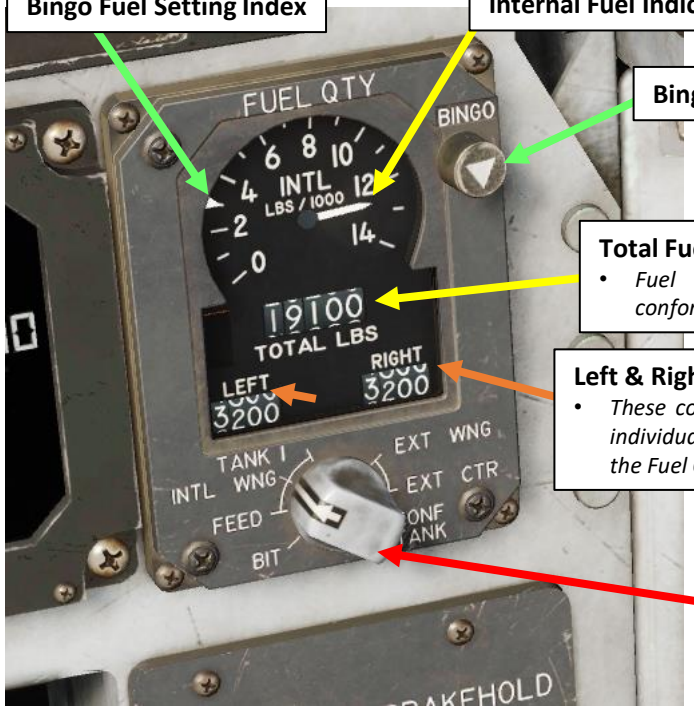
INTL WING Quantity

TANK 1 Quantity

EXT WNG Quantity

EXT CTR Quantity

CONF TANK Quantity



Bingo Fuel Setting Index

Internal Fuel Indicator (x1000 lbs)

Bingo Fuel Setting Knob

Total Fuel Indicator (lbs)

- *Fuel quantity of internal tanks, conformal tanks and external tanks*

Left & Right Fuel Counters (lbs)

- *These counters monitor fuel remaining in individual tanks based on the position of the Fuel Quantity Selector Knob*

Fuel Quantity Selector Knob

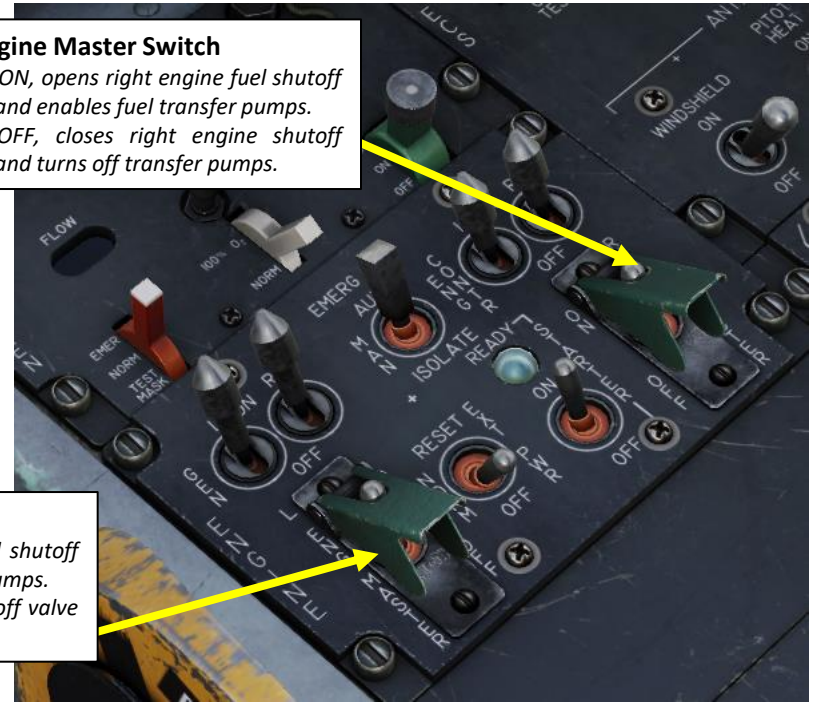
Selects which fuel tanks are being monitored in the Left & Right Fuel Counters

- *BIT: Built-In-Test 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: Engine feed fuel tanks*
- *INTL WING: Internal wing fuel tanks*
- *TANK 1: Fuel available in Tank No. 1 (displayed on LEFT counter)*
- *EXT WNG: External wing fuel tanks*
- *EXT CTR: Fuel available in external centerline fuel tank (displayed on LEFT counter)*
- *CONF TANK: Conformal fuel tanks*

2 – FUEL
2.1 – Fuel System Overview

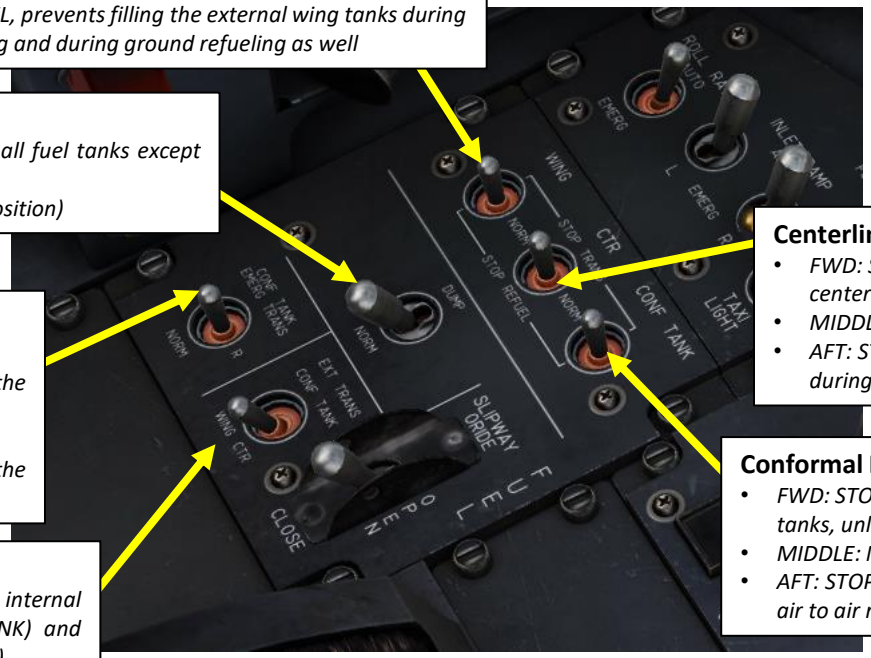
Fuel is mainly transferred automatically between tanks. There are manual Fuel Tank Control Switches that allow the pilot to override automatic fuel transfer.

Fuel shutoff valves can be closed with the Engine Master Switches being set to OFF.



Right Engine Master Switch
- *FWD: ON, opens right engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes right engine shutoff valve and turns off transfer pumps.*

Left Engine Master Switch
- *FWD: ON, opens left engine fuel shutoff valve and enables fuel transfer pumps.*
- *AFT: OFF, closes left engine shutoff valve and turns off transfer pumps.*



Wing Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external wing tanks, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external wing tanks during air to air refueling and during ground refueling as well*

Fuel Dump Switch
- *FWD: dumps fuel from all fuel tanks except engine feed tanks.*
- *AFT: Normal (Default Position)*

Centerline Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external centerline tank, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external centerline tank during air to air refueling and during ground refueling as well*

Conformal Fuel Tanks Emergency Transfer Switch
- *LEFT: deactivates all pitot heaters and enable the left conformal tank center sump transfer pump*
- *MIDDLE: Normal (Default Position)*
- *RIGHT: deactivates all pitot heaters and enable the right conformal tank center sump transfer pump*

Conformal Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the conformal tanks, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the conformal tanks during air to air refueling and during ground refueling as well*

External Fuel 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)
- *FWD: CONF TANK*
- *AFT: WING CTR*

2 – FUEL
2.1 – Fuel System Overview

Air-to-air refueling is performed by opening the slipway door.

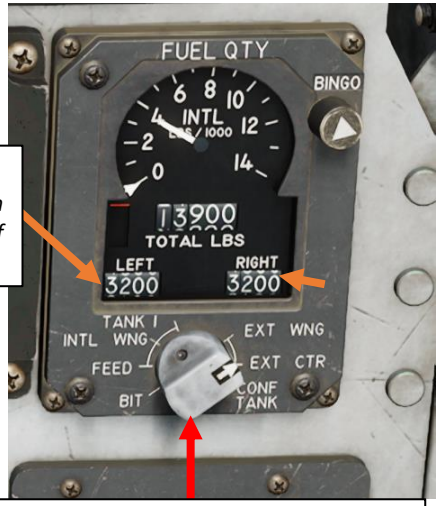
2 – FUEL
2.2 – External Drop Tanks

External Fuel Tank – Normal Operation

The F-15E can carry up to three external drop tanks (610 gal each).

When external drop tanks are installed, fuel is consumed from them first. You can monitor drop tank fuel quantity by setting the Fuel Quantity Selector Knob to either EXT WNG or EXT CTR based on aircraft configuration.

Left & Right Fuel Counters (lbs)
- *These counters monitor fuel remaining in individual tanks based on the position of the Fuel Quantity Selector Knob*

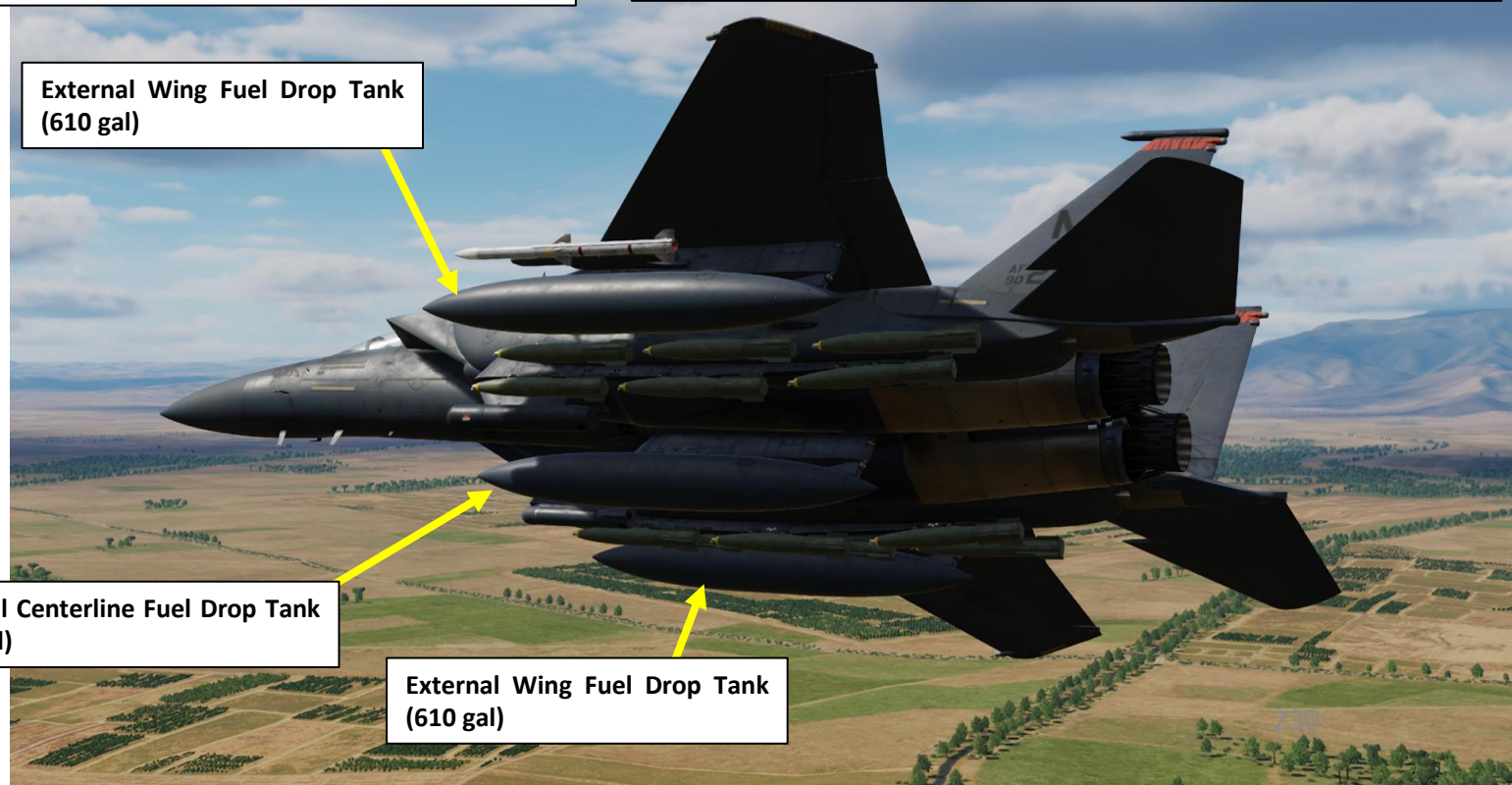


Wing Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external wing tanks, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external wing tanks during air to air refueling and during ground refueling as well*

Centerline Fuel Tank Control Switch
- *FWD: STOP TRANSFER, stops any transfer from the external centerline tank, unless the FUEL LOW light is ON*
- *MIDDLE: Normal*
- *AFT: STOP REFUEL, prevents filling the external centerline tank during air to air refueling and during ground refueling as well*

Fuel Quantity Selector Knob
Selects which fuel tanks are being monitored in the Left & Right Fuel Counters
- *EXT WNG: External wing fuel tanks*
- *EXT CTR: Fuel available in external centerline fuel tank (displayed on LEFT counter)*

External Fuel 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)
- *FWD: CONF TANK*
- *AFT: WING CTR*



External Wing Fuel Drop Tank (610 gal)

External Centerline Fuel Drop Tank (610 gal)

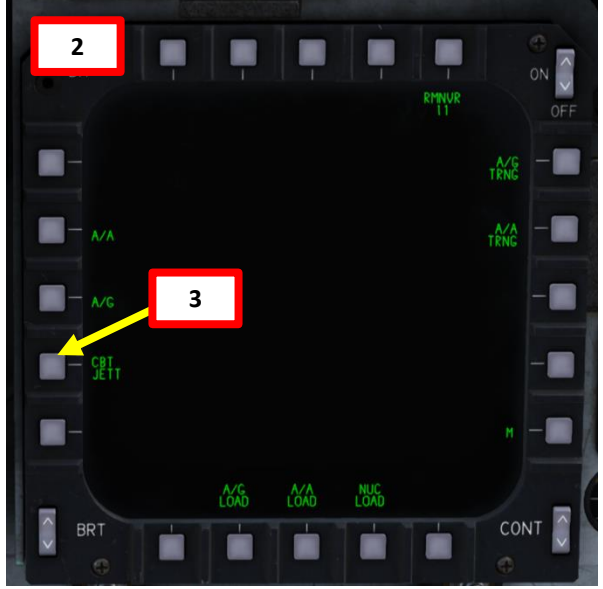
External Wing Fuel Drop Tank (610 gal)

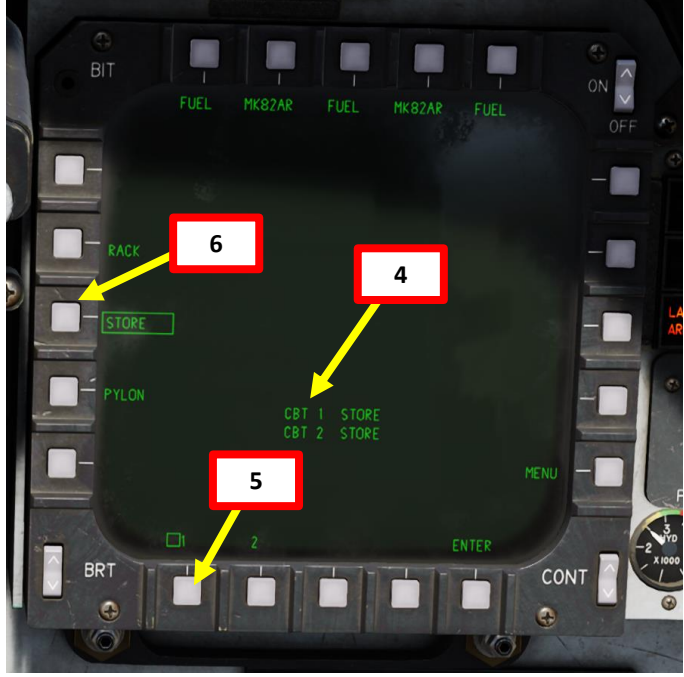
2 – FUEL
2.2 – External Drop Tanks

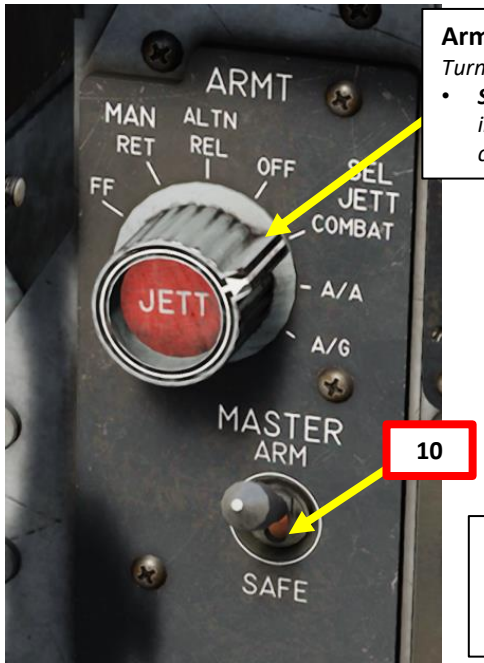
External drop tanks can be jettisoned either by pressing the Emergency Jettison button (jettisons most of the ordnance equipped, which you might not necessarily want to do) or by using the Selective Jettison method. In this example, we will use the Selective Jettison method.

External Fuel Tank Jettison (Selective Combat Jettison)

1. Set Armament Jettison Selector to SEL JETT COMBAT.
2. Go in ARMT (Armament) page
3. Select CBT JETT.
4. You can create up to two individual Combat Jettison profiles. We will program a single profile (CBT 1).
5. Select Combat Jettison profile No. 1.
6. Select STORE.
7. Select drop tanks you want to jettison by boxing desired "FUEL" stations. We will select all of them.
8. Select ENTER.
9. Combat Jettison Profile No. 1 (CBT 1) now displays "LCR STORE", which means that Left, Center and Right Stores will be jettisoned for this combat jettison profile.
10. Set Master Arm – ARM (UP)







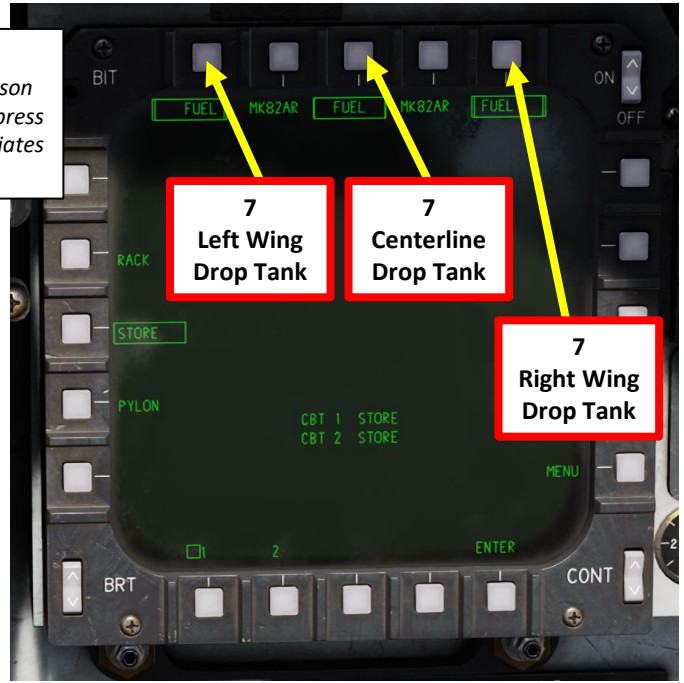
Armament Jettison Selector 1

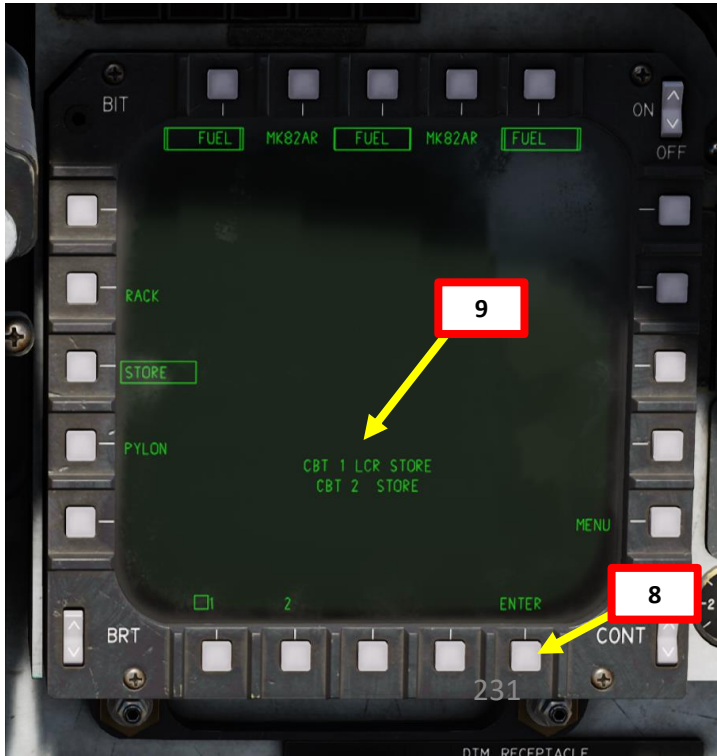
Turn to select ordnance, then push Red JETT Button to jettison

- ***SEL JETT COMBAT**: selective jettison button first press initiates combat jettison program 1. Second press initiates combat jettison program 2.*

Emergency Jettison Button

- *When pressed for approximately 1 second, the contents of all CFT stations and stations 2, 5 and 8 pylons are jettisoned.*





2 – FUEL
2.2 – External Drop Tanks

External Fuel Tank Jettison (Selective Combat Jettison)

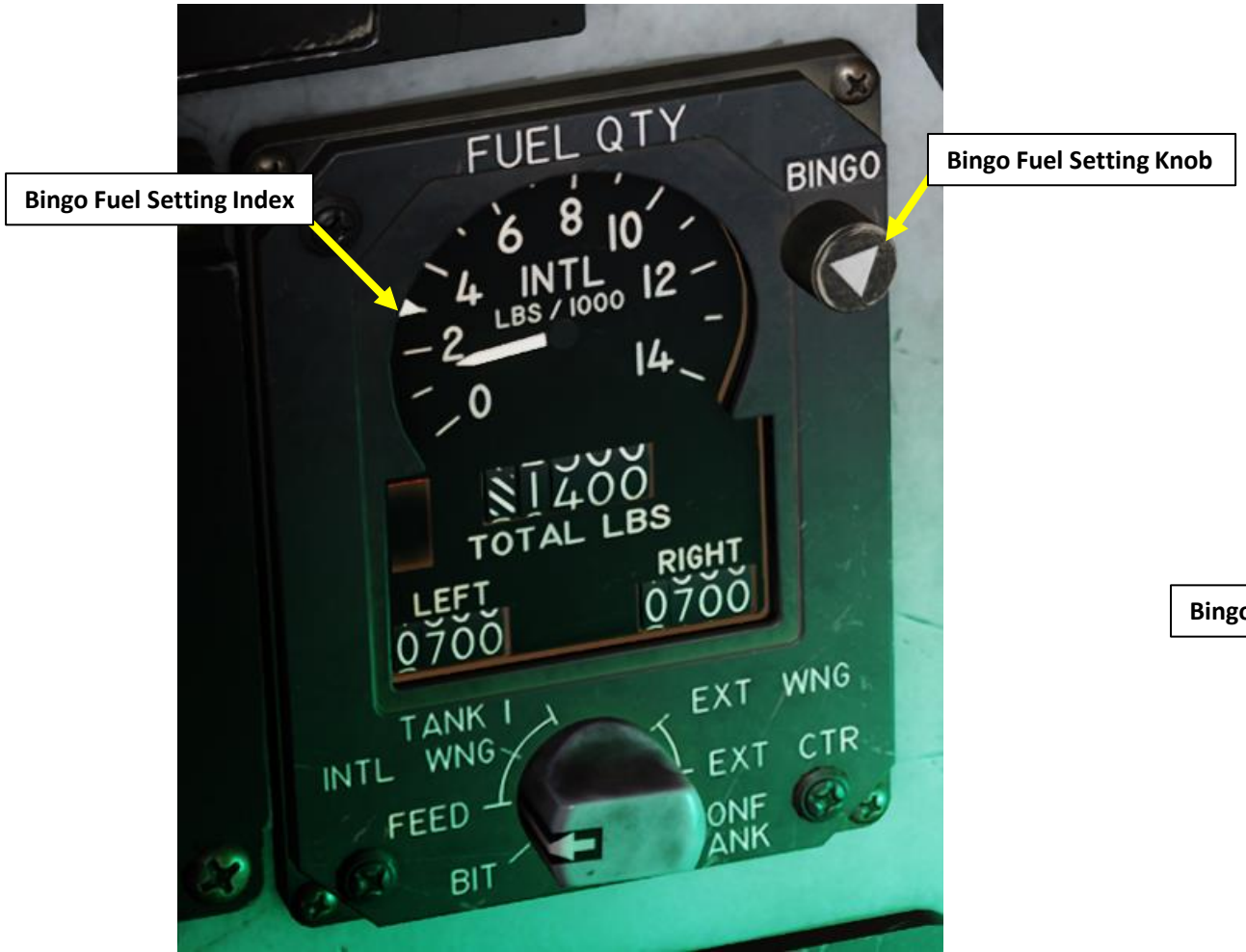
11. Press Armament Jettison Selector button IN to jettison external drop tanks.

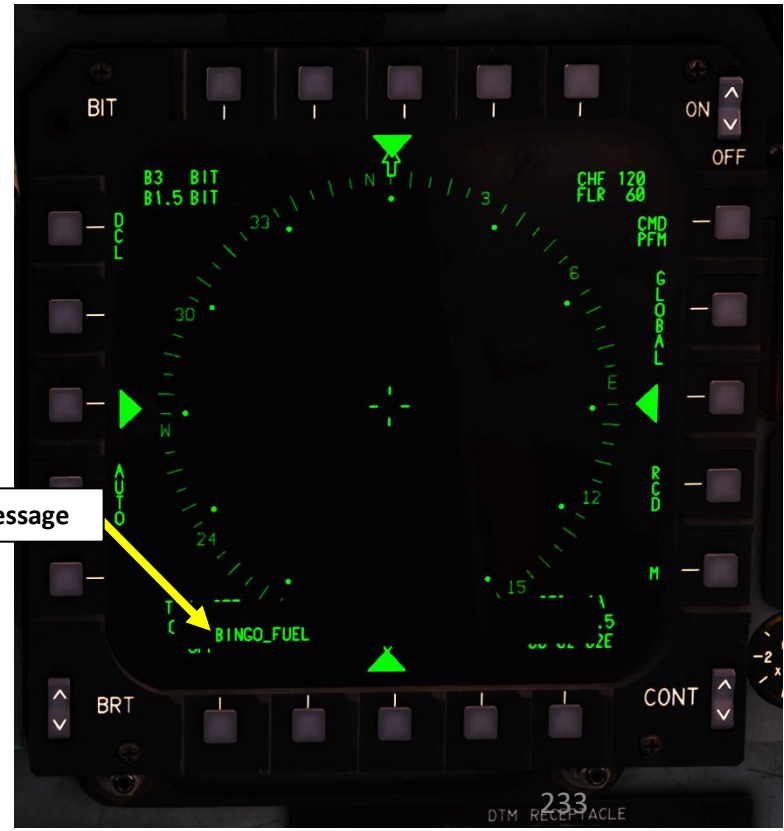
2 – FUEL
2.3 – Bingo Fuel

BINGO fuel is the amount of fuel that once reached triggers an immediate return to home base. It takes into account the fuel needed to fly the return leg of the flight, the fuel required to fly the briefed approach, the fuel to go to the alternate (if necessary) and the emergency fuel which is not supposed to be used except in an emergency.

Your “BINGO FUEL” can be set by using the Bingo Fuel Setting Knob on the FUEL QTY panel,

When fuel state falls below BINGO fuel limit, an aural cue “Bingo Fuel” will be audible and a BINGO FUEL indication on your MPD pages will appear. MASTER CAUTION will illuminate as well.





2 – FUEL
2.4 – Fuel Dumping

In some situations, the pilot may want to jettison excess fuel in order to lighten up the aircraft (i.e. landing). To jettison fuel, set the Fuel Dump Switch to DUMP (FWD). Fuel will then be jettisoned through the right wingtip's fuel dump outlet until either:

- Fuel quantity reaches the Bingo Fuel Setting or,
- All fuel tanks are empty except engine feed tanks (about 2700 lbs remaining).

The left wingtip only vents fuel when an overpressure or overfuelled condition exists.

Fuel Dump Switch

- *FWD: dumps fuel from all fuel tanks except engine feed tanks.*
- *AFT: Normal (Default Position)*

FLIGHT CONTROLS

The F-15E has a **hydro-mechanical flight control system**. The control system is powered by three separate hydraulic systems: Power Control One (PC-1) driven by the left engine. Power Control Two (PC-2) driven by the right engine, and a Utility system which contains two pumps, one on each engine. Both the pilot and WSO can control the aircraft with the flight stick and rudder pedals. Flying the F-15 is quite a "manual" experience compared to other fully-fly-by-wire aircraft.

The flight control system is supplemented with a **CAS (Control Augmentation System)** in the pitch, roll and yaw axis; the primary surface actuators contain an electronically controlled input to the actuator which can move the surface without pilot control stick motion.

This website has an interesting section the topic :

- Hydro-Mechanical System: https://www.f15sim.com/operation/f15_hydro_mech.html
- Flight Control System: https://www.f15sim.com/operation/f15_flight_control_system.htm

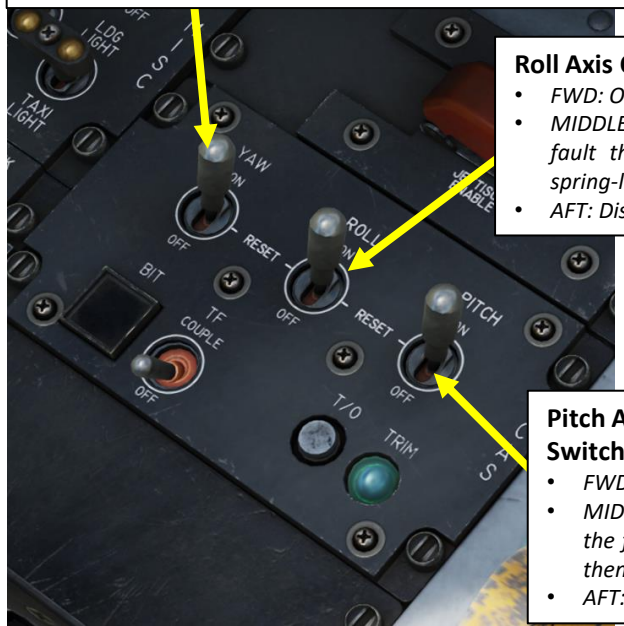
Flight Stick

Trim Hat Switch

- *UP: Nose DOWN*
- *DOWN: Nose UP*
- *LEFT: Left Wing DOWN*
- *RIGHT: Right Wing DOWN*

Yaw Axis CAS (Control Augmentation System) Switch

- *FWD: ON, Normal yaw axis operation*
- *MIDDLE: RESET, engages disconnected yaw axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages yaw axis*

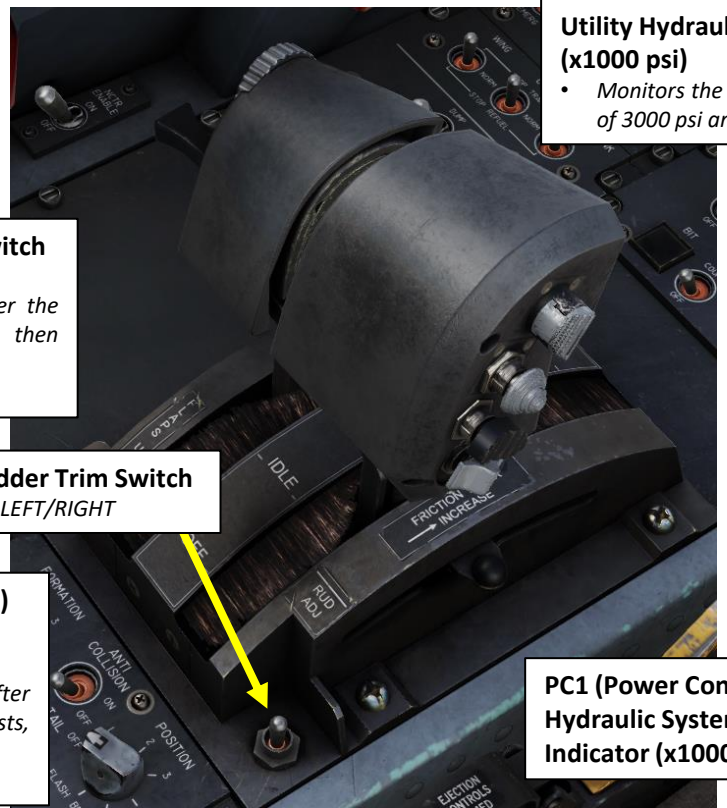


Roll Axis CAS (Control Augmentation System) Switch

- *FWD: ON, Normal roll axis operation*
- *MIDDLE: RESET, engages disconnected roll axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages roll axis*

Rudder Trim Switch

- *LEFT/RIGHT*



Pitch Axis CAS (Control Augmentation System) Switch

- *FWD: ON, Normal pitch axis operation*
- *MIDDLE: RESET, engages disconnected pitch axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages pitch axis*

Utility Hydraulic System Pressure Gauge Indicator (x1000 psi)

- *Monitors the operation of two pumps: left with pressure of 3000 psi and right with pressure of 2775 psi.*

PC1 (Power Control 1) Hydraulic System Pressure Indicator (x1000 psi)

PC2 (Power Control 2) Hydraulic System Pressure Indicator (x1000 psi)

FLIGHT CONTROLS

FLIGHT CONTROLS

The basic hydro-mechanical system has the following components:
- Pitch Ratio System
- Pitch Trim Compensator (PTC)
- Roll Ratio Changer
- Aileron/Rudder Interconnect (ARI) System

The **Pitch Ratio** system adjusts the amount of pitch stabilator deflection available for a given longitudinal stick motion. The ratio is scheduled to produce essentially the same stick travel per "g" throughout the flight envelope. The pitch radio system is scheduled by Mach number and altitude but it does not cover the full range of aircraft and stabilator power.

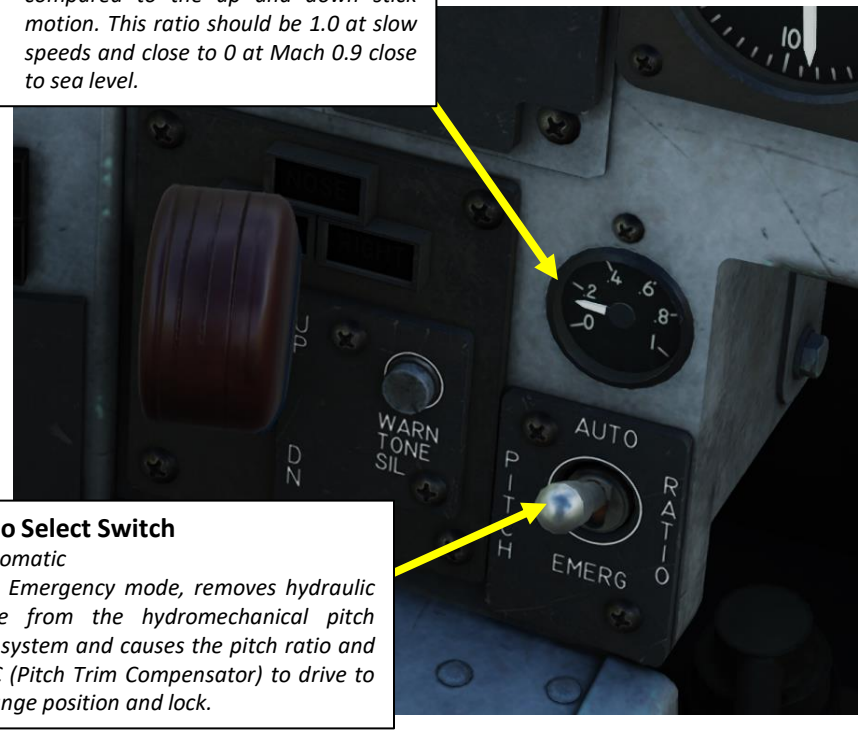
The **Pitch Trim Compensator (PTC)** system relieves the pilot of the task of compensating pitch disturbances (flap extension, turbulence, etc.) with large longitudinal stick motions. In practice, the F-15 flies at essentially a constant stick position for a given g. If that stick position changes and the aircraft is not responding with the correct g schedule, the PTC will move the stabilator in the direction to maintain the g schedule. The stick will not move perceptibly, the but the stabilator will. It will continue to move to the limits of the PTC authority so long as the error signal between the stick position and the aircraft g schedule exists. As you the aircraft speed changes, there is no requirement to trim the aircraft in pitch.

The **Roll Ratio Changer** system maintains the initial roll response of the aircraft somewhat constant when the pilot uses both ailerons and differential stabilator for hydro-mechanical roll control.

The **Aileron/Rudder Interconnect (ARI)** system keeps the adverse yaw from killing the roll rate at positive angles and prevents the proverse yaw from producing extremely high roll rates at negative angle of attack. During rolling maneuvers, the F-15 has its share of adverse yaw at positive angles of attack and proverse yaw at negative angles of attack (primarily in the subsonic area, so the hydro-mechanical ARI is cut out during supersonic flight). The roll ratio changer is used to wash out the yaw producing differential controls at aft or forward stick positions and produce rudder in the direction of the roll at positive (aft stick) angles of attack and against the roll at negative (forward stick) angles of attack.

Rudder Hydro-Mechanical Authority:
- +/- 15 degrees of pilot input below Mach 1.5
- +/- 5 degrees of pilot input above Mach 1.5
- +/- 30 degrees for ARI input with the stick held full aft and full lateral inputs made

Pitch Ratio Indicator
- *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.*



Pitch Ratio Select Switch
- *UP: Automatic*
- *DOWN: Emergency mode, removes hydraulic pressure from the hydromechanical pitch control system and causes the pitch ratio and the PTC (Pitch Trim Compensator) to drive to a midrange position and lock.*

Roll Ratio Switch
- *FWD: Automatic Mode*
- *AFT: Emergency Mode, removes hydraulic pressure from roll control system, causing the roll ratio to lock at midrange*

SPECIFICATIONS & LIMITATIONS

Aircraft Limitations

	Maximum Airspeed	Load Factor
Landing Gear Extension/Retraction	300 kts (air-to-air, with CFT, without LANTIRN) 250 kts (any configuration)	1.25 g 2.0 g
Flaps Extension	250 kts	0 to +4.0 g
Inlet Ramps in Emergency Position	Above 0.95 Mach	-1.0 to +4.0 g
Canopy Open	60 kts	-
Tyres	Nose Gear: 210 kts Main Gear: 227 kts	-
Maximum Gross Weight Limit	81000 lbs	
Max Positive G Limit (Structural)	+9.0 g	
Negative G Limit	Negative G flight is limited to 10 seconds at all power settings. Exceeding this limit can potentially cause fuel starvation and engine flameout.	

TF (Terrain Following Radar) Limits

Bank Angle Limit	60 deg, flyup if not corrected within 2 seconds
Turn Rate Limit	5.5 deg in all modes (except LIP and VLC), flyup if not corrected within 2 seconds.
Turn Acceleration Limit	2.2 deg per second, flyup if not corrected within 2 seconds
Dive Angle Limit	Any dive steeper than 15 deg, flyup if not corrected within 3 seconds

Aircraft Specifications

Crew	2 (pilot + 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	31700 lbs (14379 kg)
Max Takeoff Weight	81000 lbs (36741 kg)
Max Speed (High Altitude)	1434 kts (2656 km/h)
Max Speed (Low Altitude)	782 kts (1448 km/h)
Combat Range	687 nm (1272 km)
Service Ceiling	60000 ft (18000 m)
Rate of Climb	50000 ft/min
Powerplant	2 x Pratt & Whitney P100-PW-229 Dry Thrust: 17800 lbs each Afterburner Thrust: 29160 lbs each
Thrust-to-Weight Ratio	0.93

LOW ALTITUDE WARNING SYSTEM (LAWS)

The Low Altitude Warning System provides a cue to the pilot with a voice warning and a LOW ALT warning light if the aircraft climbs above and then descends below a preset safety altitude (250 ft above ground level by default).

On the Main UFC (Upfront Control Panel) menu, the number shown next to the LAW data field represents this altitude. If a number is shown, it indicates the low altitude warning system (LAWS) has been enabled.

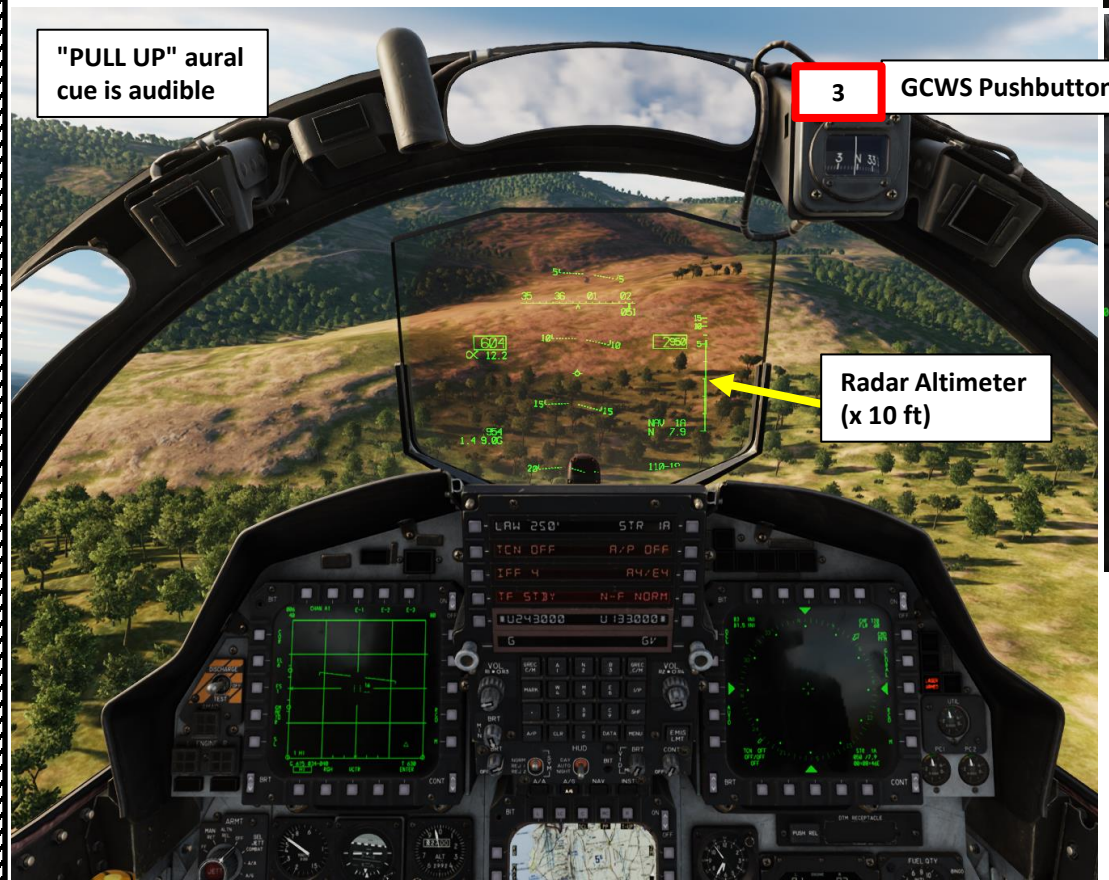
The LAW altitude is changed by keyboard entry into the scratchpad and pressing the pushbutton next to LAW (based on CARA, Combined Altitude Radar Altimeter). The LAW is turned off by pressing Pushbutton next to LAW with a blank scratchpad.

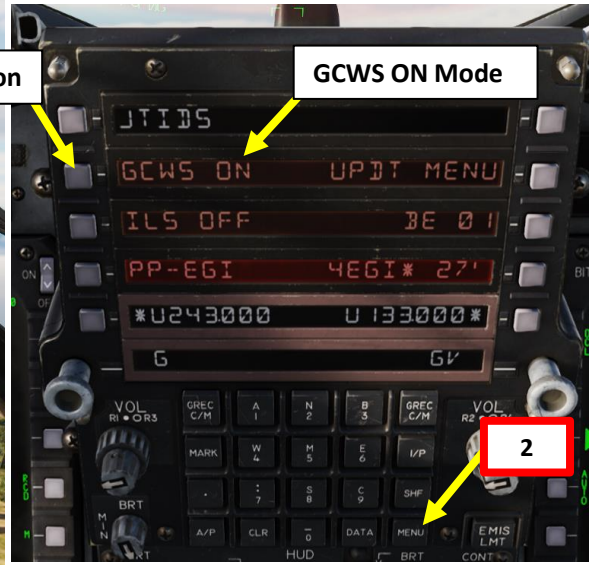
GROUND COLLISION WARNING SYSTEM (GCWS)

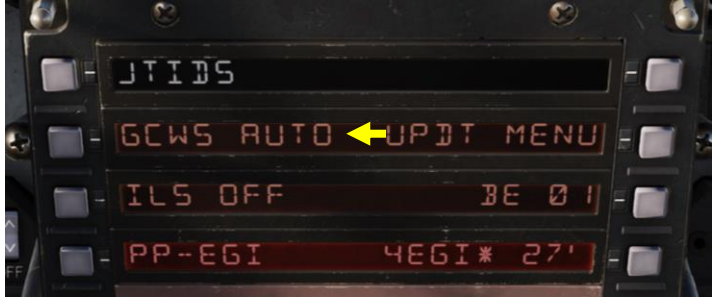
The Ground Collision Warning System provides a cue to the pilot if the aircraft is on the verge of colliding with terrain. Currently, only a "PULL UP" aural cue is audible when you risk colliding with the ground.

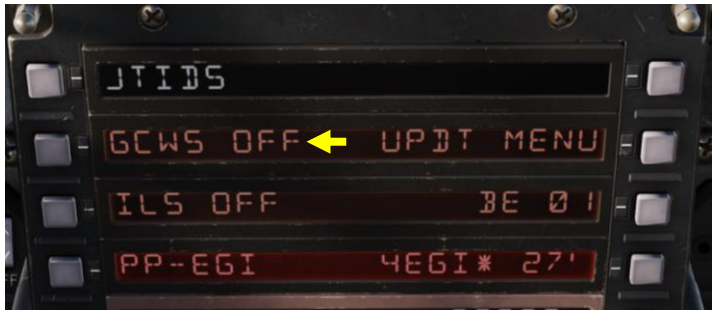
On the Main UFC (Upfront Control Panel) MENU 2 (accessed by pressing on MENU button twice), the GCWS status is displayed and its mode can be toggled by pressing the button next to the GPWS data field. GCWS Modes are:

- **OFF**: GCWS warning are disabled and no advisory is displayed.
- **AUTO**: GCWS warnings are enabled if not in INST master mode and operating between 5000 ft and 400 ft AGL (Above Ground Level).
- **ADV** (Advisory): GCWS warnings are disabled and an advisory is displayed only on the HUD.
- **ON**: GCWS warnings are enabled (both advisory and aural cue).

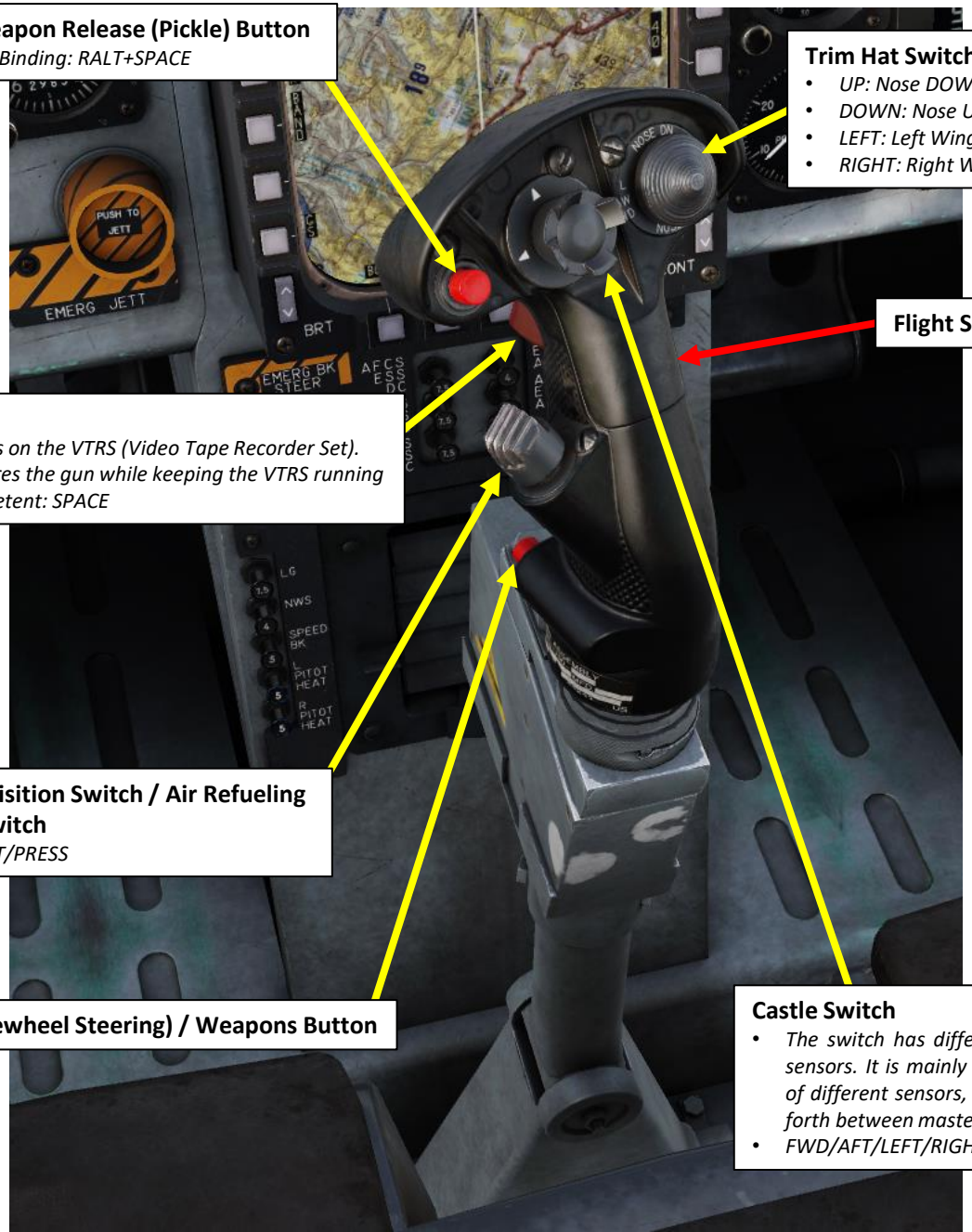








PILOT HOTAS (HANDS ON THROTTLE AND STICK): FLIGHT STICK



Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

Trim Hat Switch
- *UP: Nose DOWN*
- *DOWN: Nose UP*
- *LEFT: Left Wing DOWN*
- *RIGHT: Right Wing DOWN*

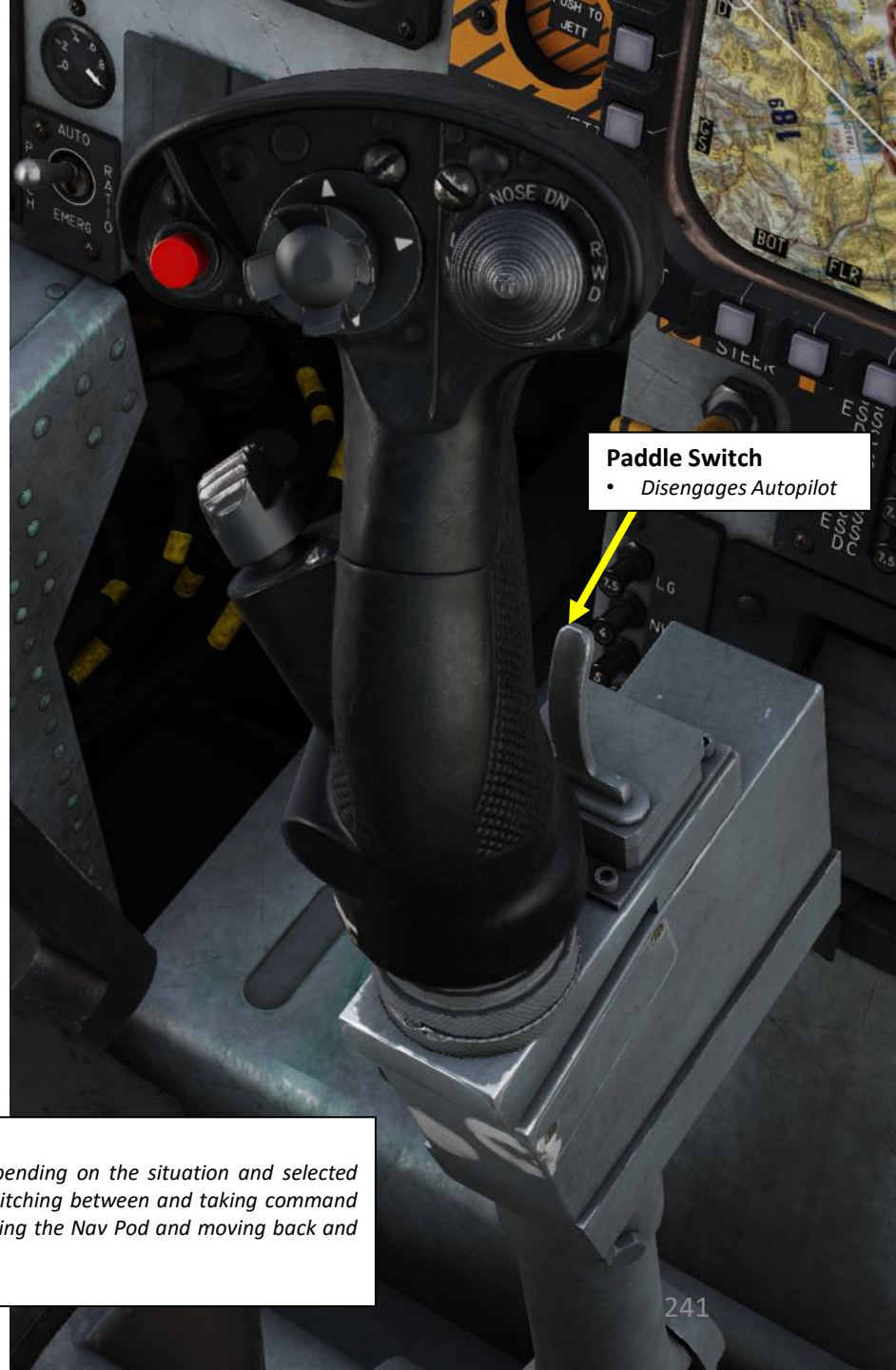
Flight Stick

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

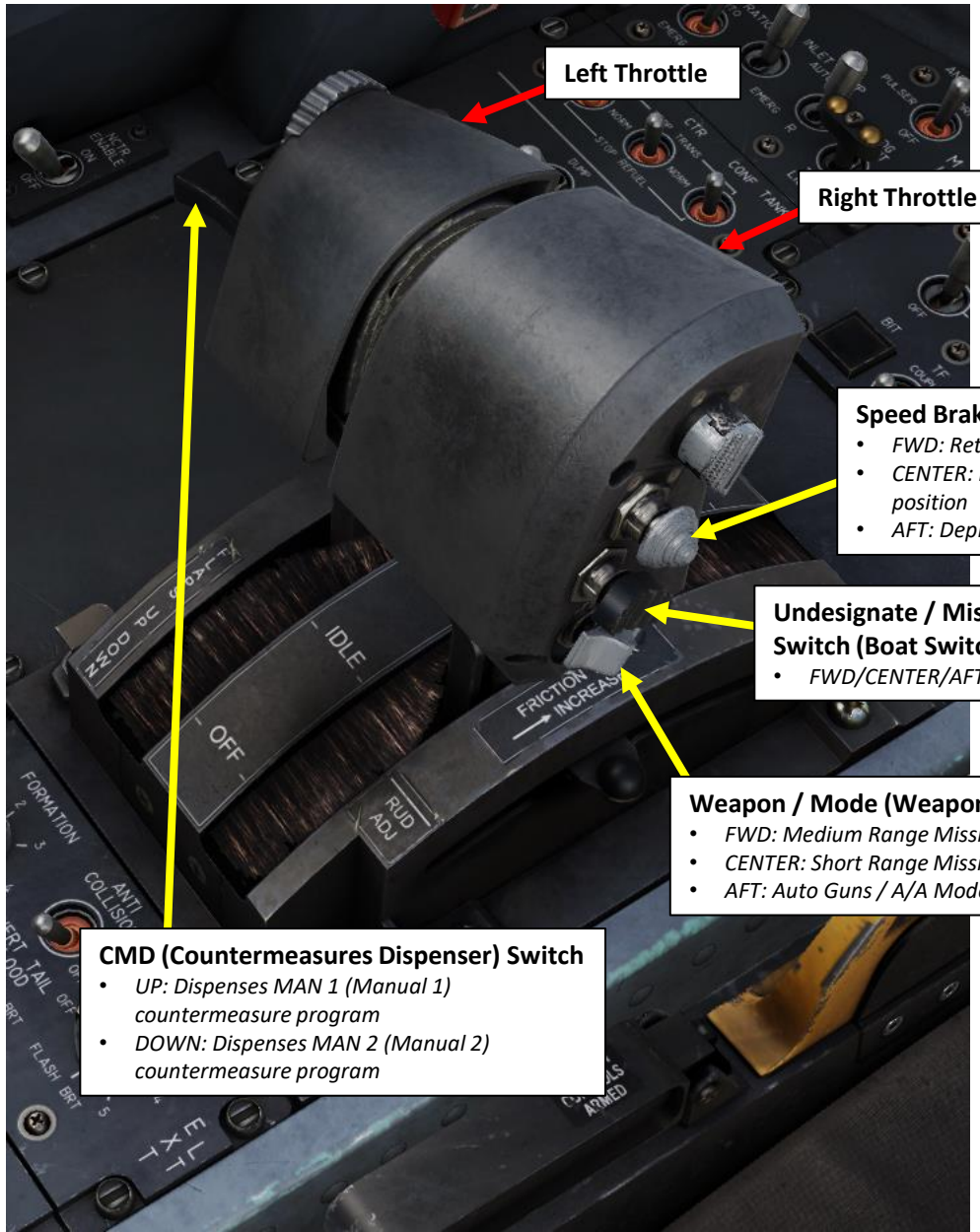
NWS (Nosewheel Steering) / Weapons Button

Castle Switch
- *The switch has 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.*
- *FWD/AFT/LEFT/RIGHT/DEPRESS*



Paddle Switch
- *Disengages Autopilot*

PILOT HOTAS (HANDS ON THROTTLE AND STICK): THROTTLE



Left Throttle

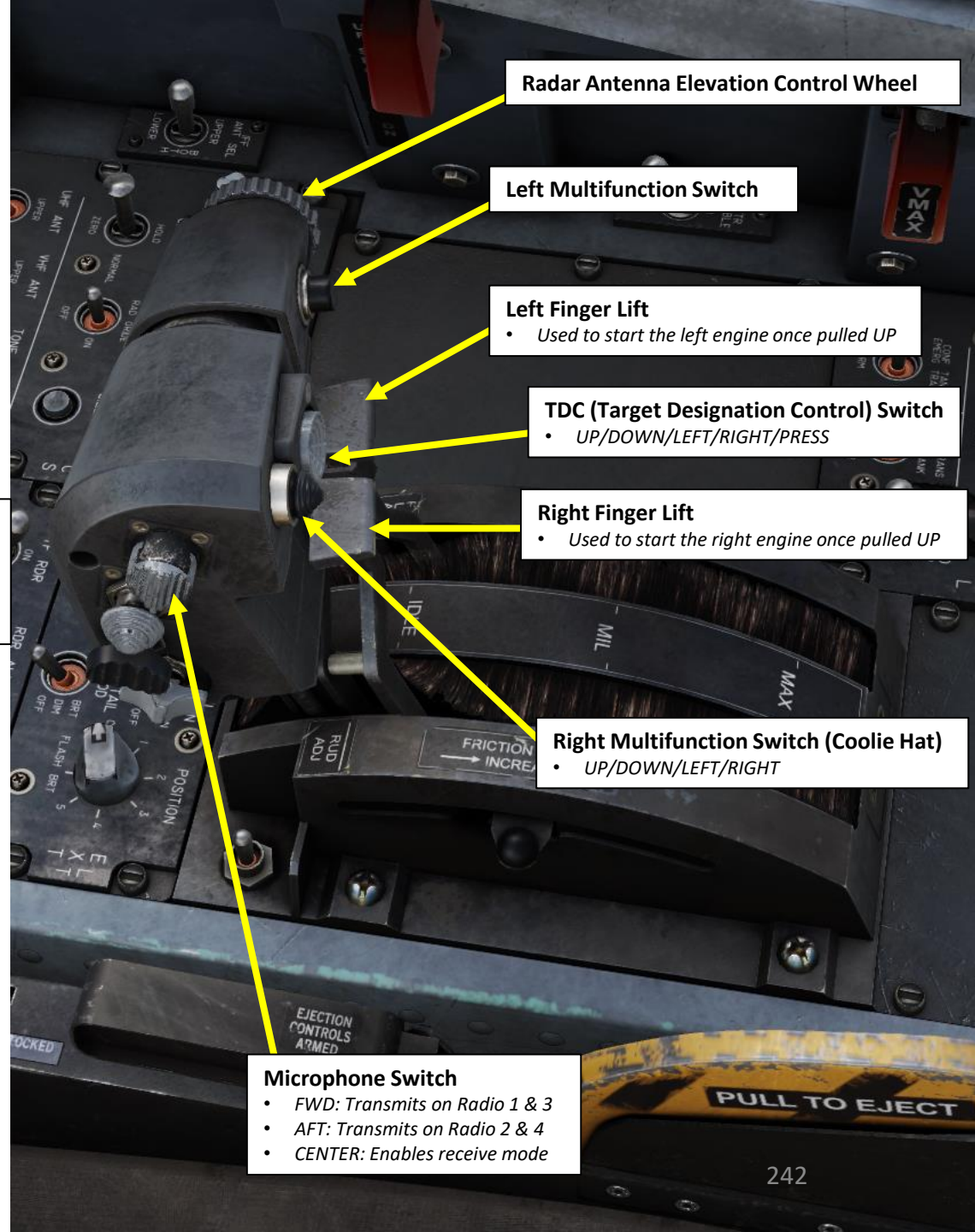
Right Throttle

Speed Brake Switch
- *FWD: Retracts Speed Brake*
- *CENTER: Holds the brake in current position*
- *AFT: Deploys Speed Brake*

Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

CMD (Countermeasures Dispenser) Switch
- *UP: Dispenses MAN 1 (Manual 1) countermeasure program*
- *DOWN: Dispenses MAN 2 (Manual 2) countermeasure program*



Radar Antenna Elevation Control Wheel

Left Multifunction Switch

Left Finger Lift
- *Used to start the left engine once pulled UP*

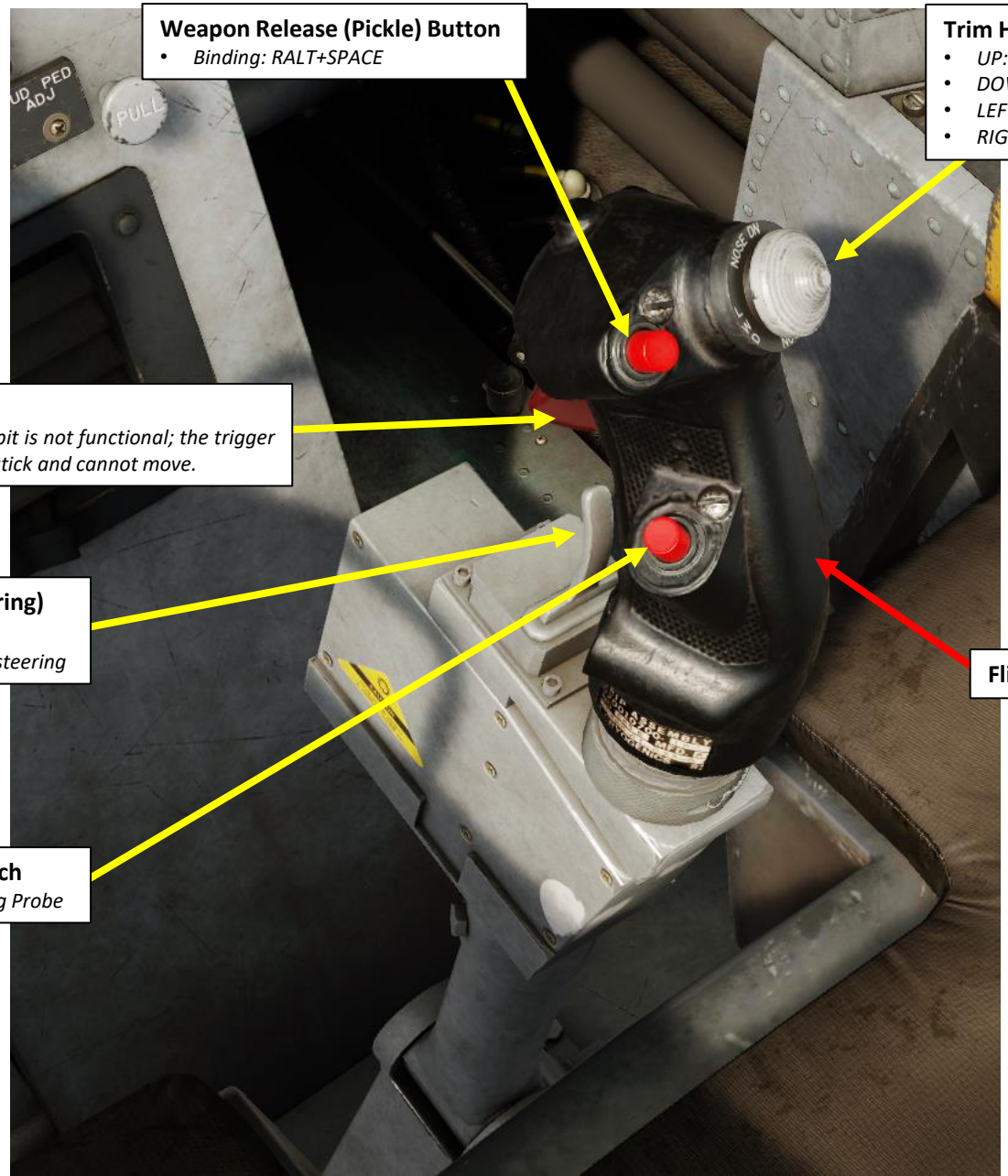
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Right Finger Lift
- *Used to start the right engine once pulled UP*

Right Multifunction Switch (Coolie Hat)
- *UP/DOWN/LEFT/RIGHT*

Microphone Switch
- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

WSO HOTAS (HANDS ON THROTTLE AND STICK): FLIGHT STICK



Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

Trim Hat Switch
- *UP: Nose DOWN*
- *DOWN: Nose UP*
- *LEFT: Left Wing DOWN*
- *RIGHT: Right Wing DOWN*

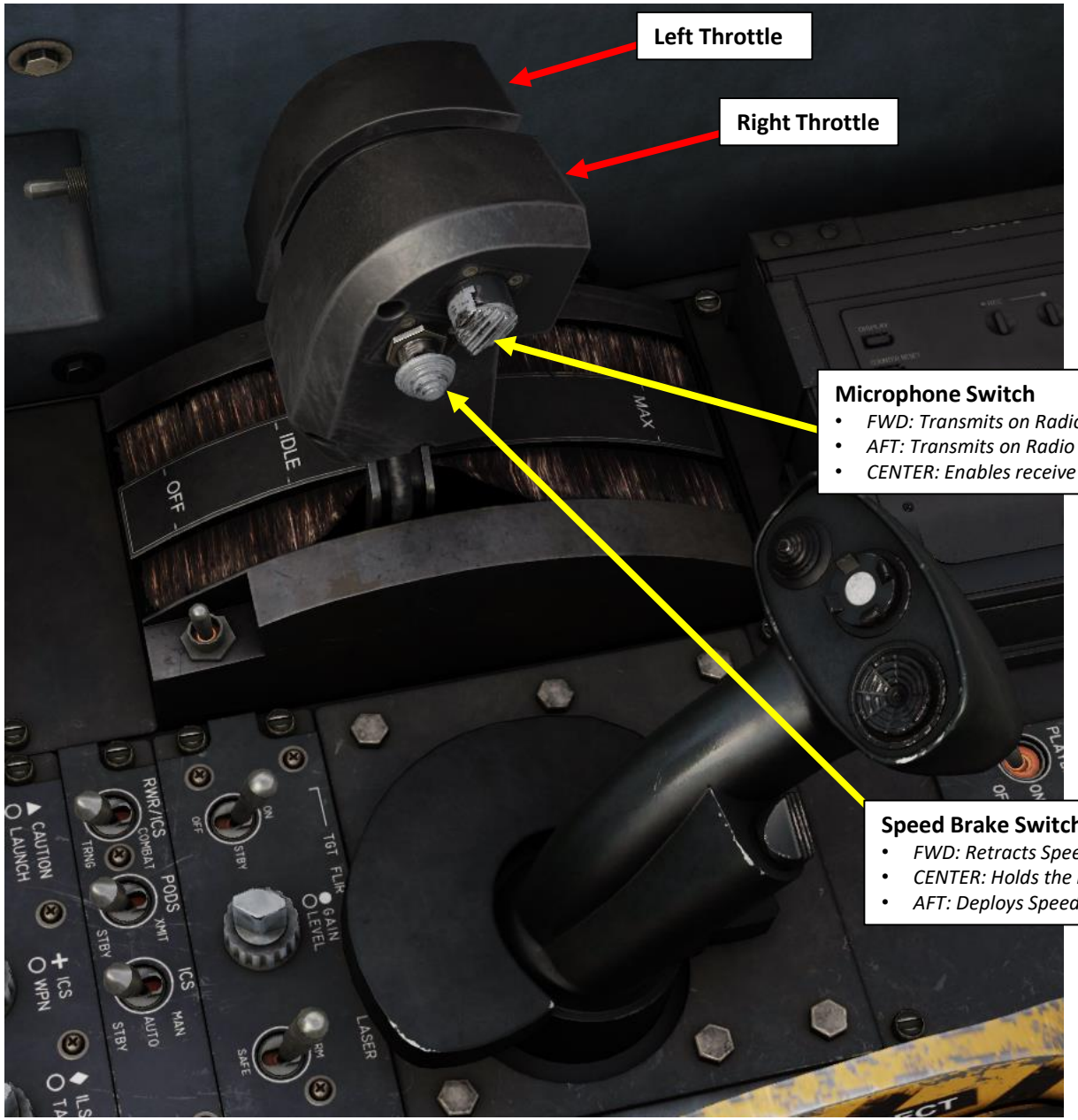
Trigger (Not Functional)
- *The trigger in the rear cockpit is not functional; the trigger is actually melded into the stick and cannot move.*

Autopilot / NWS (Nose Wheel Steering) Disengage (Paddle) Switch
- *Disengages Autopilot and nose wheel steering*

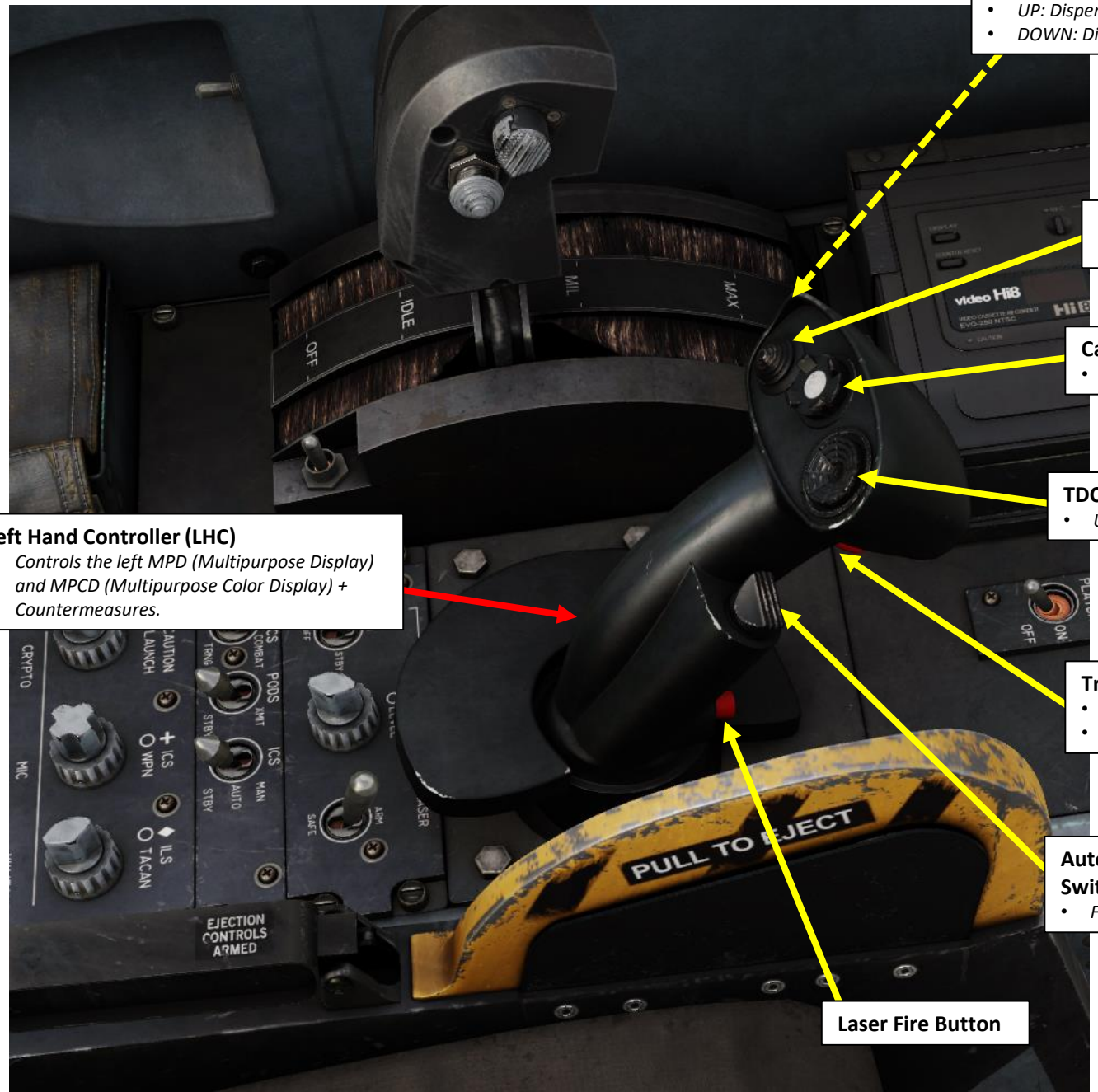
Flight Stick

Air Refueling Release Switch
- *Disengages the Air Refueling Probe*

WSO HOTAS (HANDS ON THROTTLE AND STICK): THROTTLE



WSO LHC (LEFT HAND CONTROLLER)



CMD (Countermeasures Dispenser) Switch (Hidden)
- *UP: Dispenses MAN 2 (Manual 2) countermeasure program*
- *DOWN: Dispenses MAN 1 (Manual 1) countermeasure program*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

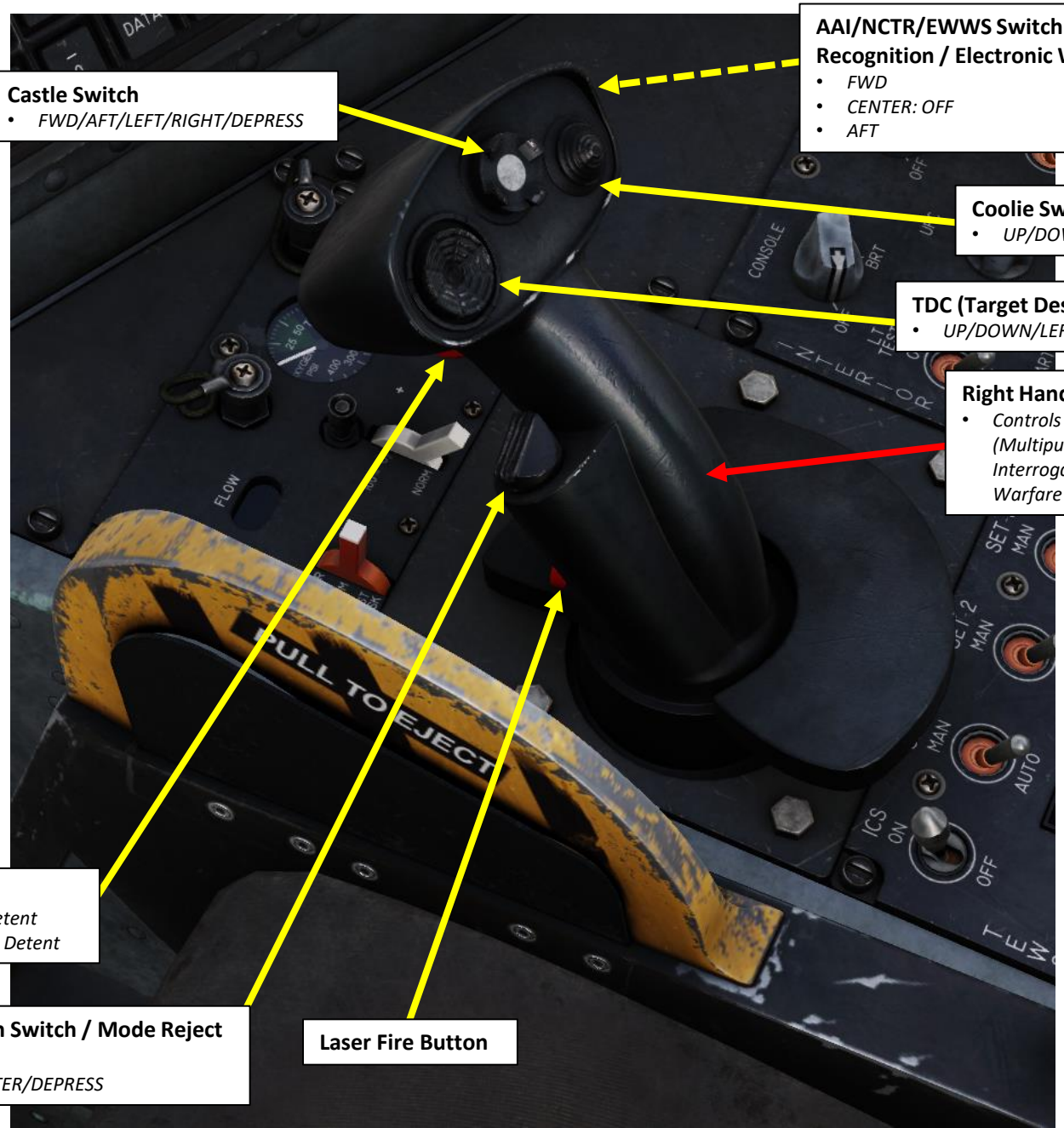
Left Hand Controller (LHC)
- *Controls the left MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + Countermeasures.*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

WSO RHC (RIGHT HAND CONTROLLER)



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Right Hand Controller (RHC)
- *Controls the right MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + the AAI/NCTR/EWWS (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set).*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

Tables by Kennedy

PILOT HOTAS CONTROLS

Front Stick

Switch	Direction	Action
Trigger	1st Detent	VTR
	2nd Detent	Fire Gun
Weapon Release	PRESS	Weapon Release [1]
Trim	Fore/Aft/ Left/Rright	Flight Control Trim
	PRESS	CMD MAN 1

NWS Button	Direction	Weight on Wheels	AIM-9
	PRESS	HOLD: NWS Hi	Cage/ Uncage

AP/ Steering Disengage (Paddle)	Direction	Weight on Wheels	Autopilot	Manual TF	Auto TF
	PRESS	Stop AFCS Bit	AP Disengage	Reset Flyup	AP Disengage
	HOLD	NWS Disengage		AP Disengage	Revert to Manual TF

Castle	Direction	Short	Long	Take Command Enable [2]	~~Look Into Turn Enable [4]~~	~~Caution Control Enable [5]~~
	FWD	A/A or A/G Master Mode		Take Command HUD [3]	~~Look Down~~	
	AFT	Scroll MPCD	Take Command MPCD	~~Take Command MPCD~~	~~Look Up~~	~~MPCD~~
	LEFT	Scroll L MPD	Take Command L MPD	~~Take Command L MPD~~	~~Look L~~	~~L MPD~~
	RIGHT	Scroll R MPD	Take Command R MPD	~~Take Command R MPD~~	~~Look R~~	~~R MPD~~
	PRESS	*Take Command Enable*				

Auto Acquisition Switch/ Air Refueling Release	Direction	HUD	TSD	A/A Radar	RBM	HRM	TPOD	AAR
	FWD		~~Smaller Cue~~	See A/A Chart 1 [7]	Smaller Window		SHORT: FoV Toggle LONG: Snowplow	
	AFT	A/G: Auto/CDIP	~~Larger Cue~~		Larger Window/ PSL Enable/Disable [6]		SHORT: Return to Cue LONG: STAB	
	PRESS		~~Return to PP Map~~		Mode Reject		Track/Untrack	AAR Probe Disengage

[7] A/A Chart 1

Switch	Direction	Search	STT	2TWSH	4TWSH	3HDT	2HDT	Narrow	AIM-7
Auto Acq	FWD Short	SS or BST	3HDT			4TWSH	3HDT		
	FWD Long	LR BST	2HDT						VS BST
	AFT Short	VTS	2TWSH	STT					
	AFT Long								HPRF Flood
	PRESS	Return to Search							

[0] Non-functional features in EA marked with ~~Strikethrough~~
[1] If A/G with TPOD HUD BS and no target, designates on HUD LoS
[2] Short Press AFTER Castle PRESS Short
[3] Taking command a second time in A/G mode sets TPOD HUD BS
[4] With Coolie Down simultaneously
[5] With Master Caution Held Simultaneously
[6] Pattern Steering Line Enable/Disable when cursor function target

Front Throttle

Switch	Direction	Action
Mic	FWD	Tx Radio 1/3
	AFT	Tx Radio 2
Speed Brake	FWD	Retract
	CENTER	Hold
	AFT	Extend
Weapon/ Mode Switch (China)	FWD	MRM
	CENTER	SRM
	AFT	Guns
Undesignate/ Missile Reject (Boat)	FWD	Missile Reject
	AFT	Undesignate
Antenna Elevation Wheel	ROTATE	Elevation Rate Control
CMD (Pinky)	UP	CMD MAN 2
	DOWN	CMD MAN 1

[4] With Castle Simulataneously
[8] Must be In Command of HUD in A/G, NAV, or INST
[9] A/A Chart 2 below

Switch	Direction	Action
TDC	PRESS	SHORT: Miniraster LONG: Search Sort

TDC	Direction	RWS	3HDT/ 2HDT/ 4TWSH	2TWSH/ Narrow
	Azimuth Bump	Wide/Narrow	2TWSH	4TWSH

Left Multifunction Switch	Direction	HUD	TSD	SRM	RBM/HRM	TPOD
	PRESS	~~Cage/Ungage VV [8]~~	~~Track/ Untrack~~	Manual SBR	Freeze/ Unfreeze	Laser Fire/ Stop Firing

Coolie	Direction	A/A Radar	A/A Gun	RBM/HRM/ TPOD/TSD
	UP	Quick Step	LCOS/GSD	Quick Step
	DOWN	Missile BS/ Gun Sight Stiffen/ ~~Look Into Turn Enable [4]~~		
	RIGHT	HOLD: NCTR		
	LEFT	HOLD: IFF Interrogate		

TDC	Direction	Nav or A/G HUD	TSD	A/A Radar	RBM/HRM/ TPOD	Nav Pod
	Slew	Slew	~~Slew~~	See A/A Chart 2 [9]	Slew	
	PRESS	Designate	~~Cue~~		Cursor Function	

Tables by Kennedy

WSO HOTAS, LHC & RHC CONTROLS

WSO Stick and Throttle

Switch	Direction	Action
Trim	F/A/L/R	Flight Control Trim
Weapon Release	PRESS	Weapon Release
AAR Disengage	PRESS	AAR Disengage

AP/Steering Disengage (Paddle)	Direction	Weight on Wheels	Autopilot	Manual TF	Auto TF
	PRESS	Stop AFCS Bit	AP Disengage	Reset Flyup	AP Disengage
	HOLD	NWS Disengage		AP Disengage	Manual TF

Mic	FWD	Tx Radio 1/3
	AFT	Tx Radio 2
Speed Brake	FWD	Retract
	CENTER [10]	Speed Brake Follows Front Cockpit Command
	AFT	Extend

[10] The WSO Speed Brake switch is spring centered

WSO Hand Controllers

Switch	Direction	Action
CMD	FWD	CMD MAN 1
	AFT	CMD MAN 2
AAI	FWD	HOLD: IFF Interrogate
	AFT	HOLD: NCTR
Coolie	UP	Scroll MPD
	DOWN	Scroll MPCD
	LEFT	Take Command L/ Move Cautions [5]
	RIGHT	Take Command R/ Move Cautions [5]

[5] With Master Caution Held Simultaneously
[7] See A/A Chart 1 on page 2
[9] See A/A Chart 2 on page 4
[11] With Trigger Half-Action
[12] When Cursor Function Target

Laser Fire	Direction	AIM-9	RBM/HRM	TPOD
	PRESS	SBR	Freeze/Unfreeze	Laser Fire

	Direction	TSD	A/A Radar	RBM	HRM	TPOD
Castle	FWD	~~Decrease Map Scale~~	MRM Search	Cursor Map		SHORT: White/Black/Auto Track **LONG: Black/White Hot**
	AFT	~~Increase Map Scale~~	SRM Search	Cursor Target		
	LEFT	~~Toggle Radar/FLIR Cue~~	Undesignate	Cursor Cue/Mark		SHORT: Cursor Cue/Mark ~~**LONG: Handoff Initiate STA 2**~~
	RIGHT		Missile Reject	Cursor Update		SHORT: Cursor Update ~~**LONG: Handoff Initiate STA 8**~~
	PRESS	~~Sequence Point Select~~	Quick Step	Sequence Point Select		
TDC	Slew	~~Slew~~	Slew [9]/ Elevation Control [11]	Slew/ Elevation Control [11]	Slew	
	PRESS				Expand [11]	
Auto Acq [12]	FWD	~~Smaller Cue~~	See A/A Chart 1 [7]	Smaller Window/ PPI Range [11]		SHORT: FoV Toggle **LONG: Snowplow**
	AFT	~~Larger Cue~~		Larger Window/ PPI Range [11]/ PSL Enable [12]		SHORT: Return to Cue **LONG: STAB**
	PRESS	~~Return to PP Map~~		Mode Reject/ PSL Undesignate [12]		Undesignate
Trigger	Half-Action	~~Track/Untrack~~	*Elevation Control/ PPI Range Change/ Expand Enable [11]*			Track/Untrack
	Full-Action	~~Cue~~	Designate	Cursor Function		

PART 10 – RADAR & SENSORS

SECTION STRUCTURE

- **1 – SENSORS**
  - 1.1 – Introduction to Sensors
  - 1.2 – Sensors Display Selection
  - 1.3 – Sensor Master Modes
  - 1.4 – My Sensors Control Setup

- **2 – AN/APG-70 Radar**
  - 2.1 – Air-to-Air Modes
    - 2.1.1 – Radar Display & Performance
    - 2.1.2 – Main Modes Overview
    - 2.1.3 – RWS (Range While Search) Mode
    - 2.1.4 – VCTR (Vector Scan) Mode
    - 2.1.5 – RGH (Range-Gated High) Mode
    - 2.1.6 – STT (Single Target Track) Mode / Radar Lock
    - 2.1.7 – TWS (Track While Scan) Mode
    - 2.1.8 – Auto Acquisition Modes
      - 2.1.8.1 – SS (Supersearch) Sub-Mode
      - 2.1.8.2 – BST (Boresight) Sub-Mode
      - 2.1.8.3 – LR BST (Long Range Boresight) Sub-Mode
      - 2.1.8.4 – VTS (Vertical Scan) Sub-Mode
      - 2.1.8.5 – Guns Sub-Mode
    - 2.1.9 – Radar Electronic Protection
  - 2.2 – Air-to-Ground Modes
    - 2.2.1 – Air-to-Ground Operating Modes
    - 2.2.2 – RBM (Real Beam Map) Mode
    - 2.2.3 – GMT (Ground Moving Target) Mode
    - 2.2.4 – HRM (High Resolution Map) Mode
    - 2.2.5 – PVU (Precision Velocity Update) Mode
    - 2.2.6 – AGR (Air-to-Ground Ranging) Mode
  - 2.3 – Aircrew Roles & Sensor Operation
  - 2.4 – Radar Lingo & Terminology

- **3 – AN/AAQ-14 LANTIRN Targeting Pod (TGP)**
  - 3.1 – Introduction
  - 3.2 – Display
  - 3.3 – Controls
  - 3.4 – Start-Up & Lasing Procedure
  - 3.5 – Snowplow Mode
  - 3.6 – Tracking Modes
    - 3.6.1 – Area Track (ATRK)
    - 3.6.2 – Point Track (PTRK)
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    - 3.6.4 – Offset Track (OTRK)
  - 3.7 – Cue Mode
    - 3.7.1 – Slaving TGP to Sequence Point (NAV Cue)
    - 3.7.2 – Slaving TGP to Air-to-Ground Radar (RDR Cue)
    - 3.7.3 – Slaving TGP to Tactical Situation Display (TSD Cue)
    - 3.7.4 – Slaving TGP to Situation Display (SIT Cue)
    - 3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)
    - 3.7.6 – Slaving TGP to Targeting Reticle (RET Cue)
  - 3.8 – Cursor Functions
    - 3.8.1 – Target Designation (TGT) Function
    - 3.8.2 – Markpoint Designation (MARK) Function
    - 3.8.3 – Sensor Slaving (CUE) Function
    - 3.8.4 – Position Update (UPDT) Function
  - 3.9 – Air-to-Air Operation

SECTION STRUCTURE

- **4 – AN/AAQ-13 LANTIRN Navigation Pod (NVP)**
  - 4.1 – Introduction
  - 4.2 – TFR (Terrain Following Radar)
    - 4.2.1 – Basics
    - 4.2.2 – Controls
    - 4.2.3 – TF Modes Overview
    - 4.2.4 – Operation
      - 4.2.4.1 – Manual (MTF) vs Automatic (ATF) Operation
        4.2.4.2 – Manual TF Operation (MTF)
      - 4.2.4.3 – Automatic TF Operation (ATF)
      - 4.2.4.4 – Blended Mode
    - 4.2.5 – Limits, Warnings & Cautions
    - 4.2.6 – Flyup Manoeuvers
  - 4.3 – NAV FLIR
    - 4.3.1 – Basics
    - 4.3.2 – Power-Up
    - 4.3.3 – Controls & Interface

- **5 – JHMCS (Joint Helmet-Mounted Cueing System)**
  - 5.1 – Not Yet Implemented

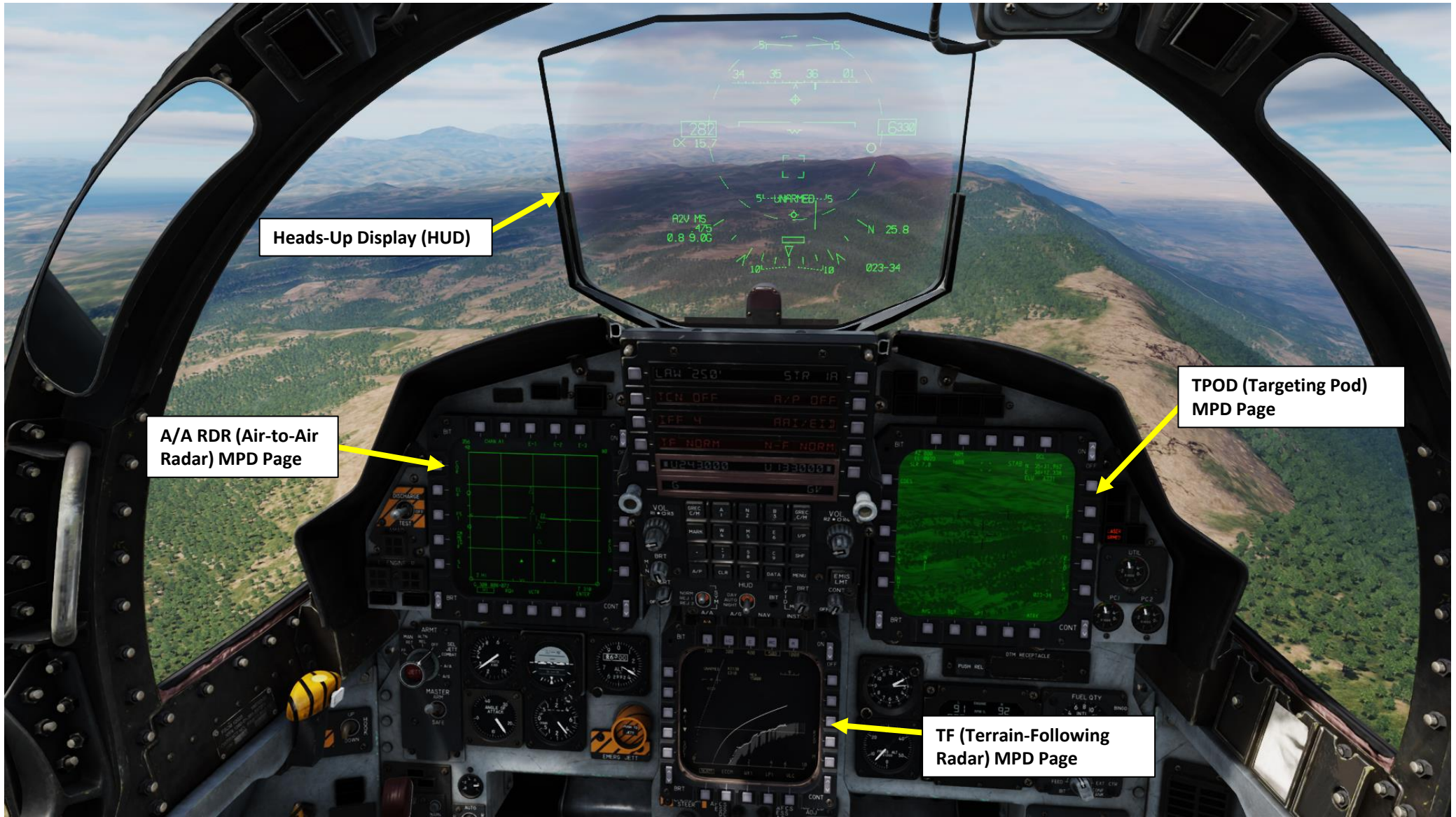
1 – SENSORS
1.1 – Introduction to Sensors

The F-15 is a very versatile aircraft when it comes to armament and sensors. Here is an overview of how the Strike Eagle can « see » the outside world.

- **AN/APG-70 Radar:** Pulse-Doppler, look-down/shoot-down radar with both BVR (Beyond Visual Range) and close in automatic modes of operation for air-to-air combat. Air-to-Ground modes are also implemented, which makes it a very powerful tool at your disposal.
- **AN/AAQ-14 LANTIRN Targeting Pod (TGP):** Targeting system developed to provide precision strike capability. Target designation is achieved by using a laser designator/range finder or an infrared laser marker, which can be created by the pod itself. It is also capable of displaying a FLIR (Forward-Looking infrared) thermal imagery.
- **AN/AAQ-13 LANTIRN Navigation Pod (NVP):** This pod provides high-speed penetration and precision attack on tactical targets at night and in adverse weather. The navigation pod contains a terrain-following radar and a fixed thermographic camera, which provides a visual cue and input to the aircraft's flight control system, enabling it to maintain a pre-selected altitude above the terrain and avoid obstacles. This sensor displays an infrared image of the terrain in front of the aircraft, to the pilot, on a Heads-Up display. The navigation pod enables the pilot to fly along the general contour of the terrain at high speed, using mountains, valleys and the cover of darkness to avoid detection.

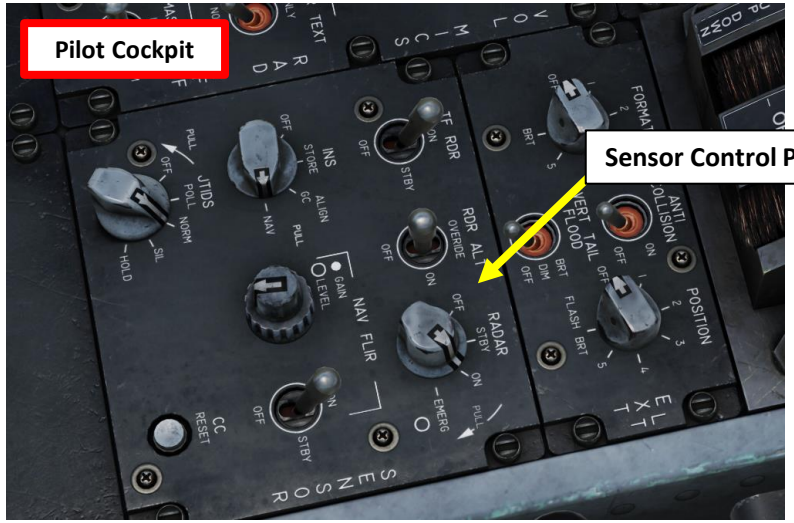
1 – SENSORS
1.1 – Introduction to Sensors

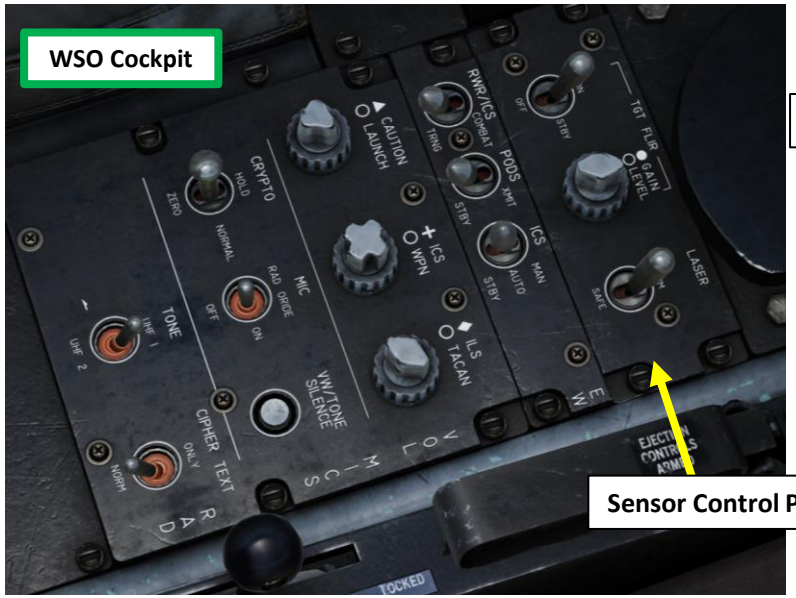
Your sensors can be monitored through various MPD (Multipurpose Display) pages and the HUD (Heads-Up Display). Sensors can be monitored from both the front and rear cockpit positions.

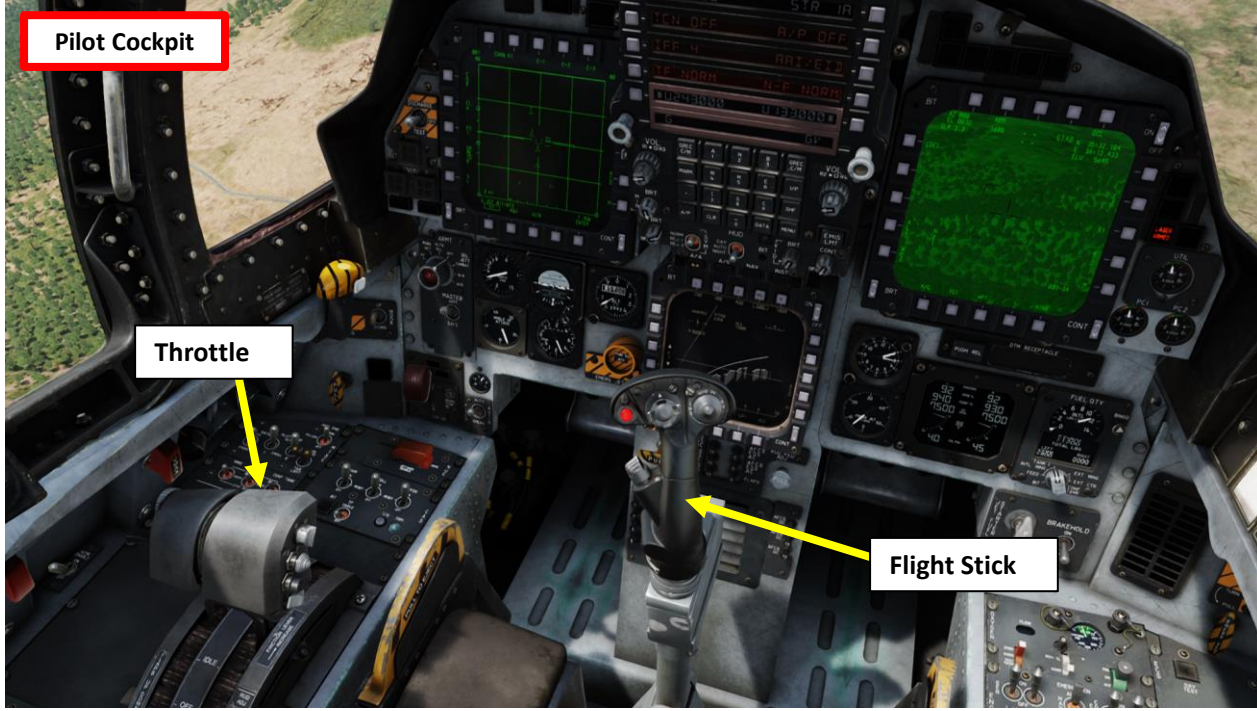


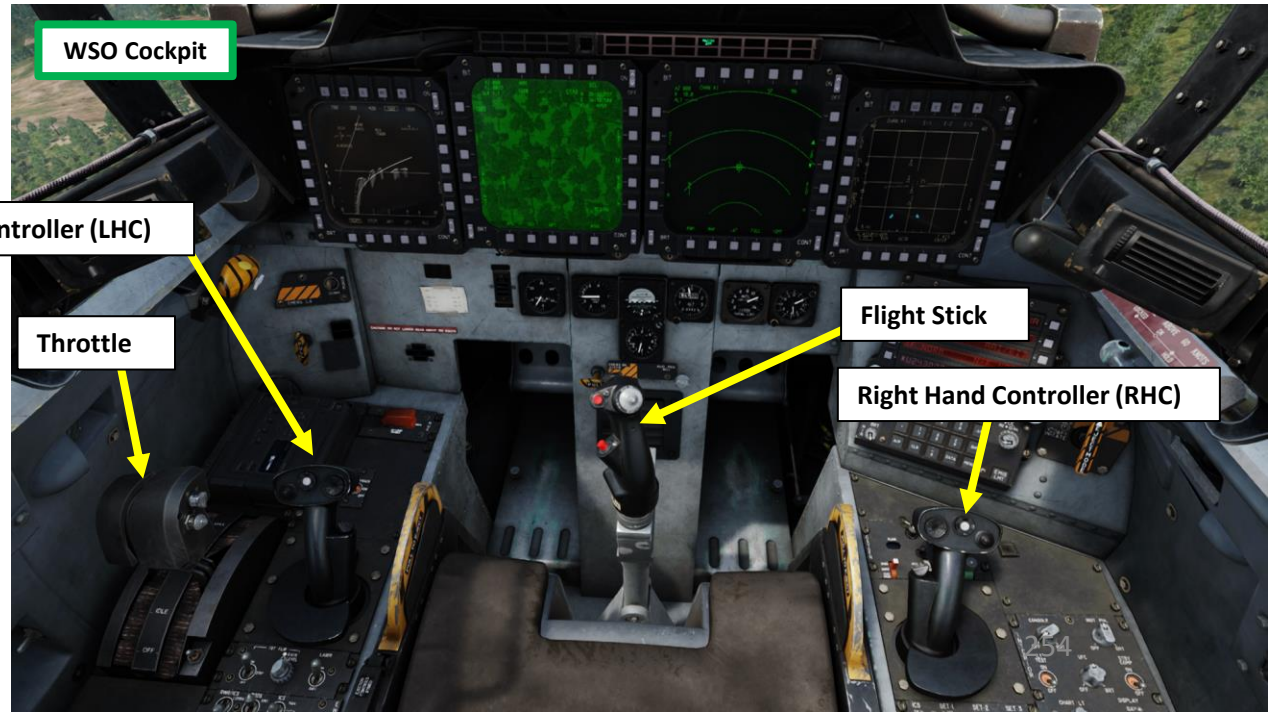
1 – SENSORS
1.1 – Introduction to Sensors

Sensor controls are split across HOTAS stick and throttle, LHC (Left Hand Controller) RHC (Right Hand Controller), MPD pages and various cockpit switches. Sensors can be controlled from both the front and rear cockpit positions.





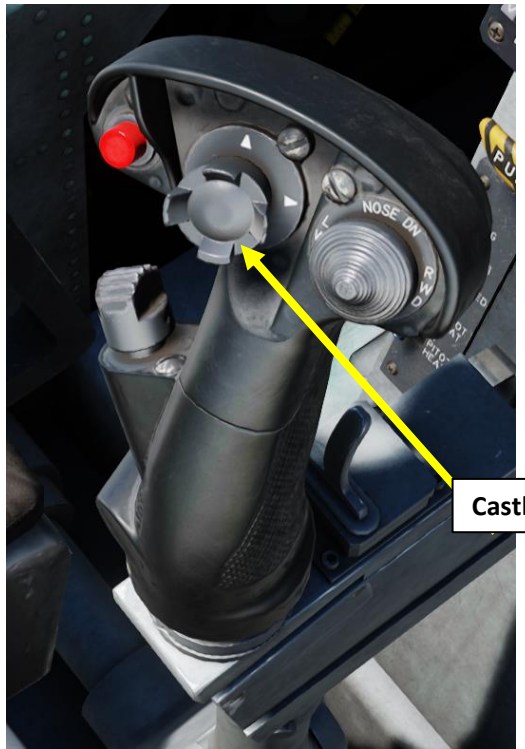




1 – SENSORS
1.2 – Sensors Display Selection

In the **front cockpit**, the **Castle Switch** on the stick is used to take control of a specific sensor display. The Castle Switch can be used to select the air-to-air radar, air-to-ground radar, targeting pod and Heads-Up Display (HUD).

- **Left MPD** (Multipurpose Display) Selection: Press **Castle Switch LEFT LONG** (more than 1 sec).
  - Selection is indicated with selection bars at the bottom of the display.
- **Right MPD** (Multipurpose Display) Selection: Press **Castle Switch RIGHT LONG** (more than 1 sec)
  - Selection is indicated with selection bars at the bottom of the display.
- **Lower MPCD** (Multipurpose Color Display) Selection: Press **Castle Switch AFT LONG** (more than 1 sec)
  - Selection is indicated with selection bars at the bottom of the display.
- **HUD** (Heads-Up Display) Selection: **DEPRESS Castle Switch SHORT** (less than 1 sec), **then** press **Castle Switch FWD SHORT** (less than 1 sec).
  - Selection is indicated with the “IN CMD” (In Command) Cue.



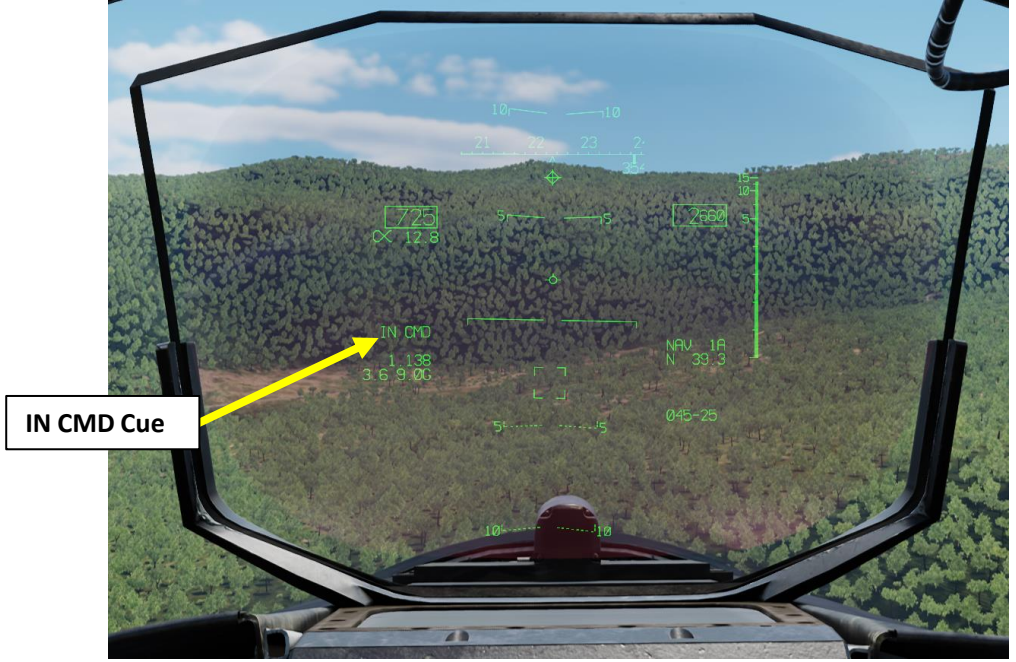
1 – SENSORS
1.2 – Sensors Display Selection

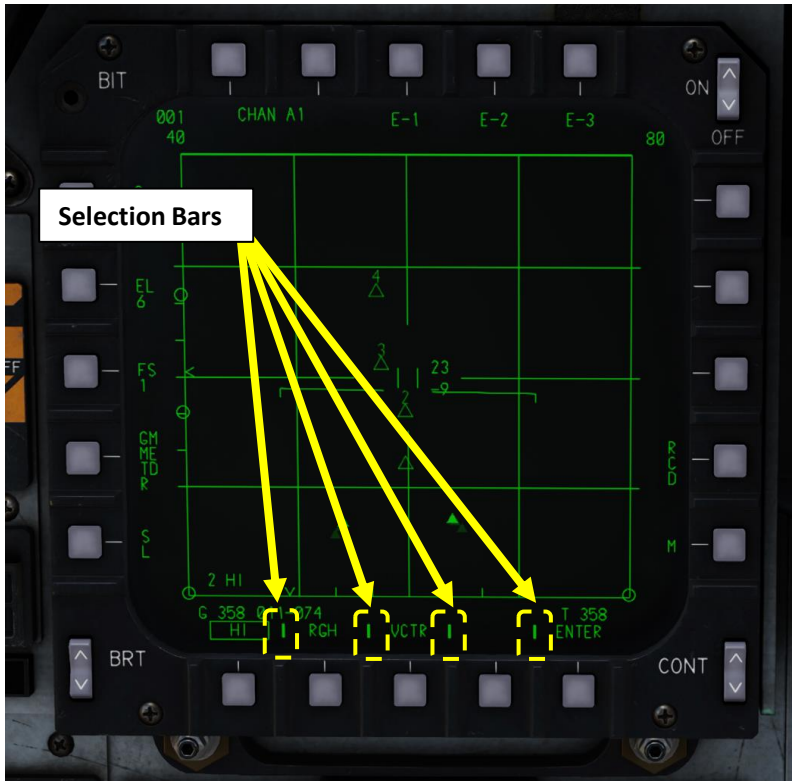
How do you know **which page/sensor is selected**?

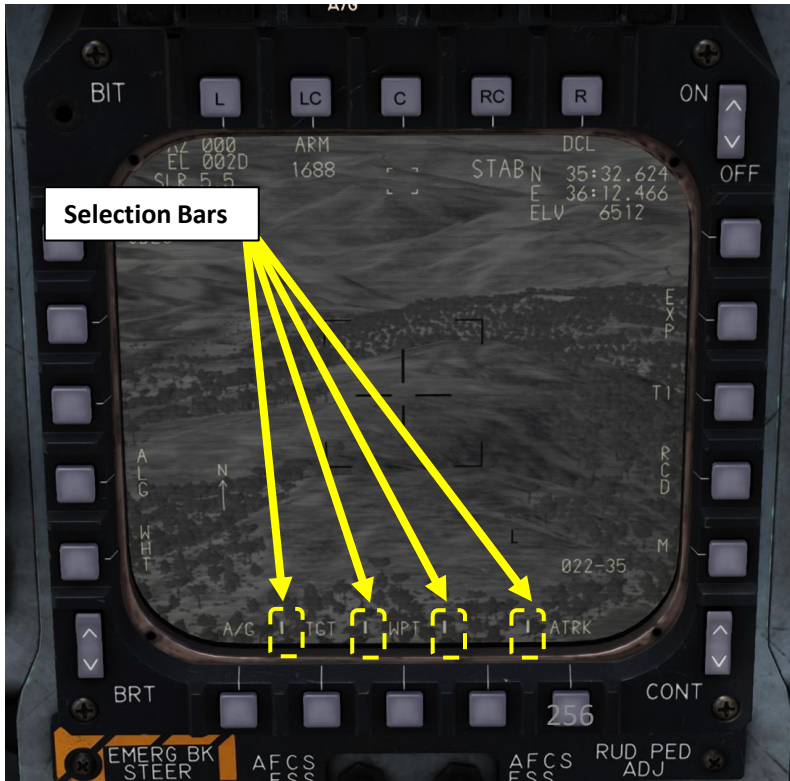
When a MPD page is selected, **selection bars** are visible at the bottom of the display.

When the HUD is selected, the "**IN CMD**" (In Command) Cue is visible.

The available Screens that can be "in command" are:
- HUD
- RDR (A/A and A/G)
- TGP
- TSD
- HMD (JHMCS)
- TEWS
- SIT
- VID 2/5/8
- Imagery
- Data Frame







1 – SENSORS
1.2 – Sensors Display Selection

In the **rear cockpit**, the **LHC (Left Hand Controller) and RHC (Right Hand Controller) Coolie Switches** are used to take control of a specific sensor display.

- **Left MPCD** (Multipurpose Color Display) Selection: Press **LHC Coolie Switch LEFT**.
- **Left MPD** (Multipurpose Display) Selection: Press **LHC Coolie Switch RIGHT**.
- **Right MPD** (Multipurpose Display) Selection: Press **RHC Coolie Switch RIGHT**.
- **Right MPCD** (Multipurpose Color Display) Selection: Press **RHC Coolie Switch LEFT**.

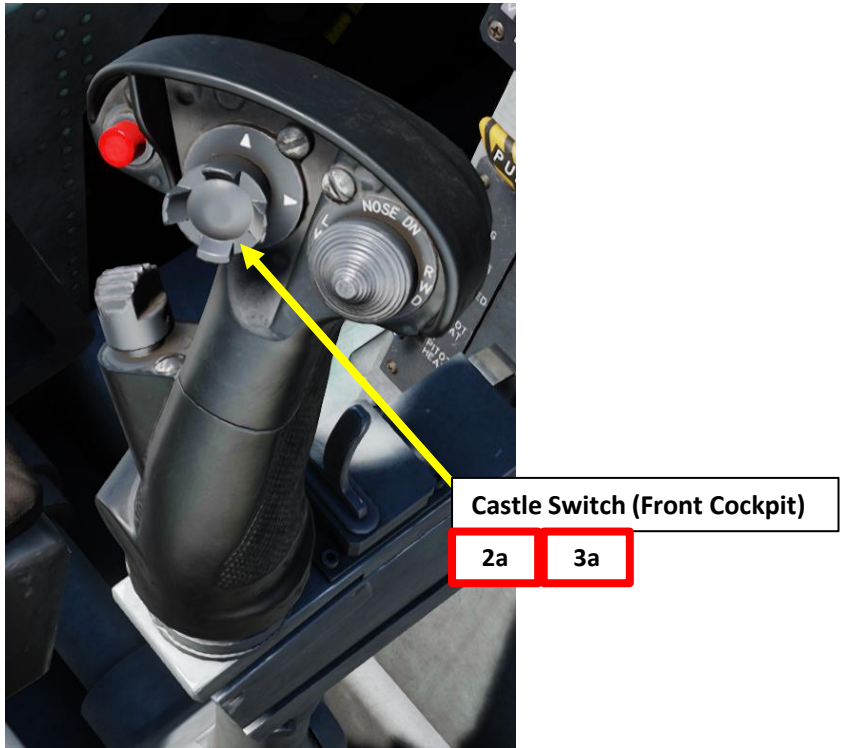
Selection is indicated with selection bars at the bottom of the display.

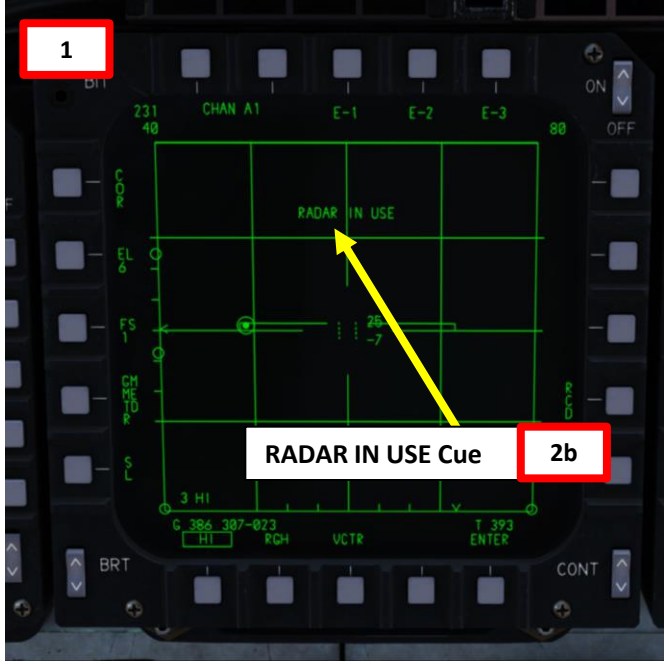
1 – SENSORS
1.2 – Sensors Display Selection

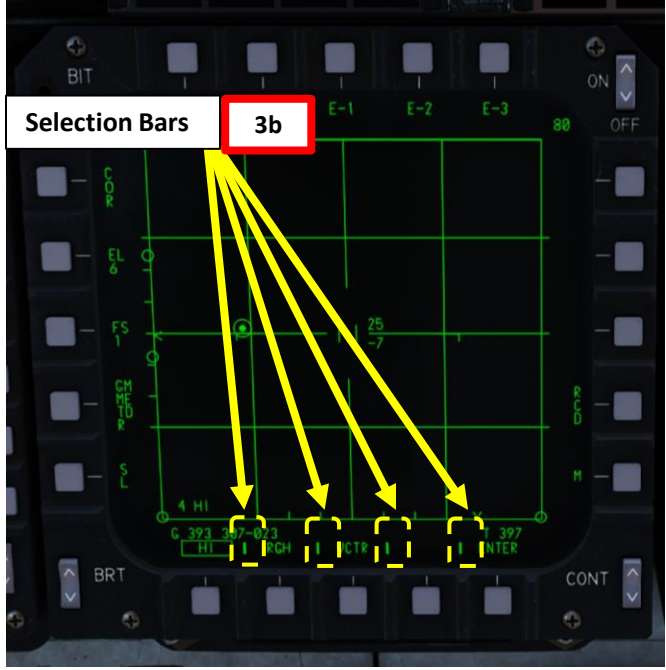
While a sensor can be selected and controlled by either the pilot or the WSO, keep in mind that both crew members **cannot control the same sensor at the same time**. The "IN USE" message indicates that a sensor is being controlled by the other crew member already. However, it is possible to forcefully take control by repeating the same "display selection" procedure shown previously.

As an example, if the WSO is controlling the air-to-air radar and the pilot wants to take control of it:

1. The pilot has the A/A RDR page set on his left MPD.
2. The pilot presses the Castle Switch LEFT LONG, but the "RADAR IN USE" cue prevents him from taking control of the radar.
3. If the pilot presses the Castle Switch LEFT LONG a second time, the "RADAR IN USE" cue will then disappear and the selection bars will be visible, indicating that the pilot now has control of the A/A RDR page.
4. When taking control of a sensor, an aircrew typically calls it out to let the other to let him know that his sensor is being taken over (example: "My radar").







1 – SENSORS
1.3 – Sensors Master Modes

Master Modes set the operational status of the PACS (Programmable Armament Control Set) and HUD (Heads-Up Display) avionics equipment. Master modes are selected with **Master Mode Buttons** below the UFC (Upfront Control Panel).

- **A/A (Air-to-Air)** Master Mode: Select by pressing A/A button or selecting GUN on the Weapon Select Switch on the throttle. This is used when engaging air targets. The HUD will display symbology relevant to Gun, SRM (Short Range Missile) or MRM (Medium Range Missile) employment provided the Master Arm Switch is set to ARM.
- **A/G (Air-to-Ground)** Master Mode: Select by pressing the A/G button. This is used when engaging ground targets. The HUD will display symbology relevant to A/G weapon employment provided the PACS (Programmable Armament Control Set) is set correctly with the weapons selected.
- **NAV (Navigation)** Master Mode: Select by pressing the NAV button. This is used to display navigation-related information on the HUD. Air-to-air weapons can still be employed in this master mode, but the use of air-to-ground weapons is inhibited.
- **INST (Instrument)** Master Mode: Select by pressing the INST button. This master mode selects a canned display program on the MPDs/MPCDs in both cockpits. The gun and air-to-air missiles can be fired, but use of the A/G weapons is inhibited.

The use of these master modes will be further explored in relevant sensor and weapon sub-sections.

Master Arm Switch
- *UP: ARM*
- *DOWN: SAFE*

Master Mode Buttons
- *A/A: Air-to-Air*
- *A/G: Air-to-Ground*
- *NAV: Navigation*
- *INST: Instrument*

Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

1 – SENSORS
1.3 – Sensors Master Modes

1 – SENSORS
1.4 – My Sensors Control Setup

Real Aircraft Controls (Pilot)

Flight Stick

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

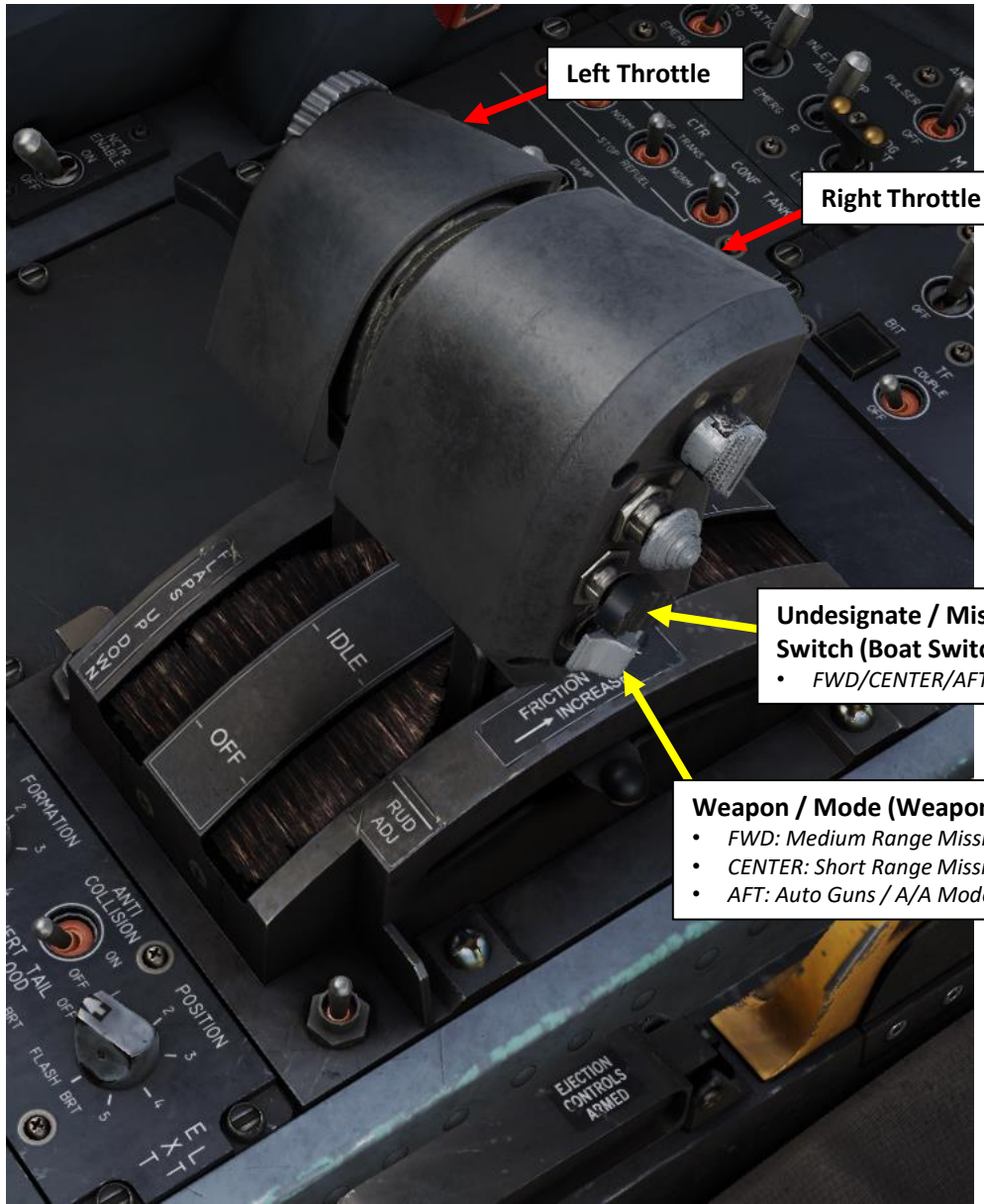
Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

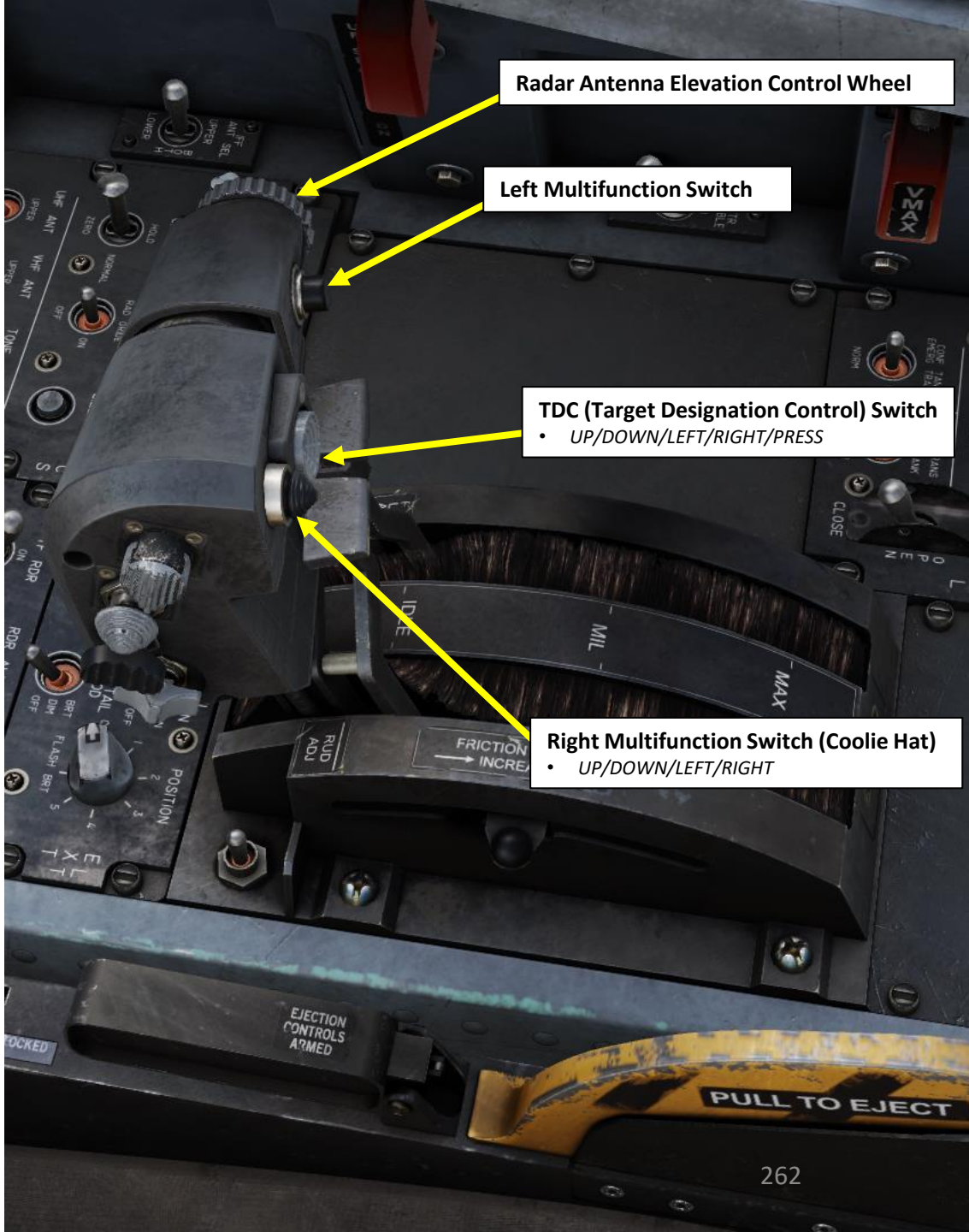
Castle Switch
The switch has different functions depending on the situation and selected sensors. It is mainly responsible for switching between and taking command of different sensors, as well as controlling the Nav Pod and moving back and forth between master modes.
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

NWS (Nosewheel Steering) / Weapons Button

1 – SENSORS
1.4 – My Sensors Control Setup

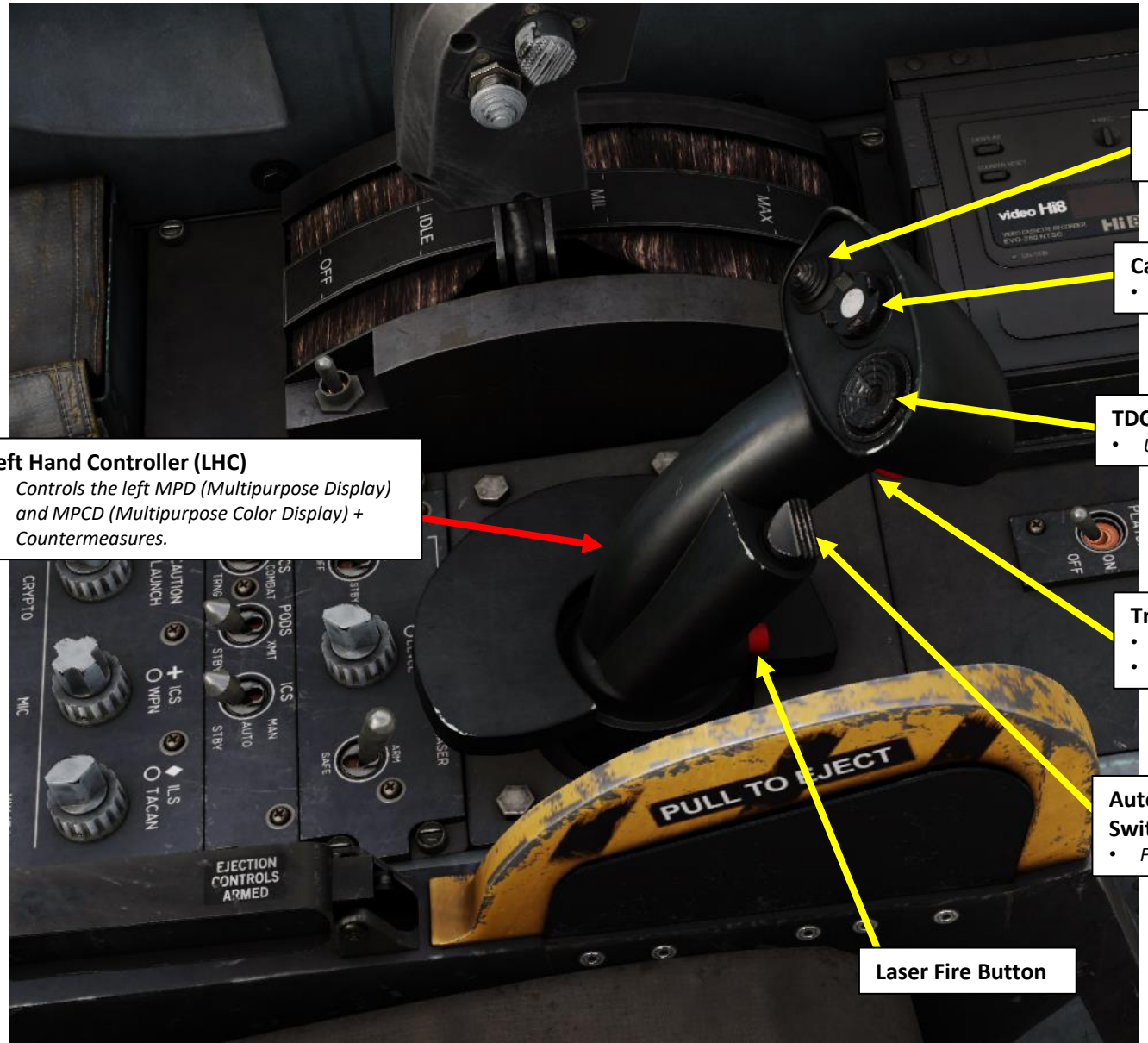
Real Aircraft Controls (Pilot)





1 – SENSORS
1.4 – My Sensors Control Setup

Real Aircraft Controls (WSO)



Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Left Hand Controller (LHC)
- *Controls the left MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + Countermeasures.*

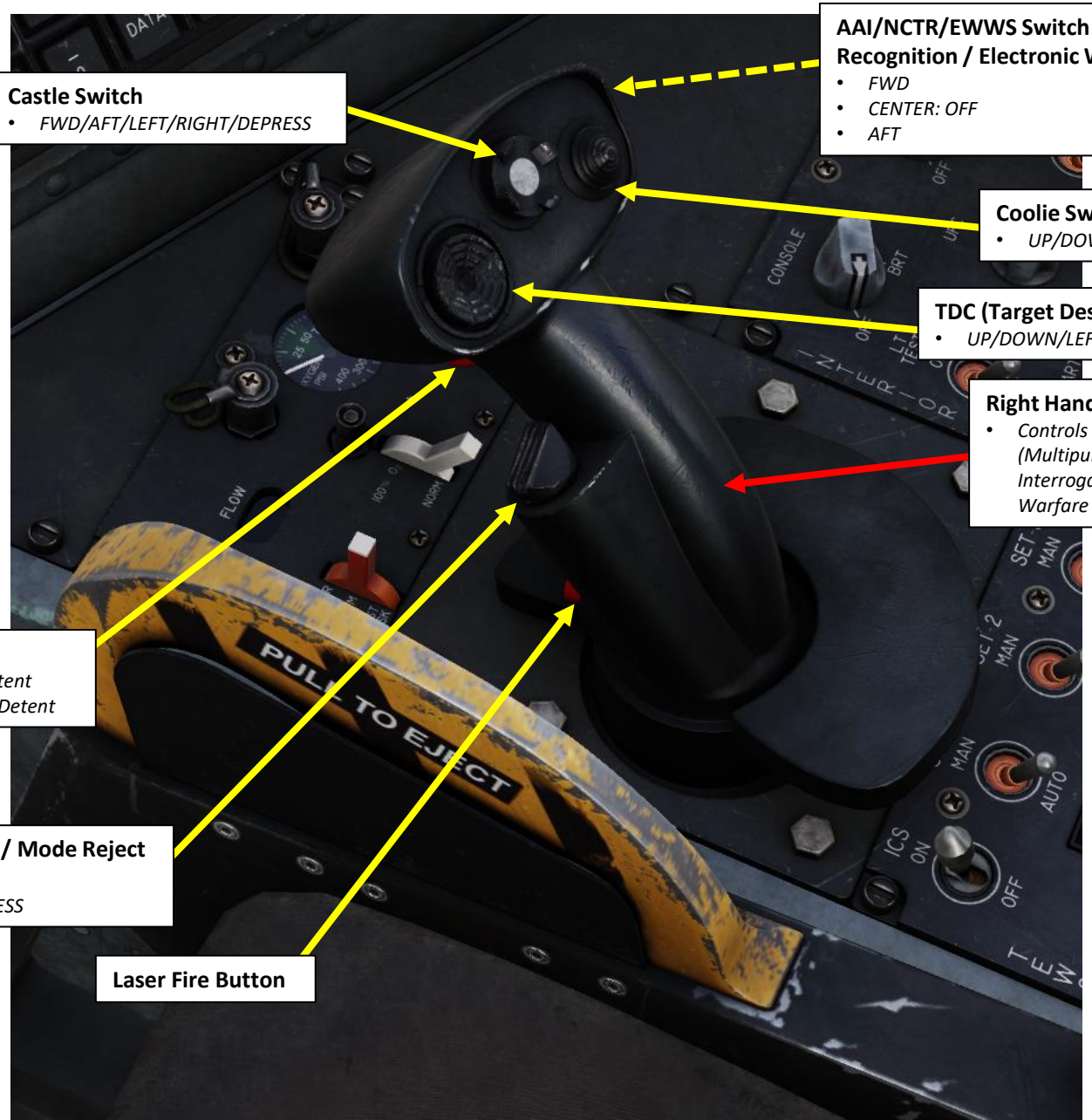
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

1 – SENSORS
1.4 – My Sensors Control Setup

Real Aircraft Controls (WSO)



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Right Hand Controller (RHC)
- *Controls the right MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + the AAI/NCTR/EWWS (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set).*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

1 – SENSORS
1.4 – My Sensors Control Setup

My Controls (Pilot)

↑ Castle Switch – FWD
→ Castle Switch – RIGHT
↓ Castle Switch – AFT
← Castle Switch – LEFT

↑
→ TDC – PRESS
↓
← Castle Switch – PRESS

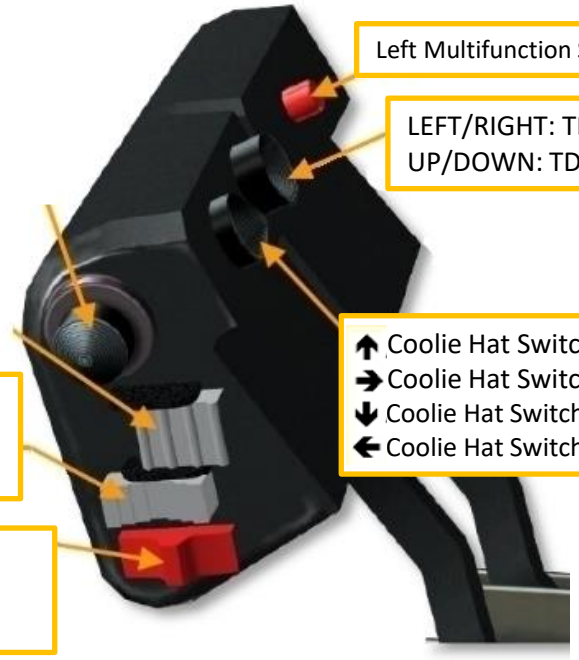
Trigger (First Detent)
Trigger (Second Detent, Space)

↑ Auto Acquisition Switch – FWD
→
↓ Auto Acquisition Switch – AFT
←
P Auto Acquisition Switch – PRESS

NWS (Nosewheel Steering) / Weapons Button

1 – SENSORS
1.4 – My Sensors Control Setup

My Controls (Pilot)



Left Multifunction Switch

LEFT/RIGHT: TDC Slew Axis – Horizontal (JOY X)
UP/DOWN: TDC Slew Axis – Vertical (JOY Y)

Coolie Hat Switch – UP
Coolie Hat Switch – RIGHT
Coolie Hat Switch – DOWN
Coolie Hat Switch – LEFT

Boat Switch (Undesignate / Missile Reject) – AFT

Boat Switch (Undesignate / Missile Reject) – FWD

Weapons / Mode Switch Cycle – AFT

Weapons / Mode Switch Cycle – FWD

Radar Antenna
Elevation (JOY SLIDER)

1 – SENSORS
1.4 – My Sensors Control Setup

Note: Controls in Red use the LSHIFT Modifier. This simulates using the right hand controller (RHC) instead of the left hand controller (LHC).

My Controls (WSO)

↑ LHC / **RHC** Castle Switch – FWD
→ LHC / **RHC** Castle Switch – RIGHT
↓ LHC / **RHC** Castle Switch – AFT
← LHC / **RHC** Castle Switch – LEFT

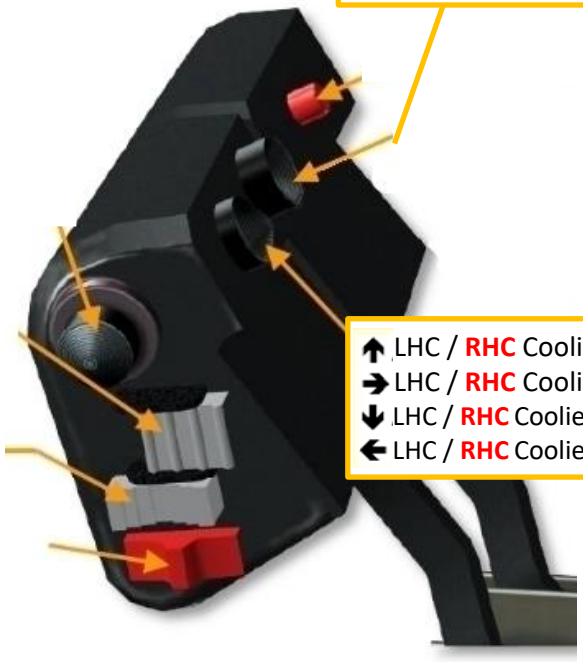
↑
→ LHC / **RHC** TDC – PRESS
↓
← LHC / **RHC** Castle Switch – PRESS

LHC / **RHC** Trigger (HA, Half-Action Detent)
LHC / **RHC** Trigger (FA, Full-Action Detent)

↑ LHC / **RHC** Auto Acquisition Switch – FWD
→ RHC – AAI Switch – FWD
↓ LHC / **RHC** Auto Acquisition Switch – AFT
← RHC – AAI Switch – AFT
P LHC / **RHC** Auto Acquisition Switch – PRESS

LHC / **RHC** – Laser Fire

LEFT/RIGHT: LHC / **RHC** TDC Slew Axis – Horizontal (JOY X)
UP/DOWN: LHC / **RHC** TDC Slew Axis – Vertical (JOY Y)



↑ LHC / **RHC** Coolie Hat Switch – UP
→ LHC / **RHC** Coolie Hat Switch – RIGHT
↓ LHC / **RHC** Coolie Hat Switch – DOWN
← LHC / **RHC** Coolie Hat Switch – LEFT

2 – AN/APG-70 RADAR

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

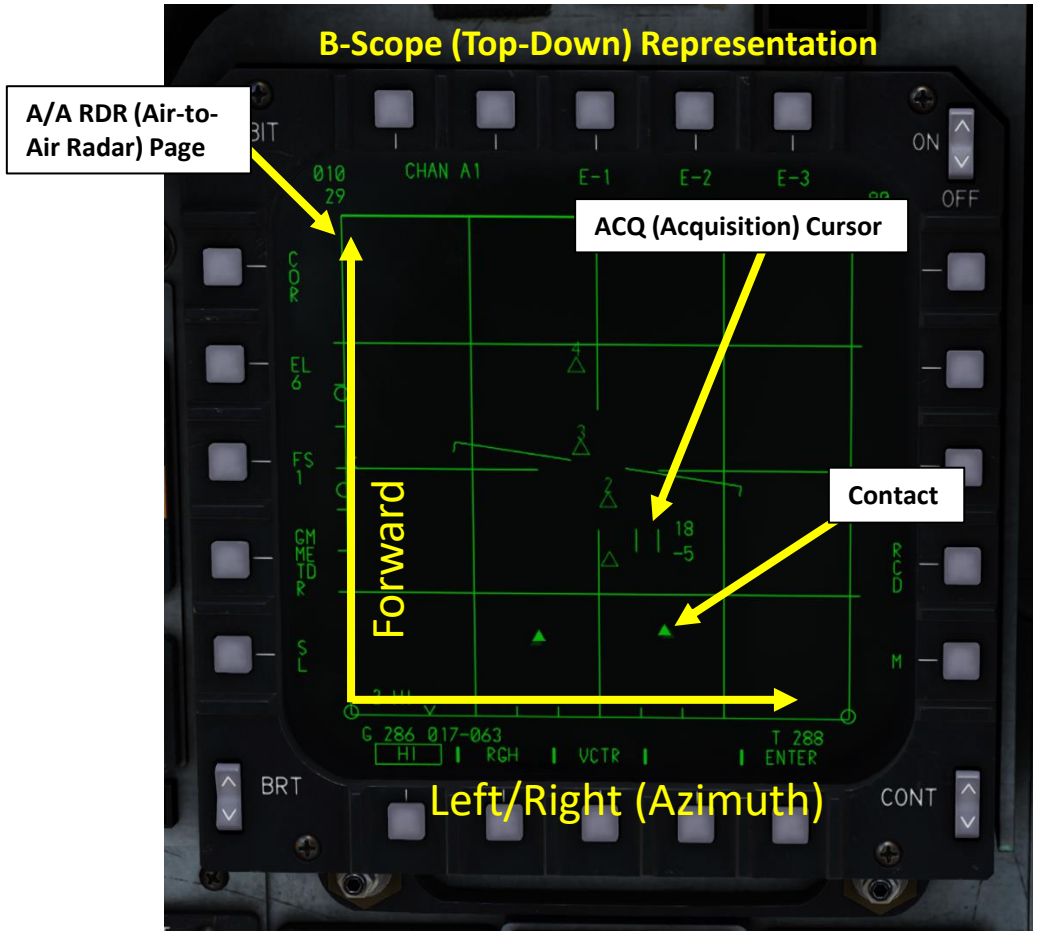
The air-to-air radar uses a B-Scope representation, which is a top-down view of what's in front of you.

Radar Data can be shown on the **A/A RDR (Air-to-Air Radar) page** and on the HUD (Heads-Up Display).

The **Radar Power Switch** must be set ON and the Master Mode needs to be set to **A/A** (Air-to-Air) for the radar to be functional. Take note that radar is inhibited while aircraft is on the ground.

A/A Master Mode Button

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

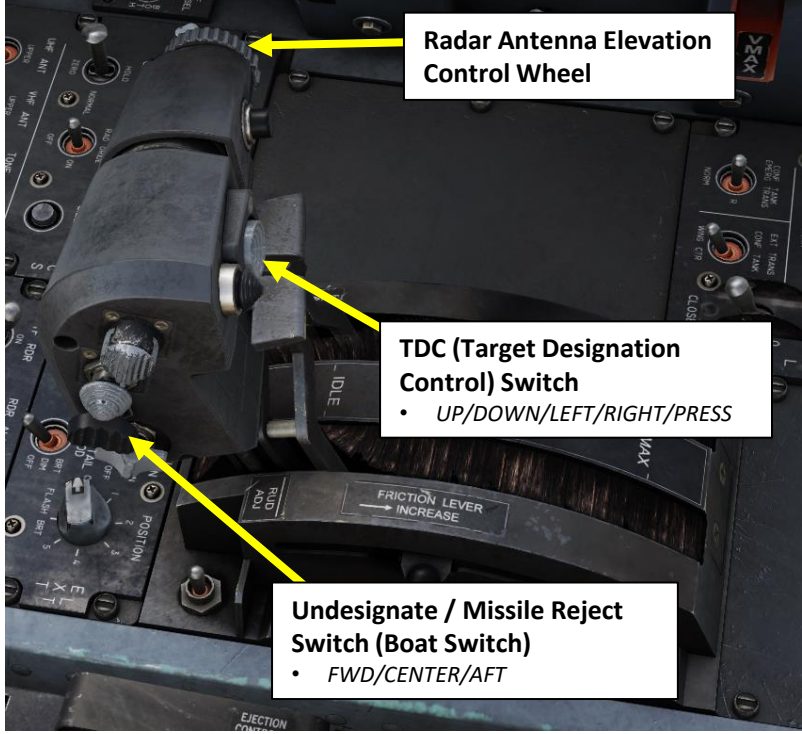


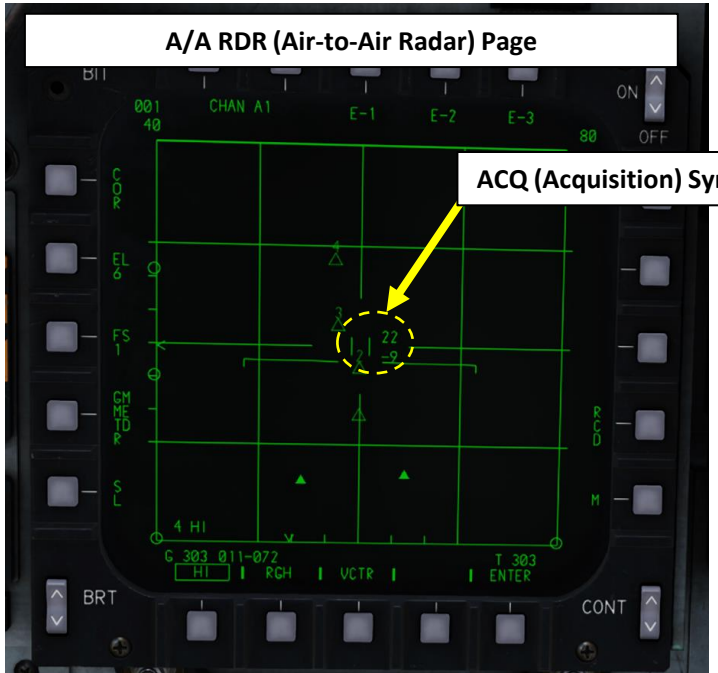
HUD (Heads-Up Display)

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

Pilot Interface

- You can slew your radar using the **TDC (Target Designation Control)** on the pilot's throttle. This will move the ACQ (Acquisition) symbol on the A/A RDR page.
    - The **TDC** can be **PRESSED** to **radar lock** a target once the TDC symbol is over a target.
        - 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" mode near the acquisition symbol position, which is followed by lockon in any radar search mode.
    - The **Auto Acquisition Switch** can be **DEPRESSED** to **unlock** a locked target**.**
- The **Radar Antenna Elevation Control Wheel** on the pilot's throttle is used to control where your radar antenna is scanning vertically.
- The **Castle Switch on the pilot's flight stick** is used to select which display (Multipurpose Display or Heads-Up Display) is selected to control a specific sensor. Selection bars at the bottom of a display indicate the page is selected.
- The **Auto Acquisition Switch** allows you to select radar modes that automatically lock targets.

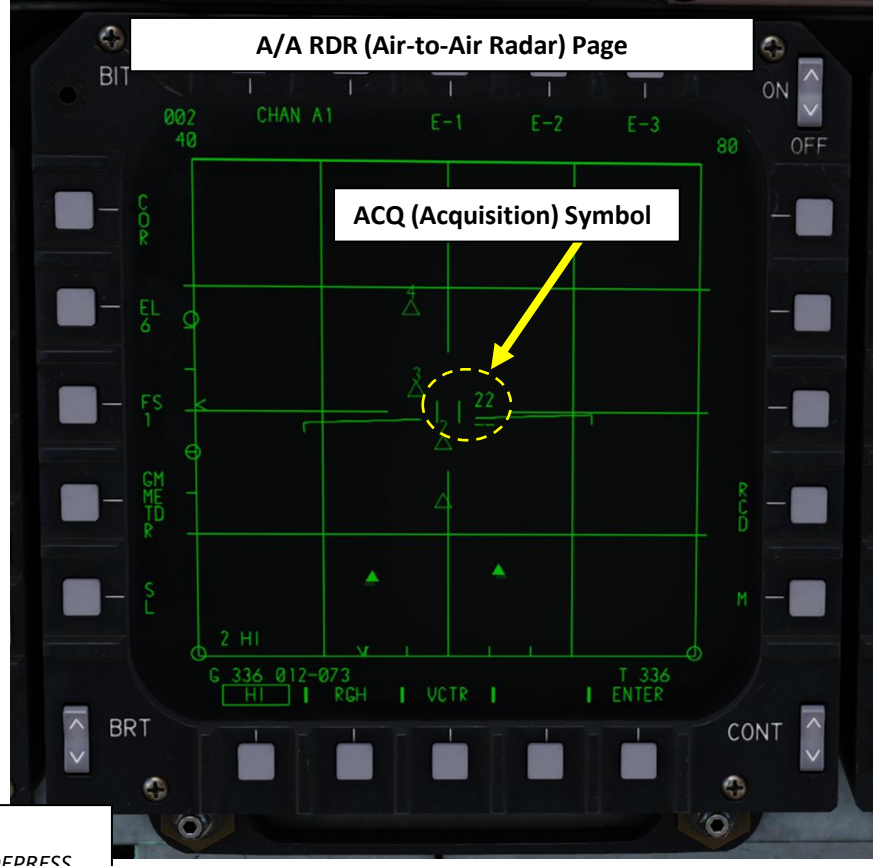


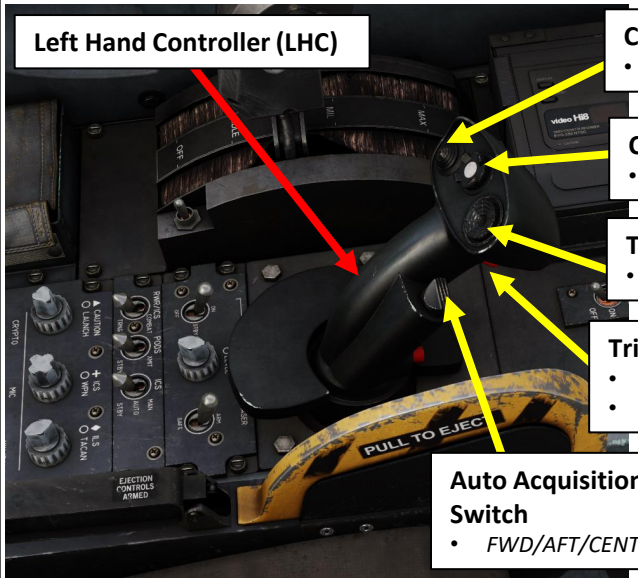


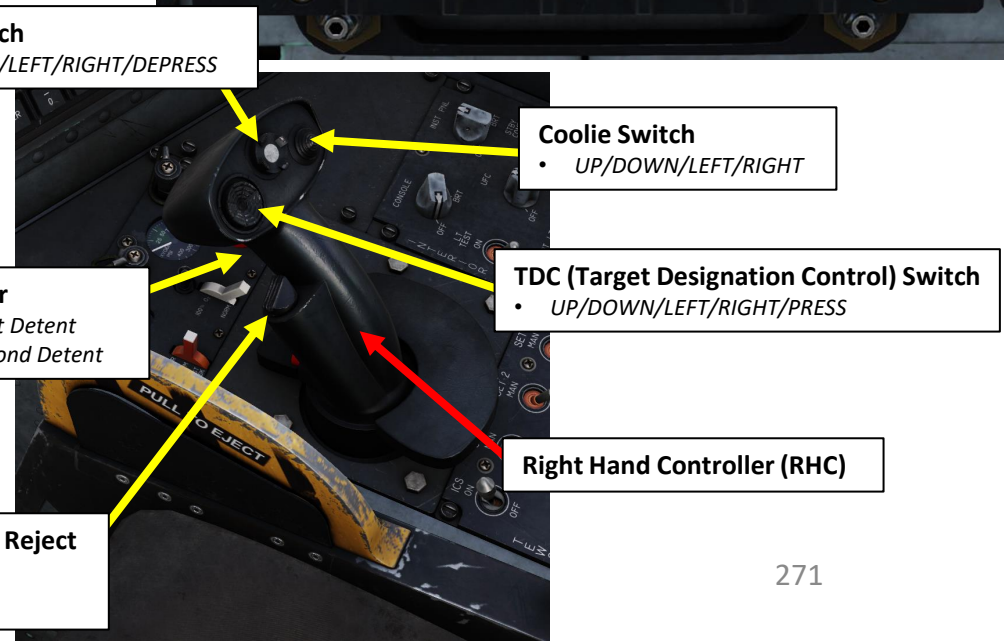
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

WSO Interface

- You can slew your radar using the **TDC (Target Designation Control)** on the WSO's L/RHC (Left/Right Hand Controllers). This will move the ACQ (Acquisition) symbol on the A/A RDR page.
    - The **TDC** can be **PRESSED** to **radar lock** a target once the TDC symbol is over a target.
        - 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" mode near the acquisition symbol position, which is followed by lockon in any radar search mode.
    - The **Castle Switch** on the L/RHC (Left/Right Hand Controllers) being pressed **LEFT unlocks** a locked target
- **Holding WSO's L/RHC** (Left/Right Hand Controllers) **Trigger in the first detent (Half Action) while slewing** the **TDC (Target Designation Control) UP/DOWN** controls where your radar antenna is scanning vertically.
- The **Coolie Hat Switches** on the L/RHC (Left/Right Hand Controllers) are used to select which display (Multipurpose Display or Heads-Up Display) is selected to control a specific sensor.



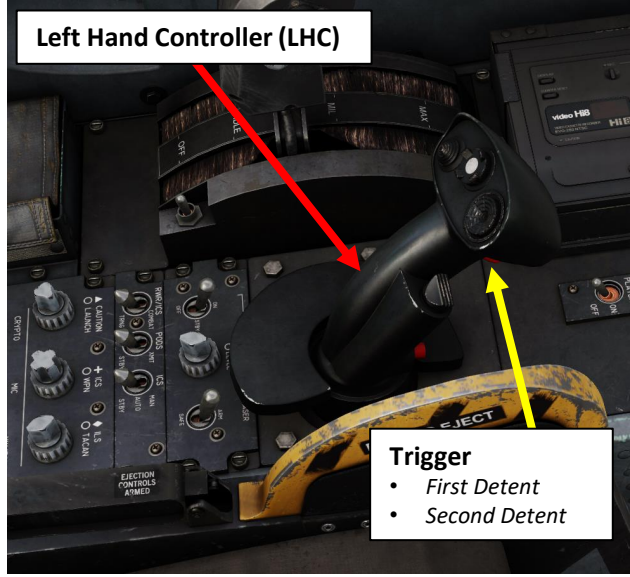


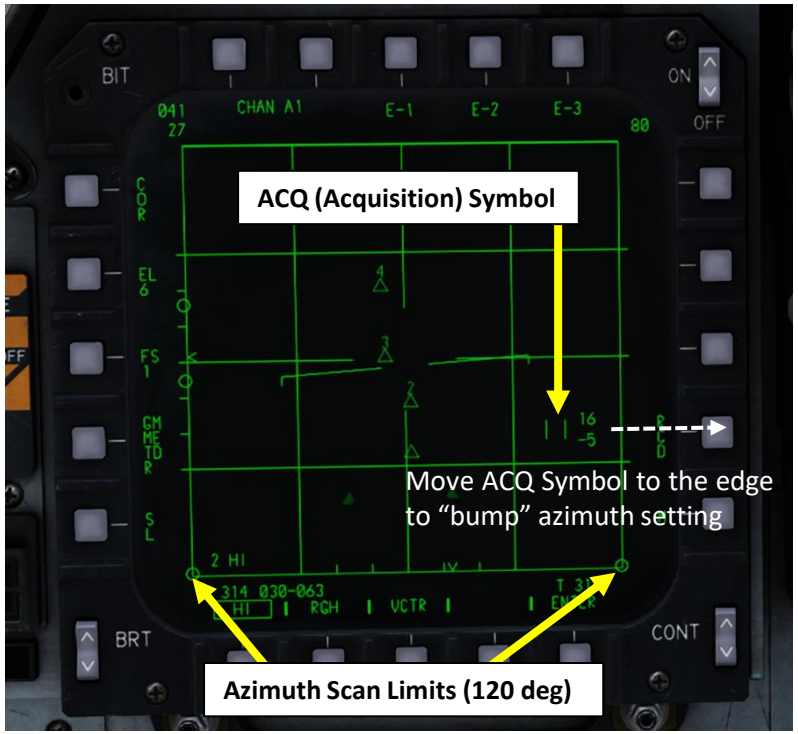


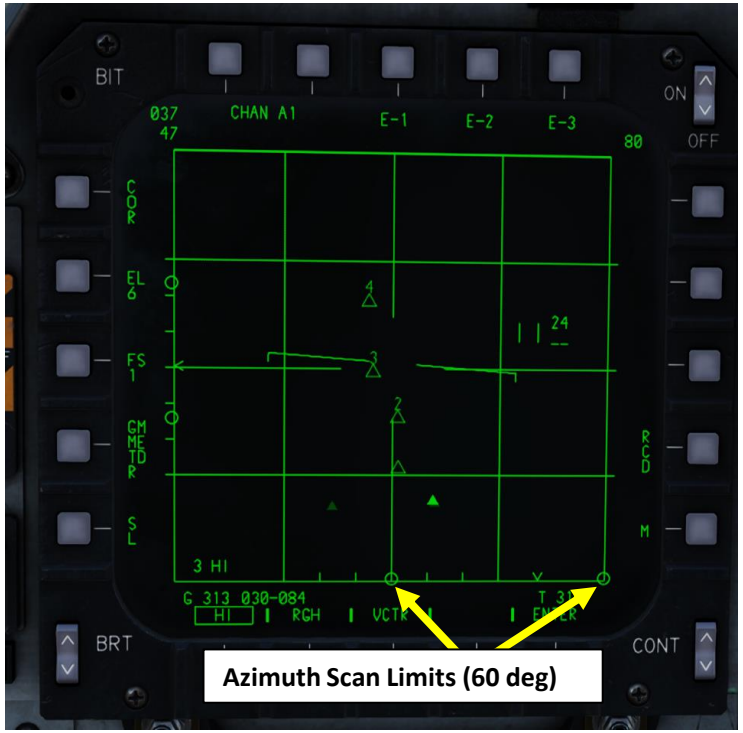
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

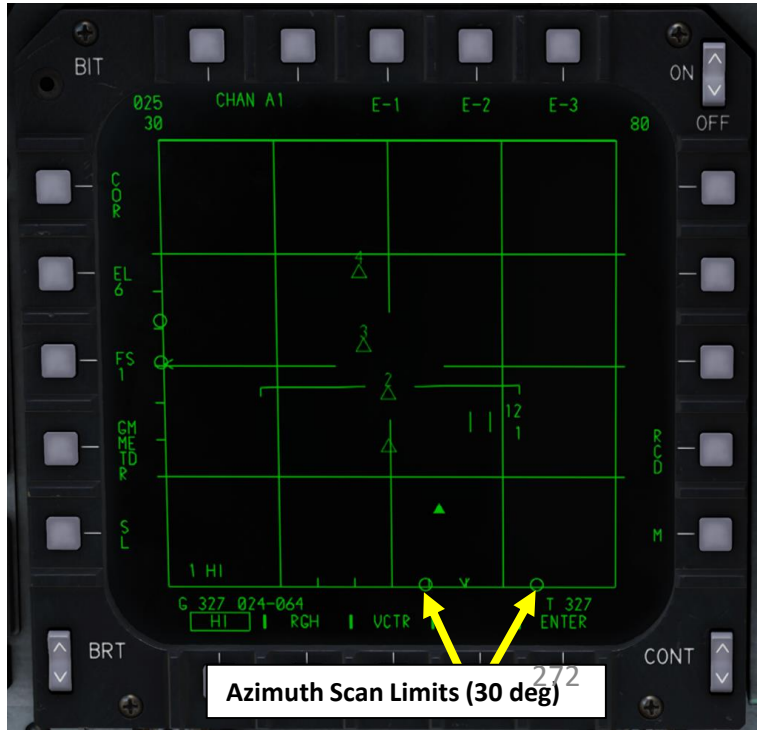
"Azimuth Bumping", or how to change radar azimuth coverage

- If the ACQ (Acquisition) Symbol is moved with the **TDC (Target Designation Control)** to the left or right edge of the display, it changes the azimuth scan setting. This is what we call "azimuth bumping", or "AZ bumping".
- When AZ bumping, the default scan (120 deg) switches to 60 deg. However, the azimuth scan can be narrowed down further to 30 deg by either:
  - **(Pilot)** Pressing the TDC on the front stick for more than 1 second, or
  - **(WSO)** Squeezing the trigger to first detent in the rear (LHC / RHC Trigger HA, Half-Action Detent) for more than 1 second.
- To return to full scan (120 deg), the ACQ Symbol should be moved once again to the extreme edge of the display.





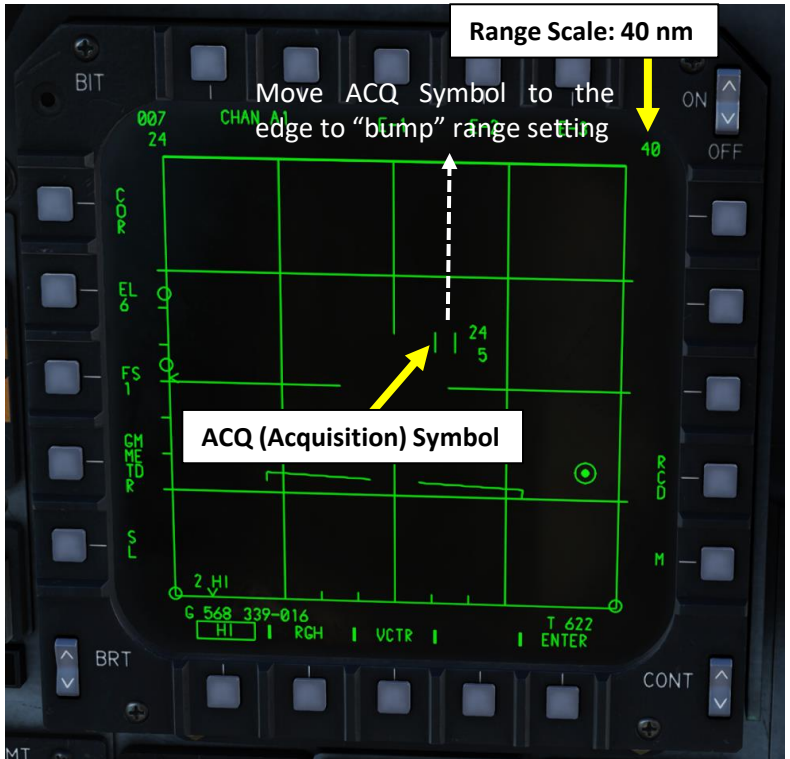


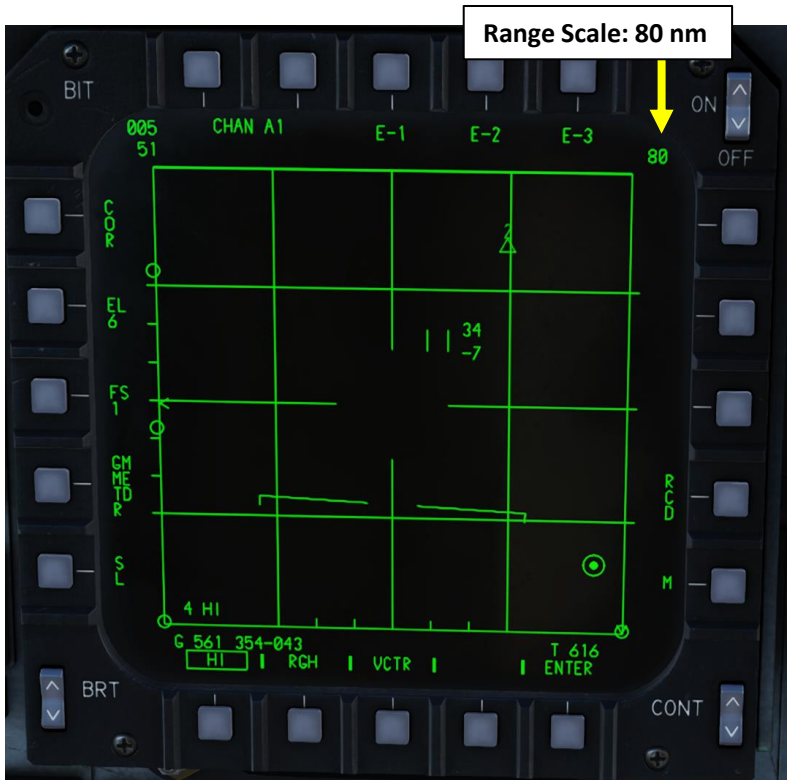


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

"Range Bumping", or how to change radar range coverage

- If the ACQ (Acquisition) Symbol is moved with the **TDC (Target Designation Control)** to the upper or lower edge of the display, it changes the range scan setting. This is what we call "range bumping".
- Bumping to the upper edge increases the range scale.
- Bumping to the lower edge deceases the range scale.
- Range scale settings are 10, 20, 40, 80 or 160 nm.

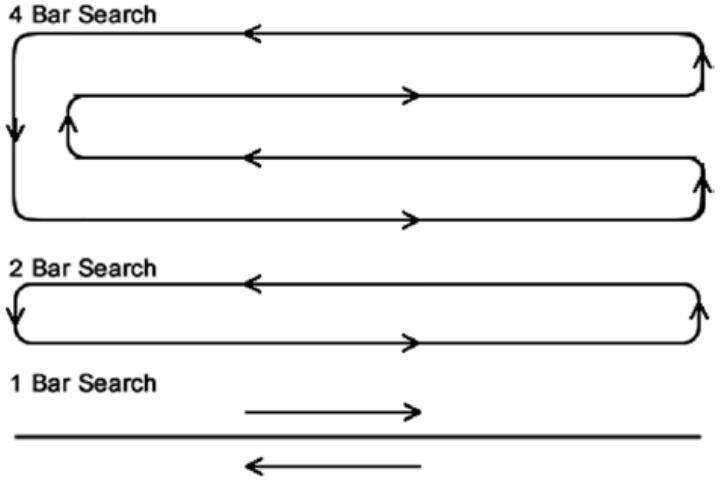




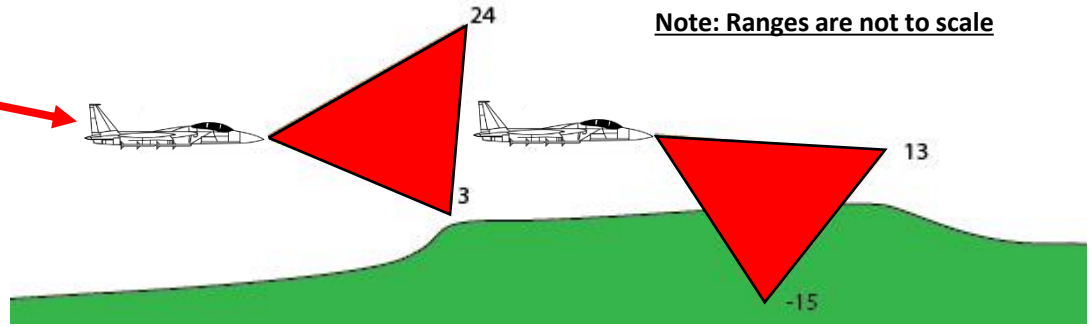
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

The F-15's radar has an effective range of approximately 80+ nautical miles (with a maximum display range of 160 nm on the A/A RDR page), a horizontal arc of 120 degrees and a variable vertical arc that is customizable. You can control the radar scan pattern (bars), which will give you a taller or shorter scanning area.

The numbers next to the Acquisition Symbol (ACQ) correspond to the altitudes (in thousands of feet) of the top and bottom of the radar beam at the distance of the target designator. As you move the acquisition symbol closer and further you will see the numbers change. The practical application is that the radar will not detect targets above or below these altitudes which is why you need to slew the radar antenna up and down to do a complete search.

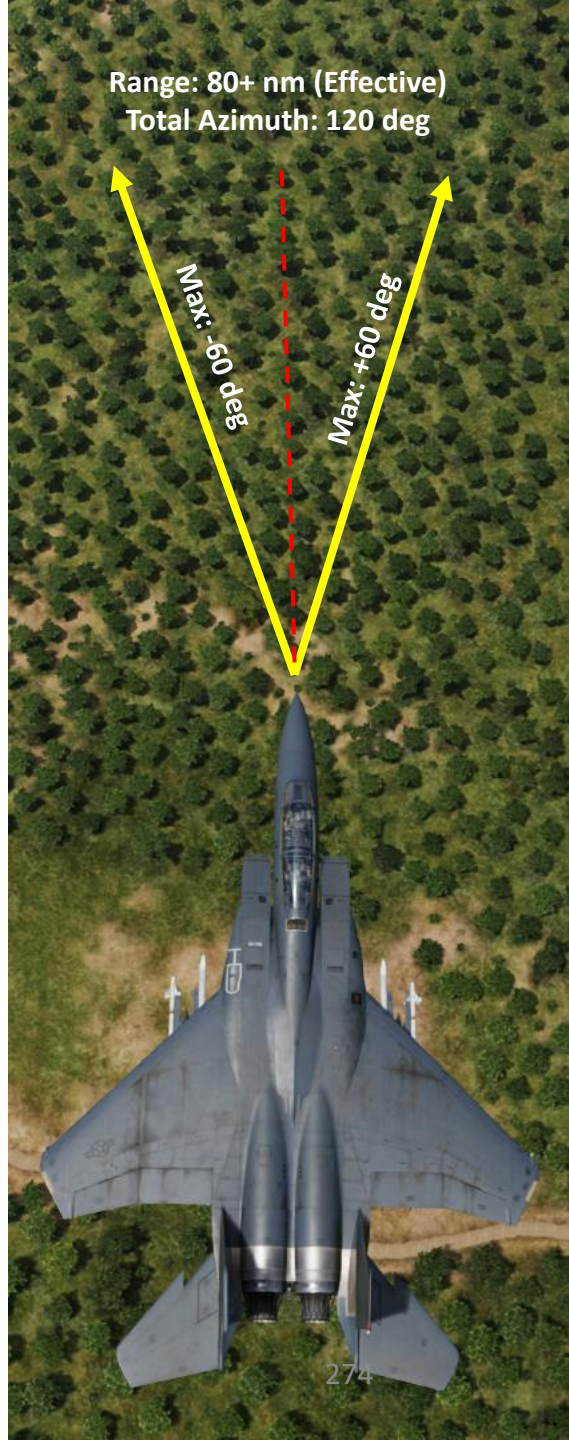


Acquisition (ACQ) Symbol
Upper number: Upper altitude covered by radar (17000 ft)
Lower number: Lower altitude covered by radar (-4000 ft)

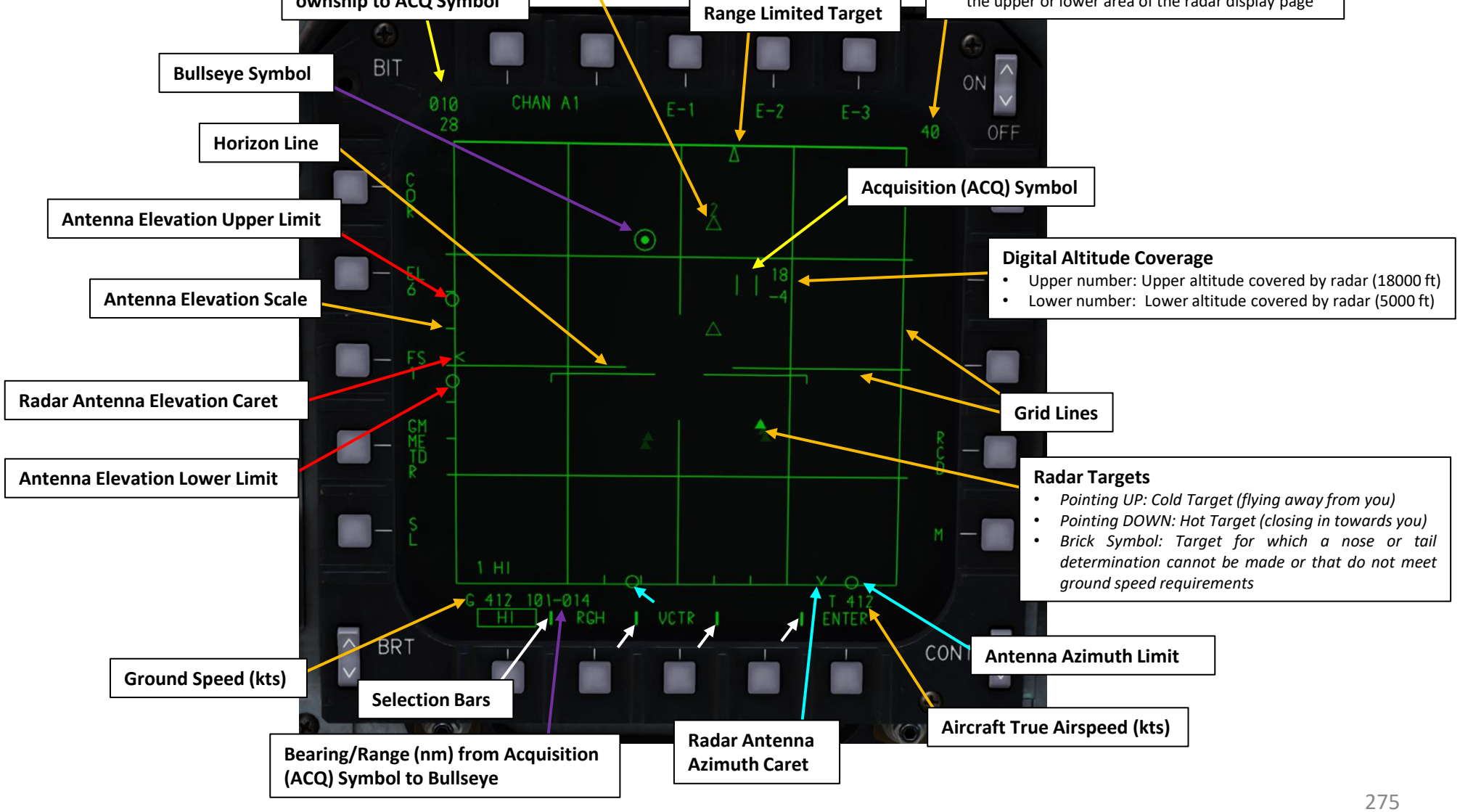


Note: Ranges are not to scale

Note: Radar range varies depending on what radar mode is selected and the target's RCS (Radar Cross-Section). The effective range listed here is only a ballpark value for ideal conditions.



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance



Bearing/Range (nm) from ownship to ACQ Symbol

Steerpoint Symbol

Range Limited Target

Radar Range Scale (nm)
- 10, 20, 40, 80 or 160 nm
- Range scale is changed by "bumping" the TDC to the upper or lower area of the radar display page

Bullseye Symbol

Horizon Line

Antenna Elevation Upper Limit

Acquisition (ACQ) Symbol

Digital Altitude Coverage
- Upper number: Upper altitude covered by radar (18000 ft)
- Lower number: Lower altitude covered by radar (5000 ft)

Antenna Elevation Scale

Radar Antenna Elevation Caret

Grid Lines

Antenna Elevation Lower Limit

Radar Targets
- *Pointing UP: Cold Target (flying away from you)*
- *Pointing DOWN: Hot Target (closing in towards you)*
- *Brick Symbol: Target for which a nose or tail determination cannot be made or that do not meet ground speed requirements*

Antenna Azimuth Limit

Ground Speed (kts)

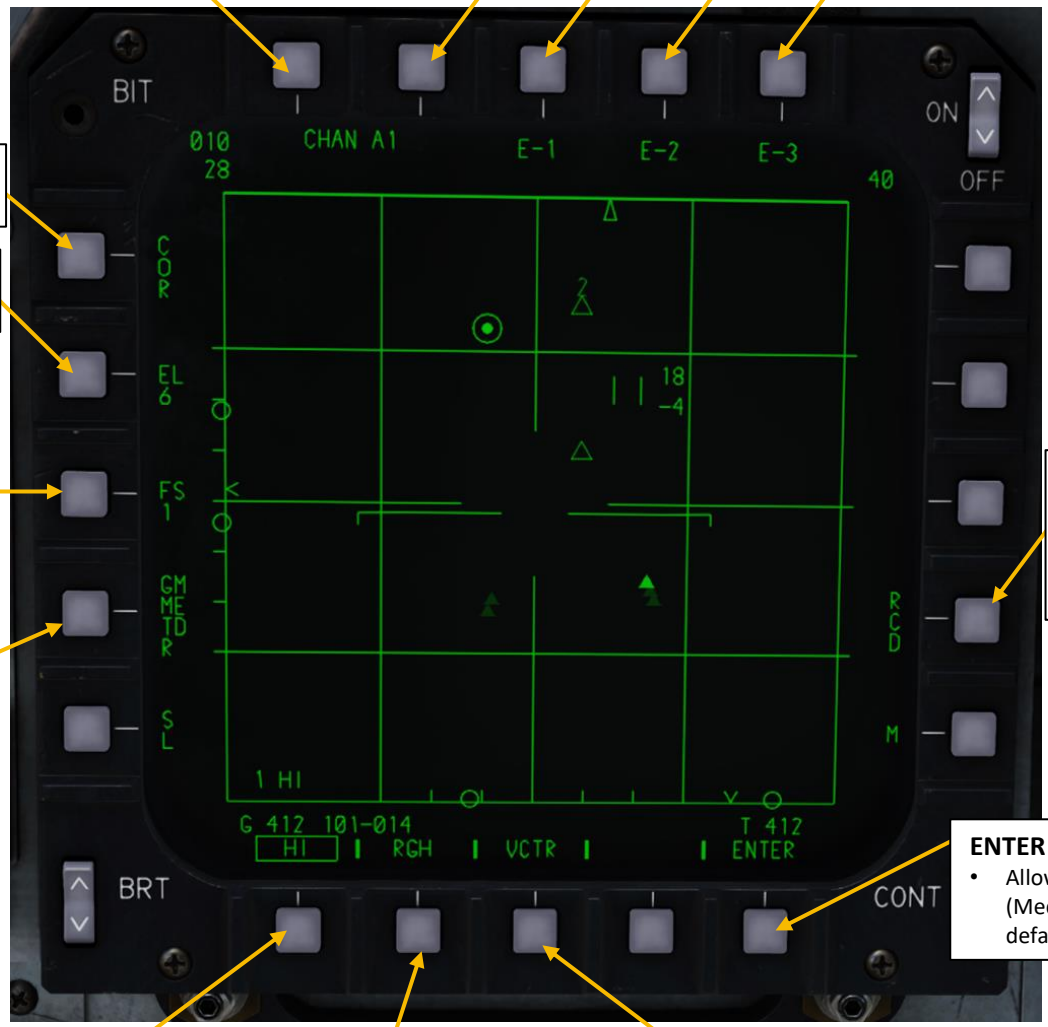
Selection Bars

Aircraft True Airspeed (kts)

Radar Antenna Azimuth Caret

Bearing/Range (nm) from Acquisition (ACQ) Symbol to Bullseye

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance



Radar Frequency Band Selector (A, B, C…)

Radar Channel Number Selector (1, 2, 3…)

Electronic Protection Modes Settings (Not Simulated)

COR Button
- *Not simulated.*

Radar Elevation Scan Setting Control
- *1, 2, 4, 6 or 8 bar settings*

Frame Store (FS) Setting Control
- *A "frame" is one full scan of the selected bars.*
- *Frame Store allows the air crew to manually select the length of time a target return is visible on the display, measured in frames.*
- *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.*

GMTR (Ground Moving Target Rejection) Setting Control
- *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.*
- *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.*

GMTR Selection	Airborne Notch
LO	45 knots
MED	63 knots
HI	87 knots
CHAF	95 knots

RCD (Record) Button
- Allows the recording of the display for post-mission review. RCD takes a still snapshot every 5 sec of the display and saves it in your "Saved Games/Screenshot" folder.

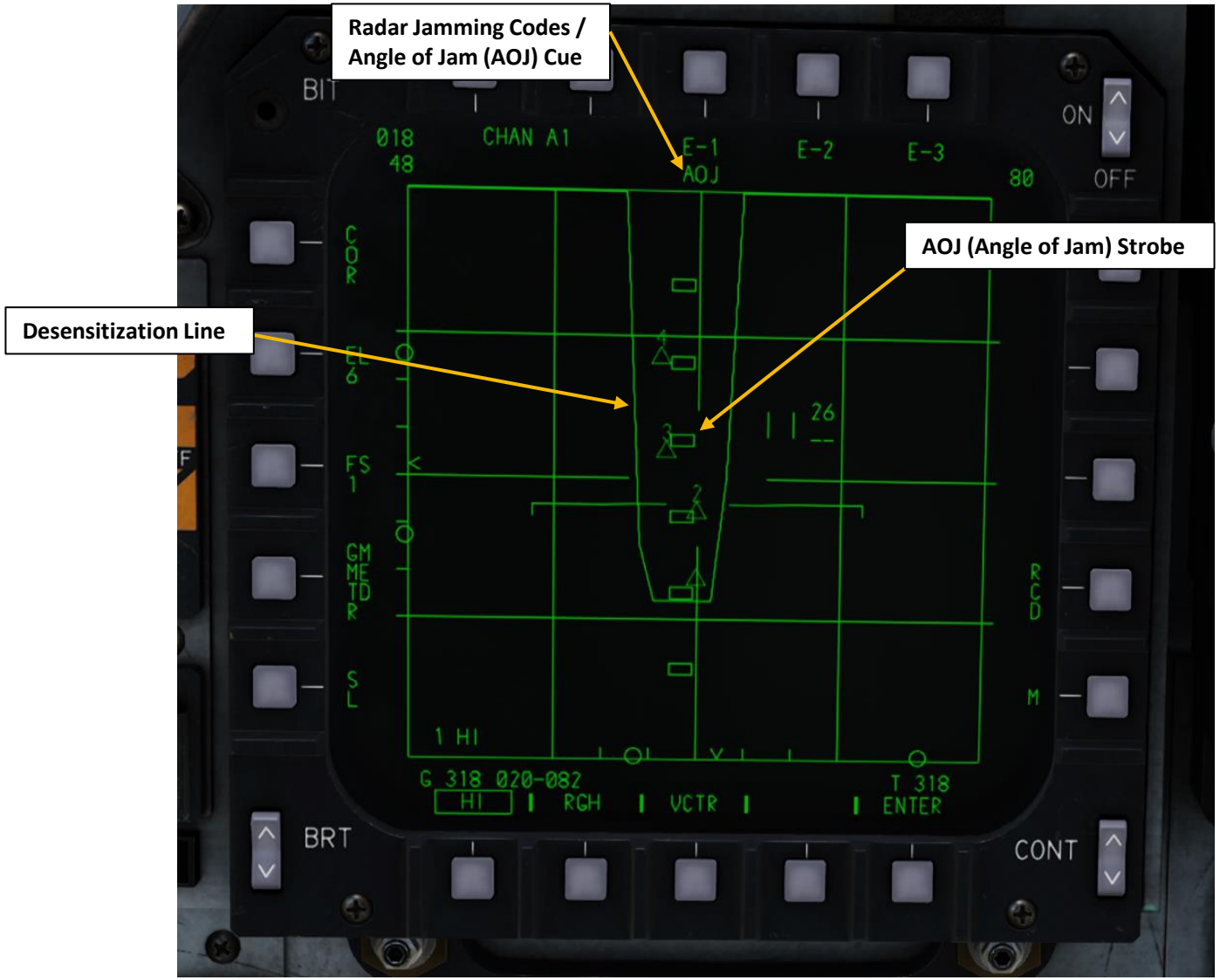
ENTER Button
- Allows the aircrew to reprogram the MRM / SRM (Medium Range Missile / Short Range Missile) default parameters

PRF (Pulse Repetition Frequency) Setting Control
- Toggles between High (HPRF), Medium (MPRF) and Interleaved (H/MPRF).

RGH (Range Gated High) Mode Control
- Toggles RGH mode, which employs an intermediate PRF falling between medium and high frequency over all range scales.

VCTR (Vector Scan) Mode Control
- Toggles VCTR Mode, which 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.

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.1 – Radar Display & Performance

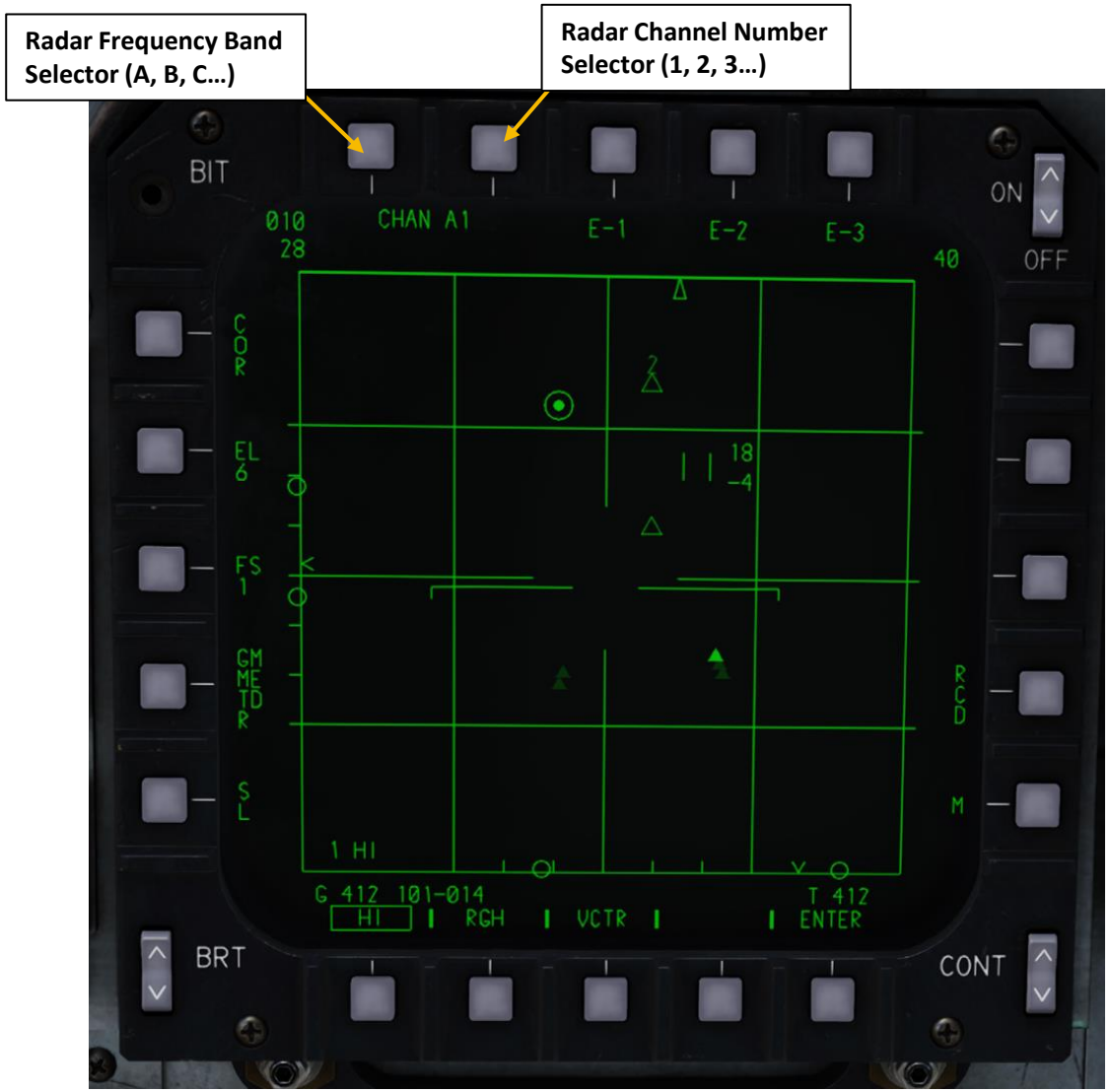
Radar Emission Channels

When multiple radars emit in the vicinity of each other, they will receive each other radar waves coming from the radar main lobe, side lobe or environment reflections. These radar waves will not be expected by the radar and prevent it from operating properly. Most of the time, these waves will be interpreted by the radar as very strong jamming and will reduce its performance significantly. In order to prevent this, radars will have different emission channels that allow multiple aircraft to operate next to each other.

The A/A RDR page allows you 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 stays at the same band but choose different channels.

In the F-15E, use the Radar Frequency Band and Radar Channel Number selectors on the A/A RDR page in order to deconflict / avoid interference between operating radars. Simply put, when flying with other F-15s, it is important to coordinate each aircraft radar emission channels so there is no overlap.



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.2 – Main Modes Overview

The radar has the following main modes: **Search Modes** (used for long-distance engagements), and **Auto Acquisition Modes** (used for close air engagements), and STT (Single Target Track).

Search sub-modes include:

- **RWS** (Range While Search): RWS radar mode allows for detection of contacts in a large volume. It is the default search mode for air-to-air or when an air-to-air missile is placed in priority. RWS mode provides all-aspect (nose-on, tail-on) and all altitude (look-up, look-down) target detection. The display shows range as the vertical axis and azimuth angle on the horizontal axis. RWS Modes Pulse Repetition Frequency (PRF) settings include:
    - **MPRF** (Medium Pulse Repetition Frequency)
    - **HPRF** (High Pulse Repetition Frequency)
    - **INLV** (Interleaved)
- **TWS** (Track While Scan): TWS maintains an actual track on several aircraft while still searching for others. While in TWS mode, the radar can maintain up to 10 trackfiles (targets) on top of additional 20 observation files (displayed as half intensity symbols). The radar allocates part of its power to tracking the target or targets while part of its power is allocated to scanning, unlike the straight tracking mode, when the radar directs all its power to tracking the acquired targets. In the TWS mode the radar has a possibility to acquire additional targets as well as providing an overall view of the airspace and helping maintain better situational awareness. Since the radar is sharing its computing time between targets, the accuracy is less precise than for a single target track (STT) mode of operation. TWS mode allows for trackfiles to be kept at a high update rate. To accomplish this, TWS artificially limits the scan volume (bars/azimuth) and provides for automatic scan centering. It is also optimal for providing post-launch datalink for the AIM-120 AMRAAM missile while remaining in search. TWS sub-modes include:
    - **Wide Pattern Mode (2TWS):** 2-bar, 60 deg in azimuth, best used when facing multiple targets at similar altitude but separated horizontally.
    - **Medium Pattern Mode (4TWS):** 4-bar, 30 deg in azimuth, best used for general surveillance of targets separated both in azimuth and elevation.
    - **Narrow Pattern Mode:** 6-bar, 15 deg in azimuth, best use when facing targets which are stacked vertically.
    - **High Data Pattern Mode (3HDT):** 3-bar, 30 deg in azimuth, best used when facing targets manoeuvering vertically.
    - **High Data Pattern Mode (2HDT):** 2-bar, 30 deg in azimuth, best used when facing manoeuvering co-altitude targets.

    Note: The TWS mode displayed is followed by its Pulse Repetition Frequency (PRF) setting. As an example, "2TWSH" refers to a Wide Pattern Mode (2TWS) with a High (H) PRF setting. "4TWSM" refers to a Medium Pattern Mode (4TWS) with a Medium (M) PRF setting.
- **Vector Scan Mode**: This mode works similarly to HPRF RWS, but the radar antenna horizontal scan range is reduced from 70° per second to 35° per second. This significantly increases the radar sensitivity for detecting small RCS (radar cross-section) targets, such as cruise missiles.
- **Range-Gated High** Mode: This mode provides a middle ground between MPRF and HPRF. It works quite well against targets in frontal aspect (closing), but is less effective against targets in tail aspect (opening) and limited against targets in tail aspect which are at the same speed or closing.

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2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.2 – Main Modes Overview

STT

- **STT** (Single Target Track): STT mode is a traditional radar "lock" where the radar continuously scans a single target, resulting in a very high update rate; this makes it the primary method of providing guidance to air-to-air weapons. STT maintains a trackfile for its target and automatically designates it. The radar is slaved to this trackfile; as such, manual antenna elevation control is inhibited and the B-sweep follows the trackfile. Only the trackfile that is placed in STT is visible and all onboard trackfiles are dropped. In STT, the A/A RDR page format is presented in azimuth along the horizontal axis and range along the vertical axis.
- Single Target Track is obtained by:
  - Placing the Acquisition Symbol over a target (with the TDC, Target Designation Controller), then PRESSING the TDC… or
  - using an Auto Acquisition mode
- STT is exited by depressing the Auto Acquisition Switch on the pilot's stick, or pressing on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.

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2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.2 – Main Modes Overview

Auto Acquisition sub-modes include:

- **SS (Supersearch)**: this mode scans a 20° by 20° area in 6-bar scan pattern in front of the aircraft. The lock range is 10 nautical miles. The radar automatically locks on to the first target in this zone. When locked, the target is automatically tracked in STT mode.
    - Range: 500 ft to 10 nm.
    - To enter the Supersearch Mode, pilot should short (<1s) press the Auto Acquisition Switch FWD once when in search mode.
- **BST (Boresight):** this mode scans in a 4° circle visible on the HUD. BST is useful for quickly locking a target within visual range (WVR) and allows a degree of fine control as to the target being locked. The first target detected within 10 nautical miles is locked and automatically tracked in STT mode.
    - Range: 500 ft to 10 nm.
    - To enter the Boresight mode, pilot should short (<1s) press the Auto Acquisition Switch FWD once when in SS mode (or twice from search).
- **LR BST (Long Range Boresight)**: similar to BST, this mode scans in a 2.5° circle visible on the HUD but for a higher range. The first target detected within 40 nautical miles is locked and automatically tracked in STT mode.
    - Range: 3000 ft to 40 nm.
    - To enter LR BST mode, pilot should long press (>1s) the Auto Acquisition Switch FWD. LR BST is available from Search, BST, VTS, SS or Guns.
- **VTS (Vertical Scan)**: this mode sets the radar antenna to scan vertically from +5° to +55° above the HUD waterline. This mode is useful when you have a direction to look, for example ‘bandits 2 o’clock high’, but have not picked them up visually yet. When locked, the target is automatically tracked in STT mode.
    - Range: 500 ft to 10 nm.
    - To enter VTS, pilot should short press (<1s) the Auto Acquisition Switch aft. VTS is available from Search, BST, LR BST, SS or Guns.
- **Guns**: this mode provides a positionable scan pattern with the auto acquisition capability.
    - Range: 3000 ft to 15 nm.
    - To enter GUNS, pilot should place the Weapon / Mode (Weapon Select) Switch in AFT (Auto Guns) position.

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2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.2 – Main Modes Overview

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	
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	

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.3 – RWS (Range While Search) Mode

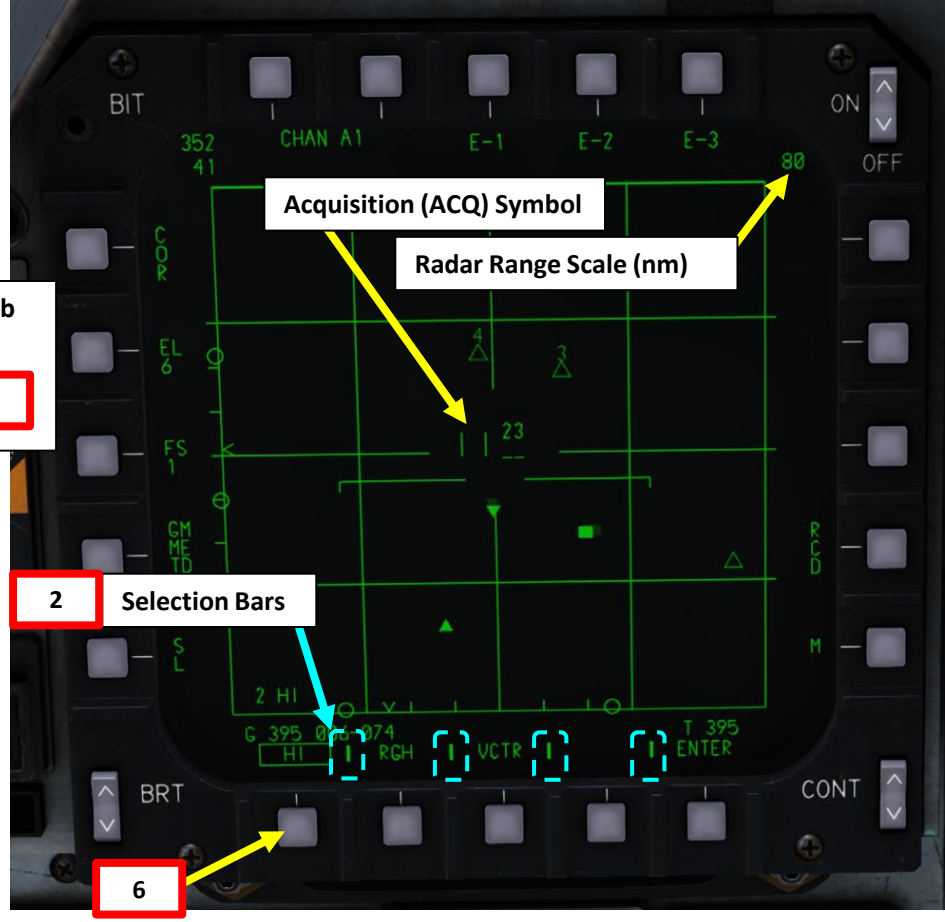
The Range While Search (RWS) mode is used for long-range acquisition and engagement. The pilot can set the acquisition range (10, 20, 40, 80, or 160 nautical miles) and change the azimuth width and elevation. You can then select a specific track and lock it into STT mode.

RWS is selected in the following manner:

1. Radar Power Switch must be set to ON.
2. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
3. By default, RWS mode is selected.
4. Radar azimuth is changed from 120 deg to 60 deg by slewing the ACQ (Acquisition) Symbol to the left or right edge of the display using the TDC (Target Designation Control). This is what we call “azimuth bumping”, or “AZ bumping”.
5. Radar range scale is changed by slewing the ACQ (Acquisition) Symbol to the upper or lower edge of the display using the TDC (Target Designation Control).
6. Press the button next to the PRF (Pulse Repetition Frequency) Setting Control to toggle between High (HI, HPRF), Medium (MED, MPRF) and Interleaved (INLV, H/MPRF) as desired. I recommend using Interleaved (INLV, H/MPRF).

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

1



Acquisition (ACQ) Symbol

Radar Range Scale (nm)

2 Selection Bars

6

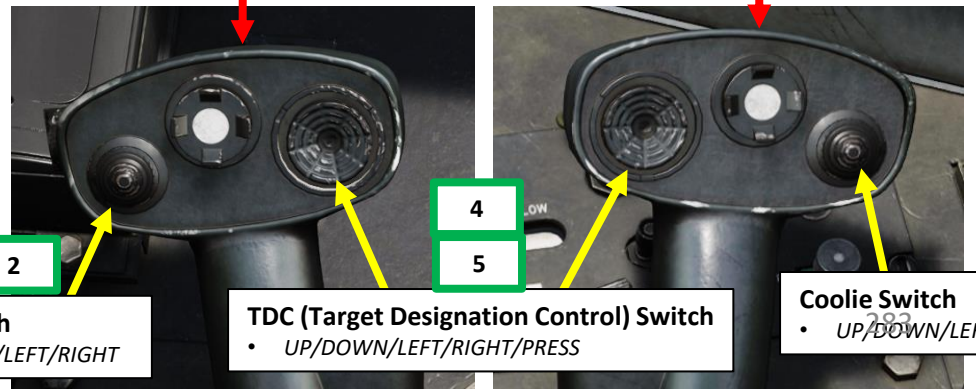
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

4 5

2 Castle Switch

Left Hand Controller (LHC)

Right Hand Controller (RHC)



2 Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

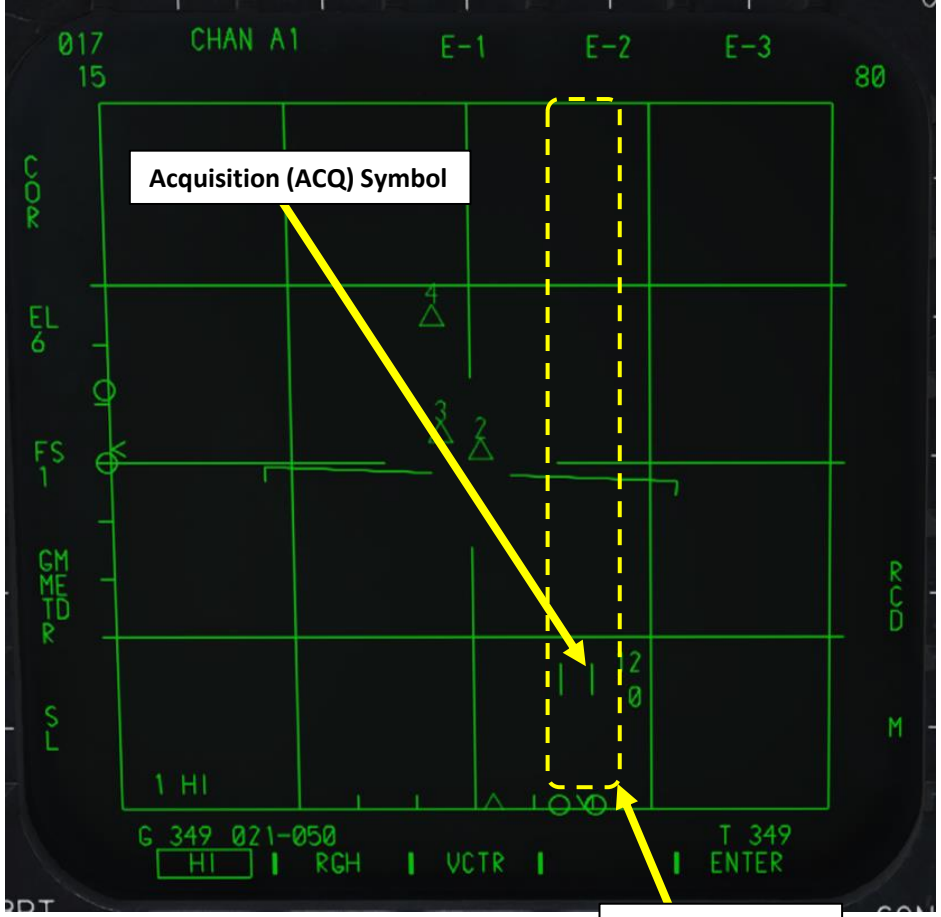
4 5 TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

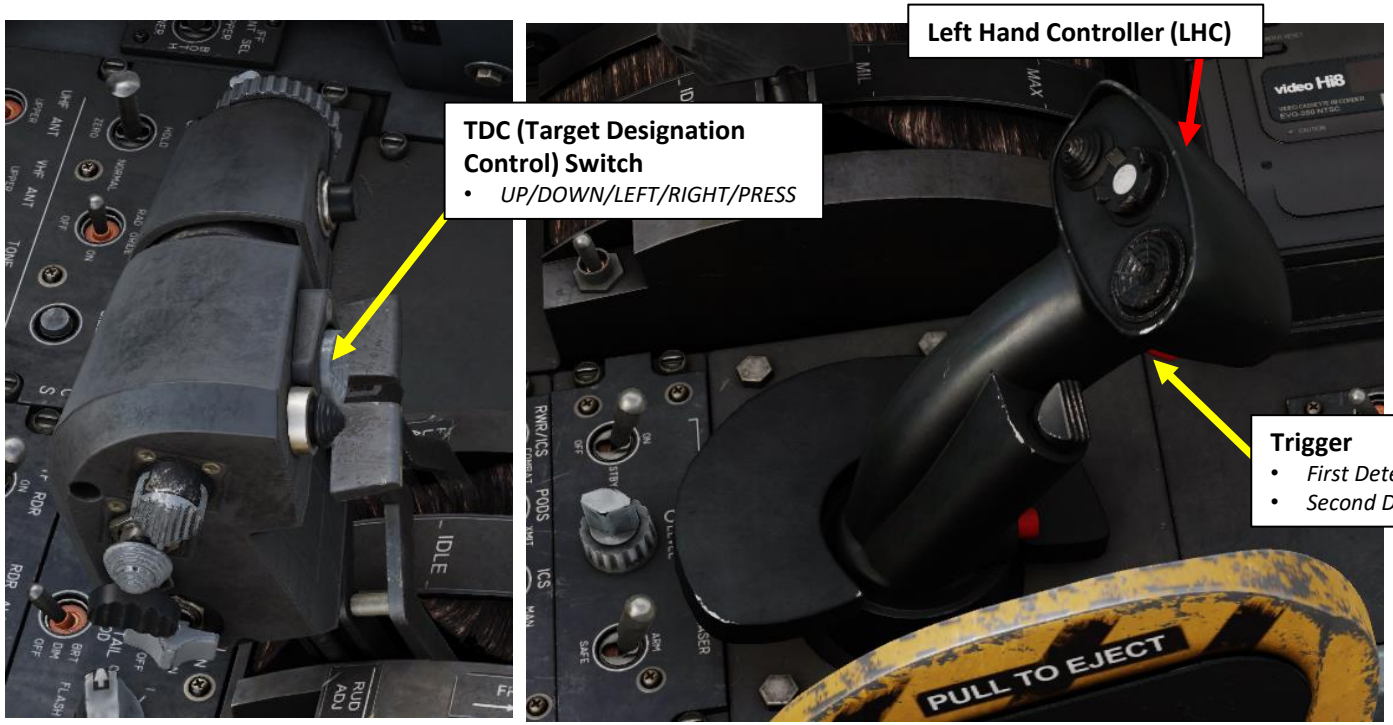
2 Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.3 – RWS (Range While Search) Mode

Note: When in Range While Search radar mode, the radar antenna can be slaved to the acquisition symbol and enter a **miniraster scan by:**

- **Pilot**: Pressing the TDC short (<1s).
- **WSO**: Pressing the L/RHC (Left/Right Hand Controller) trigger to full action (second detent).

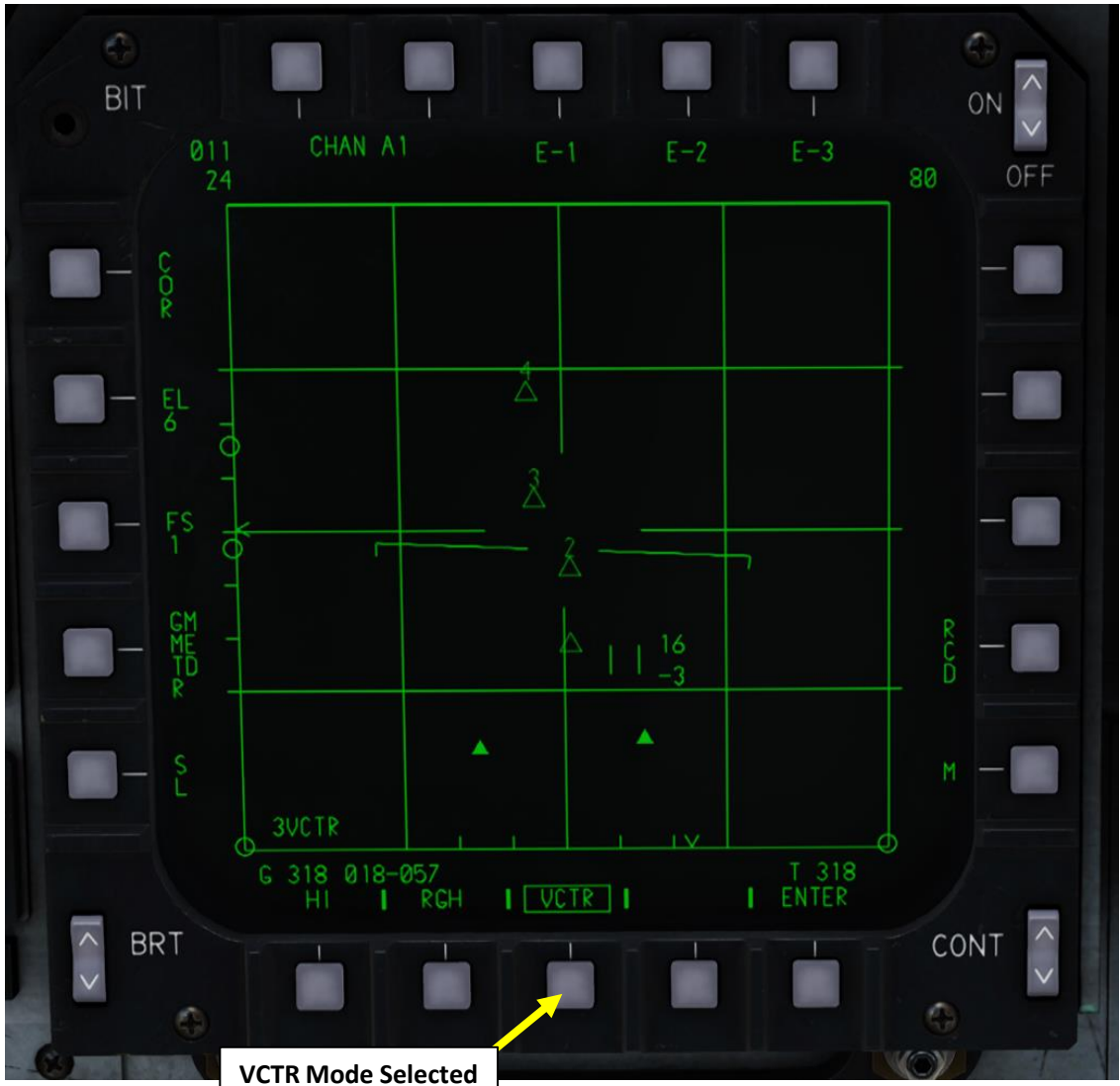




2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.4 – VCTR (Vector Scan) Mode

Vector Scan mode works similarly to HPRF RWS, but the radar antenna horizontal scan range is reduced from 70 deg per second to 35 deg per second. This significantly increases the radar sensitivity for **detecting small RCS (radar cross-section) targets**, such as cruise missiles.

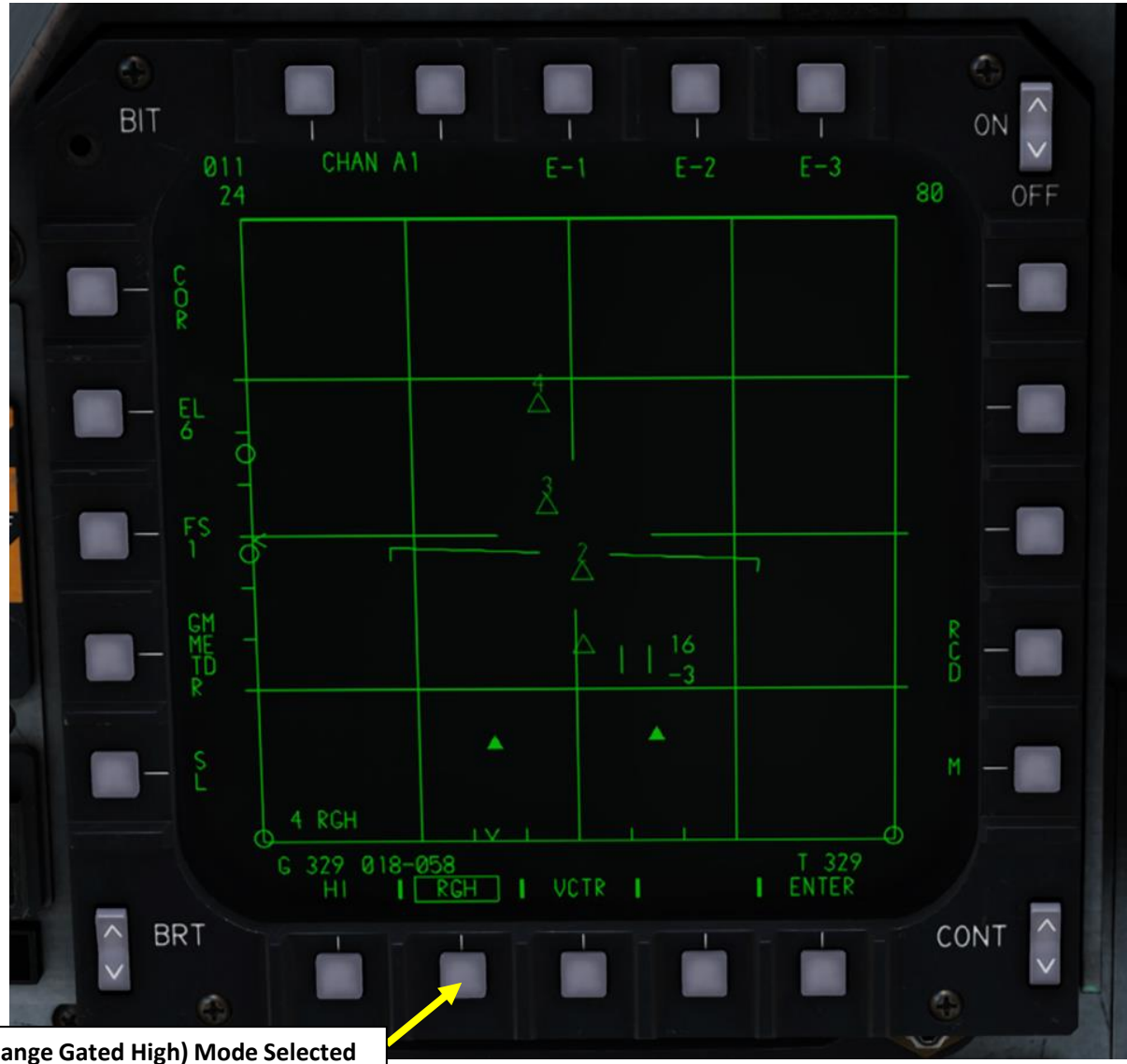
To use Vector Scan, select VCTR on the A/A RDR page. Just like with RWS mode, you can perform a radar lock with STT (Single Target Track) in the same manner.



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.5 – RGH (Range-Gated High) Mode

Range-Gated High mode provides a middle ground between MPRF and HPRF. It works quite well **against targets in frontal aspect (closing)**, but is less effective against targets in tail aspect (opening) and limited against targets in tail aspect which are at the same speed or closing.

To use Range-Gated High Mode, select RGH on the A/A RDR page. Just like with RWS mode, you can perform a radar lock with STT (Single Target Track) in the same manner.



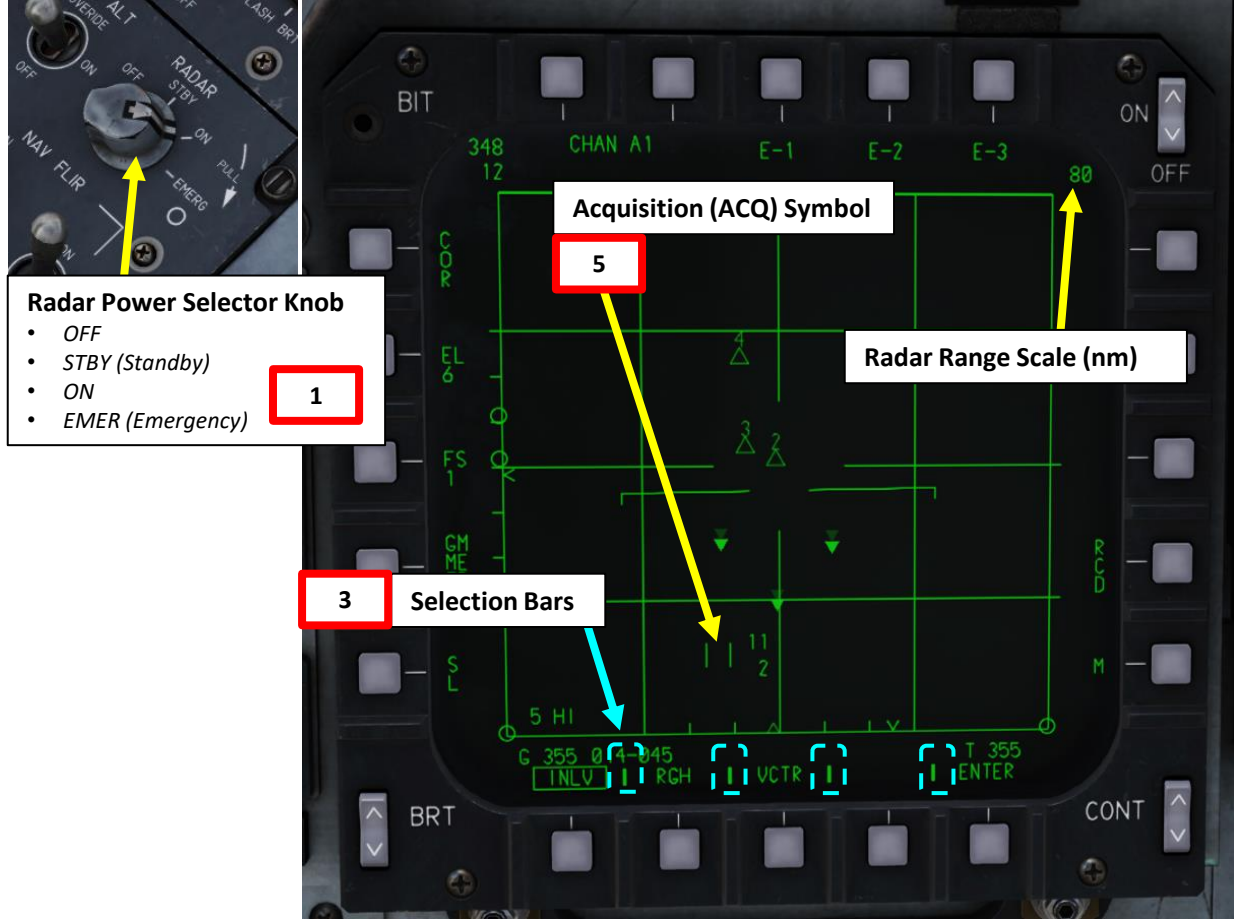
RGH (Range Gated High) Mode Selected

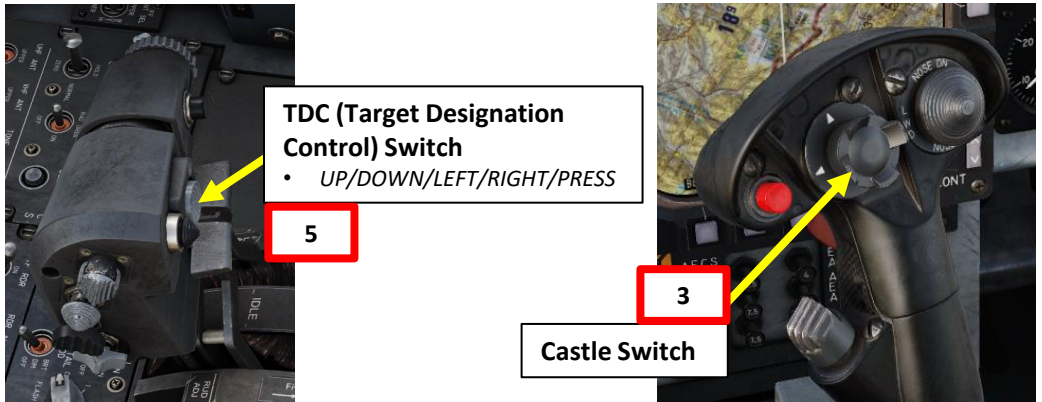
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.6 – STT (Single Target Track) Mode / Radar Lock

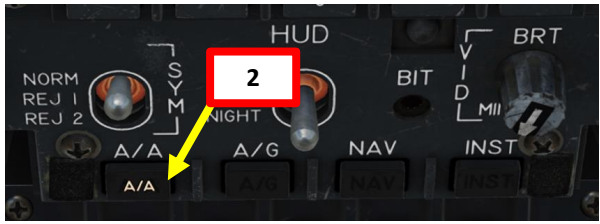
Single Target Track mode is a traditional radar "lock" where the radar continuously scans a single target, resulting in a very high update rate; this makes it the primary method of providing guidance to air-to-air weapons. STT maintains a trackfile for its target and automatically designates it. The radar is slaved to this trackfile; as such, manual antenna elevation control is inhibited and the B-sweep follows the trackfile. Only the trackfile that is placed in STT is visible and all onboard trackfiles are dropped. In STT, the A/A RDR page format is presented in azimuth along the horizontal axis and range along the vertical axis.

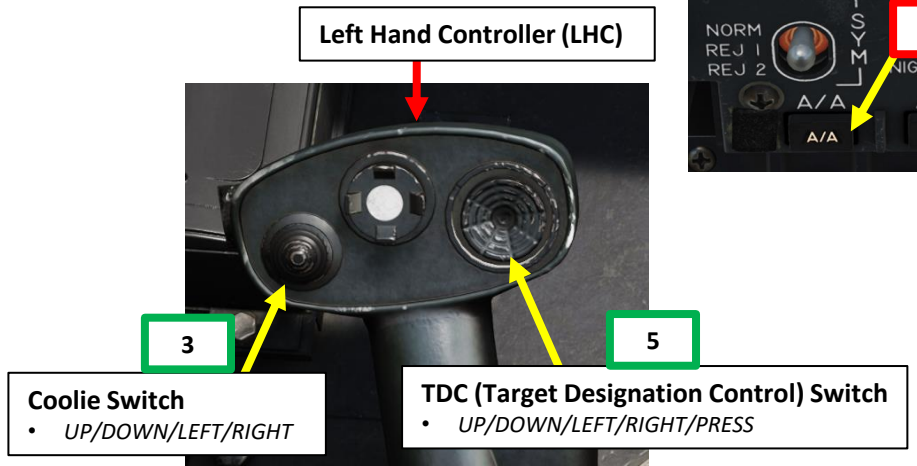
To Perform a radar lock:

1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
4. By default, RWS mode is selected.
5. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to lock.







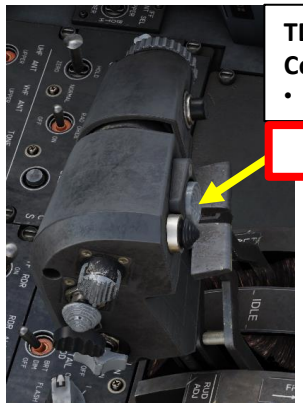


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.6 – STT (Single Target Track) Mode / Radar Lock

To Perform a radar lock:

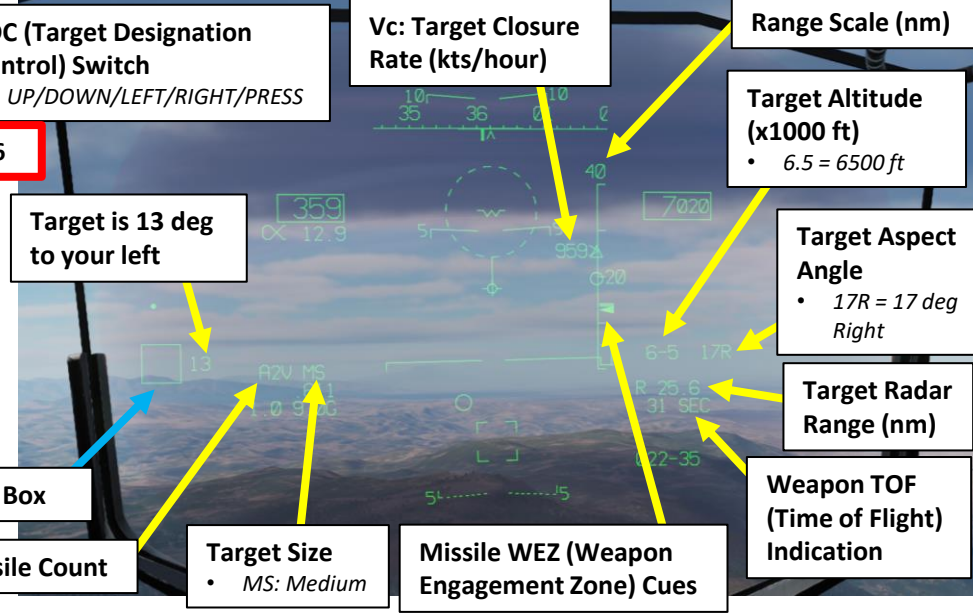
6. Once Acquisition Symbol (ACQ) is over the target, perform a radar lock:
   - **Pilot**: Press TDC (Target Designation Control) Switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
7. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.

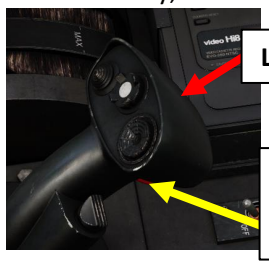
Note: alternatively, STT radar lock can be obtained from an auto acquisition radar mode.



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

6





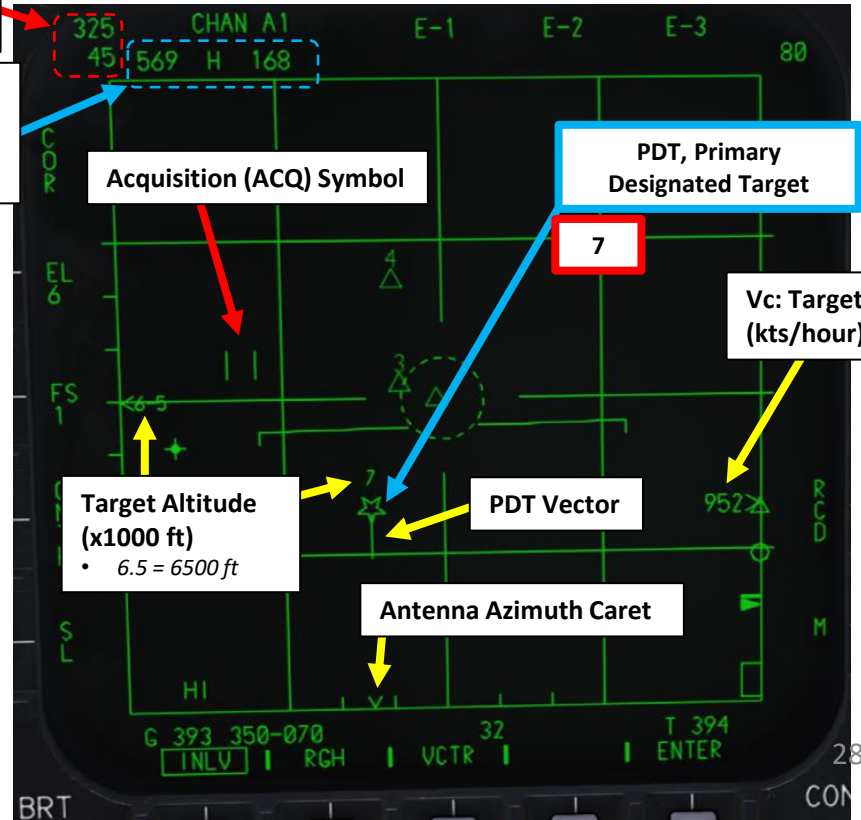
Left Hand Controller (LHC)

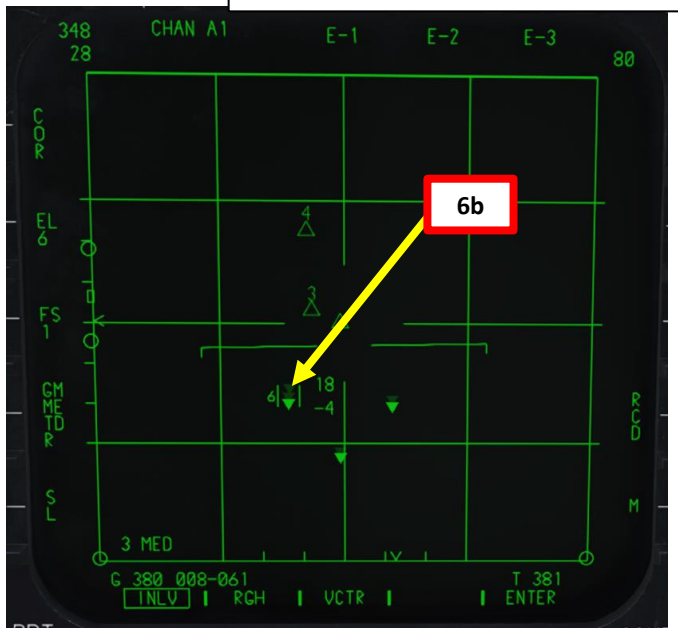
Trigger
- *First Detent*
- *Second Detent*

6

Acquisition Symbol (ACQ) Data Block
- *325: Bearing from Ownship to ACQ Symbol*
- *45: Range (nm) from Ownship to ACQ Symbol*

Locked Target Data Block
- *569: Target True Airspeed*
- *H: Target Aspect, H for Hot / C for Cold*
- *168: Target Bearing*



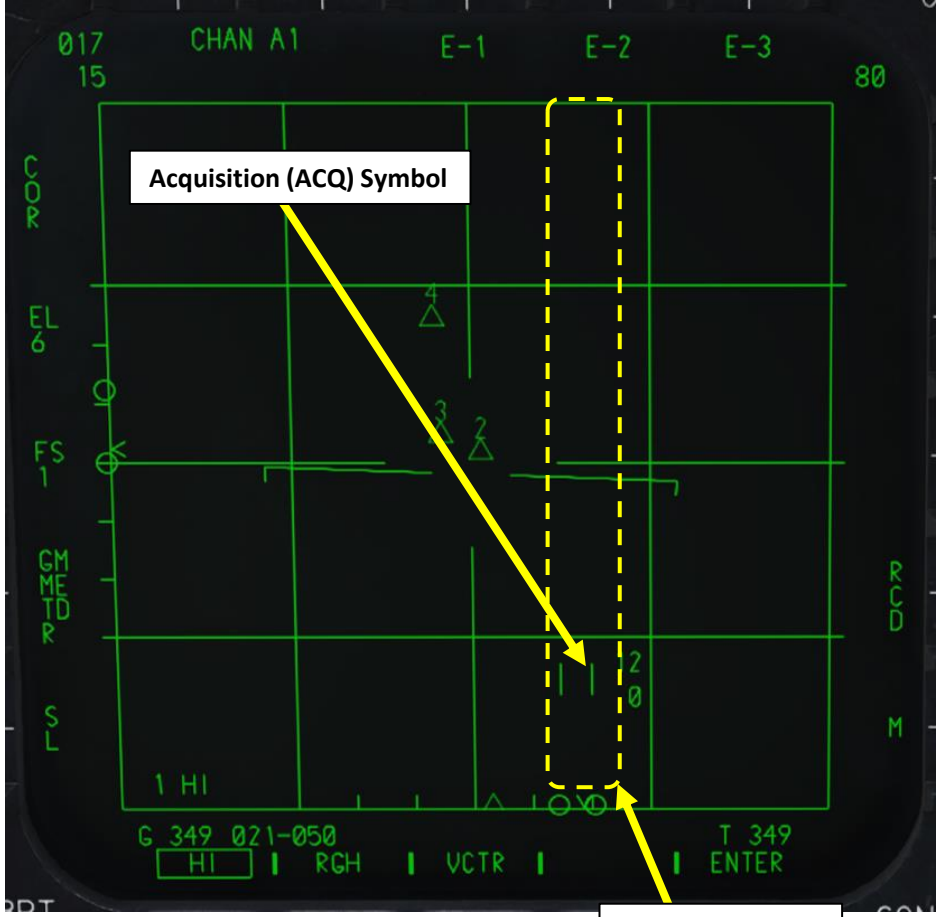


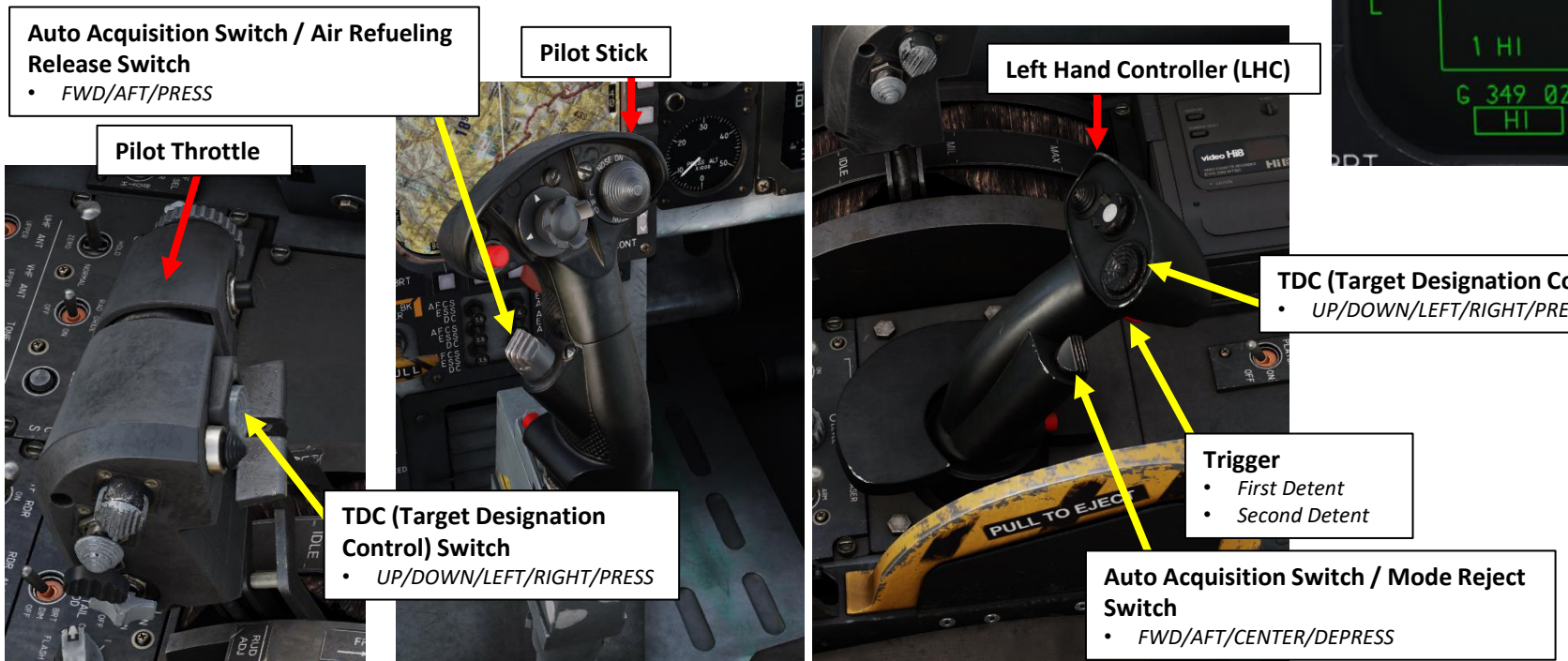
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.6 – STT (Single Target Track) Mode / Radar Lock

"Miniraster" Radar Scan:

In practice, the radar tries to correlate any returns with the position of the Acquisition Symbol (ACQ), and when it succeeds, it enters a two-bar, 3° scan at the target. This is what we call a "miniraster". If there are two target hits within 1.5 second, the radar lockon is accomplished.

- To command miniraster:
  - **Pilot**: With TDC (Target Designation Control), slew Acquisition Symbol (ACQ) over desired area of the A/A RDR page, then depress and hold the TDC switch. Releasing the TDC commands radar lockon.
  - **WSO**: With TDC (Target Designation Control), slew Acquisition Symbol (ACQ) over desired area of the A/A RDR page. Then, press and hold the L/RHC (Left/Right Hand Controller) trigger to full action (second detent). Releasing the trigger commands radar lockon.
- To exit miniraster, depress the Auto Acquisition Switch on the pilot's stick, or depress the Auto Acquisition Switch on the WSO's L/RHC (Left/Right Hand Controllers).

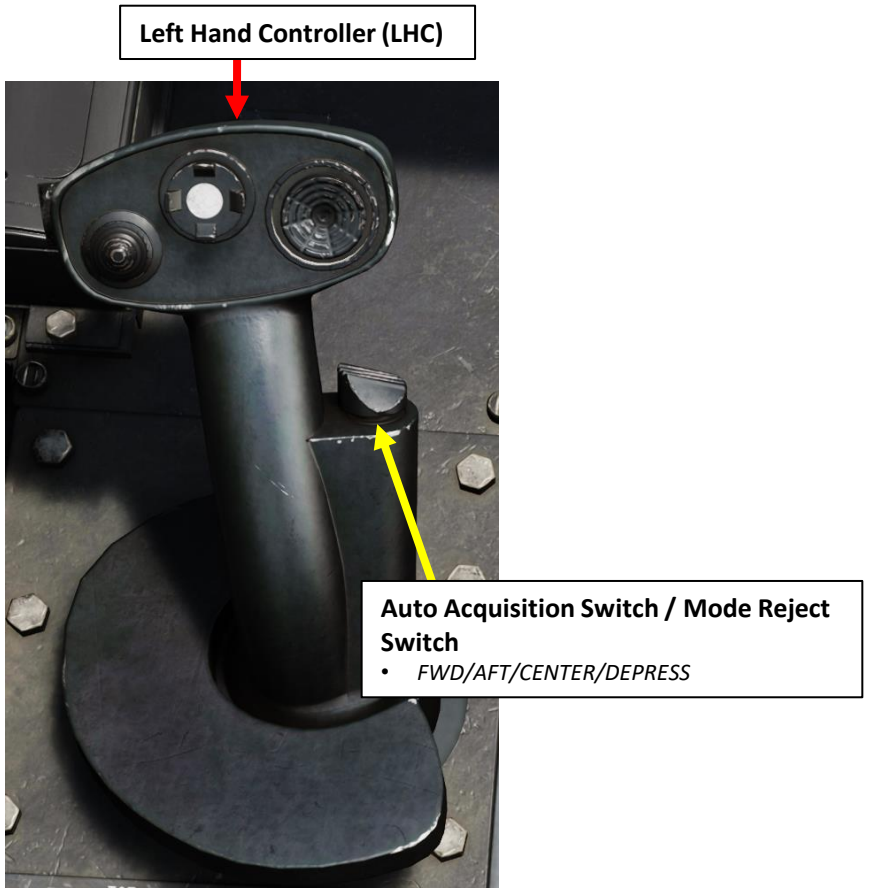


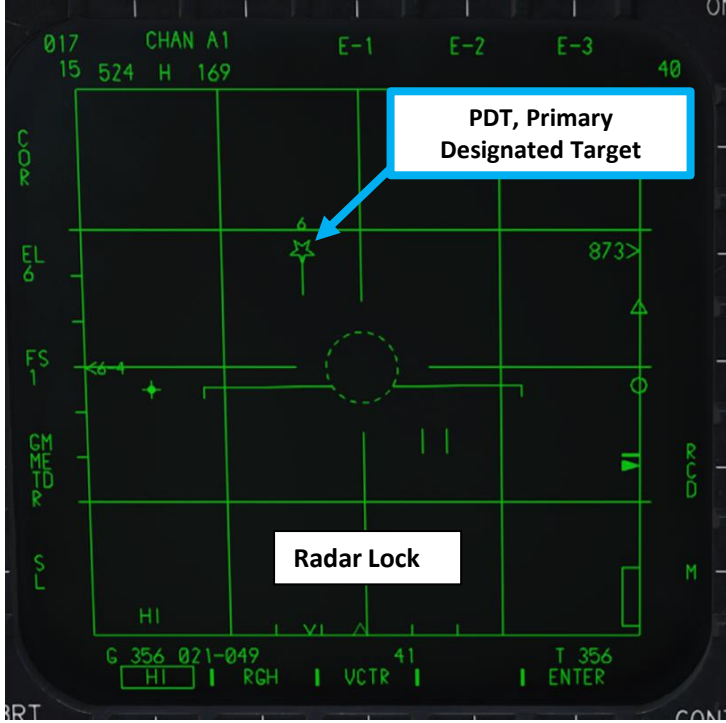


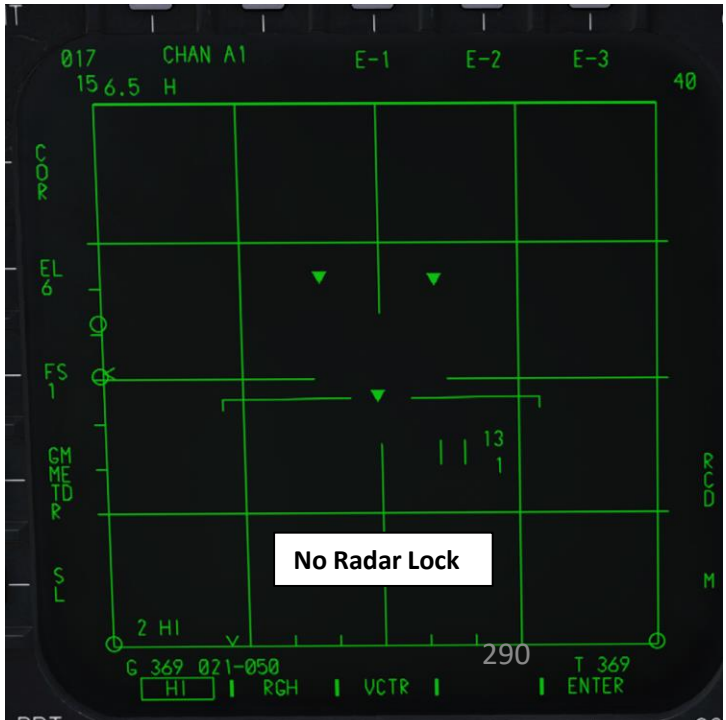
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.6 – STT (Single Target Track) Mode / Radar Lock

To exit radar lock:

Depress the Auto Acquisition Switch on the pilot's stick, or depress the Auto Acquisition Switch on the WSO's L/RHC (Left/Right Hand Controllers).







2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

A – Introduction

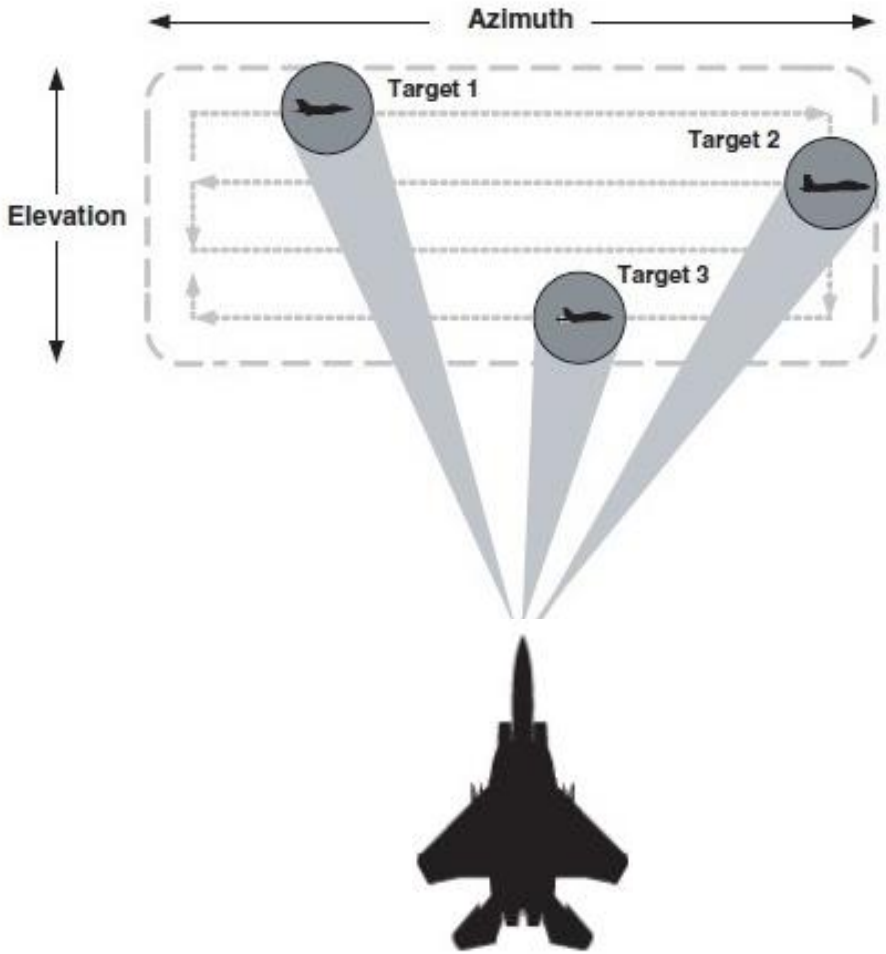
TWS (Track While Scan) mode combines the information unique to RWS and STT (Single Target Track) modes. Generally, the TWS display is very similar to the RWS display. TWS mode allows for trackfiles to be kept at a high update rate. To accomplish this, TWS artificially limits the scan volume (bars/azimuth) and provides for automatic scan centering. It is also optimal for providing post-launch datalink for the AIM-120 AMRAAM missile while remaining in search.

When combined with the AIM-120, TWS provides a powerful ability to engage multiple targets quickly. Nevertheless, the target tracking reliability is less than STT. Unlike STT though, a TWS launch with an AMRAAM will not provide the enemy aircraft with a radar lock and launch indication. As such, the first warning the enemy pilot will likely get is when the active radar seeker of the AIM-120 missile goes active near the target.

TWS has several restrictions. The radar will attempt to build track files for each contact, but given a large scan volume, there will be a sizable refresh time between scans. During each scan the radar will try to predict the position of the contact for the next scan. If, however the target takes evasive, high-G maneuvers and quickly changing its trajectory and speed, the radar can lose the track by making an incorrect track file prediction. Using such a defensive tactic, the hunter can quickly become the hunted.

Since TWS mode is one of the more complex (yet powerful!) radar modes, this section will be divided in the following sub-sections:

- **A: Introduction**
- **B: TWS Sub-Modes**
- **C: TWS Manual Target Designation**
- **D: TWS Automatic Target Designation**
- **E: DTT (Dual Target Track)**



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

B – TWS Sub-Modes

Search Mode (RWS, Range While Search)

Slew TDC on a target, then press TDC to radar lock it

Pilot Stick AACQ PRESSED or WSO L/RHC AACQ PRESSED

Radar Lock / STT (Single Target Track)

"Designated" TWS Sub-Modes

Slew TDC on a blank space, then press TDC to perform "miniraster" radar scan.

"Undesignated" TWS Sub-Modes

AACQ FWD SHORT → **3HDT TWS (High Data Pattern, 3-bar, 30 deg azimuth)**

- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Alternates between **4TWS** and **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**

AACQ AFT SHORT → **2TWS TWS (Wide Pattern, 2-bar, 60 deg azimuth)**

- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Switches to **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **4TWS**
- Slew TDC over "2TWS" legend in bottom-left of display, then momentarily TDC PRESS: Switches to **NARROW**

AZBUMP

4TWS TWS (Medium Pattern, 4-bar, 30 deg azimuth)

- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Switches to **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**
- Slew TDC over "4TWS" legend in bottom-left of display, then momentarily TDC PRESS: Switches to **NARROW**

From **STT**, **2TWS**, **4TWS** or **3HDT**: Press AACQ FWD LONG → **2HDT TWS (High Data Pattern, 2-bar, 30 deg azimuth)**

- AACQ FWD SHORT: Switches to **3HDT**. Subsequent presses alternate between **4TWS** and **3HDT.**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**

From **2TWS** or **4TWS** → **NARROW TWS (Narrow Pattern, 6-bar, 15 deg azimuth)**

- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **4TWS**

Legend:
- AZBUMP: "Azimuth Bump" refers to slewing the Acquisition Symbol with the TDC to the left/right edge of A/A RDR display
- AACQ: Auto Acquisition Switch
- TDC: Target Designation Control Switch

2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

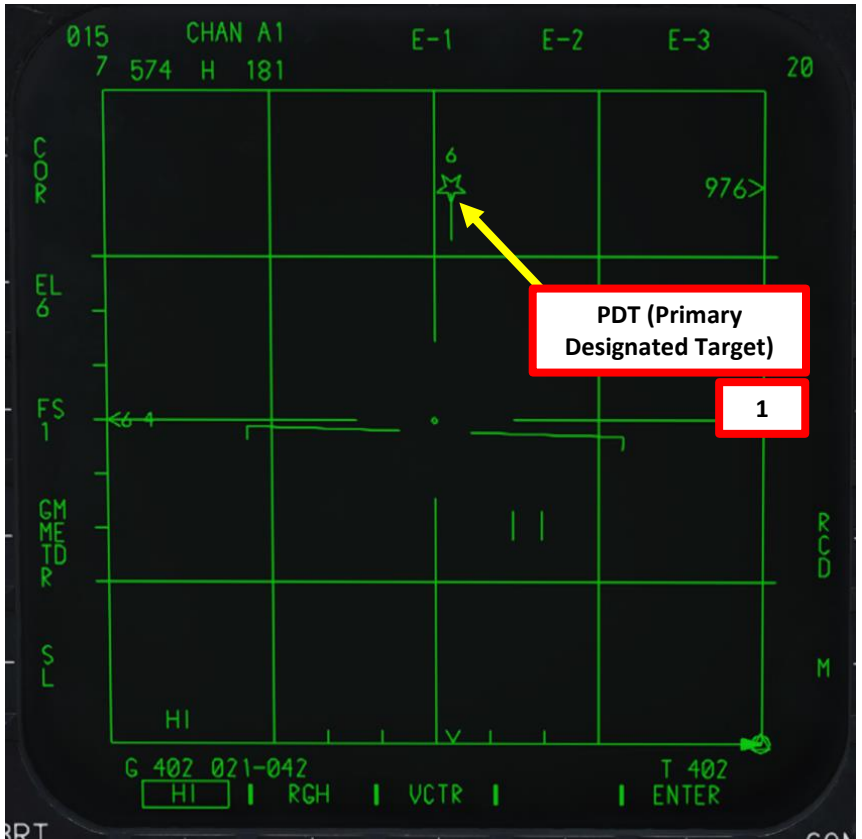
2TWS TWS
(Wide Pattern, 2-bar, 60 deg azimuth)

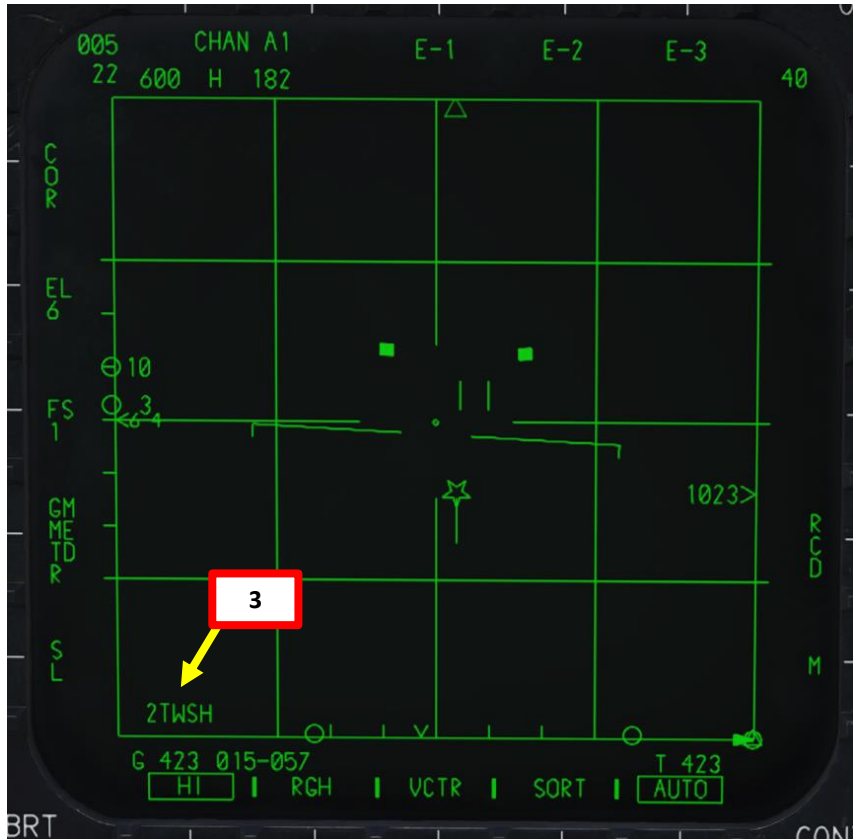
- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Switches to **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **4TWS**
- Slew TDC over "2TWS" legend in bottom-left of display, then momentarily TDC PRESS: Switches to **NARROW**

B – TWS Sub-Modes

2TWS Sub-Mode: Wide Pattern, 2-bar, 60 deg azimuth

1. Perform a radar lock using STT (Single Target Track) mode.
   - Alternatively, you can also slew the Acquisition Symbol with the TDC (Target Designation Control) on a blank space, then press TDC to perform "miniraster" radar scan. This will allow you to use the "undesignated" TWS mode.
2. Press Auto Acquisition Switch AFT SHORT (less than 1 sec).
3. Radar mode switches from STT to 2TWS TWS mode, allowing you to lock other targets and track them as well.





2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

B – TWS Sub-Modes

4TWS Sub-Mode: Medium Pattern, 4-bar, 30 deg azimuth

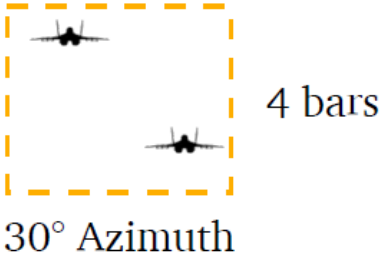
1. Perform a radar lock using STT (Single Target Track) mode.
   - Alternatively, you can also slew the Acquisition Symbol with the TDC (Target Designation Control) on a blank space, then press TDC to perform "miniraster" radar scan. This will allow you to use the "undesignated" TWS mode.
2. Press Auto Acquisition Switch AFT SHORT (less than 1 sec).
3. Radar mode switches from STT to 2TWS TWS mode, allowing you to lock other targets and track them as well.
4. Perform "azimuth bumping", or "AZ bumping". This is done by slewing the ACQ (Acquisition) Symbol to the left or right edge of the display using the TDC (Target Designation Control), changing radar azimuth setting in the process.
5. Radar mode switches from 2TWS TWS mode to 4TWS TWS mode.

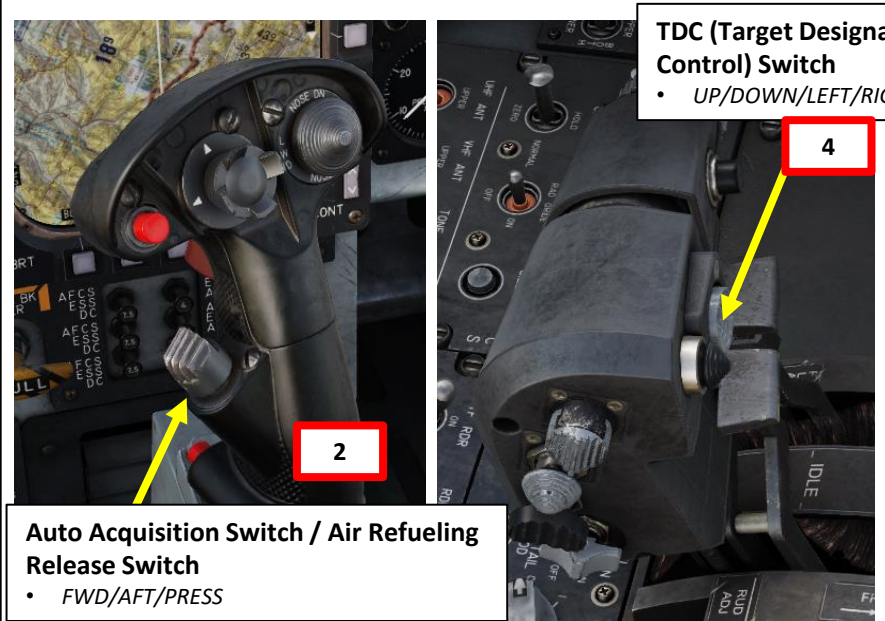
4TWS TWS
(Medium Pattern, 4-bar, 30 deg azimuth)

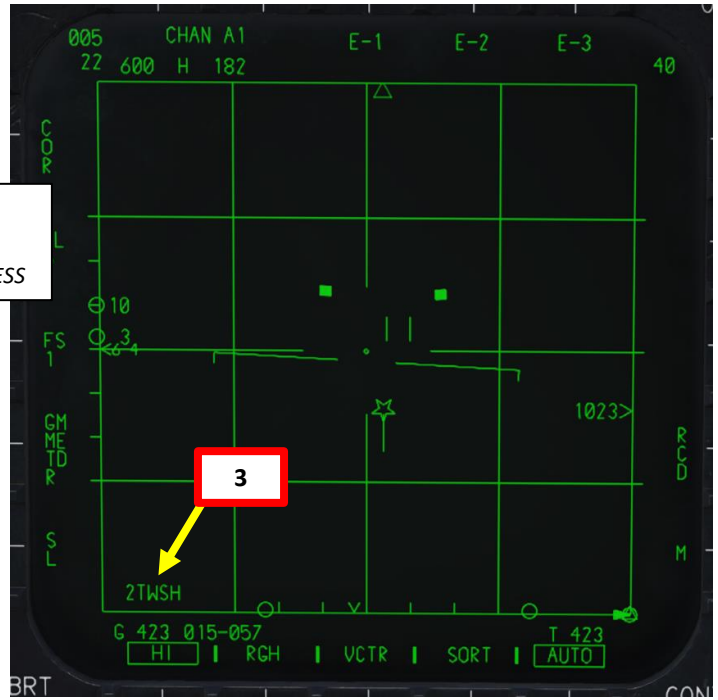
AZBUMP

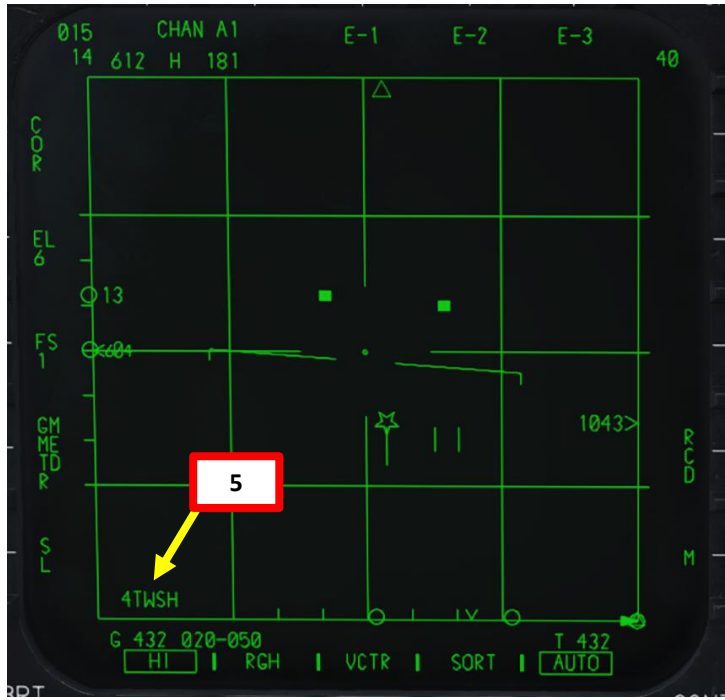
2TWS TWS
(Wide Pattern, 2-bar, 60 deg azimuth)

- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Switches to **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**
- Slew TDC over "4TWS" legend in bottom-left of display, then momentarily TDC PRESS: Switches to **NARROW**









2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

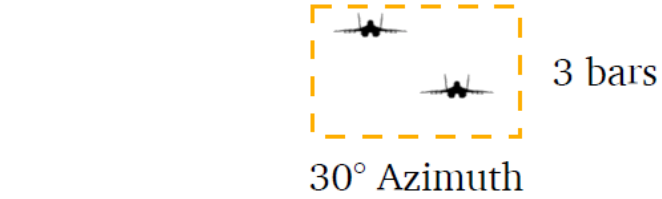
3HDT TWS
(High Data Pattern, 3-bar, 30 deg azimuth)

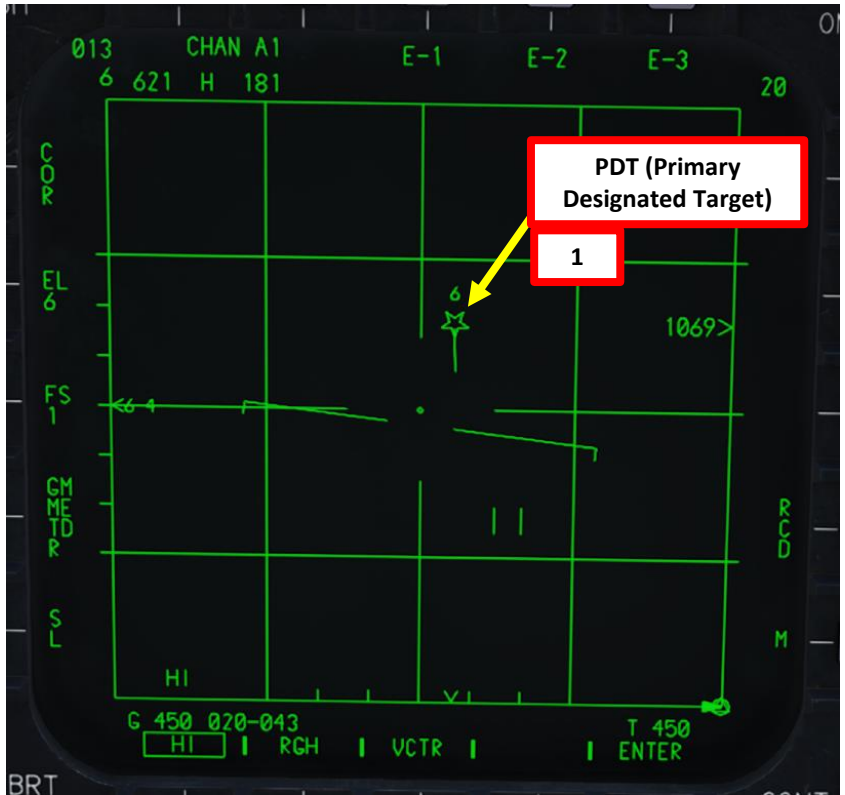
- AACQ FWD LONG: Switches to **2HDT**
- AACQ FWD SHORT: Alternates between **4TWS** and **3HDT**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**

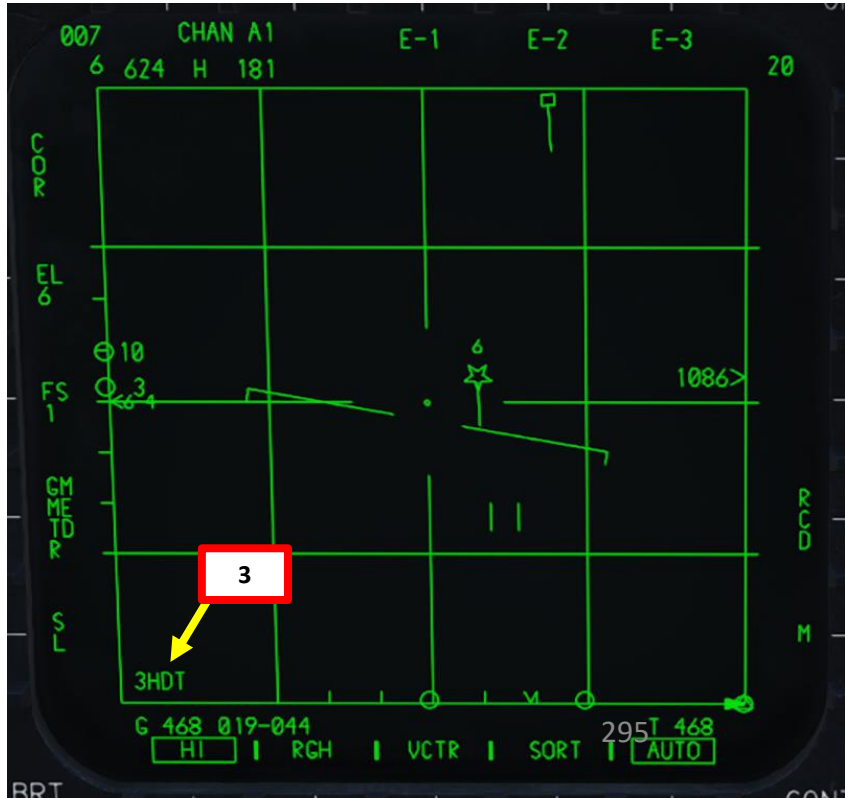
B – TWS Sub-Modes

3HDT Sub-Mode: High Data Pattern, 3-bar, 30 deg azimuth

1. Perform a radar lock using STT (Single Target Track) mode.
   - Alternatively, you can also slew the Acquisition Symbol with the TDC (Target Designation Control) on a blank space, then press TDC to perform "miniraster" radar scan. This will allow you to use the "undesignated" TWS mode.
2. Press Auto Acquisition Switch FWD SHORT (less than 1 sec).
3. Radar mode switches from STT to 3HDT TWS mode, allowing you to lock other targets and track them as well.







2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

From **STT**, **2TWS**, **4TWS** or **3HDT**:
Press AACQ FWD LONG

→ **2HDT TWS**
(High Data Pattern, 2-bar, 30 deg azimuth)

- AACQ FWD SHORT: Switches to **3HDT**. Subsequent presses alternate between **4TWS** and **3HDT.**
- AACQ AFT SHORT: Returns to **STT**
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to **2TWS**

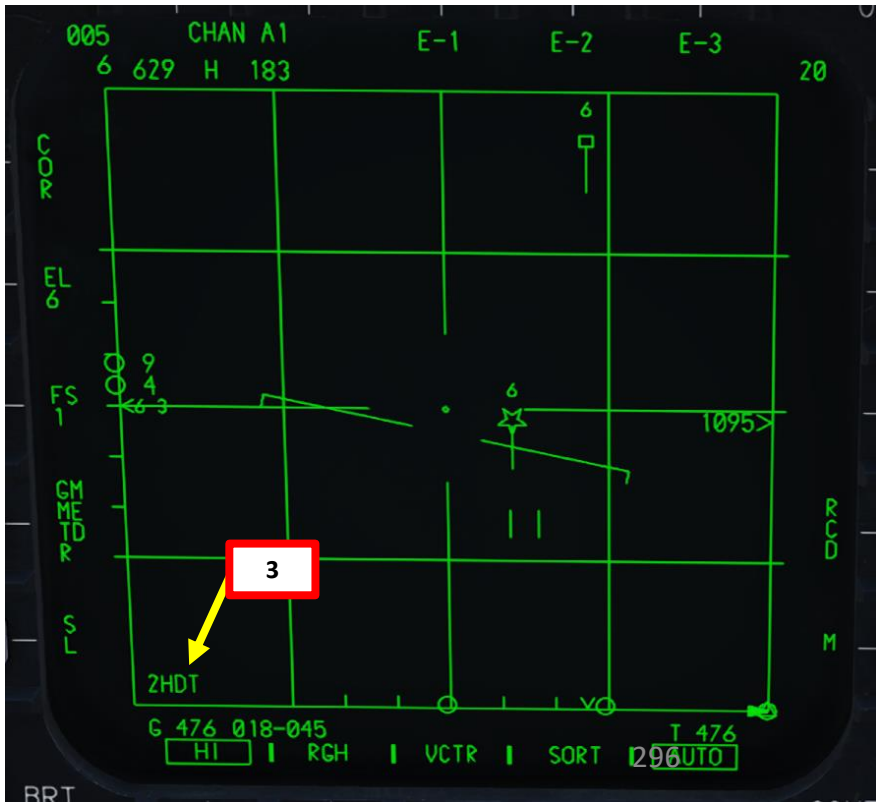
B – TWS Sub-Modes

2HDT Sub-Mode: High Data Pattern, 2-bar, 30 deg azimuth

1. Ensure either STT, 2TWS, 4TWS or 3HDT mode is selected.
2. Press Auto Acquisition Switch FWD LONG (less than 1 sec).
3. Radar mode switches from previously selected mode to 2HDT TWS mode, allowing you to lock other targets and track them as well.

2 bars

30° Azimuth



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

From 2TWS or 4TWS → **NARROW TWS (Narrow Pattern, 6-bar, 15 deg azimuth)**

- AACQ AFT SHORT: Returns to STT
- AACQ PRESSED (REJECT Position): Returns to **Search** Mode
- AZBUMP: Switches to 4TWS

B – TWS Sub-Modes

NARROW Sub-Mode: Narrow Pattern, 6-bar, 15 deg azimuth

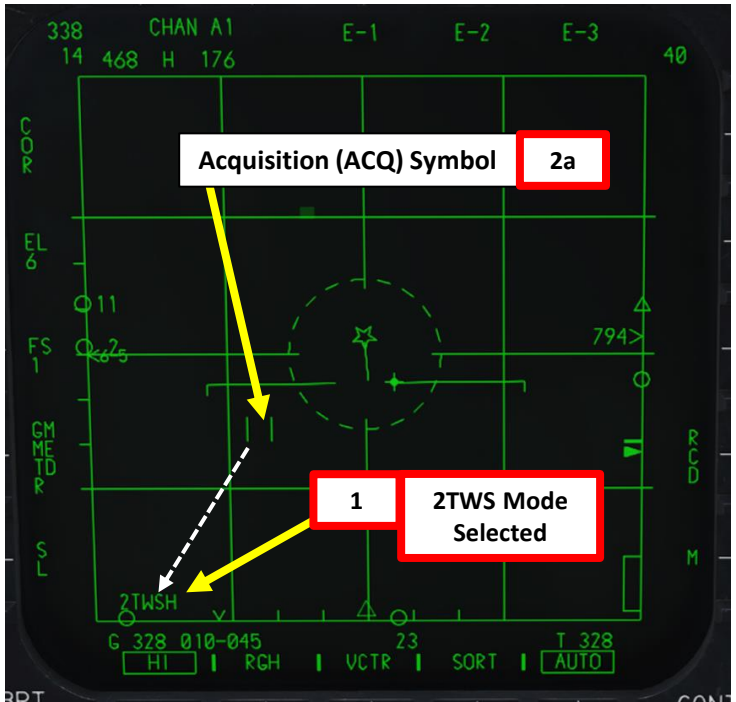
1. Ensure either 2TWS or 4TWS mode is selected.
2. Using the TDC, slew Acquisition Symbol (ACQ) over "2TWS" or "4TWS" legend in bottom-left of display, then momentarily TDC PRESS.
3. Radar mode switches from previously selected mode to NARROW TWS mode, allowing you to lock other targets and track them as well but with a narrower azimuth setting.

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

2

6 bars

15° Azimuth



2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

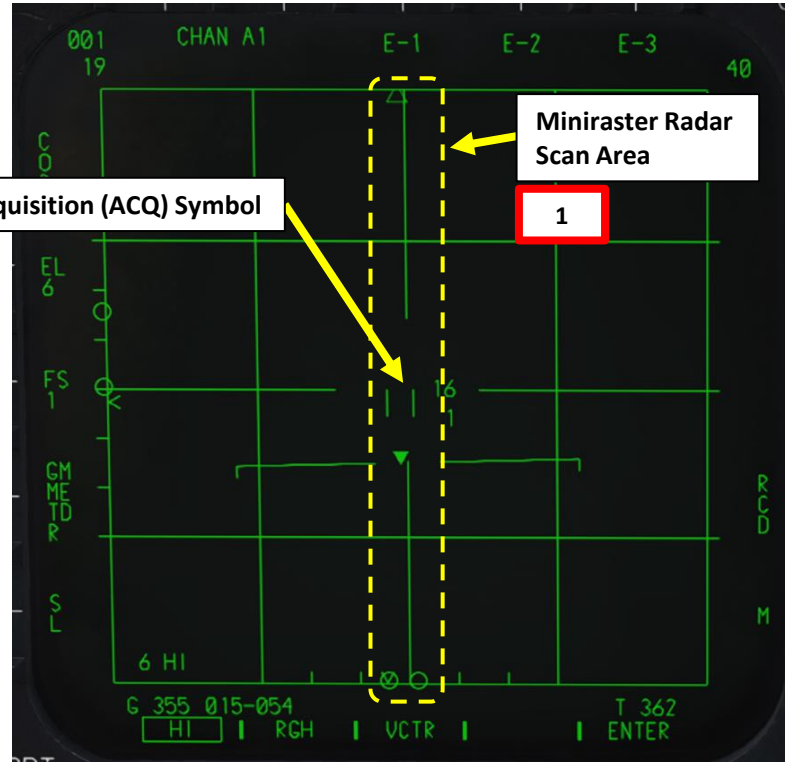
B – TWS Sub-Modes

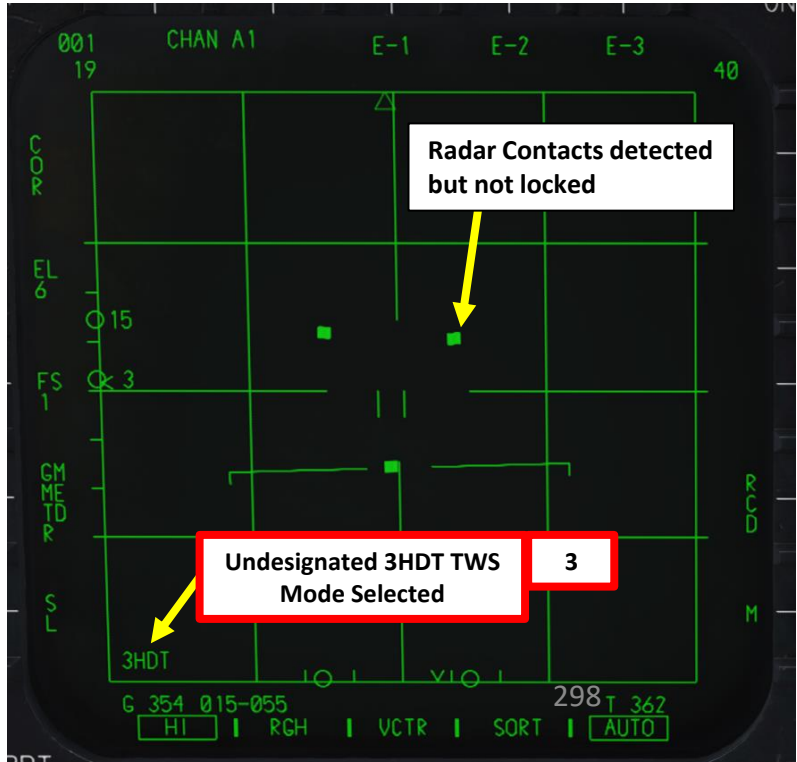
Undesignated TWS

It is possible to enter a TWS mode without having to radar lock a target. This is what we call “undesignated TWS”.

1. Command a miniraster radar scan:
   - **Pilot**: With TDC (Target Designation Control), slew Acquisition Symbol (ACQ) over desired area of the A/A RDR page, then depress and hold the TDC switch. Releasing the TDC commands radar lockon.
   - **WSO**: With TDC (Target Designation Control), slew Acquisition Symbol (ACQ) over desired area of the A/A RDR page. Then, press and hold the L/RHC (Left/Right Hand Controller) trigger to full action (second detent). Releasing the trigger commands radar lockon.
2. Enter any desired TWS mode (**2TWS**, **4TWS, 2HDT**, or **3HDT**) as shown previously. As an example, we will select 3HDT TWS by pressing Auto Acquisition Switch FWD SHORT (less than 1 sec).
3. Radar mode switches from Search Mode to 3HDT TWS mode, but no target is radar locked in the process. You can still lock targets as desired.

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

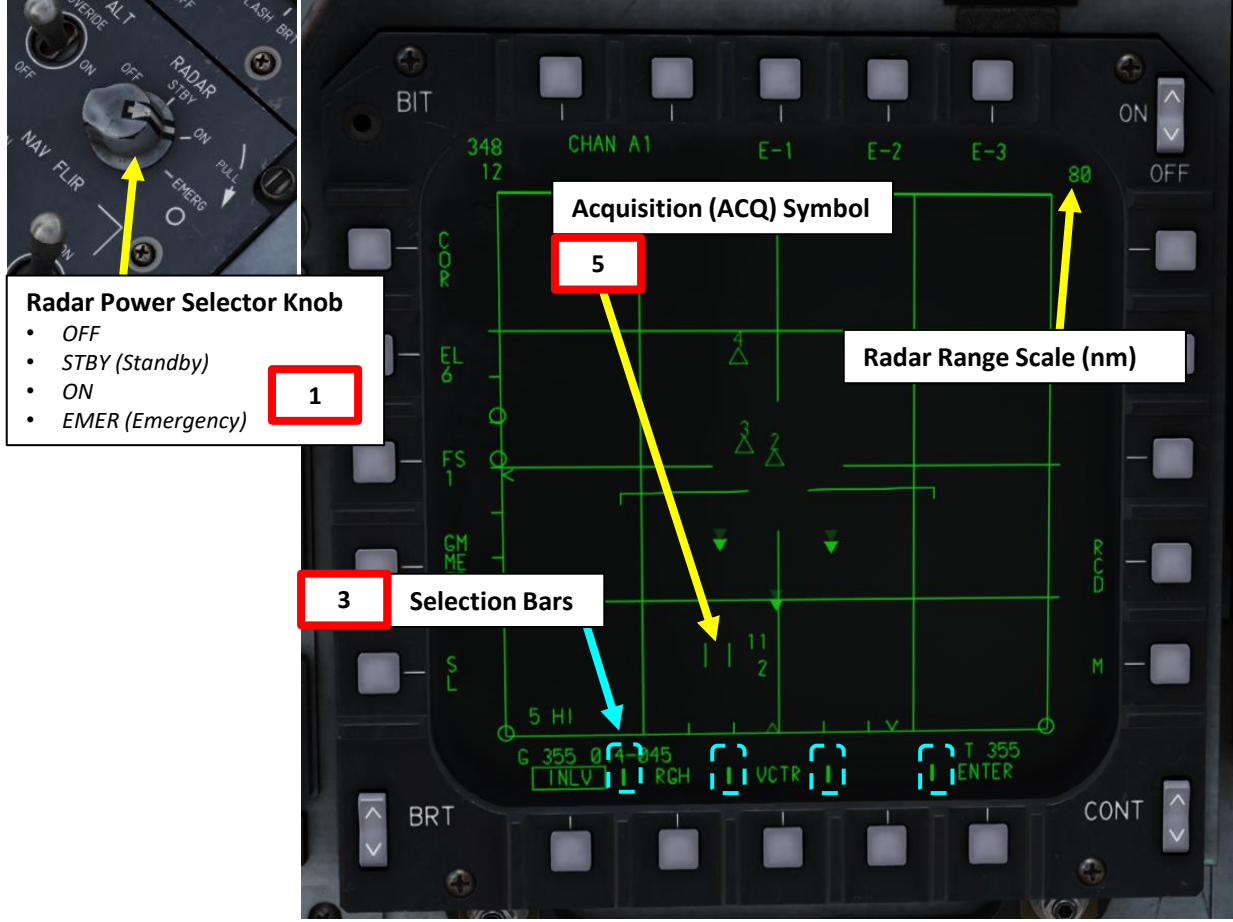


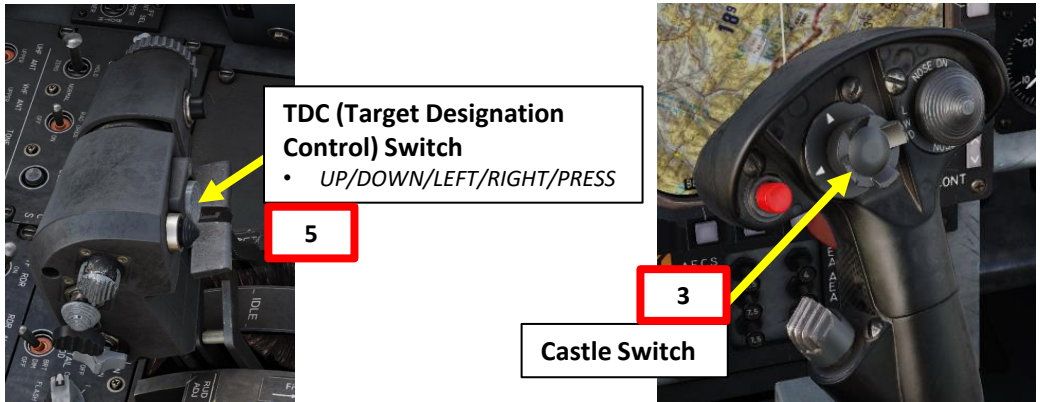


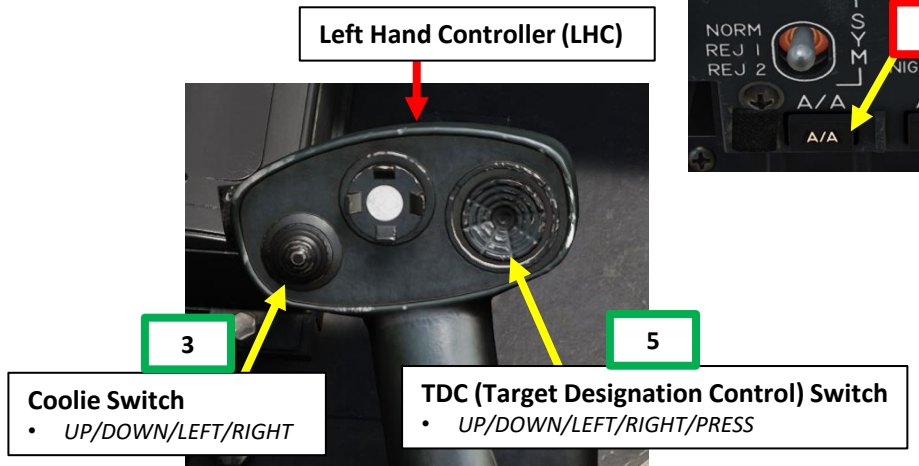
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

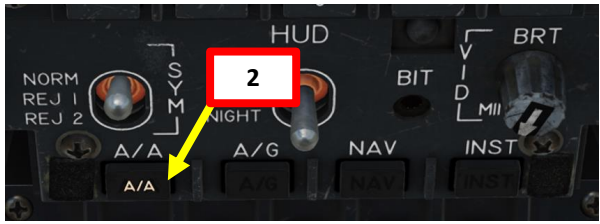
C – TWS Manual Target Designation

1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. By default, RWS mode is selected.
5. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to lock.





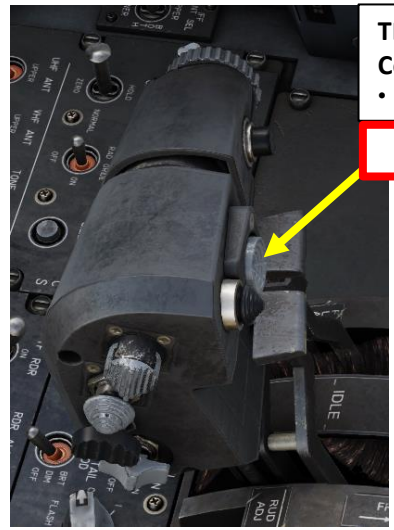


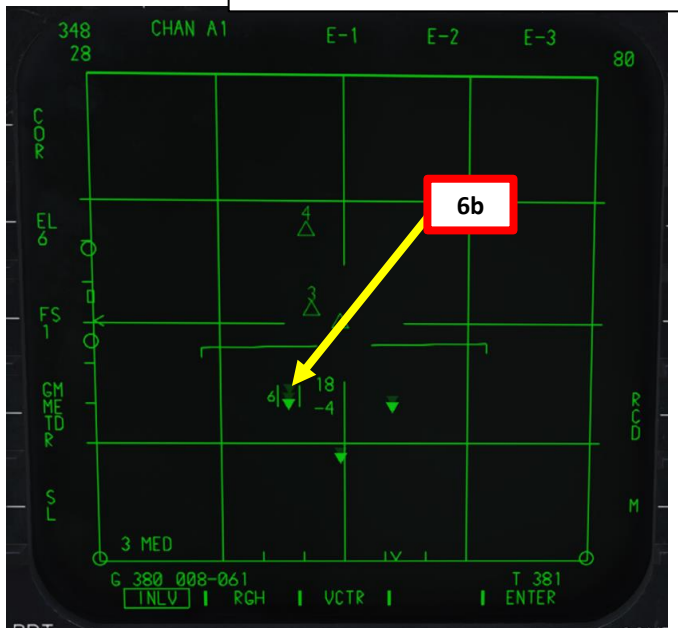


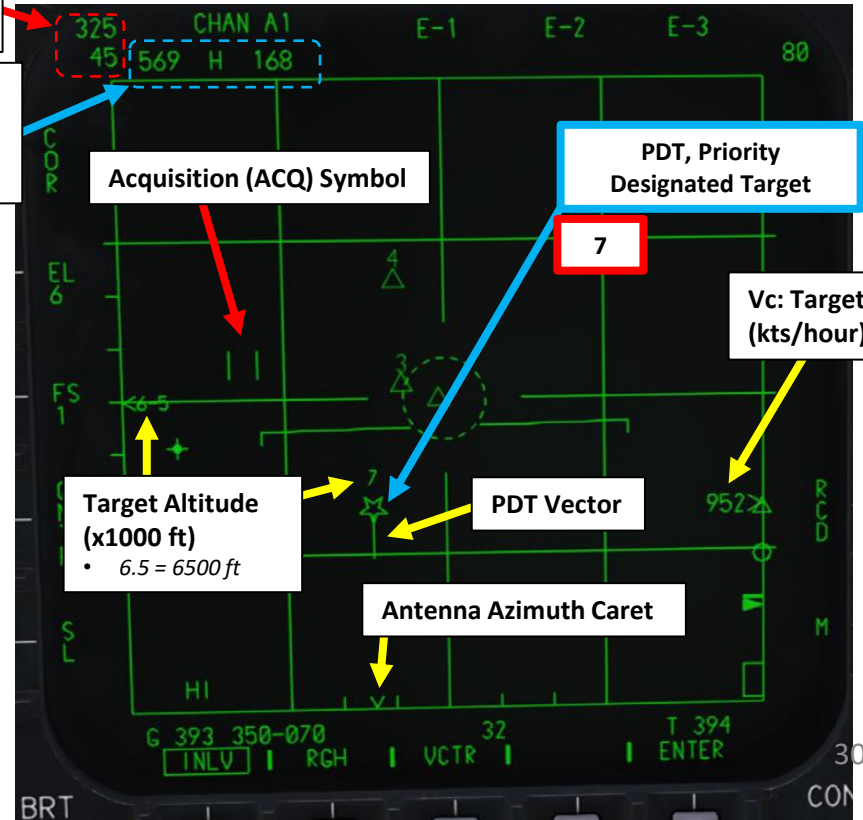
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

C – TWS Manual Target Designation

6. Once Acquisition Symbol (ACQ) is over the target, perform a radar lock:
   - **Pilot**: Press TDC (Target Designation Control) Switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
7. Locked target will turn into a star with a vector (referred as "PDT", or "Priority Designated Target"), which represents the relative heading between the target and your aircraft.
8. Once radar lock has been performed, we will then switch to a TWS mode (in this example, we will use "3HDT TWS" in order to track (radar lock) additional targets.



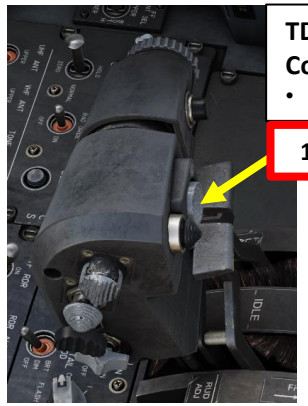


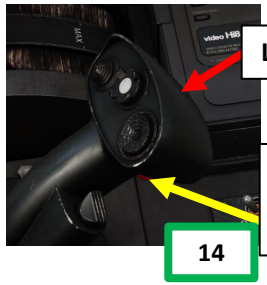


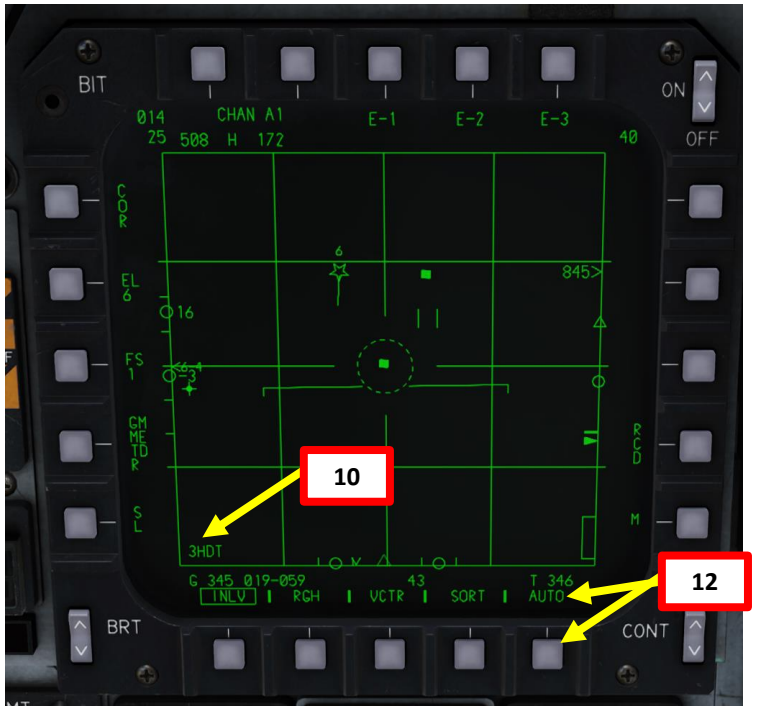
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

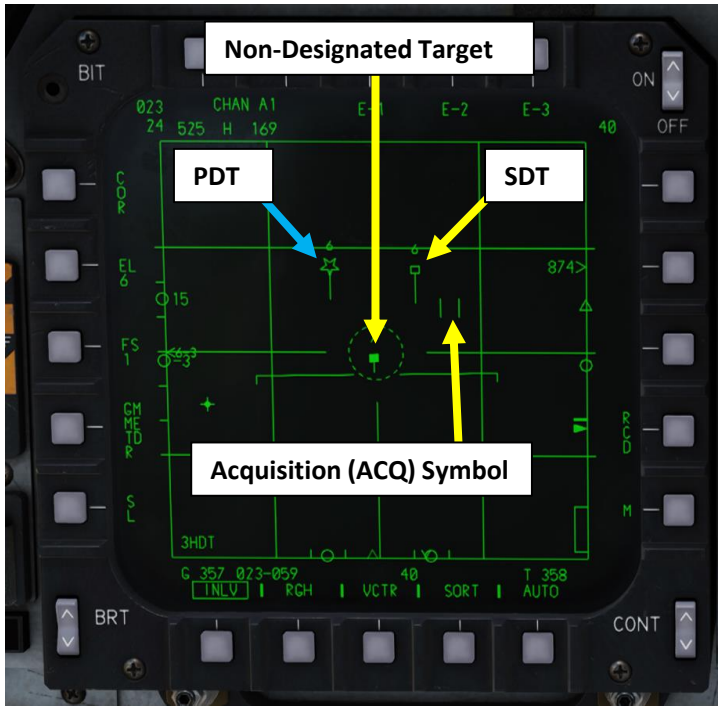
C – TWS Manual Target Designation

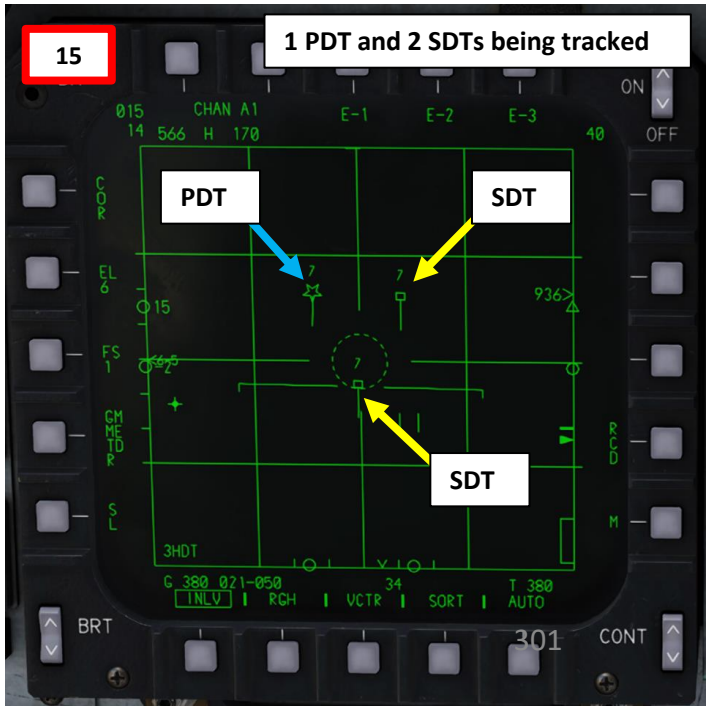
9. Enter desired TWS mode as shown in the previous section. We will enter 3HDT TWS mode; press Auto Acquisition Switch FWD SHORT (less than 1 sec).
10. Radar mode switches from STT to 3HDT TWS mode, allowing you to lock other targets and track them as well.
11. We can designate 9 more targets (referred as SDTs, or "Secondary Designated Targets") in addition to the PDT (Priority Designated Target). This can be done either manually or automatically.
12. For this example, we will unbox AUTO mode in order to select Manual Target Designation.
13. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to designate as a SDT (Secondary Designated Target).
14. Once Acquisition Symbol (ACQ) is over the target, designate it:
    - **Pilot**: Press TDC (Target Designation Control) Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
15. You can designate other targets in a similar manner, for a maximum of 1 Priority Designated Target and 9 Secondary Designated Targets.







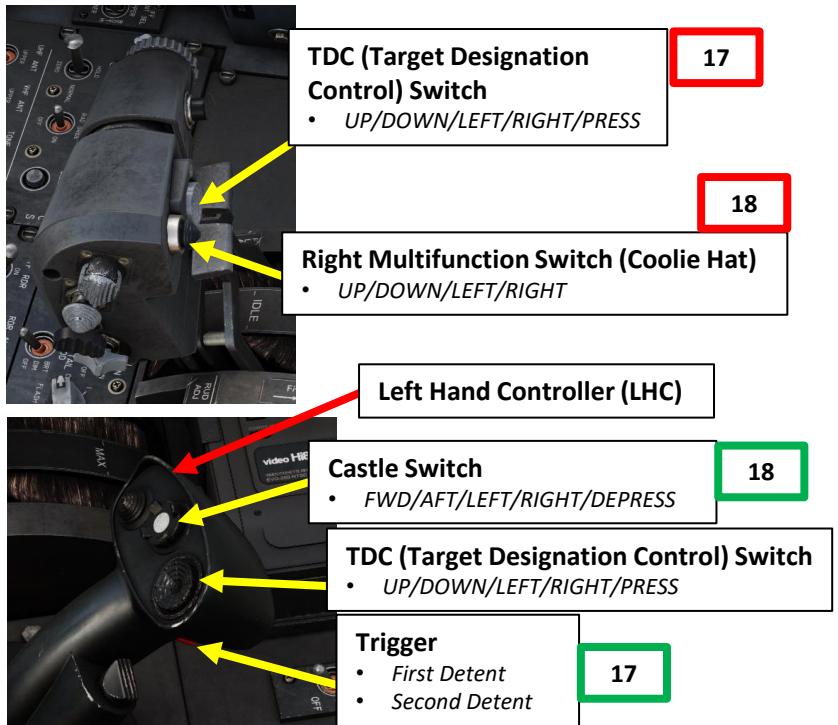


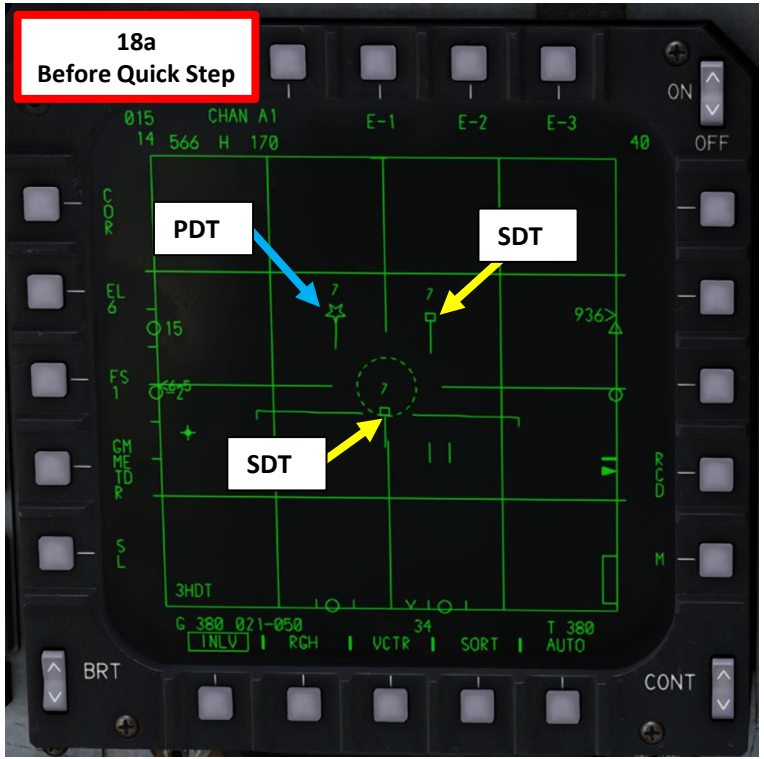


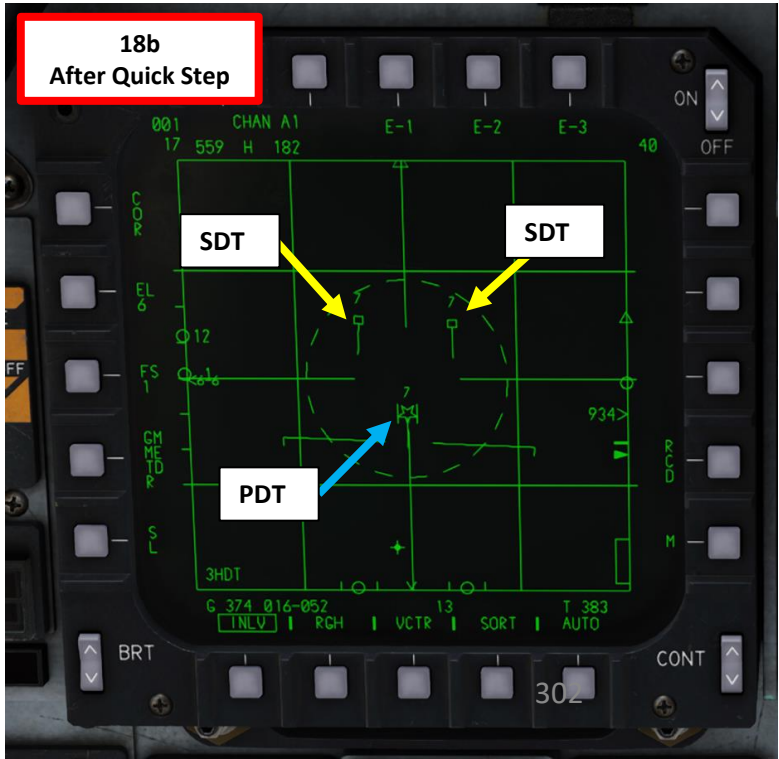
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

C – TWS Manual Target Designation

16. You might have to adjust the radar azimuth by "azimuth bumping" to maintain tracking of several targets. On the HUD (Heads-Up Display), **only the priority target is shown with a TD Box**.
17. **QUICK PICK**: It is possible to quickly "pick" (select) any Secondary Designated Target (SDT) target as the Priority Designated Target (PDT).
    - **Pilot**: Slew TDC on any designated target, then press TDC (Target Designation Control) Switch SHORT (less than 1 sec).
    - **WSO**: Slew TDC on any designated target, then press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
18. **QUICK STEP**: It is possible to quickly "step" between designated targets to change the Priority Designated Target (PDT) to the next Secondary Designated Target (SDT) in range. The order of switching is from left to right in azimuth.
    - **Pilot**: Press Coolie Switch UP SHORT (less than 1 sec).
    - **WSO**: DEPRESS Castle Switch.



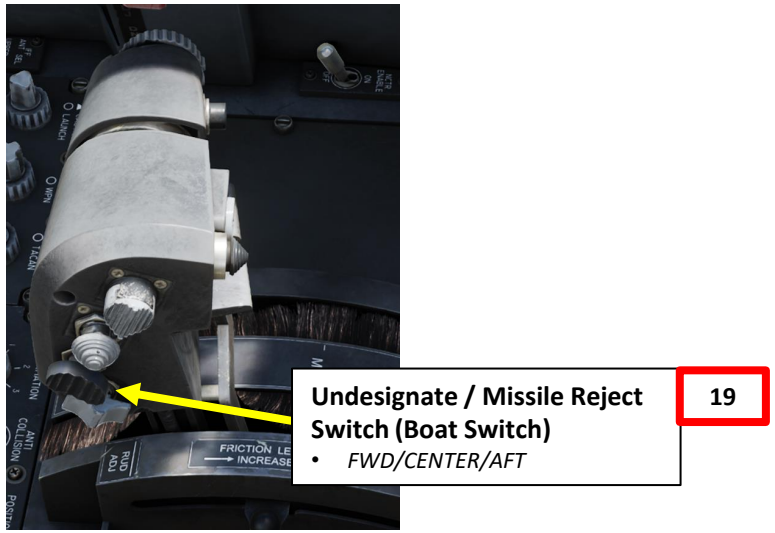


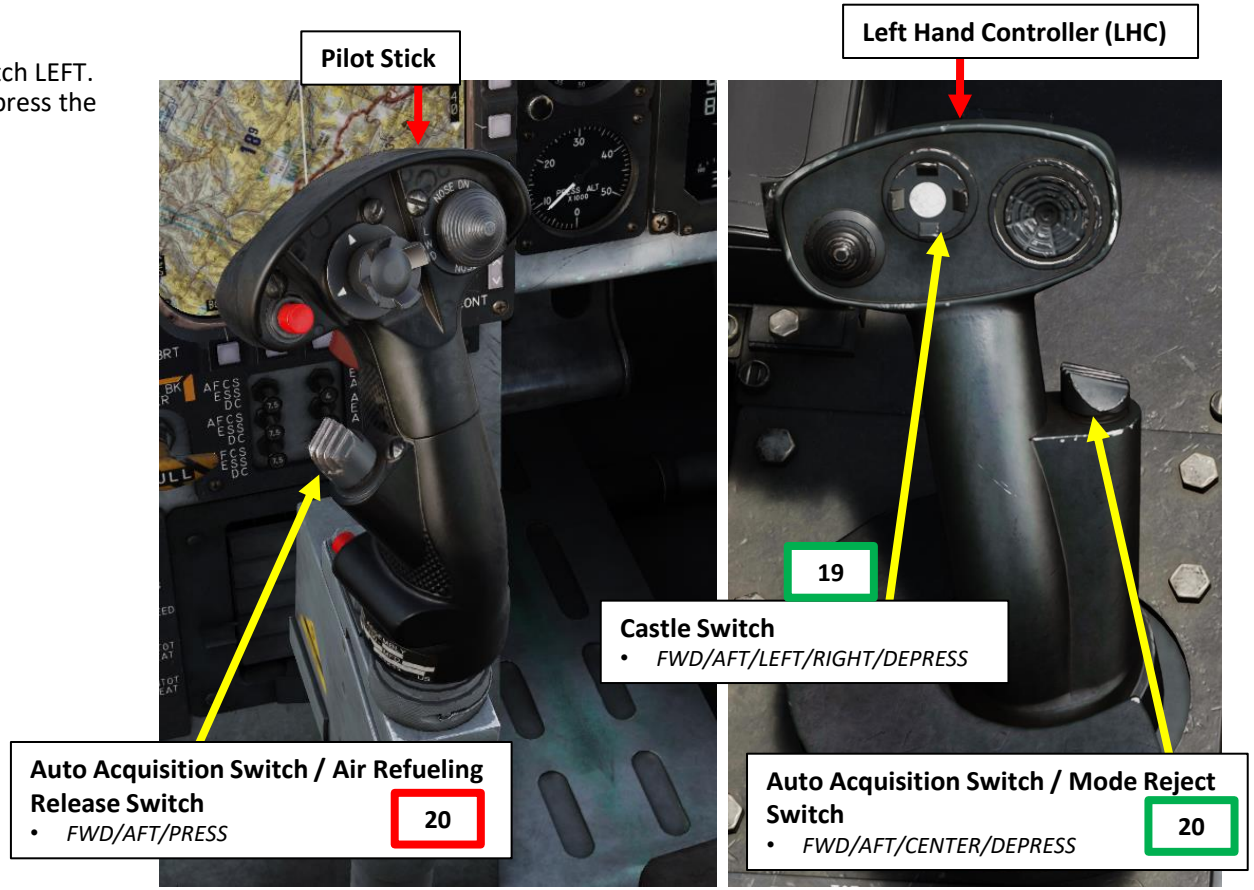


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

C – TWS Manual Target Designation

19. **To undesignate a TWS target**:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).
    - **WSO**: Press on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.
20. **To exit radar lock**: Depress the Auto Acquisition Switch on the pilot's stick, or depress the Auto Acquisition Switch on the WSO's L/RHC (Left/Right Hand Controllers).





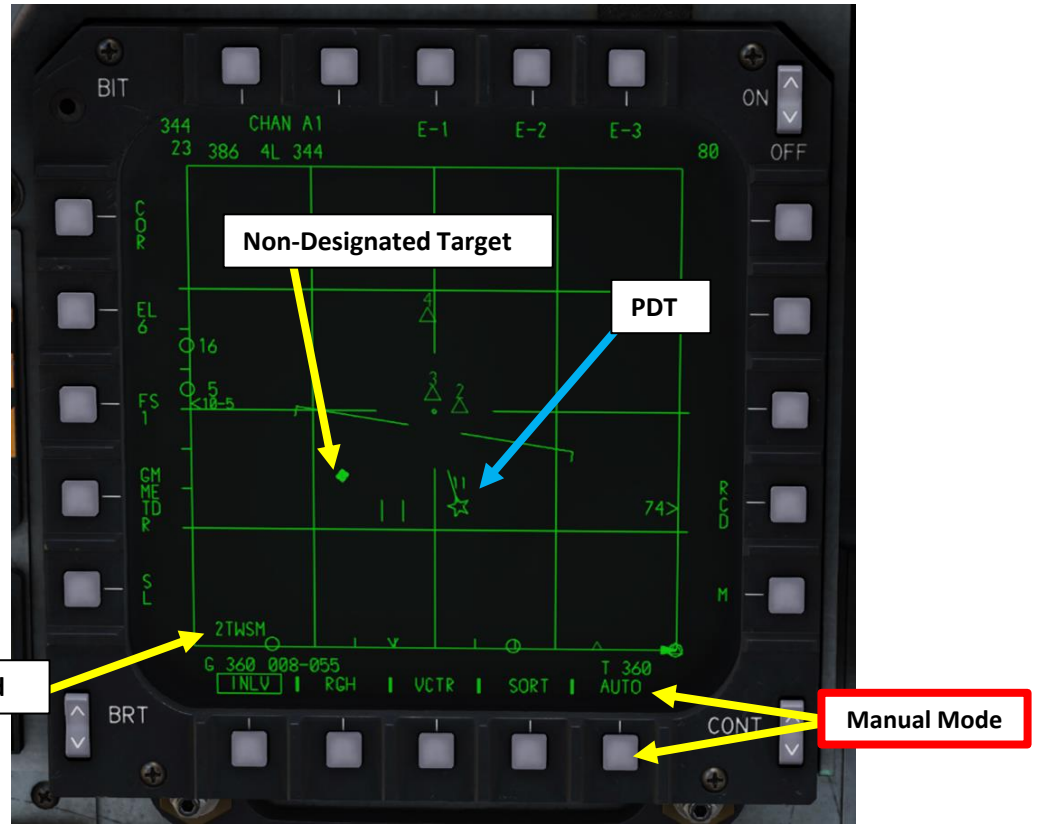
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

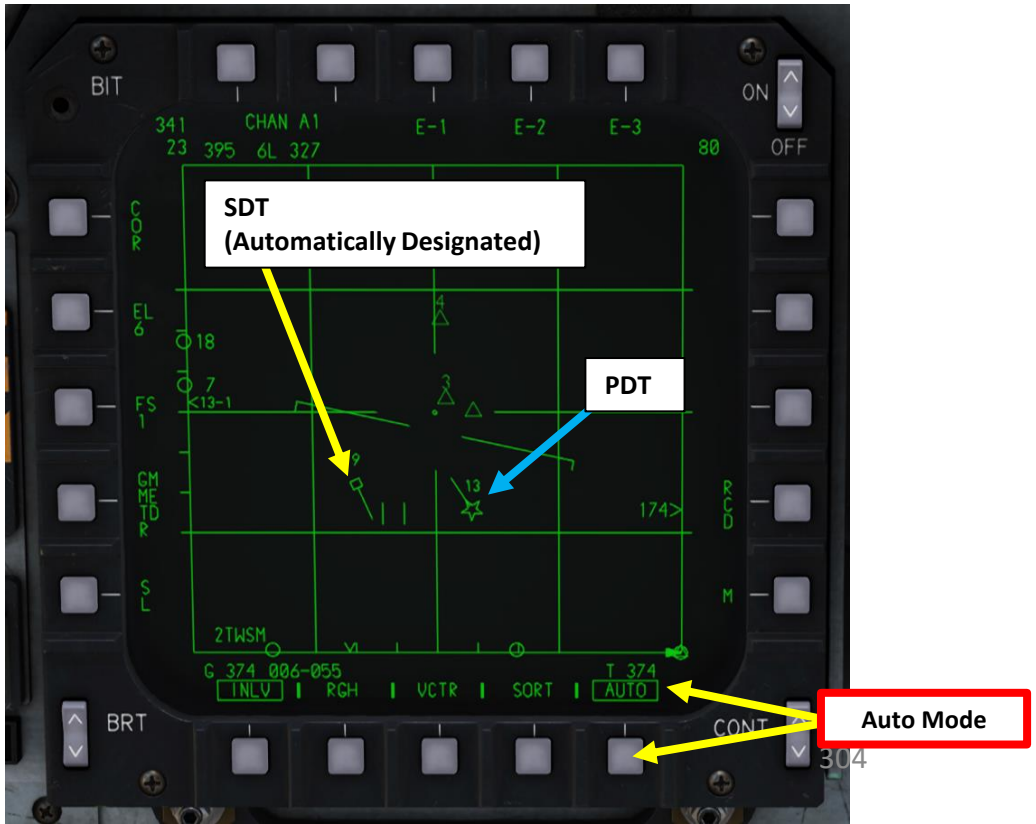
D – TWS Automatic Target Designation

When in TWS mode, aircrew has the option enable automatic designation of Secondary Designated Targets (STDs), provided a Priority Designated Target (PDT) is already designated.

If AUTO legend is boxed (toggled with associated pushbutton), up to nine targets with vector are automatically designated.

Even if automatic target designation is selected, manual designation is still available. Take note that manually undesignated targets will not be eligible for automatic designation again.





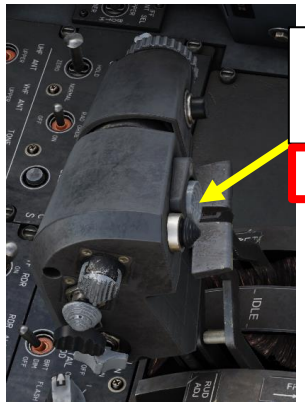
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.7 – TWS (Track While Scan) Mode

E – DTT (Dual Target Track)

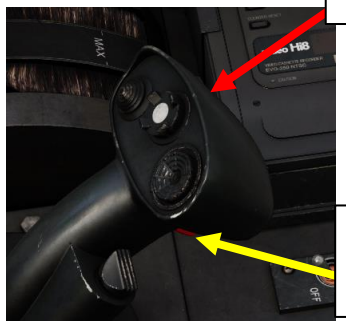
TWS can be used for missile guidance. Two widely-spaced targets can be simultaneously engaged with two radar-guided missiles with a TWS sub-mode called Dual Target Track (DTT). To switch from TWS to DTT:

1. Make sure you have a Priority Designated Target (PDT) and a Secondary Designated Target (SDT) as shown in the previous steps of the **TWS Manual Target Designation procedure**. After that:
   - **Pilot**: Slew TDC on any designated target, then press TDC (Target Designation Control) Switch LONG (more than 1 sec).
   - **WSO**: Slew TDC on any designated target, then press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
2. Radar mode will then switch from TWS to DTT. You can then fire a missile on the PDT, perform a **Quick Step** to the SDT, then fire a missile on the SDT in short succession.
3. Pressing Auto Acquisition Switch AFT SHORT when in DTT returns to STT (Single Target Track) mode. Auto Acquisition PRESSED (REJECT Position) returns to radar to Search (RWS) Mode.
4. Note: it is advised to disable the AUTO option before attempting the DTT to avoid automatic designation of additional targets.

Auto Acquisition Switch / Air Refueling Release Switch 3
- *FWD/AFT/PRESS*

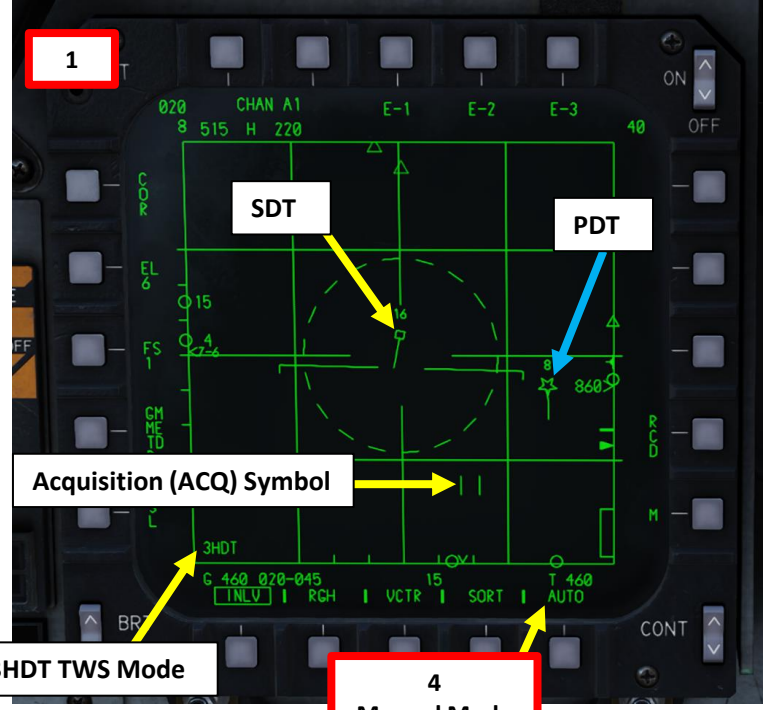


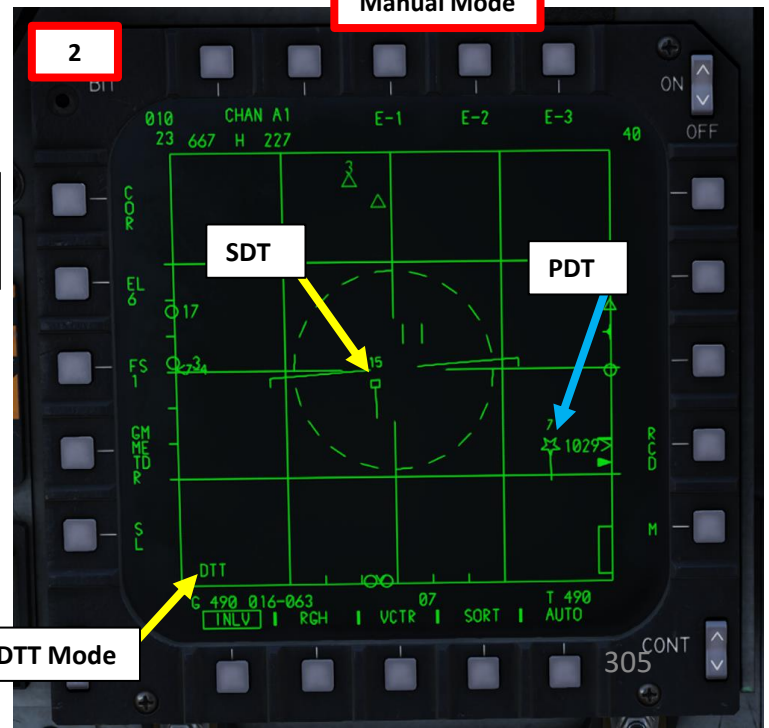
TDC (Target Designation Control) Switch 1
- *UP/DOWN/LEFT/RIGHT/PRESS*



Left Hand Controller (LHC)

Trigger 1
- *First Detent*
- *Second Detent*

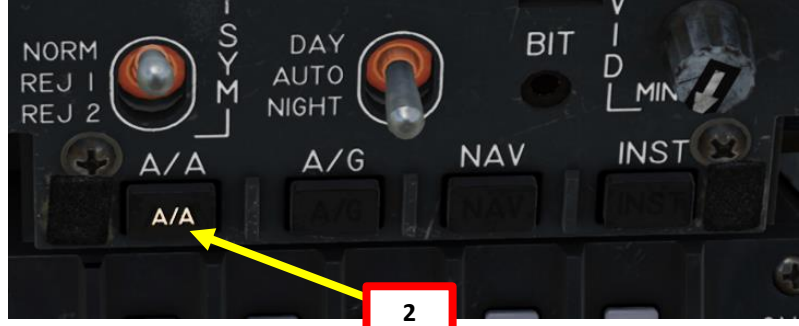


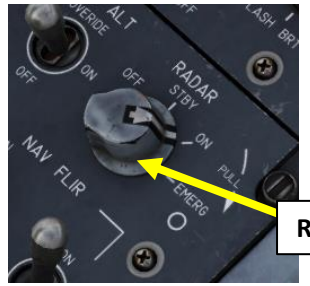


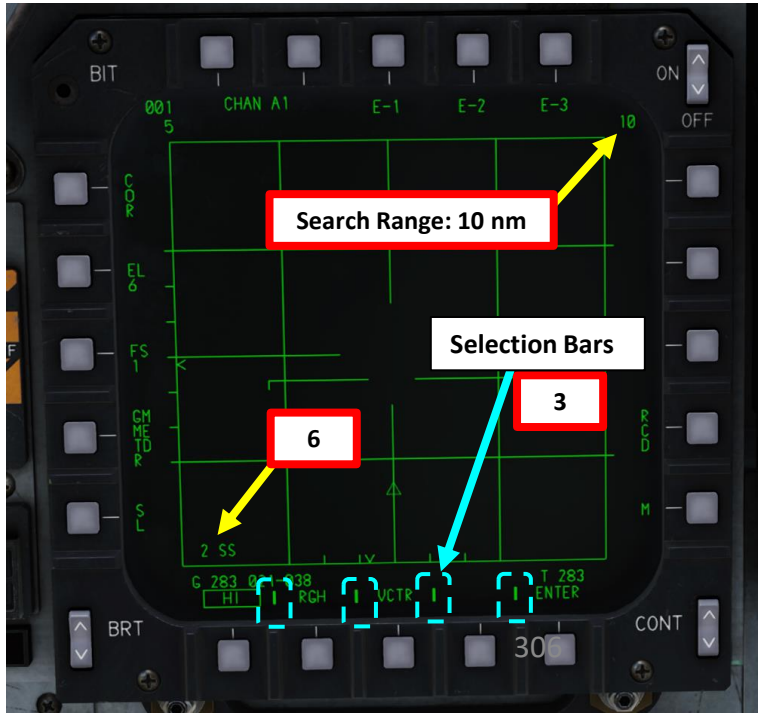
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.1 – SS (Supersearch) Sub-Mode

Supersearch auto acquisition mode automatically scans a **20 deg x 20 deg area in 6-bar scan pattern** until a lockon is achieved or the crew selects a return to search. Radar **search range is between 500 ft and 10 nm**. To enter Supersearch:

1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
5. Press Auto Acquisition Switch FWD SHORT (less than 1 sec).
6. On the A/A RDR page, the "SS" legend indicates that the radar has entered Supersearch mode. The number before it indicates current bar (between 1 and 6).
7. On the HUD (Heads-Up Display), the large circle indicates the area painted/searched by the radar.



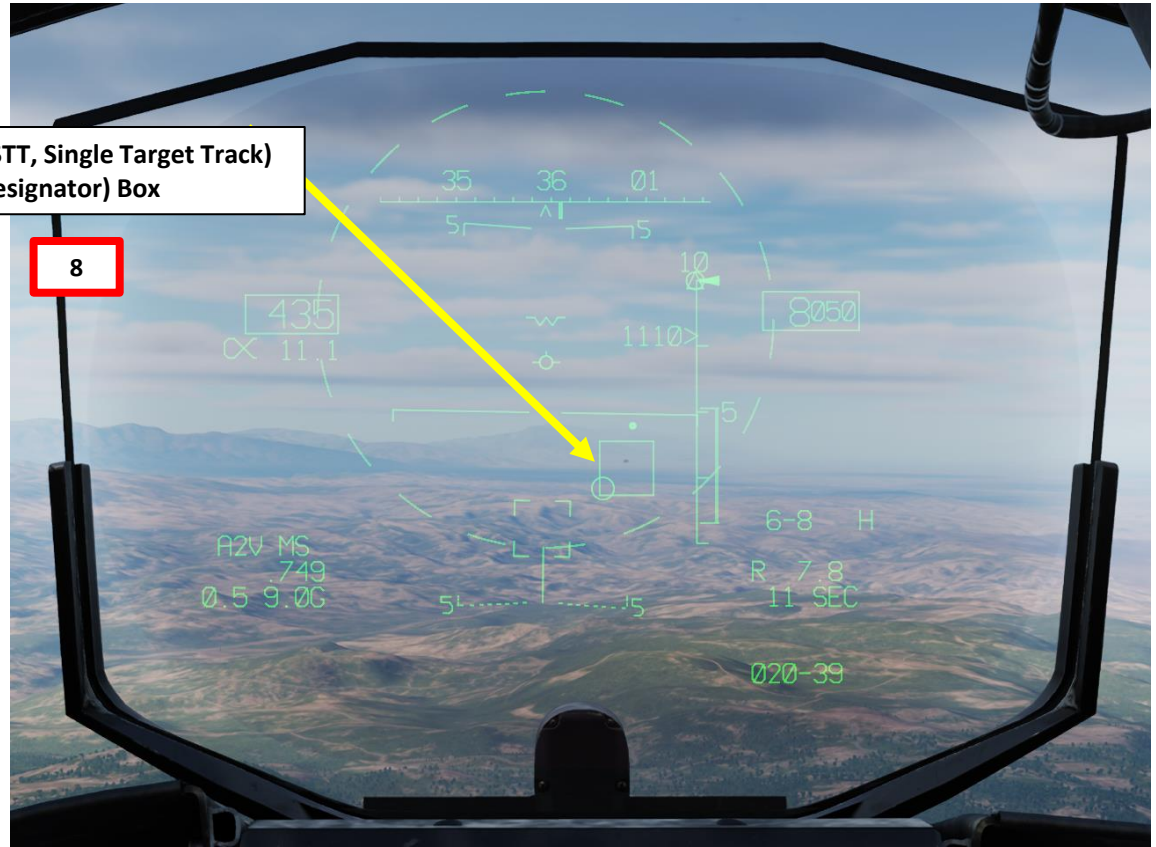




2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.1 – SS (Supersearch) Sub-Mode

8. As soon as a radar target is detected within the search area, a lock is attempted to enter STT (Single Target Track).
9. To unlock target: Depress the Auto Acquisition Switch on the pilot's stick.

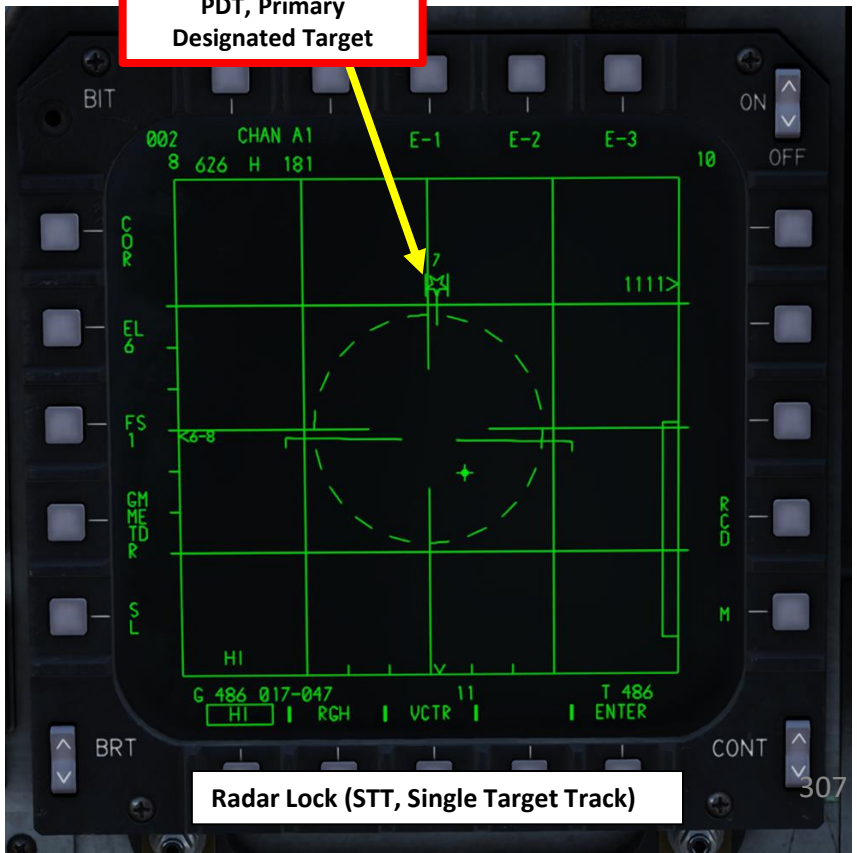
Auto Acquisition Switch / Air Refueling Release Switch **9**
- *FWD/AFT/PRESS*



Radar Lock (STT, Single Target Track)
TD (Target Designator) Box

8

PDT, Primary Designated Target

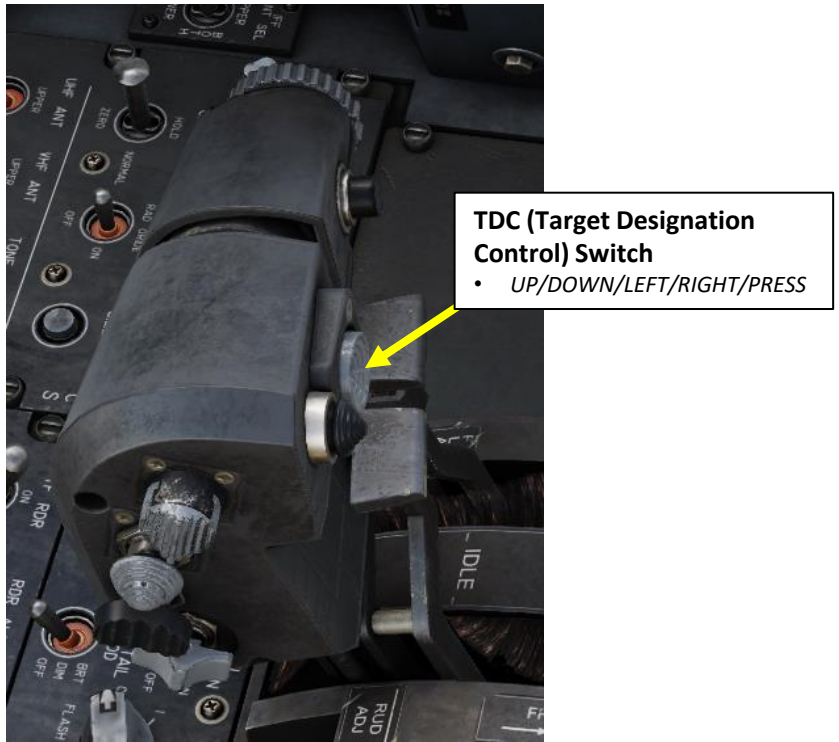


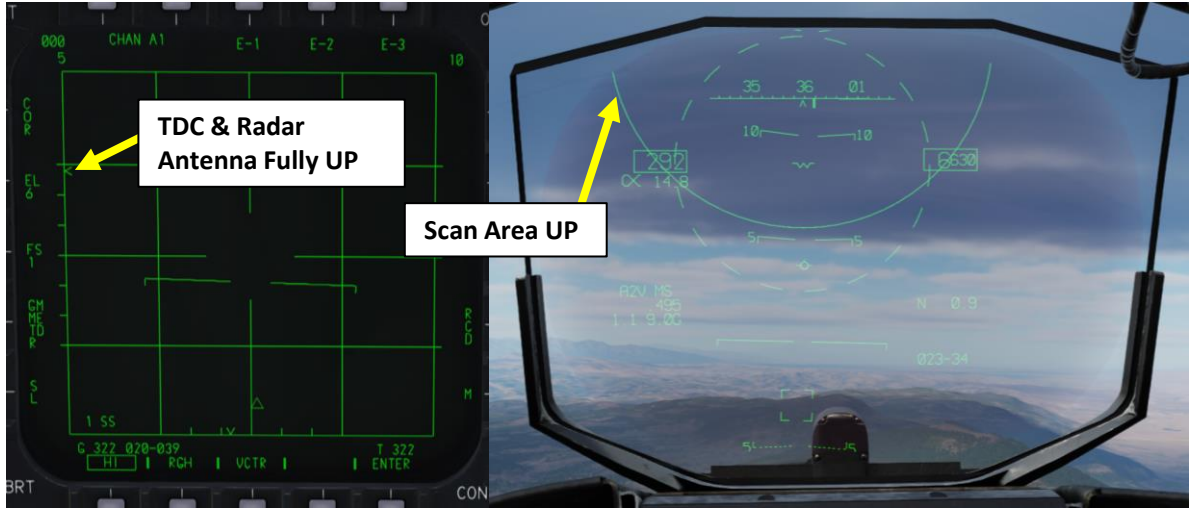
Radar Lock (STT, Single Target Track)

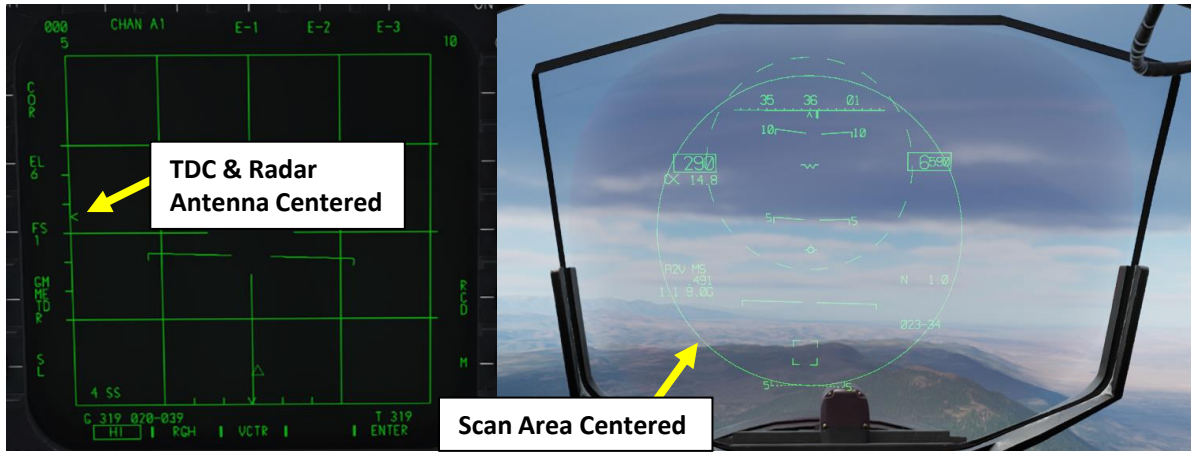
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.1 – SS (Supersearch) Sub-Mode

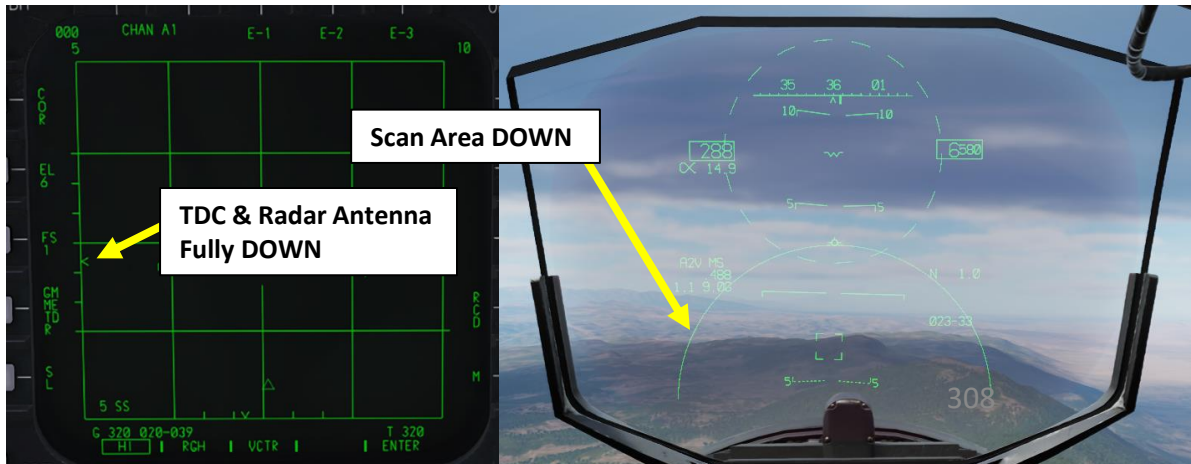
Note: the pilot can move the radar antenna up or down in the vertical plane using the **TDC (Target Designation Control)**.

- Full UP motion of the TDC places the center of the scan at +28 deg.
- Full DOWN motion of the TDC places the center of the scan to -19 deg.





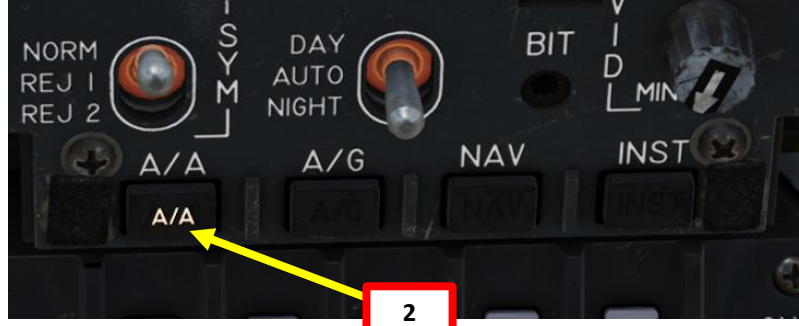


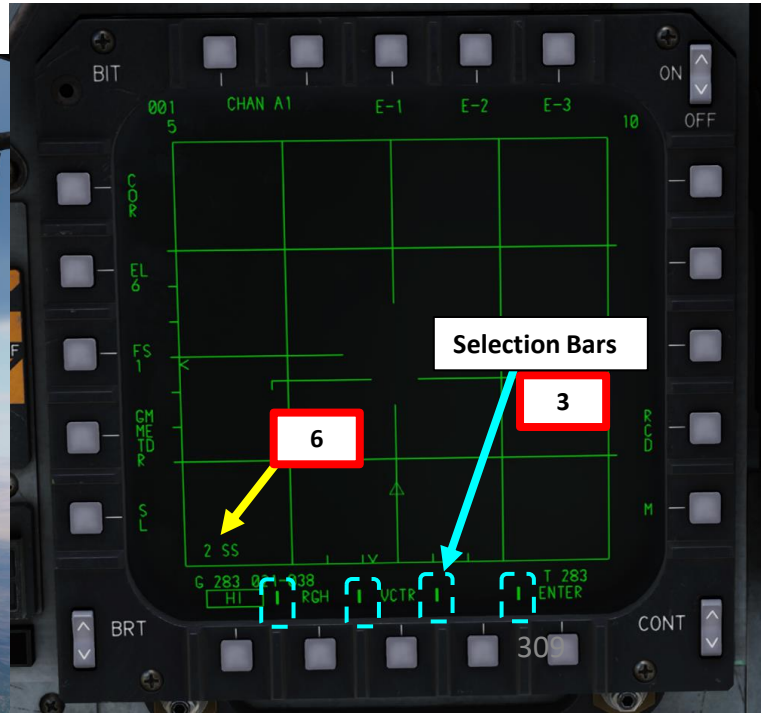


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.2 – BST (Boresight) Sub-Mode

Boresight auto acquisition mode automatically scans a **4 deg circular area** until a lockon is achieved or the crew selects a return to search. The radar antenna is slaved to the Radar Boresight Line (RBL). Radar **search range is between 500 ft and 10 nm**. To enter Boresight:

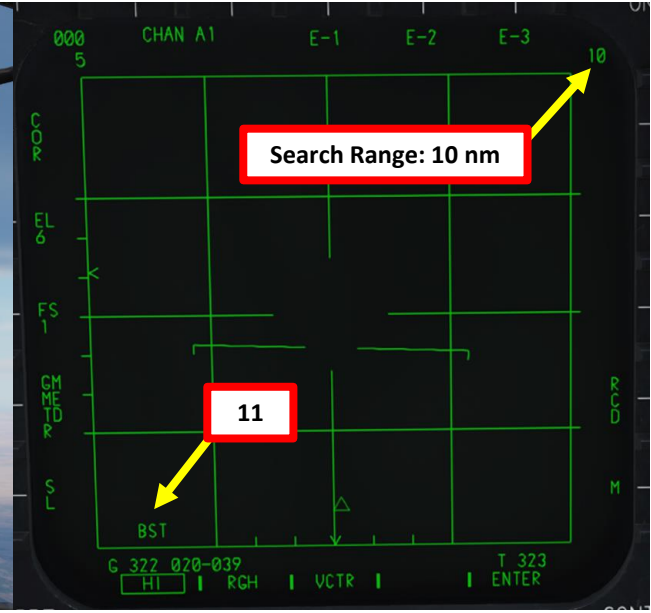
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
5. Press Auto Acquisition Switch FWD SHORT (less than 1 sec).
6. On the A/A RDR page, the "SS" legend indicates that the radar has entered Supersearch mode.

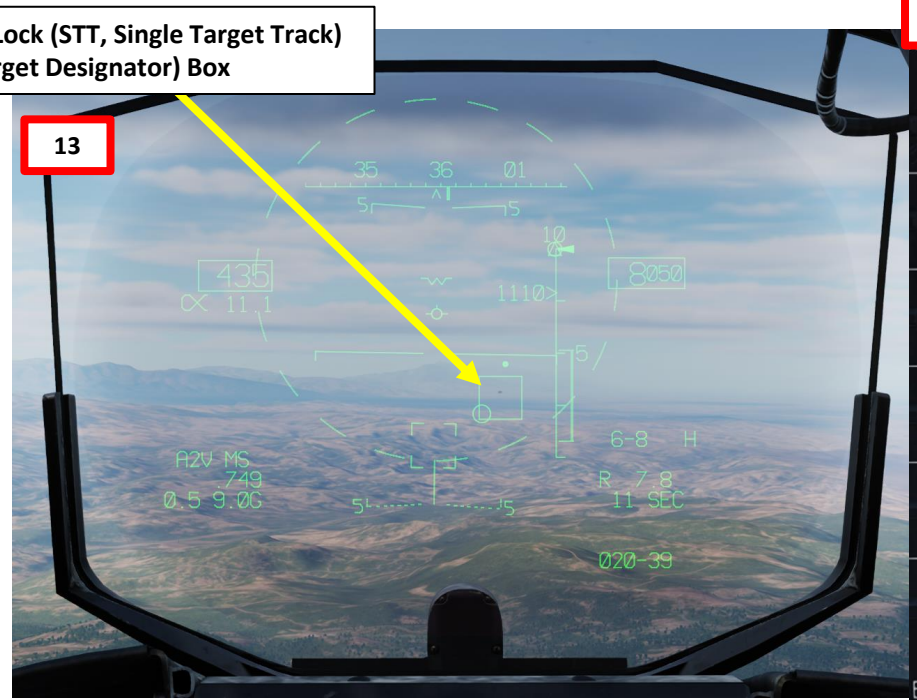


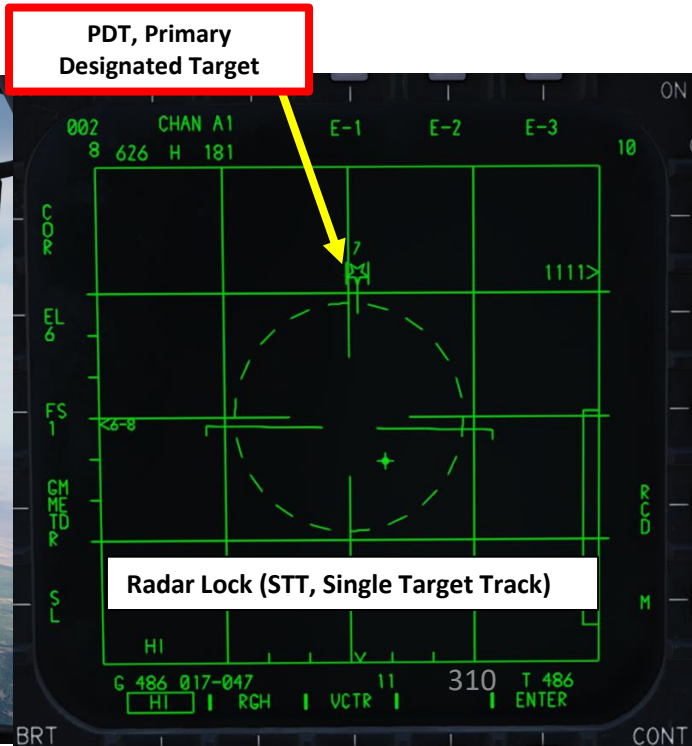


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.2 – BST (Boresight) Sub-Mode

10. Press Auto Acquisition Switch FWD SHORT (less than 1 sec) a second time to enter BST mode from SS mode.
11. On the A/A RDR page, the "BST" legend indicates that the radar has entered Boresight mode.
12. On the HUD (Heads-Up Display), the circle indicates the area painted/searched by the radar.
13. As soon as a radar target is detected within the search area, a lock is attempted to enter STT (Single Target Track)
14. To unlock target: Depress the Auto Acquisition Switch on the pilot's stick.



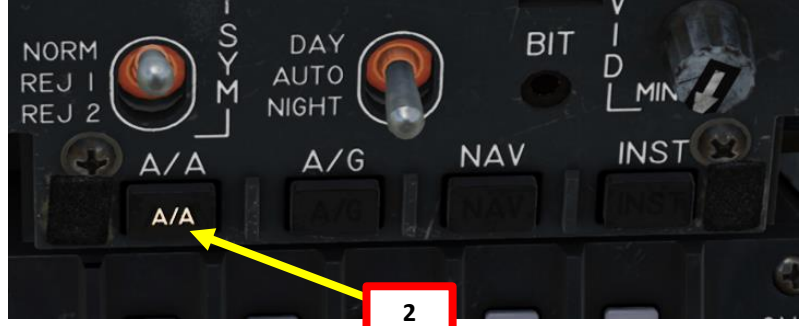


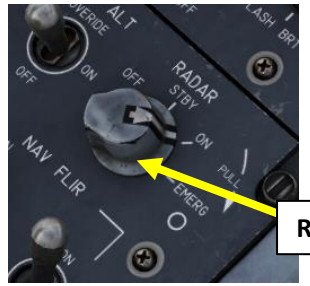


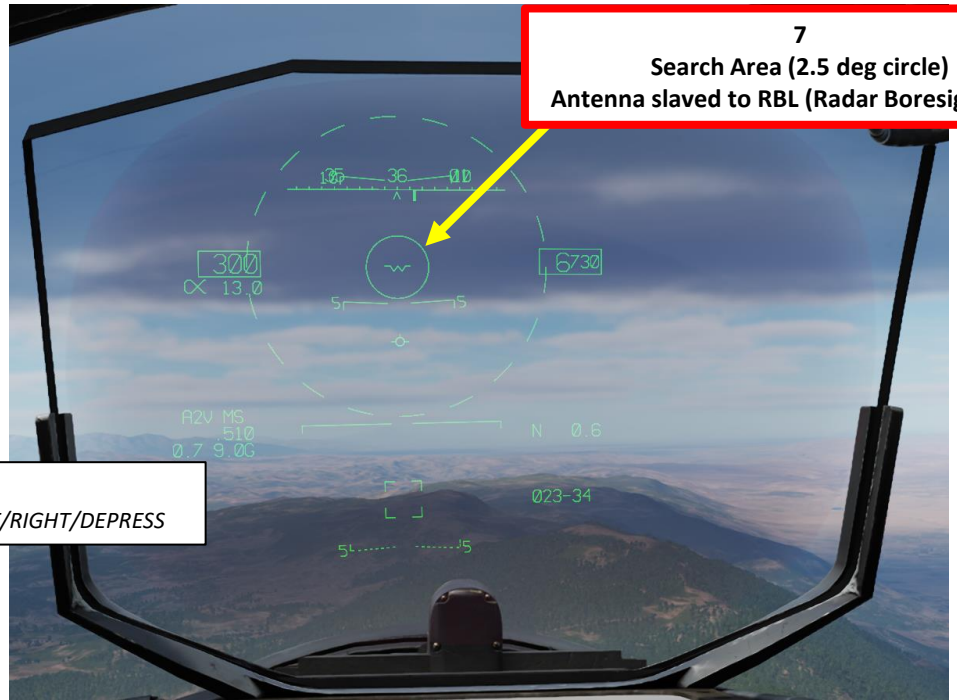
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.3 – LR BST (Long Range Boresight) Sub-Mode

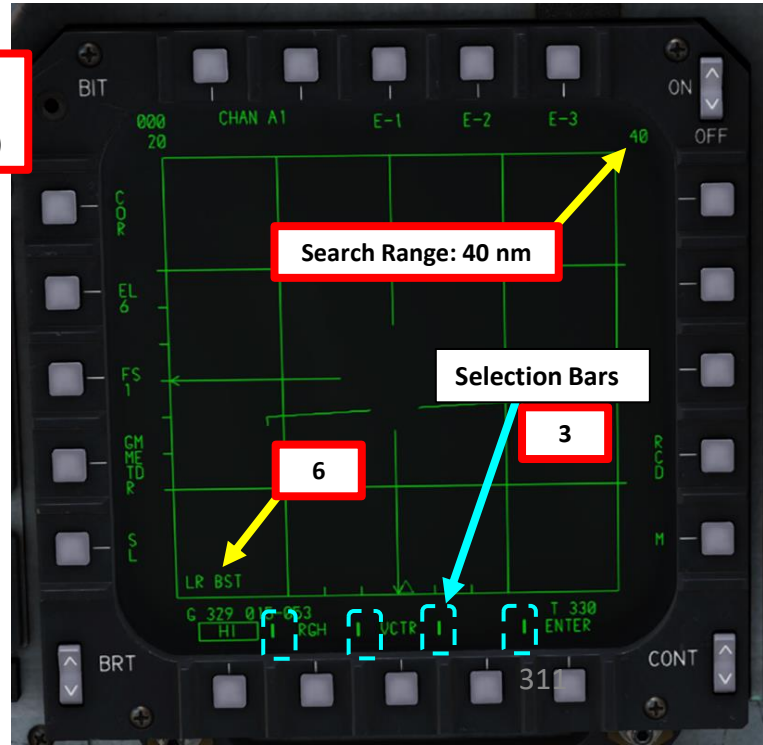
Long Range Boresight auto acquisition mode automatically scans a **2.5 deg circular area** until a lockon is achieved or the crew selects a return to search. The radar antenna is slaved to the Radar Boresight Line (RBL). Radar **search range is between 3000 ft and 40 nm**. To enter Long Range Boresight:

1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
5. Press Auto Acquisition Switch FWD LONG (more than 1 sec).
6. On the A/A RDR page, the "LR BST" legend indicates that the radar has entered Long Range Boresight mode.
7. On the HUD (Heads-Up Display), the circle indicates the area painted/searched by the radar.





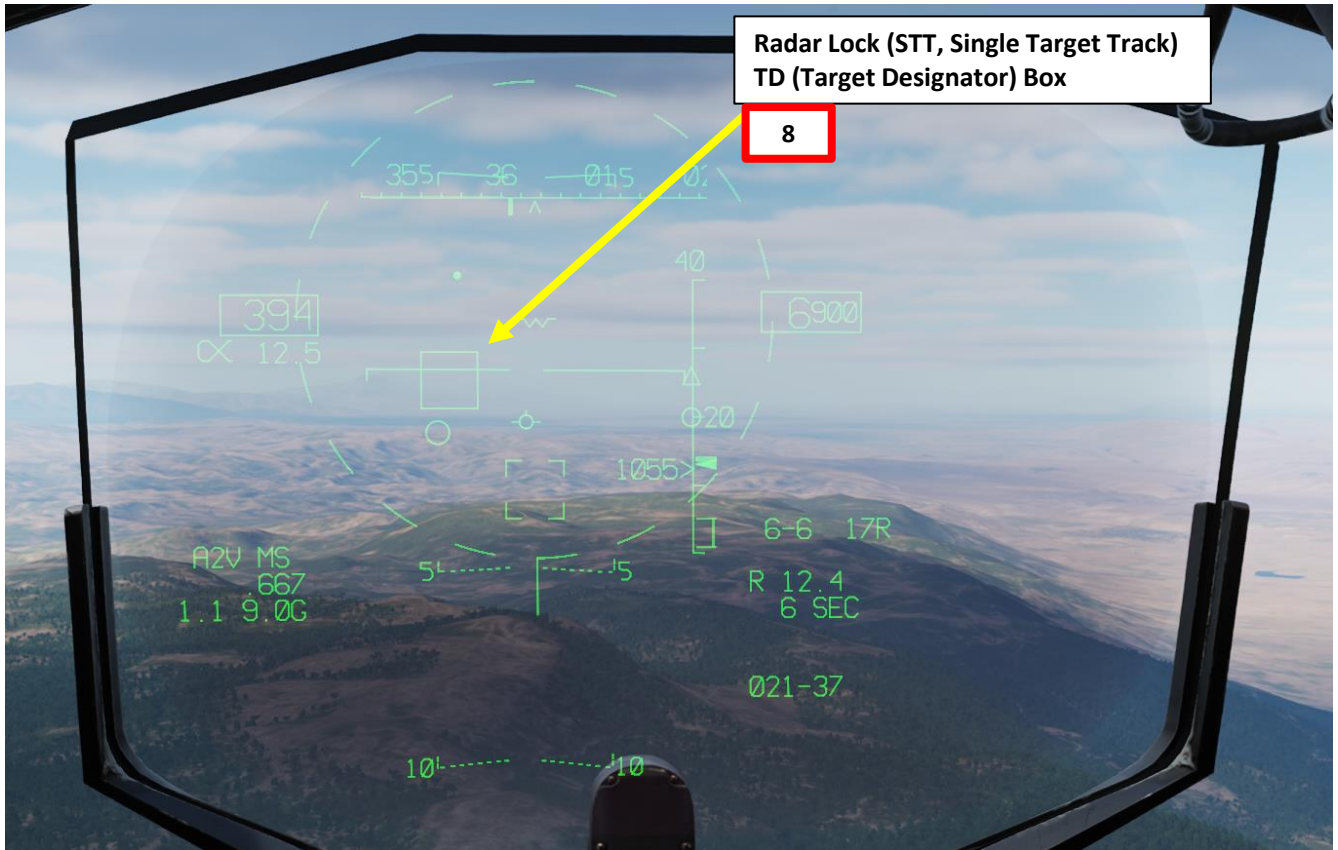


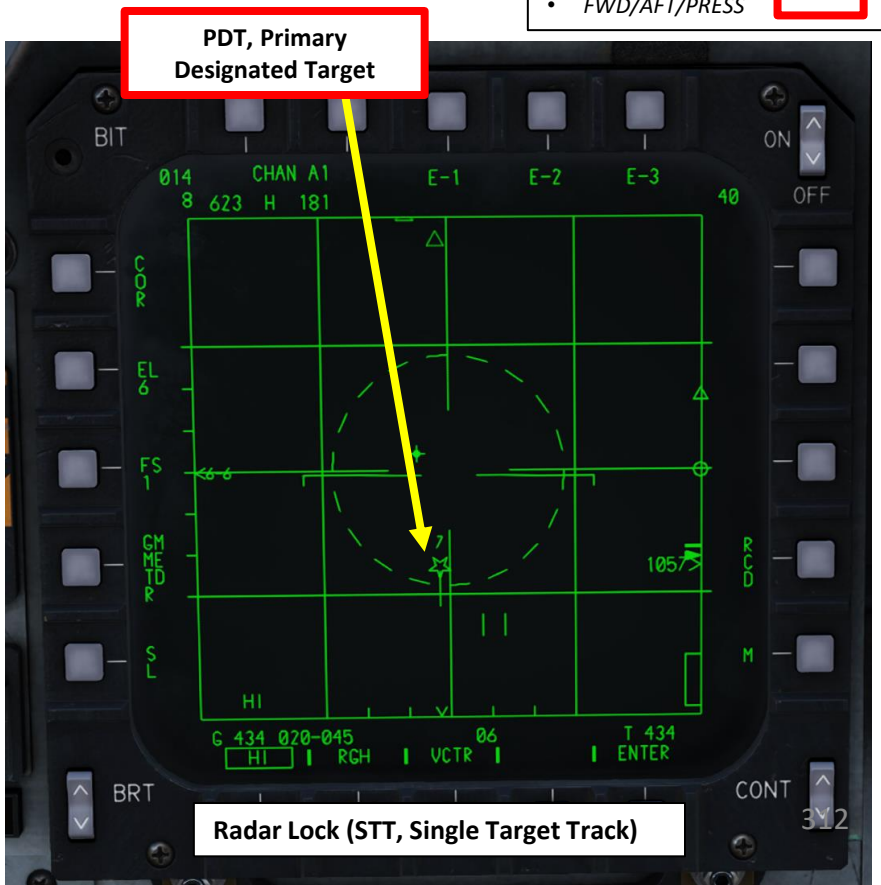


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.3 – LR BST (Long Range Boresight) Sub-Mode

8. As soon as a radar target is detected within the search area, a lock is attempted to enter STT (Single Target Track).
9. To unlock target: Depress the Auto Acquisition Switch on the pilot's stick.

Auto Acquisition Switch / Air Refueling Release Switch 9
- *FWD/AFT/PRESS*

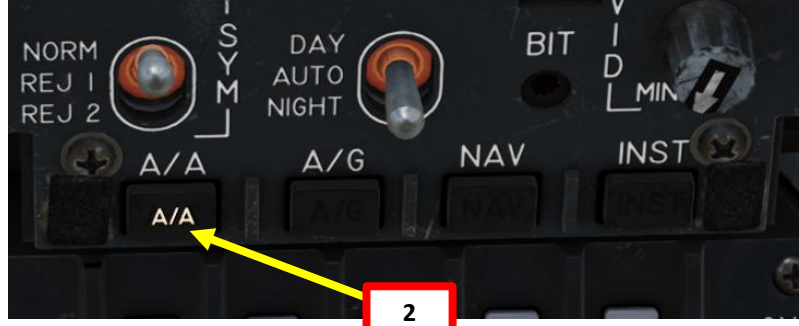


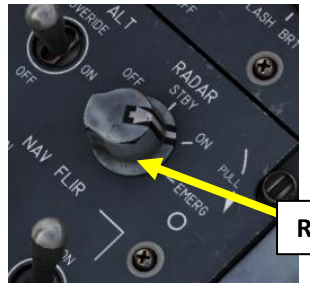


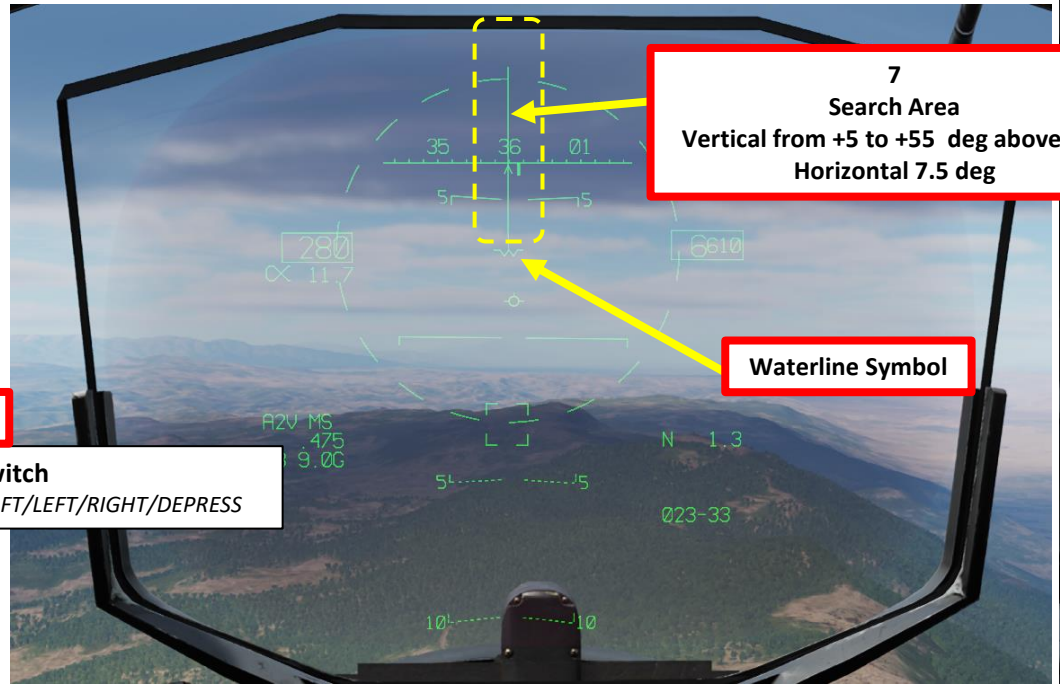
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.4 – VTS (Vertical Scan) Sub-Mode

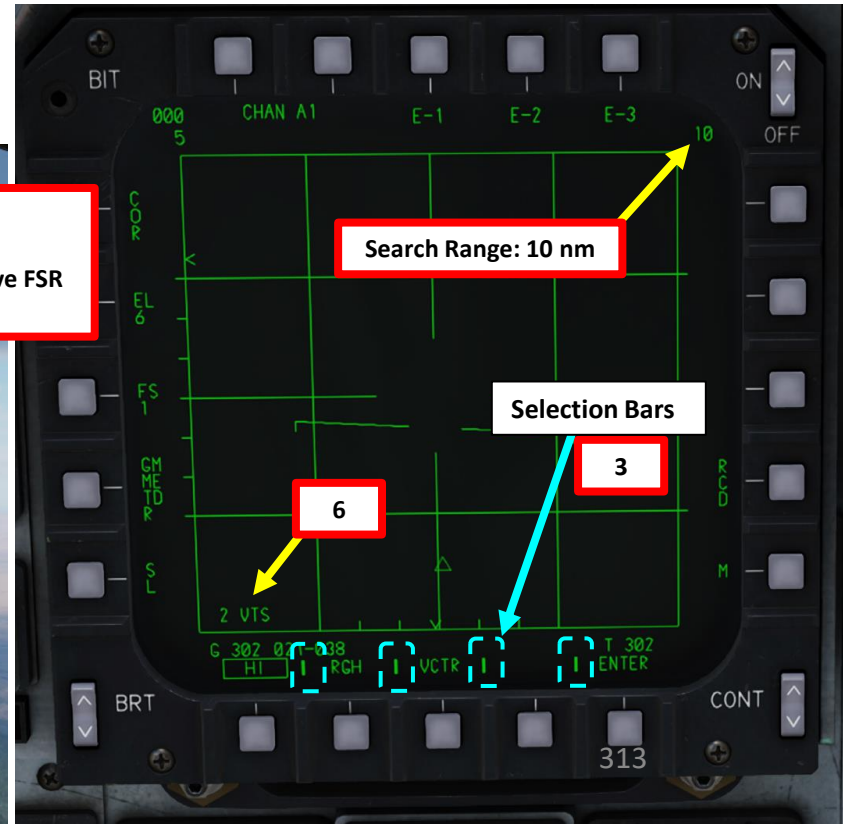
Vertical Scan auto acquisition mode automatically scans vertically an aircraft-stabilized area from +5 deg to +55 deg above the Fuselage Reference Line (FSR) until a lockon is achieved or the crew selects a return to search. The horizontal scan is 7.5 deg. Radar **search range is between 500 ft and 10 nm**. To enter Vertical Scan:

1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
5. Press Auto Acquisition Switch AFT SHORT (less than 1 sec).
6. On the A/A RDR page, the "VTS" legend indicates that the radar has entered Vertical Scan mode. The number before it indicates current bar (between 1 and 6).
7. On the HUD (Heads-Up Display), a vertical line extends from the Waterline Symbol to signify that the radar is in VTS.





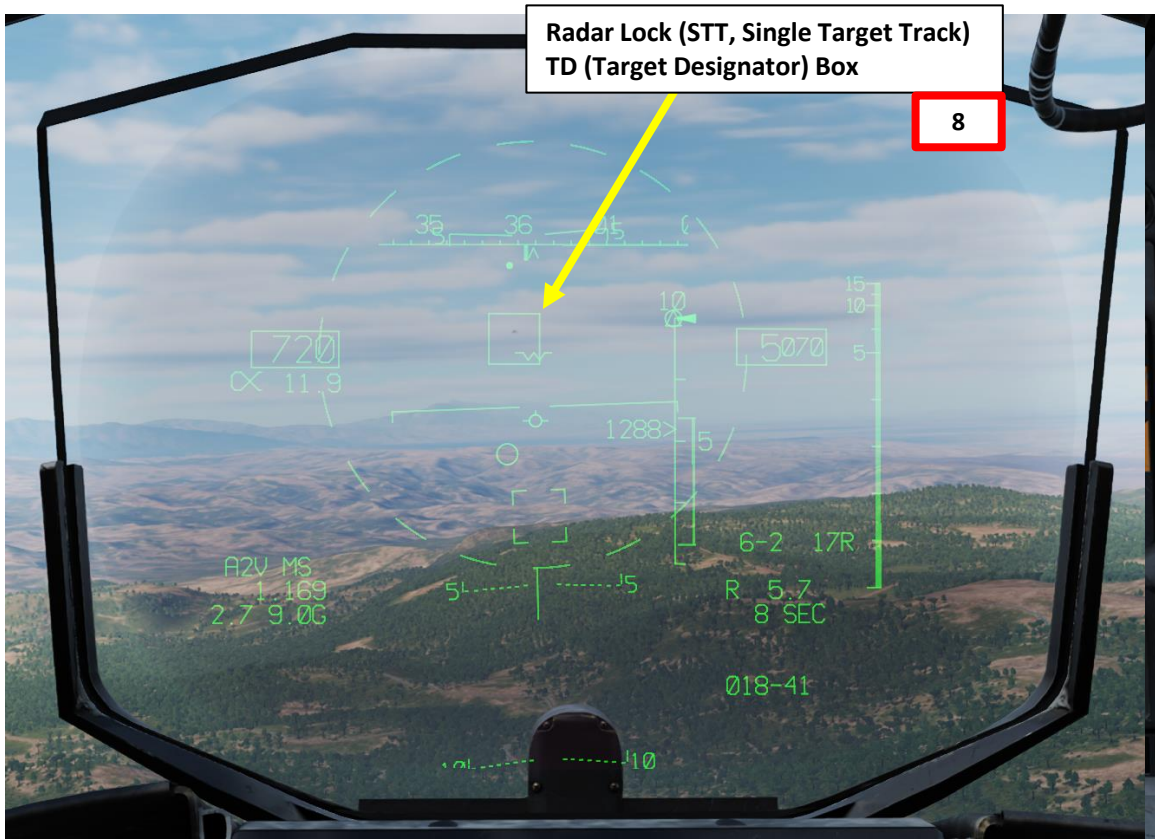


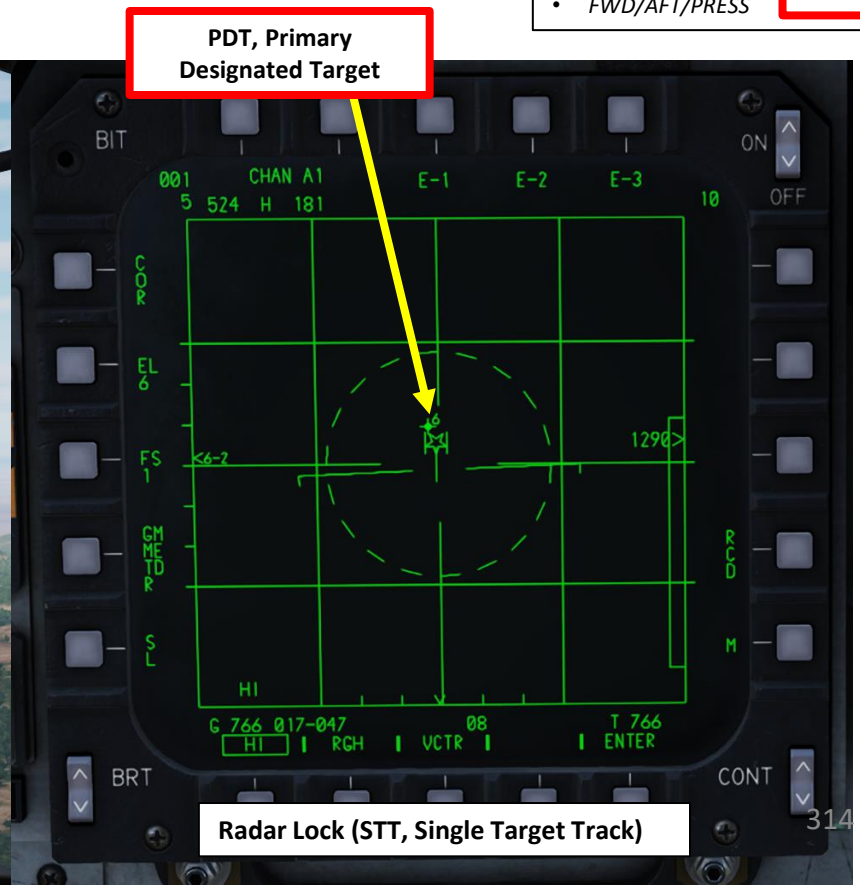


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.4 – VTS (Vertical Scan) Sub-Mode

8. As soon as a radar target is detected within the search area, a lock is attempted to enter STT (Single Target Track).
9. To unlock target: Depress the Auto Acquisition Switch on the pilot's stick.

Auto Acquisition Switch / Air Refueling Release Switch **9**
- *FWD/AFT/PRESS*

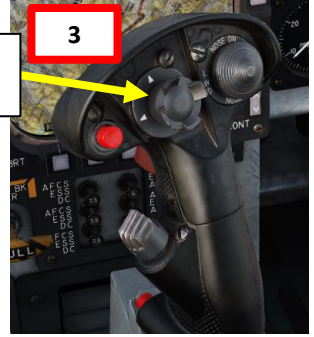


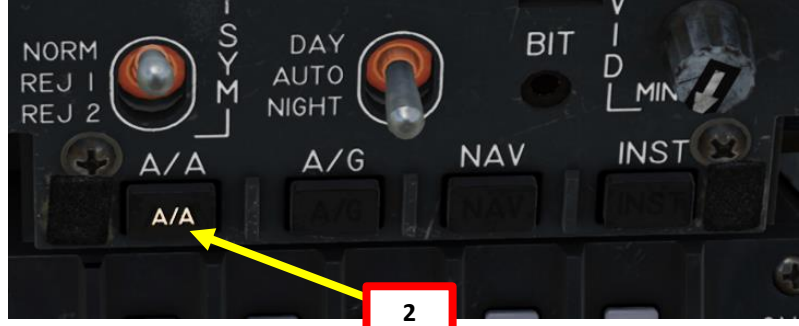


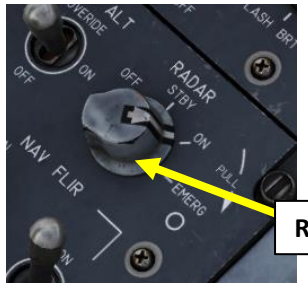
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.5 – Guns Sub-Mode

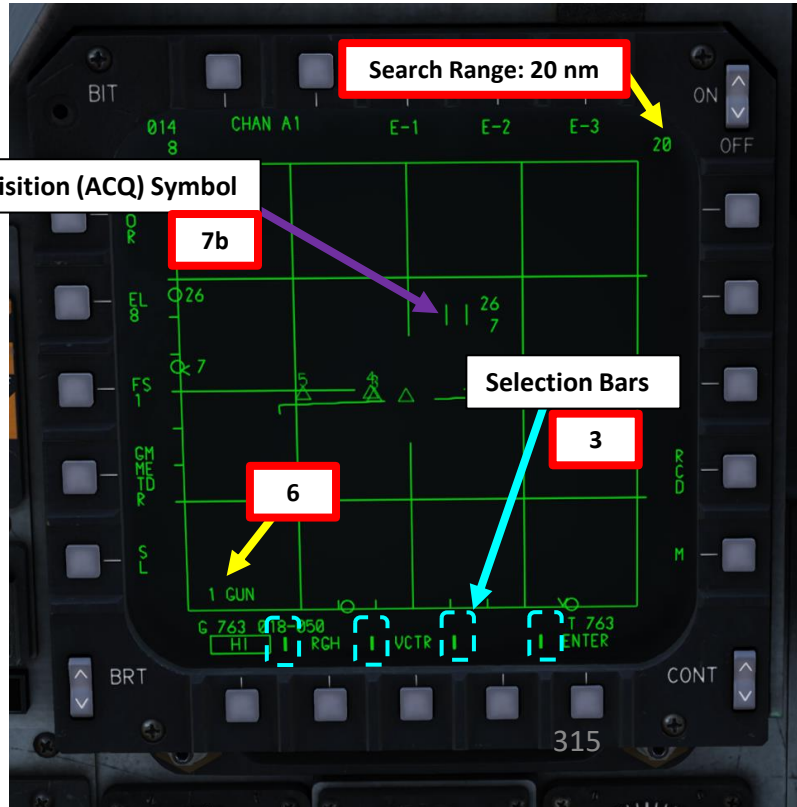
Guns auto acquisition mode automatically scans a positionable pattern **(60 deg in azimuth x 20 deg in elevation)** until a lockon is achieved or the crew selects a return to search. The pattern is 6 bars with a 3.4 deg bar spacing and is space stabilized. Radar **search range is between 3000 ft and 15 nm**. To enter Guns:

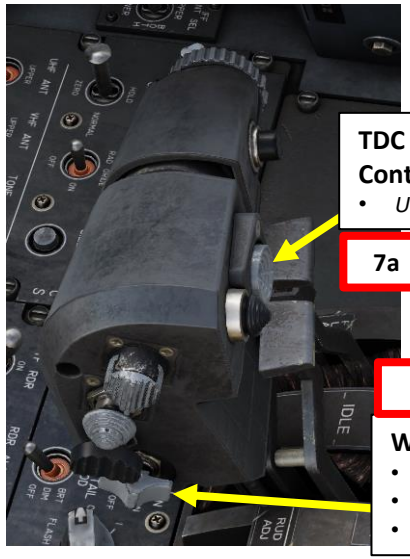
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
5. Press Weapon / Mode (Weapon Select) Switch AFT (Auto Guns position).
6. On the A/A RDR page, the "GUN" legend indicates that the radar has entered Guns mode. The number before it indicates current bar (between 1 and 6).
7. The center of the search pattern is indicated by the acquisition symbol (ACQ), which can be positioned in azimuth and elevation using the TDC.

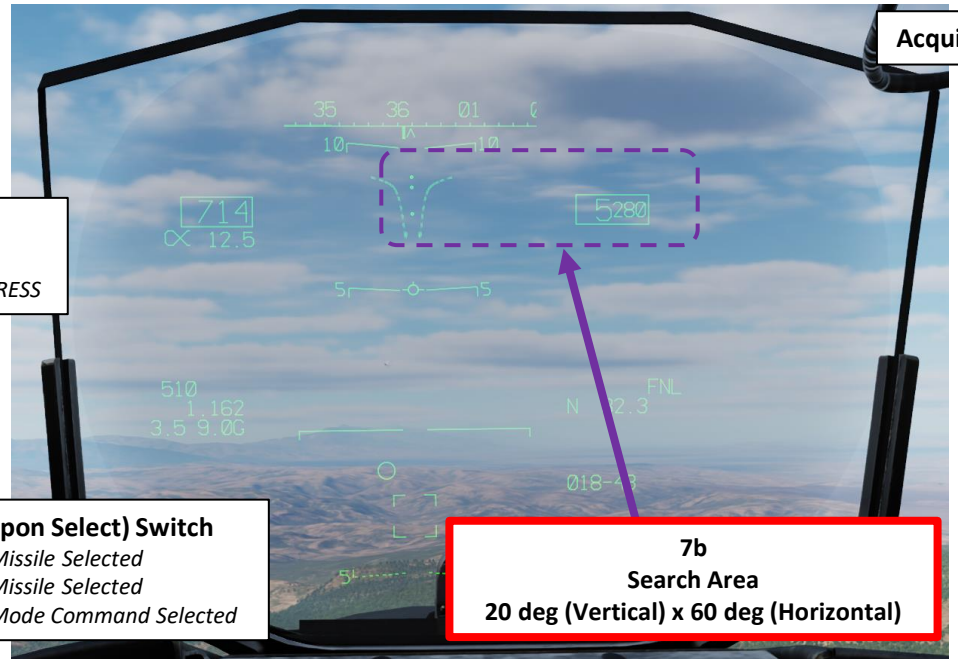








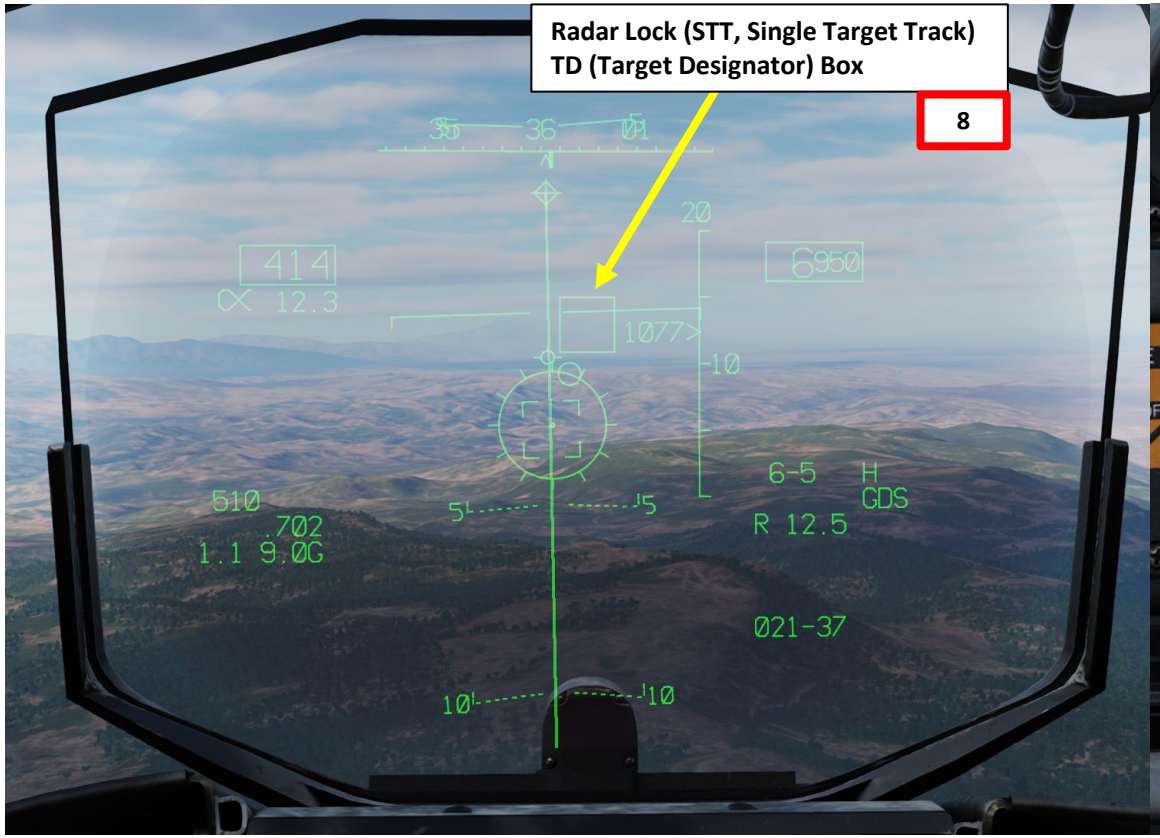


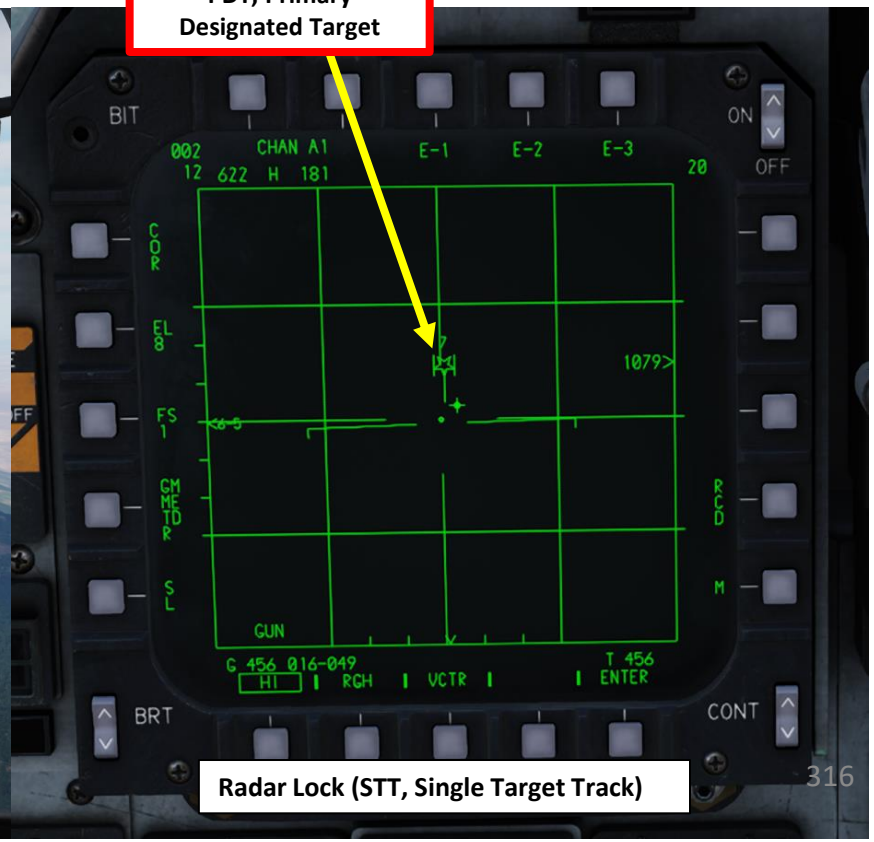


2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.8 – Auto Acquisition Modes
2.1.8.5 – Guns Sub-Mode

8. As soon as a radar target is detected within the search area, a lock is attempted to enter STT (Single Target Track).
9. To unlock target: Depress the Auto Acquisition Switch on the pilot's stick.

Auto Acquisition Switch / Air Refueling Release Switch **9**
- *FWD/AFT/PRESS*





2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.9 – Radar Electronic Protection

Radar Electronic Protection Modes

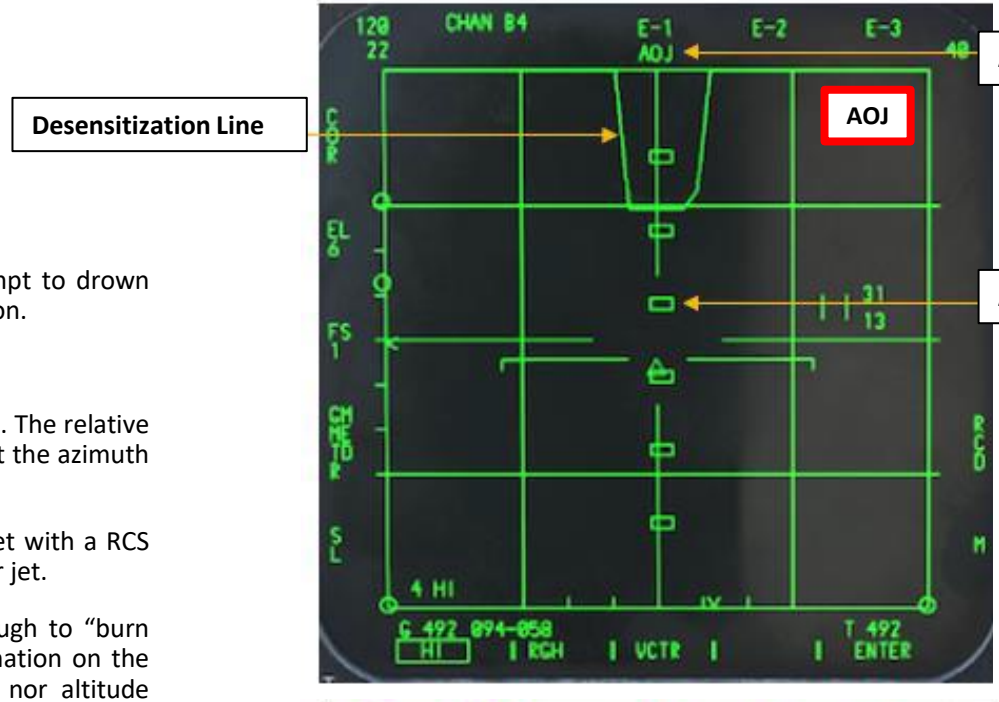
The radar has the capability of detecting electronic attack devices like jammers, which attempt to drown radar returns in “noise”. This has the effect of providing incorrect radar contact range and location.

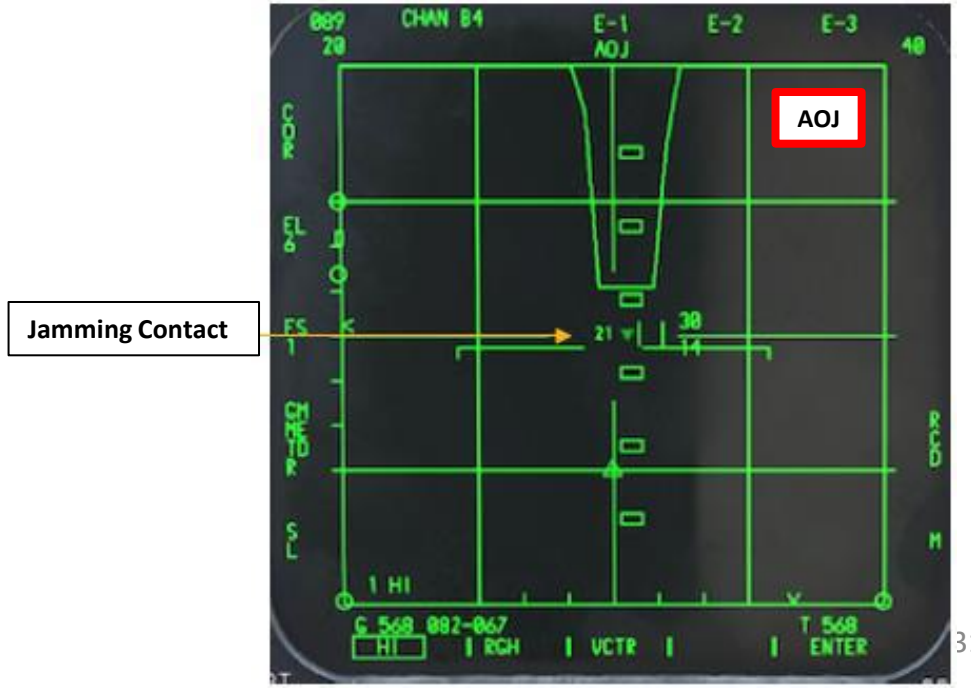
Angle of Jam (AOJ) Track Mode

If the OJ (Angle of Jam) cue is visible, a noise jammer is detected during radar search operations. The relative bearing of the jammer is indicated by the AOJ strobe; the symbols are evenly spaced in range at the azimuth position of the jammer.

The desensitization line is the estimated range at which the aircraft’s radar is blind for a target with a RCS (radar cross-section) of 5 square meters, which is approximately the RCS value for a Su-30 fighter jet.

Until burn-through is achieved (meaning that you approach the incoming jammer close enough to “burn through” the jamming signals, allowing you to obtain relatively accurate radar ranging information on the jamming target), 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.





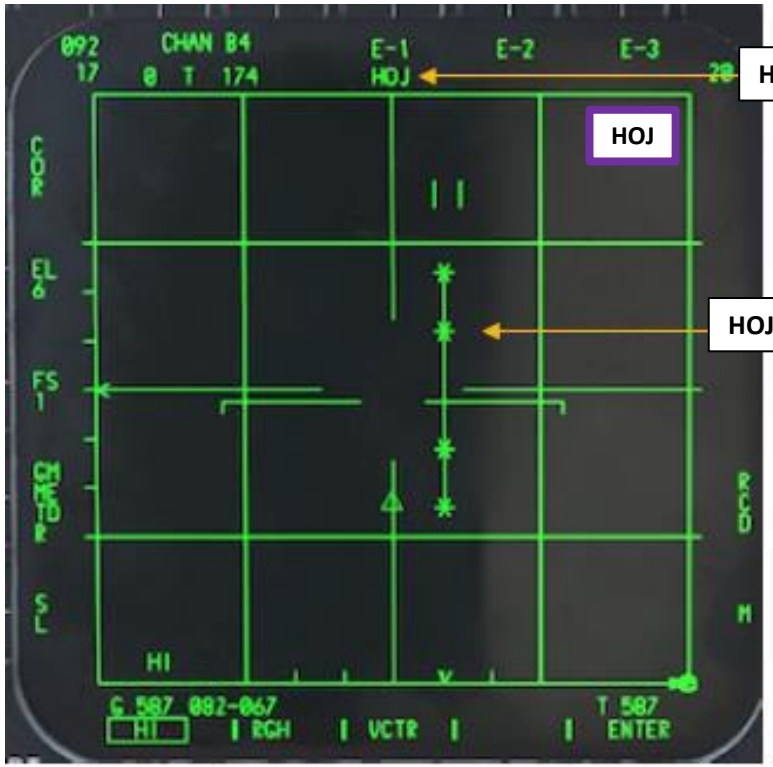
2 – AN/APG-70 RADAR
2.1 – Air-to-Air Modes
2.1.9 – Radar Electronic Protection

Home on Jam (HOJ) Mode

If the HOJ Cue is visible, the radar is locking/homing on the source of a jamming signal emitter. After lock-on, the contact's position is displayed on the HUD, but the range, closure and altitude data will constantly be changing until burn-through occurs (by approaching the incoming jammer close enough).

JAM Track Mode

If an asterisk/flake symbol is visible, this indicates that the JAM tracking mode is active and that some jamming is detected by the radar antenna; this means that the data provided to the system may be corrupted and that ranging information is unknown and is being extrapolated by the radar.



Home on Jam Cue

HOJ Strobe

JAM Track Mode
- *Asterisk/flake symbol means that the range is being extrapolated*

In reality, target is notching (in this case, flying perpendicular to you)

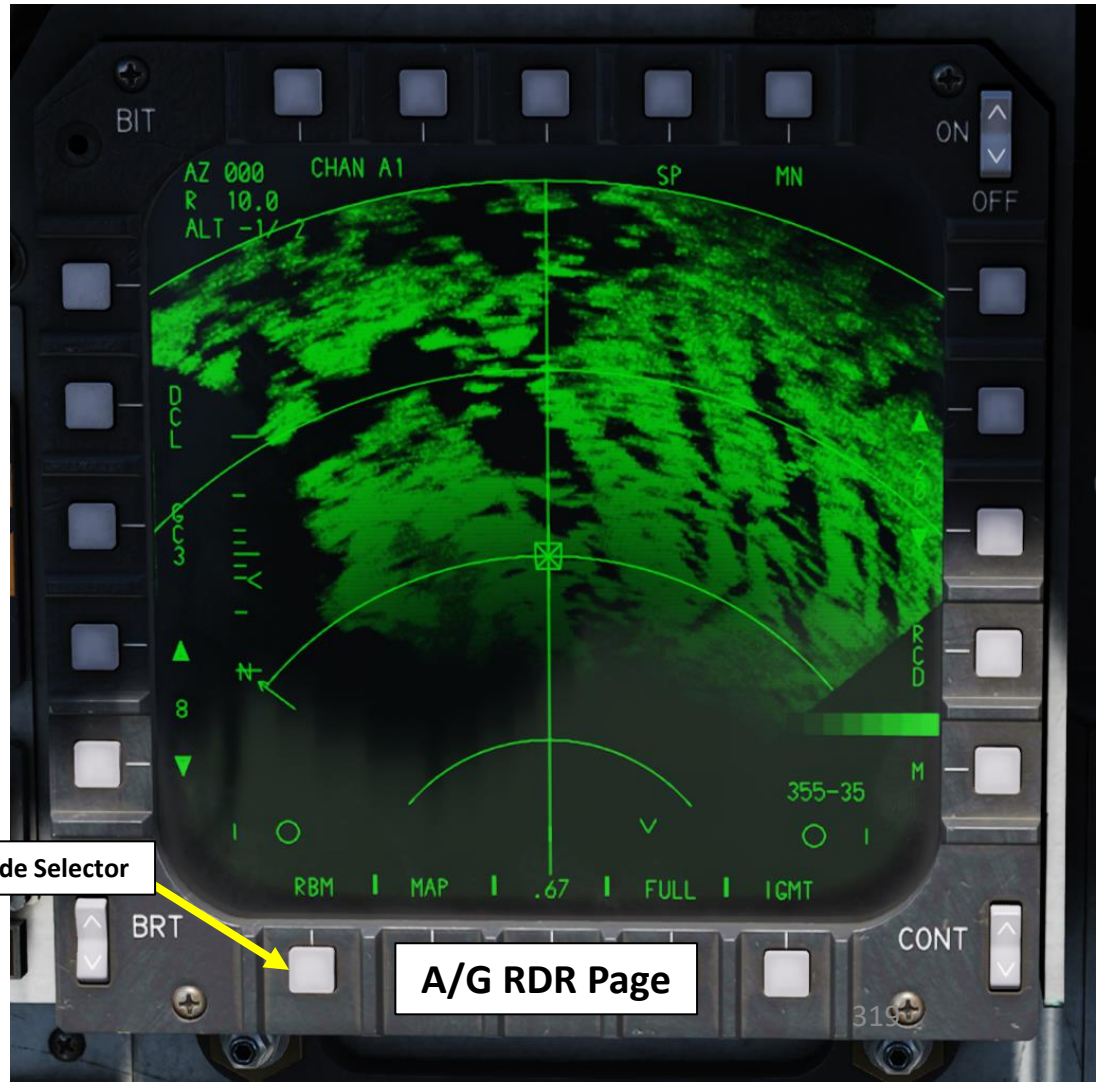
Real range is around 25 nm

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.1 – Air-to-Ground Operating Modes

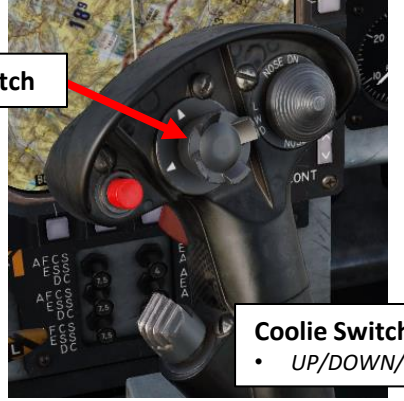
The Air-to-Ground Radar features several operating modes, each designed for specific tasks ranging from target detection and tracking to navigation and ranging. These modes will never be as precise as a targeting pod, but it has a much longer range and can see through cloud layers obscuring the view. Using these functionalities will be entirely up to you and the type of mission you're flying… and the type of ordnance you have available (like JDAMs or JSOWs).

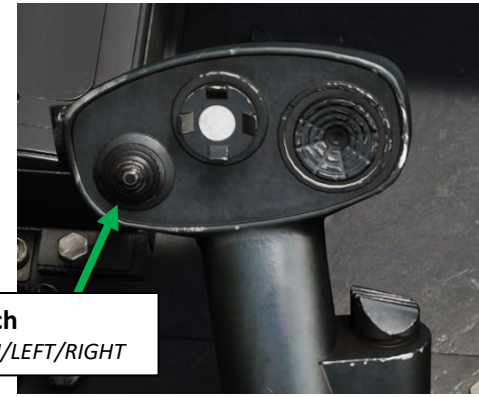
Here is an overview of the different modes available:

- **Real Beam Mapping (RBM):** provides low resolution ground mapping, weather detection and target designation capability.
- **Ground Moving Target (GMT):** detects moving targets on the ground (such as truck convoys, tanks, etc) and facilitates targeting them using the targeting pod.
- **HRM (High Resolution Map):** builds radar maps in high resolution.
- **PVU (Precision Velocity Update):** provides an estimate of velocity error for updating the MN (Mission Navigator) or the INS (Inertial Navigation System).
- **AGR (Air-to-Ground Ranging):** provides slant range measurement for target altitude determination, target designation or position updates.



2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

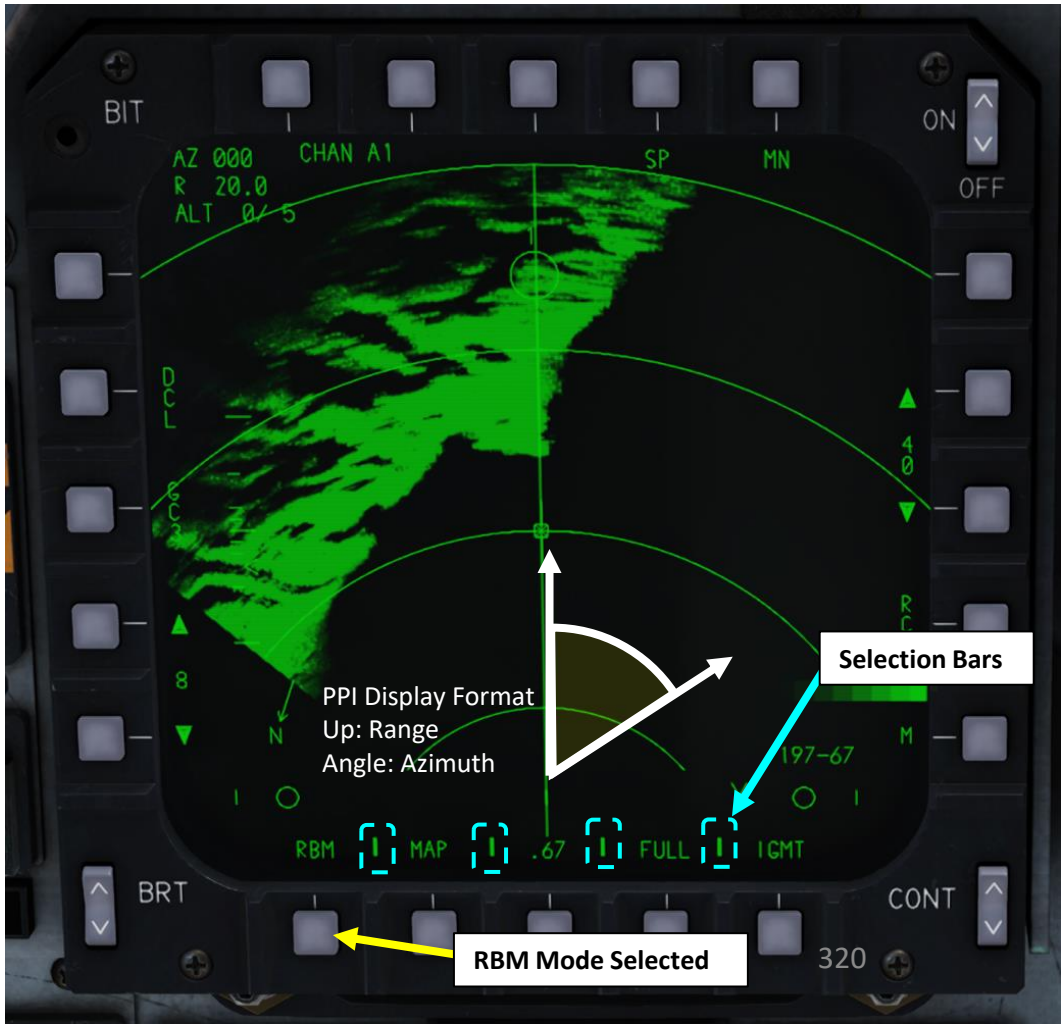




Display

The real beam map (ground mapping) mode is a B-scope raster scan of terrain ahead of the aircraft. Image intensity is a function of the strength of a radar return. The display format is a range versus azimuth Plan-Position-Indicator (PPI), a format similar to the weather radar display on civilian aircraft. Certain ground features will have higher intensity (e.g., buildings or vehicles) and others will have lower intensity (e.g., water). Terrain or tall structures will impede the radar beam from traveling further, creating distinctive shadows, giving the resulting image the appearance of an elevation relief map. Keep in mind that in order to display the ground mapping overlay on the A/G RDR (Air-to-Ground Radar) page, the "RBM" mode should be selected and display should be selected (**selections bars** should be visible) by:

- **Pilot**: pressing Castle Switch LONG (more than 1 sec) in the direction of the radar display.
- **WSO**: using Left/Right Hand Controller Coolie Switch to select desired radar display.
    - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.

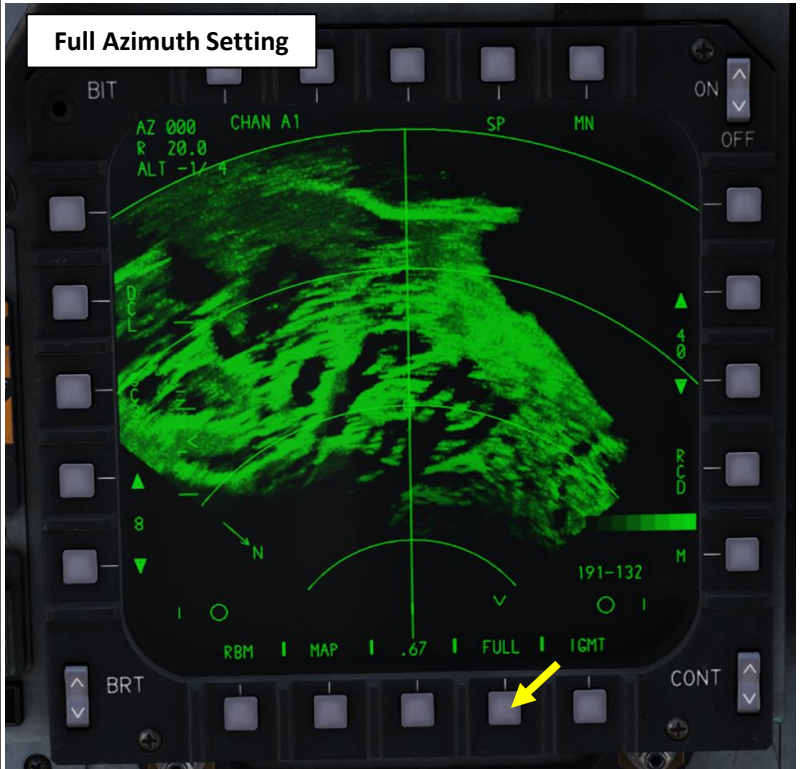


2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

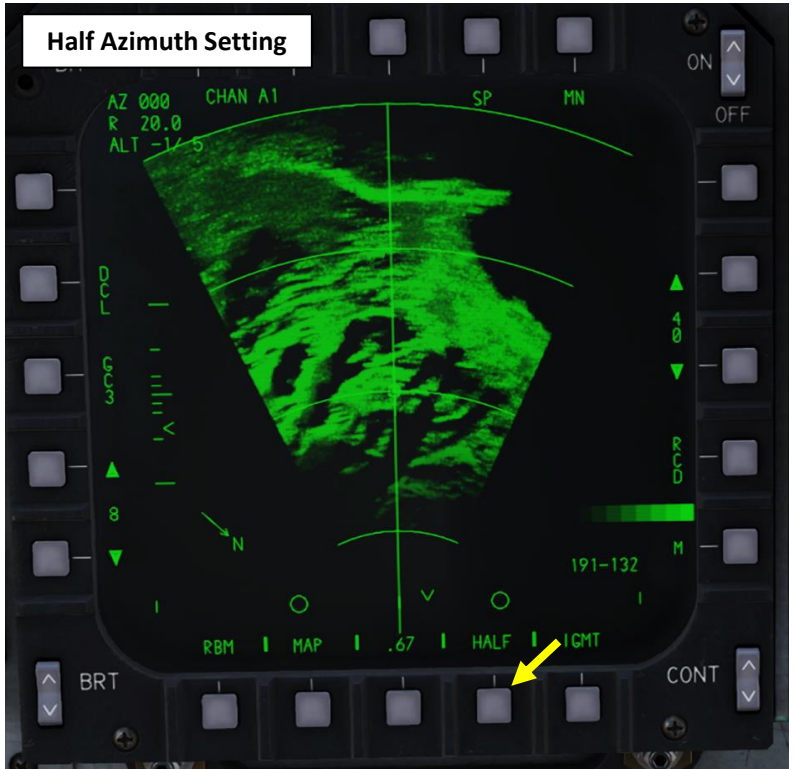
Display

Normally, the radar scans the area in front of the aircraft. RBM uses a single bar azimuth sweep with a full azimuth scan of 100°. You can change the azimuth setting by pressing the button next to FULL/HALF/QUARTER.

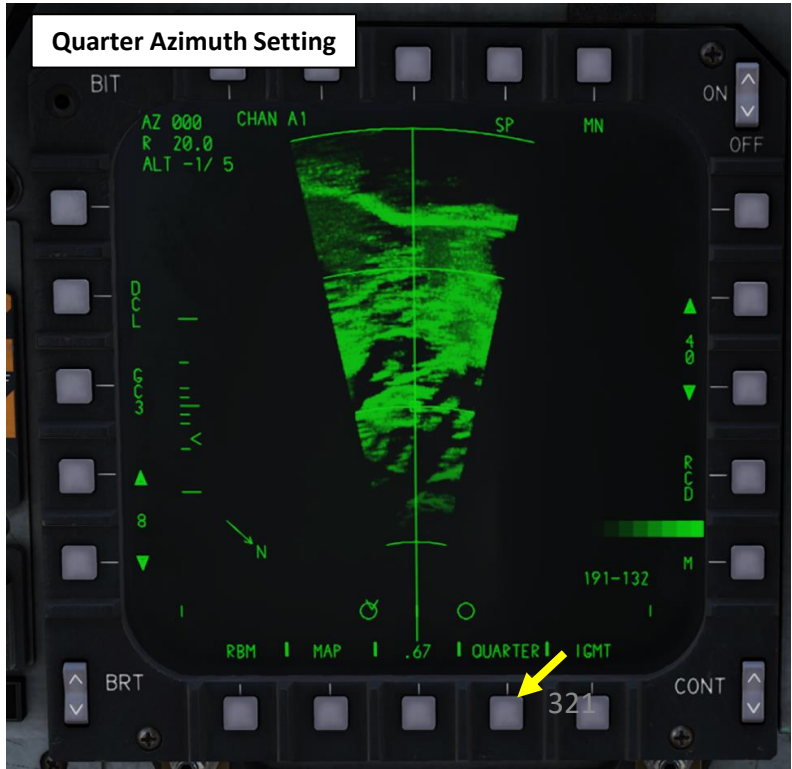
Full Azimuth Setting



Half Azimuth Setting



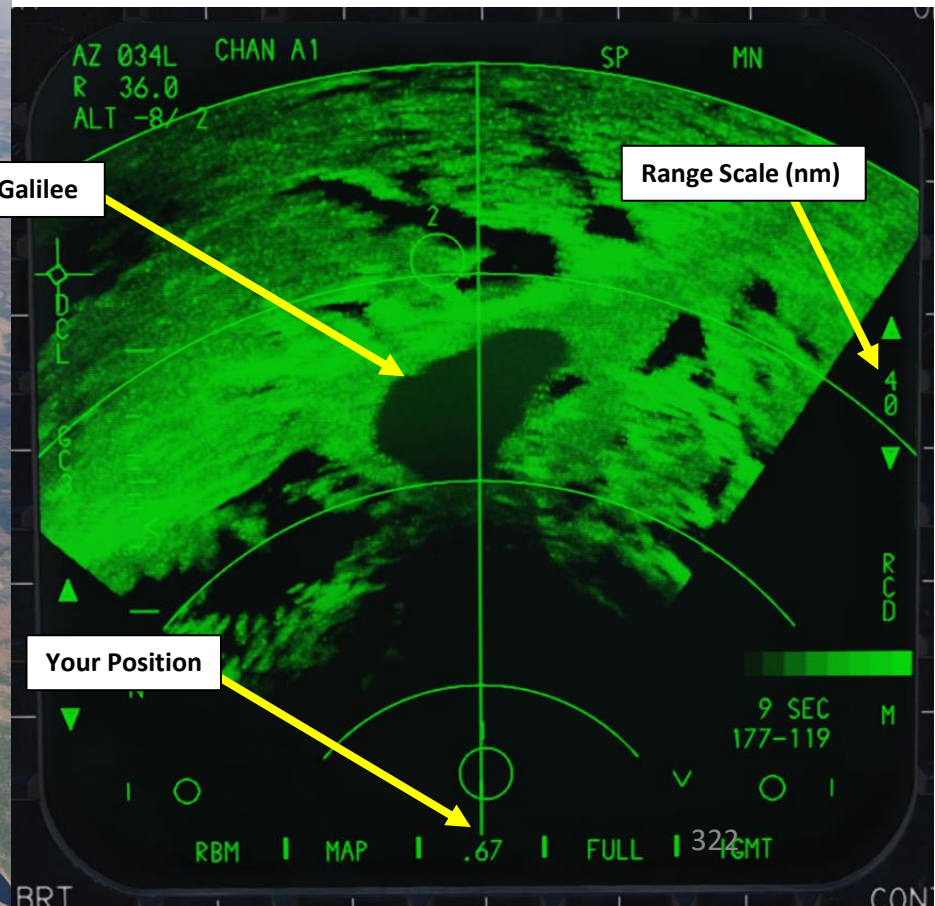
Quarter Azimuth Setting



2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Display

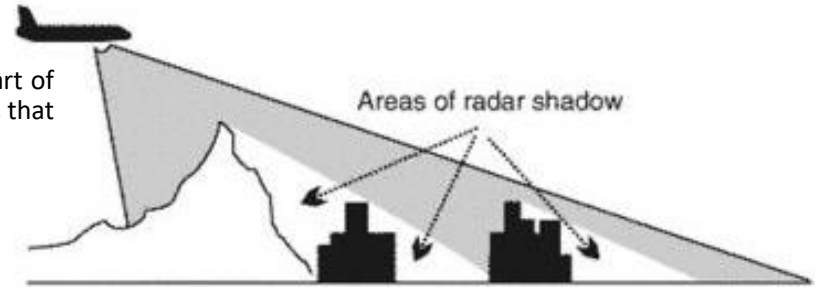
Regions that do not provide radar returns are black (such as water). The bright/green regions are generally man-made structures (buildings, power lines, roads, etc.) or mountains.

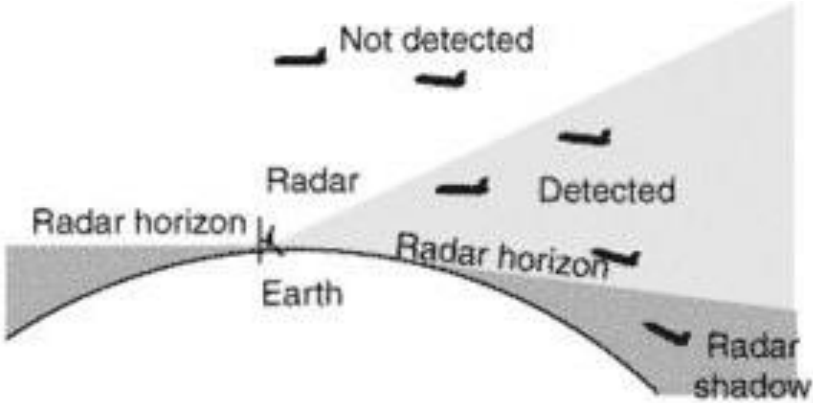


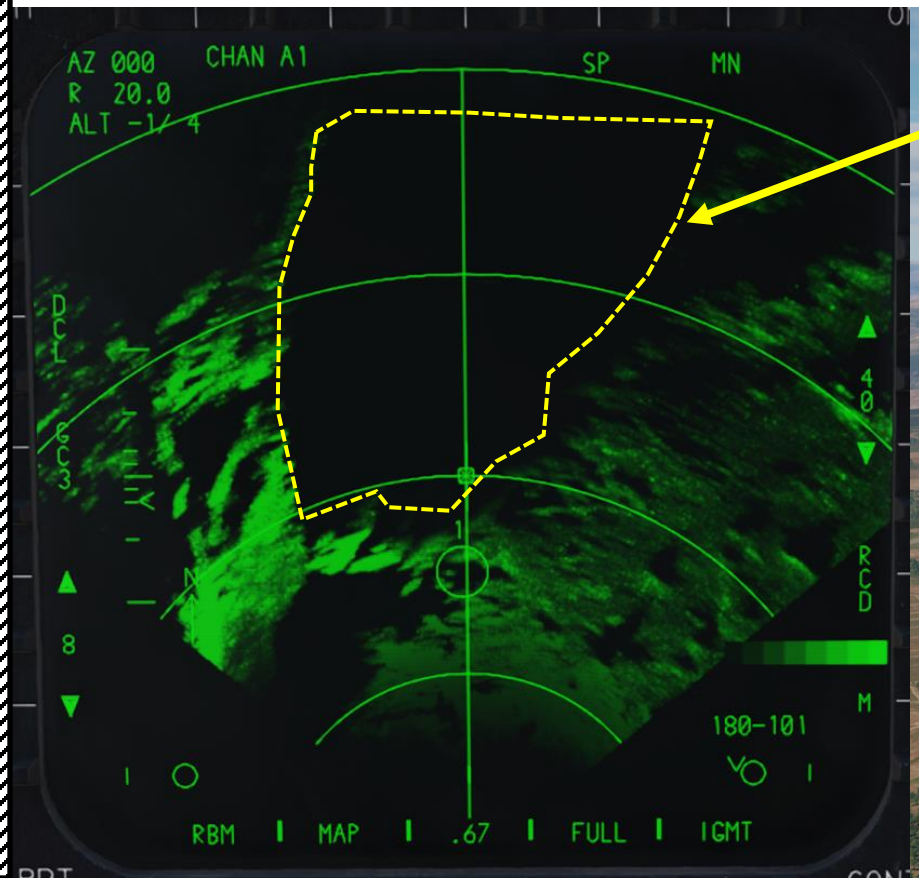
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Display

Some of the black areas on the real beam map display are part of the radar shadow, which are regions behind hills or mountains that the radar cannot see behind.

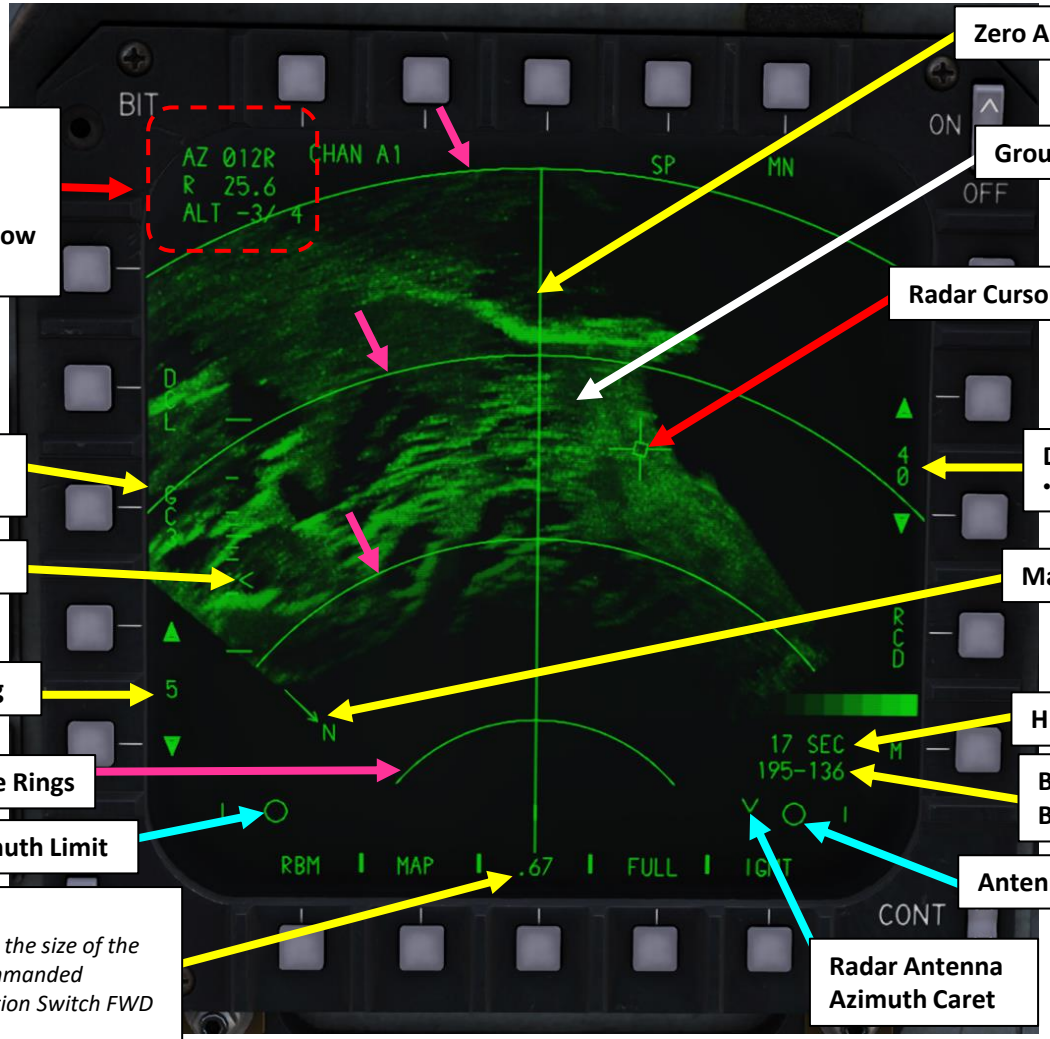






2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Display



Radar Cursor Information
- **Azimuth (AZ): 012R = 12 deg right**
- **Range (R): 25.6 nm**
- **Altitude Coverage: -3 / 4 = from 3000 ft below ground level to 4000 ft above ground level**

Zero Azimuth Reference LIne

Ground Mapping Returns

Radar Cursor

Radar Gain Control (GC) Level
- *From GC0 to GC3*

Radar Antenna Elevation Caret

Map Display Brightness Setting

Range Rings

Antenna Azimuth Limit

Display Window (DW) Size
- *The display window appears around the cursor and equals the size of the HRM (High Resolution Map) patch map that would be commanded*
- *These values can be changed by pressing the Auto Acquisition Switch FWD and AFT.*
- *DW Size Settings: 0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80 nm)*

Display Range Setting (nm)
- *Range Settings: 4.7, 10, 20, 40, 80 and 160 nm*

Magnetic Heading North Reference

HRM (High Resolution Map) Processing Time (sec)

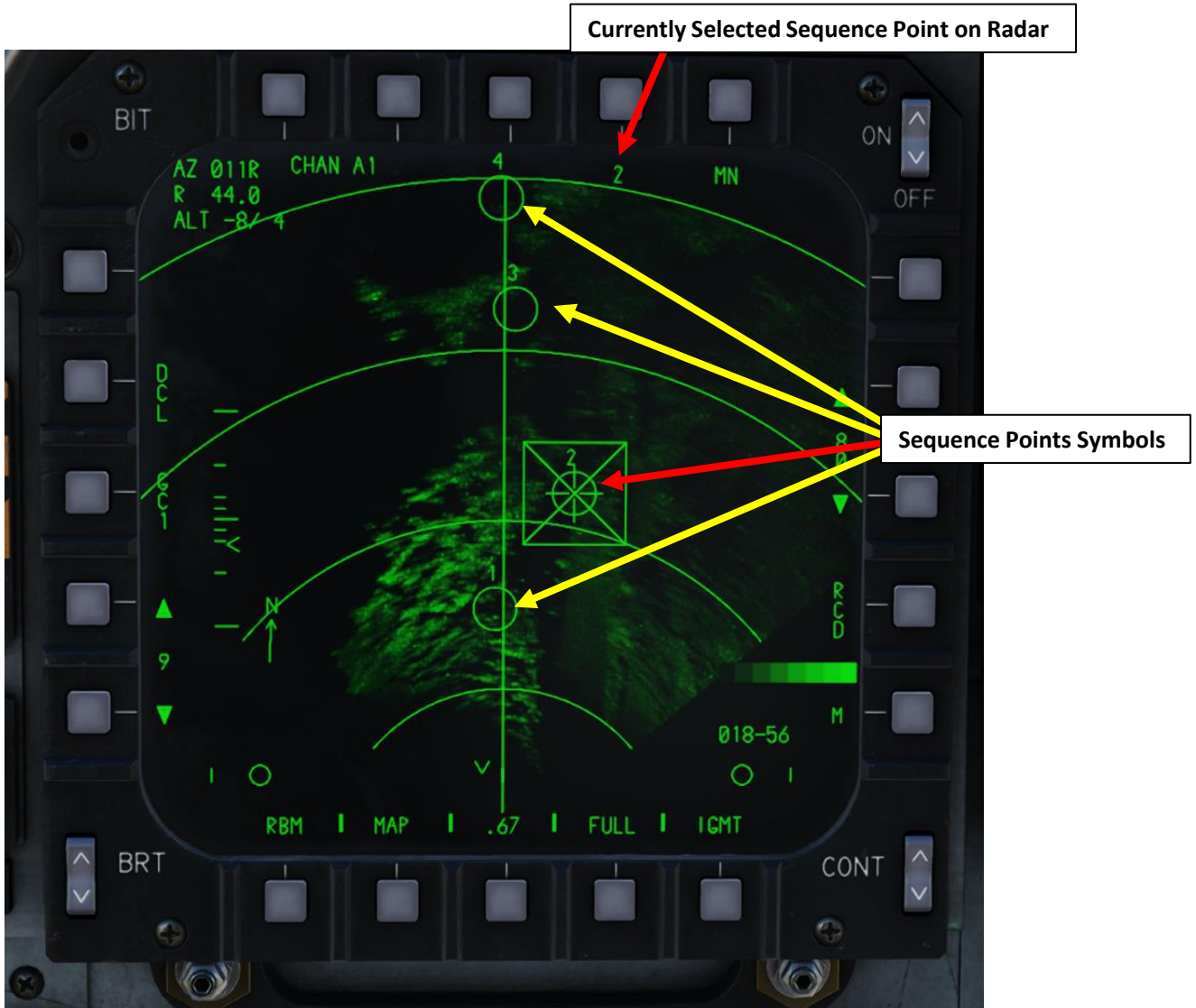
Bearing/Range (nm) from Bullseye to Radar Cursor

Antenna Azimuth Limit

Radar Antenna Azimuth Caret

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Display

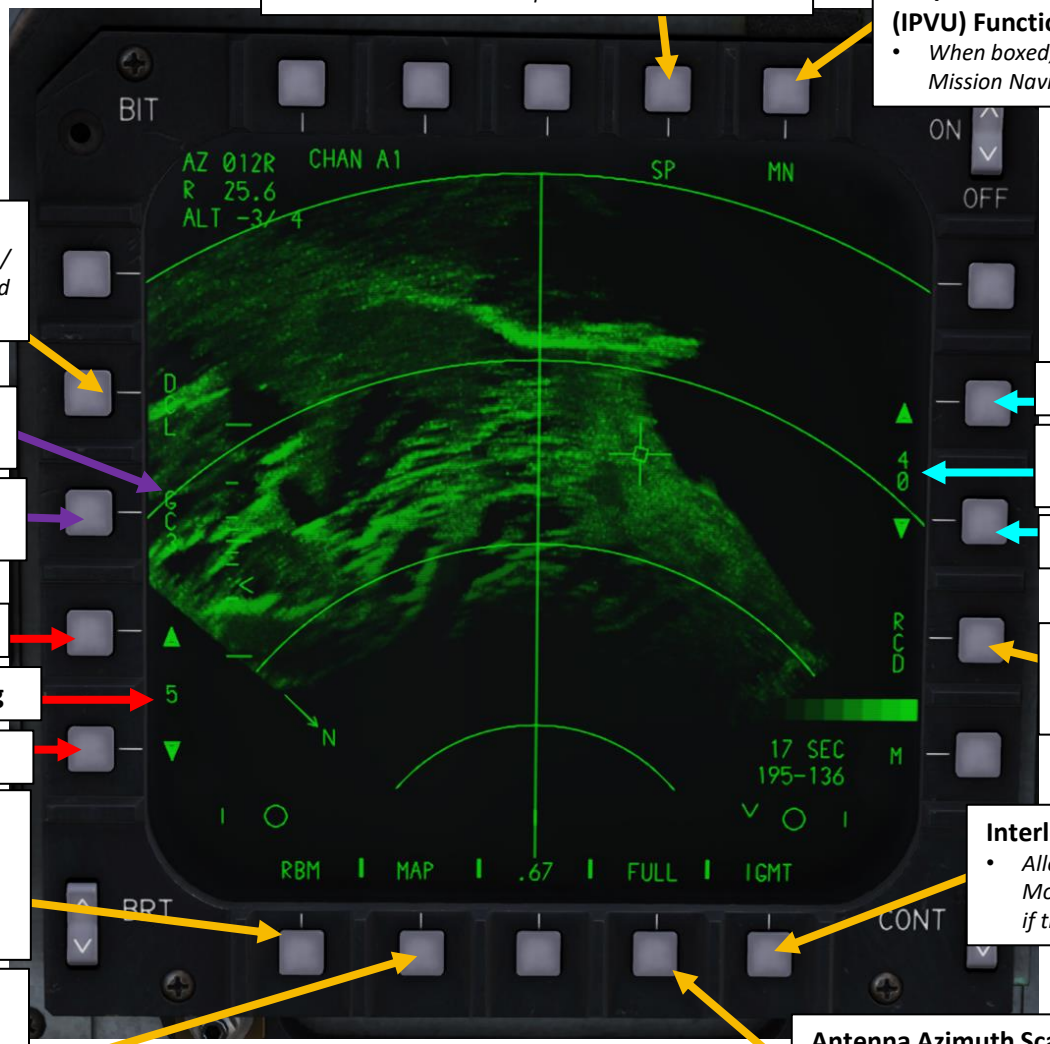


Sequence Points Symbol Types

- **Steerpoint**
- **Aim Point associated with Steerpoint**
- **Initial Point (IP): Steerpoint before the target point**
- **Aim Point Associated with the Initial Point**
- **Target Point**
- **Offset Point associated with target point**
- **Base:** point of origin of current mission / flight
- **Bullseye:** used as a reference point for all assets in a given mission, providing bearing and range from that point to target or selected position.
- **Markpoint**

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Controls (A/G RDR Page)



Sequence Point (SP) Indicator Selector
- *Displays the currently selected Sequence Point on the radar beneath the pushbutton.*

MN/IPVU: Interleaved Position Velocity Update (IPVU) Function Selector
- *When boxed, the radar automatically updates the Mission Navigator (MN) velocities every 60 seconds.*

Declutter (DCL) Function
- *When selected, "declutter" removes Magnetic Heading / Direction Display, Sequence points and their numbers, and the Pattern Steering Line (PSL) and attack heading number*

Radar Gain Control (GC) Level
- *From GC0 to GC3*

Radar Gain Control (GC) Level Button
- *Press to toggle between level settings*

Map Display Brightness Setting Control Button (Increase)

Map Display Brightness Setting

Map Display Brightness Setting Control Button (Decrease)

A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

Display Range Setting Control Button (Increase)

Display Range Setting (nm)
- *Range Settings: 4.7, 10, 20, 40, 80 and 160 nm*

Display Range Setting Control Button (Decrease)

RCD (Record) Button
- Allows the recording of the display for post-mission review (not simulated)

Interleaved Ground Moving Target (IGMT) Mode Selector
- *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*

Antenna Azimuth Scan Selection Setting
- *FULL: Azimuth scan of 100 deg*
- *HALF: Azimuth scan of 50 deg*
- *QTR (Quarter): Azimuth scan of 25 deg*

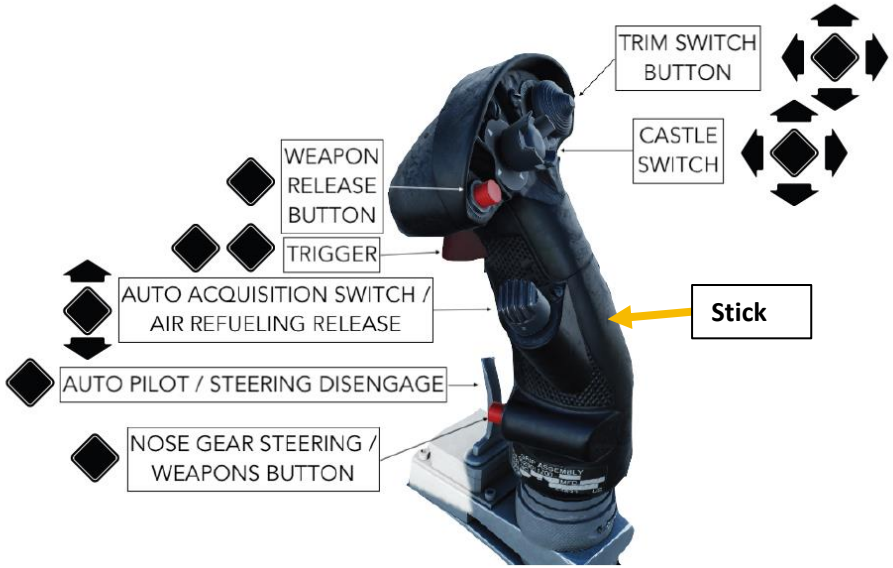
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

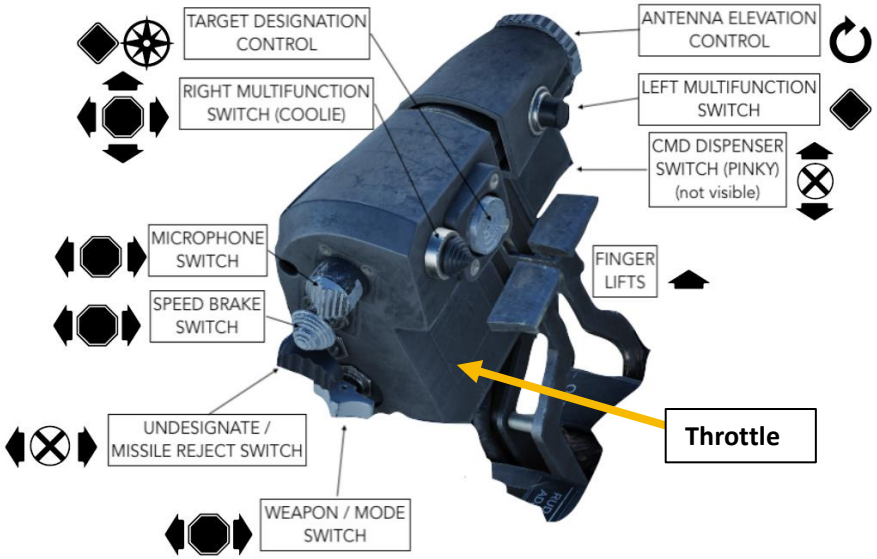
Controls (HOTAS)

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**



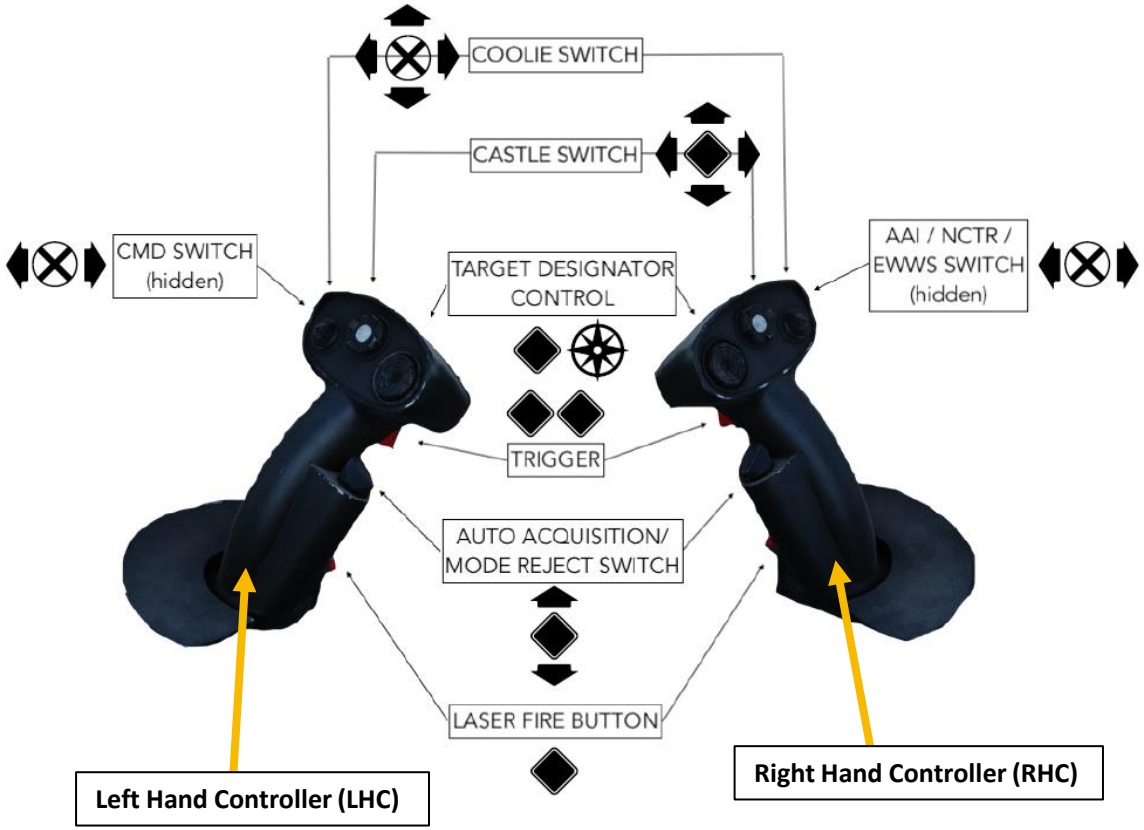


2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Controls (HOTAS)

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**				

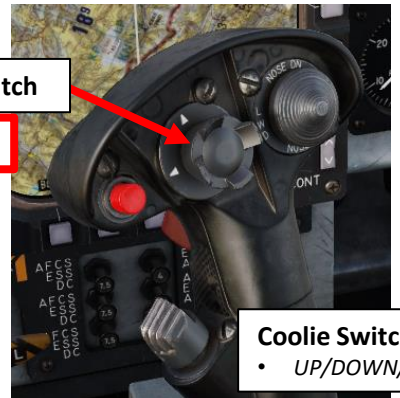


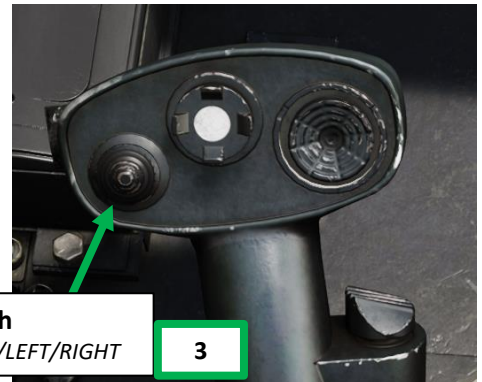
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

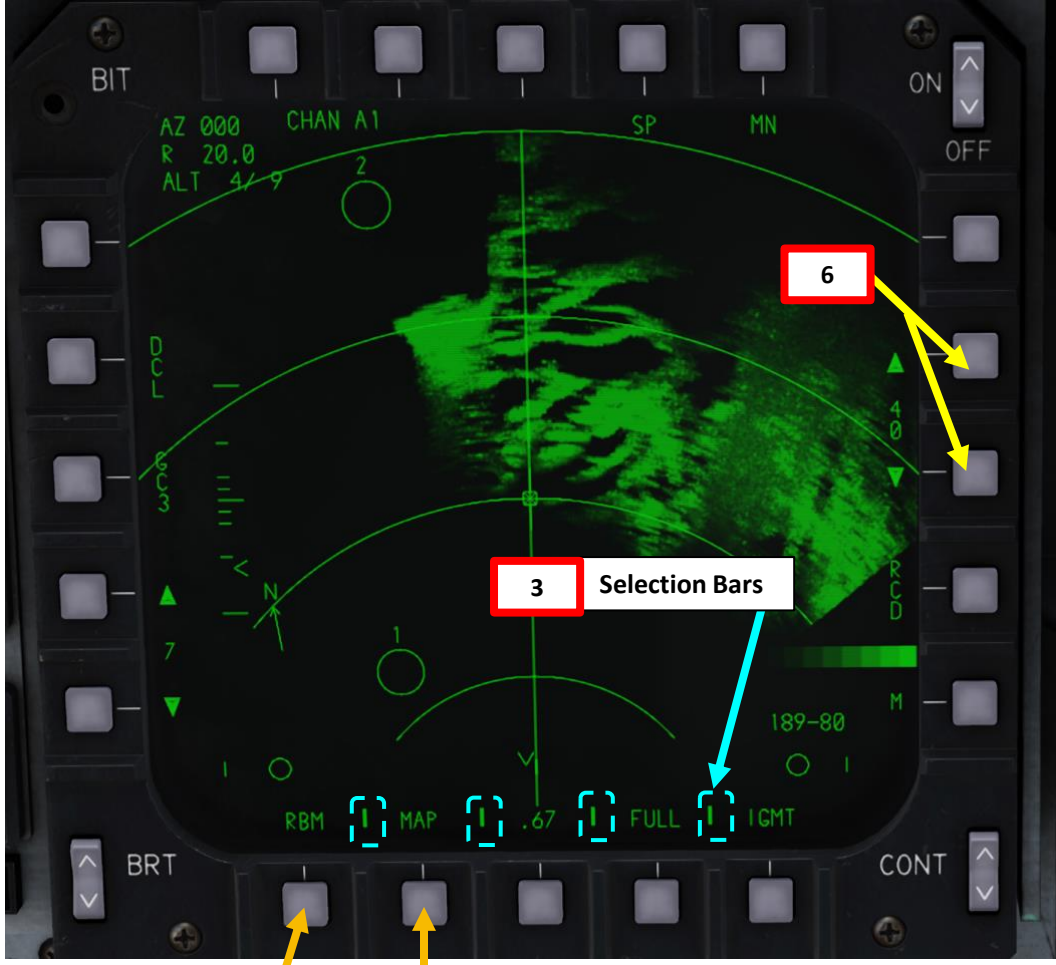
Cursor Function: Command HRM Patch Map (MAP)

The MAP function is used to prepare the system for commanding HRM (High Resolution Map) patch maps (a sort of high resolution zoom of a section of the ground radar mapping) or to enable mode rejecting into PVU (Precision Velocity Update). To command a HRM patch map from RBM mode:

1. Radar Power Switch must be set to ON.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
5. On A/G RDR page, select MAP cursor function by toggling the Cursor Function Selector button as needed.
6. Adjust display range as desired.







A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

4

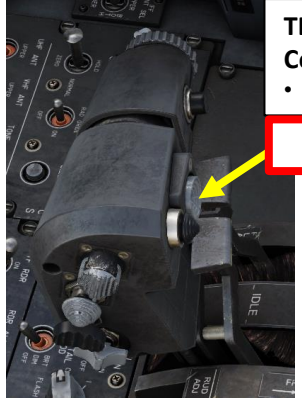
Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

5

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

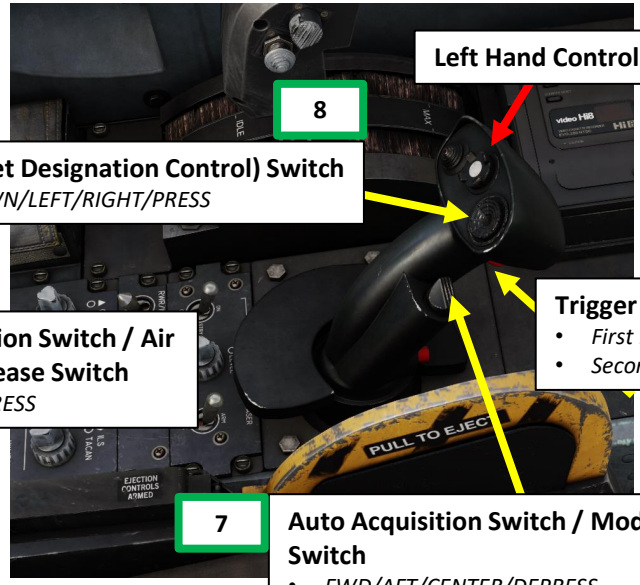
Cursor Function: Command HRM Patch Map (MAP)

7. 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. The size can be changed pressing the Auto Acquisition Switch FWD and AFT. Currently selected DW size is displayed at the bottom center of the display (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80 nm).
8. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select. Make sure the area isn't directly in front of the aircraft or you might have the "BLIND ZONE" caution, inhibiting patch map generation.
9. To command the HRM (High Resolution Map) patch map:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
10. When patch map is commanded, MAP indication becomes boxed and time-to-go clock counts down in the bottom-right corner of the display while the HRM is being computed.
11. After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

8 9



Left Hand Controller (LHC)

8

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

9

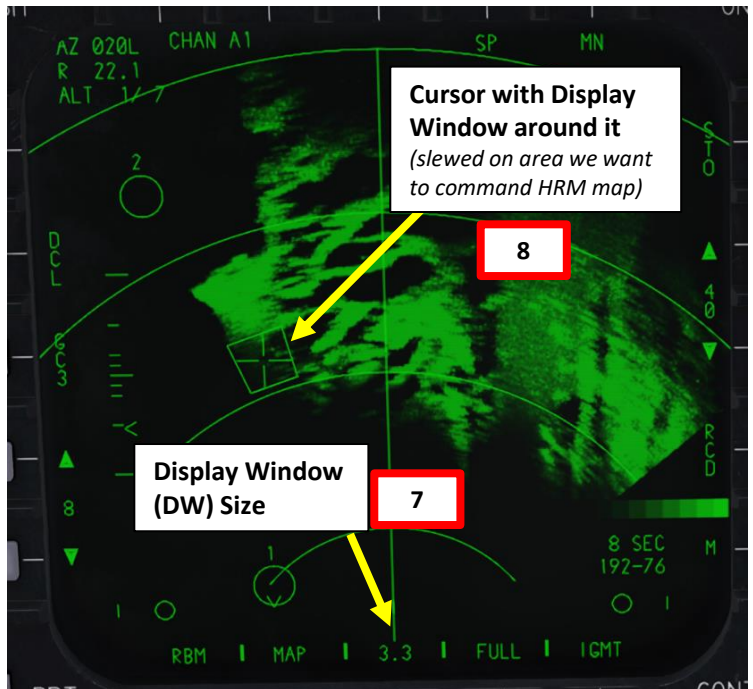
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

7

7

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

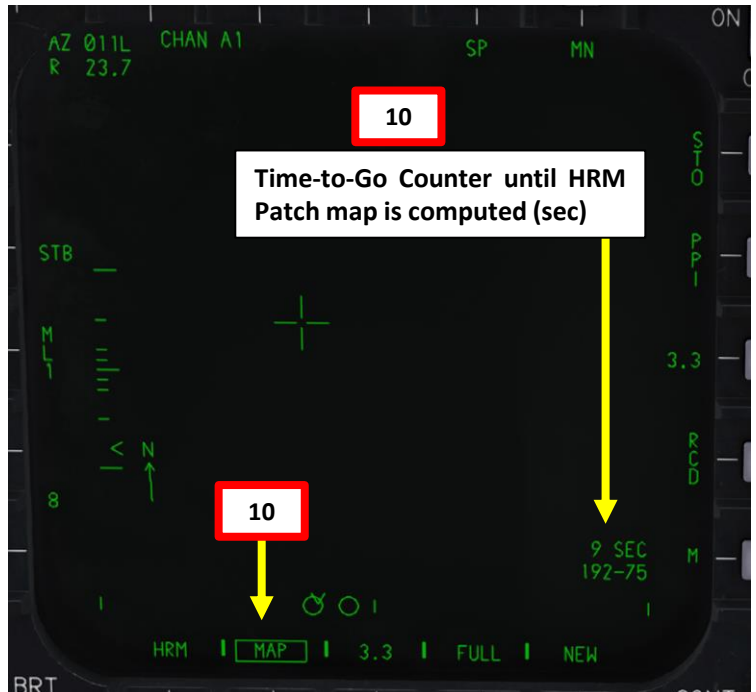


Cursor with Display Window around it
(slewed on area we want to command HRM map)

8

Display Window (DW) Size

7



10

Time-to-Go Counter until HRM Patch map is computed (sec)

10

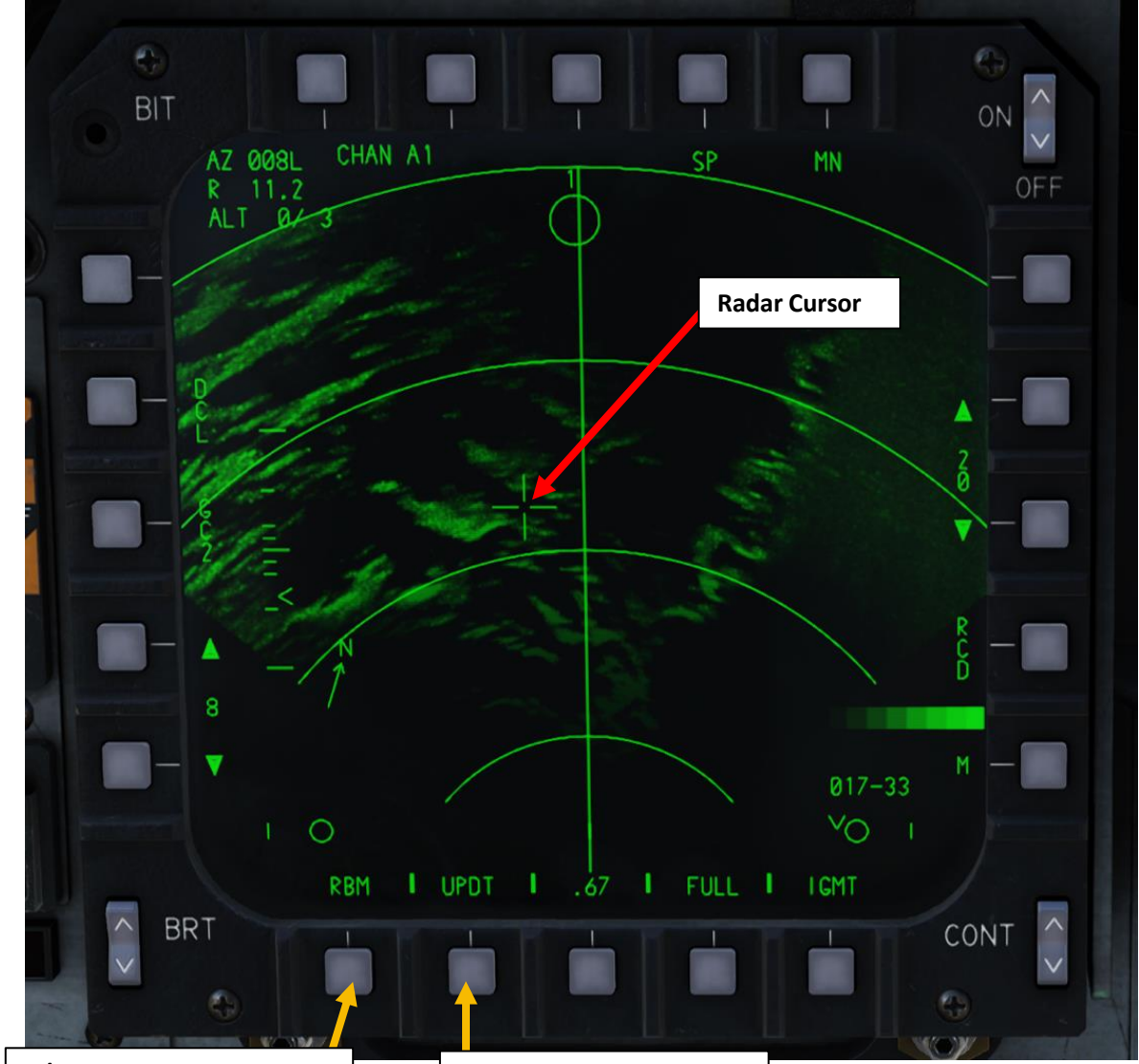
11

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Position Update (UPDT)

The Position Update (PDT) function is selected when the pilot/WSO needs to perform a position update to either the Mission Navigator (MN) or Inertial Navigation System (INS) from the real beam map.

Note: UPDT function is not implemented yet for the DCS F-15E.



A/G Radar Mode Selector
- *RBM: Real Beam Map*

Cursor Function Selector
- *UPDT: Position Update*

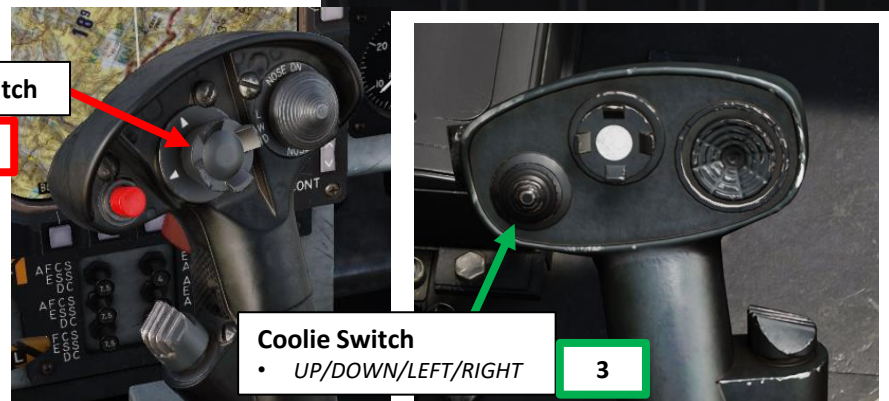
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

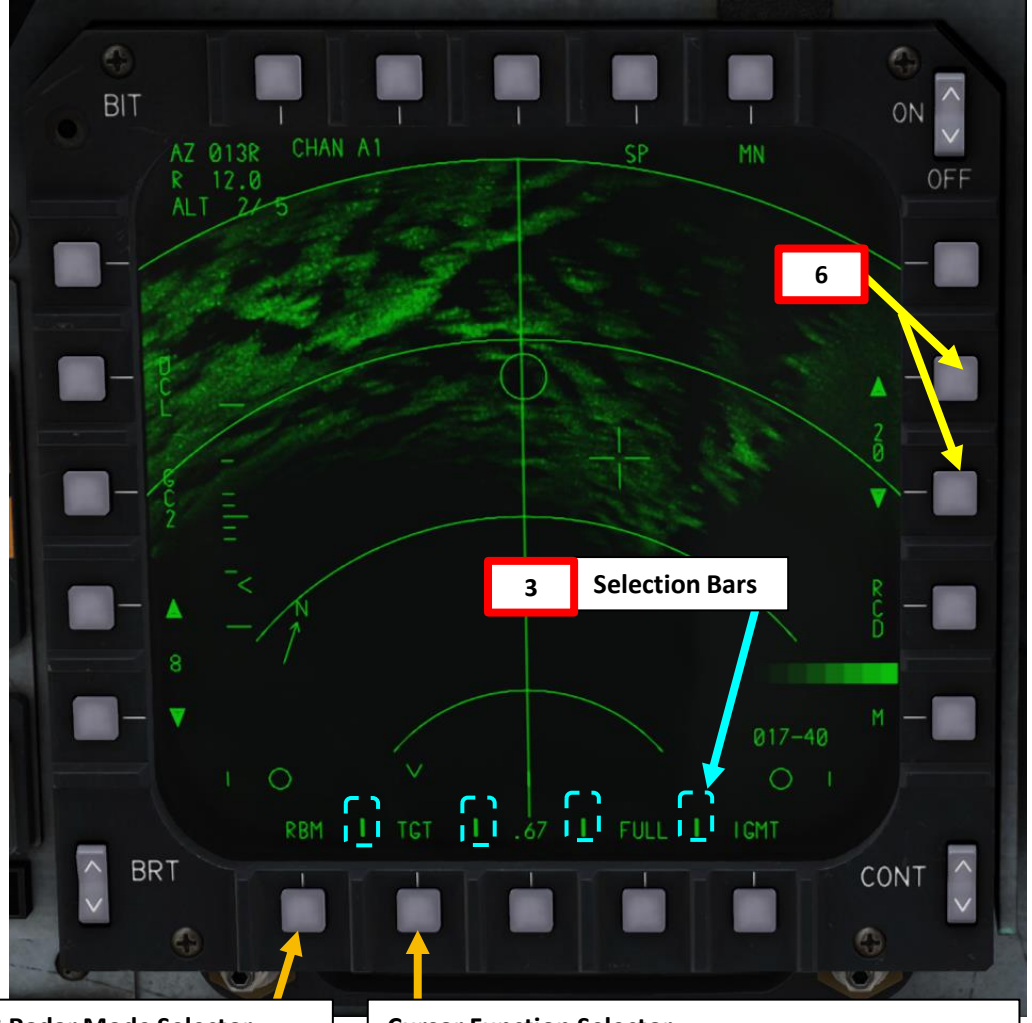
Cursor Function: Target Designation (TGT)

The TGT (Target Designation) function is used to designate a point on a real beam map for weapons delivery. To designate a target with the air-to-ground radar:

1. Radar Power Switch must be set to ON.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
5. On A/G RDR page, select TGT cursor function by toggling the Cursor Function Selector button as needed.
6. Adjust display range as desired.

- Note: Before designating a target, it is good practice (but not mandatory) to FREEZE the display. See step 10.





A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

4

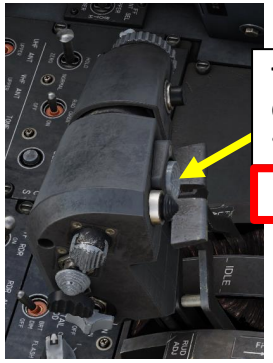
Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

5

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Target Designation (TGT)

7. Using the TDC (Target Designation Control) switch, slew cursor over the point you want to designate.
8. To designate the target:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
9. The PSL (Pattern Steering Line) indicates the line-of-sight from the aircraft to the target at the moment of designation. The PSL can be slewed around if there is a need to approach the target at a different heading. To slew the PSL:
   a) Press the Auto Acquisition Switch AFT
   b) Slew PSL left or right around the designation triangle using the TDC (Target Designation Control) Switch.
   c) Press the Auto Acquisition Switch AFT a second time once the PSL orientation is as desired.

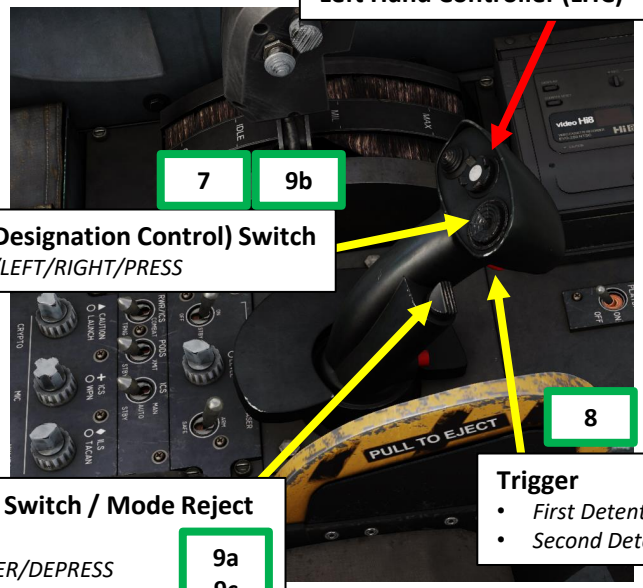


TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

7 | 8 | 9b

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

9a 9c



Left Hand Controller (LHC)

7 | 9b

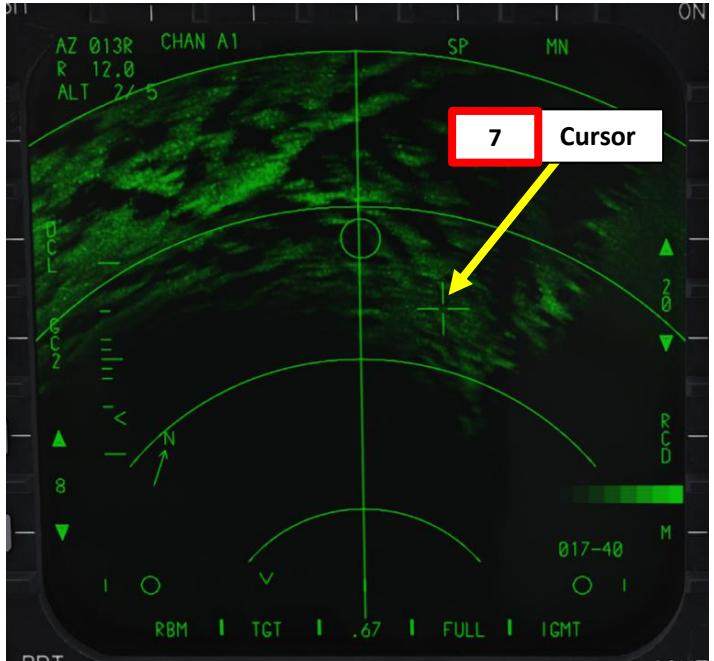
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

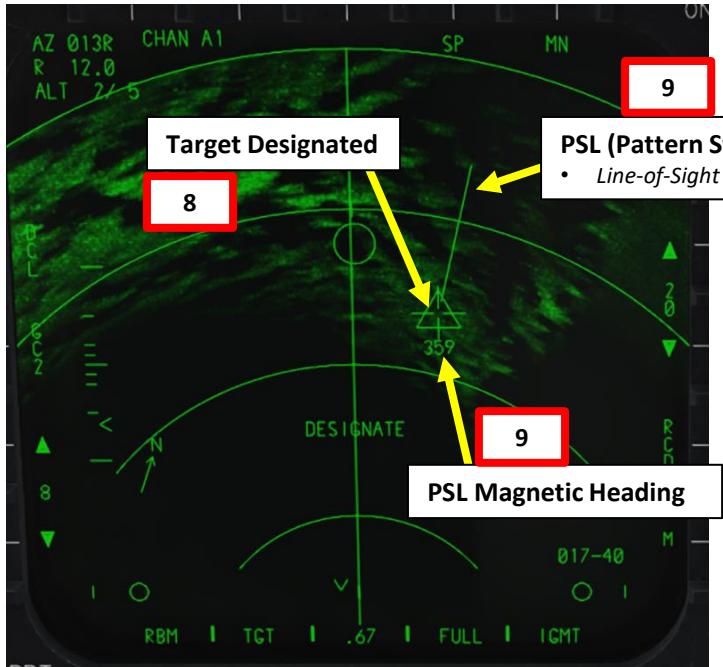
8

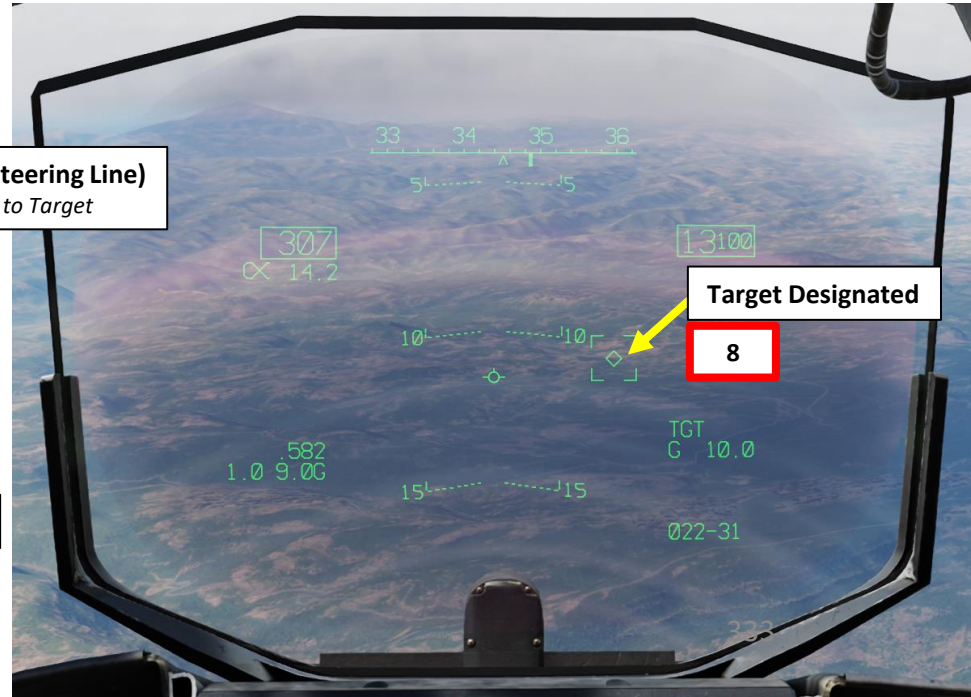
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

9a 9c



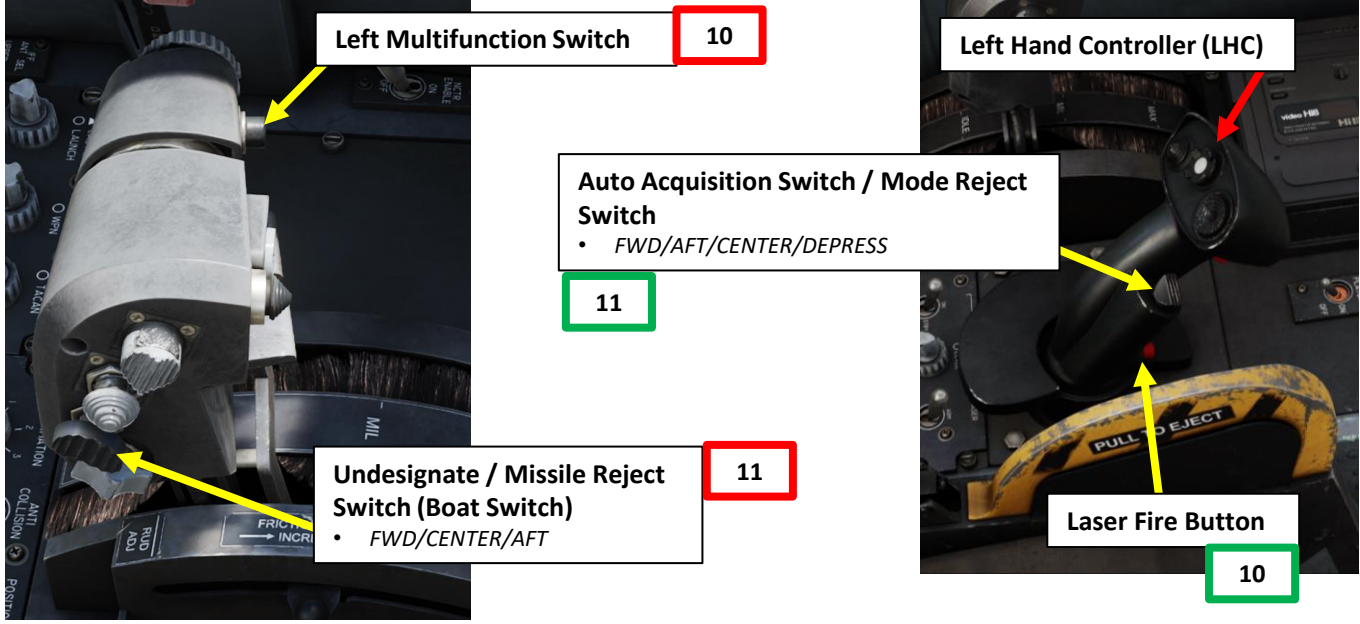


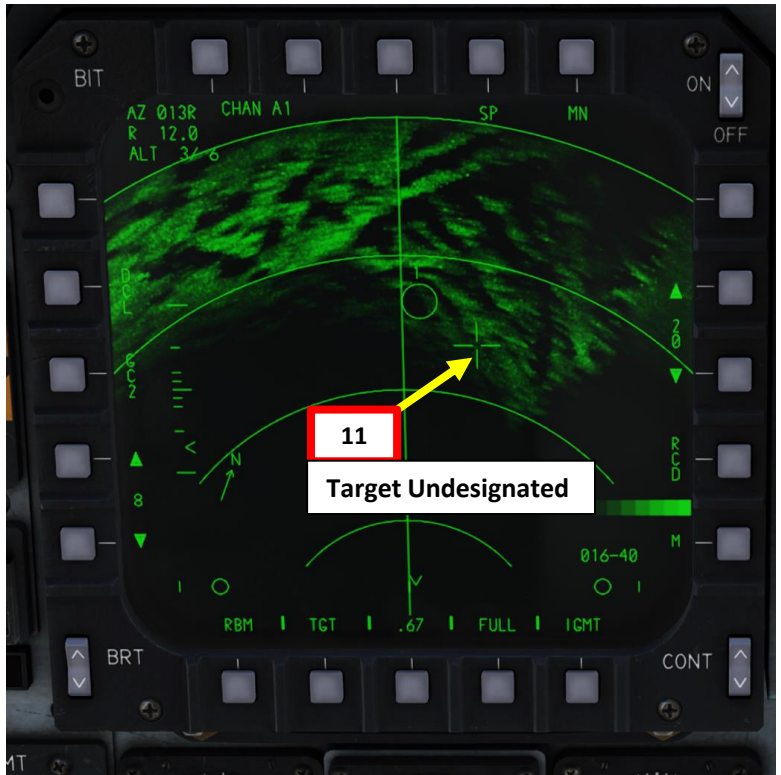


2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Target Designation (TGT)

10. Selecting TGT does not pause the real beam map scan. If you want to stop the continuous scanning ("freeze" it) in order to designate a target more precisely, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
11. To undesignate a target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.
    - **WSO**: DEPRESS Auto Acquisition Switch



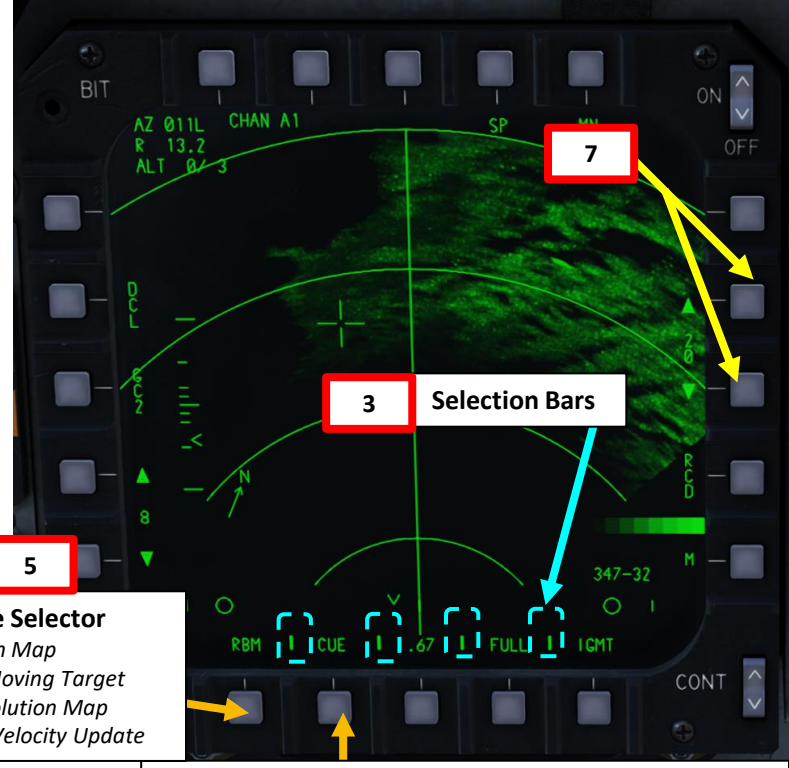


2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Sensor Slaving (CUE)

The CUE function is used to slave or direct an imaging supporting sensor like the LANTIRN targeting pod to a selected point on the real beam map display. To slave the targeting pod to a target designated with the air-to-ground radar:

1. Verify targeting pod and radar are both powered. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On the other page, monitor TPOD (Targeting Pod) feed.
5. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
6. On A/G RDR page, select CUE cursor function by toggling the Cursor Function Selector button as needed.
7. Adjust display range as desired.

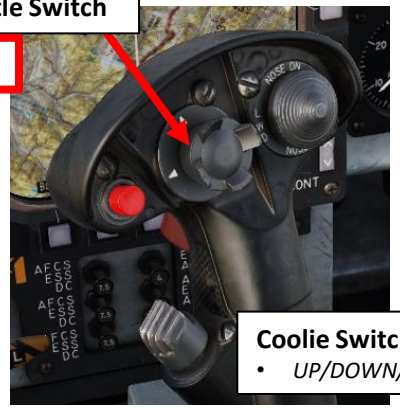


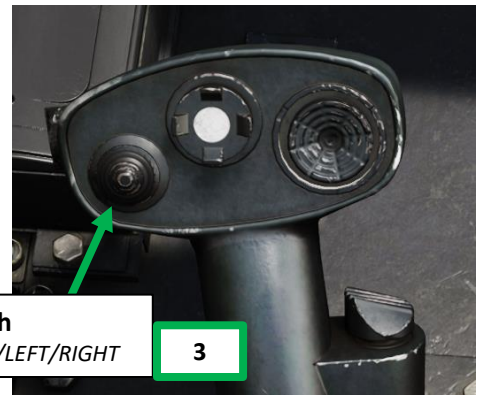
5 – A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

Cursor Function Selector — 6
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

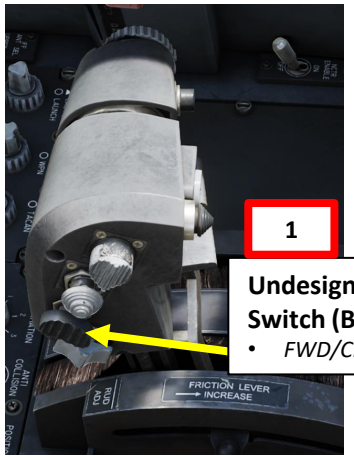
A/G (Air-to-Ground) Master Mode Button — 2

Castle Switch — 3





Coolie Switch — 3
- *UP/DOWN/LEFT/RIGHT*

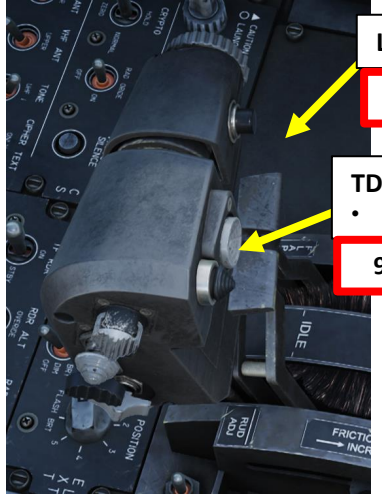


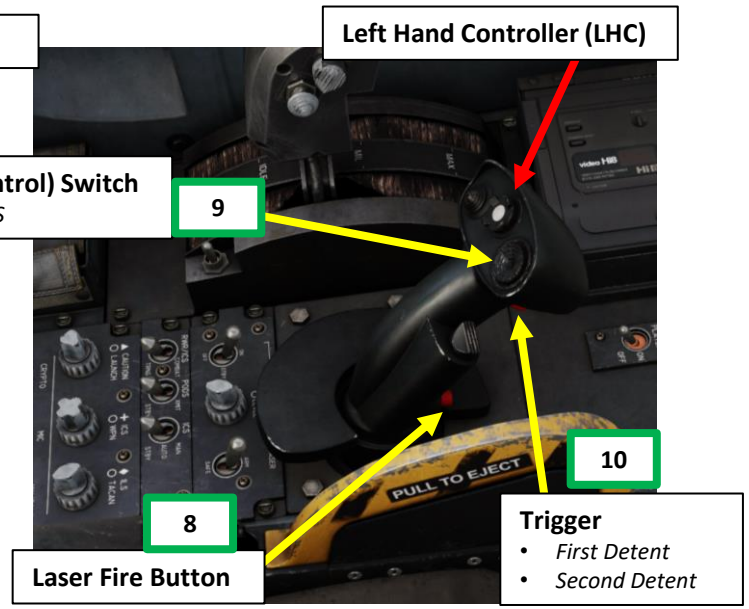
1 – Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

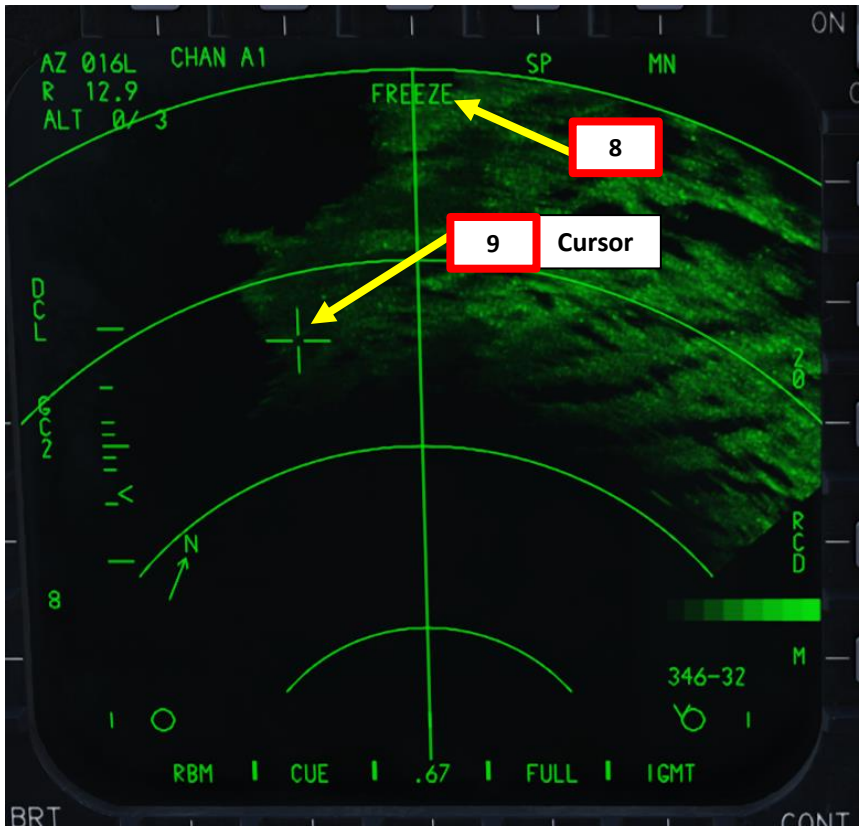
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

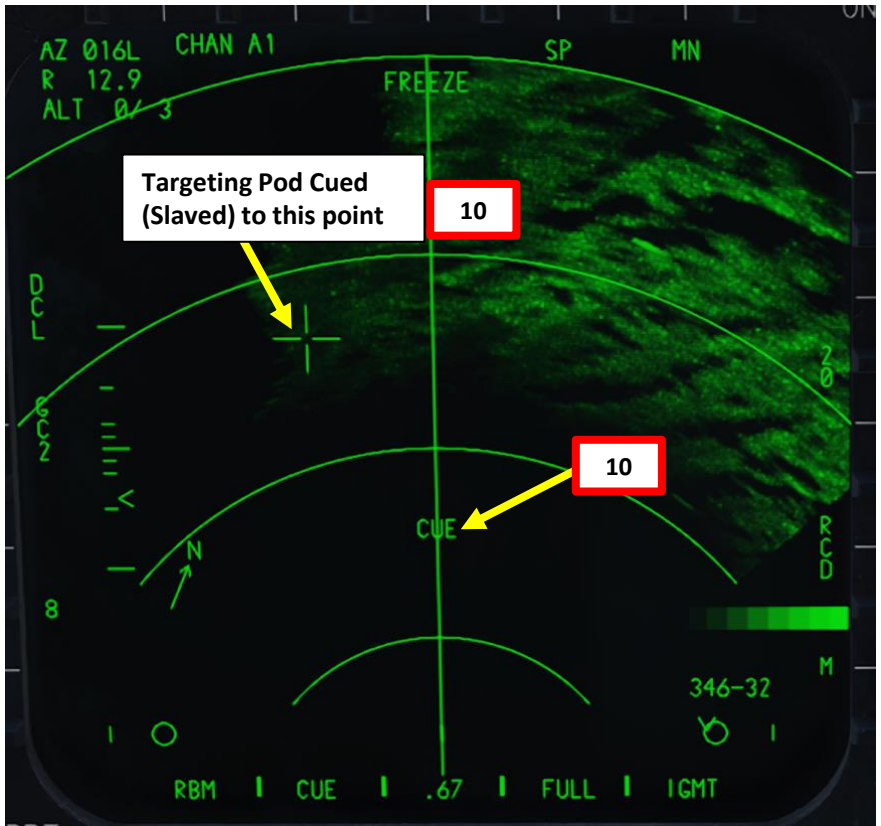
Cursor Function: Sensor Slaving (CUE)

8. Freeze the RBM display:
   - **Pilot**: Press the Left Multifunction Switch.
   - **WSO**: Press the Laser Fire Button
9. Using the TDC (Target Designation Control) switch, slew cursor of the A/G RDR page over the point you want to slave the targeting pod to.
10. To designate the point and slave (CUE) the targeting pod to it:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.





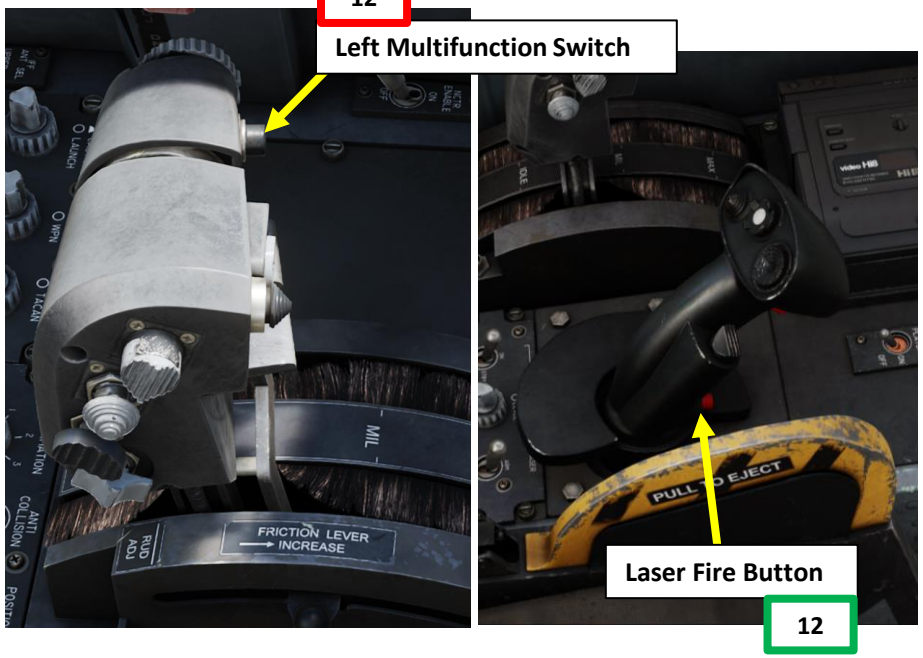


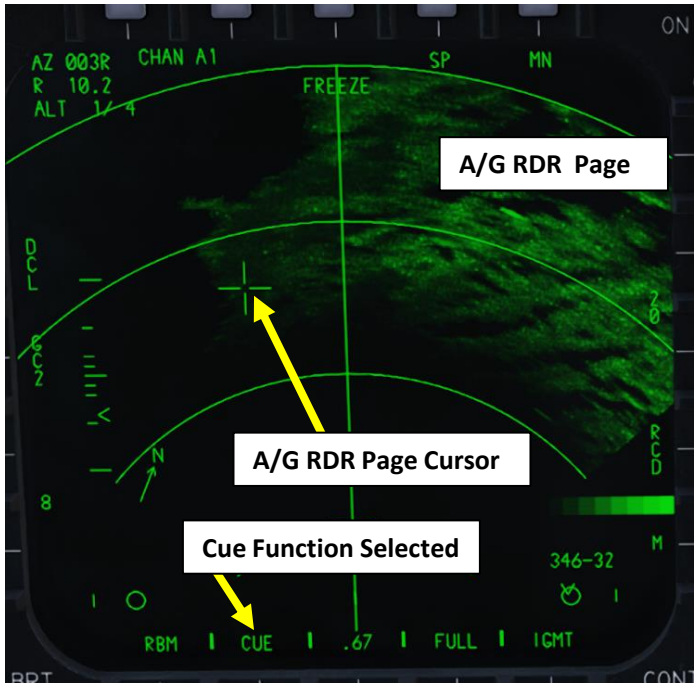


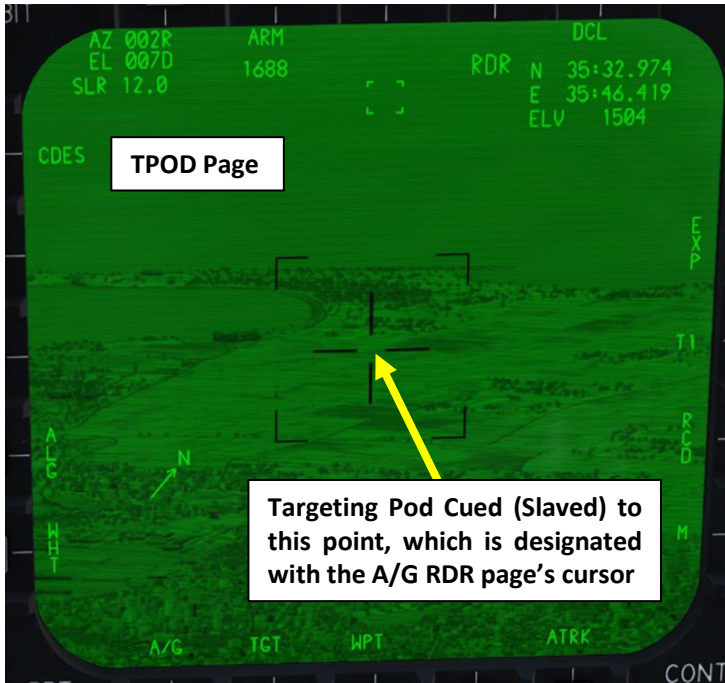
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Sensor Slaving (CUE)

11. If you check on the TPOD (Targeting Pod) page, you will see that the targeting pod has been slaved to the A/G RDR page's cursor.
12. To "unfreeze" the real beam map display, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.





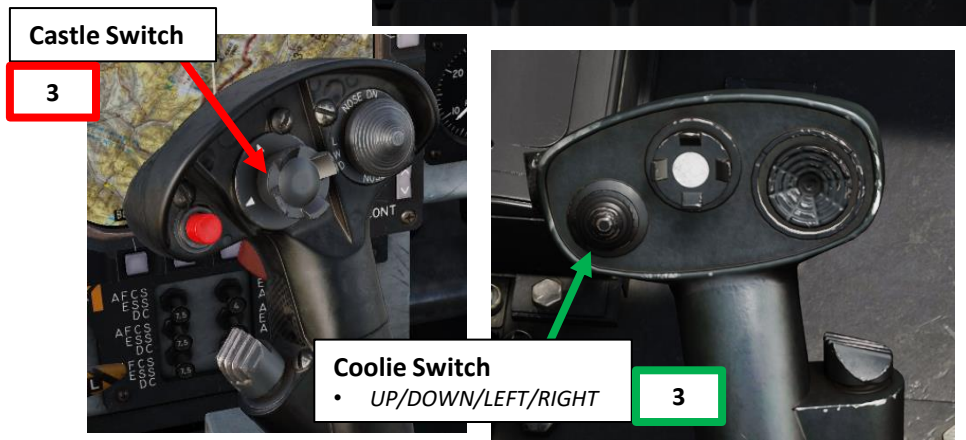


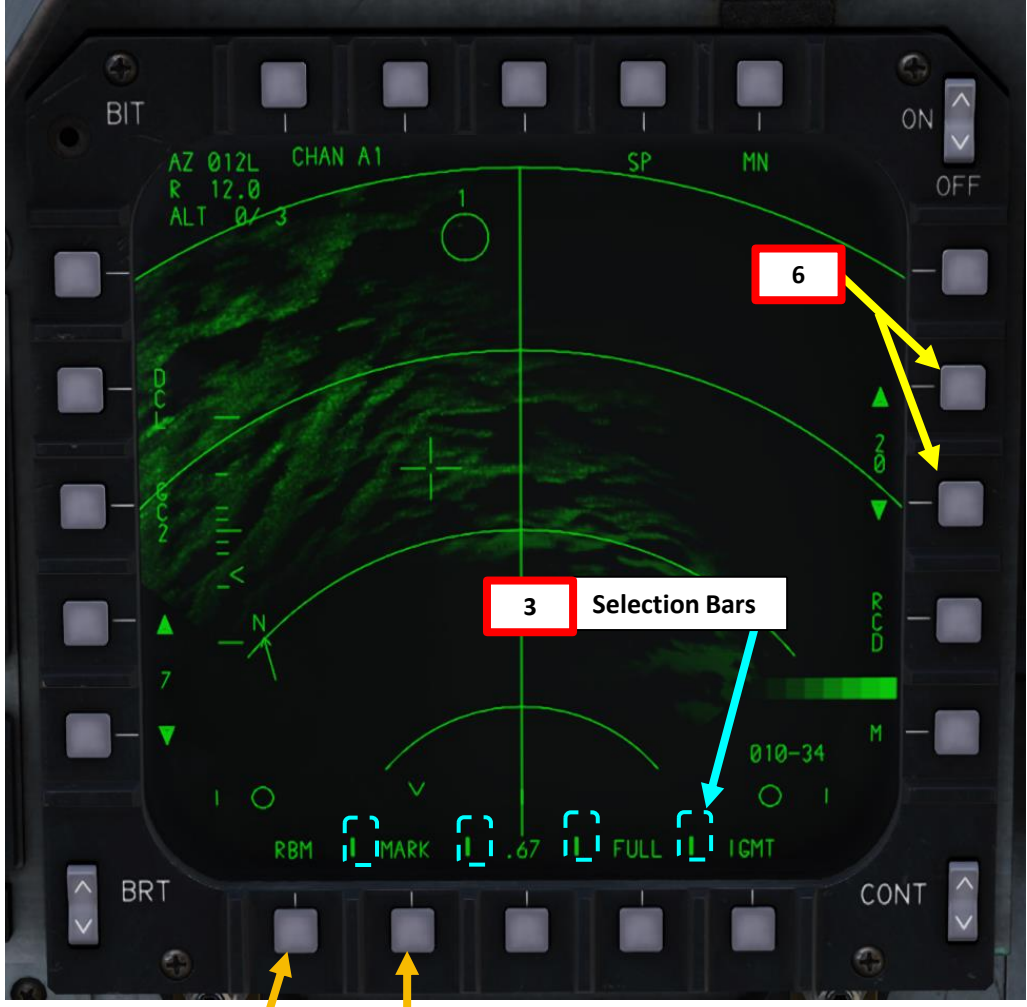
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

Cursor Function: Markpoint Designation (MARK)

The MARK function is used to create a markpoint on the real beam map display for future reference. To mark a target with the air-to-ground radar:

1. Verify targeting pod and radar are both powered
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
5. On A/G RDR page, select MARK cursor function by toggling the Cursor Function Selector button as needed.
6. Adjust display range as desired.





A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

4

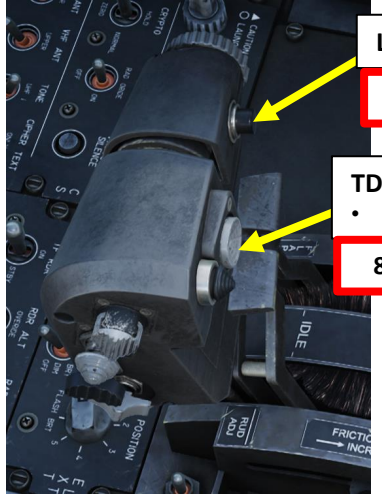
Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

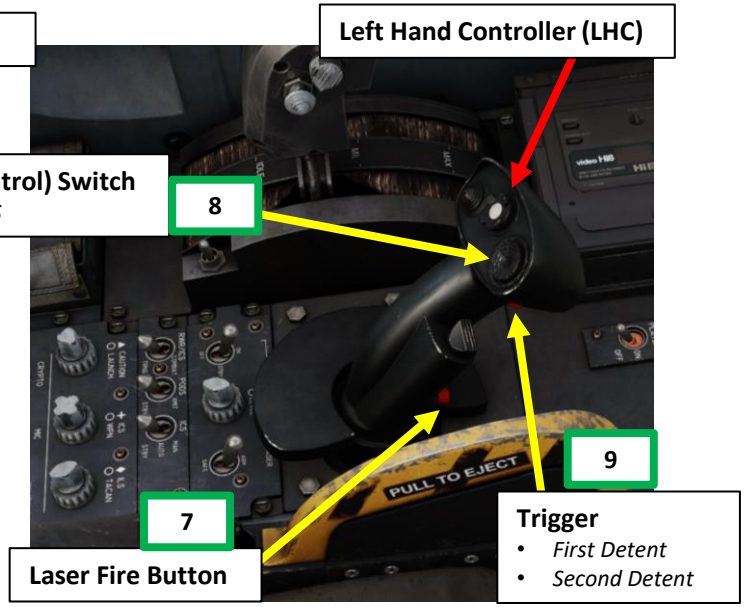
5

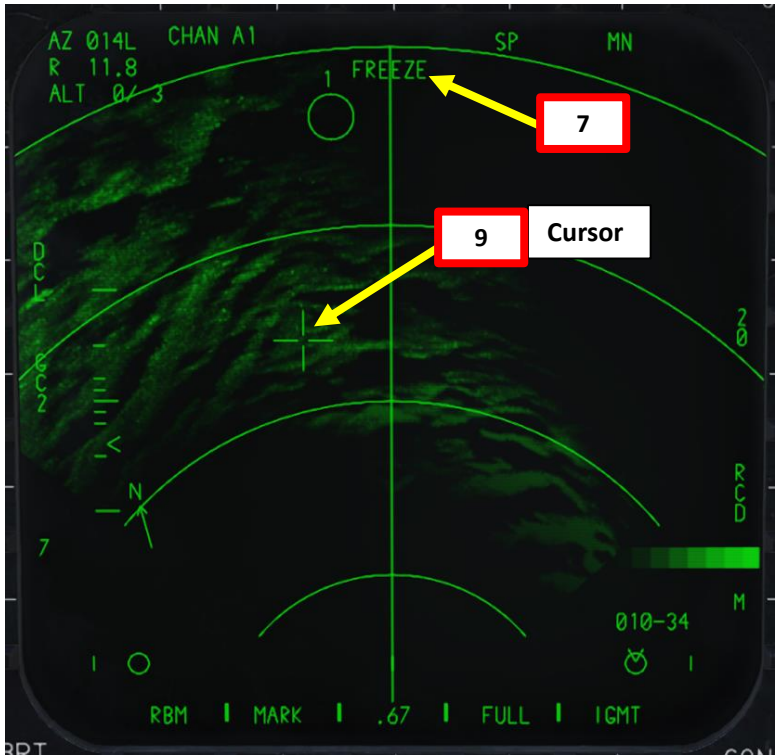
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.2 – RBM (Real Beam Map) Mode

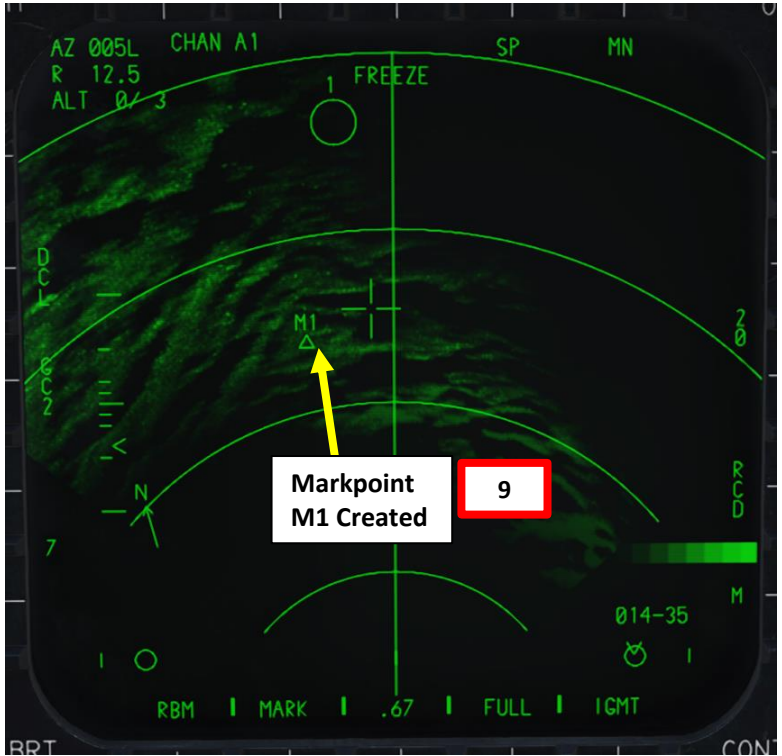
Cursor Function: Markpoint Designation (MARK)

7. Freeze the RBM display if desired:
   - **Pilot**: Press the Left Multifunction Switch.
   - **WSO**: Press the Laser Fire Button
8. Using the TDC (Target Designation Control) switch, slew cursor over the point you want to designate as a markpoint.
9. To designate the markpoint:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
10. A maximum of 10 markpoints can be designated. Any mark above the tenth overwrites the first one, then the second one, and so on. A maximum of 5 markpoints can be displayed at the same time.









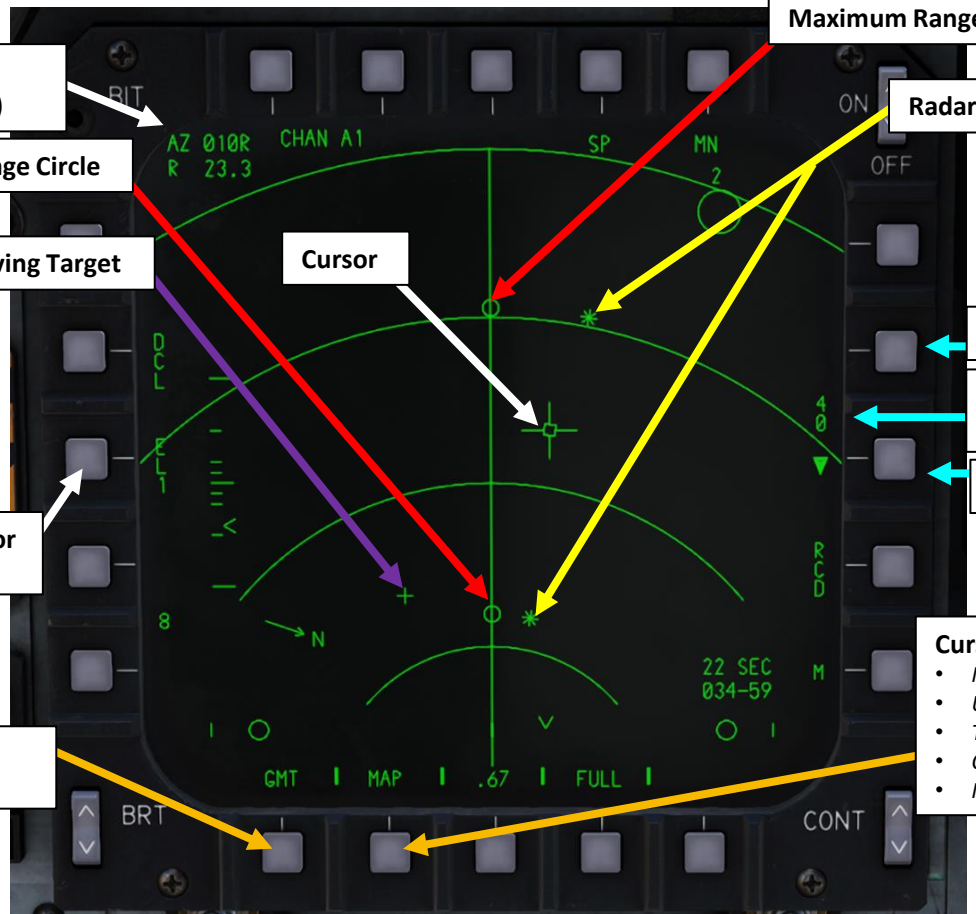
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.3 – GMT (Ground Moving Target) Mode

Display & Controls

The Ground Moving Target (GMT) radar mode scans for and highlights moving targets, detected by their Doppler shift. Detected targets are displayed as crosses (+). **Maximum range for target detection in GMT is 32 nm**, with the maximum selectable scan range of 40 nm.

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.

Keep in mind that the A/G RDR page needs to be selected. The default air-to-ground radar mode is MAP (Real Beam Map); the radar mode has to be toggled to GMT by toggling the A/G Radar Mode Selector button as needed.



Maximum Range Coverage Circle

Cursor Azimuth and Range (nm)

Radar Scanning Coverage Cues

Minimum Range Coverage Circle

Detected Ground Moving Target

Cursor

Display Range Setting Control Button (Increase)

Display Range Setting (nm)
- *Range Settings: 4.7, 10, 20, and 40 nm*

Display Range Setting Control Button (Decrease)

Radar Antenna Elevation Bars (EL) Setting Selector
- *Press this button to toggle between 1, 2, 3 or 4 bars.*

Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

A/G Radar Mode Selector
- *GMT: Ground Moving Target*

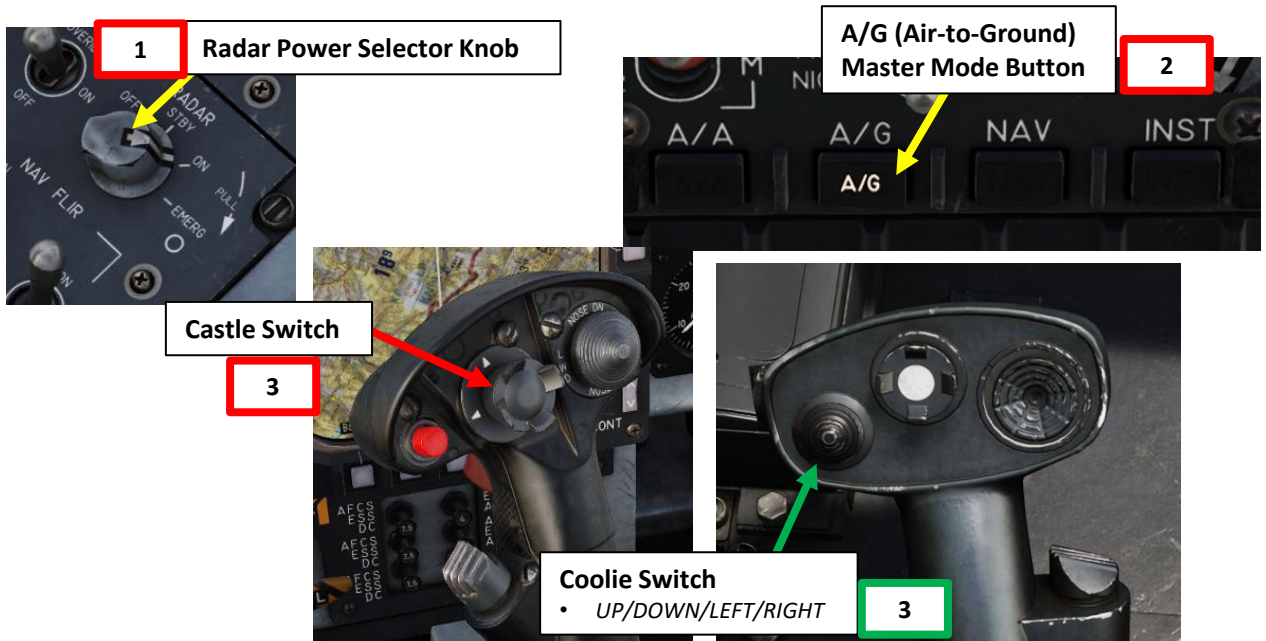
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.3 – GMT (Ground Moving Target) Mode

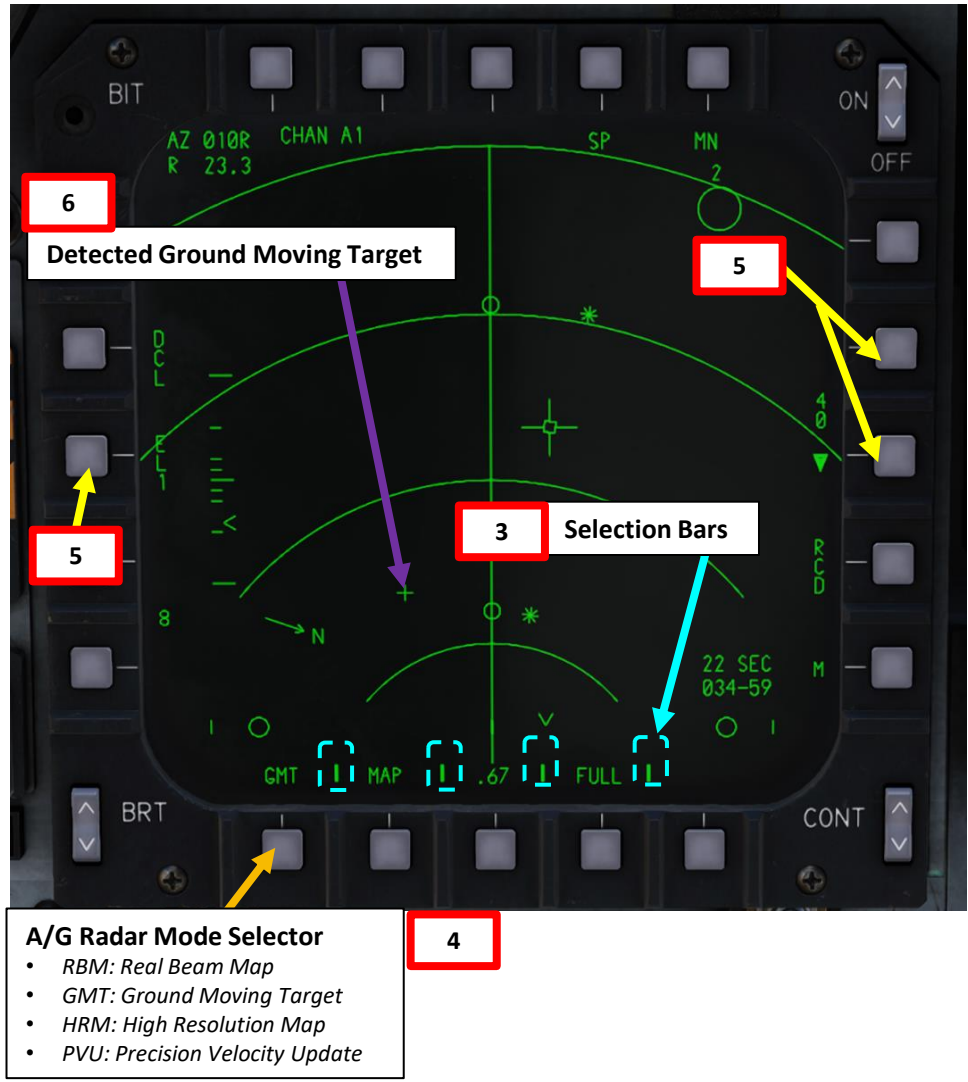
Display & Controls

The controls for GMT are almost the same as for RBM. The default air-to-ground radar mode is MAP (Real Beam Map); the radar mode has to be toggled to GMT by toggling the A/G Radar Mode Selector button as needed.

Keep in mind that in order to enter GMT mode:

1. Radar Power Switch must be set to ON.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select GMT (Ground Moving Target) mode by toggling the A/G Radar Mode Selector button as needed.
5. Adjust display range and elevation bars as desired.
6. Radar will then be scanning for moving targets.



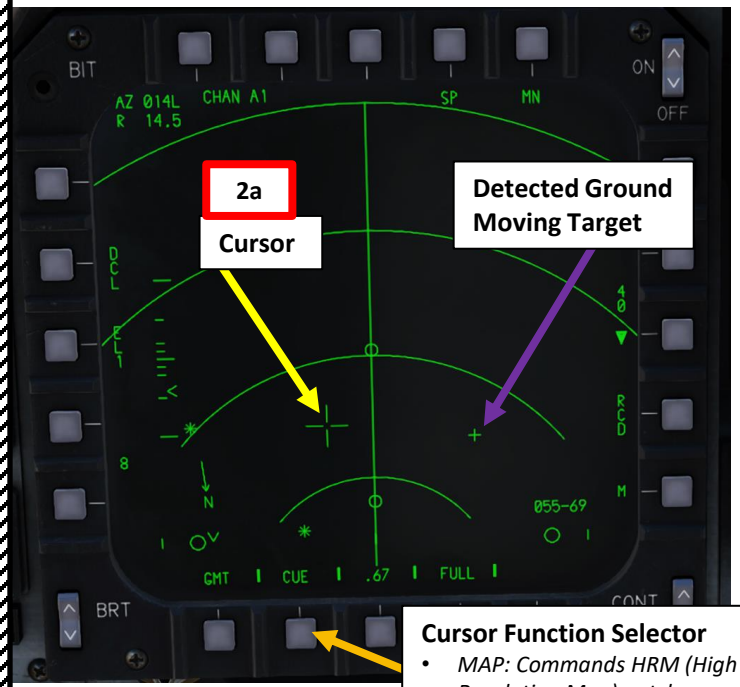


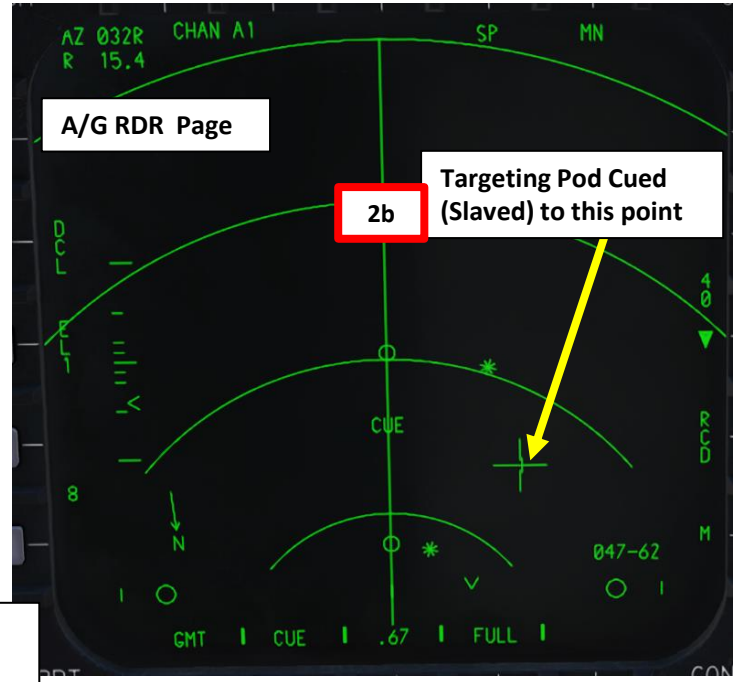
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.3 – GMT (Ground Moving Target) Mode

Employment Principles

It is important to understand that when using GMT mode, you **cannot directly "radar lock" and track a moving target**. GMT is primarily used as a "passive" sensor. However, GMT is useful in the sense that you can use Cursor Functions similarly to RBM (Real Beam Map) mode to slave another sensor like the targeting pod to the approximate location of a spotted moving target (+ symbol). In the example below:

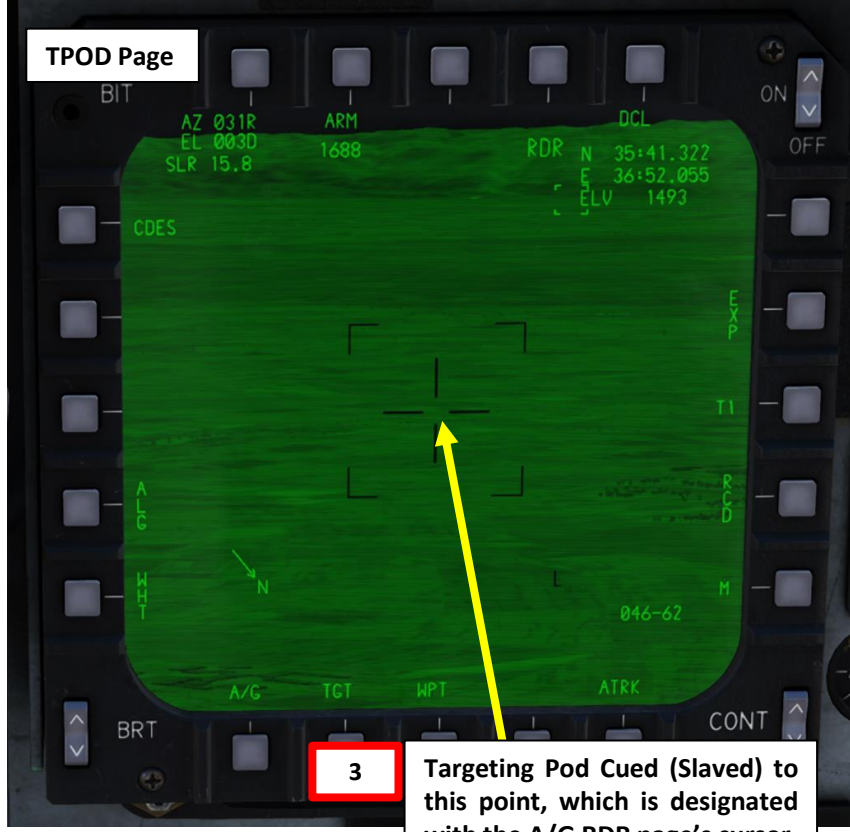
1. We selected the CUE Cursor Function.
2. We slewed the radar cursor using the TDC (Target Designation Control) switch
3. We cued/slaved the targeting pod to the radar cursor's location:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.

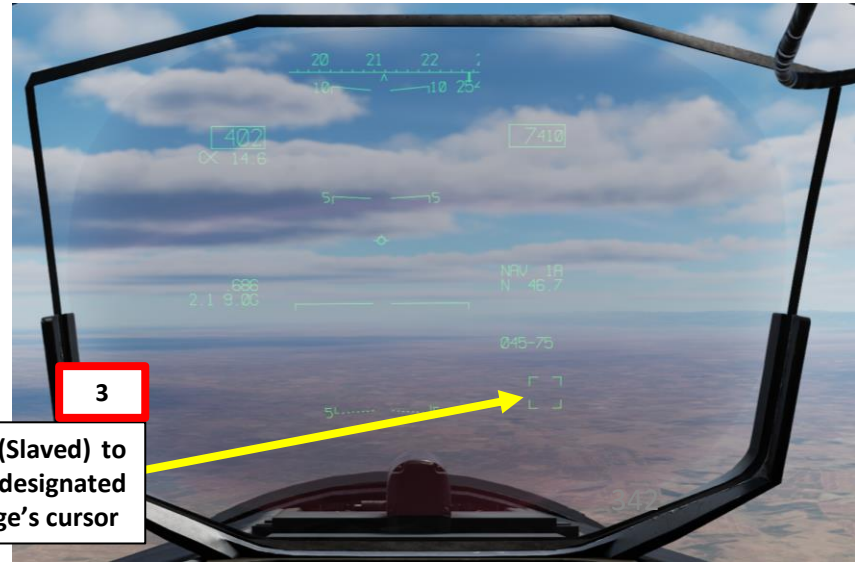




Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

1



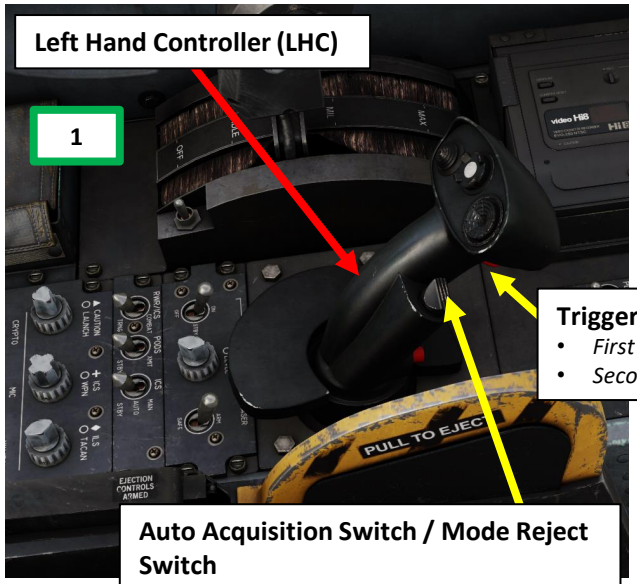


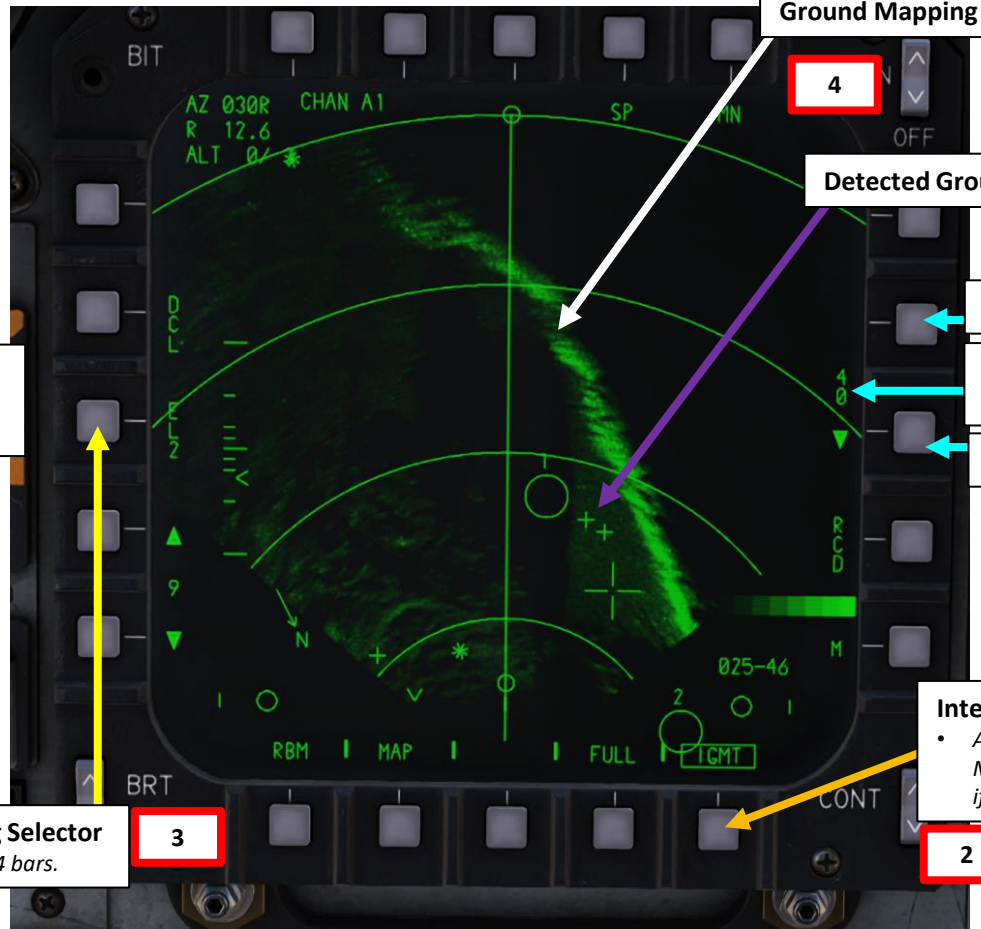
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.3 – GMT (Ground Moving Target) Mode

Combining RBM (Real Beam Map) & GMT (Ground Moving Target) Overlay
IGMT: Interleaved Ground Moving Target Mode

It is possible to superimpose the RBM (Real Beam Map) display and detected GMTs (Ground Moving Targets). In order to select IGMT:

1. Set map scale to 40 nm or less. For map scales greater than 40 nm, the IGMT mode is inhibited.
   - **WSO**: using Left/Right Hand Controller Auto Acquisition Switch FWD or AFT while the Trigger in Half Action (First Detent) is held also changes the range scale.
2. Press pushbutton next to IGMT to select this mode (boxed when selected). Interleaved Ground Moving Target mode is boxed when selected.
3. You can change radar antenna elevation bar setting by toggling the button next to "EL".
4. The display will then combined ground mapping returns and moving targets.





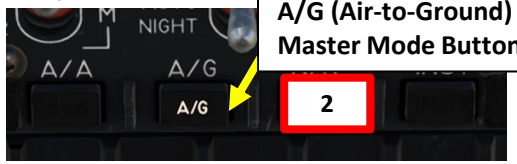
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

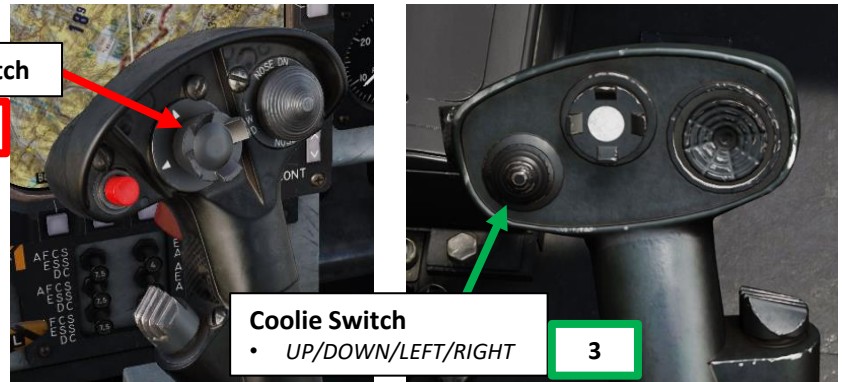
HRM Mode Introduction

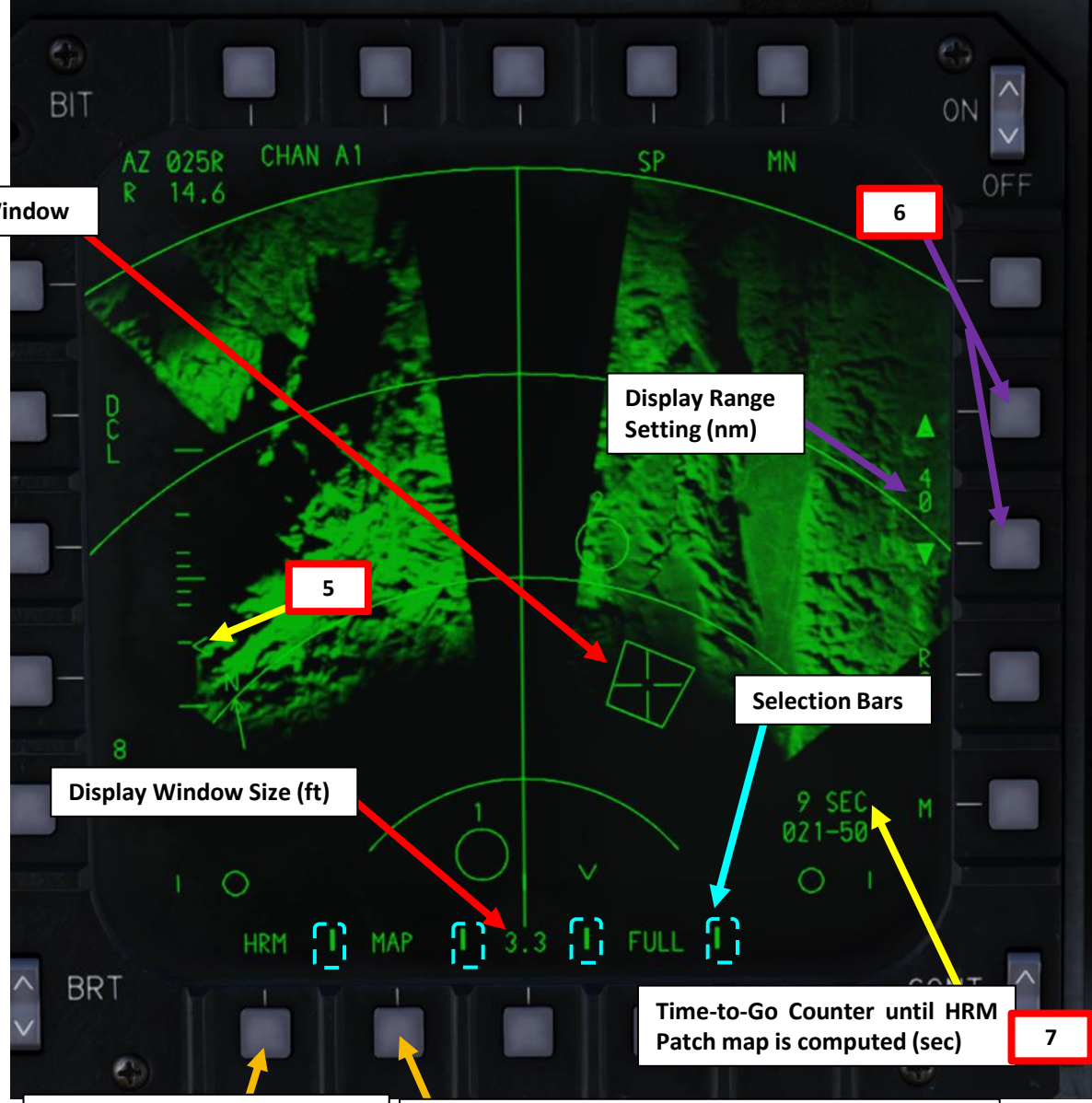
The HRM mode was designed to build radar maps in high resolution. Resolution of the display is measured in feet, with the best being 8.5 feet.

HRM mode is entered with the following procedure:

1. Radar Power Switch must be set to ON.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select HRM mode by toggling the A/G Radar Mode Selector button as needed.
5. Antenna elevation is controlled automatically and does not require any input from the aircrew.
6. Adjust display range as desired.
7. Building maps takes time (usually between 2-12 seconds). Up to five markpoints and sequence points can be overlayed on the map simultaneously.





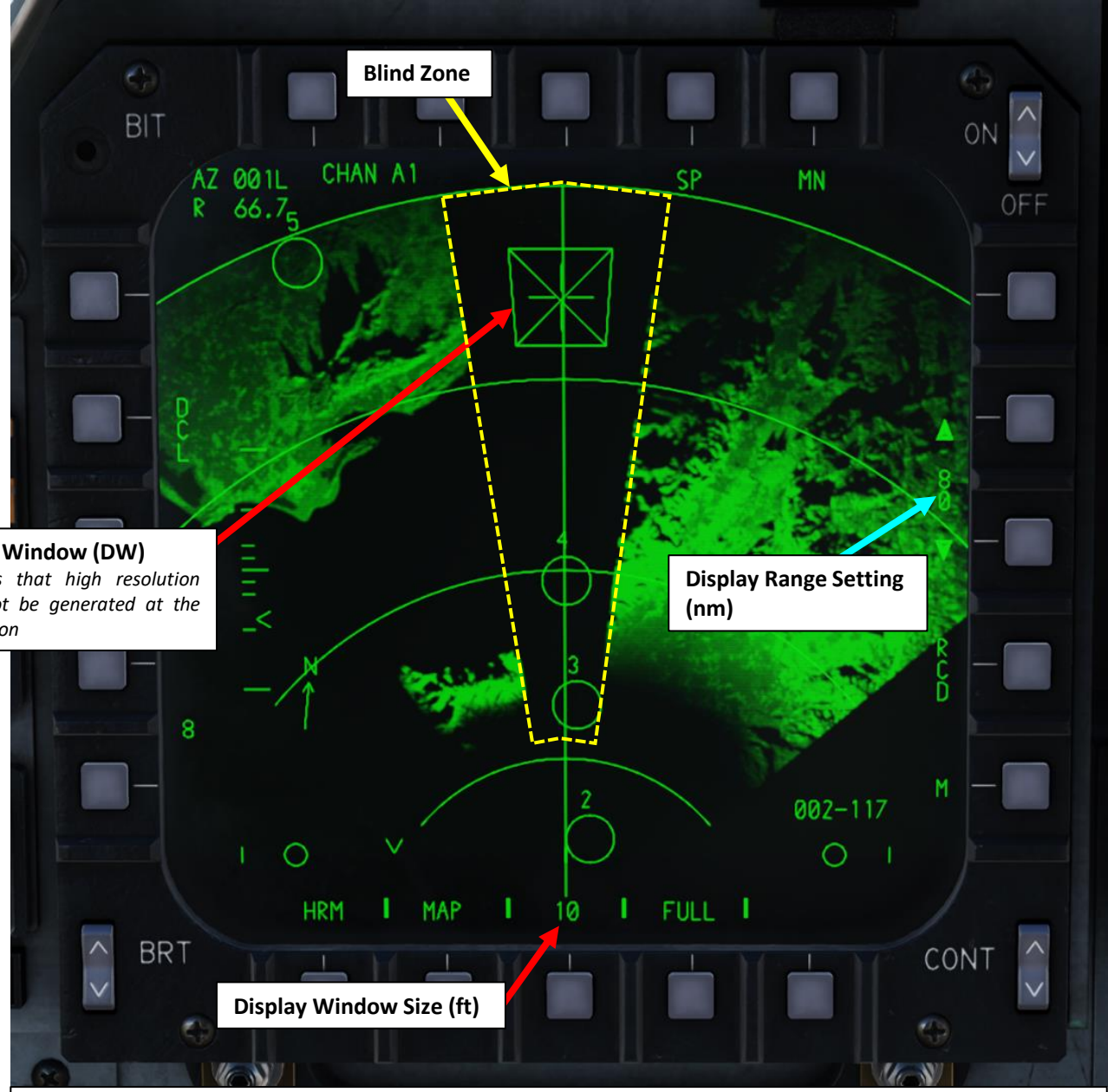


2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

Limitations Overview

There are several restrictions that have to be taken into account when building a HRM:

- HRM is **not available** in **aircraft's blind zone**, which extends 8 deg around the aircraft ground track.
- HRM is **not available** if the aircrew is trying to map the **area too close to the gimbal limit**.
- HRM is **not available** if the aircrew is trying to map a patch with **size too large for current range.** As an example, a 20 nm patch map requested when display is at a range scale set to 10 nm will not be able to be generated.



In this example, the size of the patch map is 10 nm, as indicated by Display Window (DW) Size. The range scale is 80 nm. Should the DW size be too large to properly map, a large X would be displayed superimposed over the Map Display Window.

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

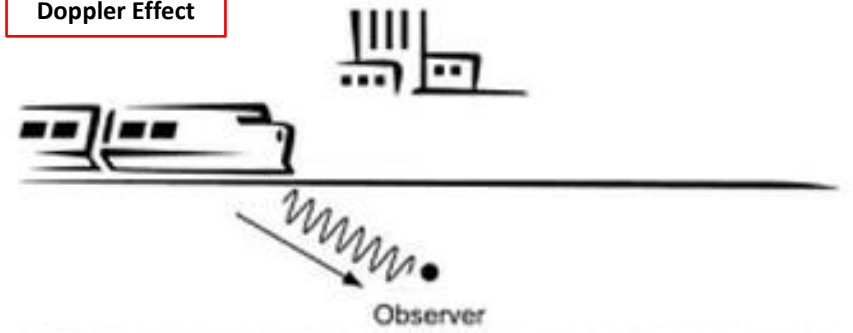
Limitations: The "Doppler Shift" Effect

The **Doppler Effect** is probably that boring phenomenon you heard about in high school and didn't care about at the time. Basically, the Doppler Effect is the reason why airplane fly-bys in airshows are so awesome to listen to: a moving object (like a plane) is emitting waves (like sound waves) that are received by an observer (you), and the frequency of this wave (like the sound pitch) will change the closer or farther the aircraft comes to you.

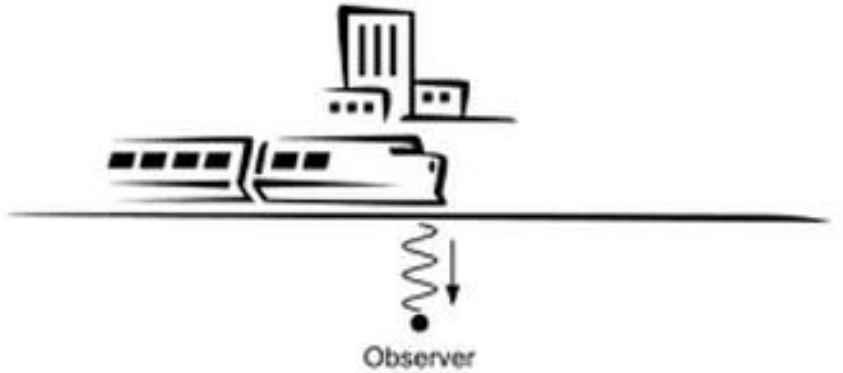
The received frequency is higher (compared to the emitted frequency) during the approach, it is identical at the instant of passing by, and it is lower during the recession. This variation of frequency also depends on the direction the wave source is moving with respect to the observer; it is maximum when the source is moving directly toward or away from the observer and diminishes with increasing angle between the direction of motion and the direction of the waves, until when the source is moving at right angles to the observer, there is no shift.

Where am I going with this? Well, the radar is affected by the Doppler Effect since it emits and receives radar waves, which will affect your doppler-beam-sharpened modes. How? Hang on, I'm getting there.

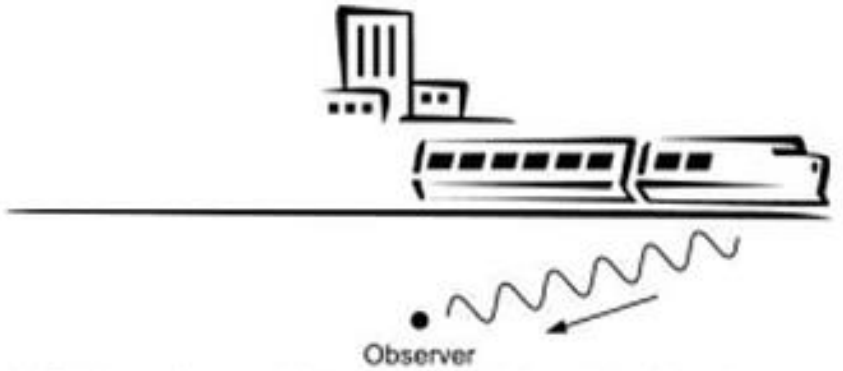
Doppler Effect



(a) Train moving towards the observer (more cycles in a given time therefore the observer perceives a higher pitch)



(b) Train nearest to the observer (observer perceives the exact pitch)



(c) Train moving away from the observer (less cycles in a given time therefore the observer perceives a lower pitch)

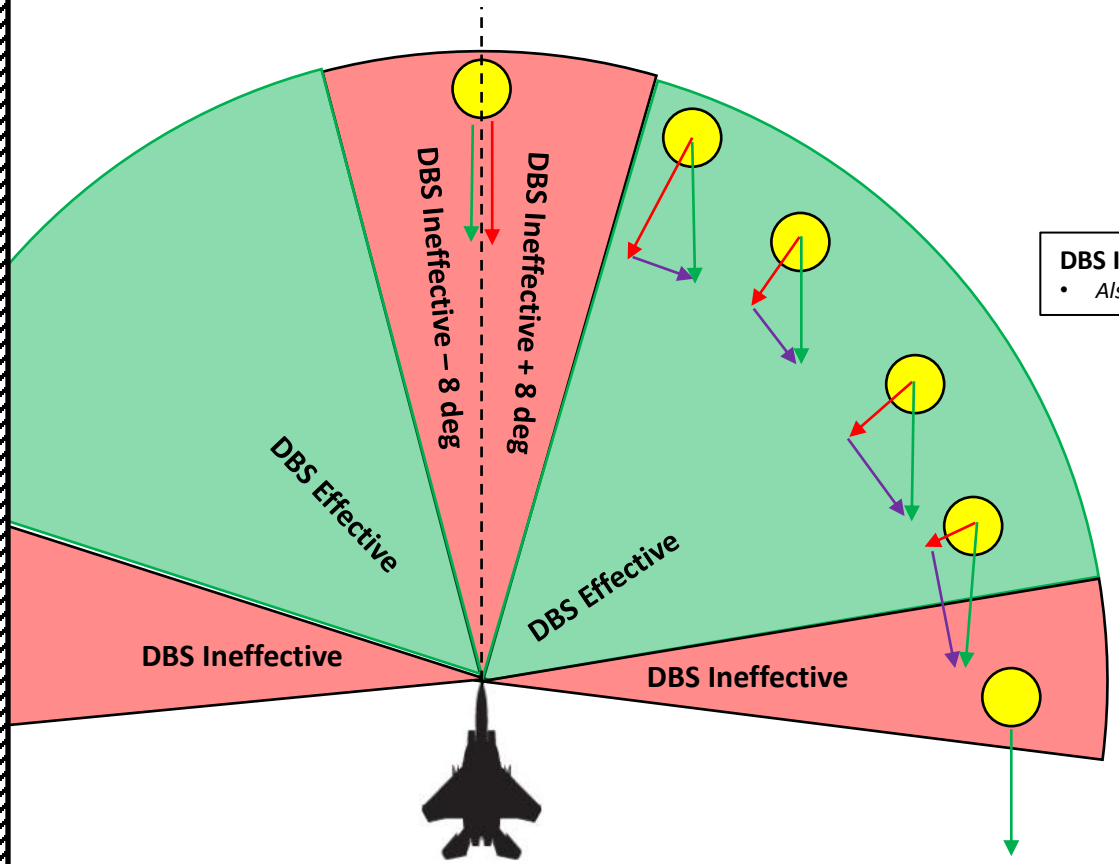
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

Limitations: The "Doppler Shift" Effect

Doppler beam sharpened (DBS) maps directly across the aircraft ground track become increasingly difficult to map because of the large shift in Doppler frequency within those regions. This means that certain regions will not be computed properly, creating these black regions in certain areas relative to your aircraft. To get the best coverage of an area, I would suggest that you fly at a 45 deg angle from it, not directly towards it.

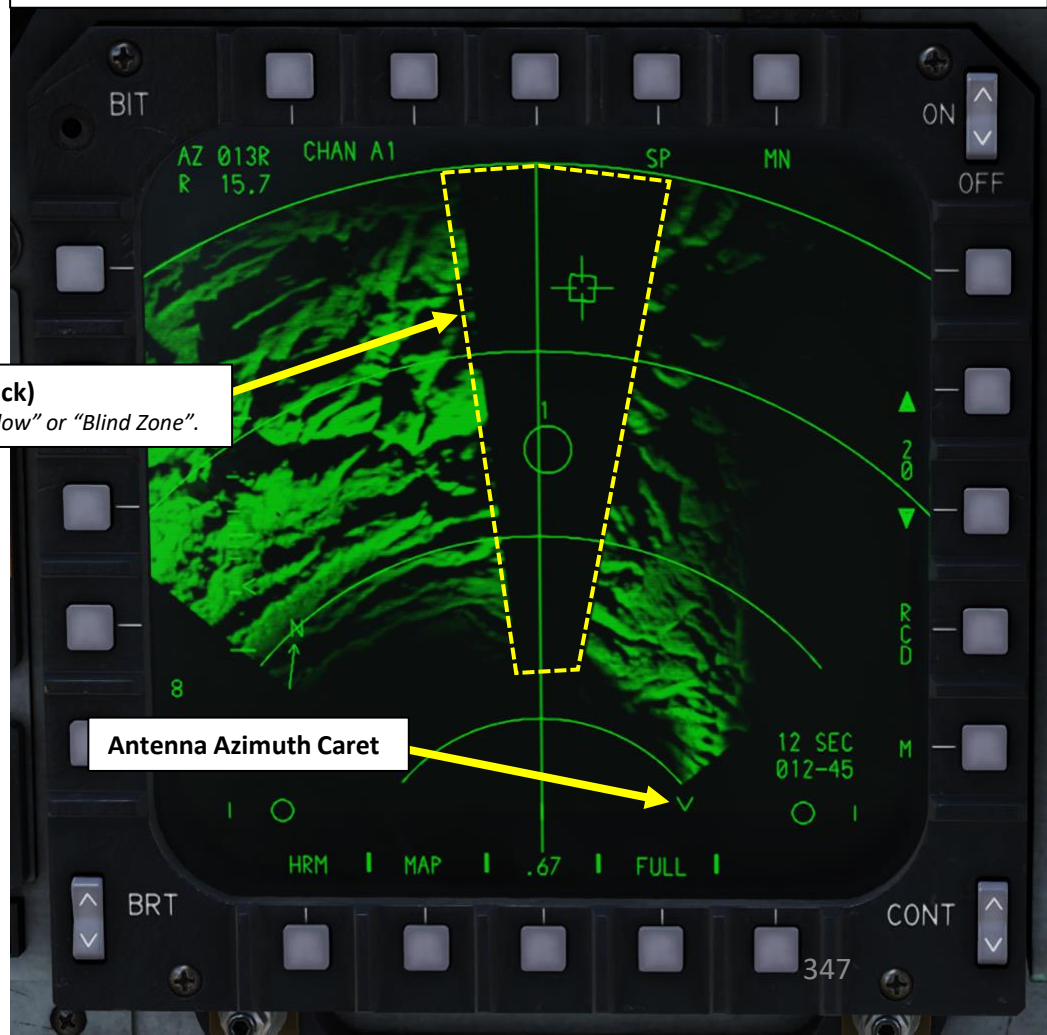
This video showcases the frequency shift with sound pitch frequency:

https://youtu.be/-P5J7XEwZIs



The Blank Window is a blind zone of roughly 8 deg on each side of aircraft's ground track (16 deg 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.

DBS Ineffective Region (Black)
- *Also referred as "Blank Window" or "Blind Zone".*

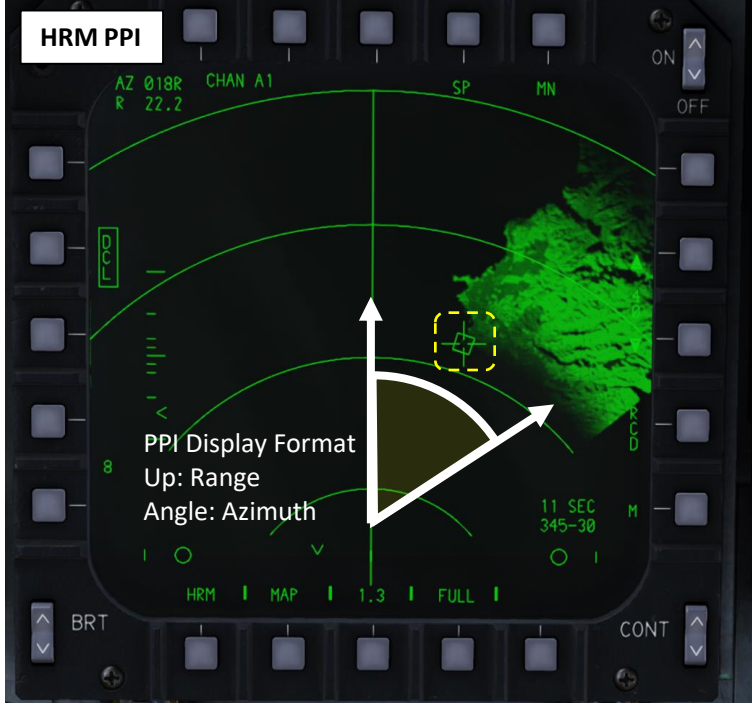


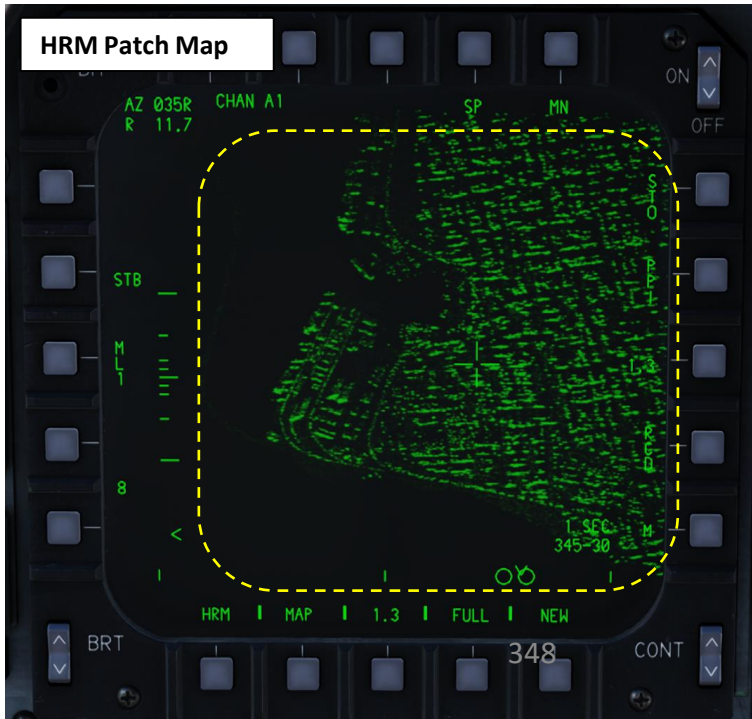
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

HRM Types: PPI (Plan Position Indicator) vs Patch Map

Two types of high resolution maps can be generated:

- **HRM PPI (Plan Position Indicator) Map**: This presentation mode is similar to real beam map (RBM) mode, but in higher resolution. This sub-mode covers a relatively large area and is useful for terrain surveillance and situation awareness. This map type is selected by default when selecting "HRM Mode".
- **HRM Patch Map**: HRM patch provides a smaller, area-specific and higher resolution map than the PPI. You can see this as a fancy "expanded" mode to obtain radar maps with better detail.





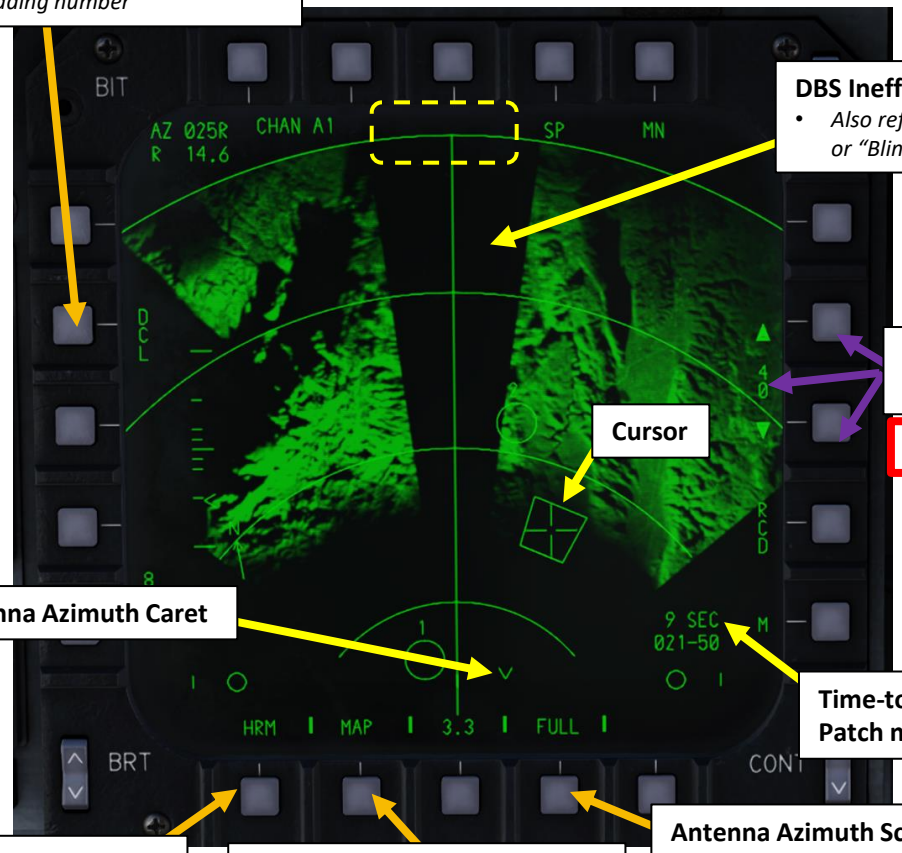
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

HRM PPI (Plan Position Indicator) Map

The Plan Position Indicator (PPI) presentation, as stated previously, can be considered as a "high-resolution real beam map".

1. To enter HRM in PPI mode, the air crew should follow the procedure listed in the **HRM Mode Introduction** section.
2. The selectable range scales for the PPI mode are 4.7, 10, 20, 40, 80 and 160 nm.
3. Depending on aircraft speed, it takes some time (typically 7 - 10 seconds) to build the HRM. 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.
4. HALF and QUARTER azimuth widths are selectable and require less time to construct. They can be chosen by pressing the pushbutton next to FULL/HALF/QTR.
5. "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).
6. Pushbuttons in PPI mode have the same functions as those described in the RBM Mode section.

Declutter (DCL) Function
- *When selected, "declutter" removes Magnetic Heading / Direction Display, Sequence points and their numbers, and the Pattern Steering Line (PSL) and attack heading number*



DBS Ineffective Region (Black)
- *Also referred as "Blank Window" or "Blind Zone".*

Display Range Setting (nm) & Controls

2

Cursor

Antenna Azimuth Caret

3

Time-to-Go Counter until HRM Patch map is computed (sec)

A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

1

Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

Antenna Azimuth Scan Selection Setting
- *FULL: Azimuth scan of 100 deg*
- *HALF: Azimuth scan of 50 deg*
- *QTR (Quarter): Azimuth scan of 25 deg*

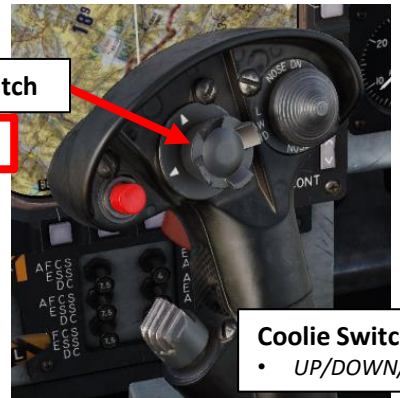
4

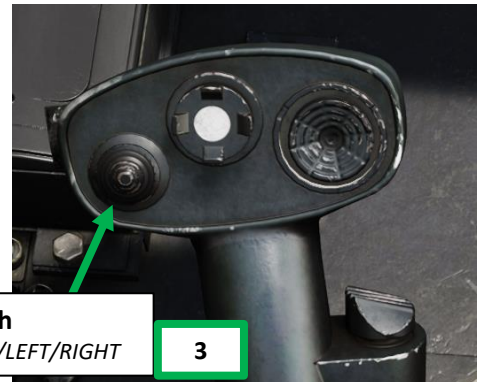
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

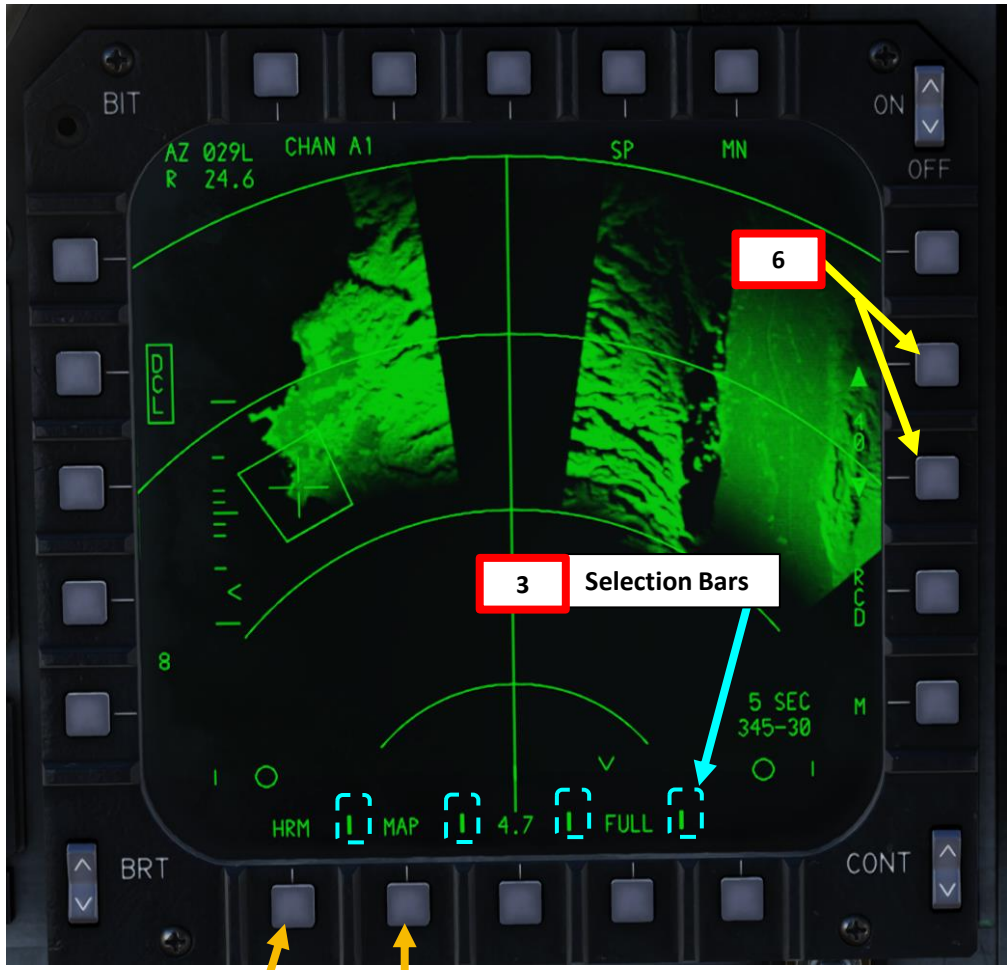
HRM Patch Map

HRM patch provides a smaller, area-specific and higher resolution map than the PPI. The MAP function is used to prepare the system for commanding HRM (High Resolution Map) patch maps. HRM patch can be selected from almost any A/G radar mode: HRM PPI, RBM, GMT and PVU. To command a HRM patch map from HRM mode:

1. Radar Power Switch must be set to ON.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select either RBM, GMT, HRM or PVU mode by toggling the A/G Radar Mode Selector button as needed. We will select HRM straight away to get a better detailed PPI (Plan Position Indicator) view.
5. On A/G RDR page, select MAP cursor function by toggling the Cursor Function Selector button as needed.
6. Adjust display range as desired.







A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

4

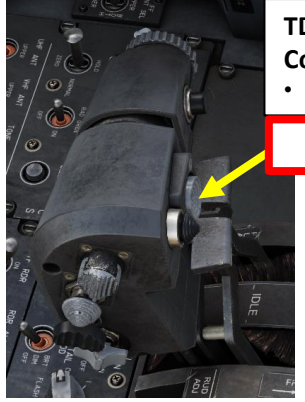
Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

5

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

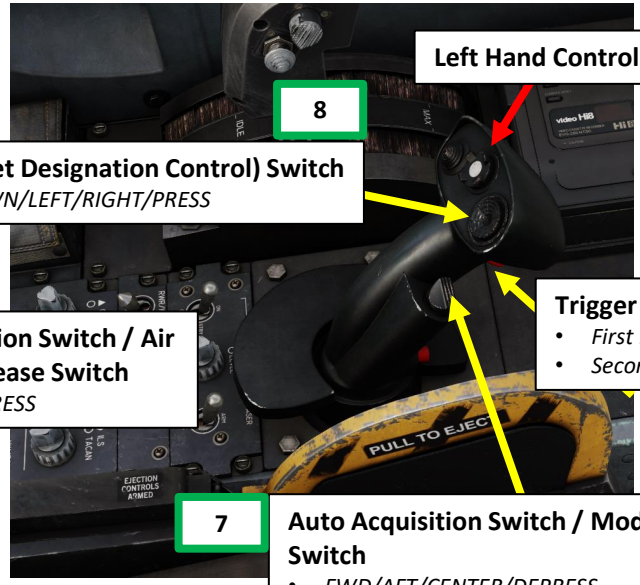
HRM Patch Map

7. 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. The size can be changed pressing the Auto Acquisition Switch FWD and AFT. Currently selected DW size is displayed at the bottom center of the display (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80 nm).
8. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select. Make sure the area isn't directly in front of the aircraft or you might have the "BLIND ZONE" caution, inhibiting patch map generation.
9. To command the HRM (High Resolution Map) patch map:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
10. When patch map is commanded, MAP indication becomes boxed and time-to-go clock counts down in the bottom-right corner of the display while the HRM is being computed.
11. After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

8 9



Left Hand Controller (LHC)

8

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

9

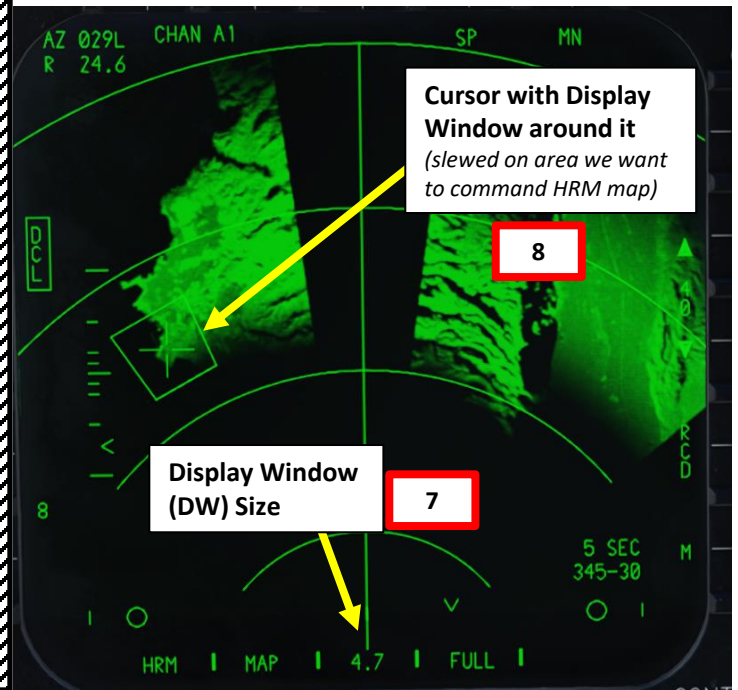
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

7

7

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

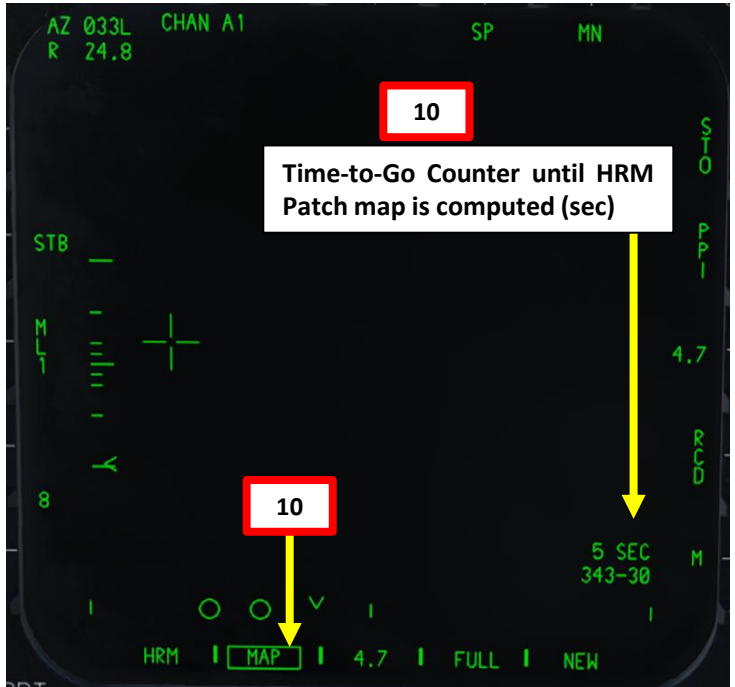


Cursor with Display Window around it
(slewed on area we want to command HRM map)

8

Display Window (DW) Size

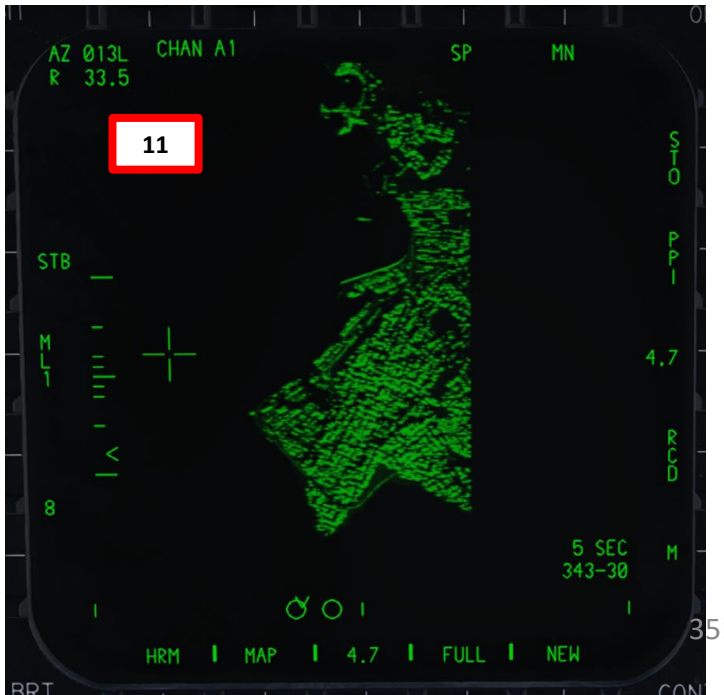
7



10

Time-to-Go Counter until HRM Patch map is computed (sec)

10



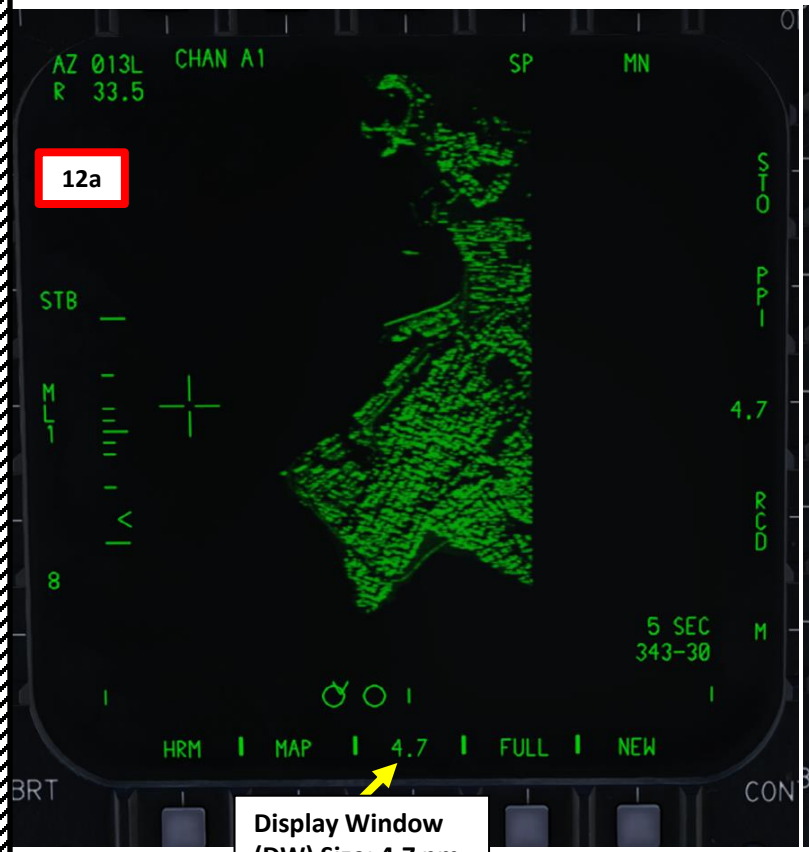
11

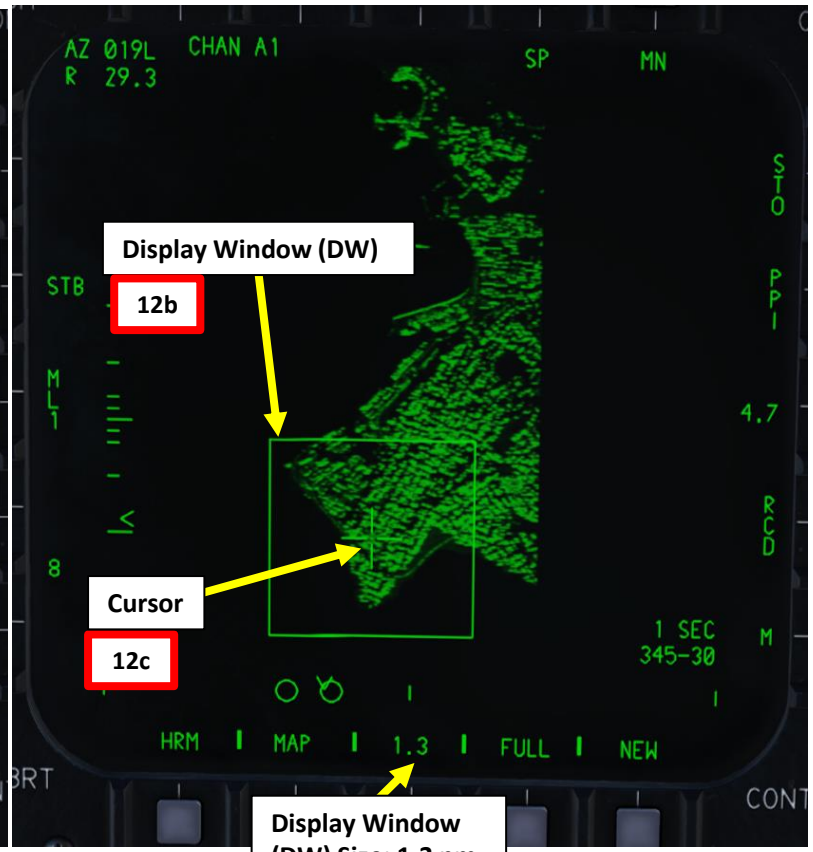
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

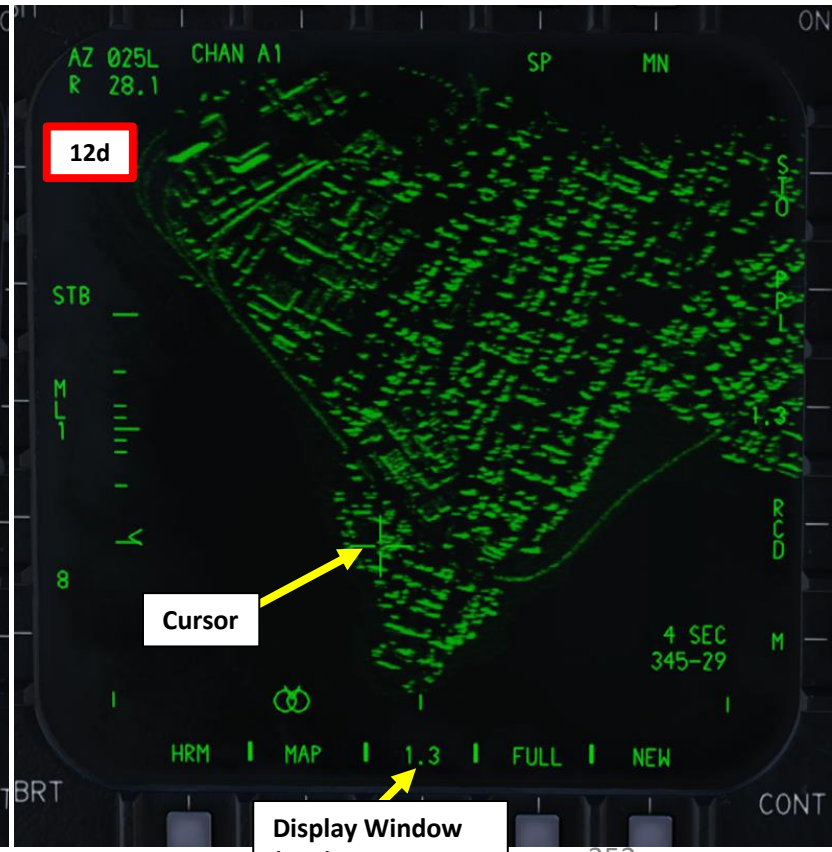
HRM Patch Map

12. You can repeat previous steps 7 through 11 for further picture refinements.

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



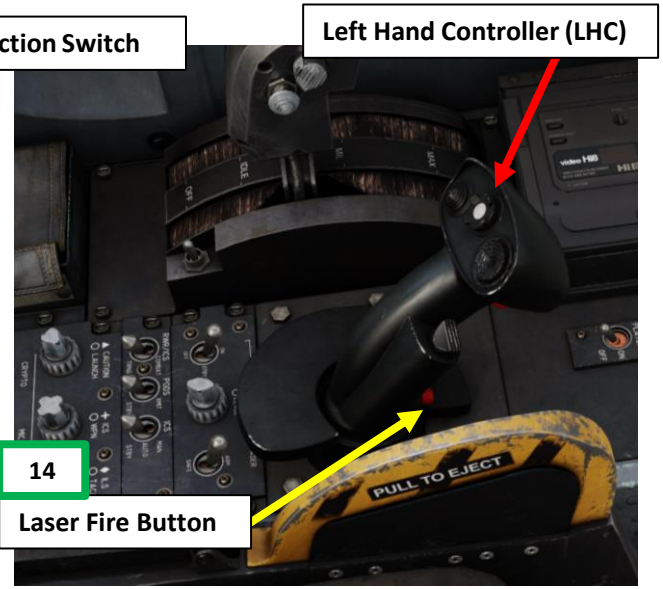




2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.4 – HRM (High Resolution Map) Mode

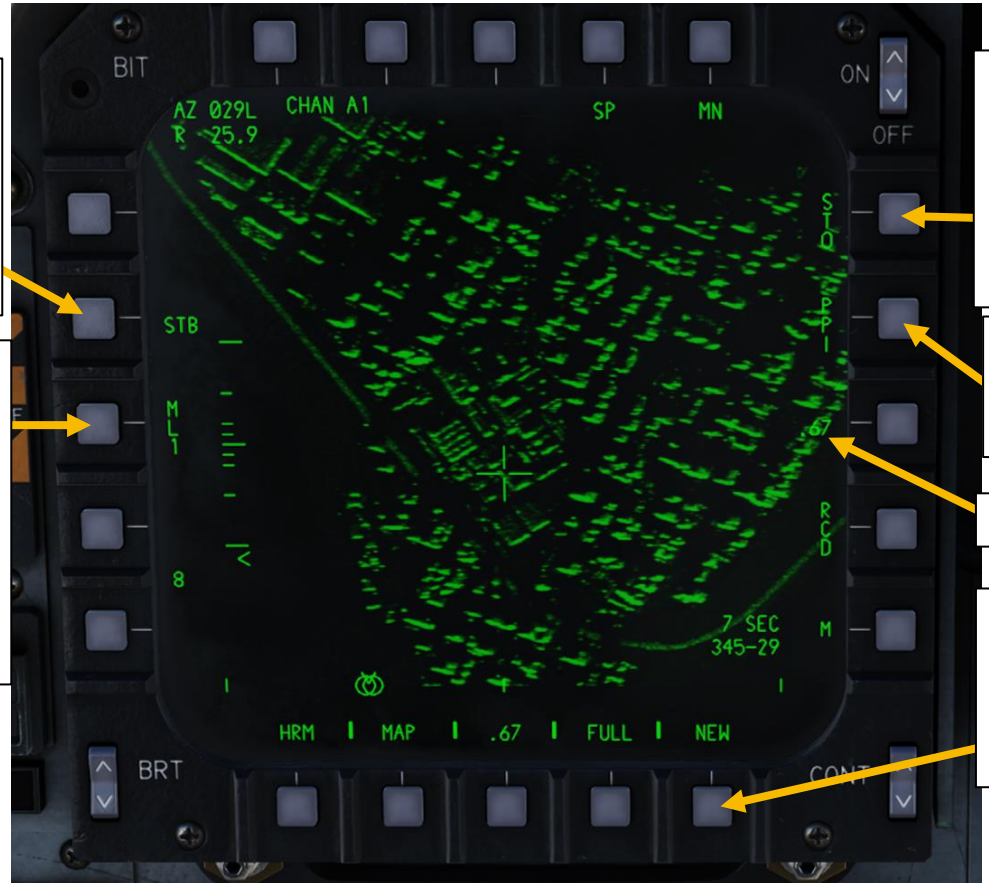
HRM Patch Map

13. Here is an overview of the additional pushbuttons and options available for the HRM when in Patch Mapping.
14. Reminder: If you want to "freeze" the picture, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.



Patch Map Stabilization Option Selector
- *STB: 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.*
- *PRG: Progressive patch maps are constructed at a fixed range and angle off the velocity vector and will follow the aircraft movement.*

Multilook Option Selector
- *Two options are available, ML1 and ML2. With either option, the radar map is generated by dividing the selected map into certain arrays for video processing.*
- *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.*
- *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.*



Store (STO) Option Selector
- *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. Pressing the "Recall Option Selector" (NEW/OLD) Pushbutton cycles between these two (as opposed to current and one before it without the STO pushbutton selected). Store selection is only possible when FREEZE is commanded (STO becomes boxed).*

PPI Map Type Selector
- *During the HRM patch mapping pressing this pushbutton will tell the radar to immediately return to HRM PPI mode with the last selected PPI range scale and full azimuth scan.*

HRM Displayed Map Size (nm)

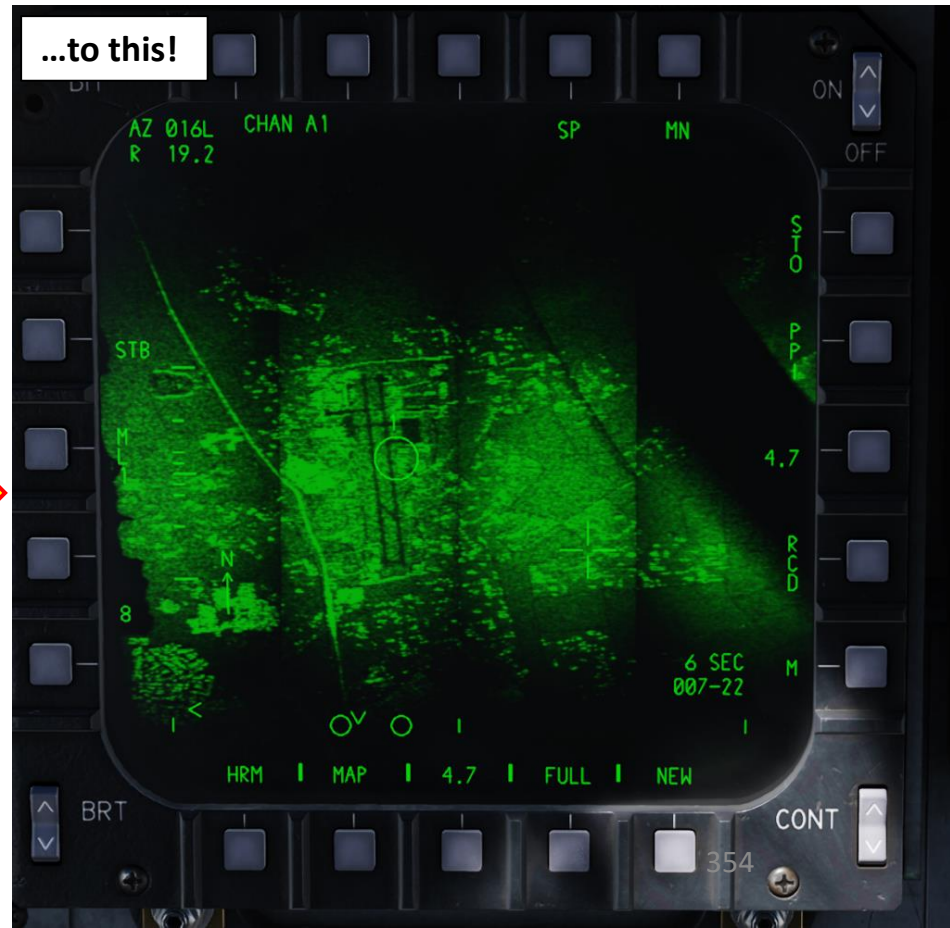
Recall (NEW/OLD) Option Selector
- *Allows the aircrew to show the current map (NEW) or recall the previous map displayed (OLD). If a new map is constructed, it overwrites whichever map is not currently displayed and the previously displayed map becomes an old map.*

2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

Introduction

The radar's PVU (Precision Velocity Update) mode provides an estimate of velocity error for updating the MN (Mission Navigator) or the INS (Inertial Navigation System). Irrespective of the version (MN PVU, INS PVU, or Interleaved PVU), the 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.

In other words… when using radar ground mapping in modes like RBM (Real Beam Map) or HRM (High Resolution Map), **velocity errors accumulate over time**. These errors degrade the generated radar picture's quality. Using PVU mode, the **radar can determine the velocity errors and apply corrections**, improving the picture's quality and precision in the process.



2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

PVU Versions

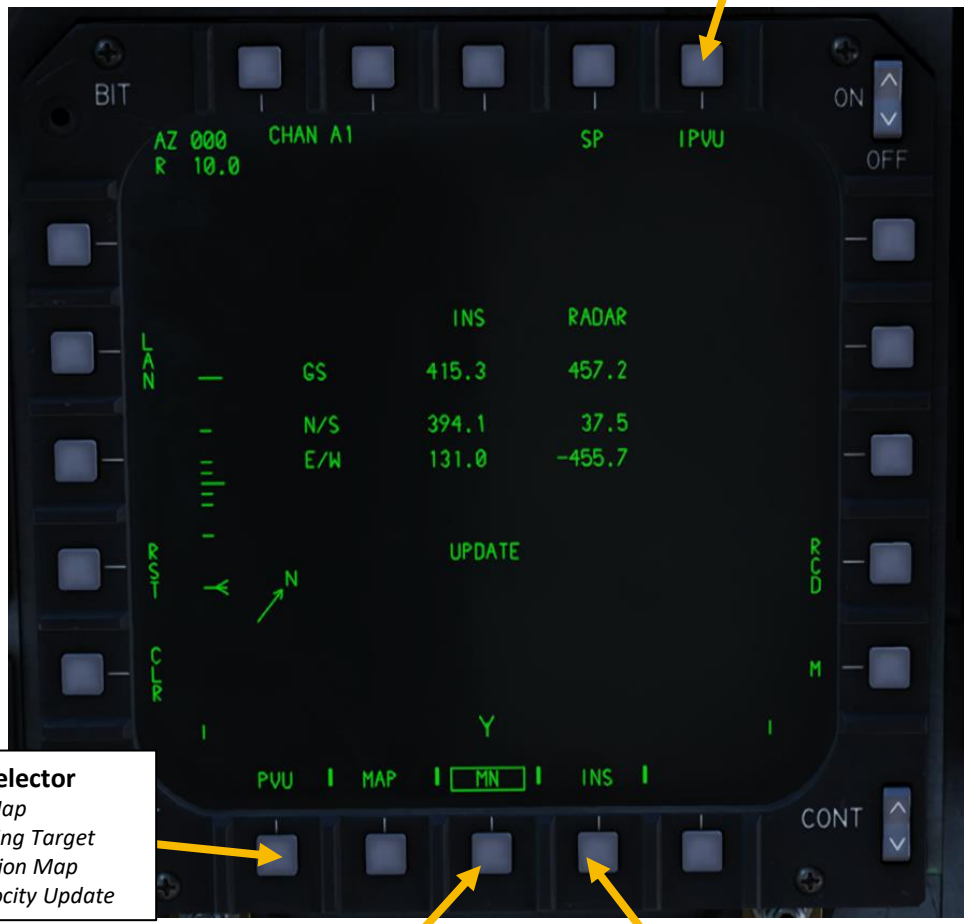
There are three different PVU versions available to the aircrew. They are selected with their respective pushbuttons in the A/G RDR page when the PVU mode is selected with the A/G Radar Mode Selector pushbutton.

A. MN (Mission Navigator) PVU: This mode provides updates to the Mission Navigator, offering the accurate short term system velocity without affecting the INS.
1. First, the radar performs a coarse doppler estimate to detect potentially large velocity errors.
2. Once valid coarse data for two successive positions is obtained, the radar proceeds with determining the PVU error. This usually takes around 10 seconds.
3. 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.

B. INS (Inertial Navigation System) PVU: This mode 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.
1. First, the aircrew needs to enter the dedicated PVU mode and box the INS to prepare for an update.
2. 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.
3. 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.

C. Interleaved PVU (IPVU): This mode is an automated version of PVU available in HRM (High Resolution Map) and RBM (Real Beam Map) 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 commanded PVU, which should be performed with MN (Mission Navigator) as PPKS (Present Position Keeping Source) before building the first HRM map.

IPVU (Interleaved PVU) Version Selector
- *This pushbutton has to be selected (shows "IPVU" when selected) to perform the interleaved precision velocity update.*



A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

MN (Mission Navigator) PVU Version Selector
- *This version/option is boxed by default upon entering the PVU mode.*
- *Allows updating the MN velocities once the aircrew accepts the PVU errors.*

INS (Inertial Navigation System) PVU Version Selector
- *This pushbutton has to be selected/boxed to perform the INS velocity update. Once the errors are displayed, the aircrew has to accept them to begin the update process.*

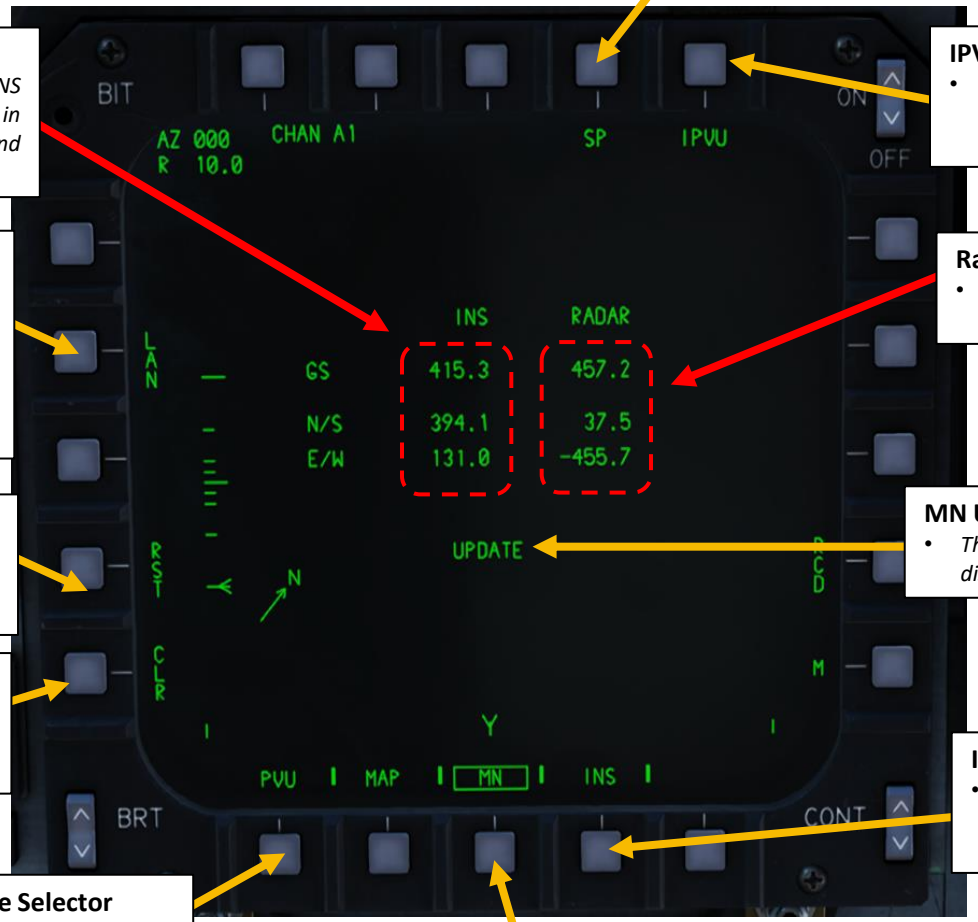
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

PVU Page

Sequence Point (SP) Pushbutton
- *This displays the currently selected Sequence Point. If a SP is chosen while in PVU and REJECT button is pressed on Auto Acquisition Switch, it returns the radar to HRM patch of the given SP.*

Reference Velocities
- *Displays ground speed components as provided by INS (Inertial Navigation System). Components are listed in absolute (GS), but also in terms of N/S (North/South) and E/W (East/West) components..*

IPVU (Interleaved PVU) Version Selector
- *This pushbutton has to be selected (shows "IPVU" when selected) to perform the interleaved precision velocity update.*



Land/Sea Update Option Selector
- *For the majority of updates, LAN (Land) 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.*

Radar Velocity Errors
- *Shows the difference between the Reference Velocities and the computations made by the radar.*

Reset (RST) Selector
- *This option allows the aircrew to reinitialize the PVU, deleting the current data and starting the averaging process anew.*

MN UPDATE Cue
- *This cue is displayed for 5 seconds below the PVU data display when the aircrew has commanded an update.*

Clear (CLR) Selector
- *This option 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.*

INS (Inertial Navigation System) PVU Version Selector
- *This pushbutton has to be selected/boxed to perform the INS velocity update. Once the errors are displayed, the aircrew has to accept them to begin the update process.*

A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

MN (Mission Navigator) PVU Version Selector
- *This version/option is boxed by default upon entering the PVU mode.*
- *Allows updating the MN velocities once the aircrew accepts the PVU errors.*

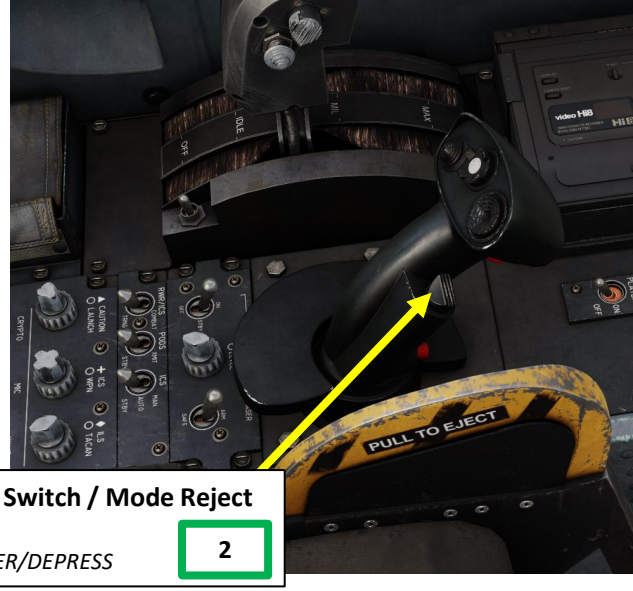
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

How to Command a Mission Navigation (MN) Precision Velocity Update (PVU)

1. In this example, we will assume that you have already commanded a HRM patch map on a specific area. This will give you a better idea of the improvements a precision velocity update can do.
2. On A/G RDR page, select PVU mode by toggling the A/G Radar Mode Selector button as needed.
    - Note: Alternatively, you can also access PVU mode from RBM (Real Beam Map) mode by depressing the Auto Acquisition Switch.
3. By default, the MN PVU version is selected/boxed.
4. If you want to change the PVU version, press the pushbuttons next to either “INS” for INS PVU or “MN/IPVU” for Interleaved PVU. We will leave the PVU version to “MN”.
5. Select desired LAND/SEA Update Option as desired. We will select LAN since we use the ground radar for a ground area.

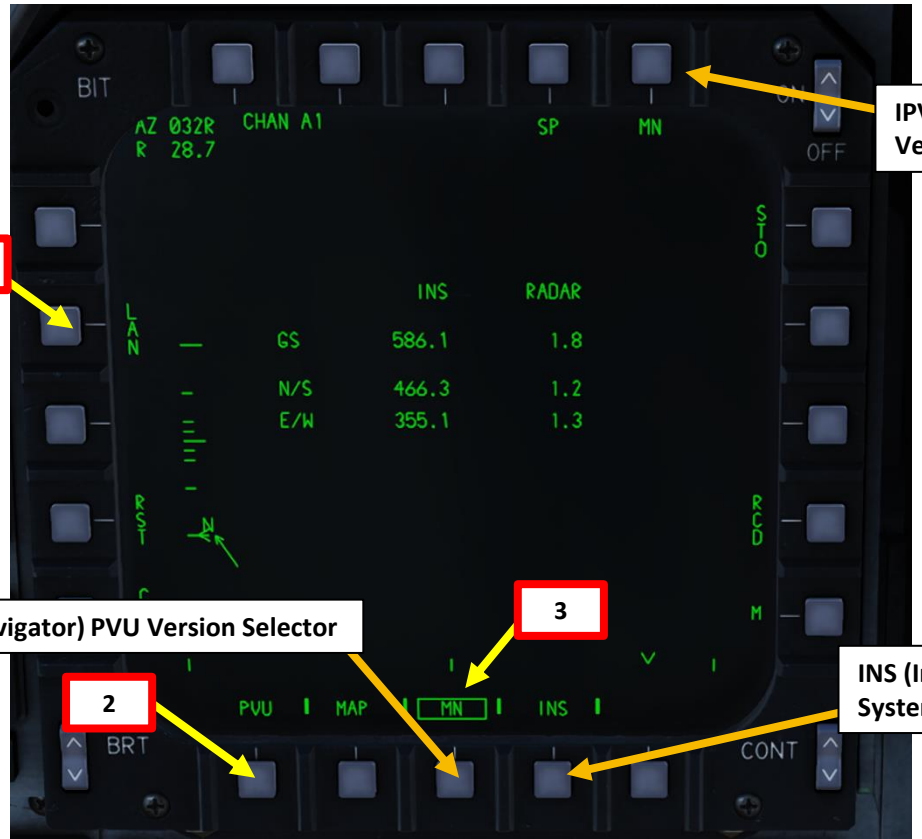
Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

2



Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

2



IPVU (Interleaved PVU) Version Selector

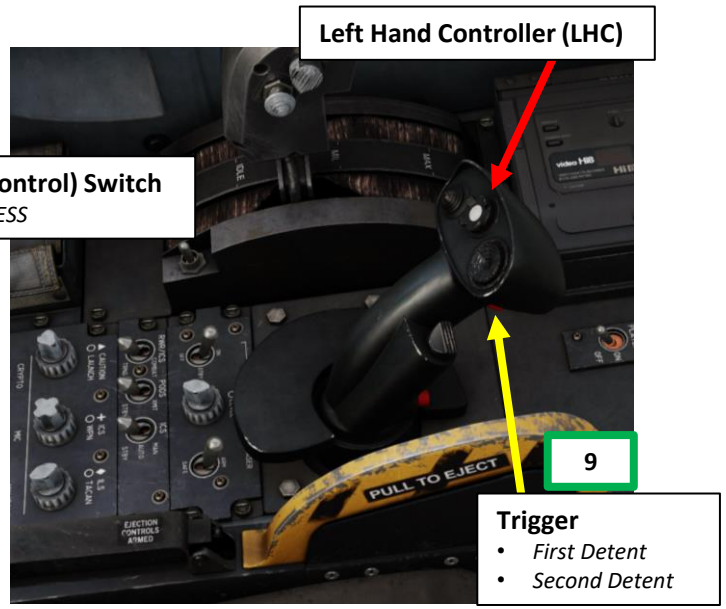
MN (Mission Navigator) PVU Version Selector

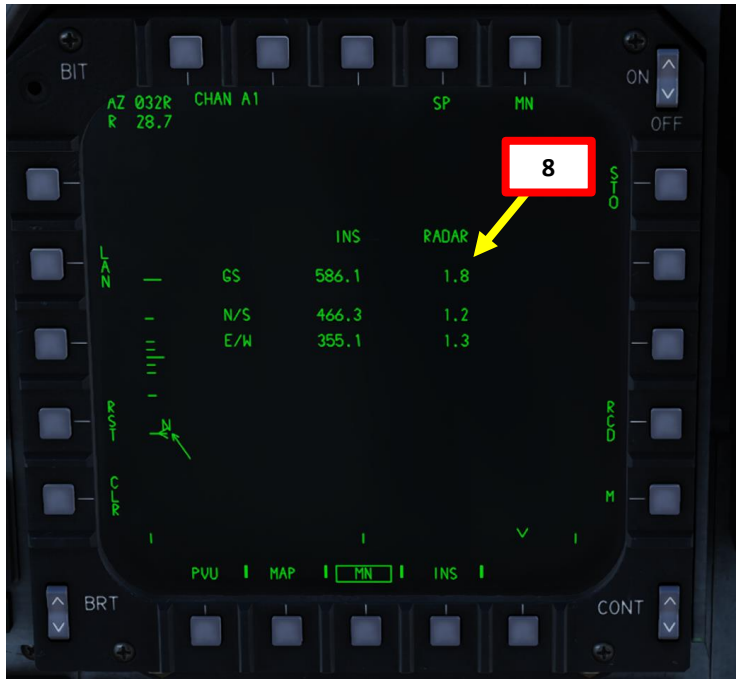
INS (Inertial Navigation System) PVU Version Selector

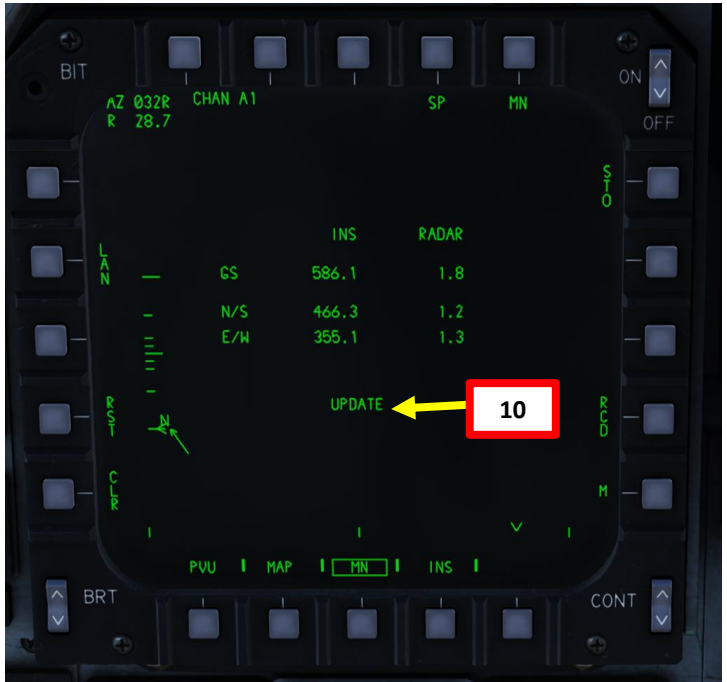
2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

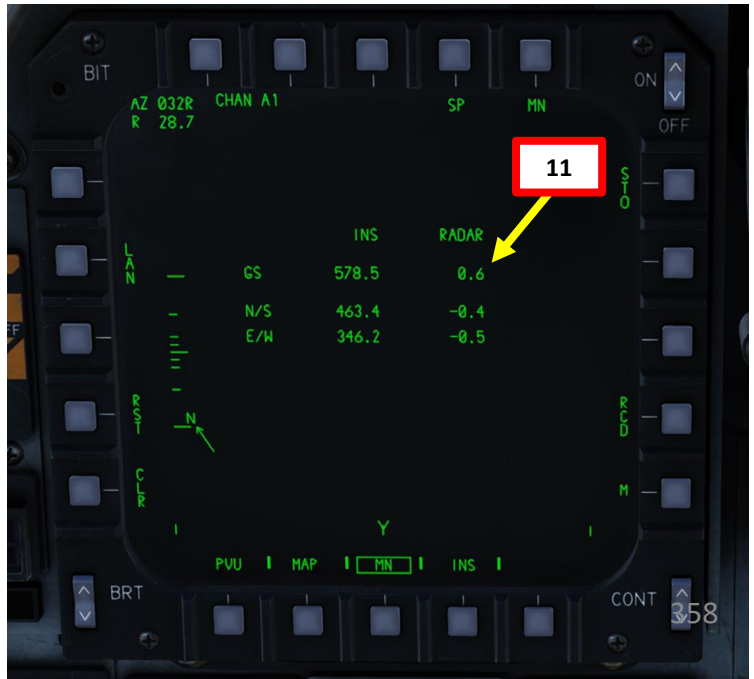
How to Command a Mission Navigation (MN) Precision Velocity Update (PVU)

6. The radar performs a coarse doppler estimate to detect potentially large velocity errors.
7. Once valid coarse data for two successive positions is obtained, the radar proceeds with determining the PVU error. This usually takes around 10 seconds.
8. Monitor the radar velocity errors to get an idea of how much error has accumulated.
9. Command a MN PVU:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
10. The MN PVU updates the Mission Navigator by accepting the errors, which causes the display to freeze for 4 seconds and the word UPDATE to be displayed.
11. Once update is performed, the error values should be smaller.





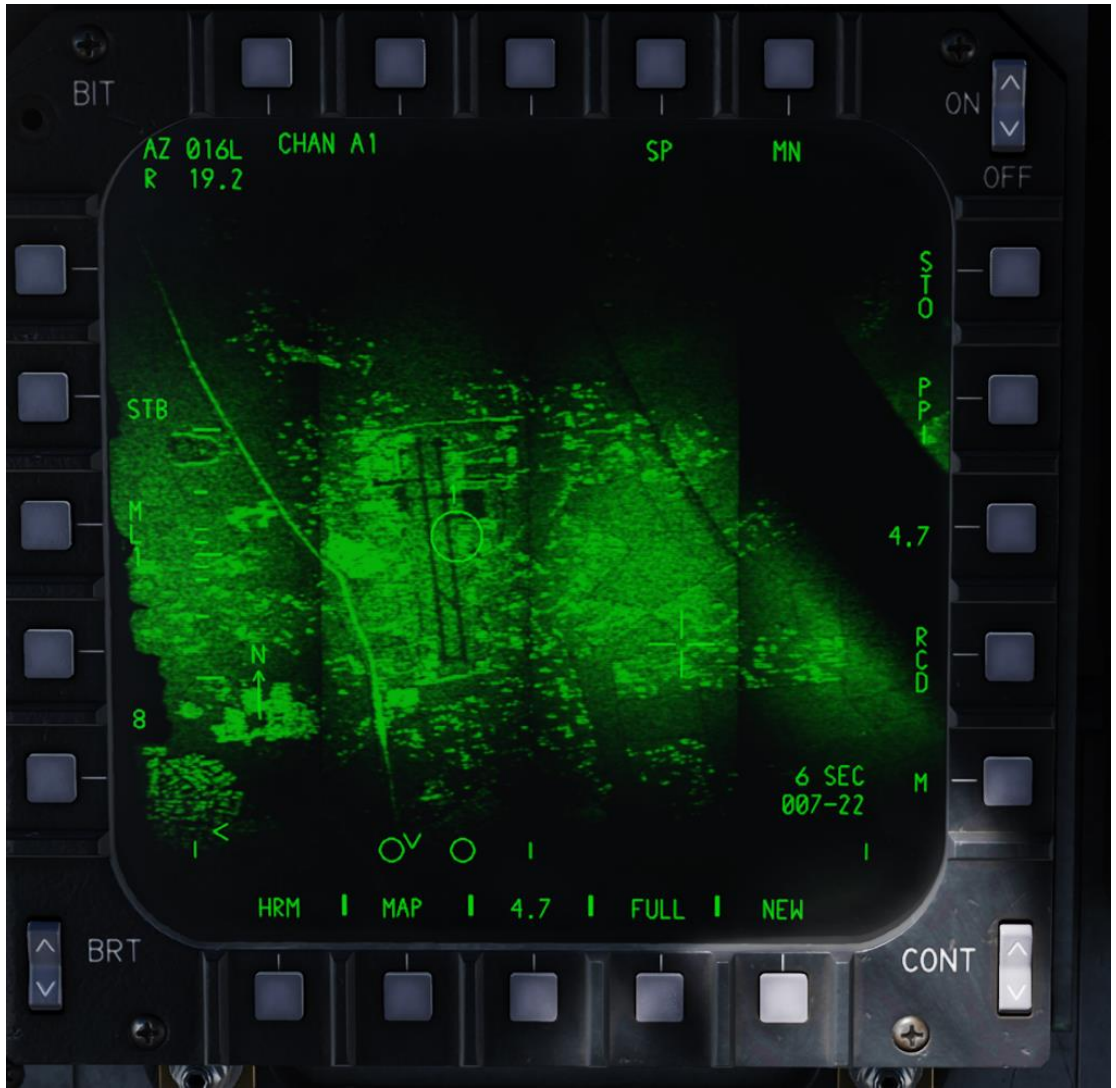




2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.5 – PVU (Precision Velocity Update) Mode

How to Command a Mission Navigation (MN) Precision Velocity Update (PVU)

12. You can perform another HRM Patch map to see if the air-to-ground radar mapping has improved in terms of precision and quality.



2 – AN/APG-70 RADAR
2.2 – Air-to-Ground Modes
2.2.6 – AGR (Air-to-Ground Ranging) Mode

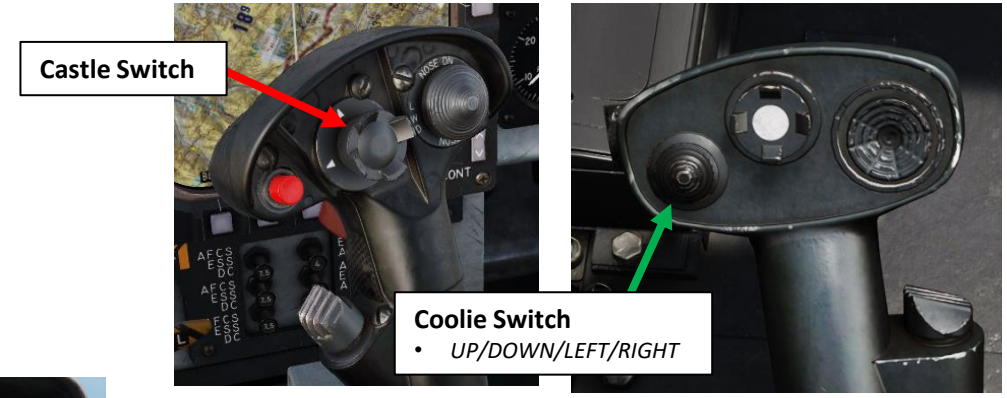
The AGR mode provides slant range measurement for target altitude determination, target designation or position updates. This mode cannot be selected and is commanded automatically every time the CC (Central Computer) determines that a slant range is necessary for proper designation or weapons delivery. It is worth noting that AGR mode interrupts other radar mode operations in progress and should be carefully monitored by the aircrew.

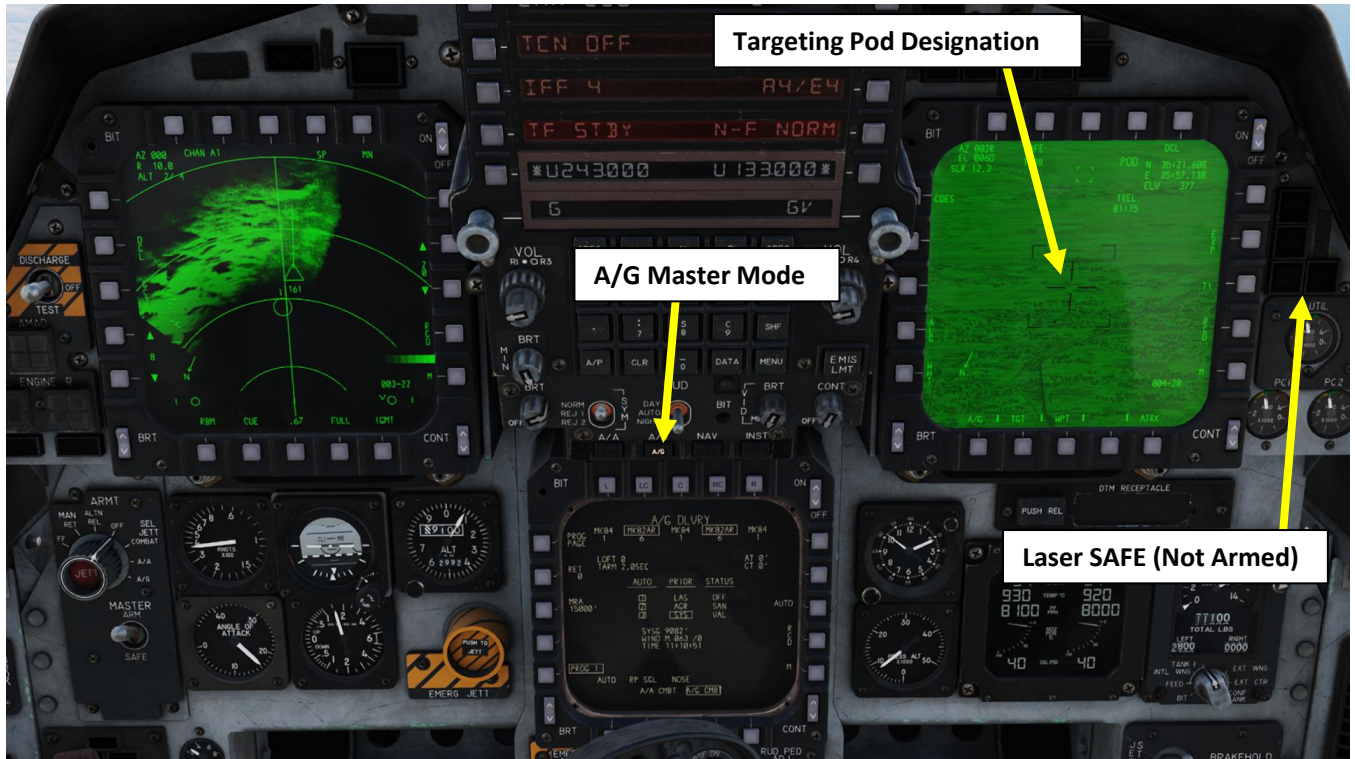
Here are two examples where AGR will interrupt other radar modes:

- Example 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.
- Example 2: During targeting pod designation when laser is not armed or not operational, the CC (Central Computer) will use AGR provided that the radar was cued to the targeting pod line-of-sight.

Note: 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.

- **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
- **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
  LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.

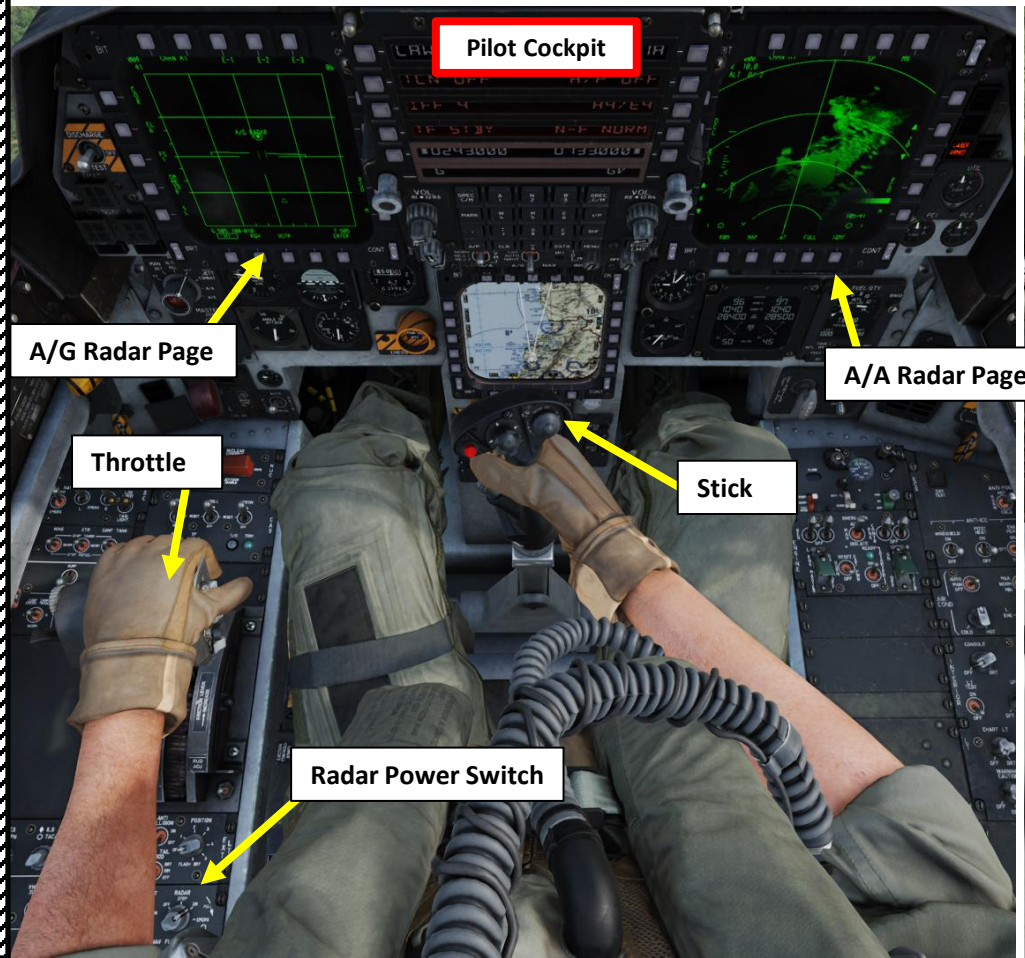


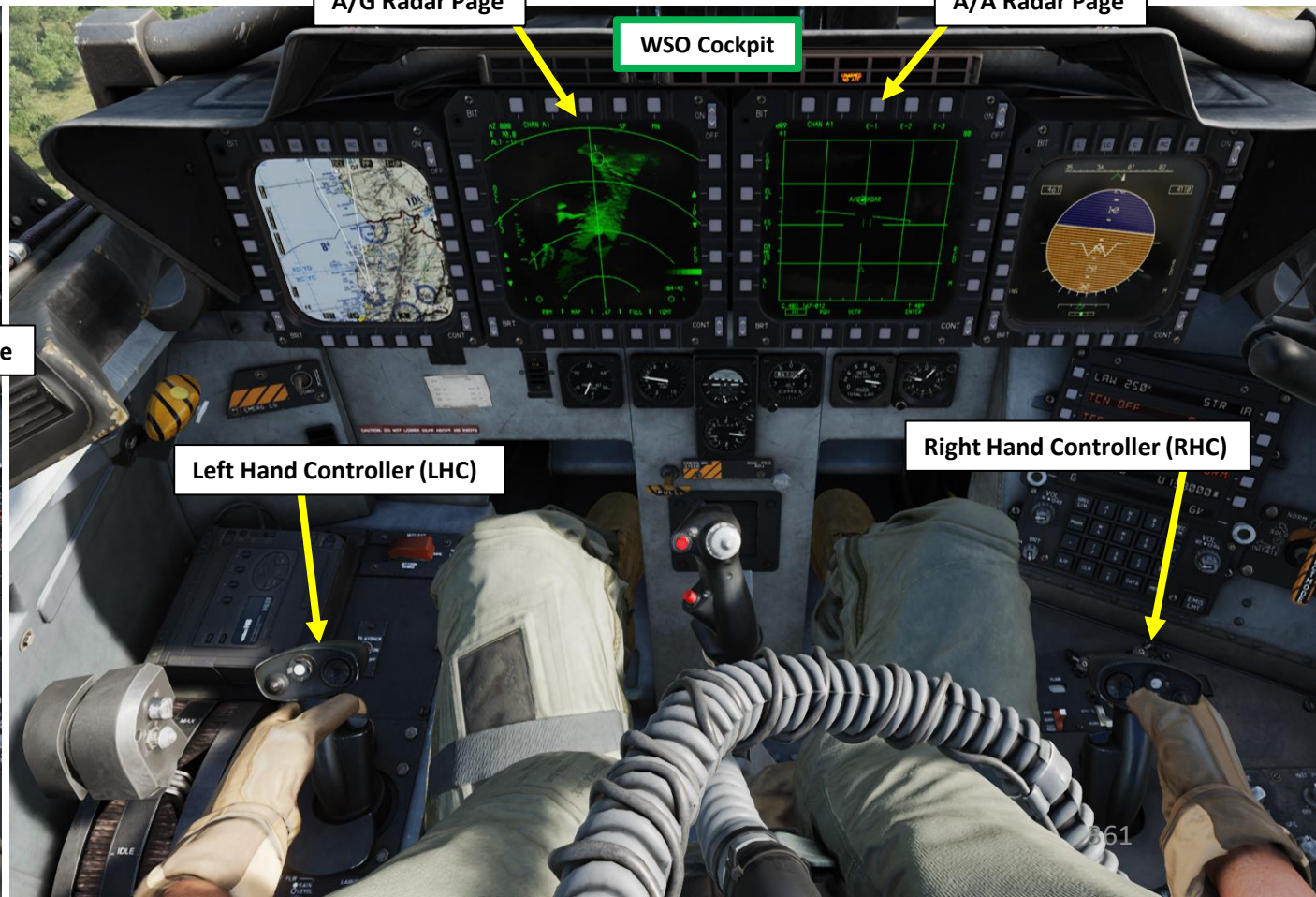


2 – AN/APG-70 RADAR
2.3 – Aircrew Roles & Sensor Operation

The radar can be operated from either the front or rear cockpit, but only one crew member may control the sensor at a time.

- The pilot uses the HOTAS stick, throttle, A/A RDR page and A/G RDR page to control the radar, and ultimately has control over the radar power switch.
- The WSO uses the Left/Right Hand Controller (LHC/RHC), A/A RDR page and A/G RDR page pushbuttons to control the radar.





2 – AN/APG-70 RADAR
2.3 – Aircrew Roles & Sensor Operation

Take note that the air-to-air (A/A) and air-to-ground (A/G) functions cannot be used at the same time.

2 – AN/APG-70 RADAR
2.4 – Radar Lingo & Terminology

- BANDIT: Identified Enemy Aircraft
- BOGEY: Unidentified Aircraft
- SPIKE: Air-to-Air radar is locked on you
- BUDDY SPIKE: Friendly radar is locked on you
- NAILS: RWR contact, which emits radar waves but does not have a radar lock on you
- FOX 1: semi-active radar missile (27R/ER + AIM-7)
- FOX 2: heat-seeking infrared missile (27T/ET + AIM-9 + R-73/60)
- FOX 3: active radar missile, meaning the missile tracks to an aircraft's radar up to a certain distance, then its internal radar activates (pitbull) (AIM-120/R-77)
- RIFLE: AGM-65 Air-to-Ground missile
- RAYGUN: When locking a target with your radar, it is good practice to say "RAYGUN" so your teammates are aware that you are locking someone. It is often used to identify a contact as friend or foe. If a person yells "BUDDY SPIKE!", it's very likely that you are locking a friendly contact.
- IFF: meaning "Is he friendly or bandit (enemy)?"
- PITBULL: Any FOX 3 (active radar) missile that starts using its onboard radar for tracking

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)

3.1 – Introduction

The AN/AAQ-14 LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) Targeting Pod is a targeting system developed to provide precision strike capability. Target designation is achieved by using a laser designator/range finder or an infrared laser marker, which can be created by the pod itself. It is also capable of displaying a FLIR (Forward-Looking Infrared) thermal imagery. The LANTIRN does not have all the modern capabilities or resolution of the newer LITENING or ATFLIR targeting pods of the F/A-18C Hornet, but the LANTIRN was very advanced hardware for the time.

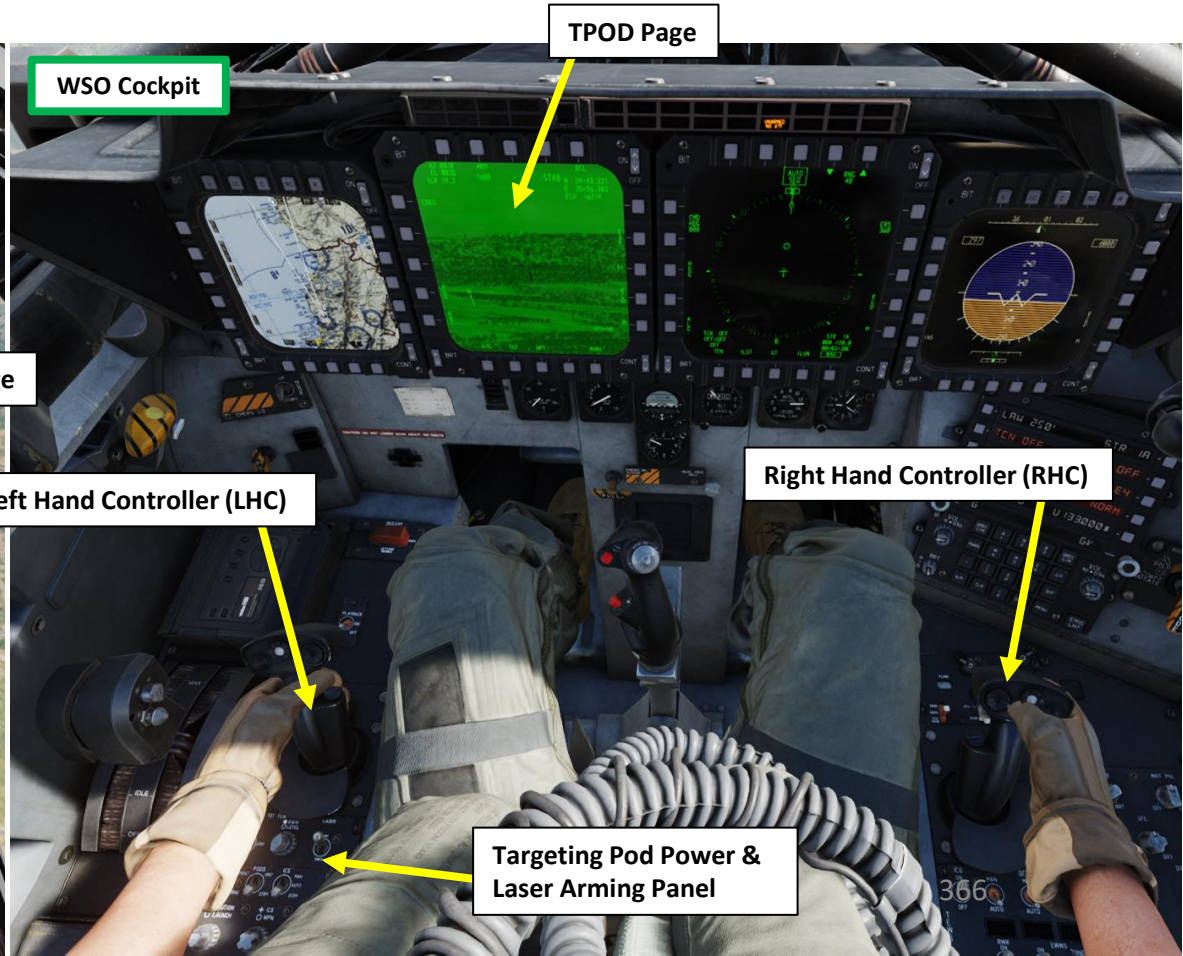
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)

3.1 – Introduction

Aircrew Roles & Sensor Operation

The targeting pod can be operated from either the front or rear cockpit, but only one crew member may control the sensor at a time.

- The pilot uses the HOTAS stick, throttle and TPOD page pushbuttons to control the targeting pod.
- The WSO uses the Left/Right Hand Controller (LHC/RHC) and TPOD page pushbuttons to control the targeting pod, and ultimately has control over the Targeting Pod power switch and laser arming switch.

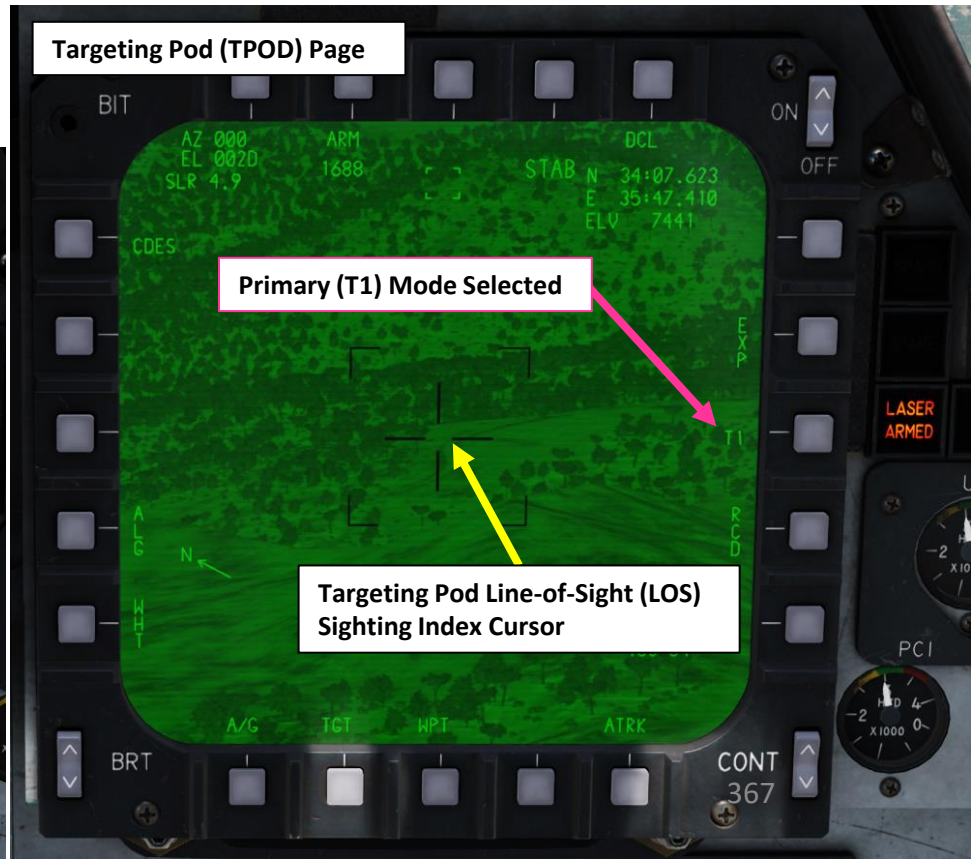


3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

The targeting pod feed can be displayed on either MPD (Multipurpose Display) or on the MPCD (Multipurpose Color Display). Take note that the TPOD page on the MPCD is displayed in white and black, while the TPOD page on the MPD are in shades of black and green.

To display targeting pod feed, press pushbutton next to “M” to reach main menu, then select TPOD page. By default, Primary (T1) Mode is selected.

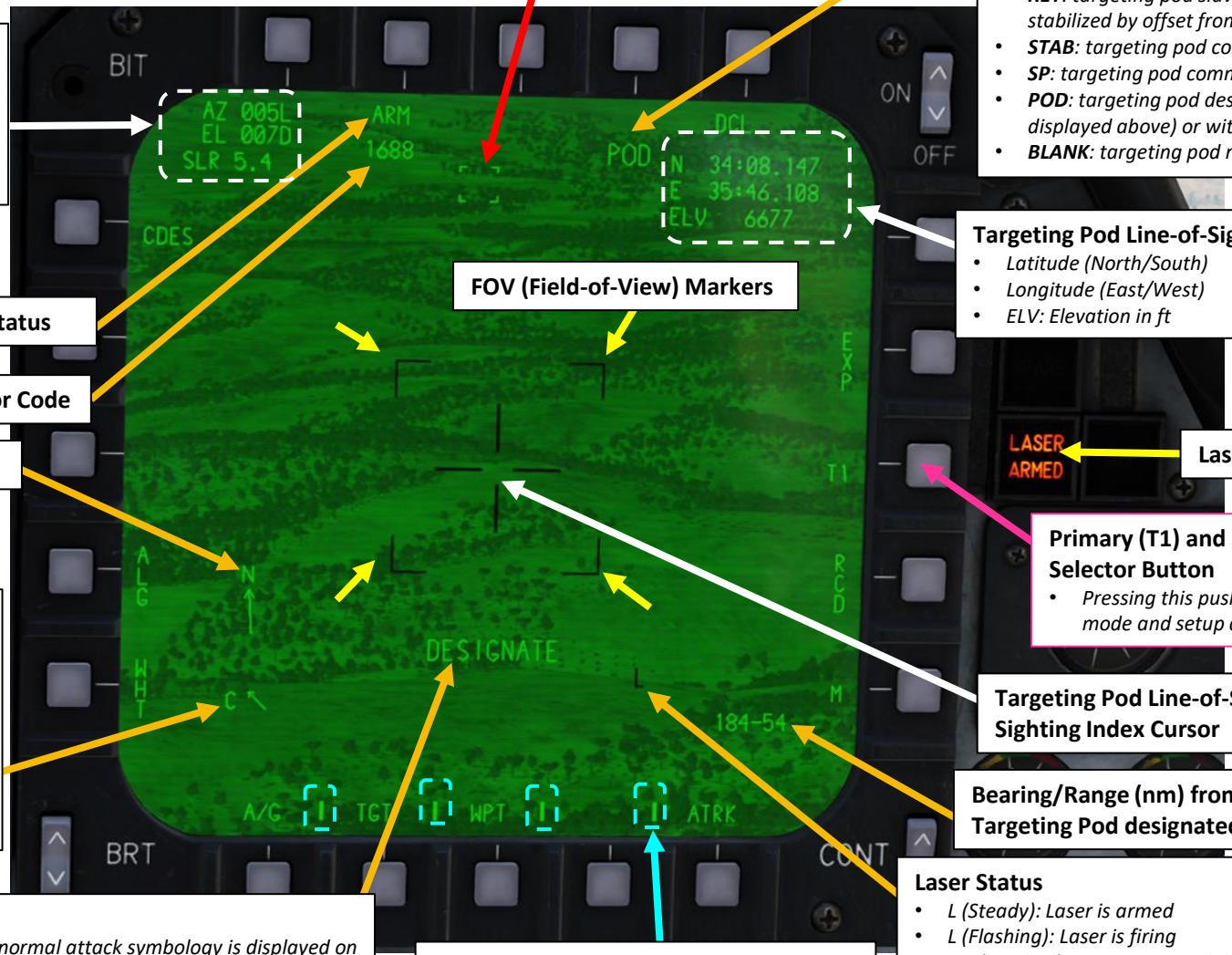
From the Main Menu (M) page, you can access the targeting pod feed by pressing the pushbutton next to “TPOD”.



3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

Primary (T1) Mode

Here is an overview of the LANTIRN symbology in Primary (T1) Mode, which is selected with the **Primary (T1) and Setup (T2) Display Mode Selector Button.**



Targeting Pod Line-of-Sight Cue (Targeting Pod View Relative Direction)

Targeting Pod Cue Source Selected

Indicates the source of the cue of the targeting pod.

- ***RDR**: targeting pod cued from A/G Radar Display.*
- ***TSD**: targeting pod cued from the Tactical Situation Display.*
- ***NAV**: targeting pod cued from NAV designation or quick step.*
- ***SIT**: targeting pod cued from Situation Page.*
- ***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.*

Targeting Pod Line-of-Sight (LOS) Information

Shows the azimuth and elevation of the targeting pod's line of sight with respect to the aircraft.

- *Azimuth (AZ): 005L = 5 deg left*
- *Elevation (EL): 007D = 7 deg down*
- *SLR: Computed Slant Range to Target (nm)*

Targeting Pod Line-of-Sight (LOS) Information

- *Latitude (North/South)*
- *Longitude (East/West)*
- *ELV: Elevation in ft*

Laser Arming Status

Laser Designator Code

FOV (Field-of-View) Markers

Magnetic Heading North Reference

Laser Armed Light

Primary (T1) and Setup (T2) Display Mode Selector Button

- *Pressing this pushbutton switches between the primary mode and setup display for the targeting pod.*

Slew Status Window

- *Indication of active slewing action magnitude and direction.*
- *The arrows indicate the direction that the line-of-sight is being commanded by the TDC (*Target Designation Control*) 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.*

Targeting Pod Line-of-Sight (LOS) Sighting Index Cursor

Bearing/Range (nm) from Bullseye to Targeting Pod designated target

DESIGNATE Legend

- *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.*

Selection Bars

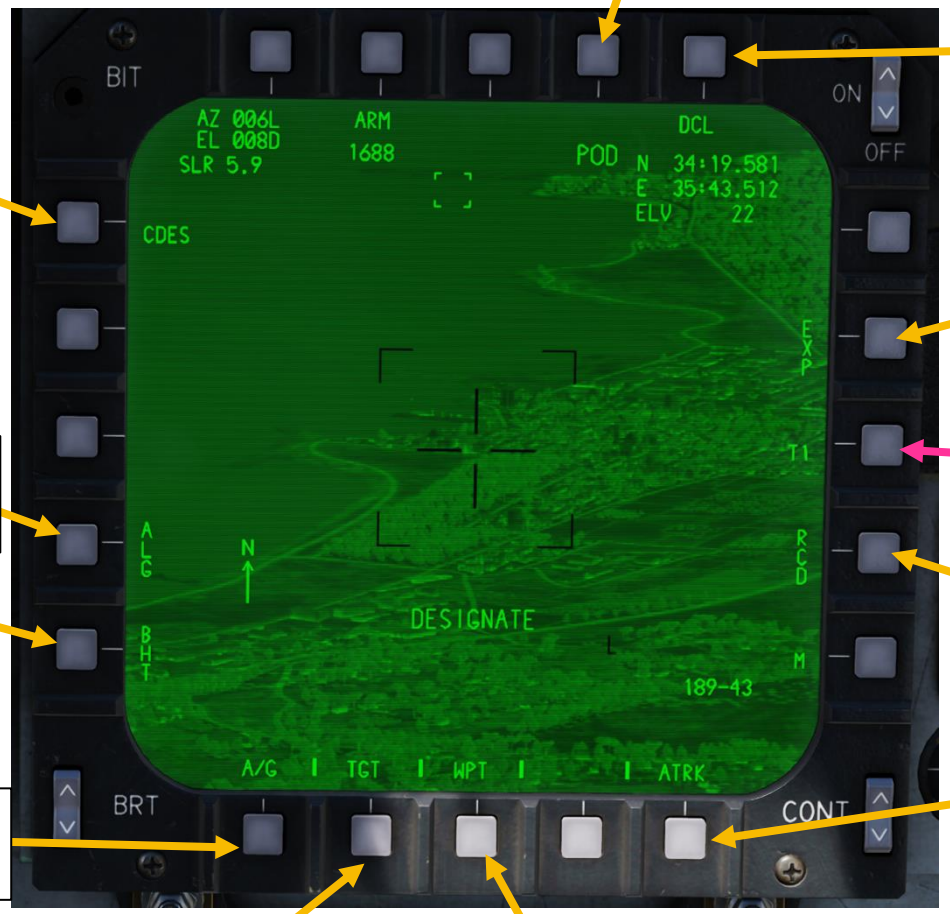
- *Indicates that Targeting Pod is in command*

Laser Status

- *L (Steady): Laser is armed*
- *L (Flashing): Laser is firing*
- *M (Masked): Targeting pod line-of-sight may be obscured by the aircraft structure and the laser is inhibited from firing.*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

Primary (T1) Mode



Targeting Pod Cue Source Selector
- *Pressing this pushbutton cycles through all available Sequence Points and cues the line-of-sight to them (NAV source).*

Declutter (DCL) Function
When selected, "declutter" removes:
- *Bullseye Bearing/Range*
- *Weapon launch zones and range scale*
- *Weapon status and delivery data*
- *Targeting pod line-of-sight latitude / longitude data*
- *Magnetic heading / direction display.*

CDES (Continuous Designation) Status
- *When selected (boxed), enables continuous designation of the target.*

Expanded (EXP) Mode Selector
- *When boxed (selected), enables the use of ENFOV (Expanded Narrow Field of View) zoom mode.*

Primary (T1) and Setup (T2) Display Mode Selector Button
- *Pressing this pushbutton switches between the primary mode and setup display for the targeting pod.*

ALG (Auto/Manual Level Gain Select) Pushbutton
- *Selects between manual and auto gain levels.*

RCD (Record) Button
- Allows the recording of the display for post-mission review

Video Polarity Selection Option
- *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.*
- *The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.*

Track Mode Selector
- ATRK: Area Track, used for a static target
- PTRK: Point Track, tracks a moving object like a high-contrast vehicle
- CMPT: Computed Mode Track, non-active track mode that uses line-of-sight and line-of-sight rate extrapolation techniques

Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

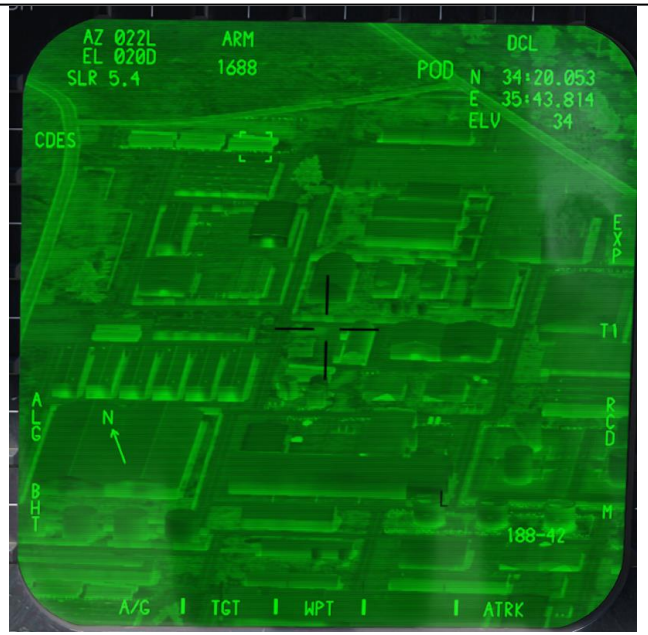
Tracker Polarity Selector
- WPT (White Polarity Track): targeting pod tracks white / green targets. All targeting pod embedded symbology is black.
- BPT (Black Polarity Track): targeting pod tracks black targets and all embedded symbology is white.
- APT (Auto Polarity Track): targeting pod tracks either white / green or black targets, depending on the color of the target at the centre of the crosshairs when point track is initiated.
- *Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)

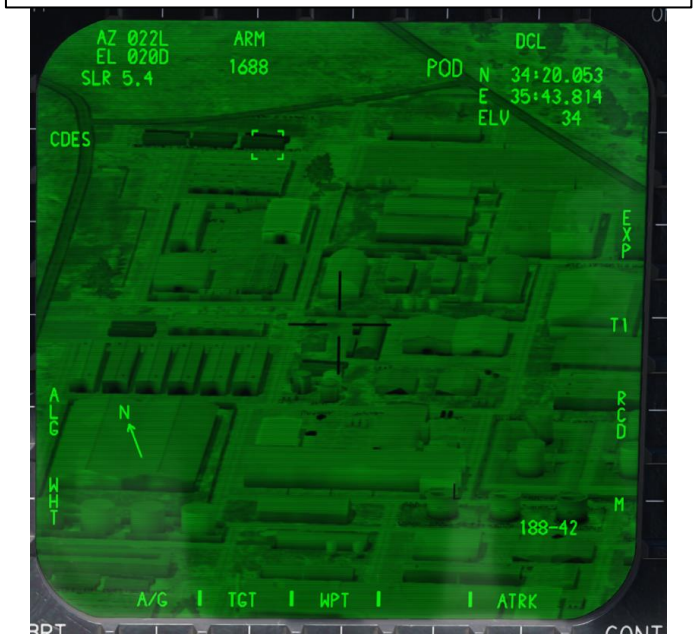
3.2 – Display

Polarity Settings

MPD (Multipurpose Display) – White Hot (WHOT) Polarity

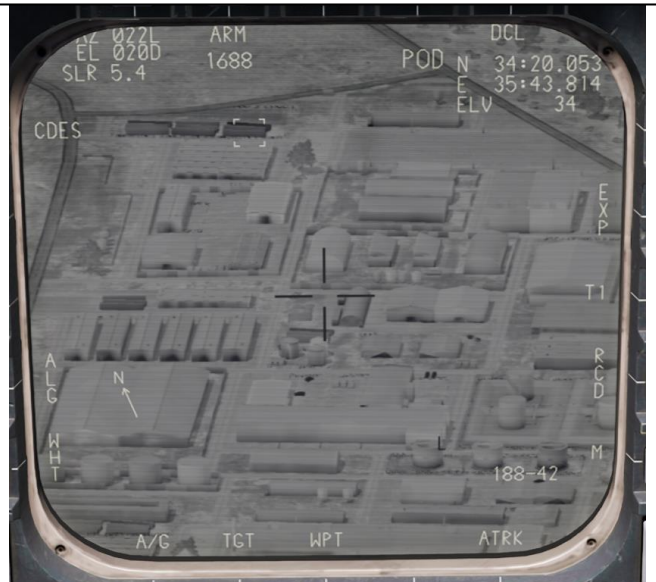


MPD (Multipurpose Display) – Black Hot (BHOT) Polarity



MPCD (Multipurpose Color Display) – White Hot (WHOT) Polarity

MPCD (Multipurpose Color Display) – Black Hot (BHOT) Polarity



3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

Field-of-View (FOV) Settings

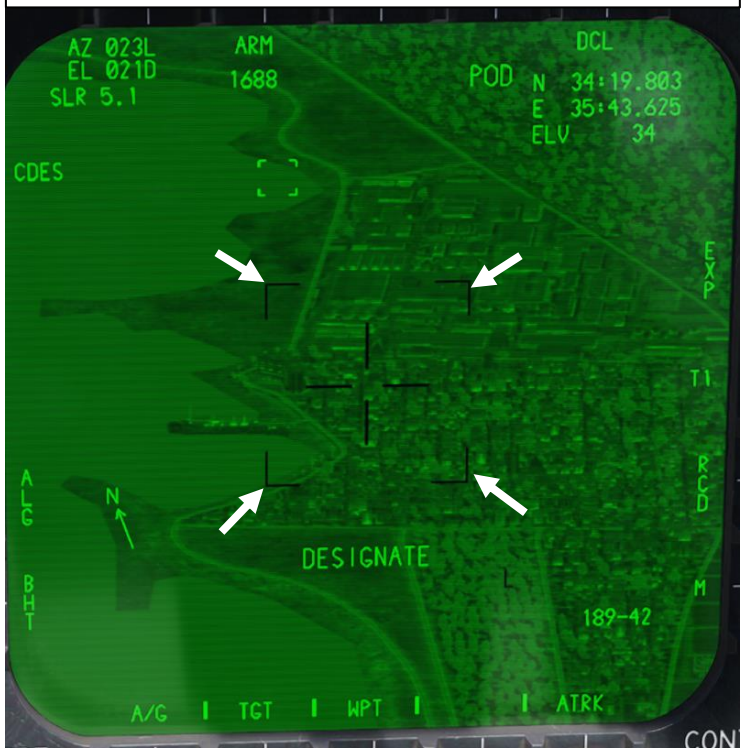
The targeting pod has two different sets of zoom logics, which are selected using the Expanded Mode Selector Pushbutton:

- **Normal FOV Mode:** When Expanded FOV mode is not selected (EXP unboxed), pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec) toggles between WFOV (Wide) and NFOV (Narrow) zoom levels.
- **Expanded FOV Mode:** When Expanded FOV mode is selected (EXP boxed), pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec) toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.

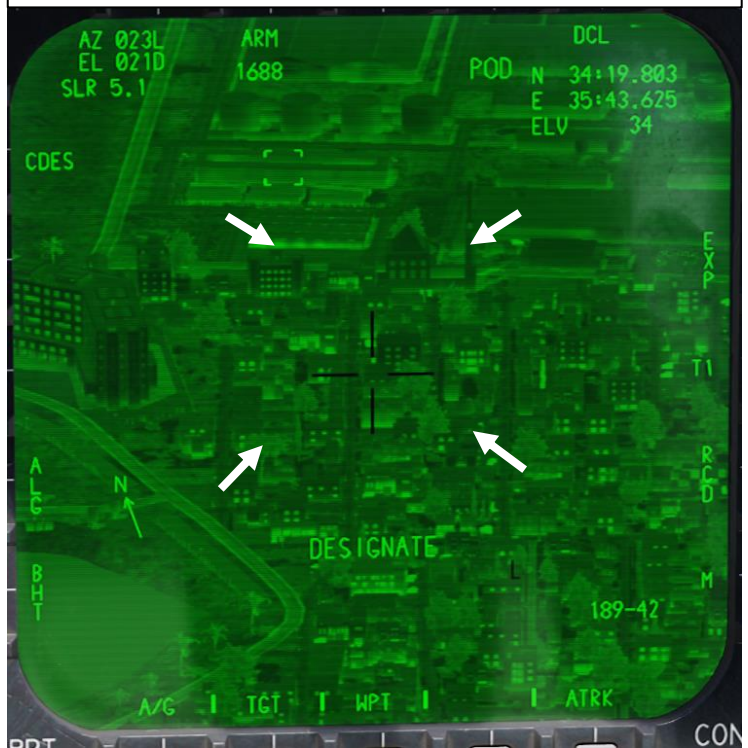
FOV	Video Dimension	MPD Magnification	MPCD Magnification
WFOV	5.87° x 5.87°	2.3x	1.9x
NFOV	1.65° x 1.65°	8x	6.7x
ENFOV	0.825° x 0.825°	16x	13.4x

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

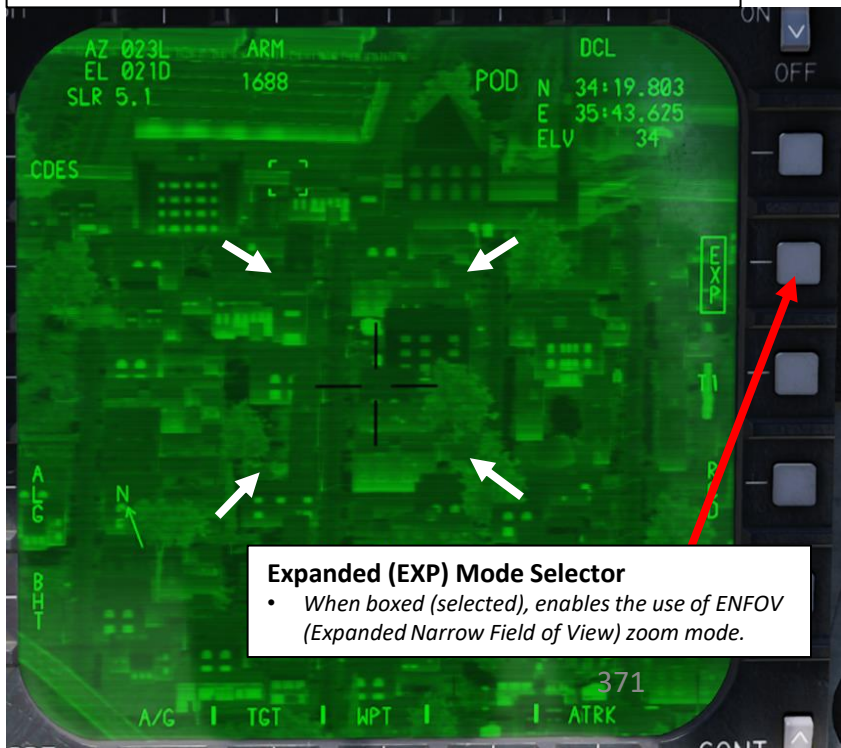
WFOV (Wide Field-of-View)



NFOV (Narrow Field-of-View)



ENFOV (Expanded Narrow Field-of-View)

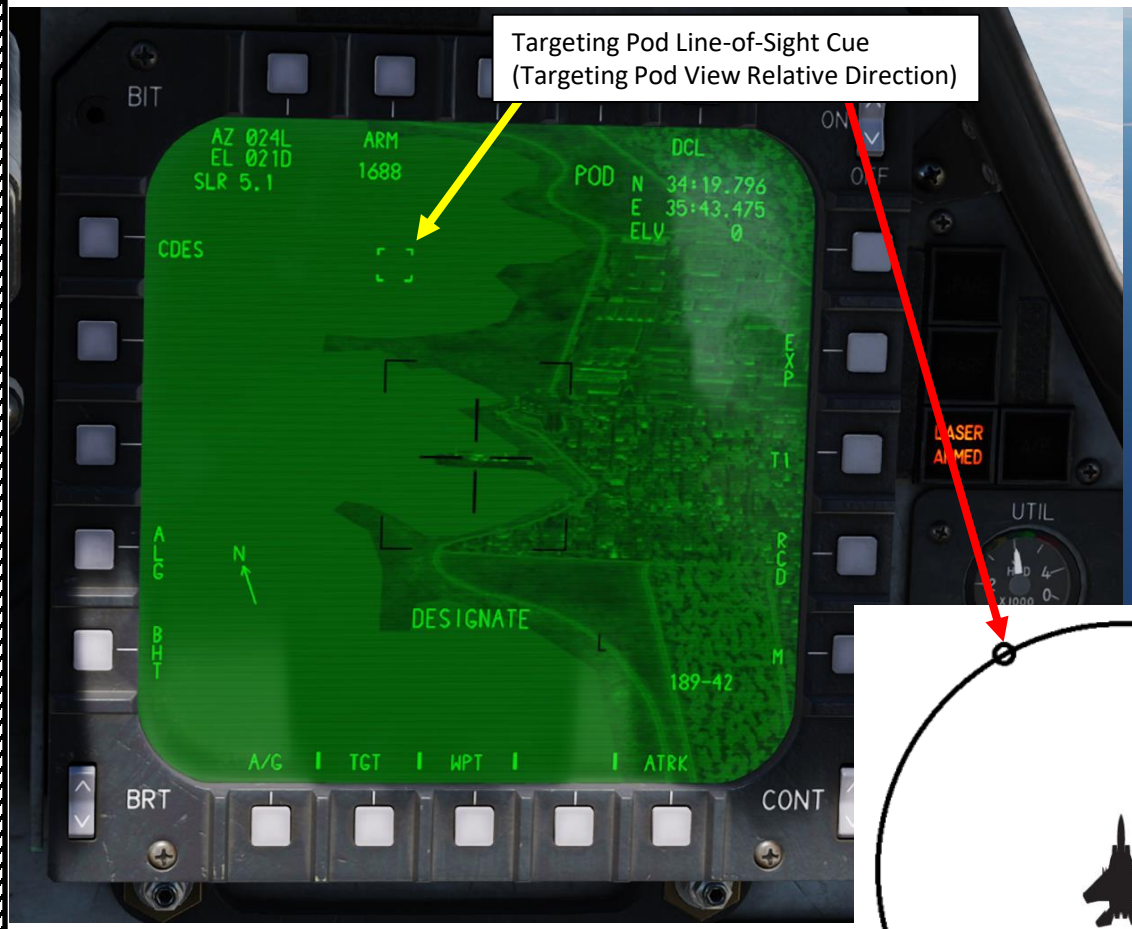


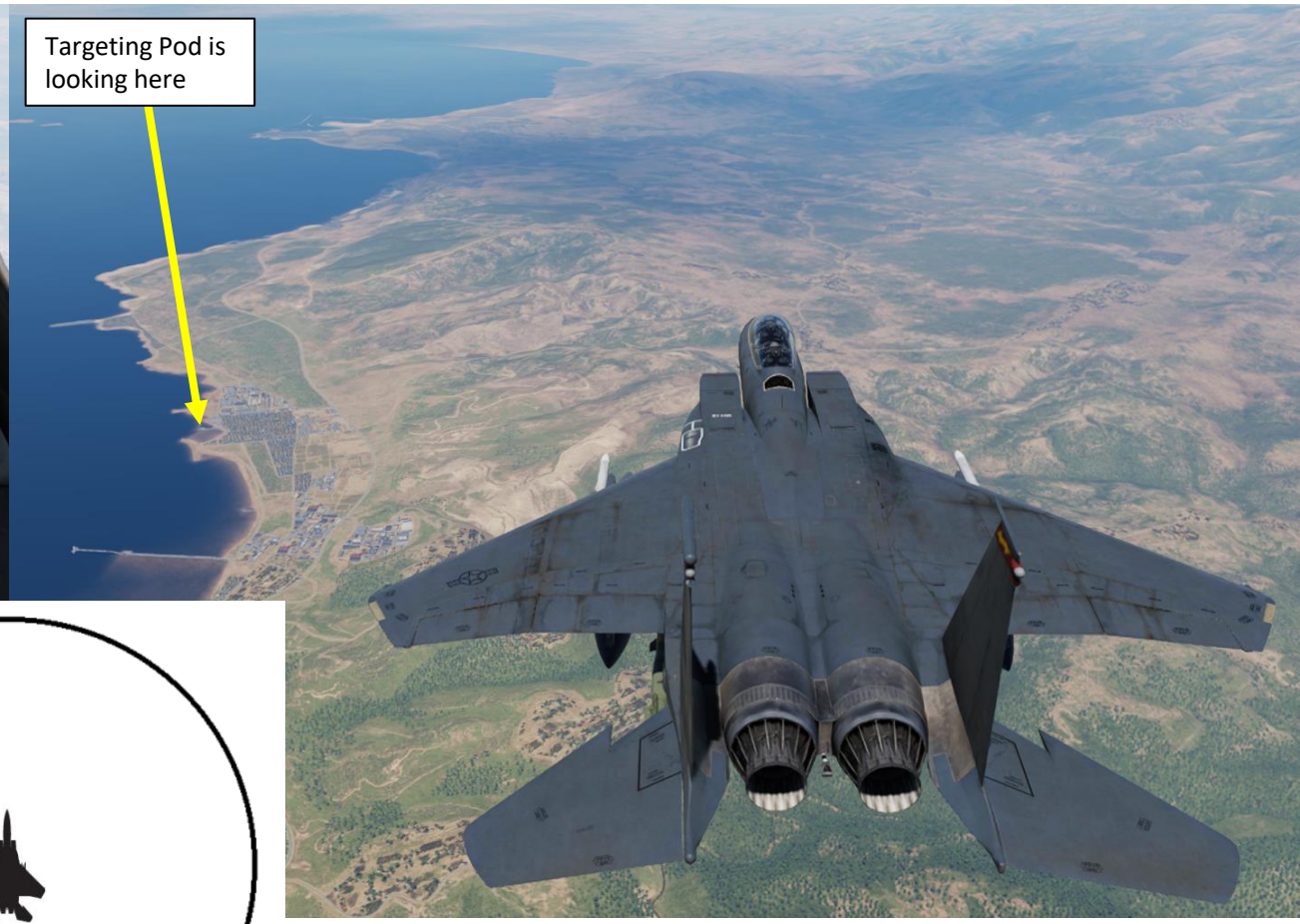
Expanded (EXP) Mode Selector
- *When boxed (selected), enables the use of ENFOV (Expanded Narrow Field of View) zoom mode.*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

Line-of-Sight (LOS) Cue Symbol

The Targeting Pod Line-of-Sight (LOS) Cue symbol on the FLIR display can give you a good idea of where the pod is pointing in relationship to your aircraft. This view direction is represented in a top-down view.





3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.2 – Display

Setup (T2) Mode

You can access a "setup" page (referred as "T2 mode") for the targeting pod, which is selected with the **Primary (T1) and Setup (T2) Display Mode Selector Button.**

GRY (Grayscale) Button
- *Enables a gray scale used to adjust the gain / level of the targeting pod.*

Yaw, Pitch and Roll Pushbuttons for Targeting Pod Mechanical Boresight (not simulated)

Manual Focus Control Buttons
- *Adjusts the Infrared video sharpness and clarity*

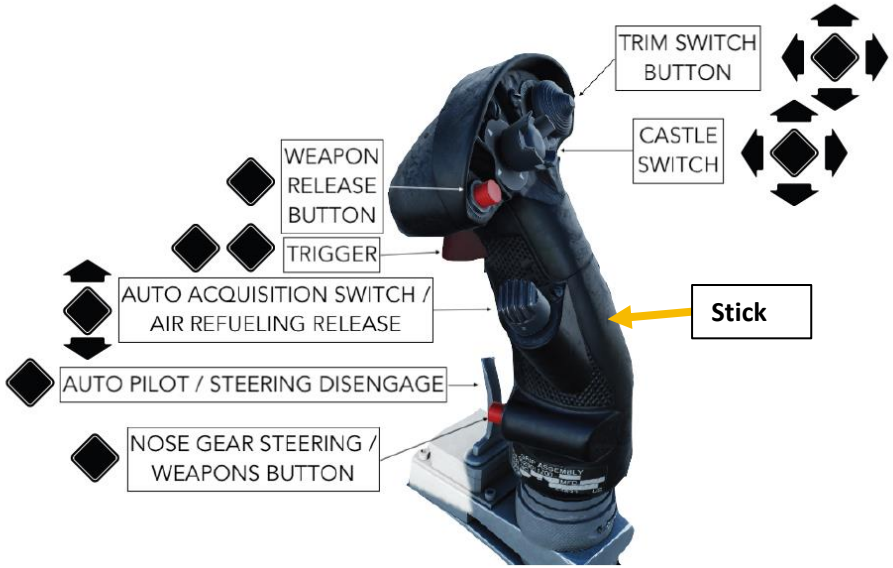
Primary (T1) and Setup (T2) Display Mode Selector Button
- *Pressing this pushbutton switches between the primary mode and setup display for the targeting pod.*

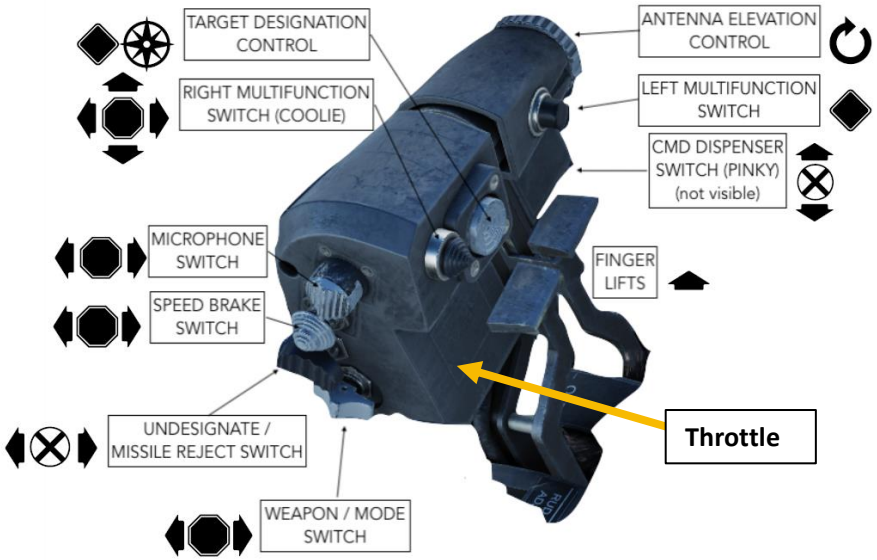
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.3 – Controls

HOTAS Controls

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**

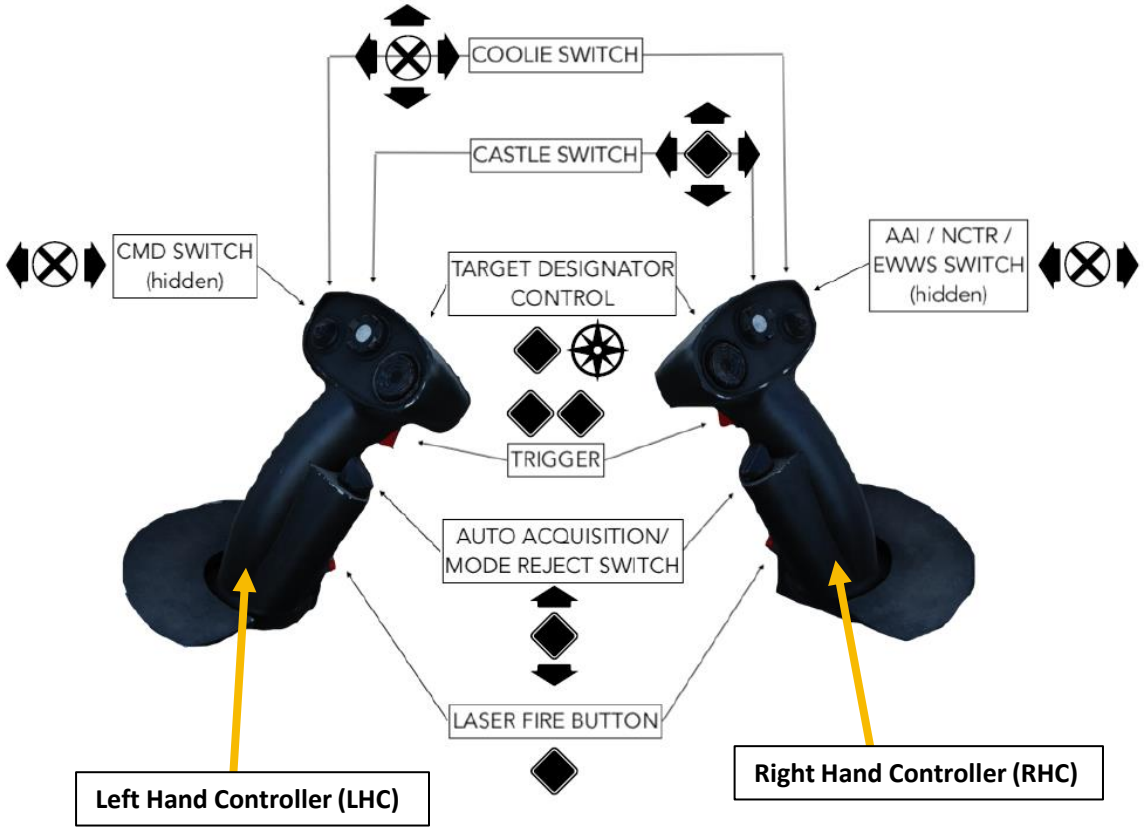




3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.3 – Controls

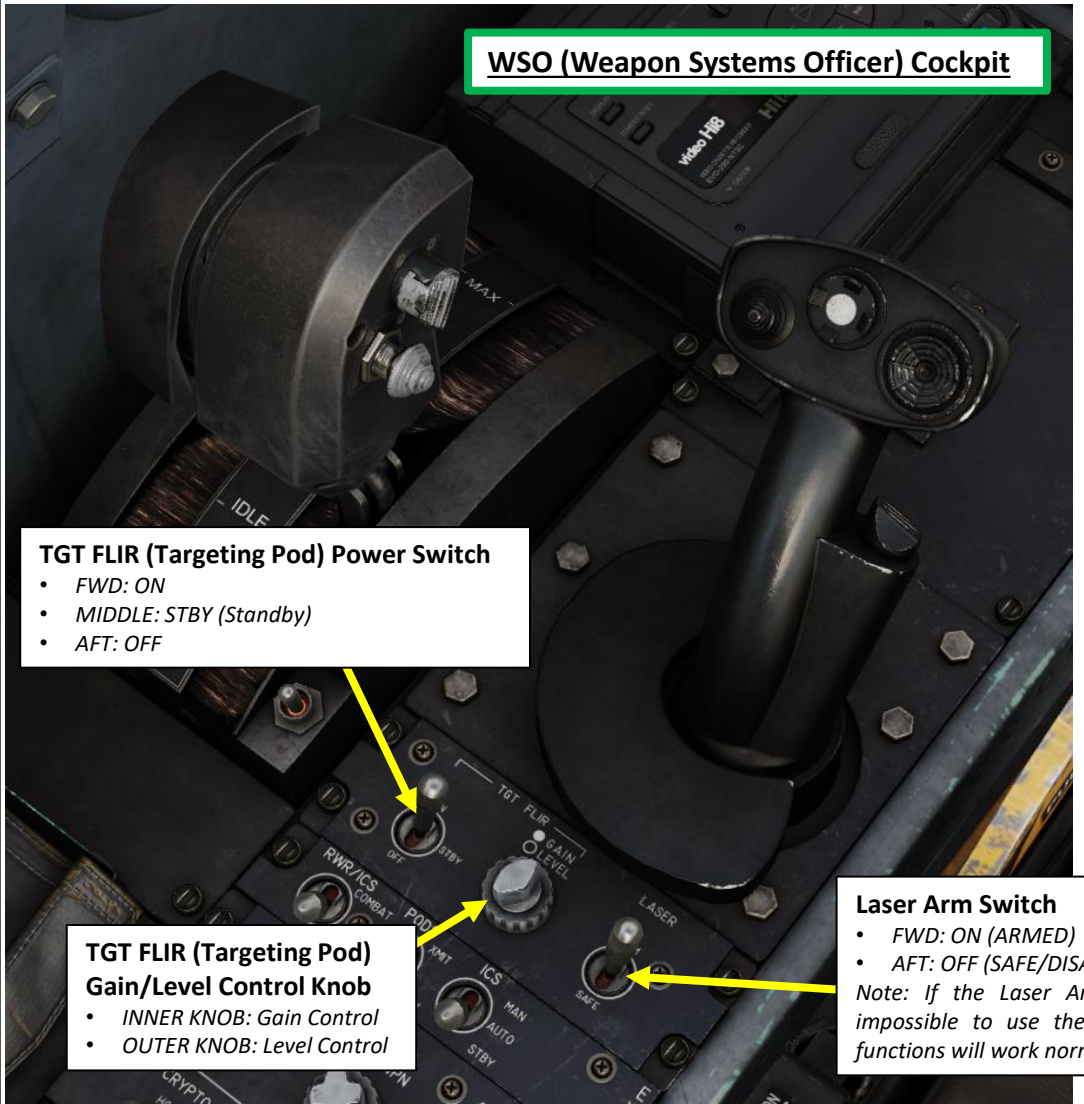
HOTAS Controls

HAND CONTROLLERS - REAR COCKPIT						
SWITCH	**CONDITION**	**ACTION**				
TARGET DESIGNATOR CONTROL	TGP in Command	Movement: **Controls the movement of the targeting pod**			Press DOWN **Switches between PTRK / ATRK**	
CASTLE SWITCH	TGP in Command	FWD Short **Tracker Polarity**	AFT Short **Cursor target**	LEFT Short **CUE / MARK**	RIGHT Short **UPDATE**	DOWN **Quick Step**
	TGP in Command	FWD Long **WHT / BHT**	LEFT Long **Station 2 handoff (Mav)**		RIGHT Long **Station 8 handoff (Mav)**	
TRIGGER	TGP in Command	HALF Action: **Track / Untrack**				
	Designate Cursor	FULL Action: **Designate the selected spot**				
	Mark Cursor	FULL Action: **Create markpoint**				
	CUE Cursor	FULL Action: **Cue sensors to selected location**				
	Position Update Cursor	FULL Action: **Update position**				
AUTO ACQUISIT-ION SWITCH	TGP in Command	FWD Short **Change FOV**	FWD Long **Snowplow**	AFT Short **Return to cue**	AFT Long **Space Stabilize**	Press DOWN **Track / Untrack**
LASER FIRE BUTTON	TGP in Command	DOWN Press **Laser Fire / Stop Fire**				



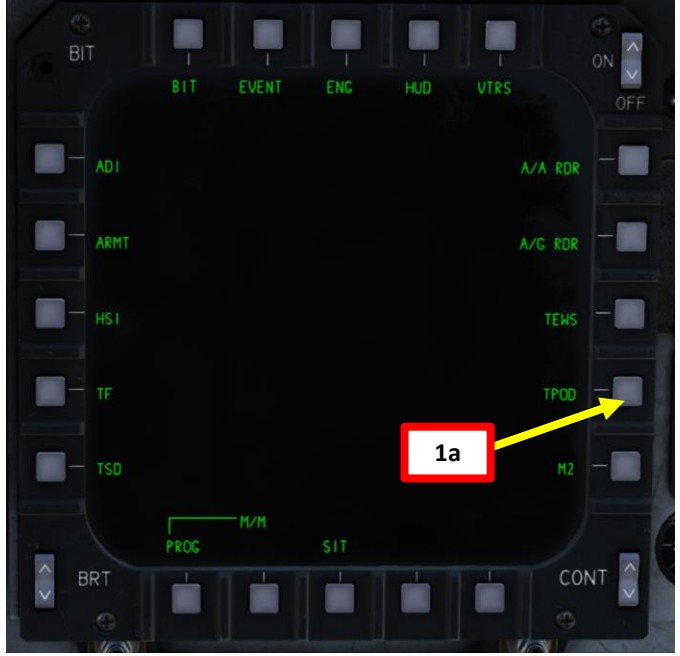
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.3 – Controls

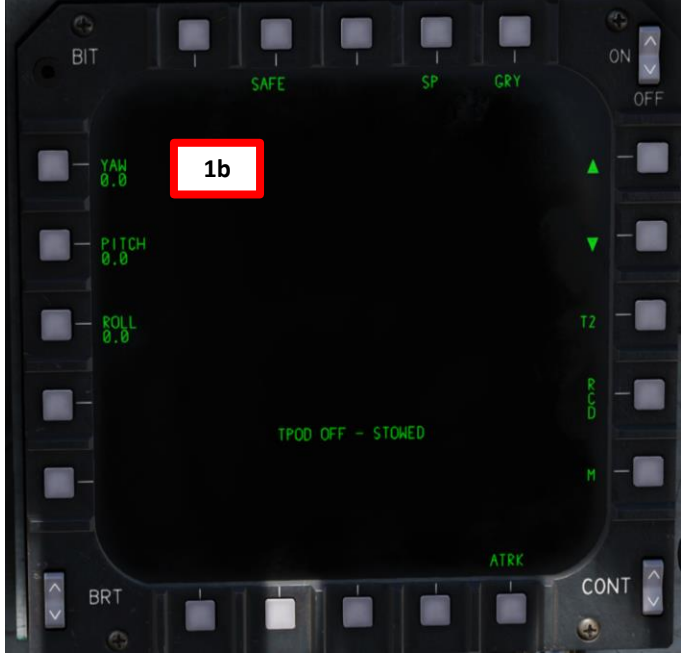
Targeting Pod Control Panel



3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

1. From the main MPD menu page, select TPOD page.
2. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – STANDBY (MIDDLE).
3. *[WSO]* The targeting pod remains stowed during the power-up sequence, which takes between 5 to 8 minutes. The targeting pod status will change as follows:
   - TPOD OFF – STOWED: pod is unpowered and stowed
   - TPOD NRDY: pod is powering up, but not ready
   - TPOD NRDY – STOWED: pod is powering up and stowed, but not ready
   - TPOD STBY – STOWED: pod is powered up in standby mode and stowed
4. *[WSO]* Once power-up sequence of the targeting pod is complete, the TPOD STBY – STOWED indication means that the pod is in standby mode and stowed.

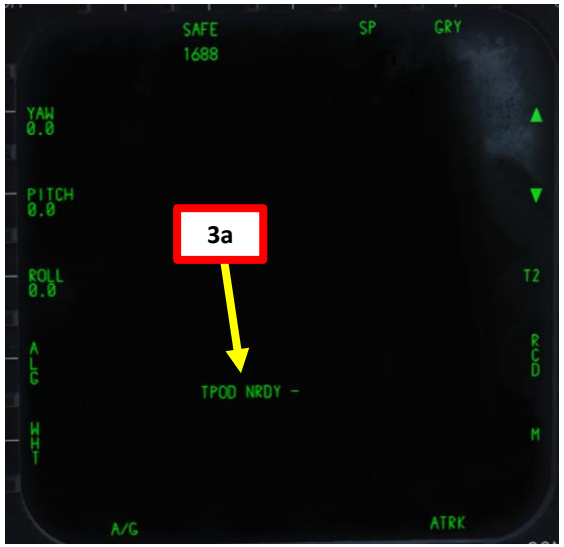




WSO (Weapon Systems Officer) Cockpit

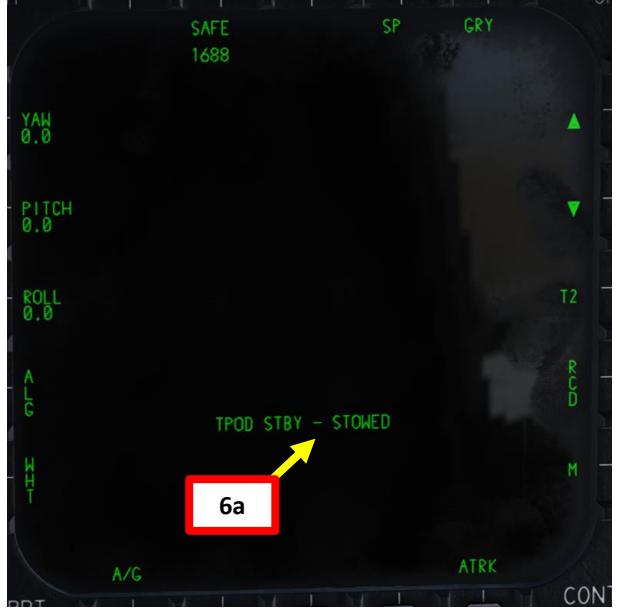
TGT FLIR (Targeting Pod) Power Switch
- *FWD: ON*
- *MIDDLE: STBY (Standby)*
- *AFT: OFF*

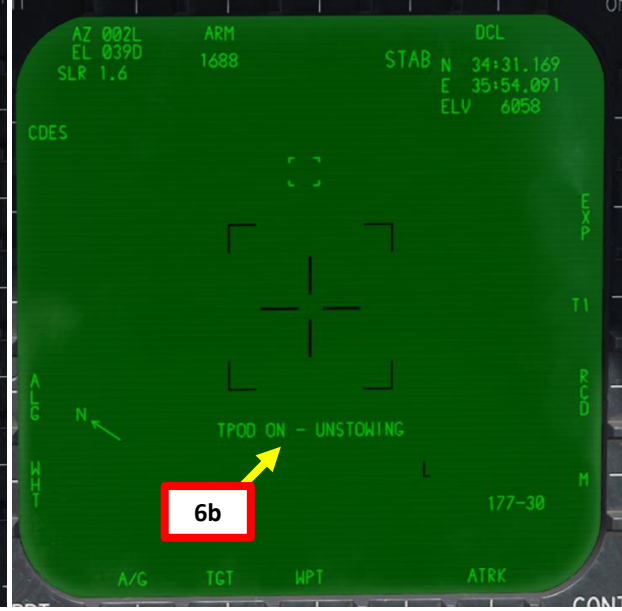
2

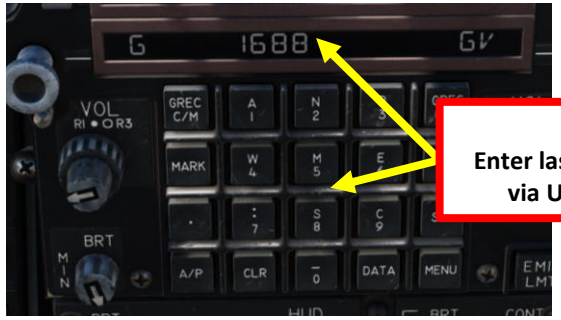


3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

5. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – ON (FWD). This will un-stow the camera.
6. When targeting pod is un-stowed, the TPOD OPER – UNSTOWED indication will momentarily appear on the TPOD page.
7. *[WSO]* Set Laser Arm Switch to ARMED (FWD).
8. *[WSO]* Adjust TGT FLIR Gain/Level – As required.
9. To set laser designation code, enter a valid code on the UFC (Upfront Control Panel) keypad, then press pushbutton next to the laser status/code indication (ARM/1688 in this example). Valid laser codes are 1111 thru 1788, therefore we will use laser designation code 1688.







9a
Enter laser code 1688 via UFC keypad

TGT FLIR (Targeting Pod) Power Switch
- *FWD: ON*
- *MIDDLE: STBY (Standby)*
- *AFT: OFF*

5

Targeting Pod Stowed

Targeting Pod Un-Stowed

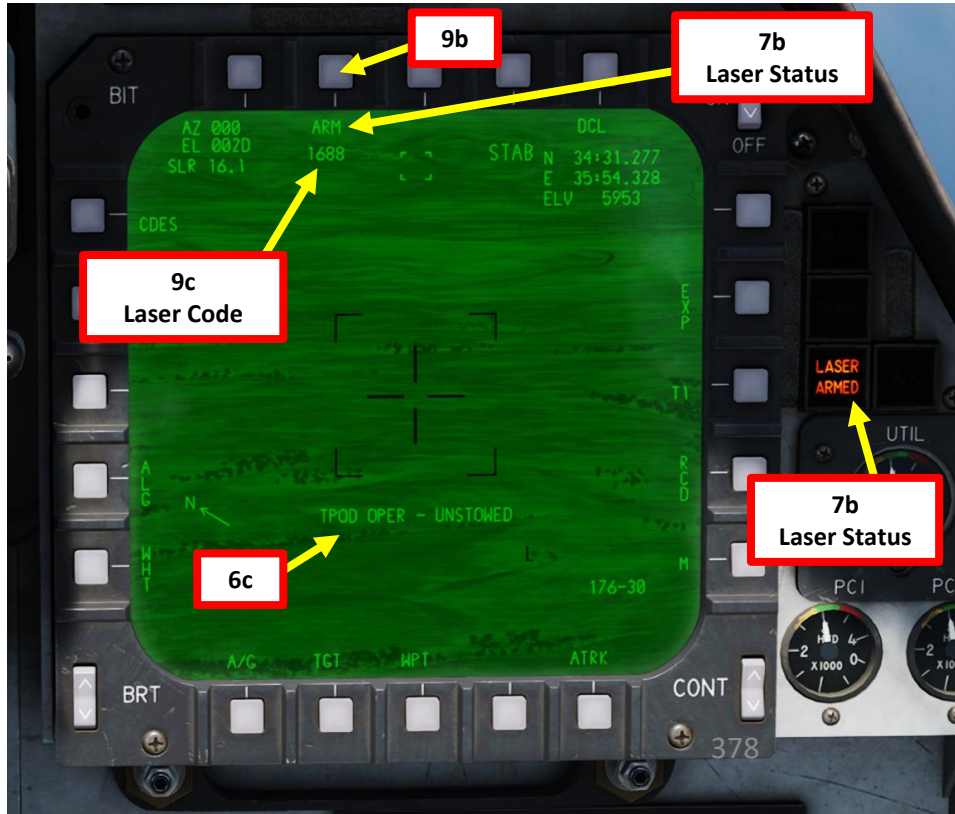
8

TGT FLIR (Targeting Pod) Gain/Level Control Knob
- *INNER KNOB: Gain Control*
- *OUTER KNOB: Level Control*

7a

Laser Arm Switch
- *FWD: ON (ARMED)*
- *AFT: OFF (SAFE/DISARMED)*

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.



9b

7b Laser Status

9c Laser Code

7b Laser Status

WSO (Weapon Systems Officer) Cockpit

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

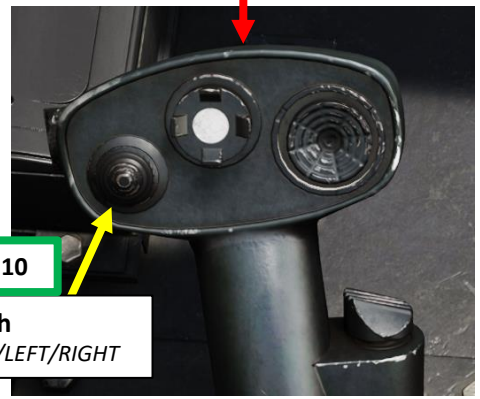
10. Make sure the TPOD page is selected, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
11. Select A/G Master Mode
12. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
13. Set Targeting Pod Function Selector to TGT (Target Designation).
14. Select Primary (T1) Mode.
15. Before using the targeting pod's laser designator, verify that the following conditions are met (otherwise laser designation is inhibited):
    a) **Aircraft altitude is below 25000 ft.**
    b) **Weight off wheels (aircraft is flying) and landing gear is retracted.**
    c) **Valid laser code is entered.**
    d) **Laser is armed.**

A/G (Air-to-Ground) Master Mode Button — **11**

10

Castle Switch

Left Hand Controller (LHC)



10

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

12

Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

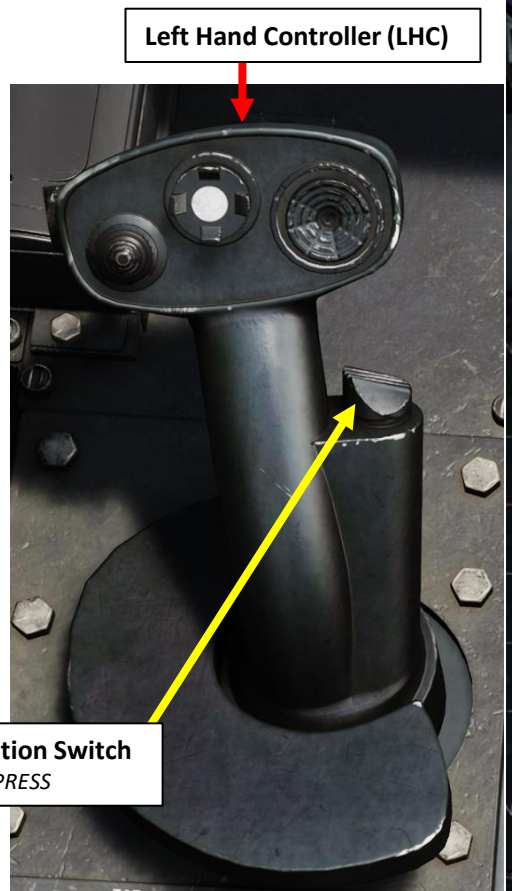
13

Selection Bars
- *Indicates that Targeting Pod is in command*

10

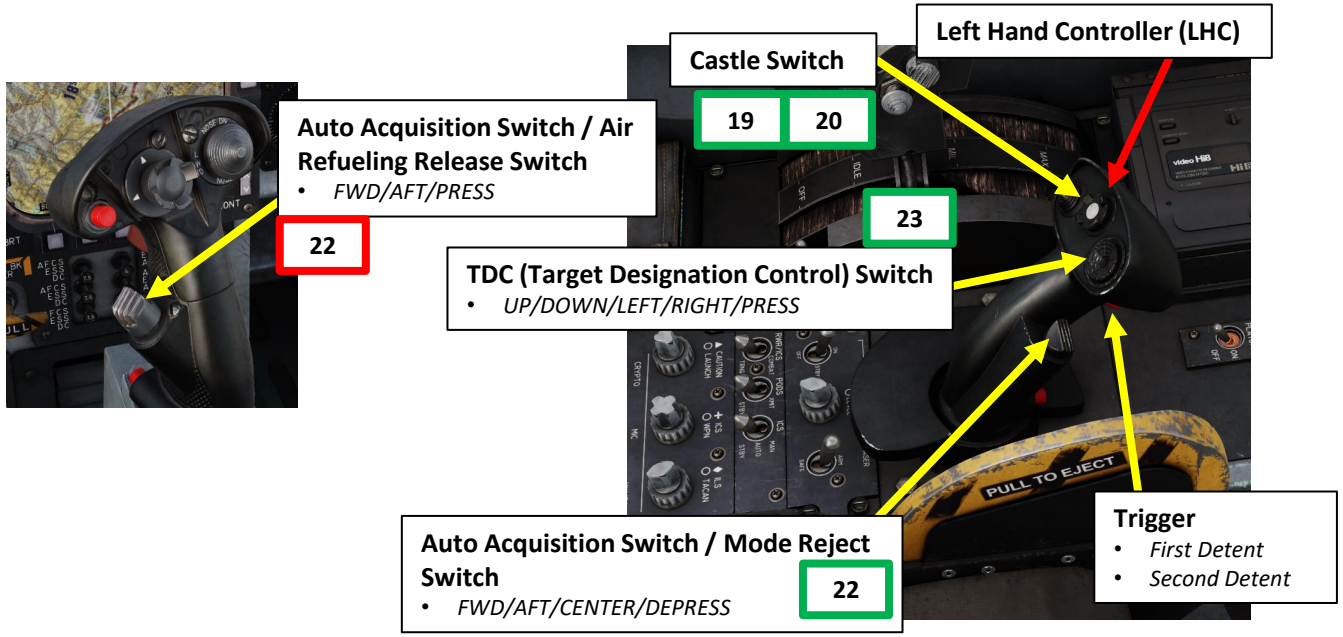
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

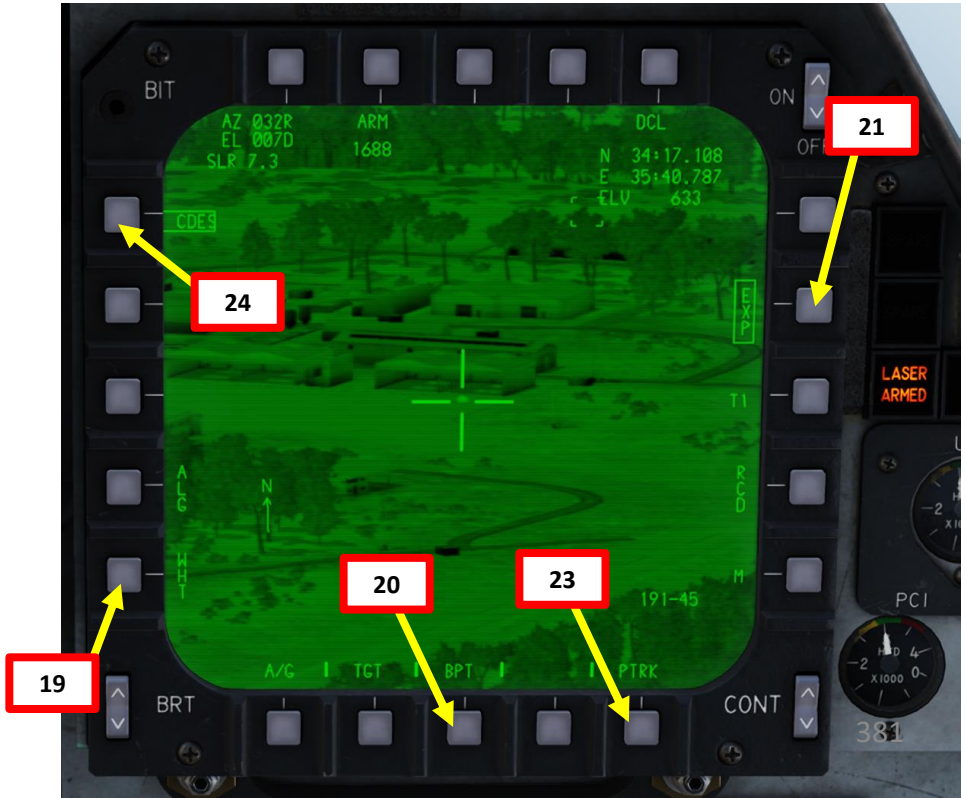
16. You can cue (slave) the targeting pod to a navigation point or other systems (which we will talk about in section 3.7 – Cue Mode), but for this example we will use the simplest method of using the targeting pod in snowplow mode.
17. Press Auto Acquisition Switch – FWD LONG (more than 1 sec) to enter SNOWPLOW STAB mode.
18. The targeting pod's SNOWPLOW STAB mode is space-stabilized to a point below the horizon along the heading vector. The targeting pod's line-of-sight is not tied to the ground; instead, it points at the space at the azimuth angle and elevation the pod had when space stabilization was first initialized.



3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

19. Select Video Polarity – As desired.
    - Pressing the Video Polarity Selection Option pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.
    - The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD LONG (more than 1 sec)
20. Select Tracker Polarity Selector – As desired.
    - 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 center of the crosshairs when point track is initiated.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD SHORT (less than 1 sec)
    - Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.
21. If you want to use the ENFOV (Expanded Narrow Field-of-View) zoom mode, select/box the EXP option. In this example, we will select it.
22. Zoom as required by pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec), which toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.
23. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
    - Point Track (PTRK) tracks a moving object like a high-contrast vehicle
    - Area Track (ATRK) is used for a static target
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS
24. If a continuous laser designation is desired, select/box the CDES option. The designation will be continuously updated with new range and line-of-sight designation.
    - If CDES is unselected/unboxed, lasing the target is only performed as long as the Left Multifunction Switch (pilot) or laser trigger (WSO) is depressed.





3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

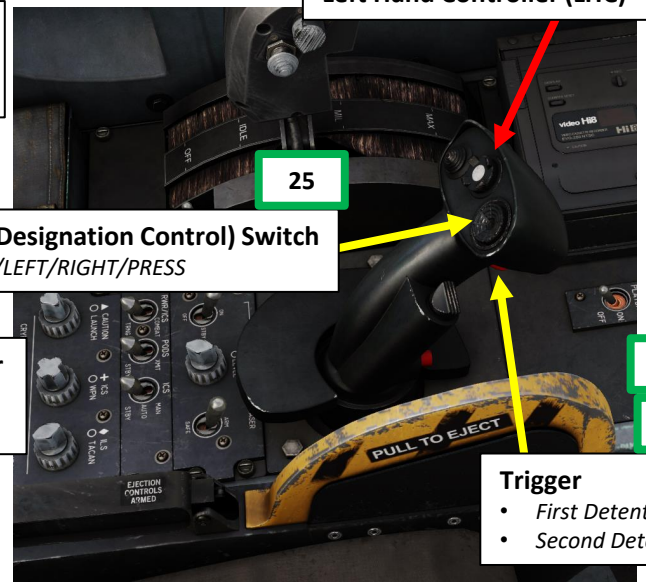
25. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to designate and range with a laser.
26. Initiate a targeting pod "track" on the target (either point or area track).
    - **Pilot**: Depress Auto Acquisition Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
27. Once the target is tracked, the targeting pod will compute a slant range and either PTRK or ATRK will be boxed depending on what tracking method you have selected previously.
28. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
29. Once target is designated, the DESIGNATE legend appears for 5 seconds.

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

25 28

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

26



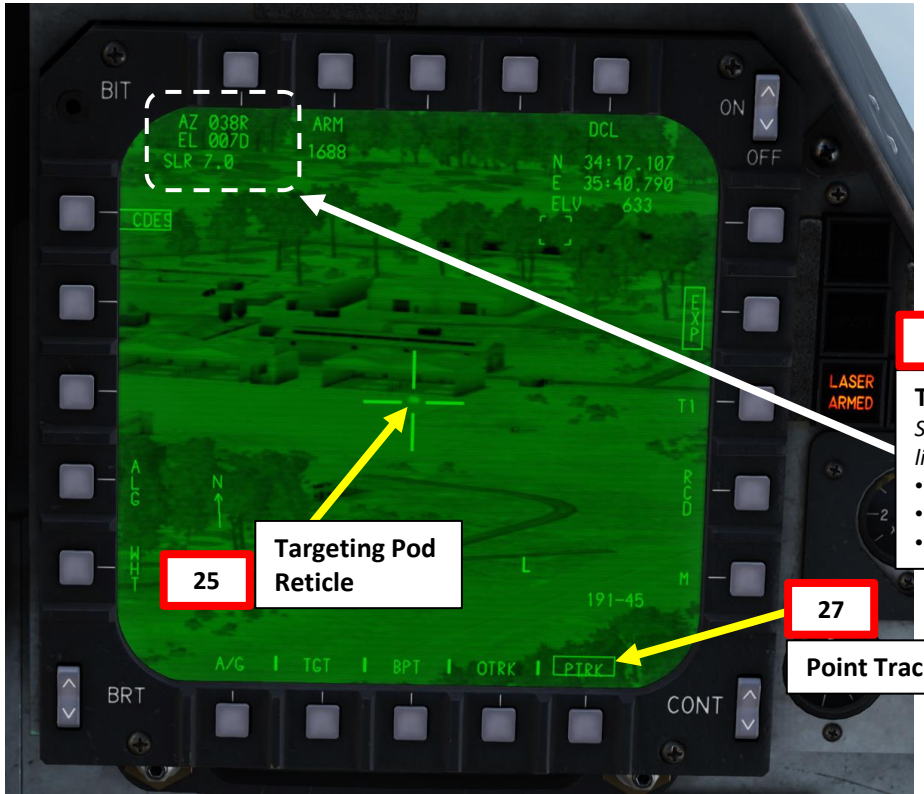
Left Hand Controller (LHC)

25

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

26 28

Trigger
- *First Detent*
- *Second Detent*

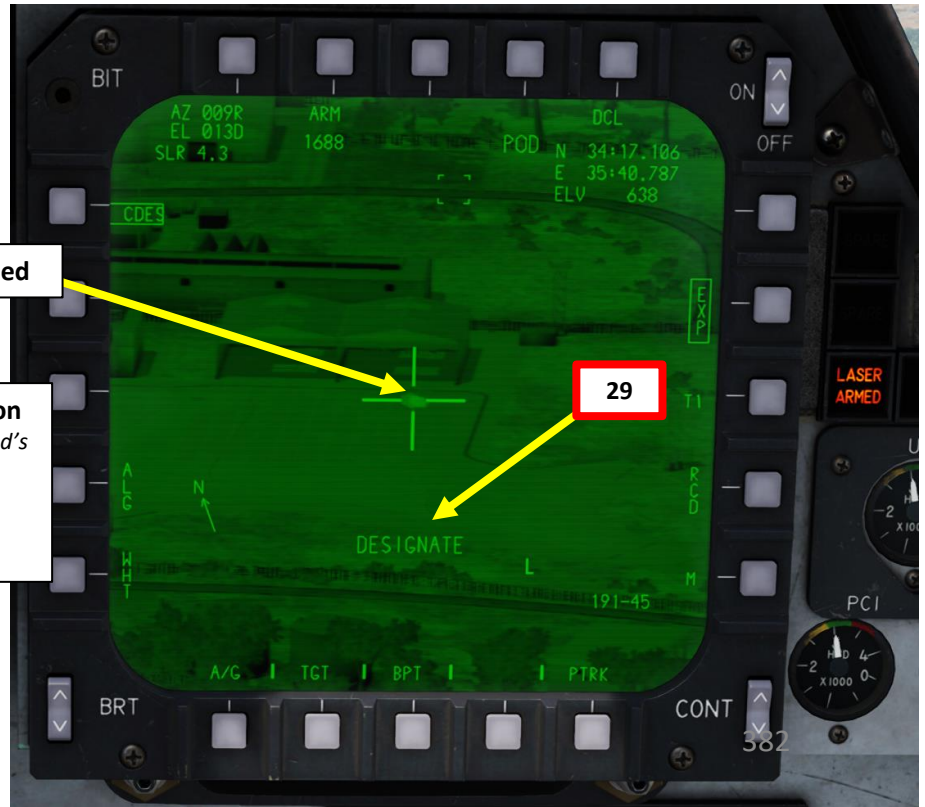


25 **Targeting Pod Reticle**

27 **Point Track on Target**

27

Targeting Pod Line-of-Sight (LOS) Information
Shows the azimuth and elevation of the targeting pod's line of sight with respect to the aircraft.
- *Azimuth (AZ): 038R = 38 deg right*
- *Elevation (EL): 007D = 7 deg down*
- *SLR: Computed Slant Range to Target (nm)*

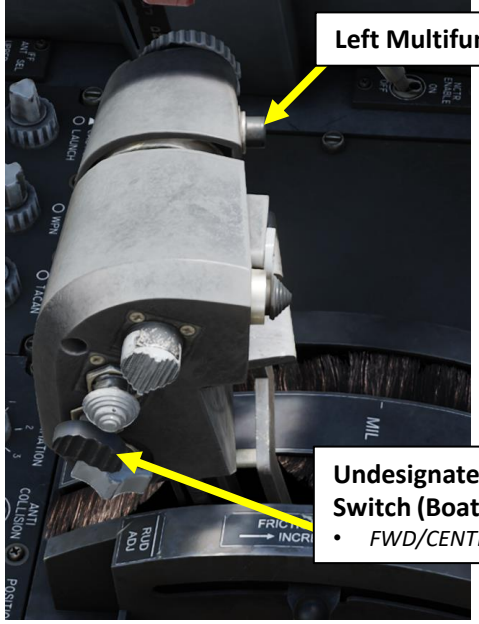


Target Designated

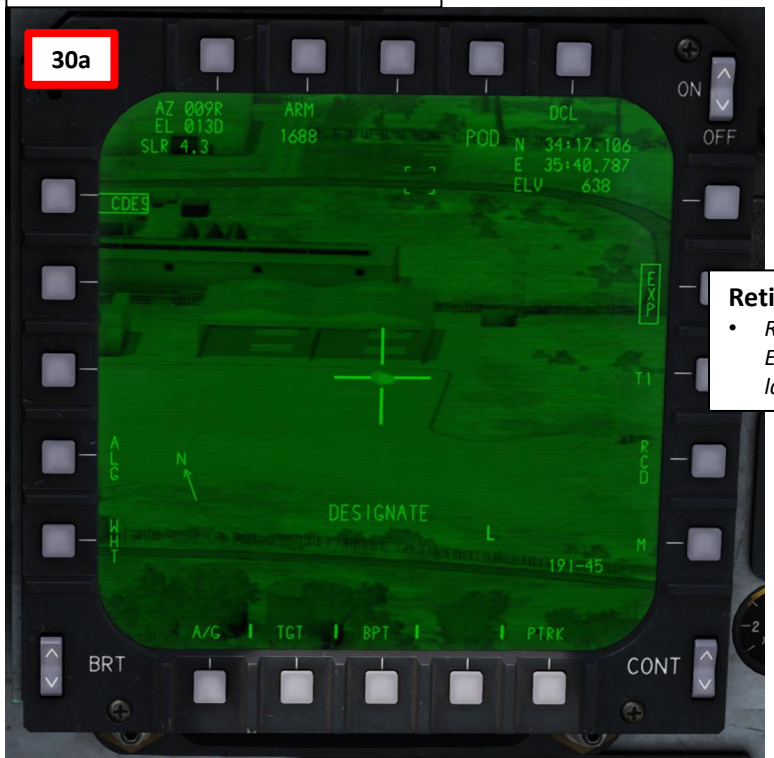
29

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

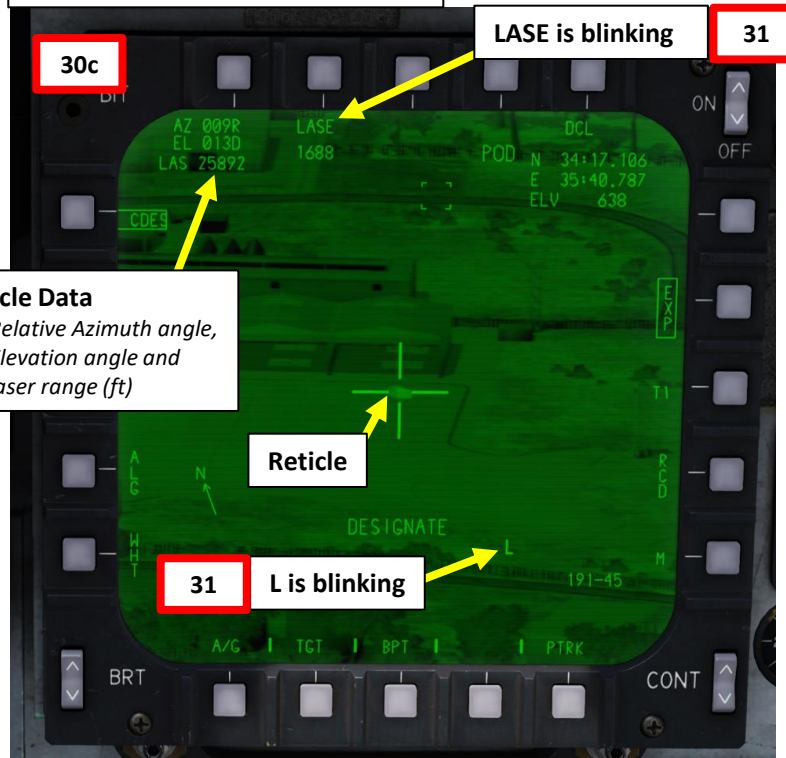
30. The maximum range of the laser is about 13 nm (which can also be further reduced due to weather and visibility conditions). Toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
31. Target ranging information is updated based on the range computed by the laser designator. When laser is firing, the "LASE" and "L" indications blink on the TPOD page.
    - Note: The "MASKED" indication means that the targeting pod's line-of-sight is masked by the airframe or stores and the laser has been commanded to fire.
32. You may now launch laser-guided weapons as per their release procedure.
33. To stop lasing, toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
34. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.

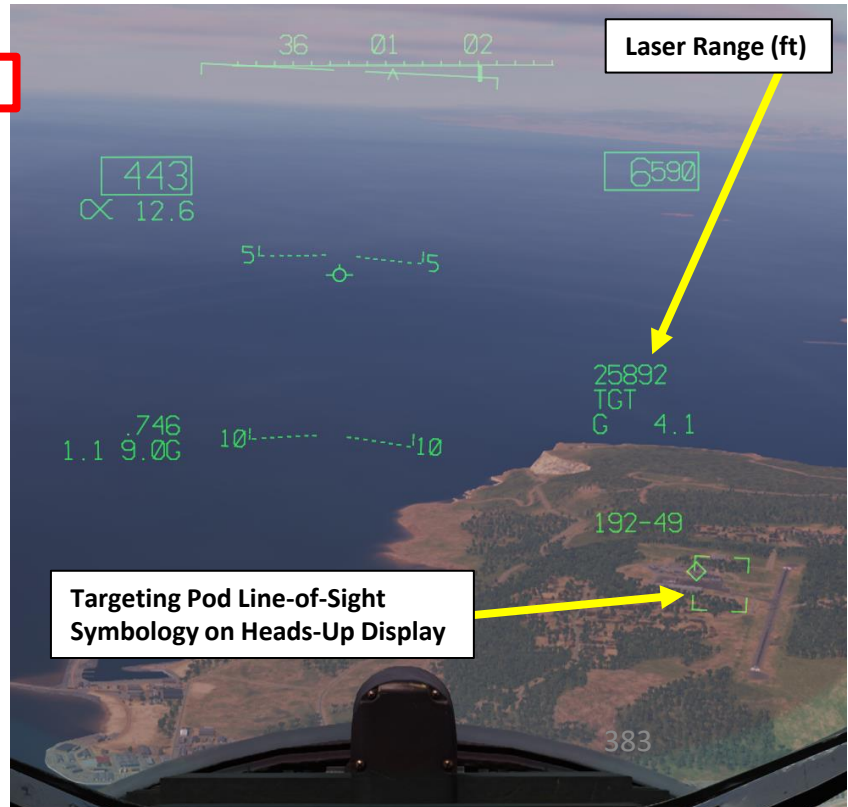


Target designated, laser not firing



Target designated, laser is firing





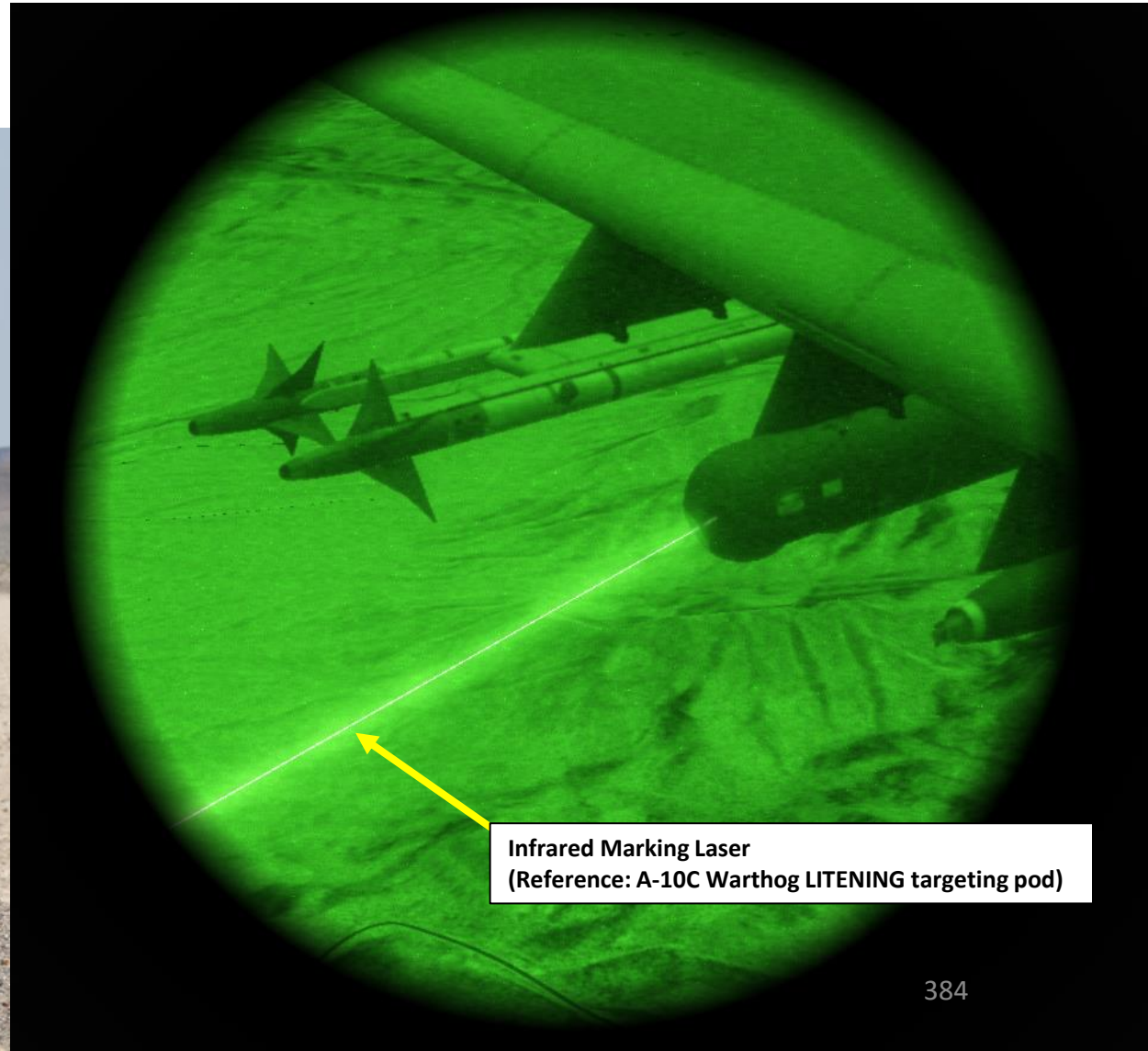
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.4 – Start-Up & Lasing Procedure

Note for laser spotting & laser marking

The LANTIRN targeting pod has **no LSS/LST (Laser Spot Search/Laser Spot Track) capability**, which means that the pod cannot home on a laser from another designator (i.e. JTAC, or another aircraft laser designating a target).

There is also **no infrared laser marking capability** for night operations.

JTAC (Joint Tactical Air Controller) with a laser designator

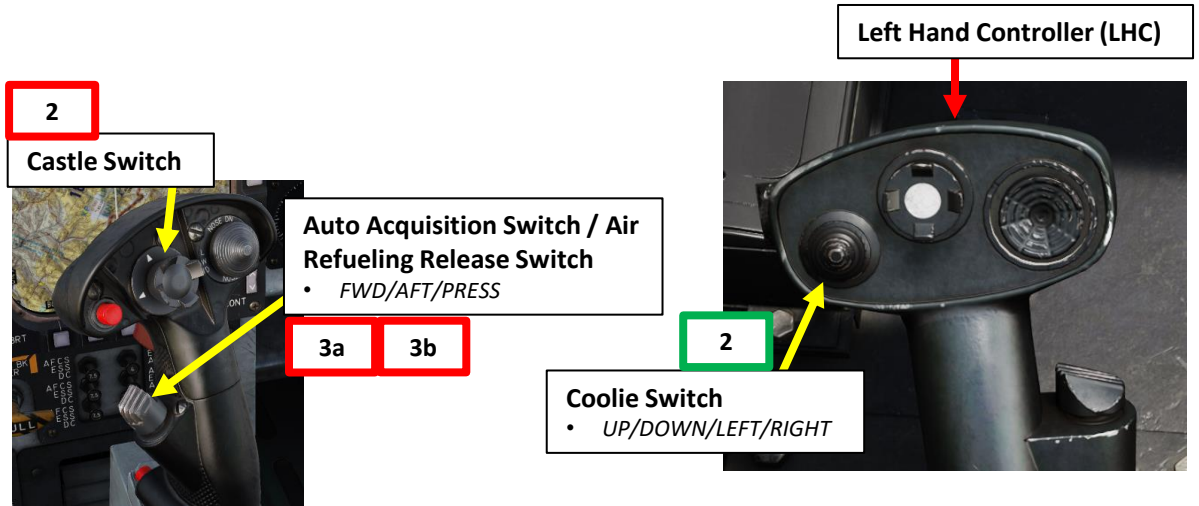


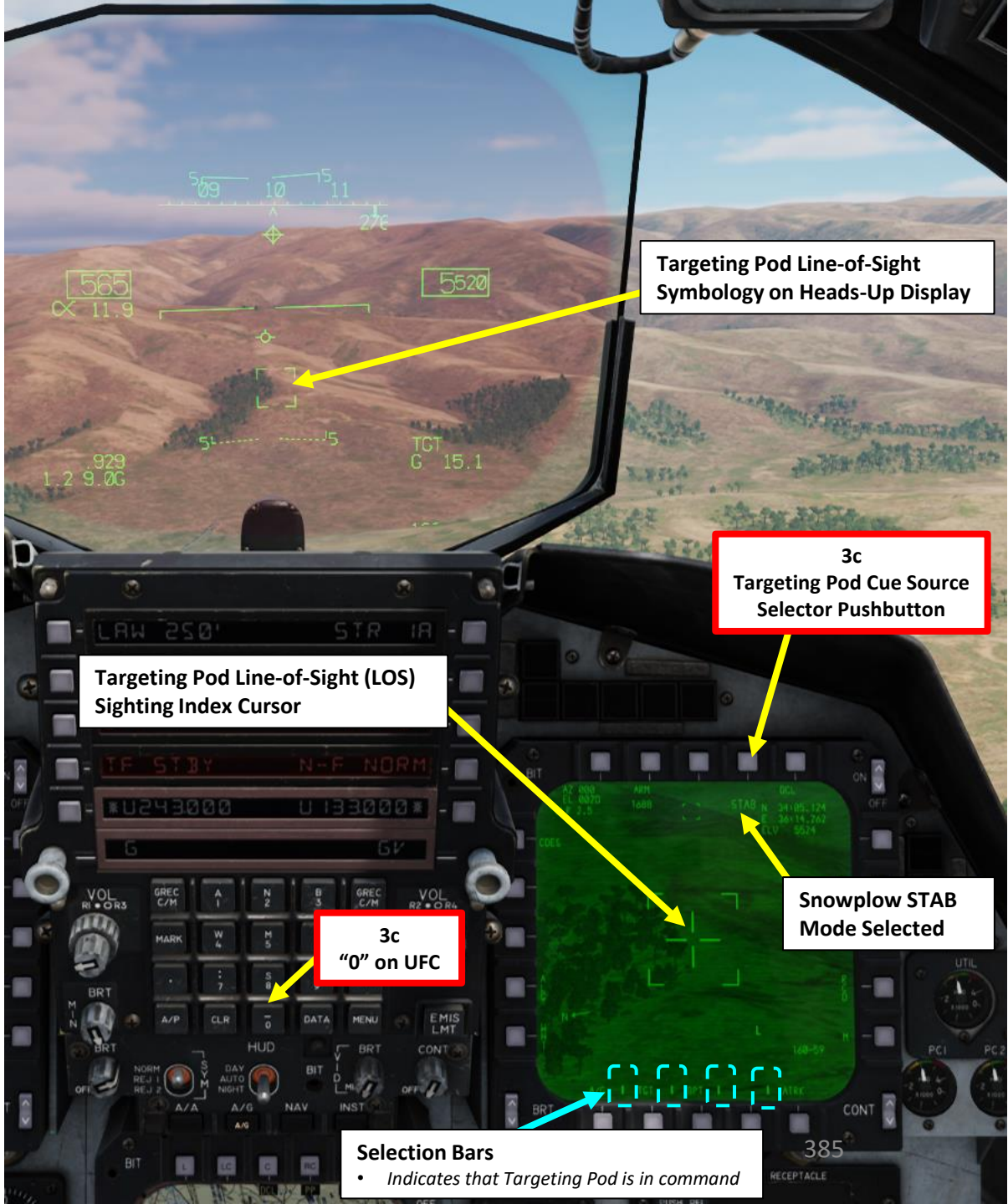
Infrared Marking Laser
(Reference: A-10C Warthog LITENING targeting pod)

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.5 – Snowplow Mode

The targeting pod can enter a space-stabilized (STAB) mode continuously cued/slaved below the horizon, along the heading vector. This mode is referred as "Snowplow" mode. When space-stabilized, the targeting pod's line-of-sight points at the space at angle azimuth and elevation it had when space stabilization was initialized.

1. From the main MPD menu page, select TPOD page.
2. Make sure the TPOD page is selected, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
3. Enter Snowplow Stabilization mode by either:
   a) Pressing Auto Acquisition Switch – FWD LONG (more than 1 sec), or;
   b) Pressing Auto Acquisition Switch – AFT LONG (more than 1 sec), or;
   c) Pressing "0" on the UFC (Upfront Control Panel), then pressing the Targeting Pod Cue Source Selector pushbutton.
4. The STAB indication means the targeting pod is now space-stabilized. You may then slew the targeting pod using the TDC (Target Designation Control) switch as desired.
5. Snowplow mode is exited when the TGP is commanded to track, or the TGP is cued/slaved by another source, or when a designation is commanded, or when ground stabilization is commanded by the aircrew.



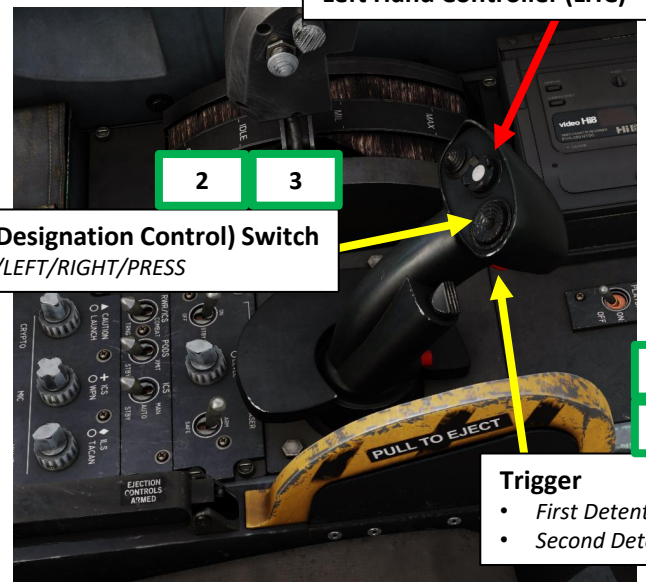


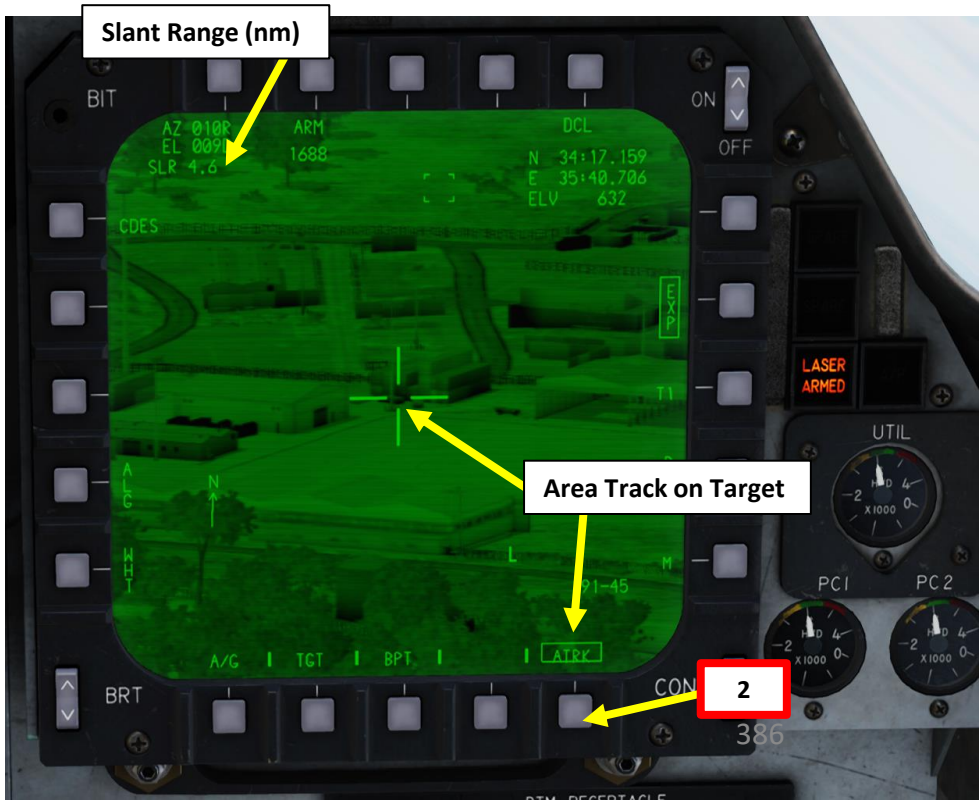
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.6 – Tracking Modes
3.6.1 – Area Track (ATRK)

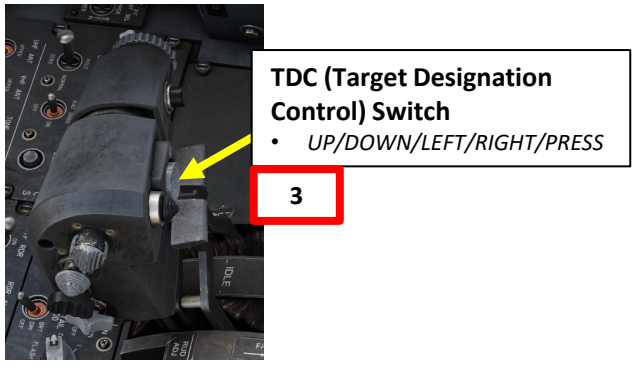
Area track makes the targeting pod track the video scene using an area correlation tracker. This pointing method is used for stationary targets (buildings, roads, bridges, etc.)

To perform an area track:

1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select ATRK (Area Track).
   - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS switch.
3. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to track.
4. Initiate a targeting pod "track" on the target.
   - **Pilot**: Depress Auto Acquisition Switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
5. Once the target is tracked, the targeting pod will compute a slant range and ATRK will be boxed.
6. If ATRK cannot be maintained or is broken, the pod defaults to CMPT (Computed Track) mode.
7. To "un-track" the target:
   - **Pilot**: Depress Auto Acquisition Switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.





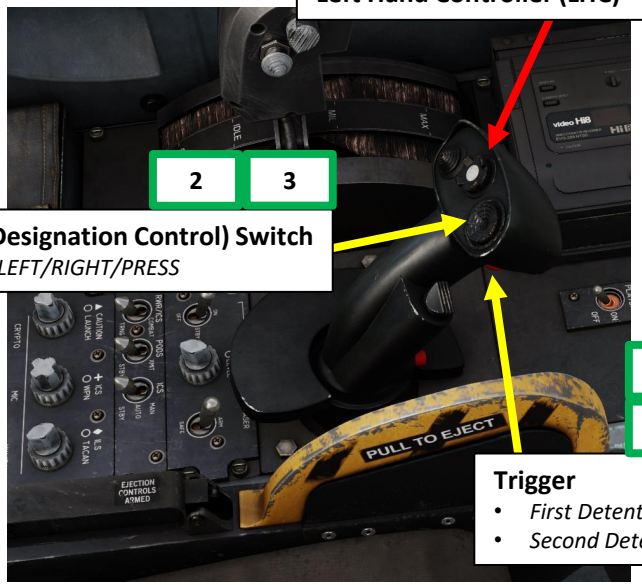


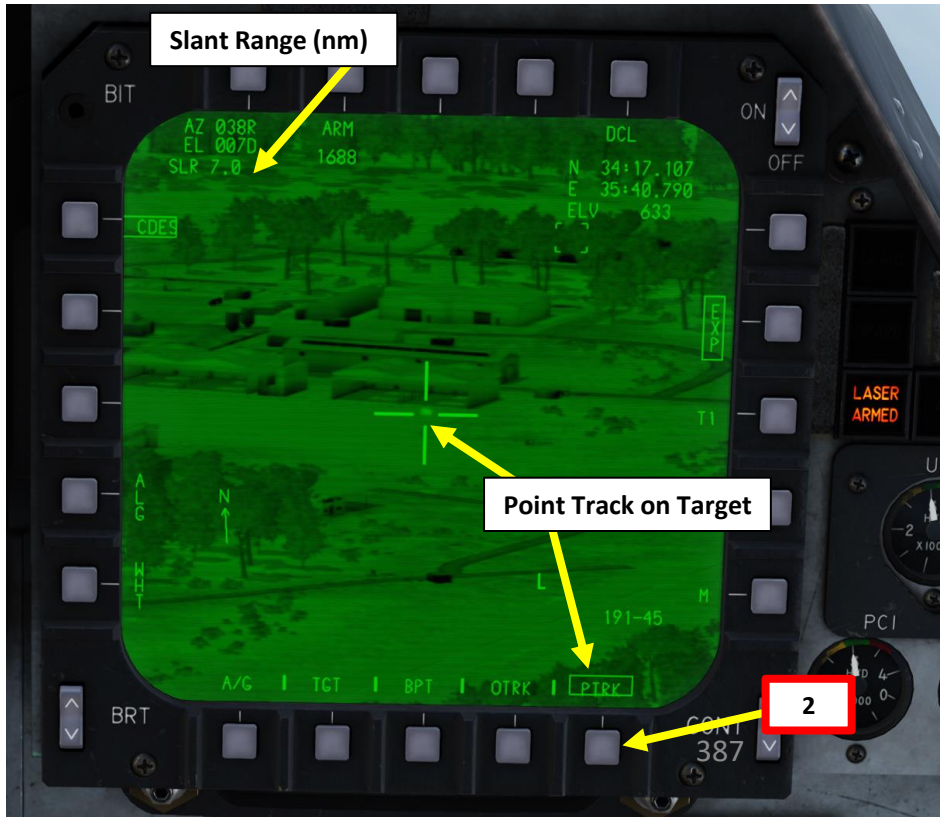
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.6 – Tracking Modes
3.6.2 – Point Track (PTRK)

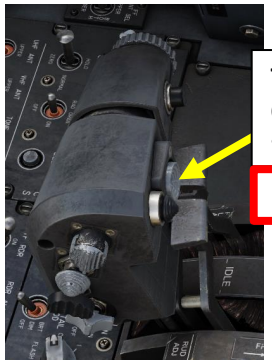
Point track makes the targeting pod track a target using a point contrast video tracker, looking for infrared transitions on each side of the target. This pointing method is better used for targets that are well-defined against the background, such as moving objects like a high-contrast vehicle.

To perform a point track:

1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
   - WSO L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS switch.
3. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to track.
4. Initiate a targeting pod "track" on the target.
   - Pilot: Depress Auto Acquisition Switch.
   - WSO: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
5. Once the target is tracked, the targeting pod will compute a slant range and PTRK will be boxed.
6. If PTRK cannot be maintained or is broken, the pod defaults to ATRK (Area Track) mode.
7. To "un-track" the target:
   - Pilot: Depress Auto Acquisition Switch.
   - WSO: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.





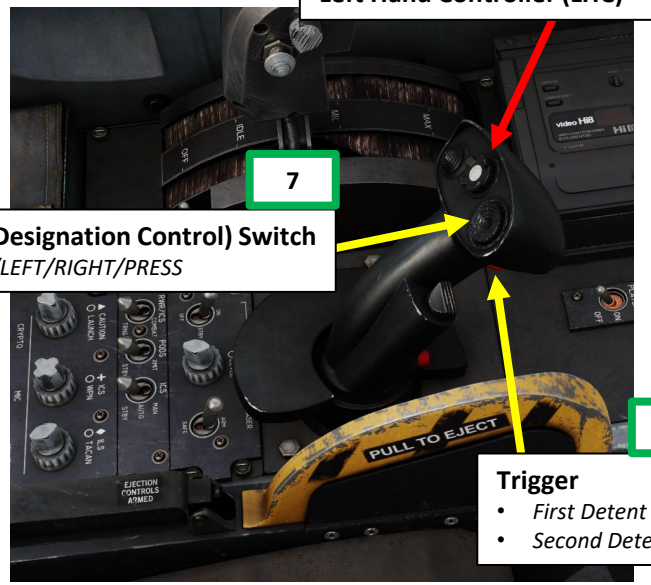


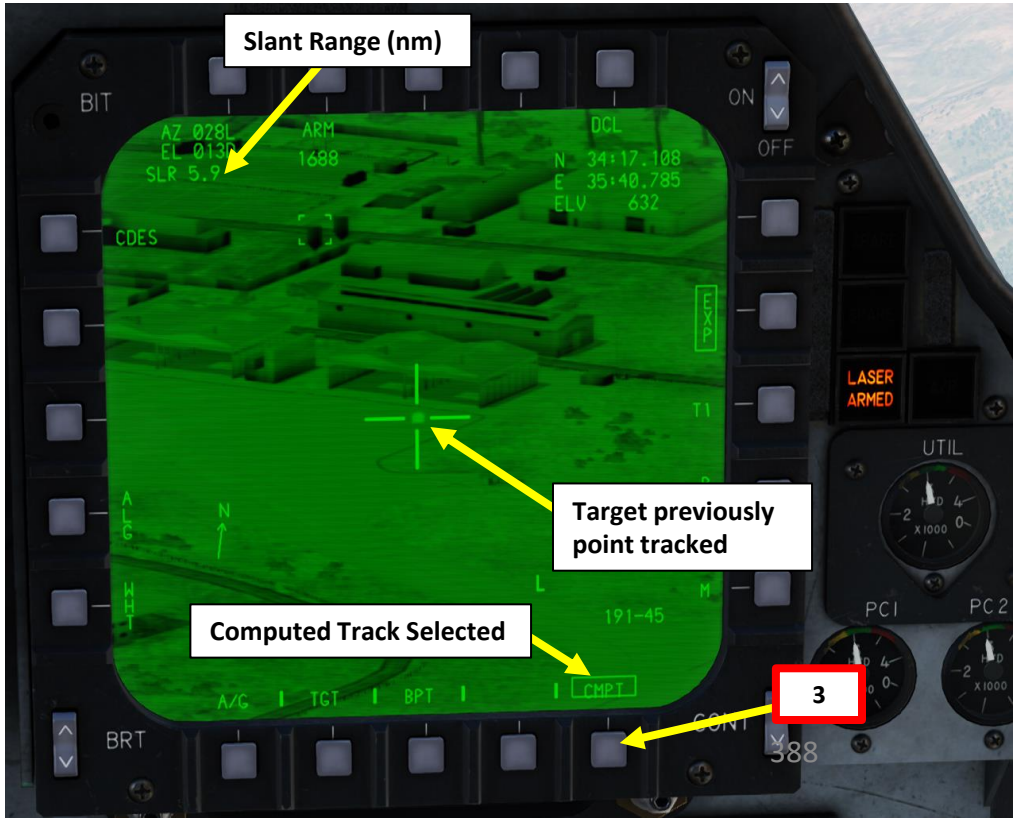
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.6 – Tracking Modes
3.6.3 – Computed Rate Track (CMPT)

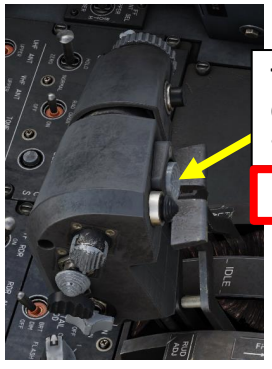
Computed track attempts to maintain a track on a previously tracked target that was impossible to maintain (via either Area Track or Point Track). As soon as you initiate a TDC slew when in CMPT mode, the pod tries to re-enter PTRK or ATRK at the termination of the slew.

To perform a computed track:

1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. Perform an area track or a point track as previously shown.
3. Select CMPT (Computed Track) tracking method using the pushbutton next to PTRK/ATRK.
   - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS switch.
4. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to track
5. As soon as you initiate a TDC slew when in CMPT mode, the pod tries to re-enter PTRK or ATRK at the termination of the slew.
6. Once the target is tracked, the targeting pod will compute a slant range and CMPT will be boxed.
7. To "un-track" the target:
   - **Pilot**: Depress Auto Acquisition Switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.







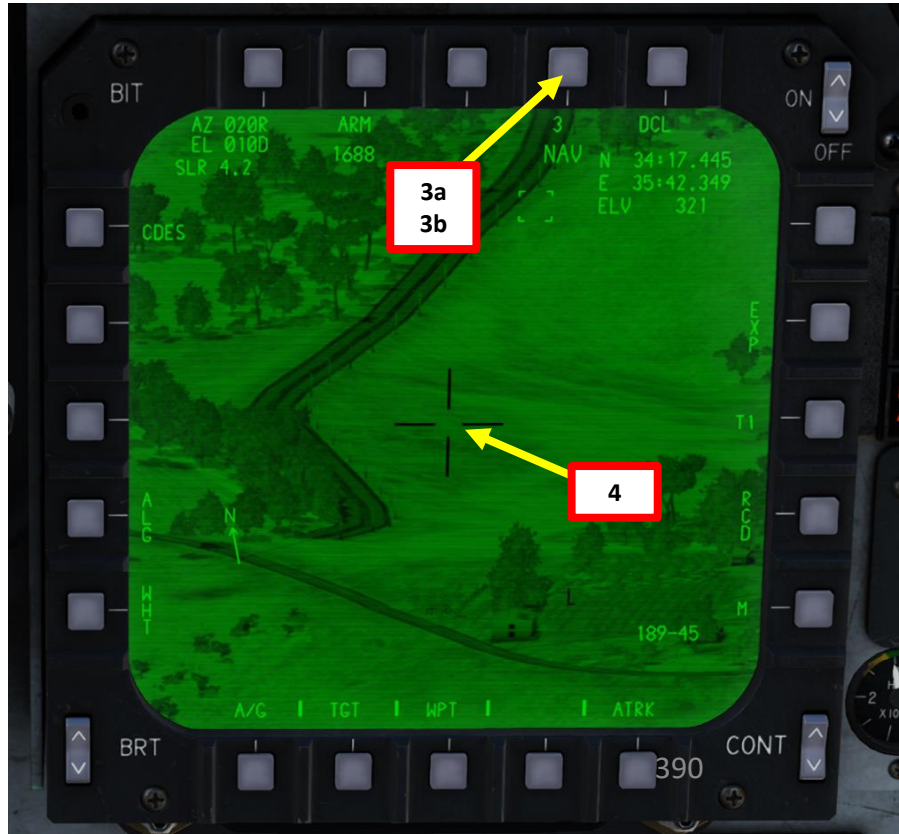
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.6 – Tracking Modes
3.6.4 – Offset Track (OTRK)

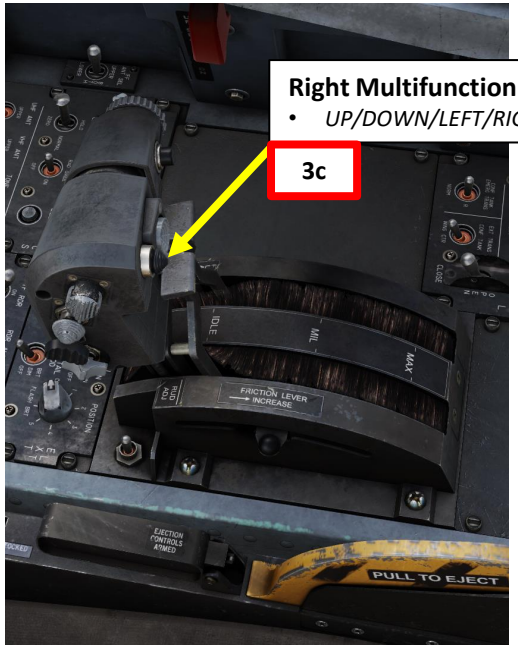
Note: This function is not implemented yet for the DCS F-15E.

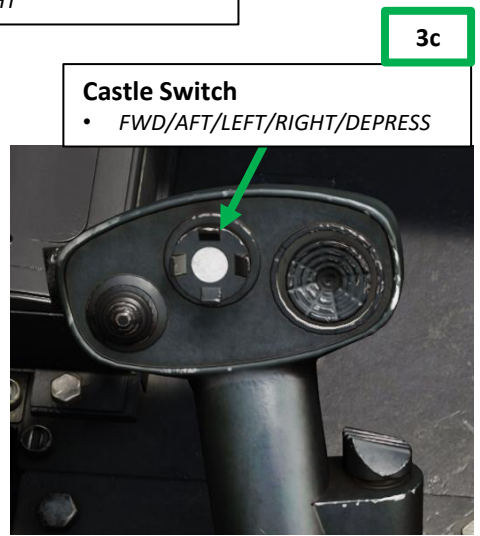
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.1 – Slaving TGP to Sequence Point (NAV Cue)

The NAV Cue function allows the targeting pod to slave itself to a sequence/navigation point in your flight plan database. To perform a TGP Navigation Cue:

1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. We want to slave the targeting pod to sequence point No. 3.
3. Select Sequence point 3 by either:
    a) Pressing "3" on the UFC (Upfront Control Panel), then pressing the Targeting Pod Cue Source Selector pushbutton; or
    b) Repeatedly pressing the Targeting Pod Cue Source Selector push to toggle between sequence points until "3" is selected; or
    c) Quick stepping between sequence points until Sequence Point No. 3 is selected.
        - **Pilot**: Press Right Multifunction Switch (Coolie Hat) – UP.
        - **WSO**: Depress L/RHC (Left/Right Hand Controller) Castle Switch.
4. Targeting pod will then lock (ground stabilize) its line-of-sight to the sequence point.
5. You can un-slave the targeting pod by entering Snowplow Stabilization mode by pressing Auto Acquisition Switch – FWD LONG (more than 1 sec).



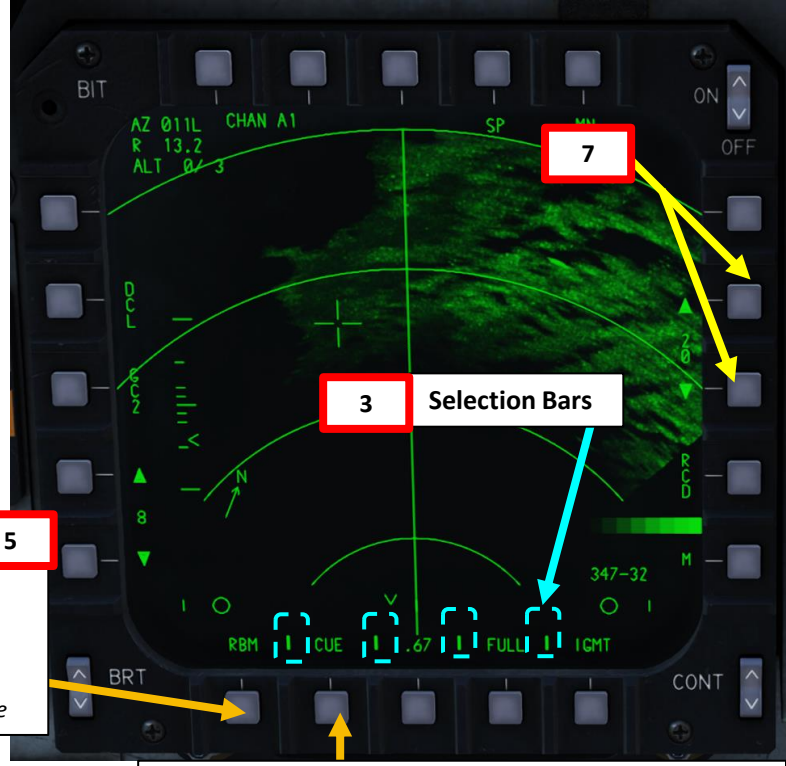




3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.2 – Slaving TGP to Air-to-Ground Radar (RDR Cue)

The RDR Cue function allows the targeting pod to slave itself to a point designated by the air-to-ground radar. To perform a TGP radar Cue:

1. Verify targeting pod and radar are both powered. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On the other page, monitor TPOD (Targeting Pod) feed.
5. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
6. On A/G RDR page, select CUE cursor function by toggling the Cursor Function Selector button as needed.
7. Adjust display range as desired.



5

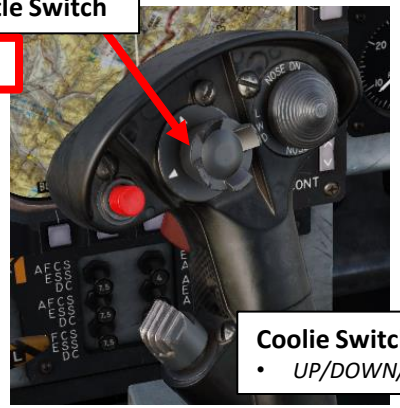
A/G Radar Mode Selector
- *RBM: Real Beam Map*
- *GMT: Ground Moving Target*
- *HRM: High Resolution Map*
- *PVU: Precision Velocity Update*

Cursor Function Selector
- *MAP: Commands HRM (High Resolution Map) patch maps*
- *UPDT: Position Update*
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*

6

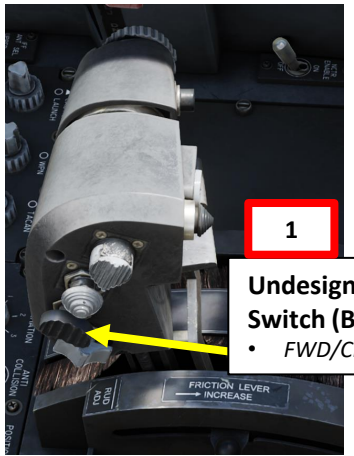
A/G (Air-to-Ground) Master Mode Button **2**

Castle Switch **3**



Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

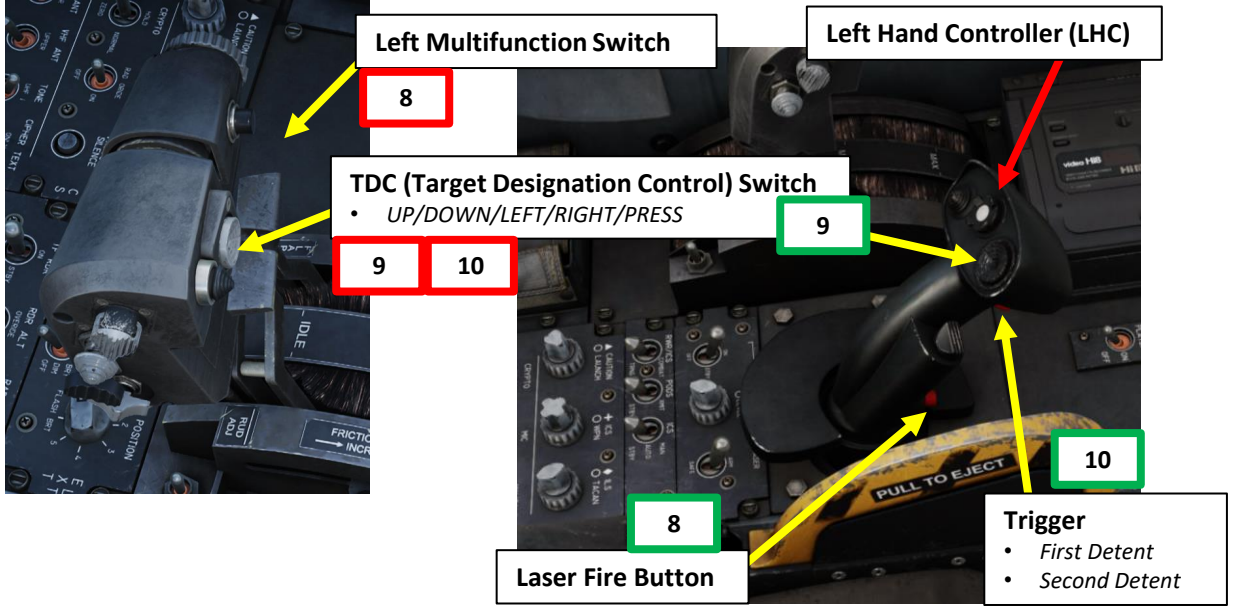
3

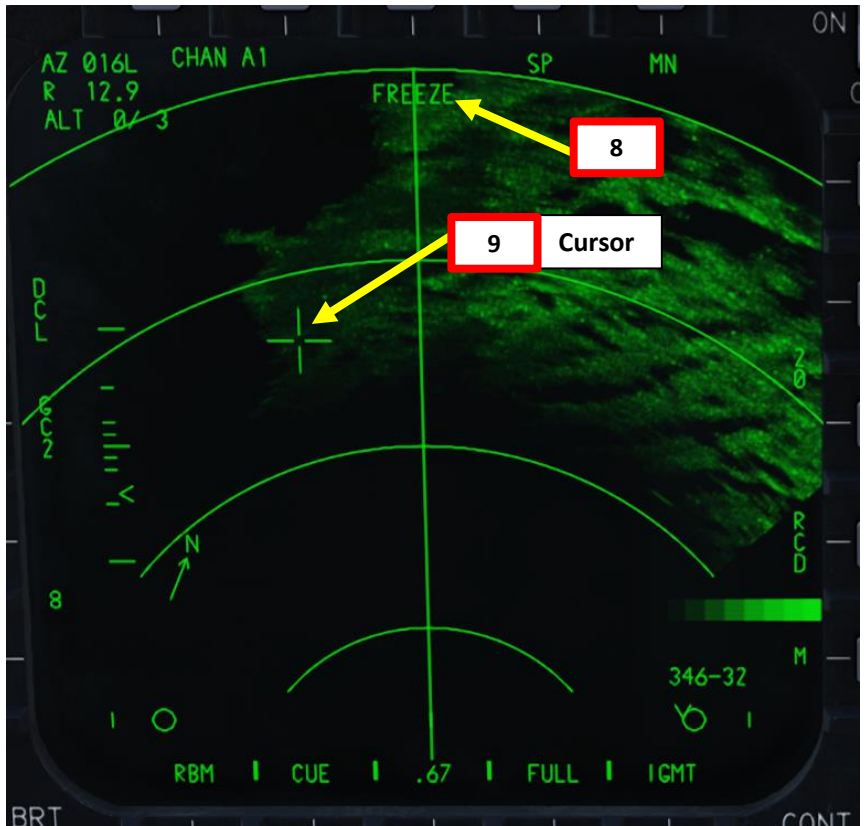


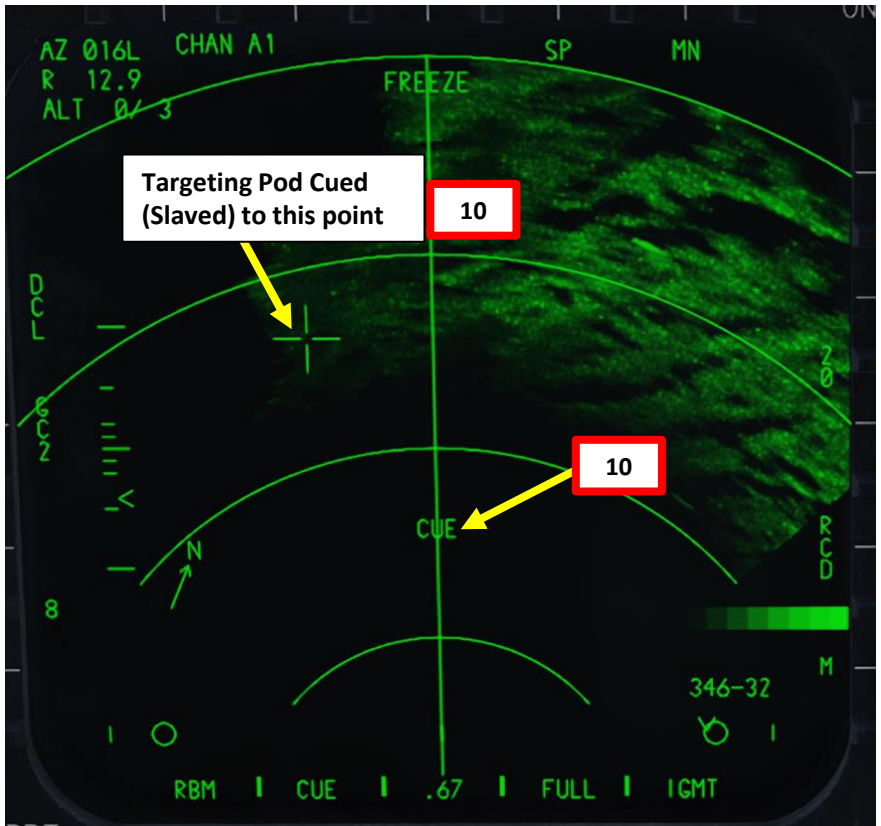
Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.2 – Slaving TGP to Air-to-Ground Radar (RDR Cue)

8. Freeze the RBM display:
   - **Pilot**: Press the Left Multifunction Switch.
   - **WSO**: Press the Laser Fire Button
9. Using the TDC (Target Designation Control) switch, slew cursor of the A/G RDR page over the point you want to slave the targeting pod to.
10. To designate the point and slave (CUE) the targeting pod to it:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.

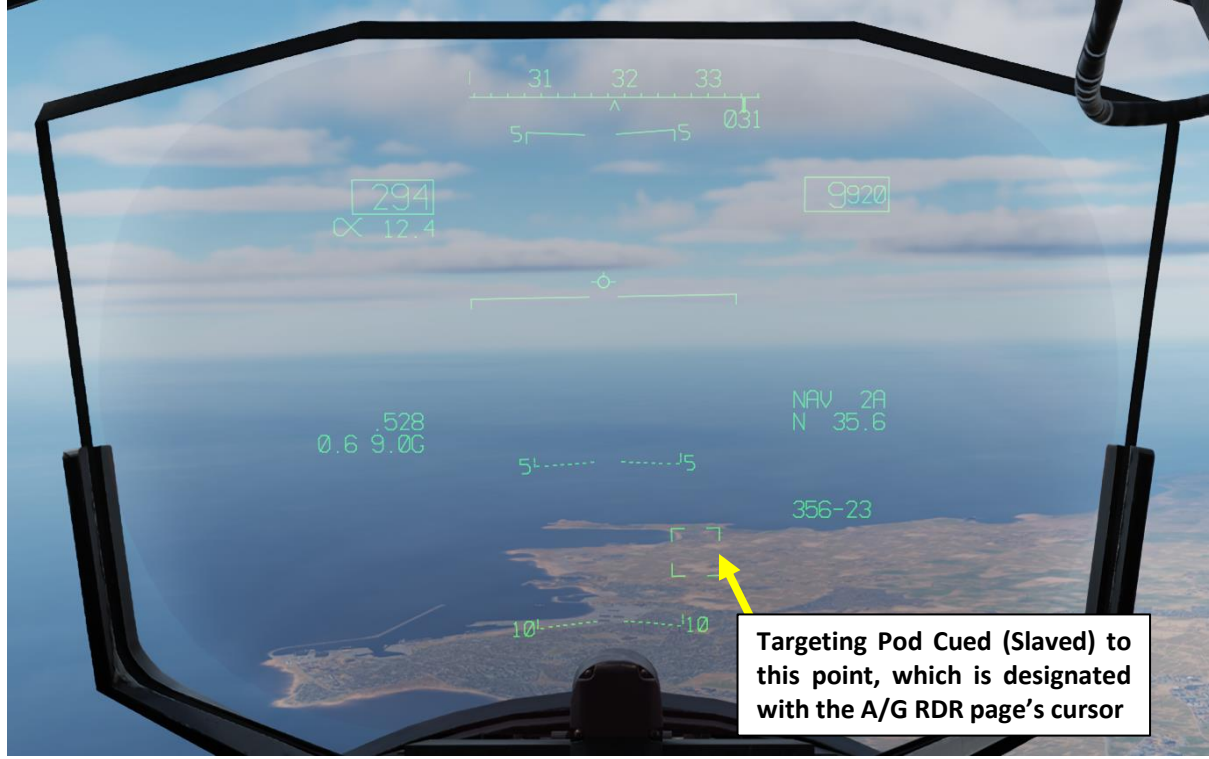


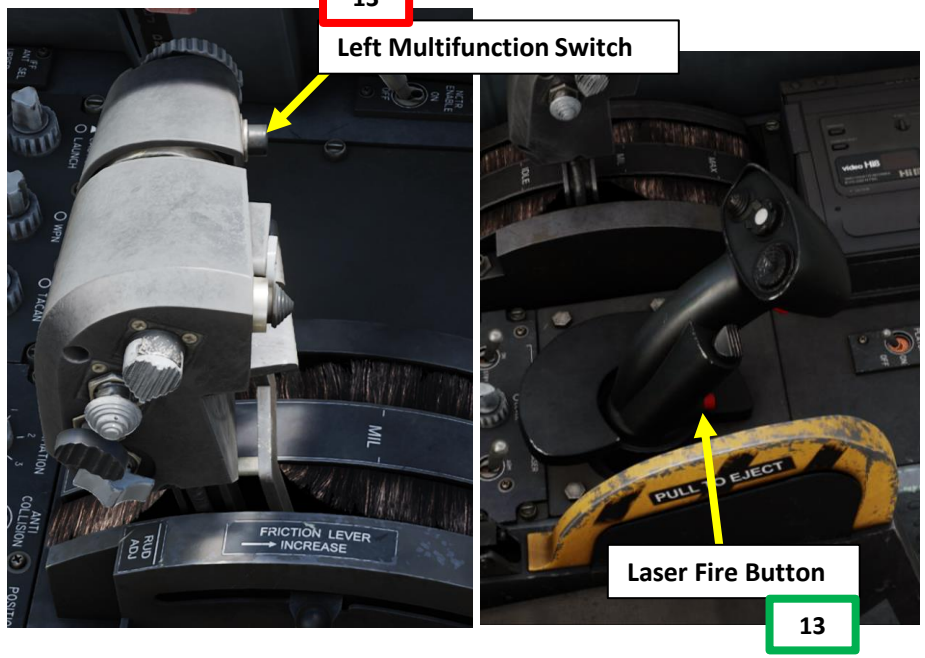


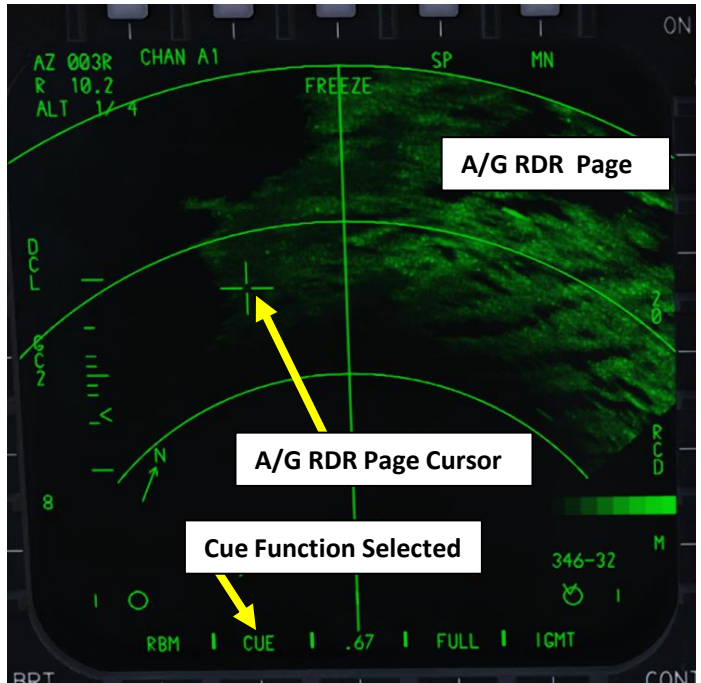


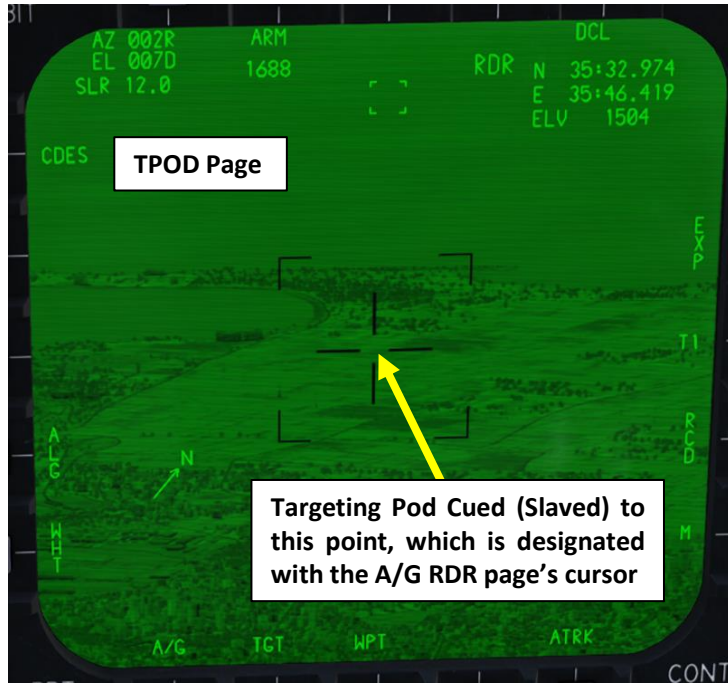
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.2 – Slaving TGP to Air-to-Ground Radar (RDR Cue)

11. When A/G radar designation is performed, the targeting pod line-of-sight will snap to this designated point.
12. If you check on the TPOD (Targeting Pod) page, you will see that the targeting pod has been slaved to the A/G RDR page's cursor.
13. To "unfreeze" the real beam map display, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.









3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.3 – Slaving TGP to Tactical Situation Display (TSD Cue)

Note: This function is not implemented yet for the DCS F-15E.

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.4 – Slaving TGP to Situation Display (SIT Cue)

Note: This function is not implemented yet for the DCS F-15E.

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)

The HUD Cue function allows the targeting pod to slave itself to a point designated from the heads-up display. In order to do so, you must have an air-to-ground weapon selected. The designation method will change based on which weapon delivery mode is selected; CDIP (Continuously Displayed Impact Point) mode will slave the targeting pod to the CDIP pipper/reticle, while Auto mode will slave the targeting pod to the TD (Target Designation) box, which can be slewed at will.

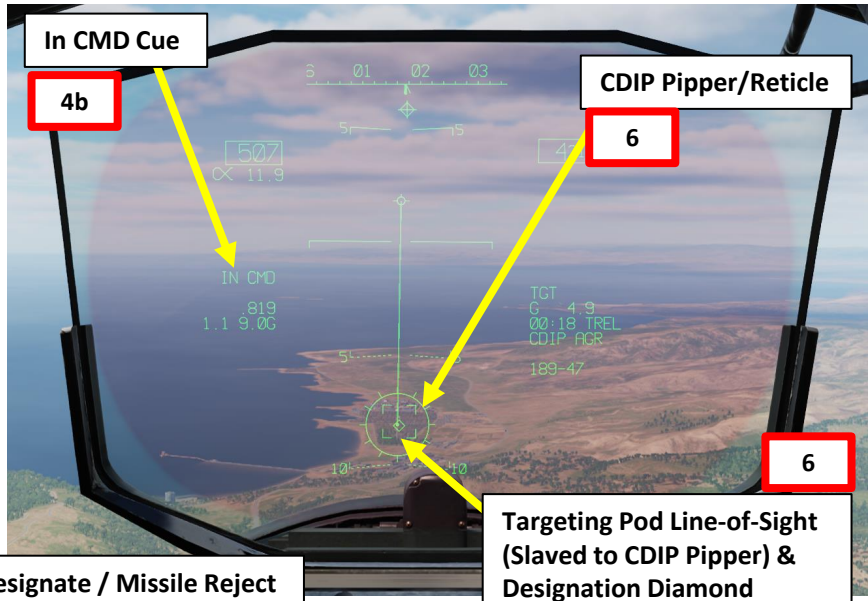
Targeting Pod Slaved to HUD Designation from CDIP (Continuously Displayed Impact Point) Mode Pipper/Reticle

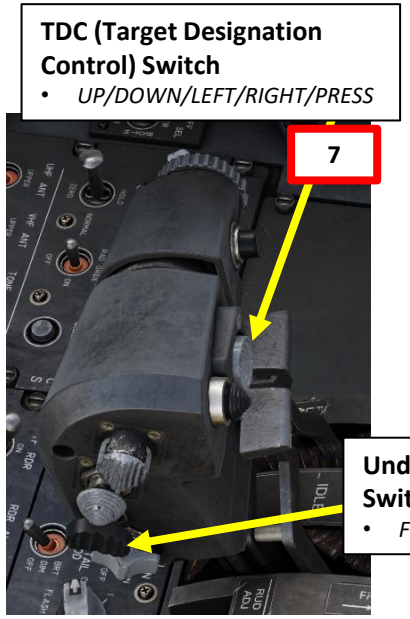
Targeting Pod Slaved to HUD Designation from Auto Mode TD (Target Designation) Box

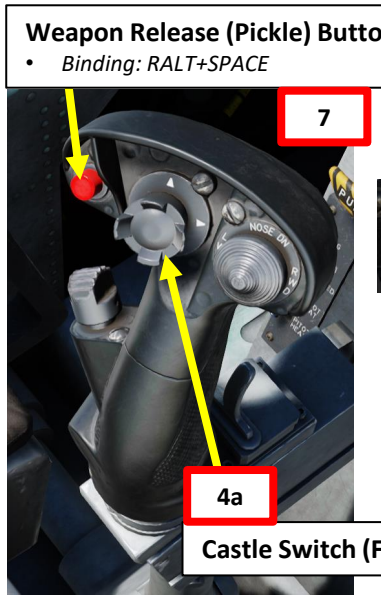
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)

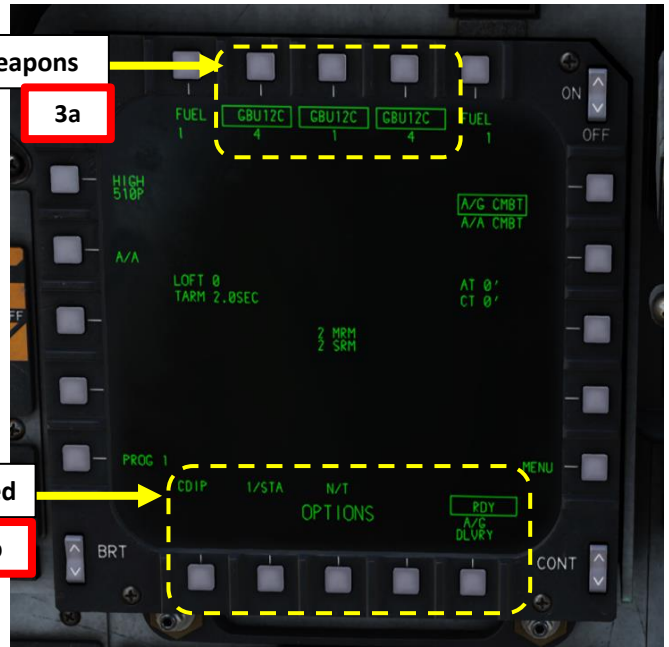
To perform a TGP HUD Cue in CDIP (Continuously Displayed Impact Point) Mode:

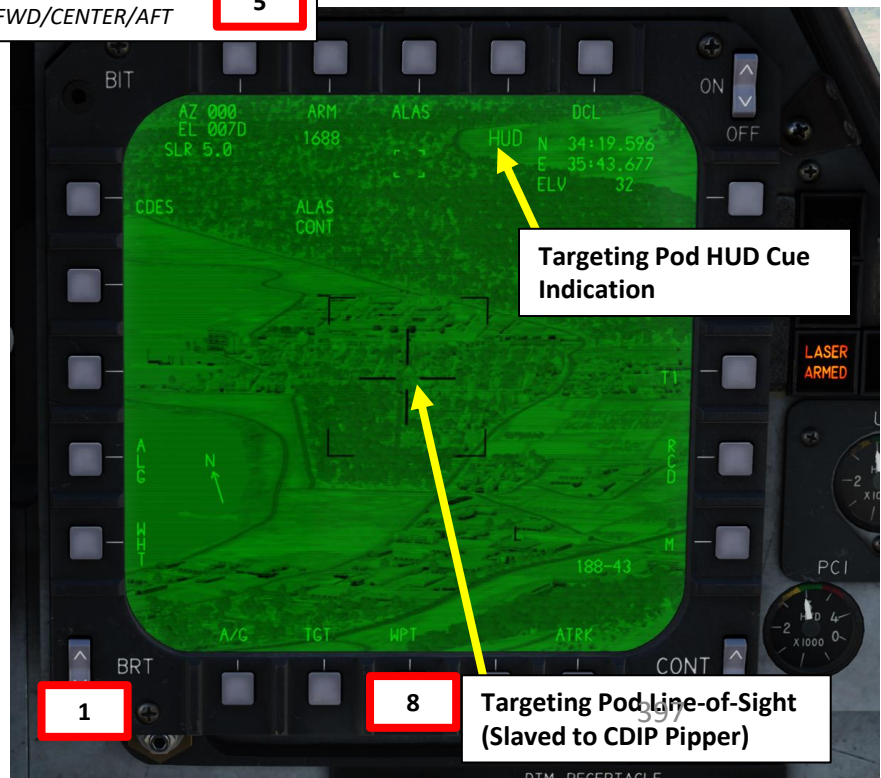
1. Power up the targeting pod, select the TPOD page.
2. Select A/G Master Mode
3. From ARMT (Armament) page, select a weapon with CDIP Release mode (see Weapon section for a more detailed procedure).
4. Take command on the HUD (Heads-Up Display). DEPRESS Castle Switch SHORT (less than 1 sec), then press Castle Switch FWD SHORT (less than 1 sec).
    - Selection is indicated with the "IN CMD" (In Command) Cue.
5. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
6. Steer the aircraft to place the CDIP pipper/reticle on the target you want to designate.
7. Designate target; you can either:
    a) Press and release the TDC (Target Designation Control) switch, or
    b) Press the Weapon Release (Pickle) Button (RALT+SPACE).
8. The Targeting pod will then lock (ground stabilize) its line-of-sight to the CDIP pipper/reticle at the time of designation.







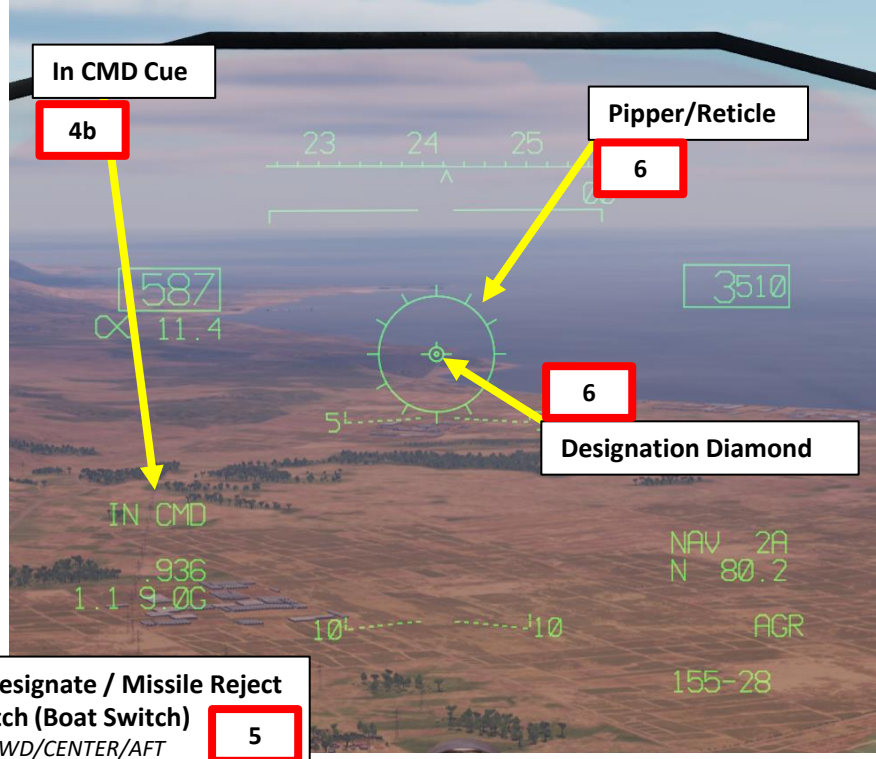


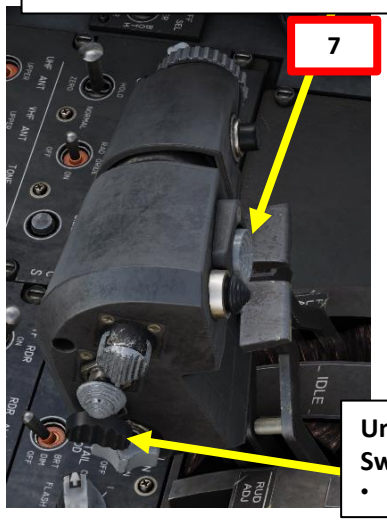


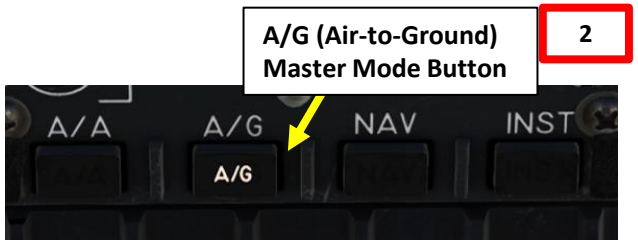
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)

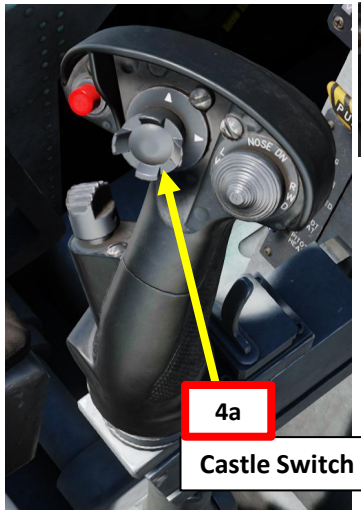
To perform a TGP HUD Cue in Auto Mode:

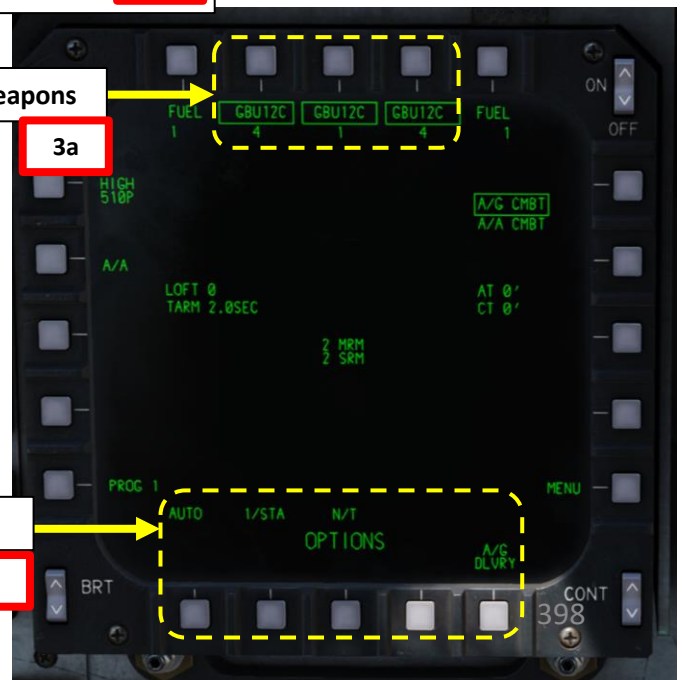
1. Power up the targeting pod, select the TPOD page.
2. Select A/G Master Mode
3. From ARMT (Armament) page, select a weapon with Auto Release mode (see Weapon section for a more detailed procedure).
4. Take command on the HUD (Heads-Up Display). DEPRESS Castle Switch SHORT (less than 1 sec), then press Castle Switch FWD SHORT (less than 1 sec).
    - Selection is indicated with the "IN CMD" (In Command) Cue.
5. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
6. In Auto Mode, the designation is first slaved to the center of the pipper/reticle, which needs to be placed near the target.









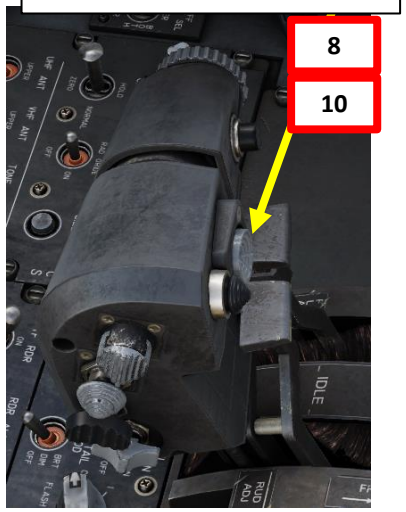


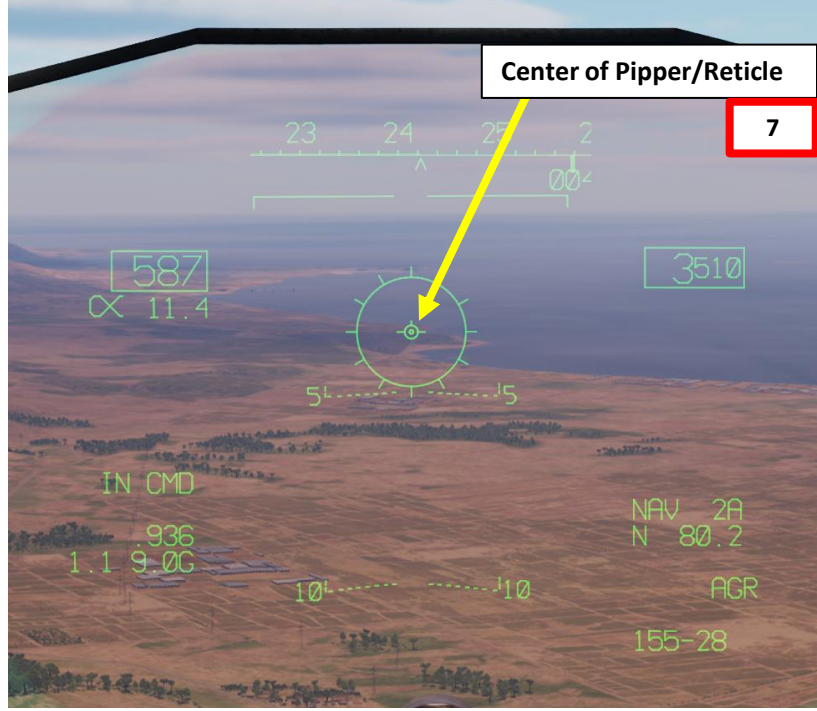
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)

To perform a TGP HUD Cue in Auto Mode:

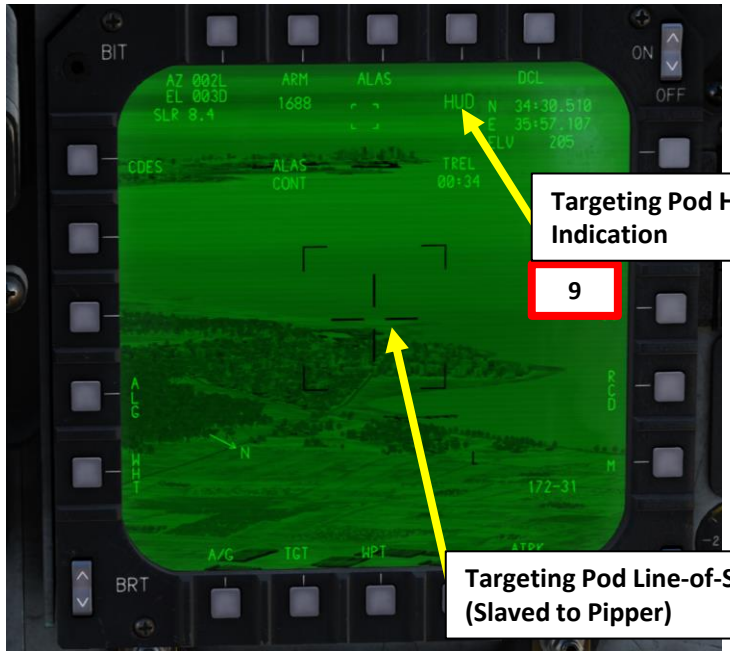
7. Steer the aircraft to place the pipper/reticle on the target you want to designate.
8. Designate target; you can either:
   a) Press and release the TDC (Target Designation Control) switch, or
   b) Press the Weapon Release (Pickle) Button (RALT+SPACE).
9. The targeting pod will then lock (ground stabilize) its line-of-sight to the pipper/reticle at the time of designation, indicated by a TD (Target Designation) Box.
10. Pressing and holding the TDC while slewing it UP/DOWN/LEFT/RIGHT allows you to change the TD (Target Designation) Box. The targeting pod will follow the TD box.

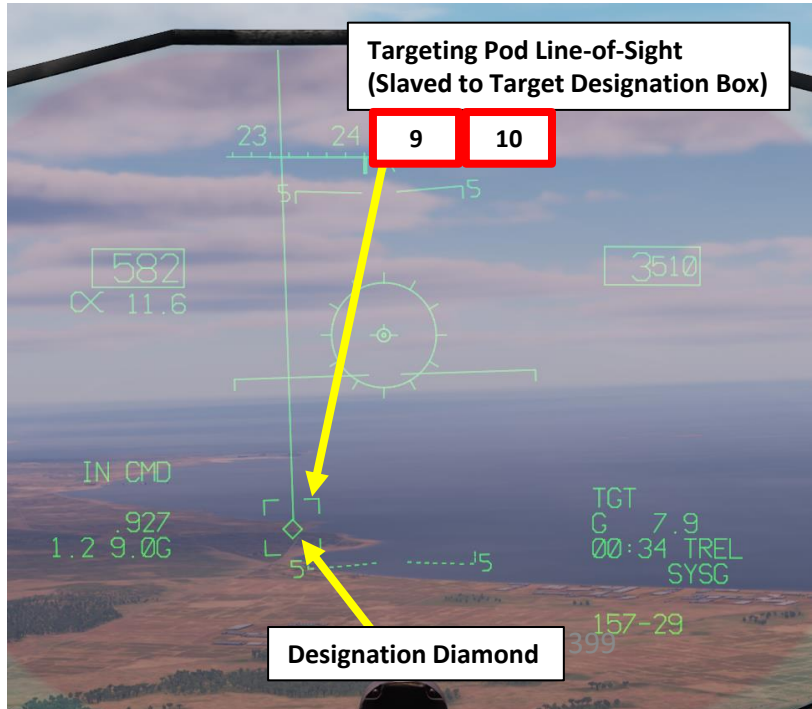
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*





Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

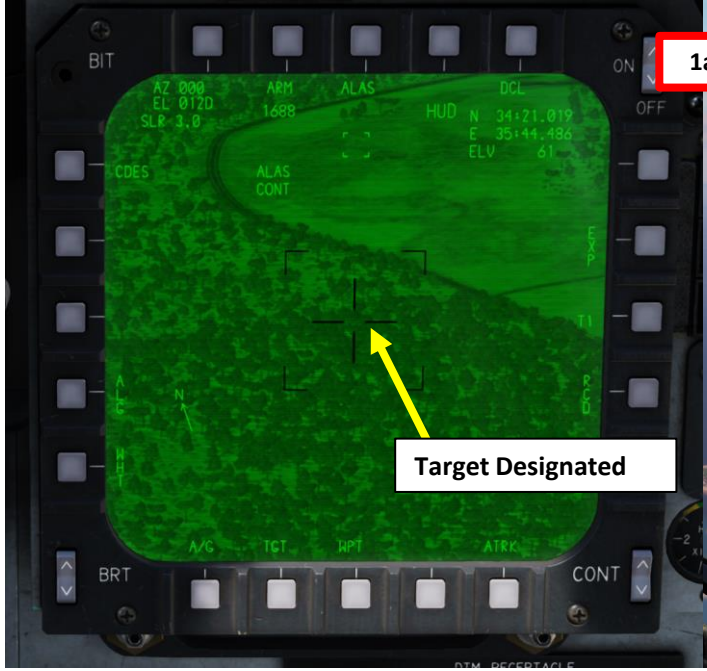


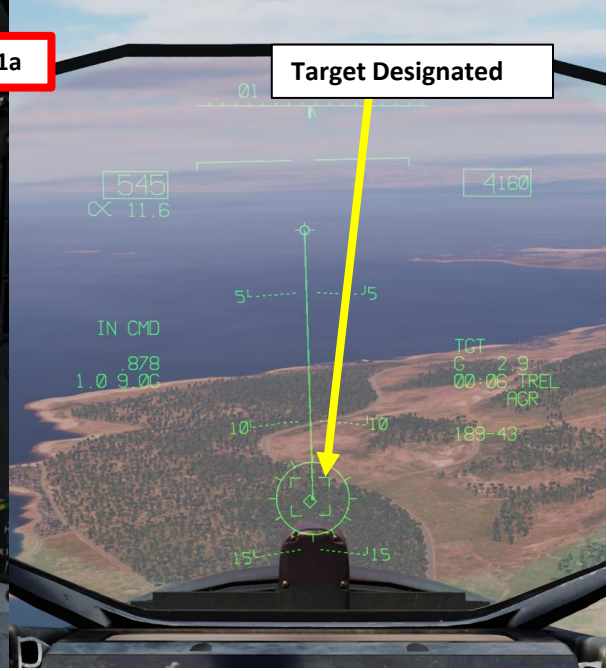


3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.5 – Slaving TGP to Heads-Up Display (HUD Cue)

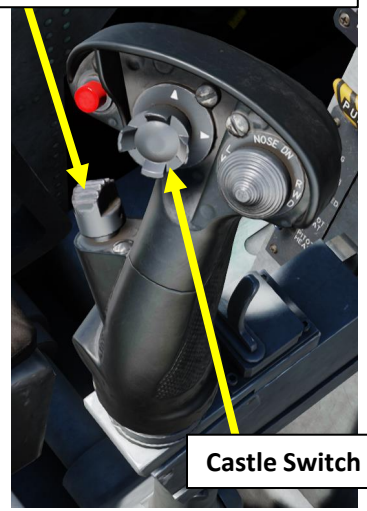
To un-slave the targeting pod:

1. While the HUD is the sensor in command, press the Undesignate (Boat) Switch – AFT
2. Press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display to take command of it.
3. Enter Snowplow Stabilization mode by pressing Auto Acquisition Switch – FWD LONG (more than 1 sec).

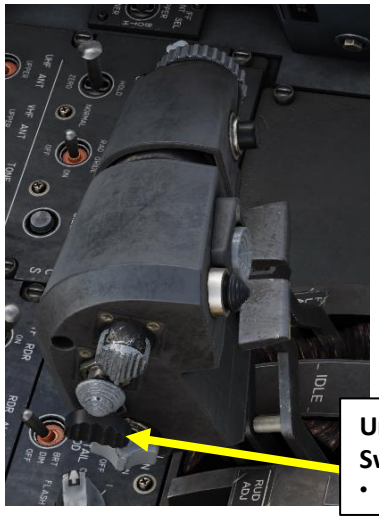




Auto Acquisition Switch / Air Refueling Release Switch — **3a**
- *FWD/AFT/PRESS*



2
Castle Switch (Front Cockpit)

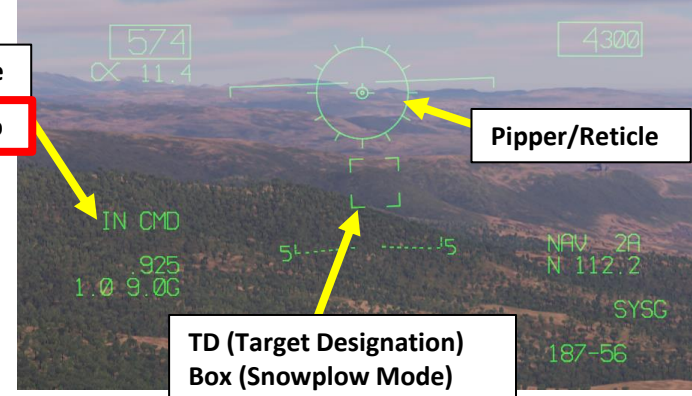


Undesignate / Missile Reject Switch (Boat Switch) — **1b**
- *FWD/CENTER/AFT*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.6 – Slaving TGP to Targeting Reticle (RET Cue)

The RET Cue function allows the targeting pod to slave itself to a point designated by the targeting reticle (visible on the heads-up display). To perform a TGP reticle Cue:

1. Power up the targeting pod, select the TPOD page.
2. Select A/G Master Mode
3. From ARMT (Armament) page, select a weapon with either CDIP or Auto Release mode (see Weapon section for a more detailed procedure). In this example, we will select auto mode.
4. Take command on the HUD (Heads-Up Display). DEPRESS Castle Switch SHORT (less than 1 sec), then press Castle Switch FWD SHORT (less than 1 sec).
    - Selection is indicated with the "IN CMD" (In Command) Cue.
5. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
6. Select Reticle (RET) Mode. DEPRESS Castle Switch SHORT (less than 1 sec), then press Castle Switch FWD SHORT (less than 1 sec).

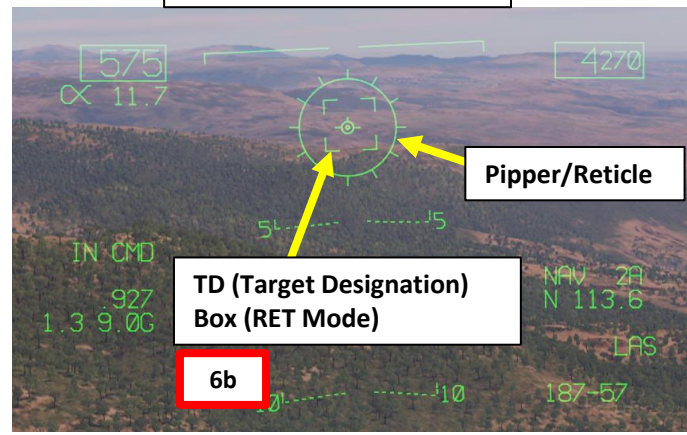


In CMD Cue

4b

Pipper/Reticle

TD (Target Designation) Box (Snowplow Mode)

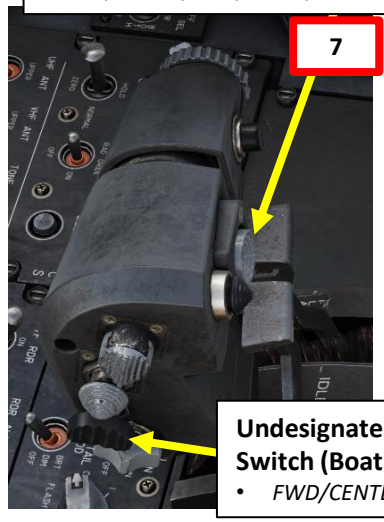


Pipper/Reticle

TD (Target Designation) Box (RET Mode)

6b

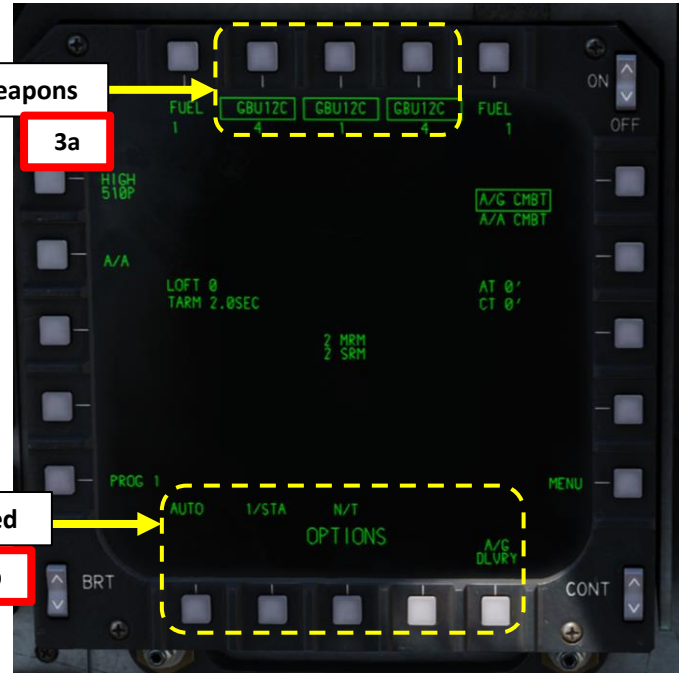
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*



7

Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

5

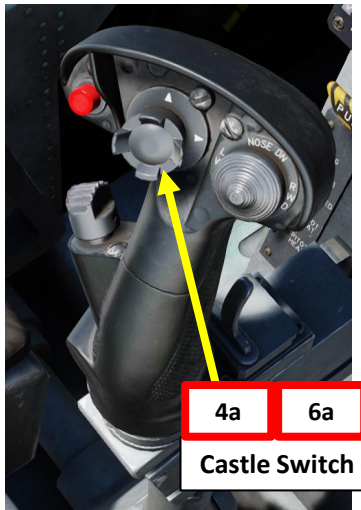


Selected Weapons

3a

Auto Weapon Profile Selected

3b



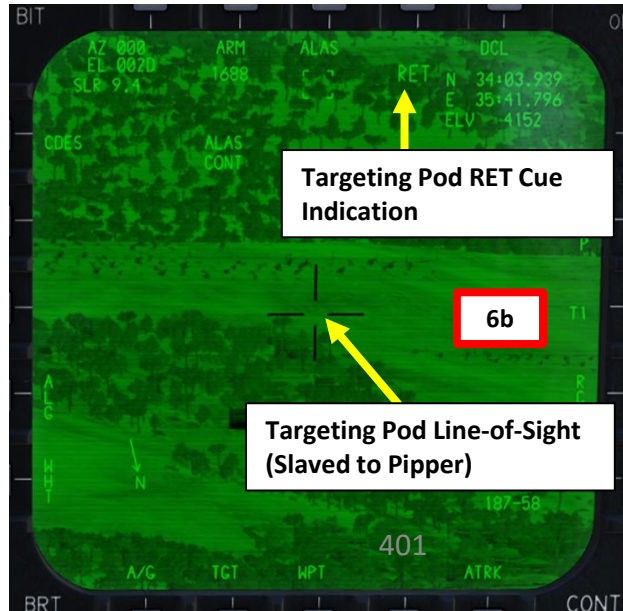
2

A/G (Air-to-Ground) Master Mode Button

4a

6a

Castle Switch (Front Cockpit)



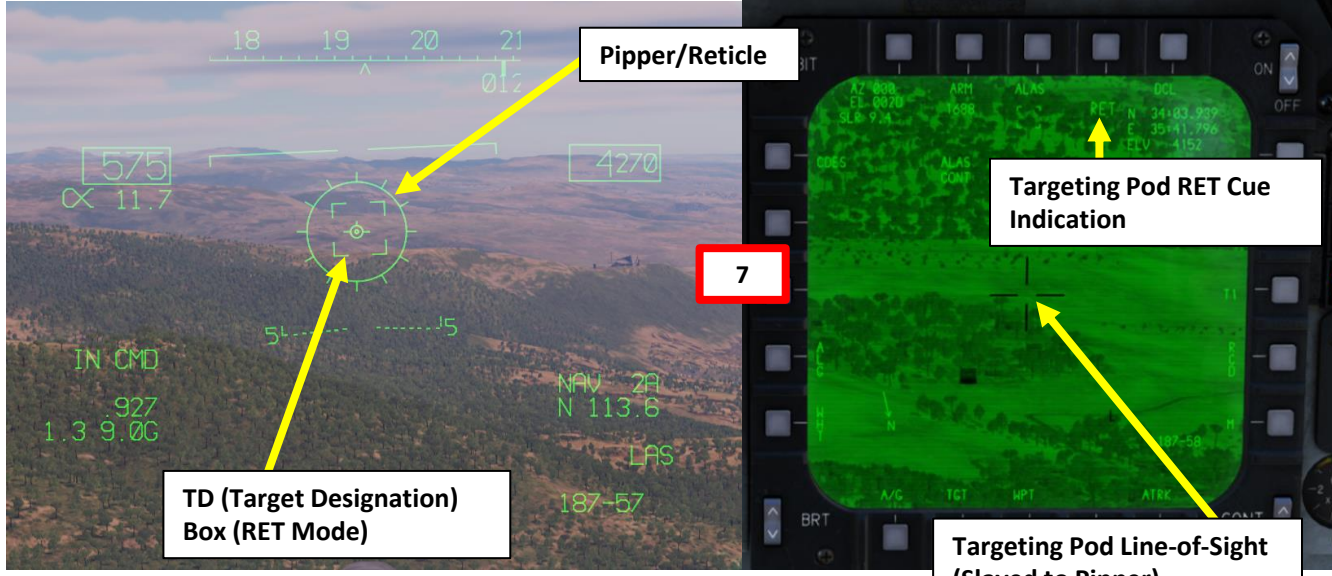
Targeting Pod RET Cue Indication

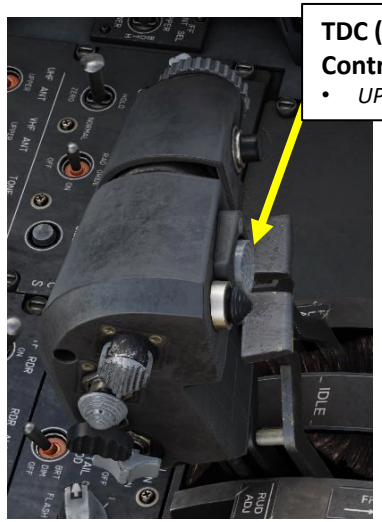
6b

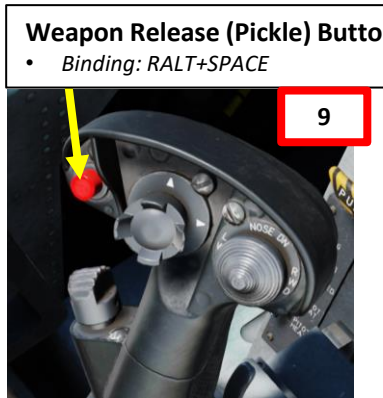
Targeting Pod Line-of-Sight (Slaved to Pipper)

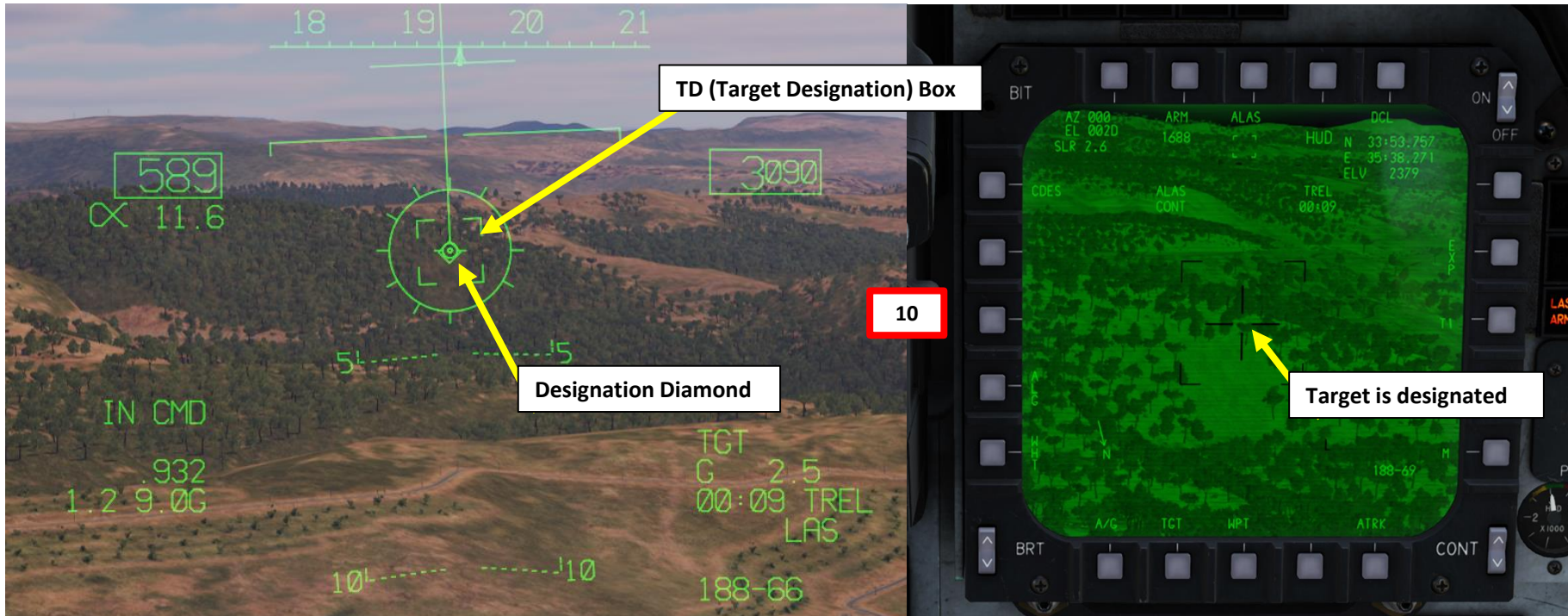
3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.7 – Cue Mode
3.7.6 – Slaving TGP to Targeting Reticle (RET Cue)

7. In Reticle (RET) Mode, the targeting pod is slaved to the center of the pipper/reticle, which needs to be placed on the target.
8. Steer the aircraft to place the pipper/reticle on the target you want to designate.
9. Designate target; you can either:
    a) Press and release the TDC (Target Designation Control) switch, or
    b) Press the Weapon Release (Pickle) Button (RALT+SPACE).
10. The targeting pod will then lock (ground stabilize) its line-of-sight to the pipper/reticle at the time of designation, indicated by a TD (Target Designation) Box and designation diamond.









3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.8 – Cursor Functions
3.8.1 – Target Designation (TGT) Function

The TGT (Target Designation) function allows the aircraft to designate a target. It is selected by using the **Targeting Pod Function Selector**.

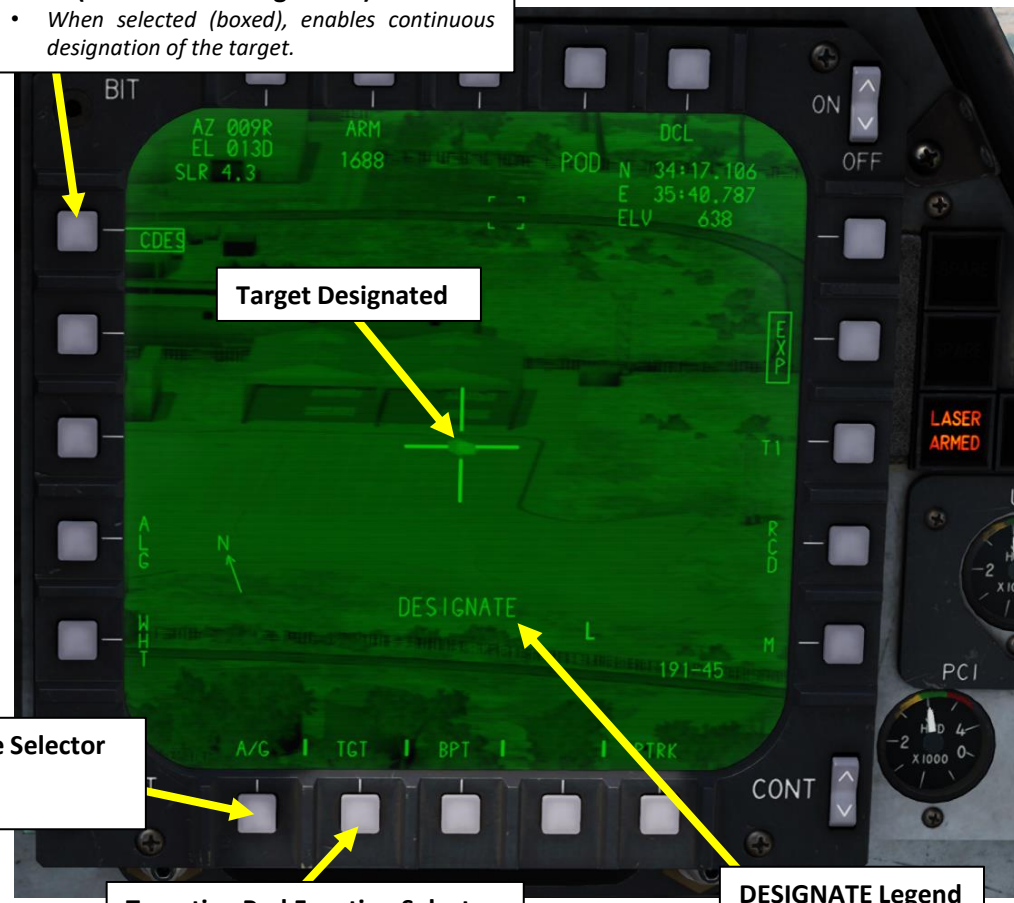
To designate a target using this method, the crosshairs should be placed over the desired spot (which can already be tracked by the pod) and the special cursor function should be performed by::

- **Pilot**: Pressing and releasing the **TDC (Target Designation Control) switch**.
- **WSO**: Pressing L/**RHC (Left/Right Hand Controller) trigger to full action (second detent)**, then releasing it.

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 designation** or **continuous designation (CDES)**, which can be toggled by boxing the CDES legend with its respective pushbutton.

- If a **one time designation** is performed, current range and line-of-sight 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.
- If **continuous designation** was selected (CDES is boxed), the designation is updated continuously with new range and line-of-sight information. This means that designation follows pod's line-of-sight 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 the active sensor in manual mode (in AUTO, only LAS can be used).



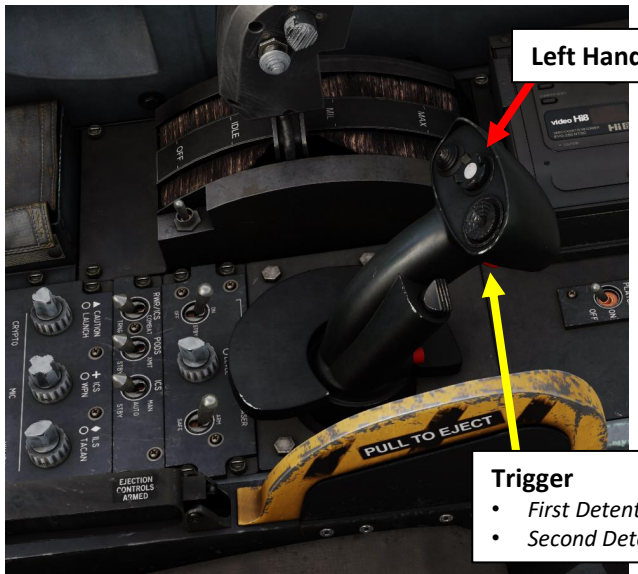
CDES (Continuous Designation) Status
- *When selected (boxed), enables continuous designation of the target.*

Target Designated

Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

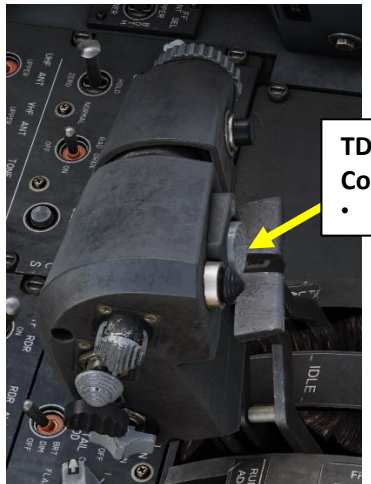
Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

DESIGNATE Legend



Left Hand Controller (LHC)

Trigger
- *First Detent*
- *Second Detent*

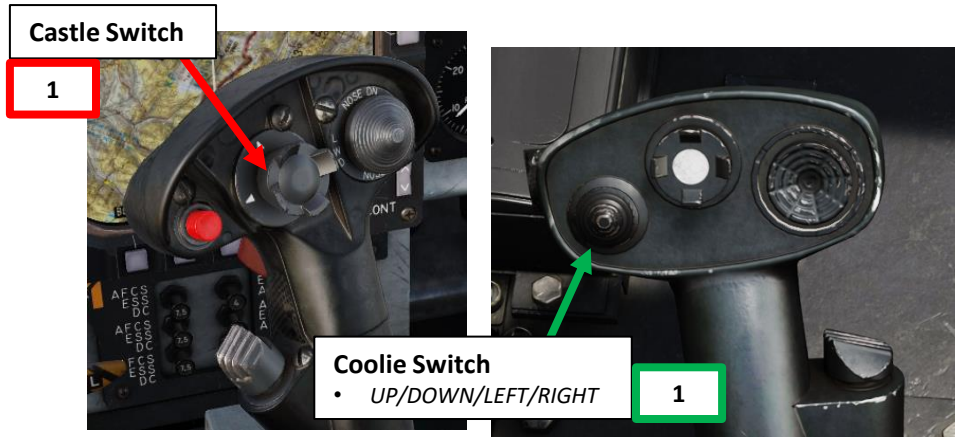


TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.8 – Cursor Functions
3.8.2 – Markpoint Designation (MARK) Function

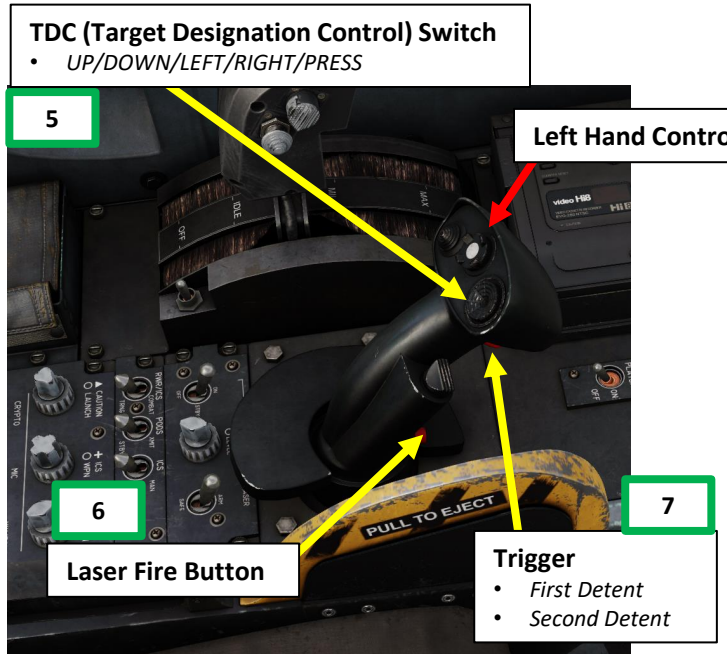
The MARK function is used to create a markpoint on the targeting pod for future reference. To mark a target with the TGP:

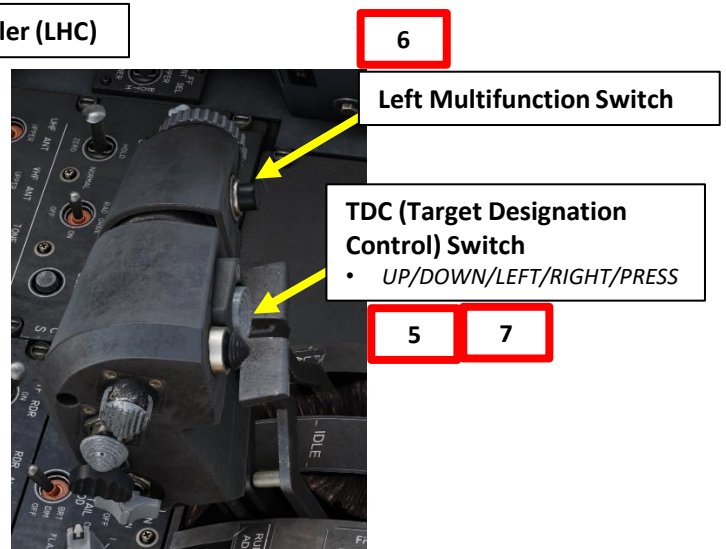
1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. Select A/G Master Mode
3. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
4. Set Targeting Pod Function Selector to MARK (Markpoint Designation).

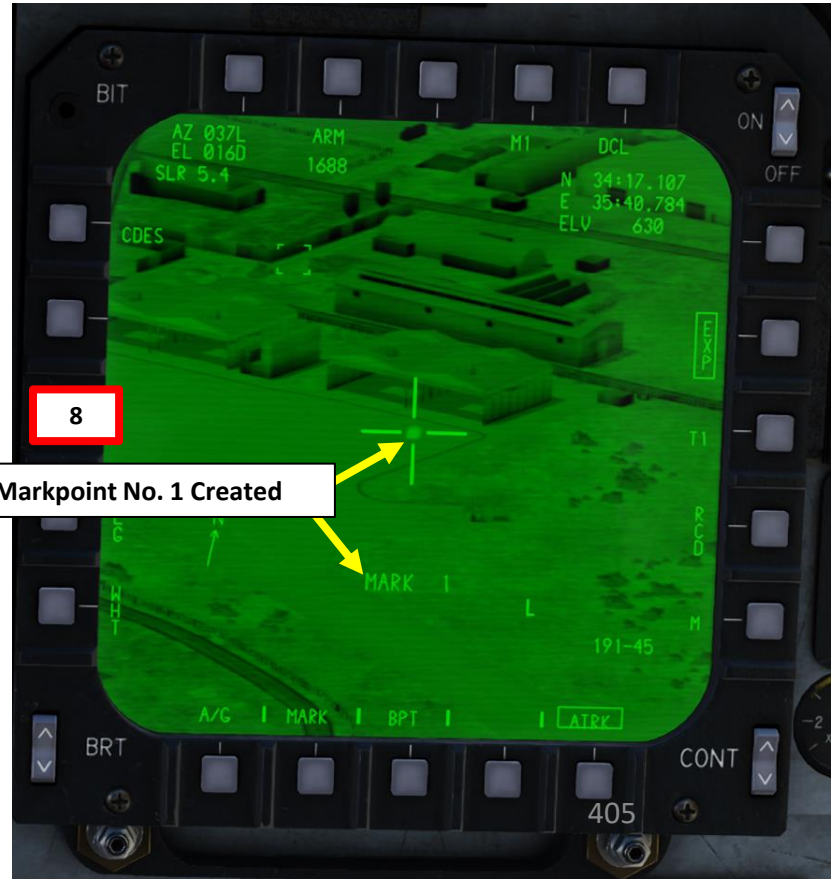


3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.8 – Cursor Functions
3.8.2 – Markpoint Designation (MARK) Function

5. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to create a markpoint on.
6. If desired, lase the target to get a more accurate range. You can toggle the laser firing ON or OFF by:
   - **Pilot**: Pressing the Left Multifunction Switch.
   - **WSO**: Pressing the Laser Fire Button.
7. To designate the markpoint:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
8. Once target is marked, a new markpoint is created (Markpoint No. 1 in this case). Then, the MARK X legend (X being its respective markpoint number) appears for 5 seconds.
9. The UFC (Upfront Control Panel) displays coordinates of the newly created Markpoint and the time when it was recorded/designated.
10. A maximum of 10 markpoints can be designated. Any mark above the tenth overwrites the first one, then the second one, and so on. A maximum of 5 markpoints can be displayed at the same time.







3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.8 – Cursor Functions
3.8.3 – Sensor Slaving (CUE) Function

Note: This function is not implemented yet for the DCS F-15E.

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.8 – Cursor Functions
3.8.4 – Position Update (UPDT) Function

Note: UPDT function is not implemented yet for the DCS F-15E.

3 – AN/AAQ-14 LANTIRN TARGETING POD (TGP)
3.9 – Air-to-Air Operation

Note: Air-to-Air Targeting Pod Operation is not implemented yet for the DCS F-15E.

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)

4.1 – Introduction

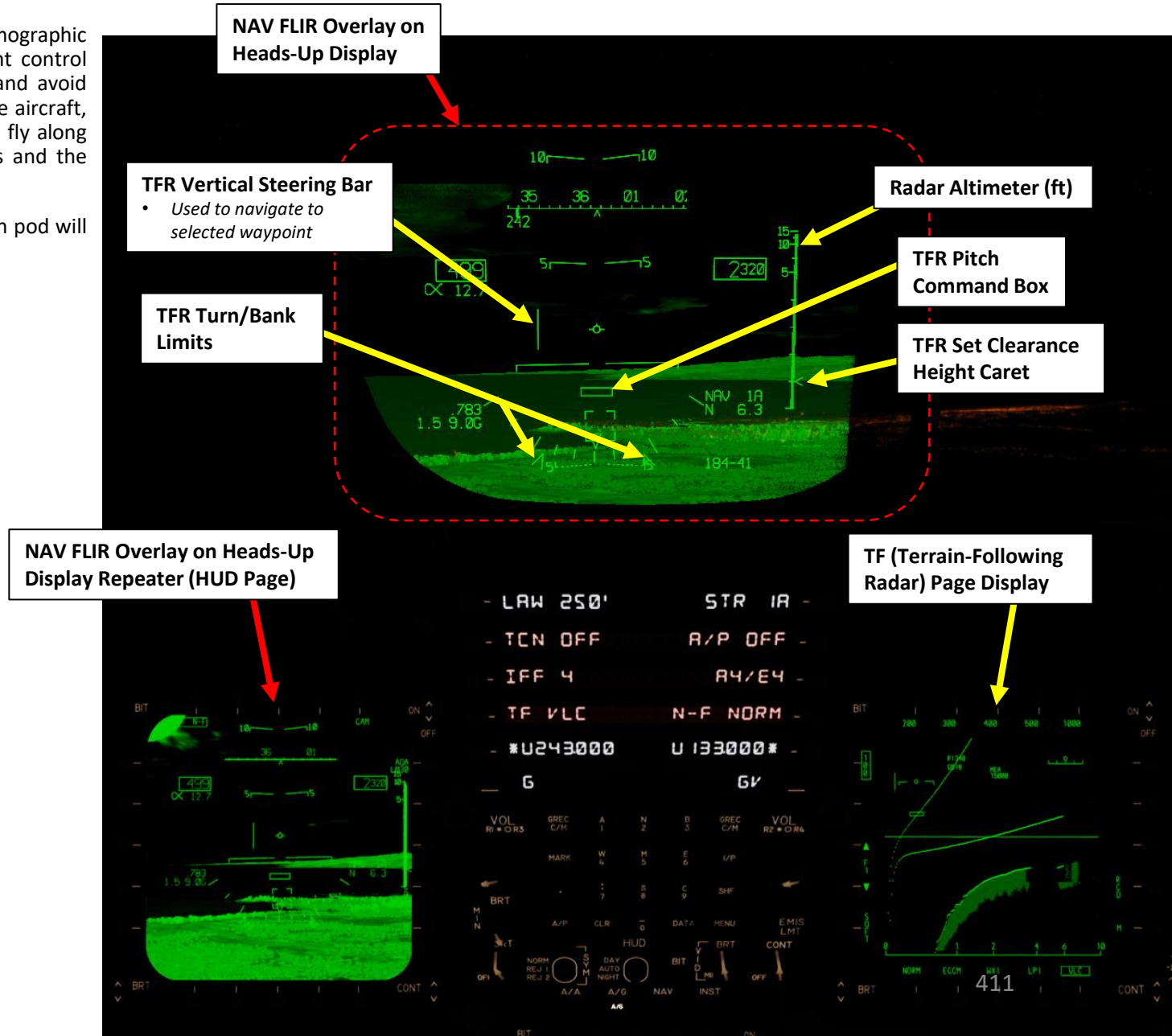
The AN/AAQ-13 LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) Navigation Pod provides high-speed penetration and precision attack on tactical targets at night and in adverse weather. Prior to the days of night vision goggles (NVGs), the navigation pod was mainly used as a supplemental sensor to help the pilot navigate in low visibility conditions. This tool is primarily used by the pilot, but it can also be monitored by the WSO. Unlike the AN/AAQ-14 LANTIRN Targeting Pod (TGP), the AN/AAQ-13 pod has no targeting capabilities.

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)

4.1 – Introduction

The navigation pod contains a terrain-following radar (**TFR**) and a fixed thermographic camera (**FLIR**), which provides a visual cue and input to the aircraft's flight control system, enabling it to maintain a pre-selected altitude above the terrain and avoid obstacles. This sensor displays an infrared image of the terrain in front of the aircraft, to the pilot, on a Heads-Up Display. The navigation pod enables the pilot to fly along the general contour of the terrain at high speed, using mountains, valleys and the cover of darkness to avoid detection.

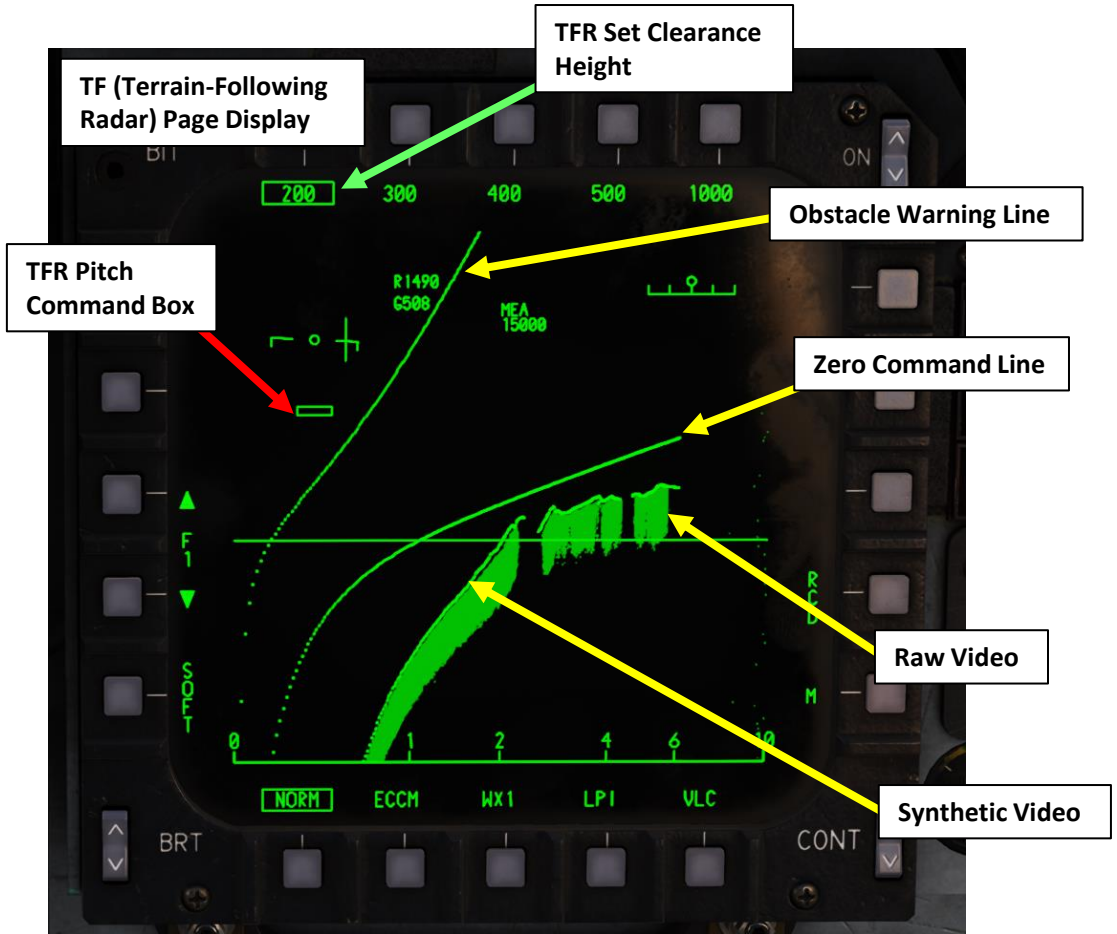
The use and functions of the TFR and NAV FLIR sub-systems of the navigation pod will be further explained in the following sections.

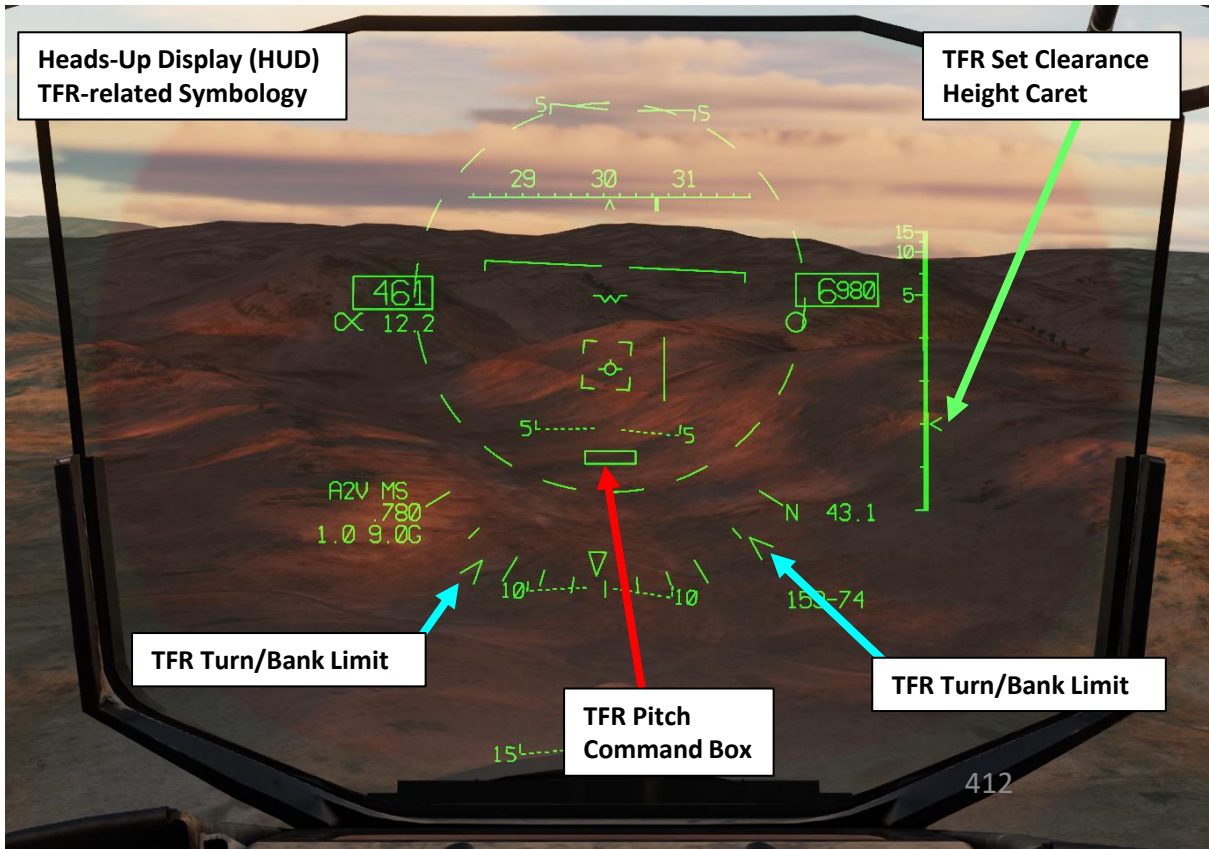


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

The AN/AAQ-13 LANTIRN Navigation Pod provides a terrain-following radar system that is mainly used to help the pilot navigate at low altitude in low-visibility conditions.

- The TF page displays terrain elevation and range (E-scope format) scanned by the radar. Two types of terrain video are shown on the display; synthetic (also called stored) and raw. Pitch command cues to fly the commanded flight profile are also visible.
- The HUD displays TFR various cues such as the pitch command box and TFR banking limits. This is your primary tool to steer the aircraft at the clearance height above terrain.





4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

Fun fact: [Studies have shown that the average time-to-disconnect of a DCS player flying in clouds is 178 seconds.]

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

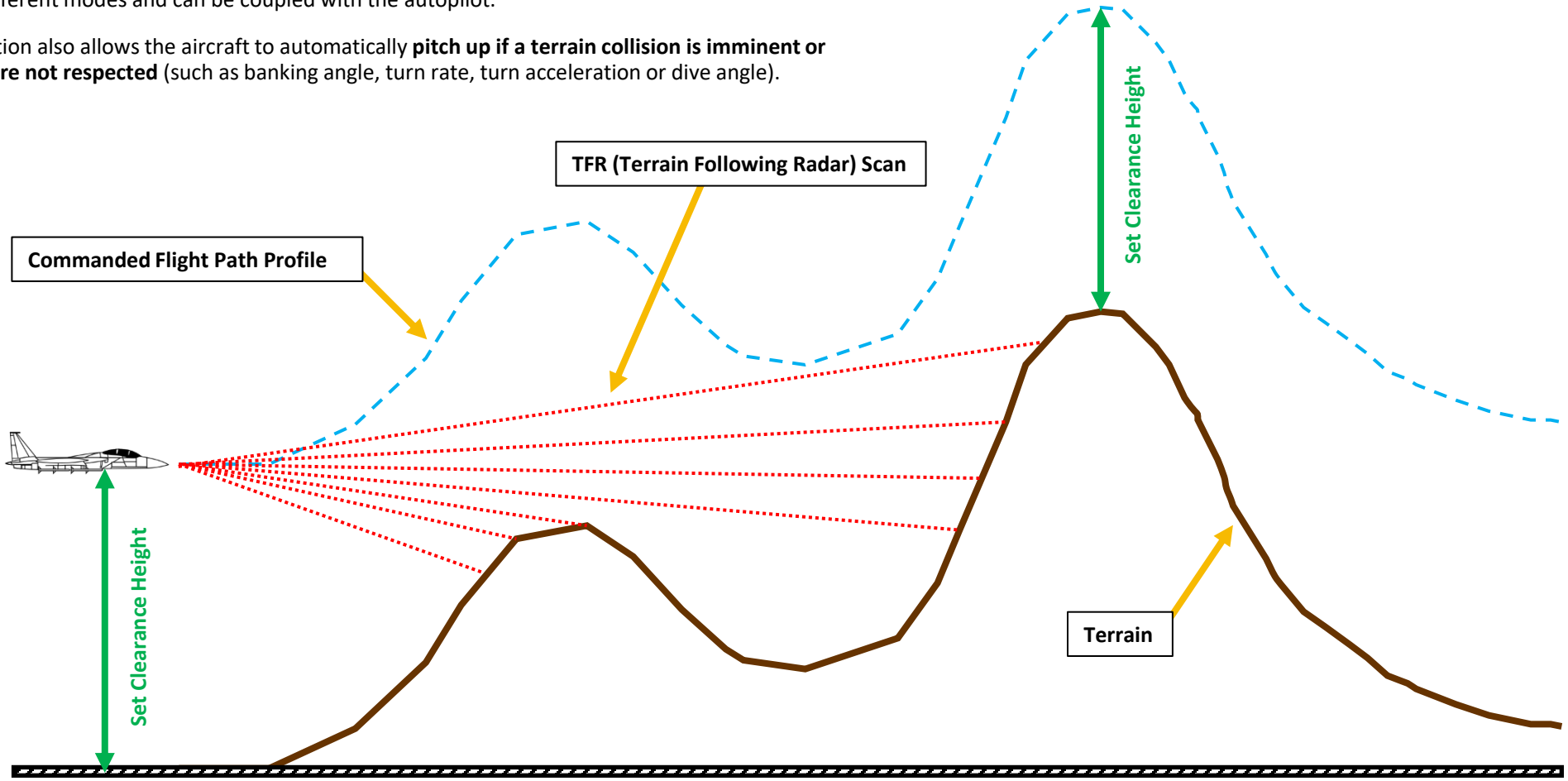
Notso's TFR Tutorial Part 1– Basic Operation: https://youtu.be/k2_LxQYek8M
Notso's TFR Tutorial Part 2 – TF Limits, Warnings, & Flyups https://youtu.be/bs7v5yDAgOA
Notso's TFR Tutorial Part 3 – Night SAT (Surface Attack Tactics) https://youtu.be/oLWw2oq89lE

The main use of a terrain-following radar is to allow the pilot to **fly the aircraft at low altitude** and "**follow" the terrain** with a set **obstacle clearance height above ground level**. The closer to the ground the aircraft flies, the smaller the chances of being detected by enemy air-to-air or surface-to-air radars, which means increased chances of survival in contested areas. The obstacle clearance height's main use is to avoid colliding with the terrain when flying in conditions where the pilot does not necessarily see the terrain itself.

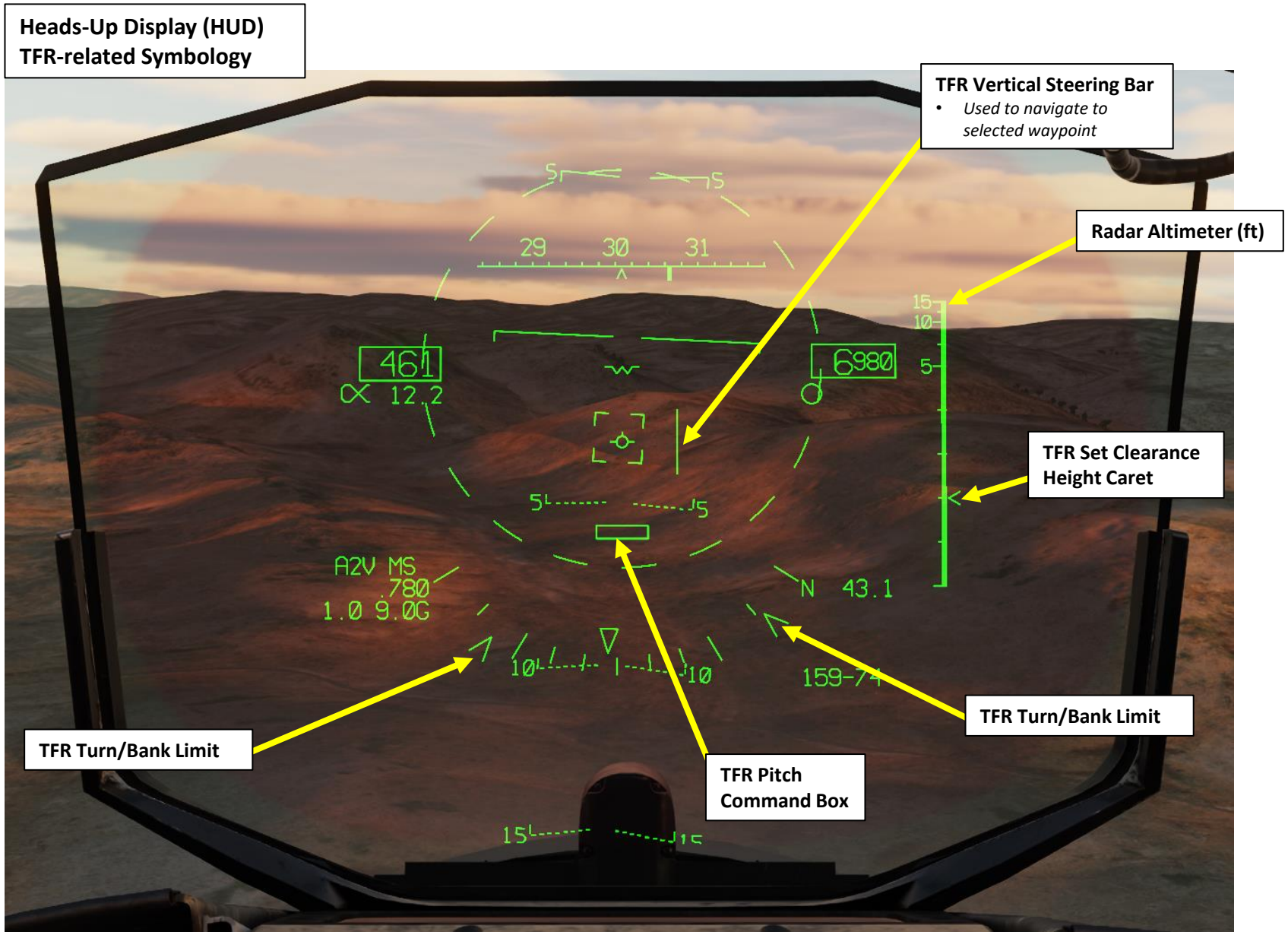
The TFR system computes a **flight profile** with visual cues on the HUD (Heads-Up Display) and TF (Terrain Following Radar) page based on radar returns. In specific missions where visibility is a concern, the pilot should follow these **flight path command cues** for a set clearance height. This will ensure the aircraft stays low and (hopefully) remains undetected, while not crashing into a mountain or obstacle.

The TFR has different modes and can be coupled with the autopilot.

A "**Flyup**" function also allows the aircraft to automatically **pitch up if a terrain collision is imminent or certain limits are not respected** (such as banking angle, turn rate, turn acceleration or dive angle).

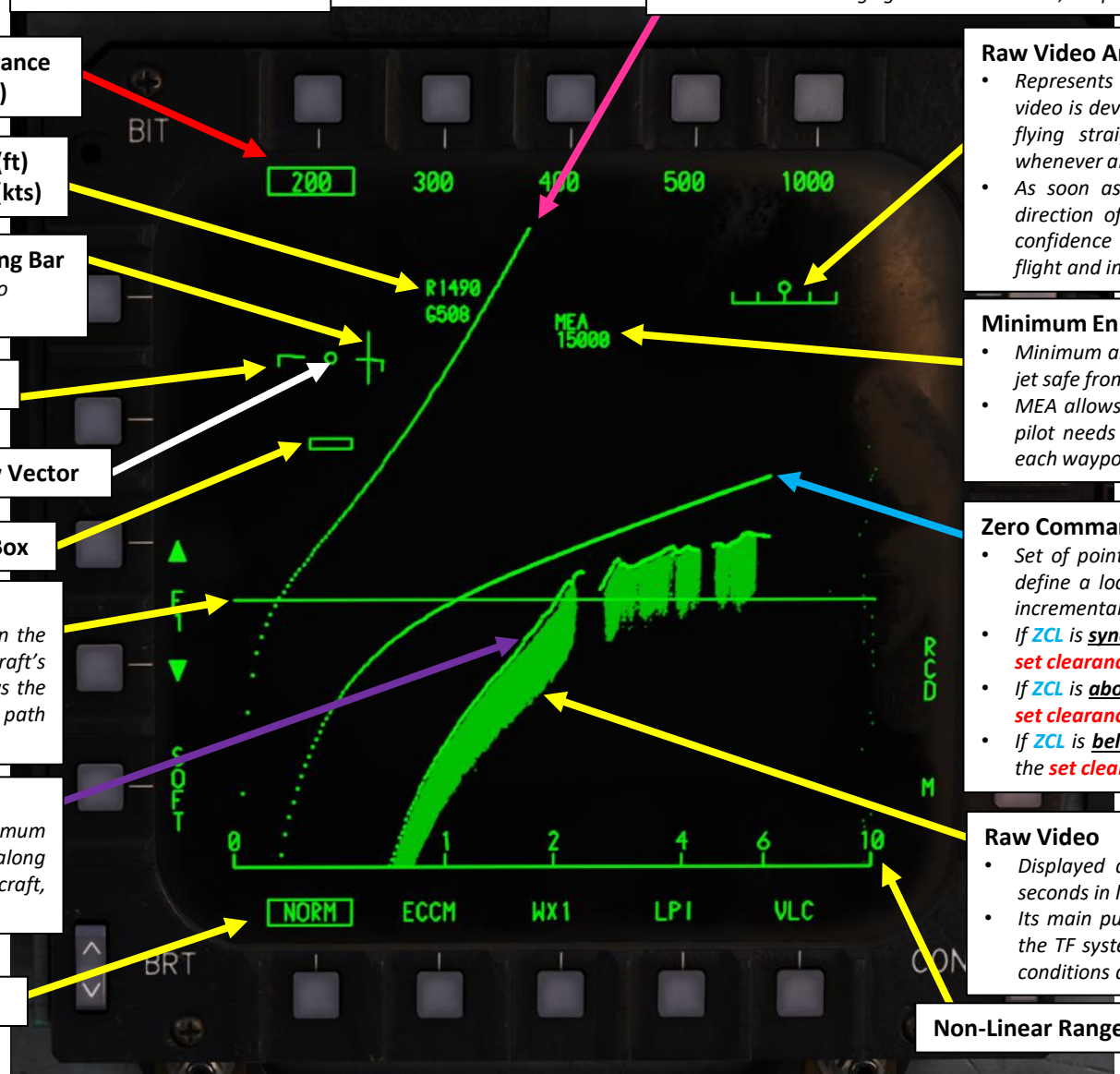


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics



4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

TF (Terrain-Following Radar) Page Display



Selected Clearance Height (boxed)

R: Radar Altitude (ft)
G: Ground Speed (kts)

TFR Vertical Steering Bar
- *Used to navigate to selected waypoint*

Horizon Line

Velocity Vector

TFR Pitch Command Box

Aircraft Flight Vector Line
- *Graphical representation of the **velocity vector** in the HUD and provides information about aircraft's position with respect to the ground. It also allows the aircrew to determine at what distance the flight path will intersect the ground.*

Synthetic Video
- *Displayed at full intensity out to a maximum range of 6 NM, containing terrain data along the projected flight path of the aircraft, updated every 0.5 seconds.*

Selected TFR Sub-Mode (boxed)

Obstacle Warning Line (OWL)
- *Allows the pilot to anticipate a flyup during a TF operation. Whenever the **synthetic video** touches or goes over the **OWL**, a FLYUP cue is displayed in the HUD, ADI and TF display. Red OBSTACLE warning light also illuminates, coupled with the audio warning "obstacle ahead".*

Raw Video Antenna Position Indicator
- *Represents the azimuth position of the bar scan from which the TF video is developed. The center bar is indicated when the aircraft is flying straight and level, while the outside bar is indicated whenever aircraft is in turn.*
- *As soon as aircraft starts to turn, the dot should shift in the direction of the turn. The role of this indicator is to provide a confidence check that the antenna is working properly in level flight and in turn.*

Minimum Enroute Altitude (MEA)
- *Minimum altitude for each leg of the TFR low level that will keep the jet safe from terrain if you maneuver outside of TFR limits.*
- *MEA allows setting a safe altitude (with respect to terrain) that the pilot needs to reach in case of any TF problem. The MEA is set for each waypoint during the mission planning phase.*

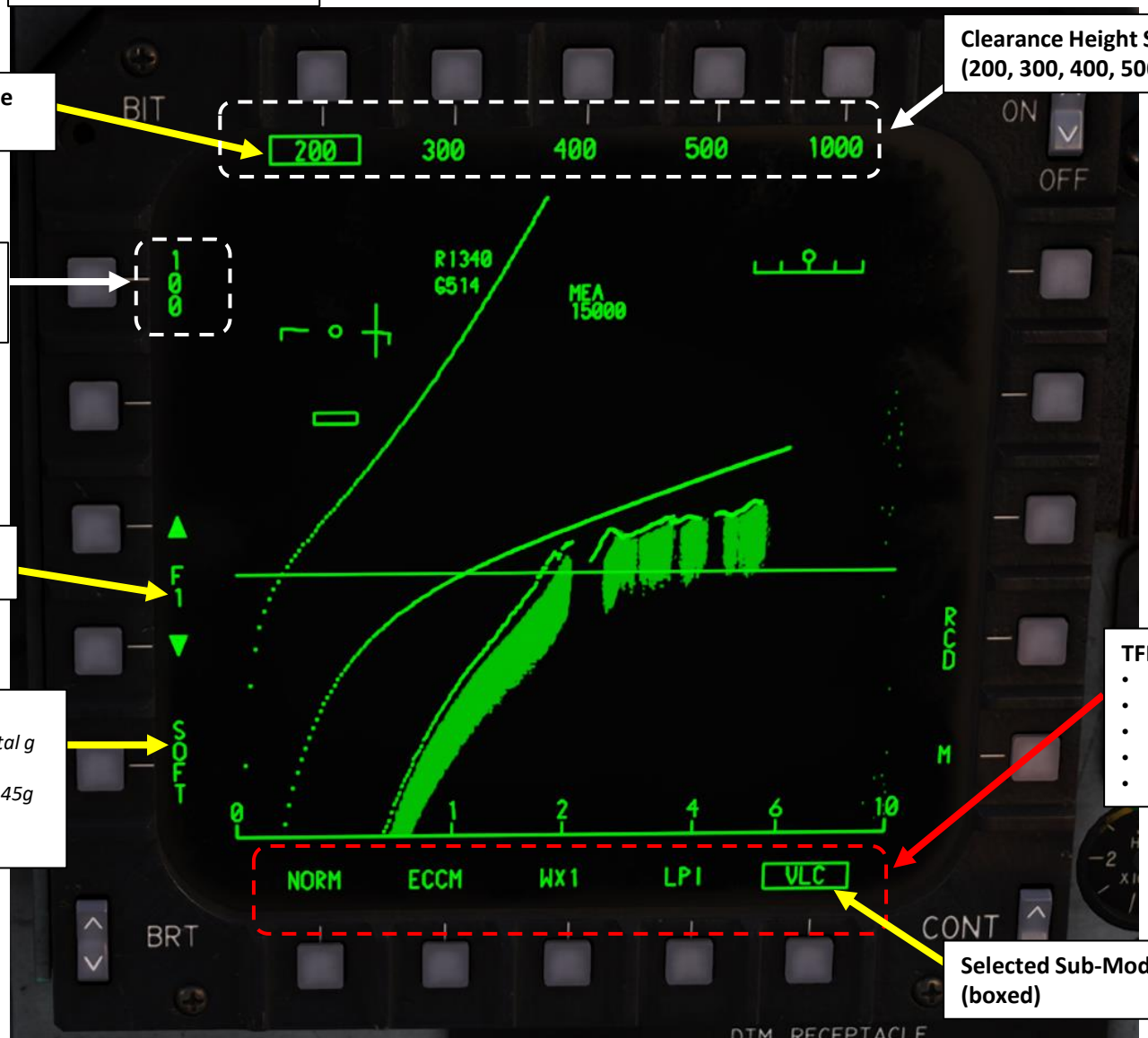
Zero Command Line (ZCL)
- *Set of points which, for the present position and motion parameters, define a location with respect to the aircraft that would result in an incremental g command of zero.*
- *If **ZCL** is **synced** with the **synthetic video** line, the aircraft is flying at the **set clearance altitude**.*
- *If **ZCL** is **above** **synthetic video** line, the aircraft is flying higher than the **set clearance altitude**.*
- *If **ZCL** is **below** the **synthetic video** line, then the aircraft is lower than the **set clearance altitude**.*

Raw Video
- *Displayed at half intensity up to 10 nm and is updated every 1.25 seconds in level flight and every 2.5 seconds when in turn.*
- *Its main purpose is to provide the aircrew with confidence check that the TF system is working correctly. It also can detect adverse weather conditions ahead or jamming.*

Non-Linear Range Scale (nm)

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

TF (Terrain-Following Radar) Page Display



Selected Clearance Height (boxed)

Clearance Height Selection (200, 300, 400, 500 and 1000 ft)

Clearance Height Selection (100 ft)
- *This setting is only available if VLC TFR sub-mode is selected*

TFR Frequency Sub-Band
- *Used for deconfliction between flight members.*

Ride Selection
- *Options with different amount of negative incremental g commanded for vertical maneuvering.*
- *SOFT selects an incremental g command range of -0.45g to +2.0g.*
- *HARD selects range between -0.9g to +2.0g.*

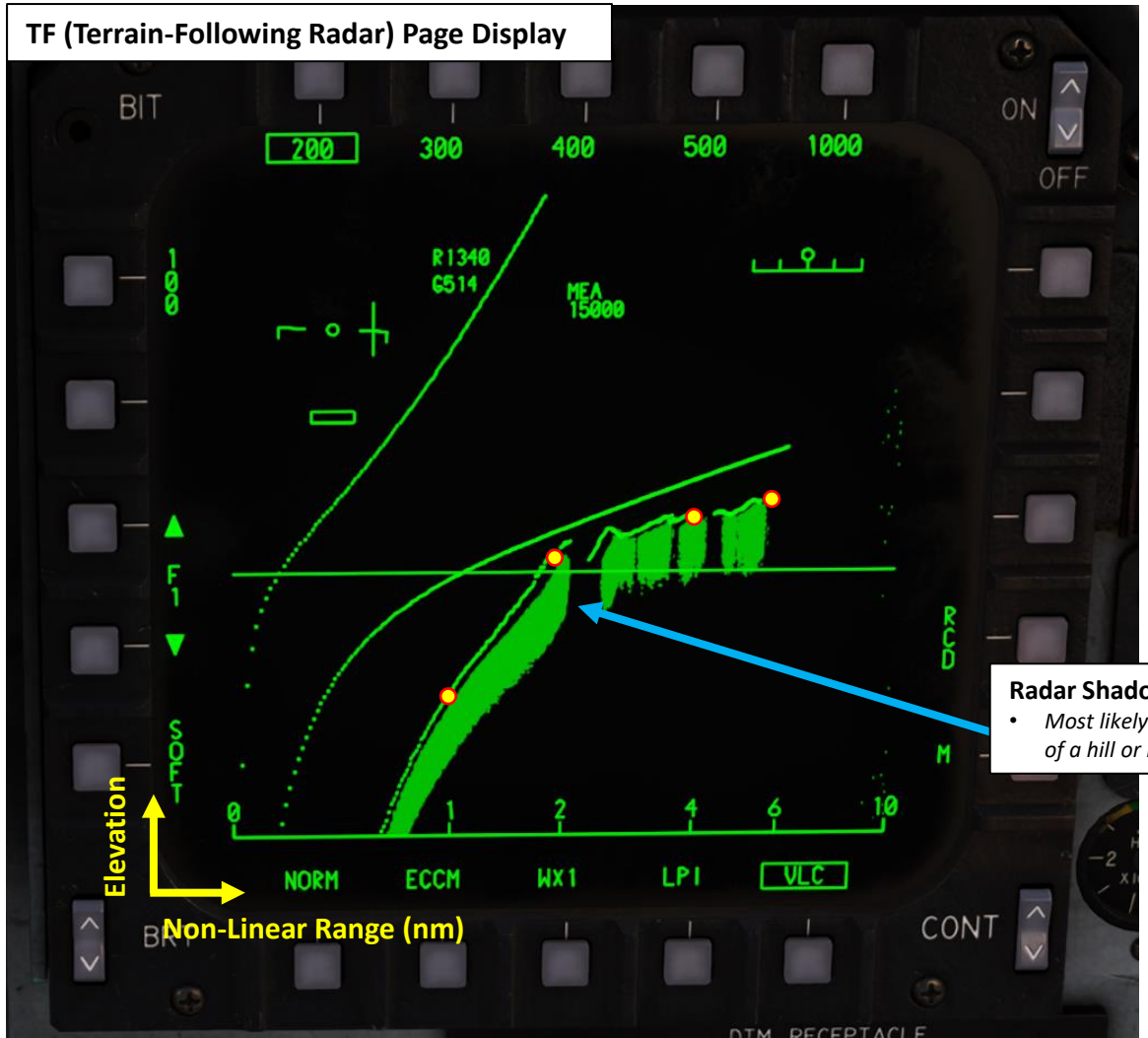
TFR Sub-Mode Selection
- *NORM: Normal*
- *ECCM: Electronic Counter Countermeasures*
- *WX1/WX2: Weather 1/Weather 2*
- *LPI: Low Probability of Intercept*
- *VLC: Very Low Clearance*

Selected Sub-Mode (boxed)

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

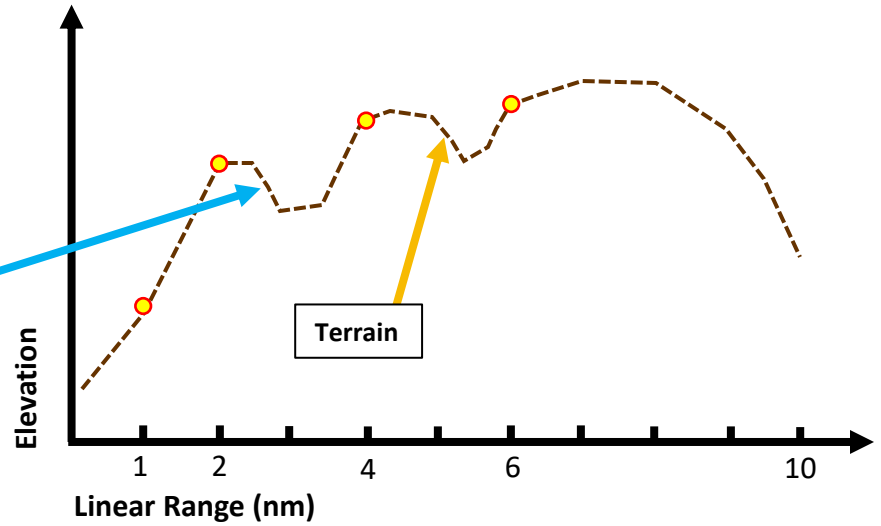
The TFR display has an "**E-scope**" format and mainly shows terrain elevation with a non-linear range scale. The "E-scope" format is essentially a B-scope format displaying range vs elevation, rather than range vs azimuth. The non-linear range scale aims to give you a more detailed view closer to you, while a more "general" idea of the terrain further ahead. The TFR effective range depends of what mode is selected and what conditions the aircraft is flying in. Radar shadow areas indicate an area where the radar cannot scan, such as behind hills or mountains.

TF (Terrain-Following Radar) Page Display



Radar Shadow Area
- *Most likely the reverse slope of a hill or mountain*

Actual Terrain Representation
(with a linear range scale, but definitely not a perfect extrapolation)

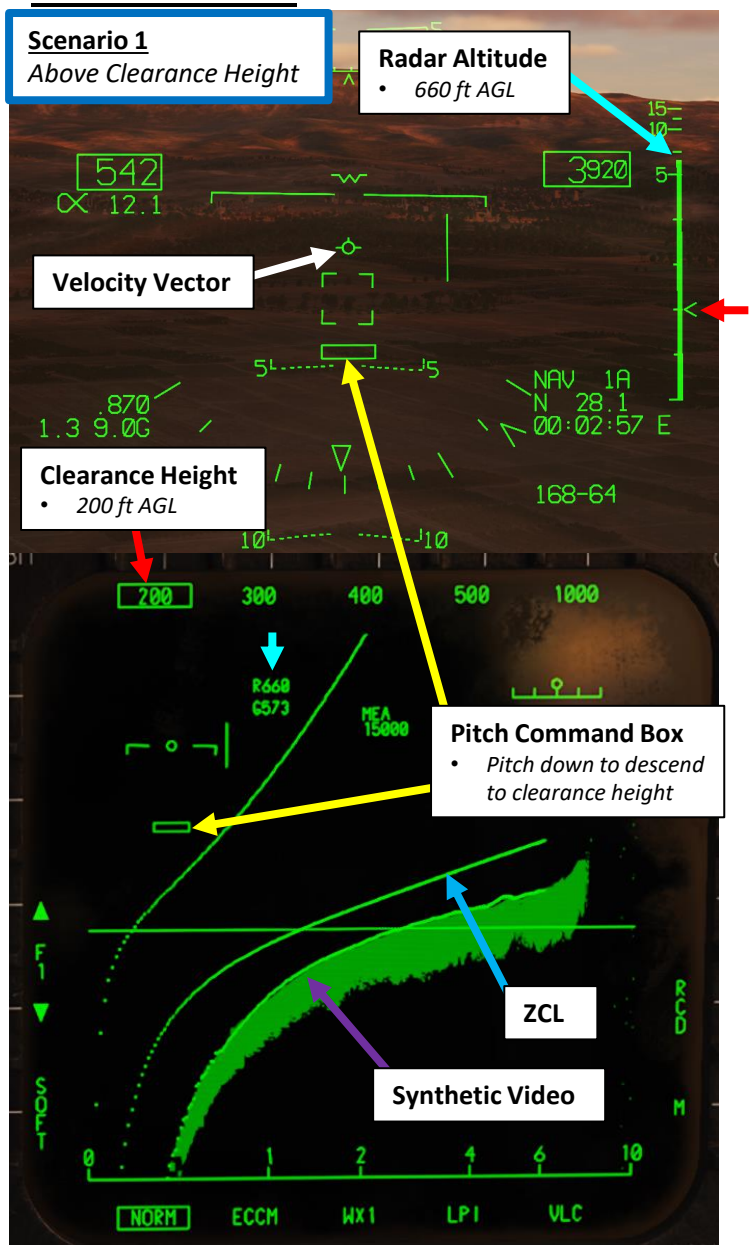


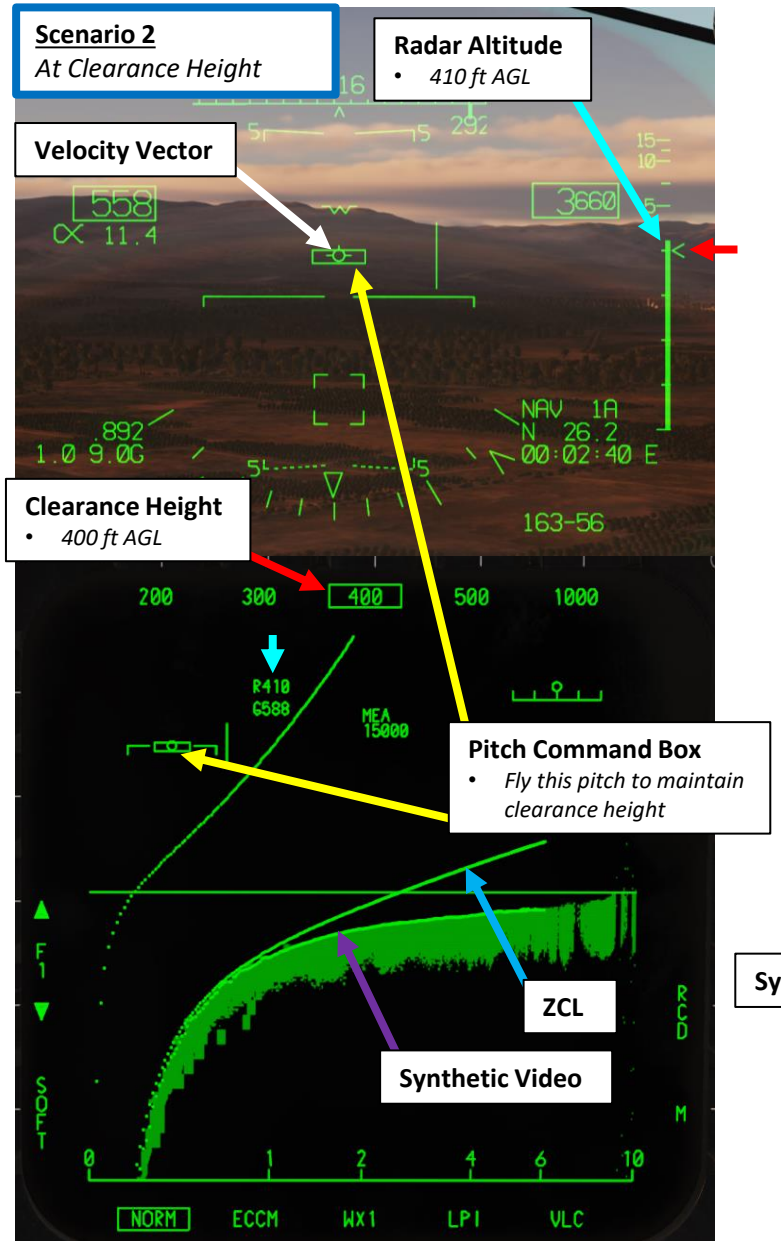
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.1 – Basics

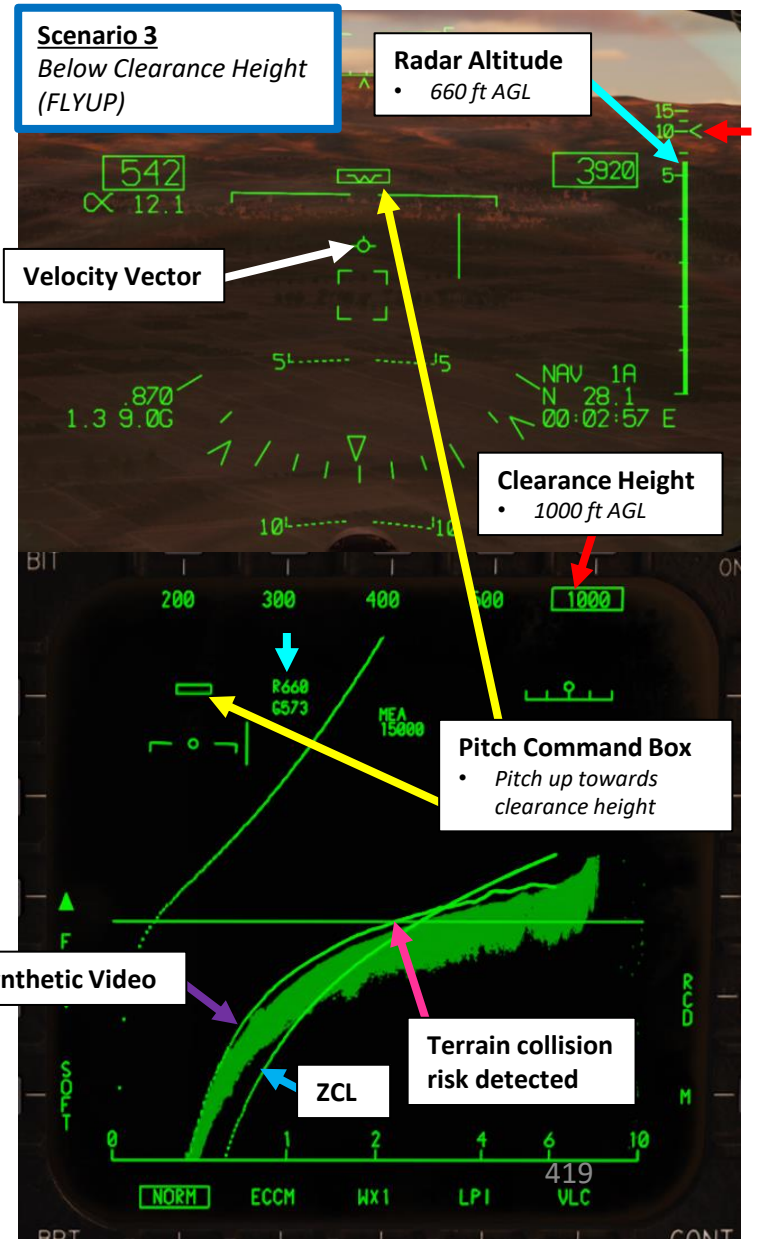
Zero Command Line (ZCL) Logic Overview

This line defines a location with respect to the aircraft that would result in an incremental g command of zero.

- *If ZCL is **synced** with the synthetic video line, the aircraft is flying at the set clearance altitude.*
- *If ZCL is **above** synthetic video line, the aircraft is flying higher than the set clearance altitude.*
- *If ZCL is **below** the synthetic video line, then the aircraft is lower than the set clearance altitude.*





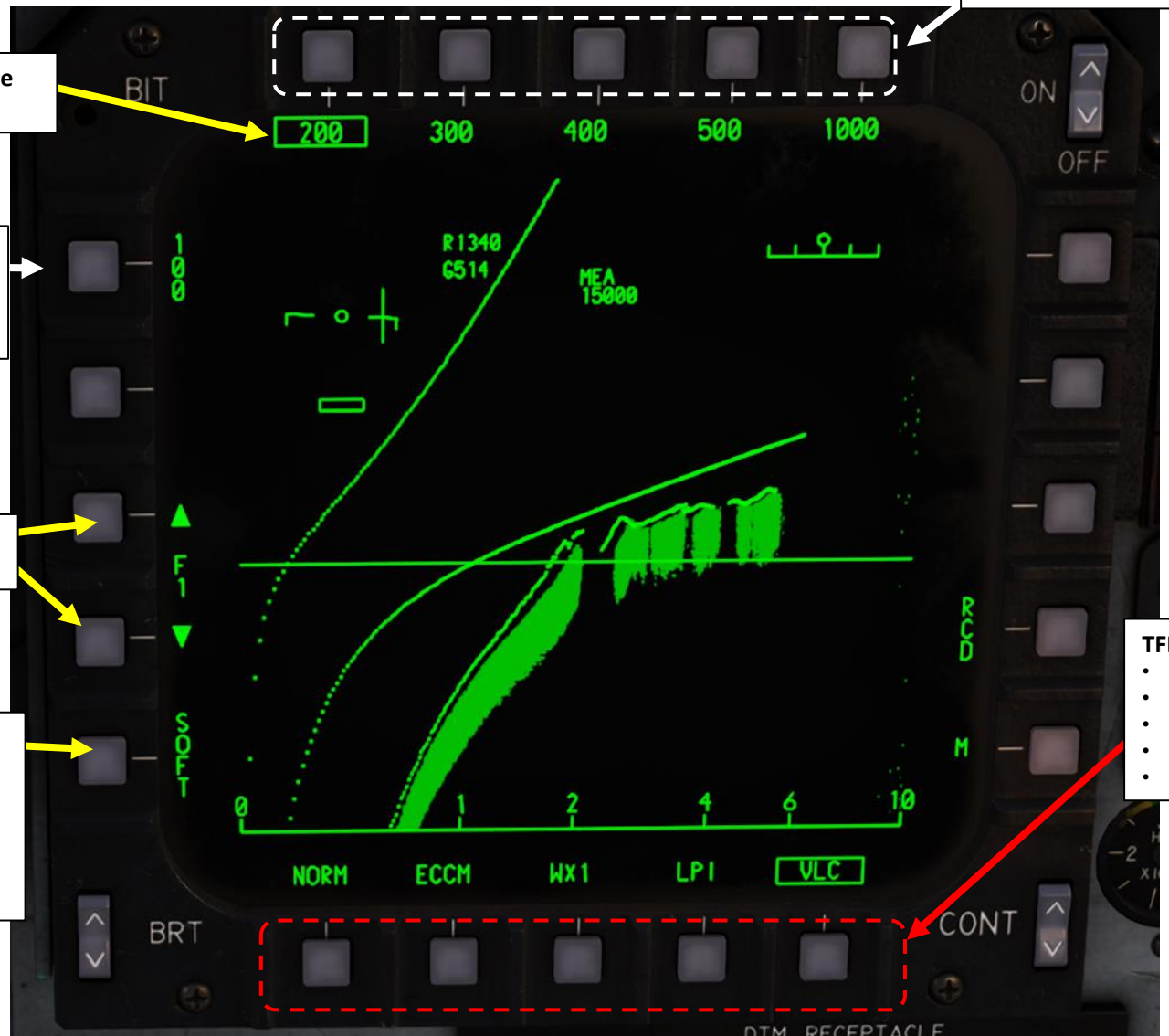


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.2 – Controls

The TF (Terrain-Following Radar) page display allows you set the clearance height parameter, TFR mode, frequency sub-bands and ride selection (how many Gs the system will submit the pilot to when attempting to follow the terrain-following profile.

Clearance Height Selection Buttons (200, 300, 400, 500 and 1000 ft)

Selected Clearance Height (boxed)



Clearance Height Selection Button (100 ft)
- *This setting is only available if VLC TFR sub-mode is selected*

TFR Frequency Sub-Band Selectors
- *Used for deconfliction between flight members.*

Ride Selection Button
- *Options with different amount of negative incremental g commanded for vertical maneuvering.*
- *SOFT selects an incremental g command range of -0.45g to +2.0g.*
- *HARD selects range between -0.9g to +2.0g.*

TFR Sub-Mode Selection Buttons
- *NORM: Normal*
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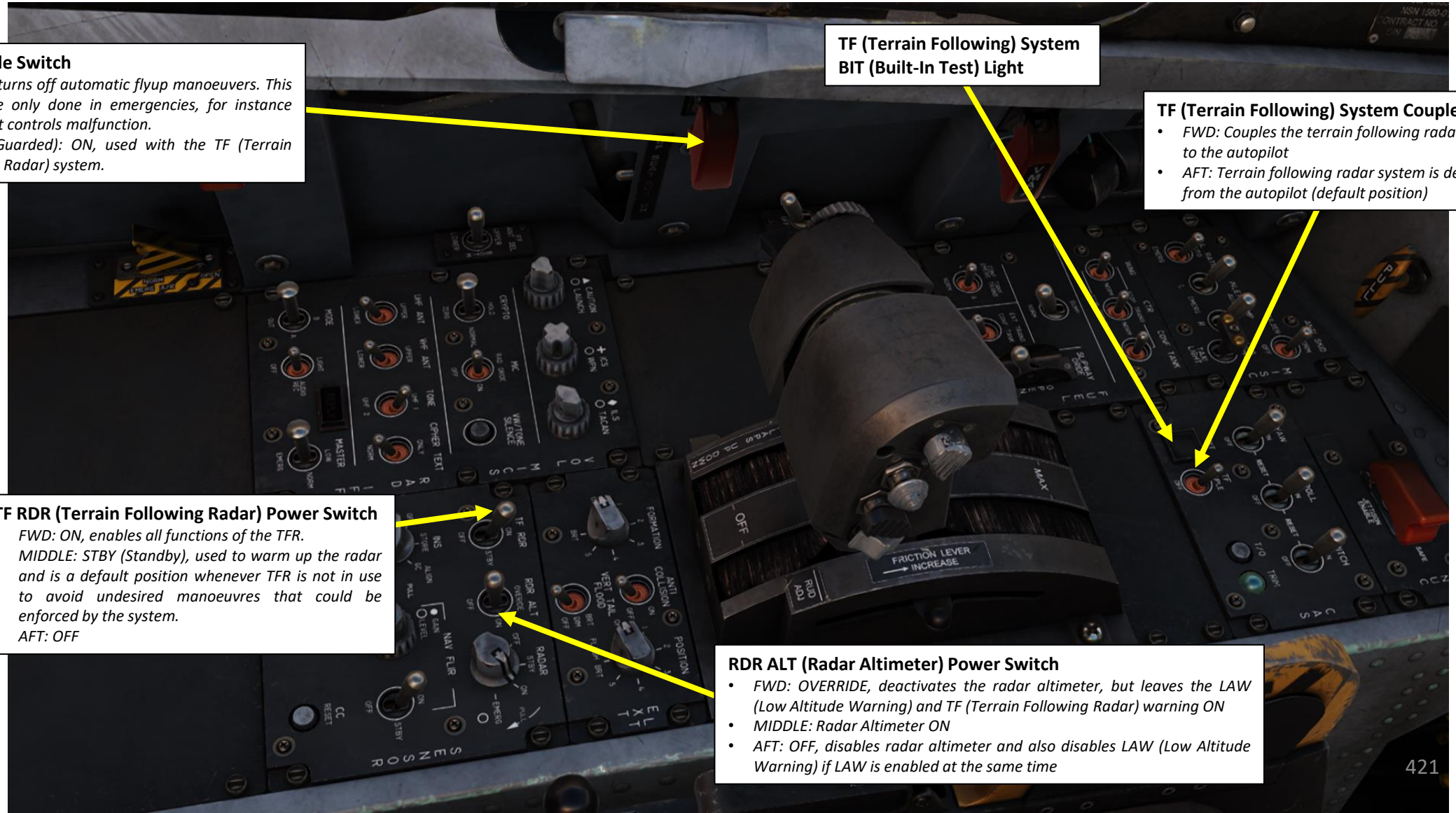
- *WX1/WX2: Weather 1/Weather 2*
- *LPI: Low Probability of Intercept*
- *VLC: Very Low Clearance*

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.2 – Controls

The left console in the pilot seat has most controls to turn on or off the TFR, and to arm/disarm the flyup logic. There is also a switch to couple the TFR with the autopilot.



Flyup Enable Switch
- *UP: OFF, turns off automatic flyup manoeuvers. This should be only done in emergencies, for instance with flight controls malfunction.*
- *DOWN (Guarded): ON, used with the TF (Terrain Following Radar) system.*

TF (Terrain Following) System BIT (Built-In Test) Light

TF (Terrain Following) System Couple Switch
- *FWD: Couples the terrain following radar system to the autopilot*
- *AFT: Terrain following radar system is de-coupled from the autopilot (default position)*

TF RDR (Terrain Following Radar) Power Switch
- *FWD: ON, enables all functions of the TFR.*
- *MIDDLE: STBY (Standby), used to warm up the radar and is a default position whenever TFR is not in use to avoid undesired manoeuvres that could be enforced by the system.*
- *AFT: OFF*

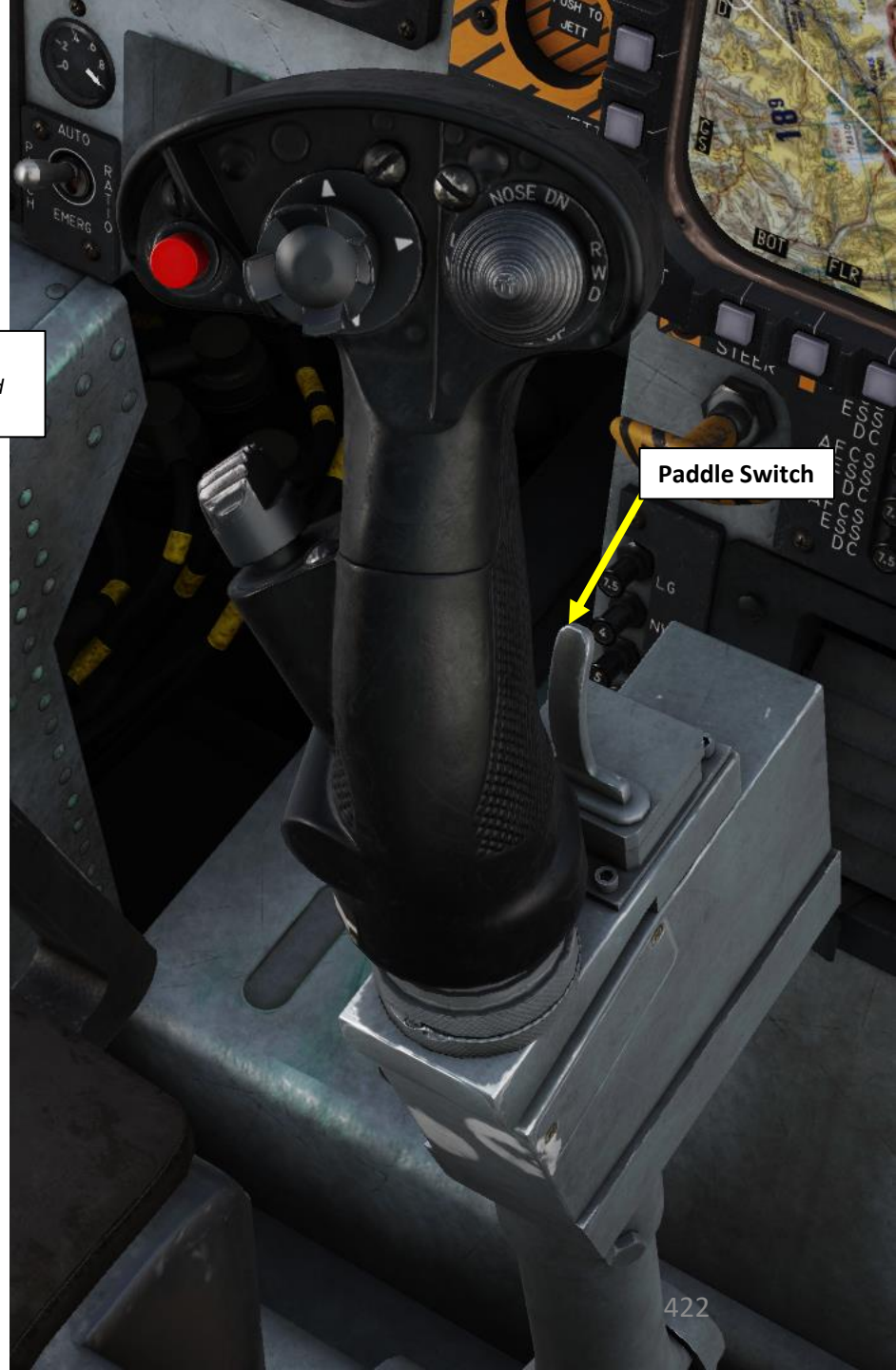
RDR ALT (Radar Altimeter) Power Switch
- *FWD: OVERRIDE, deactivates the radar altimeter, but leaves the LAW (Low Altitude Warning) and TF (Terrain Following Radar) warning ON*
- *MIDDLE: Radar Altimeter ON*
- *AFT: OFF, disables radar altimeter and also disables LAW (Low Altitude Warning) if LAW is enabled at the same time*

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.2 – Controls

The UFC (Upfront Control Panel) MENU 1 page displays information regarding what TF mode is selected and whether or not the autopilot is coupled with the TFR. The Paddle switch is used to revert to unarmed manual TF mode.

Autopilot Mode Selected
- *TF indicates the selected mode is coupled with the terrain-following radar*

TFR Sub-Mode Selected
- *NORM: Normal*
- *ECCM: Electronic Counter Countermeasures*
- *WX1/WX2: Weather 1/Weather 2*
- *LPI: Low Probability of Intercept*
- *VLC: Very Low Clearance*

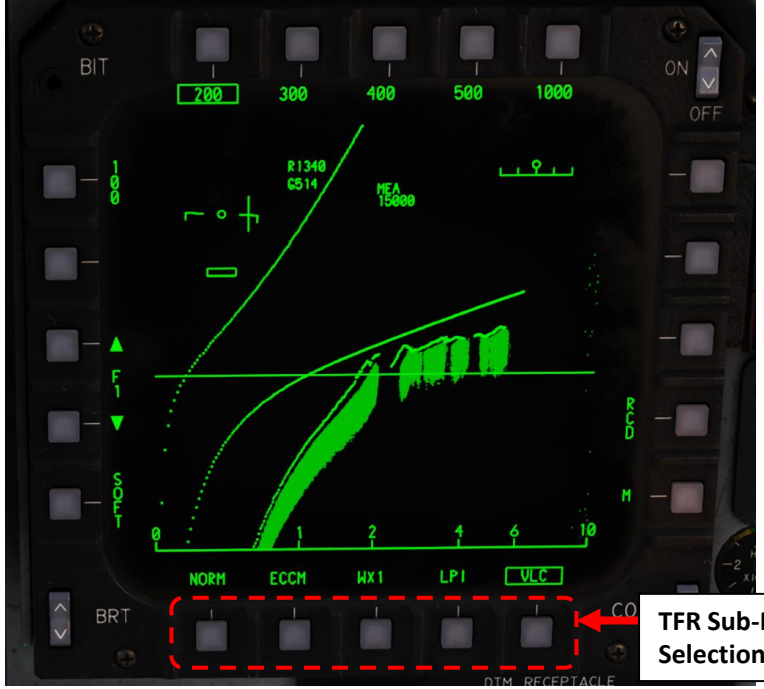


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.3 – TF Modes Overview

The terrain-following radar can use different sub-modes based on what conditions the aircraft is flying in.

- **NORM** (Normal): Used by default for normal operation. Roll limit is set to 60 deg. Limited auto ECCM features are also provided.
- **ECCM** (Electronic Counter Countermeasures): Fully automatic electronic counter countermeasures at the expense of vertical scan and limited maximum command range.
- **WX1** (Weather 1): Used in light rain (up to 10 mm/hour). It has a smaller vertical scan range compared to NORM and also limited maximum command range.
- **WX2** (Weather 2): Used in moderate or heavy rain, but offers only two clearance settings and has much more desensitized scan compared to other modes.
    - Note: Press pushbutton next to WX1 to toggle between WX1 and WX2 modes.
- **LPI** (Low Probability of Intercept): Used to minimize the risk of detection by enemy radars and is automatically enabled when EMIS LMT mode is selected on the UFC (Upfront Control Panel).
- **VLC** (Very Low Clearance): Allows to set the clearance height to 100 ft, mainly used for operation over smooth terrain or water. Not advised to use it in any other conditions.

EMIS LMT (Emission Limit) Button
- *Reduces electronic emissions from the aircraft for passive operations*



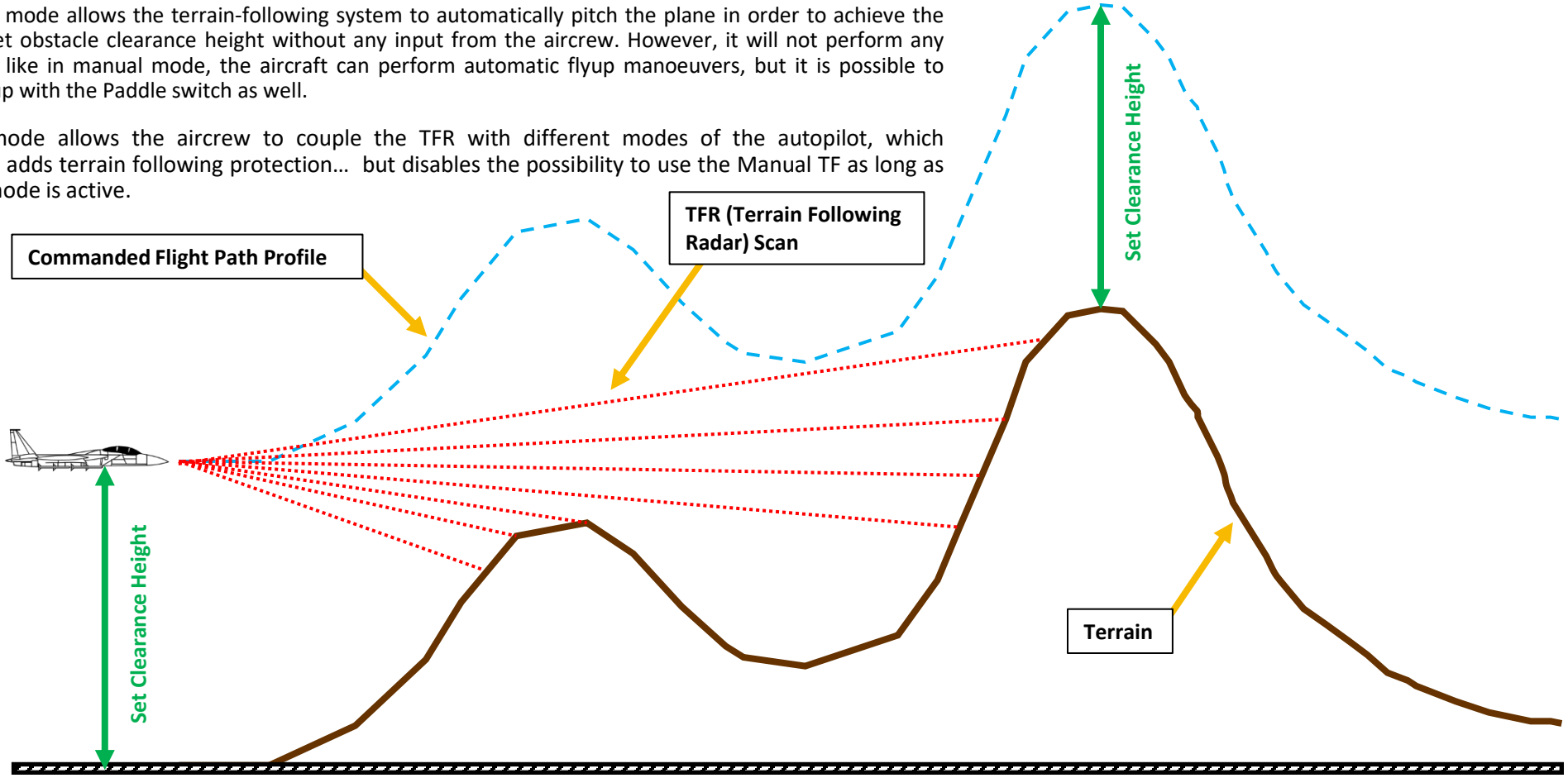
TFR Sub-Mode Selection Buttons

	Scan	Turn rate limit	Clearance	Vertical Scan	Other
NORMAL	8 bar every 2.5s	5.5° / sec	200,300,400, 500, 1000	+10° to -20°	Maximum command range
ECCM	8 bar every 2.5s	5.5° / sec	200,300,400, 500, 1000	+5° to -20°	15,000 feet command range
WX 1	8 bar every 2.5s	5.5° / sec	200,300,400, 500, 1000	+5° to -20°	Use in light rain.
WX 2	8 bar every 2.5s	5.5° / sec	500, 1000	+5° to -20°	Use in moderate or heavy rain.
LPI	1 bar every 2.5s	0.5° / sec	200,300,400, 500, 1000	-	Minimized radiated power to reduce detection
VLC	2 bar every 0.5s	1° / sec at 100 f 2° / sec higher	100, 200,300,400, 500, 1000	-	Use over smooth terrain or water

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.1 – Manual (MTF) vs Automatic (ATF) Operation

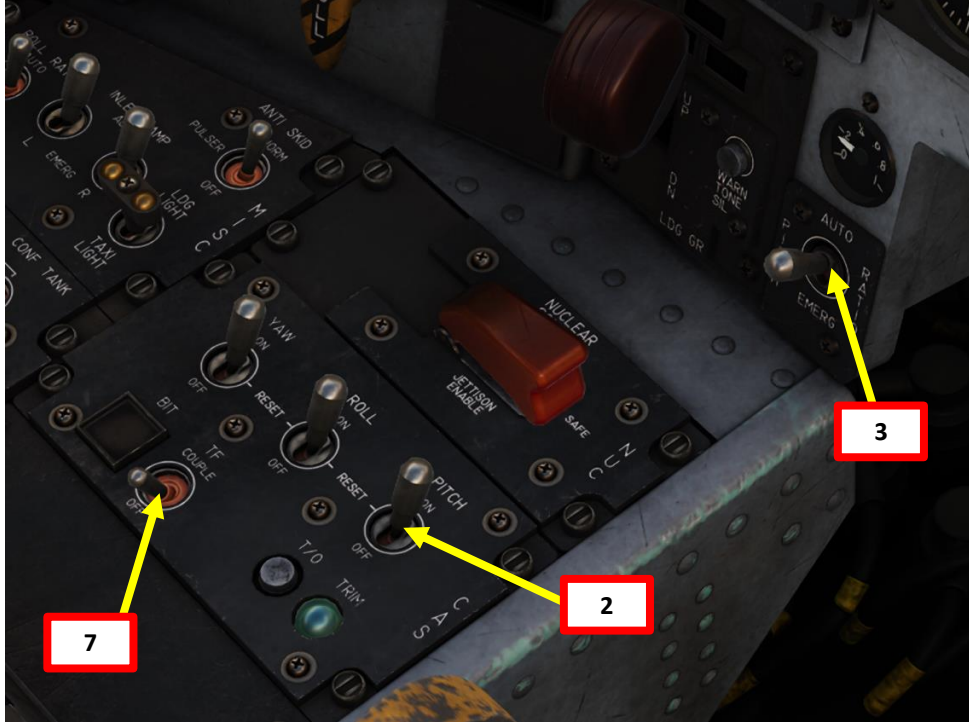
There are three primary methods of using the TFR: manual, automatic or blended.

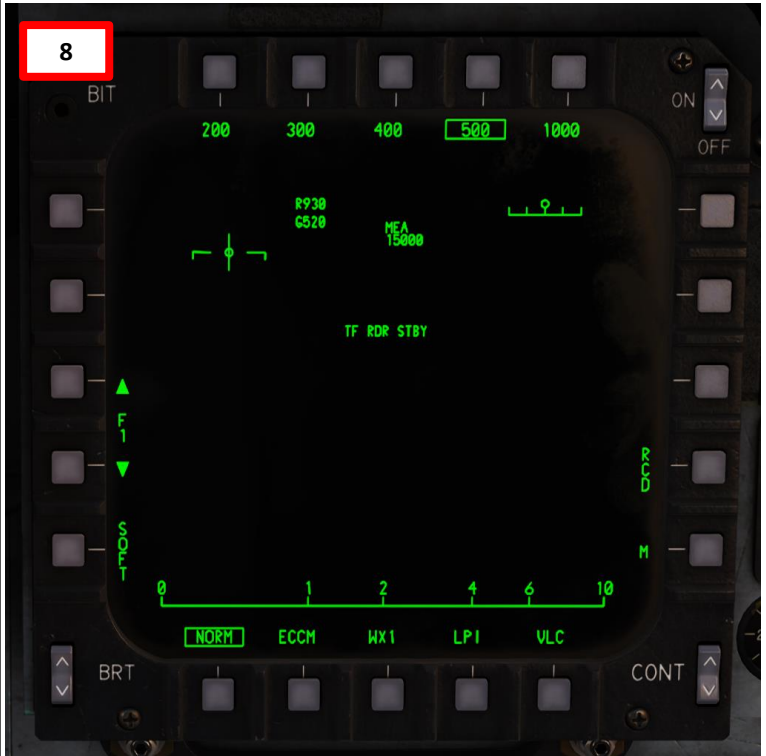
- **Manual** mode allows the pilot to fly the aircraft manually. A pitch command cue is used as a reference to know if the aircraft is below or above the commanded flight path to maintain the set obstacle clearance height. Keep in mind that even in manual mode, the aircraft can still perform automatic flyup manoeuvers if NAV pod limits are exceeded or a malfunction is detected. It is possible to disarm flyup with the Paddle switch.
- **Automatic** mode allows the terrain-following system to automatically pitch the plane in order to achieve the selected set obstacle clearance height without any input from the aircrew. However, it will not perform any turns. Just like in manual mode, the aircraft can perform automatic flyup manoeuvers, but it is possible to disarm flyup with the Paddle switch as well.
- **Blended** mode allows the aircrew to couple the TFR with different modes of the autopilot, which effectively adds terrain following protection… but disables the possibility to use the Manual TF as long as blended mode is active.

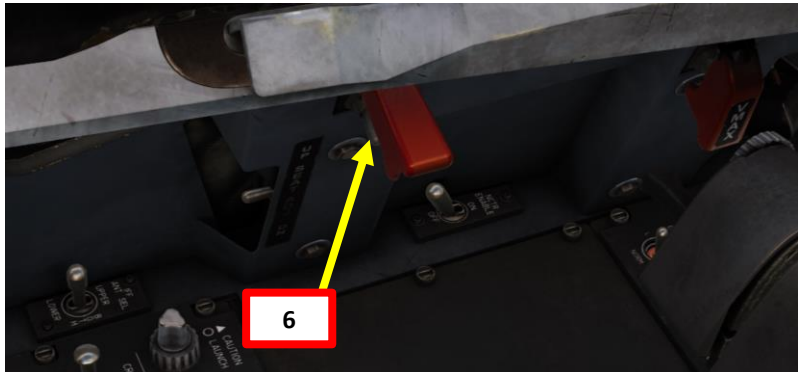


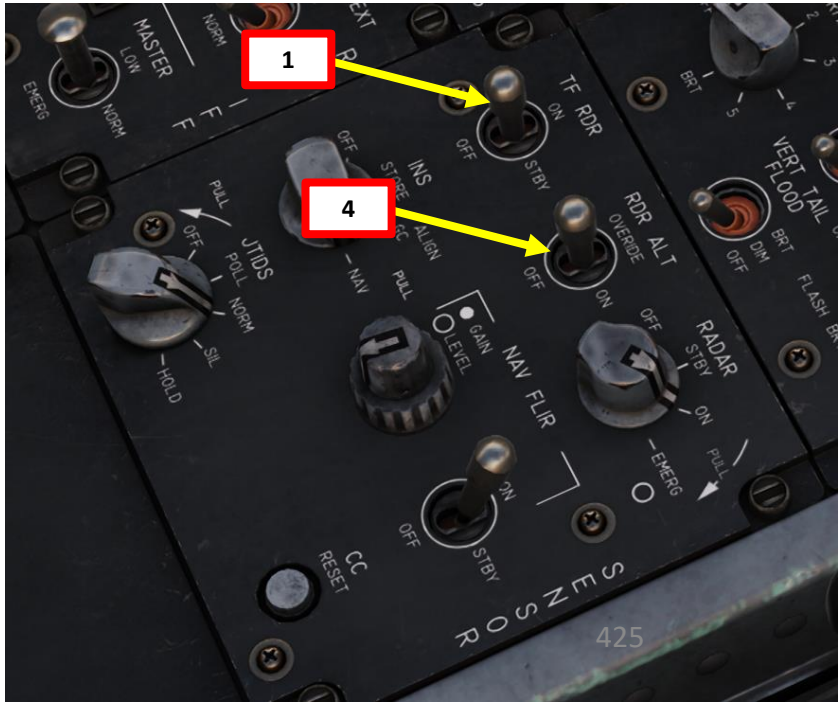
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.2 – Manual TF Operation (MTF)

1. Set TF RDR Power Switch – STBY/Standby (MIDDLE). Standby mode will warm up the radar and is a default position whenever TFR is not in use to avoid undesired manoeuvers (Flyup) that could be enforced by the system.
2. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD)
3. Set Pitch Ratio Select Switch – AUTO (UP).
4. Set RDR ALT (Radar Altimeter) Power Switch – ON (MIDDLE).
5. If you want to display steering cues to the selected sequence point, select either NAV or INST Master Mode.
6. Set Flyup Enable Switch – ON/ARMED (DOWN, GUARDED). This will allow automatic flyup manoeuvers.
7. Set TF Couple Switch – OFF (AFT).
    - This will ensure the autopilot is de-coupled from the terrain-following radar.
8. Select TF (Terrain-Following Radar) Page.



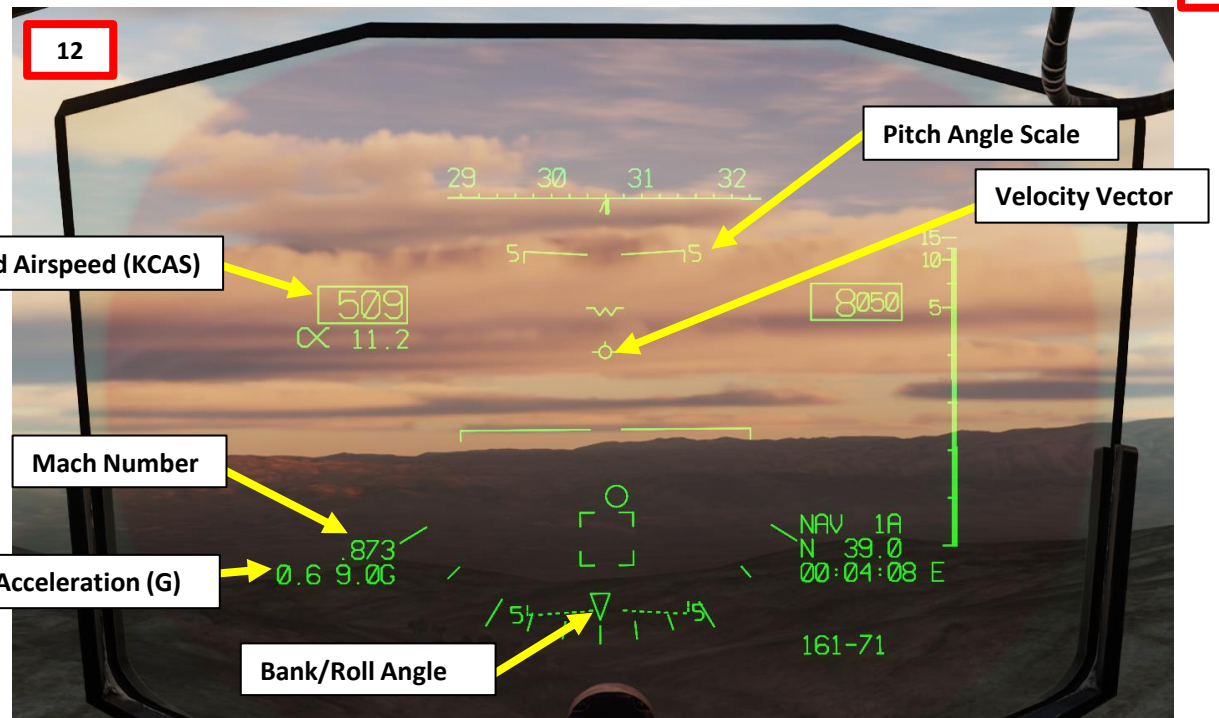


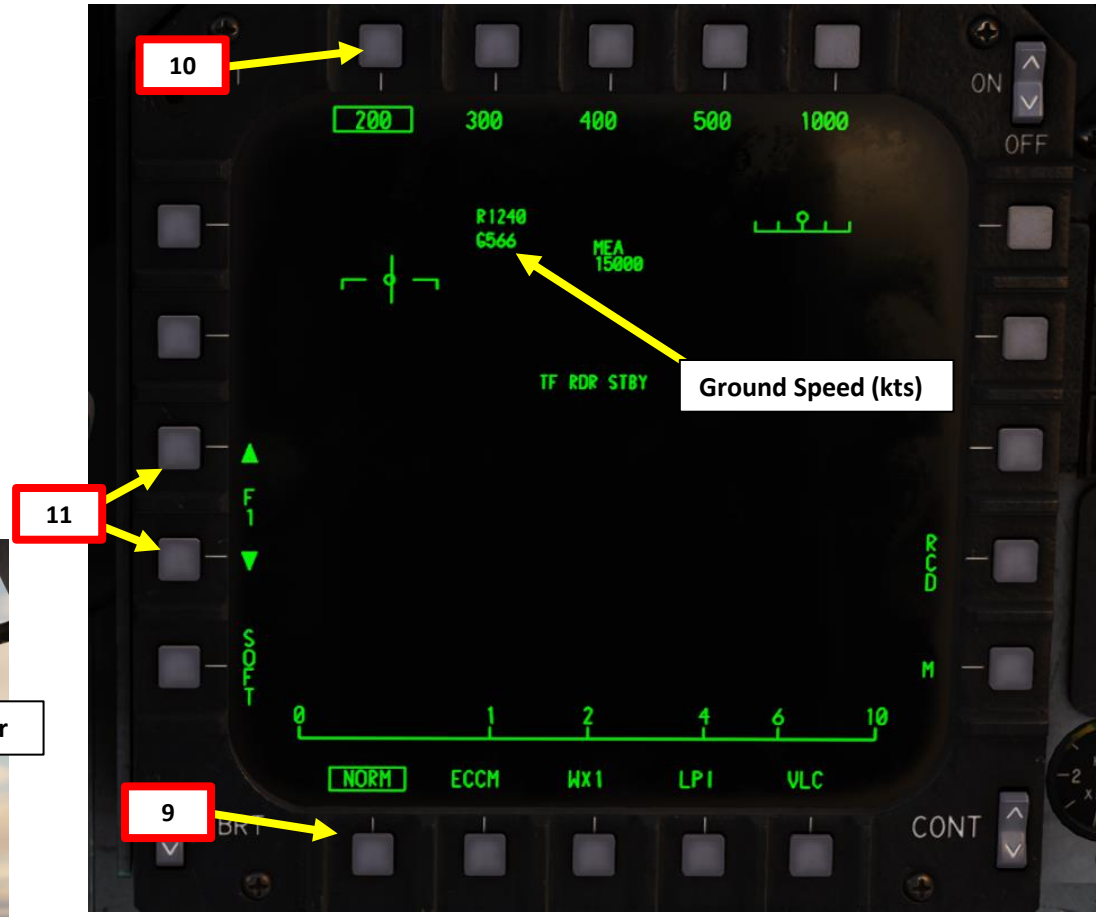




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.2 – Manual TF Operation (MTF)

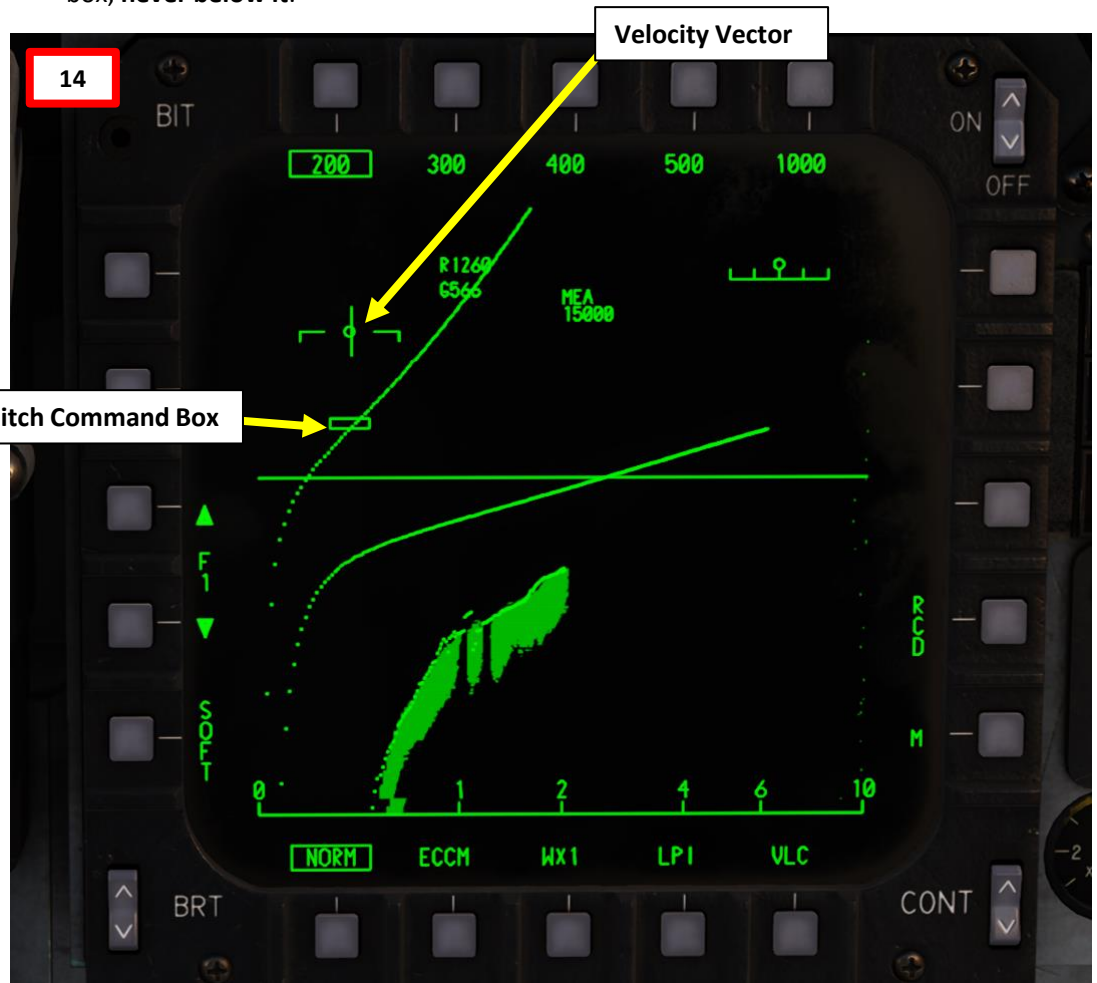
9. From TF page, select desired sub-mode. We will select NORM (Normal).
10. Select desired obstacle clearance height. We will select 200 ft.
    - Note: for 100 ft clearance height to be available, you need to select VLC (Very Low Clearance) sub-mode.
11. If multiple F-15Es are operating in the area, it is advisable to set different a TFR Frequency Sub-Band from your flight members. Since we are flying alone in this tutorial, we will leave it to F1.
12. **Very Important**: Fly the aircraft and verify the following conditions are respected:
    - Pitch angle is above -15 deg (dive)
    - Roll/Bank angle is less than 60 deg
    - Turn rate is less than 5.5 deg/sec
    - Turn acceleration is less than 2.2 deg/sec
    - Acceleration is approximately 1g +/- 0.5g.
    - Airspeed is above 350 KCAS (Calibrated) and 400 kts (Ground Speed)
    - Airspeed is below 0.96 Mach / 650 kts Ground Speed

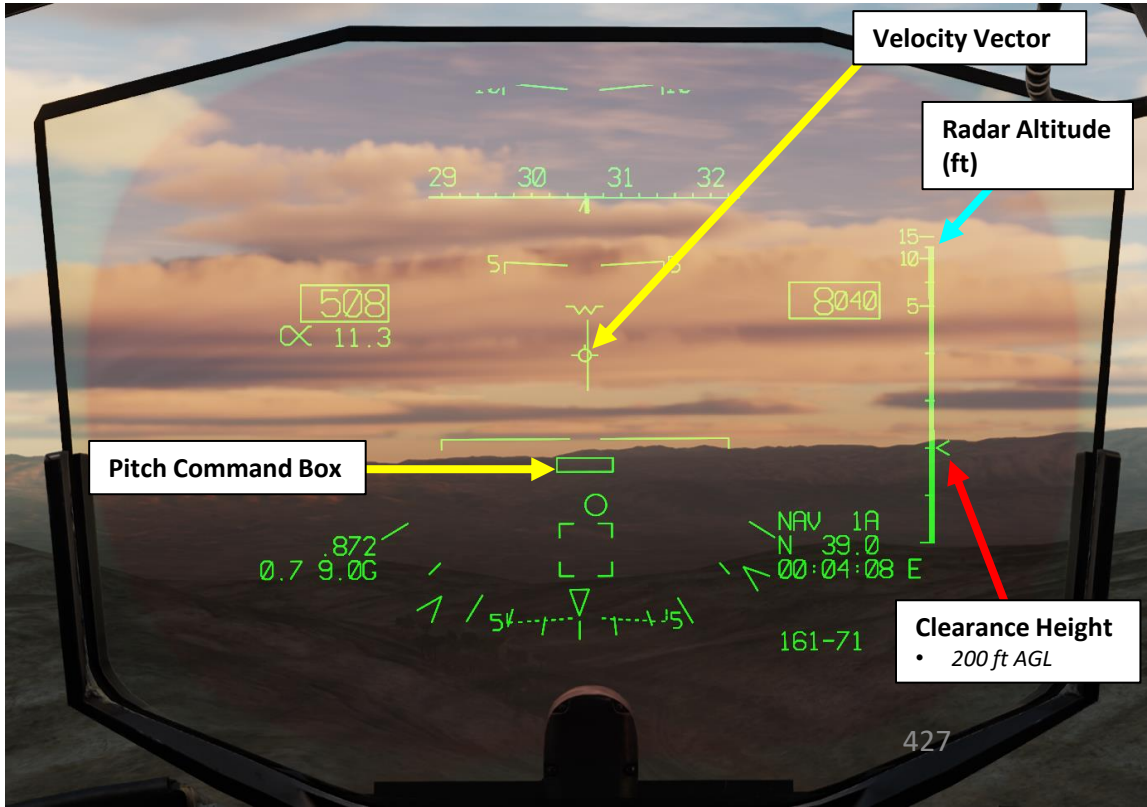




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.2 – Manual TF Operation (MTF)

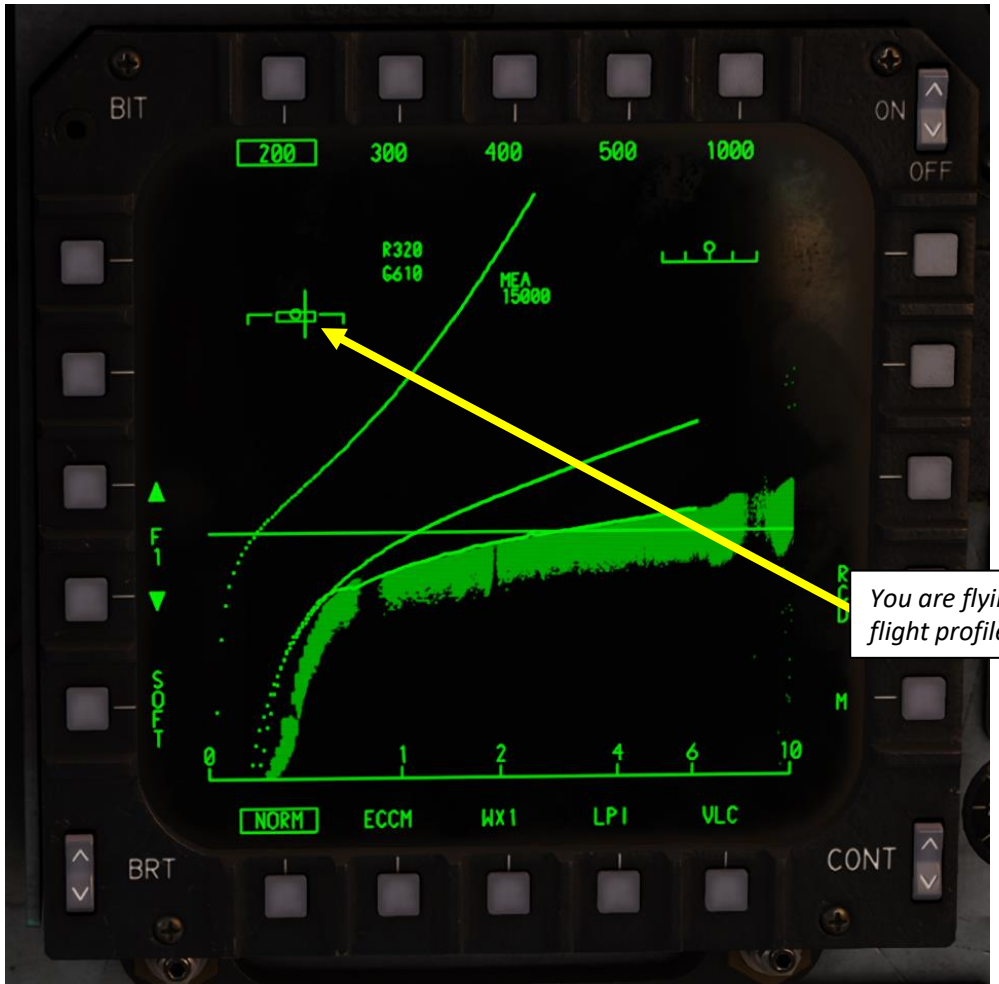
13. Once flight parameters mentioned in the previous step are respected, set TF RDR Power Switch – ON (FWD).
14. You should be operating the TFR in Manual TF Operation Mode (MTF). The pilot retains control over pitch and roll of the aircraft and is provided with visual cues that need to be followed in order to maintain the set clearance and avoid obstacles.
15. To follow the commanded flight path to maintain the desired clearance height over the terrain, fly the aircraft to put the velocity vector on the Pitch Command Box. Keep the HUD velocity vector centered in the Pitch Command Box or held slightly at the top of the box, **never below it**.



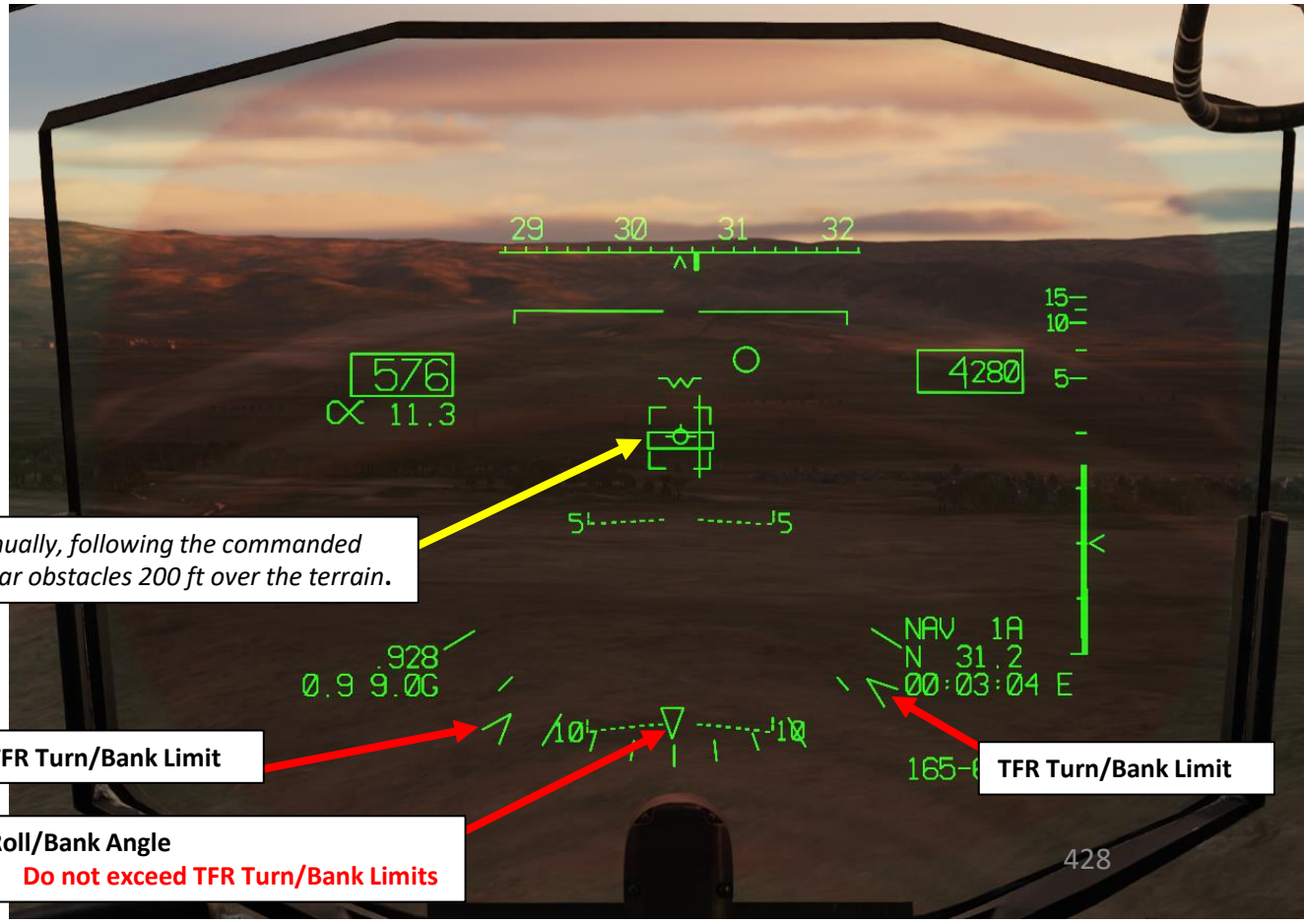


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.2 – Manual TF Operation (MTF)

16. Steer the aircraft using roll and pitch inputs. Make sure you remain within the roll and turn rate limits or a Flyup may be commanded.
17. Take note that while TFR is ON, the aircraft can perform a Flyup manoeuver when a system malfunction or an unsafe condition is detected by the NAV pod and / or Flight Control Computer. Failure to correct the cause of most of these conditions/warnings within 2 seconds will command a flyup from the system even while in MTF mode. These conditions are very specific and will be further explained in the Flyup sub-section.

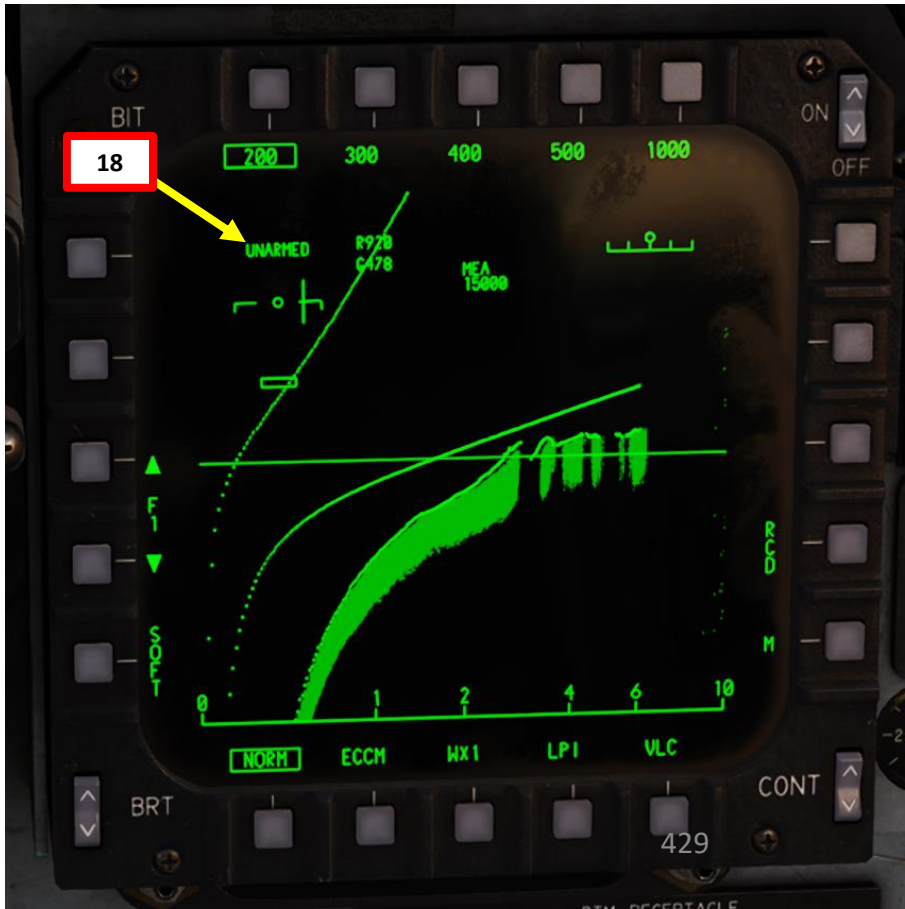


You are flying manually, following the commanded flight profile to clear obstacles 200 ft over the terrain.



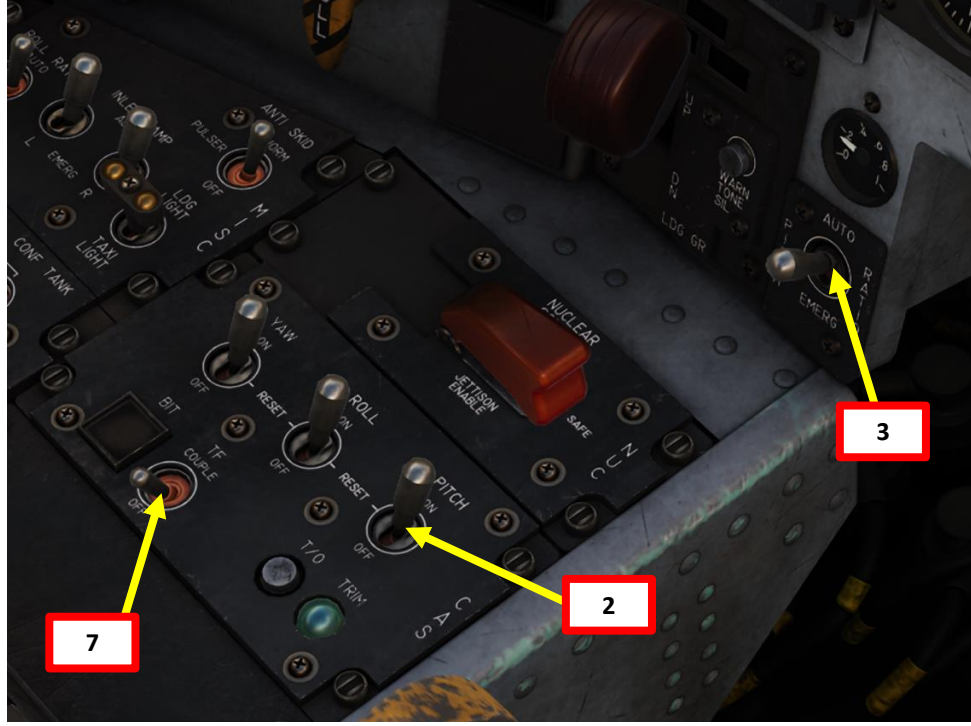
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.2 – Manual TF Operation (MTF)

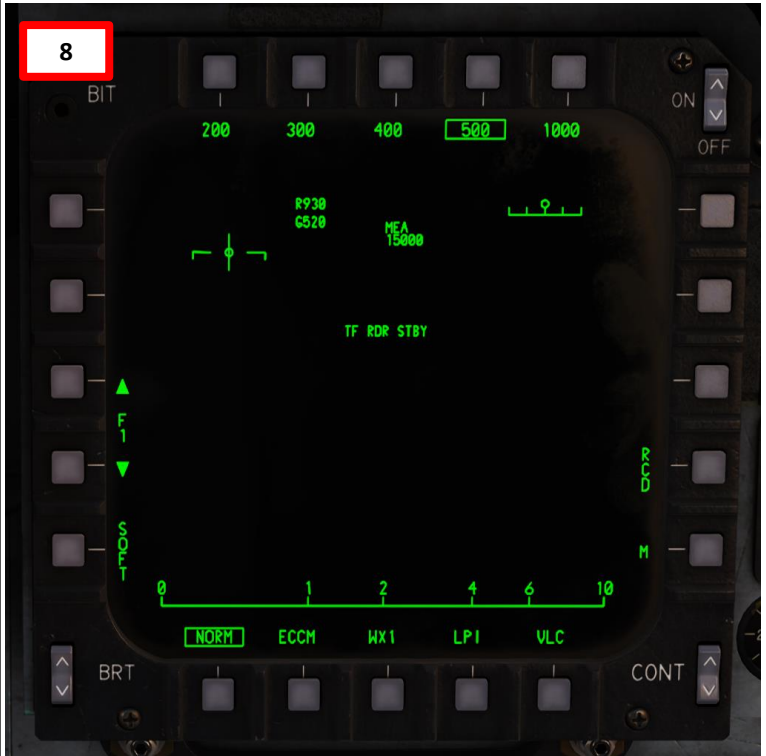
18. During normal use of the MTF mode, the Flyup function is ARMED. In cases when the pilot wants to have full authority over the flight controls while seeing TFR symbology, it is possible to disarm the Flyup function. To do so, **press and hold the Paddle Switch** on the stick. The UNARMED indication becomes visible and the pilot has full control over the aircraft, meaning that any the Flyup manoeuver is directly overridden by pilot input.
    - Note: Once the paddle switch is released, the system reverts to normal ARMED MTF, provided that all the engagement criteria are satisfied and unsafe conditions that caused the flyup no longer exist.
19. To turn off TFR and resume normal flight, set the TF RDR Power Switch – STBY/Standby (MIDDLE) or OFF (AFT).

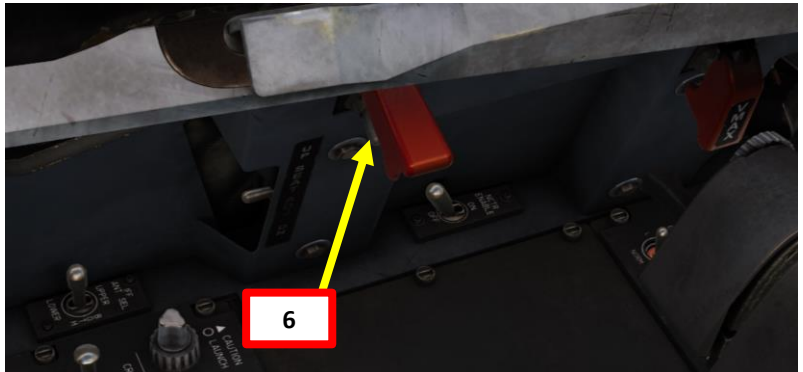


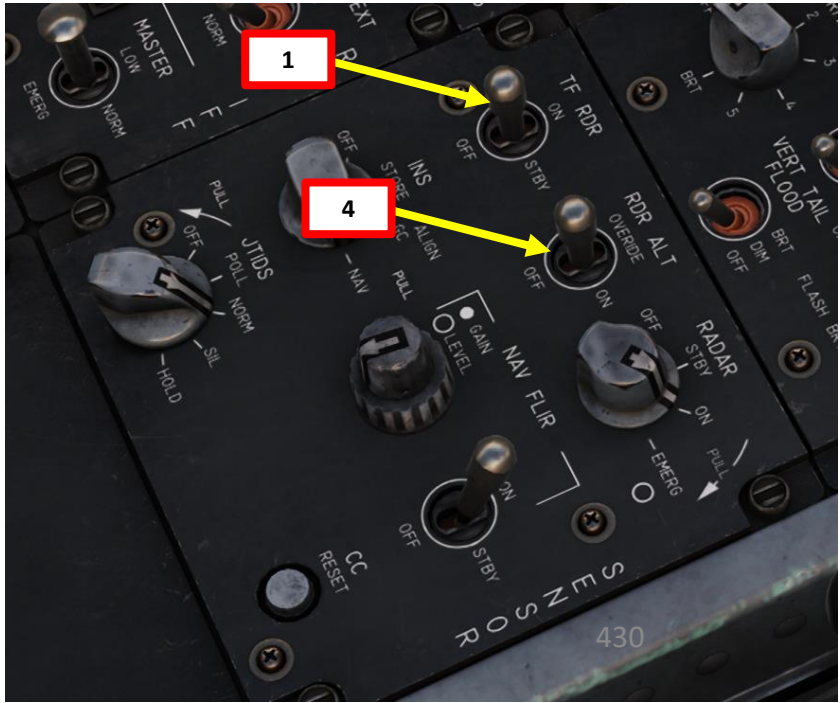
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.3 – Automatic TF Operation (ATF)

1. Set TF RDR Power Switch – STBY/Standby (MIDDLE). Standby mode will warm up the radar and is a default position whenever TFR is not in use to avoid undesired manoeuvers (Flyup) that could be enforced by the system.
2. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD)
3. Set Pitch Ratio Select Switch – AUTO (UP).
4. Set RDR ALT (Radar Altimeter) Power Switch – ON (MIDDLE).
5. If you want to display steering cues to the selected sequence point, select either NAV or INST Master Mode.
6. Set Flyup Enable Switch – ON/ARMED (DOWN, GUARDED). This will allow automatic flyup manoeuvers.
7. Set TF Couple Switch – OFF (AFT).
    - This will ensure the autopilot is at first de-coupled from the terrain-following radar. Coupling the autopilot without first checking what mode and obstacle clearance height settings are used may end up in unwanted aircraft behavior.
8. Select TF (Terrain-Following Radar) Page.



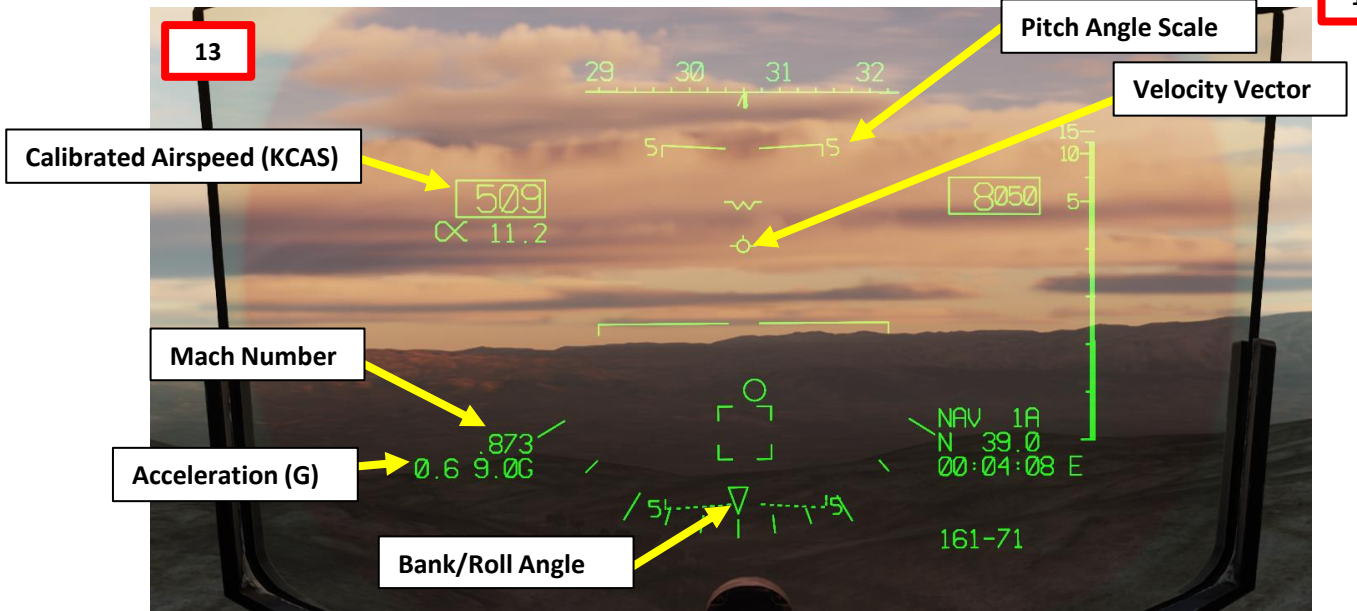


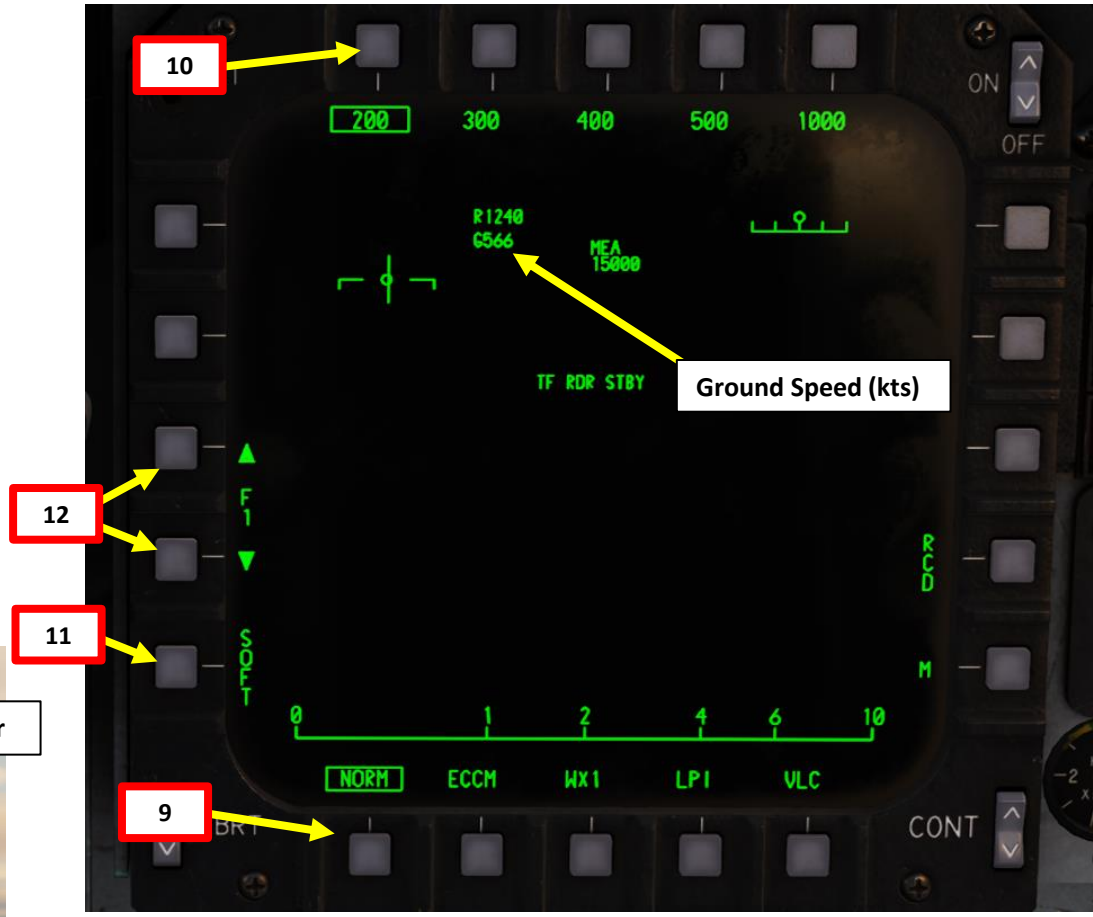




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.3 – Automatic TF Operation (ATF)

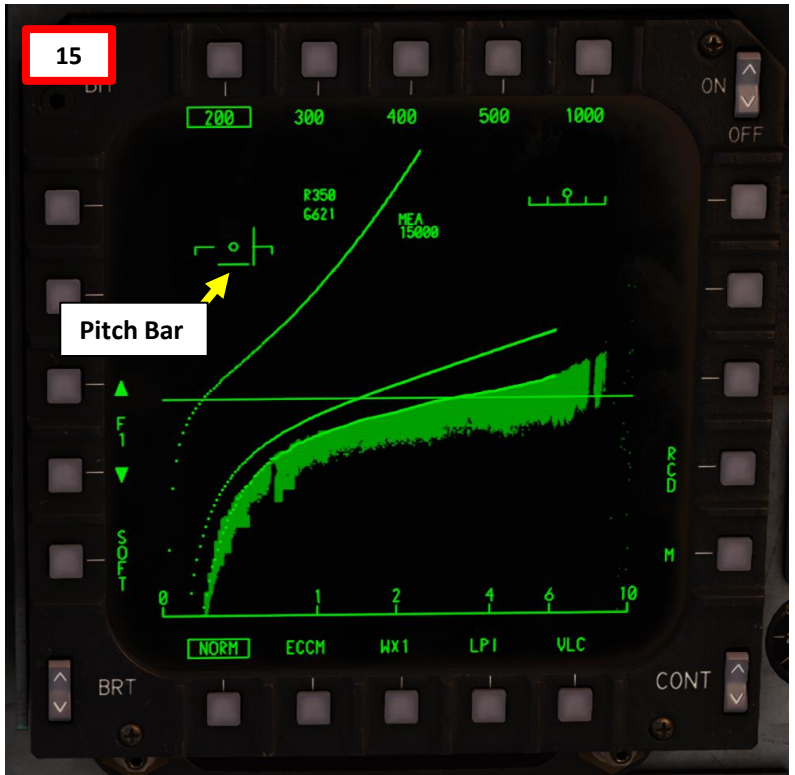
9. From TF page, select desired sub-mode. We will select NORM (Normal).
10. Select desired obstacle clearance height. We will select 200 ft.
    - Note: for 100 ft clearance height to be available, you need to select VLC (Very Low Clearance) sub-mode.
11. Select desired Ride Option (amount of negative incremental g commanded for vertical maneuvering when the autopilot takes over). I typically select SOFT since it is a less aggressive setting.
    - SOFT selects an incremental g command range of -0.45g to +2.0g.
    - HARD selects a g command range between -0.9g to +2.0g.
12. If multiple F-15Es are operating in the area, it is advisable to set different a TFR Frequency Sub-Band from your flight members. Since we are flying alone in this tutorial, we will leave it to F1.
13. **Very Important**: Fly the aircraft and verify the following conditions are respected:
    - Pitch angle is above -15 deg (dive)
    - Roll/Bank angle is less than 60 deg
    - Turn rate is less than 5.5 deg/sec
    - Turn acceleration is less than 2.2 deg/sec
    - Acceleration is approximately 1g +/- 0.5g.
    - Airspeed is above 350 KCAS (Calibrated) and 400 kts (Ground Speed)
    - Airspeed is below 0.96 Mach / 650 kts Ground Speed

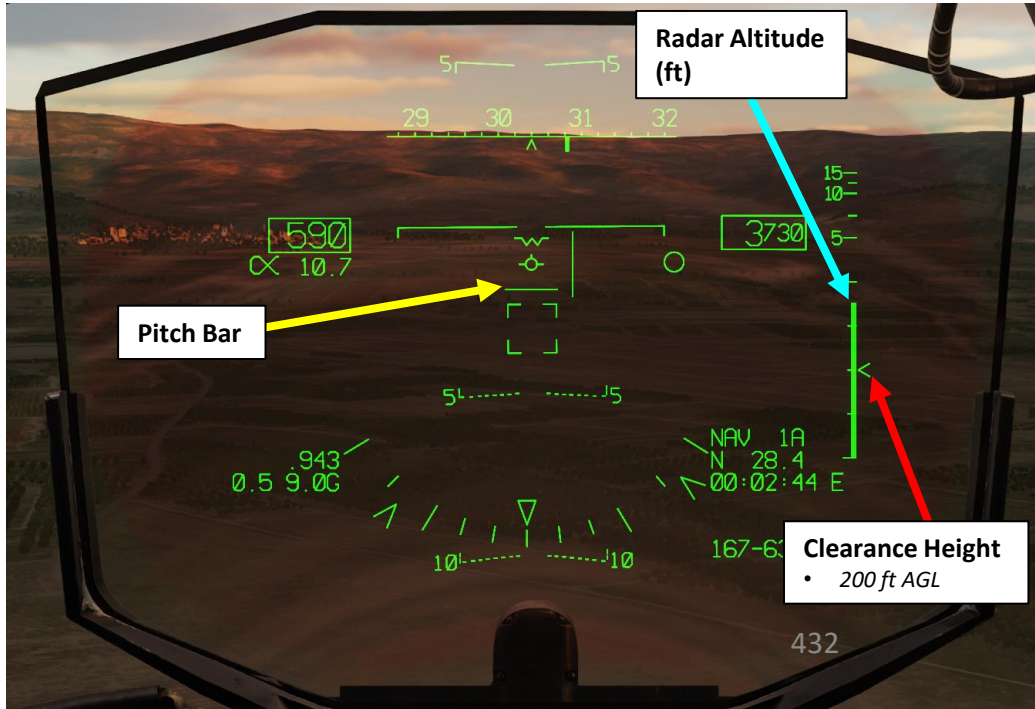




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.3 – Automatic TF Operation (ATF)

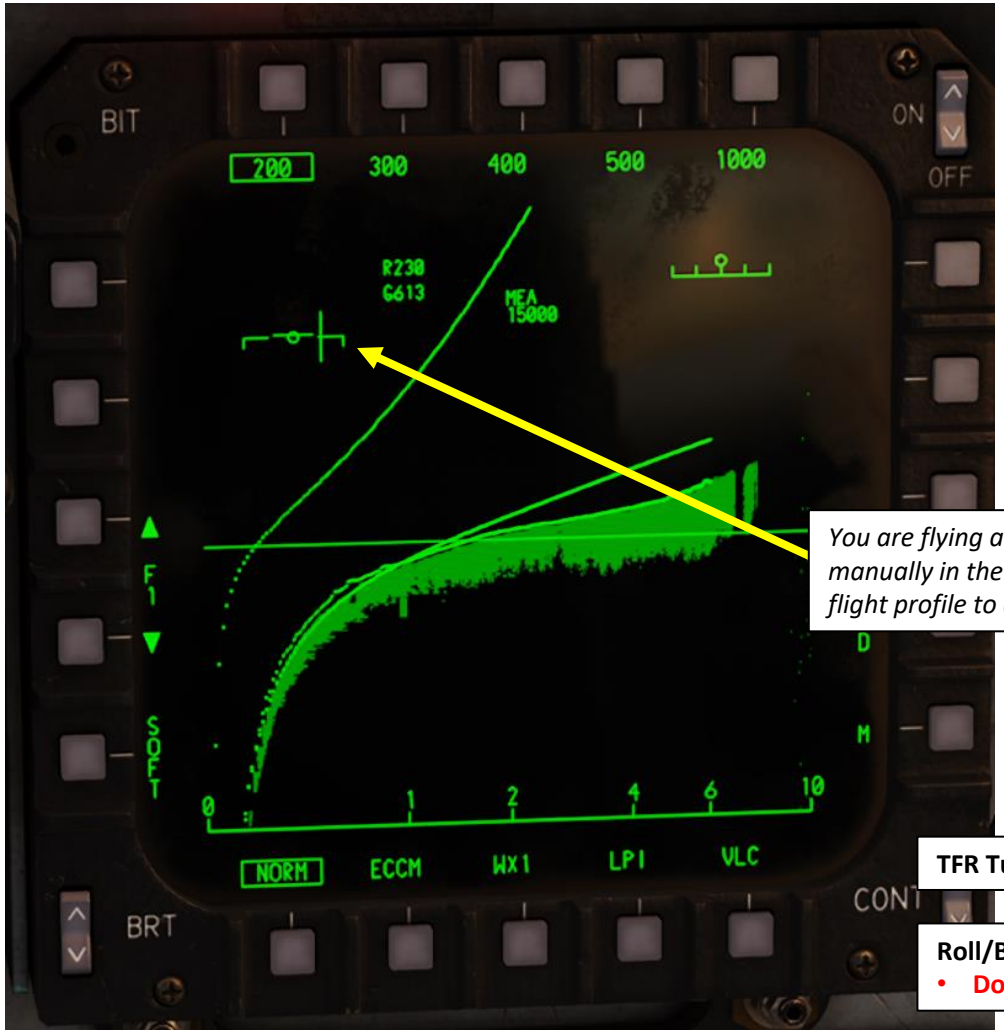
14. Once flight parameters mentioned in the previous step are respected, set TF RDR Power Switch – ON (FWD).
15. Set TF Couple Switch – ON (FWD). This will couple the autopilot with the commanded flight profile to clear obstacles and operate in Automatic Terrain Following mode (ATF).
16. Upon ATF activation, only the basic roll autopilot (roll attitude hold / ground attack hold) is automatically engaged, which is confirmed by "A/P TF" legend on the UFC (Upfront Control Panel). The terrain-following system automatically pitches the aircraft (pitch command is indicated by the Pitch bar) in order to achieve the selected set obstacle clearance height without any input from the aircrew. However, ATF mode will not perform any turns.
    - Note: If autopilot steer mode was engaged before coupling the ATF, it will be retained. Otherwise after coupling the TF, autopilot will enter ground track hold (if the roll angle was less than 7 deg) or attitude hold (if the roll angle equals or exceeds 7 deg).

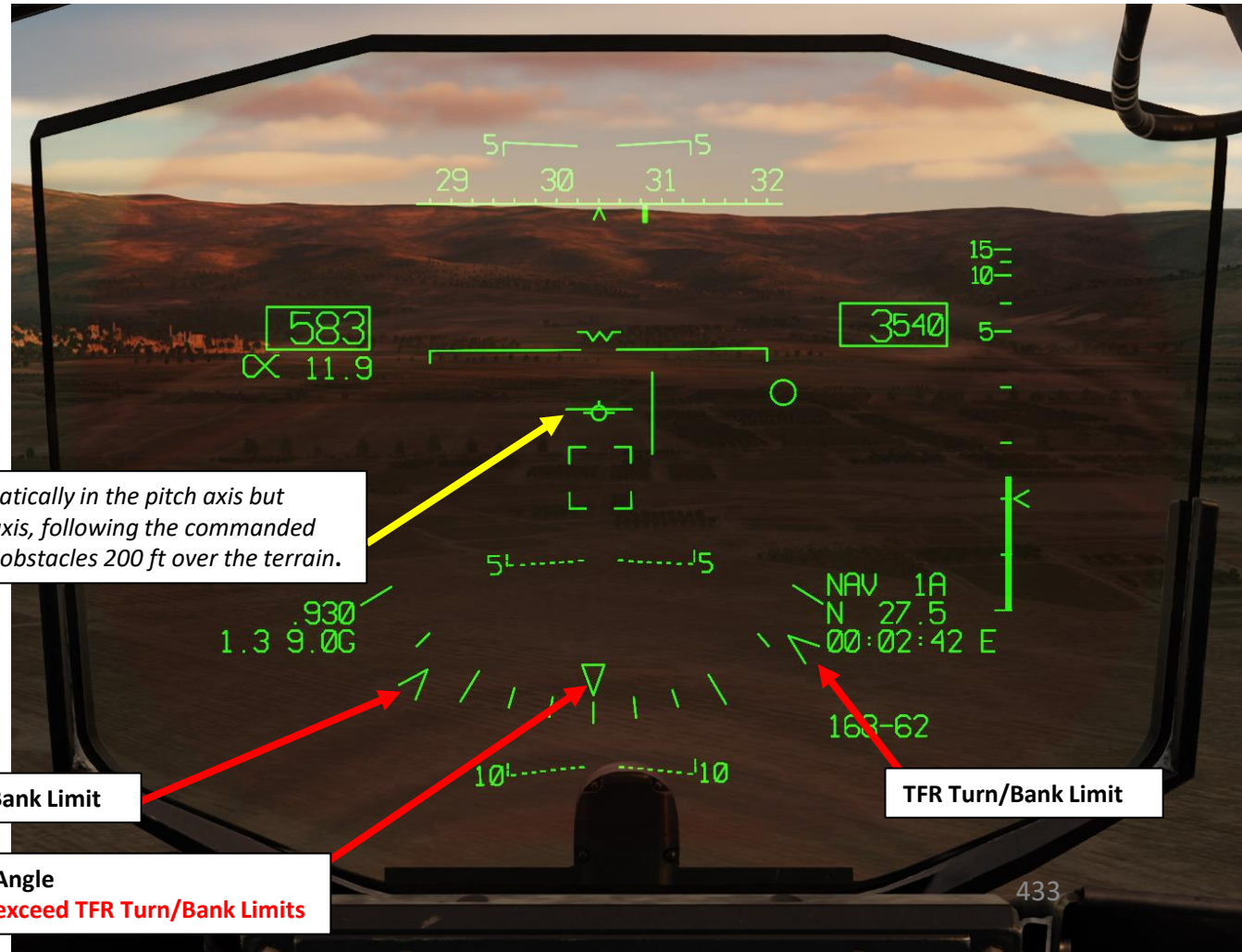




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.3 – Automatic TF Operation (ATF)

17. Steer the aircraft using roll inputs; the autopilot's pitch channel will control the aircraft altitude for you. Make sure you remain within the roll limits or a Flyup may be commanded.
18. Take note that while TFR is ON, the aircraft can perform a Flyup manoeuver when a system malfunction or an unsafe condition is detected by the NAV pod and / or Flight Control Computer. Failure to correct the cause of most of these conditions/warnings within 2 seconds will command a flyup from the system. These conditions are very specific and will be further explained in the Flyup sub-section.





You are flying automatically in the pitch axis but manually in the roll axis, following the commanded flight profile to clear obstacles 200 ft over the terrain.

TFR Turn/Bank Limit

Roll/Bank Angle
- **Do not exceed TFR Turn/Bank Limits**

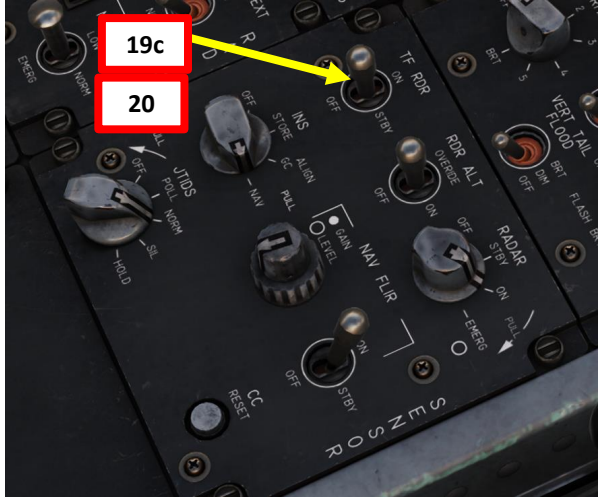
TFR Turn/Bank Limit

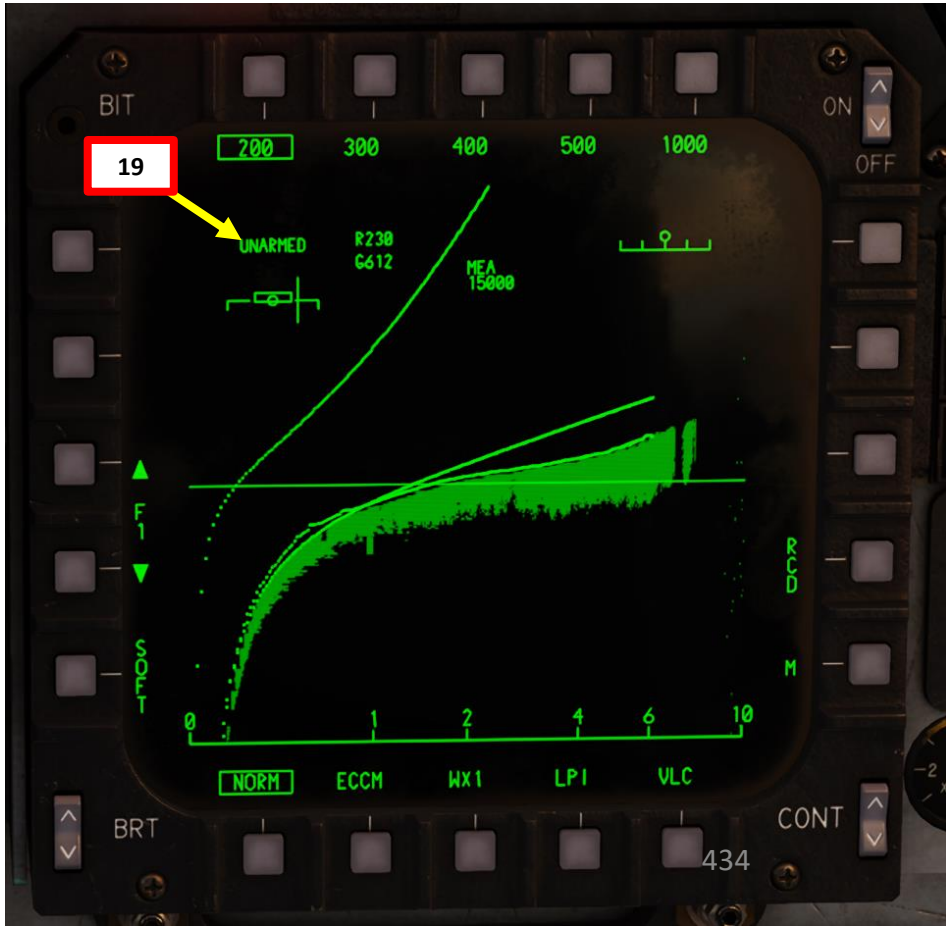
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.3 – Automatic TF Operation (ATF)

19. During normal use of the ATF mode, the Flyup function is ARMED. In cases when the pilot wants to have full authority over the flight controls while seeing TFR symbology, it is possible to disarm the Flyup function and revert to Manual Terrain Following (MTF) mode. To do so, you can disengage ATF by either:
    a) Pressing and holding the Paddle Switch on the stick, or;
    b) Setting the TF Couple Switch – OFF (AFT) position, or;
    c) Setting TF RDR Power Switch – STBY/Standby (MIDDLE) or OFF (AFT), or;
    d) Exceeding the aft or forward pitch breakout force on the stick when inside Terrain-Following limits.

    - Note 1: When ATF is disengaged, the UNARMED indication becomes visible, the Pitch Command box reappears on the HUD and TF display. The pilot has full control over the aircraft, meaning that any the Flyup manoeuver is directly overridden by pilot input.
    - Note 2: Once the paddle switch is released, the system reverts to normal ARMED ATF, provided that all the engagement criteria are satisfied and unsafe conditions that caused the flyup no longer exist.

20. To turn off TFR and resume normal flight, set the TF RDR Power Switch – STBY/Standby (MIDDLE) or OFF (AFT).



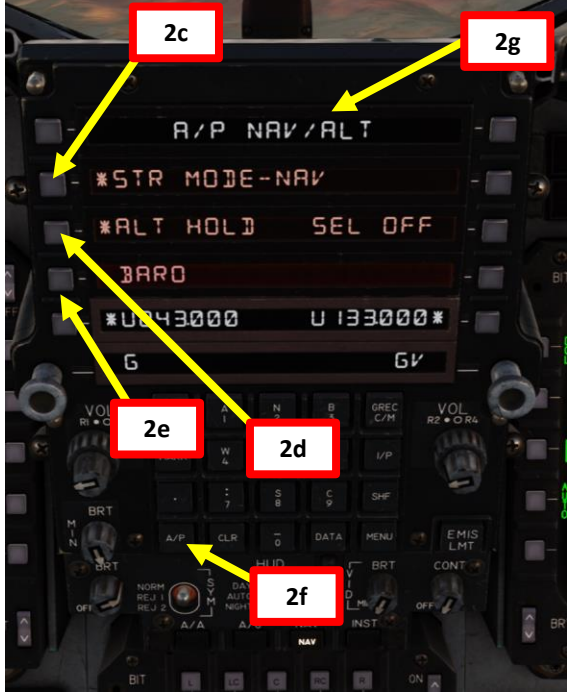


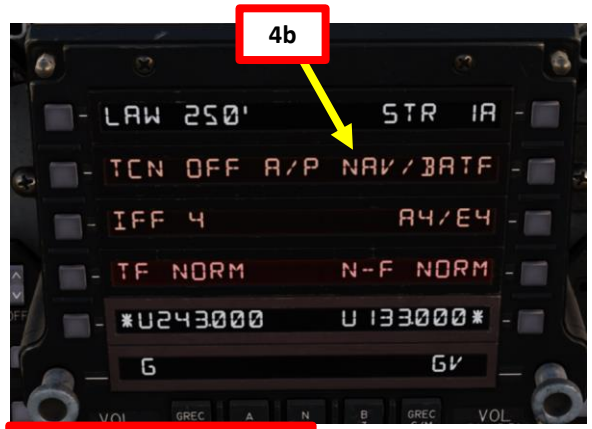
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.4 – Blended Mode

Blended Terrain Following mode allows the aircrew to couple the TFR with different autopilot modes, which effectively adds terrain following protection. However, blended mode disables the possibility to use the Manual terrain following as long as blended mode is active.

How to enter Blended Mode when ALTITUDE HOLD Autopilot Mode is already active:

1. Verify all prerequisites for ATF activation are met, as shown in the Automatic Terrain Following section. Make sure the TF RDR Power Switch is set to STBY/Standby (MIDDLE) and the TF Couple Switch is set to OFF (AFT).
2. Set aircraft in desired autopilot mode. We will select STR NAV (Coupled Navigation Steering) and BARO ALTITUDE HOLD.
3. in order to enter the blended mode, first set the TF Couple Switch to COUPLE (FWD), and then set the TF RDR Switch to ON (FWD).
    - Note 1: It is also possible to change the order, as long as Couple Switch is engaged within 4 seconds from enabling the TF RDR Switch. If all conditions for initiating the ATF are satisfied, Blended mode becomes active.
    - Note 2: If TF Couple Switch is not engaged within 4 seconds from enabling TF RDR switch, the system disables ALT HOLD and goes into Manual TFR.
4. The autopilot will then track the selected steerpoint (NAV) while holding the barometric altitude at the time of autopilot activation and avoiding flying below the obstacle clearance height set in the TF page. The A/P NAV/BATF indication means that the NAV/ALT autopilot mode is coupled/blended with the ATF (automatic terrain following) mode.



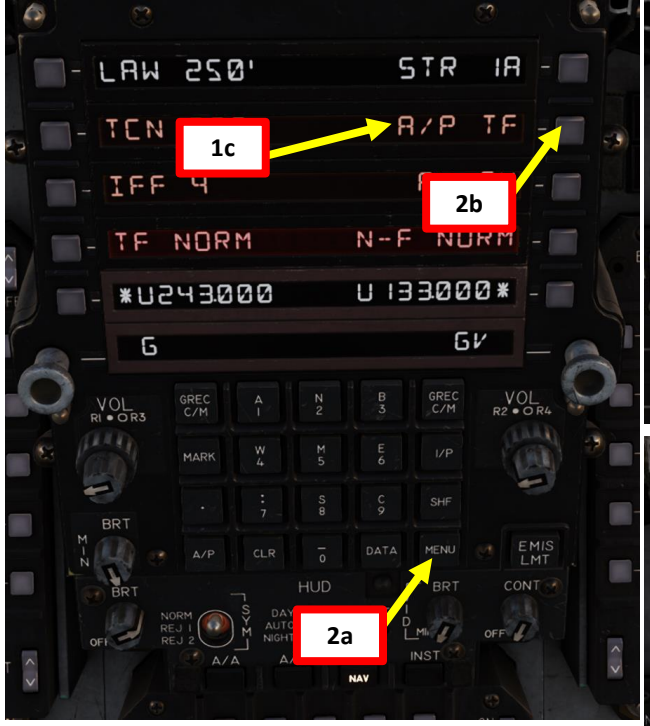


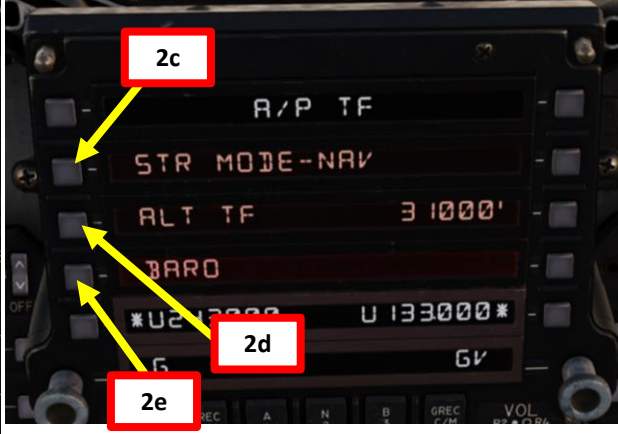
MENU 1 UFC Page

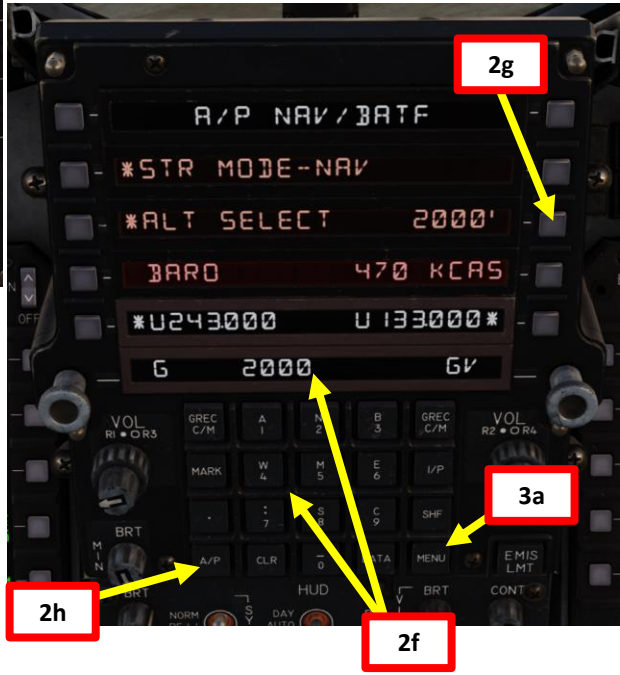
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.4 – Blended Mode

How to enter Blended Mode when Automatic Terrain Following is already active:

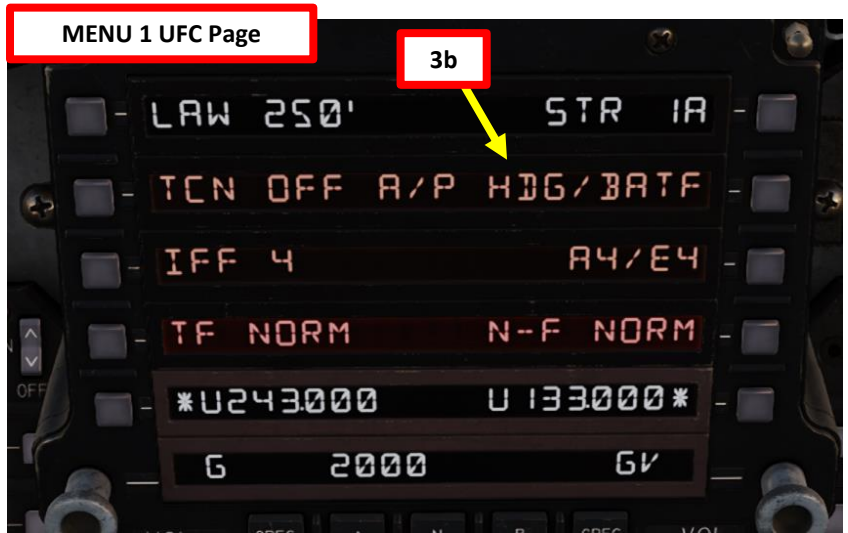
1. Verify all prerequisites for ATF activation are met, as shown in the Automatic Terrain Following section. Make sure the TF RDR Power Switch is set to ON (FWD) and the TF Couple Switch is set to ON (FWD).
2. Set aircraft in desired autopilot mode. We will select STR NAV (Coupled Navigation Steering) and BARO ALTITUDE SELECT.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) Select A/P menu.
    c) Select STR MODE-NAV (* appears when selected).
    d) Select ALT SELECT (* appears when selected).
    e) Select BARO (Barometric) or RAD (Radar Altimeter) altitude reference as desired.
    f) Enter desired altitude on UFC keypad
    g) Press button next to altitude setting to acknowledge.
    h) Press A/P button to engage autopilot modes.
    i) Return to UFC MENU 1.
3. The autopilot will then track the selected steerpoint (NAV) while holding the barometric altitude at the time of autopilot activation and avoiding flying below the obstacle clearance height set in the TF page. The A/P NAV/BATF indication means that the NAV/ALT autopilot mode is coupled/blended with the ATF (automatic terrain following) mode.







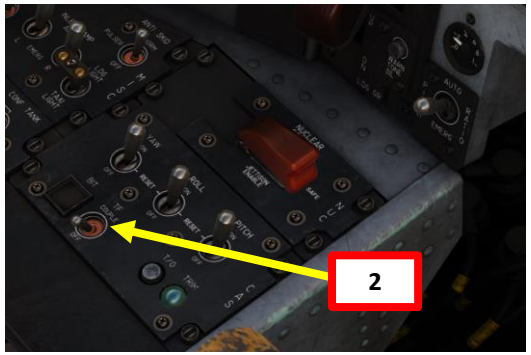
MENU 1 UFC Page

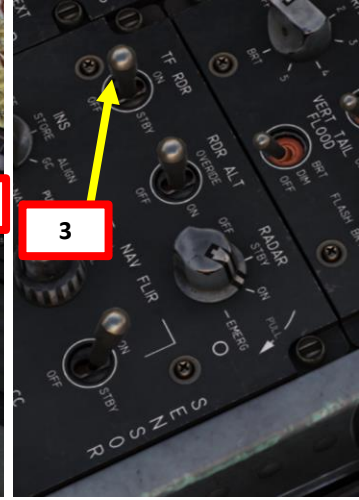


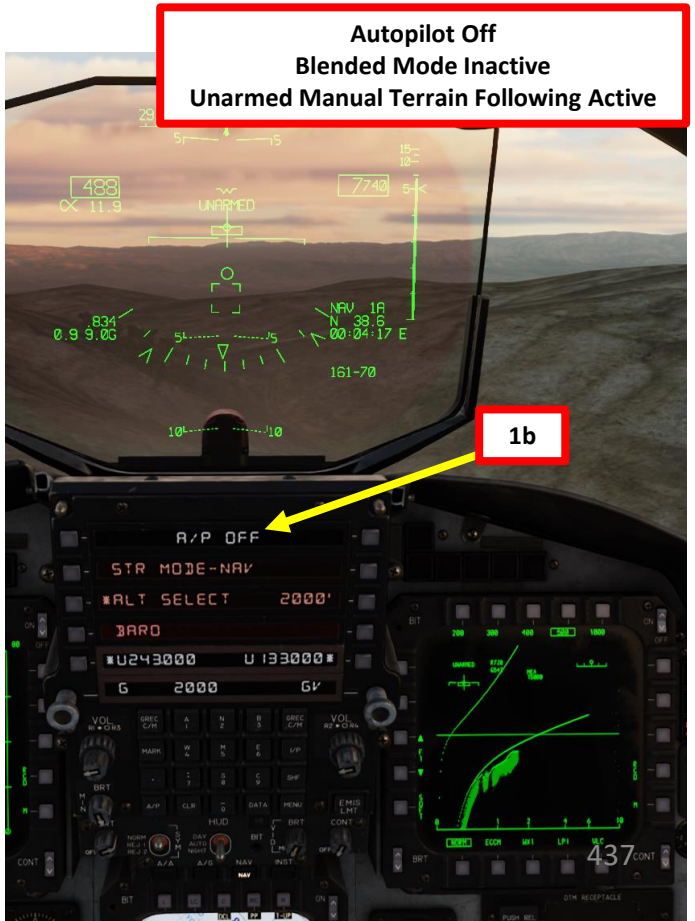
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.4 – Operation
4.2.4.4 – Blended Mode

In order to disengage Blended mode, use one of the options listed below:

1. Pressing and holding the Paddle Switch. This removes the altitude hold and steer mode engaged portion and reverts to unarmed MTF (Manual Terrain Following).
2. Placing the TF Couple Switch to OFF. This also results in return to MTF.
3. Placing the TF Radar Switch to STBY or OFF.
4. Pressing the A/P submenu AP Altitude Mode Selector pushbutton. The aircraft will return to ATF (Automatic Terrain Following).







4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.5 – Limits, Warnings & Cautions

During TF operation, system status information is displayed on the HUD, TF displays and ADI. The more immediate / important cautions also have audio warnings and warning lights associated with them.

Limits

There are four radar limits that are displayed on the HUD, TF Displays and ADI as soon as they are exceeded. If these are not corrected within specific time frame (usually 2 seconds), automatic flyup occurs.

TF (Terrain Following Radar) Limits	
Bank Angle Limit	60 deg, flyup if not corrected within 2 seconds
Turn Rate Limit	5.5 deg in all modes (except LIP and VLC), flyup if not corrected within 2 seconds.
Turn Acceleration Limit	2.2 deg per second, flyup if not corrected within 2 seconds
Dive Angle Limit	Any dive steeper than 15 deg, flyup if not corrected within 3 seconds

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.5 – Limits, Warnings & Cautions

Warnings

Warnings require immediate attention and are often accompanied with warning lights and voice warnings. They appear above the velocity vector on the HUD.

TF Warnings	
FLY UP	Displayed as soon as flyup manoeuver is initiated. The purpose is to alert the crew to take control of the aircraft and recover from the flyup manoeuver. It is accompanied by TF FAIL, LOW ALT or OBSTACLE red warning lights and the appropriate voice warning.
UNARMED	Displayed when flyup arming is requested but not available.
NO ATF	Displayed when TF Couple Switch is in COUPLE, but the Automatic Terrain Following is disabled (usually because the aircraft is outside ATF limits and the system cannot re-engage).
TF FAIL	Displayed when part of the Terrain Following system fails, accompanied by warning light and voice warning.
OBSTACLE or G-LIMIT	Radar detects an obstacle that will require a 2g or more to pull up to clear.
TF LOW	Displayed when aircraft is approaching or descends below 75% of the selected clearance. The LOW ALT warning lights turn on.

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.5 – Limits, Warnings & Cautions

Cautions

Cautions appear below the velocity vector (VV) on the HUD and in the warning area on the TF displays. The only exception are OBSTACLE cautions that are shown either on the left or right from the VV, depending on physical presence of the detected obstacle. They appear one at a time with the priority order described below

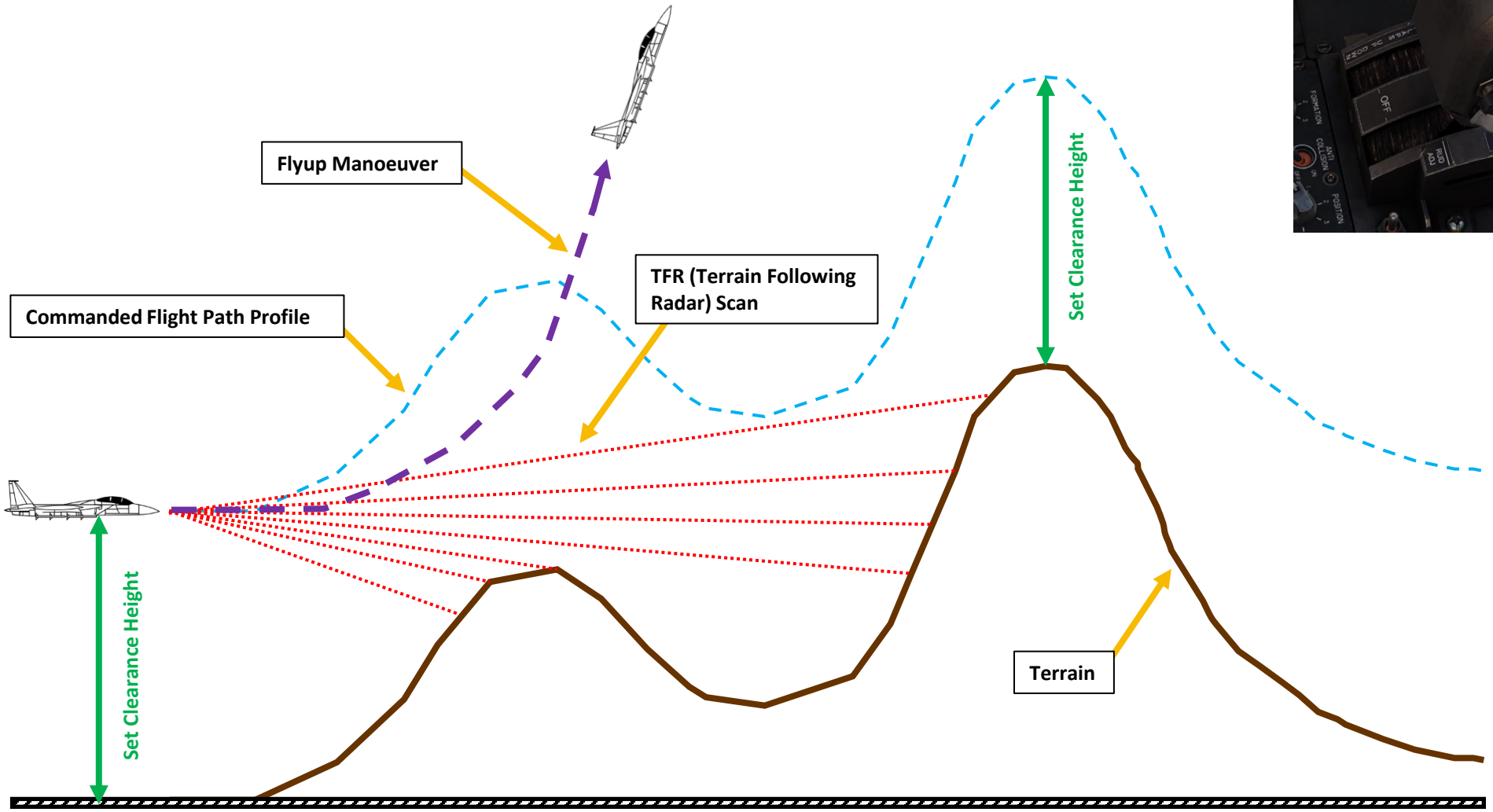
TF Cautions	
N-F LOS	NAV FLIR line-of-sight is out of tolerance
ROLL	Aircraft bank angle exceeds 60 deg
TURN RATE	Turn rate limit is exceeded
TURN ACCEL	Turn acceleration exceeds 2.2 deg per second
DIVE ANGLE	Dive angle is 15 deg or greater
INS LIMIT	Ground speed is less than 360 kts, drift angle is greater than 10 deg, outer roll angle is between 90 and 180 deg, or the pitch angle or flight vector angle limits have been exceeded. Indicates that the terrain following radar antenna gimbal angle is outside operational limits.
AIRSPEED	• Flashing: Airspeed falls below 370 kts (calibrated) or goes above Mach 0.97. • Steady: Ground speed is below 400 kts.
NO TERRAIN	Altitude, attitude or terrain type precludes the terrain following radar from obtaining terrain data within the given envelope.
ECCM	Jamming environment may begin to interfere with TFR operation.
N-F BRST	NAV FLIR is displayed on the HUD and is in boresight mode.
OBST	Separate caution light displayed simultaneously with all other cautions, indicates an obstacle has been detected and there is a high chance of automatic flyup.

4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.6 – Flyup Manoeuvers

Flyup Enable Switch
- *UP: OFF, turns off automatic flyup manoeuvers. This should be only done in emergencies, for instance with flight controls malfunction.*
- *DOWN (Guarded): ON, used with the TF (Terrain Following Radar) system.*

The terrain following radar can command a "flyup" manoeuver in situations when there is a significant risk of colliding with the terrain or TFR system limits are exceeded. There are two types of flyup maneuver: **automatic** (which happens without pilot's input as long as certain conditions are met) or **manual** (in which the pilot has to perform the flyup manually).

The **Flyup Enable switch** is typically left ON (DOWN) in normal operating conditions.



4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.6 – Flyup Manoeuvers

Automatic Flyup

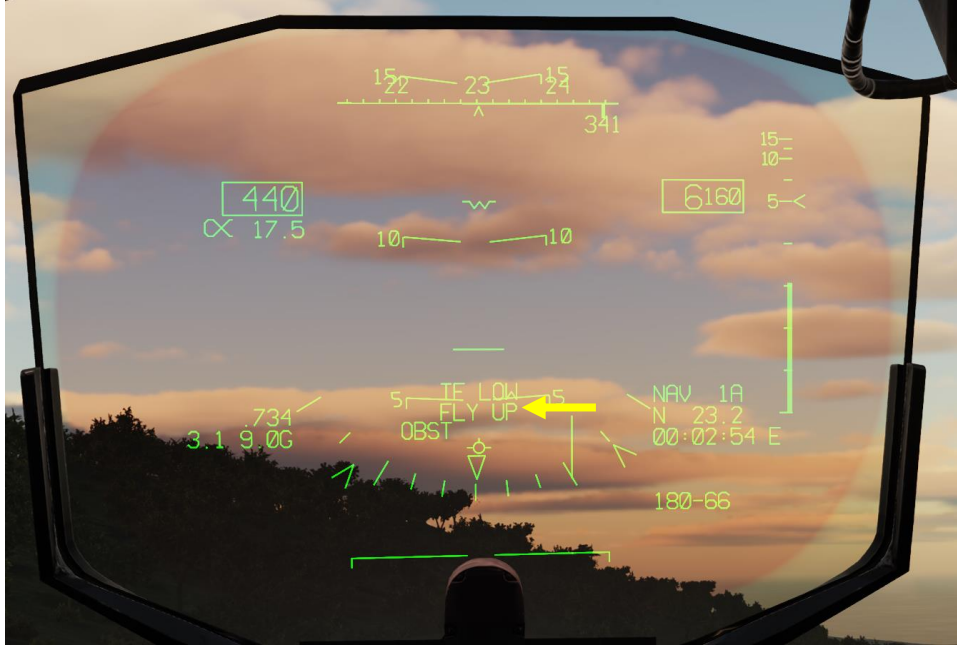
An automatic flyup occurs in armed TF operation (both automatic and manual) when a system malfunction or unsafe condition is detected by the NAV pod and / or Flight Control Computer. These are:

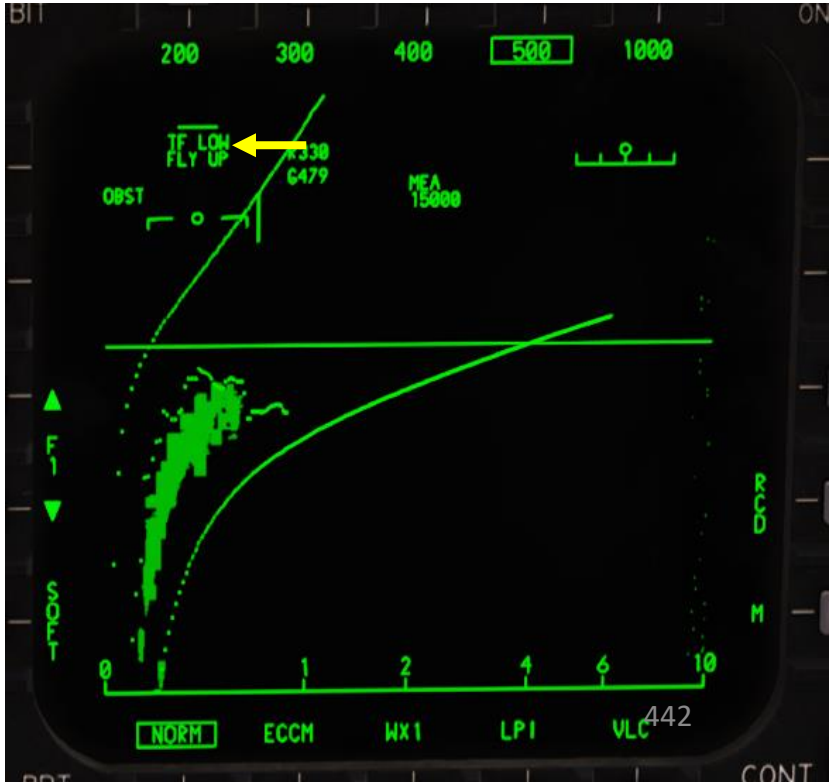
- Altitude less than 75% of set clearance
- G limit
- Obstacle warning
- Flying outside of TF limits, which are:
  - Pitch (15 deg dive angle)
  - Bank angle (60 deg)
  - Turn rate (5.5 deg/sec)
  - Turn acceleration (2.2 deg/sec)
- System failure

Whenever any of these conditions occur, a relevant warning appears on the HUD, TF Display and on ADI. If said condition is not removed within two seconds, the FLY UP legend is displayed and automatic flyup takes place. It induces an incremental 2 or 3g pull-up o 20 deg climb out. If the flyup happens when banked, an automatic roll to wings level at approximately 20 deg / second will be attempted by the system.

- Note: Automatic flyups are inhibited if the aircraft ground speed is below 360 knots, climb angle is greater that 40 deg, drift angle is greater than 10 deg or bank angle is greater than 75 deg. When any of these conditions happen, TF steering is removed, a TF FAIL voice warning is played together with warning light. The UNARMED warning is displayed on the HUD, ADI and TF displays.

- In cases when the pilot wants to have full authority over the flight controls while seeing TFR symbology, it is possible to disarm the Flyup function. To do so, **press and hold the Paddle Switch** on the stick. The UNARMED indication becomes visible and the pilot has full control over the aircraft, meaning that any the Flyup manoeuver is directly overridden by pilot input.



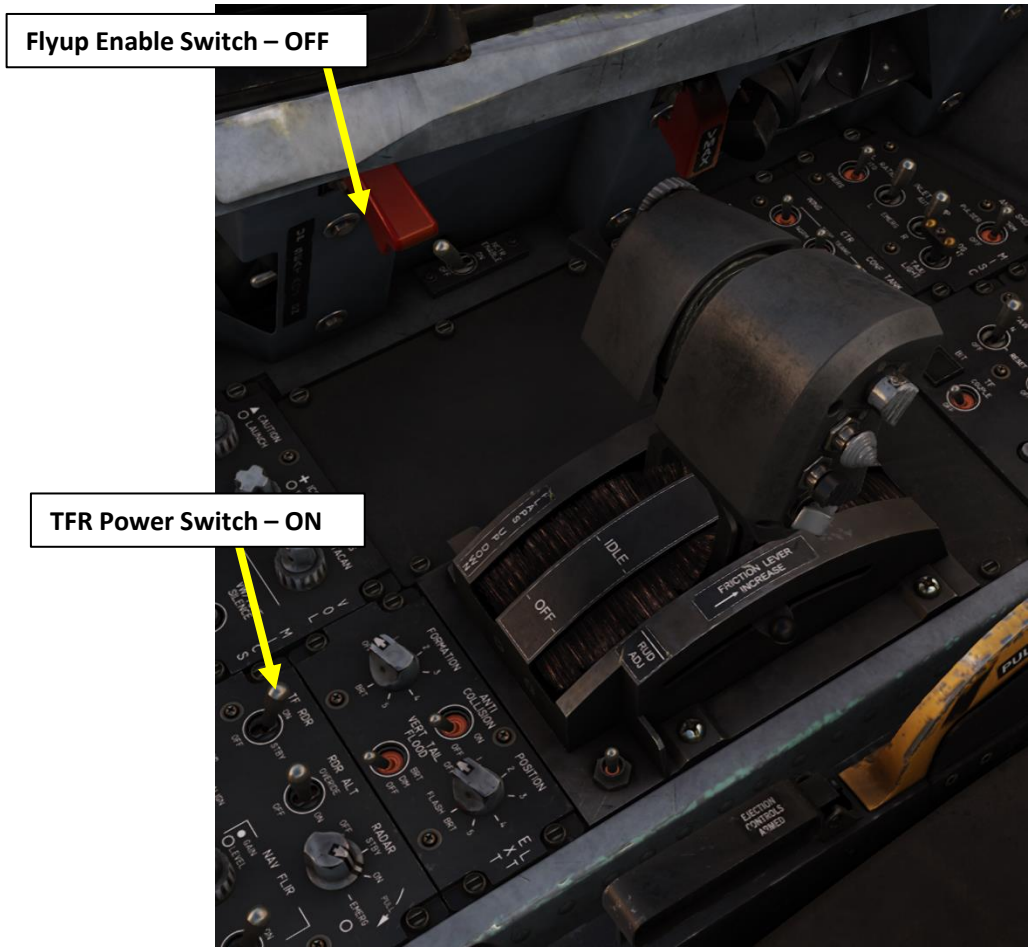


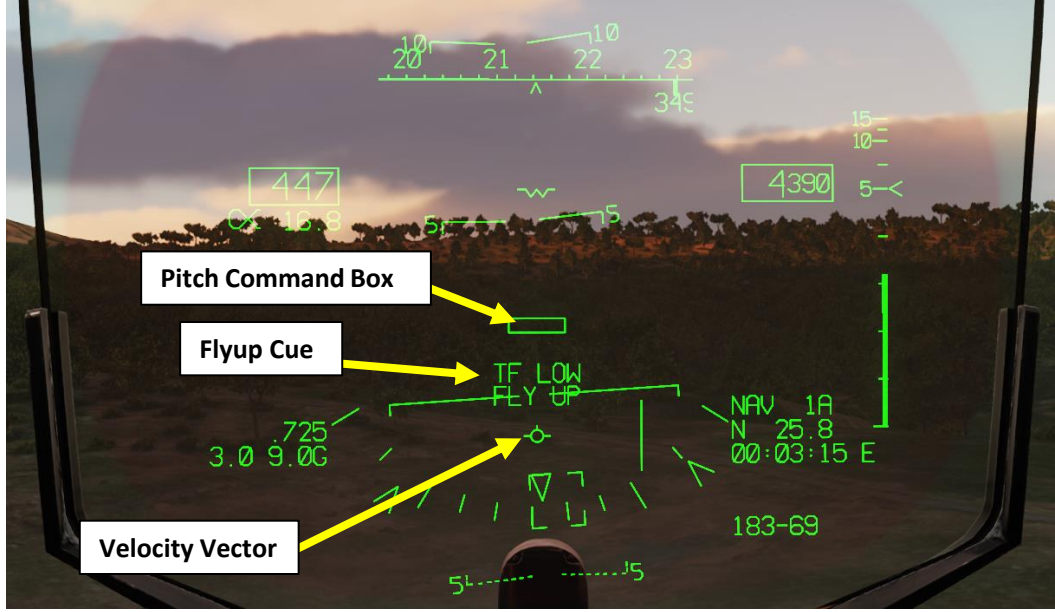
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.6 – Flyup Manoeuvers

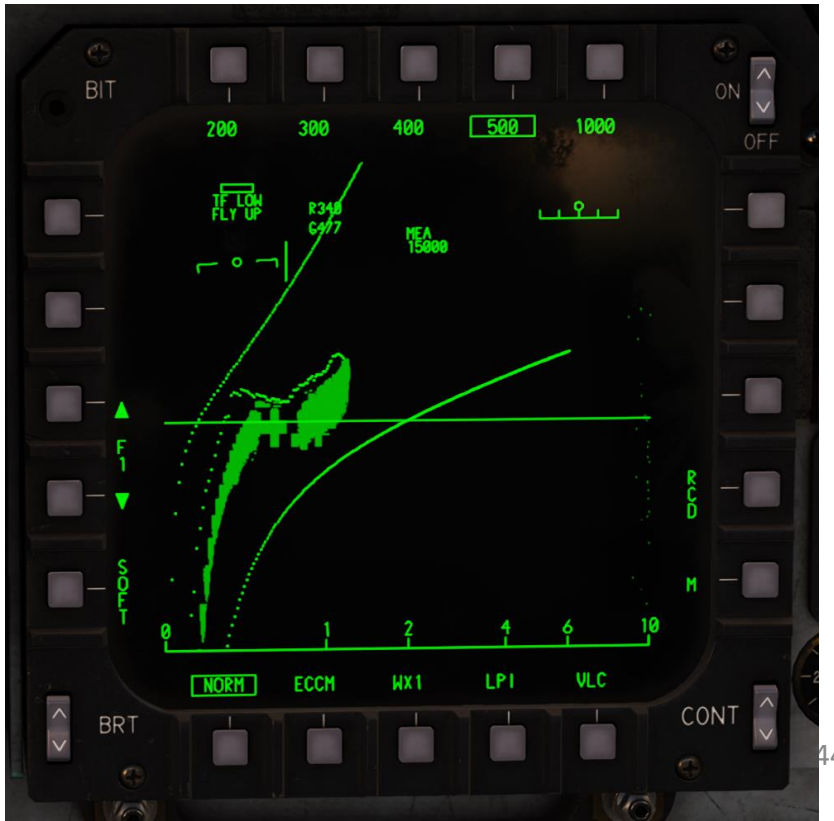
Manual Flyup

A manual fly up can only happen during an unarmed MTF (with Flyup Enable Switch set to OFF/UP). In that case no automatic pitch steering command is generated, but the pitch command box still provides a steering cue to alert the pilot and begin the flyup manually.

To perform a manual flyup, the aircraft should be pitched up to place the velocity vector inside the Pitch Command Box.





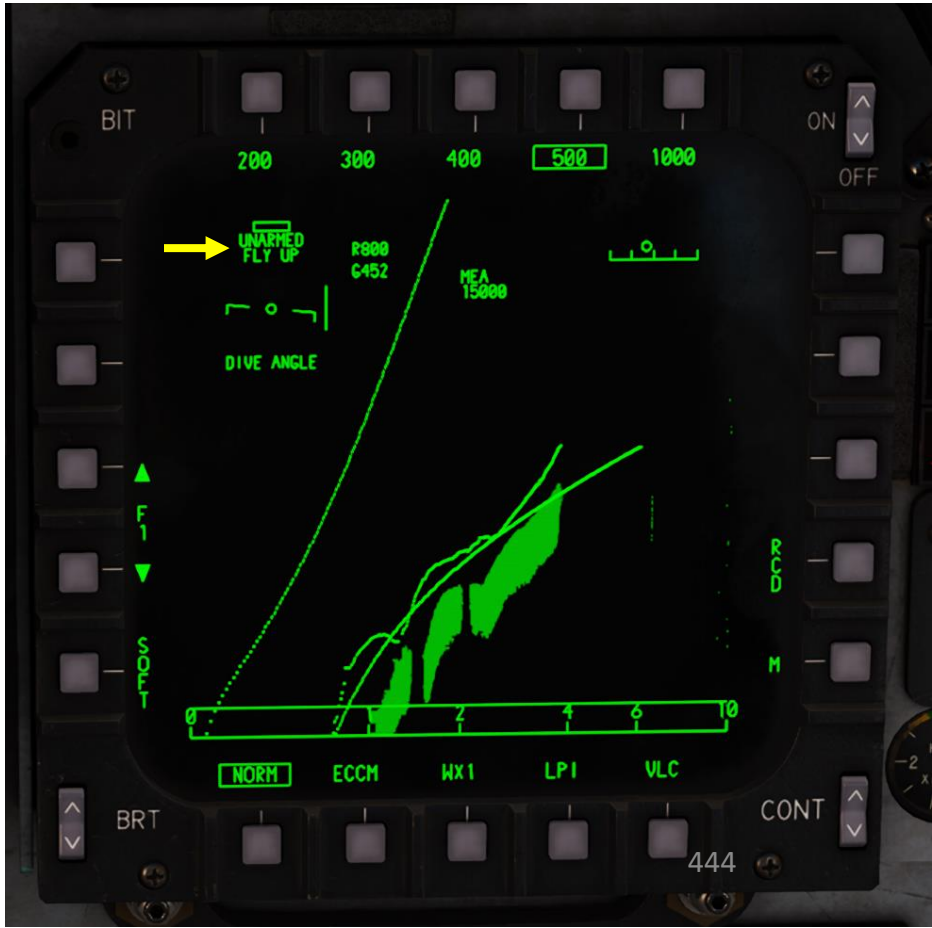


4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.2 – TFR (Terrain Following Radar)
4.2.6 – Flyup Manoeuvers

Flyup Inhibit

Automatic flyups are inhibited if the aircraft ground speed is below 360 knots, climb angle is greater that 40 deg, drift angle is greater than 10 deg or bank angle is greater than 75 deg. When any of these conditions happen, TF steering is removed, a TF FAIL voice warning is played together with warning light. The UNARMED warning is displayed on the HUD, ADI and TF displays.

In cases when the pilot wants to have full authority over the flight controls while seeing TFR symbology, it is possible to disarm the Flyup function. To do so, **press and hold the Paddle Switch** on the stick. The UNARMED indication becomes visible and the pilot has full control over the aircraft, meaning that any the Flyup manoeuver is directly overridden by pilot input.



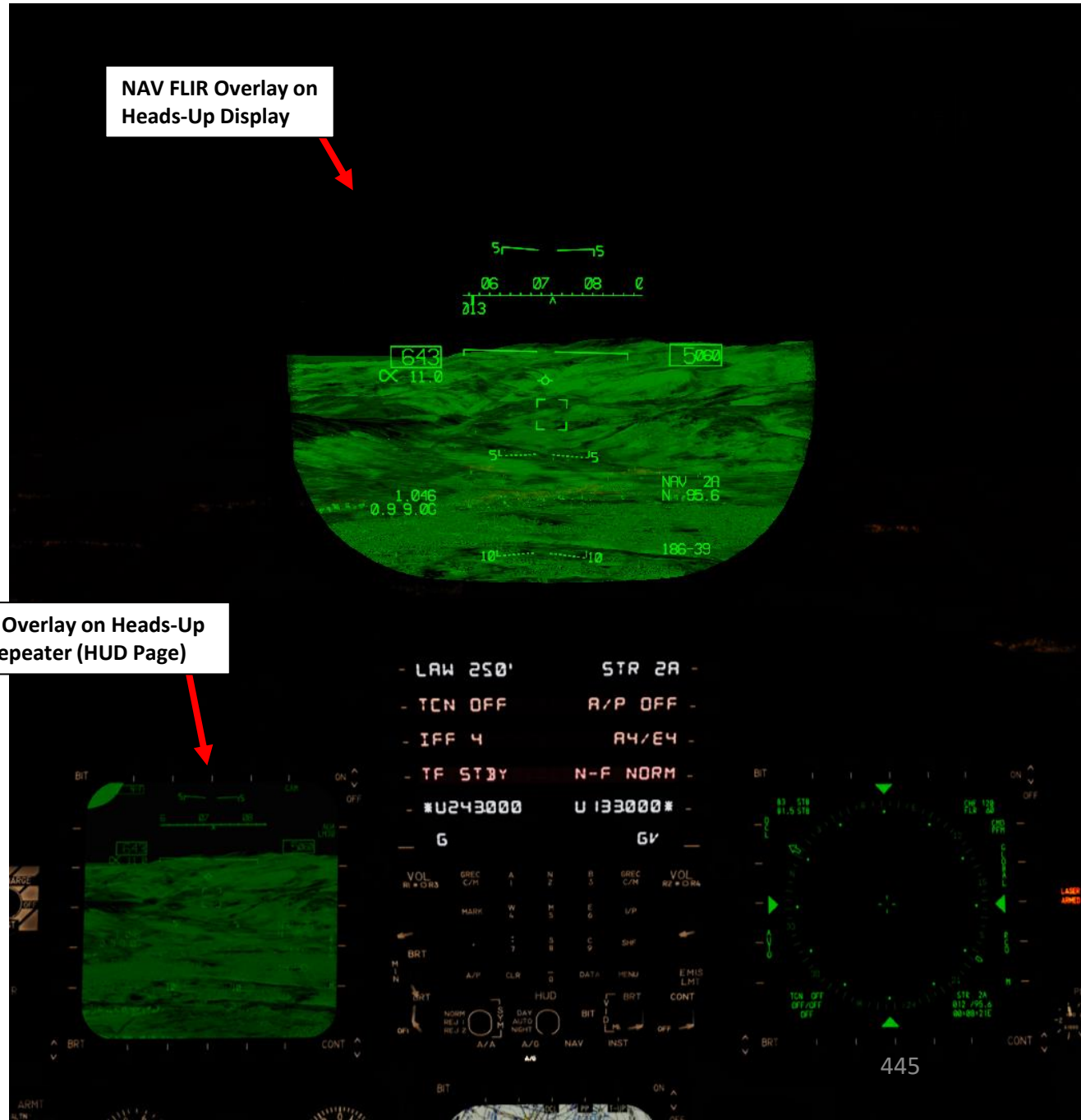
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.1 – Basics

The NAV FLIR (Navigation Forward-Looking Infrared) system provides infrared, forward terrain video on a HUD display in support of the Terrain Following Radar operation. The Navigation Pod has to be installed on the jet in order for the pilot to be able to use the NAV FLIR capabilities.

NAV FLIR may seem redundant with the advent of modern night vision goggles of the 2000's era, but back in the 1980's… it was a much needed feature to help the pilot navigate through low visibility conditions.

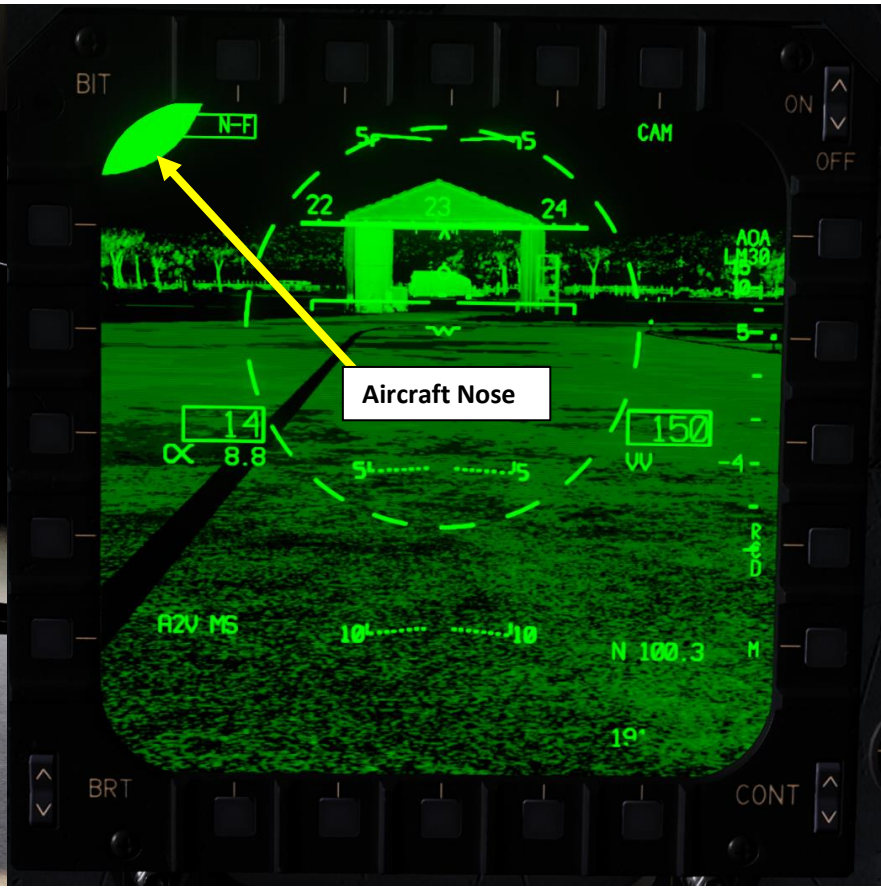
Keep in mind that NAV FLIR is used for navigation and has no targeting capabilities. It can be used independently from the TFR (Terrain-Following Radar) capability of the navigation pod, or in conjunction with it as a complementary system. I would strongly recommend to use NAV FLIR with TFR in order to maximize your situational awareness and make your life easier.

Here is a great tutorial by Notso: https://youtu.be/0A7UHrzA5rs



4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.1 – Basics

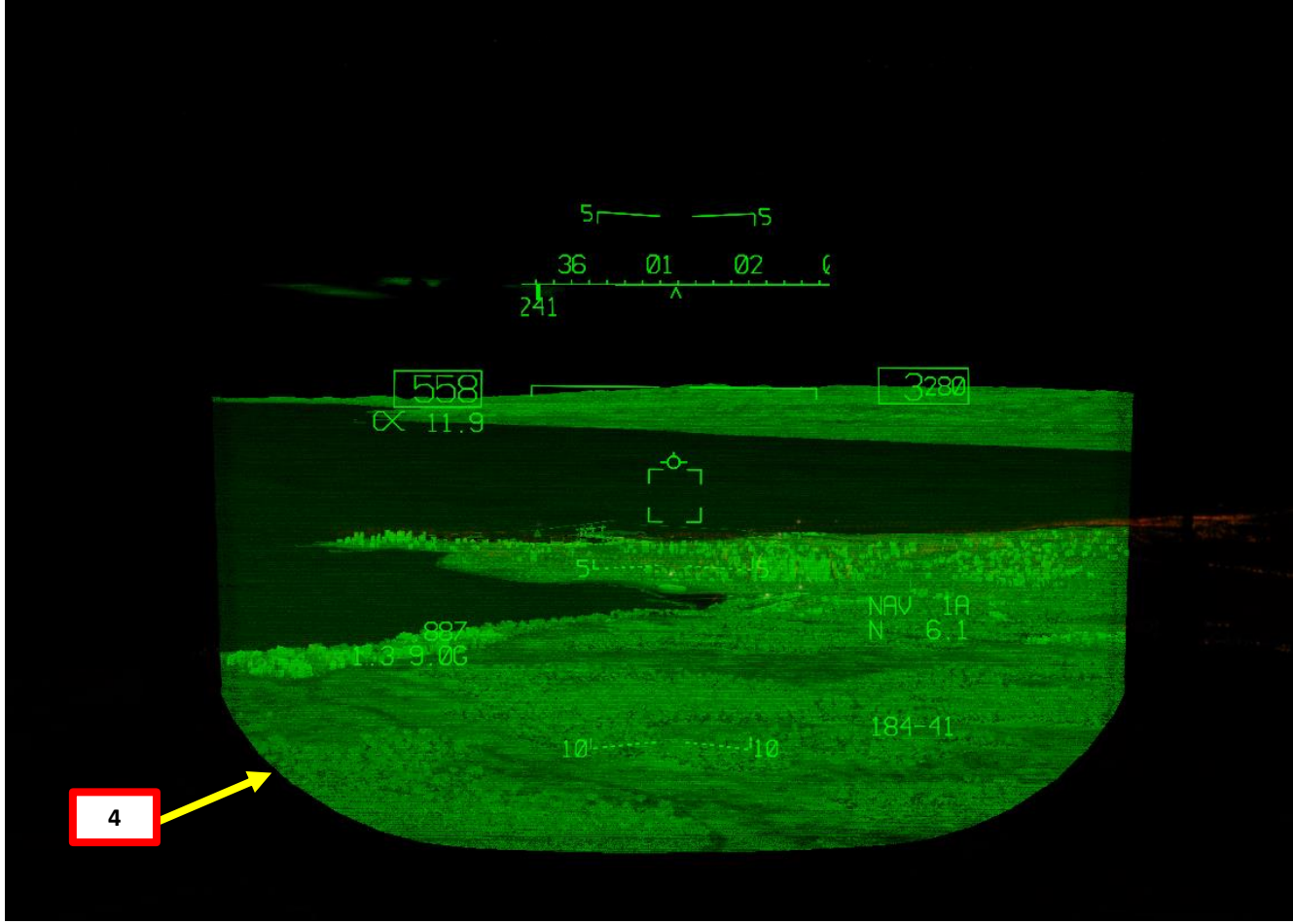
Take note that the NAV FLIR camera is located on the Navigation Pod, therefore the view is not centered with the aircraft… in fact, it is offset to the right. This is quite apparent if you taxi at night.

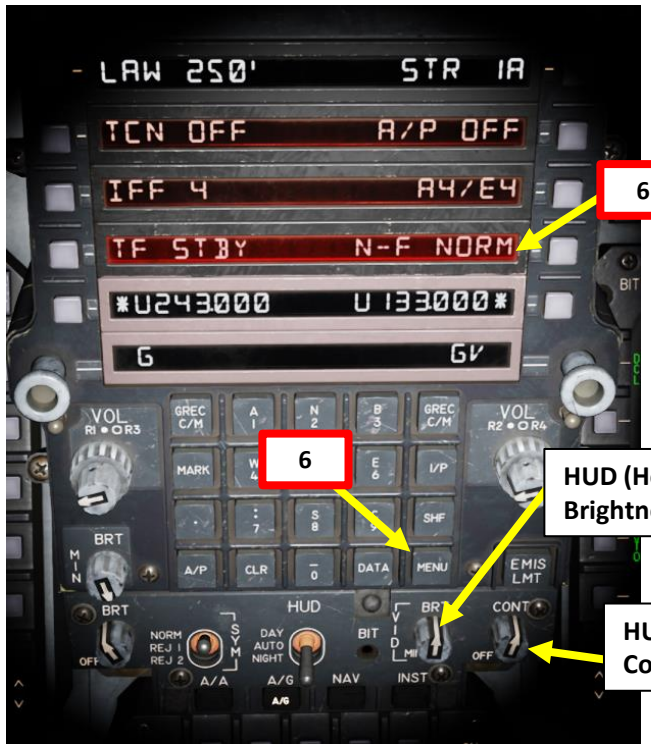


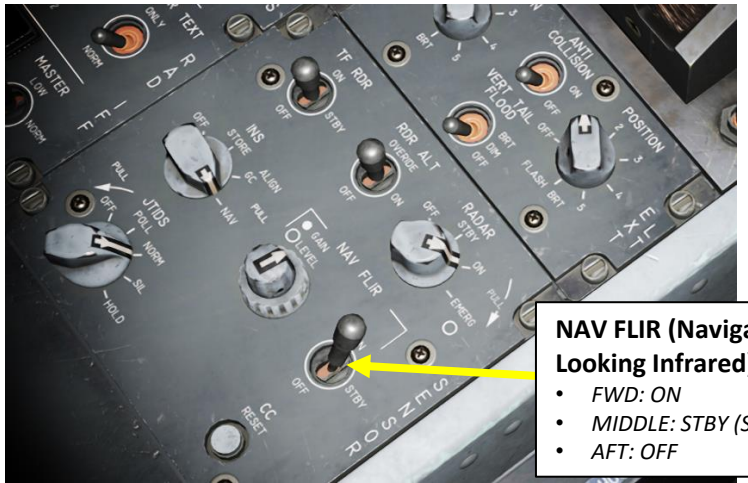
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.2 – Power-Up

To use NAV FLIR:

1. Set NAV FLIR Power Switch – ON (FWD).
2. Set HUD Video Brightness Control Knob – As desired beyond OFF mark.
3. Set HUD Contrast Control Knob – As desired beyond OFF mark.
4. The HUD Video Brightness and Contrast knobs both need to be turned ON for the NAV FLIR feed to appear on the Heads-Up Display.
5. The feed is taken from the pod's camera, which is located below the aircraft and a few feet to the right of the nose.
6. If "Menu 1" Data Fields are not displayed on the UFC (Upfront Control Panel), press the "MENU" button until the "N-F NORM" indication is visible. This means that the NAV FLIR system is operating in Normal (NORM) mode.





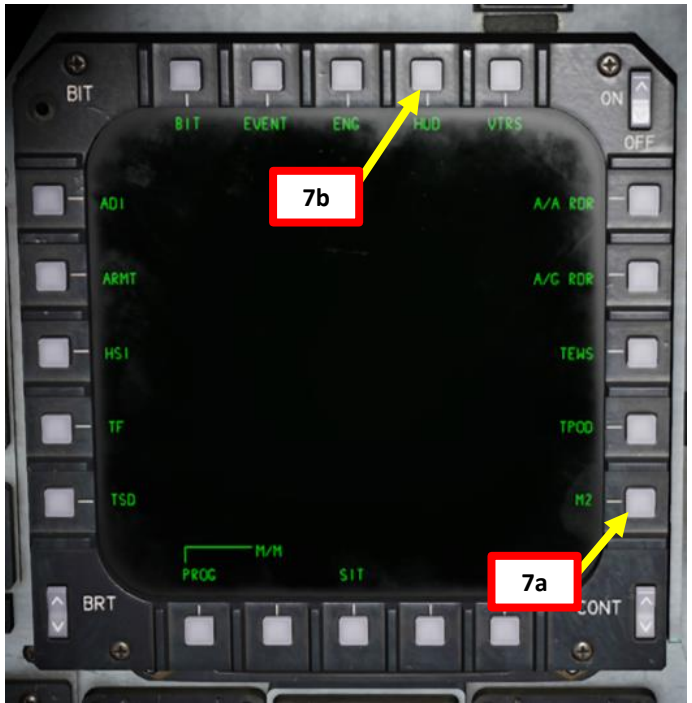


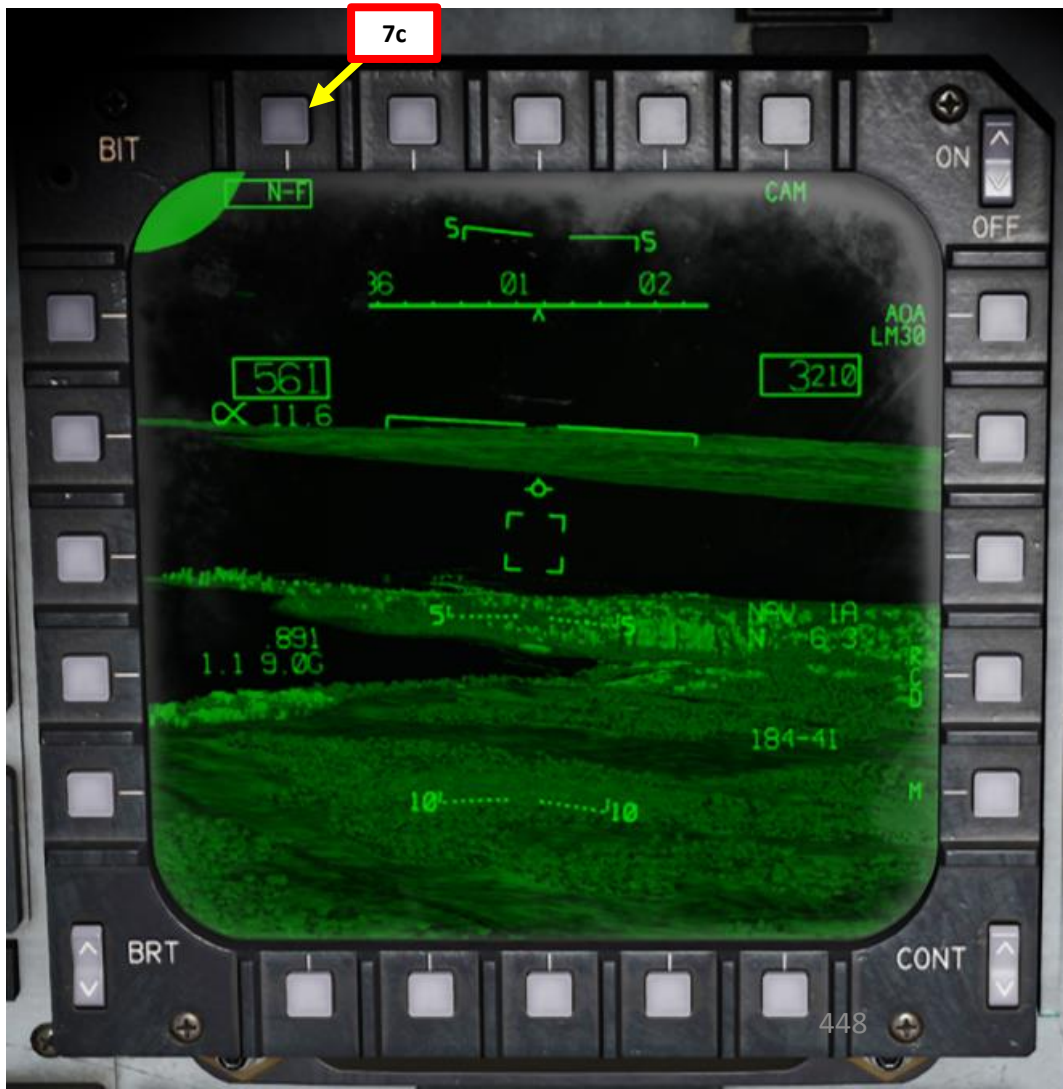
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.2 – Power-Up

To use NAV FLIR:

7. To see the NAV FLIR repeater on a MPD (Multipurpose Display), from the main MPD menu page, select HUD page, then select N-F button (boxed when selected).
8. Adjust NAV FLIR Gain by rotating the Inner Gain/Level Control Knob.
    - This knob controls the navigation pod settings; it can be used to adjust the image displayed on HUD repeater on MPD / MPCD (independently from the controls for the HUD).
9. Adjust NAV FLIR Level by rotating the Outer Gain/Level Control Knob.
    - This knob controls the navigation pod settings; it can be used to adjust the image displayed on HUD repeater on MPD / MPCD (independently from the controls for the HUD).

NAV FLIR (Navigation Forward-Looking Infrared) Gain/Level Control Knob
- *INNER KNOB: Gain Control*
- *OUTER KNOB: Level Control*

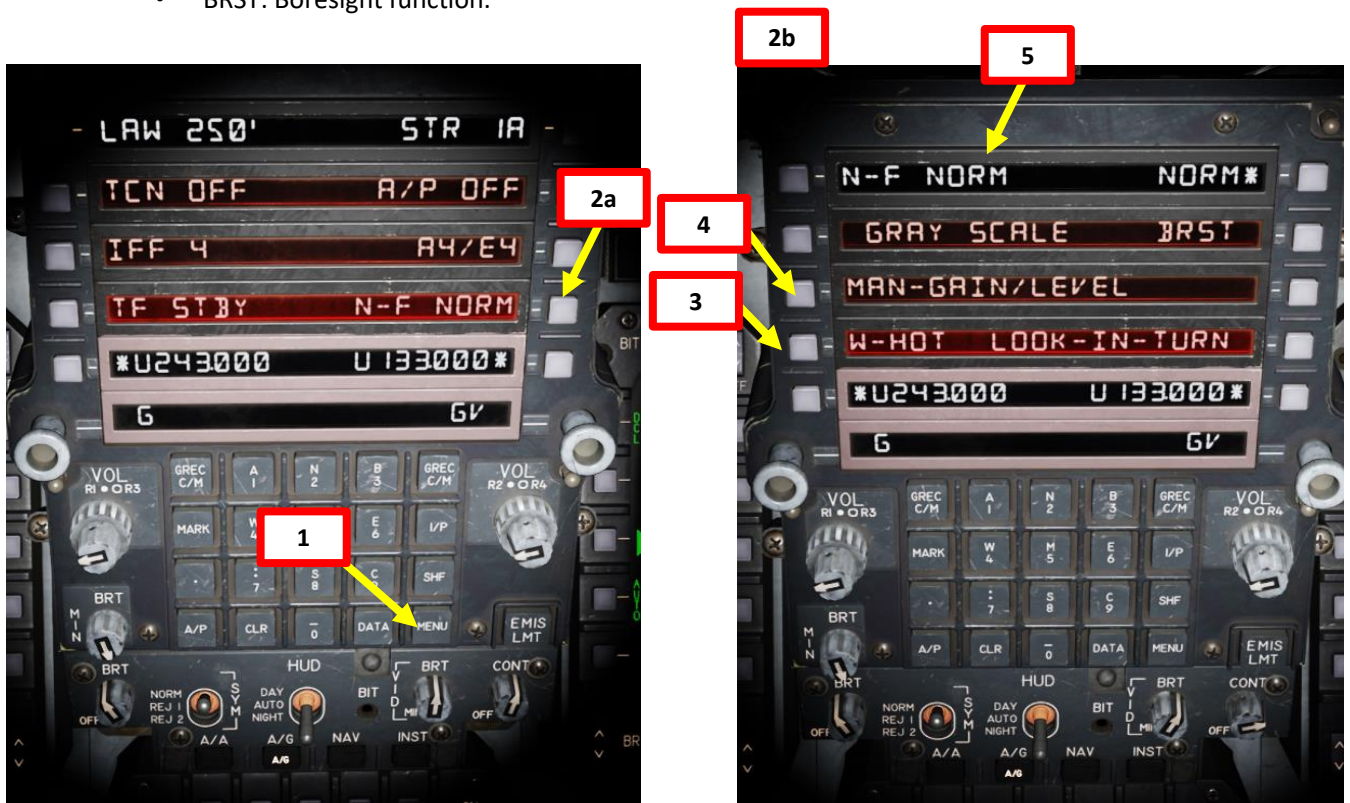


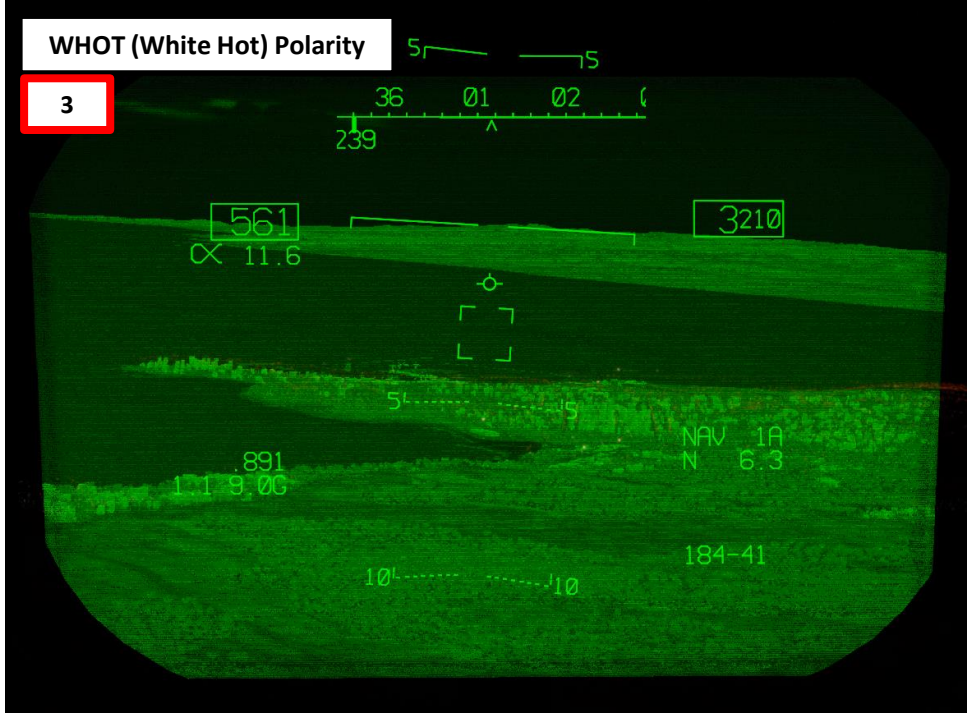


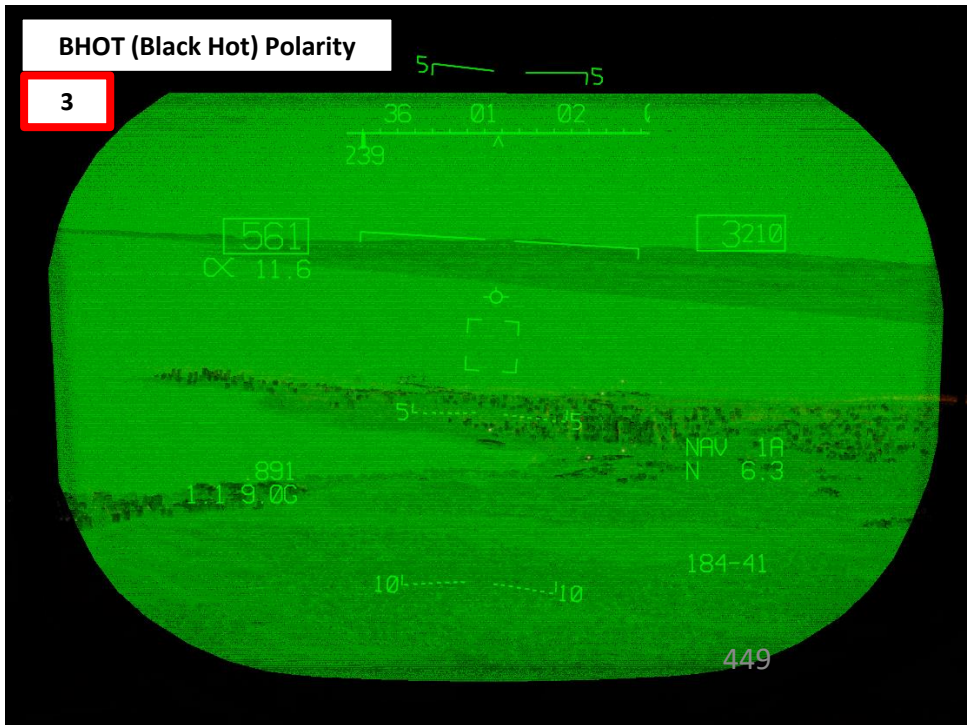
4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.3 – Controls & Interface

To access NAV FLIR settings:

1. If “Menu 1” Data Fields are not displayed on the UFC (Upfront Control Panel), press the “MENU” button until the “N-F NORM” indication is visible.
2. Press button next to “N-F” Data Field to enter UFC NAV FLIR menu.
3. Press button next to “W-HOT/B-HOT” to toggle between White Hot and Black Hot polarity.
4. Press button next to “MAN/AUT GAIN/LEVEL” to toggle between automatic and manual Gain/Level control.
5. The Data Field next to N-F indicates the NAV FLIR status:
    - OFF: No power supplied or no LANTIRN installed.
    - N/R: Not ready .
    - STBY: Standby.
    - NORM: Normal operation.
    - BRST: Boresight function.



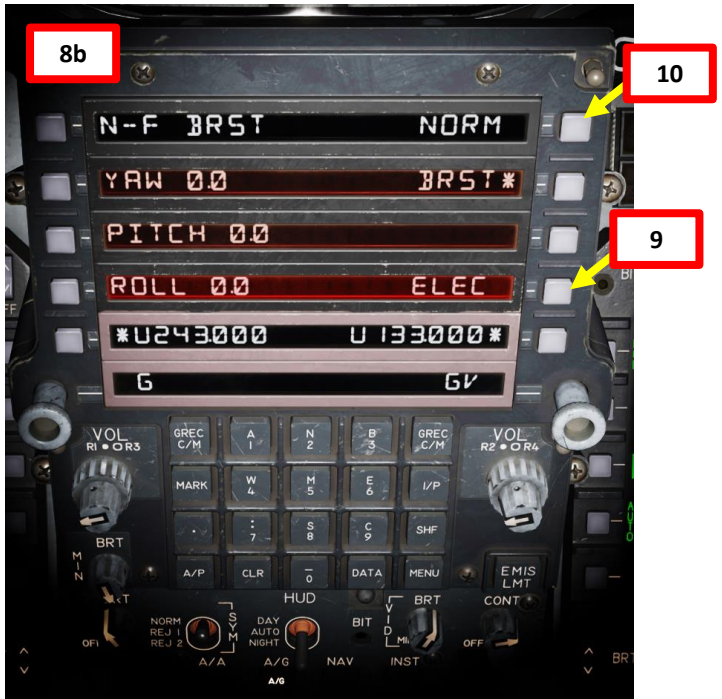




4 – AN/AAQ-13 LANTIRN NAVIGATION POD (NVP)
4.3 – NAV FLIR
4.3.3 – Controls & Interface

To access NAV FLIR settings:

6. If GRAY SCALE is selected, a gray scale is displayed across the bottom of the HUD in order to adjust the HUD contrast / brightness. **Not implemented.**
7. If pressing the pushbutton next to LOOK-IN-TURN function (* when selected), the pod automatically positions its line of sight 6 deg in the direction of turn when the bank angle is greater than 33 deg. It can also work in manual mode with Coolie switch pressed. **Not implemented.**
8. If you want to boresight the pod to align with the nose of the aircraft / real world image through the HUD, press button next to BRST to select BORESIGHT function. Values indicated next to YAW, PITCH and ROLL should already be set up correctly, but it is still 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).
9. If BRST function is selected, the ELEC function (* when selected) allows for the boresight to be electrically slewed using the TDC (Target Designation Control) in order to align the NAV FLIR image with the real world image visible through the HUD. **Not implemented.**
10. Pressing NORM pushbutton returns NAV FLIR to NORMAL mode (* when selected).



5 – JHMCS (JOINT HELMET-MOUNTED CUEING SYSTEM)

Note: JHMCS is not implemented yet for the DCS F-15E.

SECTION STRUCTURE

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  - 1.1 – Introduction to Weapons
  - 1.2 – Armament Overview
  - 1.3 – My Weapons Control Setup
  - 1.4 – PACS (Programmable Armament Control Set) Page
  - 1.5 – Re-Arming Considerations
  - 1.6 – Bomb Delivery Modes

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    - 2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
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    - 2.5.1 – Introduction to Smart Weapons
    - 2.5.2 – GBU-38 JDAM: Pre-Planned Target (CC MEM) with Auto Mode
    - 2.5.3 – AGM-154A JSOW : Pre-Planned Target (WPN MEM) with Direct Mode
    - 2.5.4 – GBU-31(V)3/B JDAM: Air-to-Ground Radar (WPN MEM) with Auto Mode
    - 2.5.5 – GBU-54B LJDAM: Targeting Pod (WPN MEM) with Auto Mode
  - 2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
    - 2.6.1 – CDIP Mode
    - 2.6.2 – Manual Mode **(Not available yet)**
  - 2.7 – AGM-65 Maverick Air-to-Ground Missile **(Not available yet)**

- **3 – AIR-TO-AIR WEAPONS**
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    - 3.1.1 – Funnel (FNL) Gunsight Mode (No Radar)
    - 3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)
    - 3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)
  - 3.2 – Infrared-Guided AIM-9 Sidewinder Missile
    - 3.2.1 – AIM-9M (No Radar)
    - 3.2.2 – AIM-9P (With Radar)
  - 3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)
  - 3.4 – Active Radar Homing AIM-120C AMRAAM Missile
    - 3.4.1 – Single Target (With Radar)
    - 3.4.2 – Multiple Targets (With Radar)

- **4 – ORDNANCE JETTISON**
  - 4.1 – Selective Ordnance Jettison
  - 4.2 – Emergency Stores Jettison

1 – INTRODUCTION
1.1 – Introduction to Weapons

The F-15E carries a good variety of weapons. The strength of the Mudhen lies in its array of sensors: the radar and targeting pod provide you a lot of information in order to use both guided and unguided weapons with great precision. The Strike Eagle is a multirole aircraft by design, therefore the types of missions you can perform is quite extensive. Most of the weapon functions are directly accessible from HOTAS (Hands On Throttle And Stick) controls. The workload should be relatively light while allowing you as many options to use your weapons as the mission requires.

1 – INTRODUCTION
1.2 – Armament Overview

BOMBS

WEAPON	TYPE	WEAPON	TYPE
MK-82	500 lbs low-drag unguided bomb ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***	***CBU-87***	Combined Effects Munitions (CEM) weighs 950 lbs and is an all-purpose cluster bomb. ***Fuze Setting:*** • ***N/T (Nose & Tail): Bomblets dispense using settings displayed on ARMT/PACS page*** • ***NOSE: Bomblets dispense immediately after release*** • ***TAIL: Dud (Disarmed)***
MK-82SE Snake Eye	500 lbs unguided low-drag retarded bomb ***Fuze Setting:*** • ***N/T (Nose & Tail): High Drag*** • ***NOSE: Low Drag*** • ***TAIL: High Drag***	***CBU-97***	1,000-pound class weapon containing sensor-fused sub-munitions for specifically attacking armor. ***Fuze Setting:*** • ***N/T (Nose & Tail): Bomblets dispense using settings displayed on ARMT/PACS page*** • ***NOSE: Bomblets dispense immediately after release*** • ***TAIL: Dud (Disarmed)***
MK-82AIR	500 lbs high-drag unguided bomb ***Fuze Setting:*** • ***N/T (Nose & Tail): High Drag*** • ***NOSE: Low Drag*** • ***TAIL: High Drag***	***CBU-105***	Wind Corrected Munitions Dispenser (WCMD, or "Wick Mid") tail kit version of the CBU-97. Using Inertial Navigation System (INS) guidance, the CBU-105 can be dropped at much higher altitudes than the CBU-97 and guide to the targeted location. The CBU-105 contains sensor-fused sub-munitions for specifically attacking armor.
MK-84	2000 lbs low-drag unguided bomb ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***	***BDU-50***	500 lbs inert training bomb
MK-84AIR	2000 lbs high-drag unguided bomb ***Fuze Setting:*** • ***N/T (Nose & Tail): High Drag*** • ***NOSE: Low Drag*** • ***TAIL: High Drag***	***GBU-10/12 Paveway II***	2000/500 lbs laser-guided bomb ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***
MK-20 Rockeyes	490 lbs unguided cluster munitions (247 x HEAT bomblets)	***GBU-24 Paveway III***	2000 lbs laser-guided bomb ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***

1 – INTRODUCTION
1.2 – Armament Overview

BOMBS

WEAPON	TYPE	WEAPON	TYPE
AGM-154A JSOW	Global Positioning System (GPS)-guided Joint Standoff Weapon (JSOW) glide bombs	***GBU-31 JDAM***	2000 lbs Global Positioning System (GPS)-guided Joint Direct Attack Munition (JDAM) bombs ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***
GBU-38 JDAM	500 lbs Global Positioning System (GPS)-guided Joint Direct Attack Munition (JDAM) bombs ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***	***GBU-54 LJDAM***	A hybrid of a GBU-38 JDAM and a GBU-12 laser-guided bomb is the GBU-54 LJDAM (Laser Joint Directed Attack Munition) ***Fuze Setting:*** • ***Either Nose, Tail, or N/T (Nose/Tail) for redundancy.***
BLU-107 Durandal	440 lbs Anti-Runway penetration bomb. • 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.		

AIR-TO-AIR MISSILES

WEAPON	TYPE
AIM-9J/L/M Sidewinder	Infrared guided air-to-air missile.
AIM-7F/M/MH Sparrow	Semi-active radar-guided air-to-air missile.
AIM-120B/C AMRAAM	Advanced Medium Range Air-to-Air Missile (AMRAAM), active radar homing air-to-air missile.

GUN

WEAPON	TYPE
M61A1 Vulcan	Six-barrel 20 mm Gatling-type rotary cannon (500 rounds).

AIR-TO-GROUND MISSILES

WEAPON	TYPE
AGM-65 Maverick	Air-to-Ground missile guided by infrared imaging system and used at night and during bad weather. **(Not simulated yet)**

1 – INTRODUCTION
1.3 – My Weapons Control Setup

Real Aircraft Controls (Pilot)

Weapon Release (Pickle) Button
- *Binding: RALT+SPACE*

Flight Stick

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

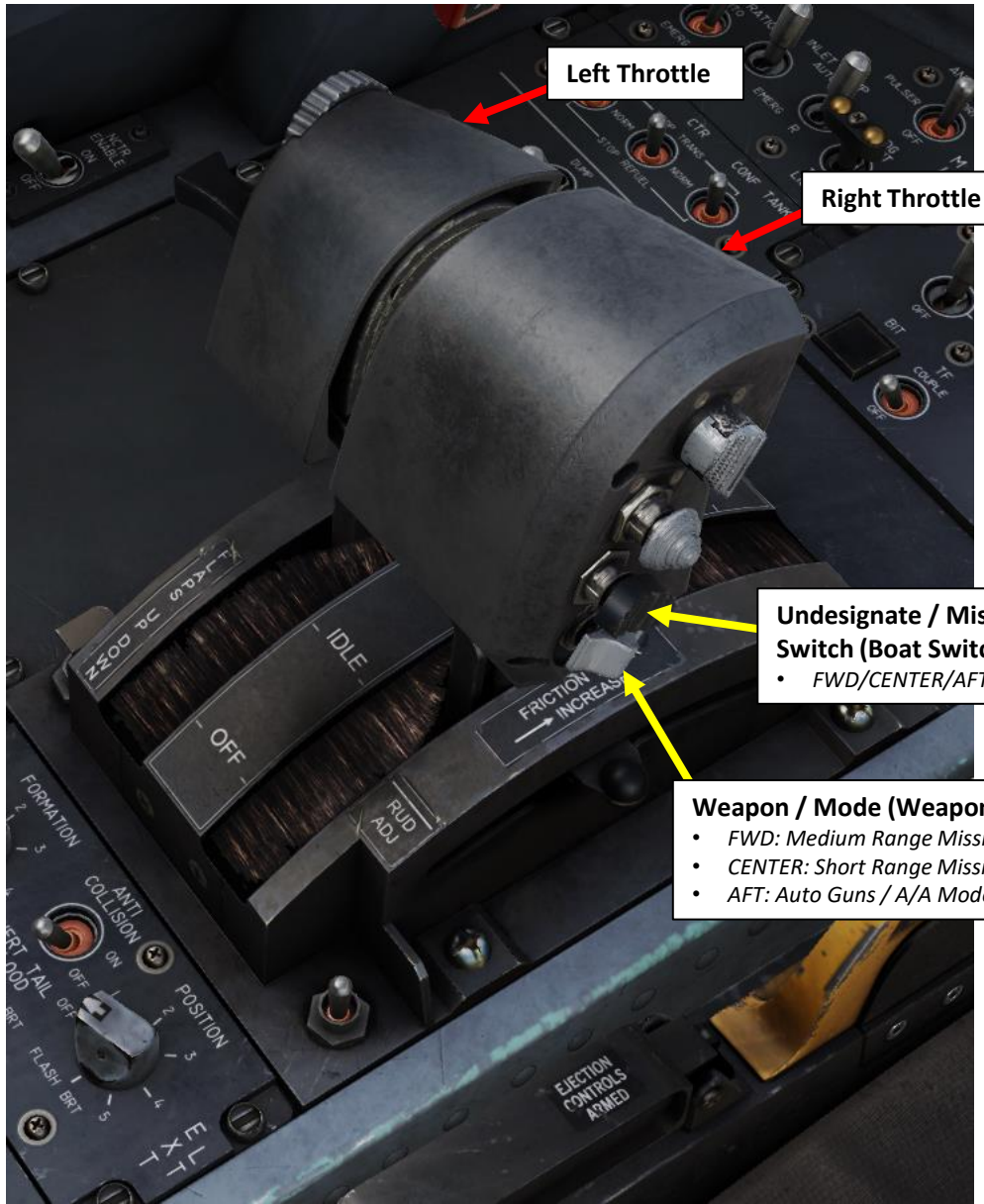
Castle Switch

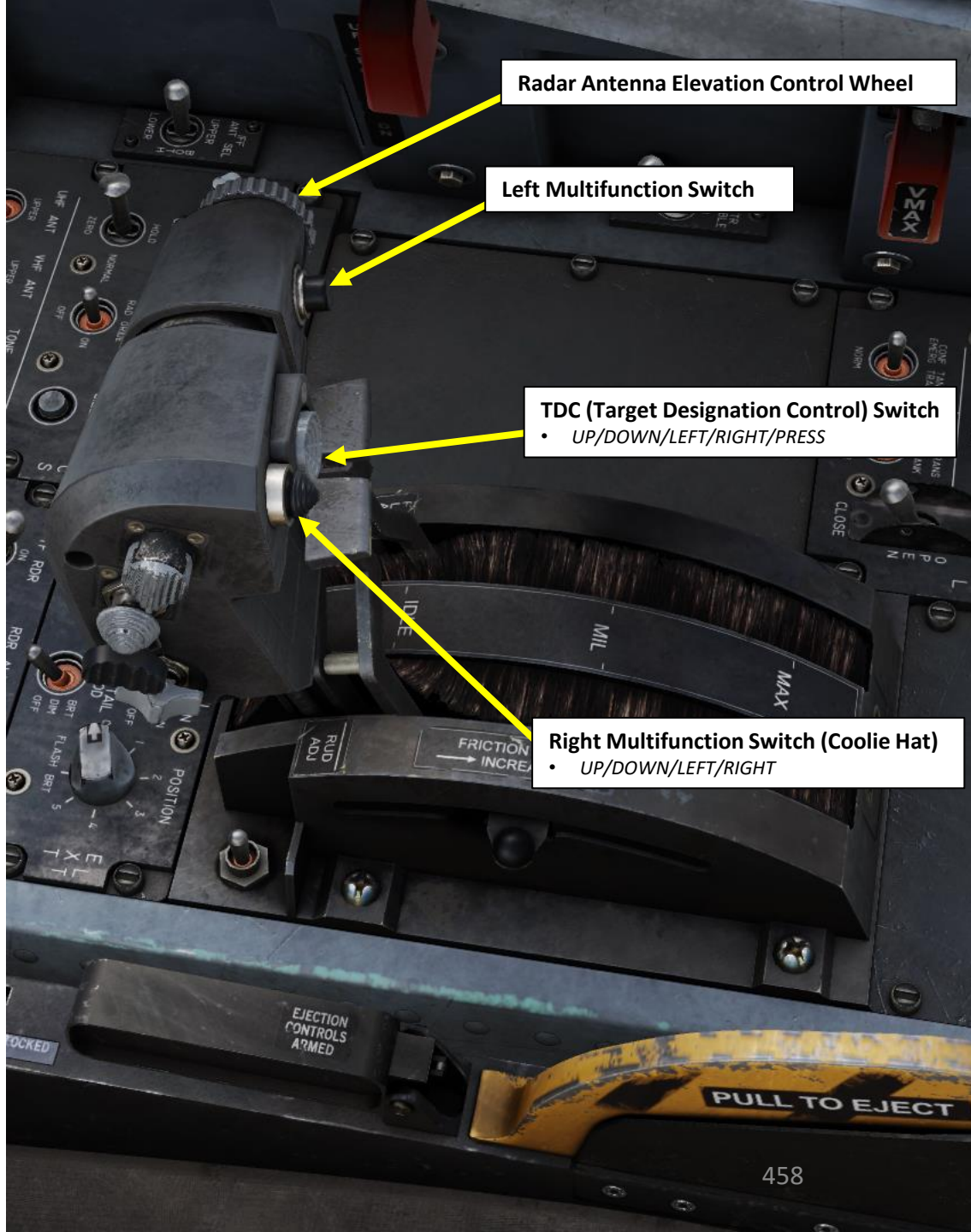
The switch has different functions depending on the situation and selected sensors. It is mainly responsible for switching between and taking command of different sensors, as well as controlling the Nav Pod and moving back and forth between master modes.
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

NWS (Nosewheel Steering) / Weapons Button

1 – INTRODUCTION
1.3 – My Weapons Control Setup

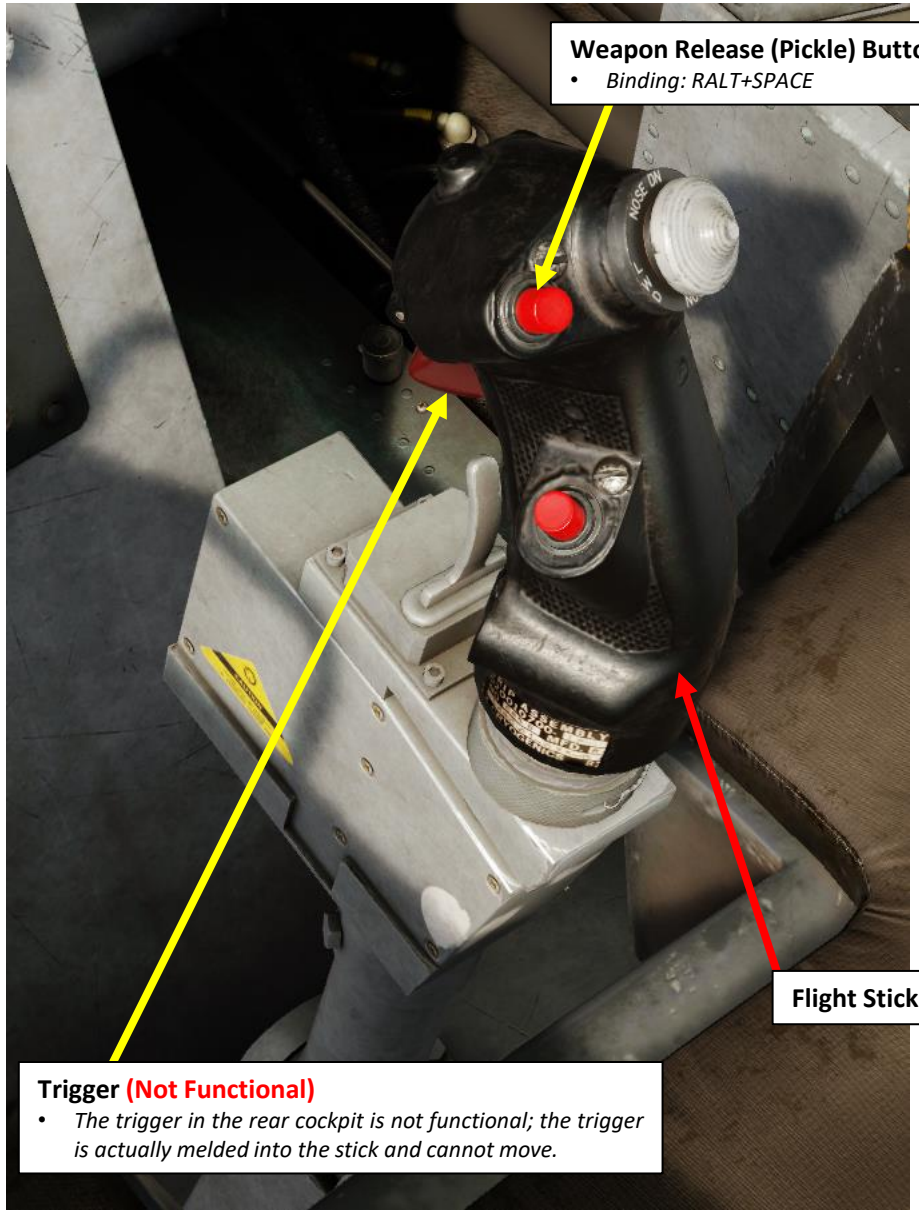
Real Aircraft Controls (Pilot)

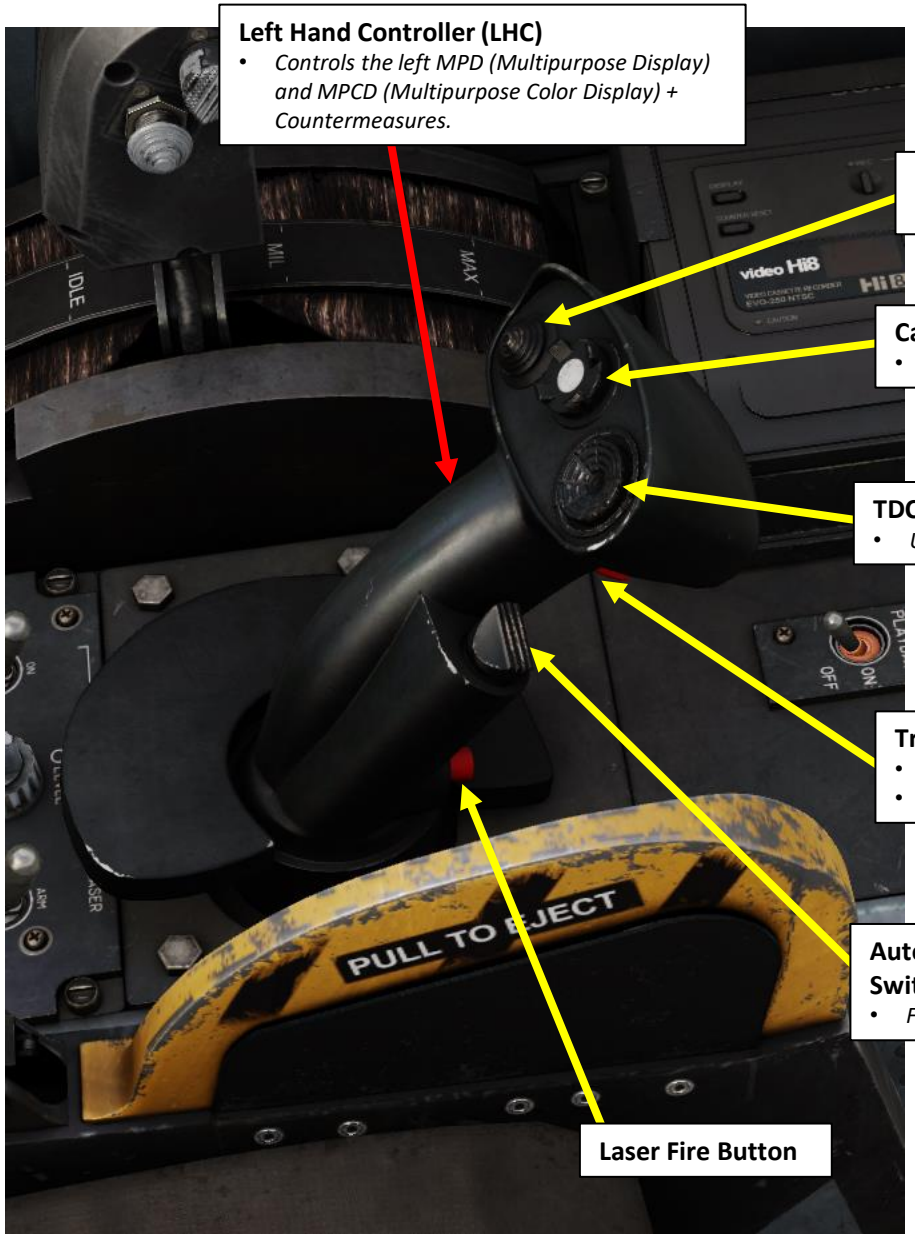




1 – INTRODUCTION
1.3 – My Weapons Control Setup

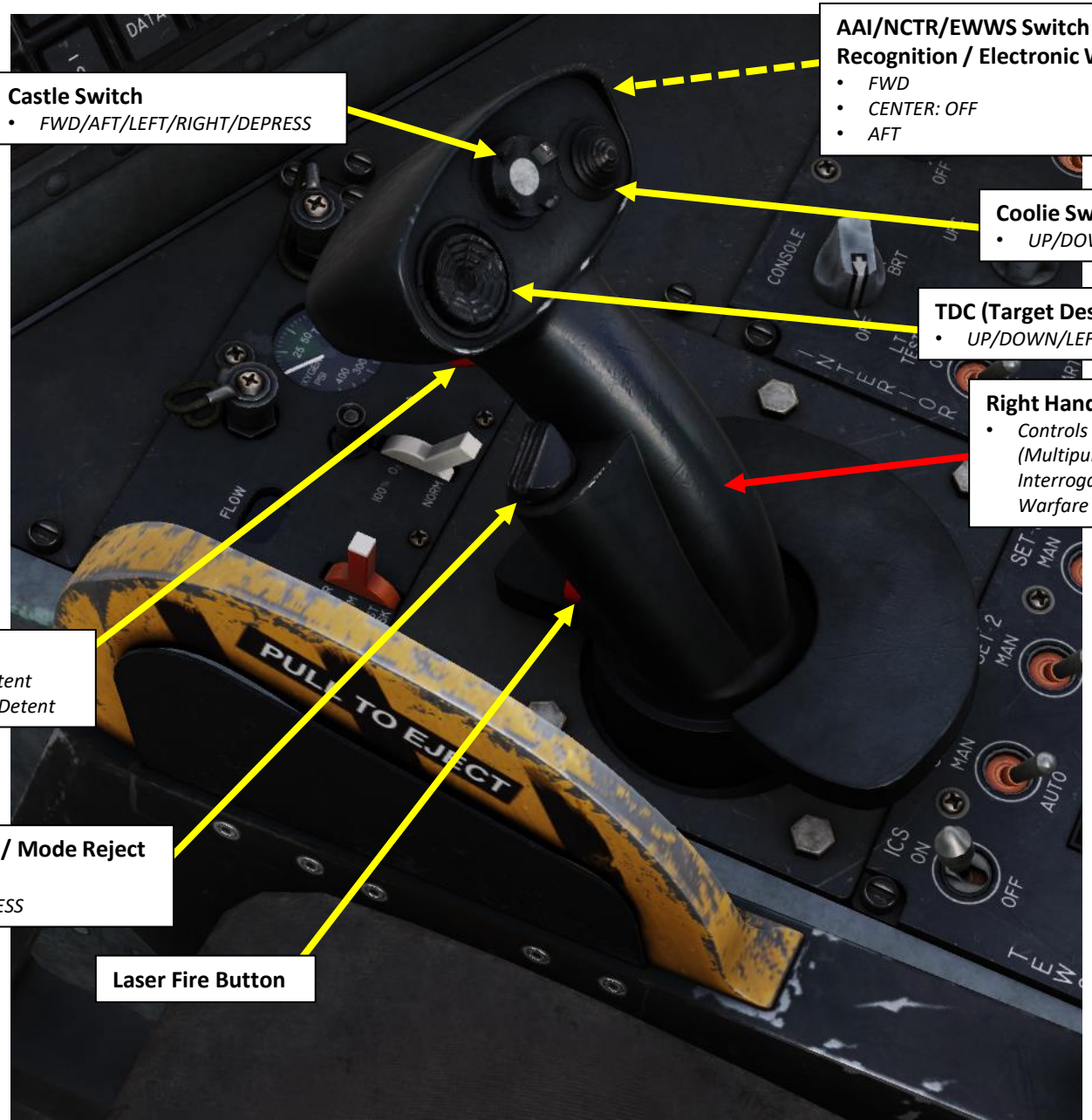
Real Aircraft Controls (WSO)





1 – INTRODUCTION
1.3 – My Weapons Control Setup

Real Aircraft Controls (WSO)



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Right Hand Controller (RHC)
- *Controls the right MPD (Multipurpose Display) and MPCD (Multipurpose Color Display) + the AAI/NCTR/EWWS (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set).*

Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

Laser Fire Button

1 – INTRODUCTION
1.3 – My Weapons Control Setup

My Controls (Pilot)

↑ Castle Switch – FWD
→ Castle Switch – RIGHT
↓ Castle Switch – AFT
← Castle Switch – LEFT

↑
→ TDC – PRESS
↓
← Castle Switch – PRESS

Weapon Release (Pickle)
(RALT+Space)

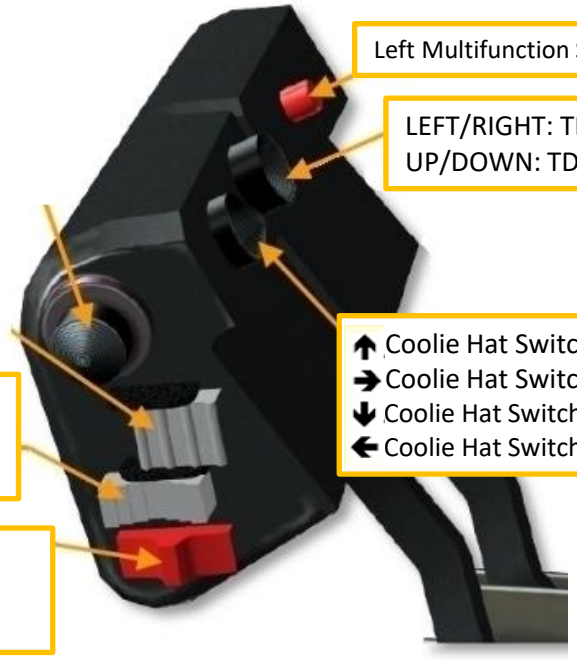
Trigger (First Detent)
Trigger (Second Detent, Space)

↑ Auto Acquisition Switch – FWD
→
↓ Auto Acquisition Switch – AFT
←
P Auto Acquisition Switch – PRESS

NWS (Nosewheel Steering) / Weapons Button

1 – INTRODUCTION
1.3 – My Weapons Control Setup

My Controls (Pilot)



Left Multifunction Switch

LEFT/RIGHT: TDC Slew Axis – Horizontal (JOY X)
UP/DOWN: TDC Slew Axis – Vertical (JOY Y)

Coolie Hat Switch – UP
Coolie Hat Switch – RIGHT
Coolie Hat Switch – DOWN
Coolie Hat Switch – LEFT

Boat Switch (Undesignate / Missile Reject) – AFT

Boat Switch (Undesignate / Missile Reject) – FWD

Weapons / Mode Switch Cycle – AFT

Weapons / Mode Switch Cycle – FWD

Radar Antenna
Elevation (JOY SLIDER)

1 – INTRODUCTION
1.3 – My Weapons Control Setup

Note: Controls in Red use the LSHIFT Modifier. This simulates using the right hand controller (RHC) instead of the left hand controller (LHC).

My Controls (WSO)

↑ LHC / **RHC** Castle Switch – FWD
→ LHC / **RHC** Castle Switch – RIGHT
↓ LHC / **RHC** Castle Switch – AFT
← LHC / **RHC** Castle Switch – LEFT

Weapon Release (Pickle)
(RALT+Space)

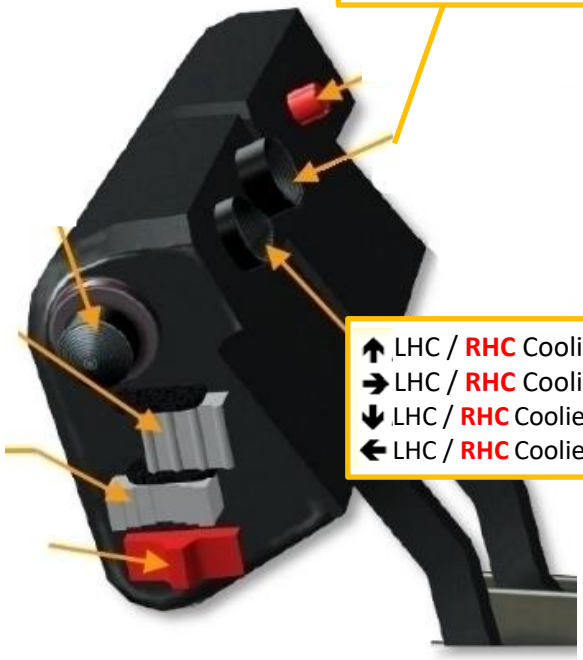
↑
→ LHC / **RHC** TDC – PRESS
↓
← LHC / **RHC** Castle Switch – PRESS

LHC / **RHC** Trigger (HA, Half-Action Detent)
LHC / **RHC** Trigger (FA, Full-Action Detent)

↑ LHC / **RHC** Auto Acquisition Switch – FWD
→ RHC – AAI Switch – FWD
↓ LHC / **RHC** Auto Acquisition Switch – AFT
← RHC – AAI Switch – AFT
P LHC / **RHC** Auto Acquisition Switch – PRESS

LHC / **RHC** – Laser Fire

LEFT/RIGHT: LHC / **RHC** TDC Slew Axis – Horizontal (JOY X)
UP/DOWN: LHC / **RHC** TDC Slew Axis – Vertical (JOY Y)



↑ LHC / **RHC** Coolie Hat Switch – UP
→ LHC / **RHC** Coolie Hat Switch – RIGHT
↓ LHC / **RHC** Coolie Hat Switch – DOWN
← LHC / **RHC** Coolie Hat Switch – LEFT

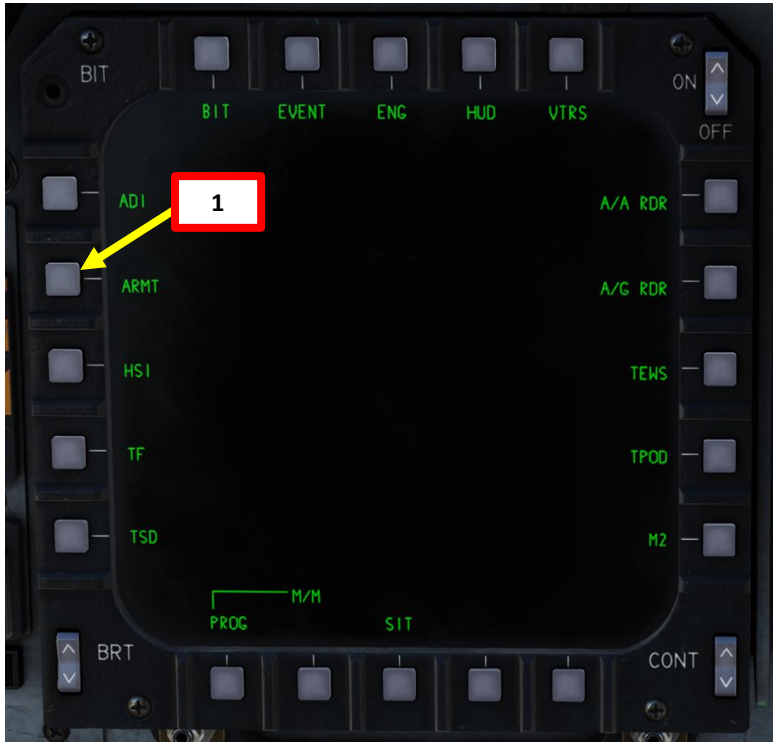
1 – INTRODUCTION
1.4 – PACS (Programmable Armament Control Set) Page

PACS (Programmable Armament Control Set), also referred as the ARMT (Armament) page, provides weapon monitoring and weapon 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. There are two main modes of PACS operation for A/A (Air-to-Air) and A/G (Air-to-Ground) domains:

- **Combat (CMBT):** This mode is used to operate weapons in… err… combat (d'uh!).
- **Training (TRNG)**: In this mode, munitions cannot be expended for as long as A/G TRNG (or 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.

These modes can be enabled independently between the domains. PACS menu can be accessed from Menu 1 on any MPD / MPCD by pressing the **ARMT pushbutton**.



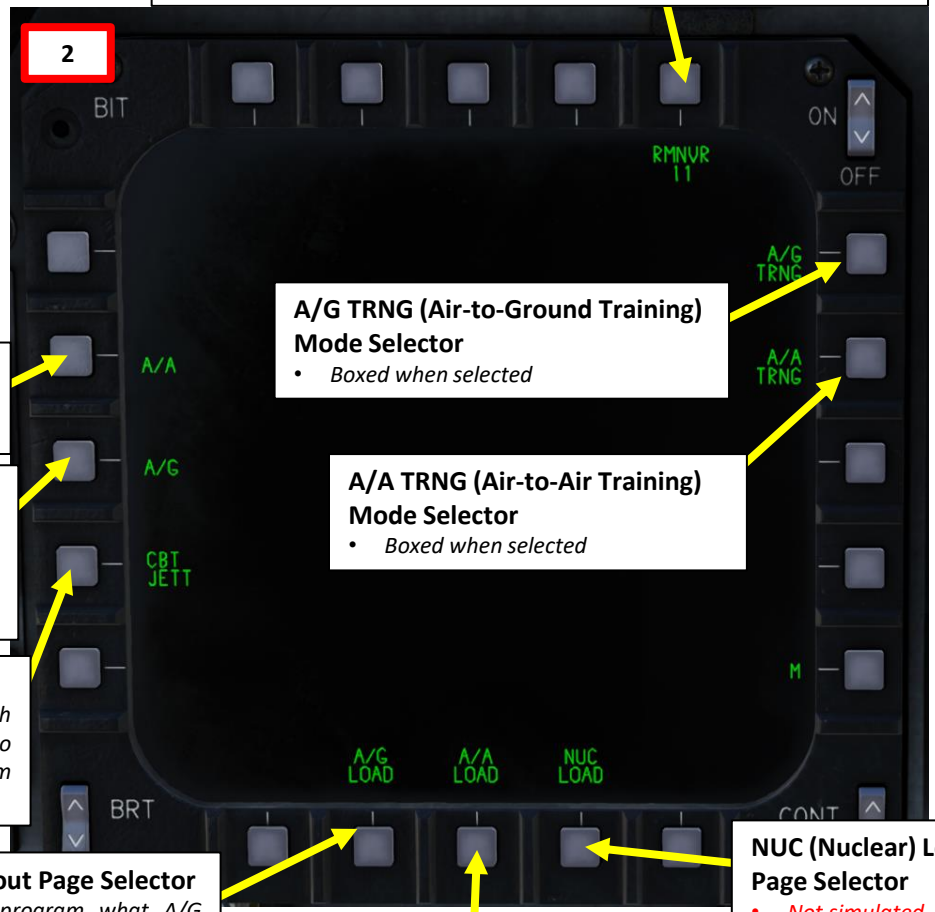
A/A (Air-to-Air) Combat Page Selector
- *Shows A/A weapon configuration, status and arming status*

A/G (Air-to-Ground) Combat Page Selector
- *Shows A/G weapon configuration, status and arming status.*
- *Used to program delivery profiles (A/G DLVRY)*

CBT JETT (Combat Jettison) Page Selector
- *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 a button.*

A/G (Air-to-Ground) Loadout Page Selector
- *Allows you to manually program what A/G weapon is installed on which station since some weapons are not automatically detected..*

RMNVR (Medium Range Missile Manoeuvering Range) Selector
- *Pressing this pushbutton 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 deg.*



A/G TRNG (Air-to-Ground Training) Mode Selector
- *Boxed when selected*

A/A TRNG (Air-to-Air Training) Mode Selector
- *Boxed when selected*

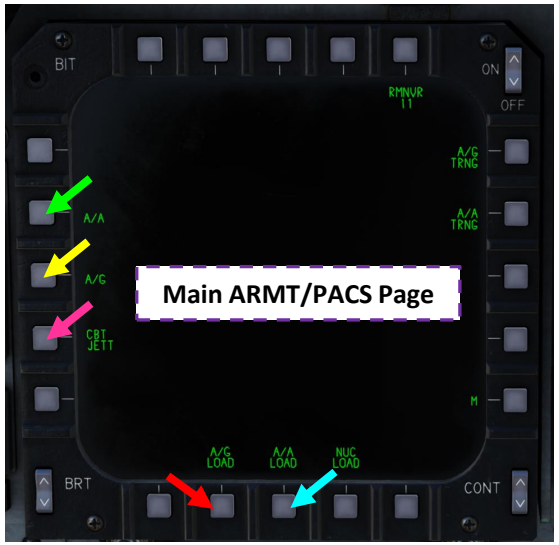
NUC (Nuclear) Loadout Page Selector
- *Not simulated*

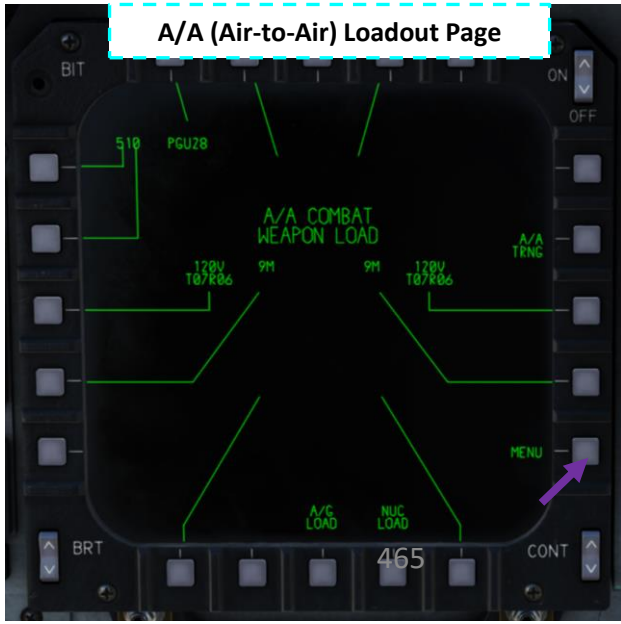
A/A (Air-to-Air) Loadout Page Selector
- *Allows you to manually program what A/A weapon is installed on which station since some weapons are not automatically detected..*

1 – INTRODUCTION
1.4 – PACS (Programmable Armament Control Set) Page

Here is an overview of the PACS sub-menus.

Selecting **MENU** returns to the main ARMT/PACS page.

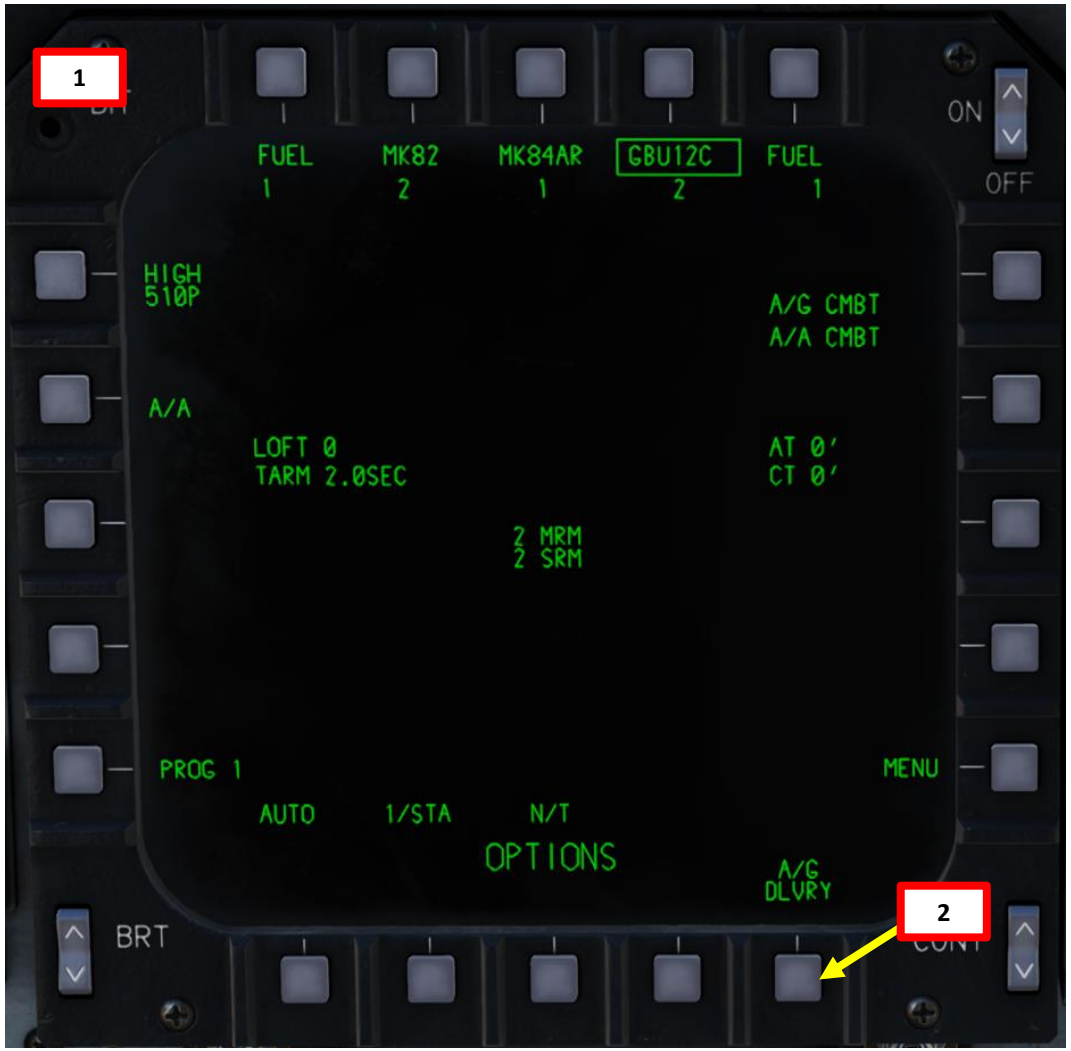




1 – INTRODUCTION
1.4 – PACS (Programmable Armament Control Set) Page

From the **A/G Combat page**, you can select a weapon and program its delivery profile (**A/G DLVRY page**).
We will explain them further in weapon-specific tutorials.

A/G (Air-to-Ground) Combat Page

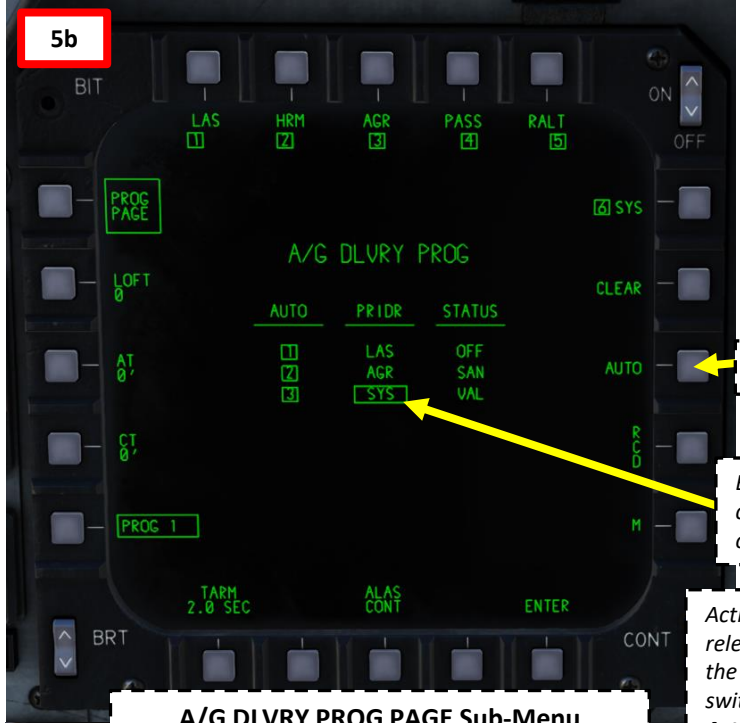


A/G DLVRY (Air-to-Ground Delivery) Page

1 – INTRODUCTION
1.4 – PACS (Programmable Armament Control Set) Page

From the **A/G DLVRY (Air-to-Ground Delivery) page's PROG PAGE sub-menu**, you can program **onboard sensor hierarchy** (which sensors take precedence when designating a target to compute range, firing solution, etc.). We will explain them further in weapon-specific tutorials.

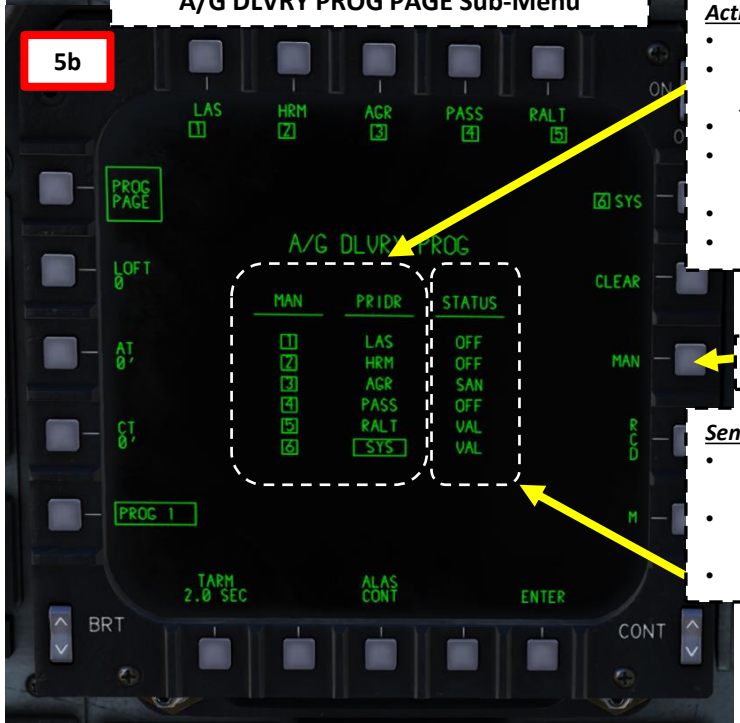
A/G DLVRY (Air-to-Ground Delivery) Page



Auto Sensor Hierarchy

Box indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG).

A/G DLVRY PROG PAGE Sub-Menu



Active Sensor Hierarchy (is used 15 sec before release to increase accuracy). If first sensor on the list becomes unavailable, the system switches to the next one, and so on.

Active sensor legend:

- ***LAS**: Targeting pod laser ranging*
- ***HRM**: Ground range to target designated from high resolution map (HRM) patch map*
- ***AGR**: Air-to-ground radar ranging*
- ***PASS**: Passive ranging from targeting pod line-of-sight (LOS) and LOS rate*
- ***RALT**: Radar altimeter*
- ***SYS**: System altitude*

Manual Sensor Hierarchy

Sensor Status legend:

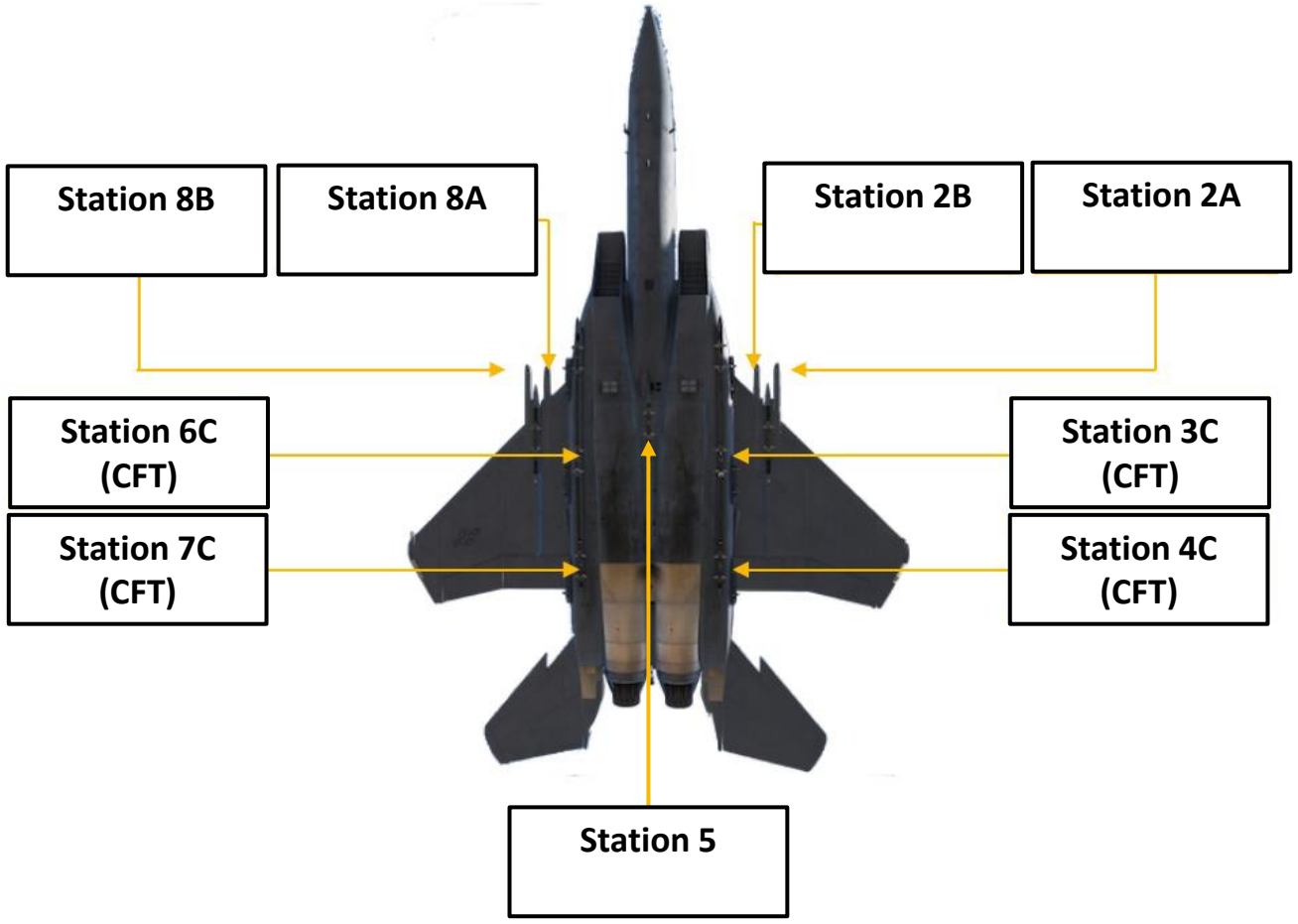
- ***VAL**: Sensor passes validity and HUD sanity checks*
- ***SAN**: Sensor does not pass HUD sanity checks*
- ***OFF**: Sensor cannot be used*

1 – INTRODUCTION
1.5 – Re-Arming Considerations

The F-15E is a great multirole platform, but it still has some loadout restrictions. Even if it is possible to mix air-to-air and air-to-ground ordnance, there are many restrictions linked to the shape and proximity of certain weapons.

As a general rule:

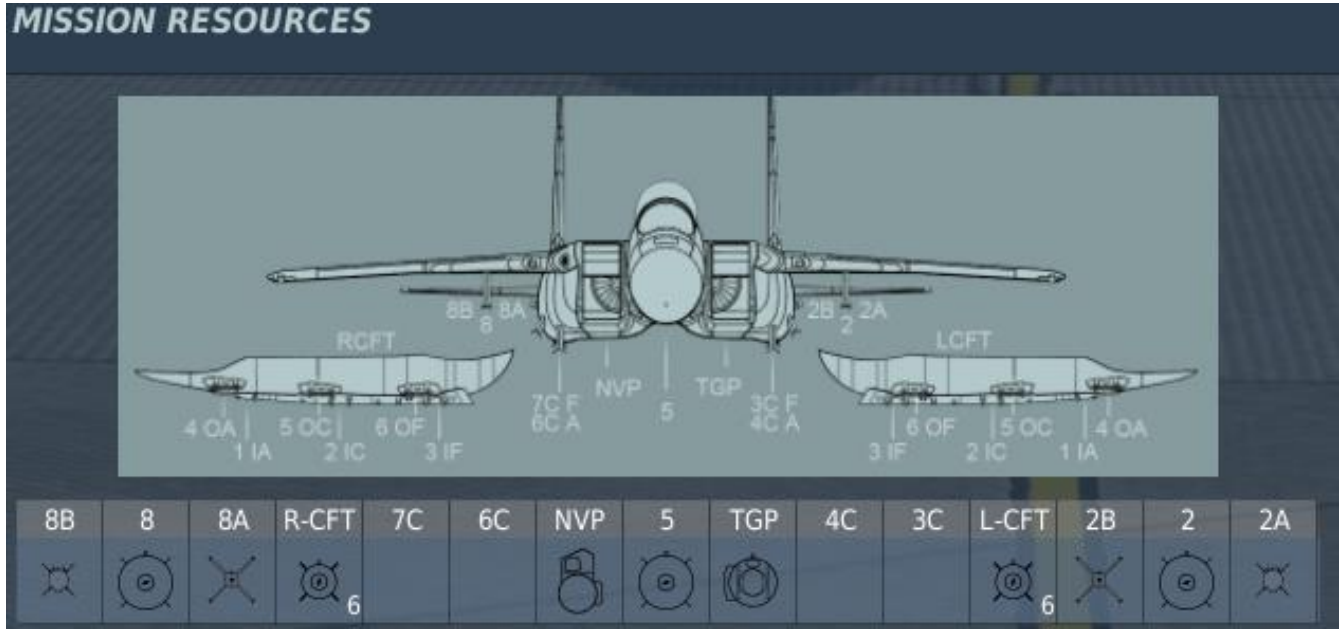
- Air-to-Air missiles cannot be loaded on stations 2A-B and 8A-B next to some guided-bomb units (GBUs).
- If bombs are present on L and R CFT (Left and Right Conformal Fuel Tank), no missiles can be added to stations 3C, 4C, 6C and 7C.

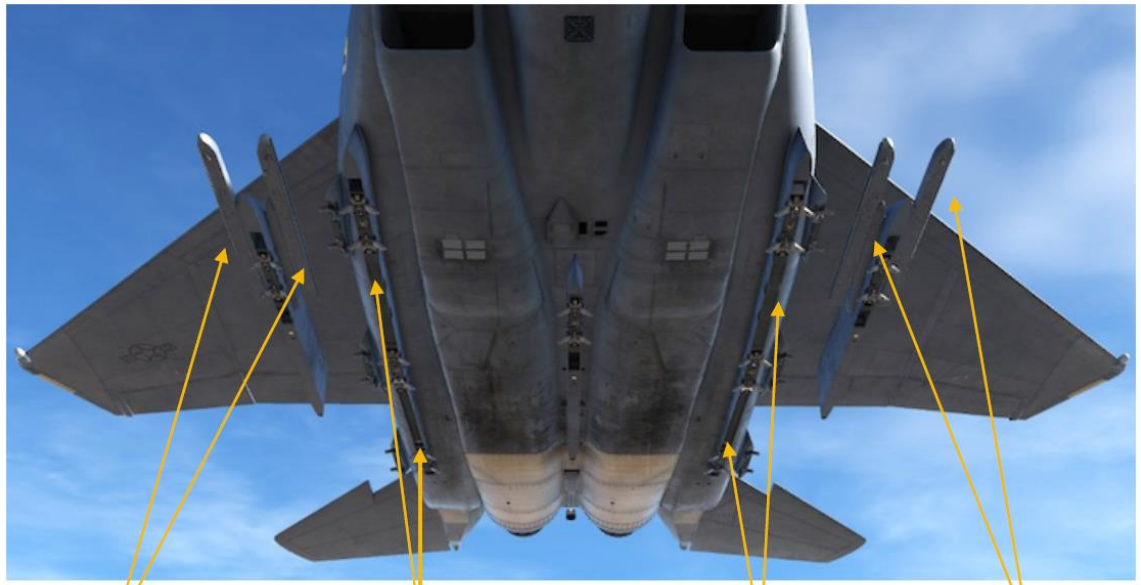


1 – INTRODUCTION
1.5 – Re-Arming Considerations

Air-to-Air Loadouts

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 here.





Station 8B (Left)
Station 8A (Right)

Station 6C (Fwd)
Station 7C (Aft)

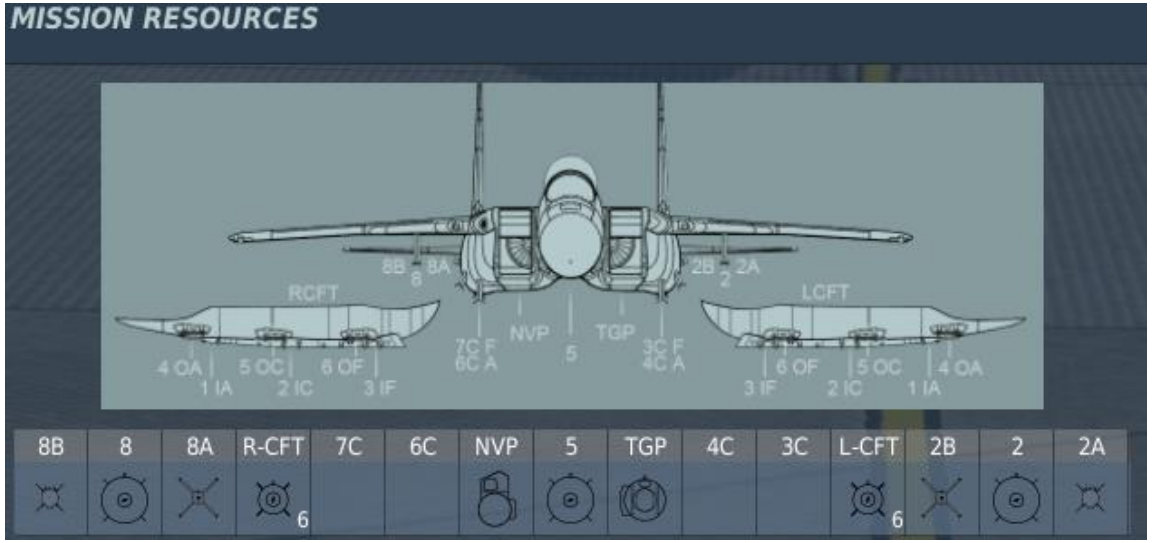
Station 3C (Fwd)
Station 4C (Aft)

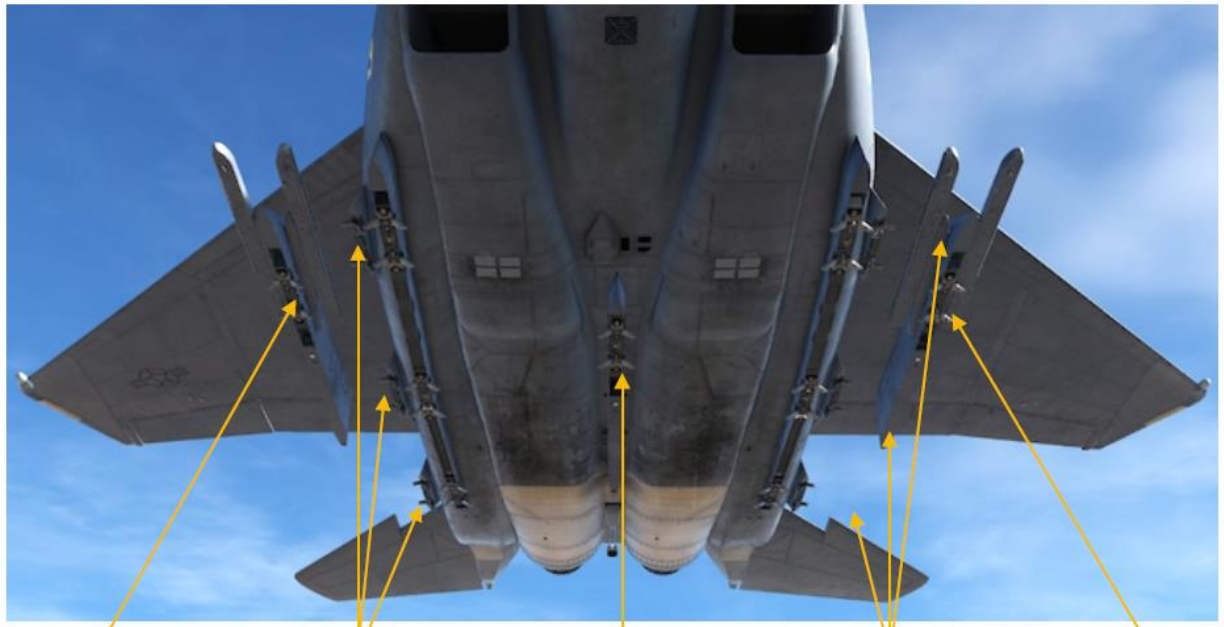
Station 2B (Left)
Station 2A (Right)

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

1 – INTRODUCTION
1.5 – Re-Arming Considerations

Air-to-Ground Loadouts





Station 8	Right CFT	Station 5	Left CFT	Station 2

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)
GBU-31(V)1/B (1x)	MXU 648 (1x)	GBU-31(V)1/B (1x)	MXU 648 (1x)	GBU-31(V)1/B (1x)
GBU-31(V)3/B (1x)	GBU-31(V)1/B **	GBU-31(V)3/B (1x)	GBU-31(V)1/B **	GBU-31(V)3/B (1x)
GBU-38 (1x)	GBU-31(V)3/B **	GBU-38 (1x)	GBU-31(V)3/B **	GBU-38 (1x)
GBU-54 (1x)	GBU-38 (3x)	GBU-54 (1x)	GBU-38 (3x)	GBU-54 (1x)
AGM-154 (1x)	GBU-54 (3x)	AGM-154 (1x)	GBU-54 (3x)	AGM-154 (1x)
	AGM-154 (1x)		AGM-154 (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	

1 – INTRODUCTION
1.5 – Re-Arming Considerations

When rearming the aircraft, the PACS (Programmable Armament Control Set) **does not automatically recognize every type of ordnance installed on the pylons**. Therefore, it is necessary to **program manually** in the PACS ARMT (Armament) page what the ground crew has installed. Some weapons like AIM-120 AMRAAMS, JDAMs or External Fuel Tanks are detected automatically by the aircraft, while other weapon types like MK-82 dumb bombs need to be programmed. **Here is how to program the PACS after re-arming:**

1. Press « RSHIFT+K » to open up kneeboard and check your Mission Worksheet. The PACS SETUP field indicates what is loaded on which pylon, and the LASER section what laser codes are programmed on which laser-guided bombs.

Station Number

Ordnance Loaded

MISSION WORKSHEET

INITIAL POSITION			1.6.2.206/2.4.2
1. LATITUDE	37°00.341N	GC ALIGN REQUIRED	5. INT FUEL
2. LONGITUDE	35°26.383E		6. EXT FUEL
3.. ALTITUDE	217.9		7. TOT FUEL
4. MAG VAR	4°46E		

PACS SETUP

2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V

COMBAT JETT

	RACK	STORE	PYLON	L	LC	C	RC	R
CBT 1								
CBT 2								

A/G DELIVERY

	SELECTED WEAPON	REL MOD	REL SEQ	FUZ	QTY	INTVL	LASER MODE	LASER TIME
PROG 1								
PROG 2								
PROG 3								
PROG 4								

LASER

	L	LC	C	RC	R	
CODE	1688	1688	1688	1688	1688	MIN LASE TIME
						MIN LASE ALT

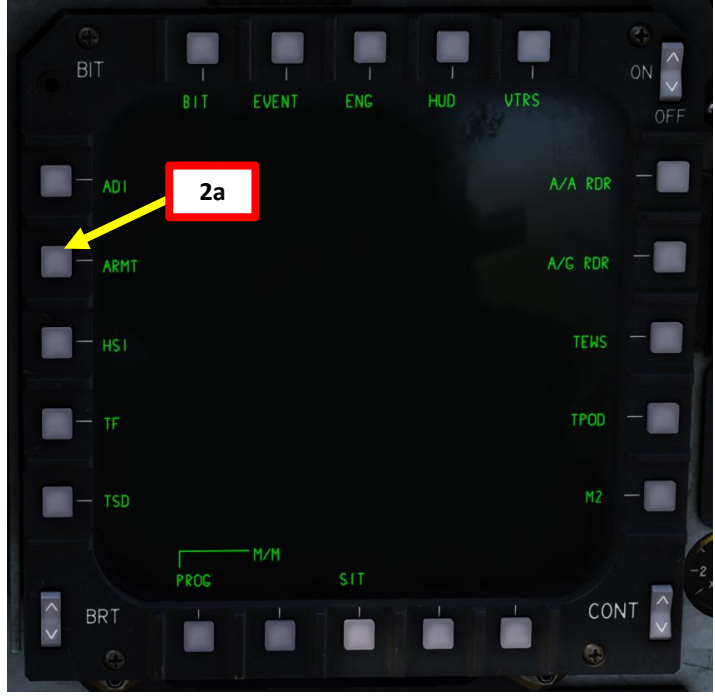
WARNING: WEAPONS LASER CODES CAN ONLY BE SET BY THE GROUND CREW

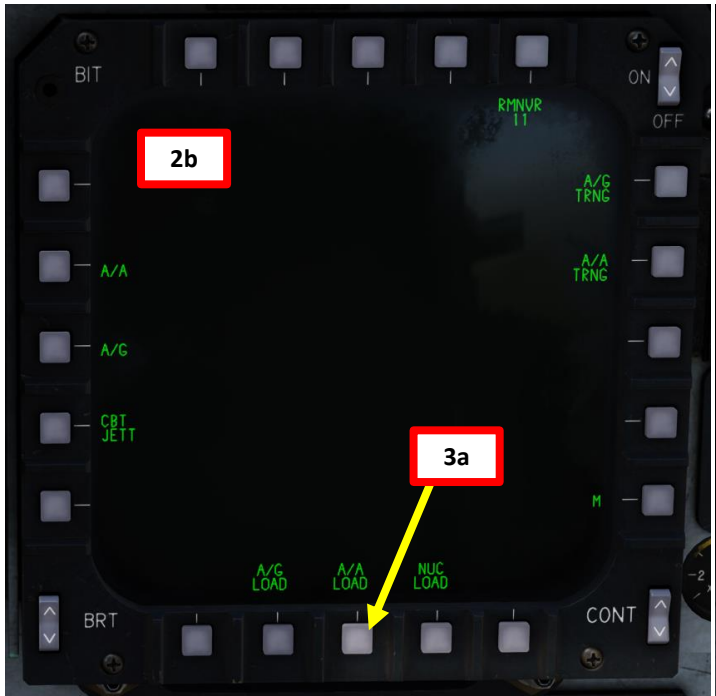
1 – INTRODUCTION
1.5 – Re-Arming Considerations

2. On any display, press PB (Pushbutton) next to ARMT (Armament) to select PACS (Programmable Armament Control Set) page.
3. We will check air-to-air weapons first. Press PB next to A/A LOAD to display the A/A COMBAT WEAPON LOAD page.

Smart weapons like the AIM-120 air-to-air missile are automatically detected (with the newer version of AIM-120Cs being displayed as 120V). However, the PACS 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.

For simplicity's sake, the loadout we have is comprised of AIM-120Cs and AIM-9Ms, which are already detected by the aircraft and loaded in the PACS.





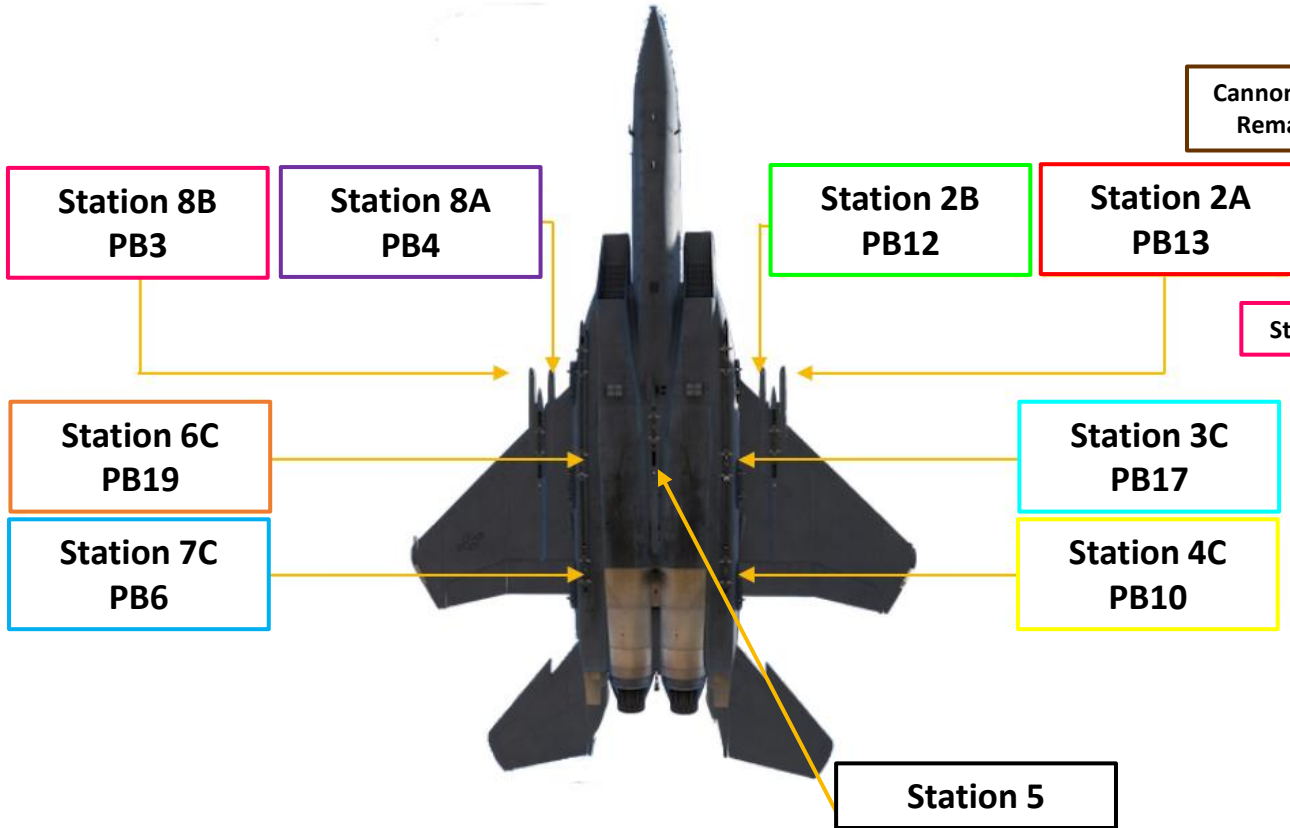
PACS SETUP									
2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V

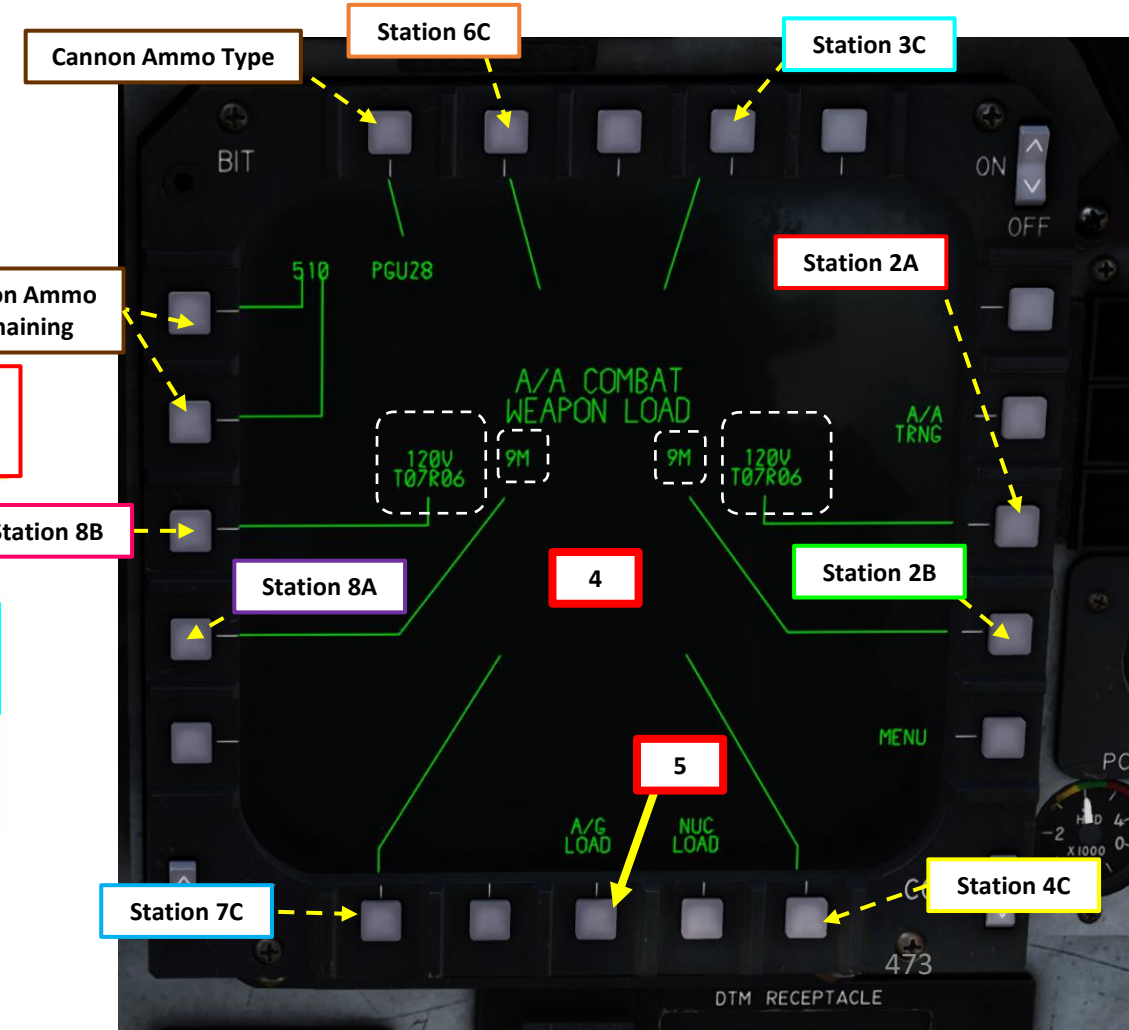
1 – INTRODUCTION
1.5 – Re-Arming Considerations

4. Compare Mission Worksheet PACS SETUP with the A/A COMBAT WEAPON LOAD page. Verify that the configuration matches what is displayed on the PACS A/A COMBAT WEAPON LOAD page.
5. Let's check air-to-ground weapons. Press the PB (Pushbutton) next to A/G LOAD to display the A/G COMBAT WEAPON LOAD page.
    - Alternatively, you can press the PB next to MENU to return back to the PACS MENU page and select the A/G LOAD page from there.

4

PACS SETUP									
2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510 PGU-28				9M	120V



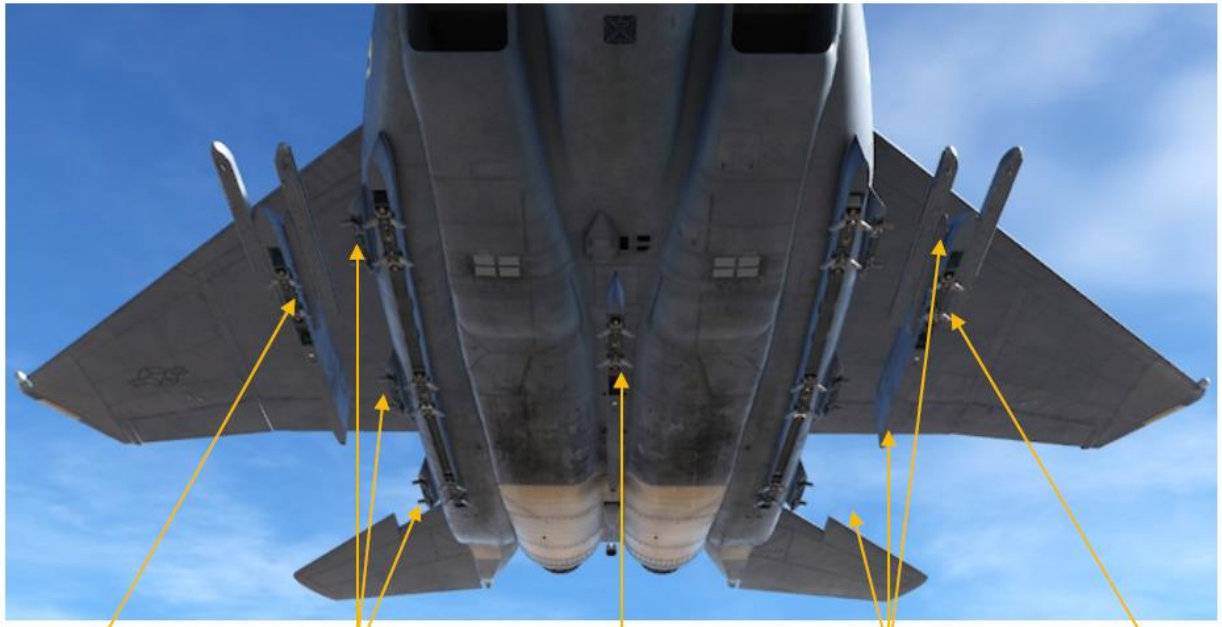


1 – INTRODUCTION
1.5 – Re-Arming Considerations

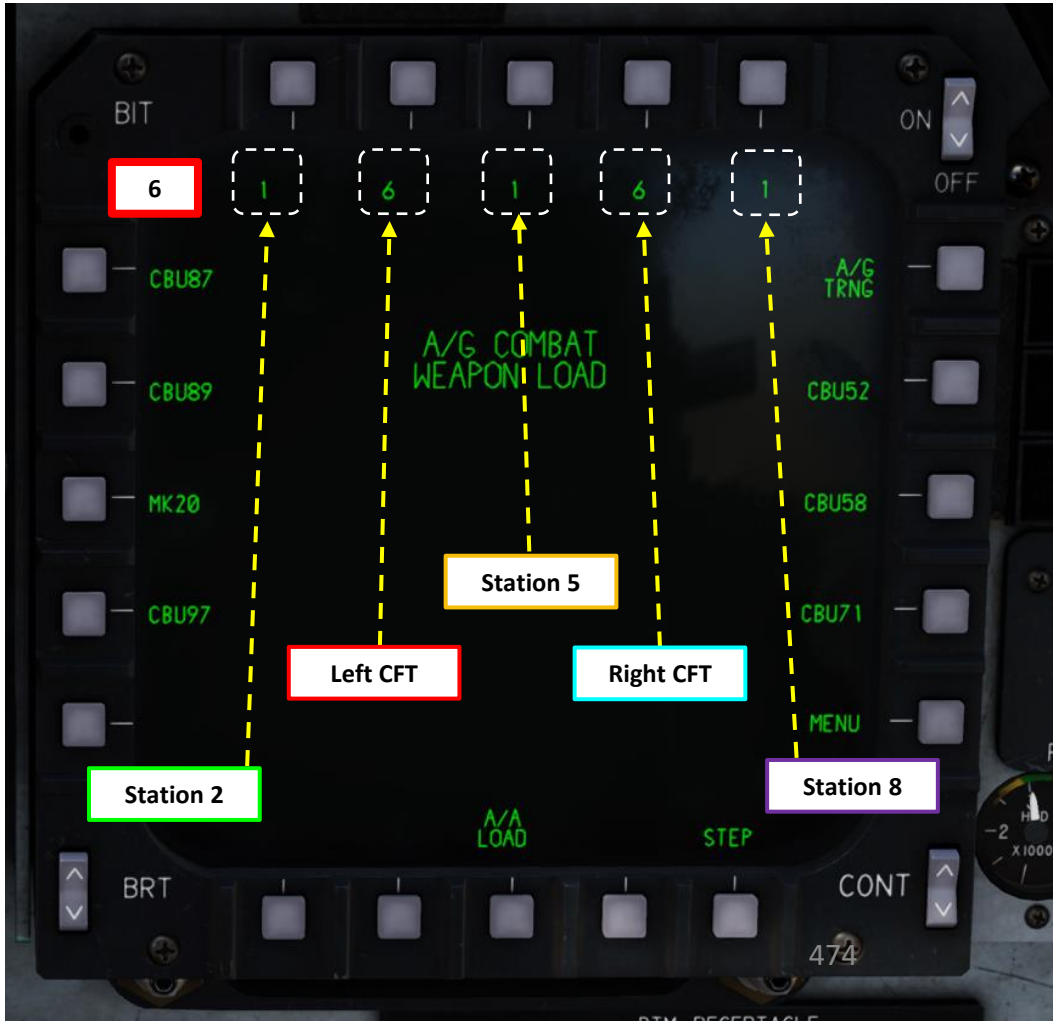
6. Compare Mission Worksheet PACS SETUP with the A/G COMBAT WEAPON LOAD page. As we can see, the configuration does not match what is displayed on the PACS A/G COMBAT WEAPON LOAD page since no ordnance types are visible.
7. We have to manually program in the PACS what weapons we have installed while using the Mission Worksheet as a reference.
    - Note: smart weapons like JDAMs or External Fuel Tanks (FUEL) are automatically detected.

6

PACS SETUP									
2		LC		5		RC		8	
84		6 2AR	3 2AR	84		3 2AR	6 2AR	84	
		5 2AR	2 2AR	TGP	NVP	2 2AR	5 2AR		
		4 2AR	1 2AR	L14	L13	1 2AR	4 2AR		
2A	2B	3C	4C	GUN		7C	6C	8A	8B
120V	9M			510PGU-28				9M	120V

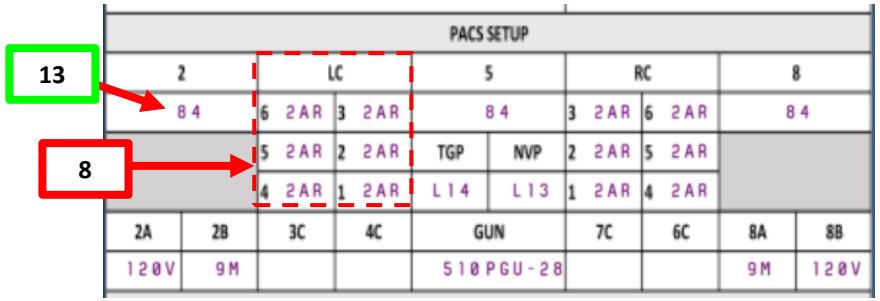


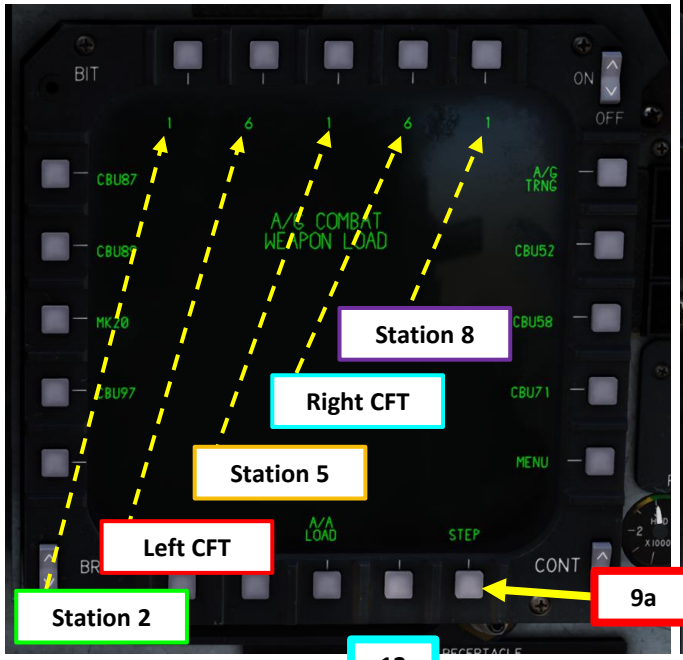
Station 8 PB16	Right CFT PB17	Station 5 PB18	Left CFT PB19	Station 2 PB20

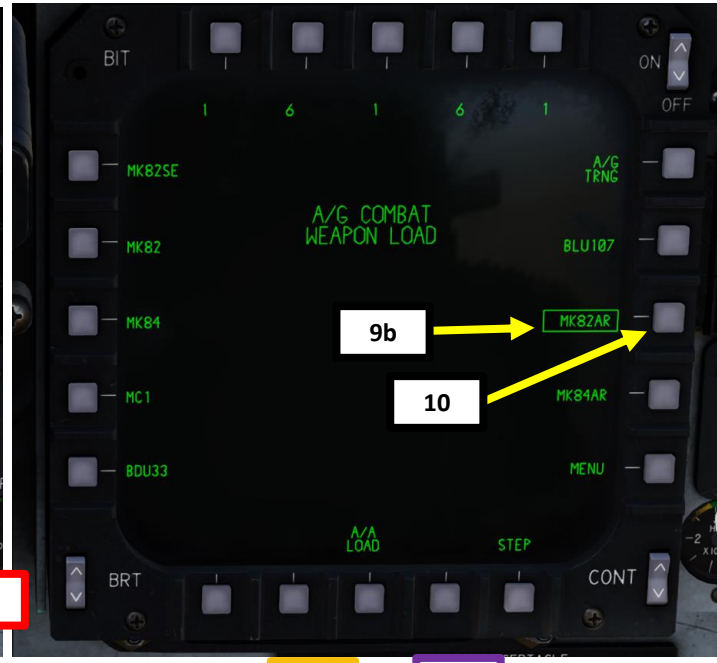


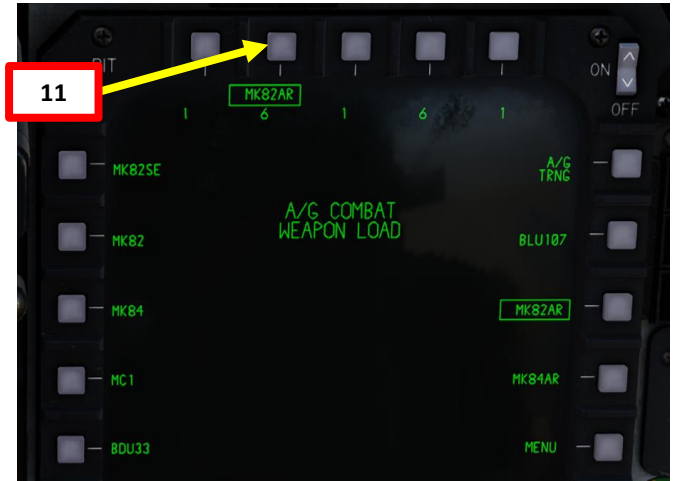
1 – INTRODUCTION
1.5 – Re-Arming Considerations

8. Let's start by programming the Left CFT (Conformal Fuel Tank) station. The Mission Worksheet indicates that MK-82 Air Retarded Bombs (2AR) are installed.
9. Press PB (Pushbutton) next to STEP to cycle between weapon types until you find "2AR" (MK-82 Air Bomb).
10. Press PB next to "MK82AR" to box (select) MK-82 Air Bomb Weapon Type.
11. Press PB next to the Left CFT station, which will change to "MK82AR".
12. Repeat previous step, but for Right CFT Station.
13. Now, let's program Station 2, Station 5 and Station 8, which all have a MK-84 bomb installed. If needed, press PB next to STEP until you find the "MK-84" type.
14. Press PB next to "MK84" to box (select) MI-84 Bomb Weapon Type.
15. Press PB next to Station 2, which will change to "MK84".
16. Repeat previous step, but for Stations 5 and 8 as well.
17. And that's it! The aircraft now recognizes our air-to-ground weapons.









1 – INTRODUCTION
1.6 – Bomb Delivery Modes

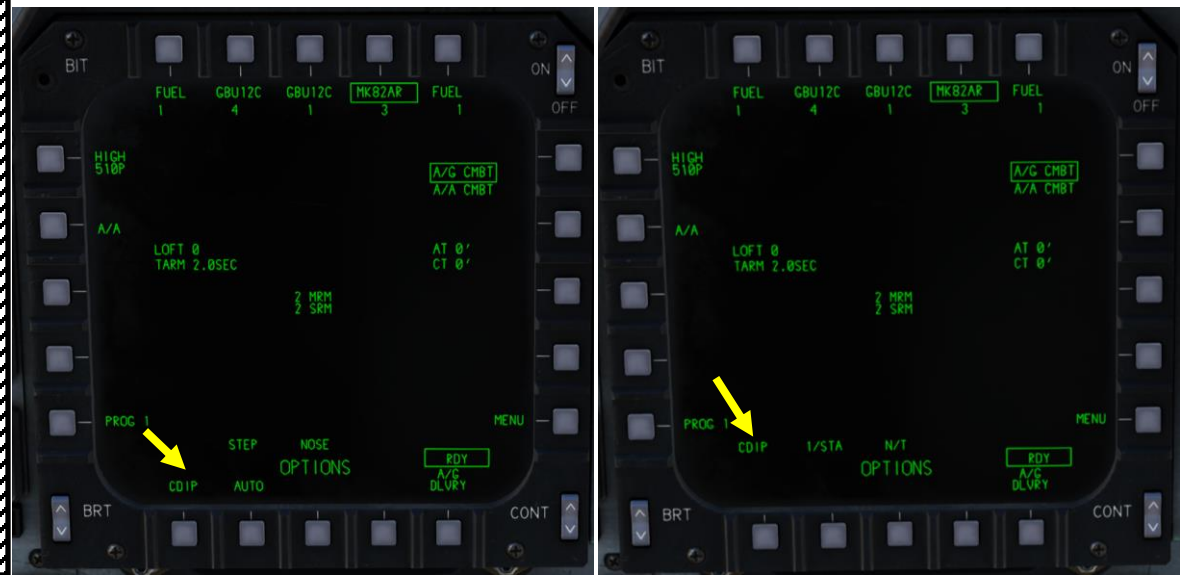
There are 4 main methods to deliver a bomb in the Strike Eagle:
- CDIP (Continuously Displayed Impact Point)
- Auto (Automatic)
- Direct
- Manual (Not simulated yet)

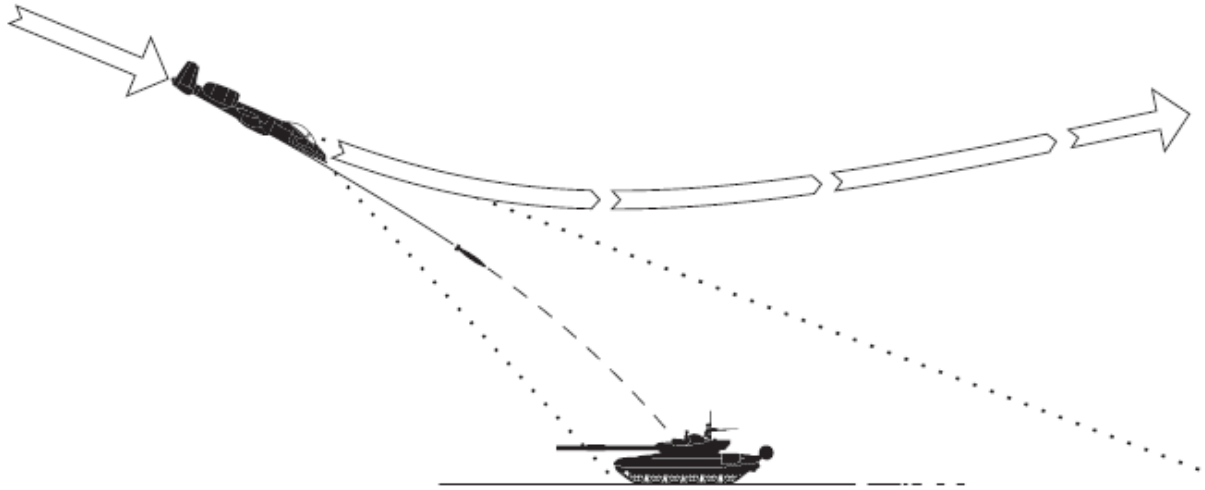
CDIP mode is the traditional dive bombing approach: you dive on target and the reticle will tell you where the bomb will impact.

However, dive bombing is a risky business, especially if anti-air defences are surrounding your target. The lower you go, the more vulnerable you are. This is why Auto release mode (sometimes referred as “CCRP” for other aircraft, or “Continuously Computed Release Point”) was invented.

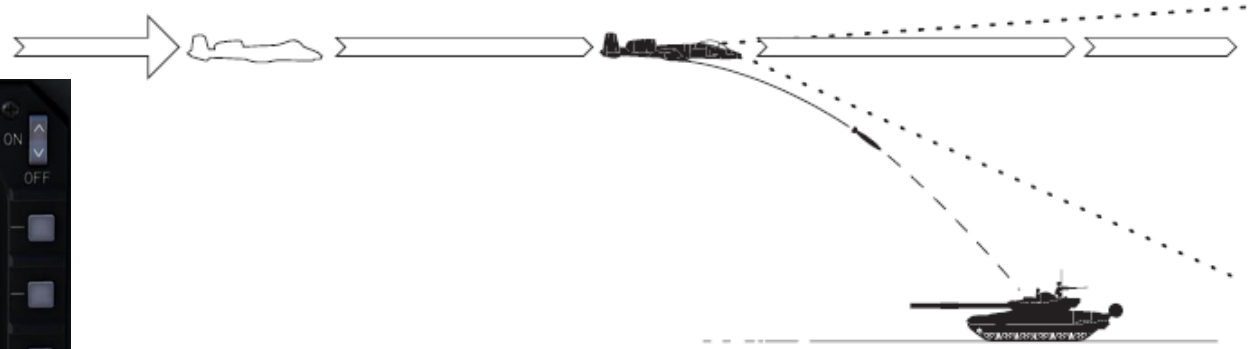
Auto mode allows you to fly straight and level without having to dive down. The HUD will tell you when to release your bomb for the target you have designated with your targeting pod or any other sensor. It is a much safer way to release a bomb, but as you may have guessed already, it is less precise.

Direct mode is mostly used for smart weapons that require lock on target.





CDIP Release: Continuously Displayed Impact Point

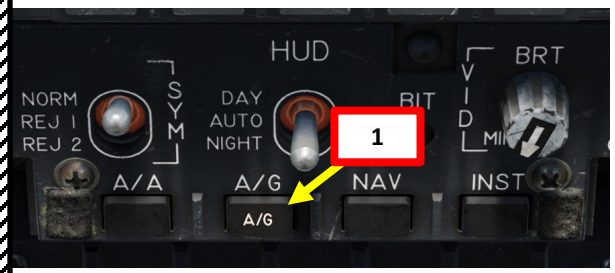


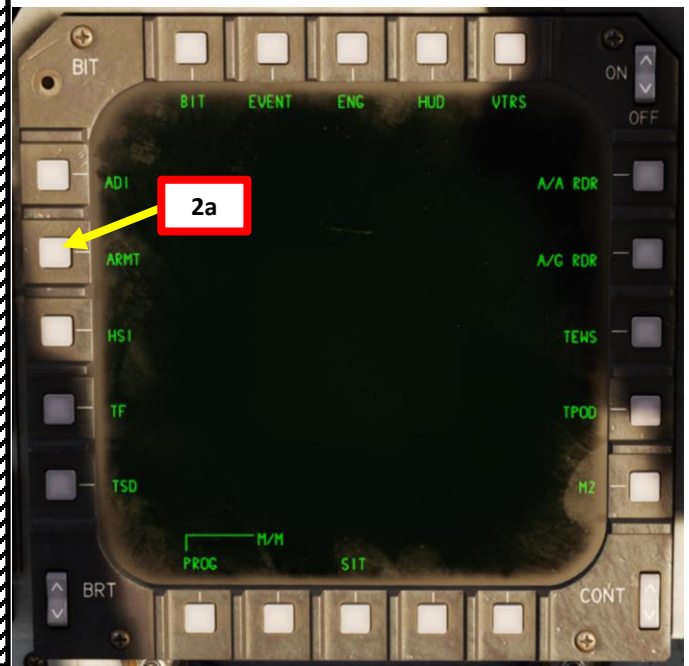
Automatic Release

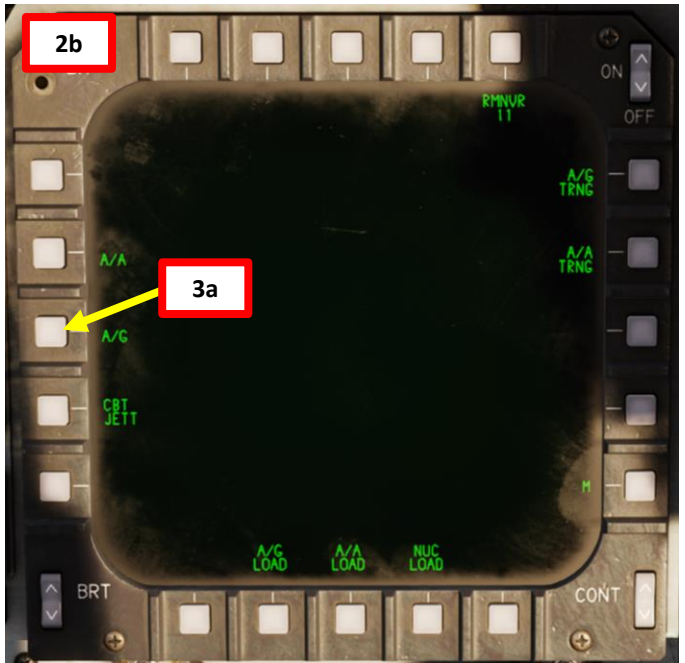
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)

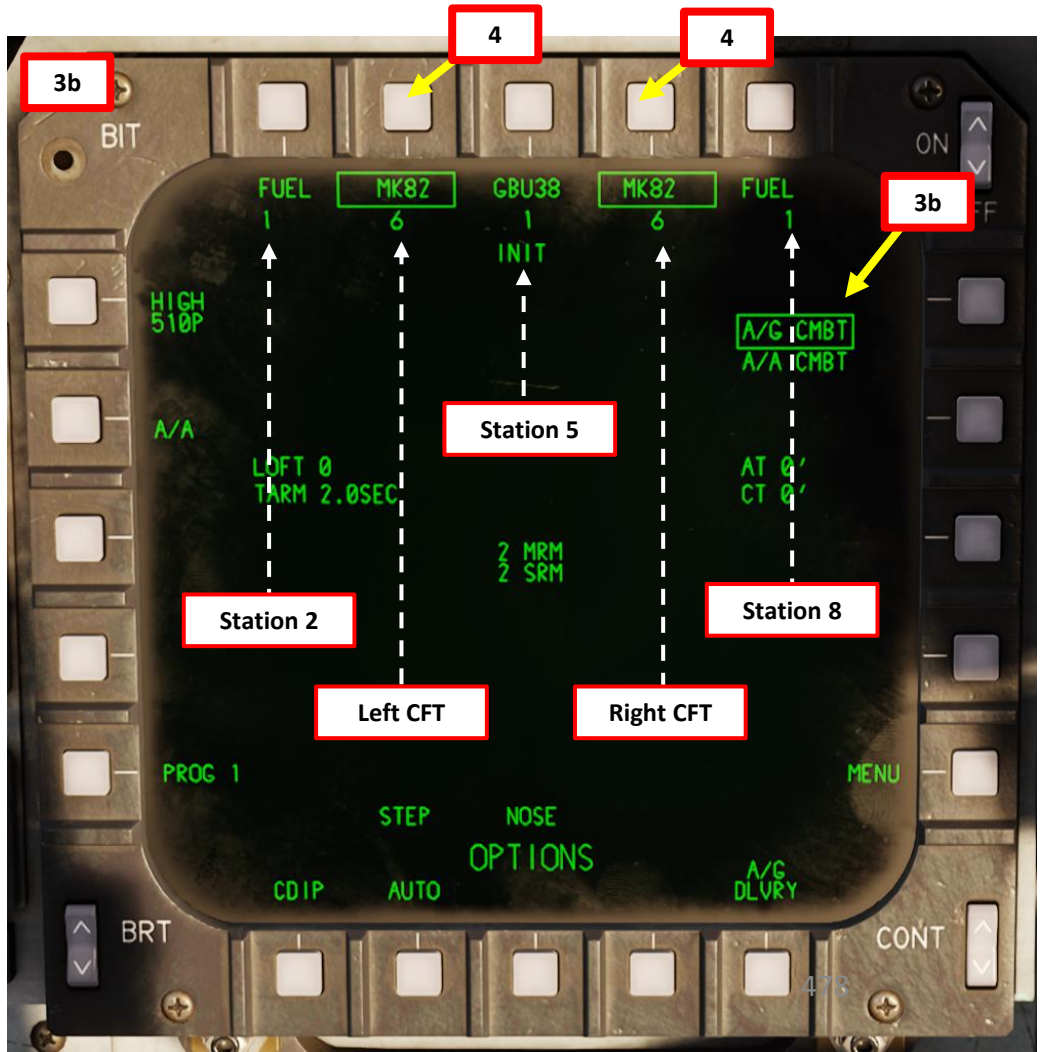
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “MK82” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.



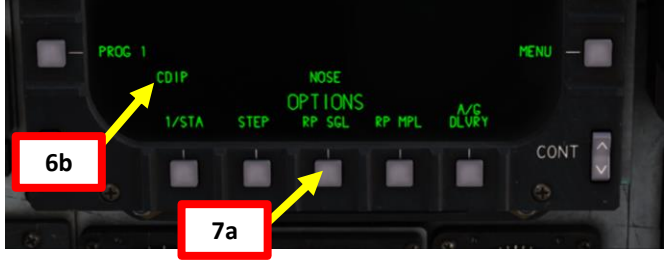


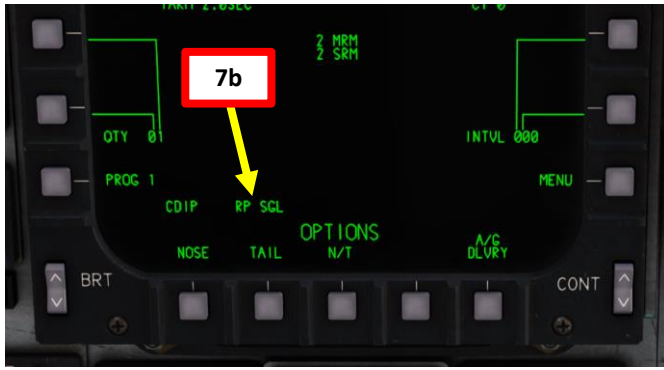


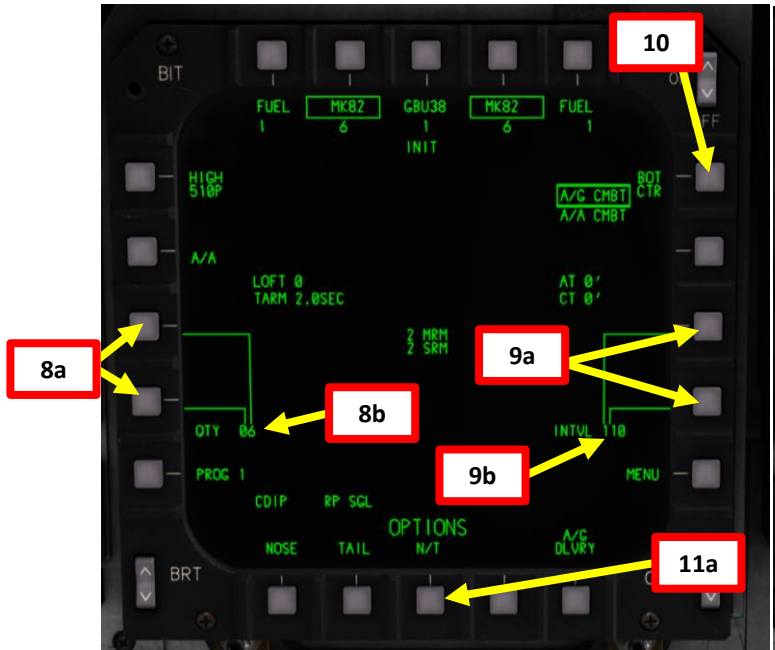


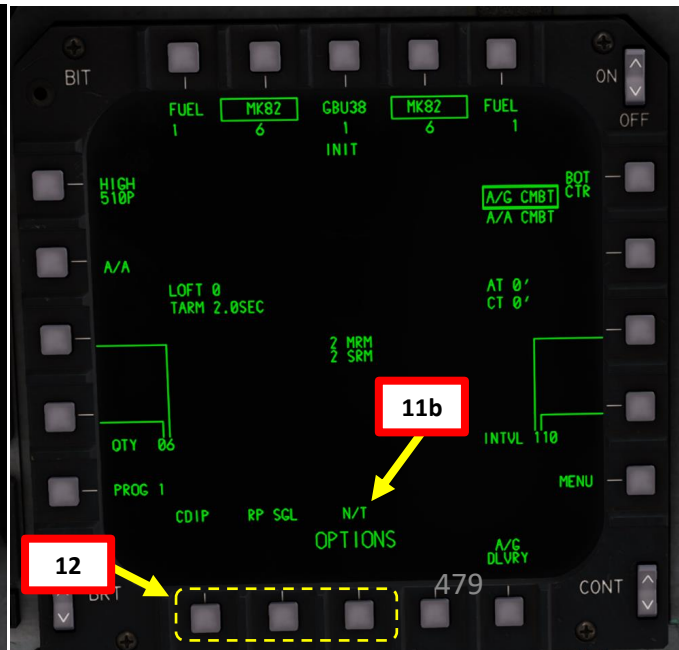
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select CDIP (Continuous Displayed Impact Point) Delivery Mode.
7. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 6 bombs by toggling the pushbuttons next to the QTY data field.
9. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
10. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



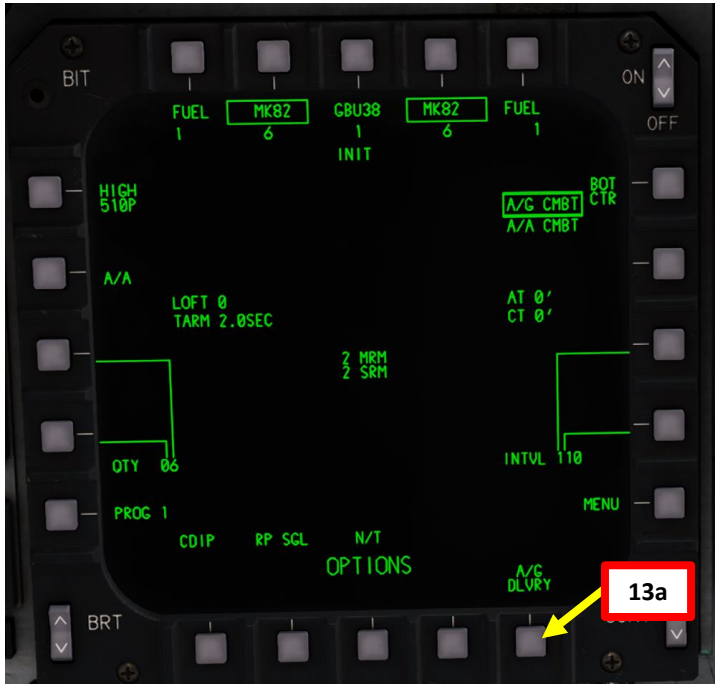




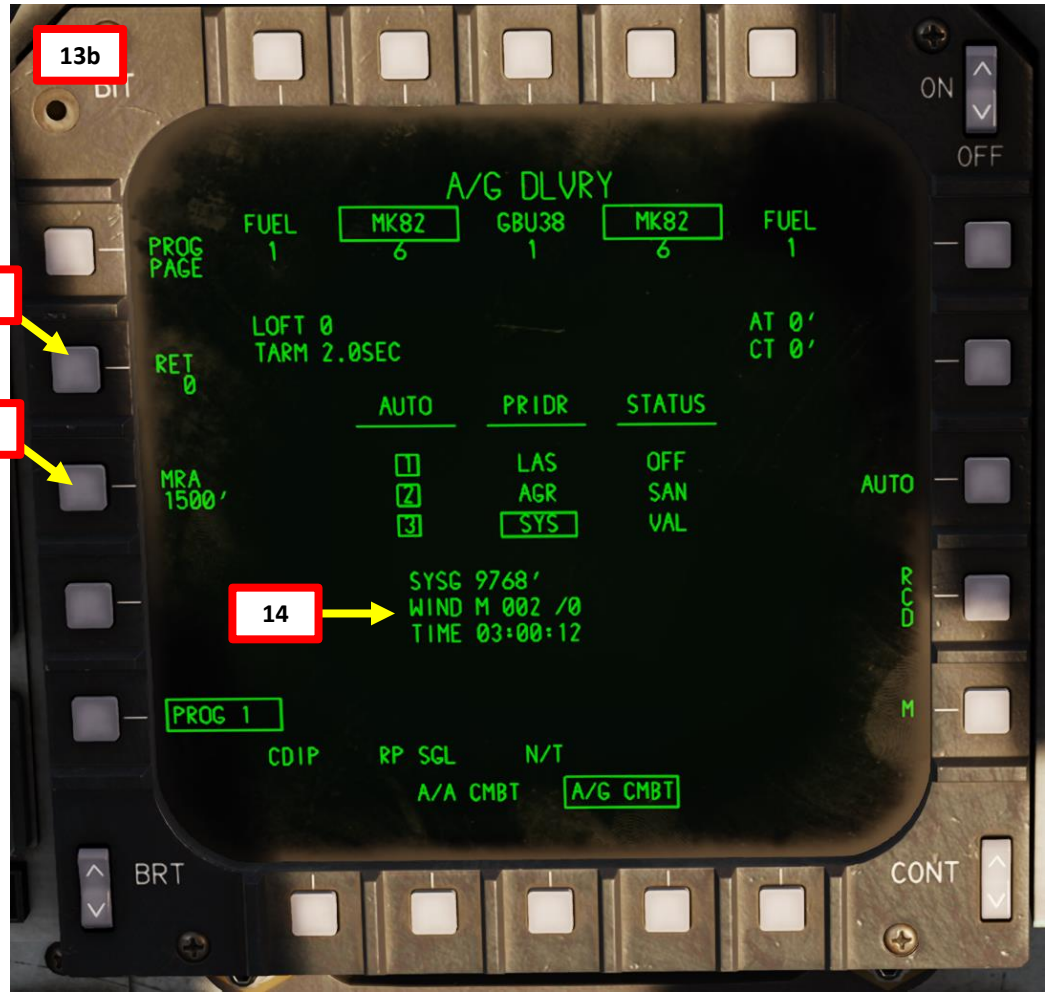


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.

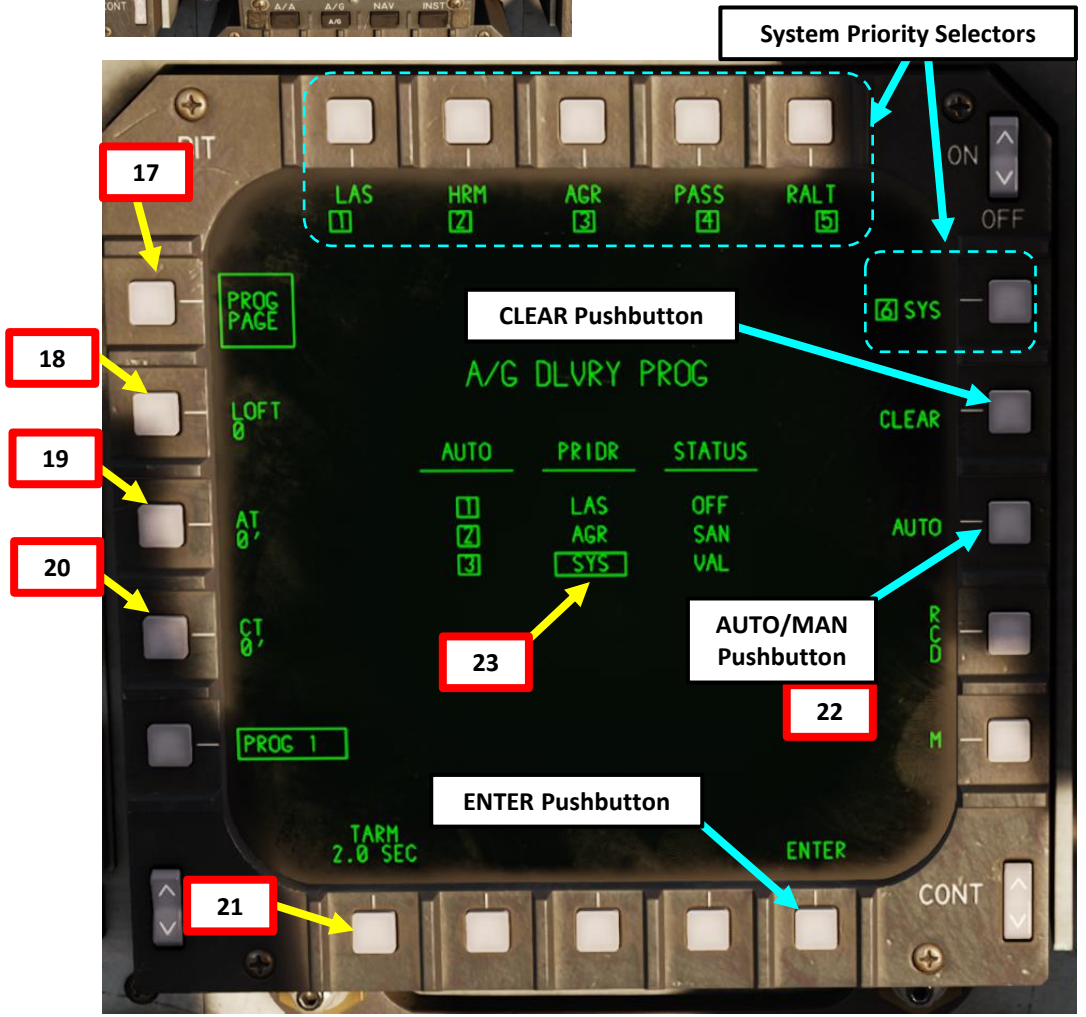


UFC (Upfront Control Panel) Scratchpad



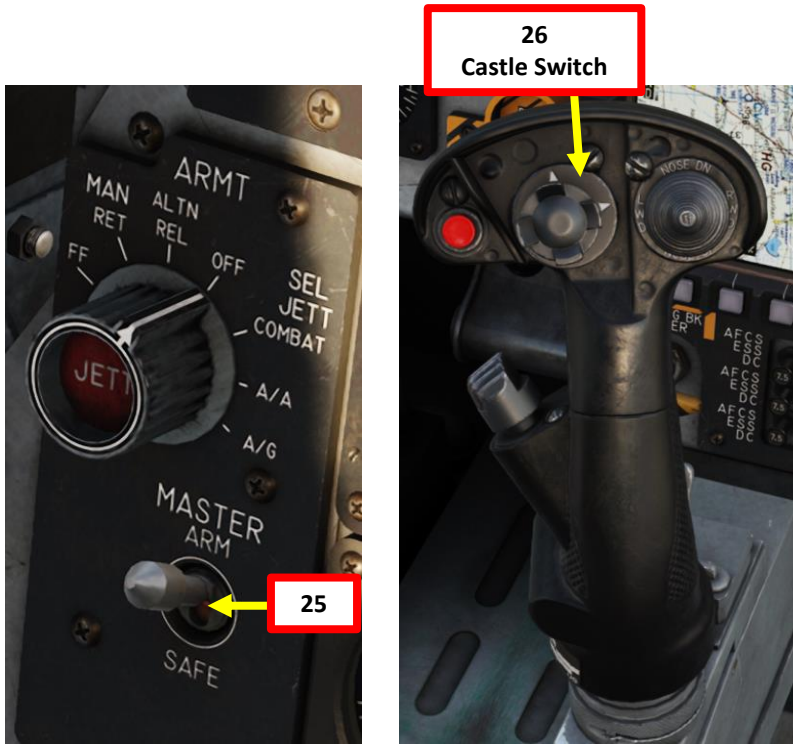
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
A – Weapon Setup

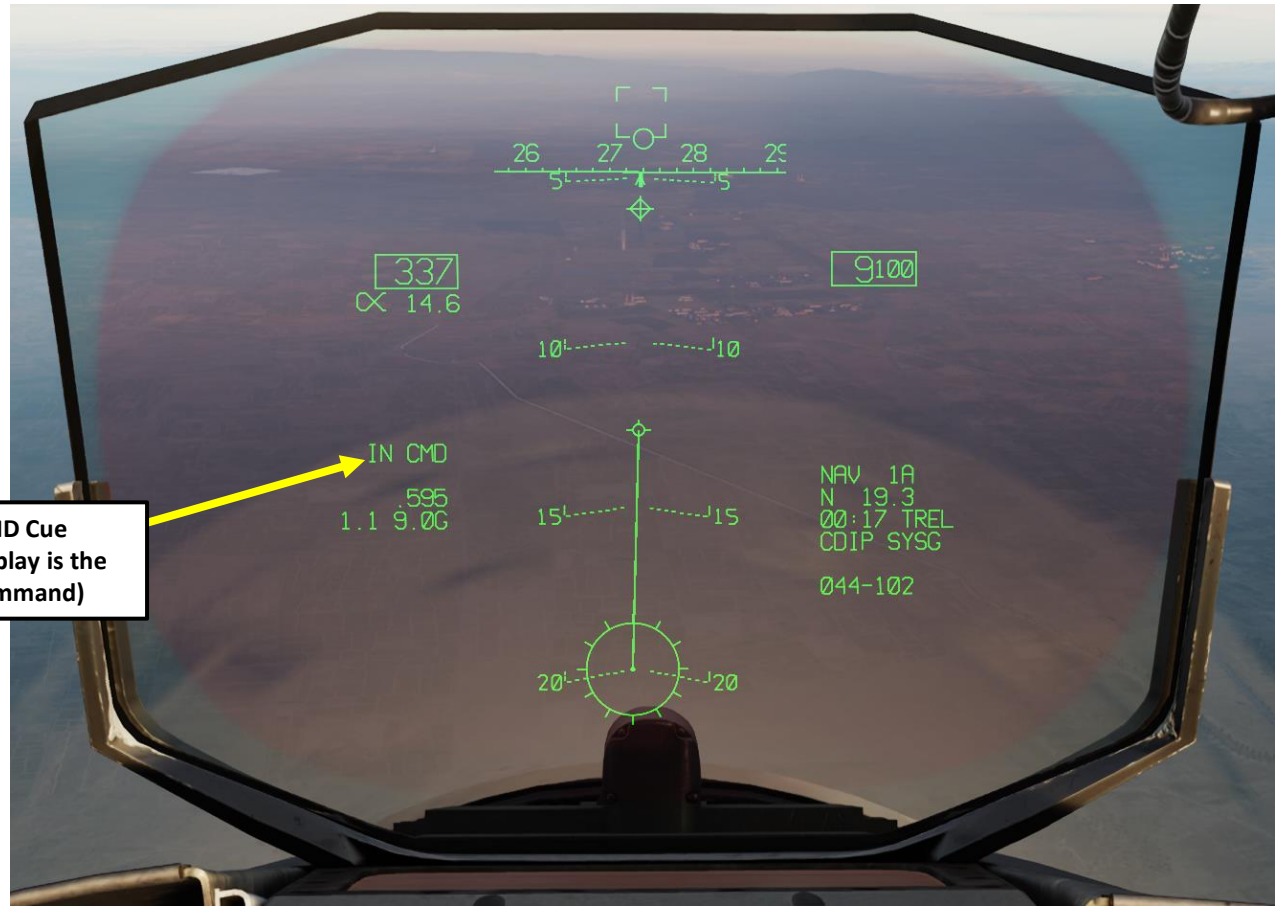
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
B – Perform Attack

25. Set Master Arm Switch – ARM (UP)
26. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the "IN CMD" (In Command) Cue.
    - Note: This step is **optional**, but being IN CMD of the HUD is very useful since it not only allows quick un-designation after ordnance release, but more importantly enables air-to-ground radar (AGR) ranging through the CDIP pipper, which is very important for accurate bombing.

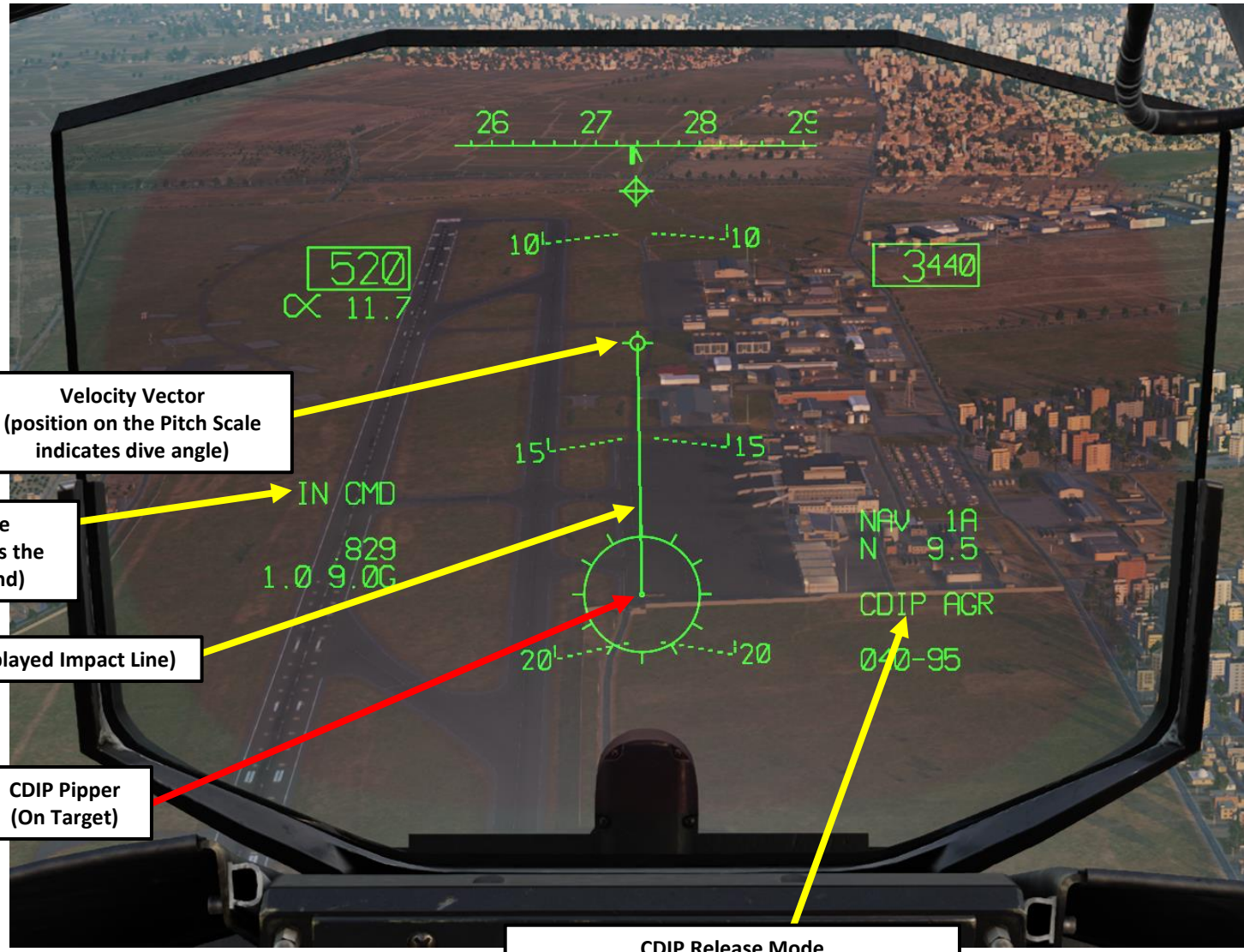




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
B – Perform Attack

27. Perform a shallow dive between 10 and 45 deg from at least 10000 ft. A dive bombing angle of 30 deg is recommended.
28. Steer the aircraft to line up the target with the DIL (Display Impact Line).
29. Steer the aircraft to place the center of the CDIP (Continuously Displayed Impact Point) Pipper on the target.
30. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bombs.

30
Weapon Release (Pickle) Button



Velocity Vector
(position on the Pitch Scale indicates dive angle)

HUD IN CMD Cue
(Heads-Up Display is the sensor in command)

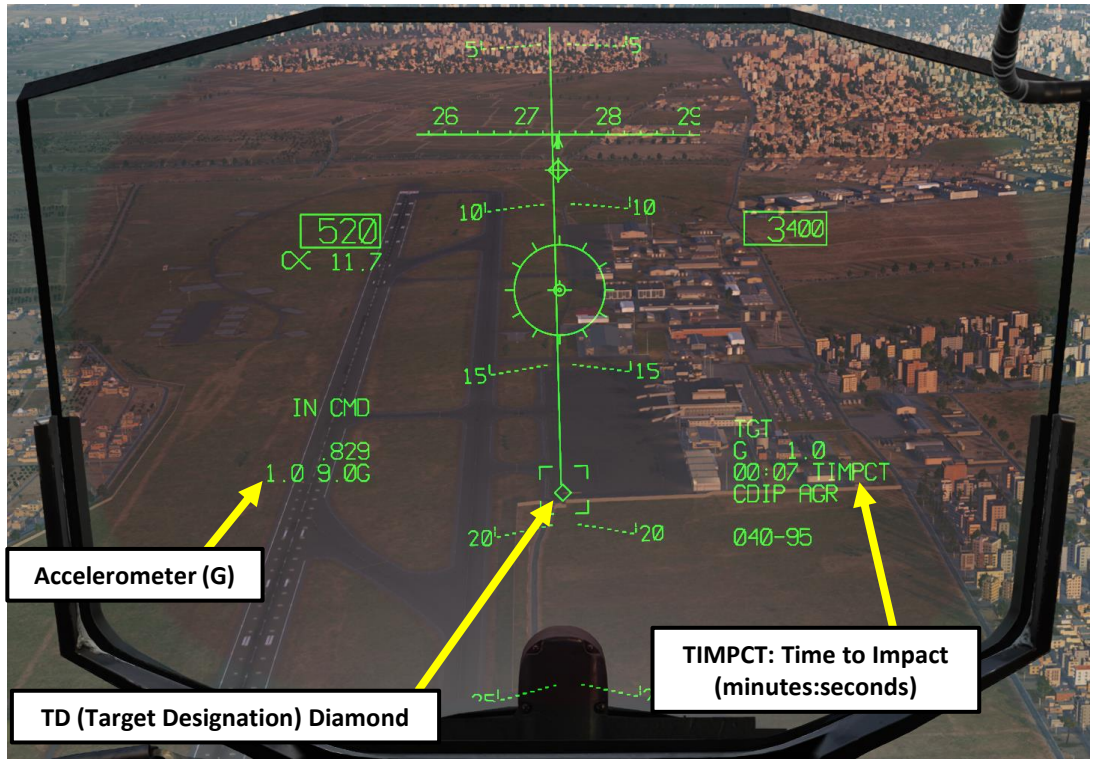
DIL (Displayed Impact Line)

CDIP Pipper
(On Target)

CDIP Release Mode
AGR (Air-to-Ground Radar) Ranging Mode

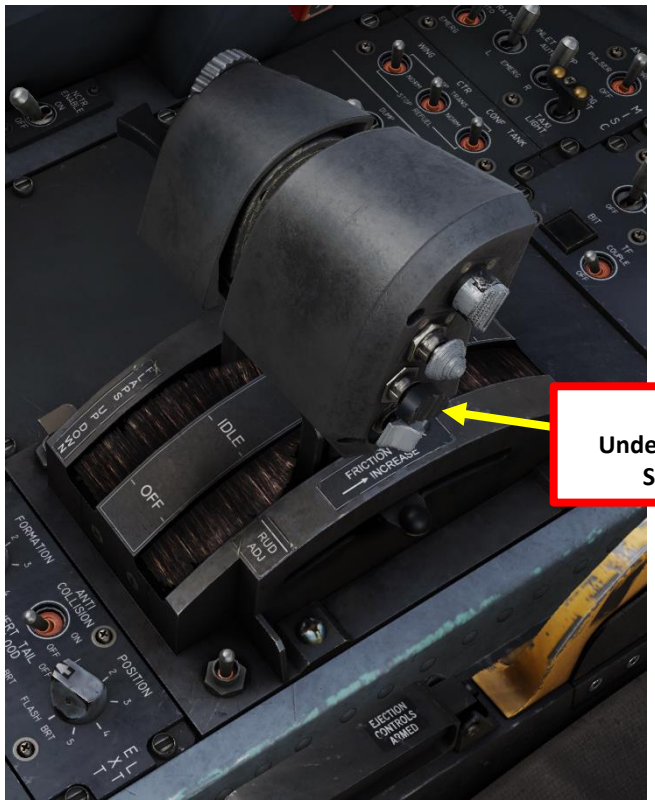
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
B – Perform Attack

31. Once bombs are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
32. A TD (Target Designation) Diamond is automatically created on the CDIP Pipper's location at the time of bomb release, which allows you to either re-engage or assess damage done on the target.
33. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

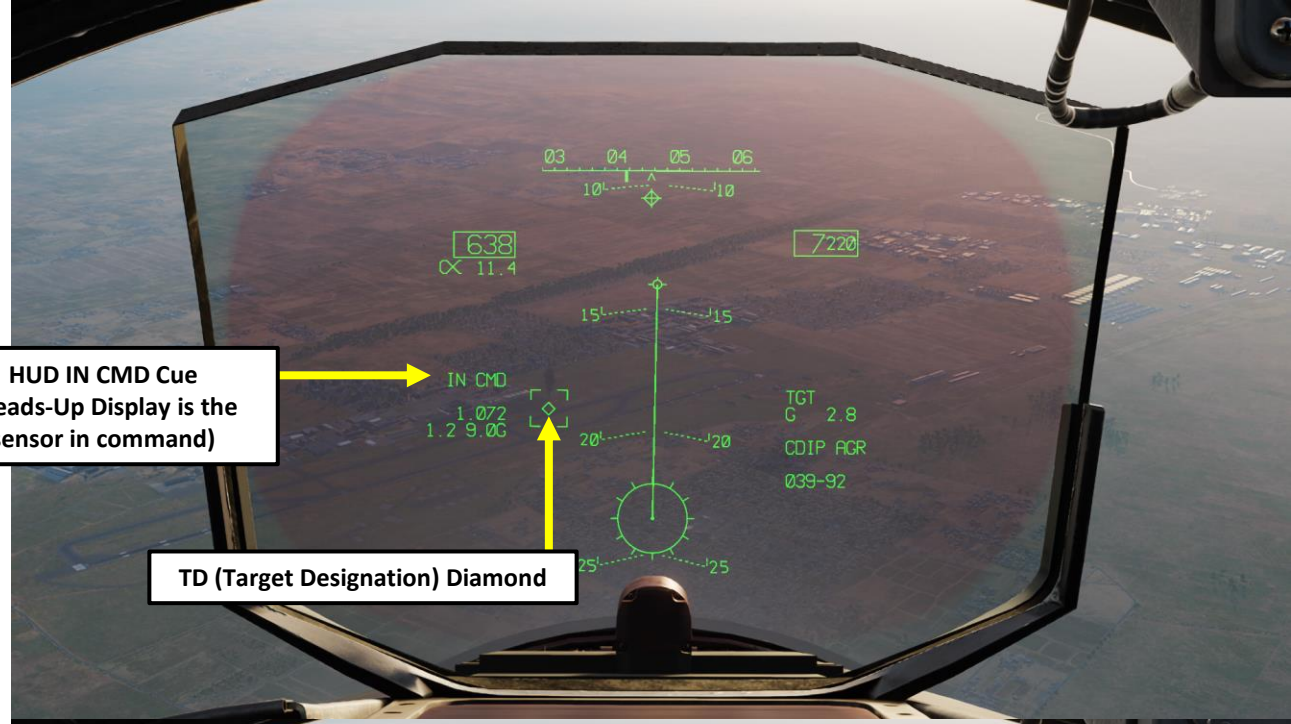


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.1 – MK-82 Low Drag (CDIP Mode)
B – Perform Attack

34. To un-designate target and remove the TD (Target Designation) diamond, press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).
    - Note: this step is **optional**, but un-designating from CDIP must be done while the HUD (Heads-Up Display) sensor is in command.



34
Undesignate / Missile Reject Switch (Boat Switch)



HUD IN CMD Cue (Heads-Up Display is the sensor in command)

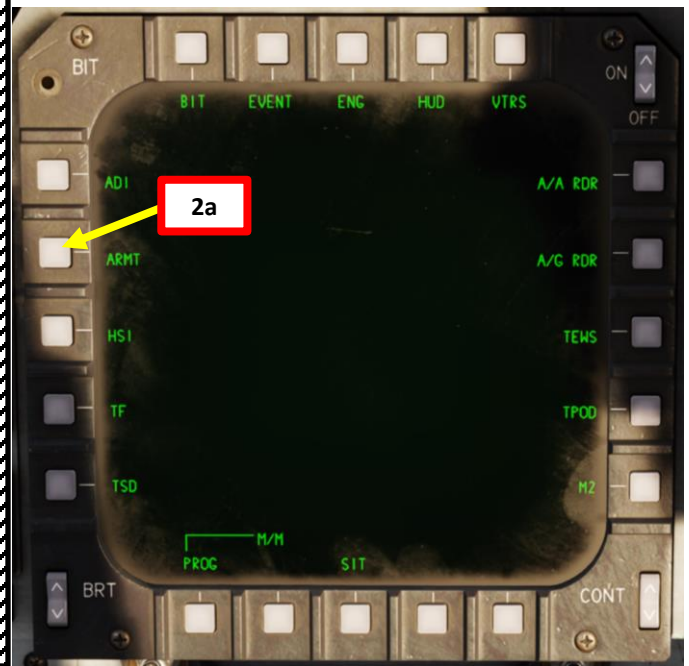
TD (Target Designation) Diamond

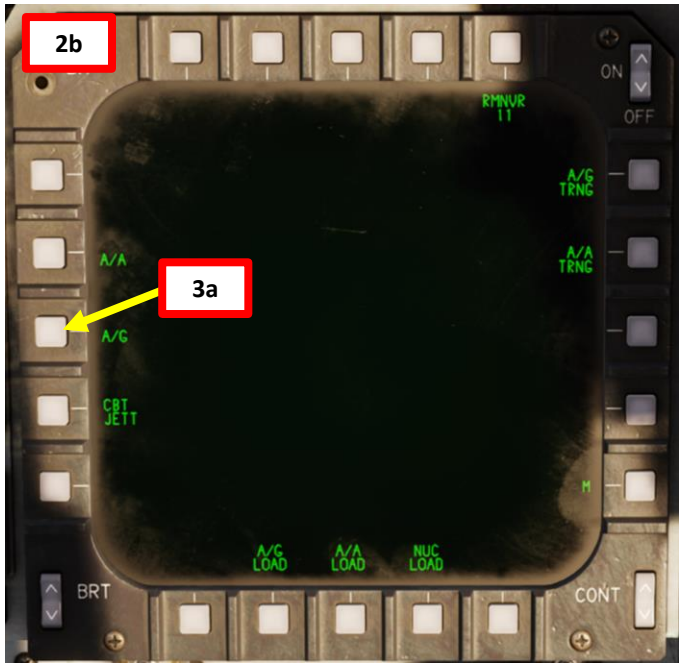
TD (Target Designation) Diamond Removed (Un-designated)

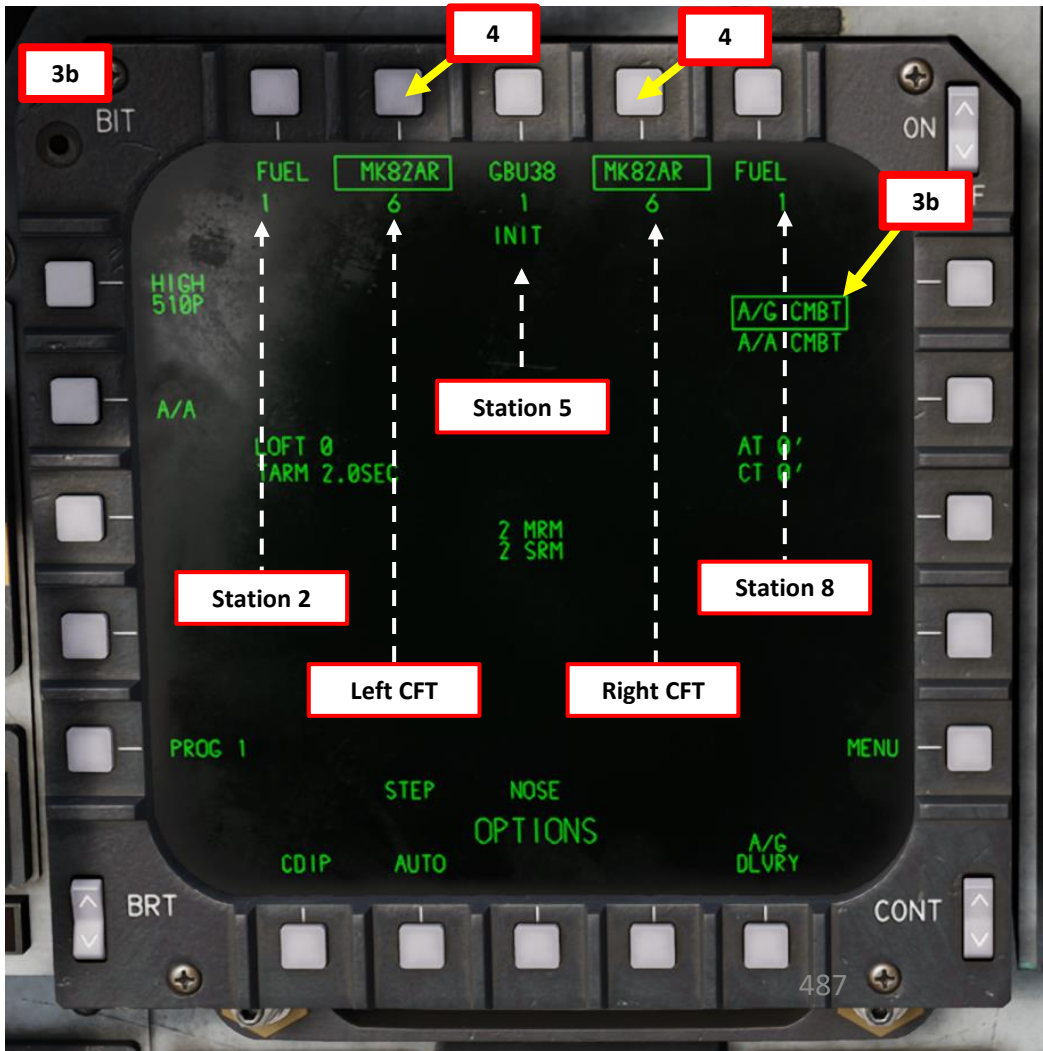
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “MK82AR” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.

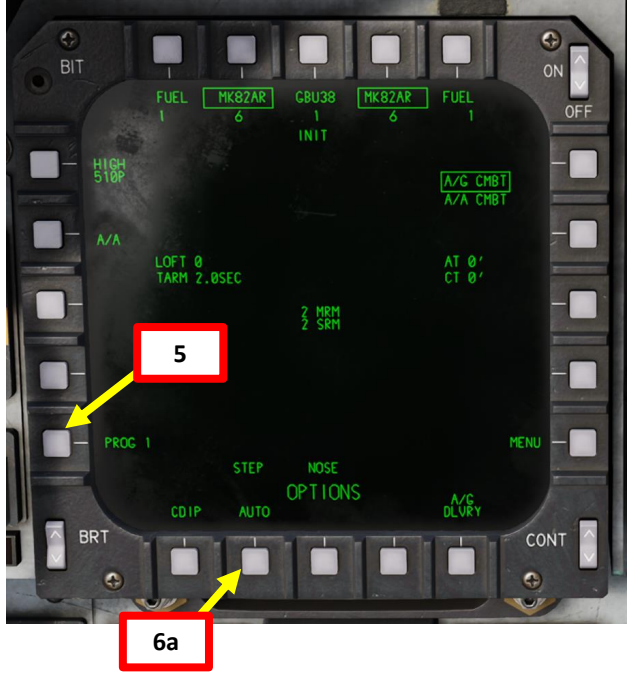


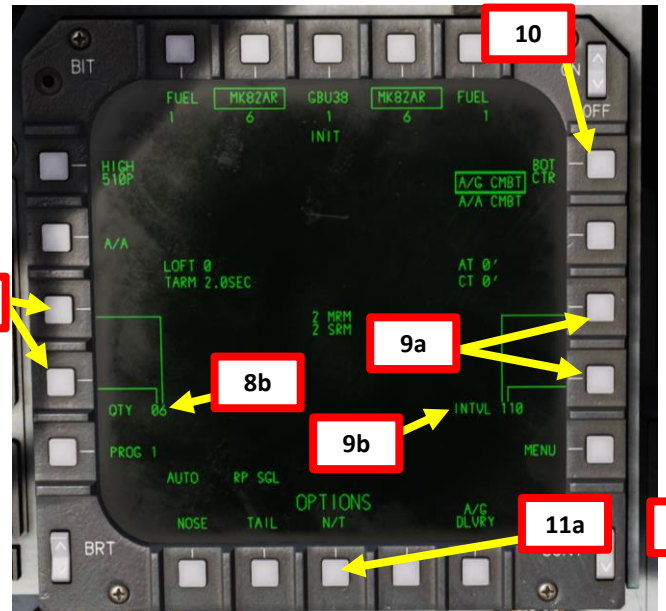




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
A – Weapon Setup

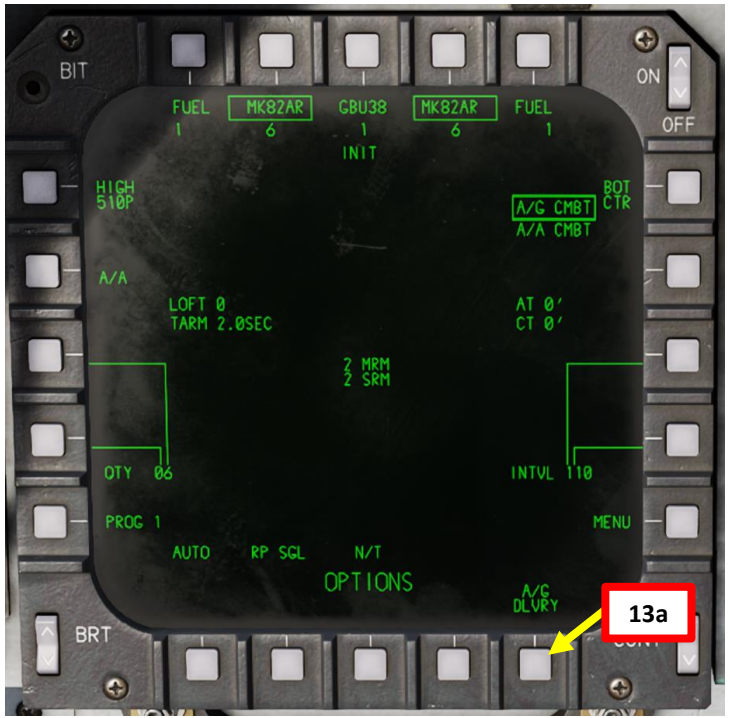
5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 6 bombs by toggling the pushbuttons next to the QTY data field.
9. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
10. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select Fuzing Option – As desired. We will select N/T for a high drag configuration.
    - *N/T (Nose & Tail): High Drag configuration*
    - *NOSE: Low Drag configuration*
    - *TAIL: High Drag configuration*
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.

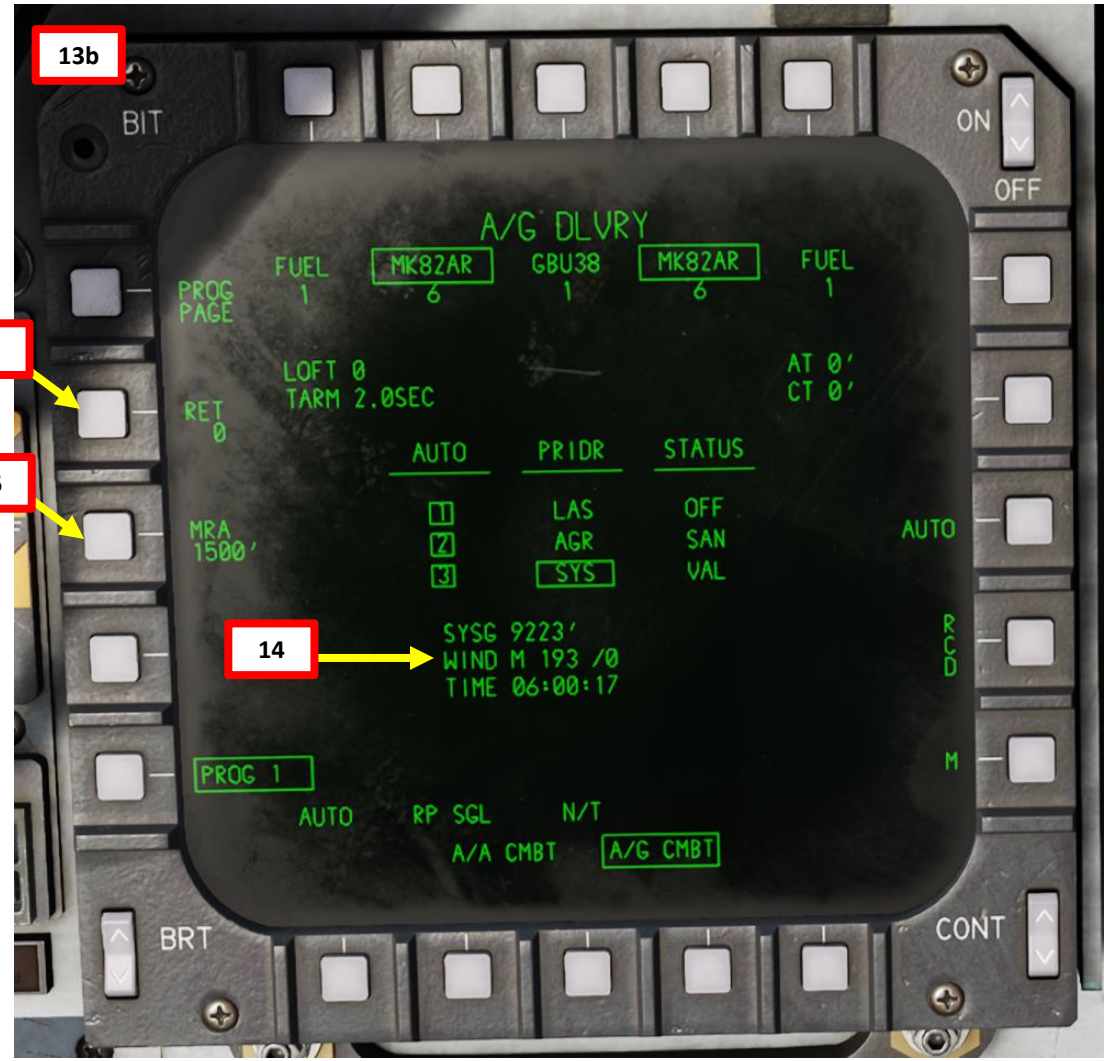




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
A – Weapon Setup

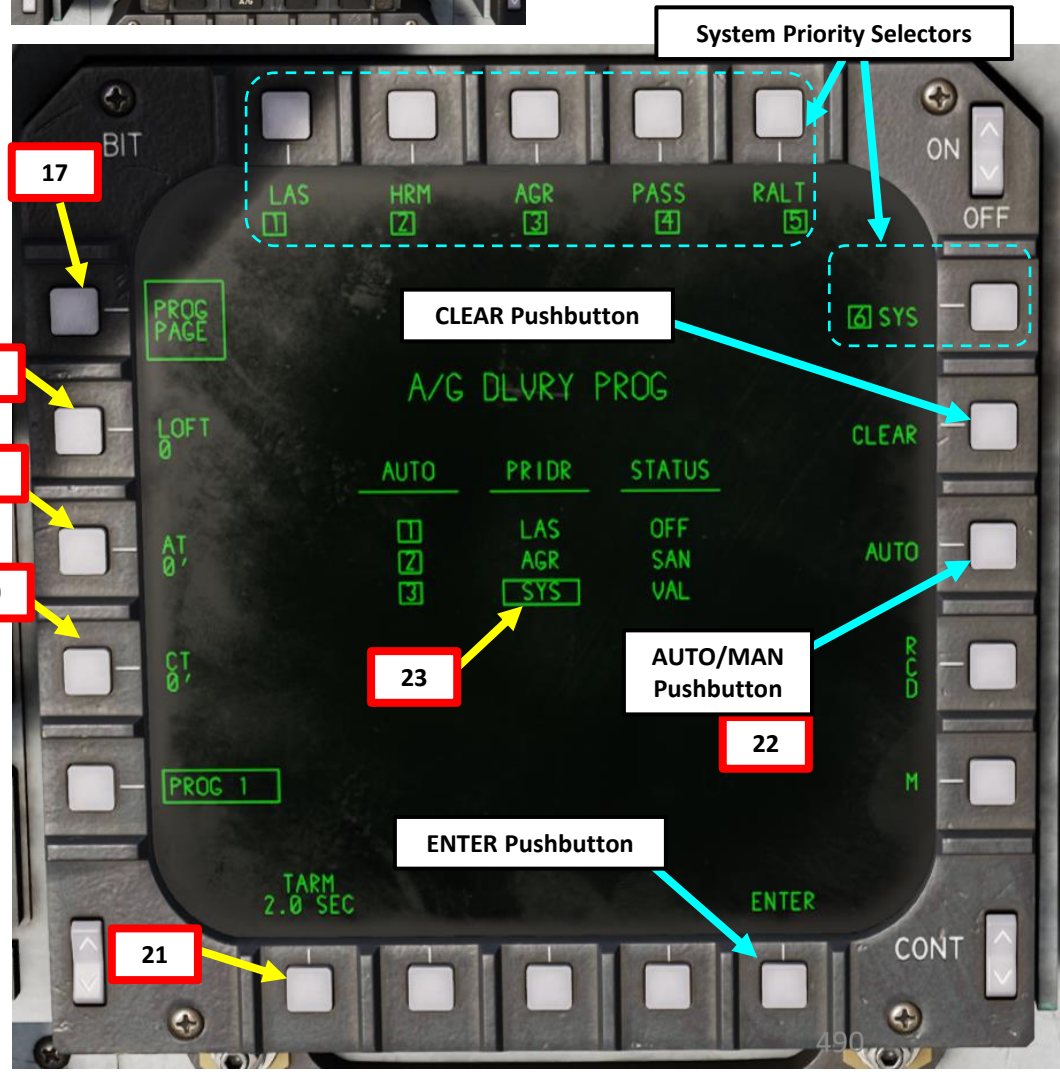
13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





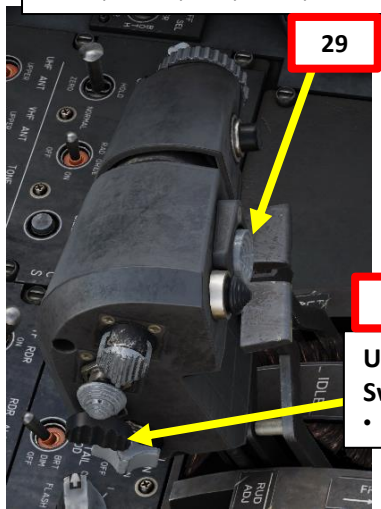
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
A – Weapon Setup

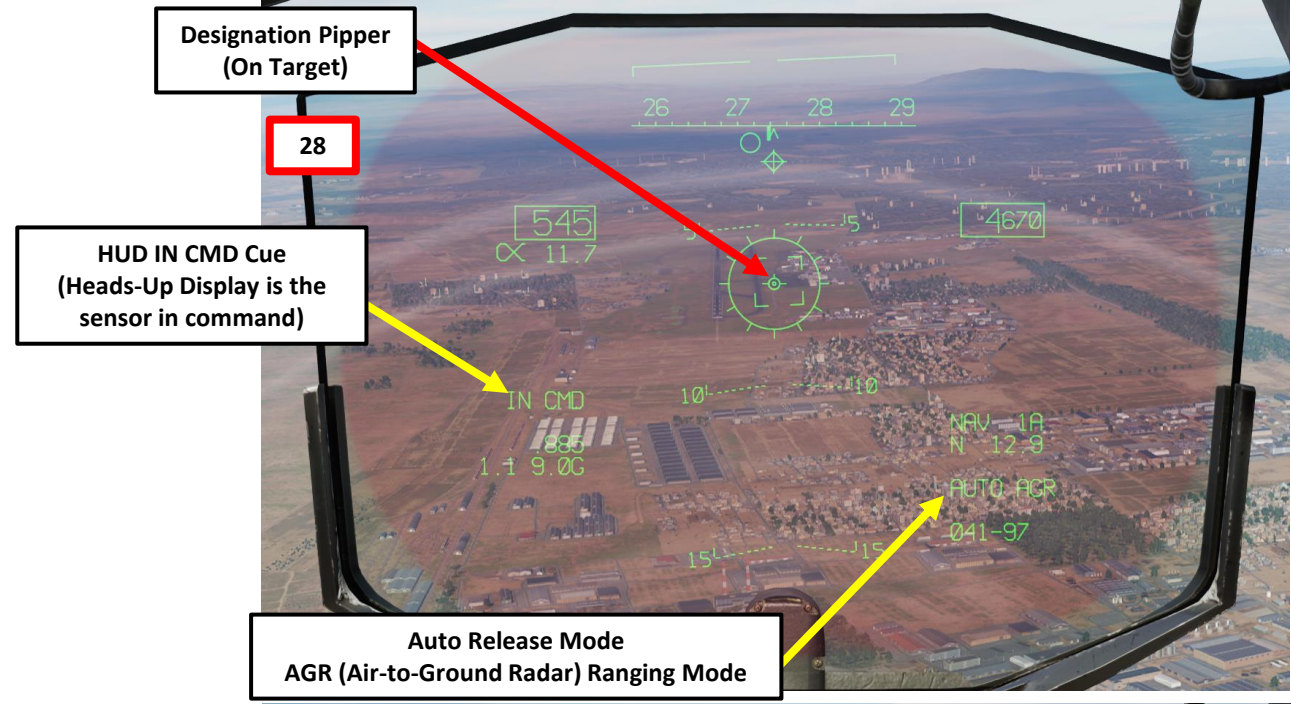
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
B – Weapon Arming & Target Designation

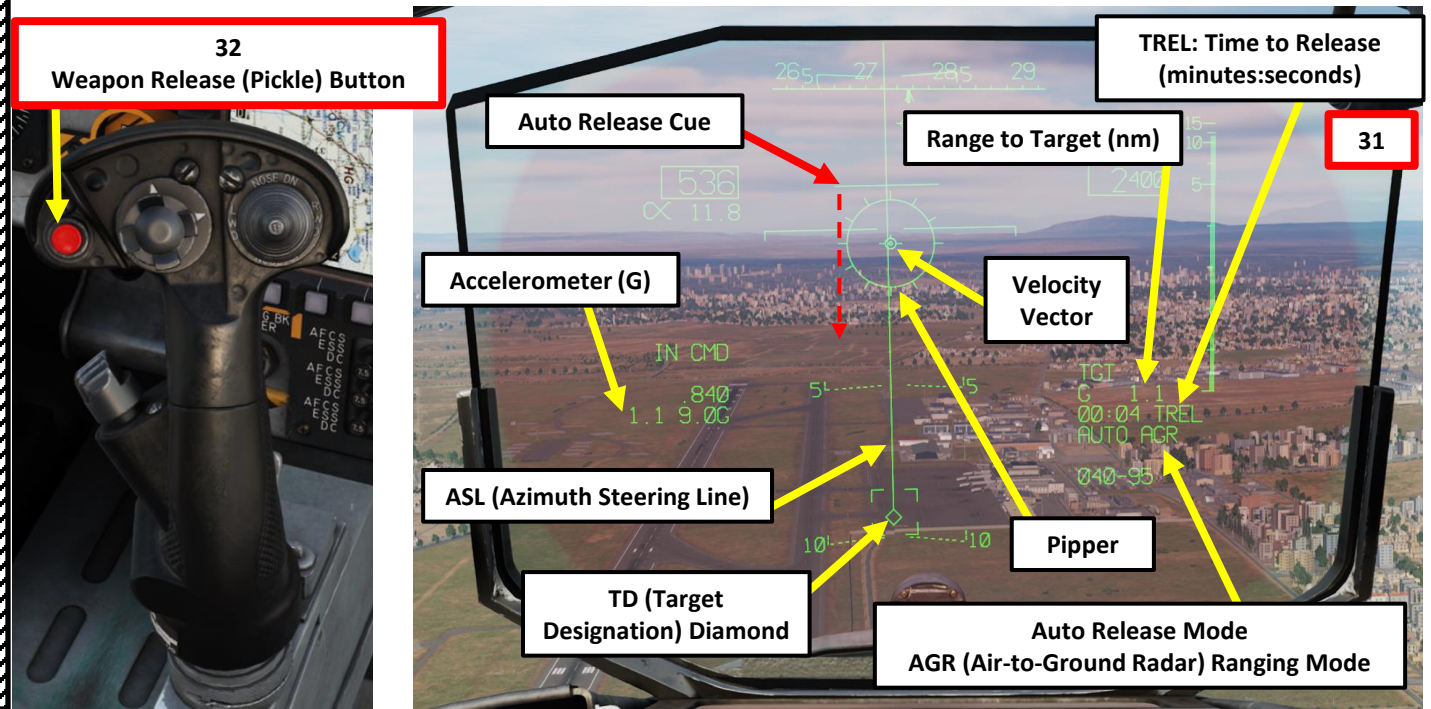
25. Set Master Arm Switch – ARM (UP)
26. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the "IN CMD" (In Command) Cue.
    • Note: HUD designation enables air-to-ground radar (AGR) ranging through the pipper, which is very important for accurate bombing.
27. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
28. Steer the aircraft to place the pipper/reticle on the target you want to designate.
29. Designate target by pressing and releasing the TDC (Target Designation Control) switch.

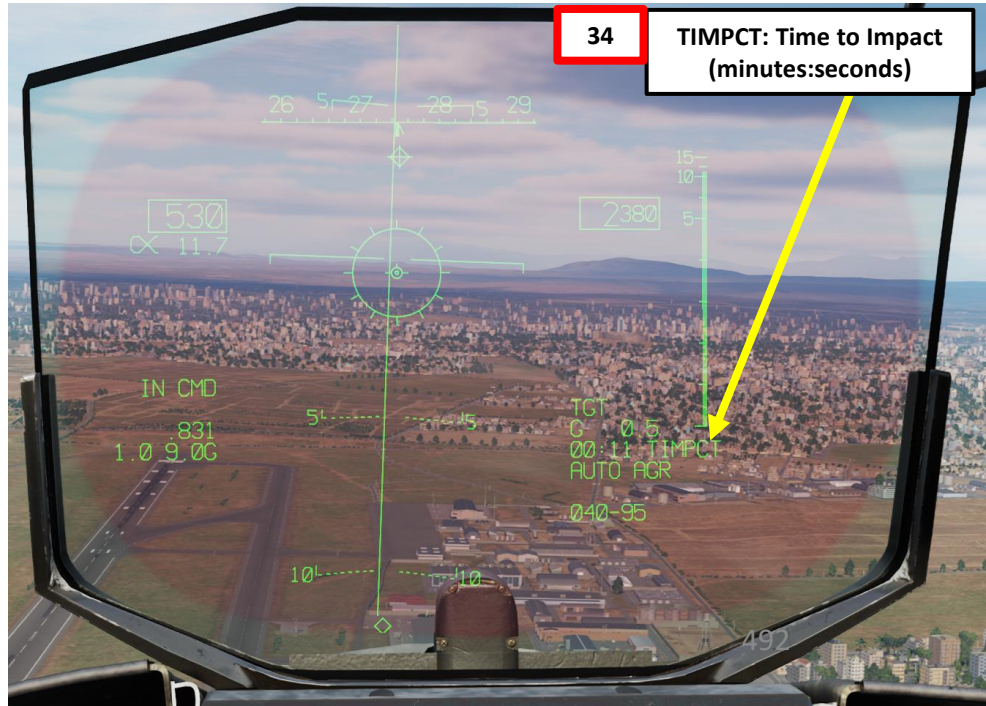




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
C – Perform Attack

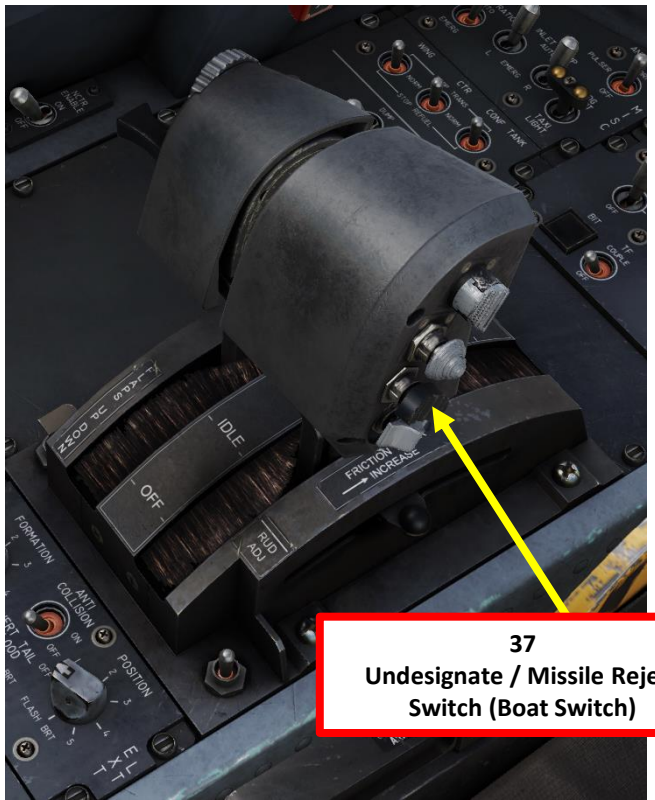
30. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
31. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
32. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bombs.
33. Bombs will automatically drop when the auto release cue crosses the velocity vector.
34. Once bombs are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
35. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
36. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

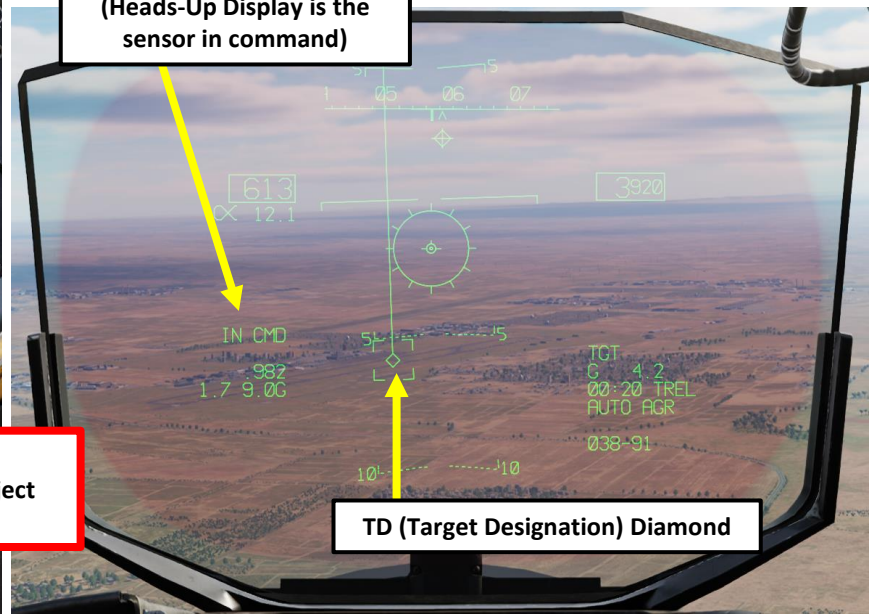


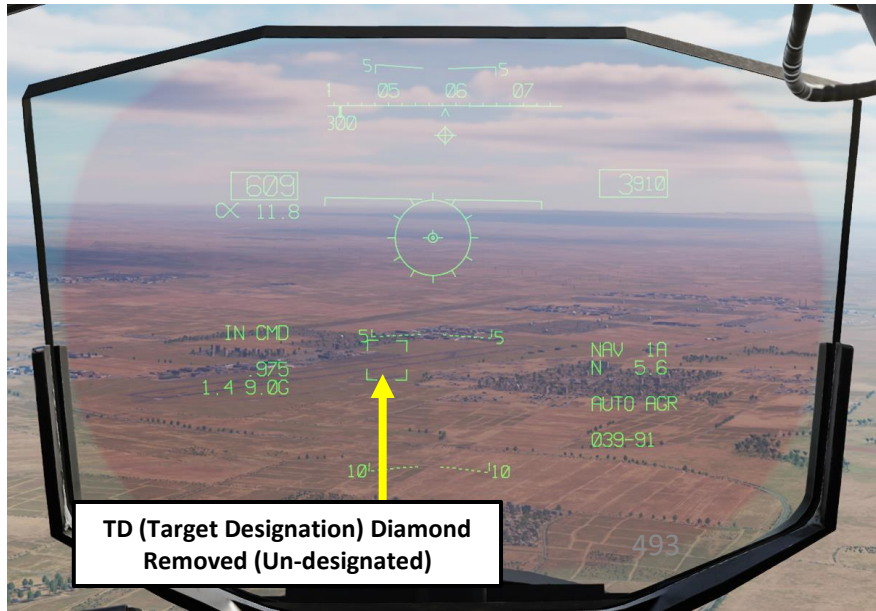


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.2 – MK-82AIR High Drag (Auto Mode with HUD)
C – Perform Attack

37. To un-designate target and remove the TD (Target Designation) diamond, press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).



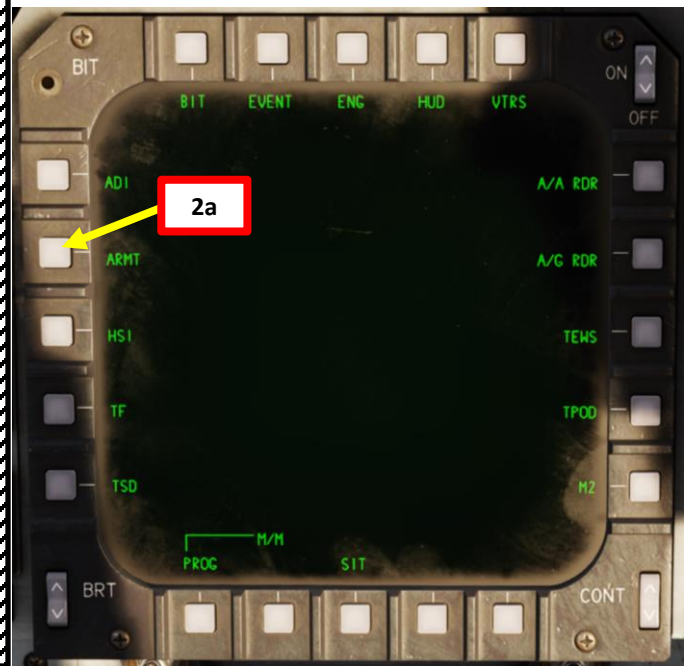


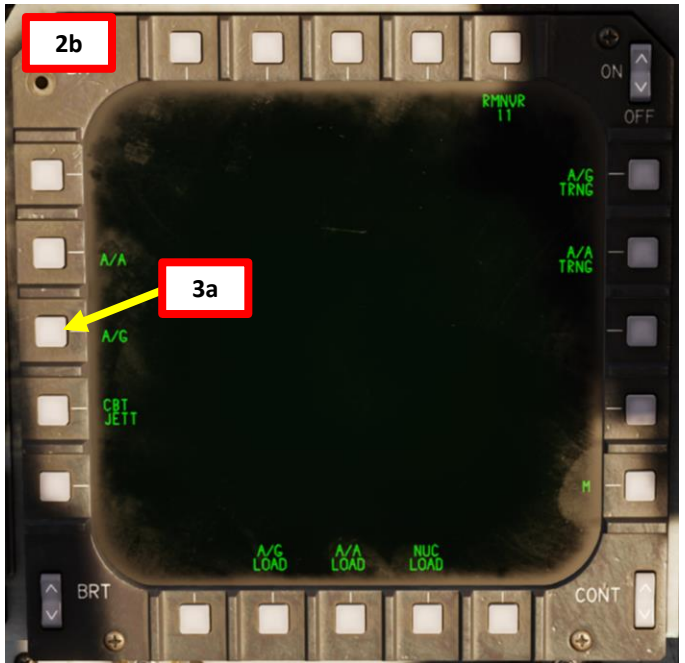


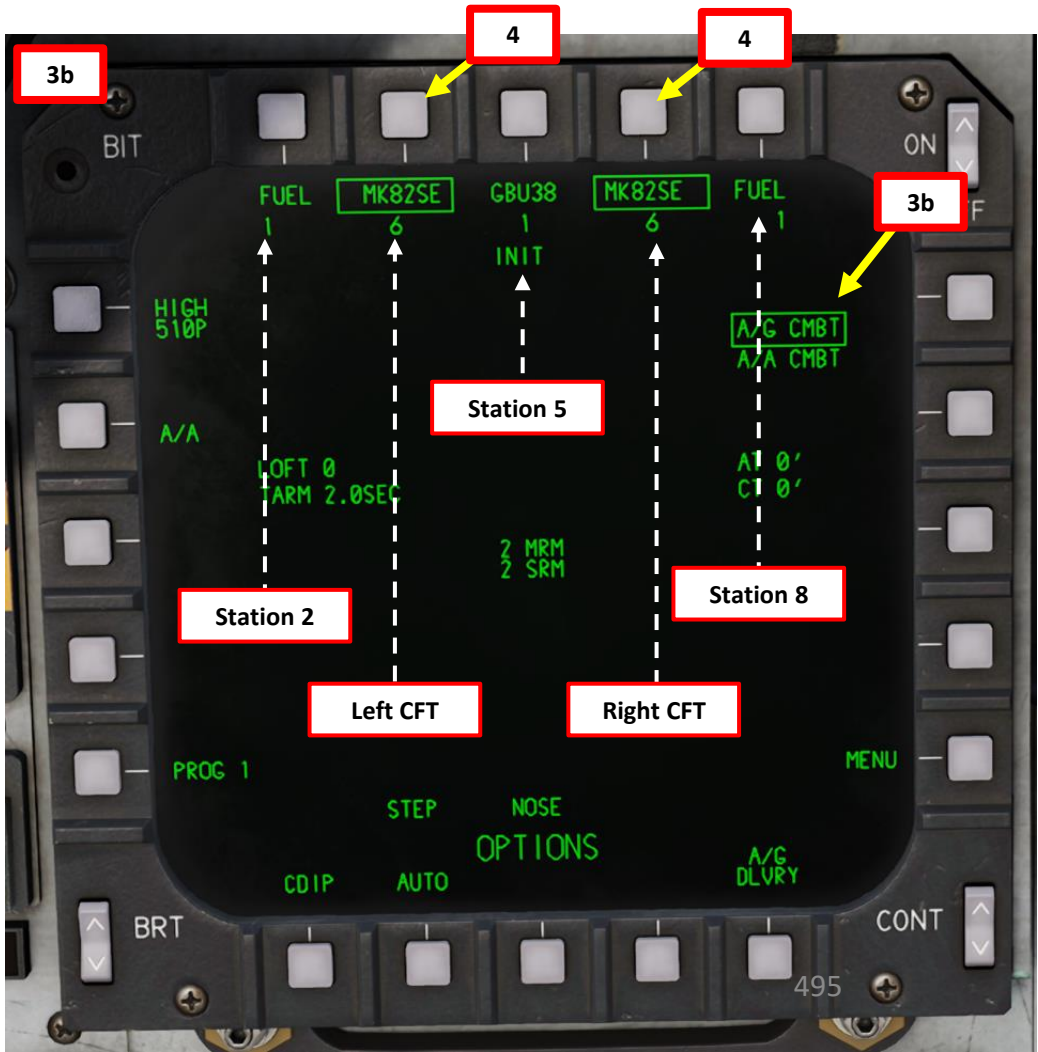
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “MK82AR” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.

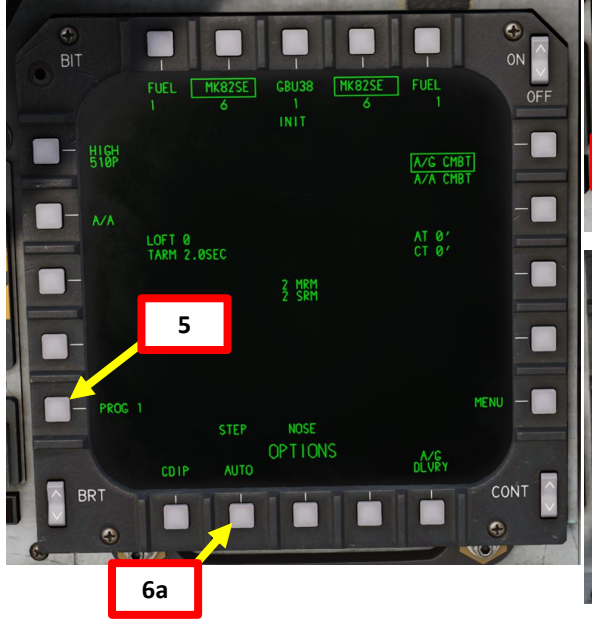


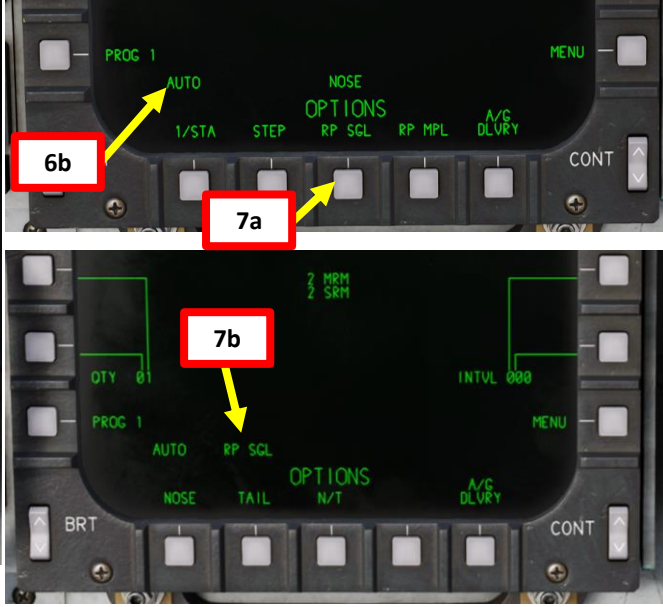


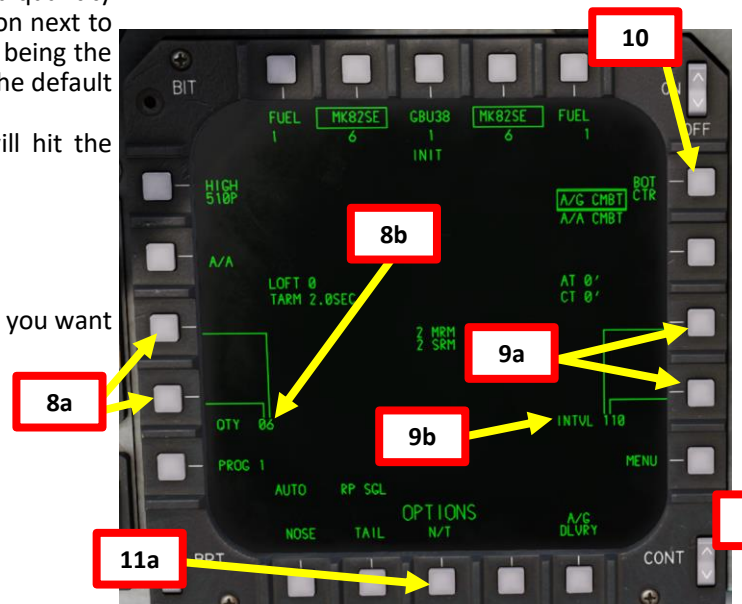


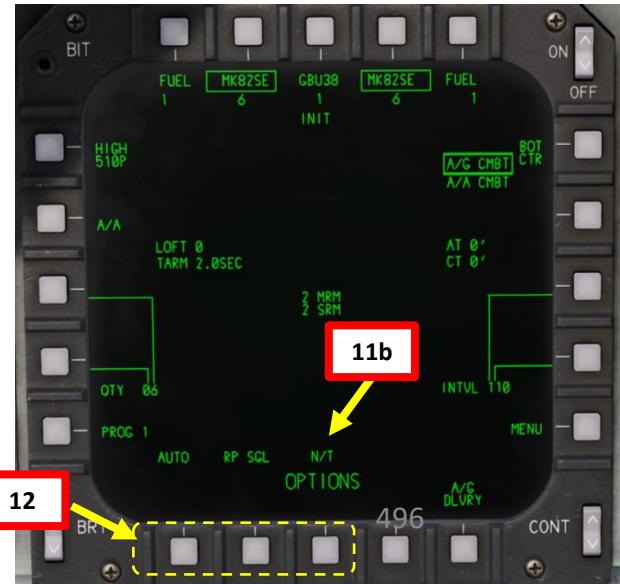
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 6 bombs by toggling the pushbuttons next to the QTY data field.
9. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
10. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select Fuzing Option – As desired. We will select N/T for a high drag configuration.
    - *N/T (Nose & Tail): High Drag configuration*
    - *NOSE: Low Drag configuration*
    - *TAIL: High Drag configuration*
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



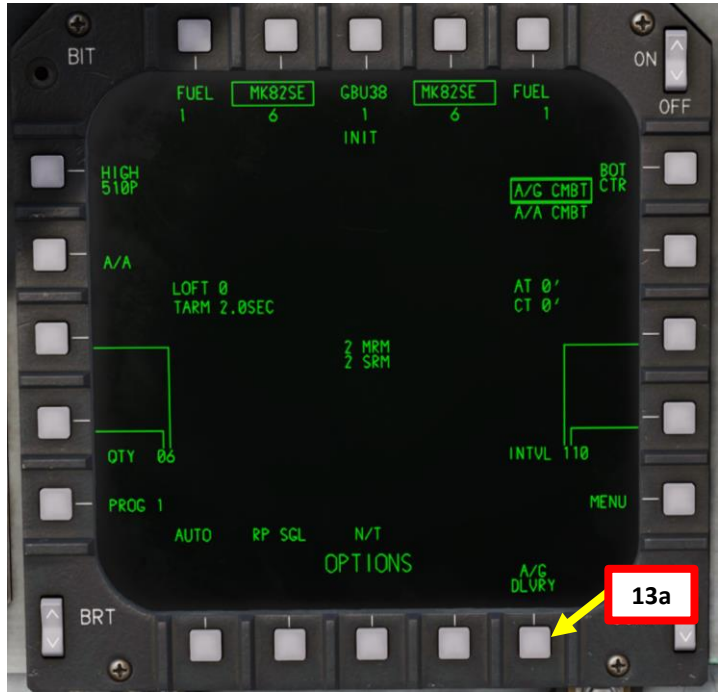


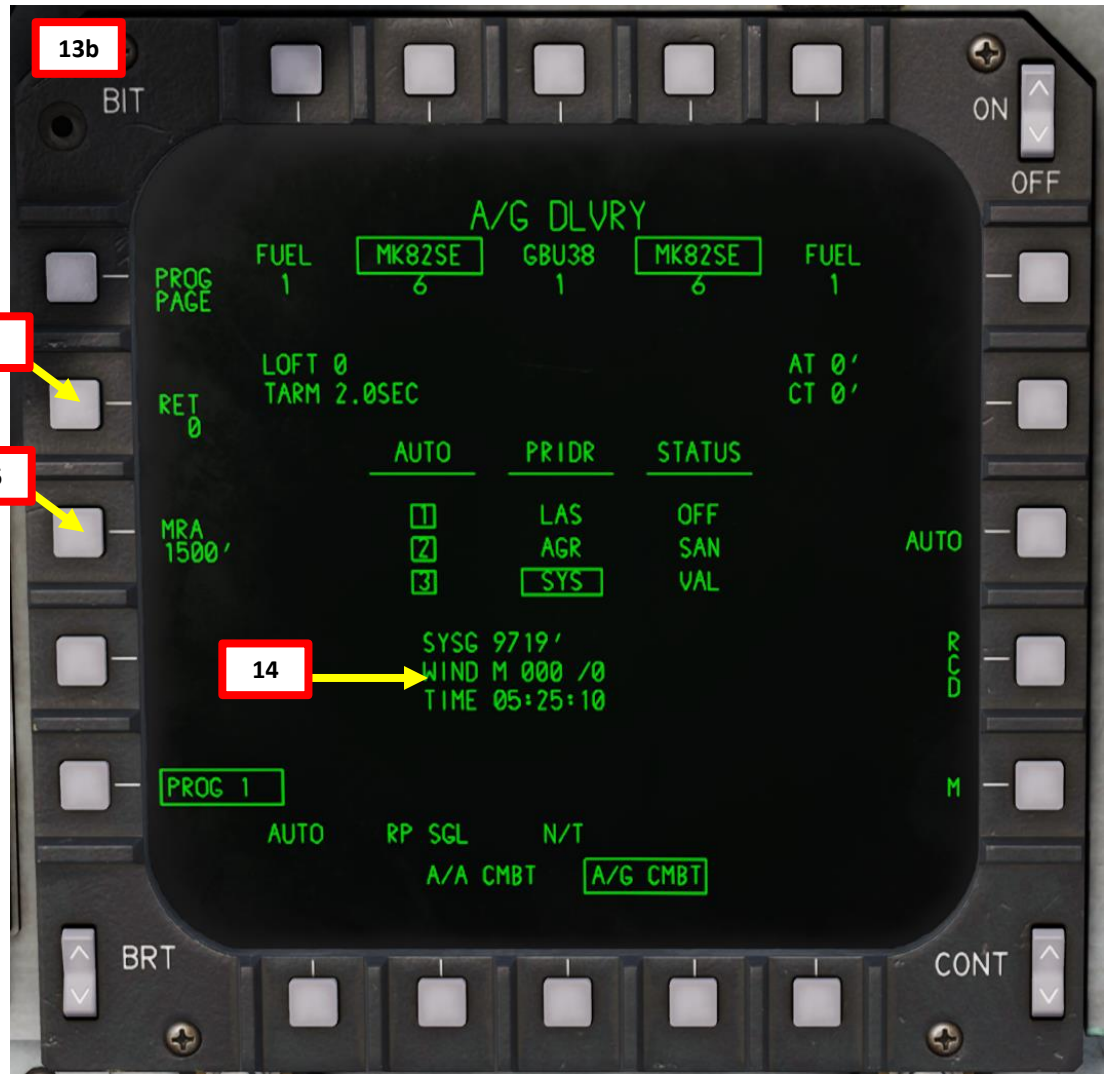




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
A – Weapon Setup

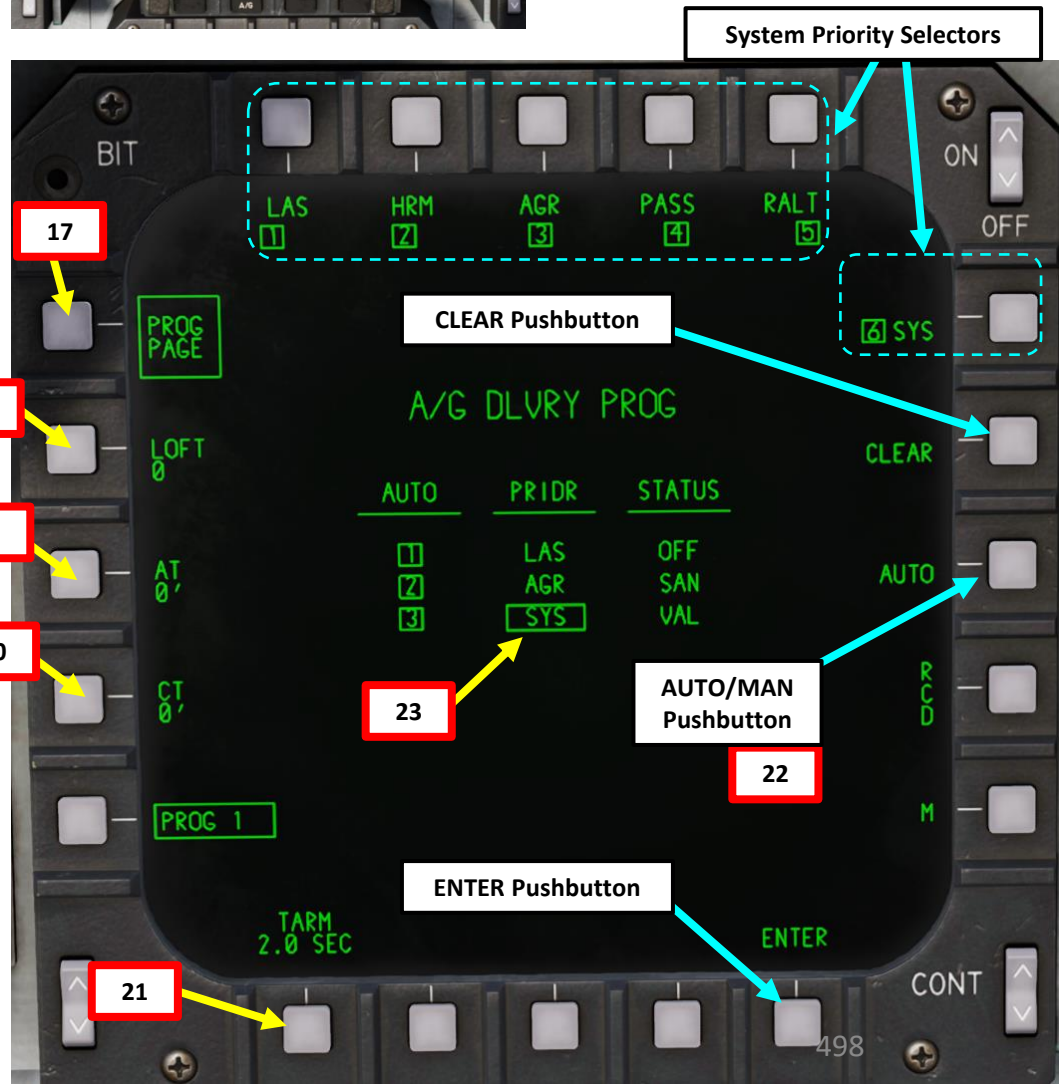
13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





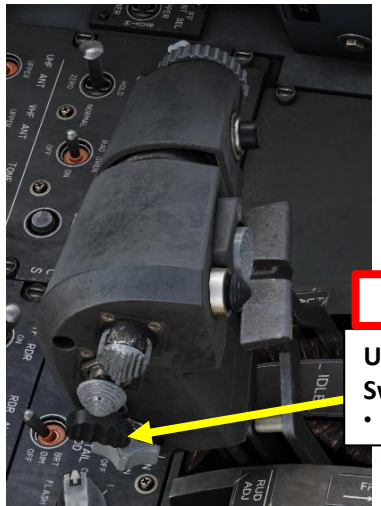
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
A – Weapon Setup

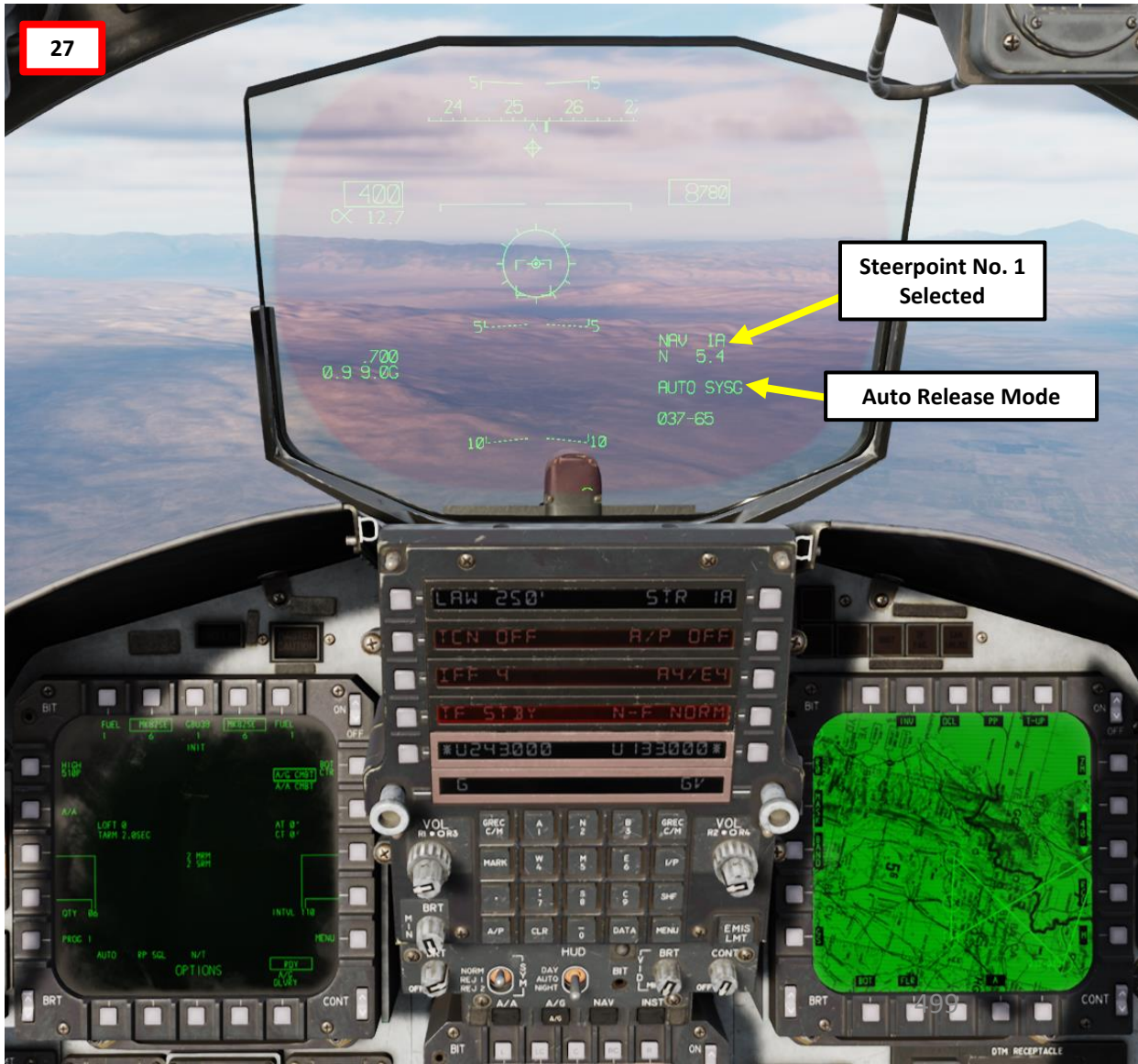
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
B – Weapon Arming & Target Designation

25. Set Master Arm Switch – ARM (UP)
26. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
27. In this tutorial, we will assume Steerpoint No. 2 is already created and set over the target. However, we have not selected it yet.



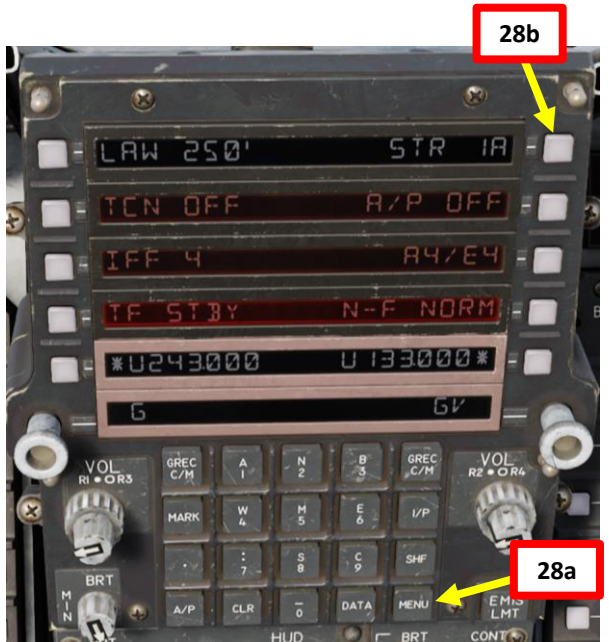


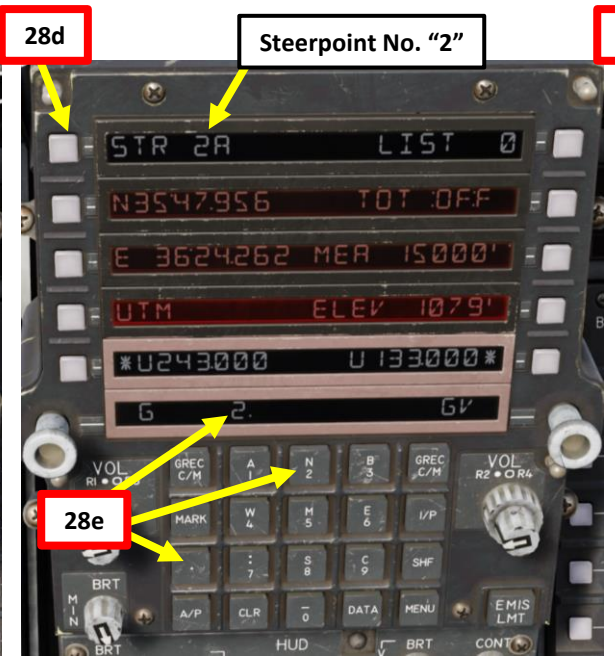
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
B – Weapon Arming & Target Designation

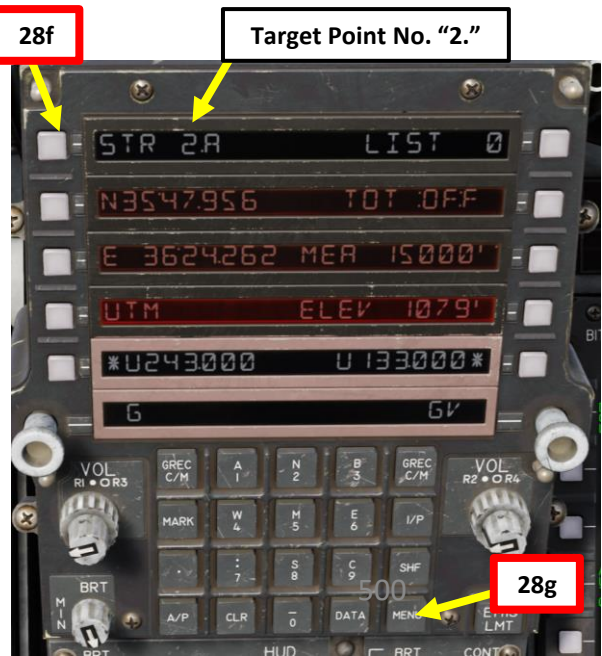
28. The target is located on Steerpoint No. 2. We will have to convert our existing Steerpoint No. 2 into a Target Point No. 2, which is referred as “2.” (two, followed by a dot).
    a) Select UFC (Upfront Control Panel) MENU 1.
    b) Press pushbutton next to STR to select Steerpoint Menu.
    c) On UFC scratchpad, type “2”.
    d) Press pushbutton next to STR. Steerpoint No. 2 is now selected.
    e) On UFC scratchpad, type “2”, then “.” after (two, followed by a dot).
    f) Press pushbutton next to STR. Steerpoint No. 2 is now converted into Target Point “2.”.
    g) Return to UFC MENU 1.

TSD (Tactical Situation Display) Page
Steerpoint “2” (Not converted to Target Point)

TSD (Tactical Situation Display) Page
Target Point “2.”

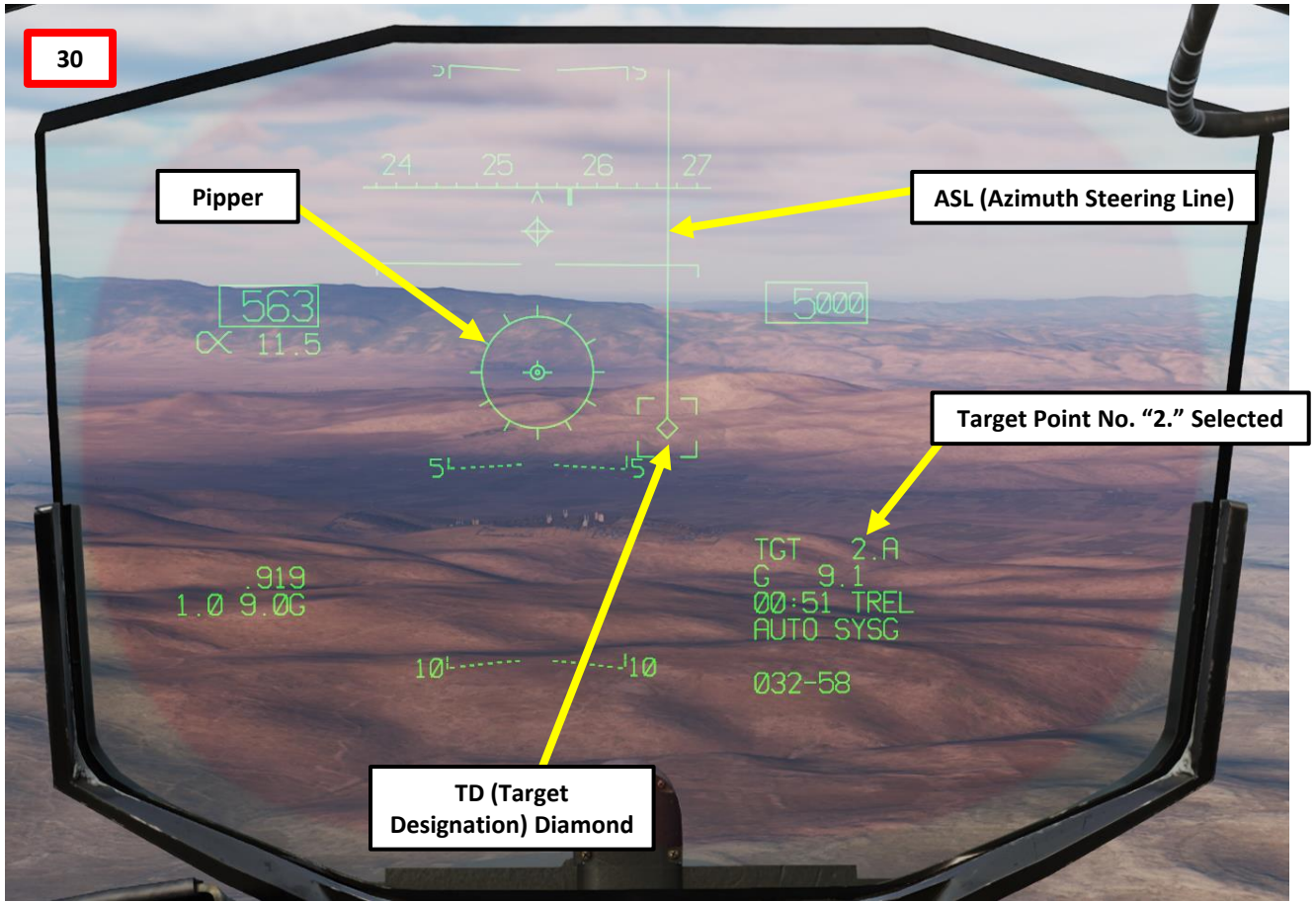


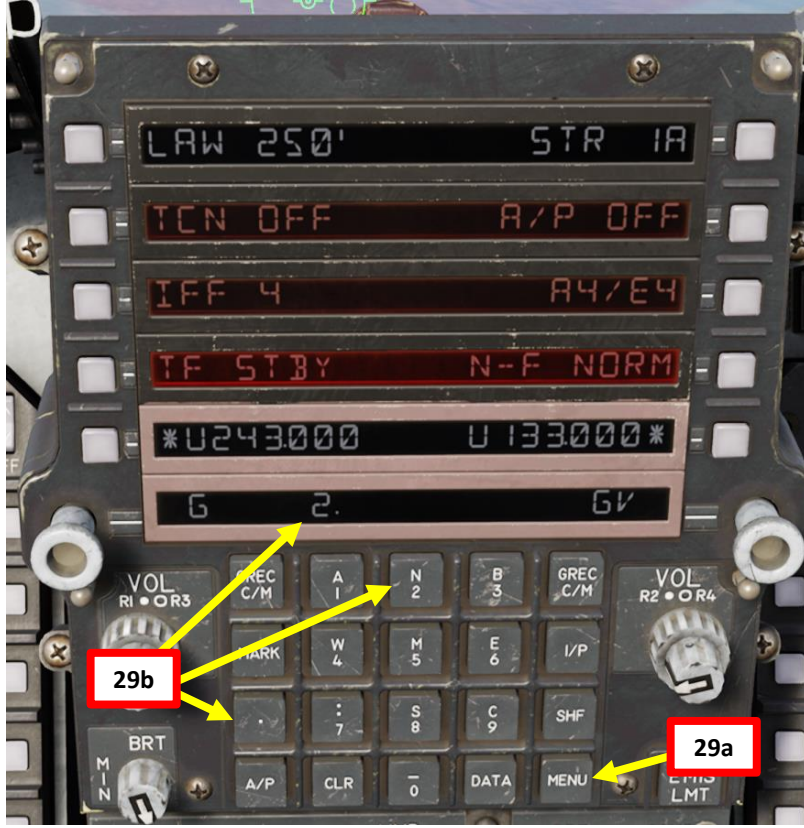




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
B – Weapon Arming & Target Designation

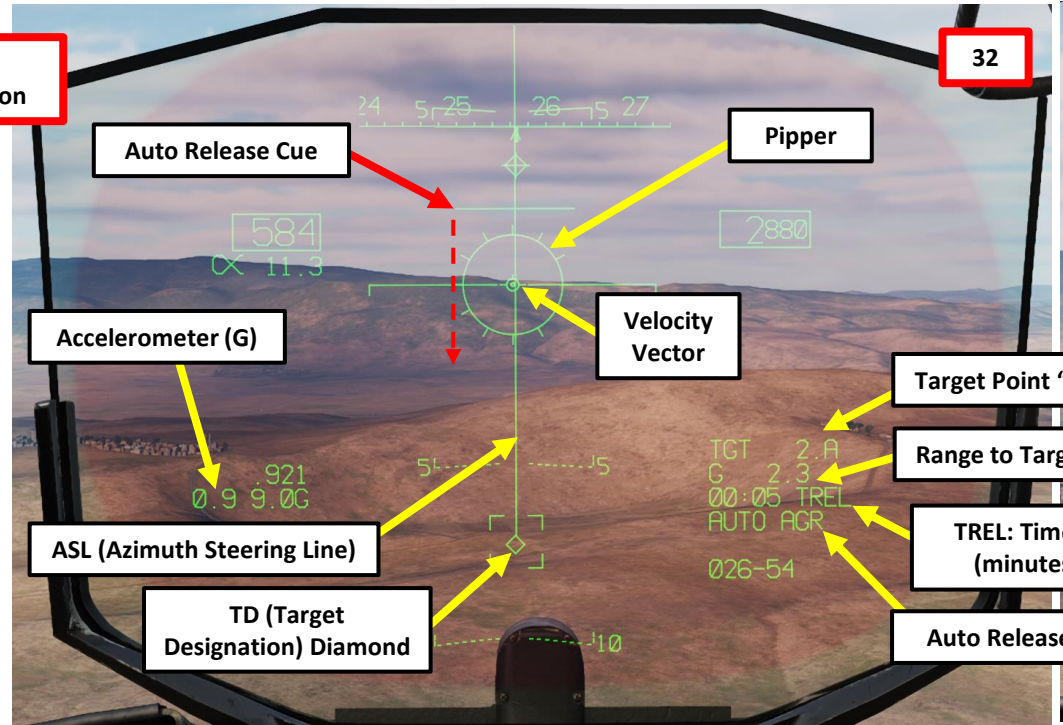
29. Select Target Point No.2 (2.).
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type "2", then "." after (two, followed by a dot).
    c) Press pushbutton next to STR to select Steerpoint Menu.
    d) Target Point No. 2 (2.) is now selected.
30. If the weapons are selected and set up for AUTO delivery and the Target Point is within the HUD line-of-sight, the target and the ASL (Azimuth Steering Line) will appear.

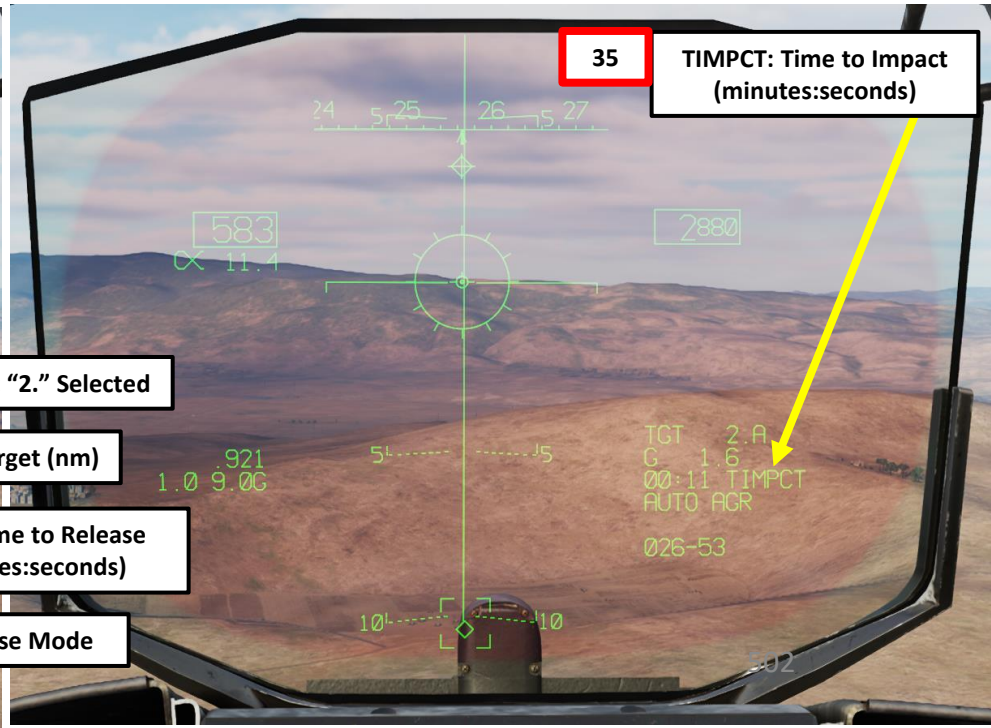




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
C – Perform Attack

31. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
32. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
33. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bombs.
34. Bombs will automatically drop when the auto release cue crosses the velocity vector.
35. Once bombs are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
36. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
37. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.



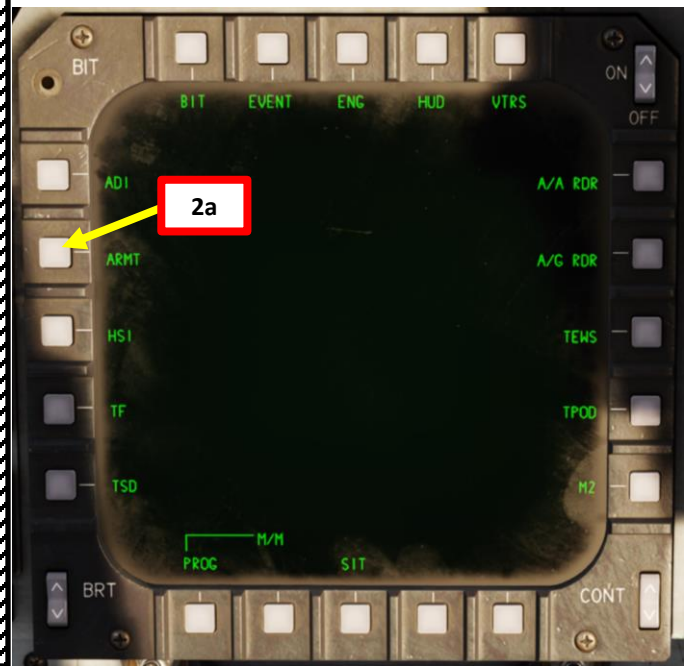


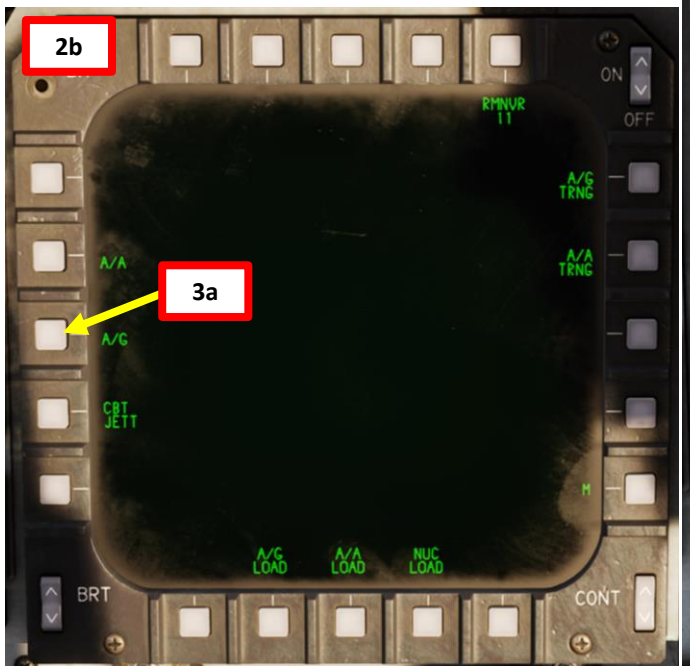
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.3 – MK-82 Snake Eyes (Auto Mode with Steerpoint)
C – Perform Attack

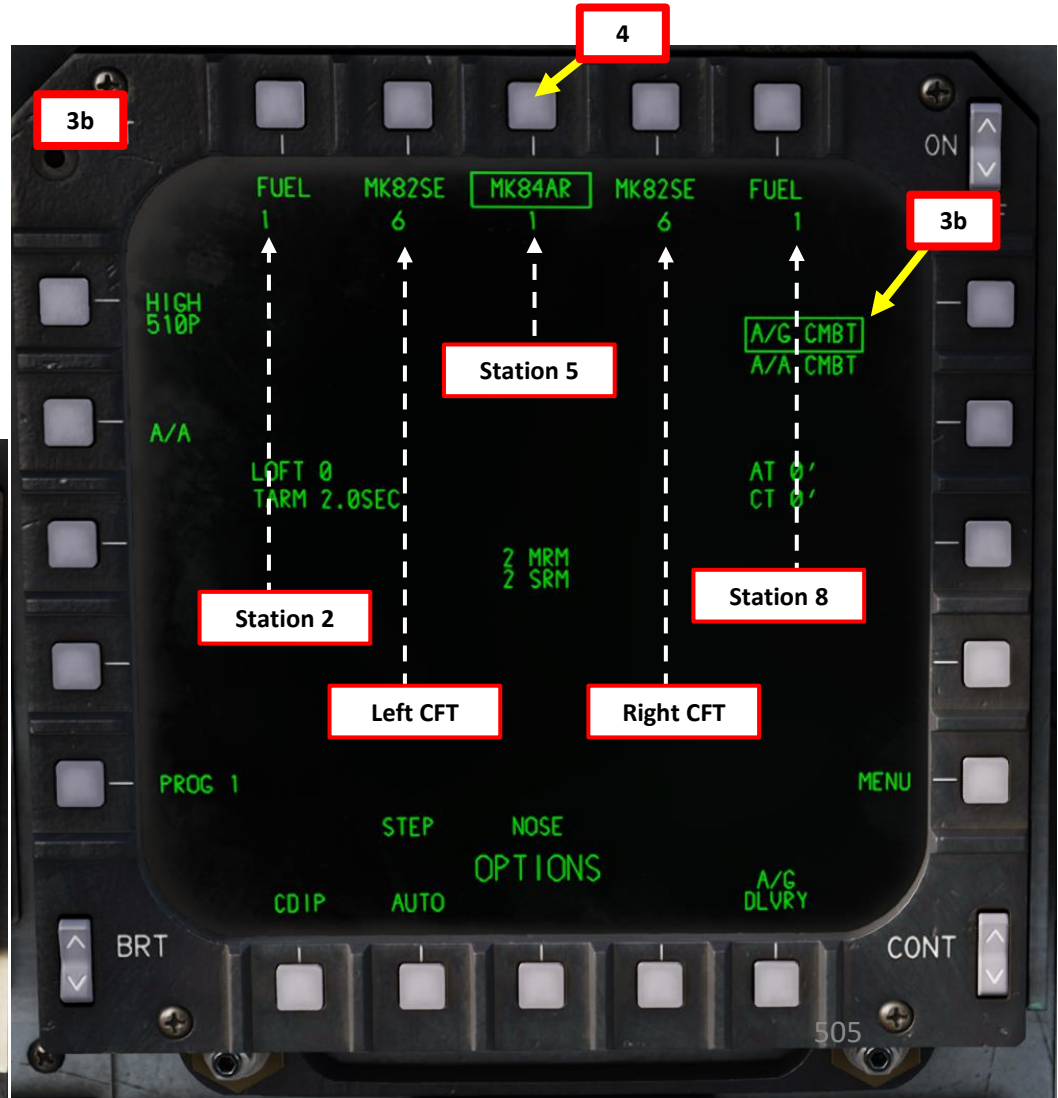
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “MK84AR” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.



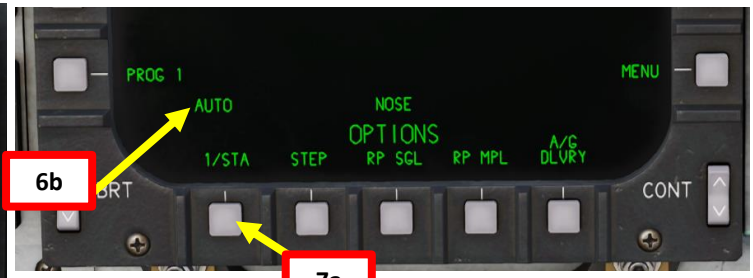


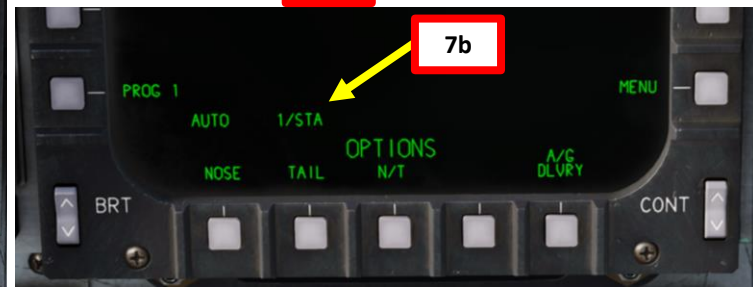


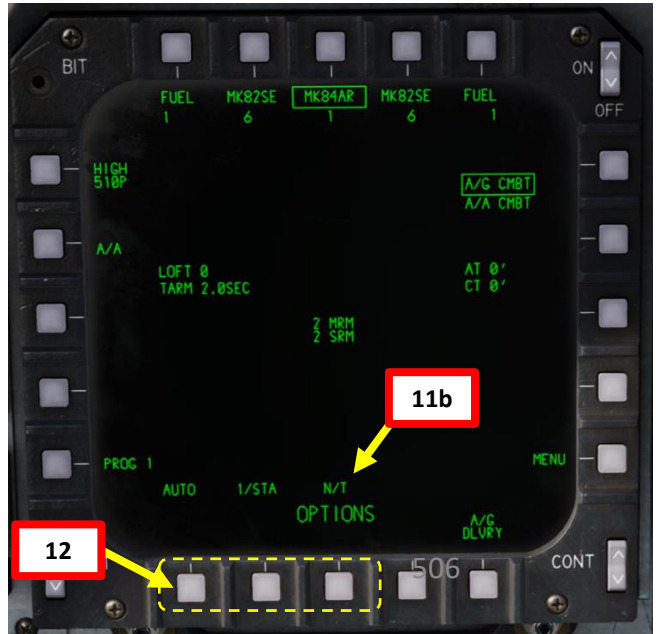
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)

A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select 1/STA.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select Fuzing Option – As desired. We will select N/T for a high drag configuration.
    - *N/T (Nose & Tail): High Drag configuration*
    - *NOSE: Low Drag configuration*
    - *TAIL: High Drag configuration*
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.

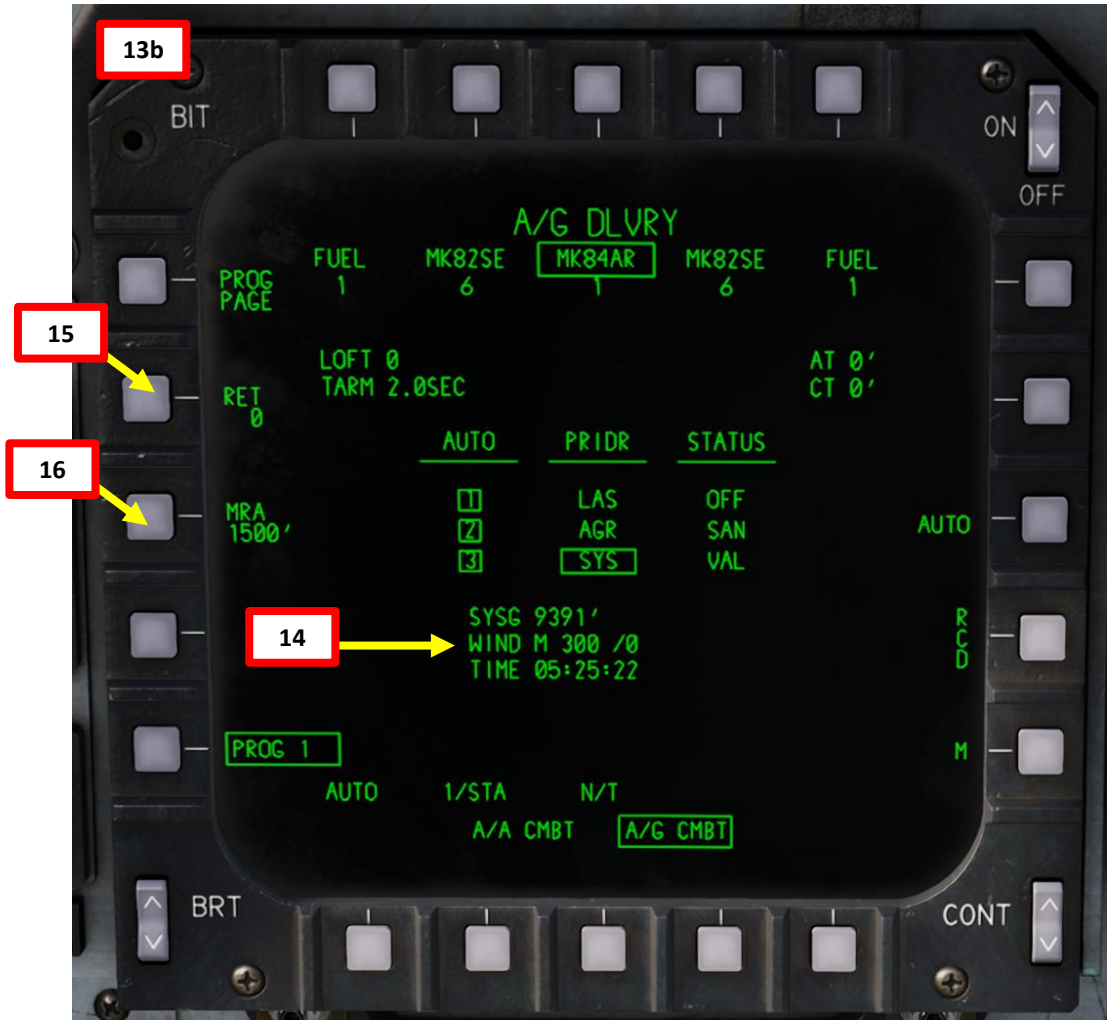






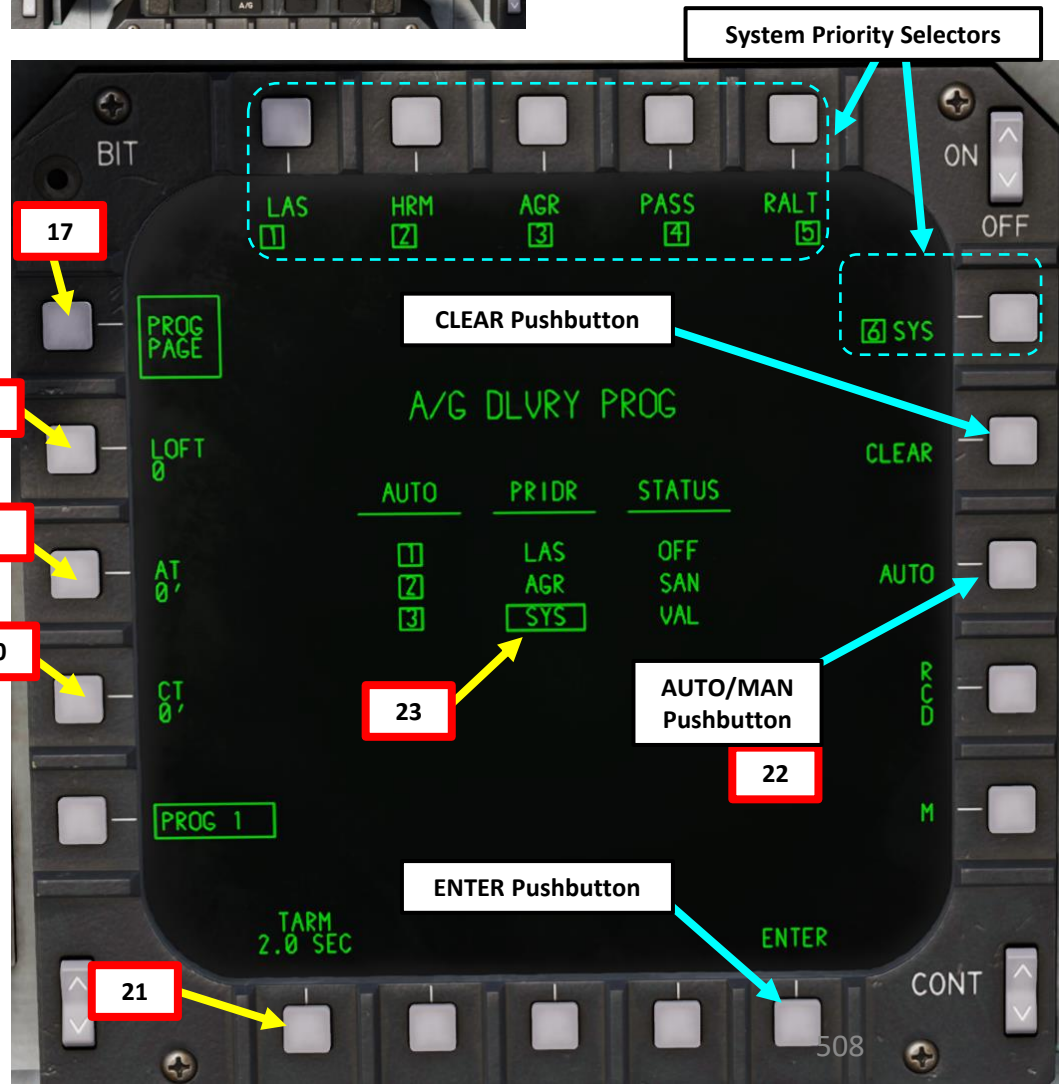
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.



2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
A – Weapon Setup

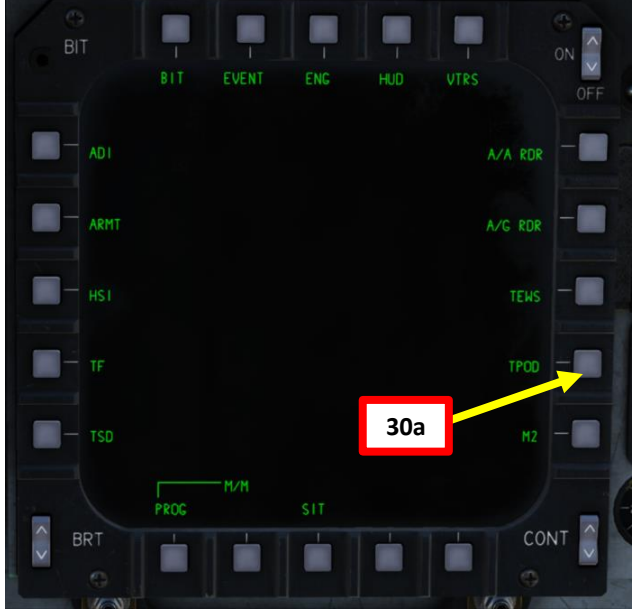
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

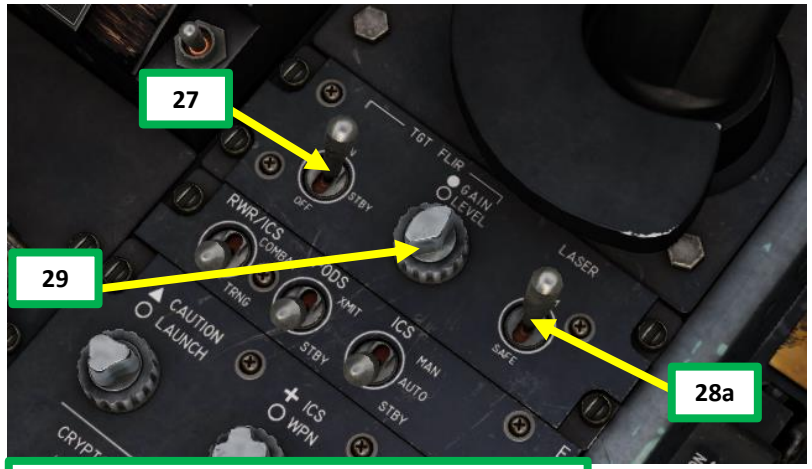


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

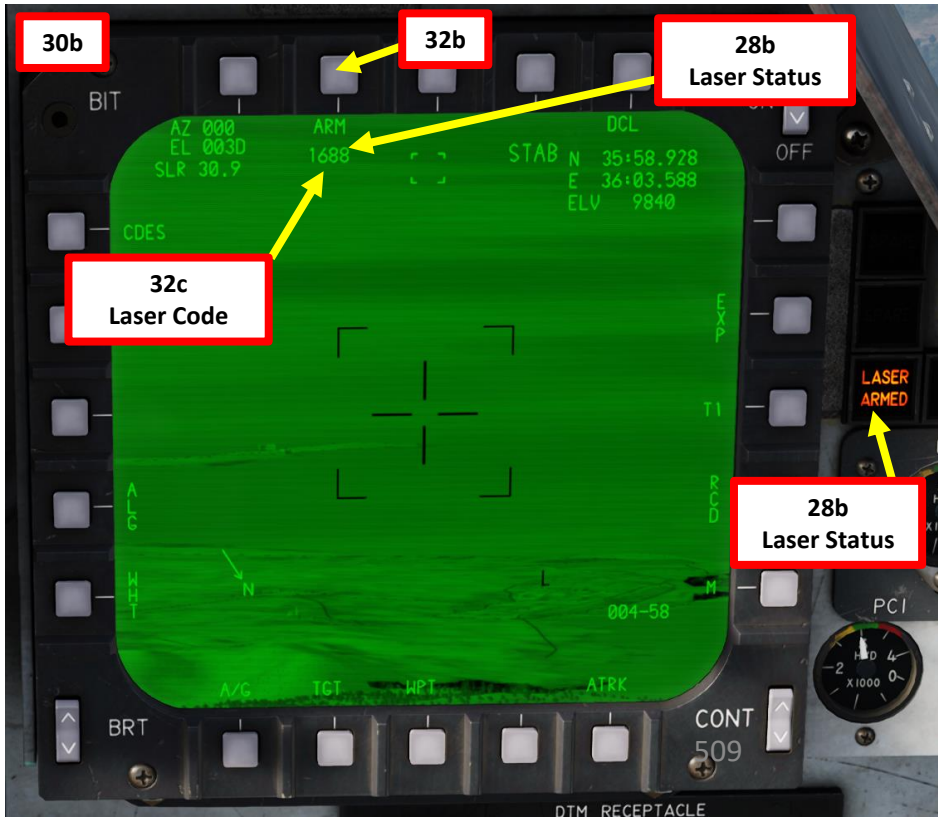
25. *[P]* Set Master Arm Switch – ARM (UP)
26. *[P]* Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
27. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – ON (FWD).
28. *[WSO]* Set Laser Arm Switch to ARMED (FWD).
29. *[WSO]* Adjust TGT FLIR Gain/Level – As required.
30. From the main MPD menu page, select TPOD page.
31. When using dumb bombs with a targeting pod designation, using a laser is not mandatory. However, laser ranging helps the aircraft to compute a more accurate target range.
32. To set laser designation code, enter a valid code on the UFC (Upfront Control Panel) keypad, then press pushbutton next to the laser status/code indication (ARM/1688 in this example). Valid laser codes are 1111 thru 1788, therefore we will use laser designation code 1688.

Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*



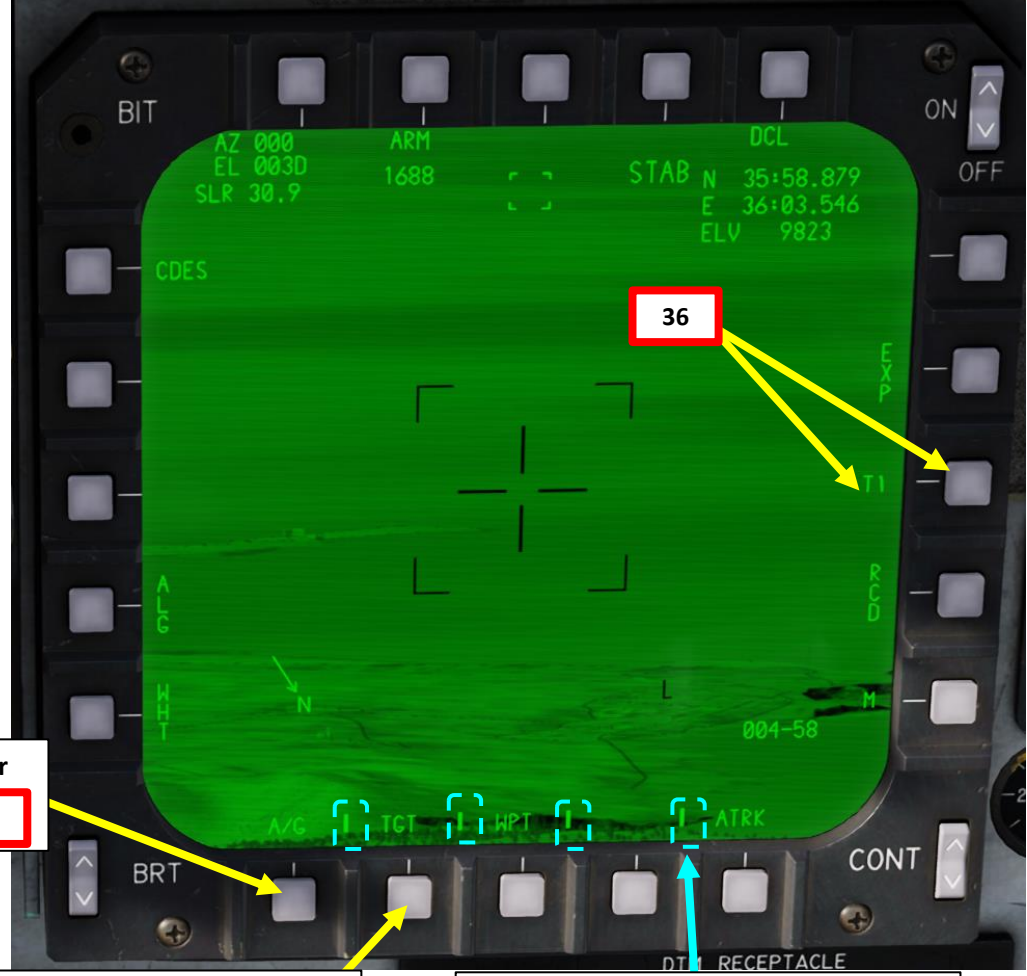


WSO (Weapon Systems Officer) Cockpit



2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

33. Make sure the TPOD page is selected, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
34. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
35. Set Targeting Pod Function Selector to TGT (Target Designation).
36. Select Primary (T1) Mode.
37. Before using the targeting pod's laser ranger/designator, verify that the following conditions are met (otherwise laser designation is inhibited):
    a) **Aircraft altitude is below 25000 ft.**
    b) **Weight off wheels (aircraft is flying) and landing gear is retracted.**
    c) **Valid laser code is entered.**
    d) **Laser is armed.**



Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

34

Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

35

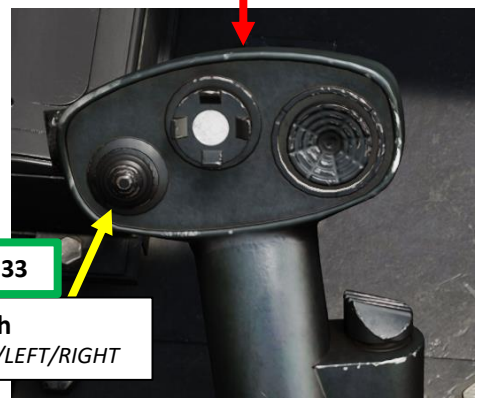
Selection Bars
- *Indicates that Targeting Pod is in command*

33

33

Castle Switch

Left Hand Controller (LHC)

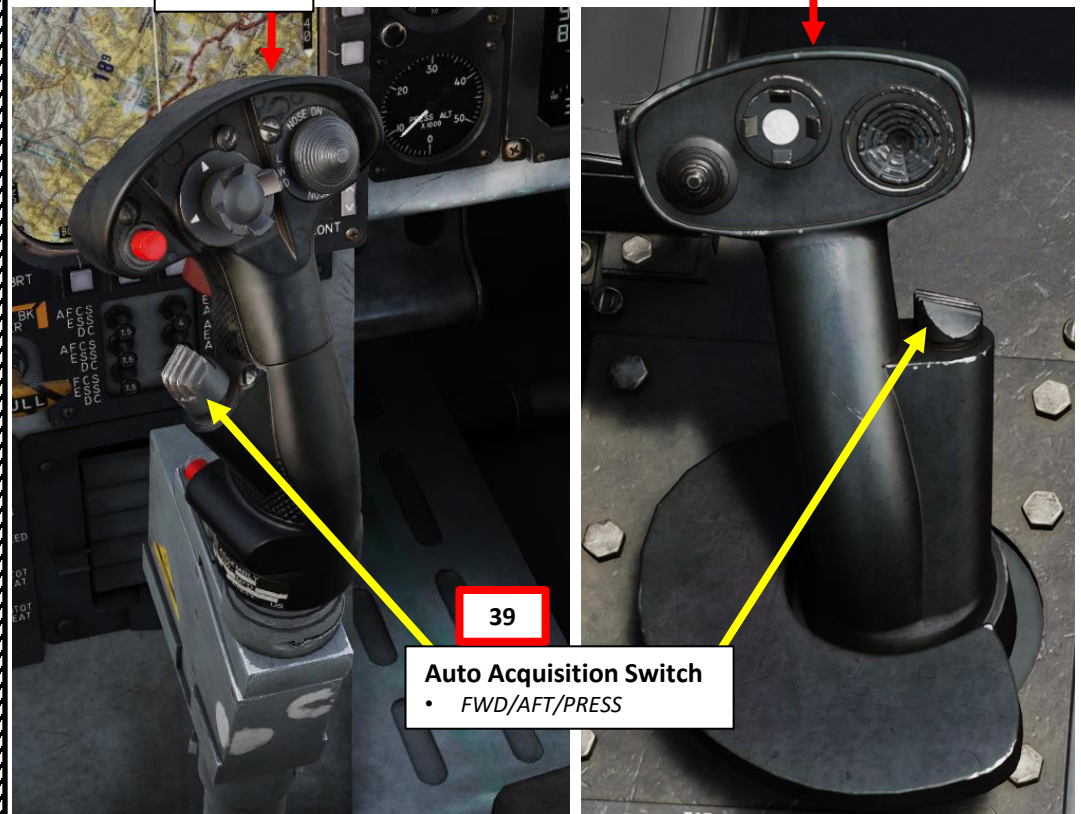


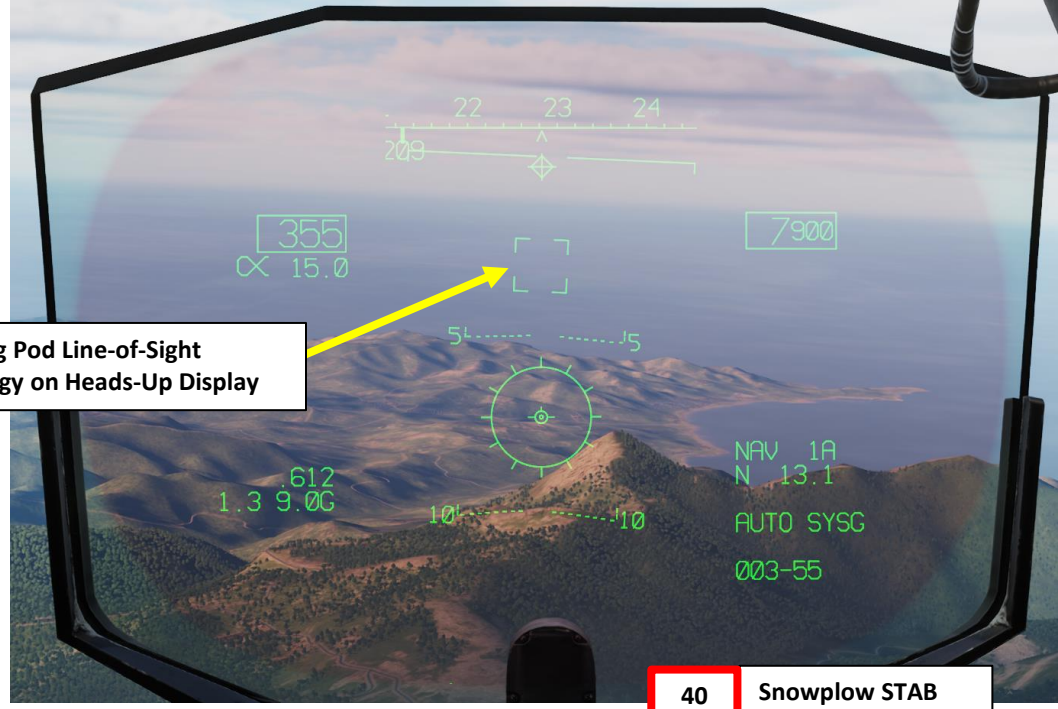
33

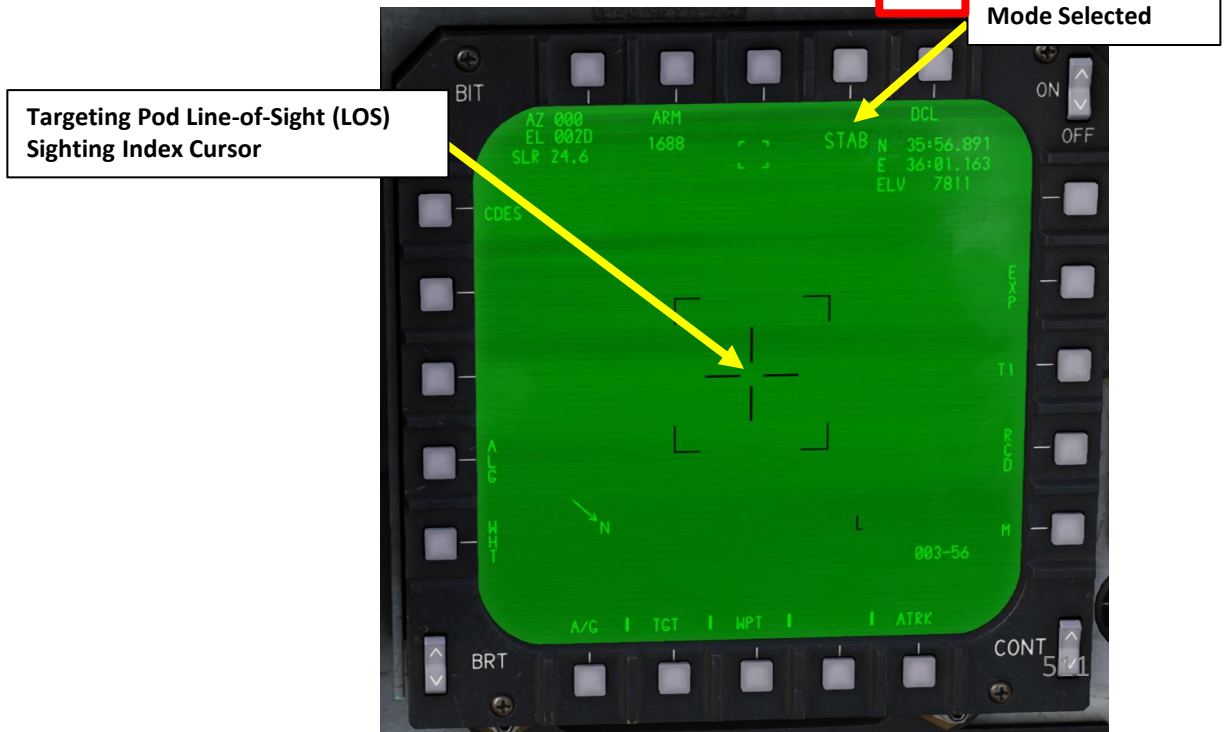
Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

38. You can cue (slave) the targeting pod to a navigation point or other systems (which we talk about in the Cue Mode section), but for this example we will use the simplest method of using the targeting pod in snowplow mode.
39. Press Auto Acquisition Switch – FWD LONG (more than 1 sec) to enter SNOWPLOW STAB mode.
40. The targeting pod's SNOWPLOW STAB mode is space-stabilized to a point below the horizon along the heading vector. The targeting pod's line-of-sight is not tied to the ground; instead, it points at the space at the azimuth angle and elevation the pod had when space stabilization was first initialized.

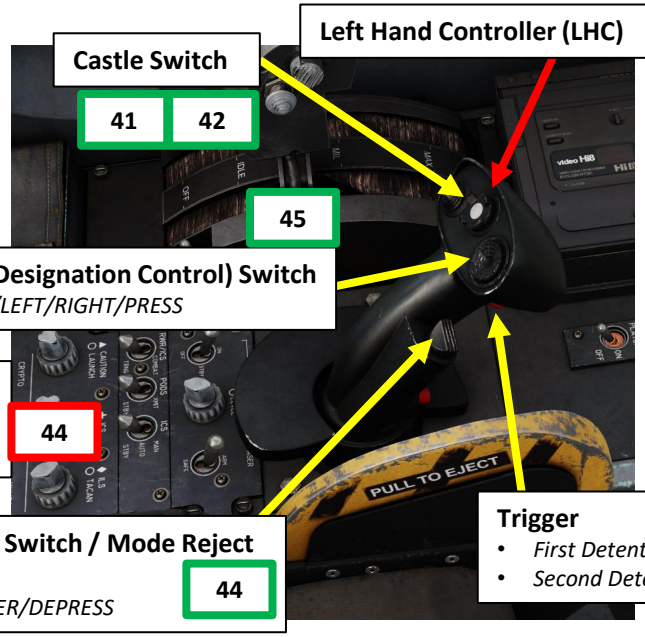


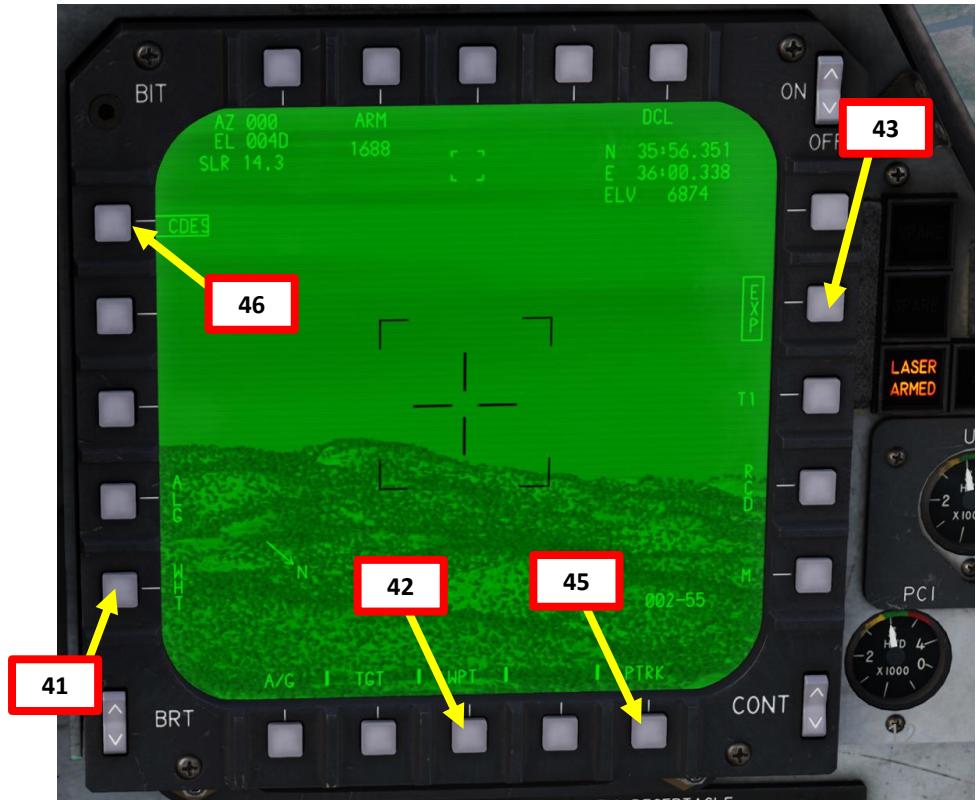




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

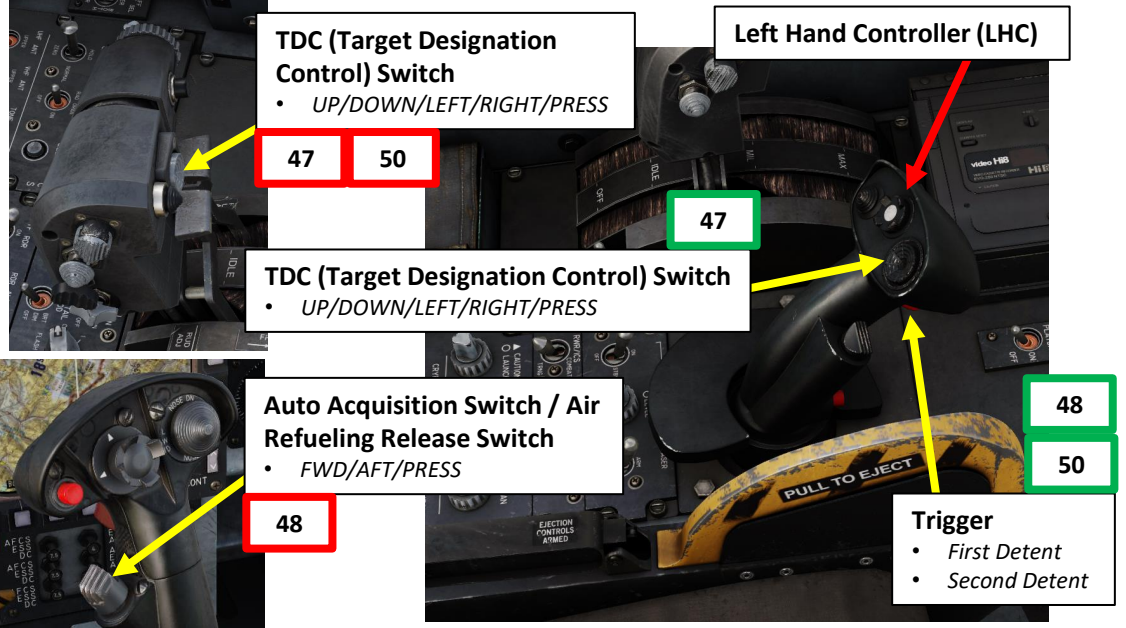
41. Select Video Polarity – As desired.
    - Pressing the Video Polarity Selection Option pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.
    - The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD LONG (more than 1 sec)
42. Select Tracker Polarity Selector – As desired.
    - 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 center of the crosshairs when point track is initiated.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD SHORT (less than 1 sec)
    - Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.
43. If you want to use the ENFOV (Expanded Narrow Field-of-View) zoom mode, select/box the EXP option. In this example, we will select it.
44. Zoom as required by pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec), which toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.
45. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
    - Point Track (PTRK) tracks a moving object like a high-contrast vehicle
    - Area Track (ATRK) is used for a static target
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS
46. If a continuous laser designation is desired, select/box the CDES option. The designation will be continuously updated with new range and line-of-sight designation.
    - If CDES is unselected/unboxed, lasing the target is only performed as long as the Left Multifunction Switch (pilot) or laser trigger (WSO) is depressed.

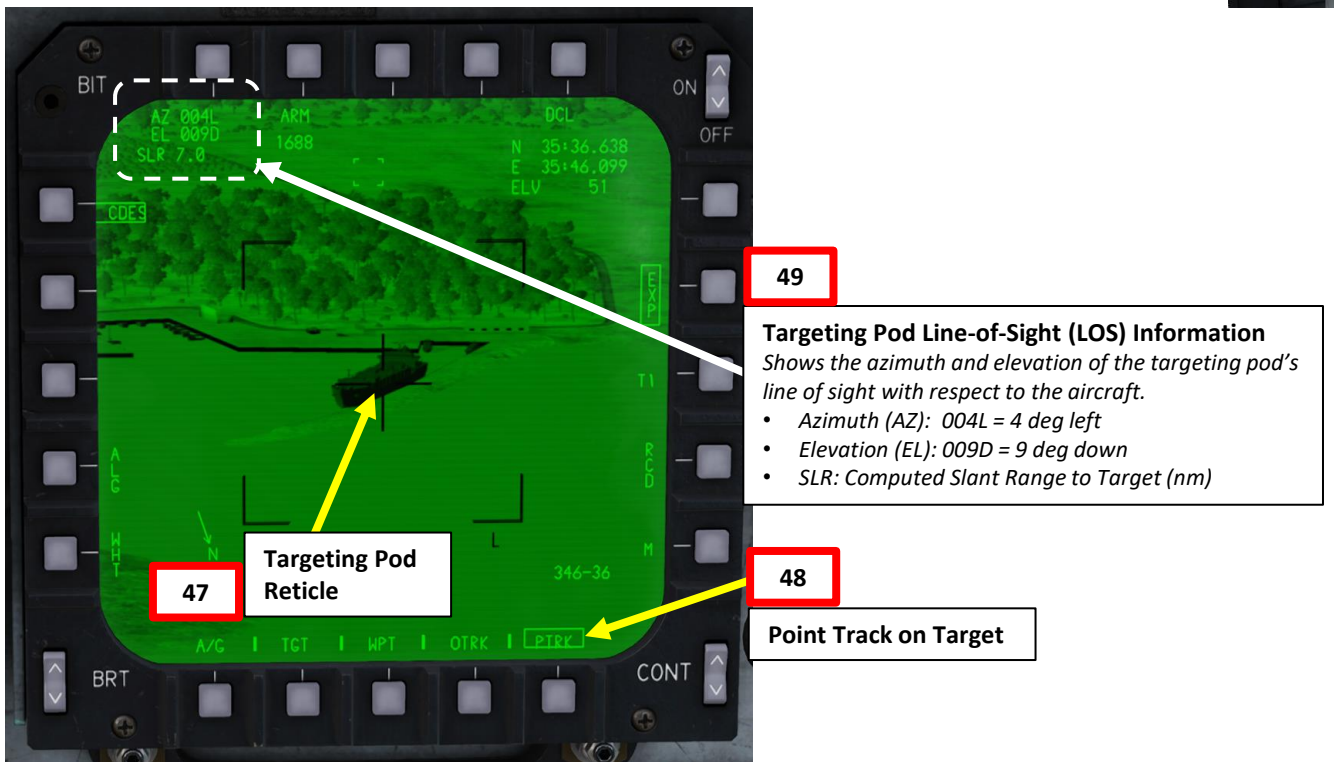


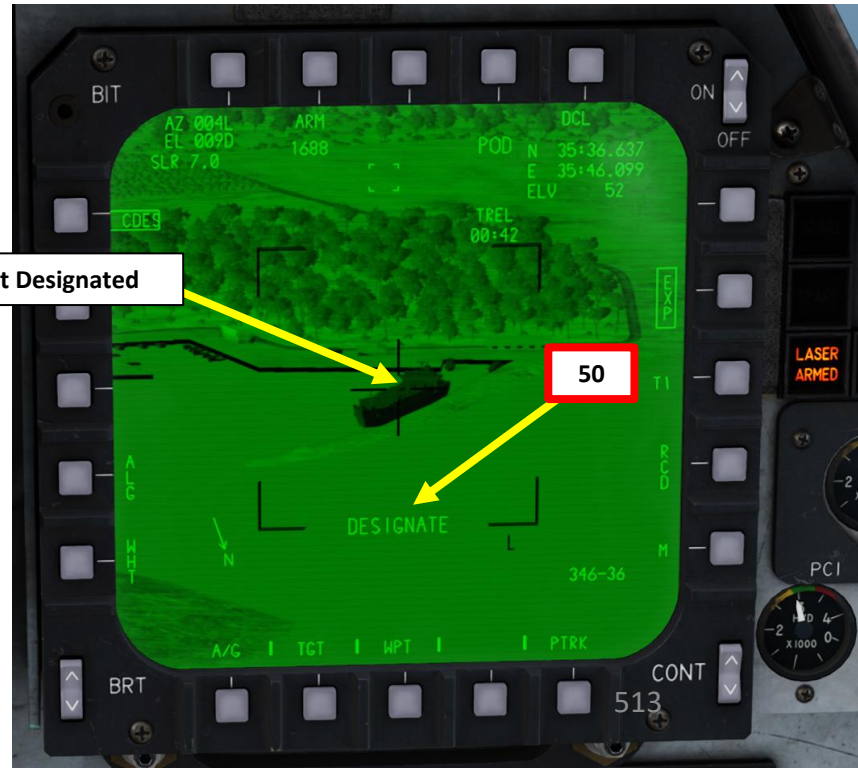


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

47. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to designate and range with a laser.
48. Initiate a targeting pod "track" on the target (either point or area track).
    - **Pilot**: Depress Auto Acquisition Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
49. Once the target is tracked, the targeting pod will compute a slant range and either PTRK or ATRK will be boxed depending on what tracking method you have selected previously.
50. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
51. Once target is designated, the DESIGNATE legend appears for 5 seconds.

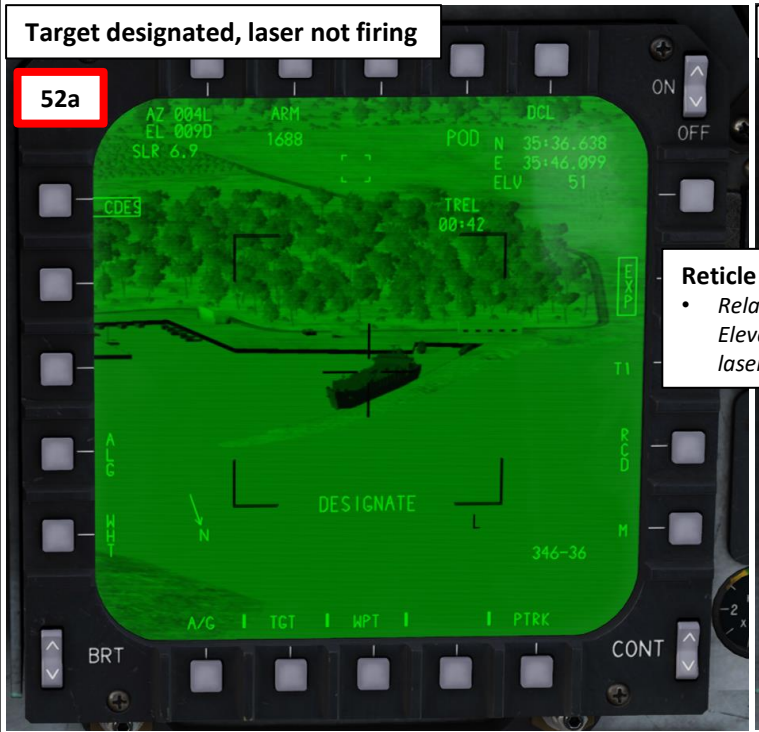


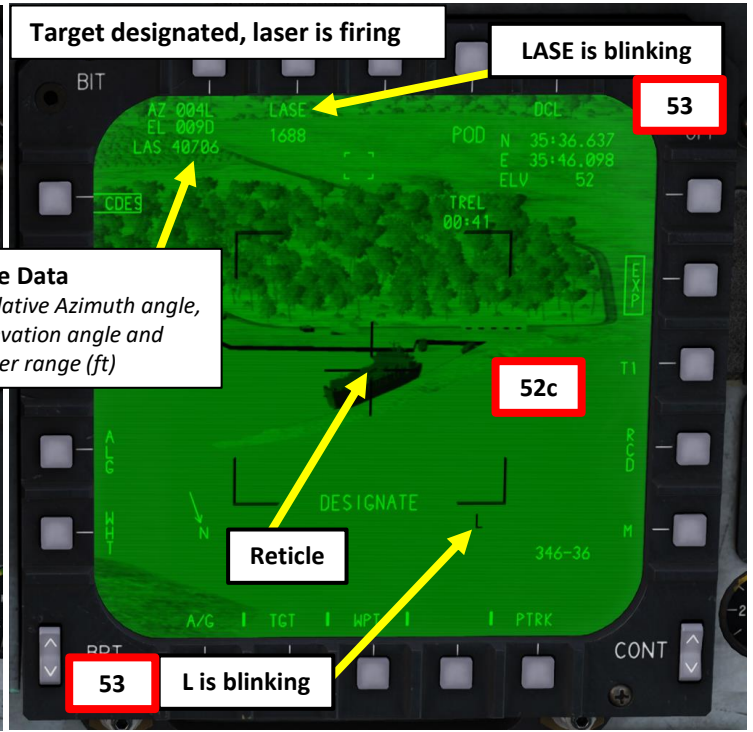


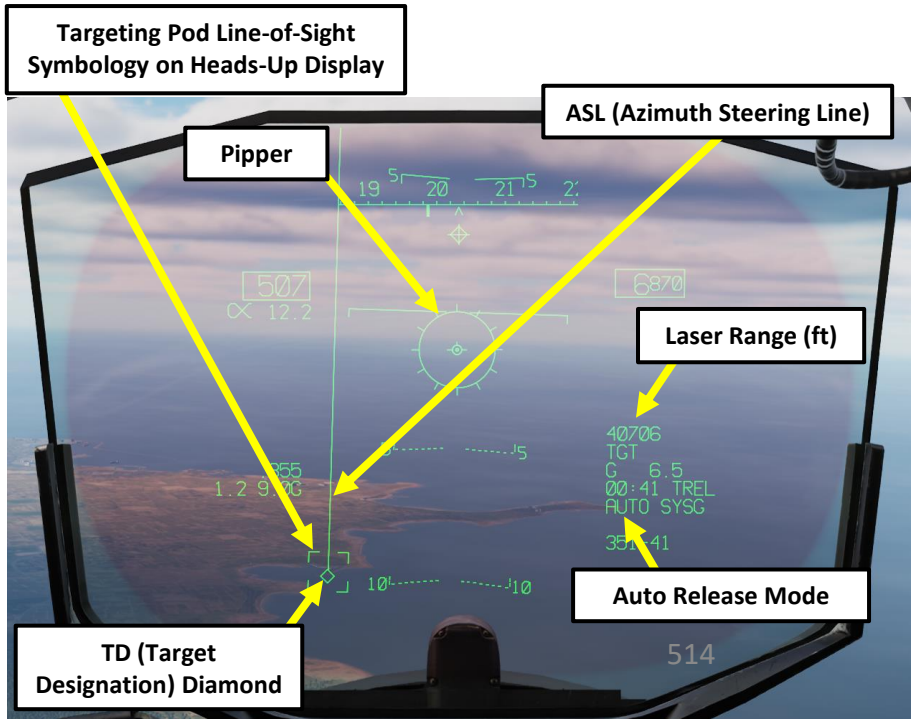


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
B – Weapon Arming & Target Designation

52. For "dumb" ordnance that does not require to be laser-guided (like in this example), firing the laser is not mandatory. However, it does provide better ranging information with laser ranging and is good practice. The maximum range of the laser is about 13 nm (which can also be further reduced due to weather and visibility conditions). You can toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
53. Target ranging information is updated based on the range computed by the laser designator. When laser is firing, the "LASE" and "L" indications blink on the TPOD page.
    - Note: The "MASKED" indication means that the targeting pod's line-of-sight is masked by the airframe or stores and the laser has been commanded to fire.

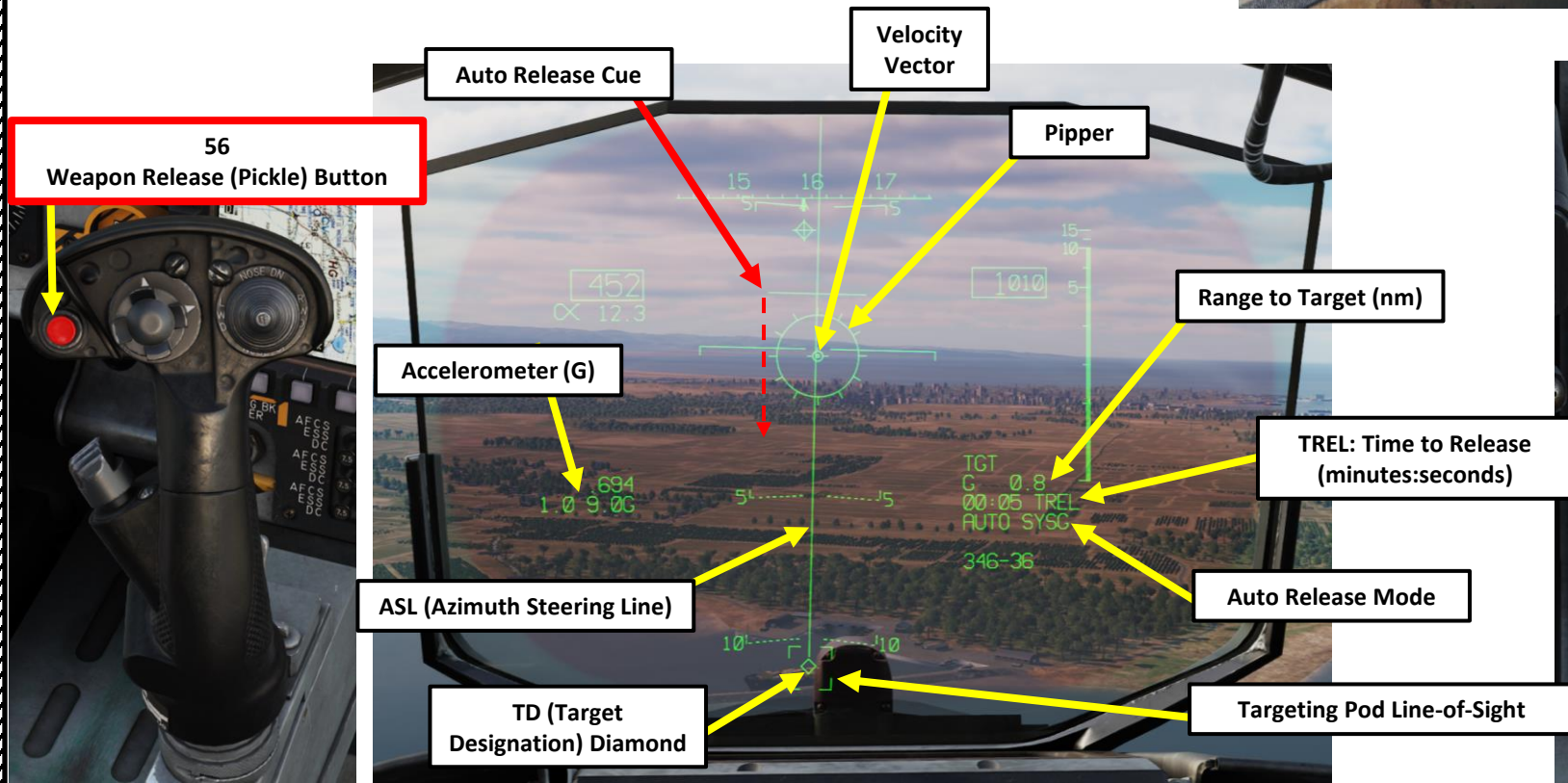






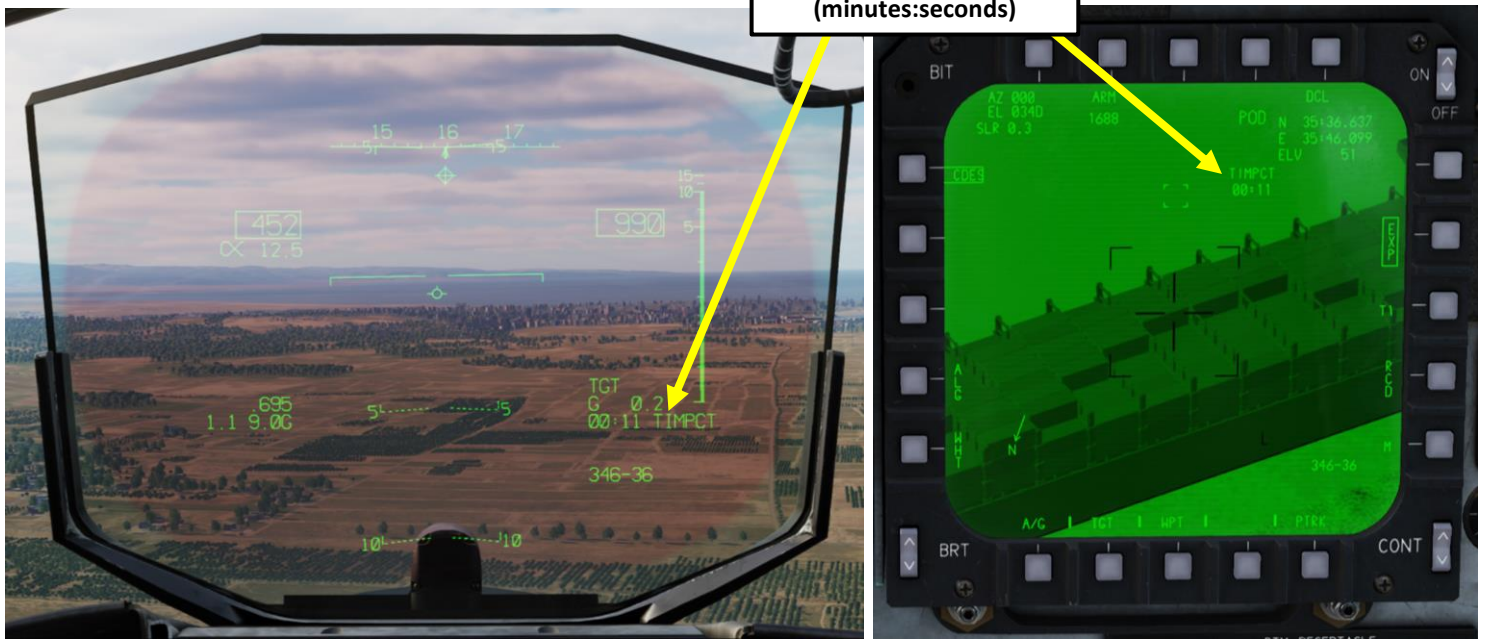
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
C – Perform Attack

54. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
55. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
56. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bomb.
57. Bomb will automatically drop when the auto release cue crosses the velocity vector.



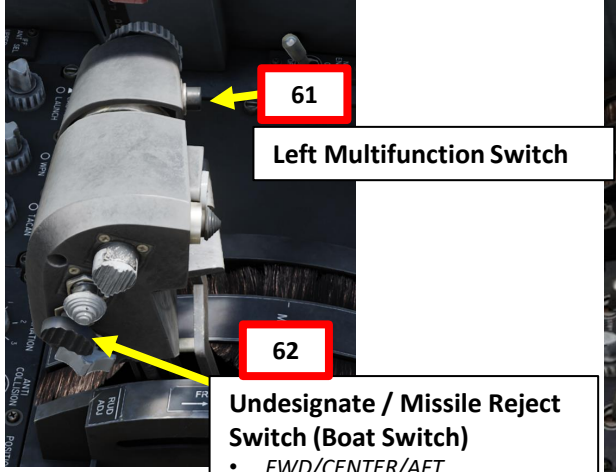
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
C – Perform Attack

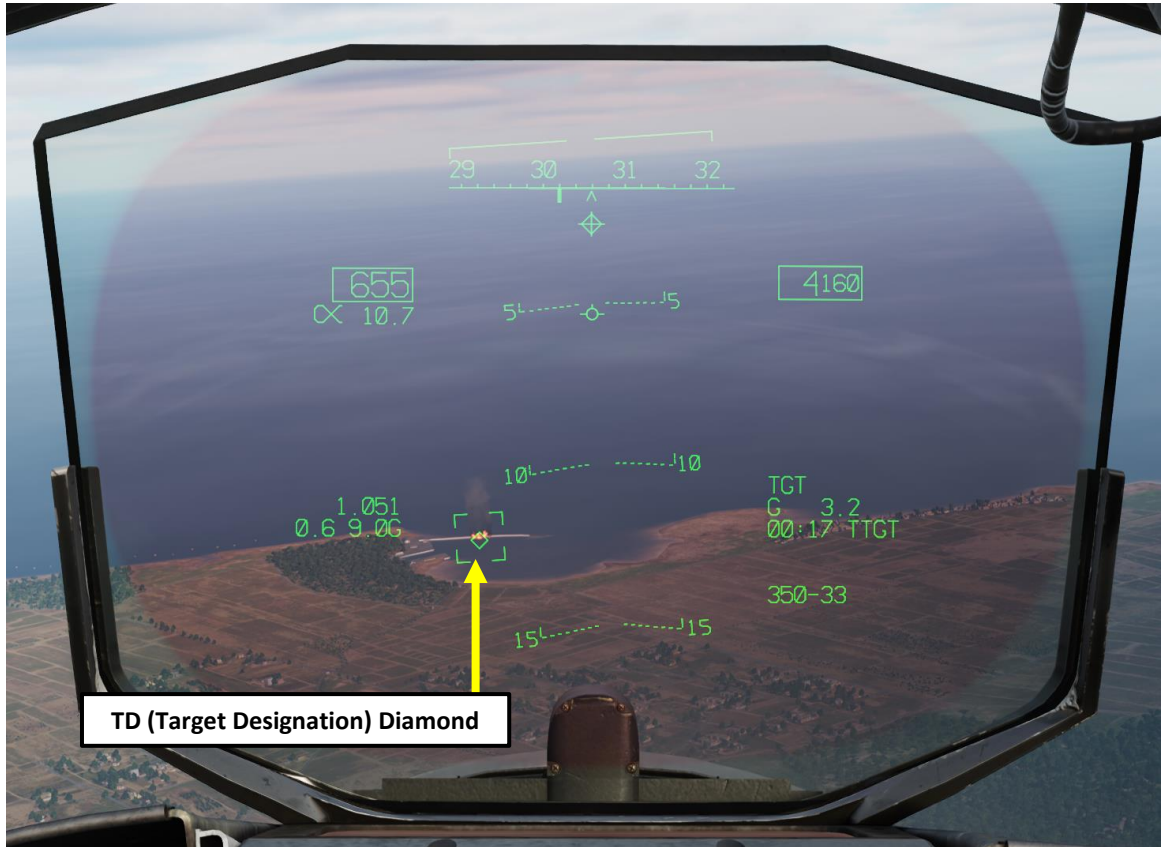
58. Once bomb is dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
59. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

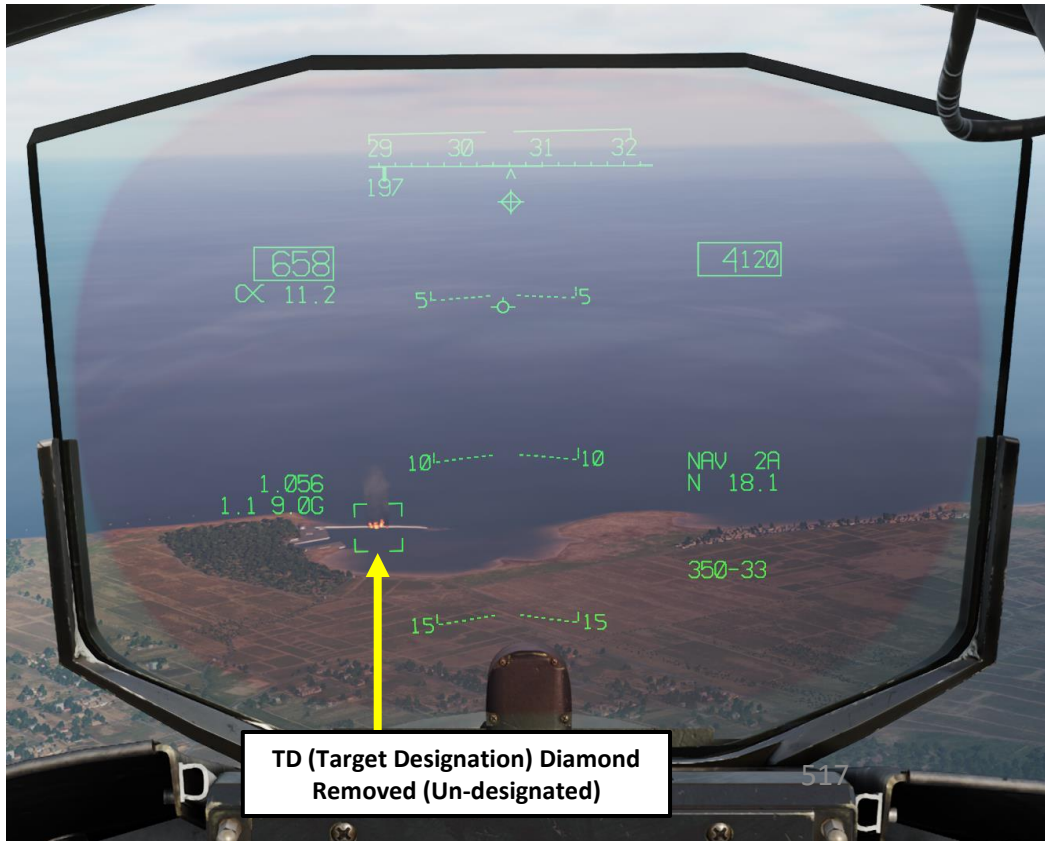


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
C – Perform Attack

60. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
61. To stop lasing, toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
62. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.







2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.4 – MK-84AIR High Drag (Auto Mode with Targeting Pod)
C – Perform Attack

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)

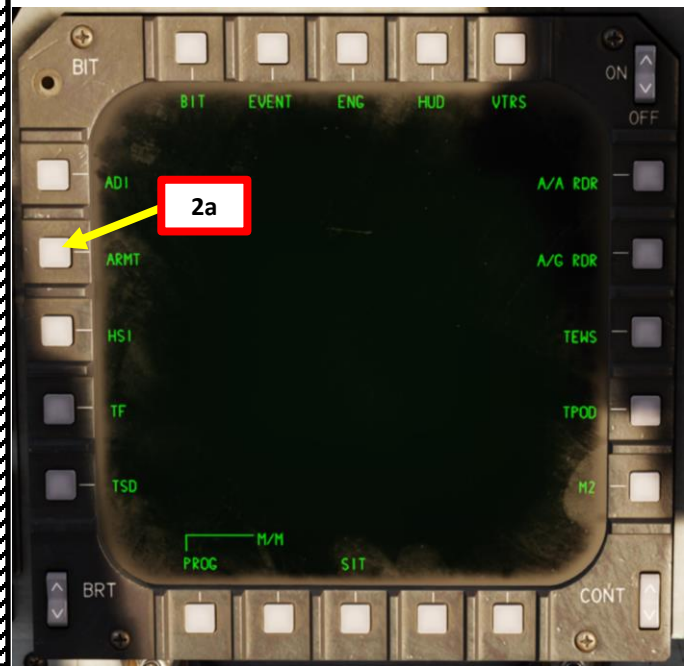
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)

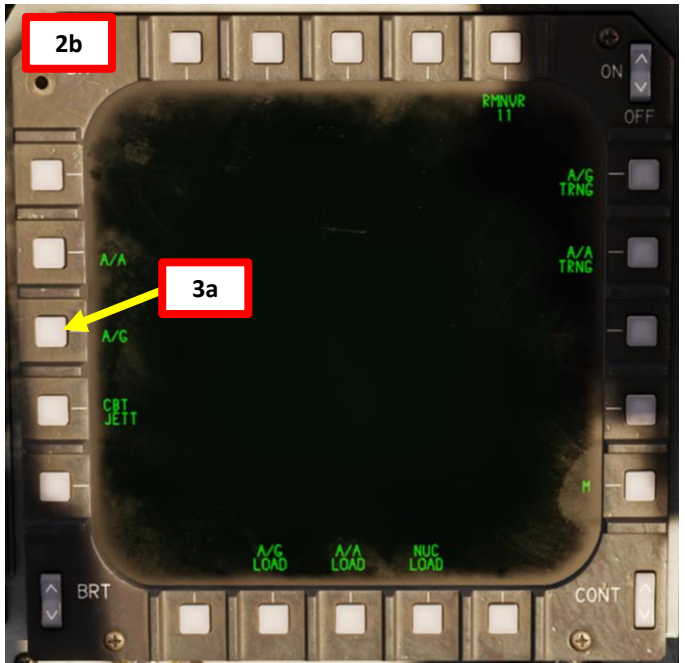
In this tutorial, we will use the air-to-ground radar to designate a target. In order to make things easier to find the target, we have already set up Steerpoint No. 2 near the target to have a general idea where the target is.

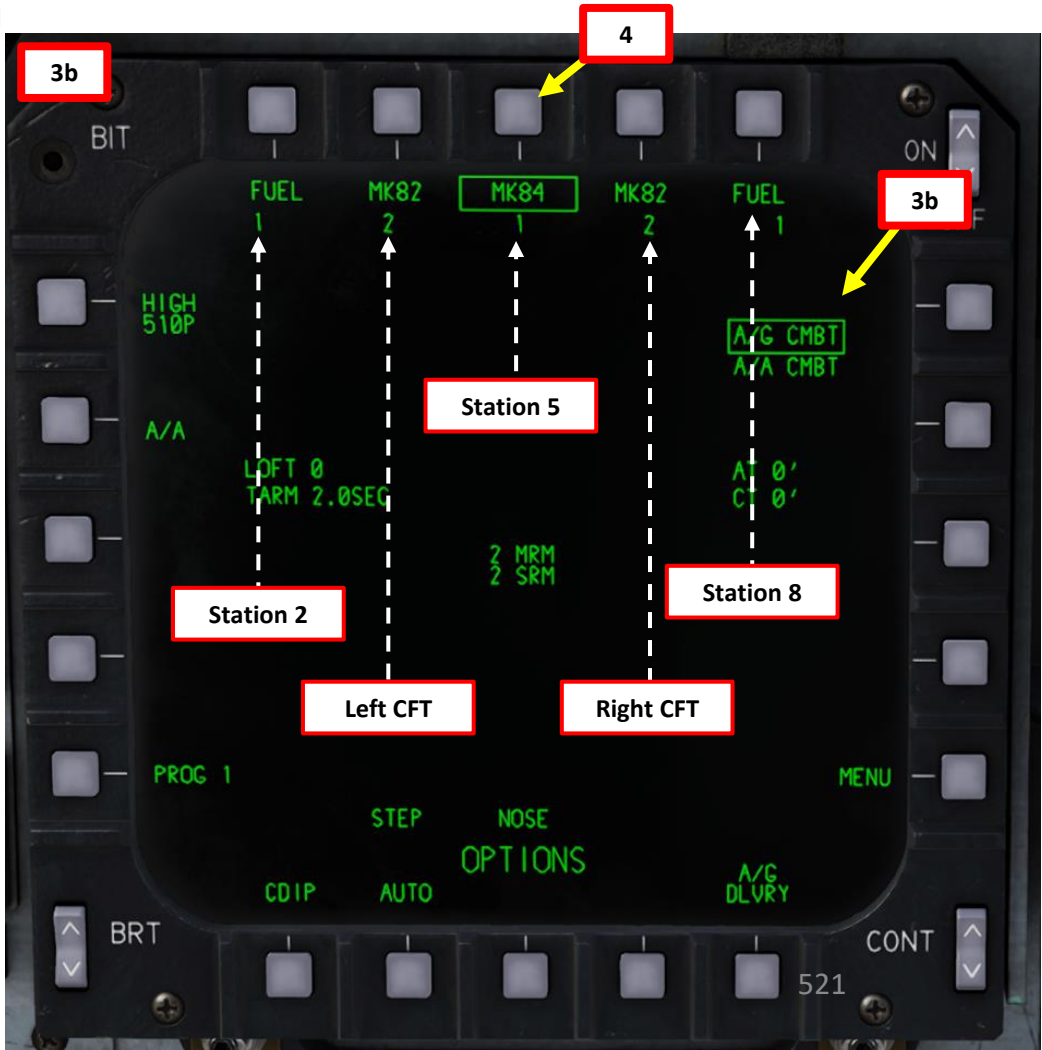
We will attack Tu-22 Bombers parked in the Bassel Al-Assad Airport.

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “MK84” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.



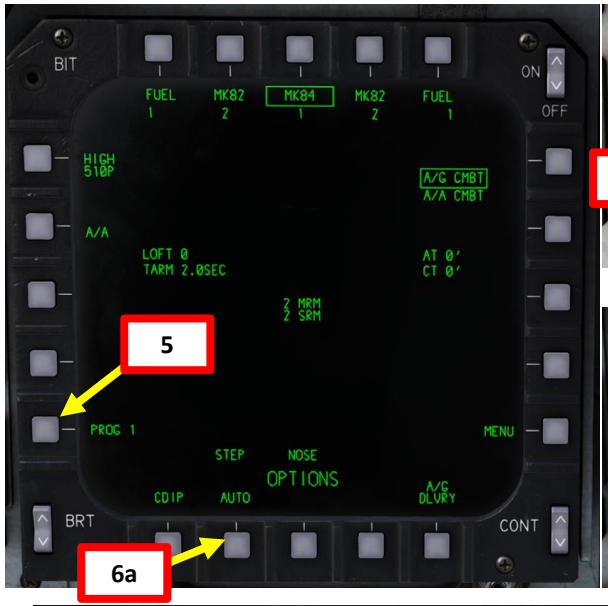


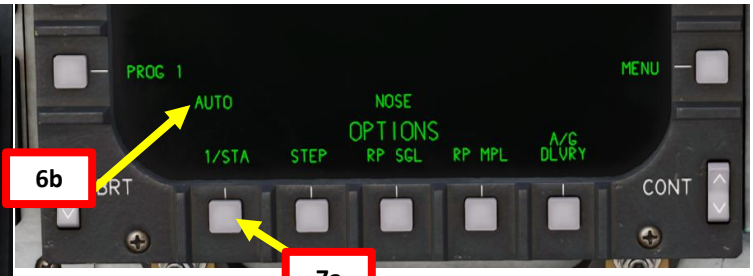


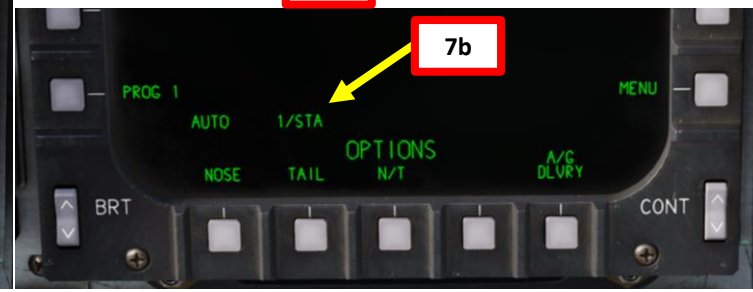
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)

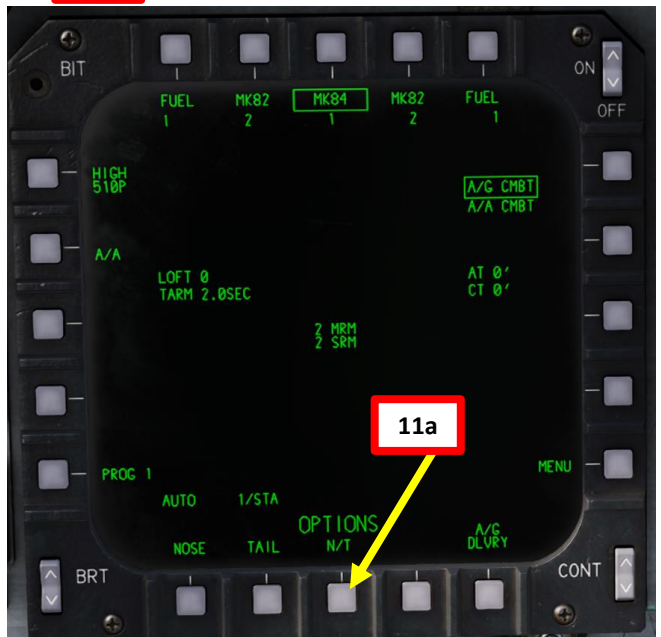
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select 1/STA.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



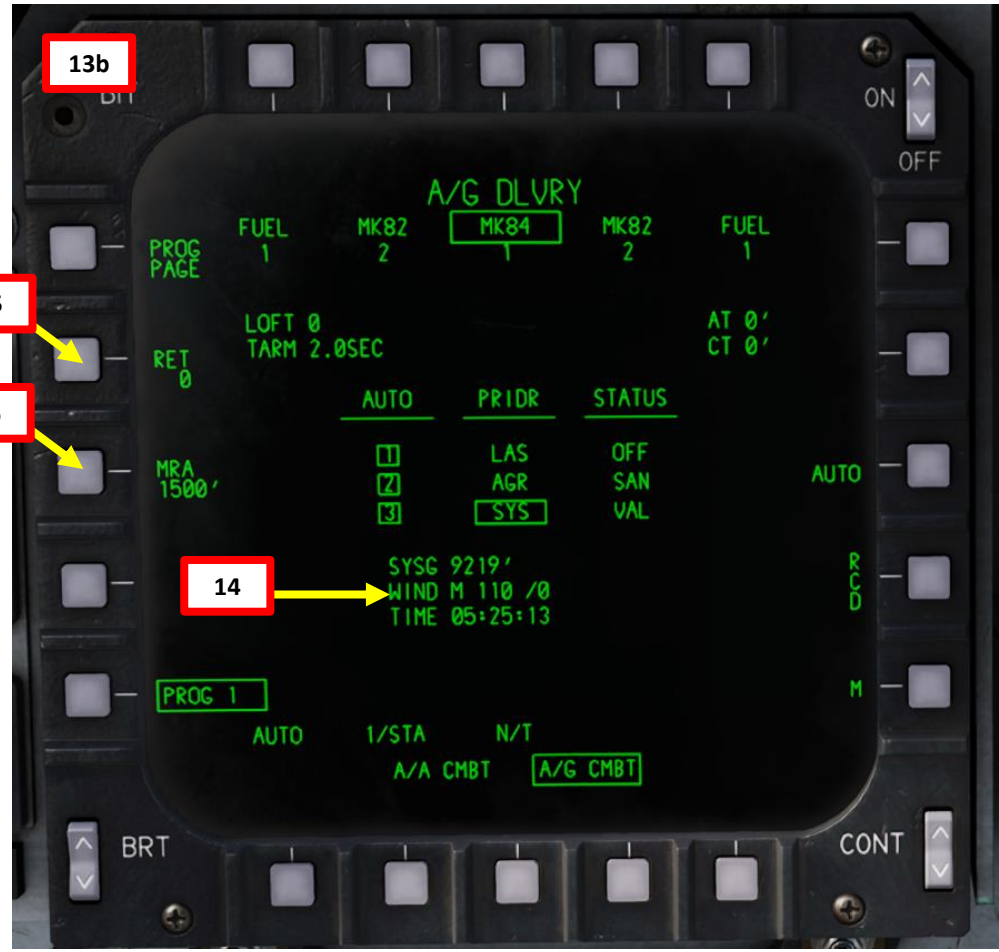






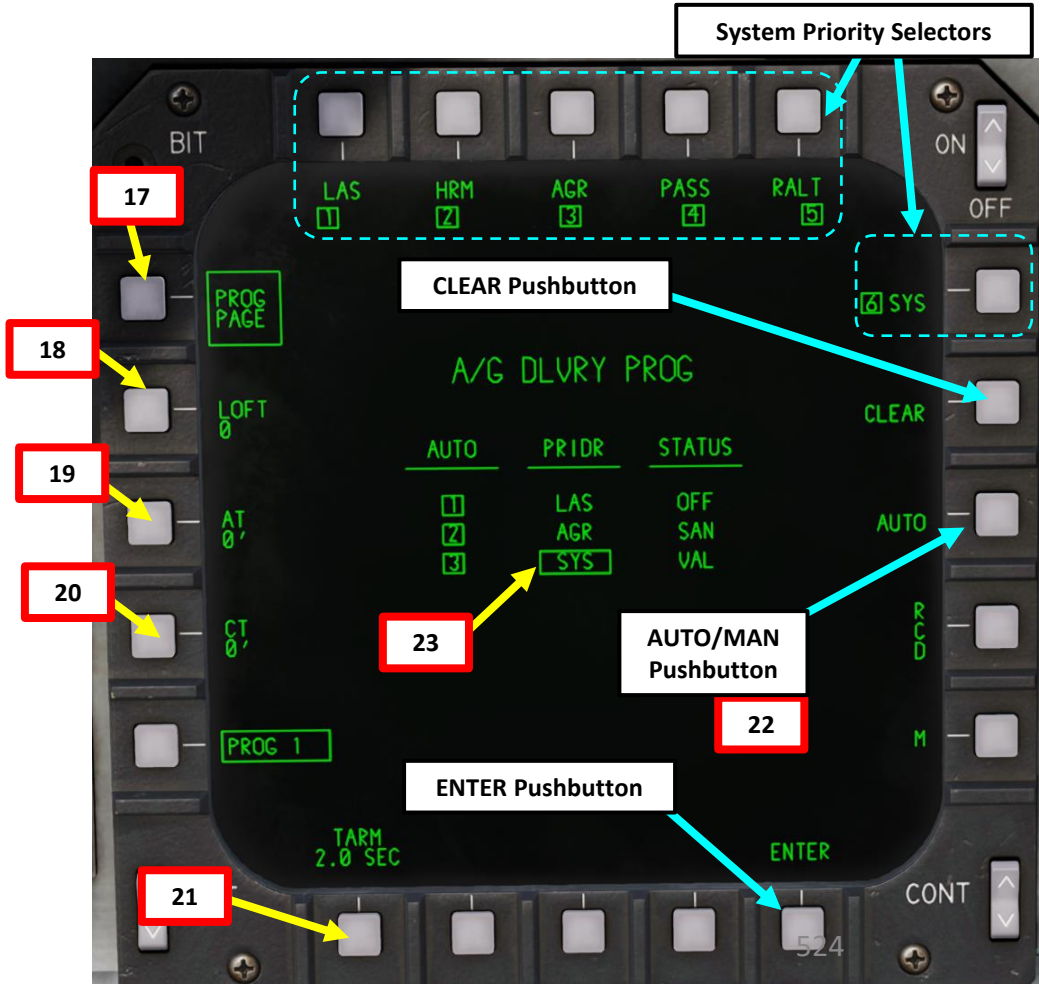
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.



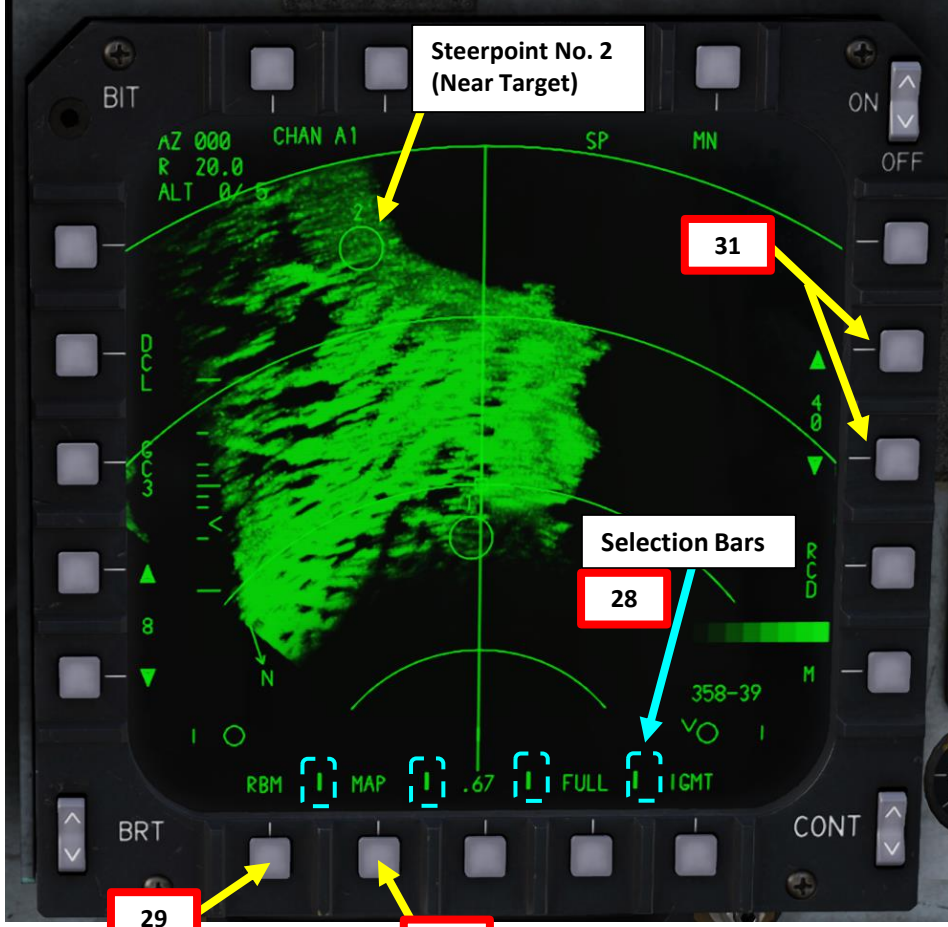
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
A – Weapon Setup

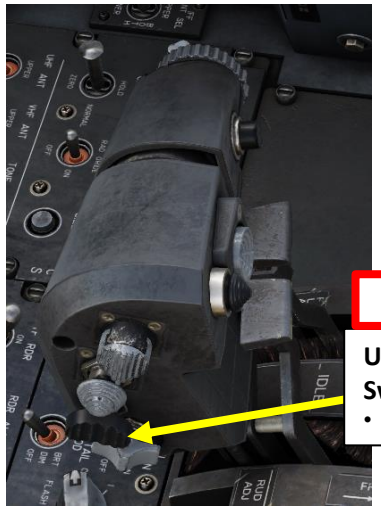
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

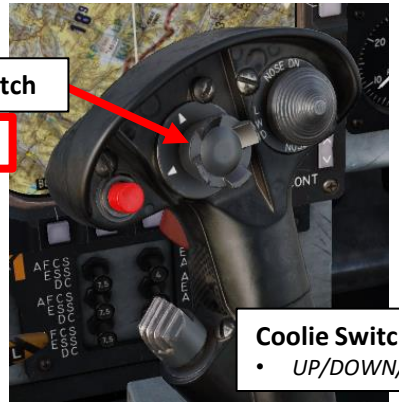


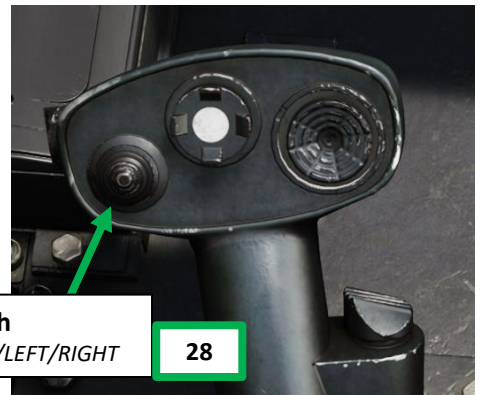
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

25. Set Master Arm Switch – ARM (UP)
26. Radar Power Switch must be set to ON.
27. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
28. Select A/G RDR page, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
29. On A/G RDR page, select either RBM or HRM mode by toggling the A/G Radar Mode Selector button as needed. We will select RBM (Real Beam Map) first to get a general view, then perform a HRM (High Resolution Map) Patch Map to get a better detailed PPI (Plan Position Indicator) view.
30. On A/G RDR page, select MAP cursor function by toggling the Cursor Function Selector button as needed.
31. Adjust display range as desired.



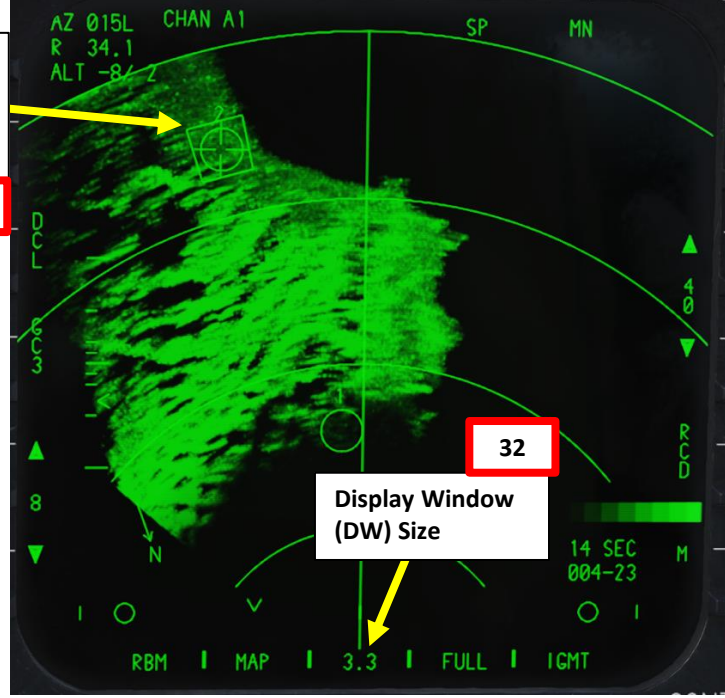






2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

32. When MAP Cursor 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. The size can be changed pressing the Auto Acquisition Switch FWD and AFT. Currently selected DW size is displayed at the bottom center of the display (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80 nm).
33. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select.
34. To command the HRM (High Resolution Map) patch map:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
35. When patch map is commanded, MAP indication becomes boxed and time-to-go clock counts down in the bottom-right corner of the display while the HRM is being computed.
36. After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.

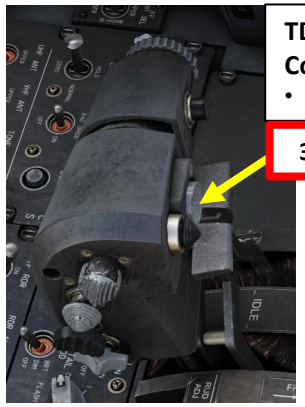


Cursor with Display Window around it
(slewed on area we want to command HRM map)

33

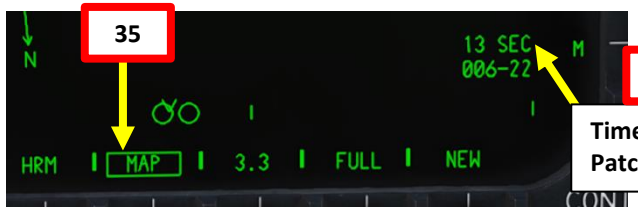
32

Display Window (DW) Size



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

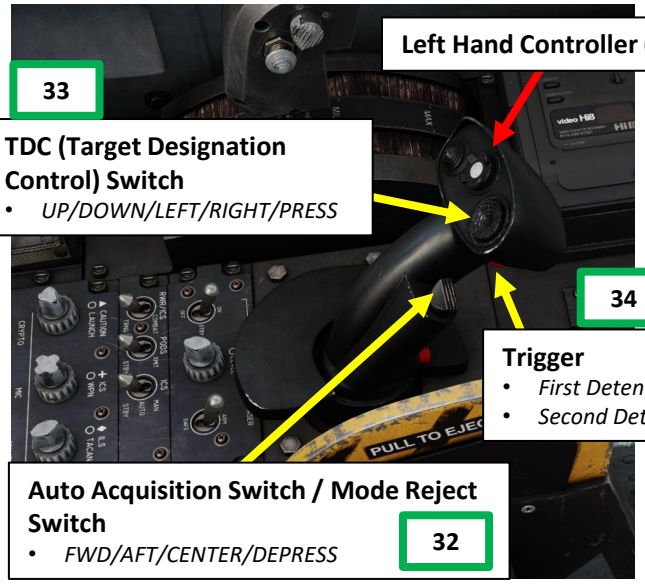
33 34



35

35

Time-to-Go Counter until HRM Patch map is computed (sec)



33

Left Hand Controller (LHC)

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

34

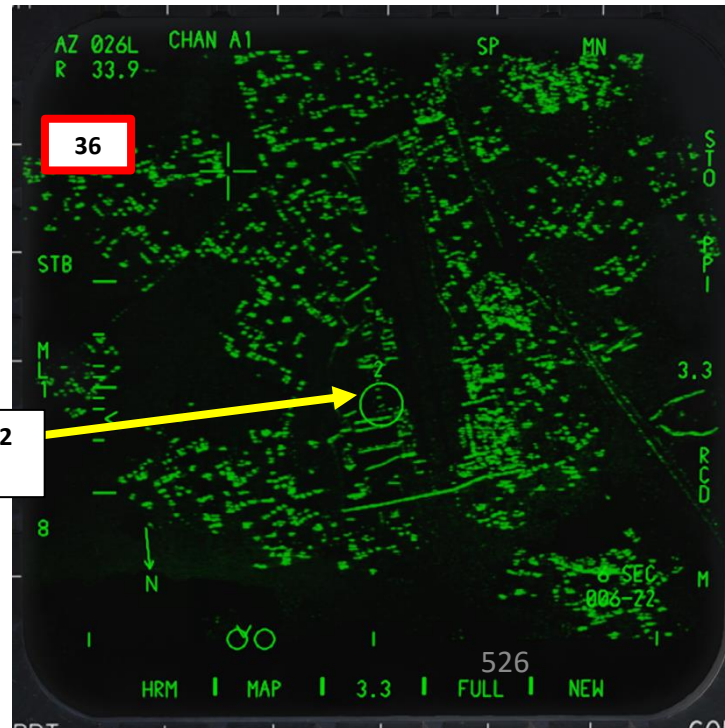
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

32

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

32

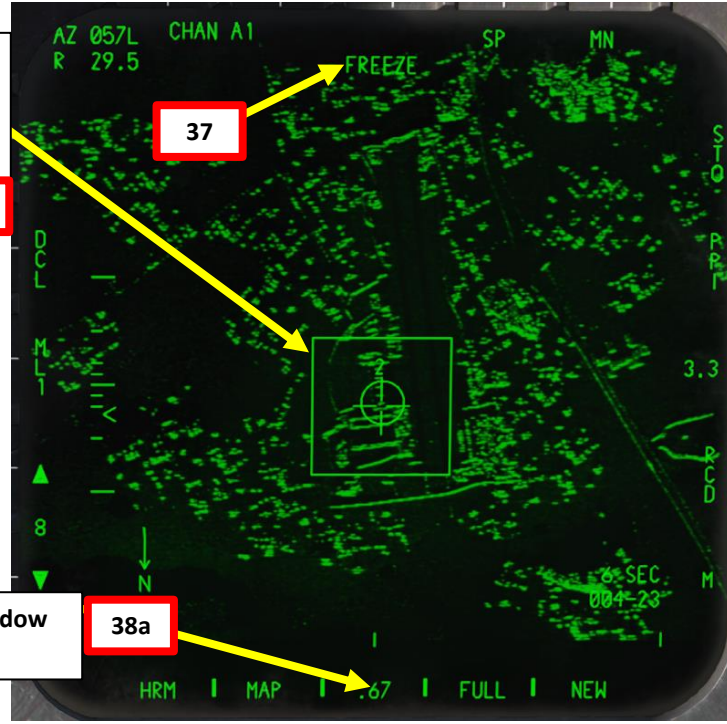


36

Steerpoint No. 2 (Near Target)

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

37. If you want to "freeze" the picture, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
38. Zoom in further as required.
    a) Press Auto Acquisition Switch FWD or AFT to change the DW (Display Window) Size.
    b) Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select.
    c) Command another HRM (High Resolution Map) patch map:
        - **Pilot**: Press and release the TDC (Target Designation Control) switch.
        - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
    d) After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.
39. Note: Remember that the picture is not being updated while FREEZE is ON. Don't forget to set FREEZE OFF after commanding a patch map.



Cursor with Display Window around it
(slewed on area we want to command HRM map)

37

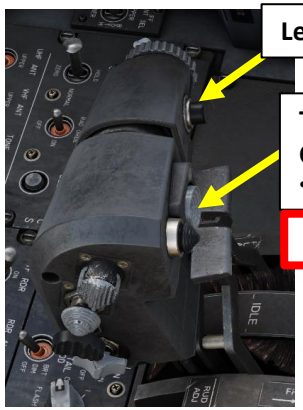
38b

Display Window (DW) Size

38a

38d

Time-to-Go Counter until HRM Patch map is computed (sec)



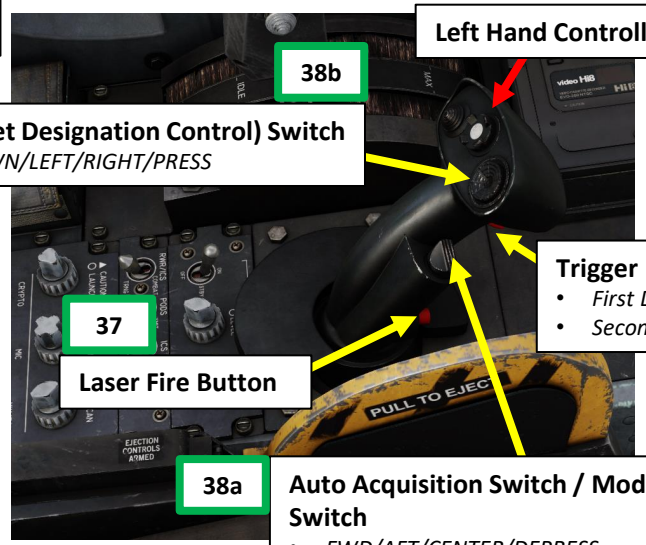
Left Multifunction Switch **37**

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

38b **38c**

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

38a



38b

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Left Hand Controller (LHC)

38c

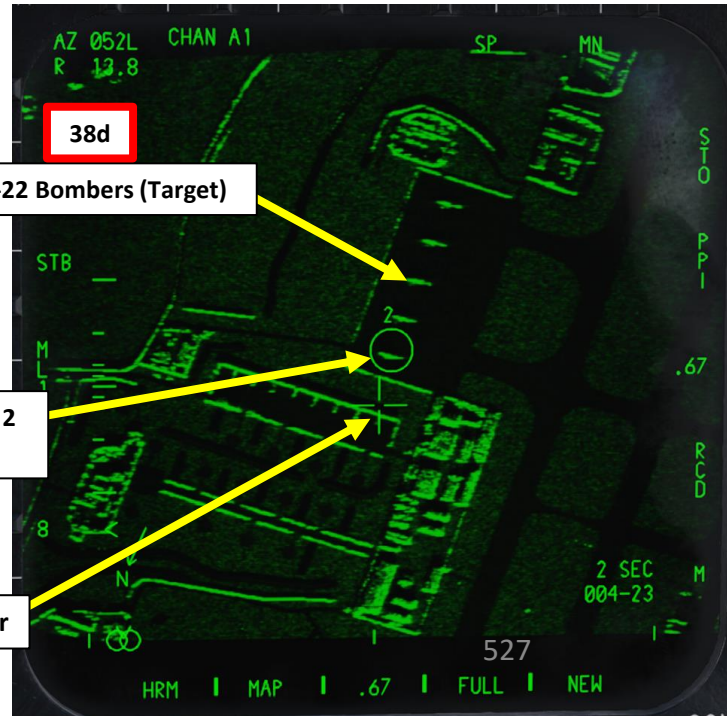
Trigger
- *First Detent*
- *Second Detent*

37

Laser Fire Button

38a

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*



38d

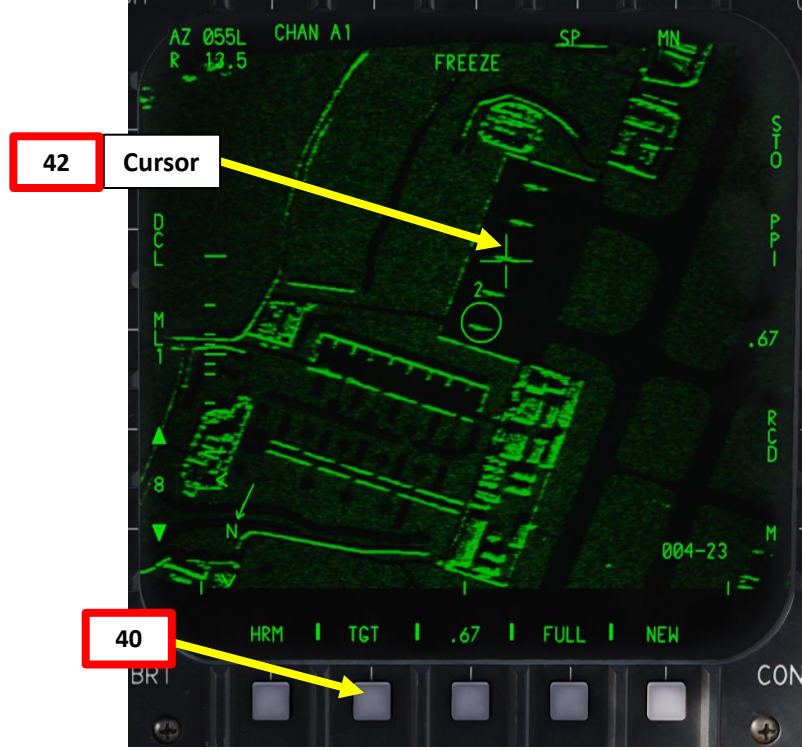
Tu-22 Bombers (Target)

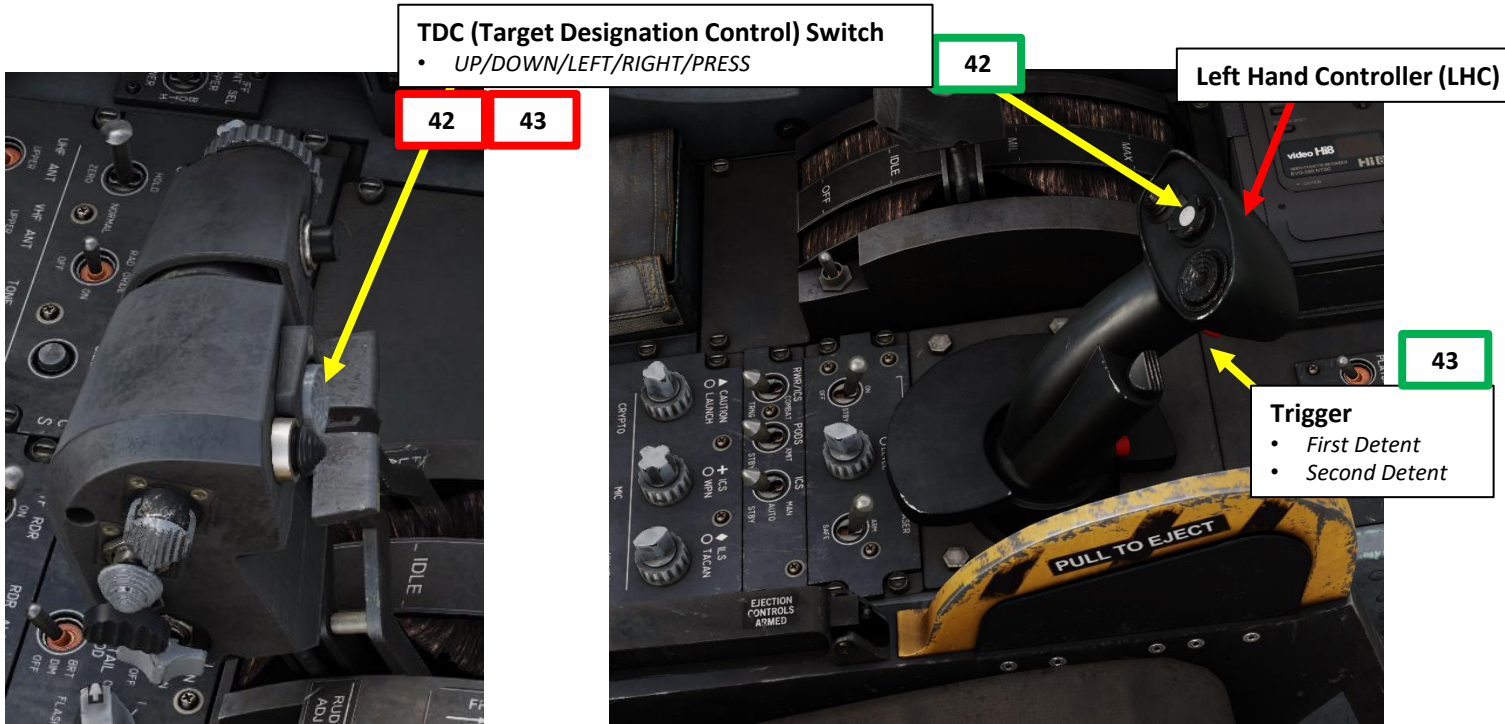
Steerpoint No. 2 (Near Target)

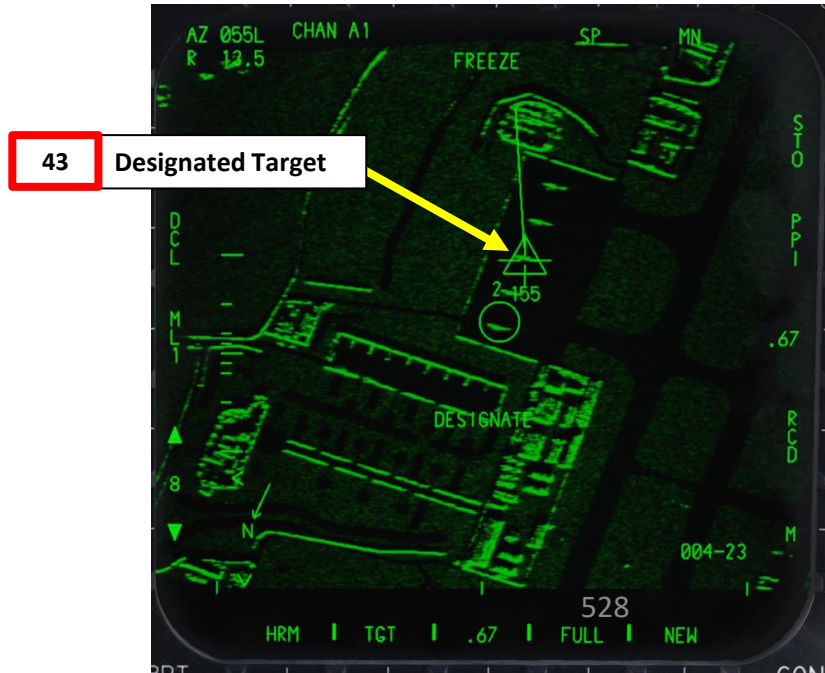
Cursor

2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

40. On A/G RDR page, select TGT cursor function by toggling the Cursor Function Selector button as needed.
41. Before designating a target, it is good practice (but not mandatory) to FREEZE the display (see previous page).
42. Using the TDC (Target Designation Control) switch, slew cursor over the point you want to designate.
43. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.

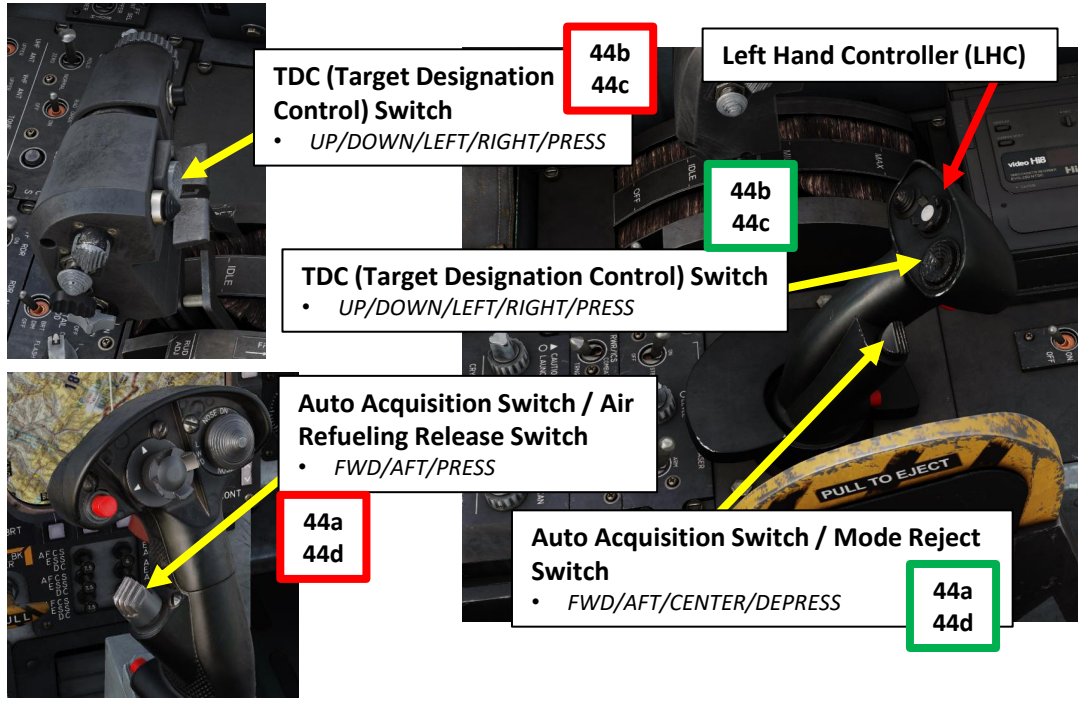


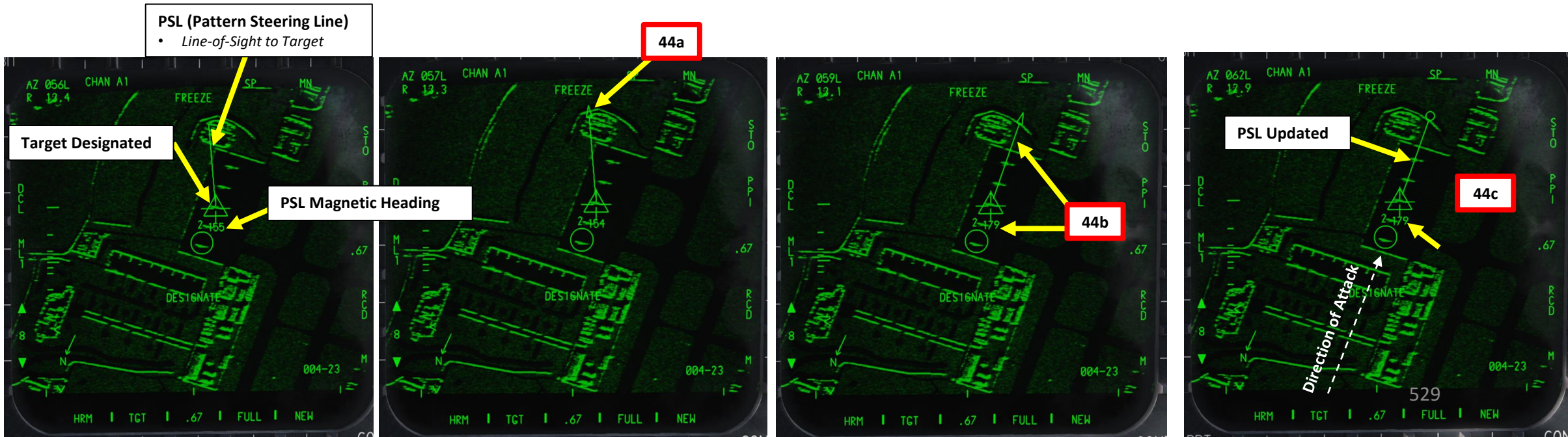




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

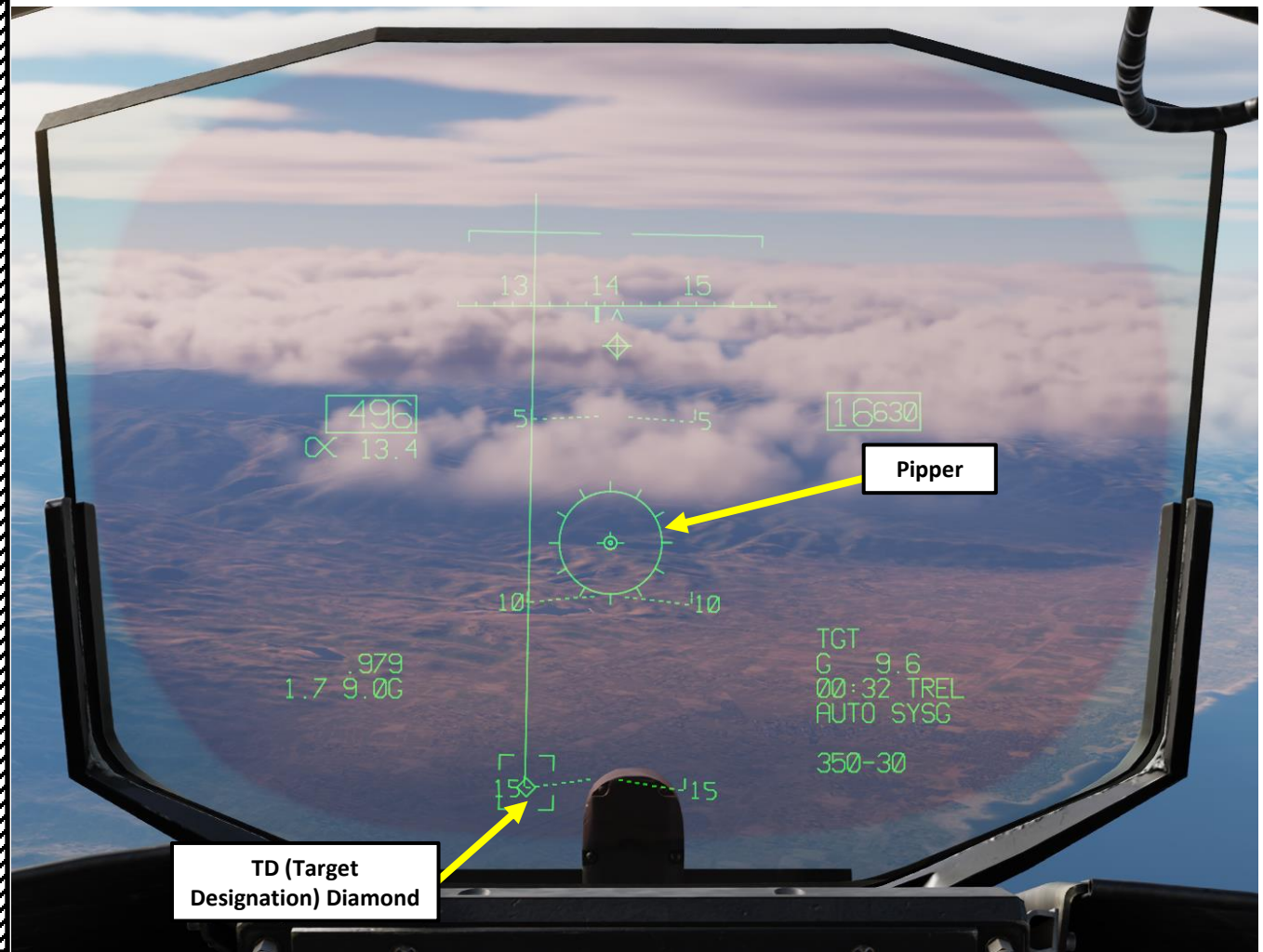
44. The PSL (Pattern Steering Line) indicates the line-of-sight from the aircraft to the target at the moment of designation. The PSL can be slewed around if there is a need to approach the target at a different heading. To slew the PSL:
    a) Press the Auto Acquisition Switch AFT
    b) Slew PSL left or right around the designation triangle using the TDC (Target Designation Control) Switch.
    c) Once the PSL orientation is as desired, press TDC to confirm.
    d) Press the Auto Acquisition Switch AFT a second time.

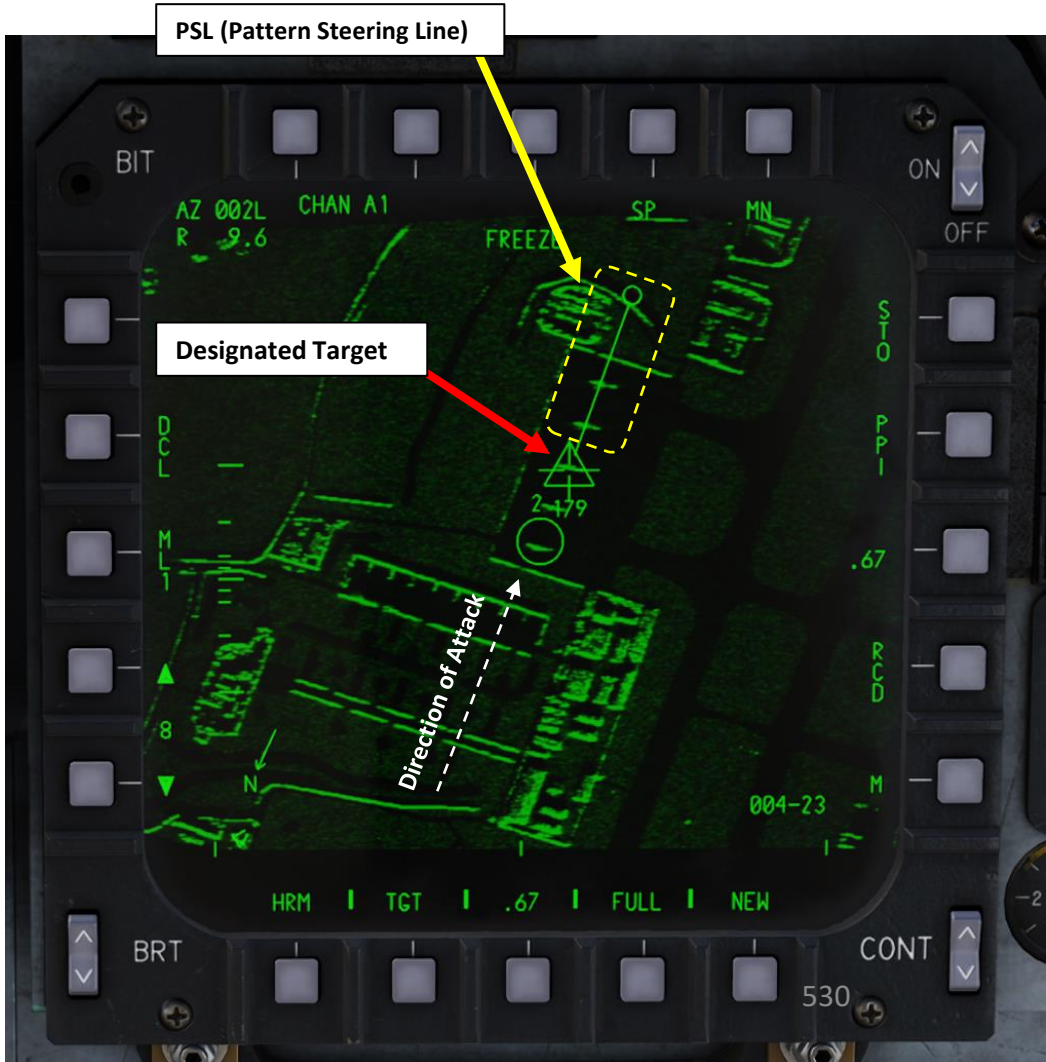




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
B – Weapon Arming & Target Designation

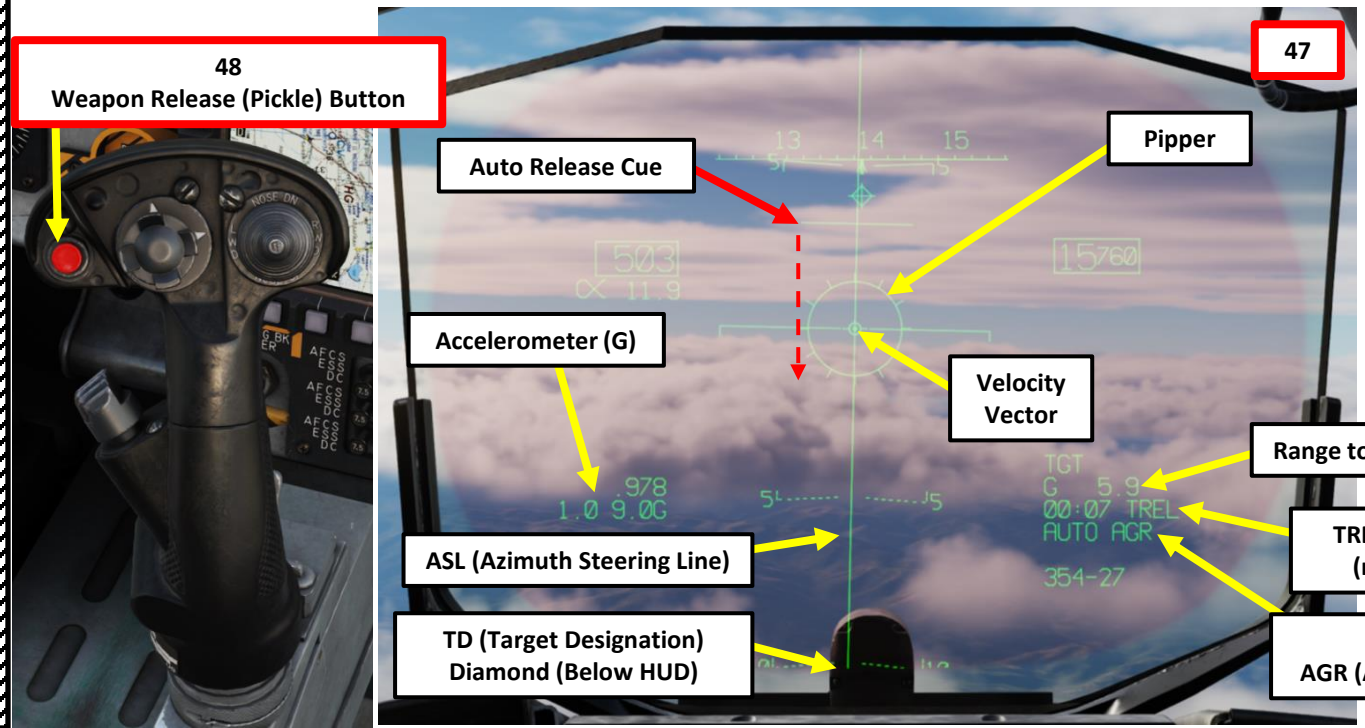
45. Now that we have a target designation, a direction of attack and our bomb is armed and ready, symbology on the HUD indicates the target location.

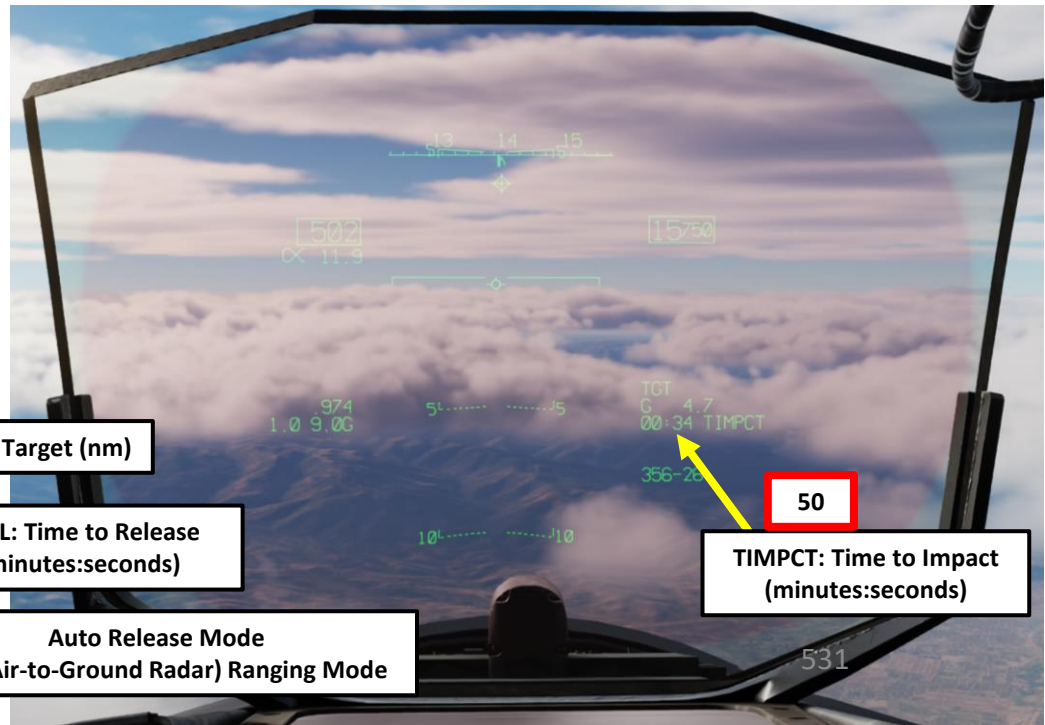




2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
C – Perform Attack

46. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
47. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
48. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bomb.
49. Bombs will automatically drop when the auto release cue crosses the velocity vector.
50. Once bomb is dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).





2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
C – Perform Attack

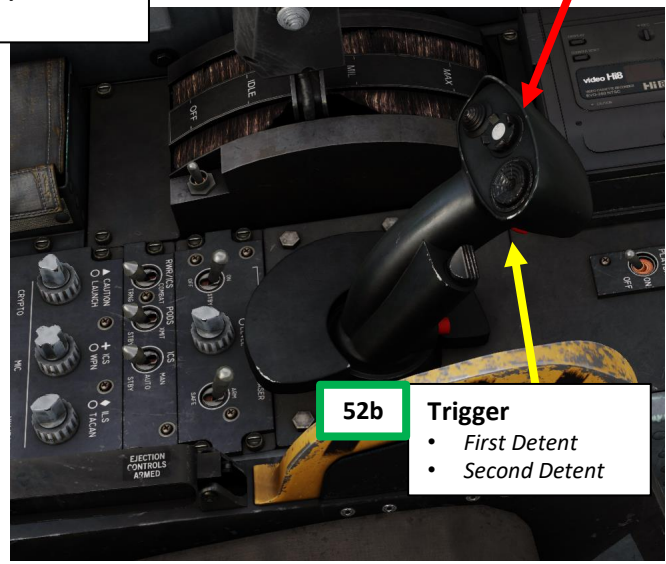
51. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

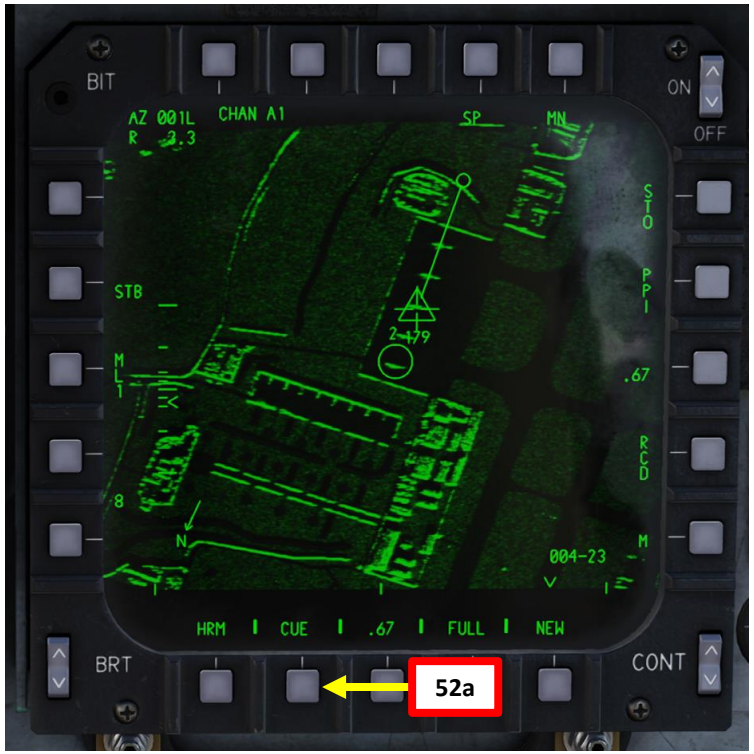
2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
C – Perform Attack

52. (Optional) In cases where you want to use the targeting pod to assess damage (or even designate more accurately if visibility permits it), you can use the CUE function to slave the targeting pod to the Air-to-Ground radar designation. To do so:
    a) On A/G RDR page, select CUE cursor function by toggling the Cursor Function Selector button as needed.
    b) To designate the point and slave (CUE) the targeting pod to it:
        - **Pilot**: Press and release the TDC (Target Designation Control) switch.
        - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
    c) If you check on the TPOD (Targeting Pod) page, you will see that the targeting pod has been slaved to the A/G RDR page's cursor.
    d) If you want, you can then take control of the TPOD sensor and designate from it.

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

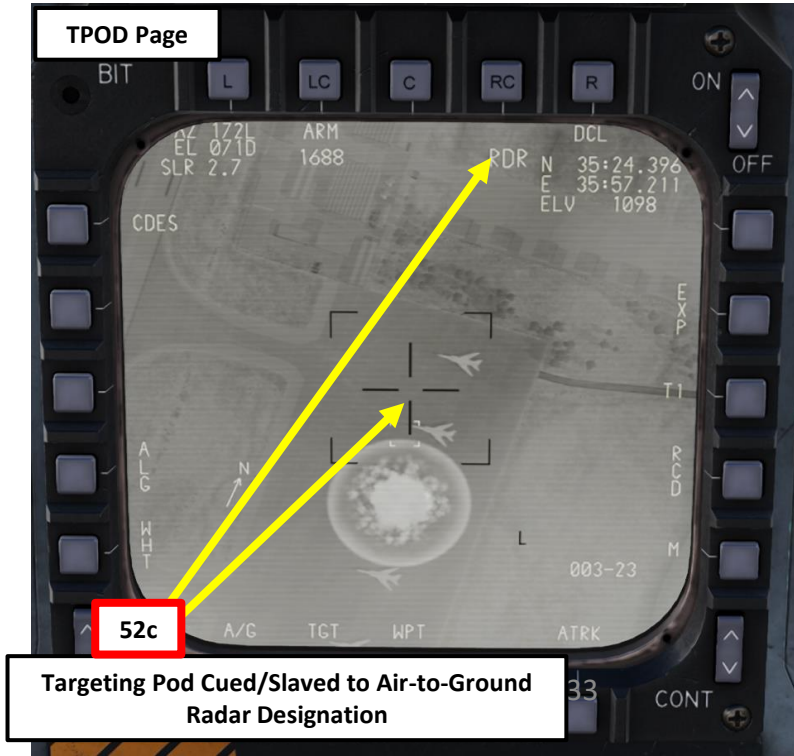
Left Hand Controller (LHC)





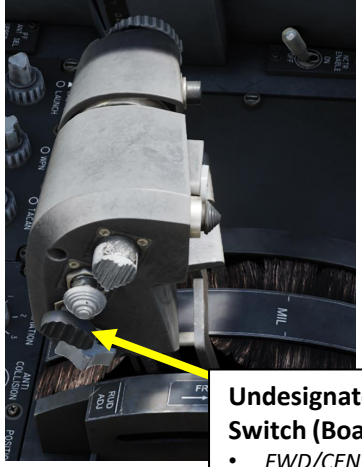
A/G RDR Page

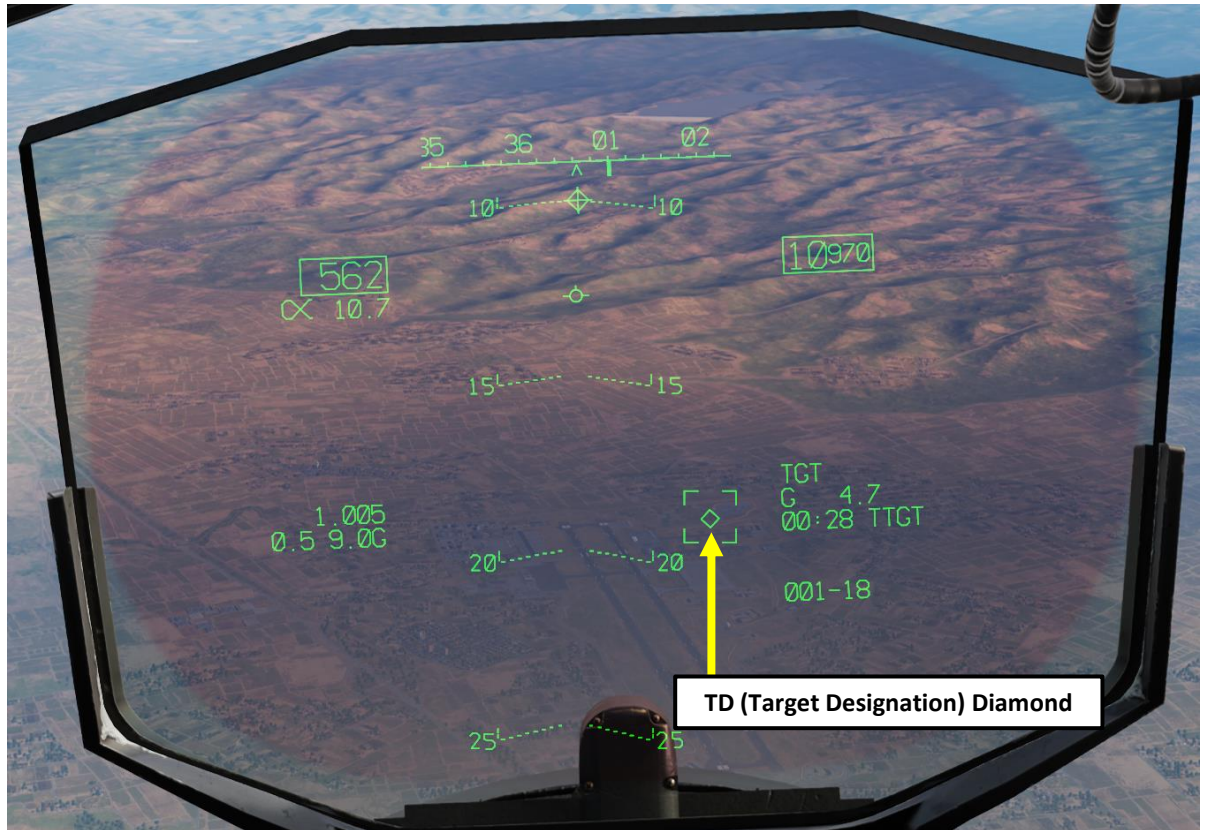
TPOD Page

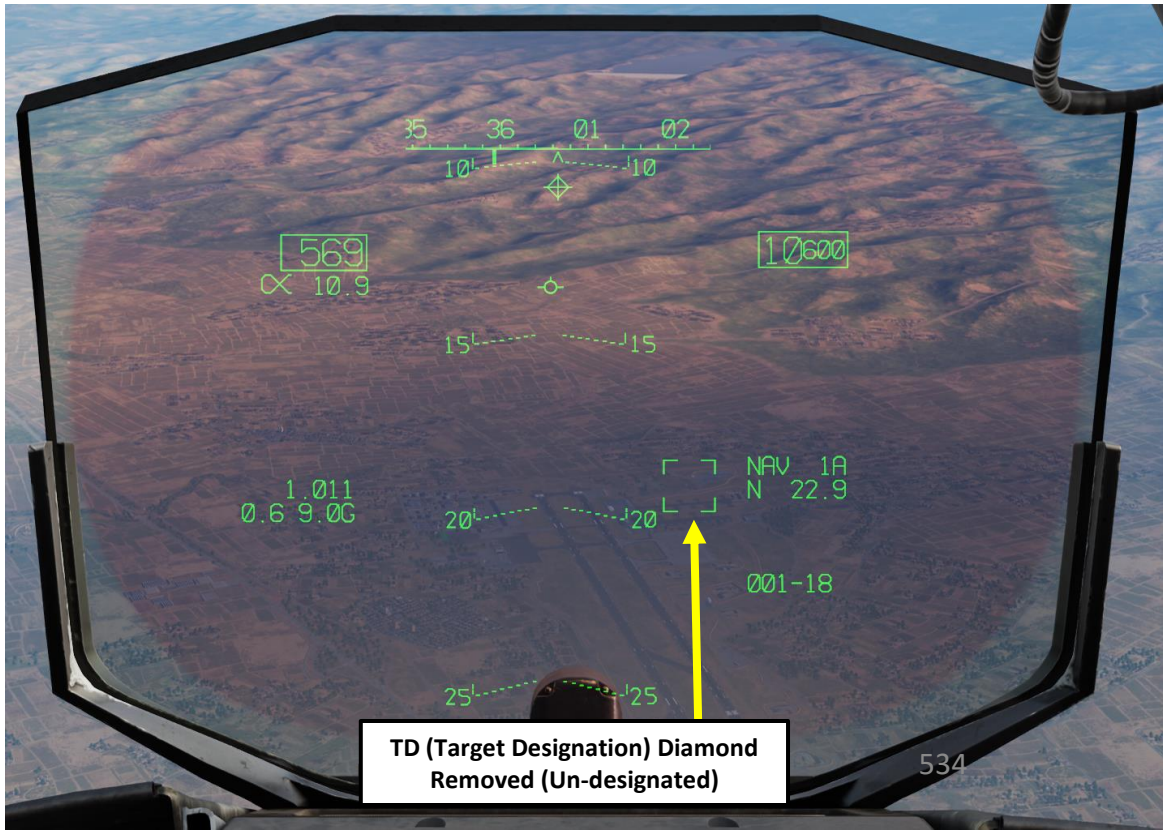


2 – AIR-TO-GROUND WEAPONS
2.1 – Unguided Bombs
2.1.5 – MK-84 Low Drag (Auto Mode with Air-to-Ground Radar)
C – Perform Attack

53. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
54. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.







2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions

2 – AIR-TO-GROUND WEAPONS

2.2 – Cluster Munitions

Introduction

CBUs (Cluster Bomb Units) are generally used against "soft" targets. Some of them like the CBU-103 and CBU-105 use Wind Corrected Munition Dispenser kits to correct the effect of the wind on their trajectory, but they are not available for the DCS F-15E Strike Eagle.

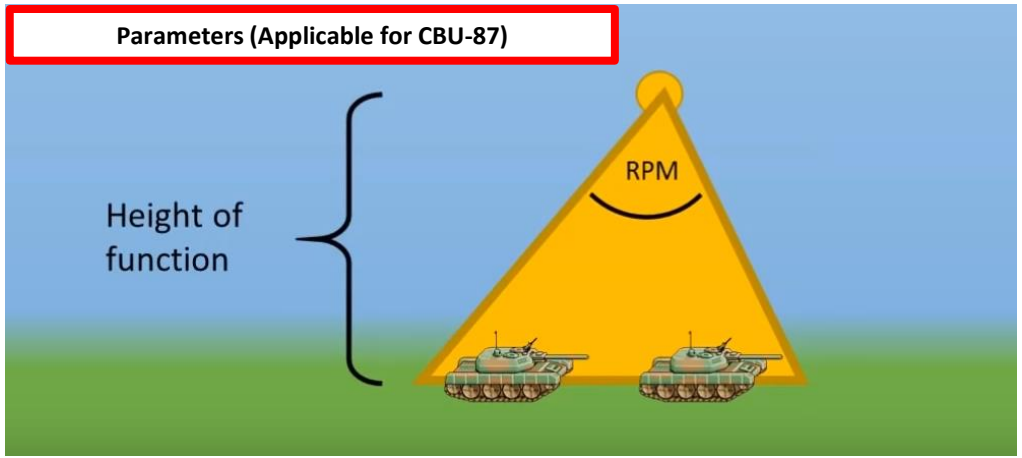
Keep in mind that there are parameters that we can adjust to improve the effectiveness of CBUs:

- **Burst Height of Function (HoF),** which determines at which height the bombs will release (burst height above ground level). It impacts area spread and accuracy. The greater the Height, the larger the covered area is (at the expense of density). This setting is mutually exclusive from Burst Time.
- **Burst Time**, which determines the time from bomb drop in seconds after which bomblets are released. This setting is mutually exclusive from Burst Height.
- **Spin Setting (RPM)**, which is the area spread of the bomblets that affects the concentration of fire available on the target. This parameter is applicable to the CBU-87 only. The greater the spin, the larger the covered area is (at the expense of density). Recommended value is experimental, but you can use a value of 1000 ("Spin 3" setting).

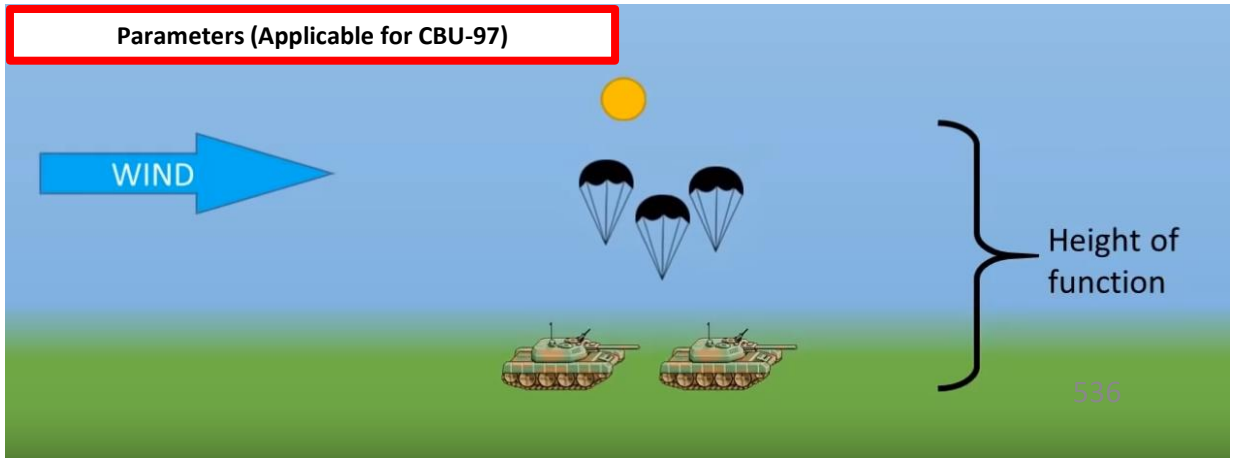
CBU (Cluster Bomb Unit) Types

CBU-87: This Combined Effects Munitions (CEM) weighs 950 lbs and is an all-purpose cluster bomb. The SW-65 Tactical Munitions Dispenser contains 202 BLU-97/B Combined Effects Bomblets (CEB) and they are effective against armored and unarmored targets. • *Recommended HoF/RPM parameters: 300 ft/1000 RPM (Spin 3)*	**MK-20 Rockeyes:** 490 lbs unguided cluster munitions (247 x HEAT bomblets) • *Recommended HoF parameter: 700 ft*
CBU-97: 1,000-pound class weapon containing sensor-fused sub-munitions for specifically attacking armor. The CBU-97 holds 40 skeets capable of detecting tanks and vehicles and guiding into them. • *Recommended HoF parameter: 700 ft*	

Parameters (Applicable for CBU-87)



Parameters (Applicable for CBU-97)



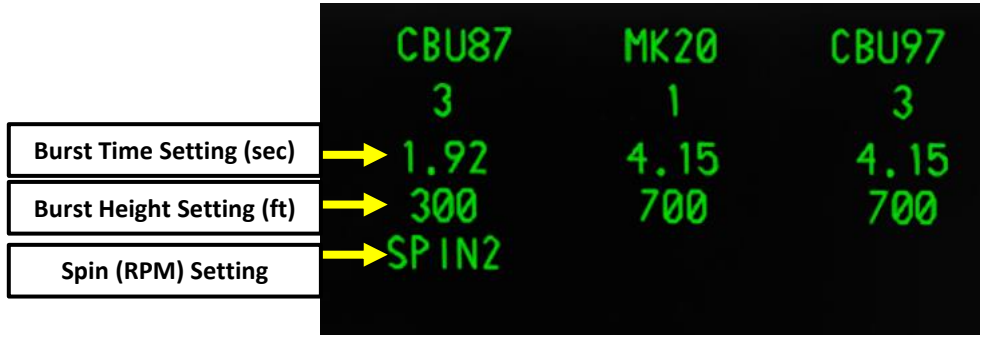
2 – AIR-TO-GROUND WEAPONS

2.2 – Cluster Munitions

Introduction

In the ARMT page A/G LOAD sub-menu, you can program CBU-87, CBU-97 and MK-20 parameters. Normally, bomb parameters are already set on the equipment itself and the aircrew simply sets the parameters to reflect those.

Since we use these bombs within a simulated environment, the bomb parameters on the ordnance are automatically updated to match the ones entered in the A/G LOAD sub-menu when the aircraft is on the ground.



Burst Time Settings (Seconds)										
N	O	P	R	S	T	U	V	X	V	Z
0.95	1.28	1.60	1.92	2.23	2.55	2.87	3.19	3.51	3.83	4.15

Burst Height Settings (feet Above Ground Level)									
A	B	C	D	E	F	G	H	J	K
300	500	700	900	1200	1500	1800	2200	2600	3000

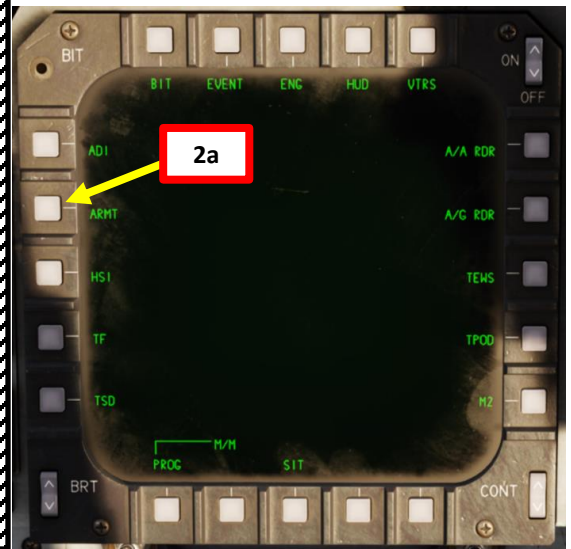
Spin (RPM) Settings					
1	2	3	4	5	6
0	500	1000	1500	2000	2500

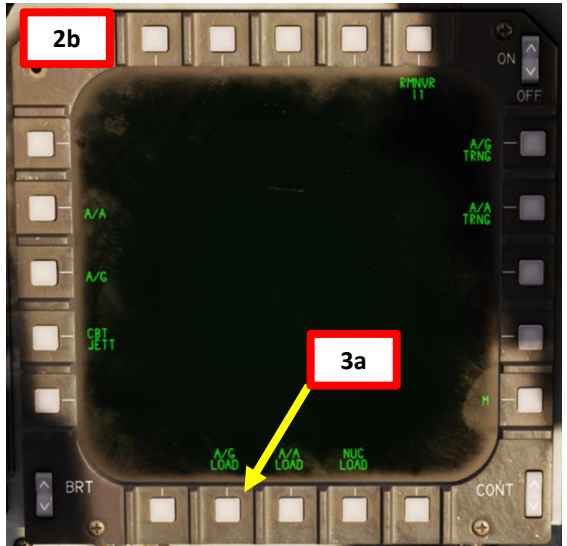
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)

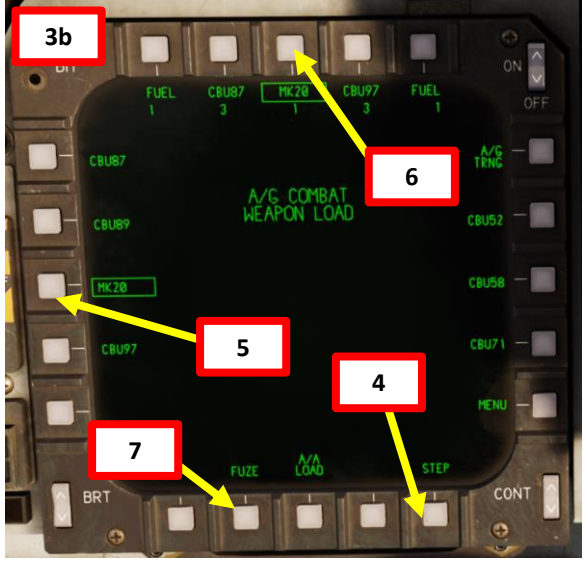
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)

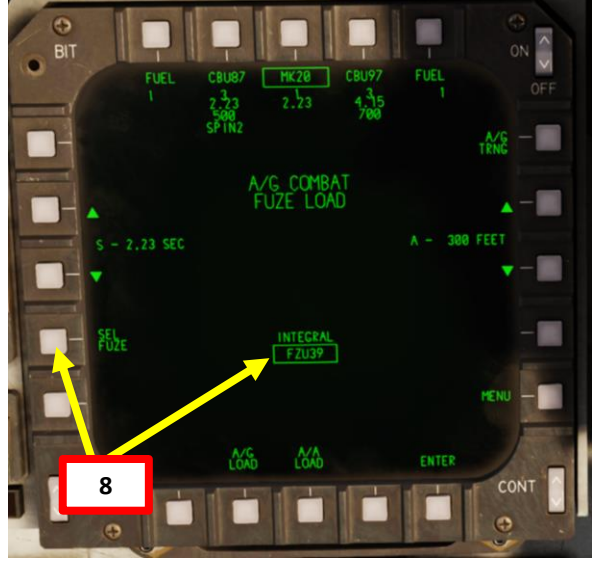
A – Weapon PACS Loading

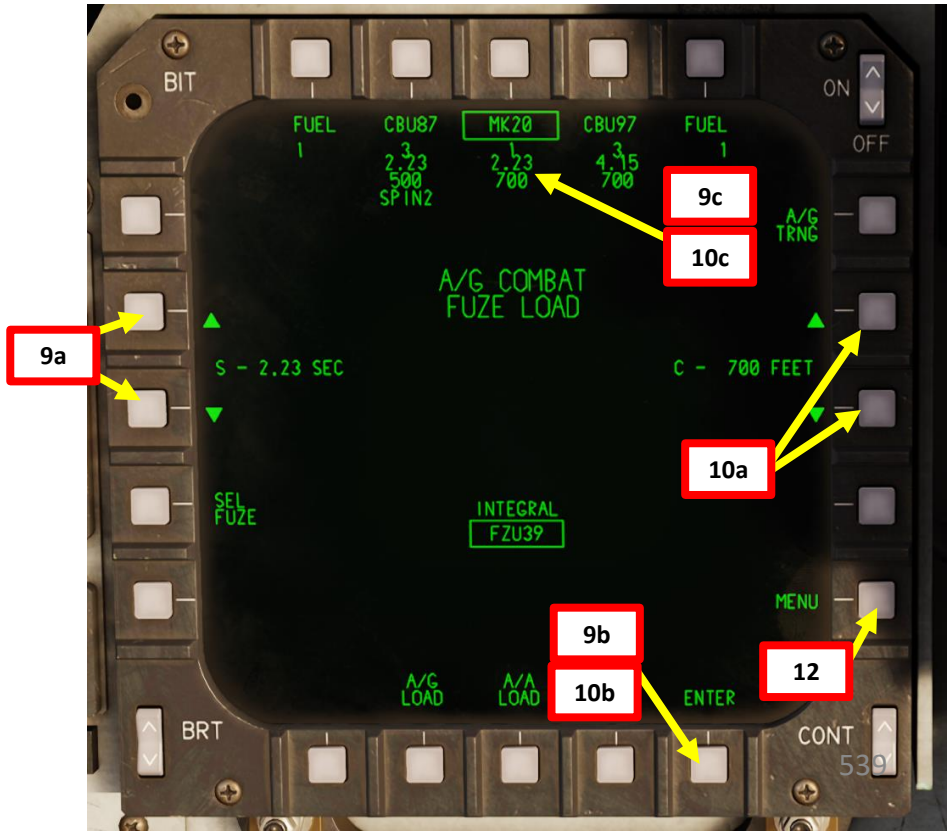
1. Ordnance should already be installed on the aircraft by the ground crew with preset parameters like Burst Height. We want to use a **HoF (Height of Function) parameter of 700 ft.**
    - *In real life, bomb parameters are already preset and cannot be changed during the mission; the aircrew should load these parameters on ground via the PACS A/G LOAD page to reflect them.*
    - *Since we use these bombs within a simulated environment, the bomb parameters on the ordnance are automatically updated to match the ones entered in the A/G LOAD sub-menu when the aircraft is on the ground. In this tutorial, we will manually enter these parameters.*
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G COMBAT WEAPON LOAD page.
4. Press PB (Pushbutton) next to STEP to cycle between weapon types until you find “MK20” (MK-20 Rockeyes).
5. Press PB next to “MK20” to box (select) MK-20 Rockeye Weapon Type.
6. Press PB next to the desired weapon station, which will change to “MK20”.
7. Press PB next to “FUZE”.
8. Select “FZU39” fuze using the “SEL FUZE” PB.
9. If you want the cluster munitions to use a time setting, use PBs next to the Burst Time Setting, then press PB next to “ENTER”. In this case, we will leave it as is and use a Burst Height instead.
10. If you want the cluster munitions to use a burst height setting, use PBs next to the Burst Height Setting, then press PB next to “ENTER”. In this case, we will use a Burst Height of 700 ft.
11. For Rockeyes, there is no Spin (RPM) setting available.
12. Press PB next to MENU twice to return to the ARMT/PACS page.





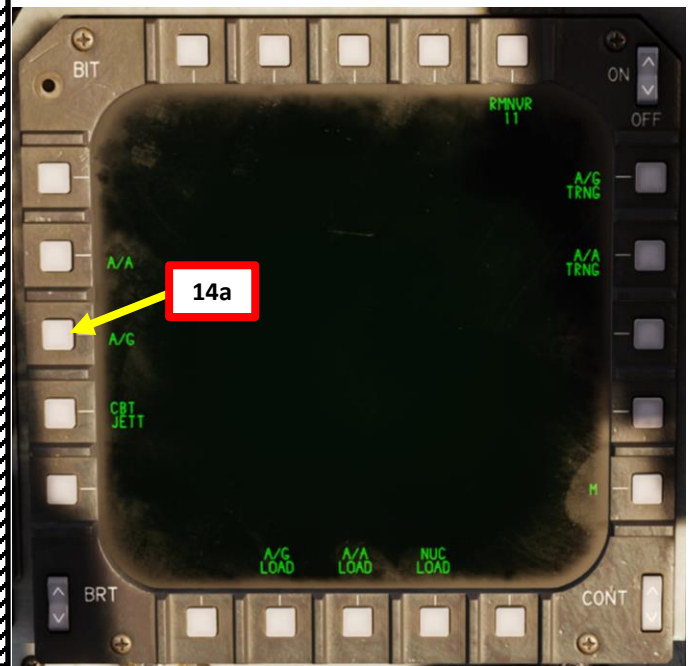


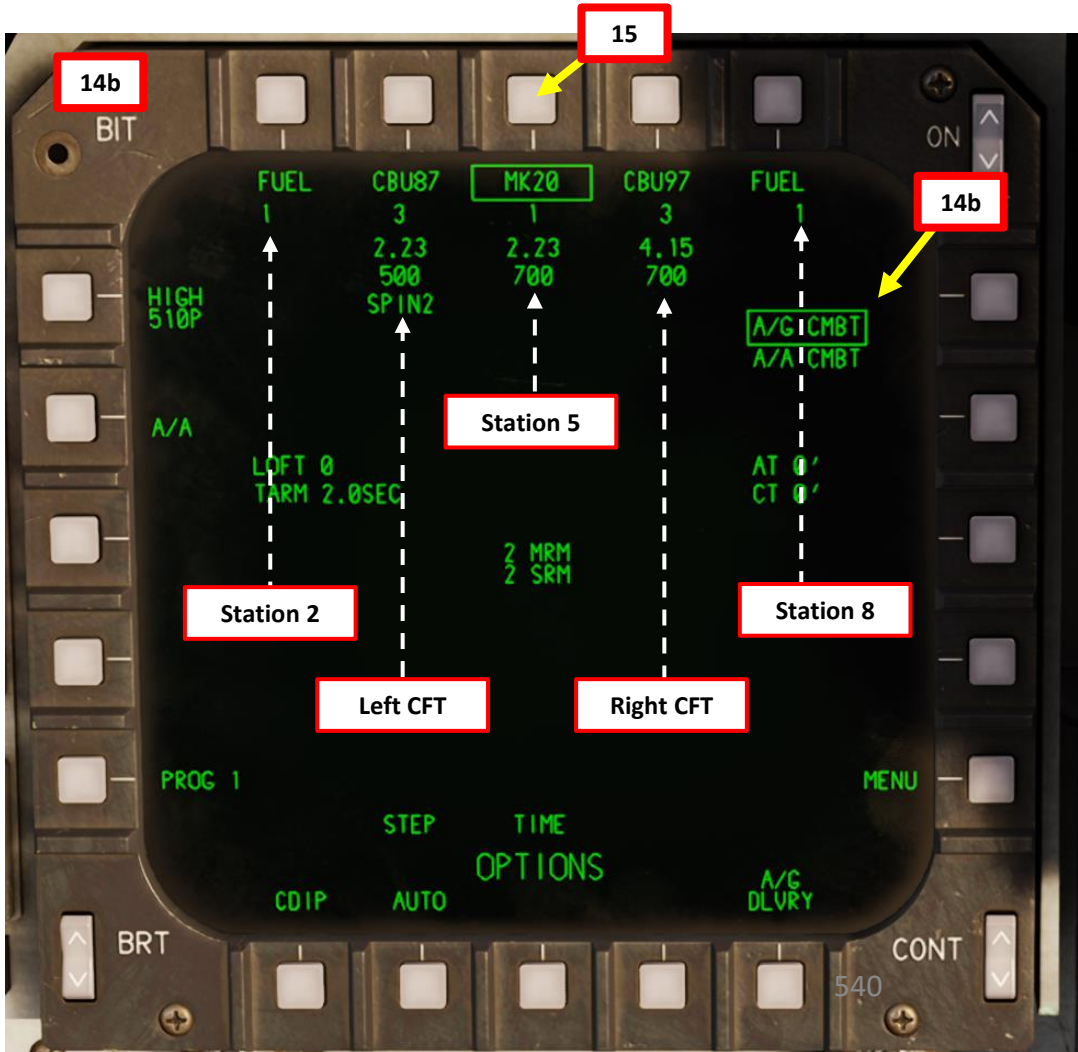




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
B – Weapon Setup

13. Select A/G Master Mode.
14. From ARMT/PACS (Armament/Programmable Armament Control Set) Page, select A/G CMBT (Air-to-Ground Combat) Sub-Page.
15. Select desired stations by pressing pushbuttons next to “MK20” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.

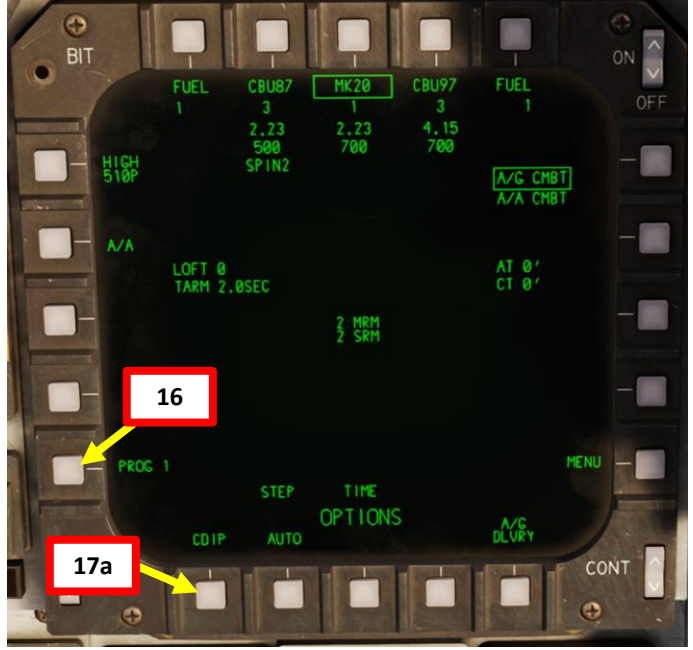


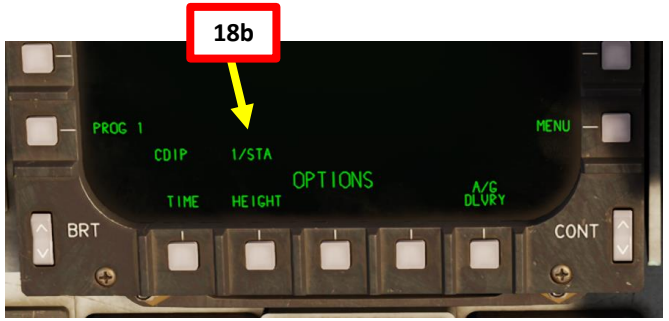


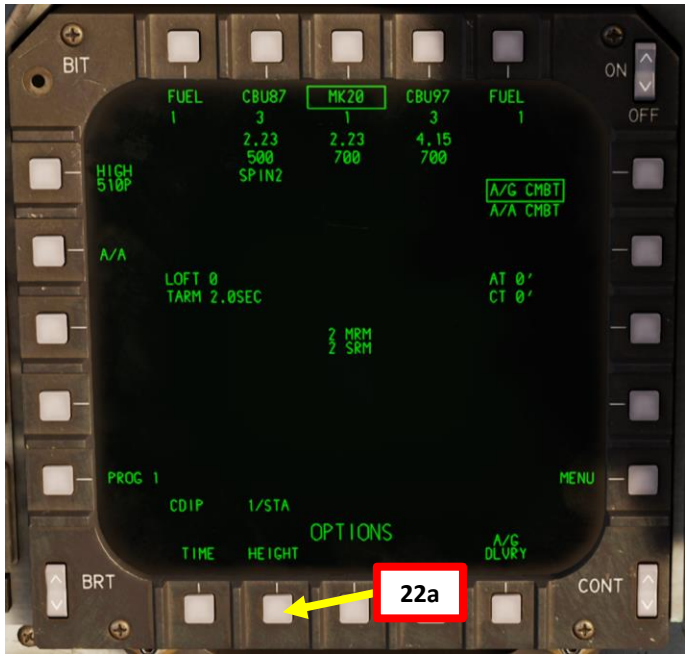
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)

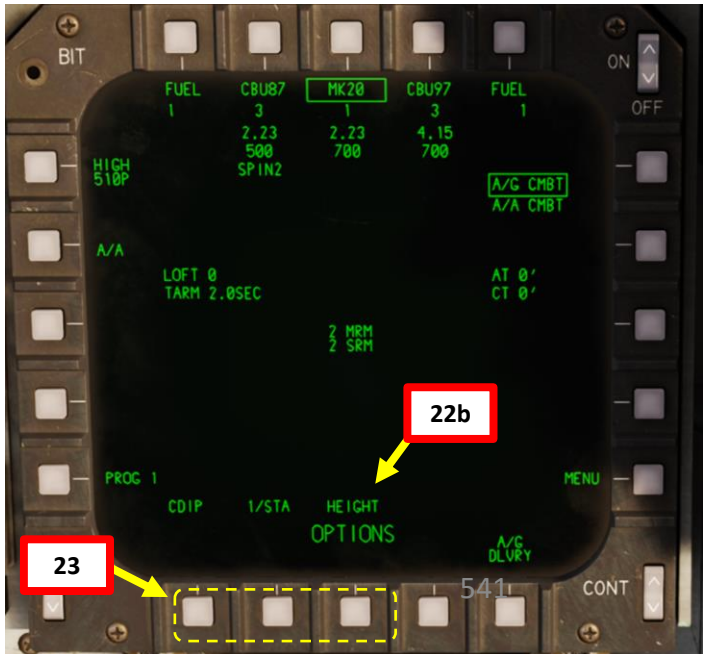
B – Weapon Setup

16. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
17. Select CDIP (Continuous Displayed Impact Point) Delivery Mode.
18. Select desired Release Sequence. We will select 1/STA.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
19. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity.
20. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops).
21. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
22. Select TIME or HEIGHT Fuzing Option as desired. In this tutorial, we will use a Burst Height of Function (700 ft), as programmed previously.
23. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



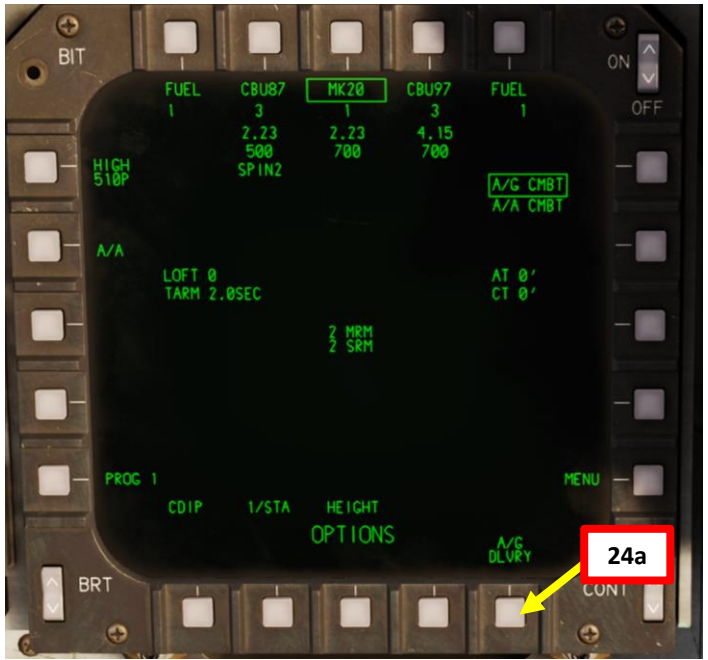


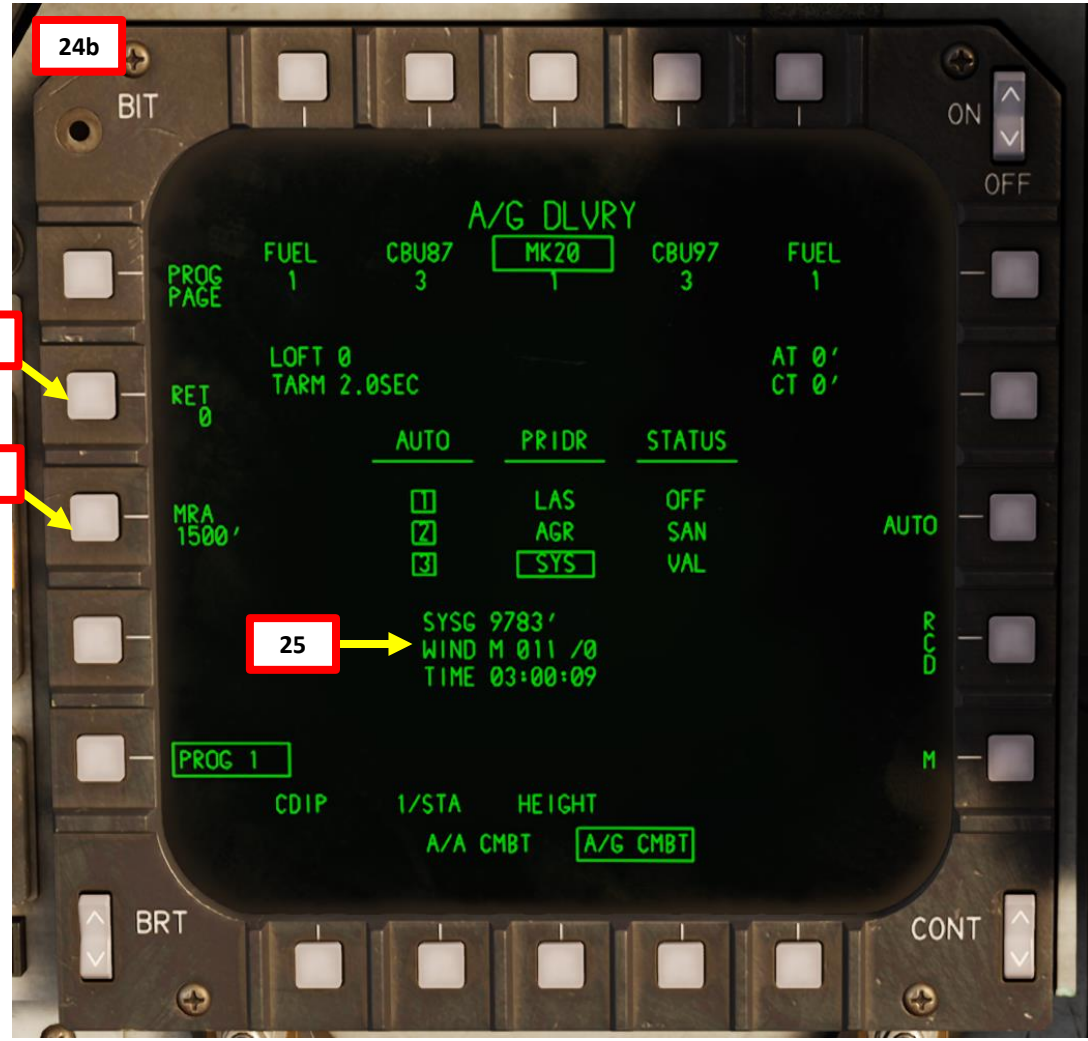




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
B – Weapon Setup

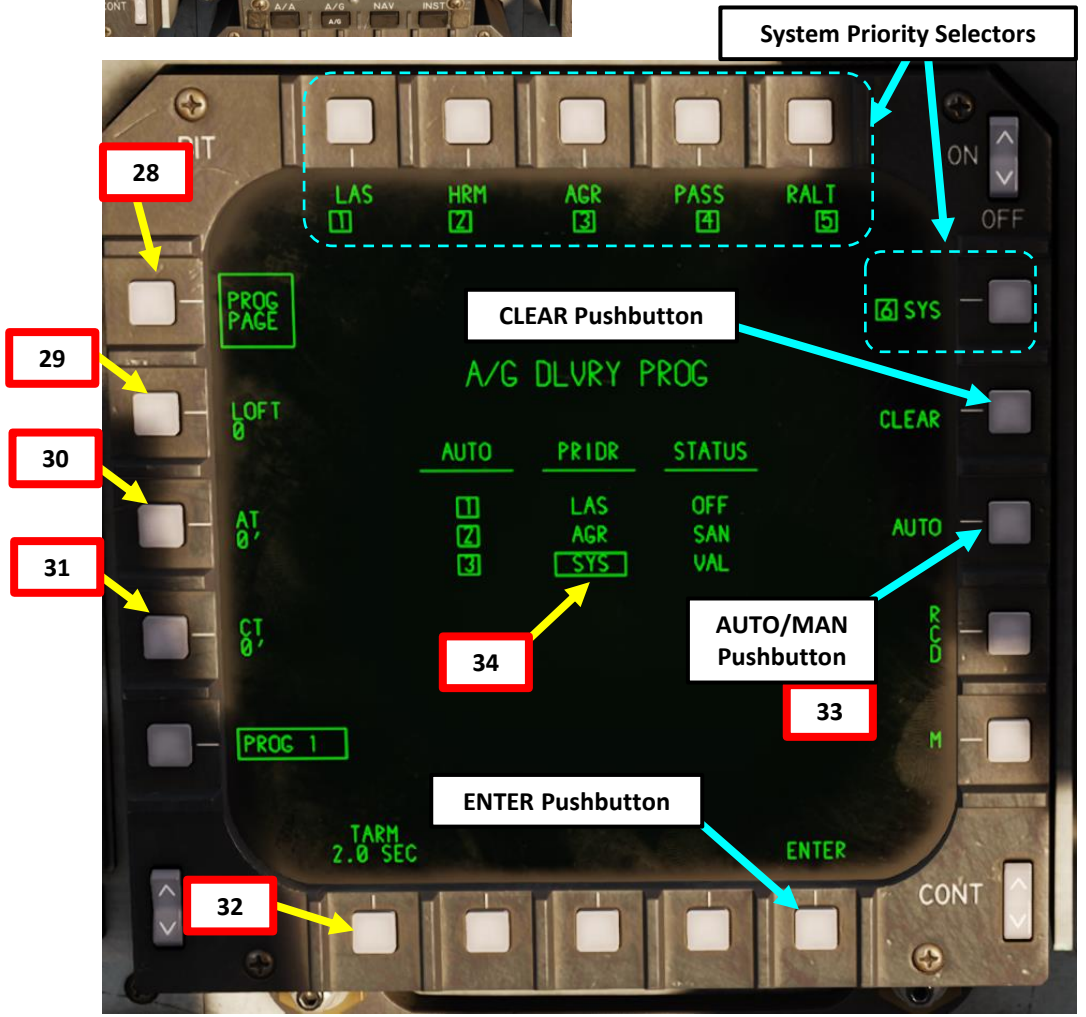
24. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
25. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
26. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
27. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





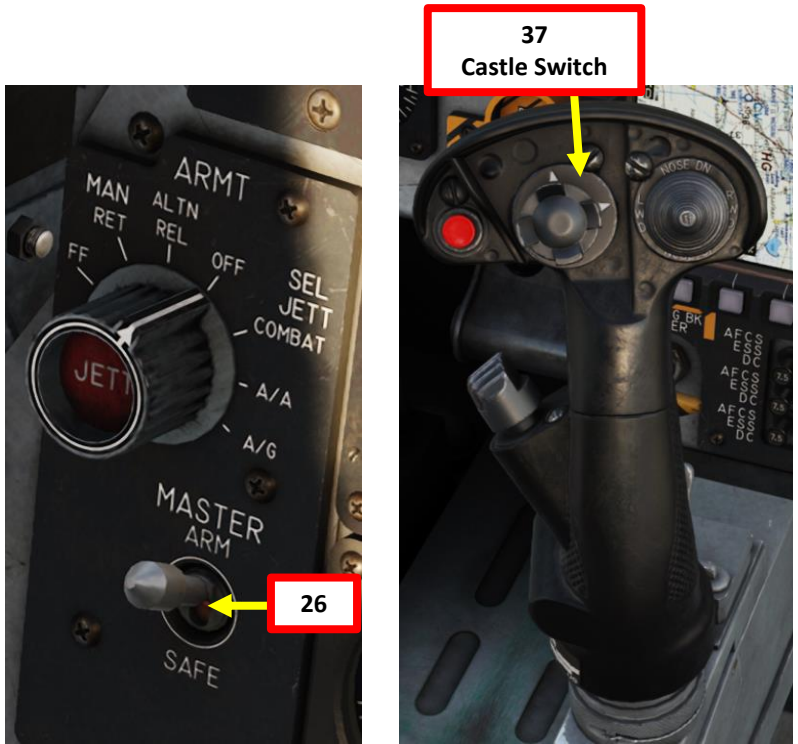
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
B – Weapon Setup

28. Select PROG PAGE (boxed when selected).
29. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
30. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
31. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
32. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
33. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
34. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
35. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



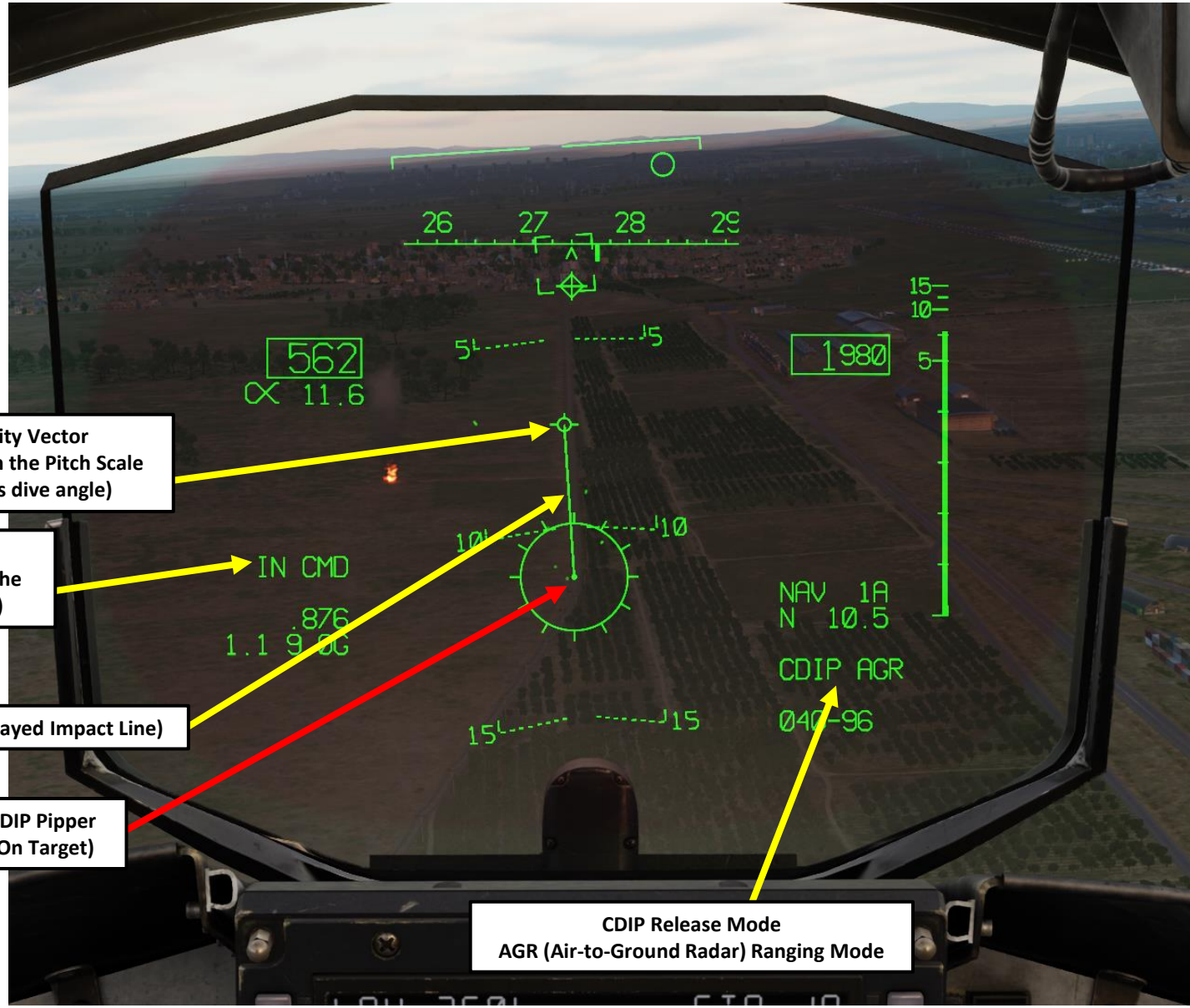
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
C – Perform Attack

36. Set Master Arm Switch – ARM (UP)
37. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the "IN CMD" (In Command) Cue.
    - Note: This step is **optional**, but being IN CMD of the HUD is very useful since it not only allows quick un-designation after ordnance release, but more importantly enables air-to-ground radar (AGR) ranging through the CDIP pipper, which is very important for accurate bombing.



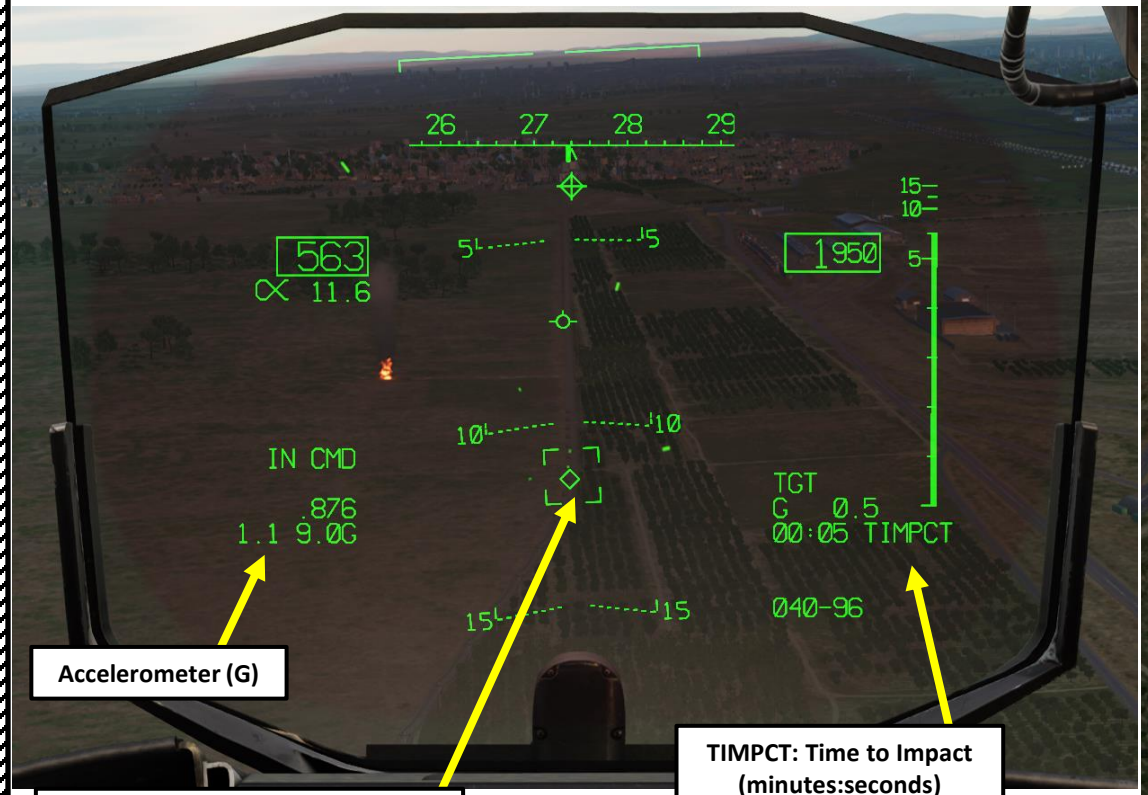
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
C – Perform Attack

38. Perform a shallow dive between 10 and 45 deg from at least 10000 ft. A dive bombing angle of 30 deg is recommended.
39. Steer the aircraft to line up the target with the DIL (Display Impact Line).
40. Steer the aircraft to place the center of the CDIP (Continuously Displayed Impact Point) Pipper on the target.
41. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bombs.



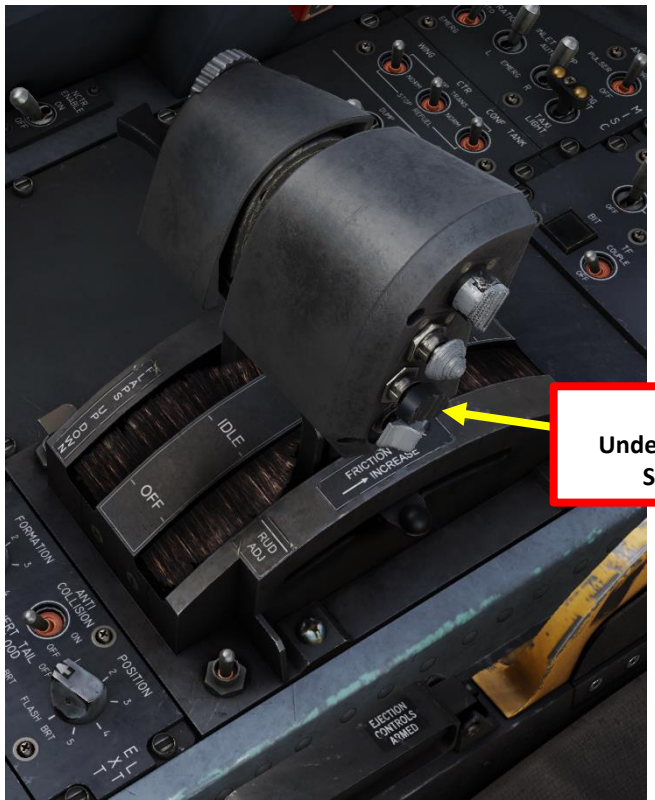
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
C – Perform Attack

42. Once bomb is dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
43. A TD (Target Designation) Diamond is automatically created on the CDIP Pipper's location at the time of bomb release, which allows you to either re-engage or assess damage done on the target.
44. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

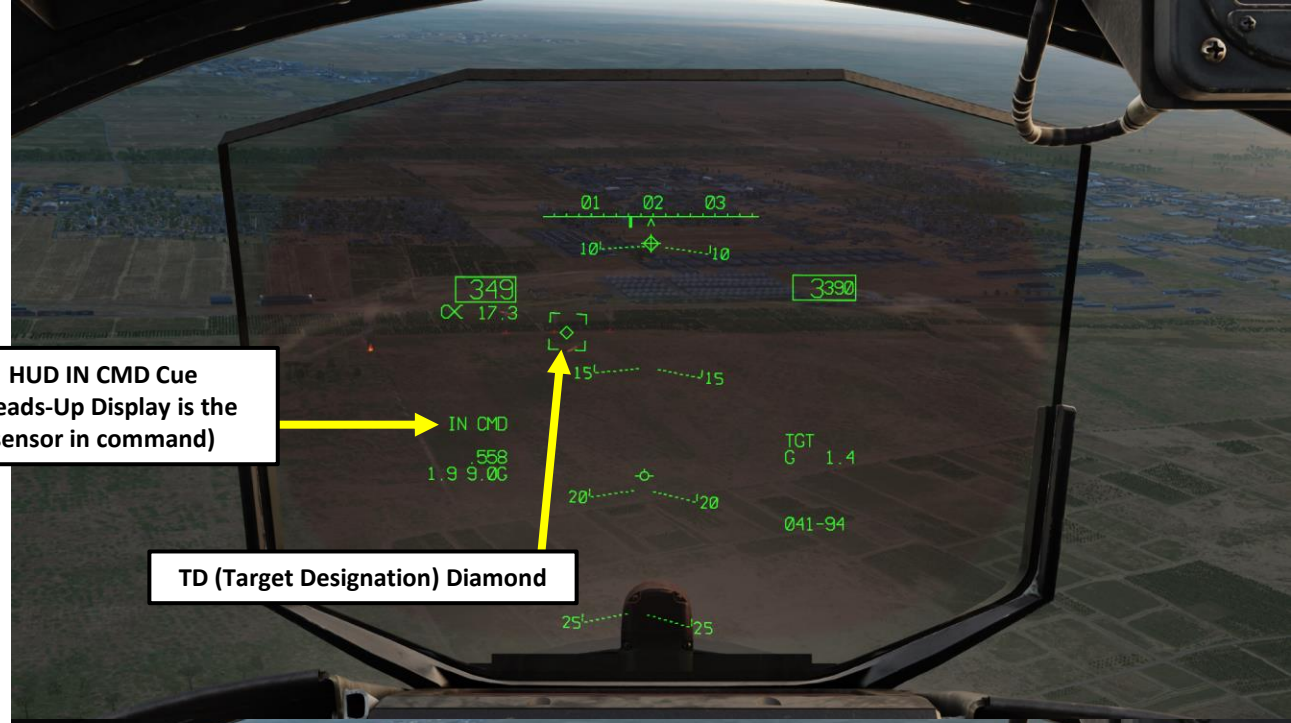


2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.1 – MK-20 Rockeyes (CDIP Mode)
C – Perform Attack

45. To un-designate target and remove the TD (Target Designation) diamond, press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).
    - Note: this step is **optional**, but un-designating from CDIP must be done while the HUD (Heads-Up Display) sensor is in command.

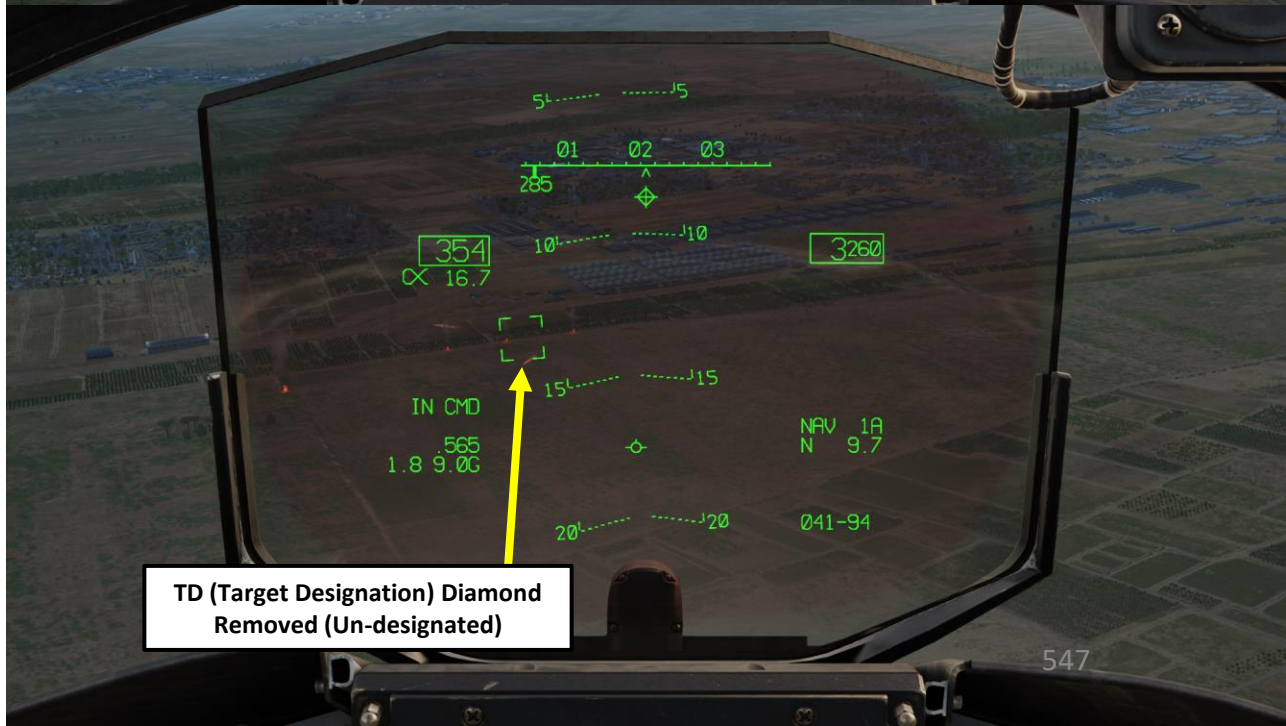


45
Undesignate / Missile Reject Switch (Boat Switch)



HUD IN CMD Cue (Heads-Up Display is the sensor in command)

TD (Target Designation) Diamond



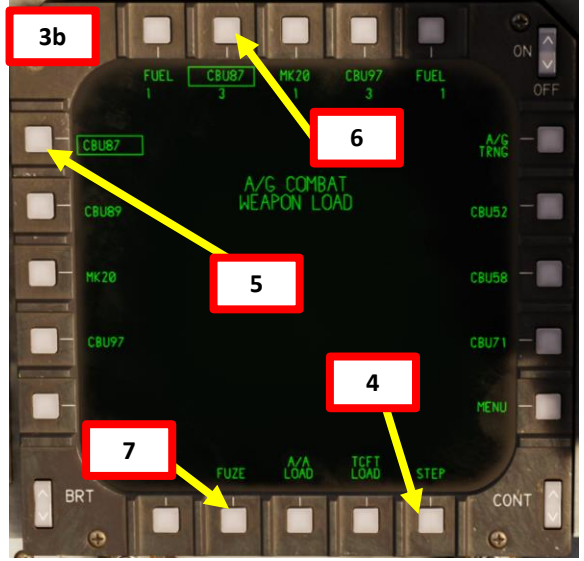
TD (Target Designation) Diamond Removed (Un-designated)

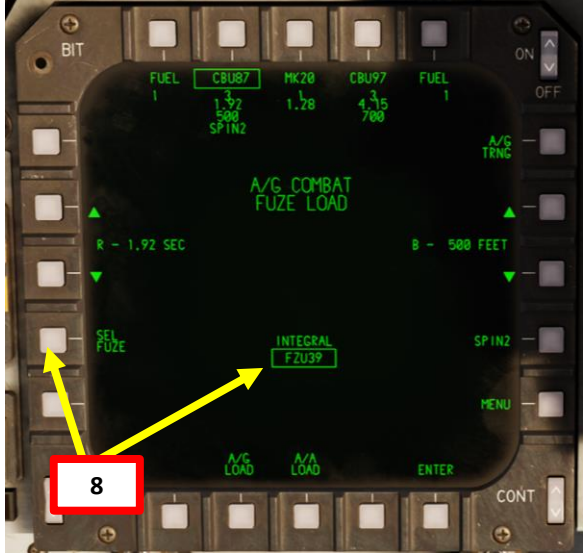
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)

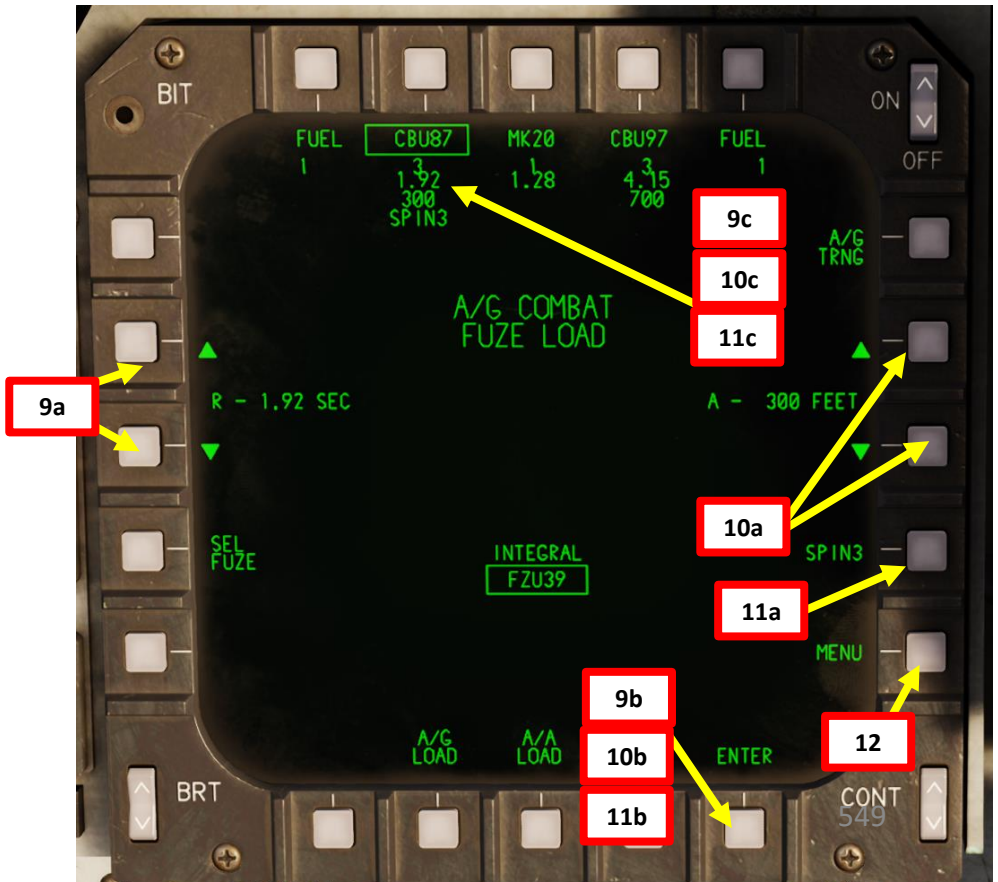
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)

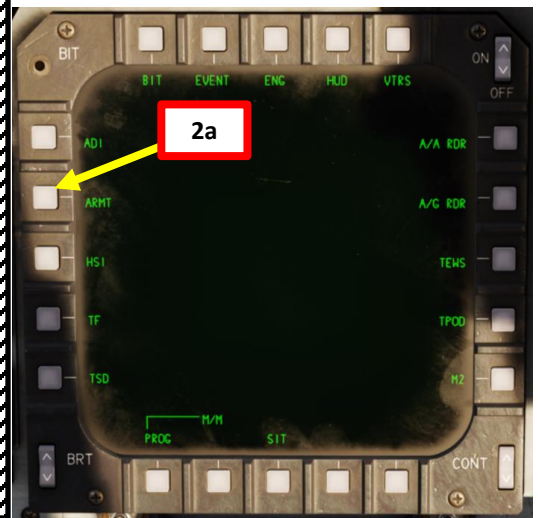
A – Weapon PACS Loading

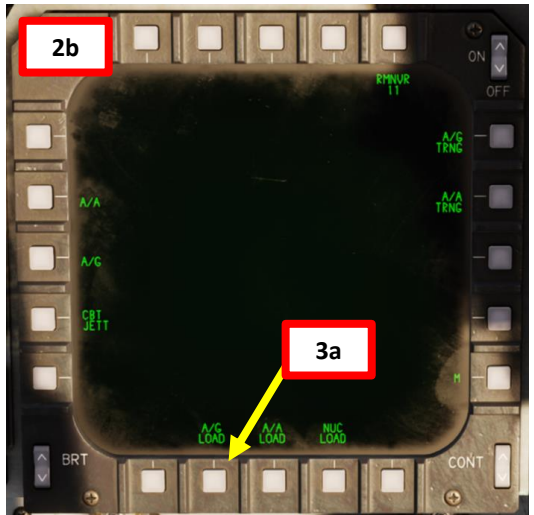
1. Ordnance should already be installed on the aircraft by the ground crew with preset parameters like Burst Height. We want to use a **HoF (Height of Function) parameter of 300 ft with 1000 RPM (Spin 3).**
   - *In real life, bomb parameters are already preset and cannot be changed during the mission; the aircrew should load these parameters on ground via the PACS A/G LOAD page to reflect them.*
   - *Since we use these bombs within a simulated environment, the bomb parameters on the ordnance are automatically updated to match the ones entered in the A/G LOAD sub-menu when the aircraft is on the ground. In this tutorial, we will manually enter these parameters.*
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G COMBAT WEAPON LOAD page.
4. Press PB (Pushbutton) next to STEP to cycle between weapon types until you find “CBU87”.
5. Press PB next to “CBU87” to box (select) CBU-87 Weapon Type.
6. Press PB next to the desired weapon station, which will change to “CBU87”.
7. Press PB next to “FUZE”.
8. Select “FZU39” fuze using the “SEL FUZE” PB.
9. If you want the cluster munitions to use a time setting, use PBs next to the Burst Time Setting, then press PB next to “ENTER”. In this case, we will leave it as is and use a Burst Height instead.
10. If you want the cluster munitions to use a burst height setting, use PBs next to the Burst Height Setting, then press PB next to “ENTER”. In this case, we will use a Burst Height of 300 ft.
11. Use PBs next to the Spin (RPM) Setting, then press PB next to “ENTER”. In this case, we will use SPIN 3 (1000 RPM).
12. Press PB next to MENU twice to return to the ARMT/PACS page.





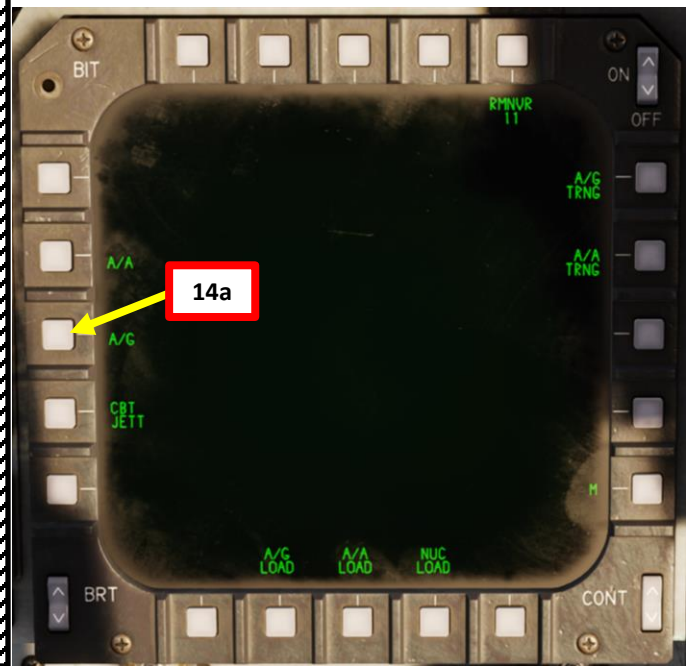


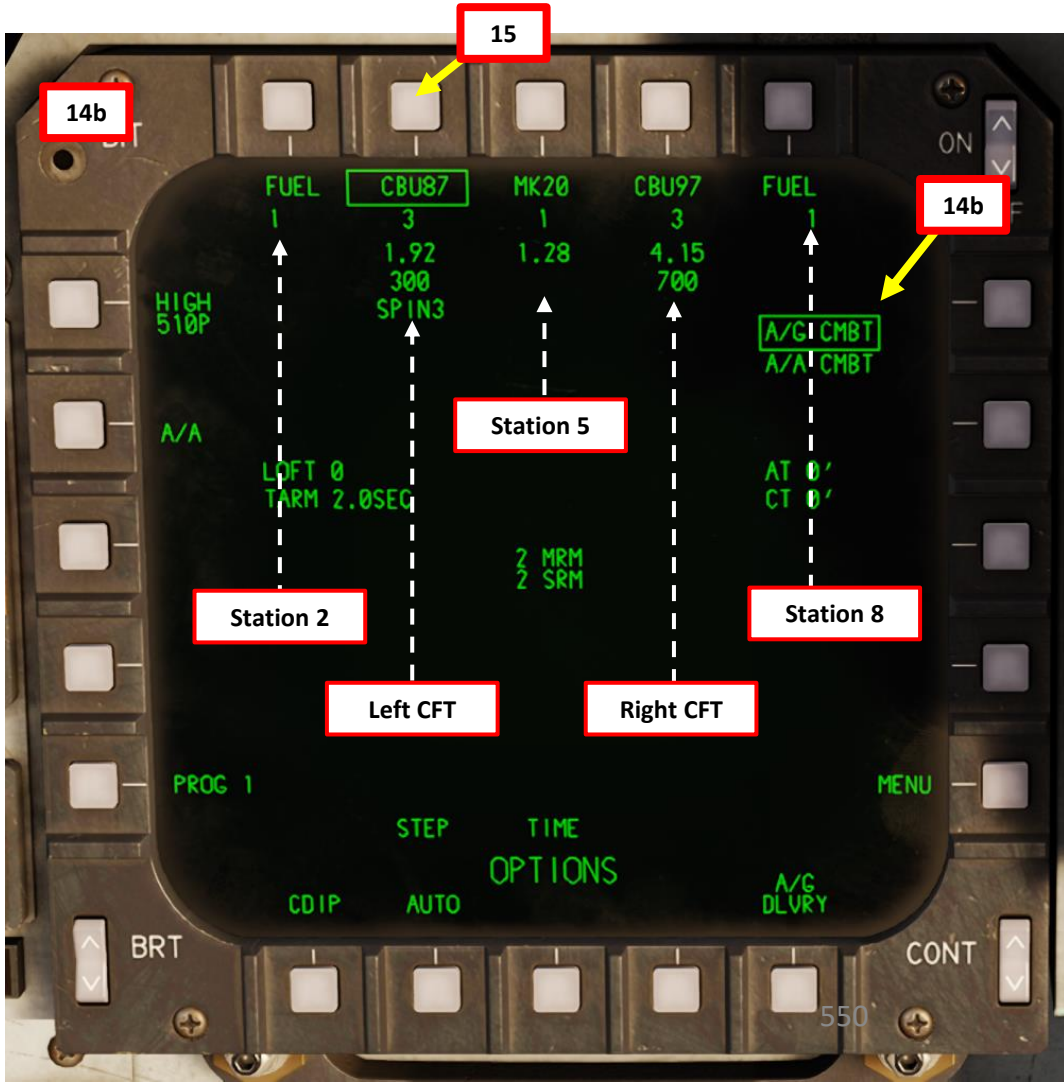




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
B – Weapon Setup

13. Select A/G Master Mode.
14. From ARMT/PACS (Armament/Programmable Armament Control Set) Page, select A/G CMBT (Air-to-Ground Combat) Sub-Page.
15. Select desired stations by pressing pushbuttons next to “CBU87” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.

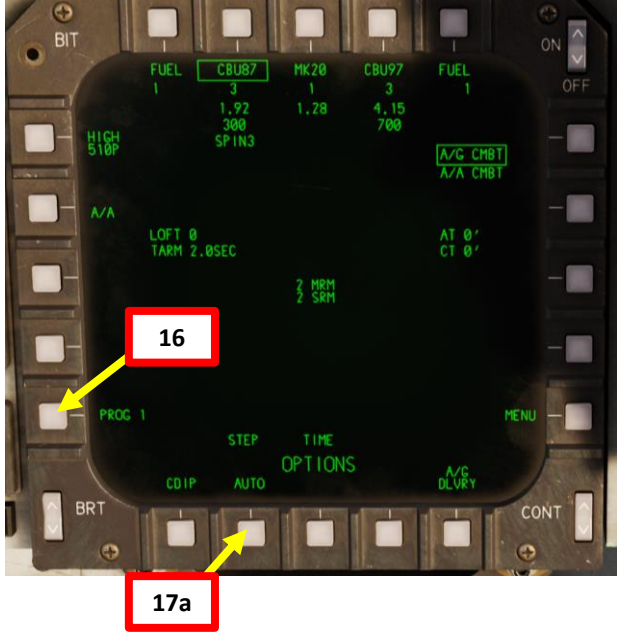


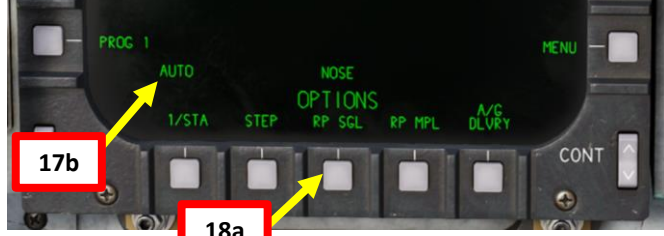


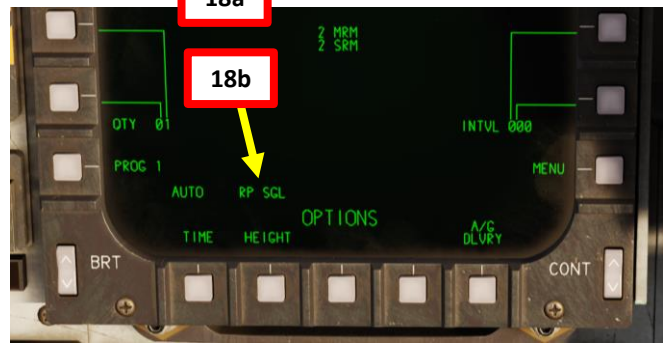
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)

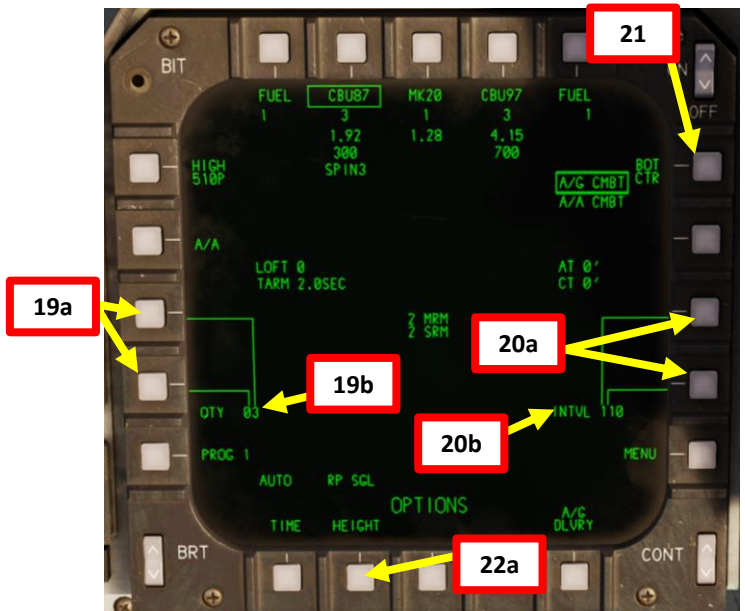
B – Weapon Setup

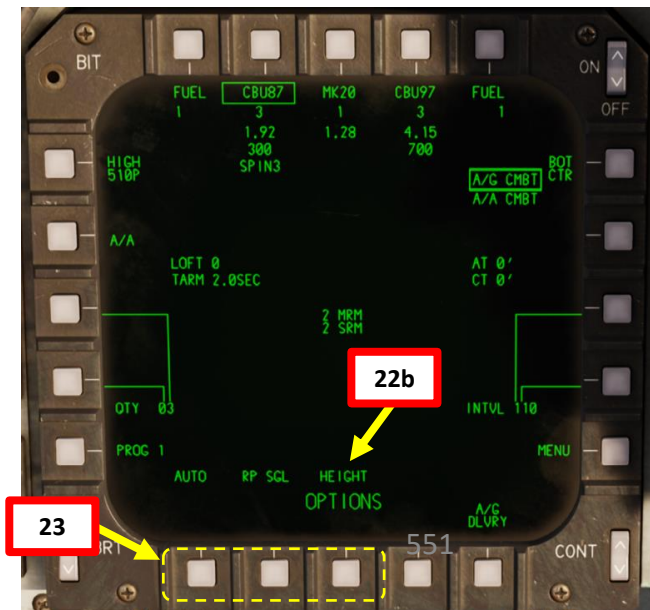
16. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
17. Select Automatic Delivery Mode.
18. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
19. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 3 bombs by toggling the pushbuttons next to the QTY data field.
20. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
21. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
22. Select TIME or HEIGHT Fuzing Option as desired. In this tutorial, we will use a Burst Height of Function (300 ft), as programmed previously.
23. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.





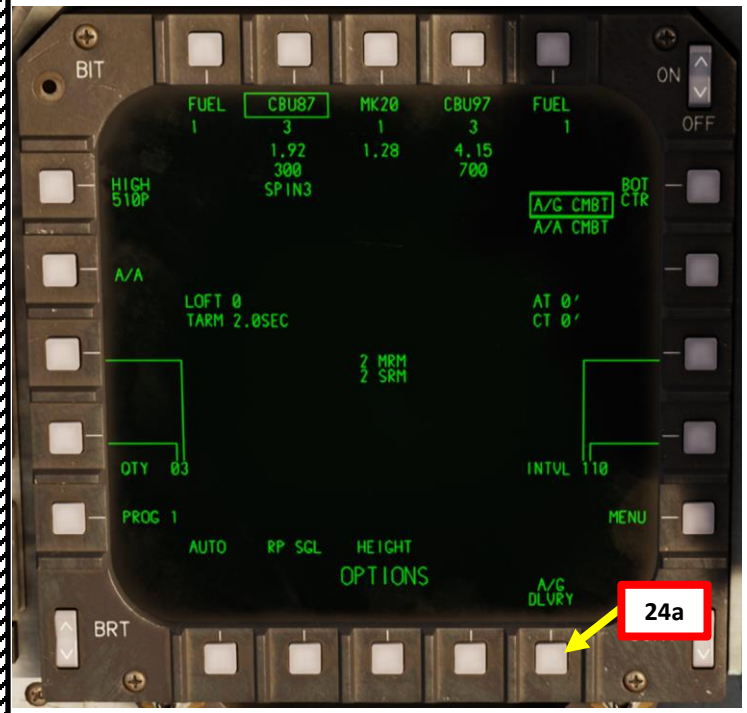


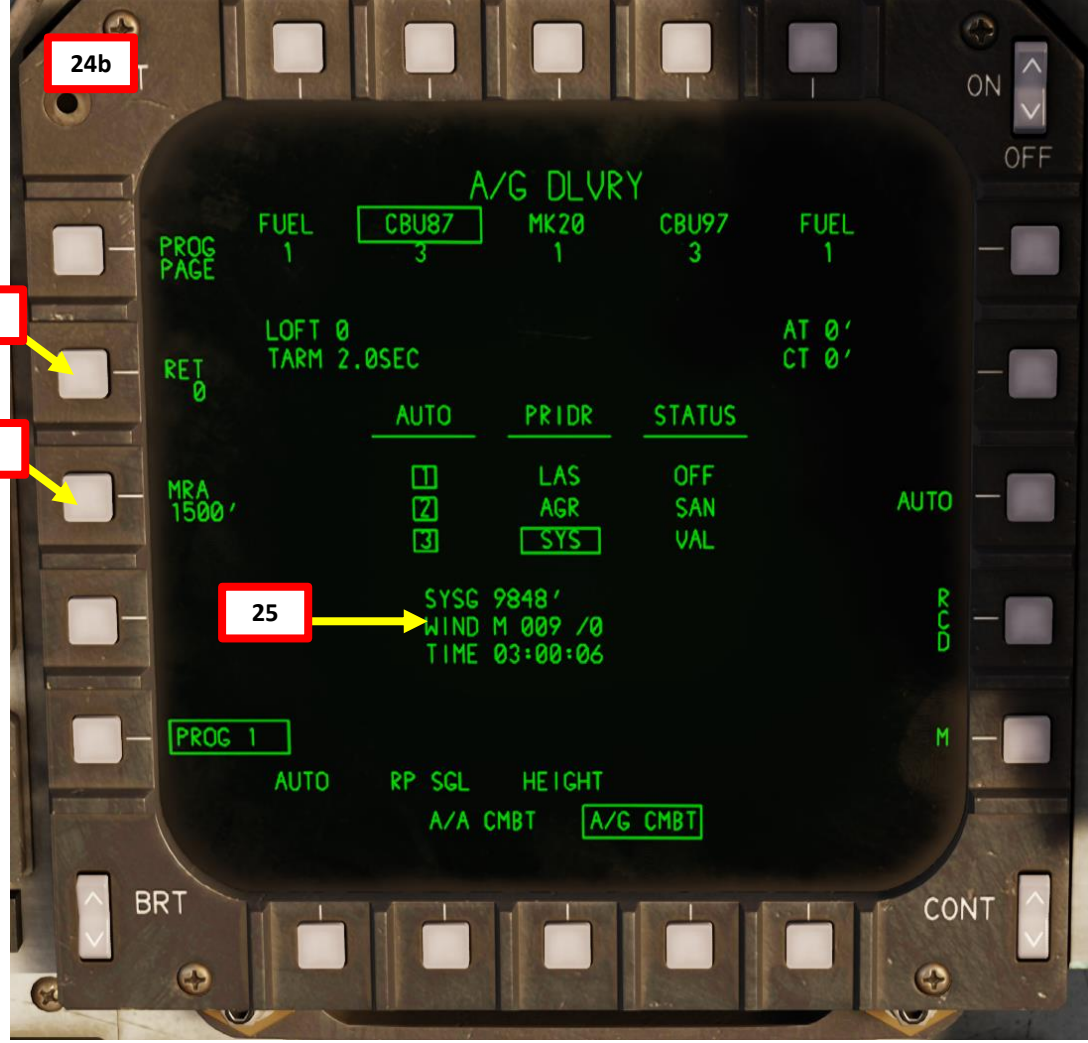




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
B – Weapon Setup

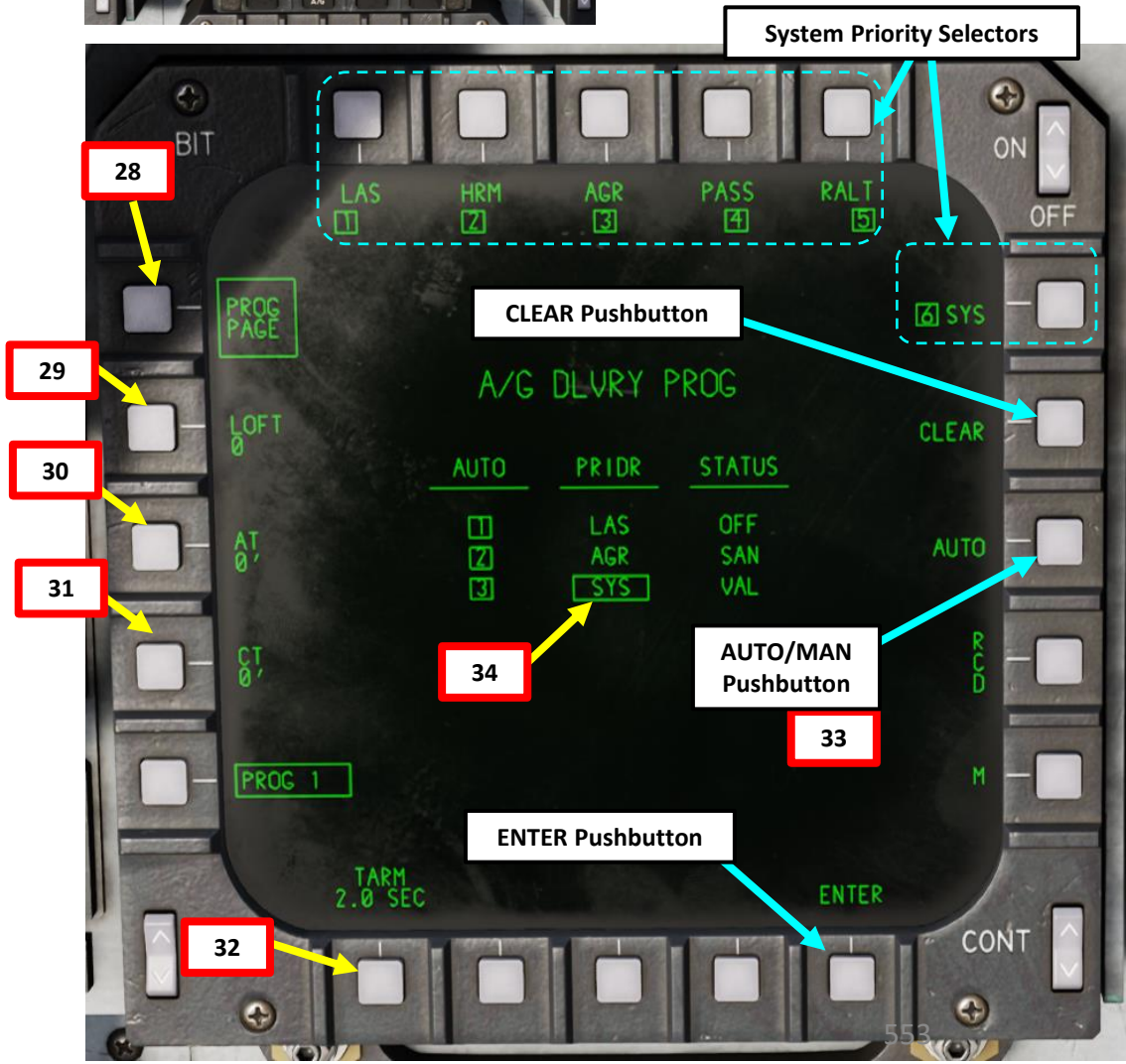
24. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
25. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
26. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
27. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





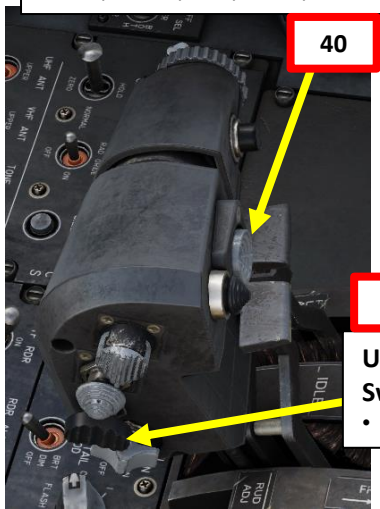
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
B – Weapon Setup

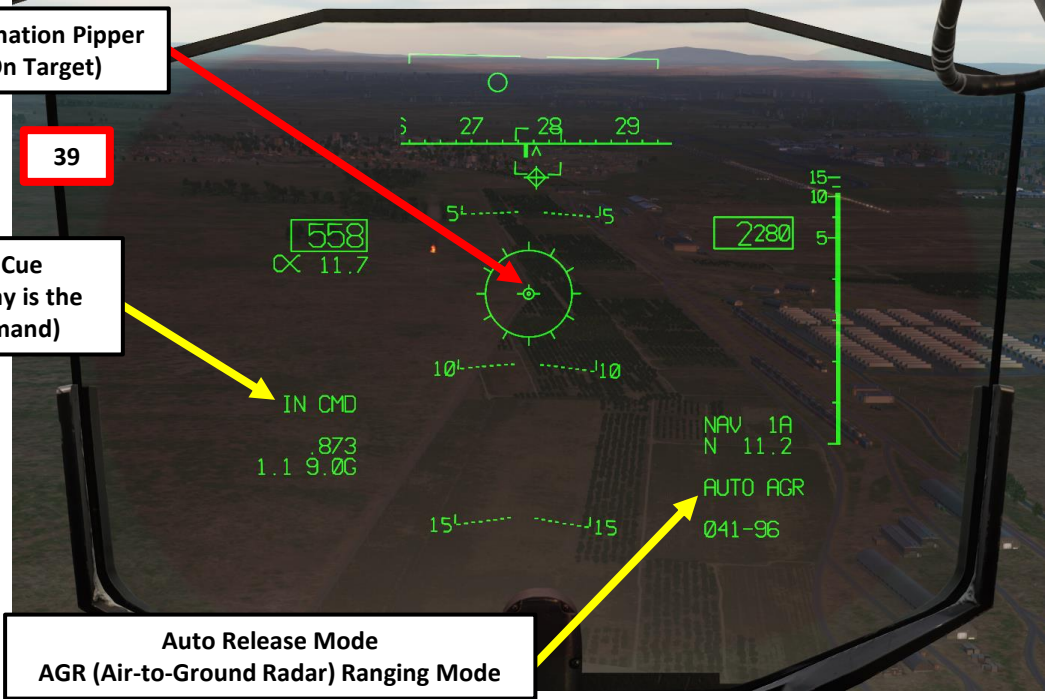
28. Select PROG PAGE (boxed when selected).
29. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
30. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
31. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
32. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
33. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
34. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
35. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
C – Weapon Arming & Target Designation

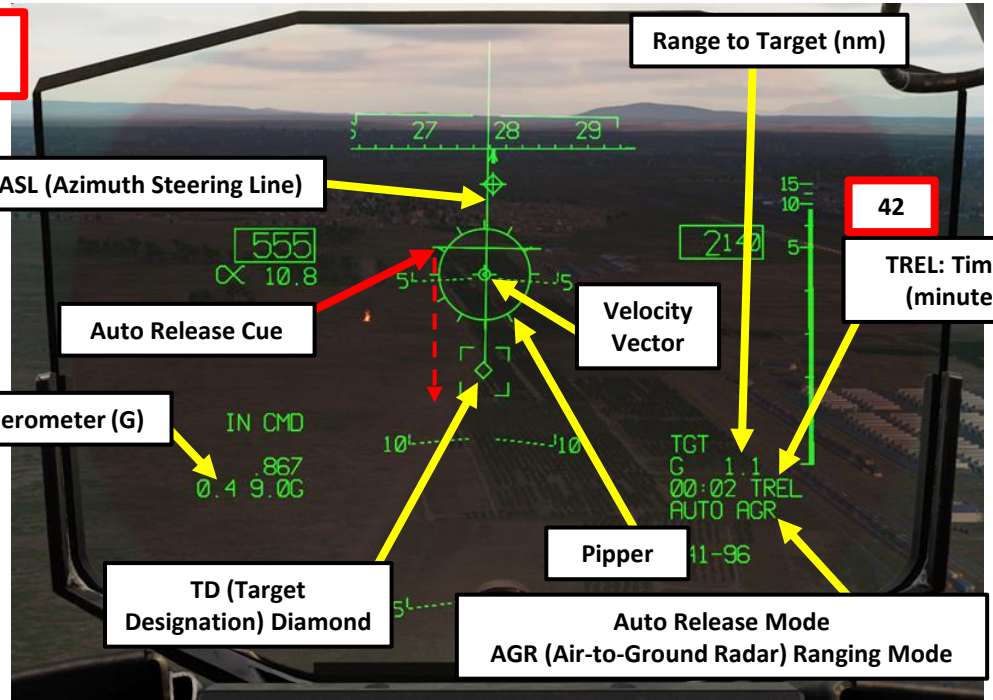
36. Set Master Arm Switch – ARM (UP)
37. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the "IN CMD" (In Command) Cue.
    • Note: HUD designation enables air-to-ground radar (AGR) ranging through the pipper, which is very important for accurate bombing.
38. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
39. Steer the aircraft to place the pipper/reticle on the target you want to designate.
40. Designate target by pressing and releasing the TDC (Target Designation Control) switch.

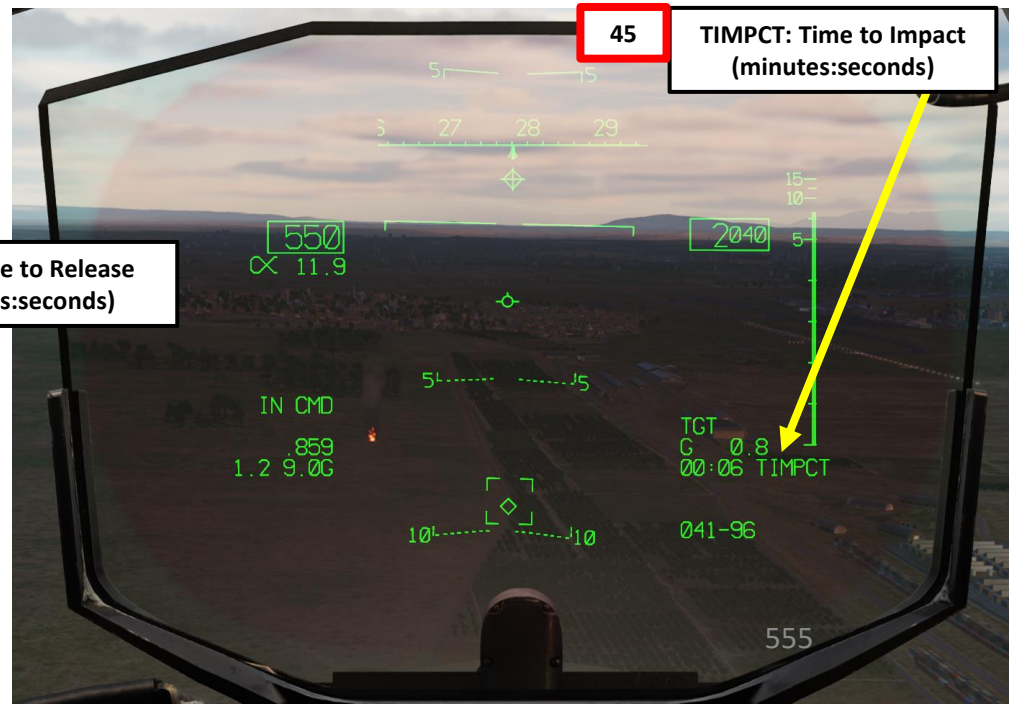




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
D – Perform Attack

41. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
42. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
43. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release ordnance.
44. CBU-87 canisters will automatically drop when the auto release cue crosses the velocity vector.
45. Once CBU-87 canisters are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
46. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
47. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.



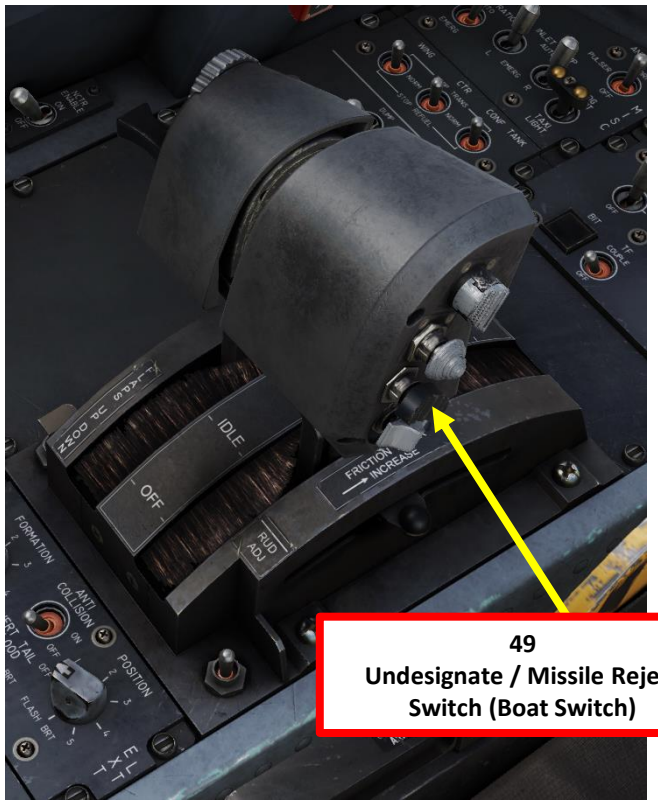


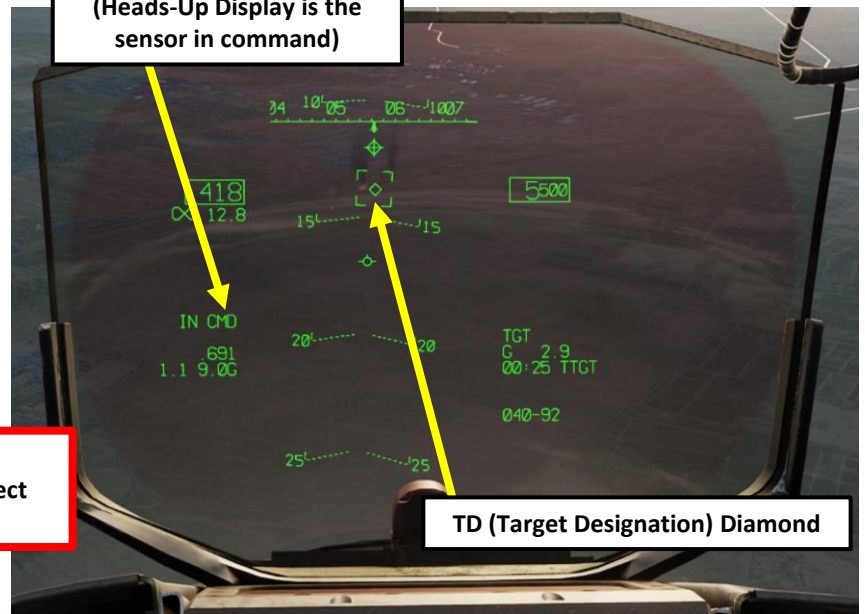
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
D – Perform Attack

48. At the preset altitude (Burst Height of Function of 300 ft), the canisters break open and submunitions are released.

2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)
D – Perform Attack

49. To un-designate target and remove the TD (Target Designation) diamond, press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).





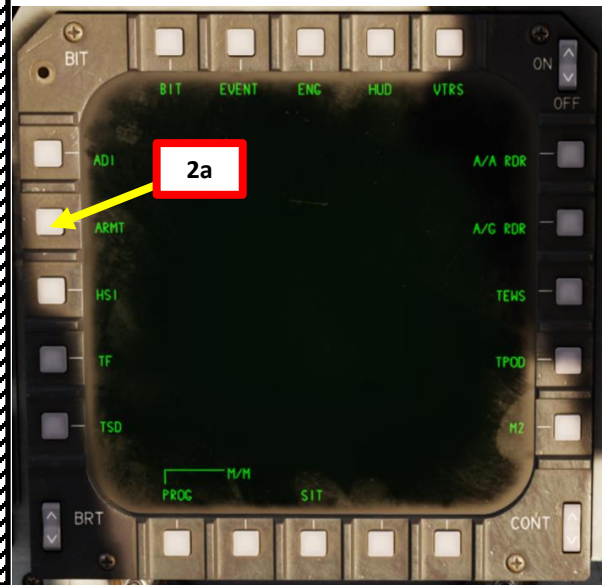
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.2 – CBU-87 Cluster Bombs (Auto Mode with HUD)

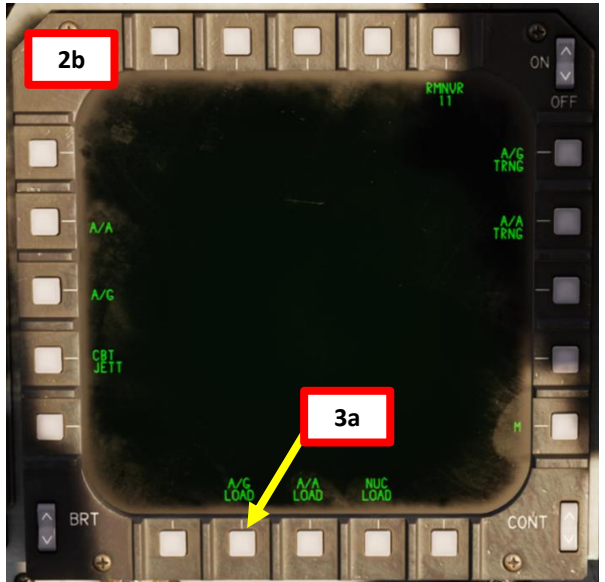
D – Perform Attack

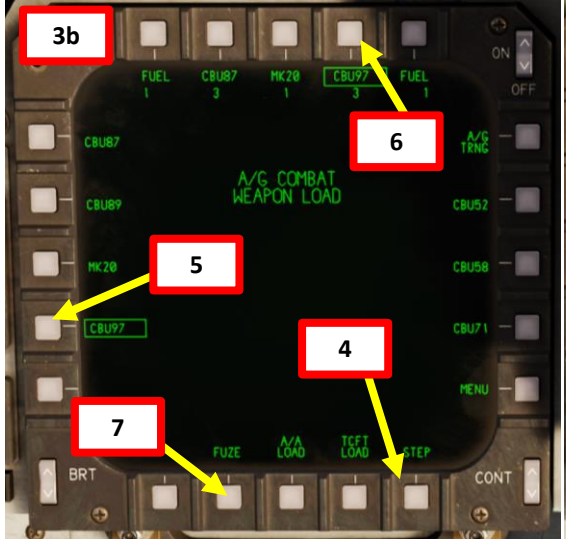
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)

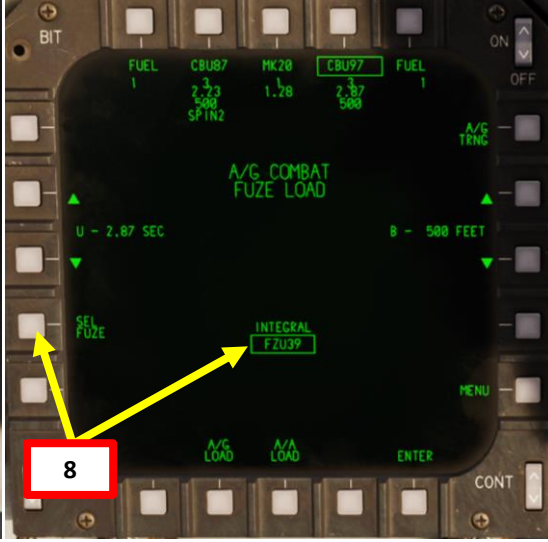
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
A – Weapon PACS Loading

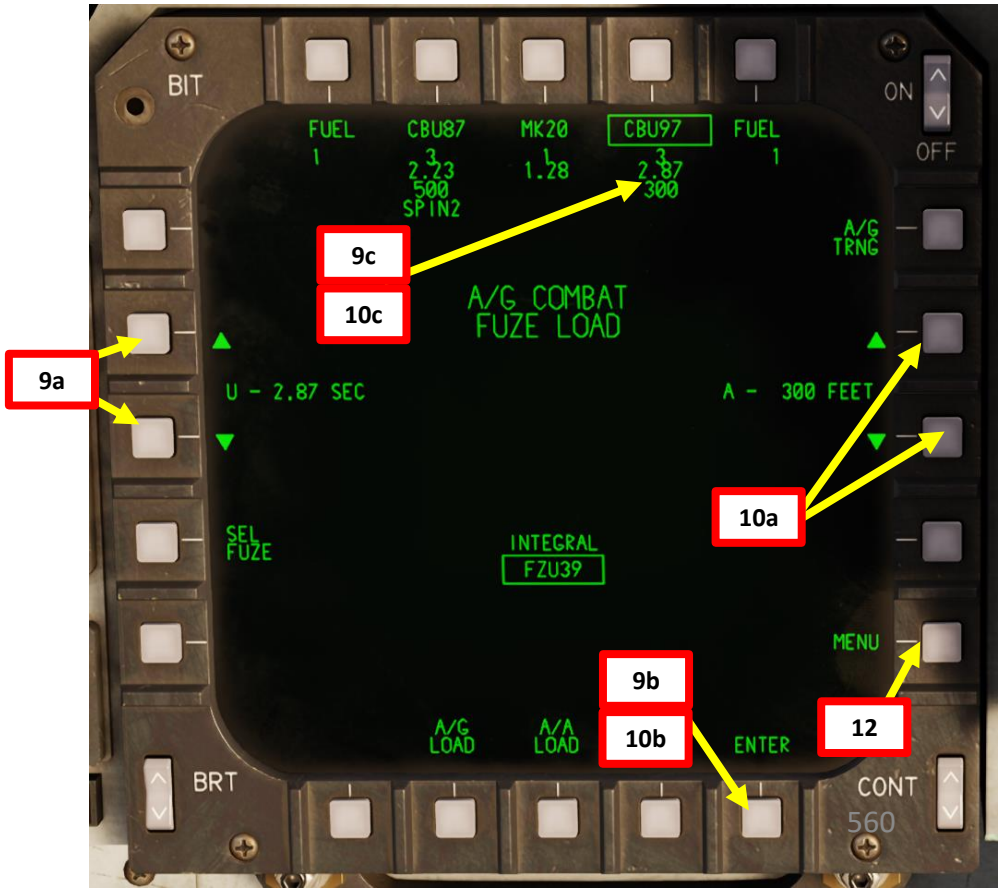
1. Ordnance should already be installed on the aircraft by the ground crew with preset parameters like Burst Height. We want to use a **HoF (Height of Function) parameter of 700 ft.**
    - *In real life, bomb parameters are already preset and cannot be changed during the mission; the aircrew should load these parameters on ground via the PACS A/G LOAD page to reflect them.*
    - *Since we use these bombs within a simulated environment, the bomb parameters on the ordnance are automatically updated to match the ones entered in the A/G LOAD sub-menu when the aircraft is on the ground. In this tutorial, we will manually enter these parameters.*
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G COMBAT WEAPON LOAD page.
4. Press PB (Pushbutton) next to STEP to cycle between weapon types until you find “CBU97”.
5. Press PB next to “CBU97” to box (select) CBU-97 Weapon Type.
6. Press PB next to the desired weapon station, which will change to “CBU97”.
7. Press PB next to “FUZE”.
8. Select “FZU39” fuze using the “SEL FUZE” PB.
9. If you want the cluster munitions to use a time setting, use PBs next to the Burst Time Setting, then press PB next to “ENTER”. In this case, we will leave it as is and use a Burst Height instead.
10. If you want the cluster munitions to use a burst height setting, use PBs next to the Burst Height Setting, then press PB next to “ENTER”. In this case, we will use a Burst Height of 300 ft.
11. For CBU-97s, there is no Spin (RPM) setting available.
12. Press PB next to MENU twice to return to the ARMT/PACS page.





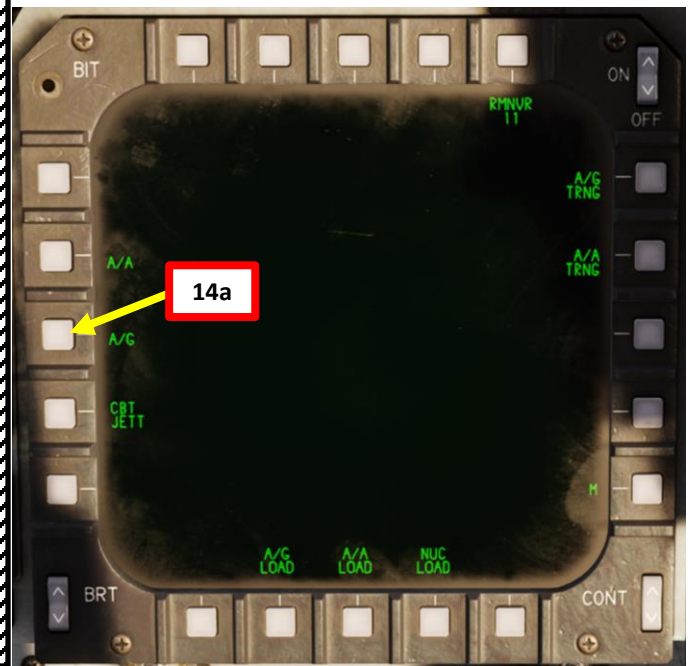


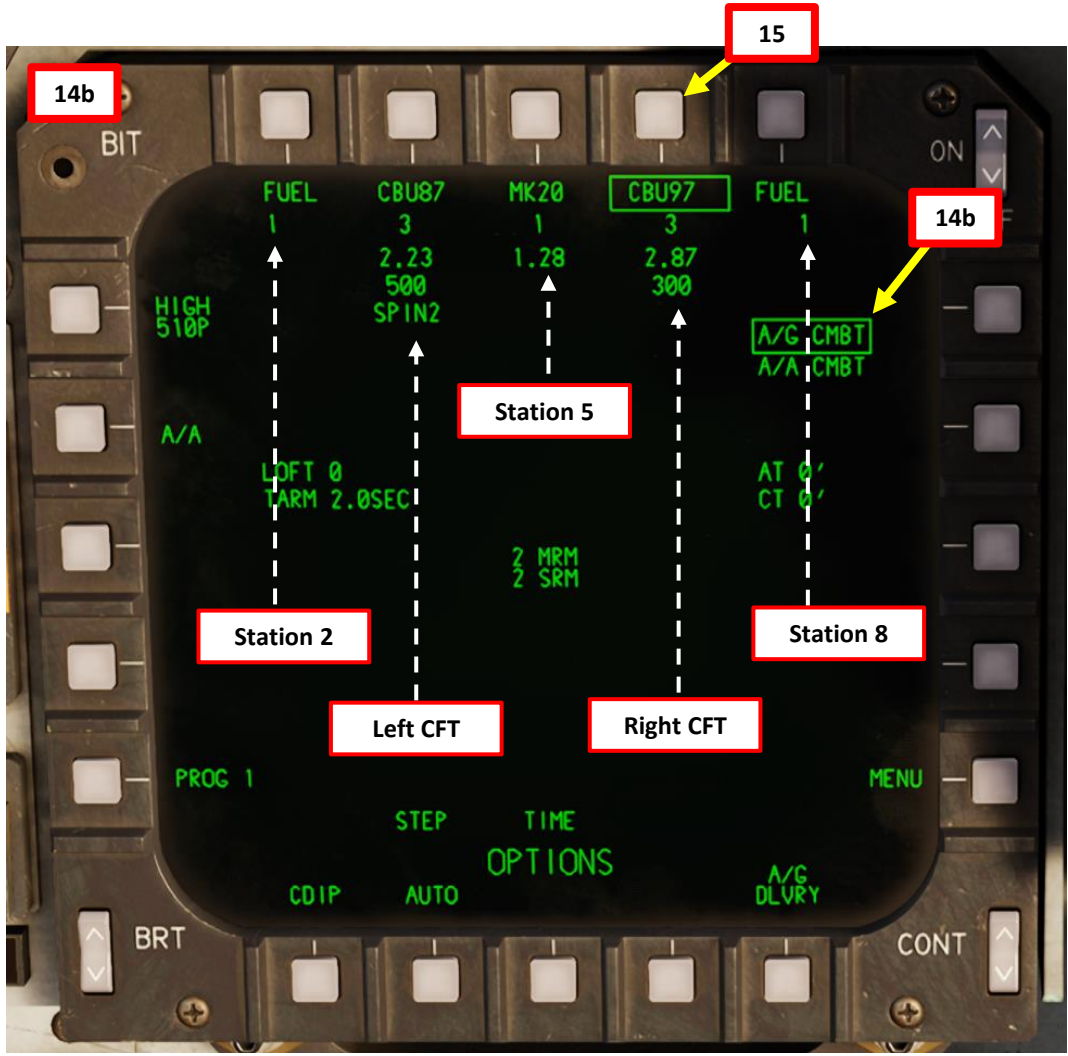




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
B – Weapon Setup

13. Select A/G Master Mode.
14. From ARMT/PACS (Armament/Programmable Armament Control Set) Page, select A/G CMBT (Air-to-Ground Combat) Sub-Page.
15. Select desired stations by pressing pushbuttons next to “CBU97” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.





2 – AIR-TO-GROUND WEAPONS
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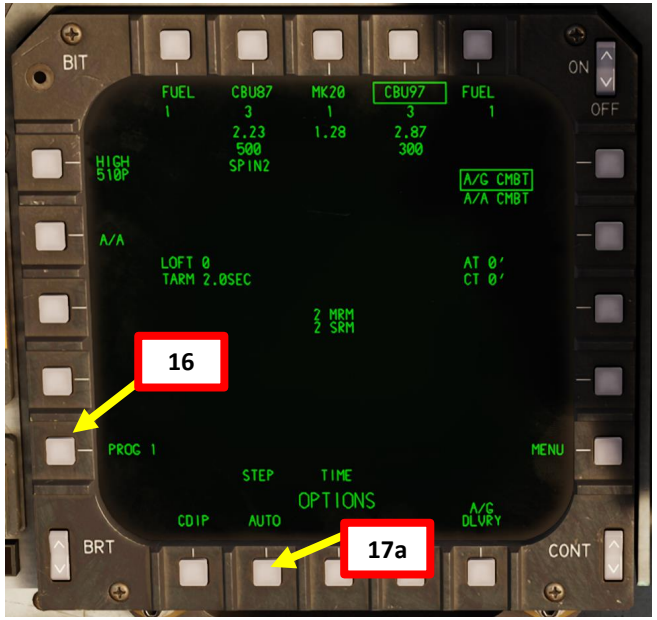
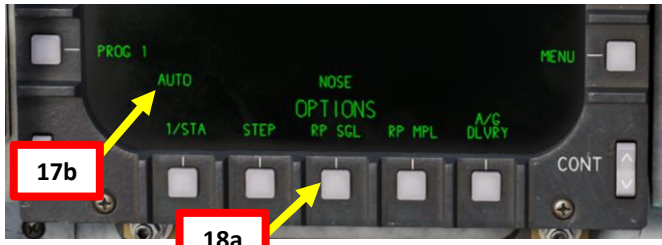
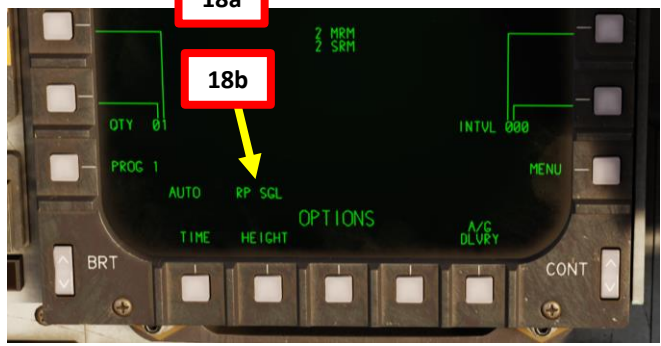
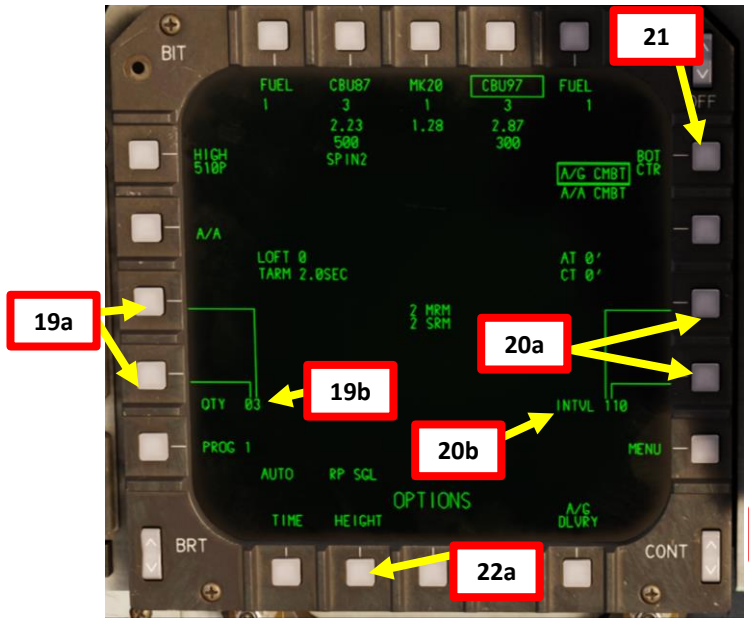
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
B – Weapon Setup

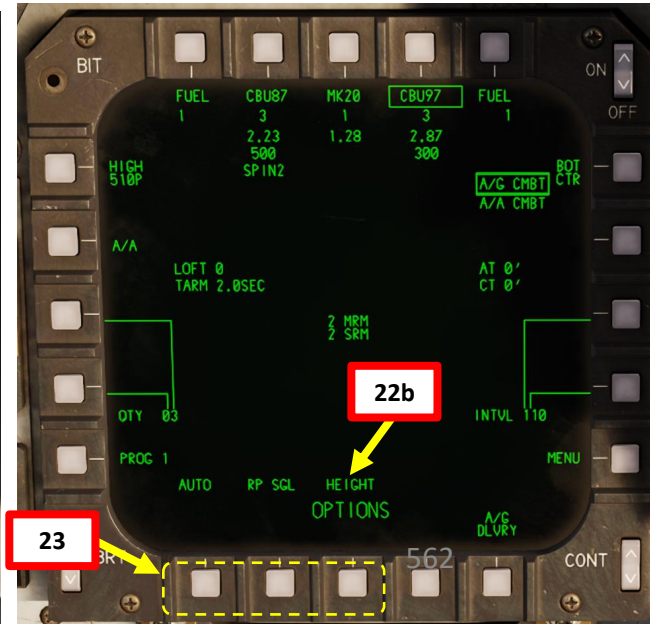
16. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
17. Select Automatic Delivery Mode.
18. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
19. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 3 bombs by toggling the pushbuttons next to the QTY data field.
20. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
21. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default "CTR" setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
22. Select TIME or HEIGHT Fuzing Option as desired. In this tutorial, we will use a Burst Height of Function (700 ft), as programmed previously.
23. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.





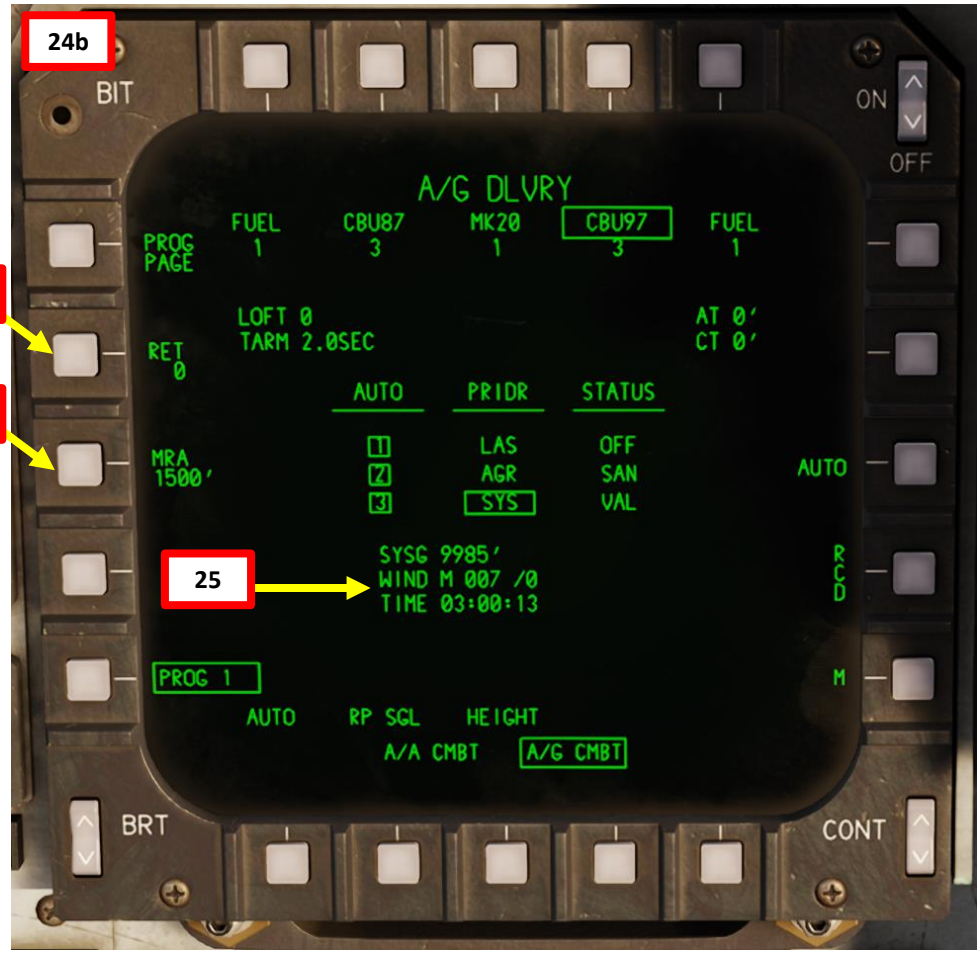


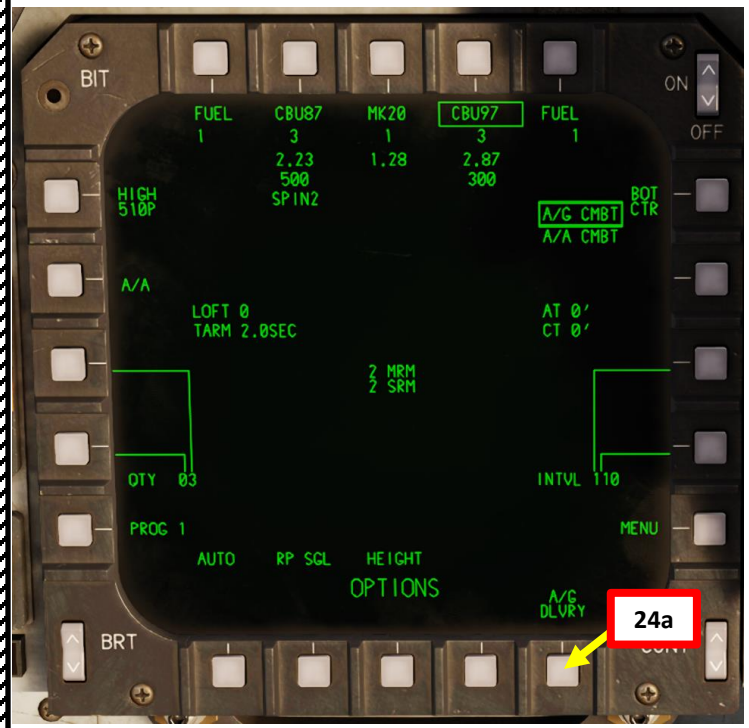




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
B – Weapon Setup

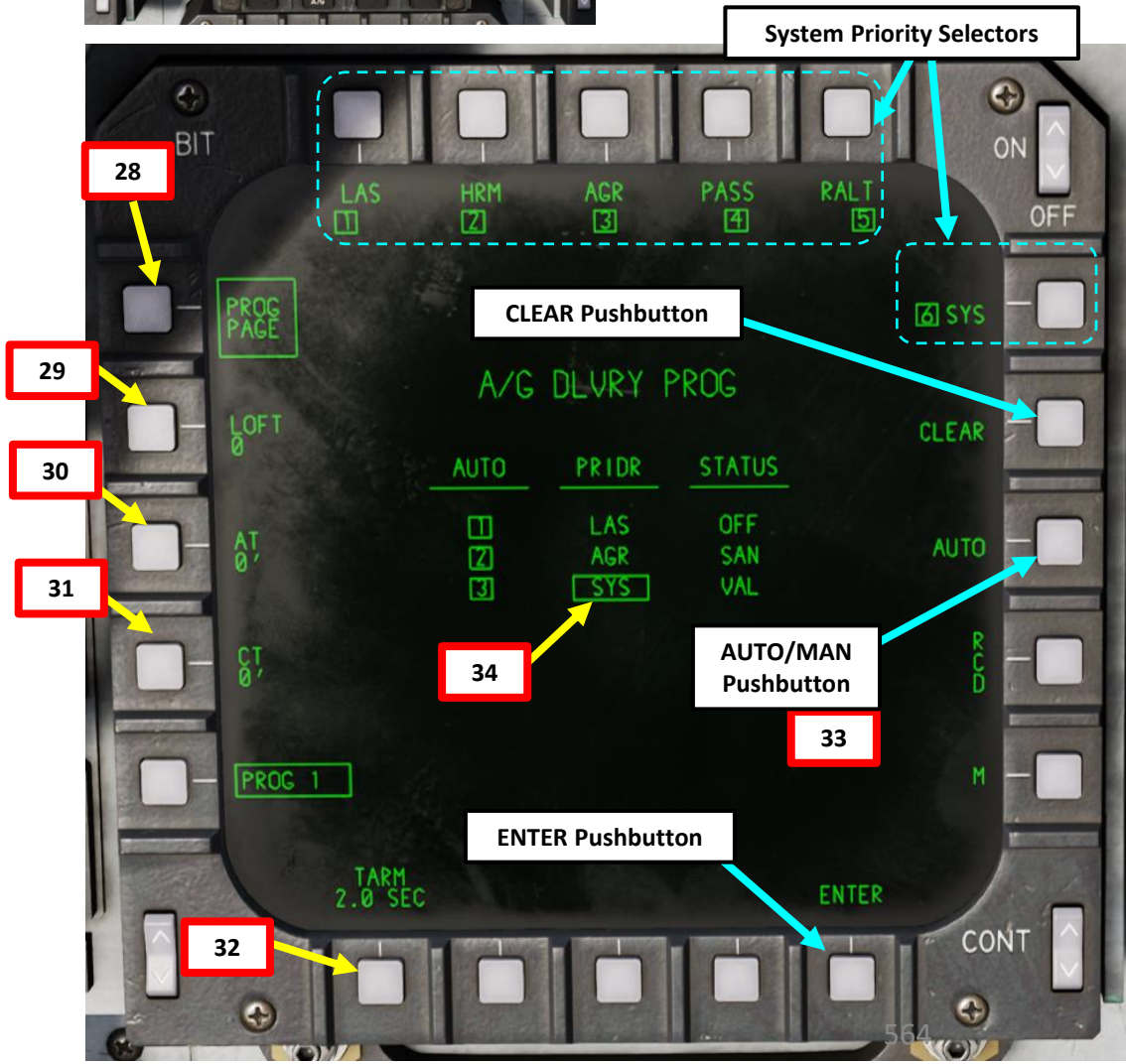
24. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
25. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
26. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
27. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
B – Weapon Setup

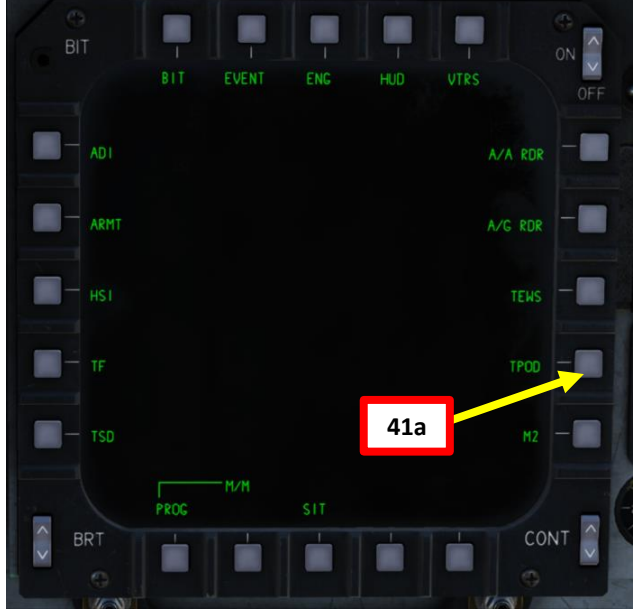
28. Select PROG PAGE (boxed when selected).
29. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
30. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
31. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
32. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
33. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
34. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
35. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

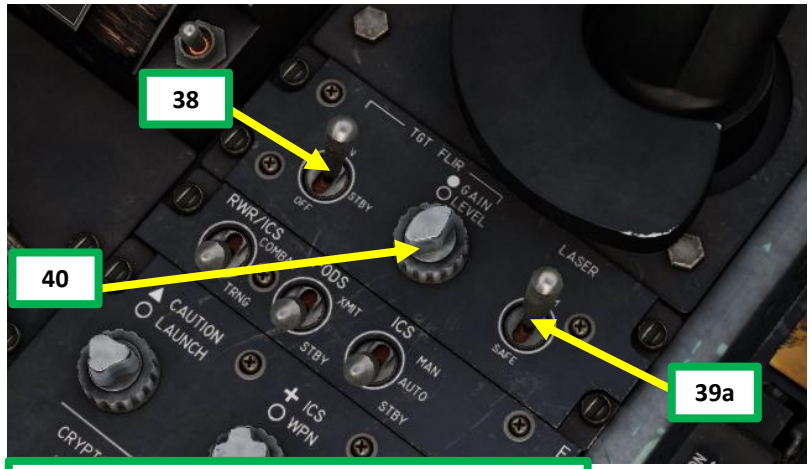


2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
C – Weapon Arming & Target Designation

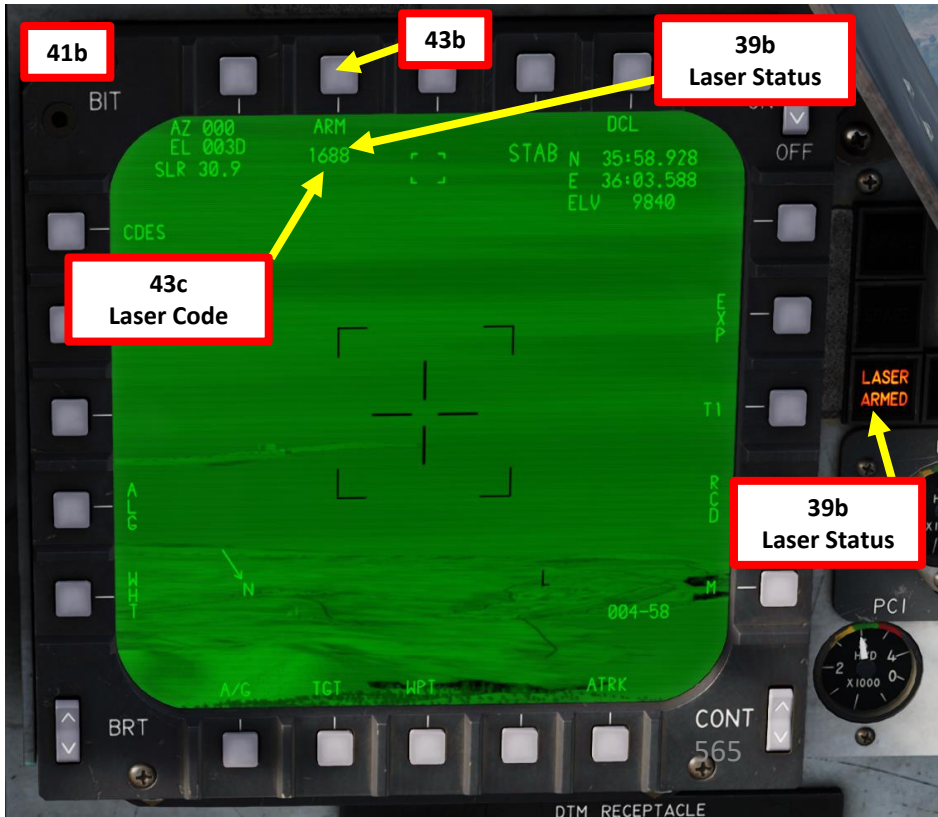
36. *[P]* Set Master Arm Switch – ARM (UP)
37. *[P]* Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
38. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – ON (FWD).
39. *[WSO]* Set Laser Arm Switch to ARMED (FWD).
40. *[WSO]* Adjust TGT FLIR Gain/Level – As required.
41. From the main MPD menu page, select TPOD page.
42. When using dumb bombs with a targeting pod designation, using a laser is not mandatory. However, laser ranging helps the aircraft to compute a more accurate target range.
43. To set laser designation code, enter a valid code on the UFC (Upfront Control Panel) keypad, then press pushbutton next to the laser status/code indication (ARM/1688 in this example). Valid laser codes are 1111 thru 1788, therefore we will use laser designation code 1688.

Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*



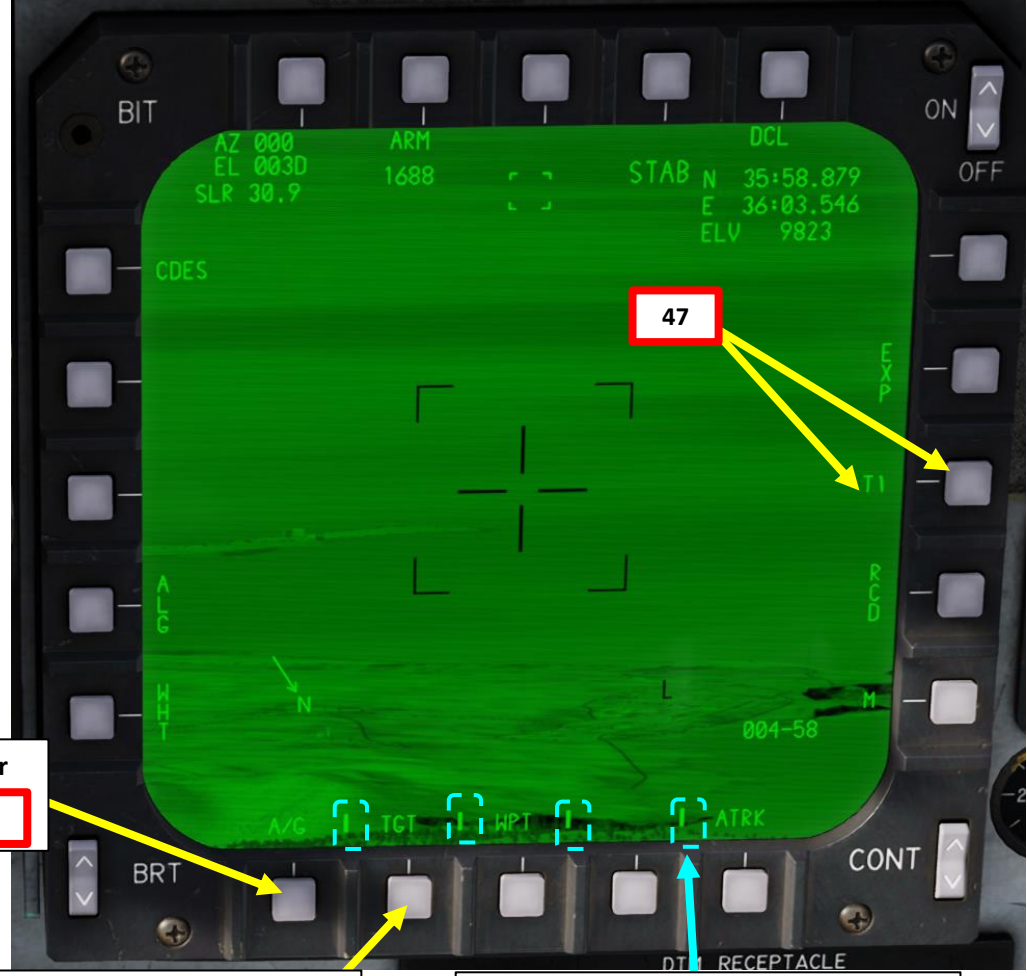


WSO (Weapon Systems Officer) Cockpit



2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
C – Weapon Arming & Target Designation

44. Make sure the TPOD page is selected, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
45. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
46. Set Targeting Pod Function Selector to TGT (Target Designation).
47. Select Primary (T1) Mode.
48. Before using the targeting pod's laser ranger/designator, verify that the following conditions are met (otherwise laser designation is inhibited):
    a) **Aircraft altitude is below 25000 ft.**
    b) **Weight off wheels (aircraft is flying) and landing gear is retracted.**
    c) **Valid laser code is entered.**
    d) **Laser is armed.**



Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

45

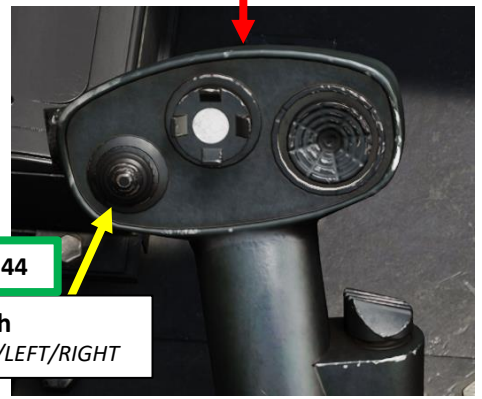
Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

46

Selection Bars
- *Indicates that Targeting Pod is in command*

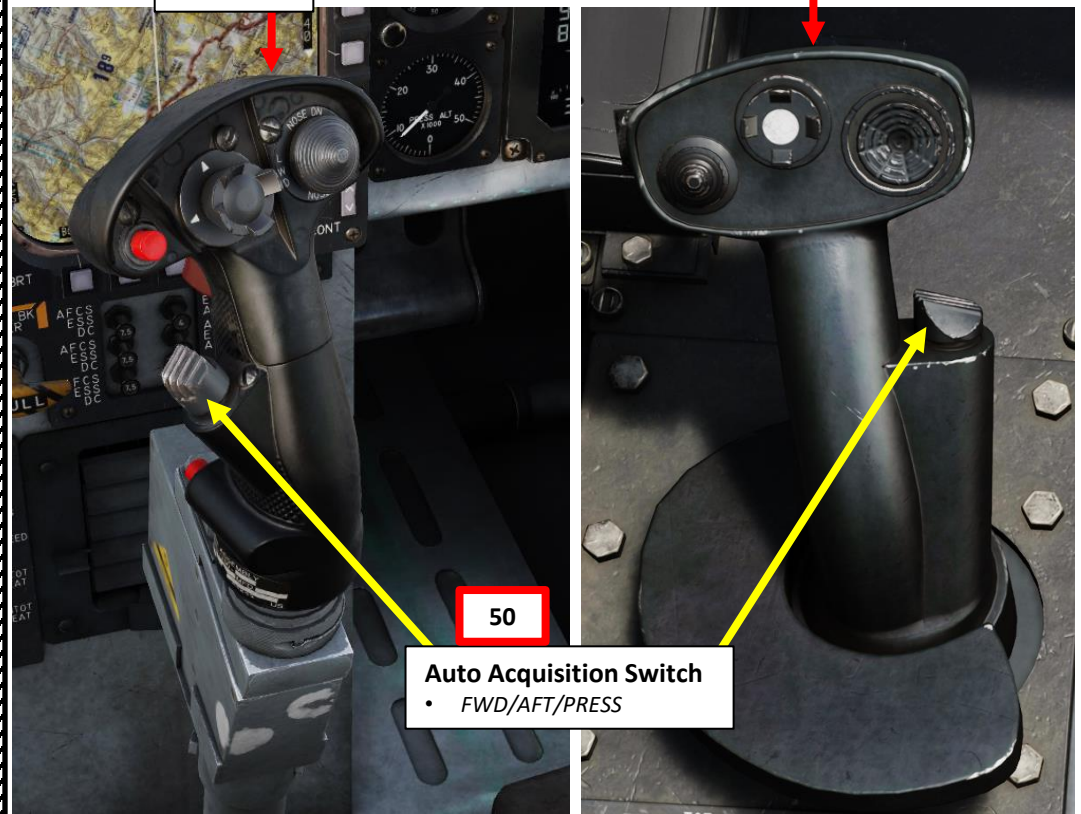
44

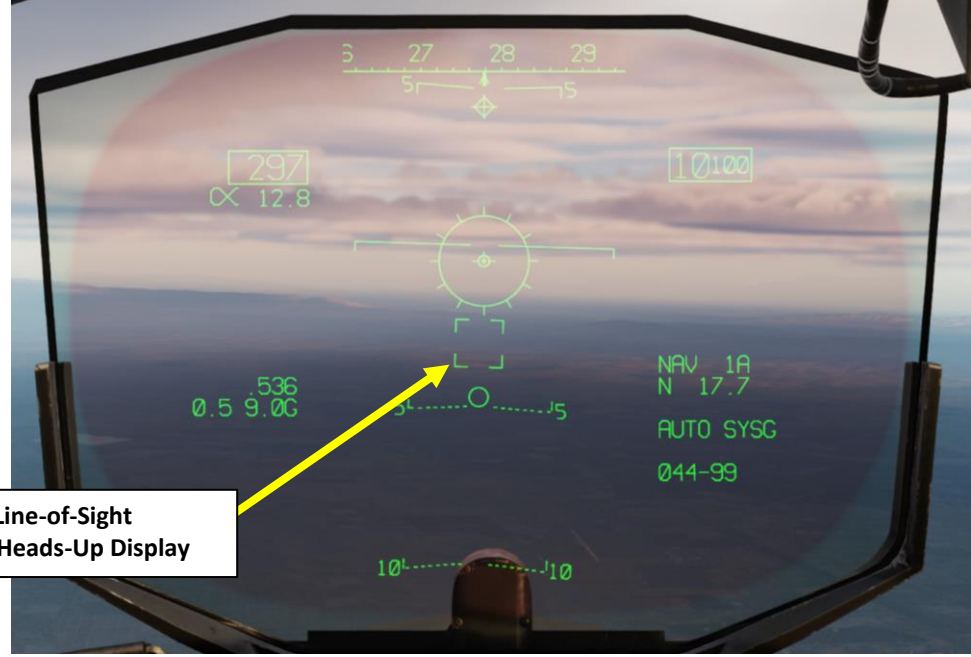
Left Hand Controller (LHC)

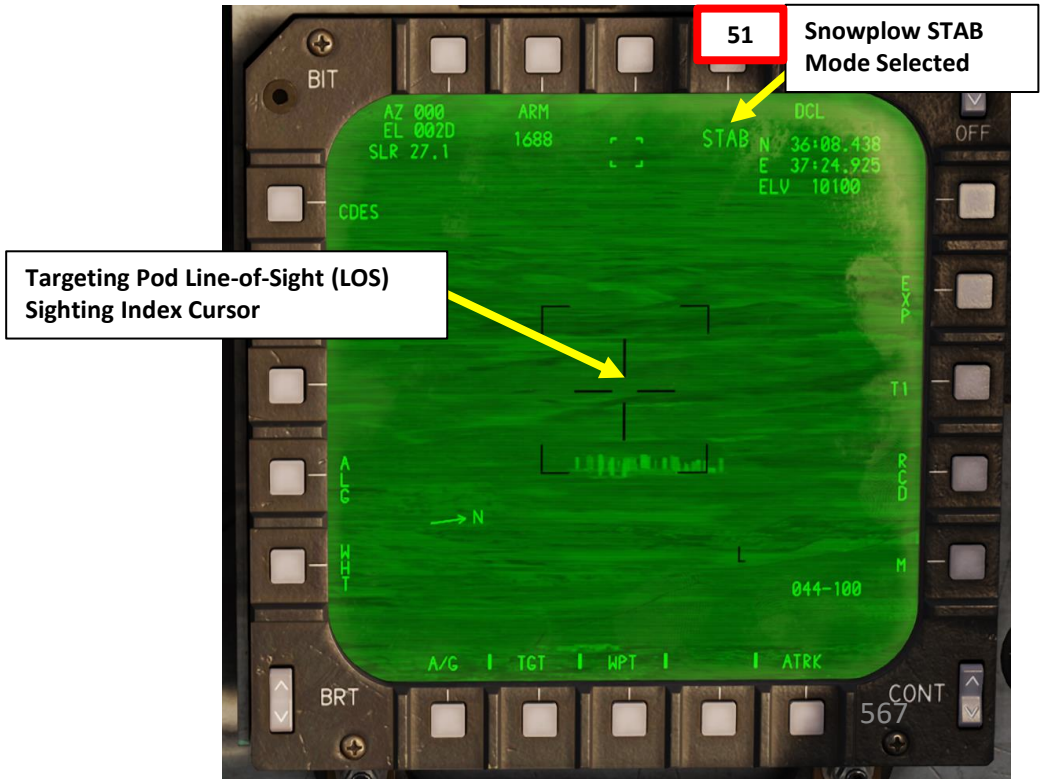


2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
C – Weapon Arming & Target Designation

49. You can cue (slave) the targeting pod to a navigation point or other systems (which we talk about in the Cue Mode section), but for this example we will use the simplest method of using the targeting pod in snowplow mode.
50. Press Auto Acquisition Switch – FWD LONG (more than 1 sec) to enter SNOWPLOW STAB mode.
51. The targeting pod's SNOWPLOW STAB mode is space-stabilized to a point below the horizon along the heading vector. The targeting pod's line-of-sight is not tied to the ground; instead, it points at the space at the azimuth angle and elevation the pod had when space stabilization was first initialized.







2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
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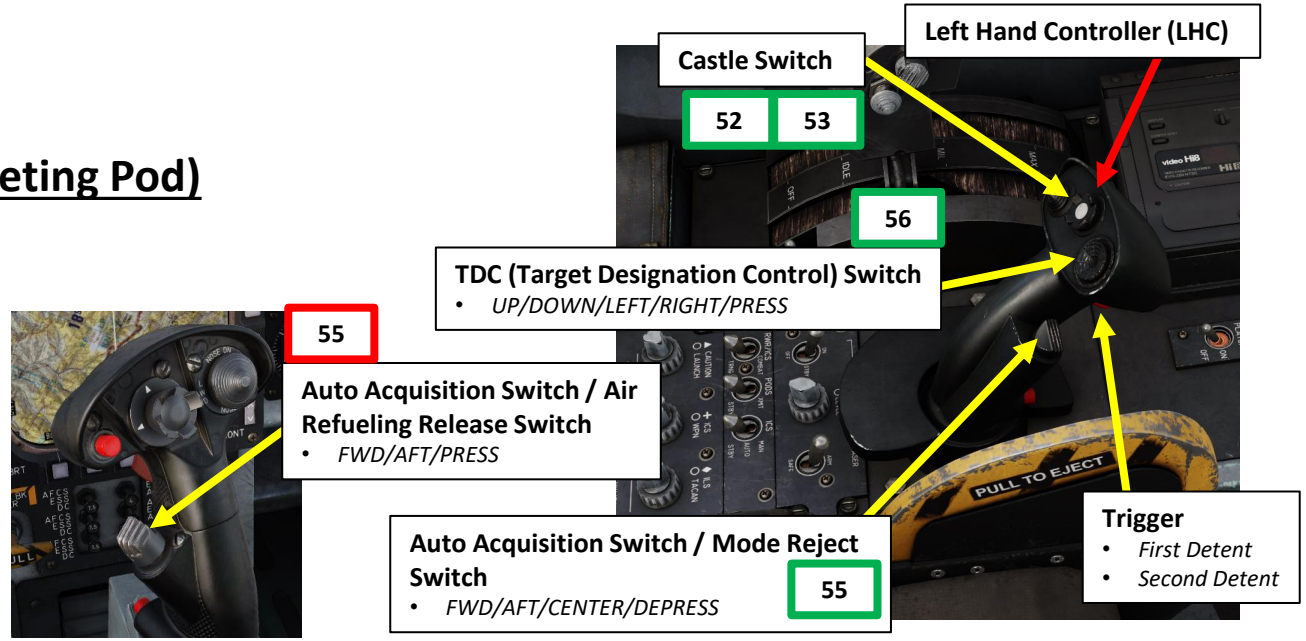
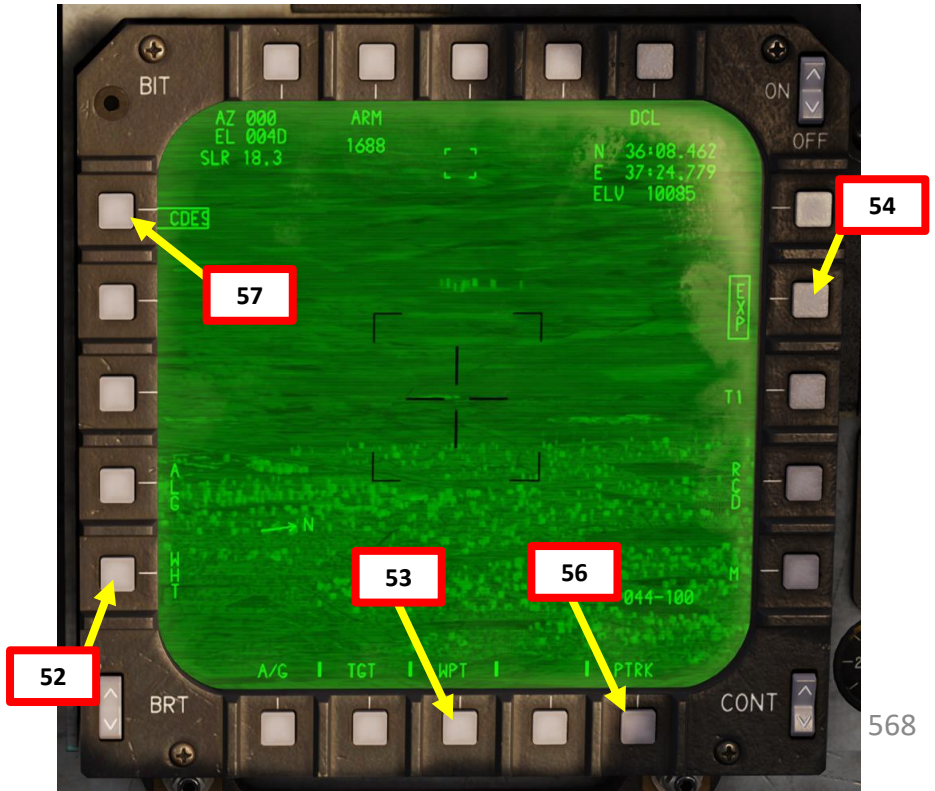
C – Weapon Arming & Target Designation

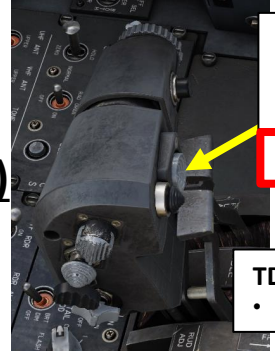
52. Select Video Polarity – As desired.
    - Pressing the Video Polarity Selection Option pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.
    - The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD LONG (more than 1 sec)
53. Select Tracker Polarity Selector – As desired.
    - 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 center of the crosshairs when point track is initiated.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD SHORT (less than 1 sec)
    - Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.
54. If you want to use the ENFOV (Expanded Narrow Field-of-View) zoom mode, select/box the EXP option. In this example, we will select it.
55. Zoom as required by pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec), which toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.
56. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
    - Point Track (PTRK) tracks a moving object like a high-contrast vehicle
    - Area Track (ATRK) is used for a static target
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS
57. If a continuous laser designation is desired, select/box the CDES option. The designation will be continuously updated with new range and line-of-sight designation.
    - If CDES is unselected/unboxed, lasing the target is only performed as long as the Left Multifunction Switch (pilot) or laser trigger (WSO) is depressed.





2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
C – Weapon Arming & Target Designation

58. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to designate and range with a laser.
59. Initiate a targeting pod "track" on the target (either point or area track).
    - **Pilot**: Depress Auto Acquisition Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
60. Once the target is tracked, the targeting pod will compute a slant range and either PTRK or ATRK will be boxed depending on what tracking method you have selected previously.
61. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
62. Once target is designated, the DESIGNATE legend appears for 5 seconds.

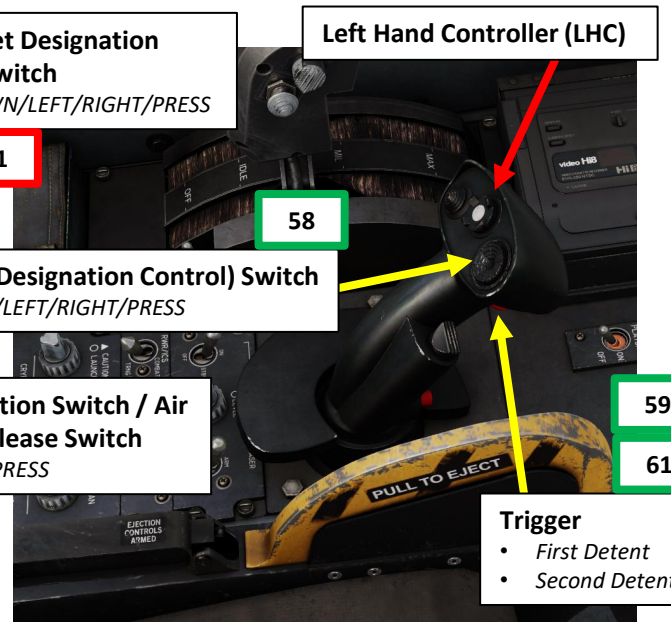


TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

58 61

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

59



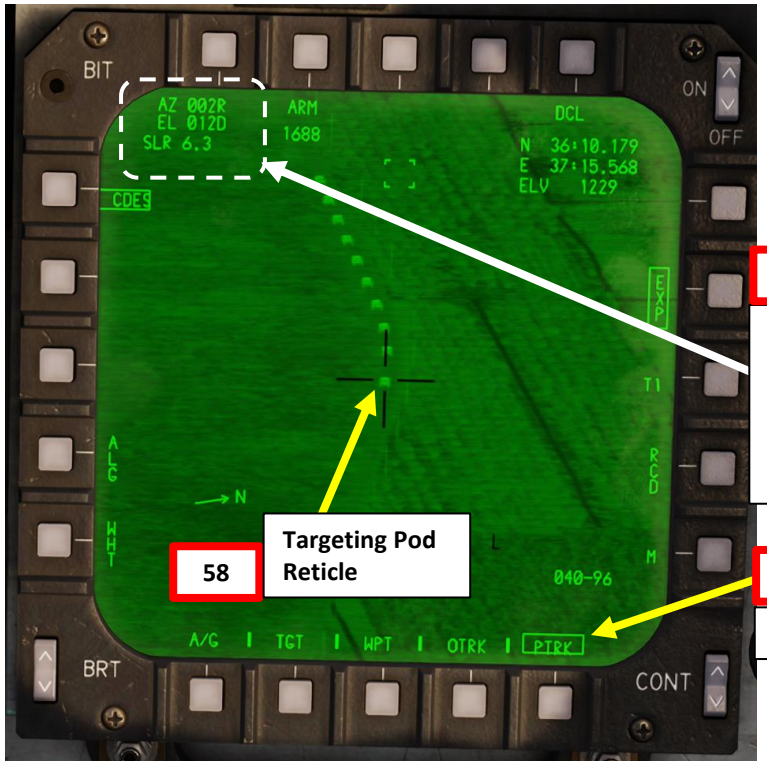
Left Hand Controller (LHC)

58

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

59 61

Trigger
- *First Detent*
- *Second Detent*

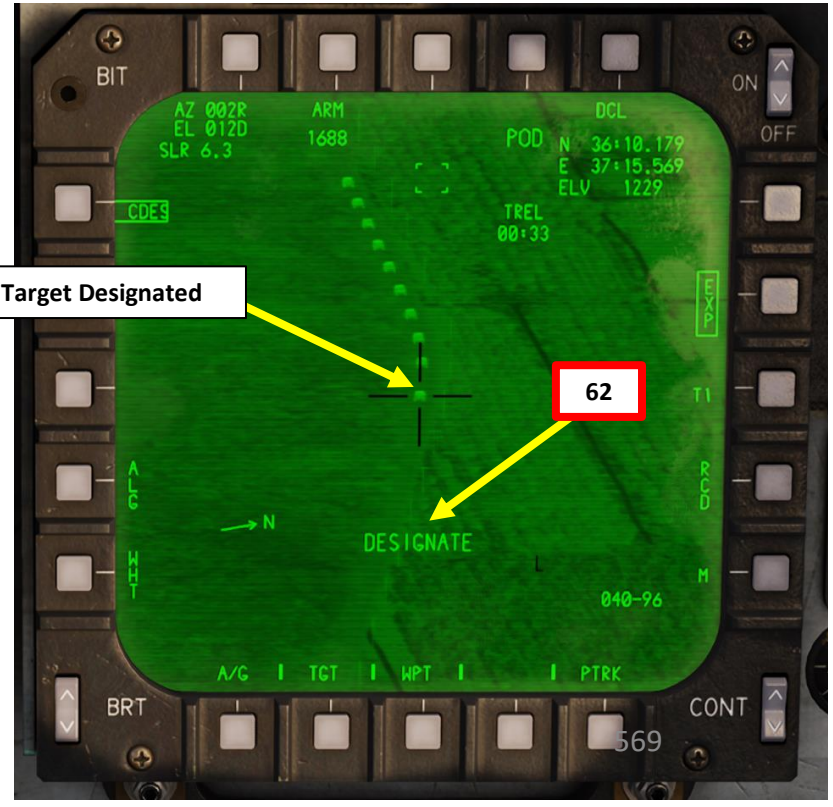


60

Targeting Pod Line-of-Sight (LOS) Information
Shows the azimuth and elevation of the targeting pod's line of sight with respect to the aircraft.
- *Azimuth (AZ): 002R = 2 deg right*
- *Elevation (EL): 012D = 12 deg down*
- *SLR: Computed Slant Range to Target (nm)*

58 **Targeting Pod Reticle**

59 **Point Track on Target**

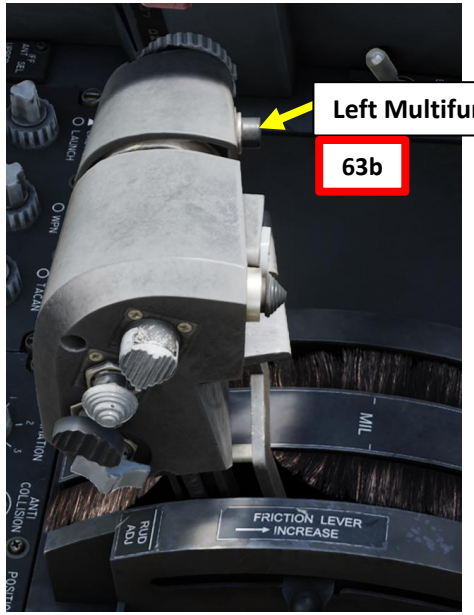


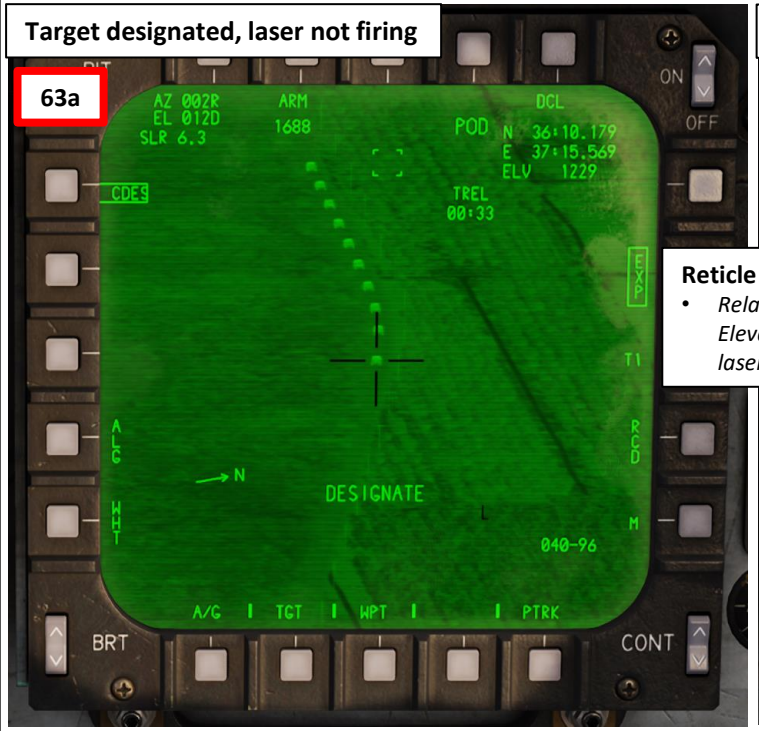
Target Designated

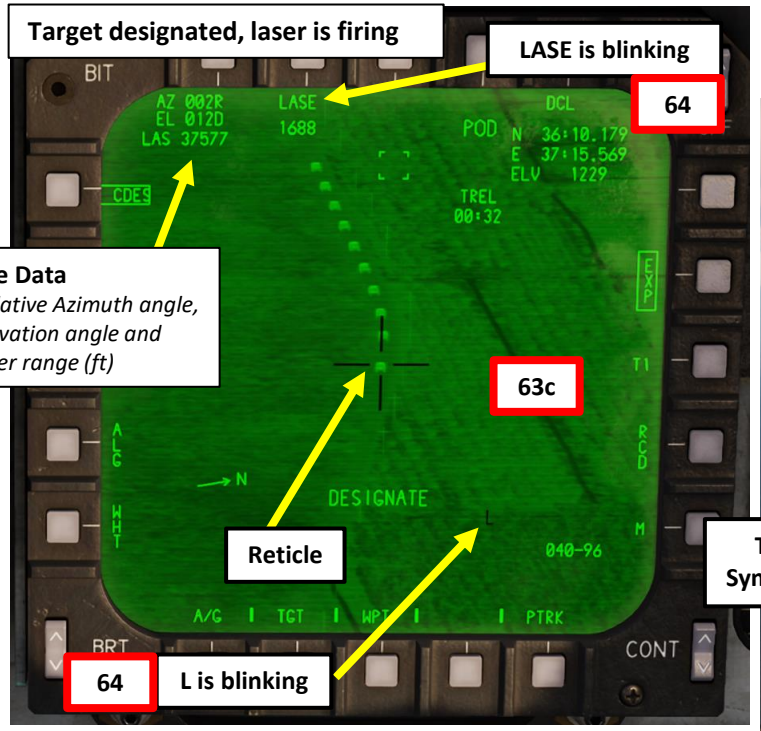
62

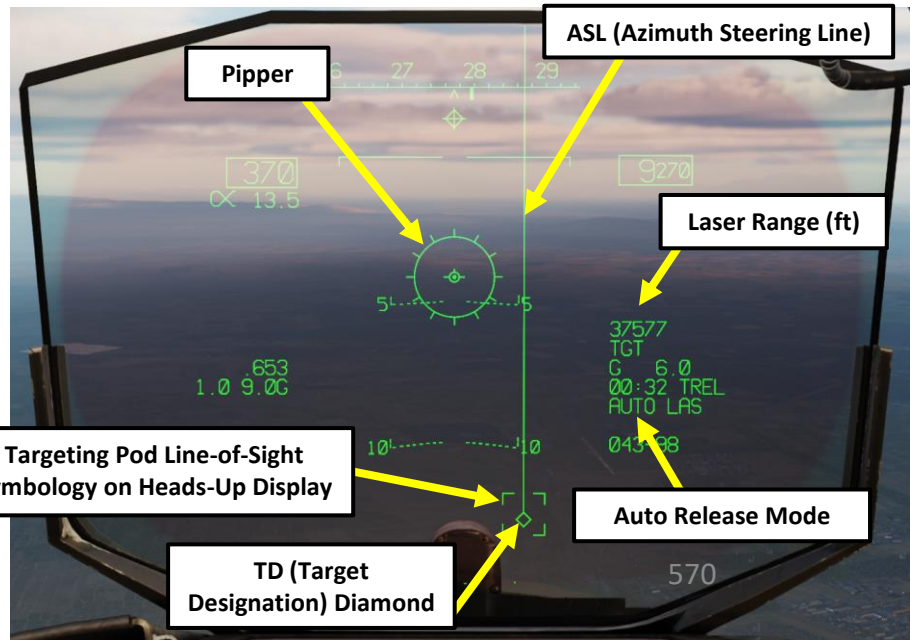
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
C – Weapon Arming & Target Designation

63. For "dumb" ordnance that does not require to be laser-guided (like in this example), firing the laser is not mandatory. However, it does provide better ranging information with laser ranging and is good practice. The maximum range of the laser is about 13 nm (which can also be further reduced due to weather and visibility conditions). You can toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
64. Target ranging information is updated based on the range computed by the laser designator. When laser is firing, the "LASE" and "L" indications blink on the TPOD page.
    - Note: The "MASKED" indication means that the targeting pod's line-of-sight is masked by the airframe or stores and the laser has been commanded to fire.



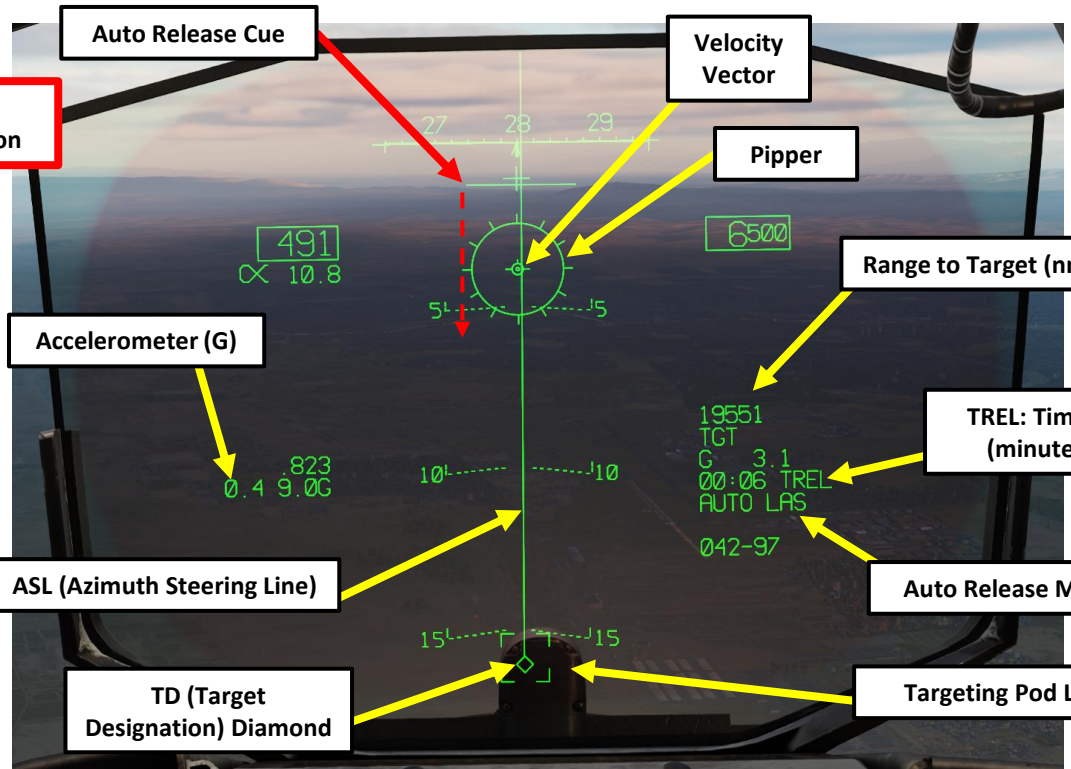


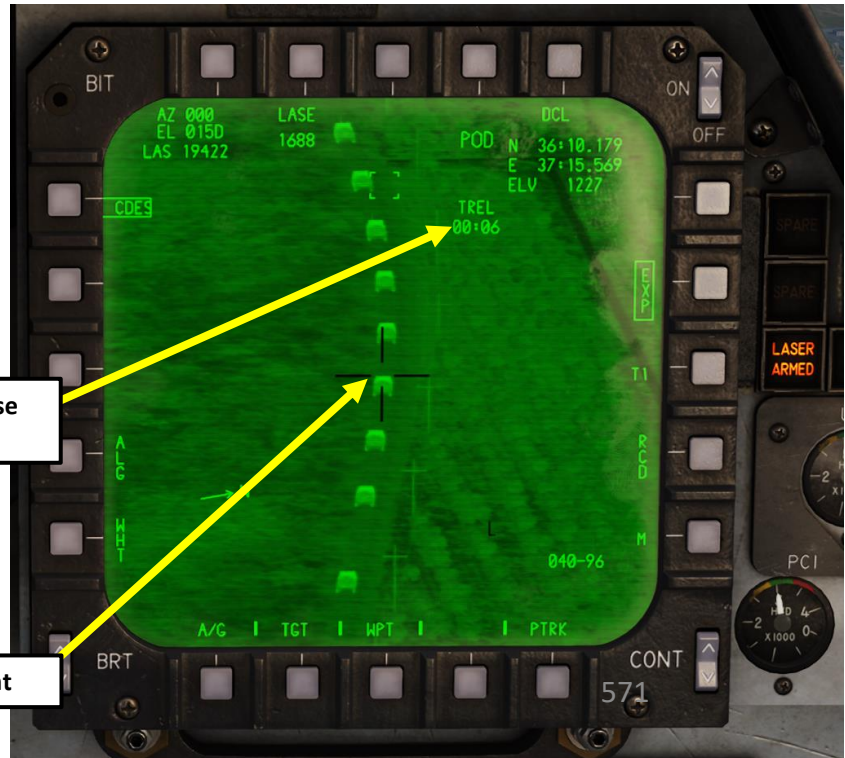




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
D – Perform Attack

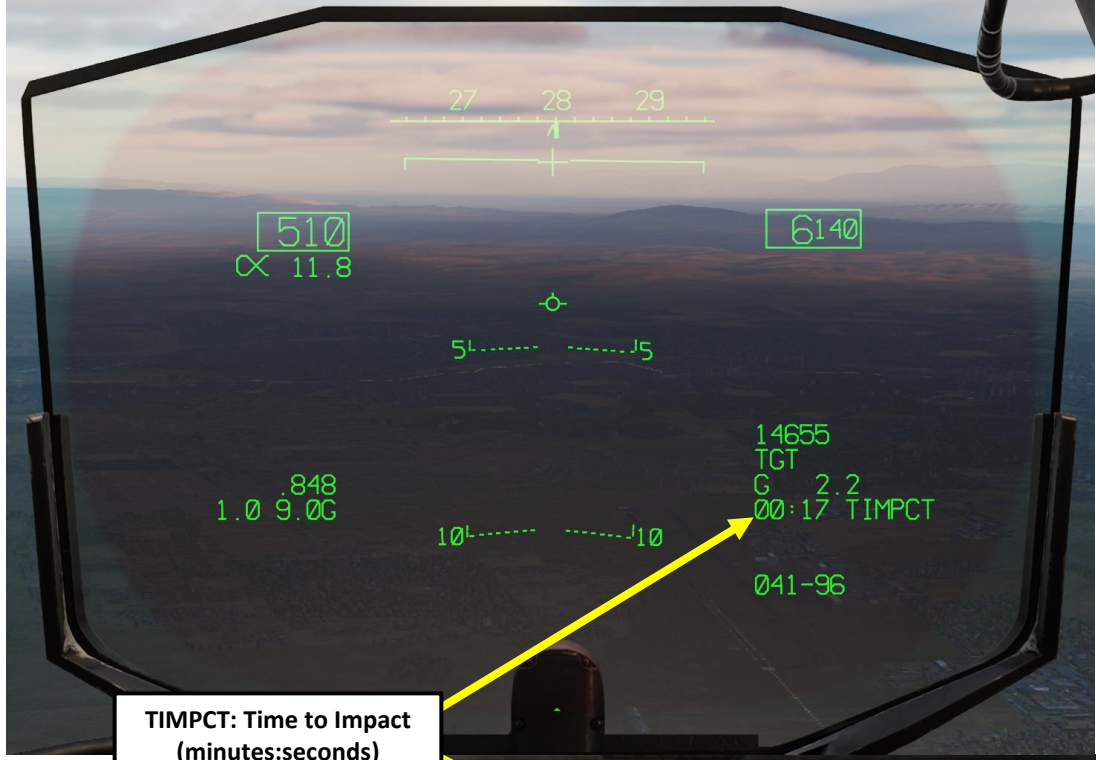
65. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
66. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
67. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release ordnance.
68. CBU-97 canisters will automatically drop when the auto release cue crosses the velocity vector.

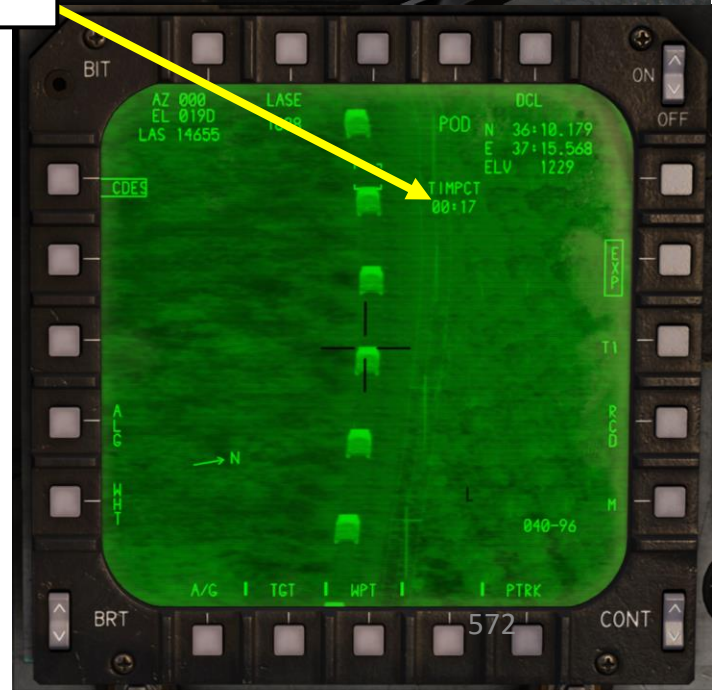




2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
D – Perform Attack

69. Once CBU-97 canisters are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
70. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.





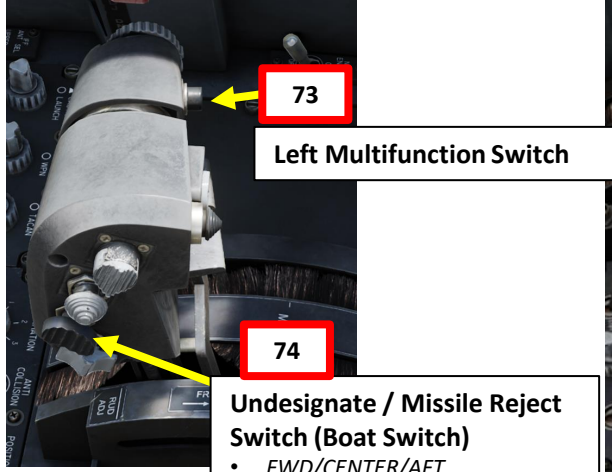
2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)

D – Perform Attack

71. At the preset altitude (Burst Height of Function of 700 ft), the canisters break open and submunitions are released. Each CBU-97 holds 40 skeets, which detect tanks and vehicles and guide into them.

2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
D – Perform Attack

72. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
73. To stop lasing, toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
74. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.



2 – AIR-TO-GROUND WEAPONS
2.2 – Cluster Munitions
2.2.3 – CBU-97 Cluster Bombs (Auto Mode with Targeting Pod)
D – Perform Attack

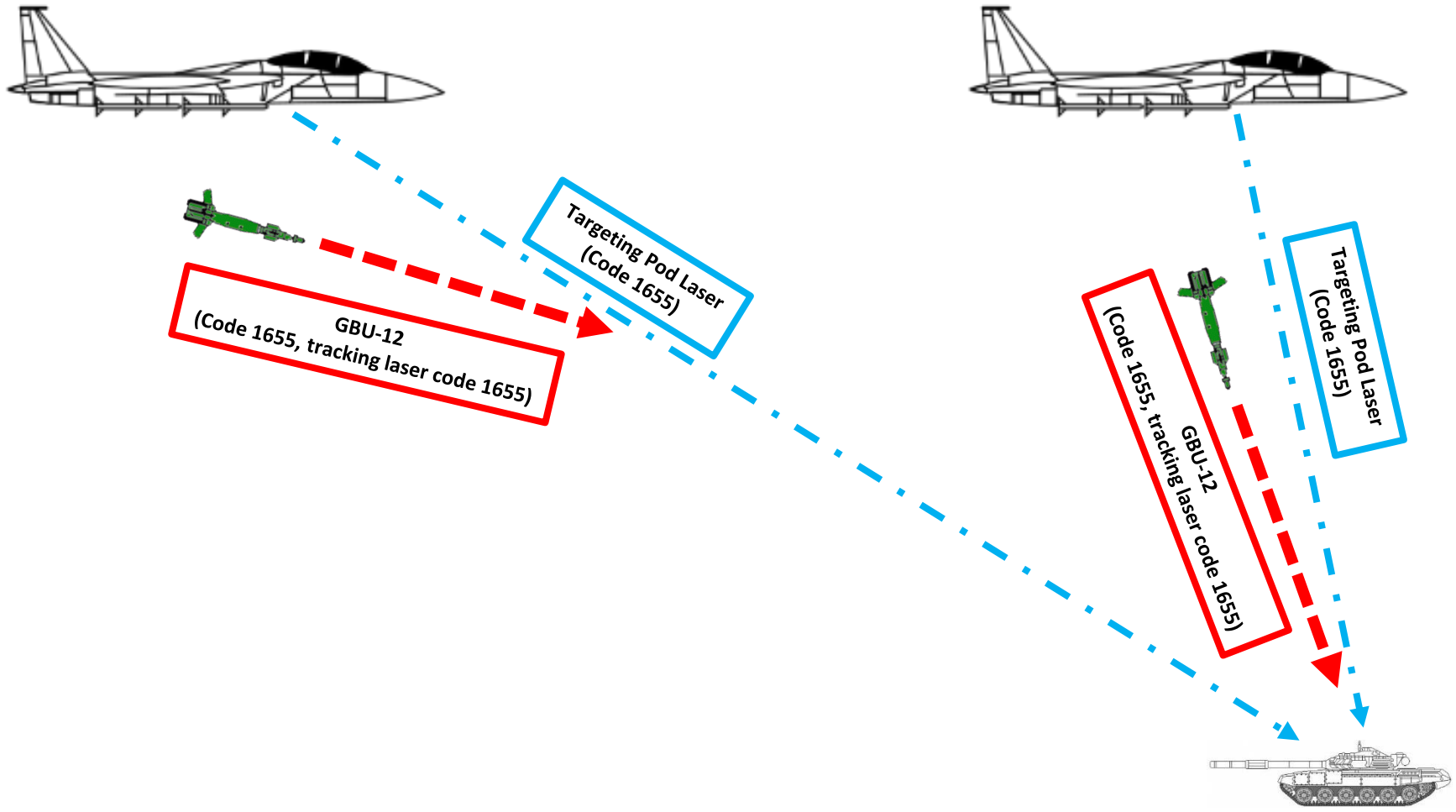
2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

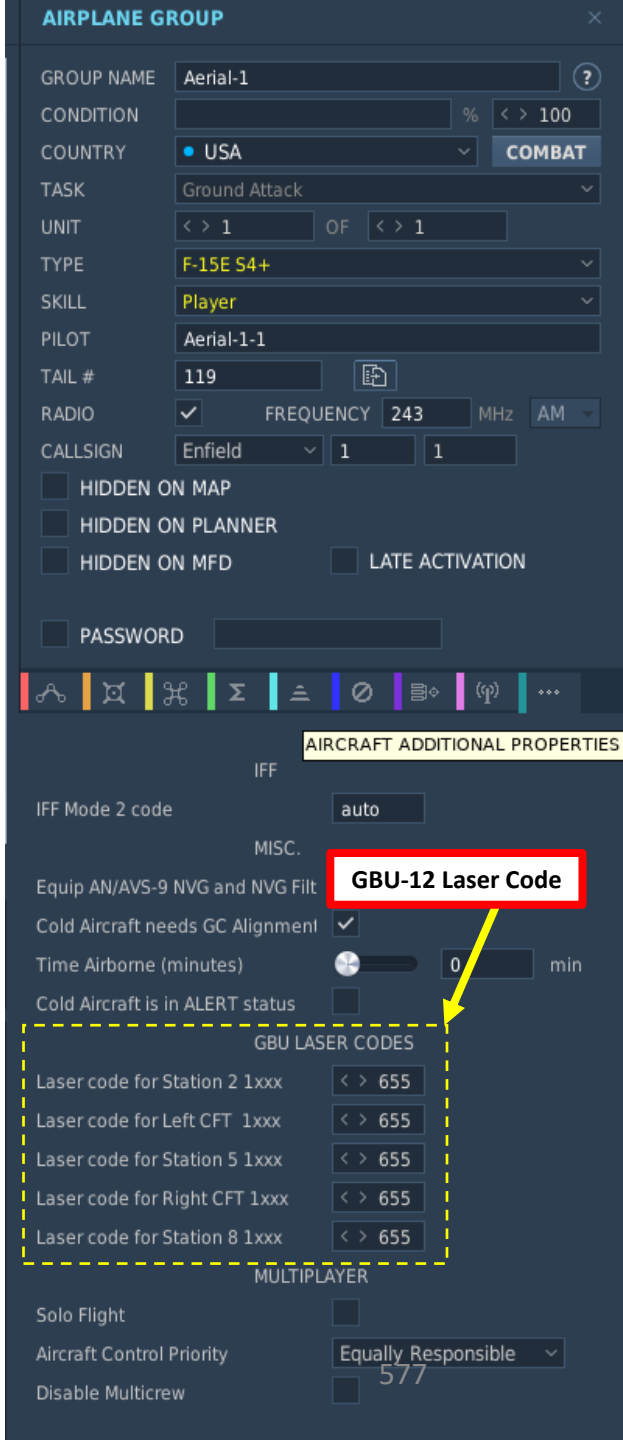
2 – AIR-TO-GROUND WEAPONS

2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

A – Weapon Setup

The GBU-12 Paveway II is the laser-guided version of the Mk-82 unguided, general purpose bomb. The GBU-12 guides using the same principles as the GBU-10, the only difference being the bomb the LGB is based on. The seeker head on each laser guided bomb is set to track only a specific laser pulse rate frequency (PRF) code. These are manually set by the weapons load crew during ground operations (via Mission Editor) and may not be set from the cockpit during flight.





2 – AIR-TO-GROUND WEAPONS

2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

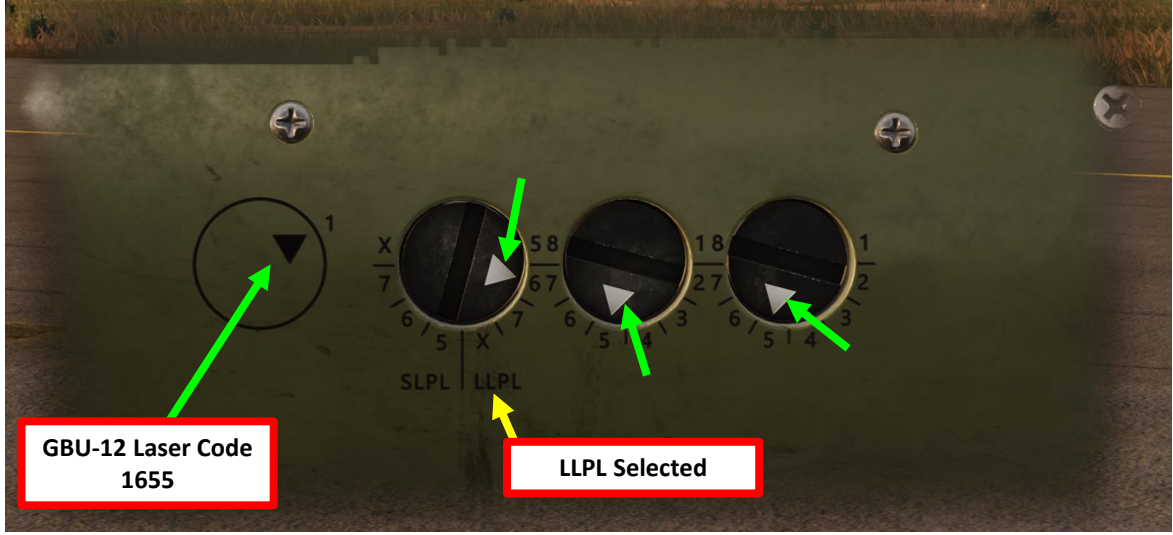
A – Weapon Setup

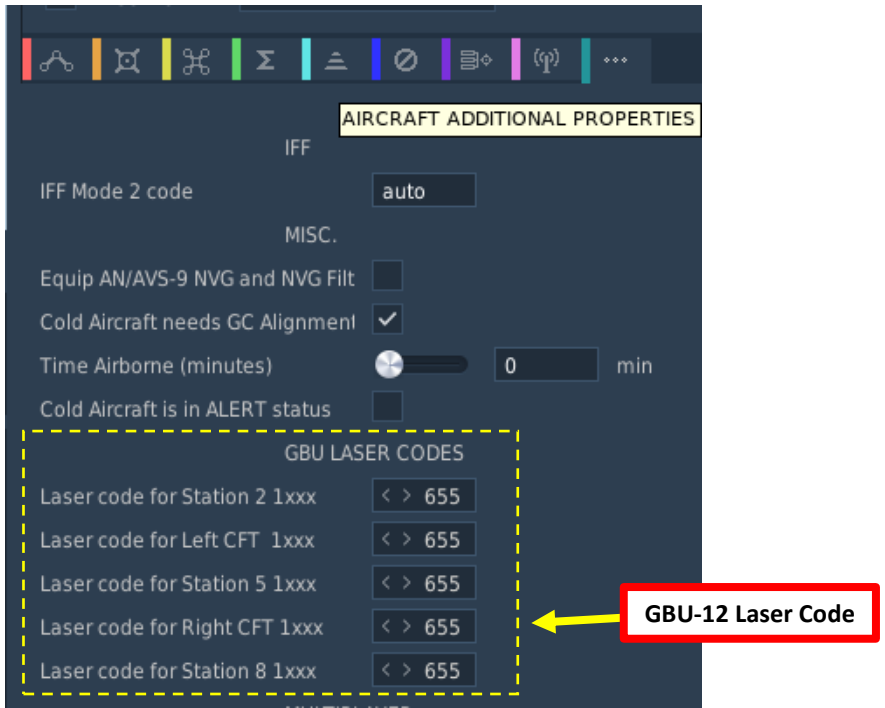
If you are flying in multiplayer and do not know your GBU-12 code, you can open the WEAPON Kneeboard page by pressing "RSHIFT+K". This will show you the laser code set on your GBU-12 laser-guided bomb.

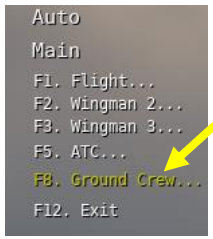
To manually set GBU-12 laser codes:

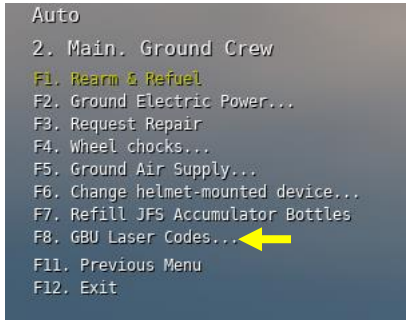
- Contact Ground Crew using "\", then F8 (Ground Crew), then F8 (GBU Laser Codes), then either F1, F2, F3, F4, F5 or F6 to select your desired station.
- On the pop-up interface that appears in the cockpit, click on the GBU-12 laser code selectors (white triangles) as desired (1688 by default). This is the laser code the bombs will track. We will use LLPL (Long Last Pulse Logic) instead of SLPL (Short Last Pulse Logic).
- Contact Ground Crew using "\", then F8 (Ground Crew), then F8 (GBU Laser Codes), then F7 to hide the interface.

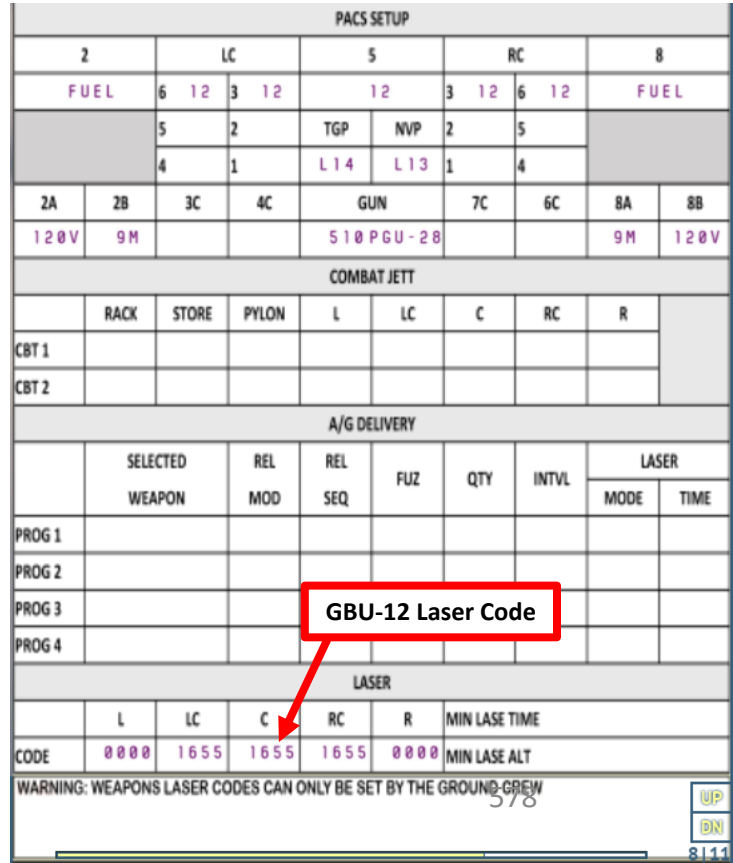
Take note that setting the bomb laser code should be done when the engine is shut down.







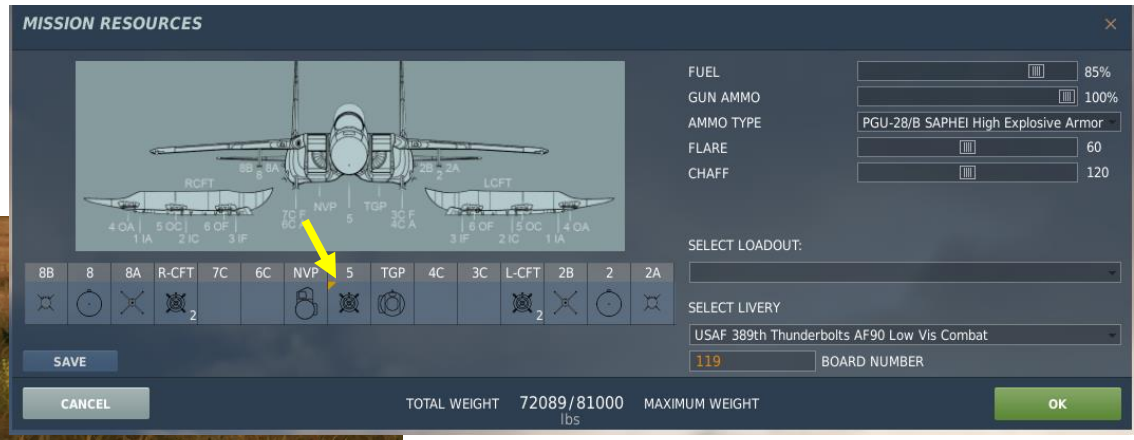


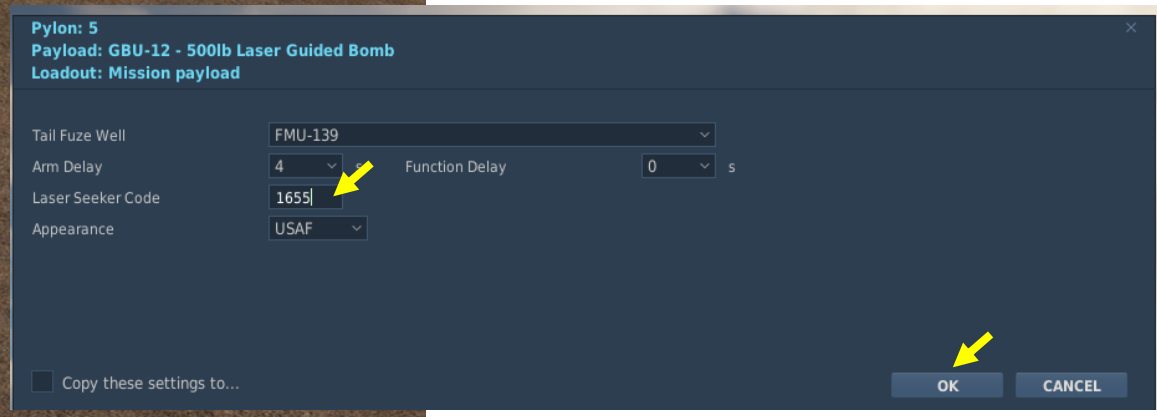


2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
A – Weapon Setup

Alternatively, laser code can also be changed by clicking on the yellow triangle on the GBU-12 station.

The targeting pod designator code needs to be set to match the laser code of the GBU-12. This will be done later during the target designation procedure.



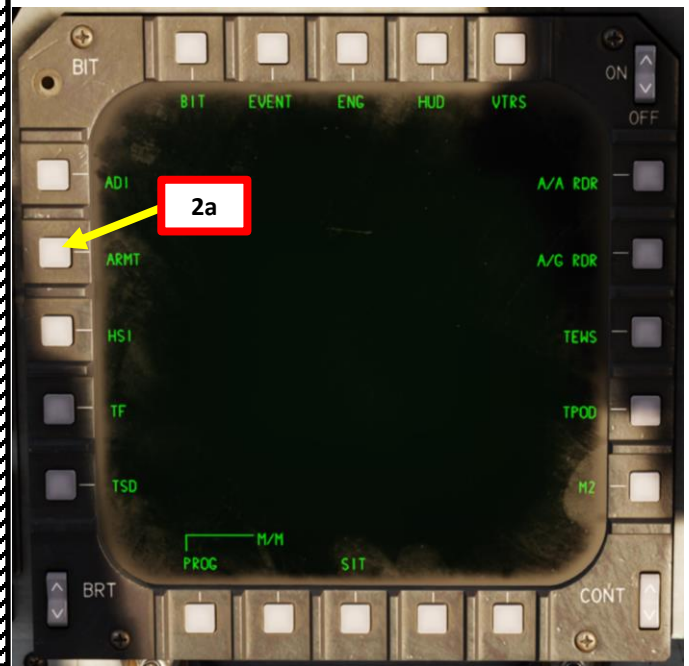


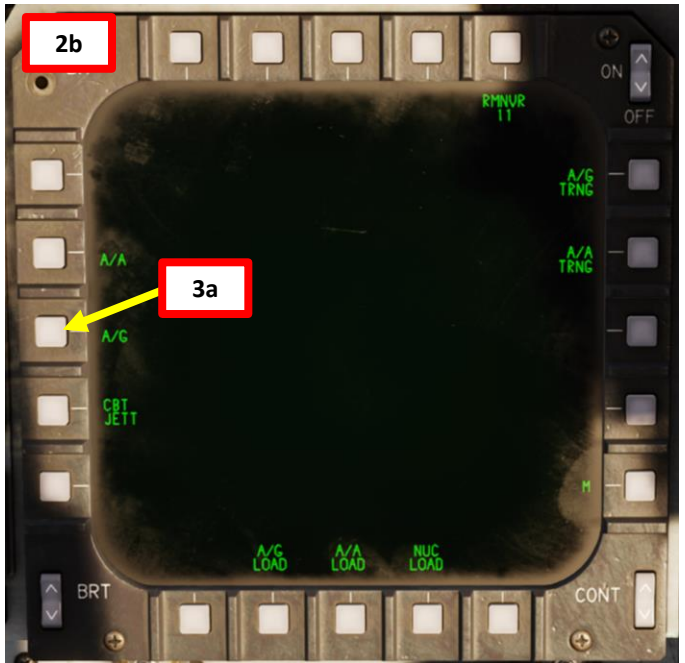
2 – AIR-TO-GROUND WEAPONS

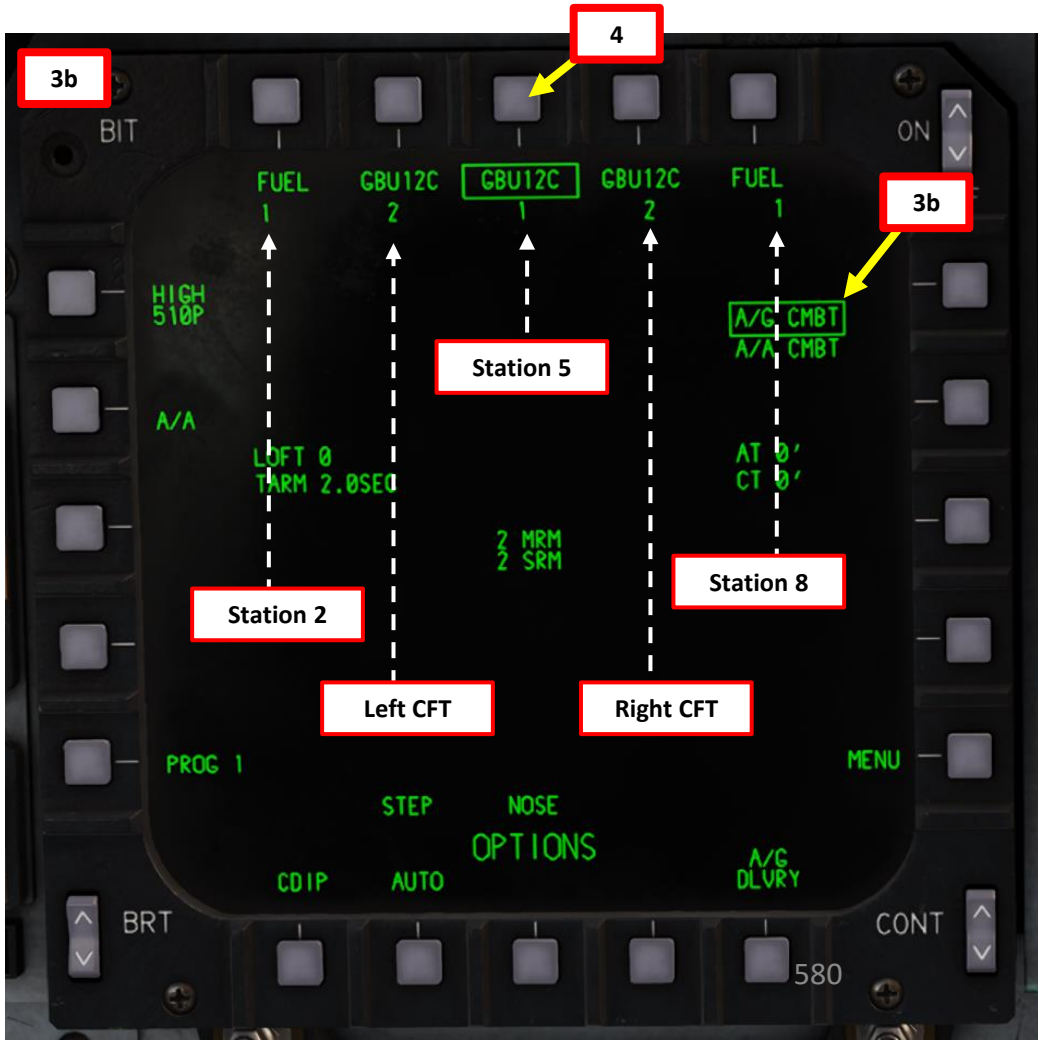
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “GBU12C” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.





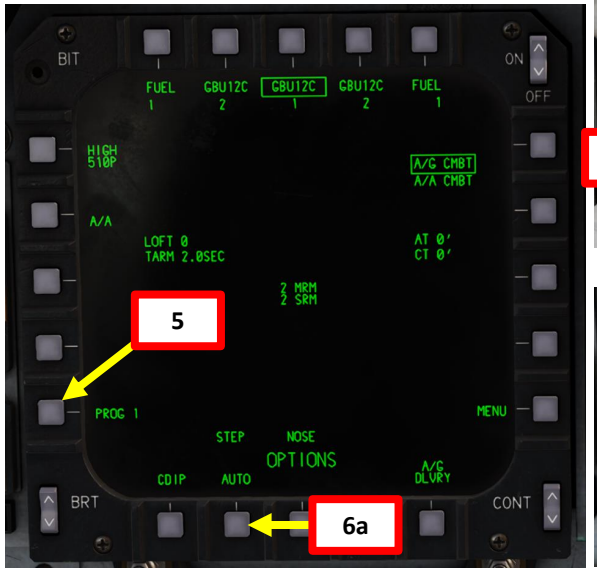


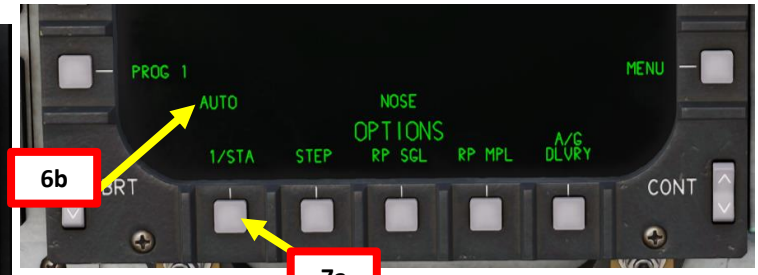
2 – AIR-TO-GROUND WEAPONS

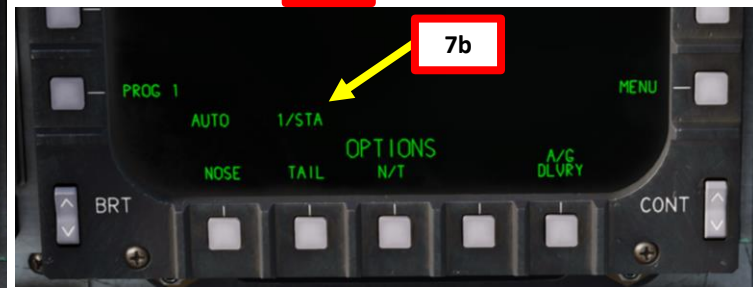
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

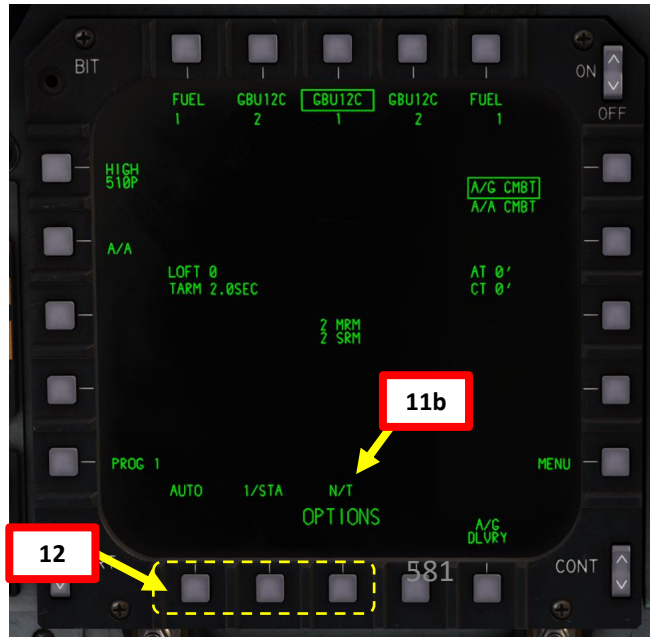
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select 1/STA.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



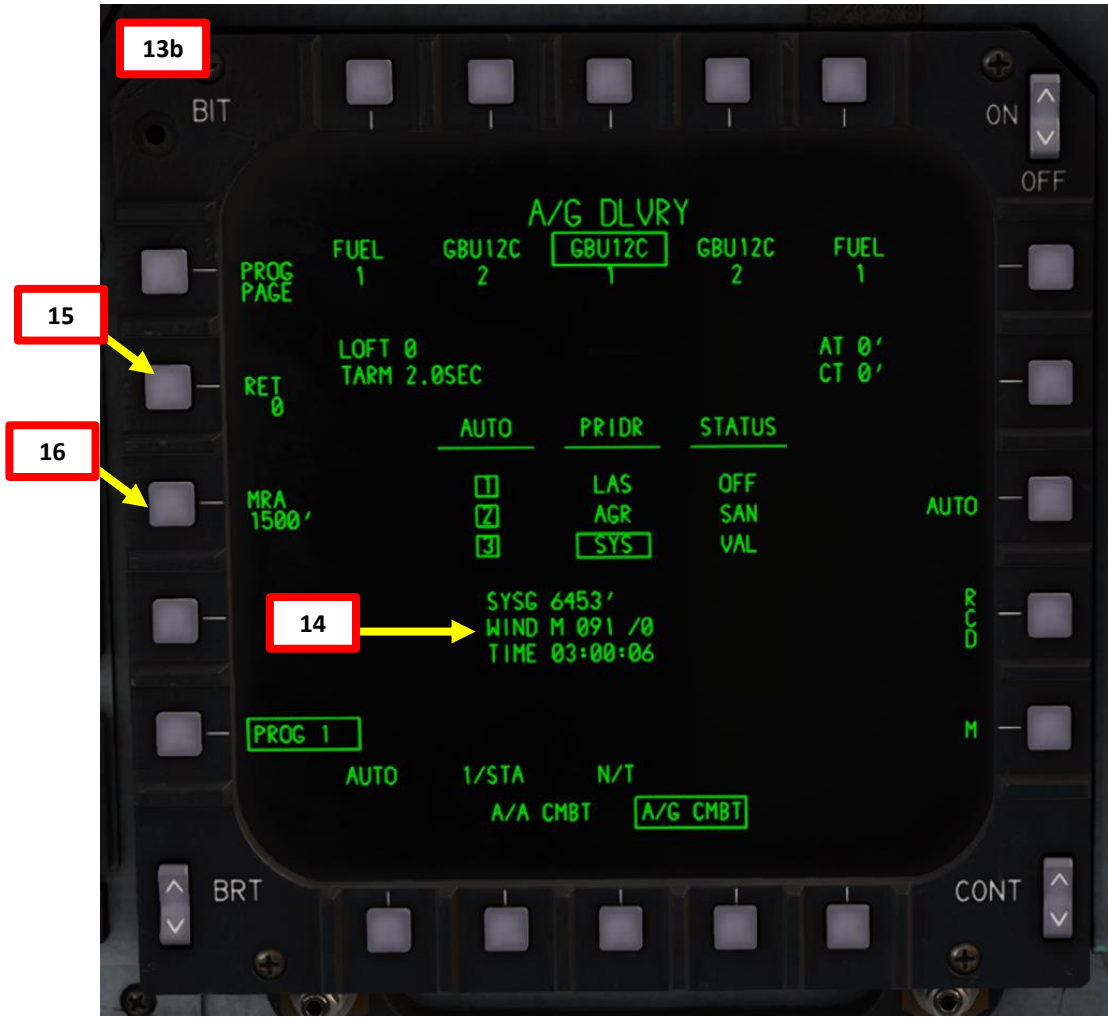






2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.

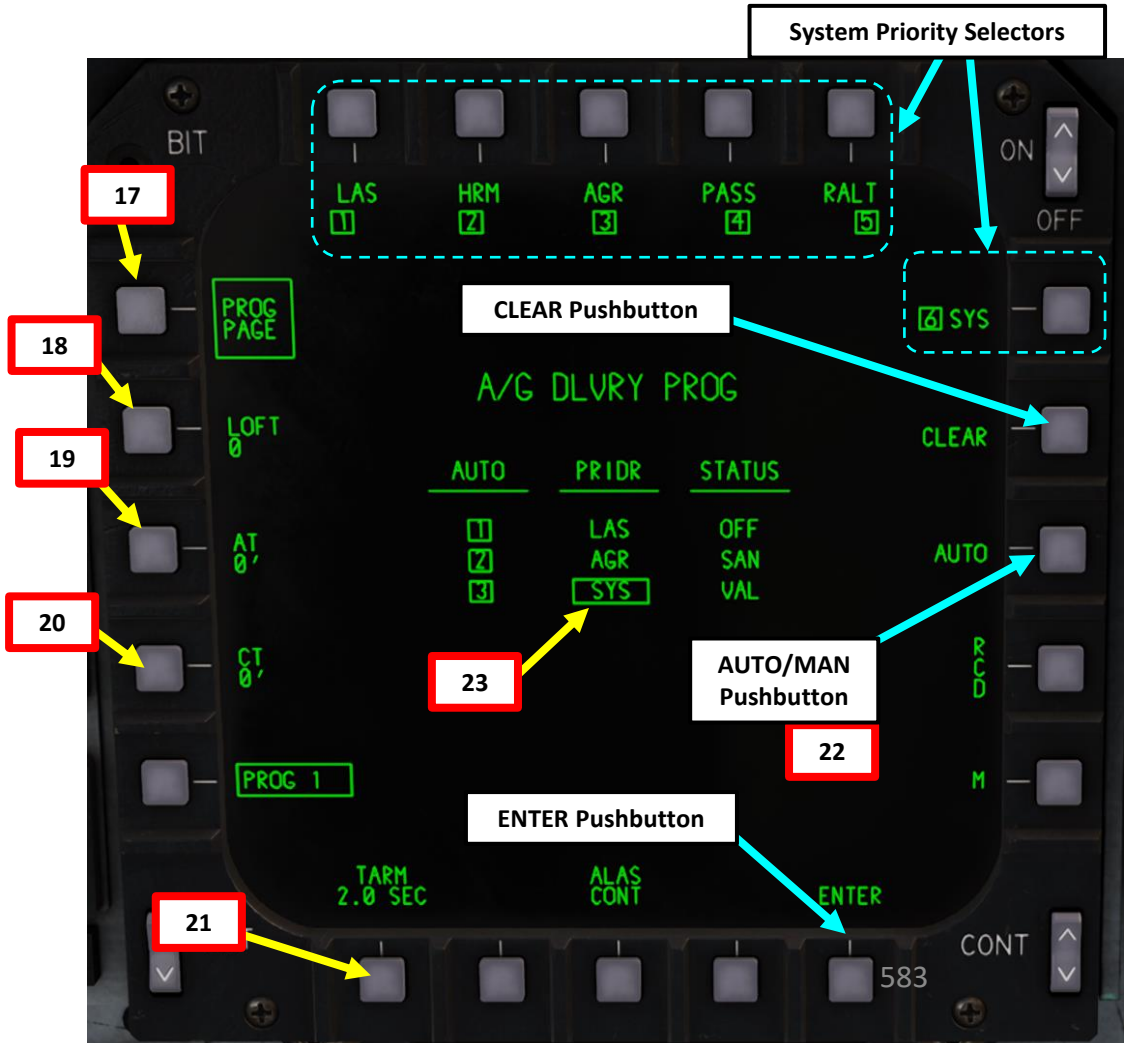


2 – AIR-TO-GROUND WEAPONS

2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

A – Weapon Setup

17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.



2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
A – Weapon Setup

24. Select Targeting Pod Lasing Mode – As desired. ALAS stands for Automatic Lasing and MLAS stands for Manual Lasing. You can also set a lasing time setting if desired, but this is optional.

    a) For this example, **we will leave lasing mode to ALAS CONT** (Automatic Continuous Lasing).

    - *If UFC scratchpad is blank, pushing MLAS/ALAS pushbutton toggles between MLAS and ALAS (the first being manual lasing, the other automatic). Below, either CONT or TIME will be displayed.*
    - *With AUTO CONT selected, targeting pod laser will continuously paint the target as soon as the bomb is dropped.*
    - *With AUTO TIME set, targeting pod it will only fire laser for the given amount of time before impact.*
    - *In MANUAL mode, the laser will fire only after appropriate HOTAS command is issued.*

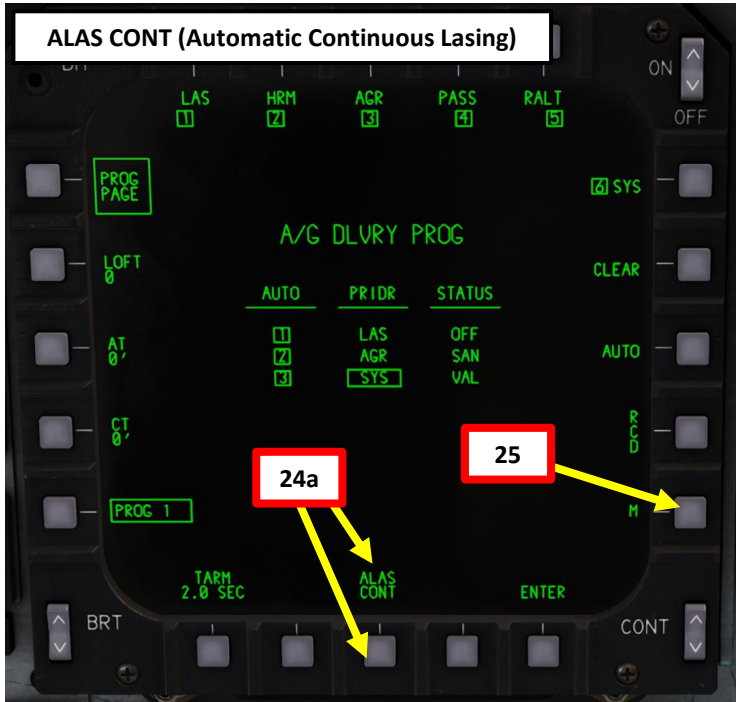
    If you want to enter a specific lasing time:

    b) To enter a desired lasing time, enter time value on UFC scratchpad (valid entries are 0:01 thru 0:31). As an example, type "15" on the UFC to enter a time of 0:15 (fifteen seconds).

    c) Press on the ALAS/MLAS pushbutton to select if the time is applied to Auto (ALAS) or Manual (MLAS) mode.

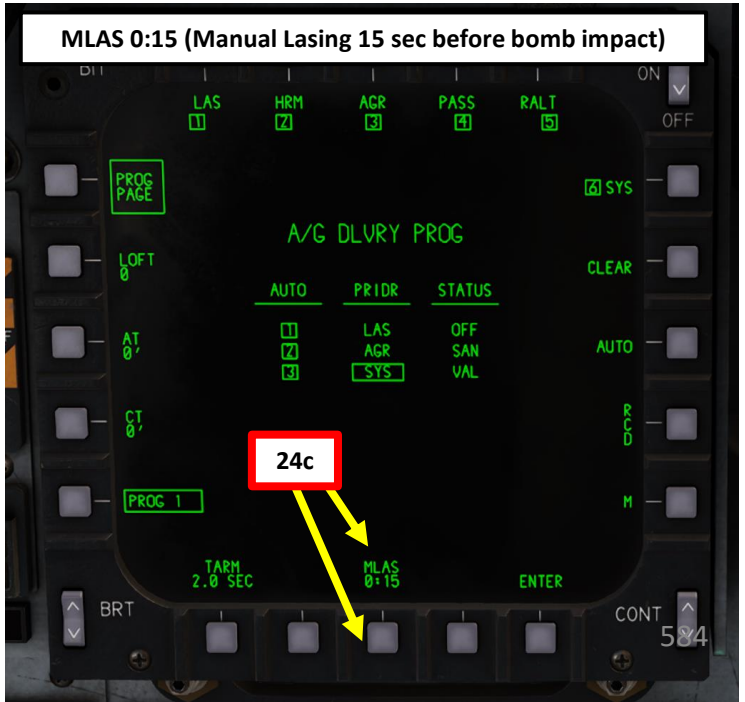
25. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

ALAS CONT (Automatic Continuous Lasing)



ALAS 0:15 (Automatic Lasing 15 sec before bomb impact)

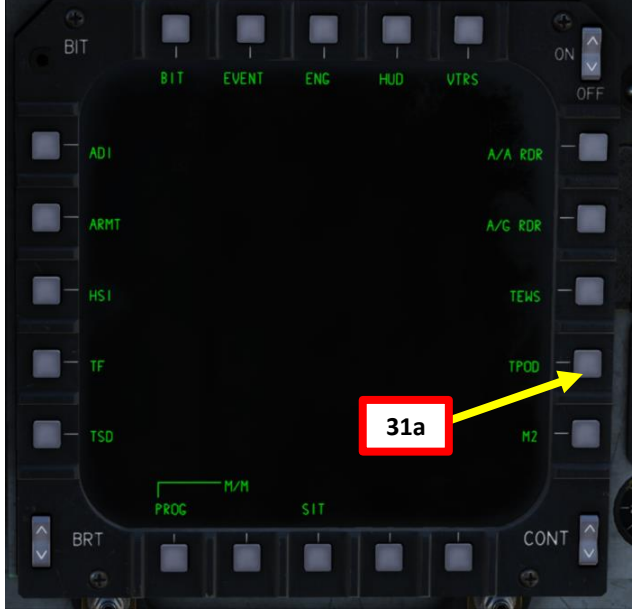
MLAS 0:15 (Manual Lasing 15 sec before bomb impact)

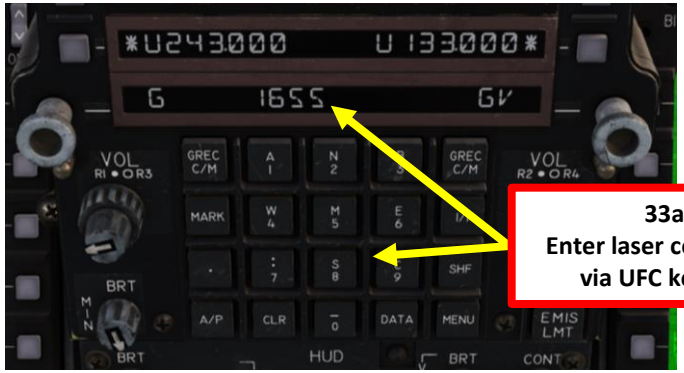


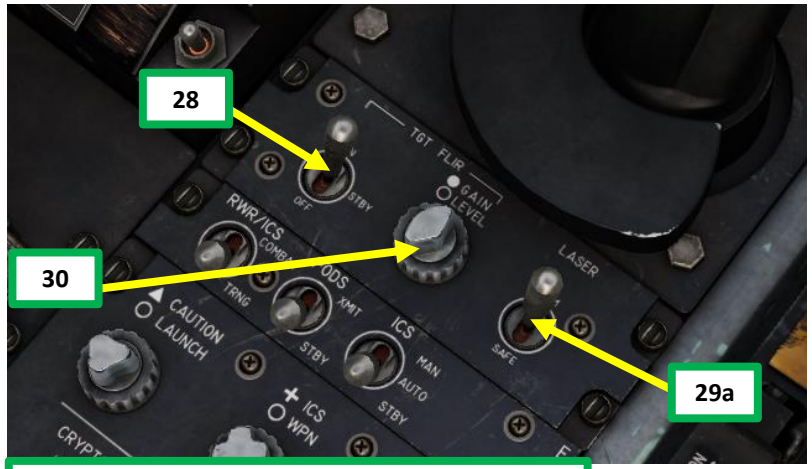
2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
B – Weapon Arming & Target Designation

26. *[P]* Set Master Arm Switch – ARM (UP)
27. *[P]* Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
28. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – ON (FWD).
29. *[WSO]* Set Laser Arm Switch to ARMED (FWD).
30. *[WSO]* Adjust TGT FLIR Gain/Level – As required.
31. From the main MPD menu page, select TPOD page.
32. When using laser-guided bombs with a targeting pod designation, **using a laser is mandatory**.
33. To set laser designation code, enter the GBU-12 laser code set previously on the UFC (Upfront Control Panel) keypad, then press pushbutton next to the laser status/code indication (ARM/1655 in this example). Valid laser codes are 1111 thru 1788, therefore we will use laser designation code 1655.

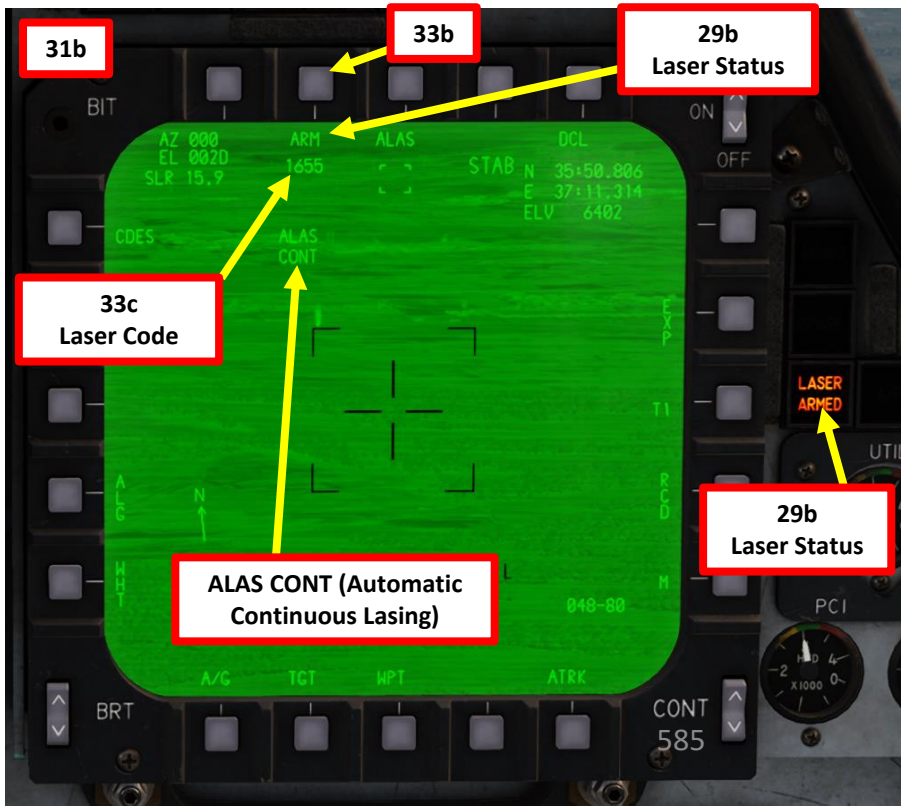
Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*





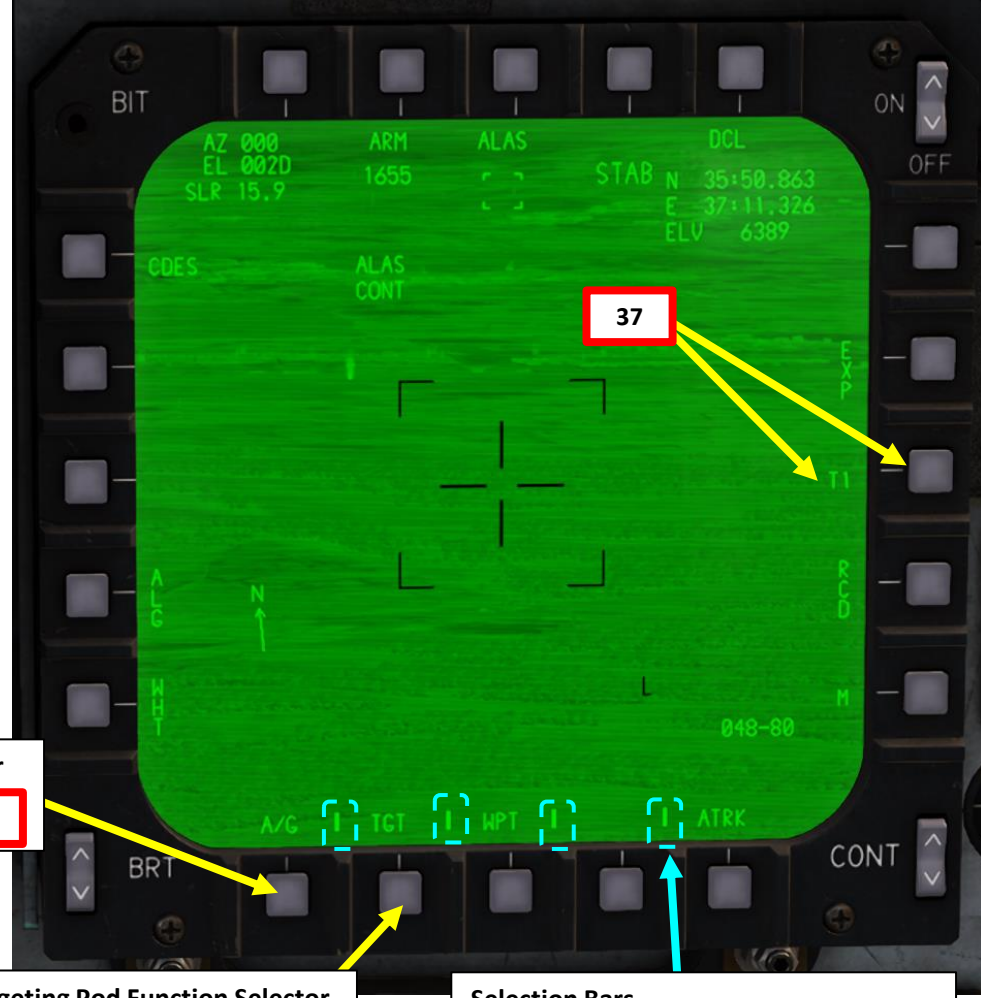


WSO (Weapon Systems Officer) Cockpit



2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
B – Weapon Arming & Target Designation

34. Make sure the TPOD page is selected, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
35. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
36. Set Targeting Pod Function Selector to TGT (Target Designation).
37. Select Primary (T1) Mode.
38. Before using the targeting pod's laser ranger/designator, verify that the following conditions are met (otherwise laser designation is inhibited):
    a) **Aircraft altitude is below 25000 ft.**
    b) **Weight off wheels (aircraft is flying) and landing gear is retracted.**
    c) **Valid laser code is entered.**
    d) **Laser is armed.**



Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

35

Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

36

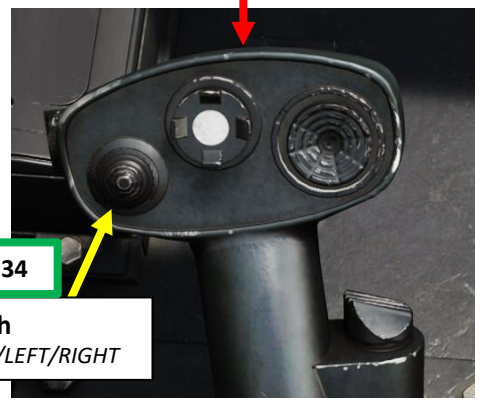
Selection Bars
- *Indicates that Targeting Pod is in command*

34

34

Castle Switch

Left Hand Controller (LHC)

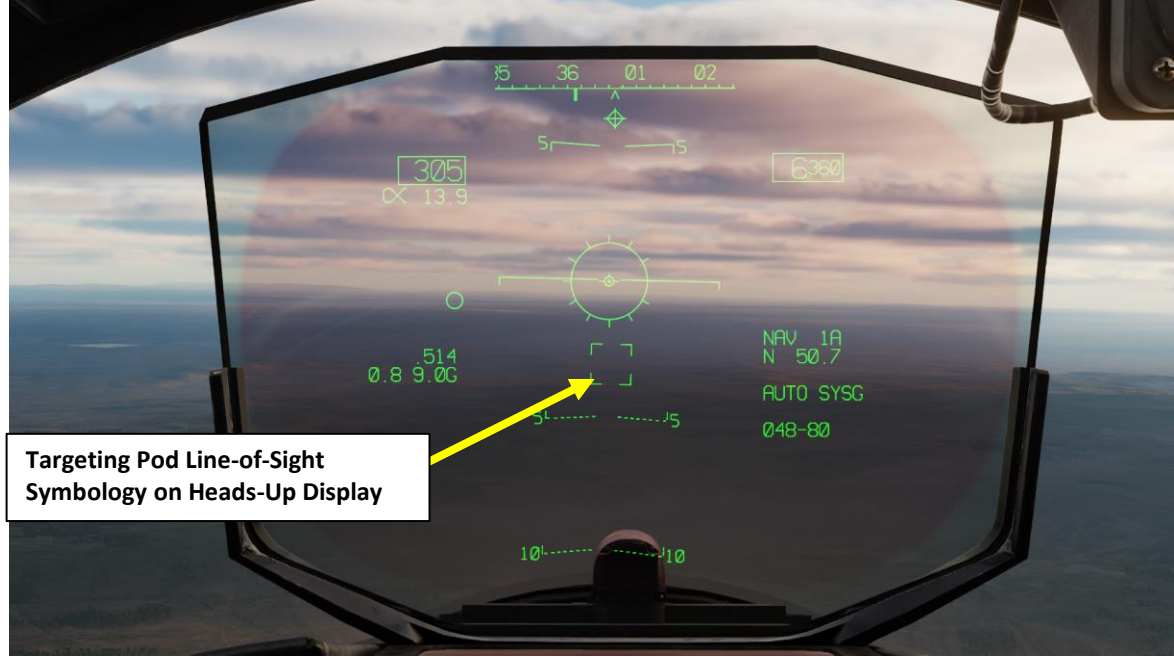


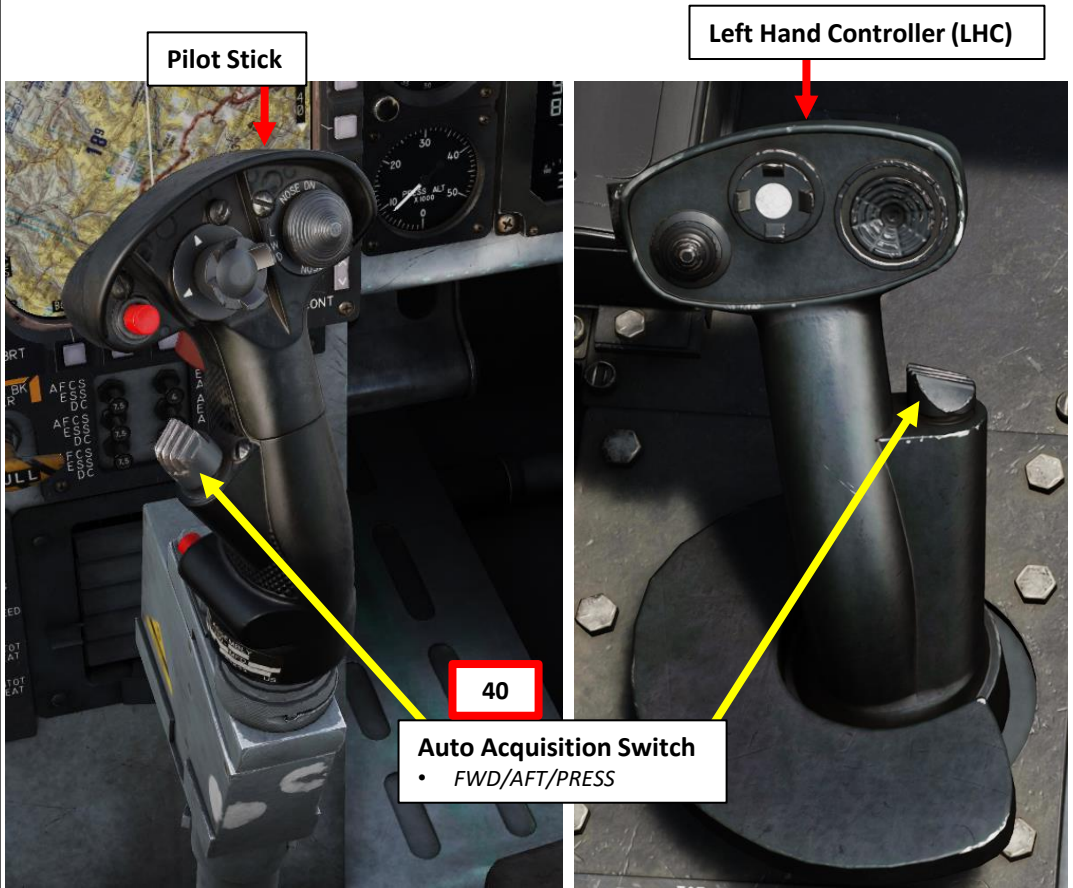
34

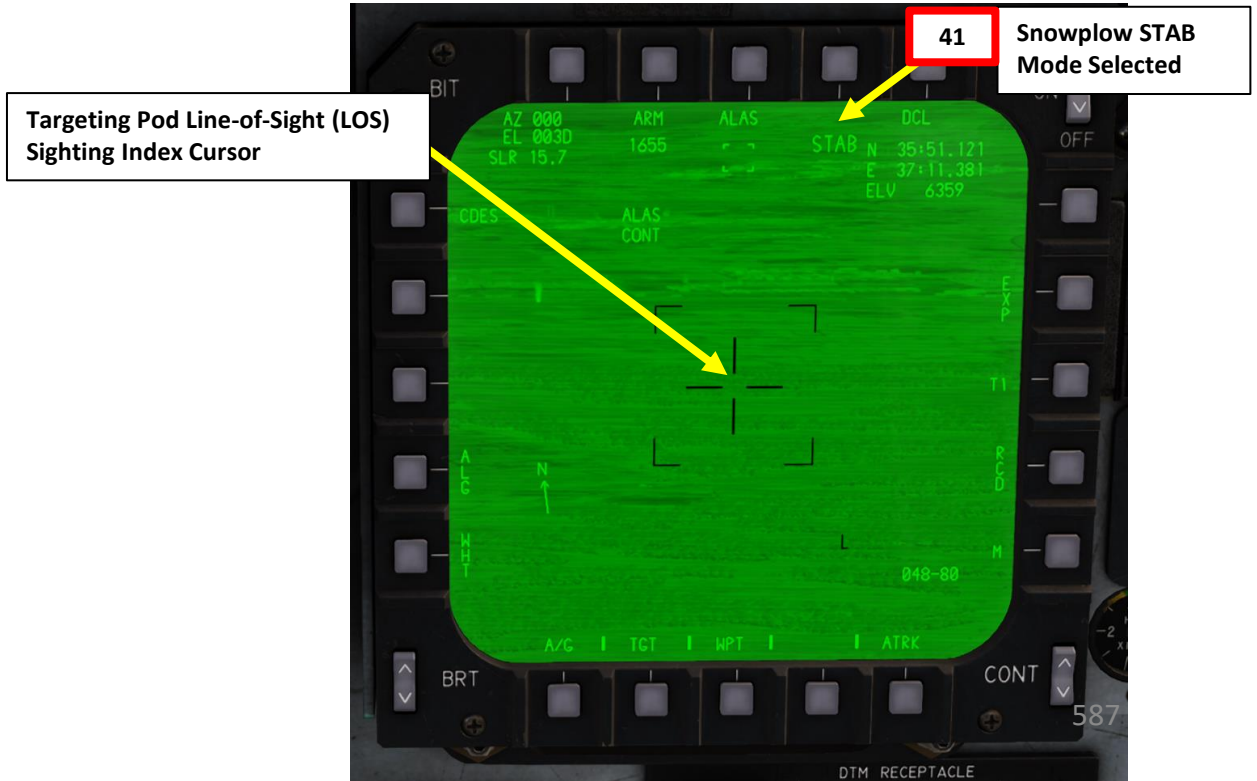
Coolie Switch
- *UP/DOWN/LEFT/RIGHT*

2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
B – Weapon Arming & Target Designation

39. You can cue (slave) the targeting pod to a navigation point or other systems (which we talk about in the Cue Mode section), but for this example we will use the simplest method of using the targeting pod in snowplow mode.
40. Press Auto Acquisition Switch – FWD LONG (more than 1 sec) to enter SNOWPLOW STAB mode.
41. The targeting pod's SNOWPLOW STAB mode is space-stabilized to a point below the horizon along the heading vector. The targeting pod's line-of-sight is not tied to the ground; instead, it points at the space at the azimuth angle and elevation the pod had when space stabilization was first initialized.

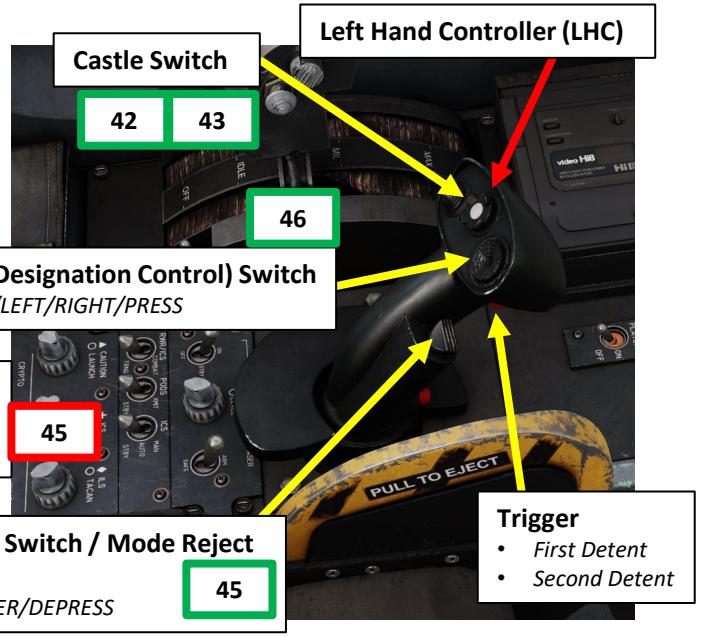


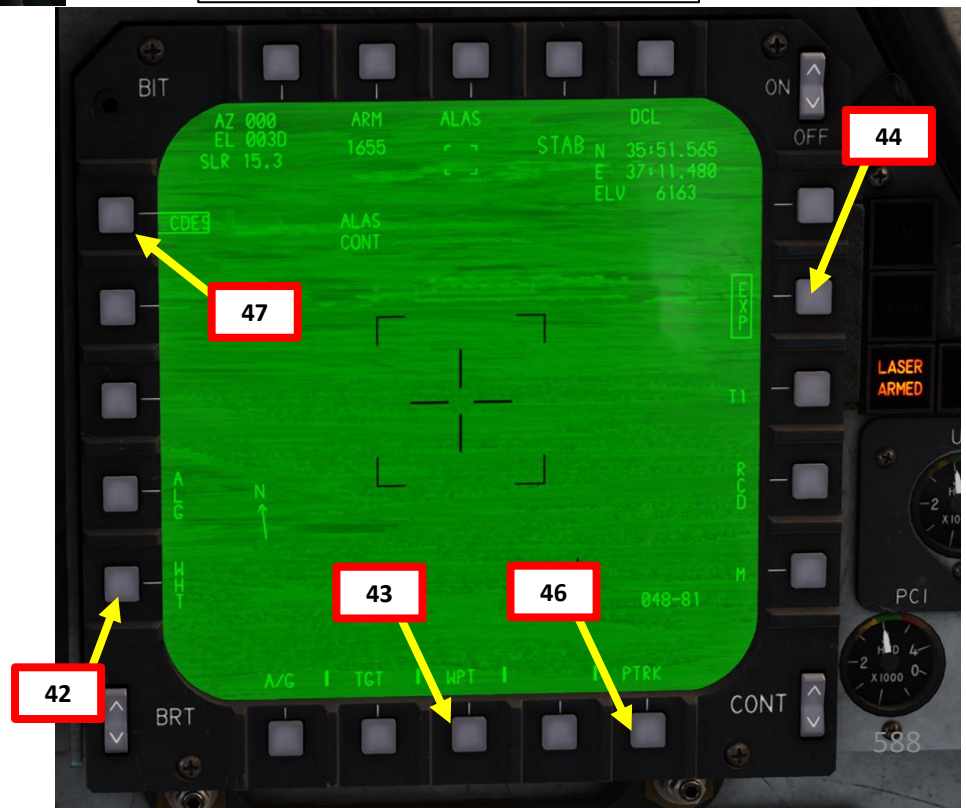




2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
B – Weapon Arming & Target Designation

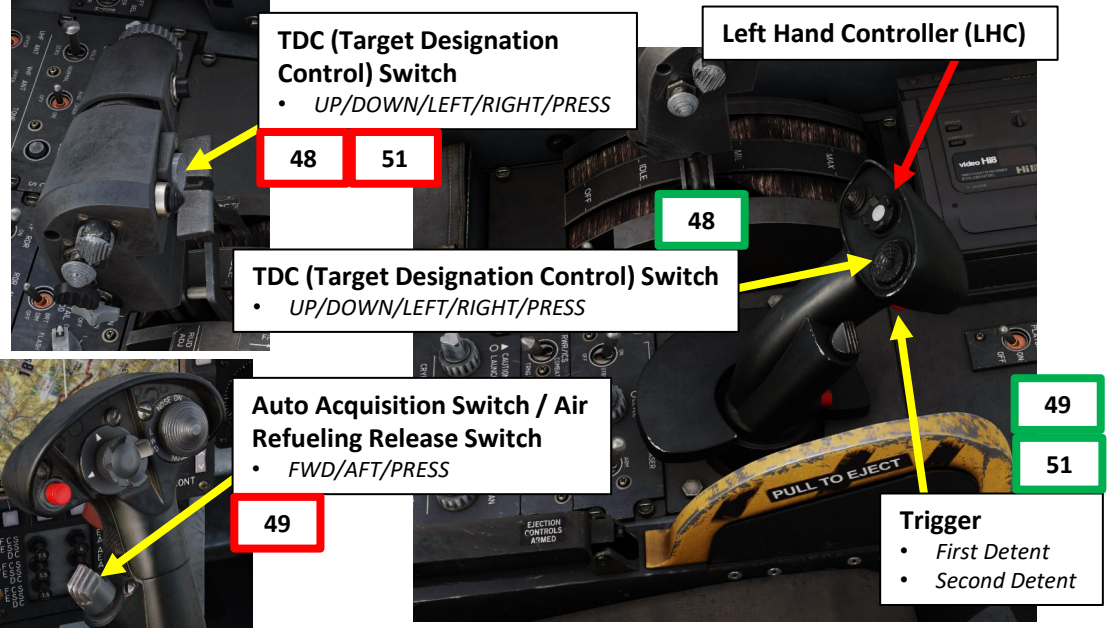
42. Select Video Polarity – As desired.
    - Pressing the Video Polarity Selection Option pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.
    - The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD LONG (more than 1 sec)
43. Select Tracker Polarity Selector – As desired.
    - 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 center of the crosshairs when point track is initiated.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD SHORT (less than 1 sec)
    - Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.
44. If you want to use the ENFOV (Expanded Narrow Field-of-View) zoom mode, select/box the EXP option. In this example, we will select it.
45. Zoom as required by pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec), which toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.
46. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
    - Point Track (PTRK) tracks a moving object like a high-contrast vehicle
    - Area Track (ATRK) is used for a static target
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS
47. If a continuous laser designation is desired, select/box the CDES option. The designation will be continuously updated with new range and line-of-sight designation.
    - If CDES is unselected/unboxed, lasing the target is only performed as long as the Left Multifunction Switch (pilot) or laser trigger (WSO) is depressed.

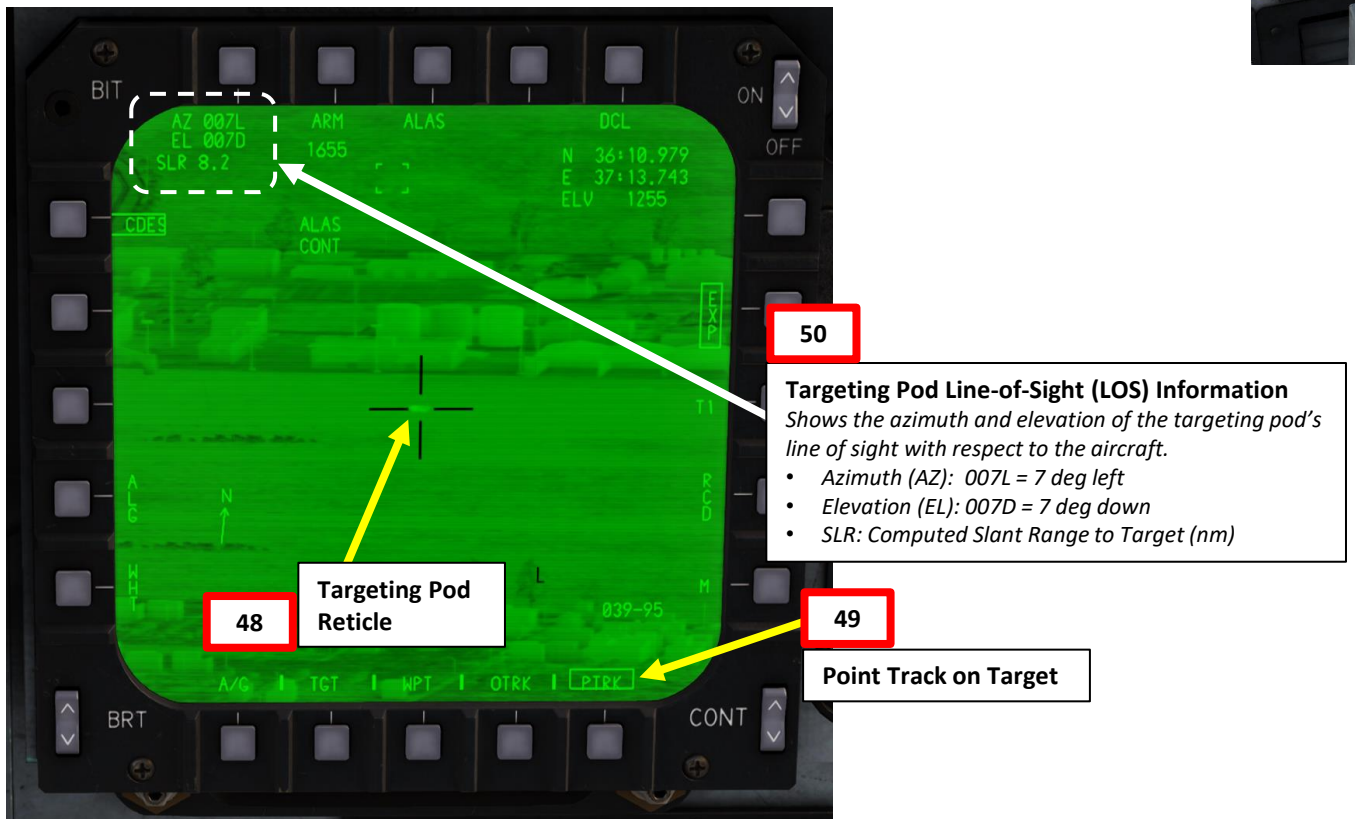


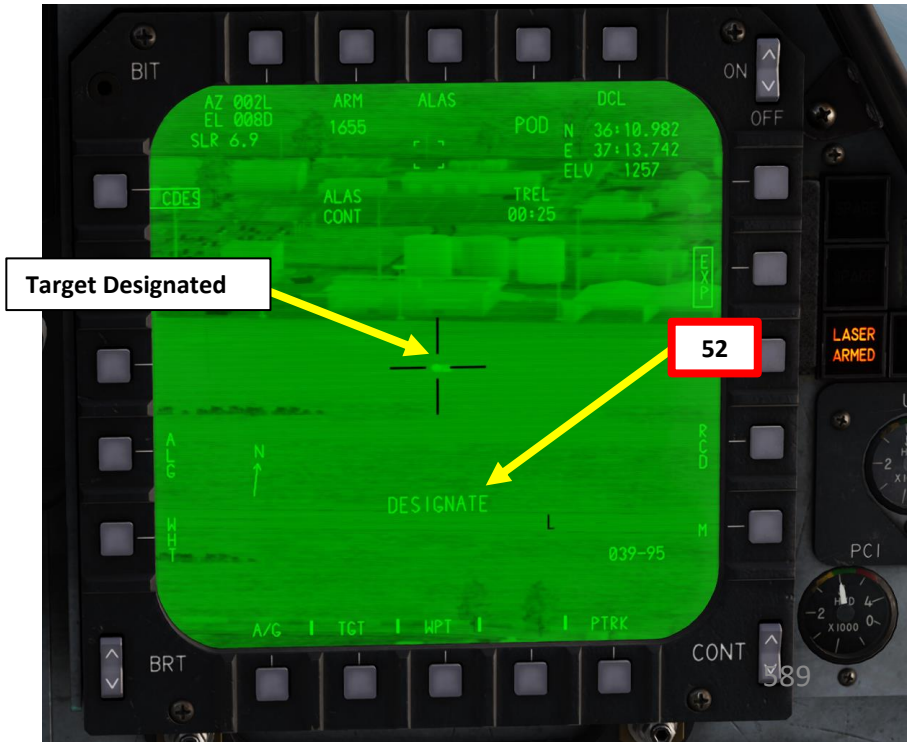


2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
B – Weapon Arming & Target Designation

48. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to designate and range with a laser.
49. Initiate a targeting pod "track" on the target (either point or area track).
    - **Pilot**: Depress Auto Acquisition Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
50. Once the target is tracked, the targeting pod will compute a slant range and either PTRK or ATRK will be boxed depending on what tracking method you have selected previously.
51. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
52. Once target is designated, the DESIGNATE legend appears for 5 seconds.

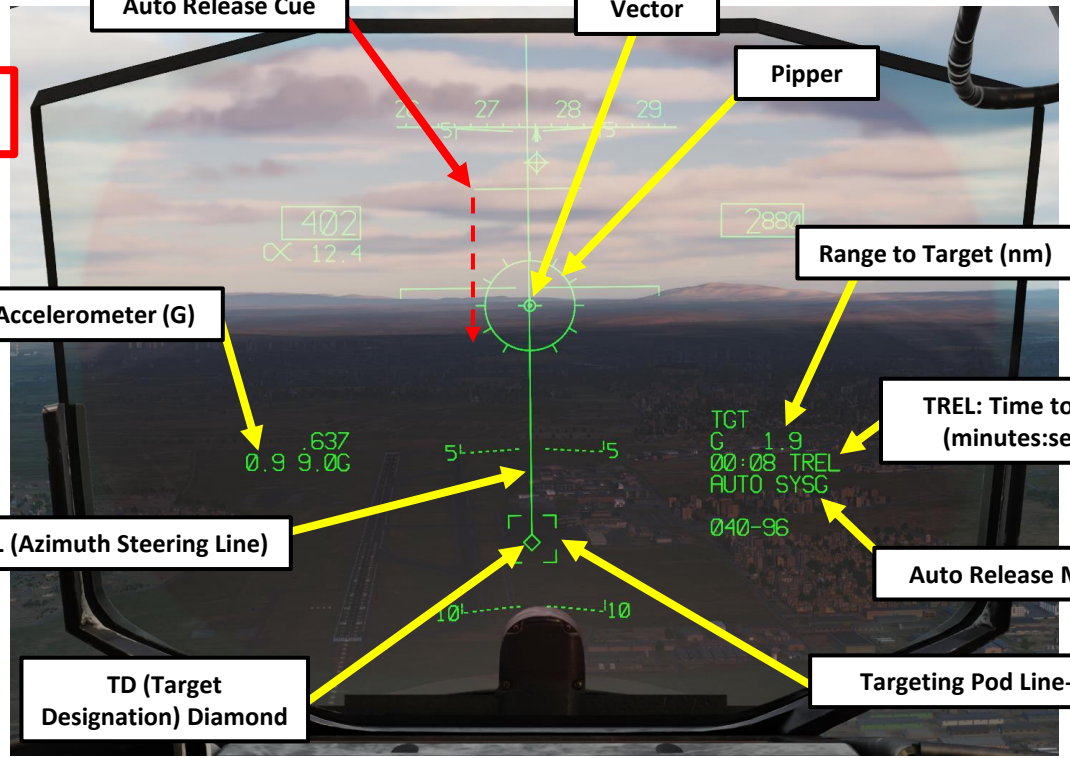


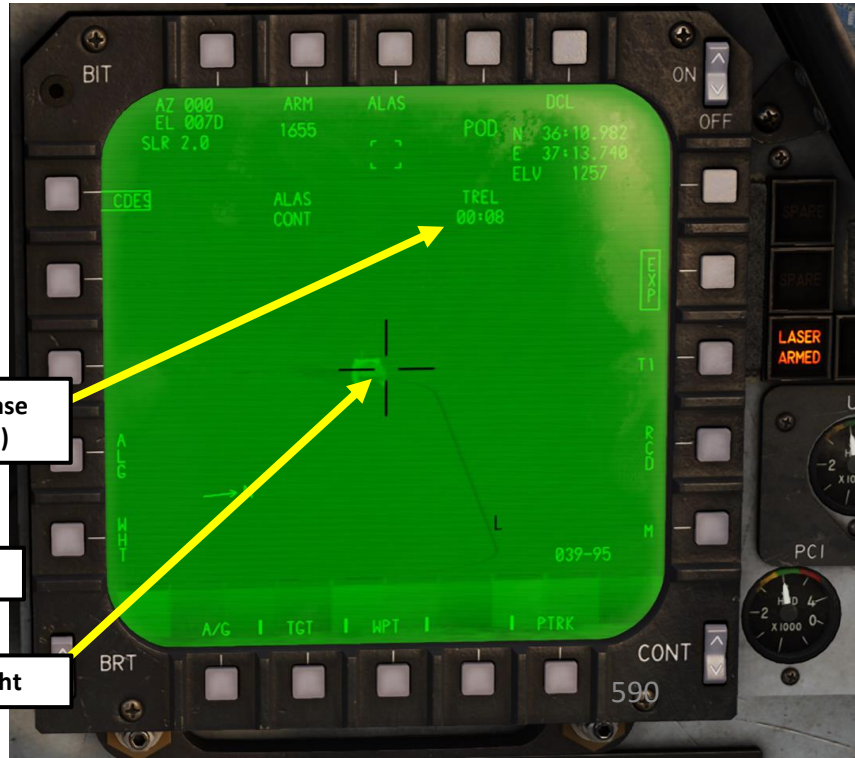




2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
C – Perform Attack

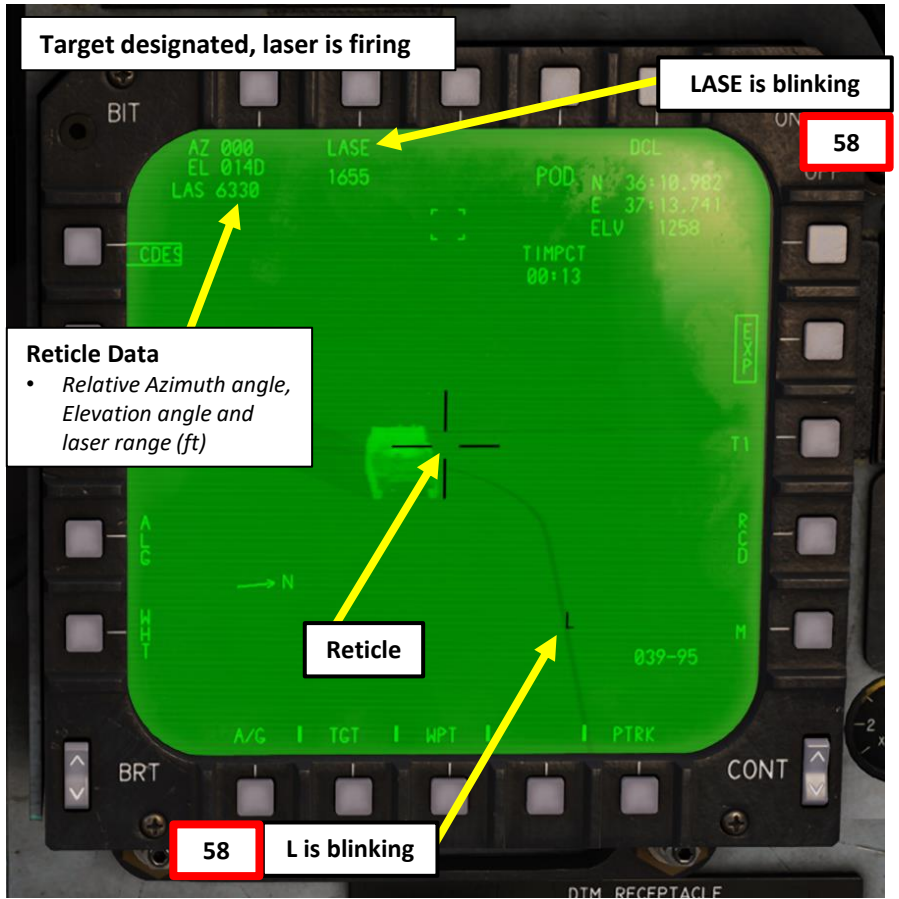
53. Fly level and maneuver the aircraft to align the pipper with the ASL (Azimuth Steering Line).
54. When TREL (Time-to-Release) reaches 10 seconds, the auto release cue is displayed on the ASL 5 deg above the velocity vector. Keep the ASL centered on the pipper.
55. As the auto release cue travels down the ASL, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bomb.
56. GBU-12 will automatically drop when the auto release cue crosses the velocity vector.

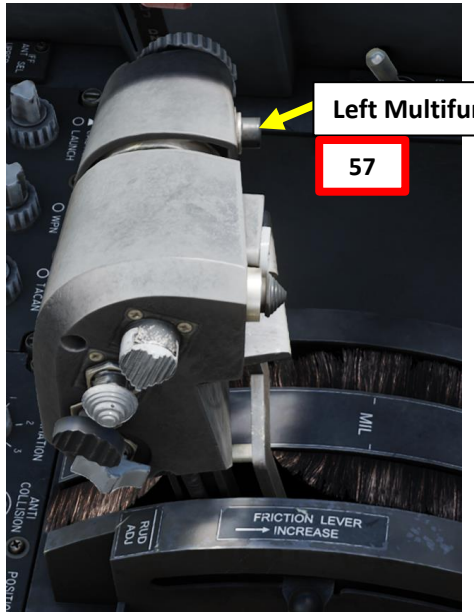




2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
C – Perform Attack

57. In this example, we have selected automatic lasing (ALAS). The targeting pod will automatically lase the target when the GBU-12 is released to guide it until impact. Take note that the maximum range of the laser is about 13 nm (which can also be further reduced due to weather and visibility conditions). If lasing manually, you can manually toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
58. Target ranging information is updated based on the range computed by the laser designator. When laser is firing, the "LASE" and "L" indications blink on the TPOD page.
    - Note: The "MASKED" indication means that the targeting pod's line-of-sight is masked by the airframe or stores and the laser has been commanded to fire.



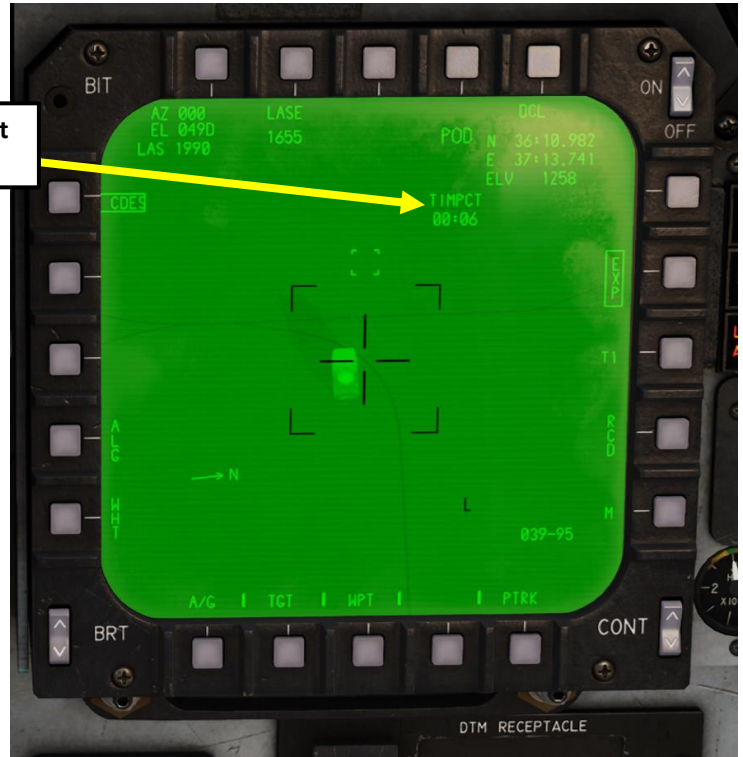


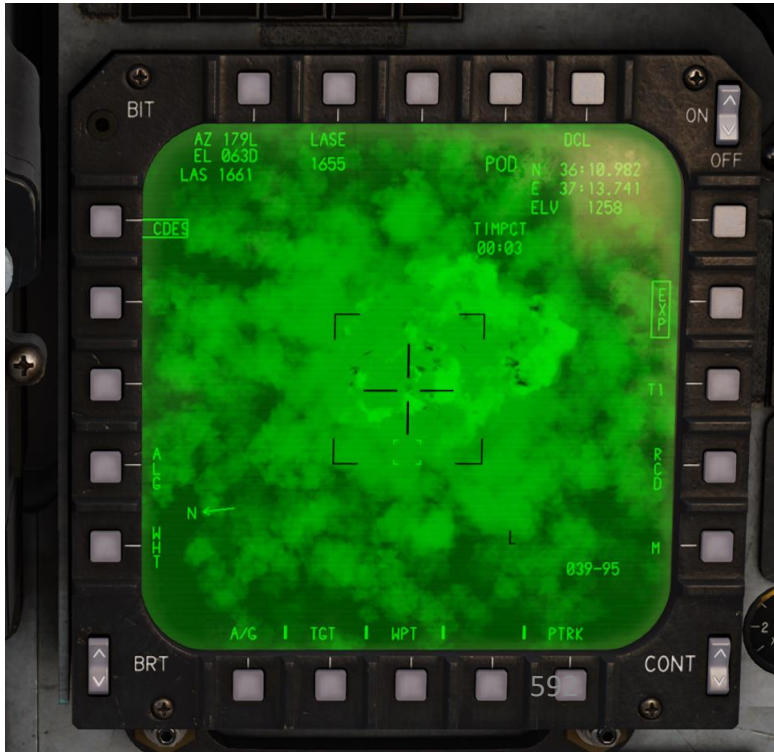
2 – AIR-TO-GROUND WEAPONS

2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

C – Perform Attack

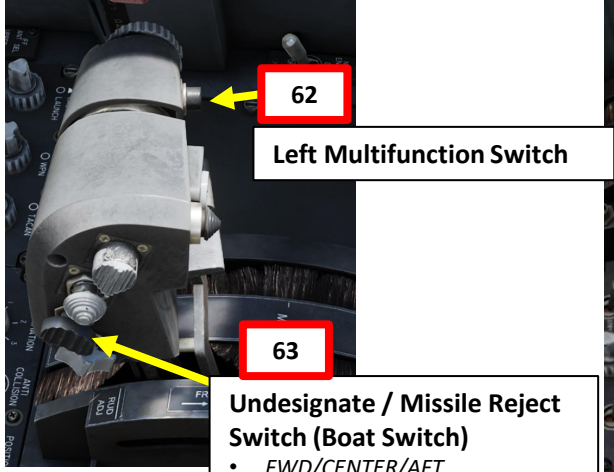
59. Once bomb is dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds). Since ALAS CONT (Automatic Continuous Lasing) has been selected previously, the targeting pod will lase the target and guide the GBU-12 all the way until impact.
60. Make sure to maintain enough altitude (at least 1500 ft AGL) to avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

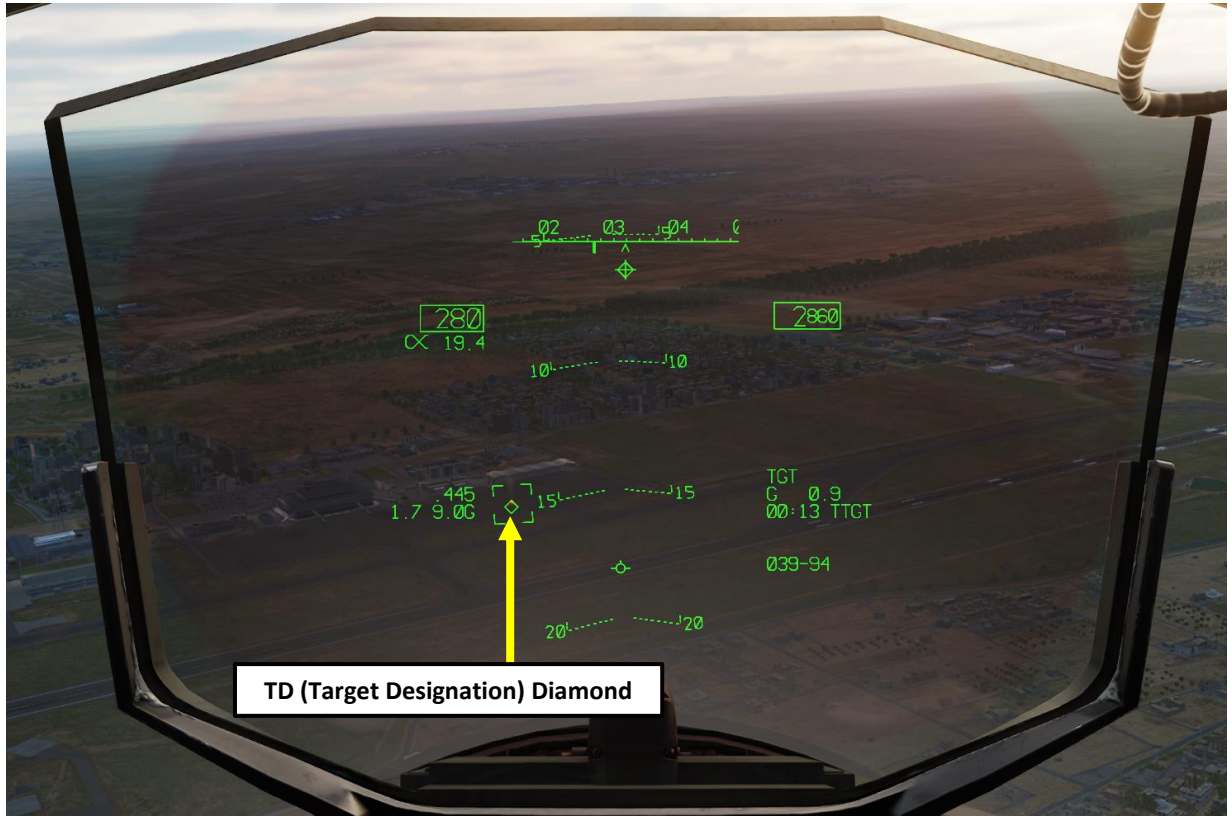


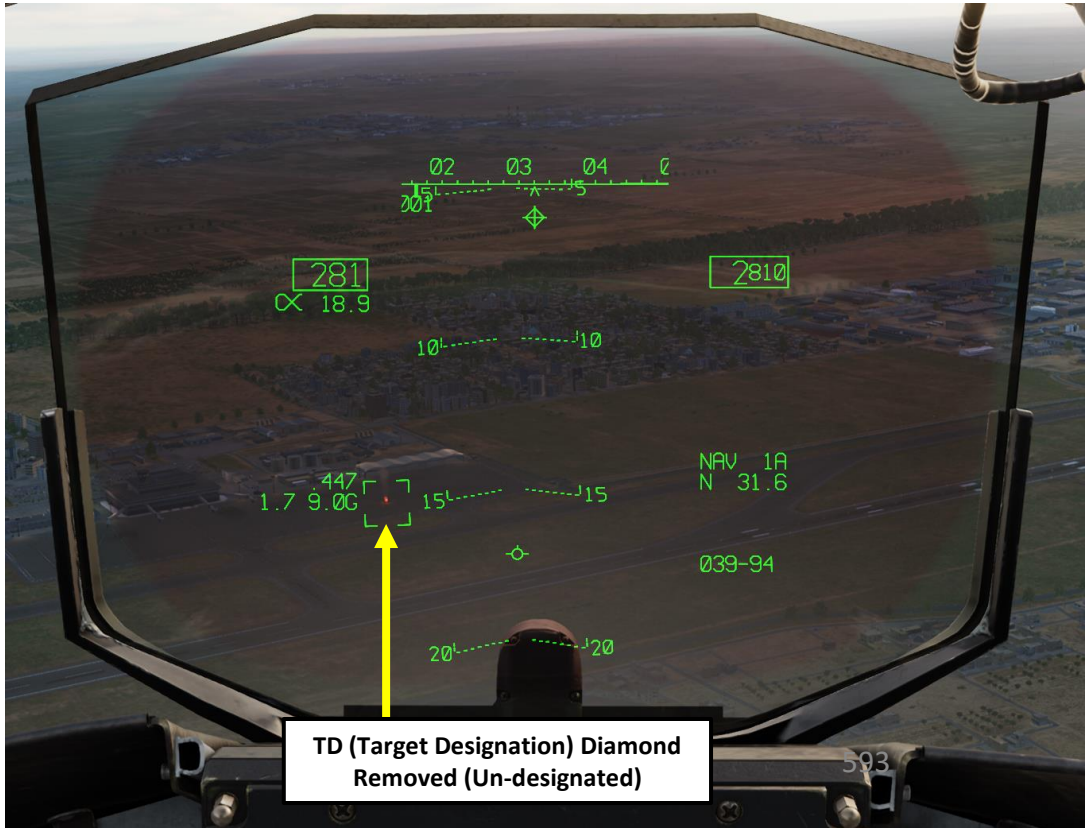


2 – AIR-TO-GROUND WEAPONS
2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)
C – Perform Attack

61. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
62. To stop lasing, toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
63. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.







2 – AIR-TO-GROUND WEAPONS

2.3 – GBU-12 Paveway II (Laser-Guided with Targeting Pod)

C – Perform Attack

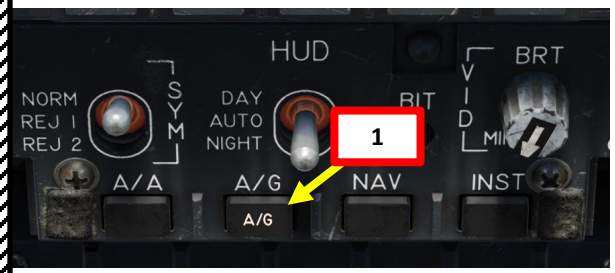
2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

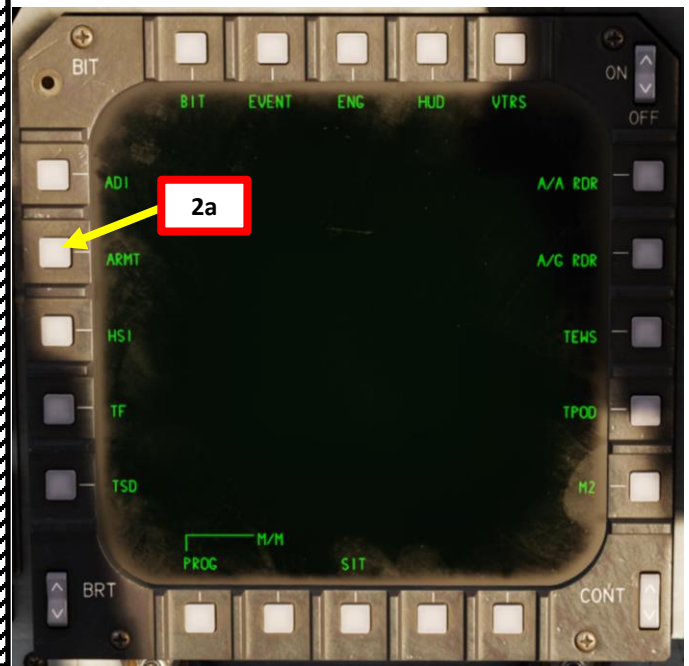
2 – AIR-TO-GROUND WEAPONS

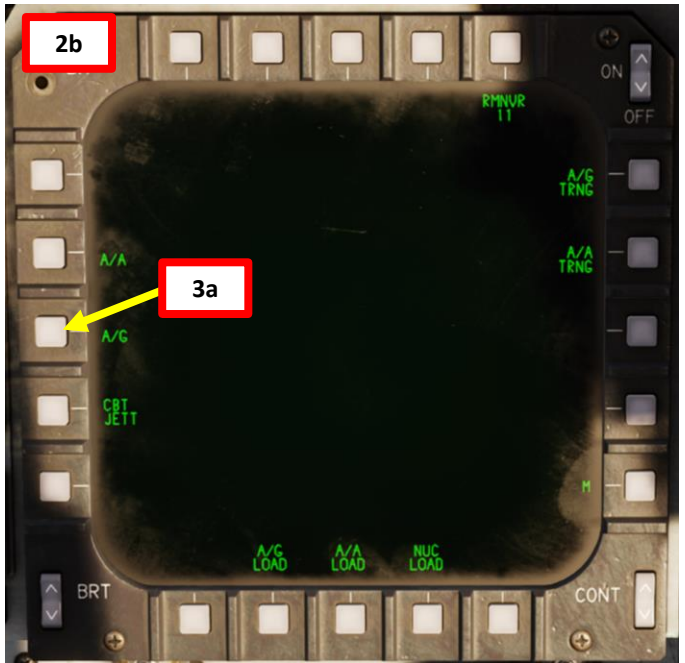
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

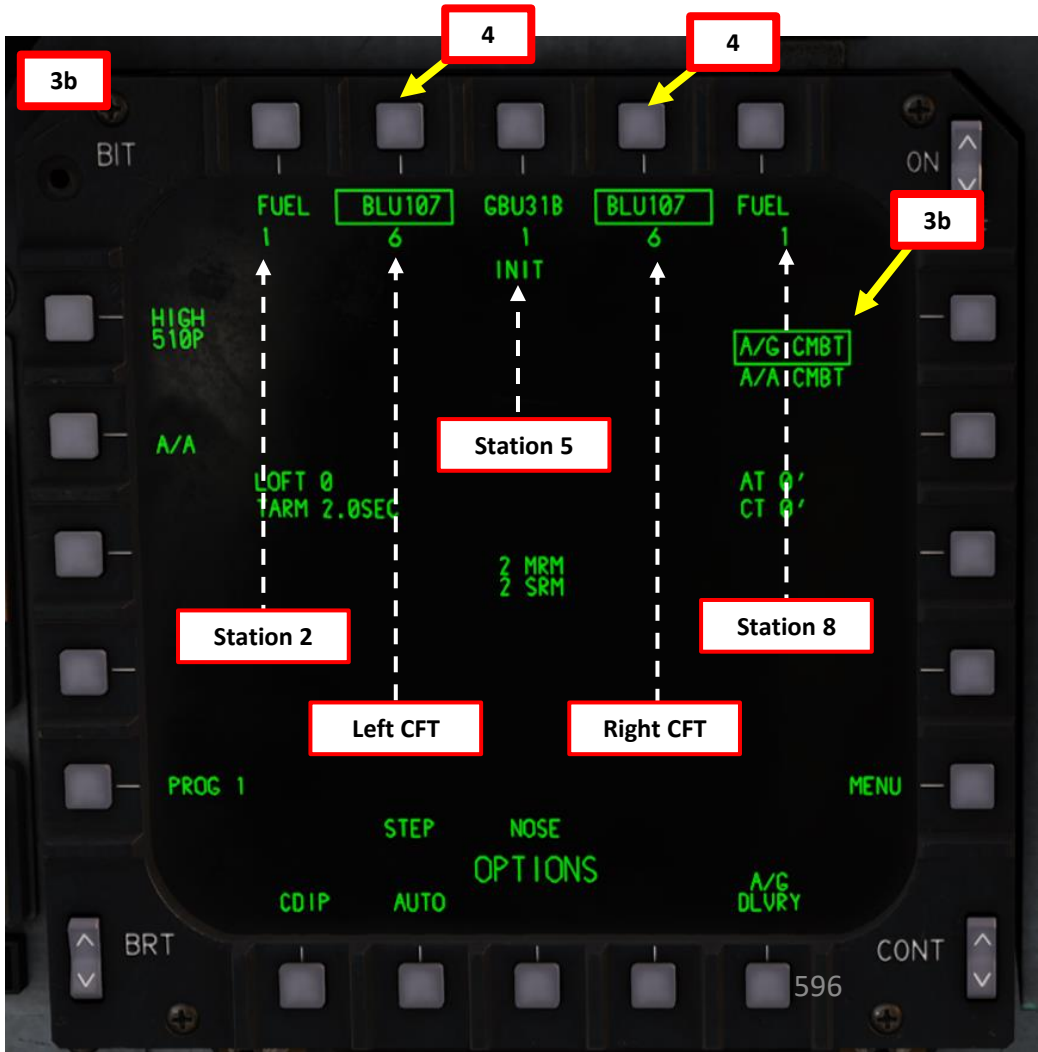
A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “BLU107” (boxed when selected).
    - Note: The weapon type is only displayed if the PACS WEAPON LOAD procedure has been performed correctly after re-arming the aircraft.







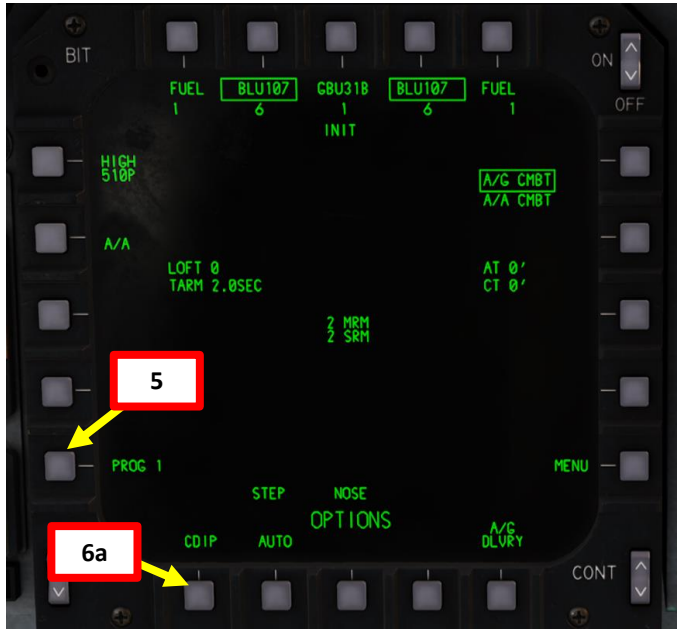


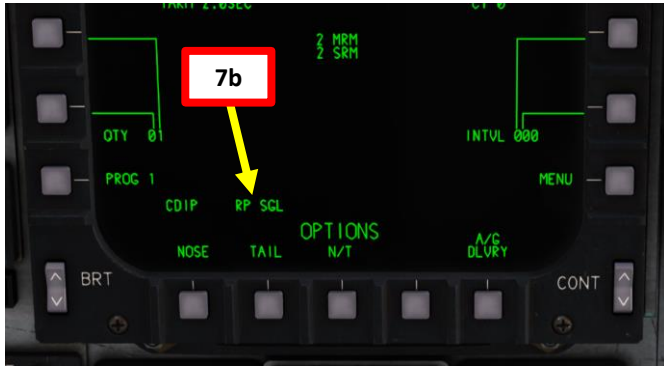
2 – AIR-TO-GROUND WEAPONS

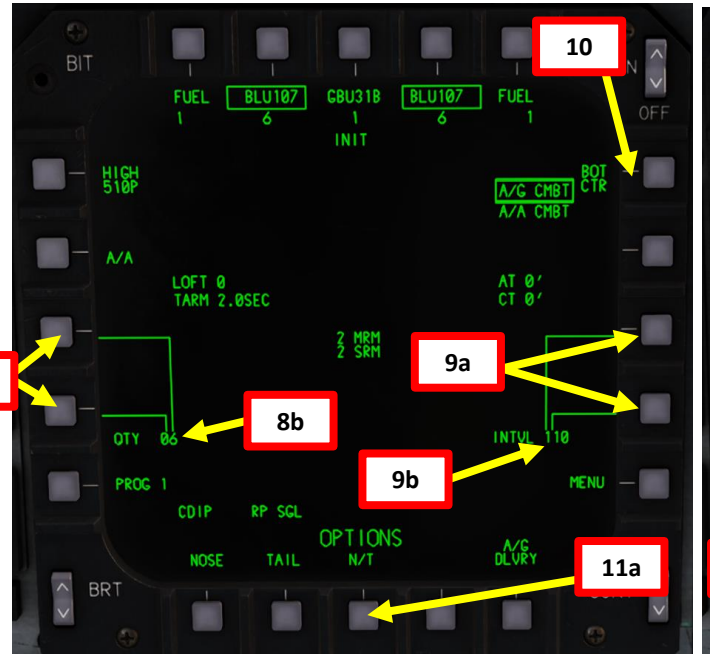
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

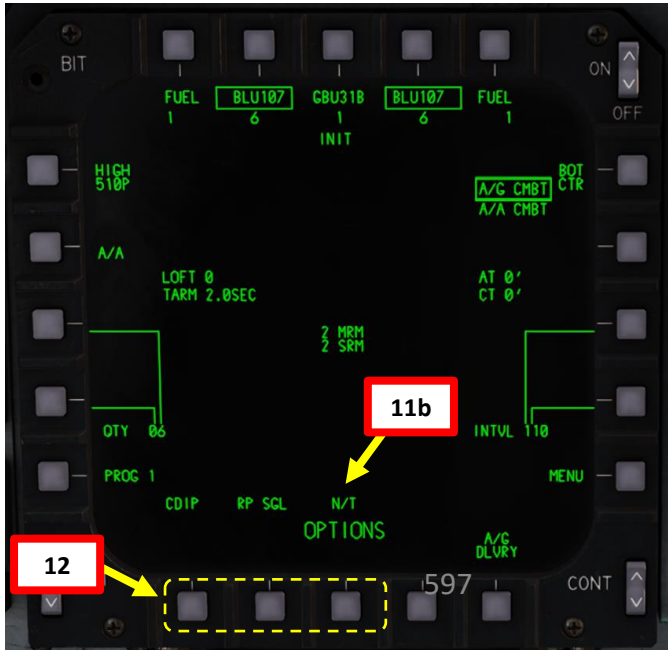
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select CDIP (Continuous Displayed Impact Point) Delivery Mode.
7. Select desired Release Sequence. We will select RIPPLE SINGLE.
    - *1/STA: One weapon per selected station dropped simultaneously with each press of Weapon Release (Pickle) Button.*
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
    - *RIPPLE MULTIPLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped from each selected station simultaneously.*
8. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Release Quantity. We will select 6 bombs by toggling the pushbuttons next to the QTY data field.
9. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence), select Interval (distance in feet between bomb drops). We will use 110 ft intervals by toggling the pushbuttons next to the INTVL data field.
10. If required (using RIPPLE SINGLE or RIPPLE MULTIPLE release sequence is set with a quantity greater than 1), set the BOT (Bomb On Target) option as desired. Press pushbutton next to BOT to toggle between which bomb number in the string will fall on the target (1 being the first bomb dropped, CTR being the bomb at the center of the string). We will use the default “CTR” setting.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.



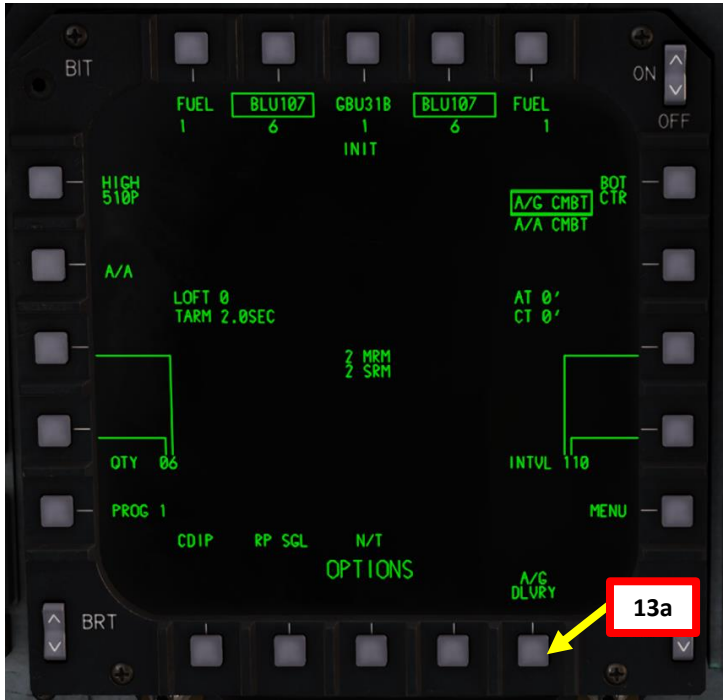


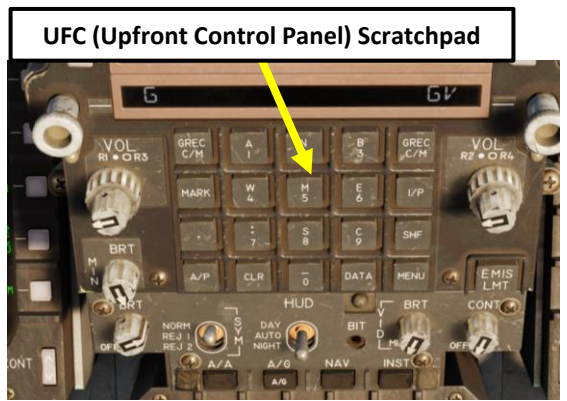


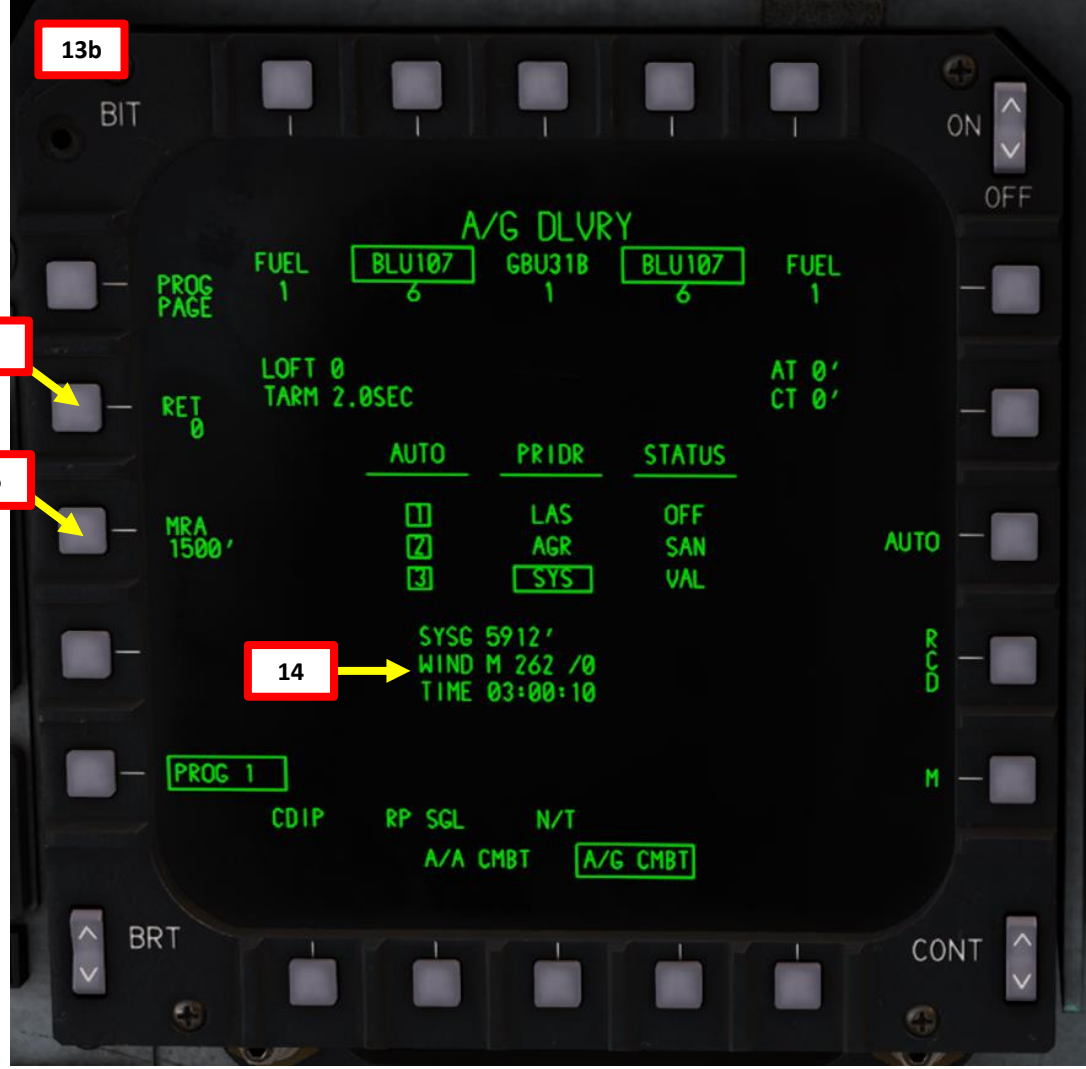


2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.

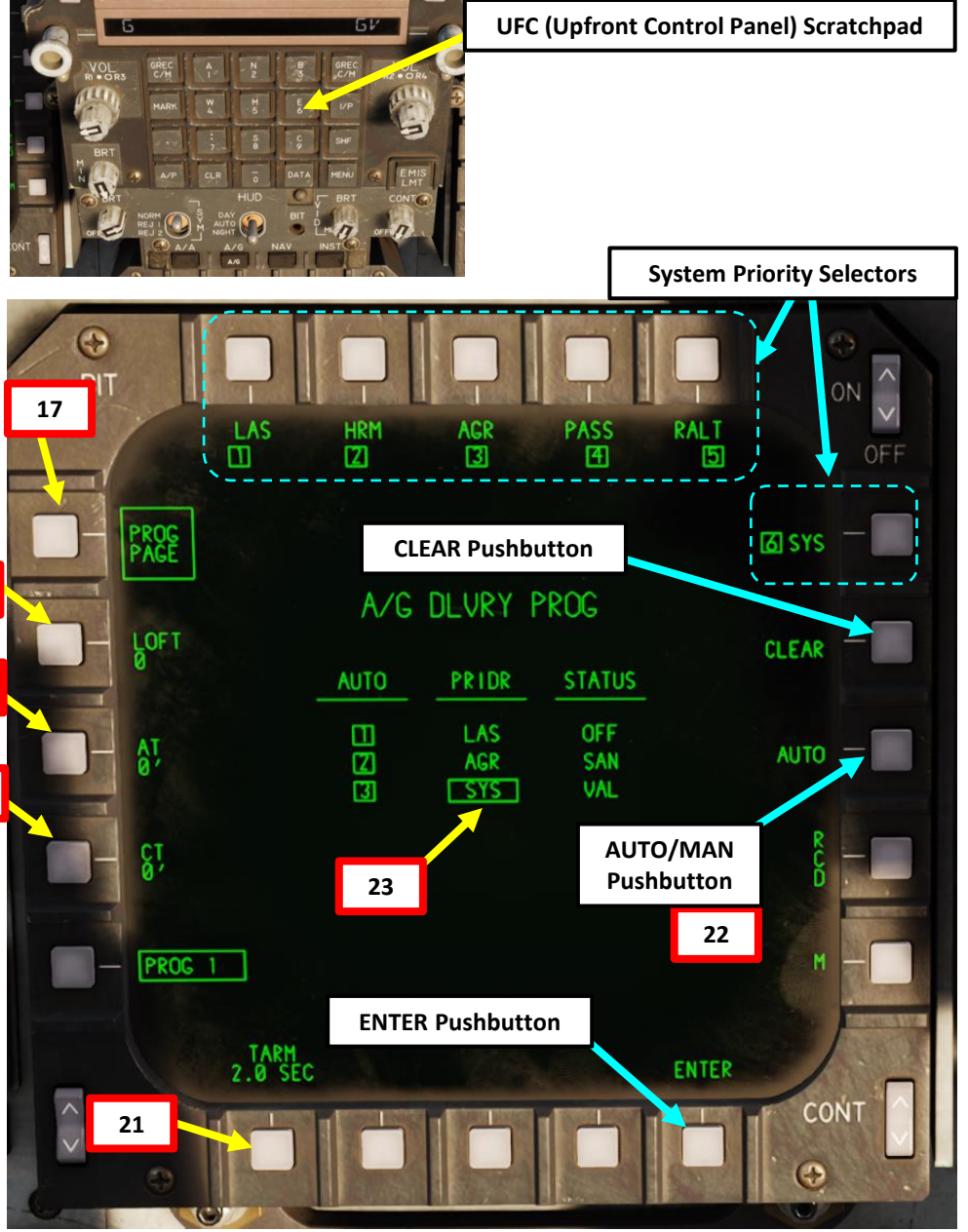






2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)
A – Weapon Setup

17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

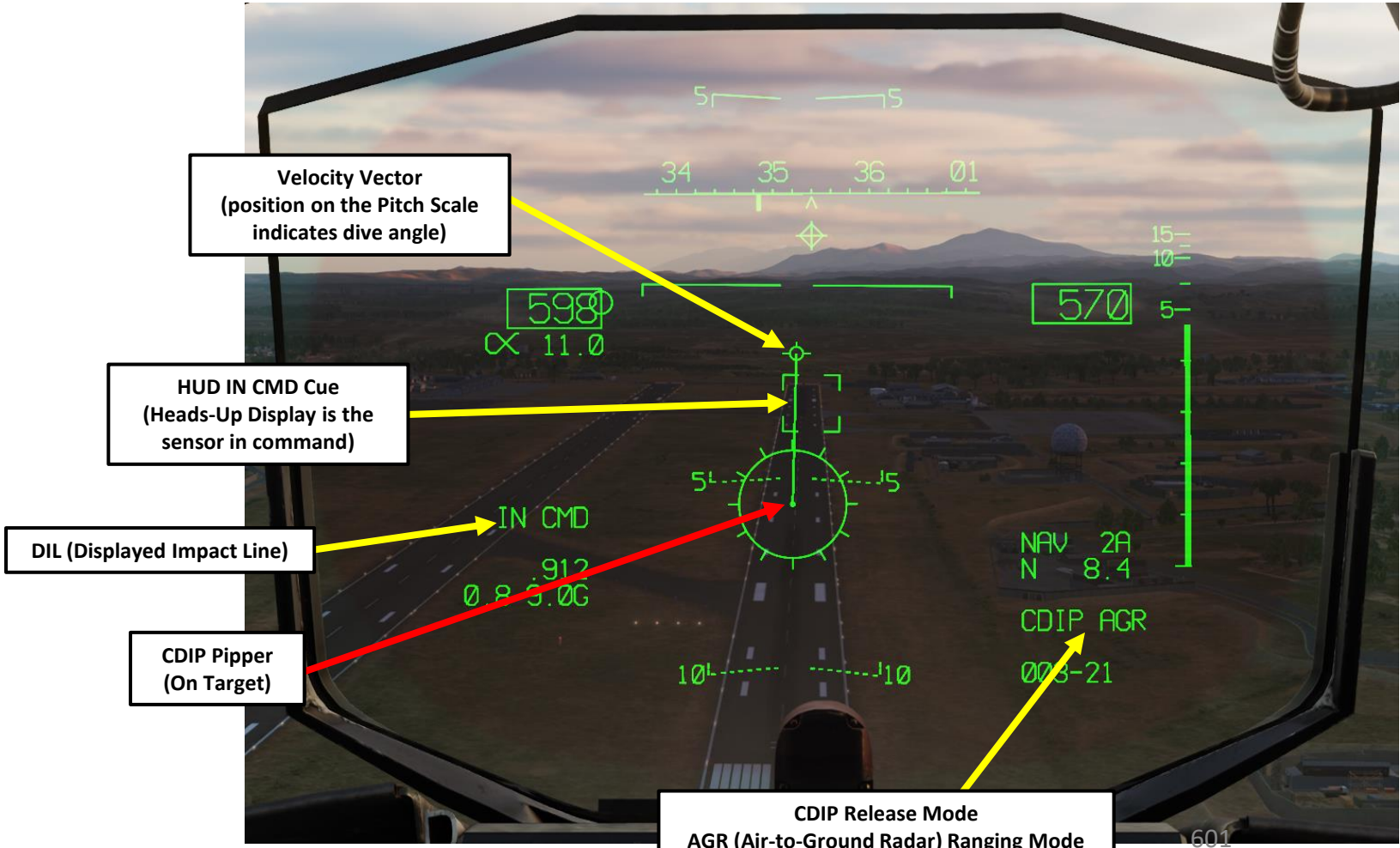


2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)
B – Perform Attack

25. Set Master Arm Switch – ARM (UP)
26. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the "IN CMD" (In Command) Cue.
    - Note: This step is **optional**, but being IN CMD of the HUD is very useful since it not only allows quick un-designation after ordnance release, but more importantly enables air-to-ground radar (AGR) ranging through the CDIP pipper, which is very important for accurate bombing.

2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)
B – Perform Attack

27. Approach the target by flying low and level (or with a very shallow dive angle). Fly at least 300 ft AGL above the target.
28. Steer the aircraft to line up the target with the DIL (Display Impact Line).
29. Steer the aircraft to place the center of the CDIP (Continuously Displayed Impact Point) Pipper on the target while flying at least 300 ft above the target.
30. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release bombs.

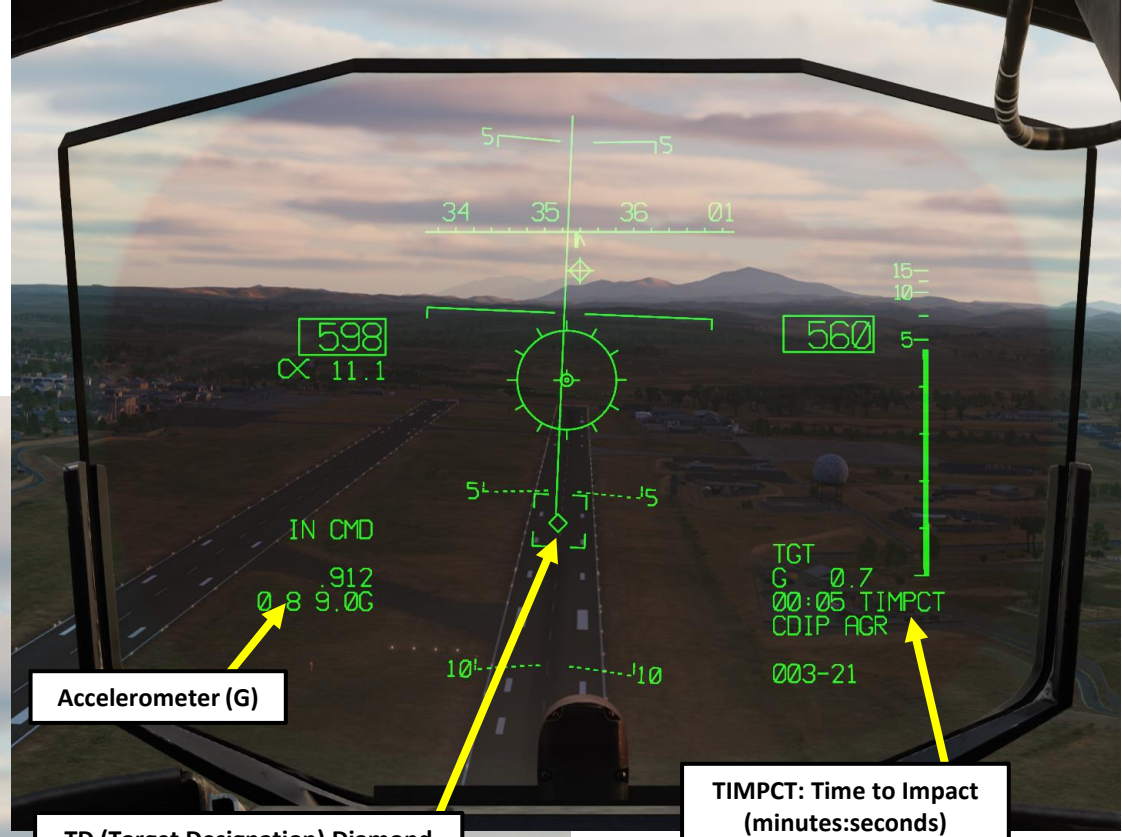


2 – AIR-TO-GROUND WEAPONS

2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

B – Perform Attack

31. Once bombs are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).
32. A TD (Target Designation) Diamond is automatically created on the CDIP Pipper's location at the time of bomb release, which allows you to either re-engage or assess damage done on the target.
33. Perform safe-escape manoeuver by pulling 5 Gs; this will avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.



2 – AIR-TO-GROUND WEAPONS

2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

B – Perform Attack

34. Durandals are used against hard/reinforced targets like runways. The forward half of the bomb holds the explosives, the penetrator and the fuse. The aft half contains the booster, the 4 stabilizing fins and the deployable chute. Just after the bomb is released, the parachute is deployed, separating the bomb from the aircraft and slowing it down. A short delay after, the parachute is jettisoned and the booster rocket is fired, accelerating the bomb into the ground. After penetration is achieved, the bomb explodes… creating a crater.

2 – AIR-TO-GROUND WEAPONS

2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)

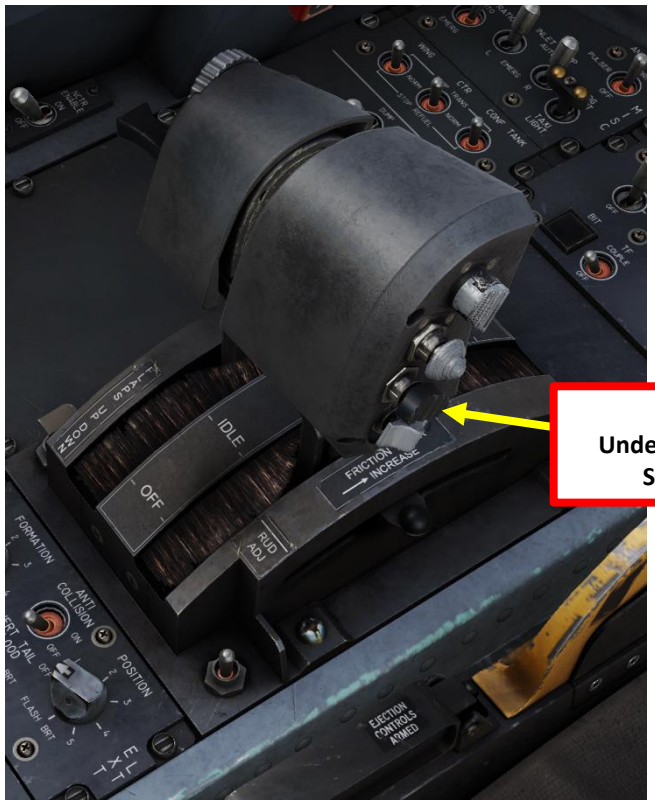
B – Perform Attack

2 – AIR-TO-GROUND WEAPONS
2.4 – BLU-107 Durandal Anti-Runway Bombs (CDIP Mode)
B – Perform Attack

35. To un-designate target and remove the TD (Target Designation) diamond, press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).
    - Note: this step is **optional**, but un-designating from CDIP must be done while the HUD (Heads-Up Display) sensor is in command.

HUD IN CMD Cue (Heads-Up Display is the sensor in command)

TD (Target Designation) Diamond



35
Undesignate / Missile Reject Switch (Boat Switch)

TD (Target Designation) Diamond Removed (Un-designated)

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.1 – Introduction to Smart Weapons

The F-15E is able to employ the Global Positioning System (GPS)-guided Joint Direct Attack Munition (**JDAM**) bombs and the Joint Standoff Weapon (**JSOW**) glide bombs. JDAMs are modified general purpose bombs, equipped with a GPS and inertial navigation system (INS) for guidance as well as flight controls. The JSOW has the same guidance and is a bomb with wings to provide lift and maneuvering flight controls. As such, it has a significantly longer range than JDAMs. The JDAMs/JSOWs have (at optimal INS alignment) a margin of error of approximately 16 ft (5m). Independent programming of each individual bomb allows for simultaneous multi-target attacks.

The DCS F-15E has four JDAM types available:
- **GBU-38**: MK-82 500-pound bomb with JDAM guidance kit.
- **GBU-31(V)1/B**: MK-84 2,000-pound bomb with JDAM guidance kit.
- **GBU-31(V)3/B**: BLU-109 2,000-pound hardened penetration bomb with JDAM guidance kit.
- **GBU-54B**: MK-82 500-pounds bomb with JDAM guidance kit and a laser-guidance mode. GBU-54s are referred in the ARMT/PACS page as “GBU-38”.

The warhead of the **AGM-154A** JSOW consists of 145 BLU-97/B Combined Effects Bomb (CEB) submunitions. These bomblets have a shaped charge for armor defeating capability, a fragmenting case for material destruction, and a zirconium ring for incendiary effects.

JSOW A-1 with the BLU-111 warhead

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.1 – Introduction to Smart Weapons

Basically, the way to employ JDAMs or JSOWs is to first get your target coordinates from either the mission briefing or using the F10 map, input them to the weapons. It is also possible to designate targets with the targeting pod or the air-to-ground radar. Programming these smart weapons is done through the **SMRT WPNS** page, which allows you to transfer target data through CC MEM mode or WPN MEM mode.

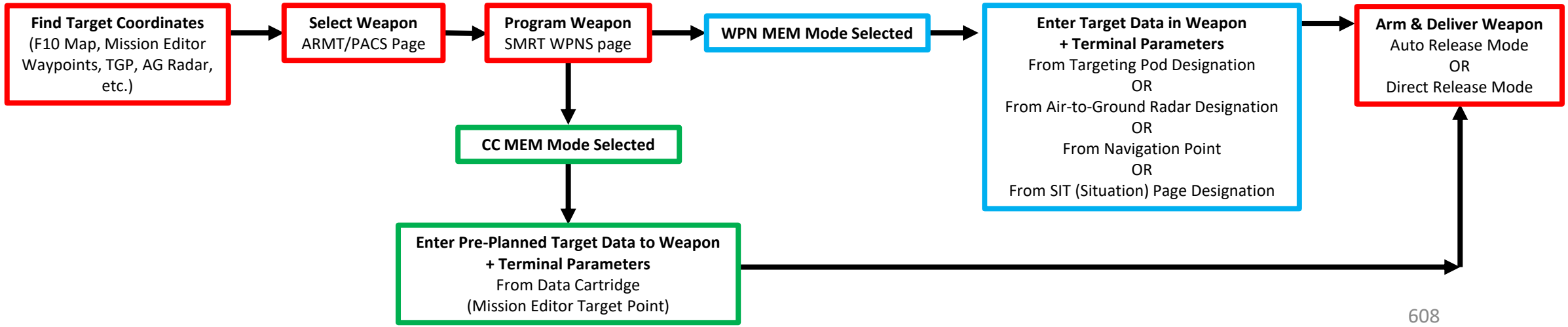
- **WPN MEM (Weapon Memory) Target Data Transfer:** This is the default mode for the system whenever the SMRT WPNS page is entered for the first time. The targets can be uploaded in this mode either from existing designation by a sensor or system (such as TGP, ground radar, NAV or SIT) or manually entered by entering coordinates using the UFC (Upfront Control Panel). Take note that target data uploaded from CC MEM (Central Computer Memory) to a given station can also be edited in this mode.

- **CC MEM (Central Computer Memory**) **Target Data Transfer**: This mode contains pre-planned targets that are uploaded to the aircraft's Central Computer using the data cartridge; these target coordinates are set up during the mission planning phase (i.e. via the Mission Editor). Pre-determined smart weapons targets are called "absolute targets" and cannot be created from the cockpit. However, absolute targets can be edited using the WPN MEM (Weapon Memory) Mode.

Smart weapons have the following release modes: AUTO and DIRECT.

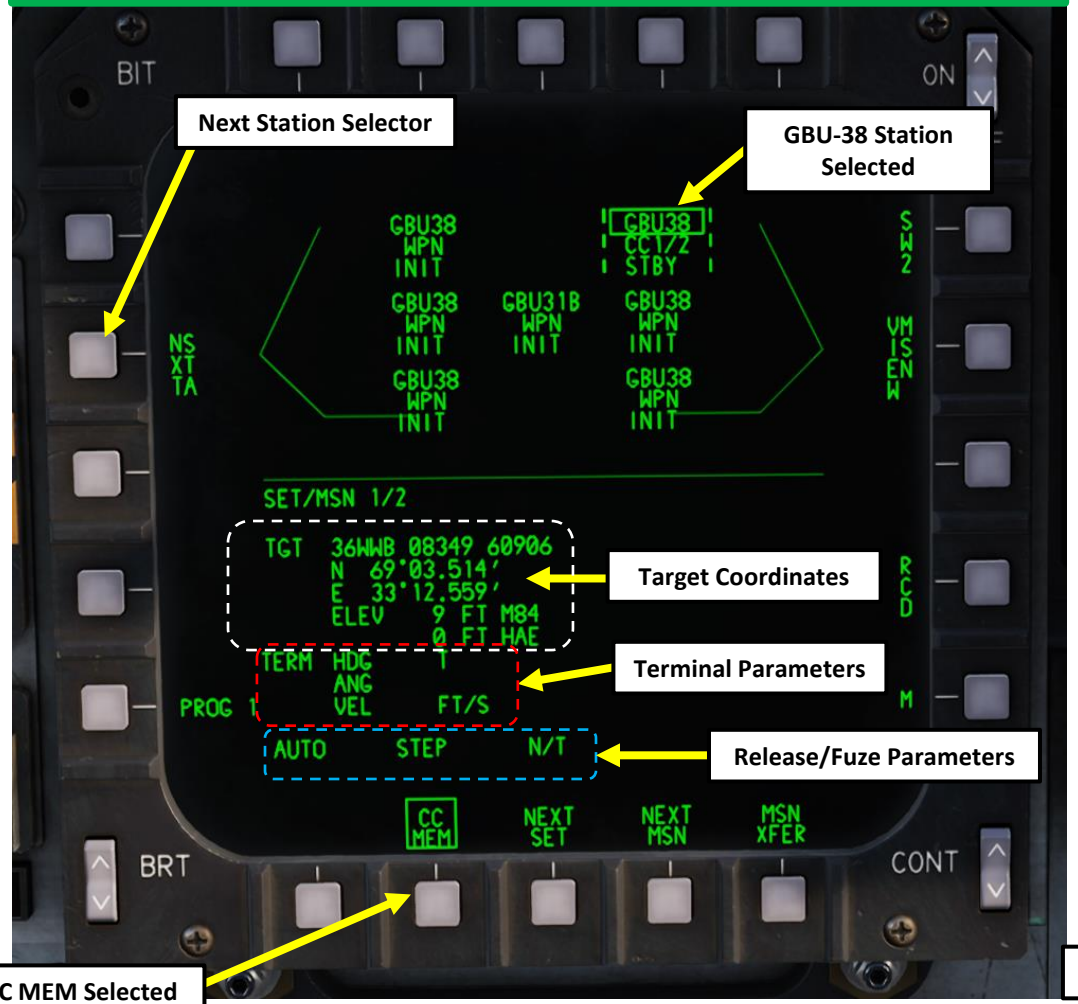
- **AUTO Release Mode** symbology guides the pilot to a very specific release point; you will not be able to release bombs until you reach the release point for Auto. Before reaching the release point, the Weapon Release/Pickle button will be cold (will not release when pressed).

- **DIRECT Release Mode** allows to drop the bomb as the pilot sees fit, either in LAR (Launch Acceptable Range) or in-zone. In Direct mode, the Weapon Release/Pickle button will be hot (will release when pressed) even before being in range, which means you could potentially release too early and miss the target by having the ordnance fall short.

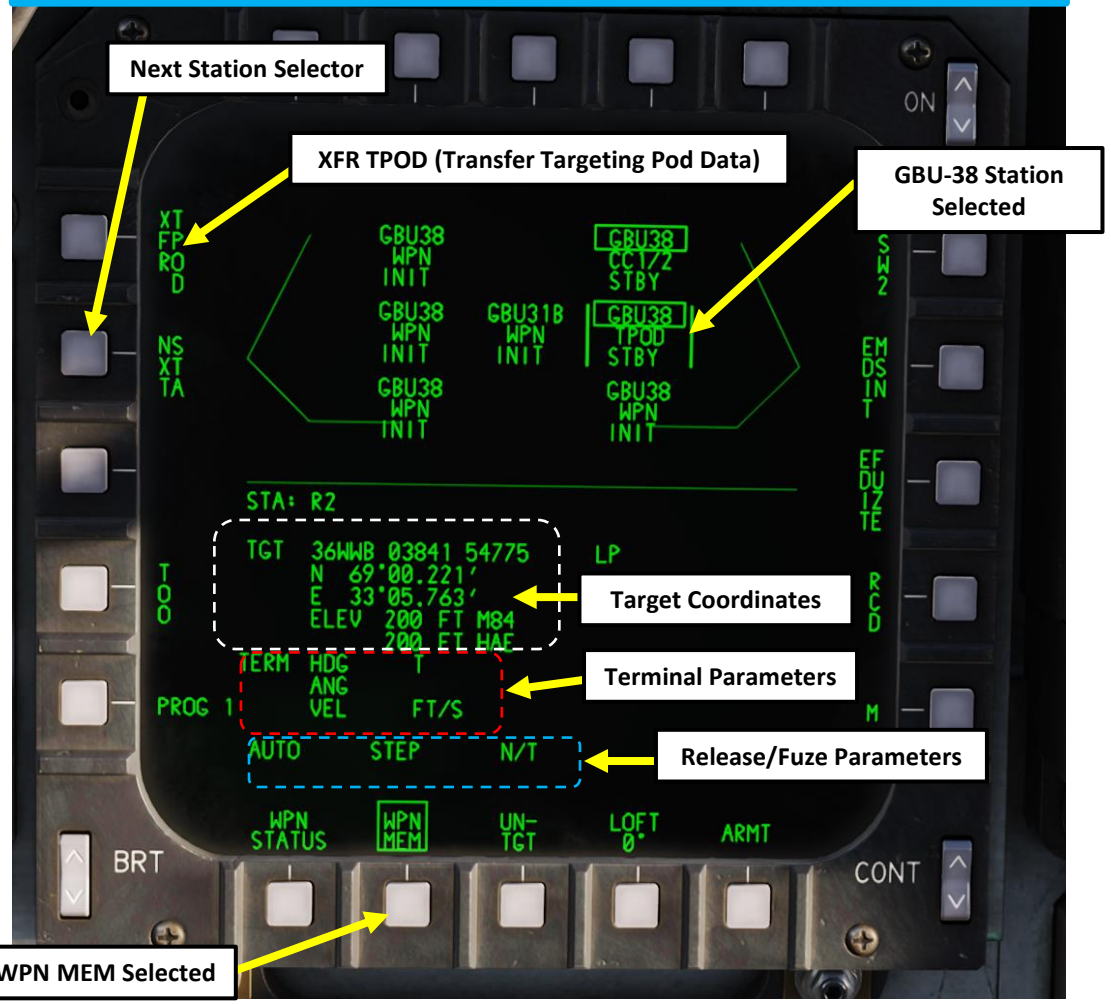


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.1 – Introduction to Smart Weapons

SMRT WPNS Page: Weapon in CC MEM (Central Computer Memory) Mode
Target coordinates from Mission Editor Target Point



SMRT WPNS Page: Weapon in WPN MEM (Weapon Memory) Mode
Target coordinates from Targeting Pod (TPOD)



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

A – Mission Setup

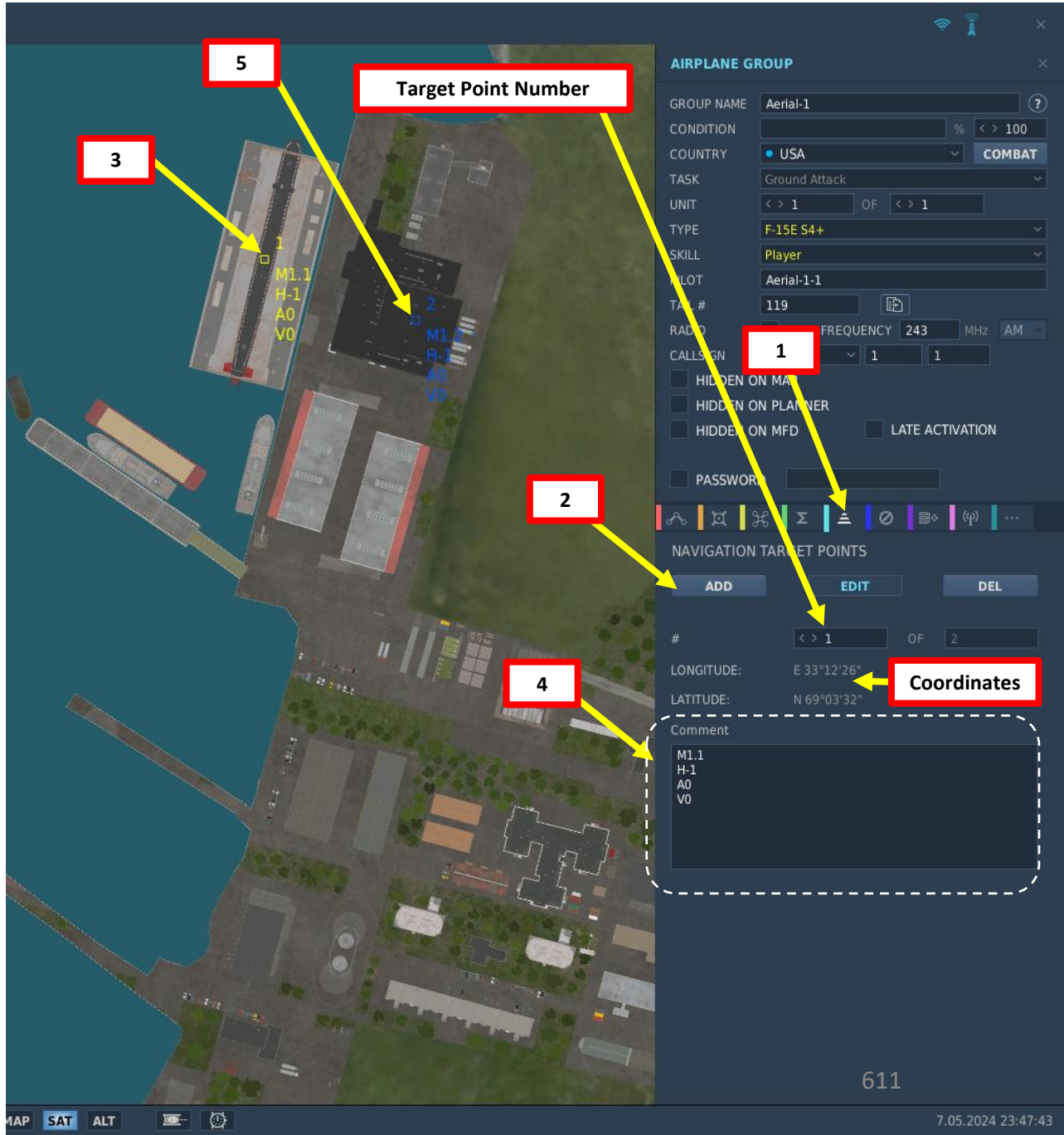
For this tutorial, we will use the Central Computer Memory (CC MEM) mode, which means that we have two pre-planned targets that are **uploaded to the aircraft's Central Computer (CC) using the data cartridge**. We will program the data cartridge using the Mission Editor and preset Navigation Target Points.

To simulate the real-life capability of creating missions when still on the ground and then uploading them into the jet using the Data Cartridge, a special Mission Editor option has been added to the F-15E. In the jet, data files specific to a certain store / weapon type are called MiDEFs (Mission Data Exchange Format). The CDS (Configuration Data Set) is a collection of data files that allows the F-15E to interface with the selected smart weapon. When starting on the ground, the pilot has to manually insert the data cartridge and upload the CDS. The **data cartridge is currently always automatically loaded**.

The system can store up to 9 sets, each one with up to 8 missions. However, the maximum number of missions across all sets is 40. The special data file containing mission data is called MiDEF, and one MiDEF can only contain one set.

To set Navigation Target Points:

1. Click on Navigation Target Fix Points tab
2. Click ADD
3. Click on the target to create the navigation target point.
4. In the "Comment" box, enter the target data and terminal parameters.
    - **MX.Y**: "X" is the Target Set and "Y" is the Mission Number within the target set.
    - **HXXX (or H-1)**: Weapon Terminal Heading. XXX is bomb's heading in range from 0 to 359. If "-1" is typed, there will be no terminal heading set and the bomb will fly at the aircraft heading. In this case we didn't assign specific heading, typing 'H-1'.
    - **AXX (or A0)**: Weapon Dive Angle. The valid range is between 65 and 89 degrees. If "A0" is entered, the bomb will use the default angle of 65 degrees.
    - **VXXX (or V0)**: Weapon Terminal Velocity. The valid range is between 700 and 1200 feet per second. If "V0" is entered, the bomb will use default terminal velocity.
5. Repeat for other targets. We will set up two targets.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

A – Mission Setup

In this example, the first target is a **submarine pen** in Murmansk **(Set 1, Mission 1)**.

Comment Box:

M1.1
H-1
A0
V0

****

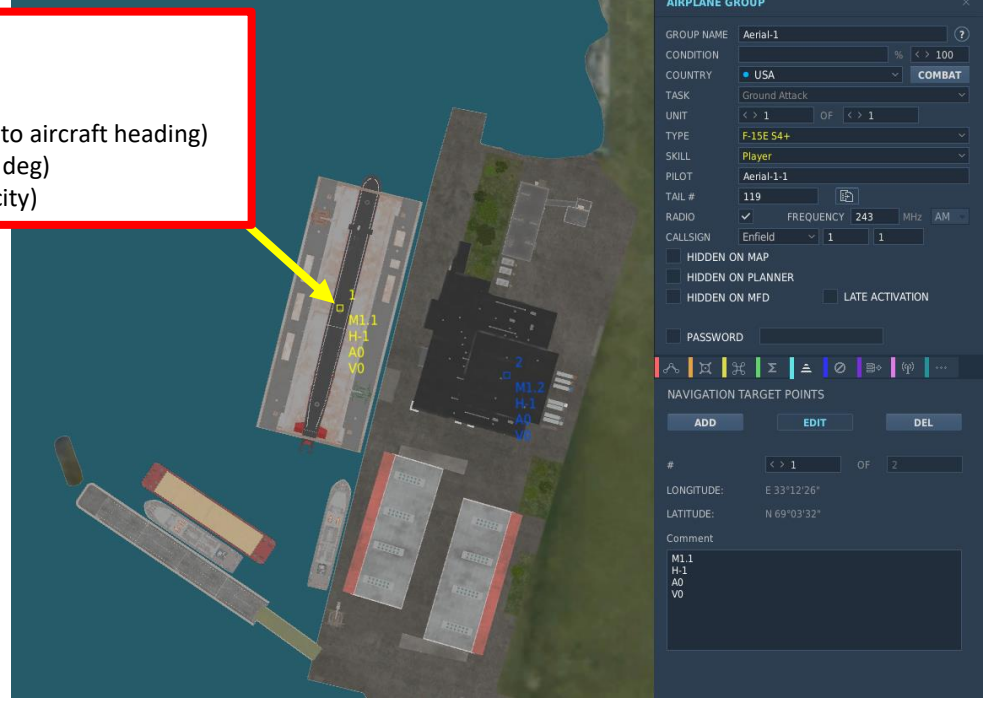
The second target is a **building** next to it **(Set 1, Mission 2)**.

Comment Box:

M1.2
H-1
A0
V0

Submarine Pen (first target)

M1.1 (Target Set 1, Mission 1)
H-1 (Terminal Weapon Heading set to aircraft heading)
A0 (Default Weapon Dive Angle, 65 deg)
V0 (Default Weapon Terminal Velocity)



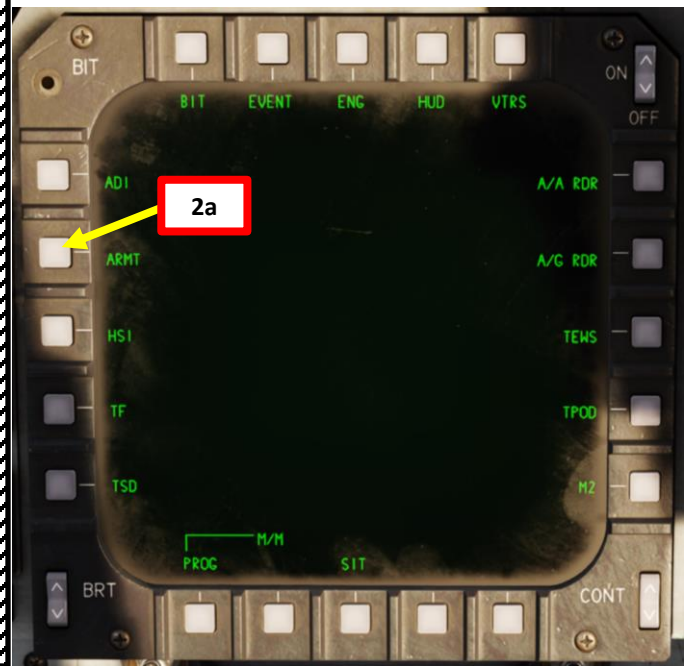
Building (second target)

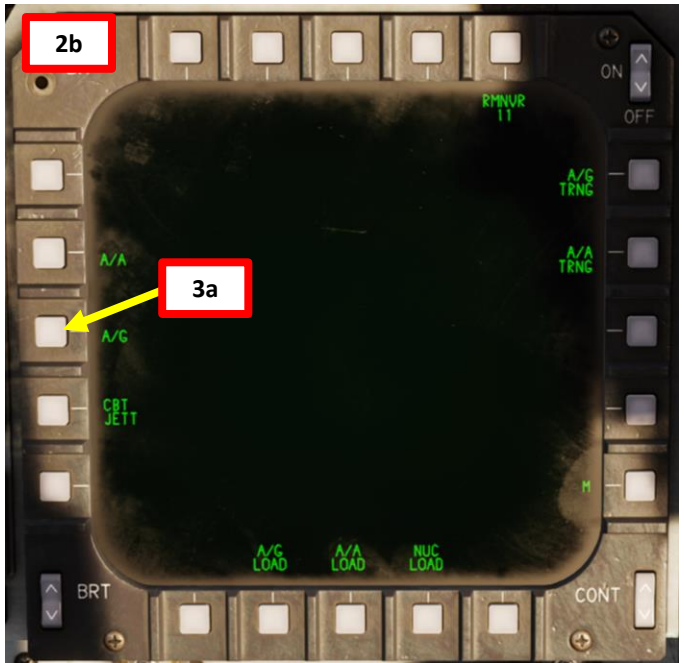
M1.2 (Target Set 1, Mission 2)
H-1 (Terminal Weapon Heading set to aircraft heading)
A0 (Default Weapon Dive Angle, 65 deg)
V0 (Default Weapon Terminal Velocity)

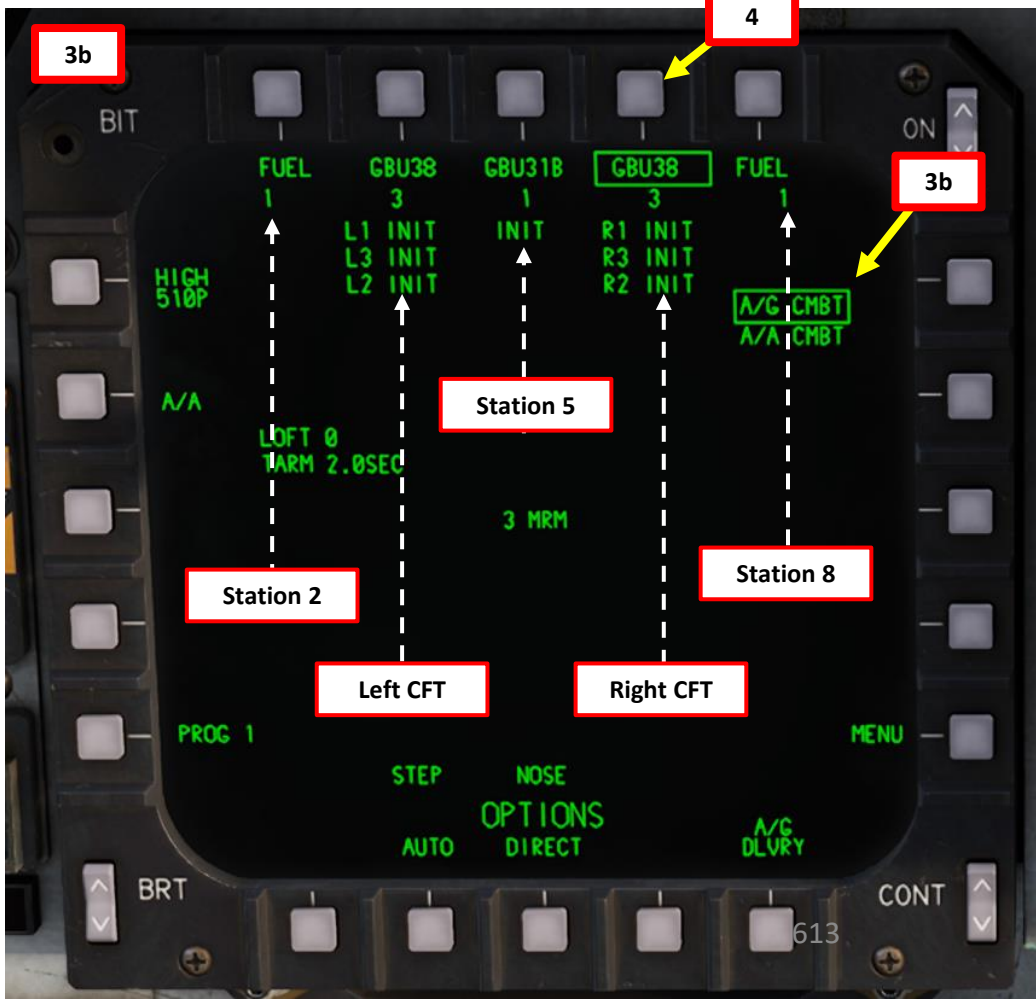
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

B – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “GBU38” (boxed when selected).
    - Note: For smart weapons, the weapon type should automatically be detected by the aircraft.

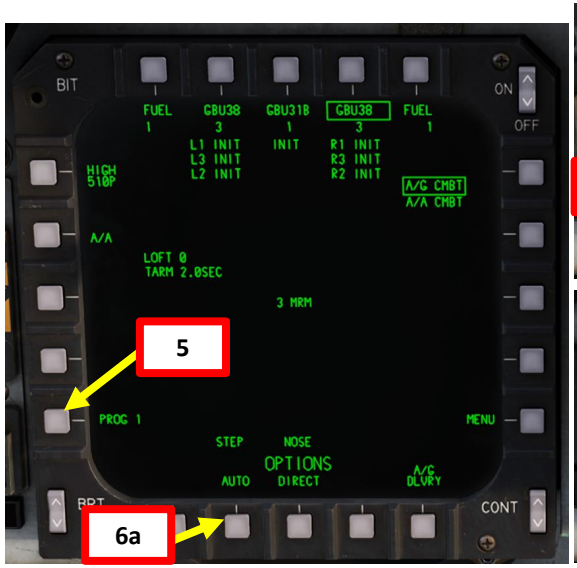


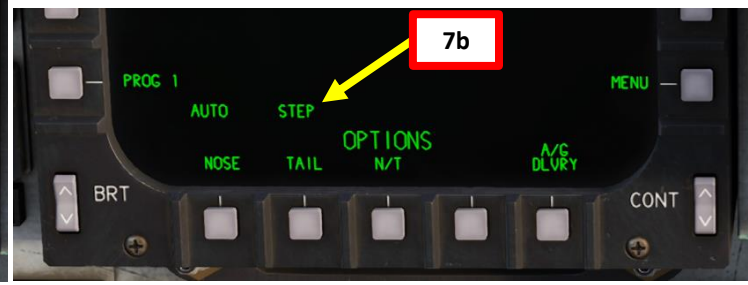




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
B – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select STEP.
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.

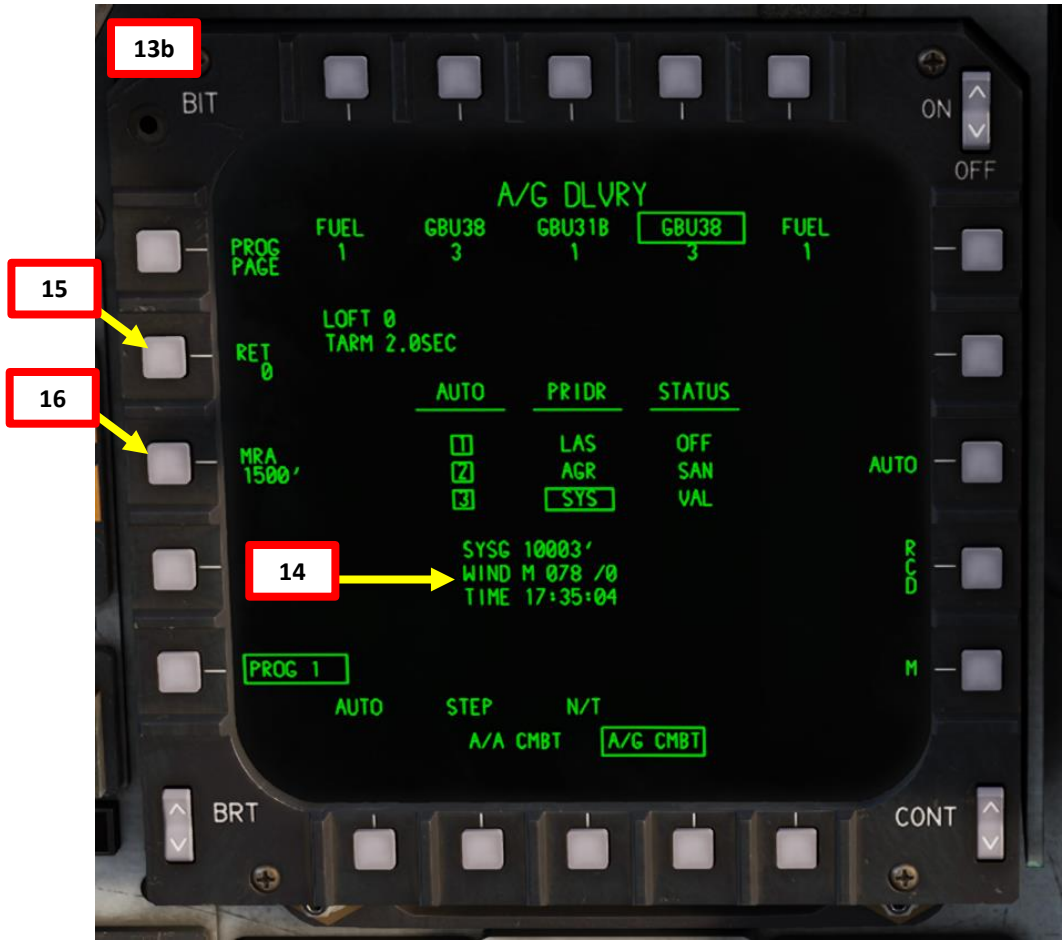




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

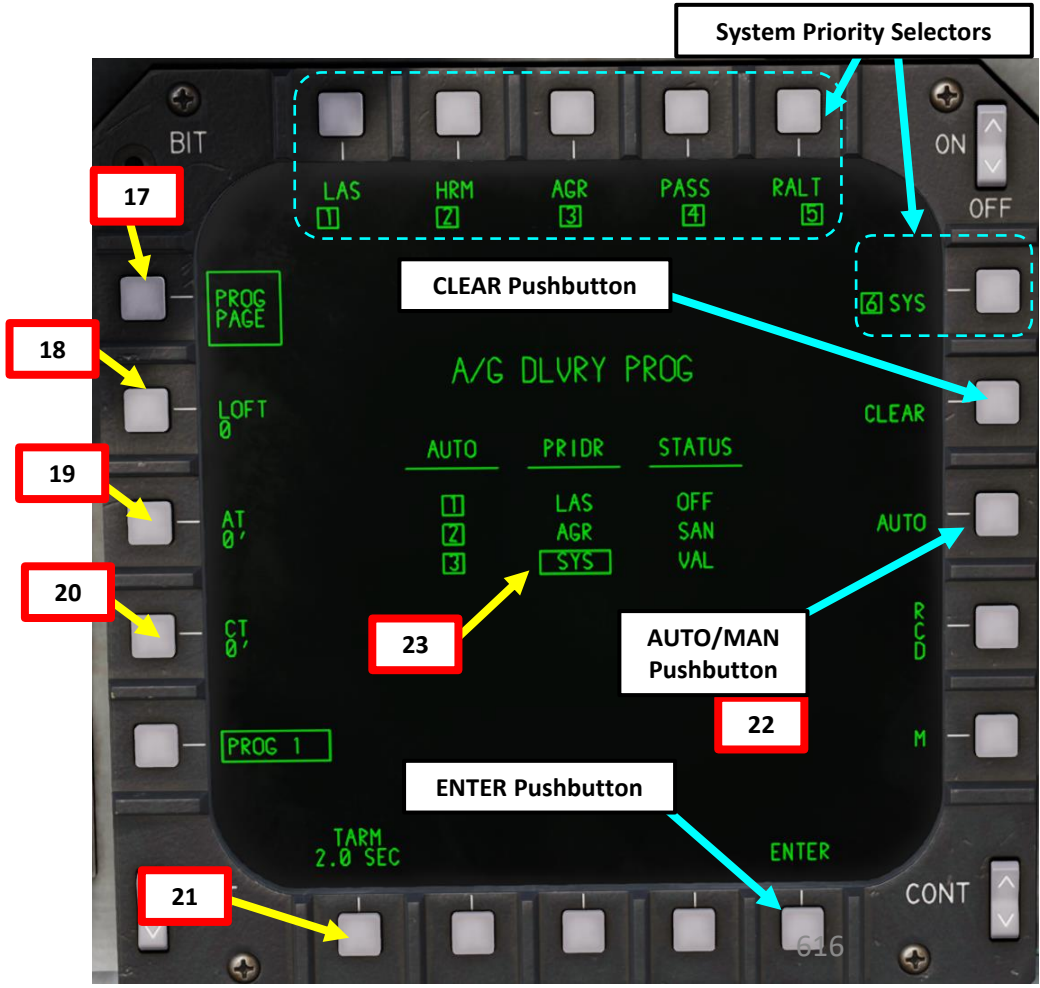
B – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.



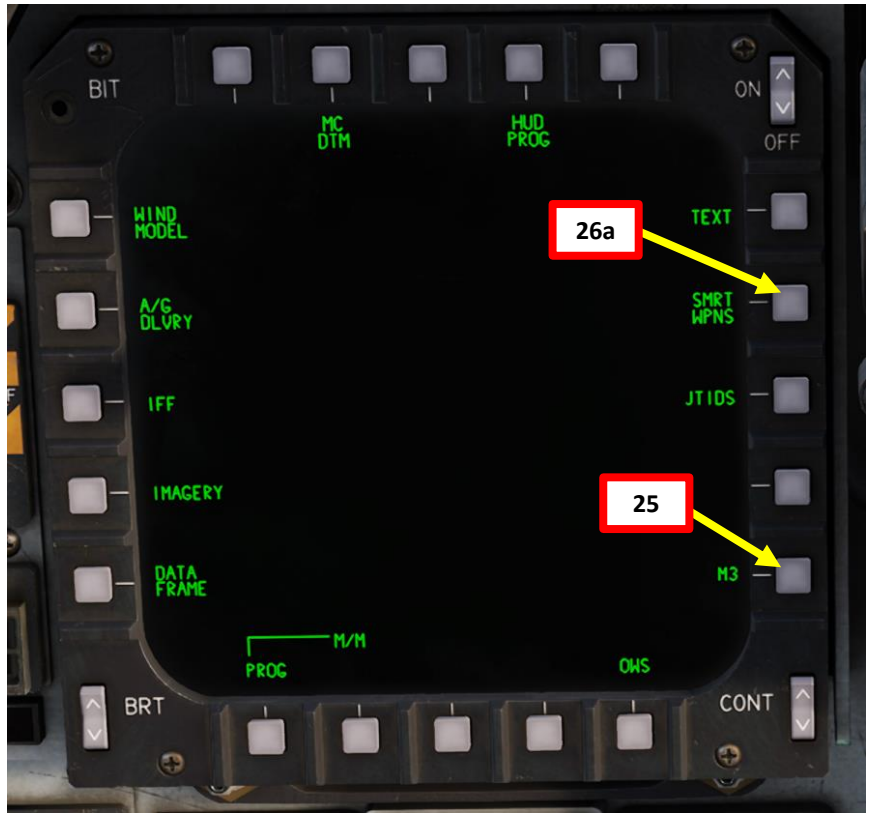
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
B – Weapon Setup

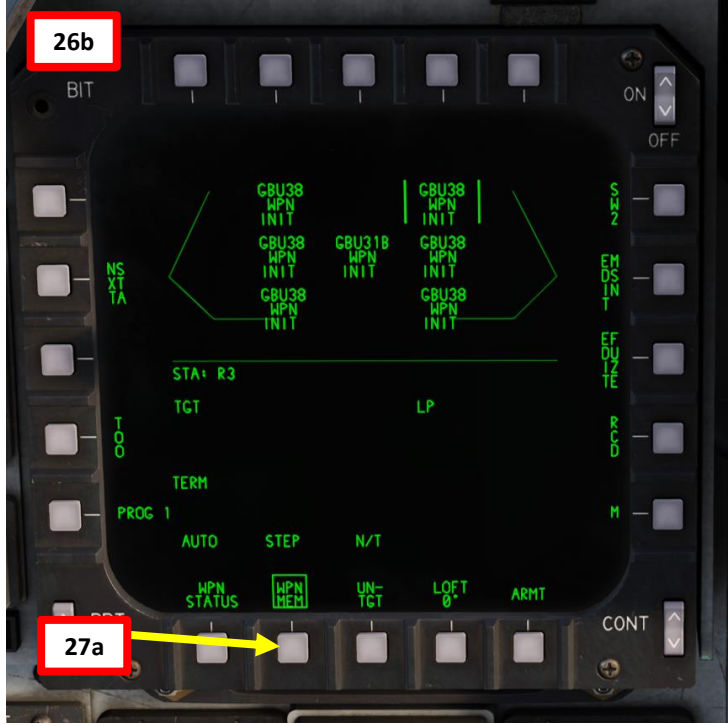
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        - *a) Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        - *b) Press CLEAR*
        - *c) Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        - *d) When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

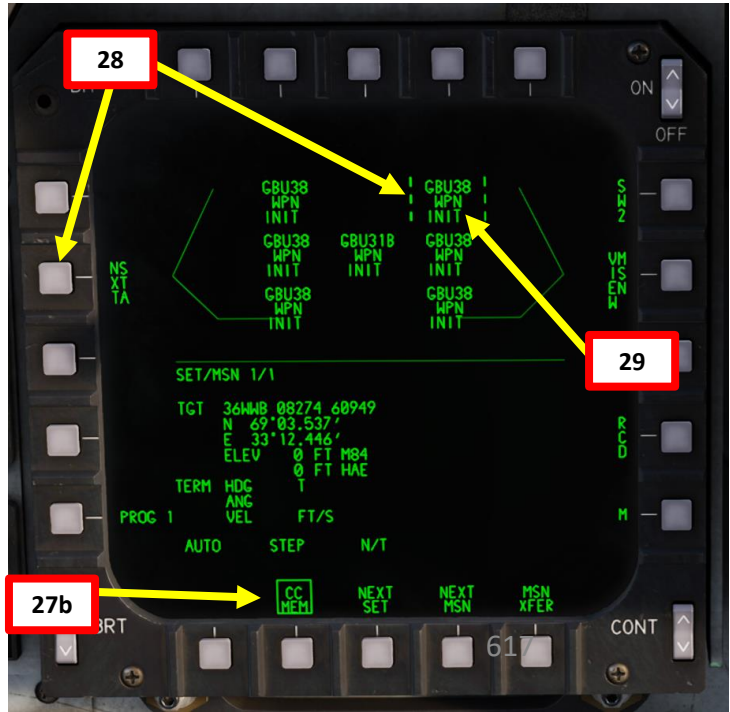


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
C – Upload Targeting Data from Central Computer to Weapon

25. Press the Menu Selection PB (Pushbutton) to toggle between MENU 1 (M) and MENU 2 (M2).
26. Select SMRT WPNS page.
27. "WPN MEM" (Weapon Memory) mode is selected by default. Select "CC MEM" (Central Computer Memory) mode.
28. Press NXT STA (Next Station) PB until desired weapon is selected (indicated by dashed goal posts).
29. "INIT" indicates that the smart weapon does not have coordinates stored in currently. We will have to enter them from the Central Computer.

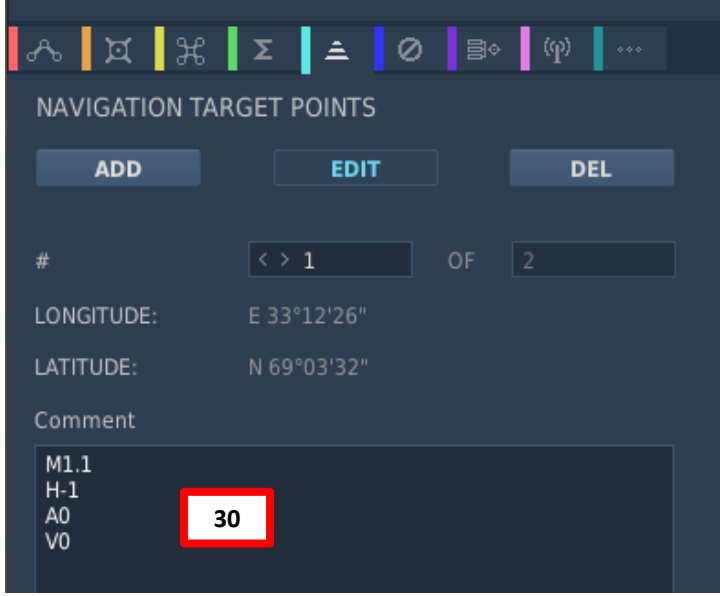


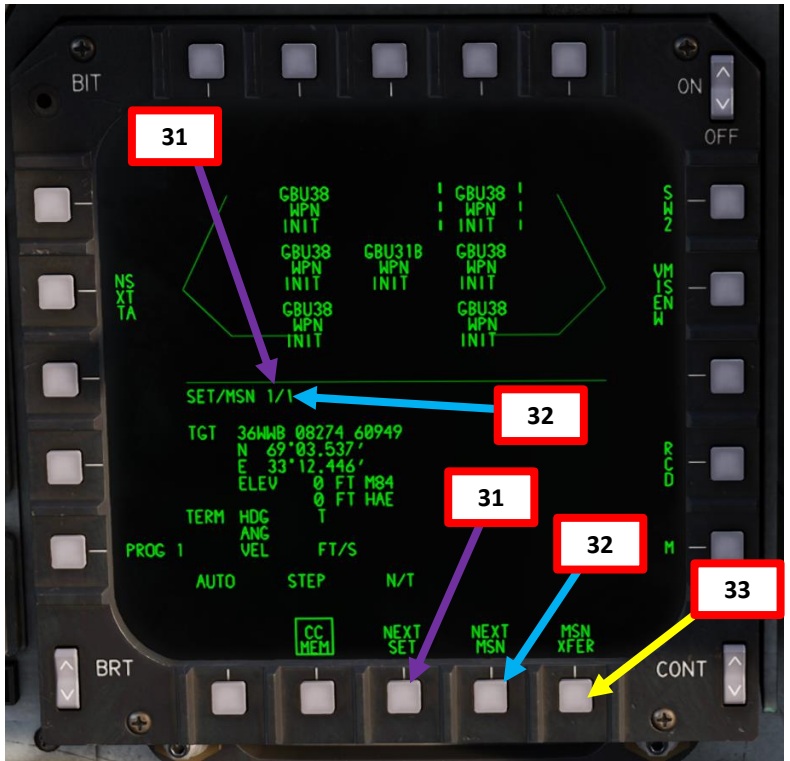


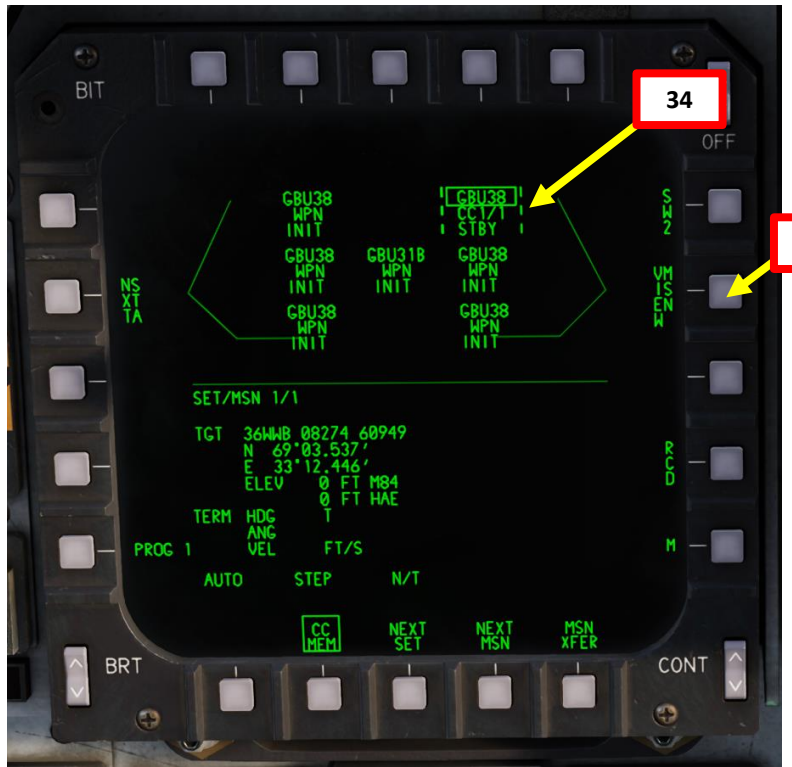


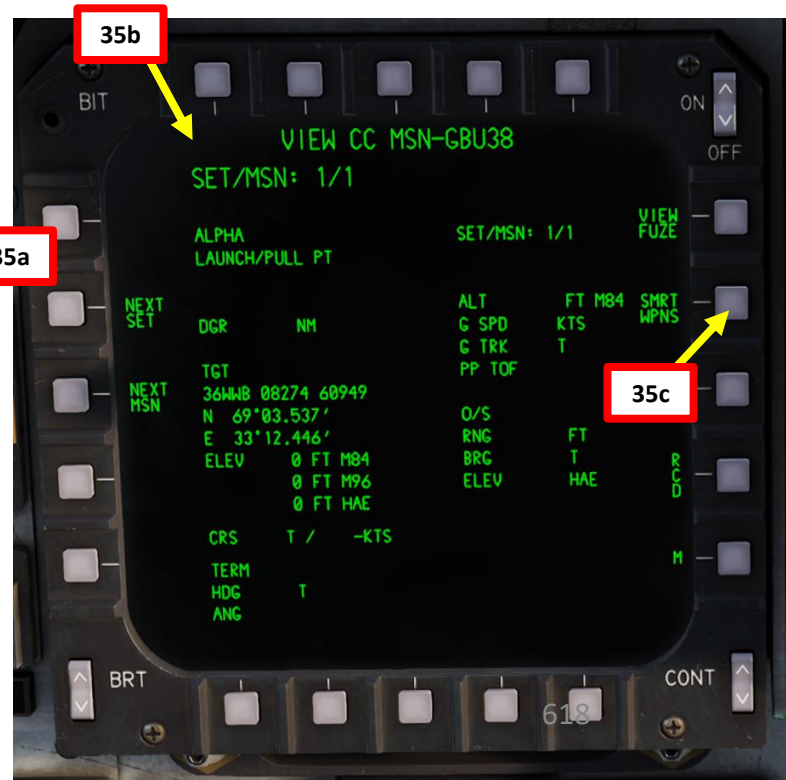
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
C – Upload Targeting Data from Central Computer to Weapon

30. **Target 1 (Submarine Pen)** is set to **Set 1 / Mission 1.**
31. Use NEXT SET button (if needed) to select Set 1.
32. Use NEXT MSN button to select Mission 1 (within Set 1).
33. Press MSN XFER (Mission Transfer) to transfer target data to the weapon.
34. Once transfer is complete, the weapon status changes from INIT to STBY. "**CC1/1**" indicates that the selected ordnance is now set for the target coordinates stored for **Set 1 / Mission 1**.
35. If desired, you can see the mission data by pressing VIEW MSN button and using the NEXT SET and NEXT MSN pushbuttons to navigate through sets and missions. To return to the SMRT WPNS page, press the SMRT WPNS button.



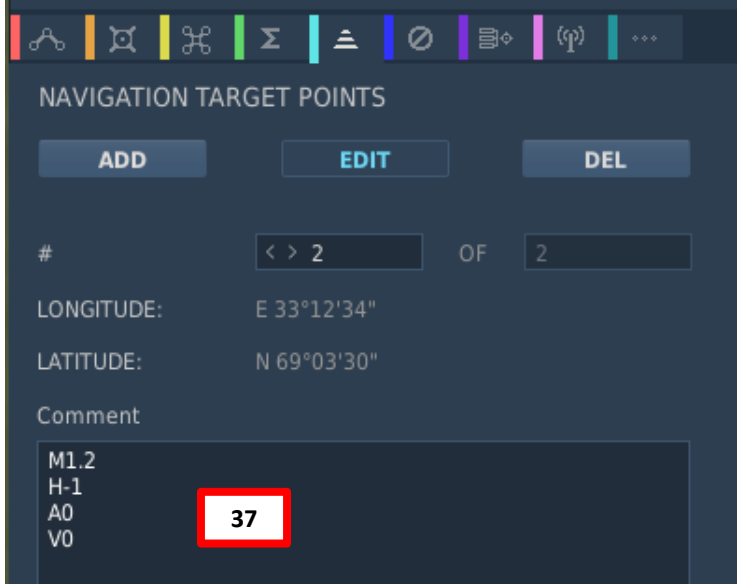


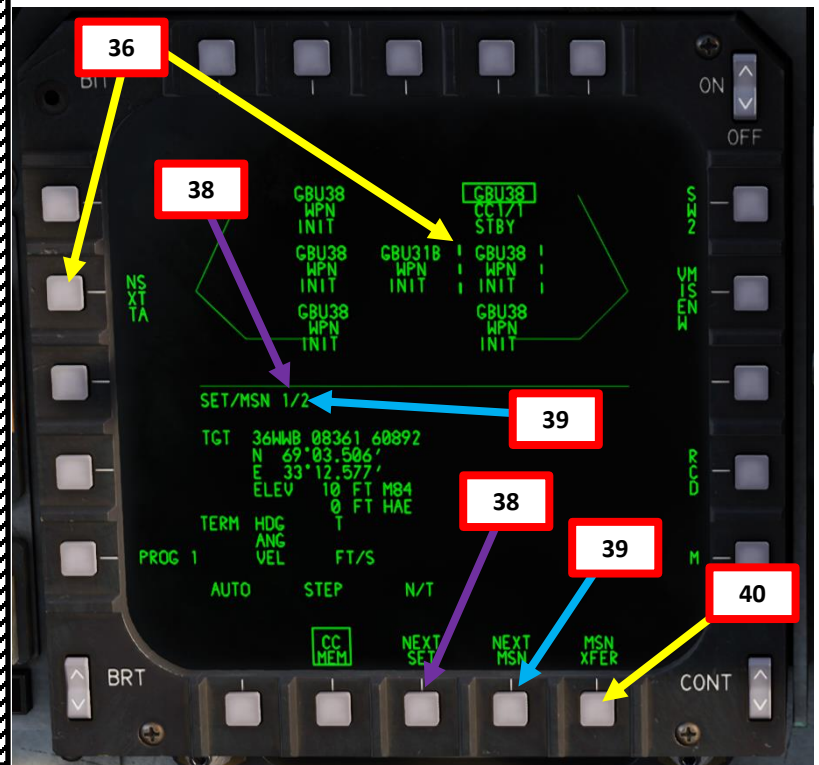


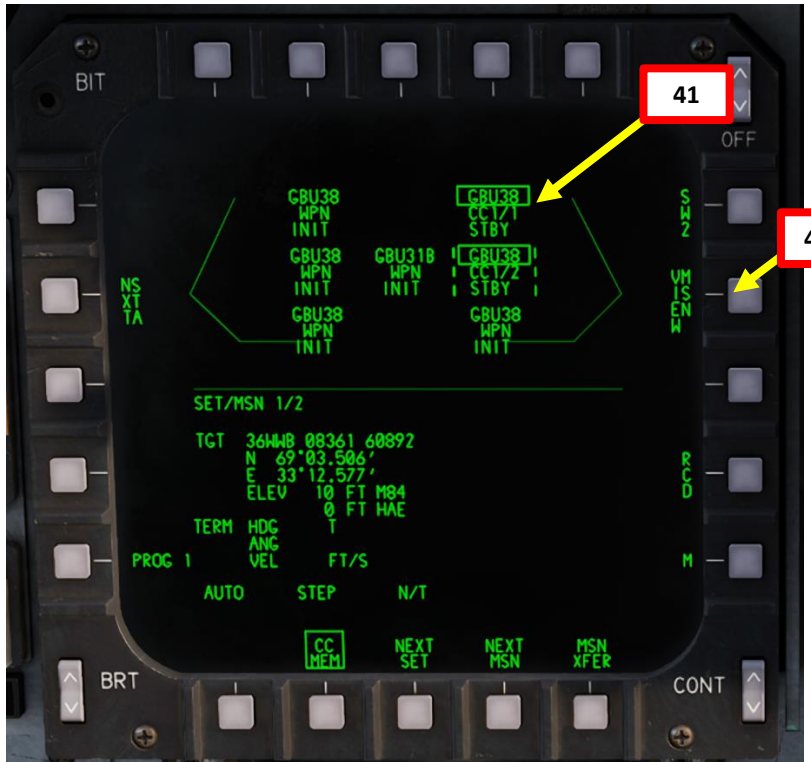


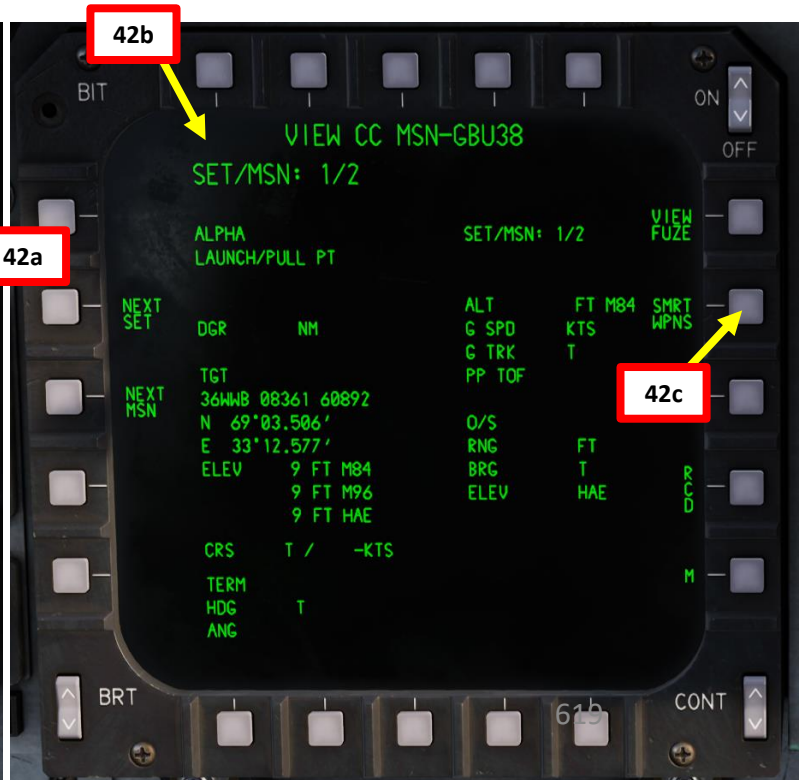
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
C – Upload Targeting Data from Central Computer to Weapon

36. Press NXT STA (Next Station) PB until desired weapon for the second target is selected (indicated by dashed goal posts).
37. **Target 2 (Building)** is set to **Set 1 / Mission 2.**
38. Use NEXT SET button (if needed) to select Set 1.
39. Use NEXT MSN button to select Mission 2 (within Set 1).
40. Press MSN XFER (Mission Transfer) to transfer target data to the weapon.
41. Once transfer is complete, the weapon status changes from INIT to STBY. "**CC1/2**" indicates that the selected ordnance is now set for the target coordinates stored for **Set 1 / Mission 2**.
42. If desired, you can see the mission data by pressing VIEW MSN button and using the NEXT SET and NEXT MSN pushbuttons to navigate through sets and missions. To return to the SMRT WPNS page, press the SMRT WPNS button.









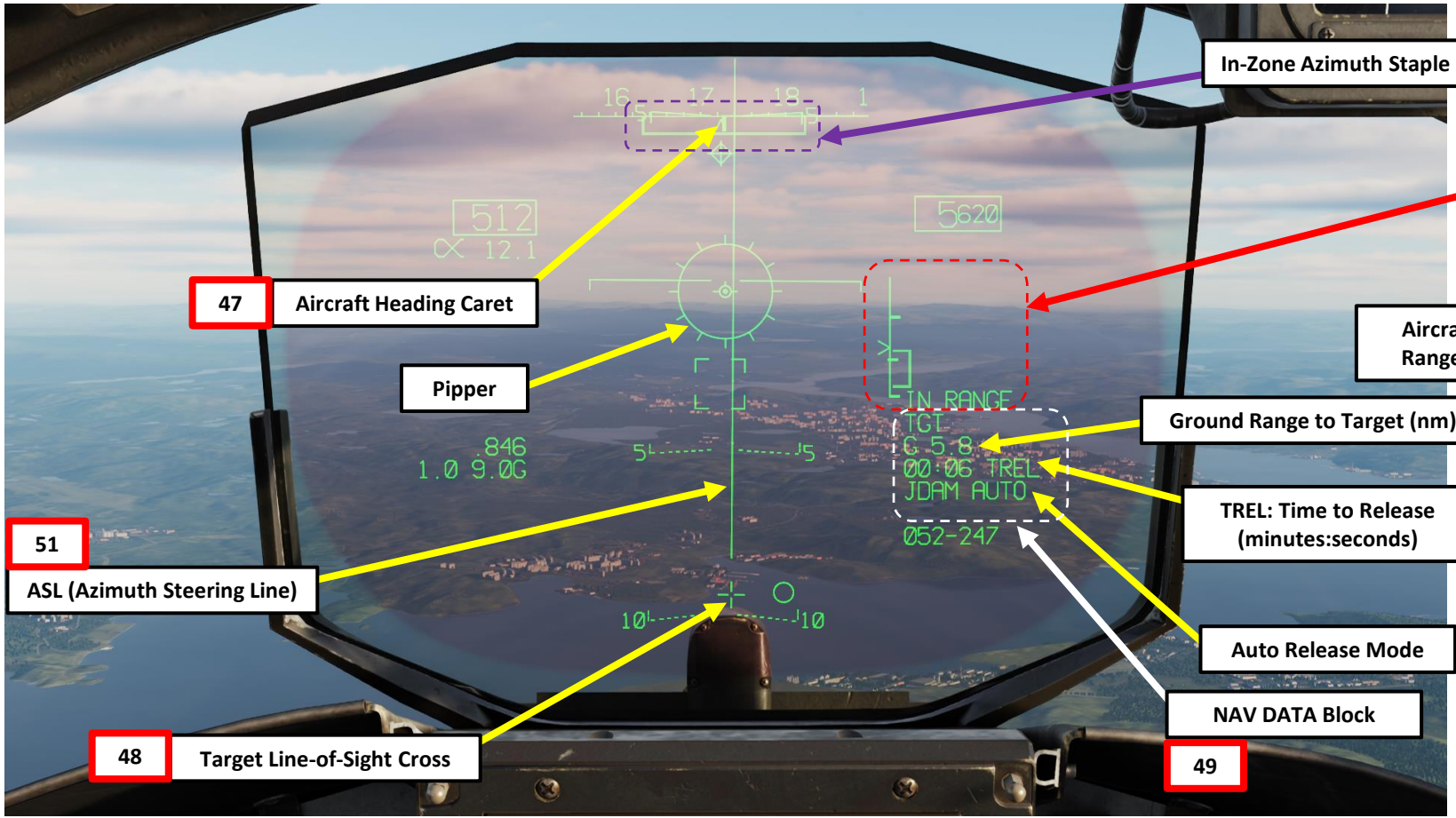
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

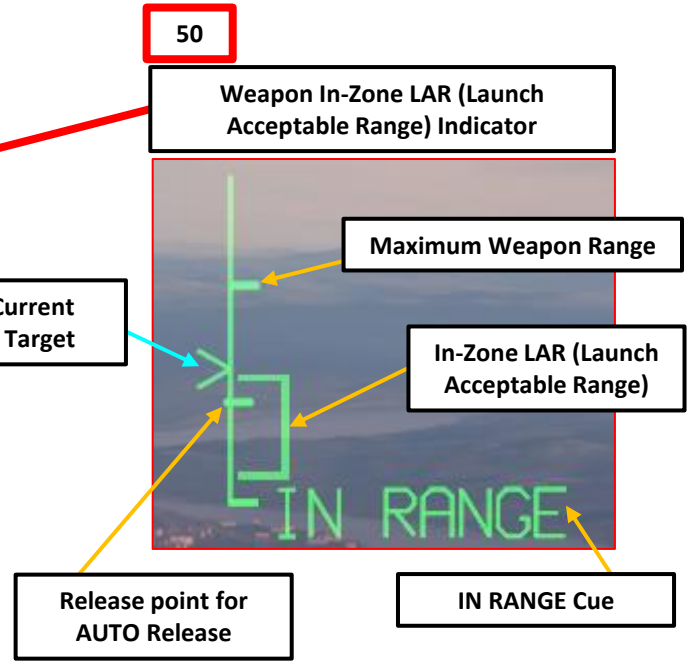
D – Weapon Arming

43. Set Master Arm Switch – ARM (UP)
44. Check ARMT (PACS) page that weapon status indicates STBY (Standby).
45. Check HUD (Heads-Up Display) that the weapon status indicates JDAM AUTO..

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
E – Perform Attack

46. From an altitude of at least 5000 ft (optimal between 10000 ft and 15000 ft), fly level. Airspeed should be above 450 kts.
47. Steer the aircraft to line up the aircraft heading caret within the In-Zone Azimuth Staple on the HUD (Heads-Up Display).
48. The target line-of-sight cross indicates the location of the target.
49. Check NAV DATA Block and Weapon In-Zone LAR (Launch Acceptable Range) symbology on the HUD for target range information.
50. The IN RANGE cue indicates that you are in range to the target, but that the weapon cannot achieve all programmed terminal parameters yet.
51. When you are within maximum range, the ASL (Azimuth Steering Line) becomes visible on the HUD. Keep the ASL centered on the pipper.



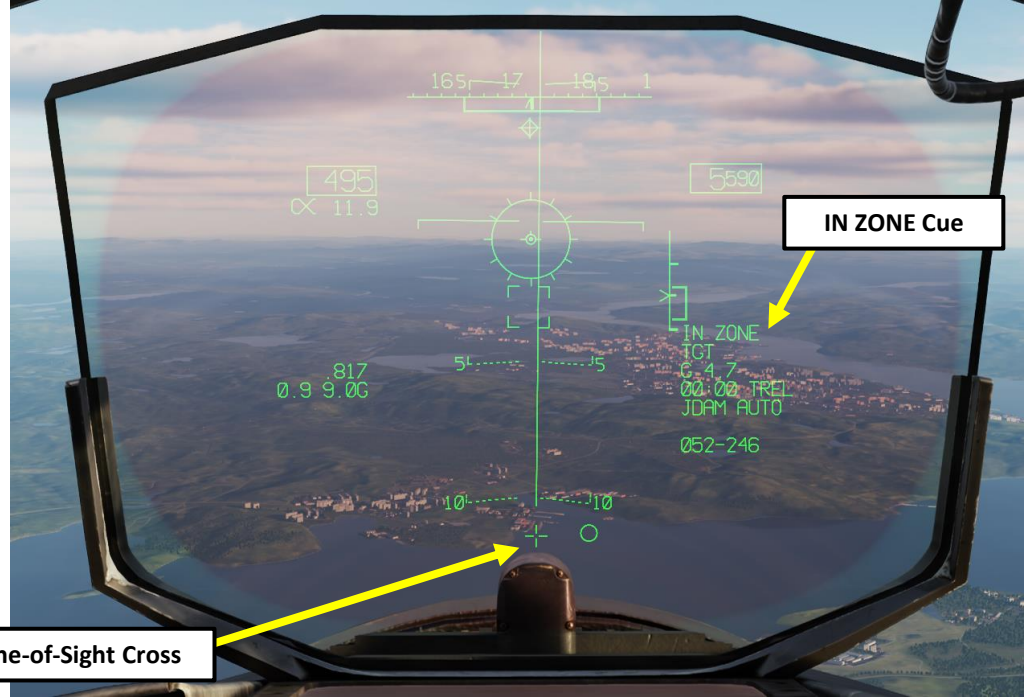


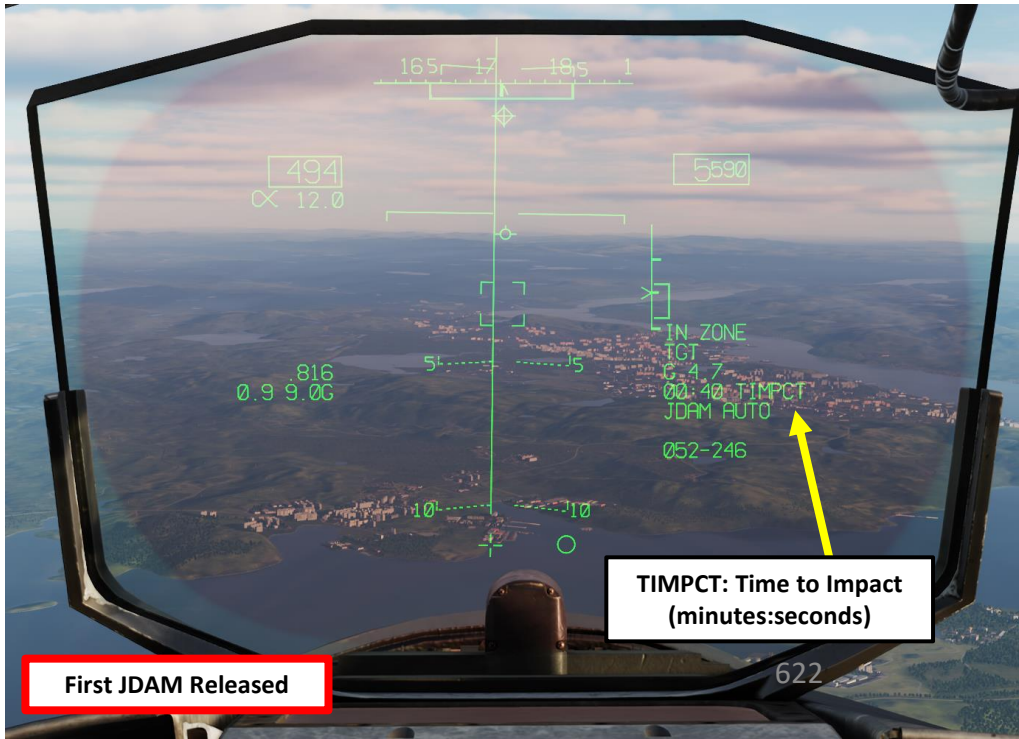
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

E – Perform Attack

52. The IN ZONE cue indicates that you are in range to the target and that the weapon can achieve all programmed terminal parameters. You may then deliver your ordnance.
    - **Note about Auto mode**: Before reaching the release point, the Weapon Release/Pickle button will be cold (will not release when pressed).
53. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) a first time to release first JDAM. The weapon will home on the coordinates uploaded into it previously.

53
54
Weapon Release (Pickle) Button

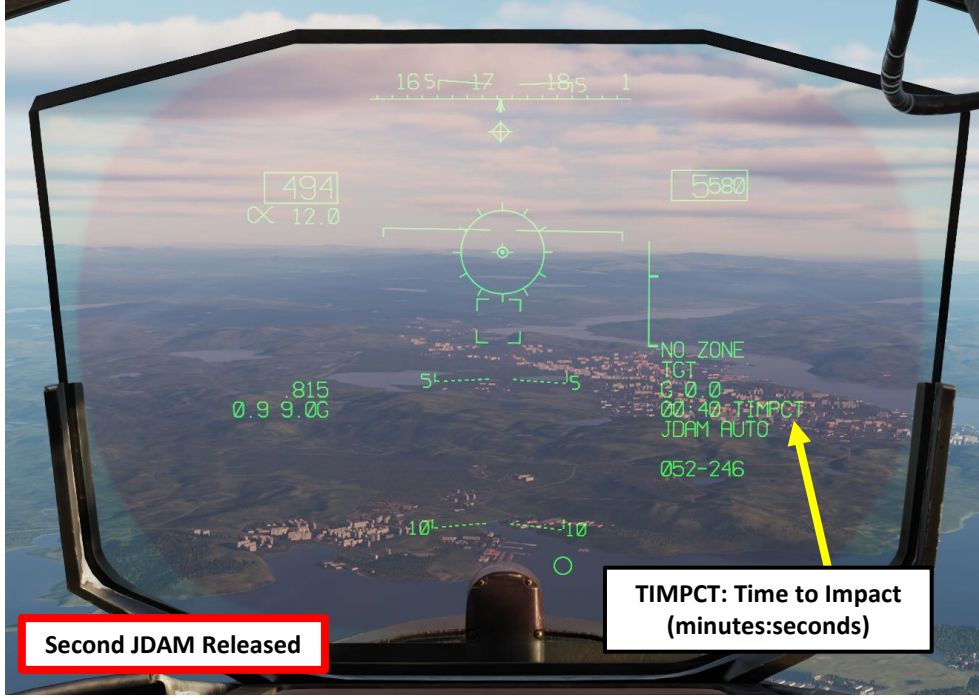




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode

E – Perform Attack

54. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) a second time to release second JDAM. The weapon will home on the coordinates uploaded into it previously.
55. Once bombs are dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds).



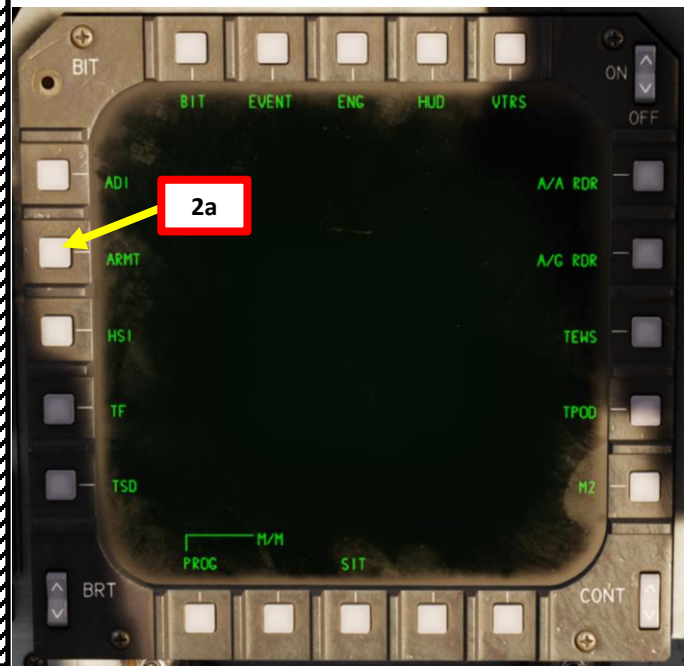
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.2 – GBU-38 JDAM
Pre-Planned Target (CC MEM) with Auto Mode
E – Perform Attack

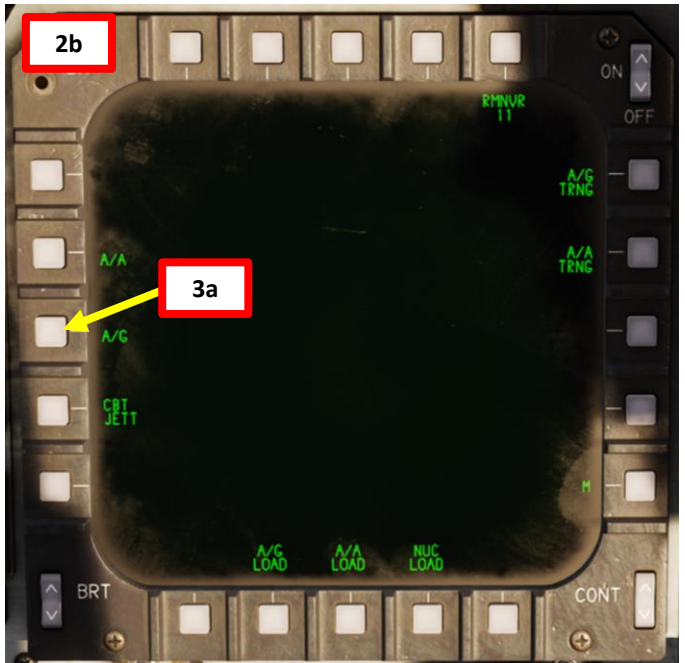
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW

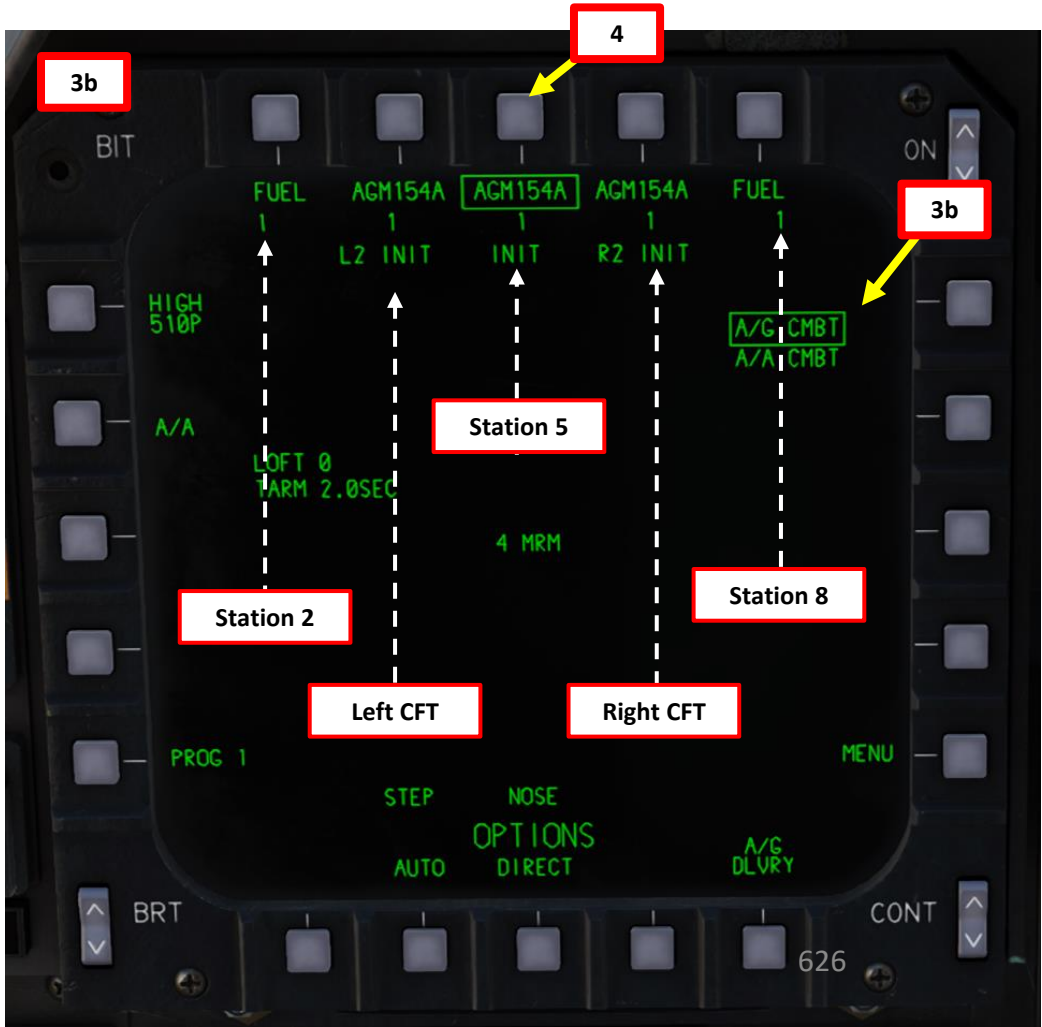
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “AGM154A” (boxed when selected).
    - Note: For smart weapons, the weapon type should automatically be detected by the aircraft.



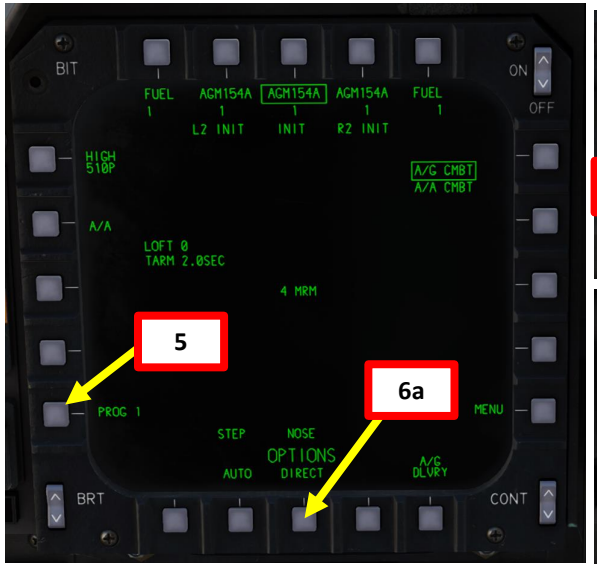


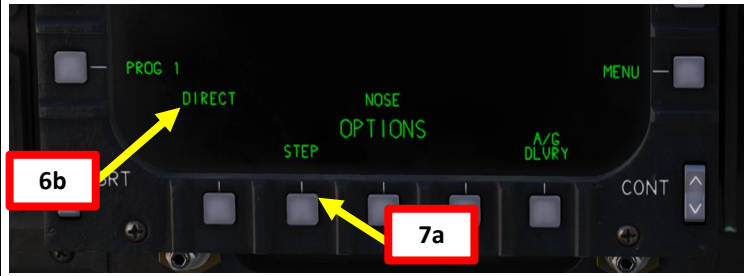


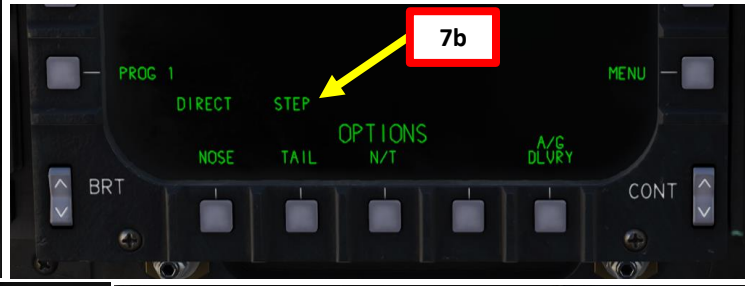
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

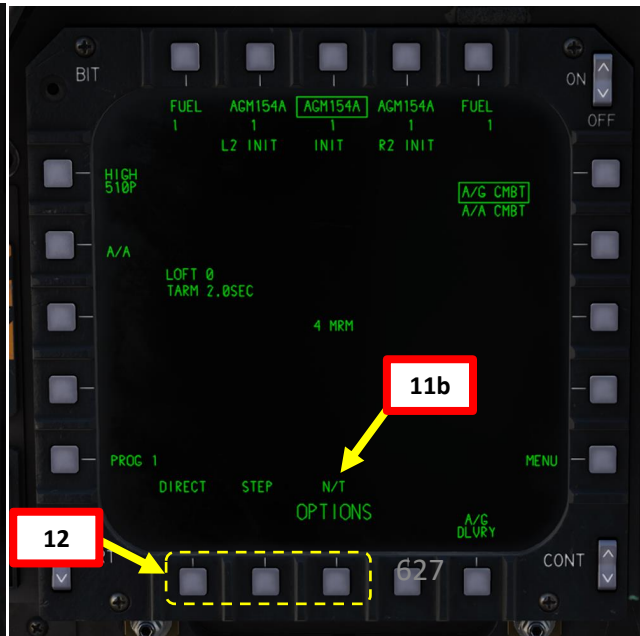
A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select STEP.
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.





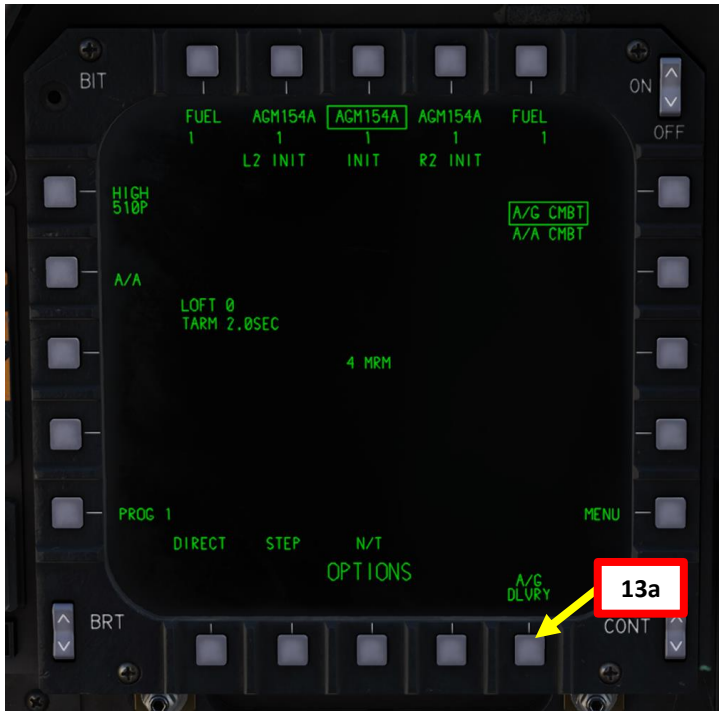


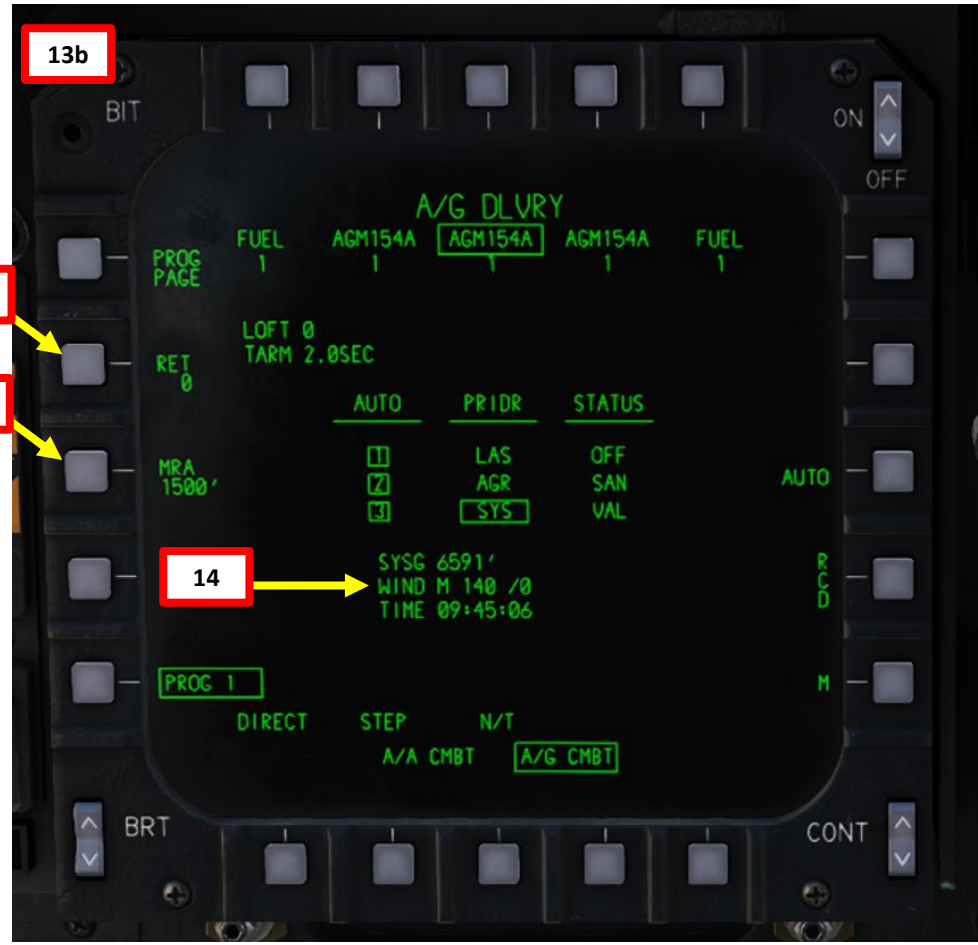


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

A – Weapon Setup

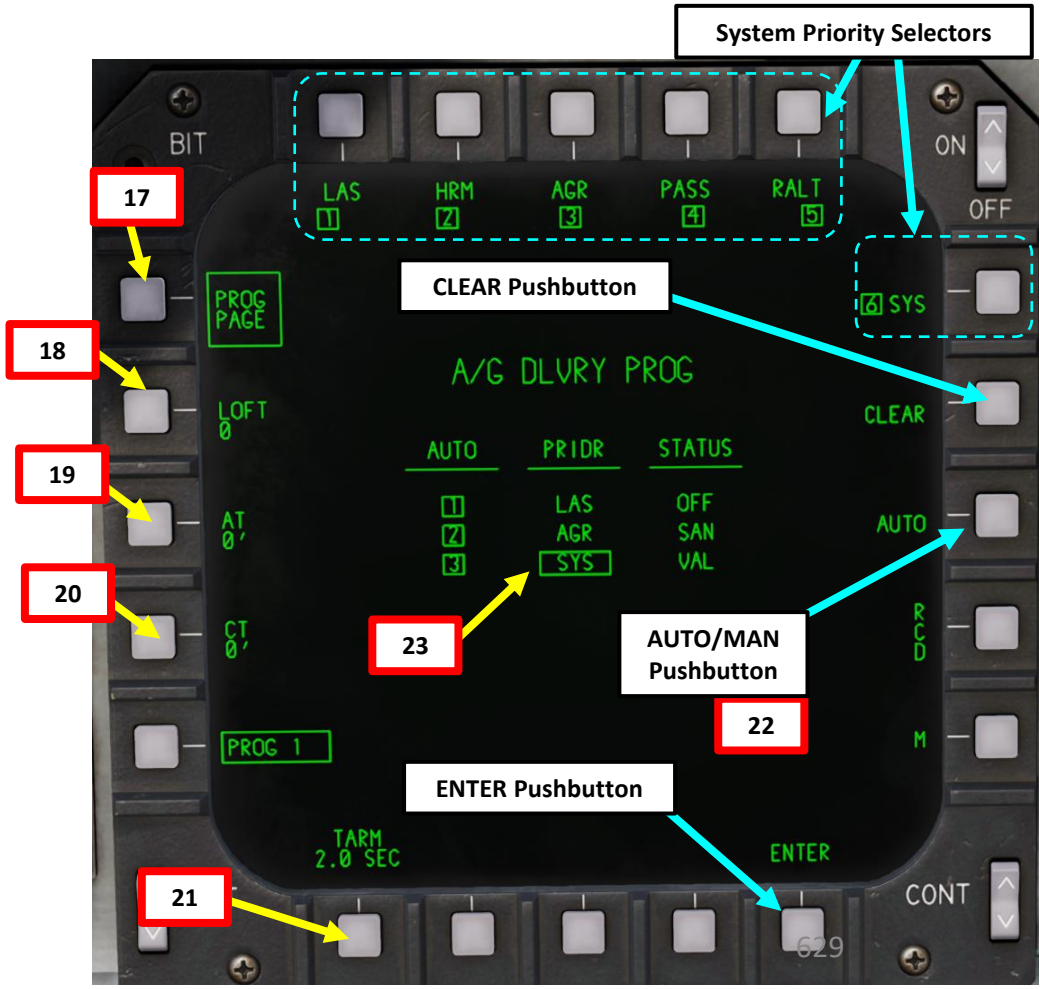
13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.





2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
A – Weapon Setup

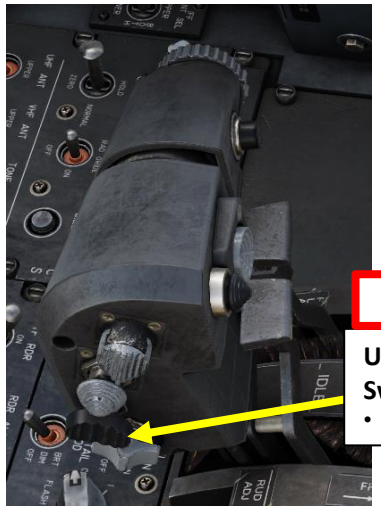
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

B – Weapon Arming & Target Designation

25. Set Master Arm Switch – ARM (UP)
26. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
27. In this tutorial, we will assume Steerpoint No. 2 is already created and set over the target. However, we have not selected it yet.



Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

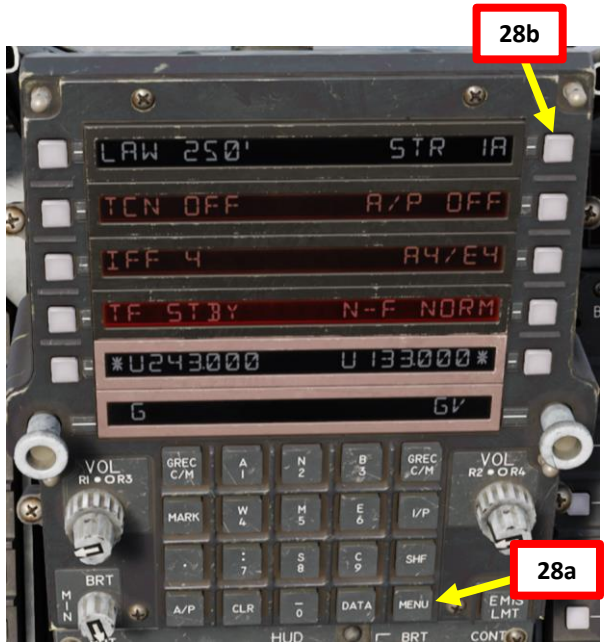
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

B – Weapon Arming & Target Designation

28. The target is located on Steerpoint No. 2. We will have to convert our existing Steerpoint No. 2 into a Target Point No. 2, which is referred as "2." (two, followed by a dot).
    a) Select UFC (Upfront Control Panel) MENU 1.
    b) Press pushbutton next to STR to select Steerpoint Menu.
    c) On UFC scratchpad, type "2".
    d) Press pushbutton next to STR. Steerpoint No. 2 is now selected.
    e) On UFC scratchpad, type "2", then "." after (two, followed by a dot).
    f) Press pushbutton next to STR. Steerpoint No. 2 is now converted into Target Point "2.".
    g) Return to UFC MENU 1.

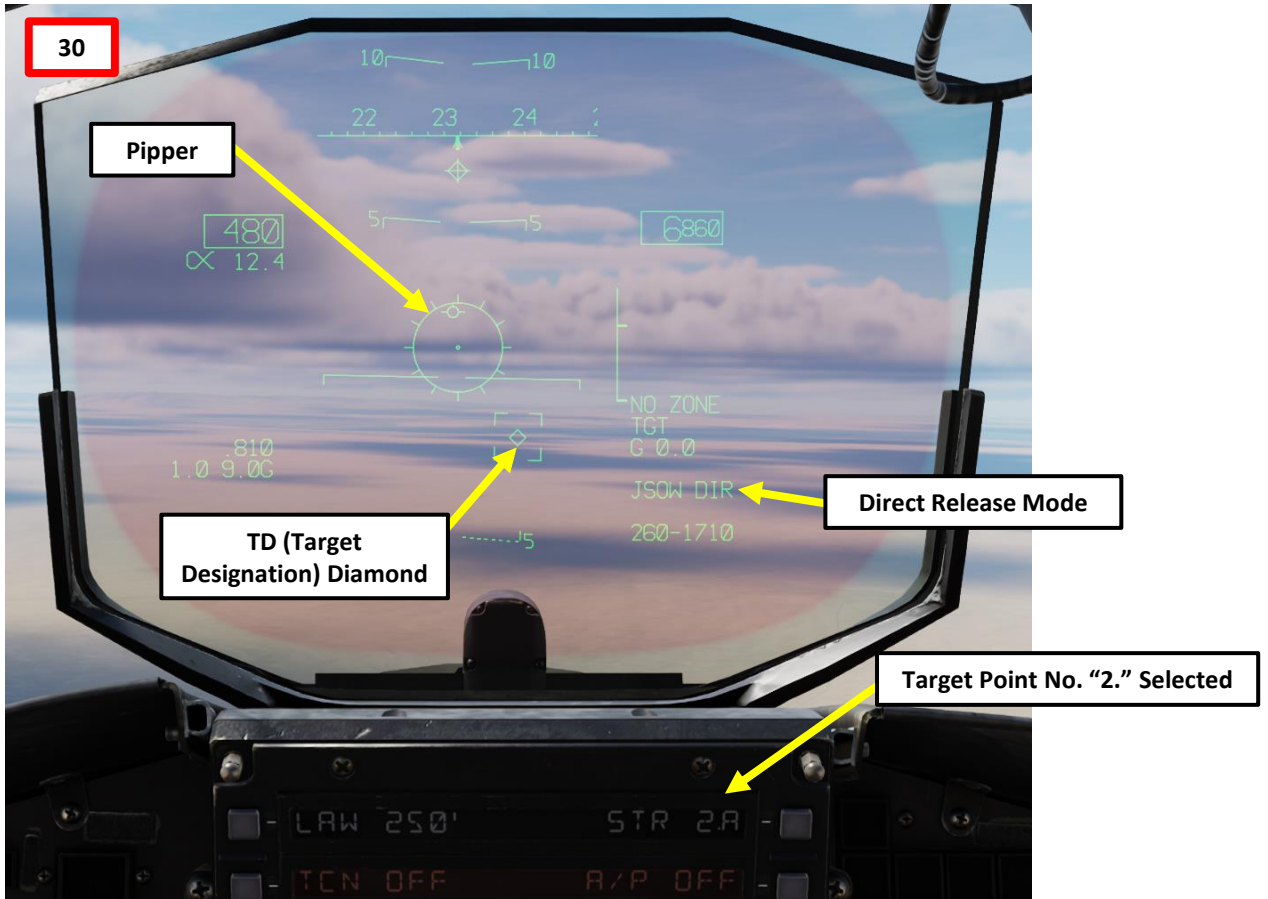
TSD (Tactical Situation Display) Page
Steerpoint "2" (Not converted to Target Point)

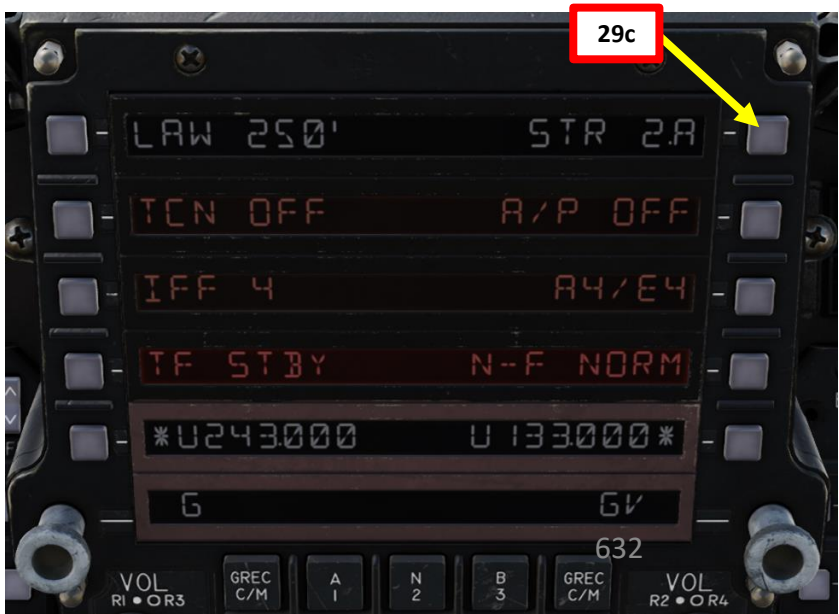
TSD (Tactical Situation Display) Page
Target Point "2."



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
B – Weapon Arming & Target Designation

29. Select Target Point No.2 (2.).
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type "2", then "." after (two, followed by a dot).
    c) Press pushbutton next to STR to select Steerpoint Menu.
    d) Target Point No. 2 (2.) is now selected.
30. If the weapons are selected and set up for DIRECT delivery, a TD (Target Designation Diamond) will appear. However, since we have not uploaded coordinates to the JSOW yet, there is currently no range information available.





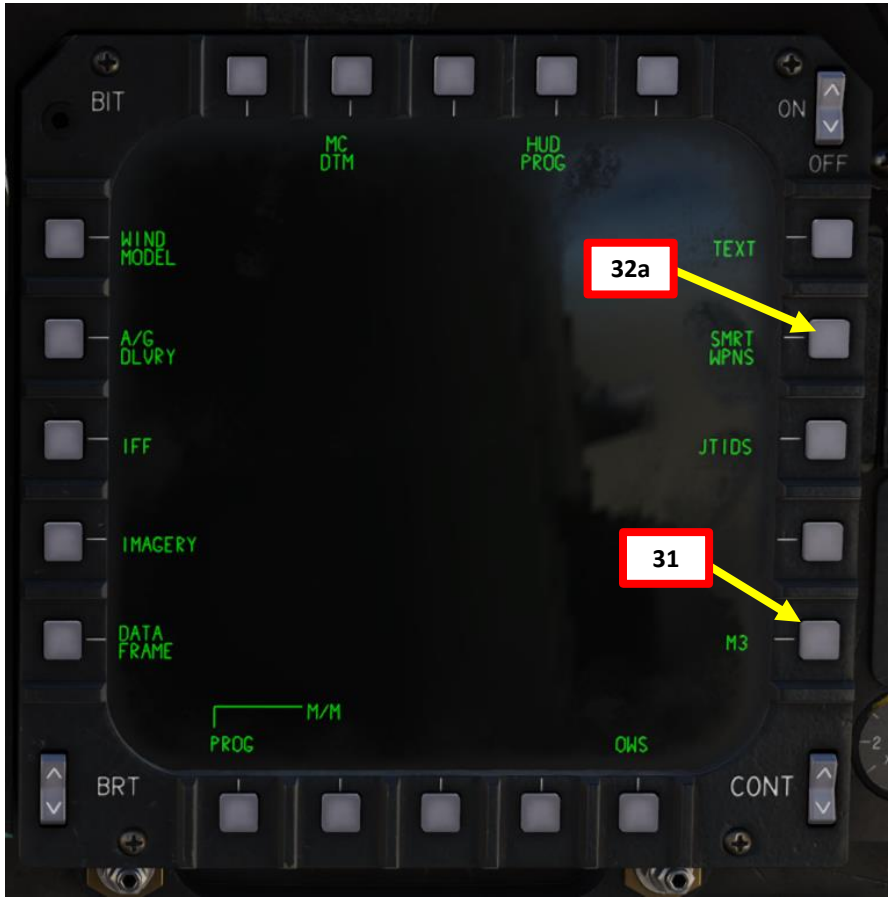
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
C – Upload Targeting Data from Onboard Sensor (Sequence Point) to Weapon

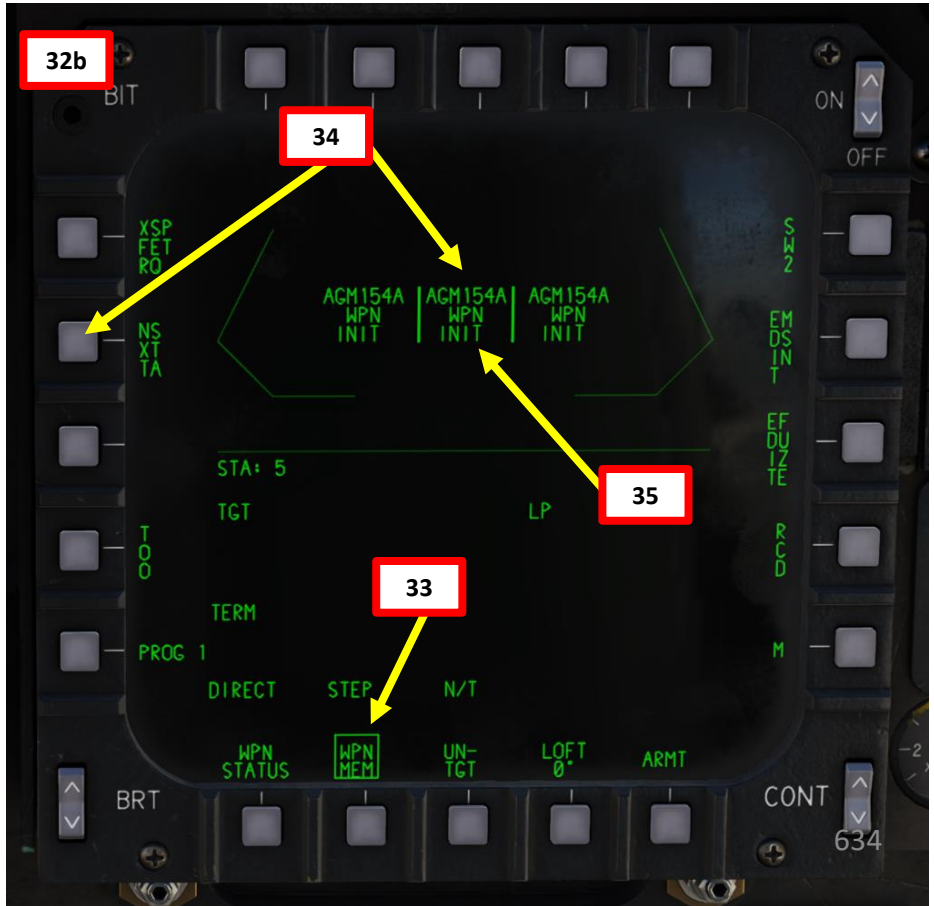
The target is an oil depot. In our navigation flight plan database, we have Sequence Point 2, which is relatively close to the target. In this tutorial, we will first use Sequence Point 2 as an initial input to the JSOW. We will then edit those coordinates and replace them with more accurate ones.

As an example, the **target coordinates of the oil depot** are obtained on the **F10 map by holding ALT, then clicking on the target**. The COORDINATES box will display the required coordinates in Lat Long Decimal Minutes format.

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
C – Upload Targeting Data from Onboard Sensor (Sequence Point) to Weapon

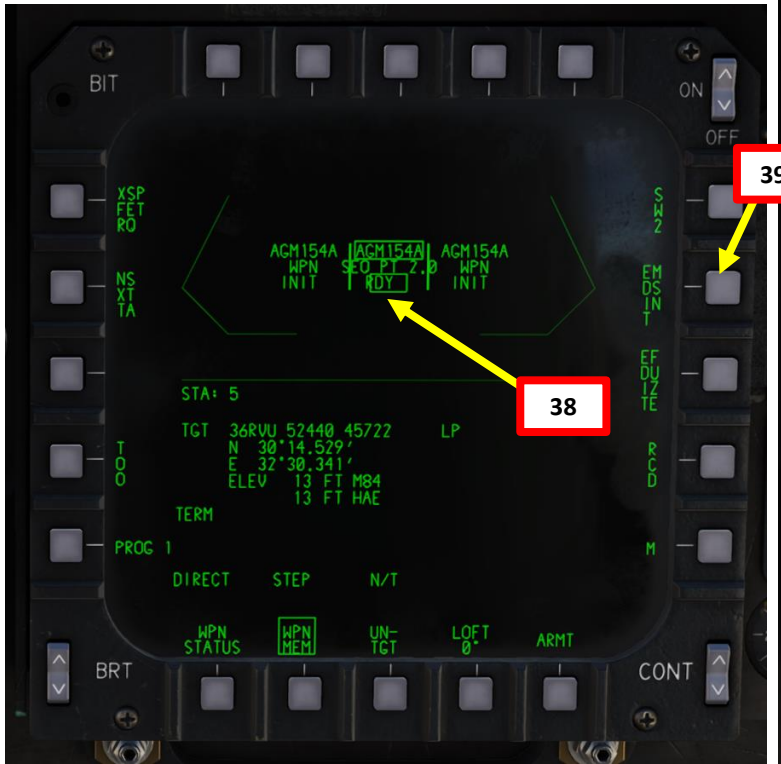
31. Press the Menu Selection PB (Pushbutton) to toggle between MENU 1 (M) and MENU 2 (M2).
32. Select SMRT WPNS page.
33. "WPN MEM" (Weapon Memory) mode is selected by default.
34. Press NXT STA (Next Station) PB until desired weapon is selected (indicated by goal posts).
35. "INIT" indicates that the smart weapon does not have coordinates stored in currently. We will have to enter them from an onboard sensor, which is the Sequence Point.

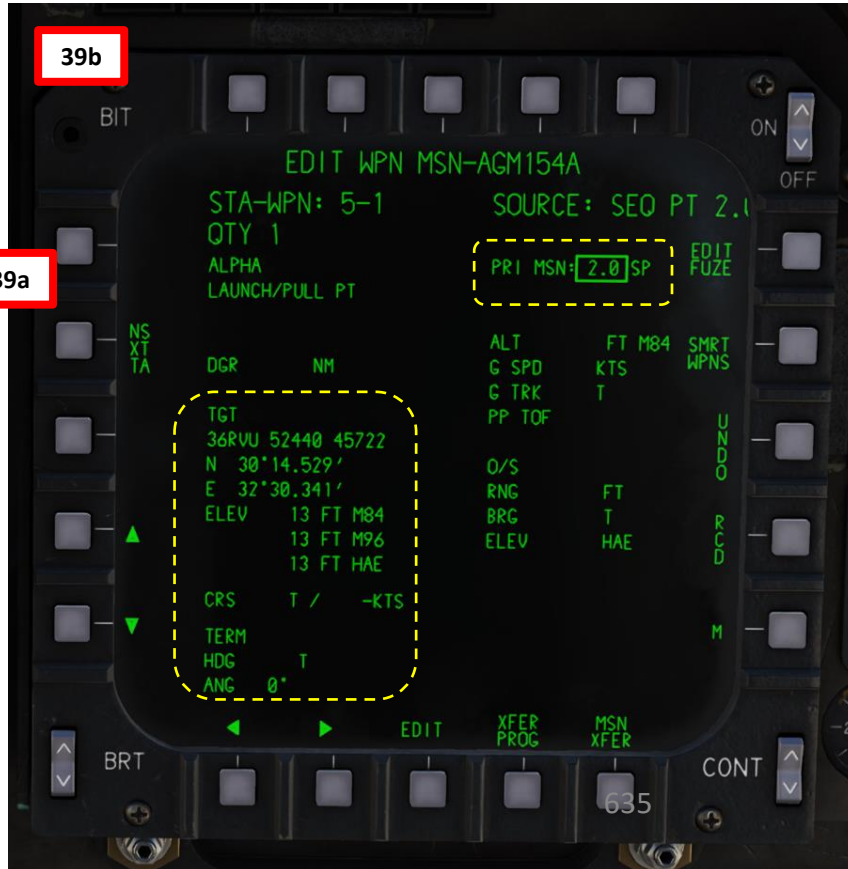




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
C – Upload Targeting Data from Onboard Sensor (Sequence Point) to Weapon

36. **We will upload target coordinates from "Sequence Point 2.".**
37. Press XFR SEQ PT (Transfer Sequence Point) to transfer target data to the weapon.
38. Once transfer is complete, the weapon status changes from INIT to RDY. "**SEQ PT 2.0**" indicates that the selected ordnance is now set for the target coordinates stored for "**Sequence Point 2.**", as shown in the "PRI MSN 2.0 SP" data field**.**
39. Press EDIT MSN button to edit mission and terminal parameters. From this page, you can see the current target coordinates.

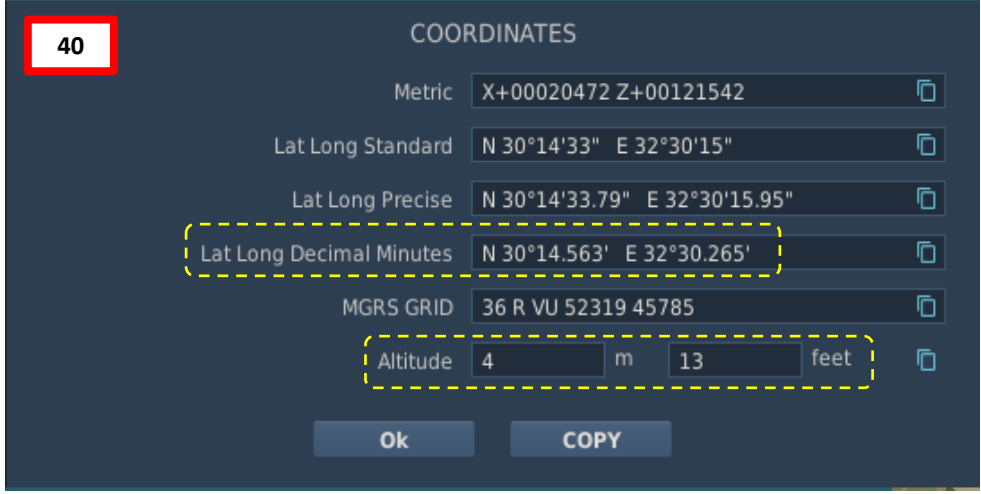


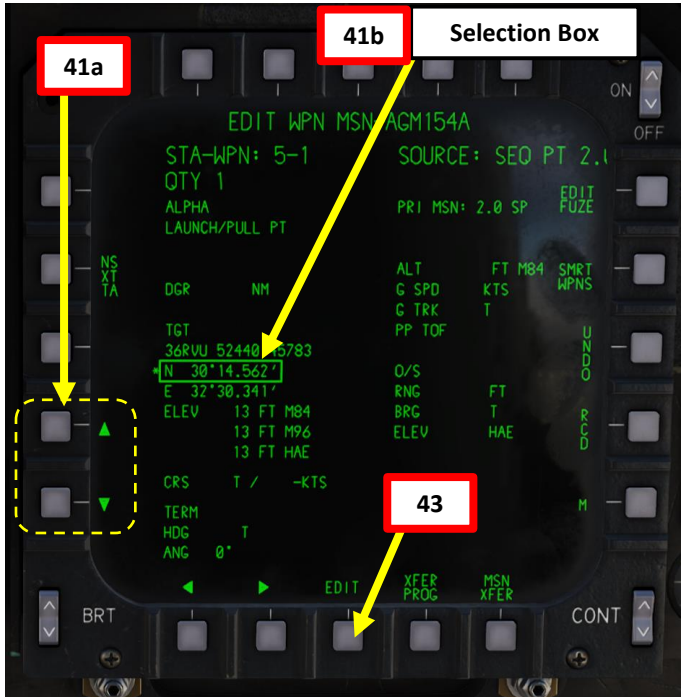


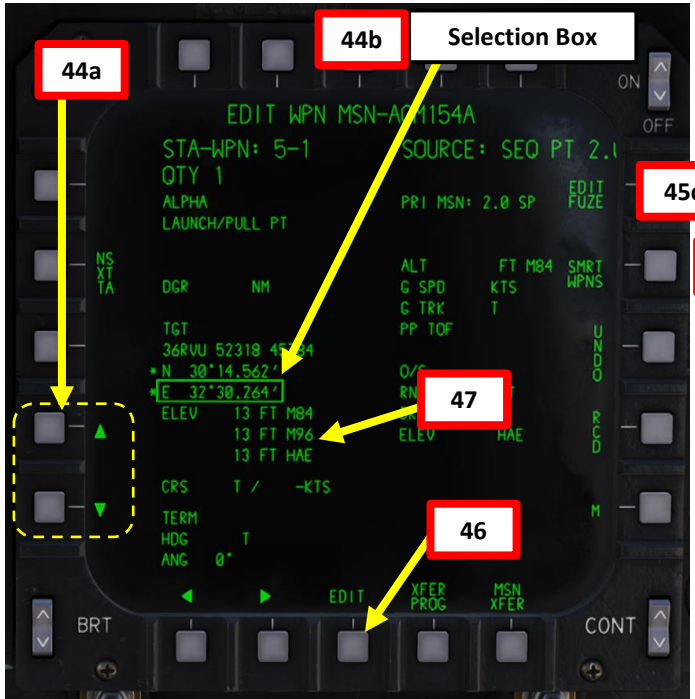
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

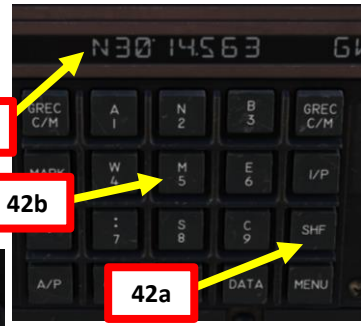
C – Upload Targeting Data from Onboard Sensor (Sequence Point) to Weapon

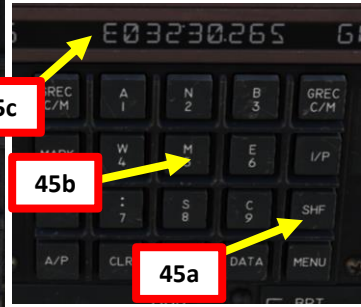
40. **We will edit target coordinates to use the oil depot coordinates we obtained from the F10 map (by using ALT and clicking on the target) instead of Sequence Point 2.**
    - **Coordinates: North 30°14.563' East 032°30.265'**
41. Use UP and DOWN arrow buttons to move the selection box to the target coordinates latitude field.
42. On UFC (Upfront Control Panel) keypad, enter target latitude: **North 30 14.563** (deg minutes.decimal-minutes).
    - Use "SHF" then "2 (N)" button to select "North", then type "3014563"
43. Press EDIT to update the latitude field. An edited field is preceded by an asterisk *.
44. Use UP and DOWN arrow buttons to move the selection box to the target coordinates longitude field.
45. On UFC (Upfront Control Panel) keypad, enter target longitude: **East 032 30.265** (deg minutes.decimal-minutes).
    - Use "SHF" then "6 (E)" button to select "East", then type "03230265"
46. Press EDIT to update the longitude field. An edited field is preceded by an asterisk *.
47. In this example, target altitude will be left as is (13 ft) since it is already set to the correct value. Editing that value is done the same way as previously done for LAT/LONG.







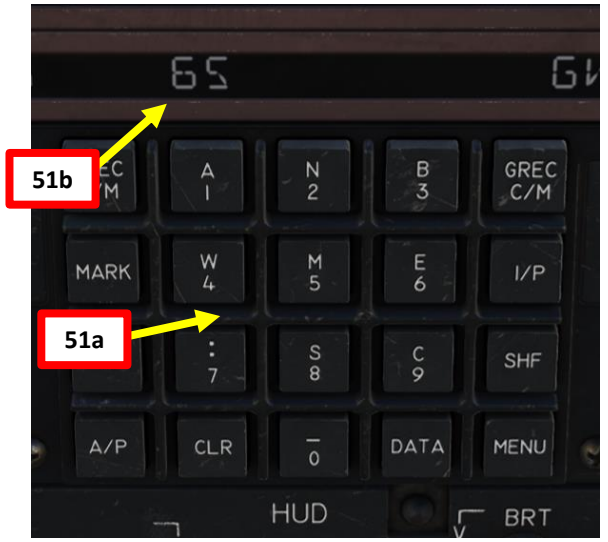




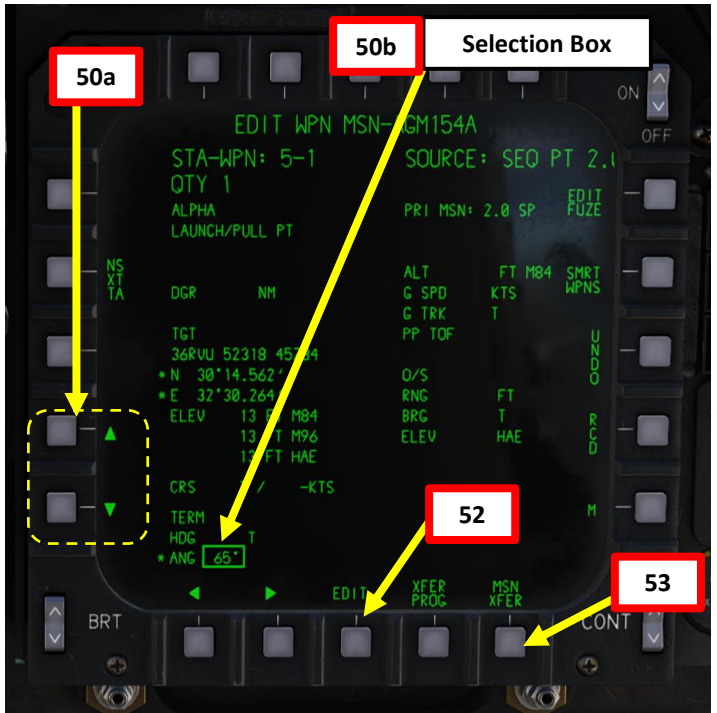
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

C – Upload Targeting Data from Onboard Sensor (Sequence Point) to Weapon

Note: VEL (Weapon Terminal Velocity) terminal parameter is not currently available for modification. The valid range is between 700 and 1200 feet per second.

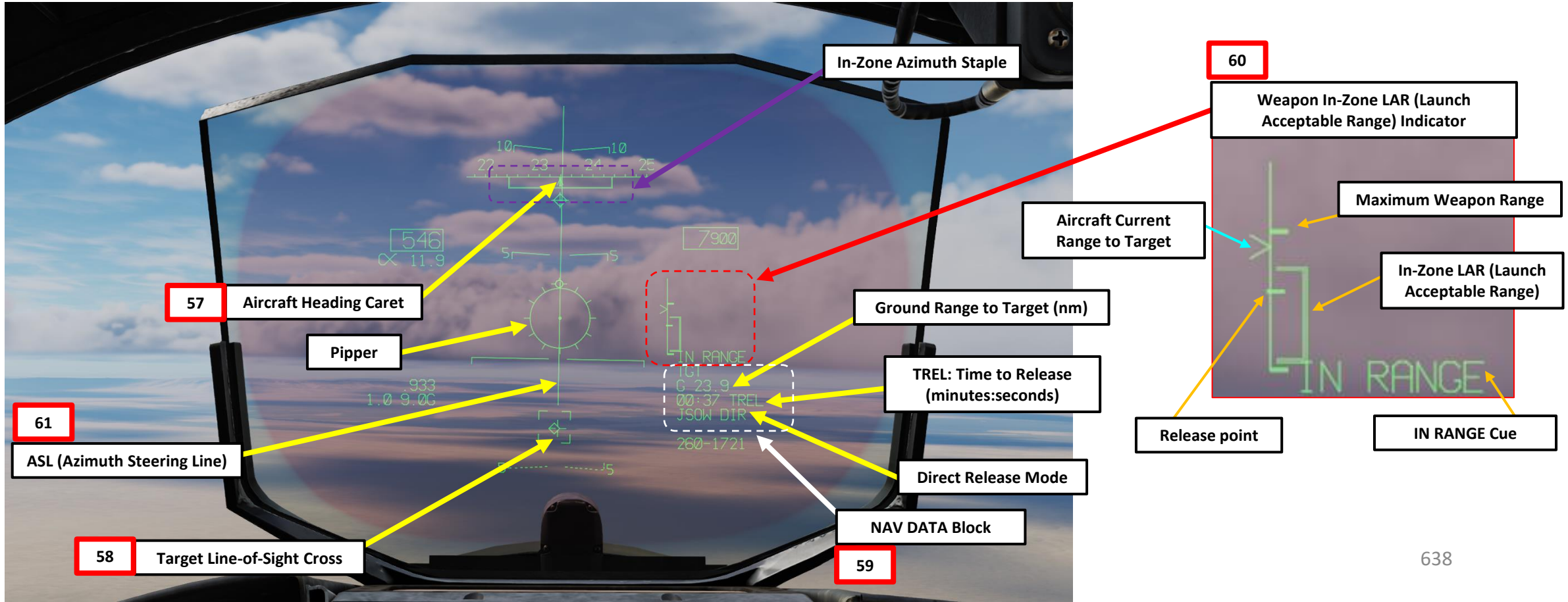


48. We will now set Weapon Terminal Parameters.
49. Use UP and DOWN arrow buttons to move the selection box to the TERM HDG (Weapon Terminal Heading) data field. Desired value ranges from 0 to 359. We will leave it blank and not assign a specific heading.
50. Use UP and DOWN arrow buttons to move the selection box to the ANG (Weapon Dive Angle) data field. Desired value ranges from 65 and 89 degrees.
51. On UFC (Upfront Control Panel) keypad, enter desired ANG value (65).
52. Press EDIT to update the ANG field. An edited field is preceded by an asterisk *.
53. Transfer data to weapon. We will use MSN XFER.
    - Use “MSN XFER” button to transfer the edited mission to the weapon.
    - Use “XFER PROG” button to transfer all edits to all weapons on all selected stations.
54. When data transfer is complete, asterisks disappear from the edited fields.
55. To return to the SMRT WPNS page, press the SMRT WPNS button.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
D – Perform Attack

56. From an altitude of at least 5000 ft (optimal between 10000 ft and 15000 ft), fly level. Airspeed should be above 450 kts.
57. Steer the aircraft to line up the aircraft heading caret within the In-Zone Azimuth Staple on the HUD (Heads-Up Display).
58. The target line-of-sight cross indicates the location of the target.
59. Check NAV DATA Block and Weapon In-Zone LAR (Launch Acceptable Range) symbology on the HUD for target range information.
60. The IN RANGE cue indicates that you are in range to the target, but that the weapon cannot achieve all programmed terminal parameters yet.
61. When you are within maximum range, the ASL (Azimuth Steering Line) becomes visible on the HUD. Keep the ASL centered on the pipper.



2 – AIR-TO-GROUND WEAPONS
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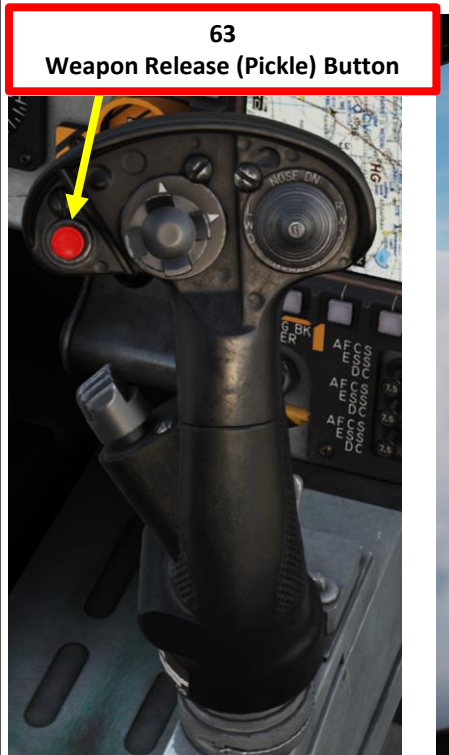
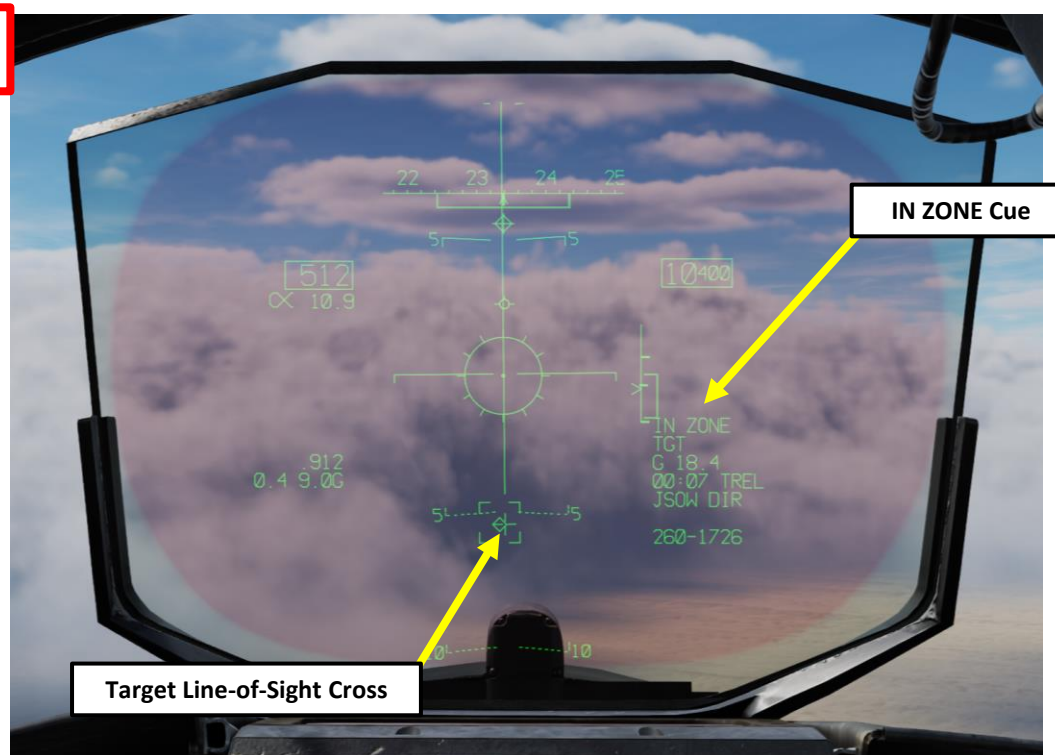
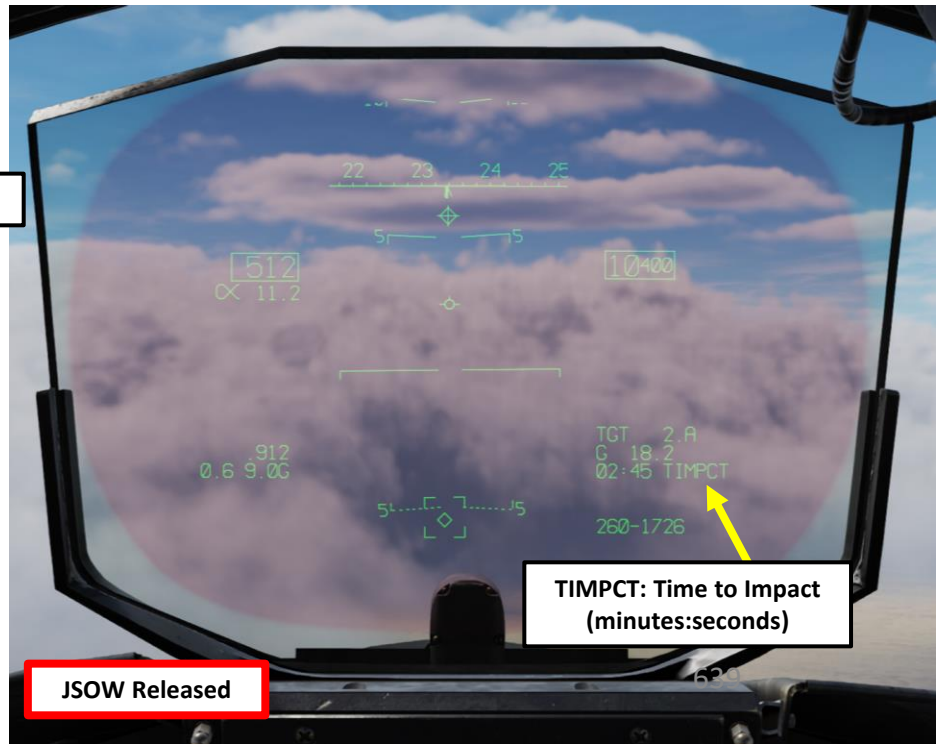
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
D – Perform Attack

62. The IN ZONE cue indicates that you are in range to the target and that the weapon can achieve all programmed terminal parameters. You may then deliver your ordnance.
    - **Note about Direct Mode**: The Weapon Release/Pickle button will be hot (will release when pressed) even before being in range, which means you could potentially release too early and miss the target by having the ordnance fall short.
63. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release JSOW. The weapon will home on the coordinates uploaded into it previously.
64. Once ordnance is released, the TIMPCT indication shows the time-to-impact (minutes:seconds).







2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode

D – Perform Attack

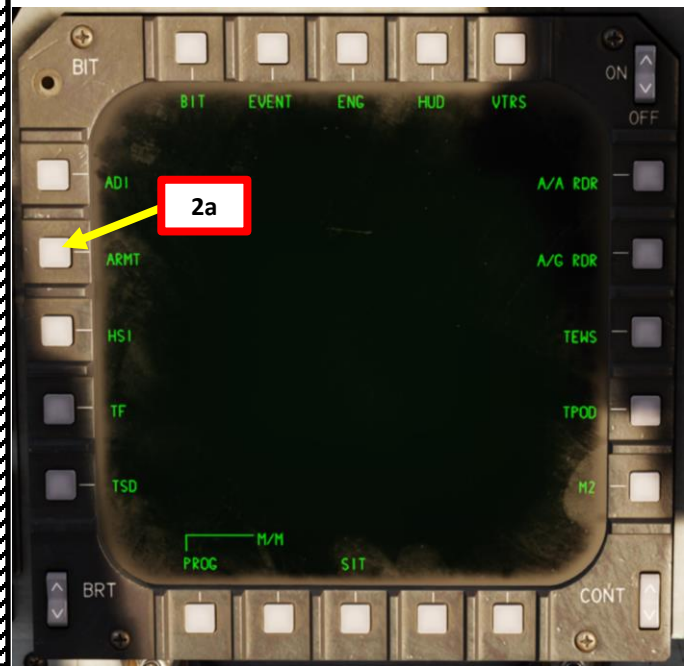
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.3 – AGM-154 JSOW
Pre-Planned Target (WPN MEM) with Direct Mode
D – Perform Attack

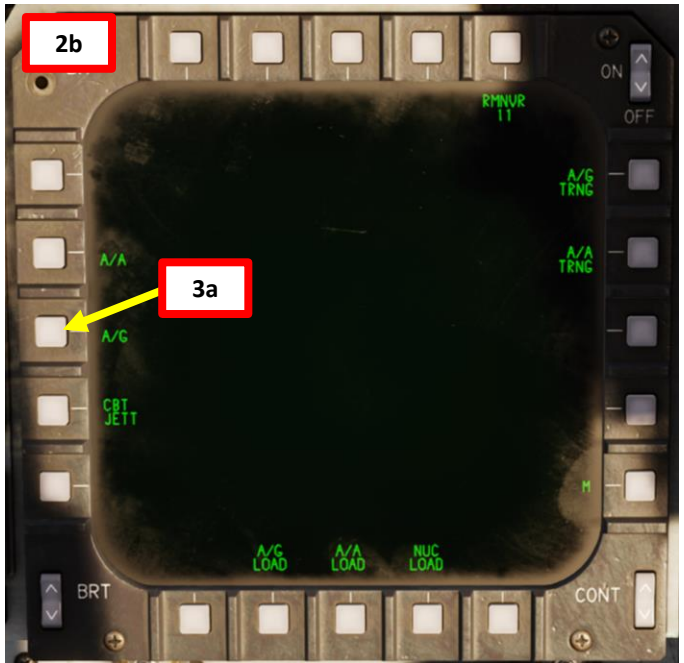
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM

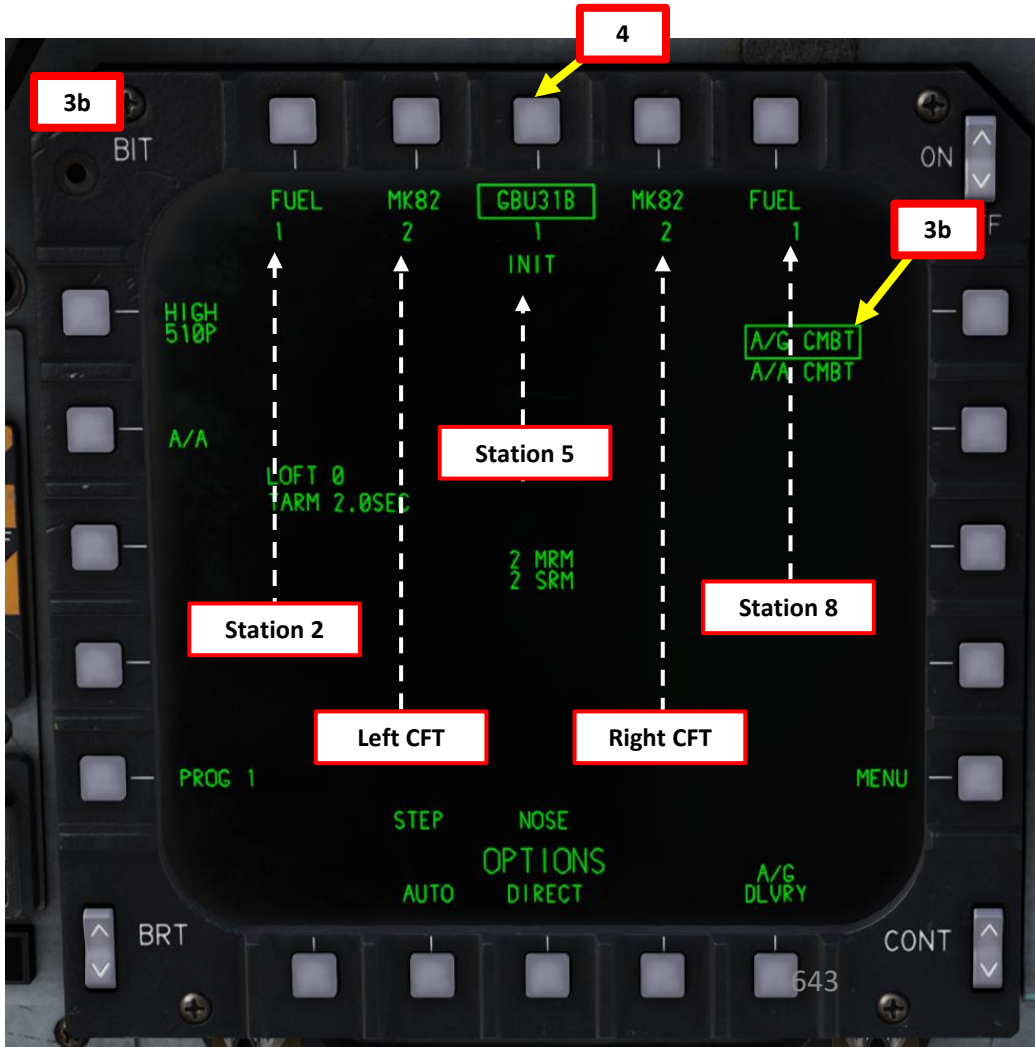
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “GBU31B” (boxed when selected).
    - Note: For smart weapons, the weapon type should automatically be detected by the aircraft.



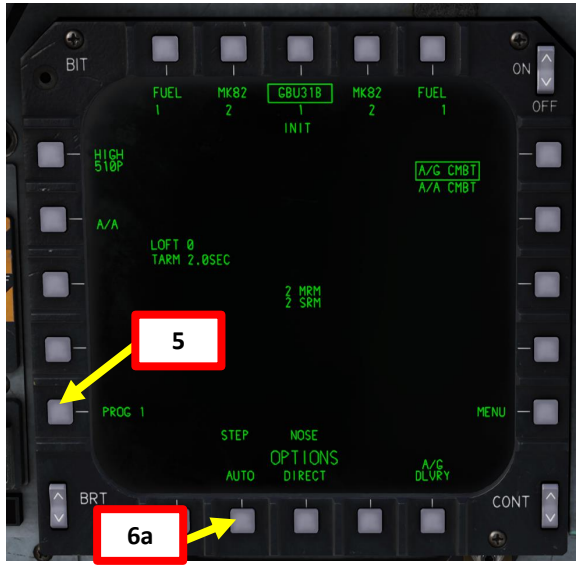


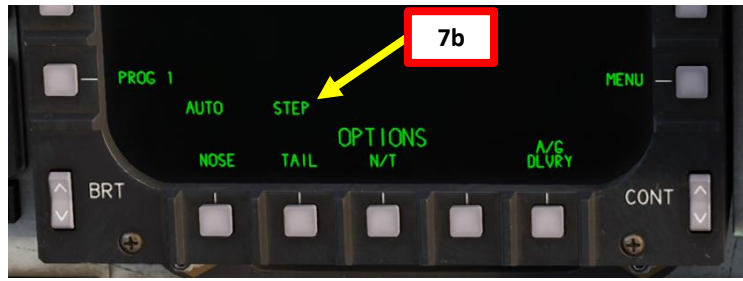


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select STEP.
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.

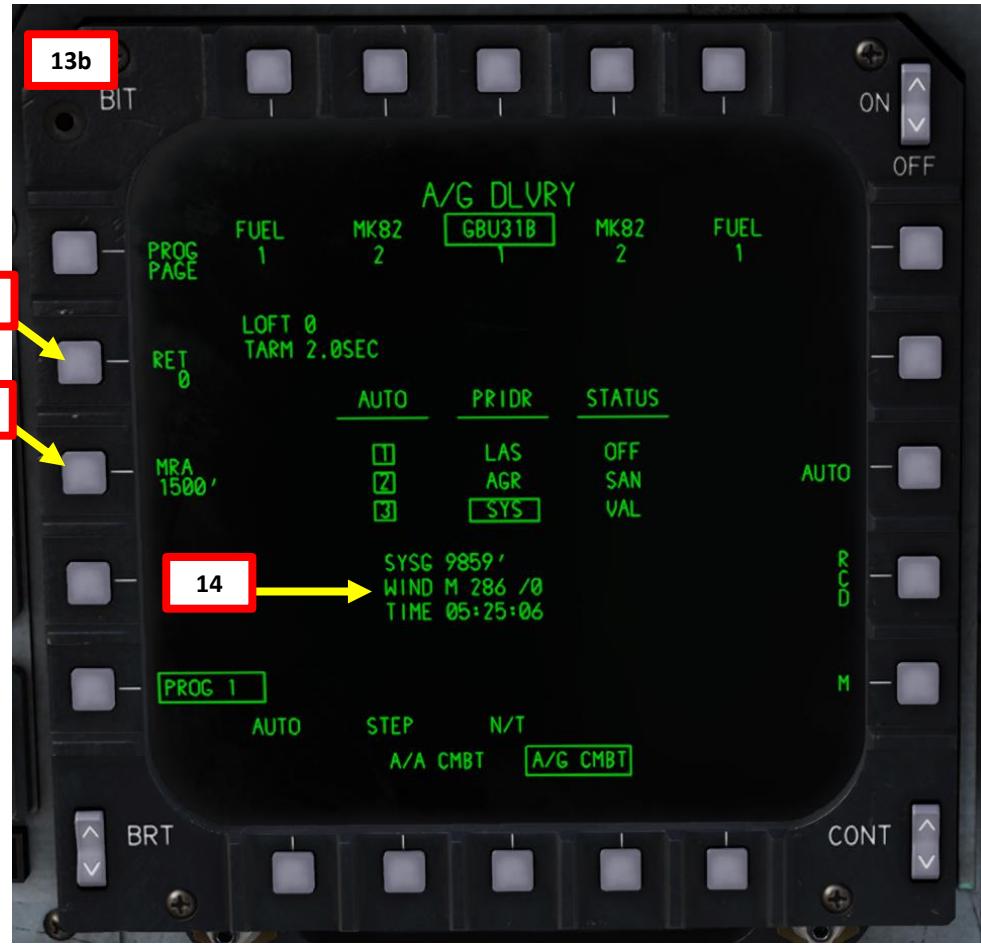




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

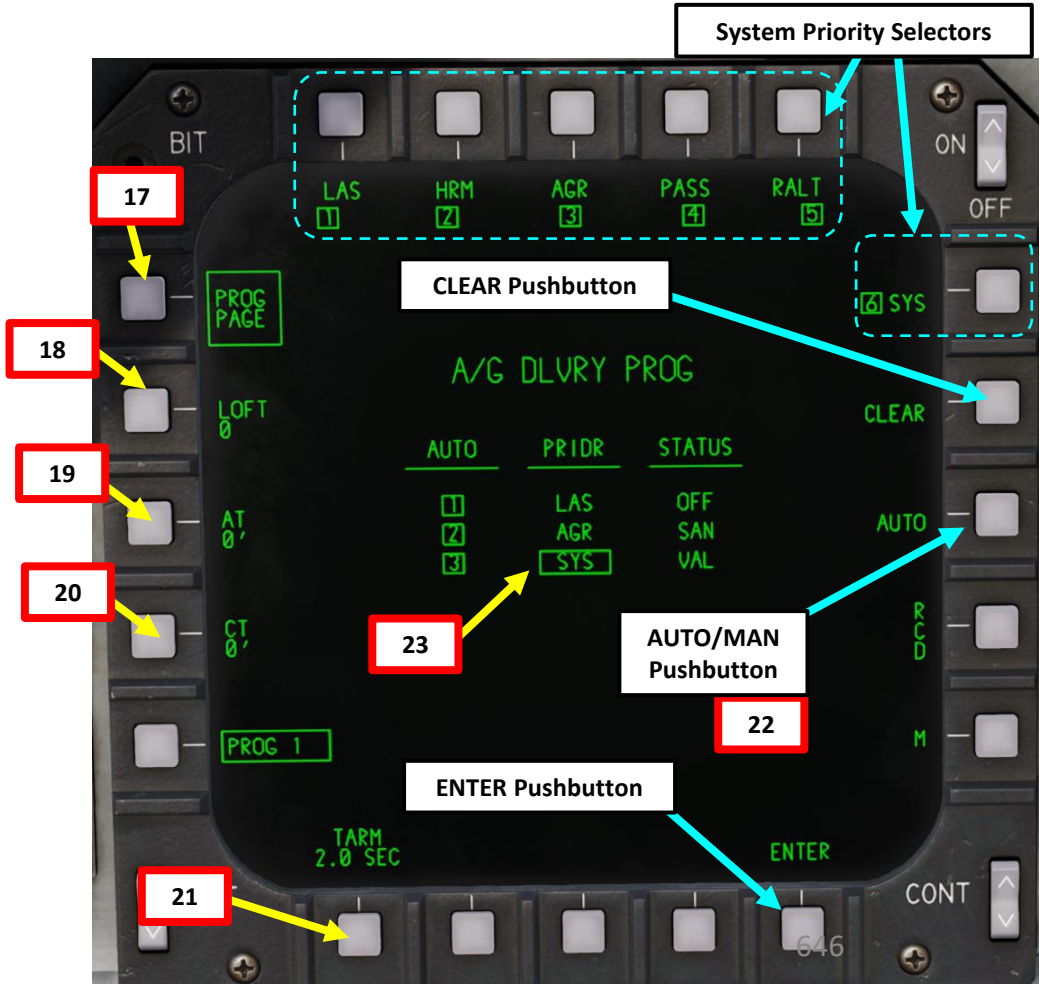
A – Weapon Setup

13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.



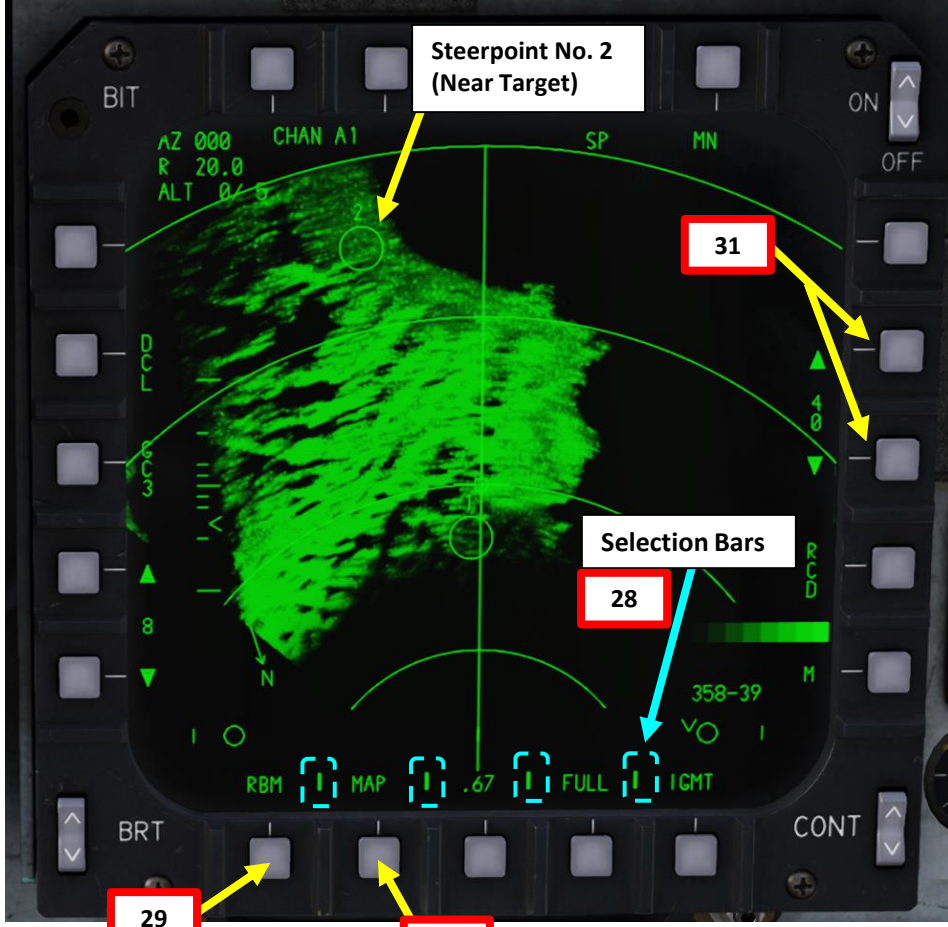
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
A – Weapon Setup

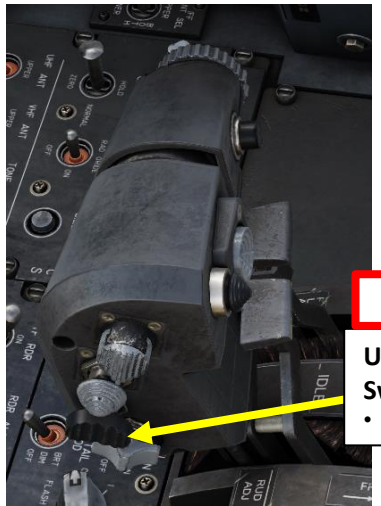
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.

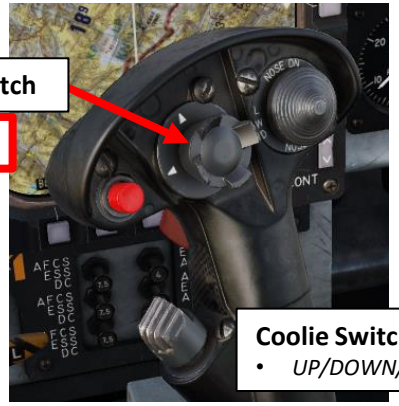


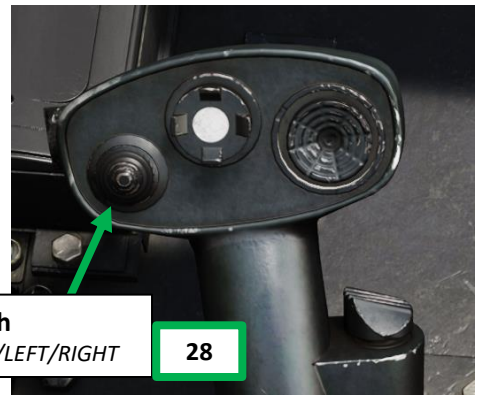
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

25. Set Master Arm Switch – ARM (UP)
26. Radar Power Switch must be set to ON.
27. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
28. Select A/G RDR page, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
29. On A/G RDR page, select either RBM or HRM mode by toggling the A/G Radar Mode Selector button as needed. We will select RBM (Real Beam Map) first to get a general view, then perform a HRM (High Resolution Map) Patch Map to get a better detailed PPI (Plan Position Indicator) view.
30. On A/G RDR page, select MAP cursor function by toggling the Cursor Function Selector button as needed.
31. Adjust display range as desired.



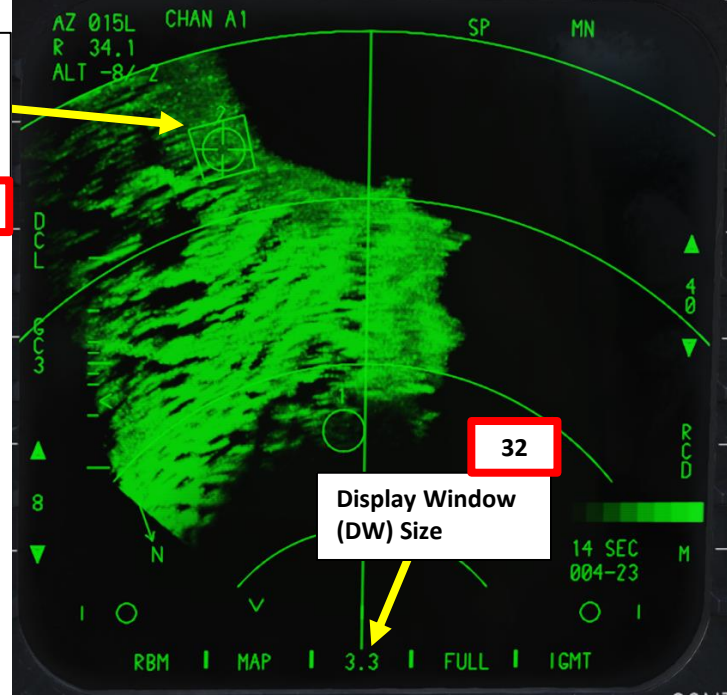






2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

32. When MAP Cursor 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. The size can be changed pressing the Auto Acquisition Switch FWD and AFT. Currently selected DW size is displayed at the bottom center of the display (0.67, 1.3, 3.3, 4.7, 10, 20, 40 and 80 nm).
33. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select.
34. To command the HRM (High Resolution Map) patch map:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
35. When patch map is commanded, MAP indication becomes boxed and time-to-go clock counts down in the bottom-right corner of the display while the HRM is being computed.
36. After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.

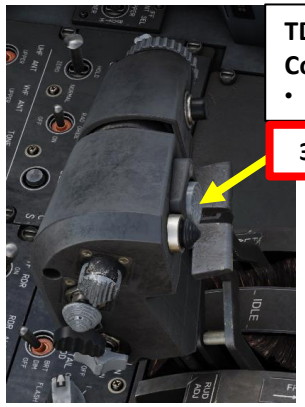


Cursor with Display Window around it
(slewed on area we want to command HRM map)

33

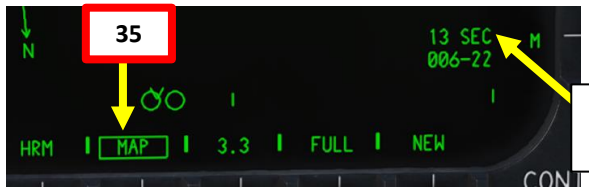
32

Display Window (DW) Size



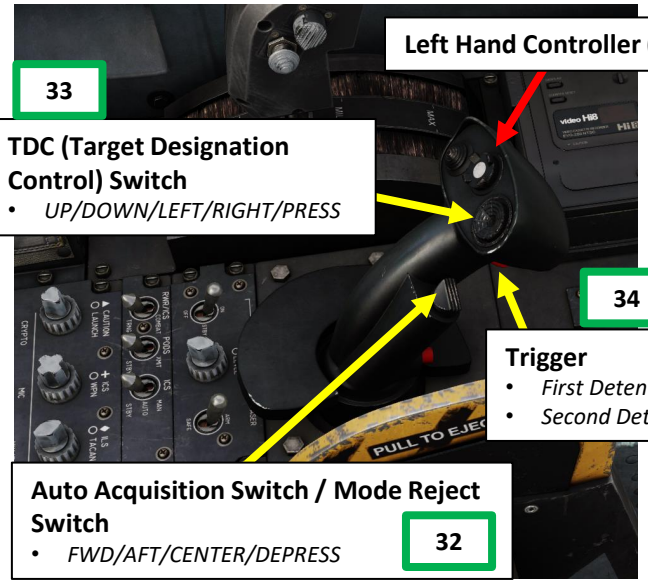
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

33 34



35

Time-to-Go Counter until HRM Patch map is computed (sec)



33

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Left Hand Controller (LHC)

34

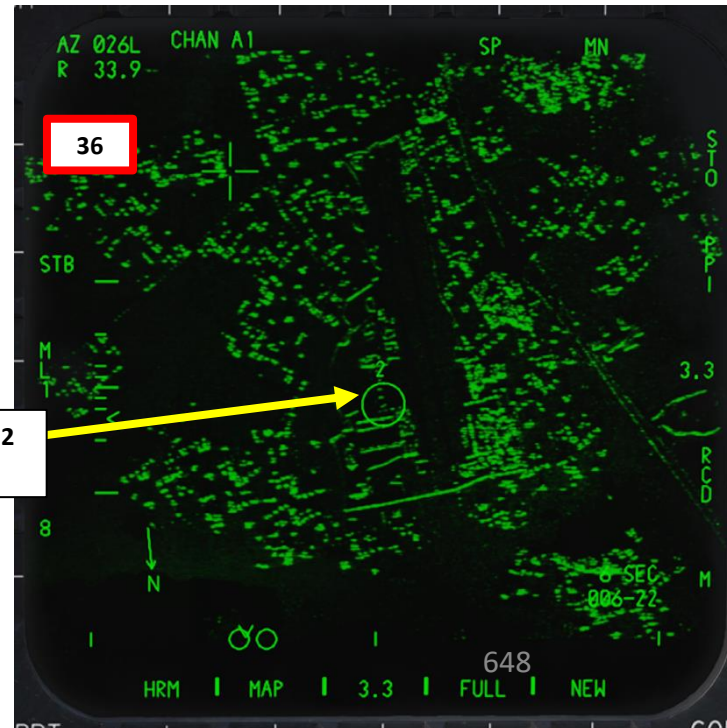
Trigger
- *First Detent*
- *Second Detent*

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

32

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

32

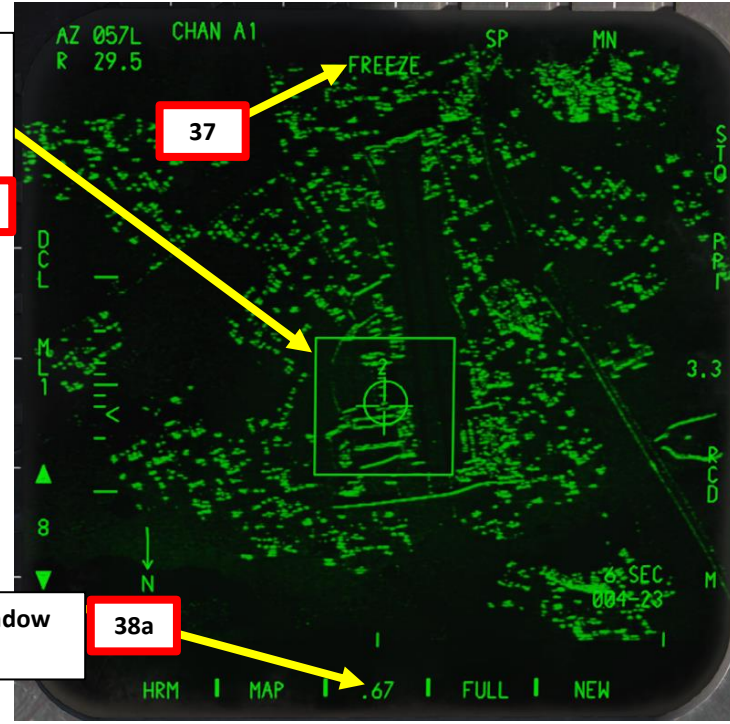


36

Steerpoint No. 2 (Near Target)

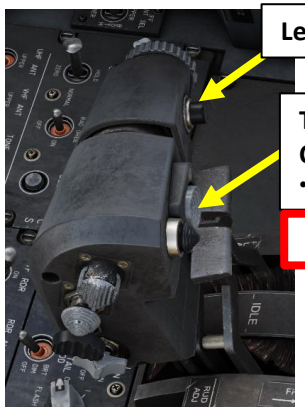
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

37. If you want to "freeze" the picture, you can toggle FREEZE ON and OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
38. Zoom in further as required.
    a) Press Auto Acquisition Switch FWD or AFT to change the DW (Display Window) Size.
    b) Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the area you want to select.
    c) Command another HRM (High Resolution Map) patch map:
        - **Pilot**: Press and release the TDC (Target Designation Control) switch.
        - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
    d) After it time-to-go counter reaches 0, a high-resolution map of the desired area is displayed and MAP is unboxed.
39. Note: Remember that the picture is not being updated while FREEZE is ON. Don't forget to set FREEZE OFF after commanding a patch map.



Cursor with Display Window around it
(slewed on area we want to command HRM map)

Display Window (DW) Size



Left Multifunction Switch **37**

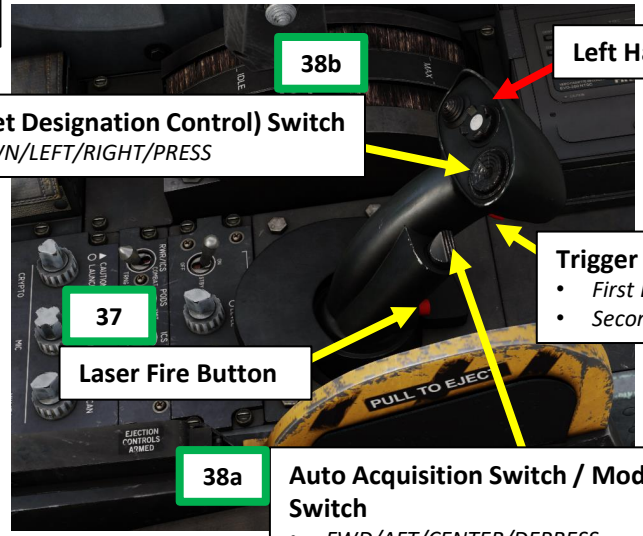
TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

38b **38c**

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

38a

Time-to-Go Counter until HRM Patch map is computed (sec)



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Left Hand Controller (LHC)

38c

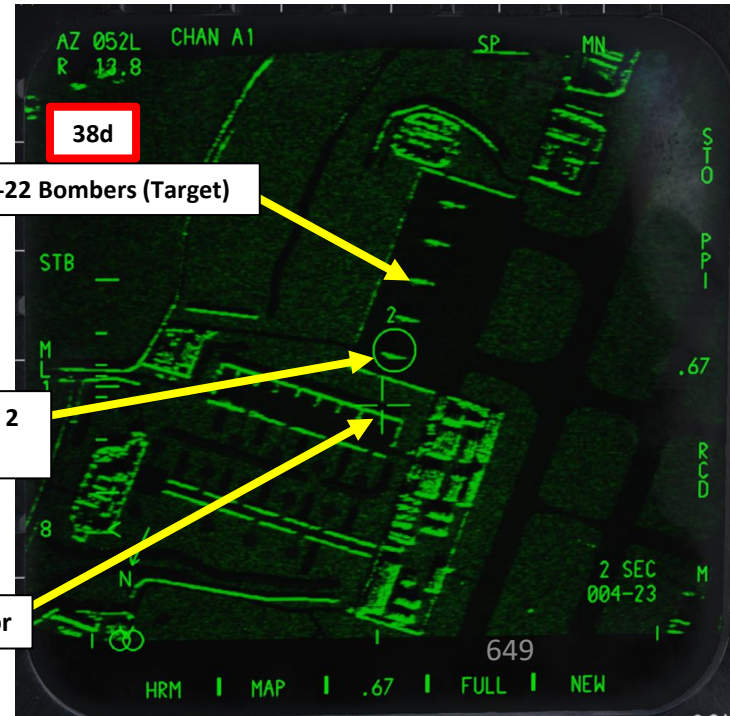
Trigger
- *First Detent*
- *Second Detent*

37

Laser Fire Button

38a

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*



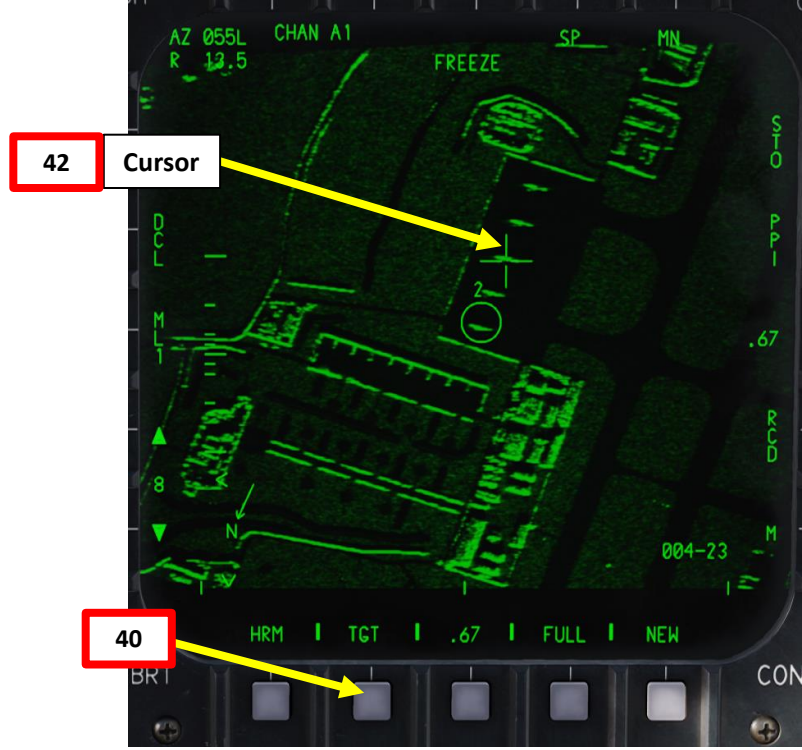
Tu-22 Bombers (Target)

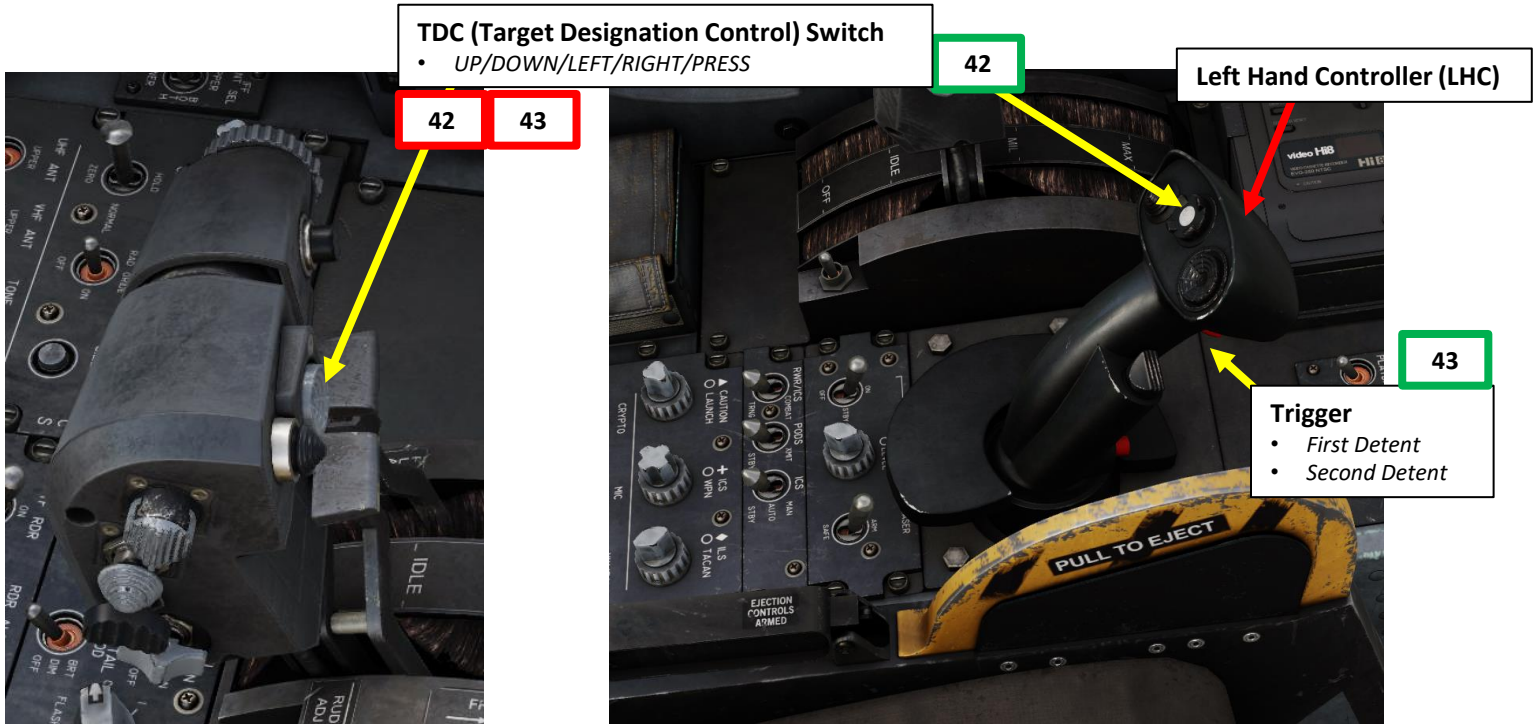
Steerpoint No. 2 (Near Target)

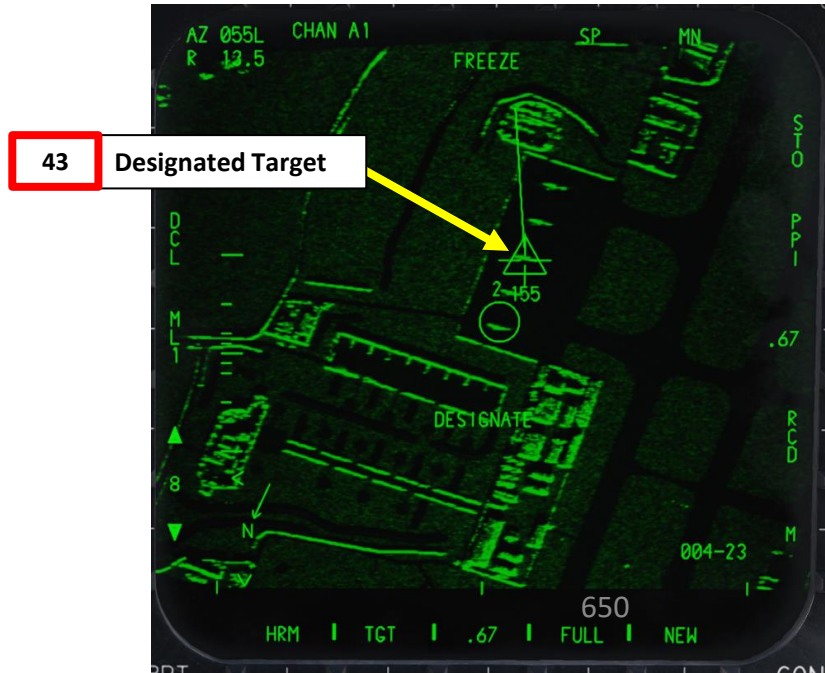
Cursor

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

40. On A/G RDR page, select TGT cursor function by toggling the Cursor Function Selector button as needed.
41. Before designating a target, it is good practice (but not mandatory) to FREEZE the display (see previous page).
42. Using the TDC (Target Designation Control) switch, slew cursor over the point you want to designate.
43. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.

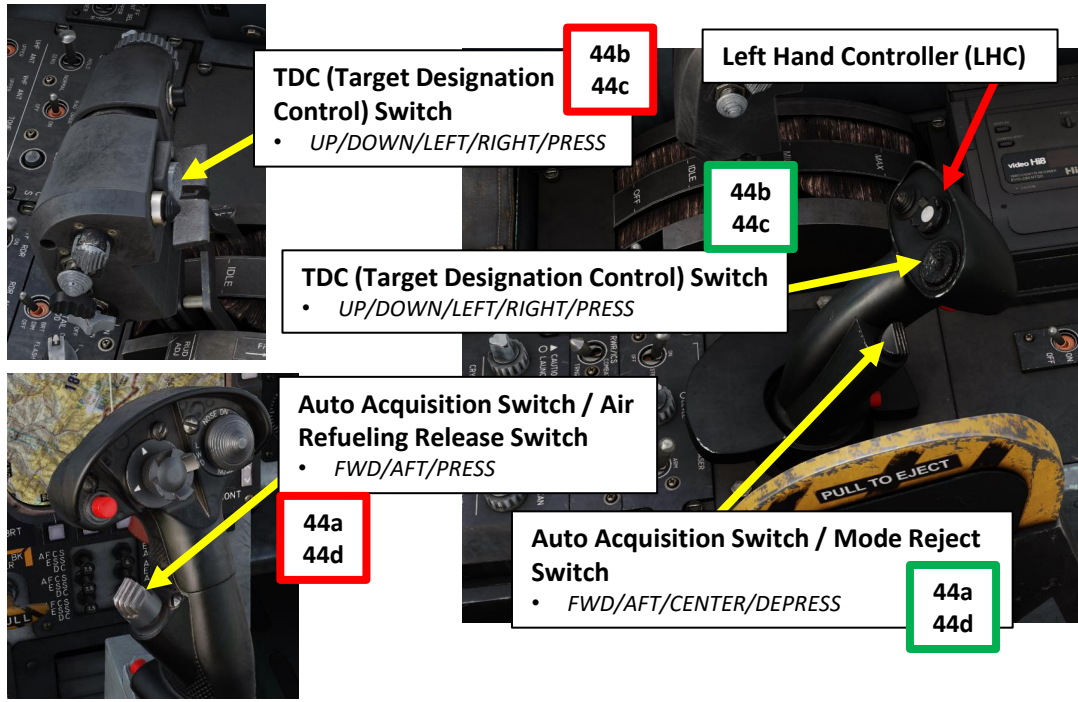


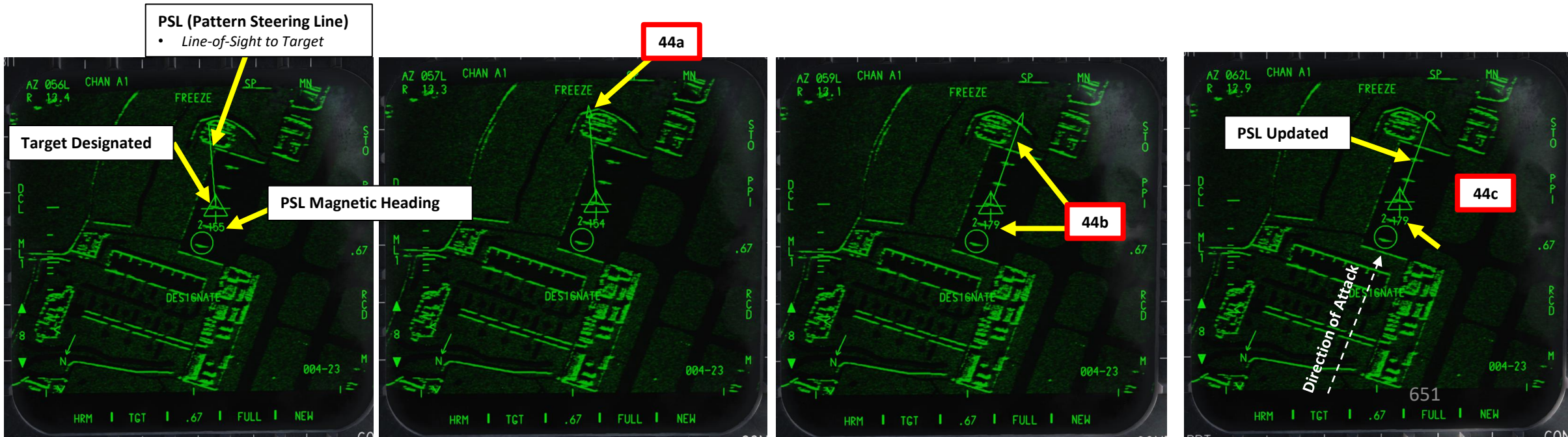




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

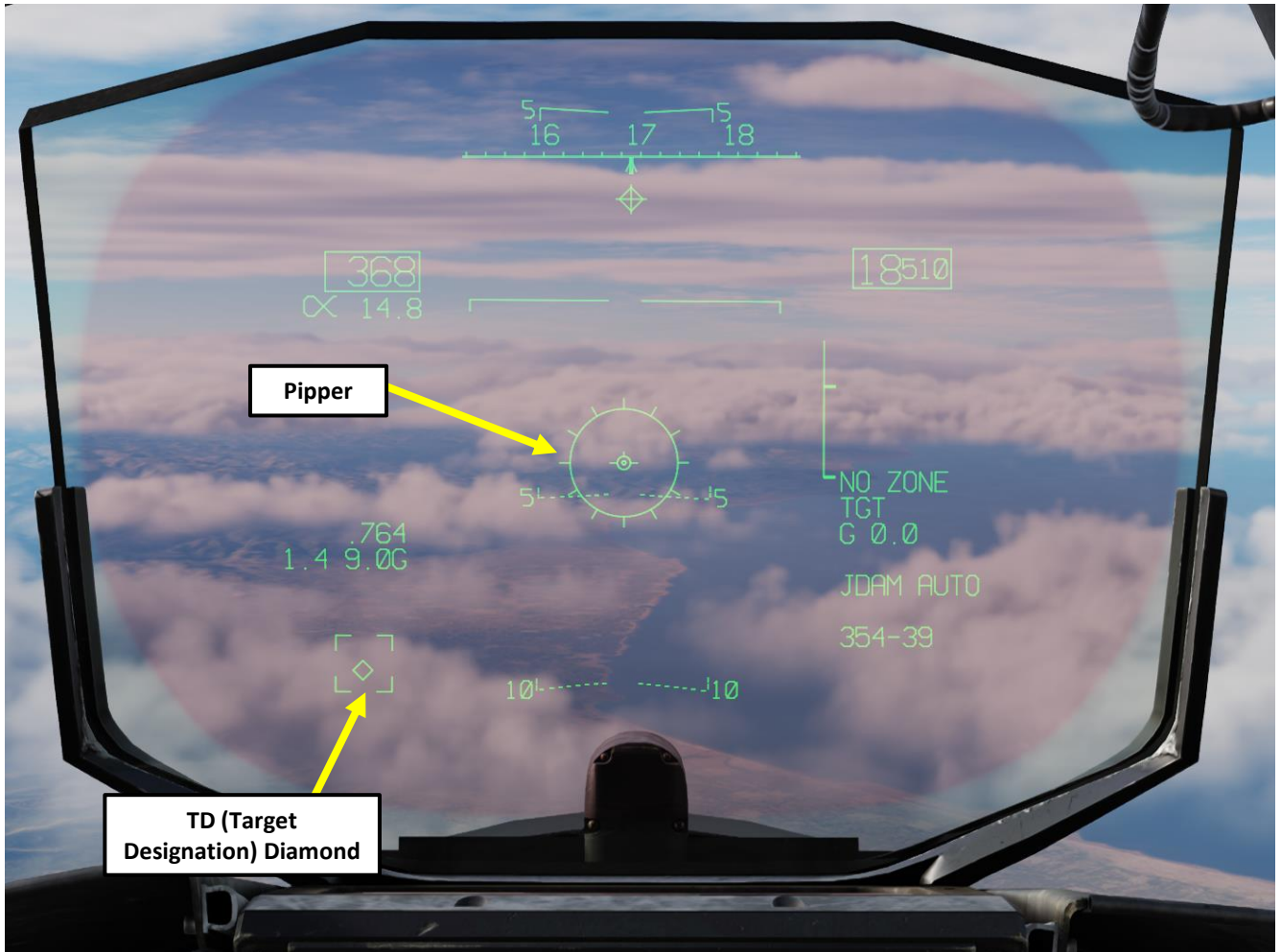
44. The PSL (Pattern Steering Line) indicates the line-of-sight from the aircraft to the target at the moment of designation. The PSL can be slewed around if there is a need to approach the target at a different heading. To slew the PSL:
    a) Press the Auto Acquisition Switch AFT
    b) Slew PSL left or right around the designation triangle using the TDC (Target Designation Control) Switch.
    c) Once the PSL orientation is as desired, press TDC to confirm.
    d) Press the Auto Acquisition Switch AFT a second time.

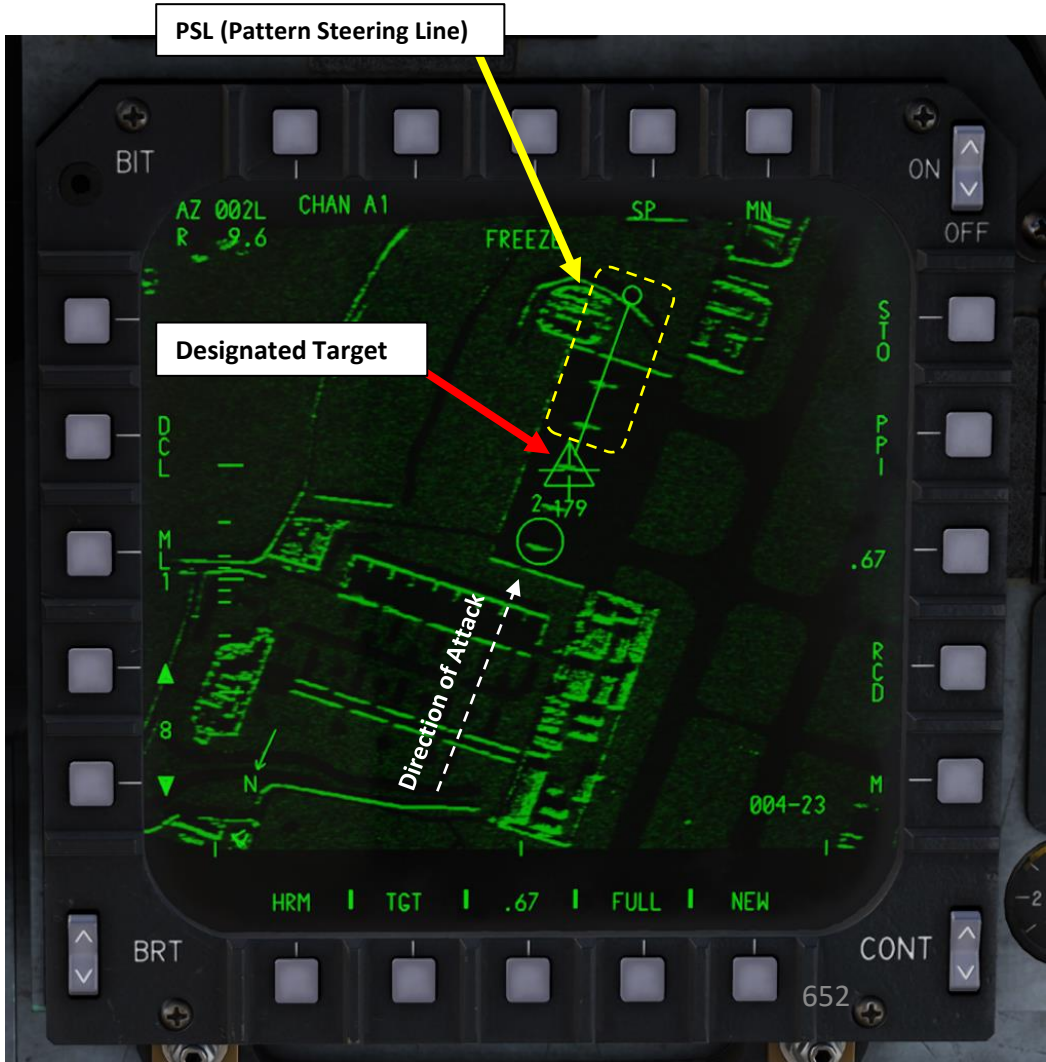




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

45. Now that we have a target designation, a TD (Target Designation Diamond) will appear. However, since we have not uploaded coordinates to the JDAM yet, there is currently no range information available.

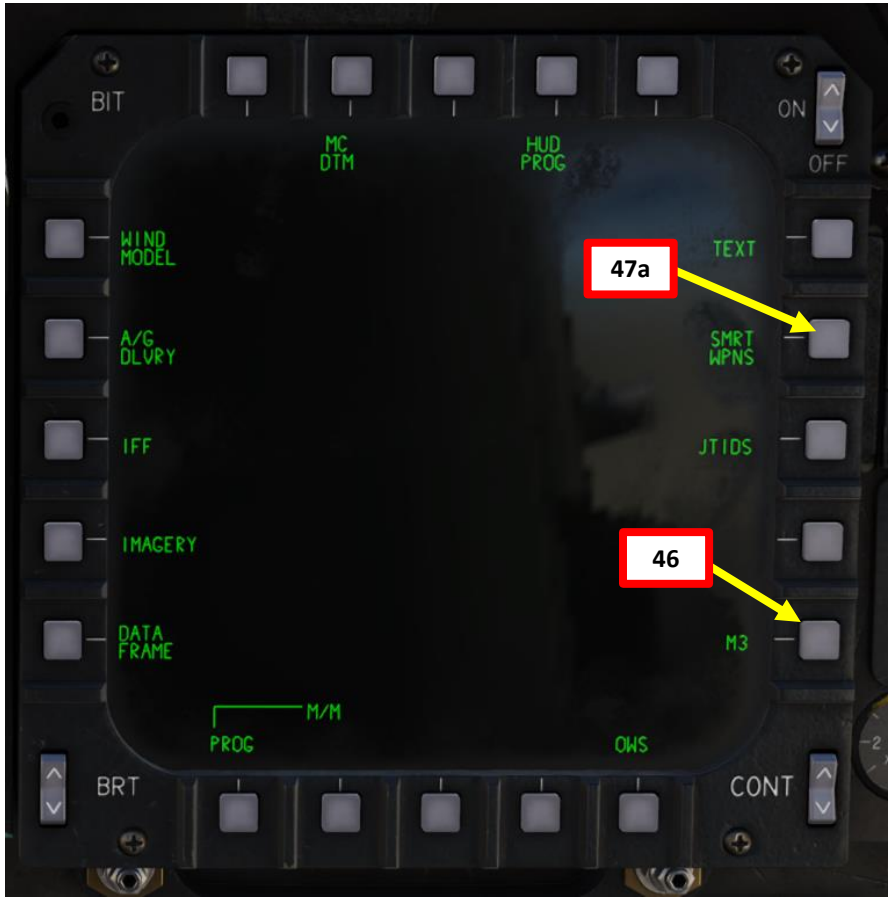


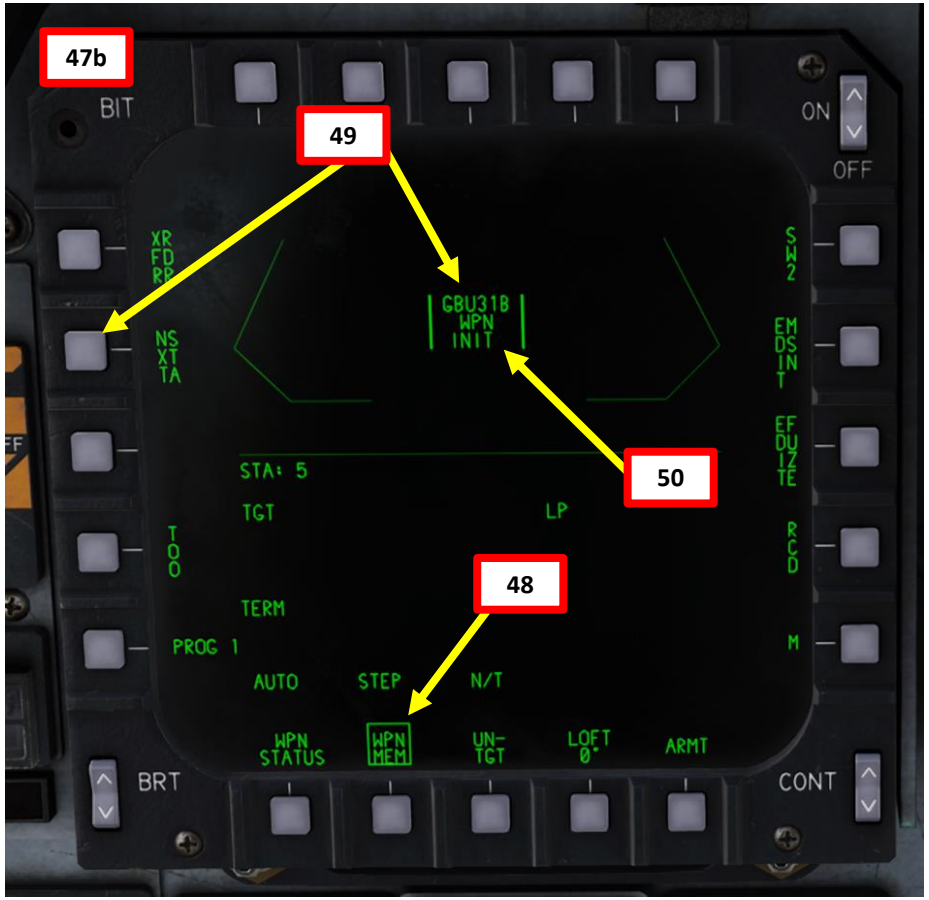


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

C – Upload Targeting Data from Onboard Sensor (Air-to-Ground Radar) to Weapon

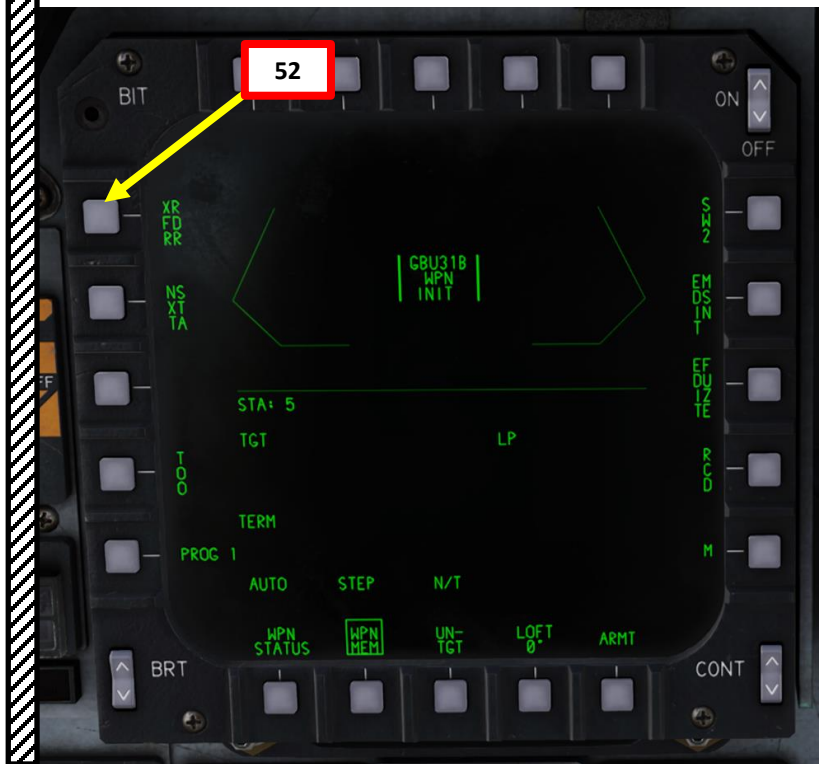
46. Press the Menu Selection PB (Pushbutton) to toggle between MENU 1 (M) and MENU 2 (M2).
47. Select SMRT WPNS page.
48. "WPN MEM" (Weapon Memory) mode is selected by default.
49. If required, press NXT STA (Next Station) PB until desired weapon is selected (indicated by goal posts).
50. "INIT" indicates that the smart weapon does not have coordinates stored in currently. We will have to enter them from an onboard sensor, which is the air-to-ground radar.

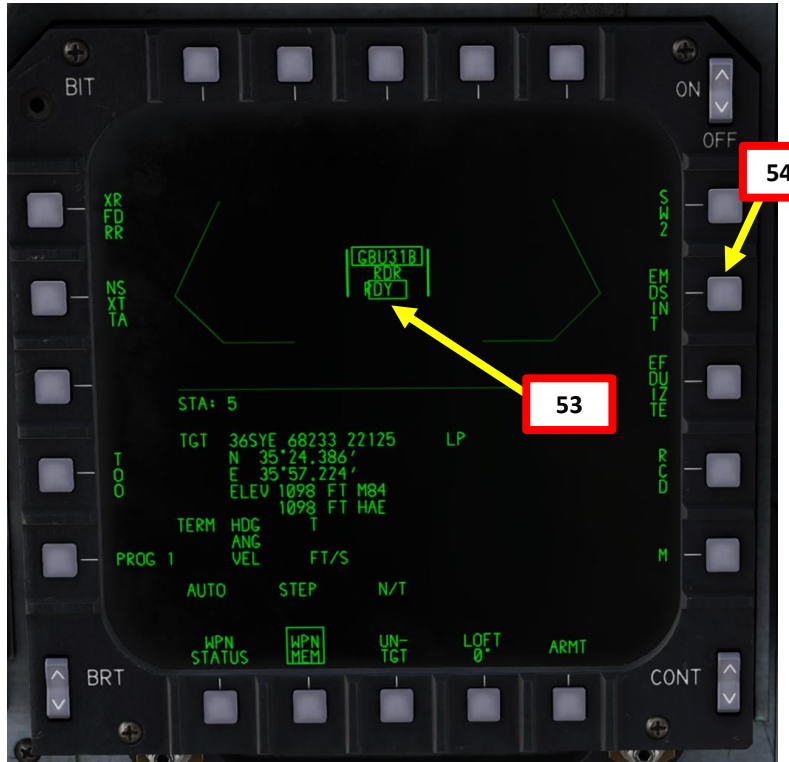


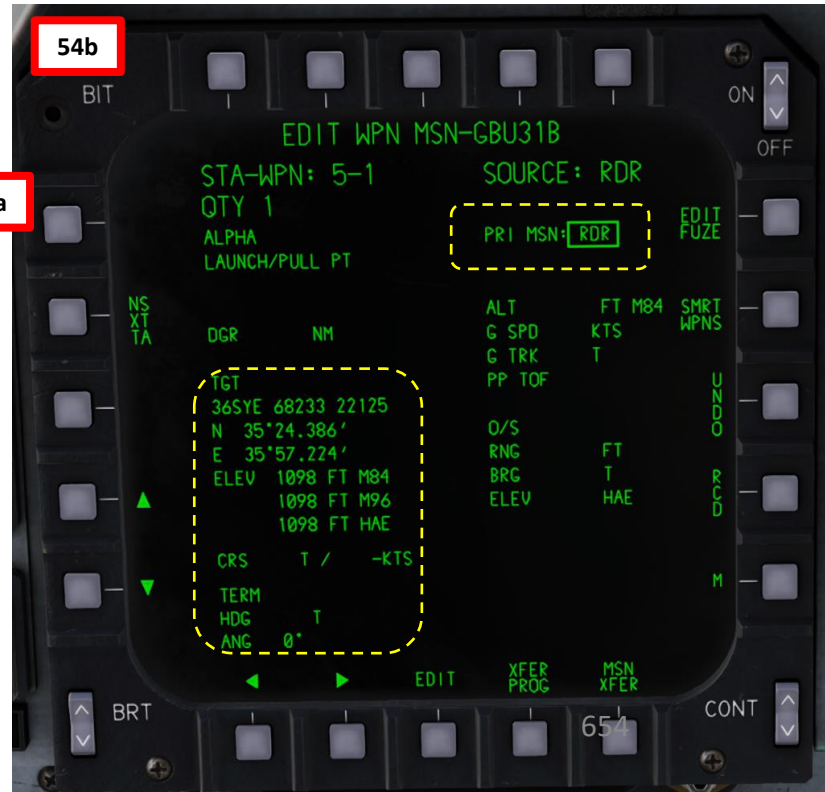


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
C – Upload Targeting Data from Onboard Sensor (Air-to-Ground Radar) to Weapon

51. **We will upload target coordinates from the air-to-ground radar designation.**
52. Press XFR RDR (Transfer Air-to-Ground Radar) to transfer target data to the weapon.
53. Once transfer is complete, the weapon status changes from INIT to RDY. "**RDR**" indicates that the selected ordnance is now set for the target coordinates stored for "**air-to-ground radar designation"**, as shown in the "PRI MSN RDR" data field**.**
54. Press EDIT MSN button to edit mission and terminal parameters. From this page, you can see the current target coordinates.



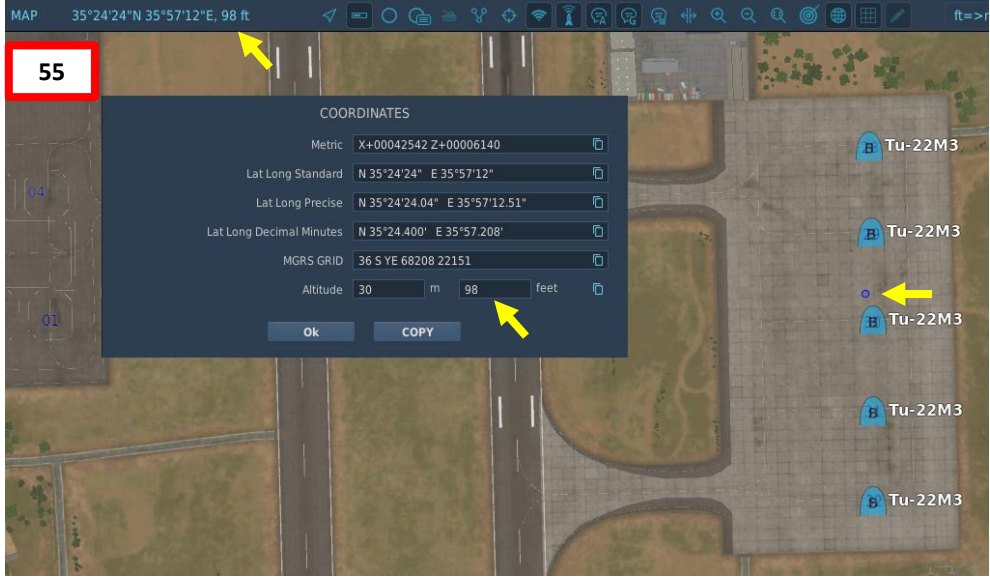


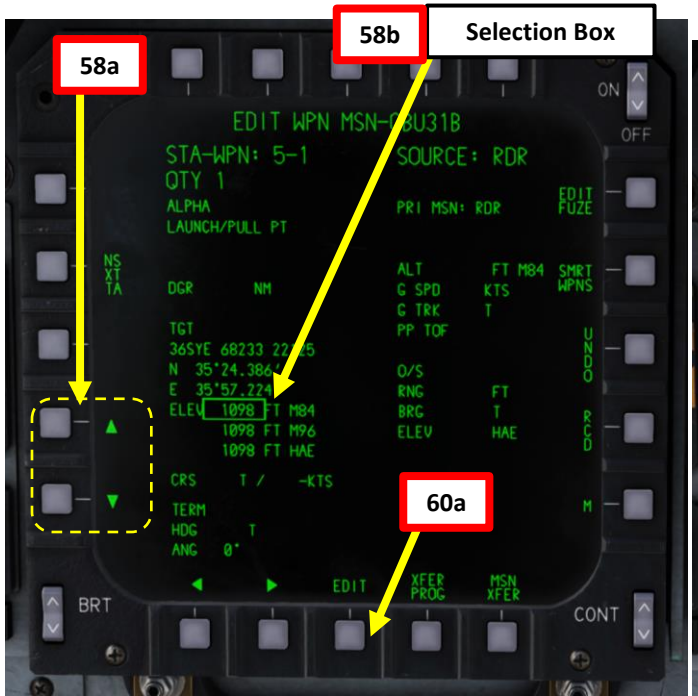


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

C – Upload Targeting Data from Onboard Sensor (Air-to-Ground Radar) to Weapon

55. **Verify target coordinates and elevation. We can obtain those from the F10 map (by using ALT and clicking on the target).**
56. For simplicity, we will assume target latitude/longitude coordinates are good enough.
57. In this example, we see there is a mismatch for the target altitude, which should be 98 ft.
58. Use UP and DOWN arrow buttons to move the selection box to the M84 target elevation field.
    - M84 represents WGS-84 Ellipsoid. World Geodetic System (WGS) is a standard used in cartography, geodesy, and satellite navigation including GPS.
    - M96 represents EGM96 Geoid, which is a more complex model based on the gravitational force of the Earth (which is not constant) that defines what "sea level" or "up/down" mean. This model represents the Earth as a smooth but irregular shape called "geoid".
    - HAE represents Height Above Ellipsoid.
59. On UFC (Upfront Control Panel) keypad, enter target elevation in feet (98 ft).
60. Press EDIT to update the ELEV field. An edited field is preceded by an asterisk *.



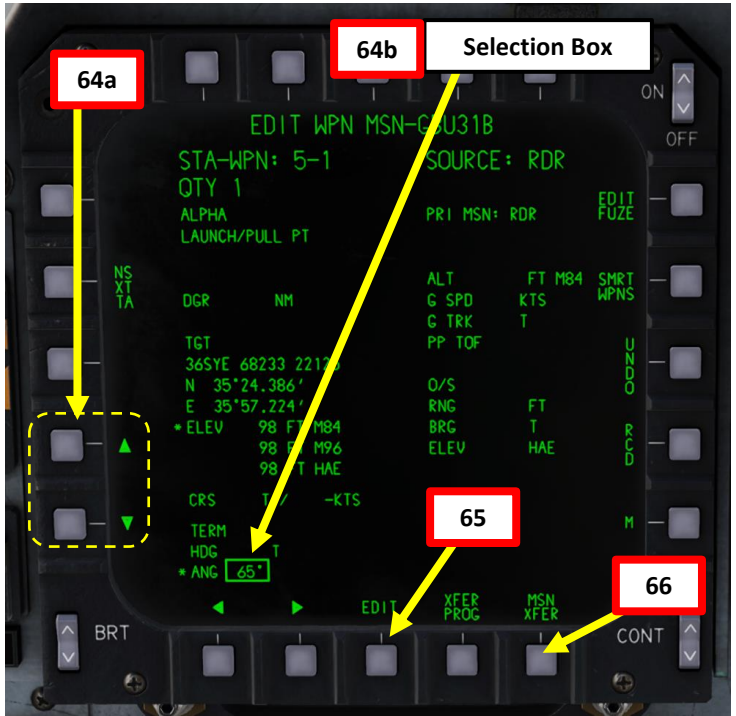


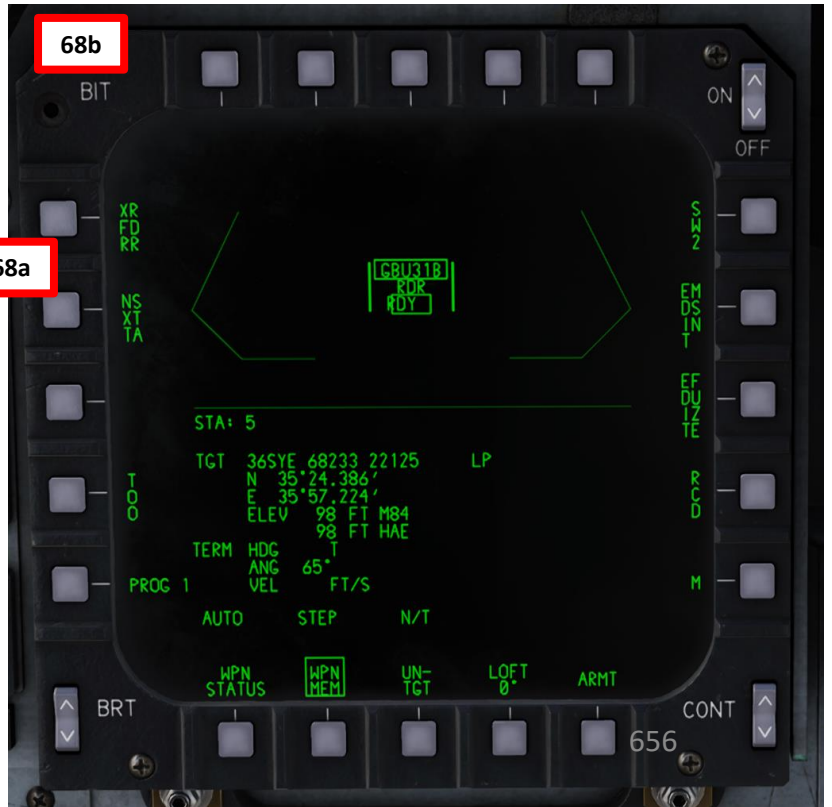
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode

C – Upload Targeting Data from Onboard Sensor (Air-to-Ground Radar) to Weapon

Note: VEL (Weapon Terminal Velocity) terminal parameter is not currently available for modification. The valid range is between 700 and 1200 feet per second.

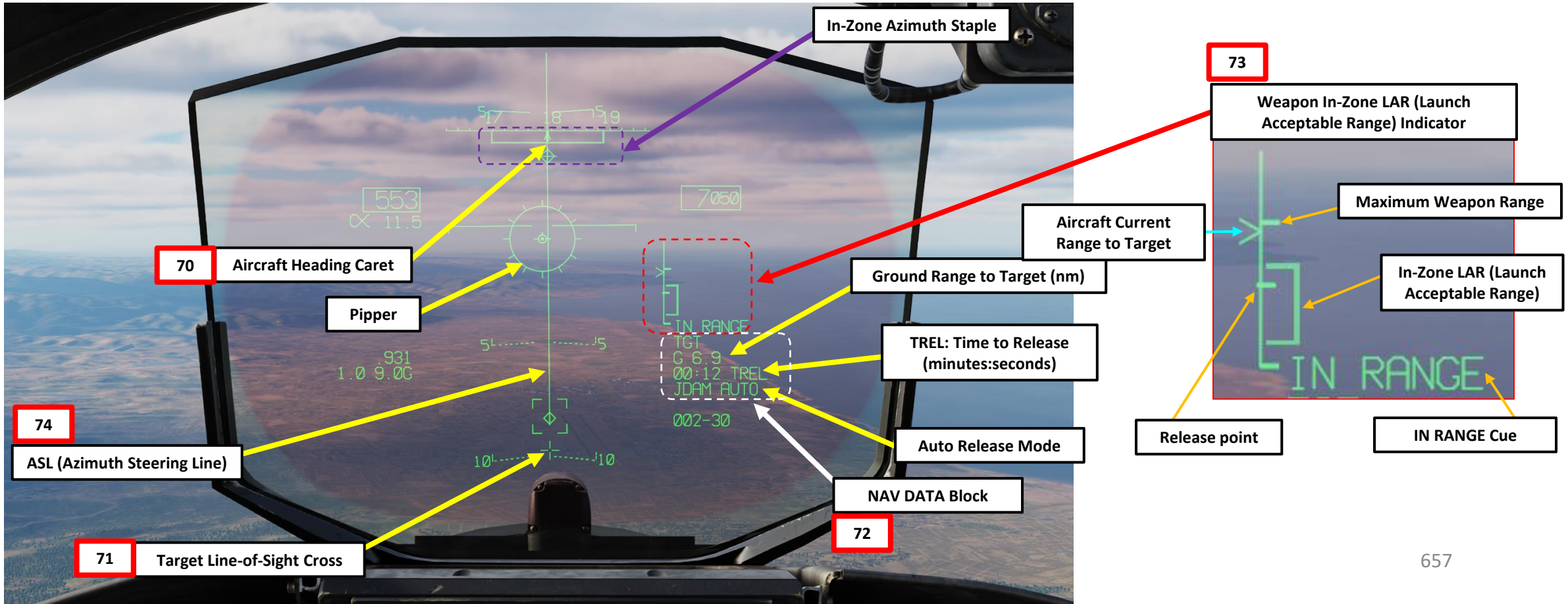
61. We will now set Weapon Terminal Parameters.
62. Use UP and DOWN arrow buttons to move the selection box to the TERM HDG (Weapon Terminal Heading) data field. Desired value ranges from 0 to 359. We will leave it blank and not assign a specific heading.
63. Use UP and DOWN arrow buttons to move the selection box to the ANG (Weapon Dive Angle) data field. Desired value ranges from 65 and 89 degrees.
64. On UFC (Upfront Control Panel) keypad, enter desired ANG value (65).
65. Press EDIT to update the ANG field. An edited field is preceded by an asterisk *.
66. Transfer data to weapon. We will use MSN XFER.
    - Use “MSN XFER” button to transfer the edited mission to the weapon.
    - Use “XFER PROG” button to transfer all edits to all weapons on all selected stations.
67. When data transfer is complete, asterisks disappear from the edited fields.
68. To return to the SMRT WPNS page, press the SMRT WPNS button.





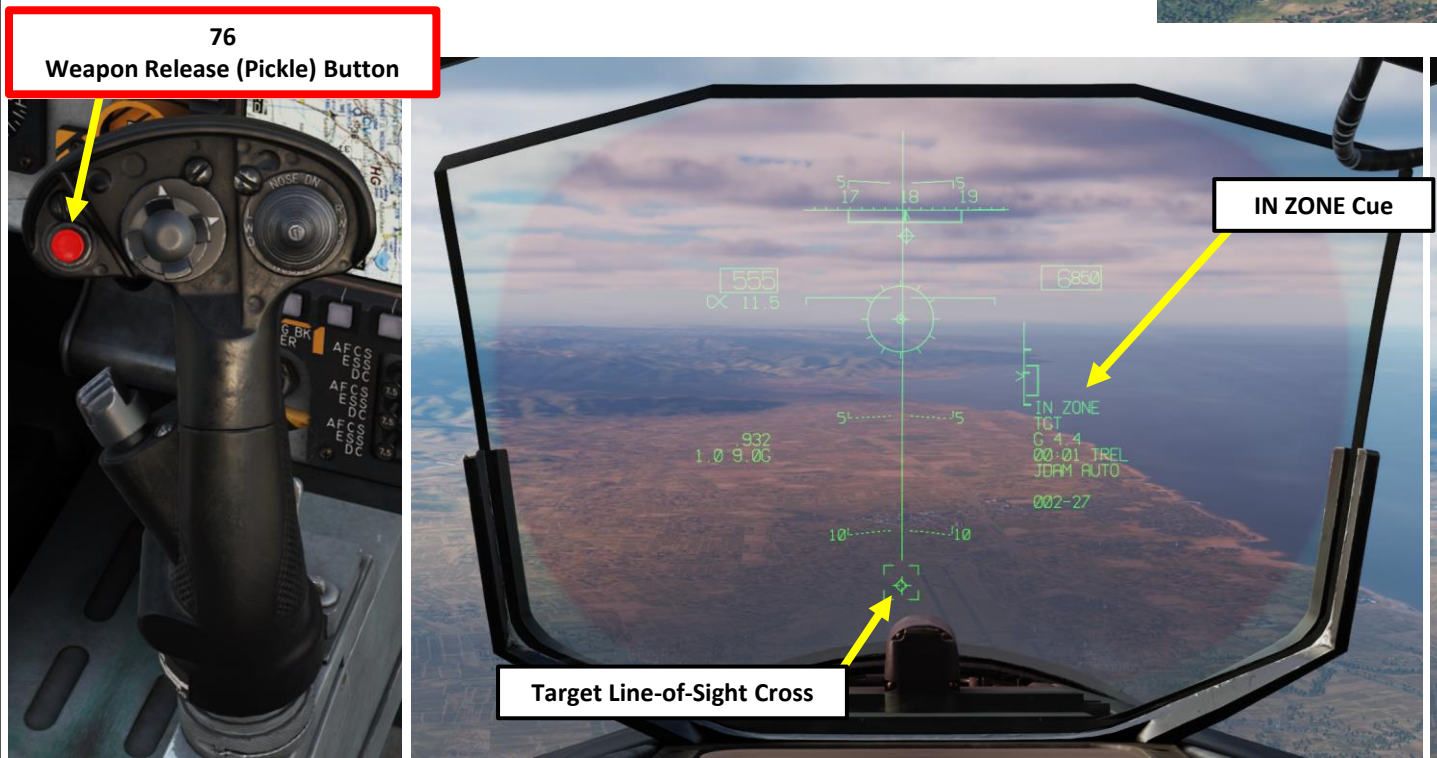
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
D – Perform Attack

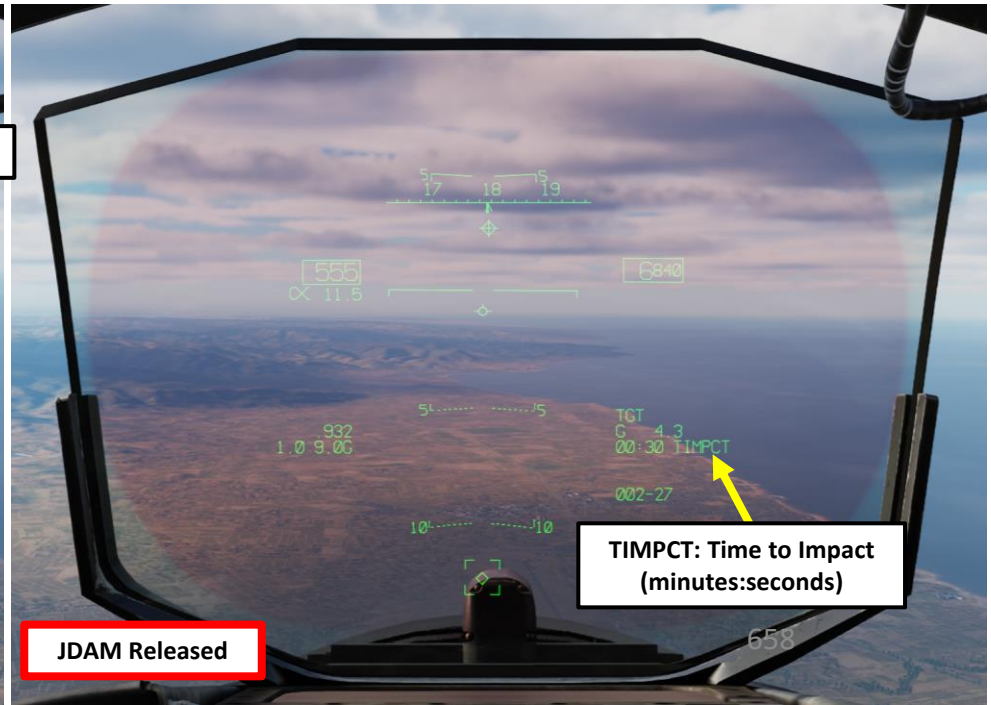
69. From an altitude of at least 5000 ft (optimal between 10000 ft and 15000 ft), fly level. Airspeed should be above 450 kts.
70. Steer the aircraft to line up the aircraft heading caret within the In-Zone Azimuth Staple on the HUD (Heads-Up Display).
71. The target line-of-sight cross indicates the location of the target.
72. Check NAV DATA Block and Weapon In-Zone LAR (Launch Acceptable Range) symbology on the HUD for target range information.
73. The IN RANGE cue indicates that you are in range to the target, but that the weapon cannot achieve all programmed terminal parameters yet.
74. When you are within maximum range, the ASL (Azimuth Steering Line) becomes visible on the HUD. Keep the ASL centered on the pipper.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
D – Perform Attack

75. The IN ZONE cue indicates that you are in range to the target and that the weapon can achieve all programmed terminal parameters. You may then deliver your ordnance.
    - **Note about Auto mode**: Before reaching the release point, the Weapon Release/Pickle button will be cold (will not release when pressed).
76. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release JDAM. The weapon will home on the coordinates uploaded into it previously.
77. Once ordnance is released, the TIMPCT indication shows the time-to-impact (minutes:seconds).



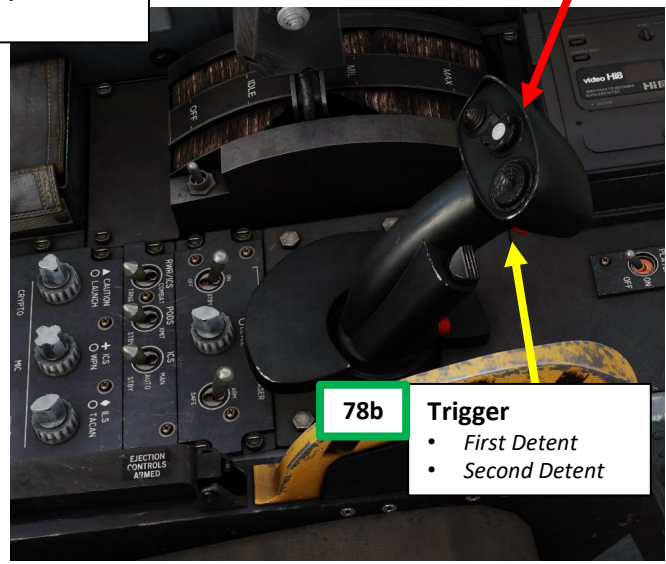


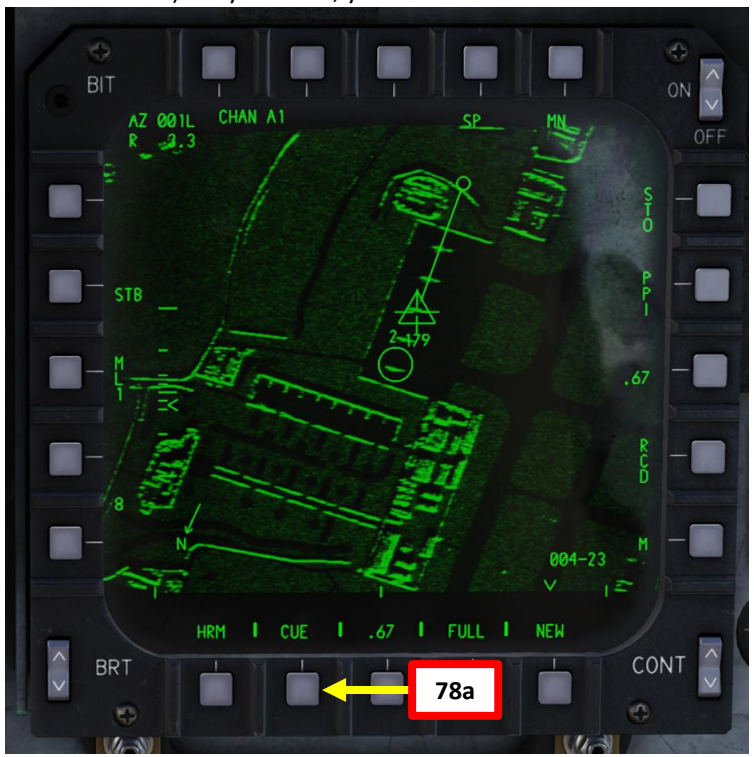
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
D – Perform Attack

78. (Optional) In cases where you want to use the targeting pod to assess damage (or even designate more accurately if visibility permits it), you can use the CUE function to slave the targeting pod to the Air-to-Ground radar designation. To do so:
    a) On A/G RDR page, select CUE cursor function by toggling the Cursor Function Selector button as needed.
    b) To designate the point and slave (CUE) the targeting pod to it:
        - **Pilot**: Press and release the TDC (Target Designation Control) switch.
        - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
    c) If you check on the TPOD (Targeting Pod) page, you will see that the targeting pod has been slaved to the A/G RDR page's cursor.
    d) If you want, you can then take control of the TPOD sensor and designate from it.

TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

Left Hand Controller (LHC)

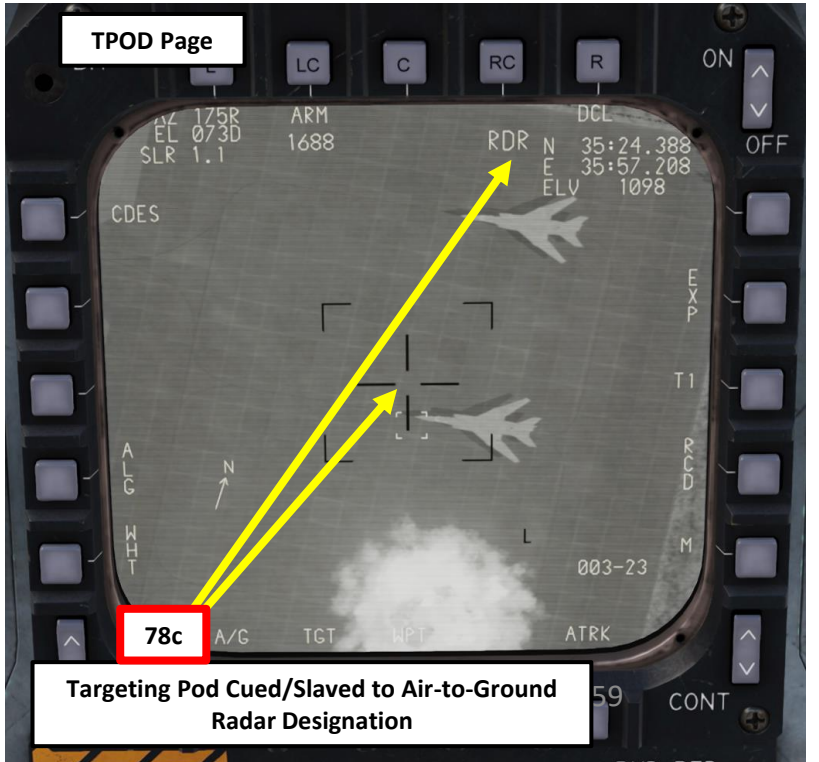




A/G RDR Page

Air-to-Ground Radar Designation

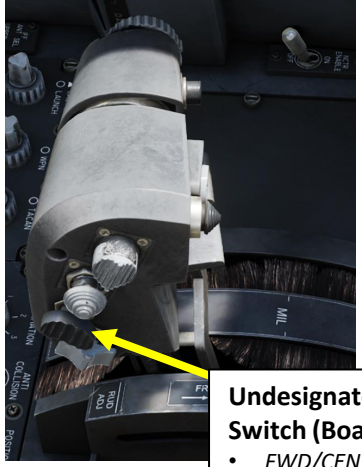
TPOD Page



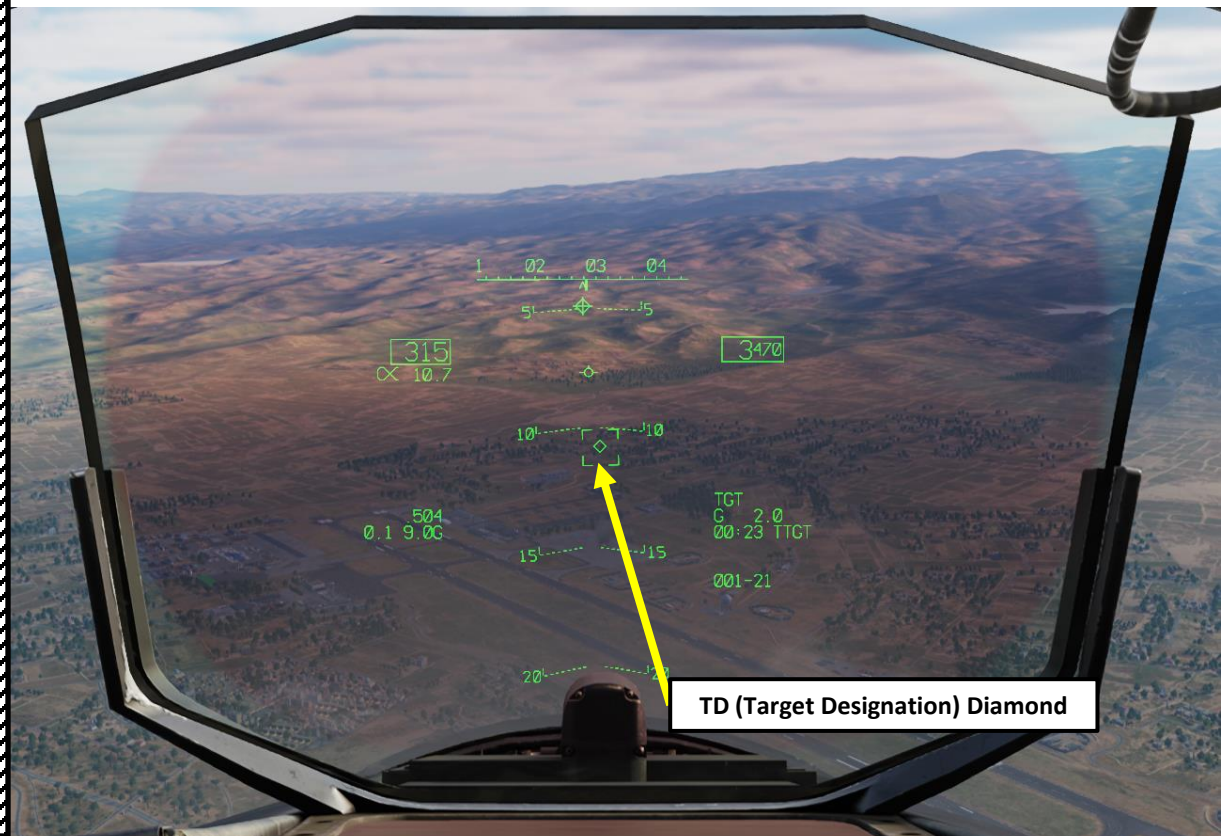
Targeting Pod Cued/Slaved to Air-to-Ground Radar Designation

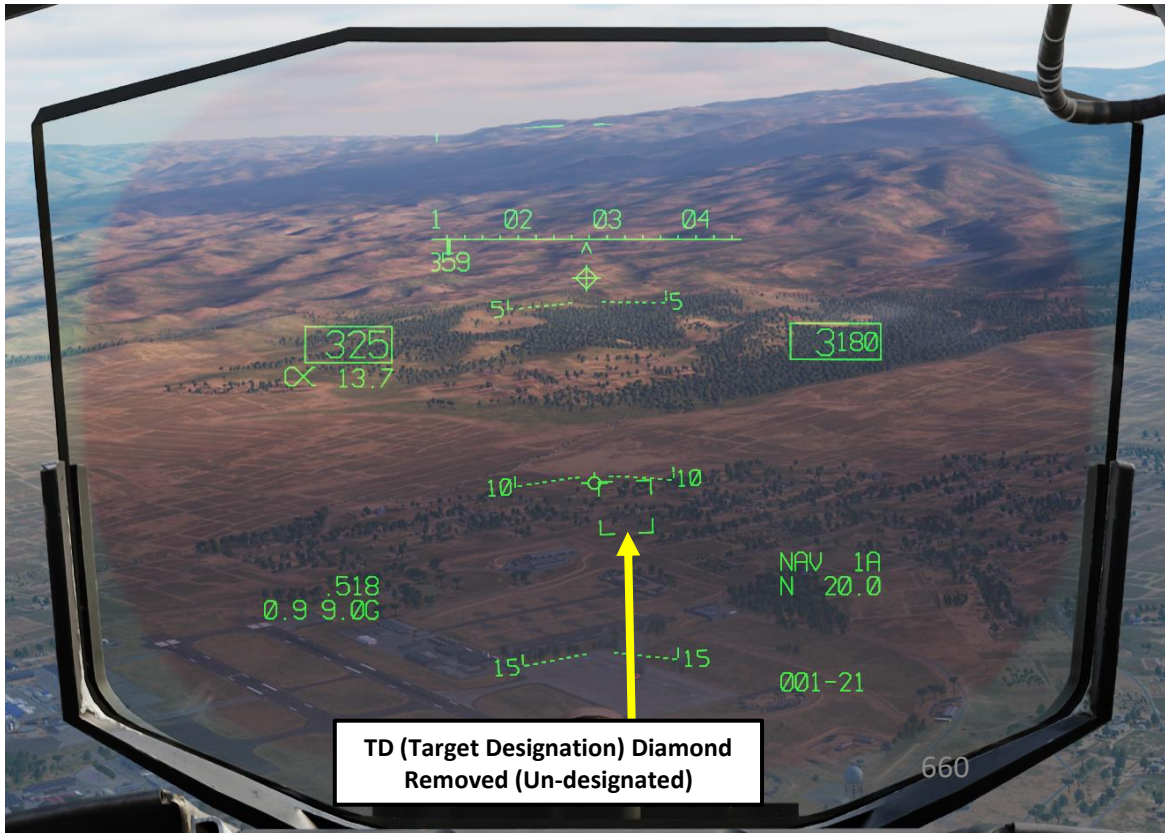
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
D – Perform Attack

79. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
80. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.



Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*





2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.4 – GBU-31(V)3/B JDAM
Air-to-Ground Radar (WPN MEM) with Auto Mode
D – Perform Attack

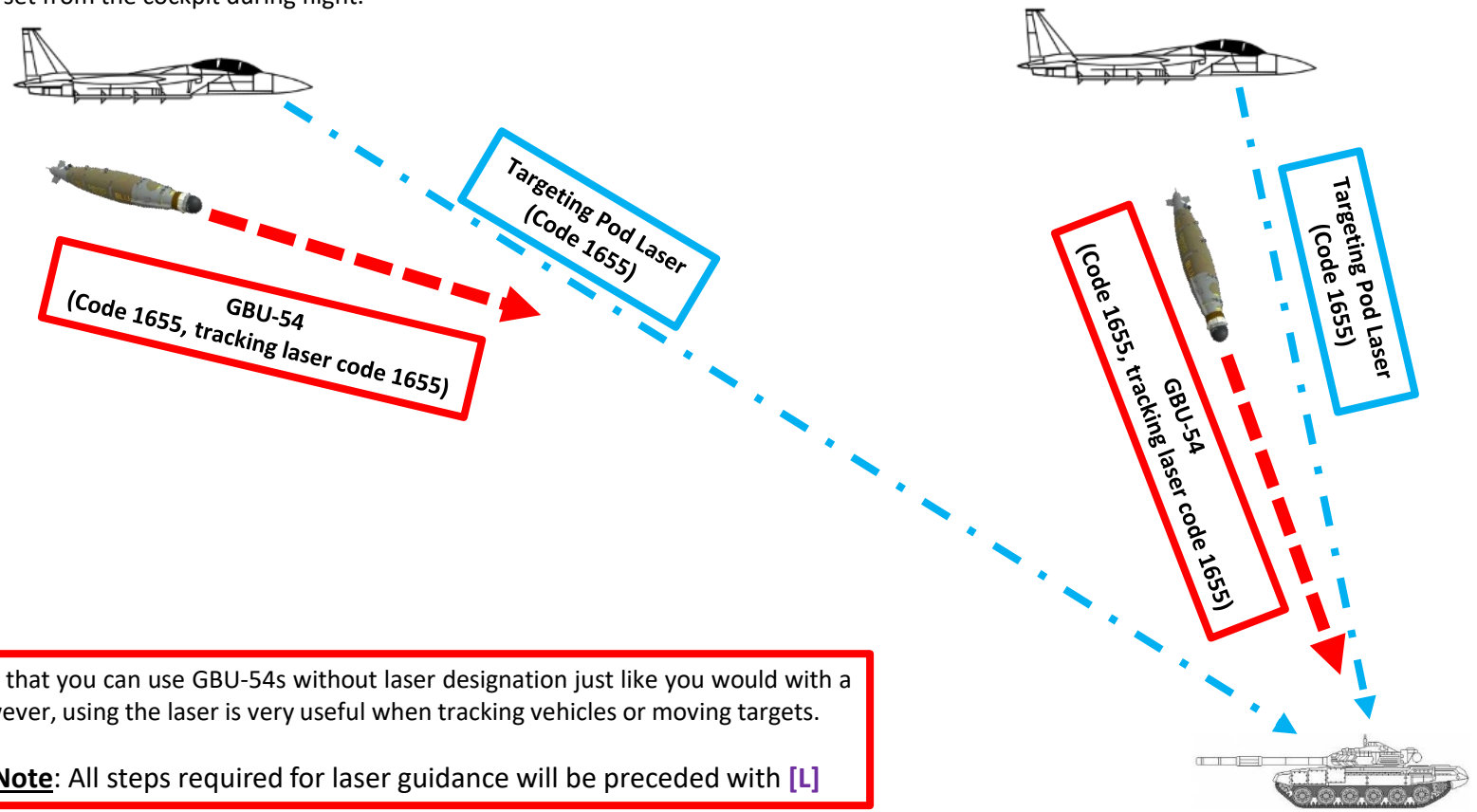
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup (if using laser guidance)

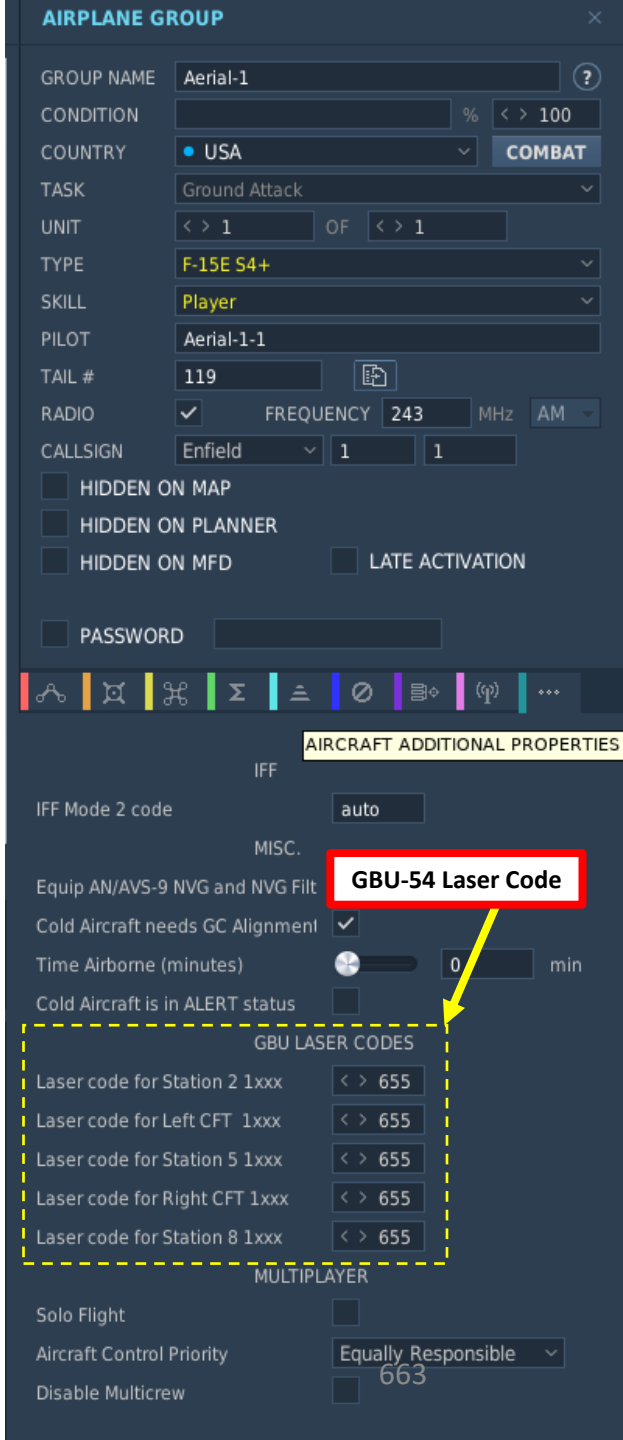
A hybrid of a GBU-38 JDAM and a GBU-12 laser-guided bomb is the GBU-54/B LJDAM. This weapon can act in both INS/GPS and laser-guidance modes, this allowing it launch-and-leave and engaging through cloud/dust as an INS/GPS weapon, and with the precision and ability to engage moving targets that laser-guidance provides. The GBU-54's laser tracking mode will automatically take precedence over the coordinates/TGP method. This is useful when designating a moving target with a targeting pod laser or using laser designators from friendly wingmen or a JTAC.

GBU-54 LJDAM release modes are almost exactly the same as GBU-38 JDAM. The seeker head on each laser guided bomb is set to track only a specific laser pulse rate frequency (PRF) code. These are manually set by the weapons load crew during ground operations (via Mission Editor) and may not be set from the cockpit during flight.



Keep in mind that you can use GBU-54s without laser designation just like you would with a GBU-38. However, using the laser is very useful when tracking vehicles or moving targets.

Important Note: All steps required for laser guidance will be preceded with **[L]**



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

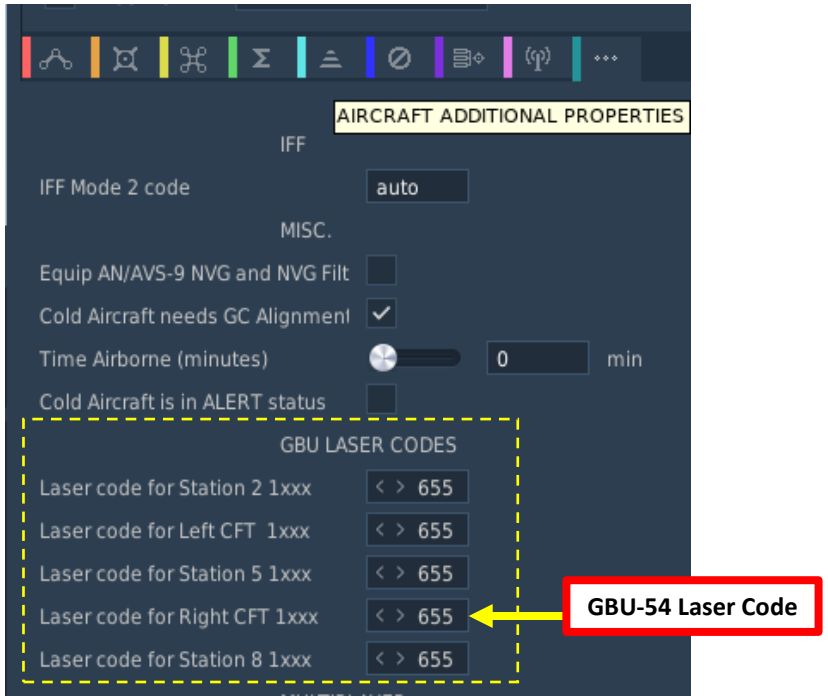
A – Weapon Setup (if using laser guidance)

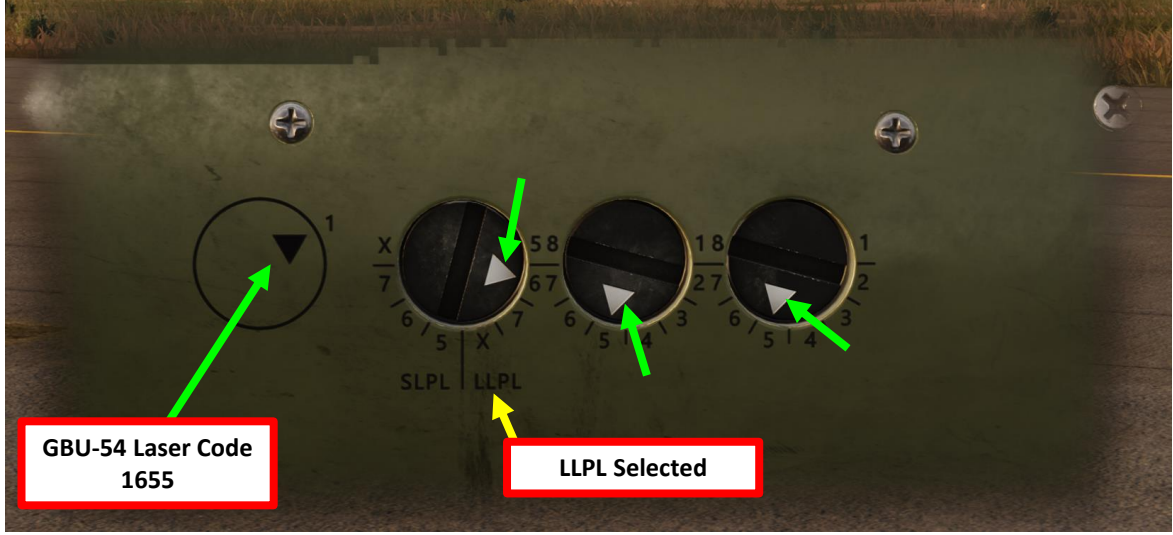
If you are flying in multiplayer and do not know your GBU-54 code, you can open the WEAPON Kneeboard page by pressing "RSHIFT+K". This will show you the laser code set on your GBU-54 laser-guided bomb.

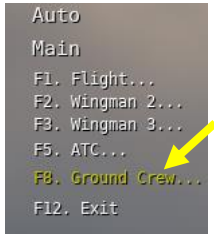
To manually set GBU-12 laser codes:

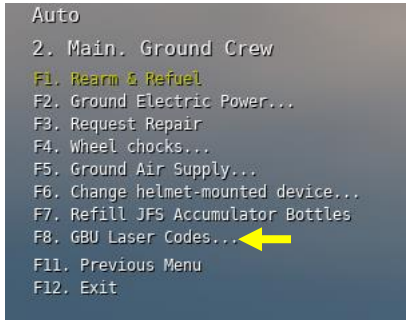
- Contact Ground Crew using "\", then F8 (Ground Crew), then F8 (GBU Laser Codes), then either F1, F2, F3, F4, F5 or F6 to select your desired station.
- On the pop-up interface that appears in the cockpit, click on the GBU-54 laser code selectors (white triangles) as desired (1688 by default). This is the laser code the bombs will track. We will use LLPL (Long Last Pulse Logic) instead of SLPL (Short Last Pulse Logic).
- Contact Ground Crew using "\", then F8 (Ground Crew), then F8 (GBU Laser Codes), then F7 to hide the interface.

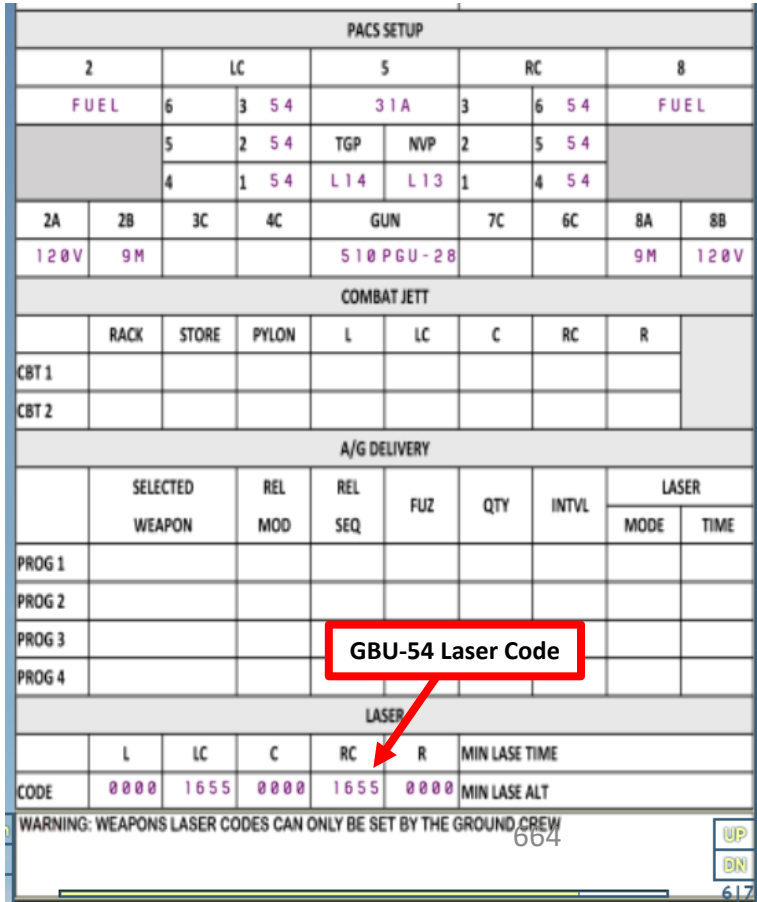
Take note that setting the bomb laser code should be done when the engine is shut down.







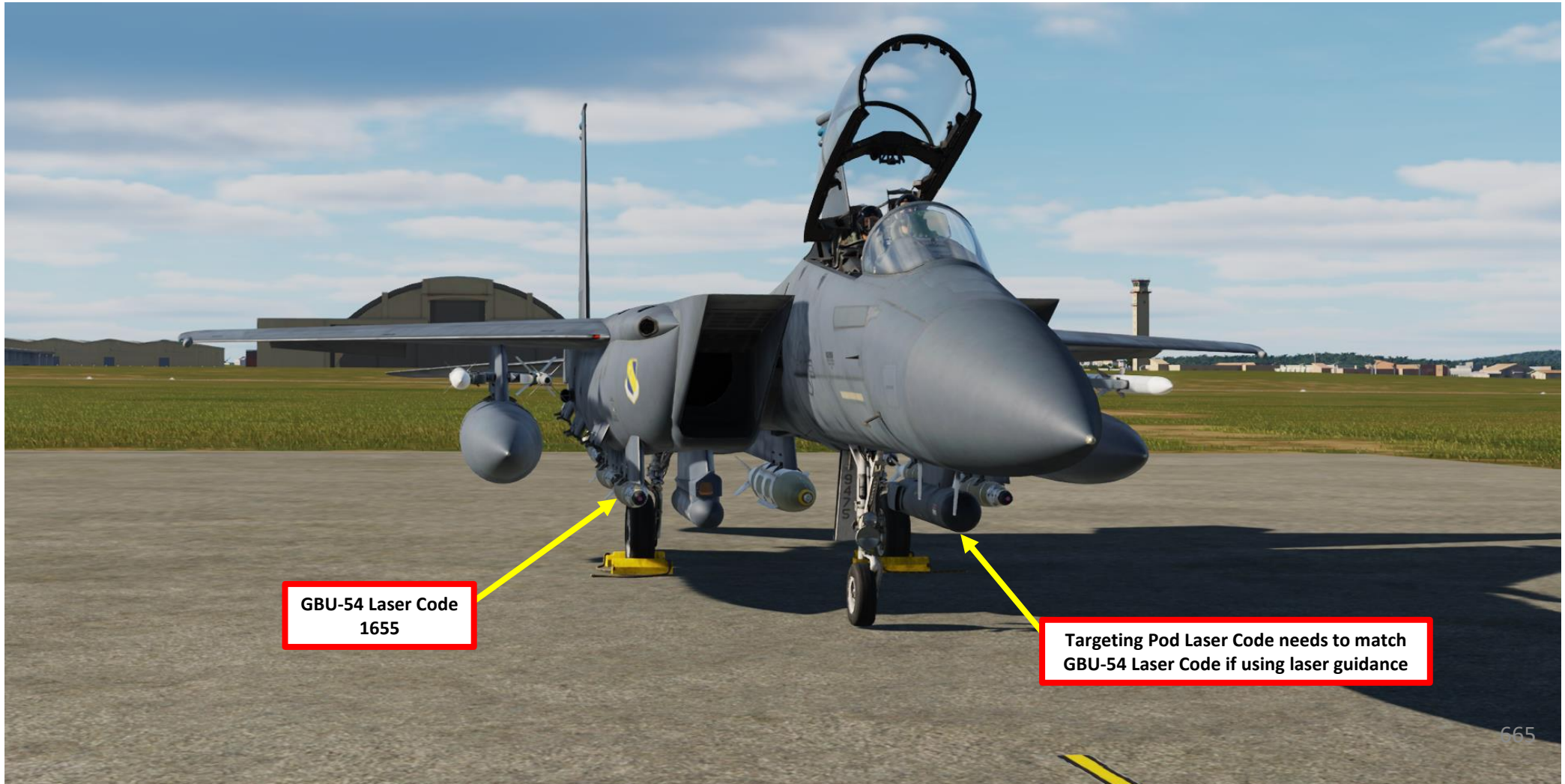




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup (if using laser guidance)

If you want to use the laser for GBU-54 guidance, the targeting pod designator code needs to be set to match the laser code of the GBU-54. This will be done later during the target designation procedure. **If using the GPS/INS mode only, the laser code does not need to match.**



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
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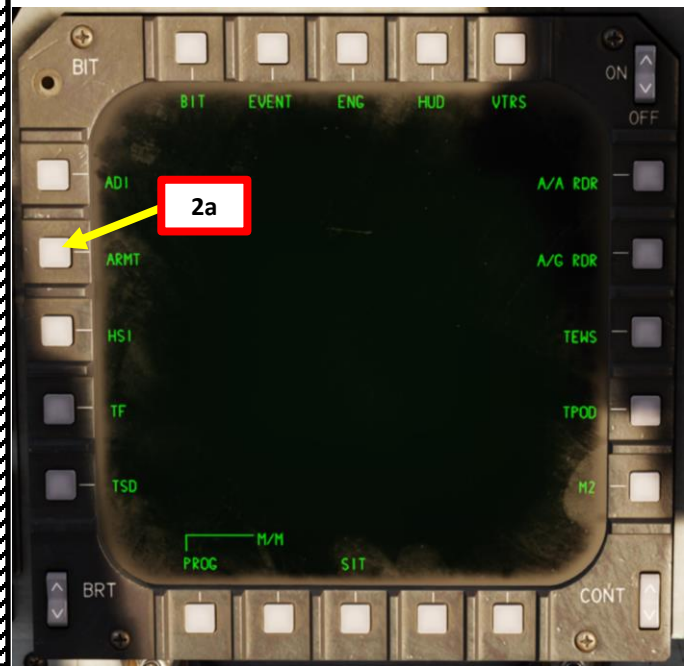
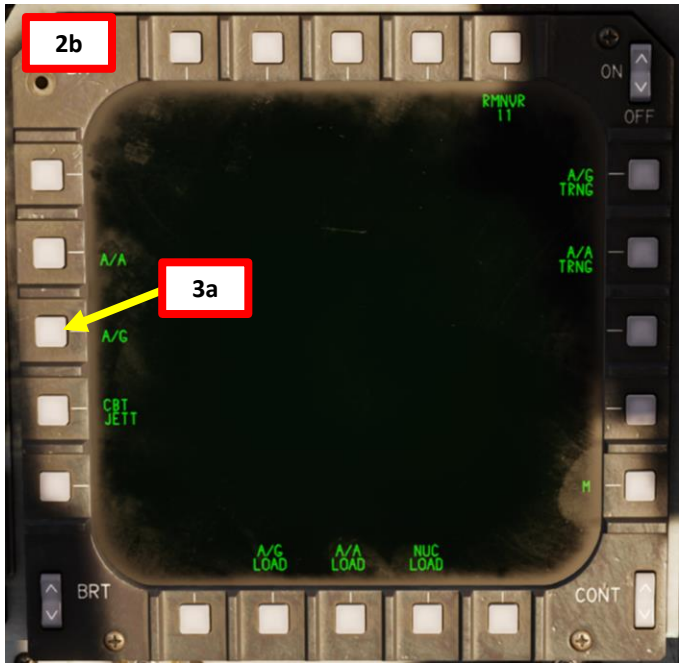
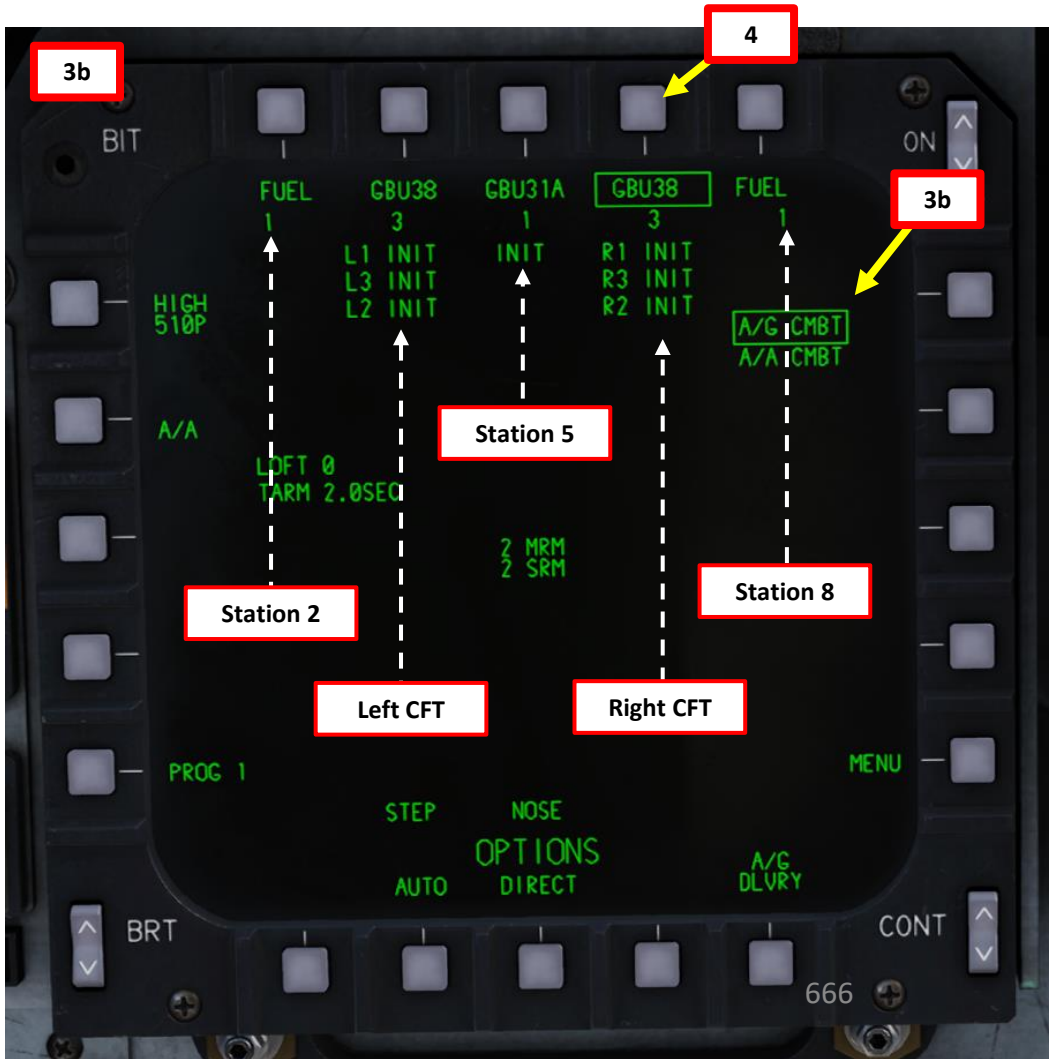
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup

1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Select desired stations by pressing pushbuttons next to “GBU38” (boxed when selected).
    - Note: For smart weapons, the weapon type should automatically be detected by the aircraft.







2 – AIR-TO-GROUND WEAPONS
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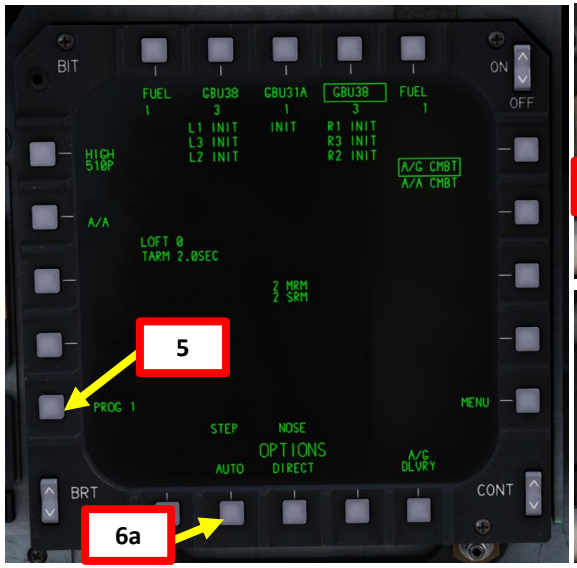
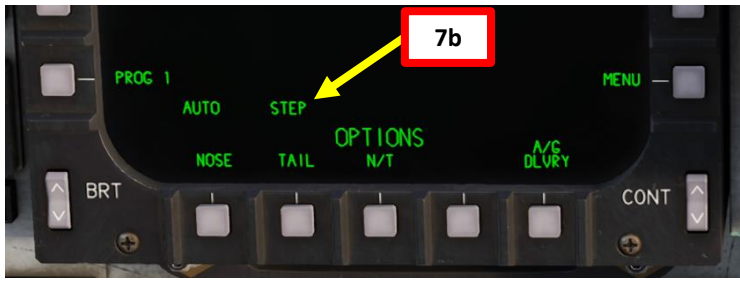
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup

5. Select what weapon program number you want to set by toggling the PROG pushbutton as desired. We will select Program 1.
    - Up to four different weapon programs can be set, which allows you to quickly change between weapons and delivery profiles.
6. Select Automatic Delivery Mode.
7. Select desired Release Sequence. We will select STEP.
    - *STEP: One weapon dropped with each press of Pickle Button, alternating between stations to maintain best possible balance.*
    - *RIPPLE SINGLE: Drops a string of weapons for as long as Pickle Button is pressed until set quantity is reached. Bombs are dropped alternating between selected stations.*
8. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Release Quantity.
9. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), select Interval (distance in feet between bomb drops).
10. *(Not required in this tutorial)* If required (using RIPPLE SINGLE), set the BOT (Bomb On Target) option as desired.
    - BOT setting determines which bomb in the string during the attack will hit the designated target/spot under the pipper.
11. Select N/T (Nose/Tail) Fuzing Option.
12. If you want to edit a parameter again, press the pushbutton next to the parameter you want to edit.

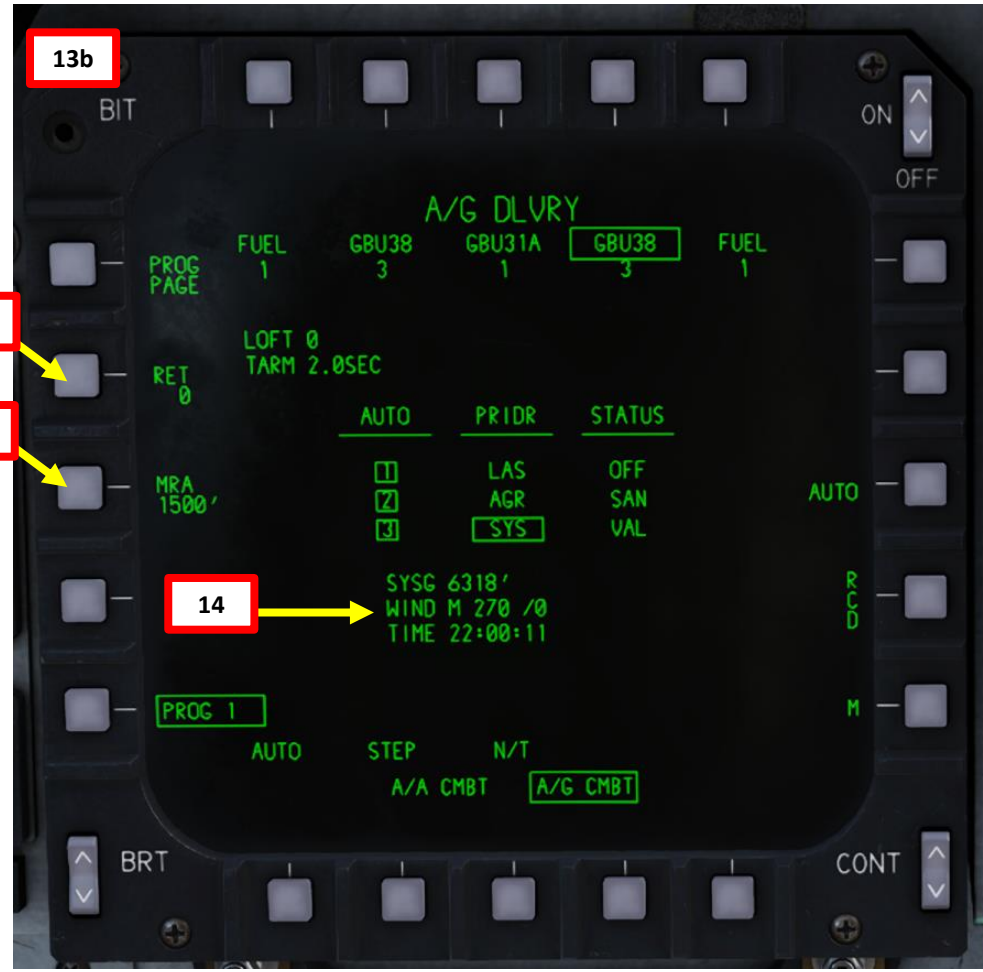




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup

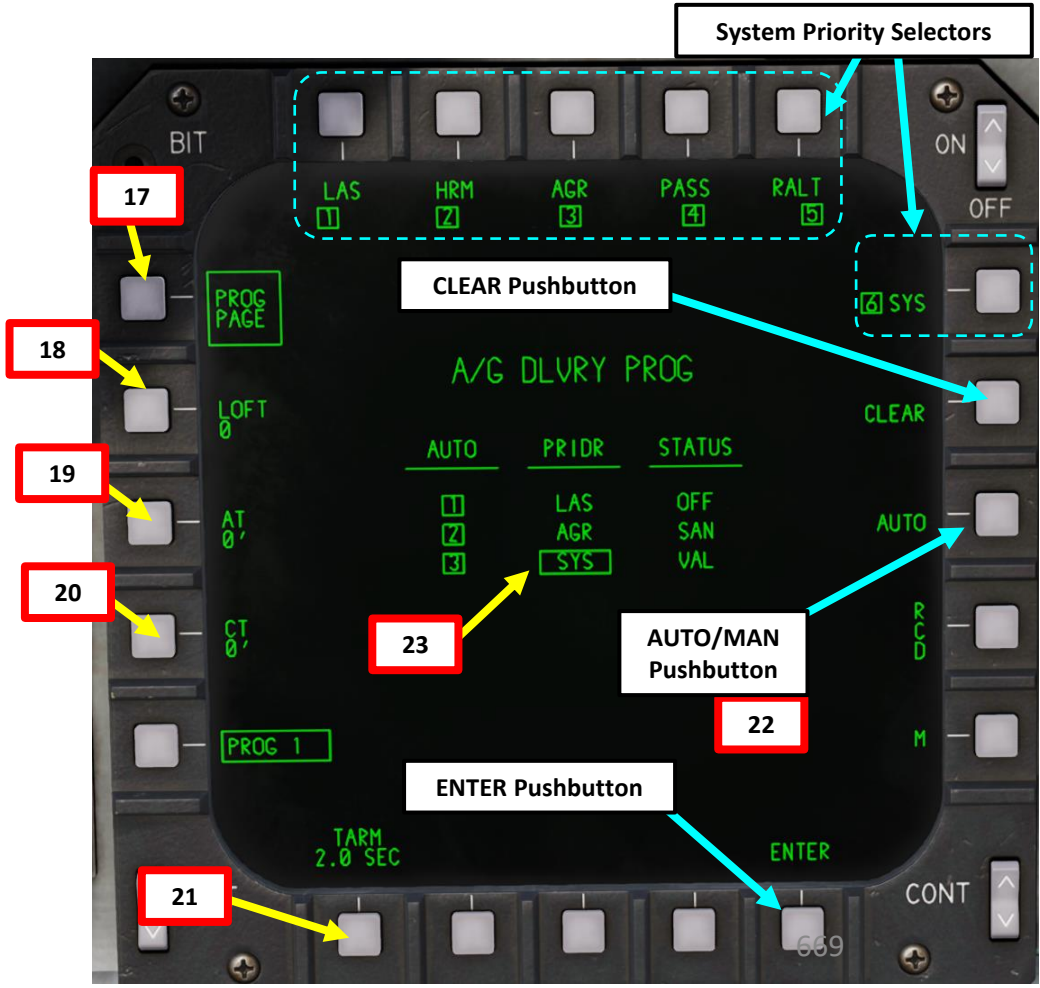
13. Select A/G DLVRY (Air-to-Ground Delivery) sub-menu.
    - Note: Weapons cannot be selected from the A/G DLVRY page. They can only be selected from the A/G ARMT (PACS) page we used previously.
14. System altitude, wind speed and TOD (Time-of-Day) information can be consulted on the A/G DLVRY page.
15. Optional: If you want to manually set Reticle Depression (RET), enter the reticle depression setting in mils (between 0 and 250 mils) on the UFC (Upfront Control Panel), then press pushbutton next to RET.
    - For this tutorial, we will leave RET setting to 0 mils.
16. Optional: If you want to see Minimum Release Altitude cues on the Heads-Up Display, set Minimum Recovery Altitude (MRA) setting by entering the value in feet on the UFC (Upfront Control Panel), then pressing the pushbutton next to MRA.
    - For this tutorial, we will set MRA setting to 1500 ft.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

A – Weapon Setup

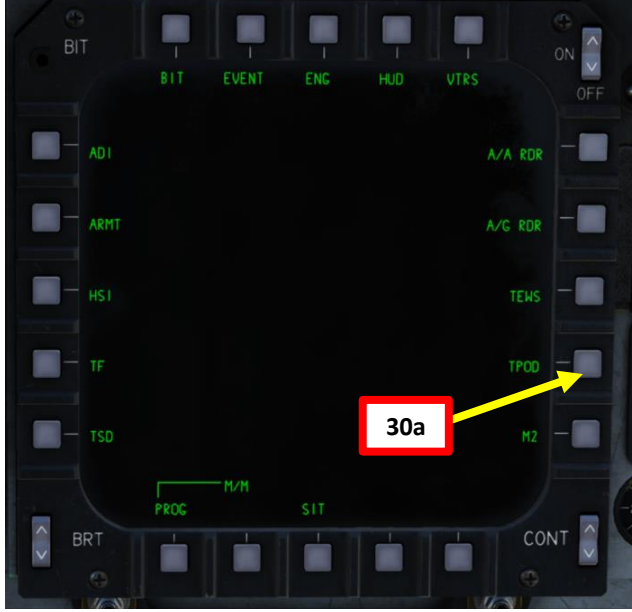
17. Select PROG PAGE (boxed when selected).
18. Optional: Set Loft Angle (LOFT) setting by entering an angle between 0 and 45 deg on the UFC (Upfront Control Panel) scratchpad, then pressing the pushbutton next to LOFT.
    - We will use a LOFT setting of 0 deg.
19. Optional: Set Along Track (AT) Bias setting. We will leave setting to 0 ft.
    - *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. If "AT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet into milliradians and the legend will show AT XX MIL. The possible value for bias here is between -50 and 50.*
20. Optional: Set Cross Track (CT) Bias setting. We will leave setting to 0 ft.
    - *This option 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 CT will move the impact point right to correct for left errors. Negative CT 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. If "CT" pushbutton is pressed with blank scratchpad, the unit will be changed from feet to milliradians and the legend will show CT XX MIL. The possible value for bias here is between -50 and 50.*
21. Set Time-to-Arm (TARM) setting. We will leave it to 2.0 sec.
    - *This option 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 "TARM" pushbutton. If decimal is not manually entered, the system adds it before the right most digit.*
22. Select Auto or Manual Sensor Hierarchy as desired. The set sensor hierarchy is used 15 seconds before release to increase accuracy. We will select Auto for simplicity.
    - *Note: To manually set sensor hierarchy:*
        a) *Select Manual Sensor Hierarchy with the AUTO/MAN pushbutton*
        b) *Press CLEAR*
        c) *Press pushbuttons next to LAS, HRM, AGR, PASS, RALT and SYS to assign them a priority number (1 being the highest priority setting, 6 being the lowest).*
        d) *When sensor priority hierarchy has been set, press pushbutton next to ENTER to validate.*
23. The boxed sensor (SYS, or "system" in this case) indicates which sensor is used to calculate Height Above Target (HAT) or Height Above Ground (HAG). "VAL" status indicates the sensor passes validity and HUD sanity checks.
24. If you wish to return to the A/G CMBT page, press pushbutton next to "M", then select "ARMT" (PACS) page.



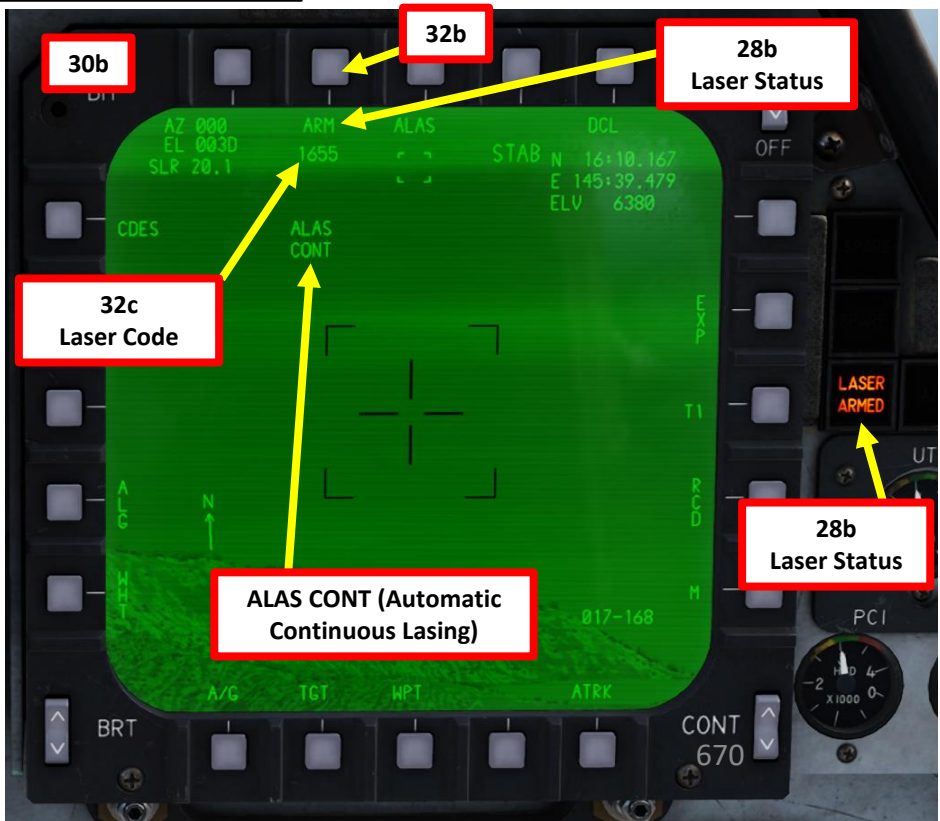
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

25. *[P]* Set Master Arm Switch – ARM (UP)
26. *[P]* Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
27. *[WSO]* Set TGT FLIR (Targeting Pod) Power Switch – ON (FWD).
28. *[WSO]* Set Laser Arm Switch to ARMED (FWD).
29. *[WSO]* Adjust TGT FLIR Gain/Level – As required.
30. From the main MPD menu page, select TPOD page.
31. **[L]** When using GBU-54s with a targeting pod designation, **using a laser for guidance is optional but still recommended**.
32. **[L]** To set laser designation code, enter the GBU-54 laser code set previously on the UFC (Upfront Control Panel) keypad, then press pushbutton next to the laser status/code indication (ARM/1655 in this example). Valid laser codes are 1111 thru 1788, therefore we will use laser designation code 1655.

Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*



WSO (Weapon Systems Officer) Cockpit



2 – AIR-TO-GROUND WEAPONS
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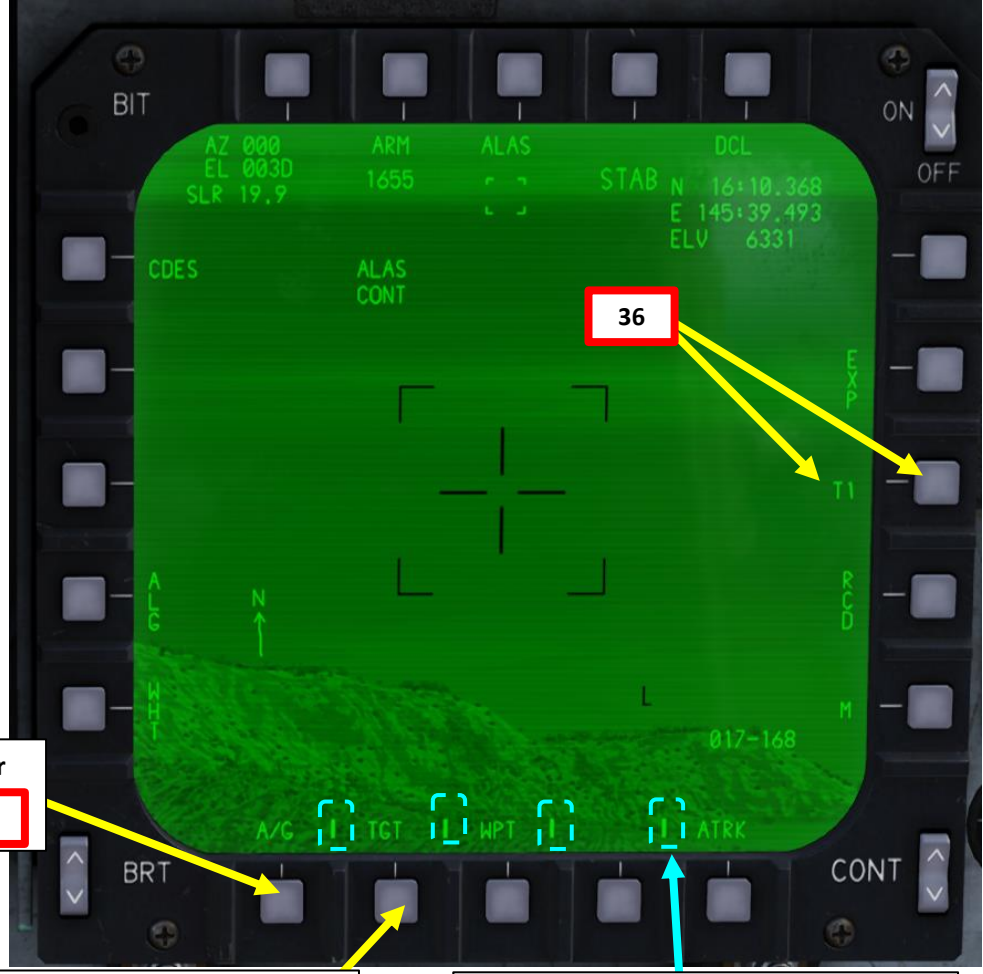
Targeting Pod (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

33. Make sure the TPOD page is selected, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the TPOD display.
    - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired TPOD display.
        - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
    - Selection bars at the bottom of a display indicate the page is selected.
34. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
35. Set Targeting Pod Function Selector to TGT (Target Designation).
36. Select Primary (T1) Mode.
37. Before using the targeting pod's laser ranger/designator, verify that the following conditions are met (otherwise laser designation is inhibited):
    a) **Aircraft altitude is below 25000 ft.**
    b) **Weight off wheels (aircraft is flying) and landing gear is retracted.**
    c) **Valid laser code is entered.**
    d) **Laser is armed.**



Targeting Pod Mode Selector
- *A/G: Air-to-Ground*
- *A/A: Air-to-Air*

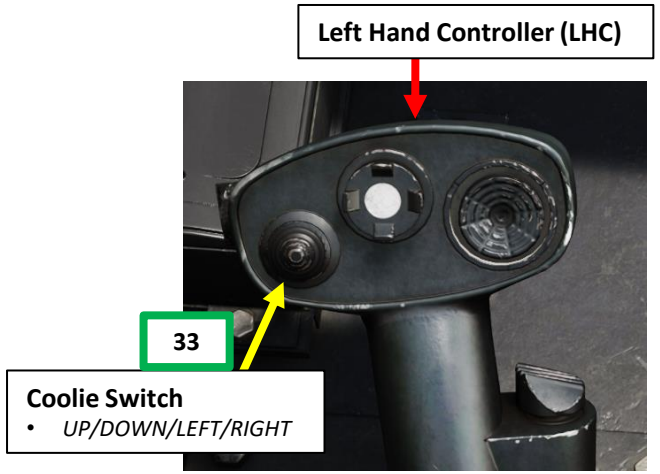
34

Targeting Pod Function Selector
- *TGT: Target Designation*
- *CUE: Sensor Slaving*
- *MARK: Markpoint Designation*
- *UPDT: Position Update*

35

Selection Bars
- *Indicates that Targeting Pod is in command*

33



2 – AIR-TO-GROUND WEAPONS
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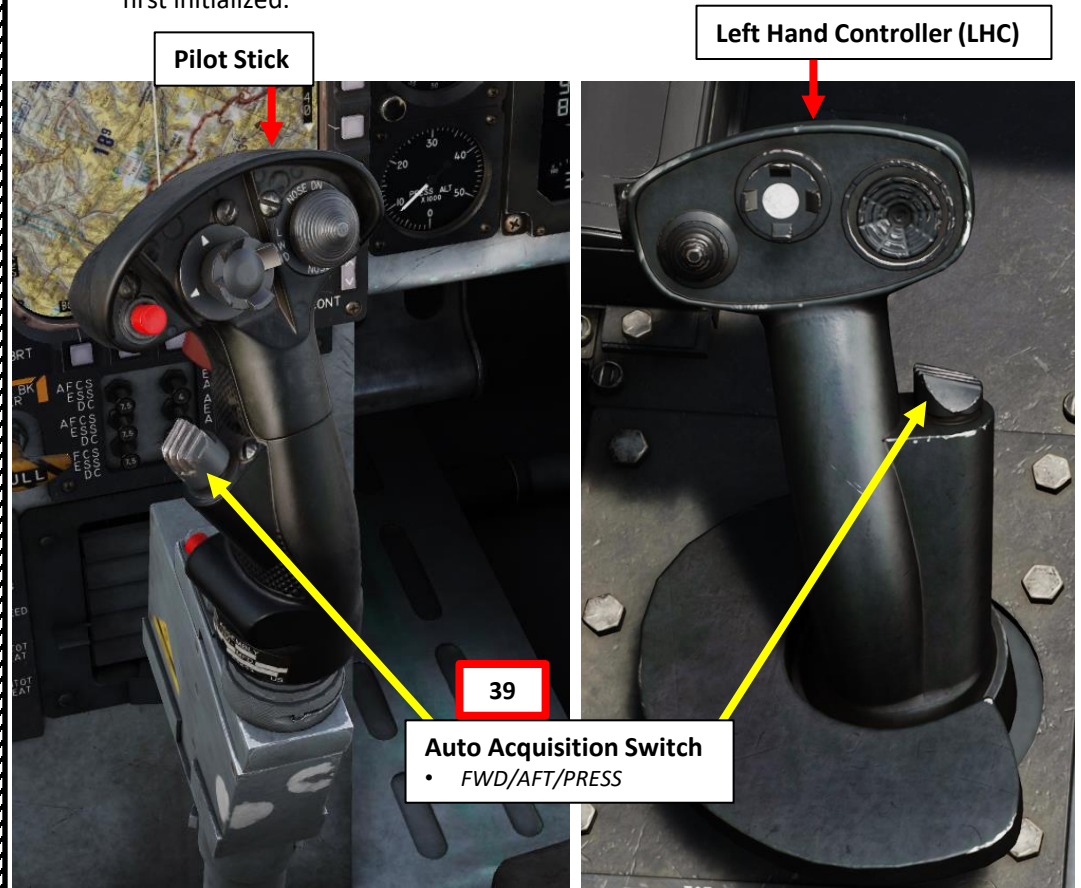
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

38. You can cue (slave) the targeting pod to a navigation point or other systems (which we talk about in the Cue Mode section), but for this example we will use the simplest method of using the targeting pod in snowplow mode.
39. Press Auto Acquisition Switch – FWD LONG (more than 1 sec) to enter SNOWPLOW STAB mode.
40. The targeting pod's SNOWPLOW STAB mode is space-stabilized to a point below the horizon along the heading vector. The targeting pod's line-of-sight is not tied to the ground; instead, it points at the space at the azimuth angle and elevation the pod had when space stabilization was first initialized.

Targeting Pod Line-of-Sight Symbology on Heads-Up Display

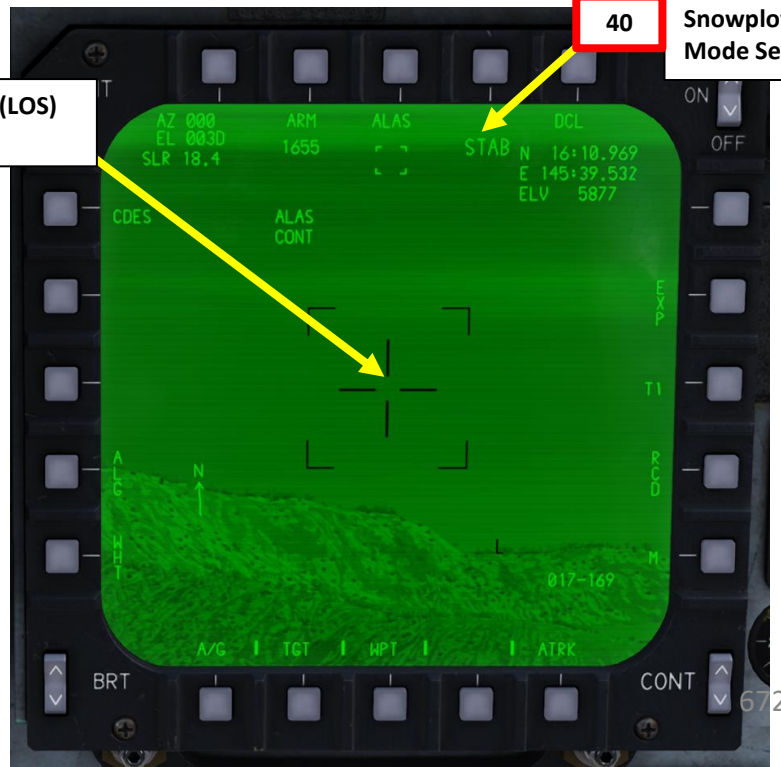


Pilot Stick

Left Hand Controller (LHC)

39

Auto Acquisition Switch
- *FWD/AFT/PRESS*



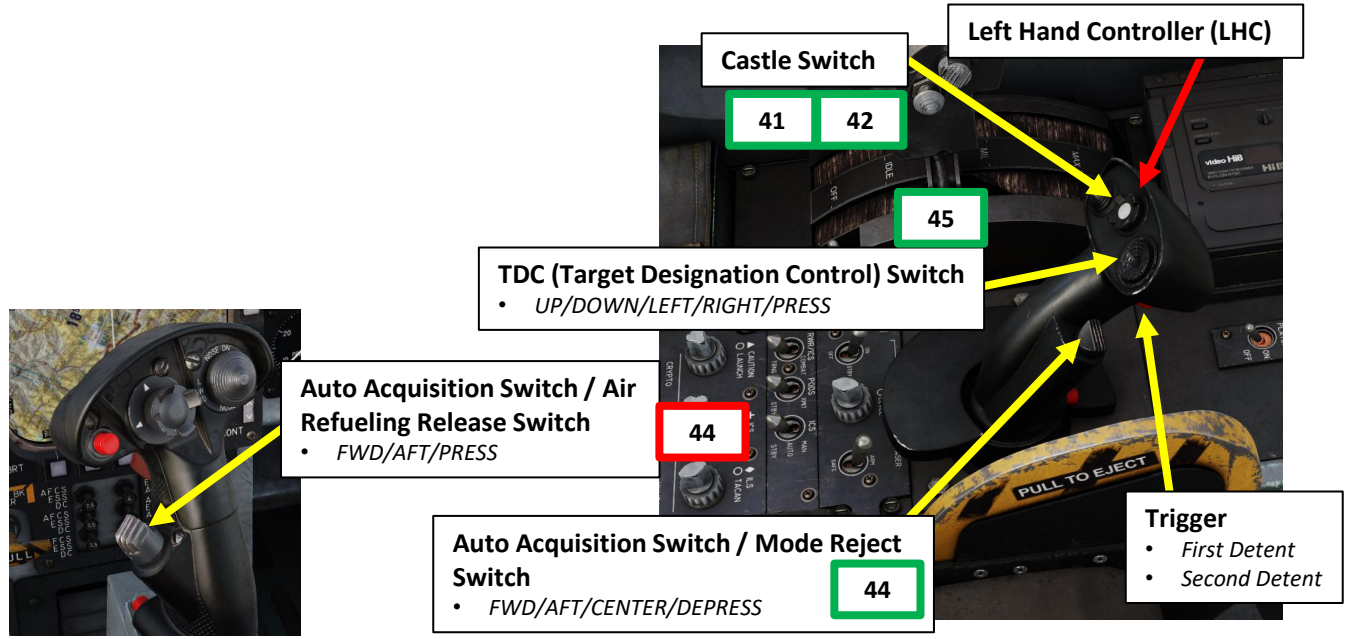
40

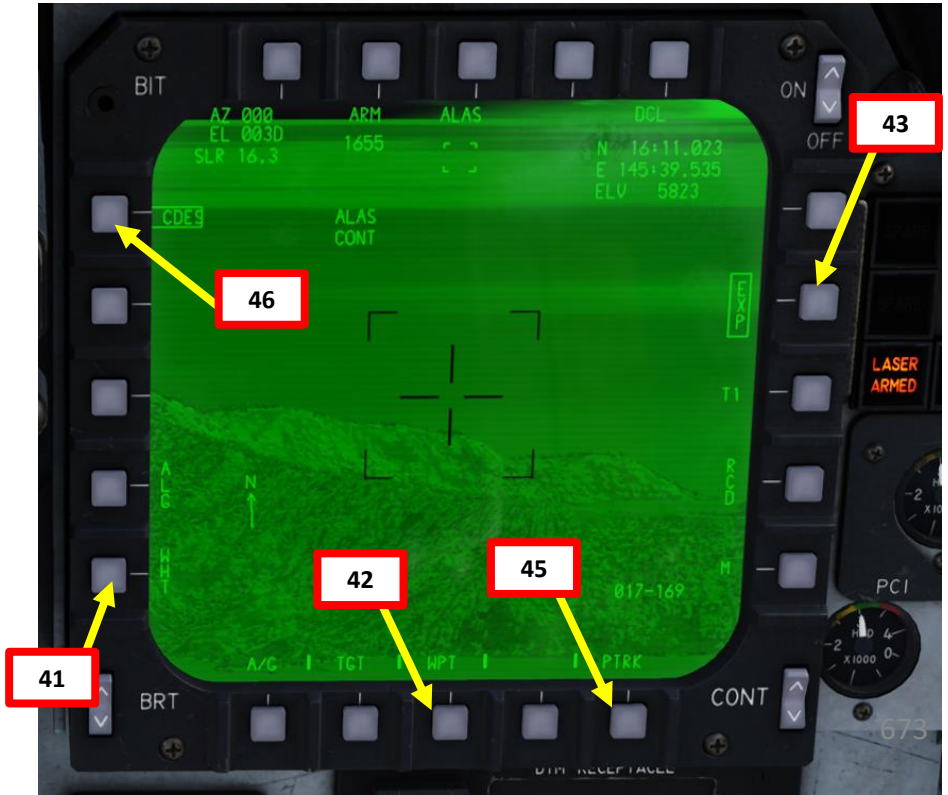
Snowplow STAB Mode Selected

Targeting Pod Line-of-Sight (LOS) Sighting Index Cursor

2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

41. Select Video Polarity – As desired.
    - Pressing the Video Polarity Selection Option pushbutton on the TGT IR display changes the White Hot (WHT) or Black Hot (BHT) video polarity of the targeting pod IR tracker.
    - The BHT/WHT indication shows what polarity will be selected when pressing the pushbutton.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD LONG (more than 1 sec)
42. Select Tracker Polarity Selector – As desired.
    - 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 center of the crosshairs when point track is initiated.
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut: Castle Switch FWD SHORT (less than 1 sec)
    - Note: The WPT/BTP/APT indication shows what tracker polarity will be selected when pressing the pushbutton.
43. If you want to use the ENFOV (Expanded Narrow Field-of-View) zoom mode, select/box the EXP option. In this example, we will select it.
44. Zoom as required by pressing the Auto Acquisition Switch FWD SHORT (less than 1 sec), which toggles between WFOV (Wide), NFOV (Narrow) and ENFOV (Expanded Narrow) zoom levels.
45. Select desired tracking method using the pushbutton next to PTRK/ATRK. We will select PTRK (Point Track).
    - Point Track (PTRK) tracks a moving object like a high-contrast vehicle
    - Area Track (ATRK) is used for a static target
    - **WSO** L/RHC (Left/Right Hand Controller) Shortcut : TDC PRESS
46. If a continuous laser designation is desired, select/box the CDES option. The designation will be continuously updated with new range and line-of-sight designation.
    - If CDES is unselected/unboxed, lasing the target is only performed as long as the Left Multifunction Switch (pilot) or laser trigger (WSO) is depressed.





2 – AIR-TO-GROUND WEAPONS
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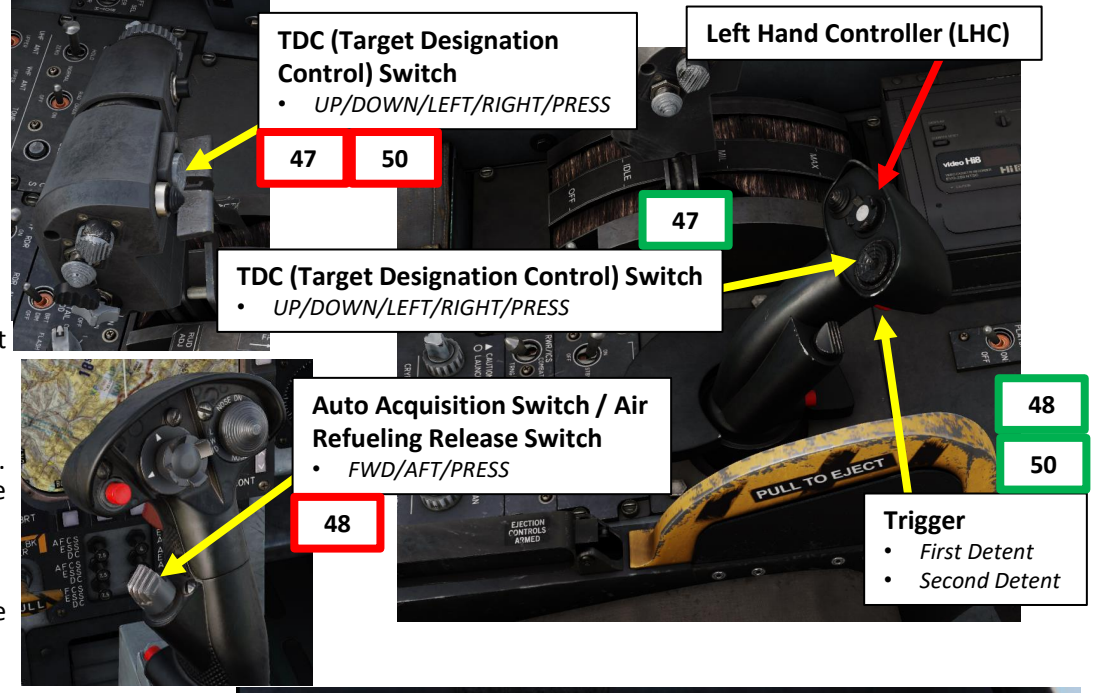
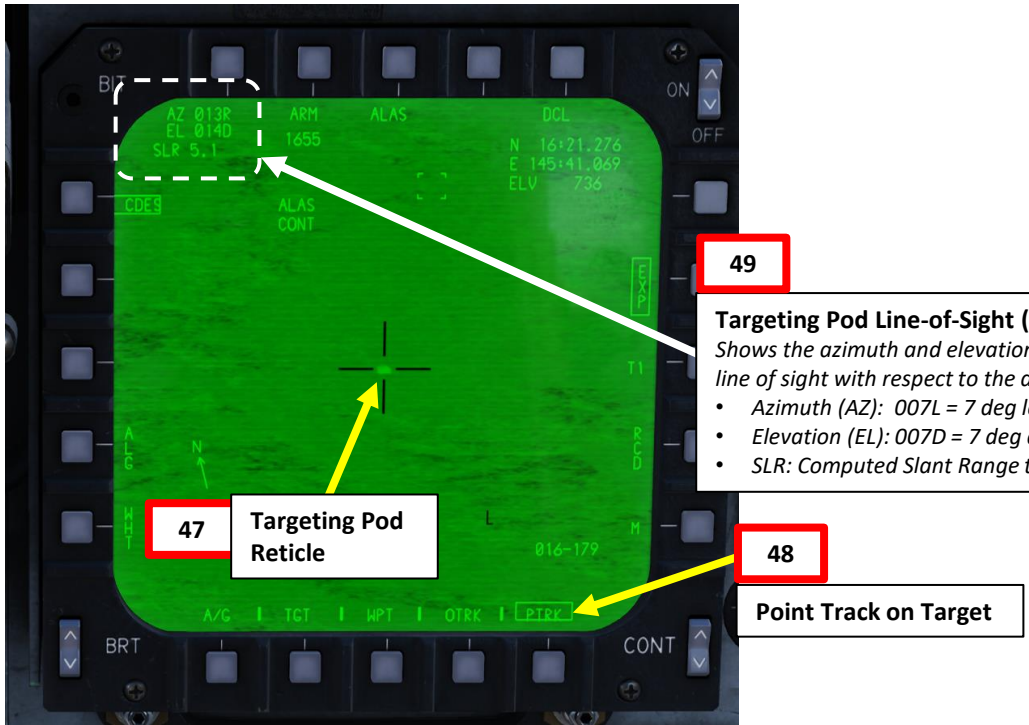
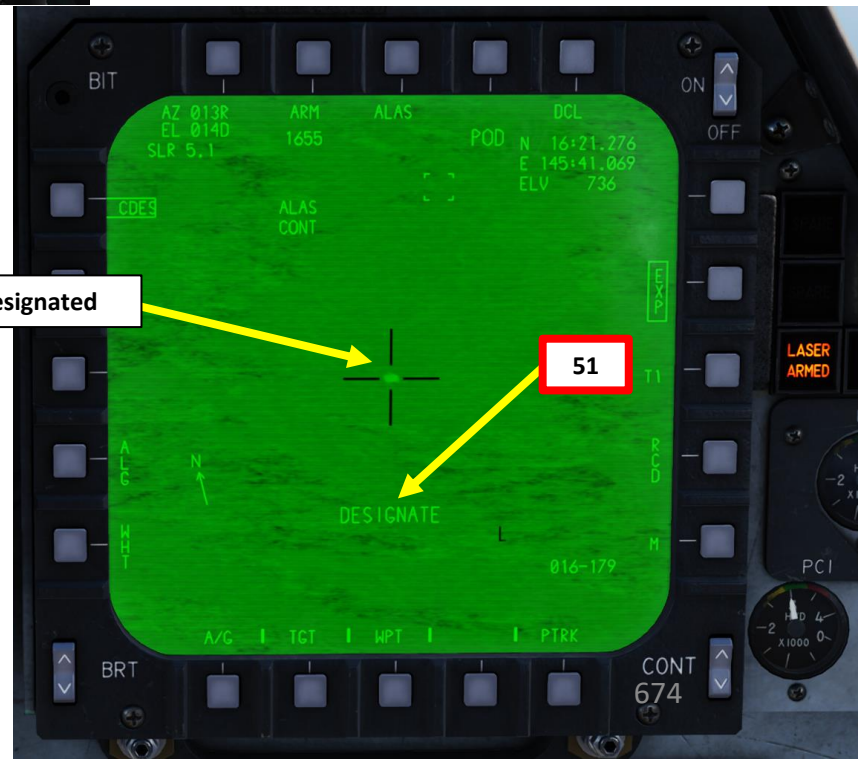
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
B – Weapon Arming & Target Designation

47. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to designate and range with a laser.
48. Initiate a targeting pod "track" on the target (either point or area track).
    - **Pilot**: Depress Auto Acquisition Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to half action (first detent), then release it.
49. Once the target is tracked, the targeting pod will compute a slant range and either PTRK or ATRK will be boxed depending on what tracking method you have selected previously.
50. To designate the target:
    - **Pilot**: Press and release the TDC (Target Designation Control) switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
51. Once target is designated, the DESIGNATE legend appears for 5 seconds.

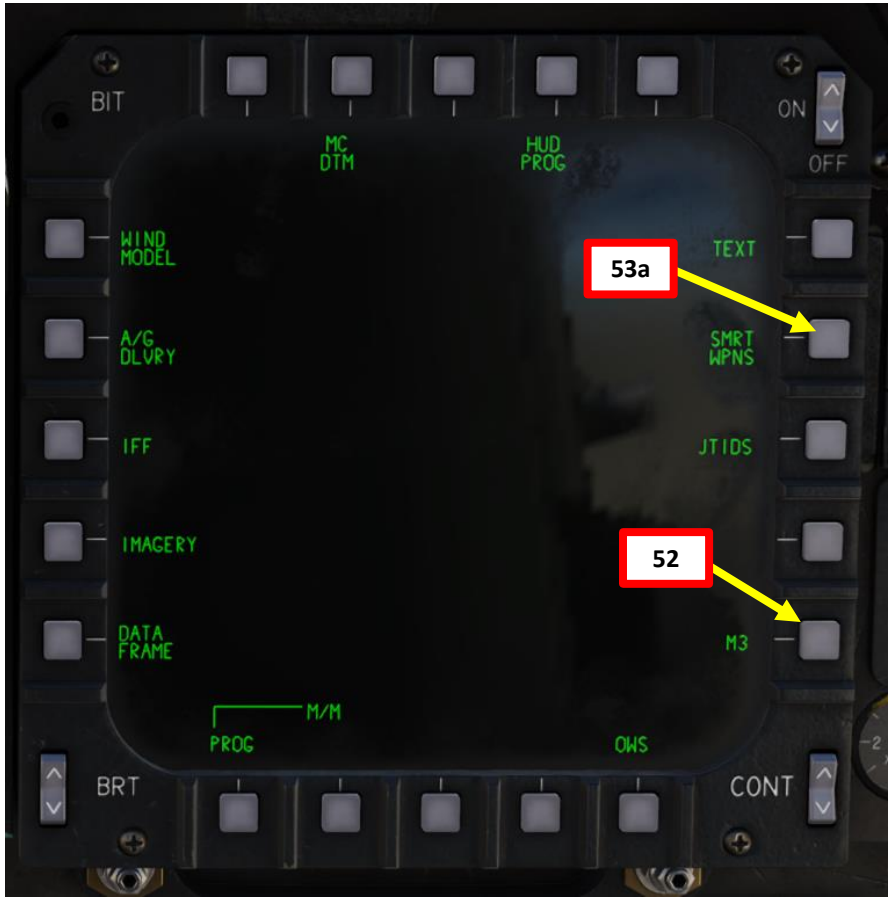


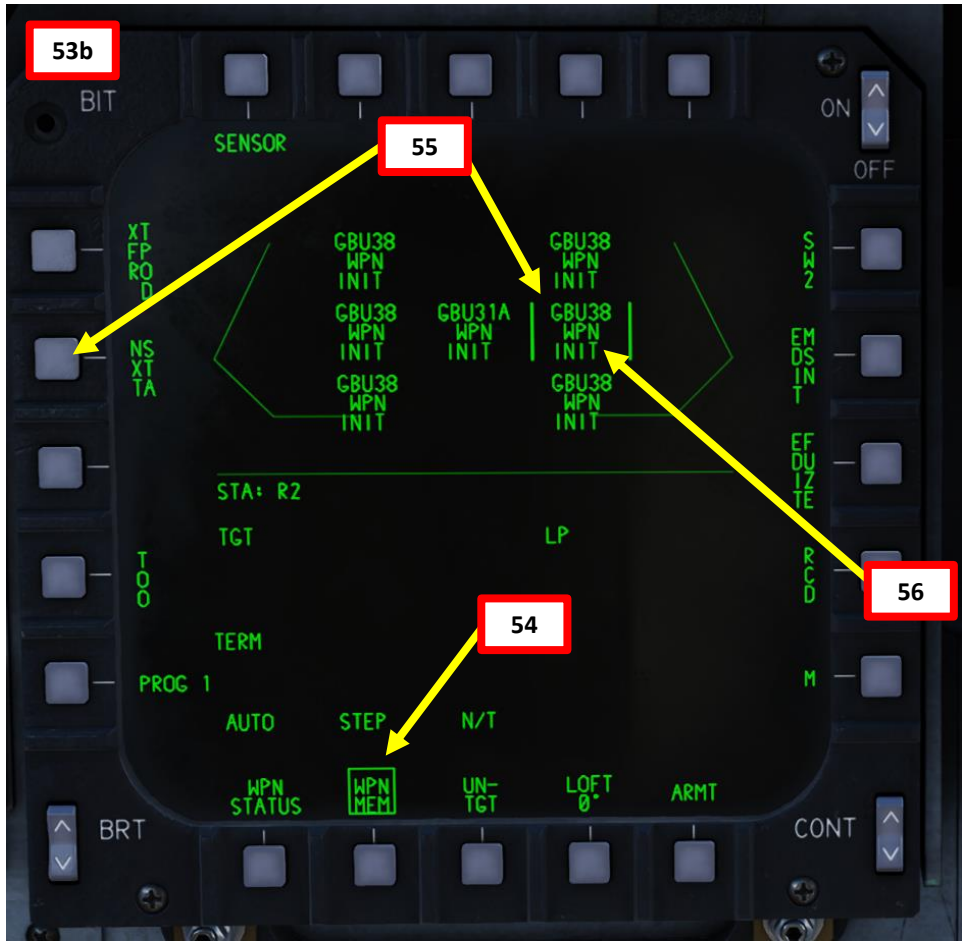




2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
C – Upload Targeting Data from Onboard Sensor (Targeting Pod) to Weapon

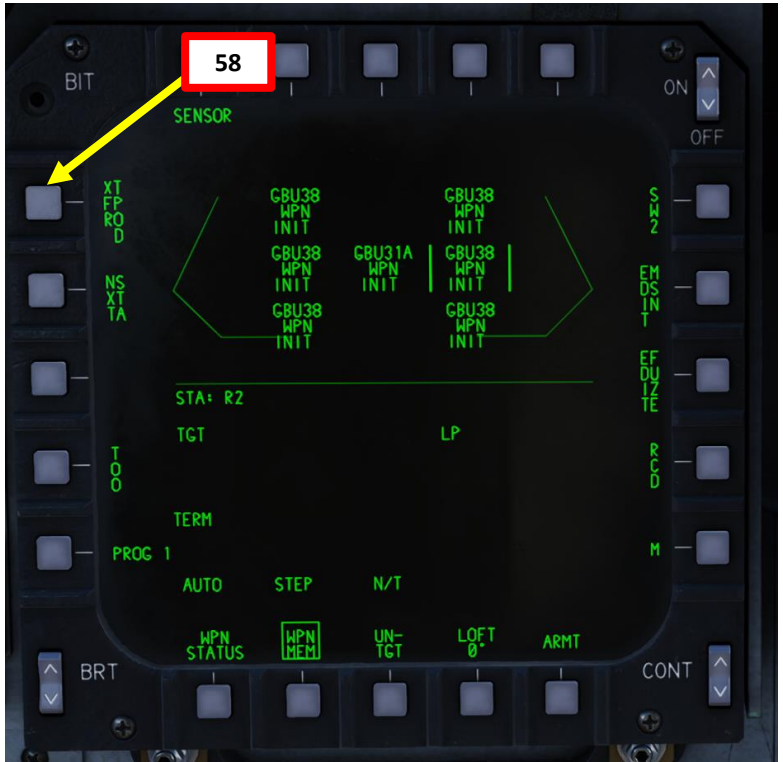
52. Press the Menu Selection PB (Pushbutton) to toggle between MENU 1 (M) and MENU 2 (M2).
53. Select SMRT WPNS page.
54. "WPN MEM" (Weapon Memory) mode is selected by default.
55. If required, press NXT STA (Next Station) PB until desired weapon is selected (indicated by goal posts).
56. "INIT" indicates that the smart weapon does not have coordinates stored in currently. We will have to enter them from an onboard sensor, which is the targeting pod.

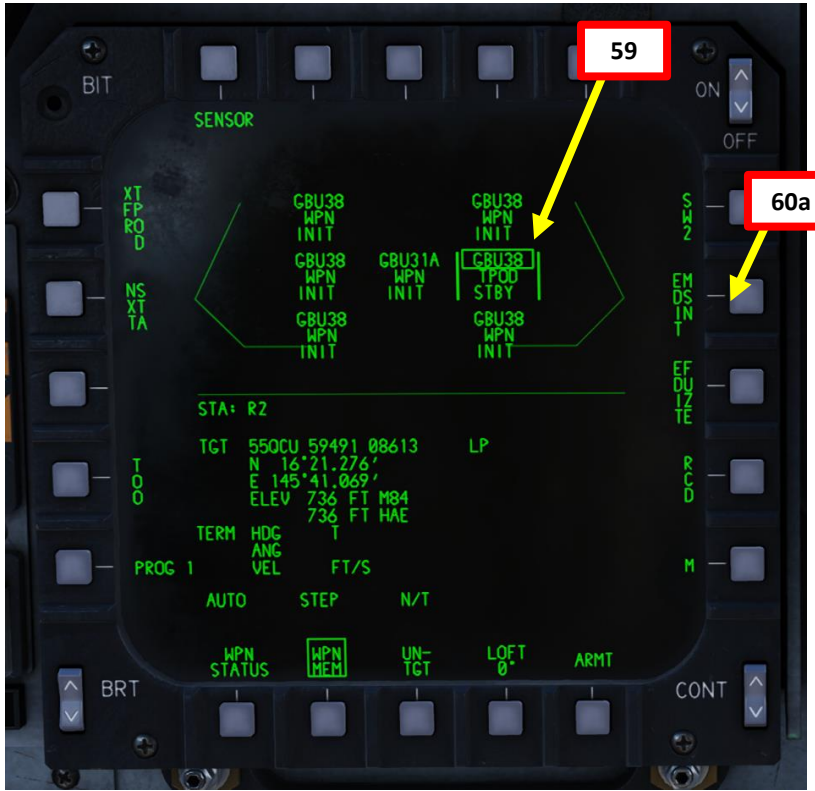


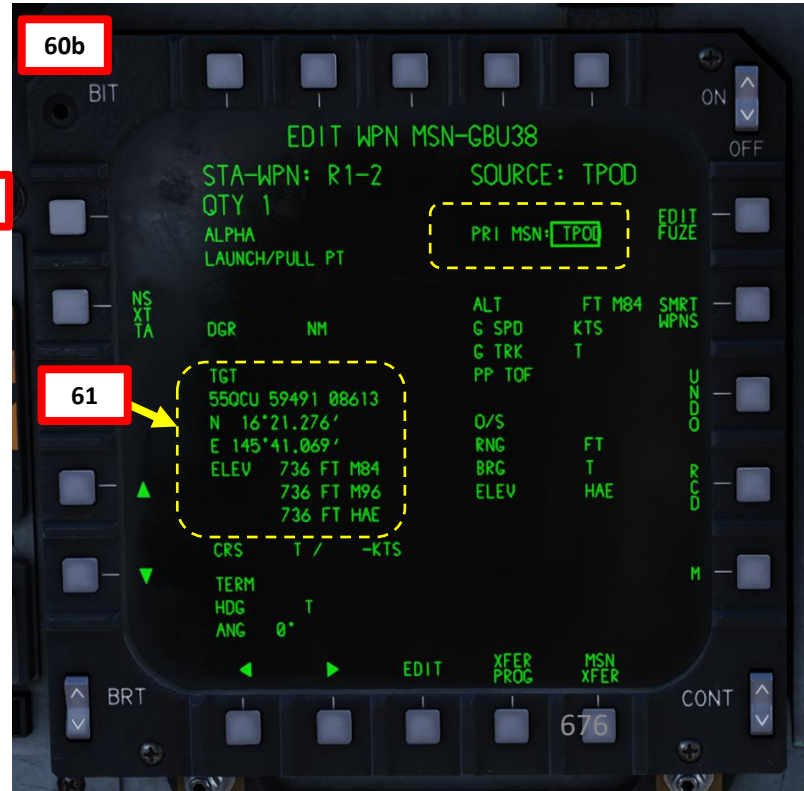


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
C – Upload Targeting Data from Onboard Sensor (Targeting Pod) to Weapon

57. **We will upload target coordinates from the air-to-ground radar designation.**
58. Press XFR TPOD (Transfer Targeting Pod) to transfer target data to the weapon.
59. Once transfer is complete, the weapon status changes from INIT to STBY. "**TPOD**" indicates that the selected ordnance is now set for the target coordinates stored for "**targeting pod designation"**, as shown in the "PRI MSN TPOD" data field**.**
60. Press EDIT MSN button to edit mission and terminal parameters. From this page, you can see the current target coordinates.
61. **Verify target coordinates and elevation.**
62. For simplicity, we will assume target latitude/longitude coordinates and elevation are good enough.





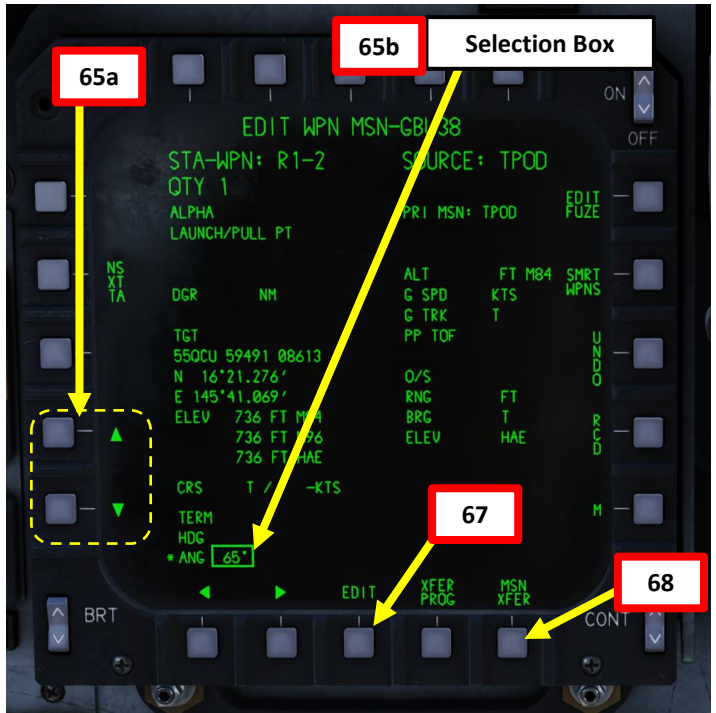


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

C – Upload Targeting Data from Onboard Sensor (Targeting Pod) to Weapon

Note: VEL (Weapon Terminal Velocity) terminal parameter is not currently available for modification. The valid range is between 700 and 1200 feet per second.

63. We will now set Weapon Terminal Parameters.
64. Use UP and DOWN arrow buttons to move the selection box to the TERM HDG (Weapon Terminal Heading) data field. Desired value ranges from 0 to 359. We will leave it blank and not assign a specific heading.
65. Use UP and DOWN arrow buttons to move the selection box to the ANG (Weapon Dive Angle) data field. Desired value ranges from 65 and 89 degrees.
66. On UFC (Upfront Control Panel) keypad, enter desired ANG value (65).
67. Press EDIT to update the ANG field. An edited field is preceded by an asterisk *.
68. Transfer data to weapon. We will use MSN XFER.
    - Use “MSN XFER” button to transfer the edited mission to the weapon.
    - Use “XFER PROG” button to transfer all edits to all weapons on all selected stations.
69. When data transfer is complete, asterisks disappear from the edited fields.
70. To return to the SMRT WPNS page, press the SMRT WPNS button.

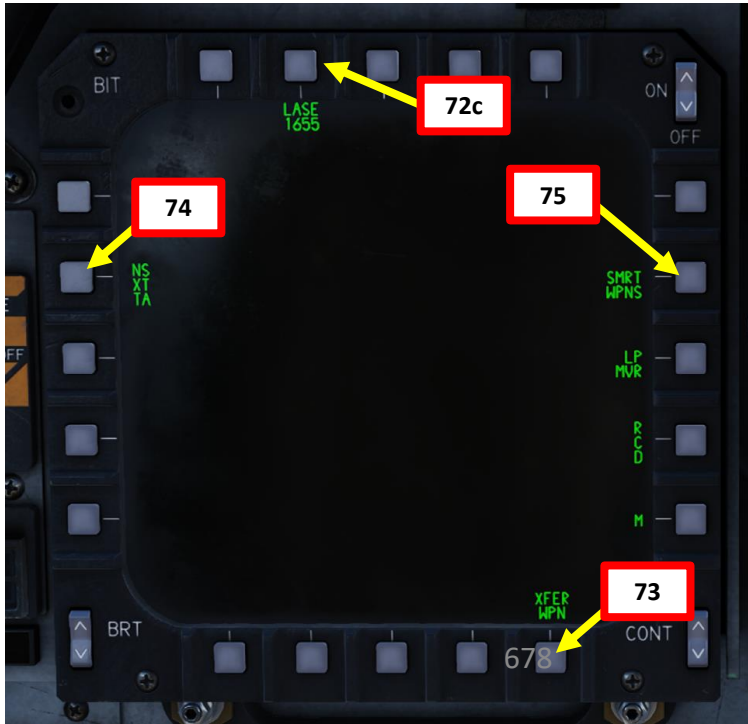


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

D – Program Weapon Laser Code (if using laser guidance)

71. **[L]** From the SMRT WPNS page, select SENSOR sub-page.
72. **[L]** To set laser designation code, enter the GBU-54 laser code set previously on the UFC (Upfront Control Panel) keypad (code 1655), then press pushbutton next to the laser status/code indication (LASE/1688 in this example). The laser code will change from 1688 to 1655.
73. **[L]** Press XFER WPN (Transfer Weapon) to transfer the laser code to the selected weapon.
74. **[L]** If you need to employ other GBU-54s with other laser codes, repeat procedure by pressing NXT STA (Next Station) and repeating previous steps.

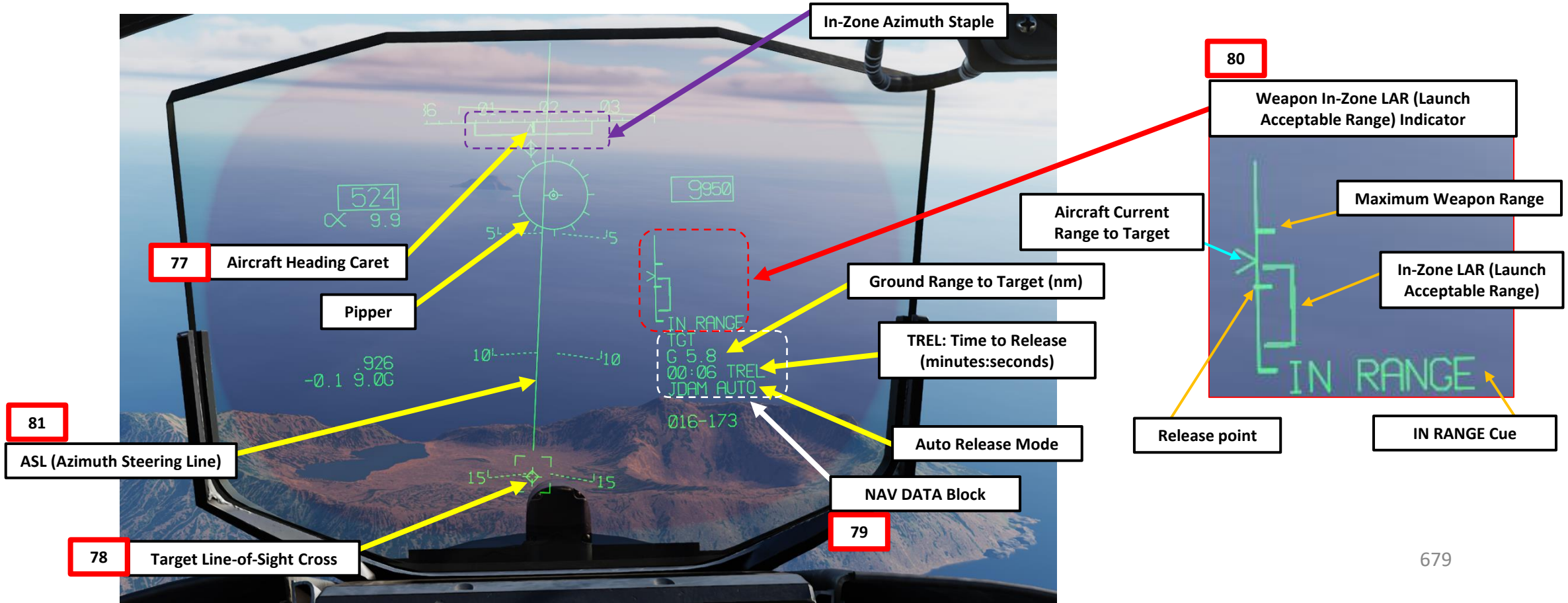
75. To return to the SMRT WPNS page, press the SMRT WPNS button.



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

E – Perform Attack

76. From an altitude of at least 5000 ft (optimal between 10000 ft and 15000 ft), fly level. Airspeed should be above 450 kts.
77. Steer the aircraft to line up the aircraft heading caret within the In-Zone Azimuth Staple on the HUD (Heads-Up Display).
78. The target line-of-sight cross indicates the location of the target.
79. Check NAV DATA Block and Weapon In-Zone LAR (Launch Acceptable Range) symbology on the HUD for target range information.
80. The IN RANGE cue indicates that you are in range to the target, but that the weapon cannot achieve all programmed terminal parameters yet.
81. When you are within maximum range, the ASL (Azimuth Steering Line) becomes visible on the HUD. Keep the ASL centered on the pipper.

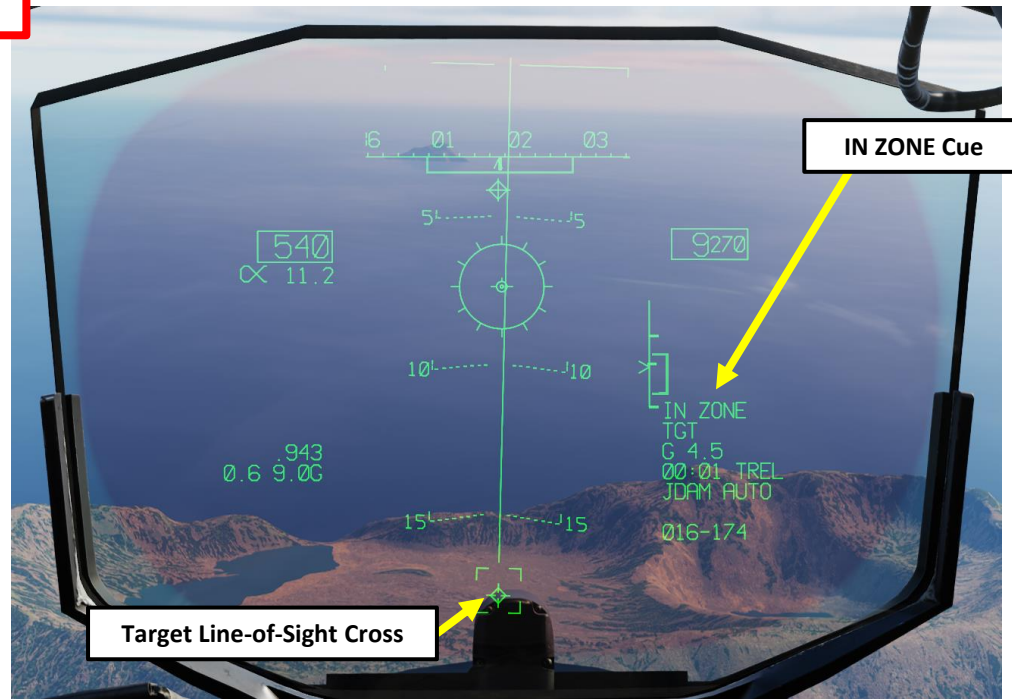


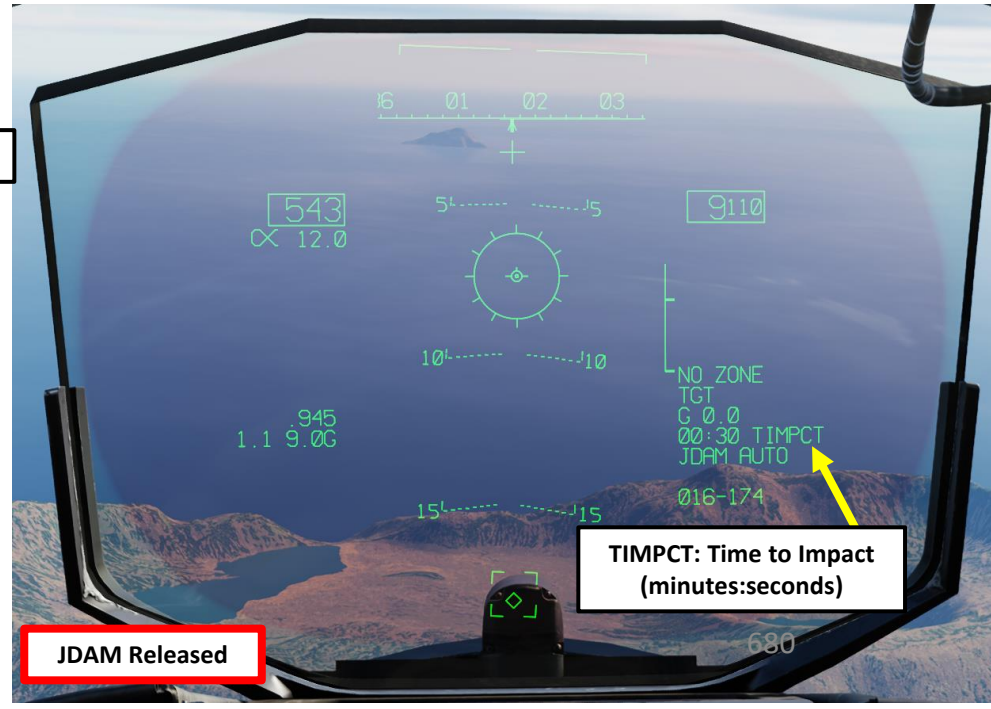
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

E – Perform Attack

82. The IN ZONE cue indicates that you are in range to the target and that the weapon can achieve all programmed terminal parameters. You may then deliver your ordnance.
    - **Note about Auto mode**: Before reaching the release point, the Weapon Release/Pickle button will be cold (will not release when pressed).
83. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to release JDAM. The weapon will home on the coordinates uploaded into it previously.
84. Once ordnance is released, the TIMPCT indication shows the time-to-impact (minutes:seconds).

83
Weapon Release (Pickle) Button

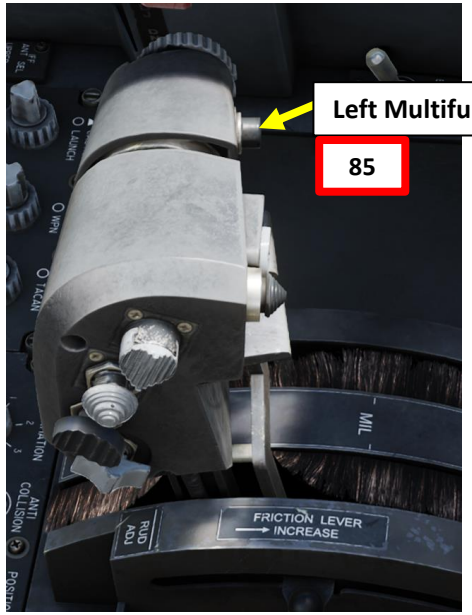


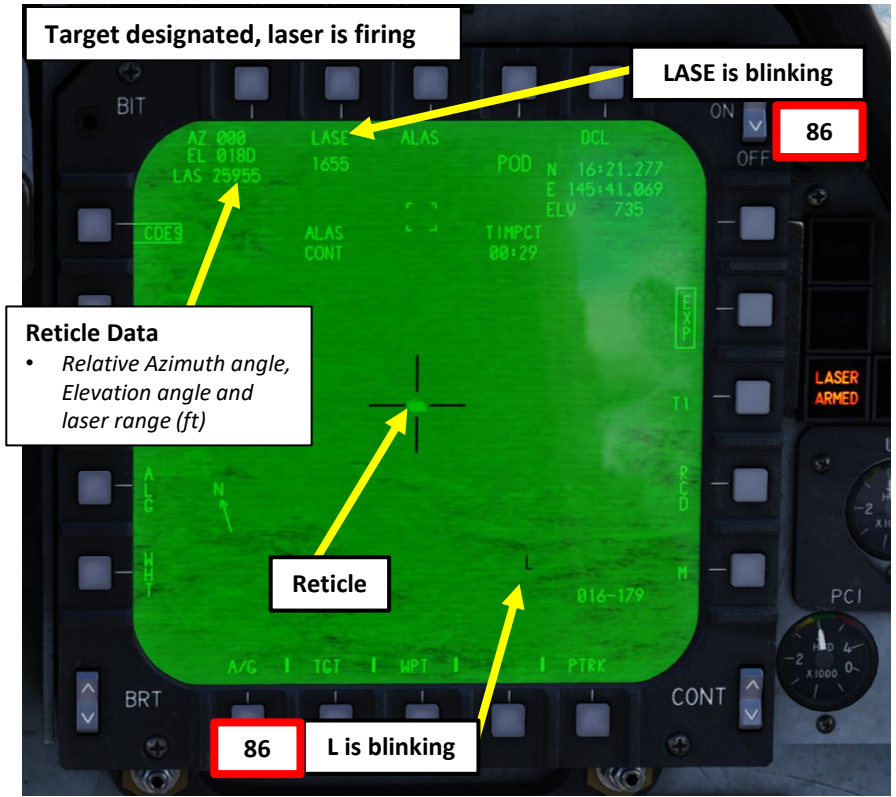


2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

E – Perform Attack (if using laser guidance)

85. **[L]** In this example, we have selected automatic lasing (ALAS). The targeting pod will automatically lase the target when the GBU-54 is released to guide it until impact. Take note that the maximum range of the laser is about 13 nm (which can also be further reduced due to weather and visibility conditions). If lasing manually, you can manually toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
86. **[L]** Target ranging information is updated based on the range computed by the laser designator. When laser is firing, the "LASE" and "L" indications blink on the TPOD page.
    - Note: The "MASKED" indication means that the targeting pod's line-of-sight is masked by the airframe or stores and the laser has been commanded to fire.

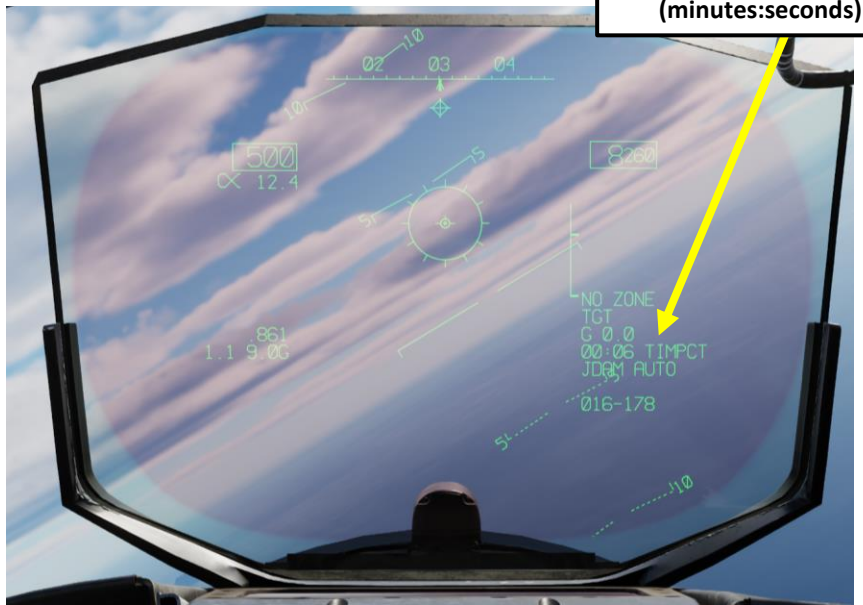




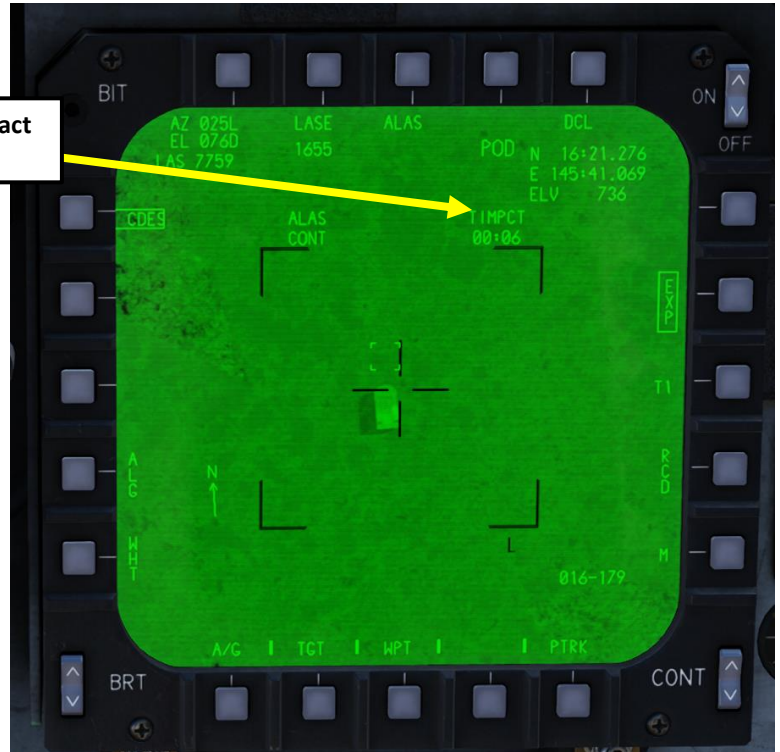
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode

E – Perform Attack

87. Once bomb is dropped, the TIMPCT indication shows the time-to-impact (minutes:seconds). Since ALAS CONT (Automatic Continuous Lasing) has been selected previously, the targeting pod will lase the target and guide the GBU-54 all the way until impact. If laser designation is interrupted, the GBU-54 will still keep in memory the last position it was aiming for.
88. Make sure to maintain enough altitude (at least 1500 ft AGL) to avoid flying the aircraft into the frag envelope and suffering potential fragmentation damage.

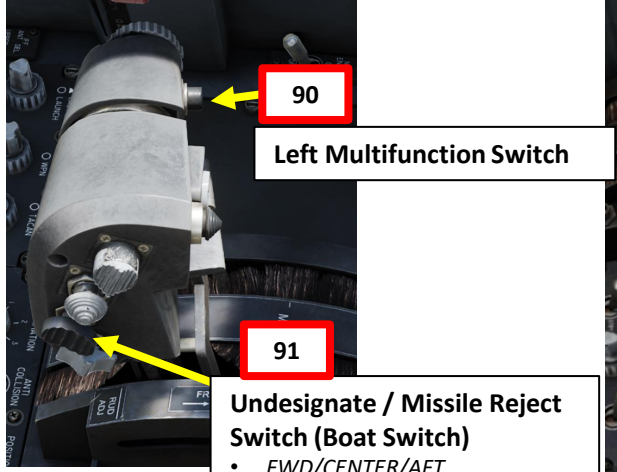


TIMPCT: Time to Impact (minutes:seconds)



2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
E – Perform Attack

89. The TD (Target Designation) Diamond allows you to either re-engage or assess damage done on the target.
90. To stop lasing, toggle the laser firing ON or OFF by:
    - **Pilot**: Pressing the Left Multifunction Switch.
    - **WSO**: Pressing the Laser Fire Button.
91. To undesignate the target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT.



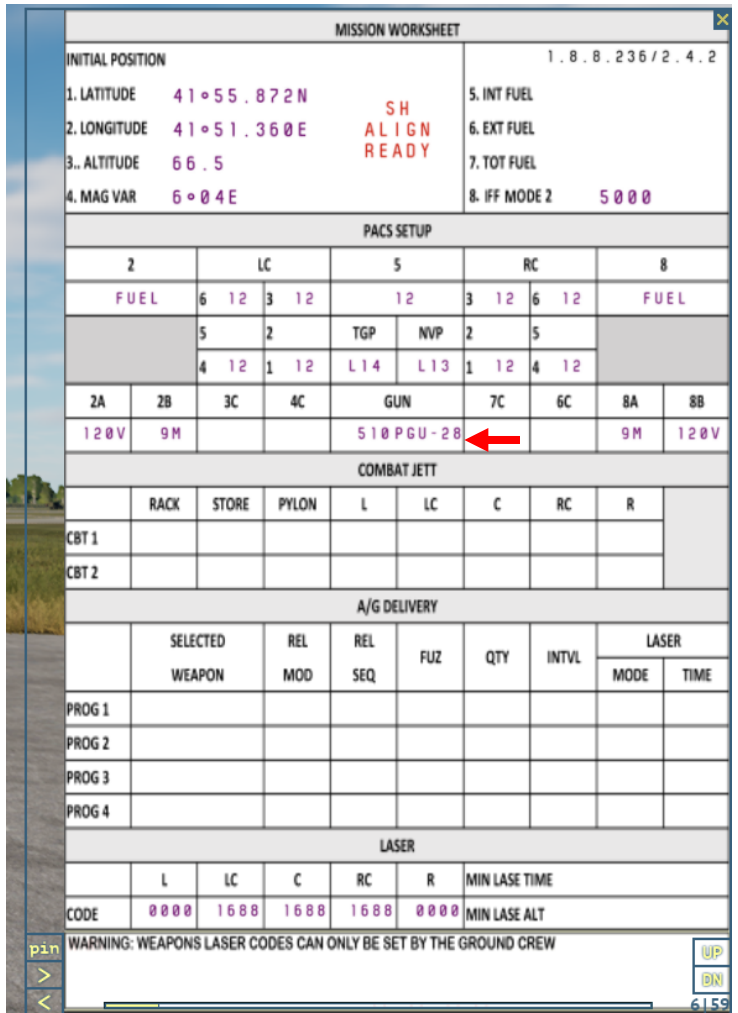
2 – AIR-TO-GROUND WEAPONS
2.5 – GPS-Guided Munitions
2.5.5 – GBU-54B LJDAM
Targeting Pod (WPN MEM) with Auto Mode
E – Perform Attack

2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.1 – CDIP Mode

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)

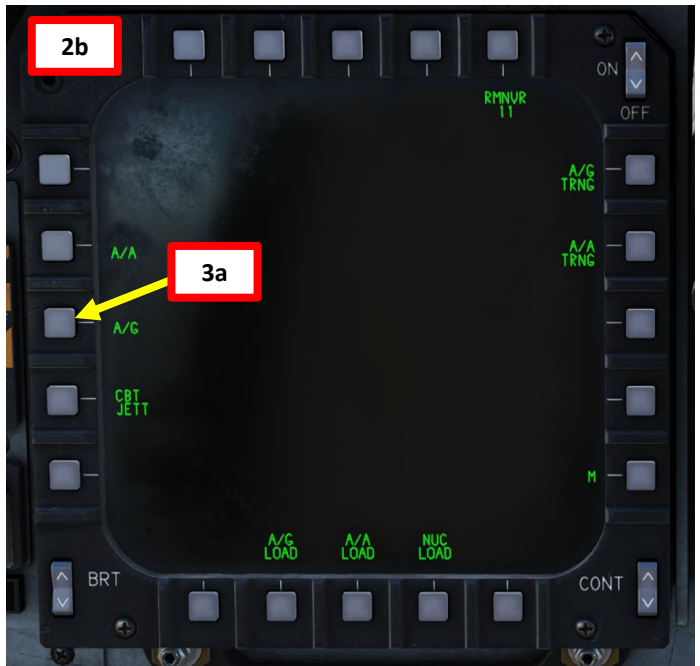
CDIP (Continuously Displayed Impact Point) gun mode offers a radar and computer-driven reticle which includes the range bar on the HUD. **Take note that the range bar is not implemented yet for the DCS F-15E.**

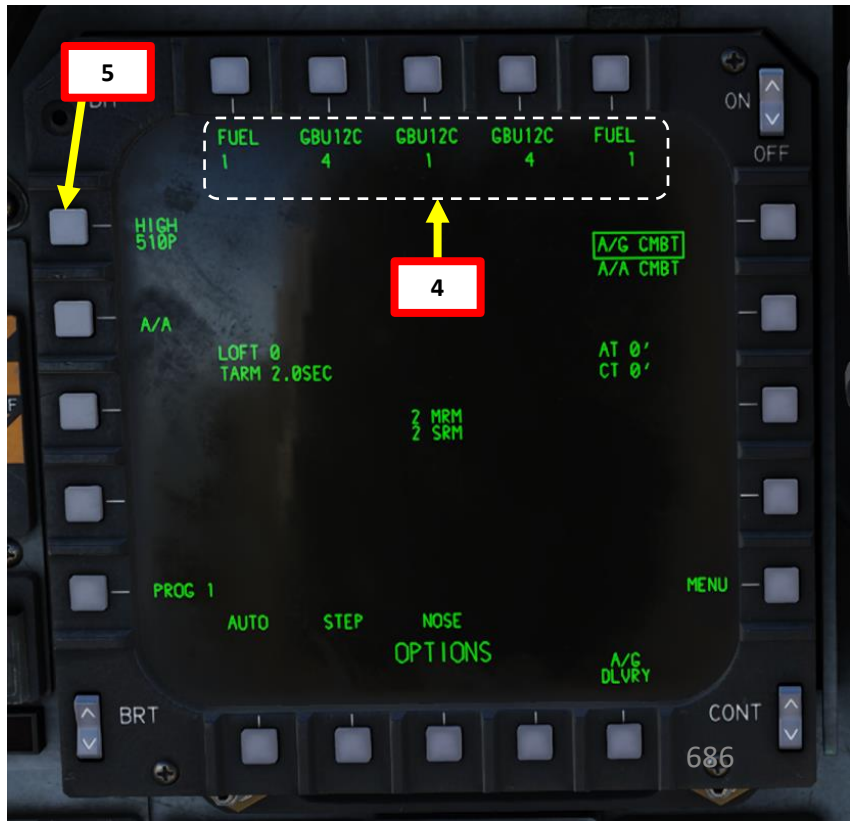
The M61A1 20 mm Vulcan gun has 500 rounds. Two ammunition types are available from the ground crew (or Mission Editor):
- PGU-28/B SAPHEI (High Explosive Armor Piercing)
- M56 HEI (High Explosive Incendiary)



2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.1 – CDIP Mode

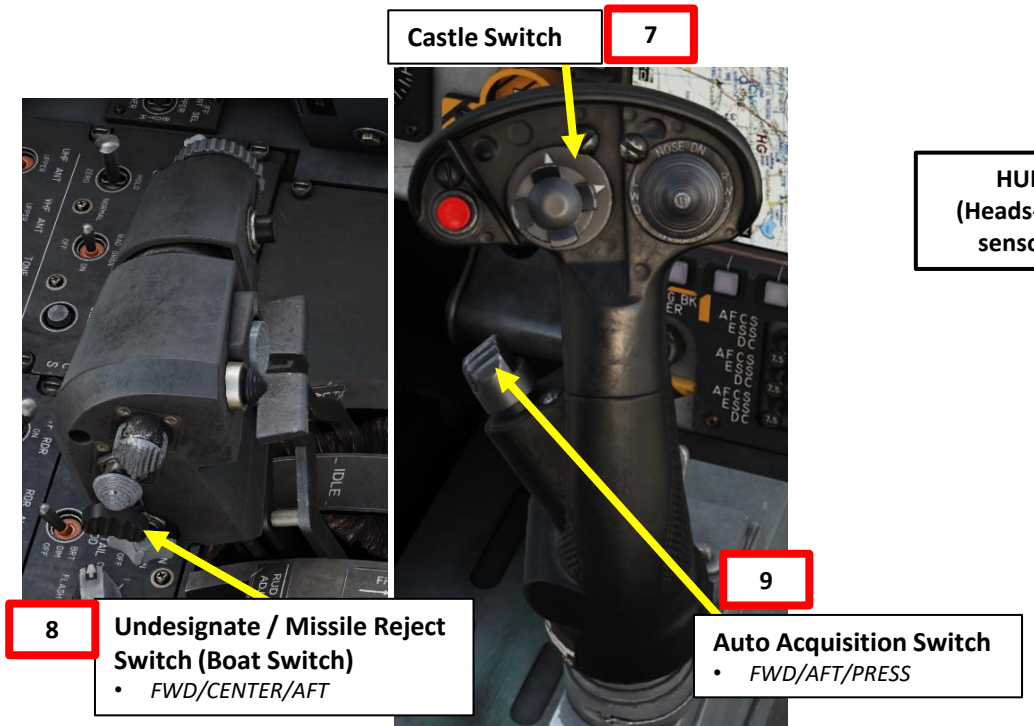
1. Select A/G Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/G CMBT (Air-to-Ground Combat) Sub-Page.
4. Verify no stations are selected (boxed when selected).
5. Select Gun Fire Rate – As desired (LOW or HIGH).
    - Low: 4000 rounds per minute
    - High: 6000 rounds per minute
6. Set Master Arm Switch – ARM (UP)





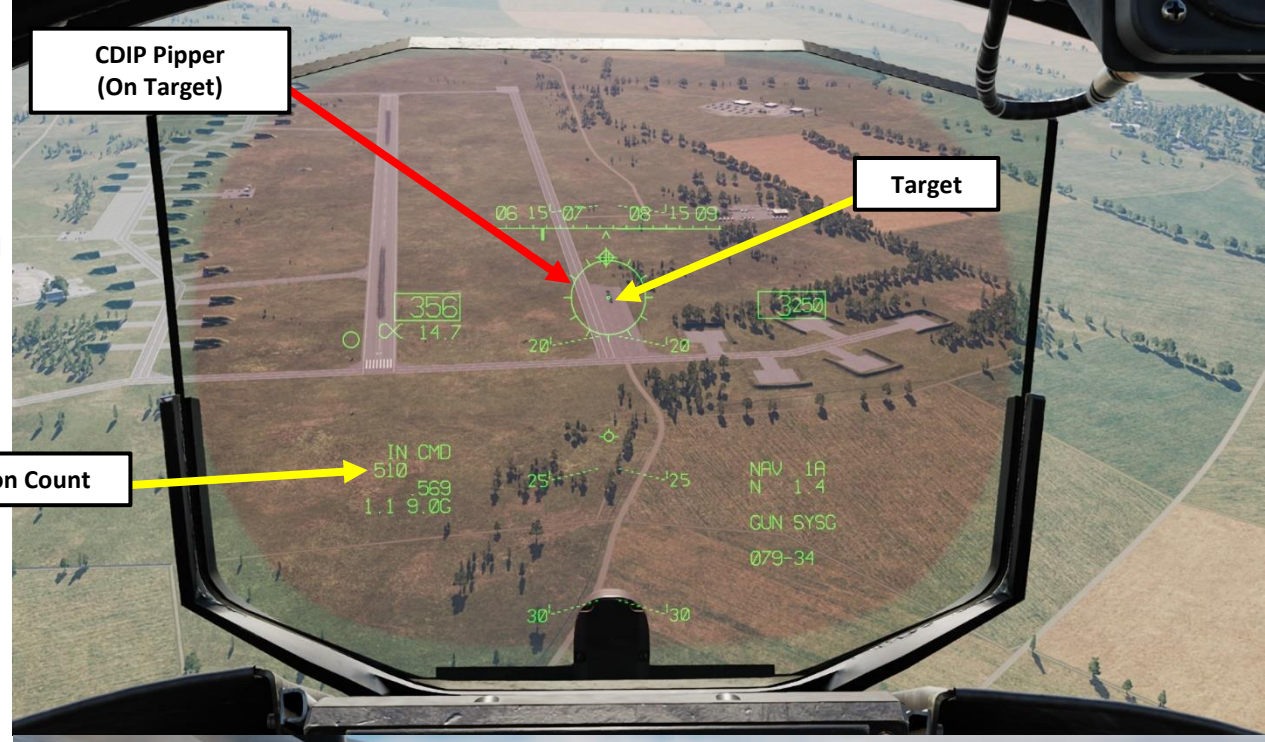
2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.1 – CDIP Mode

7. Set the HUD (Heads-Up Display) as the sensor in command:
    a) DEPRESS Castle Switch SHORT (less than 1 sec)
    b) Press Castle Switch FWD SHORT (less than 1 sec).
    c) Selection is indicated with the “IN CMD” (In Command) Cue.
    • Note: HUD designation enables air-to-ground radar (AGR) ranging through the pipper, which is very important for accurate aiming.
8. Verify that no target has already been designated by pressing the Undesignate (Boat) Switch – AFT.
9. Press the Auto Acquisition Switch AFT SHORT (less than 1 sec). Confirm that GUN SYSG indication is visible.



2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.1 – CDIP Mode

10. Roll in on target and aim CDIP pipper on the target. Maintain airspeed between 350 and 400 kts.
11. Squeeze Gun Trigger Second Detent (Spacebar) to fire the gun.



Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.1 – CDIP Mode

2 – AIR-TO-GROUND WEAPONS
2.6 – M61A1 Vulcan Cannon (20 mm) – Air-to-Ground
2.6.2 – Manual Mode

Note: Not implemented yet for the DCS F-15E.

2 – AIR-TO-GROUND WEAPONS
2.7 – AGM-65 Maverick Air-to-Ground Missile

Note: Not implemented yet for the DCS F-15E.

3 – AIR-TO-AIR WEAPONS

3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air

3 – AIR-TO-AIR WEAPONS

3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air

The M61A1 20 mm Vulcan gun system is an electrically controlled, hydraulically powered, air-cooled, 6-barrelled internal Gatling gun. It is capable of firing up to 6000 round per minute. The gun's dispersion forms an approximate 8-mil cone.

There are two gunsight modes with GUN selected on the Weapon Select Switch: **Funnel (FNL)** and **Gun Director Sight (GDS)**. Without the radar track, only Funnel can be used. With radar track, the pilot can choose between FNL and GDS.

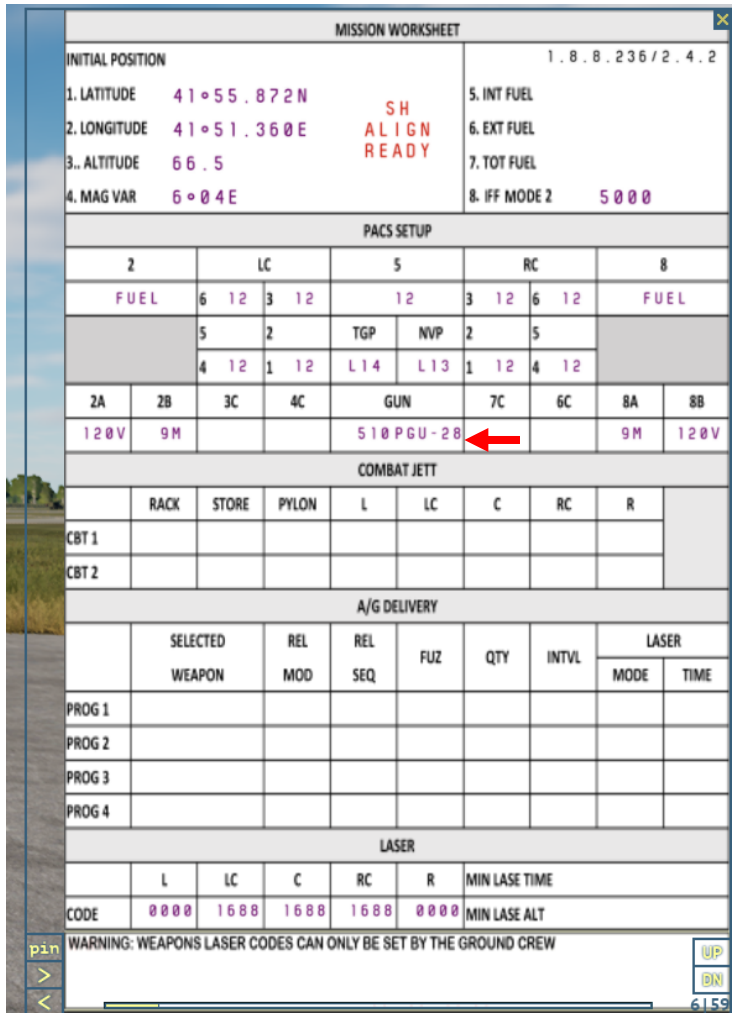
- The **Search Funnel** is calculated using the LCOS (Lead-Computing Optical Sight) algorithm and only ownship data. The funnel is based on the LCOS assumption that the target is performing the same maneuvers as the F-15 shooter. Thus, the funnel responds to changes in F-15 acceleration.
- The **Gun Director Sight 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 time-of-flight. However, with higher range and manoeuvering target the probability of a hit decreases, especially without a valid radar lock.

3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air

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)

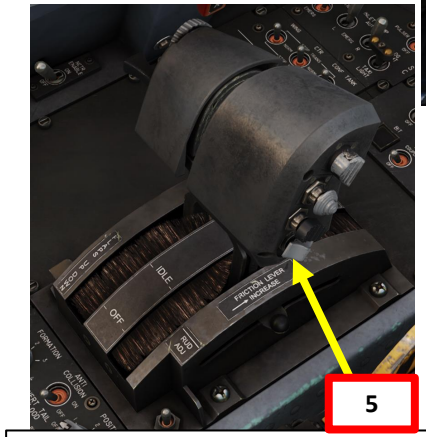
The gun has 500 rounds. Two ammunition types are available from the ground crew (or Mission Editor):

- PGU-28/B SAPHEI (High Explosive Armor Piercing): better for air to air gunnery, as it offers increased maximum range and decreased lead angle requirement.
- M56 HEI (High Explosive Incendiary): has a slightly lower muzzle velocity than the PGU-28.

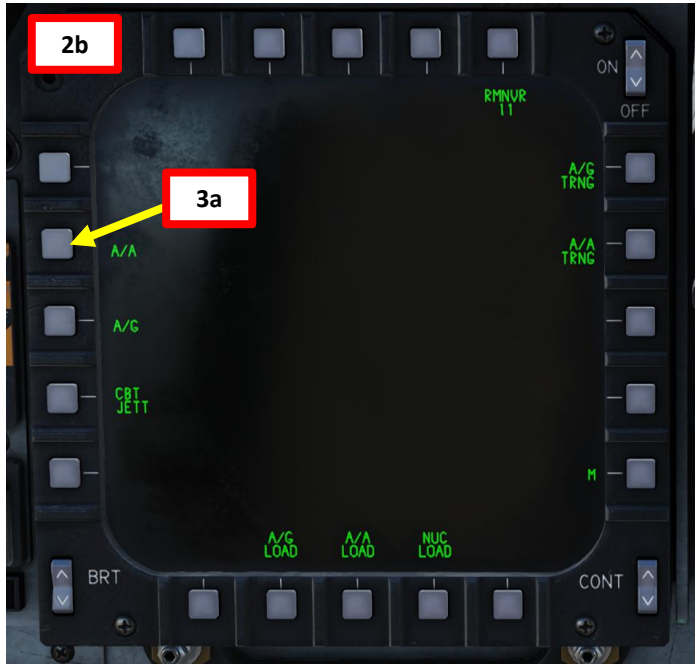


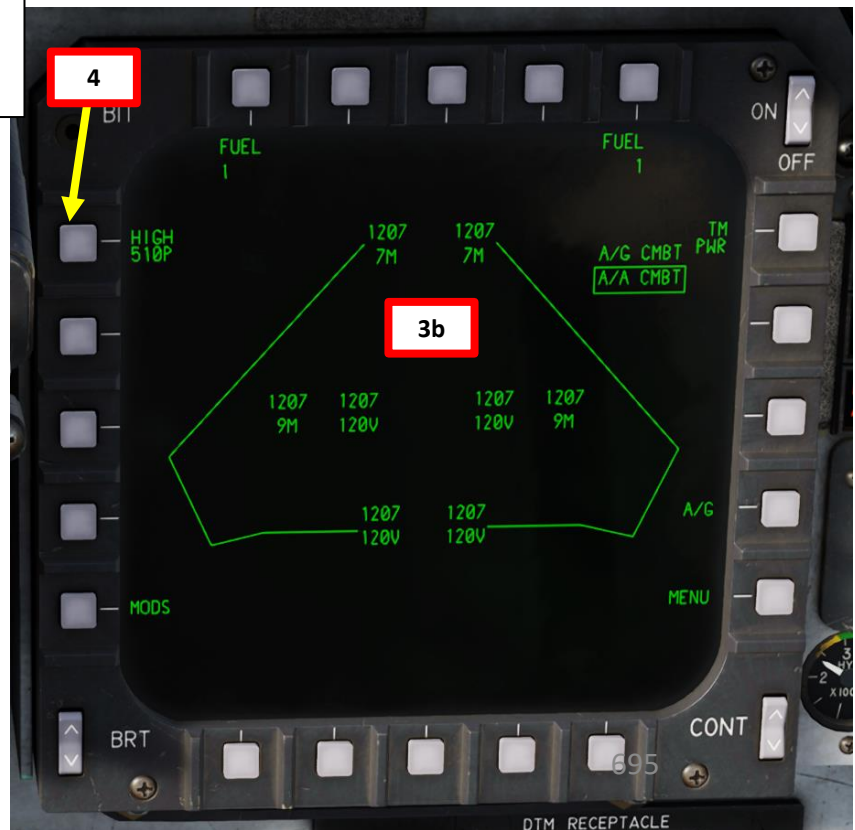
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.1 – Funnel (FNL) Gunsight Mode (No Radar)

1. Select A/A Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/A CMBT (Air-to-Air Combat) Sub-Page.
4. Select Gun Fire Rate – As desired
   - Low: 4000 rounds per minute
   - High: 6000 rounds per minute
5. Set Weapon / Mode (Weapon Select) Switch – AFT. This will select the Gun.
6. Set Master Arm Switch – ARM (UP)
7. Set Radar Power Switch – STBY (Standby).



Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

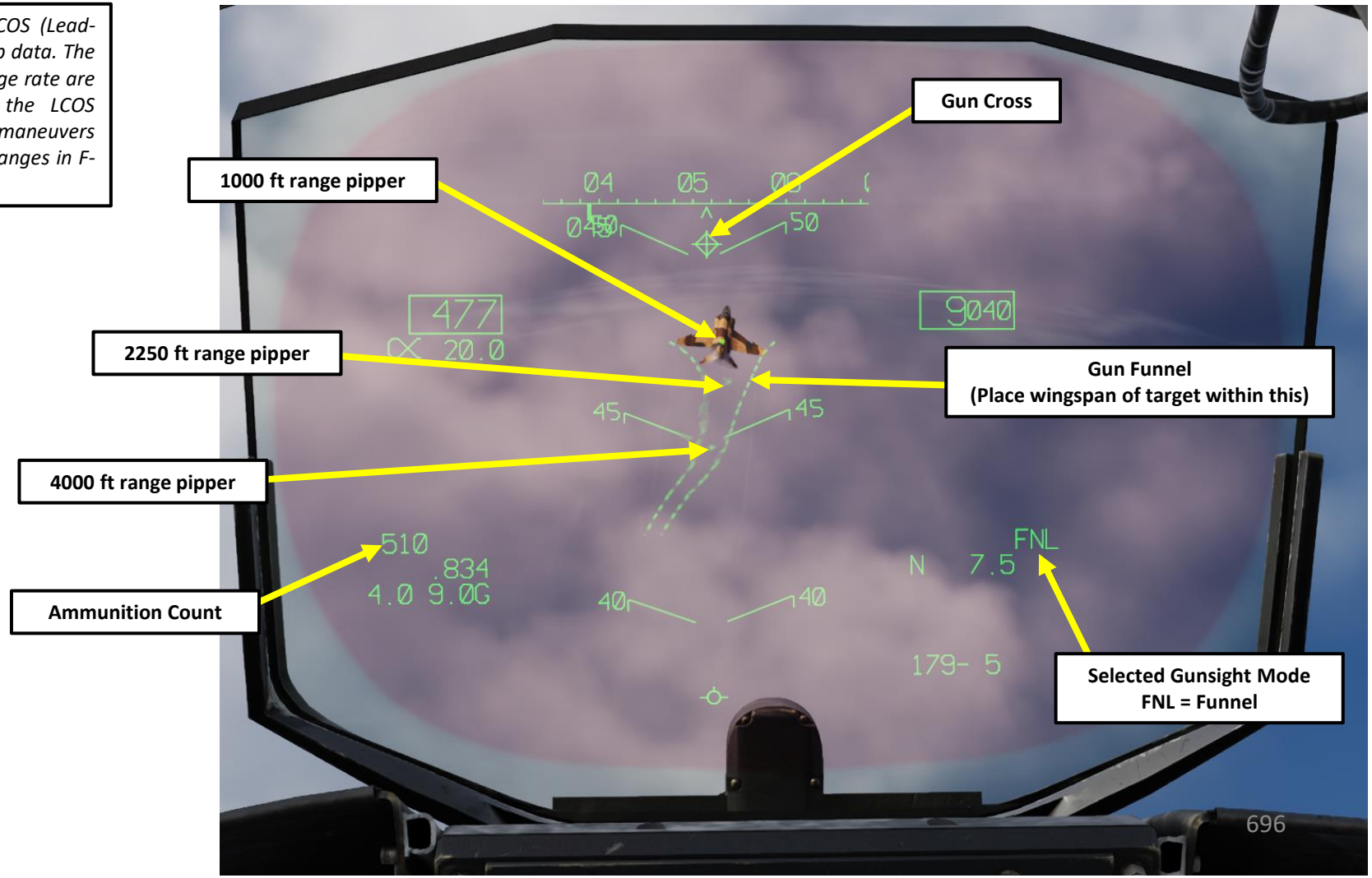




3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.1 – Funnel (FNL) Gunsight Mode (No Radar)

8. By default, FNL (Funnel) mode is selected.
9. Manoeuver the aircraft to put the target near the desired funnel pipper.
10. The end of the funnel is limited to the bullet maximum range when less than 5000 ft. The three pippers set to 1000, 2250 and 4000 feet are provided if there is no radar lock. Funnel width corresponds to a 40-ft target wingspan at a selected range.

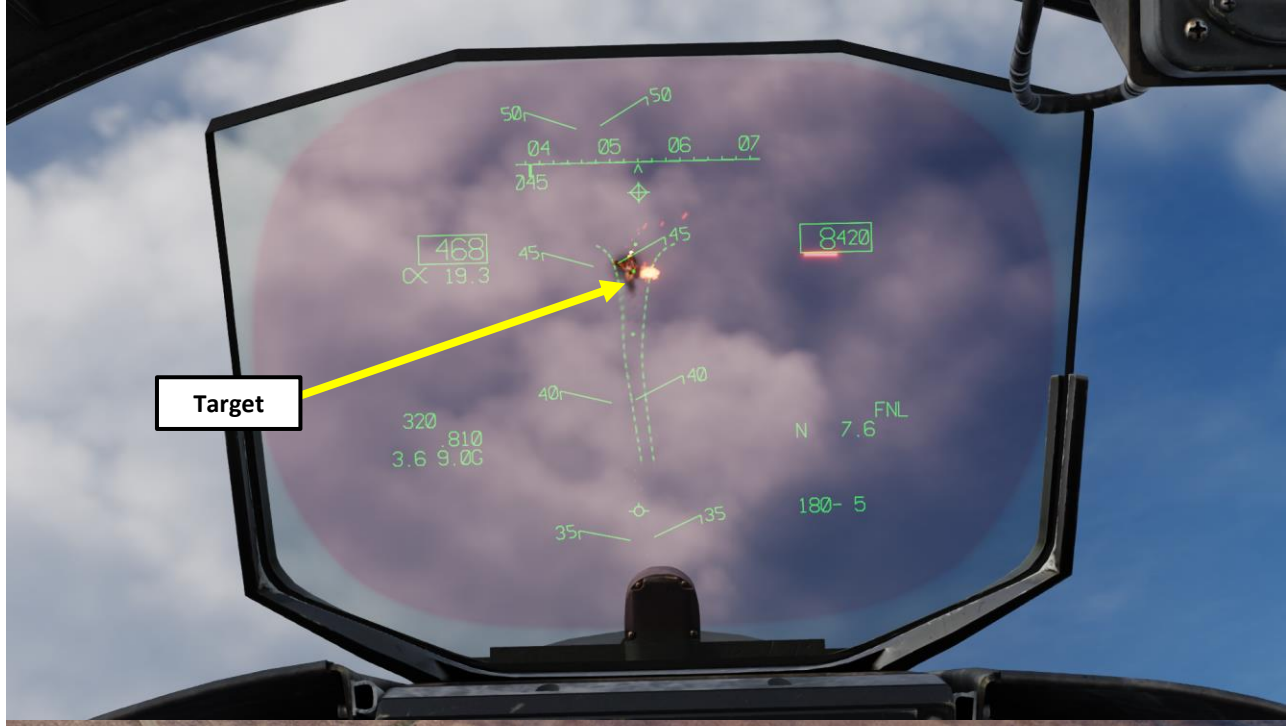
Note: The Search Funnel is calculated using the LCOS (Lead-Computing Optical Sight) algorithm and only ownship data. The only exception to this is that radar range and/or range rate are used when available. The funnel is based on the LCOS assumption that the target is performing the same maneuvers as the F-15 shooter. Thus, the funnel responds to changes in F-15 acceleration.



3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.1 – Funnel (FNL) Gunsight Mode (No Radar)

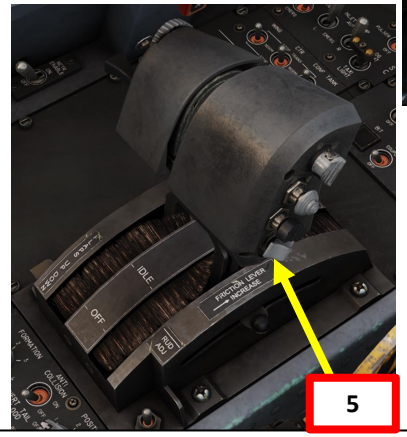
11. Squeeze Gun Trigger Second Detent (Spacebar) to fire the gun.

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*



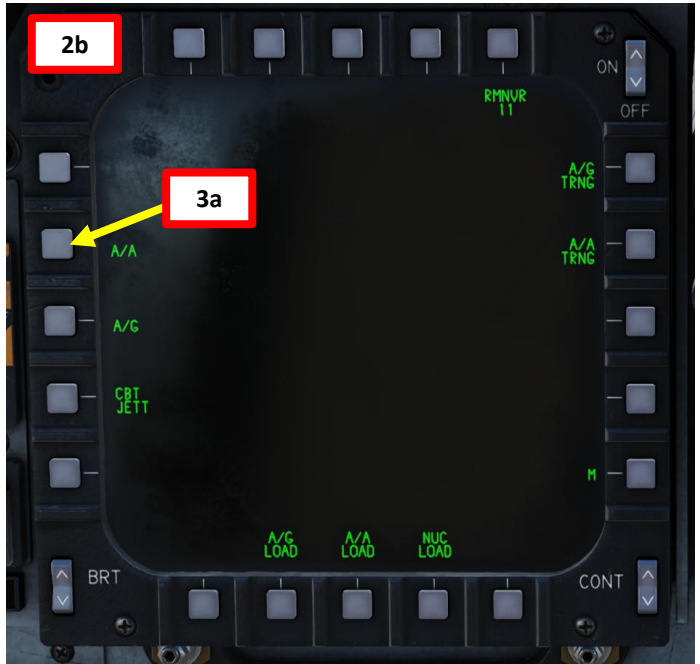
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)

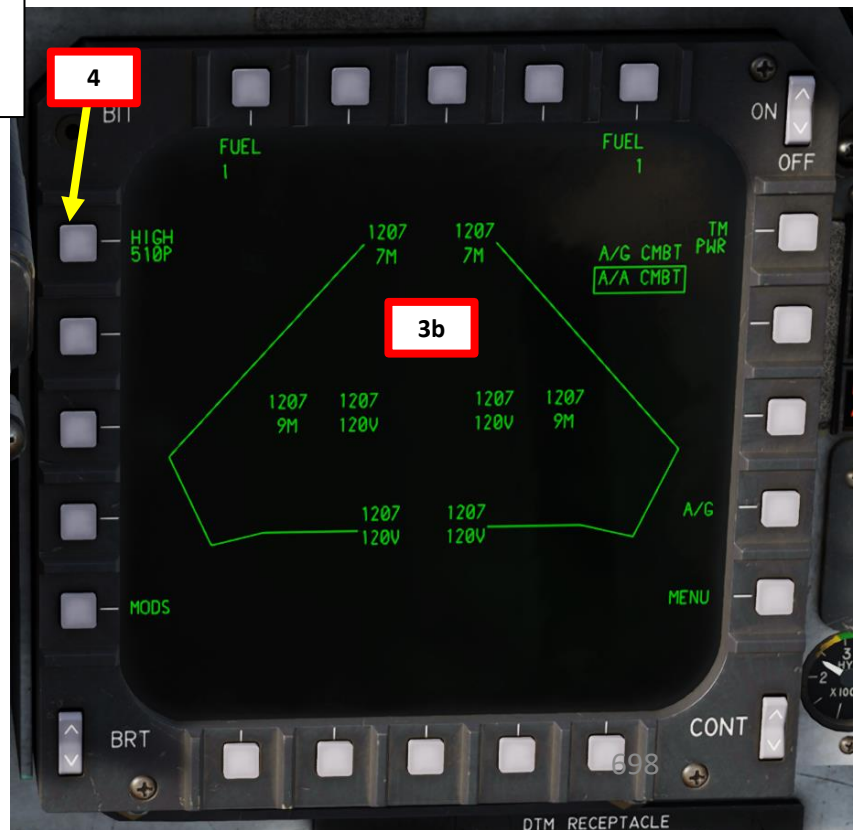
1. Select A/A Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/A CMBT (Air-to-Air Combat) Sub-Page.
4. Select Gun Fire Rate – As desired
   - Low: 4000 rounds per minute
   - High: 6000 rounds per minute
5. Set Weapon / Mode (Weapon Select) Switch – AFT. This will select the Gun.
6. Set Master Arm Switch – ARM (UP)
7. Set Radar Power Switch – ON.



Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

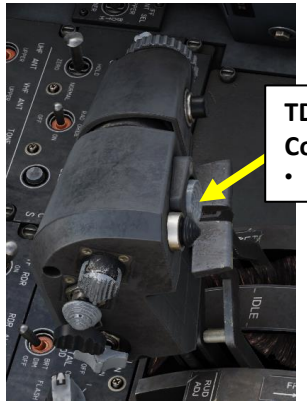
Radar Power Selector Knob



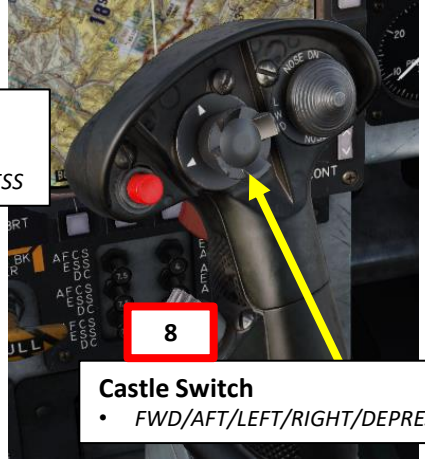


3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)

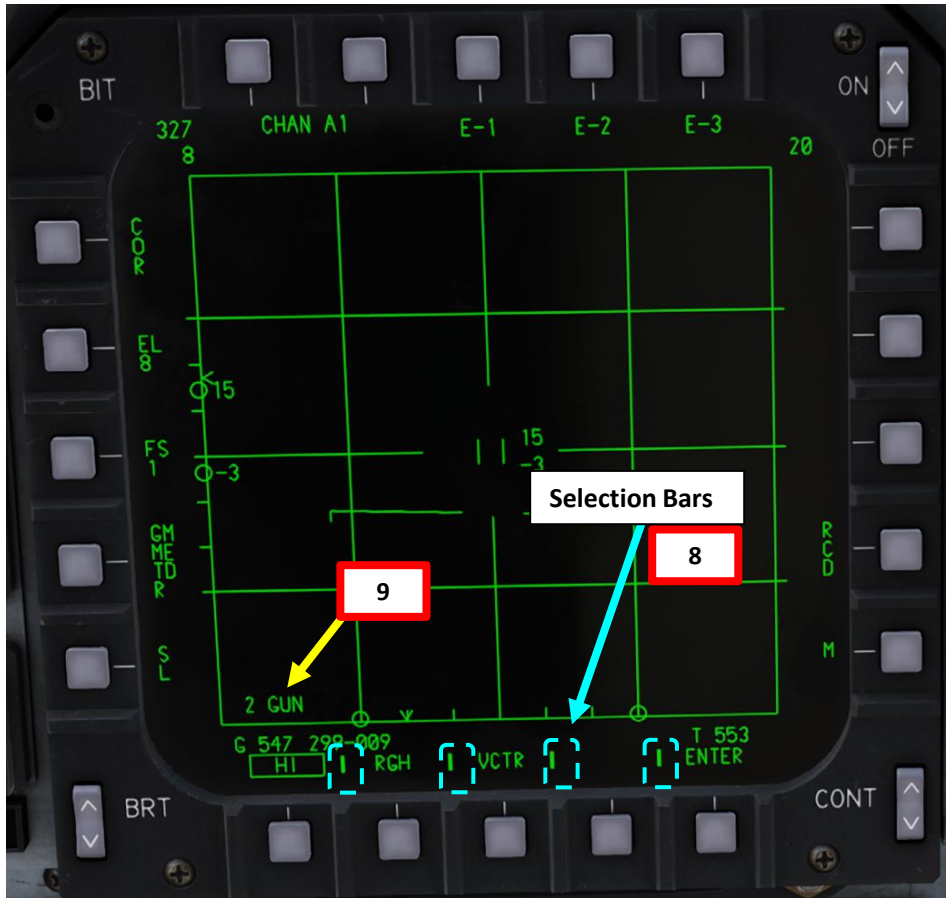
8. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
9. When the Weapon / Mode (Weapon Select) Switch has selected the air-to-air gun, the "GUN" legend on the the A/A RDR page indicates that the radar has entered GUNS mode until a lockon is achieved or the crew selects a return to search.
   - This mode provides a slewable scan pattern with the auto acquisition capability between 0.5 and 15 nm. The scan pattern is 60° in azimuth, 20 deg (six-bar, 3.4 deg bar spacing) in elevation, and is space stabilized. The center of the pattern, indicated by the acquisition symbol, can be positioned in azimuth and elevation using the TDC (Target Designation Control).



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*

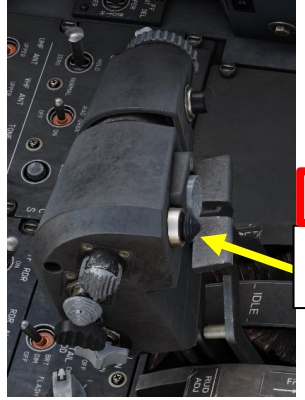


Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*



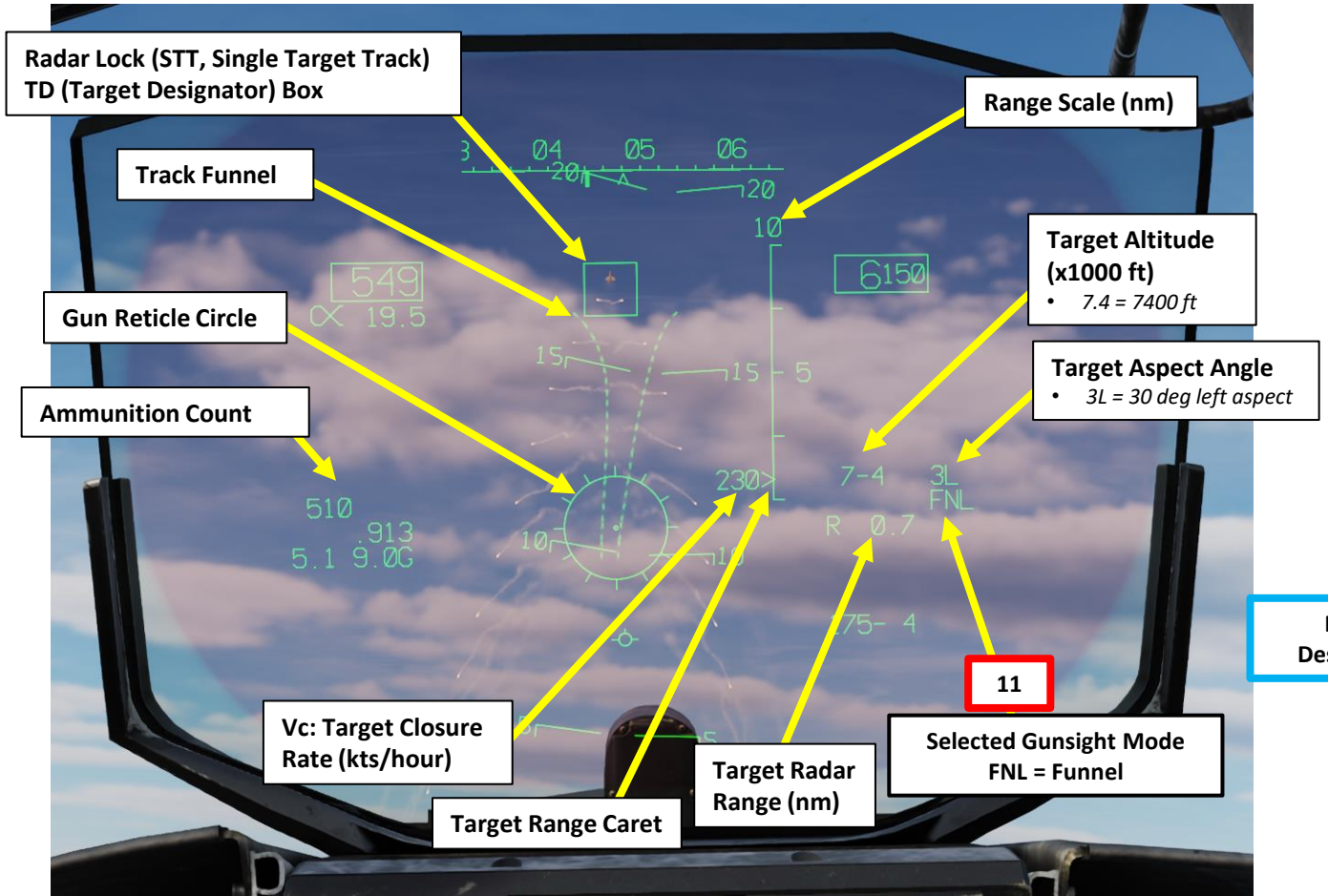
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)

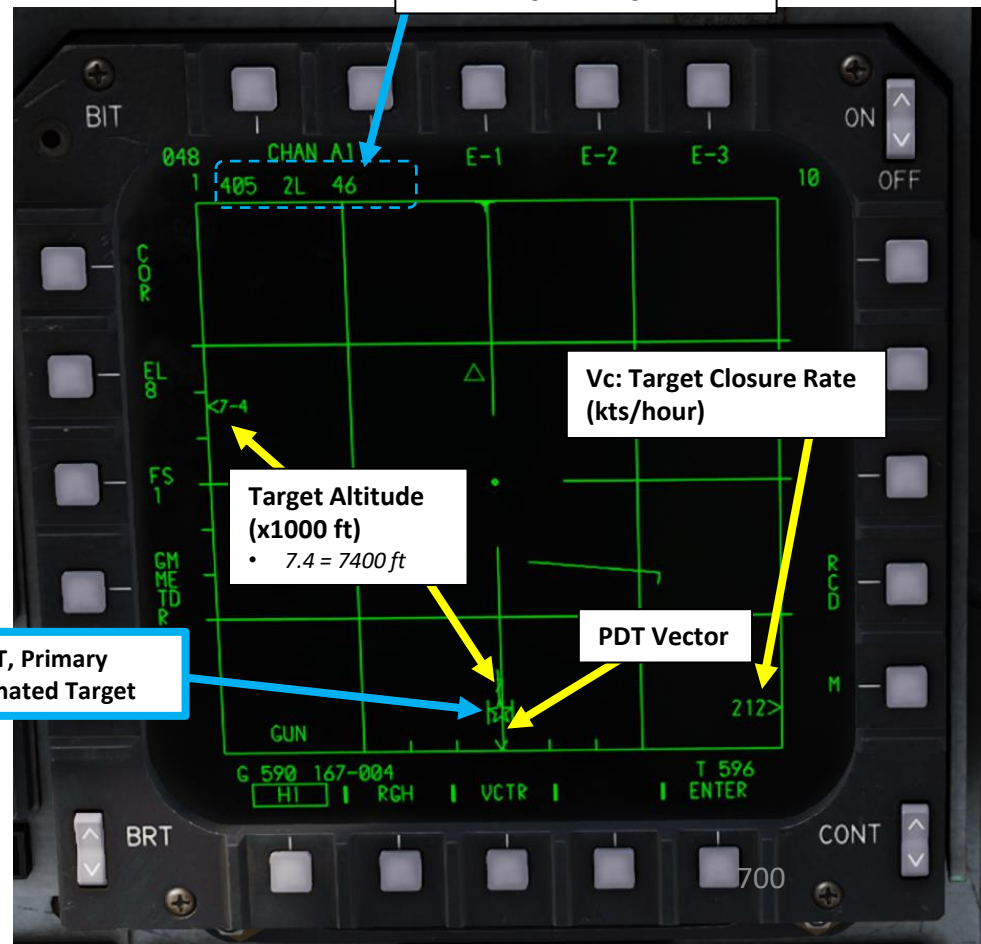
10. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.
11. By default, FNL (Funnel) mode is selected. If required, you can cycle between Funnel (FNL) and Gun Sight Director (GDS) mode by pressing the Coolie Switch UP SHORT (less than 1 sec).



11

Right Multifunction Switch (Coolie Hat)
- *UP/DOWN/LEFT/RIGHT*



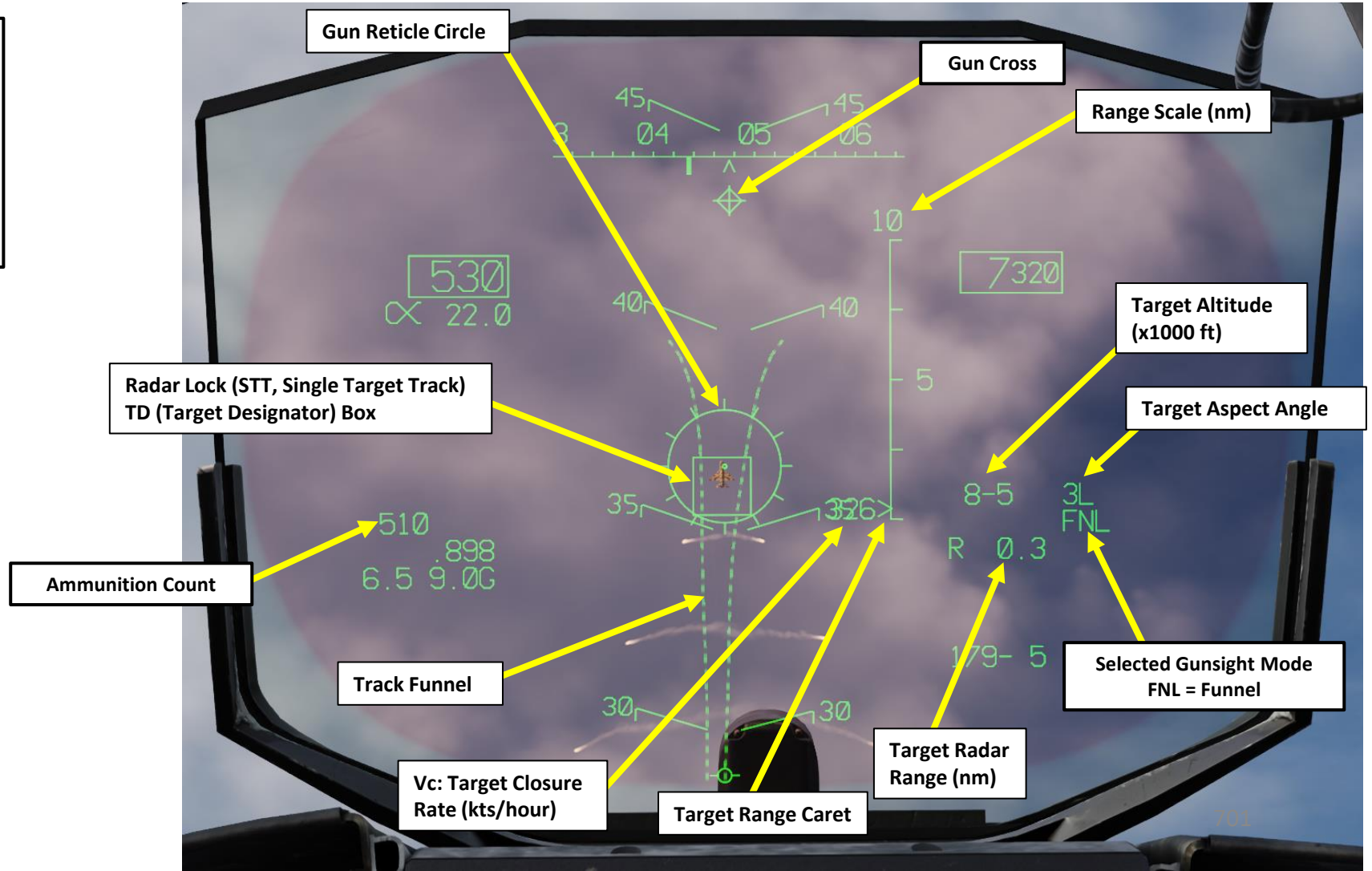


3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)

12. Manoeuver the aircraft to put the Gun Reticle on the target. The gun reticle circle should be superimposed over the TD (Target Designation) box
13. it is important to remember that the gun reticle works better and is 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.

Note:

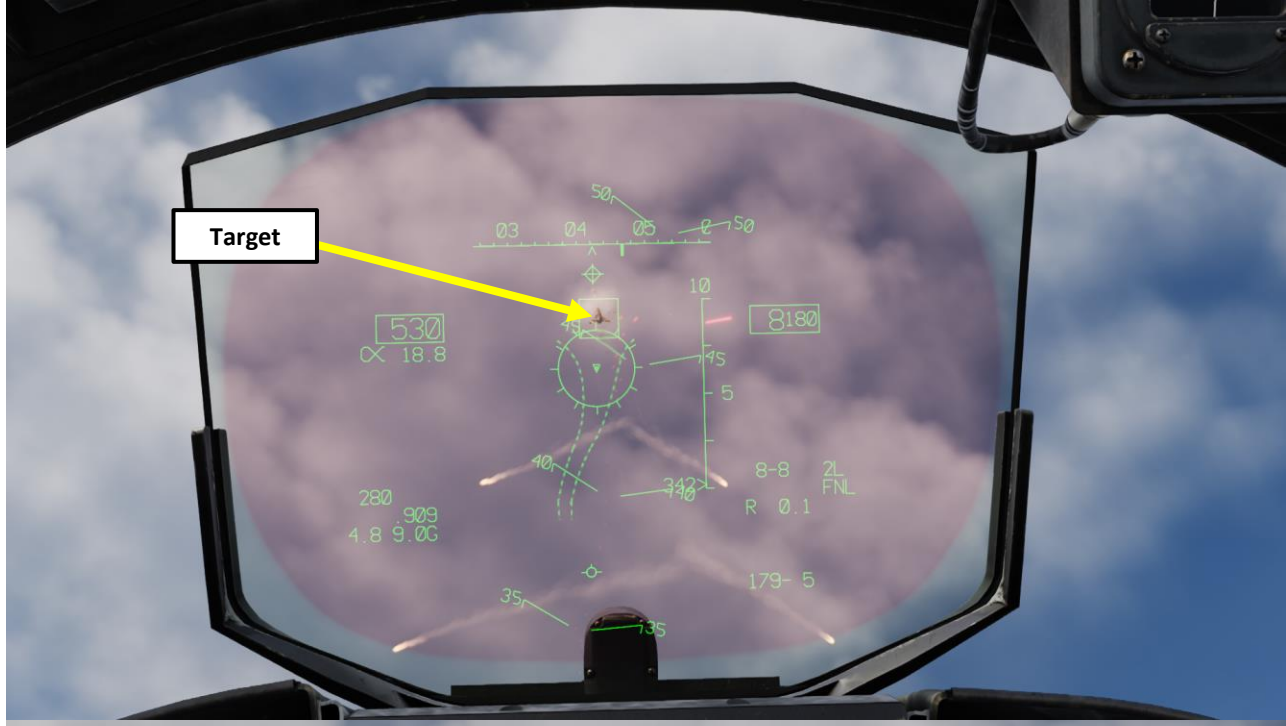
*The **Track Funnel** appears when the target range or range rate is valid. New data appears on the HUD, including the radar range scale, TD box, target altitude, range and aspect, as well as the 25-mil reticle circle. The latter disappears if target is in maximum firing range (around 3000 feet) and the circle would be superimposed over the TD box.*



3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.2 – Funnel (FNL) Gunsight Mode (With Radar)

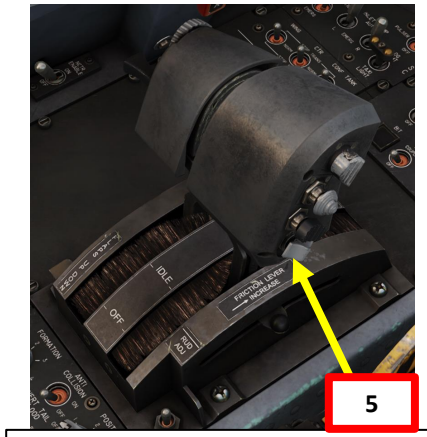
14. Squeeze Gun Trigger Second Detent (Spacebar) to fire the gun.

Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*



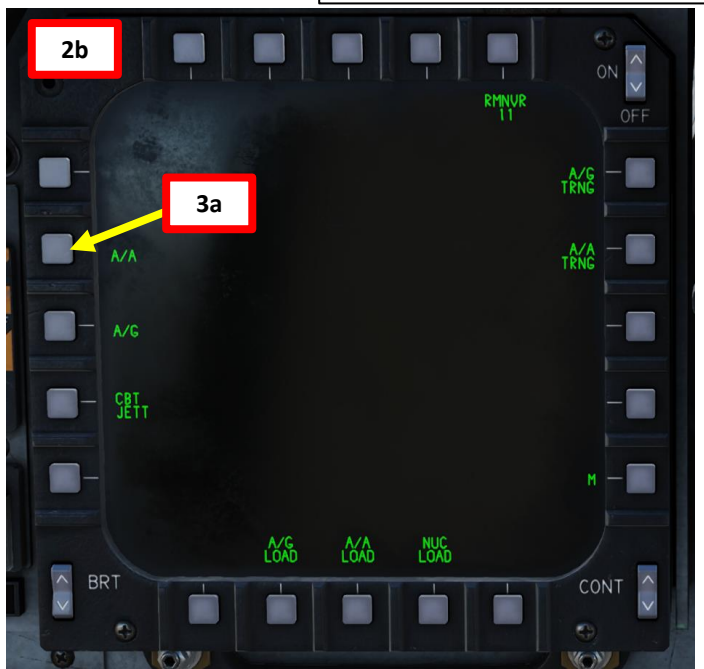
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)

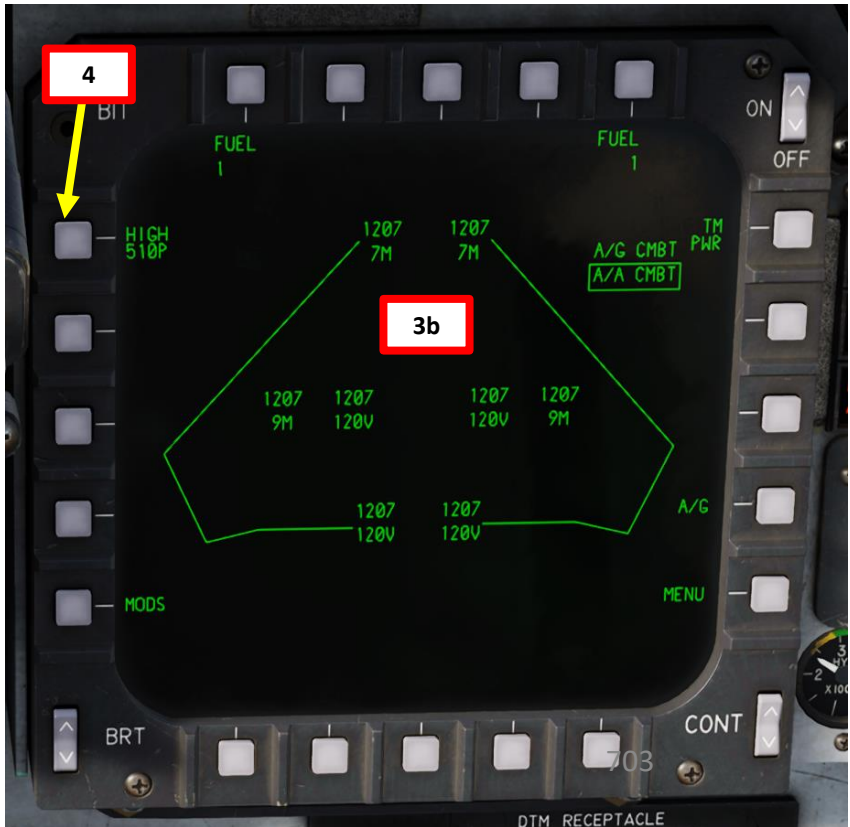
1. Select A/A Master Mode.
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. Select A/A CMBT (Air-to-Air Combat) Sub-Page.
4. Select Gun Fire Rate – As desired
   - Low: 4000 rounds per minute
   - High: 6000 rounds per minute
5. Set Weapon / Mode (Weapon Select) Switch – AFT. This will select the Gun.
6. Set Master Arm Switch – ARM (UP)
7. Set Radar Power Switch – ON.



Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

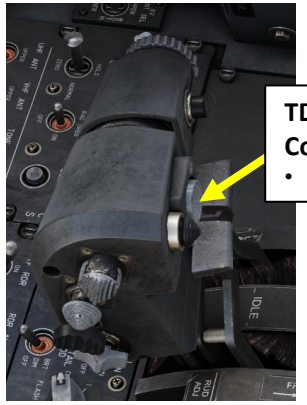
Radar Power Selector Knob



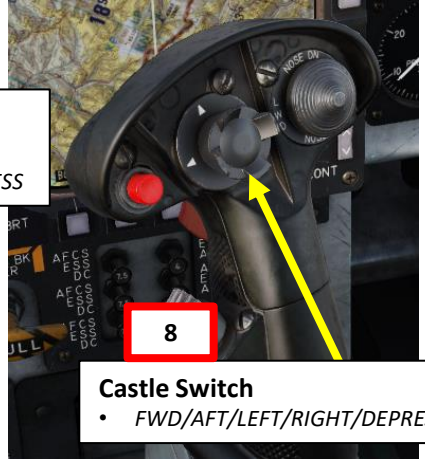


3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)

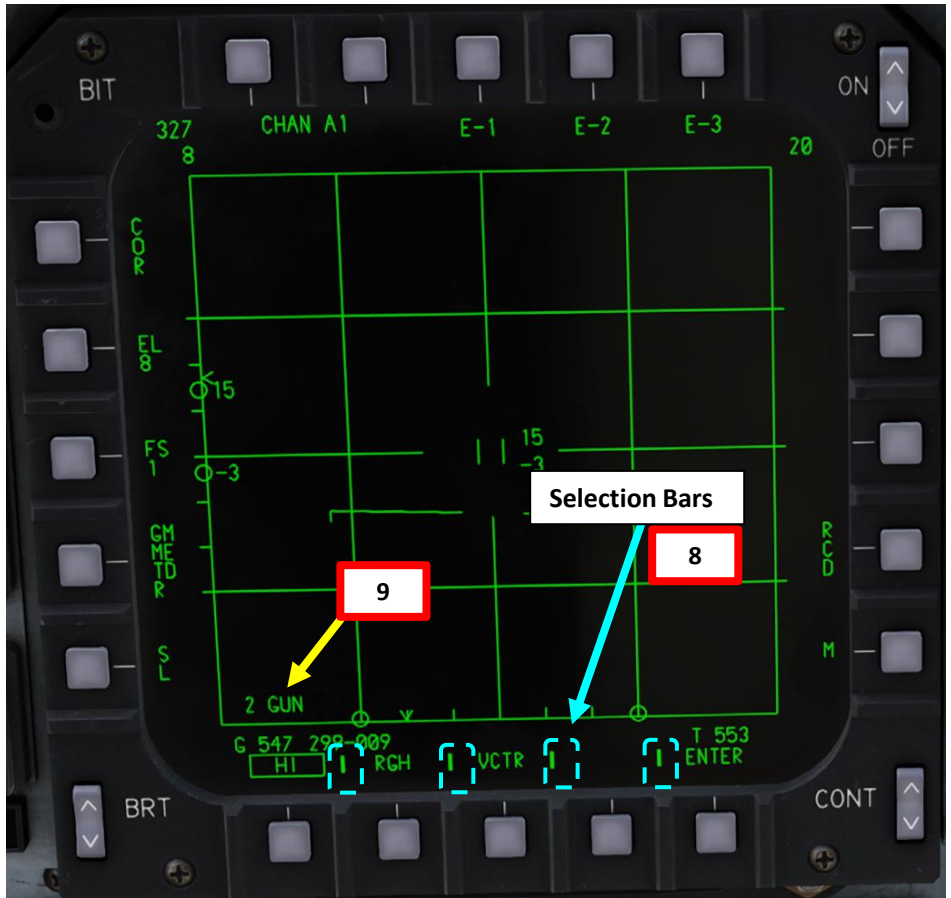
8. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - Selection bars at the bottom of a display indicate the page is selected.
9. When the Weapon / Mode (Weapon Select) Switch has selected the air-to-air gun, the "GUN" legend on the the A/A RDR page indicates that the radar has entered GUNS mode until a lockon is achieved or the crew selects a return to search.
   - This mode provides a slewable scan pattern with the auto acquisition capability between 0.5 and 15 nm. The scan pattern is 60° in azimuth, 20 deg (six-bar, 3.4 deg bar spacing) in elevation, and is space stabilized. The center of the pattern, indicated by the acquisition symbol, can be positioned in azimuth and elevation using the TDC (Target Designation Control).



TDC (Target Designation Control) Switch
- *UP/DOWN/LEFT/RIGHT/PRESS*



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

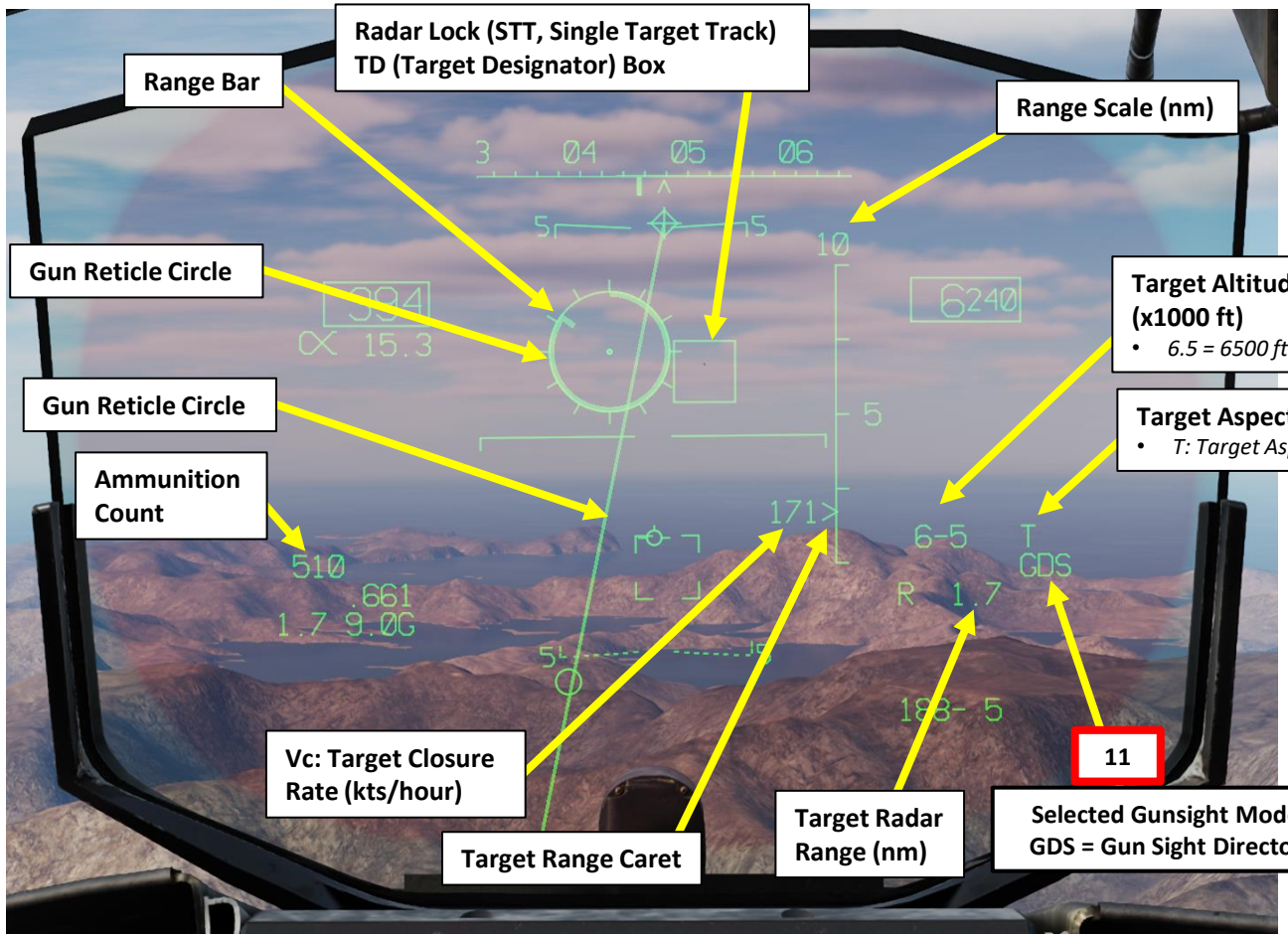


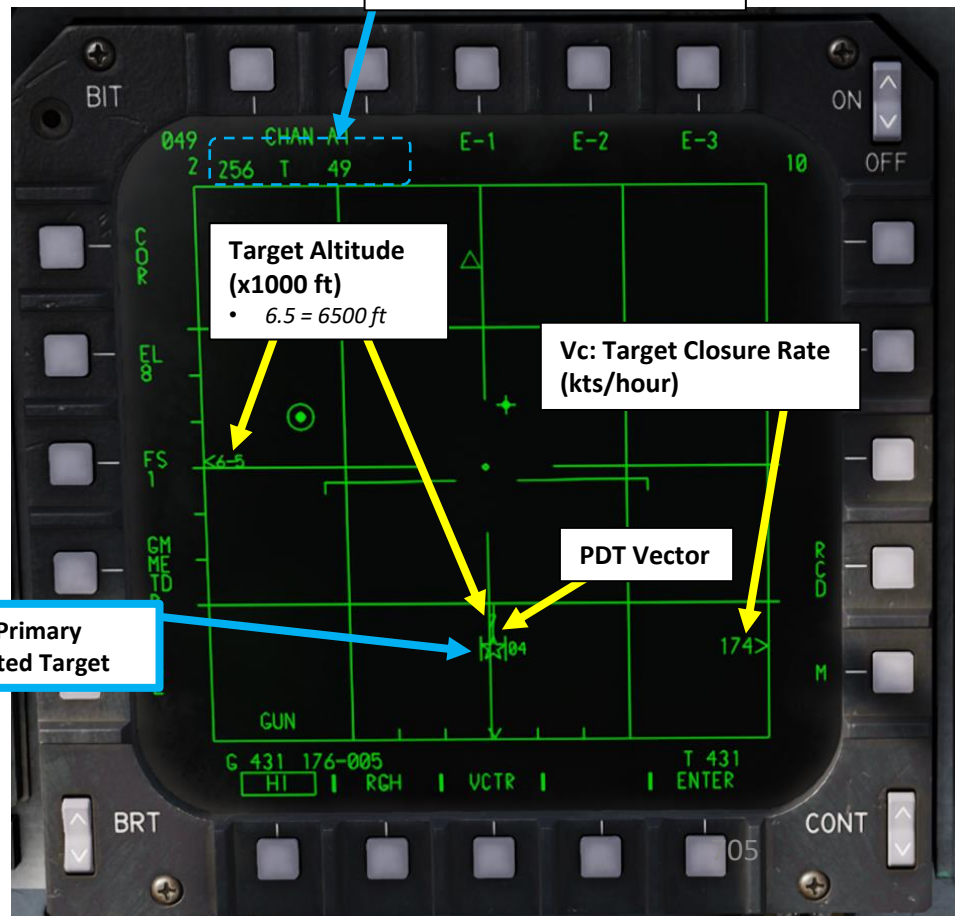
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)

10. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.
11. By default, FNL (Funnel) mode is selected. Cycle between Funnel (FNL) and Gun Sight Director (GDS) mode by pressing the Coolie Switch UP SHORT (less than 1 sec) to select GDS Mode.

11

Right Multifunction Switch (Coolie Hat)
- *UP/DOWN/LEFT/RIGHT*





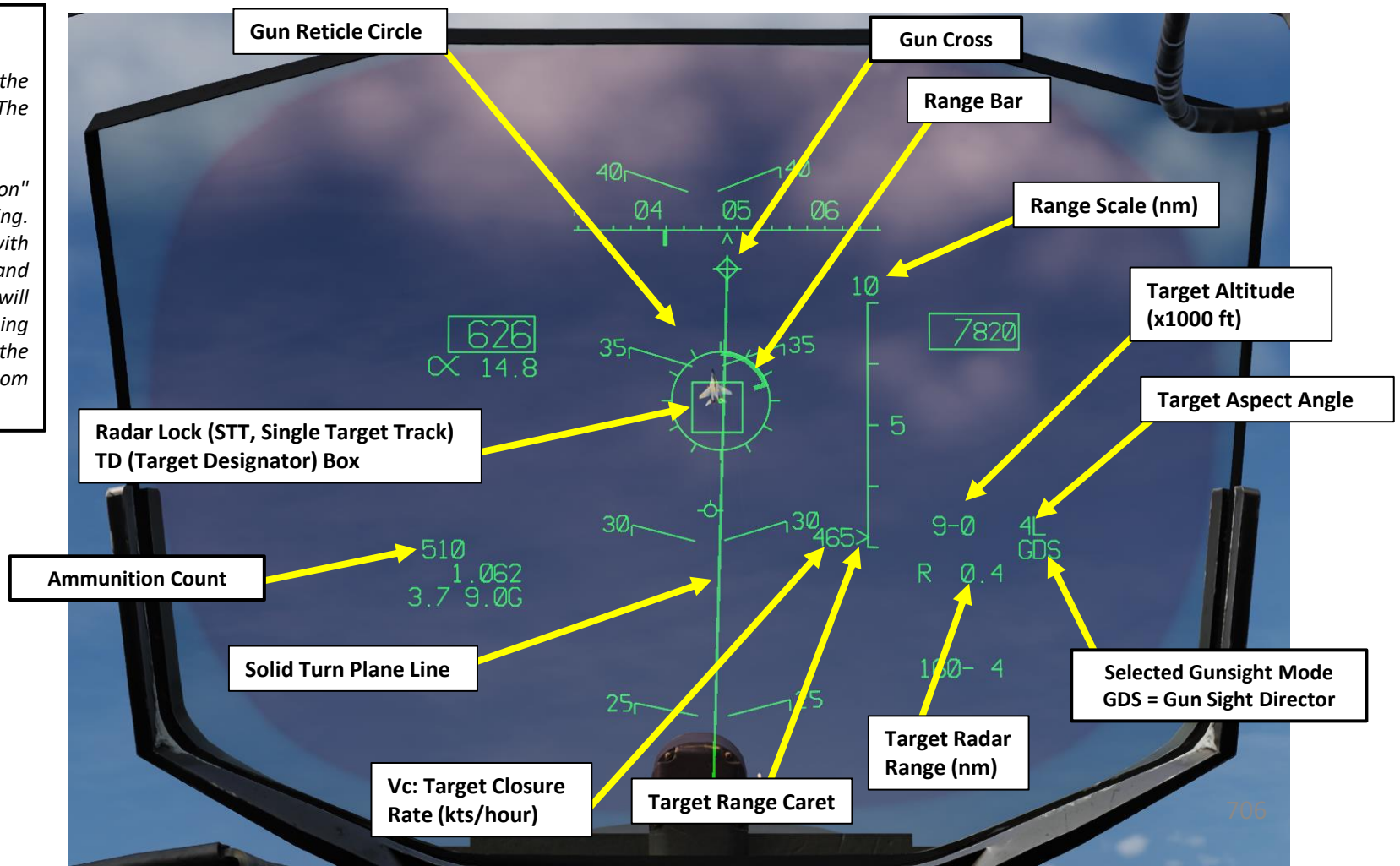
3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)

12. Manoeuver the aircraft to put the Gun Reticle on the target. The gun reticle circle should be superimposed over the TD (Target Designation) box
13. it is important to remember that the gun reticle works better and is 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.

Notes:

*The **Range Bar** indicates range in feet. Each tick mark on the gunsight represents 1000 feet, to a total of 12000. The thicker portion represents the current range.*

*The **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 pipper will slide up and down that line based on the amount of G's being pulled. At low G's the pipper 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.*



3 – AIR-TO-AIR WEAPONS
3.1 – M61A1 Vulcan Cannon (20 mm) – Air-to-Air
3.1.3 – Gun Director Sight (GDS) Gunsight Mode (With Radar)

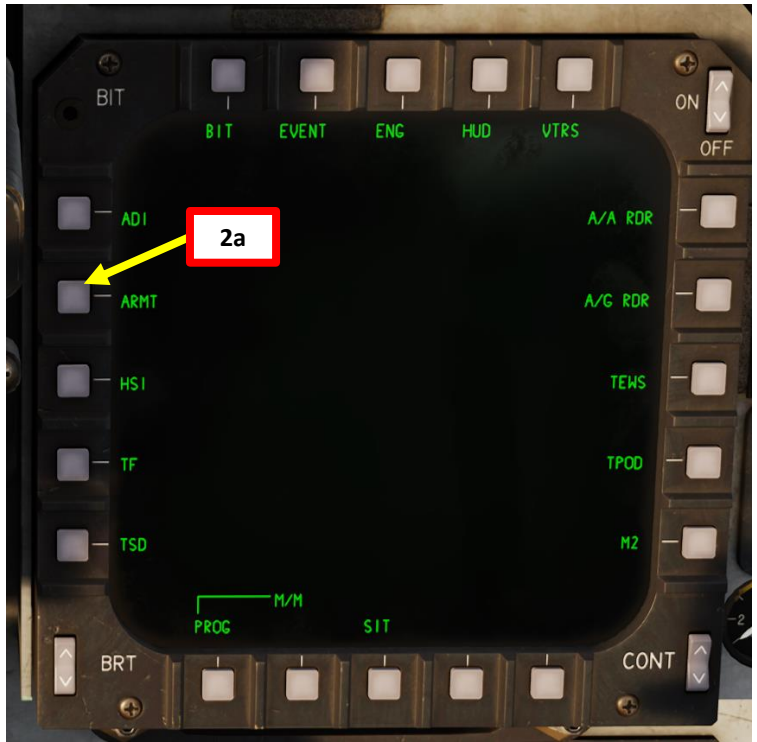
14. Squeeze Gun Trigger Second Detent (Spacebar) to fire the gun.

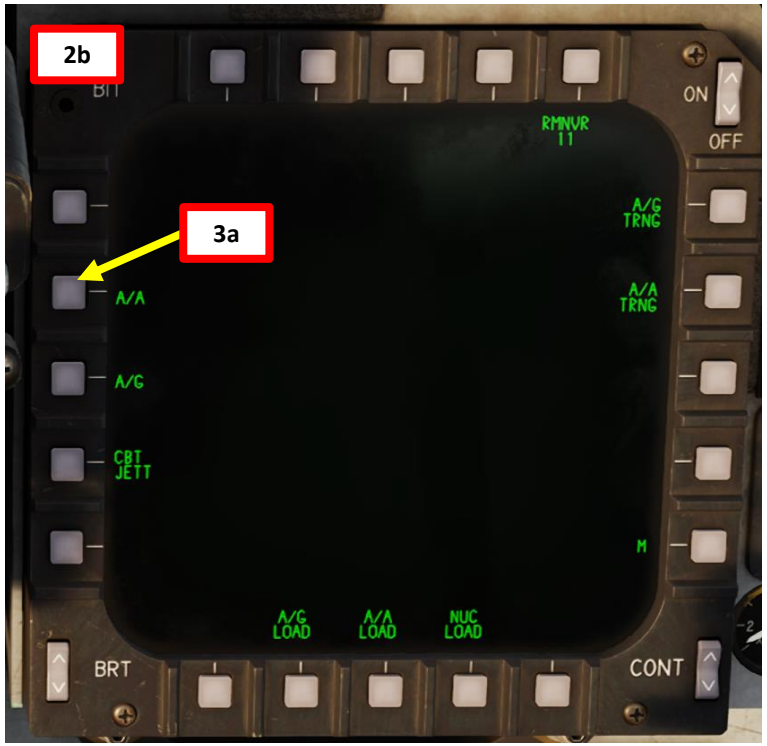
Trigger
- *First Detent: Turns on the VTRS (Video Tape Recorder Set).*
- *Second Detent: Fires the gun while keeping the VTRS running*
- *Binding for 2nd Detent: SPACE*

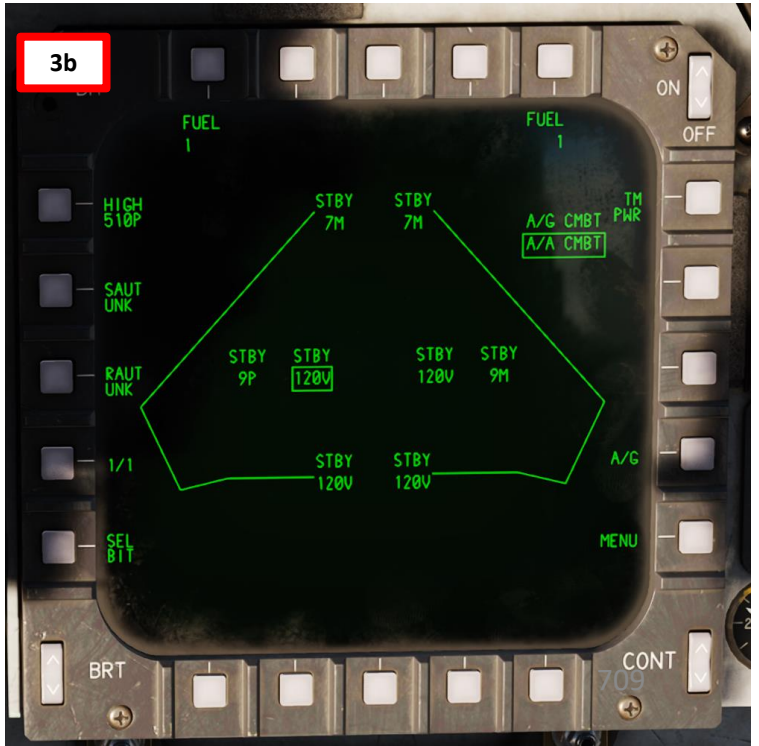
3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile

3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.1 – AIM-9M (No Radar)

1. Select A/A Master Mode
2. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
3. On a different display, select A/A CMBT (Air-to-Air Combat) Sub-Page.

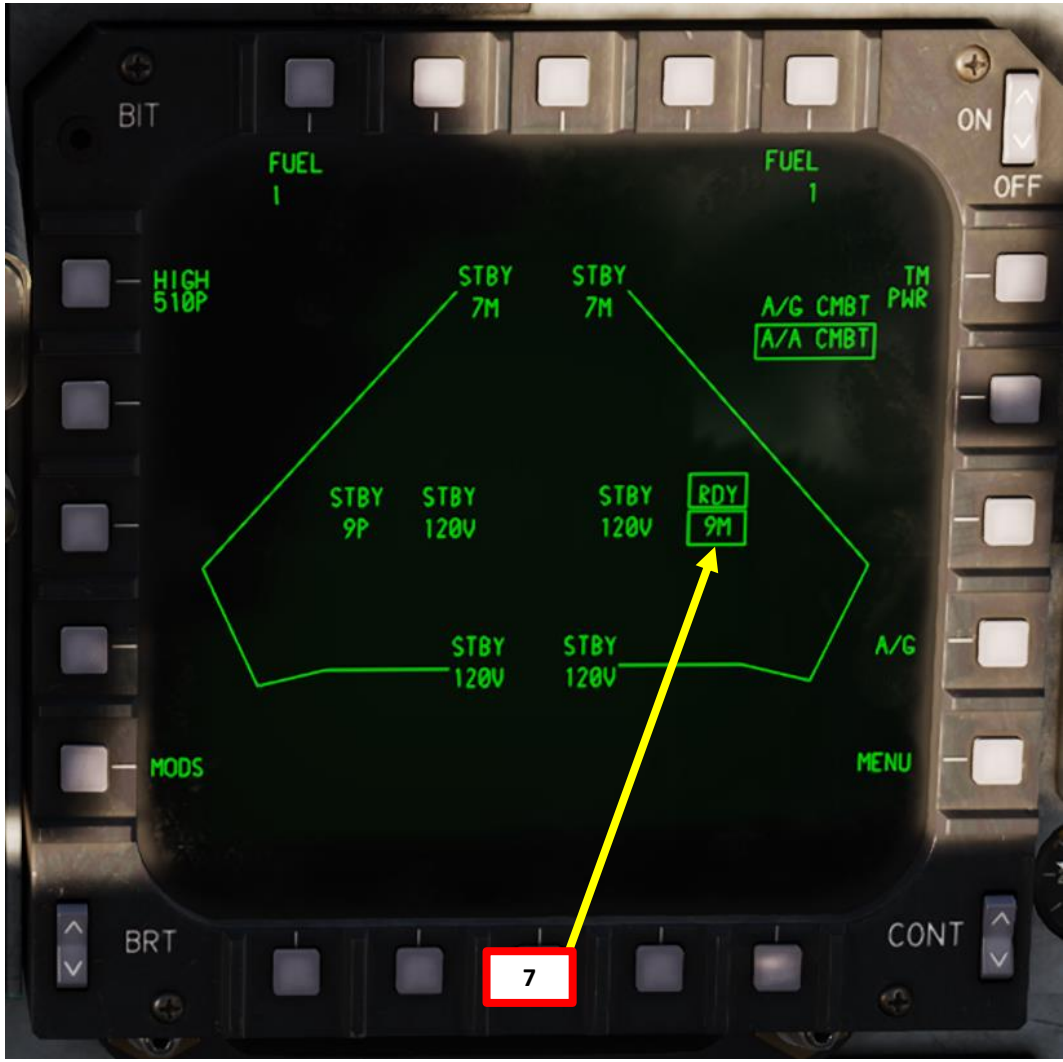


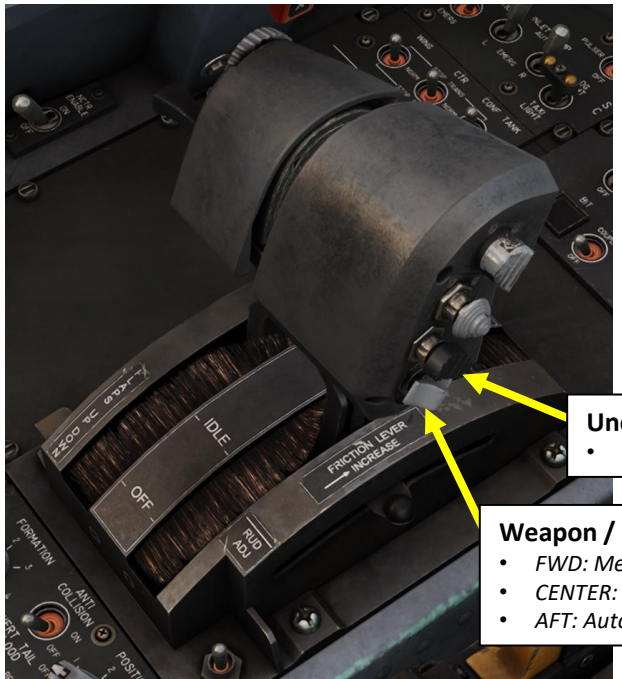




3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.1 – AIM-9M (No Radar)

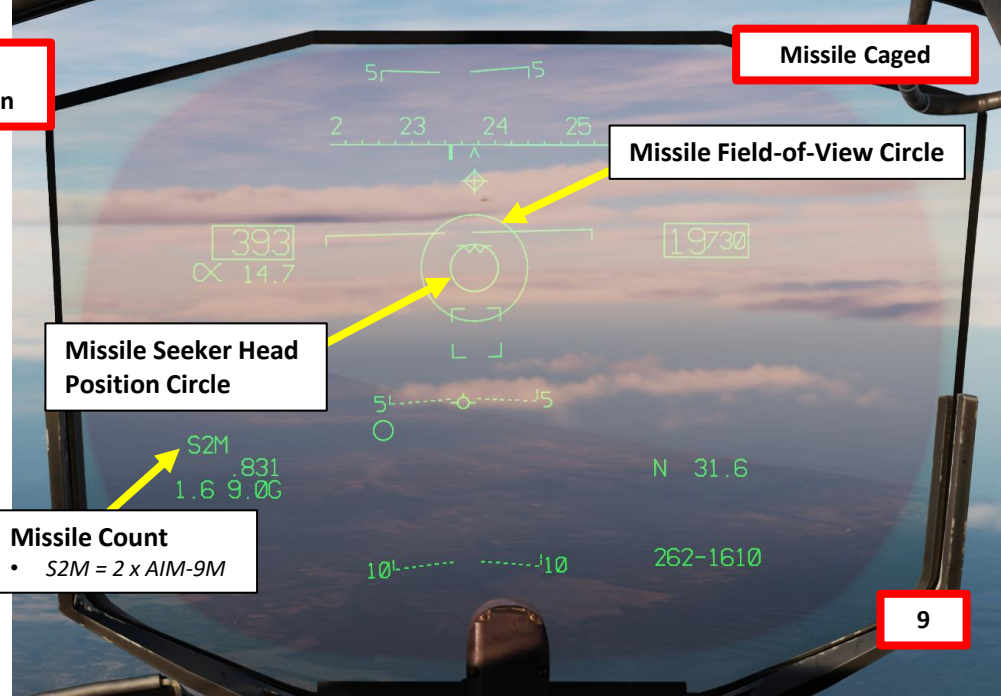
4. Set Master Arm Switch – ARM (UP)
5. Set Weapon / Mode (Weapon Select) Switch – MIDDLE. This will select Short Range Missiles (AIM-9 Sidewinder).
6. If needed, toggle between missile types (AIM-9M, AIM-9P, etc.), by using the Undesignate / Missile Reject Switch (Boat Switch) – FWD.
7. Confirm "9M" missile is selected and its status is RDY (Ready).
8. 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.

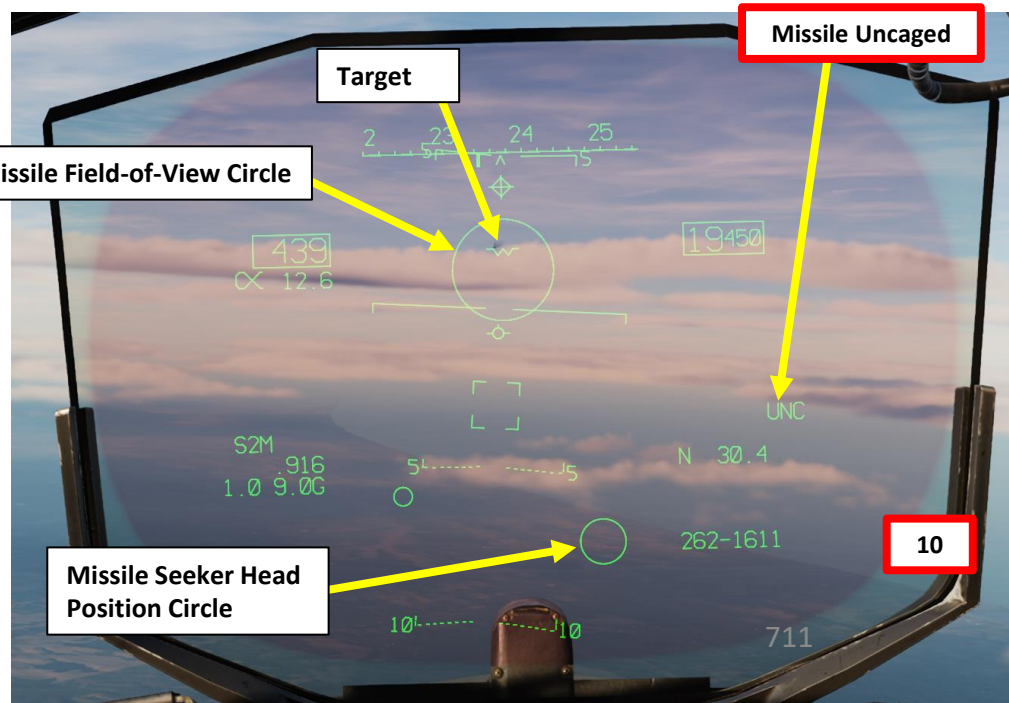




3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.1 – AIM-9M (No Radar)

9. When the AIM-9 is not detecting a heat signature, a low-pitch growl is audible. Once you have flown the aircraft to place the Missile Seeker Head Position Circle over the target, the missile seeker head will attempt to detect a heat signature.
10. The pilot may launch the missile immediately or attempt to achieve the seeker self-track (lockon) by uncaging the missile with the NWS (Nosewheel Steering) Button. Once uncaged, the UNC indication is visible on the HUD and the Seeker Head Position Circle will wander around the Missile Field-of-View Circle until it is caged again using the NWS button.
11. Once a heat signature from the target is detected, the low-pitch growl will transition into a high-pitch tone.
12. Once you are within effective missile range and the missile is tracking (high-pitch tone is audible), press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile.





3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.1 – AIM-9M (No Radar)

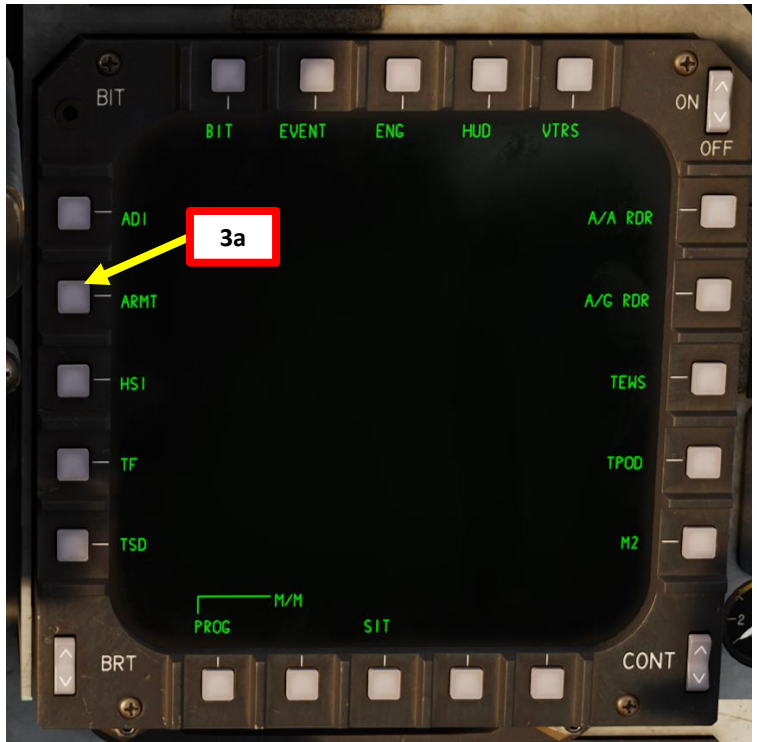
13. Once launched, the missile seeker will not require guidance by the radar since it will track heat signatures on its own; the radar is merely used to obtain an optimal firing solution.

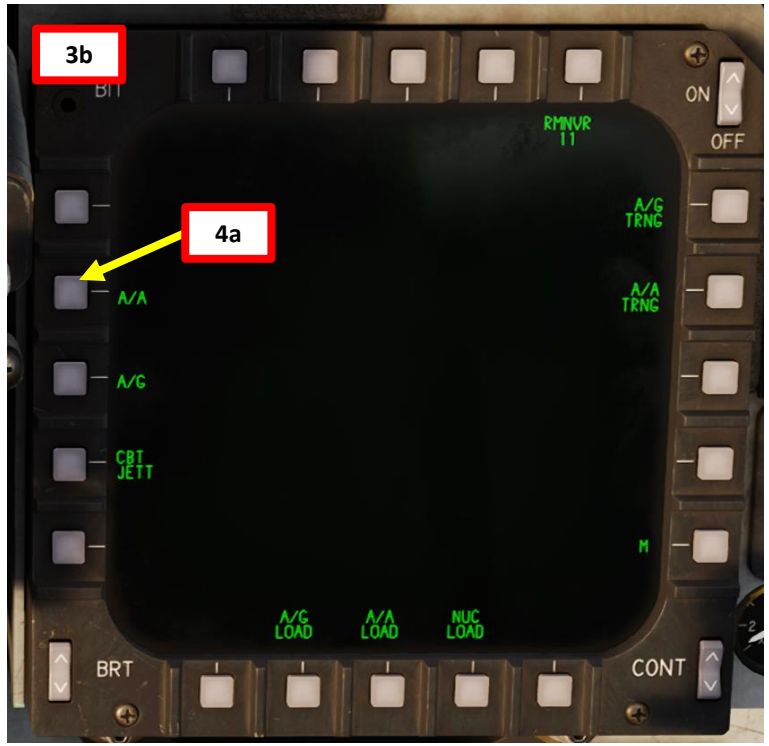
3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

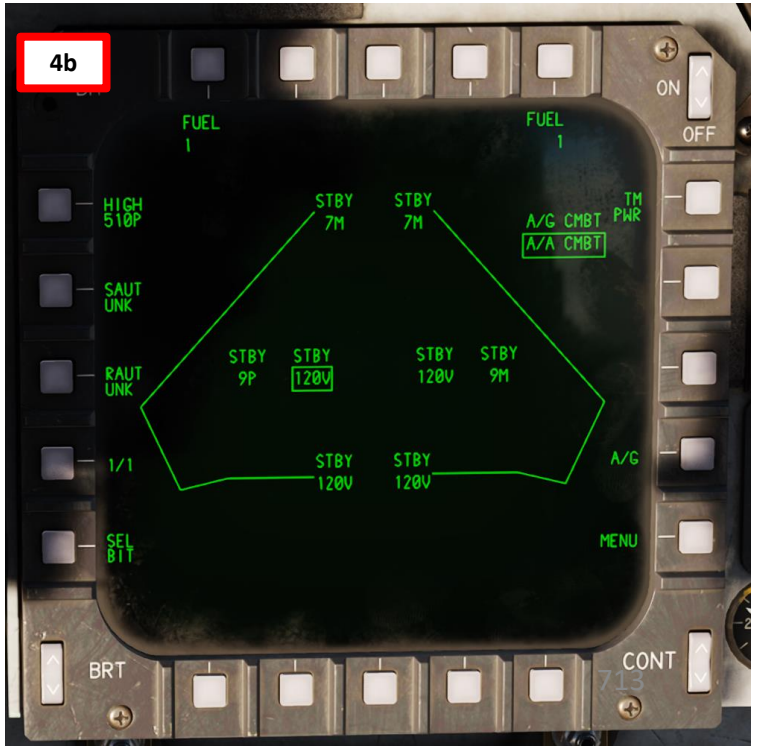
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
4. On a different display, select A/A CMBT (Air-to-Air Combat) Sub-Page.

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

1

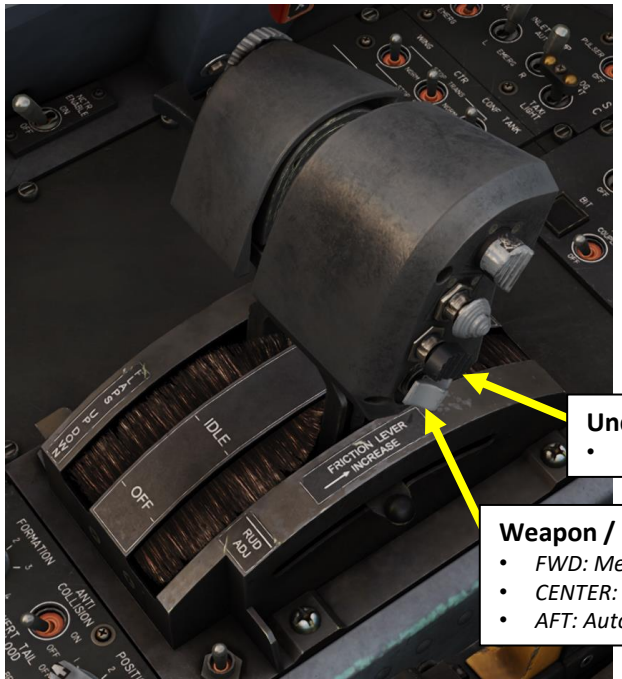




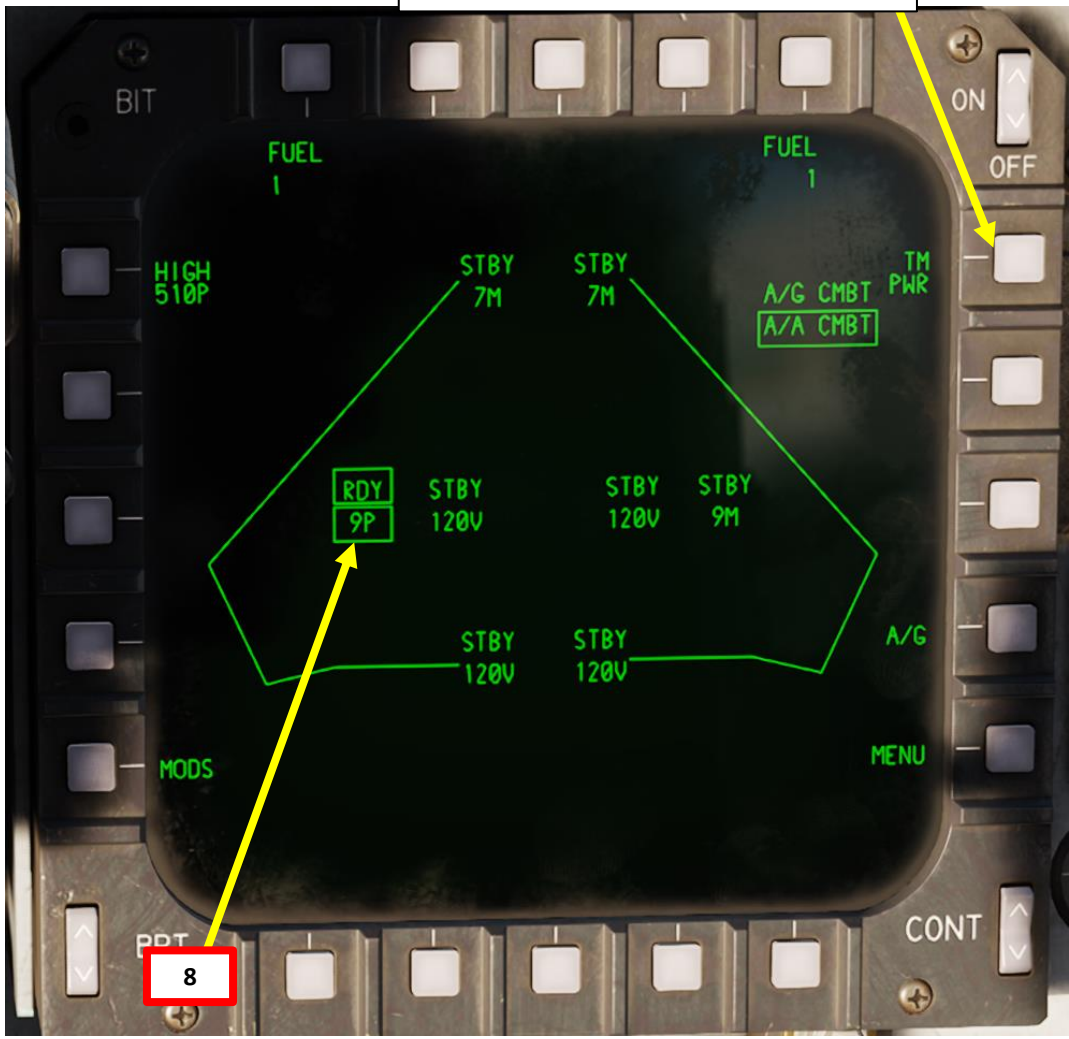


3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

5. Set Master Arm Switch – ARM (UP)
6. Set Weapon / Mode (Weapon Select) Switch – MIDDLE. This will select Short Range Missiles (AIM-9 Sidewinder).
7. If needed, toggle between missile types (AIM-9M, AIM-9P, etc.), by using the Undesignate / Missile Reject Switch (Boat Switch) – FWD.
8. Confirm "9P" missile is selected and its status is RDY (Ready).
9. 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.

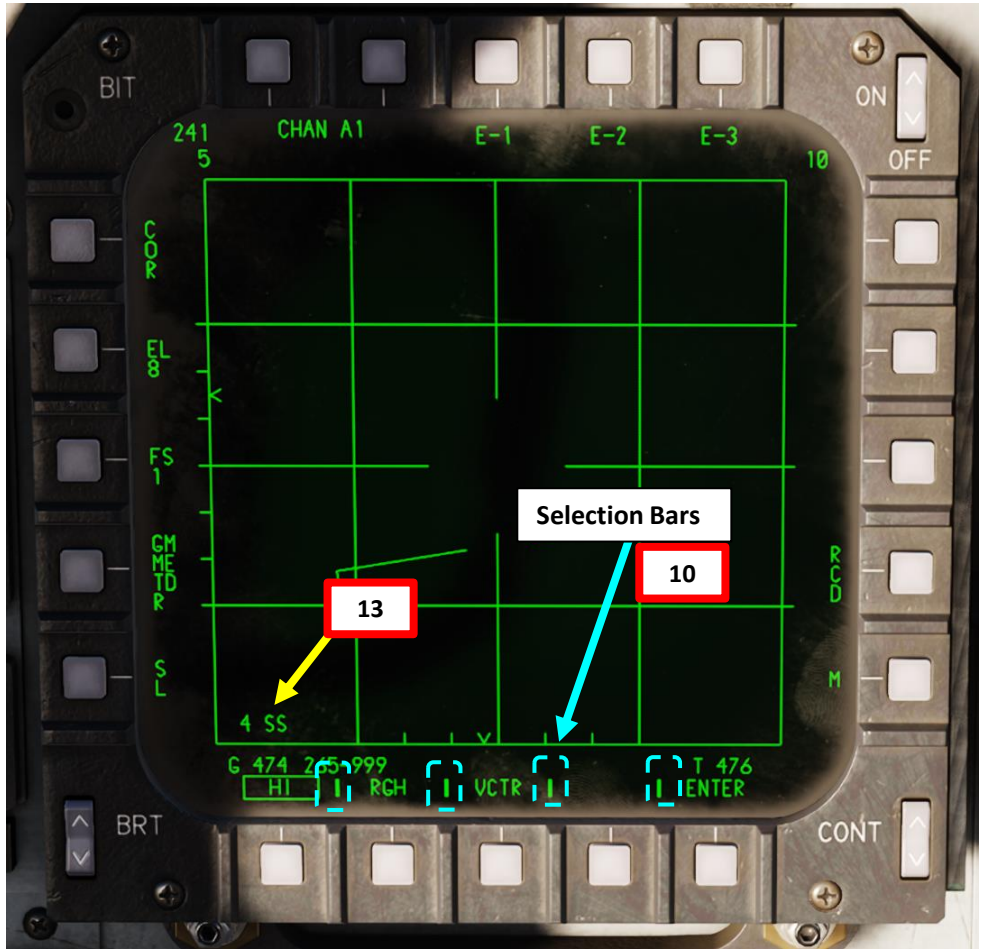


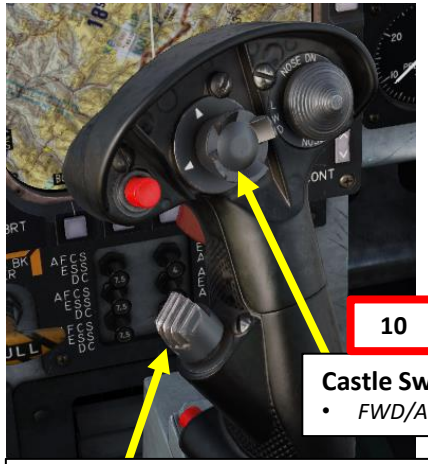
TM (Telemetry) Power (Not Simulated)
- *Pressing this button sends telemetry power to instrumented missiles.*

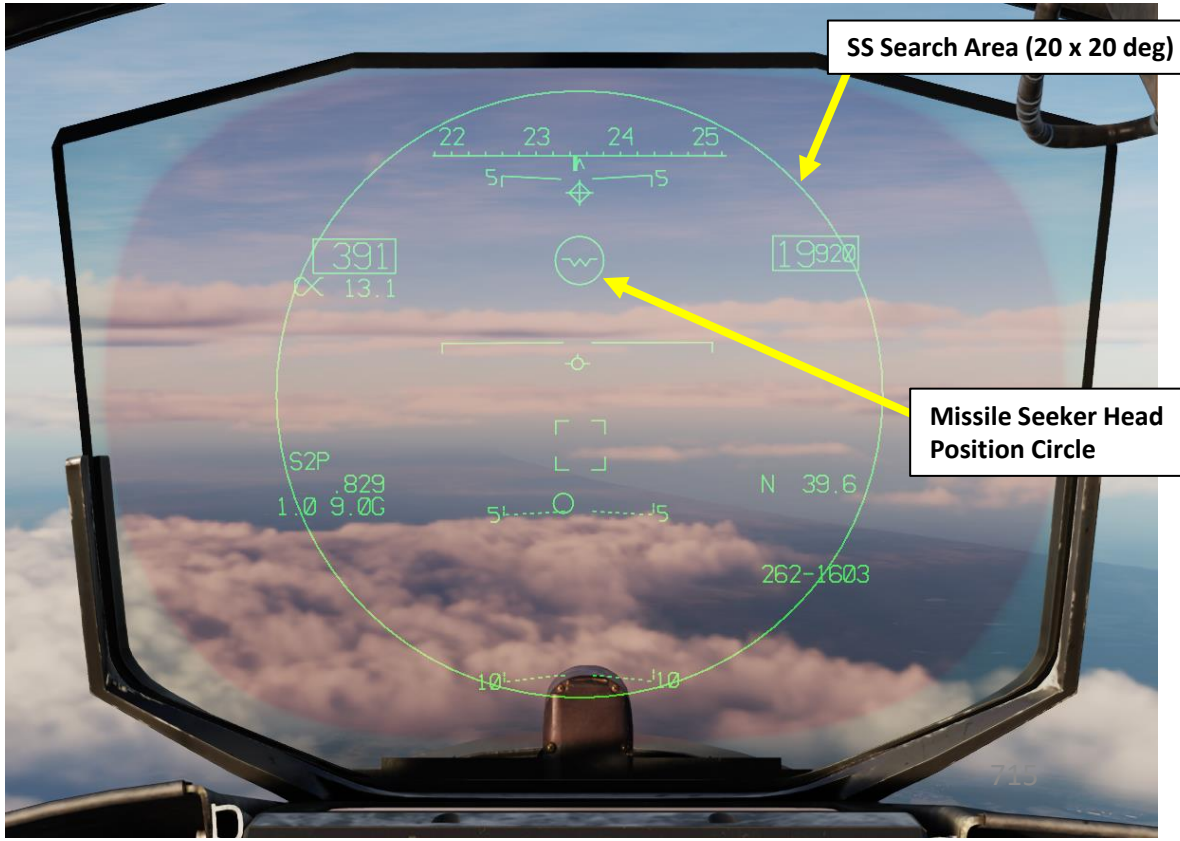


3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

10. Select A/A RDR page, then take control of the sensor page.
    - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
    - Selection bars at the bottom of a display indicate the page is selected.
11. To enter an auto acquisition mode, pilot should first be in RWS (Range While Search) mode. By default, RWS mode is selected.
12. Press Auto Acquisition Switch FWD SHORT (less than 1 sec).
13. On the A/A RDR page, the "SS" legend indicates that the radar has entered Supersearch mode.
    - *Note: Supersearch auto acquisition mode automatically scans a **20 deg x 20 deg area in 6-bar scan pattern** until a lockon is achieved or the crew selects a return to search. Radar **search range is between 500 ft and 10 nm**.*

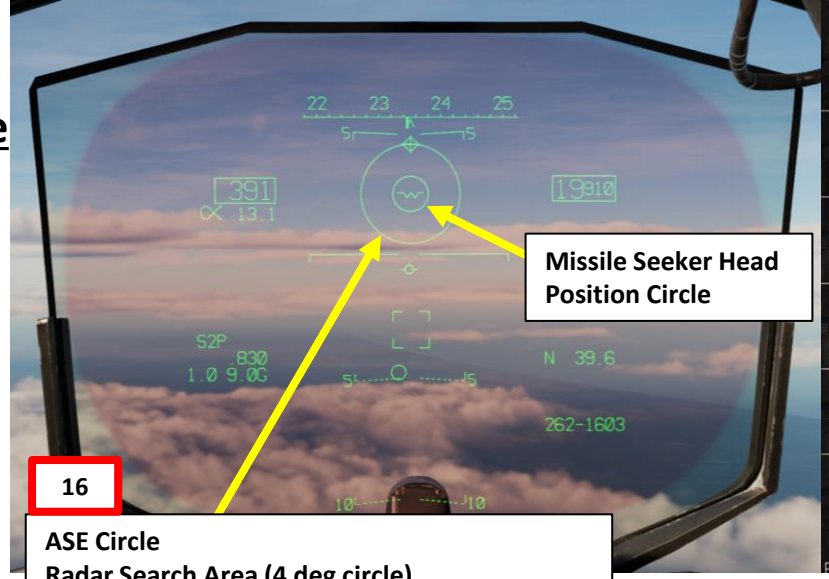


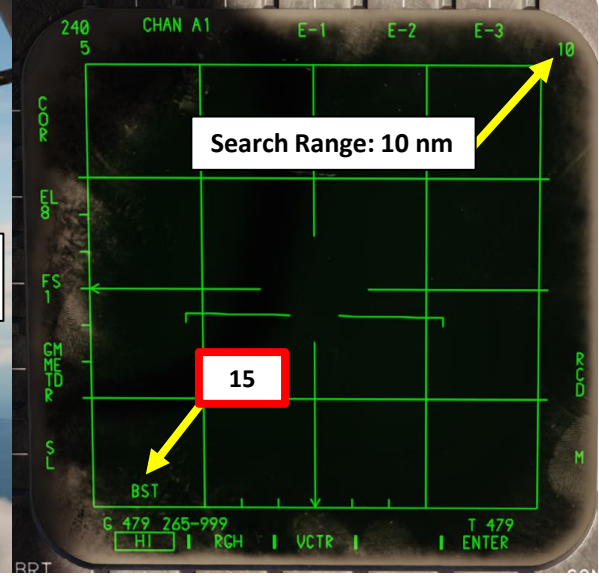


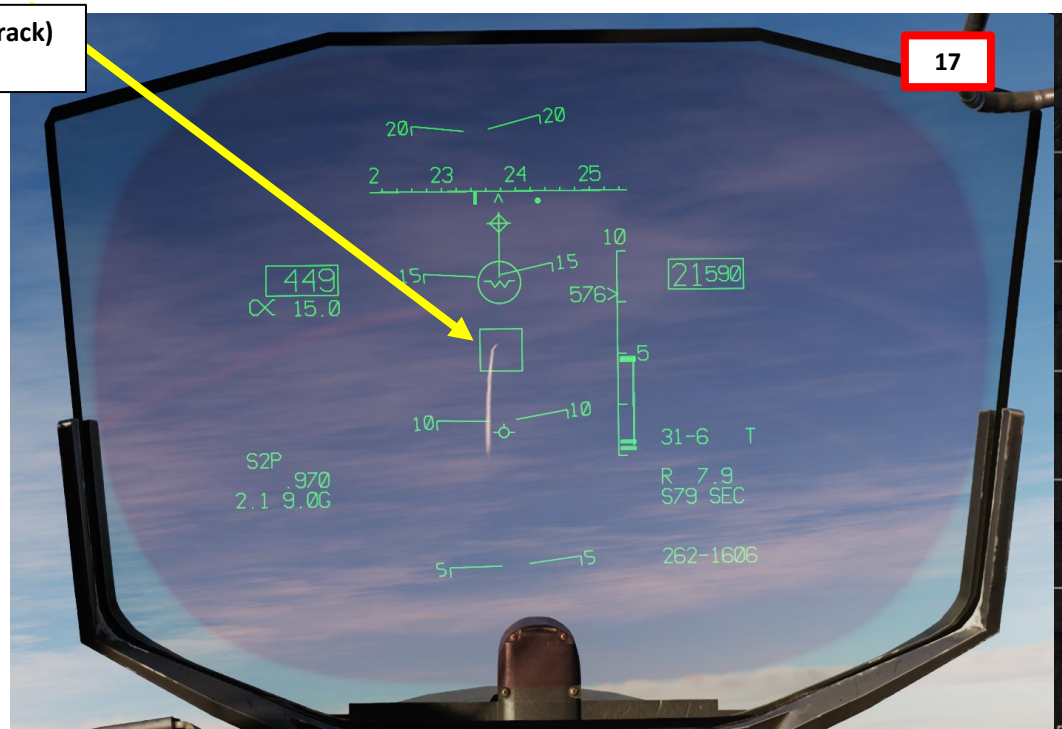


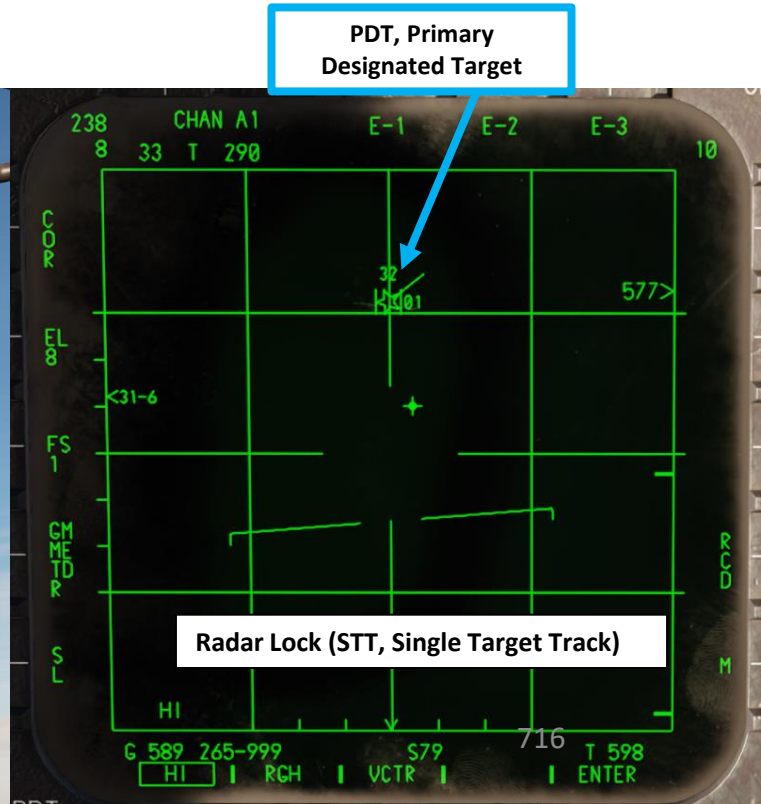
3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

14. Press Auto Acquisition Switch FWD SHORT (less than 1 sec) a second time to enter BST mode from SS mode.
15. On the A/A RDR page, the "BST" legend indicates that the radar has entered Boresight mode.
    - *Note: Boresight auto acquisition mode automatically scans a **4 deg circular area** until a lockon is achieved or the crew selects a return to search. The radar antenna is slaved to the Radar Boresight Line (RBL). Radar **search range is between 500 ft and 10 nm**.*
16. On the HUD (Heads-Up Display), the circle indicates the area painted/searched by the radar.
17. As soon as a radar target is detected within the search area (ASE Circle, or Allowable Steering Error), a lock is attempted to enter STT (Single Target Track)



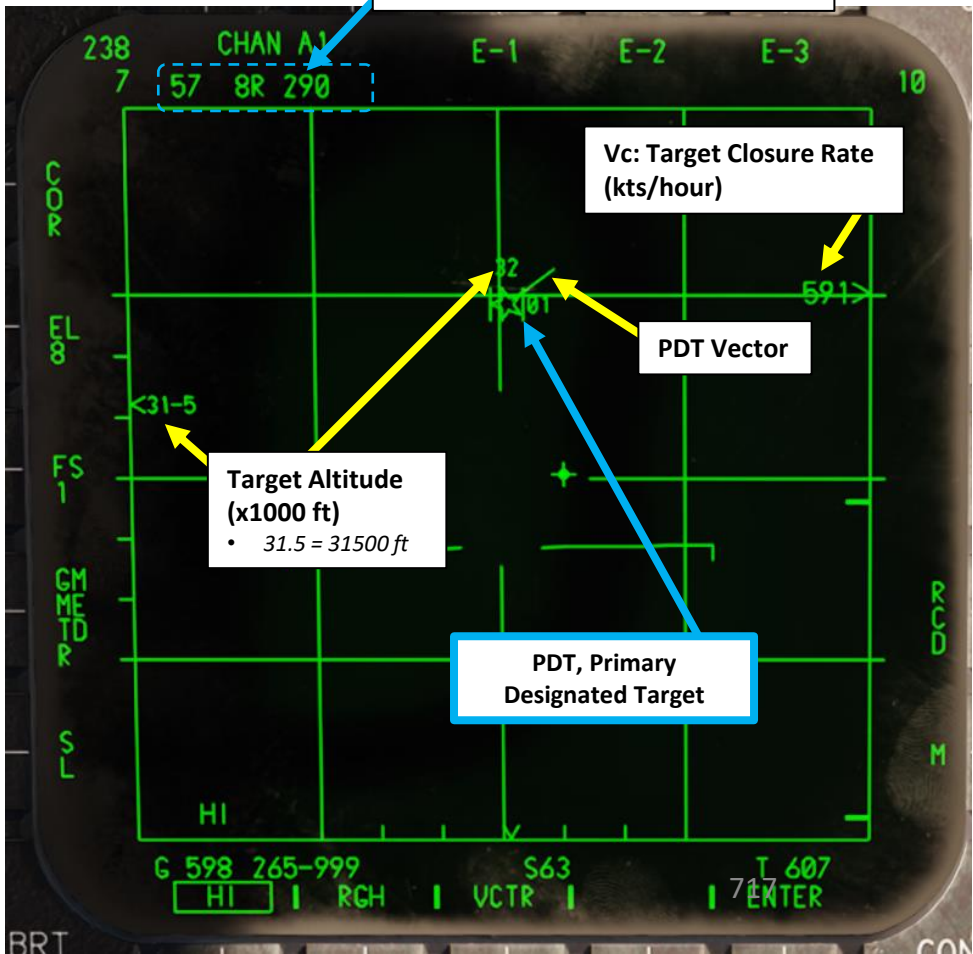






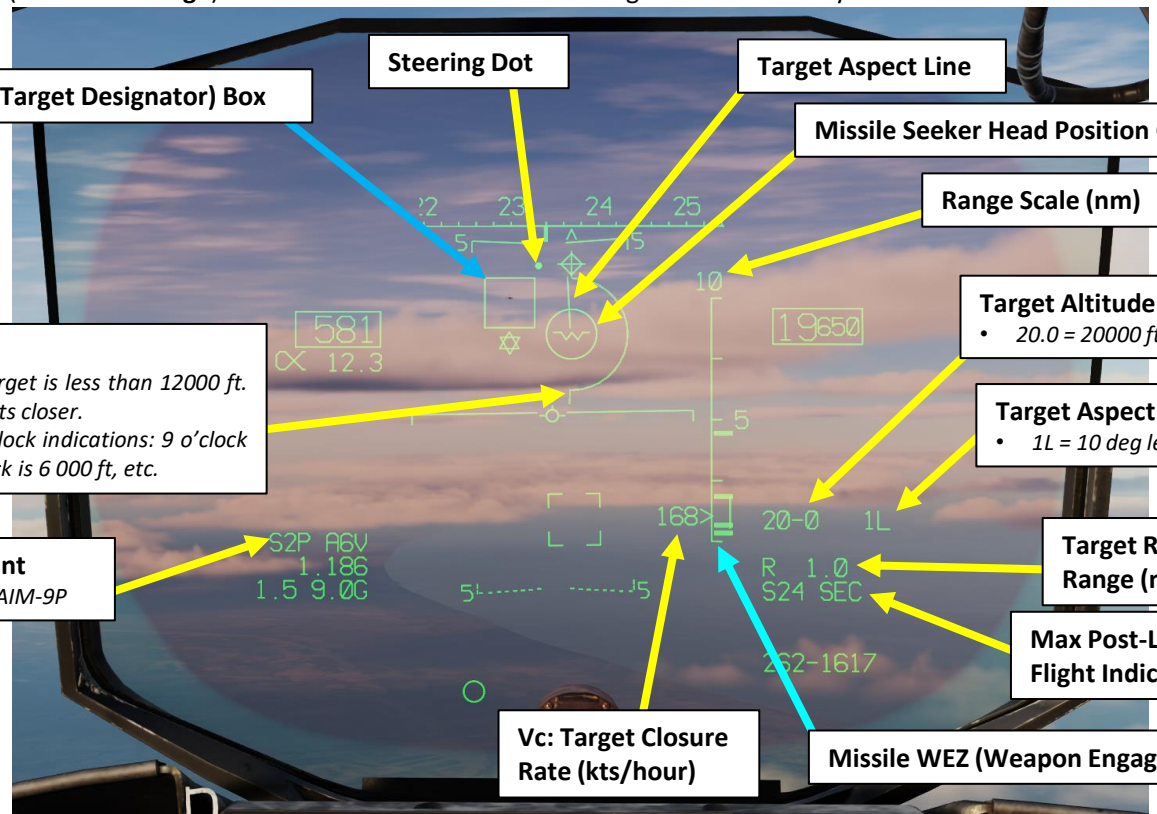
3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

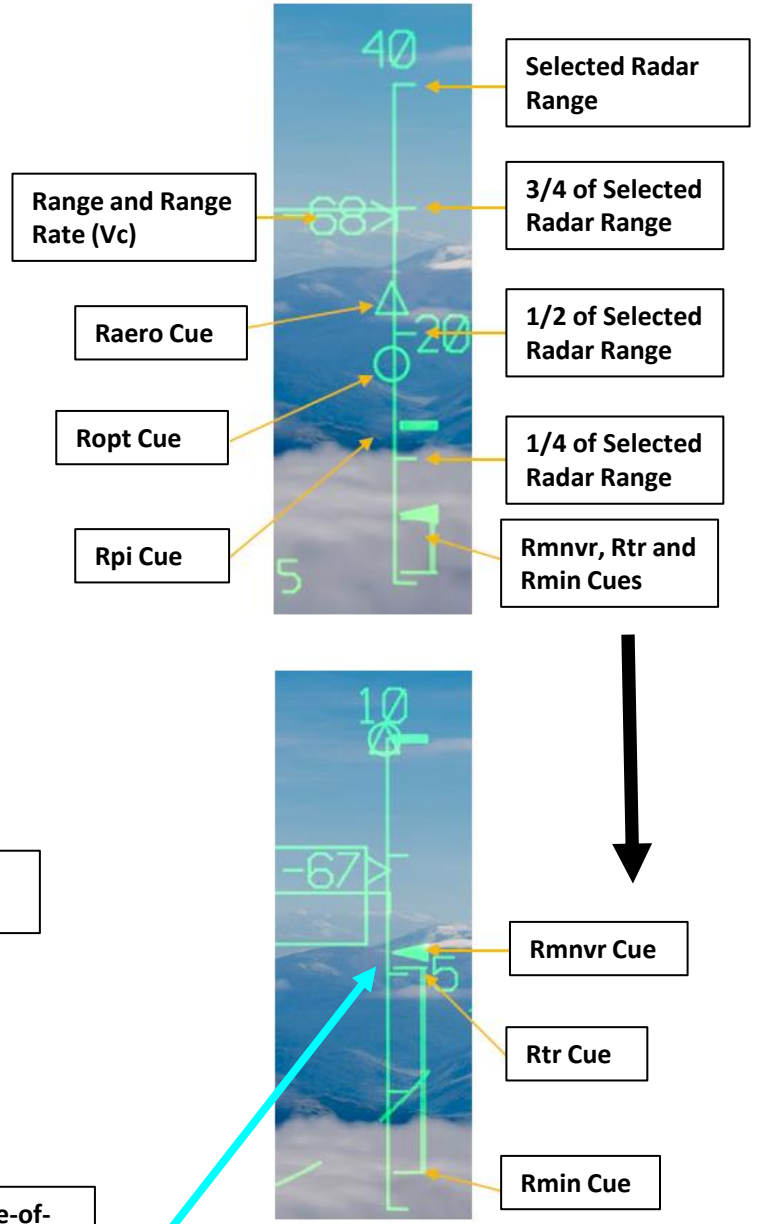
18. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.



3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

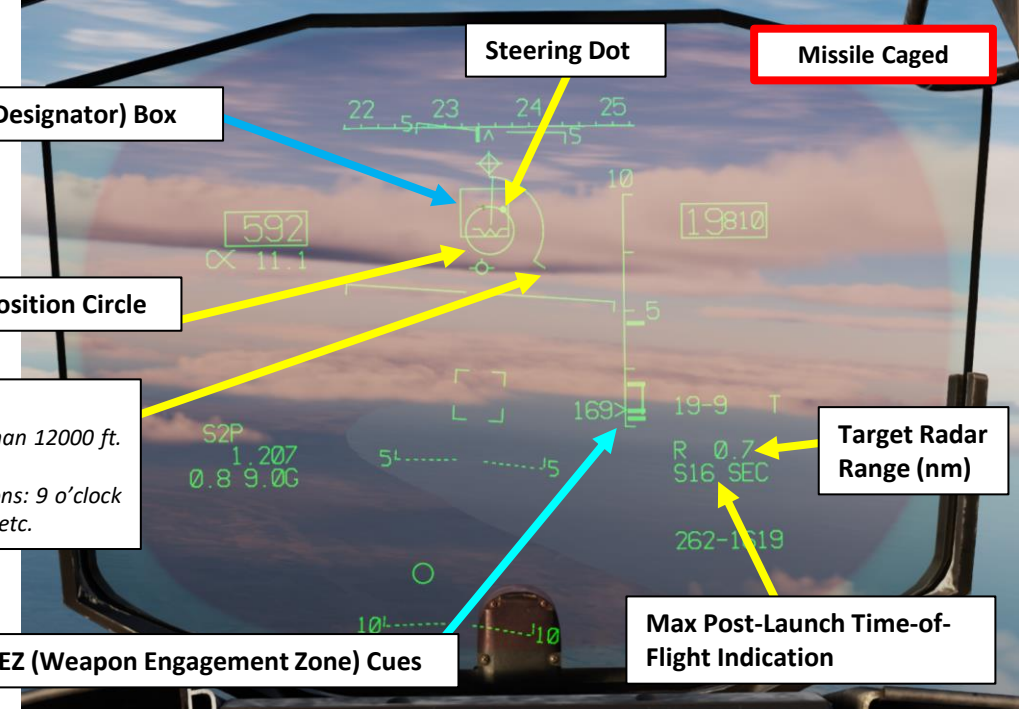
19. Once target is locked, steer aircraft to place the target on the Missile Seeker Head Position Circle on the HUD. Use Missile WEZ (Weapon Engagement Zone) cues to estimate target range, which should ideally be between within Ropt (Max Range Probability of Intercept with Optimum Steering) but further than Rmin (Minimum Launch Range).
    - **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.

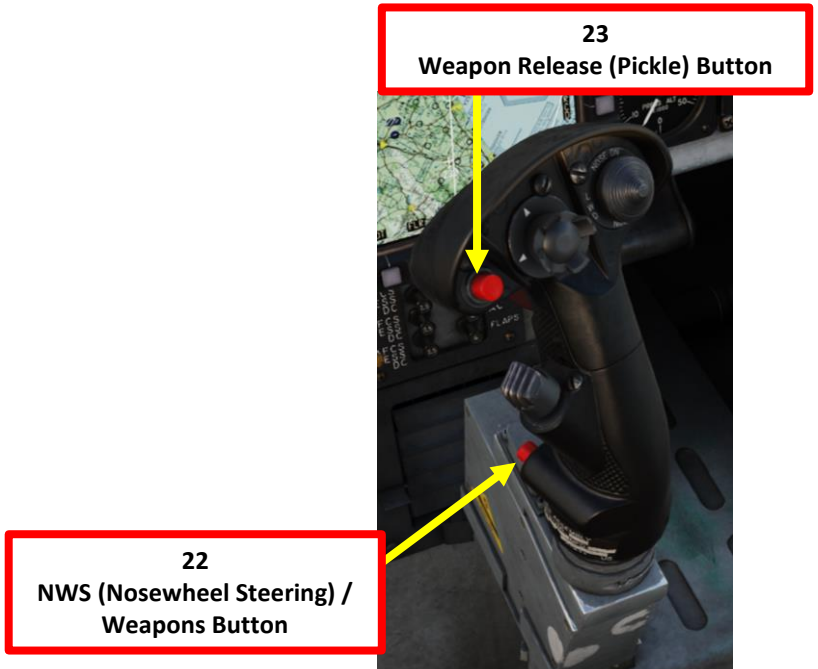


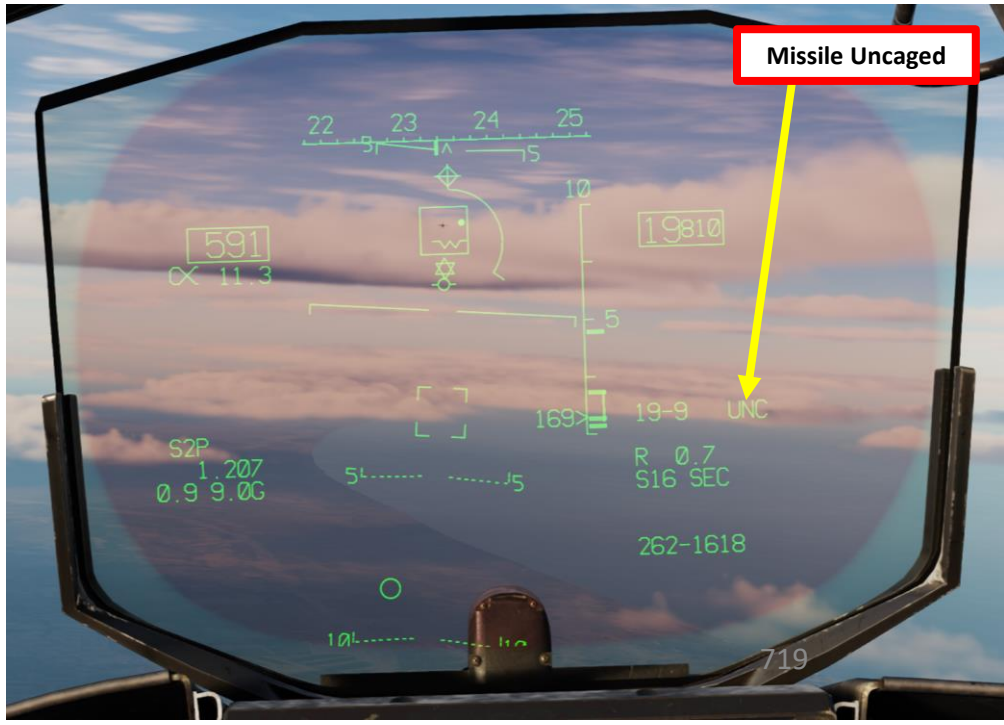


3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

20. When the AIM-9 is not detecting a heat signature, a low-pitch growl is audible. Once you have flown the aircraft to place the Missile Seeker Head Position Circle over the target, the missile seeker head will attempt to detect a heat signature.
21. Once a heat signature from the target is detected, the low-pitch growl will transition into a high-pitch tone.
22. The pilot may launch the missile immediately or attempt to achieve the seeker self-track (lockon) by uncaging the missile with the NWS (Nosewheel Steering) Button. Once uncaged, the UNC indication is visible on the HUD. This step isn't mandatory, but it is generally good practice.
23. Once you are within effective missile range and the missile is tracking (high-pitch tone is audible), press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile.

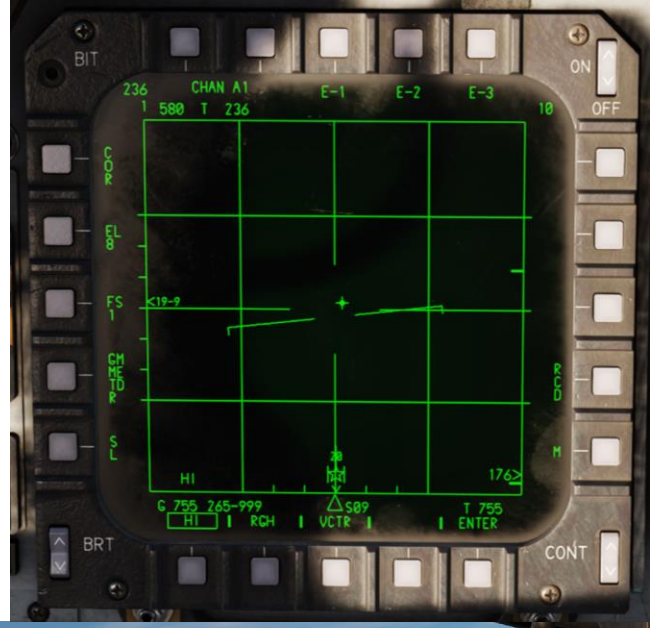






3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

24. Once launched, the missile seeker will not require guidance by the radar since it will track heat signatures on its own; the radar is merely used to obtain an optimal firing solution.



3 – AIR-TO-AIR WEAPONS
3.2 – Infrared-Guided AIM-9 Sidewinder Missile
3.2.2 – AIM-9P (With Radar)

25. To exit STT (Single Target Track) radar mode:
    - **Pilot**: Depress the Auto Acquisition Switch on the pilot's stick.

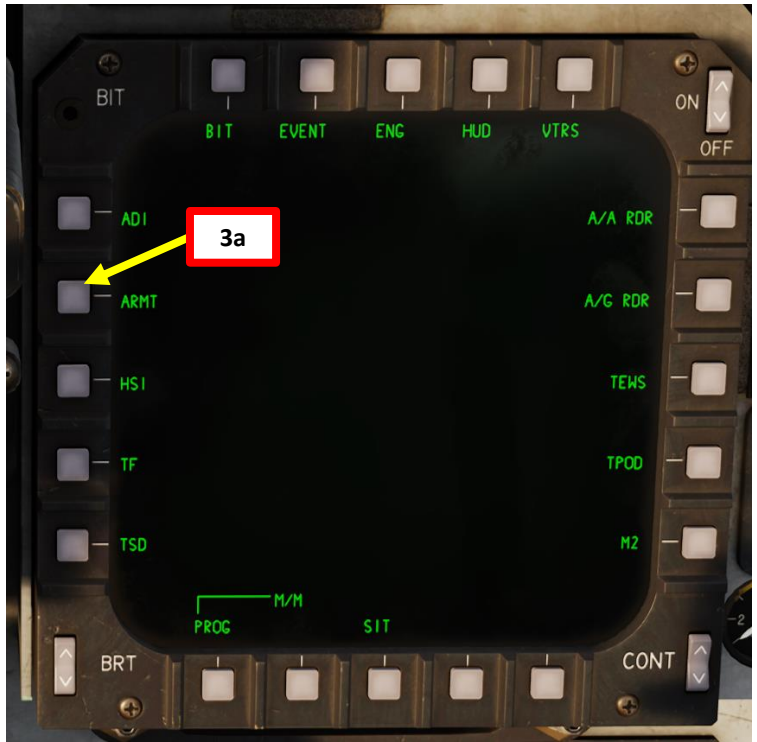
3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile

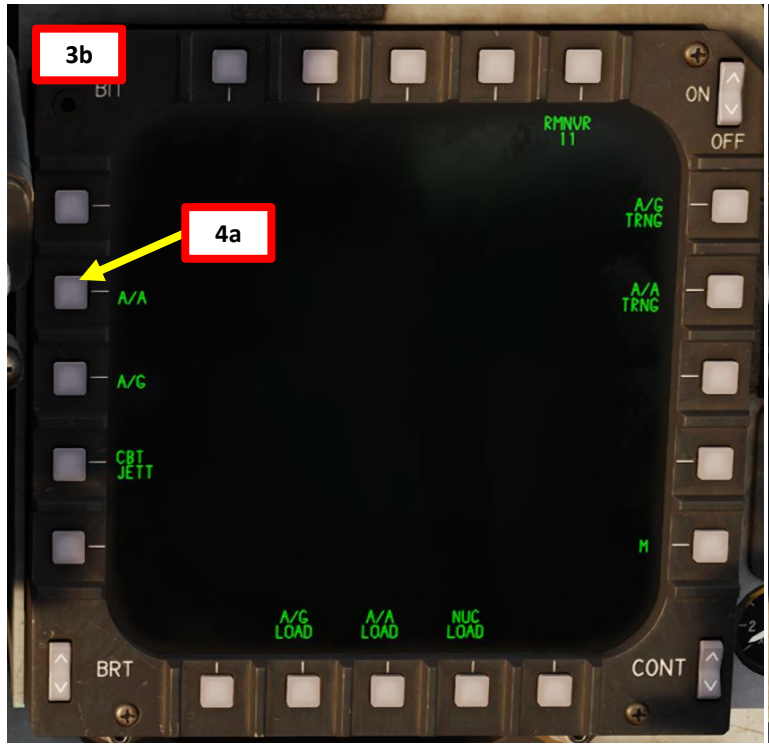
3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

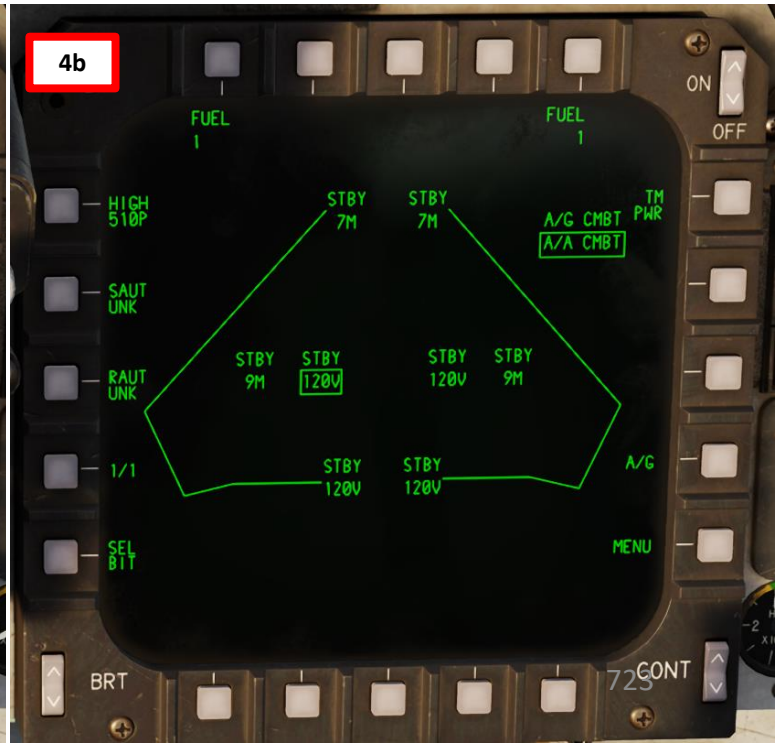
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
4. On a different display, select A/A CMBT (Air-to-Air Combat) Sub-Page.

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

1







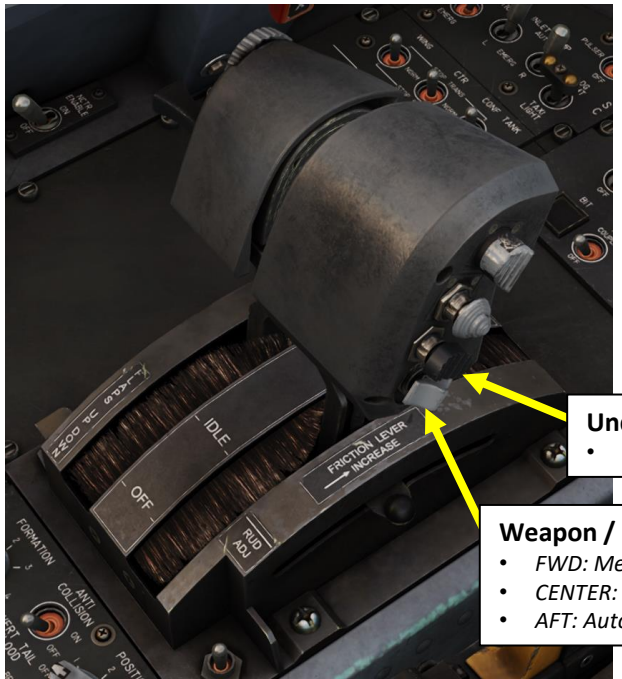
3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

5. Set Master Arm Switch – ARM (UP)
6. Set Weapon / Mode (Weapon Select) Switch – FWD. This will select Medium Range Missiles (AIM-120C AMRAAM by default).
7. Select AIM-7 missile; toggle between missile types (AIM-7M, AIM-120C, etc.), by using the Undesignate / Missile Reject Switch (Boat Switch) – FWD.
8. Confirm "7M" missile is selected and its status is RDY (Ready).

Target Size Setting (Not Simulated)
- *Pressing this button manually changes the target size, which is then used by the missile for fuze timing and flight correction.*

Target Radar Cross-Section Setting (Not Simulated)
- *Pressing this button manually changes the estimated RCS (Radar Cross-Section) for the target.*

Flight Member Identification
- *This setting allows the aircrew to enter a flight member identification for deconfliction purposes.*
- *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 a flight of four*



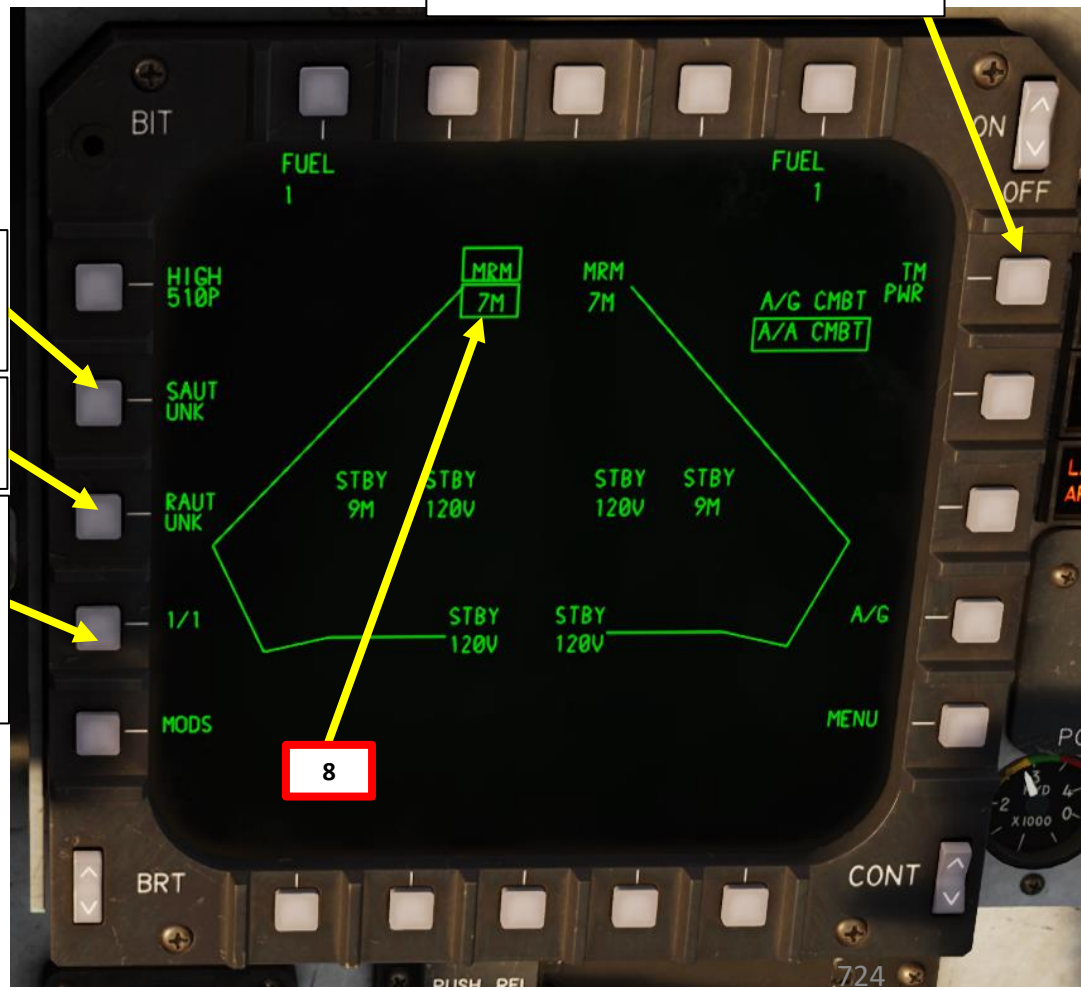
Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

7

Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

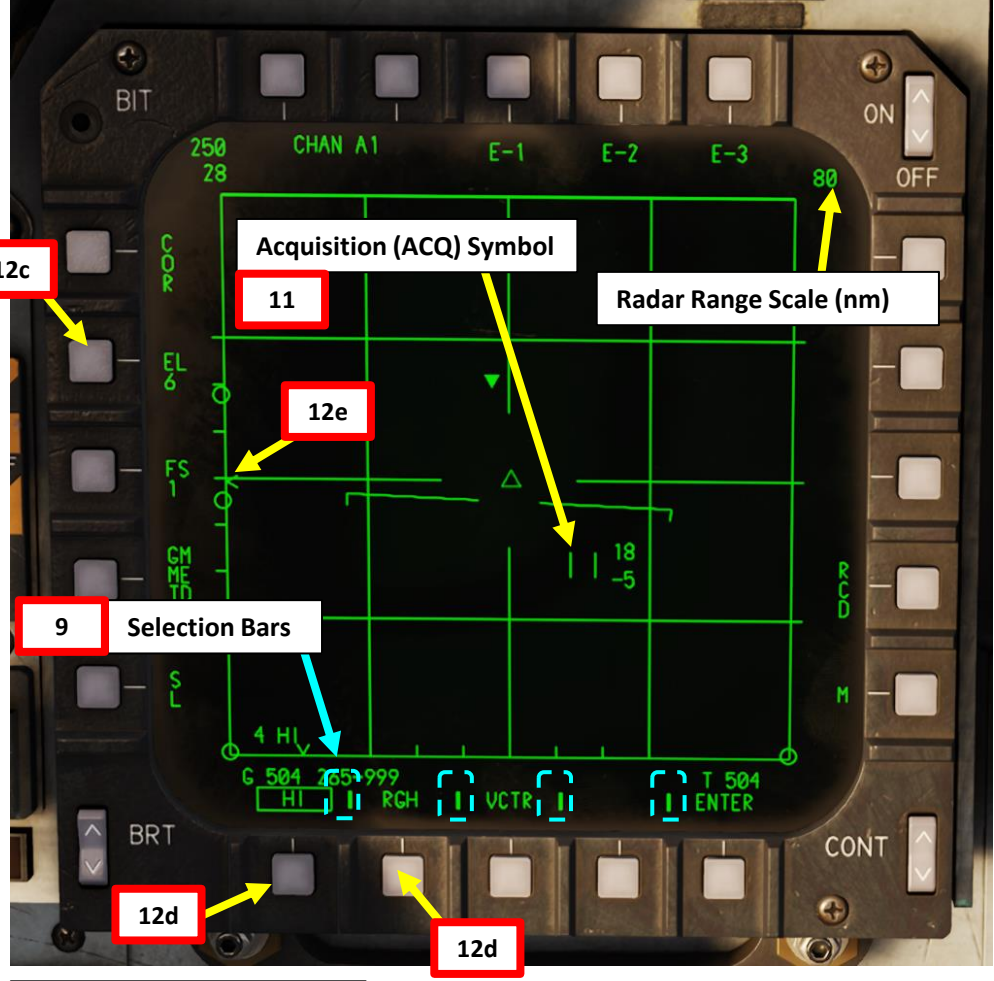
6

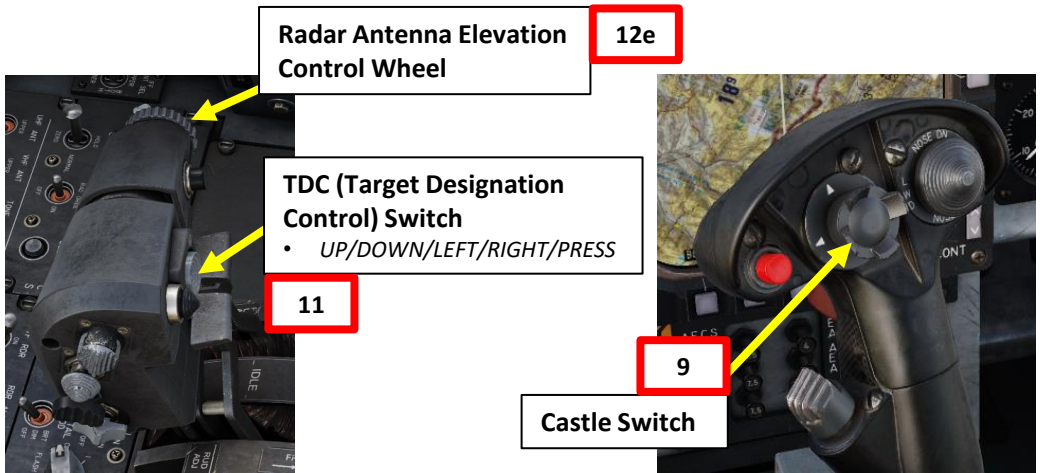
TM (Telemetry) Power (Not Simulated)
- *Pressing this button sends telemetry power to instrumented missiles.*

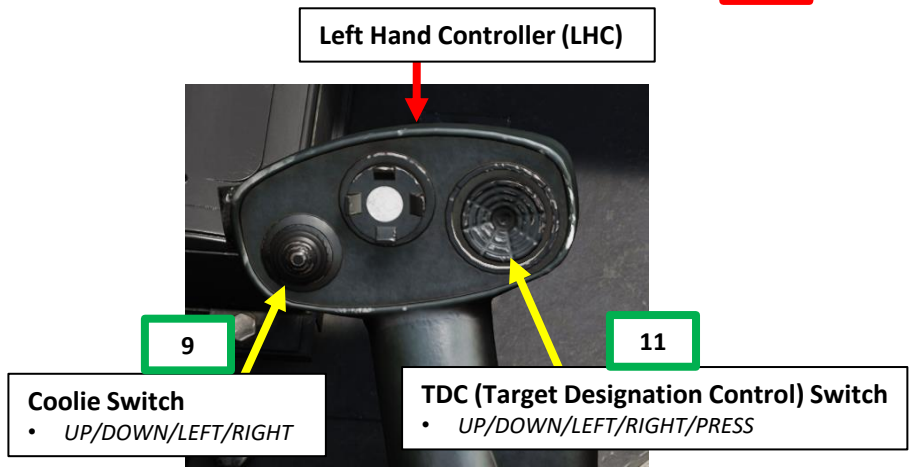


3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

9. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
10. By default, RWS (Range While Search) mode is selected.
11. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to lock.
12. Set radar Range, Azimuth, Elevation scan, PRF (Pulse Repetition Frequency) and Antenna Elevation – As desired.
    - **a) Range**: Use TDC switch to slew the Acquisition Symbol (ACQ) past top/bottom edge of screen to increase/decrease range.
    - **b) Azimuth**: Use TDC switch to slew the Acquisition Symbol (ACQ) past left/right edge of screen to decrease/increase azimuth setting.
    - **c) Elevation scan**: Use the EL pushbutton to toggle between elevation bar numbers.
    - **d) PRF setting**: Press HI/MED/INLV pushbutton to toggle between PRF settings, or press the "RGH" pushbutton to select Range Gated High mode.
    - **e) Antenna elevation**: Use **Radar Antenna Elevation Control Wheel** on pilot throttle



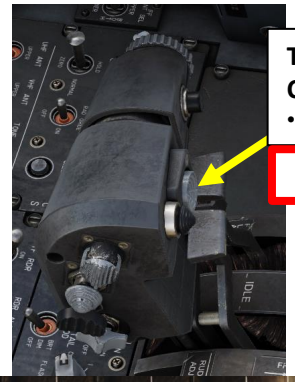


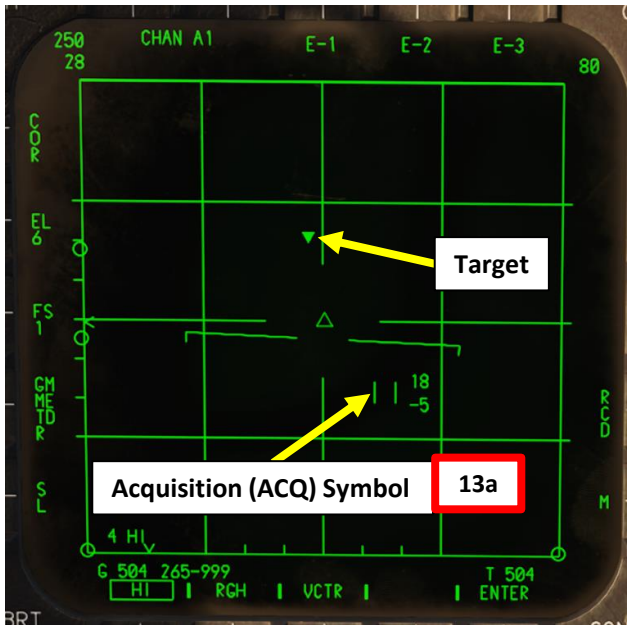


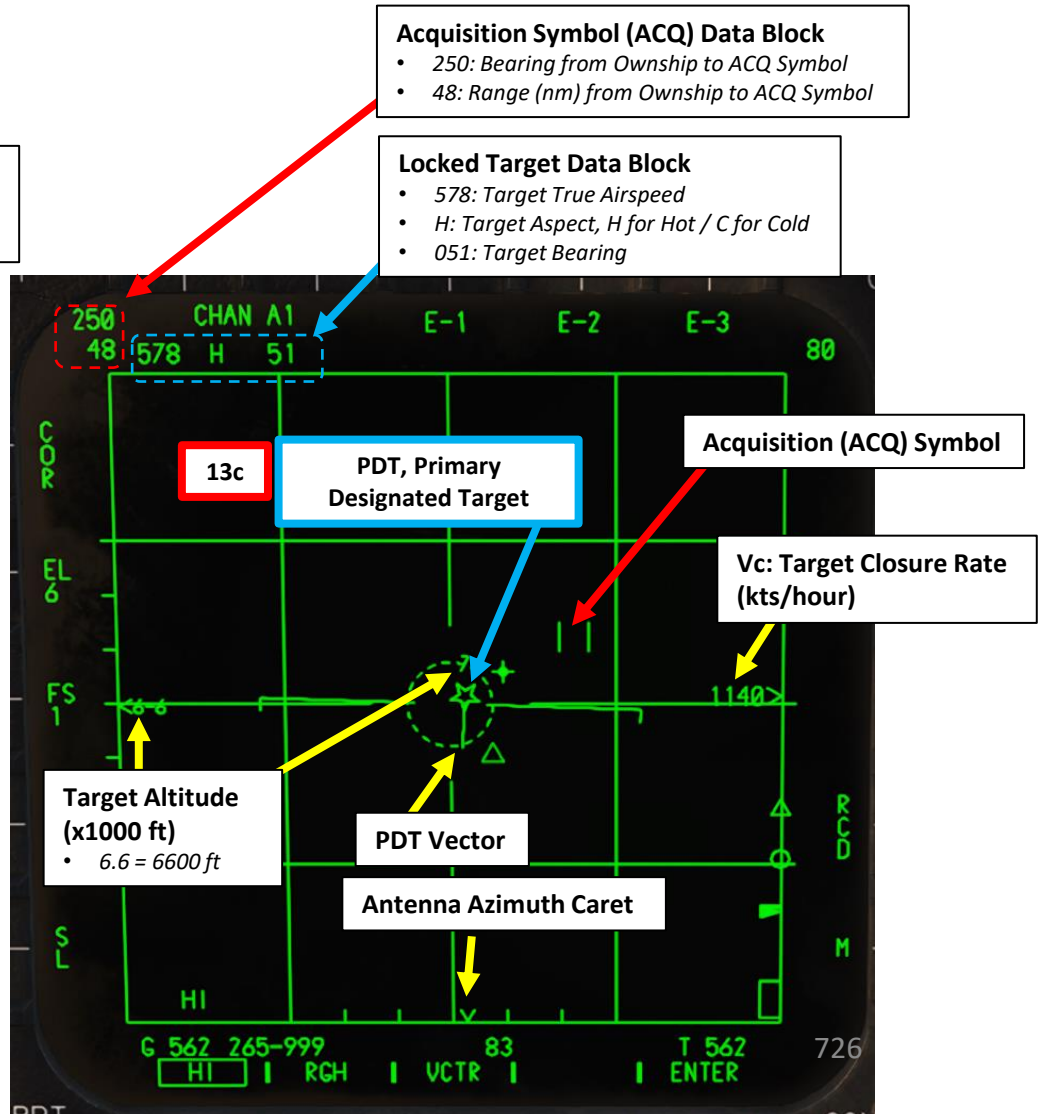
3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

13. Once Acquisition Symbol (ACQ) is over the target, perform a radar lock:
    - **Pilot**: Press TDC (Target Designation Control) Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
14. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.

Note: alternatively, STT radar lock can be obtained from an auto acquisition radar mode.

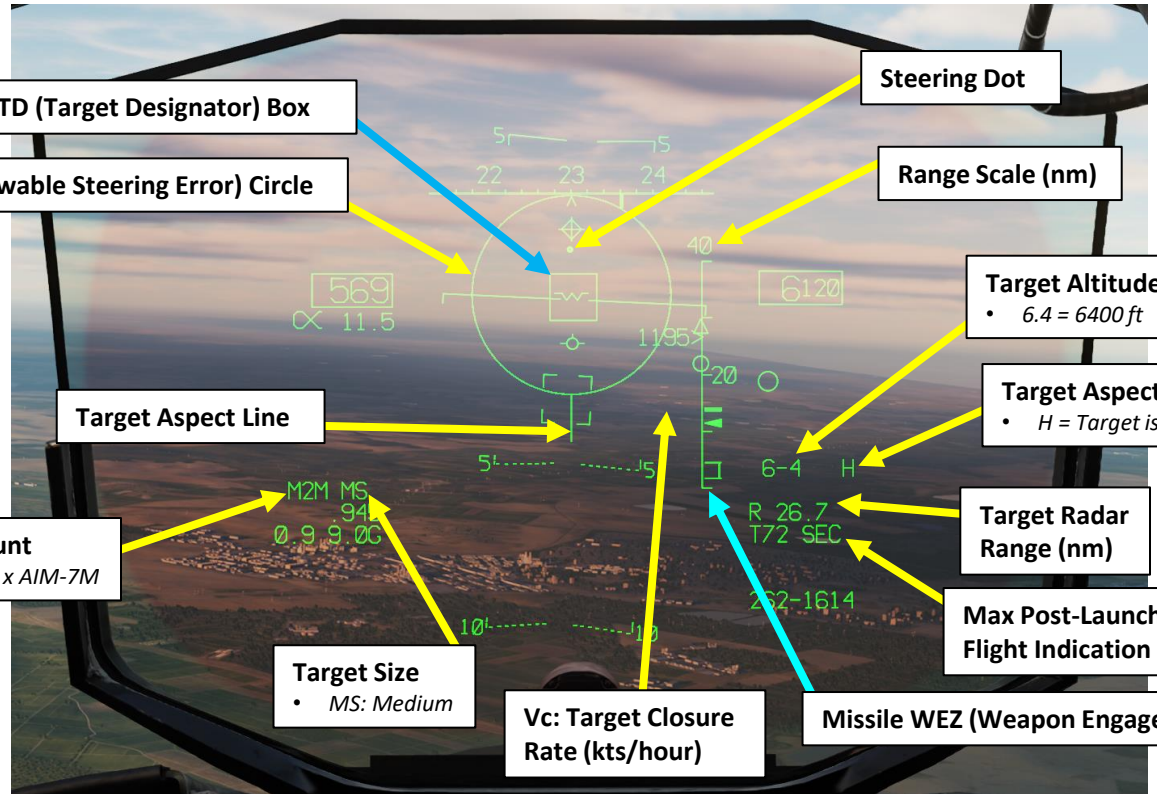


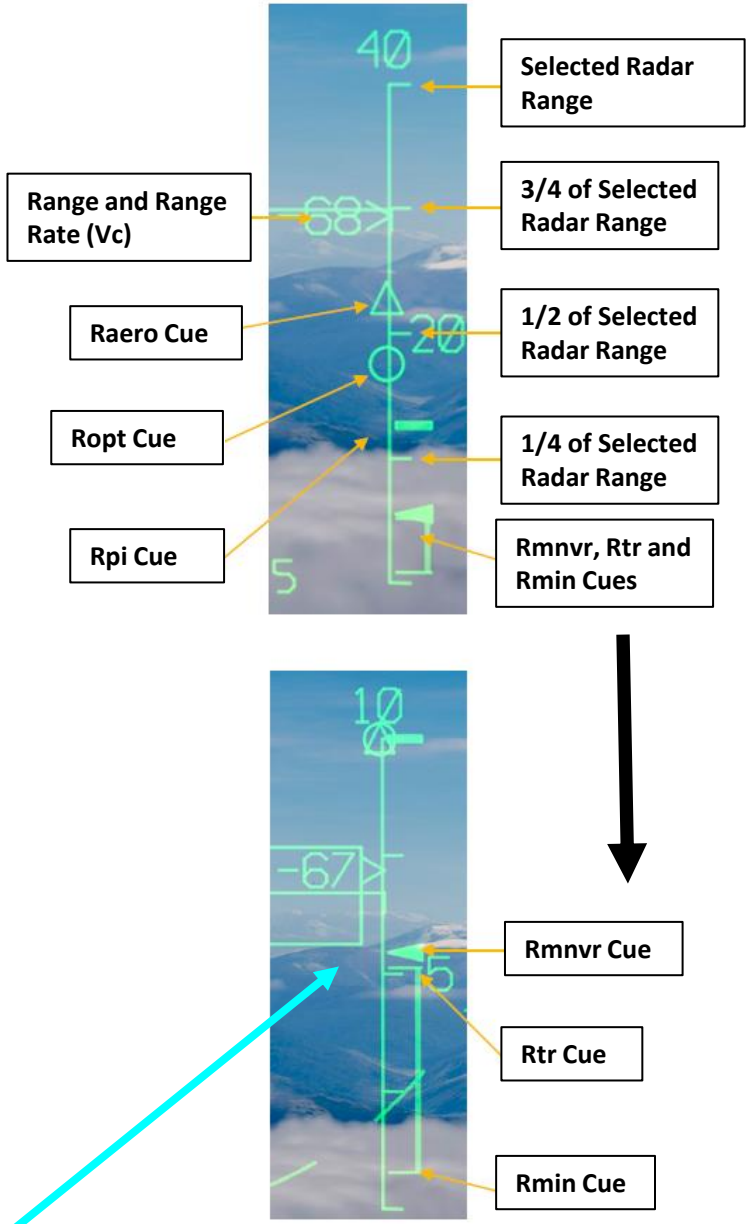




3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

15. Once target is locked, steer aircraft to place Steering Dot inside the ASE (Allowable Steering Error) circle on the HUD. Use Missile WEZ (Weapon Engagement Zone) cues to estimate target range, which should ideally be between within Ropt (Max Range Probability of Intercept with Optimum Steering) but further than Rmin (Minimum Launch Range).
    - **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.

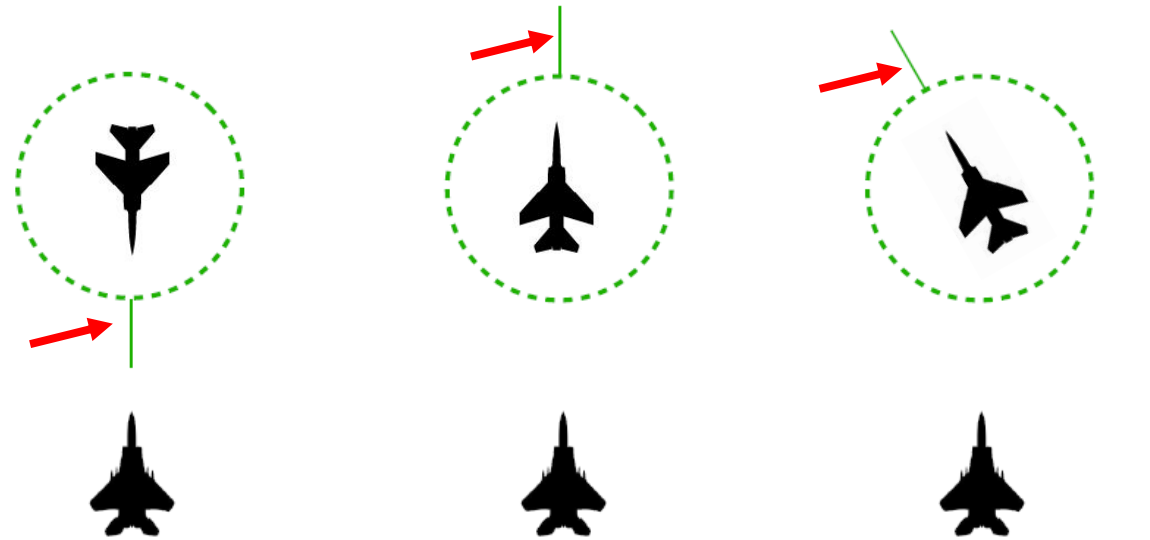


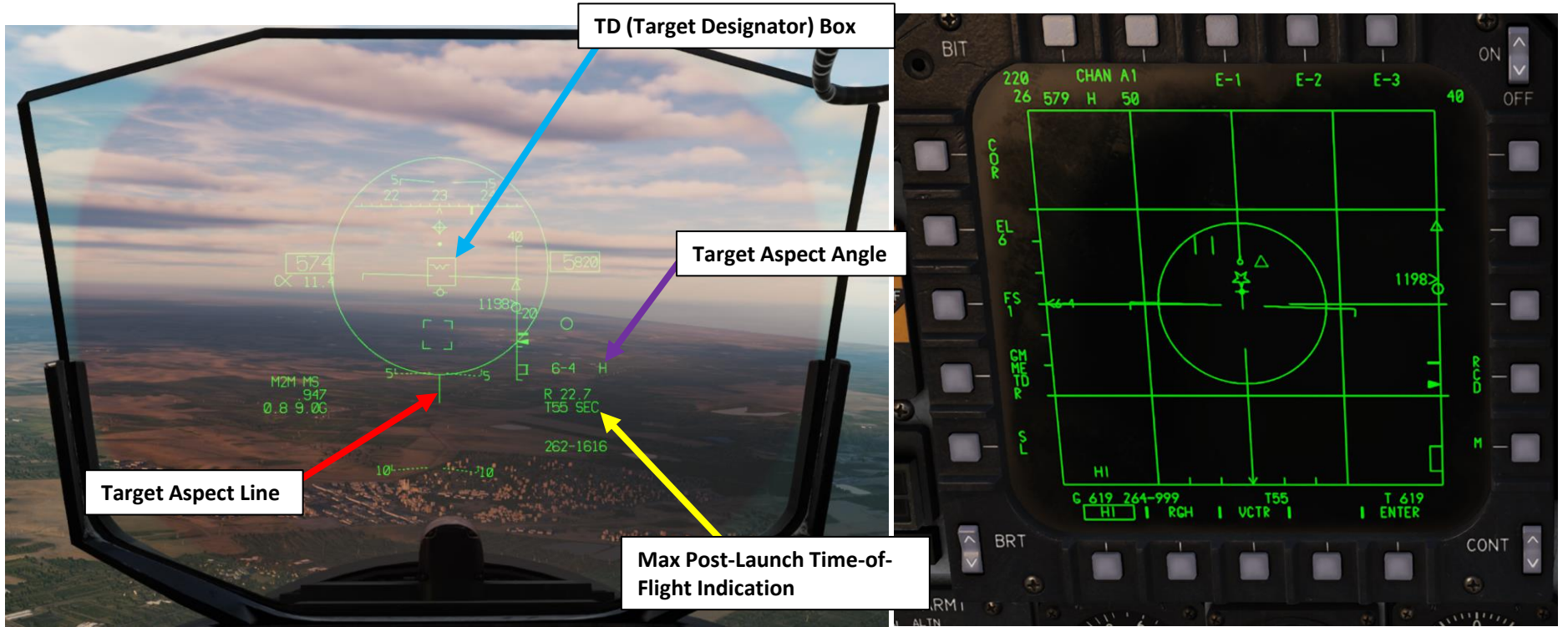


3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

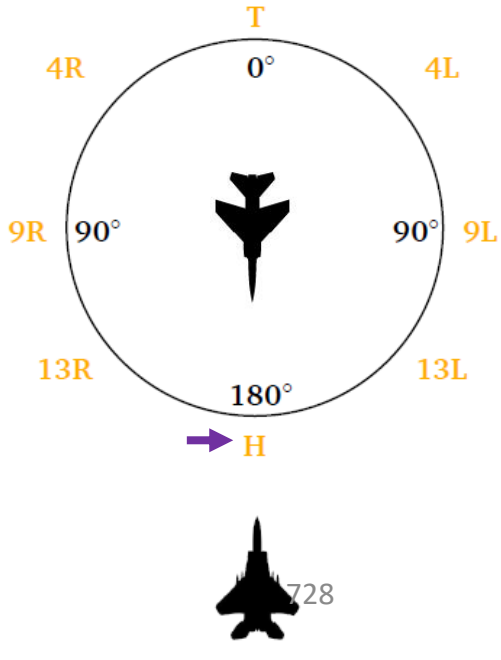
16. Use PDT (Primary Designated Target) Aspect Angle (Tail, Hot, Right, or Left) and Target Aspect Line to determine the target's orientation to maximize your chances of intercepting the target.
17. Check Max Post-Launch Time-of-Flight indication.

Target Aspect Lines (Target Aspect)



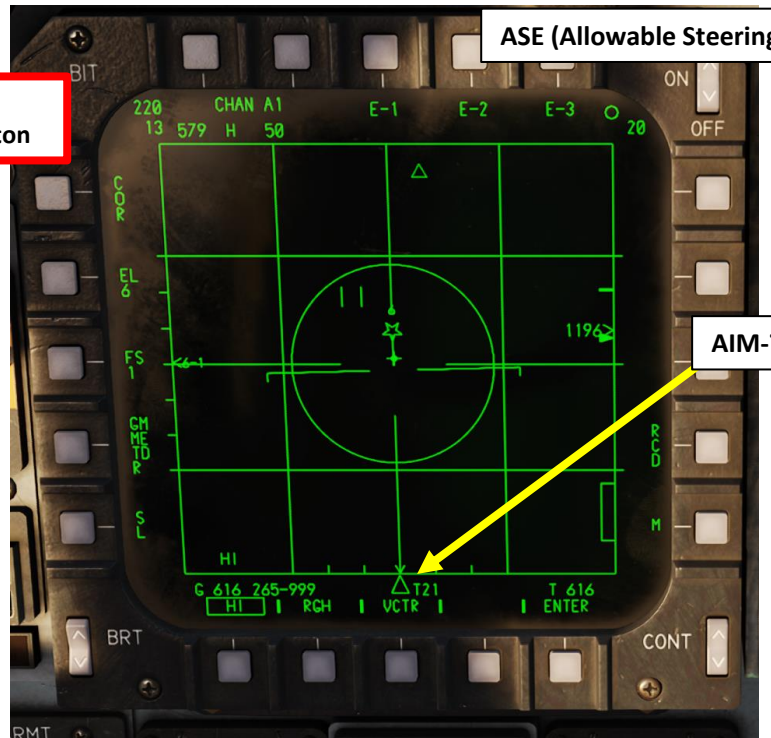


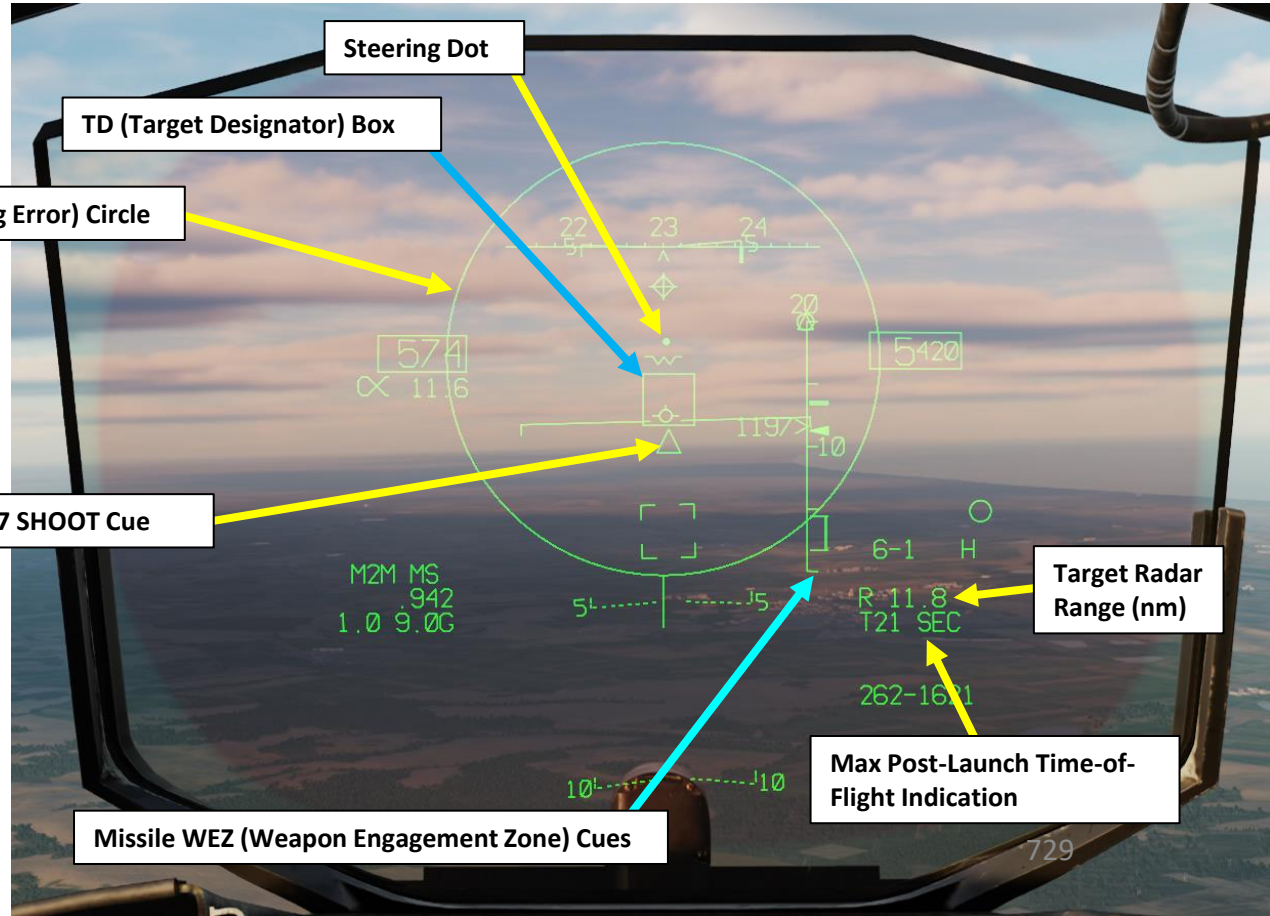
Hot (H) Target Aspect Angle



3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

18. The left and right Lock/Shoot annunciator lights on the canopy rail indicate the radar lock on target. When all conditions for a missile shot are met, the SHOOT light appears.
19. The AIM-7 SHOOT Cue (triangle) appears when:
    - Selected mode is MRM (Medium Range Missile) and the AIM-7 is in priority and ready
    - Master Arm is set to ARM
    - Radar is in STT, DTT or DTWS
    - Steering Dot is inside the ASE circle
    - Target is between Raero and Rmin range.
20. Once Steering Dot is inside the ASE (Allowable Steering Error) circle on the HUD and you are within effective missile range, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile.





3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

21. Once launched, the missile will require constant guidance by the radar. Losing a radar lock means the missile will likely go “dumb” and stop tracking the target.

3 – AIR-TO-AIR WEAPONS
3.3 – Semi-Active Radar Homing AIM-7 Sparrow Missile (With Radar)

22. To exit STT (Single Target Track) radar mode:
    - **Pilot**: Depress the Auto Acquisition Switch on the pilot's stick.
    - **WSO**: press on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.

Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

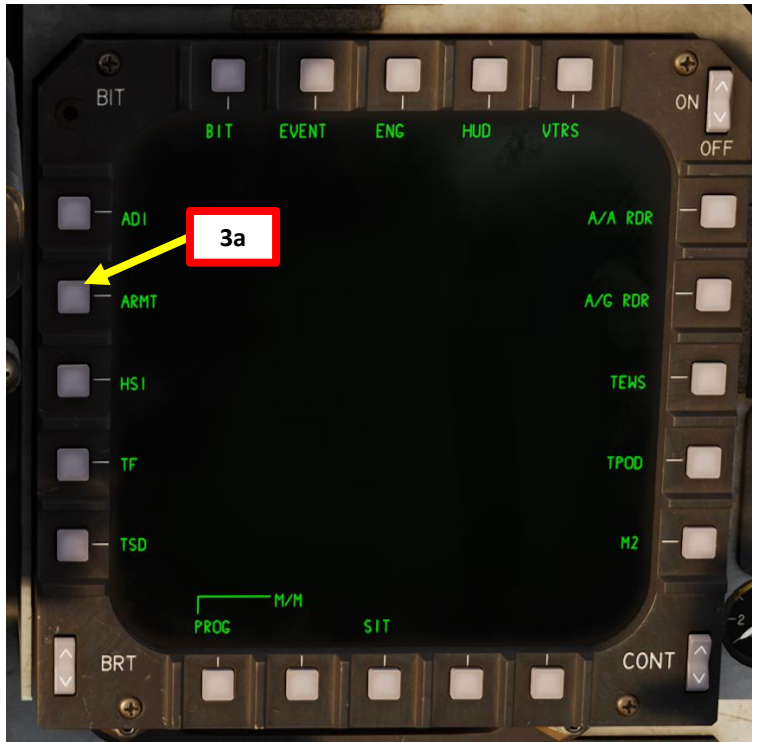
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile

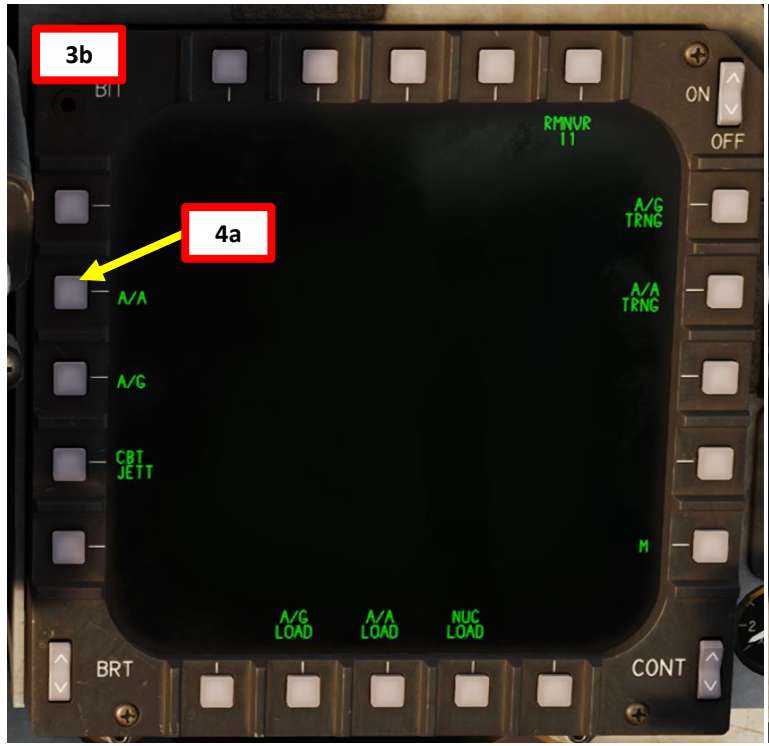
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

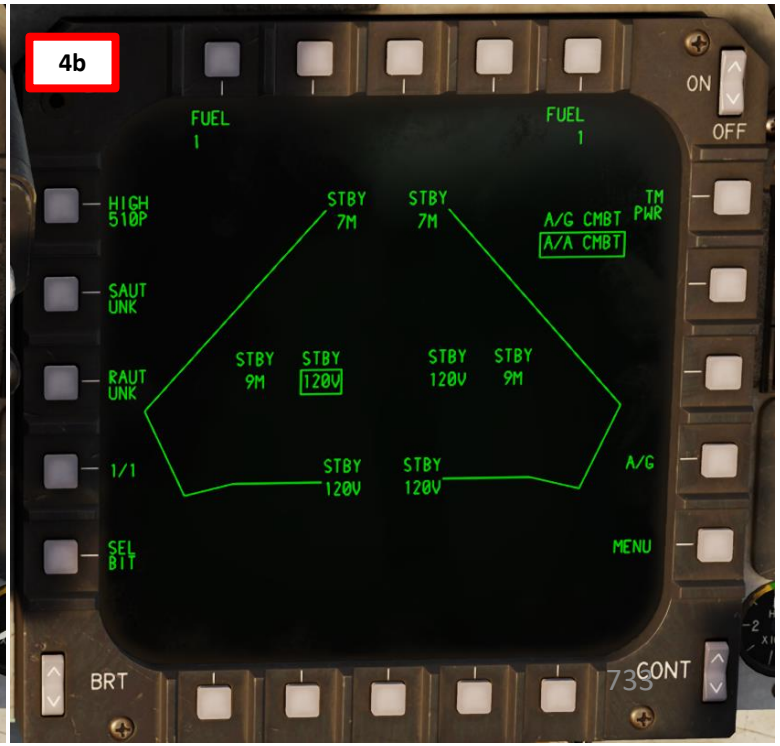
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
4. On a different display, select A/A CMBT (Air-to-Air Combat) Sub-Page.

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

1







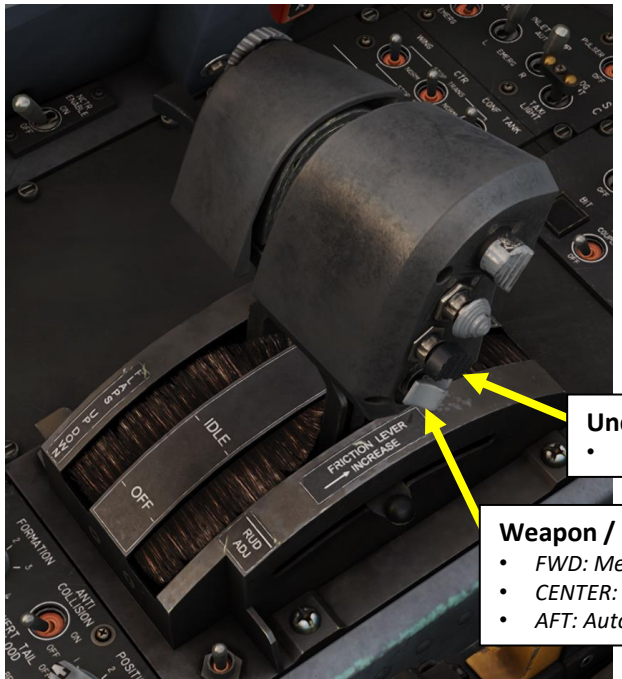
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

5. Set Master Arm Switch – ARM (UP)
6. Set Weapon / Mode (Weapon Select) Switch – FWD. This will select Medium Range Missiles (AIM-120C AMRAAM by default).
7. If needed, you can toggle between missile types (AIM-7M, AIM-120C, etc.), by using the Undesignate / Missile Reject Switch (Boat Switch) – FWD.
8. Confirm "120V" missile is selected and its status is RDY (Ready).

Target Size Setting (Not Simulated)
- *Pressing this button manually changes the target size, which is then used by the missile for fuze timing and flight correction.*

Target Radar Cross-Section Setting (Not Simulated)
- *Pressing this button manually changes the estimated RCS (Radar Cross-Section) for the target.*

Flight Member Identification
- *This setting allows the aircrew to enter a flight member identification for deconfliction purposes.*
- *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 a flight of four*



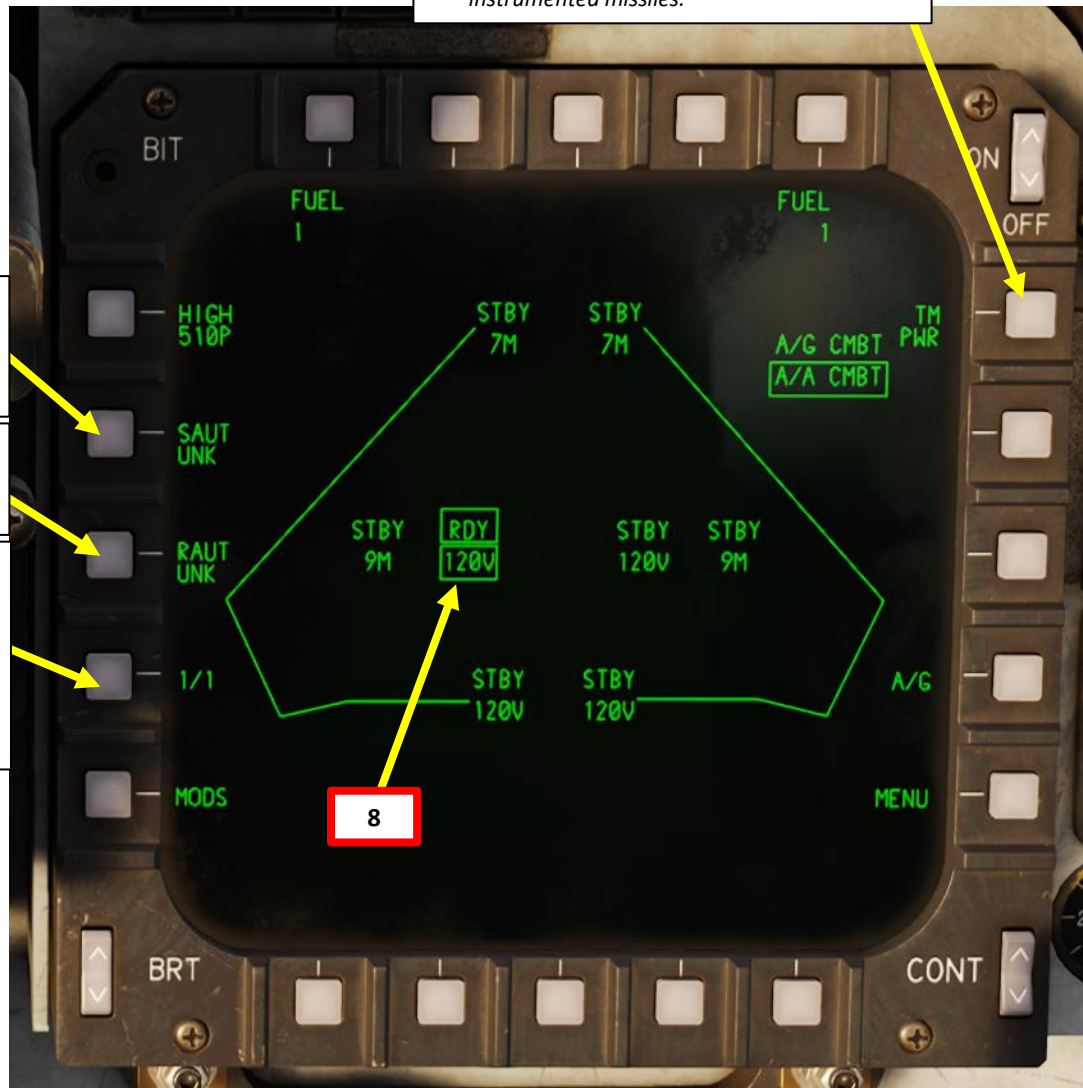
Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

7

Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

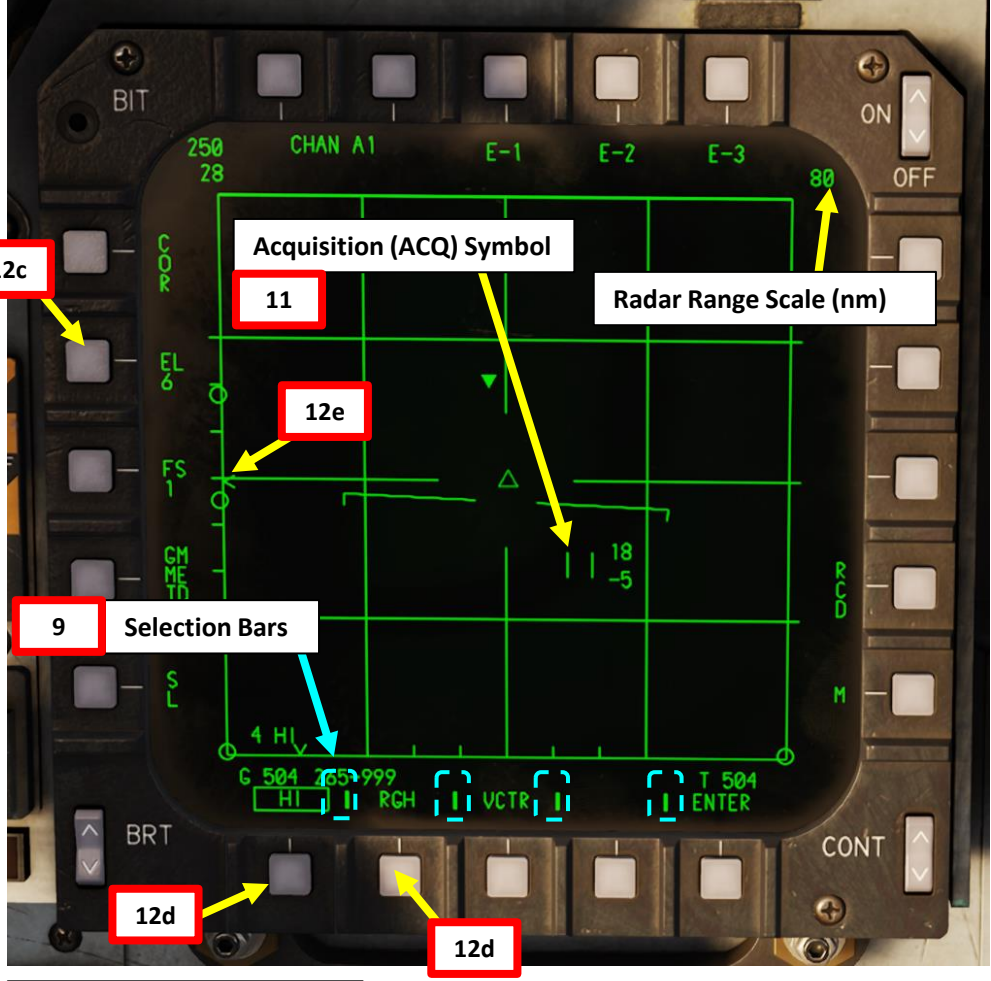
6

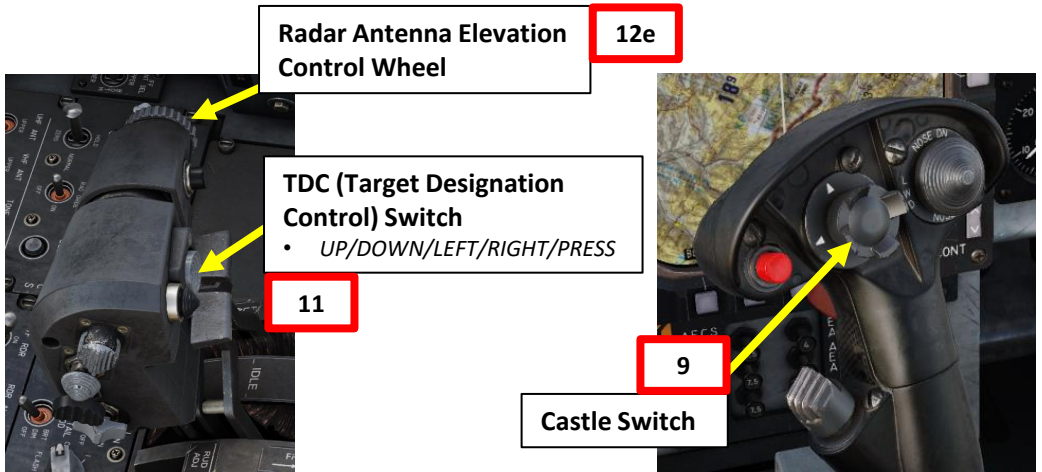
TM (Telemetry) Power (Not Simulated)
- *Pressing this button sends telemetry power to instrumented missiles.*

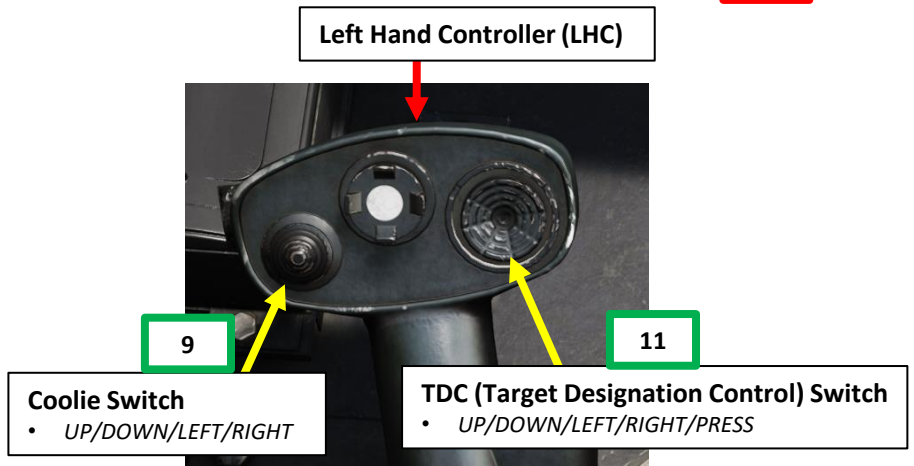


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

9. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
10. By default, RWS (Range While Search) mode is selected.
11. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to lock.
12. Set radar Range, Azimuth, Elevation scan, PRF (Pulse Repetition Frequency) and Antenna Elevation – As desired.
    - **a) Range**: Use TDC switch to slew the Acquisition Symbol (ACQ) past top/bottom edge of screen to increase/decrease range.
    - **b) Azimuth**: Use TDC switch to slew the Acquisition Symbol (ACQ) past left/right edge of screen to decrease/increase azimuth setting.
    - **c) Elevation scan**: Use the EL pushbutton to toggle between elevation bar numbers.
    - **d) PRF setting**: Press HI/MED/INLV pushbutton to toggle between PRF settings, or press the "RGH" pushbutton to select Range Gated High mode.
    - **e) Antenna elevation**: Use **Radar Antenna Elevation Control Wheel** on pilot throttle



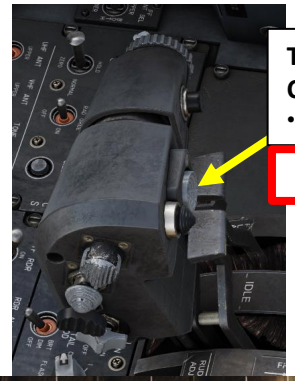


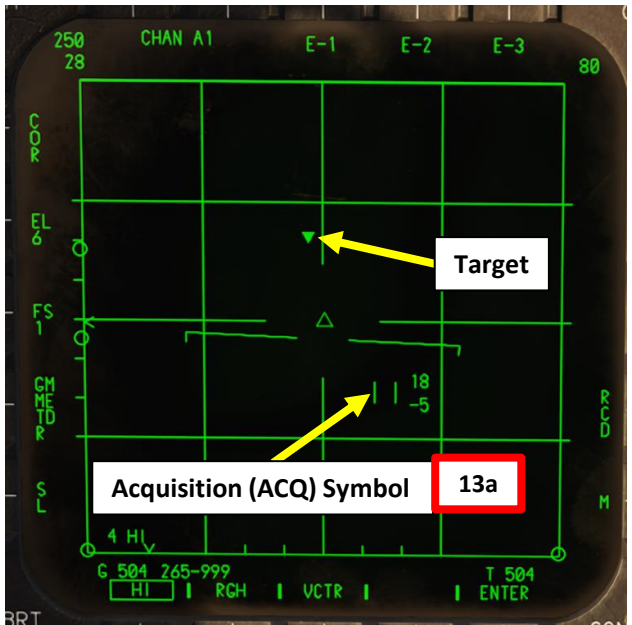


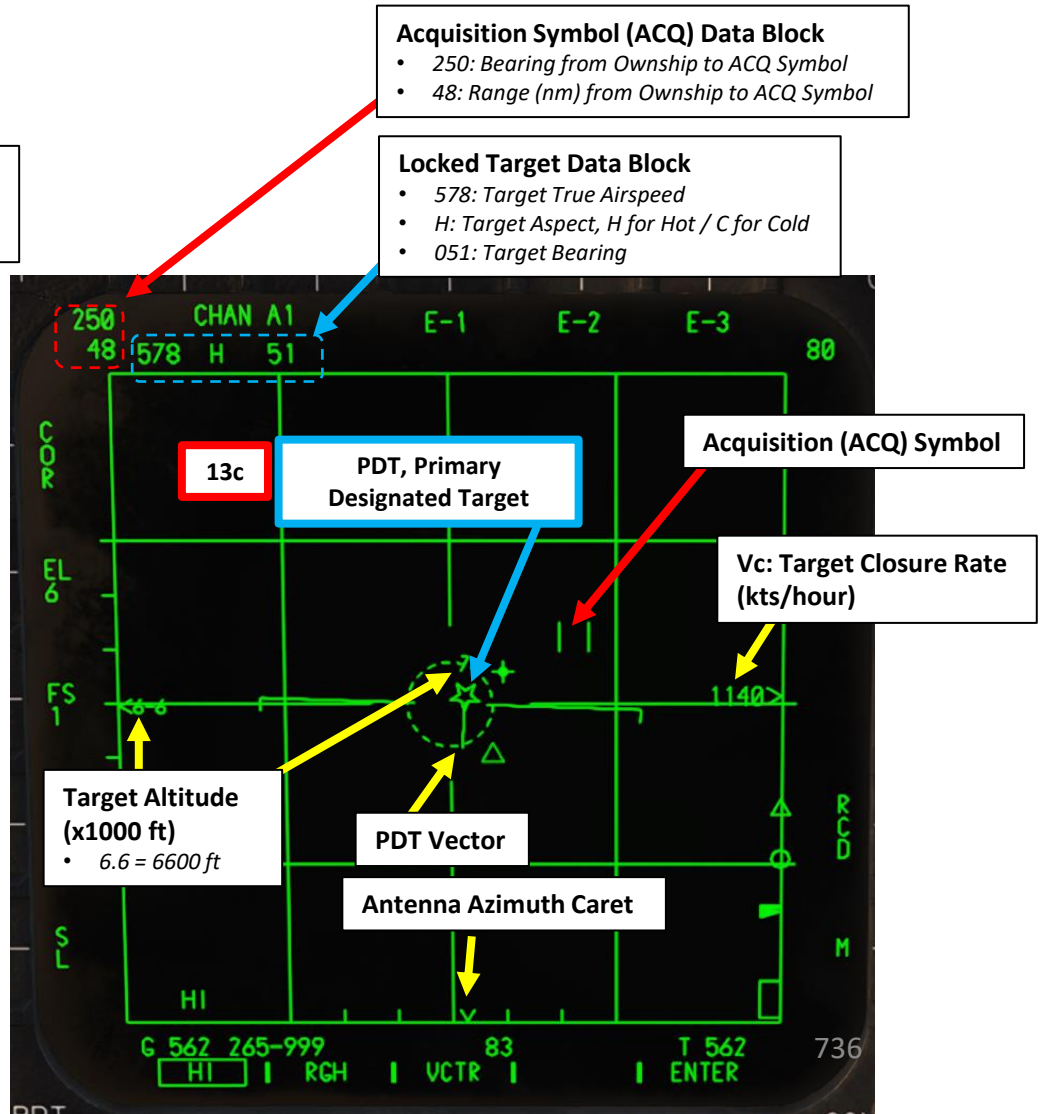
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

13. Once Acquisition Symbol (ACQ) is over the target, perform a radar lock:
    - **Pilot**: Press TDC (Target Designation Control) Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
14. Locked target will turn into a star with a vector (referred as "PDT", or "Primary Designated Target"), which represents the relative heading between the target and your aircraft.

Note: alternatively, STT radar lock can be obtained from an auto acquisition radar mode.

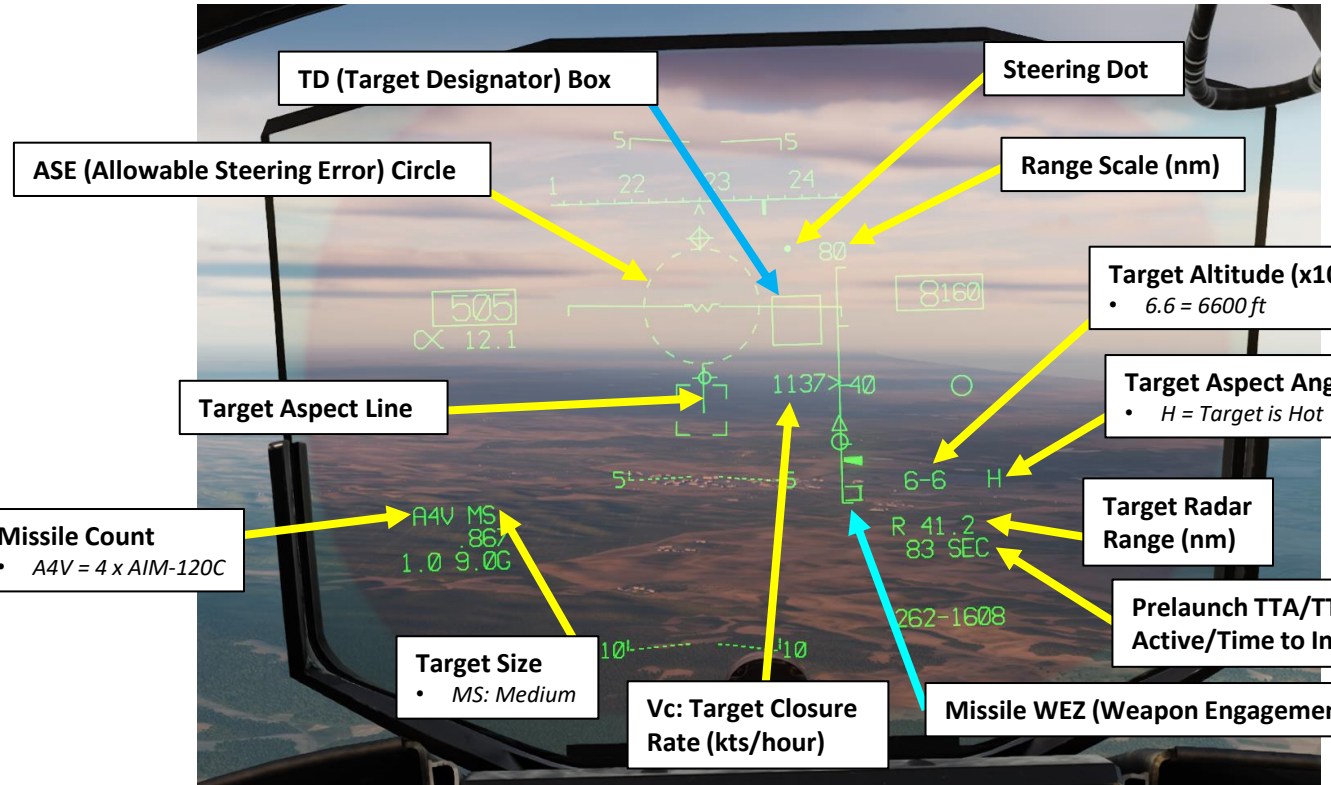


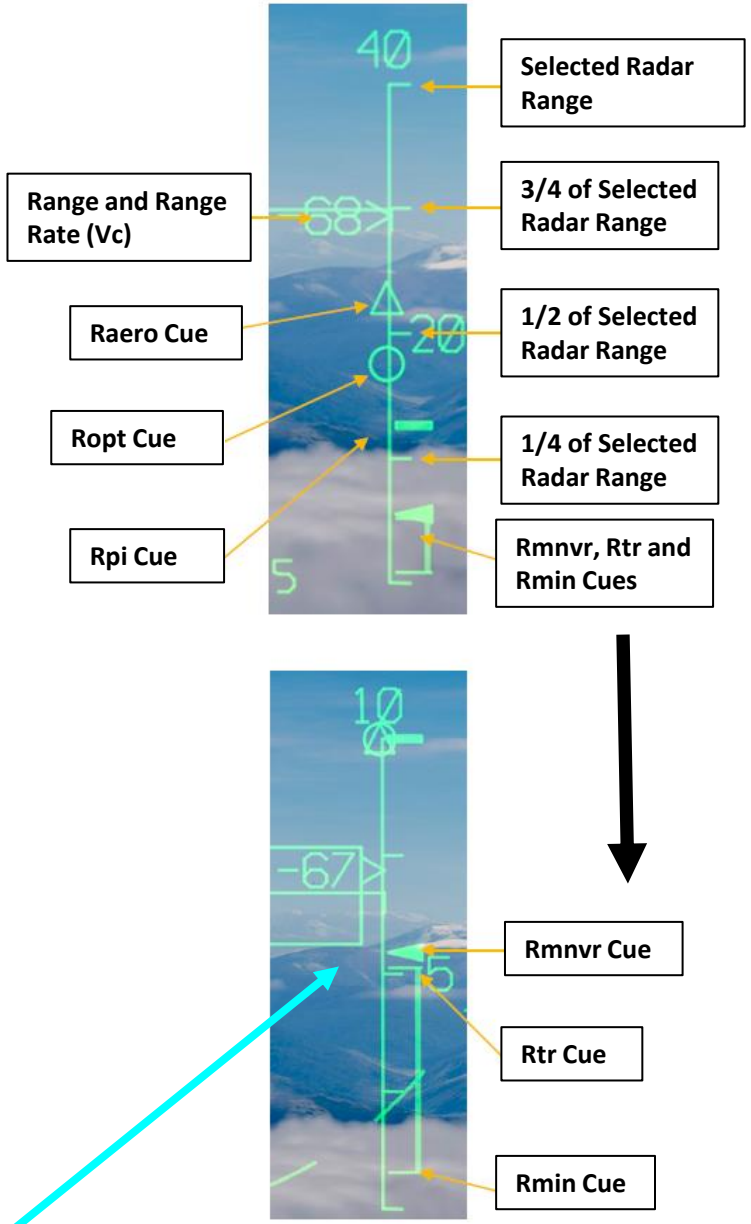




3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

15. Once target is locked, steer aircraft to place Steering Dot inside the ASE (Allowable Steering Error) circle on the HUD. Use Missile WEZ (Weapon Engagement Zone) cues to estimate target range, which should ideally be between within Ropt (Max Range Probability of Intercept with Optimum Steering) but further than Rmin (Minimum Launch Range).
    - **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.

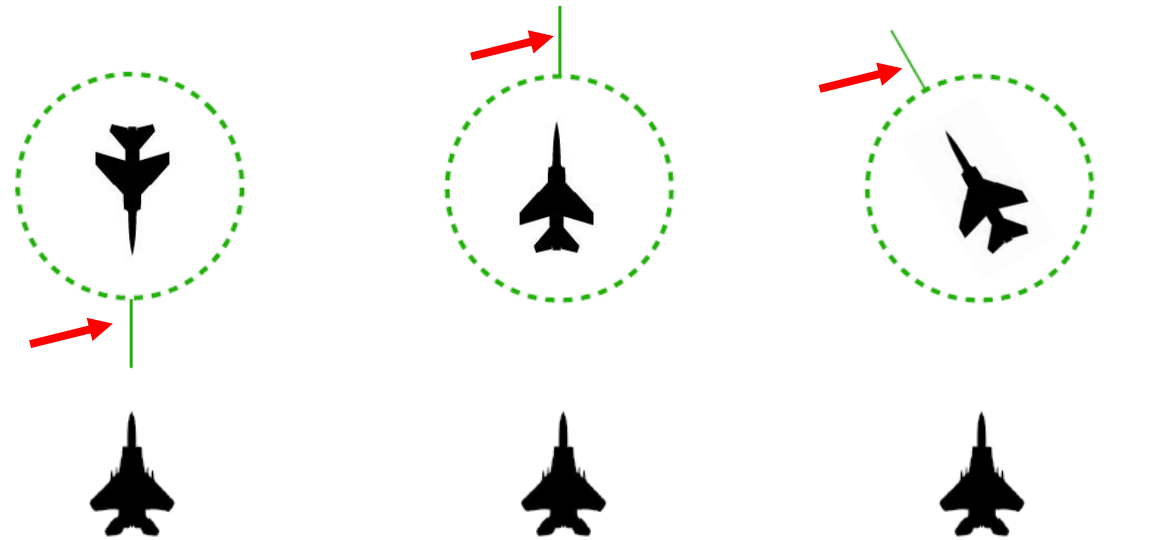


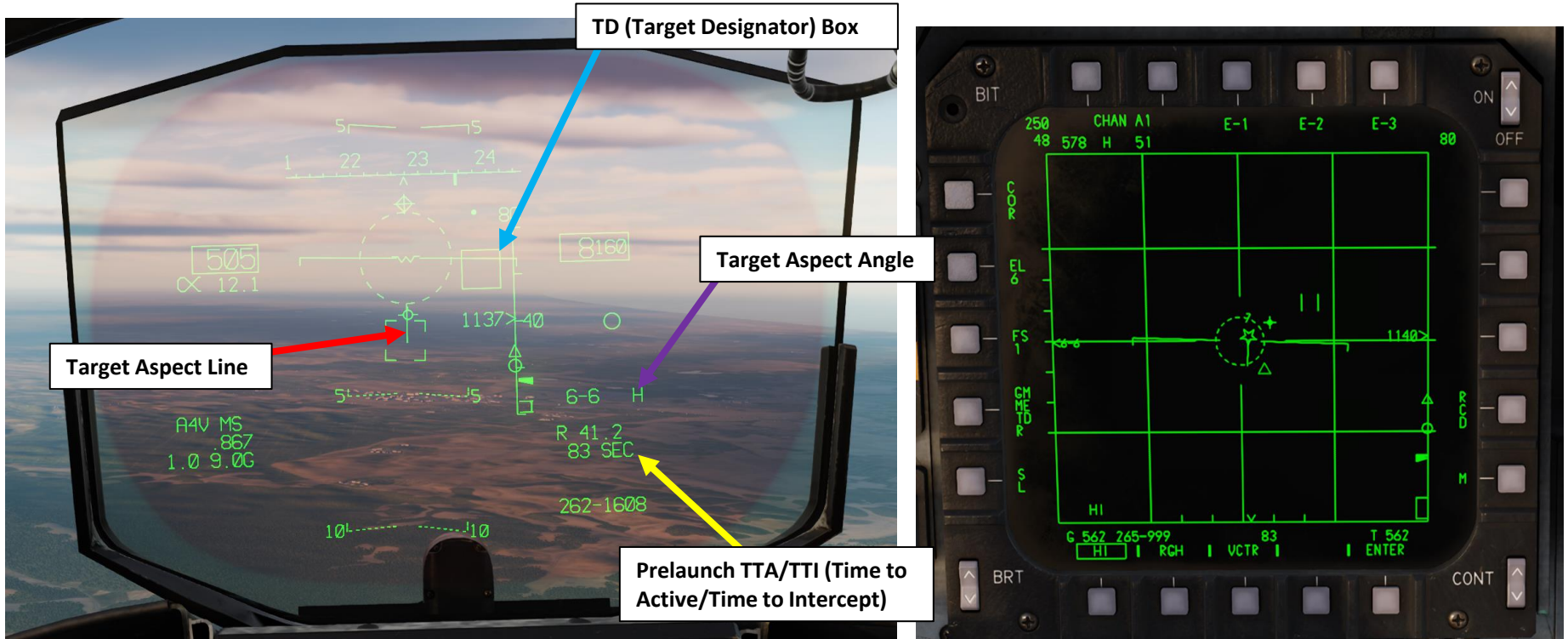


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

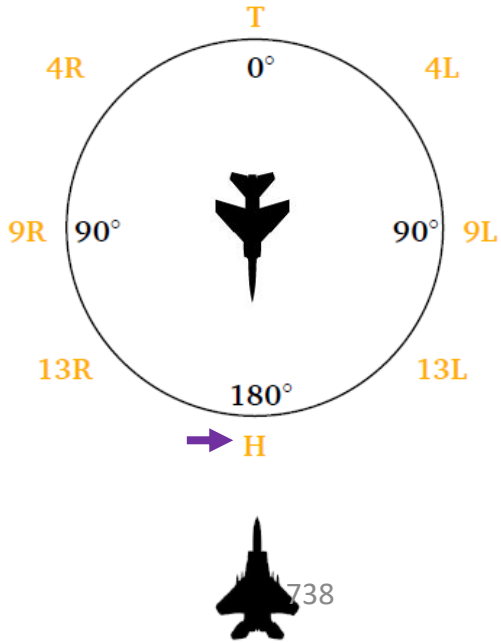
16. Use PDT (Primary Designated Target) Aspect Angle (Tail, Hot, Right, or Left) and Target Aspect Line to determine the target's orientation to maximize your chances of intercepting the target.
17. Check Prelaunch TTA/TTI indication.
    - TTA (Time to Active) is the predicted missile time of flight to range at which the priority AIM-120 goes active.
    - 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.

Target Aspect Lines (Target Aspect)



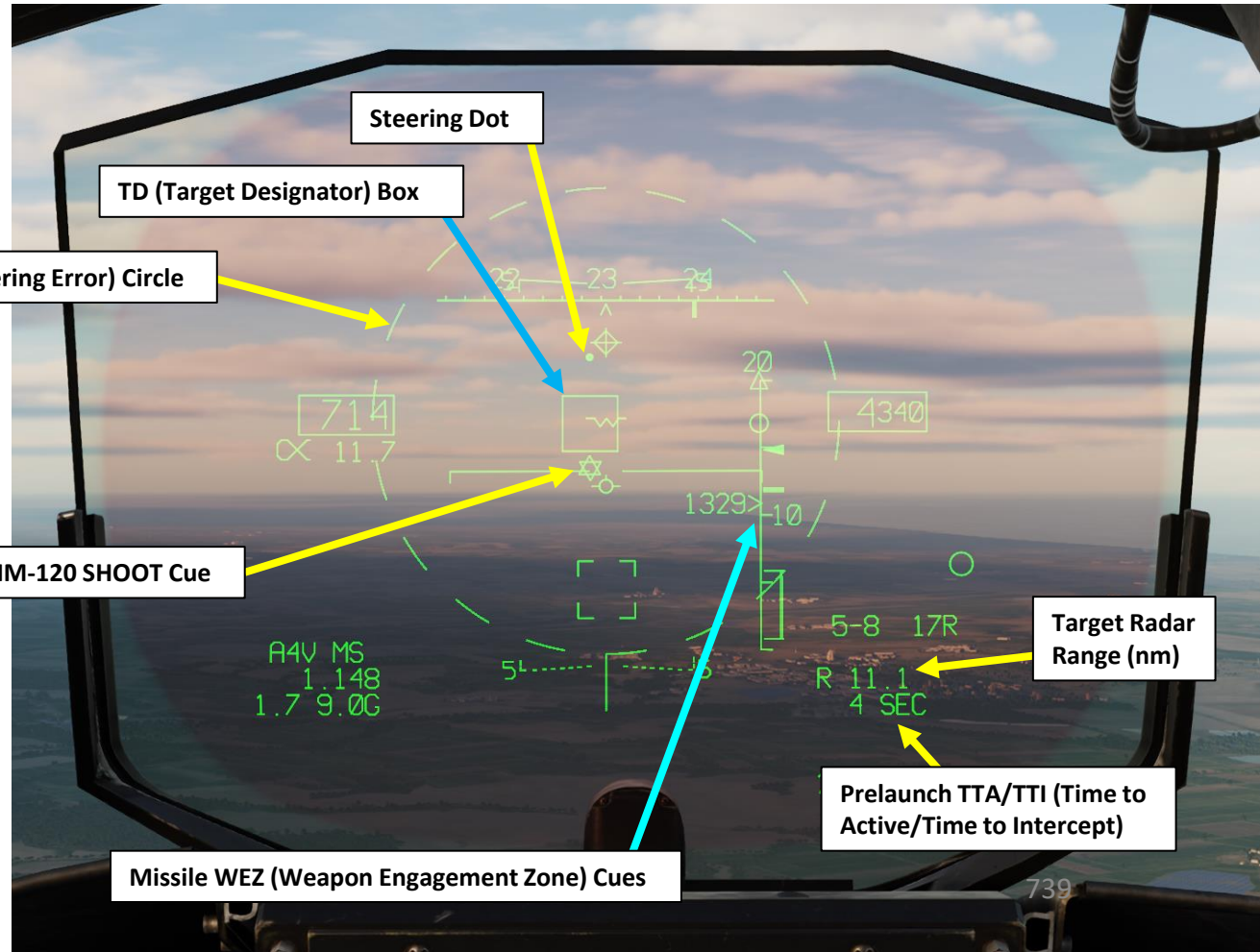


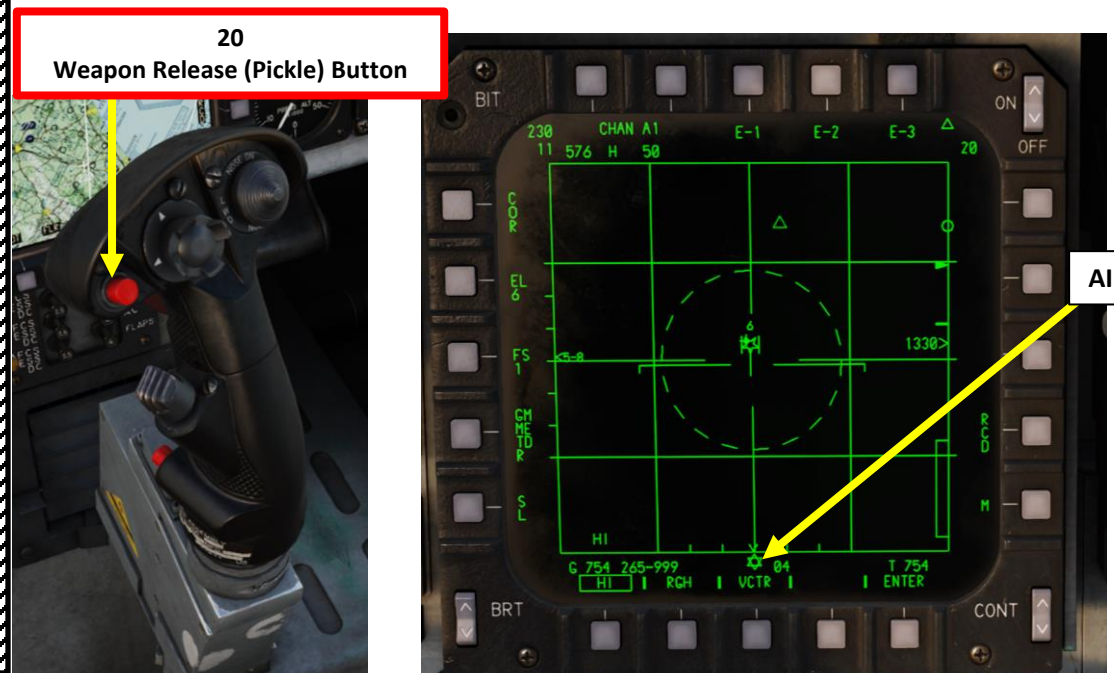
Hot (H) Target Aspect Angle



3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

18. The left and right Lock/Shoot annunciator lights on the canopy rail indicate the radar lock on target. When all conditions for a missile shot are met, the SHOOT light appears.
19. The AIM-120 SHOOT Cue (6-pointed star) appears when:
    - Selected mode is MRM (Medium Range Missile) and the AIM-120 is in priority and ready
    - Master Arm is set to ARM
    - Radar is in STT, DTT or DTWS
    - Steering Dot is inside the ASE circle
    - Target is between Raero and Rmin range.
20. Once Steering Dot is inside the ASE (Allowable Steering Error) circle on the HUD and you are within effective missile range, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile.





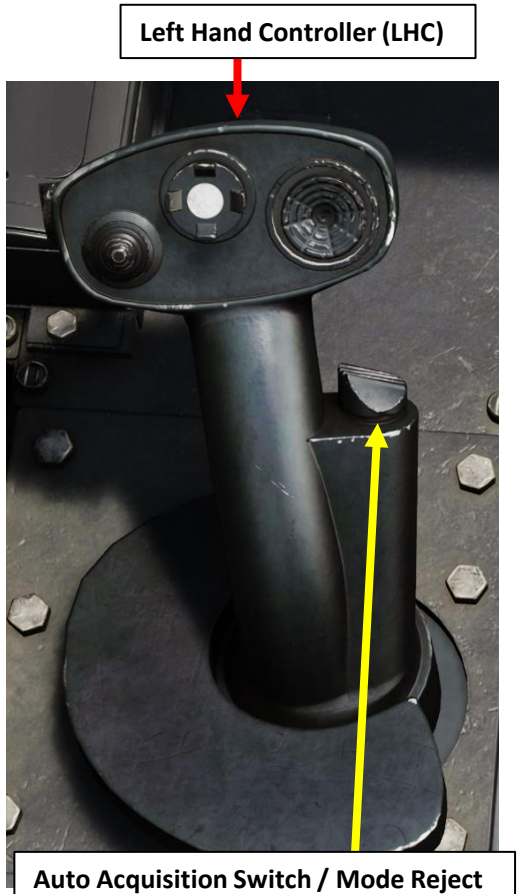
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

21. 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 (Inertial Navigation System) guidance. Once it reaches certain points, it uses its own seeker for terminal acquisition and tracking. If the radar locked is lost after launch, inertial active mode is activated, where the missile uses only its own onboard INS guidance to reach the active phase.

3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

22. To exit STT (Single Target Track) radar mode:
    - **Pilot**: Depress the Auto Acquisition Switch on the pilot's stick.
    - **WSO**: press on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.

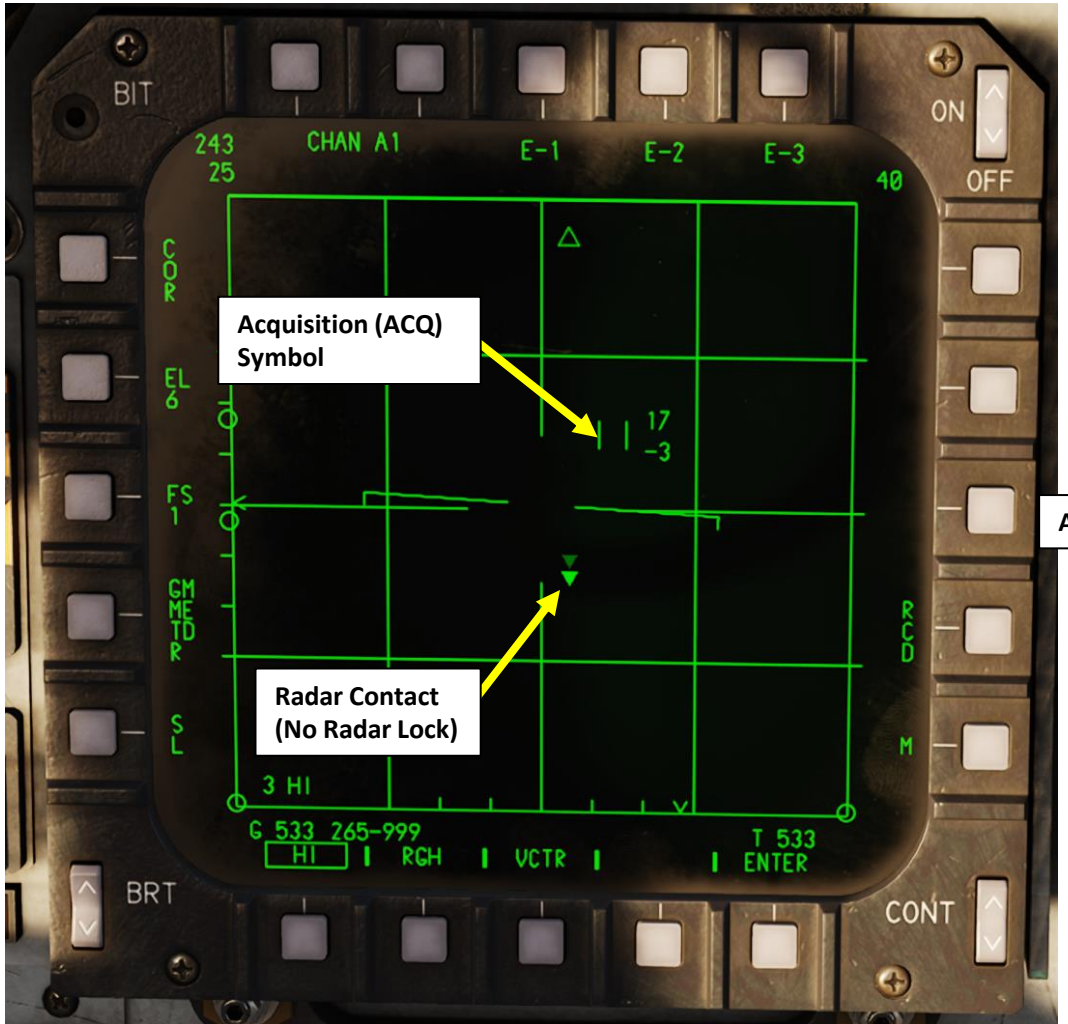
Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*



Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

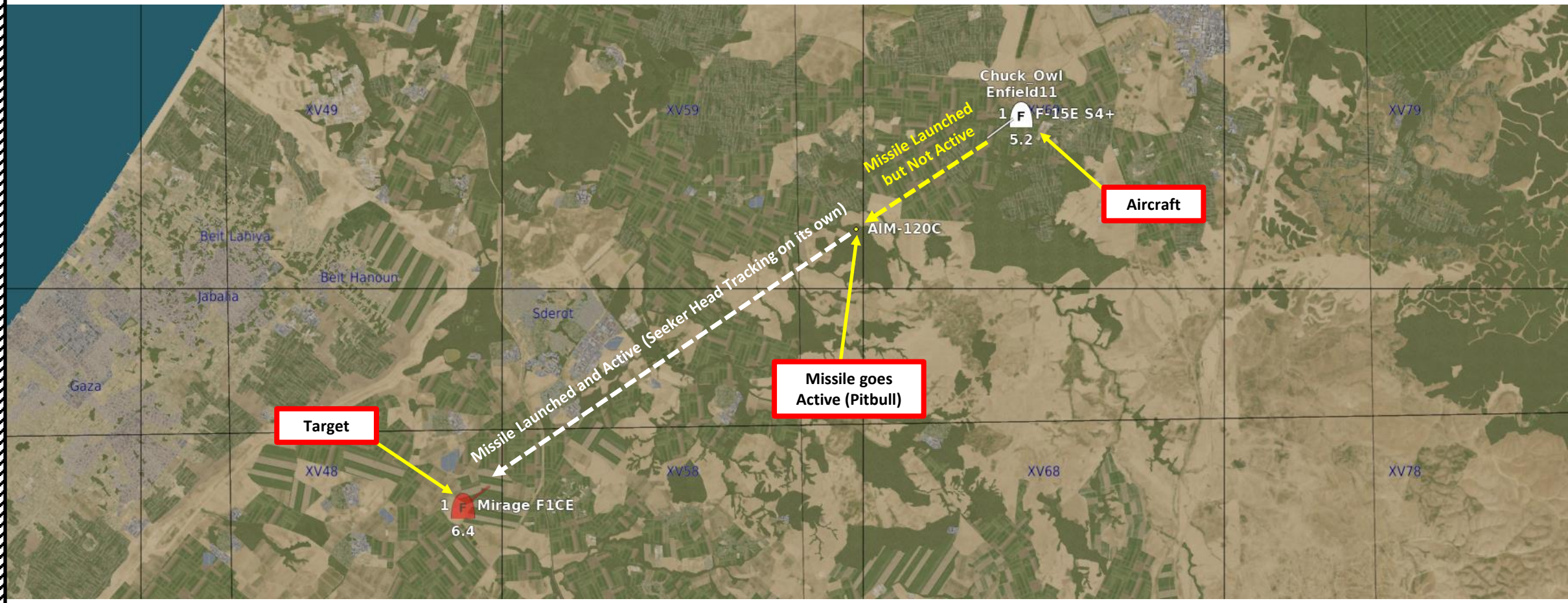
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

Note: When AMRAAM is selected and there is no radar lock yet, a large dashed circle will appear on the HUD. This circle is the seeker field-of-view if launched with no radar lock, which is termed a "Mad Dog Launch". A Mad Dog Launch will lock on to intercept the first target the missile seeker detects within the dashed circle area out to 10 miles… regardless of whether who it picks up is a friend or a foe.



3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.1 – Single Target (With Radar)

Note: When you first fire an AMRAAM missile, the missile is initially guided by your own radar. However, an "active radar homing missile" also has his own radar inside the seeker head. The moment the missile goes "active« (meaning it will start self-homing/tracking targets on his own instead of using your aircraft's radar) is called "Pitbull". When the missile goes "Pitbull", the missile truly becomes fire-and-forget. NATO brevity word "Pitbull" would be called out on the radio to inform other pilots, just as "Fox Three" would be called out upon launch.

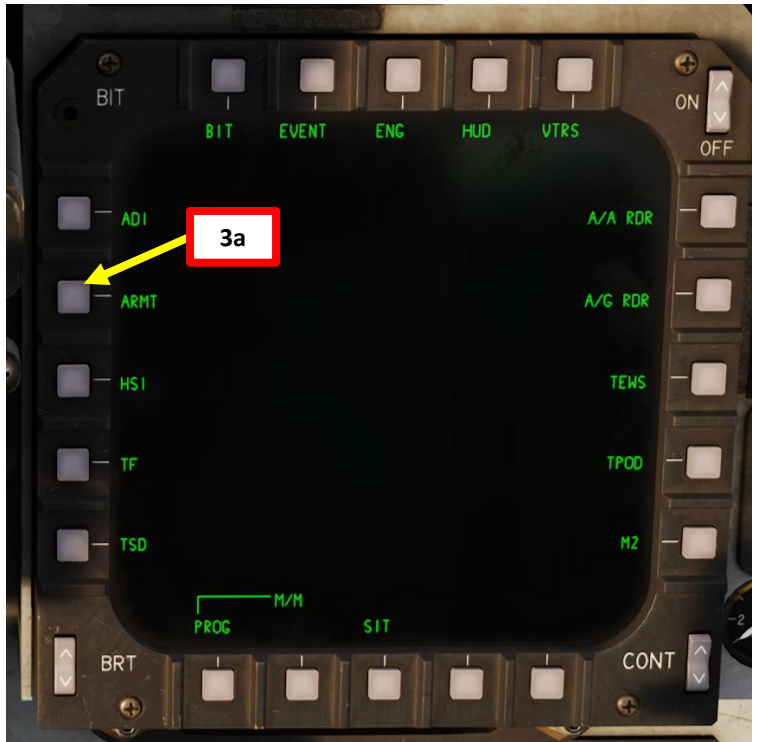


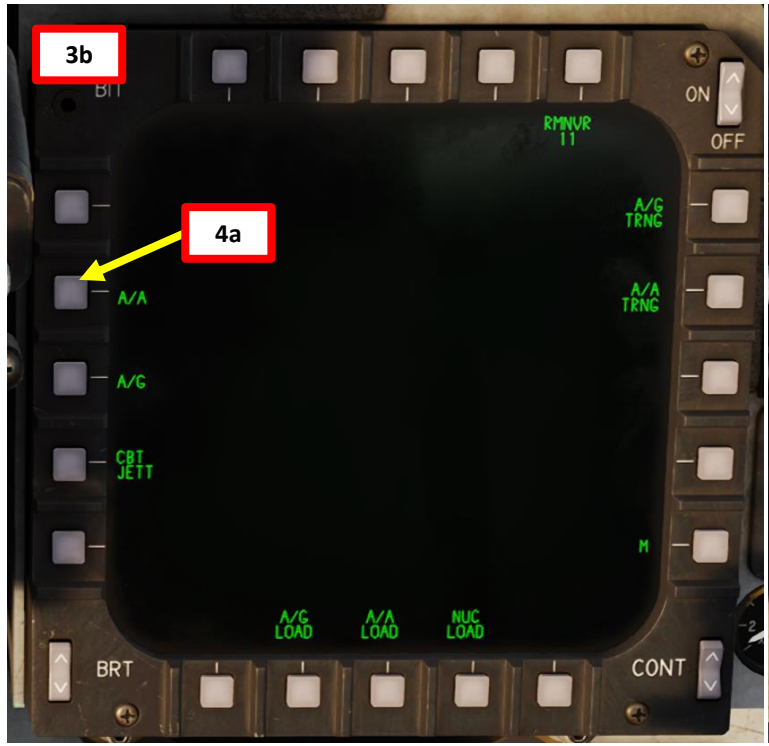
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

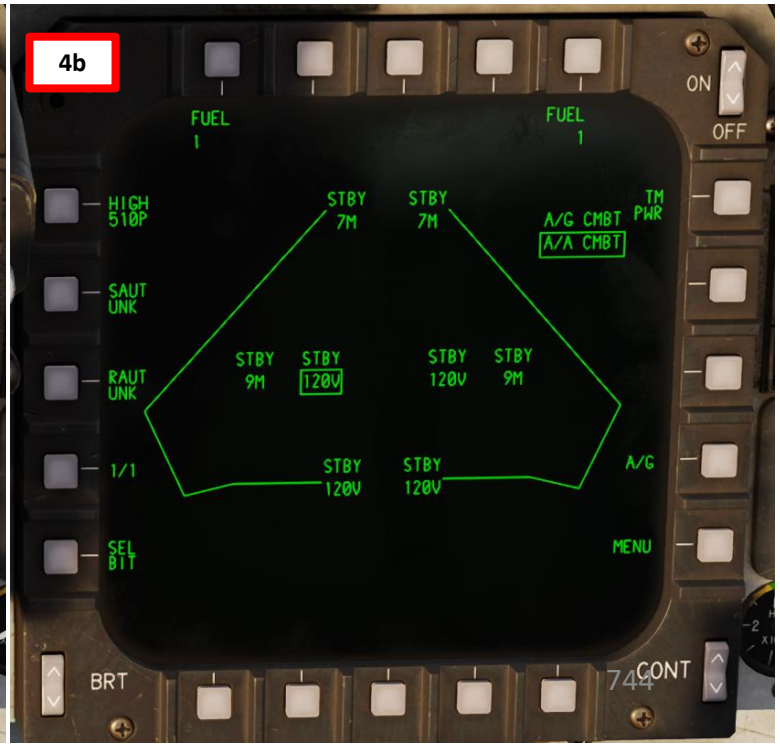
1. Radar Power Switch must be set to ON.
2. Select A/A Master Mode
3. Select ARMT/PACS (Armament/Programmable Armament Control Set) Page.
4. On a different display, select A/A CMBT (Air-to-Air Combat) Sub-Page.

Radar Power Selector Knob
- *OFF*
- *STBY (Standby)*
- *ON*
- *EMER (Emergency)*

1

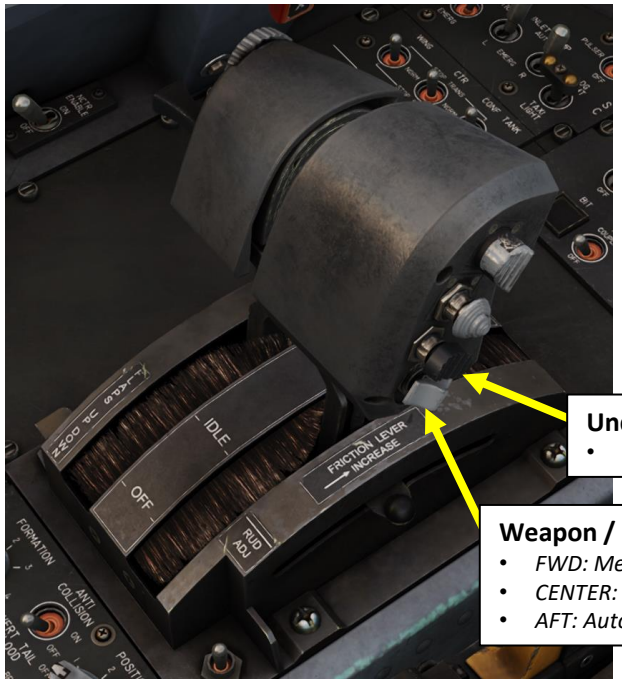






3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

5. Set Master Arm Switch – ARM (UP)
6. Set Weapon / Mode (Weapon Select) Switch – FWD. This will select Medium Range Missiles (AIM-120C AMRAAM by default).
7. If needed, you can toggle between missile types (AIM-7M, AIM-120C, etc.), by using the Undesignate / Missile Reject Switch (Boat Switch) – FWD.
8. Confirm "120V" missile is selected and its status is RDY (Ready).



Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

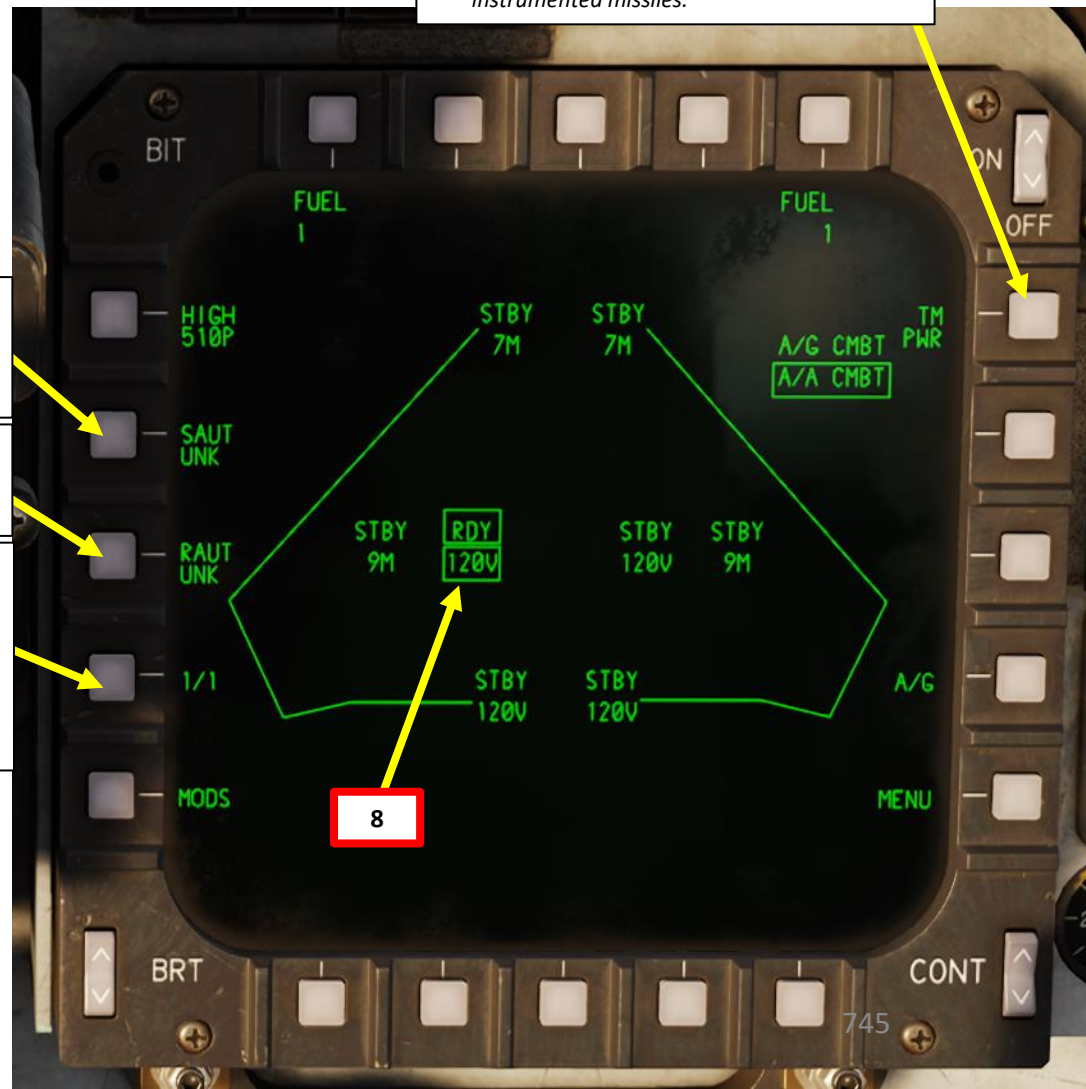
Weapon / Mode (Weapon Select) Switch
- *FWD: Medium Range Missile Selected*
- *CENTER: Short Range Missile Selected*
- *AFT: Auto Guns / A/A Mode Command Selected*

Target Size Setting (Not Simulated)
- *Pressing this button manually changes the target size, which is then used by the missile for fuze timing and flight correction.*

Target Radar Cross-Section Setting (Not Simulated)
- *Pressing this button manually changes the estimated RCS (Radar Cross-Section) for the target.*

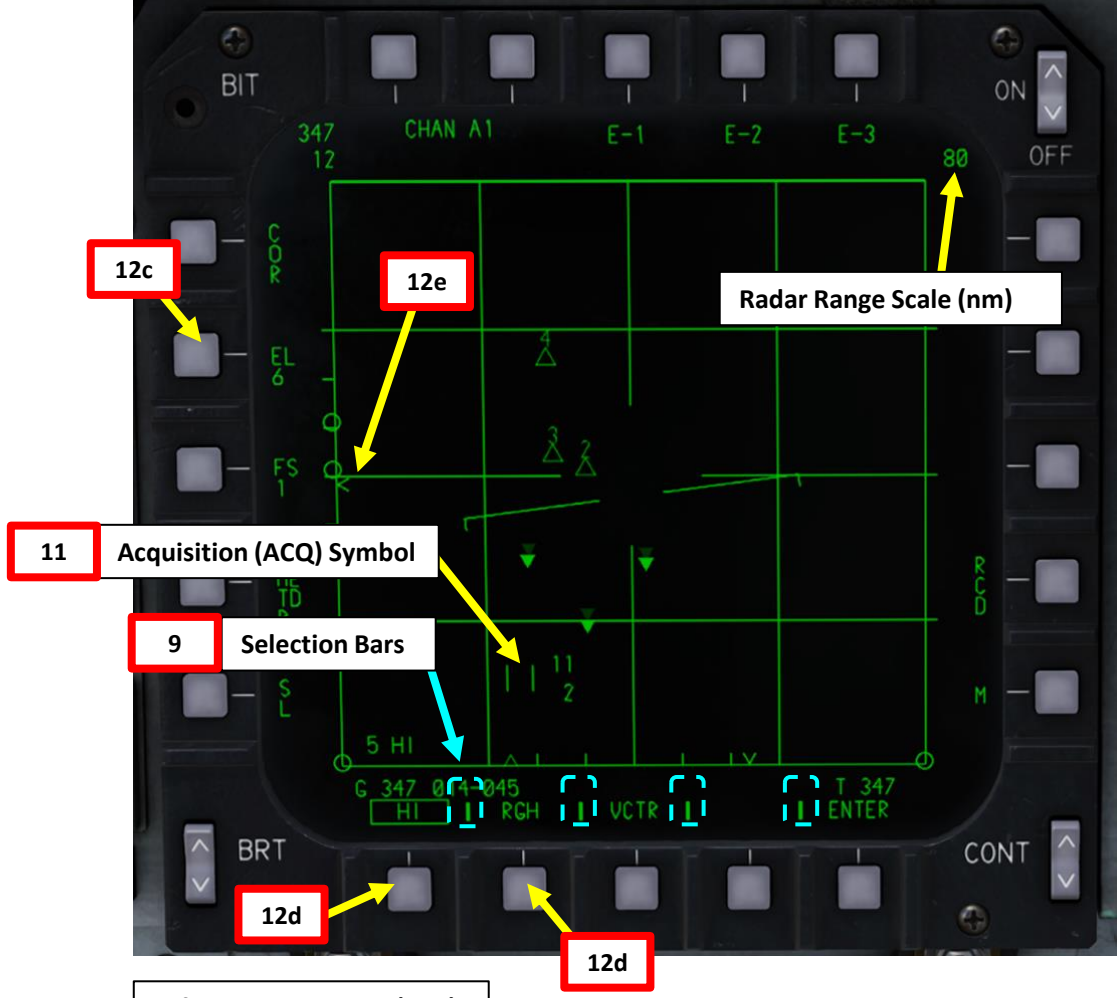
Flight Member Identification
- *This setting allows the aircrew to enter a flight member identification for deconfliction purposes.*
- *1/1: Single Ship*
- *1-2/2: Lead or wingman in flight of two*
- *1-4/4: Lead, wingman, element lead or element wingman in a flight of four*

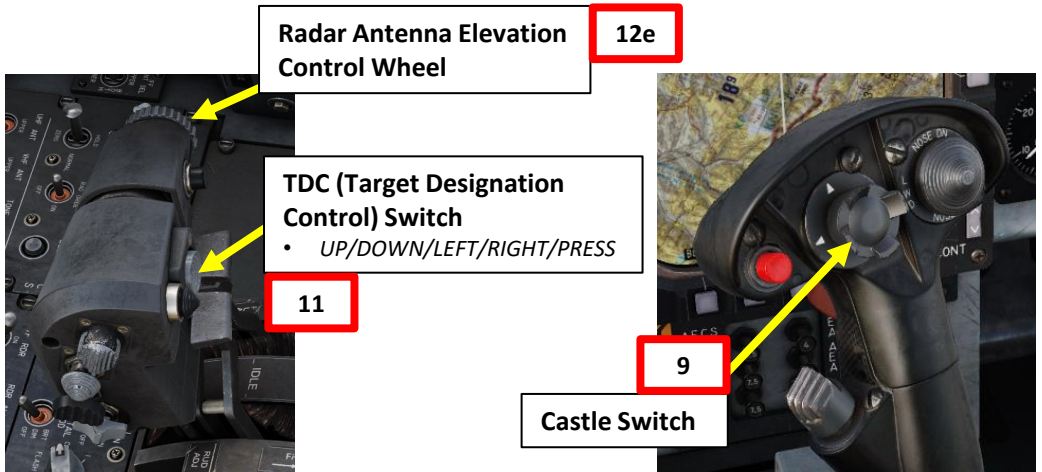
TM (Telemetry) Power (Not Simulated)
- *Pressing this button sends telemetry power to instrumented missiles.*

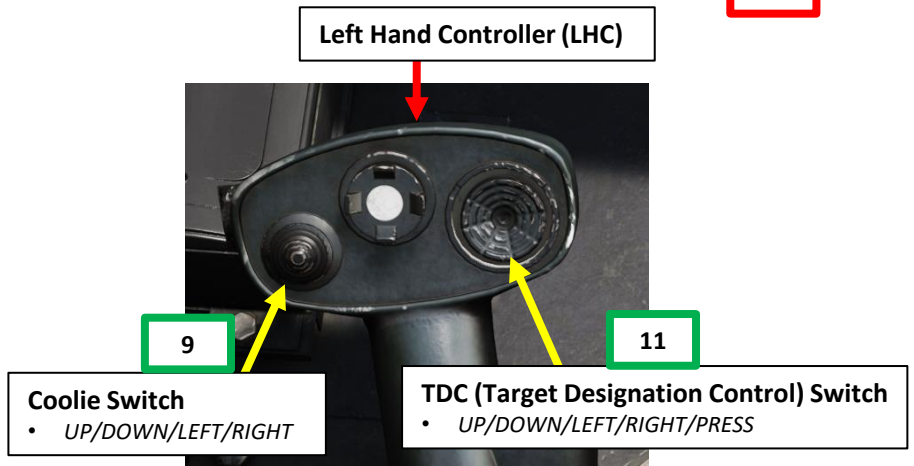


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

9. Select A/A RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
10. By default, RWS (Range While Search) mode is selected.
11. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to lock.
12. Set radar Range, Azimuth, Elevation scan, PRF (Pulse Repetition Frequency) and Antenna Elevation – As desired.
    - **a) Range**: Use TDC switch to slew the Acquisition Symbol (ACQ) past top/bottom edge of screen to increase/decrease range.
    - **b) Azimuth**: Use TDC switch to slew the Acquisition Symbol (ACQ) past left/right edge of screen to decrease/increase azimuth setting.
    - **c) Elevation scan**: Use the EL pushbutton to toggle between elevation bar numbers.
    - **d) PRF setting**: Press HI/MED/INLV pushbutton to toggle between PRF settings, or press the "RGH" pushbutton to select Range Gated High mode.
    - **e) Antenna elevation**: Use **Radar Antenna Elevation Control Wheel** on pilot throttle

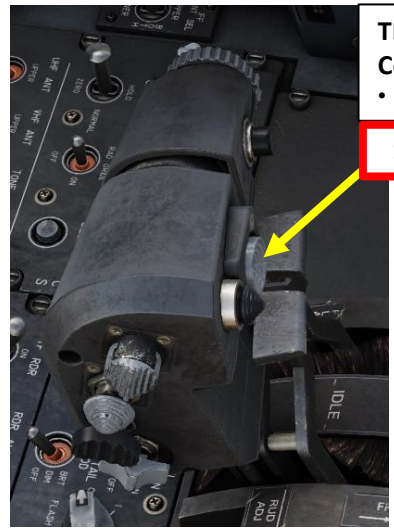


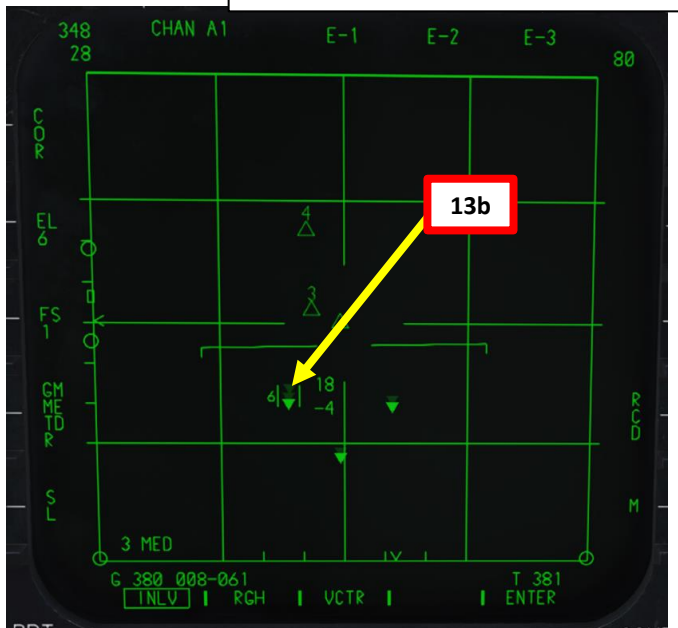


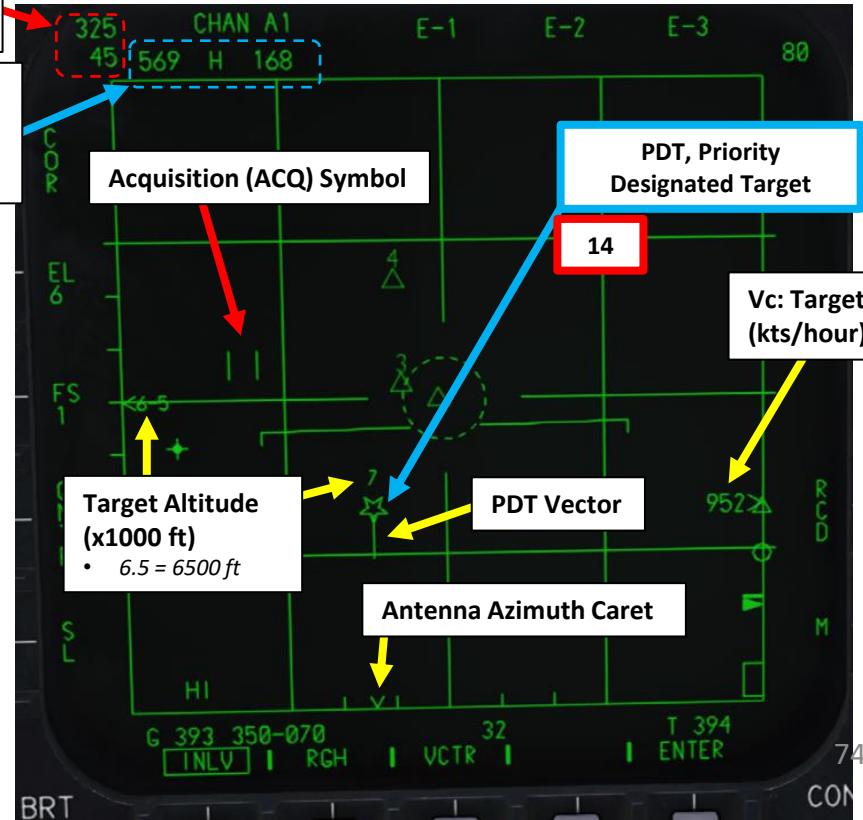


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

13. Once Acquisition Symbol (ACQ) is over the target, perform a radar lock:
    - **Pilot**: Press TDC (Target Designation Control) Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
14. Locked target will turn into a star with a vector (referred as "PDT", or "Priority Designated Target"), which represents the relative heading between the target and your aircraft.
15. Once radar lock has been performed, we will then switch to a TWS mode (in this example, we will use "3HDT TWS" in order to track (radar lock) additional targets.

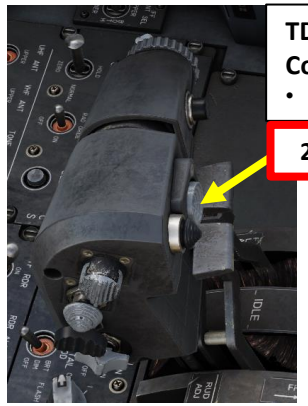


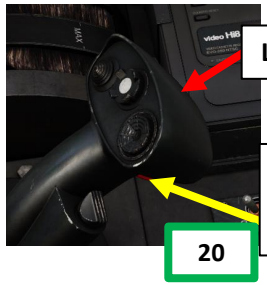


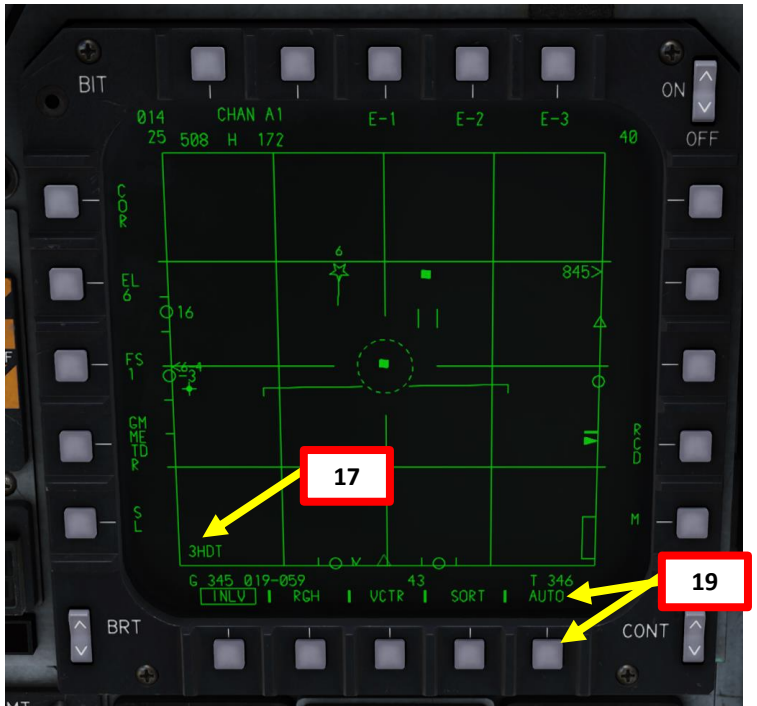


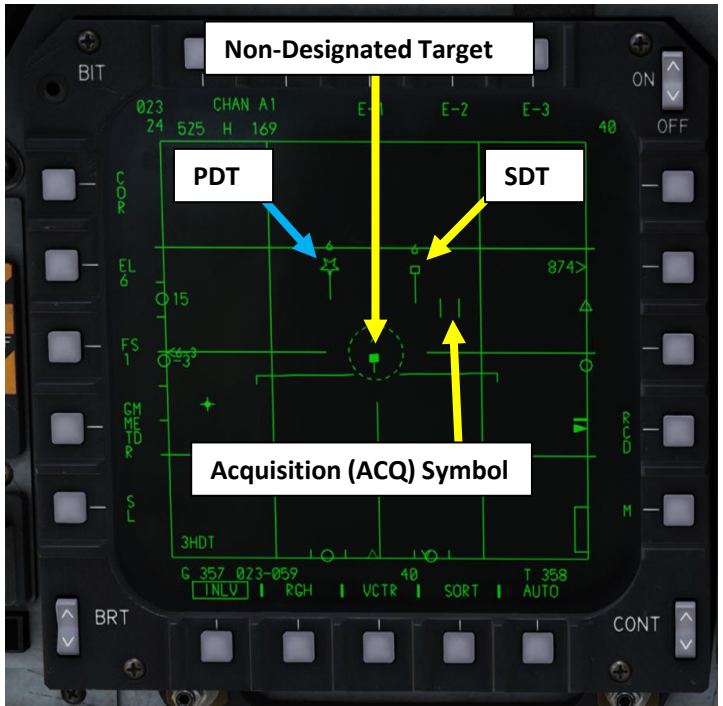
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

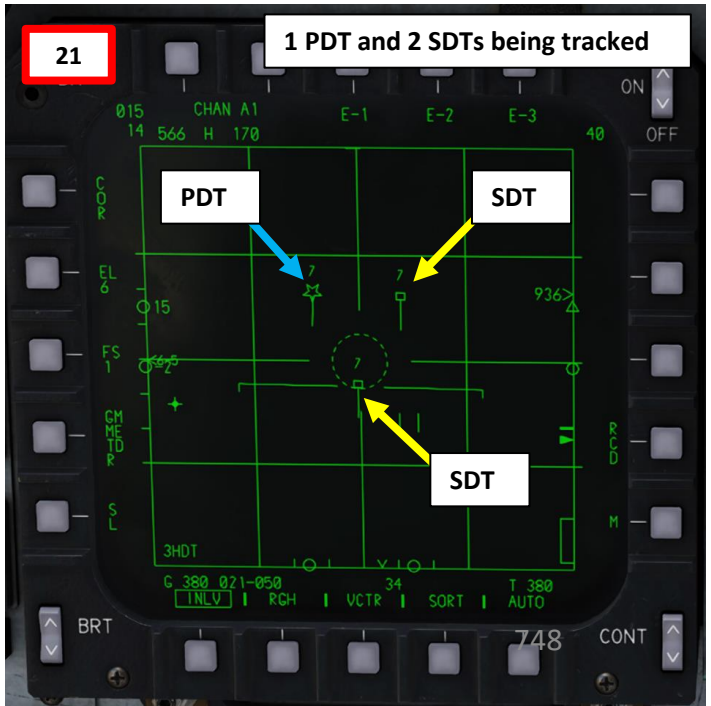
16. Enter desired TWS mode. We will enter 3HDT TWS mode; press Auto Acquisition Switch FWD SHORT (less than 1 sec).
17. Radar mode switches from STT to 3HDT TWS mode, allowing you to lock other targets and track them as well.
18. We can designate 9 more targets (referred as SDTs, or "Secondary Designated Targets") in addition to the PDT (Priority Designated Target). This can be done either manually or automatically.
19. For this example, we will unbox AUTO mode in order to select Manual Target Designation.
20. Using the TDC (Target Designation Control) switch, slew Acquisition Symbol (ACQ) over the target you want to designate as a SDT (Secondary Designated Target).
21. Once Acquisition Symbol (ACQ) is over the target, designate it:
    - **Pilot**: Press TDC (Target Designation Control) Switch.
    - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
22. You can designate other targets in a similar manner, for a maximum of 1 Priority Designated Target and 9 Secondary Designated Targets.





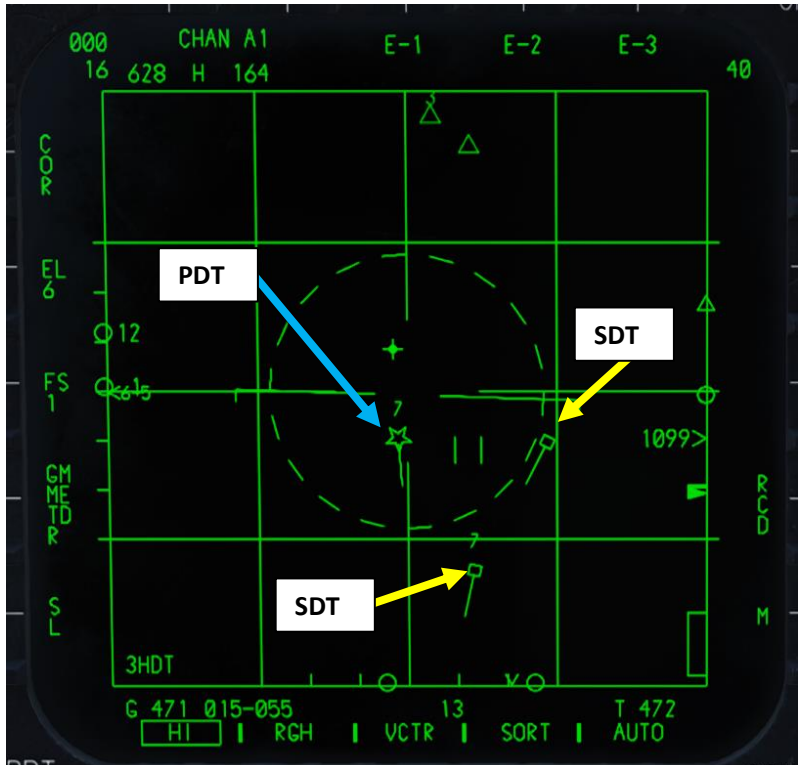


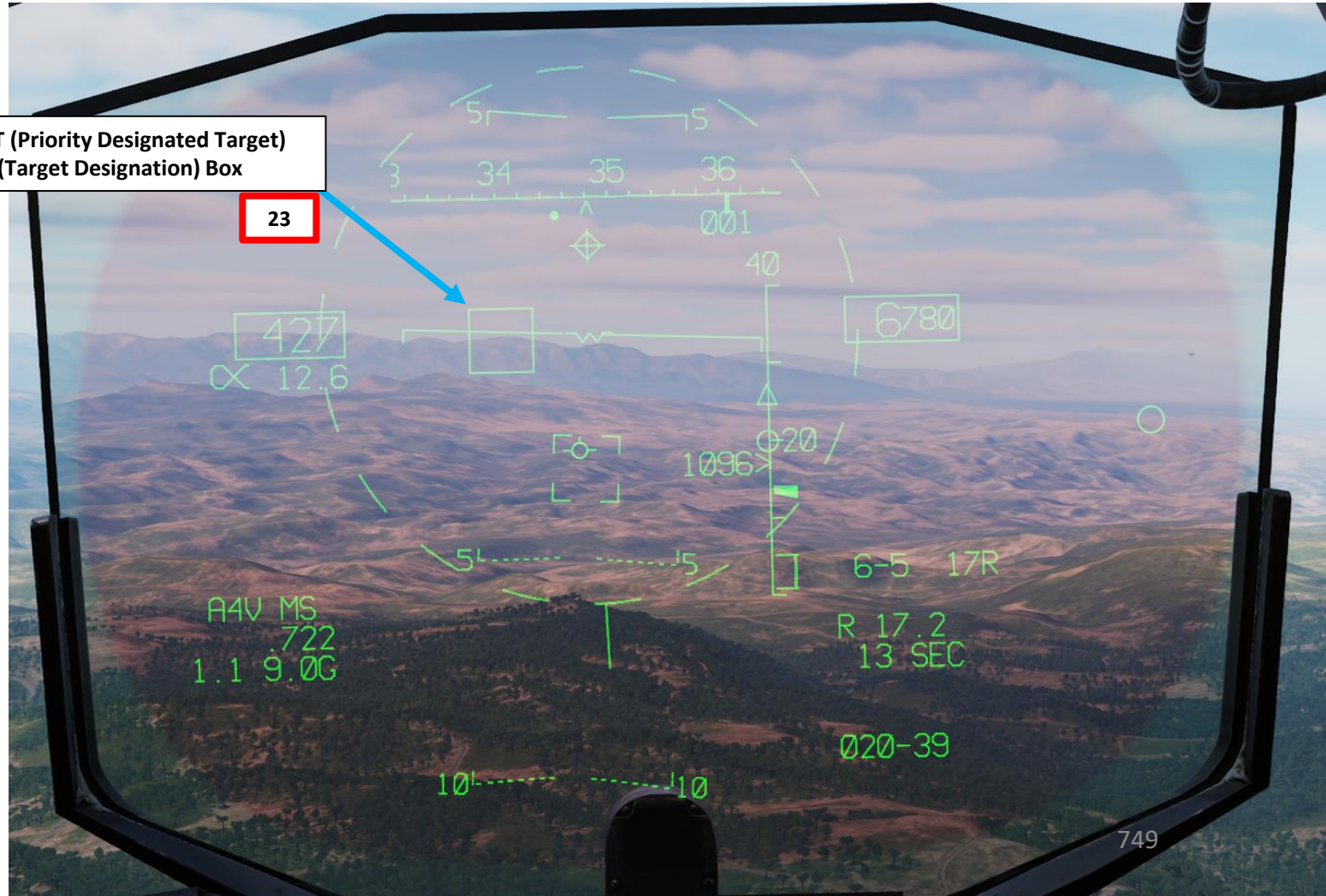




3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

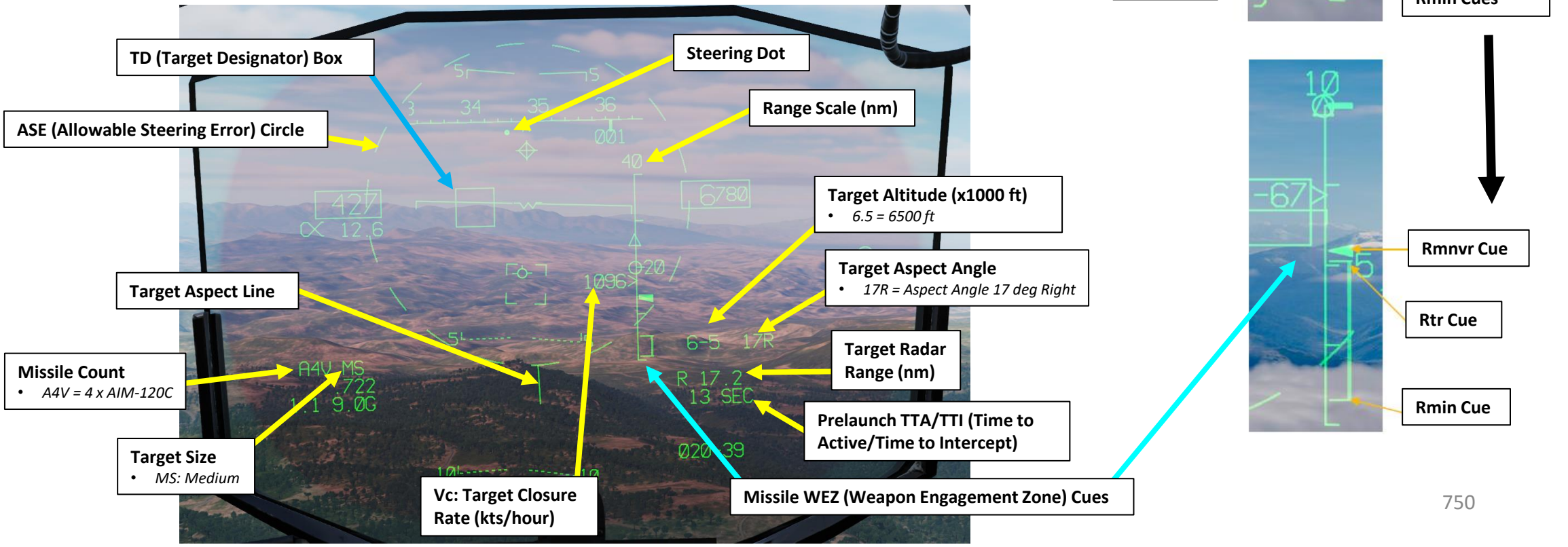
23. You might have to adjust the radar azimuth by “azimuth bumping” to maintain tracking of several targets. On the HUD (Heads-Up Display), only the priority target is shown with a TD Box.





3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

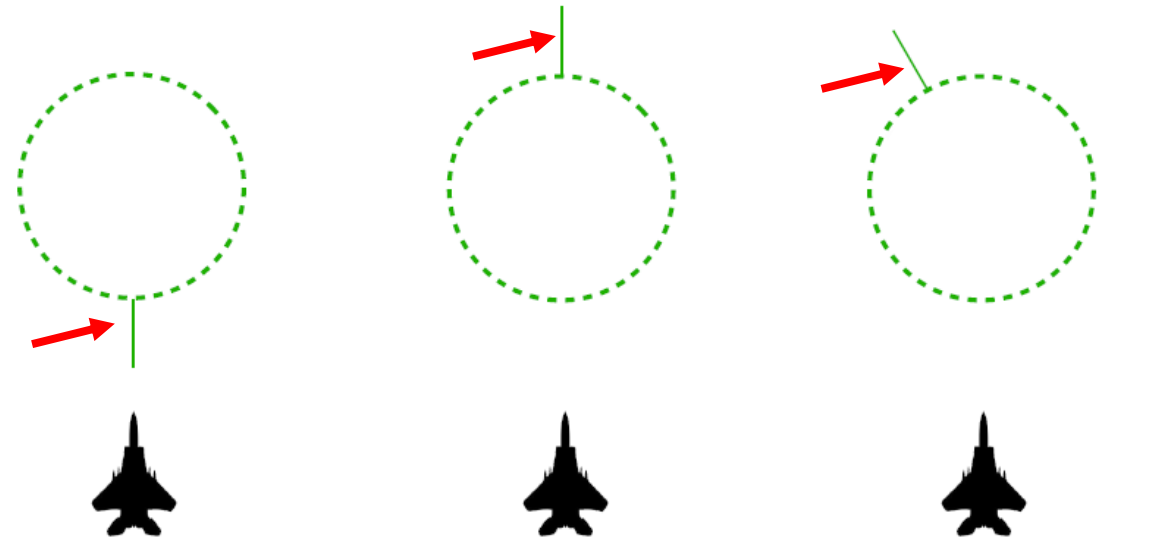
24. Once target is locked, steer aircraft to place Steering Dot inside the ASE (Allowable Steering Error) circle on the HUD. Use Missile WEZ (Weapon Engagement Zone) cues to estimate target range, which should ideally be between within Ropt (Max Range Probability of Intercept with Optimum Steering) but further than Rmin (Minimum Launch Range).
    - **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.

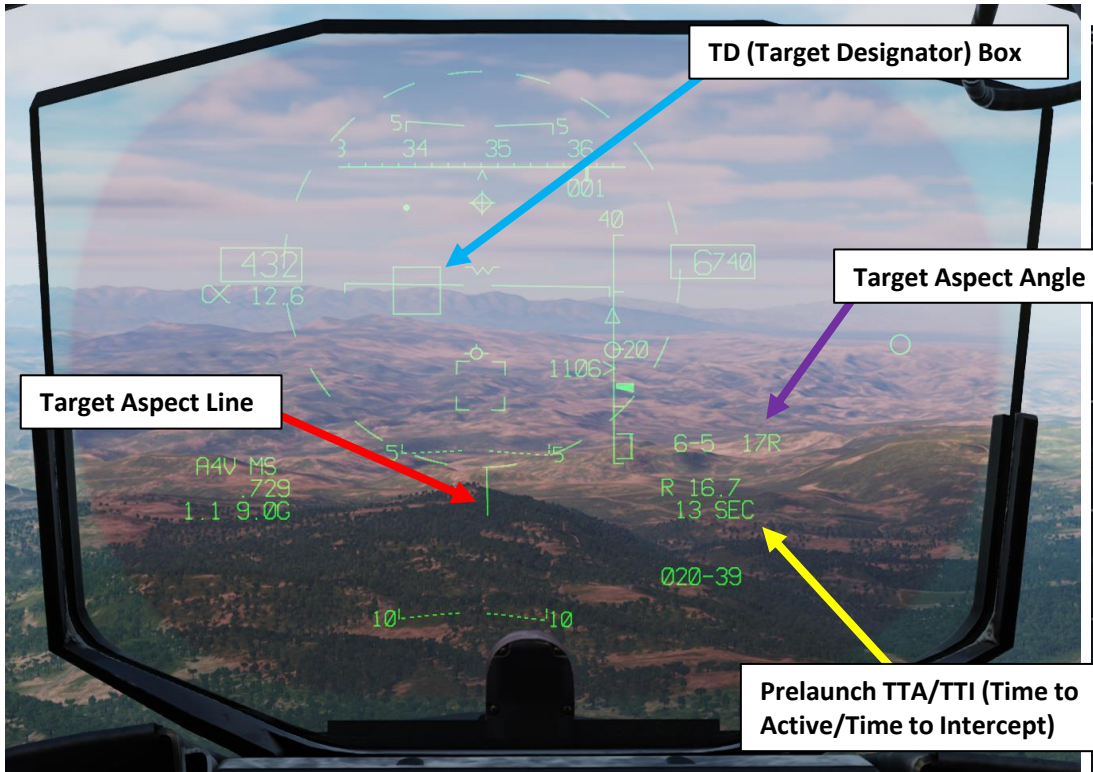


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

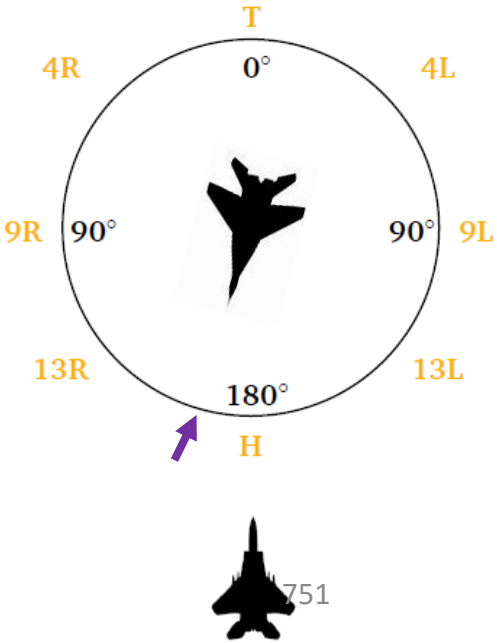
25. Use PDT (Primary Designated Target) Aspect Angle (Tail, Hot, Right, or Left) and Target Aspect Line to determine the target's orientation to maximize your chances of intercepting the target.
26. Check Prelaunch TTA/TTI indication.
    - TTA (Time to Active) is the predicted missile time of flight to range at which the priority AIM-120 goes active.
    - 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.

Target Aspect Lines (Target Aspect)



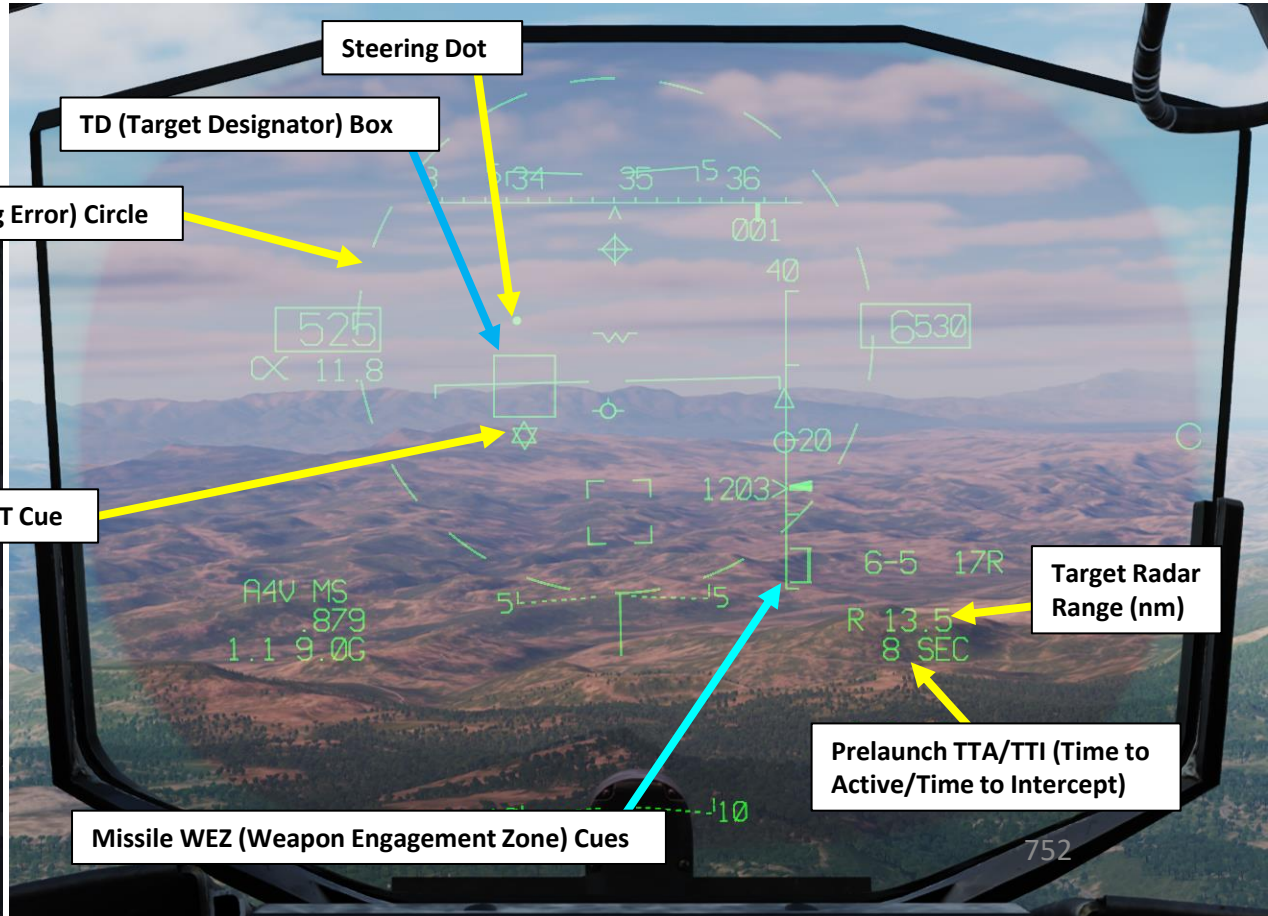


Hot (H) Target Aspect Angle



3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

27. The left and right Lock/Shoot annunciator lights on the canopy rail indicate the radar lock on target. When all conditions for a missile shot are met, the SHOOT light appears.
28. The AIM-120 SHOOT Cue (6-pointed star) appears when:
    - Selected mode is MRM (Medium Range Missile) and the AIM-120 is in priority and ready
    - Master Arm is set to ARM
    - Radar is in STT, DTT or DTWS
    - Steering Dot is inside the ASE circle
    - Target is between Raero and Rmin range.
29. Once Steering Dot is inside the ASE (Allowable Steering Error) circle on the HUD and you are within effective missile range, press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile.

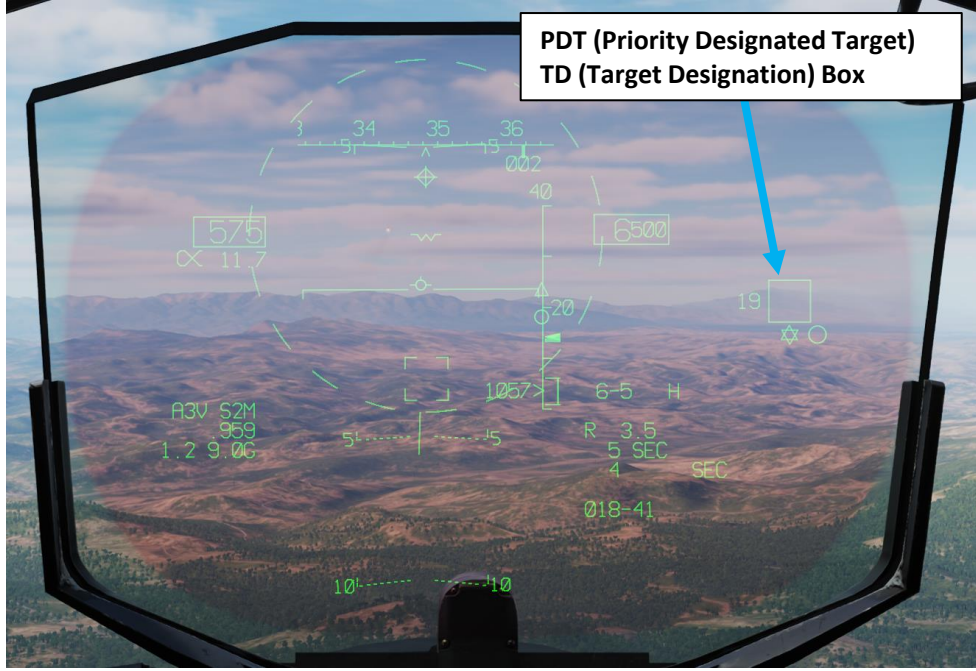


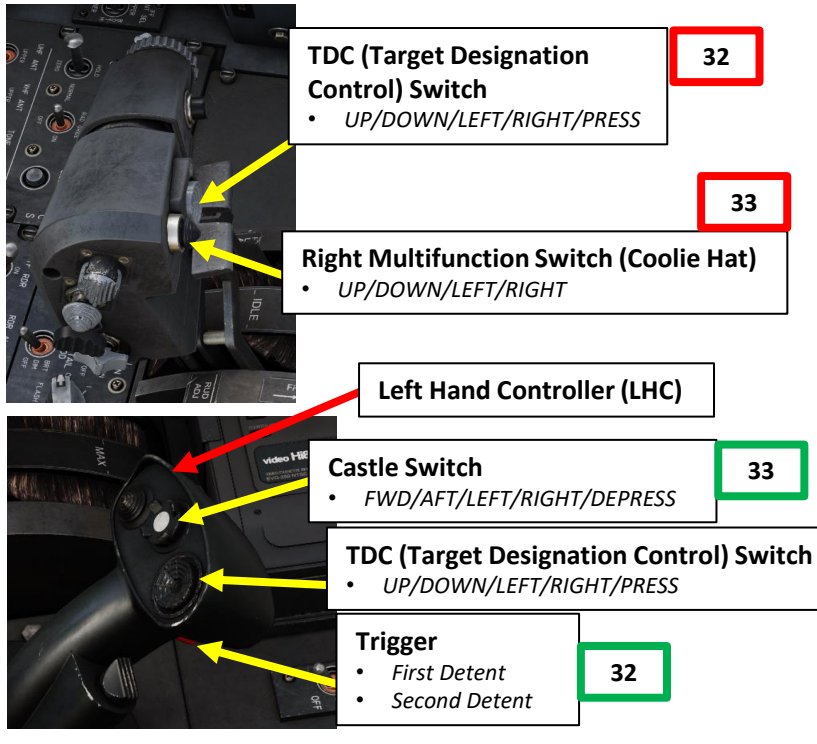
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

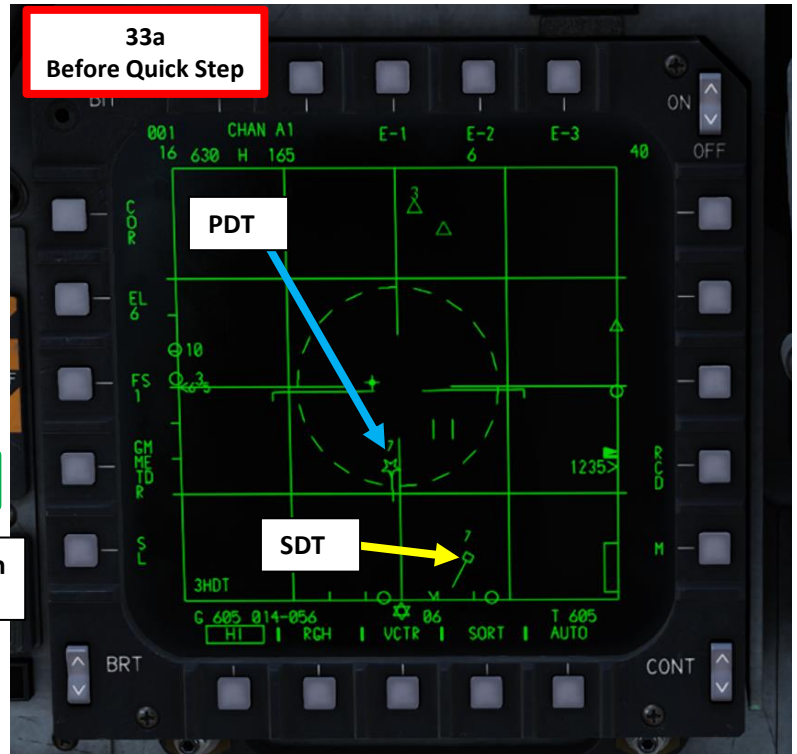
30. The missile is launched on the target locked by the aircraft's radar. For most part of the missile's flight, target information is fed to the missile via the datalink combined with the missiles INS (Inertial Navigation System) guidance. Once it reaches certain points, it uses its own seeker for terminal acquisition and tracking. If the radar locked is lost after launch, inertial active mode is activated, where the missile uses only its own onboard INS guidance to reach the active phase.

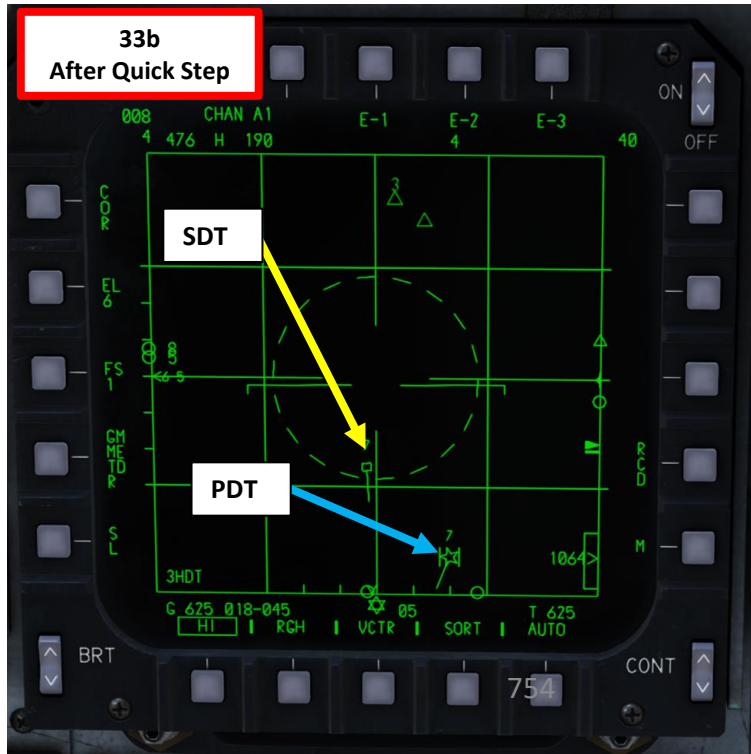
3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

31. Once first missile has been fired, select another Secondary Designated Target as the new Priority Designated Target using either "Quick Pick" or "Quick Step" function.
32. **QUICK PICK**: It is possible to quickly "pick" (select) any Secondary Designated Target (SDT) target as the Priority Designated Target (PDT).
    - **Pilot**: Slew TDC on any designated target, then press TDC (Target Designation Control) Switch SHORT (less than 1 sec).
    - **WSO**: Slew TDC on any designated target, then press L/RHC (Left/Right Hand Controller) trigger to full action (second detent).
33. **QUICK STEP**: It is possible to quickly "step" between designated targets to change the Priority Designated Target (PDT) to the next Secondary Designated Target (SDT) in range. The order of switching is from left to right in azimuth.
    - **Pilot**: Press Coolie Switch UP SHORT (less than 1 sec).
    - **WSO**: DEPRESS Castle Switch.



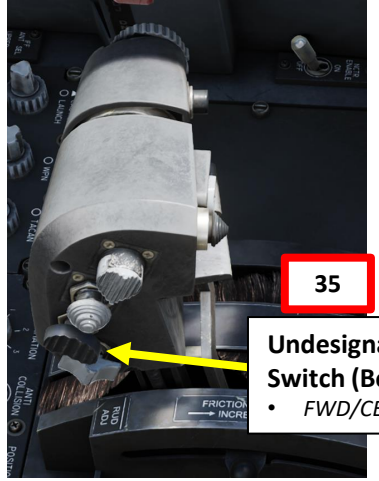




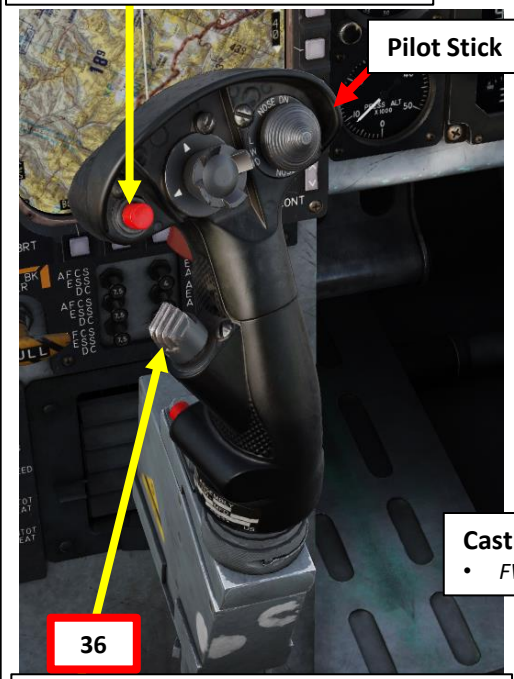


3 – AIR-TO-AIR WEAPONS
3.4 – Active Radar Homing AIM-120C AMRAAM Missile
3.4.2 – Multiple Targets (With Radar)

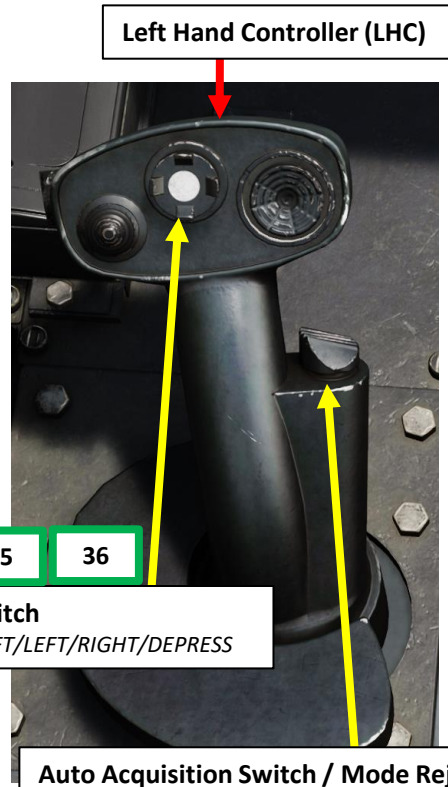
34. Press and hold the Weapon Release (Pickle) Button (RALT+SPACE) to launch missile on other target. The radar will maintain lock on the various targets you fired upon and guide missiles.
35. To undesignate a TWS target:
    - **Pilot**: Press the Undesignate (Boat) Switch – AFT SHORT (less than 1 sec).
    - **WSO**: Press on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.
36. To exit STT (Single Target Track) radar mode:
    - **Pilot**: Depress the Auto Acquisition Switch on the pilot's stick.
    - **WSO**: Press on the WSO's L/RHC (Left/Right Hand Controllers) Castle Switch LEFT.



Undesignate / Missile Reject Switch (Boat Switch)
- *FWD/CENTER/AFT*

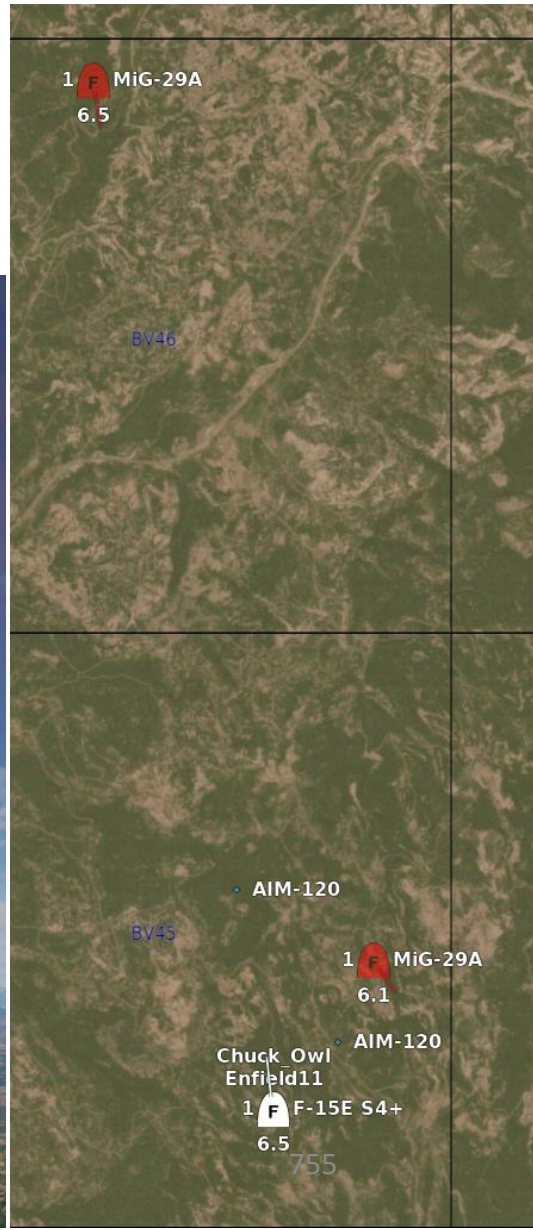


Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*



Castle Switch
- *FWD/AFT/LEFT/RIGHT/DEPRESS*

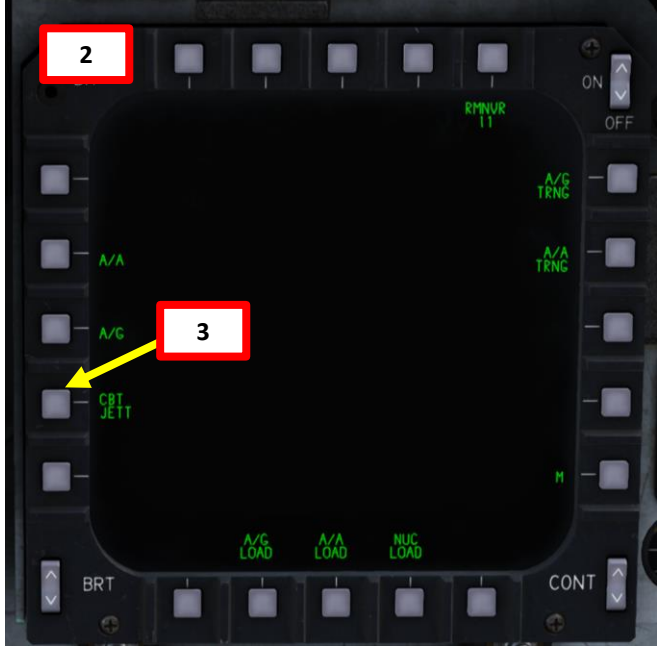
Auto Acquisition Switch / Mode Reject Switch
- *FWD/AFT/CENTER/DEPRESS*

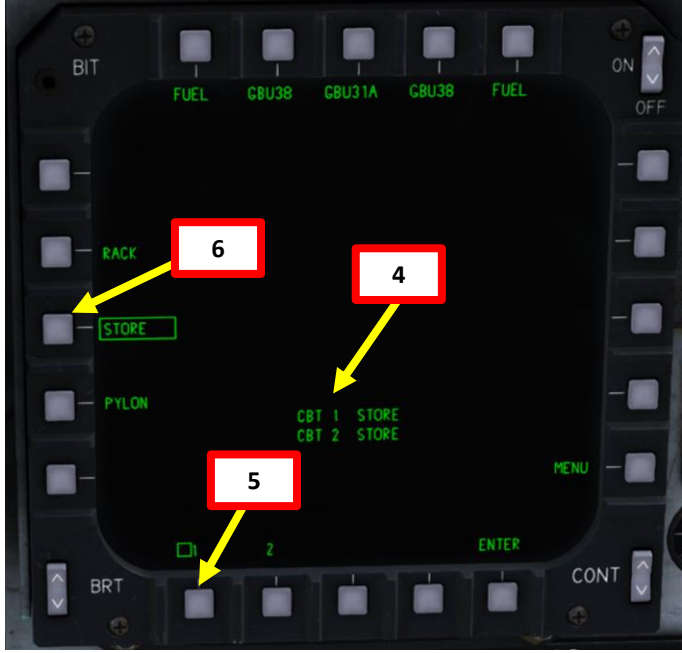


4 – ORDNANCE JETTISON
4.1 – Selective Ordnance Jettison

In order to use jettison certain stations, it is necessary to create a selective jettison profile.

1. Set Armament Jettison Selector to SEL JETT COMBAT.
2. Go in ARMT (Armament) page
3. Select CBT JETT.
4. You can create up to two individual Combat Jettison profiles. We will program a single profile (CBT 1).
5. Select Combat Jettison profile No. 1.
6. Select STORE.
7. Select what ordnance you want to jettison by boxing desired stations. We will select the center GBU31A and right GBU38 stations.
8. Select ENTER.

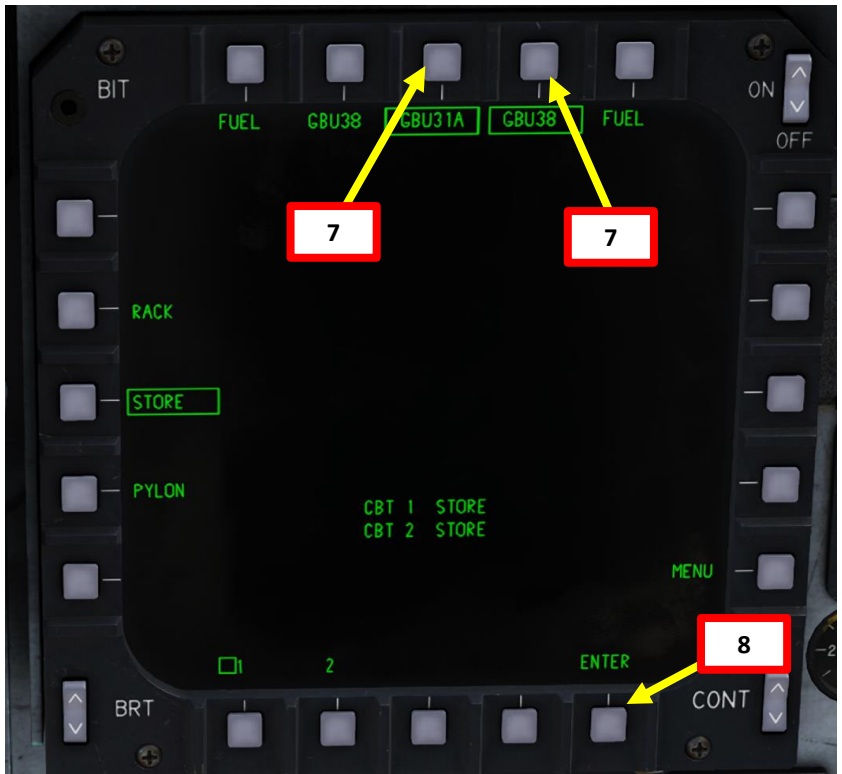




1 **Armament Jettison Selector**

Turn to select ordnance, then push Red JETT Button to jettison

- ***MAN FF**: 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.*
- ***MAN RET**: Manual Retard, selects the manual weapon release mode and tail fuze only. Each release pulse releases one weapon from each selected aircraft station while the weapon release button is pressed .*
- ***ALTN REL**: Nuclear Release Mode, not simulated.*
- ***OFF***
- ***SEL JETT COMBAT**: selective jettison button first press initiates combat jettison program 1. Second press initiates combat jettison program 2.*
- ***SEL JETT A/A**: selects air-to-air selective jettison.*
- ***SEL JETT A/G**: selects air-to-ground selective jettison.*



4 – ORDNANCE JETTISON
4.1 – Selective Ordnance Jettison

9. Combat Jettison Profile No. 1 (CBT 1) now displays “CRC STORE”, which means that Center and Right Conformal Stores will be jettisoned for this combat jettison profile.
10. Set Master Arm – ARM (UP)
11. Press Armament Jettison Selector button IN to jettison ordnance for CBT 1.
12. If a Combat Jettison No. 2 profile is set, you may jettison stations selected under program 2 by pressing and hold the Armament Jettison Selector button IN for at least one second again.

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:

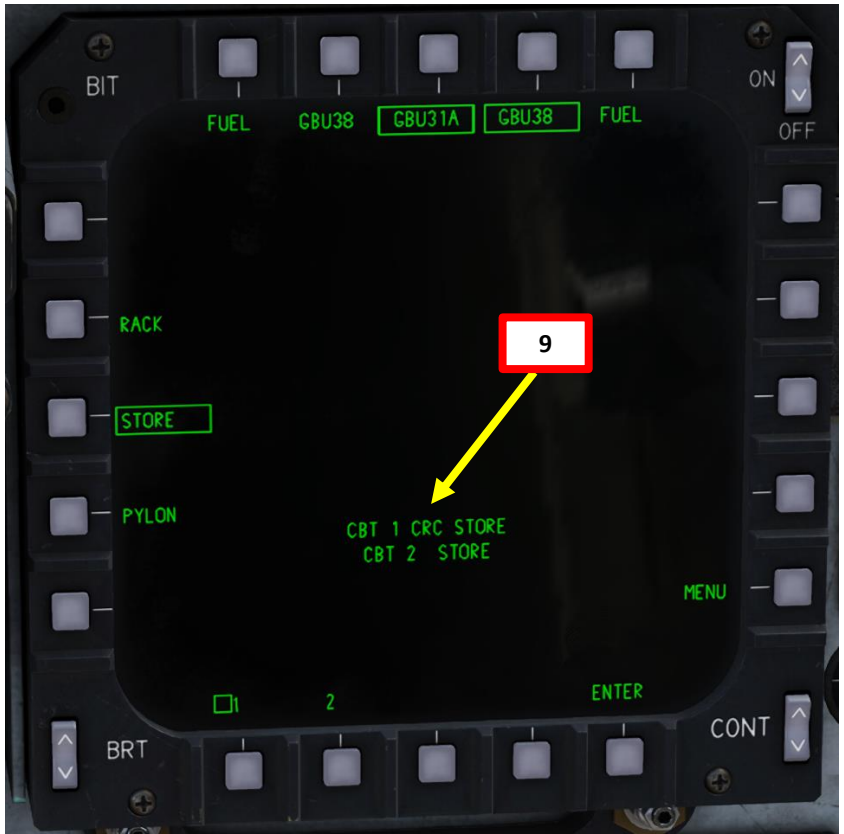
COLUMN 1	COLUMN 2	COLUMN 3
CBT 1	L (left)	RACK
CBT 2	LC (left conformal tank)	STORE
	C (center)	PYLON
	RC (right conformal tank)	
	R (right)	

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.



4 – ORDNANCE JETTISON
4.2 – Emergency Stores Jettison

To jettison all CFT (Conformal Fuel Tank) stations and stations 2, 5 and 8 pylons, press the Emergency Jettison Button for at least 1 sec.

Emergency Jettison Button

- *When pressed for approximately 1 second, the contents of all CFT stations and stations 2, 5 and 8 pylons are jettisoned.*

INTRODUCTION

Countermeasures are very simple to use. You have three countermeasure types at your disposal: flares, chaff and an ECM (Electronic Countermeasure) jammer. We will explore together what is used against what, and how.

Missiles can generally track you using 2 things: radar signature (radar waves are sent at you and you reflect them, which is called a "radar signature") and heat signature (like the exhaust of your engines). Countermeasures will only be effective against the kind of weapon it was meant to counter; a heat-seeking missile will not care if you deploy electronic countermeasures against it since it tracks heat, not radar signatures. This is why it is important to know what is attacking you in order to counter it properly. This is what the **RWR** (Radar Warning Receiver) is for: to help you know what is firing at you so you can take the adequate action to counter it.

Flares are used against missiles that track heat (infrared or IR) signatures. Instead of going for the heat signature generated by your engines, a missile will go for a hotter heat source like flares.

Chaff is a form of "passive" jamming. Passive (reflected) jamming is when a deceptive object or device reflects radar waves. Chaff is simply a bundle of small pieces of metal foil with reflective coating, which creates clusters of radar signatures that prevent a radar to get a solid lock on the aircraft itself.

The **AN/ALQ-135 Internal Countermeasures Set** is an internal Electronic Countermeasure/Jammer system. It is a form of "continuous" jamming, also called "active" or "transmitted" jamming. This device transmits its own synchronized radar waves back at your enemy's radar receiver to simulate erroneous radar wave returns. Simply put, active jamming will try to drown a radar in white noise.

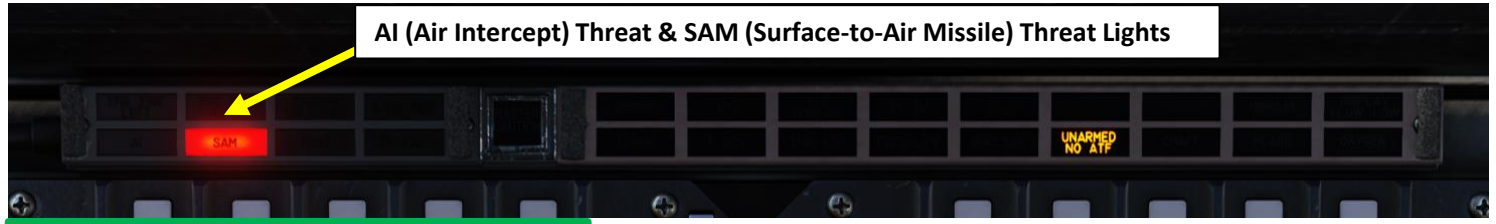
In order to use these three forms of countermeasures, you can use "countermeasure programs", routines that will deploy a number of flares/chaff for a number of cycles at a given interval.

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) Overview

The Tactical Electronic Warfare System (TEWS) is an integrated defensive suite which consists of four separate sub-systems:

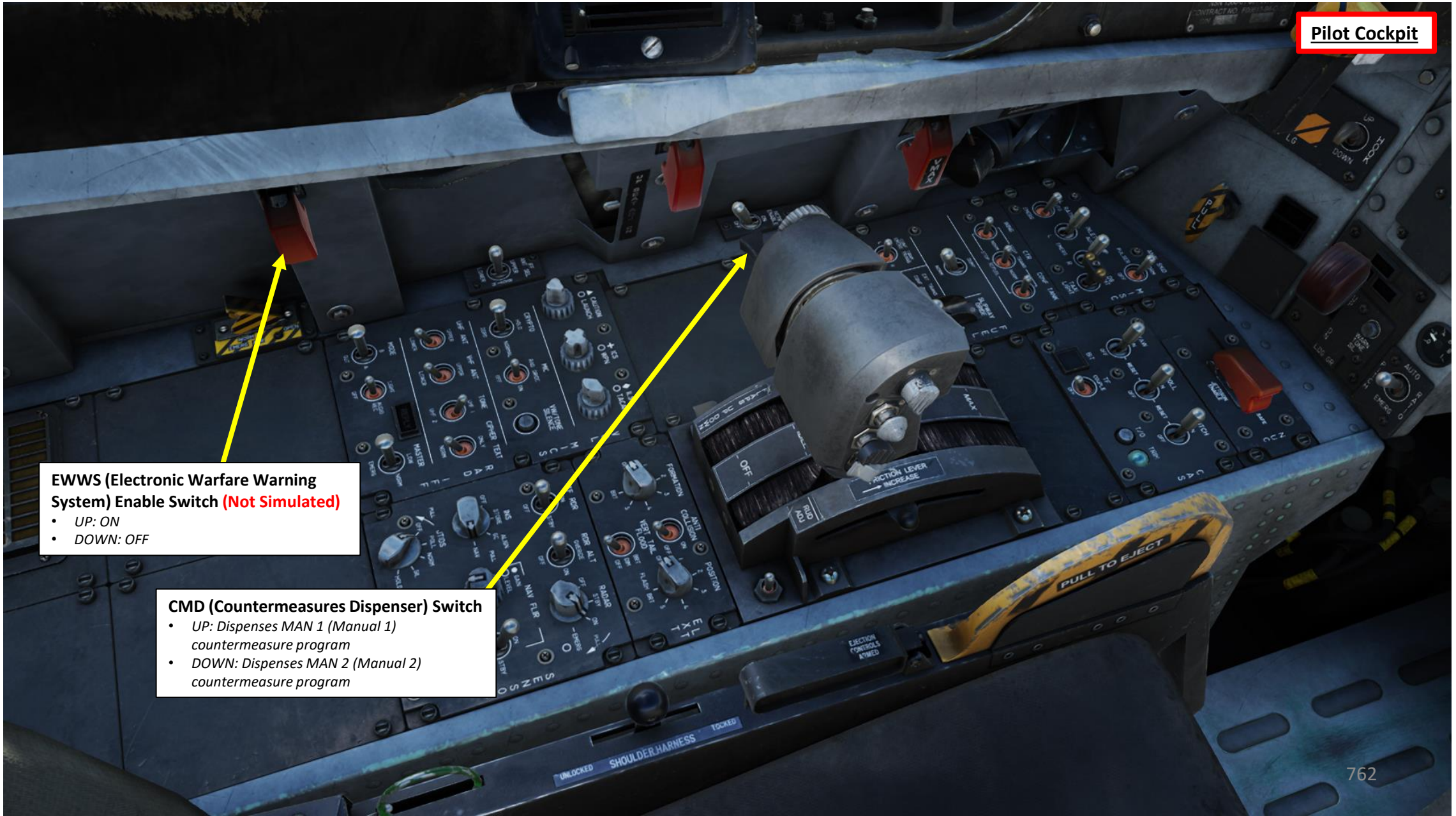
- **AN/ALR-56C Radar Warning Receiver (RWR)**: displays threat identification and location information to the aircrew on any selected MPD or MPCD.
- **AN/ALE-45 Countermeasures Dispenser Set (CMD)**: computer-driven, internally mounted chaff and flare dispenser.
- **AN/ALQ-135 Internal Countermeasures Set (ICS)**: software controlled self-protection jammer.
- **AN/ALQ-128 Electronic Warfare Warning Set (EWWS)**: array of antennas to detect and display various threats and other information.

The TEWS page is accessed by pressing the Menu Selection PB (Pushbutton) to select MENU 1 (M), then pressing on the TEWS PB.



WSO (Weapon Systems Officer) Cockpit

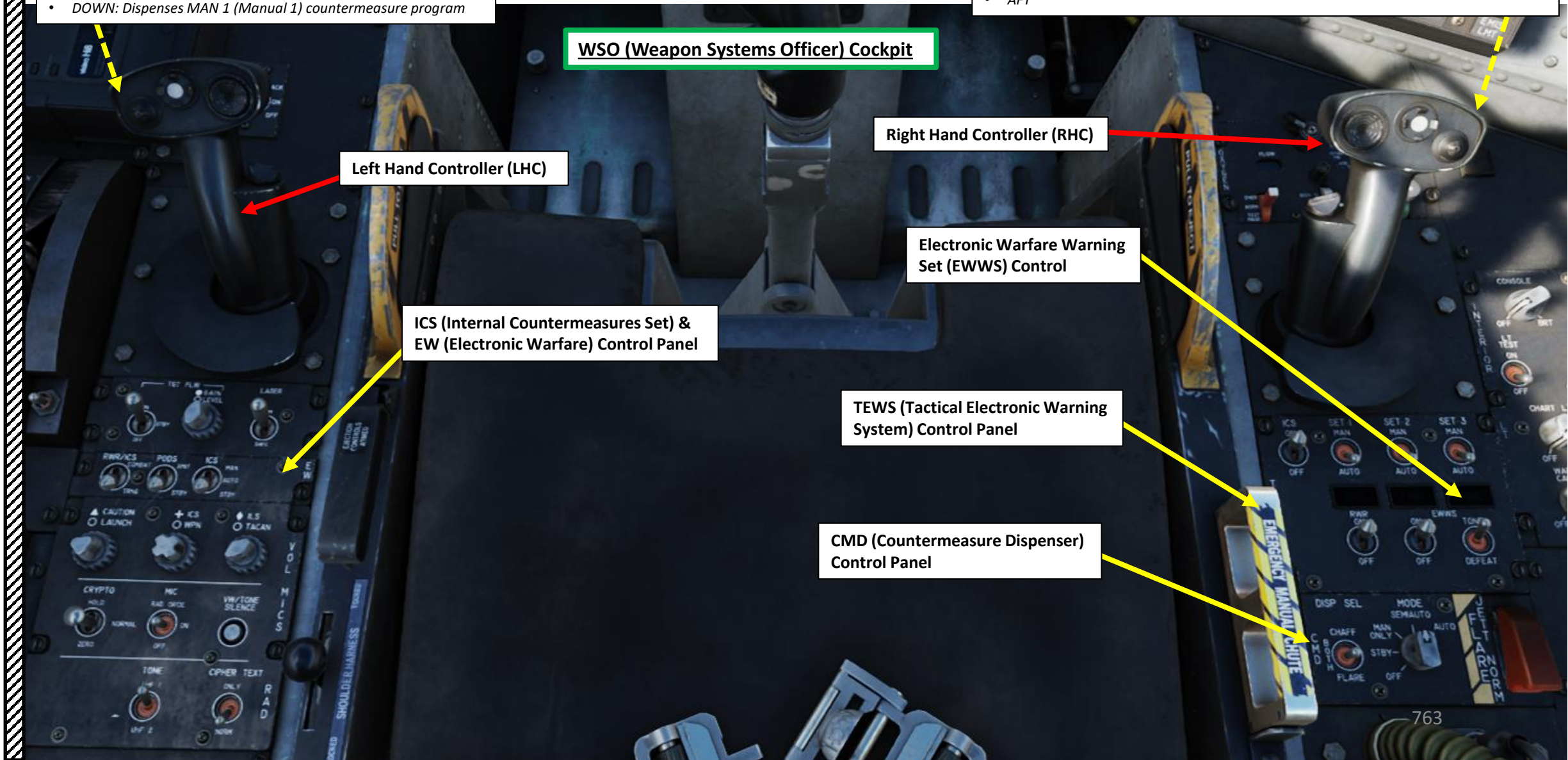
TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
Overview



TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) Overview

CMD (Countermeasures Dispenser) Switch (Hidden)
- *UP: Dispenses MAN 2 (Manual 2) countermeasure program*
- *DOWN: Dispenses MAN 1 (Manual 1) countermeasure program*

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*



TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALR-56C Radar Warning Receiver (RWR)

Detected radars are displayed on the Radar Warning Receiver (RWR). The RWR is a circular-shaped display on the TEWS page that provides you a visual representation of radar emitters around your aircraft. The display is in plan view with your aircraft in the center.

As threats are displayed around the center of the display, the icons represent the azimuth direction to the threat. In addition to the icons, an audio system will alert you to the status of the radars detected (search, track, and launch).

The **locations of radar emitters on the display do not necessarily correlate to emitter range from your aircraft**. The distance of the threat icon from the center of the display **indicates radar signal strength**. The closer the icon is to the center of the display generally indicates the closer the radar is to you.

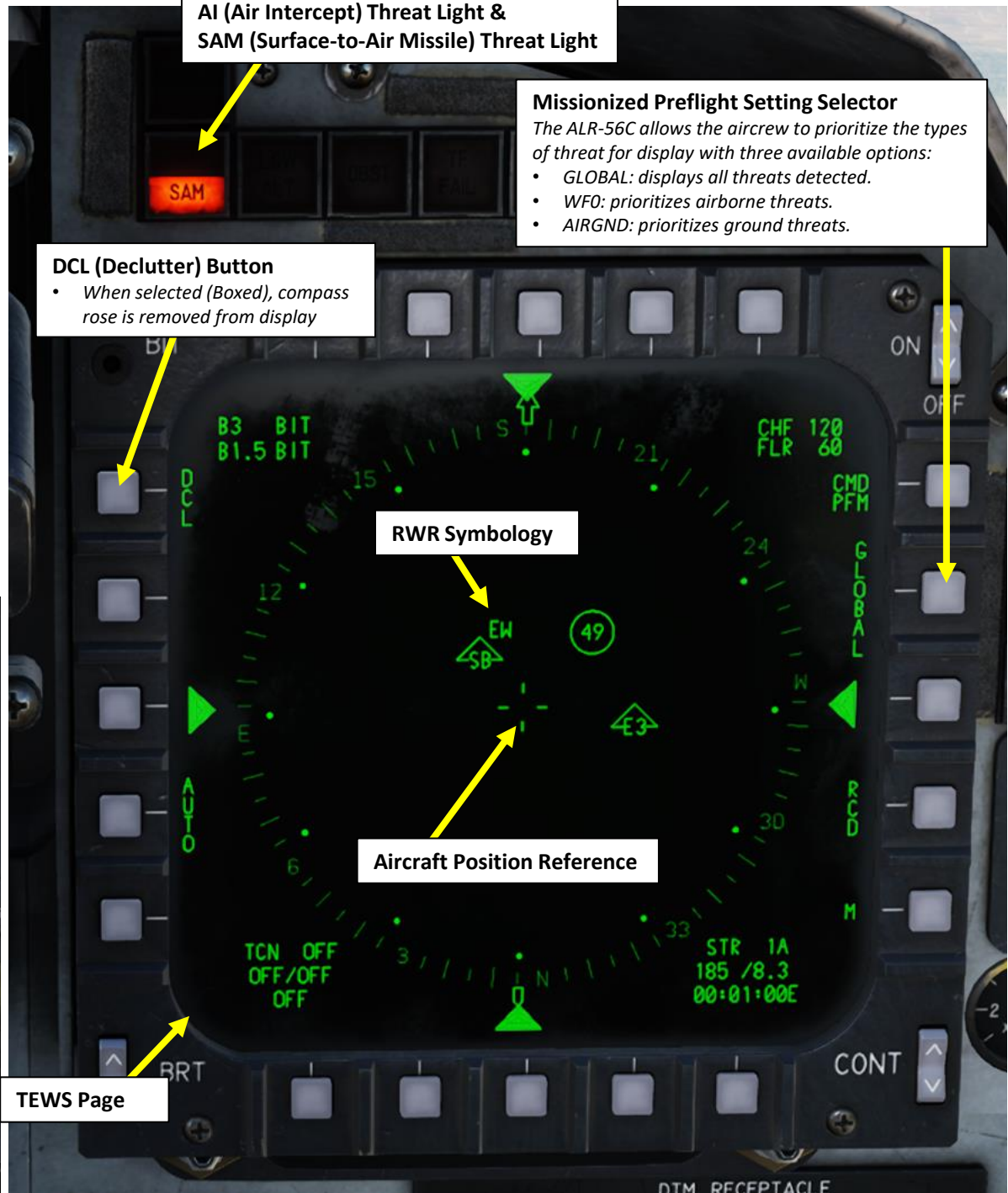
Any time a new emitter symbol is displayed on the azimuth indicator, a status change tone is generated by the system. Special tones are also generated for specific threats or critical threat modes of operation.

The RWR is **powered by setting the RWR Power Switch ON (FWD) in the WSO cockpit.**

RWR/ICS (Radar Warning Receiver/Internal Countermeasures Set) Mode Selector Switch
- *FWD: Combat Mode*
- *AFT: Training (TRNG) Mode*

RWR (Radar Warning Receiver) Power Switch
- *FWD: ON*
- *AFT: OFF*

WSO (Weapon Systems Officer) Cockpit



AI (Air Intercept) Threat Light & SAM (Surface-to-Air Missile) Threat Light

Missionized Preflight Setting Selector
The ALR-56C allows the aircrew to prioritize the types of threat for display with three available options:
- *GLOBAL: displays all threats detected.*
- *WF0: prioritizes airborne threats.*
- *AIRGND: prioritizes ground threats.*

DCL (Declutter) Button
- *When selected (Boxed), compass rose is removed from display*

RWR Symbology

Aircraft Position Reference

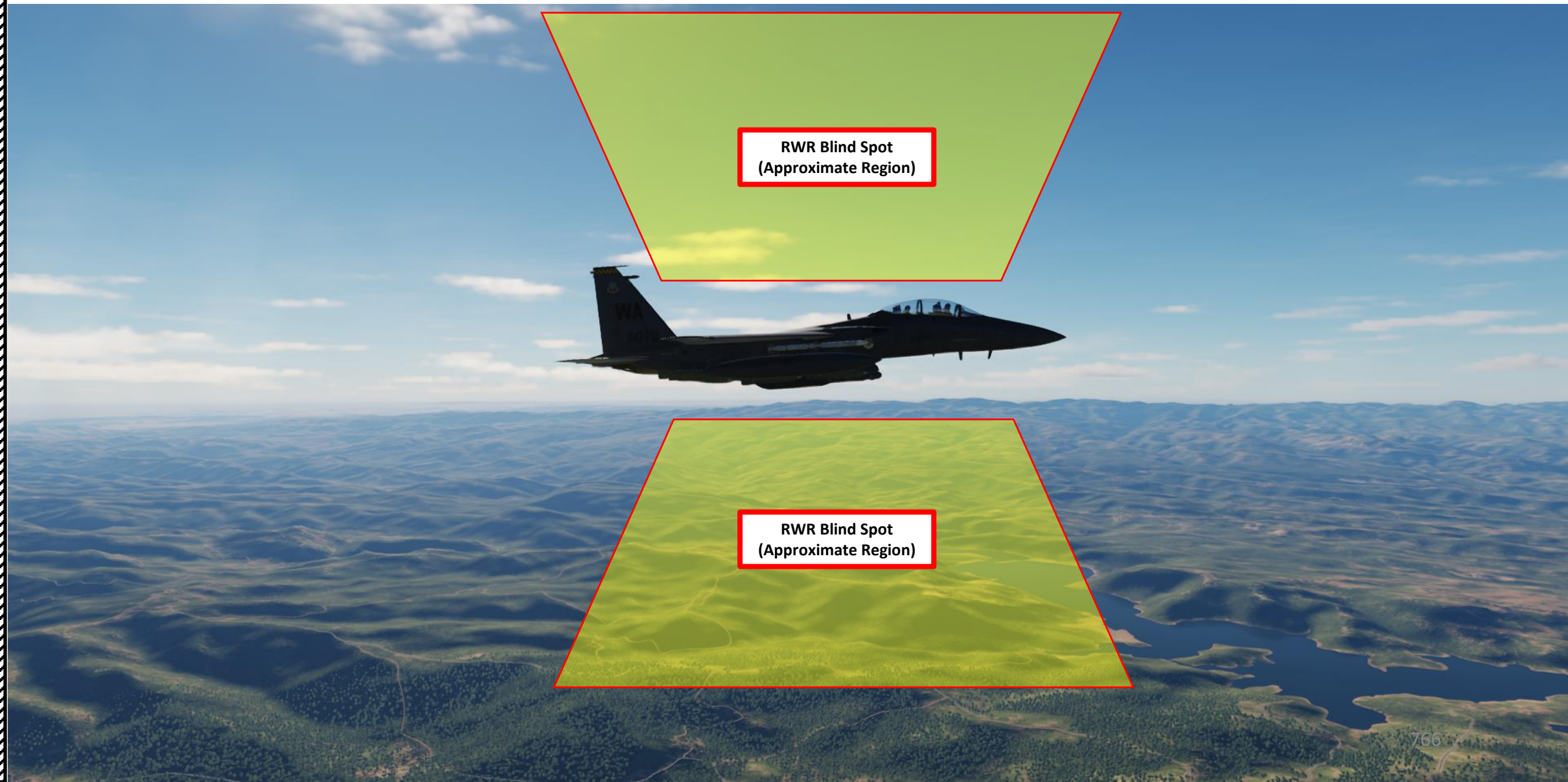
TEWS Page

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALR-56C Radar Warning Receiver (RWR)

- If a symbol is displayed **without flashing**, it indicates that the **radar is in acquisition/search mode**. When a new emitter is detected, a new threat tone will be heard.
- Surface (shipborne) radars are underlined with a boat symbol
- Airborne radars are marked with a triangle
- If a symbol **flashes**, it indicates that the **radar is supporting a missile that has been launched at you**.
- Newly detected emitters are 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.
- If ground or surface radar locks up the player's aircraft. **SAM** threat warning light turns on and the green circle is displayed around the emitter.

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
AN/ALR-56C Radar Warning Receiver (RWR)

Keep in mind that there are two blind spots on the RWR. Therefore, you cannot rely completely on the RWR to detect radar locks.



TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
AN/ALR-56C Radar Warning Receiver (RWR)

Ship Threats	
N4 – Admiral Kuznetsov Carrier	48 – Carl Vinson Nimitz Supercarrier
N9 – Pyotr Velikiy Kirov Battlecruiser	49 – Oliver Hazard Perry Frigate
N3 – Moskva Cruiser	48 – John C Stennis Nimitz Supercarrier
N9 – Neustrashimyy Frigate	48 – CVN-71/72/73/74/75 Supercarrier
N4 – Retsky Krivak Frigate	48 – Tarawa Essex-Class Carrier
N4 – Grisha Corvette	Y1 – Normandy Ticonderoga Cruiser
N5 – Molniya Tarantul Corvette	CT – La Combattante
H2 – Type-052B Luyang I Destroyer	Y1 – Arleigh Burke Destroyer
H9 – Type-052C Luyang II Destroyer	
H6 – Type-054A Jiangkai II Frigate	
H5 – Type-071/-093 Yuzhao Ship	

Ground Threats	
AA – ZU 23 AA	VL – Vulcan M163 – A
AA – ZSU 23 Shilka	GP – Gepard
9 – SA-8	RD – Roland ADS
11 – SA-11	RD – Roland EWR
13 – SA-13	RA – Rapier Blindfire Track Radar
15 – SA-15	RA – Rapier Launcher Radar
19 – SA-19	HK – Hawk Search Radar
2 – SA-2 Fan Song Track Radar	HK – Hawk Track Radar
3 – SA-3 Flat Face Search Radar	HK – Hawk Acquisition Radar
3 – SA-3 Low Blow Track Radar	PT – Patriot Search/Track Radar
6 – SA-6	77 – AN/FPPS-117
9 – SA-9 Dog Ear Search Radar	NS – NASAMS
11 – SA-11 Snow Drift Search Radar	
11 – SA-11 Clam Shell Search Radar	
10 – SA-10 Track Radar	
10 – SA-10 Big Bird Search Radar	
EW – Box Spring Early Warning Radar	
EW – Tail Rack Early Warning Radar	
2 – P-19	
S9 – 2K22 Tunguska	
H7 – HQ-7	
FC – SON-9	

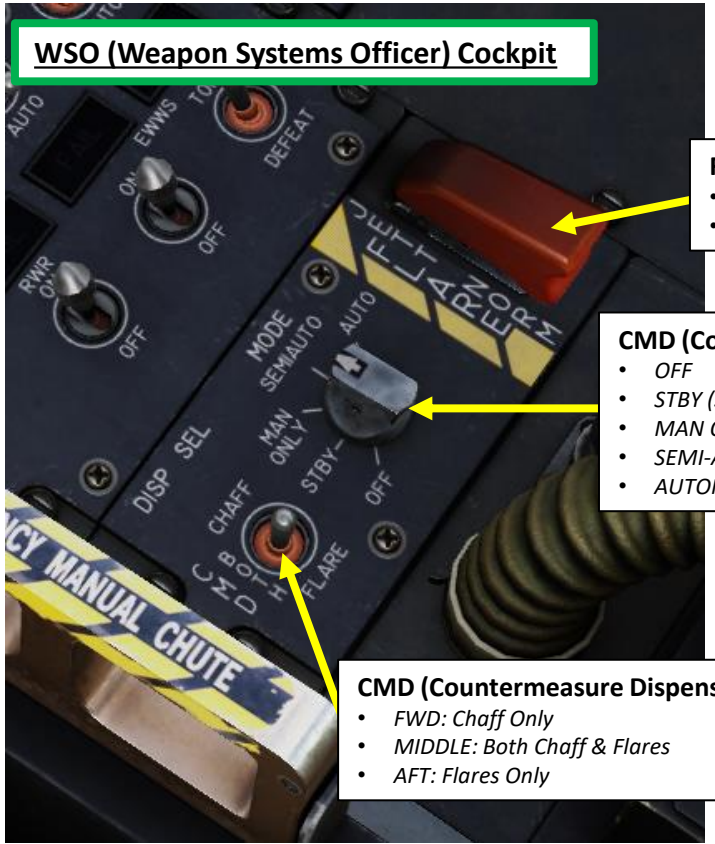
Air Threats	
FT – Su-17	F4 – F-4
19 – MiG-19	F5 – F-5E3
21 – MiG-21	14 – F-14 A/B
23 – MiG-23	15 – F-15 C/E
23 – MiG-27	16 – F-16 A/C
24 – Su-24	18 – F-18 A/C
25 – MiG-25	TO – Tornado
SB – MiG-29	M2 – Mirage 2000C
SB – Su-27	M5 – Mirage 2000C-5
31 – MiG-31	37 – AJS-37 Viggen
34 – Su-34	51 – B-1B
62 – Tu-22	52 – B-52H
65 – Tu-95	S3 – S-3B Tanker
65 – Tu-142	E2 – E-2C AWACS
65 – Tu-160	E3 – E-3A AWACS
EW – A-50 AWACS	M1 – Mirage F1
KL – JF-17	

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
AN/ALQ-45 Countermeasures Dispenser Set (CMD)

The **AN/ALQ-45 CMD (Countermeasures Dispenser Set)** 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 radar warning receiver in 12 different categories, sorted by threat radar pulse and beam widths to select chaff dispensing programs.

CMD (Countermeasures Dispenser) Switch (Hidden)
- *UP: Dispenses MAN 2 (Manual 2) countermeasure program*
- *DOWN: Dispenses MAN 1 (Manual 1) countermeasure program*

WSO (Weapon Systems Officer) Cockpit

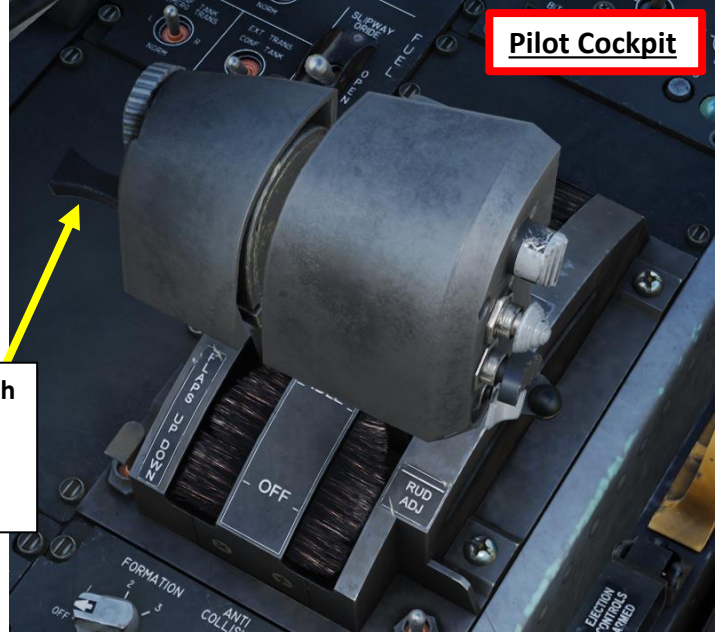


WSO (Weapon Systems Officer) Cockpit

Flare Jettison Switch
- *FWD: Jettison*
- *AFT: Normal (Default position)*

CMD (Countermeasure Dispenser) Mode Switch
- *OFF*
- *STBY (Standby)*
- *MAN ONLY (Manual Only)*
- *SEMI-AUTOMATIC*
- *AUTOMATIC*

CMD (Countermeasure Dispenser) Selection Switch
- *FWD: Chaff Only*
- *MIDDLE: Both Chaff & Flares*
- *AFT: Flares Only*



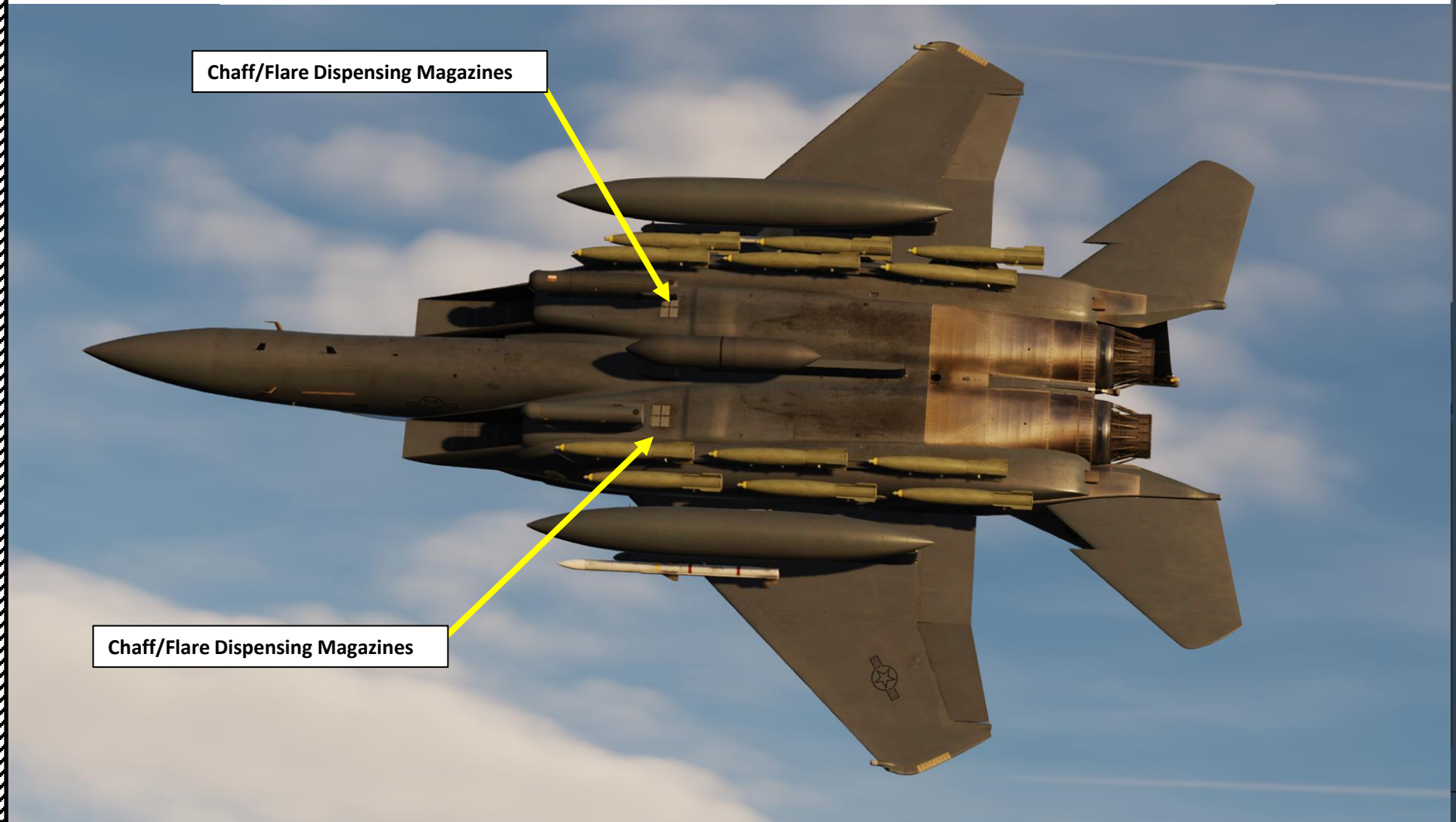
Pilot Cockpit

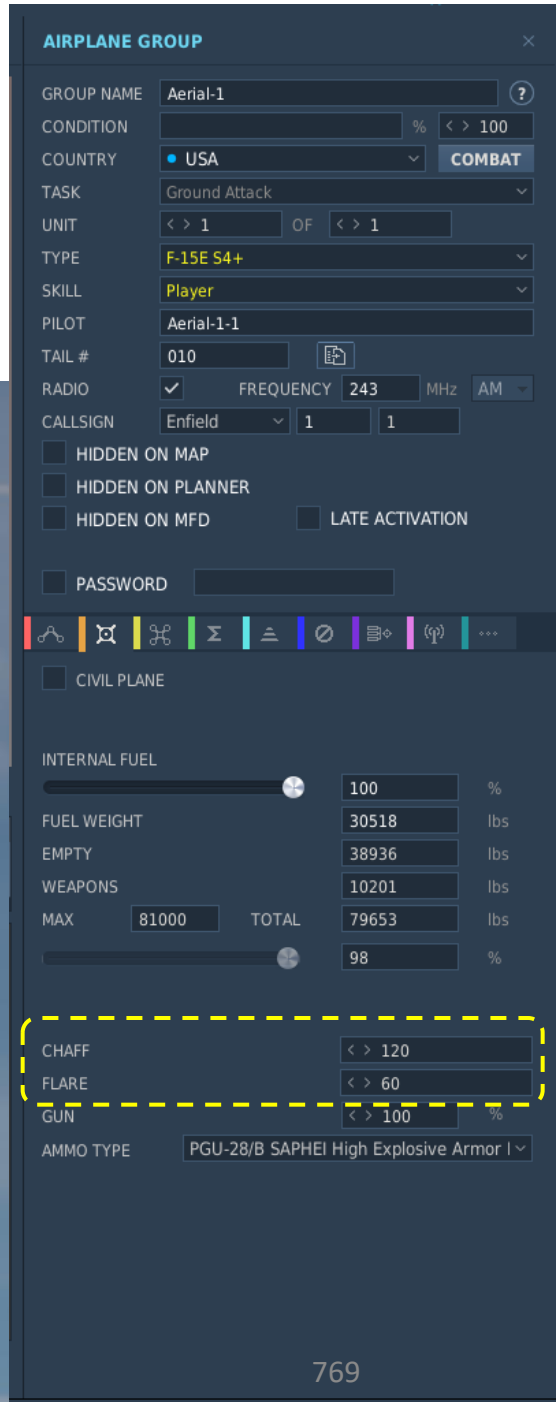
CMD (Countermeasures Dispenser) Switch
- *UP: Dispenses MAN 1 (Manual 1) countermeasure program*
- *DOWN: Dispenses MAN 2 (Manual 2) countermeasure program*

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
AN/ALQ-45 Countermeasures Dispenser Set (CMD)

The aircraft has a total of four dispensing magazines capable of loading chaff or flares. The table below lists the possible chaff/flare ratios:

CHAFF	240	210	180	150	120	90	60	30	0
FLARE	0	15	30	45	60	75	90	105	120

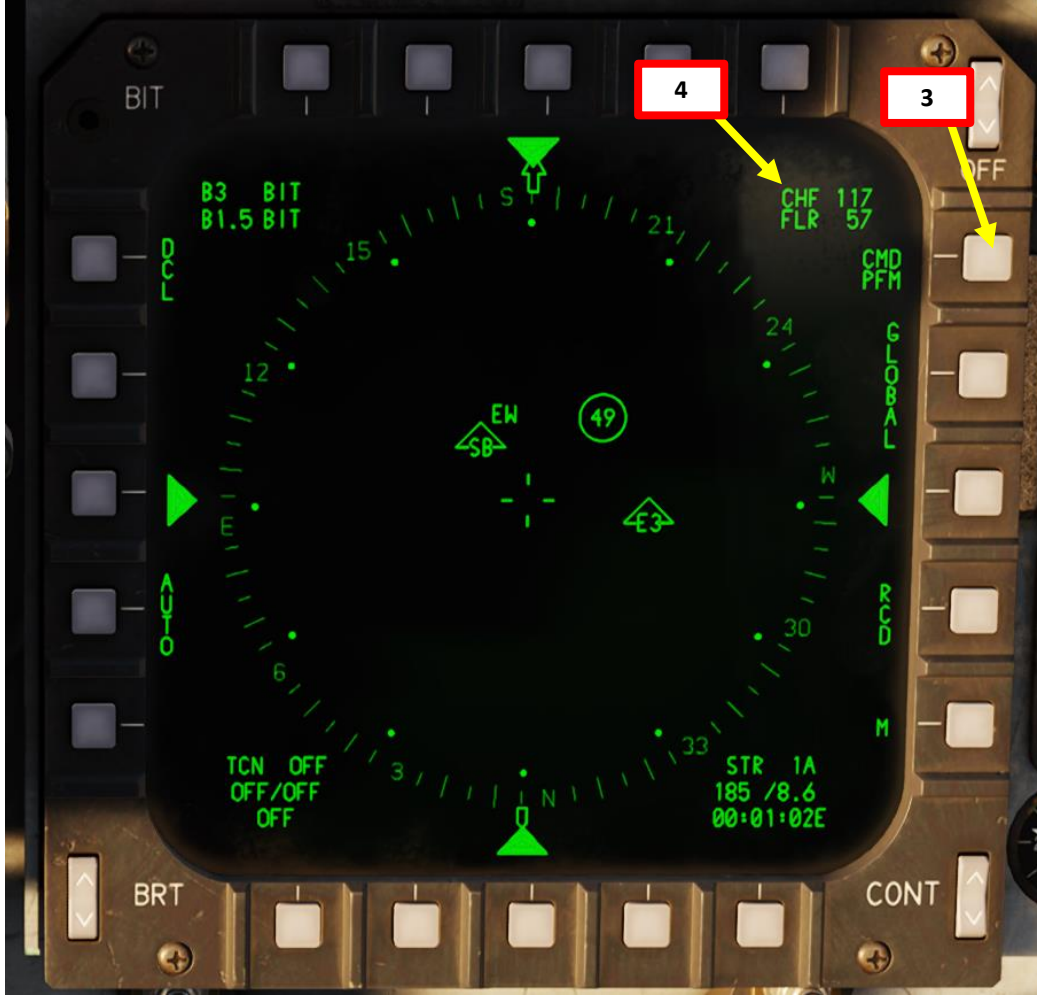




TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALQ-45 Countermeasures Dispenser Set (CMD)

Chaff/Flare Program Dispensing Procedure:

1. Set CMD Mode Switch – As desired. We will set it to Semi-Automatic.
   - 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. This mode can waste many expendables.
2. Set CMD Selection Switch – BOTH (MIDDLE position). Both Chaff & Flares will be dispensed.
3. On TEWS page, set Mission Specific CMD Programming – As desired. **(Not simulated).**
4. CHF (Chaff) and FLR (Flare) counters are visible on the TEWS page.



WSO (Weapon Systems Officer) Cockpit

CMD (Countermeasure Dispenser) Mode Switch
- *OFF*
- *STBY (Standby)*
- *MAN ONLY (Manual Only)*
- *SEMI-AUTOMATIC*
- *AUTOMATIC*

1

CMD (Countermeasure Dispenser) Selection Switch
- *FWD: Chaff Only*
- *MIDDLE: Both Chaff & Flares*
- *AFT: Flares Only*

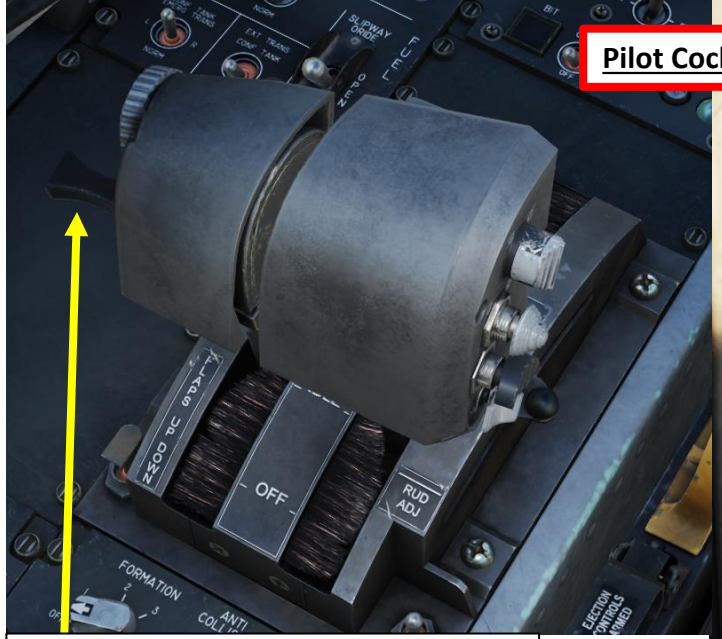
2

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALQ-45 Countermeasures Dispenser Set (CMD)

Chaff/Flare Program Dispensing Procedure:

5. Currently, the F-15E can only use two programs to dispense countermeasures: MAN1 or MAN2.
   - **MAN1** always releases a **fixed programmed** number of flares and chaff (8 of each by default, in two bursts of 1-2-1 within four seconds).
   - **MAN2** 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-Automatic position. If there are no threats detected, MAN 2 follows program set for MAN 1.
6. We will dispense countermeasures using the MAN 1 program.
   - **Pilot**: On throttle, Press the CMD Switch UP.
   - **WSO**: On Left Hand Controller, press CMD Switch UP.
7. When Chaff and Flares are being dispensed, the CHAFF and FLARE indicator lights illuminate.

Pilot Cockpit



CMD (Countermeasures Dispenser) Switch
- *UP: Dispenses MAN 1 (Manual 1) countermeasure program*
- *DOWN: Dispenses MAN 2 (Manual 2) countermeasure program*

6

CMD (Countermeasures Dispenser) Switch (Hidden)
- *UP: Dispenses MAN 2 (Manual 2) countermeasure program*
- *DOWN: Dispenses MAN 1 (Manual 1) countermeasure program*

6

WSO (Weapon Systems Officer) Cockpit

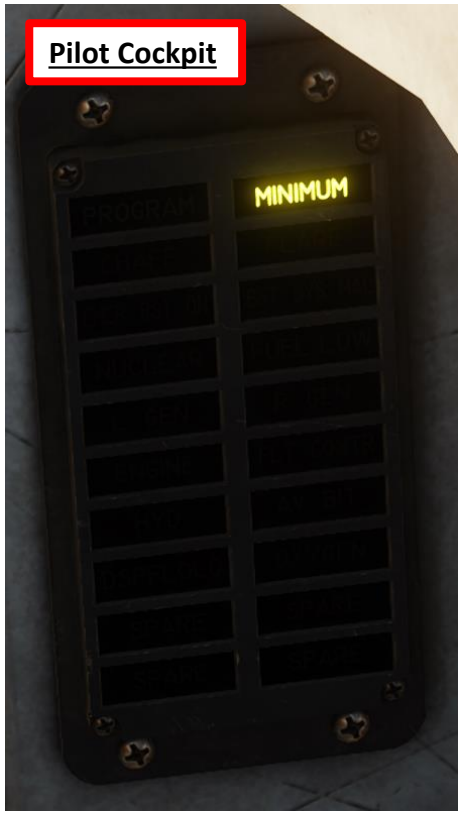
TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALQ-45 Countermeasures Dispenser Set (CMD)

Chaff/Flare Program Dispensing Procedure:

8. The MINIMUM warning light illuminates when any expendable store reaches a low quantity level. The light extinguishes once expendable count reaches zero.

WSO (Weapon Systems Officer) Cockpit

Pilot Cockpit



TEWS (TACTICAL ELECTRONIC WARNING SYSTEM) AN/ALQ-135 Internal Countermeasures Set (ICS)

The AN/ALQ-135 ICS is a software controlled **self-protection jammer**, which consists of RWR (Radar Warning Receiver) antennas, transmit antennas, amplifiers and control oscillators. The system is powered by setting the **ICS Switch to ON (FWD). RWR/ICS Mode Selector Switch** should be set to **COMBAT (FWD).**

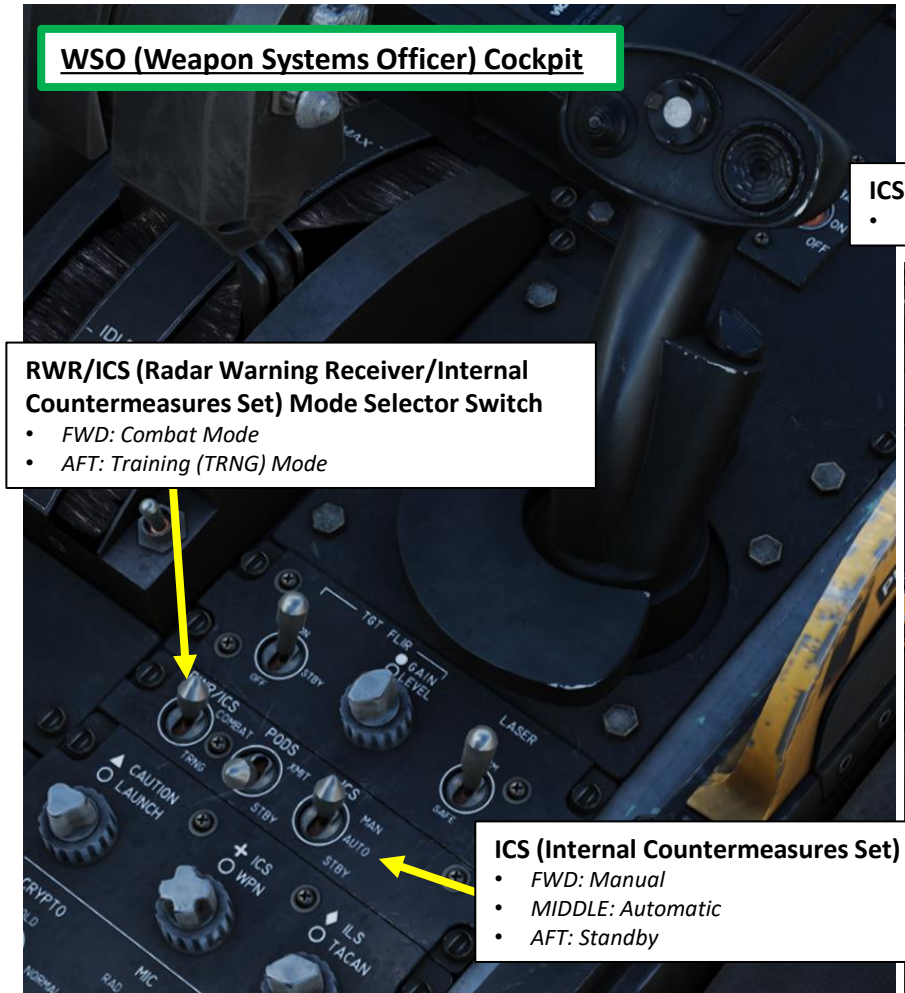
Since ICS works in bands 1.5 or 3 and neither have manual mode, setting the **ICS Mode Switch** to either **MAN** or **AUTO** position results in automatic operation. Setting it to **STBY** terminates any transmission from the ICS.

TEWS Page

ICS Band 3 and Band 1.5 Status

ICS Priority Control Set (Not Simulated)
- *Pressing this PB switches between AUTO, ATAK and DEFNS modes.*

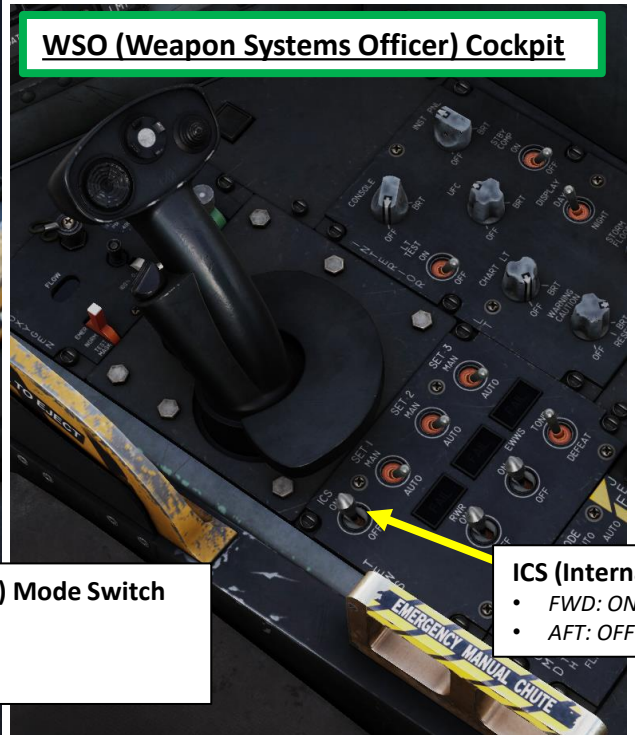
WSO (Weapon Systems Officer) Cockpit



RWR/ICS (Radar Warning Receiver/Internal Countermeasures Set) Mode Selector Switch
- *FWD: Combat Mode*
- *AFT: Training (TRNG) Mode*

ICS (Internal Countermeasures Set) Mode Switch
- *FWD: Manual*
- *MIDDLE: Automatic*
- *AFT: Standby*

WSO (Weapon Systems Officer) Cockpit

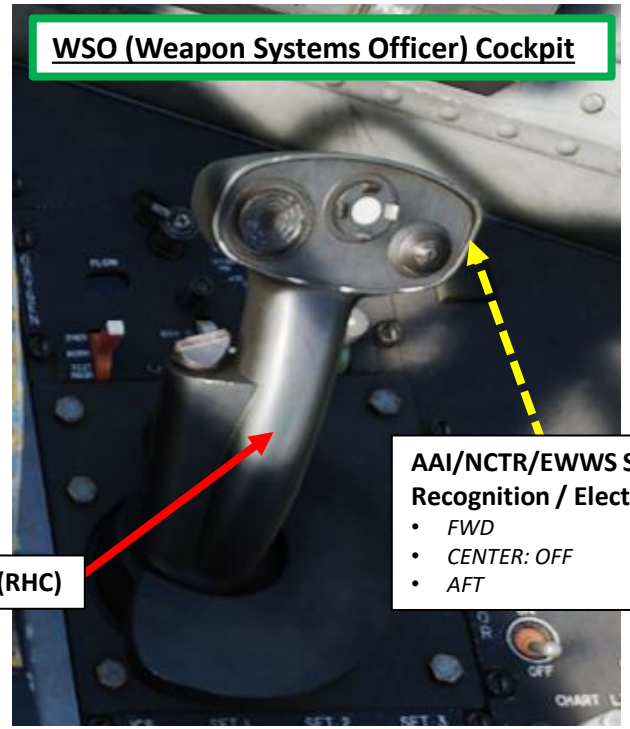


ICS (Internal Countermeasures Set) Switch
- *FWD: ON*
- *AFT: OFF*

TEWS (TACTICAL ELECTRONIC WARNING SYSTEM)
AN/ALQ-128 Electronic Warfare Warning Set (EWWS)

EWWS is not simulated.

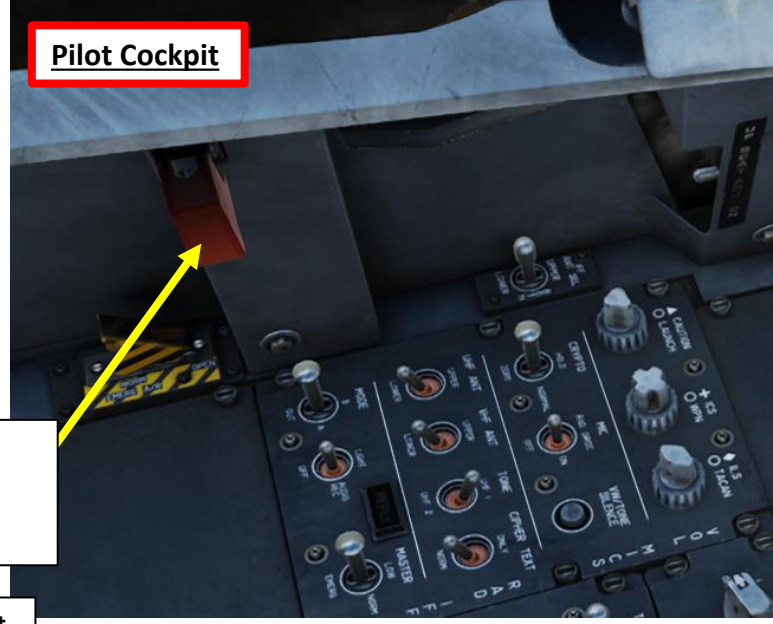
WSO (Weapon Systems Officer) Cockpit



Right Hand Controller (RHC)

AAI/NCTR/EWWS Switch (Air-to-Air Interrogator / Non-Cooperative Target Recognition / Electronic Warfare Warning Set) (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

Pilot Cockpit



EWWS (Electronic Warfare Warning Set) Power Switch (Not Simulated)
- *FWD: ON*
- *AFT: OFF*

WSO (Weapon Systems Officer) Cockpit

PODS Switch (Not Simulated)
- *FWD: XMIT (Transmit)*
- *AFT: STBY (Standby)*

TEWS (Tactical Electronic Warning System) SET-1, SET-2 and SET-3 Switches
- *FWD: Manual Jammer Modes*
- *AFT: Automatic Jammer Modes*

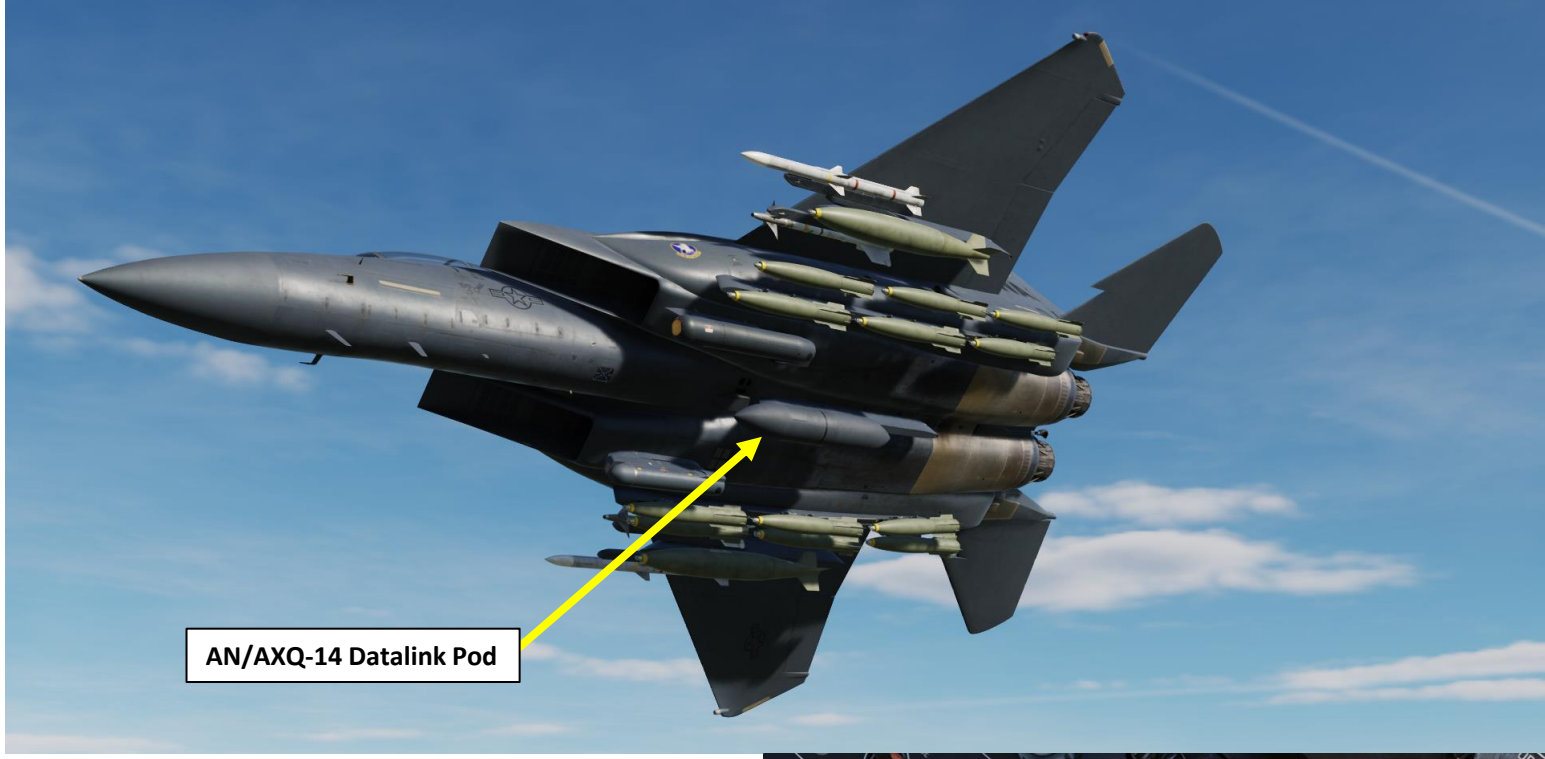
WSO (Weapon Systems Officer) Cockpit

TEWS SET-1, SET-2, and SET-3 FAIL Lights

EWWS (Electronic Warfare Warning System) Enable Switch (Not Simulated)
- *UP: ON*
- *DOWN: OFF*

DATALINK

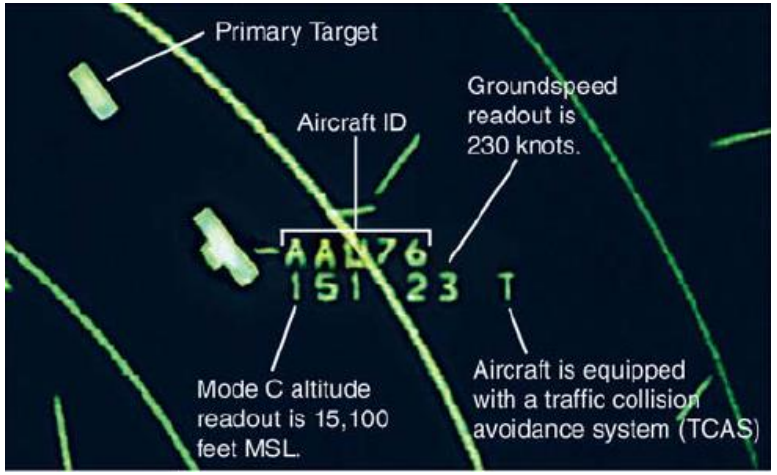
Note: Datalink & JTIDS (Joint Tactical Information Distribution System) are not implemented yet for the DCS F-15E.



JTIDS (Joint Tactical Information Distribution System) Master Control Selector

- *OFF*
- *POLL*
- *NORM (Normal)*
- *SIL*
- *HOLD*

1 – IFF INTRODUCTION



Identifying what you may or may not shoot should be your primary concern at all times. This is where the IFF (Identify-Friend-or-Foe) system comes into play.

An IFF system consists of an **INTERROGATOR** component and a **TRANSPONDER** component.

The **interrogator** component broadcasts an interrogation signal with a specific "code" (pulse frequency).

A **transponder** equipped on another aircraft will receive the interrogation signal and broadcast a reply signal with its own "code" (pulse frequency) as well. The information sent from this reply signal will vary based on the transponder mode selected.

Your own aircraft transponder will then see if the interrogation code and reply codes match, which in some cases can be used to determine whether the other aircraft is a friendly contact. The nature of the information determined will vary based on the transponder mode.

Take note that if you set an incorrect transponder code, friendly contacts may not be able to identify you as a friendly.

2 – IFF MODES & PRINCIPLES

In its simplest form, a "Mode" or interrogation type is generally determined by pulse spacing between two or more interrogation pulses. Various modes exist from Mode 1 to 5 for military use, to Mode A, C, and Mode S for civilian use. The takeaway from this table should be:

- **Mode 4 is the preferred mode in a combat** scenario because it is highly secure (encrypted). Encrypted interrogation codes cannot be detected by an enemy transponder, and your transponder will not broadcast a reply signal to the other team.
- **Mode 4 invalid/lack of reply cannot guarantee that an aircraft is hostile**, but a **valid reply is a guarantee of a friendly contact** (within DCS)
- **Modes 1, 2, and 3 are not secure to use** since any other aircraft from the opposing team could find what your Interrogator code is and set his transponder to it, fooling you into thinking he is a friendly contact. These modes also easily give away your position since every time your transponder broadcasts an answer, this signal can be intercepted by an enemy transponder, which can send your position to other enemy fighters via datalink.

Military Interrogation Mode	Civilian Interrogation Mode	Description
1		Provides 2-digit 5-bit mission code
2		Provides 4-digit octal unit code (set on ground for fighters, can be changed in flight by transport aircraft)
3	A	Provides a 4-digit octal identification code for the aircraft, set in the cockpit but assigned by the air traffic controller. Mode 3/A is often combined with Mode C to provide altitude information as well.
	C	Provides the aircraft's pressure altitude and is usually combined with Mode 3/A to provide a combination of a 4-digit octal code and altitude as Mode 3 A/C, often referred to as Mode A and C
4		Provides a 3-pulse reply, delay is based on the encrypted challenge
5		Provides a cryptographically secured version of Mode S and ADS-B GPS position
S		Mode S (Select) is designed to help avoiding overinterrogation of the transponder (having many radars in busy areas) and to allow automatic collision avoidance. Mode S transponders are compatible with Mode A and Mode C Secondary Surveillance Radar (SSR) systems. This is the type of transponder that is used for TCAS or ACAS II (Airborne Collision Avoidance System) functions

2 – IFF MODES & PRINCIPLES

The “Interrogator” component of the IFF system is used to interrogate unknown contacts. The “Transponder” component of the IFF system is used to respond to interrogations from other aircraft.

It is very important to explain F-15 system terminology when it comes to target identification:

- **IFF** (Identify-Friend-or-Foe): Refers to your transponder (“Squawk code”), how your aircraft responds to interrogation signals from other aircraft.
- **AAI** (Air-to-Air Interrogator): Refers to one of two methods/systems to interrogate other aircraft. Typically, AAI is used to find friendlies (like your wingman or an air-to-air refueling tanker). For the purposes of DCS, AAI functionally works pretty much the same as EID.
- **EID** (Enhanced Identification): Refers to one of two methods/systems to interrogate other aircraft. Typically, EID is used to find enemy fighters based on ROE (Rules of Engagement). For the purposes of DCS, EID functionally works pretty much the same as AAI.
- **NCTR** (Non-Cooperative Target Recognition): Compares the radar signature of a target to a library and determines what type of aircraft you are looking at. NCTR does not tell you whether an aircraft is friendly or not.

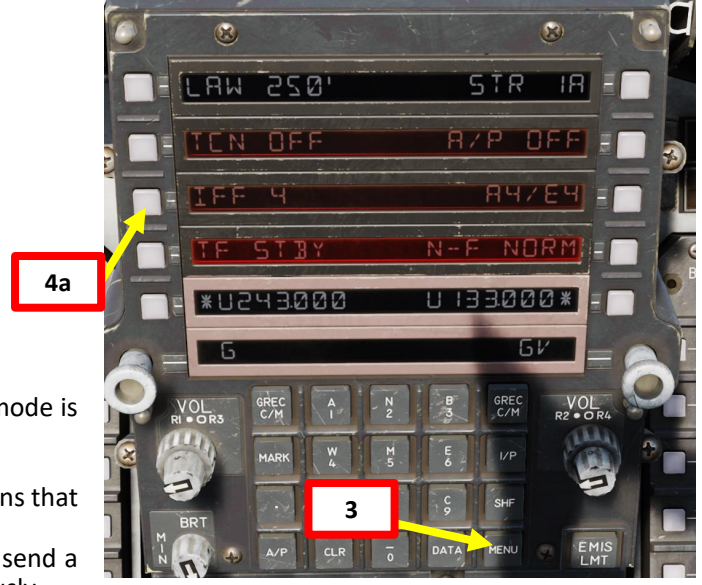
Interrogation Code (Who are you?)	Transponder Code (Who am I?)
Mode 4	Mode 4
Key A	Key A

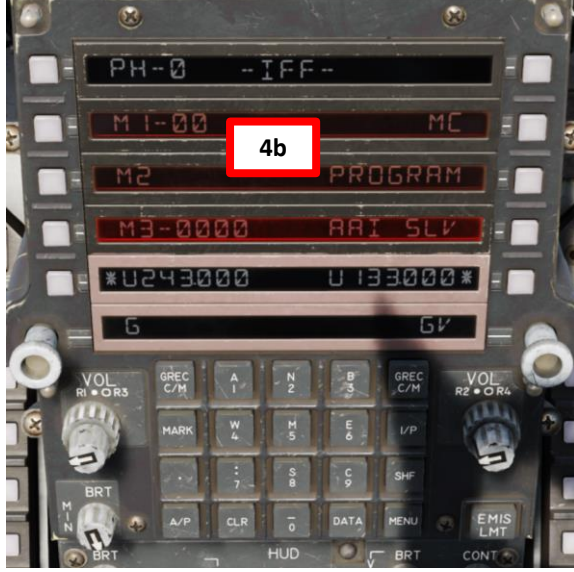
3 – IFF TRANSPONDER SETUP MODES 1, 2, or 3

If you want to set up the transponder code “1225” for Mode 3 :

1. Set IFF Master Switch – NORM (MIDDLE)
2. Set IFF Antenna Selector Switch – BOTH (MIDDLE)
3. Select UFC (Upfront Control Panel) MENU 1.
4. Press pushbutton next to IFF to select IFF Menu.
5. Enter code “1225” on the UFC scratchpad.
6. Press pushbutton next to “M3” to set Mode 3 Code 1225. The asterisk (*) indicates the mode is active.
7. Select UFC (Upfront Control Panel) MENU 1.
8. From UFC (Upfront Control Panel) MENU 1, the “IFF” data field should list “3”, which means that IFF Mode 3 is selected. In this example, “34” means that Mode 4 is also activated as well.
9. If you are interrogated with mode 3 with a code set to 1225, the transponder will then send a response signal (reply) to the interrogator with the transponder code you entered previously.
10. If the tower wants to know your position, they are likely to send you a specific IFF mode and code, then as, you to “Identify”. This requires you to press the I/P (Identification/Position) Button, which will allow the tower to know where you are from your transponder’s identification signal/transmission.

- *Note 1: Codes for Mode 1 and 3 may be changed directly from Menu 1 by typing in the mode, dash and code on the keyboard (for instance for Mode 3 code 1234, press 3, SHF, -, 1,2,3,4 and press the IFF button).*
- *Note 2: Mode 2 code can only be set up on the ground (done in game via special tab in the Mission Editor).*

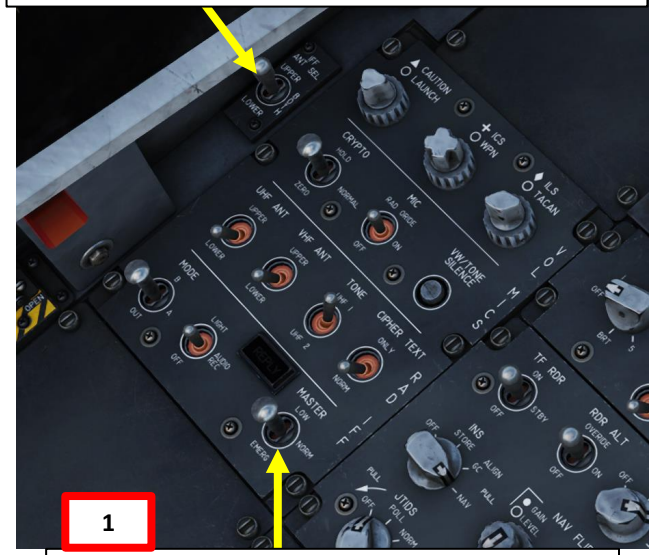




IFF (Identify-Friend-or-Foe) Antenna Select Switch

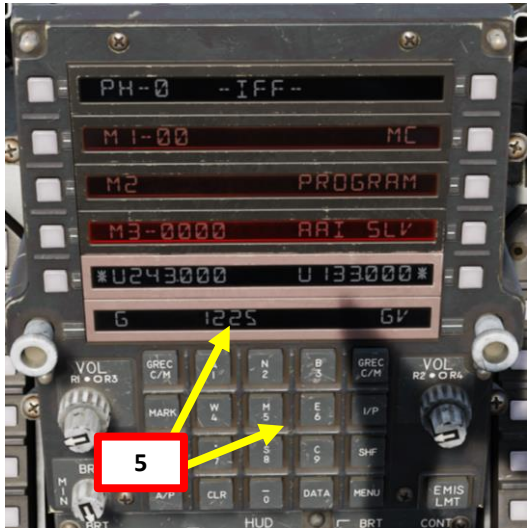
- *FWD: Upper antenna selected*
- *MIDDLE: BOTH antennas selected*
- *AFT: Lower antenna selected*

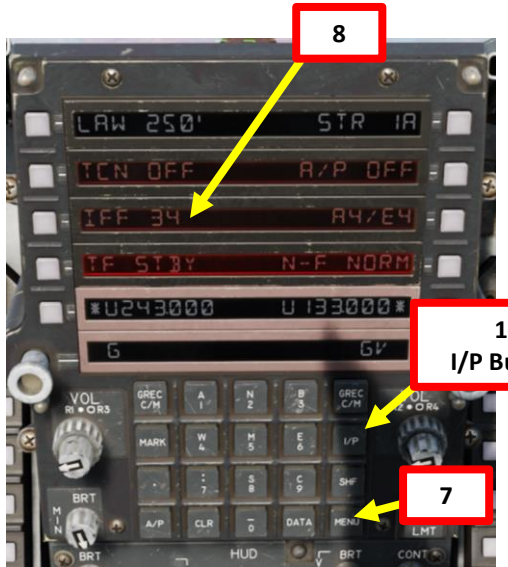
2



IFF (Identify-Friend-or-Foe) Master Switch

- *FWD: LOW, system operates in reduced sensitivity*
- *MIDDLE: NORM, full system sensitivity is enabled*
- *AFT: EMERG, enables response to interrogations in modes 1, 2, 3A, C and 4*

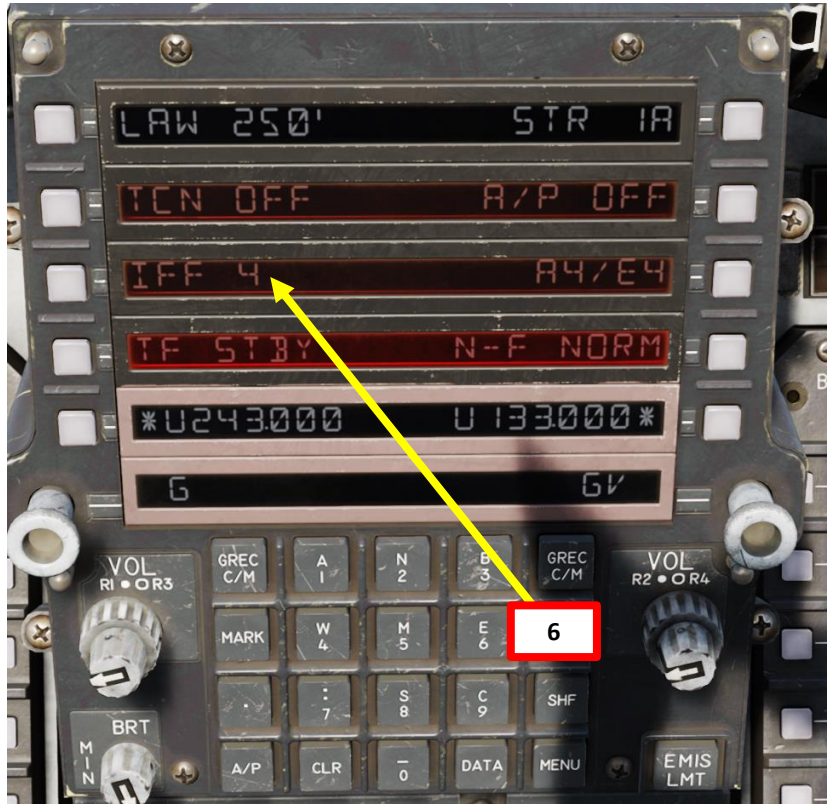


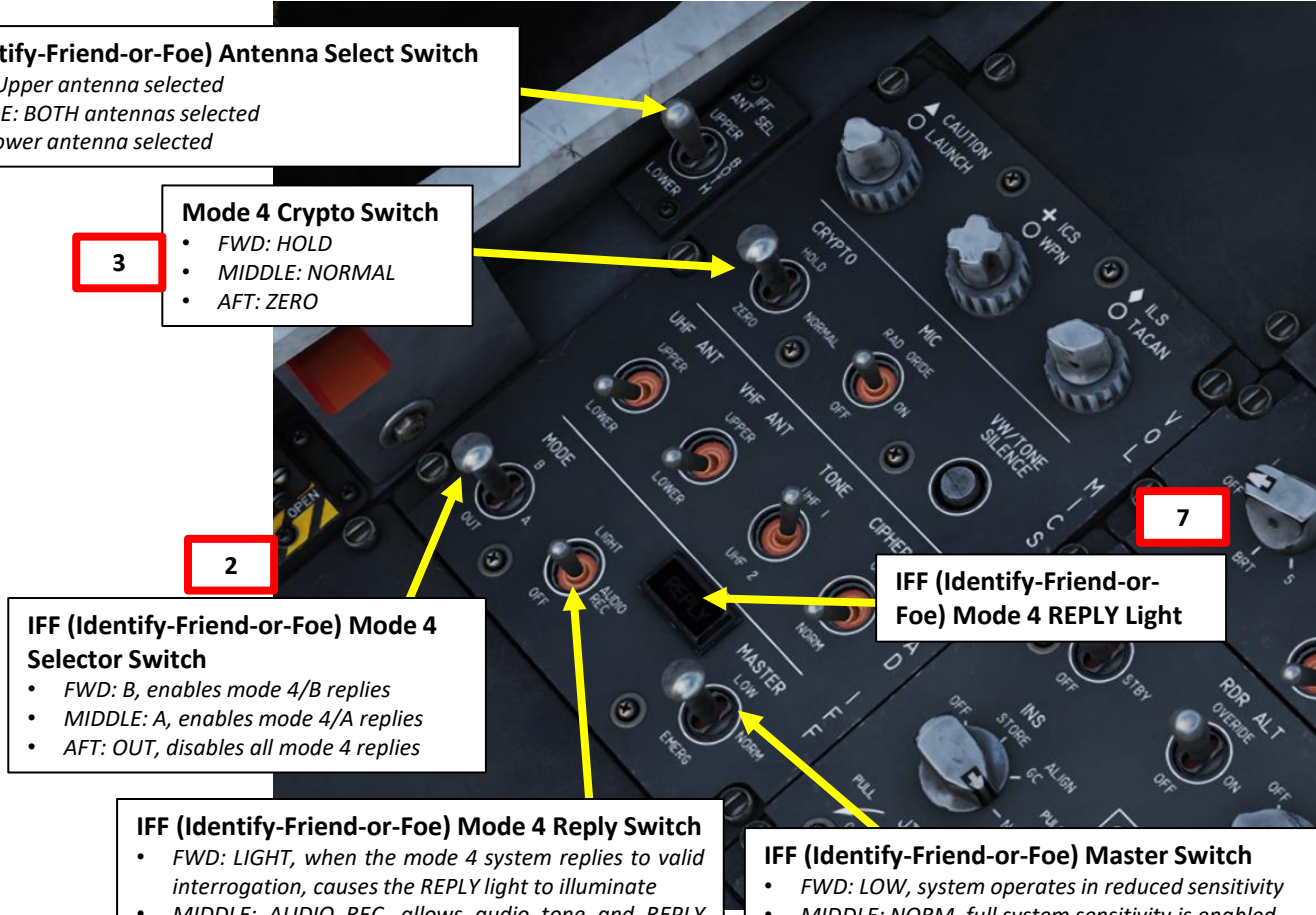


3 – IFF TRANSPONDER SETUP MODE 4

If you want to set up the transponder code for Mode 4A:

1. Set IFF Master Switch – NORM (MIDDLE)
2. Set IFF Mode 4 Selector Switch – A (MIDDLE)
3. Set Mode 4 Crypto Switch – NORMAL (MIDDLE)
4. Set IFF Antenna Selector Switch – BOTH (MIDDLE)
5. Set IFF Mode 4 Reply Switch – As desired (LIGHT or AUDIO REC).
6. From UFC (Upfront Control Panel) MENU 1, the "IFF" data field should list "4", which means that IFF Mode 4 is selected.
7. If the REPLY light illuminates, this means you are interrogated with a mode 4 encrypted interrogator. The transponder will automatically respond for you based on the IFF Mode 4 Selector Switch position.





4 **IFF (Identify-Friend-or-Foe) Antenna Select Switch**
- *FWD: Upper antenna selected*
- *MIDDLE: BOTH antennas selected*
- *AFT: Lower antenna selected*

3 **Mode 4 Crypto Switch**
- *FWD: HOLD*
- *MIDDLE: NORMAL*
- *AFT: ZERO*

7 **IFF (Identify-Friend-or-Foe) Mode 4 REPLY Light**

2 **IFF (Identify-Friend-or-Foe) Mode 4 Selector Switch**
- *FWD: B, enables mode 4/B replies*
- *MIDDLE: A, enables mode 4/A replies*
- *AFT: OUT, disables all mode 4 replies*

IFF (Identify-Friend-or-Foe) Mode 4 Reply Switch
- *FWD: LIGHT, when the mode 4 system replies to valid interrogation, causes the REPLY light to illuminate*
- *MIDDLE: AUDIO REC, allows audio tone and REPLY light to illuminate when the mode 4 system replies to valid interrogation*
- *AFT: OFF*

5

IFF (Identify-Friend-or-Foe) Master Switch
- *FWD: LOW, system operates in reduced sensitivity*
- *MIDDLE: NORM, full system sensitivity is enabled*
- *AFT: EMERG, enables response to interrogations in modes 1, 2, 3A, C and 4*

1

4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

The AAI set, in conjunction with the radar set, provides air-to-air target identification capabilities. The interrogator set transmits challenge signals and receives target AAI replies through antennas mounted on the main radar antenna. AAI interrogation can be selected from either the Air-to-Air Interrogation (AAI) or Enhanced Identification (EID) UFC submenu. Within each submenu there are multiple modes of AAI interrogations.

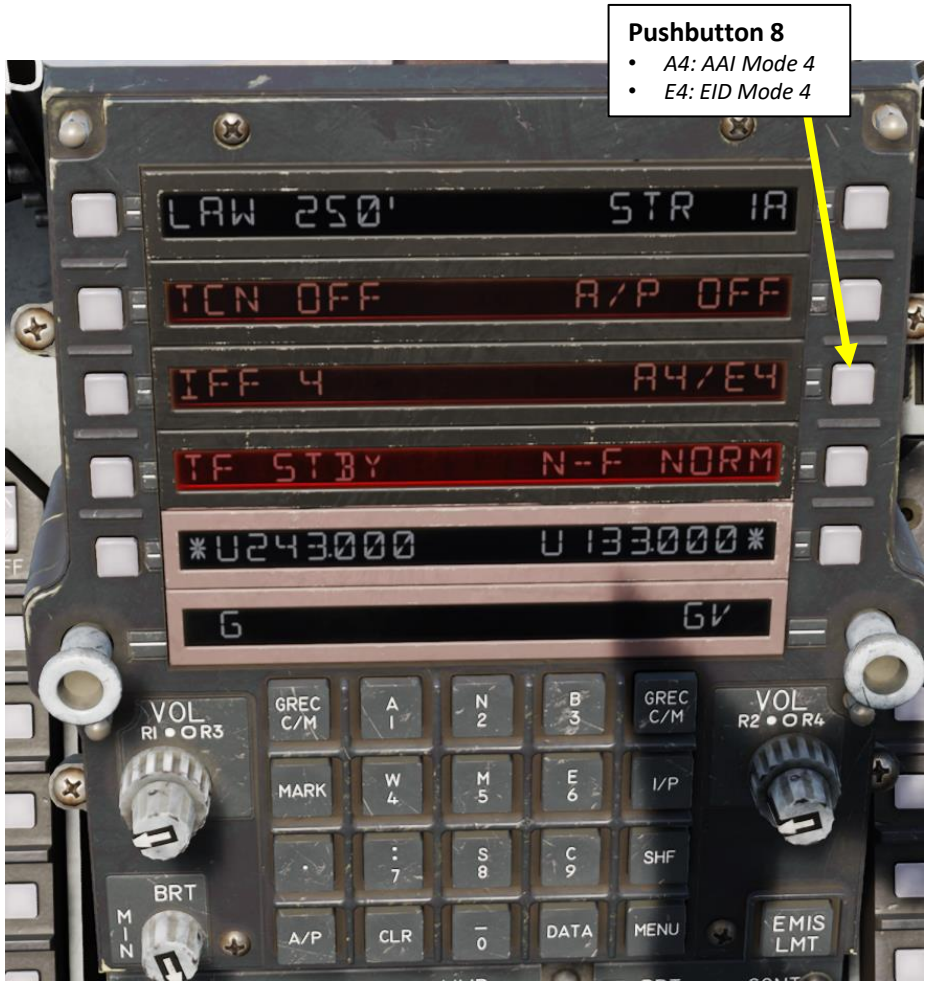
AAI and EID have basically the same function, with only difference between them being that they use different HOTAS functions to work.

AAI/EID information is displayed next to pushbutton in Menu 1. When not interrogating, UFC menu 1 Pushbutton 8 displays only AAI/EID. If interrogation is in progress, additional information on enabled modes and codes will be visible in the window next to Pushbutton 8.

If normal or automatic interrogation is in progress, an A followed by the currently enabled AAI modes and an "E" followed by modes enabled for EID are displayed. Pressing Pushbutton 8 brings up a separate menu that allows to the aircrew to set up desired combinations of modes, codes, correct code or normal, and the number of bars for each mode.

The letter "**C**" follows the code for modes 1, 2, or 3 when correct code is selected to display only replies that respond with the correct code.

The letter "**N**" is displayed for normal mode to display all returns from the selected mode.

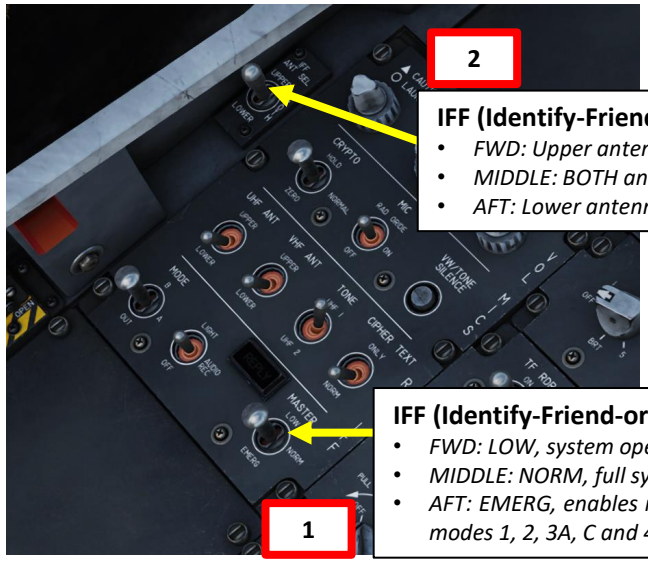


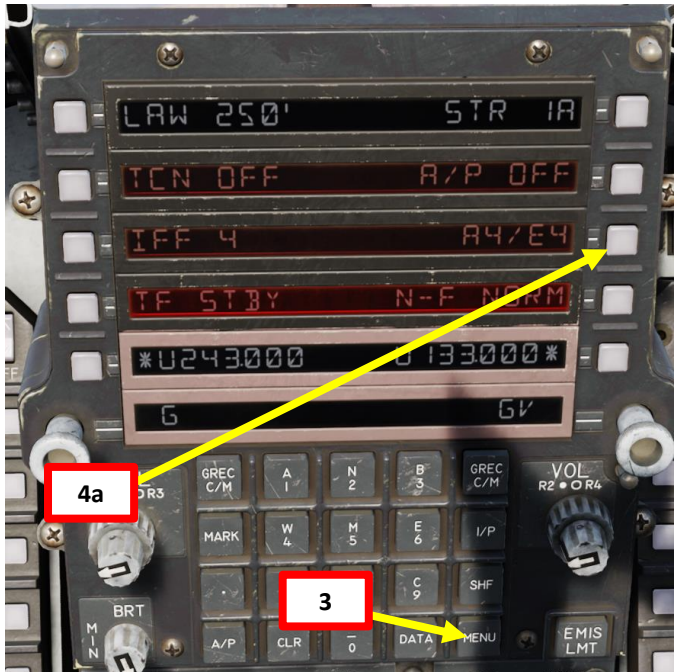
4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

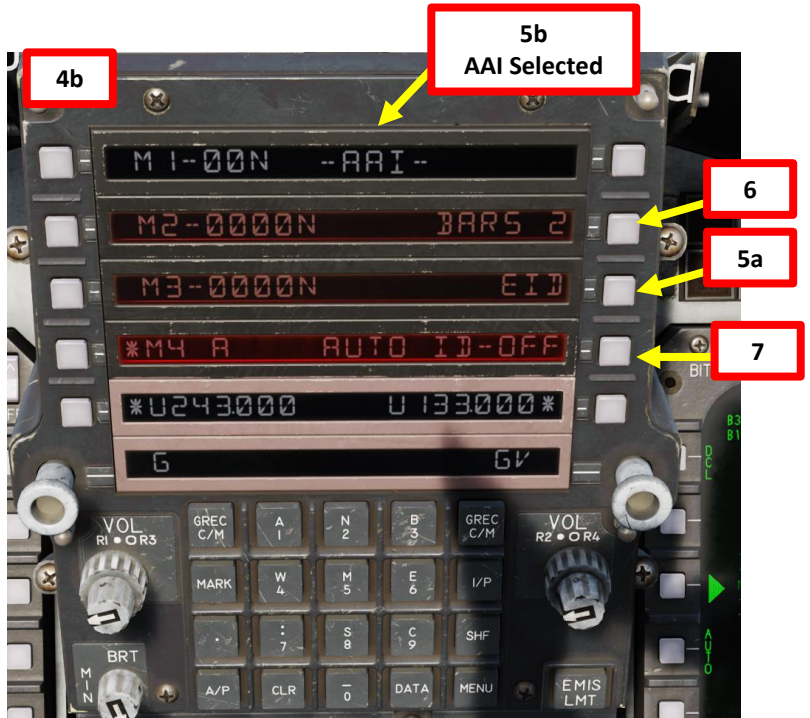
In this example, we will interrogate a target with a combination of the following interrogation modes:

- **Mode 1, Code "11", "C" (Correct) setting.**
- **Mode 3, Code "1225", "N" (Normal) setting,**
- **Mode 4A.**

1. Set IFF Master Switch – NORM (MIDDLE)
2. Set IFF Antenna Selector Switch – BOTH (MIDDLE)
3. Select UFC (Upfront Control Panel) MENU 1.
4. Press pushbutton next to AAI/EID Menu.
5. Select AAI or EID sub-menu – As desired. We will select AAI.
6. Select 2 bar or 4 bar interrogation – As desired. We will select 2 BARS.
7. If desired, select Auto Identification (AUTO ID) function. We will leave it to OFF for simplicity.
    - OFF: interrogations should be done manually by the aircrew
    - STT: the system will automatically interrogate contacts locked in Single Target Track mode
    - PDT: the system will automatically interrogate contacts both in STT and Primary Designated Track (TWS, Track While Scan) mode.



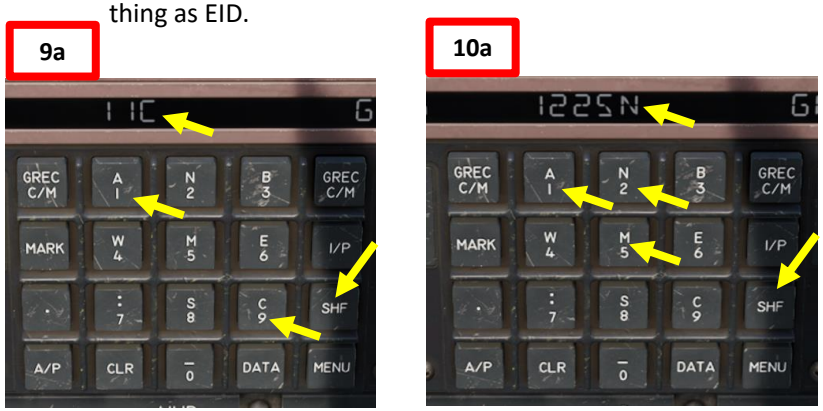


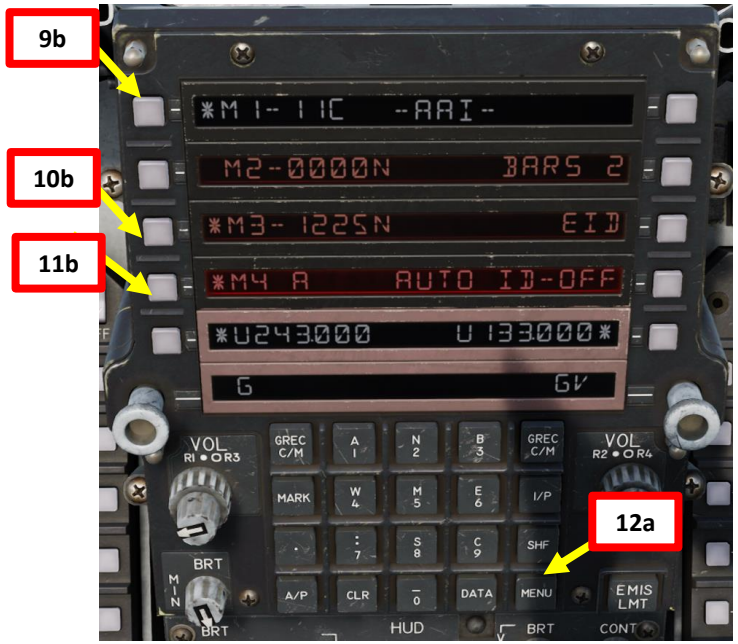


4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

- **Mode 1, Code "11", "C" (Correct) setting.**
- **Mode 3, Code "1225", "N" (Normal) setting,**
- **Mode 4A.**

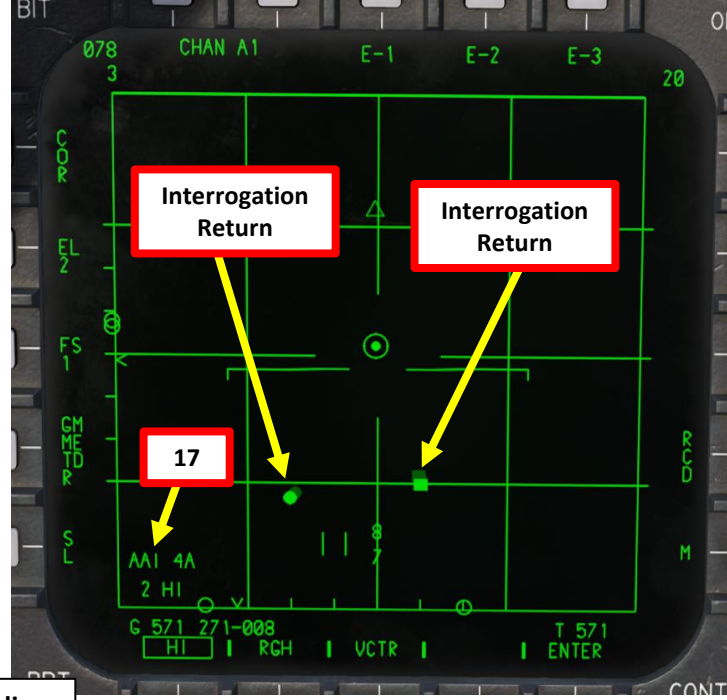
8. Press pushbuttons next to desired modes (M1, M3 and M4) to activate them. The asterisks (*) indicate active modes.
9. Set Mode 1 Setting: Enter code "11" on the UFC scratchpad, then press "SHF", then press "9" (C). Press pushbutton next to "M1" to enter data.
    - Correct code (C) setting is selected to display only replies that respond with the correct code
10. Set Mode 3 Setting: Enter code "1225" on the UFC scratchpad, then press "SHF", then press "2" (N). Press pushbutton next to "M3" to enter data.
    - Normal mode (N) setting is used to display all returns from the selected mode.
11. Set Mode 4 Setting: Press "SHF" on the UFC scratchpad, then press "1" (A). Press pushbutton next to "M4" to enter data.
    - The only options for M4 are M4A, M4B or M4AB.
    - The N or C is not displayed or selectable for mode 4 interrogations since correct code is always selected and the codes interrogated are programmed electronically by maintenance personnel.
12. Select UFC (Upfront Control Panel) MENU 1.
13. On AAI/EID data field, "A134" indicates that interrogation modes are activated for Mode 1, Mode 3 and Mode 4.
14. If desired, you can do the same process in the EID menu. We will just use AAI for simplicity since it functionally does the same thing as EID.





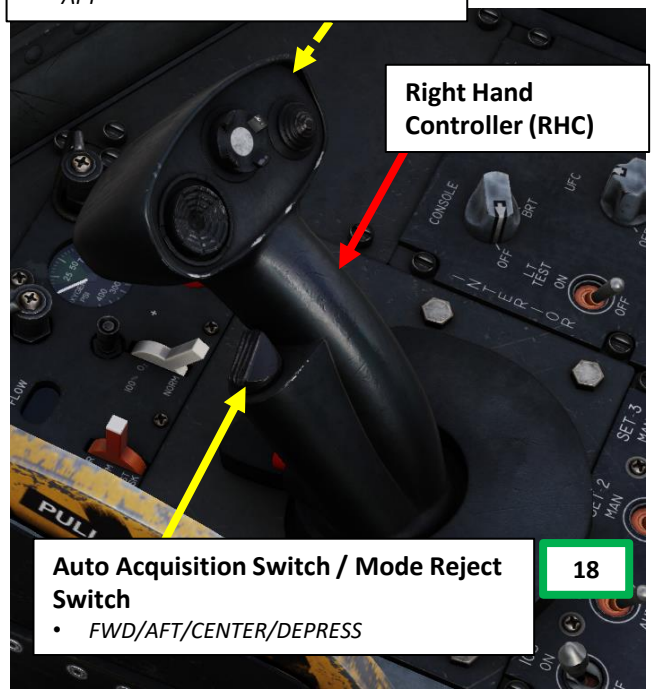
4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

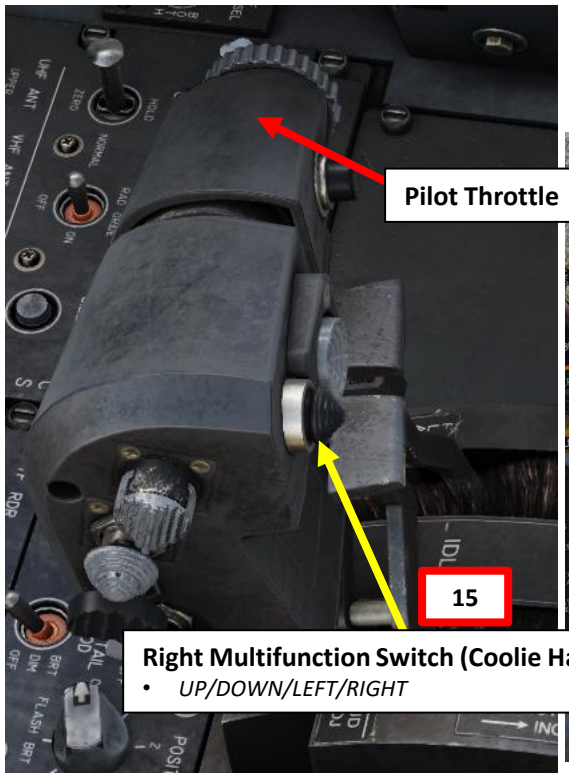
15. To start interrogating contacts in AAI mode:
    - **Pilot**: On throttle, press Coolie Switch OUTBOARD (LEFT) for more than 1 sec.
    - **WSO**: On Right Hand Controller, press AAI/NCTR/EWWS Switch FWD for more than 1 sec.
16. **(Not applicable to this tutorial)** To start interrogating contacts in EID mode:
    - **Pilot**: On throttle, press Coolie Switch INBOARD (RIGHT) for more than 1 sec.
    - **WSO**: On Right Hand Controller, press AAI/NCTR/EWWS Switch AFT for more than 1 sec.
17. Current interrogation mode is displayed on the UFC MENU 1 ("AAI 4A" means interrogation is currently performed with Mode 4A) and on the A/A RDR display as well. Radar symbology will tell you what kind of response you are getting.
18. Interrogation can be stopped by pressing the respective control once again or by depressing Auto Acquisition Switch / Mode Reject Switch.



AAI/NCTR/EWWS Switch (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

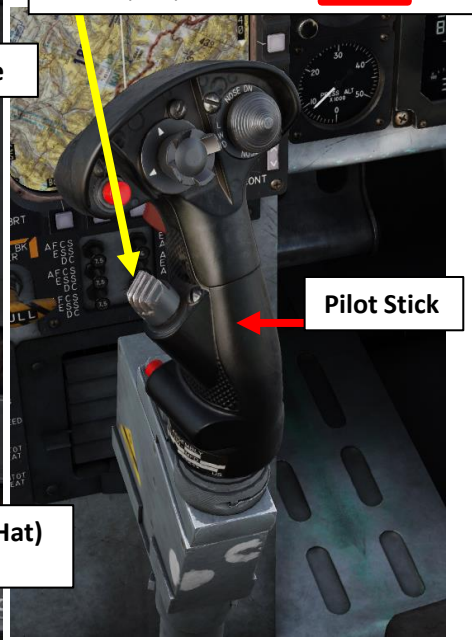
15





Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

18



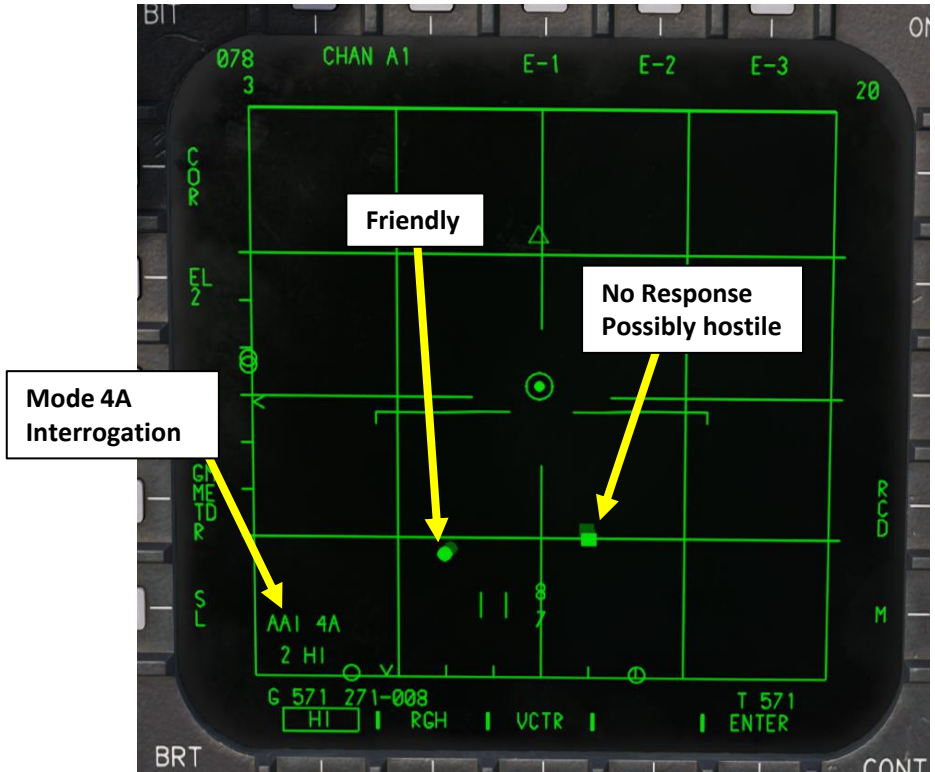
4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

19. The normal interrogation mode is used to identify a target by mode only.

- For **Interrogation Modes 1 through 3**:
  - A **diamond** symbol is displayed when a target replies to AAI mode 1 thru 3 interrogations (friendly). The correct code interrogation mode is used when the target mode and code are known. In radar search, all correct mode and code replies are displayed as a diamond at the proper azimuth and range.
  - In modes 1-3, there is no high confidence and low confidence distinction.

- For **Interrogation 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 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.
  - 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**.

- In STT (Single Target Track), the AAI symbol mipples (switches between ambiguous emitters) with the PDT Star for the length of interrogation plus 2 seconds for TWS (Track While Scan) 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).



Mode 4 Symbology

◆ ◇	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.

4 – AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION)

Here is an overview of the AAI symbology, as listed in the RAZBAM manual.

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.

Normal Search Low Confidence Return

Normal Search High Confidence Return

STT (Single Target Track) High Confidence Status

STT (Single Target Track) Home on Jam Return

Note: In modes 1-3 only diamond will be shown, there is no high confidence and low confidence distinction.

TWS HC Return mipples with PDT

DTWS Tentative Track File – LC (Low Confidence) Return

DTWS Tentative Track File – HC (High Confidence) Return

Interrogation In Progress

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

5 – NCTR (NON-COOPERATIVE TARGET RECOGNITION)

Non-Cooperative Target Recognition (NCTR) can be used to identify the aircraft type. This system compares turbine blade signatures of different engines to a database of associated aircraft types. This can be a useful system to identify the aircraft at beyond visual range of up to around 25 nm. Because NCTR requires the radar to see the engine blades, there some important requirements to meet:

1. The target nose or tail must be within 30-degrees in azimuth and elevation of your nose.
2. The target must be within about 25 nm
3. You must be in Single Target Track (STT) radar mode.

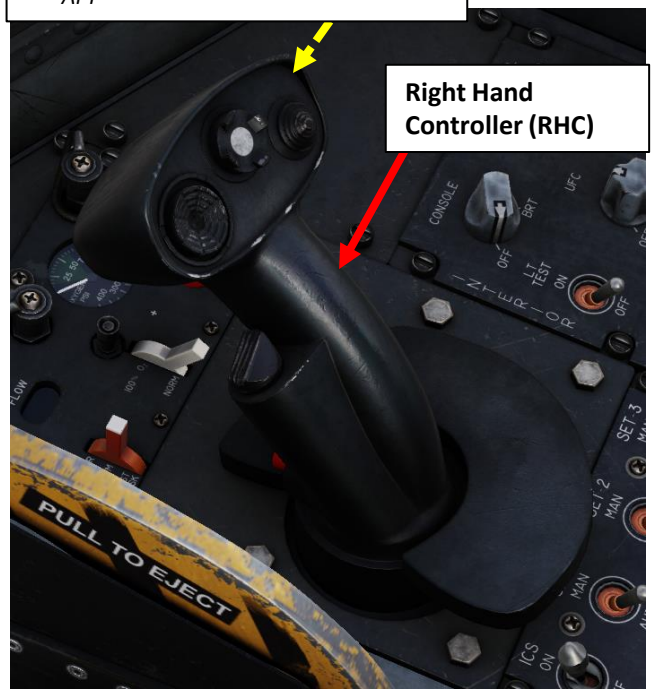
To interrogate with IFF (Identify-Friend-or-Foe) and NCTR at the same time, first set up EID modes as shown previously in the AAI/EID (AIR-TO-AIR-INTERROGATION/ENHANCED IDENTIFICATION) section. Radar lock a target, then:

- **Pilot**: On throttle, press Coolie Switch INBOARD (RIGHT) for less than 1 sec.
- **WSO**: On Right Hand Controller, press AAI/NCTR/EWWS Switch AFT for less than 1 sec.

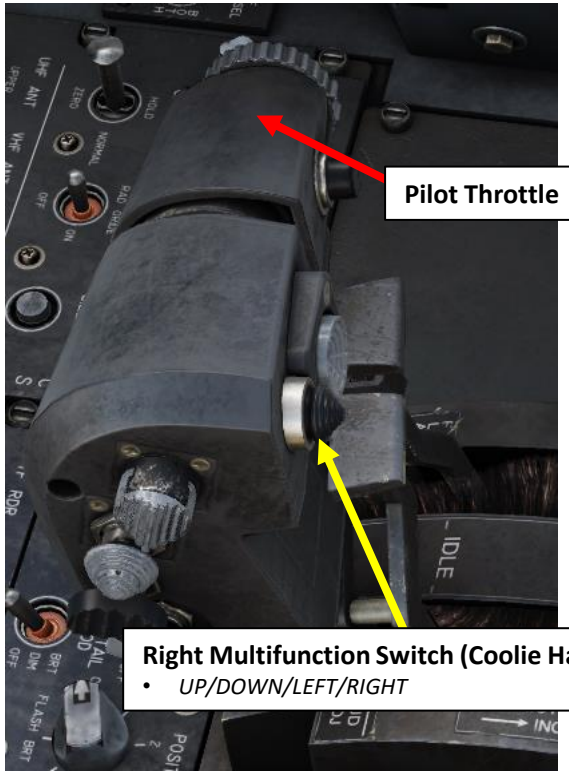
It will both perform an NCTR print on the target and perform an Identify Friend or Foe interrogation along the line of sight of the STT target.

NCTR (Non-Cooperative Target Recognition) Auto Enable Switch (Leave to OFF, not currently simulated)
- *FWD: ON*
- *AFT: OFF*

AAI/NCTR/EWWS Switch (Hidden)
- *FWD*
- *CENTER: OFF*
- *AFT*

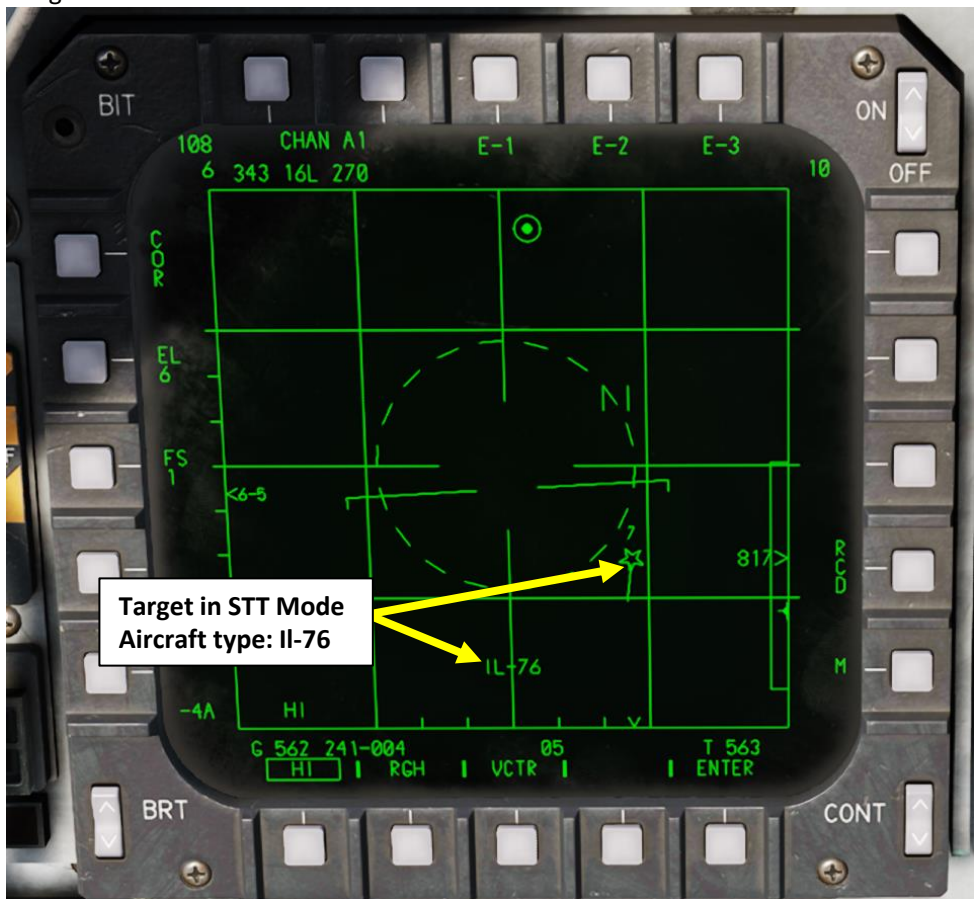


Right Hand Controller (RHC)



Pilot Throttle

Right Multifunction Switch (Coolie Hat)
- *UP/DOWN/LEFT/RIGHT*



Target in STT Mode Aircraft type: Il-76

COMMUNICATION SYSTEMS OVERVIEW

The F-15E has two radio sets:

- The AN/ARC-164 UHF Radio Set, which has 20 preset channels.
- The AN/ARC-210 V/UHF Radio Set, which also has 40 preset channels.

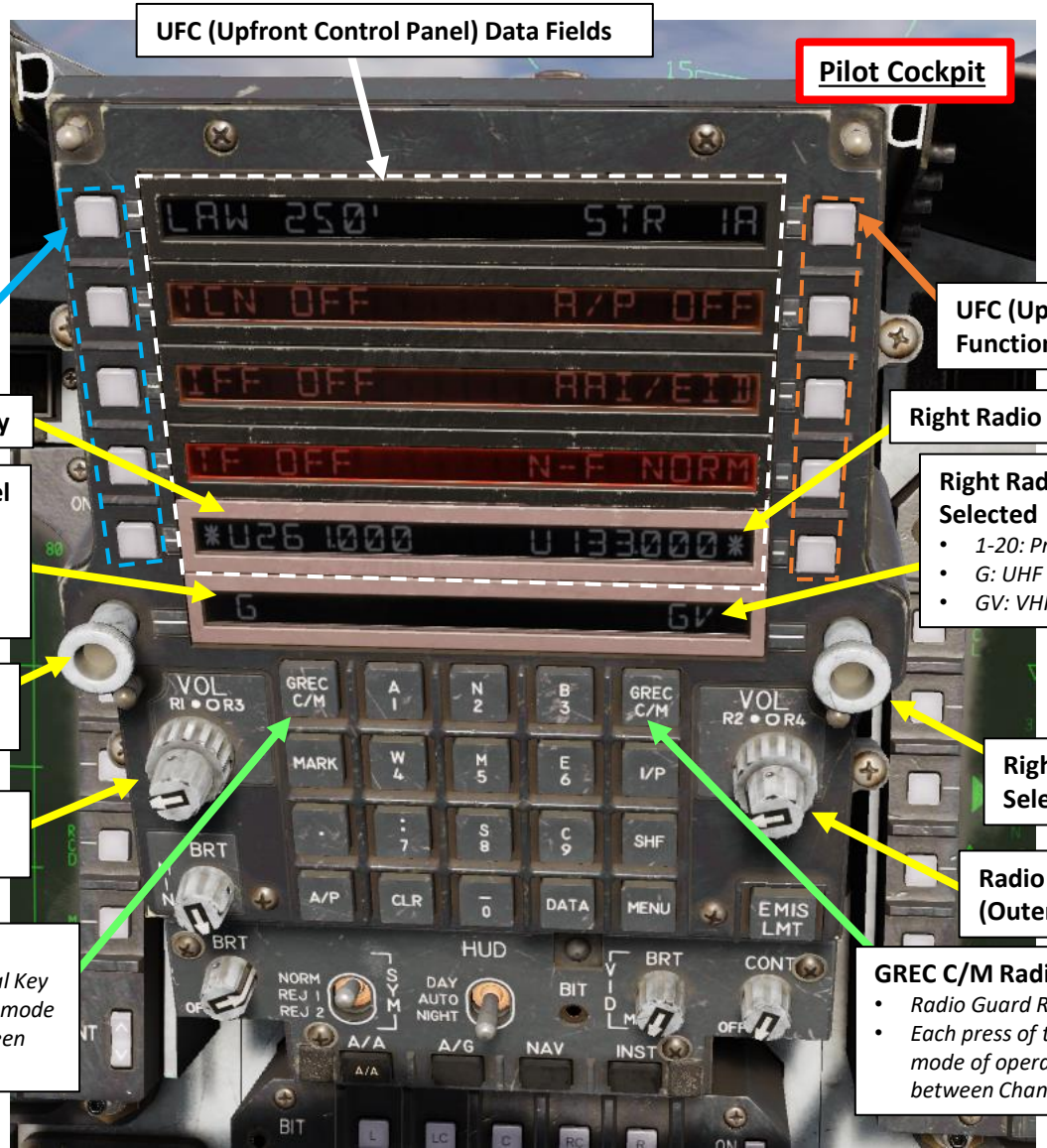
The Intercom is used for communications between the pilot and WSO (Weapon Systems Officer).

The radio interface comprises the UFC (Upfront Control Panel), Radio Intercommunications Control Panel, and Microphone Switch on the throttle.

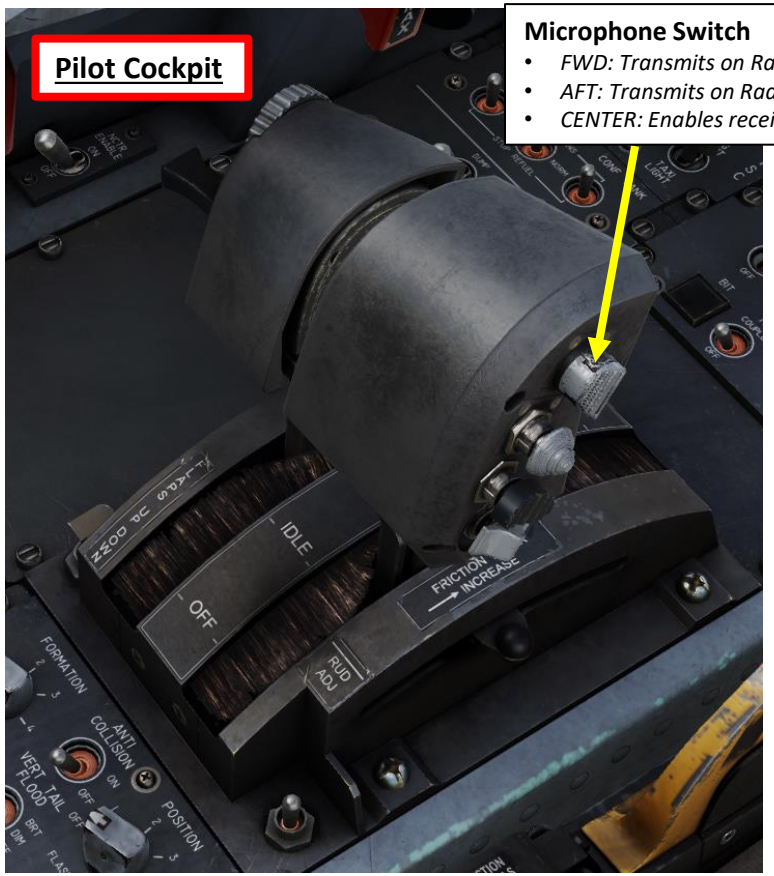
Note: Radio 3 and Radio 4 were not installed on the F-15E variant simulated.

AN/ARC-210 V/UHF Radio Frequency Range
- 30.000 to 87.975 MHz (FM)
- 108.000 to 115.975 MHz (AM, VHF)
- 118.000 to 173.975 MHz (AM, VHF)
- 225.000 to 399.975 MHz (AM, UHF)

AN/ARC-164 UHF Radio Frequency Range
- 225.000 to 399.975 MHz (AM, UHF)

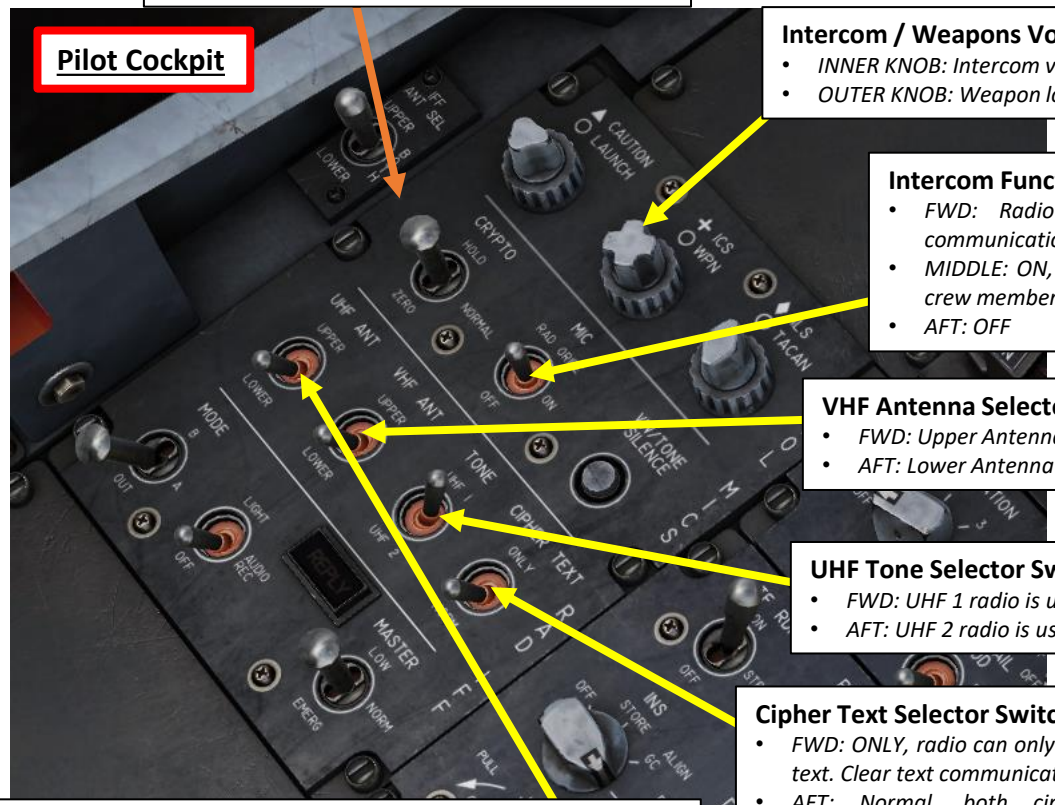


COMMUNICATION SYSTEMS OVERVIEW



Microphone Switch
- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

Radio Intercommunications Control Panel



Intercom / Weapons Volume Knob
- *INNER KNOB: Intercom volume control*
- *OUTER KNOB: Weapon lockon tone volume control*

Intercom Function Selection (Mic) Switch
- *FWD: Radio override, overrides the radio communications in favour of the intercom*
- *MIDDLE: ON, direction communication between crew members*
- *AFT: OFF*

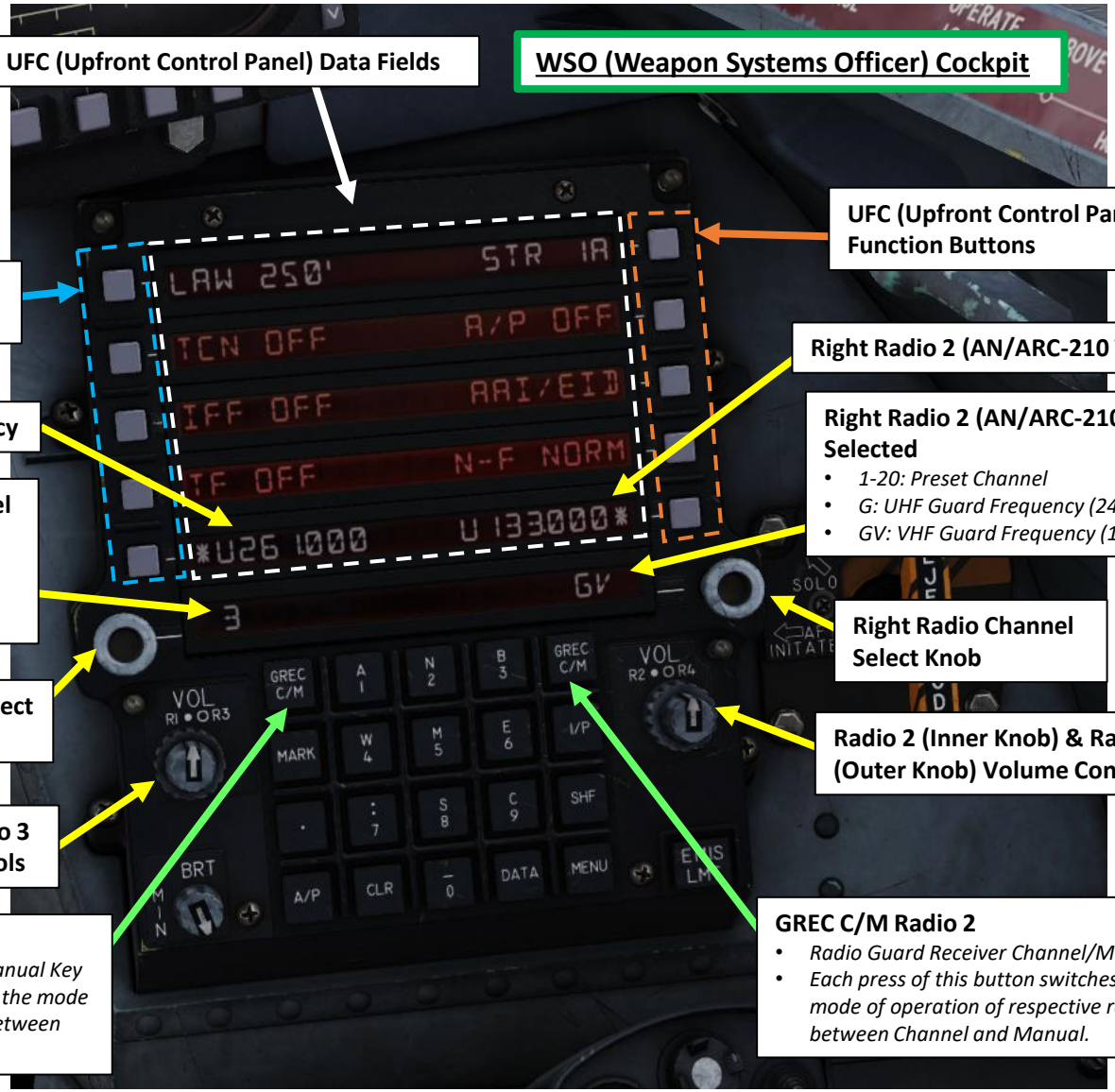
VHF Antenna Selector Switch
- *FWD: Upper Antenna*
- *AFT: Lower Antenna*

UHF Tone Selector Switch
- *FWD: UHF 1 radio is used to transmit the tone*
- *AFT: UHF 2 radio is used to transmit the tone*

Cipher Text Selector Switch
- *FWD: ONLY, radio can only receive the ciphered (encrypted) text. Clear text communications are not received.*
- *AFT: Normal, both ciphered text and clear text communications are received.*

UHF Antenna Selector Switch
- *FWD: Upper Antenna for UHF 1 Radio, Lower Antenna for UHF 2 Radio*
- *AFT: Lower Antenna for both UHF 1 and UHF 2 Radios*

COMMUNICATION SYSTEMS OVERVIEW



UFC (Upfront Control Panel) Data Fields

WSO (Weapon Systems Officer) Cockpit

UFC (Upfront Control Panel) Function Buttons

UFC (Upfront Control Panel) Function Buttons

Right Radio 2 (AN/ARC-210 V/UHF) Frequency

Left Radio 1 (AN/ARC-164 UHF) Frequency

Right Radio 2 (AN/ARC-210 V/UHF) Channel Selected
- *1-20: Preset Channel*
- *G: UHF Guard Frequency (243.0 MHz)*
- *GV: VHF Guard Frequency (121.5 MHz)*

Left Radio 1 (AN/ARC-164 UHF) Channel Selected
- *1-20: Preset Channel*
- *G: UHF Guard Frequency (243.0 MHz)*
- *GV: VHF Guard Frequency (121.5 MHz)*

Right Radio Channel Select Knob

Left Radio Channel Select Knob

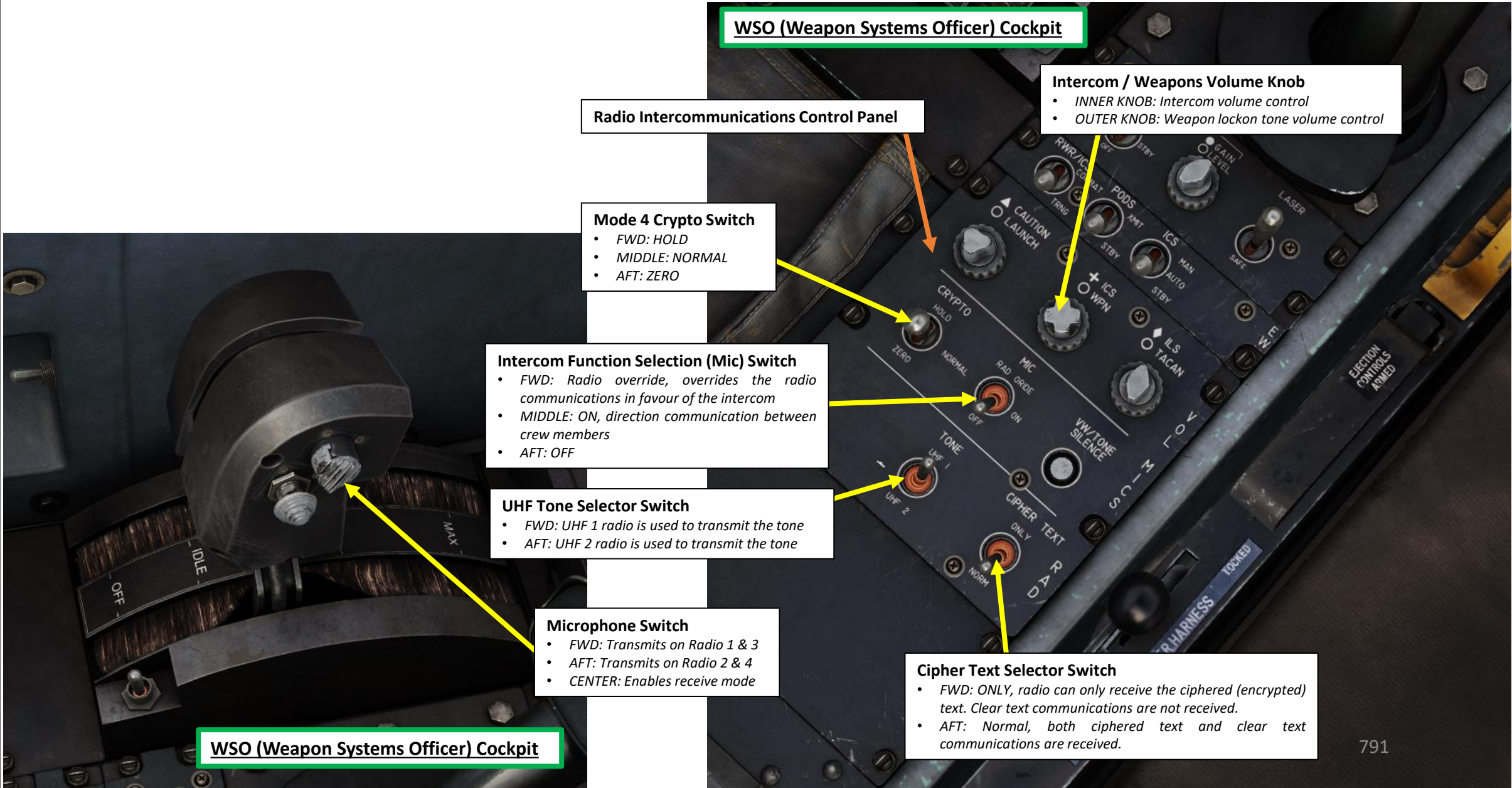
Radio 2 (Inner Knob) & Radio 4 (Outer Knob) Volume Controls

Radio 1 (Inner Knob) & Radio 3 (Outer Knob) Volume Controls

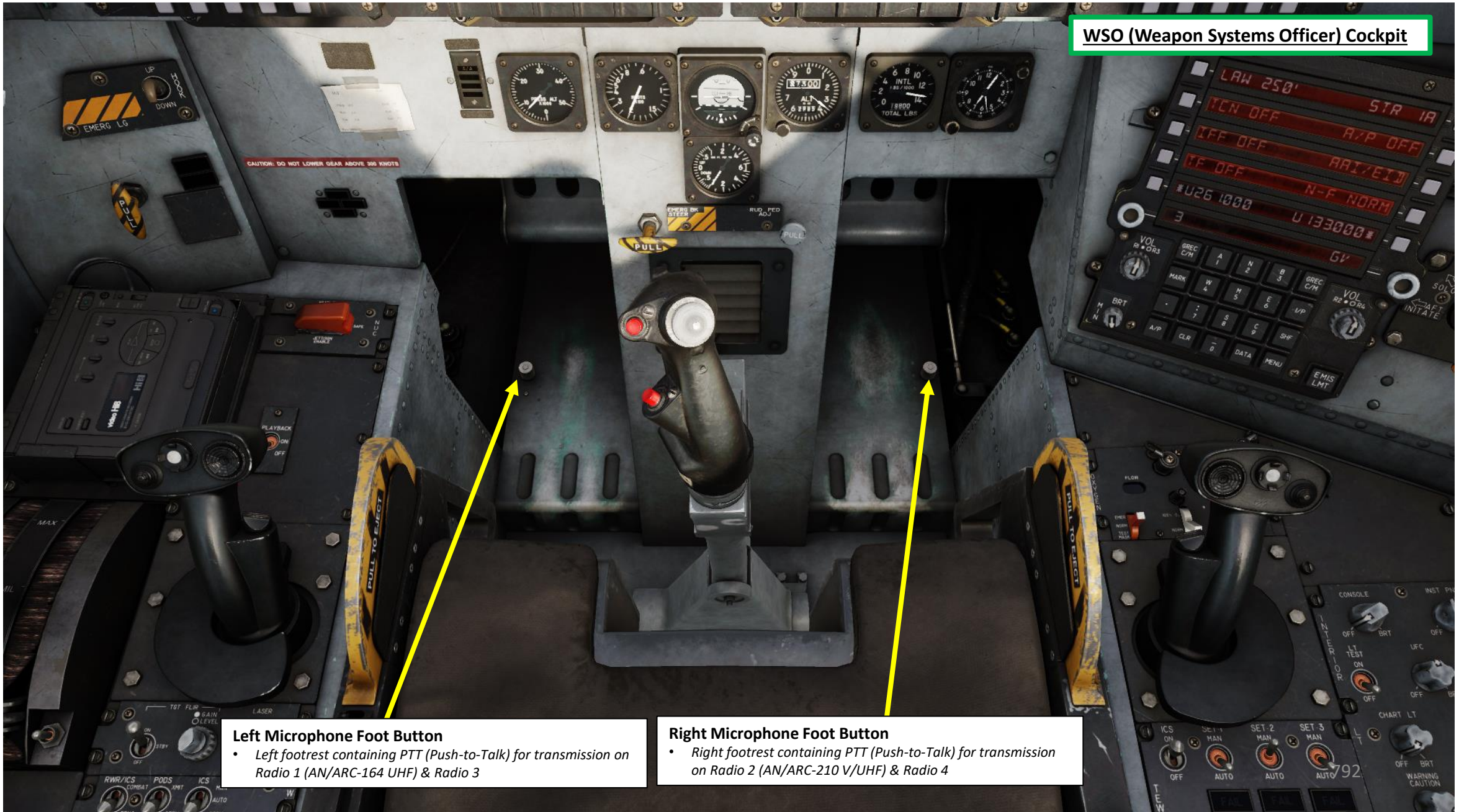
GREC C/M Radio 1
- *Radio Guard Receiver Channel/Manual Key*
- *Each press of this button switches the mode of operation of respective radio between Channel and Manual.*

GREC C/M Radio 2
- *Radio Guard Receiver Channel/Manual Key*
- *Each press of this button switches the mode of operation of respective radio between Channel and Manual.*

COMMUNICATION SYSTEMS OVERVIEW



COMMUNICATION SYSTEMS OVERVIEW



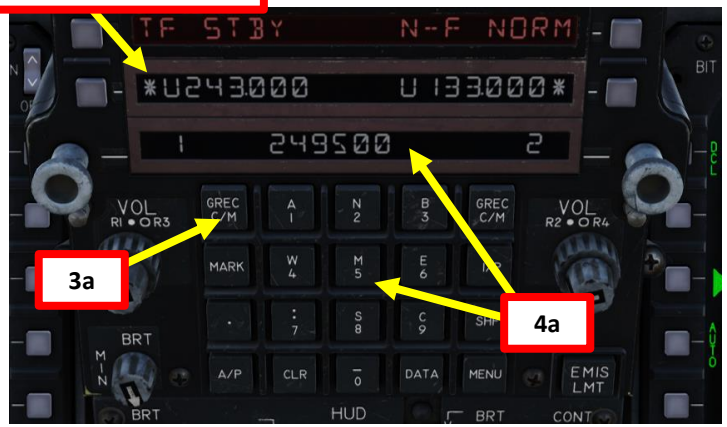
AN/ARC-164 UHF RADIO (COM1) TUTORIAL
TRANSMIT ON MANUAL FREQUENCY

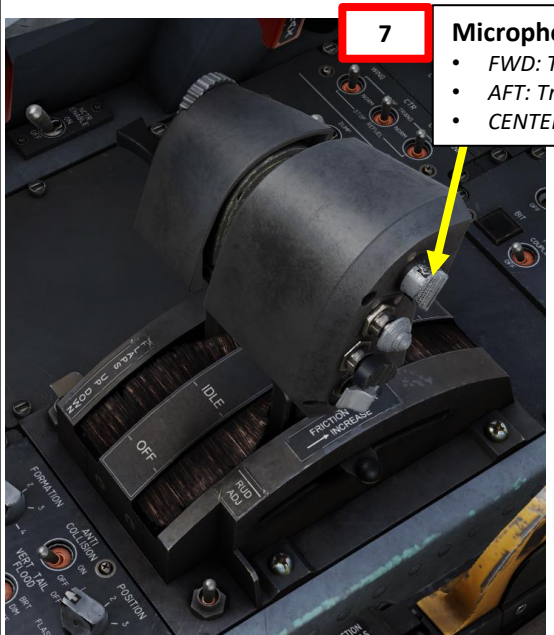
The AN/ARC-164 UHF radio can operate on up to 20 preset frequencies or manually selected ones.

1. Turn on radio 1 by pressing IN (left click) the LEFT Radio Channel Selector knob.
2. Adjust volume for Radio by turning the Radio 1 Volume Control (Left Inner Knob).
3. If required, press Left GREC C/M Button to toggle between preset and manual frequency. The asterisk on the UFC indicate which is selected.
4. Enter desired frequency manually with the UFC (Upfront Control Panel) keypad and then press the Pushbutton No. 5 (PB5). As an example, we will set the manual frequency to 249.500 MHz by entering “249500” on the UFC.
5. When a new channel or frequency is entered via scratchpad and then fed into the radio, 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.
6. Press CLR to remove previously used channel/frequency.
7. Transmit by pressing Microphone Switch – FWD.

AN/ARC-164 UHF Radio Frequency Range
- 225.000 to 399.975 MHz (AM, UHF)

3b
Manual Frequency Selected



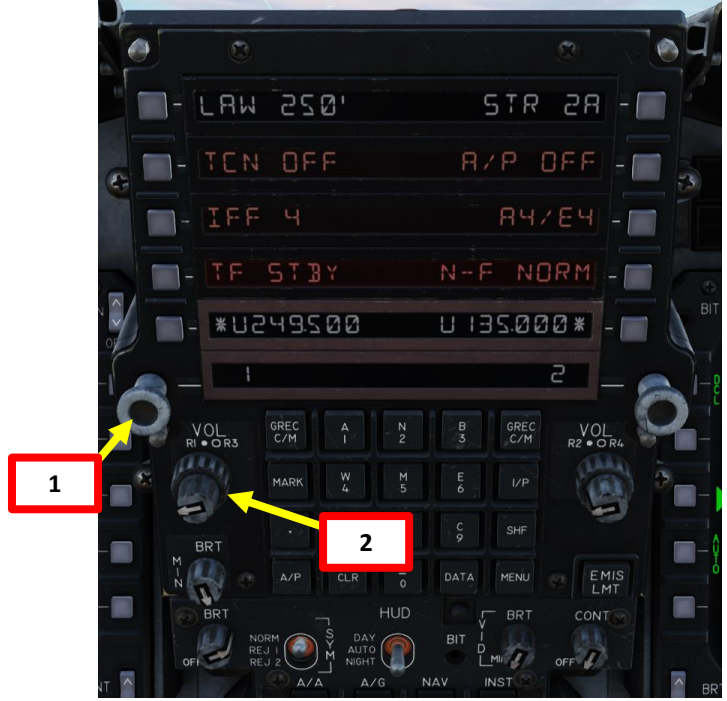


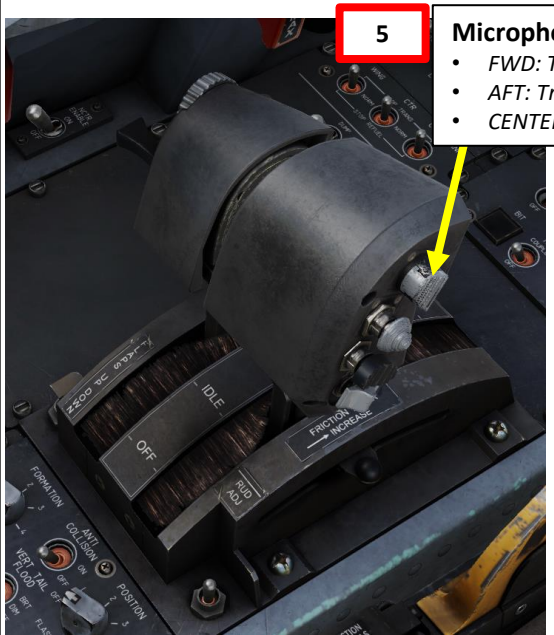
Microphone Switch
- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

AN/ARC-164 UHF RADIO (COM1) TUTORIAL TRANSMIT ON PRESET CHANNEL FREQUENCY

The AN/ARC-164 UHF radio can operate on up to 20 preset frequencies or manually selected ones.

1. Turn on radio 1 by pressing IN (left click) the LEFT Radio Channel Selector knob.
2. Adjust volume for Radio by turning the Radio 1 Volume Control (Left Inner Knob).
3. If required, press Left GREC C/M Button to toggle between preset and manual frequency. The asterisk on the UFC indicate which is selected.
4. Turn LEFT Radio Channel Selector Knob to select desired channel. These channel frequencies are already preset via the mission editor.
5. Transmit by pressing Microphone Switch – FWD.

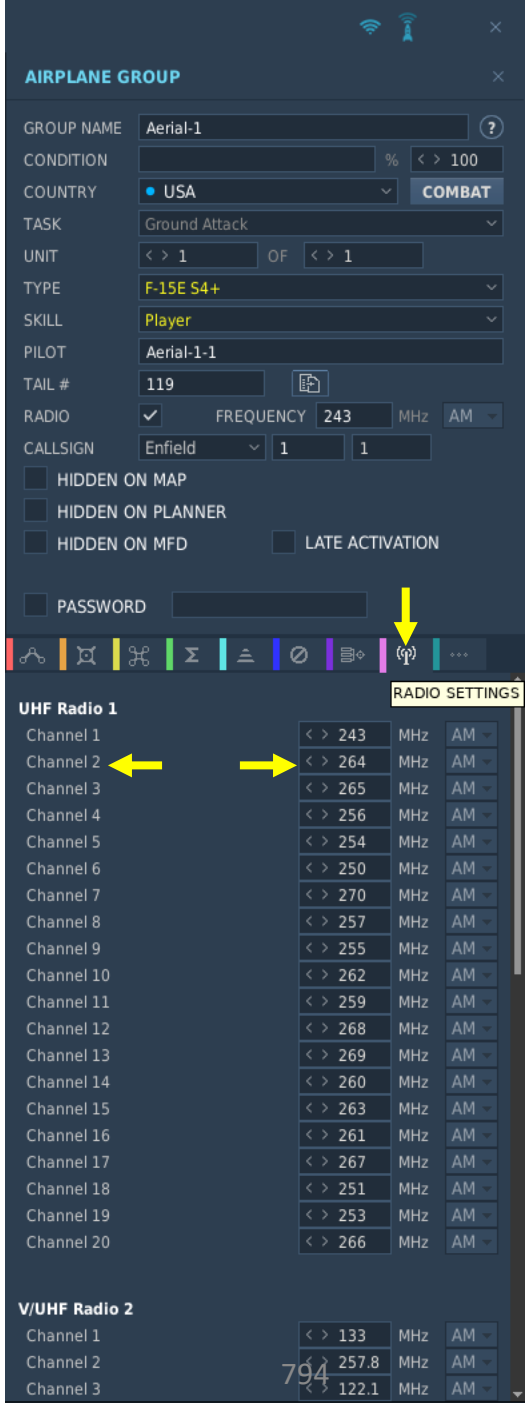




Microphone Switch
- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

3b
Preset Channel Frequency Selected

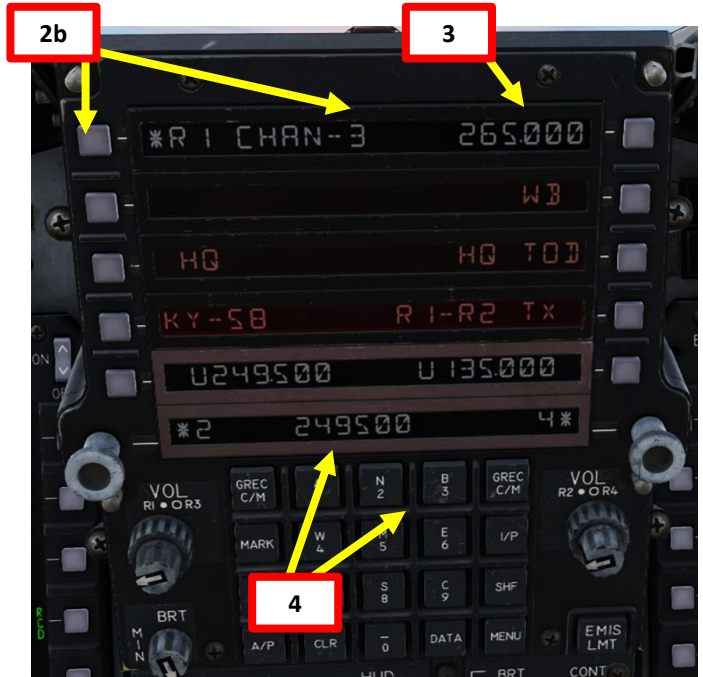
4
Channel 2 Selected



AN/ARC-164 UHF RADIO (COM1) TUTORIAL
EDIT PRESET CHANNEL

In this example, we want to change COM1 Preset Channel No. 3 frequency to 249.500 MHz.

1. Enter COM1 Radio Menu by pressing Pushbutton No. 5 (PB5).
2. Select COM1 Channel 3 by entering “3” on the UFC keypad, then pressing pushbutton next to R1.
3. R1 CHAN-3 displays a frequency of 265.000 MHz, which we want to change to 249.500 MHz.
4. Enter “249500” on UFC.
5. Press on pushbutton next to preset frequency.
6. Channel 3 frequency is now updated to 249.500 MHz.
7. Press MENU to return to main UFC menu.



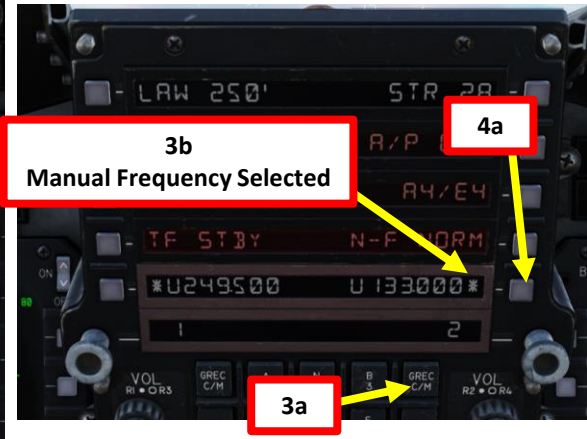
AN/ARC-210 V/UHF (COM2) RADIO TUTORIAL TRANSMIT ON MANUAL FREQUENCY

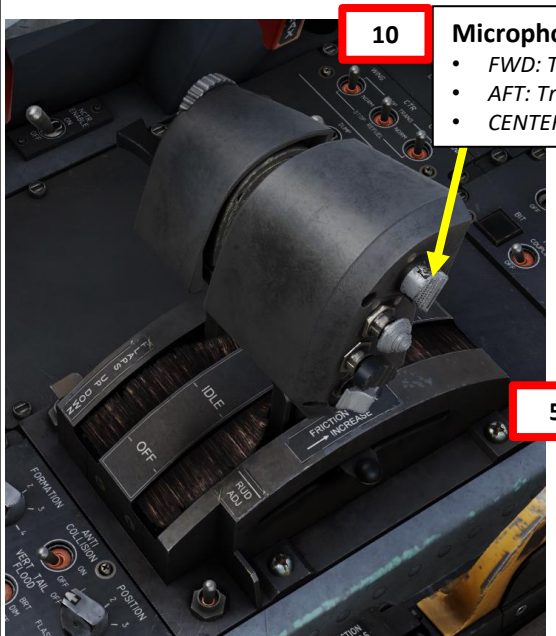
The AN/ARC-210 V/UHF radio can operate on up to 40 preset frequencies or manually selected ones.

1. Turn on radio 2 by pressing IN (left click) the RIGHT Radio Channel Selector knob.
2. Adjust volume for Radio by turning the Radio 2 Volume Control (Right Inner Knob).
3. If required, press Right GREC C/M Button to toggle between preset and manual frequency. The asterisk on the UFC indicate which is selected.
4. Enter COM2 Radio Menu by pressing Pushbutton No. 6 (PB6).
5. Select MAN-AM or MAN-FM, as desired for the frequency band you want. We will leave it to MAN-AM.
6. Press MENU to return to main UFC menu.
7. Enter desired frequency manually with the UFC (Upfront Control Panel) keypad and then press the Pushbutton No. 6 (PB6). As an example, we will set the manual frequency to 135.000 MHz by entering “135000” on the UFC.
8. When a new channel or frequency is entered via scratchpad and then fed into the radio, 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.
9. Press CLR to remove previously used channel/frequency.
10. Transmit by pressing Microphone Switch – AFT.

AN/ARC-210 V/UHF Radio Frequency Range

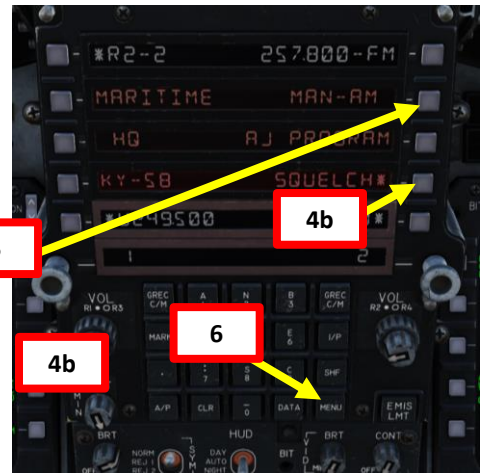
- 30.000 to 87.975 MHz (FM)
- 108.000 to 115.975 MHz (AM, VHF)
- 118.000 to 173.975 MHz (AM, VHF)
- 225.000 to 399.975 MHz (AM, UHF)

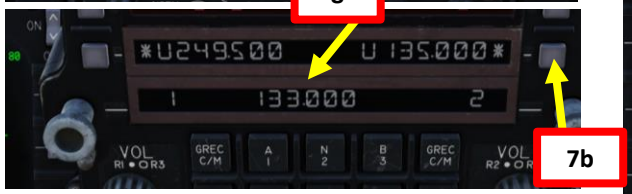




Microphone Switch

- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

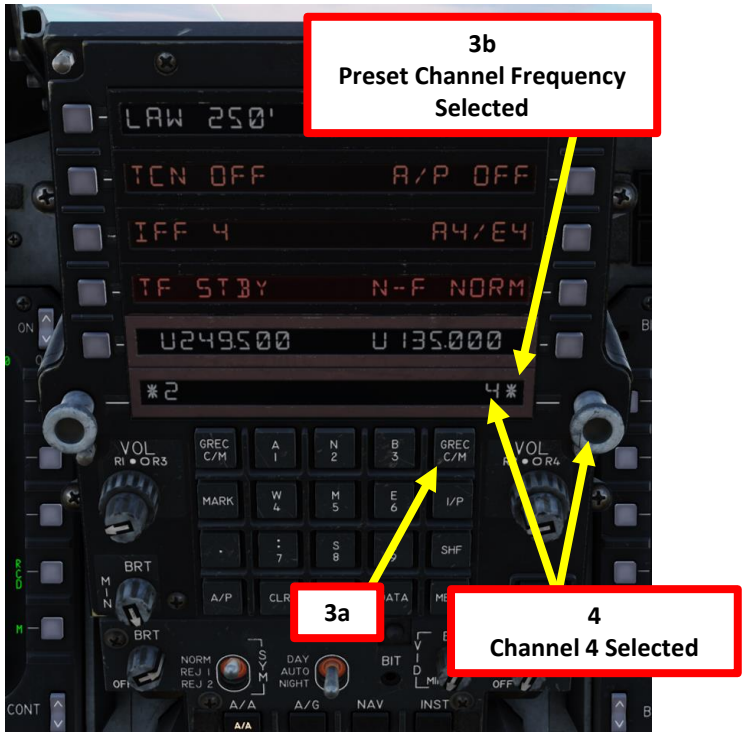


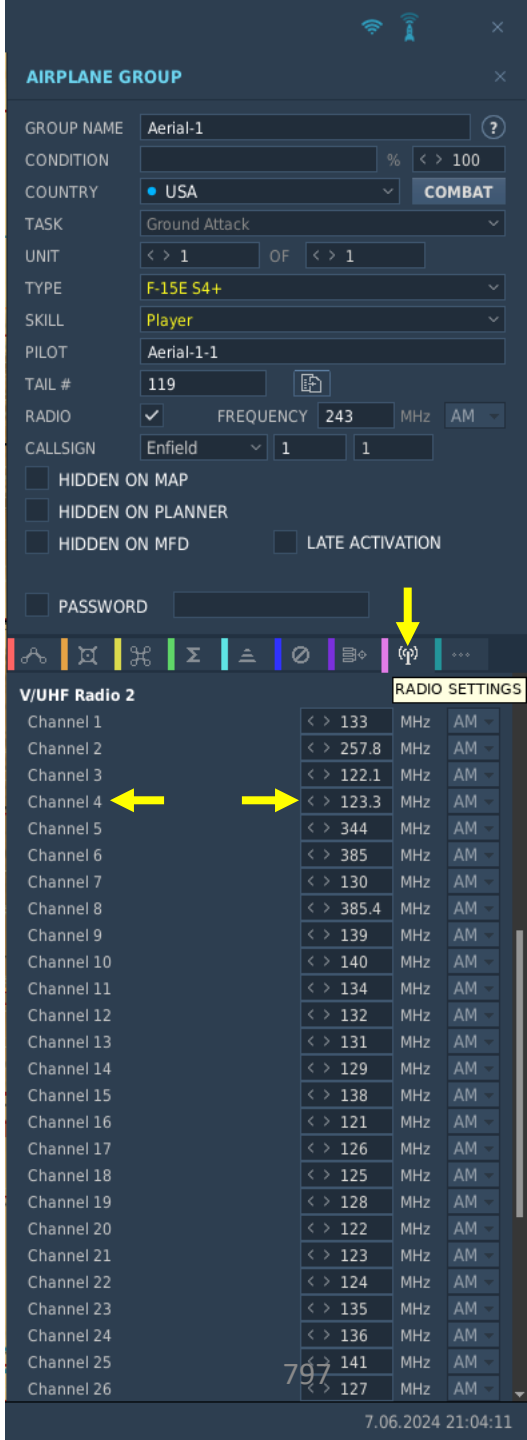


AN/ARC-210 V/UHF (COM2) RADIO TUTORIAL TRANSMIT ON PRESET CHANNEL FREQUENCY

The AN/ARC-210 V/UHF radio can operate on up to 40 preset frequencies or manually selected ones.

1. Turn on radio 2 by pressing IN (left click) the RIGHT Radio Channel Selector knob.
2. Adjust volume for Radio by turning the Radio 2 Volume Control (Right Inner Knob).
3. If required, press Right GREC C/M Button to toggle between preset and manual frequency. The asterisk on the UFC indicate which is selected.
4. Turn RIGHT Radio Channel Selector Knob to select desired channel. These channel frequencies are already preset via the mission editor.
5. Transmit by pressing Microphone Switch – AFT.

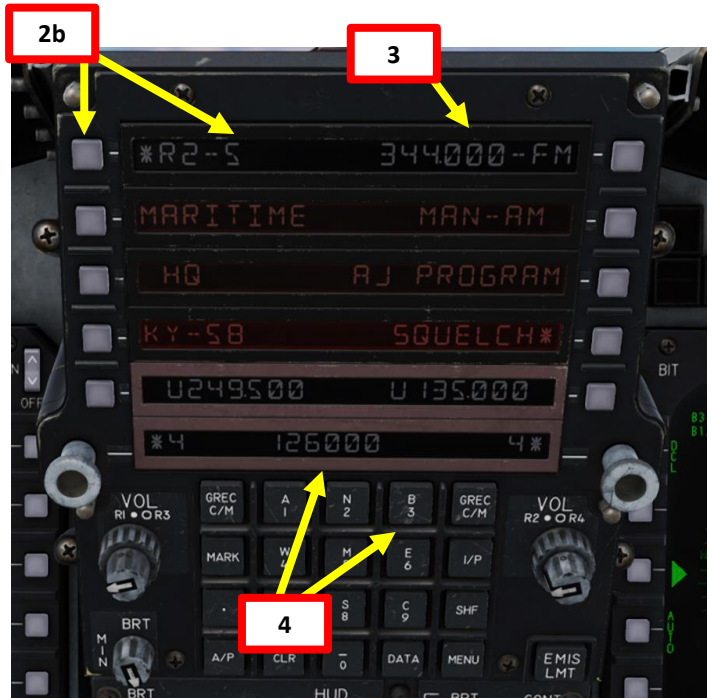


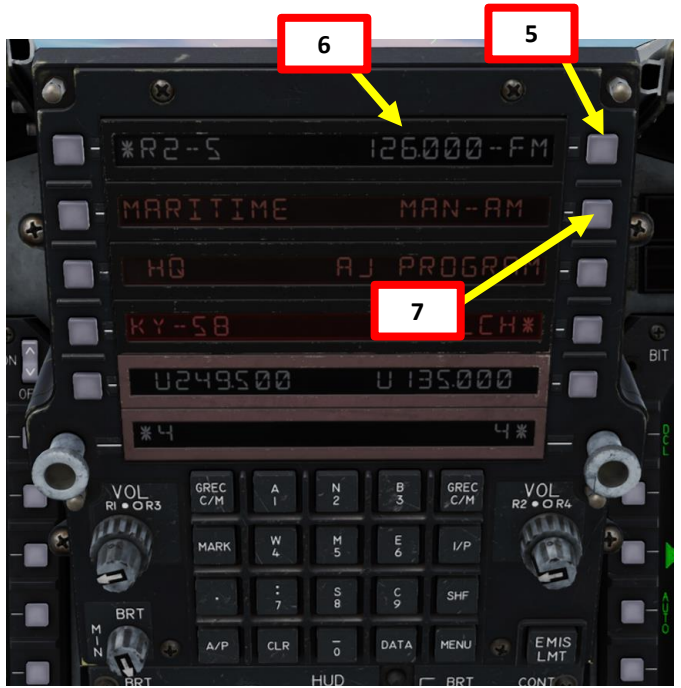


AN/ARC-210 V/UHF (COM2) RADIO TUTORIAL
EDIT PRESET CHANNEL

In this example, we want to change COM1 Preset Channel No. 5 frequency to 126.000 MHz AM.

1. Enter COM2 Radio Menu by pressing Pushbutton No. 6 (PB6).
2. Select COM2 Channel 5 by entering “5” on the UFC keypad, then pressing pushbutton next to R1.
3. R2 CHAN-5 displays a frequency of 344.000 MHz, which we want to change to 126.000 MHz.
4. Enter “126000” on UFC.
5. Press on pushbutton next to preset frequency.
6. Select MAN-AM or MAN-FM, as desired for the frequency band you want. We will leave it to MAN-AM.
7. Channel 5 frequency is now updated to 126.000 MHz AM.
8. Press MENU to return to main UFC menu.





INTERCOM

The intercom switch is generally left to the ON (Hot Mic) position. The pilot and WSO will be able to communicate freely by talking through their mask.

Pilot Cockpit

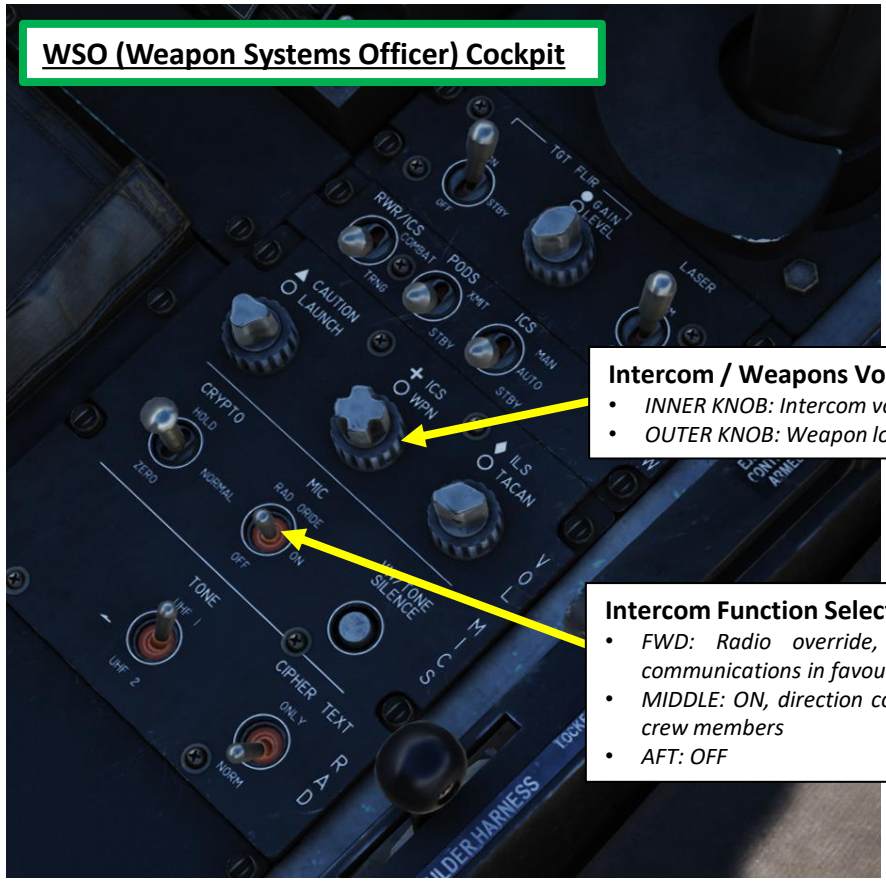
Intercom / Weapons Volume Knob

- *INNER KNOB: Intercom volume control*
- *OUTER KNOB: Weapon lockon tone volume control*

Intercom Function Selection (Mic) Switch

- *FWD: Radio override, overrides the radio communications in favour of the intercom*
- *MIDDLE: ON, direction communication between crew members*
- *AFT: OFF*

WSO (Weapon Systems Officer) Cockpit



Intercom / Weapons Volume Knob

- *INNER KNOB: Intercom volume control*
- *OUTER KNOB: Weapon lockon tone volume control*

Intercom Function Selection (Mic) Switch

- *FWD: Radio override, overrides the radio communications in favour of the intercom*
- *MIDDLE: ON, direction communication between crew members*
- *AFT: OFF*

1 – AUTOPILOT SYSTEM OVERVIEW

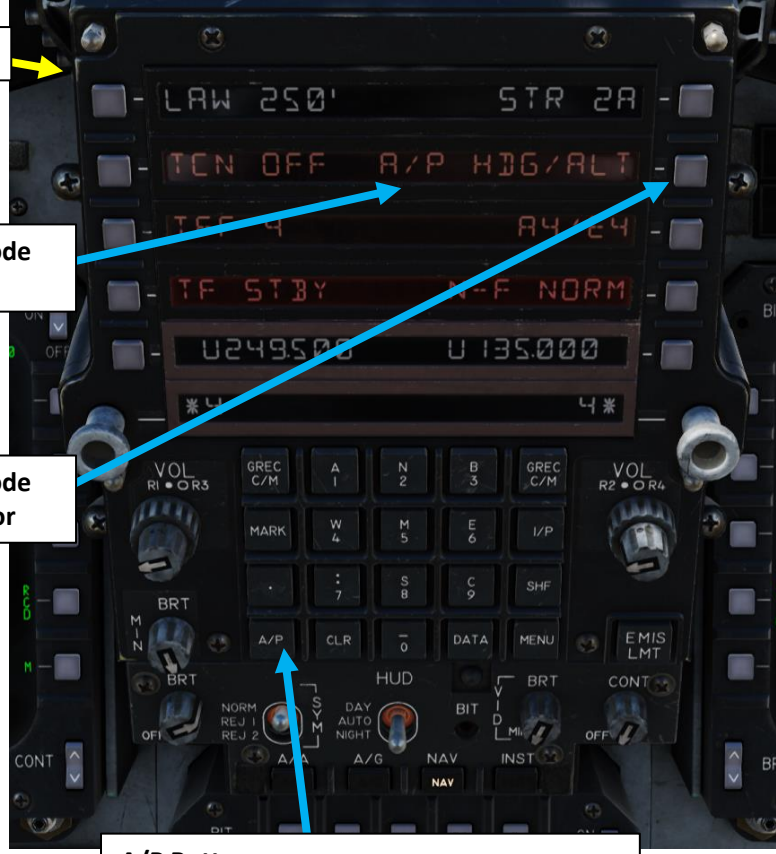
For the autopilot to work, it is necessary that all three CAS switches are set to ON. The **CAS (Control Augmentation System) stabilizes the aircraft** in the pitch, roll and yaw axis; the primary surface actuators contain an electronically controlled input to the actuator which can move the surface without pilot control stick motion.

The **UFC (Upfront Control Panel)** is the primary autopilot mode selection and engagement controller. The **A/P Button** on the UFC enables or disables the autopilot. Mode entered upon pressing the button depends on several factors. Here is a brief overview of autopilot modes:

- **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.
- **NAV / HDG SEL / GT / CRS / TCN**: autopilot is engaged in one of the blended modes.
  - ***Note: GT (Ground Track) blended mode is not simulated.***

The **Paddle Switch** disengages the autopilot.

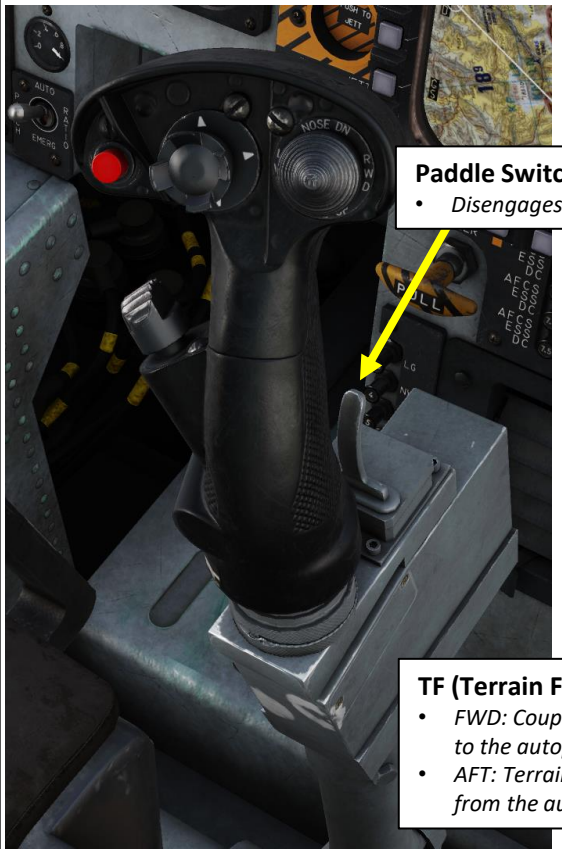
UFC (Upfront Control Panel)



Autopilot Mode Data Field

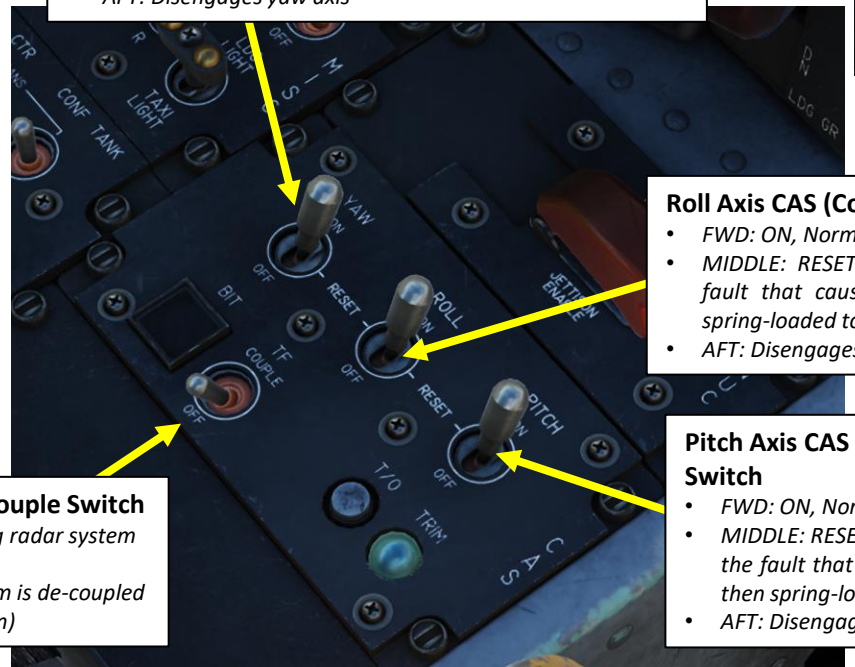
Autopilot Mode Menu Selector

A/P Button
- *Selects autopilot format and coupled modes*



Paddle Switch
- *Disengages Autopilot*

Yaw Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal yaw axis operation*
- *MIDDLE: RESET, engages disconnected yaw axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages yaw axis*



Roll Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal roll axis operation*
- *MIDDLE: RESET, engages disconnected roll axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages roll axis*

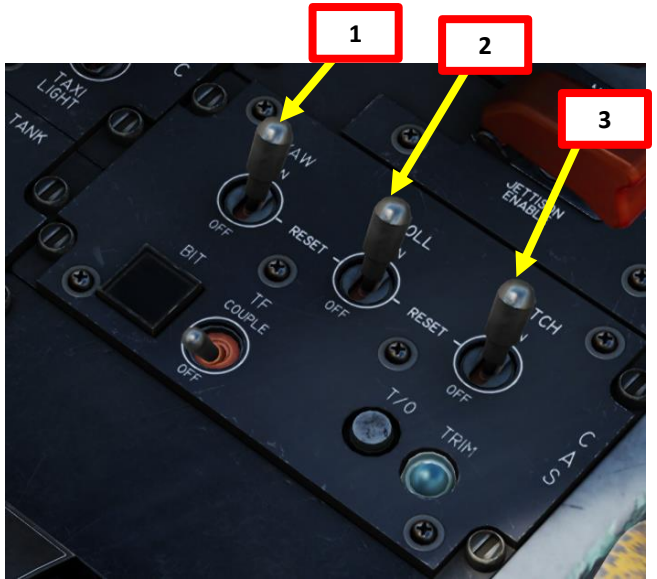
TF (Terrain Following) System Couple Switch
- *FWD: Couples the terrain following radar system to the autopilot*
- *AFT: Terrain following radar system is de-coupled from the autopilot (default position)*

Pitch Axis CAS (Control Augmentation System) Switch
- *FWD: ON, Normal pitch axis operation*
- *MIDDLE: RESET, engages disconnected pitch axis after the fault that caused the disconnect no longer exists, then spring-loaded to ON*
- *AFT: Disengages pitch axis*

2 – AUTOPILOT BASIC MODES
A – ATT (ATTITUDE HOLD) MODE

In order to set autopilot Attitude Hold Mode:

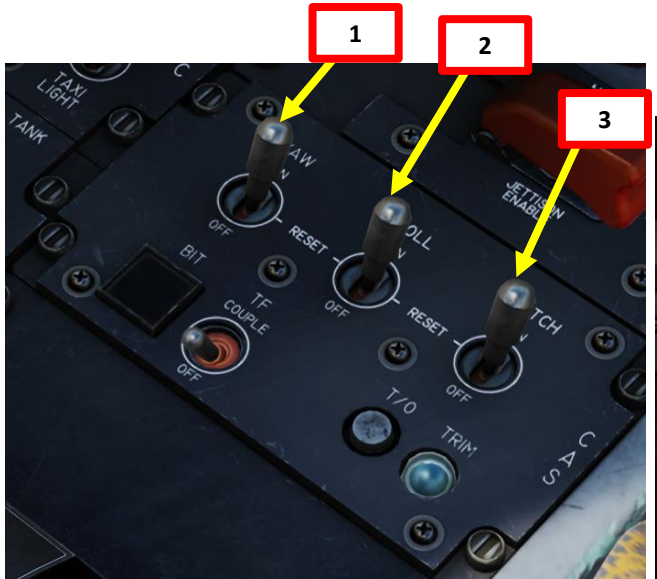
1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Press A/P Button. Depending on current pitch and roll, the A/P will engage different modes of the autopilot.
    - Autopilot will 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 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 **bank angle is between 7° and 60°** when the A/P button is pressed. **A/P ATT** will be displayed on the UFC.
5. In all three modes the autopilot will try to maintain selected flight parameters (pitch and / or heading or bank angle).
6. 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 Pushbutton 9.
7. When autopilot is engaged, a green A/P light illuminates on the caution panel.
8. To disengage autopilot, either press the A/P Button or press the Paddle Switch.

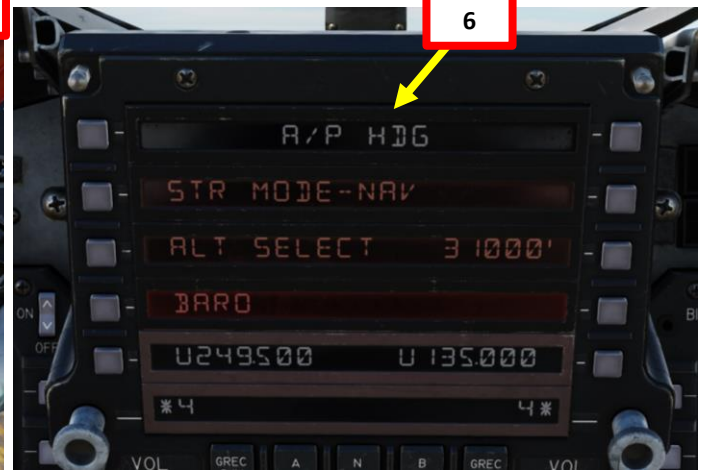


2 – AUTOPILOT BASIC MODES
B – HDG (HEADING HOLD) MODE

In order to set autopilot Hold Mode:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Press A/P Button. Depending on current pitch and roll, the A/P will engage different modes of the autopilot.
   - Autopilot will 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 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 **bank angle is between 7° and 60°** when the A/P button is pressed. **A/P ATT** will be displayed on the UFC.
5. In all three modes the autopilot will try to maintain selected flight parameters (pitch and / or heading or bank angle).
6. 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 Pushbutton 9.
7. When autopilot is engaged, a green A/P light illuminates on the caution panel.
8. To disengage autopilot, either press the A/P Button or press the Paddle Switch.



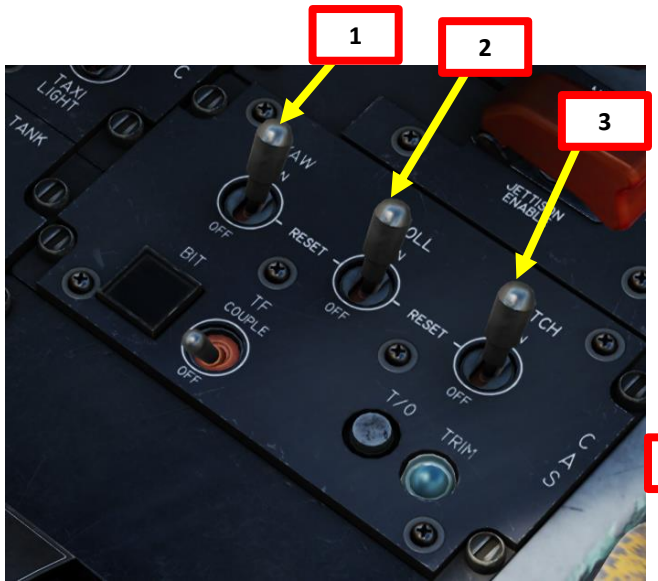


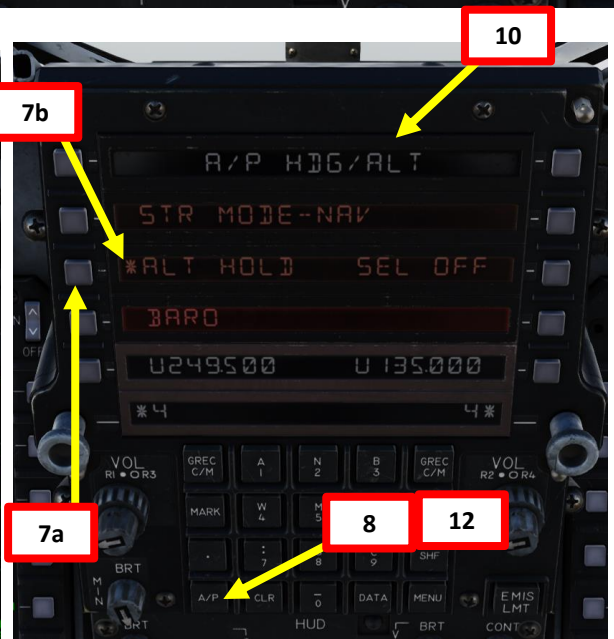
2 – AUTOPILOT BASIC MODES
C – ALT (ALTITUDE HOLD) MODE

In order to set autopilot Altitude Hold Mode:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. From MENU 1 page, select A/P Menu.
5. If required, press Pushbutton next to SEL OFF to toggle between ALT HOLD and ALT SELECT mode. Make sure ALT HOLD mode is displayed.
6. The BARO/RDR option has no function for the Altitude Hold mode.
7. Select ALT HOLD. An asterisk means the mode is selected.
8. Press A/P Button to engage altitude hold mode.
9. The aircraft will hold the current barometric altitude.
10. 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 Pushbutton 9.
11. When autopilot is engaged, a green A/P light illuminates on the caution panel.
12. To disengage autopilot, either press the A/P Button or press the Paddle Switch.

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





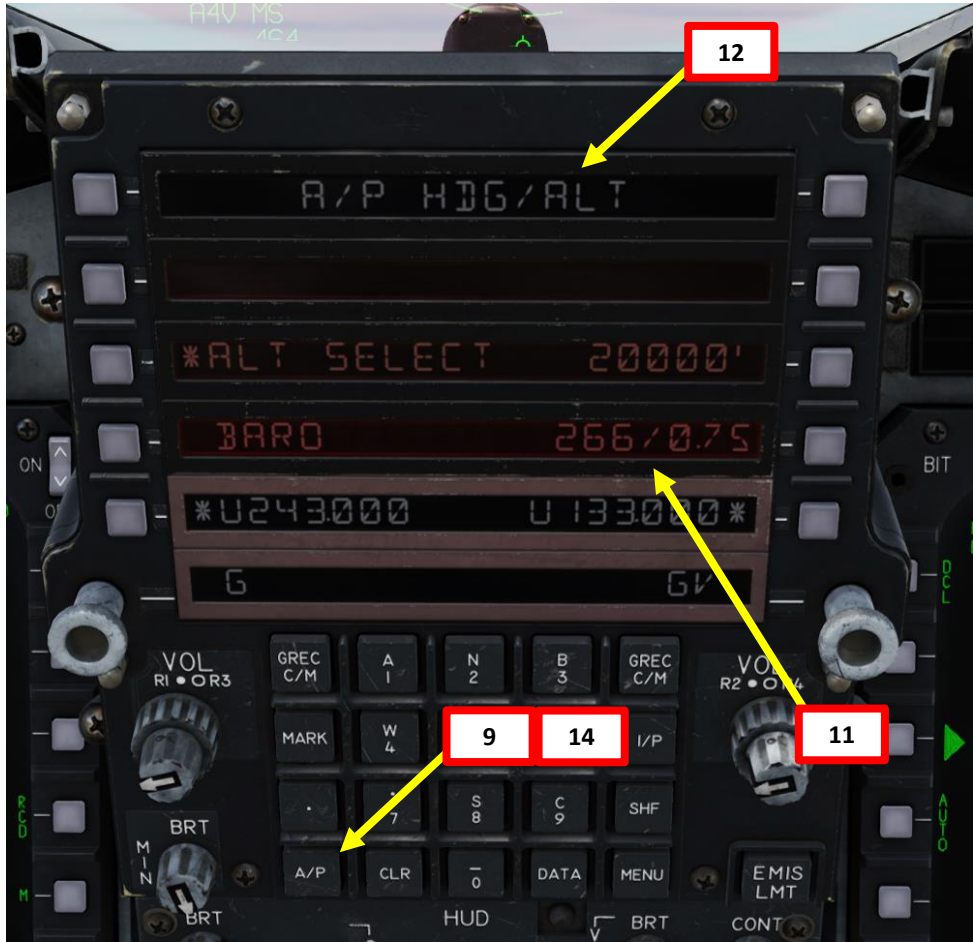
2 – AUTOPILOT BASIC MODES
D – ALT SEL (ALTITUDE SELECT) MODE

In order to set autopilot Altitude Select Mode:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. From MENU 1 page, select A/P Menu.
5. If required, press Pushbutton next to SEL OFF to toggle between ALT HOLD and ALT SEL mode. Make sure ALT SELECT mode is displayed.
6. On UFC scratchpad, enter desired altitude target (20000 ft in our case), then press pushbutton next to the altitude target.
    - The altitude value may be between 1000 ft and 50000 ft. If the entry is between 10 and 50, it will get multiplied by the system by x100.
7. Select barometric (BARO) or radar (RDR) altitude as a basis for system calculations.
    - 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 ft above ground, BARO is engaged. If the selected altitude puts the aircraft below 1000 ft above ground, the altitude source momentarily displays BARO and then reverts to RDR.
8. Select ALT SELECT. An asterisk means the mode is selected.

2 – AUTOPILOT BASIC MODES
D – ALT SEL (ALTITUDE SELECT) MODE

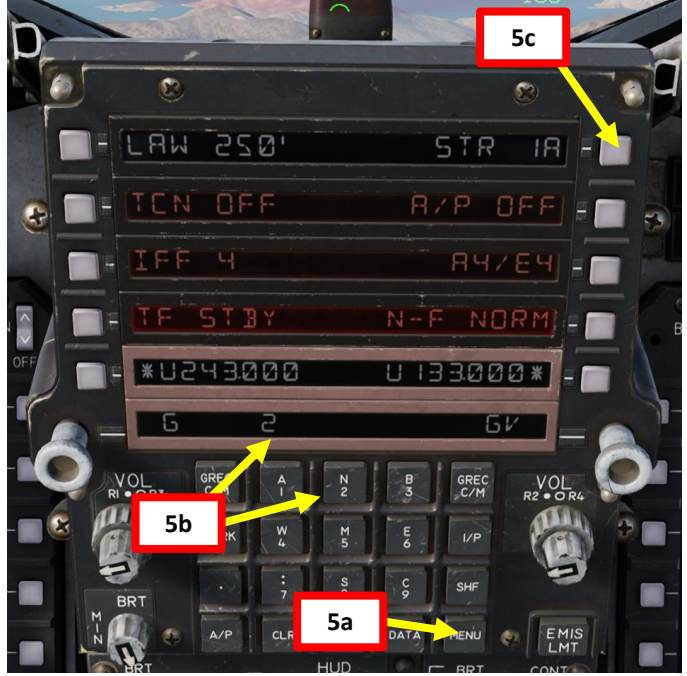
9. Press A/P Button to engage altitude select mode.
10. The aircraft will climb or descend towards the target altitude.
11. Constant airspeed switching to constant Mach number will be the climb schedule. In descent, only airspeed is displayed. The climb or descent rate is controlled with the throttle.
12. 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 Pushbutton 9.
13. When autopilot is engaged, a green A/P light illuminates on the caution panel.
14. To disengage autopilot, either press the Paddle Switch or press the A/P Button, which will revert it to normal A/P Hold.

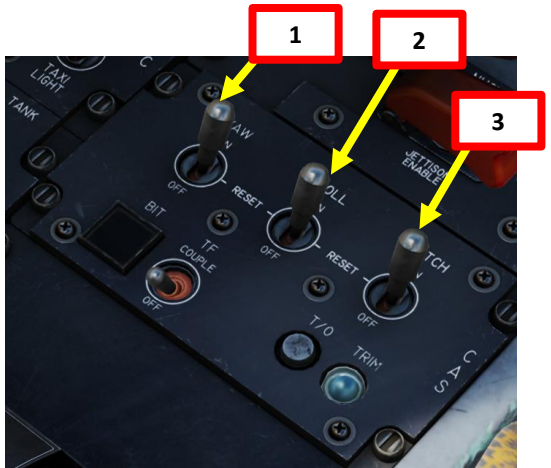


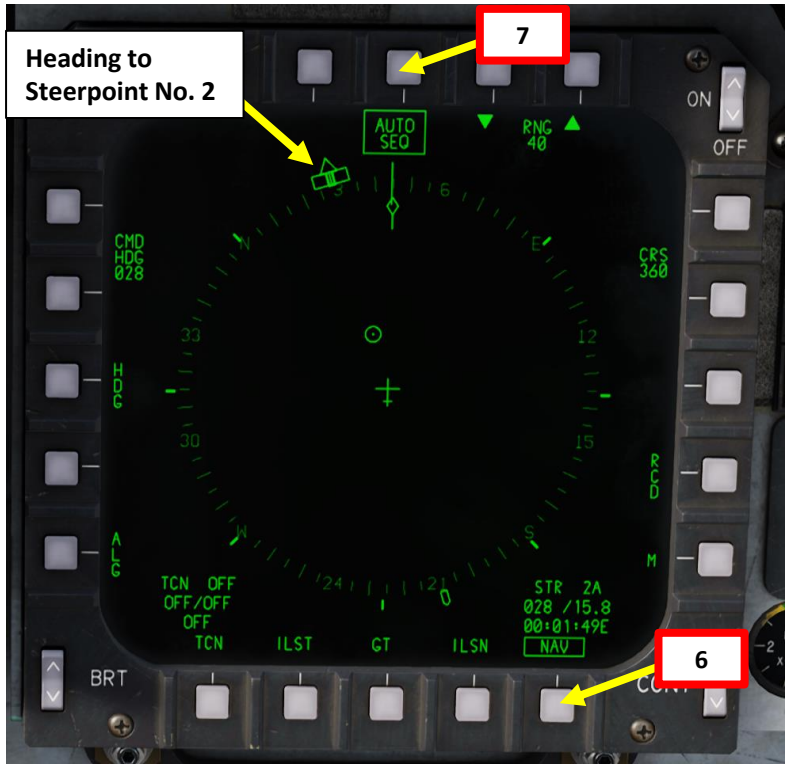
3 – AUTOPILOT COUPLED MODES
A – NAV (NAVIGATION) STEER MODE

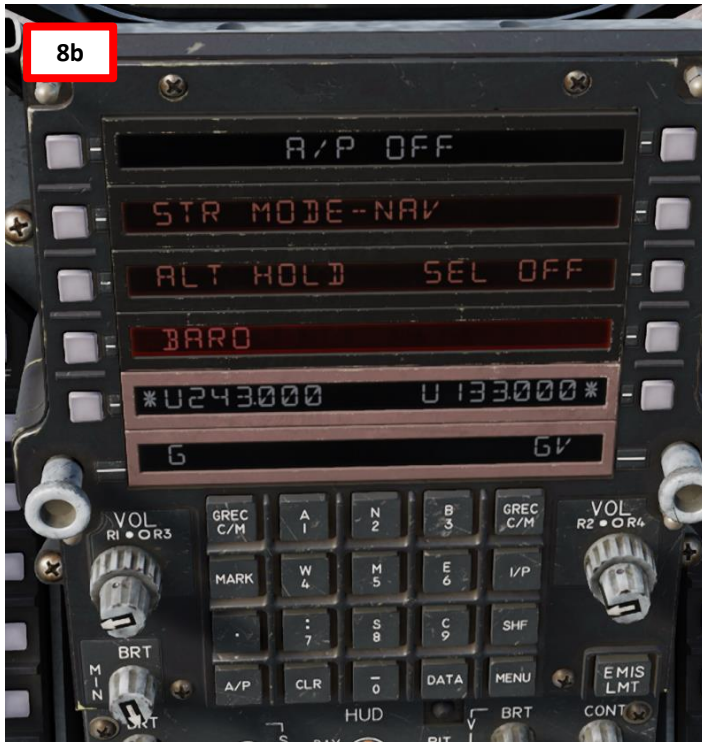
In order to set autopilot NAV Mode and follow Steerpoint No. 2:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Select NAV Master Mode
5. Select Steerpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type “2”.
    c) Press pushbutton next to STR.
    d) Steerpoint No. 2 is now selected.
6. On HSI (Horizontal Situation Indicator) page, select NAV STEERING mode (boxed).
7. If desired, set AUTO SEQ (Auto Sequencing) ON (boxed) to make the aircraft automatically transition to the next waypoint when flying over your selected waypoint.
8. From MENU 1 page, select A/P Menu.



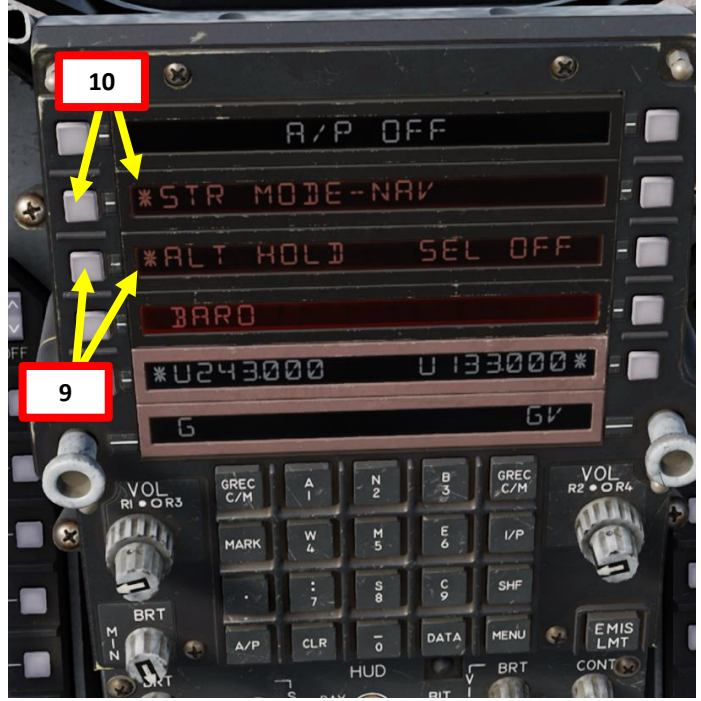


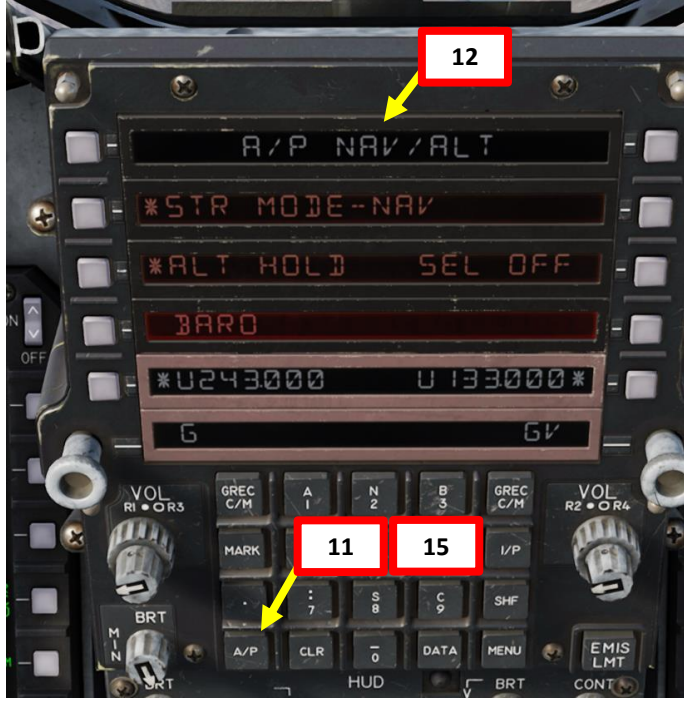




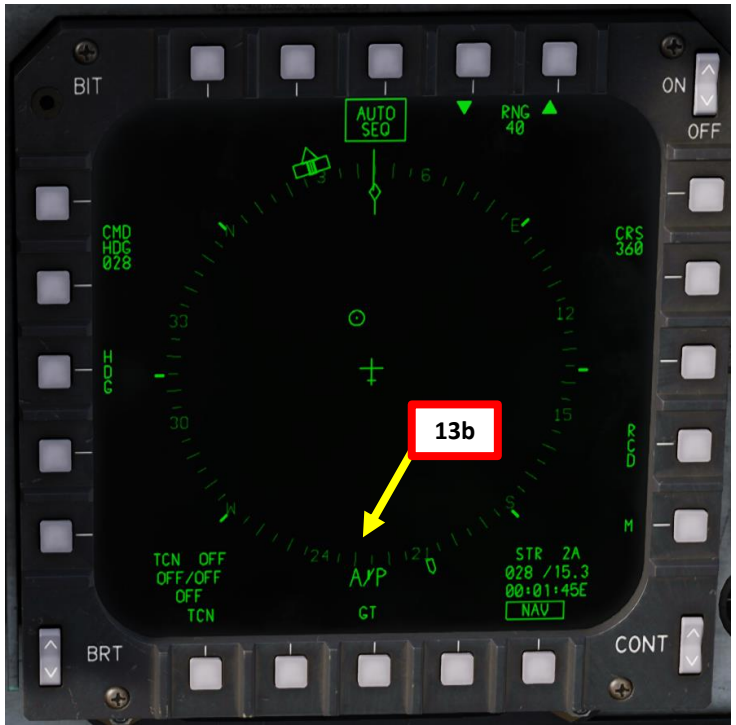
3 – AUTOPILOT COUPLED MODES
A – NAV (NAVIGATION) STEER MODE

9. If desired, select ALT HOLD to make the aircraft hold the barometric altitude. An asterisk means the mode is selected.
10. Select STR NAV. An asterisk means the mode is selected.
11. Press A/P Button to engage coupled STR NAV and ALT HOLD modes.
12. The currently selected mode will be displayed in the top line of the UFC (NAV/ALT) with A/P submenu or on MENU 1 page next to Pushbutton 9.
13. When autopilot is engaged in coupled navigation mode:
    a) A green A/P light illuminates on the caution panel.
    b) A/P indication is visible on the HSI (Horizontal Situation Indicator)
    c) ANAV indication is visible on the HUD (Heads-Up Display)
14. The autopilot will maintain current barometric altitude and steer the aircraft towards Steerpoint No. 2, then automatically switch to the next waypoint when flying over it.
15. To disengage autopilot, either press the A/P Button or press the Paddle Switch.



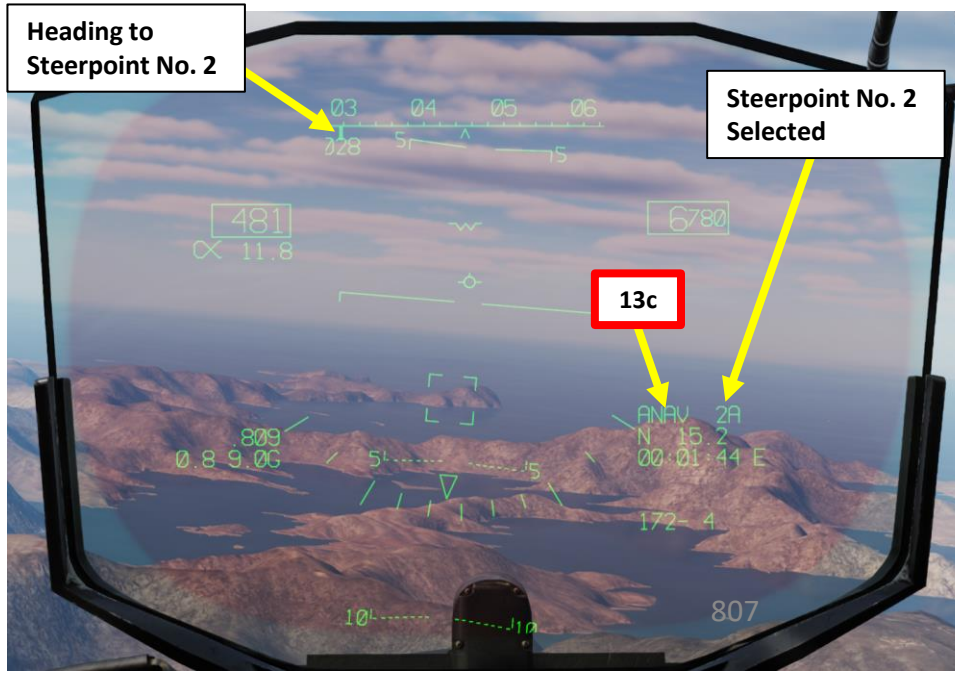


14 **Paddle Switch**
- *Disengages Autopilot*



Heading to Steerpoint No. 2

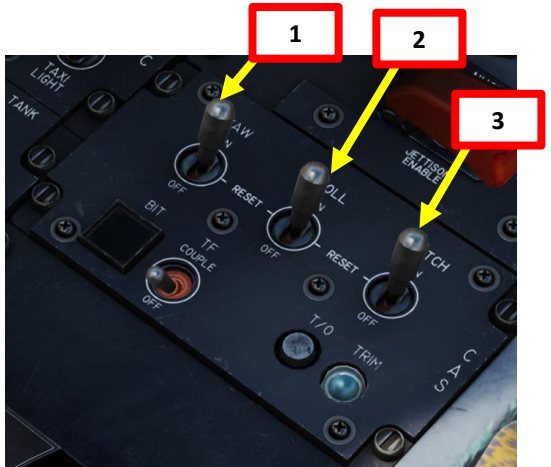
Steerpoint No. 2 Selected

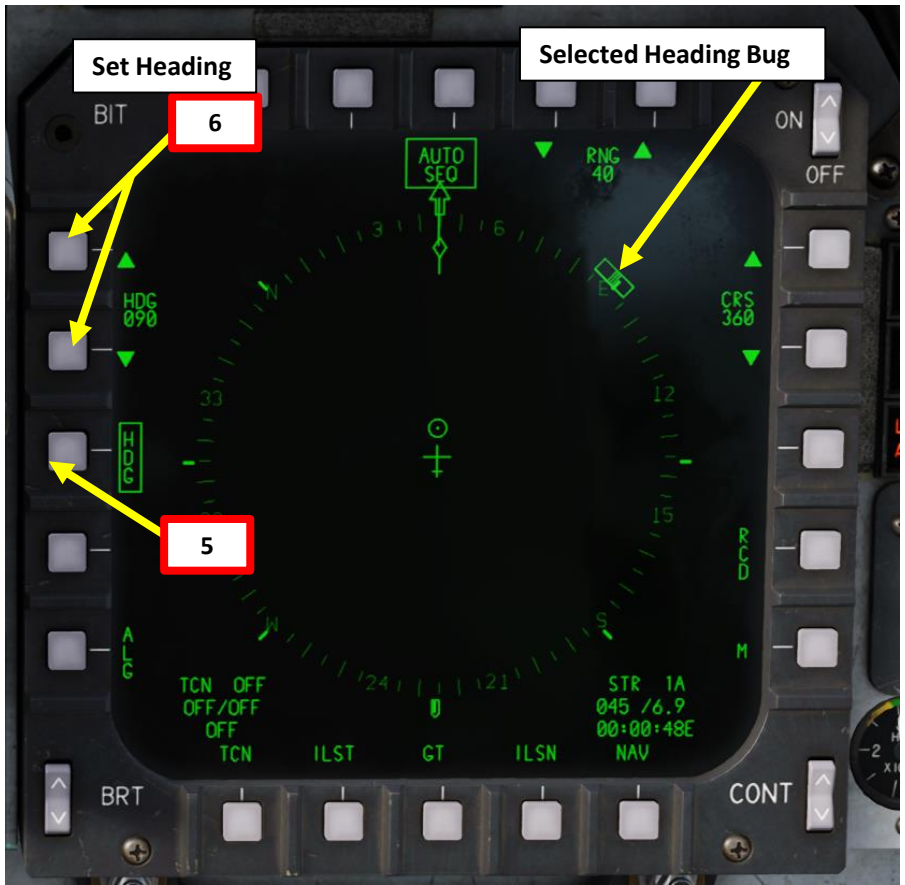


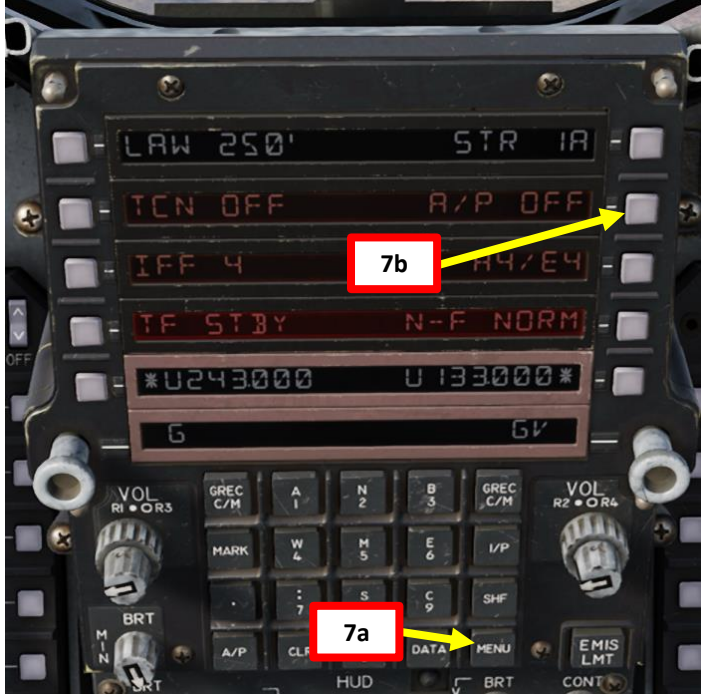
3 – AUTOPILOT COUPLED MODES
B – HDG SEL (HEADING SELECT) STEER MODE

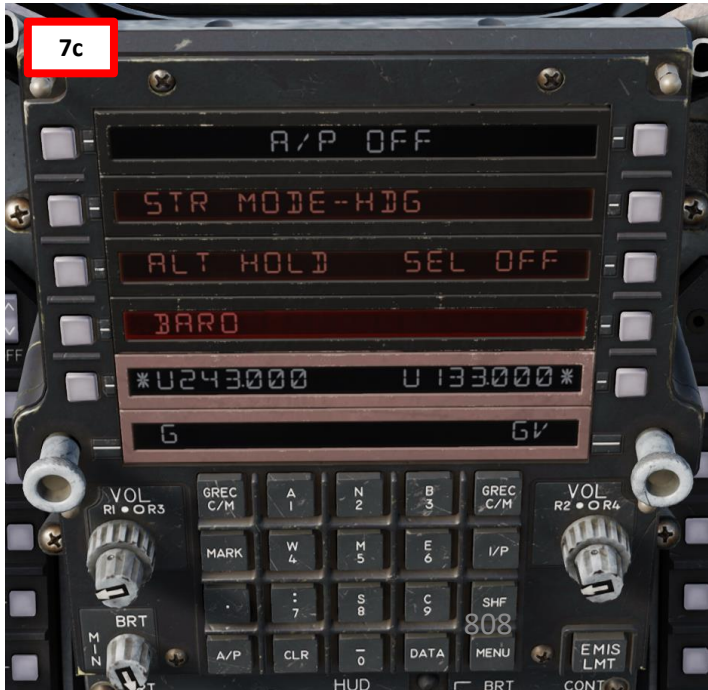
In order to set autopilot HDG SEL Mode and follow a specific heading:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Select NAV Master Mode
5. On HSI (Horizontal Situation Indicator) page, select HDG STEERING mode (boxed).
6. Set desired heading using the HDG UP and HDG DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the heading value, then press either of the HDG UP or HDG DOWN buttons.
7. From MENU 1 page, select A/P Menu.



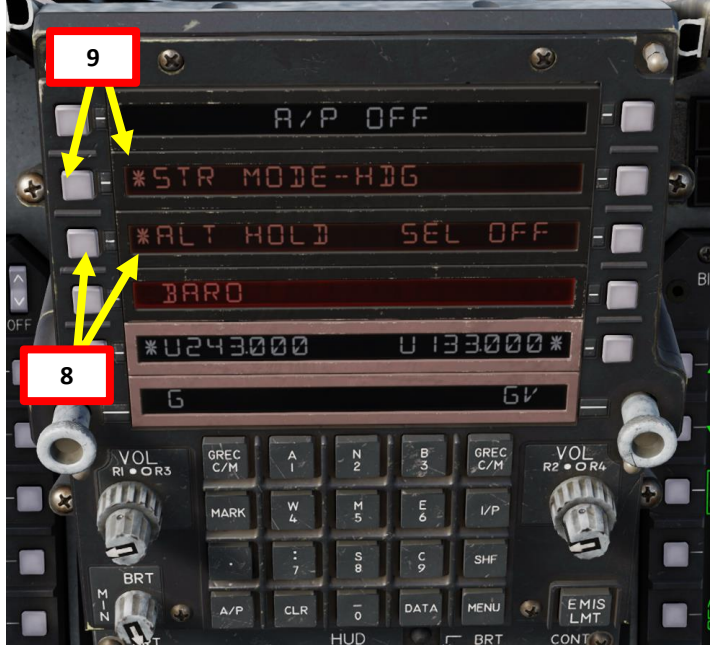


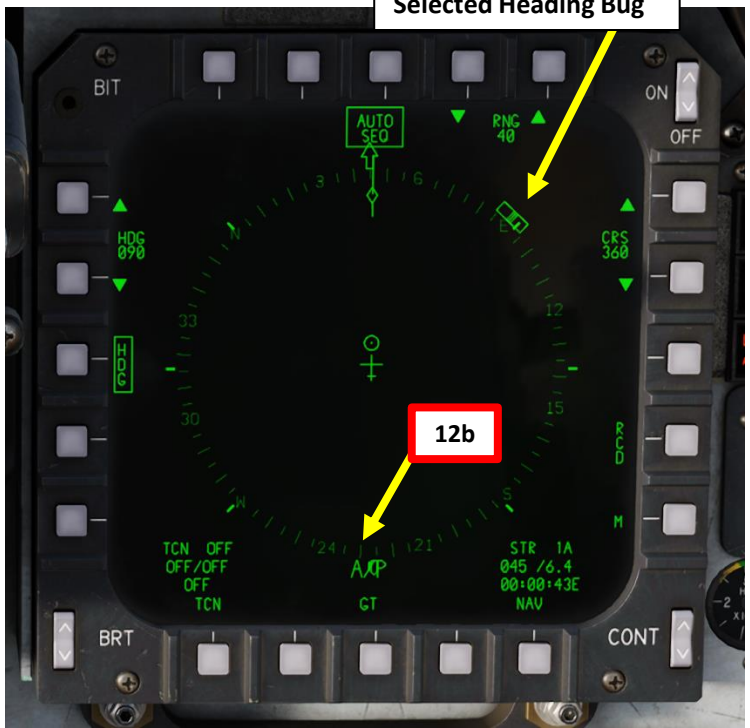


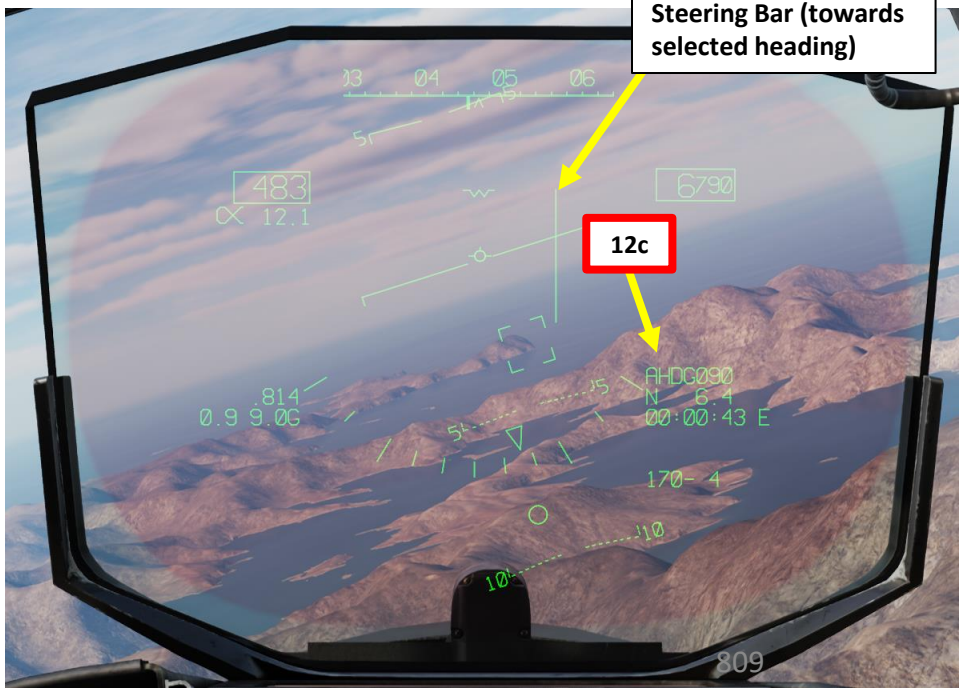


3 – AUTOPILOT COUPLED MODES
B – HDG SEL (HEADING SELECT) STEER MODE

8. If desired, select ALT HOLD to make the aircraft hold the barometric altitude. An asterisk means the mode is selected.
9. Select STR HDG. An asterisk means the mode is selected.
10. Press A/P Button to engage coupled STR HDG and ALT HOLD modes.
11. The currently selected mode will be displayed in the top line of the UFC (AHDG/ALT) with A/P submenu or on MENU 1 page next to Pushbutton 9.
12. When autopilot is engaged in coupled heading select mode:
    a) A green A/P light illuminates on the caution panel.
    b) A/P indication is visible on the HSI (Horizontal Situation Indicator)
    c) AHDG indication is visible on the HUD (Heads-Up Display)
13. The autopilot will maintain current barometric altitude and steer the aircraft towards the selected heading.
14. To disengage autopilot, either press the A/P Button or press the Paddle Switch.



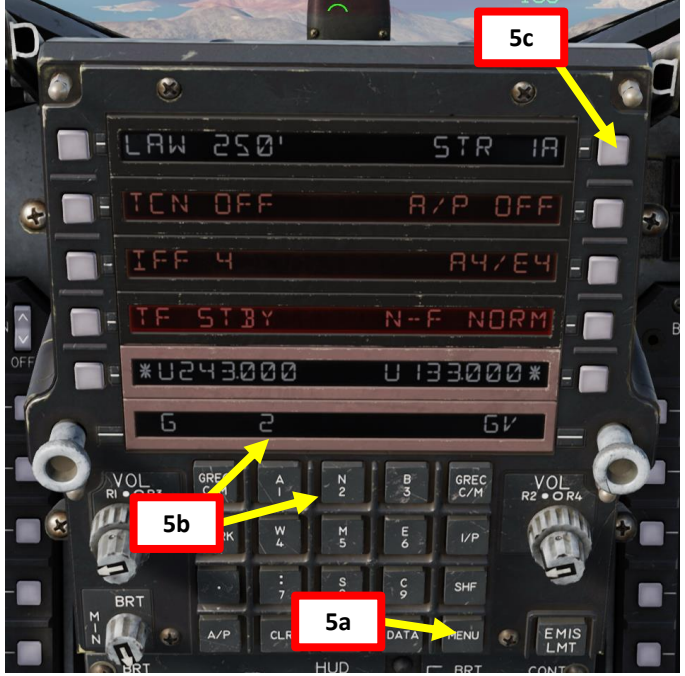


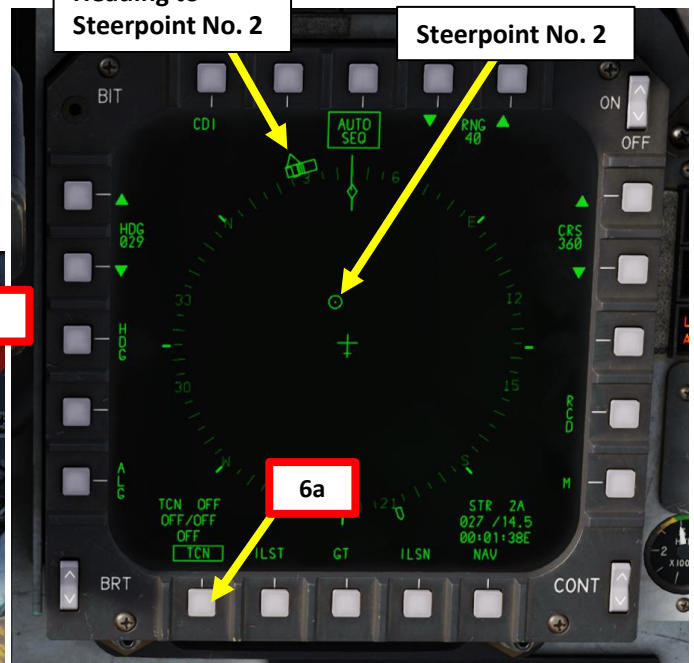


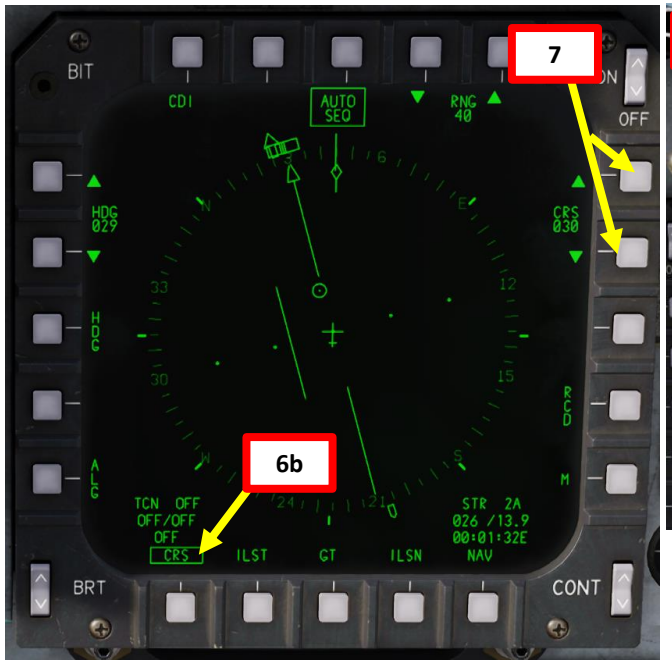
3 – AUTOPILOT COUPLED MODES
C – CRS (COURSE) STEER MODE

In order to set autopilot CRS Mode and follow Steerpoint No. 2 using a radial (course) of 030:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Select NAV Master Mode
5. Select Steerpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type “2”.
    c) Press pushbutton next to STR.
    d) Steerpoint No. 2 is now selected.
6. On HSI (Horizontal Situation Indicator) page, select CRS mode (boxed). You might have to toggle TCN mode first in order to see CRS mode.
7. Set desired radial course (030) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the course value, then press either of the CRS UP or CRS DOWN buttons.
8. From MENU 1 page, select A/P Menu.

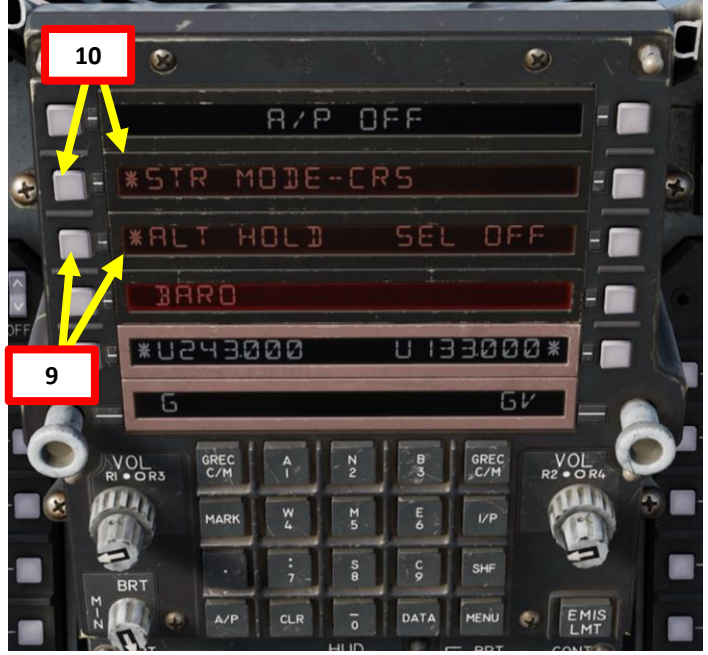


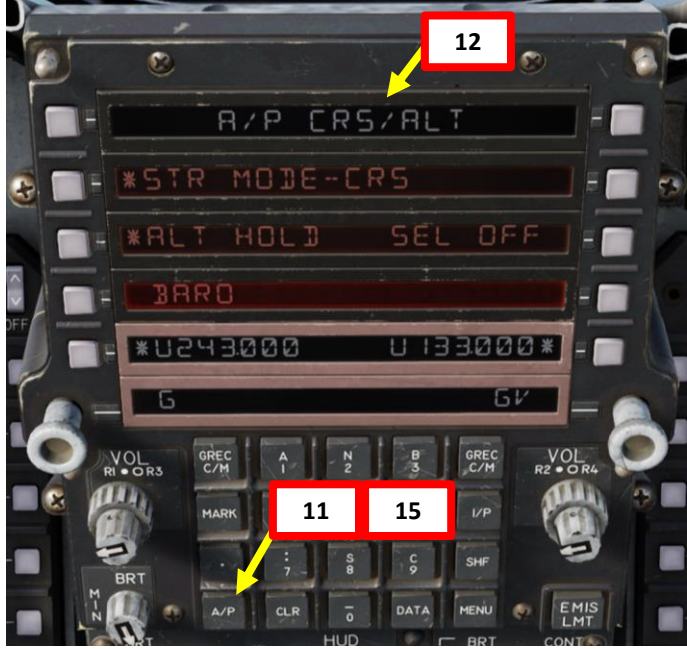


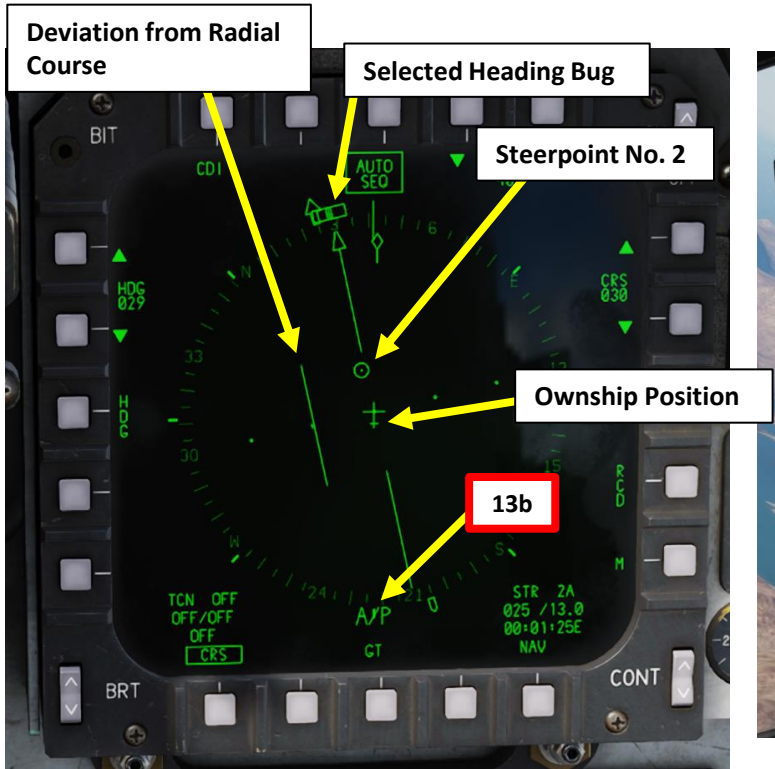


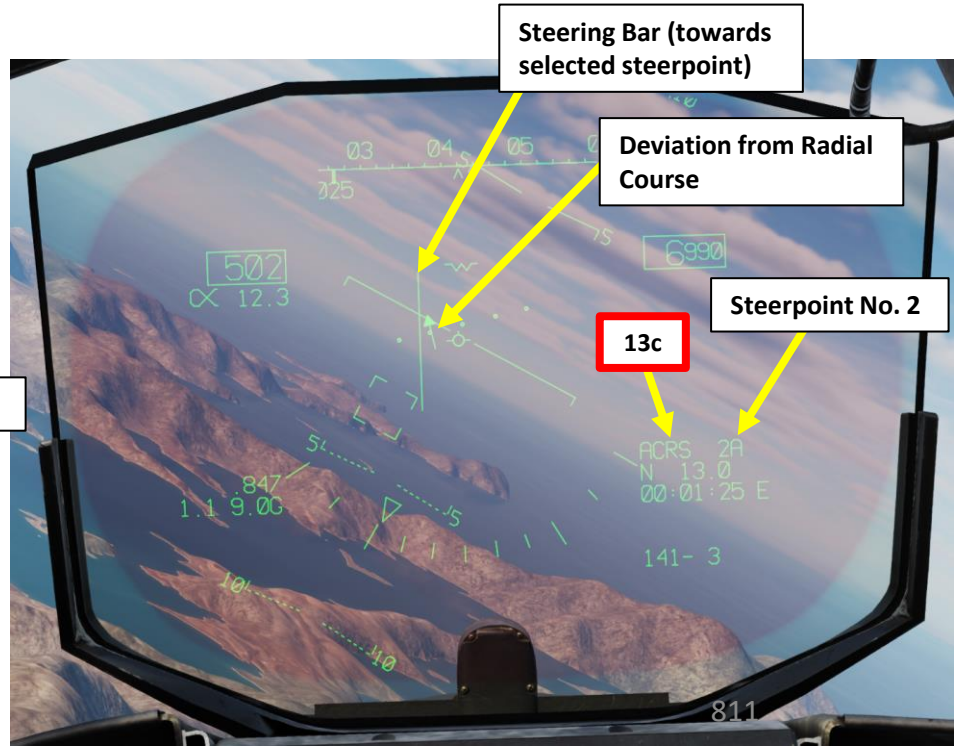
3 – AUTOPILOT COUPLED MODES
C – CRS (COURSE) STEER MODE

9. If desired, select ALT HOLD to make the aircraft hold the barometric altitude. An asterisk means the mode is selected.
10. Select STR CRS. An asterisk means the mode is selected.
11. Press A/P Button to engage coupled STR CRS and ALT HOLD modes.
12. The currently selected mode will be displayed in the top line of the UFC (CRS/ALT) with A/P submenu or on MENU 1 page next to Pushbutton 9.
13. When autopilot is engaged in coupled course mode:
    a) A green A/P light illuminates on the caution panel.
    b) A/P indication is visible on the HSI (Horizontal Situation Indicator)
    c) ACRS indication is visible on the HUD (Heads-Up Display)
14. The autopilot will maintain current barometric altitude and steer the aircraft to intercept the selected steerpoint (No. 2) while following the selected radial course (030).
15. To disengage autopilot, either press the A/P Button or press the Paddle Switch.







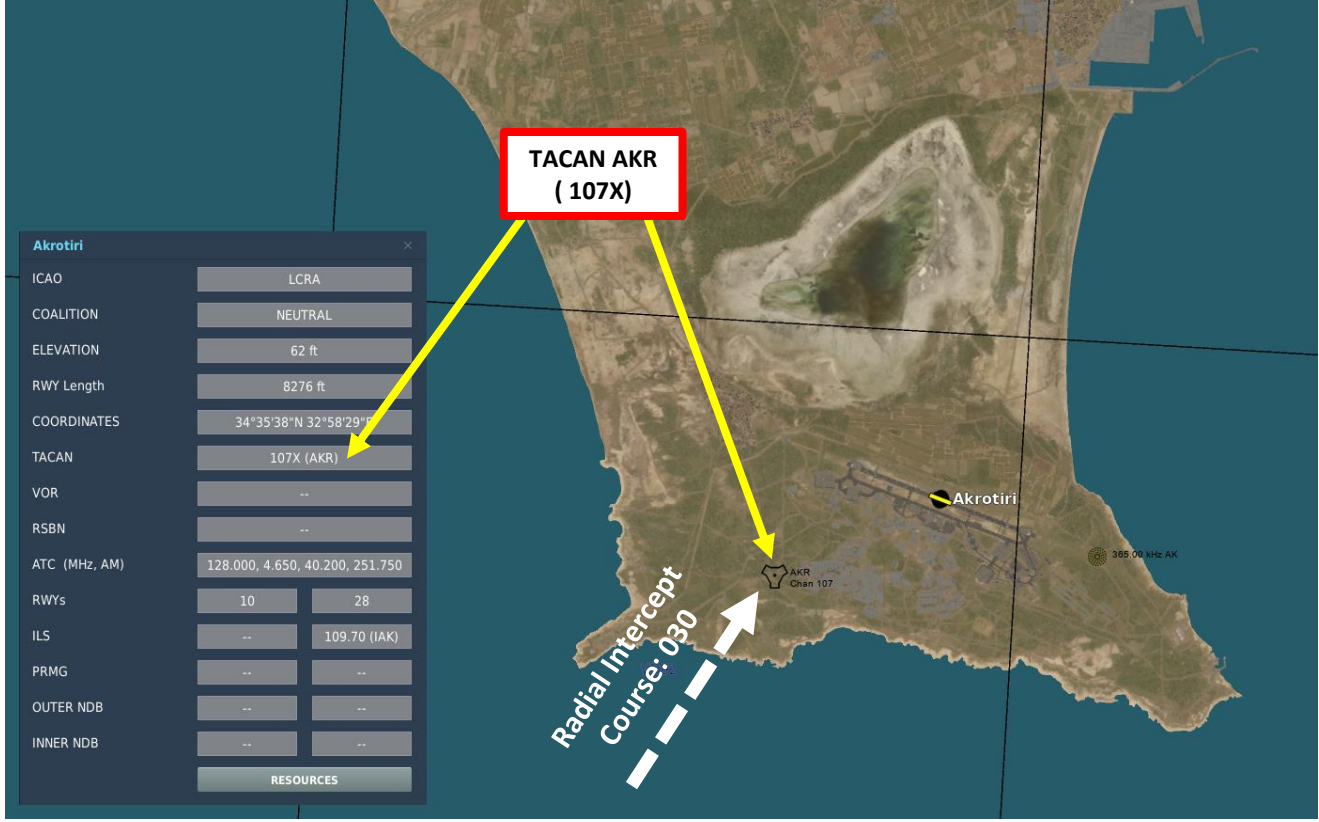


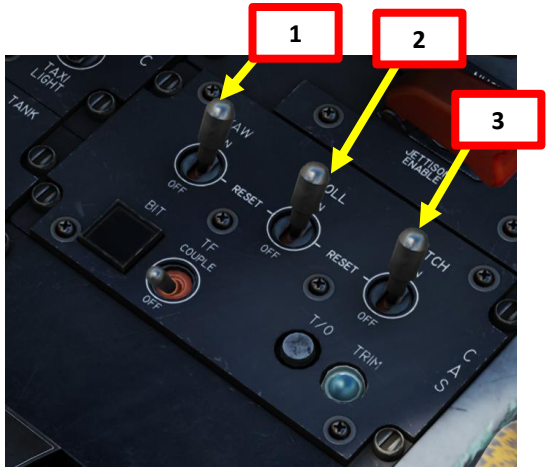
3 – AUTOPILOT COUPLED MODES
C – CRS (COURSE) STEER MODE

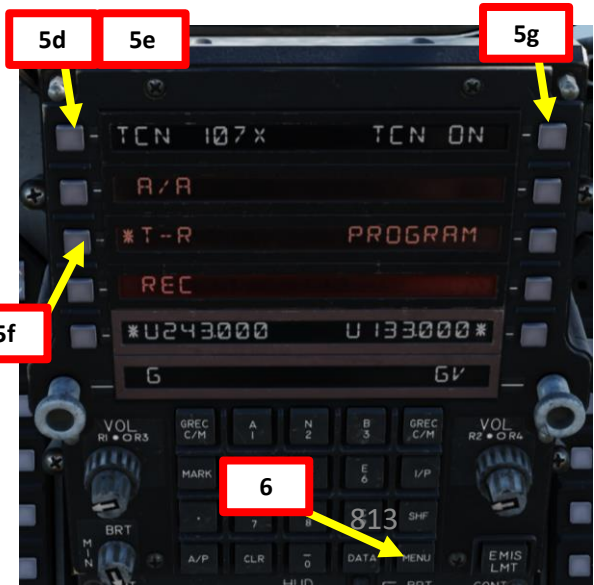
3 – AUTOPILOT COUPLED MODES
D – TCN (TACAN) STEER MODE

In order to set autopilot TACAN Mode and follow TACAN Station AKR (Channel 107X) using a radial (course) of 030:

1. Set Yaw Axis CAS (Control Augmentation System) Switch – ON (FWD).
2. Set Roll Axis CAS (Control Augmentation System) Switch – ON (FWD).
3. Set Pitch Axis CAS (Control Augmentation System) Switch – ON (FWD).
4. Select NAV Master Mode
5. Select TACAN Station 107X.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) Select TCN (TACAN) sub-menu.
    c) On UFC scratchpad, type “107”.
    d) Press pushbutton next to TCN channel.
    e) If needed, press pushbutton next to TCN channel to toggle between X and Y channel. We will leave it to 107X.
    f) Press pushbutton next to T-R (Transmit/Receive)
    g) Press pushbutton next to TCN, which will change from OFF to ON.
    h) TACAN 107X is now selected and powered on.
6. Return to MENU 1.

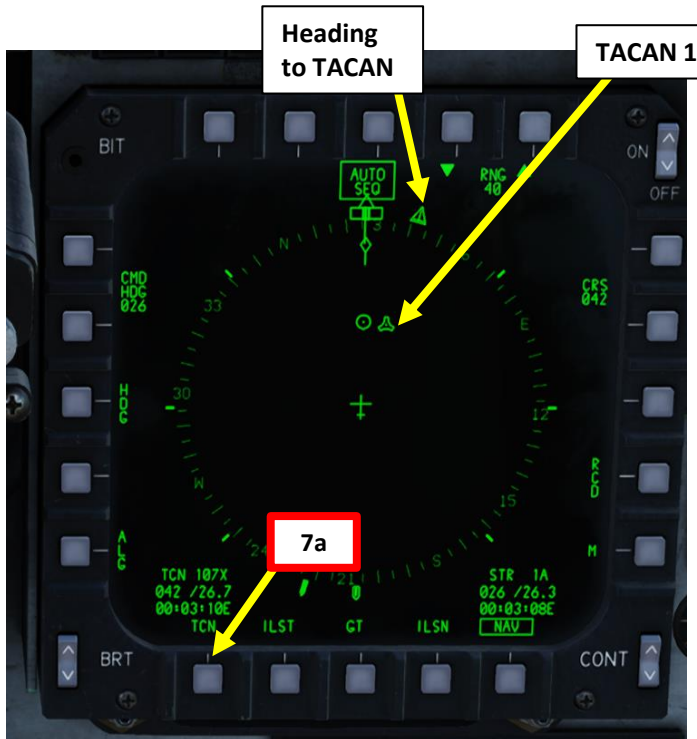


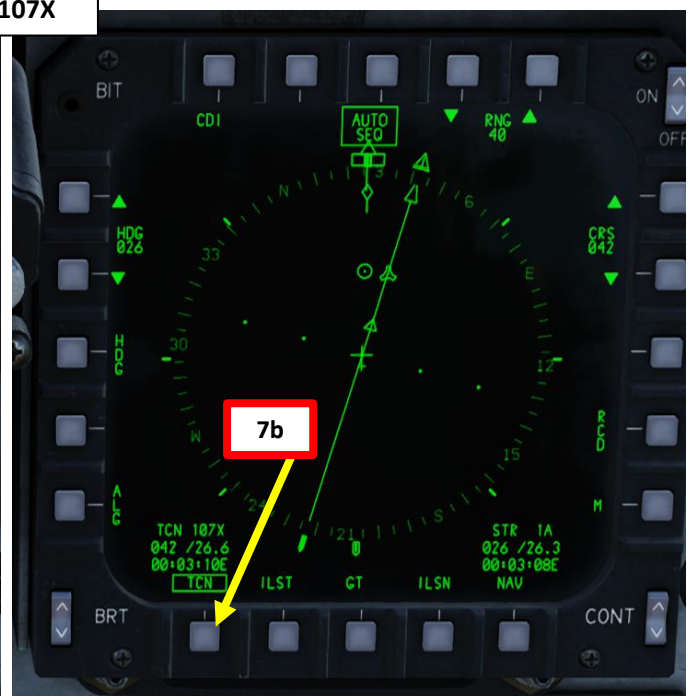




3 – AUTOPILOT COUPLED MODES
D – TCN (TACAN) STEER MODE

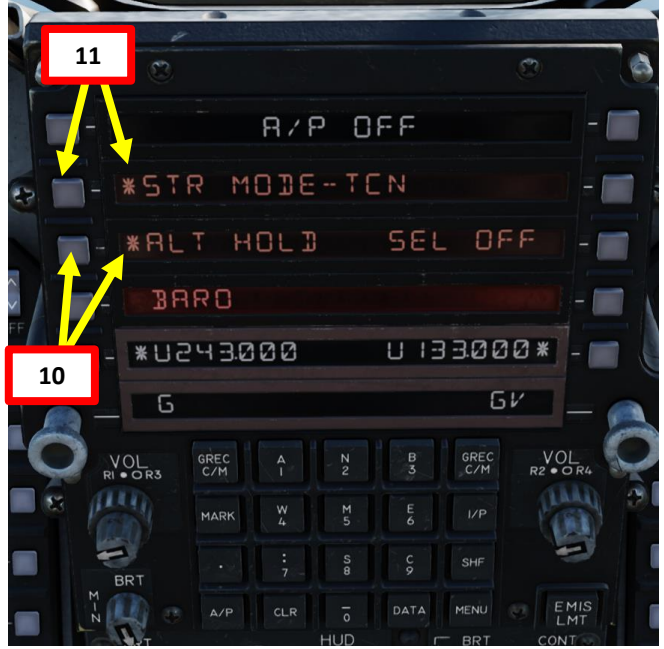
7. On HSI (Horizontal Situation Indicator) page, select TCN mode (boxed).
8. Set desired radial course (030) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the course value, then press either of the CRS UP or CRS DOWN buttons.
9. From MENU 1 page, select A/P Menu.

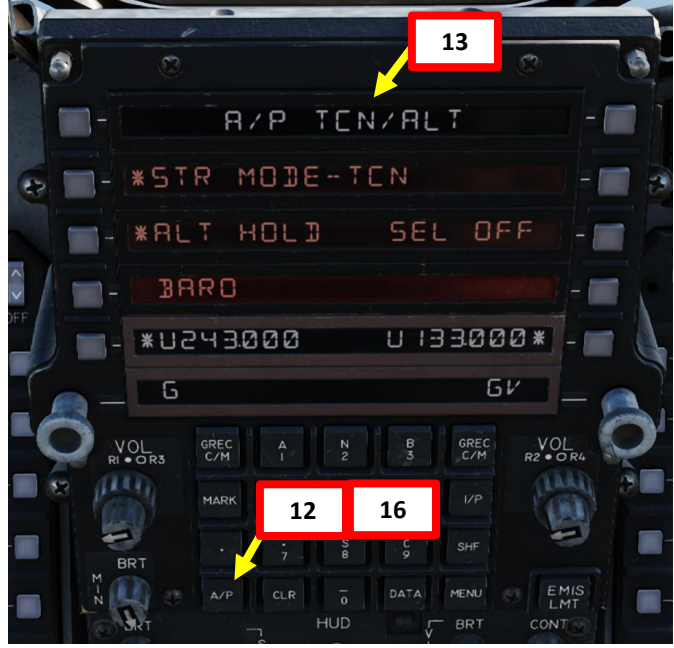


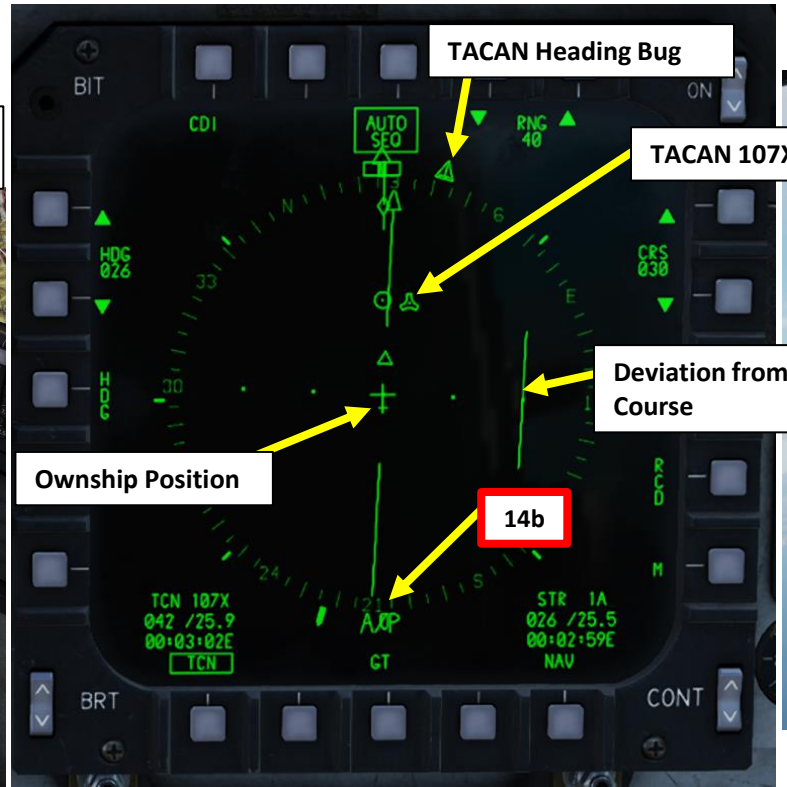


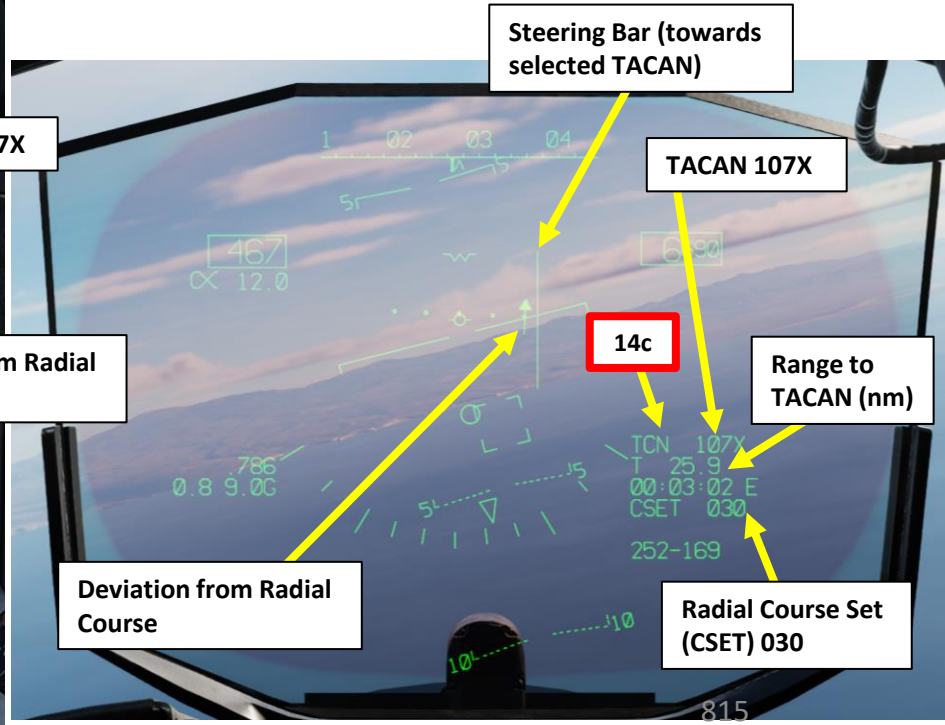
3 – AUTOPILOT COUPLED MODES
D – TCN (TACAN) STEER MODE

10. If desired, select ALT HOLD to make the aircraft hold the barometric altitude. An asterisk means the mode is selected.
11. Select STR TCN. An asterisk means the mode is selected.
12. Press A/P Button to engage coupled STR TCN and ALT HOLD modes.
13. The currently selected mode will be displayed in the top line of the UFC (TCN/ALT) with A/P submenu or on MENU 1 page next to Pushbutton 9.
14. When autopilot is engaged in coupled course mode:
    a) A green A/P light illuminates on the caution panel.
    b) A/P indication is visible on the HSI (Horizontal Situation Indicator)
    c) TCN 107X and CSET (Course Set) 030" indications are visible on the HUD (Heads-Up Display)
15. The autopilot will maintain current barometric altitude and steer the aircraft to intercept the selected TACAN Station (107X) while following the selected radial course (030).
16. To disengage autopilot, either press the A/P Button or press the Paddle Switch.







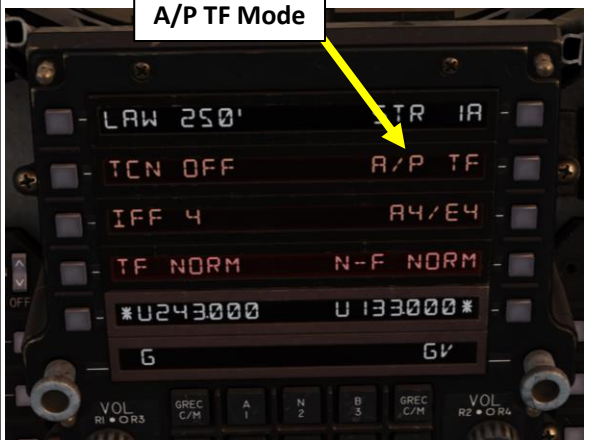


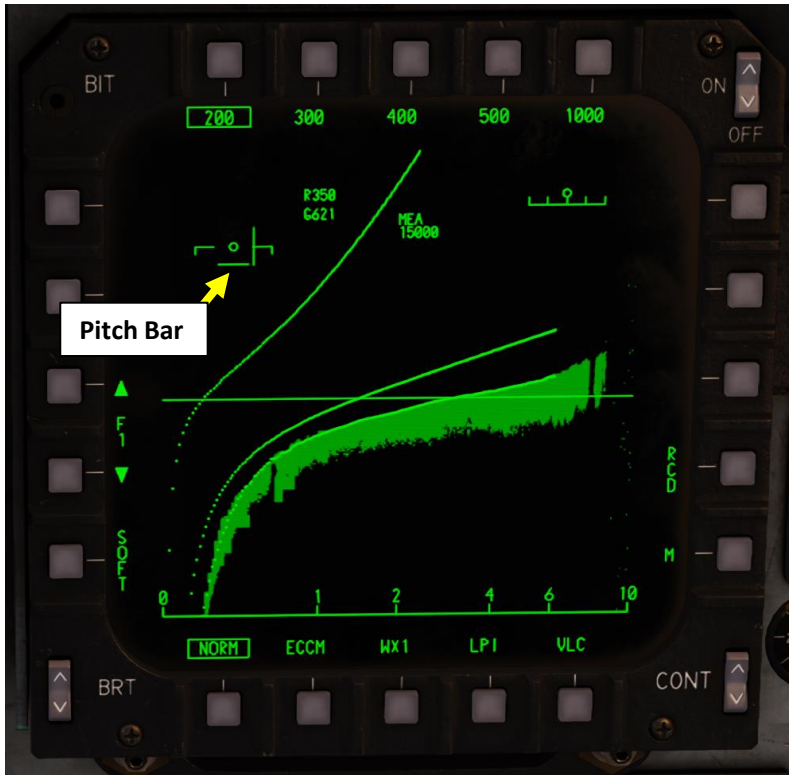
3 – AUTOPILOT COUPLED MODES
D – TCN (TACAN) STEER MODE

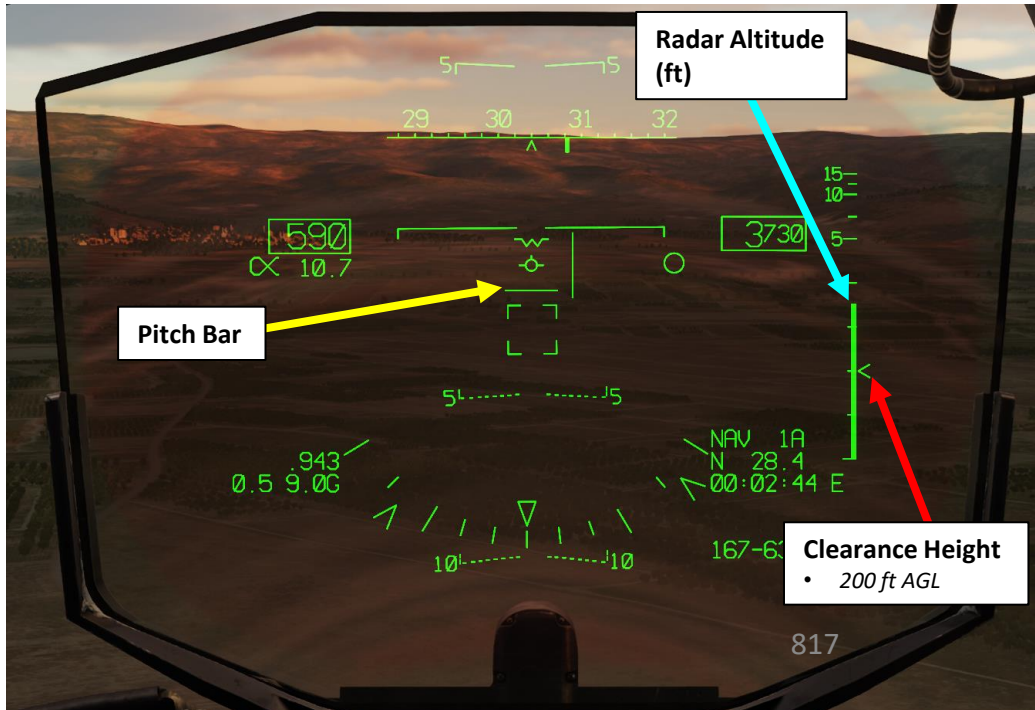
3 – AUTOPILOT COUPLED MODES
E – TF (TERRAIN FOLLOWING RADAR) BLENDED MODE

The terrain-following system can be coupled with the autopilot and automatically pitch the aircraft (pitch command is indicated by the Pitch bar) in order to achieve the selected set obstacle clearance height without any input from the aircrew.

See PART 10 – RADAR & SENSORS in section 4.2.4.3 – Automatic TF Operation (ATF) and section 4.2.4.4 – Blended Mode for more information.





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SECTION STRUCTURE

- 1 – Navigation Introduction
- 2 – HSI (Horizontal Situation Indicator)
- 3 – ADI (Attitude Director Indicator)
- 4 – TSD (Tactical Situation Display)
- 5 – UFC (Upfront Control Panel)
- 6 – Sequence Point Types
- 7 – Steerpoints
  - 7.1 – Steerpoint Navigation
    - 7.1.1 – Steerpoint Database
    - 7.1.2 – Manual vs Auto Sequencing
    - 7.1.3 – Navigation (NAV) Steering Tutorial
    - 7.1.4 – Ground Track (GT) Steering Tutorial
    - 7.1.5 – Course (CRS) Steering Tutorial
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- 9 – Markpoints
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  - 9.2 – How to Add Markpoints
    - 9.2.1 – Overfly Designation
    - 9.2.2 – Targeting Pod Designation
    - 9.2.3 – Air-to-Ground Radar Designation
  - 9.3 – Slaving a Sensor to a Markpoint
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- 11 – Bullseye
- 12 – INS (Inertial Navigation System) Drift
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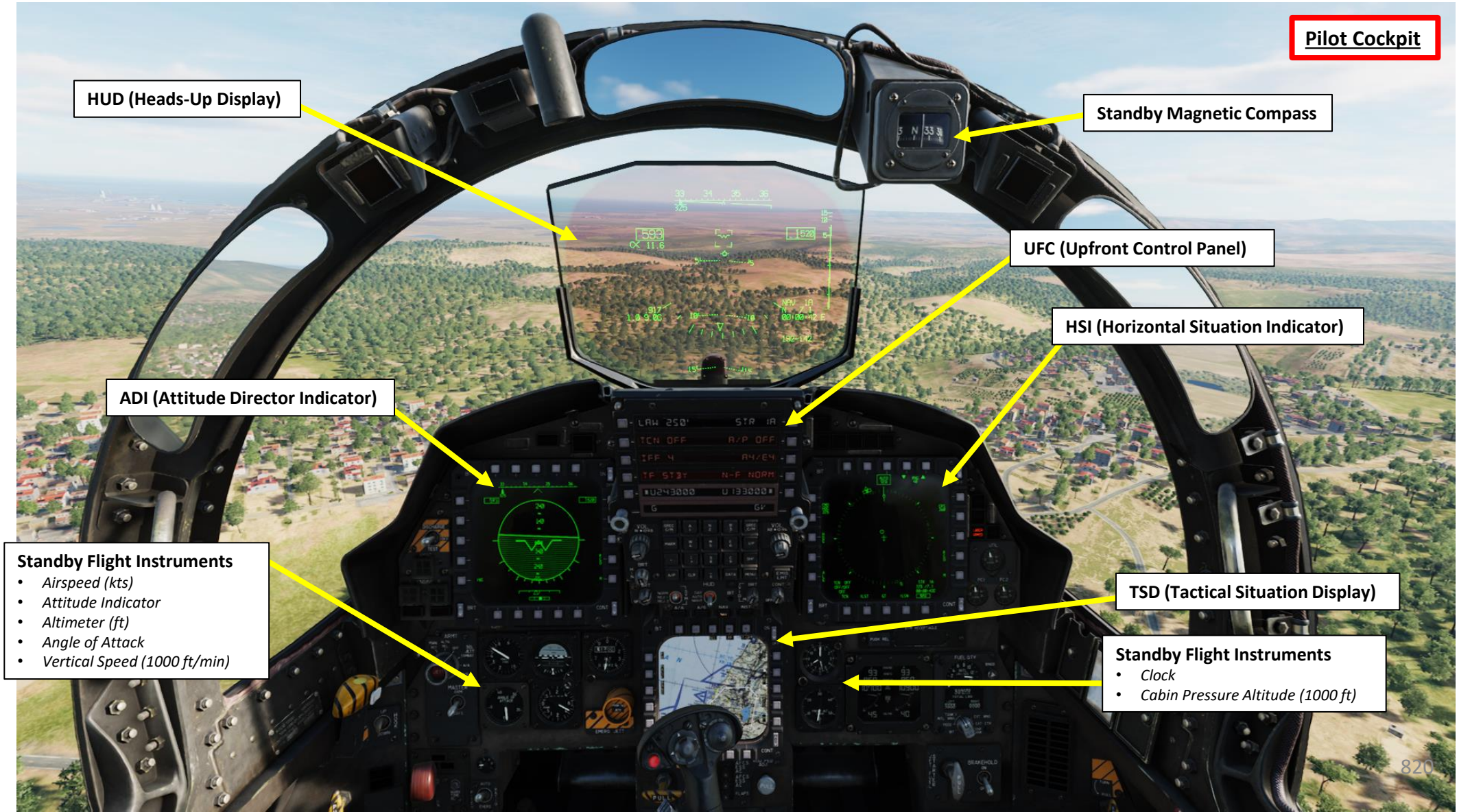
  - 12.5 – PVU (Precision Velocity Update)
- 13 – ILS (Instrument Landing System) Tutorial
  - 13.1 – Basics
  - 13.2 – ILSN vs ILST
  - 13.3 – ILS Setup
    - 13.3a – ILSN (Navigation Source) Approach
    - 13.3b – ILST (TACAN Source) Approach
  - 13.4 – Performing ILS Approach

1 – NAVIGATION INTRODUCTION

Navigation in the F-15E is mostly done through the HSI (Horizontal Situation Indicator), TSD (Tactical Situation Display), HUD (Heads-Up Display) and ADI (Attitude Director Indicator) localizer & glide slope reference bars. The Standby Magnetic Compass can also be used as a backup. The UFC (Upfront Control Panel) allows you to consult and edit navigation data. The A/A and A/G RDR (Radar) pages also display steerpoints. Take note that while TACAN and ILS beacons are supported in the F-15E, NDB (Non-Directional Beacons) navigation with an ADF (Automatic Direction Finder) is **not** supported in the simulated avionics suite.



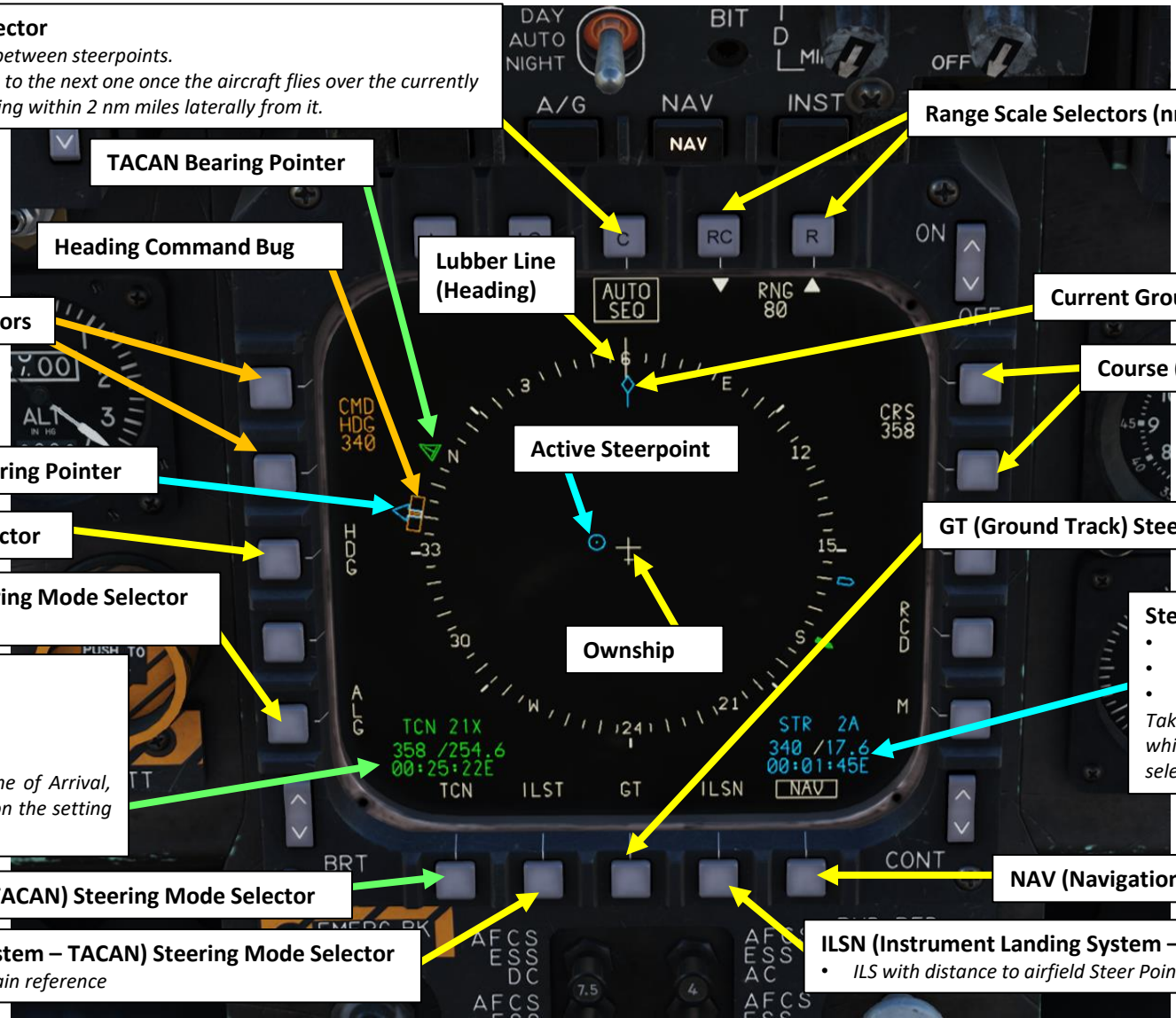
1 – NAVIGATION INTRODUCTION

2 – HSI (HORIZONTAL SITUATION INDICATOR)

The HSI (Horizontal Situation Indicator) is one of the most important tools at your disposal for navigation. The HSI displays a plan-view of your current tactical situation with the symbols representing your aircraft position (Ownship), current steerpoint, and active flight plan.

The HSI is your primary indicator to assist in navigation to steerpoints and TACAN beacons. While you will likely be using HUD symbology for most of your navigation purposes, a firm understanding of the HSI is necessary for access to additional navigation data that is not present on the HUD or other displays, and also in case of battle damage.

AUTO SEQ (Automatic Sequencing) Selector
- *Enables or disables automatic sequencing between steerpoints.*
- *When enabled (boxed), steerpoint 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.*



TACAN Bearing Pointer

Range Scale Selectors (nm)

Heading Command Bug

Lubber Line (Heading)

Current Ground Track

Heading Command Selectors

Course (CRS) Command Selectors

Active Steerpoint

Steerpoint Bearing Pointer

HDG (Heading) Select Steering Mode Selector

GT (Ground Track) Steering Mode Selector

ALG (Autonomous Landing Guidance) Steering Mode Selector
- *Not simulated.*

Ownship

Steerpoint Data Block
- *2A: Selected Steerpoint Number*
- *340 / 17.6: Bearing / Range (nm)*
- *00:01:46E: Time-to-Go to steerpoint.*

Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

TACAN Data Block
- *21X: Selected TACAN Channel*
- *358 / 254.6: Bearing / Range (nm)*
- *00:25:22E: Time-to-Go to TACAN.*

Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

TCN (TACAN) Steering Mode Selector

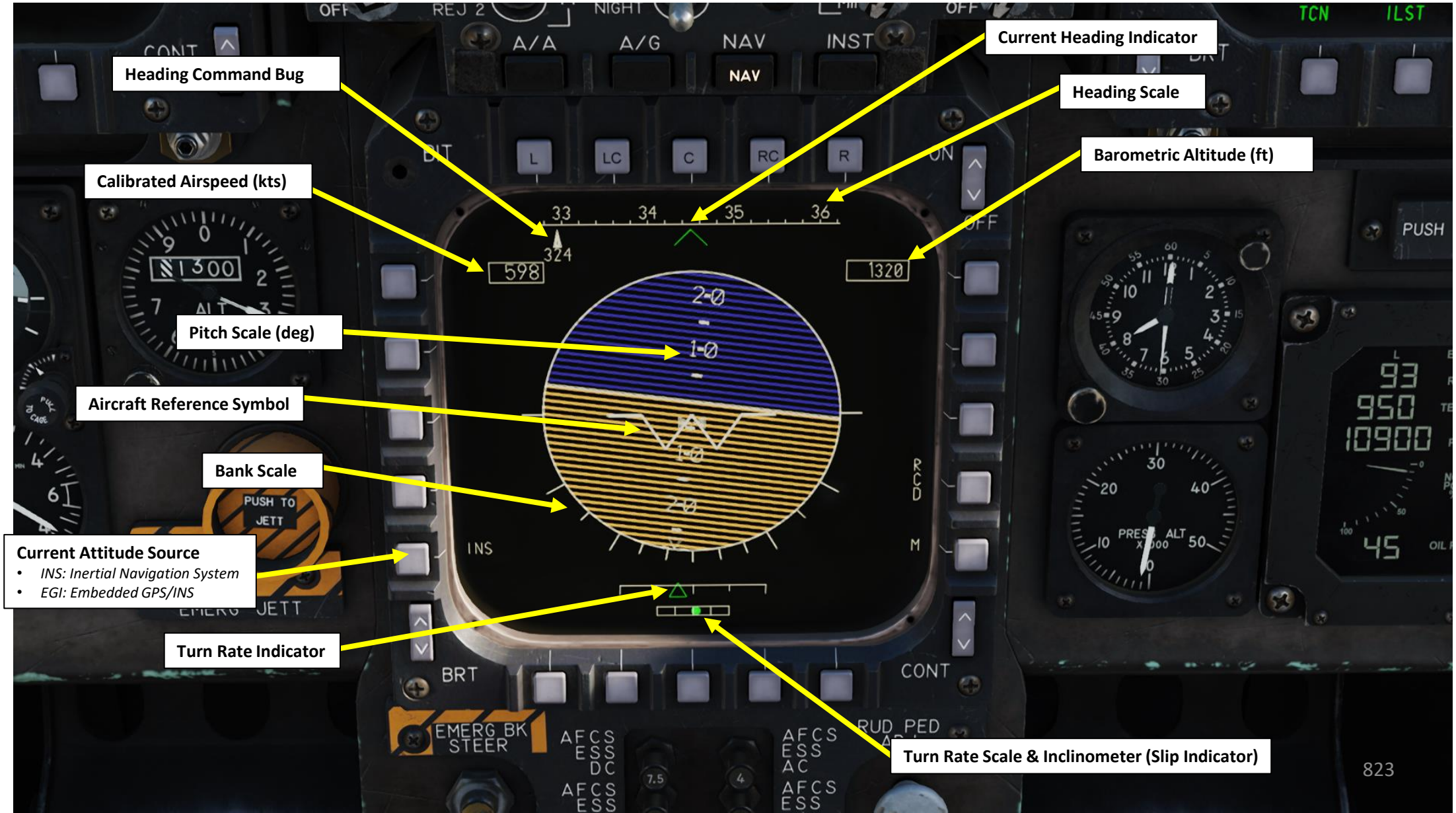
NAV (Navigation Steerpoint) Steering Mode Selector

ILST (Instrument Landing System – TACAN) Steering Mode Selector
- *ILS with TACAN distance as main reference*

ILSN (Instrument Landing System – NAV) Steering Mode Selector
- *ILS with distance to airfield Steer Point as main reference*

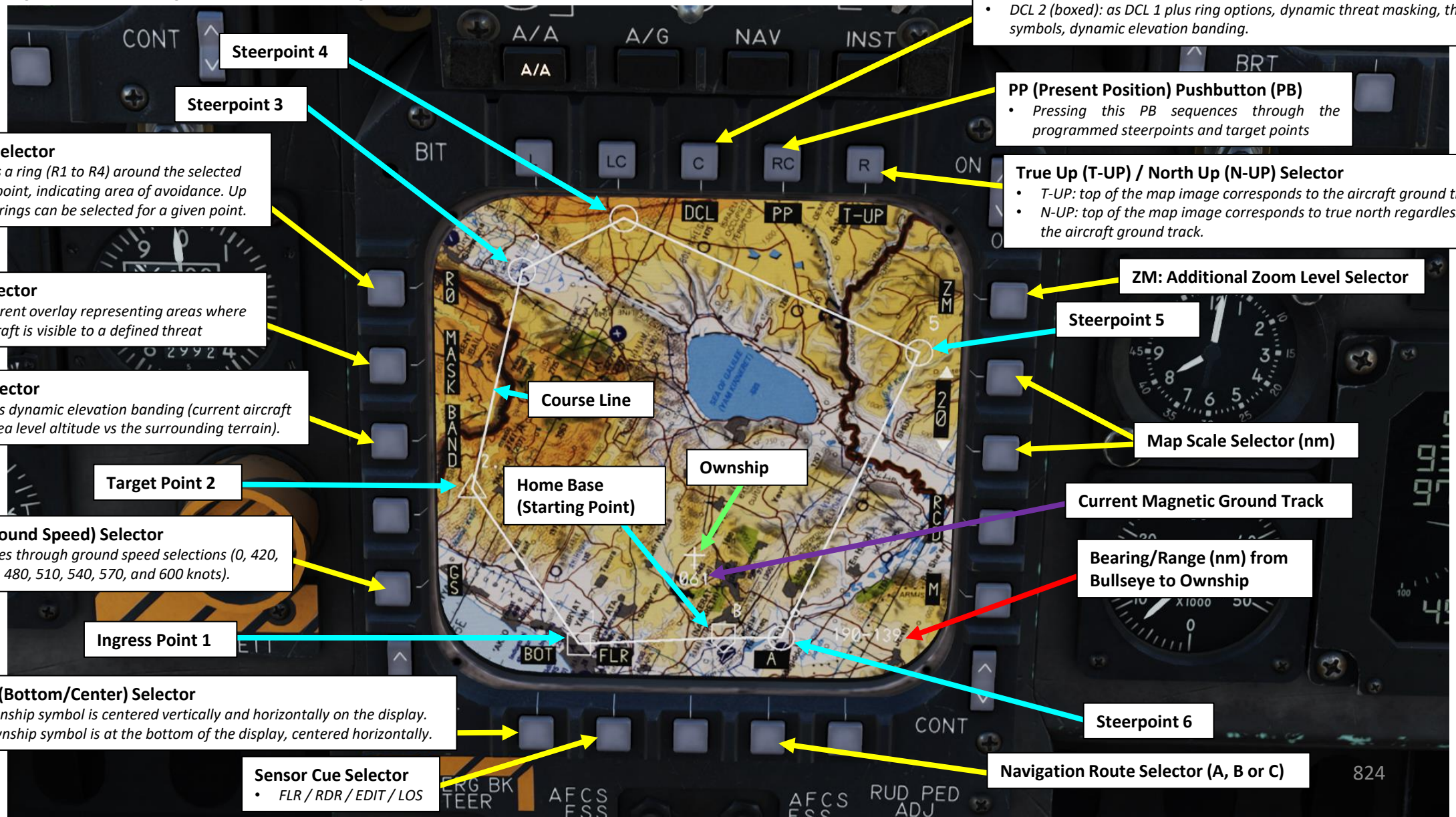
3 – ADI (ATTITUDE DIRECTOR INDICATOR)

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.



4 – TSD (TACTICAL SITUATION DISPLAY)

The TSD (Tactical Situation 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.



DCL (Declutter Selector
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.*

Steerpoint 4

Steerpoint 3

PP (Present Position) Pushbutton (PB)
- *Pressing this PB sequences through the programmed steerpoints and target points*

R (Ring) Selector
- *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.*

True Up (T-UP) / North Up (N-UP) Selector
- *T-UP: top of the map image corresponds to the aircraft ground track.*
- *N-UP: top of the map image corresponds to true north regardless of the aircraft ground track.*

ZM: Additional Zoom Level Selector

MASK Selector
- *Transparent overlay representing areas where the aircraft is visible to a defined threat*

Steerpoint 5

BAND Selector
- *Provides dynamic elevation banding (current aircraft mean sea level altitude vs the surrounding terrain).*

Map Scale Selector (nm)

Target Point 2

Current Magnetic Ground Track

GS (Ground Speed) Selector
- *Cycles through ground speed selections (0, 420, 450, 480, 510, 540, 570, and 600 knots).*

Bearing/Range (nm) from Bullseye to Ownship

Ingress Point 1

Steerpoint 6

BOT/CTR (Bottom/Center) Selector
- *CTR: ownship symbol is centered vertically and horizontally on the display.*
- *BOT: ownship symbol is at the bottom of the display, centered horizontally.*

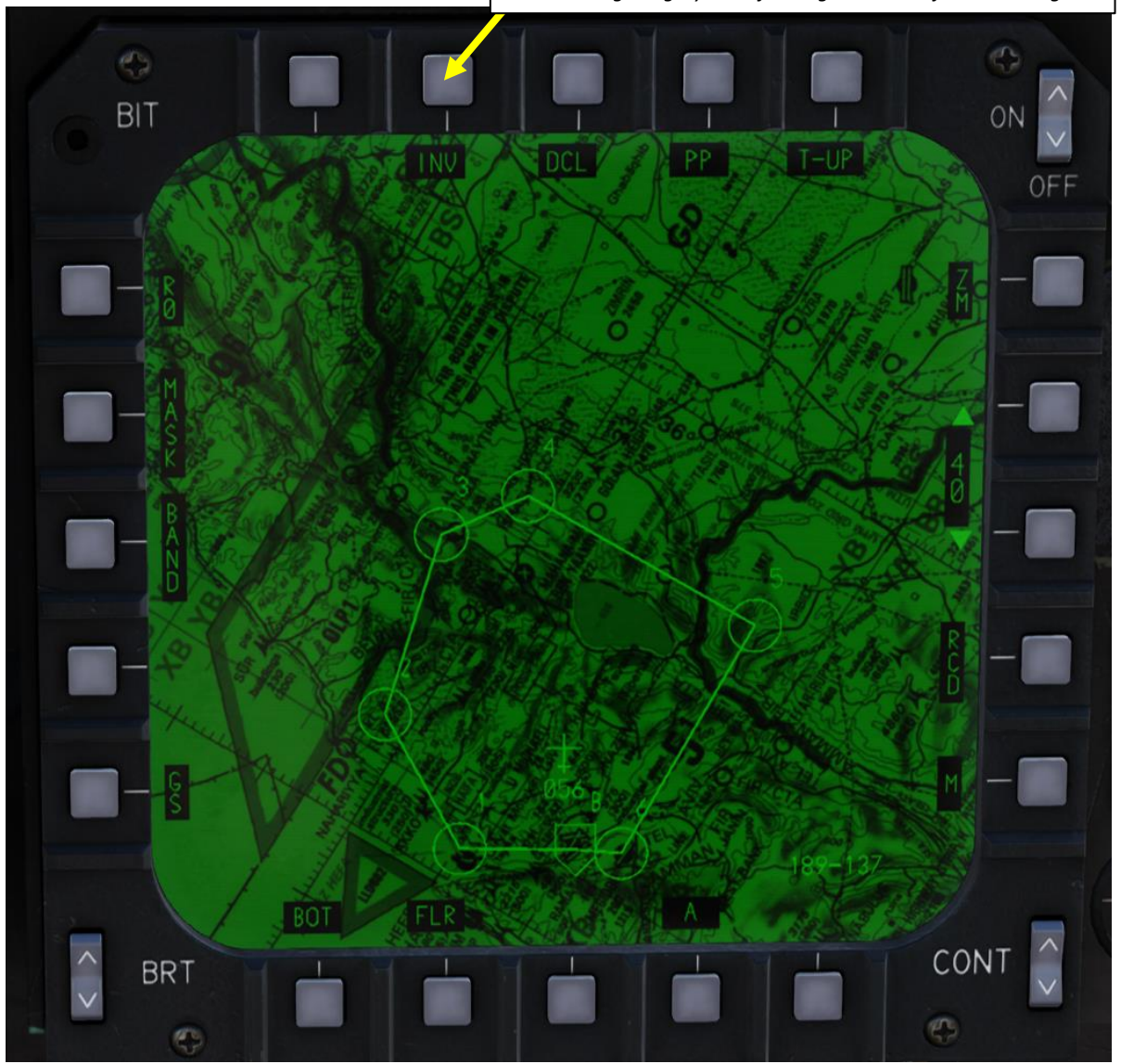
Navigation Route Selector (A, B or C)

Sensor Cue Selector
- *FLR / RDR / EDIT / LOS*

4 – TSD (TACTICAL SITUATION DISPLAY)

INV (Invert Video) Selector

- *Available only on MPD (monochrome display).*
- *INV 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.*



TSD Symbol Types

- **Steerpoint**
- **Aim Point associated with Steerpoint**
- **Initial Point (IP): Steerpoint before the target point**
- **Aim Point Associated with the Initial Point**
- **Target Point**
- **Offset Point associated with target point**
- **Base:** point of origin of current mission / flight

5 – UFC (UPFRONT CONTROL PANEL)

When selecting the UFC MENU 1 or UFC DATA 1 menu, you can access the **Point Data** submenus, which are used to input and display the coordinates, elevation and other data that is associated with sequence points.

Point Data Submenu **3**

List Point (not simulated)

Time On Target (TOT) (not simulated)

Selected Sequence Point

Minimum Enroute Altitude (MEA) Setting (ft)

Selected Sequence Point Latitude Coordinates

Selected Sequence Point Longitude Coordinates

Selected Sequence Point Elevation (ft)

UTM Submenu Selector

- *When pressed, sequence point coordinates are shown in UTM (Universal Transverse Mercator) grid format.*

5 – UFC (UPFRONT CONTROL PANEL)

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

Pressing the DATA button toggles UFC (Upfront Control Panel) DATA 1 and DATA 2 pages

DATA 1

Left Sub-Menus

- **XXX/YY.Y:** Bearing/Range (nm) to selected steerpoint
- **ETA/ETE:** Estimated Time-of-Arrival / Enroute to selected steerpoint. 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.
- **T:** True Airspeed (kts)
- **G:** Ground Speeds (kts)

Right Sub-Menus

- **STR:** Sequence/Steering Point Selected
- **R:** CARA (Combined Altitude Radar Altitude) Setting (ft)
- **TIME:** Shows current time
- **WIND:** Wind Direction (Magnetic or True) & Speed (kts)

DATA 2

Left Sub-Menus

- **SP (Row 1):** Sequence/Steering Point Selected
- **G:** Ground Speeds (kts)
- **SP (Row 3):** Selected Look-Ahead Point
- **GC:** Commanded Ground Speed (kts)

Right Sub-Menus

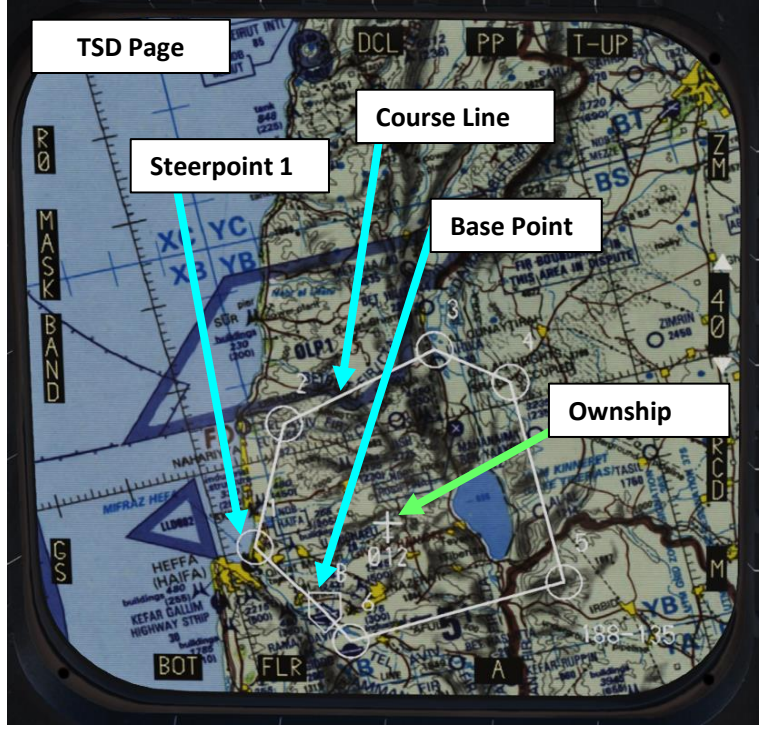
- **XXX/YY.Y or Z LBS:** Bearing/Range (X/Y) to Selected Sequence/Steering Point or Fuel Remaining (Z) at this point. Press button to toggle between data
- **ETE/ETA:** Estimated Time-of-Arrival / Enroute to selected steerpoint.
- **X LBS:** Fuel Remaining at Selected Look-Ahead Point
- **TOA/TOT:** Time-of-Arrival/Time-On-Target

6 – SEQUENCE POINT TYPES

These are the available Navigation Point (also referred as “Sequence Point”) types used in the F-15, which are geographical points that are described by latitude, longitude and elevation:

- **Steerpoints (SP)**
  - Steerpoints (or Waypoints) are pre-planned navigational points of reference for you to follow on route to your area of operation. You can create new ones, edit their coordinates and create flight plans with them. Steerpoints define the basic route of flight.
  - Labelled with a number, followed by the route letter (1A, 2B, etc.).
  - Note: the route letter next to the steerpoint is only visible on the UFC, HSI and HUD.
- **Target Points**
  - Targets points are specialized points for attack, which when selected in A/G master mode automatically become designated.
  - Labelled with a number, followed by a decimal point and a route letter (1.A as an example).
- **Markpoints**
  - Markpoints are used to "mark" a point of interest, whether flying over an interesting area or an enemy sighting.
  - Labelled by a number from 1 – 10.
- **Base Point**
  - The Base point is a single point common to all three routes which is normally the place where the INS (Inertial Navigation System) was aligned. Base Point is also referred as “Home Plate”.
  - Labelled with the letter B.
- **Initial Points (IP)**
  - The initial point is the last steerpoint before the given target point.
  - IP numbering is the same as for normal steerpoints.
- **Bullseye / Anchor Point**
  - Also referred to as a “Bullseye”, an anchor point serves as a common geographic reference for a mission amongst friendly forces.

Note: Three sets of sequence points (or routes) can be stored in the aircraft’s computer, labelled with letters A, B and C.



6 – SEQUENCE POINT TYPES

- **Aim Points**

  - Aim points are always associated with a steerpoint. Up to seven aim points can be assigned to a single steerpoint.
  - Labelled as the number of the assigned steerpoint followed by a decimal point, tenth digit and a route letter (1.1A as an example).

- **Offset Points**

  - Offset points are visually associated with a target point. Each target point can have up to seven offset points assigned to it.
  - Labelled as the number of the assigned target point plus a decimal point, followed by a hundredth point and sometimes a route letter (1.01A, as an example).

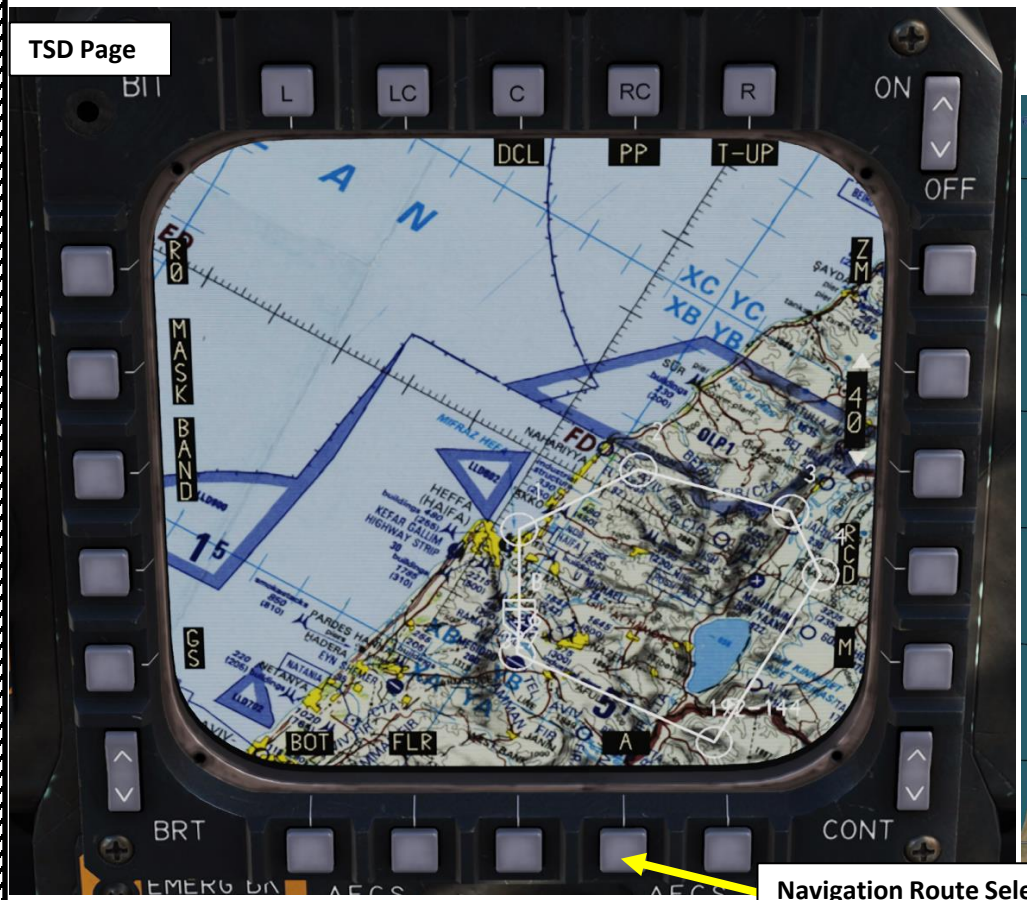
- **Aim Points for IP**

  - These aim points are always associated with a given initial point. Up to seven aim points can be assigned to a single initial point.
  - Labelled as the number of the assigned initial point, followed by a decimal point, tenth digit and a route letter (1.1A as an example).

7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.1 – Steerpoint Database

The F-15E can store up to 99 Navigation/Target points across the A, B and C routes. Currently, only Route A is available. Navigation routes can be selected from the TSD (Tactical Situation Display) page.

Note: There are no "reserved" points per se within the database.

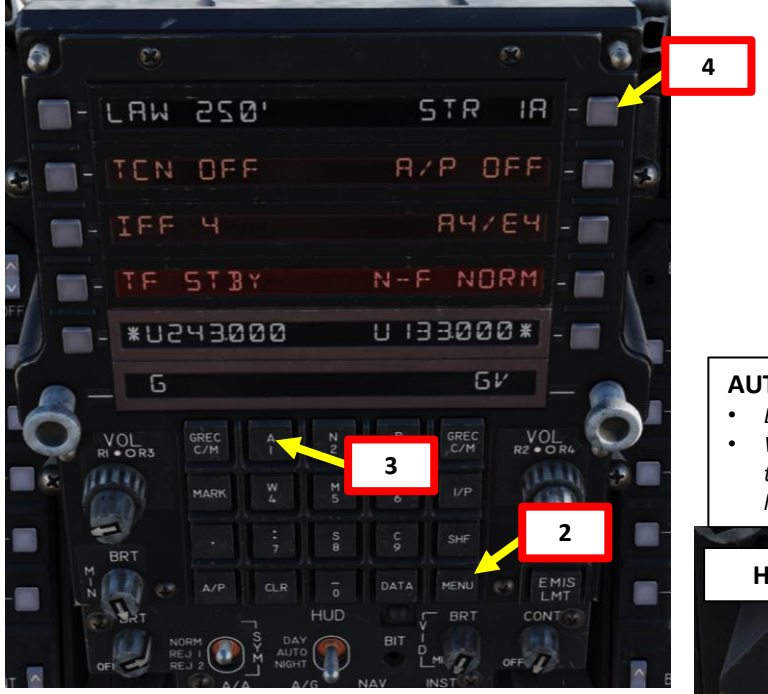


7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.2 – Manual vs Auto Sequencing

"Auto Sequencing" is a function that allows you to automatically switch to the next steerpoint in the route when flying over it. This function is available in the HSI (Horizontal Situation Indicator) page by selecting/boxing AUTO SEQ.

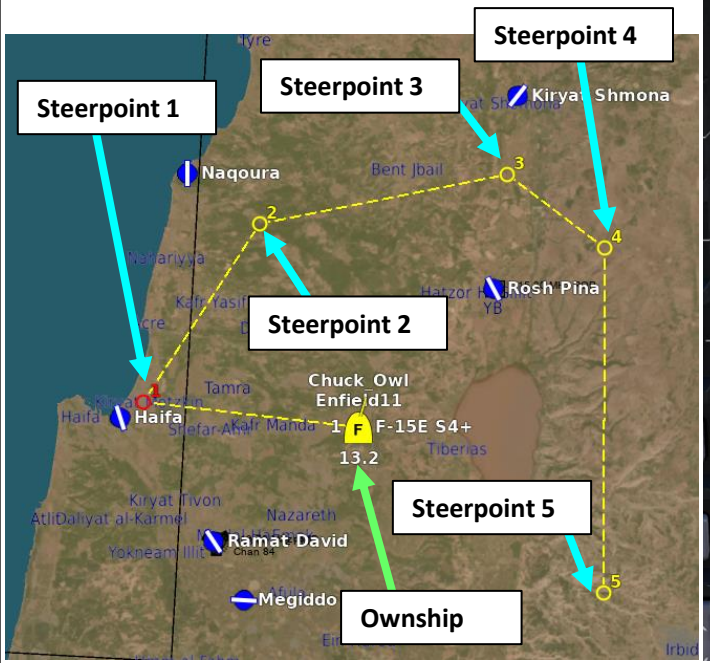
Manual sequencing is done by un-selecting AUTO SEQ, and steerpoints are manually selected from the UFC (Upfront Control Panel). To manually select a steerpoint:

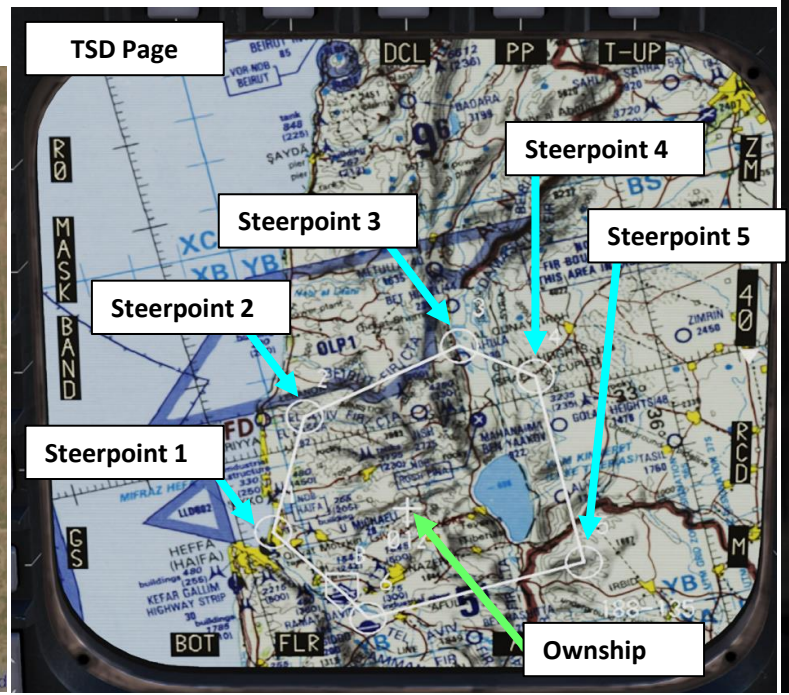
1. Un-box AUTO SEQ from HSI page
2. Select MENU 1 from the UFC
3. Enter steerpoint number on the UFC scratchpad.
4. Press on button next to STR to manually select steerpoint.

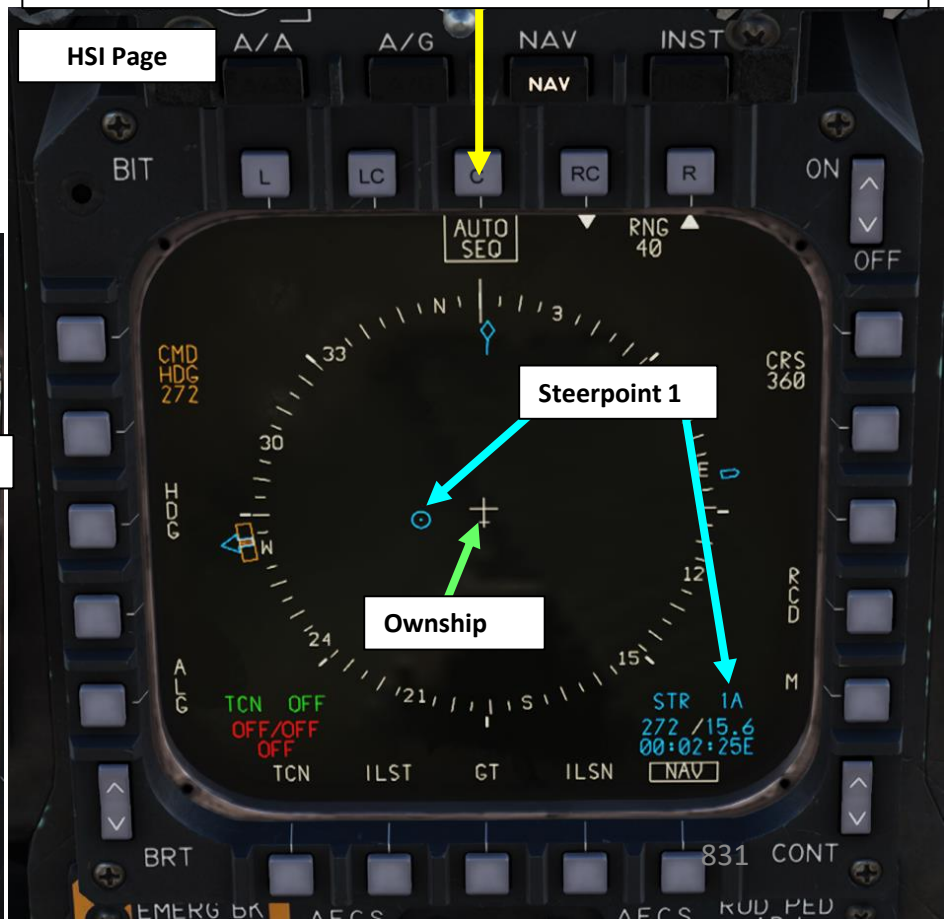


AUTO SEQ (Automatic Sequencing) Selector

- *Enables or disables automatic sequencing between steerpoints.*
- *When enabled (boxed), steerpoint 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.*

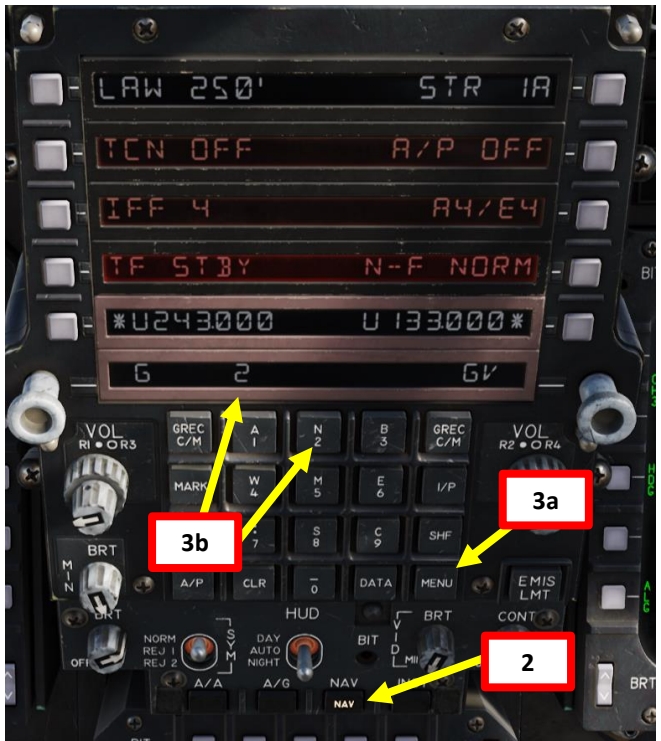


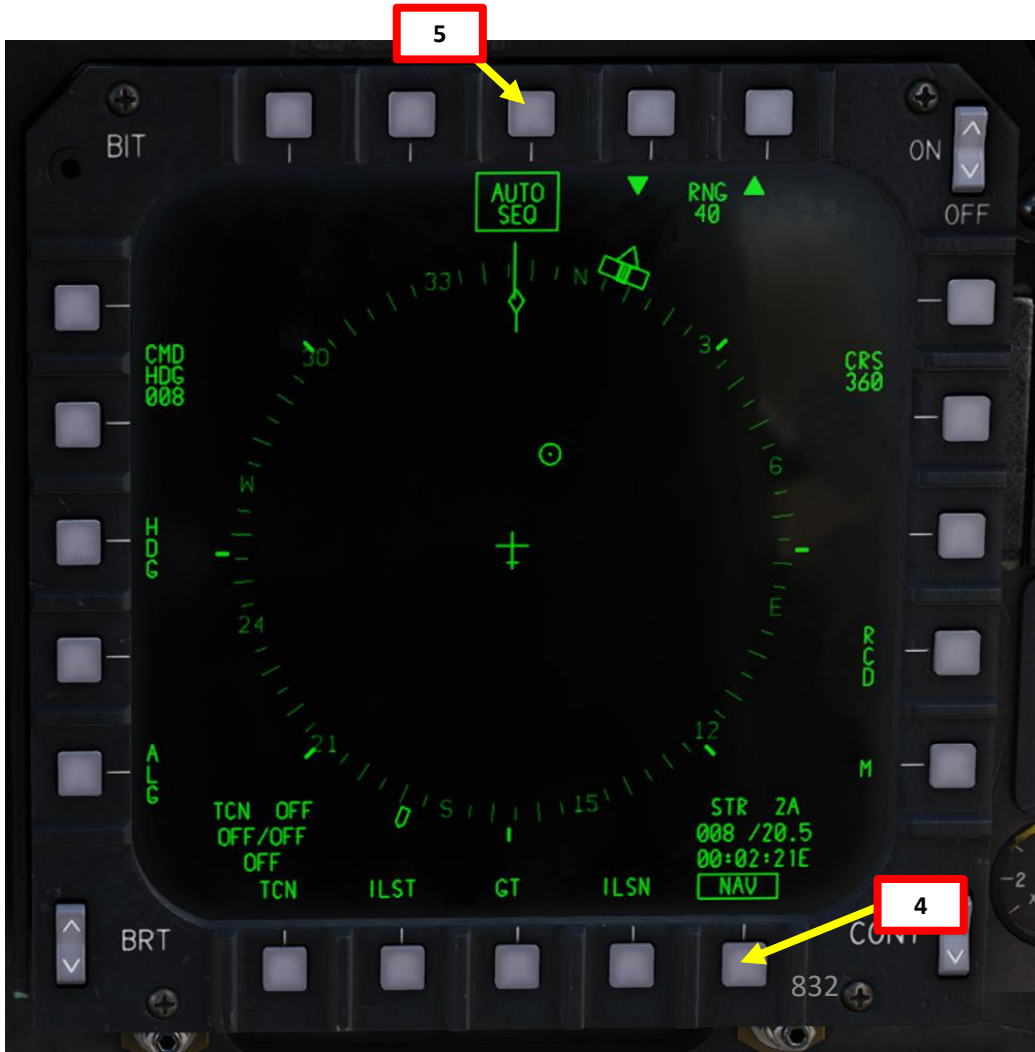




7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.3 – Navigation (NAV) Steering Tutorial

1. **We will navigate to Steerpoint 2 from Route A.**
2. Select NAV Master Mode.
3. Select Steerpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type “2”
    c) Press pushbutton next to STR to select Steerpoint Menu.
    - *Note: Alternatively, you can also perform the following: From MENU 1 UFC scratchpad, press pushbutton next to STR to toggle between steerpoints until 2A is selected.*
4. On HSI (Horizontal Situation Indicator) page, select NAV STEERING mode (boxed).
5. If desired, set AUTO SEQ (Auto Sequencing) ON (boxed) to make the aircraft automatically transition to the next waypoint when flying over your selected waypoint.

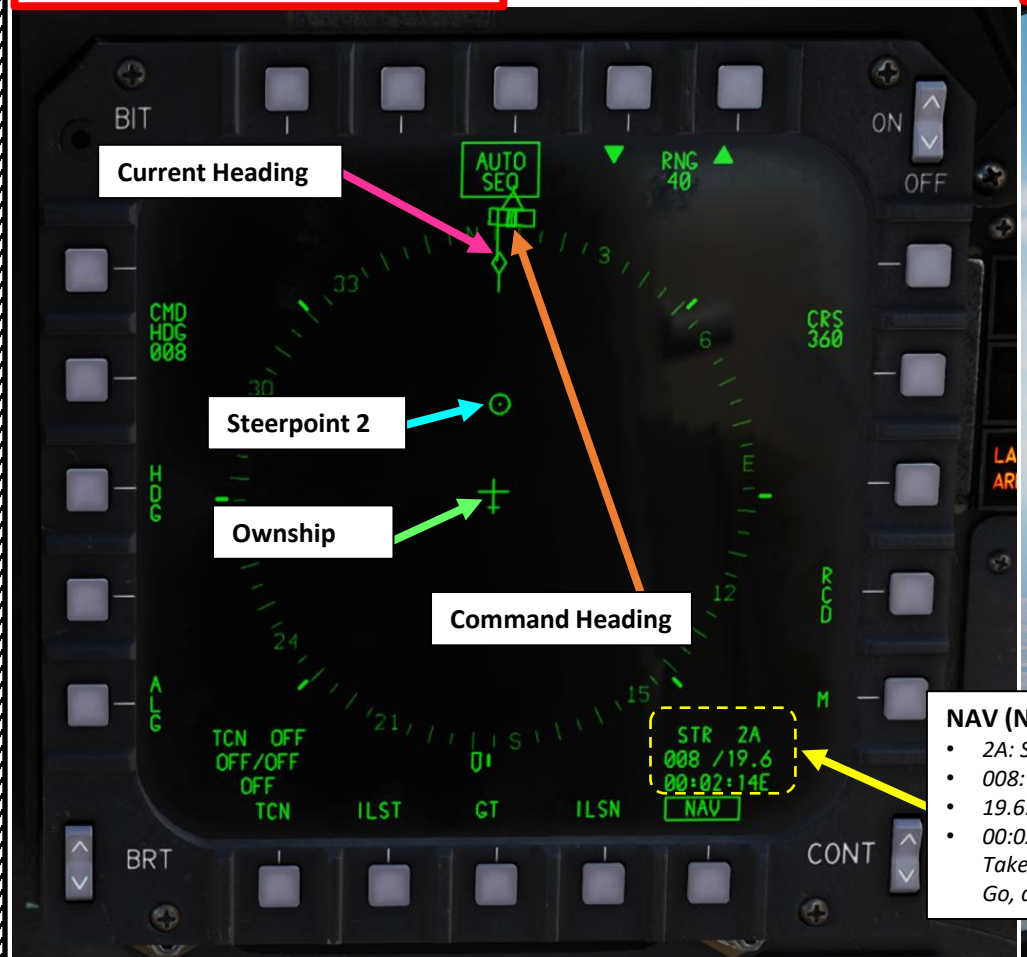




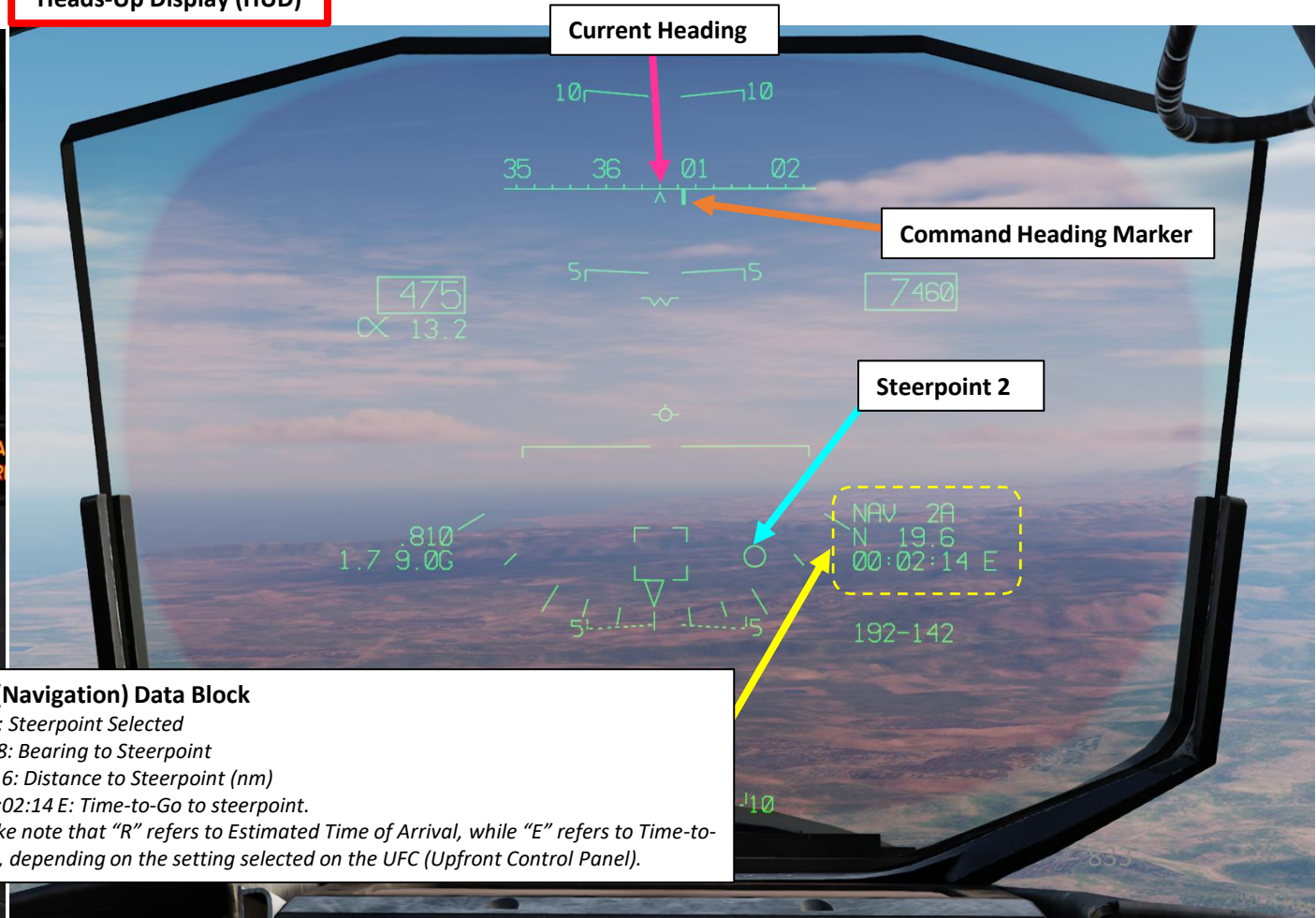
7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.3 – Navigation (NAV) Steering Tutorial

6. Follow Command Heading Bug to steer aircraft towards the steerpoint. Symbology is visible both on the HUD (Heads-Up Display) and the HSI (Horizontal Situation Indicator).

Horizontal Situation Indicator (HSI)



Heads-Up Display (HUD)



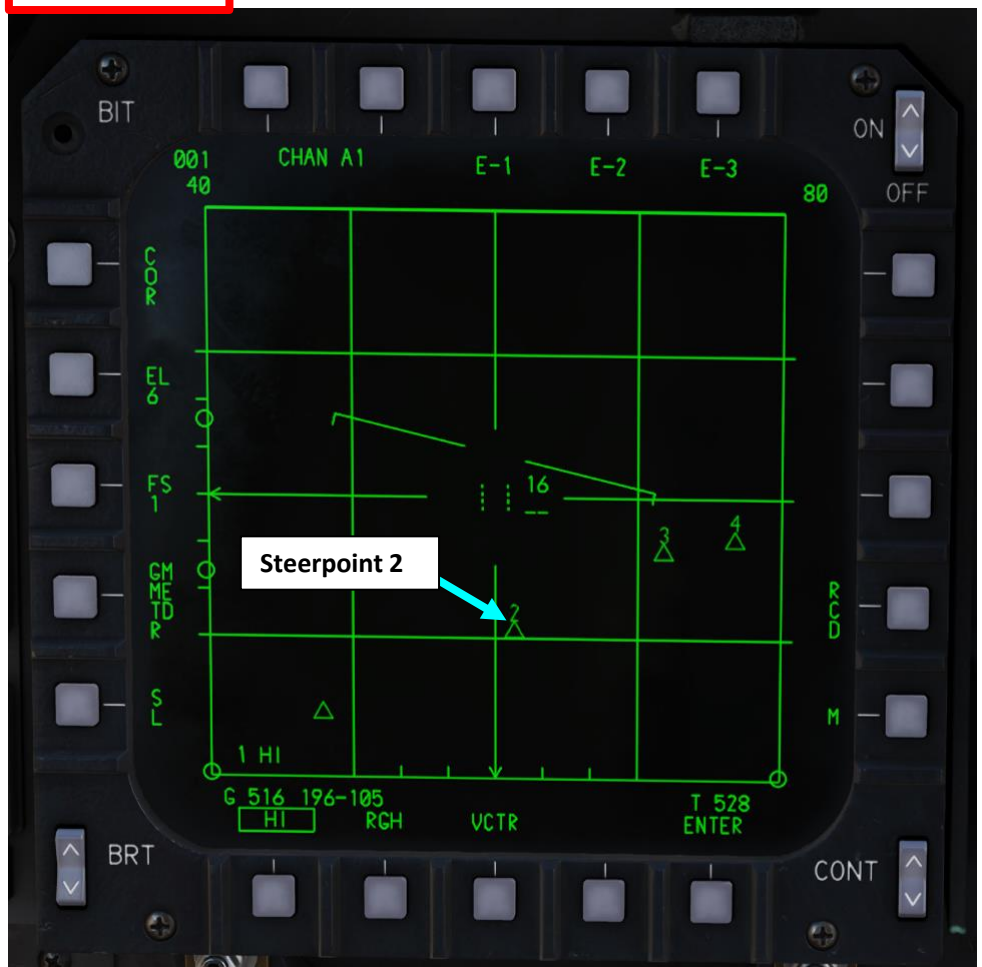
NAV (Navigation) Data Block

- *2A: Steerpoint Selected*
- *008: Bearing to Steerpoint*
- *19.6: Distance to Steerpoint (nm)*
- *00:02:14 E: Time-to-Go to steerpoint.*
  Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.3 – Navigation (NAV) Steering Tutorial

6. Take note that steerpoints are also visible on the A/A RDR and A/G RDR pages.

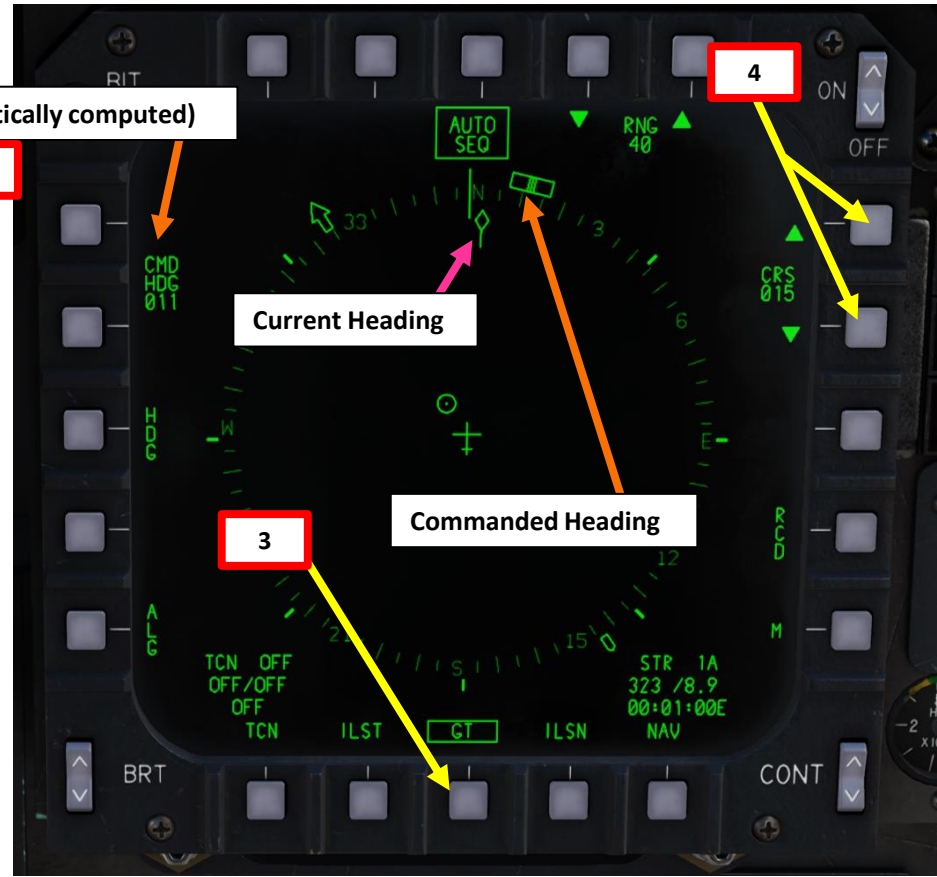
A/A RDR Page



A/G RDR Page

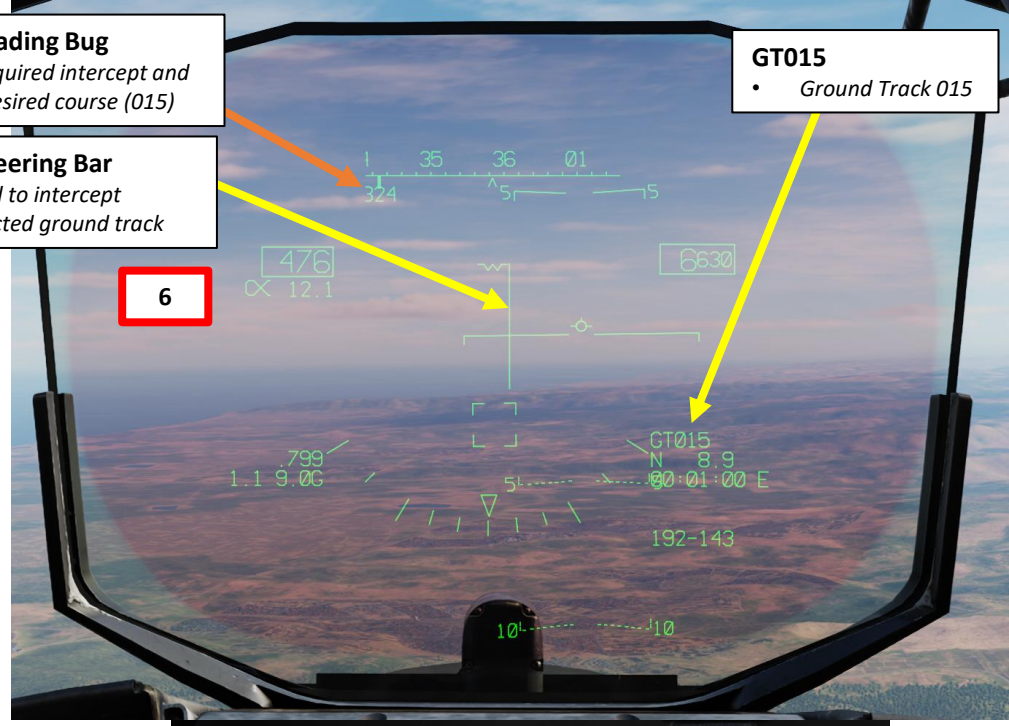
7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.4 – Ground Track (GT) Steering Tutorial

1. The Ground Track (GT) Steering Mode is used to set up a wind - corrected heading using the UFC controls and the HSI (Horizontal Situation Indicator). In other words, it is basically a crabbed flight director based on winds.
   We will navigate follow a heading of 015 (Magnetic) while we have a 30 kts crosswind blowing towards 070.
2. Select NAV Master Mode.
3. On HSI (Horizontal Situation Indicator) page, select GT STEERING mode (boxed).
4. Set desired heading to follow (015) using the CRS UP and CRS DOWN buttons.
   - Alternatively, you can type on the UFC scratchpad the heading value, then press either of the CRS UP or CRS DOWN buttons.
5. On the HSI, the Command Heading bug shows the heading which should be flown on the compass rose. 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.*

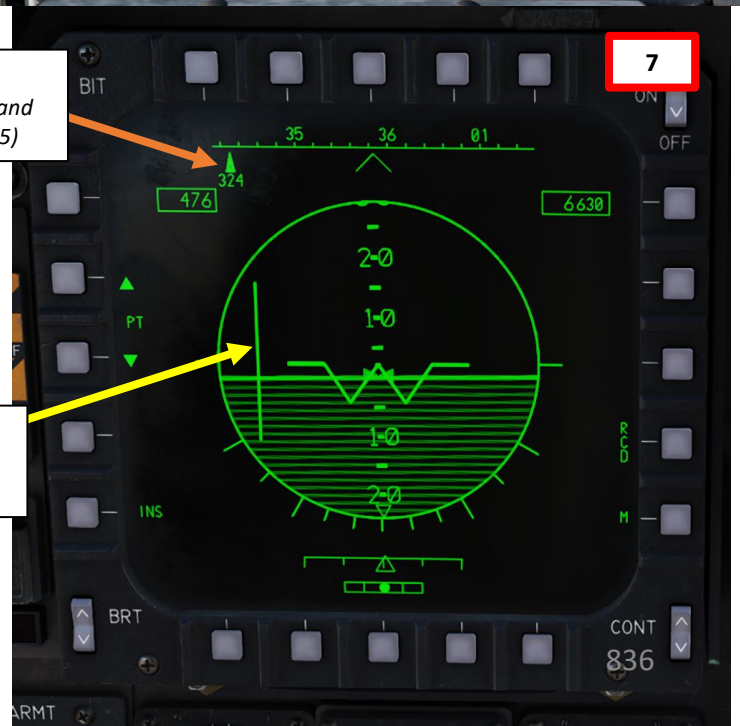


7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.4 – Ground Track (GT) Steering Tutorial

6. On the HUD (Heads-Up Display):
   - 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.
   - A Bank Steering Bar is shown giving the pilot visual designation for intercepting the selected Ground Track.
   - 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.
7. The information displayed on the ADI (Attitude Director Indicator) largely mirrors the HUD indications.
   - A Bank Steering Bar is shown giving the pilot visual designation for intercepting the selected Ground Track.
   - The Command Heading Bug on the Heading Scale indicates the course that should be flown to intercept the selected Ground Track.
8. In the UFC, the DATA 1 display contains usual information with relation to the selected Steer Point and wind FROM Bearing / Speed (kts).

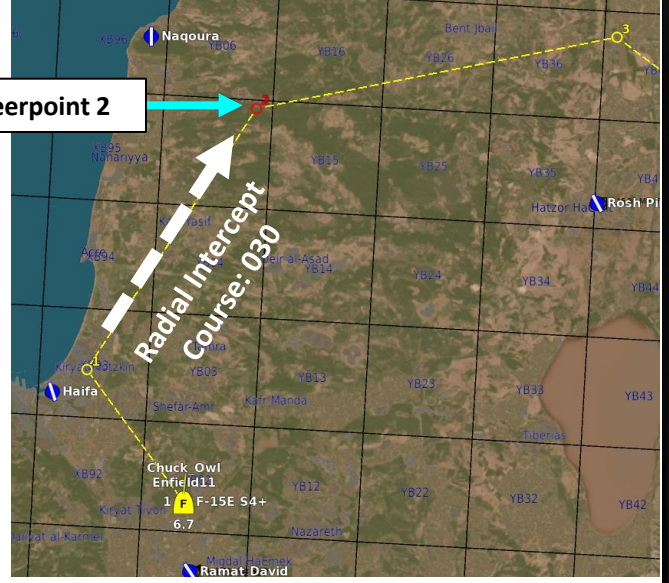


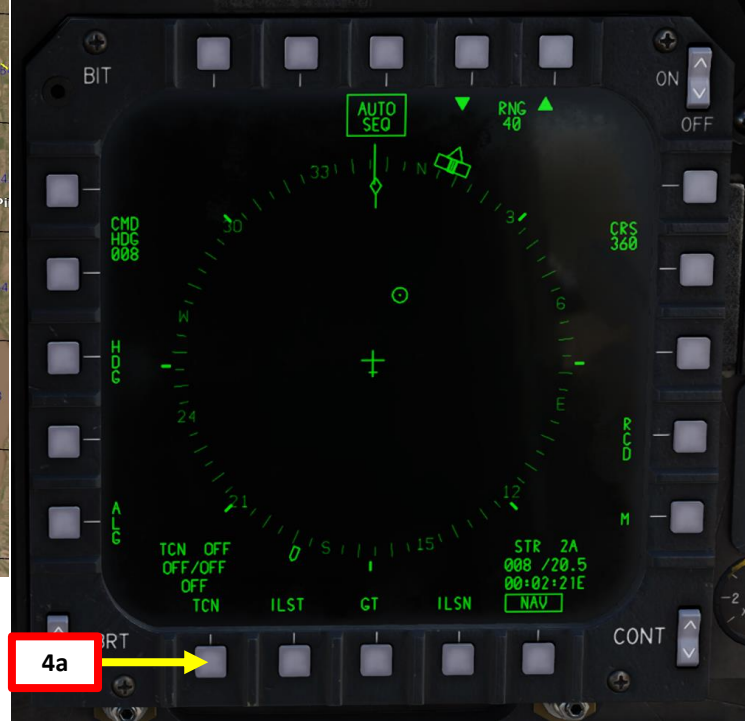
Wind Data
- *246: FROM Bearing*
- *030: Speed (kts)*

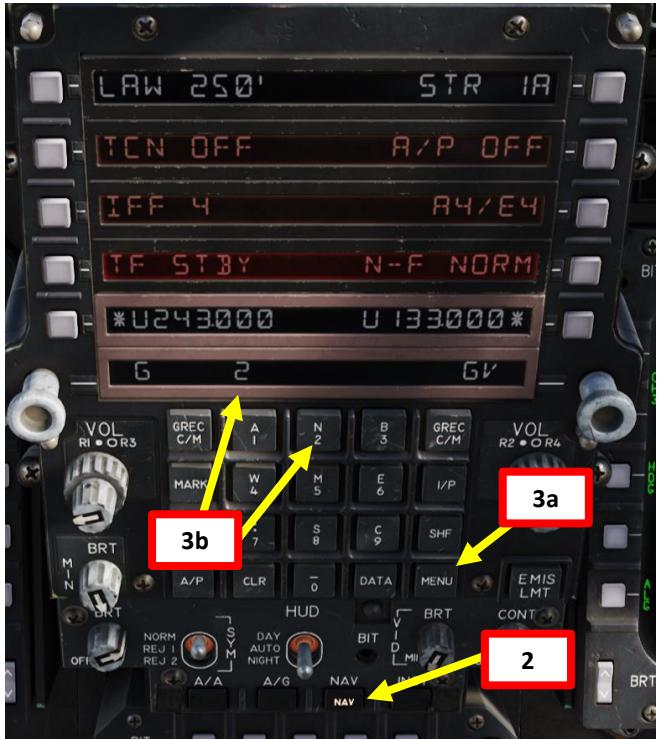


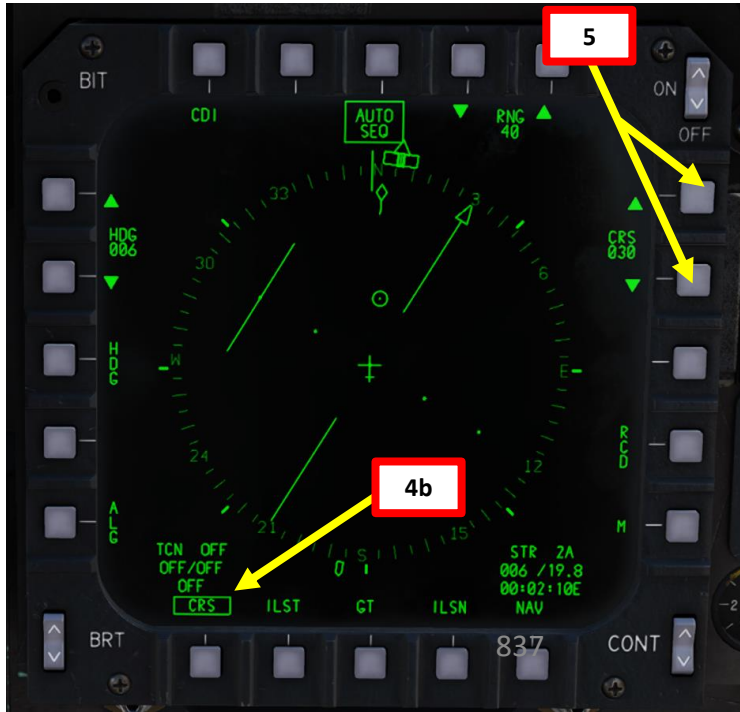
7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.5 – Course (CRS) Steering Tutorial

1. **We will navigate to Steerpoint 2 from Route A by following a radial of 030.**
2. Select NAV Master Mode.
3. Select Steerpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type “2”
    c) Press pushbutton next to STR to select Steerpoint Menu.
    - *Note: Alternatively, you can also perform the following: From MENU 1 UFC scratchpad, press pushbutton next to STR to toggle between steerpoints until 2A is selected.*
4. On HSI (Horizontal Situation Indicator) page, select CRS mode (boxed). You might have to toggle TCN mode first in order to see CRS mode.
5. Set desired radial course (030) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the course value, then press either of the CRS UP or CRS DOWN buttons.



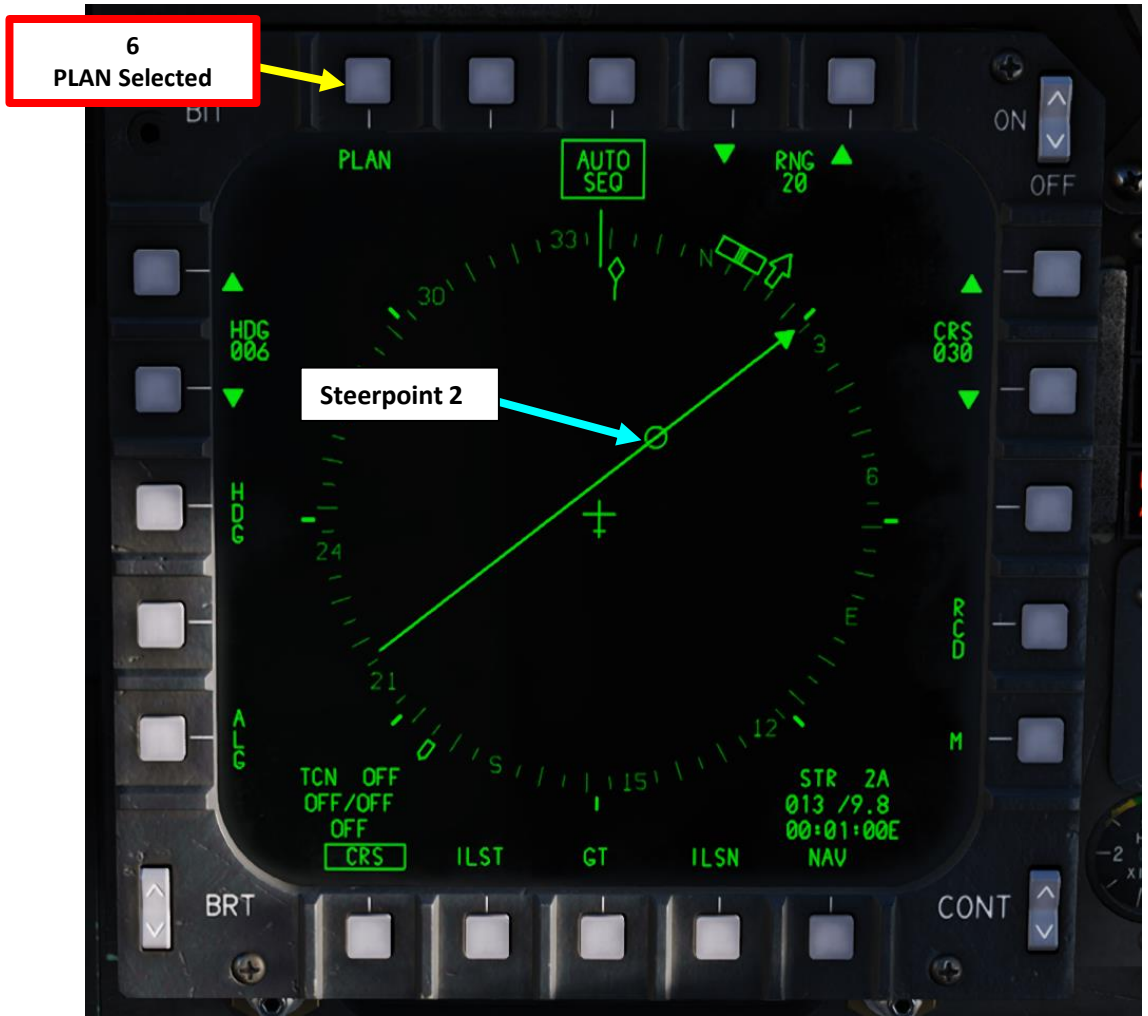






7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.5 – Course (CRS) Steering Tutorial

6. Select PLAN or CDI (Course Deviation Indicator) symbology on the HSI, as desired. We will select CDI.
   - **Course Deviation Indicator (CDI)** 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 deg deviation each. If in straight flight the CDI is aligned with the set course pointer, the aircraft is flying on the desired course. The CDI would go through the aircraft symbol and align with the course pointer (and the course pointer would intersect the Steer Point marker).
   - **PLAN** mode gives a more straightforward representation of aircraft's position in relation to the steerpoint and the desired course that needs to be intercepted with less "moving elements" on the screen.

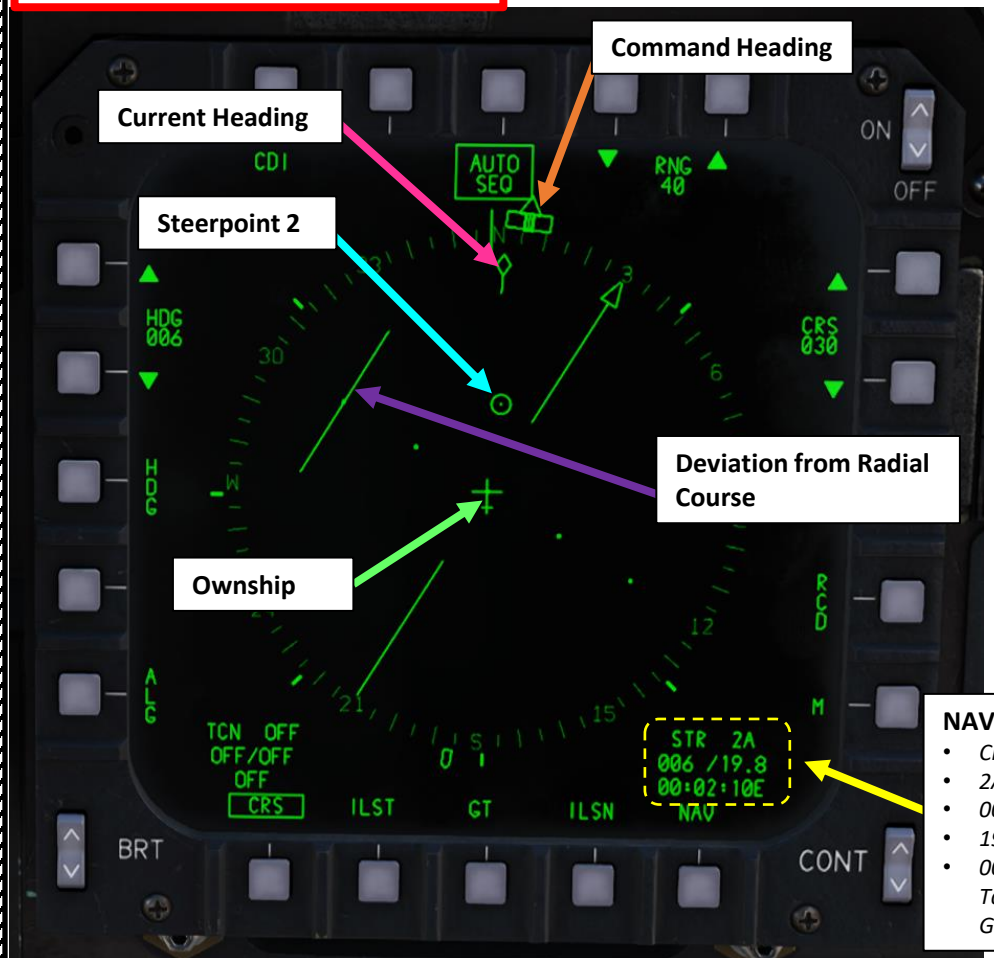


7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.5 – Course (CRS) Steering Tutorial

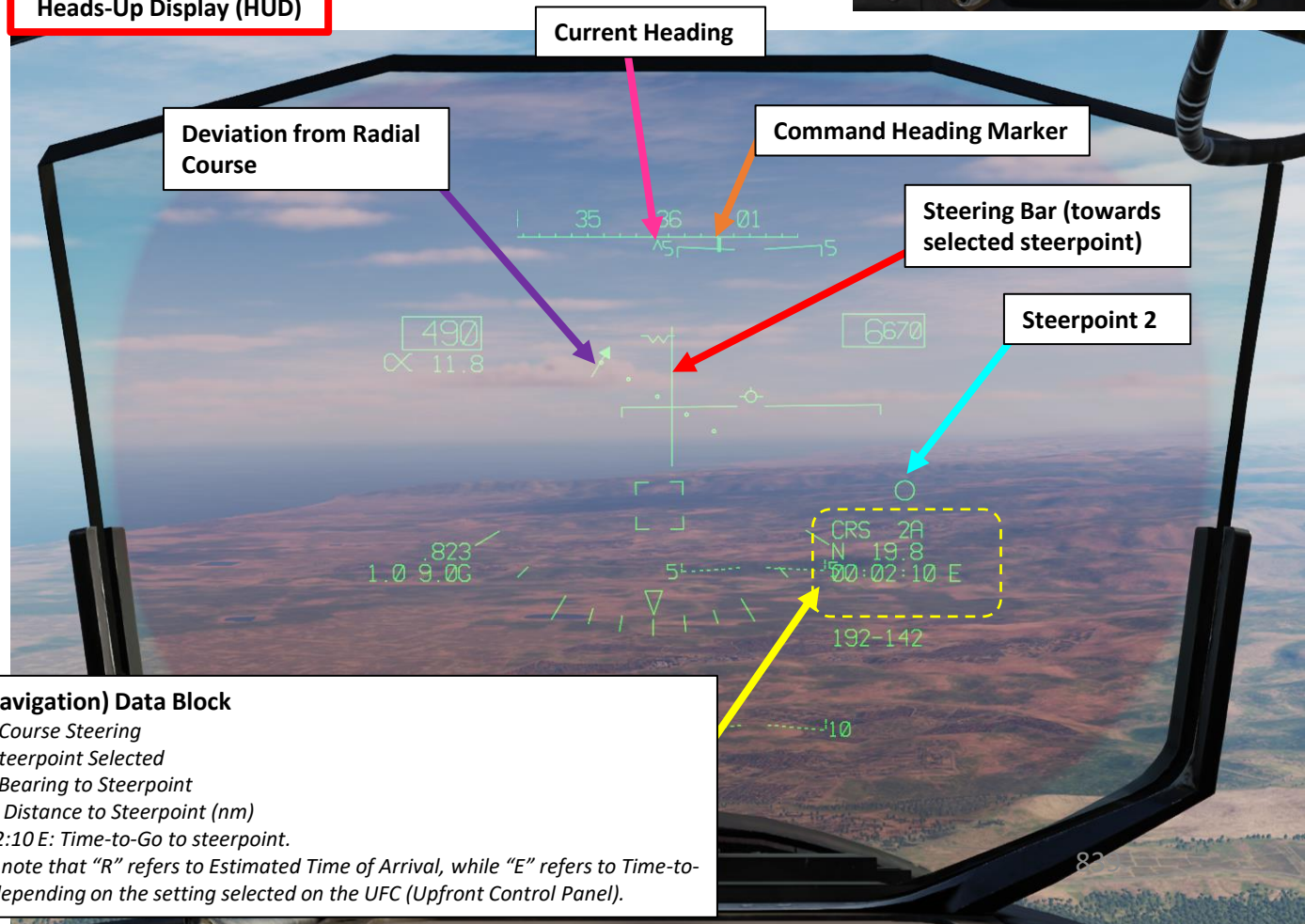
7. Follow Command Heading Bug to steer aircraft towards the steerpoint. Steering symbology is visible both on the HUD (Heads-Up Display), HSI (Horizontal Situation Indicator) and ADI (Attitude Director Indicator).
8. The Course Deviation Indicator moves away from the set course pointer the further aircraft is from the desired course. The dots to the left and right from the set course pointer signify a 5 deg deviation each. If in straight flight the CDI is aligned with the set course pointer, the aircraft is flying on the desired course.

Attitude Director Indicator (ADI)

Horizontal Situation Indicator (HSI)



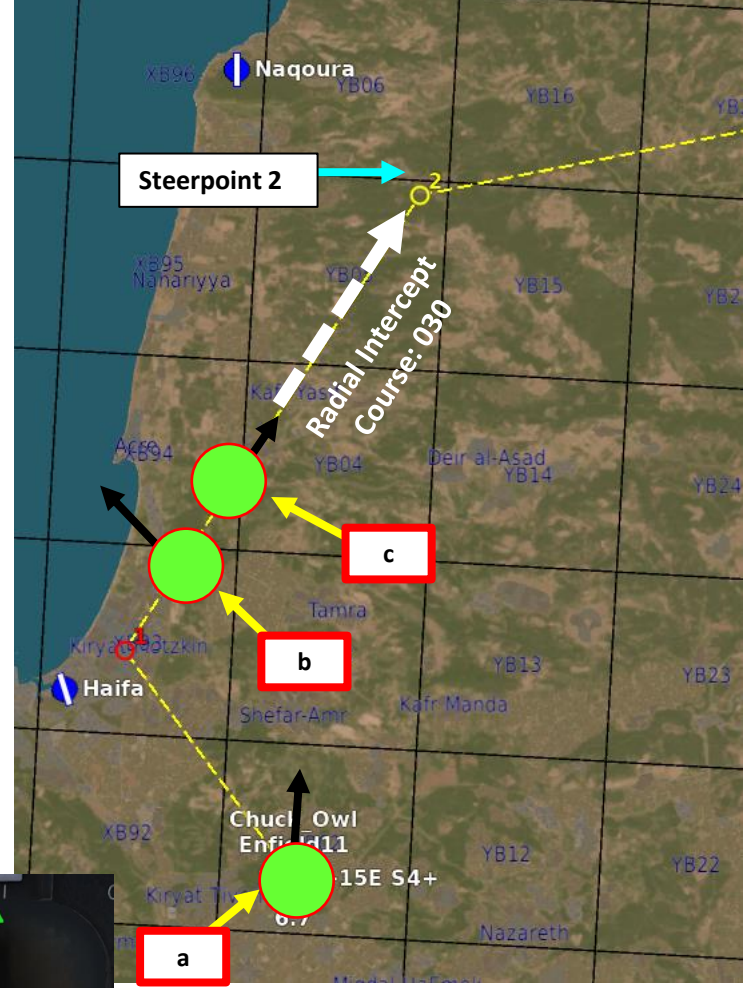
Heads-Up Display (HUD)



NAV (Navigation) Data Block

- *CRS: Course Steering*
- *2A: Steerpoint Selected*
- *006: Bearing to Steerpoint*
- *19.8: Distance to Steerpoint (nm)*
- *00:02:10 E: Time-to-Go to steerpoint.*
  Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.5 – Course (CRS) Steering Tutorial



7 – STEERPOINTS
7.1 – Steerpoint Navigation
7.1.6 – Heading (HDG) Steering Tutorial

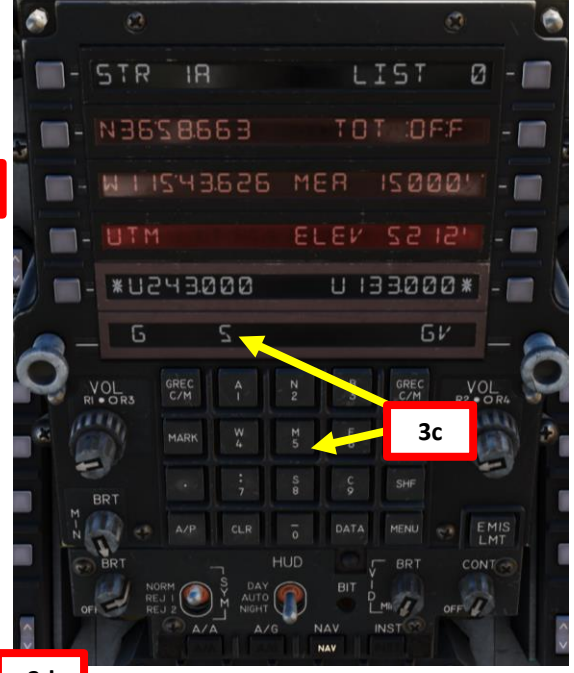
The HDG steer mode is mutually exclusive with all the other steering modes. Coupled with the autopilot, it allows the air crew to enter a desired heading which will be intercepted and held by the aircraft.

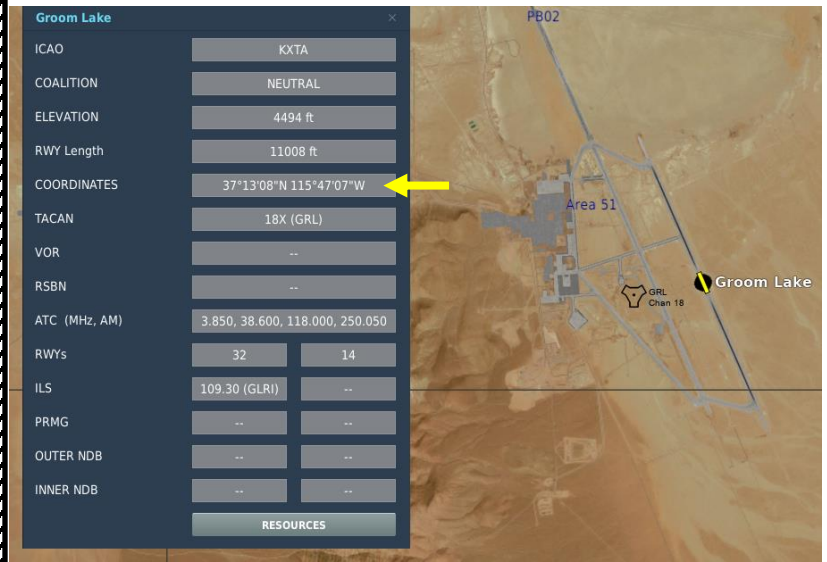
HDG Steering Mode is not yet implemented.

7 – STEERPOINTS
7.2 – How to Add/Edit Steerpoints

Take note that the **F-15E takes coordinates in Degrees, minutes, decimal minutes**. By default, map coordinates are given in Degrees, minutes, seconds. To change coordinate format on the F10 map, use "LALT+Y".

1. We will add the coordinates (Deg, minutes, decimal minutes) for Groom Lake AFB:
   - **37°13'08'' North 115°47'07'' West (Deg, minutes, seconds)**
   - **37°13.133' North 115°47.116' West (Deg, minutes, decimal minutes)**
   - **Elevation 4494 ft**
2. Our current flight plan has four steerpoints. We will add a fifth one (Steerpoint No. 5).
3. Create (or select, if existing) Steerpoint No.5.
   a) Select UFC (Upfront Control Panel) MENU 1
   b) Press pushbutton next to STR to select Steerpoint Menu.
   c) On UFC scratchpad, type "5"
   d) Press pushbutton next to STR to select Steerpoint 5.
   e) Coordinates and elevation data fields should be empty since we have not cerated this steerpoint yet.

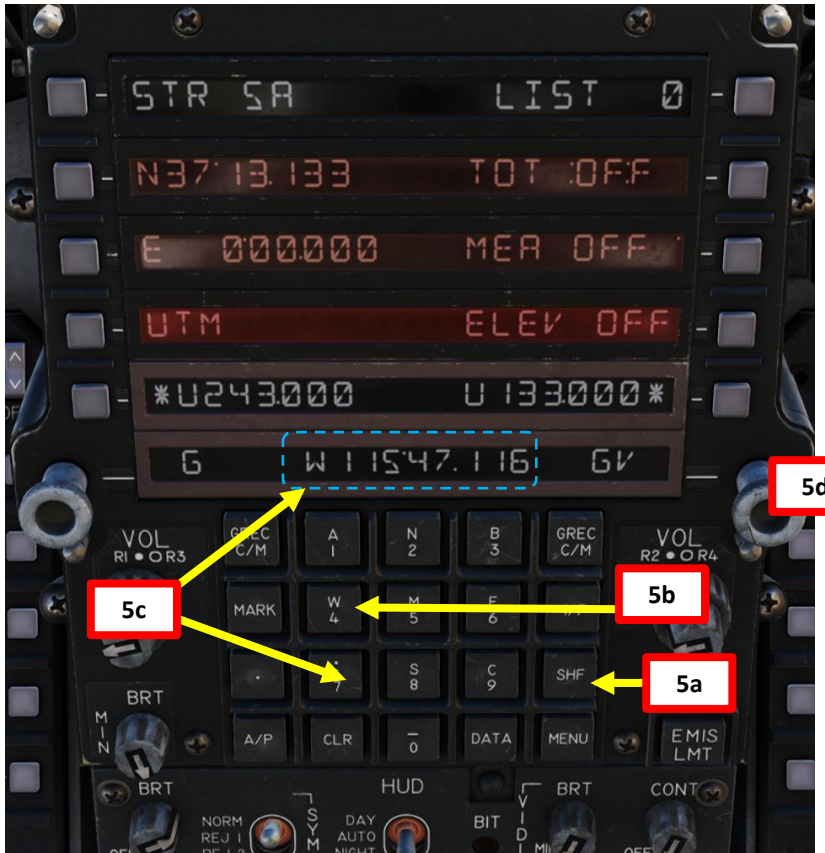




7 – STEERPOINTS
7.2 – How to Add/Edit Steerpoints

Steerpoint No. 5 Data
LATITUDE: **37°13.133' North** (Deg, minutes, decimal minutes)
LONGITUDE: **115°47.116' West** (Deg, minutes, decimal minutes)
ELEVATION: **4494 ft**

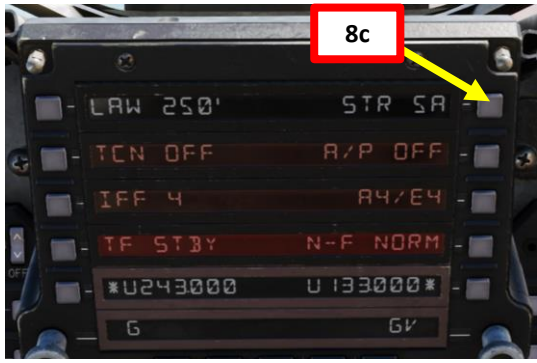
4. Enter Latitude Coordinates **37°13.133 North:**
   a) Press SHF (Shift) Button on UFC Keypad
   b) Press "2" button for North Latitude (or "8" for South if required)
   c) Press "3713133" on the keypad to enter **37°13.133** coordinates.
      - A single press of the CLR button can be used as a "backspace" key. Pressing CLR twice erases the whole line.
   d) Press PB (Pushbutton) next to Latitude data field to enter coordinates.
5. Enter Longitude Coordinates **115°47.116 West:**
   a) Press SHF (Shift) Button on UFC Keypad
   b) Press "4" button for West Longitude (or "6" for East if required)
   c) Press "11547116" on the keypad to enter **115°47.116** coordinates.
      - A single press of the CLR button can be used as a "backspace" key. Pressing CLR twice erases the whole line.
   d) Press PB (Pushbutton) next to Longitude data field to enter coordinates.



7 – STEERPOINTS
7.2 – How to Add/Edit Steerpoints

6. Enter Elevation: **4494 ft:**
   a) Press "4494" on the keypad to enter steerpoint elevation of **4494 ft**.
      - A single press of the CLR button can be used as a "backspace" key. Pressing CLR twice erases the whole line.
   b) Press PB (Pushbutton) next to ELEV data field to enter elevation.
7. Steerpoint No. 5 is now created with the correct coordinates and elevation data.
8. *Reminder*: If you want to select Steerpoint No.5 as the active steerpoint:
   a) Select UFC (Upfront Control Panel) MENU 1
   b) On UFC scratchpad, type "5"
   c) Press pushbutton next to STR to select Steerpoint Menu.

Steerpoint Point No. 5 Data
LATITUDE: **37°13.133' North** (Deg, minutes, decimal minutes)
LONGITUDE: **115°47.116' West** (Deg, minutes, decimal minutes)
ELEVATION: **4494 ft**

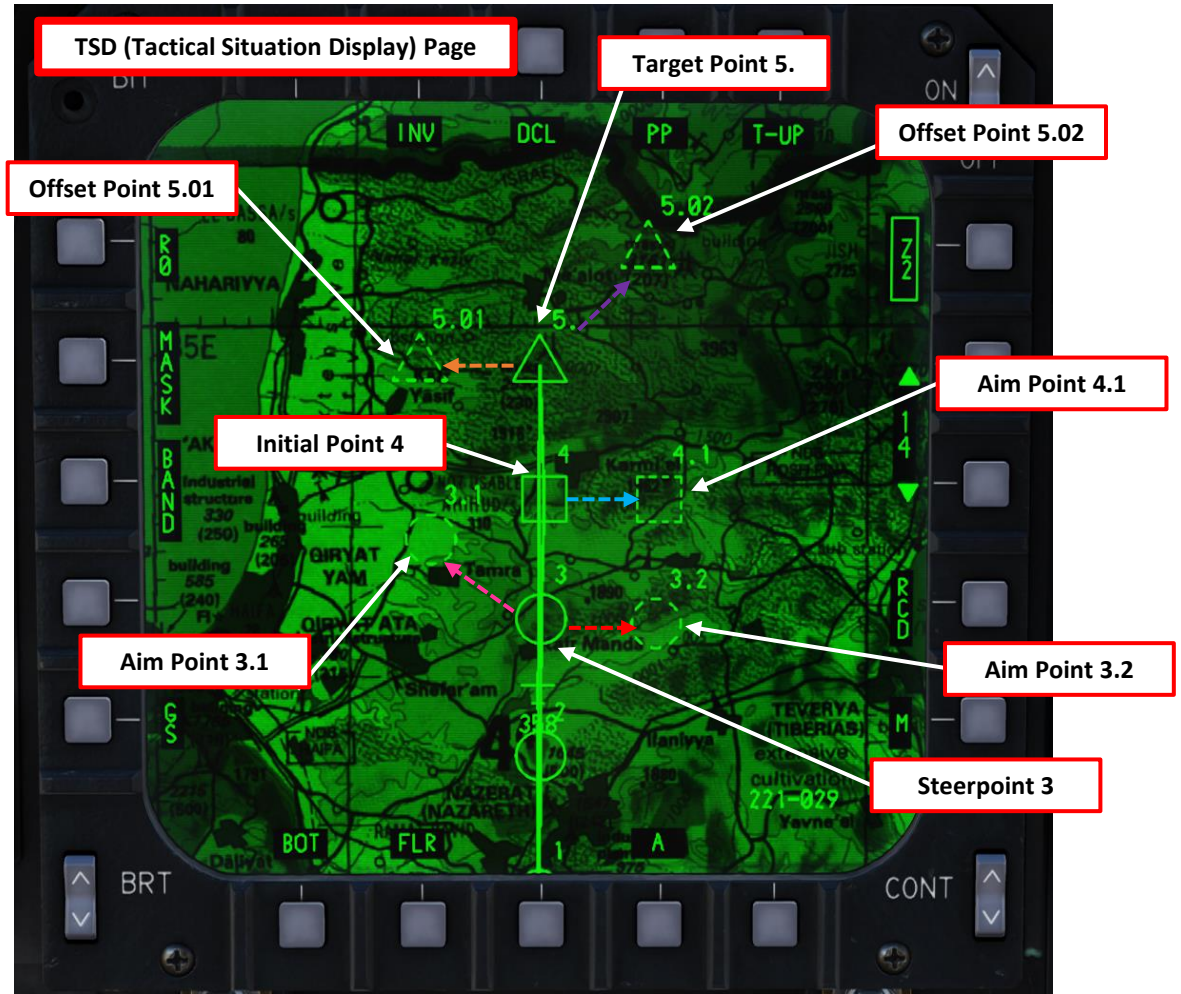


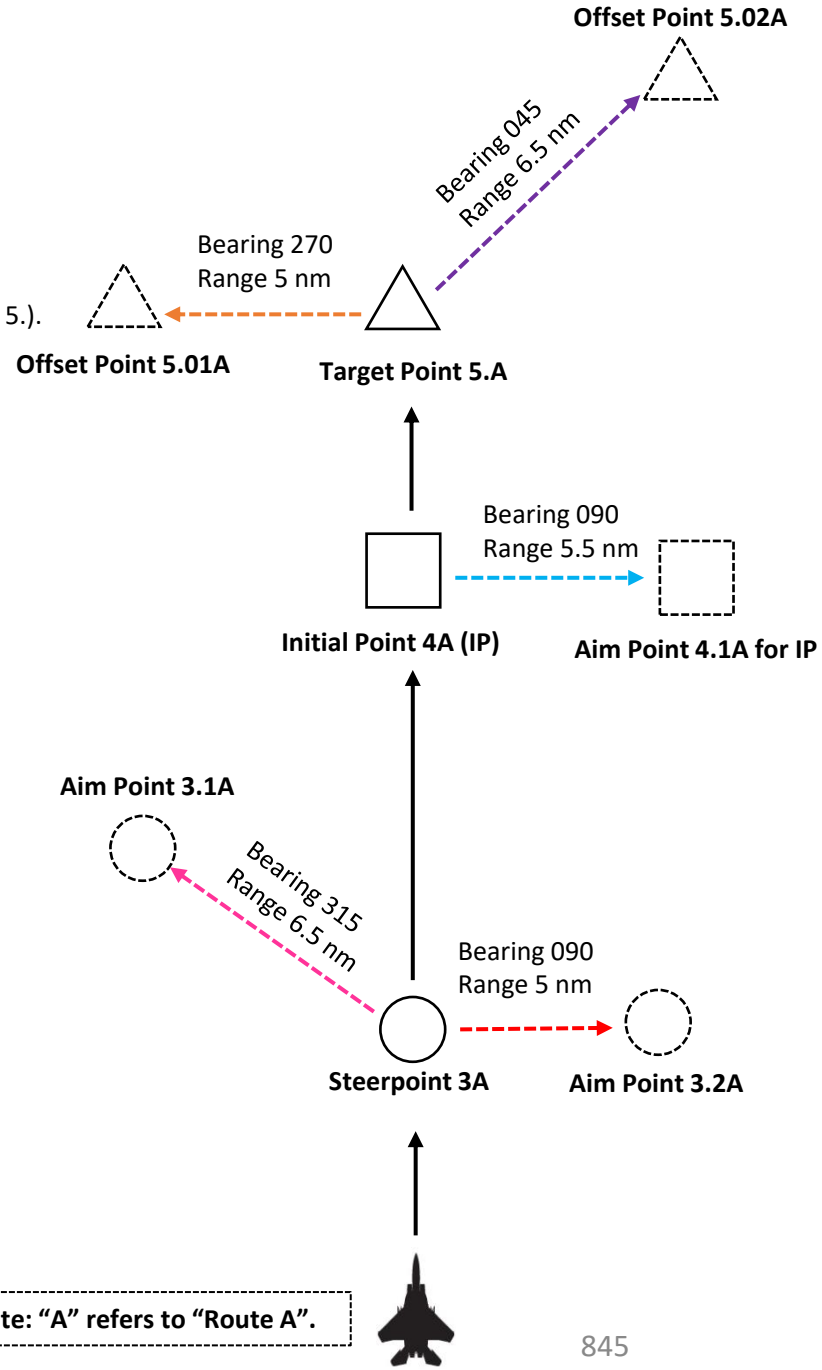
8 – TARGET POINTS, AIM POINTS & OFFSET POINTS

8.1 – Overview

Target points, aim points and offset points are often mixed up by new players. Here is a quick breakdown:

- **Steerpoints** are regular navigation points (example: Steerpoint 3). They cannot be used for target designation, just for navigation.
- **Aim Points** are associated with a **reference Steerpoint** (example, Aim Points 3.1 and 3.2 are associated with Steerpoint 3).
- **Target Points** are specialized points for attack (example: Target Point 5.). They are used for target designation.
- **Offset Points** are associated with a **reference Target Point** (example, Offset Points 5.01 and 5.02 are associated with Target Point 5.).
- **An Initial Point (IP)** is the last Steerpoint prior to a Target Point and is automatically converted as such (example: Initial Point 4).
  - Note: An IP can have an aim point as well, just like a regular steerpoint.





8 – TARGET POINTS, AIM POINTS & OFFSET POINTS

8.1 – Overview

Steerpoint

Convert to

Target Point

LAT/LONG Coordinates
Enter Lat/Long Coordinates directly

UTM Grid Coordinates
Enter UTM Coordinates directly

RNG/BRG
Range (nm) & Bearing from Mother Target Point

DIR/RNG
Lat/Long Direction & Range (in ft) from Mother Target Point

Offset Point

LAT/LONG Coordinates
Enter Lat/Long Coordinates directly

UTM Grid Coordinates
Enter UTM Coordinates directly

RNG/BRG
Range (nm) & Bearing from Mother Steerpoint

DIR/RNG
Lat/Long Direction & Range (in ft) from Mother Steerpoint

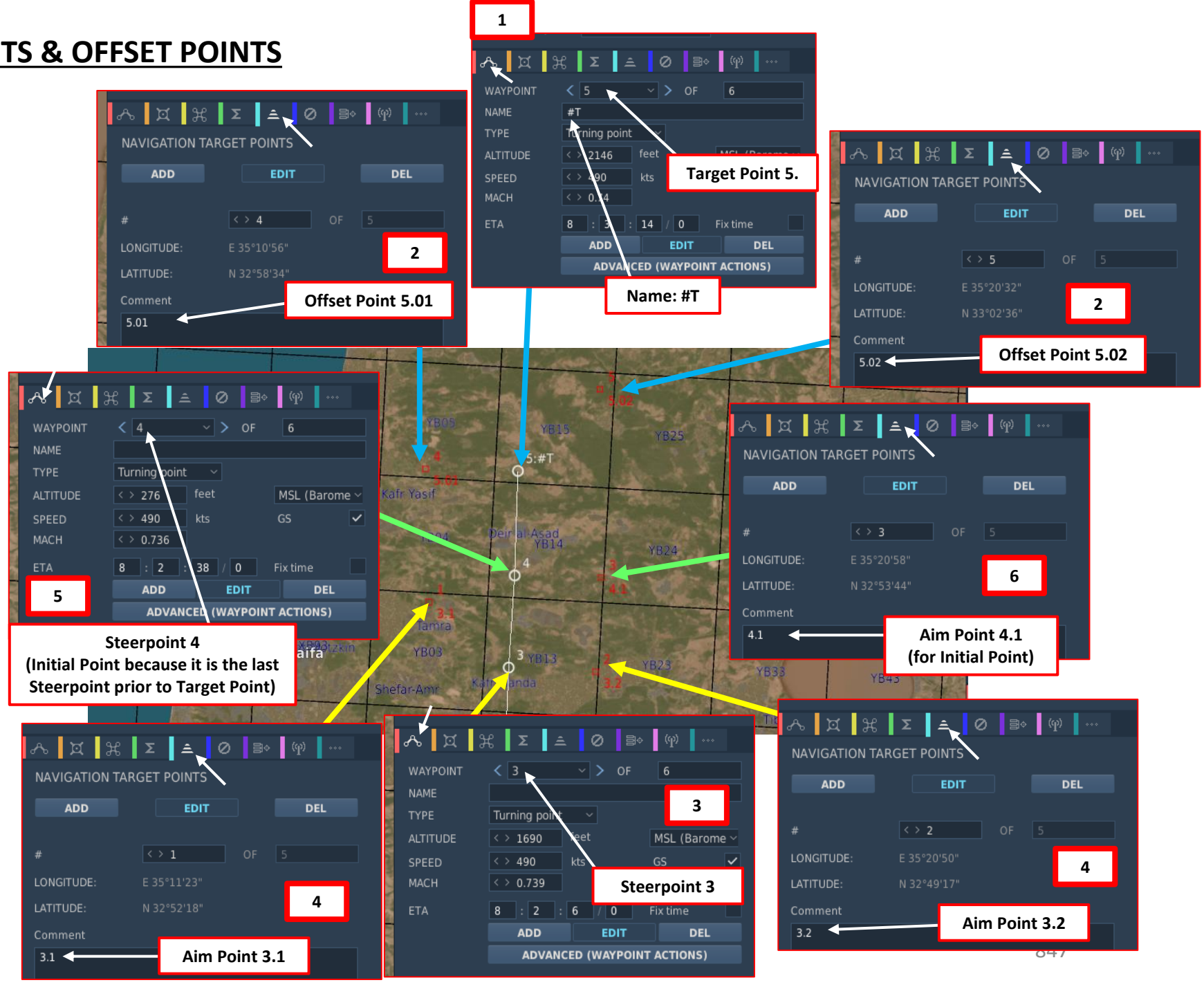
Aim Point

8 – TARGET POINTS, AIM POINTS & OFFSET POINTS

8.2 – Mission Editor

It is possible to create Target Points, Aim Points and Offset Points using the Mission Editor.

1. **Target Points** are created like normal Steerpoints/Waypoints. However, the NAME data field should be set to "#T" for the navigation database to recognize it as a target point.
2. **Offset Points** should be created from an existing target point (5. as an example). Click on Navigation Target Fix Points tab, then click ADD, then click on the target to create the navigation target point, then enter in the "Comment" box the Offset Point number (5.01 for the first offset point of Target Point 5., 5.02 for the second offset point, etc.).
3. **Steerpoints** are created like normal waypoints.
4. **Aim Points** should be created from an existing steerpoint (3 as an example). Click on Navigation Target Fix Points tab, then click ADD, then click on the target to create the navigation aim point, then enter in the "Comment" box the Aim Point number (3.1 for the first aim point of Steerpoint 3, 3.2 for the second aim point, etc.).
5. The **initial point** is created exactly the same way as a normal **steerpoint**. The database will recognize a steerpoint as an "Initial Point" automatically based on if the next point is a Target Point.
6. An **Aim Point** for an **initial point** is created exactly the same way as any aim point. In the "Comment" box, enter the Aim Point number (4.1 for the aim point of Steerpoint 4, classified as an Initial Point).



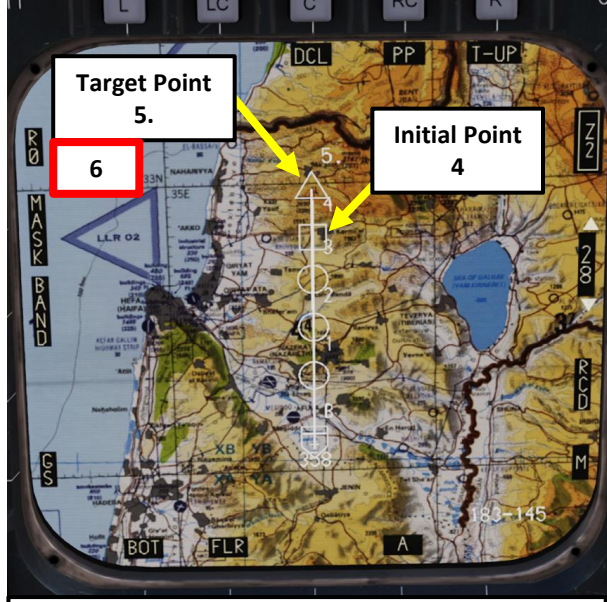
8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.3 – Target Point Creation

In order to create a Target Point, we **need to have an existing Steerpoint**. In this example, we will use Steerpoint No. 5 and convert it into Target Point 2, which will be labelled "5." (five, followed by a dot).

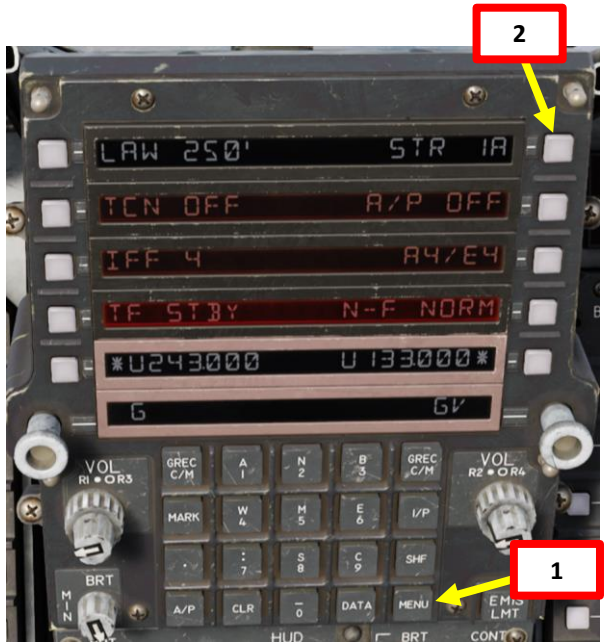
To convert a Steerpoint into a Target Point:

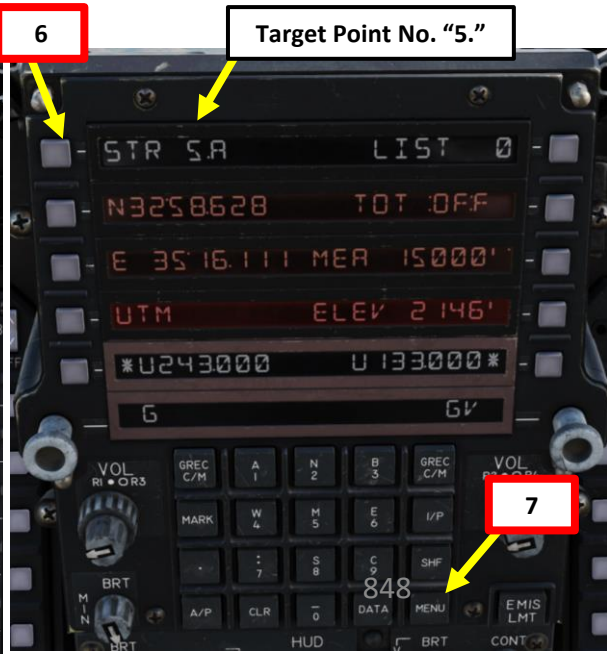
1. Select UFC (Upfront Control Panel) MENU 1.
2. Verify that Steerpoint 5 is NOT selected (if it is, select another steerpoint to make sure Steerpoint 5 is not the active one). Then, press pushbutton next to STR to select Steerpoint Menu.
3. On UFC scratchpad, type "5".
4. Press pushbutton next to STR. Steerpoint No. 5 is now selected.
5. On UFC scratchpad, type "5", then "." after (five, followed by a dot).
6. Press pushbutton next to STR. Steerpoint No. 5 is now converted into Target Point "5.".
    - *Note: The last steerpoint before Target Point 5. will automatically be converted into an Initial Point (IP).*
7. Return to UFC MENU 1.

TSD (Tactical Situation Display) Page
Steerpoint "5" (Not converted to Target Point)



TSD (Tactical Situation Display) Page
Target Point "5."



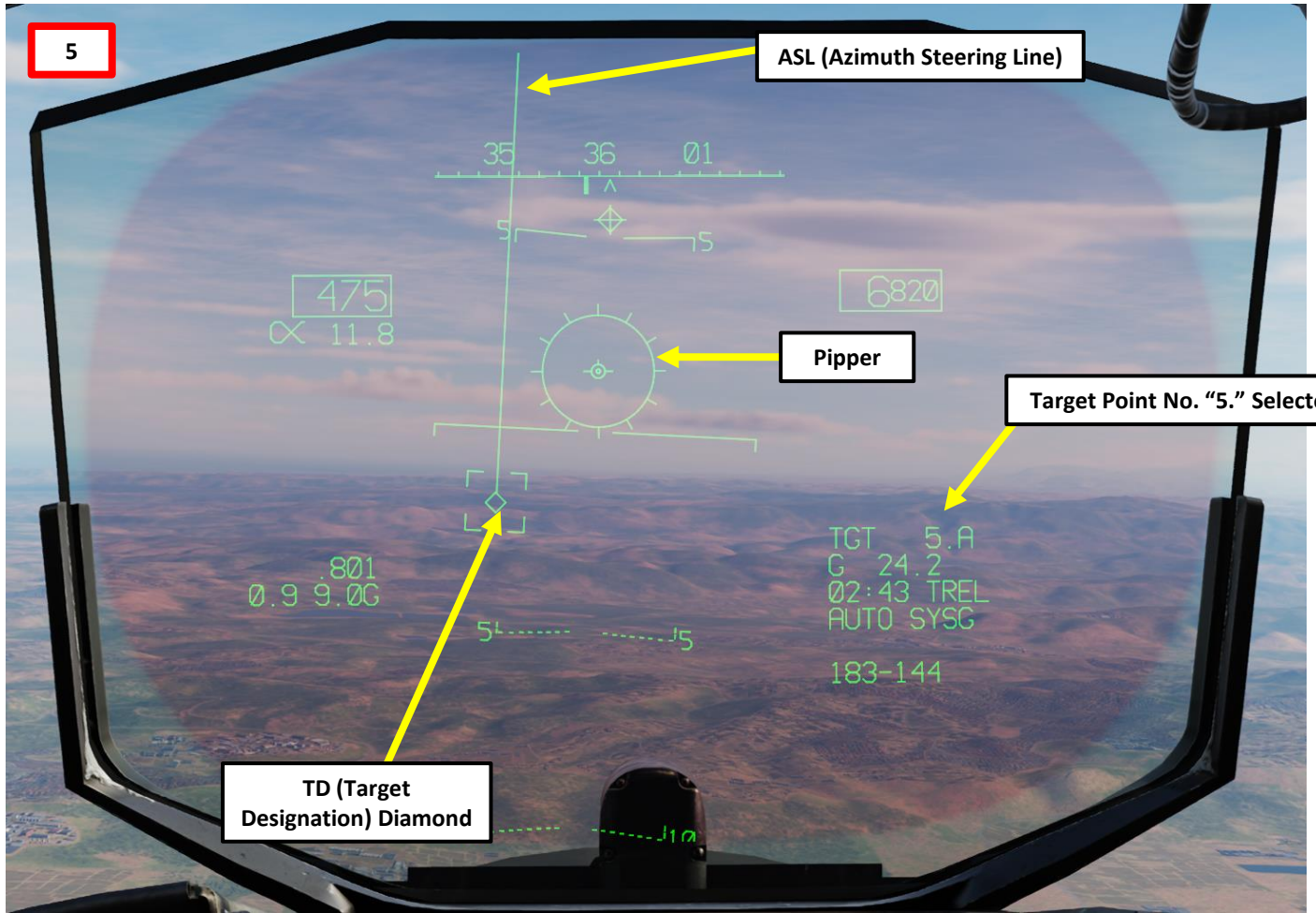


8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.3 – Target Point Creation

To select a Target Point:

If desired, select Target Point No.5 (5.).

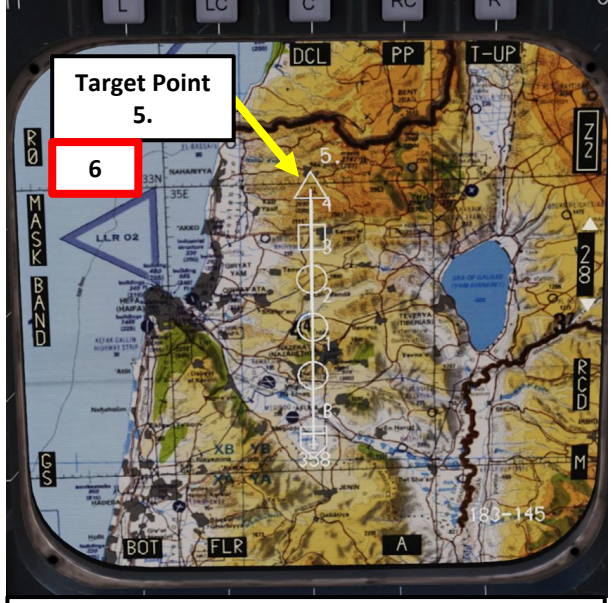
1. Select UFC (Upfront Control Panel) MENU 1
2. On UFC scratchpad, type "5", then "." after (five, followed by a dot).
3. Press pushbutton next to STR to select Steerpoint Menu.
4. Target Point No. 5 (5.) is now selected.
5. If the weapons are selected and set up for AUTO delivery and the Target Point is within the HUD line-of-sight, the target and the ASL (Azimuth Steering Line) will appear.



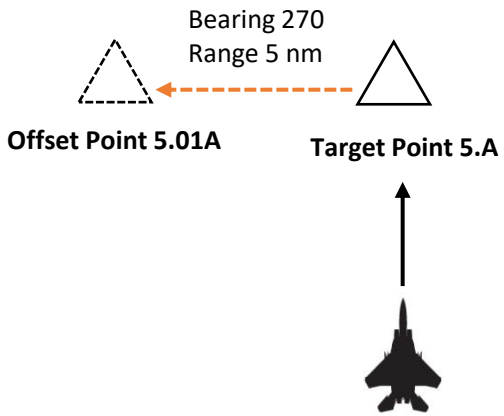
8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.4 – Offset Point Creation from Target Point

In order to create an Offset Point, we **need to have an existing Target Point**. In this example, we will use Target Point No. 5. and create an Offset Point 5.01. This Offset Point will have a Bearing of 270 and a Range of 5 nm from Target Point "5.".

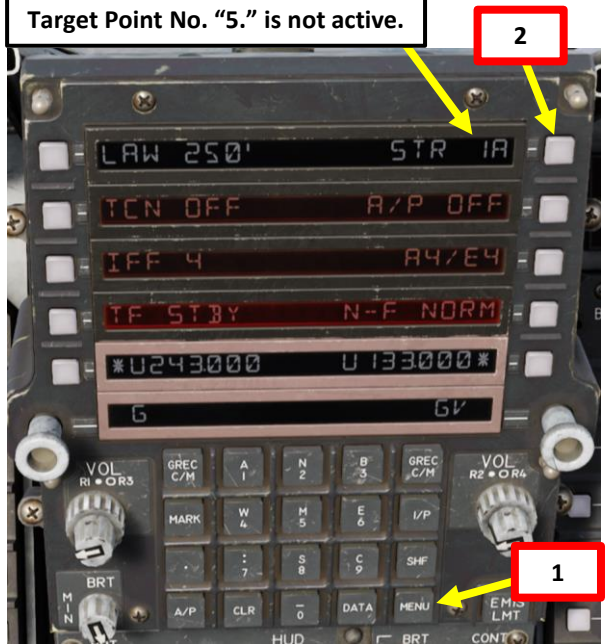
1. Select UFC (Upfront Control Panel) MENU 1.
2. Verify that Target Point 5. is NOT selected (if it is, select another steerpoint to make sure Target Point 5 is not the active one). Then, press pushbutton next to STR to select Steerpoint Menu.
3. On UFC scratchpad, type "5.01".
4. Press pushbutton next to STR. Offset Point No. 5.01 is now selected.
5. Press on pushbutton next to UTM-RNG/BRG-DIR/RNG twice to toggle between Offset Point options. Make sure DIR/RNG (Direction/Range) data field is visible.

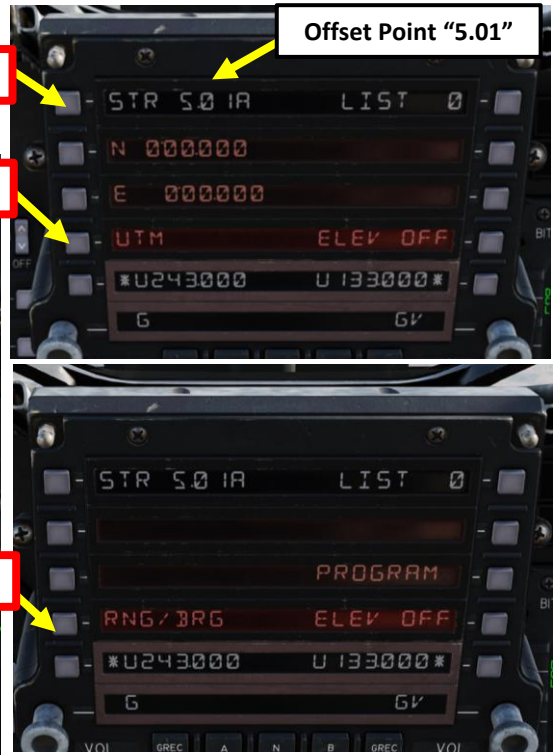


TSD (Tactical Situation Display) Page
Target Point "5."



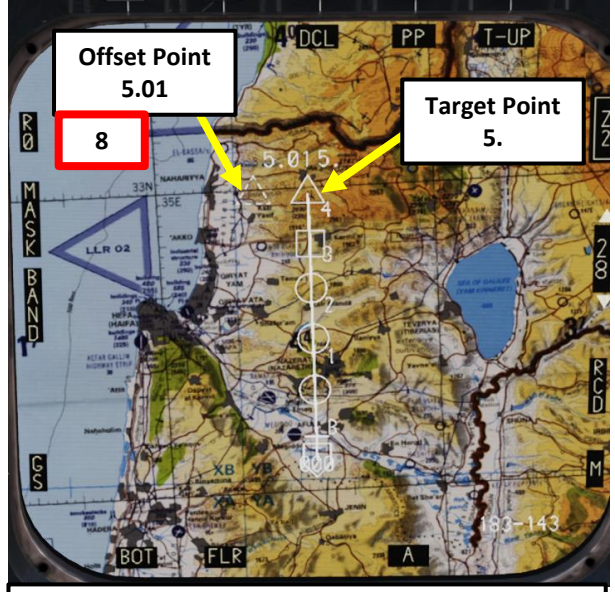
Steerpoint No. "1" selected/active, which means Target Point No. "5." is not active.



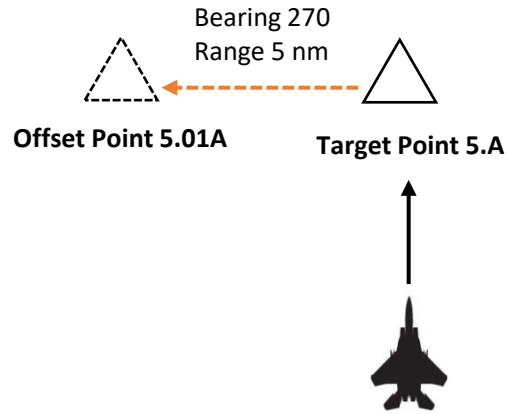


8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.4 – Offset Point Creation from Target Point

6. On UFC scratchpad, enter distance from target point to offset point (5 nm) by typing "5", then pressing on pushbutton next to Range data field.
7. On UFC scratchpad, enter bearing from target point to offset point (270) by typing "270", then pressing on pushbutton next to Bearing data field.
8. Offset Point 5.01 is now created and visible on the TSD (Tactical Situation Display).
9. Select UFC (Upfront Control Panel) MENU 1



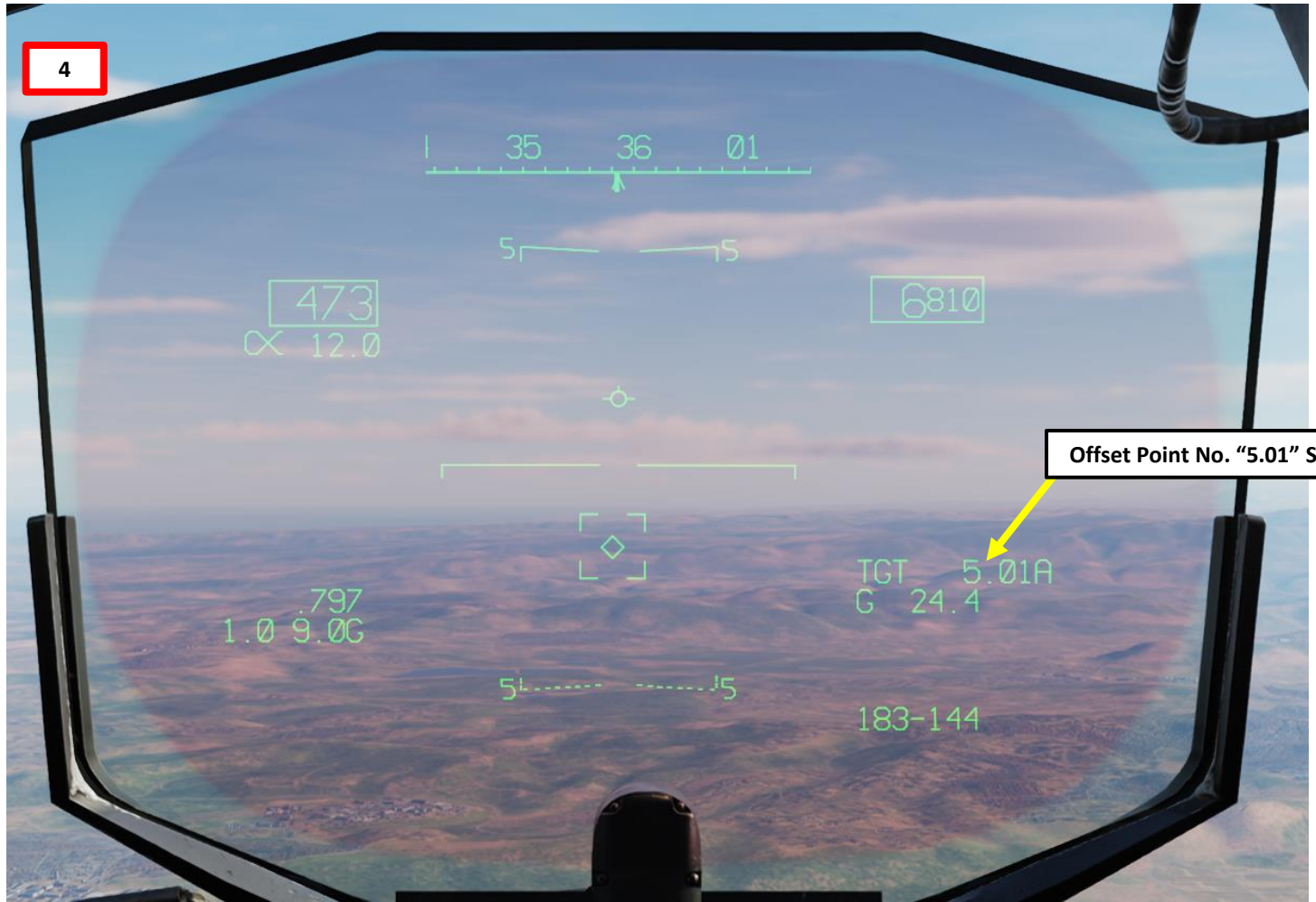
TSD (Tactical Situation Display) Page
Offset Point "5.01"

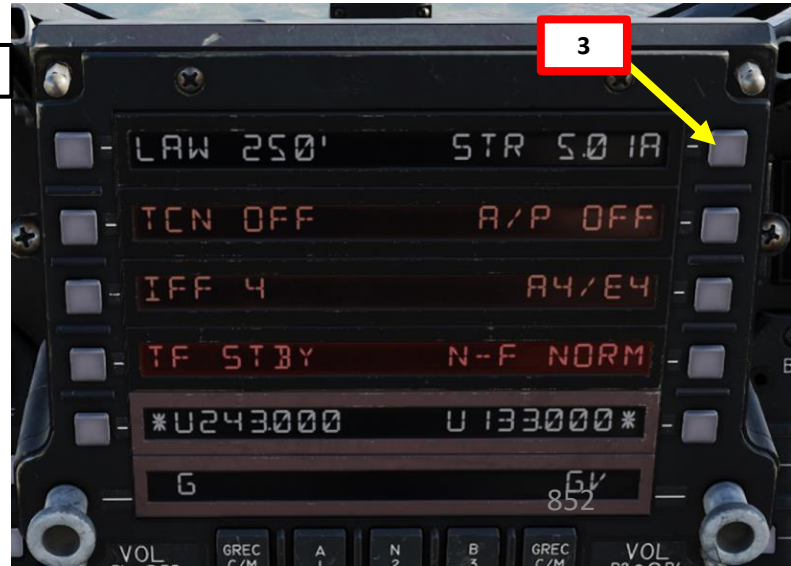


8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.4 – Offset Point Creation from Target Point

How to select an Offset Point (5.01):

1. Select UFC (Upfront Control Panel) MENU 1
2. On UFC scratchpad, type “5”, then “.”, then “01” (five, followed by a dot, followed by zero-one).
3. Press pushbutton next to STR to select Steerpoint Menu.
4. Offset Point No. 5.01 is now selected.



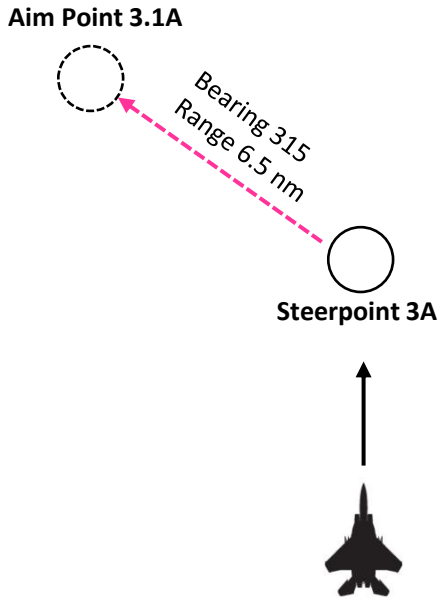


8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.5 – Aim Point Creation from Steerpoint

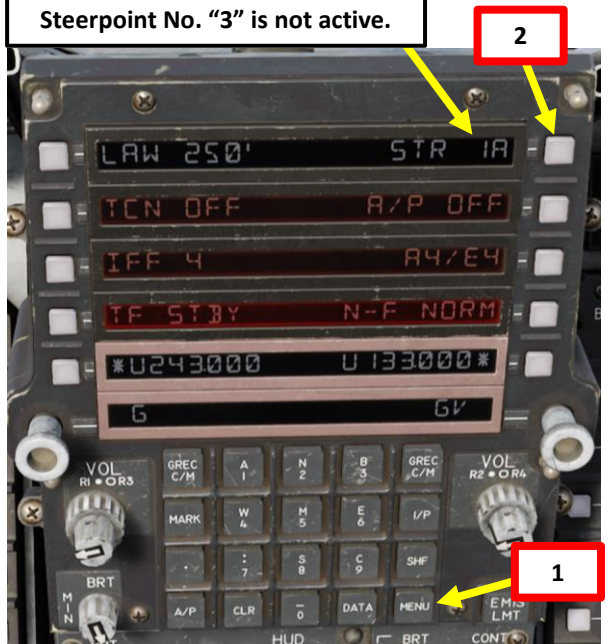
In order to create an Aim Point, we **need to have an existing Steerpoint**. In this example, we will use Steerpoint No. 3. and create an Aim Point 3.1. This Aim Point will have a Bearing of 315 and a Range of 6.5 nm from Steerpoint "3.".

1. Select UFC (Upfront Control Panel) MENU 1.
2. Verify that Steerpoint 3 is NOT selected (if it is, select another steerpoint to make sure Steerpoint 3 is not the active one). Then, press pushbutton next to STR to select Steerpoint Menu.
3. On UFC scratchpad, type "3.1".
4. Press pushbutton next to STR. Aim Point No. 3.1 is now selected.
5. Press on pushbutton next to UTM-RNG/BRG-DIR/RNG twice to toggle between Aim Point options. Make sure DIR/RNG (Direction/Range) data field is visible.

TSD (Tactical Situation Display) Page
Steerpoint "3"

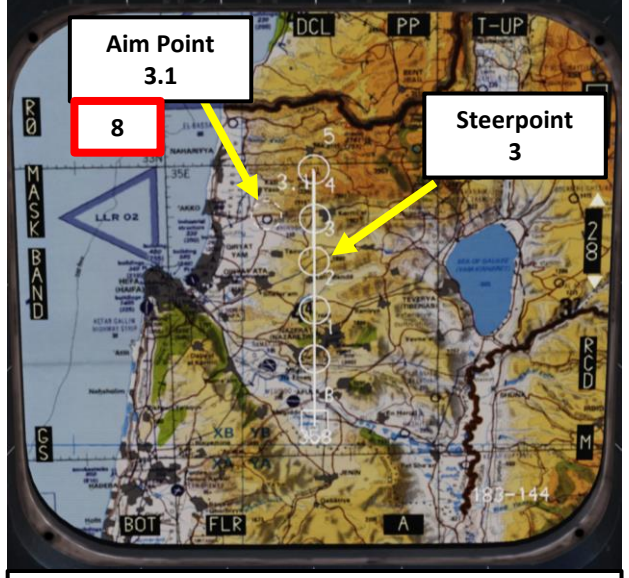


Steerpoint No. "1" selected/active, which means Steerpoint No. "3" is not active.

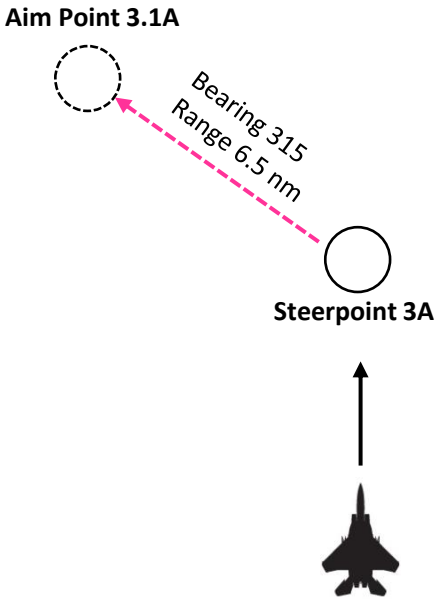


8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.5 – Aim Point Creation from Steerpoint

6. On UFC scratchpad, enter distance from Steerpoint to aim point (6.5 nm) by typing "6.5", then pressing on pushbutton next to Range data field.
7. On UFC scratchpad, enter bearing from Steerpoint to aim point (315) by typing "315", then pressing on pushbutton next to Bearing data field.
8. Aim Point 3.1 is now created and visible on the TSD (Tactical Situation Display).
9. Select UFC (Upfront Control Panel) MENU 1



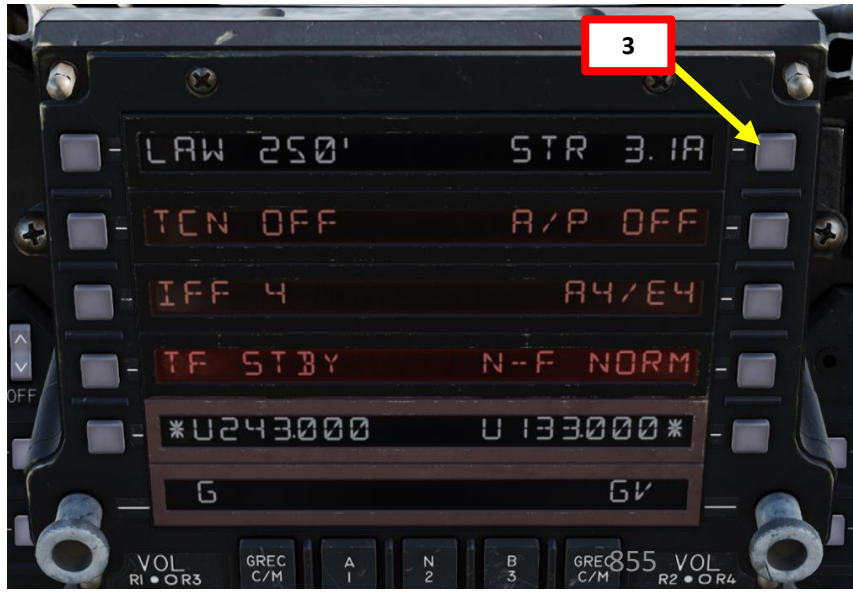
TSD (Tactical Situation Display) Page
Aim Point 3.1



8 – TARGET POINTS, AIM POINTS & OFFSET POINTS
8.5 – Aim Point Creation from Steerpoint

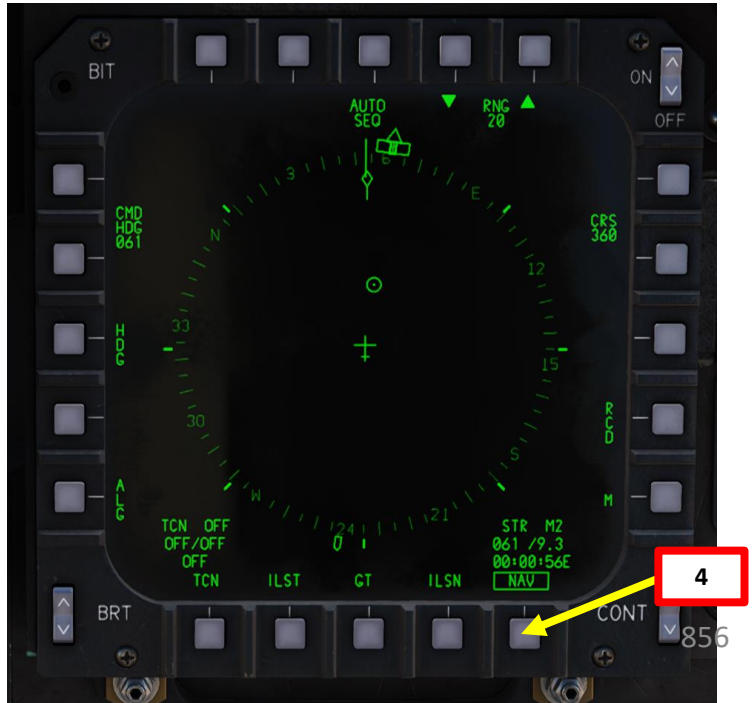
How to select an Aim Point (3.1):

1. Select UFC (Upfront Control Panel) MENU 1
2. On UFC scratchpad, type “3”, then “.”, then “1” (three, followed by a dot, followed by one).
3. Press pushbutton next to STR to select Steerpoint Menu.
4. Aim Point No. 3.1 is now selected.



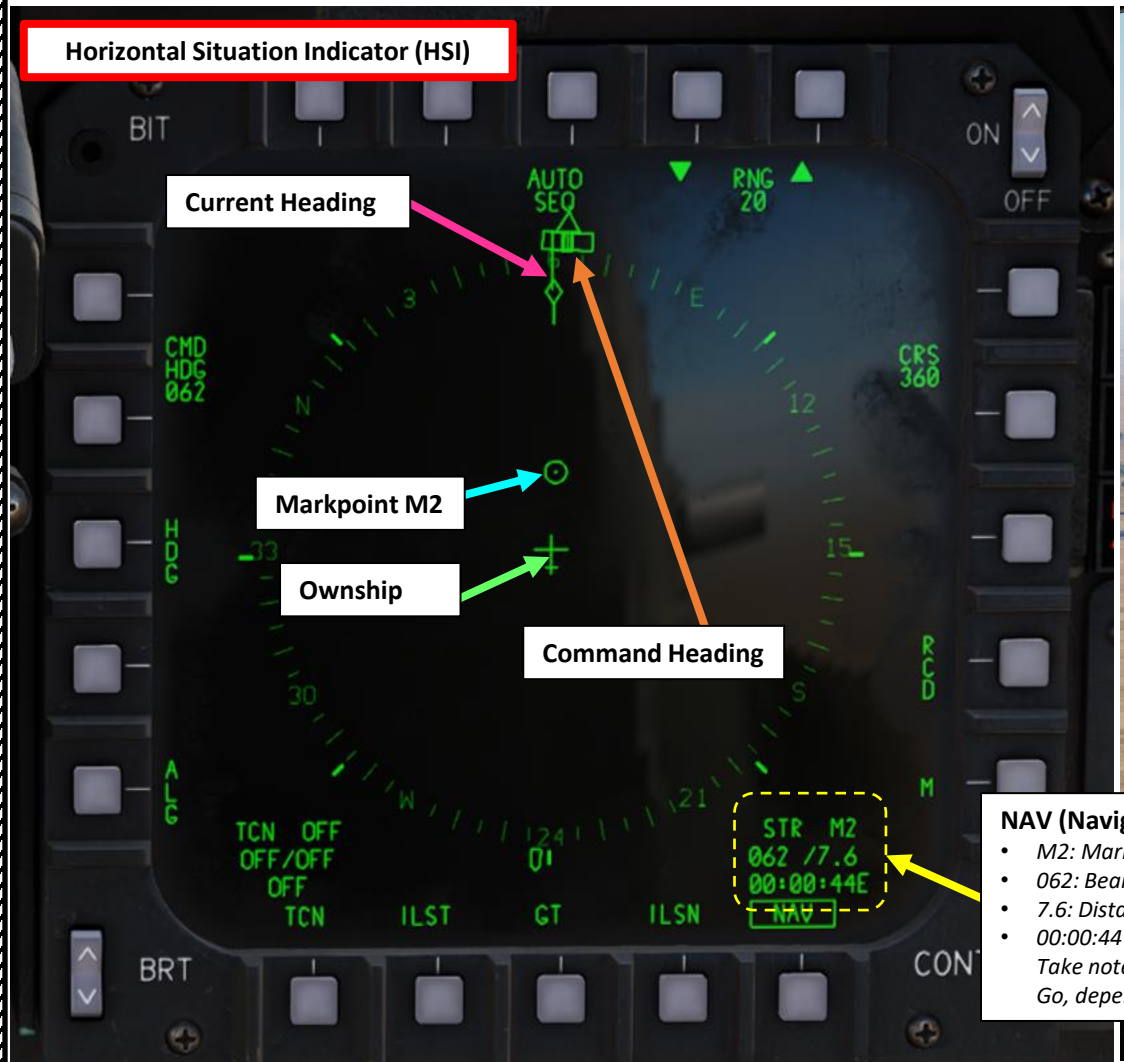
9 – MARKPOINTS
9.1 – Markpoint Navigation

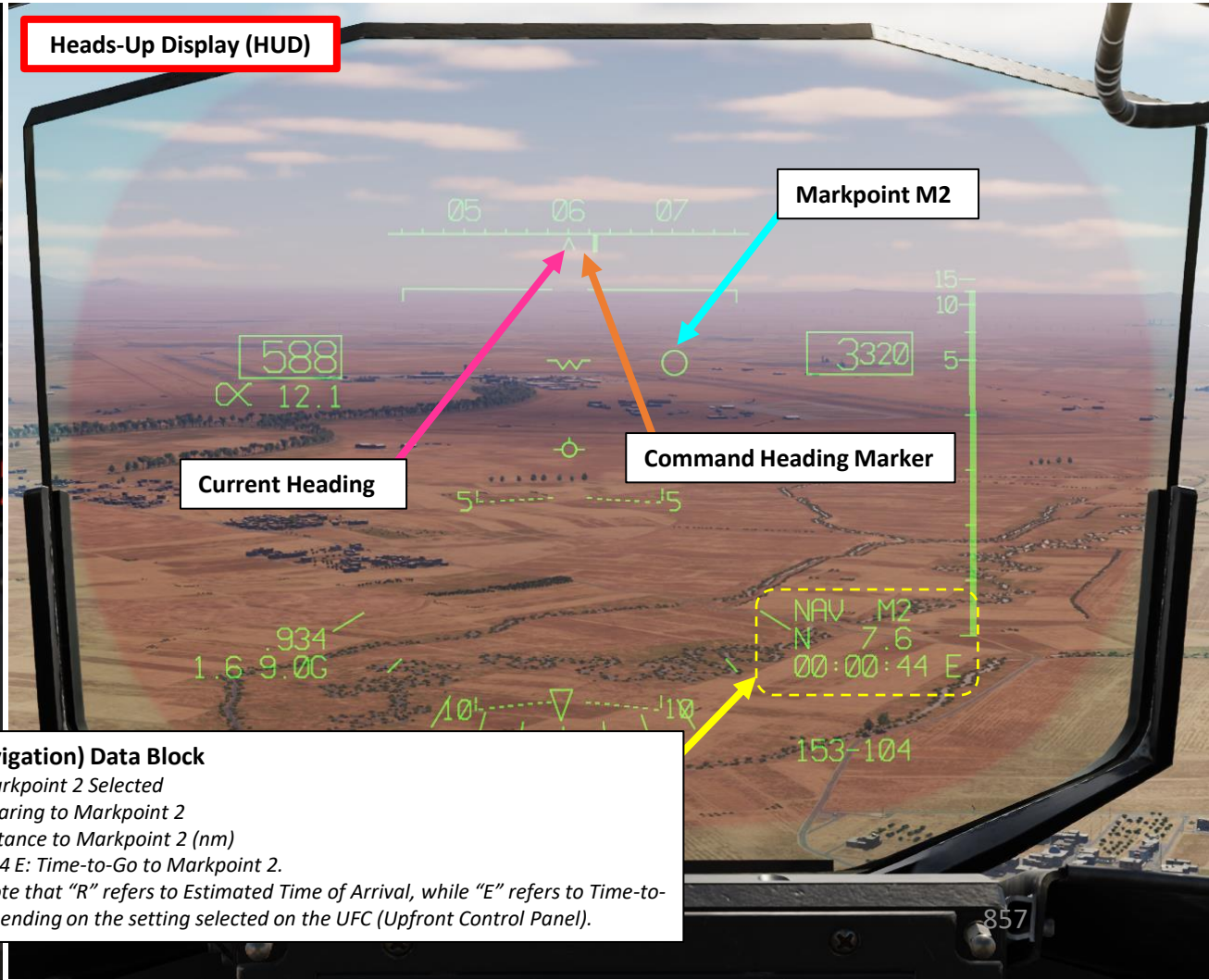
1. **We will navigate to Markpoint 2, which has already been created.**
2. Select NAV Master Mode.
3. Select Markpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) Select Markpoint M2: on UFC (Upfront Control Panel) scratchpad, press SHF, then 5 (M), then 2.
    c) Press pushbutton next to STR to select Steerpoint Menu.
    - ***Note 1:*** *From now on, when entering a number on the UFC scratchpad (as an example, "3", the associated Markpoint (M3) will be selected). This allows you to quickly switch between markpoints.*
    - ***Note 2:*** *In order to be able to select regular steerpoints again (as an example Steerpoint 4), you will have to enter "4" on the UFC scratch pad, then SHF, then 1 (A). This will switch steerpoint selection back to Steerpoint 4A (the "A" being for Route A).*
4. On HSI (Horizontal Situation Indicator) page, select NAV STEERING mode (boxed).



9 – MARKPOINTS
9.1 – Markpoint Navigation

5. Follow Command Heading Bug to steer aircraft towards the markpoint M2. Symbology is visible both on the HUD (Heads-Up Display) and the HSI (Horizontal Situation Indicator).





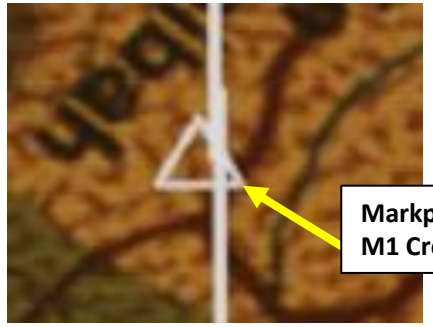
NAV (Navigation) Data Block

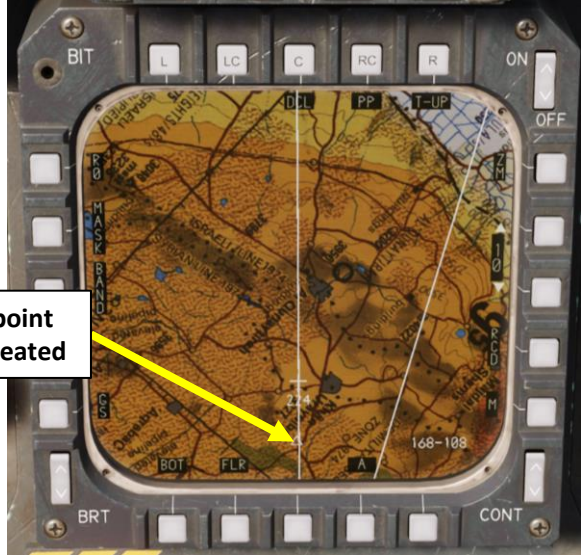
- *M2: Markpoint 2 Selected*
- *062: Bearing to Markpoint 2*
- *7.6: Distance to Markpoint 2 (nm)*
- *00:00:44 E: Time-to-Go to Markpoint 2.*
  Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

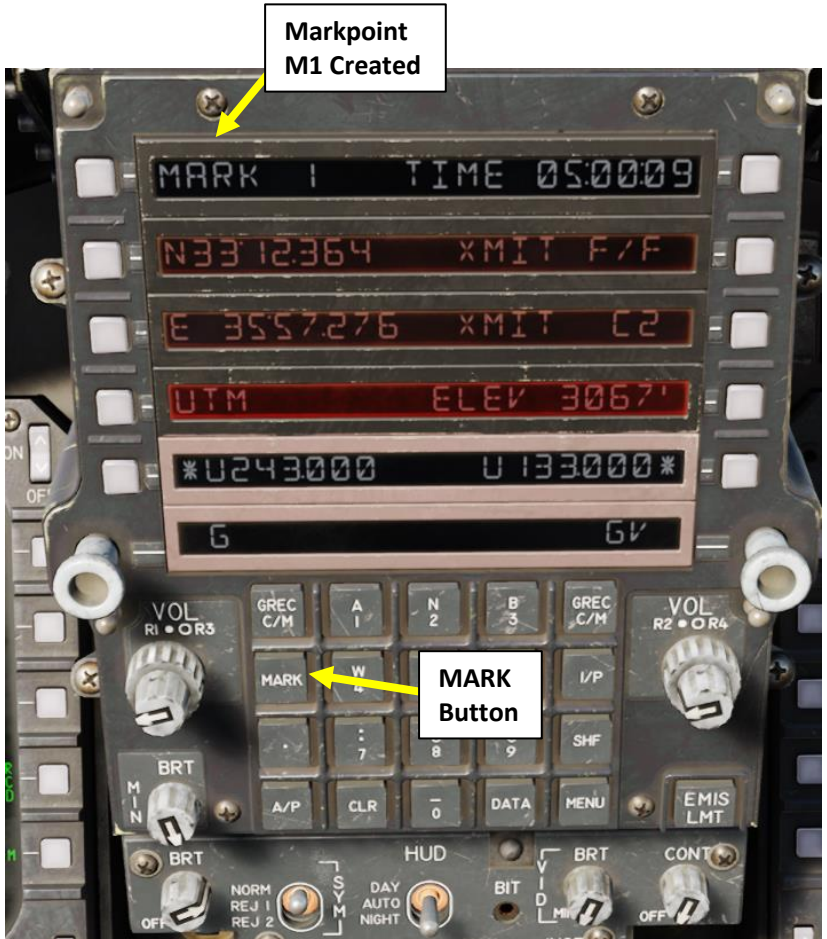
9 – MARKPOINTS
9.2 – How to Add Markpoints
9.2.1 – Overfly Designation

When flying over a point of interest, you can press the **MARK button** on the UFC (Upfront Control Panel). The system will memorize the coordinates the aircraft was at when pressing the button and store it into a markpoint.

A maximum of 10 markpoints can be designated. Any mark above the tenth overwrites the first one, then the second one, and so on. A maximum of 5 markpoints can be displayed at the same time.



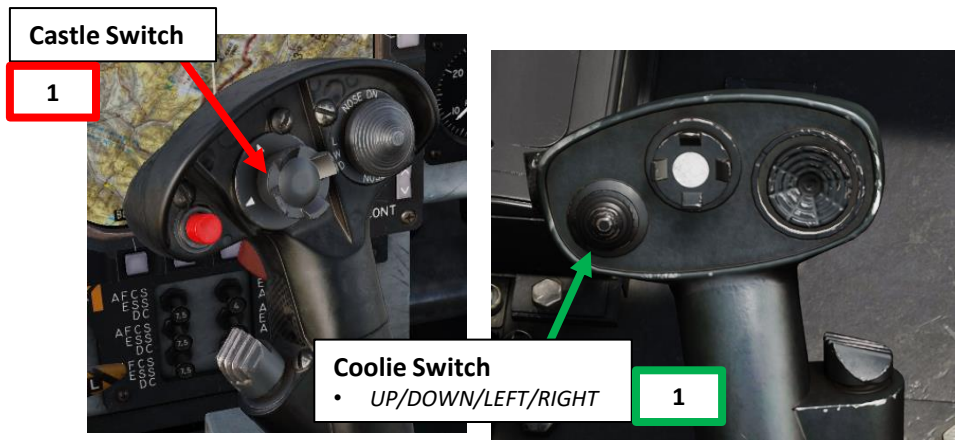




9 – MARKPOINTS
9.2 – How to Add Markpoints
9.2.2 – Targeting Pod Designation

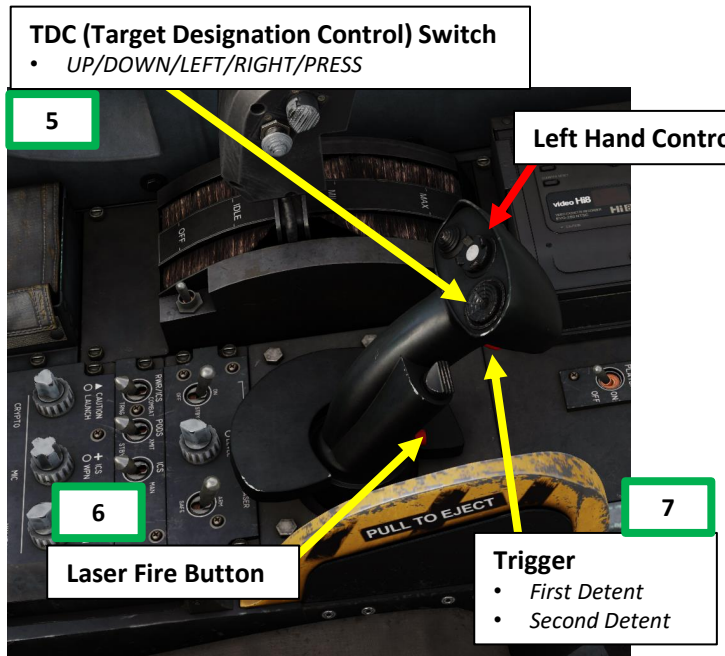
The MARK function is used to create a markpoint on the targeting pod (TPOD) display for future reference. To mark a target with the targeting pod:

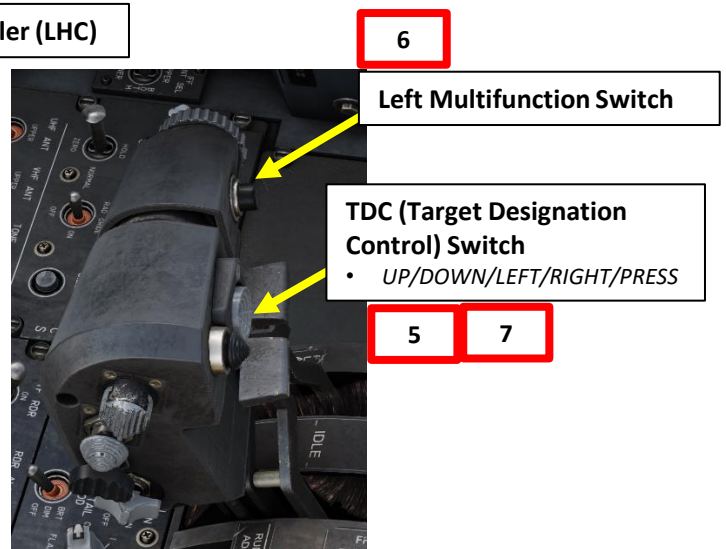
1. Power up the targeting pod, select the TPOD page, and take control of the sensor page (Pilot uses Castle Switch, WSO uses Left/Right Hand Controller Coolie Switch).
2. Select A/G Master Mode
3. Set Targeting Pod Mode Selector – A/G (Air-to-Ground)
4. Set Targeting Pod Function Selector to MARK (Markpoint Designation).

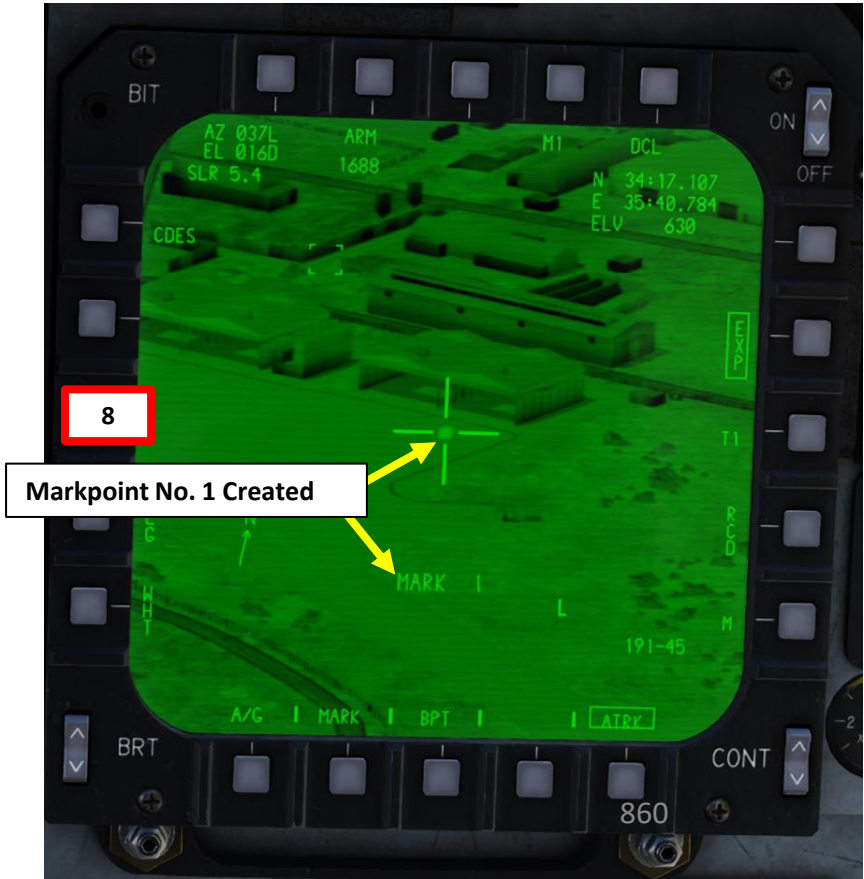


9 – MARKPOINTS
9.2 – How to Add Markpoints
9.2.2 – Targeting Pod Designation

5. Using the TDC (Target Designation Control) switch, slew the targeting pod reticle over the point you want to create a markpoint on.
6. If desired, lase the target to get a more accurate range. You can toggle the laser firing ON or OFF by:
   - **Pilot**: Pressing the Left Multifunction Switch.
   - **WSO**: Pressing the Laser Fire Button.
7. To designate the markpoint:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
8. Once target is marked, a new markpoint is created (Markpoint No. 1 in this case). Then, the MARK X legend (X being its respective markpoint number) appears for 5 seconds.
9. The UFC (Upfront Control Panel) displays coordinates of the newly created Markpoint and the time when it was recorded/designated.
10. A maximum of 10 markpoints can be designated. Any mark above the tenth overwrites the first one, then the second one, and so on. A maximum of 5 markpoints can be displayed at the same time.



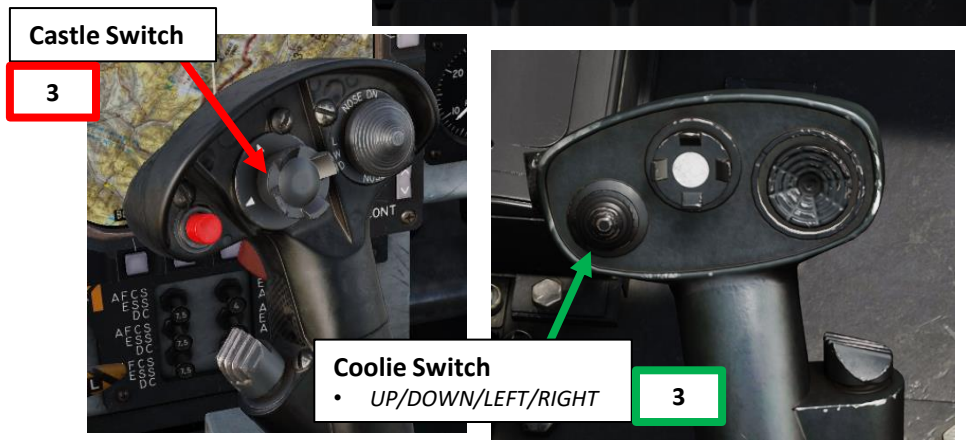


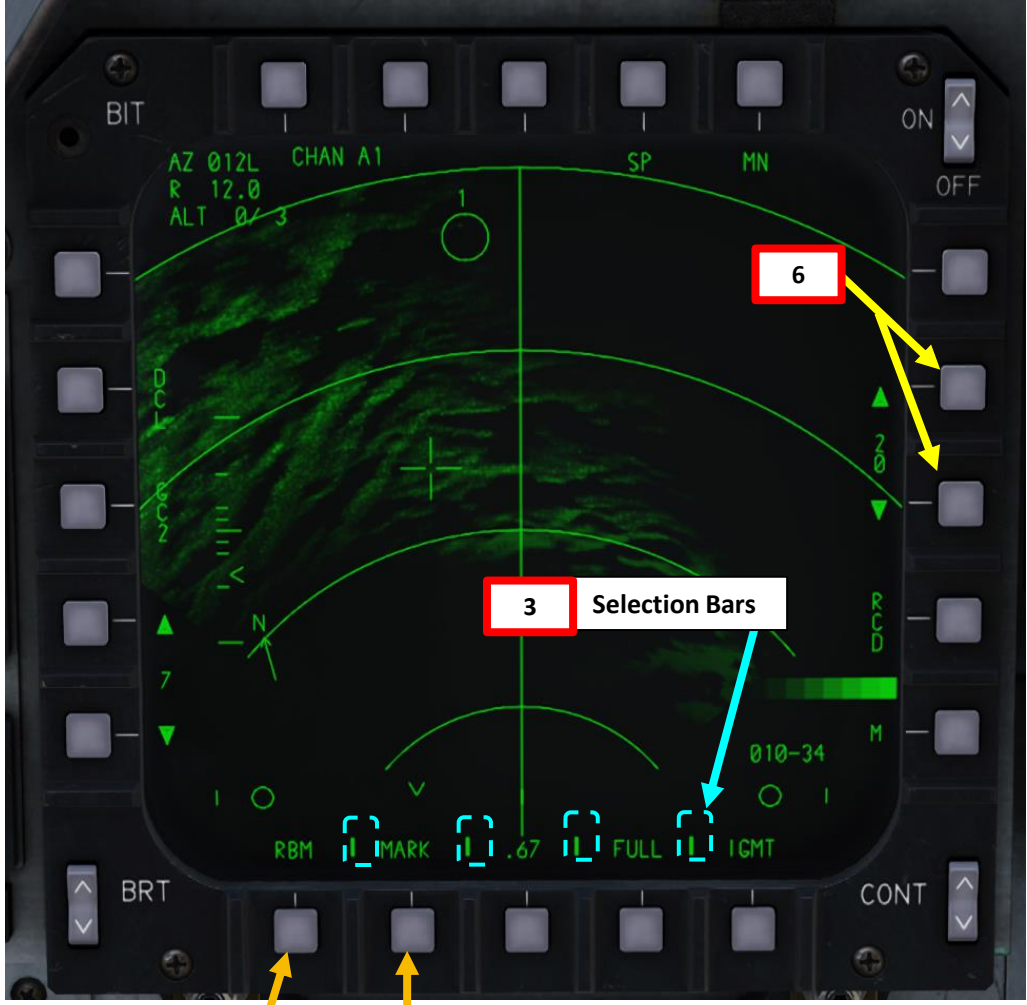


9 – MARKPOINTS
9.2 – How to Add Markpoints
9.2.3 – Air-to-Ground Radar Designation

The MARK function is used to create a markpoint on the real beam map display for future reference. To mark a target with the air-to-ground radar:

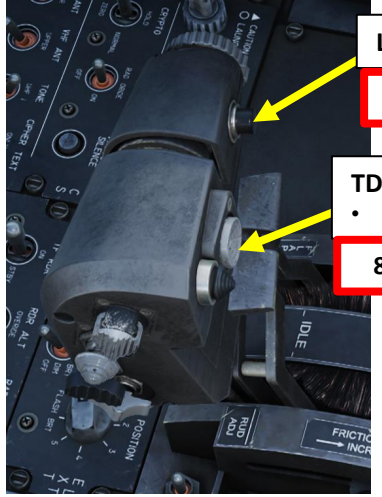
1. Verify targeting pod and radar are both powered
2. Select A/G Master Mode
3. Select A/G RDR page, then take control of the sensor page.
   - **Pilot**: press Castle Switch LONG (more than 1 sec) in the direction of the radar display.
   - **WSO**: Use Left/Right Hand Controller Coolie Switch to select desired radar display.
     - LHC Coolie LEFT for Outer Left Display, LHC Coolie RIGHT for Inner Left Display, RHC Coolie LEFT for Inner Right Display, RHC Coolie RIGHT for Outer Right Display.
   - Selection bars at the bottom of a display indicate the page is selected.
4. On A/G RDR page, select RBM (Real Beam Map) mode by toggling the A/G Radar Mode Selector button as needed.
5. On A/G RDR page, select MARK cursor function by toggling the Cursor Function Selector button as needed.
6. Adjust display range as desired.

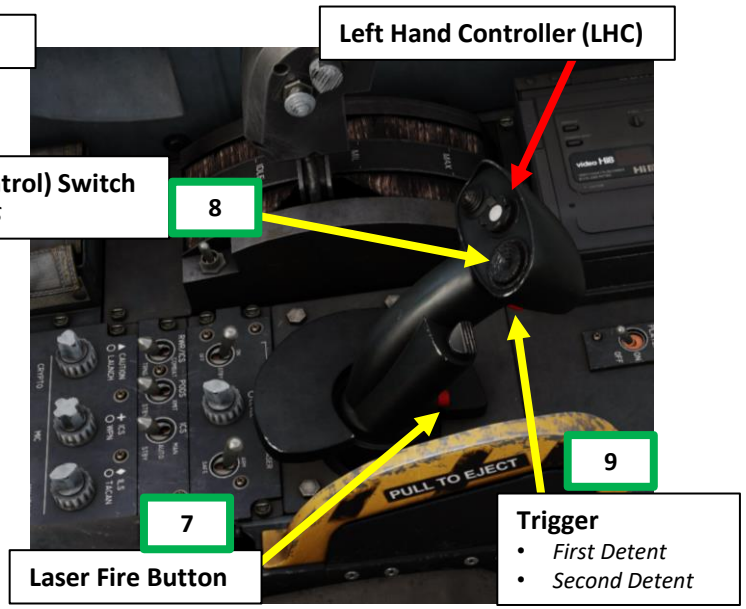


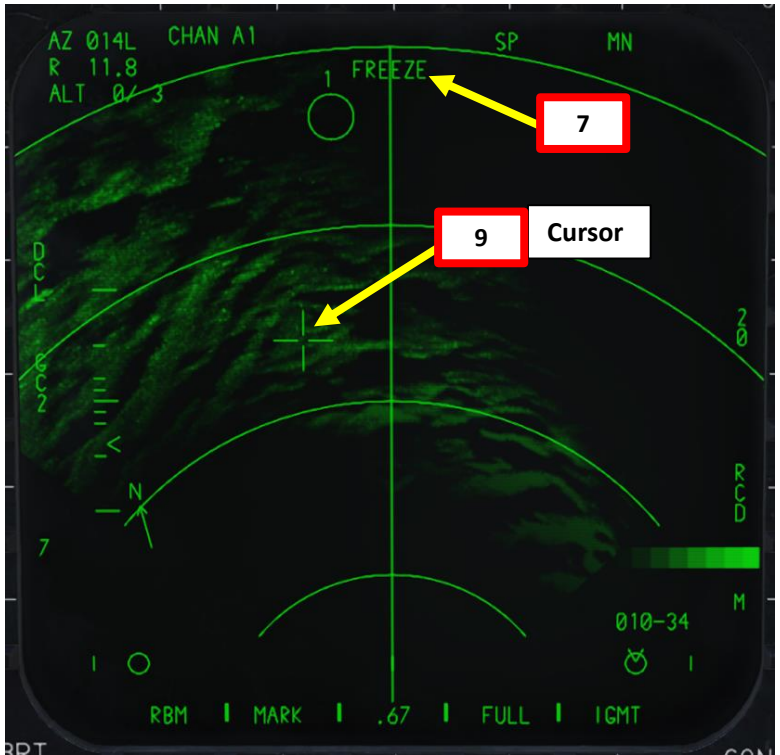


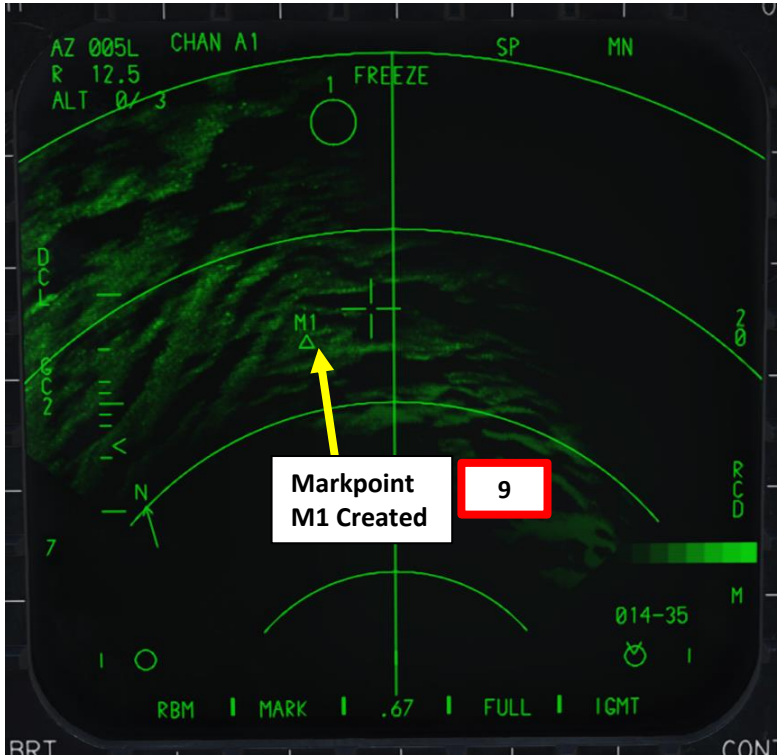
9 – MARKPOINTS
9.2 – How to Add Markpoints
9.2.3 – Air-to-Ground Radar Designation

7. Freeze the RBM display if desired:
   - **Pilot**: Press the Left Multifunction Switch.
   - **WSO**: Press the Laser Fire Button
8. Using the TDC (Target Designation Control) switch, slew cursor over the point you want to designate as a markpoint.
9. To designate the markpoint:
   - **Pilot**: Press and release the TDC (Target Designation Control) switch.
   - **WSO**: Press L/RHC (Left/Right Hand Controller) trigger to full action (second detent), then release it.
10. A maximum of 10 markpoints can be designated. Any mark above the tenth overwrites the first one, then the second one, and so on. A maximum of 5 markpoints can be displayed at the same time.





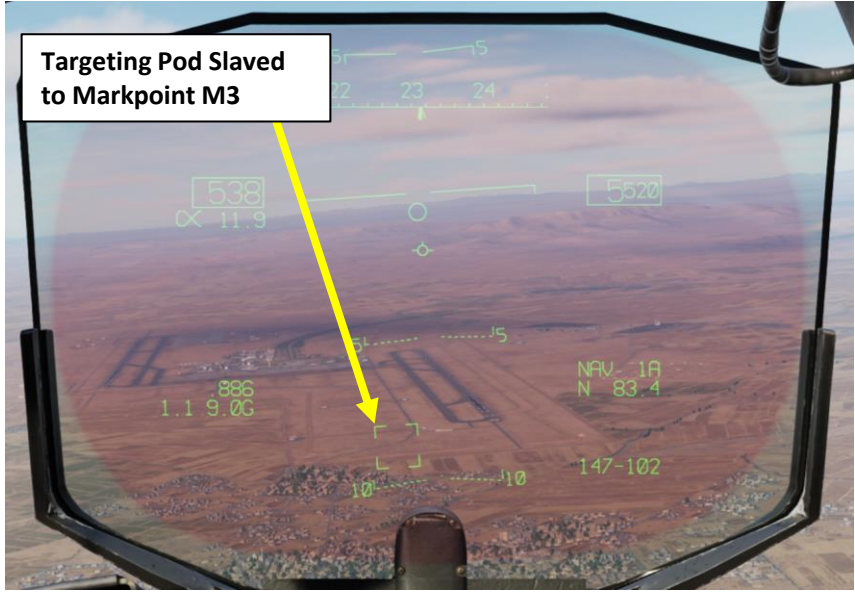


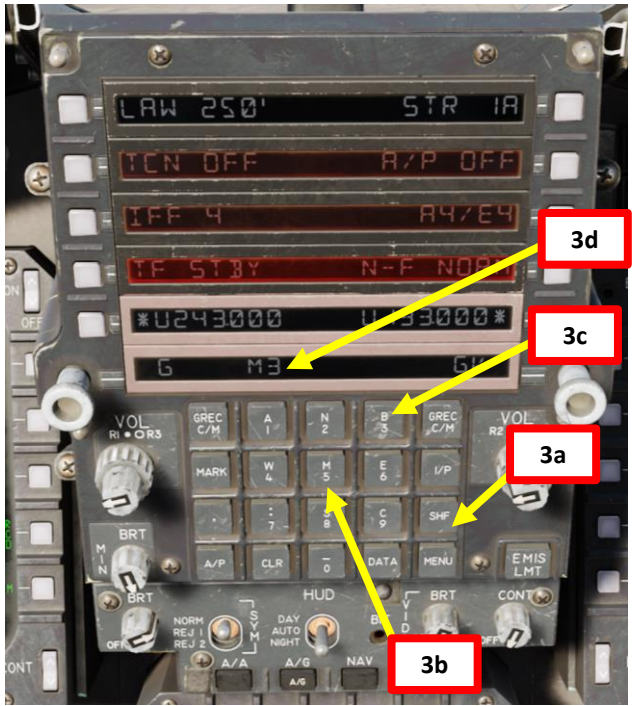


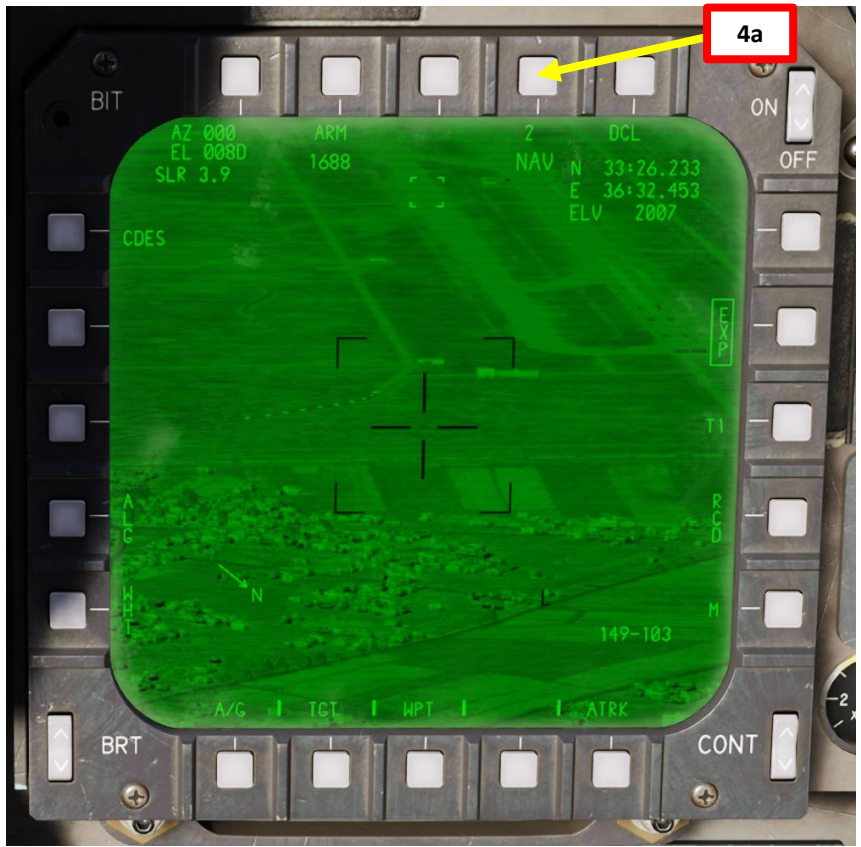
9 – MARKPOINTS
9.3 – Slaving a Sensor to a Markpoint

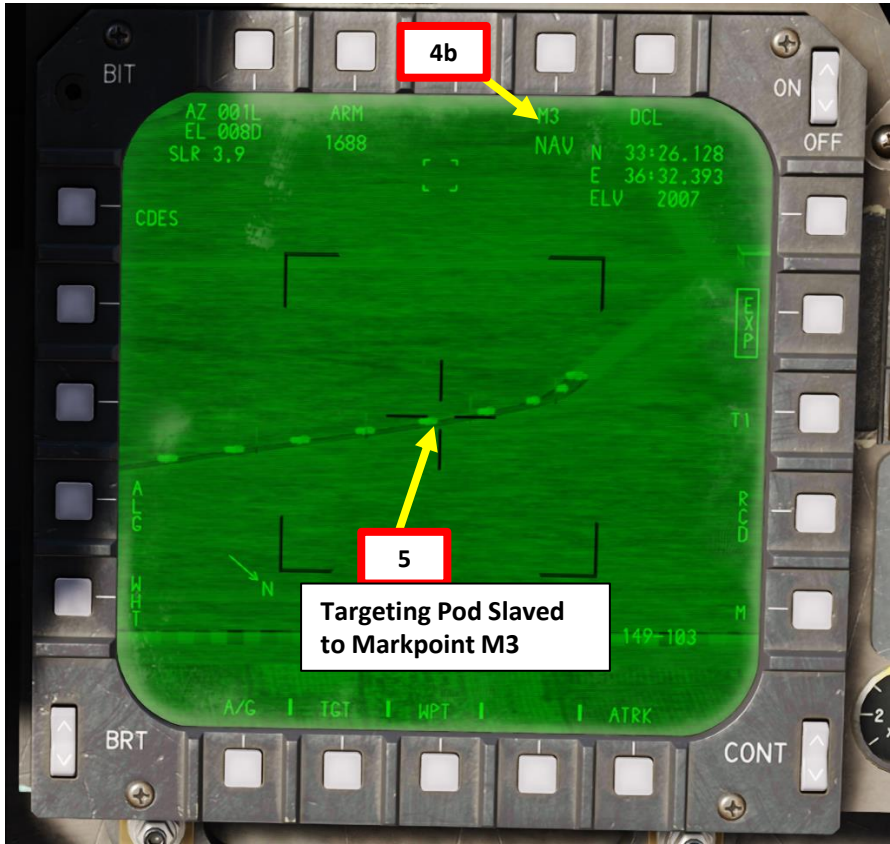
To slave a sensor like the targeting pod to an existing Markpoint (M3):

1. Verify targeting pod is powered
2. Select A/G Master Mode
3. On UFC (Upfront Control Panel) scratchpad, select Markpoint M3 by pressing SHF, then 5 (M), then 3.
4. On TPOD page, press Targeting Pod Cue Source Selector pushbutton.
5. The Targeting Pod Cue Source will switch to M3 (Markpoint 3), slaving the targeting pod to Markpoint 3.





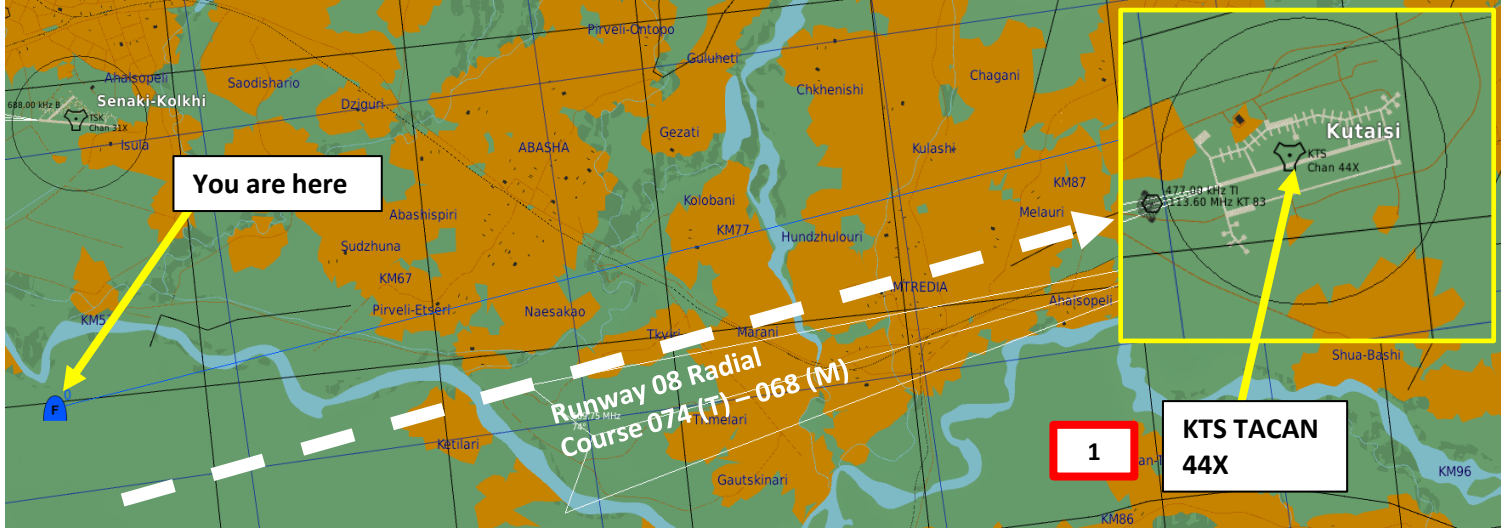




10 – TACAN NAVIGATION

TACAN (Tactical Air Navigation) stations are navigation aids typically used by the military and provide you directional and distance guidance. TACAN beacons can be installed on airdromes, air refueling tankers or even aircraft carriers. Many VOR stations are collocated with a TACAN. These stations broadcast both signals so they can be used by military and/or civilian aircraft. These stations are known as "VORTACS".

1. **We will track Kutaisi's TACAN 44X. We will use a radial (course) of 068 (Magnetic).**
2. Select NAV Master Mode
3. Select TACAN Station 44X.
   a) Select UFC (Upfront Control Panel) MENU 1
   b) Select TCN (TACAN) sub-menu.
   c) On UFC scratchpad, type "44".
   d) Press pushbutton next to TCN channel.
   e) If needed, press pushbutton next to TCN channel to toggle between X and Y channel. We will leave it to 44X.
   f) Press pushbutton next to T-R (Transmit/Receive)
   g) Press pushbutton next to TCN, which will change from OFF to ON.
   h) TACAN 44X is now selected and powered on.
   i) Adjust TACAN volume – As desired.
4. Return to MENU 1.

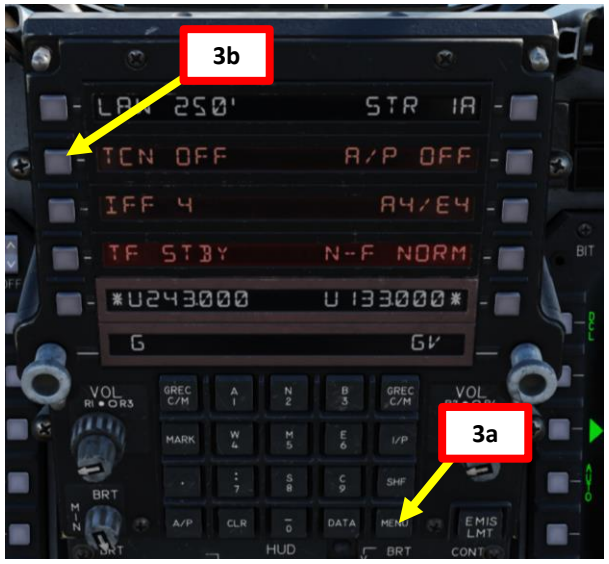


TACAN OPERATION MODES:

- **REC:** Your TACAN operates in receive mode only and provides bearing, course deviation, and station identification.
- **T/R:** The TACAN acts in a transceiver mode (send and receive) and provides bearing, range, deviation and station identification. This will be your most common selection.
- **A/A**: TACAN operates in Air-to-Air mode and provides bearing, range, deviation, and station identification with a TACAN-equipped aircraft.

ILS (Instrument Landing System) / TACAN Volume Knob

- *INNER KNOB: ILS audio volume control*
- *OUTER KNOB: TACAN station volume control*



10 – TACAN NAVIGATION

5. On HSI (Horizontal Situation Indicator) page, select TACAN mode (boxed
6. Set desired radial course (068) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the course value, then press either of the CRS UP or CRS DOWN buttons.

10 – TACAN NAVIGATION

7. Select PLAN or CDI (Course Deviation Indicator) symbology on the HSI, as desired. We will select CDI.
   - **Course Deviation Indicator (CDI)** 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 deg deviation each. If in straight flight the CDI is aligned with the set course pointer, the aircraft is flying on the desired course. The CDI would go through the aircraft symbol and align with the course pointer (and the course pointer would intersect the TACAN marker).
   - **PLAN** mode gives a more straightforward representation of aircraft's position in relation to the TACAN and the desired course that needs to be intercepted with less "moving elements" on the screen.

10 – TACAN NAVIGATION

8. After a few seconds, the HSI will display DME (Distance Measuring Equipment) distance to the TACAN in nautical miles.
9. Steer the aircraft towards the TACAN CDI (Course Deviation Indicator) Reference Line. As you approach the radial, the line deviation with the centerline of the HSI will gradually diminish. The direction of the TACAN beacon will be displayed by the TACAN Bearing Pointer. Steering symbology is visible both on the HUD (Heads-Up Display), HSI (Horizontal Situation Indicator) and ADI (Attitude Director Indicator).
10. The 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 deg deviation each. If in straight flight the CDI is aligned with the set course pointer, the aircraft is flying on the desired course.
11. CDI (Course Deviation Indicator) will indicate how far off the TACAN radial course (068) you are. When CDI Reference line is centered, this means you are on the 068 radial. Then, turn towards the TACAN Bearing Pointer (or Course Pointer) to follow the radial to the runway.

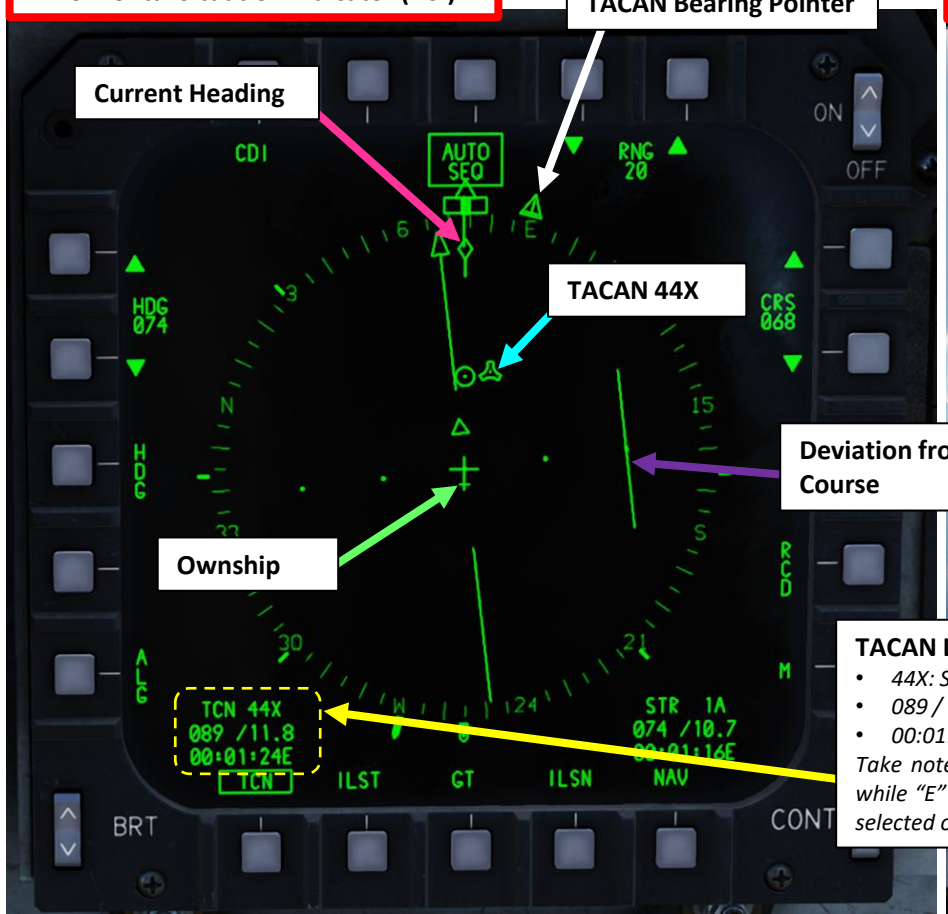
Attitude Director Indicator (ADI)

Command Heading Marker (bearing to selected Steer Point)

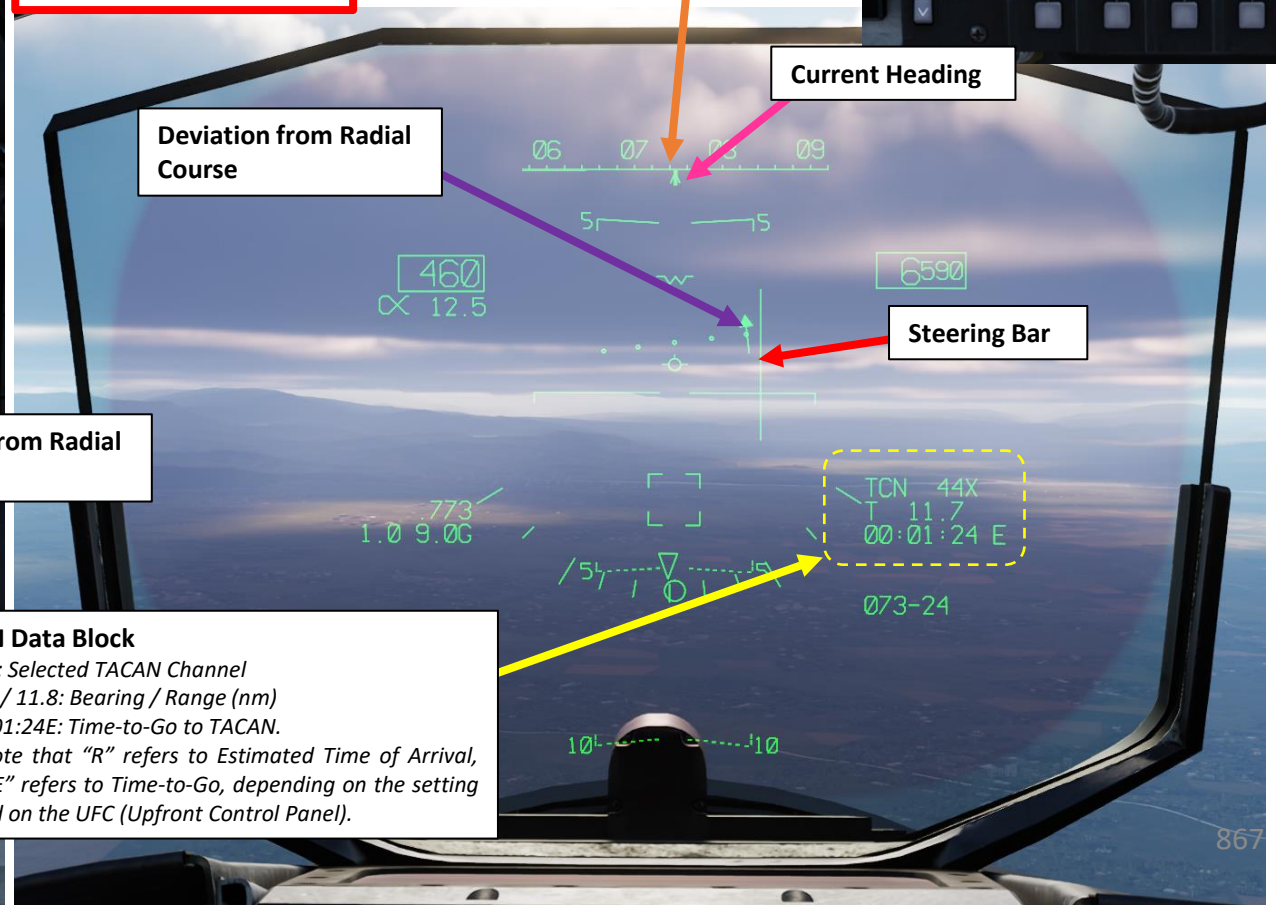
- *Even in the TCN Steering Mode, the Command Heading marker shows bearing to the currently selected Steer Point.*

Horizontal Situation Indicator (HSI)

TACAN Bearing Pointer



Heads-Up Display (HUD)

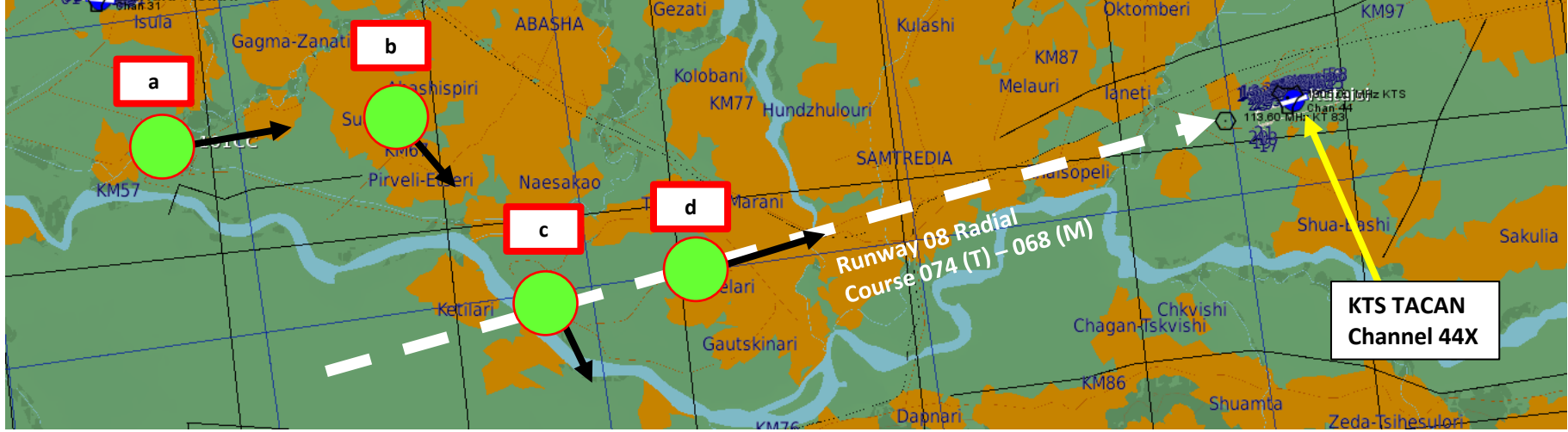


TACAN Data Block

- *44X: Selected TACAN Channel*
- *089 / 11.8: Bearing / Range (nm)*
- *00:01:24E: Time-to-Go to TACAN.*

Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).

10 – TACAN NAVIGATION



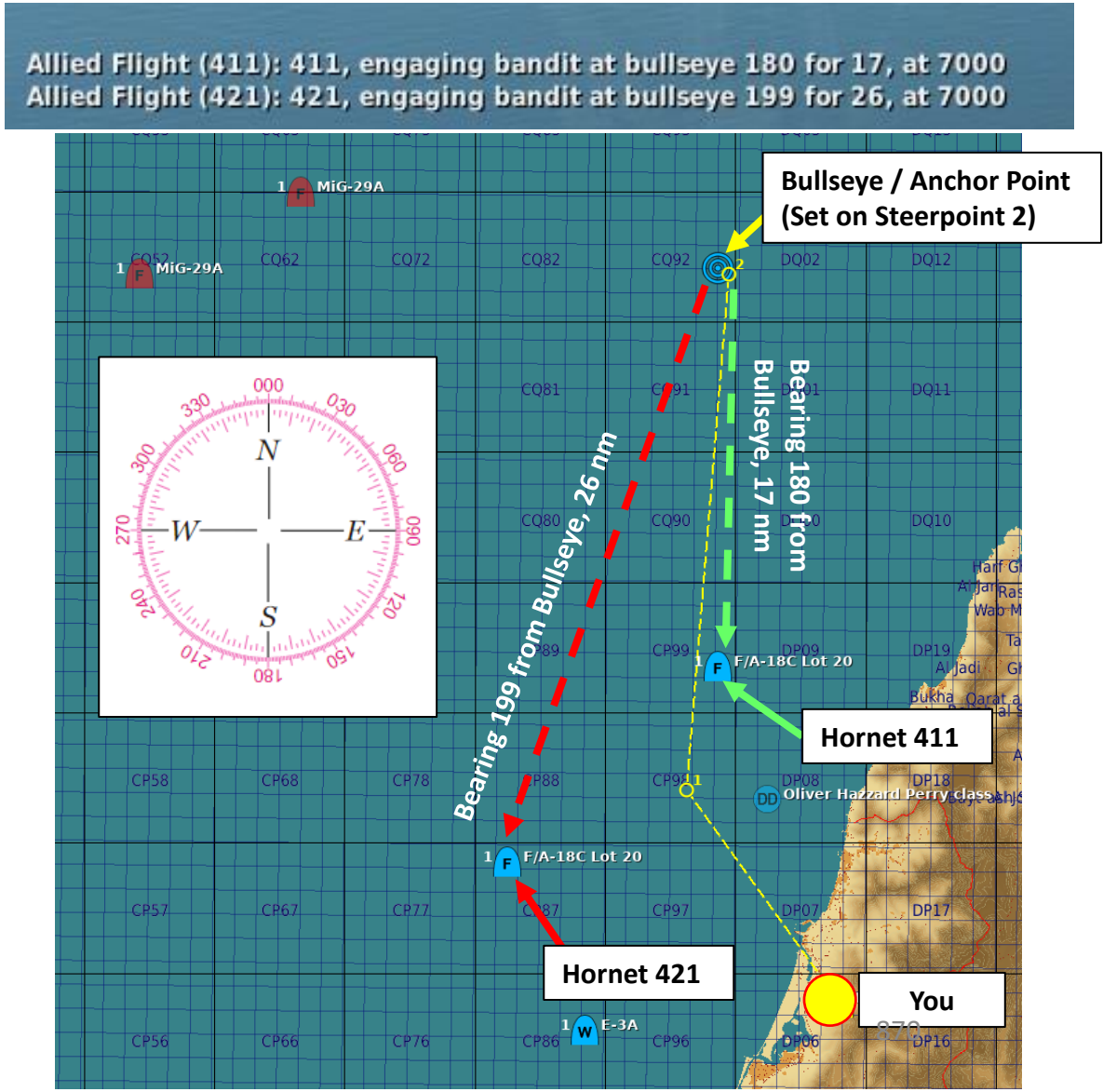
10 – TACAN NAVIGATION

11 – BULLSEYE

A “Bullseye” or “Anchor Point” is a fictional point in space that serves as a common geographic reference for a mission amongst friendly forces. If you know where the bullseye is and the enemy doesn’t, it gives you a way to communicate positions without the enemy knowing where to look from. Your wingmen and AWACS will often refer to “bulls” or “bullseye” on the radio. A bullseye call, used to communicate your position, is done in the following format:

- Bearing from bullseye
- Range from bullseye
- Altitude

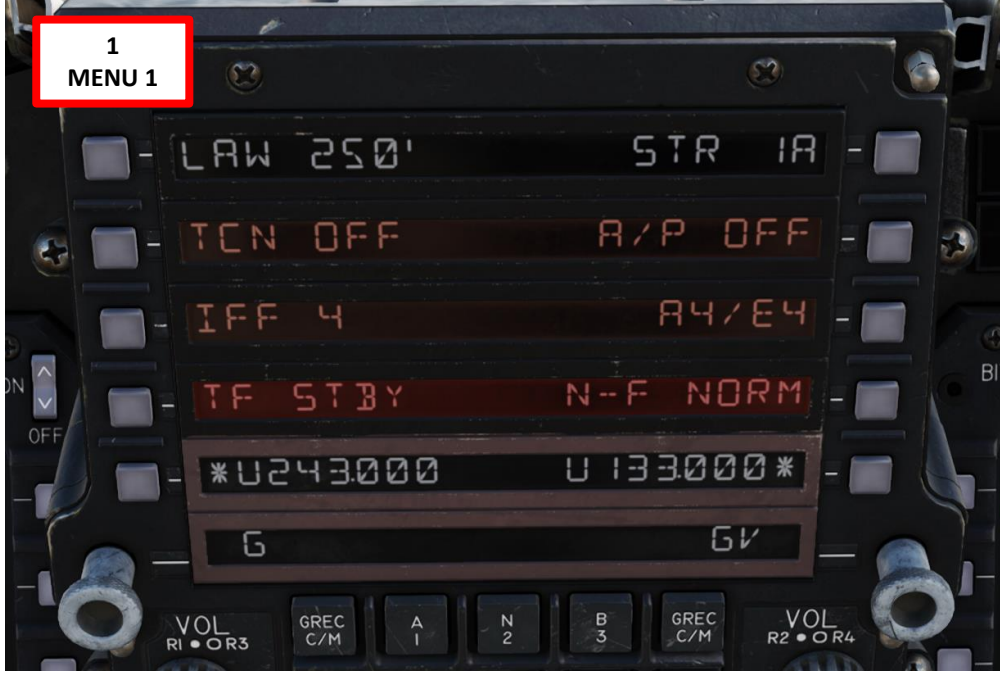
Bullseye Explanation by JediLinks: https://youtu.be/vgcXcfeGb2M

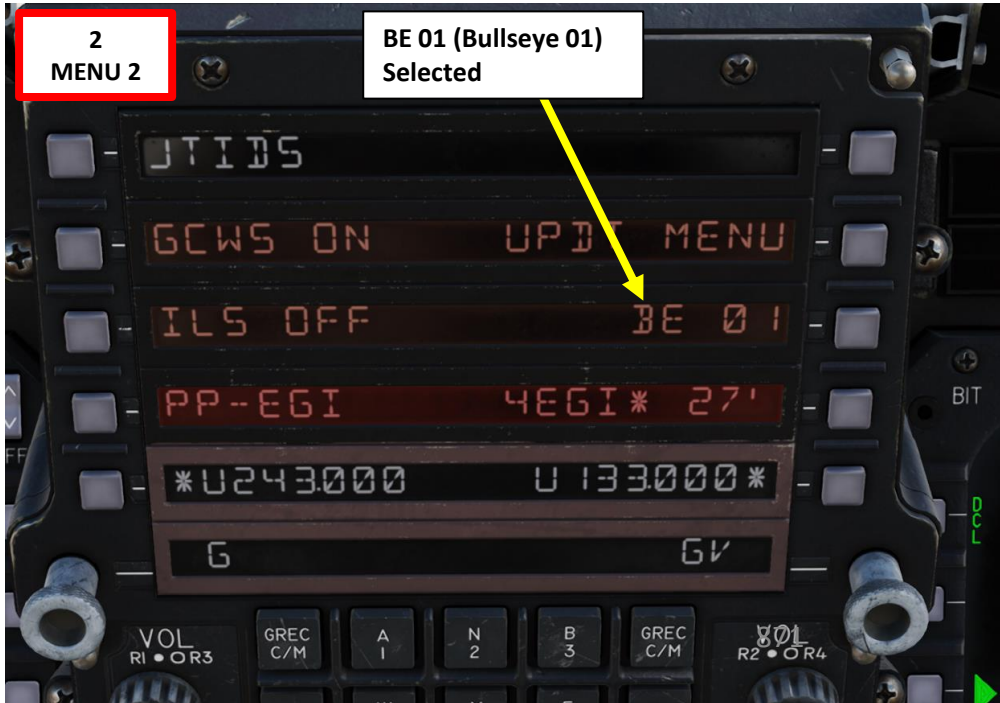


11 – BULLSEYE

When selecting MENU 2 on the UFC (Upfront Control Panel), you can select any of the 10 stored bullseye points (BE 01, BE02, etc.).

Currently, only BE 01 is available and its coordinates cannot be changed; bullseye coordinates are already preset in the Mission Editor.

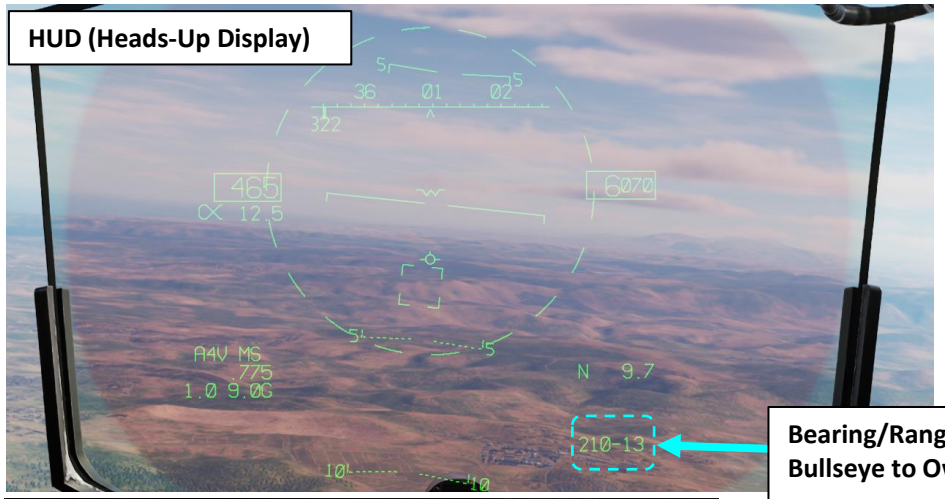


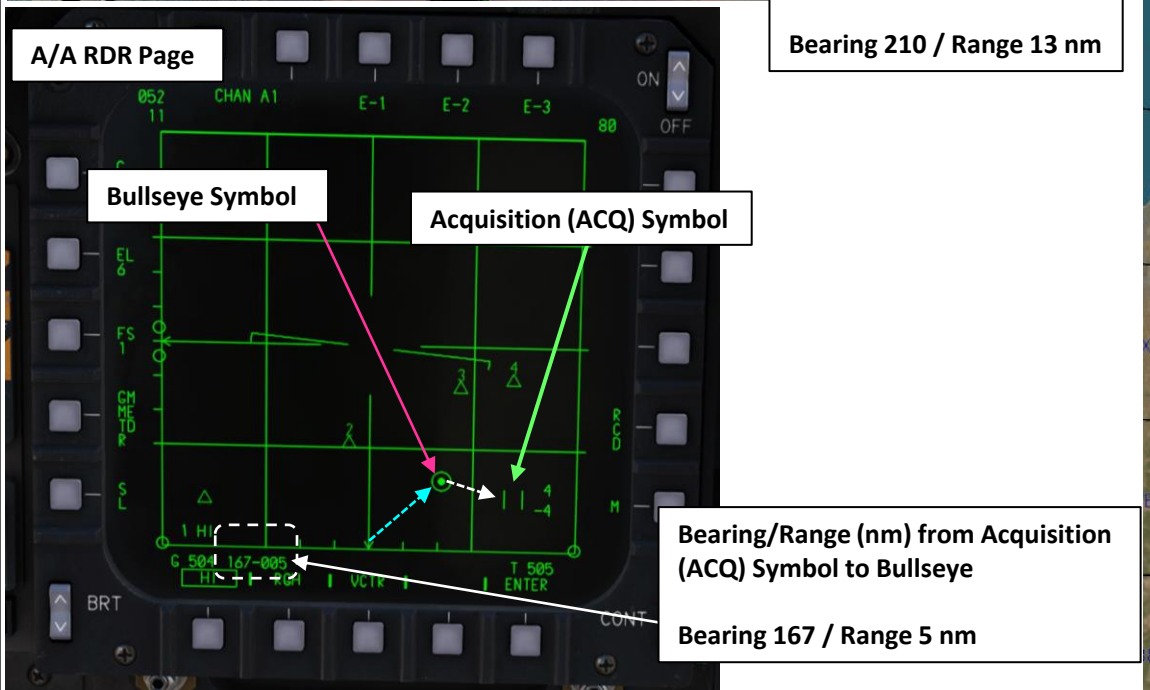


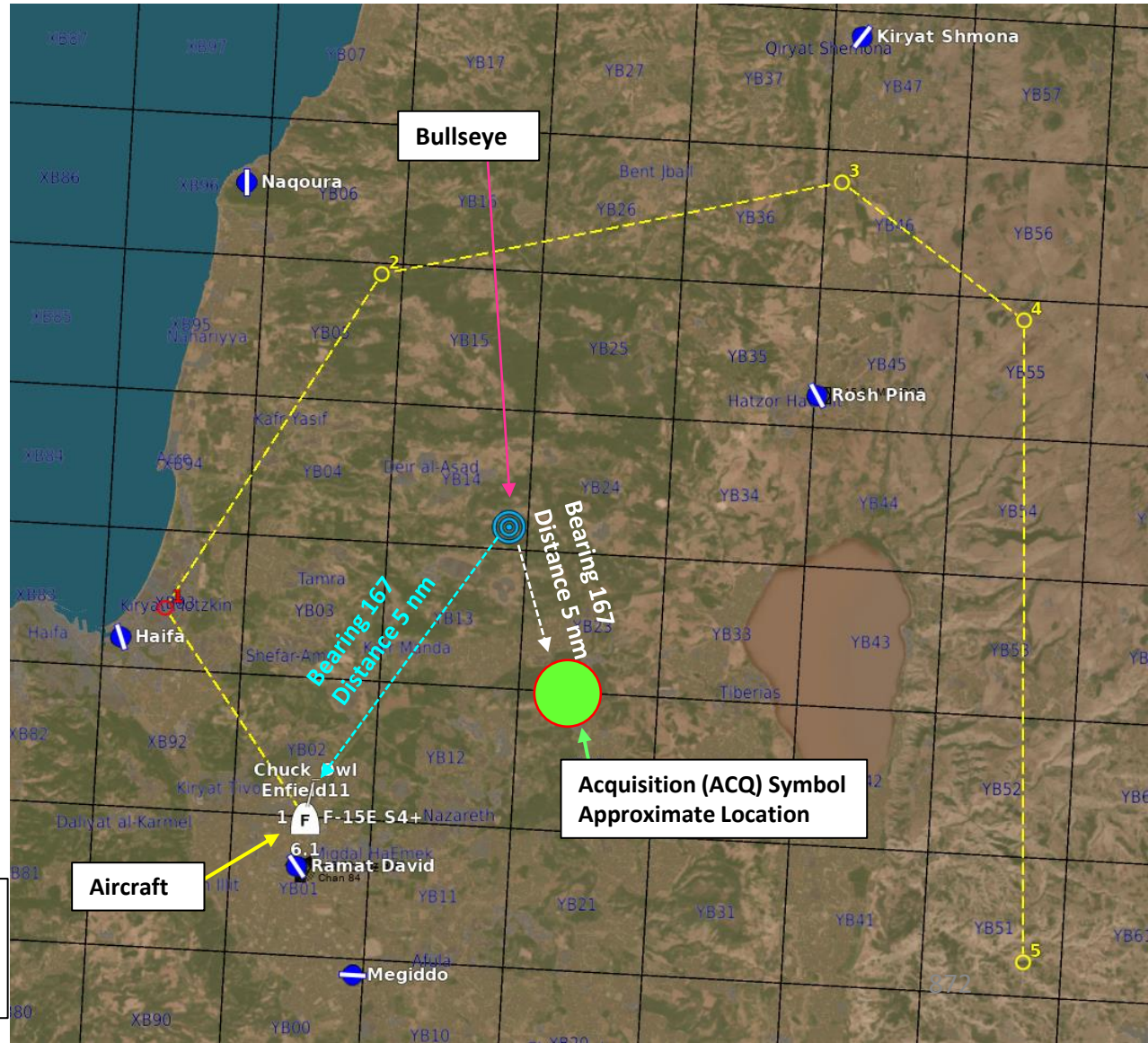
11 – BULLSEYE

On the A/A RDR Display, there is a data block that shows the Bearing/Range (nm) from Acquisition (ACQ) Symbol to Bullseye.

On the HUD, there is a data block that shows the Bearing/Range (nm) from Bullseye to Ownship (your aircraft).

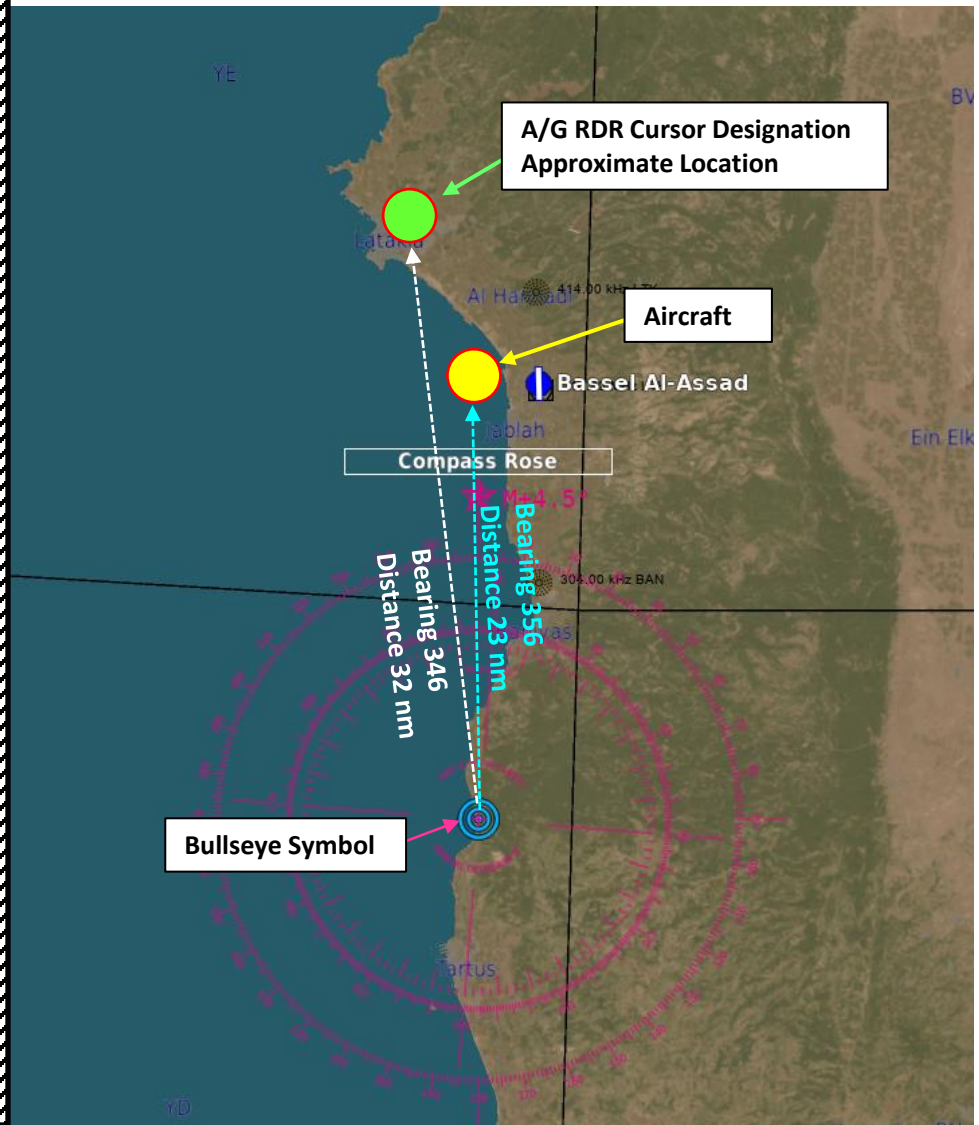


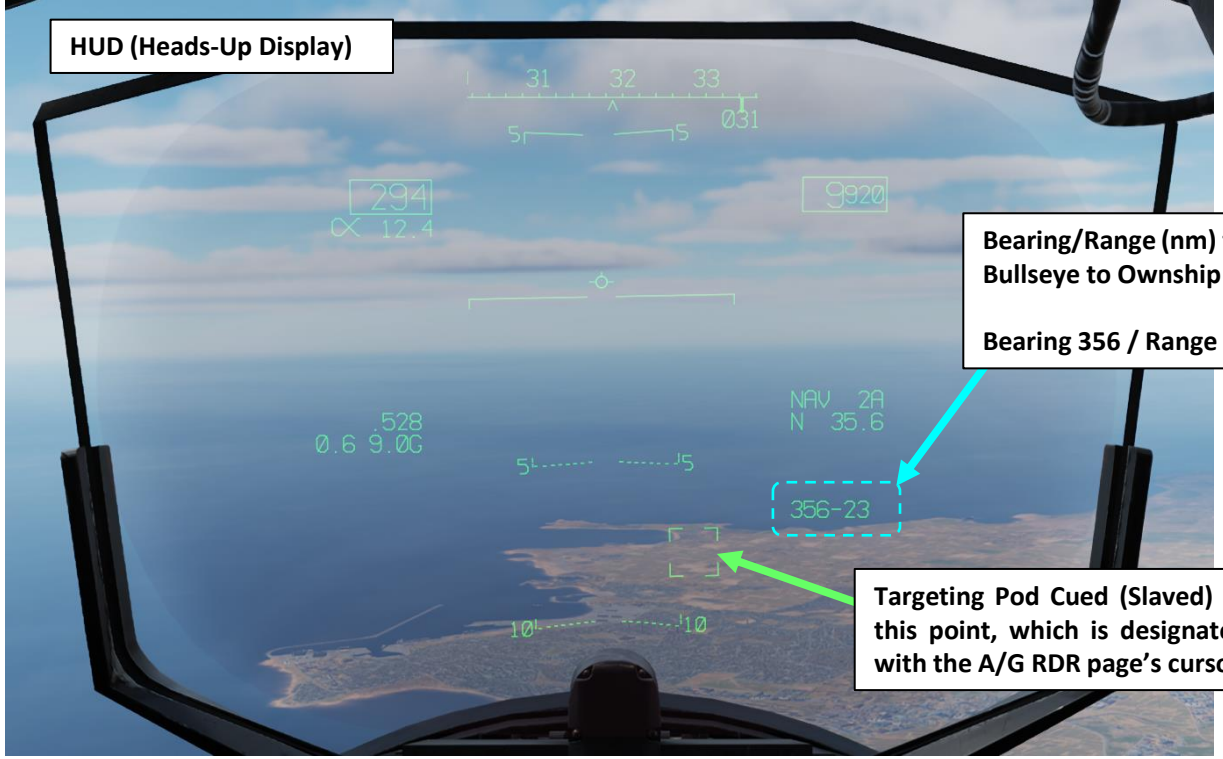


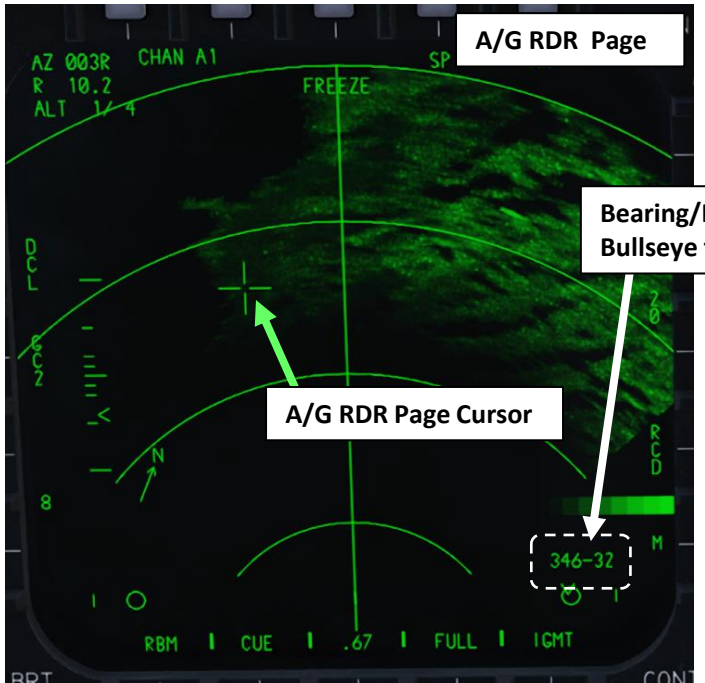


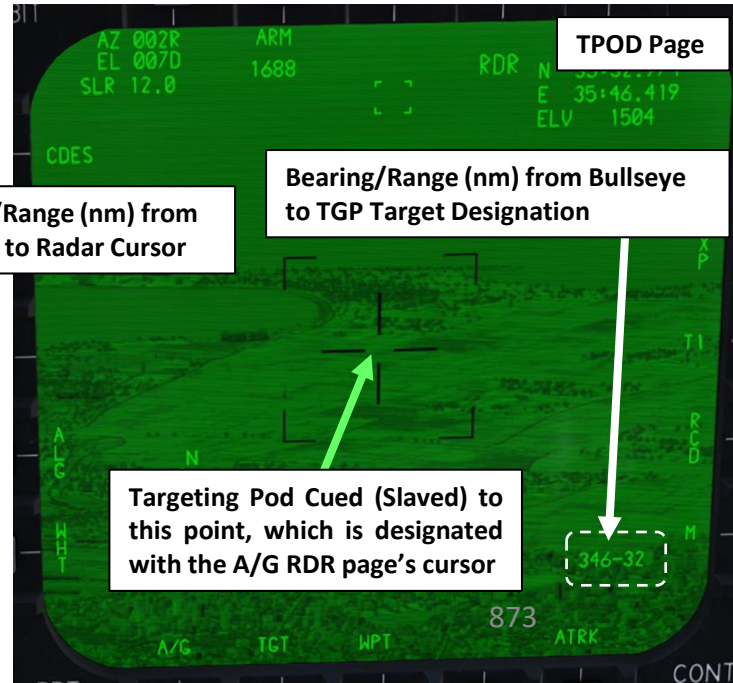
11 – BULLSEYE

On the A/G RDR Display and TPOD (Targeting Pod) Page, there is a data block that shows the Bearing/Range (nm) from a target designation to Bullseye.









12 – INS (INERTIAL NAVIGATION SYSTEM) DRIFT

12.1 – INS Basics: PPKS (Present Position Keeping Source)

The PPKS (Present Position Keeping Source) 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 position sources, in the order of precision and reliability are:

- **REALNAV**: Relative Navigation, 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.
    - Note: **REALNAV is not simulated.**

- **EGI**: Embedded Global Positioning System (GPS) / Inertial Navigation System (INS), 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.

- **MN**: Mission Navigator, which 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 (Precision Velocity Update) 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.

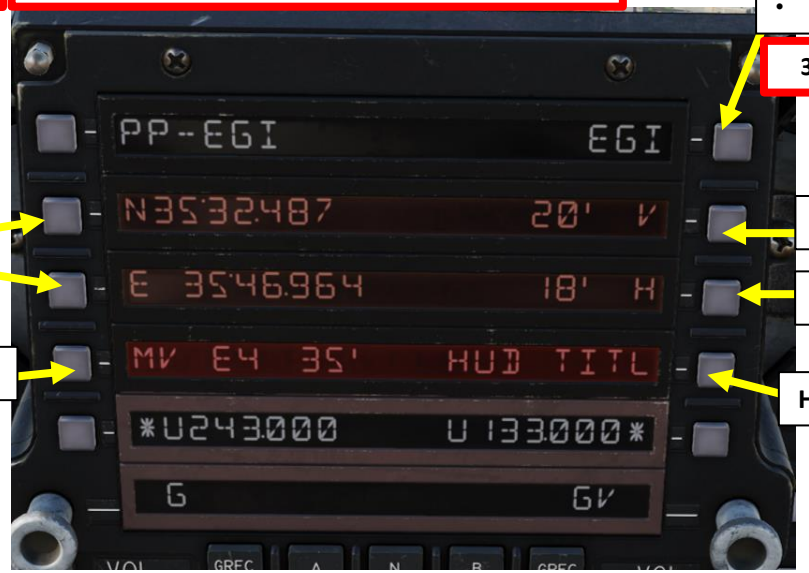
- **INS**: Inertial Navigation System: The INS is a self-contained, fully automatic Ring Laser Gyro (RLG) system which supplies the primary attitude reference for the aircraft and provides continuous PP (Present Position) monitoring. In addition, the INS provides aircraft attitude, heading, velocity, and acceleration information to the LANTIRN targeting pod, radar, AFCS (Automatic Flight Control System) and CC (Central Computer).

12 – INS (INERTIAL NAVIGATION SYSTEM) DRIFT
12.1 – INS Basics: PPKS (Present Position Keeping Source)

To access the PPKS Sub-Menu:

1. Select MENU 2 on the UFC (Upfront Control Panel) by pressing the MENU button twice.
2. Press pushbutton next to PP (Present Position) Sub-menu
3. You can change the present position keeping source by toggling the PPKS pushbutton.

2b **PPKS (Present Position Keeping Source) Sub-Menu**



PPKS Selection: Allows aircrew to select preferred PPKS source.

- *RLN (relative navigation)*
- *EGI (embedded global positioning system)*
- *MN (mission navigator)*
- *INS (inertial navigation system)*
- *A/D (air data; no PPKS available)*

3

Current Aircraft Latitude/Longitude Coordinates

EGI Vertical Position Error (ft)

EGI or RLN Horizontal Position Error (ft)

Magnetic Variation

HUD Tilting Function (Not simulated)

Embedded GPS / INS (EGI) Status

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:

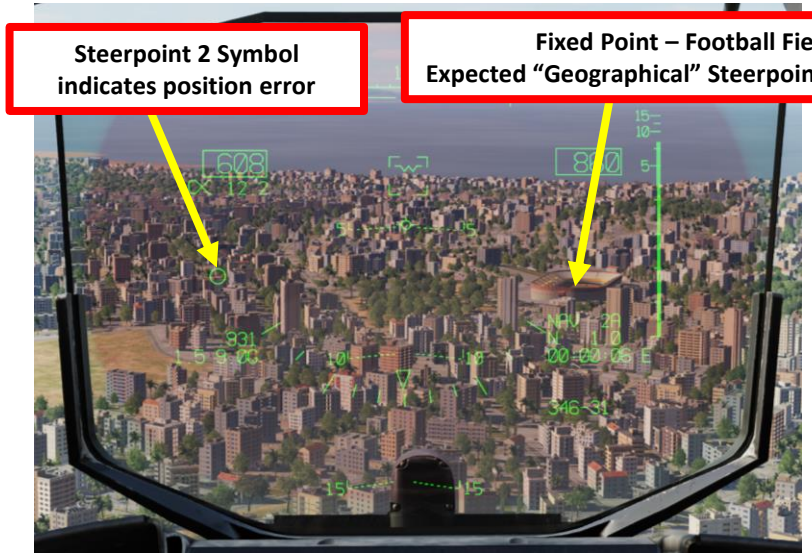
- ***GCA**: Gyro Compass Alignment*
- ***SHA**: Stored Heading Alignment*
- ***IMA**: In-Motion Alignment*

12 – INS (INERTIAL NAVIGATION SYSTEM)
12.2 – INS Drift

The INS suffers drift due to measurement errors that accumulate with time. due to imprecise sensors (gyroscopes and accelerometers) and due to the limitations of calculation methods. A cumulative error in coordinate calculations can be up to 0.8 nautical miles after 1 hour of flight. Errors in coordinate calculations will affect flight path and determination of target locations, especially if the pilot uses waypoints to navigate. To compensate for these errors, they need to be corrected. You will start noticing inertial drift once the coordinates of your waypoints do not seem to match what you see outside the cockpit.

In order to update/re-align the INS position in-flight, a pilot uses reference points such as known landmark or something easy to spot visually. These reference points are called **fixed points (or "fix")**, Fixed points, which are similar in nature to steerpoints (basically, a set of coordinates for a navigation point), are used to re-align your INS. Typically, you want to have these fixed points set up before entering a combat zone.

How do you know when to re-align, though? Well, one quick way is to select an existing waypoint as a navigation fix point; its coordinates should set on a visual landmark. When overflying this landmark, the steerpoint location can be cross-checked with the HUD (Heads-Up Display) steerpoint symbol. Position Error can also be consulted on the PPKS Sub-Menu on the UFC (Upfront Control Panel).



PPKS (Present Position Keeping Source) Sub-Menu

PPKS Selection: Allows aircrew to select preferred PPKS source.

EGI Vertical Position Error (ft)

EGI or RLN Horizontal Position Error (ft)

With INS Drift, accumulation of position error makes the Inertial Navigation System "think" Waypoint 2 is actually there

12 – INS (INERTIAL NAVIGATION SYSTEM)
12.2 – INS Drift

Here are different methods to correct INS drift:

- **OFLY** is used for a navigation fix when overflying the steerpoint using a visual position update. **(Not simulated yet)**
- **HUD** is used for a navigation fix with the Heads-Up Display using a visual position update. **(Not simulated yet)**
- **ALT** is used for altitude calibration. We basically use an aircraft sensor (radar, targeting pod, etc.) to correct the drift error. **(Not simulated yet)**
- **EGI** is used for in-flight alignment by comparing INS and GPS coordinates.
- **PVU** is used for a navigation fix with the air-to-ground radar using the Precision Velocity Update mode.

To access the PPKS Position Update Sub-Menu:

1. Select MENU 2 on the UFC (Upfront Control Panel) by pressing the MENU button twice.
2. Press pushbutton next to UPDT MENU (Update Menu) Sub-menu

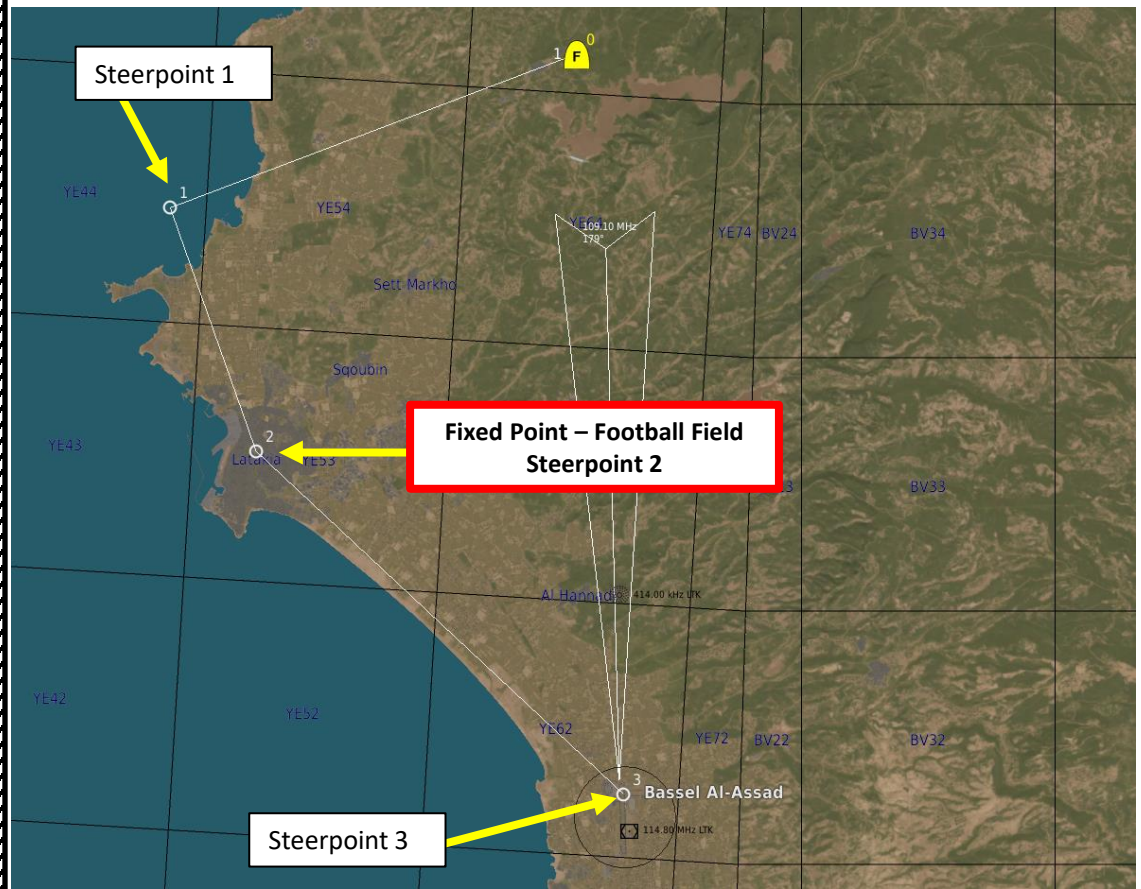
2b **UPDT MENU (Position Update Menu)**

12 – INS (INERTIAL NAVIGATION SYSTEM)
12.3 – Coordinate Correction using Overfly Position Update Fix

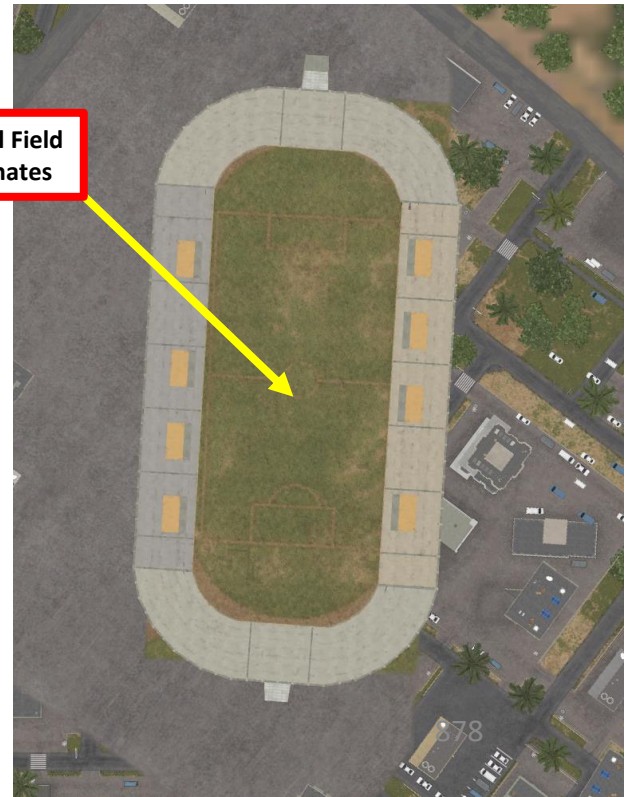
For fixed points, it is recommended to use locations that stand out in the terrain – buildings, towers, bridges, road crossings, and river merge points that are easily located along the route. In this example, our Fix Point coordinates are already entered in Steerpoint 2, which is set over a visual landmark (football field).

The Overfly Fix method synchronizes the aircraft's coordinates with the coordinates of the reference point when flying over it.

Note: Overfly Position Update Fix is not simulated yet.



Fixed Point – Football Field
Steerpoint 2 Coordinates



12 – INS (INERTIAL NAVIGATION SYSTEM)
12.4 – Coordinate Correction using HUD Position Update Fix

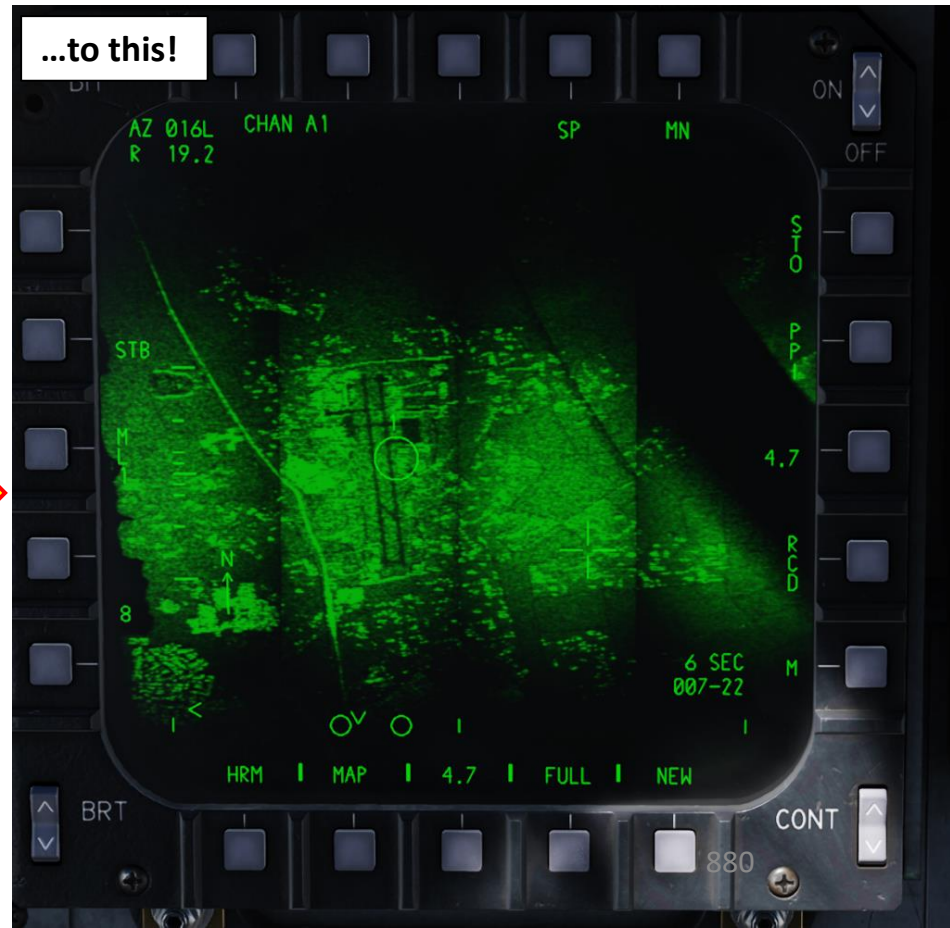
Note: HUD Position Update Fix is not simulated yet.

12 – INS (INERTIAL NAVIGATION SYSTEM)
12.5 – PVU (Precision Velocity Update)

The radar's PVU (Precision Velocity Update) mode provides an estimate of velocity error for updating the MN (Mission Navigator) or the INS (Inertial Navigation System). Irrespective of the version (MN PVU, INS PVU, or Interleaved PVU), the 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.

In other words… when using radar ground mapping in modes like RBM (Real Beam Map) or HRM (High Resolution Map), **velocity errors accumulate over time**. These errors degrade the generated radar picture's quality. Using PVU mode, the **radar can determine the velocity errors and apply corrections**, improving the picture's quality and precision in the process.

**For a tutorial on how to use PVU, consult [Part 10 (Radar & Sensors) – Section 2.2.5 – PVU (Precision Velocity Update) Mode]. **



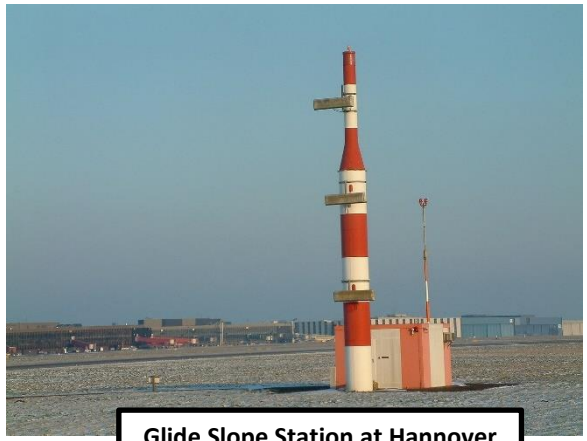
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL

13.1 – Basics

The ILS (Instrument Landing System) exists to guide you during your approach in low-visibility conditions.

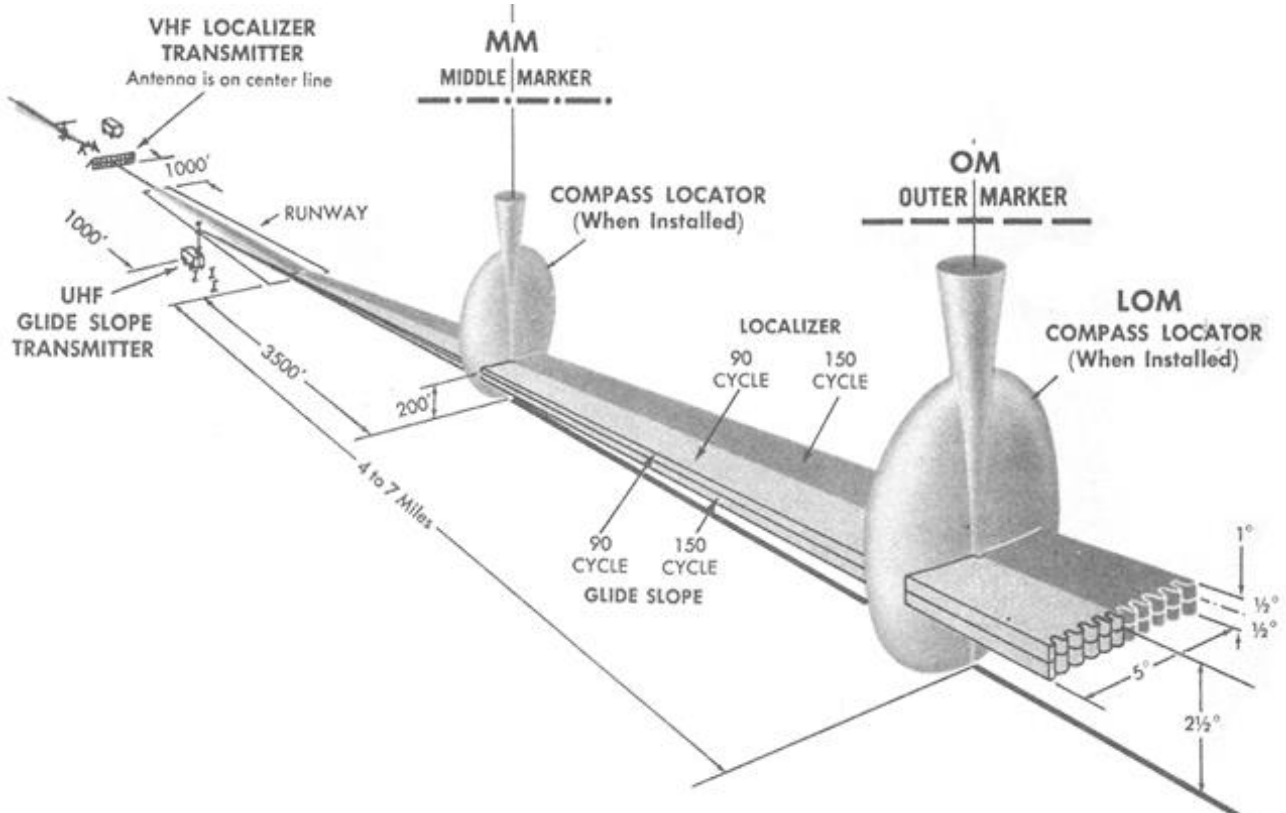
- The Localizer is generally an array of antennas that will give you a lateral reference to the center of the runway.
- The Glide Slope station will help you determine the descent speed you need in order to not smack the runway in a smoldering ball of fire.

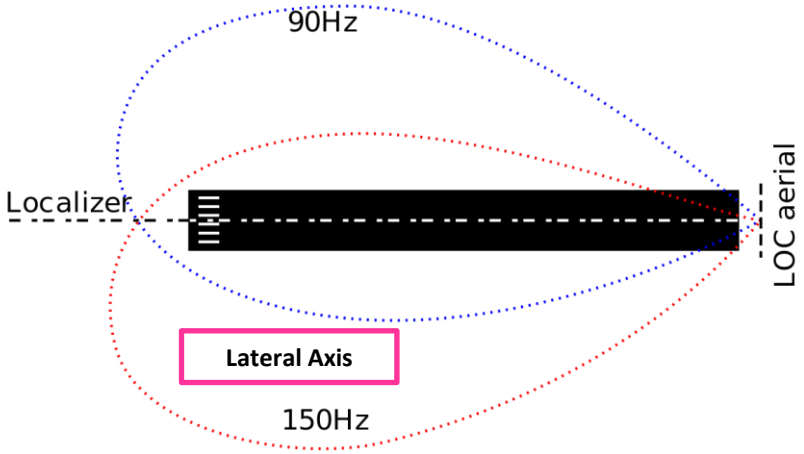
Localizer Array Station at Hannover

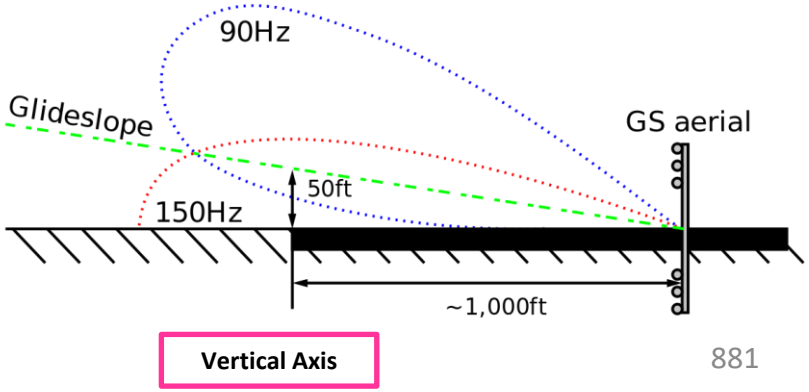


Glide Slope Station at Hannover

Great video explanation of ILS
https://www.youtube.com/watch?v=KVtEfDcNMO8







13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.2 – ILSN vs ILST

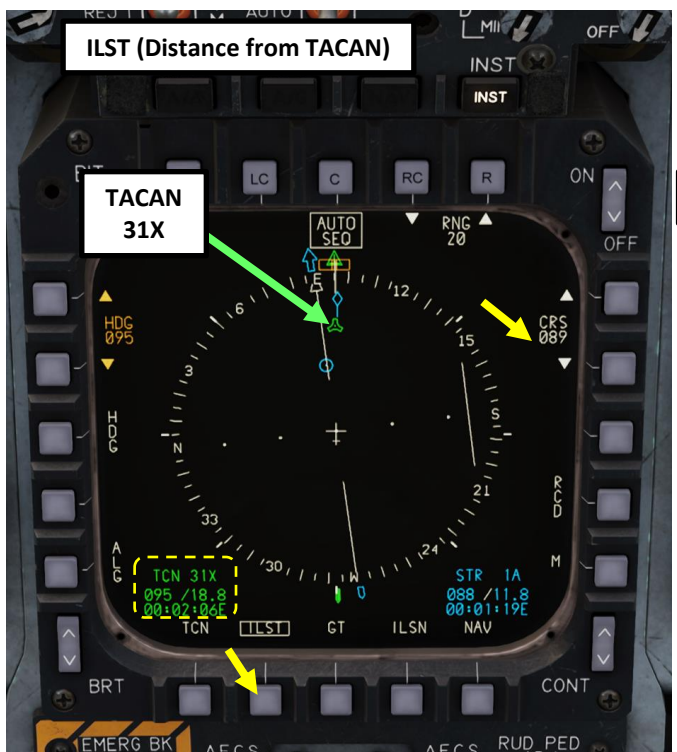
The F-15E has two different variants of the ILS using either TACAN or NAV as source for all inbound course calculations.

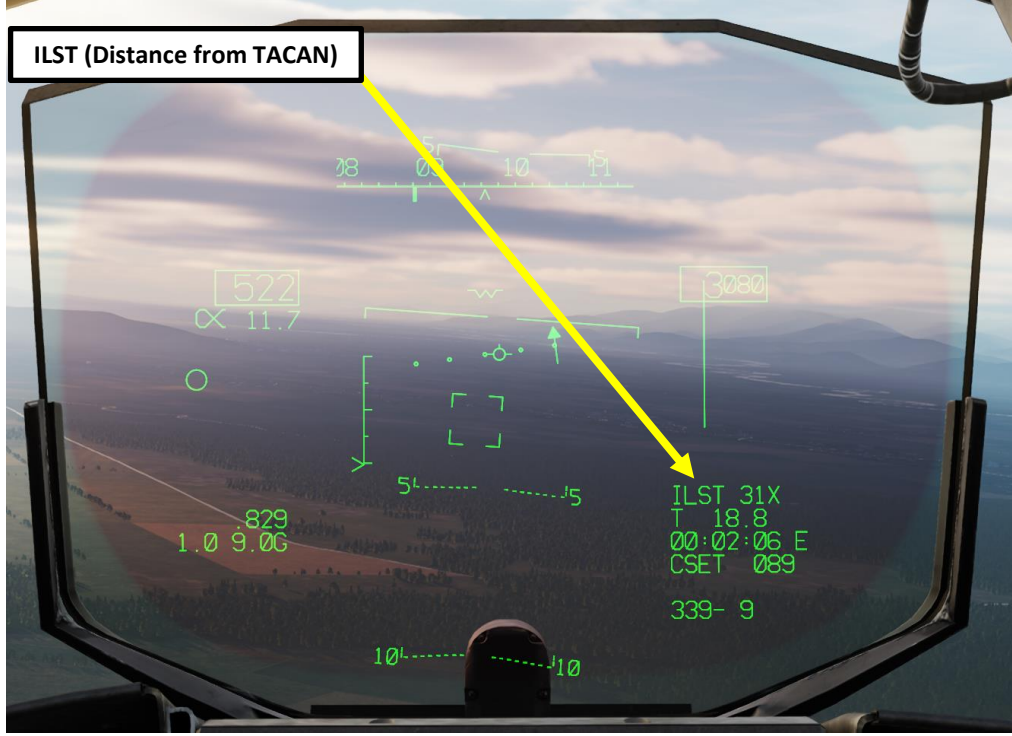
- **ILSN (Navigation Source):** the aircraft is using the internal navigation (INS, GPS) to show the distance to the currently selected steerpoint (which, ideally, should be set on the runway), just like in the main Navigation mode. However, steering cues are still provided by the Localizer & ILS systems.

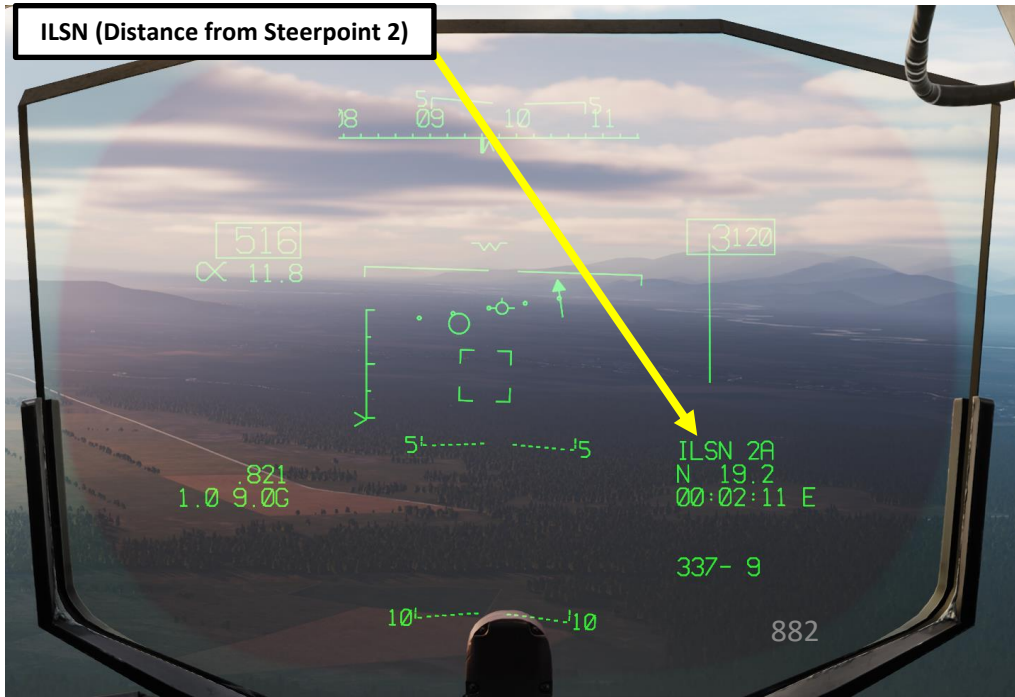
- **ILST (TACAN Source):** the aircraft is using a TACAN station to show the distance to the runway. However, steering cues are still provided by the Localizer & ILS systems. TACAN setup should be done as shown in the TACAN NAVIGATION Tutorial.

Both ILSN (Navigation Source) and ILST (TACAN Source) share the indications and symbols and therefore will be described together in the next station.

Note that for ILST mode, TACAN should first be enabled and set up. Moreover, for the ILS steering mode to work:
- ILS has to be turned on and properly set up and;
- Aircraft has to be in INST (Instrument) Master Mode.



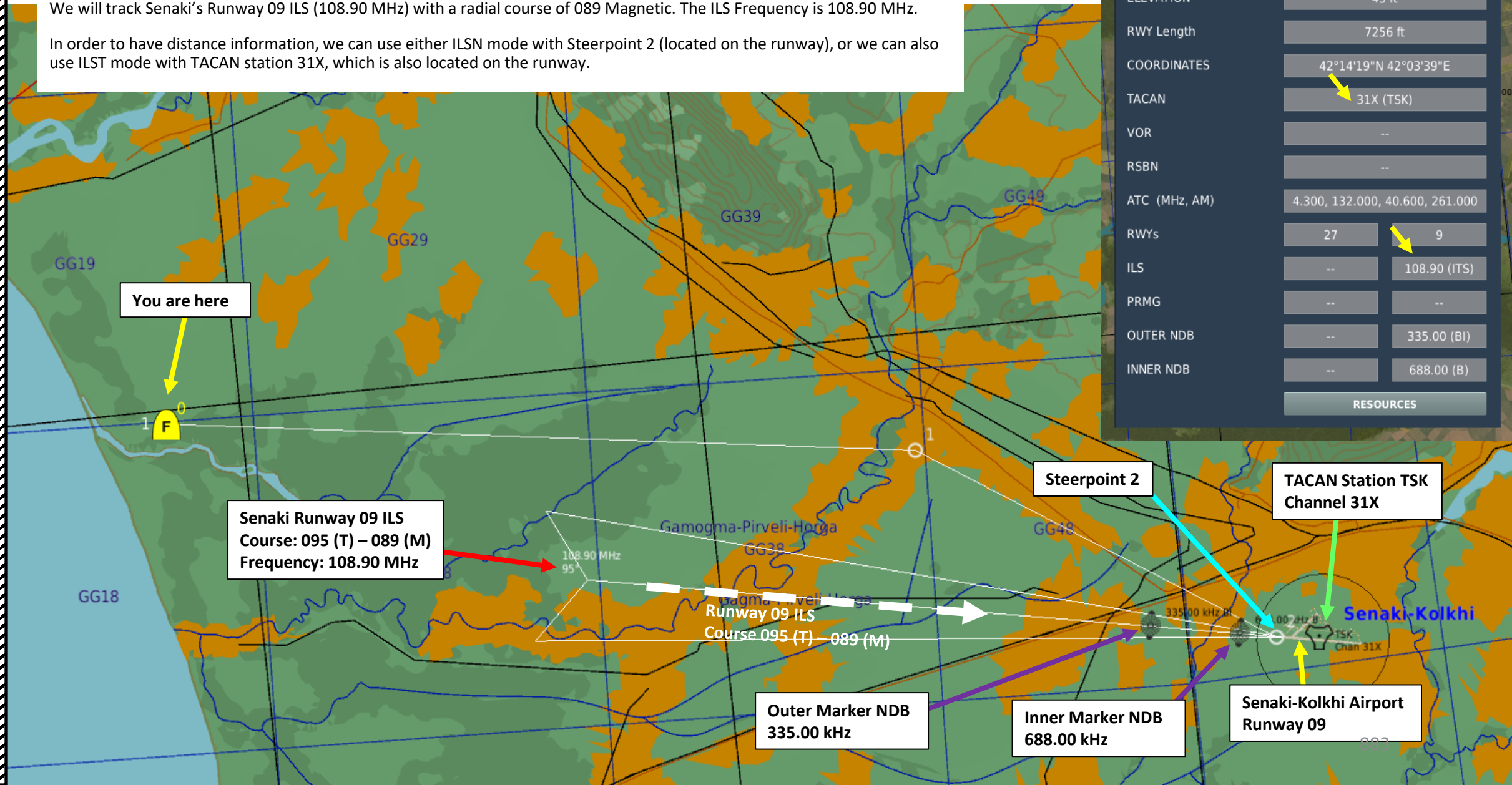




13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup

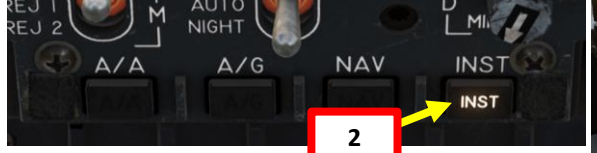
We will track Senaki's Runway 09 ILS (108.90 MHz) with a radial course of 089 Magnetic. The ILS Frequency is 108.90 MHz.

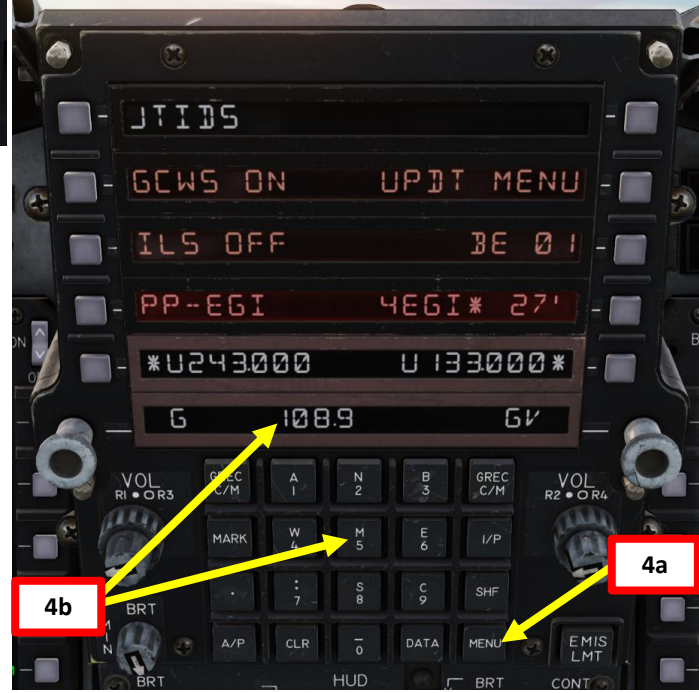
In order to have distance information, we can use either ILSN mode with Steerpoint 2 (located on the runway), or we can also use ILST mode with TACAN station 31X, which is also located on the runway.



13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3a – ILSN (Navigation Source) Approach

1. **We will use Steerpoint 2 from Route A for distance measuring while tracking ILS 108.90 MHz with a magnetic course of 089.**
2. Select INST (Instrument) Master Mode.
3. Select Steerpoint No.2.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) On UFC scratchpad, type "2"
    c) Press pushbutton next to STR to select Steerpoint Menu.
    - *Note: Alternatively, you can also perform the following: From MENU 1 UFC scratchpad, press pushbutton next to STR to toggle between steerpoints until 2A is selected.*
4. Enter ILS Frequency 108.90 MHz.
    a) Select UFC (Upfront Control Panel) MENU 2 by pressing a second time on MENU button.
    b) On UFC scratchpad, type ILS frequency "108.90".
    c) Press pushbutton next to ILS to power on the system and enter the ILS frequency.



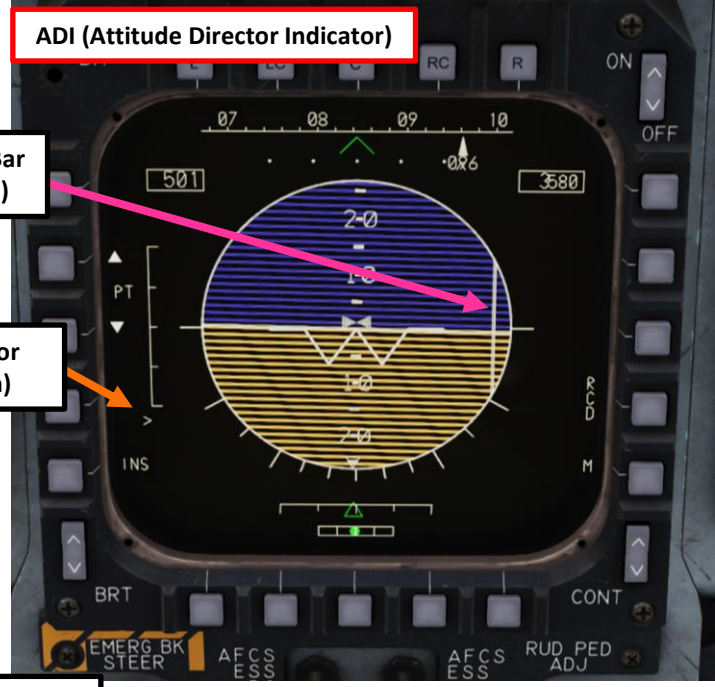


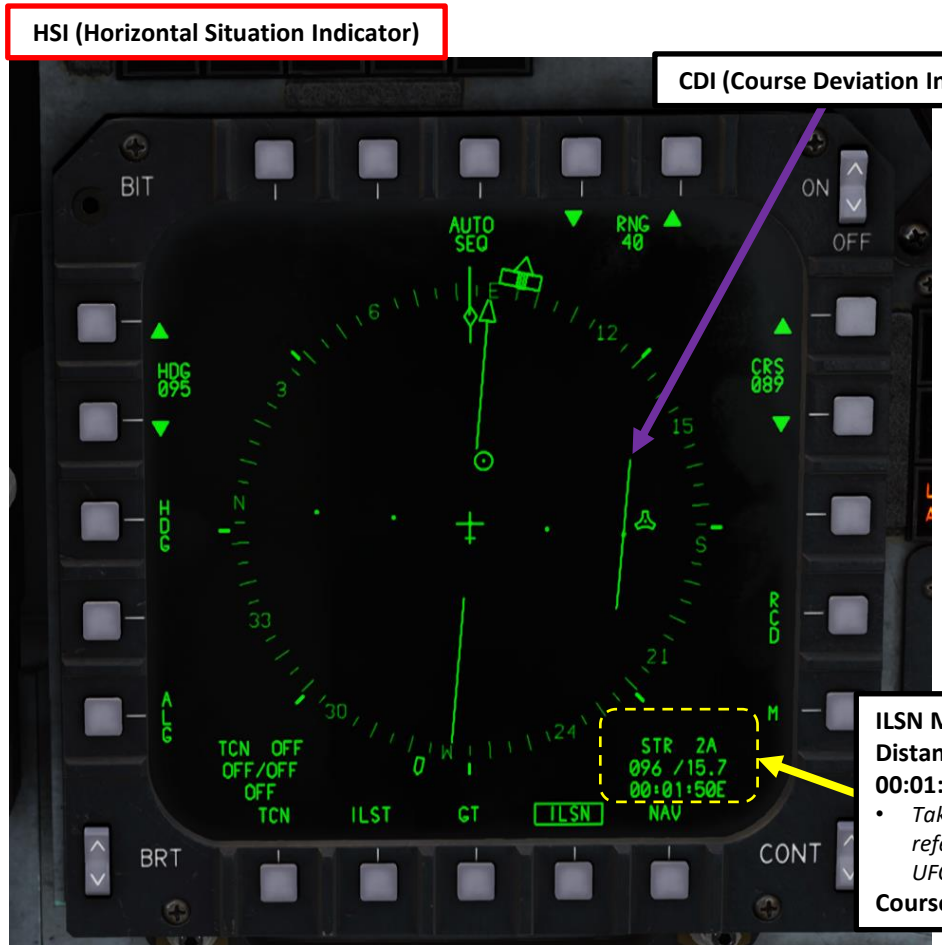
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3a – ILSN (Navigation Source) Approach

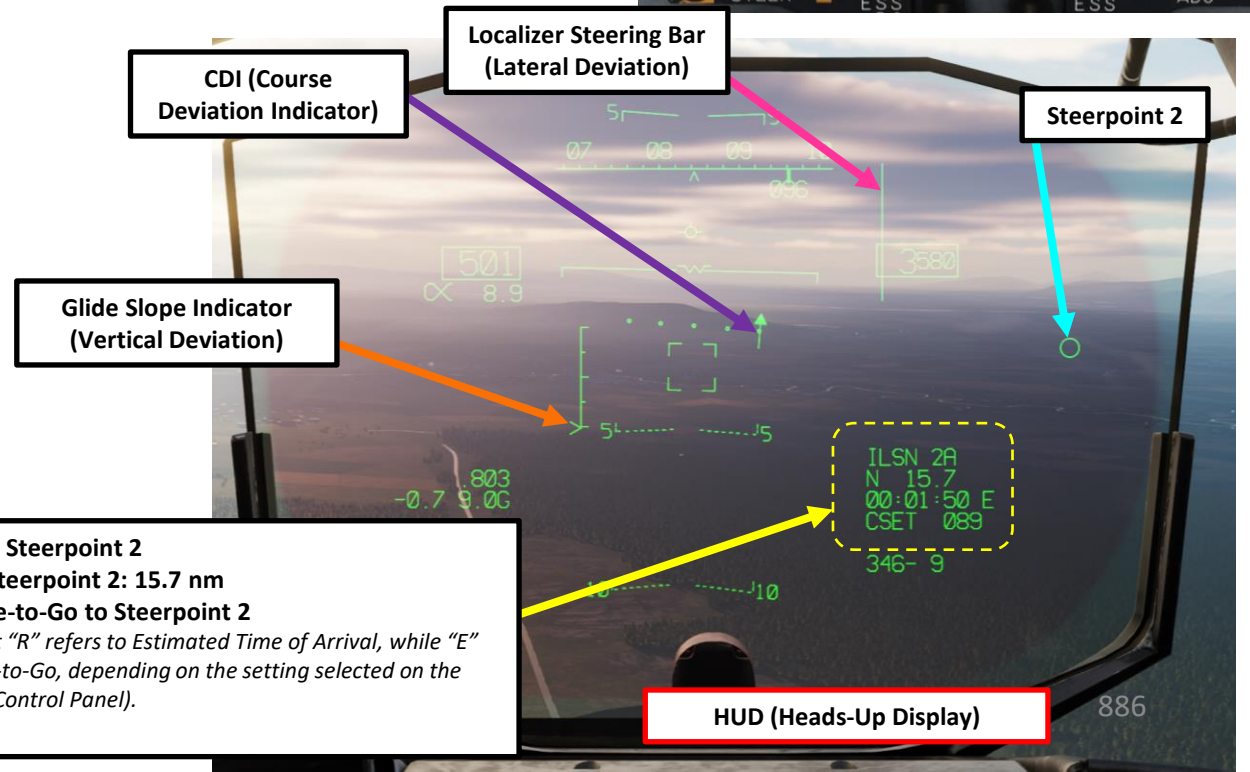
5. On HSI (Horizontal Situation Indicator) page, select ILSN Steering mode (boxed).
6. Set desired ILS course to follow (089) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the heading value, then press either of the CRS UP or CRS DOWN buttons.

13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3a – ILSN (Navigation Source) Approach

7. ILS symbology is now displayed on the HUD (Heads-Up Display), ADI (Attitude Director Indicator) and HSI (Horizontal Situation Indicator). You may start performing the approach.





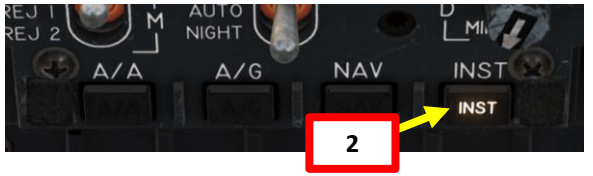


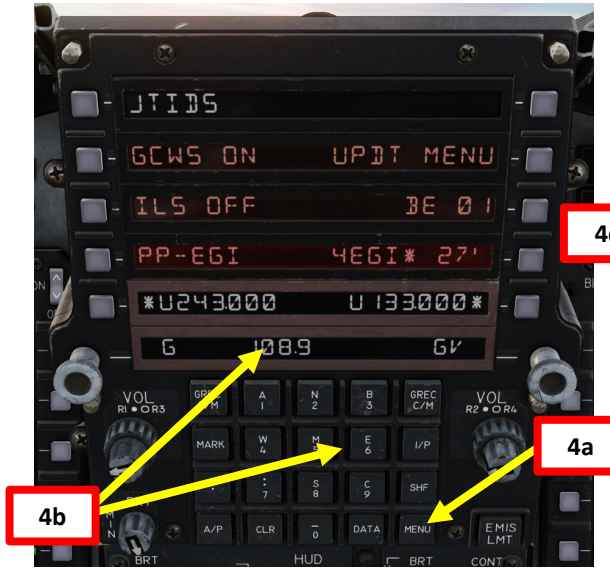
ILSN Mode with Steerpoint 2
Distance from Steerpoint 2: 15.7 nm
00:01:50 E: Time-to-Go to Steerpoint 2
- *Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).*

Course Set: 089

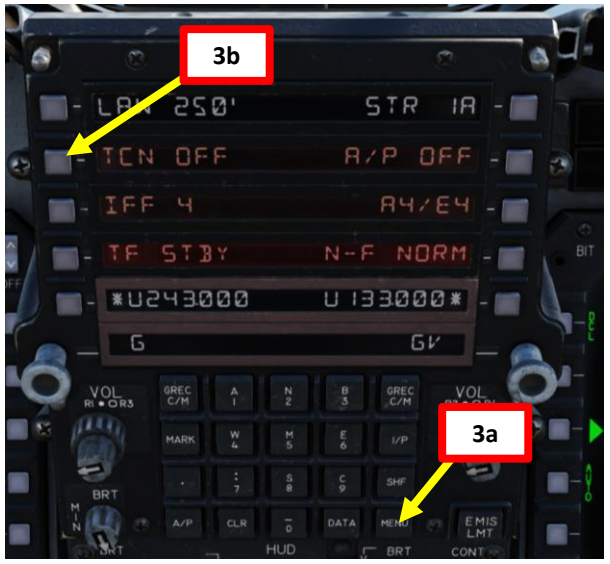
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3b – ILST (TACAN Source) Approach

1. **We will use TACAN 31X from Route A for distance measuring while tracking ILS 108.90 MHz with a magnetic course of 089.**
2. Select INST (Instrument) Master Mode.
3. Select TACAN Station 31X.
    a) Select UFC (Upfront Control Panel) MENU 1
    b) Select TCN (TACAN) sub-menu.
    c) On UFC scratchpad, type “31”.
    d) Press pushbutton next to TCN channel.
    e) If needed, press pushbutton next to TCN channel to toggle between X and Y channel. We will leave it to 31X.
    f) Press pushbutton next to T-R (Transmit/Receive)
    g) Press pushbutton next to TCN, which will change from OFF to ON.
    h) TACAN 31X is now selected and powered on.
    i) Adjust TACAN volume – As desired.
4. Enter ILS Frequency 108.90 MHz.
    a) Select UFC (Upfront Control Panel) MENU 2 by pressing a twice on MENU button.
    b) On UFC scratchpad, type ILS frequency “108.90”.
    c) Press pushbutton next to ILS to power on the system and enter the ILS frequency.



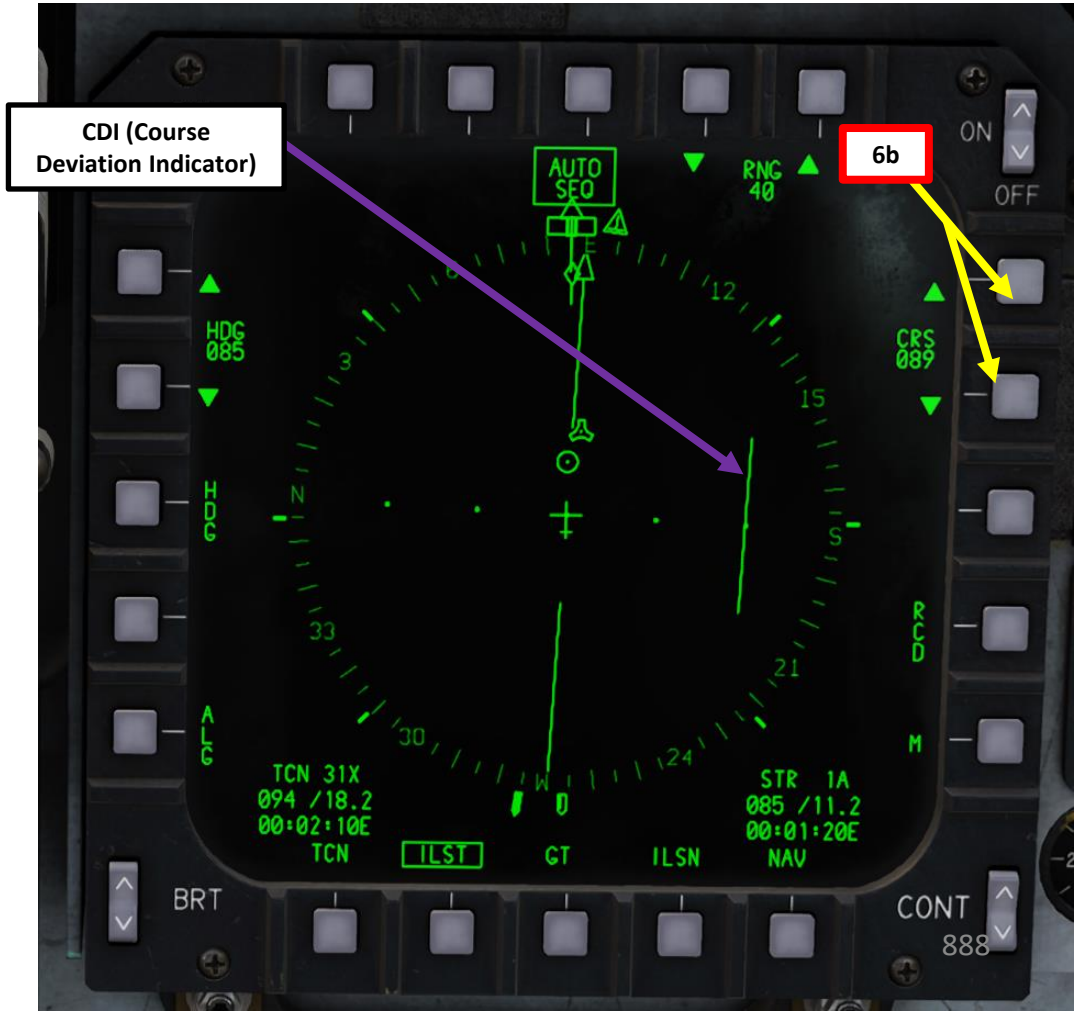


ILS (Instrument Landing System) / TACAN Volume Knob
- *INNER KNOB: ILS audio volume control*
- *OUTER KNOB: TACAN station volume control*



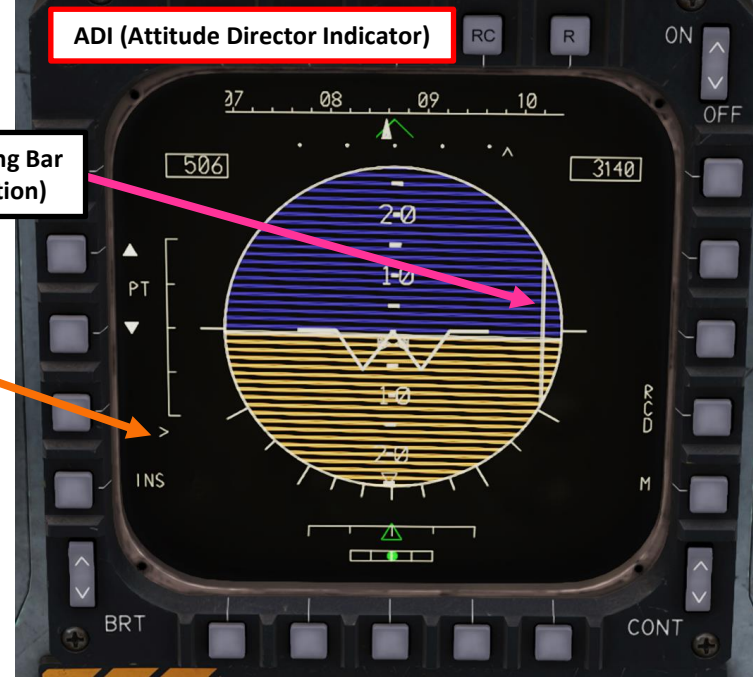
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3b – ILST (TACAN Source) Approach

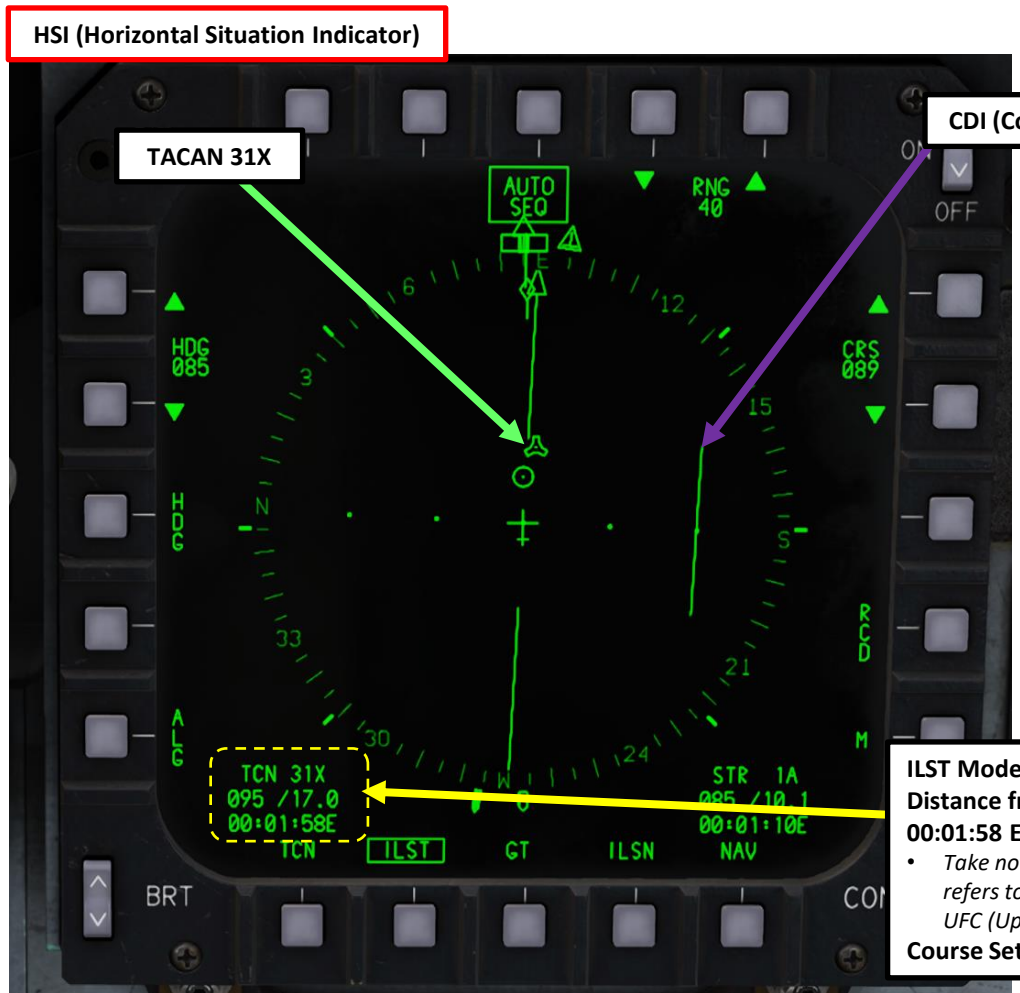
5. On HSI (Horizontal Situation Indicator) page, select ILST Steering mode (boxed).
6. Set desired ILS course to follow (089) using the CRS UP and CRS DOWN buttons.
    - Alternatively, you can type on the UFC scratchpad the heading value, then press either of the CRS UP or CRS DOWN buttons.

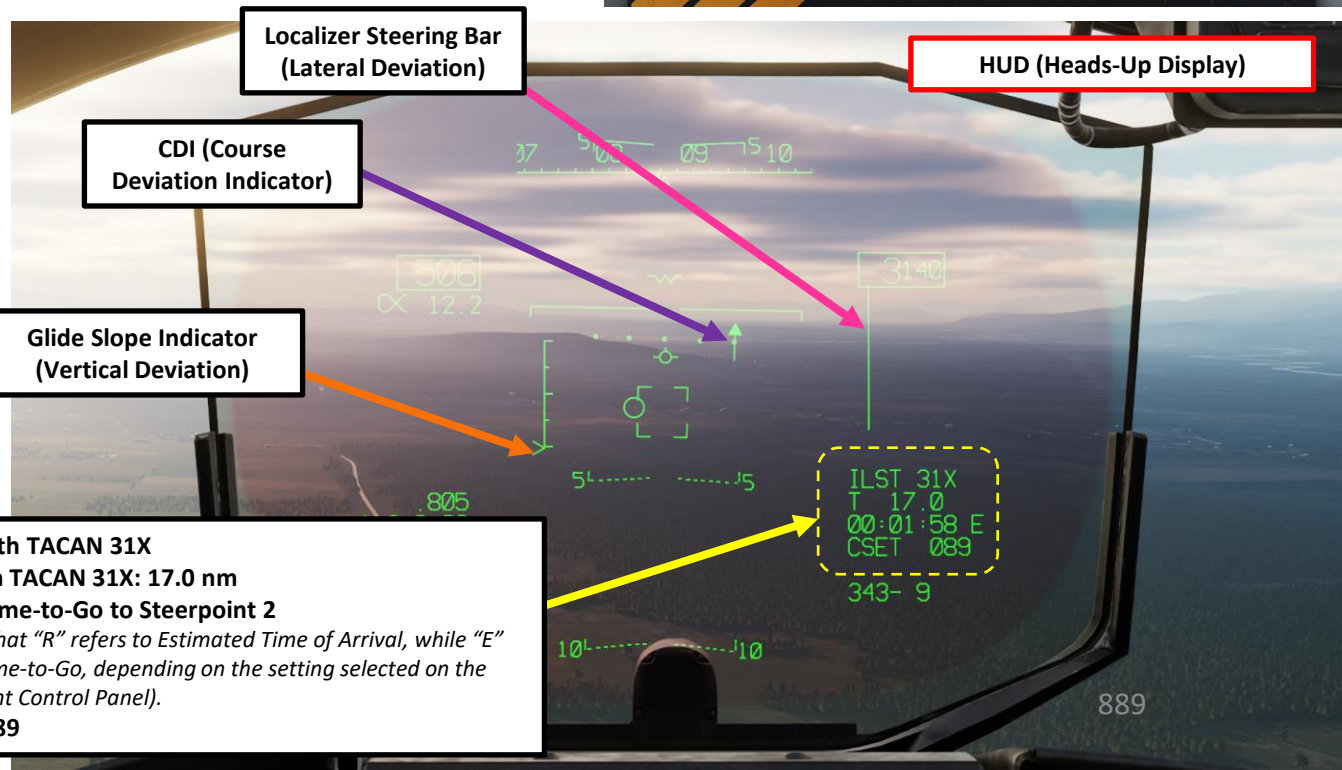


13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.3 – ILS Setup
13.3b – ILST (TACAN Source) Approach

7. ILS symbology is now displayed on the HUD (Heads-Up Display), ADI (Attitude Director Indicator) and HSI (Horizontal Situation Indicator). You may start performing the approach.







ILST Mode with TACAN 31X
Distance from TACAN 31X: 17.0 nm
00:01:58 E: Time-to-Go to Steerpoint 2
- *Take note that "R" refers to Estimated Time of Arrival, while "E" refers to Time-to-Go, depending on the setting selected on the UFC (Upfront Control Panel).*

Course Set: 089

13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

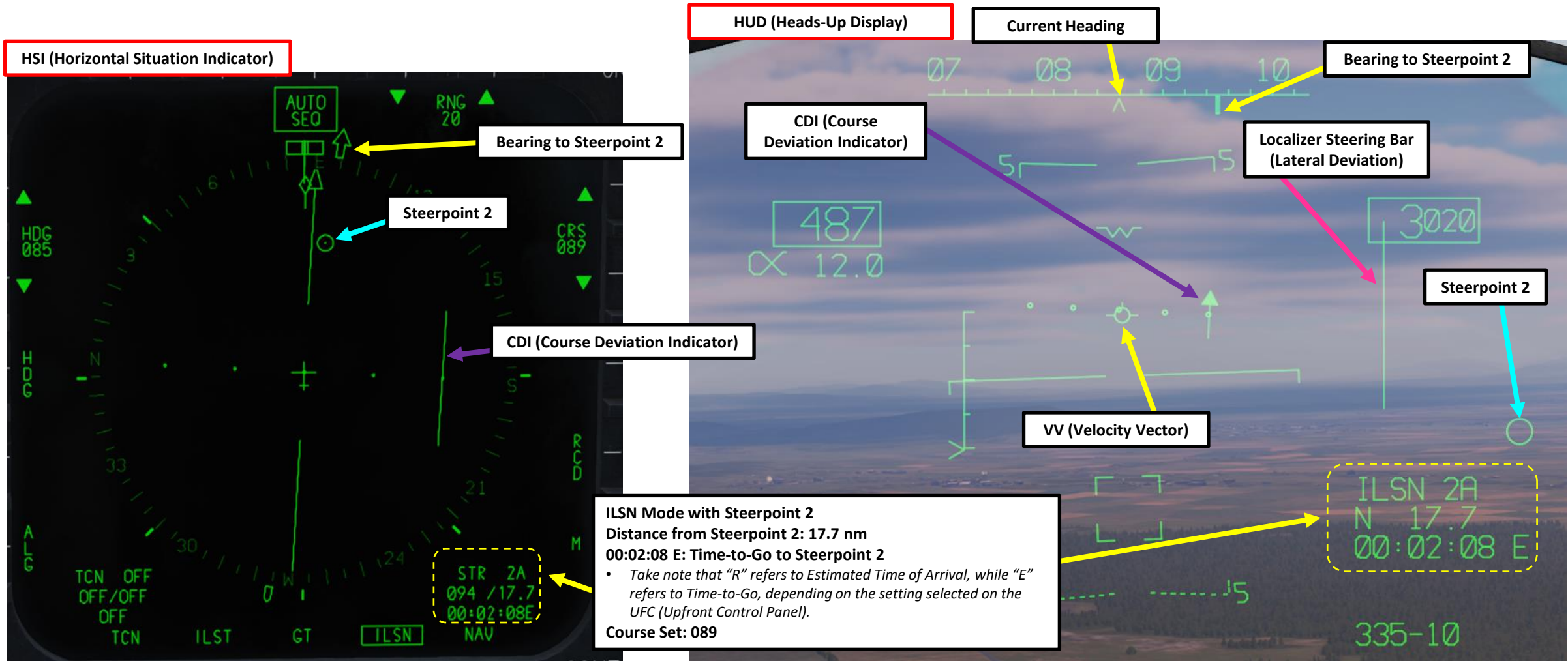
For this ILS approach, we will use ILSN (Navigation Source), but be the approach process is pretty much identical with ILST (TACAN Source).
We will use Steerpoint 2 from Route A for distance measuring while tracking ILS 108.90 MHz with a magnetic course of 089.

13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

1. Intercept the ILS localizer to "capture" the course to the runway centerline.

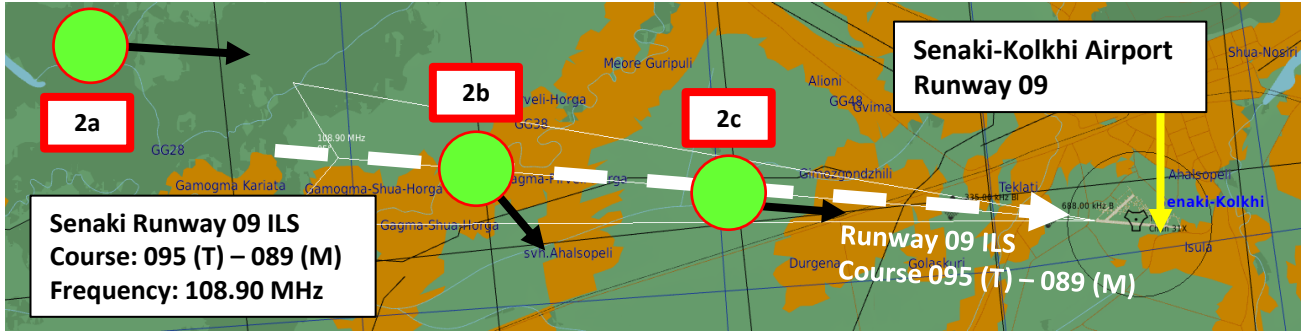
- **On the HSI**: The Course Deviation Indicator (CDI) indicates if the aircraft is aligned with the desired course. If it is too far to the right, the CDI will be to the left from the aircraft symbol. If it is too far to the left, the opposite will be true. Each dot on the scale represents a 5° deviation. The Course Deviation Line should be centered

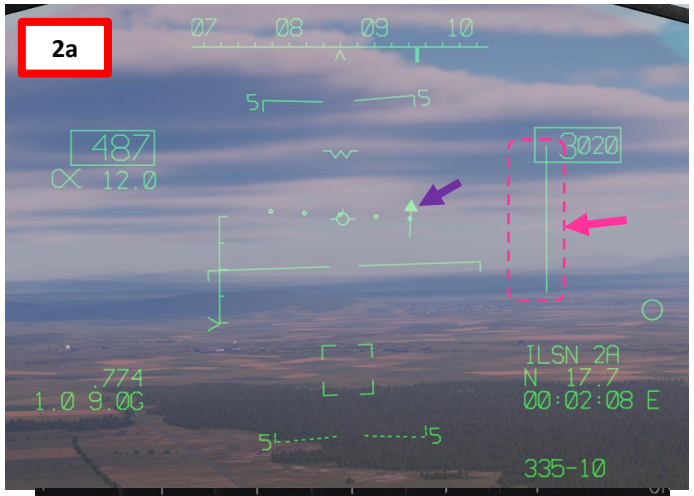
- **On the HUD**: If the ILS localizer vertical bar is positioned to the left from the VV (Velocity Vector), it means that the pilot should turn left in order to intercept it (i.e. the jet is too far to the right from the runway's centerline). If it is positioned to the right, the opposite is true. There is a Course Deviation Indicator (CDI) on the HUD, which works like the one on the HSI.

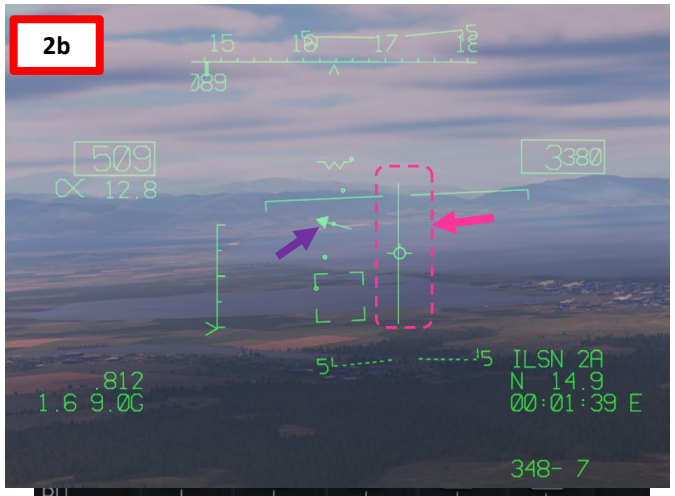


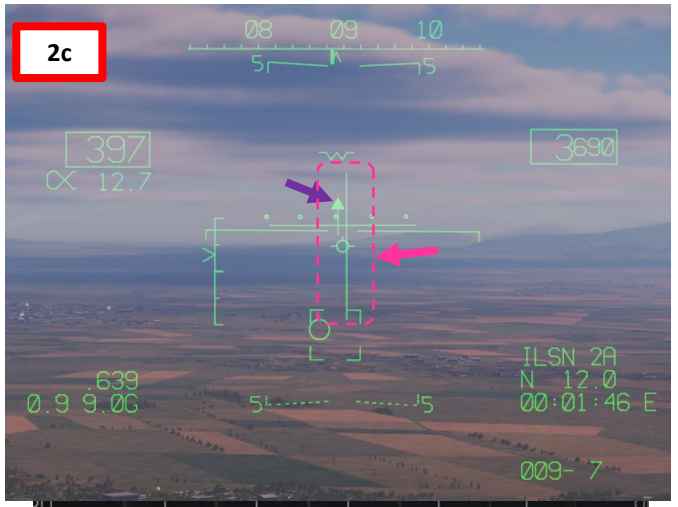
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

2. Once ILS localizer is “captured”, the aircraft should aligned with the runway centerline axis (magnetic course 089).







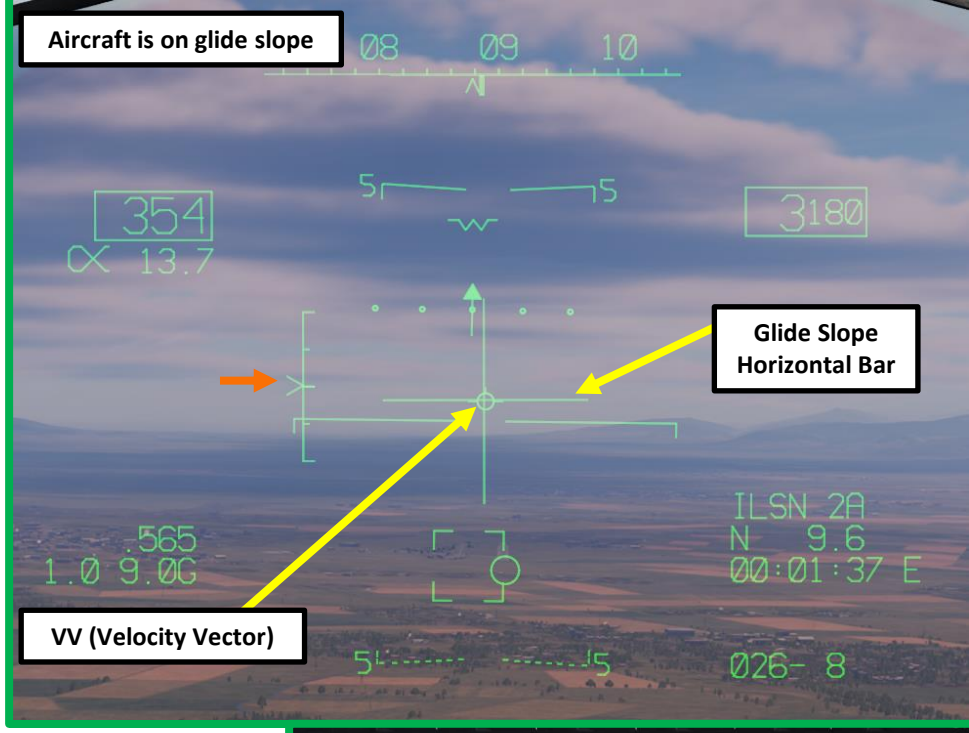


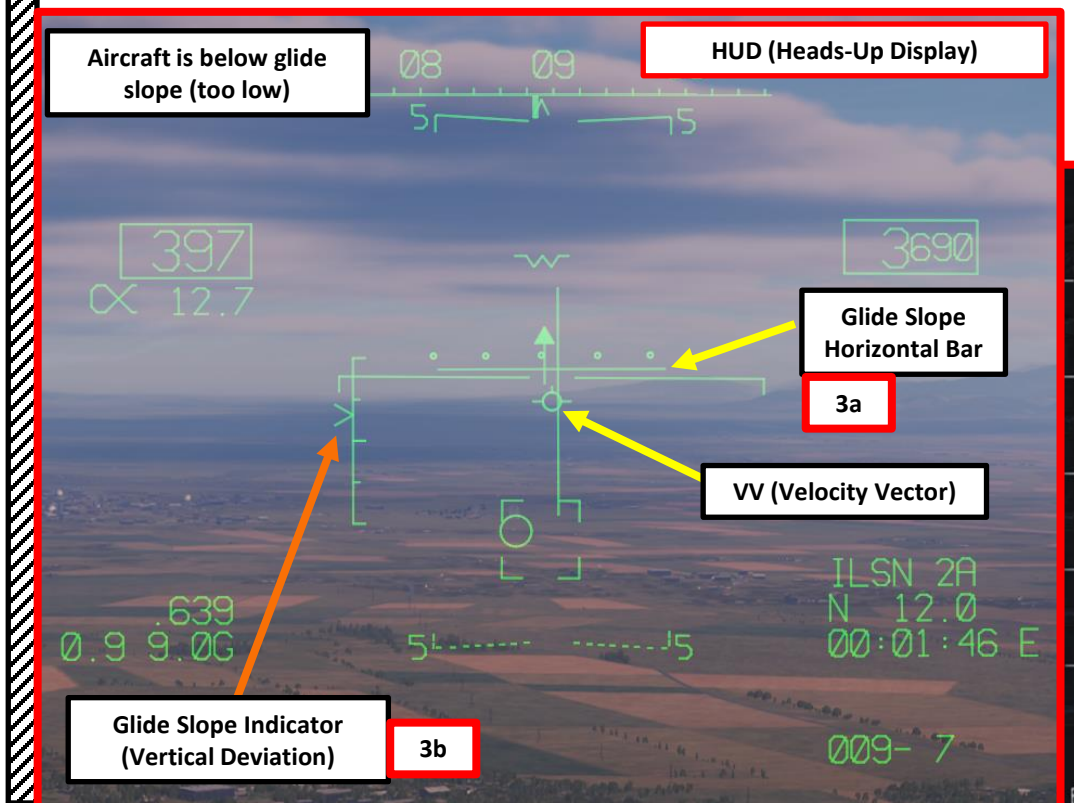
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

3. Intercept the ILS glide slope to "capture" the vertical deviation (approx. 3 deg) for the approach.

- **On the HUD**:
  a) If the ILS **Glide Slope horizontal bar** indicates the position of the aircraft in relation to the glideslope. If the horizontal bar is below the VV (Velocity Vector), that means that the aircraft is too high and the pilot should increase the pitch. If it is above, then the opposite is true.
  b) The **glideslope indicator** and deviation scale shows the vertical discrepancy between the position of the aircraft and the glideslope. The **caret 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.

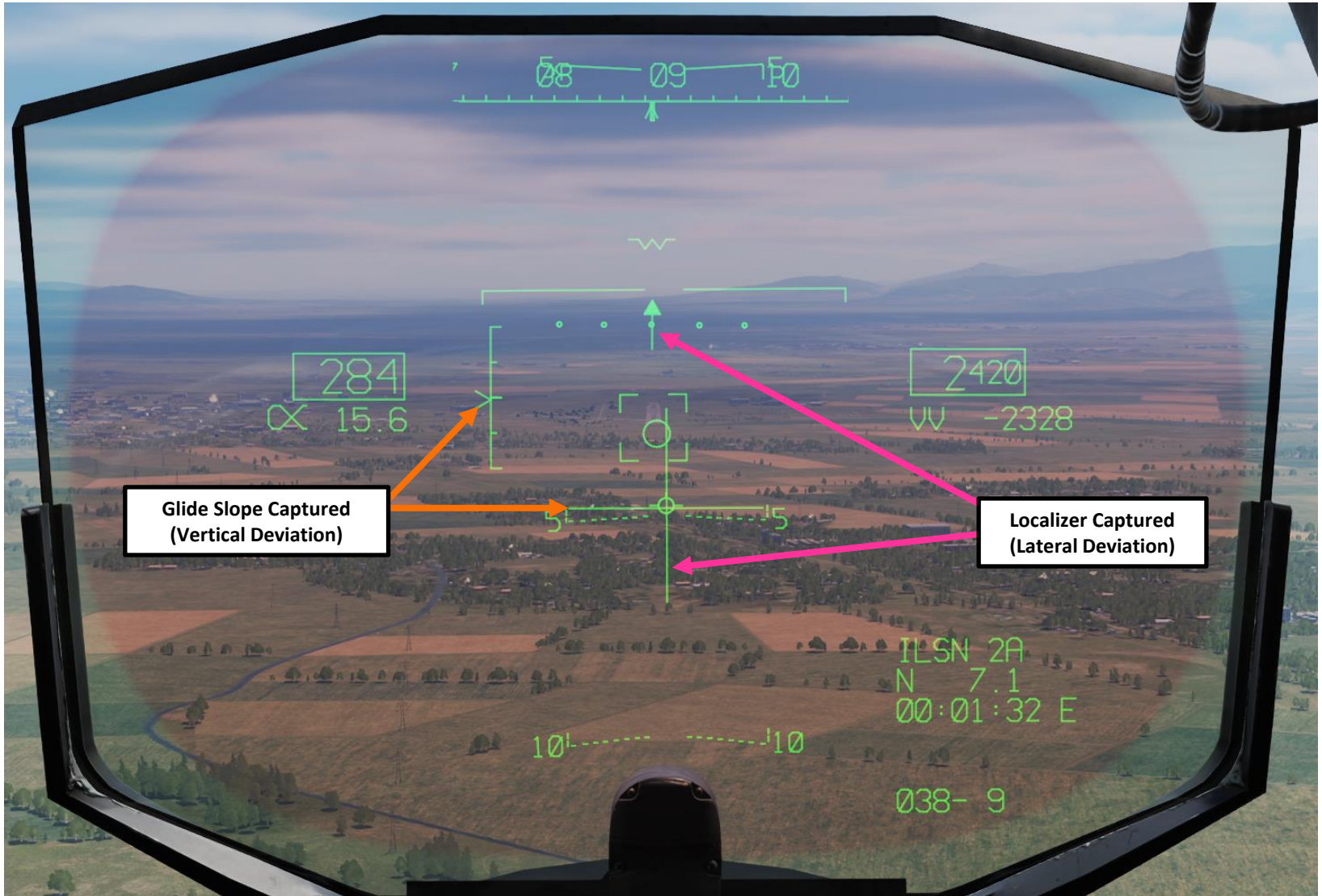
- **On the ADI**: There is a glide slope indicator as well, as shown on the HUD.





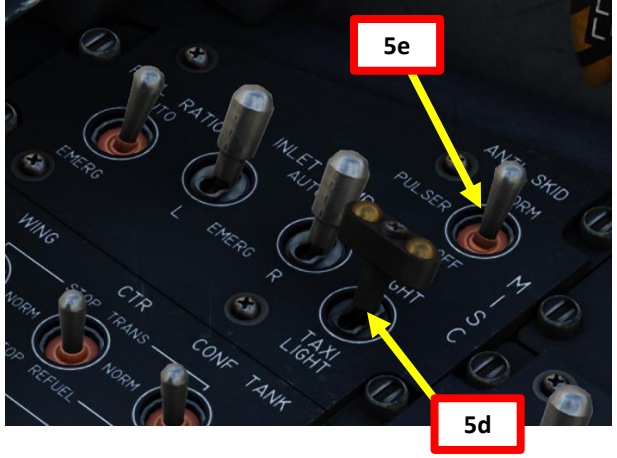
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

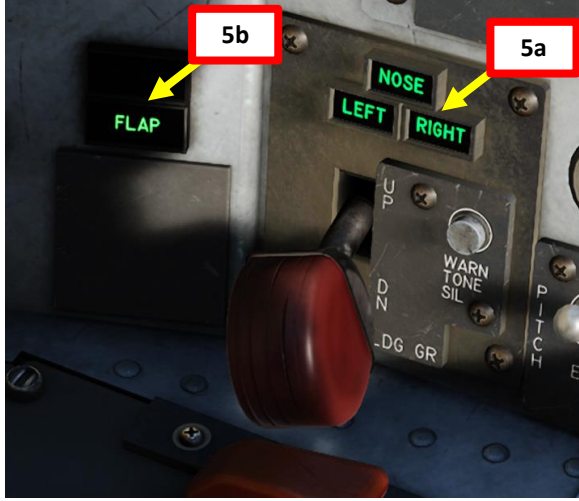
4. Once localizer (lateral deviation) and glide slope (vertical deviation) are both captured and perfectly aligned, both horizontal and vertical bars should form a perfect cross.

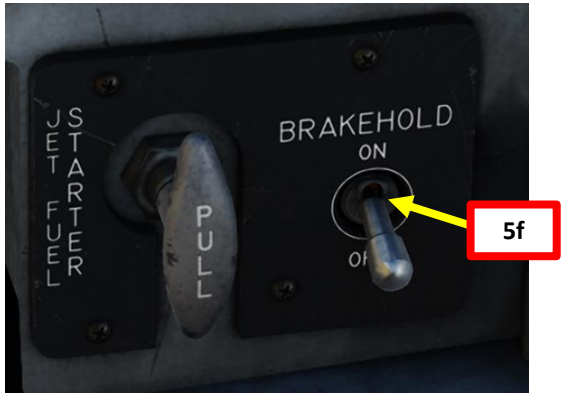


13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

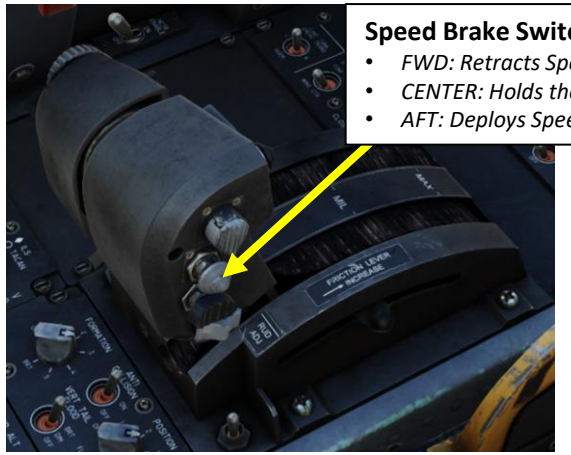
5. **Perform Before Landing Checks**
   a) Extend landing gear is down and locked when below 250 kts.
   b) Extend flaps when below 250 kts.
   c) Check hydraulic gauges are in the green (nominal pressure).
   d) Set Landing/Taxi Light Switch – LANDING (FWD)
   e) Set Anti-Skid Switch – NORMAL (FWD)
   f) Verify that Brake Hold (Parking Brake) Switch is set to OFF (DOWN).





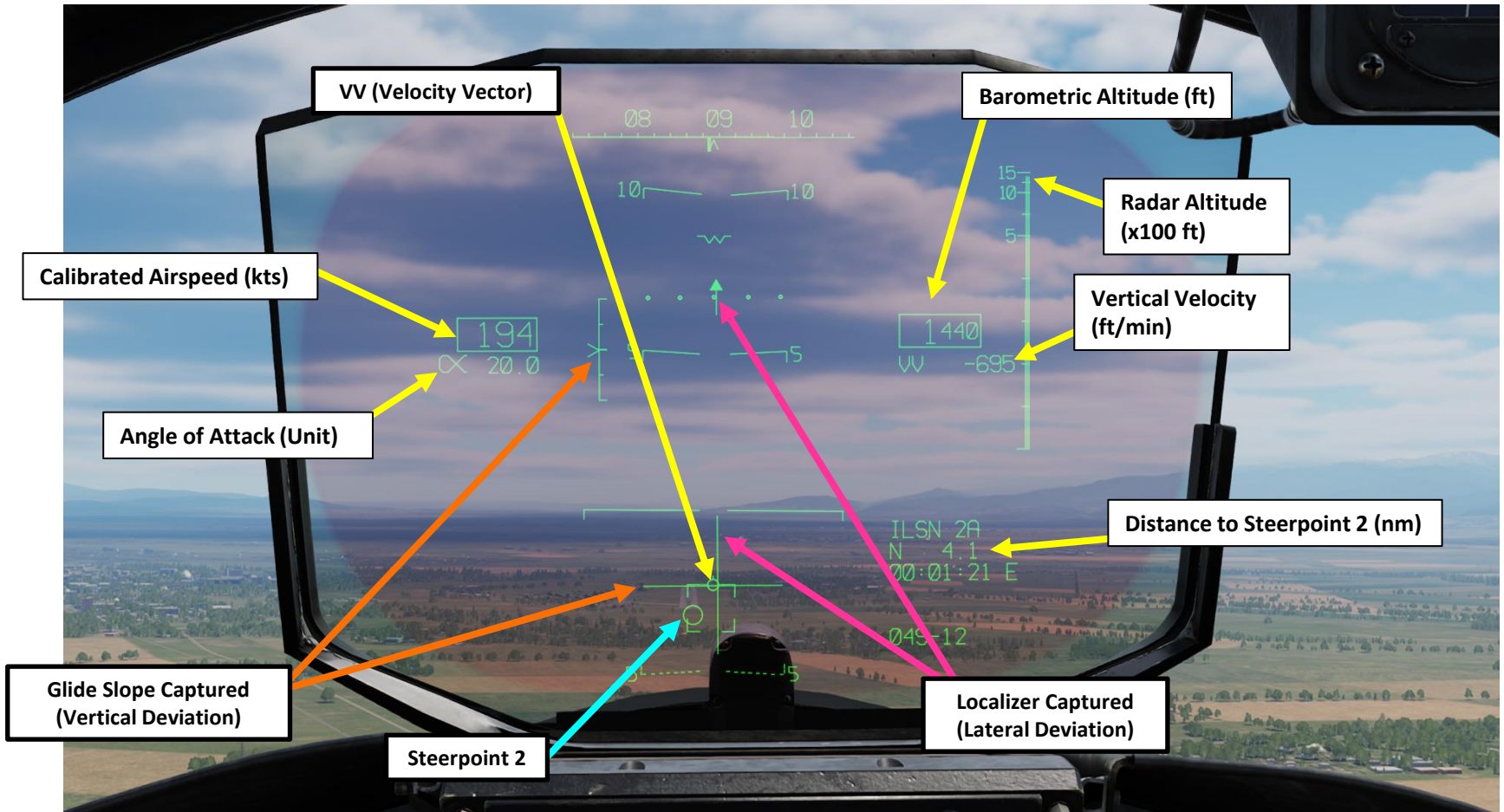


13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach



6. **Final Approach**
   a) Reduce the speed further to arrive on final with on-speed AOA (Angle of Attack) of 20-22 units.
   b) Extend Speed Brake (Speed Brake Switch AFT).

- Note: Adjust aircraft **pitch angle to control airspeed**, and adjust power with the **throttle to control glide slope & altitude**.
  - Adjust aircraft pitch with the stick and trim controls in order to control aircraft AoA (Angle of Attack). Coming in too fast generally induces a low AoA, which requires the pilot to increase aircraft pitch. Coming in too slow? Your AoA is too high; decrease aircraft pitch.
  - Once you are On Speed (the AoA is between 20 and 22 units), control altitude and glide slope with throttle input.
  - Generally, after you make a pitch adjustment you will likely have to make a throttle adjustment.



13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

7. Short Final & Flare

a) When flying over the “overrun” (also referred as “flare point”, the overrun is the portion of the runway before the primary surface starts), gently pull back on the stick to flare and reduce the descent rate. Do NOT level off. Aim to touchdown at the runway threshold.

b) 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.

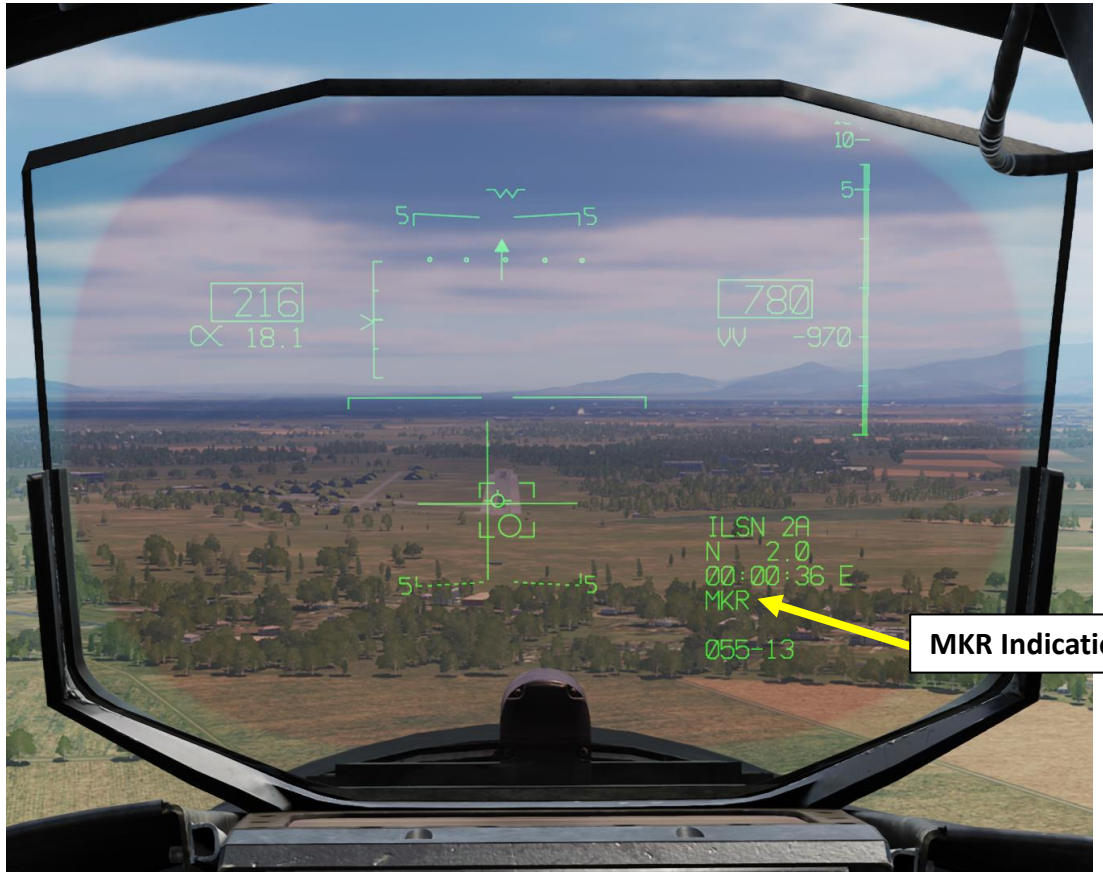
13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

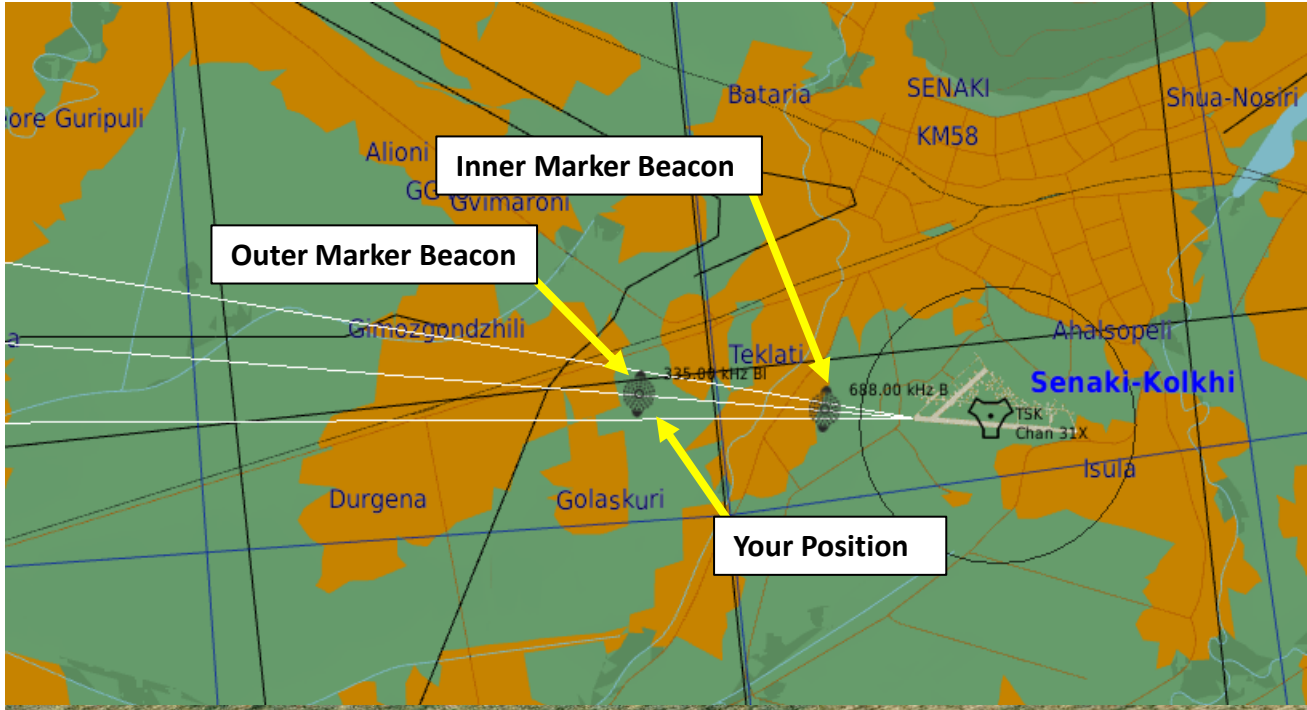
8. **Touchdown & Roll-Out**
   a) Let the wheels touch the ground once the aircraft has lost enough lift.
   b) After touchdown, keep the nose at 12 deg of pitch for best aerodynamic braking.
   c) Use toe brakes once the nose wheel is on the ground and aircraft speed is below 90 kts.
   d) Taxi off the runway.
   e) Retract speed brake and retract flaps.

13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL

13.4 – Performing ILS Approach

Note: If flying over an Outer or Inner Marker beacon, the MRK indication will appear on the HUD. Here is an example with Senaki's Outer Marker.





13 – ILS (INSTRUMENT LANDING SYSTEM) TUTORIAL
13.4 – Performing ILS Approach

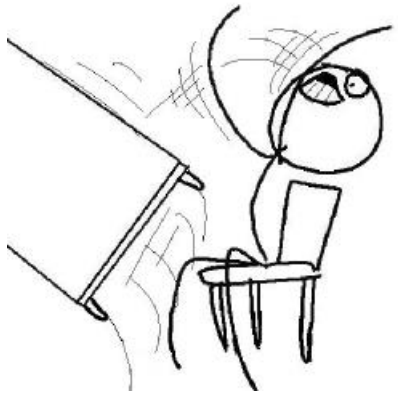

USAF
U.S. AIR FORCE

INTRODUCTION
AIR-TO-AIR REFUELING – WHY WE ALL HATE IT

Air-to-air refueling is one of the hardest, most hated, and most frustrating tasks in DCS. Ever. Of all time.

Why? Well, one of the main reasons for the difficulty behind refueling is the skill required to do formation flying. Flying in formation with another aircraft requires much more practice than you would initially think. Another reason is pure physics: there is this thing called “wake turbulence”. An aircraft flies through a fluid: air. Just like with any fluid, if you have something that displaces itself through it at a certain speed, the fluid will become disrupted (turbulence). Wingtip vortices and jetwash are both effects of this simple concept. Wake turbulence is the reason why airliners need to wait a minimum time between takeoffs: flying through disrupted air will destabilize the aircraft and it is unsafe, especially during critical phases of flight like takeoff and landing.

Unfortunately, wake turbulence is something a pilot **has** to deal with during air-to-air refueling. This is why the aircraft will fly just fine when approaching the tanker, but start wobbling around when flying in close proximity of the refueling basket/drogue and tanker engines.

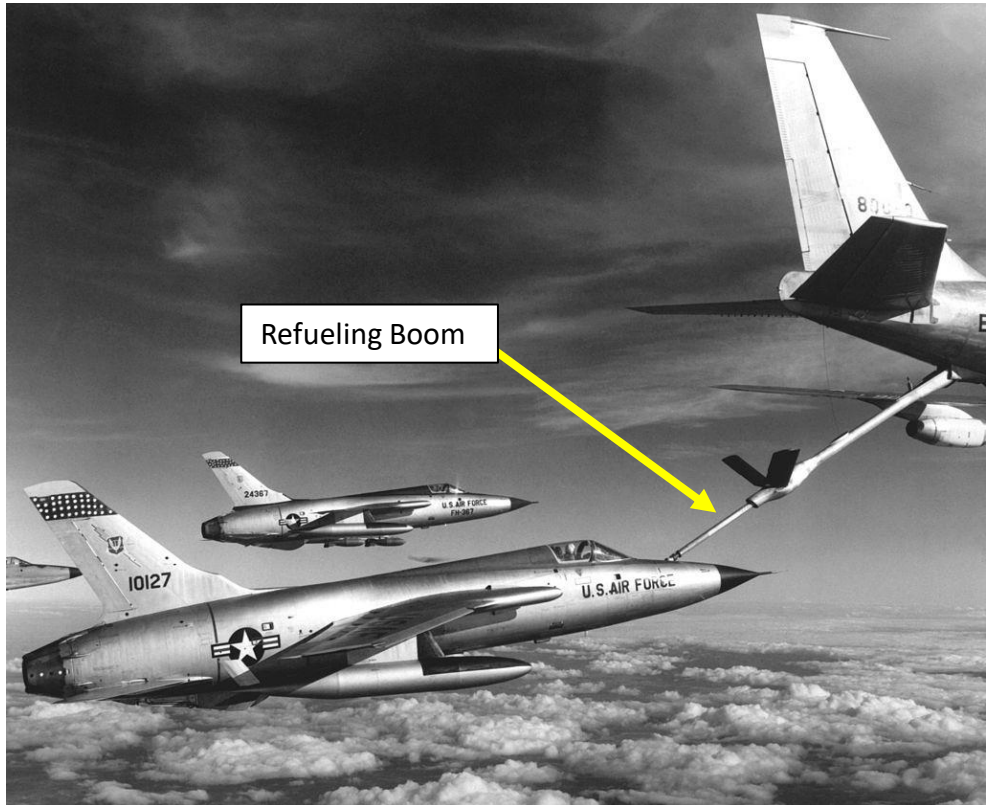


Feel free to consult ChazFlyz’s F-15E Air-to-Air Refueling Tutorial
https://youtu.be/gwYtJgikwes

INTRODUCTION
TYPES OF AIR-TO-AIR REFUELING

There are four main air-to-air refueling techniques used in military aviation:

- Probe-and-drogue (refueling probe must be inserted in the tanker's drogue basket)
- Flying Refueling Boom (guided by boom operator aboard the tanker)
- Buddy Refueling (two fighters can refuel one another independently without a tanker)
- Nose-Probe refueling



F-105 Thunderchiefs being refueled by a Boom system during the Vietnam War

Tornado GR4 being refueling by a Probe-and-Drogue system

INTRODUCTION
TYPES OF AIR-TO-AIR REFUELING

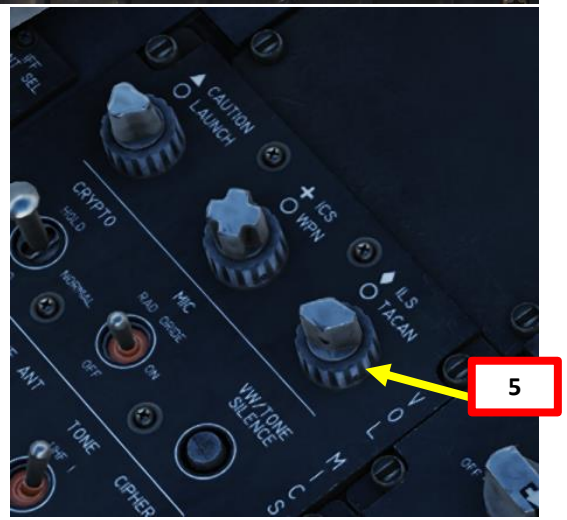
The refueling aircraft available in DCS are:

- The Ilyushin Il-78M “Midas”, a russian **probe-and-drogue** tanker, which was developed from the Il-76.
- The Boeing KC-135 “Stratotanker”, a US Air Force **flying boom** tanker, which was developed from the Boeing 367-80.
- The KC-135 MPRS (Multi-point Refueling Systems), a US Air Force KC-135 tanker modified to add refueling pods to the KC-135's wings, making it useable as a **probe-and-drogue** tanker.
- The Lockheed S-3B “Viking”, a US Navy **probe-and-drogue** tanker.
- The Lockheed KC-130 “Hercules”, a USMC **probe-and-drogue** tanker, which was developed from the C-130.

The F-15E is equipped with a refueling door compatible with a tanker’s flying boom system, so air-to-air refueling can only be performed from the KC-135 tanker in DCS.

AIR-TO-AIR REFUELING TUTORIAL

1. Read your mission briefing to know the TACAN station channel of your KC-135 Tanker (35X) and the UHF AM channel frequency you can communicate with it (255.000 MHz).
2. Select NAV Master Mode
3. Select TACAN Station 35X.
   a) Select UFC (Upfront Control Panel) MENU 1
   b) Select TCN (TACAN) sub-menu.
   c) On UFC scratchpad, type “35”.
   d) Press pushbutton next to TCN channel.
   e) If needed, press pushbutton next to TCN channel to toggle between X and Y channel. We will leave it to 35X.
   f) Press pushbutton next to T-R (Transmit-Receive)
   g) Press pushbutton next to TCN, which will change from OFF to ON.
   h) TACAN 107X is now selected and powered on.
4. Return to MENU 1.
5. Adjust TACAN volume – As desired.



MISSION OVERVIEW

Title	F-15E Aerial Refuel Practice
Start at	21/6/2016 08:00:00
My Side	USA

MISSION DATA

My task	Nothing
Flight	F-15E S4+ * 1

ALLIES FLIGHT

Allies flight	KC-135 * 1

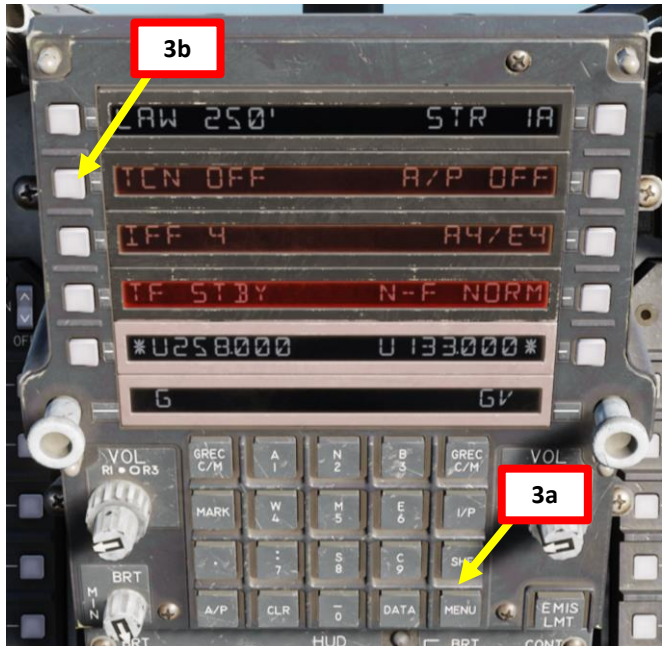
SITUATION

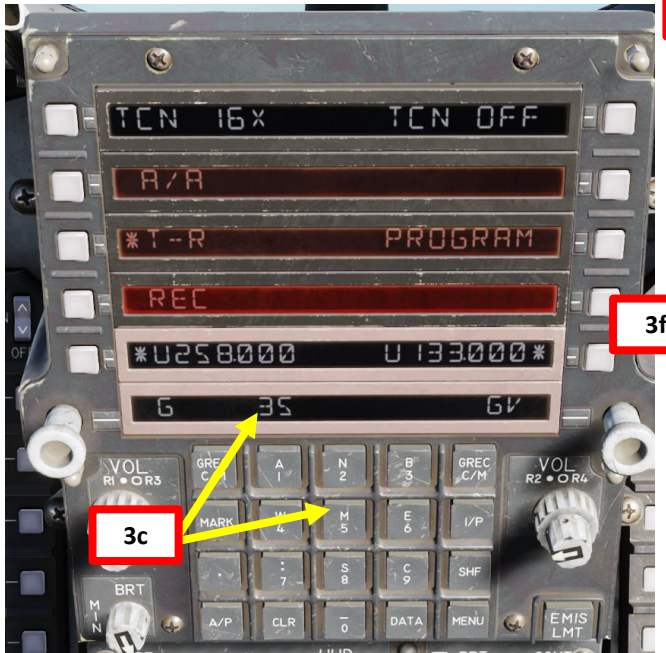
Refueling practice on a KC-135.
Return to Sukhumi after you've requalified on the tanker.

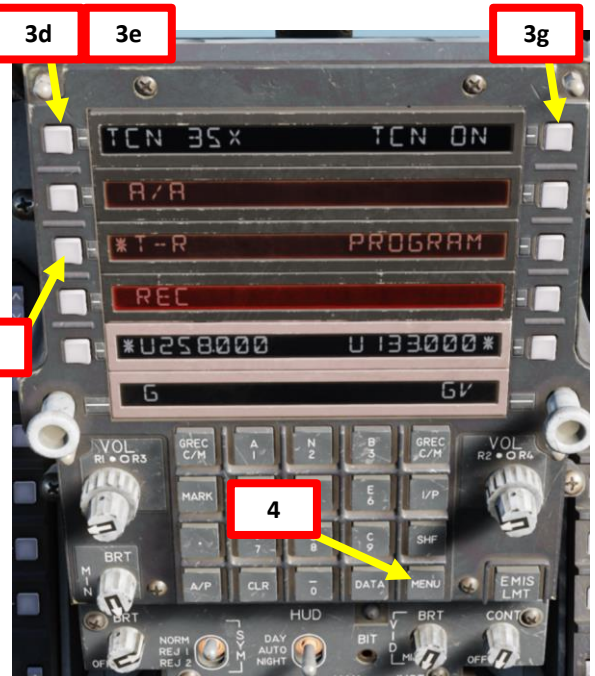
OBJECTIVE

KC-135 = Texaco 255.00 Mhz
- Tacan = 35X
- Alt = 22,000 feet.
- IAS = 310 knots.
- Route = 10 miles off shore on track between Sukhumi and Gudauta.

1

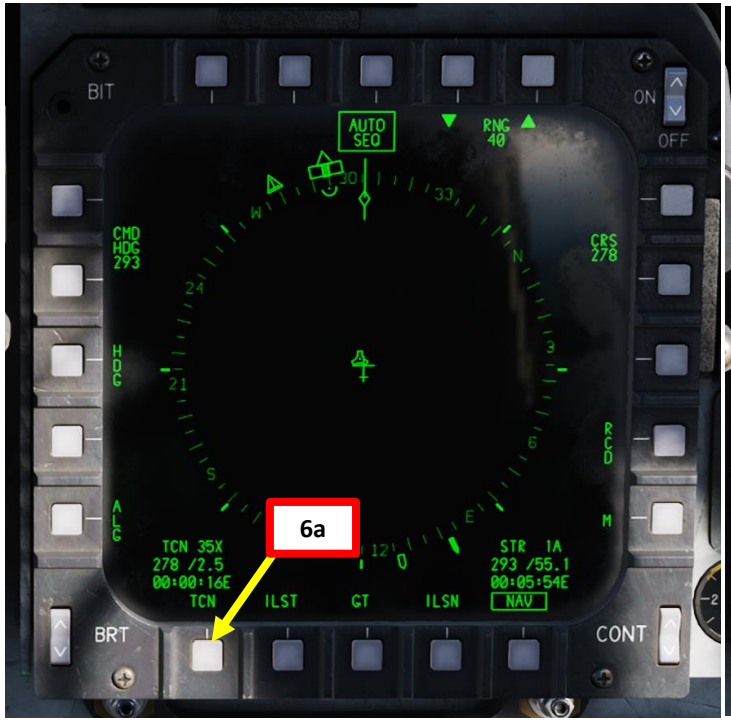


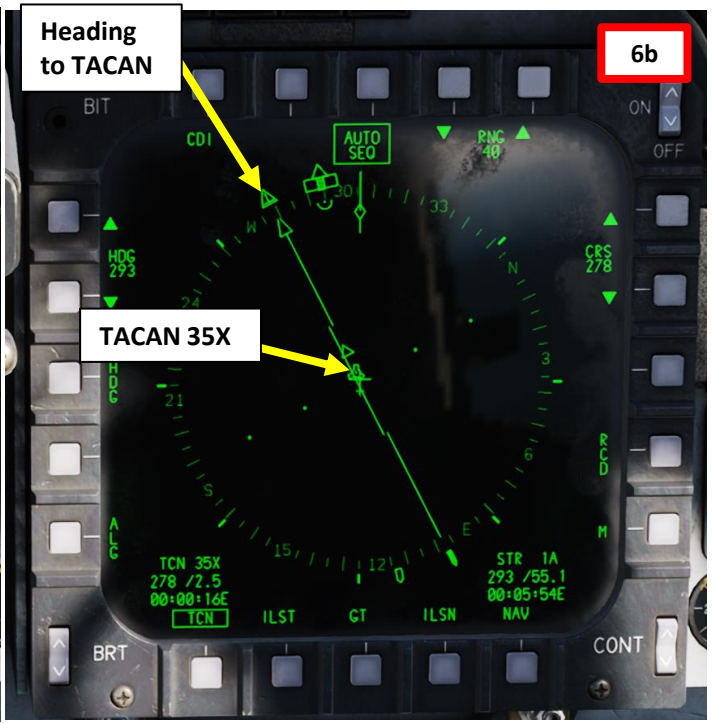




AIR-TO-AIR REFUELING TUTORIAL

6. On HSI (Horizontal Situation Indicator) page, select TCN mode (boxed).
7. Use steering cues on the HUD and HSI symbology to find the tanker if you cannot find it visually.

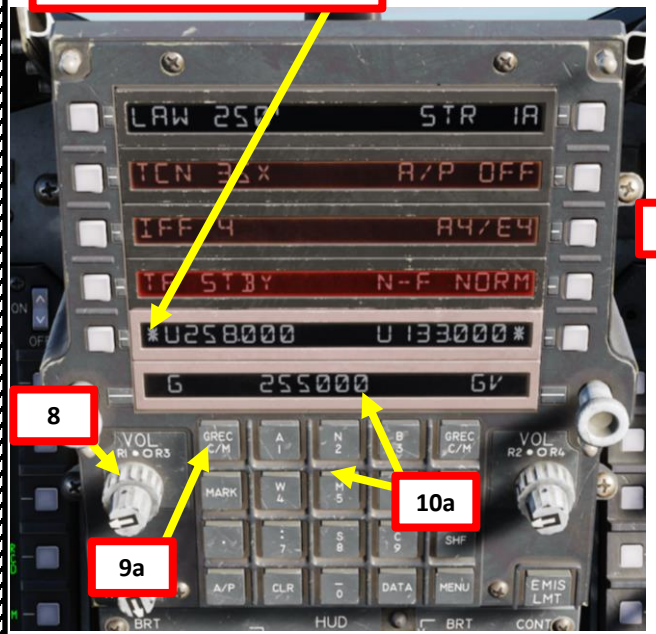


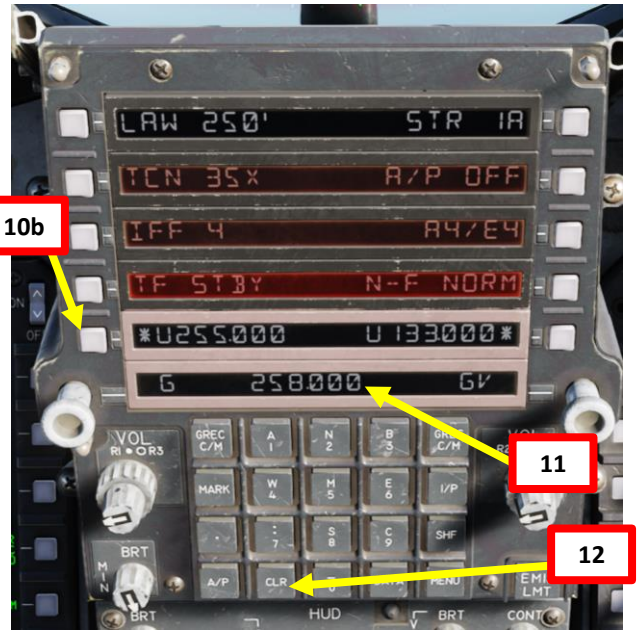


AIR-TO-AIR REFUELING TUTORIAL

8. Adjust Radio 1 volume – as desired.
9. If required, press Left GREC C/M Button to toggle between preset and manual frequency. We will select manual frequency. The asterisk on the UFC indicate which is selected.
10. Enter desired frequency manually with the UFC (Upfront Control Panel) keypad and then press the Pushbutton No. 5 (PB5). As an example, we will set the manual frequency to 255.000 MHz by entering “255000” on the UFC.
11. When a new channel or frequency is entered via scratchpad and then fed into the radio, 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.
12. Press CLR to remove previously used channel/frequency.
13. Transmit on AN/ARC-164 UHF Radio 1 by pressing Microphone Switch (FWD) and contact tanker (F6).
14. Select “Intent to refuel” in the tanker menu. The tanker will give you an altitude (usually 22,000 ft or 10,000 ft) to rendezvous at and a speed to match (i.e. 300 kts).

9b
Manual Frequency Selected





OBJECTIVE

KC-135 = Texaco 255.00 Mhz
- Tacan = 35X
- Alt = 22,000 feet.
- IAS = 310 knots.
- Route = 10 miles off shore on track between Sukhumi and Gudauta.

13a

Microphone Switch
- *FWD: Transmits on Radio 1 & 3*
- *AFT: Transmits on Radio 2 & 4*
- *CENTER: Enables receive mode*

UHF1
Main
F1. Flight...
F2. Wingman 2...
F3. Wingman 3...
F5. ATC...
F6. Tanker - Texaco1-1...
F8. Ground Crew...
F12. Exit

13b

UHF1
2. Main. Tanker - Texaco1-1
F1. Intent to refuel
F11. Previous Menu
F12. Exit

14a

14b

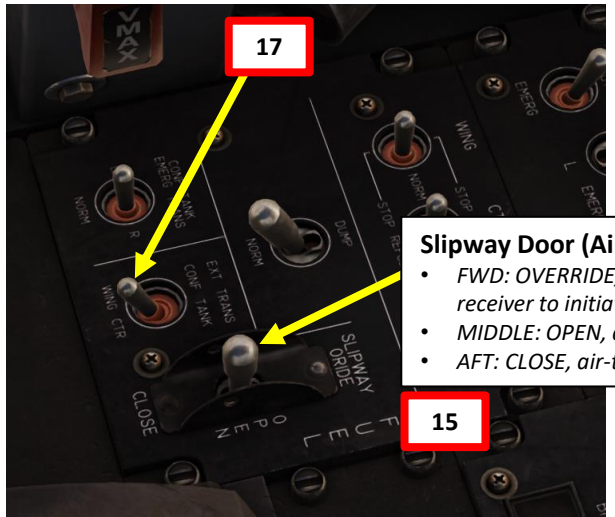
PLAYER: Texaco1-1, Ford 5-1, request rejoin

14c

Main Texaco1-1. Tanker. Pre-contact
TANKER (Texaco1-1): Ford 5-1, Texaco1-1, proceed to pre-contact at 22000 at velocity 300

AIR-TO-AIR REFUELING TUTORIAL

15. Open Slipway Door (air-to-air refueling trap door). Set the Slipway Door Switch – OPEN (MIDDLE position).
16. Confirm that READY light illuminates, which indicates that door has opened properly.
    - *Note: If the door does not open, you may set the Emergency AAR (Air-to-Air Refueling) Switch to OPEN (FWD), which opens the AAR slipway door by the means of pyrotechnic devices. However, door cannot be then closed in flight.*
17. Set External Fuel Transfer Switch – As desired.
    - *This 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)*
18. Set Master Arm switch to SAFE (DOWN).

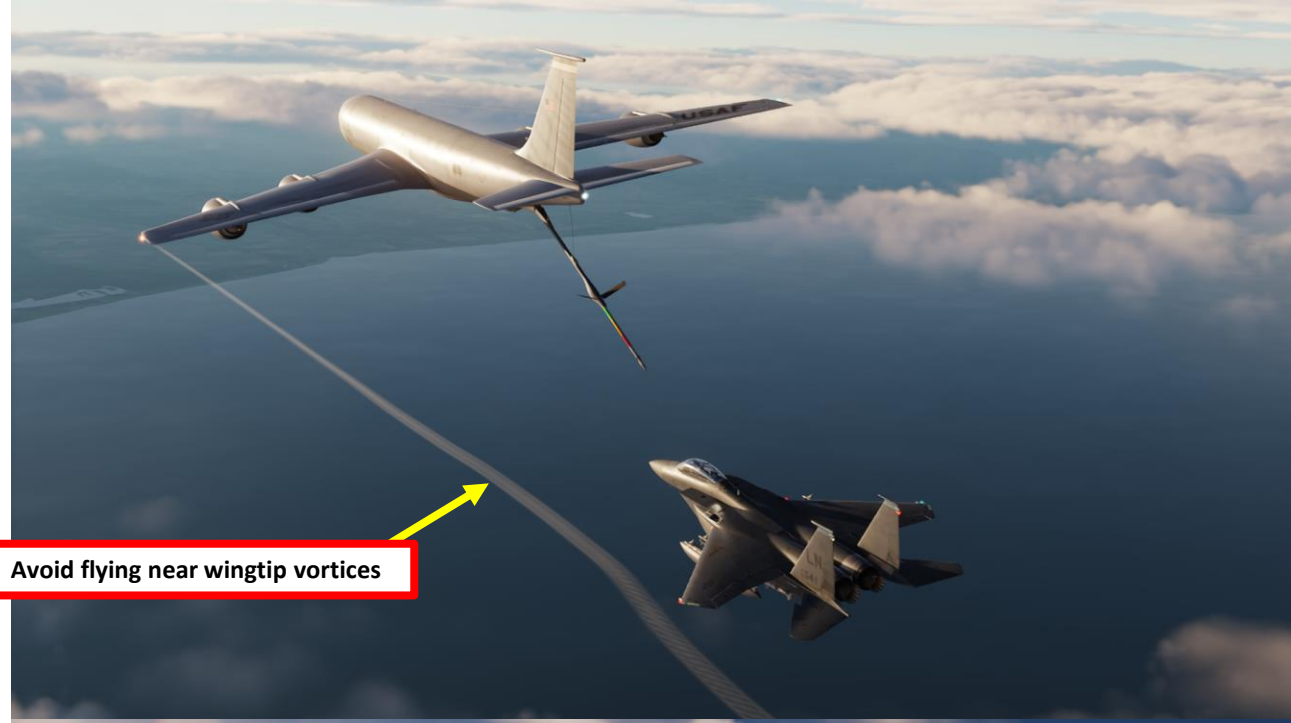


Slipway Door (Air-to-Air Refueling Door) Switch
- *FWD: OVERRIDE, allows boom locking and forces the receiver to initiate all disconnects*
- *MIDDLE: OPEN, air-to-air refueling slipway doors are open*
- *AFT: CLOSE, air-to-air refueling slipway doors are closed*

Emergency AAR (Air-to-Air Refueling) Switch
- *FWD: OPEN.*
- *AFT: CLOSE,*

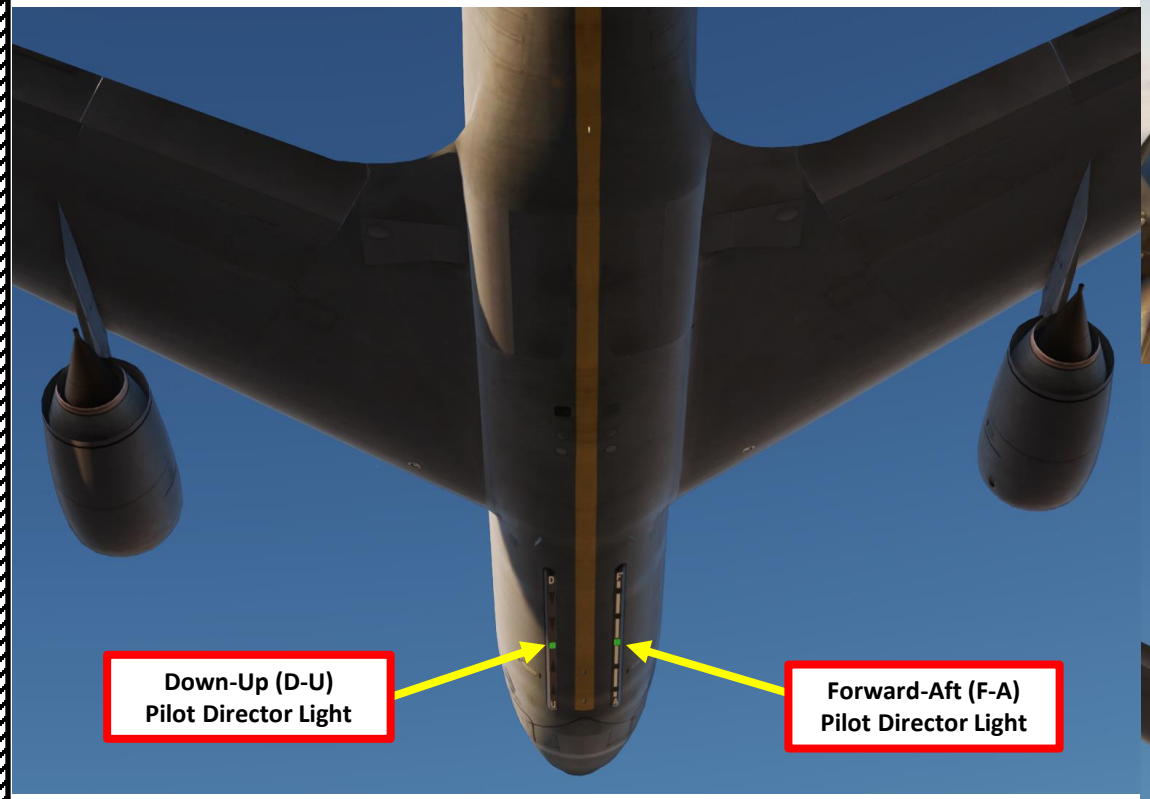
AIR-TO-AIR REFUELING TUTORIAL

18. Once you are close enough, position yourself 20 ft below the refueling boom and call the tanker to begin pre-contact. If you are lined up properly, he will grant you permission to approach.
19. Make sure you are perfectly trimmed before beginning your approach.
20. Fly formation with the tanker, not the boom.
21. Perform gentle, small stick inputs to move towards the boom. Do not use rudder pedals. Use short bursts of throttle to advance towards the tanker.
22. Allow the boom to pass just left or right of your canopy, about 2-3 feet above your head. This serves as a good first check that you are at the proper height relative to the tanker.



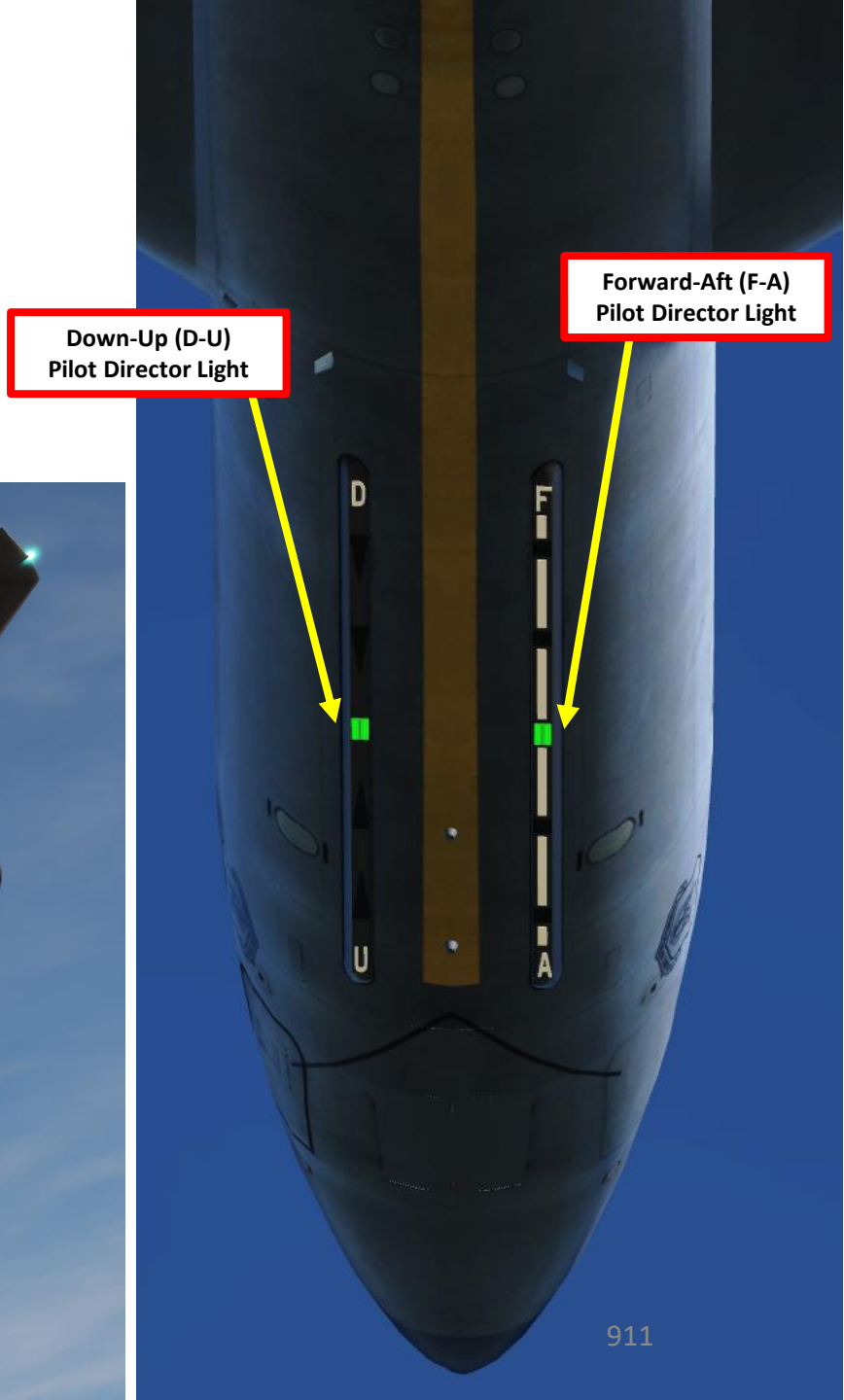
AIR-TO-AIR REFUELING TUTORIAL

23. Continue to move slowly forward, maintaining alignment with the yellow stripe painted on the bottom of the tanker. Use the Pilot Director lights on the bottom of the tanker to maintain a position within the limits of the boom.



AIR-TO-AIR REFUELING TUTORIAL

24. The PDI (Pilot Director) lights are directive, meaning they tell you the direction to travel and not your current position. In other words, preface the D, U, F and A with the word Go.
    - If the light moves toward the D, go down and if it moves toward the U, go up.
    - If the light moves toward the A, go aft and if it moves toward the F, go forward.
    - A steady light means a substantial correction is required
    - A flashing light means a small correction is required



AIR-TO-AIR REFUELING TUTORIAL

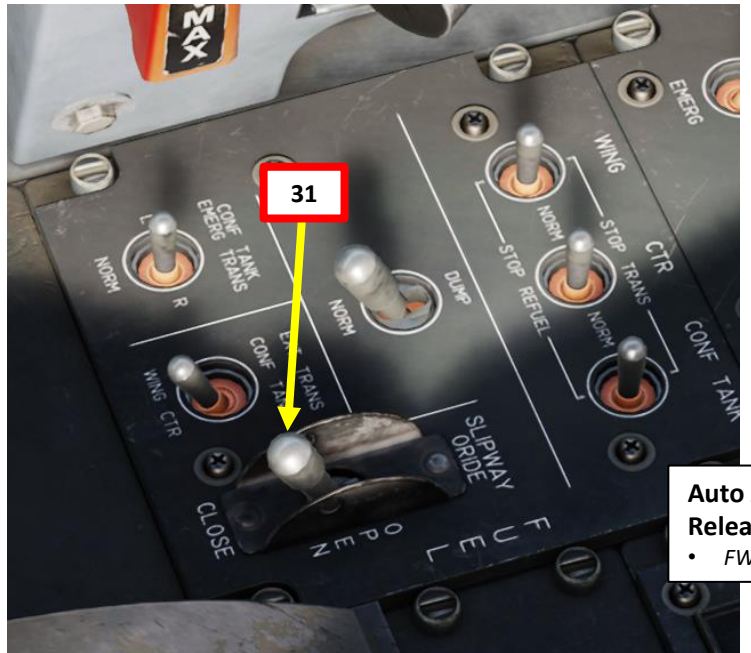
25. Fly formation on the tanker and allow the boom operator to direct the boom into the refueling receptacle behind the cockpit on your aircraft.

AIR-TO-AIR REFUELING TUTORIAL

26. The boomer will announce “contact” and ”you are taking fuel” when the connection is established.
27. The READY light will extinguish. Monitor your fuel transfer on the fuel quantity gauge.
28. Keep the aircraft aligned with the tanker using reference points such as its engines and its centerline. This will help you evaluate if your aircraft drifts or not. Correct one axis at a time only.

AIR-TO-AIR REFUELING TUTORIAL

29. Refueling procedure will be completed when the READY light illuminates.
30. If you wish to disconnect/unlatch the boom from your fuel trap door:
    - **Pilot**: On flight stick, DEPRESS Auto Acquisition Switch / Air Refueling Release Switch.
    - **WSO**: On flight stick, press the Air Refueling Release Switch.
31. Close Slipway Door (air-to-air refueling trap door) by setting the Slipway Door Switch to CLOSE (AFT position), then resume flight.



Auto Acquisition Switch / Air Refueling Release Switch
- *FWD/AFT/PRESS*

Air Refueling Release Switch
- *Disengages the Air Refueling Probe*

AIR-TO-AIR REFUELING TUTORIAL

32. And that's it! You may now go back to burning expensive fuel and convert taxpayer money into jet engine noise.


DANGER

THE CREW

Make no mistake: even if most tasks can be performed by the pilot, operating the F-15E requires **two** crewmembers in order to maximize combat performance.

The effectiveness of a crew is not necessarily a function of how well the pilot flies or how proficient a WSO (Weapon Systems Officer) is with sensors and weapons… it is how well they both work together. The Strike Eagle is a complex machine, and one of its main challenges is managing your workload in a way that avoids task saturation. You will recognize "task saturation" as a moment when you have too much to do with too little time, tools or resources to do it. Basically… you are overwhelmed and you can end up "freezing", being unable to make effective decisions.

This is why it is very important for a crew to:

1. Define who does what and when (cockpit responsibilities)
2. Delegate tasks when necessary in order to keep each crewmember's workload manageable
3. Communicate clearly, efficiently and avoiding unnecessary distractions. Be concise.
4. Practice target acquisition procedures and sensor slaving
5. When engaging targets, discuss the game plan beforehand so that both crewmembers are on the same page.
6. Share relevant information between crewmembers (location of friendly/enemy units, etc.)
7. Have two sets of eyes looking around instead of one

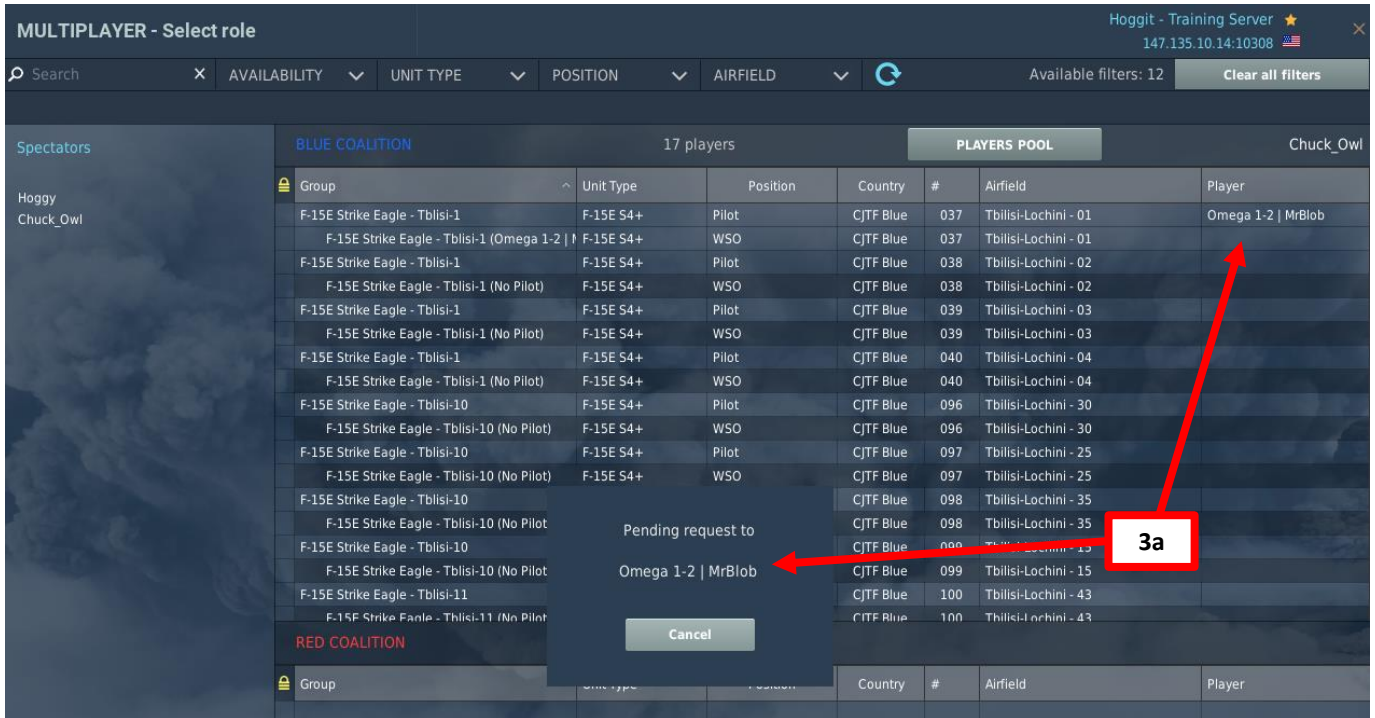
All of these things are easy to understand in theory, but practice is essential in order to see what works and what does not. Each crew is different, and your F-15E will only be as good as how you operate with your buddy as a team. This is why training in low-stress environments is of prime importance when learning the F-15E. It's one thing to learn how to use every system… it's another to figure out how to use the right tools for the job as efficiently as possible and live to tell the tale.

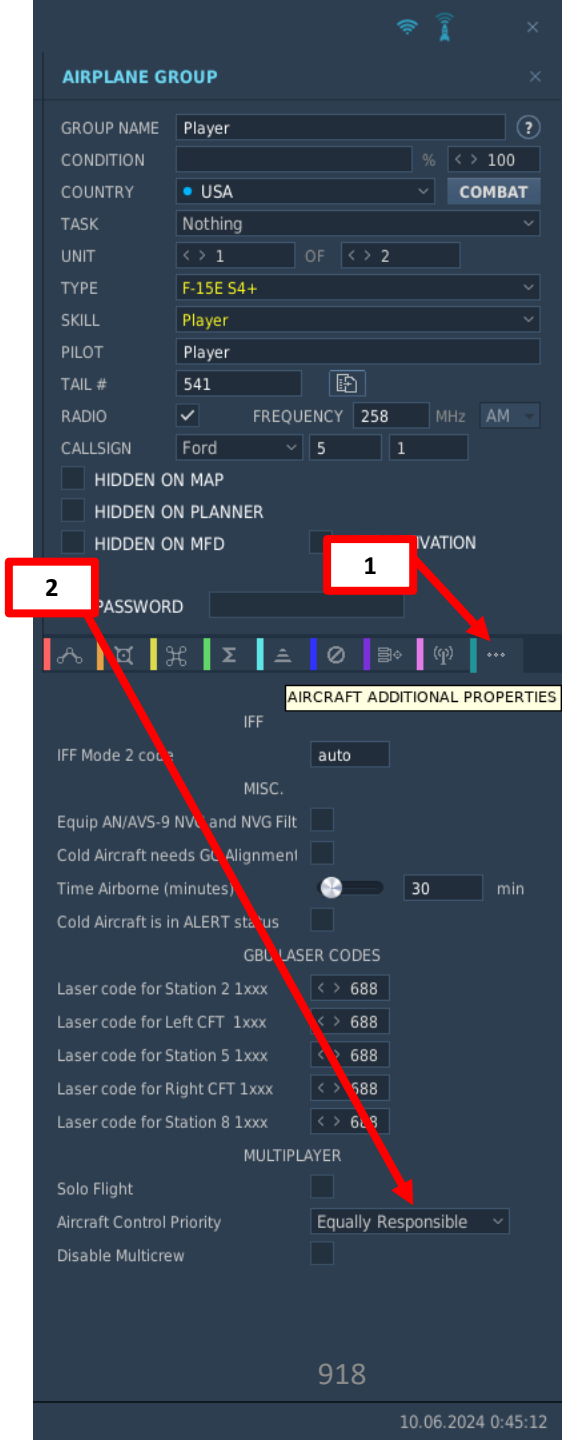
Casmo illustrates these points very well in his "Crew Coordination Techniques" for the Mi-24. Even if these tips are for a helicopter crew, the same theories apply pretty much to to any crew that operates any aircraft together.

MULTICREW TUTORIAL

The F-15E can be flown by two players in multiplayer. However, you need to go in the Mission Editor and make sure the F-15E is set up in the following manner:

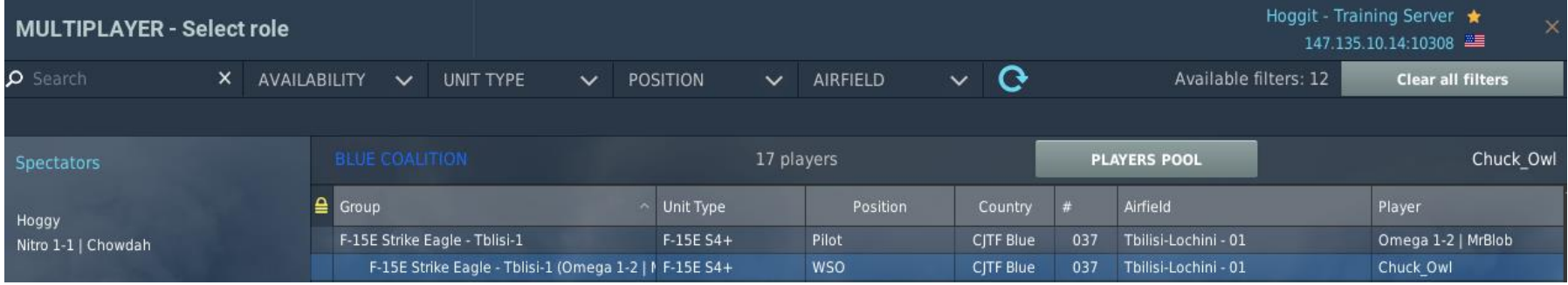
1. Select F-15E Unit and go in “Additional Properties for Aircraft” menu
2. Set “Aircraft Control Priority” to “Equally Responsible”
3. When spawning in multiplayer in any seat, the pilot will receive a request to let you take control of the other seat.





MULTICREW TUTORIAL

4. Once you are spawned, you can take control of the aircraft by pressing the “Request Aircraft Control” binding (“J” key). The other crew member you are taking controls from must accept.



REFERENCE MATERIAL

RAZBAM (Official Developer) F-15E User Manual – By Baltic Dragon

- https://www.digitalcombatsimulator.com/en/downloads/documentation/dcs-f15e_flight_manual_en/

Fighter Pilot Podcast

- Episode 074: F-15A-D (Part 1): https://youtu.be/Vpbg3UyLAPY
- Episode 075: F-15A-D (Part 2): https://youtu.be/siu_Z-eJhOg
- Episode 076: F-15E Strike Eagle: https://youtu.be/QTEv03ep3To

THANK YOU TO ALL MY PATRONS

Creating these guides is no easy task, and I would like to take the time to properly thank every single one of my Patreon supporters. The following people have donated a very generous amount to help me keep supporting existing guides and work on new projects as well:

- Tuuvas, Gamepad Guru
- Kennedy
- HMDEVILDOC
- Romanichel
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- ChazFlyz
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