DCS GUIDE
Mirage 2000C

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 Mirage 2000. The author has never had access to OEM (Original Equipment Manufacturer) data related to the Mirage 2000, its armament systems nor its defensive systems. All the information within this document is taken from public documentation (i.e. DCS M-2000C 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 M-2000C 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 Mirage 2000.

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

The **Dassault Mirage** is the very first aircraft I ever heard of. I discovered the Mirage III by reading one of my father's old "Tanguy et Laverdure" comic books by Joseph "Jijé" Gillain, Jean-Michel Charlier and Albert Uderzo. Believe it or not, these fictional French Mirage pilots are part of what sparked my interest in military aviation. The 1960's were the golden age for Franco-Belgian aviation comics like Buck Danny, Michel Tanguy, Ernest Laverdure and Dan Cooper. Artists painstakingly reproduced technical drawings by hand and drew airplane cutaway views to a level of detail that remains unparalleled even by today's standards. Some even went on airbases and talked to the pilots and ground crews directly in order to get as much information about their planes as possible. And who would blame them? After all, these were some of the most beautiful fighter jets ever built.

French military aviation history is an incredibly interesting subject. French engineers had to compete against Cold War superpowers like the United States and Russia to export their airframes to a world arming itself to the teeth. Various countries like Egypt, Greece, India, Taiwan and the United Arab Emirates became political hot spots and needed a multirole jet fighter that could reach speeds over Mach 2 while having a relatively low operation and maintenance cost.

The Mirage's bold design has a rich history that spans over decades. Many variants of the supersonic delta-winged Mirage were manufactured by Dassault Aviation such as the Mirage IV, Mirage 5, Mirage 50, Mirage F1 and Mirage 2000... but other countries developed their own version of the Mirage as well. For example, the Israeli Aircraft Industries *Kfir* and *Nesher* were modified versions of the Mirage 5. The israeli IAI *Nammer*, south african Atlas *Cheetah*, and the chilean ENAER *Pantera* are other designs strongly inspired by the French creation.

The Mirage 2000 evolved from a series of Dassault design efforts performed from 1965 to 1975. The first in this series was a collaborative project known as the Anglo-French Variable Geometry (AFVG) swing-wing aircraft, begun in 1965. The collaboration was a fiasco, and the French pulled out in 1967. The British stayed with the concept and formed another collaboration with the Germans and Italians, which eventually produced the Panavia Tornado.

Dassault then worked on several new aircraft concepts evolved from their Mirage G variable-geometry experimental prototype, resulting in a sophisticated design with the designation Avion de Combat Futur (ACF), or Future Combat Aircraft. The ACF prototype was almost complete when the French government cancelled it in 1975. The ACF was simply too big and expensive. However, Dassault had been considering other fighter options in the meantime, partly because of limited export potential. These alternatives were smaller, simpler, and cheaper than the ACF, and took the form of a number of "Mini-Mirage", or "Mimi"; concepts developed beginning in 1972 as a "back-bumer" project. These concepts congealed into an aircraft known at first as the Super Mirage III, then the Delta 1000, Delta 2000, and finally Mirage 2000.

A number of different versions of the Mirage 2000 have been developed. The “C” stands for “Chasseur” (Fighter), the “B” stands for “Biplace” (two-seater), the “D” stands for “Diversifié” (Multipurpose) and the “N” for “Nucléaire” (nuclear).

Mirage 2000 C

Mirage 2000 B

Mirage 2000 D

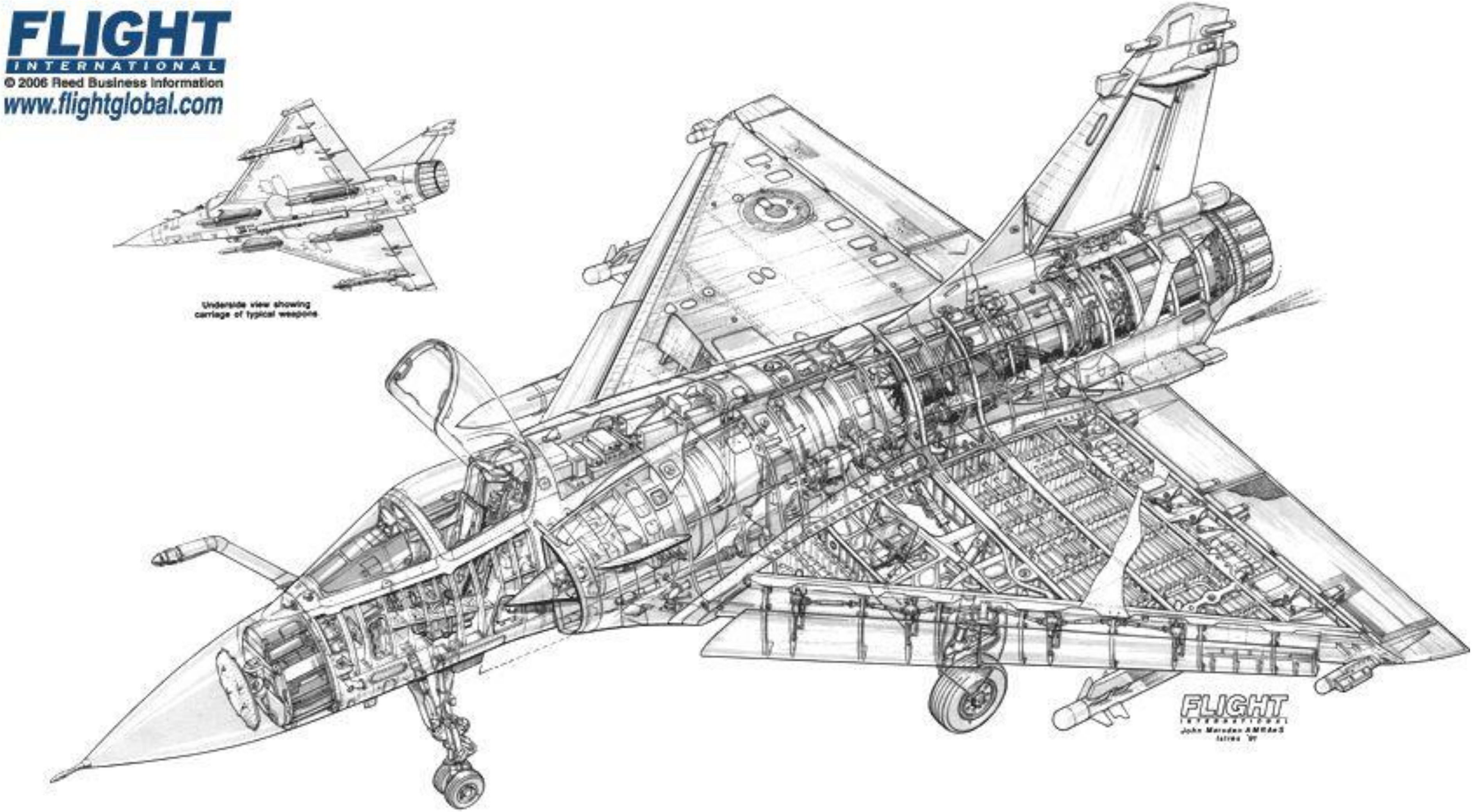
Mirage 2000 N

Mirage 2000 5F

When the ACF was cancelled, Dassault was able to immediately offer the Mirage 2000 as an alternative, and the French Defense Council accepted it. It wasn't exactly an even trade, since the ACF was a strike aircraft first and an interceptor second, while the Mirage 2000 was exactly the reverse. However, the Mirage 2000 was much more affordable. There was another reason for Dassault to push the Mirage 2000. In 1975, four European nations selected the General Dynamics F-16 as their new first-line fighter, rejecting an updated Mirage F1.

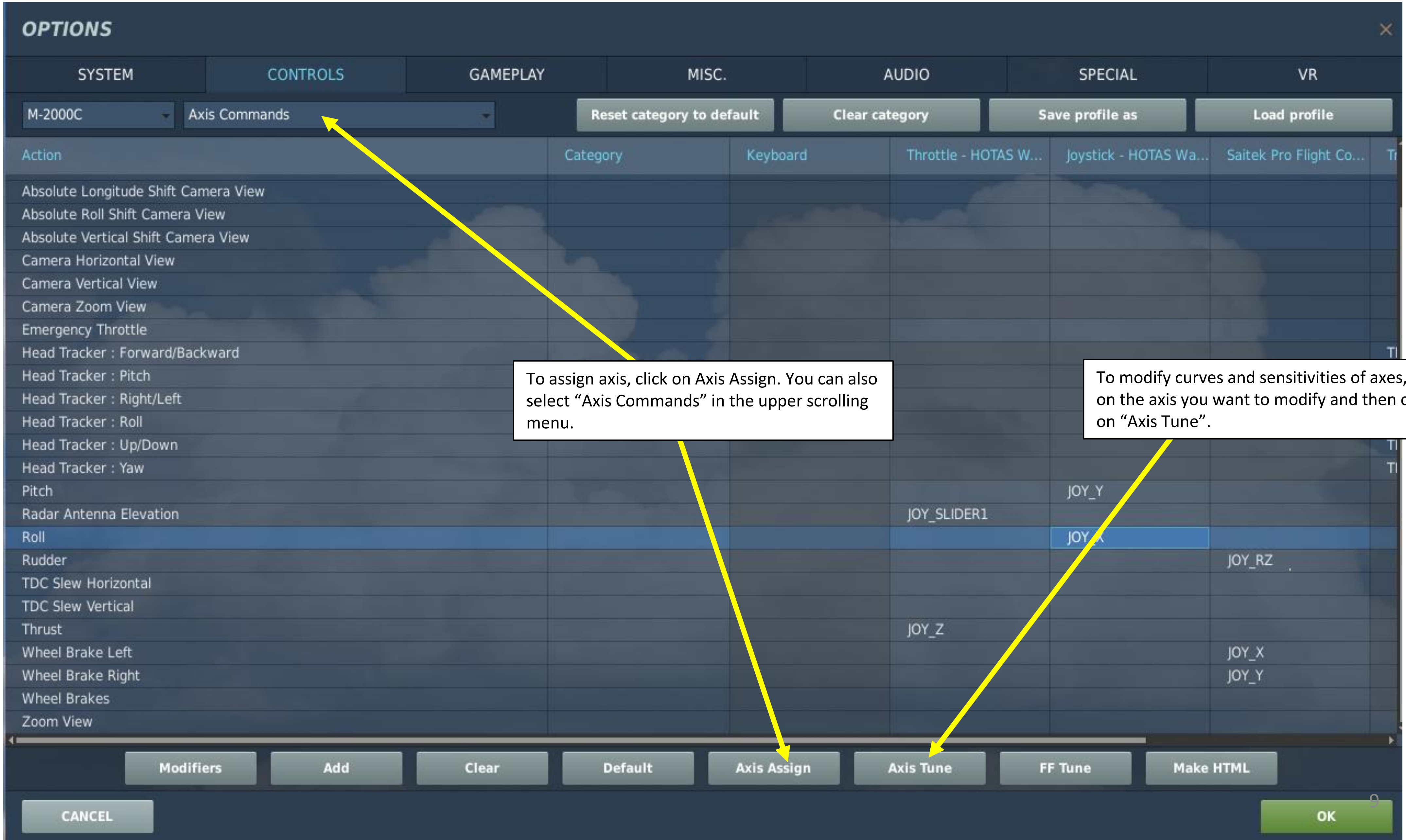
Marcel Dassault was disgusted with the choice, and felt his company could build a better aircraft. Using the delta wing configuration seemed to many like a backward step. The company had used that configuration on the Mirage III and 5, but abandoned it for the Mirage F1. A delta wing tends to be a good choice in terms of high-speed flight characteristics, simplicity of aircraft construction, relatively low radar signature, and internal volume. It tends to be a poor choice in terms of maneuverability, low-altitude flight, and length of take-off and landing run.

While the delta wing was outdated by that time, Dassault modified the aerodynamics of the new aircraft to ensure a degree of inherent instability, obtained by moving the aircraft's center of lift in front of its center of gravity. Control was maintained by a fly-by-wire control system and automatic, full length, two-segment leading-edge flaps. This gave the Mirage 2000 a level of agility that the Mirage III and 5 lacked, and the aircraft would become known for its handling. A noticeably taller tail allowed the pilot to retain control at higher angles of attack, assisted by small strakes mounted along each air intake.



The Mirage 2000 is truly a work of art. It is capable of achieving great speeds while retaining great manoeuverability. It remains one of my favorite DCS modules when it comes to fighter jets. You will be flying a very slick yet capable combat platform. Don't let its elegant silhouette fool you… this aircraft can definitely hold its own in the right scenarios. I guarantee that you will start laughing like a lunatic once you get on a bandit's six o'clock and the proverbial "knife fight in a phone booth" begins.

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.



To assign axis, click on Axis Assign. You can also select "Axis Commands" in the upper scrolling menu.

To modify curves and sensitivities of axes, click on the axis you want to modify and then click on "Axis Tune".

Bind the following axes:

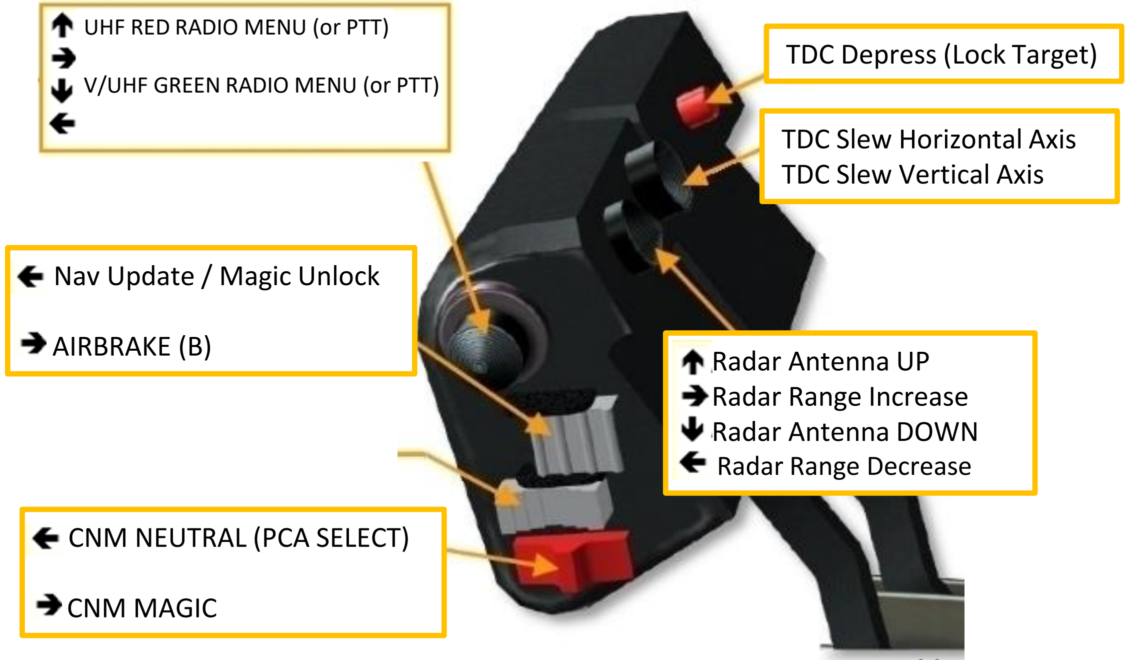
- PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 10)
- THROTTLE – CONTROLS ENGINE RPM
- WHEEL BRAKE LEFT / RIGHT

NOTES:

1. To turn on the ground, make sure nosewheel steering (DIRAV) is engaged (grey nosewheel steering button on your HOTAS, where your pinky finger should be)
2. The Airbrake key must be mapped to “AIRBRAKE” (B by default) and will act as a toggle switch.
3. There are no flaps on the Mirage 2000C… so don’t waste your time looking for them ☺

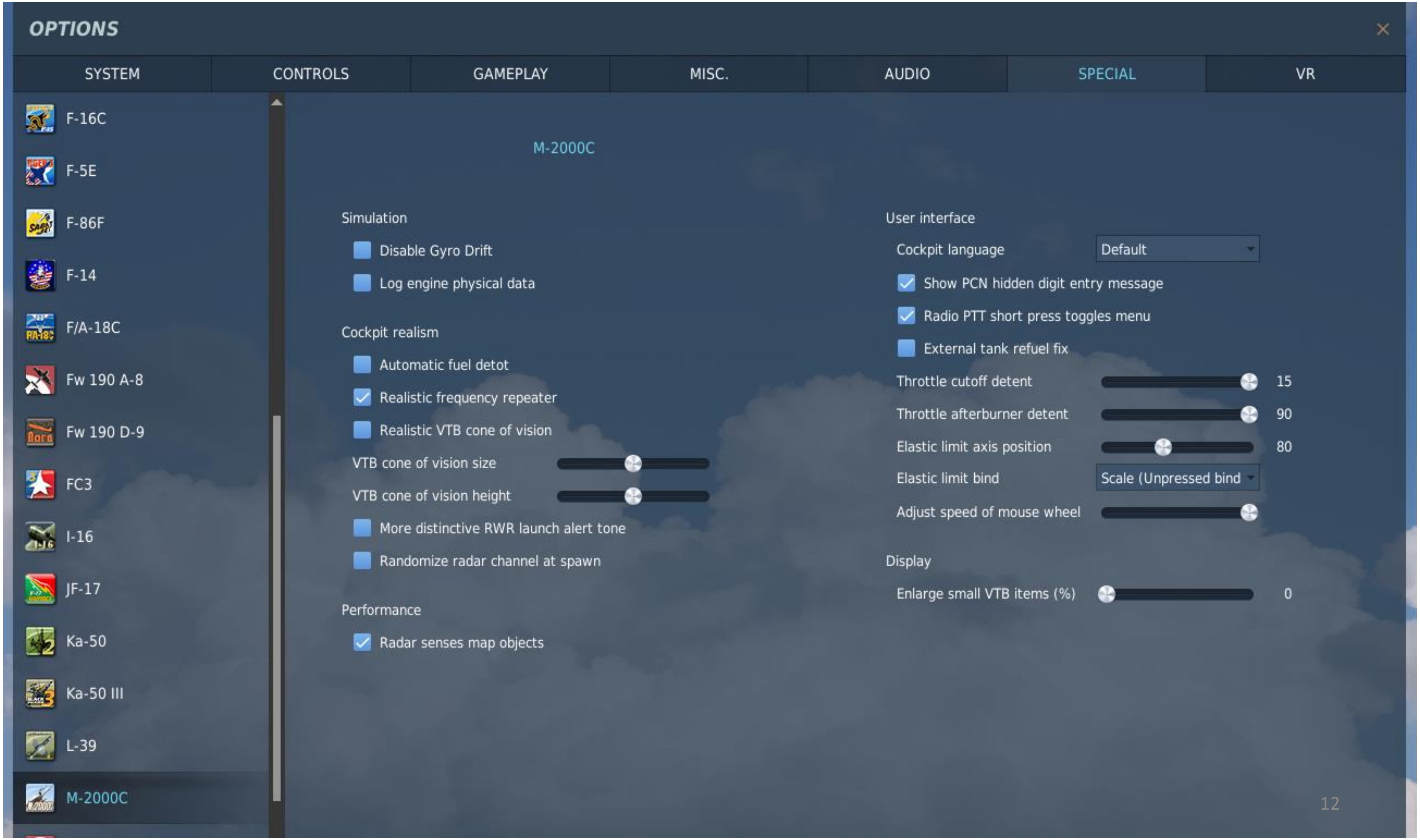
WHAT YOU NEED MAPPED

HOTAS: “**Hands On Throttle-And-Stick**”
3M: “**Main sur Manche et Manette**”



+ TOE BRAKES (MAPPED ON PEDALS)

Here are my recommendations for the Special Options Tab:

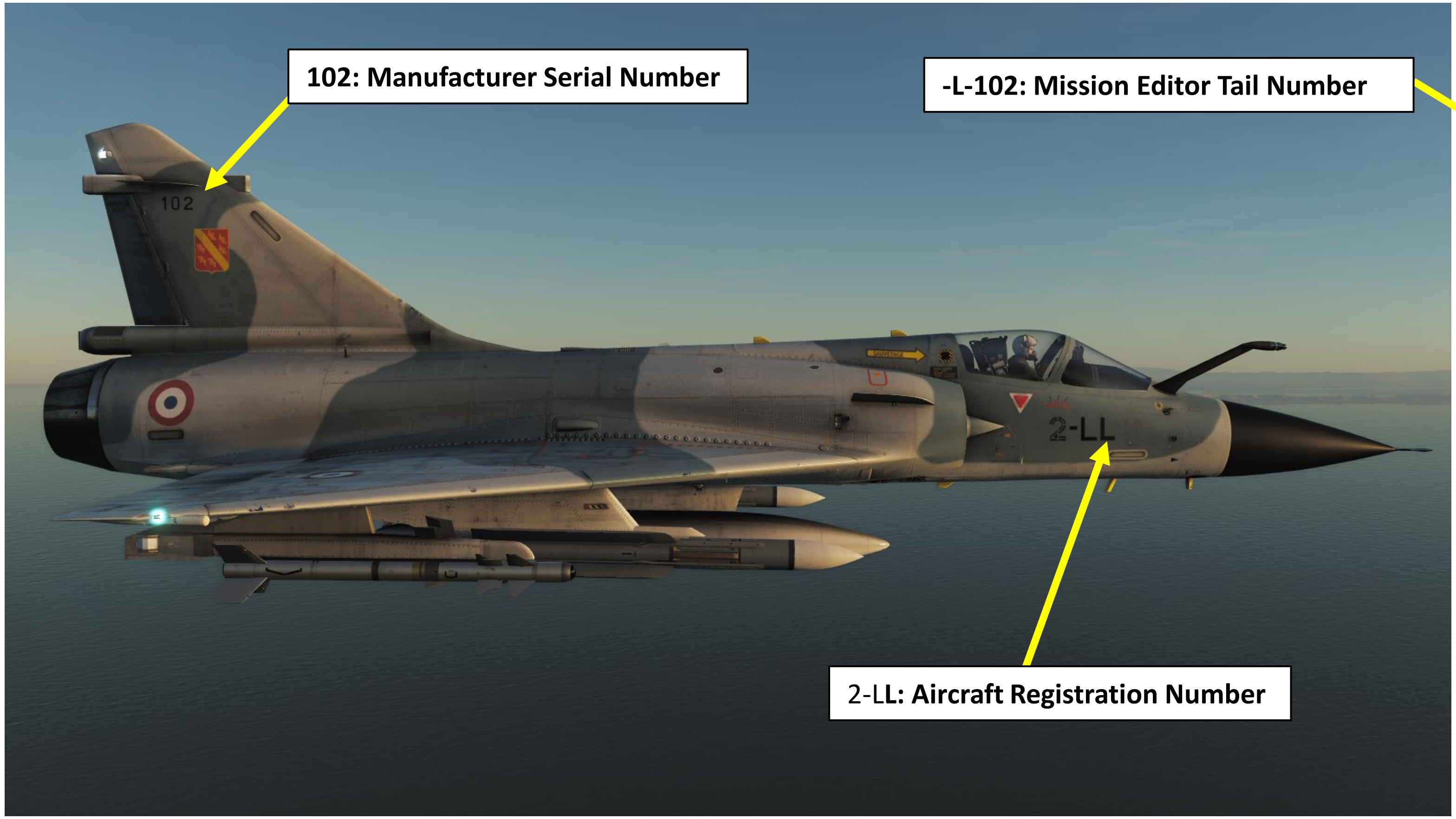


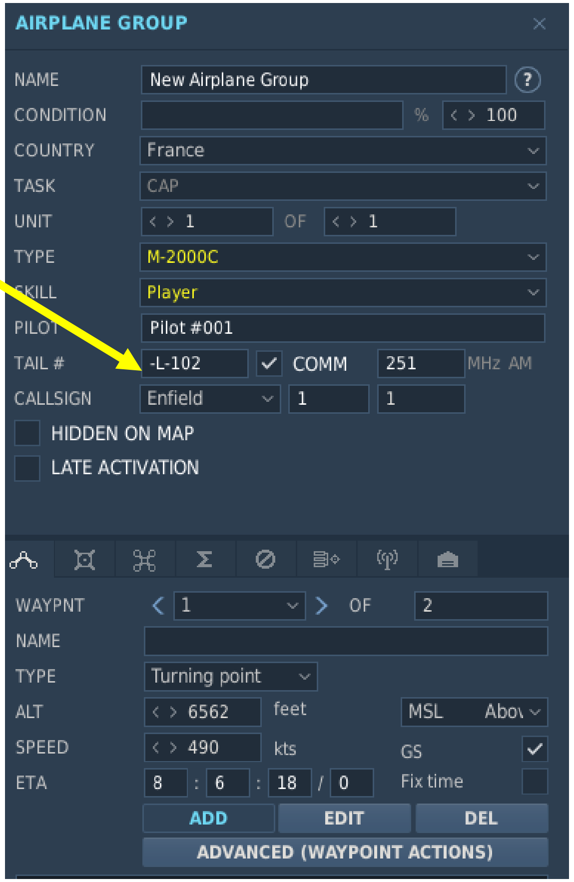
TIP: Pilot body can be toggled ON/OFF with “RSHIFT+P”.

Aircraft Designation

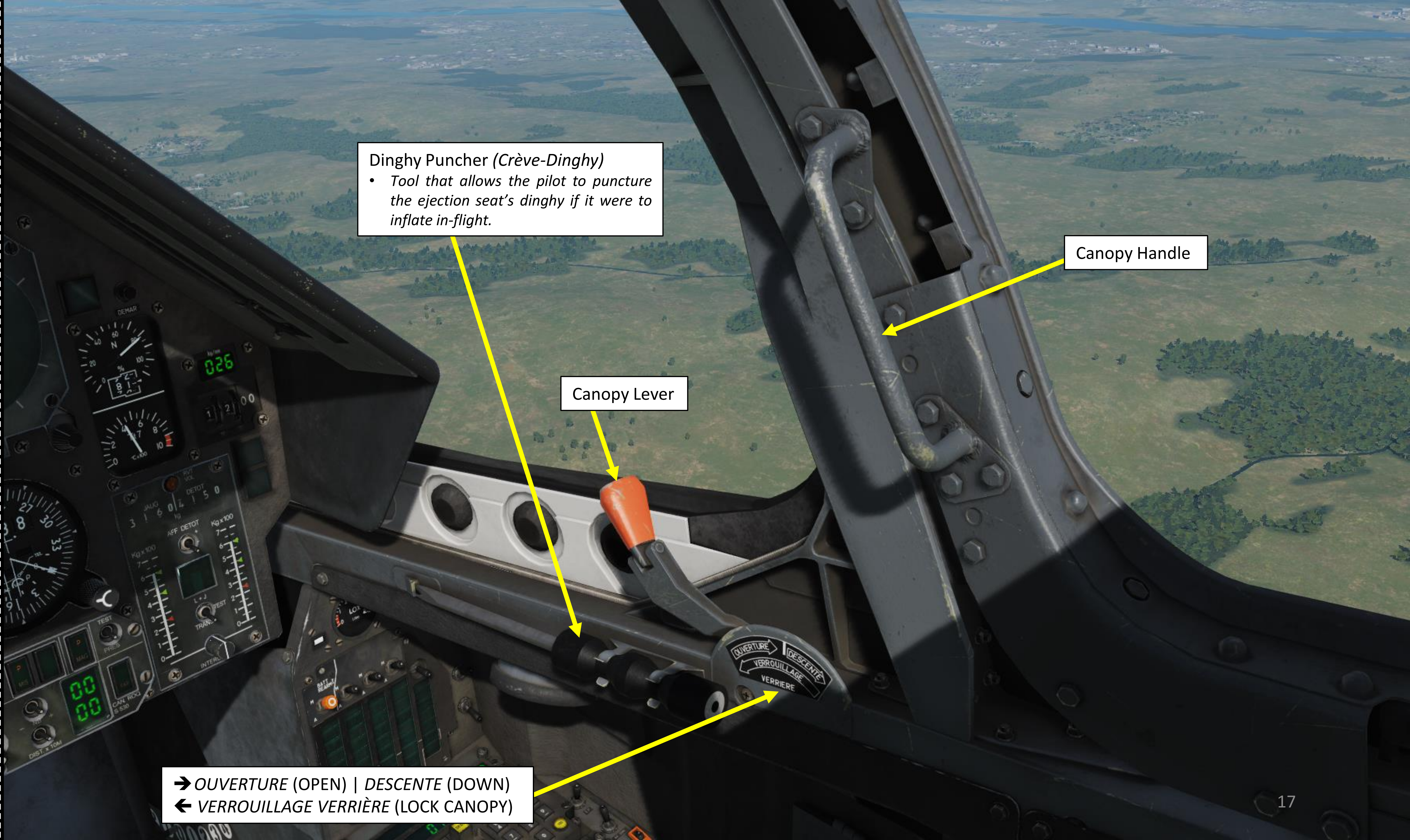
The Tail Number you enter in the Mission Editor TAIL # should be as follows:
***Example**: -L-102 (dash ONE_LETTER dash THREE_DIGITS)*

The one letter will be displayed on the side of the cockpit, as the unique letter of the aircraft registration (no digit here!): 2-LL is correct, 2-L1 is not). And the 3 digits will display as the aircraft serial number (manufacturer number, unique across the whole fleet).





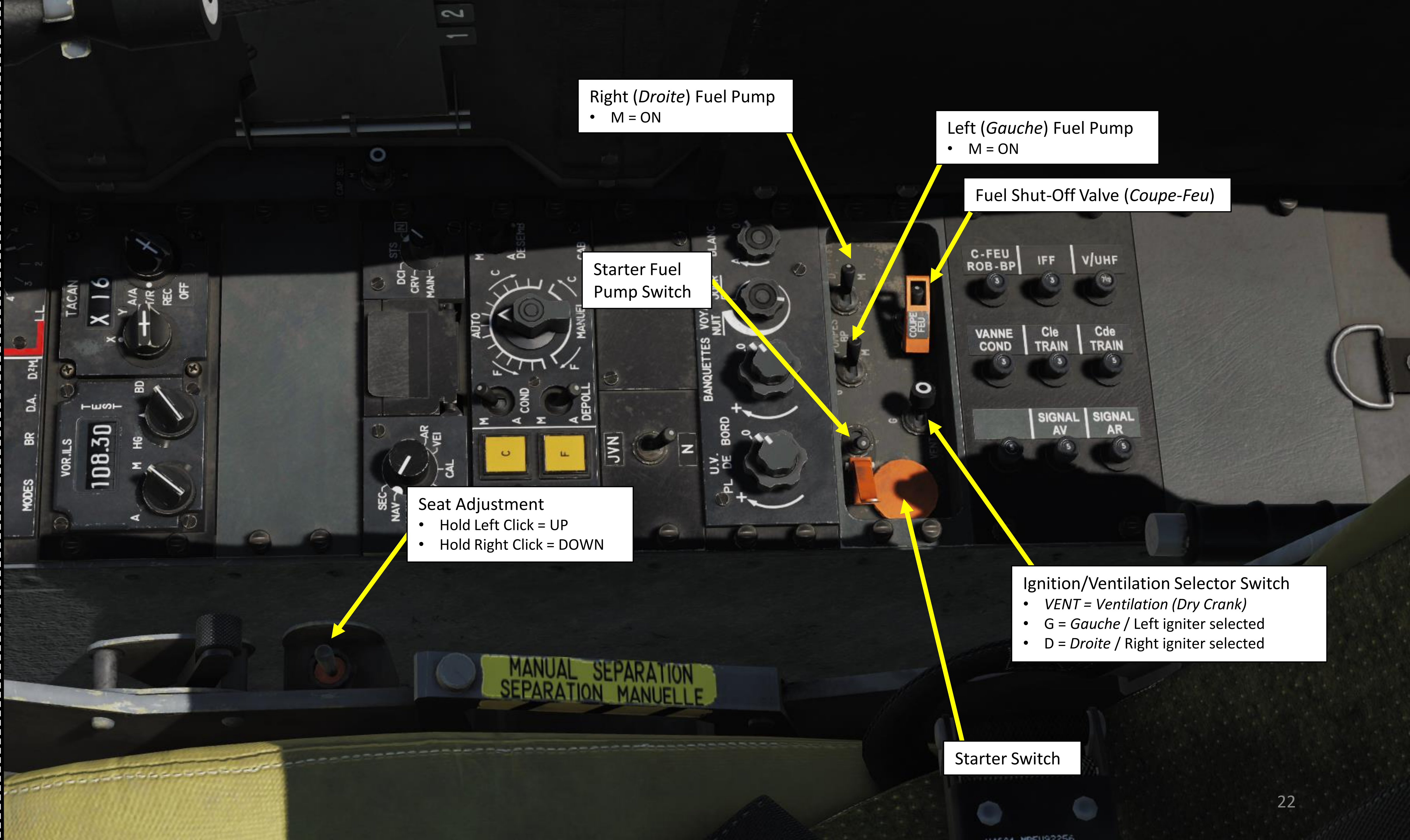

VTH Control Panel: *Visualisation Tête Haute*
Litt.: HUD (Heads-Up Display) Control Panel
PCA: *Poste Commande Armement*
Litt.: Weapon Control Panel
PPA: *Poste Préparation Armement*
Litt.: Weapons Configuration Panel
PCN: *Poste Commande Navigation*
Litt.: Navigation Control Panel
VTB Panel: *Visualisation Tête Basse*
Litt.: HDD (Heads-Down Display) Panel
PSM: *Poste Sélecteur de Modes*
Litt.: Mode Selector Panel

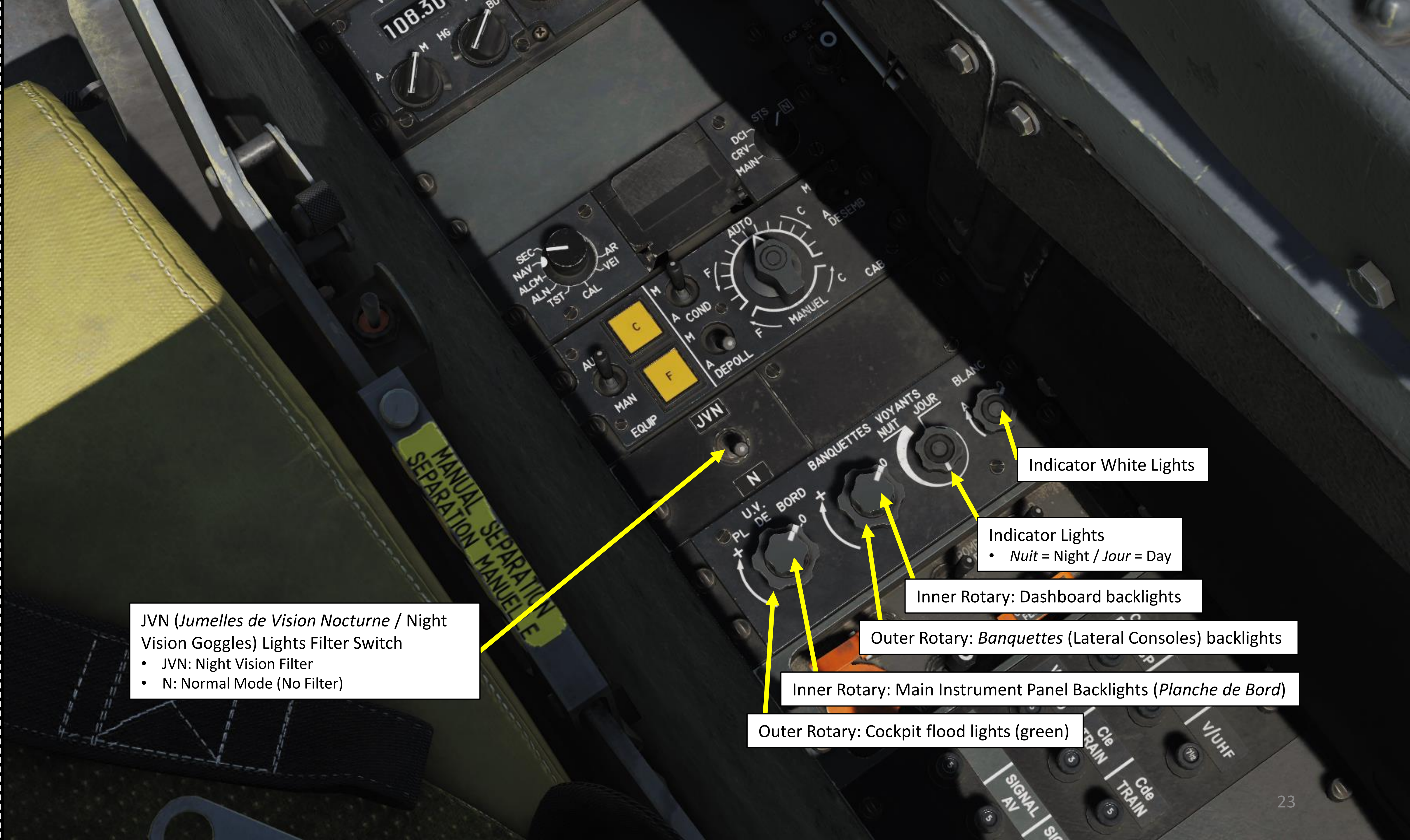

Dinghy Puncher *(Crève-Dinghy)*
• *Tool that allows the pilot to puncture the ejection seat's dinghy if it were to inflate in-flight.*
Canopy Handle
Canopy Lever
→ *OUVERTURE* (OPEN) | *DESCENTE* (DOWN)
← *VERROUILLAGE VERRIÈRE* (LOCK CANOPY)
OUVERTURE
DESCENTE
VERROUILLAGE
VERRIERE

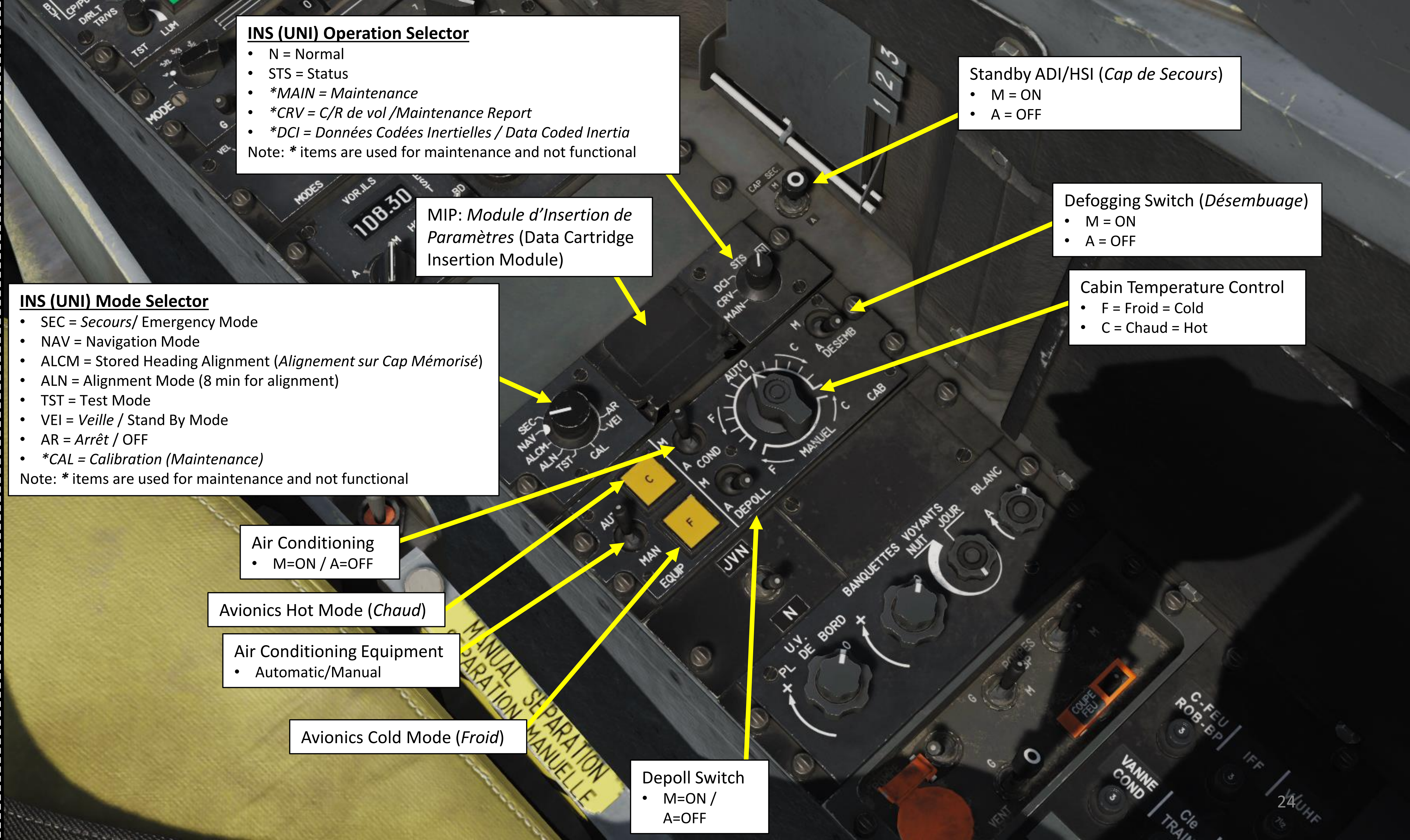
Emergency Compass
- (Left Click to Show or Hide)


Canopy Holding Handle
(used to hold the canopy half-open)


Parking Brake
• UP = ENGAGED
• DOWN = DISENGAGED


Right (*Droite*) Fuel Pump
• M = ON
Left (*Gauche*) Fuel Pump
• M = ON
Fuel Shut-Off Valve (*Coupe-Feu*)
Starter Fuel Pump Switch
Seat Adjustment
• Hold Left Click = UP
• Hold Right Click = DOWN
Ignition/Ventilation Selector Switch
• *VENT = Ventilation (Dry Crank)*
• G = *Gauche* / Left igniter selected
• D = *Droite* / Right igniter selected
Starter Switch
MANUAL SEPARATION
SEPARATION MANUELLE


JVN (*Jumelles de Vision Nocturne* / Night Vision Goggles) Lights Filter Switch
- JVN: Night Vision Filter
- N: Normal Mode (No Filter)
Indicator White Lights
Indicator Lights
- *Nuit* = Night / *Jour* = Day
Inner Rotary: Dashboard backlights
Outer Rotary: *Banquettes* (Lateral Consoles) backlights
Inner Rotary: Main Instrument Panel Backlights (*Planche de Bord*)
Outer Rotary: Cockpit flood lights (green)
JVN
N
BANQUETTES
VOYANTS
NUIT
JOUR
BLANC
U.V.
PL DE BORD
COND
DEPOLL
MANUEL
AUTO
EQUIP
MAN
MANUAL SEPARATION
SEPARATION MANUELLE
108.30



INS (UNI) Operation Selector
- N = Normal
- STS = Status
- **MAIN = Maintenance*
- **CRV = C/R de vol /Maintenance Report*
- **DCI = Données Codées Inertielles / Data Coded Inertia*

Note: * items are used for maintenance and not functional

Standby ADI/HSI (*Cap de Secours*)
- M = ON
- A = OFF

MIP: *Module d'Insertion de Paramètres* (Data Cartridge Insertion Module)

Defogging Switch (*Désembuage*)
- M = ON
- A = OFF

Cabin Temperature Control
- F = Froid = Cold
- C = Chaud = Hot

INS (UNI) Mode Selector
- SEC = *Secours*/ Emergency Mode
- NAV = Navigation Mode
- ALCM = Stored Heading Alignment (*Alignement sur Cap Mémorisé*)
- ALN = Alignment Mode (8 min for alignment)
- TST = Test Mode
- VEI = *Veille* / Stand By Mode
- AR = *Arrêt* / OFF
- **CAL = Calibration (Maintenance)*

Note: * items are used for maintenance and not functional

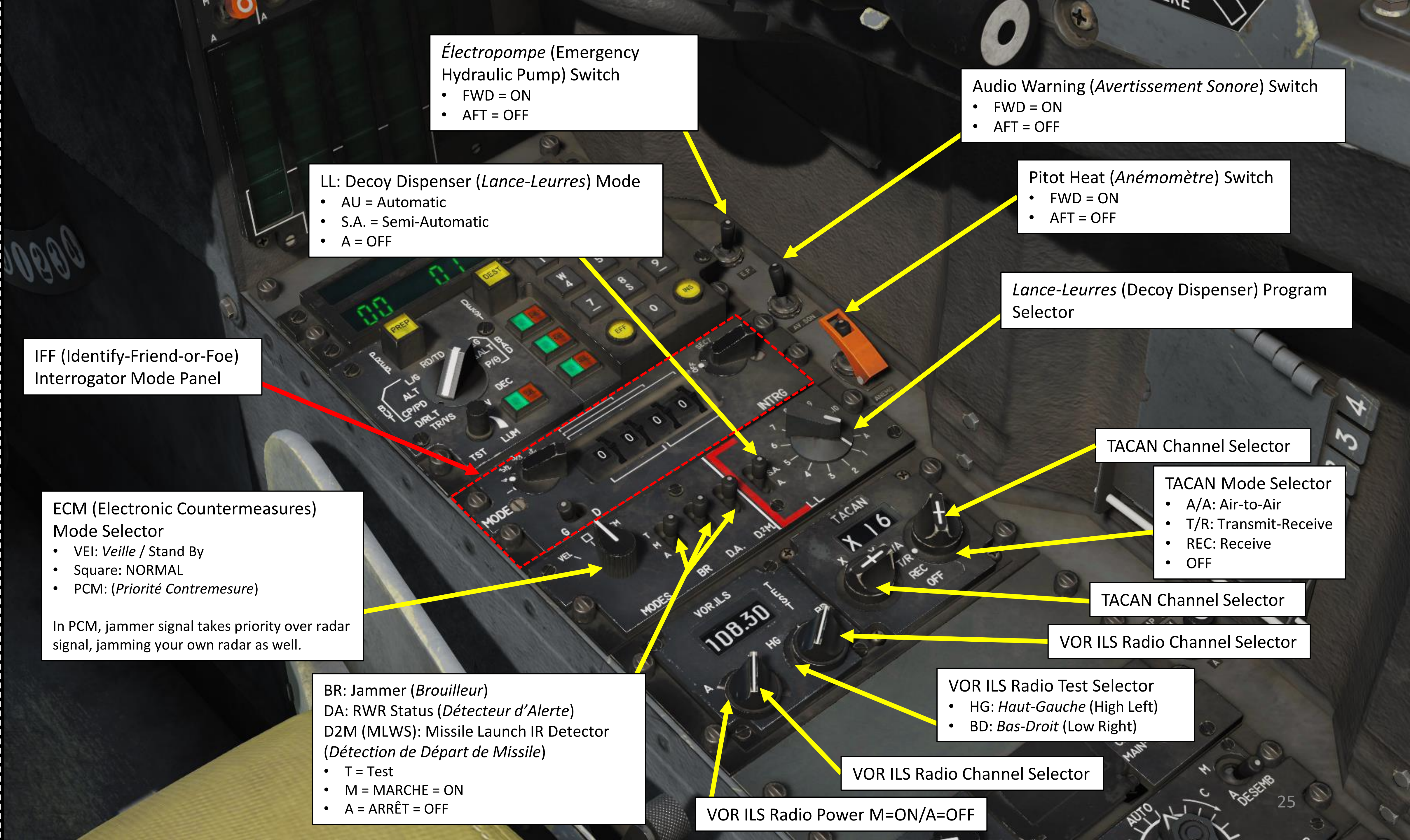
Air Conditioning
- M=ON / A=OFF

Avionics Hot Mode (*Chaud*)

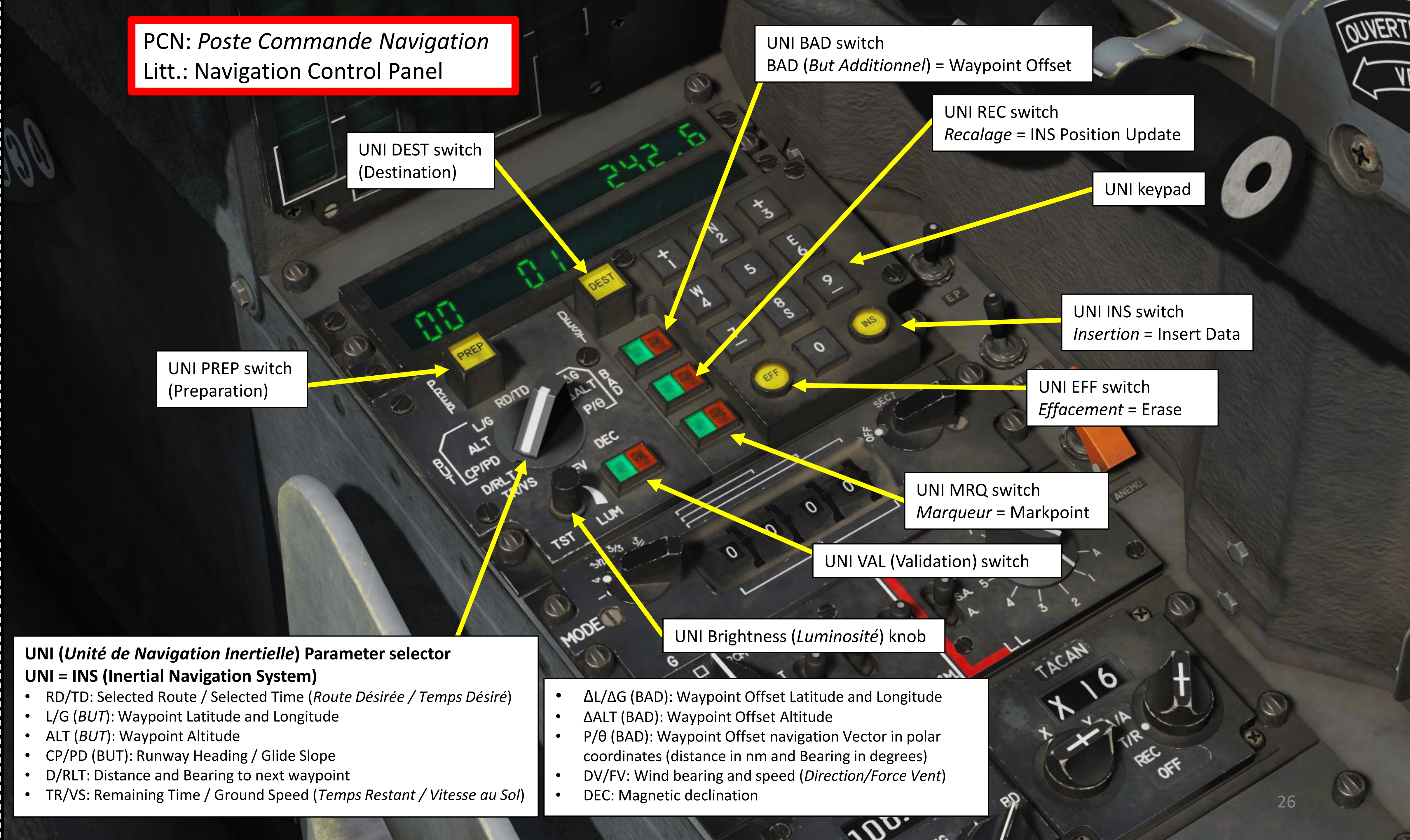
Air Conditioning Equipment
- Automatic/Manual

Avionics Cold Mode (*Froid*)

Depoll Switch
- M=ON / A=OFF


Électropompe (Emergency Hydraulic Pump) Switch
• FWD = ON
• AFT = OFF
Audio Warning (*Avertissement Sonore*) Switch
• FWD = ON
• AFT = OFF
LL: Decoy Dispenser (*Lance-Leurres*) Mode
• AU = Automatic
• S.A. = Semi-Automatic
• A = OFF
Pitot Heat (*Anémomètre*) Switch
• FWD = ON
• AFT = OFF
Lance-Leurres (Decoy Dispenser) Program Selector
IFF (Identify-Friend-or-Foe) Interrogator Mode Panel
TACAN Channel Selector
TACAN Mode Selector
• A/A: Air-to-Air
• T/R: Transmit-Receive
• REC: Receive
• OFF
ECM (Electronic Countermeasures) Mode Selector
• VEI: *Veille* / Stand By
• Square: NORMAL
• PCM: (*Priorité Contremesure*)
In PCM, jammer signal takes priority over radar signal, jamming your own radar as well.
TACAN Channel Selector
VOR ILS Radio Channel Selector
BR: Jammer (*Brouilleur*)
DA: RWR Status (*Détecteur d'Alerte*)
D2M (MLWS): Missile Launch IR Detector (*Détection de Départ de Missile*)
• T = Test
• M = MARCHE = ON
• A = ARRÊT = OFF
VOR ILS Radio Test Selector
• HG: *Haut-Gauche* (High Left)
• BD: *Bas-Droit* (Low Right)
VOR ILS Radio Channel Selector
VOR ILS Radio Power M=ON/A=OFF

PCN: *Poste Commande Navigation*
Litt.: Navigation Control Panel



UNI BAD switch
BAD (*But Additionnel*) = Waypoint Offset

UNI REC switch
Recalage = INS Position Update

UNI DEST switch
(Destination)

UNI keypad

UNI INS switch
Insertion = Insert Data

UNI PREP switch
(Preparation)

UNI EFF switch
Effacement = Erase

UNI MRQ switch
Marqueur = Markpoint

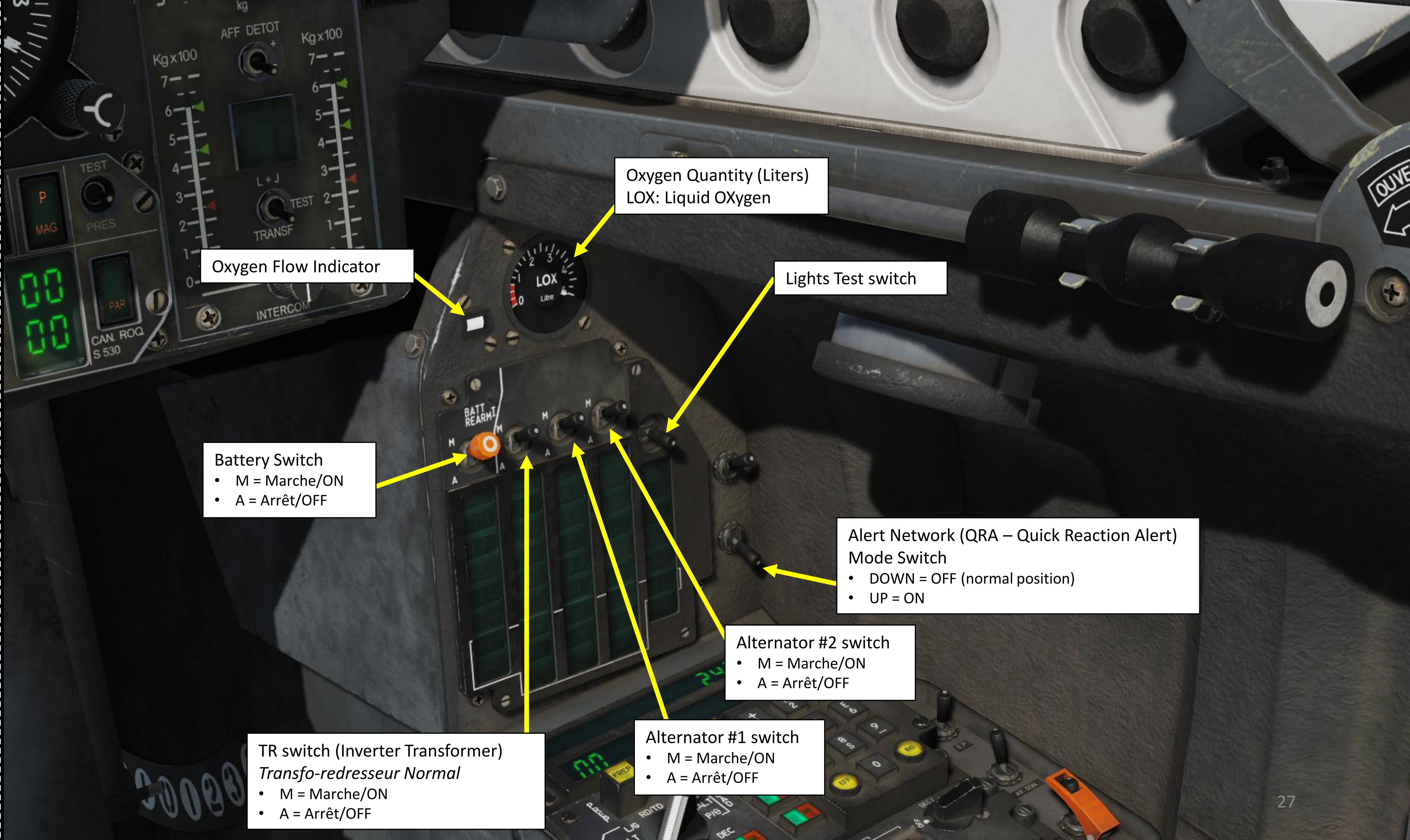
UNI VAL (Validation) switch

UNI Brightness (*Luminosité*) knob

UNI (*Unité de Navigation Inertielle*) Parameter selector
UNI = INS (Inertial Navigation System)

- RD/TD: Selected Route / Selected Time (*Route Désirée / Temps Désiré*)
- L/G (*BUT*): Waypoint Latitude and Longitude
- ALT (*BUT*): Waypoint Altitude
- CP/PD (BUT): Runway Heading / Glide Slope
- D/RLT: Distance and Bearing to next waypoint
- TR/VS: Remaining Time / Ground Speed (*Temps Restant / Vitesse au Sol*)

- ΔL/ΔG (BAD): Waypoint Offset Latitude and Longitude
- ΔALT (BAD): Waypoint Offset Altitude
- P/θ (BAD): Waypoint Offset navigation Vector in polar coordinates (distance in nm and Bearing in degrees)
- DV/FV: Wind bearing and speed (*Direction/Force Vent*)
- DEC: Magnetic declination


Oxygen Quantity (Liters)
LOX: Liquid OXygen
Oxygen Flow Indicator
Lights Test switch
Battery Switch
• M = Marche/ON
• A = Arrêt/OFF
Alert Network (QRA – Quick Reaction Alert) Mode Switch
• DOWN = OFF (normal position)
• UP = ON
Alternator #2 switch
• M = Marche/ON
• A = Arrêt/OFF
Alternator #1 switch
• M = Marche/ON
• A = Arrêt/OFF
TR switch (Inverter Transformer)
Transfo-redresseur Normal
• M = Marche/ON
• A = Arrêt/OFF

CAUTION PANEL

BATT Main Battery is disconnected or failed	TR Main or Auxiliary Transformer is disconnected or failed
HUILE Low Oil Pressure	T7 Turbine Temperature Overheat
B.P. Fuel Pumps Failure	BP.G Left Fuel Pump OFF
HYD.1 Hydraulic System 1 pressure is below 195 bars	HYD.2 Hydraulic System 2 pressure is below 195 bars
P.CAB Cockpit Open or Canopy Not Pressurized	TEMP N/A
ANEMO Pitot tube heating disabled	CC Battery is discharging, only 30 min of DC power remaining
PA Autopilot system failure	MAN Damage of Manoeuverability (control gyros, servos, etc.)
ALPHA Damage to AoA sensors	GAIN Emergency FBW computer in use

CAUTION PANEL

ALT.1 Alternator 1 is disconnected or failed	ALT.2 Alternator 2 is disconnected or failed
CALC Engine Controller (Calculateur) functionality compromised	SOURIS Engine Shockwave Cones functionality compromised
BP.D Right Fuel Pump OFF	TRANSF Fuel transfer stopped (loss of useable fuel or fuel jettison in progress)
HYD.S Hydraulic System 2 pressure is below 140 bars or EP switch OFF	EP Reserve pump (EP) is active
REG.O2 N/A	5mn.O2 5 minutes Oxygen remaining
DSV N/A	CONDIT N/A
DOM Damage to flight control surfaces or any system restricting flight envelope (*Domaine de vol*)	BECS Slats functionality compromised
RPM Turbine RPM abnormal	DECOL Take-Off *(Décollage)* configuration incorrect

CAUTION PANEL

PELLE
Engine Auxiliary Intakes / Blow-In Doors functionality compromised

NIVEAU
Fuel remaining falls below 500 kg

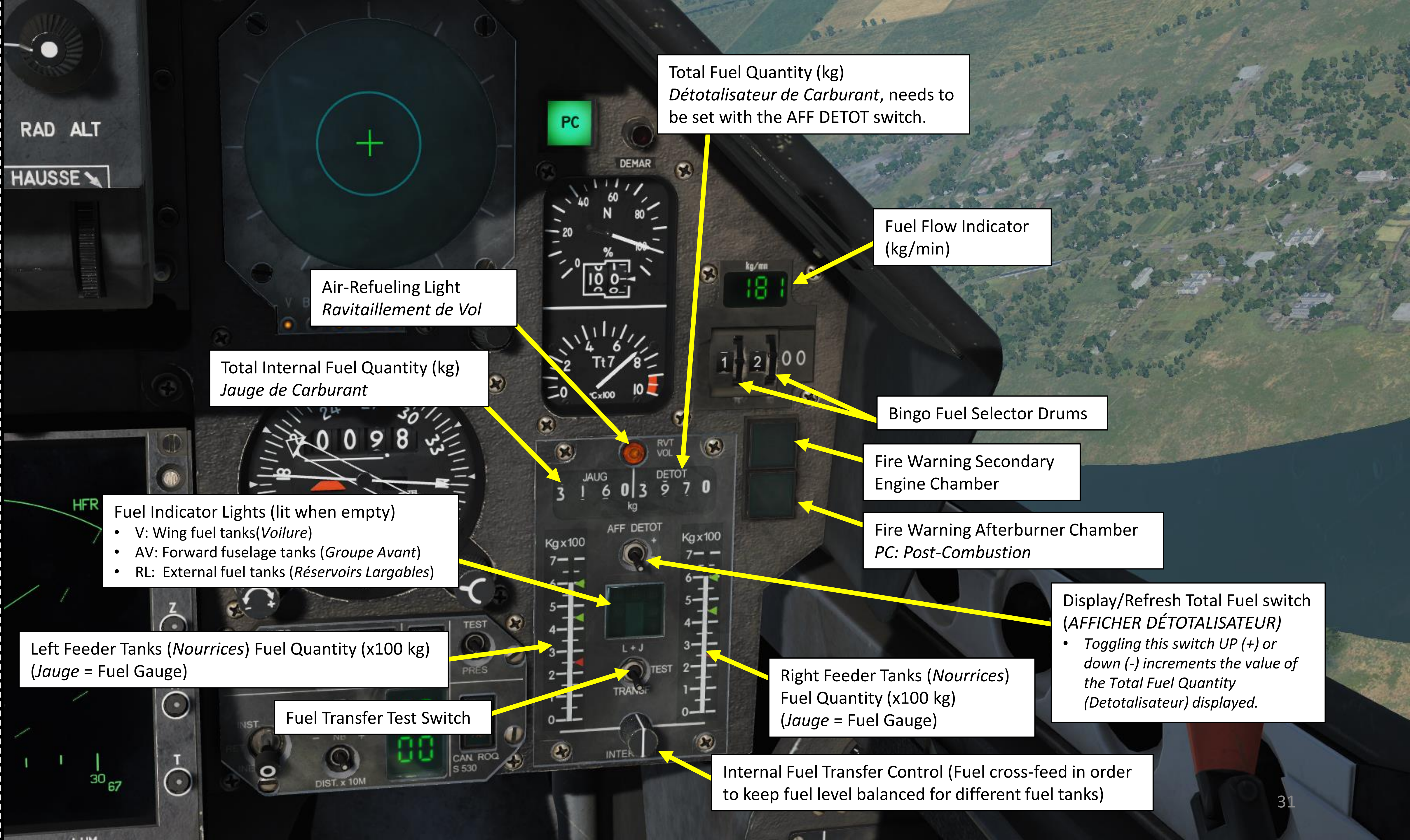
BINGO
Fuel remaining falls below BINGO level

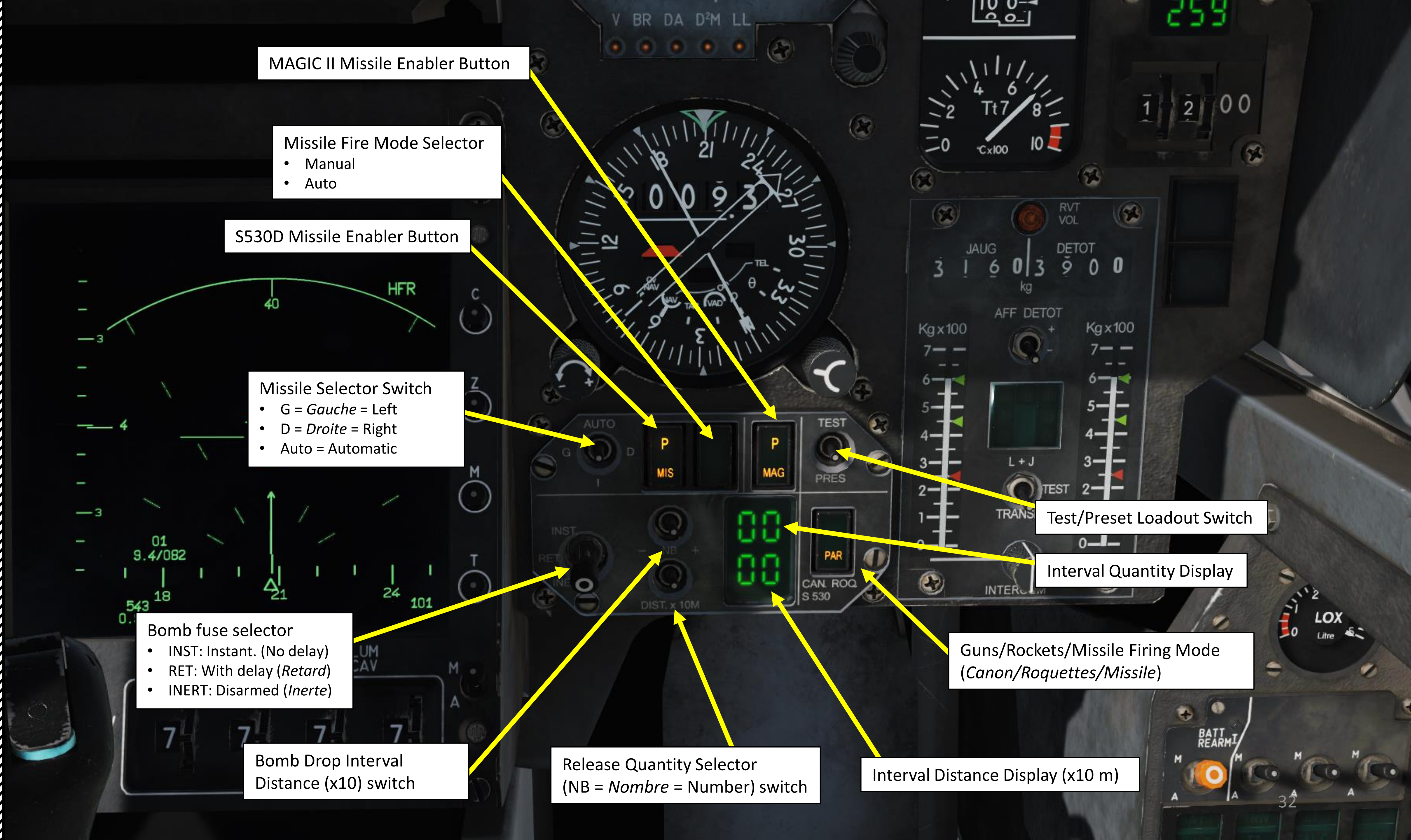
O2HA
No Function

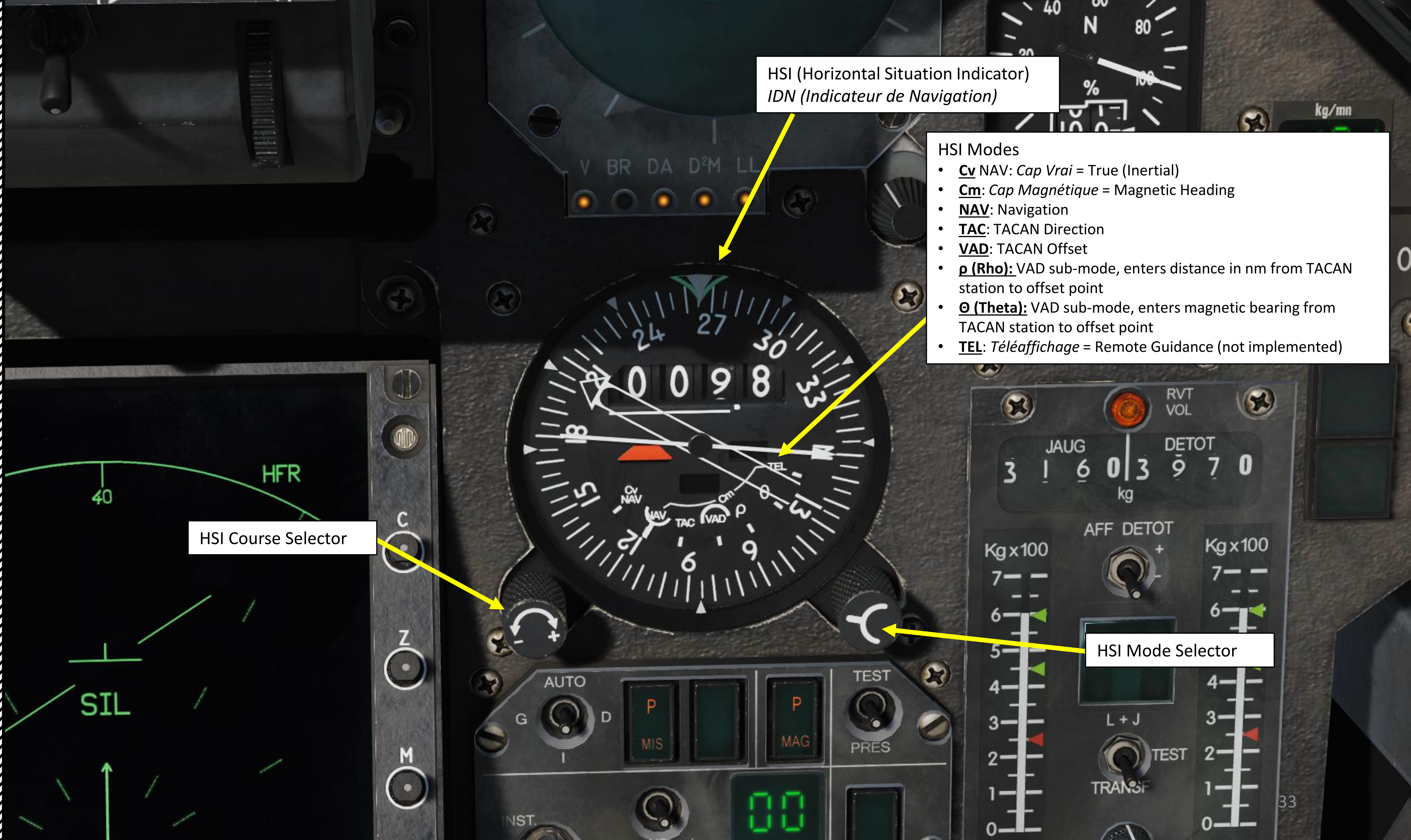
CONF
Fly-by-wire G limiter switch is in incorrect position for current weight configuration

U.S.EL
LAST EMERGENCY enabled for elevons
(Ultime Secours Élevons)

PARK.
Parking Brake Engaged


Total Fuel Quantity (kg)
Détotalisateur de Carburant, needs to be set with the AFF DETOT switch.
Fuel Flow Indicator (kg/min)
Air-Refueling Light
Ravitaillement de Vol
Total Internal Fuel Quantity (kg)
Jauge de Carburant
Bingo Fuel Selector Drums
Fire Warning Secondary Engine Chamber
Fire Warning Afterburner Chamber
PC: Post-Combustion
Fuel Indicator Lights (lit when empty)
• V: Wing fuel tanks(*Voilure*)
• AV: Forward fuselage tanks (*Groupe Avant*)
• RL: External fuel tanks (*Réservoirs Largables*)
Display/Refresh Total Fuel switch
(*AFFICHER DÉTOTALISATEUR)*
• *Toggling this switch UP (+) or down (-) increments the value of the Total Fuel Quantity (Detotalisateur) displayed.*
Left Feeder Tanks (*Nourrices*) Fuel Quantity (x100 kg)
(*Jauge* = Fuel Gauge)
Right Feeder Tanks (*Nourrices*)
Fuel Quantity (x100 kg)
(*Jauge* = Fuel Gauge)
Fuel Transfer Test Switch
Internal Fuel Transfer Control (Fuel cross-feed in order to keep fuel level balanced for different fuel tanks)
RAD ALT
HAUSSE
PC
DEMAR
RVT VOL
JAUG
DETOT
AFF DETOT
Kg x100
L + J
TEST
TRANSF
INTER
kg/mn
181
1 2 0 0
3 1 6 0 3 9 7 0
kg


MAGIC II Missile Enabler Button
Missile Fire Mode Selector
• Manual
• Auto
S530D Missile Enabler Button
Missile Selector Switch
• G = *Gauche* = Left
• D = *Droite* = Right
• Auto = Automatic
Bomb fuse selector
• INST: Instant. (No delay)
• RET: With delay (*Retard*)
• INERT: Disarmed (*Inerte*)
Bomb Drop Interval Distance (x10) switch
Release Quantity Selector (NB = *Nombre* = Number) switch
Interval Distance Display (x10 m)
Guns/Rockets/Missile Firing Mode (*Canon/Roquettes/Missile*)
Interval Quantity Display
Test/Preset Loadout Switch



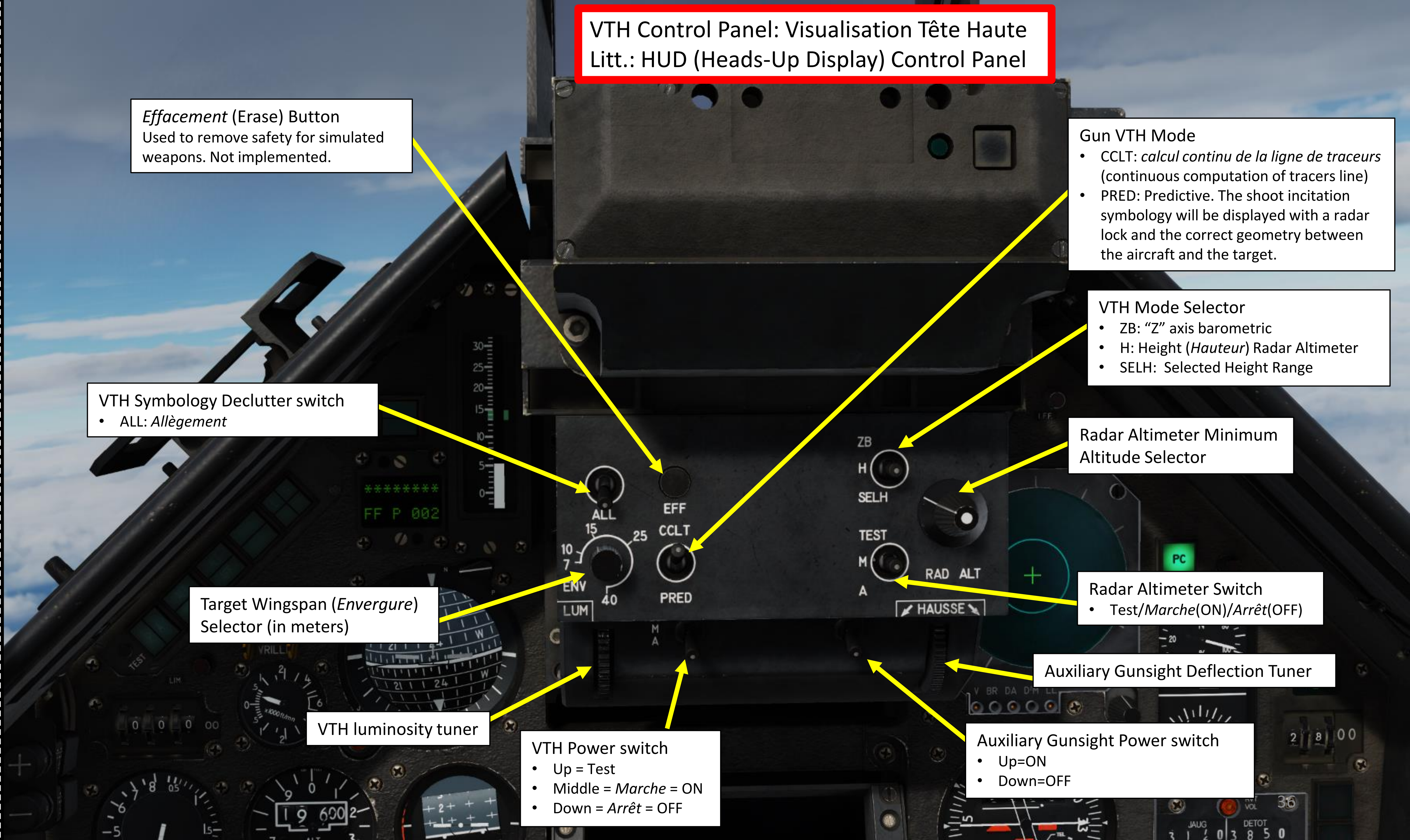
HSI Modes

- **Cv** NAV: *Cap Vrai* = True (Inertial)
- **Cm**: *Cap Magnétique* = Magnetic Heading
- **NAV**: Navigation
- **TAC**: TACAN Direction
- **VAD**: TACAN Offset
- **ρ (Rho):** VAD sub-mode, enters distance in nm from TACAN station to offset point
- **Θ (Theta):** VAD sub-mode, enters magnetic bearing from TACAN station to offset point
- **TEL**: *Téléaffichage* = Remote Guidance (not implemented)


Accelerometer (G-Meter)
IFF (Identify-Friend-or-Foe) Response Light
SERVAL (RWR): *Système d’Écoute Radar et de Visualisation de l’Alerte*
RWR: Radar Warning Receiver
PC (*Post-Combustion* = Afterburner) Indicator Light
Start-Up Indicator Light (*Démarrage* = Start-Up)
Engine RPM (%)
Tt7: Engine Turbine Exit Temperature (deg C x 100)
Counter-Measure Status Lights (Active when illuminated)
• V = *Veille* = Standby
• BR = *Brouilleur* = Jamming
• DA = *Détecteur d’Alerte* = RWR Status
• D2M = *Détection de Départ de Missile* = Missile Launch IR Detector
• LL = *Lance-Leurres* = Flares


Lance-Leurres (Decoy Dispenser) Indicator Light
• Blinks when countermeasures (i.e. chaff or flares) are being dispensed
EM (*Contremesures Électromagnétiques/*Chaff) Low Quantity Caution Light
• Blinks when chaff quantity is low
• Steady light when chaff quantity is 0 (empty)
IR (*Contremesures Infrarouges/*Flares) Low Quantity Caution Light
• Blinks when flare quantity is low
• Steady light when chaff quantity is 0 (empty)
EO (*Contremesures Électro-optiques/*Electro-Optical Countermeasures) Low Quantity Caution Light
• Blinks when EO quantity is low
• Steady light when EO quantity is 0 (empty)
• Not Simulated
EFF (*Effacement*/Erase) Button
Clears Caution Lights on the ECM Box

VTH Control Panel: Visualisation Tête Haute
Litt.: HUD (Heads-Up Display) Control Panel



Effacement (Erase) Button
Used to remove safety for simulated weapons. Not implemented.

VTH Symbology Declutter switch
- ALL: *Allègement*

Target Wingspan (*Envergure*) Selector (in meters)

VTH luminosity tuner

VTH Power switch
- Up = Test
- Middle = *Marche* = ON
- Down = *Arrêt* = OFF

Gun VTH Mode
- CCLT: *calcul continu de la ligne de traceurs* (continuous computation of tracers line)
- PRED: Predictive. The shoot incitation symbology will be displayed with a radar lock and the correct geometry between the aircraft and the target.

VTH Mode Selector
- ZB: "Z" axis barometric
- H: Height (*Hauteur*) Radar Altimeter
- SELH: Selected Height Range

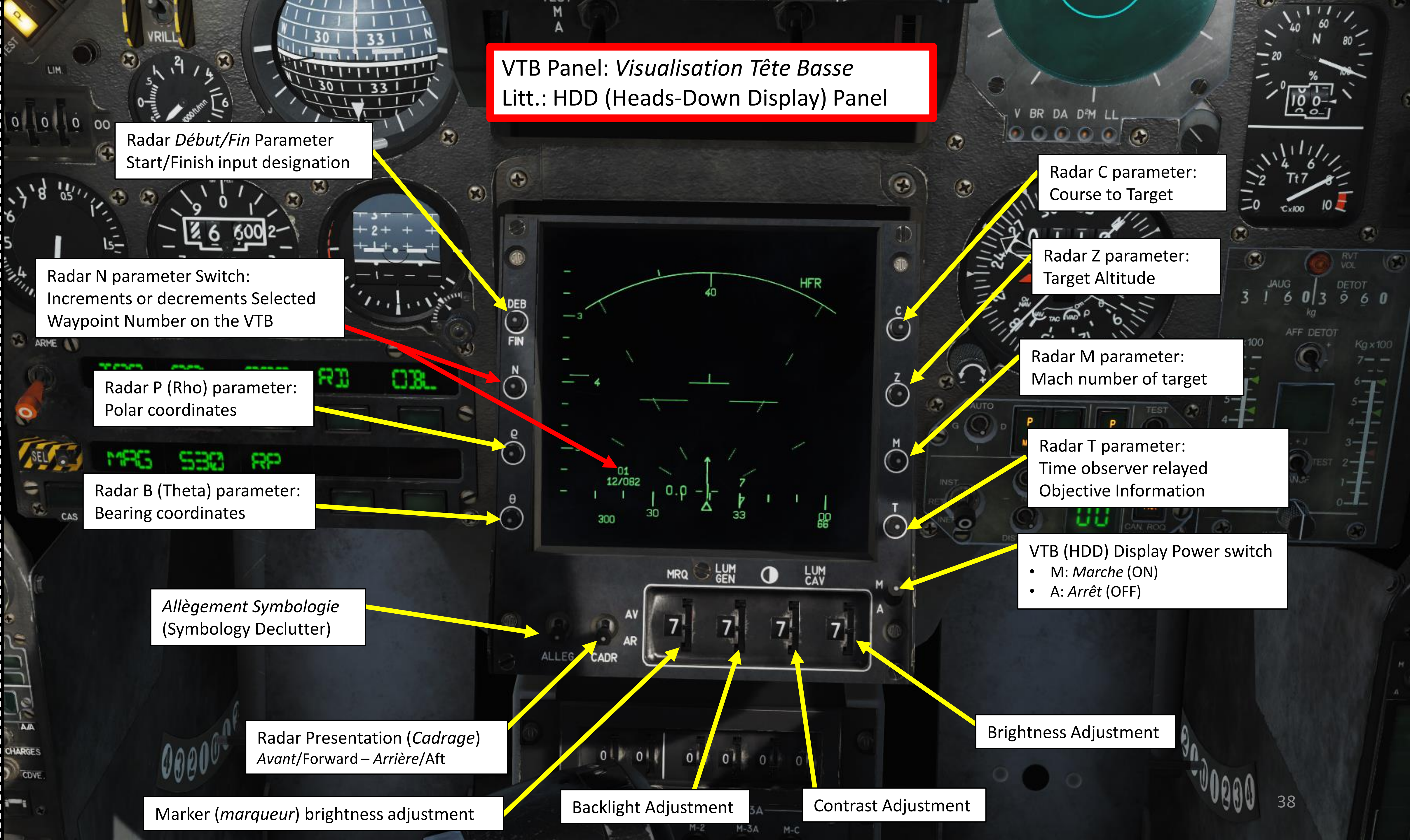
Radar Altimeter Minimum Altitude Selector

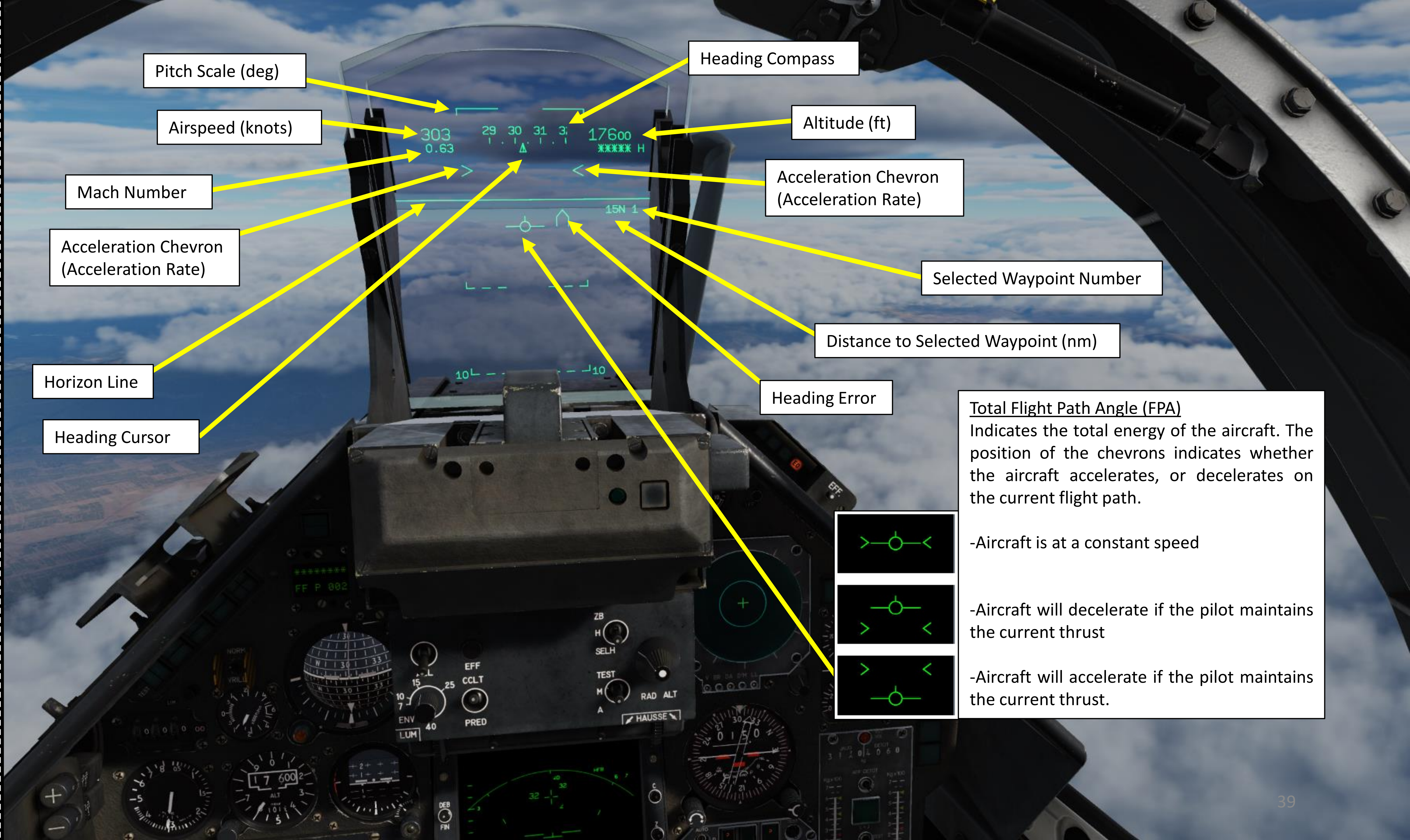
Radar Altimeter Switch
- Test/*Marche*(ON)/*Arrêt*(OFF)

Auxiliary Gunsight Deflection Tuner

Auxiliary Gunsight Power switch
- Up=ON
- Down=OFF


ALL
EFF
CCLT
PRED
ENV
LUM
ZB
H
SELH
TEST
RAD ALT
HAUSSE
TOP POL APPR RD DBL
MAG S 3 0 RP
RALLUMAGE EN VOL
N > 13 %
T7 < 950°
AVANT
NORMAL
PANNE CALC
SEC. CARB.
APRES
EFF.


VTB Panel: *Visualisation Tête Basse*
Litt.: HDD (Heads-Down Display) Panel
Radar *Début/Fin* Parameter
Start/Finish input designation
Radar N parameter Switch:
Increments or decrements Selected Waypoint Number on the VTB
Radar P (Rho) parameter:
Polar coordinates
Radar B (Theta) parameter:
Bearing coordinates
Allègement Symbologie
(Symbology Declutter)
Radar Presentation (*Cadrage*)
Avant/Forward – *Arrière*/Aft
Marker (*marqueur*) brightness adjustment
Backlight Adjustment
Contrast Adjustment
Brightness Adjustment
Radar C parameter:
Course to Target
Radar Z parameter:
Target Altitude
Radar M parameter:
Mach number of target
Radar T parameter:
Time observer relayed Objective Information
VTB (HDD) Display Power switch
• M: *Marche* (ON)
• A: *Arrêt* (OFF)
DEB
FIN
MRQ
LUM GEN
LUM CAV
ALLEG
CADR
AV
AR



Total Flight Path Angle (FPA)

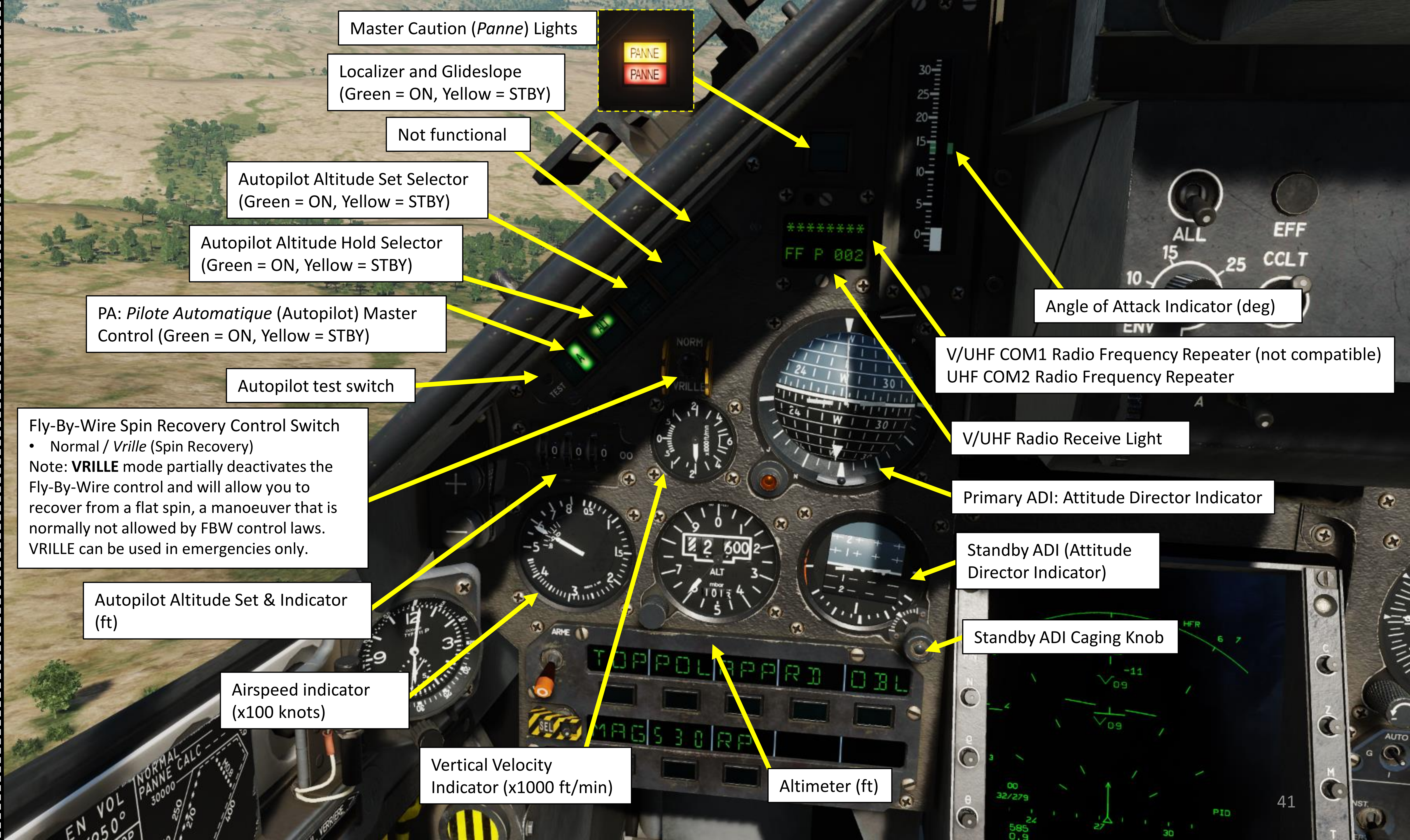
Indicates the total energy of the aircraft. The position of the chevrons indicates whether the aircraft accelerates, or decelerates on the current flight path.

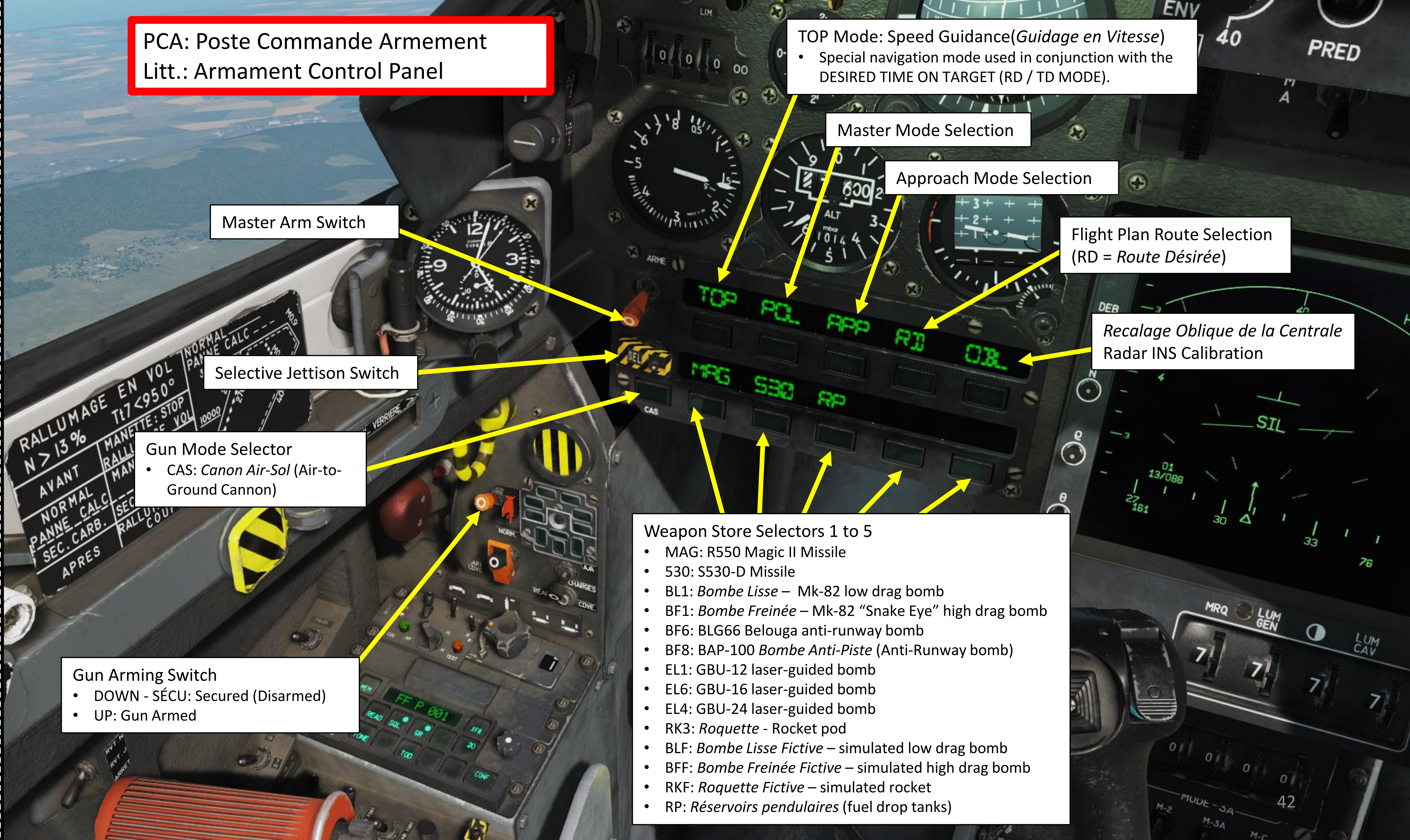
-Aircraft is at a constant speed

-Aircraft will decelerate if the pilot maintains the current thrust

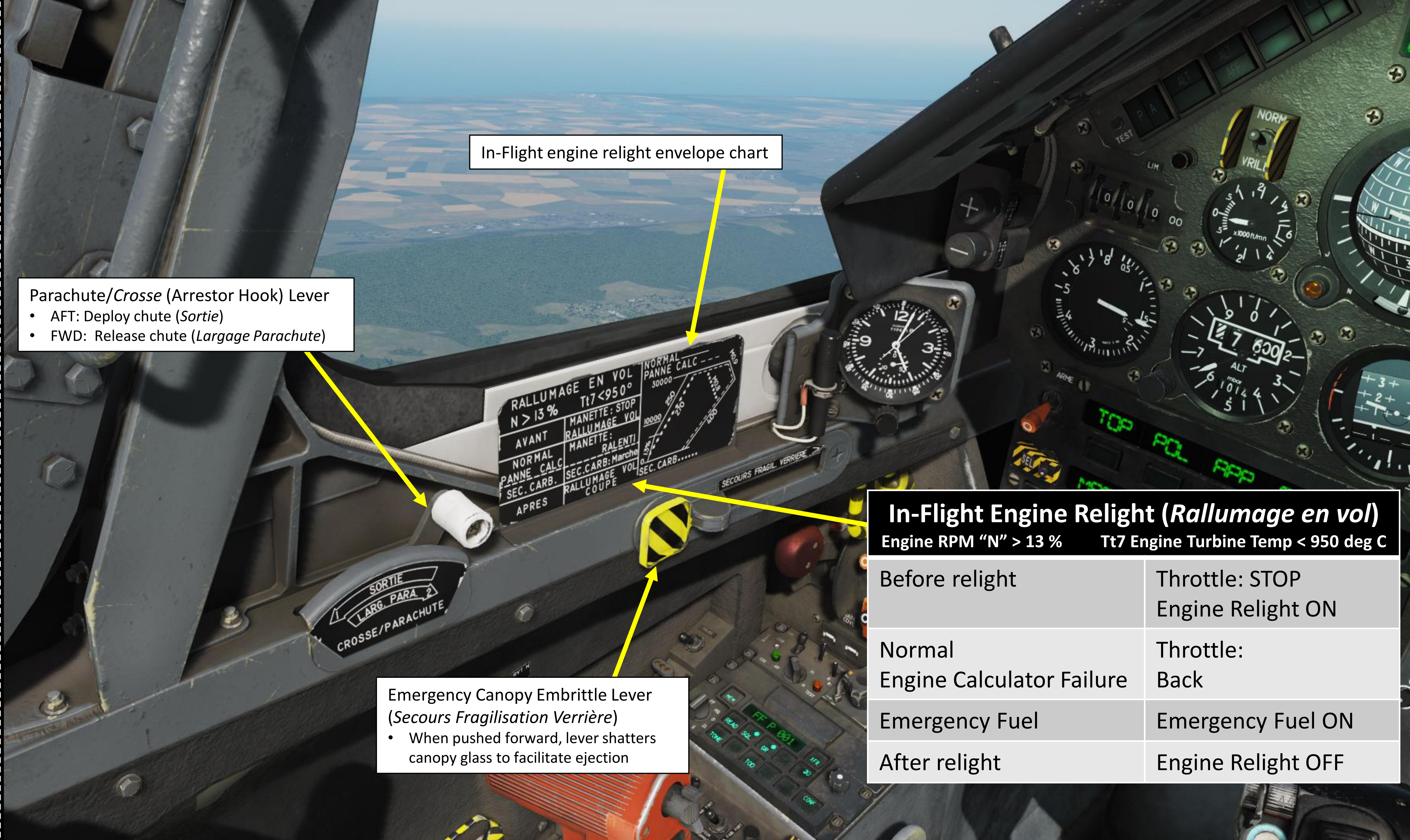
-Aircraft will accelerate if the pilot maintains the current thrust.


Weapon Selected
• CAN: Cannon
• MAG: Magic II missile
• 530: Super 530D missile
G acceleration
29 30 31 3
313
0.65
17510
MAG
1.0G
G
D
10
10


Master Caution (*Panne*) Lights
PANNE
PANNE
Localizer and Glideslope (Green = ON, Yellow = STBY)
Not functional
Autopilot Altitude Set Selector (Green = ON, Yellow = STBY)
Autopilot Altitude Hold Selector (Green = ON, Yellow = STBY)
PA: *Pilote Automatique* (Autopilot) Master Control (Green = ON, Yellow = STBY)
Autopilot test switch
Fly-By-Wire Spin Recovery Control Switch
• Normal / *Vrille* (Spin Recovery)
Note: **VRILLE** mode partially deactivates the Fly-By-Wire control and will allow you to recover from a flat spin, a manoeuver that is normally not allowed by FBW control laws. VRILLE can be used in emergencies only.
Autopilot Altitude Set & Indicator (ft)
Airspeed indicator (x100 knots)
Vertical Velocity Indicator (x1000 ft/min)
Altimeter (ft)
Angle of Attack Indicator (deg)
V/UHF COM1 Radio Frequency Repeater (not compatible)
UHF COM2 Radio Frequency Repeater
V/UHF Radio Receive Light
Primary ADI: Attitude Director Indicator
Standby ADI (Attitude Director Indicator)
Standby ADI Caging Knob
NORM
VRILLE
TEST
ALT
A
FF P 002
ALL
EFF
CCLT
ENV
ARME
SEL
TOP POL APP RD OBL
MAG S 3 0 RP
NORMAL
PANNE CALC
EN VOL


PCA: Poste Commande Armement
Litt.: Armament Control Panel
TOP Mode: Speed Guidance(*Guidage en Vitesse*)
• Special navigation mode used in conjunction with the DESIRED TIME ON TARGET (RD / TD MODE).
Master Mode Selection
Approach Mode Selection
Flight Plan Route Selection (RD = *Route Désirée*)
Recalage Oblique de la Centrale Radar INS Calibration
Master Arm Switch
Selective Jettison Switch
Gun Mode Selector
• CAS: *Canon Air-Sol* (Air-to-Ground Cannon)
Gun Arming Switch
• DOWN - SÉCU: Secured (Disarmed)
• UP: Gun Armed
Weapon Store Selectors 1 to 5
• MAG: R550 Magic II Missile
• 530: S530-D Missile
• BL1: *Bombe Lisse* – Mk-82 low drag bomb
• BF1: *Bombe Freinée* – Mk-82 “Snake Eye” high drag bomb
• BF6: BLG66 Belouga anti-runway bomb
• BF8: BAP-100 *Bombe Anti-Piste* (Anti-Runway bomb)
• EL1: GBU-12 laser-guided bomb
• EL6: GBU-16 laser-guided bomb
• EL4: GBU-24 laser-guided bomb
• RK3: *Roquette* - Rocket pod
• BLF: *Bombe Lisse Fictive* – simulated low drag bomb
• BFF: *Bombe Freinée Fictive* – simulated high drag bomb
• RKF: *Roquette Fictive* – simulated rocket
• RP: *Réservoirs pendulaires* (fuel drop tanks)


Clock
INS (Inertial Navigation System) Next Waypoint Button
INS (Inertial Navigation System) Previous Waypoint Button

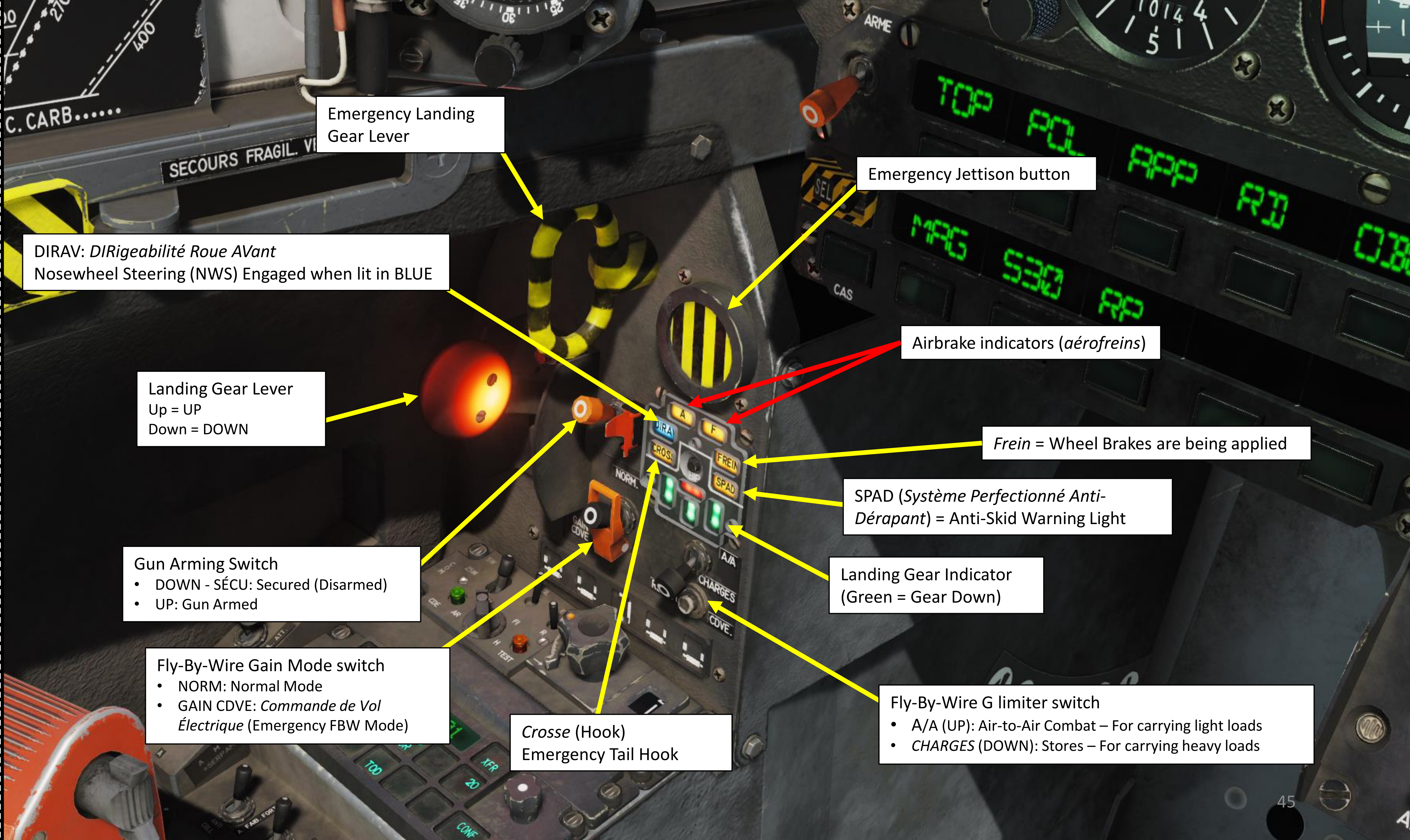


In-Flight engine relight envelope chart

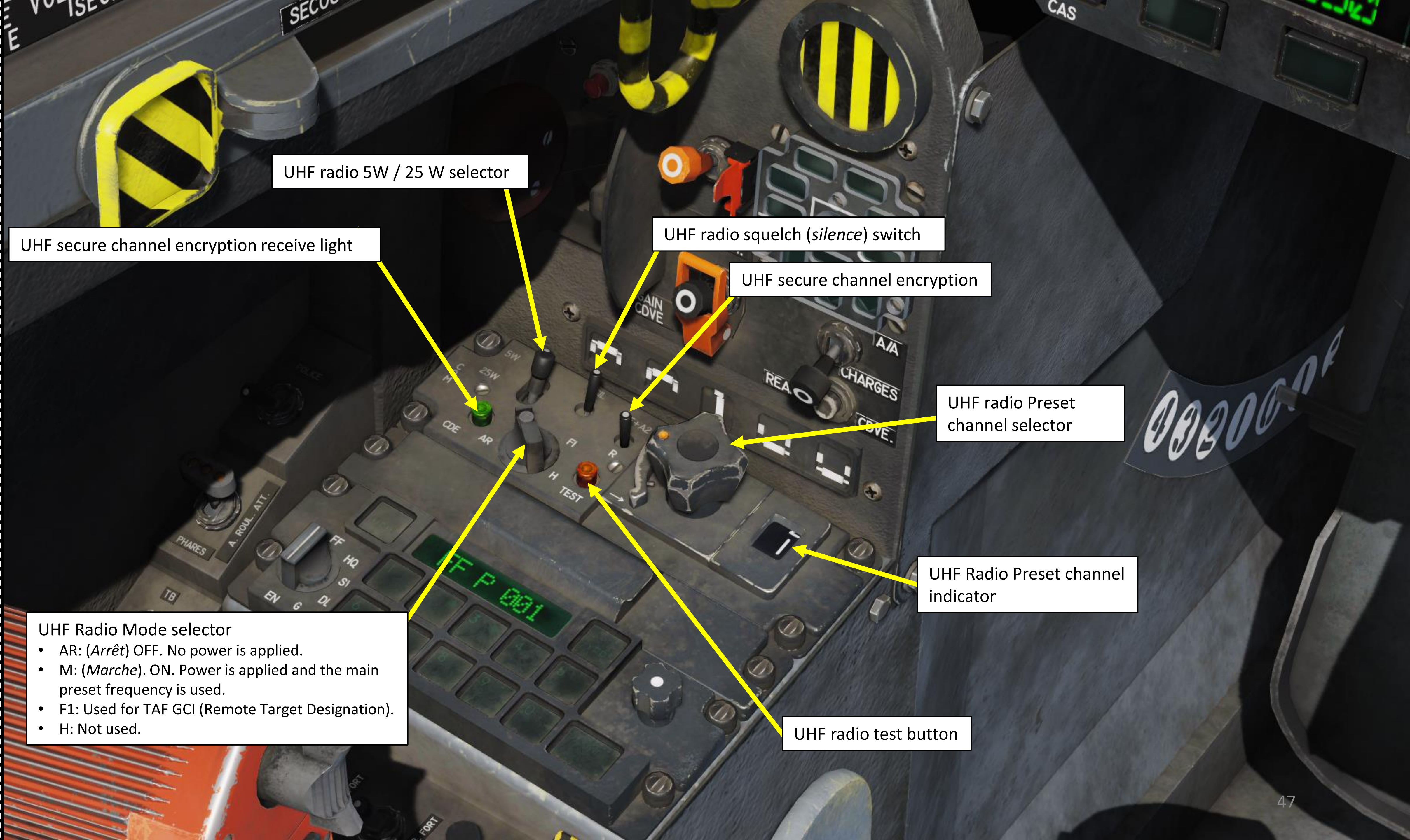
Parachute/*Crosse* (Arrestor Hook) Lever
- AFT: Deploy chute (*Sortie*)
- FWD: Release chute (*Largage Parachute*)

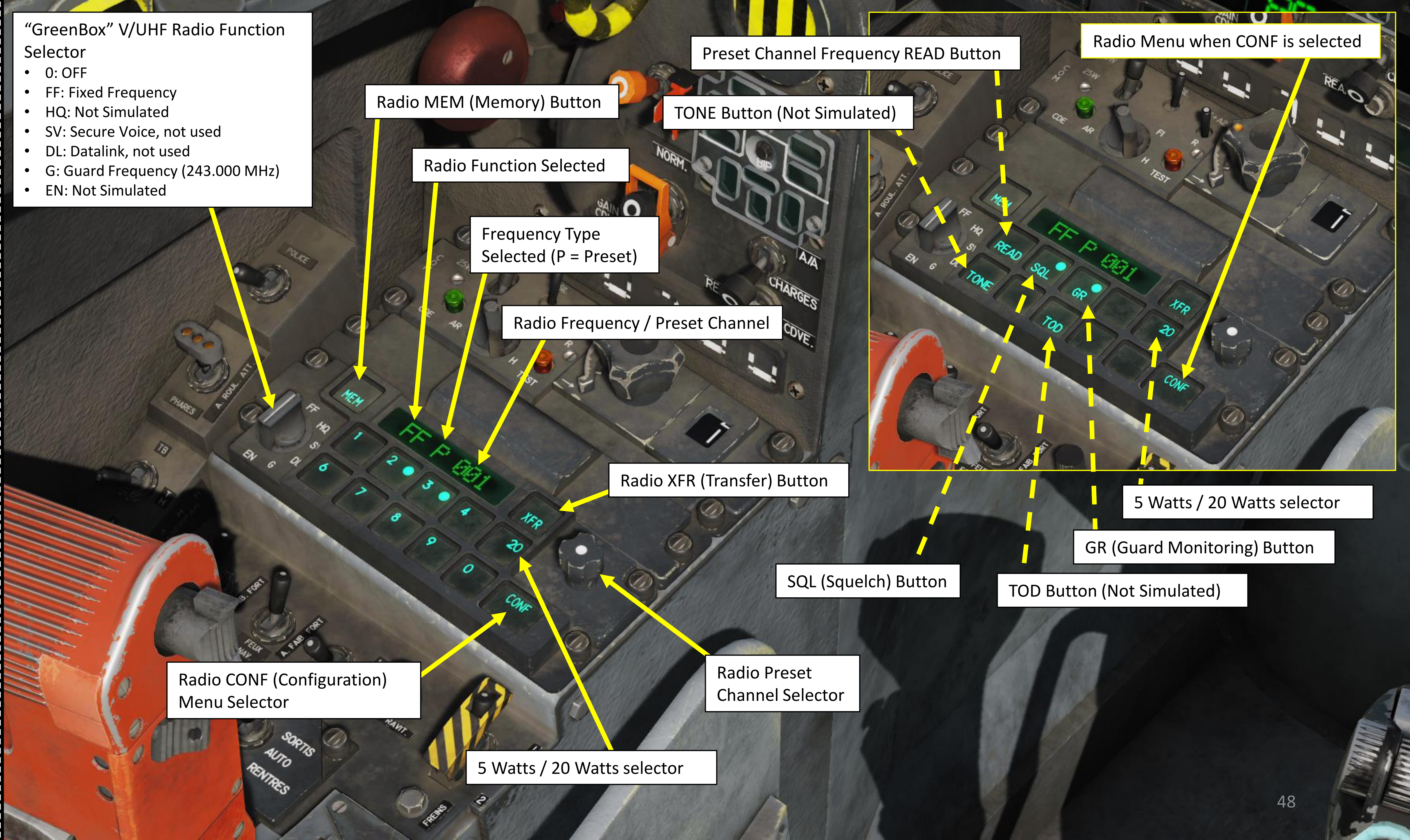
Emergency Canopy Embrittle Lever (*Secours Fragilisation Verrière*)
- When pushed forward, lever shatters canopy glass to facilitate ejection

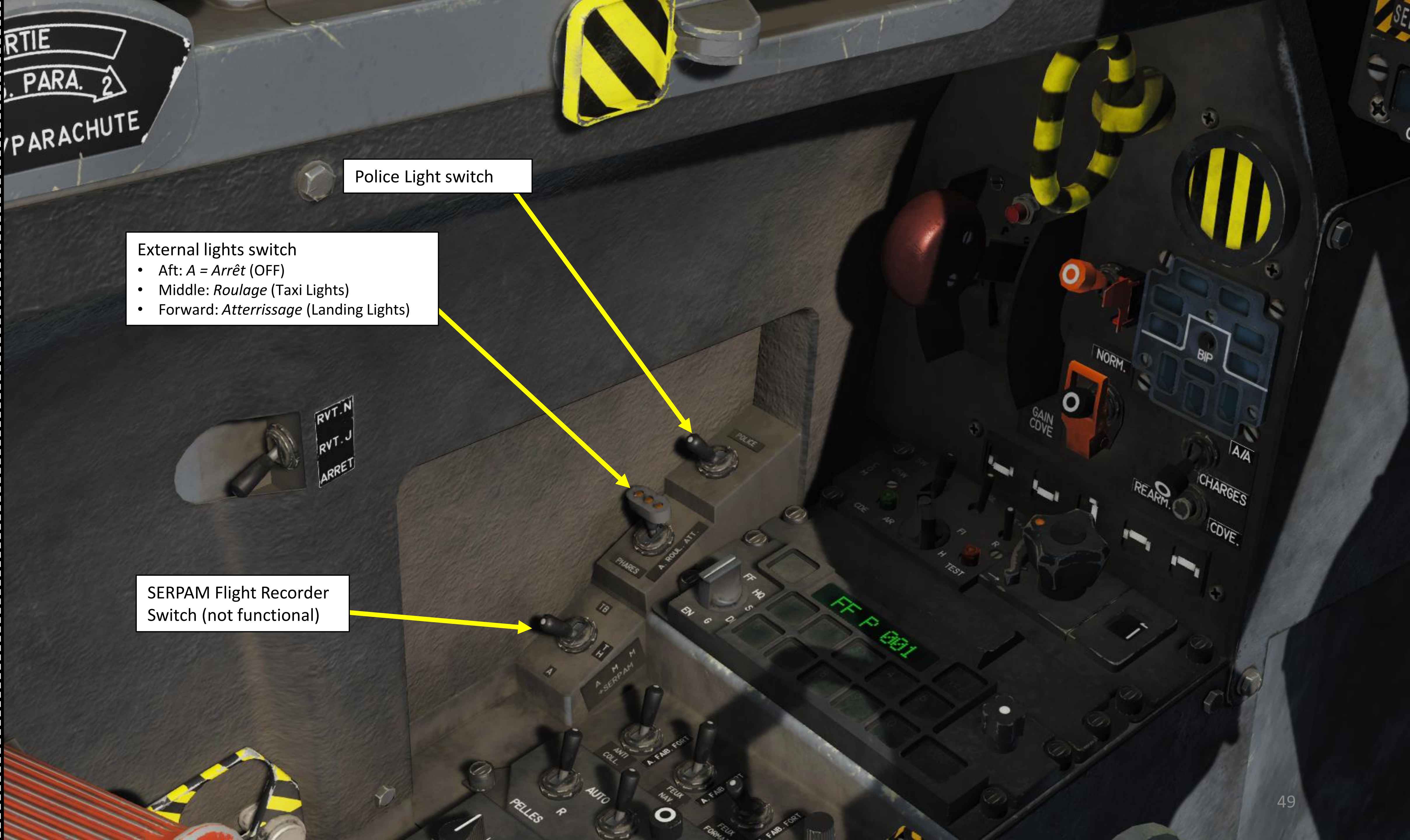
In-Flight Engine Relight (*Rallumage en vol*) Engine RPM "N" > 13 % Tt7 Engine Turbine Temp < 950 deg C	
Before relight	Throttle: STOP Engine Relight ON
Normal Engine Calculator Failure	Throttle: Back
Emergency Fuel	Emergency Fuel ON
After relight	Engine Relight OFF


Emergency Landing Gear Lever
Emergency Jettison button
DIRAV: *DIRigeabilité Roue AVant*
Nosewheel Steering (NWS) Engaged when lit in BLUE
Airbrake indicators (*aérofreins*)
Landing Gear Lever
Up = UP
Down = DOWN
Frein = Wheel Brakes are being applied
SPAD (*Système Perfectionné Anti-Dérapant*) = Anti-Skid Warning Light
Gun Arming Switch
• DOWN - SÉCU: Secured (Disarmed)
• UP: Gun Armed
Landing Gear Indicator (Green = Gear Down)
Fly-By-Wire Gain Mode switch
• NORM: Normal Mode
• GAIN CDVE: *Commande de Vol Électrique* (Emergency FBW Mode)
Crosse (Hook)
Emergency Tail Hook
Fly-By-Wire G limiter switch
• A/A (UP): Air-to-Air Combat – For carrying light loads
• *CHARGES* (DOWN): Stores – For carrying heavy loads


SECOURS FRAGIL. VERRIERE
SEC. CARB......
VOL
NORM.
A/A
CHARGES
REARM.
CDVE.
CAS
Control Surface Deflections

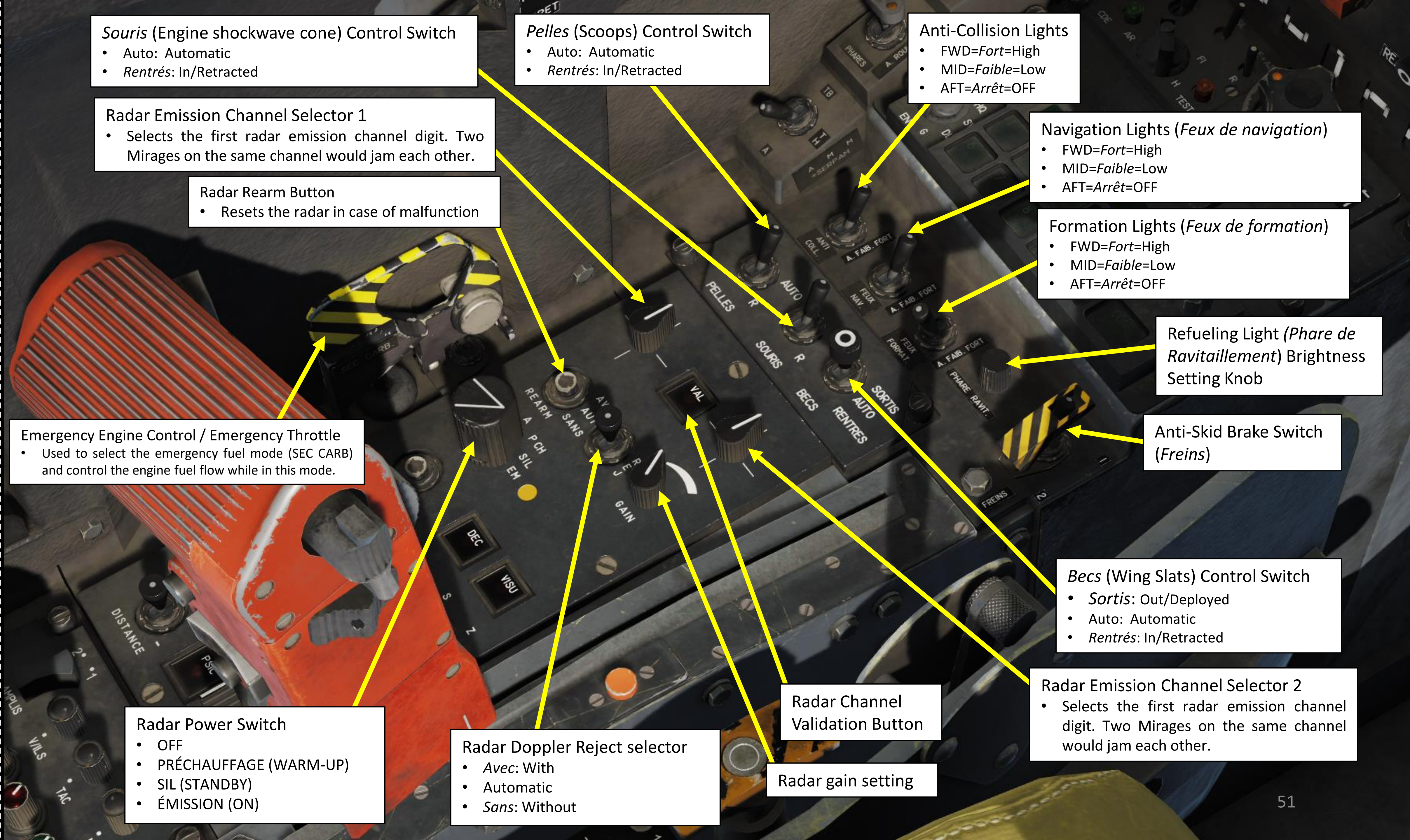

UHF radio 5W / 25 W selector
UHF secure channel encryption receive light
UHF radio squelch (*silence*) switch
UHF secure channel encryption
UHF radio Preset channel selector
UHF Radio Preset channel indicator
UHF radio test button
UHF Radio Mode selector
- AR: (*Arrêt*) OFF. No power is applied.
- M: (*Marche*). ON. Power is applied and the main preset frequency is used.
- F1: Used for TAF GCI (Remote Target Designation).
- H: Not used.

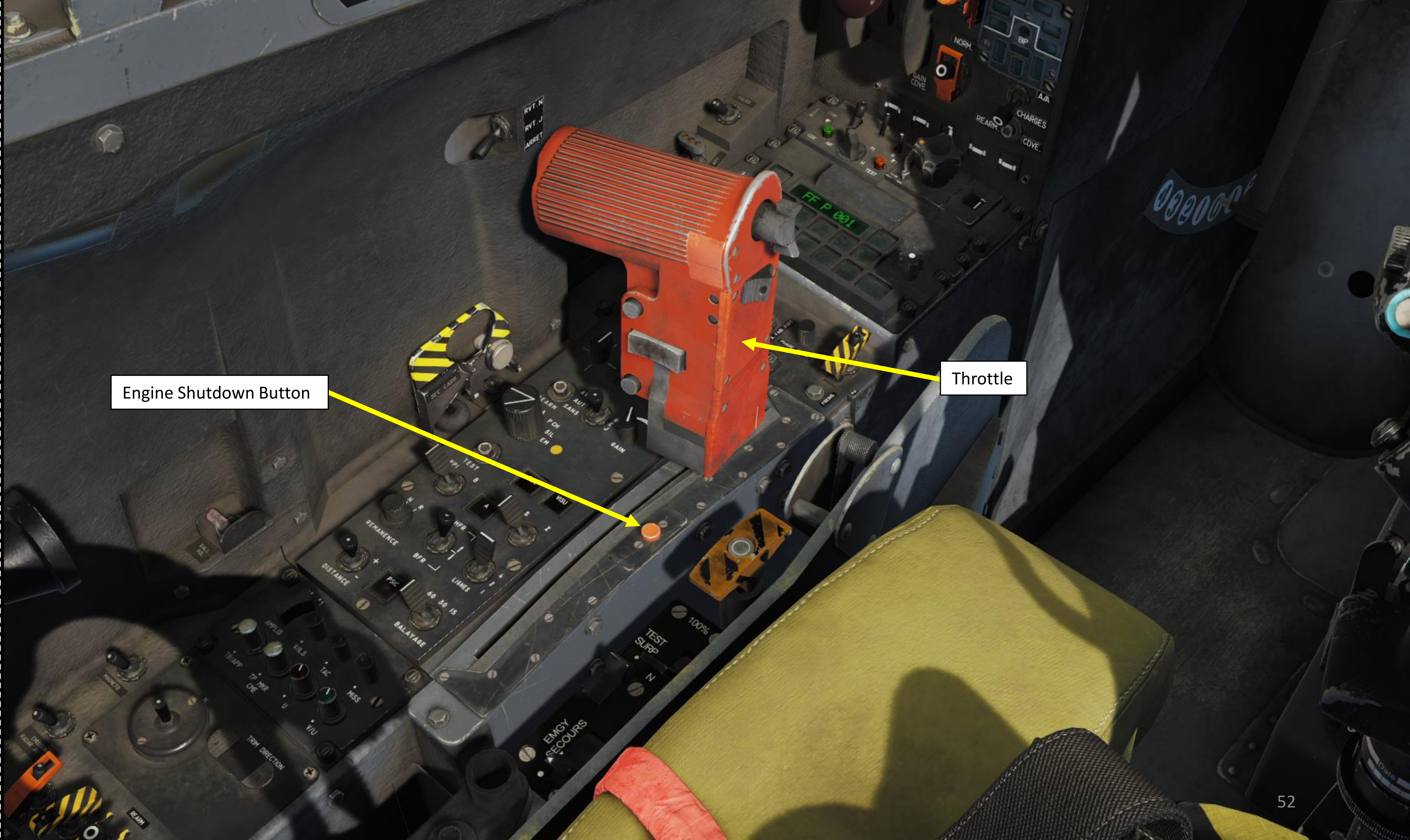

"GreenBox" V/UHF Radio Function Selector
• 0: OFF
• FF: Fixed Frequency
• HQ: Not Simulated
• SV: Secure Voice, not used
• DL: Datalink, not used
• G: Guard Frequency (243.000 MHz)
• EN: Not Simulated
Radio MEM (Memory) Button
Radio Function Selected
Frequency Type Selected (P = Preset)
Radio Frequency / Preset Channel
Preset Channel Frequency READ Button
TONE Button (Not Simulated)
Radio Menu when CONF is selected
Radio XFR (Transfer) Button
5 Watts / 20 Watts selector
GR (Guard Monitoring) Button
SQL (Squelch) Button
TOD Button (Not Simulated)
Radio CONF (Configuration) Menu Selector
Radio Preset Channel Selector
5 Watts / 20 Watts selector

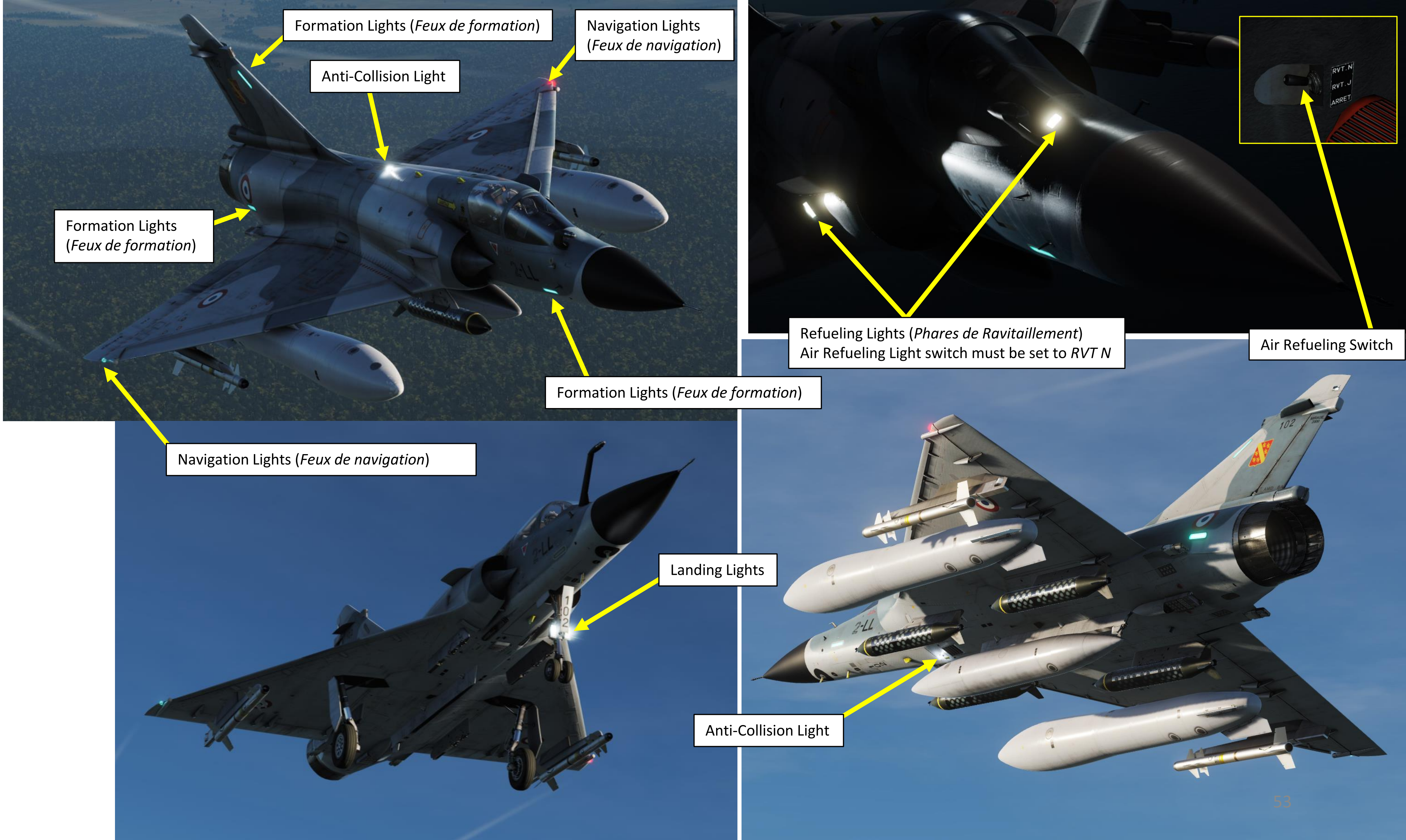

Police Light switch
External lights switch
• Aft: *A = Arrêt* (OFF)
• Middle: *Roulage* (Taxi Lights)
• Forward: *Atterrissage* (Landing Lights)
SERPAM Flight Recorder Switch (not functional)

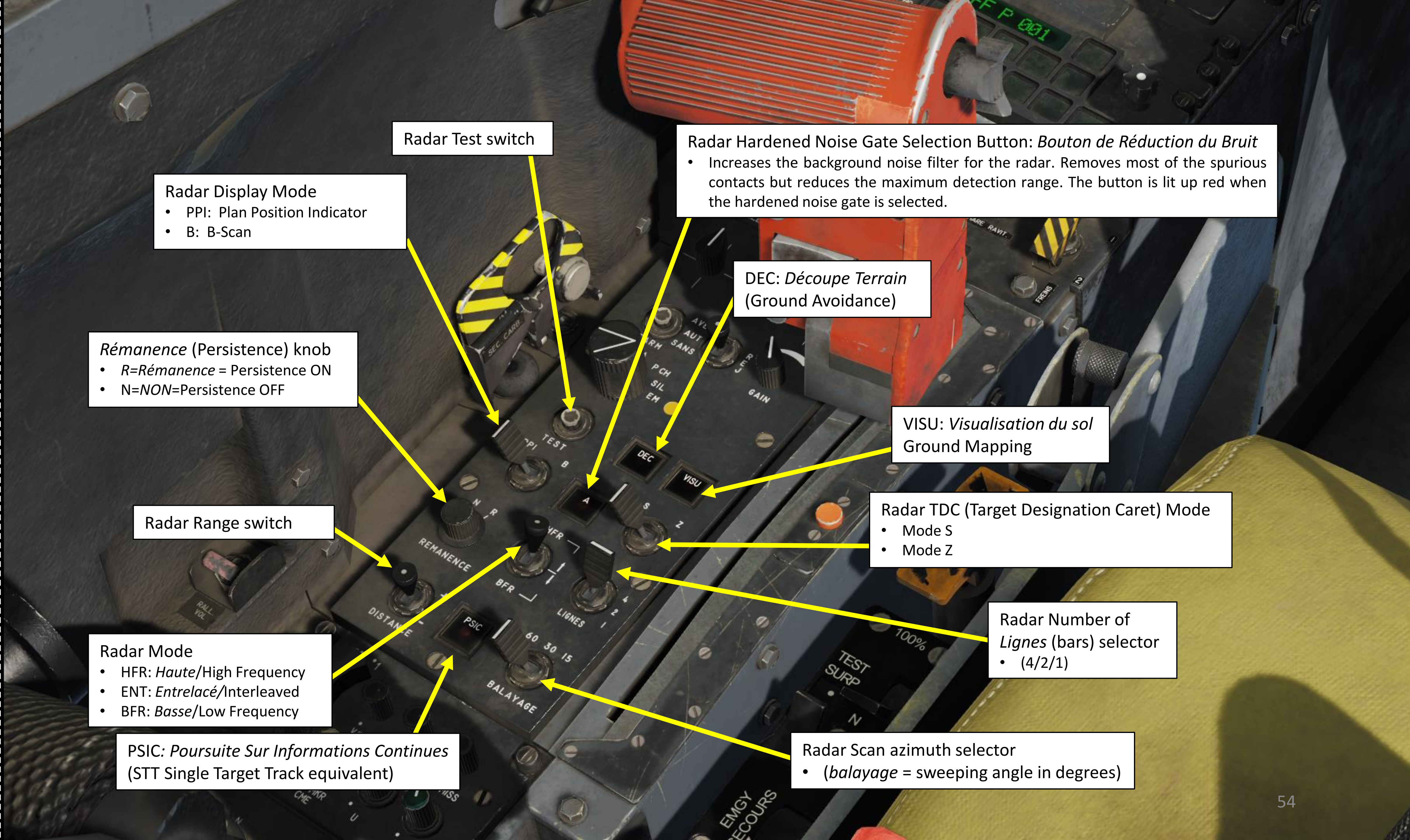
Air Refueling (*Ravitaillement*) Switch

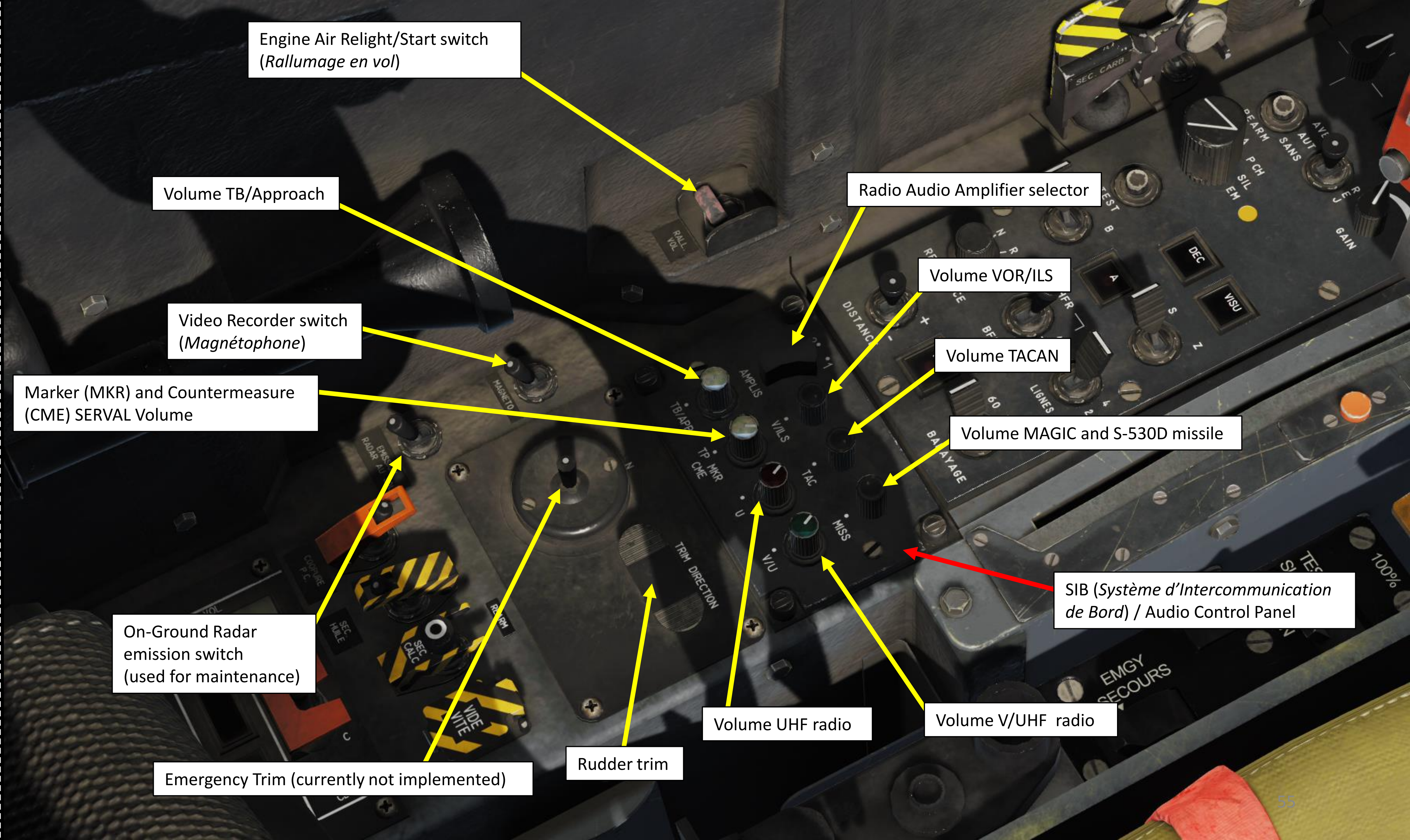
- Up = Open/ON - Night/*Nuit* Refueling (lights on)
- Middle = Open/ON - Day/*Jour* Refueling (lights off)
- Down = Closed/OFF

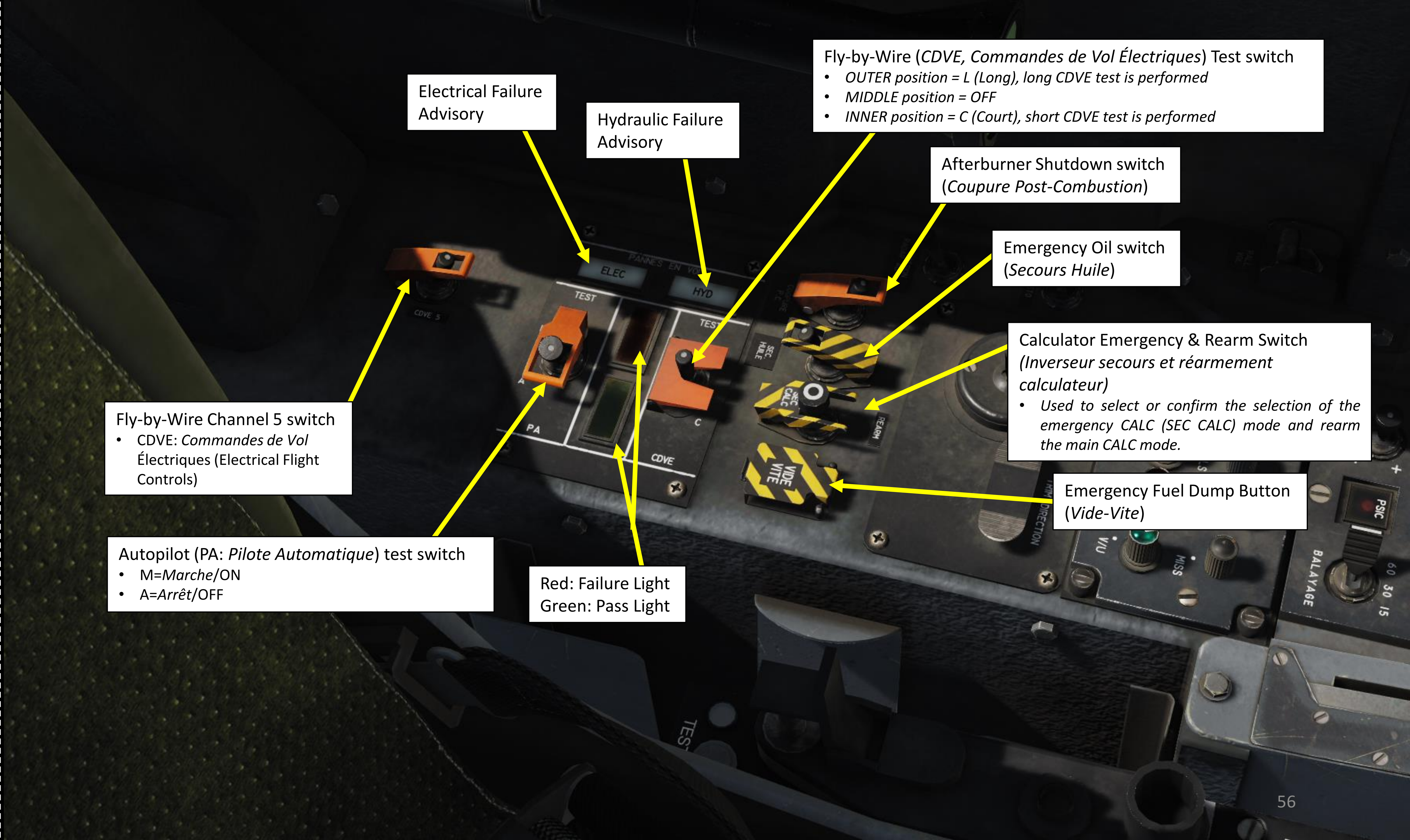

Souris (Engine shockwave cone) Control Switch
• Auto: Automatic
• *Rentrés*: In/Retracted
Pelles (Scoops) Control Switch
• Auto: Automatic
• *Rentrés*: In/Retracted
Anti-Collision Lights
• FWD=*Fort*=High
• MID=*Faible*=Low
• AFT=*Arrêt*=OFF
Radar Emission Channel Selector 1
• Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.
Radar Rearm Button
• Resets the radar in case of malfunction
Navigation Lights (*Feux de navigation*)
• FWD=*Fort*=High
• MID=*Faible*=Low
• AFT=*Arrêt*=OFF
Formation Lights (*Feux de formation*)
• FWD=*Fort*=High
• MID=*Faible*=Low
• AFT=*Arrêt*=OFF
Refueling Light (*Phare de Ravitaillement*) Brightness Setting Knob
Emergency Engine Control / Emergency Throttle
• Used to select the emergency fuel mode (SEC CARB) and control the engine fuel flow while in this mode.
Anti-Skid Brake Switch (*Freins*)
Becs (Wing Slats) Control Switch
• *Sortis*: Out/Deployed
• Auto: Automatic
• *Rentrés*: In/Retracted
Radar Power Switch
• OFF
• PRÉCHAUFFAGE (WARM-UP)
• SIL (STANDBY)
• ÉMISSION (ON)
Radar Doppler Reject selector
• *Avec*: With
• Automatic
• *Sans*: Without
Radar Channel Validation Button
Radar gain setting
Radar Emission Channel Selector 2
• Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.


Engine Shutdown Button
Throttle

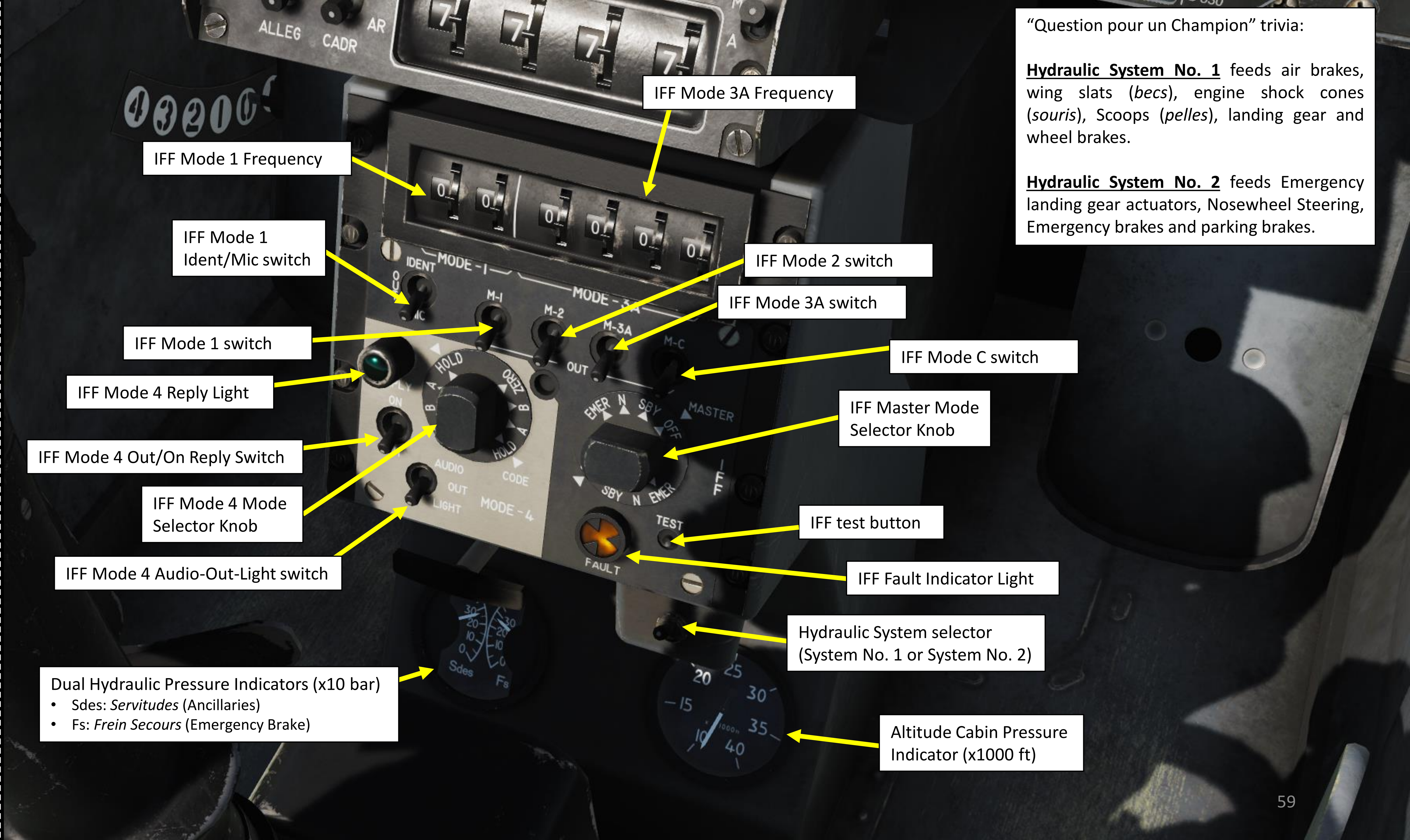

Formation Lights (*Feux de formation*)
Navigation Lights (*Feux de navigation*)
Anti-Collision Light
Formation Lights (*Feux de formation*)
Formation Lights (*Feux de formation*)
Navigation Lights (*Feux de navigation*)
RVT N
RVT J
ARRET
Refueling Lights (*Phares de Ravitaillement*)
Air Refueling Light switch must be set to *RVT N*
Air Refueling Switch
Landing Lights
Anti-Collision Light


Radar Test switch
Radar Display Mode
• PPI: Plan Position Indicator
• B: B-Scan
Rémanence (Persistence) knob
• *R=Rémanence* = Persistence ON
• N=*NON*=Persistence OFF
Radar Range switch
Radar Mode
• HFR: *Haute*/High Frequency
• ENT: *Entrelacé*/Interleaved
• BFR: *Basse*/Low Frequency
PSIC: *Poursuite Sur Informations Continues*
(STT Single Target Track equivalent)
Radar Hardened Noise Gate Selection Button: *Bouton de Réduction du Bruit*
• Increases the background noise filter for the radar. Removes most of the spurious contacts but reduces the maximum detection range. The button is lit up red when the hardened noise gate is selected.
DEC: *Découpe Terrain*
(Ground Avoidance)
VISU: *Visualisation du sol*
Ground Mapping
Radar TDC (Target Designation Caret) Mode
• Mode S
• Mode Z
Radar Number of
Lignes (bars) selector
• (4/2/1)
Radar Scan azimuth selector
• (*balayage* = sweeping angle in degrees)


Engine Air Relight/Start switch (*Rallumage en vol*)
Volume TB/Approach
Radio Audio Amplifier selector
Volume VOR/ILS
Video Recorder switch (*Magnétophone*)
Volume TACAN
Marker (MKR) and Countermeasure (CME) SERVAL Volume
Volume MAGIC and S-530D missile
SIB (*Système d'Intercommunication de Bord*) / Audio Control Panel
On-Ground Radar emission switch (used for maintenance)
Volume UHF radio
Volume V/UHF radio
Rudder trim
Emergency Trim (currently not implemented)


Electrical Failure Advisory
Hydraulic Failure Advisory
Fly-by-Wire (*CDVE, Commandes de Vol Électriques*) Test switch
• *OUTER position = L (Long), long CDVE test is performed*
• *MIDDLE position = OFF*
• *INNER position = C (Court), short CDVE test is performed*
Afterburner Shutdown switch (*Coupure Post-Combustion*)
Emergency Oil switch (*Secours Huile*)
Calculator Emergency & Rearm Switch (*Inverseur secours et réarmement calculateur)*
• *Used to select or confirm the selection of the emergency CALC (SEC CALC) mode and rearm the main CALC mode.*
Emergency Fuel Dump Button (*Vide-Vite*)
Fly-by-Wire Channel 5 switch
• CDVE: *Commandes de Vol Électriques* (Electrical Flight Controls)
Autopilot (PA: *Pilote Automatique*) test switch
• M=*Marche*/ON
• A=*Arrêt*/OFF
Red: Failure Light
Green: Pass Light
ELEC
HYD
TEST
PA
CDVE
VIDE VITE
REARM


Cockpit Flood Light Lamp



"Question pour un Champion" trivia:

Hydraulic System No. 1 feeds air brakes, wing slats (*becs*), engine shock cones (*souris*), Scoops (*pelles*), landing gear and wheel brakes.

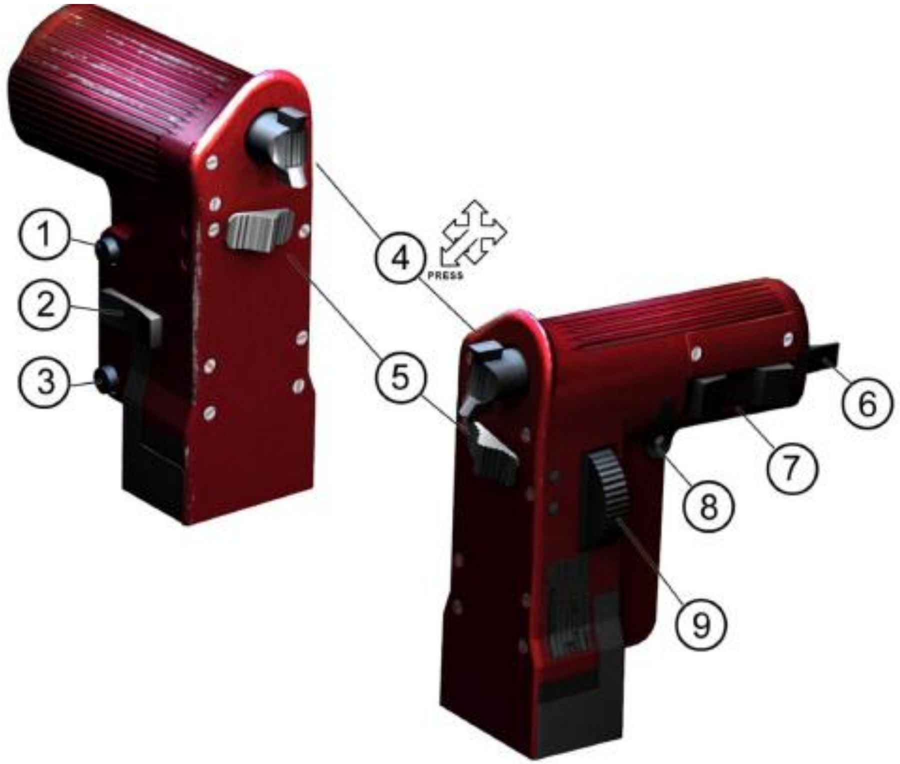
Hydraulic System No. 2 feeds Emergency landing gear actuators, Nosewheel Steering, Emergency brakes and parking brakes.


100%
TEST
SURP
EMGY
SECOURS
MANUAL SEPARATION
SEPARATION MANUELLE
VOR.ILS
108.30
TACAN
X 16
MODES
JVN
BANQUETTES VOYANTS
U.V.
PL. DE BORD
COND
DEPOLL
MANUEL
AUTO
EQUIP
TEST

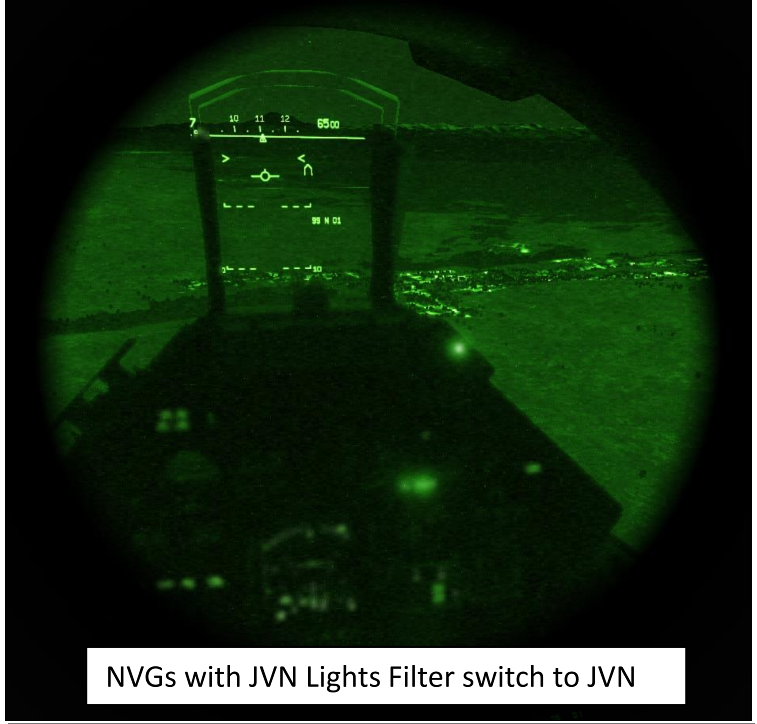
HOTAS
(Hands-On-Throttle-and-Stick)

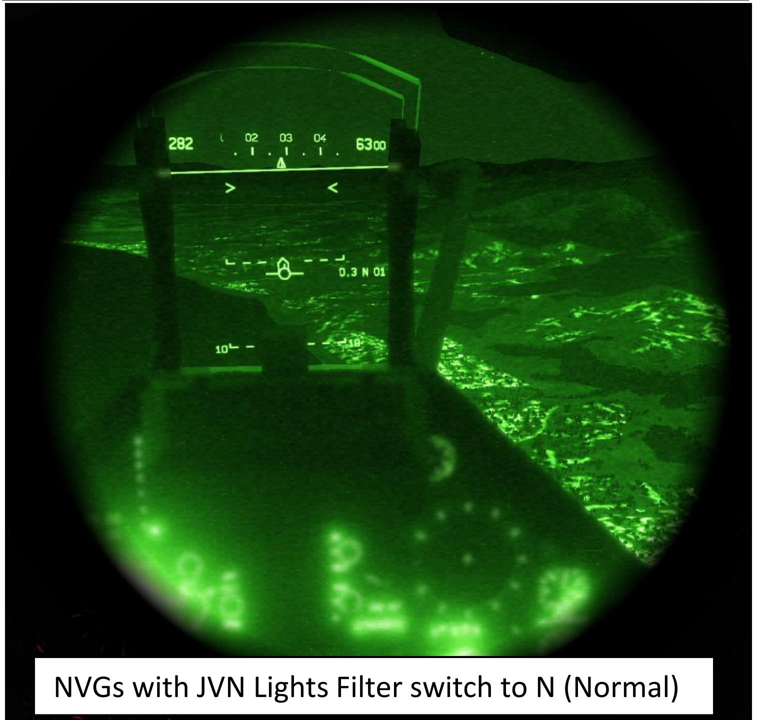
No.	Control Name	Description	Command Name	Default key
1	**Trigger Safety Indicator**	When visible, the trigger is activated to fire weapons. Automatically shows when master arm switch is set to ON.	NONE	NONE
2	**Magic Search / Vertical Fix** *(Recherche MAGIC / Recallage Vertical)*	Depending on the selected navigation or attack mode, this switch enables: • INS position update by designating a ground reference point • Magic II missile target unlock and returns seeker to search mode • Toggles between Magic II missile scan modes	NAV Update / Magic Unlock	NONE
3	**Trim Control**	Trims the aircraft in roll and pitch. When autopilot is engaged, it is use to control the aircraft by setting desired heading and adjusting the flight path.	Trim DOWN Trim LEFT Trim RIGHT Trim UP	RCTRL + W RCTRL + A RCTRL + D RCTRL + S
4	**Countermeasure Switch**	Activates countermeasures (chaff and/or flares and/or jammer).	Decoy Program release	DELETE
5	**Weapons System CMD Switch** *FWD/AFT/DEPRESSED* *Commande Temps Réel SNA*	In air-to-air mode: • FWD: toggles between close combat vertical / horizontal radar modes. • Depressed: Unlock Target (**air-to-air only**) • AFT: activates the close combat boresight radar mode In air-to-ground mode (A/G weapon selected): • FWD: sets HUD in air-to-ground Mode • AFT: returns to NAV Master Mode	Weapons System CMD FWD Weapons System CMD Depressed Weapons System CMD AFT	NONE NONE NONE
6	**MiCRoB Trigger (Missiles, Cannons, Roquettes, Bombes)**	First stage activates the gun camera and virtual tracers in air-to-air gun mode. Second stage releases selected weapon.	MiCRoB / Trigger $1^{st}/2^{nd}$ Stage	SPACEBAR
7	**AP Standby Paddle**	Sets the autopilot in standby when engaged, allowing the pilot to control the aircraft. The autopilot will resume as soon as the paddle is released.	Autopilot Standby Mode	LALT+A
8	**PSIC Toggle (Fonction PSIC)**	• Toggles between PSIC (STT) and PSID (TWS) radar lock pre-selection..	STT/TWS Toggle	NONE
9	**NWS/IFF Interrogator**	On ground, toggles ON/OFF the nosewheel steering. In the air (gear up), triggers radar target identification.	Nosewheel steering / IFF Interrogate	S
10	**AP Disconnect Switch**	Disconnects the autopilot	AP Disconnect / Exceed Elastic Limit	LSHIFT + A

Throttle



No.	Control Name	Description	Command Name	Default key
1	**Jammer Control Switch**	Activates/deactivates the jammer when in manual mode	Jammer ACTIVATE / Standby Toggle	E
2	**Radio Selection Switch**	Selects the radio used for transmission	V/UHF GREEN Radio PTT UHF RED Radio PTT	LSHIFT + Num+ LALT + Num+
3	**Panic Pushbutton**	Releases the emergency chaff/flare program (Program O)	Decoy PANIC release	INSERT
4	**Radar Designator Control**	Controls up, down, left and right the radar screen designation cross. Target radar lock is obtained by pushing in (depressing) the control.	TDC UP TDC DOWN TDC LEFT TDC RIGHT TDC DEPRESS (LOCK TARGET)	; | RALT+ UP . | RALT+ DN , | RALT+ LT / | RALT+ RT NONE
5	**Airbrake Control**	This three position sliding switch controls the speedbrakes. Extends (aft, spring-loaded position) or retracts (FWD) the airbrakes.	Airbrake TOGGLE Airbrake ON Airbrake OFF	B LSHIFT + B LCTRL + B
6	**Police Light Control Switch**	Toggles ON/OFF the police searchlight.	Police Light Toggle	NONE
7	**CNM Switch (Cannon/Neutral/Magic)**	• Left: Air-to-Air Gun Quick Selection (CAN) • Center: Weapon Control Panel Selection (PCA) • RIGHT: Magic II Missile Quick Selection	AA Gun SELECT PCA Select MAGIC SELECT	C NONE NONE
8	**Air-to-Ground Designate / Magic Slave Switch** *Weapon System Paddle, also known as "Palette SNA", for "Système de Navigation et d'Attaque".*	Depending on the VTH/HUD mode and weapon selection: • APP: Hides the ILS symbology • OBL: Designates the surface feature for the radar fix • MAG or MAV selected: Slaves the MAGICs to the radar or the radar to the MAGICs.	Magic Slave / AG Designate / INS Position Update	NONE
9	**Antenna Elevation Control**	This rotating wheel with a center detent adjusts radar antenna elevation.	Radar Antenna UP Radar Antenna DOWN Radar Antenna CENTER	NONE NONE NONE


NVGs with JVN Lights Filter switch to JVN


NVGs with JVN Lights Filter switch to N (Normal)

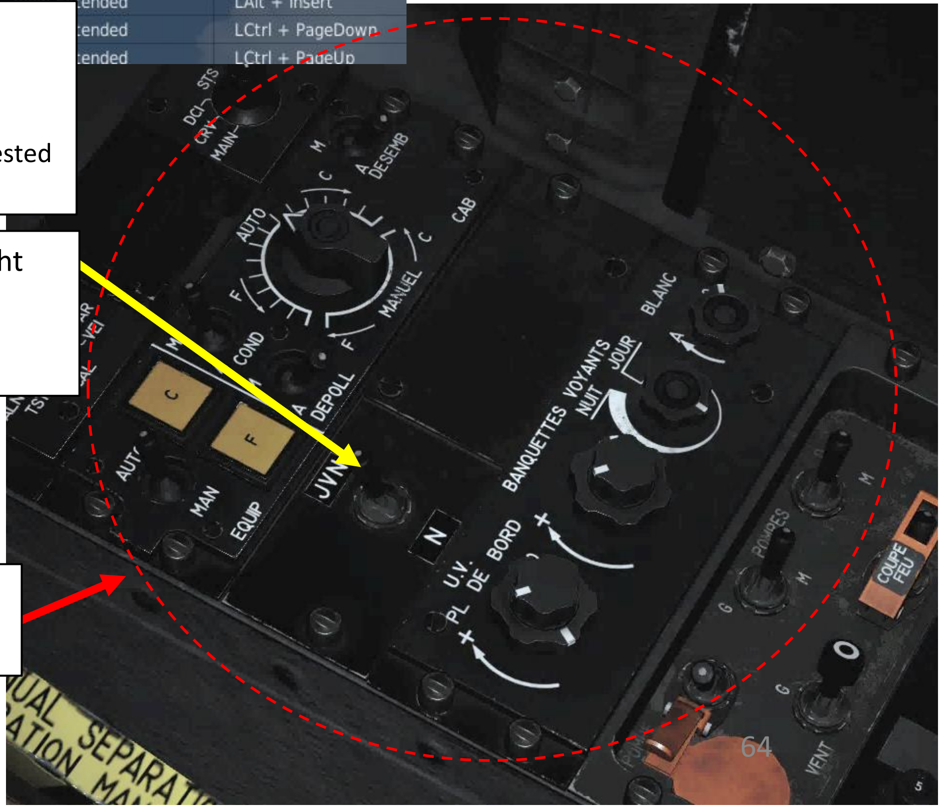
SUN VISOR
ON/OFF: LSHIFT+HOME

NIGHT VISION GOGGLES
ON/OFF: LALT+HOME

Note: NVGs or a Helmet-Mounted Visor need to be requested from the ground crew and equipped prior to takeoff.

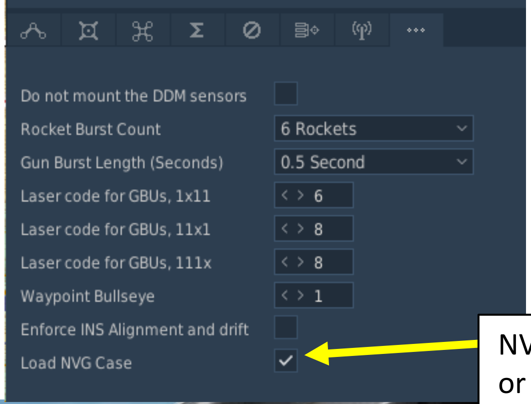
JVN (*Jumelles de Vision Nocturne* / Night Vision Goggles) Lights Filter Switch
- JVN: Night Vision Filter
- N: Normal Mode (No Filter)

FLASHLIGHT
ON/OFF: LALT+L

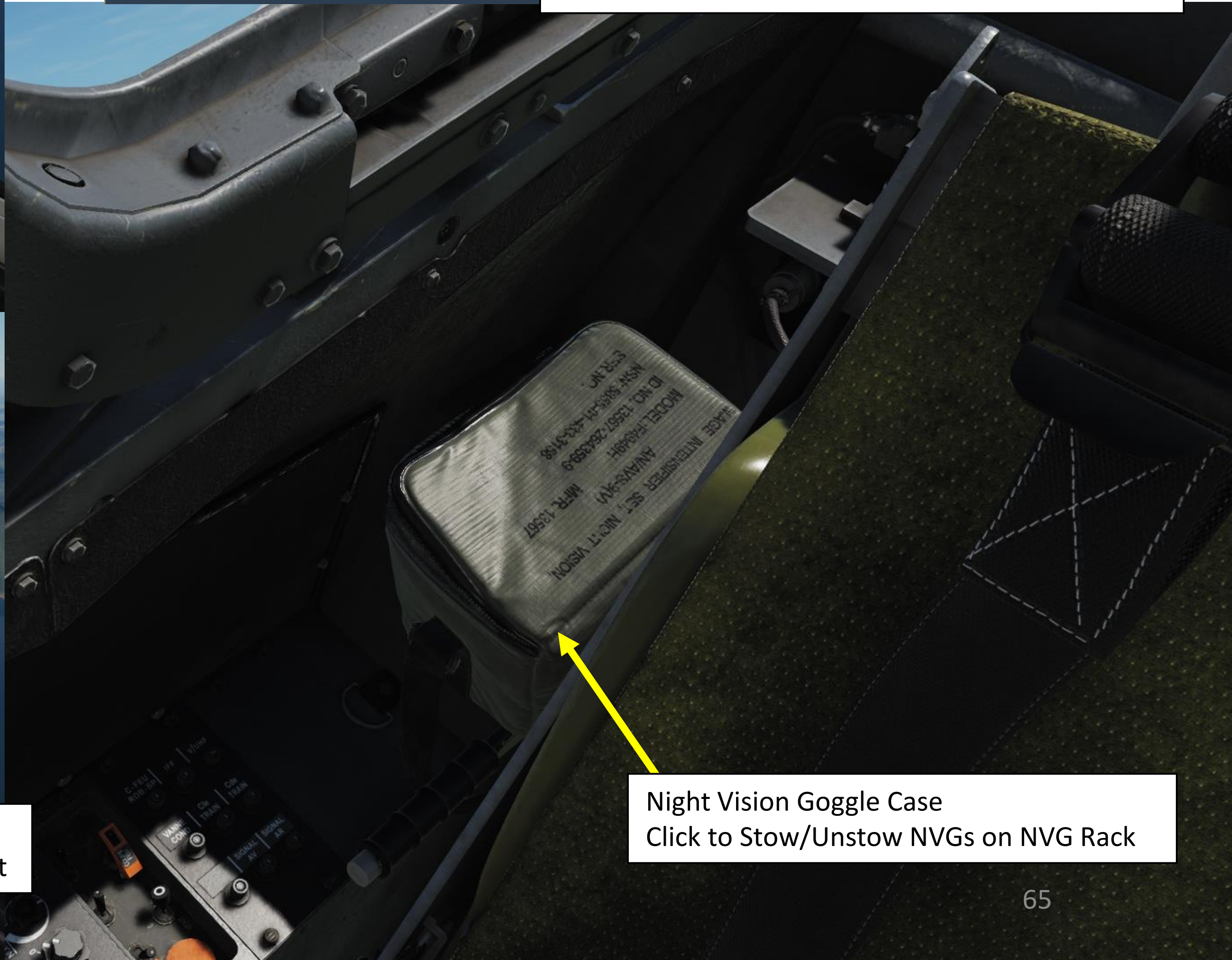


Night Vision Goggle (NVGs)

Night Vision Goggle Rack
Click to Mount/Dismount NVGs on Helmet



NVG Case needs to be equipped via Mission Editor or from the Ground Crew



Night Vision Goggle Case
Click to Stow/Unstow NVGs on NVG Rack

Martin Baker Mk 10

Zero-Zero Ejection Seat

A **zero-zero ejection seat** is designed to safely extract upward and land its occupant from a grounded stationary position (i.e., **zero** altitude and **zero** airspeed), specifically from aircraft cockpits. The zero-zero capability was developed to help aircrews escape upward from unrecoverable emergencies during low-altitude and/or low-speed flight, as well as ground mishaps. Before this capability, ejections could only be performed above minimum altitudes and airspeeds.

Zero-zero technology uses small rockets to propel the seat upward to an adequate altitude and a small explosive charge to open the parachute canopy quickly for a successful parachute descent, so that proper deployment of the parachute no longer relies on airspeed and altitude.

Controls

Seat Adjustment UP: L_SHIFT+S
Seat Adjustment DOWN: L_SHIFT+L_ALT+S

Tapettes d'Entrée d'Air **(Engine Auxiliary Intakes / Blow-In Doors)**

These doors open automatically under spring pressure at low airspeed to allow additional air into the engine intake, which is very useful during high angle-of-attack manoeuvers.

Souris **(Engine inlet shockwave cone)**

Slows the flow of air from supersonic flight speed to a subsonic speed before it enters the engine

Pelle **(Scoop)**

These doors provide additional air to the engine for added thrust during high-altitude flight.

Refueling Probe
Allows air-to-air refueling. Probe (male part) must be inserted into a drogue (female part) of a tanker.

***Bec* (Wing Slat)**
Re-directs the airflow at the front of the wing, allowing it to flow more smoothly over the upper surface at a high angle of attack. This allows the wing to be operated effectively at the higher angles required to produce more lift.

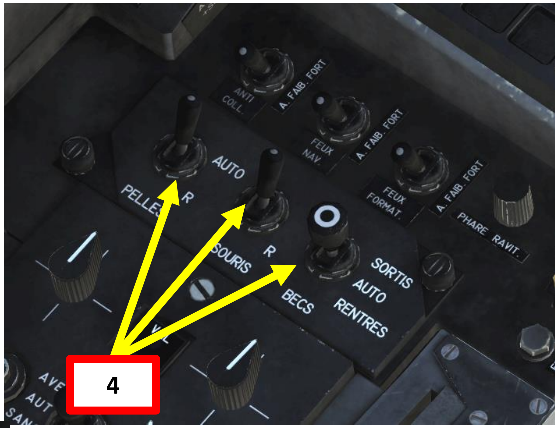
Elevon

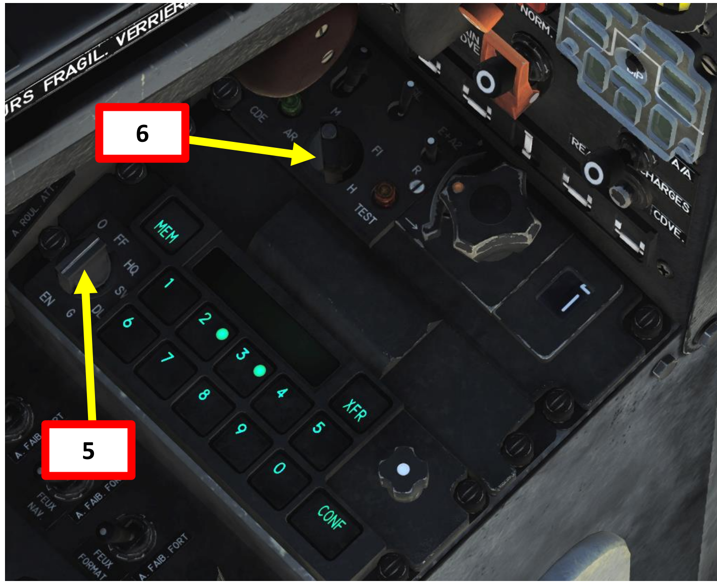
Control surface that acts as both an aileron and an elevator. Elevon position is controlled by the flight computer, which translates the pilot stick input into control laws that dictate how elevons will behave in order to move the aircraft as commanded by the joystick. We will touch this subject more in detail in the FLY-BY-WIRE chapter.

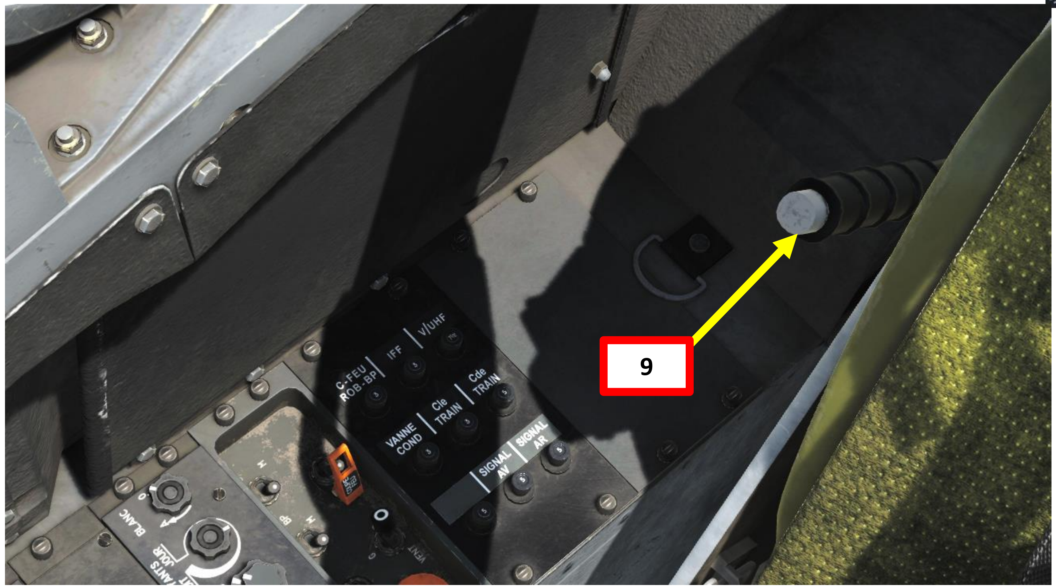
PART 4 – START-UP PROCEDURE

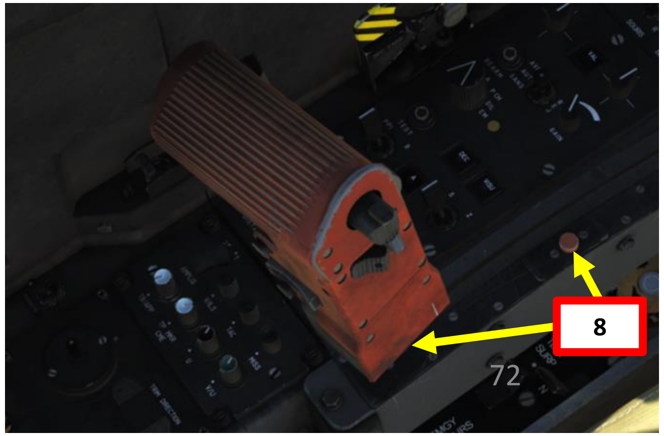
BEFORE START-UP

1. Fly-By-Wire Gain switch - NORMAL
2. Fly-By-Wire G Limiter Switch – As required
   - AA (UP) for Anti-Air missions (light payload)
   - CHARGES (DOWN) for bombing missions (heavy payload)
3. Fly-By-Wire NORM/VRILLE switch - NORMAL
4. *Pelles*, *Souris*, *Becs* switches – AUTO
5. V/UHF Green Box radio – FF (ON)
6. UHF radio – **M**ARCHE (ON)
7. Parachute/Hook lever – FORWARD
8. Set throttle to STOP position by pressing the “Engine Shutdown” button. Once throttle is set to STOP, do not touch the throttle since it needs to remain in this position for the engine start-up.
9. Parking Brake – ENGAGED (UP)
10. BINGO Selector – Insert BINGO FUEL value
    - Fuel quantity required to return to base
    - Typically 1000-1200 kg



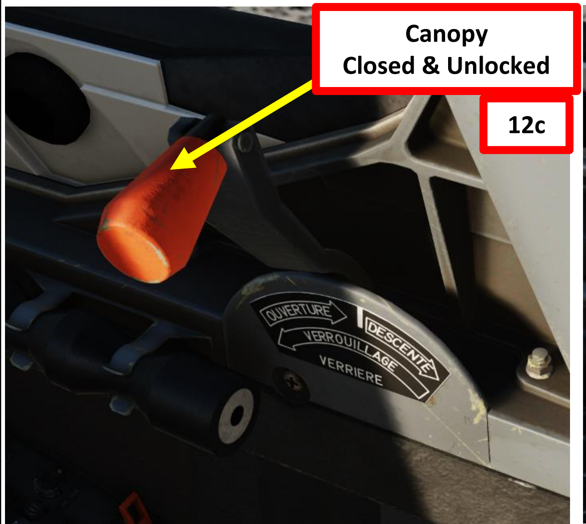


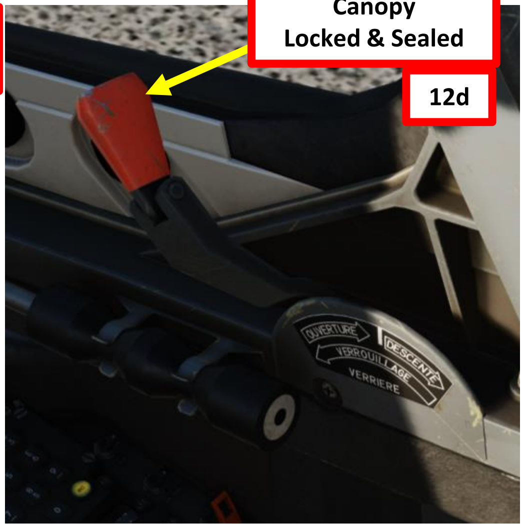


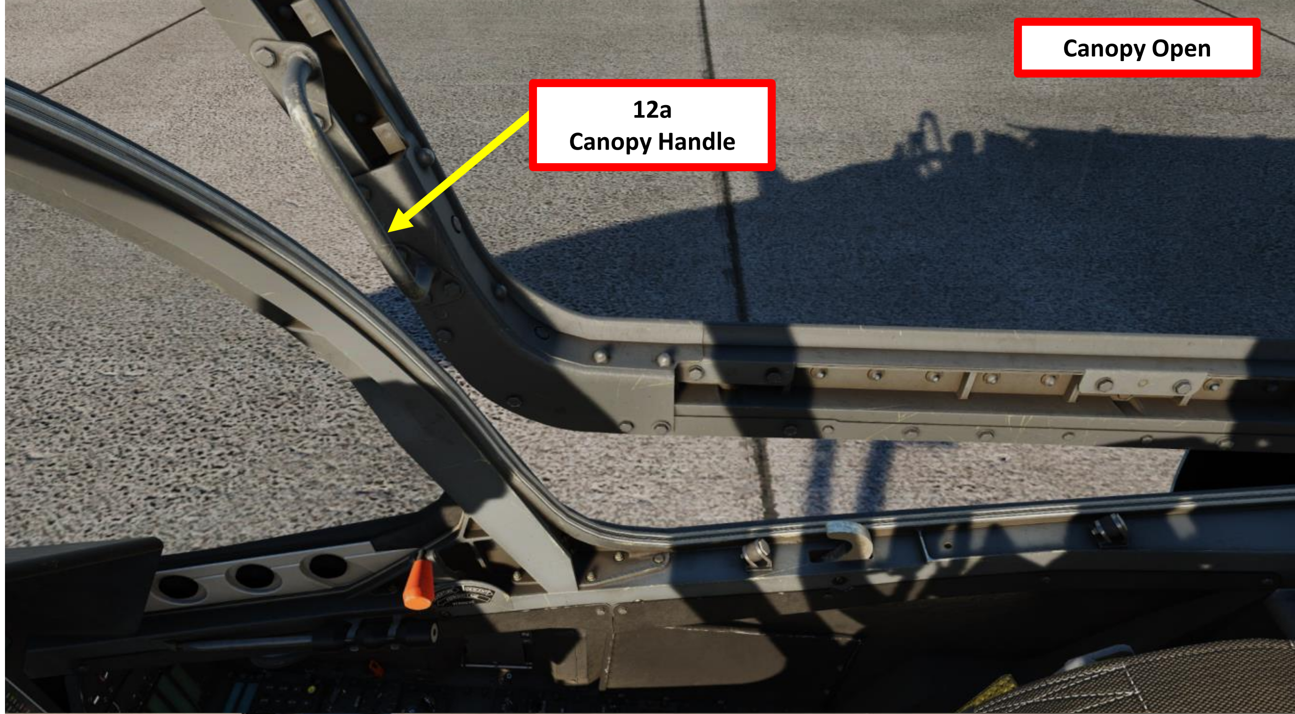


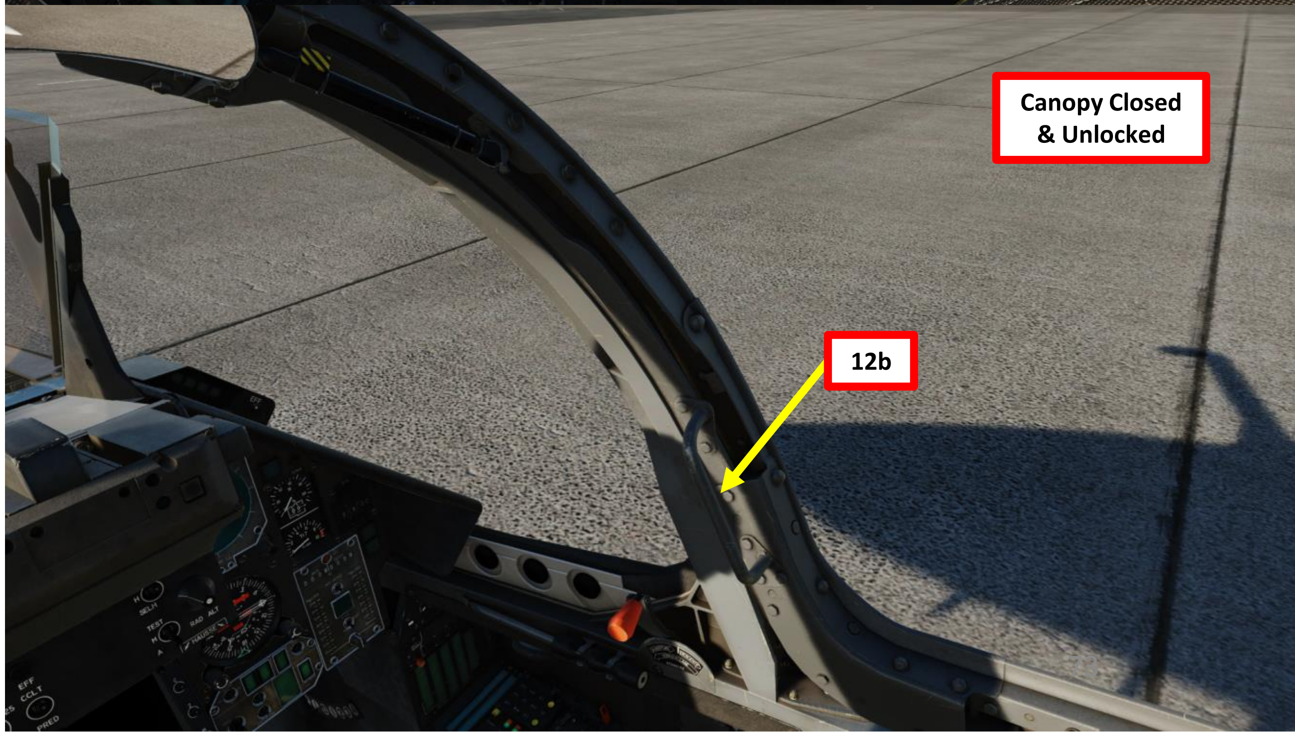
BEFORE START-UP

11. Close and lock canopy by pressing LCTRL+C.
12. The pilot lowers the canopy with the canopy handle. Once the canopy is lowered, the Canopy Lock lever is pushed forward to lock and seal the cockpit.
13. Verify that the Canopy Rest Stick is folded.



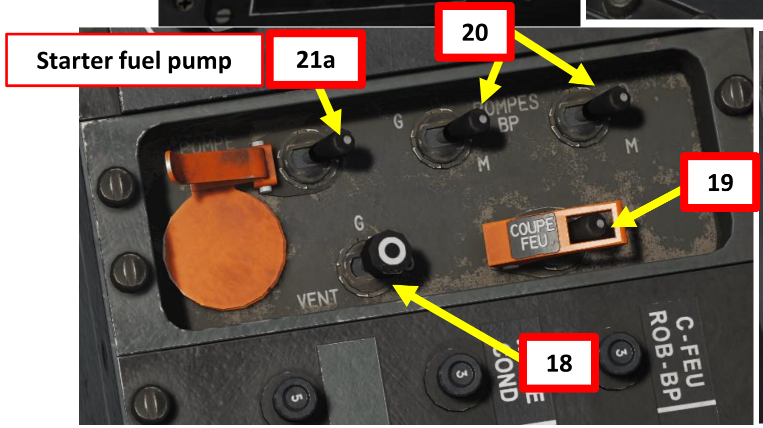


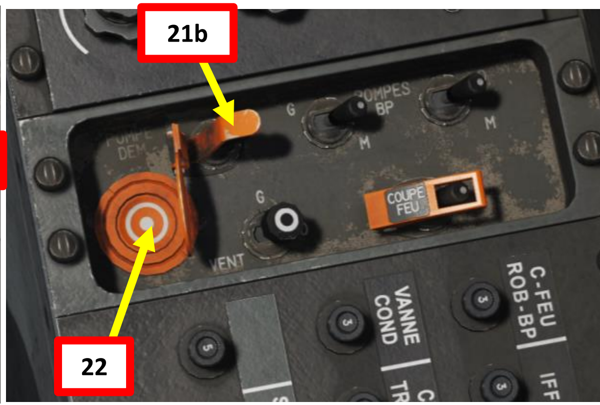


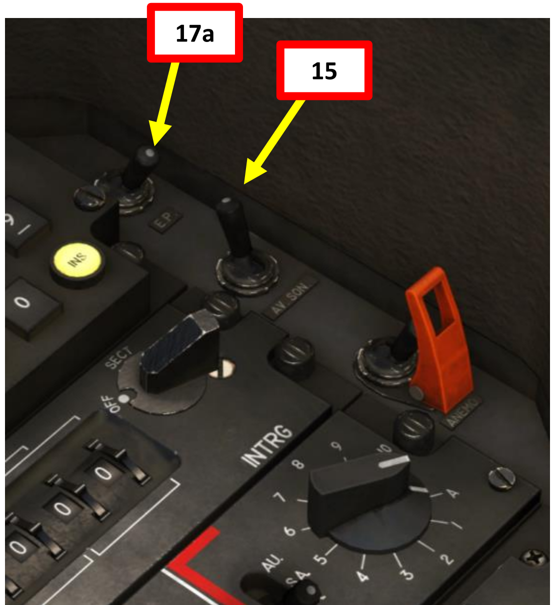


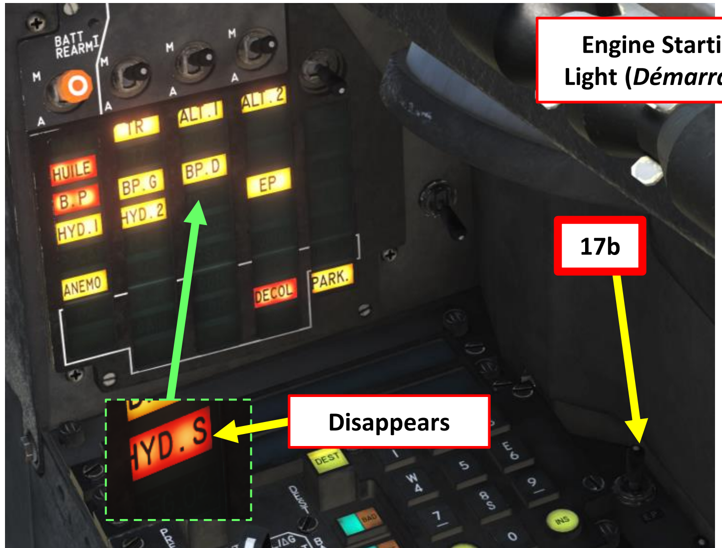
START-UP PROCEDURE

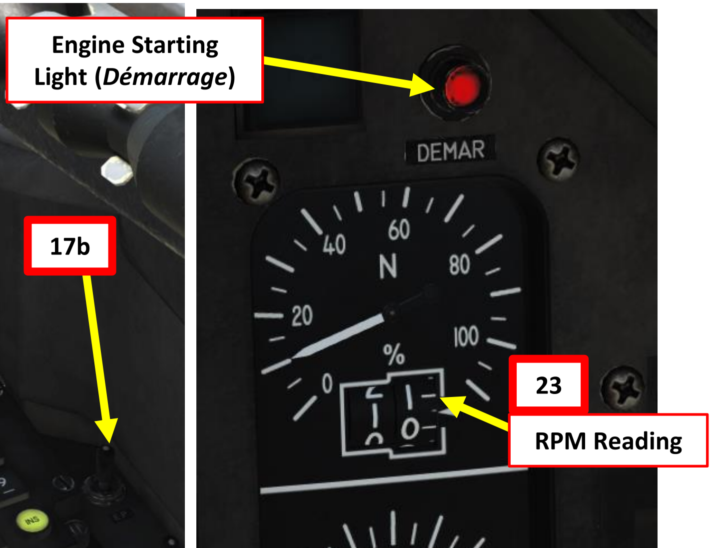
14. Set Battery to **M**ARCHE (ON) and ensure Alternator #1, Alternator #2 and TR switches are set to **M**ARCHE (ON) as well.
15. Set AV SON (*Avertissement Sonore*, Audio Warning) Switch – ON (FWD). Adjust Caution/Advisory Brightness as required
16. Press the PANNE Warning switch to reset audio warning
17. Emergency Hydraulic Pump (*Électropompe*) switch – ON (FWD). Confirm that HYD SYS caution disappears.
18. Ignition/Ventilation selector – set to either **G**AUCHE (left) or **D**ROITE (right)
19. Fuel Shut-Off Valve (*Coupe-Feu*) – OPEN (switch to the right & cover closed)
20. Left and Right Low-Pressure Fuel Pumps (*Pompe Basse-Pression Gauche et Droite*) – Set to MARCHE (ON)
21. Set starter fuel pump (*POMPE DÉMARRAGE*) to **M**ARCHE (ON)
    - Left click on the Ignition switch orange cover to ensure starter fuel pump is ON
22. Press ignition switch and wait for engine to spool up
23. When engine RPM reaches 10 %, move throttle at IDLE position. Confirm RPM, Fuel Flow and T7 (Turbine Exit Temperature) increase.
24. Once RPM reaches 60%, the engine generator kicks in and you can start aligning the INS/UNI (Inertial Navigation System/*Unité de Navigation Inertielle*).
25. Start INS alignment procedure (see next page).

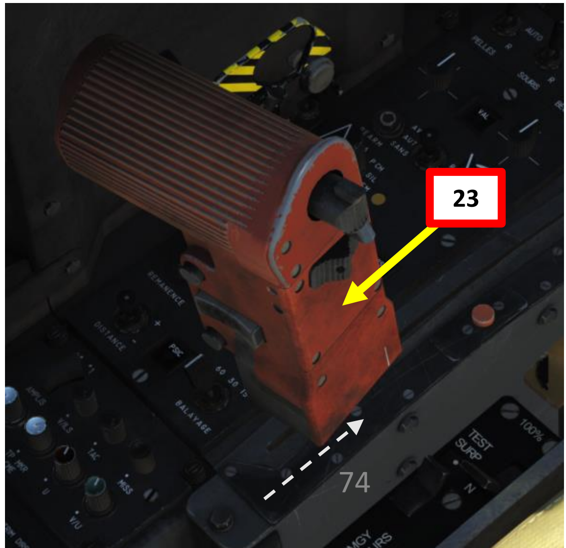












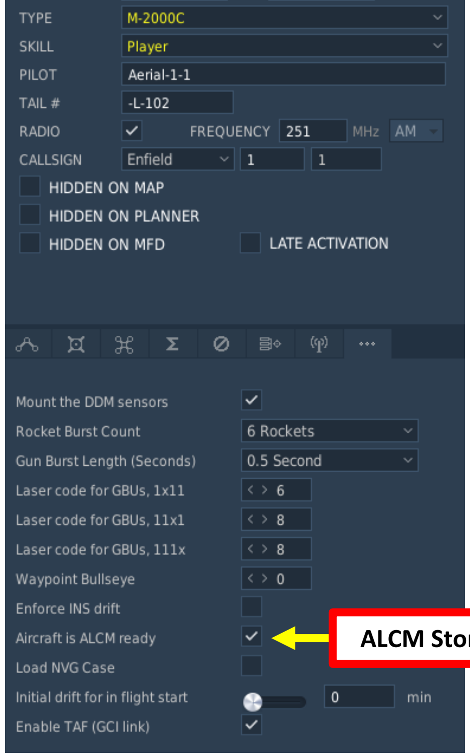
START-UP PROCEDURE

INS ALIGNMENT MODES

The INS (Inertial Navigation System) requires an initial alignment, which can be performed in two ways:

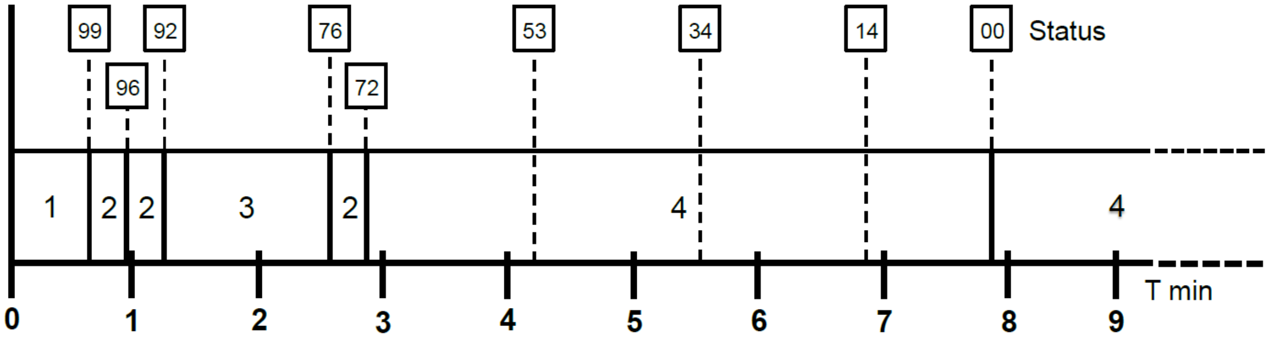
- **Normal alignment (*ALN – Alignment normal*)** is required at each cold start if the aircraft has been moved since the last time it stopped. This alignment **lasts 8 minutes** and results in a drift rate of about 0.7 nm/h. This process combines all the available phases in order to achieve the most accurate alignment possible.

- **Stored heading alignment (*ALCM – Alignment sur cap mémorisé*)** is a fast alignment method that can be used if the aircraft has not been moved since the last time its INS was stopped. The INS save its last heading when it is stopped and if the aircraft has not been moved the gyroscopes won't have moved too far from their aligned position. This allows for less alignment phases resulting in a quicker procedure at the cost of increased drift rate due to gyroscope and accelerator errors not being canceled as well as in an ALN. This alignment **lasts 1 minute 30 seconds** and the resulting drift rate is dependent on the quality and time since the last normal alignment. After a normal alignment followed by a standard flight and half a day rest for the aircraft, the drift rate will be about 3 nm/h. Doing an ALCM just after a normal alignment or at the end of QRA (Quick Reaction Alert) duty will result a drift rate equivalent to the previous alignment rate. Take note that **stored heading alignment (ALCM) must be enabled via the mission editor**.



NORMAL ALIGNMENT TIMELINE

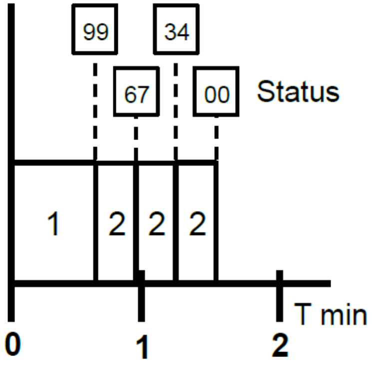
Source: RAZBAM Manual



1. Platform caging and setup
2. Rough alignment
3. Fast gyrocompass alignment
4. Fine gyrocompass alignment

STORED ALIGNMENT TIMELINE

Source: RAZBAM Manual

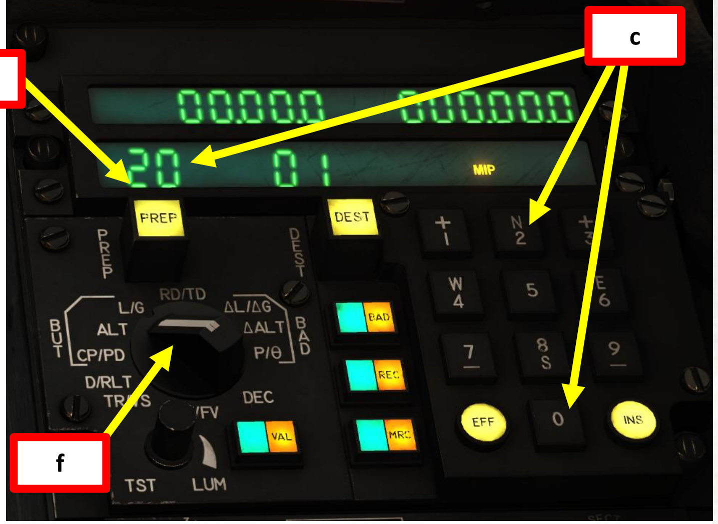


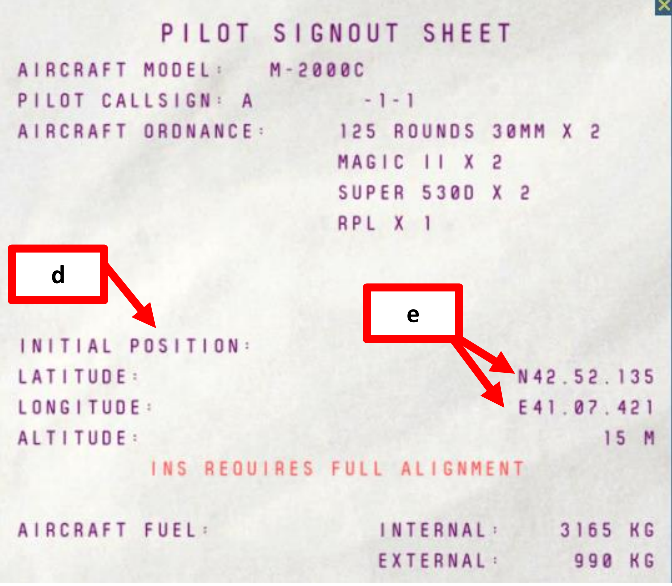
1. Platform caging and setup.
2. Rough alignment.

START-UP PROCEDURE

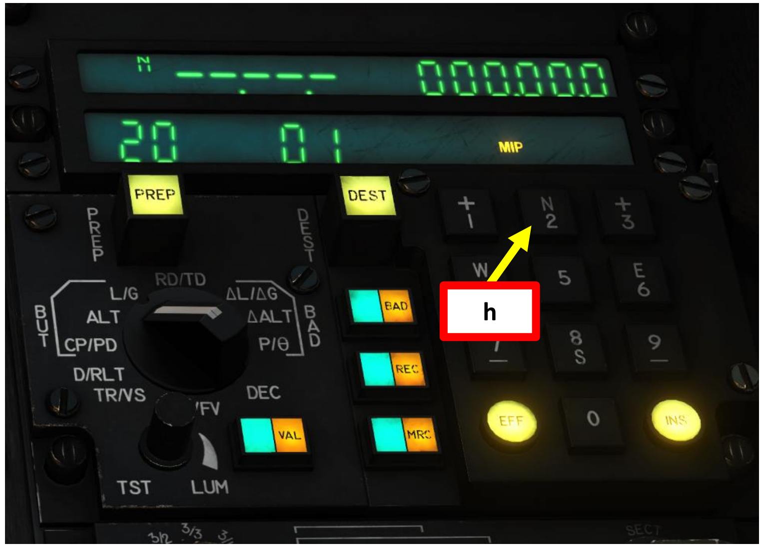
NORMAL INS ALIGNMENT PROCESS

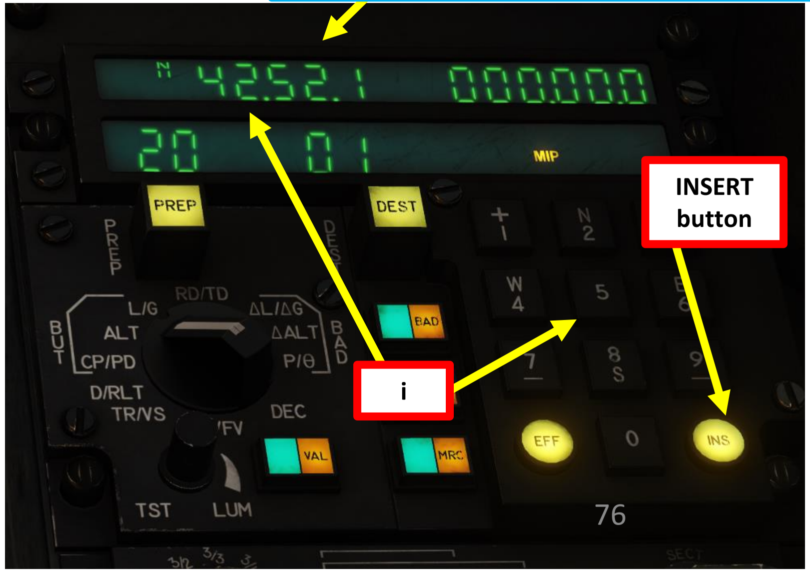
a) On PSM (*Poste Sélecteur de Modes* = Mode Selector Panel), set INS mode to *VEILLE* (Standby).
b) Set INS operation mode to “N” (Normal). This will allow you to input/edit data in the navigation computer.
c) Select a spare editable waypoint (any between 01 and 20) for initial position alignment. As an example, we will select Waypoint 20 by pressing the PREP button, then typing “20” on the keypad. **Take note that “PREP 00” is NOT an editable waypoint.**
d) Open up your kneeboard using “RSHIFT+K” and cycle through pages using the “[“ and “]” (kneeboard previous/next page bindings) to find the PILOT SIGNOUT SHEET and the aircraft’s initial position.
e) In our case, our initial position is **42°52.135 North** for Latitude and **041°07.421 East** for Longitude, with an **airport elevation of 15 meters**.
f) On PCN (*Poste Commande de Navigation* = Navigation Control Panel), set INS parameter selector to L/G.
g) Press “1” (+) button on keypad to select Latitude field
h) Press “2” (**N**orth) button on keypad to select North
i) Enter “4252135” on keypad and press “INS” (Insert) button to enter the aircraft latitude coordinates (42°52.135 North) as specified on kneeboard. If you made a mistake, press the EFF (*Effacer*/Erase) button.




PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2
MAGIC II X 2
SUPER 530D X 2
RPL X 1
INITIAL POSITION:
LATITUDE: N42.52.135
LONGITUDE: E41.07.421
ALTITUDE: 15 M
INS REQUIRES FULL ALIGNMENT
AIRCRAFT FUEL: INTERNAL: 3165 KG
EXTERNAL: 990 KG

Note: Entering coordinates “42°52.135” will only display “42.52.1” on the data field.

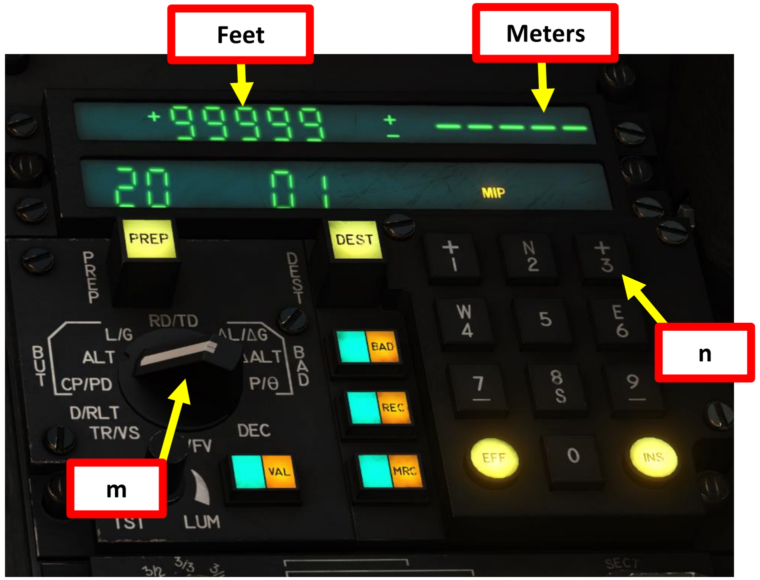


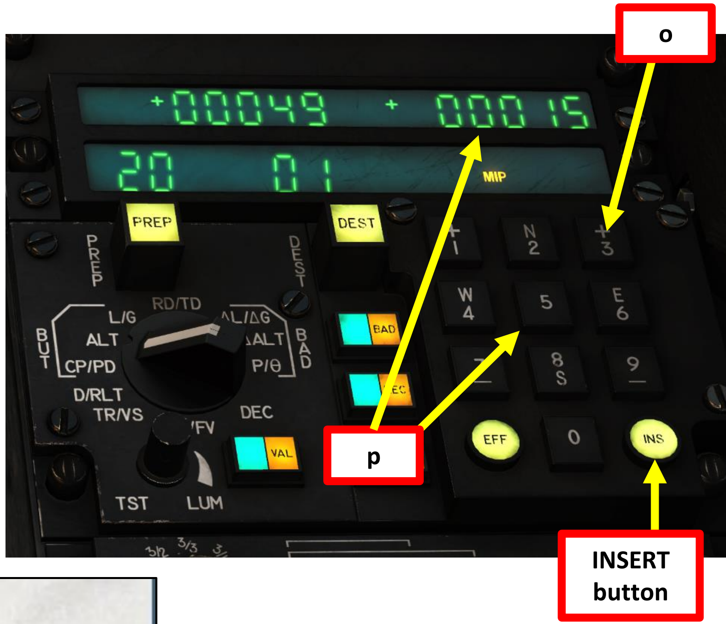


START-UP PROCEDURE

NORMAL INS ALIGNMENT PROCESS

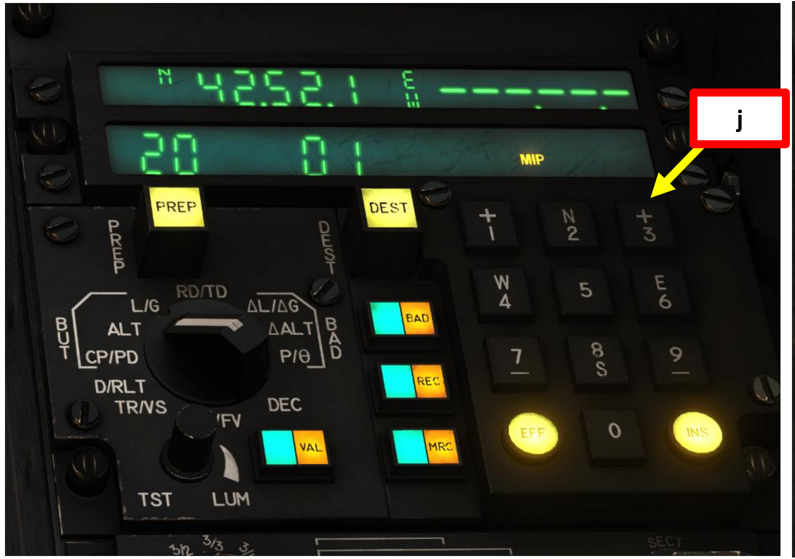
j) Press “3” (+) button on keypad to select Longitude field
k) Press “6” (**E**ast) button on keypad to select East
l) Enter “04107421” on keypad and press “INS” (Insert) button to enter the aircraft latitude coordinates (041°07.421 East) as specified on kneeboard. If you made a mistake, press the EFF (*Effacer*/Erase) button.
m) On PCN (*Poste Commande de Navigation* = Navigation Control Panel), set INS parameter selector to ALT (Altitude).
n) Press “3” (+) button on keypad to select right Altitude field (meters). Left Altitude field is for feet.
o) Press “3” (+) to select a positive altitude value.
p) Enter “15” as the airport elevation (15 meters). Don’t forget to add enough zeroes to have the right data format. Press “INS” (Insert) button to enter the aircraft. If you made a mistake, press the EFF (*Effacer*/Erase) button.

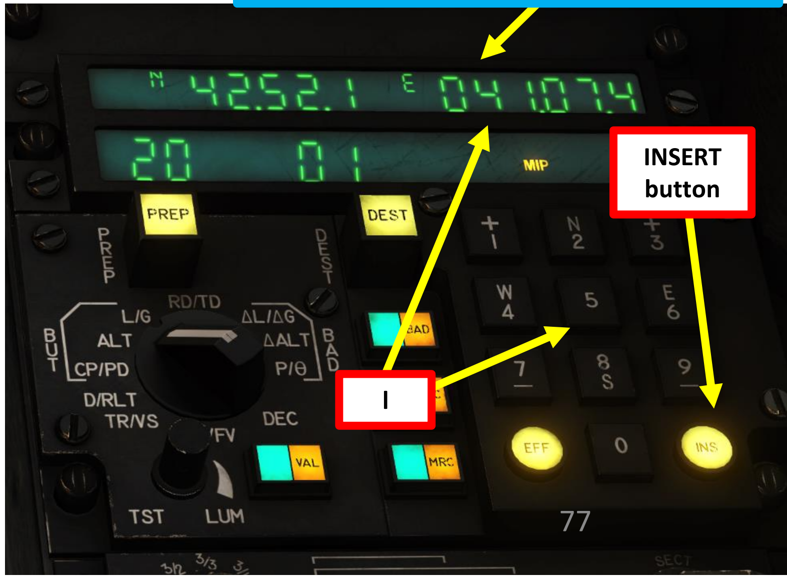





INITIAL POSITION:
LATITUDE: N42.52.135
LONGITUDE: E41.07.421
ALTITUDE: 15 M
INS REQUIRES FULL ALIGNMENT

Note: Entering coordinates “041°07.421” will only display “041.07.4” on the data field.





START-UP PROCEDURE

NORMAL INS ALIGNMENT PROCESS

q) On PSM (*Poste Sélecteur de Modes* = Mode Selector Panel), set INS mode to ALN (Alignment) to start alignment procedure of inertial systems. **VAL** button will illuminate.

r) Press **VAL** button to validate data entry.

s) Set INS operation mode to “STS” (Status) to monitor remaining alignment time.

- First alignment phase Class 4 (Coarse Alignment) will last 4 minutes.
- Second, Third, Fourth and Fifth alignment phases (Precision alignment) will last another 4 minutes.
- Total alignment process should take 8 min.

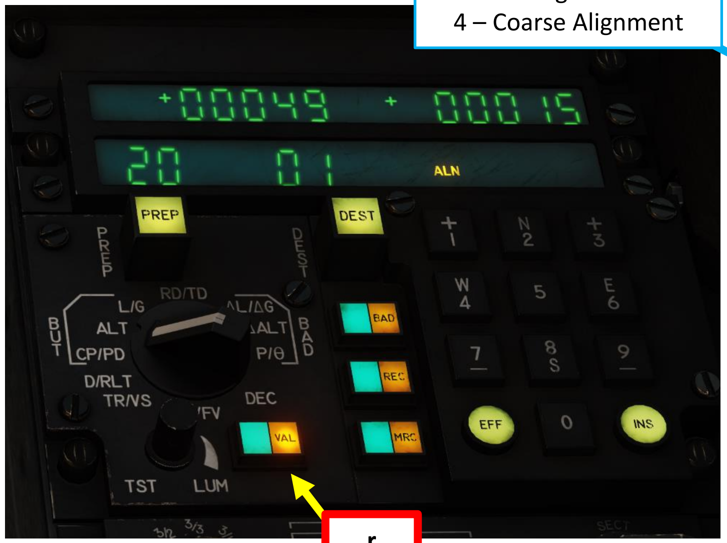
t) A yellow ALN (Alignment) caution will blink during the **first** alignment phase (Class 4, coarse alignment).

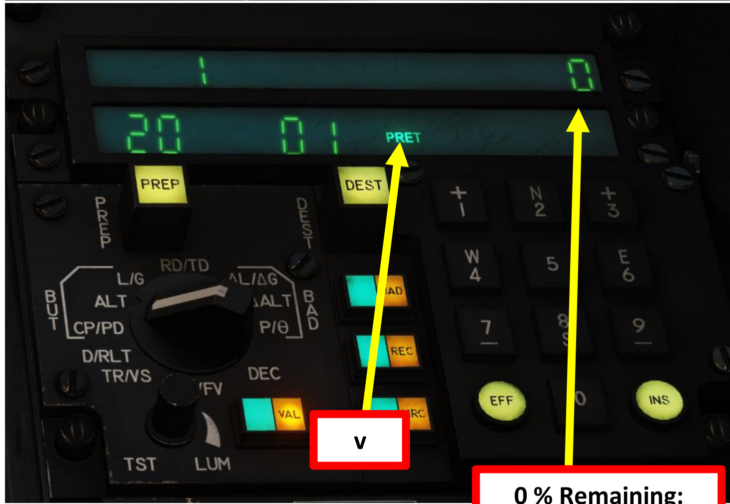
u) “*PRÊT*” (Ready) caution will blink when **first** alignment phase is complete after 4 minutes.

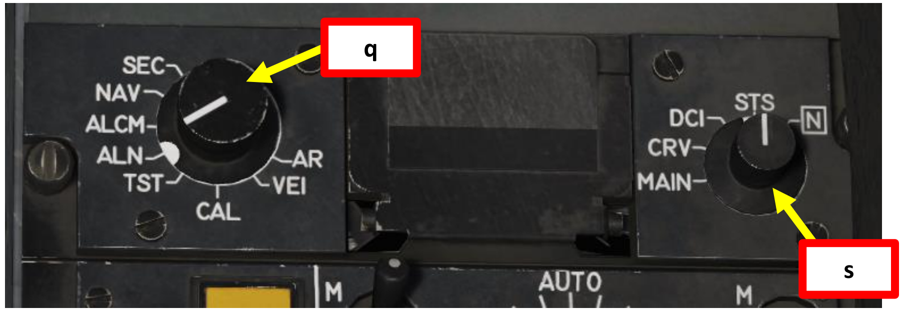
v) “*PRÊT*” (Ready) caution will remain illuminated when all remaining phases are complete after another 4 minutes.

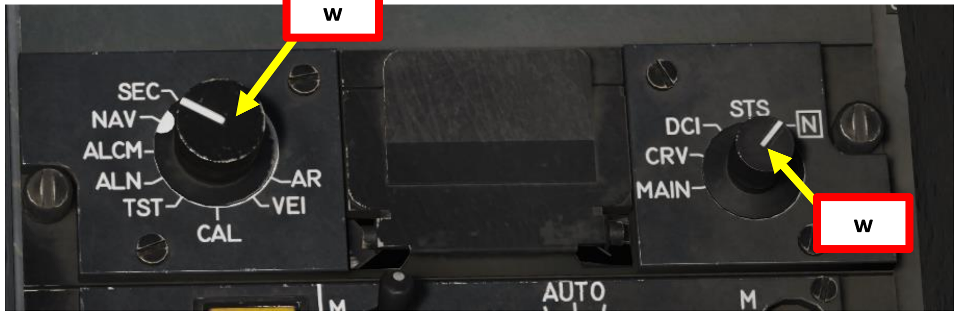
w) Set INS operation mode to “N” (Normal) when alignment phase is complete and set INS mode selector to “NAV”. <u>This step can be done right before you start taxiing.</u>

NOTE: During the alignment phase, you can add or modify waypoint entries at the same time. Waypoint entry and editing will be explained in Section 13 (NAVIGATION).









START-UP PROCEDURE

STORED HEADING INS ALIGNMENT PROCESS

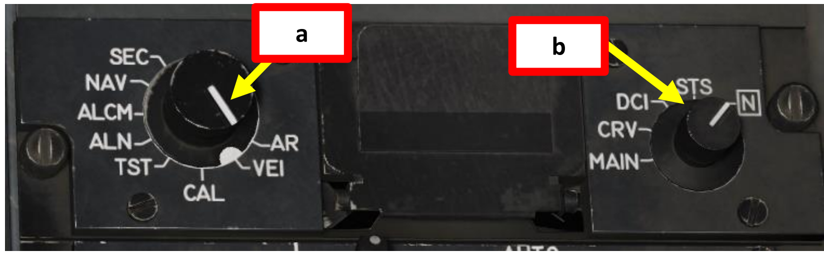
a) On PSM (*Poste Sélecteur de Modes* = Mode Selector Panel), set INS mode to *VEILLE* (Standby).

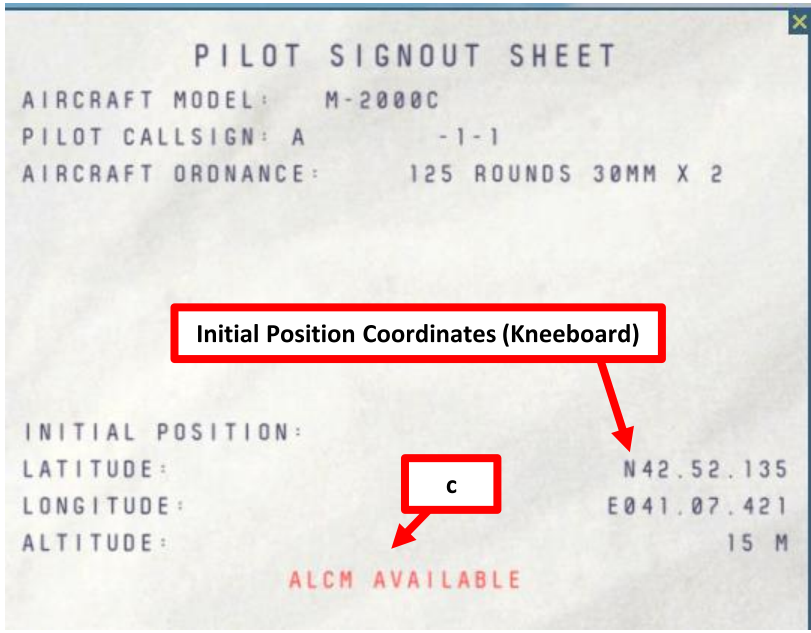
b) Set INS operation mode to "N" (Normal). This will allow you to input/edit data in the navigation computer if required.

c) Open up your kneeboard using "RSHIFT+K" and cycle through pages using the "[" and "]" (kneeboard previous/next page bindings) to find the PILOT SIGNOUT SHEET and the aircraft's initial position. Confirm that "ALCM AVAILABLE" is visible on the sheet, which means stored heading alignment is available. Using a stored heading alignment means that aircraft position (coordinates and altitude) are already entered in the navigation system, which will greatly accelerate the alignment process.

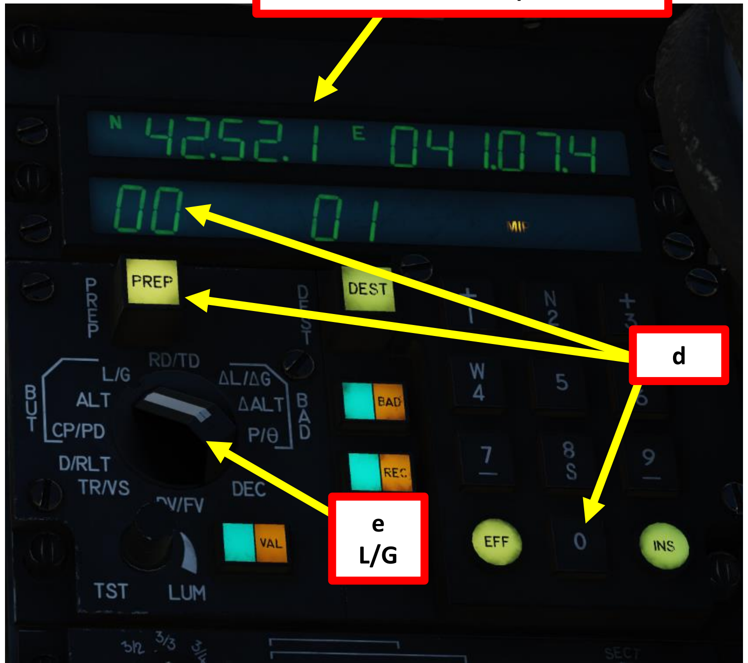
d) Select Waypoint 00 by pressing the PREP button, then typing "00" on the keypad.

e) Waypoint 00 is the current aircraft coordinates stored in the navigation system. Check that its coordinates and altitude are correct to the aircraft current position, which is listed in the PILOT SIGNOUT SHEET. Coordinates are checked by setting the INS parameter selector to L/G, and altitude is checked by setting the INS parameter selector to ALT.





e
Longitude/Latitude Coordinates stored on aircraft position



e
Altitude (ft to the left, meters to the right) stored on aircraft position

START-UP PROCEDURE

STORED HEADING INS ALIGNMENT PROCESS

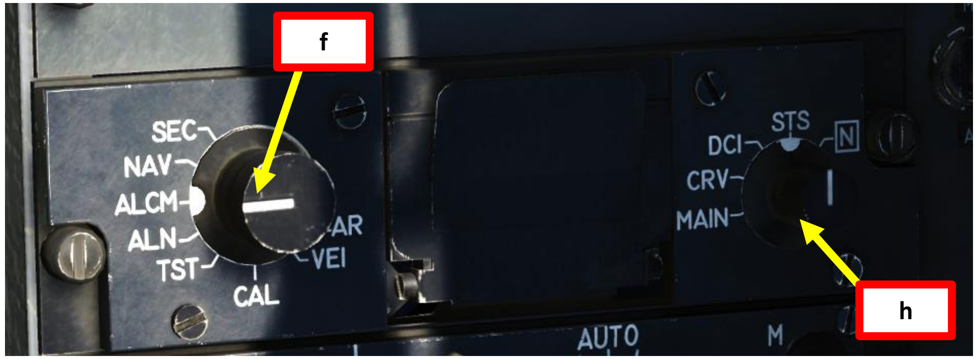
f) On PSM (*Poste Sélecteur de Modes* = Mode Selector Panel), set INS mode to ALCM (Stored Heading Alignment, *Alignement sur Cap Mémorisé*) to start alignment procedure of inertial systems. **VAL** button will illuminate and **ALN** light will flash.

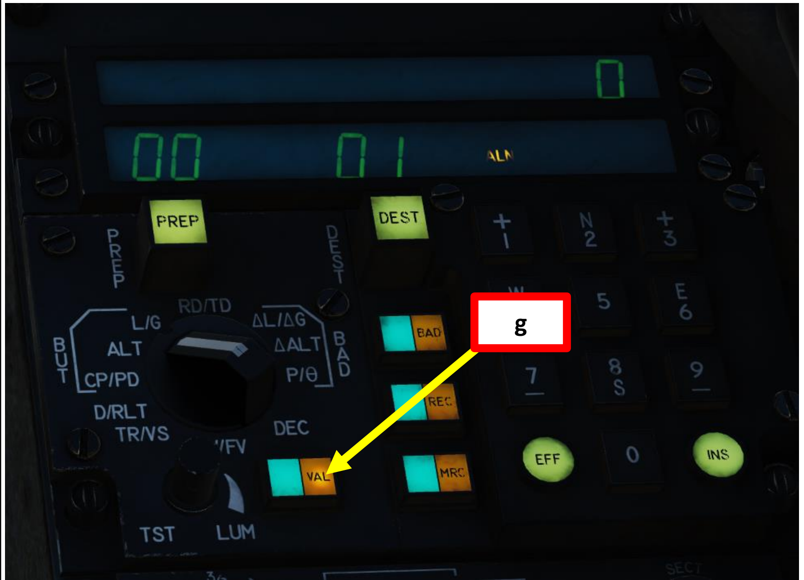
g) Press **VAL** button to validate data entry. ALN light will become steady, indicating that the INS is aligning, and the VAL button will extinguish.

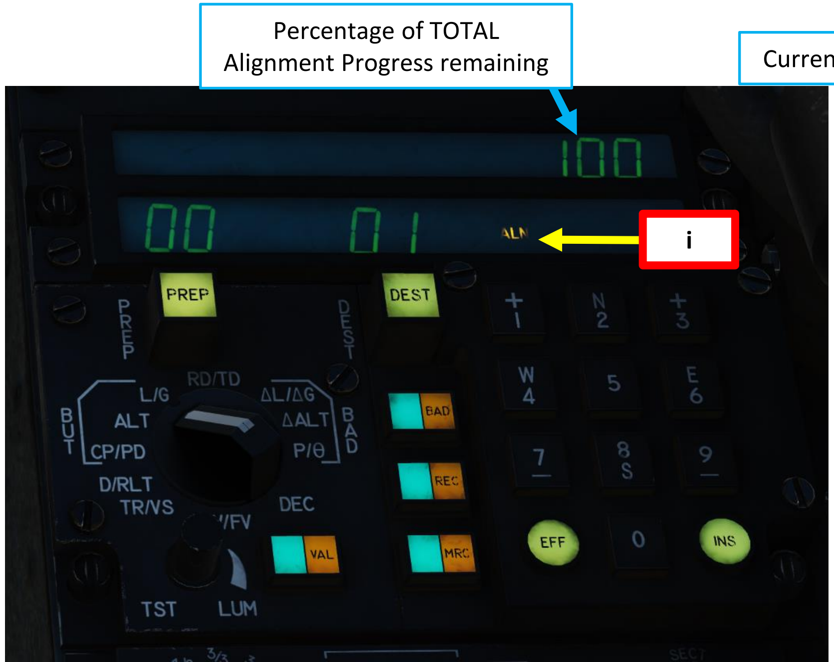
h) Set INS operation mode to “STS” (Status) to monitor remaining alignment time.

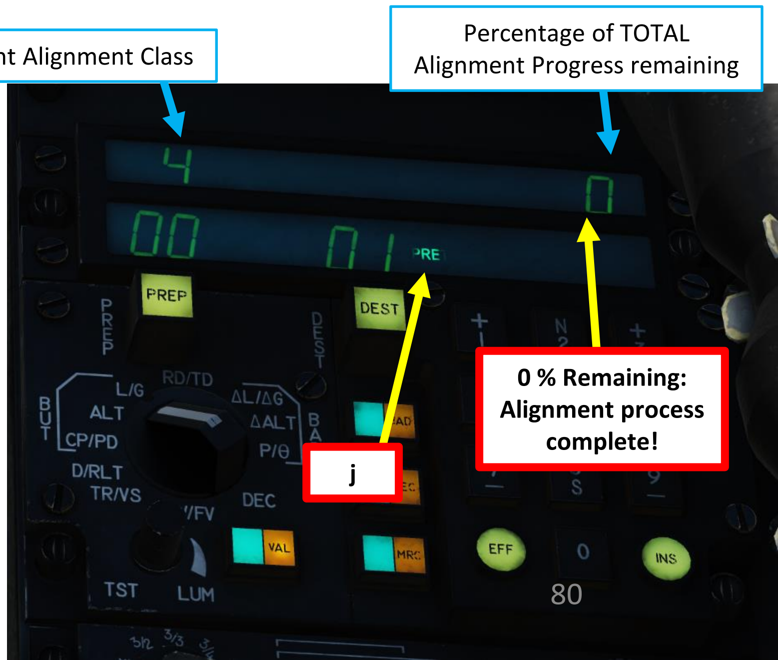
i) A yellow ALN (Alignment) caution will blink during the alignment phase . The right window will display the alignment status, going from 100 to 0 (alignment percentage remaining).

j) “*PRÊT*” (Ready) caution will blink when alignment phase is complete after 1 minute and 30 seconds.







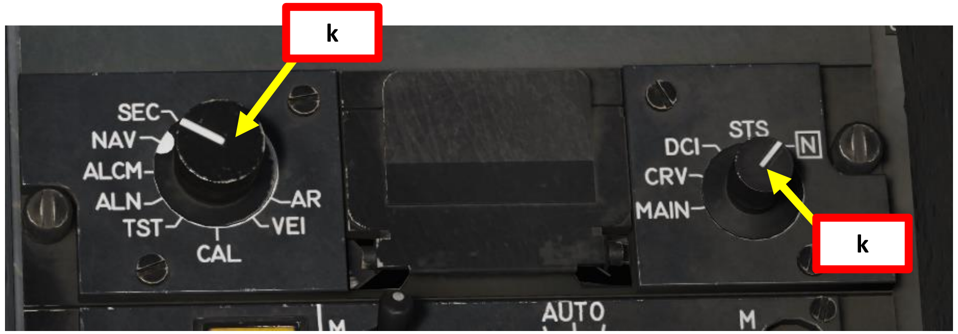


START-UP PROCEDURE

STORED HEADING INS ALIGNMENT PROCESS

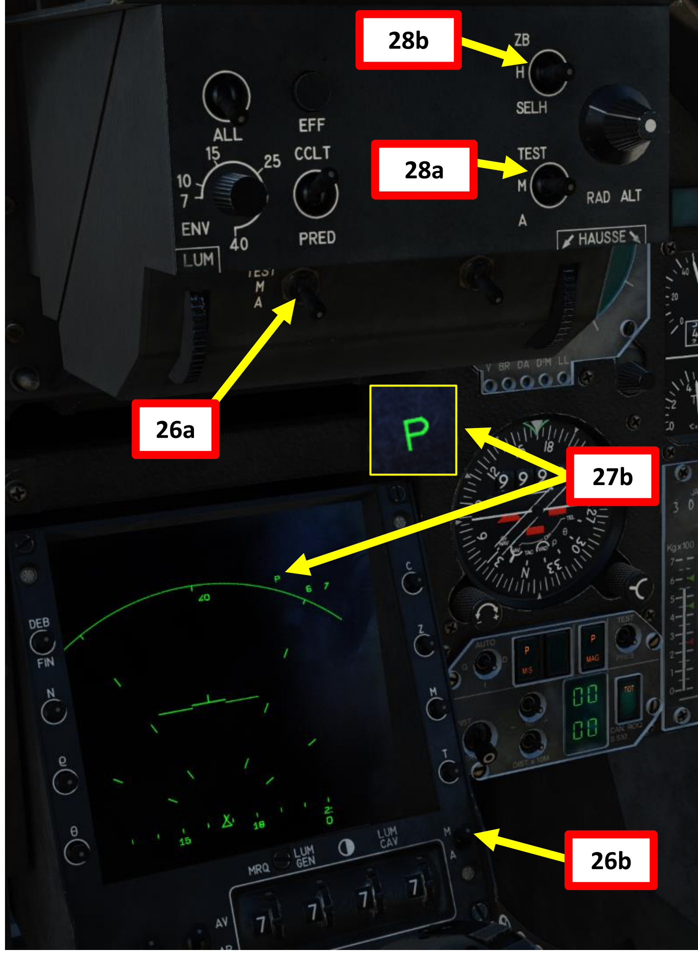
k) Set INS operation mode to “N” (Normal) when alignment phase is complete and set INS mode selector to “NAV”. This step can be done right before you start taxiing.

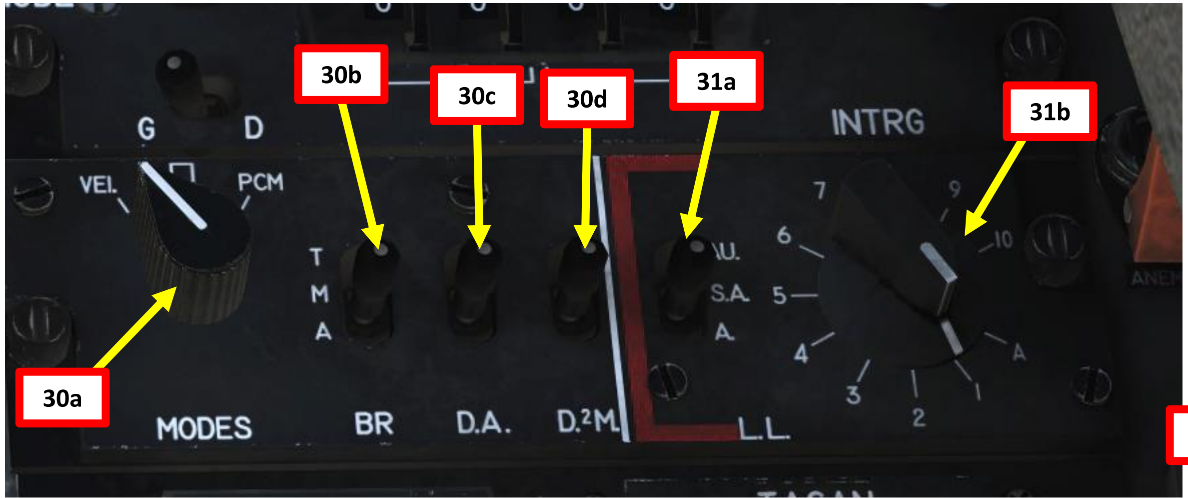
NOTE: During the alignment phase, you can add or modify waypoint entries at the same time. Waypoint entry and editing will be explained in Section 13 (NAVIGATION).

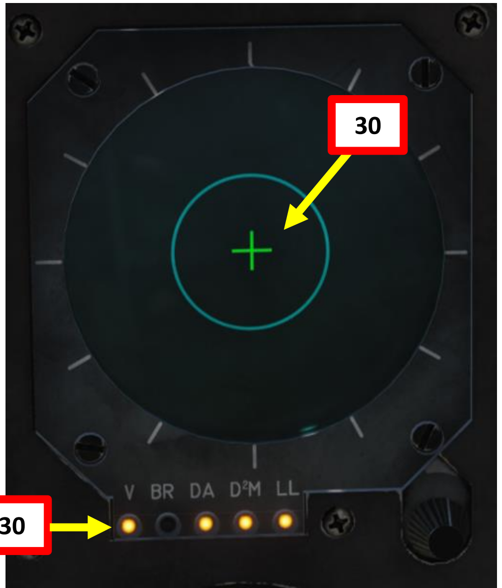


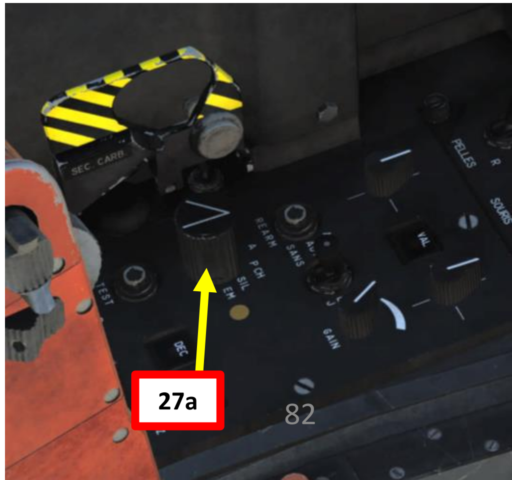
START-UP PROCEDURE

26. Power up your displays
    a) VTH/HUD (Heads-Up Display) power switch – **MARCHE** (ON) (Middle Position)
    b) VTB/HDD (Heads-Down Display) power switch – **MARCHE** (ON)
27. Set Radar Switch - **Préchauffage** (Warm-Up). Once warm-up sequence is complete, set Radar Switch to Standby (Silence) position.
28. Radar Altimeter Power switch - **MARCHE** (ON). Then, set HUD Altimeter Switch to **H**eight (Hauteur), or the middle position.
29. HSI Mode – set to NAV (Cm for Magnetic Heading or Cv for True Heading, as desired)
30. On Electronic Warfare (EW) panel, set:
    a) Set EW mode to **VEI**LLE (Standby)
    b) Set Jammer (*Brouilleur*) to **MARCHE** (ON)
    c) Set RWR (*Détecteur d'Alertes*) to **MARCHE** (ON)
    d) Set MLWS (*Détection de Départ de Missile* – Missile Launch IR Warning Detector) to **MARCHE** (ON)
31. Set Flare Dispenser Mode (*Lance-Leurres*) to S.A. (Semi-Automatic) or AU (Automatic), as desired. Then, set Countermeasure Program as desired.



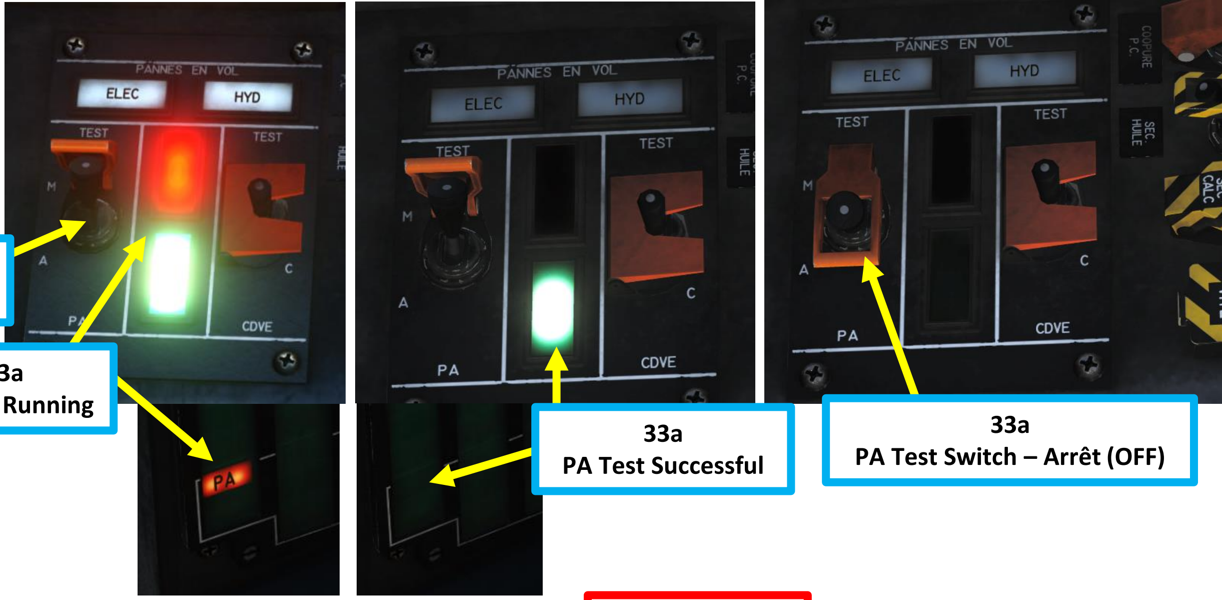


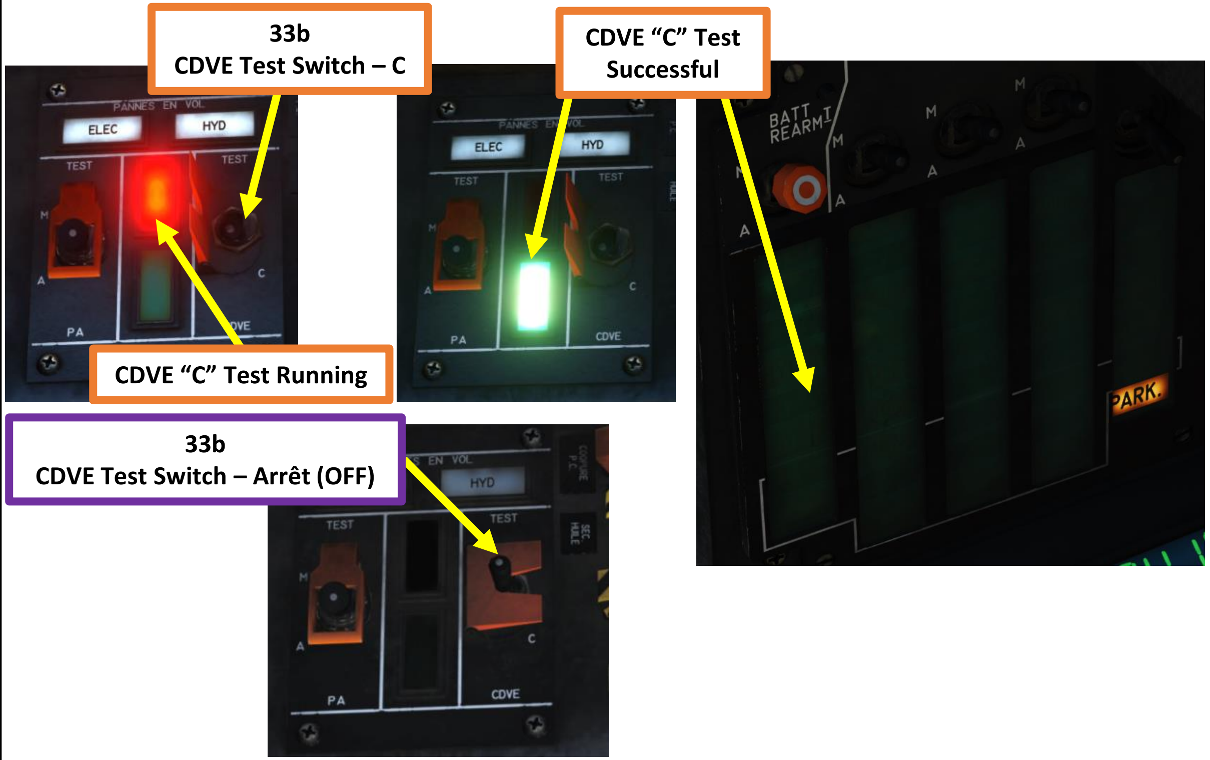


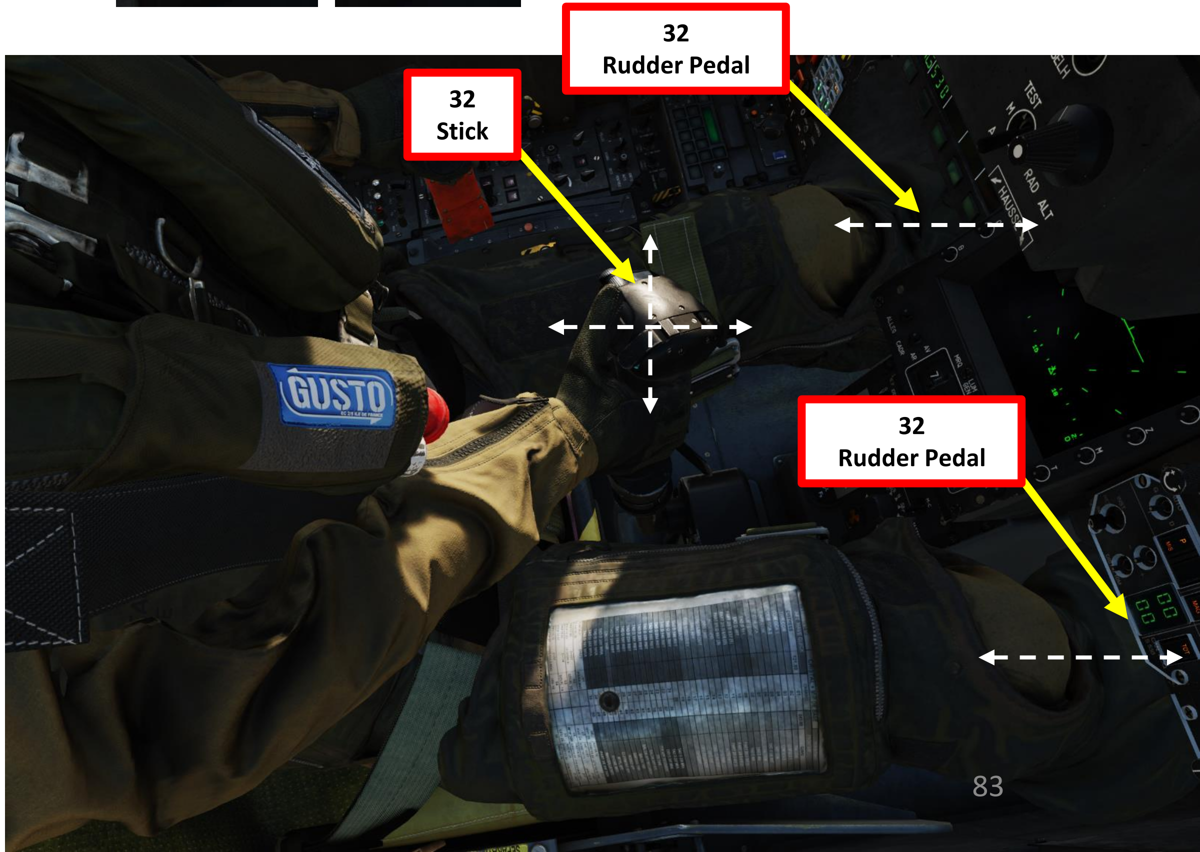


START-UP PROCEDURE

32. Perform 2 to 3 full control wipeouts to check flight controls. This step is important to allow hydraulic fluids to circulate and warm up. Failure to perform adequate control wipeout may result in autopilot and fly-by-wire test failures.
    - Stick Full Forward
    - Stick Full Aft
    - Stick Full Left
    - Stick Full Right
    - Rudder Full Left
    - Rudder Full Right
33. Perform Autopilot and Fly-By-Wire BIT (Built-In Tests).
    a) Test Autopilot system by flipping the PA test switch cover, setting switch to "M", waiting for the steady green light and then setting the test switch back to "A" and closing the cover.
    b) Test Fly-by-Wire system by flipping FBW (CDVE, *Commandes de Vol Électriques*) test switch cover, setting switch to "C" (*Court*, short test), waiting for the steady green light. Then, set the test switch back to "A" (MIDDLE position, *Arrêt*/OFF) and close the cover.

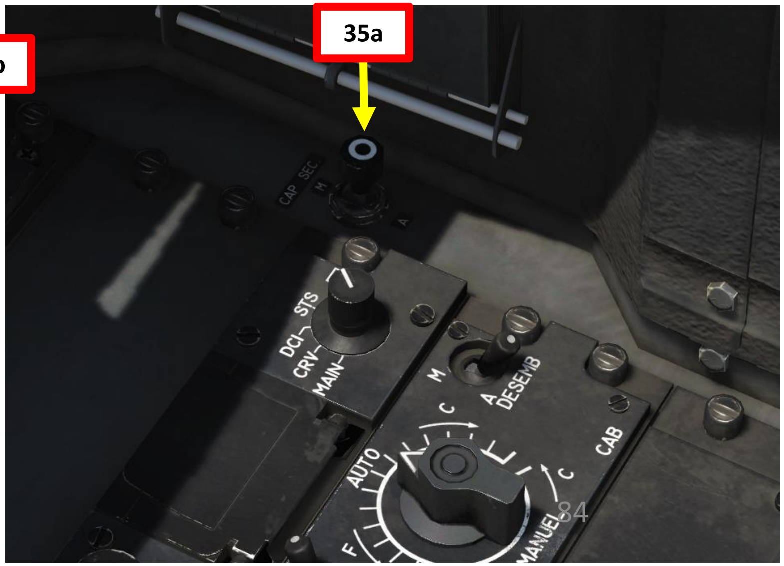






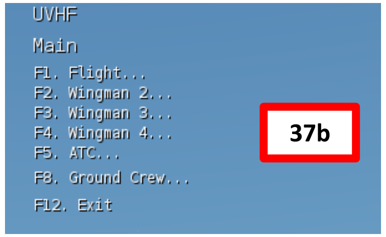
START-UP PROCEDURE

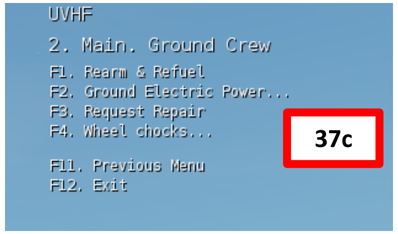
34. Set PITOT HEAT switch FWD (ON) and set orange cover switch to SAFETY position (as shown). ANEMOmeter caution will extinguish.
35. Uncage Auxiliary ADI (Attitude Director Indicator) Power switch (CAP SEC) to the Middle Position (Energized). The orange flag should disappear. Rotate the caging knob to align the ADI. This is done by left clicking on the caging knob and scrolling mousewheel downwards.
36. Set IFF Power Switch to either SECT (Sectoral, middle position) or FULL (rightmost position), as required.

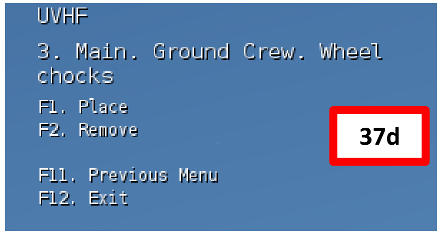


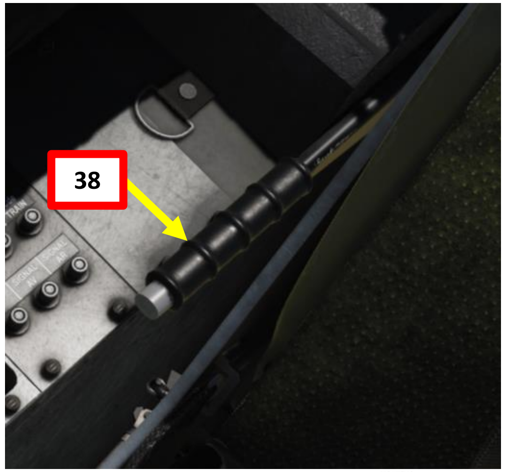
START-UP PROCEDURE

37. Remove Wheel Chocks by contacting ground crew
    (“/” –> F8 –> F4 –> F2)
    Note: Make sure the canopy is open when contacting the ground crew of the chief will not be able to hear your command.
38. Release Parking Brake (DOWN)
39. Engage DIRAV Nosewheel Steering – Press S
    - DIRAV blue light means NWS is engage
40. Re-arm equipment)weapons and external fuel tanks) as required.



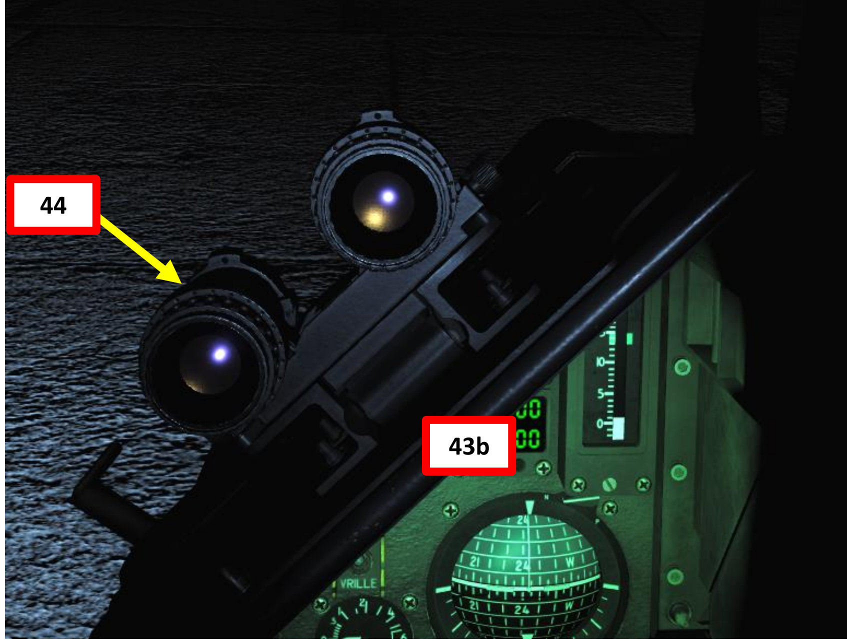


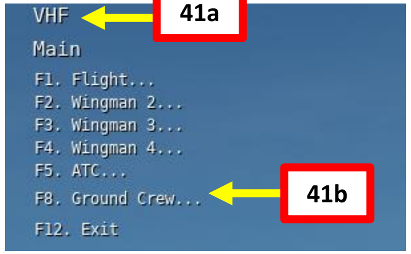


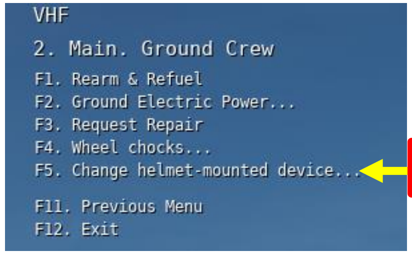


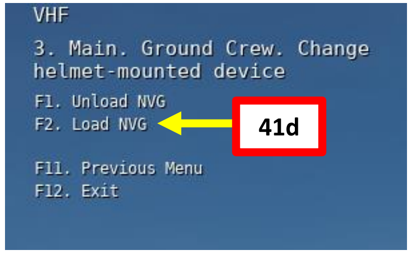
START-UP PROCEDURE

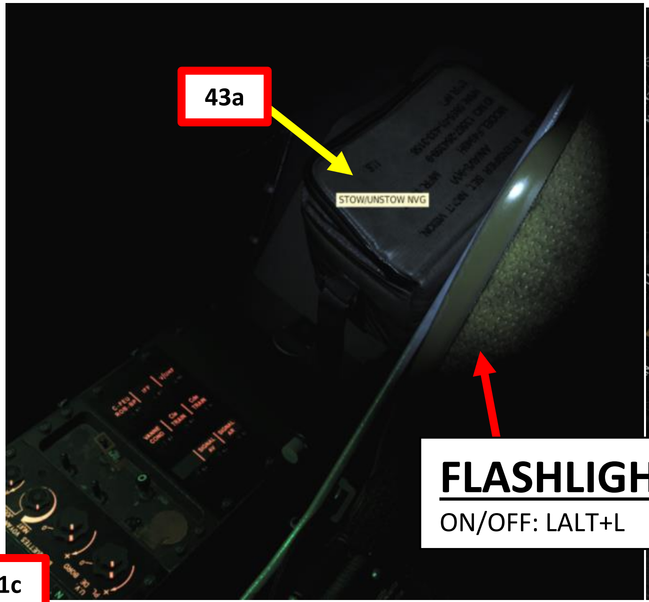
41. If required, you can equip NVGs (Night Vision Goggles) by requesting them from the ground crew
    a) Press "/" to open the communication menu
    b) Press F8 to contact the ground crew
    c) Press F5 to request to Change helmet-mounted device
    d) Press F1 to load night vision goggles. They will appear in a NVG case next to the parking brake lever.
42. You can use the flashlight by pressing « LALT+L »
43. Click on the NVG Case to install NVGs on the glareshield rack.
44. Install NVGs on your helmet by clicking on them.
45. Set JVN (*Jumelles de Vision Nocturne* / Night Vision Goggles) Filter Switch to JVN (FWD) for night operations.
46. Turn on NVGs by pressing "LALT+HOME"

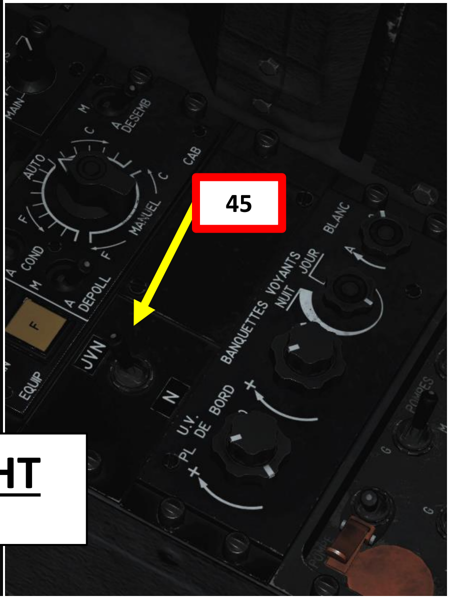


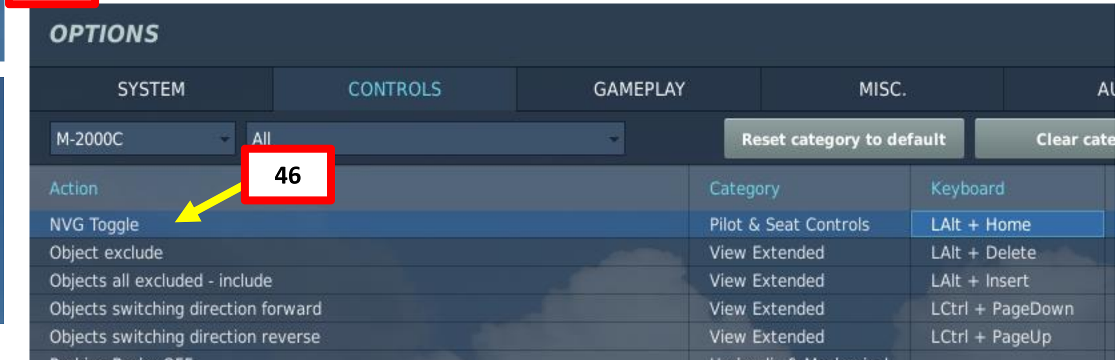










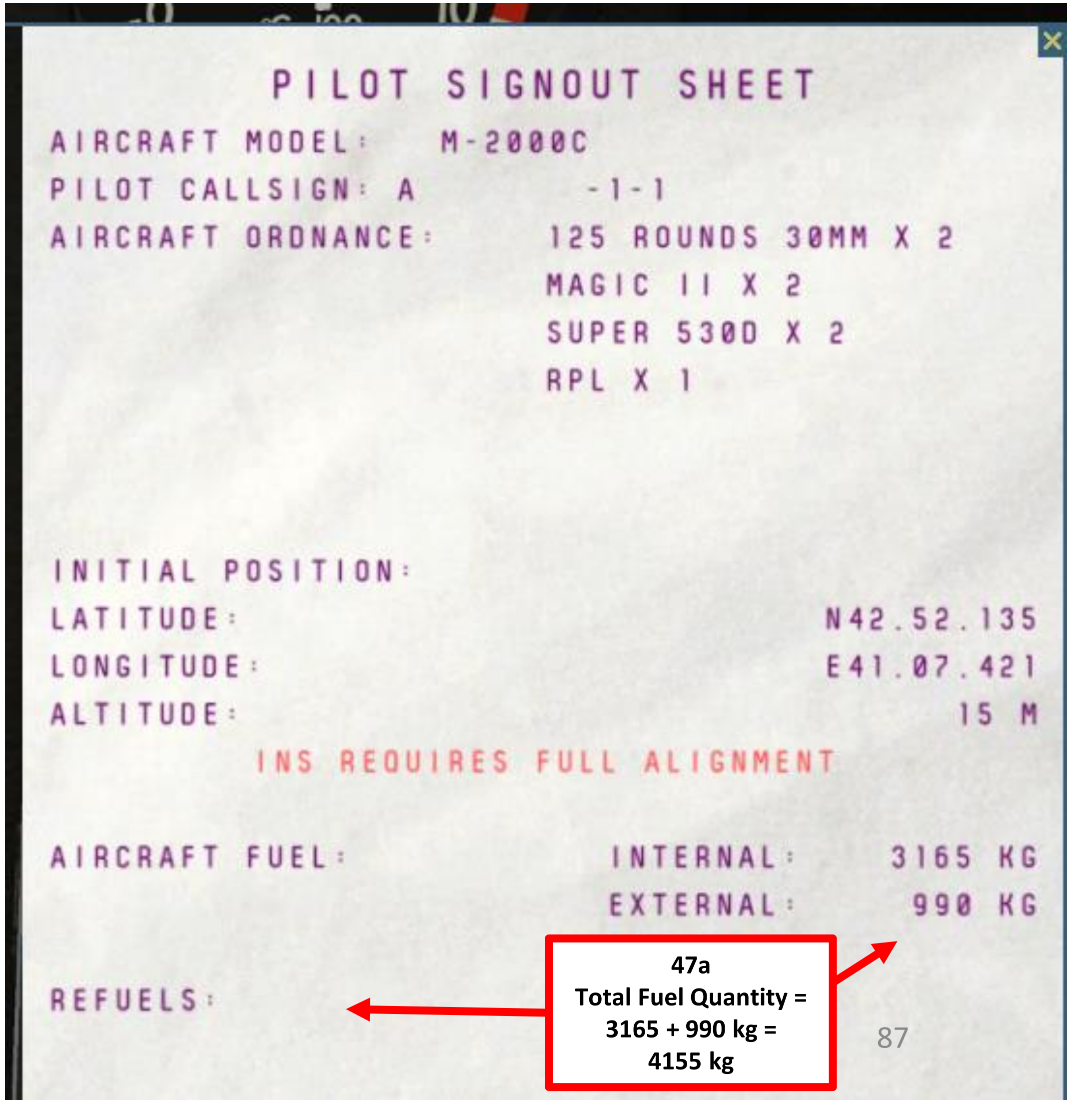


START-UP PROCEDURE

47. Before taxiing, the DETOT (Détotalisateur, or Total Fuel Quantity) has to be set manually. This is done by toggling the AFF DETOT switch +/- to set the DETOT indicator to the total fuel as per the value indicated on the Pilot Signout Sheet. In our case, the Pilot Signout Sheet says the fuel loaded is 4155 kg (external + internal fuel tank).
    - This step is very important since refueling the aircraft requires you to set the DETOT quantity if you want to have an accurate fuel reading. Ground or air refueling indicates on your Pilot Signout Sheet how much fuel was added.
48. When INS alignment process is complete (see INS ALIGNMENT section), start taxiing.

47b
AFF DETOT Switch

47c
DETOT Indicator (kg)


PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2
MAGIC II X 2
SUPER 530D X 2
RPL X 1

INITIAL POSITION:
LATITUDE: N42.52.135
LONGITUDE: E41.07.421
ALTITUDE: 15 M
INS REQUIRES FULL ALIGNMENT

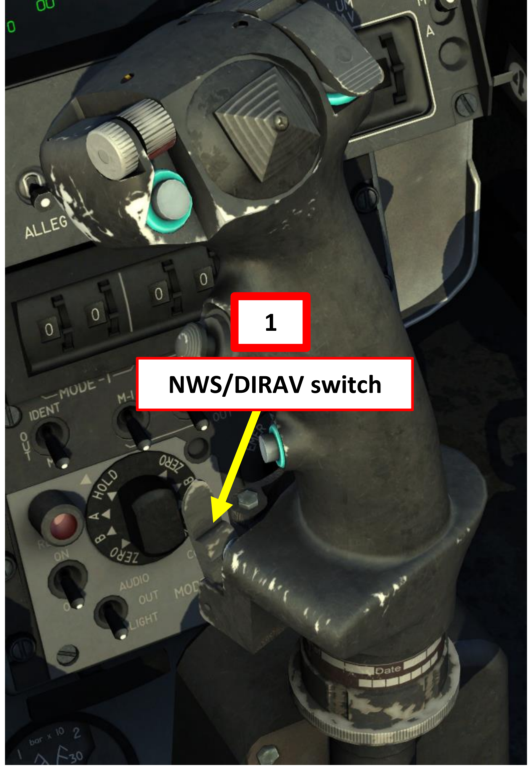
AIRCRAFT FUEL: INTERNAL: 3165 KG
EXTERNAL: 990 KG

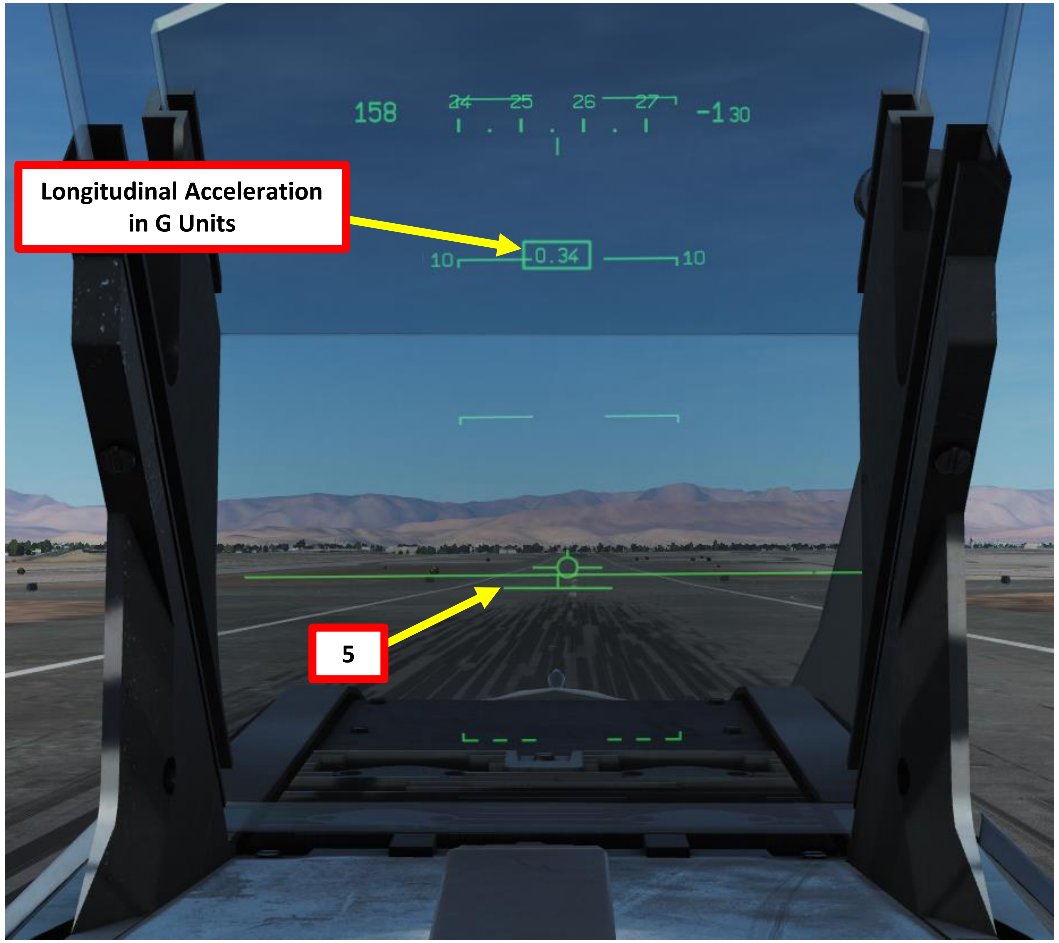
REFUELS:

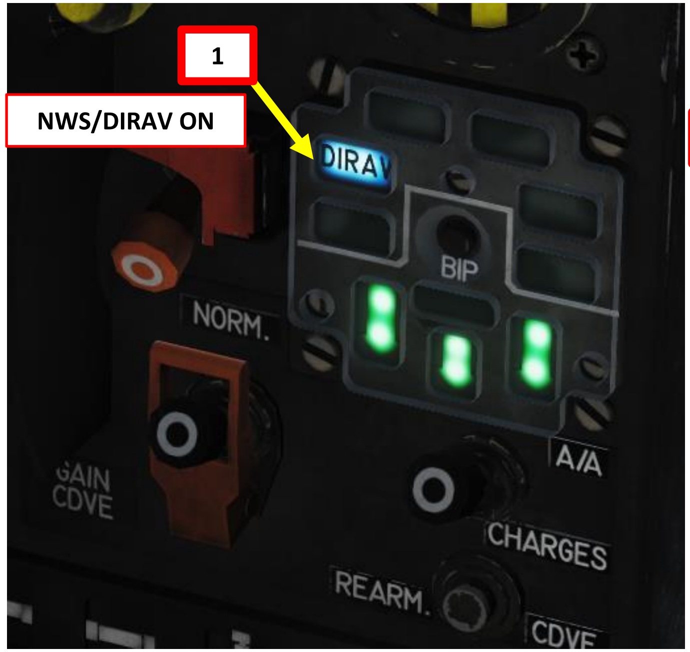
47a
Total Fuel Quantity = 3165 + 990 kg = 4155 kg

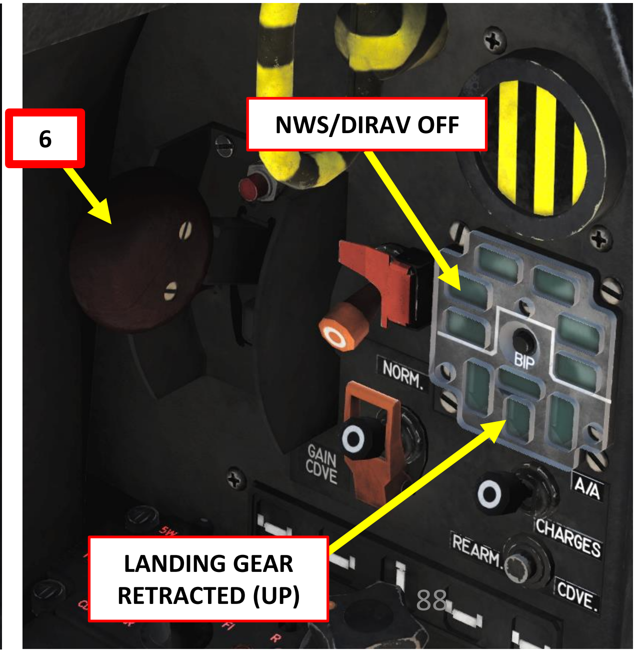
TAKEOFF

1. Taxi to the runway by using rudder pedals and toe brakes
    - Make sure your nosewheel steering (DIRAV) is engaged when taxiing
2. Once lined up on the runway, disengage nosewheel steering (DIRAV) by pressing S.
3. Hold Brakes, and apply 100% Throttle to check if engine spools up correctly and if TT7 is within safe range
4. Apply Full throttle (with Post-Combustion / Afterburner)
5. As you accelerate, keep the Inverted T Line on the horizon to achieve a takeoff pitch angle of 13 deg. This will help you avoid tail strikes on rotation.
6. Retract landing gear before you reach 260 kts









TAKEOFF

Source: RAZBAM Manual

TAKE OFF - ISA METEOROLOGICAL CONDITIONS

Configuration	Fuel (t)	GW (t)	Expected Jx	Vmaxrto (kt)	Vr (kt)	Vlof (kt)
Clean Aircraft	3.1	11.0	0.68	145	120	155
Standard Air to Air	4.1	13.2	0.55	140	125	155
Standard Air-to-Ground	6.3	16.0 or 15.7	0.44 - 0.46	130	150	175

Remarks: *Vmaxrto is the go/no-go speed, i.e. the max speed up to which it it still possible to reject take off. Above Vmaxrto the pilot must either take off or eject.*

Vmaxrto is not called V1 because it may occur above Vr on this aircraft. Vmaxrto values above assume a dry standard NATO runway (2400m) without brake chute use.

CLIMB - BEST EFFICIENCY

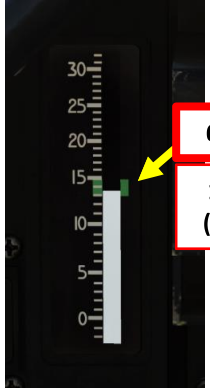
		Economic (MIL thrust)		High performances (Max AB thrust)	
Configuration	Climb up to	Best CAS (kt)	Best Mach	Best CAS (kt)	Best Mach
Clean Aircraft	FL400	500	0.90	600	0.95
Standard Air to Air	FL350	460	0.85	550	0.90
Standard Air-to-Ground	FL300	440	0.80	550	0.90

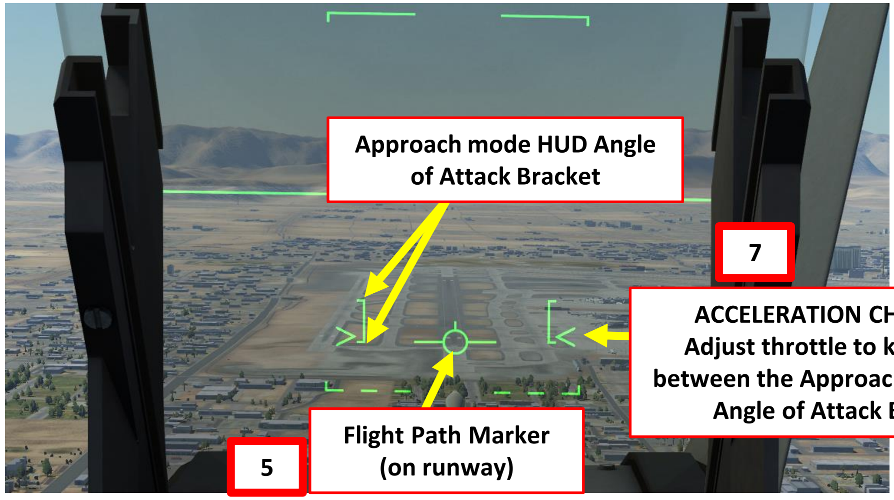
Remarks: *use best CAS (IAS) until best Mach is reached; then use best Mach for the remaining of the climb*

For MIL climb, cut AB off at 300kt after take off (AB is mandatory for all take offs with this aircraft, as per SOPs / safety consideration)

NORMAL LANDING APPROACH

1. Adjust seat height
2. Select Navigation Master Mode by setting the Weapons System CMD Switch AFT.
3. Select APPROACH mode on PCA (yellow “S” caution when engaged)
4. Deploy landing gear below 230 kts
5. Keep flight path marker where you want to touchdown
6. Trim the aircraft to about 14 deg AoA (Angle of Attack)
7. Line up flight path marker and acceleration chevrons within the Approach mode HUD Angle of Attack bracket by adjusting throttle and stick.
8. During touchdown, maintain your Angle of Attack to perform an aerobraking landing and set throttle to IDLE. This manoeuver will bleed speed in the process (your delta wing will act as a huge airbrake).

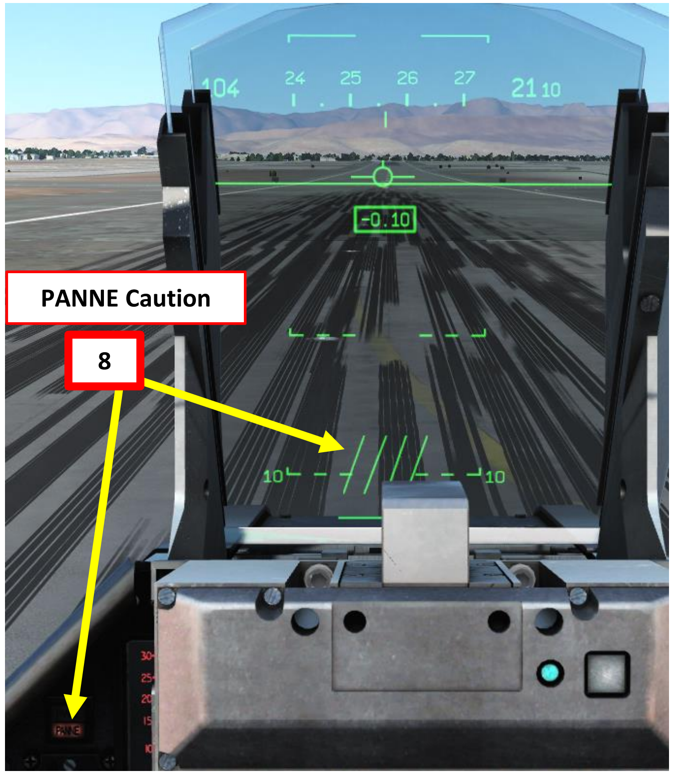


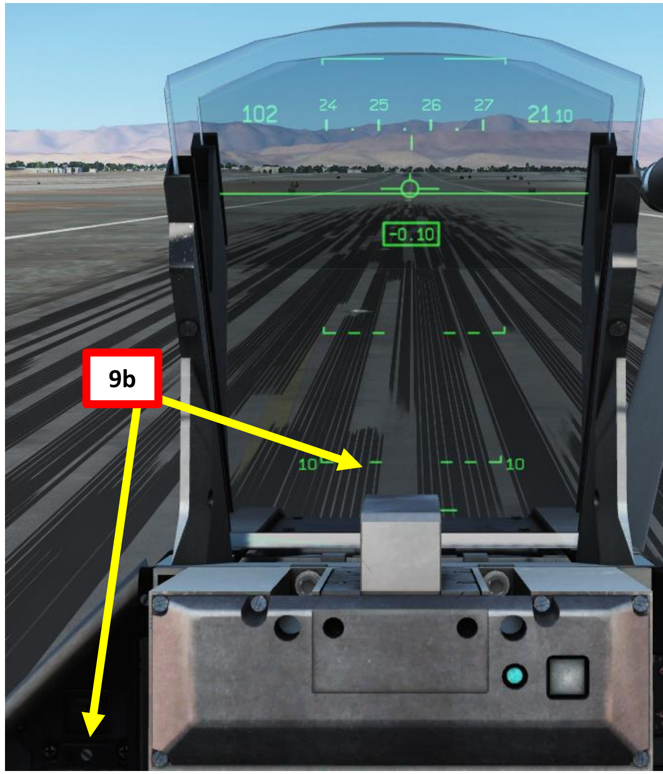


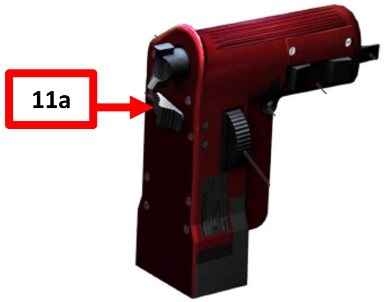
NORMAL LANDING APPROACH

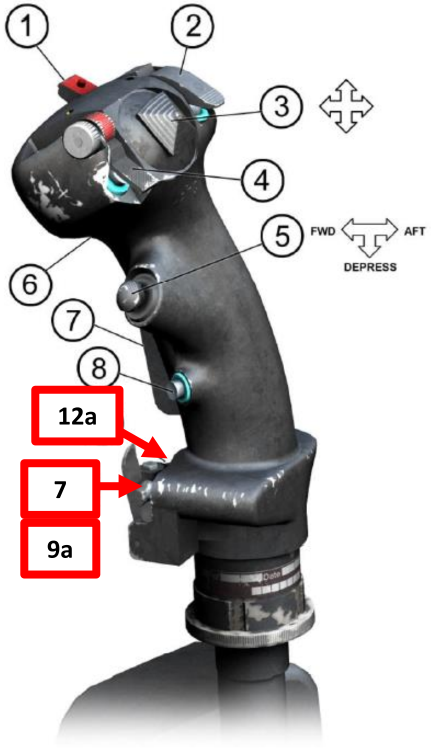
NORMAL LANDING APPROACH

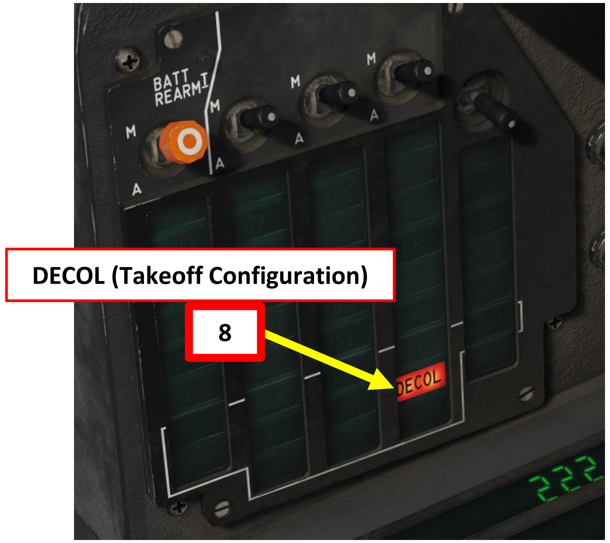
7. Once slowing down to 110 kts, press the Autopilot Standby Mode (AP Disconnect) switch on the stick to reset trim to allow the nosewheel to descend. An aural sound will be heard when trim is reset.
8. Once the nosewheel touches the ground, the PANNE and DECOL (*Décollage*, Takeoff) cautions will illuminate since the aircraft trim is not set to Neutral.
9. Press the Autopilot Standby Mode (AP Disconnect) switch on the stick to reset trim. The PANNE and DECOL cautions should extinguish, and an aural sound will be heard when trim is reset.
10. Gently apply brakes when you have slowed down under 100 kts.
11. Retract airbrakes (A & F lights out).
12. Engage Nosewheel Steering (DIRAV) when you slowed down under 40 kts.

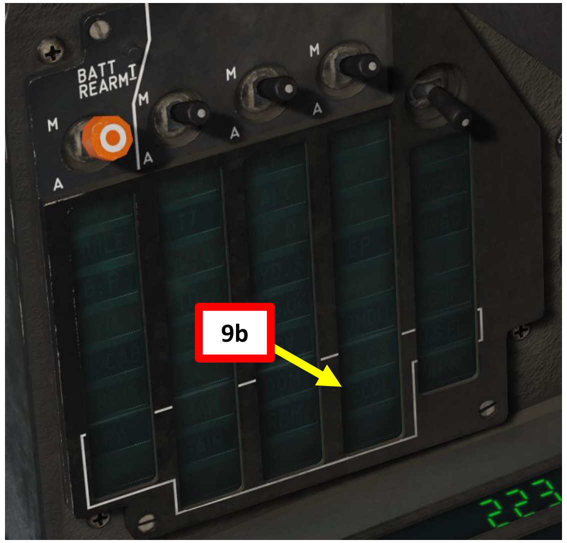


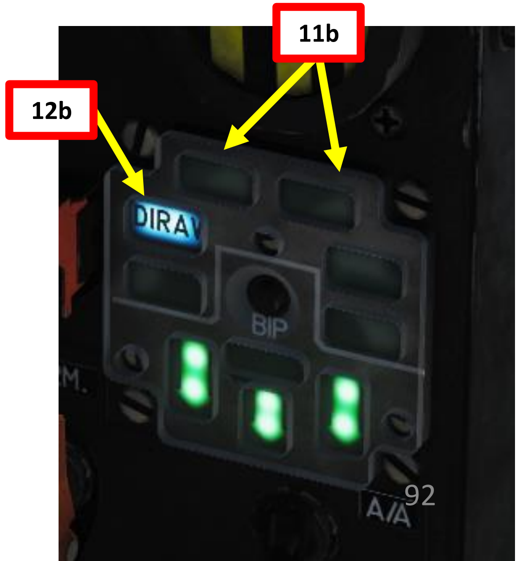












NORMAL LANDING APPROACH

VIDEO LANDING TUTORIALS

If you are having difficulties with landing, here are a couple of excellent landing tutorials for various conditions made by Slundal.

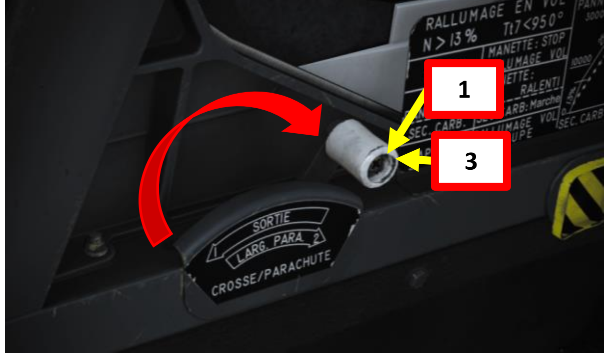
1. Landing Tutorial 1/3 - Visual Approach
   https://www.youtube.com/watch?v=XJq4eNgZ-vU

2. Landing Tutorial 2/3 - Using ILS and TACAN
   https://www.youtube.com/watch?v=P0VCssCQ0S4

3. Landing Tutorial 3/3 - Zero Visibility Landing
   https://www.youtube.com/watch?v=a_ixQHO-vpw

HOW TO USE THE DRAG CHUTE

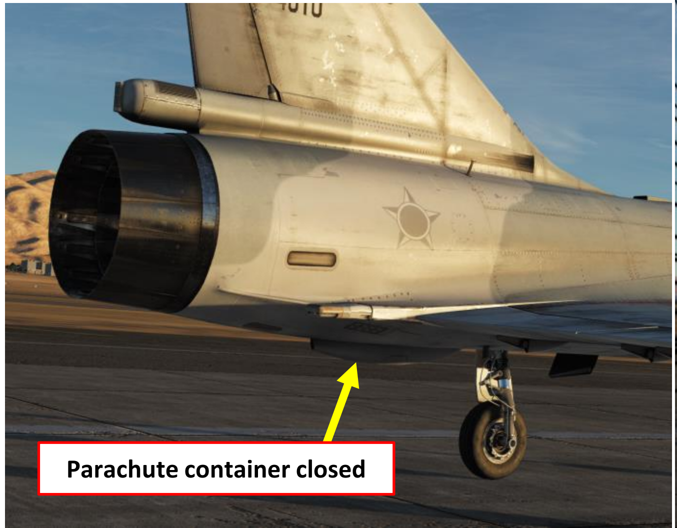
1. Verify that drag chute lever is in the FORWARD position (ARMED).
2. Deploy chute (preferably when you are wheels down) by pulling the drag chute lever AFT (*SORTIR PARACHUTE = DEPLOY CHUTE*).
3. Once you are slowed down, push drag chute lever FORWARD to release the chute (*LARGAGE PARACHUTE = RELEASE CHUTE*).

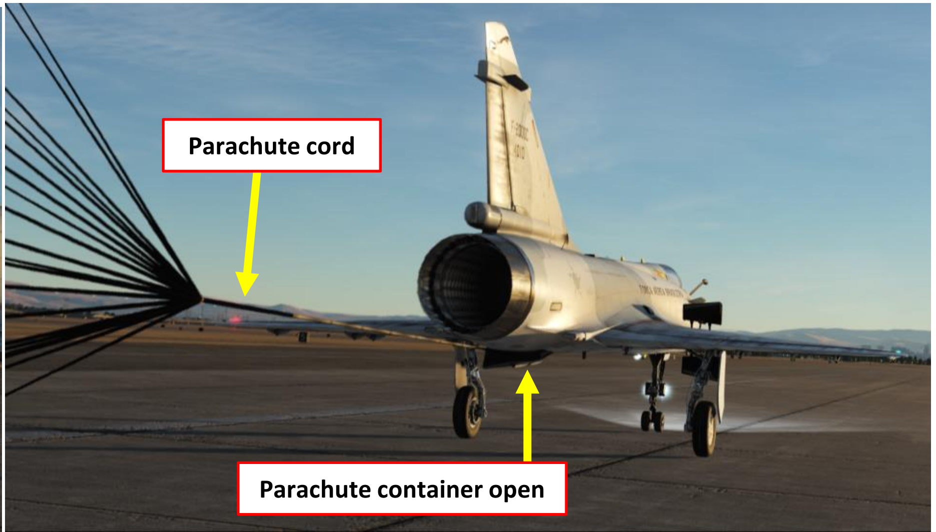


<u>NOTE</u>

The slot where the parachute container is equipped can have either the drop chute OR the ÉCLAIR countermeasure pod. In other words, if you have the ÉCLAIR equipped, you will not be able to deploy your chute since it will not fit on your aircraft.

The French *Armée de l'Air* procedures do not use a drop chute in a standard landing unless an emergency requires it, unlike other aircraft like the MiG-21bis which routinely land while deploying their drop chute. The Mirage having a very small amount of flares without the ÉCLAIR pod, I would recommend equipping the ÉCLAIR instead and gain precious countermeasures instead of a one-use drag chute that will hamper your combat effectiveness.





SECTION STRUCTURE

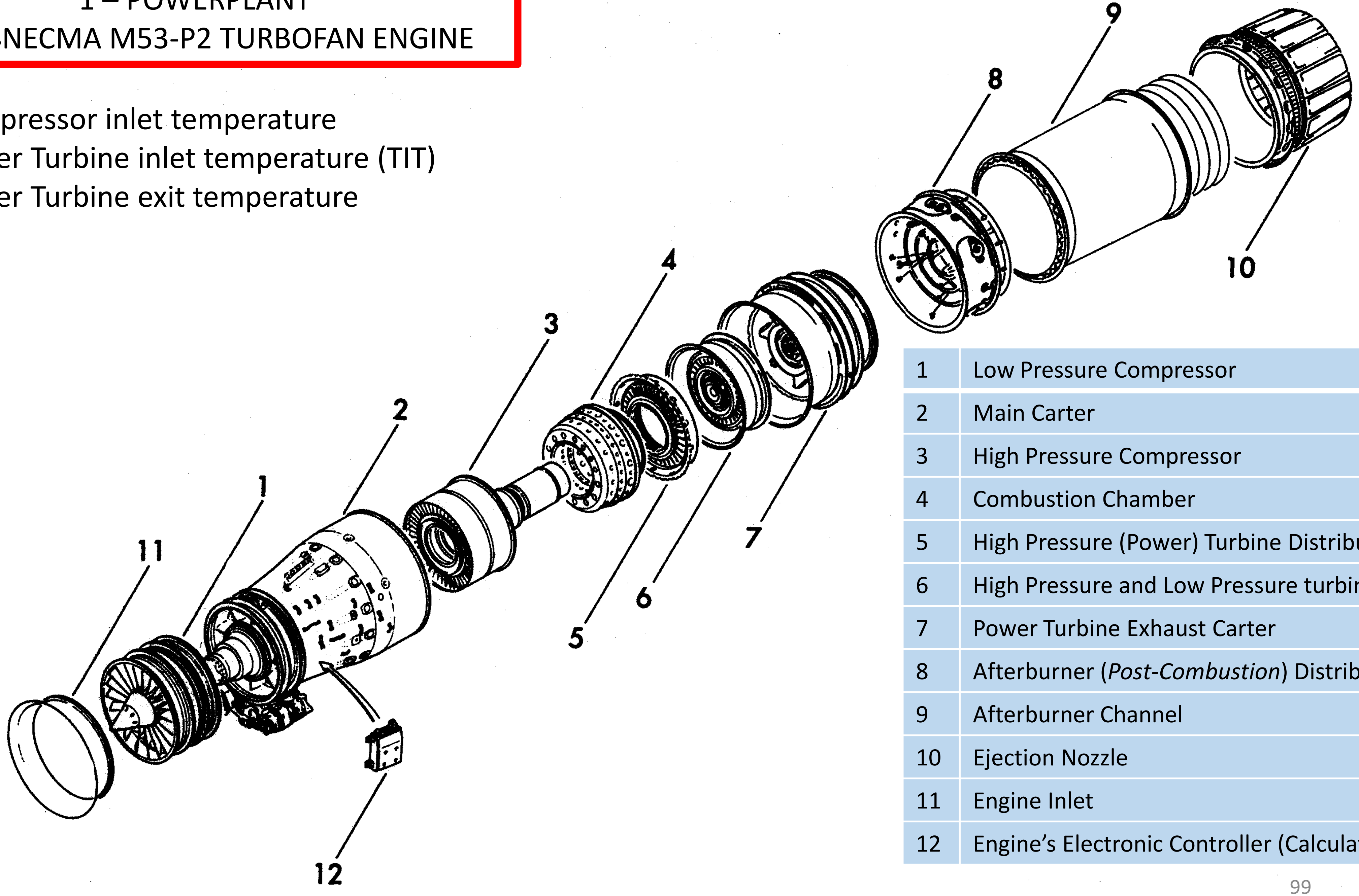
1 – POWERPLANT
1.1 – SNECMA M53-P2 TURBOFAN ENGINE

Originally called the "Super Atar", the M53 was first developed between 1967 and 1969 in order to provide an upgraded version of the Atar engine. The Super Atar was meant to be a cheaper and less complex engine than the SNECMA TF306, which was derived from the Pratt & Whitney TF30. The low operation and maintenance cost of the engine was a priority for the french *Armée de l'Air*. Initially built to be installed on an upgraded version of the Mirage F1 (which was in competition with the F-16 for a NATO contract at the time), a second version of the engine (M53 P-2) was eventually developed and installed on the Mirage 2000C in July 1983.

General Characteristics of the M53-P2	
Type	Afterburning single-shaft turbofan
Dry weight	1,515 kg (3,340 lbs)
Compressor	8-stage axial compressor
Combustors	Annular
Turbine	2-stage axial turbine
Dry thrust	64.7 kN (14,500 lbf / 6,600 kgp)
Afterburning Thrust	95.1 kN (21,400 lbf / 9,700 kgp)

1 – POWERPLANT
1.1 – SNECMA M53-P2 TURBOFAN ENGINE

TT2: Compressor inlet temperature
TT5: Power Turbine inlet temperature (TIT)
TT7: Power Turbine exit temperature

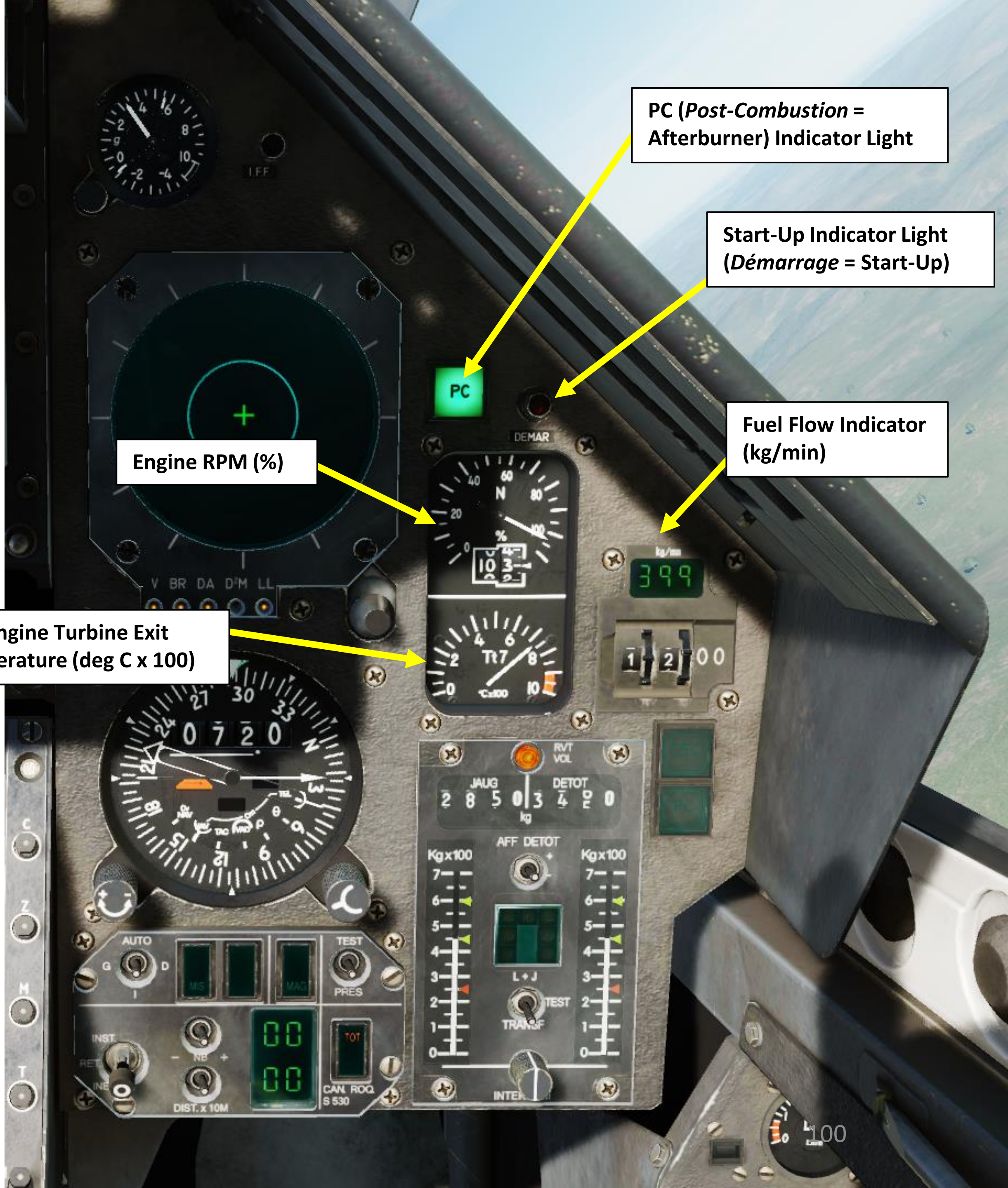


1	Low Pressure Compressor
2	Main Carter
3	High Pressure Compressor
4	Combustion Chamber
5	High Pressure (Power) Turbine Distributor
6	High Pressure and Low Pressure turbine
7	Power Turbine Exhaust Carter
8	Afterburner (*Post-Combustion*) Distributor
9	Afterburner Channel
10	Ejection Nozzle
11	Engine Inlet
12	Engine's Electronic Controller (Calculator)

1 – POWERPLANT
1.2 – ENGINE INDICATIONS

Here is an overview of the three primary engine parameters you can monitor:

- Engine RPM (%)
- Tt7 (Engine Turbine Exit Temperature) in deg C
- Fuel Flow Indicator (kg/min)



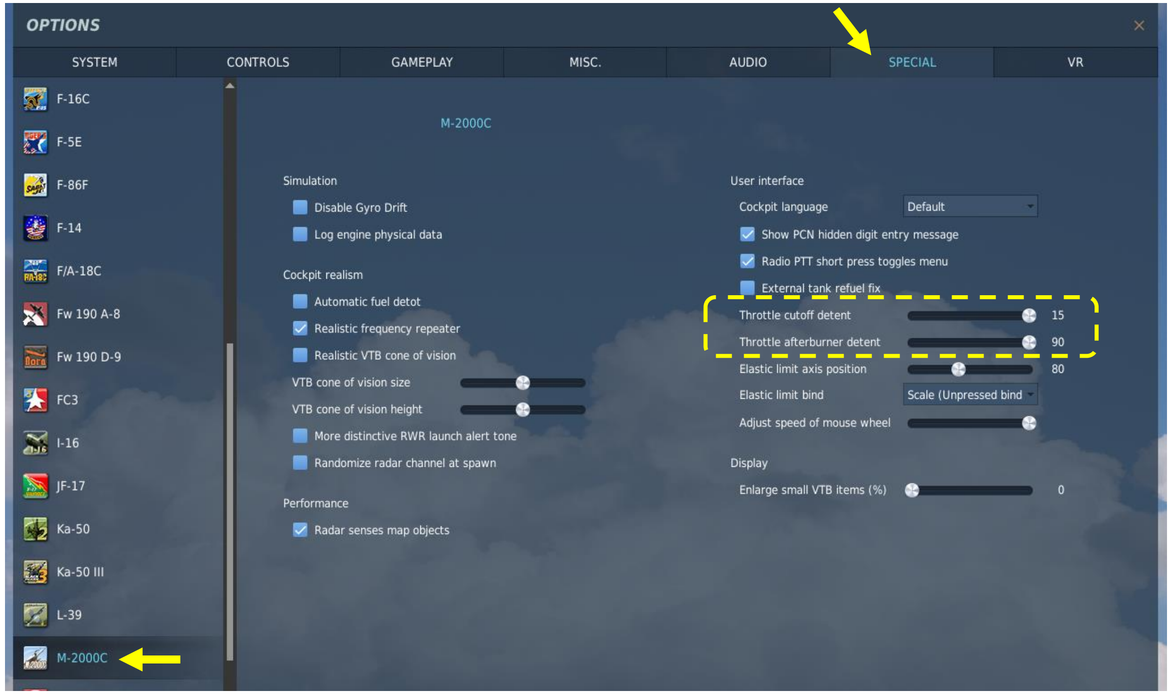
1 – POWERPLANT
1.3 – ENGINE CONTROLS

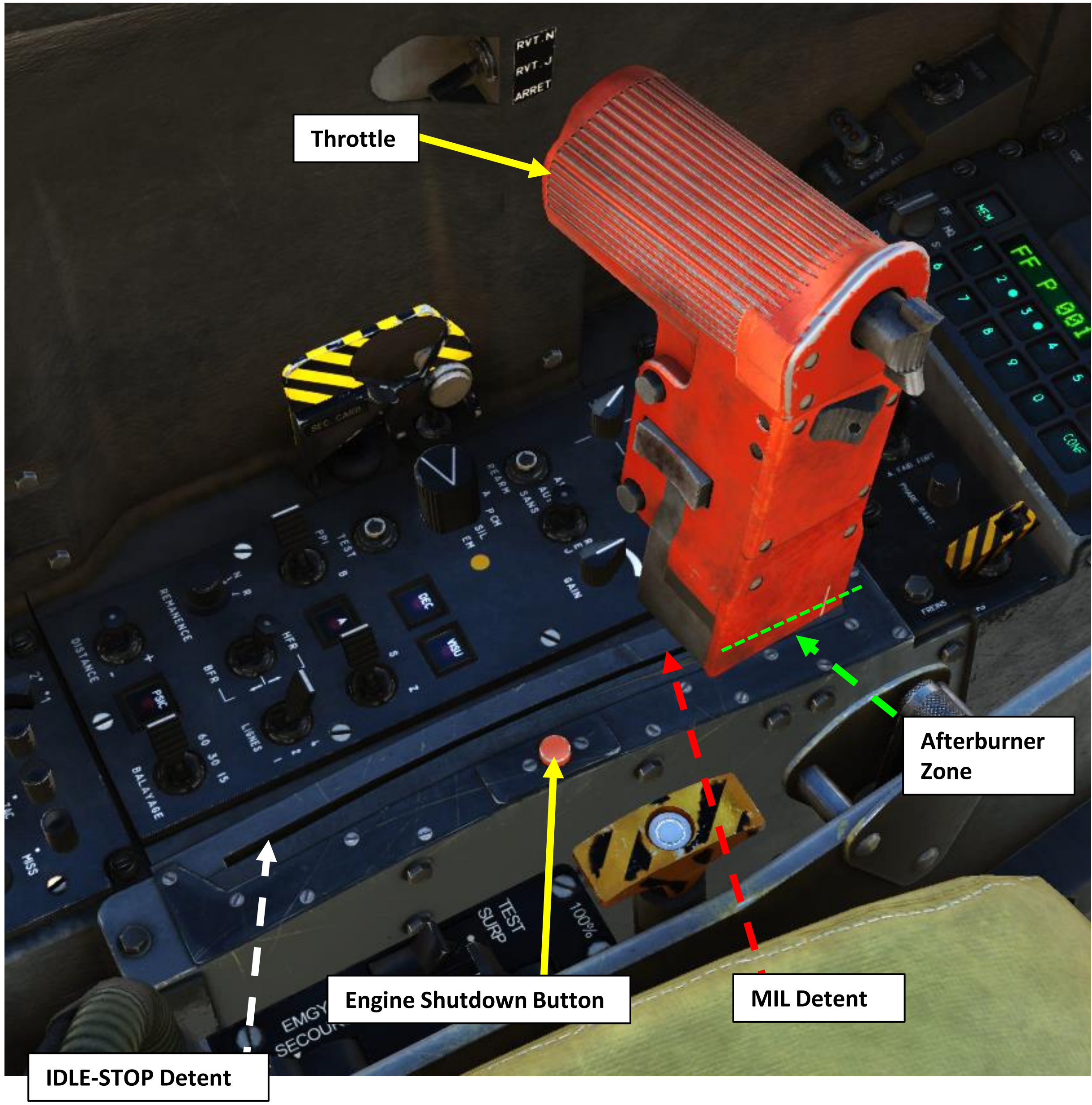
The engine is controlled primarily with the throttle, but not directly. The throttle position signal is used by the engine controller (FADEC, or Full Authority Digital Engine Control), referred as the *CALC* (*Calculateur*) in French. The FADEC controls engine parameters with control loops in order to maintain a required RPM setting.

The FADEC-commanded fuel flow is managed by a hydromechanical metering valve (HMV), which balances it against the engine RPM and ensures smooth and stable engine operation.

The throttle travel has two detents located before the ends of travel on each side:
- **IDLE stop:** at the rear before the engine cut-off end of travel position that can be bypassed by using the idle cut-off button.
- **MIL (Military) power stop**: at the front before the afterburner zone that can be bypassed by applying more force forward.

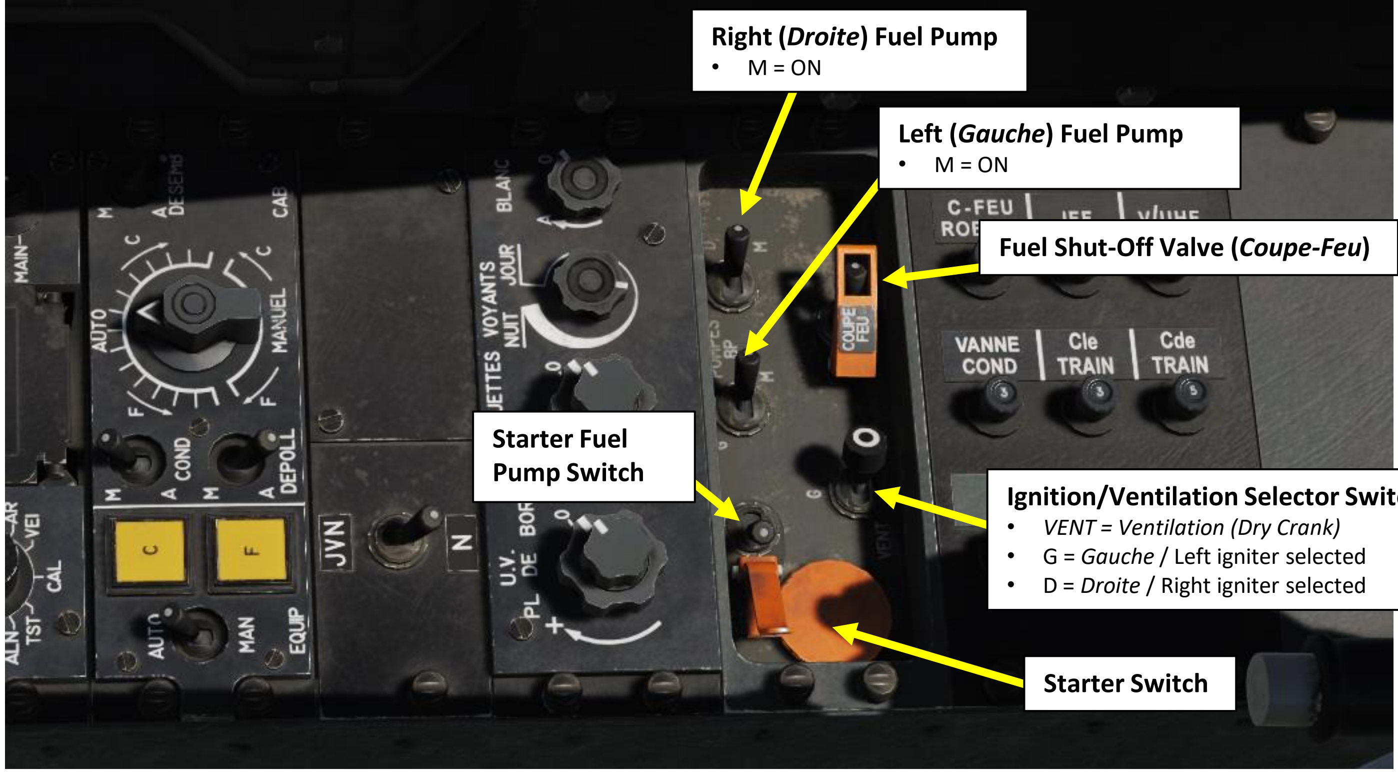
Note: Throttle detents can be customized via the DCS Special Options tab.





1 – POWERPLANT
1.3 – ENGINE CONTROLS

Emergency Engine Control / Emergency Throttle
- *Used to select the emergency fuel mode (SEC CARB) and control the engine fuel flow while in this mode.*



Right (*Droite*) Fuel Pump
- M = ON

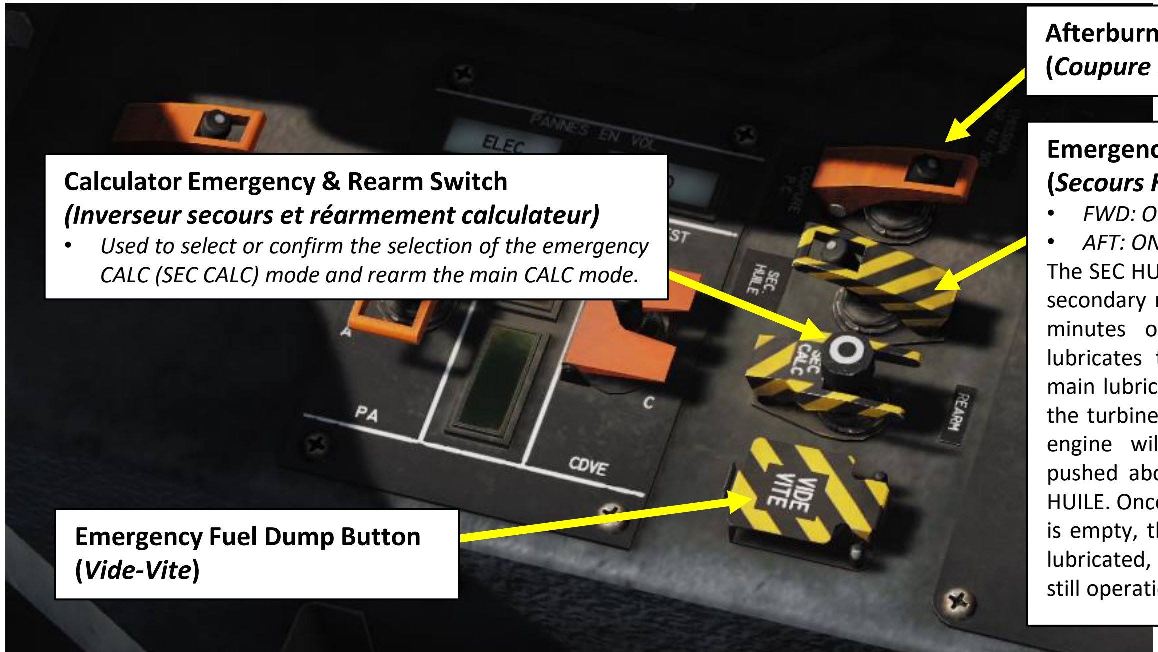
Left (*Gauche*) Fuel Pump
- M = ON

Fuel Shut-Off Valve (*Coupe-Feu*)

Starter Fuel Pump Switch

Ignition/Ventilation Selector Switch
- *VENT = Ventilation (Dry Crank)*
- G = *Gauche* / Left igniter selected
- D = *Droite* / Right igniter selected

Starter Switch



Afterburner Shutdown Switch (*Coupure Post-Combustion*)

Calculator Emergency & Rearm Switch (*Inverseur secours et réarmement calculateur)*
- *Used to select or confirm the selection of the emergency CALC (SEC CALC) mode and rearm the main CALC mode.*

Emergency Oil Switch (*Secours Huile*)
- *FWD: OFF*
- *AFT: ON*

The SEC HUILE system sprays oil from a secondary reservoir. This mode has 20 minutes of autonomy and only is lubricates the compressor, while the main lubricating system also lubricates the turbine. Due to this difference the engine will accumulate wear when pushed above 88% RPM while in SEC HUILE. Once the secondary oil reservoir is empty, the engine will no longer be lubricated, even if the main system is still operational.

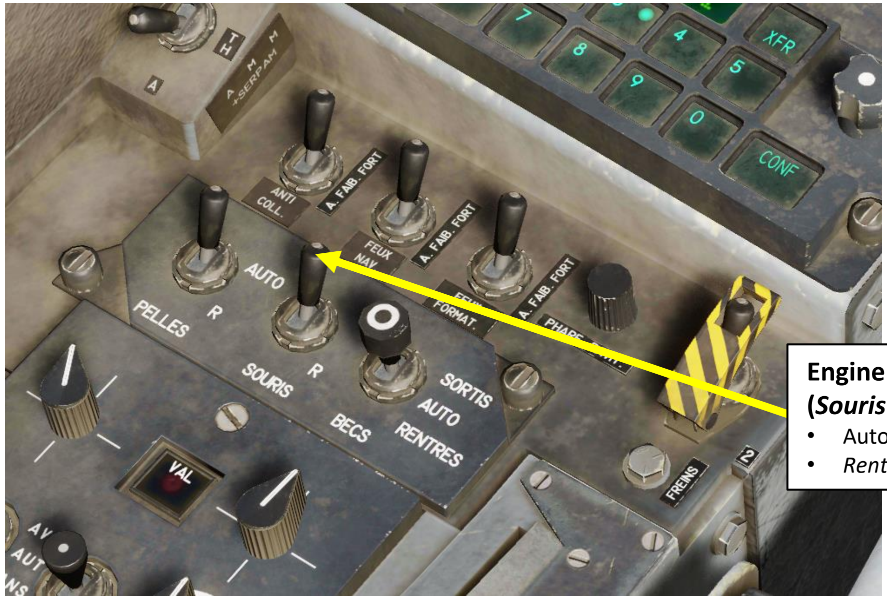
Emergency Fuel Dump Button (*Vide-Vite*)

1 – POWERPLANT
1.4 – ENGINE SHOCKS CONES (*SOURIS*)

Engine shock cones slow the flow of air from supersonic flight speed to a subsonic speed before it enters the engine to prevent ingestion of shock waves. Shock cones, also nicknamed “mice” (“*souris*” in French), can be controlled either automatically or manually; their position is a function of Mach number. If set to an incorrect position, this can disrupt the airflow to the engine and cause an engine failure or compressor stall.

Normally, shock cones operate in automatic mode if the **Engine Shockwave Cone Control Switch** is set to AUTO (FWD). Shock cones start to extend at 1.2 Mach up to the aircraft max speed.

If automatic mode has failed, shock cones can be retracted manually by setting the Engine Shockwave Cone Control Switch to *RENTRÉS*/RETRACTED (AFT).



1 – POWERPLANT
1.5 – SCOOPS & ENGINE AUXILIARY INTAKES / BLOW-IN DOORS (*PELLES & TAPETTES D'ENTRÉES D'AIR*)

Engine Auxiliary Intakes / Blow-In Doors *(Tapettes d'Entrées d'Air)* open automatically under spring pressure at low airspeed to allow additional air into the engine intake, which is very useful during high angle-of-attack manoeuvers. *Pelles,* also referred as "scoops" are doors which are automatically controlled by a signal from the air data computer (ADC) in order to provide additional air to the engine for added thrust in high-altitude flight.

Normally, scoops operate in automatic mode if the **Pelles (Scoops) Control Switch** is set to AUTO (FWD).

If automatic mode has failed, scoops can be closed/retracted manually by setting the Pelles/Scoops Control Switch to *RENTRÉS*/RETRACTED (AFT).

In **automatic** mode, the scoops extend in the following conditions:

- Altitude above 25100 ft
- Mach speed between 0.5 and 1.2
- CAS (Calibrated Airspeed) below 430 kts
- AoA (Angle of Attack) above 12°

Pelle Rentrée
Scoop Retracted

Tapettes d'Entrées d'Air Sorties
Engine Auxiliary Intakes / Blow-In Doors Open

Pelle Sortie
Scoop Deployed

***Pelles:* Scoops Control Switch**
- Auto: Automatic
- *Rentrés*: In/Retracted

1 – POWERPLANT
1.6 – AFTERBURNER (*POST-COMBUSTION*)

The afterburner is engaged once **throttle is pushed past MIL** (Military Power) detent.

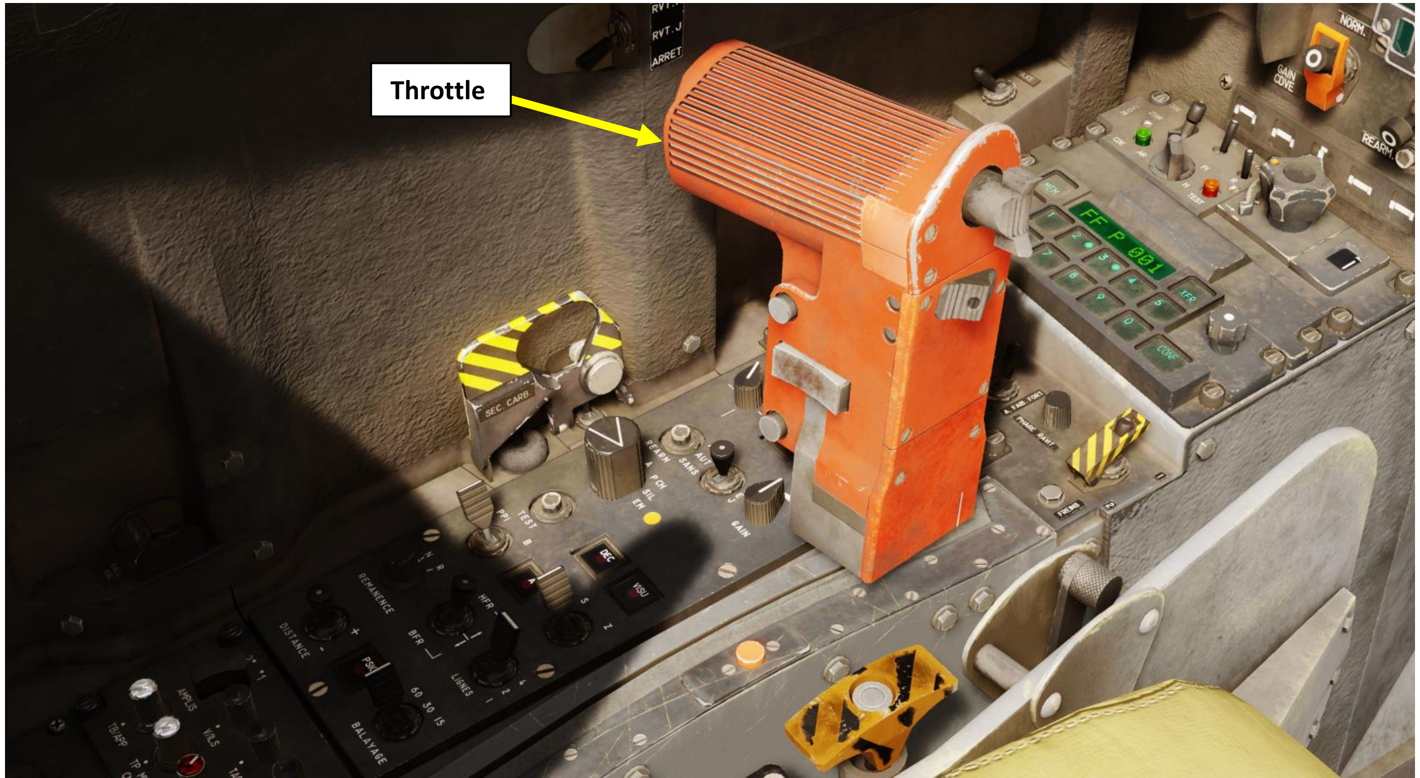
The **PC (*Post-Combustion* / Afterburner) Indicator Light** Indicates that all afterburner ramps are in use. If only the first or second ramps are in use, the light remains out. The light will flash to indicate that the engine nozzle is stuck in the open position, greatly reducing engine thrust, particularly at MIL power.

- Note: The afterburner cannot be engaged but will remain if the SEC CALC mode is selected while the afterburner was already engaged.

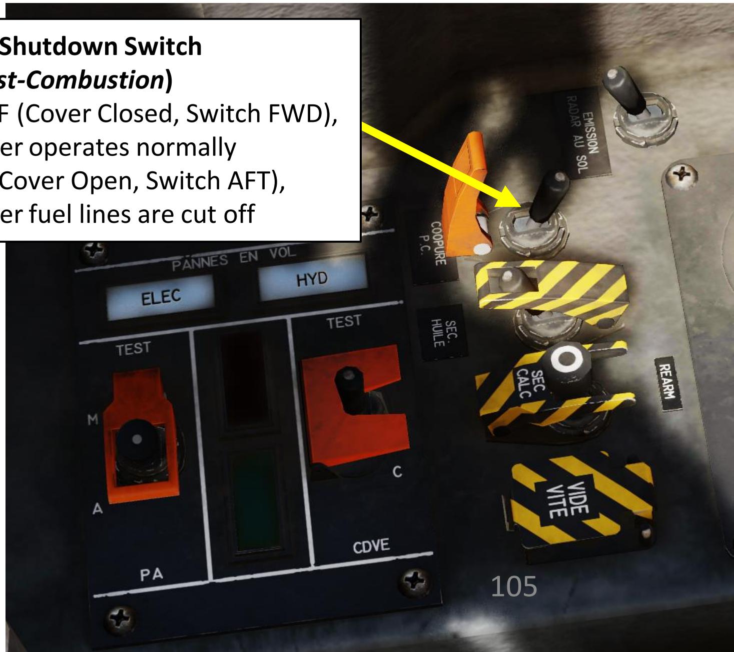
The **Afterburner Shutdown Switch** (*Coupure Secours Post-Combustion*) cuts-off the fuel line to the afterburner ramps. The Afterburner Shutdown (also referred as "Emergency Afterburner Cut-Off) should be used when the afterburner remains lit after pulling the throttle from the afterburner zone. It should also be used when the engine nozzle is damaged or does not function properly in order to prevent the afterburner from melting it.

PC (*Post-Combustion* = Afterburner) Indicator Light

Throttle



Afterburner Shutdown Switch (*Coupure Post-Combustion*)
- FWD: OFF (Cover Closed, Switch FWD), afterburner operates normally
- AFT: ON (Cover Open, Switch AFT), afterburner fuel lines are cut off



1 – POWERPLANT
1.6 – AFTERBURNER (*POST-COMBUSTION*)

1 – POWERPLANT
1.7 – ENGINE LIMITS

The engine FADEC (Full Authority Digital Engine Controller) controls engine parameters automatically in order to avoid exceeding engine limits. However, the use of emergency modes, engine wear and battle damage can push the engine to exceed these limits, therefore it is your job to make sure these limits are known and that corrective actions are taken if necessary.

Limits:
- Minimum RPM: 45 %
- Minimum Throttle Position Above Mach 1.4: MIL Power
- Maximum RPM: 105 %
- Maximum RPM while in SEC HUILE: 88 %
- Maximum Tt7 (Engine Turbine Exit Temperature): 950 deg C
- Maximum Mach Speed: 2.25

Important Note: Throttling down below MIL Power when Mach is greater than 1.4 can cause an engine flameout.

1 – POWERPLANT
1.8 – EMERGENCY ENGINE CONTROL (*SEC CALC, CALCULATEUR SECOURS*)

The engine Calculator (CALC) system, also referred as FADEC (Full Authority Digital Engine Controller) monitors the engine RPM and Tt7 temperature for any anomaly. if an abnormal engine parameter is detected, the **CALC will automatically switch to SEC CALC mode (Emergency Engine Control, or *Calculateur Secours*)**. During flight, the SEC CALC mode is indicated by the **CALC caution light** on the alarm panel.

Manually switching to SEC CALC mode is indicated in the following conditions:

- Constant engine overspeed.
- Inability to relight the engine inflight in normal mode.

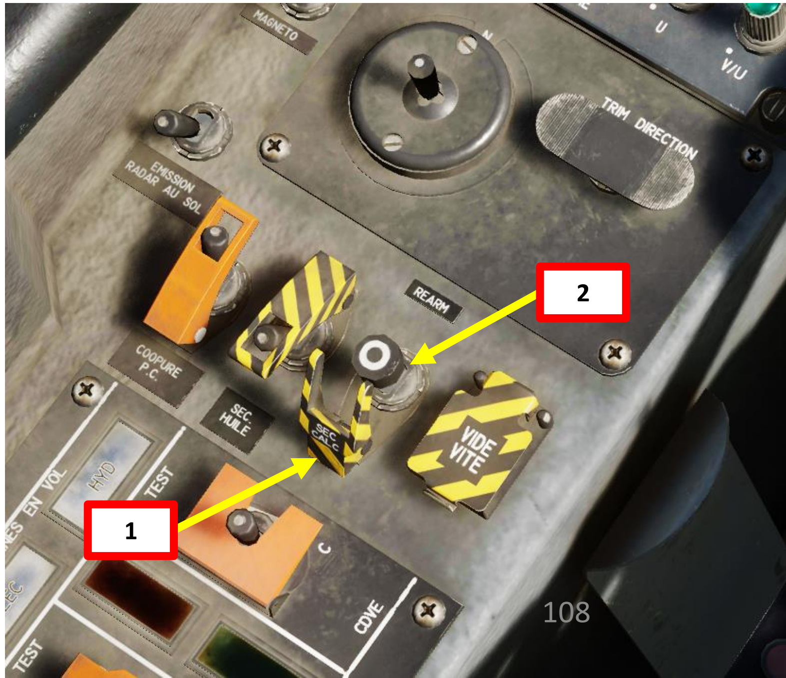
<u>To manually set the engine in SEC CALC mode:</u>

1. Flip Calculator Emergency & Rearm Switch safety cover UP
2. Set Calculator Emergency & Rearm Switch – AFT (SEC CALC ON)
3. Confirm that CALC caution light illuminates.
4. While in SEC CALC mode, bypass flaps open and the nozzle position rule changes to ensure safe operation of a degraded engine. These changes result in less thrust, especially at MIL power. In SEC CALC mode, the throttle bypasses the CALC system directly commanding the fuel flow to the regulator, resulting in a less linear throttle response.
5. The afterburner cannot be engaged but will remain if the SEC CALC mode is selected while the afterburner was already engaged. SEC CALC mode still protects the engine from overtemperature and overspeed but might momentarily overshoot these limits, requiring smooth throttle movement and constant engine monitoring from the pilot.
6. To revert into Normal CALC Mode, set Calculator Emergency & Rearm Switch FWD (Rearm) momentarily. Then, release the switch, which will spring back to the MIDDLE position.
7. Confirm that CALC caution light extinguishes.

- Note: If **CALC SEC mode has automatically engaged** during flight (**CALC Caution Light illuminates**), you can attempt to revert into Normal CALC mode by **setting the Calculator Emergency & Rearm Switch FWD (Rearm) momentarily**. If the engine functions correctly, this should clear the CALC Caution light.

Calculator Emergency & Rearm Switch
(Inverseur secours et réarmement calculateur)

- *FWD: Rearm. If the CALC has automatically switched itself in SEC CALC mode, returns in the main CALC mode.*
- *MIDDLE: OFF, Normal CALC operation*
- *AFT: CALC SEC ON. Selects or confirms the selection of the SEC CALC mode.*



3

CALC (Calculateur Secours, Emergency Engine Control) Caution Light

- *Illuminates when SEC CALC Mode is engaged*

1 – POWERPLANT
1.9 – EMERGENCY FUEL THROTTLE CONTROL (*SEC CARB, CARBURANT SECOURS*)

The emergency throttle and switch (*Carburant Secours*) are used to select the emergency fuel mode (SEC CARB) and control the engine fuel flow. This secondary engine mode is useful in cases when the engine is damaged.

Switching to SEC CARB mode is indicated in the following conditions:
- Loss of efficiency of the throttle.
- Non-recoverable engine RPM drop.
- Constant engine overspeed not recoverable via SEC CALC.
- Mechanical failure of the normal driveline.
- Inability to relight the engine inflight in normal or SEC CALC mode.

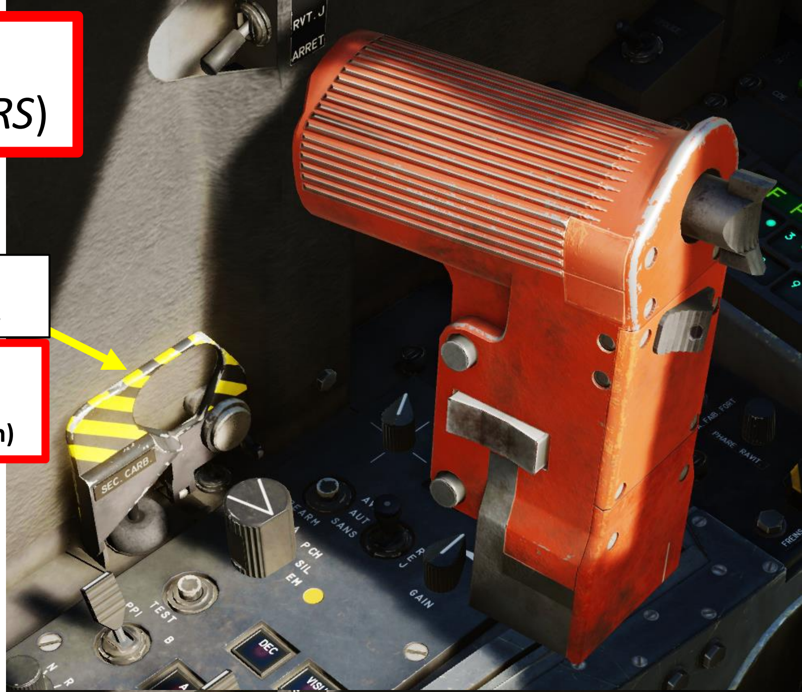
<u>To control the engine in SEC CARB mode:</u>

1. Set the Emergency Engine Control Switch DOWN. When switched down, the SEC CARB mode is selected.
2. In SEC CARB mode the throttle and throttle cut-off button are shunted and have no effect on the engine. The engine needs to be controlled using the emergency fuel throttle.
3. Move Emergency Throttle to manually control the fuel flow to the engine (FWD to increase fuel flow, AFT to decrease fuel flow). This will bypass the fuel regulator and use a simple valve to control the fuel flow. The Emergency Throttle should be used in small steps since there is no RPM regulation in SEC CARB Mode.
4. It is crucial that the pilot monitor the engine RPM and temperature to keep them within limits. In most cases requiring maximum possible fuel flow to the engine will result in overspeed, greatly damaging the engine.
5. In SEC CARB mode, a relay prevents the pilot from engaging the afterburner and IDLE RPM is higher than normal.
6. To revert into Normal Regulation Mode, set the Emergency Engine Control Switch UP.

Note: In order to shut down the engine in SEC CARB, the engine startup panel fuel shut-off valve (*Coupe-Feu*) switch must be used to starve the engine.

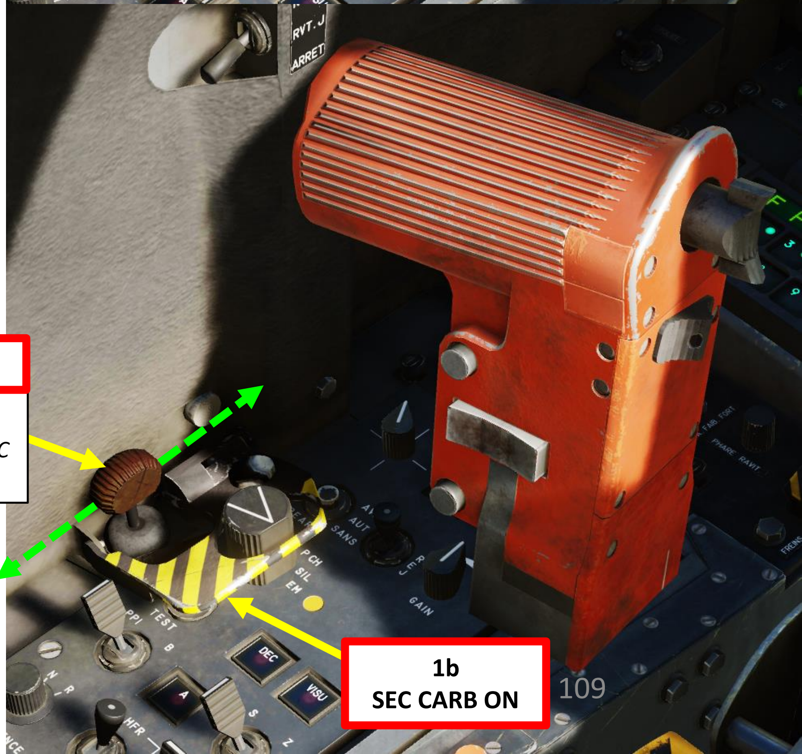
Emergency Engine Control Switch
- *Used to select the emergency fuel mode (SEC CARB).*

1a
SEC CARB OFF
(Normal Engine Operation)



3

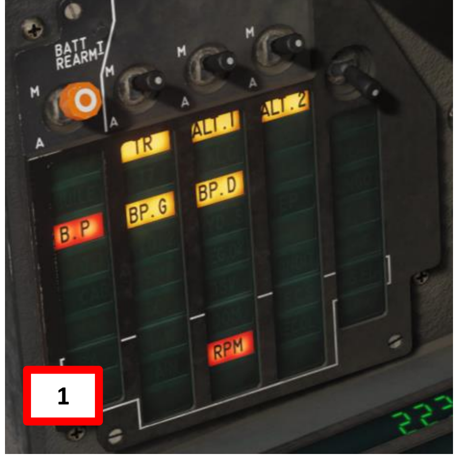
Emergency Throttle
- *Used to control the engine fuel flow while in the SEC CARB engine mode.*

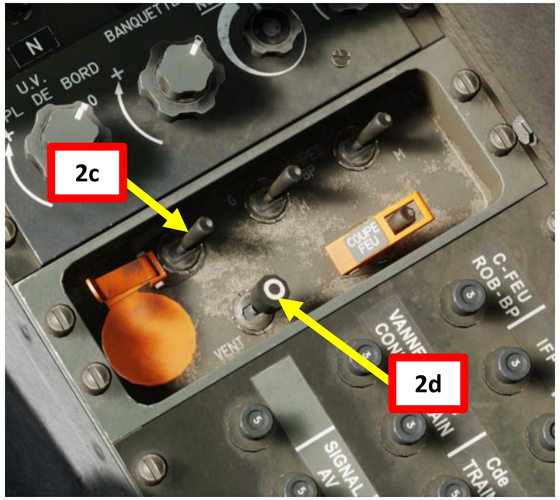


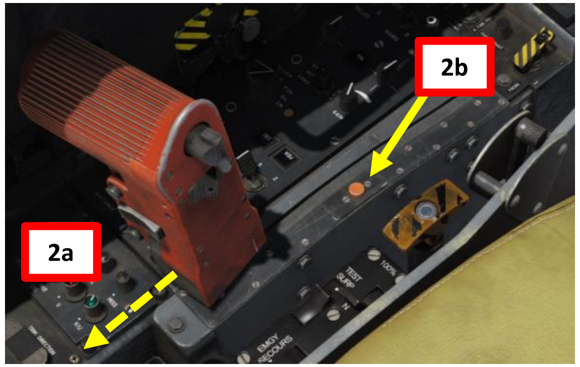
1b
SEC CARB ON

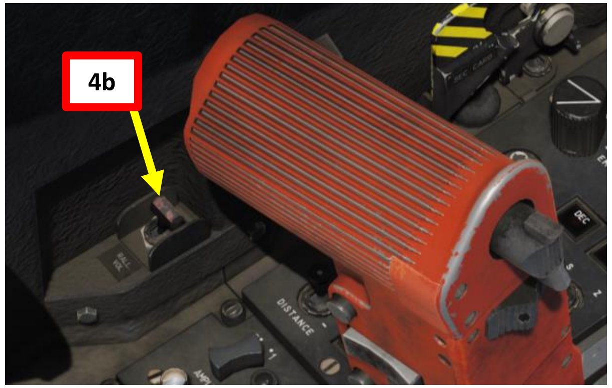
1 – POWERPLANT
1.10 – ENGINE FLAMEOUT – RELIGHT PROCEDURE

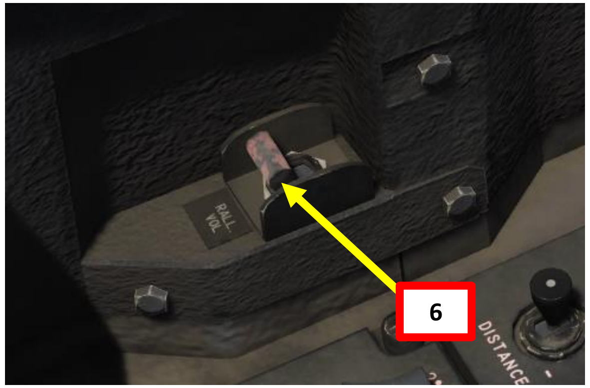
1. An engine flameout may occur if you are flying inverted for more than 15 seconds (engine will be starved of fuel because of gravity) or suffer an engine malfunction. You will notice a sudden loss in RPM, Tt7 and fuel flow.
   - Throttling down below MIL Power when Mach is greater than 1.4 also results in a flameout.
2. Set throttle to IDLE (fully aft) and click the ENGINE SHUTDOWN button to set throttle to OFF position (b). Ensure that Starter Fuel Pump Switch (c) is ON (RIGHT) and Ignition switch (d) is set to either G or D.
3. Set the aircraft in a 20-degree dive to gain airspeed (until around 300 KIAS).
4. Once RPM (N) increases to 13 % due to windmilling (air flow drives compressor blades), set the ENGINE RELIGHT switch to ON (FWD).
5. Slowly push throttle forward until RPM reaches 50 % N1 or more.
6. When engine is relit, ENGINE RELIGHT switch will reset to OFF (AFT) by itself.
7. Once RPM (N) has increased to approx. 54 %, move throttle forward and pull up to recover from the dive.





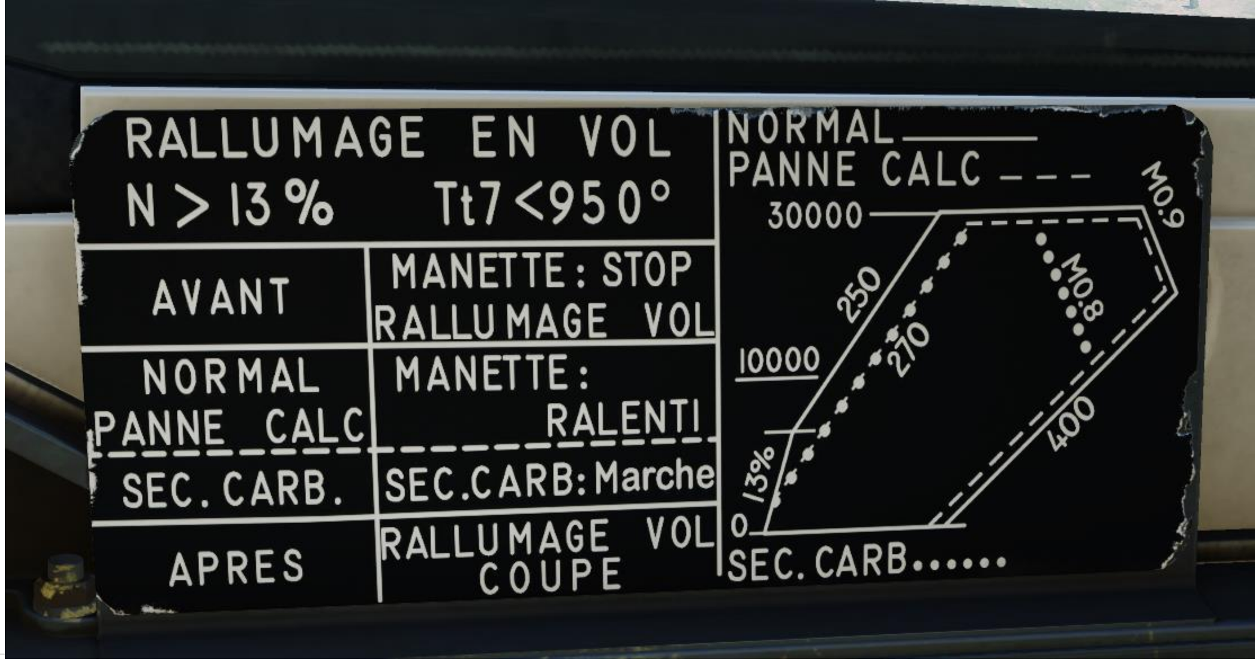




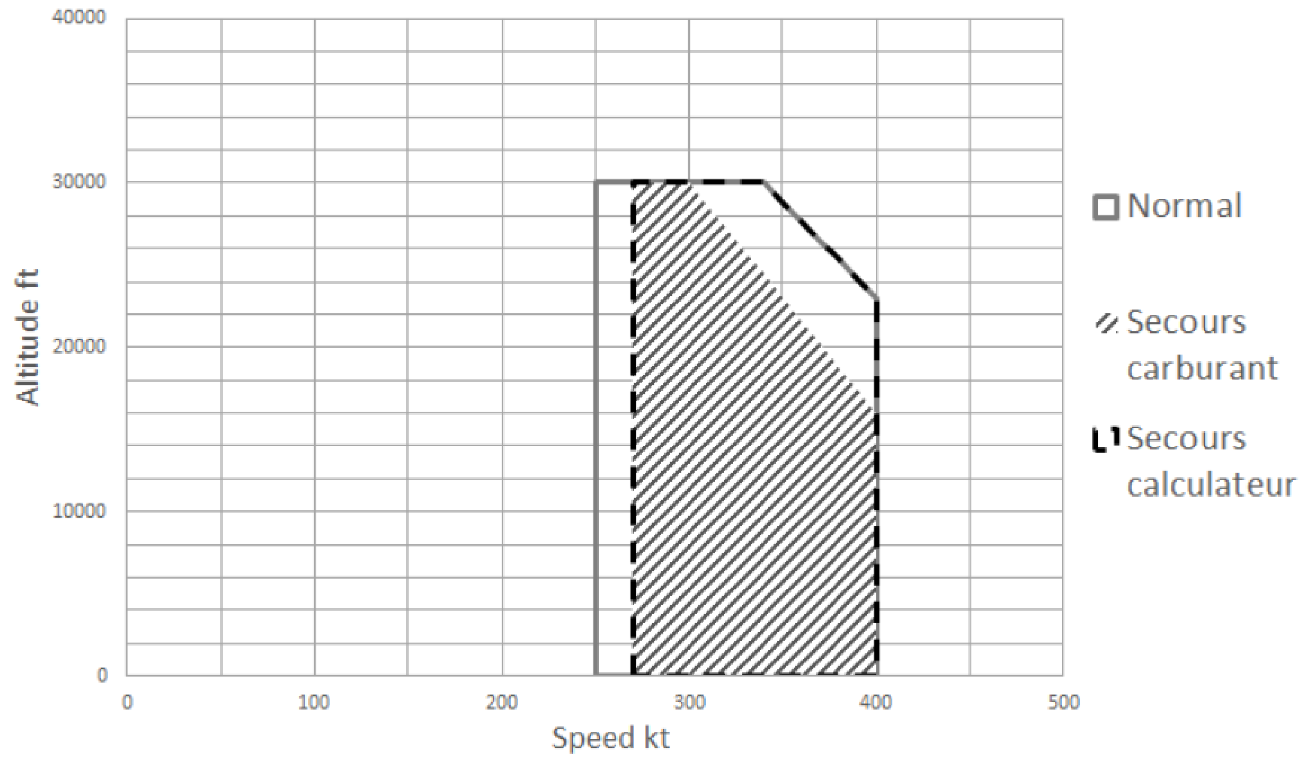


1 – POWERPLANT
1.10 – ENGINE FLAMEOUT – RELIGHT PROCEDURE

The engine relight placard shows the allowable speed and altitude parameters at which you can relight the engine while in flight.



Allowable In-Flight Engine Relight Domain (Speed vs Altitude)

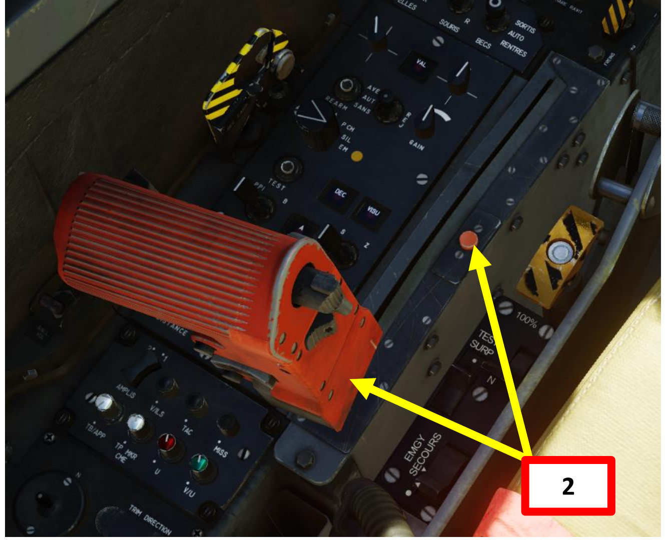


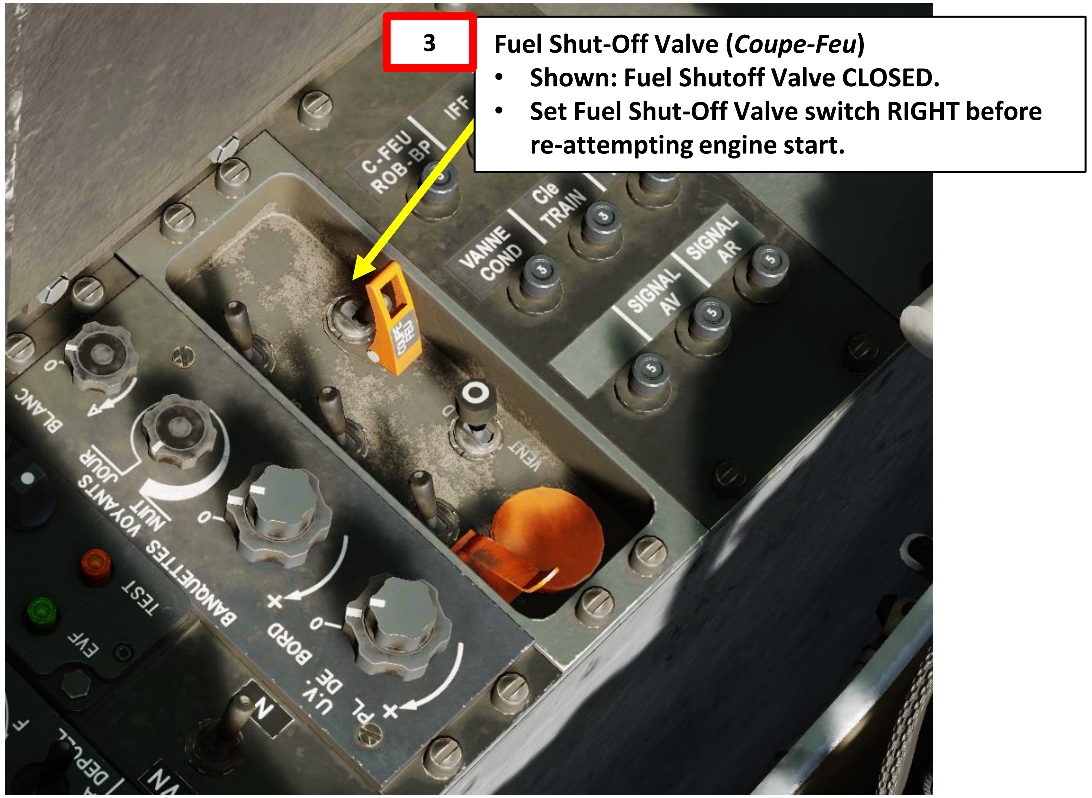
In-Flight Engine Relight (*Rallumage en vol*) **Engine RPM "N" > 13 %** **Tt7 Engine Turbine Temp < 950 deg C**	
Before relight	Throttle: STOP Engine Relight ON
Normal Engine Calculator Failure	Throttle: Back
Emergency Fuel	Emergency Fuel ON
After relight	Engine Relight OFF

1 – POWERPLANT
1.11 – ENGINE FIRE

Case 1: SEC (Secondary Engine Chamber) Light

1. If an engine fire is detected, the SEC Fire Warning Light will illuminate.
2. Immediately cut throttle (set lever to CUTOFF/STOP position).
3. Close the engine fuel cock by setting the Main Fuel Cock / Fuel Shutoff Valve Switch LEFT (Fuel Shutoff Valve Closed).
4. If the SEC Fire Warning Light extinguishes, restart the engine.
   - Note: Set Fuel Shut-Off Valve switch RIGHT (Fuel Shutoff Valve Open) before re-attempting engine start.
5. If the SEC Fire Warning Light remains illuminated, eject as soon as possible.



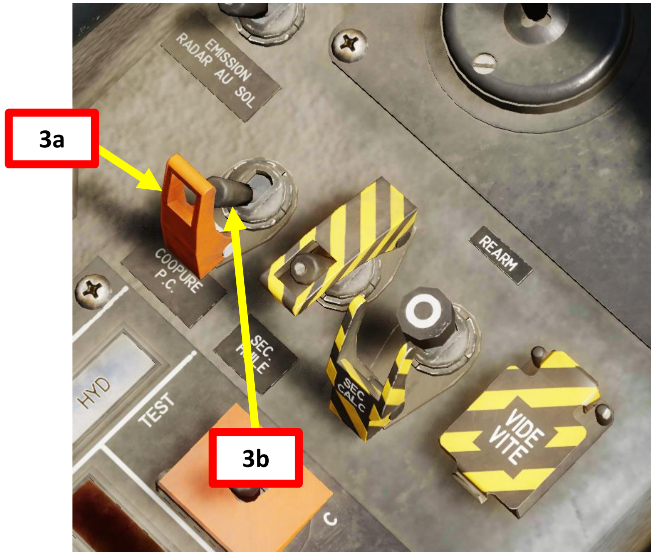


1 – POWERPLANT
1.11 – ENGINE FIRE

Case 2: PC (Post-Combustion, Afterburner) Light

1. If a fire is detected in the afterburner section of the engine, the PC (Afterburner, *Post-Combustion*) Fire Warning Light will illuminate.
2. Immediately throttle back to turn off afterburner. Confirm PC (Afterburner ON) Indicator light is extinguished.
3. Close the engine afterburner fuel cock by setting the Afterburner Shutdown Switch AFT (Afterburner Fuel Shutoff Valve Closed).
4. If the PC Fire Warning Light extinguishes, stay off the afterburner for the rest of the flight.
5. If the PC Fire Warning Light remains illuminated, eject as soon as possible.

Afterburner Shutdown Switch (*Coupure Post-Combustion*)
- *FWD: Afterburner Fuel Shutoff Valve Open (Normal Operation)*
- *AFT: Afterburner Fuel Shutoff Valve Closed (Afterburner OFF)*



2 – FUEL
2.1 – FUEL SYSTEM OVERVIEW

2 – FUEL
2.1 – FUEL SYSTEM OVERVIEW

The aircraft has a total of 7 internal fuel tanks and capability of carrying three external drop tanks, referred as “RP” (*Réservoir Pendulaire*, External Fuel Tank) or “RL” (*Réservoir Largables*, Drop Tank).

- RP-522: Centerline pylon external drop tank
- RP-541: Inboard wing pylon external drop tank

All fuel tanks transfer fuel to the feeder tanks, which then transfer it to the engine. This process is automatic.

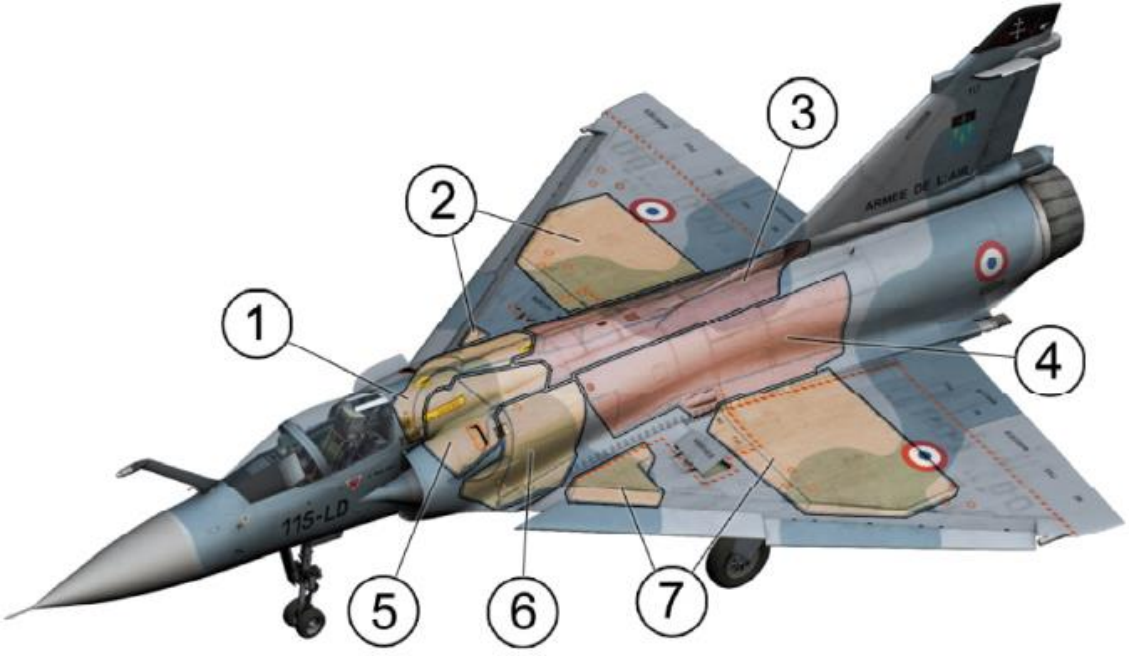
Fuel Capacity:

- Total (with 3 x External Drop Tanks): 8660 Liters
    - 1 x RP-522: Centerline External Fuel Drop Tank: 1300 Liters
    - 2 x RP-541: Wing External Fuel Drop Tank: 2000 Liters each

- Total (with 1 x RP-522 External Drop Tank): 5260 Liters
    - 1 x RP-522: Centerline External Fuel Drop Tank: 1300 Liters

- Total (with 2 x RP-541 External Drop Tanks): 7400 Liters
    - 2 x RP-541: Wing External Fuel Drop Tank: 2000 Liters each

- Total (Internal): 4000 Liters



No.	Description	Kg	Lbs.	US Gals	Liters
1	Right group forward tank	304.0	670.0	101.7	385.0
2	Right group wing tanks	523.0	1154.0	175.0	662.5
3	Right group feeder tank	592.5	1306.0	198.1	750.0
4	Left group feeder tank	592.5	1306.0	198.1	750.0
5	Center tank	320.0	705.0	107.0	405.0
6	Left group forward tank	304.0	670.0	101.7	385.0
7	Left group wing tanks	523.0	1154.0	175.0	662.5
	Total internal fuel	3160.0	6966.0	1056.6	4000.0
	RP-522 centerline tank	990.0	2182.6	343.4	1300.0
	Total internal + RP-522	4150.0	9146.6	1400.0	5260.0
	RP-541/542 wing tank (each)	1580.0	3482.3	528.6	1700.0
	Total internal + RP-522 + RP-541/542	7310.0	16111.2	2457.2	8660.0

2 – FUEL
2.1 – FUEL SYSTEM OVERVIEW

Fuel Indications

The Fuel Indicator allows you to monitor fuel quantity.

The Fuel Remaining Indicator can be adjusted manually, but the ground crew can do it for you each time you request refueling in DCS.

“Empty Lights” give the pilot a status of each fuel tank except the feeder tanks.

Fuel Flow Indicator (kg/min)

Bingo Fuel Selector Drums

“Niveau” Fuel Caution Light
- Illuminates when fuel quantity is below 500 kg

“Bingo” Fuel Caution Light
- Illuminates when fuel quantity is below the “Bingo” Fuel Setting set with the selector drums

Air-Refueling Light
Ravitaillement de Vol

Total Fuel Quantity (kg)
Détotalisateur de Carburant, needs to be set with the AFF DETOT switch.

Total Internal Fuel Quantity (kg)
Jauge de Carburant

Fuel Indicator Lights (lit when empty)
- V: Wing fuel tanks(*Voilure*)
- AV: Forward fuselage tanks (*Groupe Avant*)
- RL: External fuel tanks (*Réservoirs Largables*)

Display/Refresh Total Fuel switch
(*AFFICHER DÉTOTALISATEUR)*
- *Toggling this switch UP (+) or down (-) increments the value of the Total Fuel Quantity (Detotalisateur) displayed.*

Left Feeder Tank (*Nourrices*) Fuel Quantity (x100 kg)

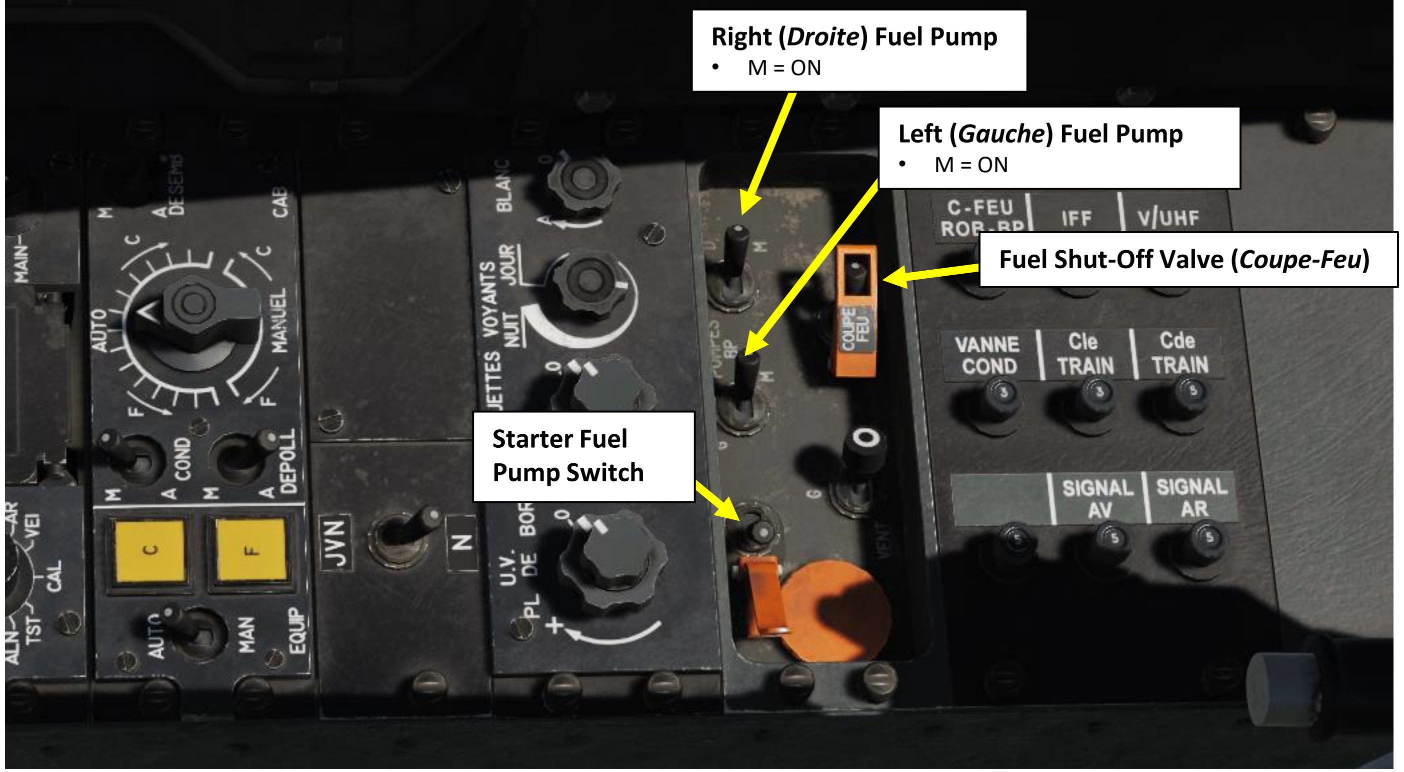
Fuel Transfer Test Switch

Right Feeder Tank (*Nourrices*) Fuel Quantity (x100 kg)

Internal Fuel Transfer Control (Not Functional)
- Fuel cross-feed, used to keep fuel level balanced for different fuel tanks

2 – FUEL
2.1 – FUEL SYSTEM OVERVIEW

Fuel Controls



2 – FUEL
2.1 – FUEL SYSTEM OVERVIEW

Fuel Dumping (*Vide-Vite*)

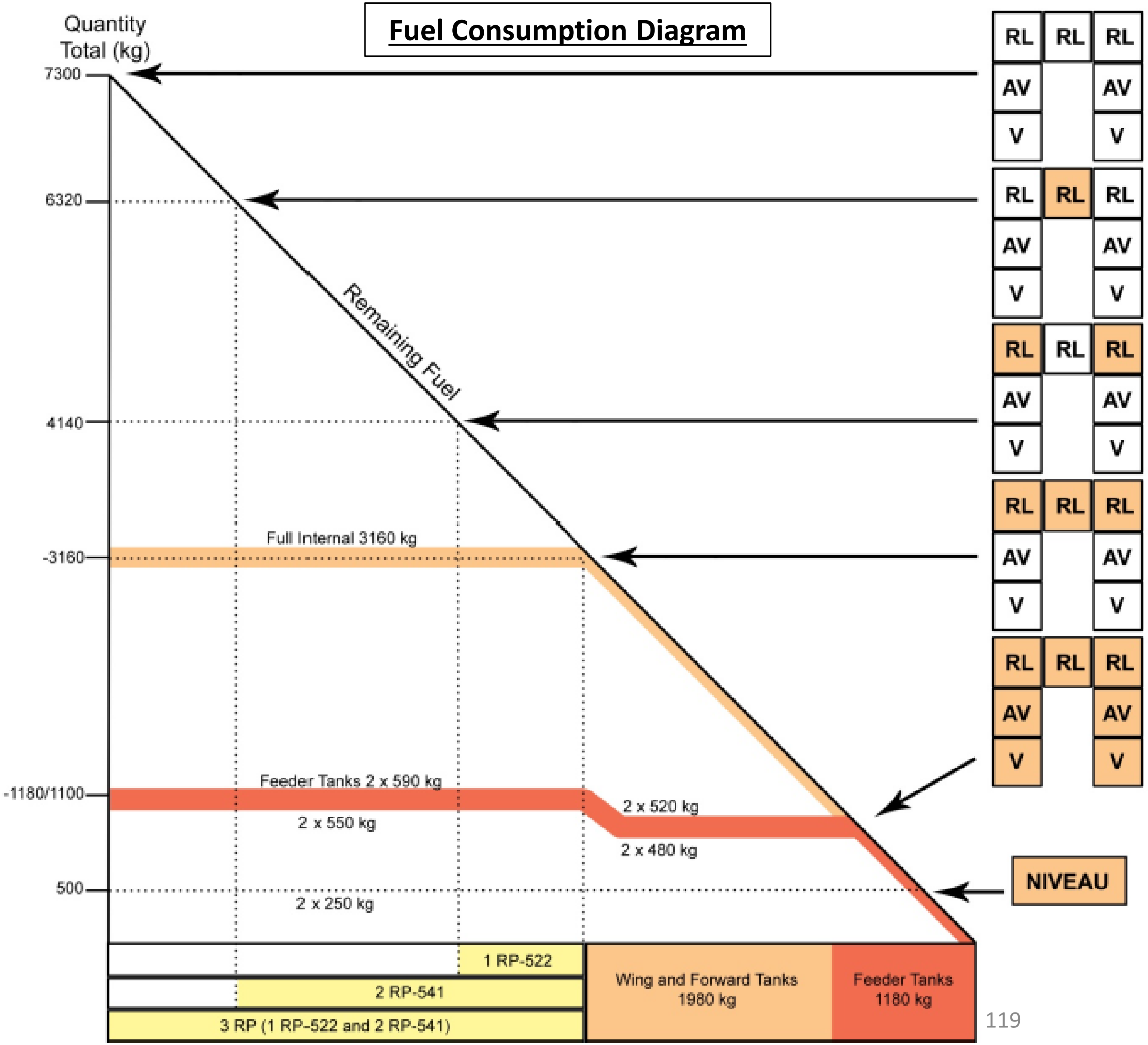
In situations where the aircraft needs to do an emergency landing, a fully-fueled aircraft with external drop tanks can be too heavy to perform a safe landing in certain conditions. Therefore, the Mirage can dump fuel in order to become lighter, which will allow landing with a shorter runway length at slower speeds.

To dump fuel from the external tanks:

1. Verify that External Fuel Drop Tanks are equipped (the Mirage 2000C can only dump fuel in its external tanks).
2. Flip *Vide-Vite* (Fuel Dump) Button Cover Guard
3. Press *Vide-Vite* Button.
4. Once fuel dump has started, it cannot be stopped.
    - RP-522 Tank fuel dump time: 2 minutes 30 sec
    - RP541 Tank fuel dump time: 4 minutes

2 – FUEL
2.2 – FUEL MANAGEMENT

Fuel management is pretty straightforward in the Mirage since it is automatically managed by the fuel system.

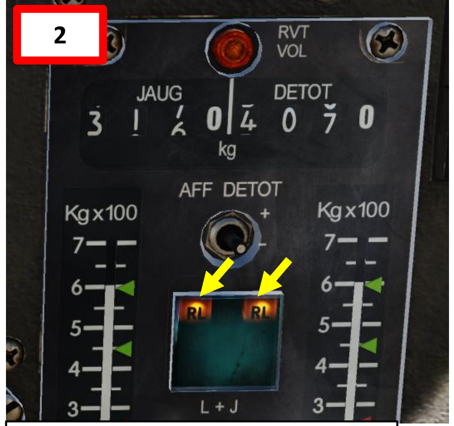


2 – FUEL
2.3 – FUEL DROP TANK OPERATION

RP-522 and RP-541 external drop tanks are consumed automatically once installed.

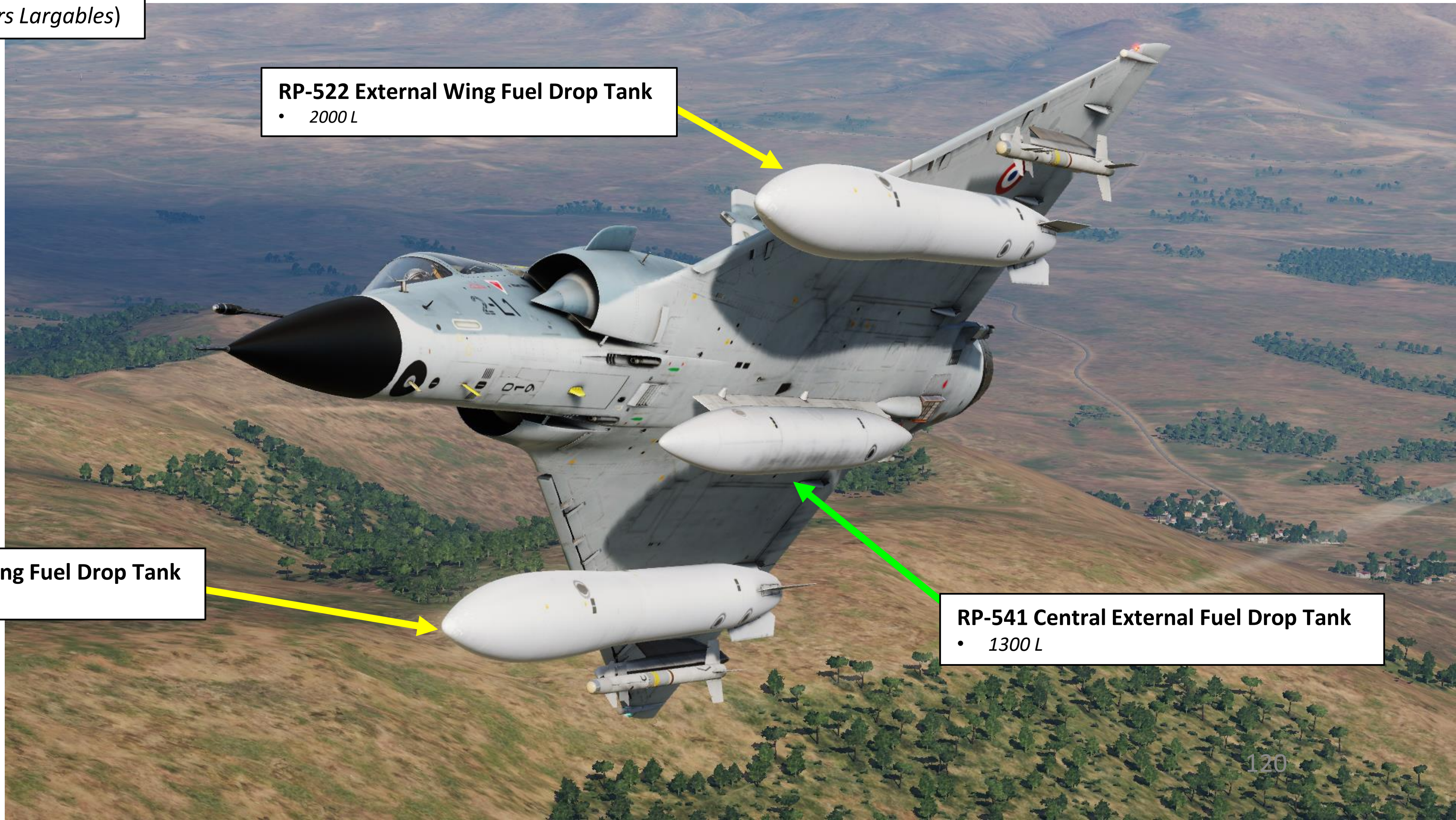
There is no fuel quantity indicator for the external tanks themselves. Once external tanks are empty, "RL" External Fuel Drop Tank Empty lights illuminate.

Fuel Indicator Lights (lit when empty)
- RL: External fuel tanks (*Réservoirs Largables*)



2 x RP-522 Wing Tanks Empty

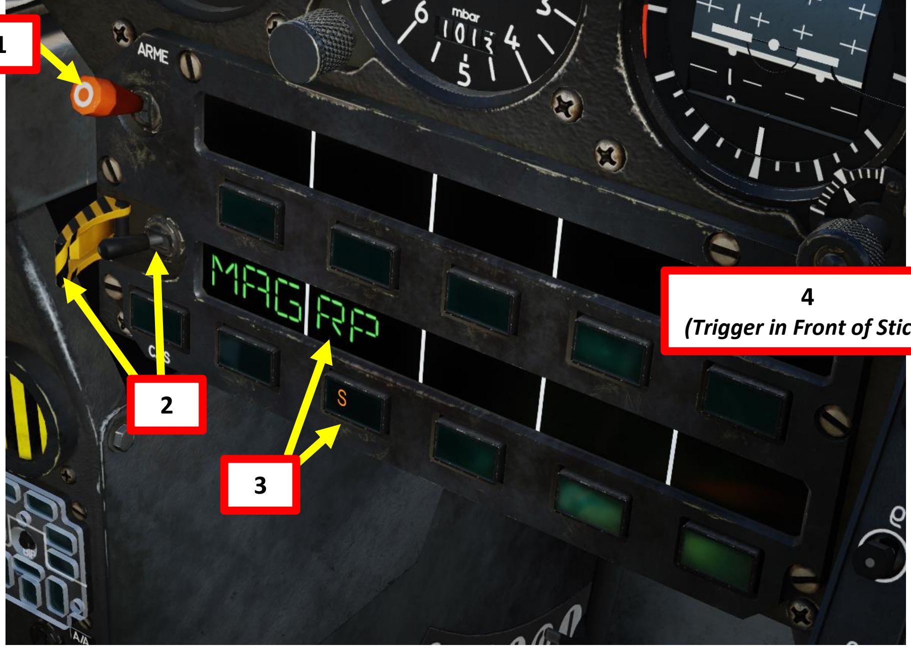
All Wing Tanks Empty

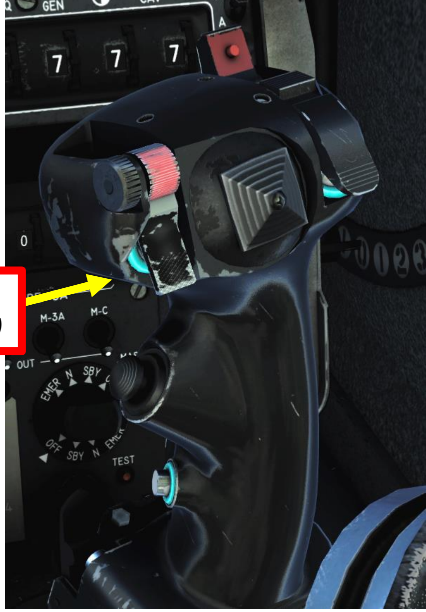


2 – FUEL
2.4 – FUEL DROP TANK JETTISON
2.4.1 – SELECTIVE JETTISON METHOD

The “Selective Jettison” method **only allows the pilot to jettison all external tanks at once**. It is not possible to jettison an individual external drop tank.

1. Set Master Arm switch to ARME (UP)
2. Click on Selective Jettison safety cover and set Selective Jettison switch to the left position
3. Click on the store you want to jettison on the PCA (we will select the external fuel tank RP). When selected, a yellow “S” caution will appear.
4. Press the MiCRoB Trigger (2nd Stage), which is SPACE by default. Store will be dropped.
5. Set the Selective Jettison switch to the right and put the safety cover back on.
6. Set Master Arm switch to OFF (DOWN)





2 – FUEL
2.4 – FUEL DROP TANK JETTISON
2.4.2 – EMERGENCY JETTISON METHOD

The Emergency Jettison button will jettison every store you have (including these expensive SUPER S530D missiles!) except for your two MAGIC II missiles.

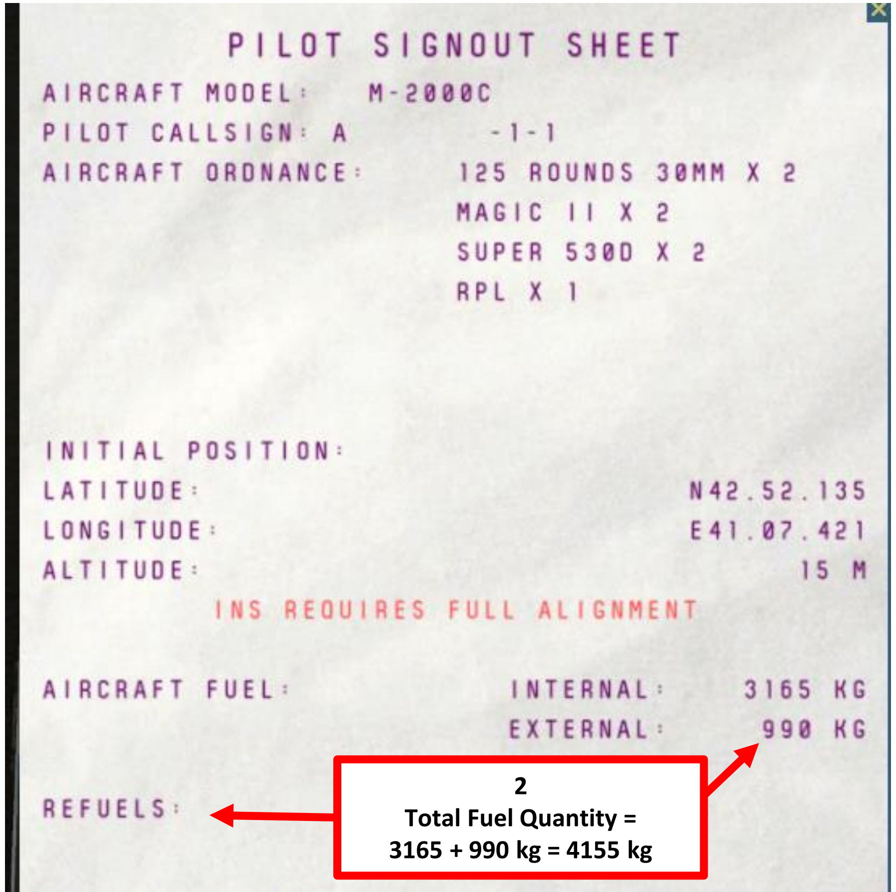
This method can be useful if you are in a hurry have get rid of everything quickly in order to land.

Emergency Jettison Button

2 – FUEL
2.5 – REFUELING ON GROUND

When you are refueling on the ground, the DETOT (Détotalisateur, or Total Fuel Quantity) has to be set manually.

1. Open up your kneeboard using “RSHIFT+K” and cycle through pages using the “[“ and “]” (kneeboard previous/next page bindings) to find the PILOT SIGNOUT SHEET.
2. In our case, the Pilot Signout Sheet says the fuel loaded is 4155 kg (external + internal fuel tank).
    - This step is very important since refueling the aircraft requires you to set the DETOT quantity if you want to have an accurate fuel reading. Ground or air refueling indicates on your Pilot Signout Sheet how much fuel was added.
3. Toggle the AFF DETOT switch +/- to set the DETOT indicator to the total fuel as per the value indicated on the Pilot Signout Sheet.



PILOT SIGNOUT SHEET

AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2
MAGIC II X 2
SUPER 530D X 2
RPL X 1

INITIAL POSITION:
LATITUDE: N42.52.135
LONGITUDE: E41.07.421
ALTITUDE: 15 M
INS REQUIRES FULL ALIGNMENT

AIRCRAFT FUEL: INTERNAL: 3165 KG
EXTERNAL: 990 KG

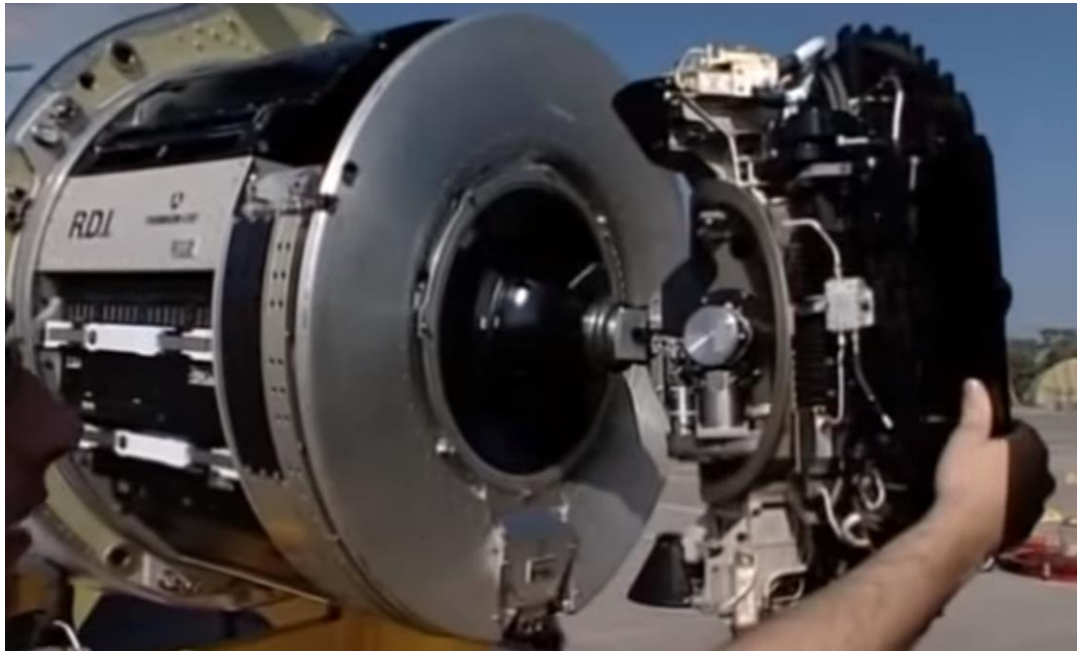
REFUELS:


102

SECTION STRUCTURE

1 – RDI RADAR INTRODUCTION

The radar installed on the Mirage 2000C is the RDI (*Radar Doppler à Impulsions*) developed by Thomson-CSF (now known as Thales). The RDI main function is to detect and track air targets at long range, but also look down against targets flying as low as 30 m. The RDI has a secondary capability to carry out ranging for air-to-ground weapon delivery as well as low altitude navigation with ground mapping and terrain avoidance modes.

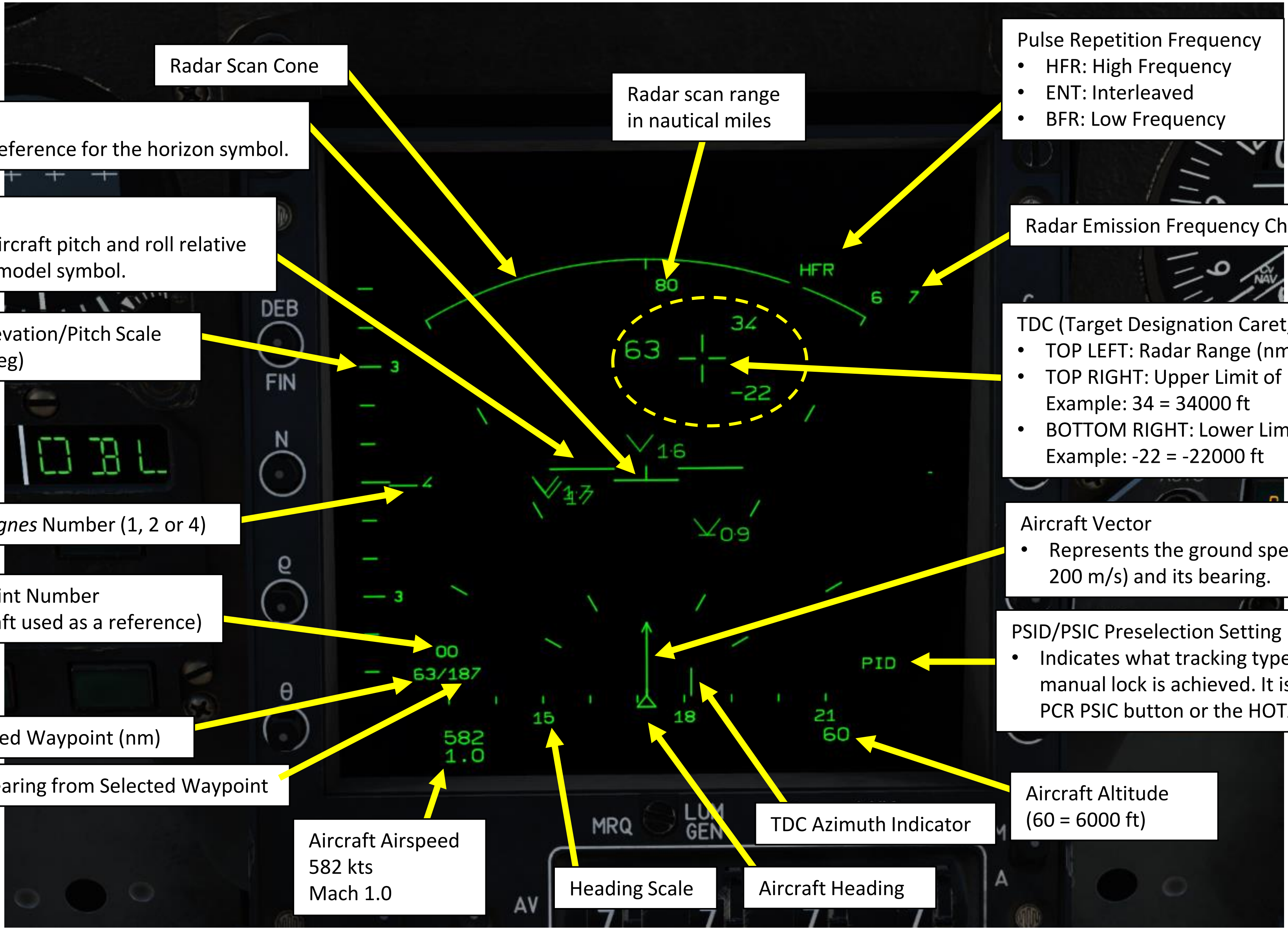


RDI Radar Characteristics

- Waveband: I/J band
- Pulse repetition frequency: High PRF (Pulse Repetition Frequency) (100 kHz+)
- Transmitter output: 4 kW
- Range: Maximum detection range of 80 nm and approx. 65 nm against a fighter-sized target (5 m^2 equivalent radar cross-section) in HPRF
- Range ambiguity error: 20 m in PSIC (Single Target Track) and 1 nm in Bar Search
- Angle resolution: 0.1 deg
- Velocity interval: -600 knots to +3600 knots
- Radar beam: 3 deg
- Gimbal limits: 60 deg in azimuth and 55 deg in elevation
- Antenna maximum speed: 120 deg/sec
- Antenna bar search speed: 100 deg/sec or 50 deg/sec

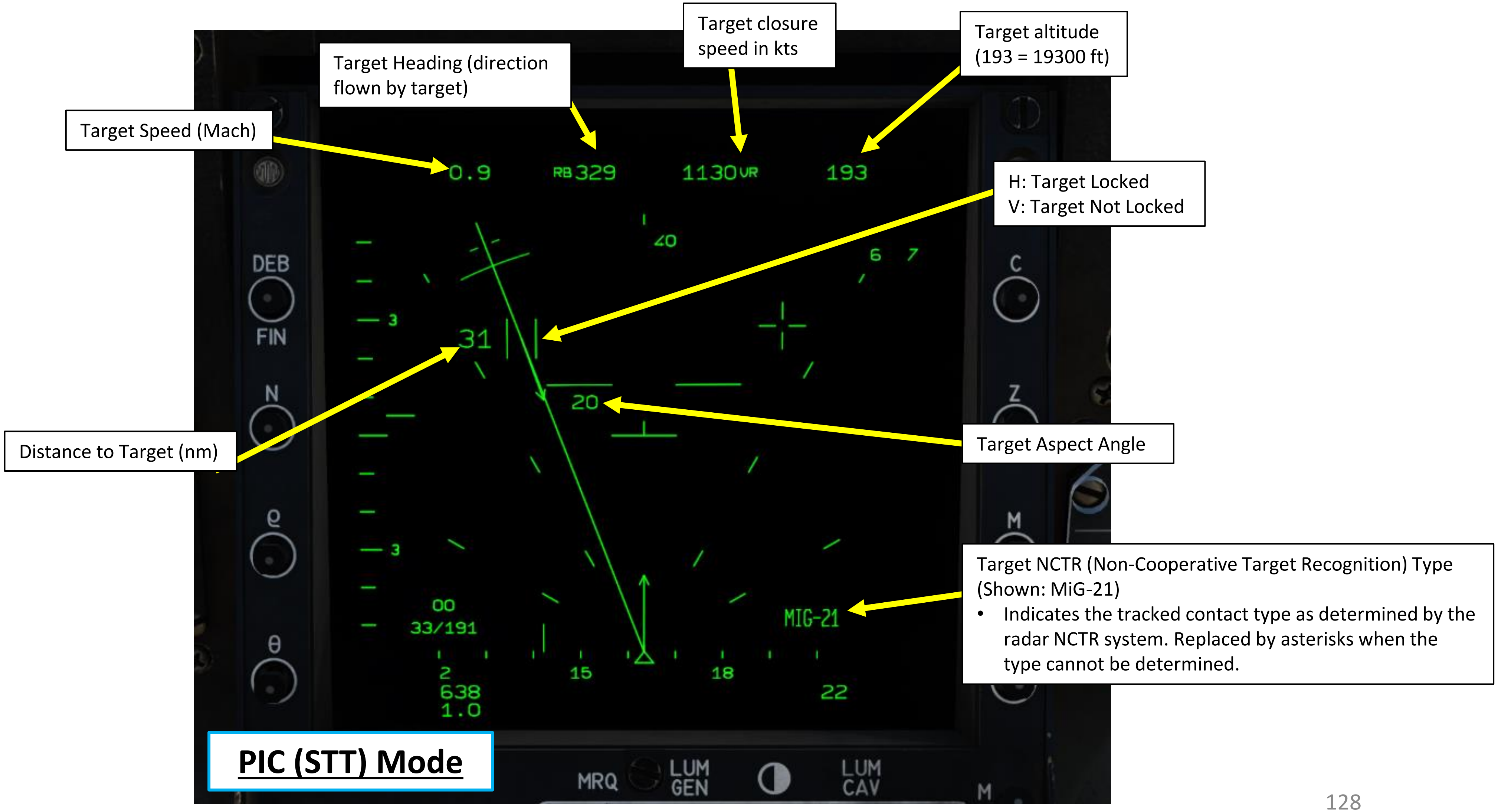
2 – RADAR INTERFACE
2.1 – Radar Information Display

The picture below shows the VTB (*Visualisation Tête-Basse* = Heads-Down Display) Radar Screen in PPI display mode.



2 – RADAR INTERFACE
2.1 – Radar Information Display

The picture below shows the VTB (*Visualisation Tête-Basse* = Heads-Down Display) Radar Screen in PPI display mode while **PSIC** (*Poursuite sur Information Continue*) mode, also known as **STT** (Single Target Track), is active on this screenshot.

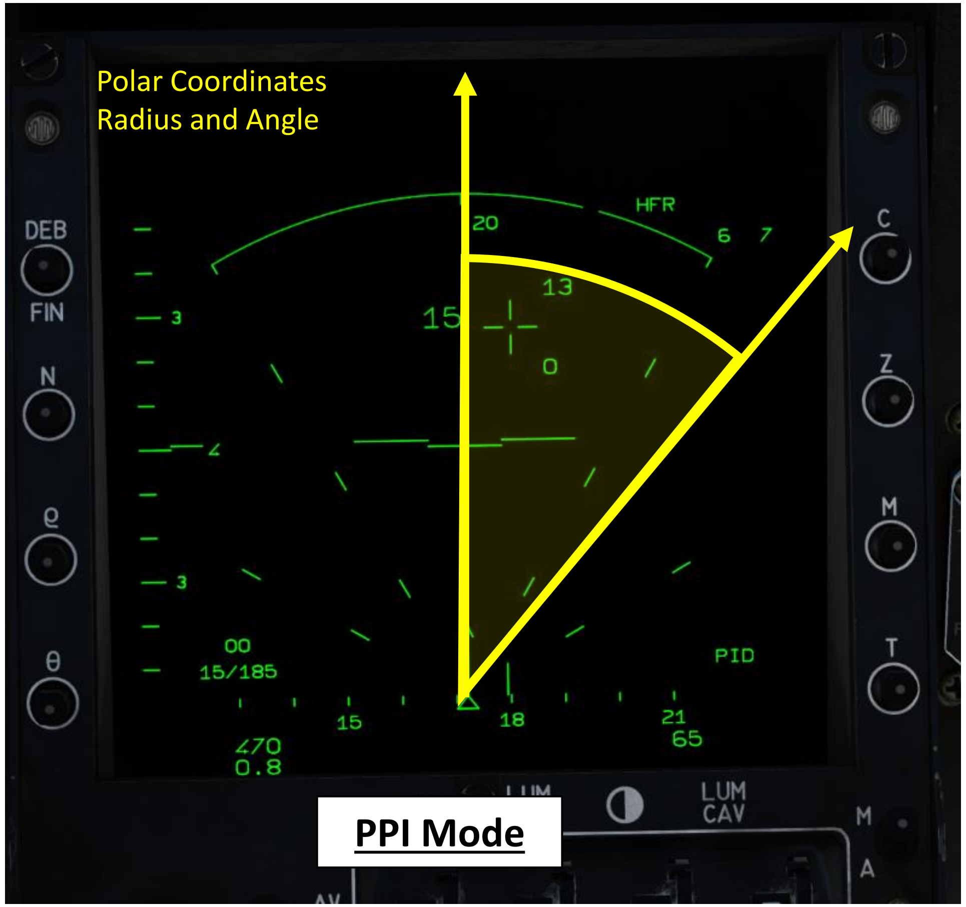


2 – RADAR INTERFACE
2.1 – Radar Information Display

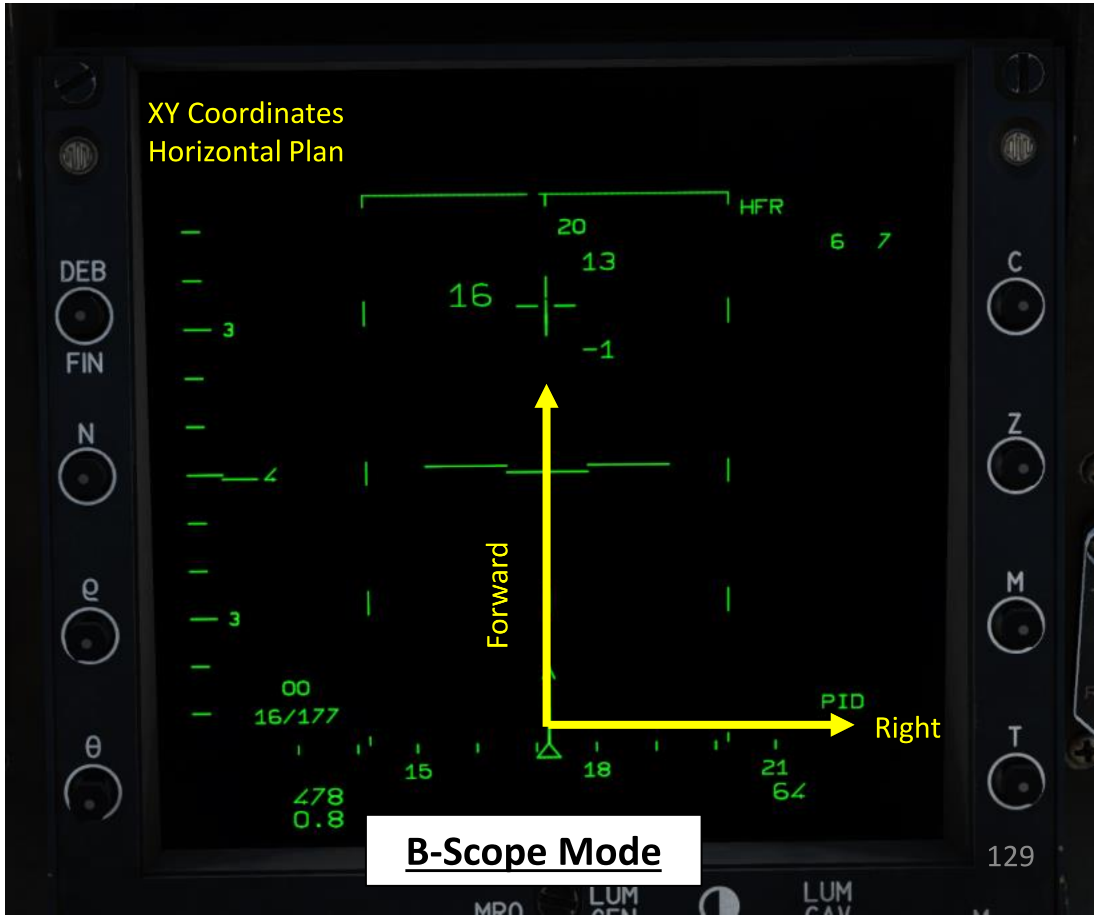
The RDI radar has two display modes: PPI (Plan Position Indicator) and B-Scope.

- PPI shows a polar view of the radar.
- B-Scope shows a 2-D top down representation of a X-Y axis grid space.

Radar Display Mode
- PPI: Plan Position Indicator
- B: B-Scan



PPI Mode



B-Scope Mode

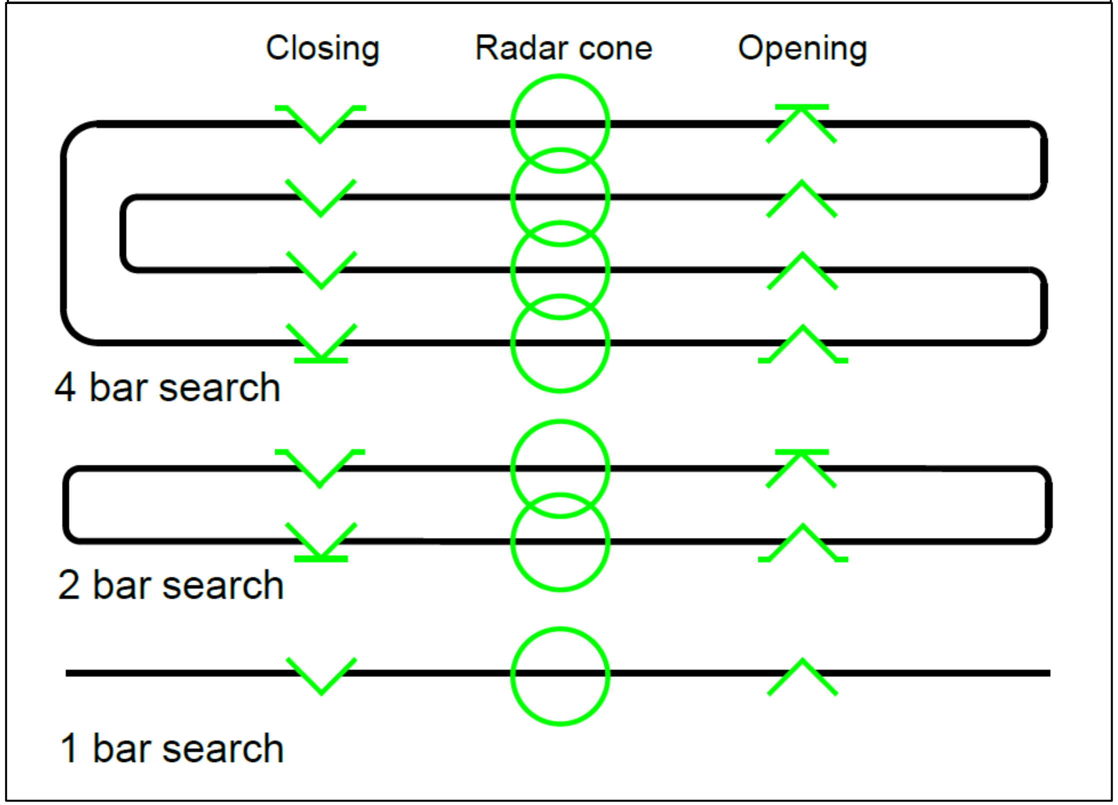
2 – RADAR INTERFACE
2.1 – Radar Information Display

The picture below shows the radar contact symbology. The direction of the "V" contact indicates whether the contact range is closing (getting nearer, indicated by a "V") or opening (getting farther, indicated by an inverted "V").

The horizontal bars at the top or bottom of the contact symbol indicate which bar scanned the contact.

Note: A single aircraft can be displayed multiple times on the VTB screen due to the bars overlapping.

Radar Contact Symbology



Contact's closing speed is < 0 (contact is moving away)
Contact is detected at 1st (highest) bar

Contact's closing speed is < 0 (contact is moving away)
Contact is detected at 2nd or 3rd (middle) bar.

Contact's closing speed is < 0 (contact is moving away)
Contact is detected at 4th (lowest) bar

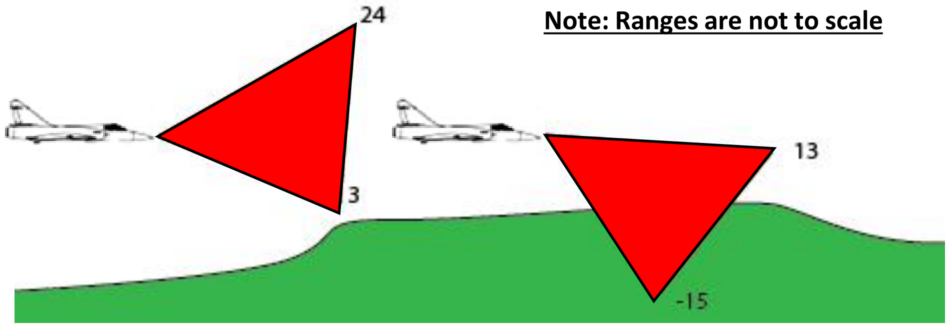
Contact's closing speed is > 0
Contact is detected at 1st (highest) bar

Contact's closing speed is > 0
Contact is detected at 2nd or 3rd (middle) bar

Contact's closing speed is > 0
Contact is detected at 4th (lowest) bar

2 – RADAR INTERFACE
2.1 – Radar Information Display

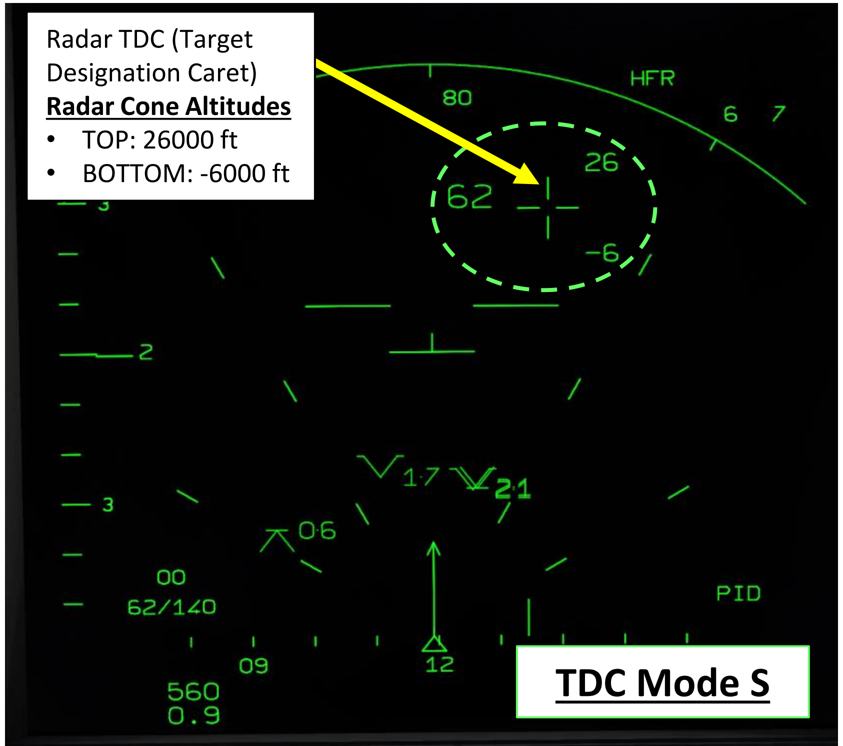
The TDC (Target Designation Caret) is also referred to as the *"alidade"* in French. The TDC is represented by a "plus" sign and is moved using the HOTAS radar designator joystick everywhere inside the VTB. It is only displayed when the radar power mode knob is in the SIL or EM position and the radar mode is bar search, PSID, PSIC, SHB, BAG or RRAS. The TDC is used to orient the antenna or antenna search pattern in azimuth and elevation as well as designate a target for the radar. The numbers next to the TDC 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 target designator 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.

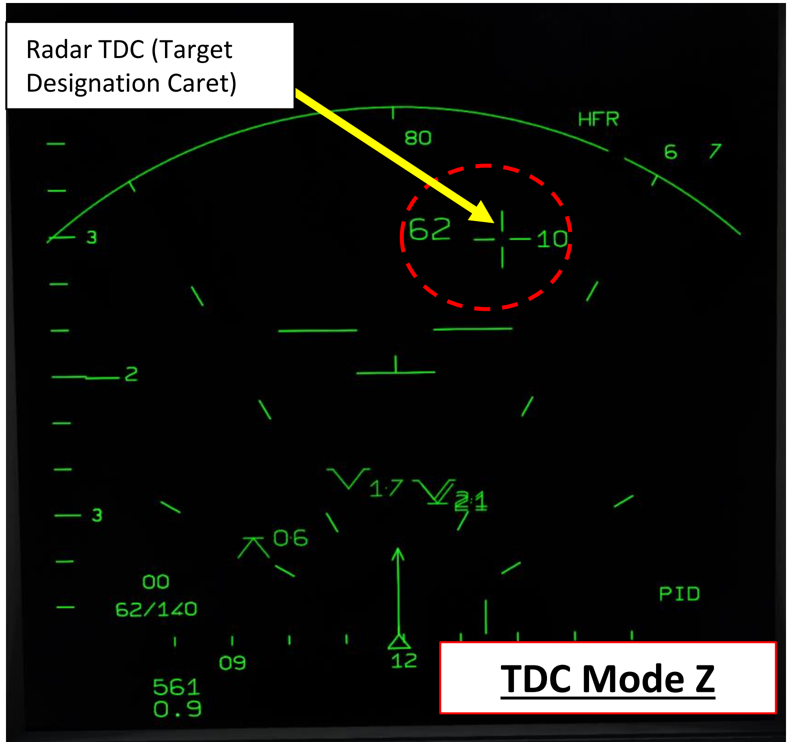


Note: Ranges are not to scale

You can display the TDC in two modes using the Radar TDC Mode Selector:

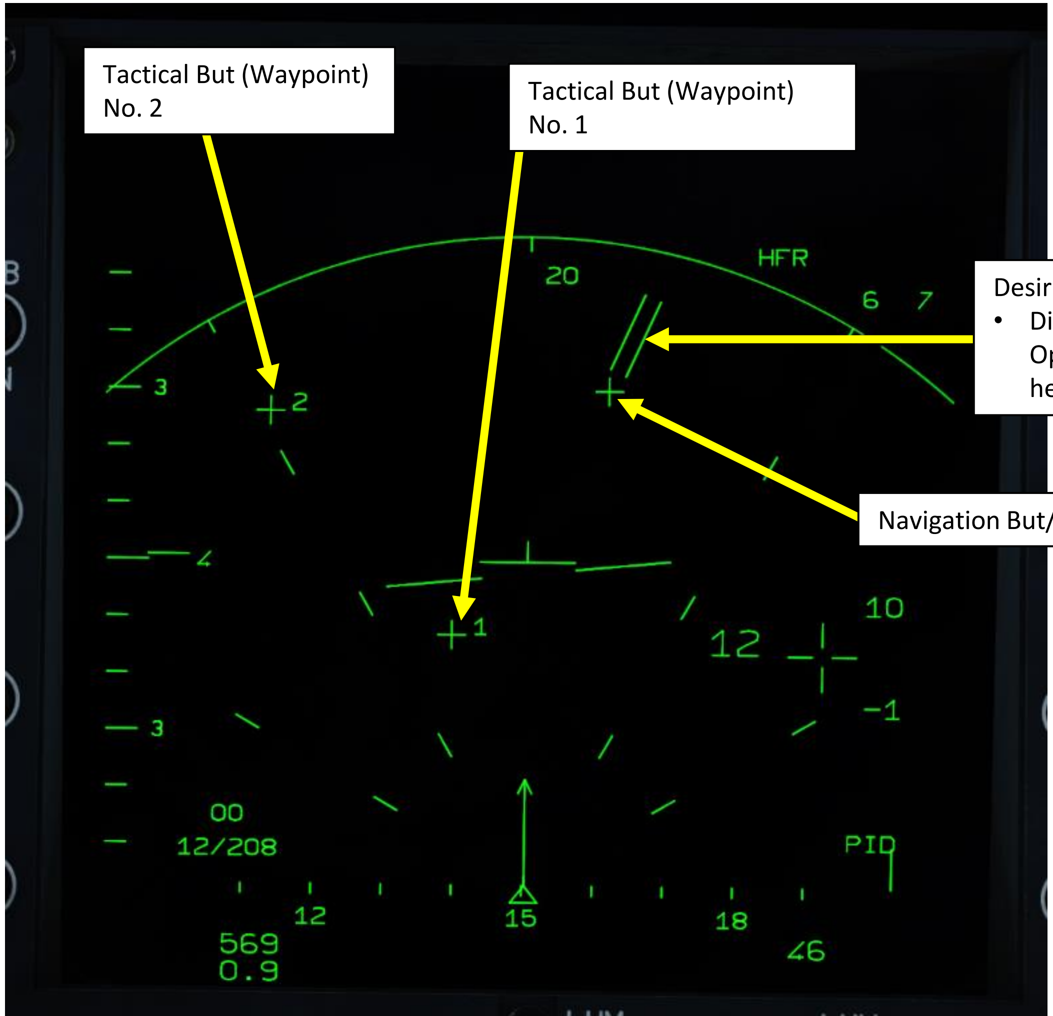
- **Mode S (Site):** Radar Cone Minimum and Maximum Altitudes are displayed next to TDC (x1000 ft). HOTAS elevation command directly moves the antenna elevation.
- **Mode Z (ZBut):** Radar Cone Center Altitude is displayed next to TDC (x1000 ft). HOTAS elevation command sets the center of the searched zone and the radar moves the antenna to match this elevation at the TDC position.





2 – RADAR INTERFACE
2.1 – Radar Information Display

Navigation data is also displayed for Navigation Buts (Waypoints) and Tactical Buts (Waypoints) if you select the RD (*Route Désirée*, Desired Route) Option. Tactical Buts are basically navigation waypoints that are numbered and that can be displayed on the radar screen to better locate radar contacts in relationship to existing navigation waypoints. Up to five tactical buts can be displayed at once.



Desired Heading
- Displayed when the navigation But/Waypoint is displayed, the RD Option is selected and the radar is in PPI mode. It displays the desired heading arrival heading relative to the navigation waypoint.

2 – RADAR INTERFACE
2.2 – Radar Controls

Target Designator Caret (TDC) Switch
DEPRESSED = Radar Lock

Antenna Elevation Thumbwheel

Radar Hardened Noise Gate Selection Button: *Bouton de Réduction du Bruit*
- Increases the background noise filter for the radar. Removes most of the spurious contacts but reduces the maximum detection range. The button is lit up red when the hardened noise gate is selected.

Radar Power Switch
- OFF
- PRÉCHAUFFAGE (WARM-UP)
- SIL (STANDBY)
- ÉMISSION (ON)

Radar Rearm Button
- Resets the radar in case of malfunction

Radar Test switch

Radar Doppler Reject selector
- *Avec*: With
- Automatic
- *Sans*: Without

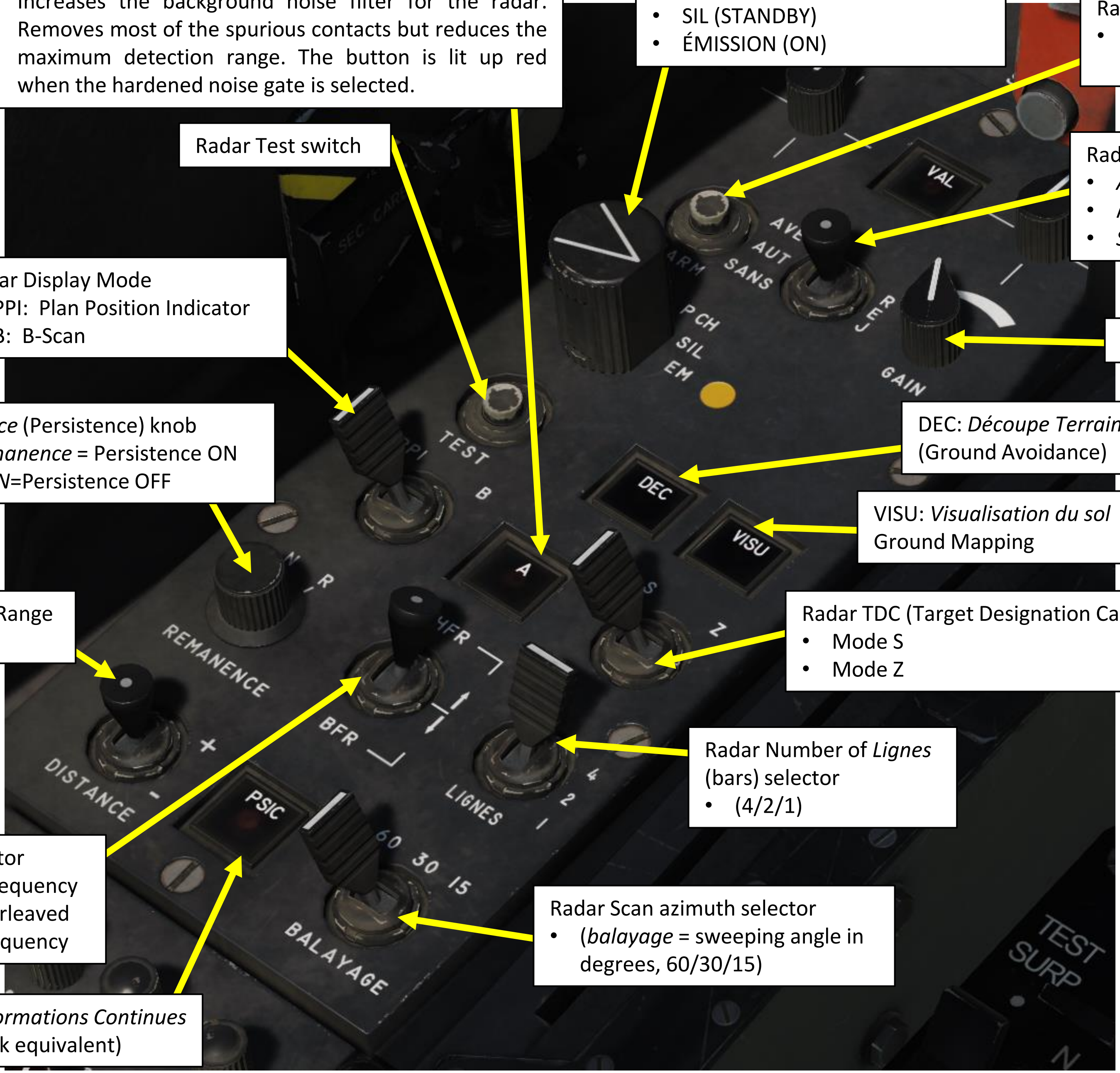
Radar Display Mode
- PPI: Plan Position Indicator
- B: B-Scan

Radar Gain Control

Rémanence (Persistence) knob
- *R=Rémanence* = Persistence ON
- N=*NON*=Persistence OFF

DEC: *Découpe Terrain* (Ground Avoidance)

VISU: *Visualisation du sol* Ground Mapping



Radar Range switch

Radar TDC (Target Designation Caret) Mode
- Mode S
- Mode Z

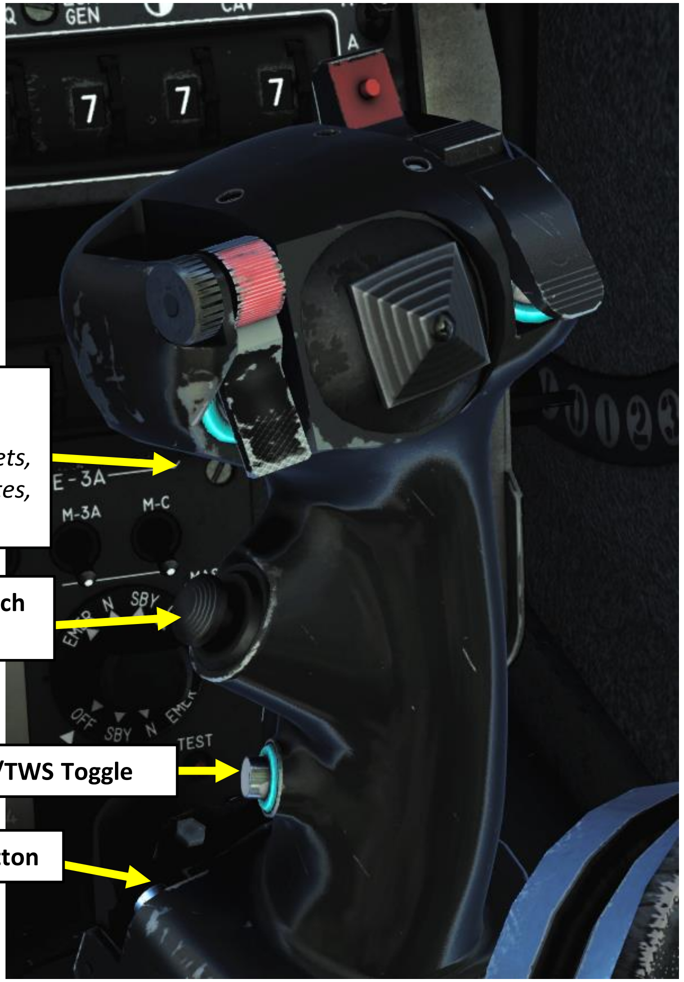
Radar Number of *Lignes* (bars) selector
- (4/2/1)

Radar PRF Mode Selector
- HFR: *Haute*/High Frequency
- ENT: *Entrelacé/*Interleaved
- BFR: *Basse*/Low Frequency

Radar Scan azimuth selector
- (*balayage* = sweeping angle in degrees, 60/30/15)

PSIC*: Poursuite Sur Informations Continues* (STT Single Target Track equivalent)

2 – RADAR INTERFACE
2.2 – Radar Controls



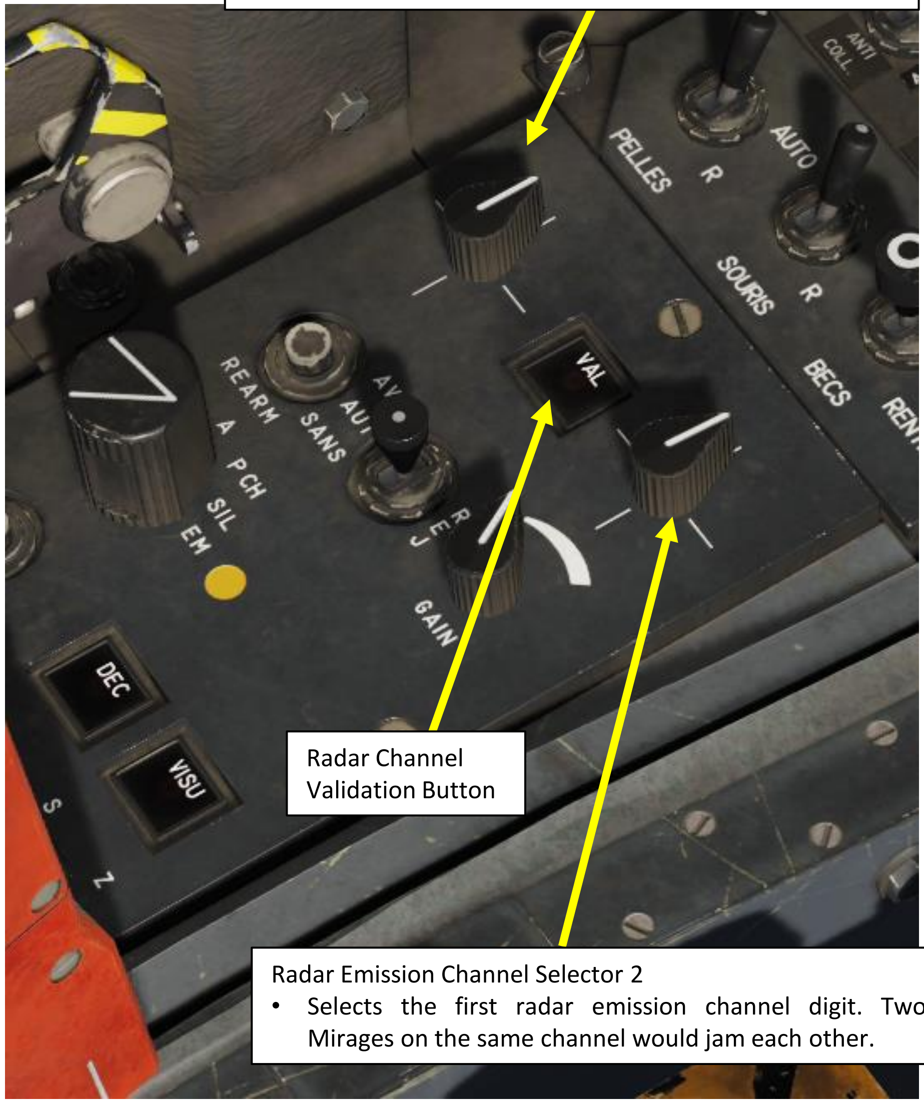
MiCRoB Trigger (2nd Stage)
(Trigger in Front of Stick)
MiCRoB means "missiles, guns, rockets, bombs" (Missiles, cannons, roquettes, bombes)

Weapons System CMD Switch
FWD/AFT/DEPRESSED

STT/TWS Toggle

NWS/IFF Interrogator Button

Radar Emission Channel Selector 1
- Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.



Radar Channel Validation Button

Radar Emission Channel Selector 2
- Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.

2 – RADAR INTERFACE
2.3 – My Radar Control Setup

2 – RADAR INTERFACE
2.4 – Radar Power Modes

In practice, the radar requires a warm-up time of 3 minutes. There are four radar power modes:

- **OFF**: The radar is not powered.
- **WARM-UP (*Préchauffage*):** The radar is in preparation mode, it pre-heats to operational temperature. Warm-up mode is indicated by a blinking "P" on the VTB display.
- **STANDBY (*Silence*):** The radar executes the selected search pattern but it not emitting. In this mode, the radar can be forced to emit by selecting a close combat or TAS mode. Standby mode is indicated by "SIL" on the VTB display.
- **EMIT (*Emission*):** radar is emitting. This is the normal operation mode.

Radar Power Switch
- *OFF (Arrêt)*
- *PRÉCHAUFFAGE (WARM-UP)*
- *SILENCE (STANDBY)*
- *ÉMISSION (ON - EMIT)*

OFF Mode

Warm-Up (*Préchauffage*) Mode

Standby (*Silence*) Mode

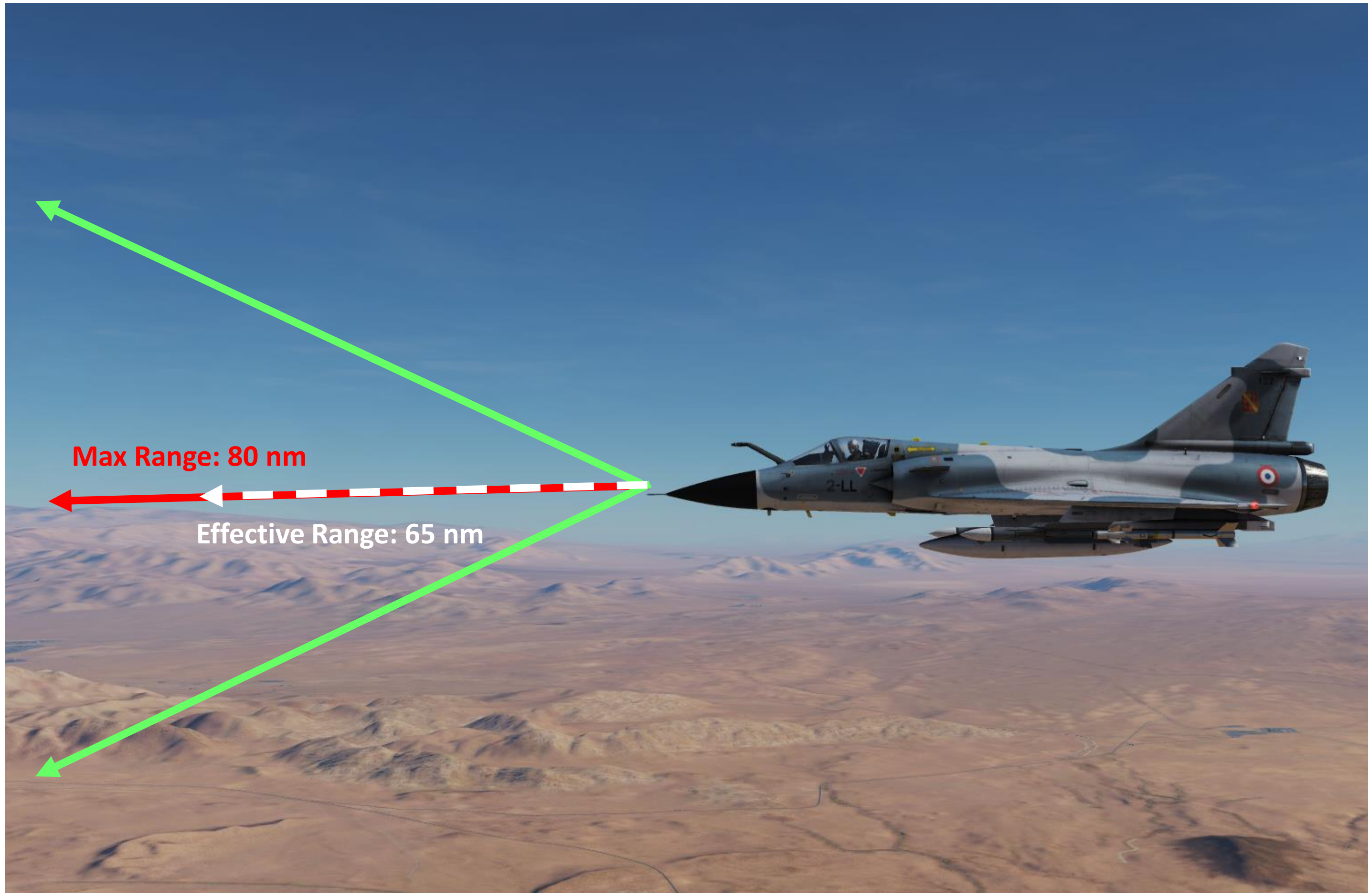
Emit (*Émission*) Mode

3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.1 – Range

The radar display range on the VTB can be changed using the radar range switch or “hitting” the top and bottom of the VTB screen with the TDC. The maximum radar range of the radar is 80 nm for targets with a large radar cross-section (RCS), but the **effective range of the radar for fighter-sized targets is closer to 65 nm**.

Selectable ranges: 10, 20, 40, 80, 160 and 320 nm.

In the 320 nm setting, no radar image (HFR contacts/BFR returns) is displayed as this range is intended to be used with a DO (*Désignation Objectif*) track.



Radar scan range in nautical miles

Radar Range switch

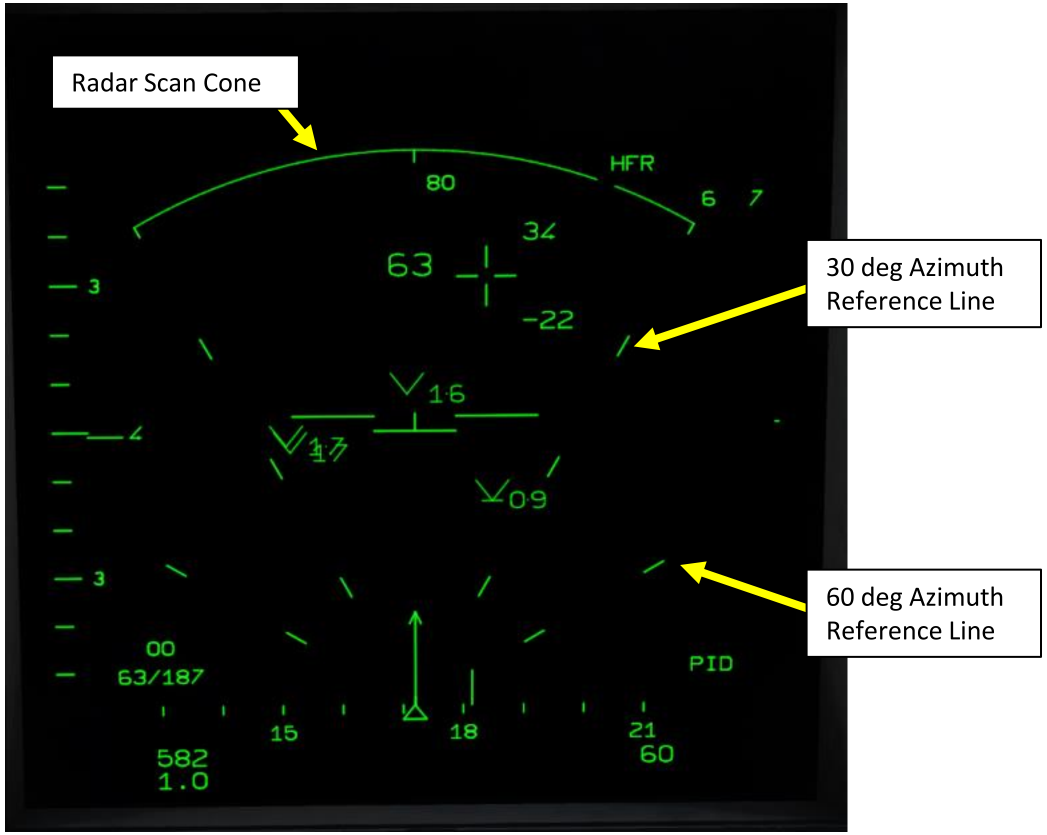
3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.2 – Azimuth

Radar azimuth aperture can be set using the Radar Scan Azimuth Selector. The radar scan cone can be controlled with the TDC as you slew the TDC left or right.

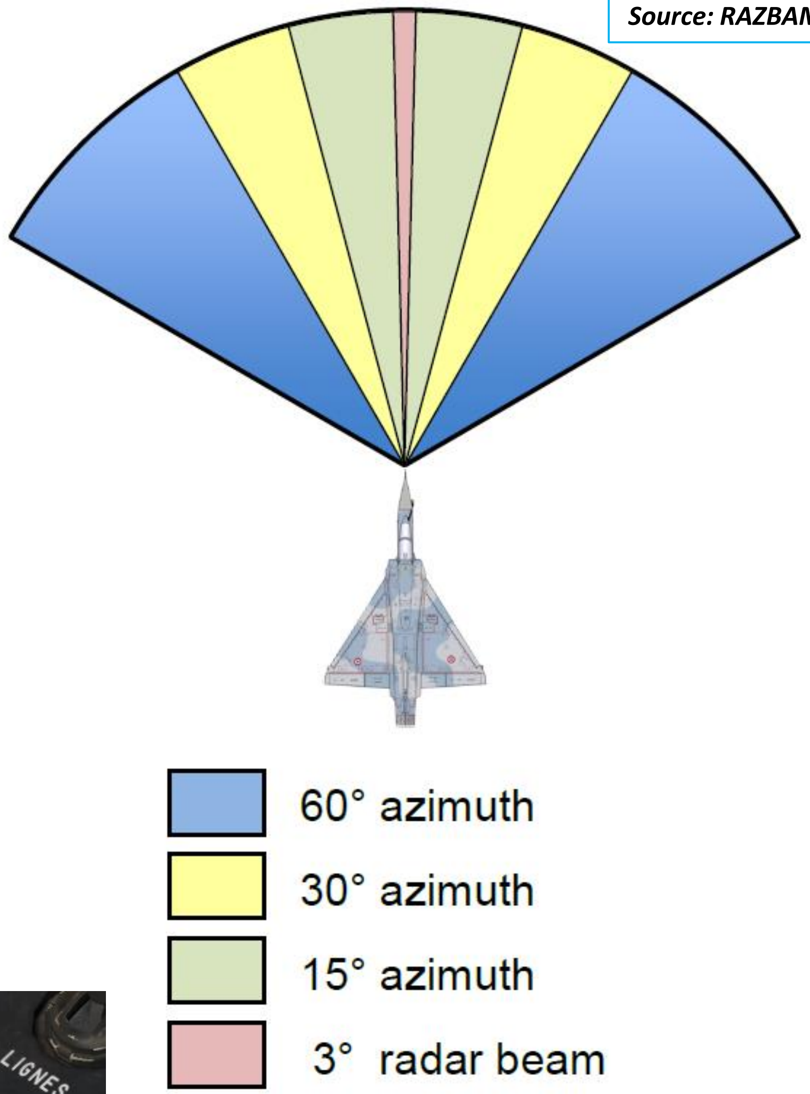
In a 60 deg azimuth setting, the radar scans 100 deg per second.
In a 30 deg or 15 deg azimuth setting, the radar scans 50 deg per second.

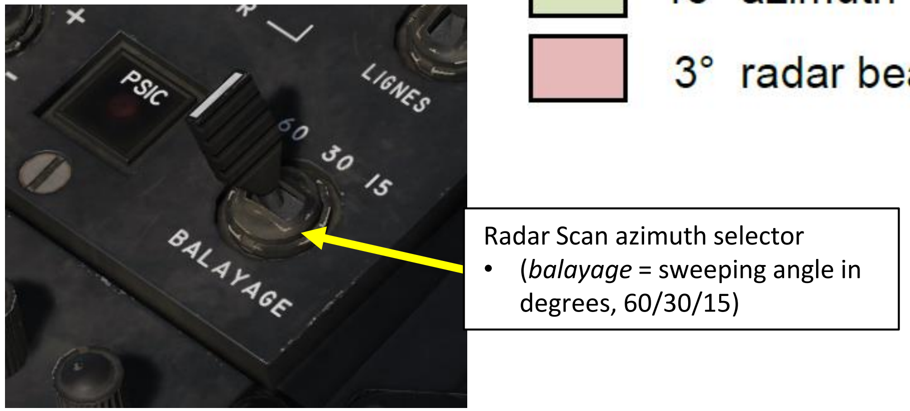
The radar’s maximum azimuth gimbal limits are +/- 60 deg.

Selectable azimuth settings: 15, 30 and 60 deg.



Source: RAZBAM Manual

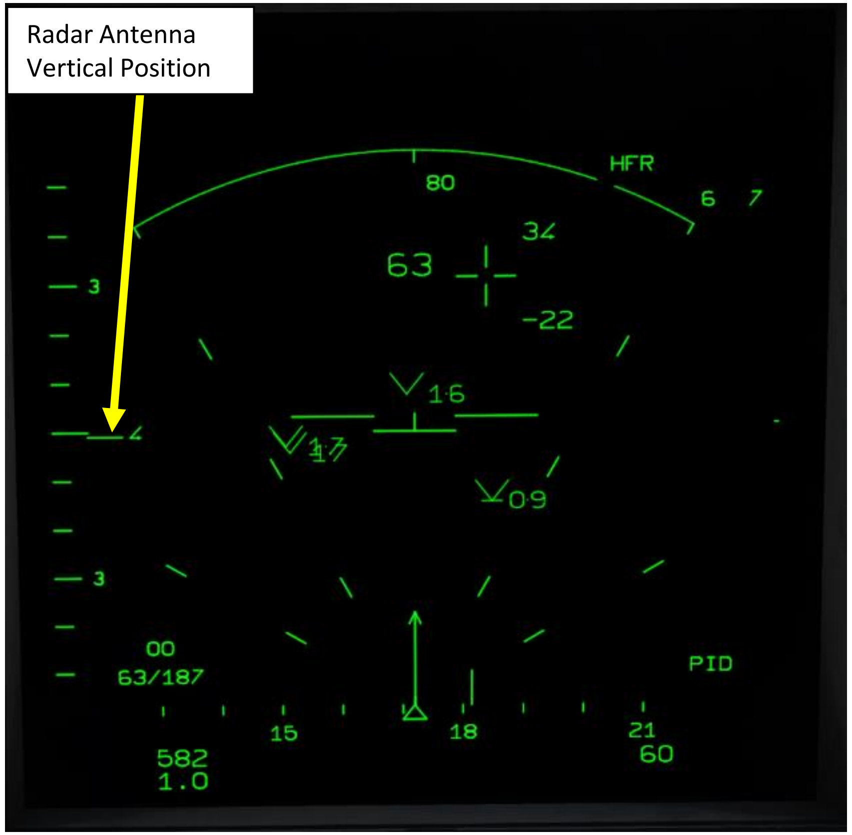




3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.3 – Elevation

You can control the vertical antenna elevation using the antenna elevation thumbwheel on the throttle.

The radar's maximum radar antenna gimbal limits are +/- 55 deg.

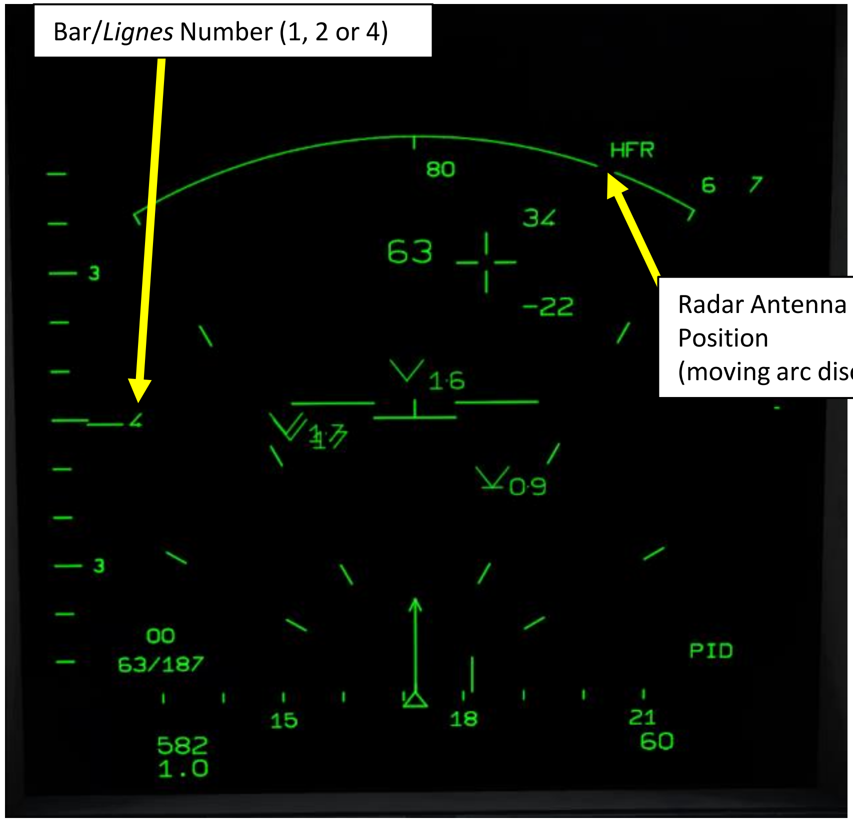


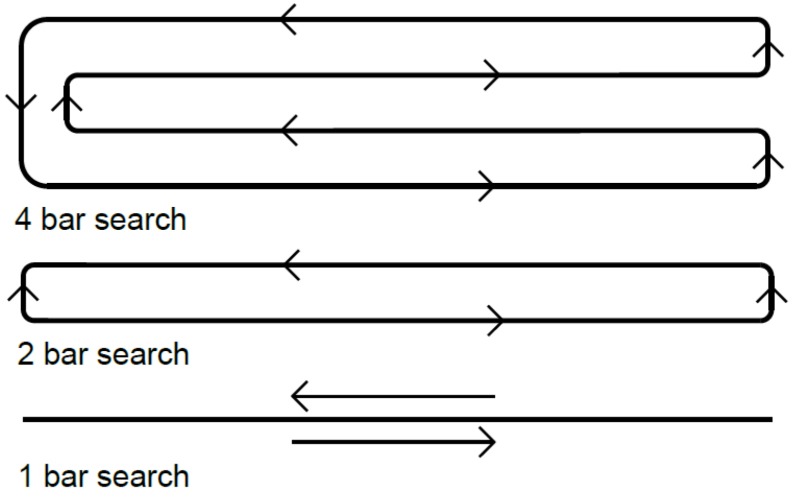
3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.4 – Bar Search Settings

Radar search patterns can be selected using the radar Lignes/Bars selector. The bar number is the number of horizontal lines that the radar will execute during a search pattern. A smaller bar search pattern means a faster search time, but an overall worst coverage, while a larger bar search patterns means a slower search time but a much better coverage.

In 2-bar and 4-bar search, the bars are overlapping each other, resulting in a 5 deg and 10 deg vertical coverage. This overlap can lead to duplicated contacts.

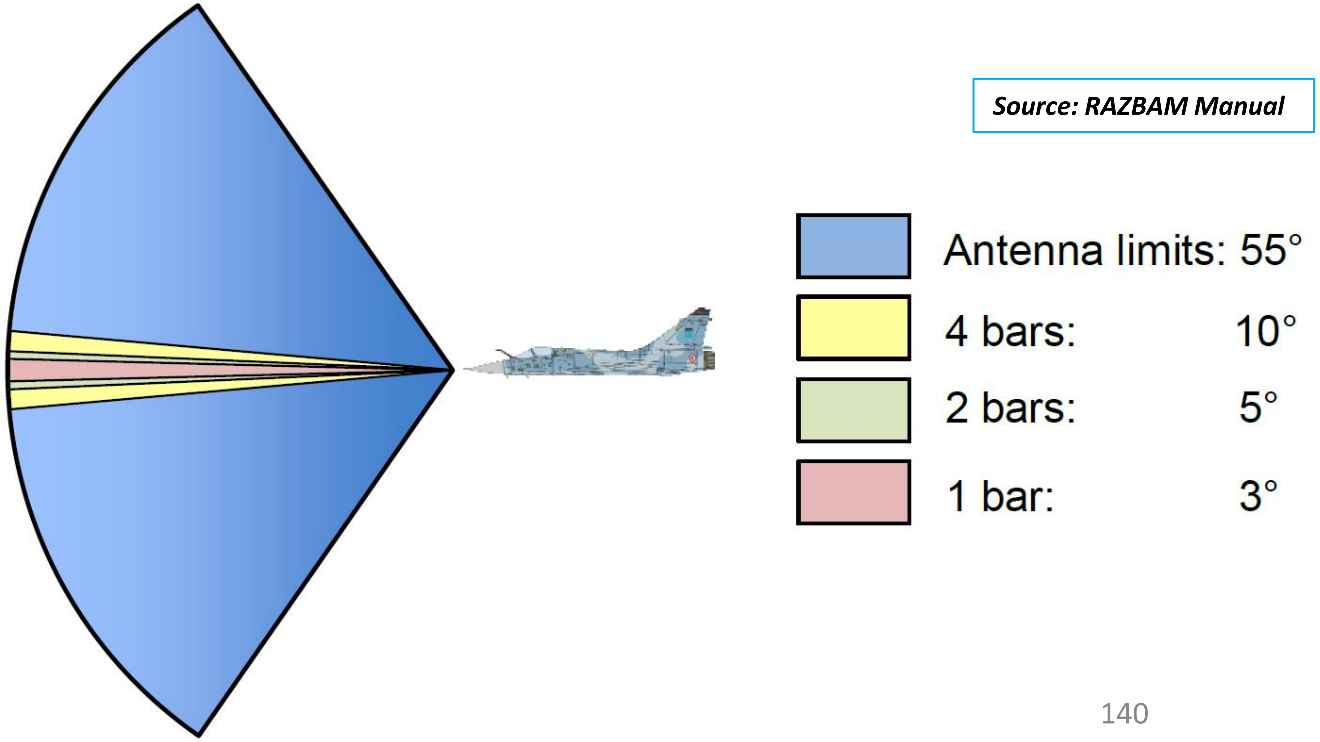
Selectable bar/*lignes* settings: 1, 2 and 4 bars.





RDI Radar Search Patterns

Radar Number of *Lignes* (bars) selector
- (4/2/1)



Source: RAZBAM Manual

3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.5 – PRF (Pulse Repetition Frequency) Settings

Radar PRF Mode Selector
- ENT: *Entrelacé*/Interleaved
- HFR: *Haute*/High Frequency
- BFR: *Basse*/Low Frequency

Radar Gain Control

The PRF (pulse repetition frequency) setting sets the PRF used by the radar while performing the search pattern. PRF settings are selectable using the Radar PRF Mode selector.

Selectable PRF settings: HFR, BFR, and ENT.

- **HFR (*Haute fréquence de récurrence* – High PRF):** The radar displays HFR contacts and no raw radar returns.
  - HFR contacts can be locked in PSIC (Single Target Track) or PSID (Track While Scan) using the TDC.

- **BFR (*Basse fréquence de récurrence* – Low PRF):** The radar displays the raw radar returns. Radar gain can be adjusted using the BFR radar gain command.
  - Since no HFR contacts are displayed, the only way to lock a contact from this mode it to enter RRAS (*Ralliement Radar sur Alidade/Site*) / Radar Slave to TDC/Elevation auto-acquisition mode.

- **ENT (*Entrelacé* – Interleaved):** The radar will alternate between HFR and BFR.
  - The BFR raw returns and HFT contacts are displayed simultaneously. The HFR contacts can then be locked in PSIC or PSID using the TDC.
  - HFR and BFR will cycle in the following pattern starting from to top bar and to the right side:
    - 4 bars cycle: HFR > HFR > BFR > HFR, restart to the top right bar, BFR > BFR > HFR > BFR, restart to the top right bar and back to the beginning.
    - 2 bars cycle: HFR > HFR, restart to the top right bar, BFR > BFR, restart to the top right bar and back to the beginning.
    - 1 bar cycle: The leftward scans are in HFR and the rightward scans are in BFR.

Pulse Repetition Frequency Setting
- ENT: Interleaved
- HFR: High Frequency
- BFR: Low Frequency

3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.6 – Radar Limitations

Doppler System

The RDI (*Radar Doppler à Impulsions*) Doppler radar has a number of limitations the pilot needs to work with.

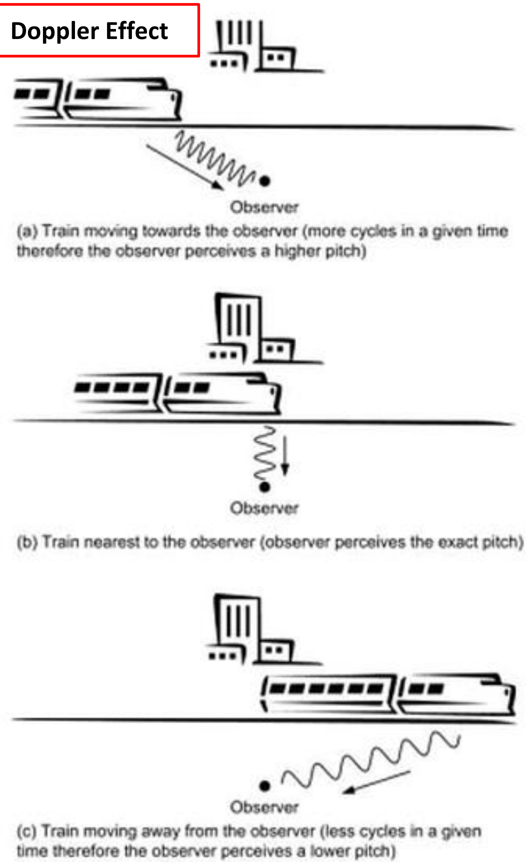
The **Doppler Effect** is probably that boring phenomenon you heard about in high school and didn't care about at the time. Basically, the Doppler Effect is the reason why airplane fly-bys in airshows are so awesome to listen to: a moving object (like a plane) is emitting waves (like sound waves) that 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.

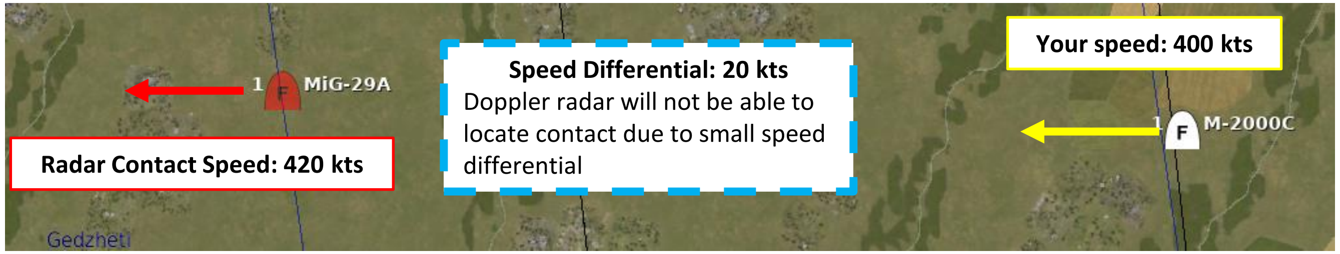
The received frequency is higher (compared to the emitted frequency) during the approach, it is identical at the instant of passing by, and it is lower during the recession. This variation of frequency also depends on the direction the wave source is moving with respect to the observer; it is maximum 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.

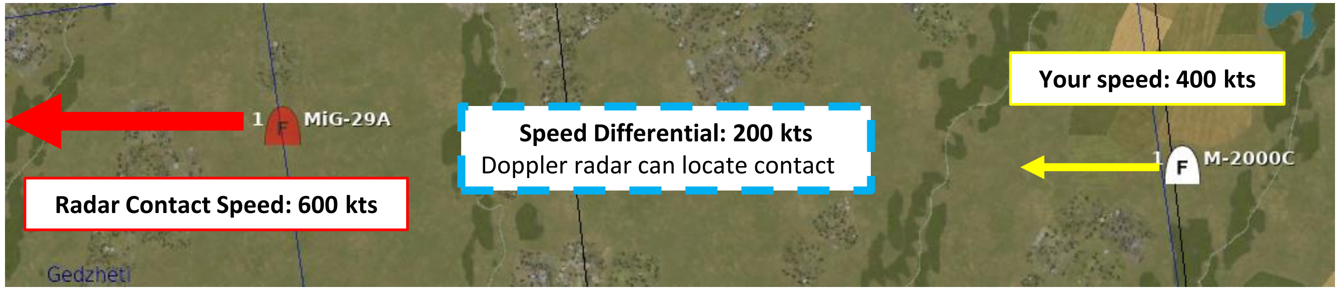
Where am I going with this? Well, the RDI radar is affected by the Doppler Effect. How? Hang on, I'm getting there.

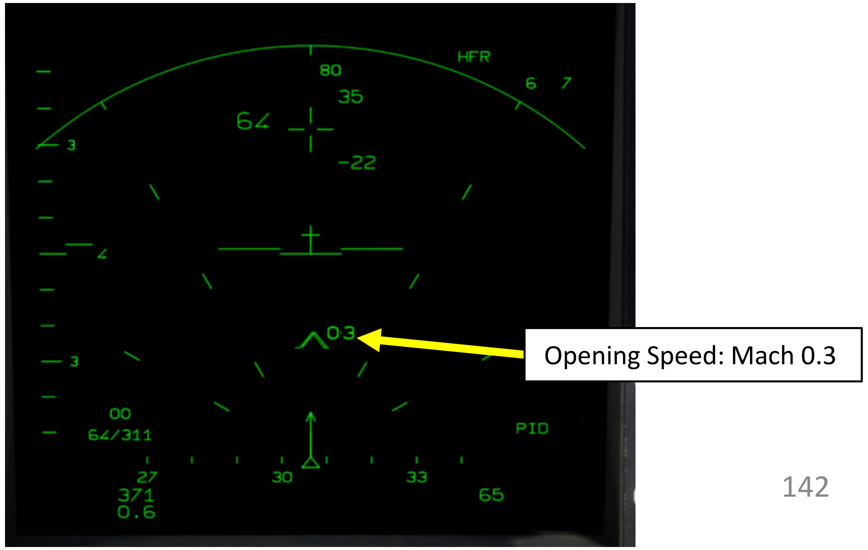
The TLDR version is this: **A bogey will be more easily detected if there is a greater speed differential between you (radar emitter/observer) and this contact (moving object). If the speed differential between a radar contact and you is too small (less than approx. 50 kts), the radar might not be able to locate it.**

Doppler Effect







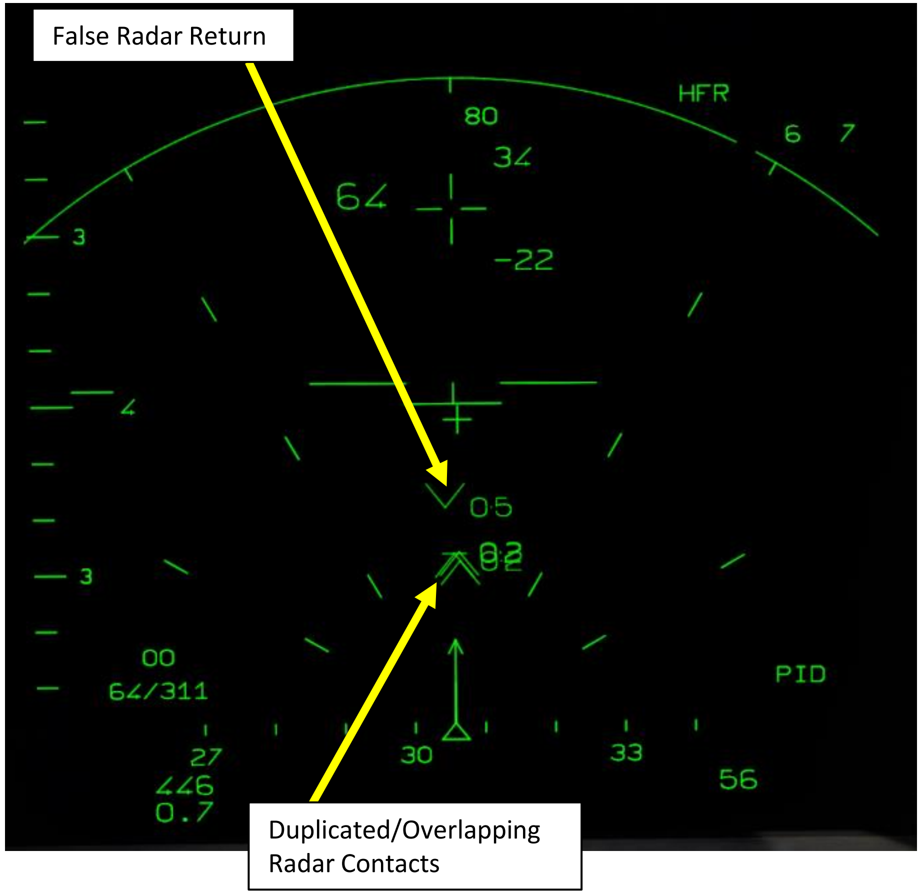


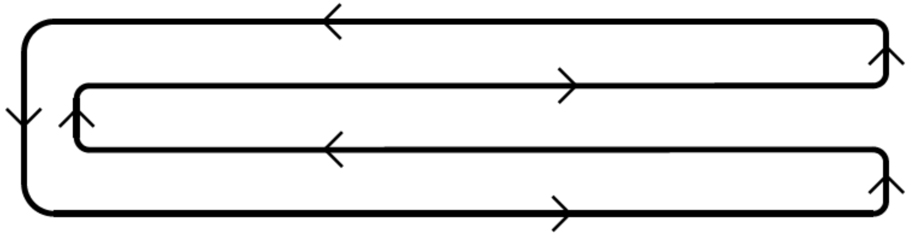
3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.6 – Radar Limitations

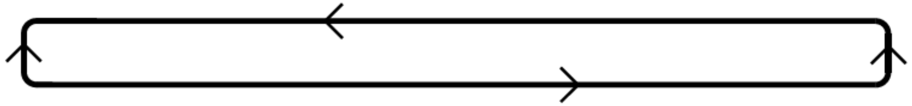
Radar theory is a complex subject. A radar detects objects by emitting electromagnetic pulses at a specific frequency. These pulses are reflected by the environment (terrain, aircraft, clouds, etc), which can create clutter that needs to be filtered. Radar waves travel at the speed of light, therefore these waves come back at the antenna after a delay corresponding to twice the object distance; this delay allows range computation. If the radar and/or the observed object are moving, the frequency of the pulse return may differ from the initial emitted frequency; this effect is commonly known as Doppler shift. This means that by measuring this shift in frequency, the radar can measure the closing speed of the observed objects. This allows measuring the radial velocity of objects, reducing confusion between multiple objects if they have different closing velocities and removing ground clutter.

PRF (Pulse Repetition Frequency) has an effect on the precision of the range computation; the lower the PRF, the less range ambiguity. There are different techniques to deal with range ambiguity problems such as having the radar use two PRFs at the same time (either by using two carriers or by alternating rapidly between PRF settings). However, this approach isn't perfect. PRF range disambiguation techniques can only simultaneously deal with a limited number of objects, which means that an excessive amount of radar returns caused by either high aerial traffic or radar jammers can lead to random object distance computations due to the radar system's failure to correlate the radar returns for one PRF with the returns of the other PRFs.

Bottom line: there are times when the radar can compute momentary "fake" radar contacts for a search cycle or two. There can also be radar contacts duplicated due to search bars overlapping each other. It is your job as a pilot to use your own judgement to see whether a radar contact is a false return or a valid target. If a contact appears for a single cycle and disappears, there are chances it's a fake return.

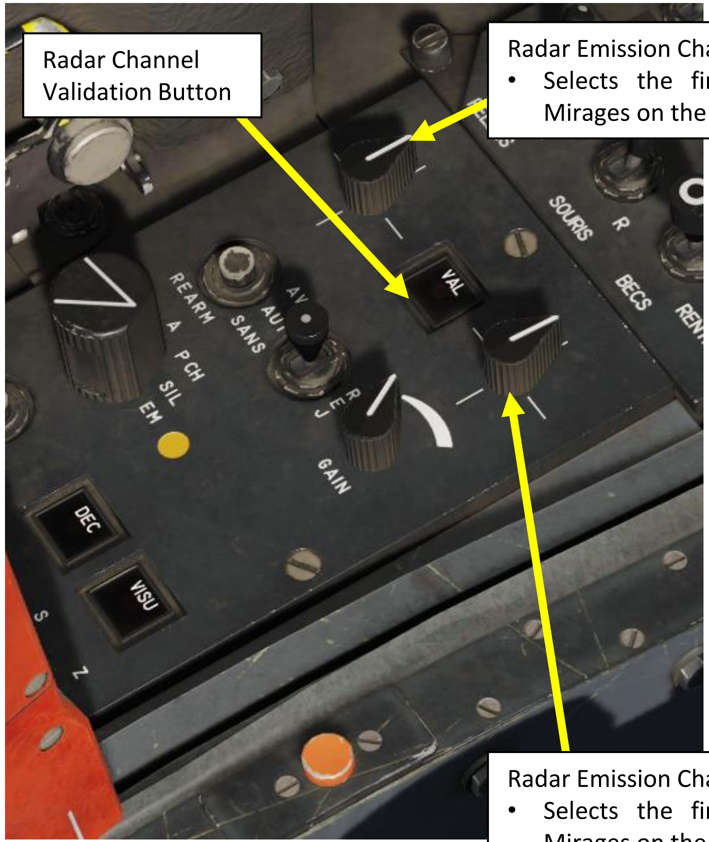



4 bar search


2 bar search

3 – RADAR AIR-TO-AIR MODES
3.1 – Radar Performance
3.1.7 – 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. In the Mirage 2000C, the RDI radar has 144 emission channels that can be set on the radar control panel. When flying with other Mirages, it is important to coordinate each aircraft radar emission channels so there is no overlap.



Radar Channel Validation Button

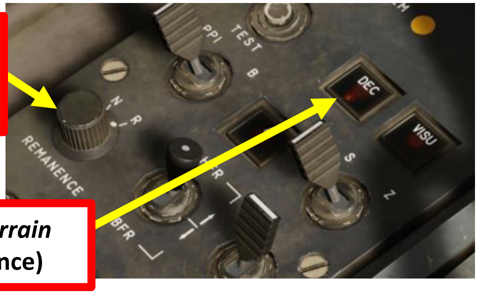
Radar Emission Channel Selector 1
- Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.

Radar Emission Channel Selector 2
- Selects the first radar emission channel digit. Two Mirages on the same channel would jam each other.

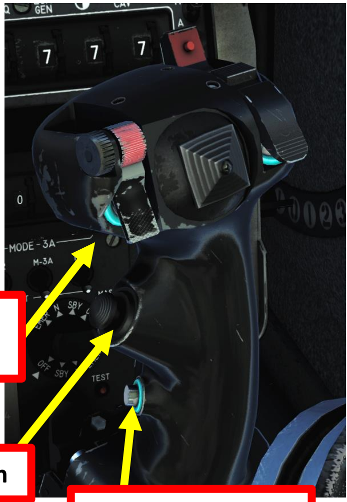
Radar Emission Frequency Channels

3 – RADAR AIR-TO-AIR MODES
3.2 – Radar Air-to-Air Modes Overview

Rémanence (Persistence) Selector
- **R=Rémanence = Persistence ON**
- **N=NON=Persistence OFF**



DEC: ***Découpe Terrain*** **(Ground Avoidance)**



MiCRoB Trigger (2nd Stage) (Trigger in Front of Stick)

Weapons System CMD Switch

STT/TWS Toggle

Target Designator Caret (TDC) Switch

RECH (Bar Search)*

Press STT/TWS Toggle switch to pre-select which radar mode will be used when locking target (PID/TWS or PIC/STT).

PID Pre-Selected

TDC Slewed on radar contact
TDC Depressed
Radar mode will switch from Bar Search to PSID

PIC Pre-Selected

TDC Slewed on radar contact
TDC Depressed
Radar mode will switch from Bar Search to PSIC

PSID/TWS (Track While Scan)*

STT/TWS Toggle Switch pressed

PSIC/STT (Single Target Track)

Press Weapons System CMD Switch DEPRESSED

Radar Unlock (if desired)
Returns to Bar Search

MiCRoB (2nd Stage) Trigger Pressed

DEC (Découpe Terrain) Button Pressed

SHB (Terrain Avoidance While Track)*

MiCRoB (2nd Stage) Trigger Pressed

PSIC/STT Super 530

Press Weapons System CMD Switch FWD

PSIC/STT Super 530 Pointé (Pointed)

Press Weapons System CMD Switch DEPRESSED

Radar Unlock (if desired)
Returns to Bar Search

Note: radar modes with an asterisk * (RECH, PSID, SHB) can be combined with Persistence/Rémanence mode .

3 – RADAR AIR-TO-AIR MODES
3.2 – Radar Air-to-Air Modes Overview

RECH (Bar Search)

No radar contact locked, all contacts visible

PSID/TWS (Track While Scan)

Single contact locked, but other contacts are still visible

PSIC/STT (Single Target Track)

Single contact locked, but other contacts are not visible

3 – RADAR AIR-TO-AIR MODES
3.2 – Radar Air-to-Air Modes Overview

Here is an overview of the main radar air-to-air modes:

Main Modes (BVR, Beyond Visual Range)

****

- **RECH (*Recherche en Lignes*) / Bar Search Mode**: The bar search mode is the main mode to use when looking for aircraft. Bar search provides all-aspect (nose-on, tail-on) and all-altitude (look-up, look-down) target detection. The VTB display shows range as the vertical axis and azimuth angle on the horizontal. In this mode, the radar is gyro stabilized to the horizon in pitch and roll.

- **PSID (*Poursuite sur Information Discontinue* / TWS (Track While Scan)**: The PSID or PID mode allows the radar to focus on a single contact and provide additional information while still scanning the airspace around the contact. The radar will keep a 1 bar search pattern centered on the locked contact in azimuth and elevation and be able to display 16 other contacts with the same info as in bar search. The bar setting is forced to 1 bar and the azimuth setting is free to be set at 60 deg, 30 deg or 15 deg. The radar will build a track of the locked contact, which means that the contact position is updated in real time according to its movement and adjusted each time the contact is scanned by the radar. This mode allows to track a contact position but is not perfect, lock can be lost due to erratic maneuvers. It also cannot be used to guide the Super 530D missile.

- **PSIC (*Poursuite Sur Information Continue*) / STT (Single Target Track)**: The PSIC or PIC mode physically locks the radar on a single contact to provide additional information and maintain maximum lock reliability. As the radar is physically locked on the target, the information provided has a greater accuracy and is updated in real time. This lock is almost impossible to evade using erratic maneuvers. If the target is lost, the radar keeps illuminating the target trajectory and try to re-acquire it for 5 seconds after which the radar will return to bar search. Locked aircraft can also be made aware that they are targeted if they are equipped with a RWR (radar warning receiver). From this mode, the Super 530D missiles can be fired and guided on the radar target. When a 530 is fired, the radar enters to a PSIC sub-mode: **PSIC Super 530**.
    - **PSIC Super 530** is a sub-mode of PSIC that is activated automatically once a Super 530D missile has been fired. The radar stays in PSIC Super 530 for 50 seconds after the last missile fired. During this time, if the target is lost, the radar will keep illuminating the target trajectory and try to re-acquire it just like PSIC mode but for 8 seconds instead of 5. After those 8 seconds, the radar will continue to illuminate the target trajectory but won't try to re-acquire the lock. This forced illumination mode lasts as long as the radar is in PSIC Super 530. If the radar is unable to continue to illuminate the target, the **PSIC Super 530 pointé (pointed)** mode can be used (with the Weapons System CMD Switch FWD) to manually illuminate the target. This mode is only selectable while the radar is in PSIC Super 530 and fixes the radar antenna to the aircraft axis, allowing the radar to be aimed at the target by flying the aircraft.

3 – RADAR AIR-TO-AIR MODES
3.2 – Radar Air-to-Air Modes Overview

Here is an overview of the main radar air-to-air modes:

Main Modes (BVR, Beyond Visual Range)

****

- **Persistence Mode (*Mode Rémanence*)**: This mode is selected by placing the persistence/*rémanence* knob in the R (Rémanence ON) position. This mode in only effective when:
    - Bar search mode is selected with the bar number selector set to 1 and the PRF (pulse repetition frequency) selection switch set to HFR (High Frequency) or ENT (Interleaved), or
    - PSID mode is selected, or
    - SHB mode is selected.

  In persistence mode, HFR contacts remain displayed for 3 search patterns instead of one. During the first search pattern after the contact is detected, it is represented by the normal HFR symbol. During the second search pattern, the normal HFR symbol is replaced by an horizonal line, this same line is used during the third search pattern but dimed. The contact disappear once the third search pattern is finished. This mode is useful to spot spurious contacts and estimate the trajectory of detected aircraft.

- **SHB (*Sécurité Haut-Bas*) / Terrain Avoidance While Track**: The SHB mode combines the DEC (*Découpe Terrain*/ Terrain Avoidance) and PSID (Track While Scan) mode. The radar performs a two bar search pattern alternates between the two modes:
    - Leftward scans for the DEC
    - Rightward scans for the PSID

  The DEC radar image is displayed up to 10 nm and the display range setting can be set to 10 or 20 nm. The PSID lock range is not more limited than in PSID. In SHB, there is 20° limit in elevation difference between the tracked target and the clearance height. If this limit is exceeded, the radar will drop the lock and switch to DEC mode. There is a similar limit in azimuth if the azimuth aperture setting is under 60°, the radar needs to keep scanning 5° on each side of the aircraft axis line.

3 – RADAR AIR-TO-AIR MODES
3.2 – Radar Air-to-Air Modes Overview

Here is an overview of the main radar air-to-air modes:

Close Combat Modes

****

- **Boresight Auto-Acquisition**: The radar is slaved to the aircraft boresight and will try to lock in PSIC any contact within 10 nm. The scanned area is equal to the antenna aperture, a 3 deg cone.

- **VTH/HUD (SVI) Auto-Acquisition**: The radar executes a spiral pattern that is roughly the size of the VTH and will try to lock in PSIC any contact within 10 nm. The scanned area is equal to a 20 deg cone. This mode is most useful to re-acquire a lost contact whose approximate position is known.

- **Vertical Auto-Acquisition**: The radar executes a pattern composed of two vertical lines relative to the aircraft. The vertical lines are just left and right of the aircraft vertical axis and goes from 10 deg under the nose to 50 deg above. The radar will try to lock any contact in PSIC within 10 nm. This mode is useful in dogfights, when the hostile aircraft is in front and above.

- **Horizontal Auto-Acquisition**: The radar executes the same search pattern as the 2 bar/30 deg bar search pattern and will lock in PSIC any contact within 10 nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command and by moving the TDC in the same way than in bar search. This mode is most useful to lock a close contact as is offers the biggest scan zone of all auto-acquisition modes. Two modes are available for horizontal auto-acquisition: **BAH** (HFR, High PRF) and **BA2** (MFR2, Medium PRF):

- **RRAS (*Ralliement Radar sur Alidade/Site*) / Radar Slave to TDC/Elevation Auto-Acquisition**: The radar executes the same search pattern as in boresight mode and will lock in PSIC any contact within 10 nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command and by moving the TDC in the same way than in bar search. This mode is most useful to achieve a HFR lock on a BFR contact.

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.1 – RECH (*Recherche en Lignes*) / Bar Search Mode

The bar search (RECH, or *Recherche en Lignes*) mode is the main air search mode, similar to RWS (Range While Search) for western fighters. Bar search provides all-aspect (nose-on, tail-on) and all-altitude (look-up, look-down) target detection. The displayed contacts are not tracked, meaning that their position is not updated with time. Contacts are erased after being displayed for one search pattern and a new contact is displayed at the new position. The VTB display shows range as the vertical axis and azimuth angle on the horizontal. In this mode, the radar is gyro stabilized to the horizon in pitch and roll.

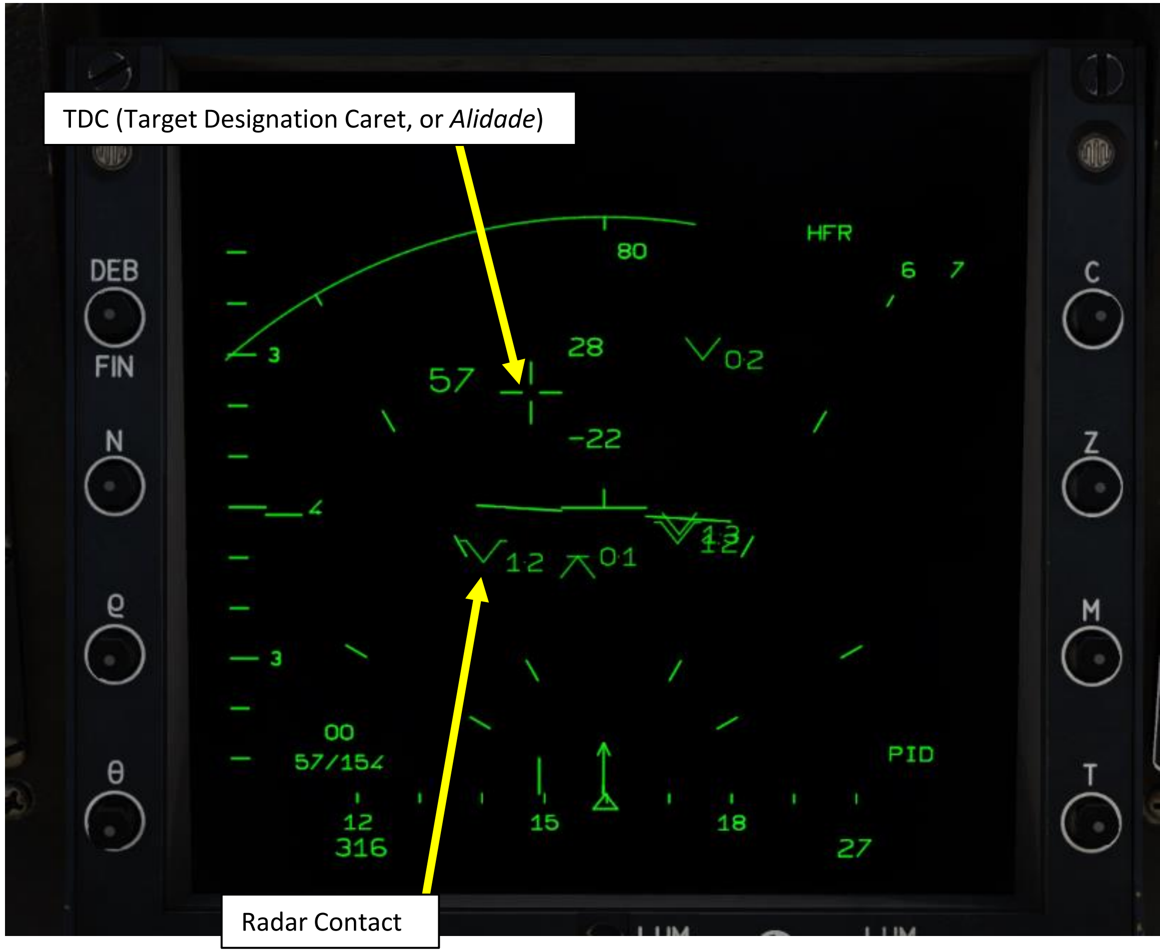
The maximum number of contacts that the radar can display is based on the selected bar number and persistence setting:

- 64 contacts in 4 bars (16 per bar)
- 64 contacts in 2 bars (32 per bar)
- 40 contacts in 1 bar without persistence/*rémanence*
- 20 contacts in 1 bar with persistence /*remanence*

You know you are in Bar Search Mode when the TDC (Target Designation Caret) is visible, no radar contact is locked and radar contacts are visible on the VTB (Heads-Down Display).

Bar Search is the default radar mode in use. To return to Bar Search from either PSID (Track While Scan) or PSIC (Single Target Track) mode, press Weapons System CMD Switch DEPRESSED.

RECH (Bar Search)



Rémanence (Persistence) Selector
- **R=Rémanence = Persistence ON**
- **N=NON=Persistence OFF**

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.1 – RECH (*Recherche en Lignes*) / Bar Search Mode

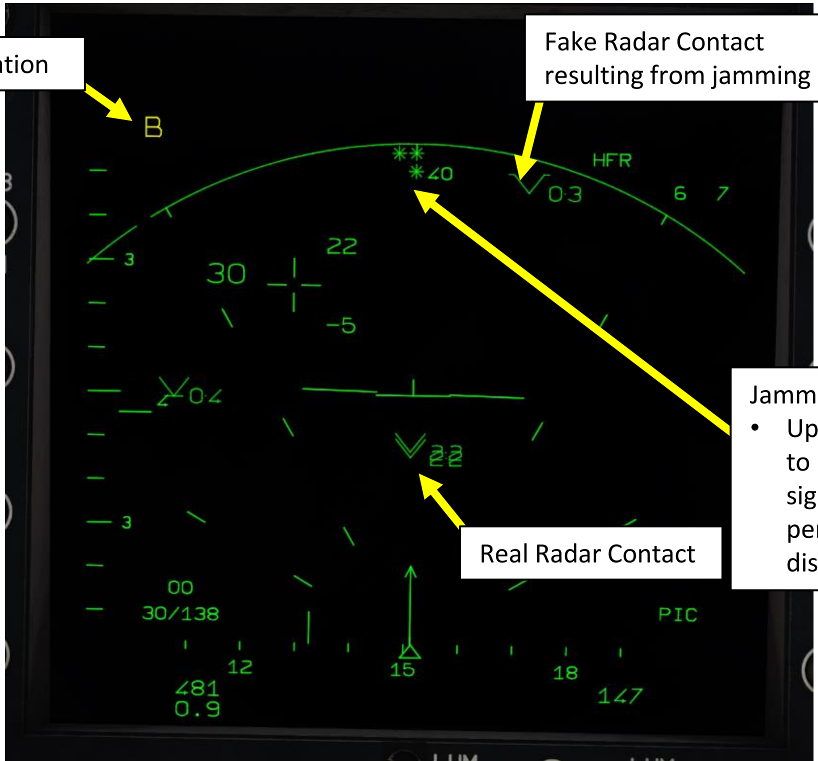
While in bar search, the radar can encounter **noise jamming** that will try to confuse it by providing it with false contacts.

- In HFR, the radar will detect that it is being jammed and reduce its sensitivity to lower its chance to display a false target from the jammer. It will also display the direction of the jamming signal as well as its strength.
- In BFR, the radar will continue to display the raw radar image including the noise coming from the jammer.

Against the RDI radar, noise jamming is only effective until around 20-25 nm, at this range, the radar will burn-through the jam and will be able to detect the target. The radar might still display jam contacts and will still have its sensitivity reduced.

When the radar is in PSID/TWS, the jamming behavior is the same as the jammer technique doesn't change.

RECH (Bar Search)
Radar Jammed while in HFR (High PRF)



RECH (Bar Search)
Radar Jammed while in BFR (Low PRF)

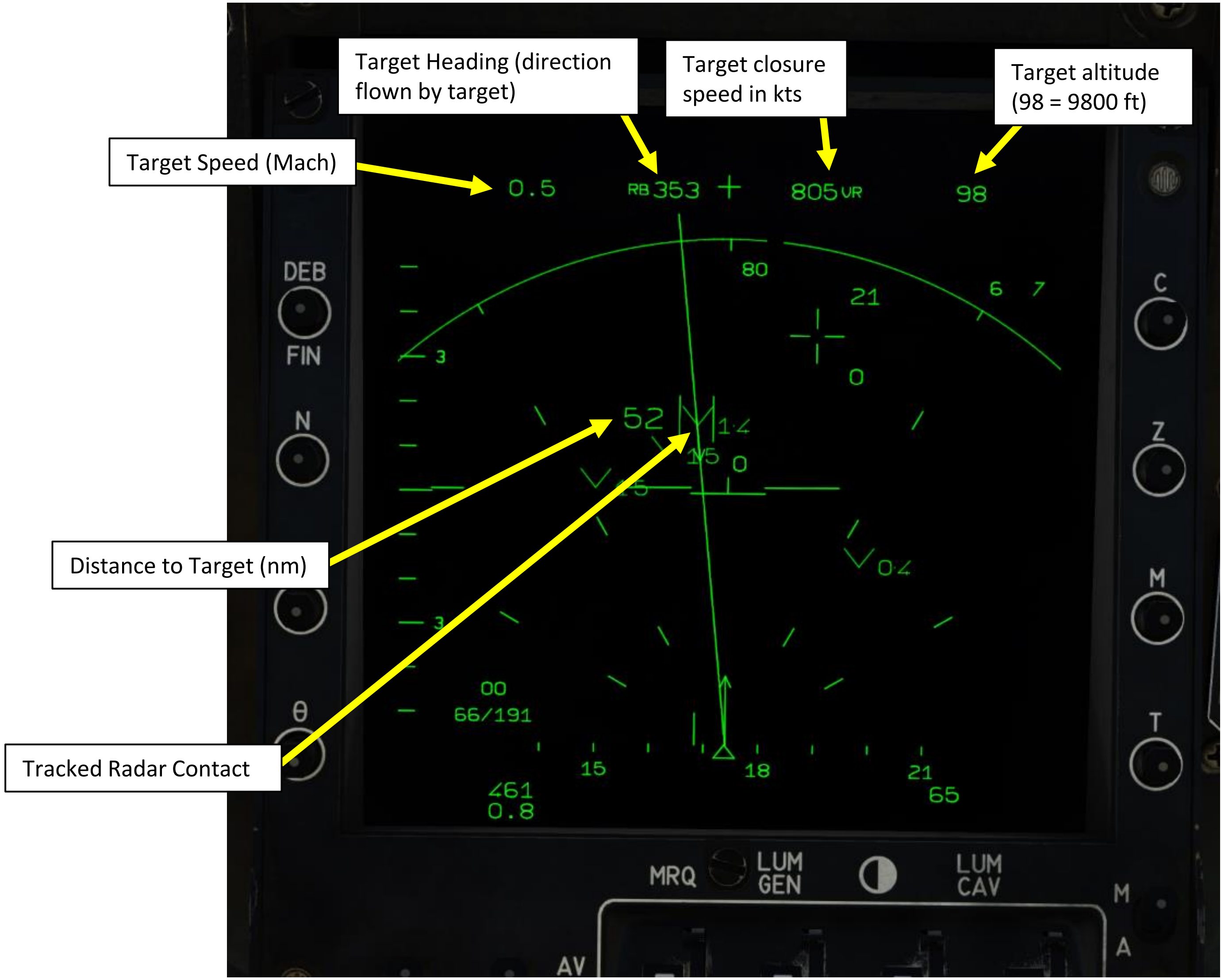
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.2 – PSID (*Poursuite sur Information Discontinue*) / TWS (Track While Scan)

The PSID (*Poursuite sur Information Discontinue*) or TWS (Track While Scan) mode allows the **radar to focus on a single contact** and provide additional information **while still scanning the airspace around the contact**.

The way to enter PSID mode is to pre-select PSID from Bar Search mode, then lock a target using the TDC (Target Designator Caret). In PSID mode, the radar will keep a 1 bar search pattern centered on the locked contact in azimuth and elevation and be able to display 16 other contacts with the same info as in bar search. This way, the pilot can still track a target while maintaining visibility over other radar contacts, which is very useful to maintain good situational awareness. The bar setting is forced to 1 bar and the azimuth setting is free to be set at 60 deg, 30 deg or 15 deg.

The radar will build a track of the locked contact. This means that the contact position is updated in real time according to its movement and adjusted each time the contact is scanned by the radar. This mode allows to track a contact position but keep in mind that it can still lose the lock due to erratic maneuvers.

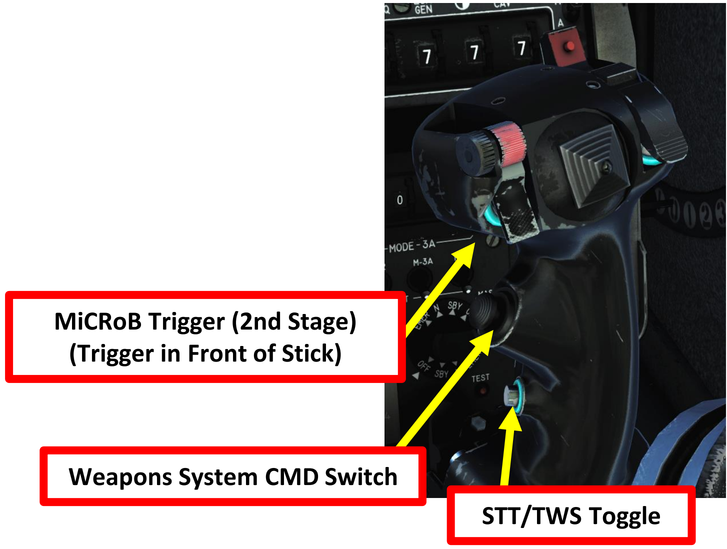
Another important point about PSID is that **it also cannot be used to guide the Super 530D missile**; the mode needs to be switched to PSIC (*Poursuite sur Information Continue*), or Single Target Track.



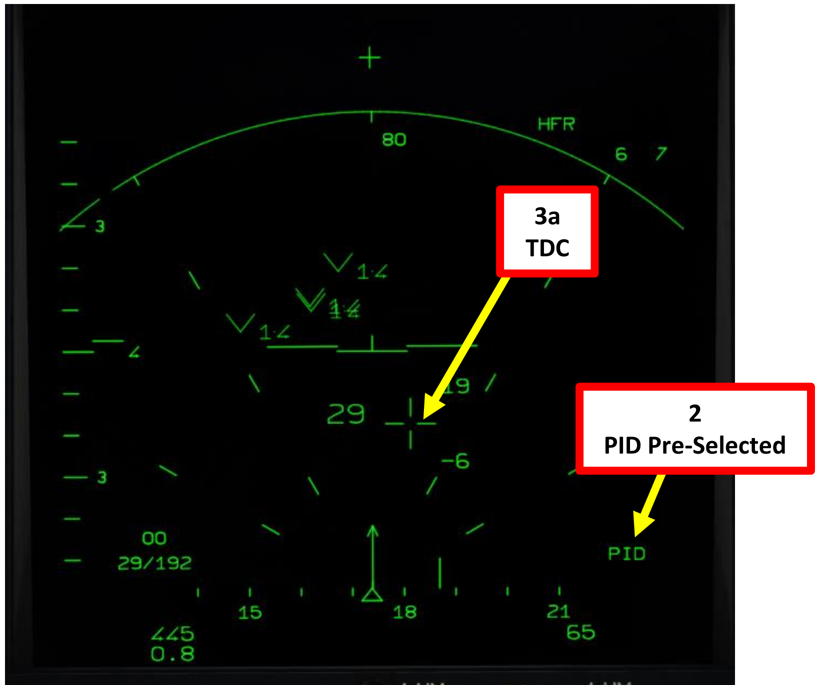
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.2 – PSID (*Poursuite sur Information Discontinue*) / TWS (Track While Scan)

In order to perform a PSID/TWS lock on a target:

1. Make sure you are in Bar Search Mode.
2. Pre-select PID mode by using the STT/TWS Toggle button on the stick. The VTB (Heads-Down Display) should indicate "PID" on the bottom right corner of the display.
3. Slew TDC (Target Designator Caret) on the radar contact you want to lock.
4. Depress TDC to lock the target.
5. Radar will switch from Bar Search to Track While Scan mode, indicated by a track line and tracking information on the upper portion of the VTB.
6. If you want to switch to the PSIC/STT mode in order to fire a Super S530 missile, it is possible to do so by either using the STT/TWS Toggle button on the stick or by pressing the MiCRoB (2nd Stage) trigger to fire the Super S530 missile.
7. If you want to unlock the target, press Weapons System CMD Switch DEPRESSED.



RECH (Bar Search)



RECH (Bar Search)

PSID/TWS (Track While Scan)

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)

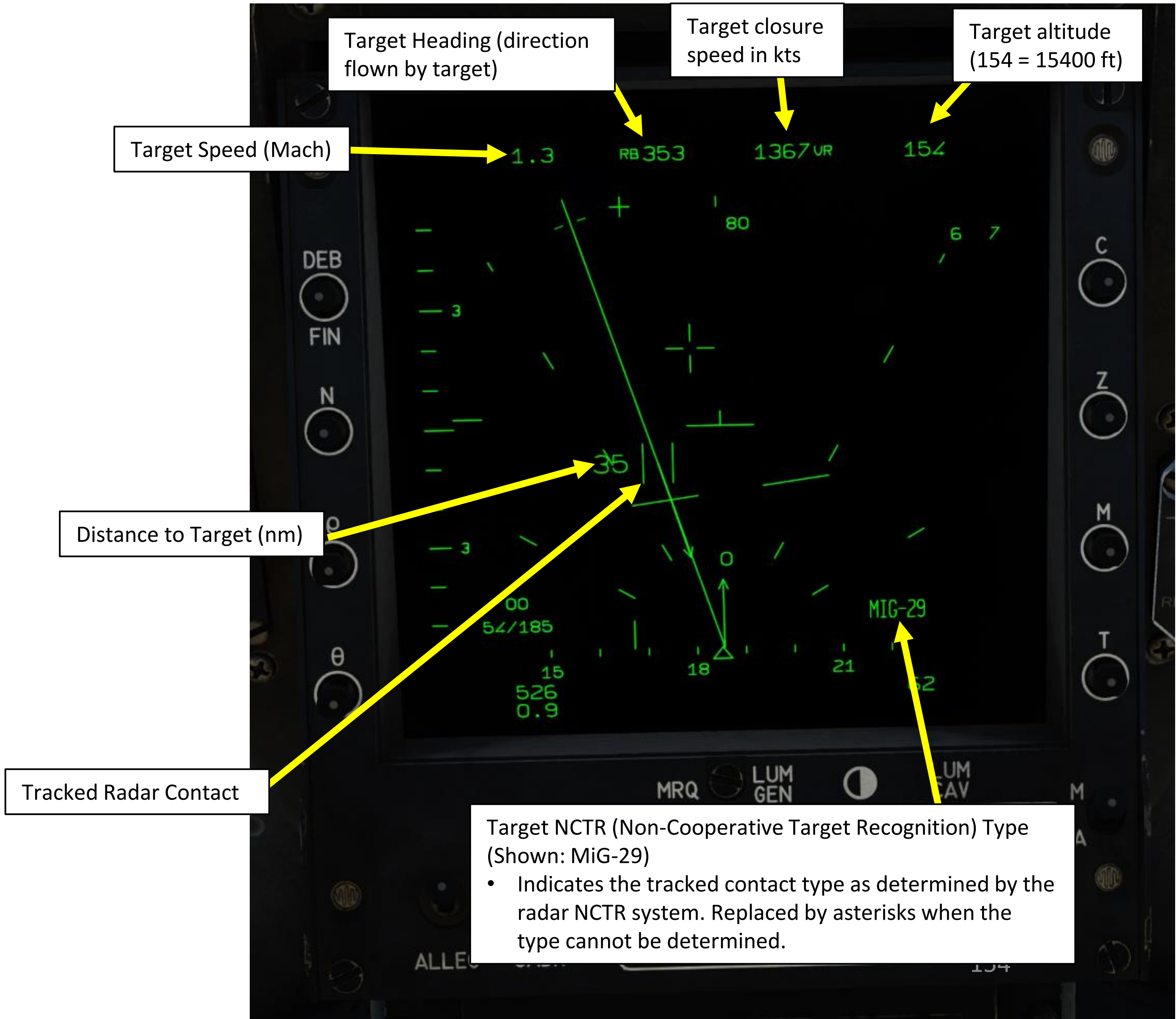
<u>3.3.3.1 – PSIC / STT Mode</u>

The PSIC (*Poursuite sur Information Continue*) or STT (Single Target Track) mode physically locks the radar on a single contact to provide additional information and maintain maximum lock reliability.

The way to enter PSIC mode is to pre-select PSIC from Bar Search mode, then lock a target using the TDC (Target Designator Caret). Alternatively, you can also lock up a target from PSID (TWS) and toggle radar mode from PSID to PSIC using the STT/TWS Toggle button on the stick.

As the radar is physically locked on the target, the information provided has a greater accuracy and is updated in real time. This lock is almost impossible to evade using erratic maneuvers. **<u>PSIC is the radar mode you need in order to guide Super S530 missiles.</u>**

If the target is lost, the radar keeps illuminating the target trajectory and try to re-acquire it for 5 seconds after which the radar will return to bar search. Locked aircraft can also be made aware that they are targeted if they are equipped with a RWR (radar warning receiver).

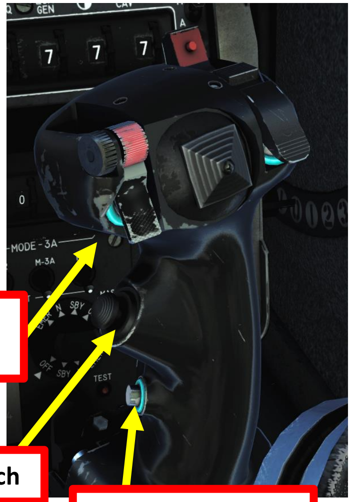


3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)

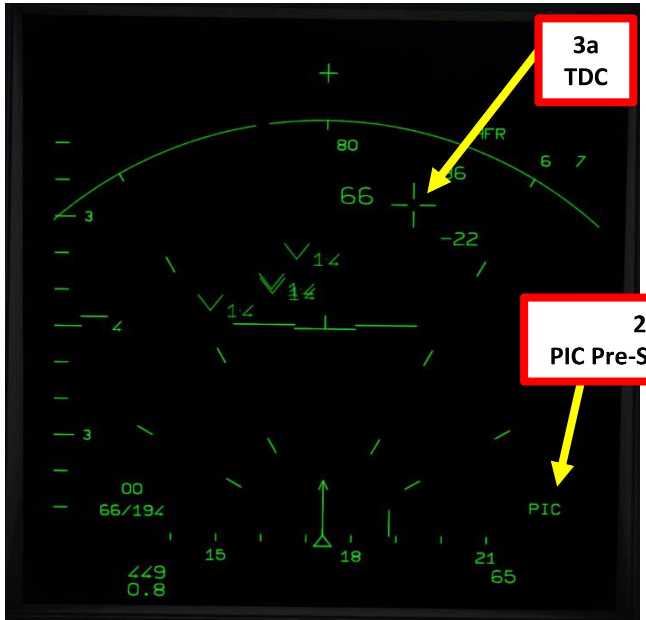
3.3.3.1 – PSIC / STT Mode

In order to perform a PSIC/STT lock on a target:

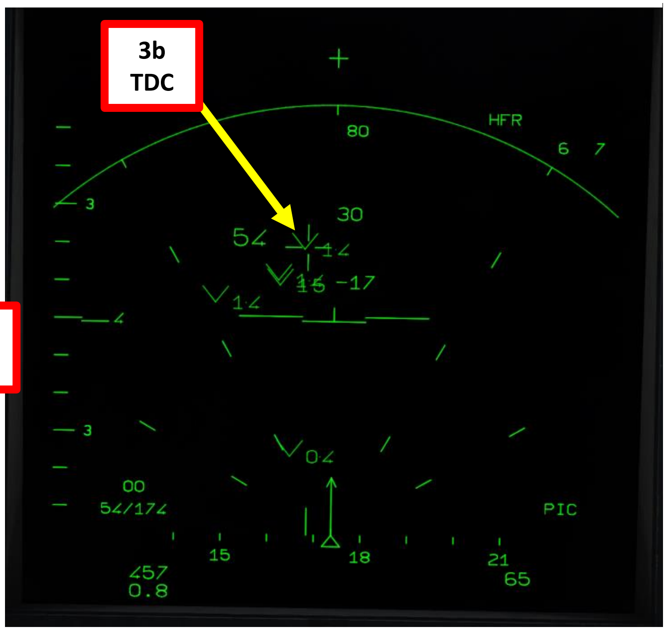
1. Make sure you are in Bar Search Mode.
2. Pre-select PIC mode by using the STT/TWS Toggle button on the stick. The VTB (Heads-Down Display) should indicate "PIC" on the bottom right corner of the display.
3. Slew TDC (Target Designator Caret) on the radar contact you want to lock.
4. Depress TDC to lock the target.
5. Radar will switch from Bar Search to Single Target Track mode, indicated by a track line and tracking information on the upper portion of the VTB.
6. If you want to unlock the target, press Weapons System CMD Switch DEPRESSED.



RECH (Bar Search)



RECH (Bar Search)



PSIC/STT (Single Target Track)

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)

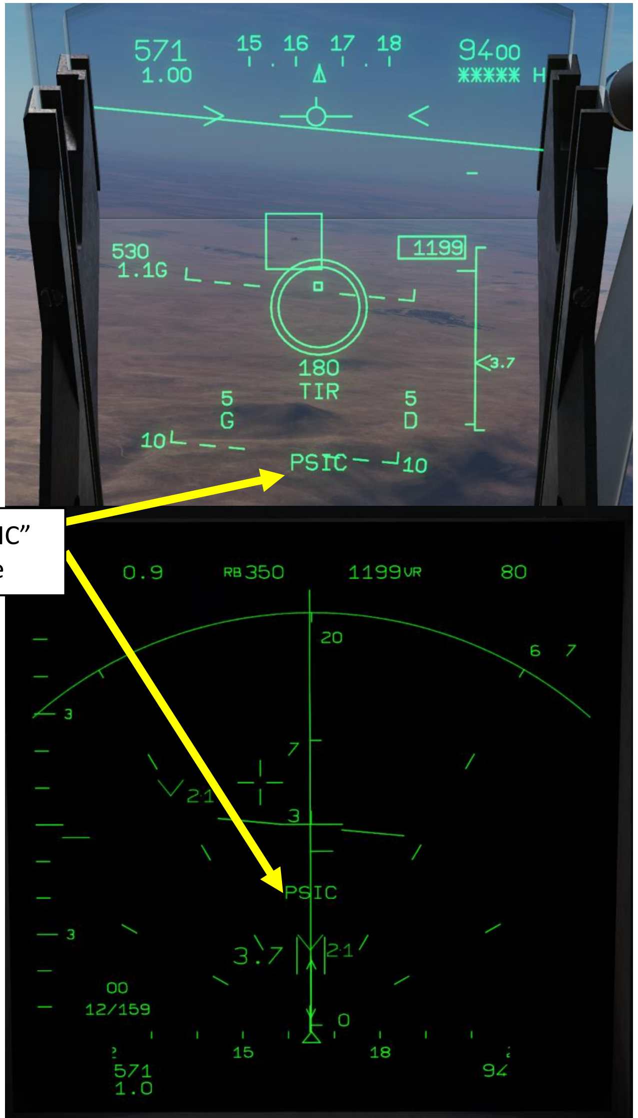
3.3.3.1 – PSIC / STT Mode

When a PSIC/STT lock or a PSID/TWS lock is performed, incitation messages can appear on the VTH (Heads-Up Display) and VTB (Heads-Down Display), which are cues that are advices about whether or not to switch from PSIC/STT to PSID/TWS or vice-versa.

- If in PSID/TWS mode, the flashing “**PSIC**” incitation cue means that the radar estimates that the noise-to-signal ratio from the contact is too low to maintain the PSID/TWS lock. “PSIC” advises you to use the STT/TWS Toggle button to **switch radar mode from PSID to PSIC** in order to get a more reliable lock.

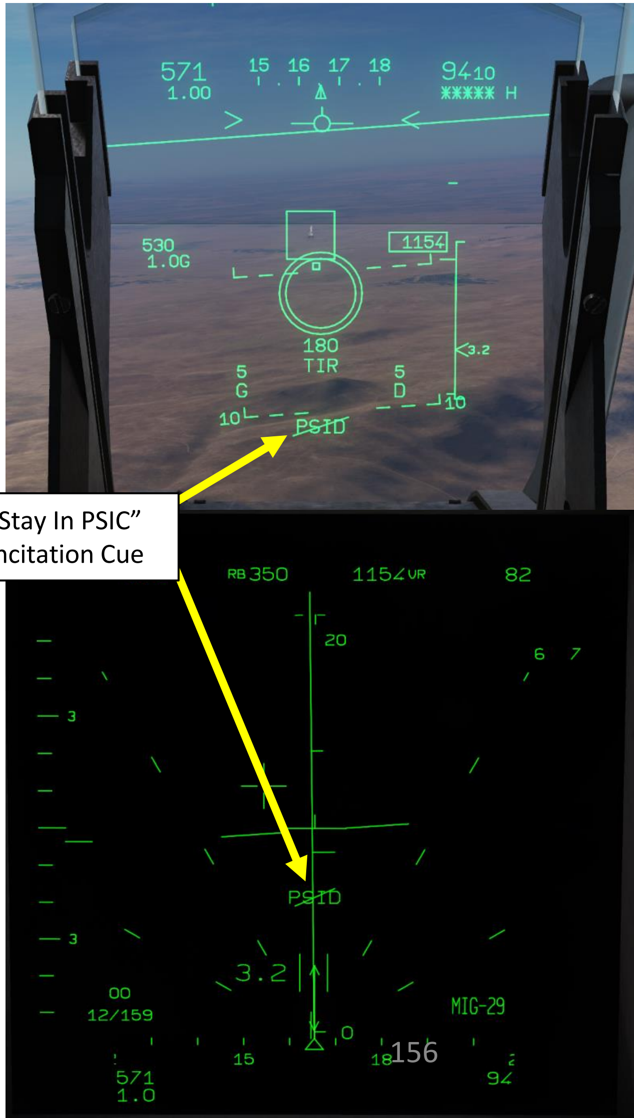
- If in PSIC/STT mode, pressing the STT/TWS Toggle button in order to switch radar mode from PSIC to PSID can generate a “**~~PSID~~**” incitation cue (which basically means “Stay in PSIC”, which is displayed steady for 3 seconds. “~~PSID~~” means that the radar estimates that the contact noise-to-signal ratio is too low to maintain a PSID lock, therefore you are advised to stay in PSIC mode instead in order to get a more reliable lock. Take note that the radar can still be forced from PSIC to PSID if the STT/TWS Toggle button is pressed while the “~~PSID~~” indication is displayed.

PSID/TWS (Track While Scan)



“Switch to PSIC” Incitation Cue

PSIC/STT (Single Target Track)



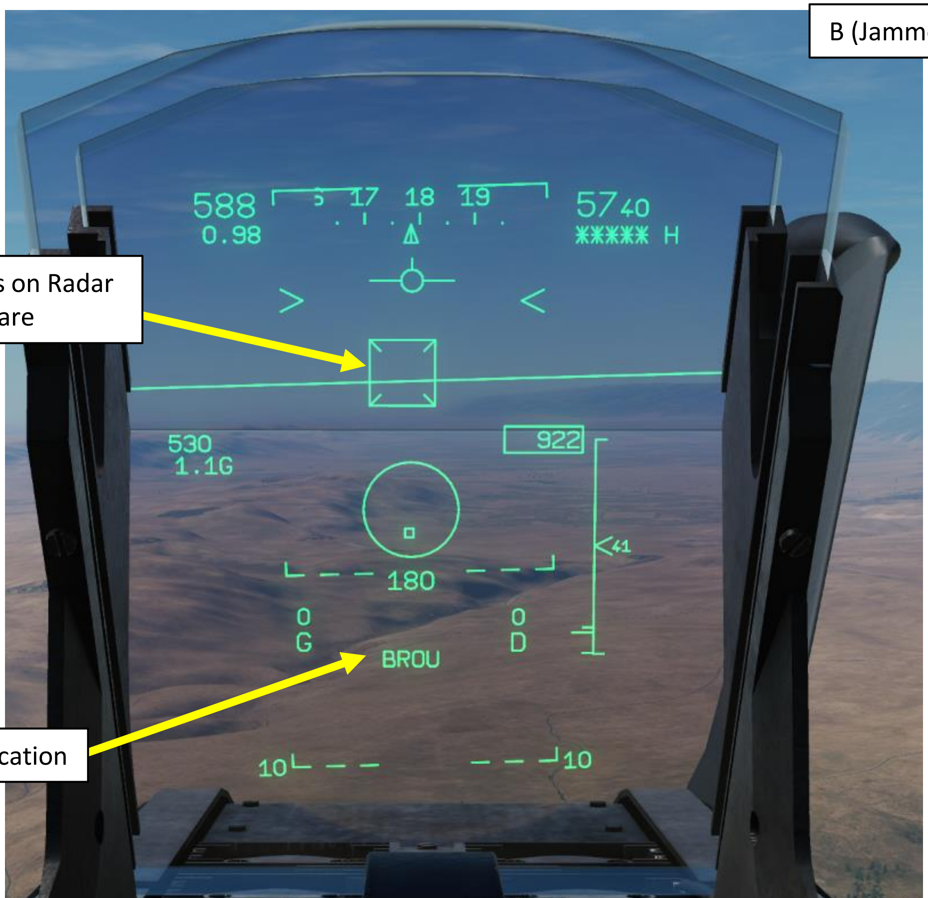
“Stay In PSIC” Incitation Cue

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)

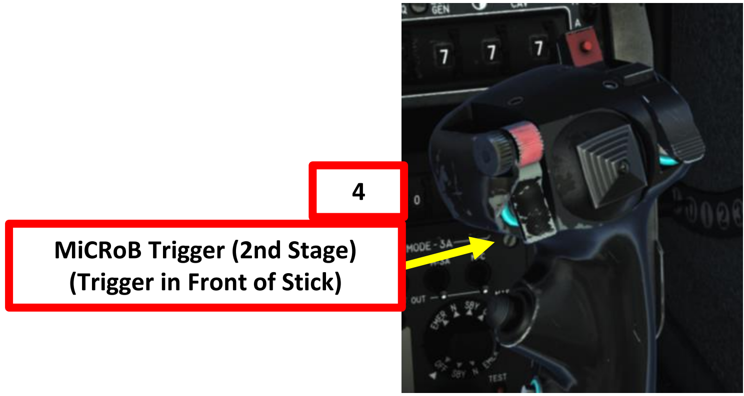
3.3.3.1 – PSIC / STT Mode

If missiles are selected, you perform a PSIC/STT lock and the **enemy aircraft is jamming your radar**:

- A hollowed-out cross appears inside the radar target position square.
  - Keep in mind that the hollowed-out cross is only visible if you are performing a PSIC/STT lock.
- "BROU" indication ("*Brouillage*", which means "*Jammed*") appears on the VTH (Heads-Up Display).
- "B" indication (stands for *Brouillage*/Jammed) appears on the VTB (Heads-Down Display).



3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)



3.3.3.2 – "PSIC / STT Super 530" & "PSIC / STT Super 530 Pointé" Sub-Modes

The "PSIC Super 530" mode is a sub-mode of PSIC that is activated automatically once a Super 530D missile has been fired.

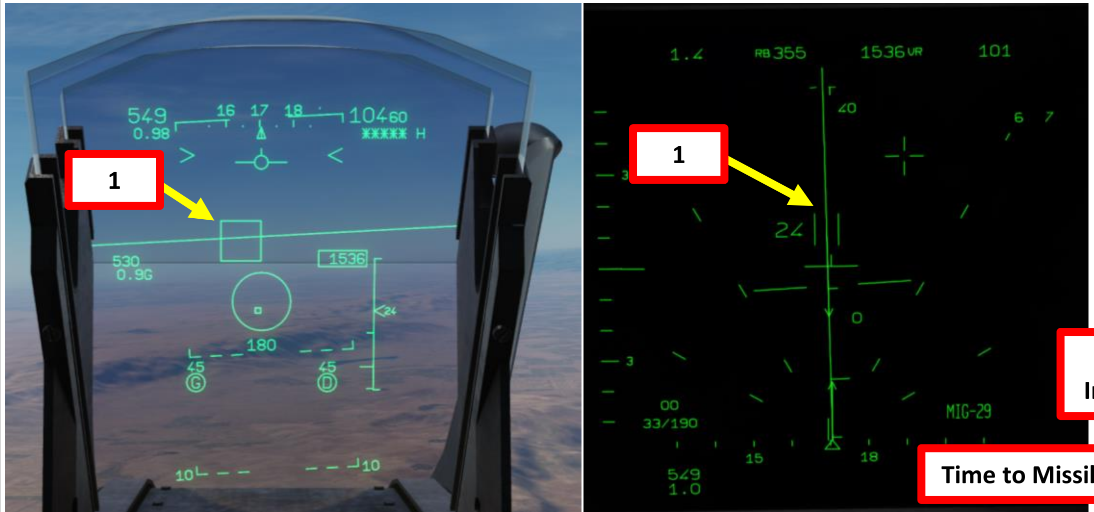
The PSIC Super 530 sub-mode requires:
1. A PSIC/STT lock to be performed
2. The Super S530 missile to be selected
3. The Master Arm switch to be ON (ARME)
4. The Super S530 missile to be fired by pressing and holding the MiCRoB Trigger (2nd Stage) for at least 0.650 seconds.

When the S530 missile is fired, the radar stays in PSIC Super 530 for 50 seconds after the last missile fired.

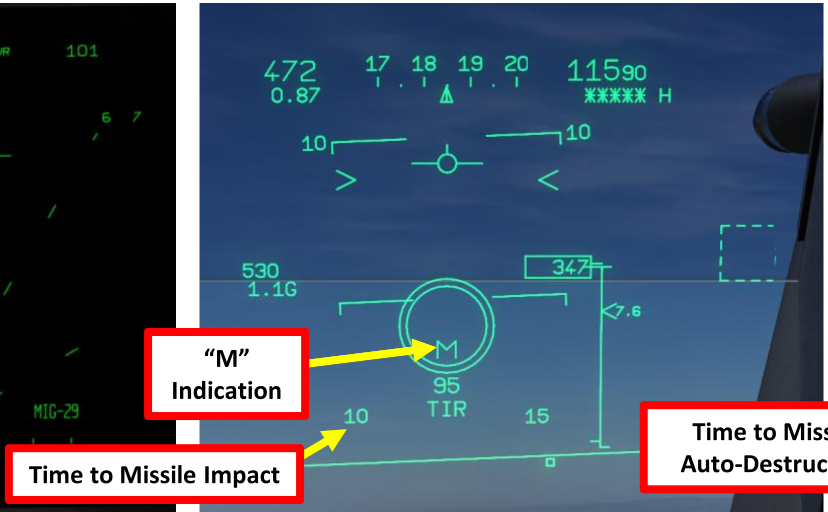
During this time, if the target is lost, a blinking "M" indicates the radar is in **"Memory" mode** and continues to illuminate the last know trajectory of the target and try to re-acquire the lock just like PSIC mode but for 8 seconds instead of 5.

After those 8 seconds are expired, the radar memory mode has run its course and will continue to illuminate the target trajectory, but won't try to re-acquire the lock, entering **"Forced Illumination" mode**, indicated by "ILLU". This forced illumination mode lasts as long as the radar is in PSIC Super 530.

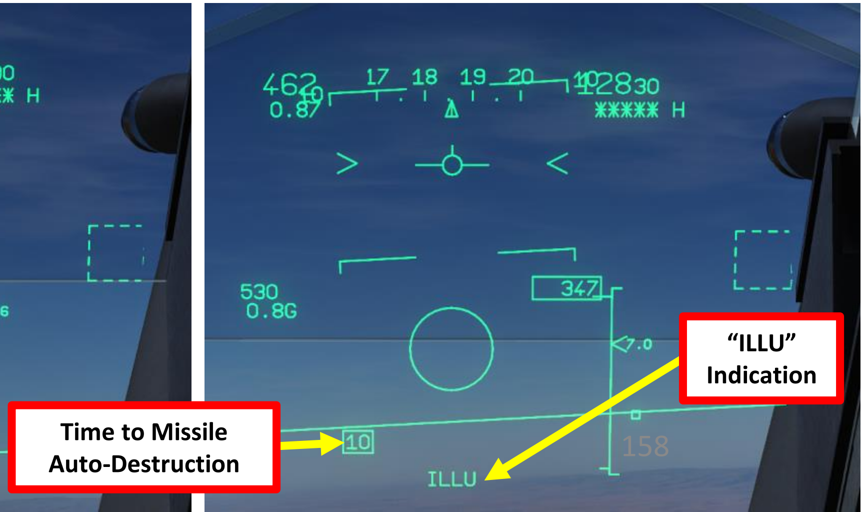
PSIC/STT (Single Target Track)



Missile Launched, Lost Lock
PSIC Super 530 + Memory Mode



Missile Launched, Lost Lock
PSIC Super 530 + Forced Illumination Mode



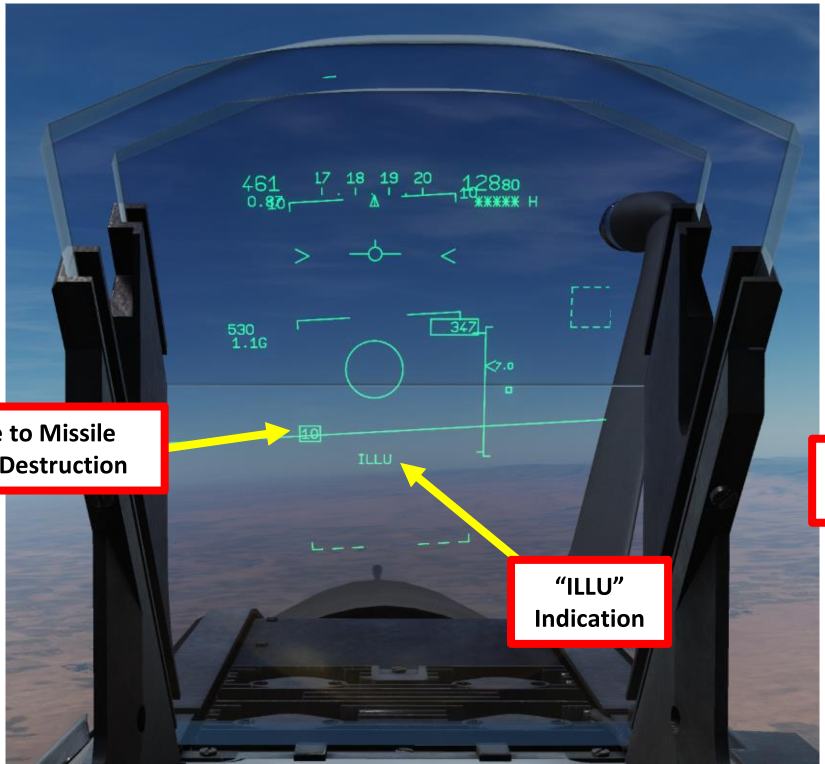
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.3 – PSIC (*Poursuite sur Information Continue*) / STT (Single Target Track)

3.3.3.2 – "PSIC / STT Super 530" & "PSIC / STT Super 530 Pointé" Sub-Modes

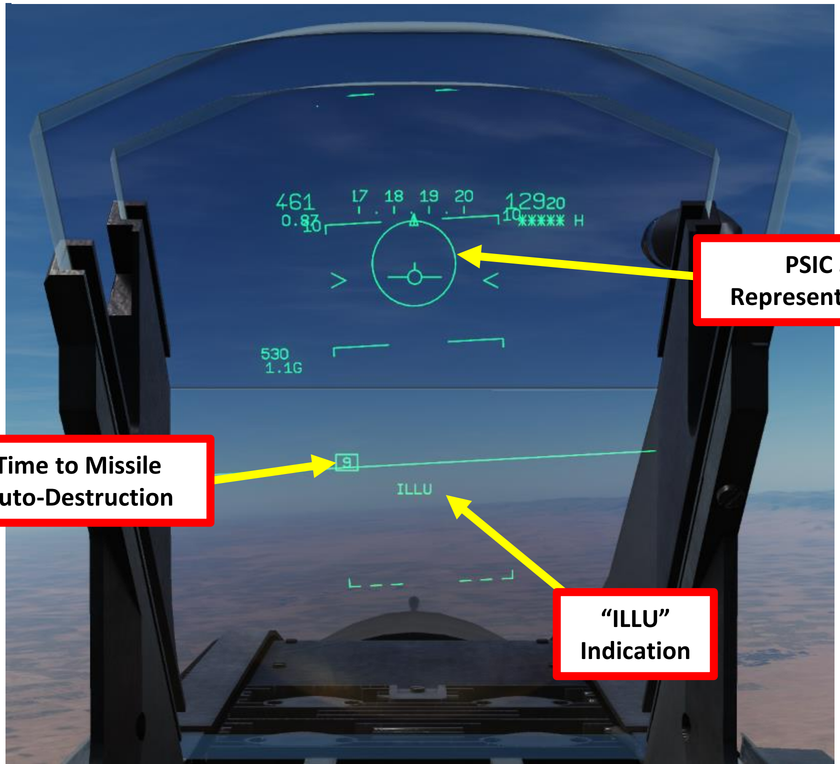
If the radar is unable to continue to illuminate the target, the "PSIC Super 530 pointé (pointed)" mode can be used by pressing the Weapons System CMD Switch FWD.

"PSIC Super 530 Pointé" manually illuminates the target on the illumination sector circle. This mode is only selectable while the radar is in "PSIC Super 530" sub-mode and fixes the radar antenna to the aircraft axis, allowing the radar to be aimed at the target by flying the aircraft. The forced illumination indication ("ILLU" is also present when the radar is in PSIC Super 530 pointé mode.

Missile Launched, Lost Lock
PSIC Super 530 + Forced Illumination Mode



Missile Launched, Lost Lock
PSIC Super 530 Pointé Mode



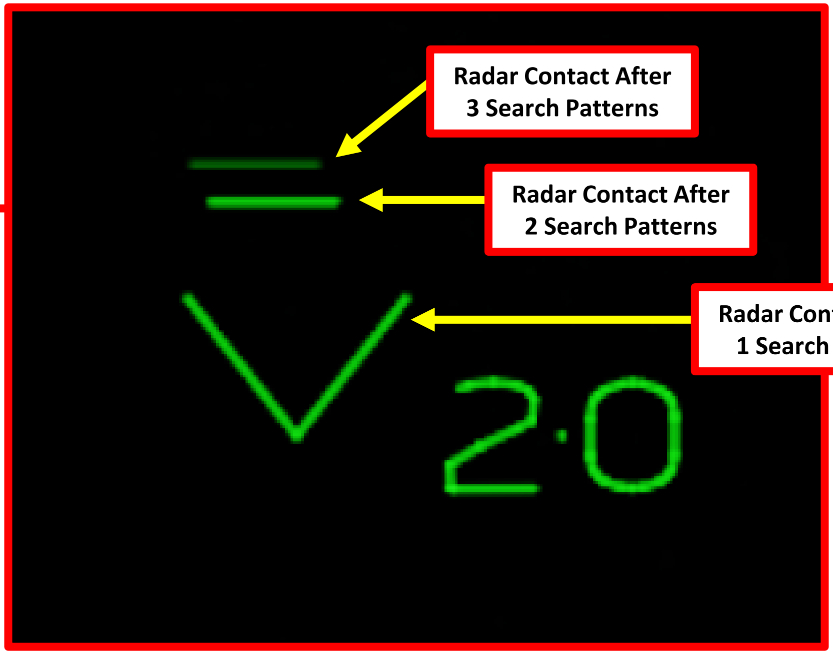
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.4 – Persistence Mode (*Mode Rémanence*)

The Persistence (*Rémanence*) mode is useful to figure out whether a radar contact is a false radar return or not. Another useful aspect of it is that it allows you to estimate the trajectory of the contact since you have a visual indication of its flight path. In this mode, HFR contacts are displayed for 3 whole search patterns instead of a single one.

This mode is selected by placing the persistence/*rémanence* knob in the R (Rémanence ON) position. The mode is only active when:

- Bar search mode is selected with the bar number selector set to 1 and the PRF (pulse repetition frequency) selection switch set to HFR (High Frequency) or ENT (Interleaved), or
- PSID mode (Track While Scan lock) is selected, or
- SHB (Terrain Avoidance While Track) mode is selected.

1. During the first search pattern after the contact is detected, the contact is represented by the normal HFR symbol (V or inverted V).
2. During the second search pattern, the normal HFR symbol is replaced by an horizonal line similar to a “brick”.
3. During the third search pattern, this same horizontal line/brick is used, but the line is dimmer. The contact disappear once the third search pattern is finished.



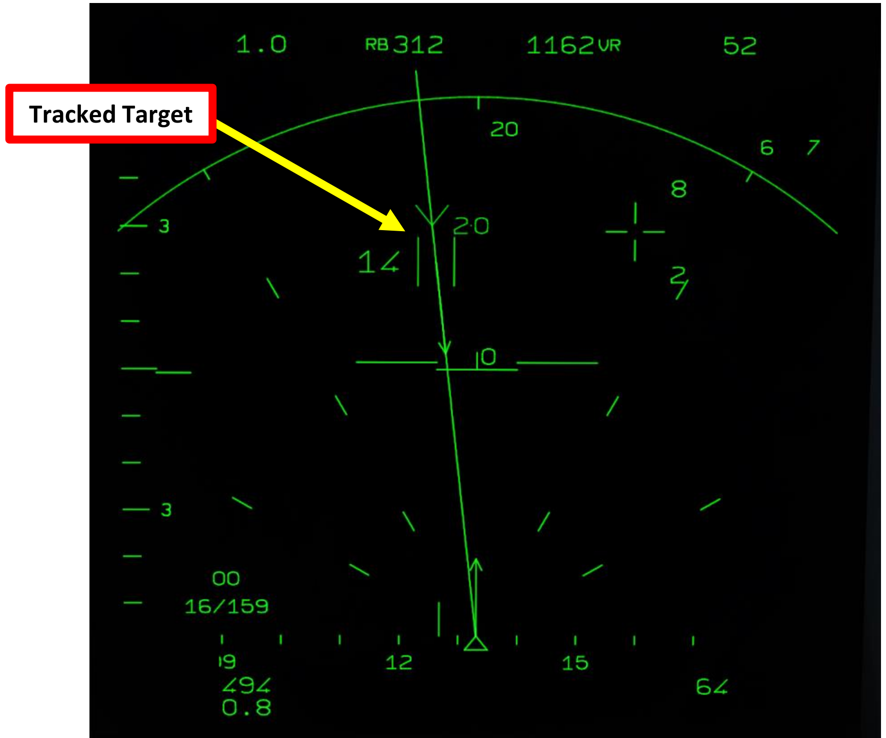
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.5 – SHB (*Sécurité Haut-Bas*) / Terrain Avoidance While Track

The SHB (*Sécurité Haut-Bas*) / Terrain Avoidance While Track mode combines the DEC (*Découpe Terrain*/ Ground Avoidance) and PSID (Track While Scan) mode. To select SHB, perform a PSID/TWS lock (see section 3.3.2), then press the DEC (*Découpe Terrain*) button.

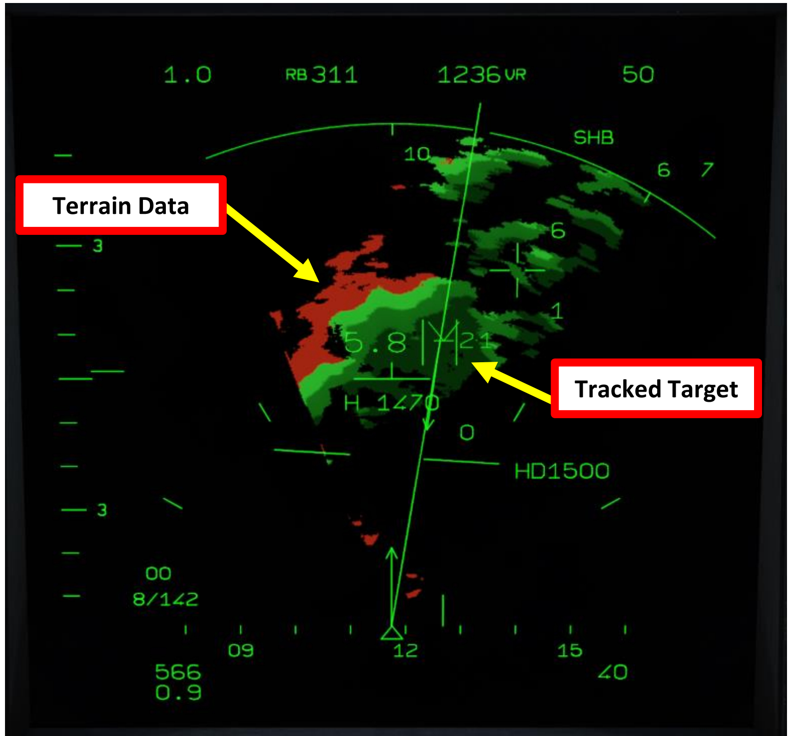
The radar then performs a two bar search pattern alternates between two modes:
- Leftward scans for the DEC, providing terrain avoidance data.
- Rightward scans for the PSID, providing information on the locked target.

The DEC radar image is displayed up to 10 nm and the display range setting can be set to 10 or 20 nm. The PSID lock range is not more limited than in PSID. In SHB, there is 20° limit in elevation difference between the tracked target and the clearance height. If this limit is exceeded, the radar will drop the lock and switch to DEC mode. There is a similar limit in azimuth if the azimuth aperture setting is under 60°, the radar needs to keep scanning 5 deg on each side of the aircraft axis line.

PSID/TWS (Track While Scan)



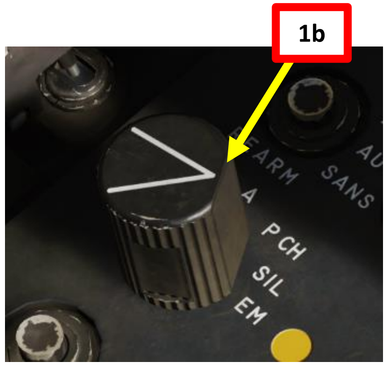
SHB Mode

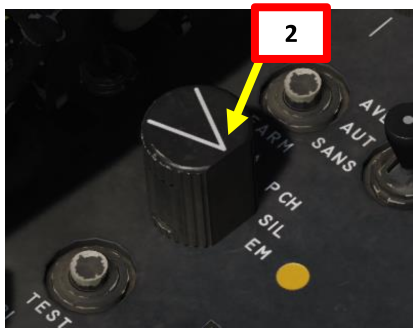


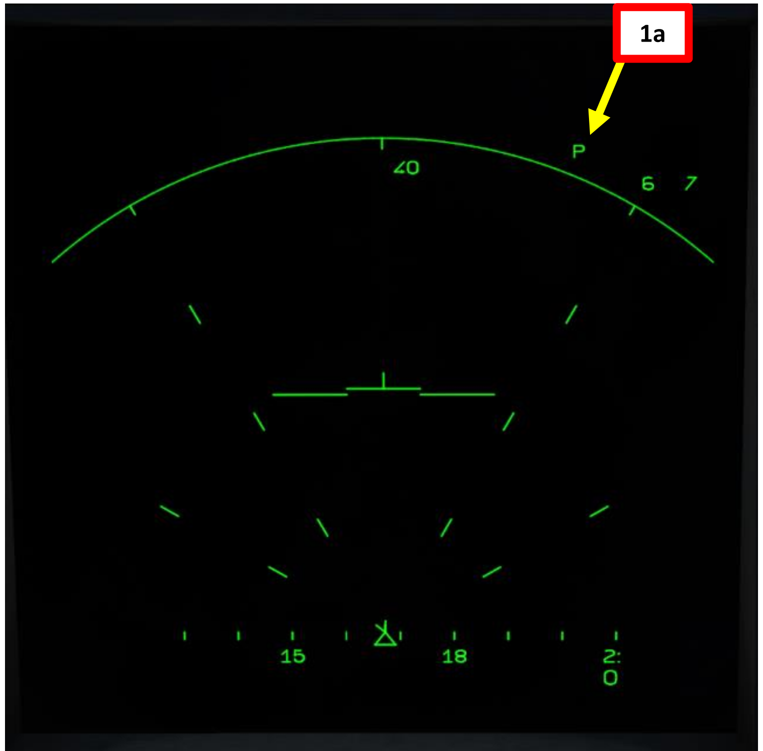
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.6 – Radar Operation Tutorial (Radar Lock)

This short tutorial will show you how to turn on your radar and lock a target.

1. ON GROUND: Set Radar Power switch to PCH (Warm-Up) for 3 minutes. “P” letter on the VTB screen will blink during warm-up phase. When “P” letter remains illuminated, this means warm-up is complete. Set Radar Power switch to SIL (Standby).
2. Set Radar Power switch to ***EM****ISSION* (ON).

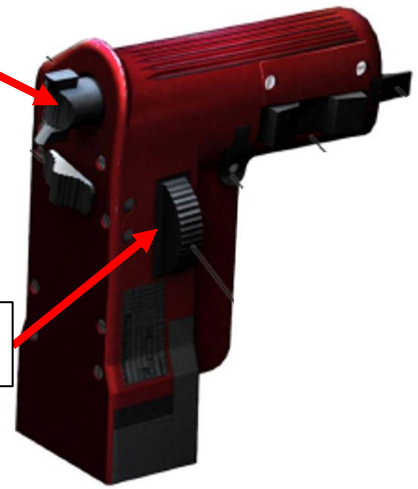




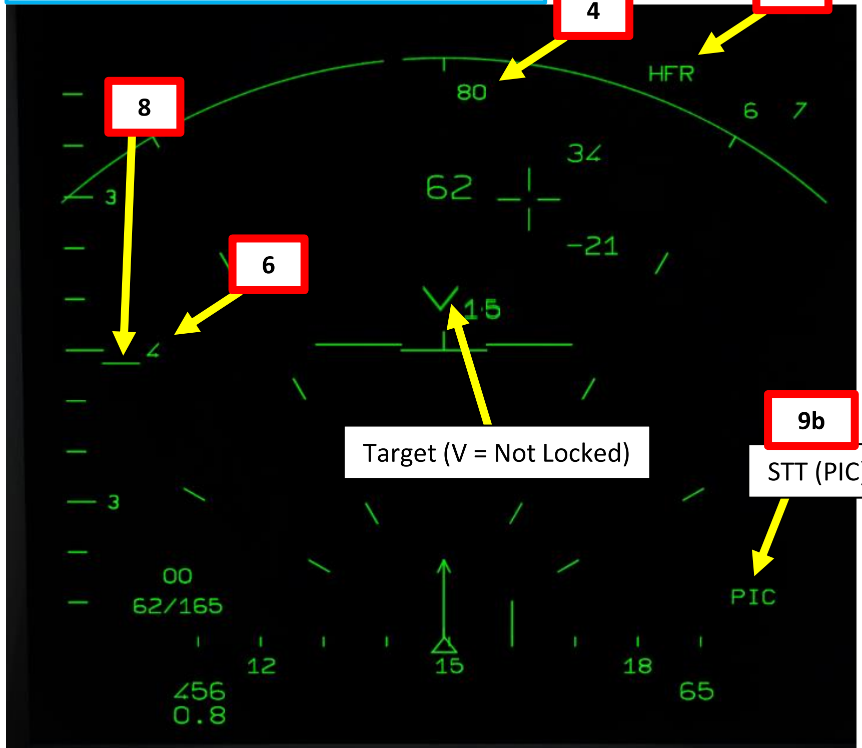


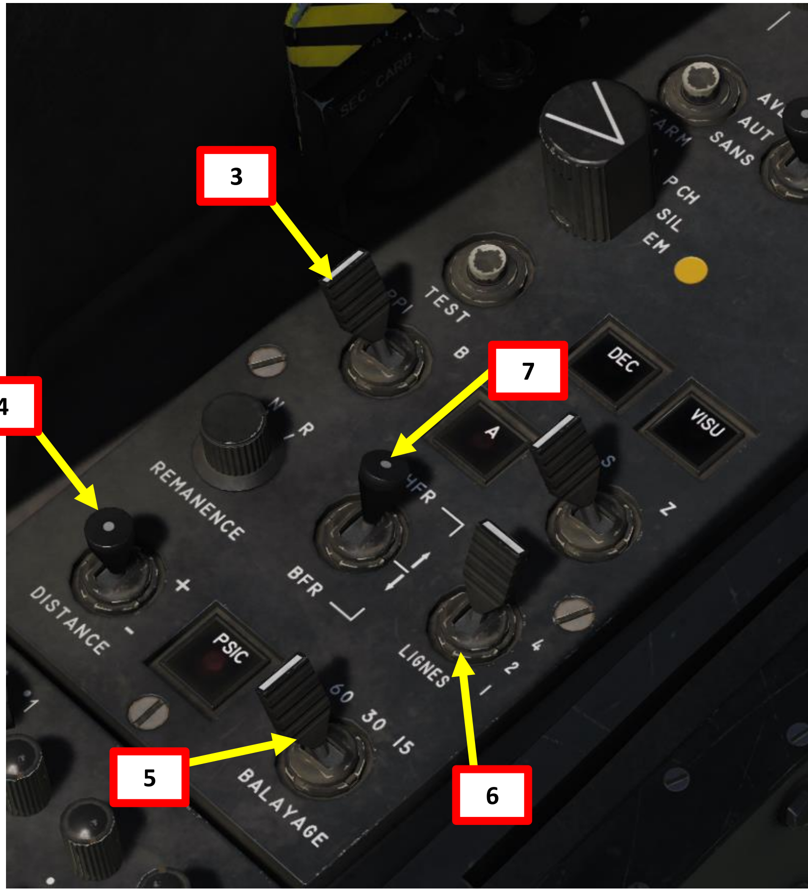
3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.6 – Radar Operation Tutorial (Radar Lock)

3. Select desired Display Mode. I typically take PPI (personal preference)
4. Select desired radar scan range (*distance*).
5. Select desired radar sweep angle (*balayage*).
6. Select desired radar bar scan pattern (*lignes*).
    - Set to “4” to cover the biggest vertical volume. Scanning the whole region will be slower.
    - Set to “1” to cover the smallest vertical volume. Scanning the smaller region will be faster.
7. Select High Pulse Repetition Frequency (HFR) for maximal detection range available.
8. Move Radar Antenna UP or DOWN to scan desired airspace area.
9. Press the STT/TWS toggle to pre-select whether you want to lock the target in STT mode (PIC) or in TWS mode (PID). We will pre-select PIC (STT).



RECH (Bar Search) Mode





3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.6 – Radar Operation Tutorial (Radar Lock)

10. Slew TDC (Target Designator Caret) on the radar contact you want to lock.
11. Depress TDC to lock the target.
12. Radar will switch from Bar Search to Single Target Track mode, indicated by a track line and tracking information on the upper portion of the VTB.
13. If you press the STT/TWS Toggle button after locking, you will toggle between TWS and STT (Single Target Track, PIC) modes at will. This step is not required.

10b

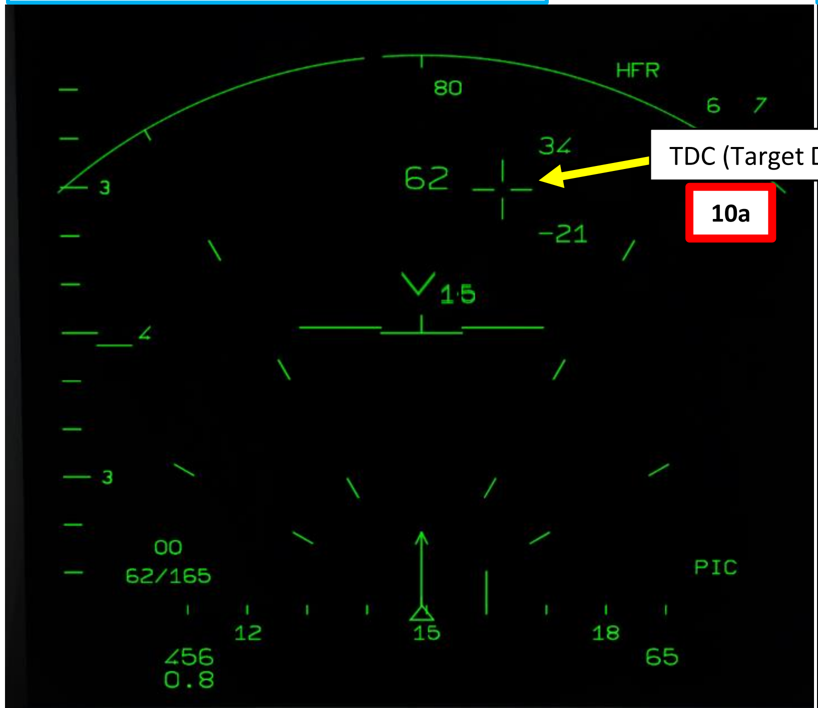
11

Target Designator Caret (TDC) Switch
DEPRESSED = Radar Lock

13
(STT/TWS Toggle)

Locked Target Data
- 0.7: Target Speed (Mach)
- AB 313: Target Heading (direction flown by target)
- 912: Target closure speed (kts)
- Target Altitude (50 = 5000 ft)

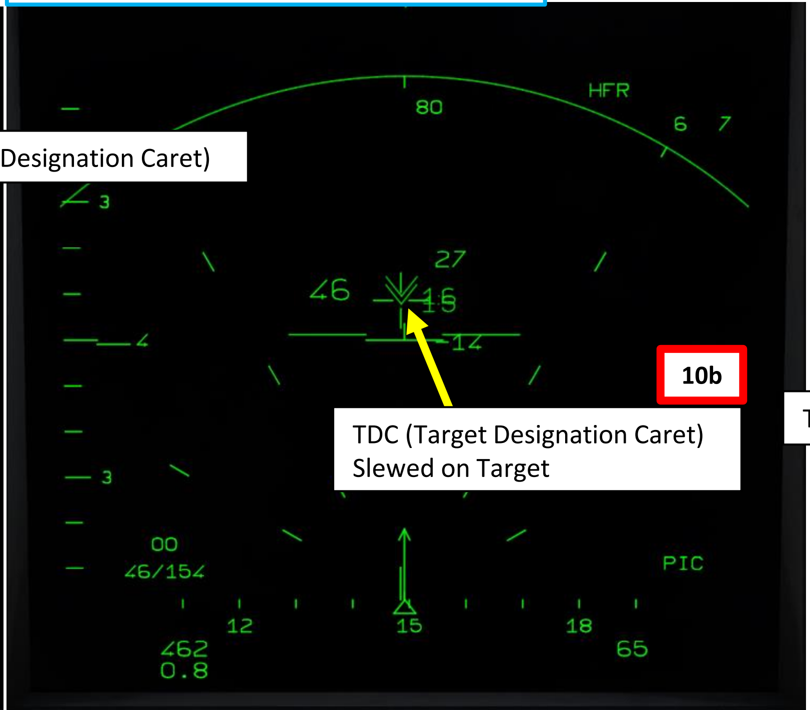
RECH (Bar Search) Mode



TDC (Target Designation Caret)

10a

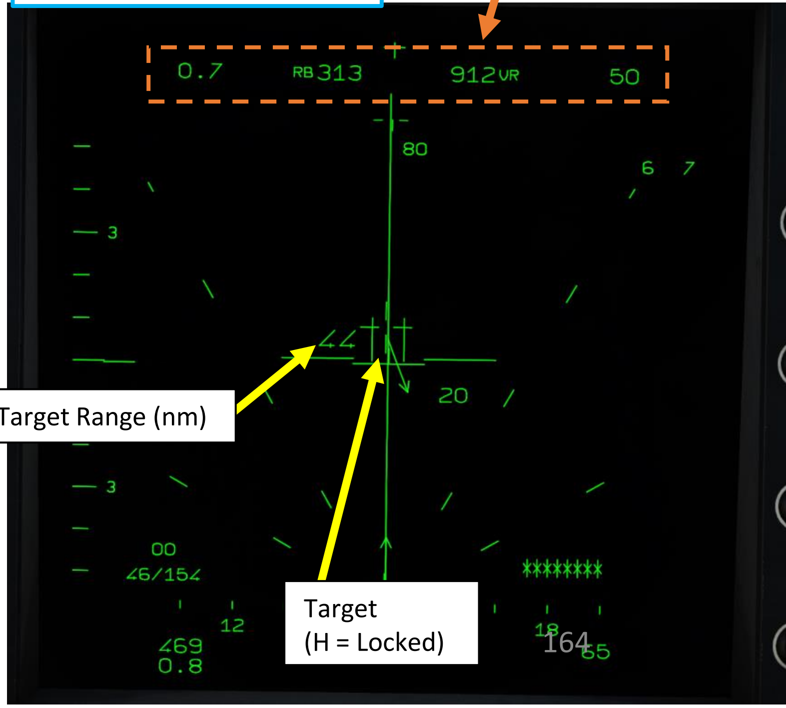
RECH (Bar Search) Mode



10b

TDC (Target Designation Caret)
Slewed on Target

PIC (STT) Mode



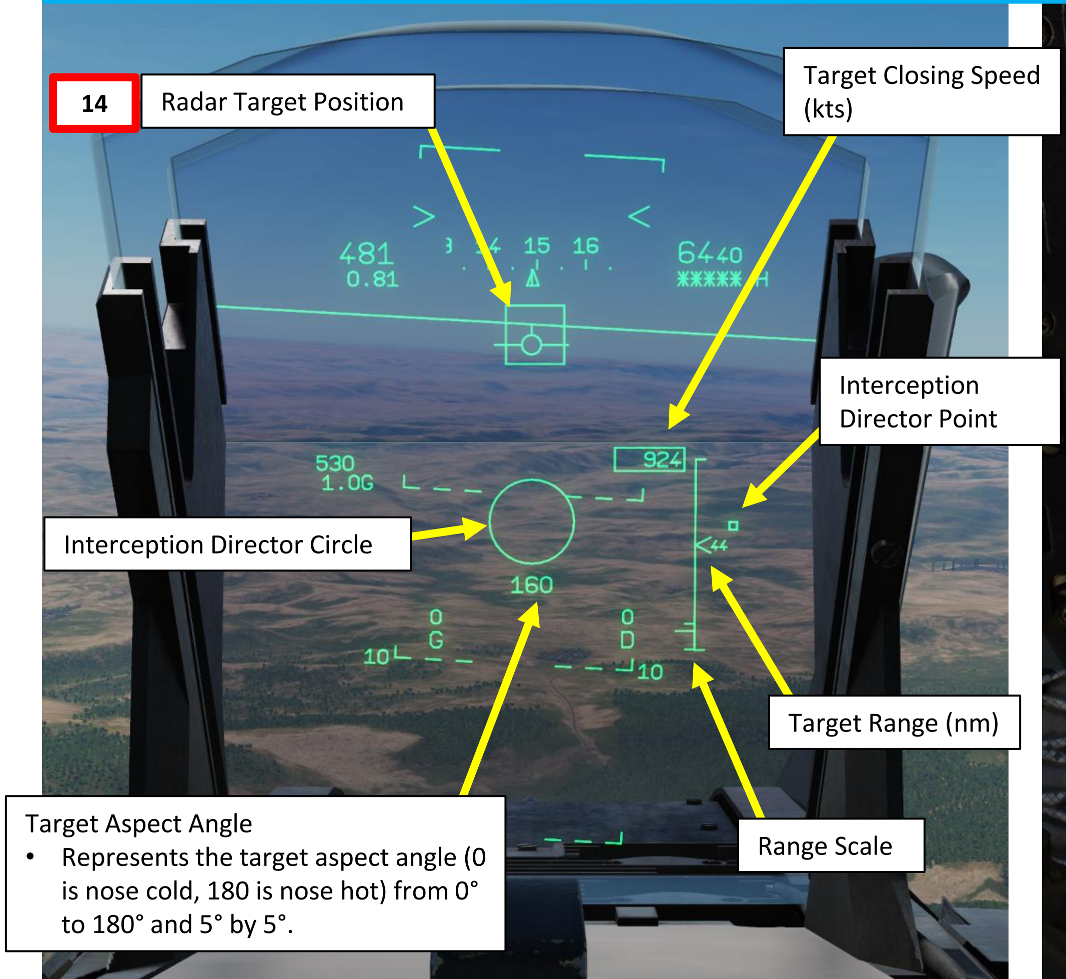
Target Range (nm)

Target
(H = Locked)

3 – RADAR AIR-TO-AIR MODES
3.3 – Radar Main Modes
3.3.6 – Radar Operation Tutorial (Radar Lock)

14. You now have a radar lock! Note: If air-to-air missiles are selected, a square should also appear on your HUD on your locked target.
15. You can unlock target using the “Weapons System CMD Switch DEPRESSED”.

PIC (STT) Mode + Super S530D Missiles Selected



3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.1 – Boresight Auto-Acquisition

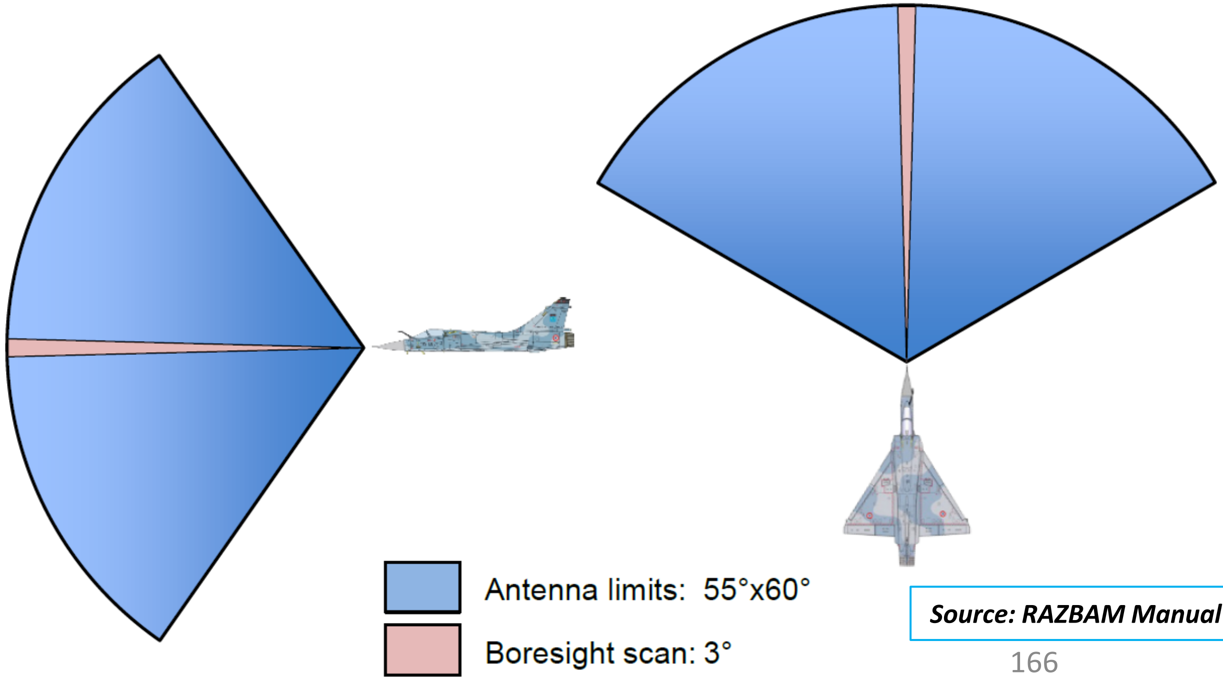
The **Boresight Auto-Acquisition radar mode** slaves the radar to the aircraft boresight and will try to lock in PSIC/STT any contact within 10 nm. The scanned area is equal to the antenna aperture, a 3 deg cone.

HOW TO:

- If the Super 530D is selected, (CNM (Cannon/Neutral/Magic) switch set to NEUTRAL/CENTER and 530 switch on the PCA is engaged), pressing the Weapons System CMD switch FWD will toggle between BORESIGHT and VTH/HUD auto-acquisition (also known as SVI, or *Spirale Viseur* Scan) mode.
- If Air-to-Air Cannon, POL (Police) or a Magic II missile is selected, pressing the Weapons System CMD switch FWD will toggle between this BORESIGHT and Vertical mode.
- When boresight is selected, the radar will be set at a range of 10 nautical miles and it will automatically STT lock on the closest contact it can detect within the boresight auto-lock sector.

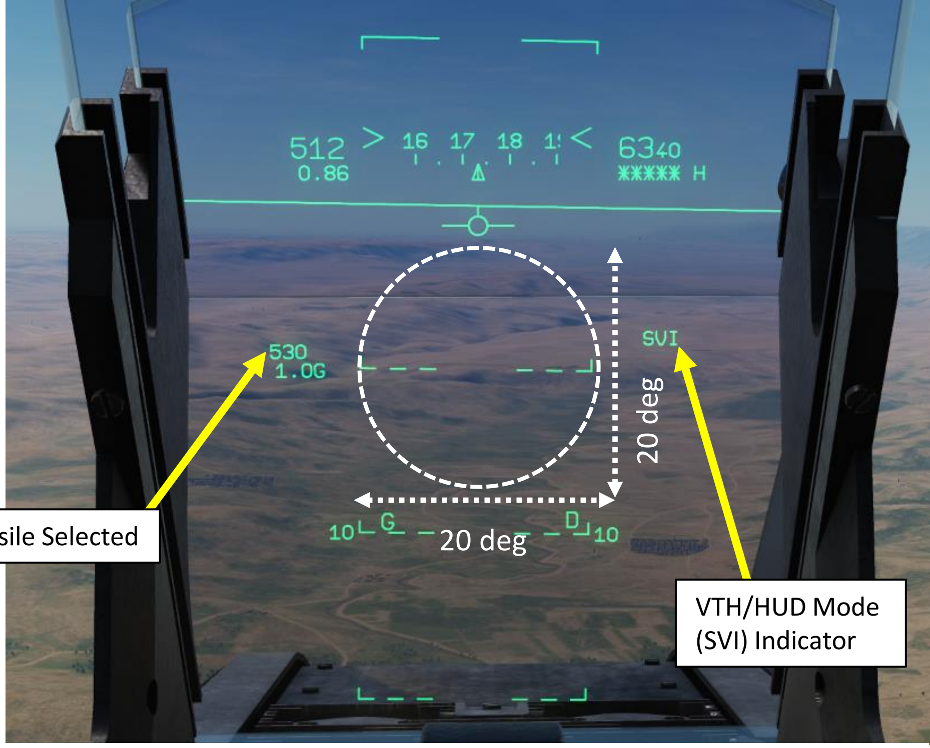
CNM (Cannon/Neutral/Magic) Switch
- *LEFT: CNM AA Gun Select*
- *CENTER: CNM Neutral (PCA Select)*
- *RIGHT: CNM Magic Select*

Weapons System CMD Switch
In *air-to-air mode (AA weapon selected):*
- *FWD: toggles between boresight and vertical (or HUD SVI) radar modes.*
- *DEPRESSED: Unlock Target*



Source: RAZBAM Manual

3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.2 – VTH/HUD (SVI) Auto-Acquisition

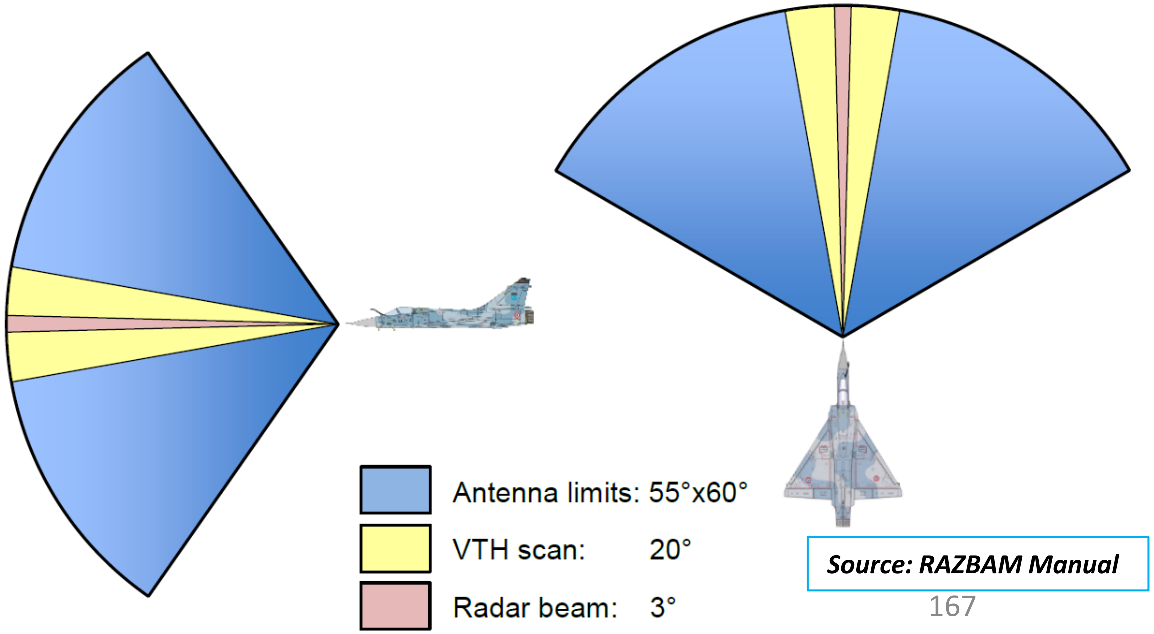


In **VTH/HUD Auto-Acquisition mode**, also known as “SVI” (*Spirale Viseur Scan*), the radar executes a spiral pattern that is roughly the size of the VTH/HUD and will try to lock in PSIC/STT any contact within 10 nm. The scanned area is equal to a 20 deg cone. **SVI mode is only available only when the S530 missiles or POL (police mode) have been selected.** This mode is useful to re-acquire a lost contact whose approximate position is known. “SVI” (*Spirale Viseur*) label is displayed on right side of the HUD.

HOW TO:
- While Super S530D missile is selected, press Weapons System CMD switch FWD to select this mode
- The radar will be set at a range of 10 nautical miles and it will automatically STT lock on the closest contact it can detect.

CNM (Cannon/Neutral/Magic) Switch
- *LEFT: CNM AA Gun Select*
- *CENTER: CNM Neutral (PCA Select)*
- *RIGHT: CNM Magic Select*

Weapons System CMD Switch
In *air-to-air mode (S530 Missile selected):*
- *FWD: activates HUD SVI mode*
- *DEPRESSED: Unlock Target*
- *AFT: toggles between Horizontal BAH and BA2 modes*



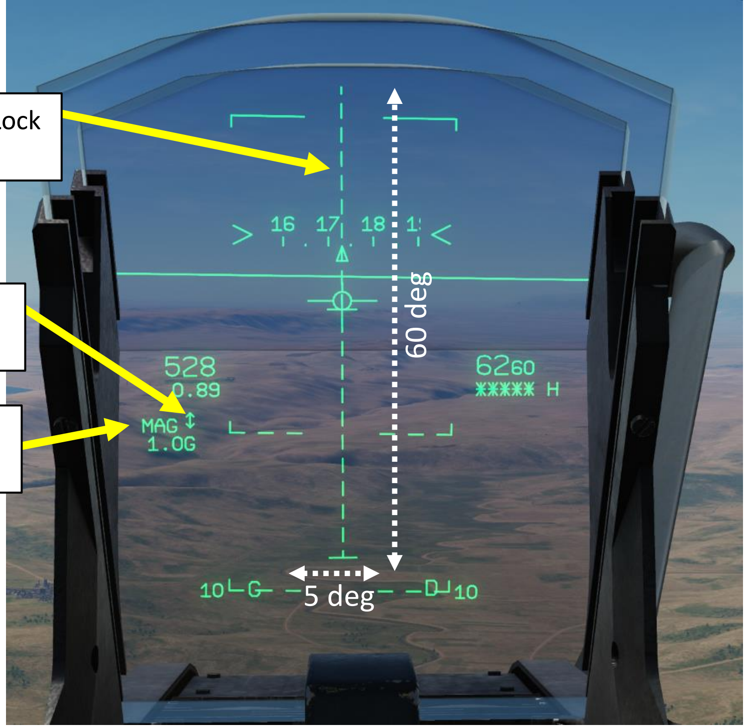
Source: RAZBAM Manual

3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.3 – Vertical Auto-Acquisition

In **Vertical Auto-Acquisition mode**, the radar executes a pattern composed of two vertical lines relative to the aircraft. The vertical lines are just left and right of the aircraft vertical axis and goes from 10 deg under the nose to 50 deg above. The radar will try to lock any contact in PSIC within 10 nm. This mode is useful in dogfights, when the hostile aircraft is in front and above.

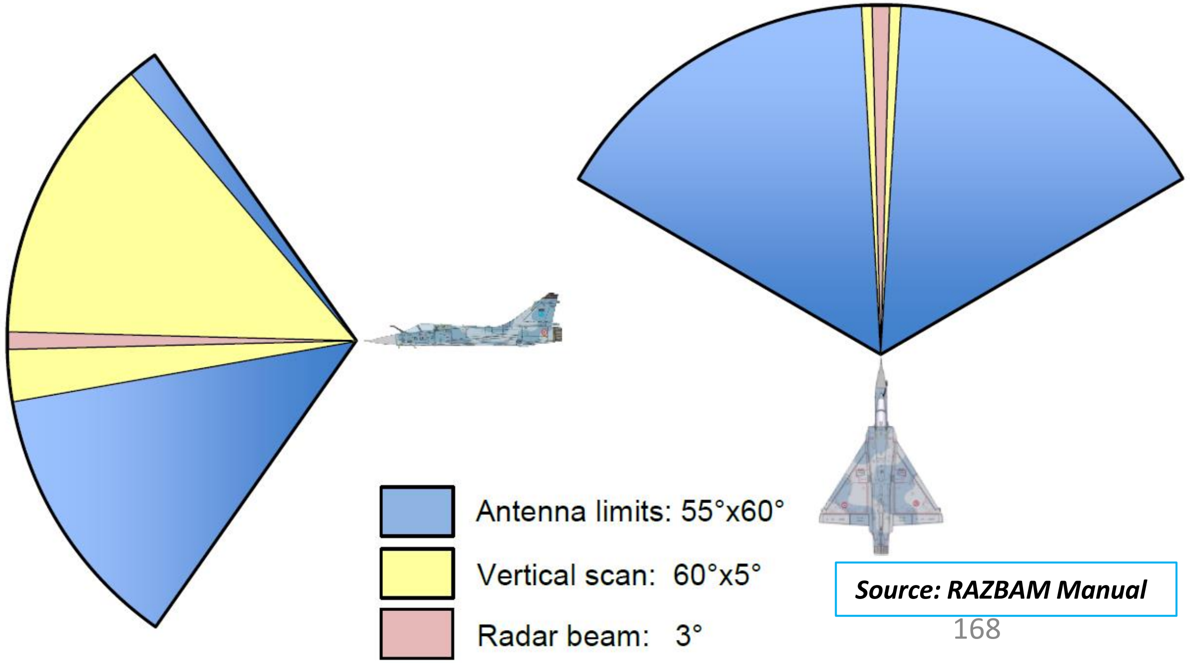
HOW TO:

- While Magic II is selected (CNM (Cannon/Neutral/Magic) switch set to MAGIC SELECT/RIGHT), press Weapons System CMD switch FWD to toggle between this mode and Boresight mode.
- The radar will be set at a range of 10 nautical miles and it will automatically STT lock on the closest contact it can detect.



CNM (Cannon/Neutral/Magic) Switch
- *LEFT: CNM AA Gun Select*
- *CENTER: CNM Neutral (PCA Select)*
- *RIGHT: CNM Magic Select*

Weapons System CMD Switch
In *air-to-air mode (Magic II/AA Cannon selected):*
- *FWD: toggles between boresight and vertical radar modes.*
- *DEPRESSED: Unlock Target*

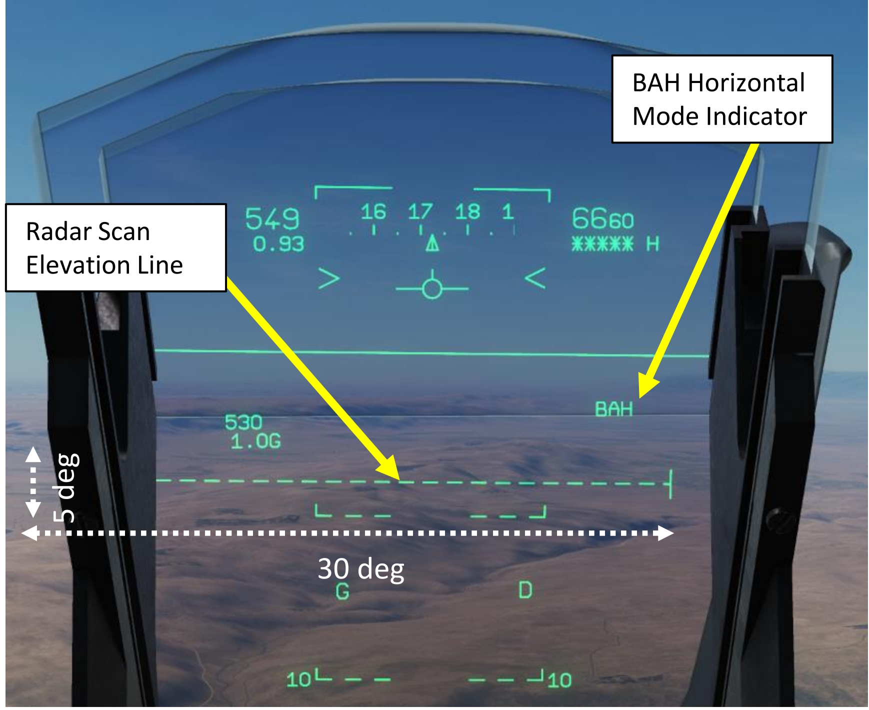


Source: RAZBAM Manual

3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.4 – Horizontal Auto-Acquisition

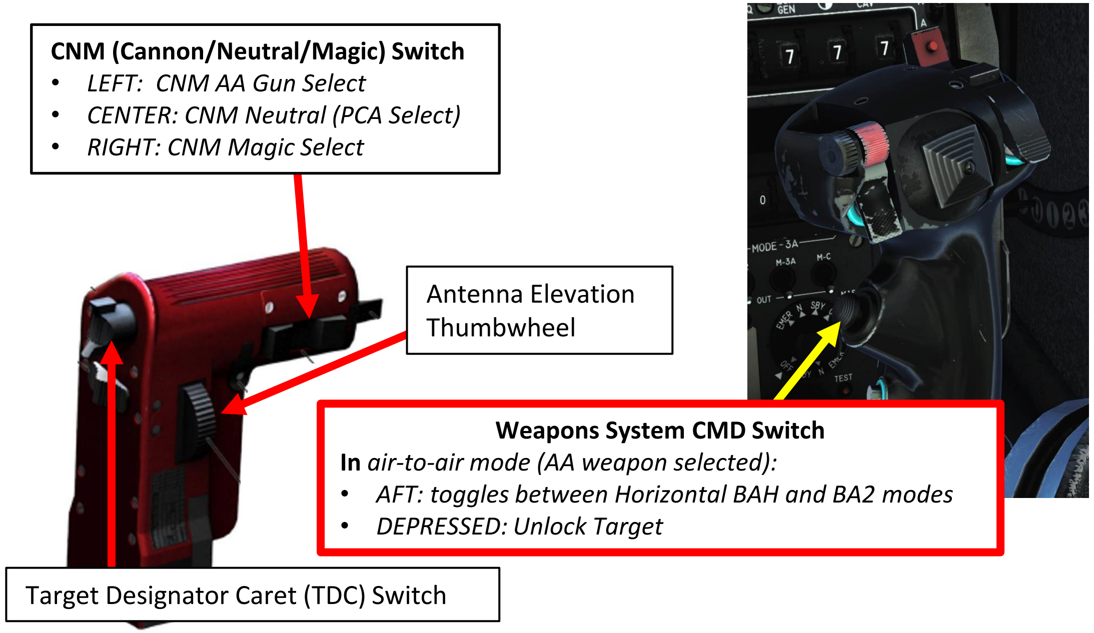
3.4.4.1 – BAH (HRF, High PRF)

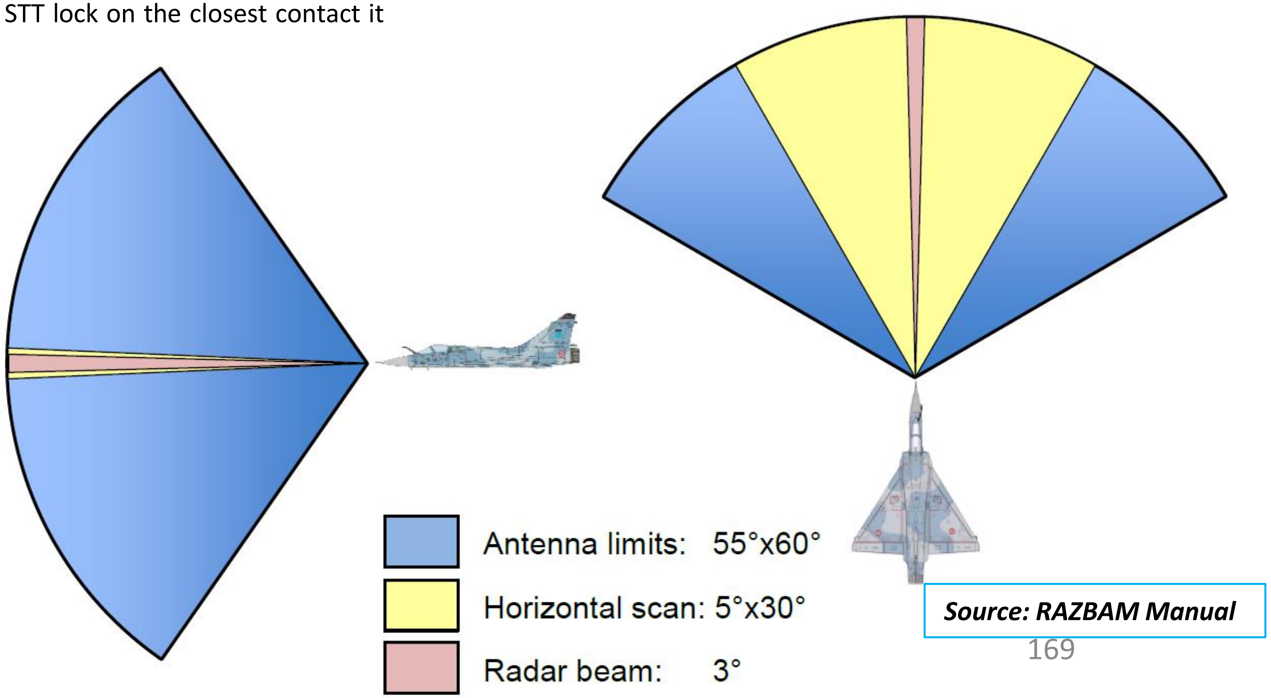
In **Horizontal Auto-Acquisition mode**, the radar executes the same search pattern as the 2 bar/30 deg bar search pattern and will lock in PSIC/STT any contact within 10 nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command… and by moving the TDC in the same way than in bar search. This mode is most useful to lock a close contact as is offers the biggest scan zone of all auto-acquisition modes. Two modes are available for horizontal auto-acquisition:
BAH (HFR, High PRF) and **BA2** (MFR2, Medium PRF):



HOW TO (BAH):

- Horizontal modes BAH and BA2 are cycled by using the Weapons System CMD Switch AFT. The difference between BAH and BA2 is the pulse repetition frequency.
- You can pan the radar scan elevation line using the Antenna Elevation Thumbwheel.
- You can slew the radar scan elevation line laterally using the TDC left/right controls.
- The radar will be set at a range of 10 nautical miles in High PRF and it will automatically STT lock on the closest contact it can detect.



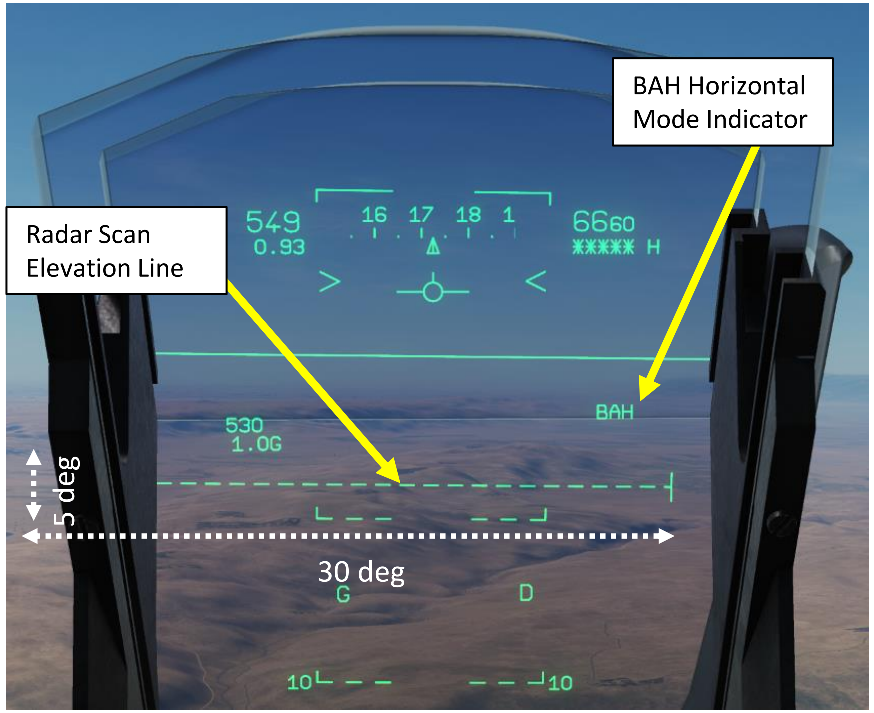


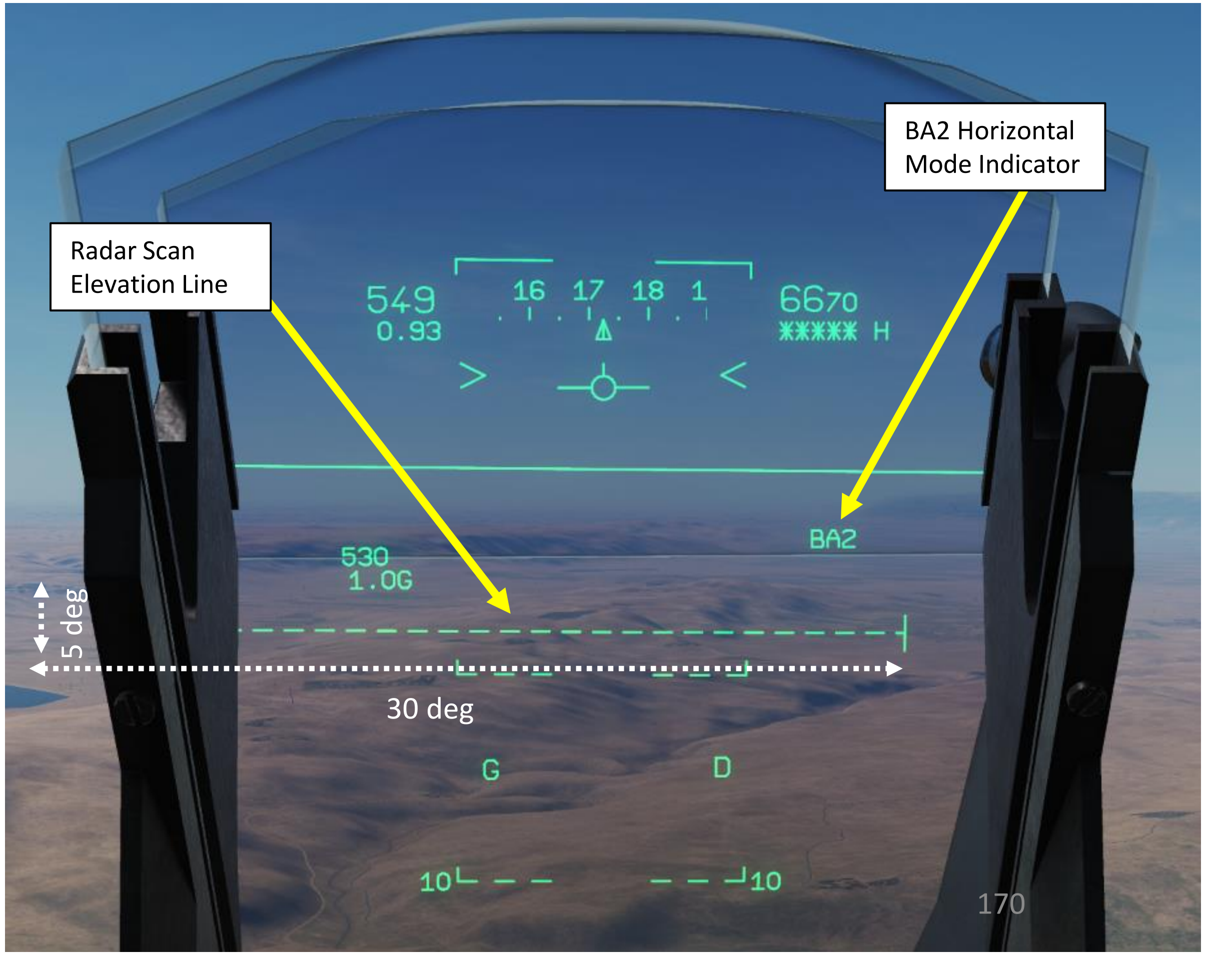
3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.4 – Horizontal Auto-Acquisition

3.4.4.2 – BA2 (MFR, Medium PRF)

BA2 horizontal mode is similar to mode BAH horizontal mode, except its PRF (Pulse Repetition Frequency) is set to MFR2 (Medium PRF) instead of HFR (High PRF).

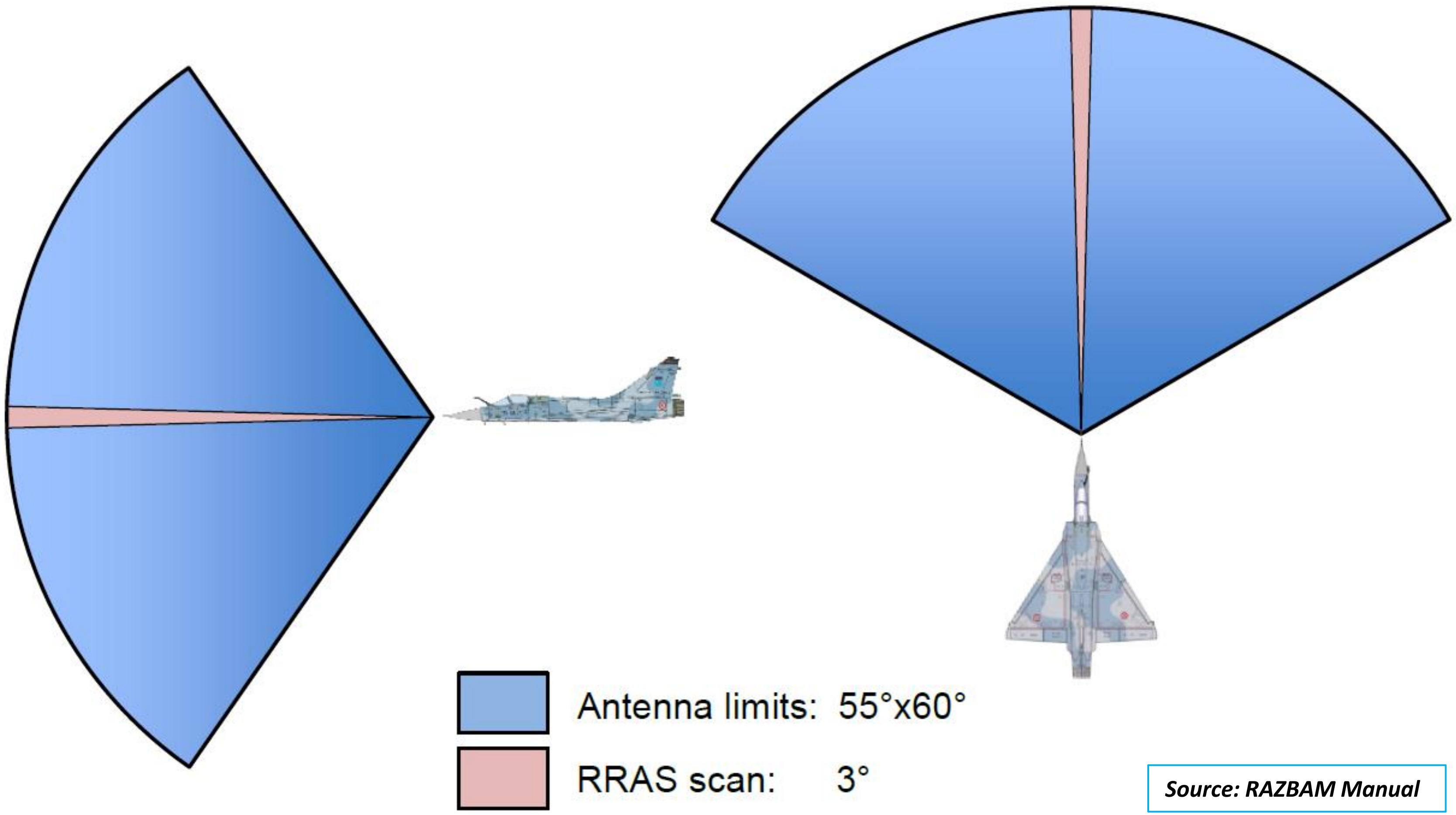
HOW TO (BA2):
- Horizontal modes BAH and BA2 are cycled by using the Weapons System CMD Switch AFT.
- Just like in BAH, you can pan the radar scan elevation line using the Antenna Elevation Thumbwheel.
- Just like in BAH, you can slew the radar scan elevation line laterally using the TDC left/right controls.
- The radar will be set at a range of 10 nautical miles in Medium PRF and it will automatically STT lock on the closest contact it can detect.





3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.5 – RRAS (*Ralliement Radar sur Alidade/Site*) / Radar Slave to TDC/Elevation Auto-Acquisition

In **RRAS (*Ralliement Radar sur Alidade/Site*) / Radar Slave to TDC/Elevation Auto-Acquisition mode**, the radar executes the same search pattern as in boresight mode and will lock in PSIC/STT any contact within 10 nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command and by moving the TDC in the same way than in bar search. In RRAS, the radar target position on the VTH/HUD flashes and its position indicates the direction of the radar antenna. RRAS mode is useful to achieve a HFR (High PRF) lock on a BFR (Low PRF) contact.

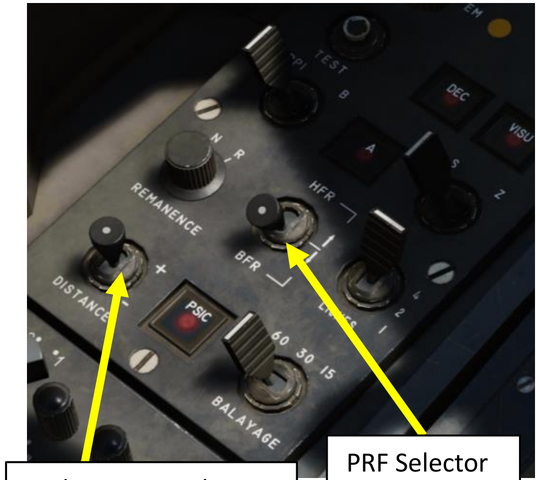


Source: RAZBAM Manual

3 – RADAR AIR-TO-AIR MODES
3.4 – Close Combat Modes
3.4.5 – RRAS (*Ralliement Radar sur Alidade/Site*) / Radar Slave to TDC/Elevation Auto-Acquisition

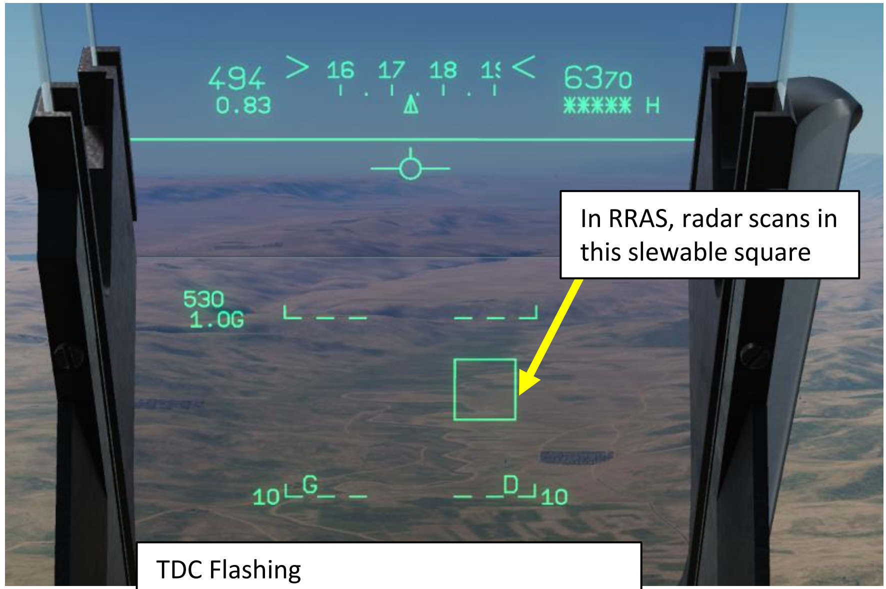
HOW TO:

- Select BFR (Low PRF setting, Pulse Repetition Frequency) or ENT (Interleaved) PRF setting.
- Set Radar Range to 10 nm.
- Slew TDC to an area where no radar contact is visible, then perform a PSIC/STT Radar lock at a range of less than 10 nm using TDC Depress. The TDC symbol will flash, meaning the radar has entered RRAS mode.
- In RRAS mode, the radar is slaved to the TDC (a square is also visible on the VTH).
- You can slew the RRAS square vertically on the VTH using the Antenna Elevation Thumbwheel.
- You can slew the RRAS square laterally on the VTH using the TDC left/right controls.
- The radar will automatically STT lock on the closest contact it can detect.



Radar Range Selector

PRF Selector



In RRAS, radar scans in this slewable square

TDC Flashing
- RRAS mode is selected since TDC has been depressed in an empty area

CNM (Cannon/Neutral/Magic) Switch
- *LEFT: CNM AA Gun Select*
- *CENTER: CNM Neutral (PCA Select)*
- *RIGHT: CNM Magic Select*

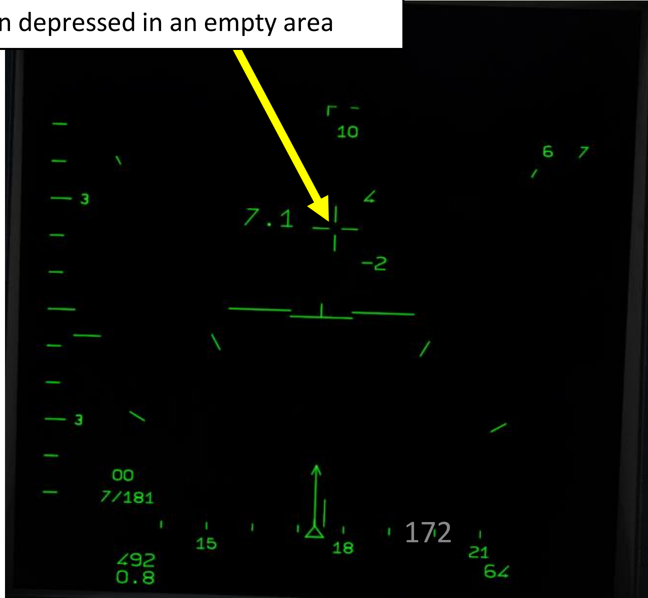
Antenna Elevation Thumbwheel

Target Designator Caret (TDC) Switch

BFR Selected

10 nm Range

TDC Not Flashing
- RRAS mode is not selected yet since TDC has not been depressed



3 – RADAR AIR-TO-AIR MODES
3.5 – Radar Presentation (*DO Centrée*)

The rear presentation (*DO centrée*) display mode is selected by placing CADR switch (*Cadrage/*Presentation) located bellow the VTB screen on the AR (*Arrière*/Rear) position.

In this presentation mode, the aircraft is at the center of the VTB display pointing at the top of the display. The radar image and TDC and is not displayed in this mode. This mode’s main use is to visualize the position of the navigation and tactical BUT as well as the target designations when they are not in front of the aircraft.

Radar Presentation (*Cadrage*)
- *Avant*/Forward

VTB Displays the standard PPI or B-Scope with all the radar information.

Radar Presentation (*Cadrage*)
- *Arrière*/Aft

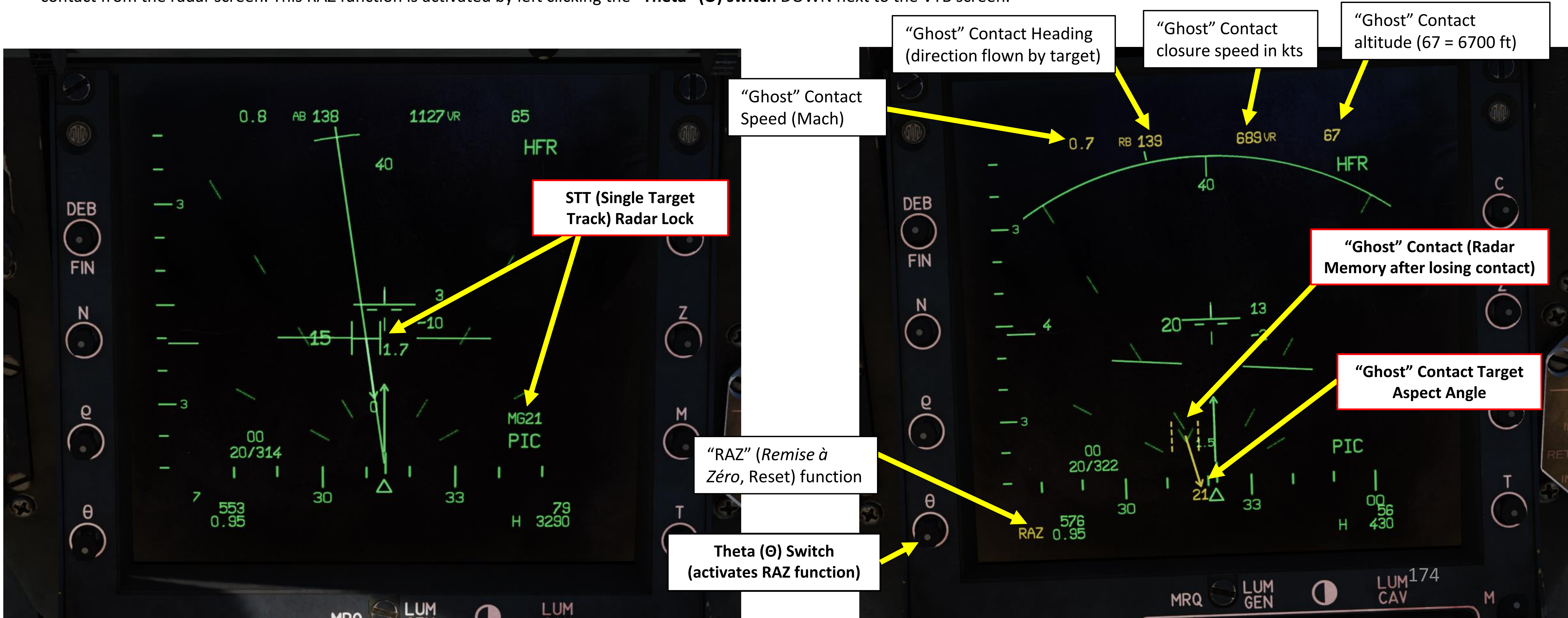
VTB displays DO Centrée mode where the aircraft is placed at the center of the screen and no radar information is displayed.

3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.1 – RDO (*Ralliement Désignation Objectif*) / Target Pursuit Mode

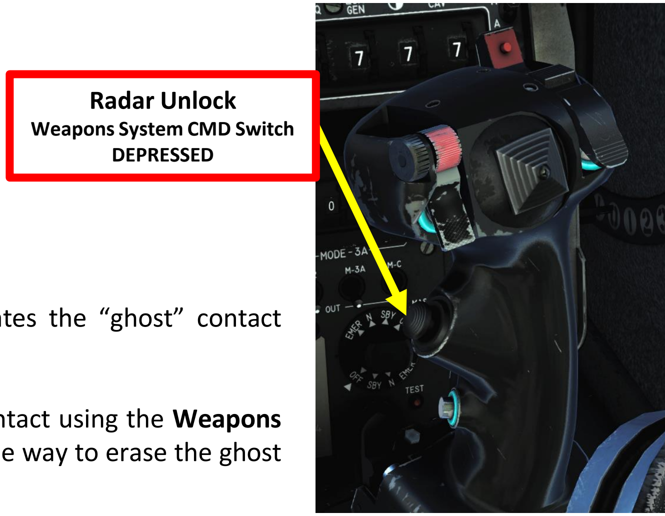
Radar Lost Contact Memory - Introduction

The Radar Memory function is always active and saves the last locked contact to memory. Therefore, if you radar lock a target and the contact is lost for any reason (manually unlocked, target breaks lock, target is destroyed, etc.) a **yellow "ghost" contact** is displayed, which is an extrapolation of where the target "should" be if it keeps the same heading and speed as when it was last memorized by the radar system.

This ghost contact will then move in the last known vector direction. When a ghost contact is created, a **yellow "RAZ" (*Remise à Zéro*, Reset) function** becomes available, which deletes the ghost contact from the radar screen. This RAZ function is activated by left clicking the **"Theta" (Θ) switch** DOWN next to the VTB screen.



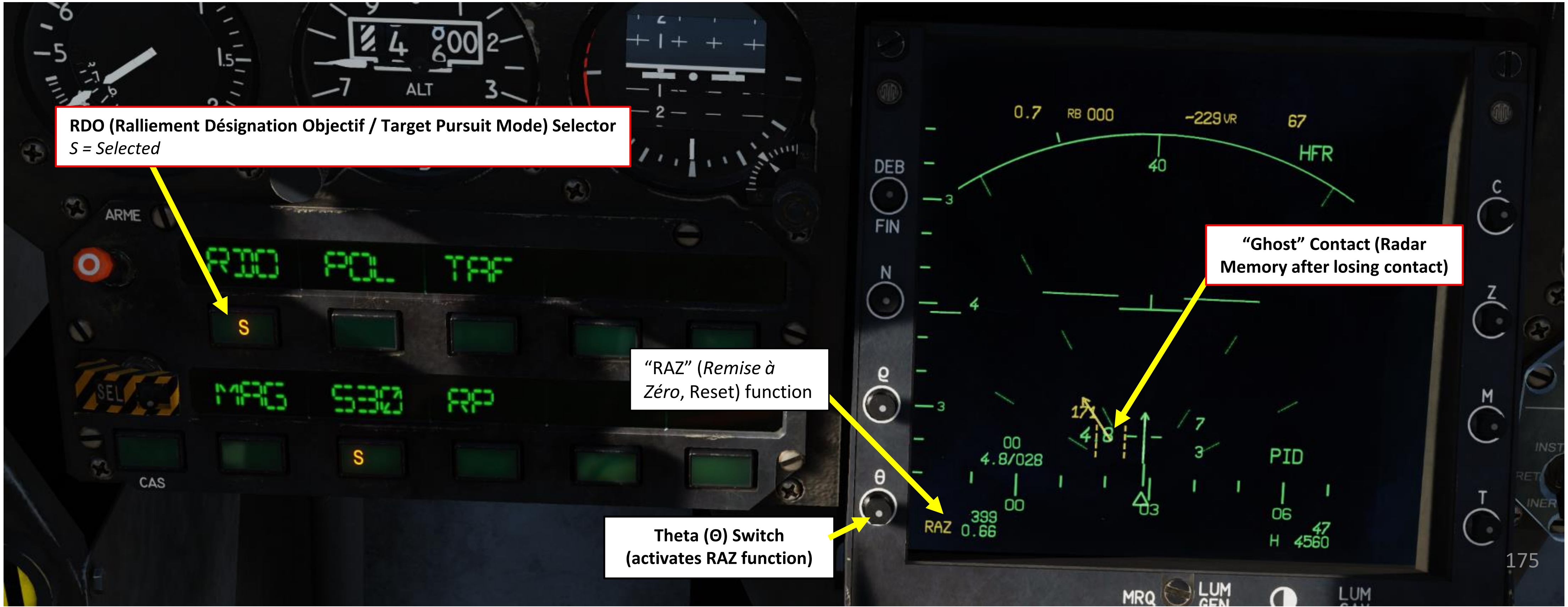
3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.1 – RDO (*Ralliement Désignation Objectif*) / Target Pursuit Mode



Radar Lost Contact Memory - RDO (Ralliement Désignation Objectif/ Target Pursuit Mode)

The RDO (Ralliement Désignation Objectif / Target Pursuit Mode) function is automatically activated when performing a radar lock. It creates the "ghost" contact mentioned earlier when a radar lock is performed.

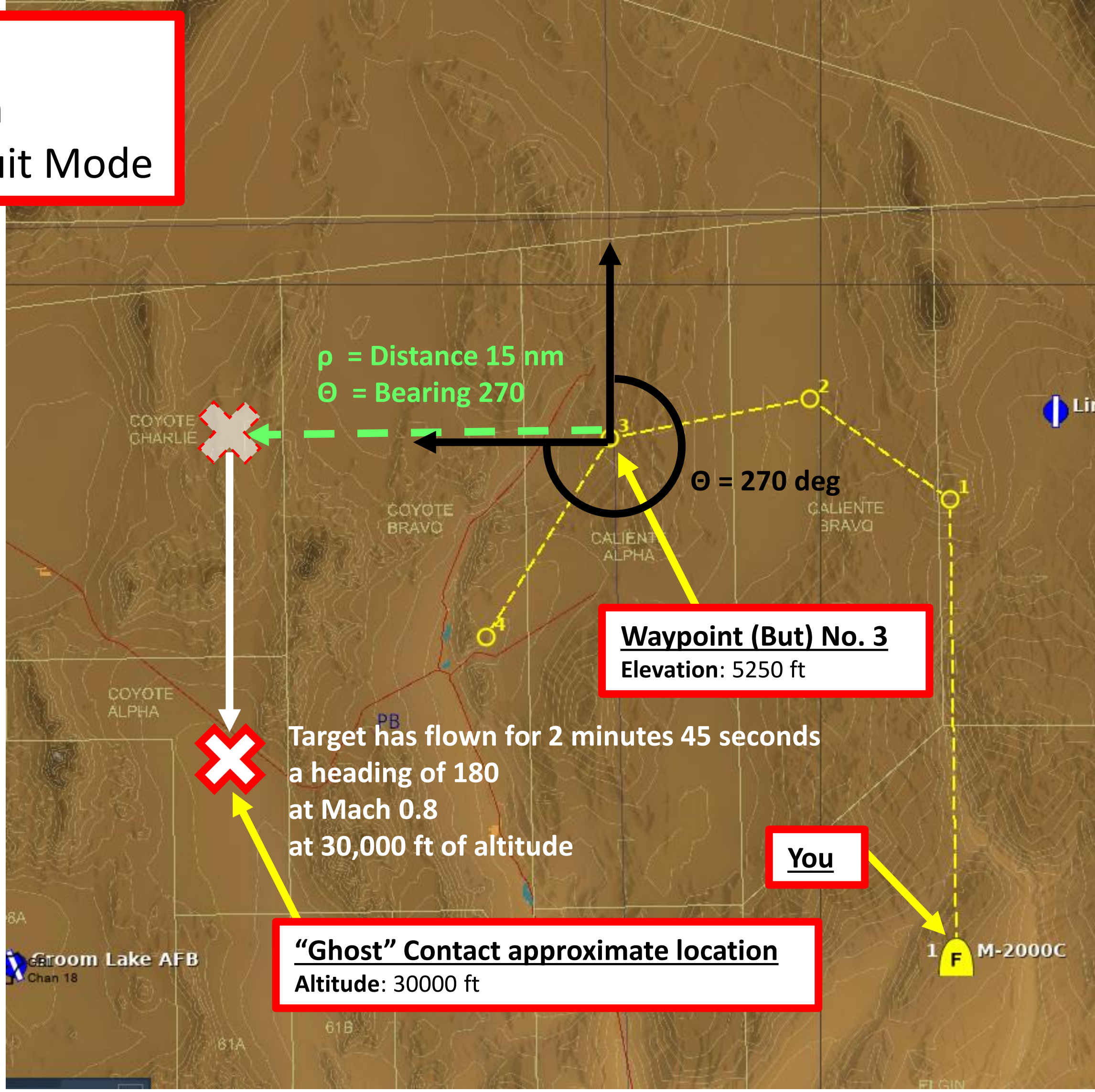
Pressing the **RDO button enables ("S" = selected) or disables DO (Radar Memory)**, but only for cases where you manually unlocked a radar contact using the **Weapons System CMD Switch DEPRESSED**. If you lose radar lock by other means, the ghost contact will still persist even if you turn off RDO. In that case, the way to erase the ghost contact would be to activate the **"RAZ" (Remise à Zéro, Reset) function** is by left clicking the **"Theta" (Θ) switch** DOWN next to the VTB screen.



3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.1 – RDO (*Ralliement Désignation Objectif*) / Target Pursuit Mode

***Désignation Objectif*/Objective Designation Input Parameters**

The Objective Designation function is used for when AWACS/Forward controllers coordinate targets for the Mirage 2000C in the theatre of operations. The AWACS/Forward controller will designate specific information to the pilot to manually input into the VTB to designate the target. This function will create a fictional radar contact on your VTB with parameters given to you by the AWACS in relationship to either yourself or an existing waypoint. This is useful for situational awareness in cases where you do not see the target on your radar or if you want to approach a target with your radar off to avoid detection.



3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.1 – RDO (*Ralliement Désignation Objectif*) / Target Pursuit Mode

***Désignation Objectif*/Objective Designation Input Parameters**

Contact Report: *"Report is 2 minutes 45 seconds ago, waypoint #3 saw a hostile flying at Mach 0.8 at 30000 ft, 15 nm from waypoint #3 in direction 270. He was heading for 180."*

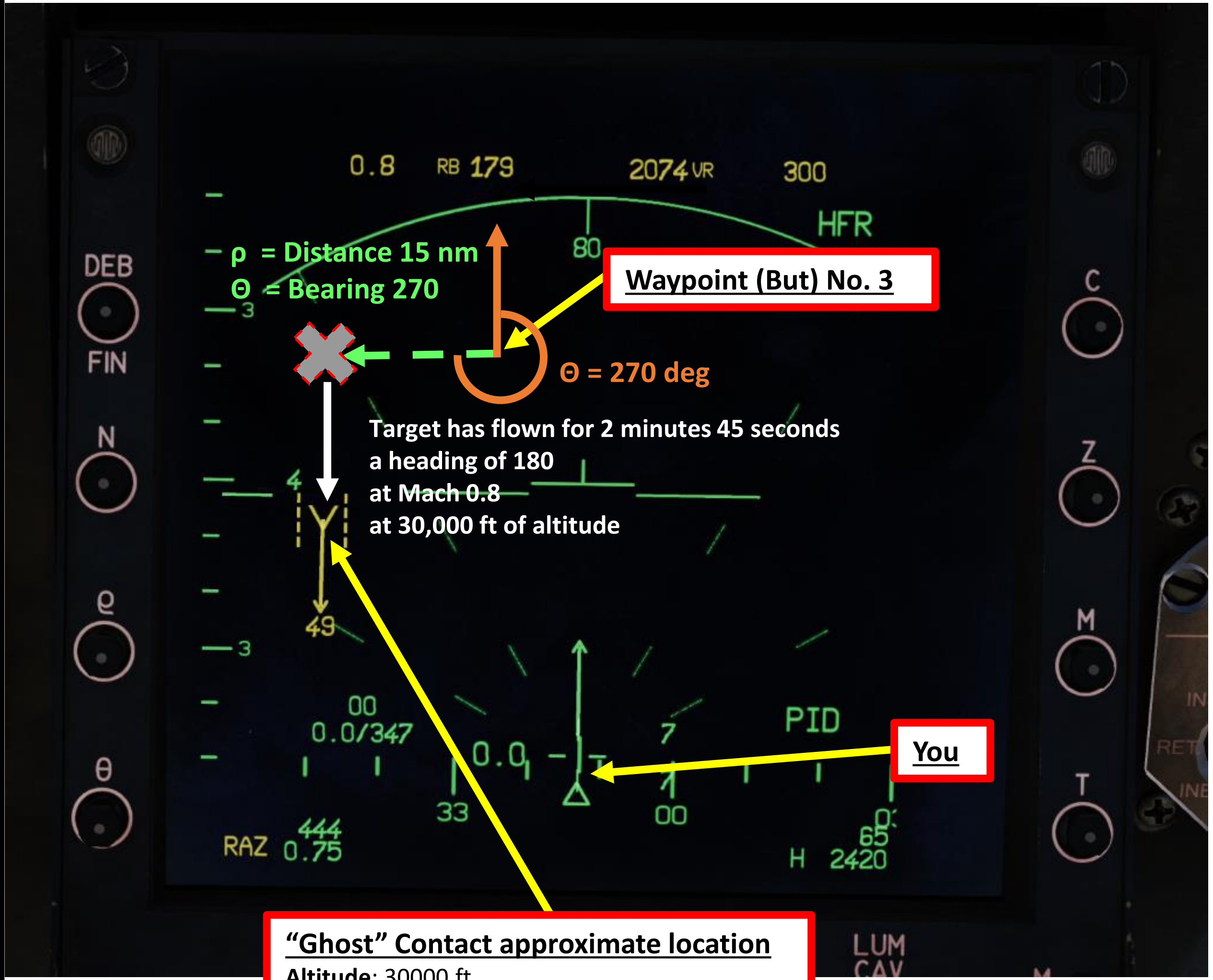
To input Objective Designation parameters:

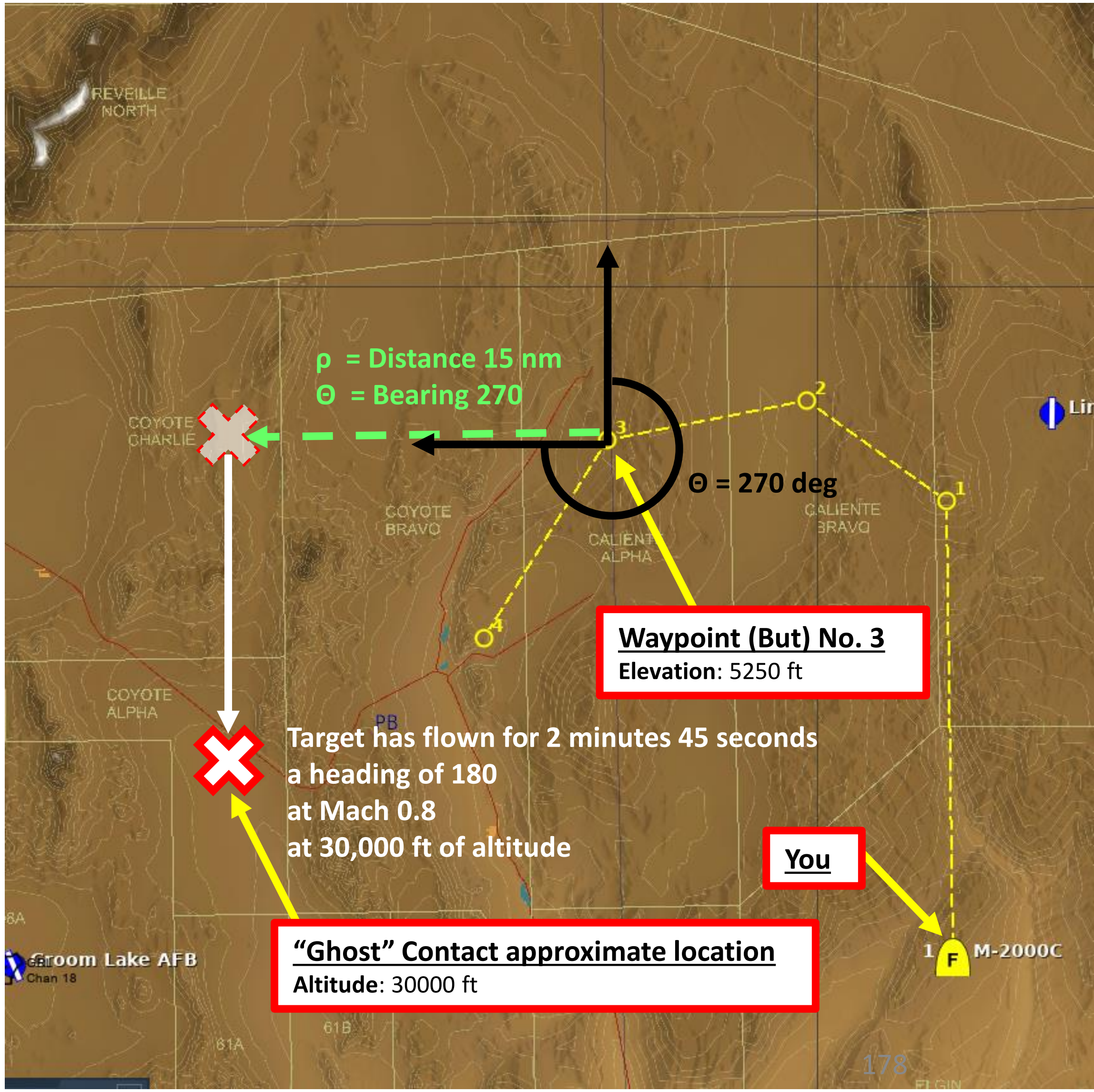
1. Right click on DEB (*Début*, Start) switch (UP)
2. Toggle "N" switch to set Waypoint 3 to be used as a reference (00 would be "you" as a reference)
3. Toggle Rho (ρ) switch to set distance from reference waypoint in nm (15)
4. Toggle Theta (Θ) switch to set bearing from reference waypoint in degrees (270)
5. Toggle C switch (*Cap*, Heading) to set target heading in degrees (180).
6. Toggle Z switch (Altitude) to set target altitude in hundreds of feet (300 = 30000 ft)
7. Toggle M switch (Mach) to set target speed in Mach (0.8)
8. Toggle T switch (Time) to set age of the report in minutes.seconds (2.45).
9. Left click on FIN (End) switch (DOWN) to create the ghost contact and designate the objective.

"Ghost" Contact approximate location
Altitude: 30000 ft, Target Aspect Angle 049 deg

3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.1 – RDO (*Ralliement Désignation Objectif*) / Target Pursuit Mode

***Désignation Objectif*/Objective Designation Input Parameters**



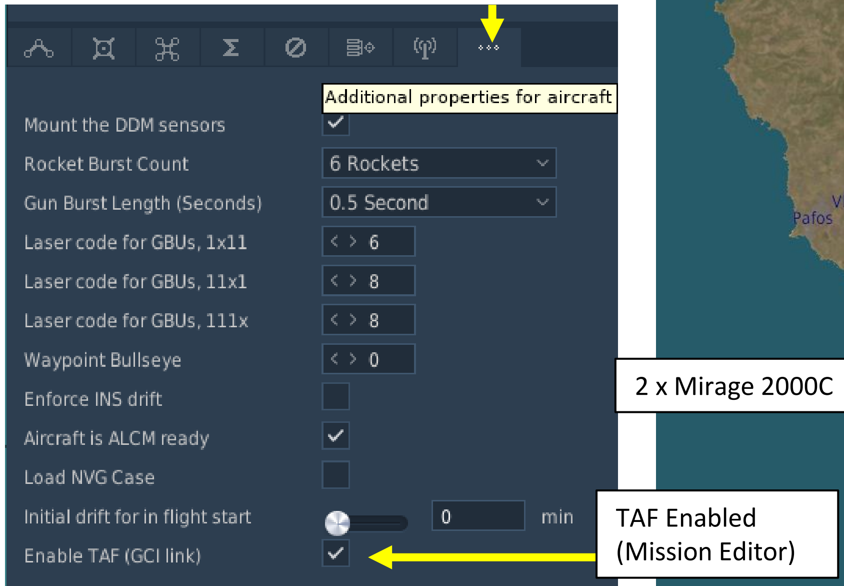


3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

The TAF (*Télé-Affichage*) of the Mirage is a GCI (Ground Control Interception) system that is meant to use ground control stations (airfields, SAM search radars, EWR (Early Warning Radar), etc.) to send guidance information to the pilot in order to intercept threats penetrating the airspace. In practice, TAF works in a similar way to Datalink. The pilot tunes to a specific channel, which is assigned to a specific station. Then, the station displays symbology for the planned trajectory and location of the targets to intercept and displays recommended rules of engagement to follow and an interception course.

In this example, we have two Mirages operating from RAF Akrotiri, a Hawk SAM site and two incoming F-16s penetrating the airspace.

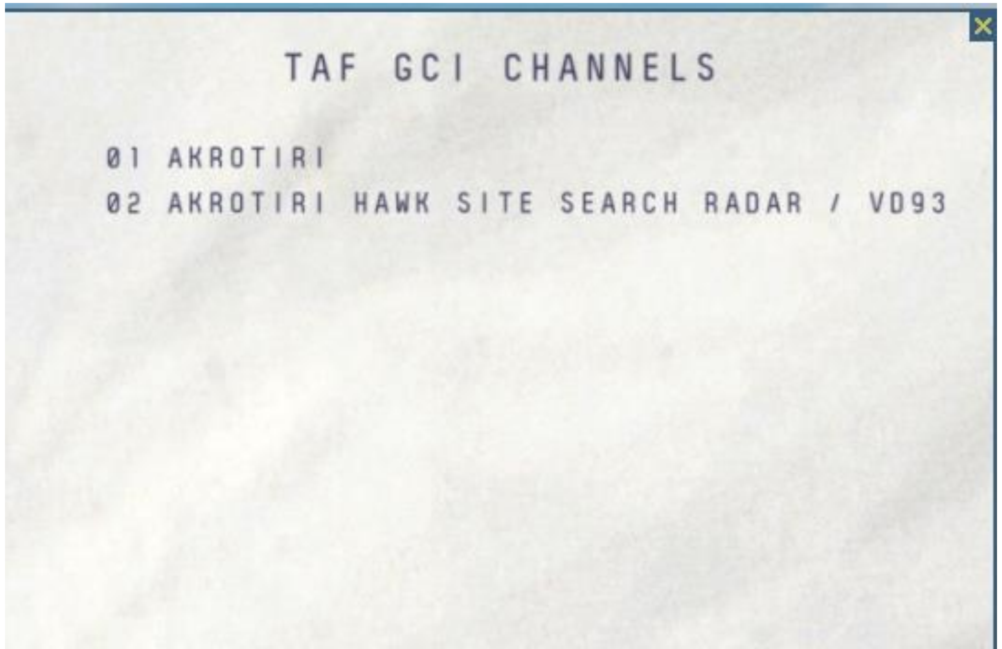
Take note that this system was tested on the aircraft but never fielded operationally. TAF can be made available or unavailable via the Mission Editor “Enable TAF GCI Link” option.

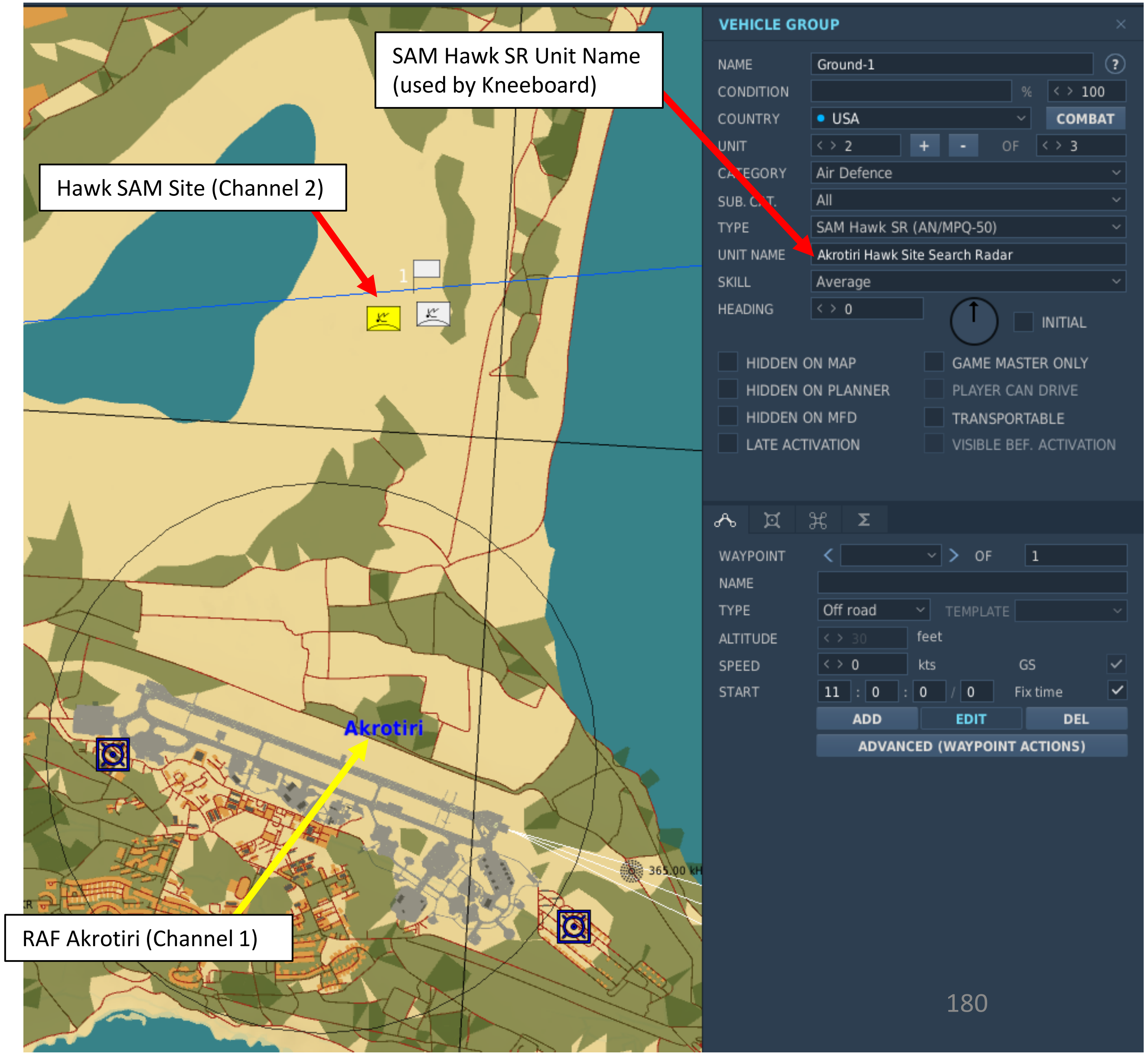


3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

The mission setup is quite simple. TAF GCI Channels are generated and allocated automatically, up to a maximum of 20 channels.

- Airfields within your coalition have their own dedicated TAF GCI Channel. In this case, RAF Akrotiri is on Channel 1.
- Search radars like the SAM Hawk SR (AN/MPQ-50) also have their own dedicated TAF GCI Channel. In this case, the Hawk SR is on Channel 2. In addition, a map grid location is available on your kneeboard (press "RSHIFT+K" and use "[" and "]" to cycle through pages) on the TAF GCI CHANNELS page. It is good practice to give a meaningful unit name since the kneeboard will use this name as a reference.





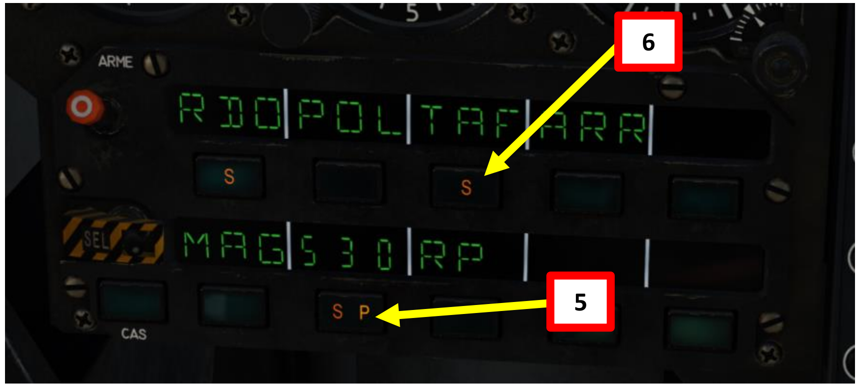
3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

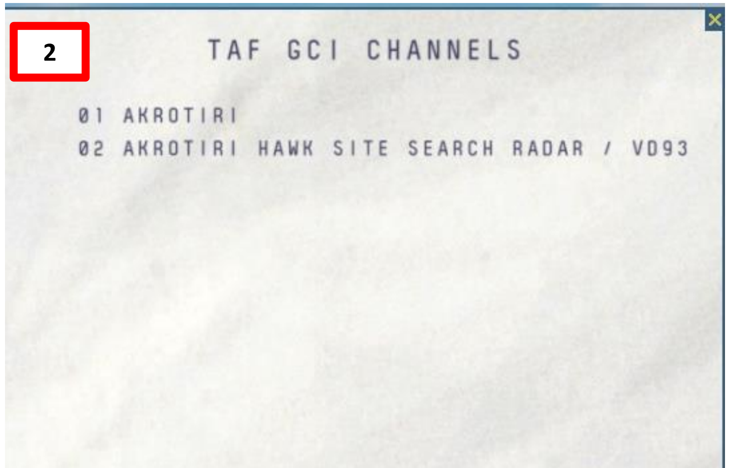
TAF Example

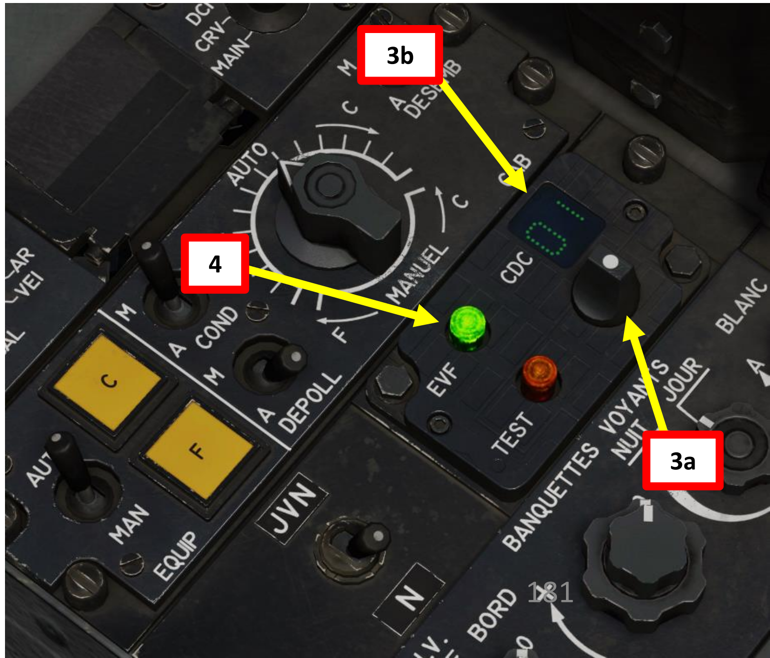
1. Set UHF Radio Mode Selector to “F1”.
   - Note: Performing this will inhibit voice transmission and reception capability on the “red” UHF radio.
2. Open kneeboard (press “RSHIFT+K” and use “[“ and “]” to cycle through pages) to the TAF GCI Channels page. We will use the AKROTIRI airfield as a ground controller, which is set on TAF Channel 1.
3. Set CDC (*Centre de Détection et de Commandement*, Detection and Control Center) Channel selector to Channel 01 (RAF Akrotiri).
4. Confirm that EVF (*Évasion Fréquence*, Frequency Hopping) green light illuminates and a short series of “beep” signals are audible. This indicates proper reception of TAF signal from the ground control station.
5. Select air-to-air missiles like the S530D via the PCA.
6. Select TAF (*Télé-Affichage*) button. “S” light means TAF is selected.

UHF Radio Mode selector
- AR: (*Arrêt*) OFF. No power is applied.
- M: (*Marche*). ON. Power is applied and the main preset frequency is used.
- F1: Used for TAF GCI (Remote Target Designation).
- H: Not used.

1

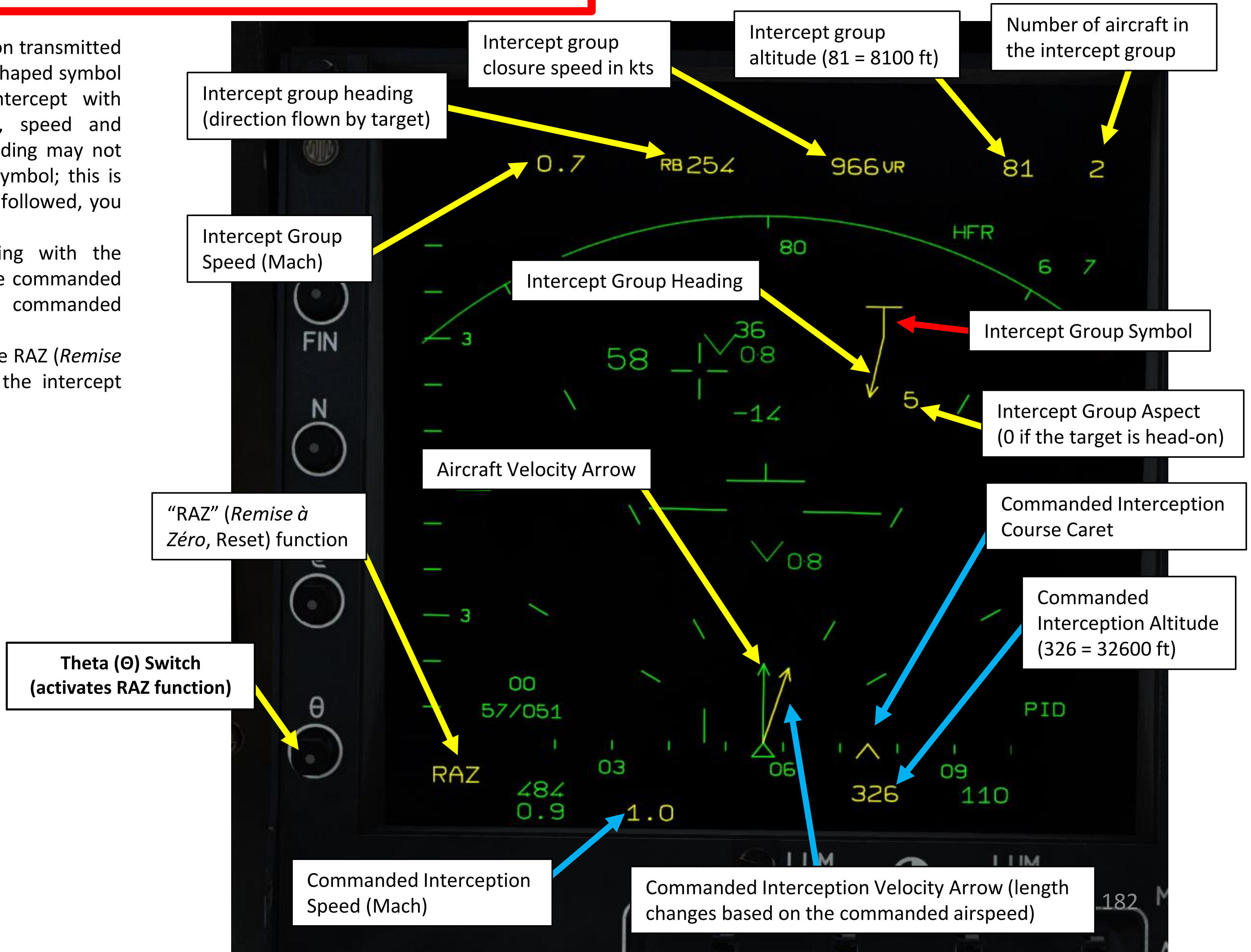






3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

7. Once TAF is selected, the VTB will display information transmitted via datalink from the ground control station. A "T" shaped symbol represents a single or group of aircraft to intercept with recommended/commanded interception heading, speed and altitude. You will notice that the commanded heading may not necessarily be lined up with the intercept group symbol; this is normal. TAF gives you a predictive heading that, if followed, you will eventually intercept the target with.
8. Steer the aircraft to line up your own heading with the commanded interception course caret, climb to the commanded interception altitude, and adjust airspeed to the commanded interception speed.
    - You can use the Theta Switch to activate the RAZ (*Remise à Zéro*, Reset) function, which will clear the intercept group from our system.



3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

9. Once you are on the intercept course, consult the VTH (Heads-Up Display) to read the ROE (Rules of Engagement) indicator. These ROE settings are computed dynamically and change based on the proximity of allied aircraft and enemy fighters. You will hear a tone whenever a ROE setting changes.
    - **LIB**: *Libre*, Fire at Will. No allied fighters are within 20 nm to the target.
    - **IFF**: Identify-Friend-or-Foe. Interrogate (IFF) target before shooting. Allied fighters are between 5 and 20 nm to the target.
    - **VIS**: Visual. Perform visual identification (VID) before shooting. Allies are between 2 and 5 nm to the target.
    - **INT**: *Interdit*, Forbidden. Hold Fire. Allies are closer than 2 nm to the target.

ROE Setting
- LIB
- IFF
- VIS
- INT

3 – RADAR AIR-TO-AIR MODES
3.6 – DO (*Désignation Objectif*) / Target Designation
3.6.2 – TAF (*Télé-Affichage*) / Remote Target Designation with Datalink

If the datalink system loses the aircraft or you lose connection, the Intercept Gropu symbol will become dashed.

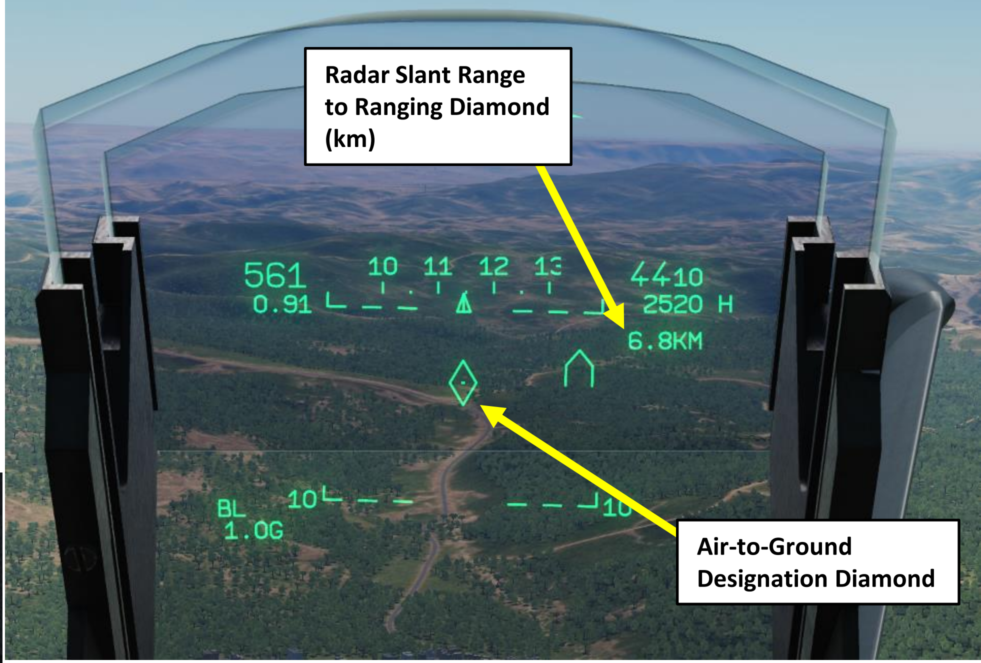
Consult Redkite's great video on TAF for more information:
https://youtu.be/LoYvRgjolCU

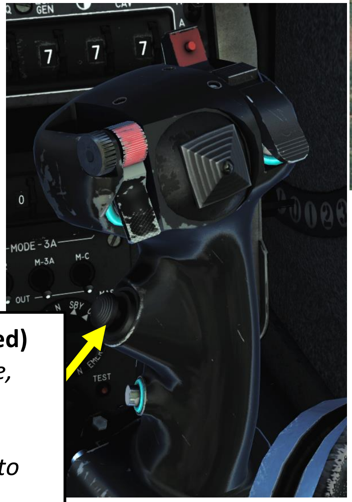
Intercept Group Symbol (dashed)

4 – RADAR AIR-TO-GROUND MODES
4.1 – TAS (*Télémétrie Air-Sol*) / Air-to-Ground Ranging Mode

The TAS (*Télémétrie Air-Sol*/Air-to-Ground Ranging) mode is the main ranging method for air-to-ground weapon delivery. The radar is slaved to the weapon delivery point or the designation diamond to provide slant range to the ground target. In air-to-ground ranging mode, the radar displays minimal symbology. In addition to the common symbology, only the azimuth aperture setting and position as well as the elevation scale is displayed.

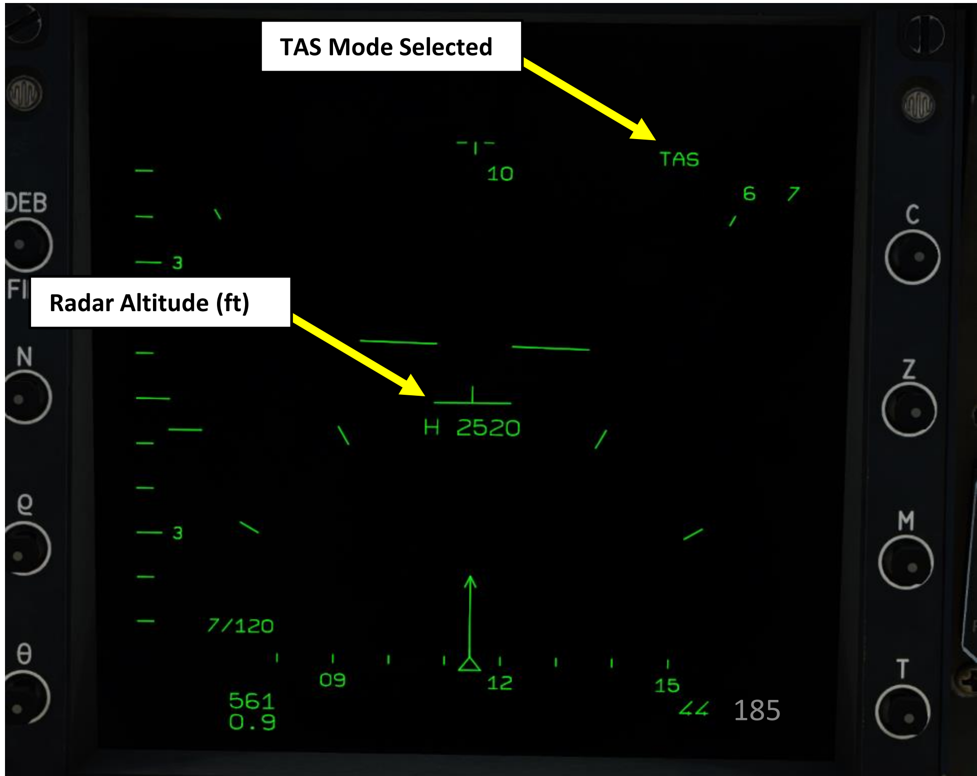
To use TAS (Air-to-Ground Ranging) mode:
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. Select an air-to-ground weapon from the PCA panel.
3. Press the Weapon System CMD Switch FWD. This will force the radar to TAS mode if selected.
4. The "TAS" button with "S" and the "TAS" indication on the VTB mean that air-to-ground ranging is selected.
5. The radar will provide slant range information for the designation diamond on the VTH/HUD.





Weapons System CMD Switch (A/G Weapon Selected)
- *FWD: Sets the SNA in air-to-ground selected mode, forces the radar to TAS mode if selected.*
- *AFT: Each press will switch between the SNA pre-selected and memorized mode, returns the radar to the previous mode if it was forced in TAS mode.*

CNM (Cannon/Neutral/Magic) Switch
- *LEFT: CNM AA Gun Select*
- *CENTER: CNM Neutral (PCA Select)*
- *RIGHT: CNM Magic Select*



PART 8 – RADAR

4 – RADAR AIR-TO-GROUND MODES
4.1 – TAS (*Télémétrie Air-Sol*) / Air-to-Ground Ranging Mode

Using a radar to range ground targets is not perfect due to the size of the radar beam. In order to determine the center of the beam, the radar averages all the ground returns it gets. This process is always occurring as long as the radar has a solid lock on the ground, meaning that this average will most likely be incorrect if the terrain is moving under the radar beam.

In order to achieve the most accurate ranging possible, a few precautions need to be taken:

- Stabilize the weapon delivery point or designation diamond on the target for at least 1 second before weapon release or designation to allow the radar to determine the center of the beam.
- Avoid uneven terrain or targets on top of ridges, the radar will have a hard time finding the center of the beam if it sees multiple planes of terrain.
- Since the radar beam is a cone, a close and steep dive angle reduce the size the area illuminated by the radar, allowing for a greater accuracy.
- Water absorbs radar waves a lot, radar ranging might be unpracticable on or near water unless using a very steep angle.

4 – RADAR AIR-TO-GROUND MODES
4.2 – DEC (*Découpe Terrain*) / Ground Avoidance Mode

The RDI radar has a mode called DEC, for “*Découpe Terrain*”. This is similar to a ground avoidance mode where terrain and obstacles that you risk colliding with are displayed in terms of color shades. In addition to the common symbology, only the azimuth aperture setting and position, elevation scale and antenna elevation are displayed. A specific clearance height symbology is displayed.

In this mode, the radar operates in BFR and the TDC is not available. The range is locked to 10 nm, the bar number to 2 or 1 and the azimuth aperture is free. The radar BFR gain command has no effect and the gain is set to its maximum.
The radar displays return from the ground in 2 colors depending on the terrain altitude relative to the clearance height:

- Green below the clearance height
- Red at and above the clearance height.

In this mode, the radar display is oriented to follow the aircraft bearing. This means that the display is not oriented to where the aircraft is pointed to but where it’s going.

4 – RADAR AIR-TO-GROUND MODES
4.2 – DEC (*Découpe Terrain*) / Ground Avoidance Mode

To select DEC Ground Avoidance mode, press the "DEC" button on the radar control panel.

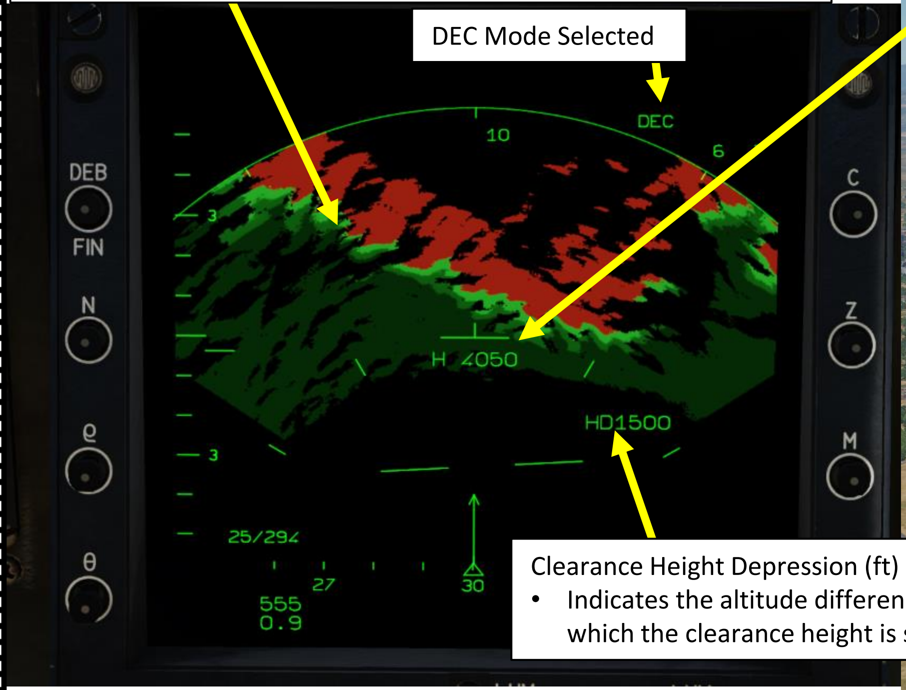
The antenna elevation thumbwheel control sets the clearance height for ground avoidance.

- A short press of the antenna elevation thumbwheel will shift the clearance height by 100 ft
- A long press of the antenna elevation thumbwheel will shift the clearance height at a rate of 1000 ft per second you hold the thumbwheel pressed.

Antenna Elevation Thumbwheel

DEC: *Découpe Terrain* (Ground Avoidance)

Radar Ground Returns
- Displayed in green is the terrain that is below the clearance height, in red, the terrain that is at or above the clearance height.



DEC Mode Selected

Clearance Height Depression (ft)
- Indicates the altitude difference bellow the aircraft at which the clearance height is set.

Radar Altimeter (ft)
- Displayed in green when the radar altitude is above the minimum altitude as set on the PCTH and red when below

4 – RADAR AIR-TO-GROUND MODES
4.3 – VISU (*Visualisation Terrain*) / Ground Mapping Mode

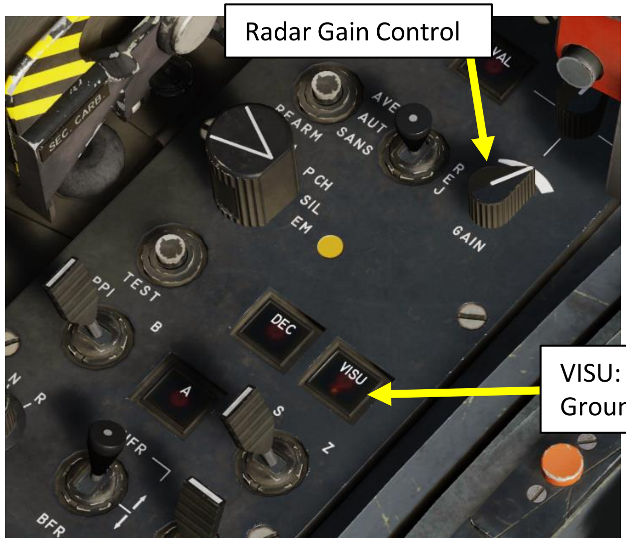
The VISU (*Visualisation du Sol/*Ground Mapping) radar mode is a terrain visualization mode. In this mode, the radar displays minimal symbology. In addition to the common symbology, only the azimuth aperture setting and position, elevation scale and antenna elevation are displayed. The radar displays the raw ground return to provide a radar map of the ground.

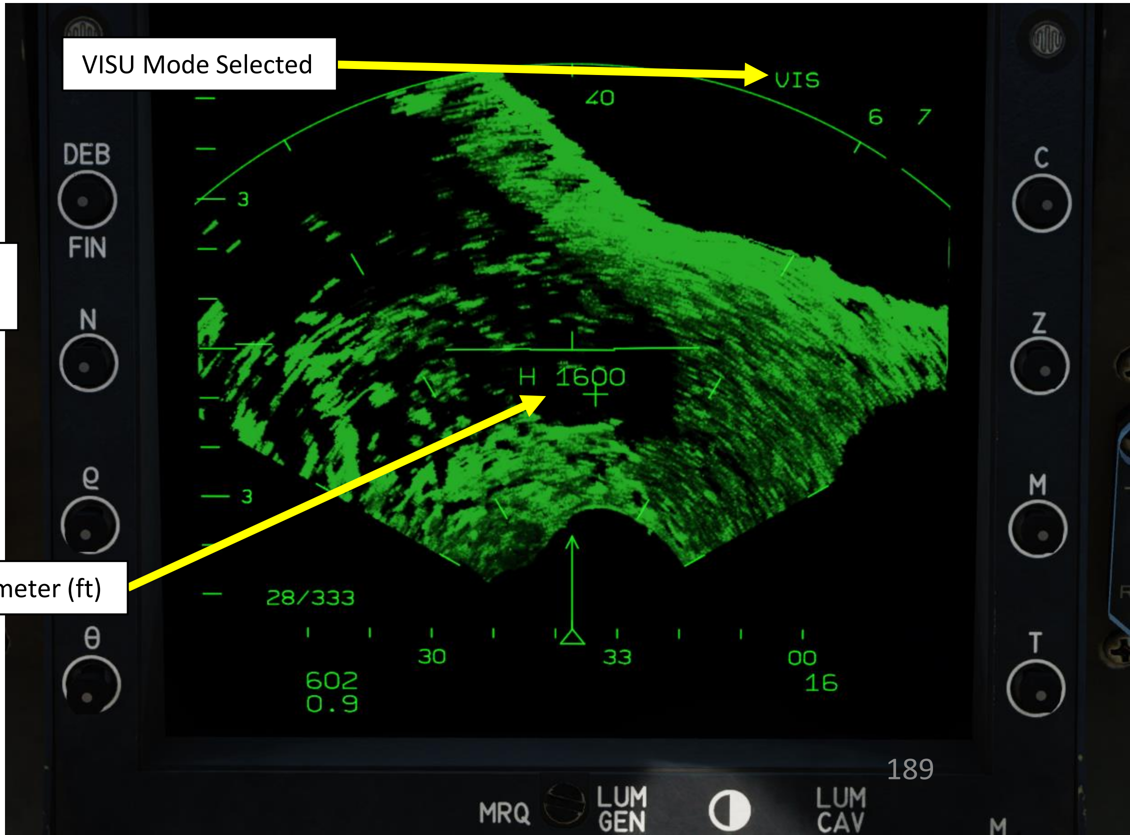
In this mode, the bar number can be set to 2 or 1 bars, the 4 bars position sets it to 2 bars, and the azimuth aperture to 60 deg, 30 deg or 15 deg. The display range can be set to 10, 20 and 40 nm.

The radar gain can be adjusted using the radar gain control, and the radar antenna attitude is set by the pilot using the antenna elevation thumbwheel .

The radar displays return from the ground in shades of green depending on the return strength, the brighter the green the stronger the return. In VISU mode, the radar display is oriented to follow the aircraft bearing. This means that the display is not oriented to where the aircraft is pointed to but where it's going. As a consequence, the aircraft vector is always pointing strait up.

To select VISU mode, press the VISU (Ground Mapping) button on the radar control panel.





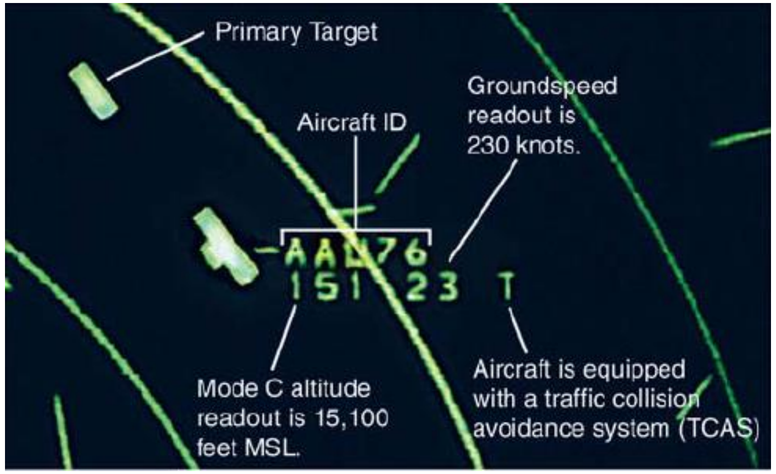
5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.1 – IFF Basics

An IFF (Identify-Friend-or-Foe) system usually 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.



5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.1 – IFF Basics

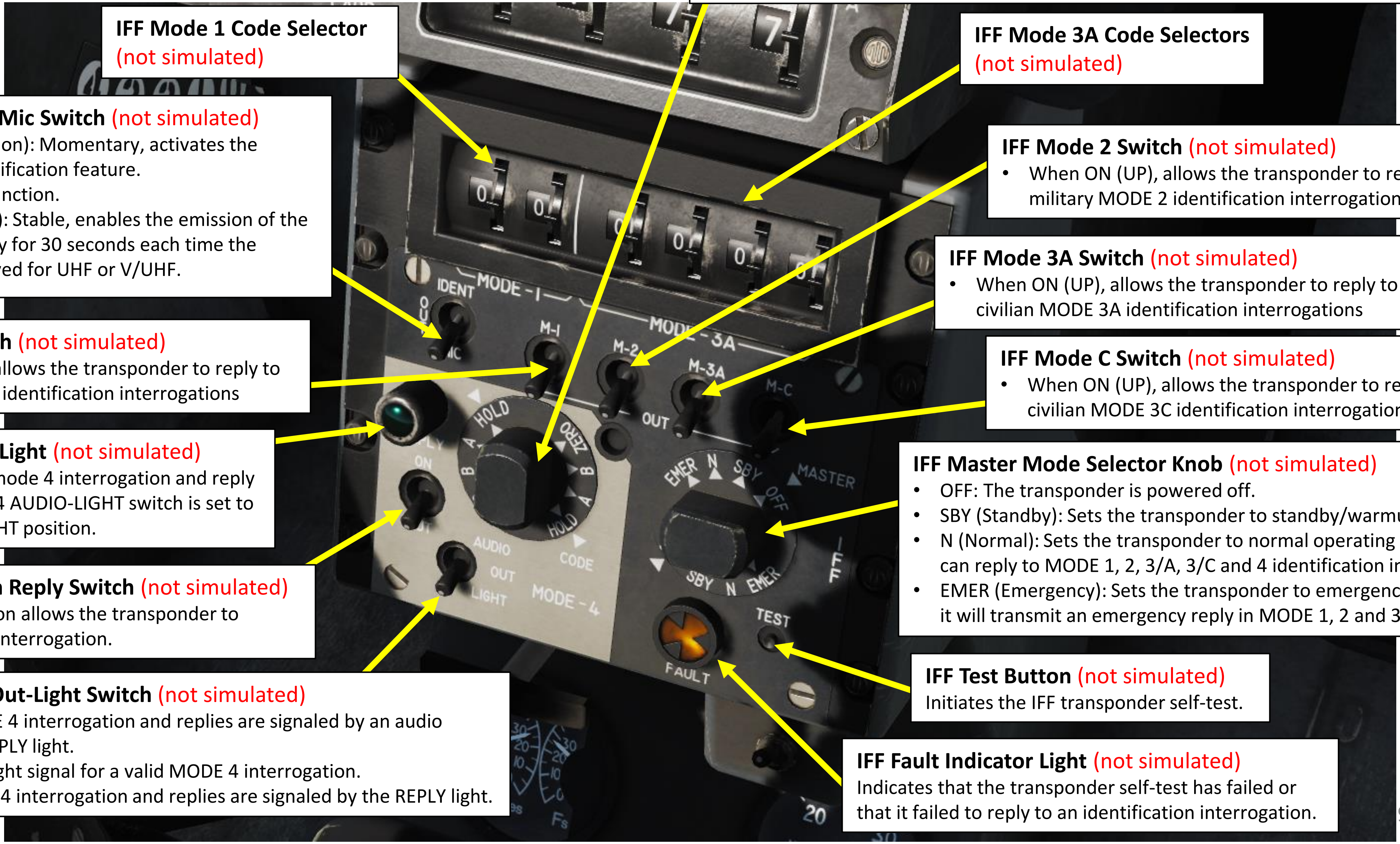
In its simplest form, a IFF "Mode" or interrogation type is generally determined by pulse spacing between two or more interrogation pulses. Various modes exist from Mode 1 to 5 for military use, to Mode A, C, and Mode S for civilian use. The takeaway from this table should be:

- **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

5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.2 – Transponder Panel

The **IFF Transponder panel** allows the selection of the transponder master mode, the MODE 1 and 3/A codes, the selection of which interrogation mode to reply to and the MODE 4 settings. Most of it is not simulated yet.



IFF Mode 4 Mode Selector Knob (not simulated)
Selects Mode 4 IFF Code of the day
- HOLD: Momentary, prevents the zeroizing of the MODE 4 IFF codes when the IFF transponder is turned off. To be used after the plane has weight on wheels.
- A: Stable, selects the A MODE 4 IFF code set.
- B: Stable, selects the B MODE 4 IFF code set.
- ZERO: Momentary, starts the zeroizing procedure to erase the MODE 4 IFF codes.

IFF Mode 1 Code Selector (not simulated)

IFF Mode 3A Code Selectors (not simulated)

IFF Mode 1 Ident/Mic Switch (not simulated)
- IDENT (Identification): Momentary, activates the transponder identification feature.
- OUT: Stable, no function.
- MIC (Microphone): Stable, enables the emission of the identification reply for 30 seconds each time the microphone is keyed for UHF or V/UHF.

IFF Mode 2 Switch (not simulated)
- When ON (UP), allows the transponder to reply to military MODE 2 identification interrogations

IFF Mode 3A Switch (not simulated)
- When ON (UP), allows the transponder to reply to civilian MODE 3A identification interrogations

IFF Mode 1 Switch (not simulated)
- When ON (UP), allows the transponder to reply to military MODE 1 identification interrogations

IFF Mode C Switch (not simulated)
- When ON (UP), allows the transponder to reply to civilian MODE 3C identification interrogations

IFF Mode 4 Reply Light (not simulated)
- Indicates a valid mode 4 interrogation and reply when the MODE 4 AUDIO-LIGHT switch is set to the AUDIO or LIGHT position.

IFF Master Mode Selector Knob (not simulated)
- OFF: The transponder is powered off.
- SBY (Standby): Sets the transponder to standby/warmup mode.
- N (Normal): Sets the transponder to normal operating mode where it can reply to MODE 1, 2, 3/A, 3/C and 4 identification interrogations.
- EMER (Emergency): Sets the transponder to emergency mode where it will transmit an emergency reply in MODE 1, 2 and 3/A.

IFF Mode 4 Out/On Reply Switch (not simulated)
- The ON (UP) position allows the transponder to decode a MODE 4 interrogation.

IFF Test Button (not simulated)
Initiates the IFF transponder self-test.

IFF Mode 4 Audio-Out-Light Switch (not simulated)
- AUDIO: Valid MODE 4 interrogation and replies are signaled by an audio warning and the REPLY light.
- OUT: No audio or light signal for a valid MODE 4 interrogation.
- LIGHT: Valid MODE 4 interrogation and replies are signaled by the REPLY light.

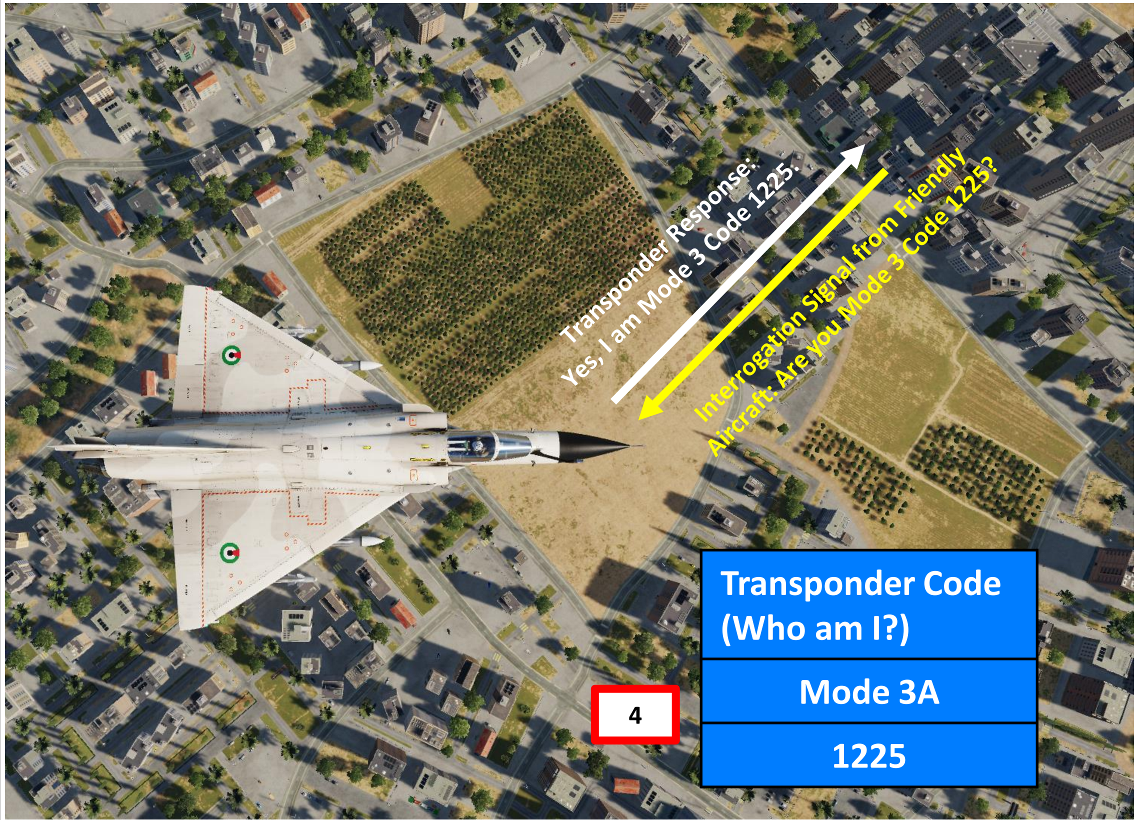
IFF Fault Indicator Light (not simulated)
Indicates that the transponder self-test has failed or that it failed to reply to an identification interrogation.

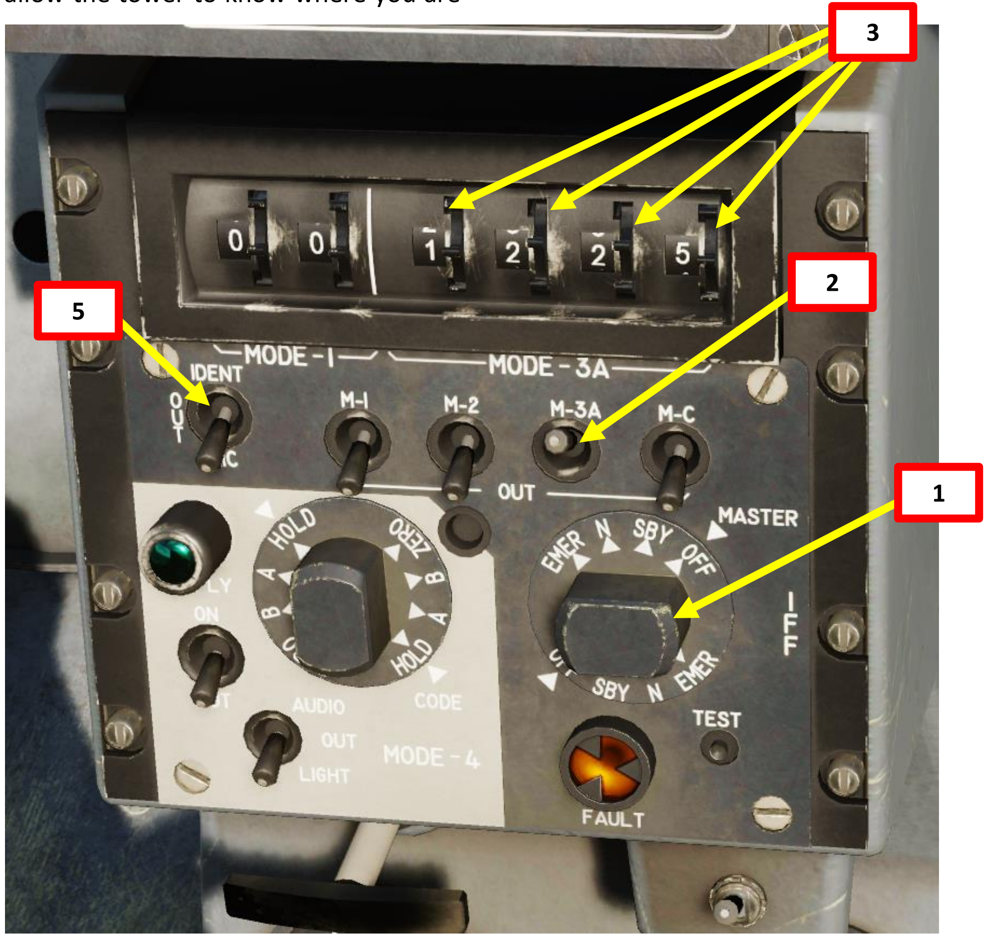
5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.2 – Transponder Panel

Setting up IFF Transponder

As an example, let's say that the mission briefing needs us to set the IFF transponder to **Mode 3A with a code of 1225**.

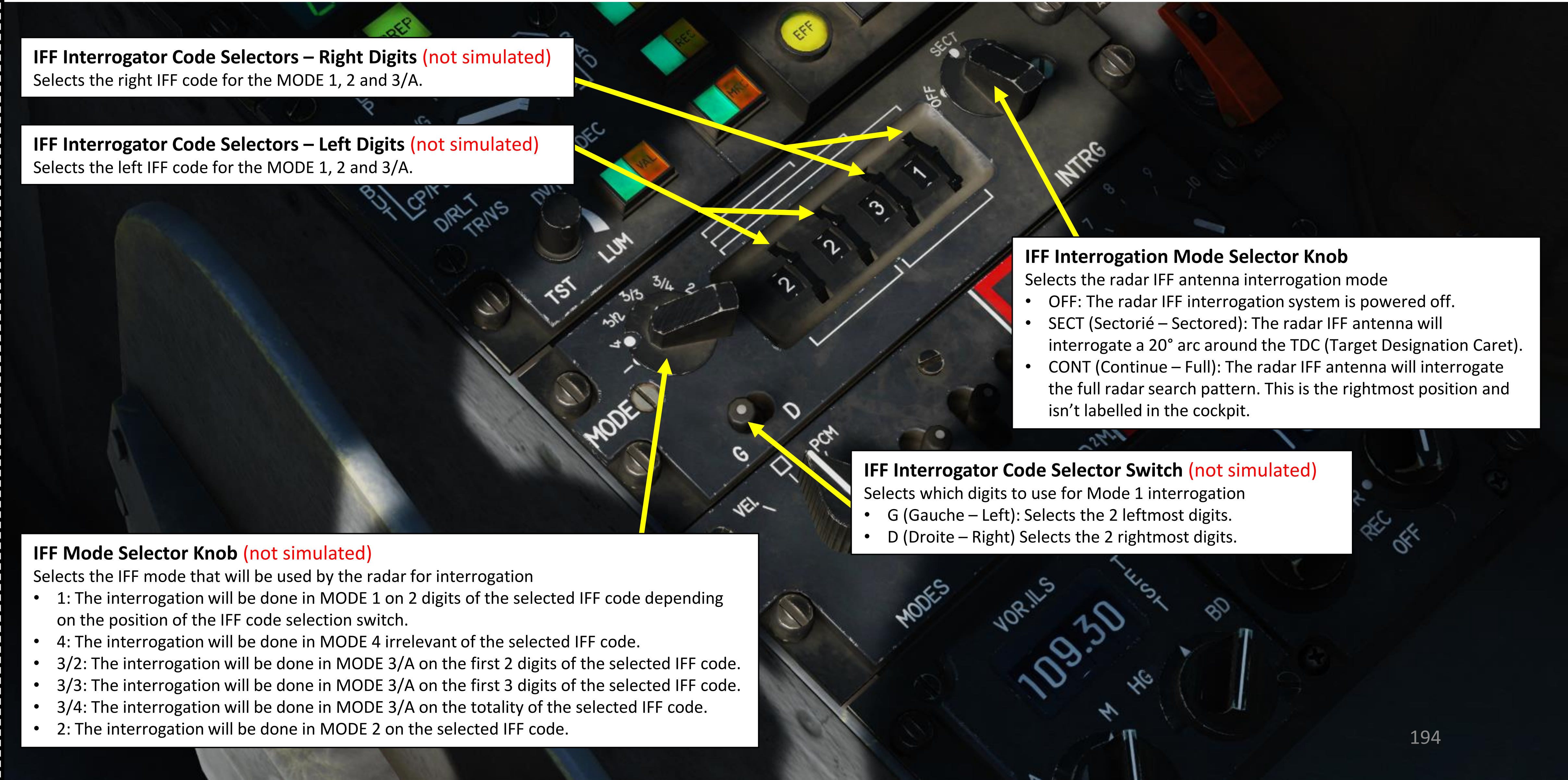
1. Set IFF Master Switch to N – NORMAL **(Not Simulated)**
2. Set IFF Mode 3/A Switch – UP (ON)
3. Set IFF MODE 3/A Channel Wheel Selectors to "1225".
4. If you are interrogated with mode 3A with a code set to 1225, the transponder will then send a response signal (reply) to the interrogator with the transponder code you entered previously.
5. If the tower wants to know your position, they are likely to send you a specific IFF mode and code, then ask you to "*Identify*". This requires you to press the IFF Identification/Microphone Switch to IDENT (UP), which will allow the tower to know where you are from your transponder's identification signal/transmission.





5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.3 – Interrogator Panel

The **IFF Interrogator panel** allows the configuration of the radar IFF interrogation.



IFF Interrogator Code Selectors – Right Digits (not simulated)
Selects the right IFF code for the MODE 1, 2 and 3/A.

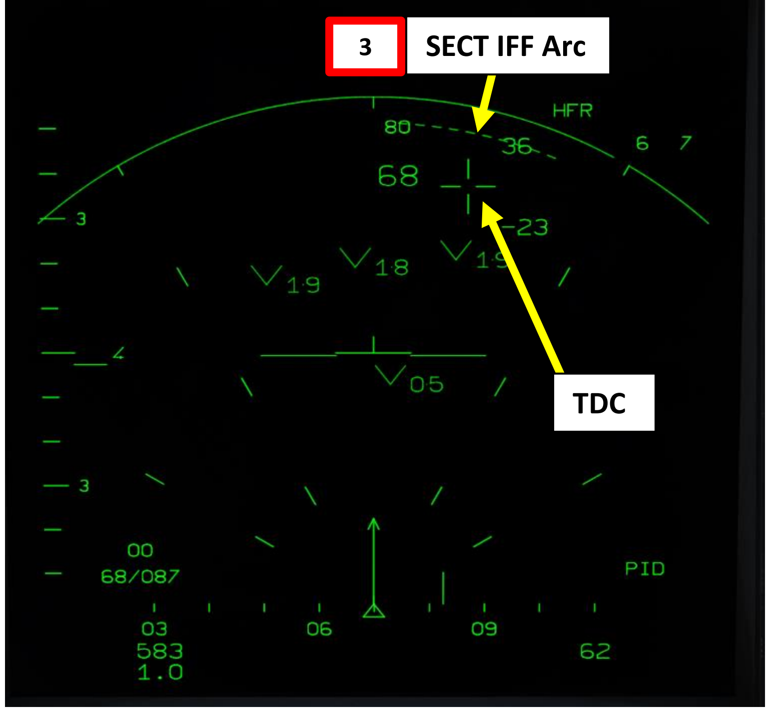
IFF Interrogator Code Selectors – Left Digits (not simulated)
Selects the left IFF code for the MODE 1, 2 and 3/A.

IFF Interrogation Mode Selector Knob
Selects the radar IFF antenna interrogation mode
- OFF: The radar IFF interrogation system is powered off.
- SECT (Sectorié – Sectored): The radar IFF antenna will interrogate a 20° arc around the TDC (Target Designation Caret).
- CONT (Continue – Full): The radar IFF antenna will interrogate the full radar search pattern. This is the rightmost position and isn’t labelled in the cockpit.

IFF Interrogator Code Selector Switch (not simulated)
Selects which digits to use for Mode 1 interrogation
- G (Gauche – Left): Selects the 2 leftmost digits.
- D (Droite – Right) Selects the 2 rightmost digits.

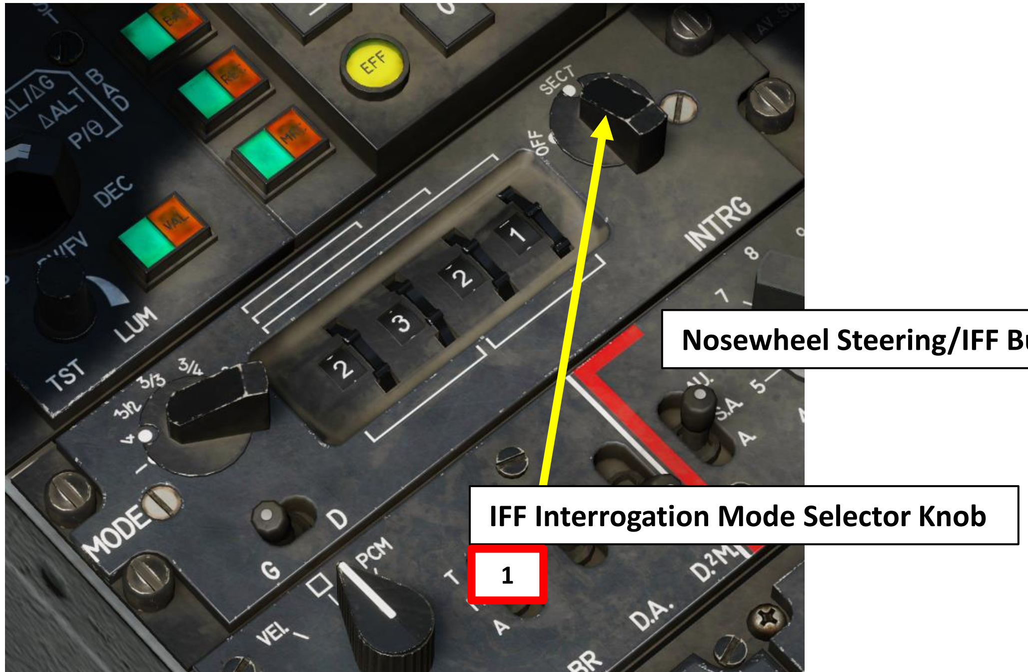
IFF Mode Selector Knob (not simulated)
Selects the IFF mode that will be used by the radar for interrogation
- 1: The interrogation will be done in MODE 1 on 2 digits of the selected IFF code depending on the position of the IFF code selection switch.
- 4: The interrogation will be done in MODE 4 irrelevant of the selected IFF code.
- 3/2: The interrogation will be done in MODE 3/A on the first 2 digits of the selected IFF code.
- 3/3: The interrogation will be done in MODE 3/A on the first 3 digits of the selected IFF code.
- 3/4: The interrogation will be done in MODE 3/A on the totality of the selected IFF code.
- 2: The interrogation will be done in MODE 2 on the selected IFF code.

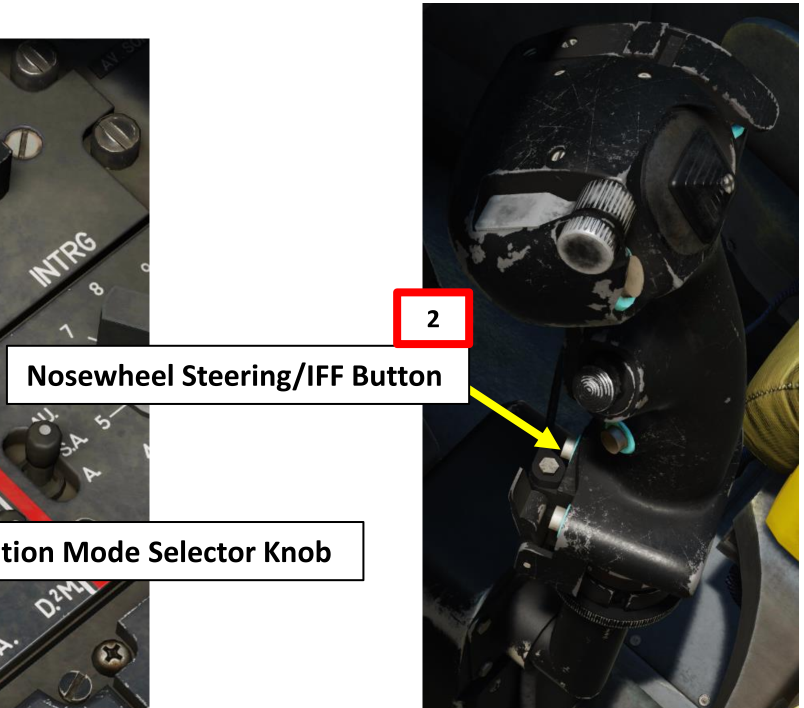
5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.4 – IFF Interrogation Procedure



To interrogate a contact:

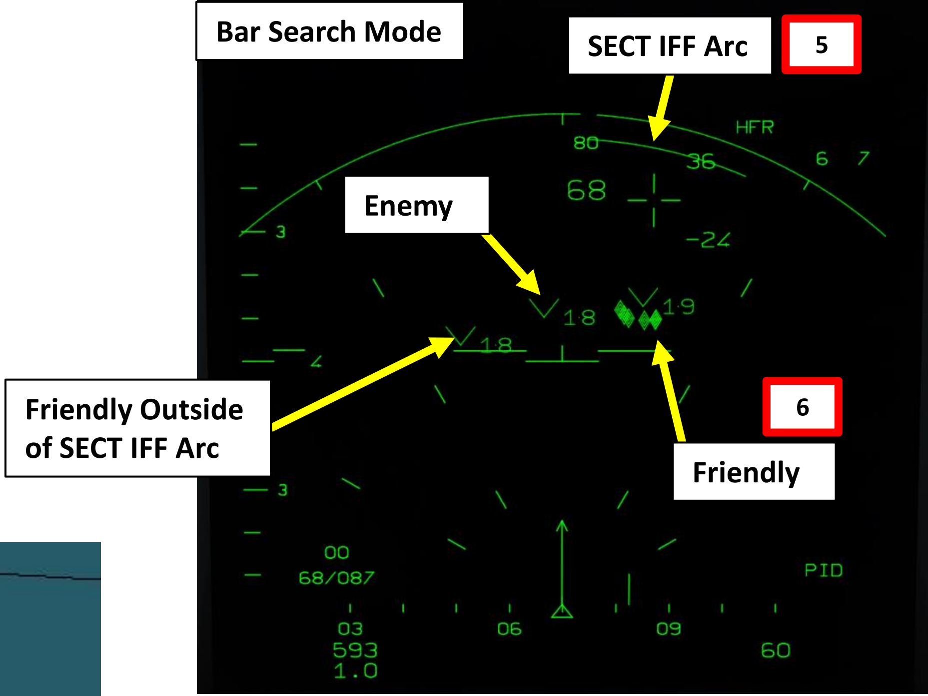
1. Set IFF Power Switch to either SECT (Sectoral, middle position) or FULL (rightmost position), as desired.
   - SECT (Sectorié – Sectored): The interrogation is sent in a 20° arc around the TDC (Target Designation Caret).
   - CONT (Continue – Full): The interrogation is sent in the full search pattern, within the limits of its azimuth setting and orientation.
2. Press the NWS/IFF button (keyboard shortcut: "S") to interrogate. The IFF interrogation is maintained as long as the command is pressed and last at least a complete scan pattern.
   - Note: IFF interrogation is only available with the radar in standby, bar search, PSID, PSIC and SHB.
3. The IFF antenna is placed on the radar antenna and thus follow its azimuth and elevation. Its field of interrogation is 10° wide. With the radar in bar search (only with the PRF set to HFR or ENT) or PSID, the execution of an interrogation is represented by a doubling of the radar range marker arc. The size of the interrogation arc is dependent on the position of IFF interrogation mode on the IFF interrogator panel.
4. When an **IFF interrogation is requested**, the **arc is dashed** until the interrogation is effective. When **interrogation is effective, the arc is displayed full**. With IFF interrogation mode in CONT, it lasts only 0.5 sec while in SECT, the interrogation is effective is only when the radar antenna is oriented in the requested interrogation azimuth.

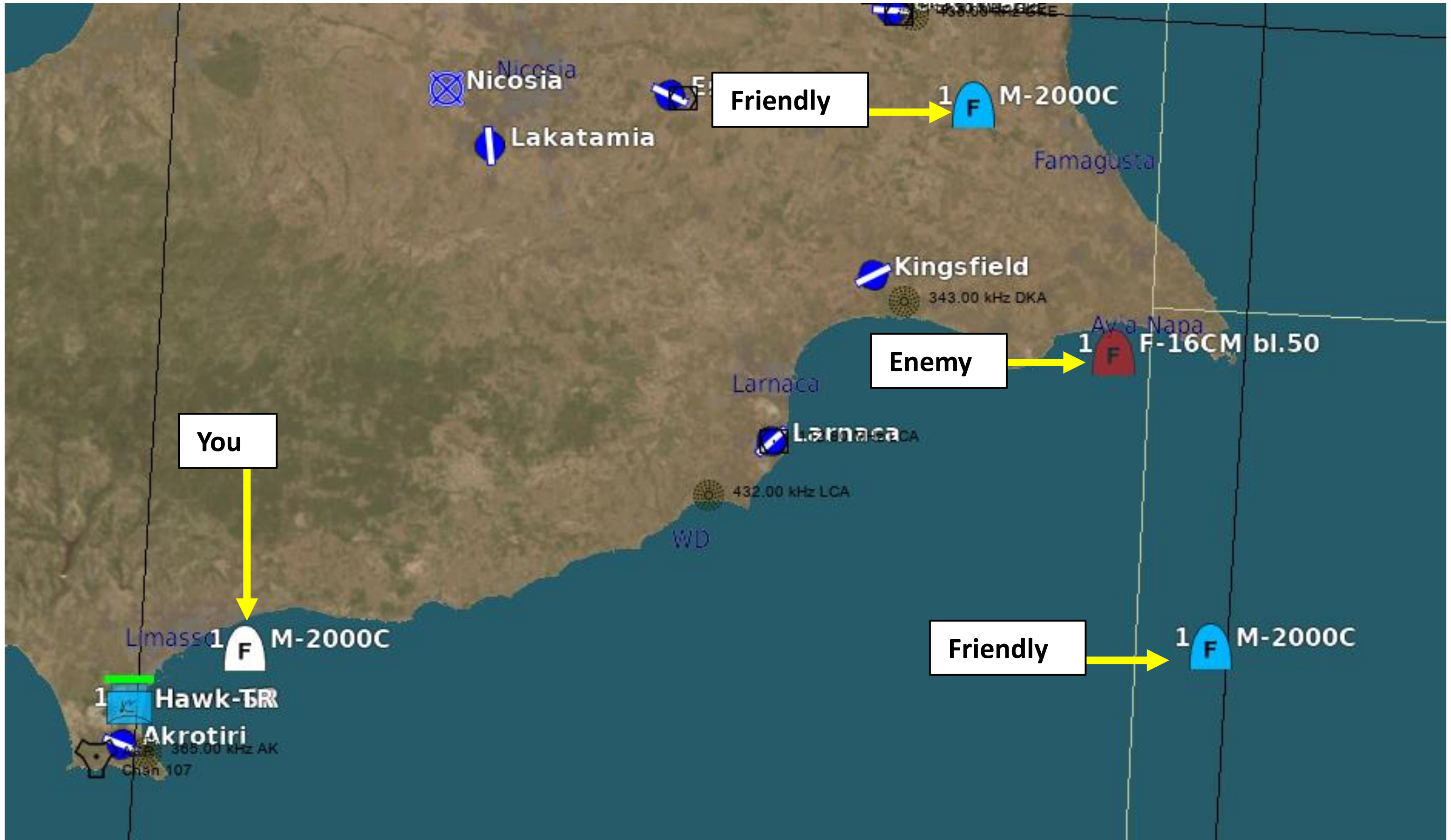


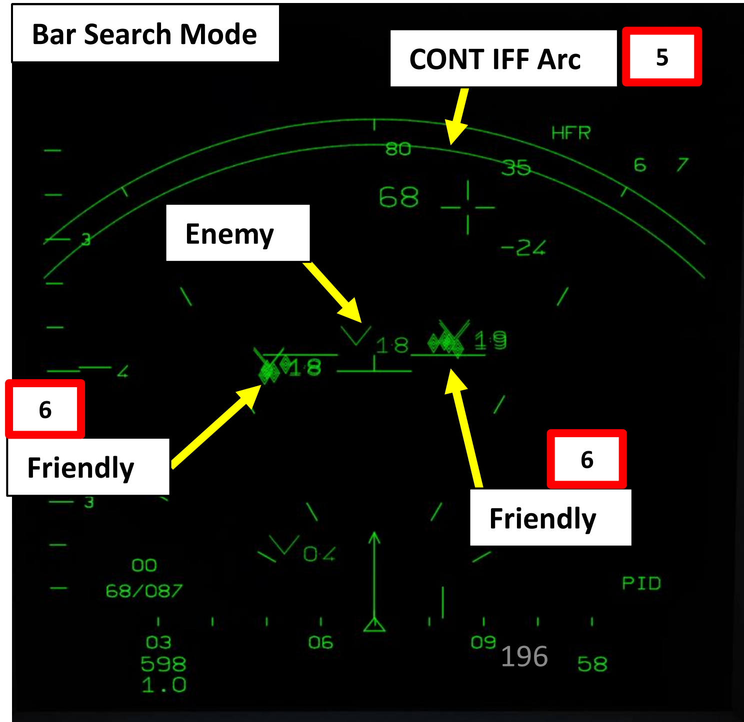


5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.4 – IFF Interrogation Procedure

5. When targets have been interrogated, the dashed arc becomes full.
6. In **bar search and PSID/TWS**, friendly IFF replies are represented by a full diamond located at the rough location of the IFF replying aircraft. The IFF diamonds are not correlated to HFR contacts and are displayed for a full search pattern, which means that there can be multiple diamonds overlapping for a single target. The maximum number of IFF diamonds that can be displayed is 64. In this example, we can see the differences between using SECT and CONT IFF. In SECT, IFF responses are only provided on the smaller arc, while the CONT mode interrogates targets over a much larger sweep.
    - Friendlies: Diamond
    - Unknown/Enemies: No Diamond







5 – IFF (IDENTIFY-FRIEND-OR-FOE)
5.4 – IFF Interrogation Procedure

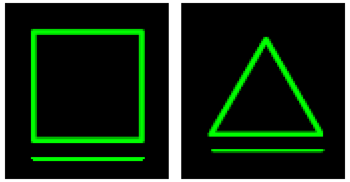
Note:

In **PSIC/STT** radar lock, the interrogation arc is 20° wide, centered on the tracked target. Interrogation is still performed with the NWS/IFF button on the stick, however the **IFF diamonds are no longer displayed when receiving a friendly IFF response.**

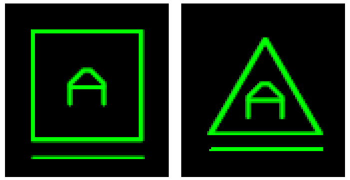
- The two vertical bars on the position of the tracked target are doubled if it replies the IFF interrogation.
- The two vertical bars on the position of the tracked target are single lines if it does not reply correctly the IFF interrogation.
- A diagonal line indicates that the received reply is doubtful, meaning that the position of the IFF replying aircraft does not totally correspond to the position of the tracked target.

Friendly Mirage IFF Response

IFF Interrogation In Progress & IFF Correlation (PSIC/STT)

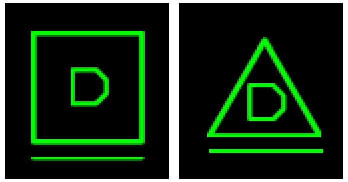


Indicates that radar target is being interrogated by the IFF system



Indicates that radar target has replied as a friend to the IFF interrogation.

"A" stands for "Ami", or "Friendly".

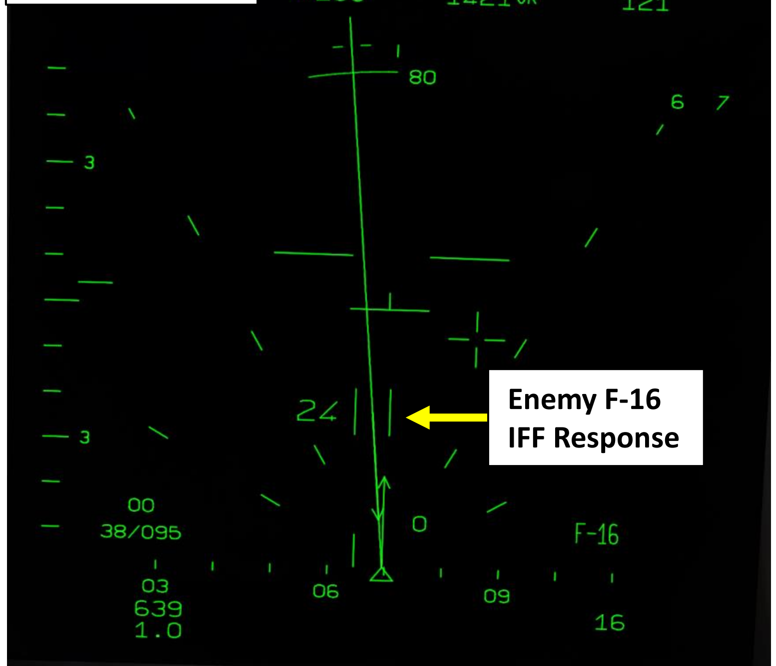


Indicates that the radar has received a friendly reply from the target, but the position of the IFF replying aircraft does not correspond to the target position.

PSIC/STT Mode

Friendly Mirage IFF Response

PSIC/STT Mode



Enemy F-16 IFF Response

PSIC/STT Mode

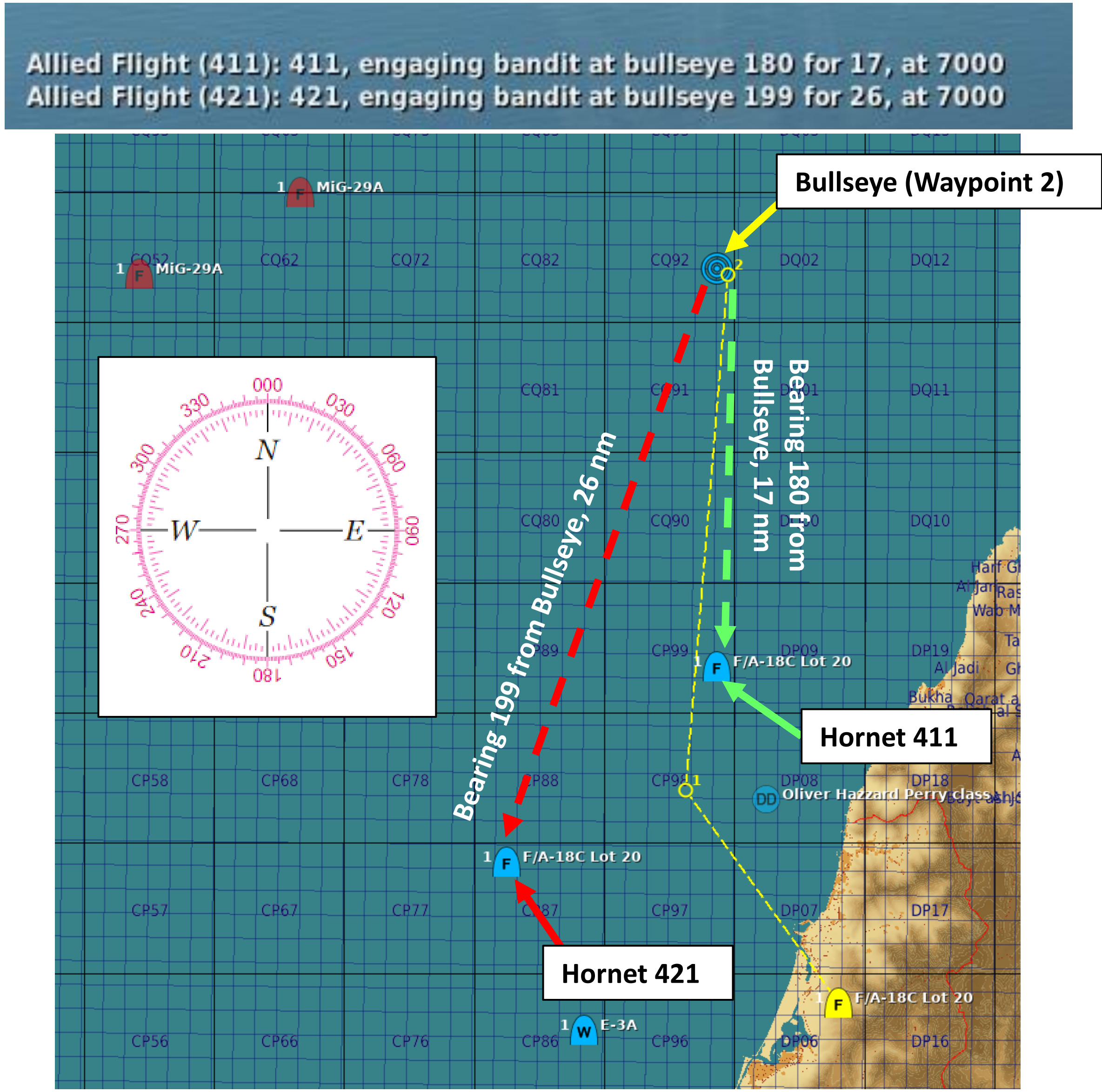
IFF Reply Ambiguous/Doubtful

6 – BULLSEYE

A “Bullseye” is a fictional point in space used as a reference to locate yourself, friendly contacts and enemy contacts. 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 to bullseye
- Altitude

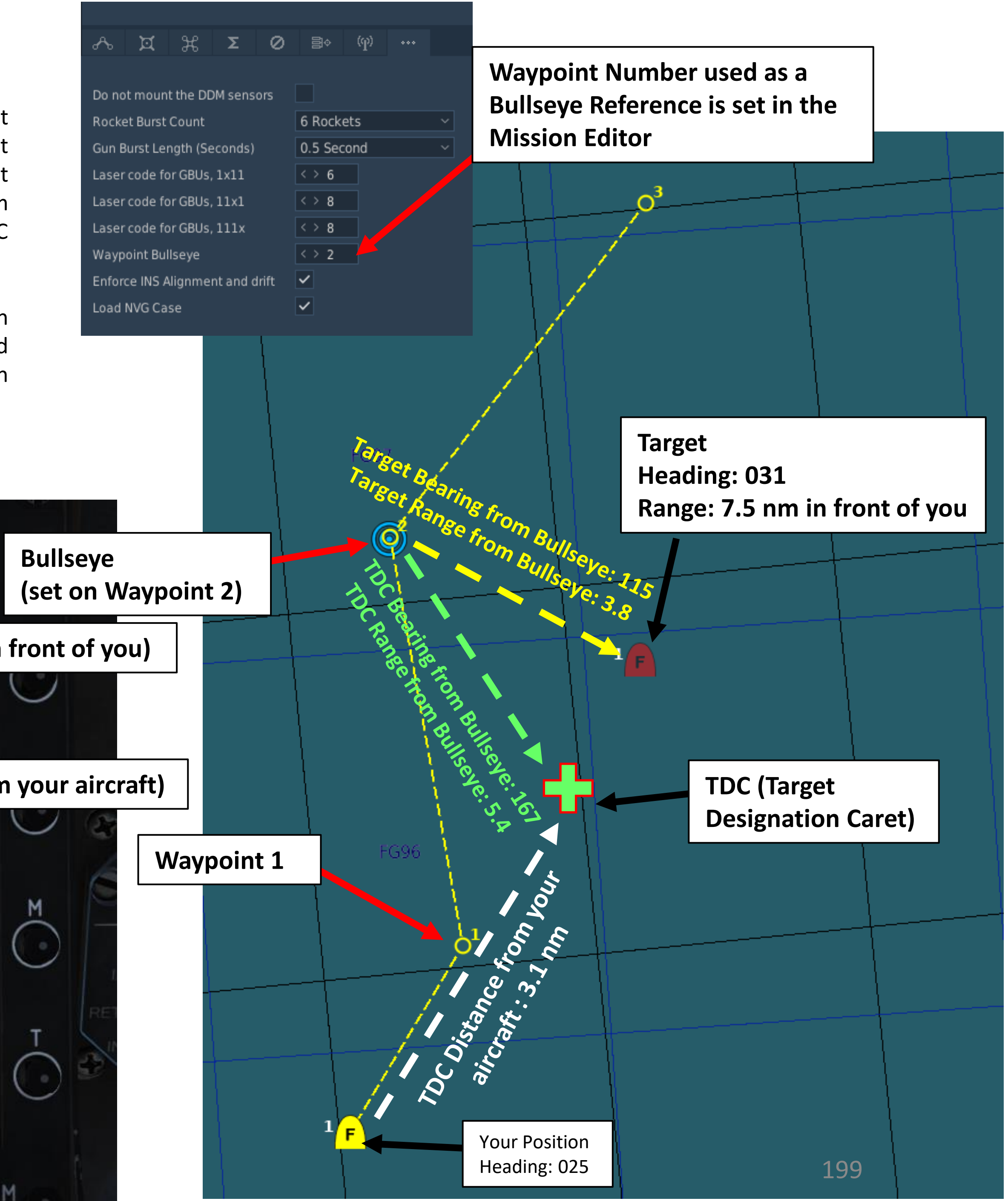
Bullseye Explanation by JediLinks: https://youtu.be/vgcXcfeGb2M

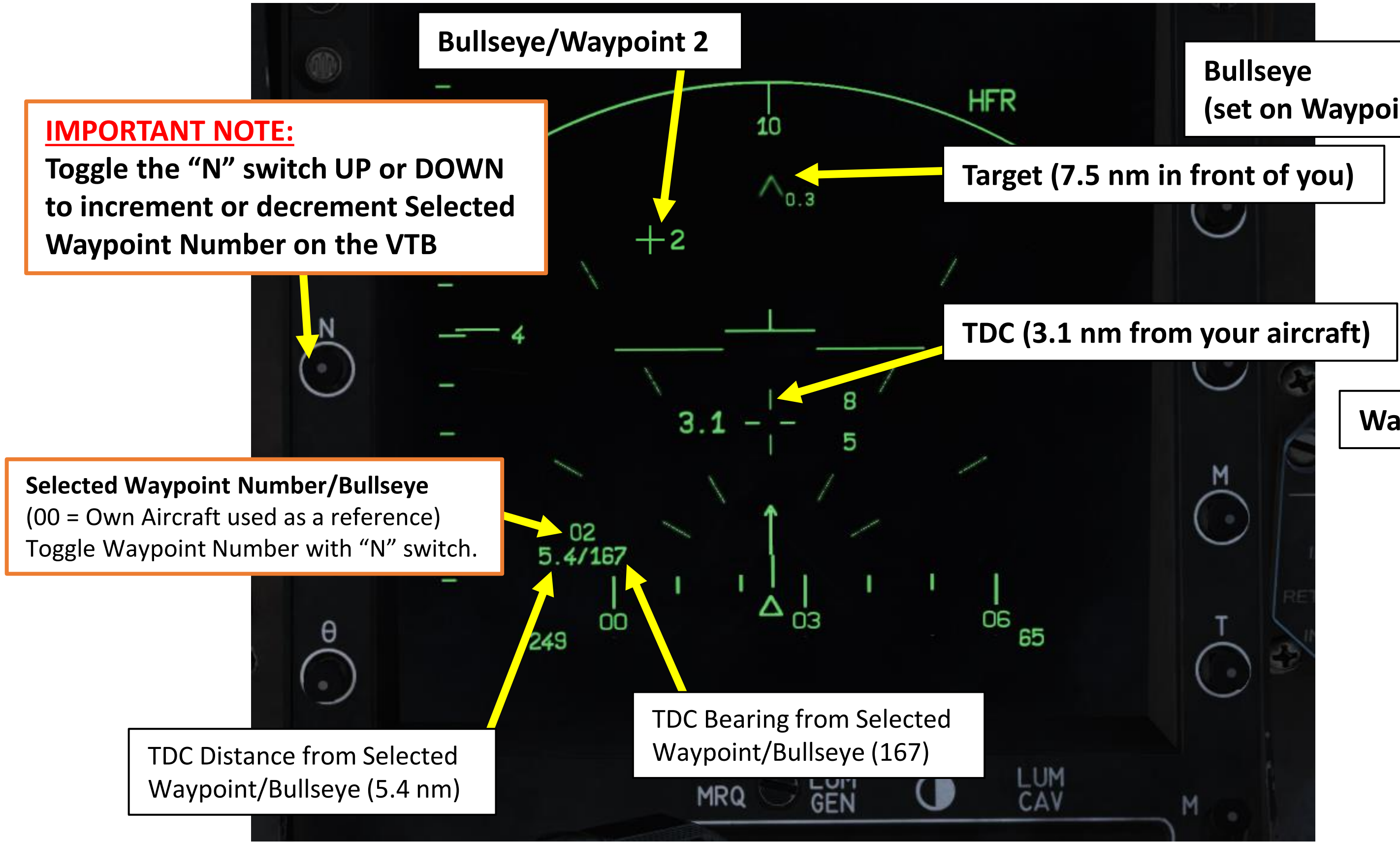


6 – BULLSEYE

When an AWACS calls out a target using a BRA call (i.e. “Enemy bandit at bullseye 115 for 3.8, at 7000 ft”), there is an indication on the lower left corner of the VTB that tells you the TDC (Target Designation Caret) distance and bearing from any waypoint selected. If a particular waypoint is set on the Bullseye location, you can use this indication as a TDC Bearing/Distance indication from Bullseye. Therefore, you could find the target by simply moving the TDC while using the TDC Distance and Bearing from Waypoint/Bullseye indications.

Keep in mind that the Waypoint Number used as a Bullseye reference must be set in the mission editor first (it can be modified with the « N » switch on the VTB. In the case where the Selected Waypoint number is 00, this means that the TDC indications are in relationship to your own aircraft.





7 – 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 (Super S530D + 27R/ER + AIM-7)
- FOX 2: heat-seeking infrared missile (Magic II + 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

FOX1
Semi-active radar homing missile
e.g. AIM-7, AA-10, Super 530D

FOX2
Passive IR homing missile
e.g. AIM-9, AA-11, IRIS-T, Magic II

FOX3
Active radar homing missile IR homing missile
e.g. AIM-120, AA-12, Meteor

No equipment for Mirage 2000C

SECTION STRUCTURE

1.1 – ARMAMENT OVERVIEW

The Mirage 2000C can use a good variety of weapons.

MISSILES

WEAPON	TYPE	RANGE	COMPARABLE TO
MATRA R550 MAGIC II	Infrared guided missile	0.25 to 8 nautical miles (500 m to 15 km)	AIM-9M Sidewinder
MATRA SUPER S530D	Semi-Active radar homing	10 nautical miles @ Sea Level 23 nautical miles @ 40,000 ft	AIM-7 Sparrow

BOMBS

WEAPON	TYPE	WEAPON	TYPE	WEAPON	TYPE
MK-82	500 lbs unguided low-drag bomb	MK-82AIR	500 lbs unguided high-drag bomb	SAMP-250	250 kg (550 lbs) unguided bomb by the *Société des Ateliers Mécanique de Port-sur-Sambre* (SAMP)
MK-82SE (Snake Eye)	500 lbs unguided low-drag retarded bomb	GBU-12	500 lbs laser guided bomb		
BLG-66 (Belouga)	Unguided low-drag anti-runway cluster bomb	GBU-16	1,000 lbs laser guided bomb		
BAP-100	Unguided very-high-drag anti-runway cluster bomb (*Bombe Anti-Piste*)	GBU-24	2,000 lbs laser guided bomb		

GUNS

WEAPON	TYPE
2 x *DEFA* 554	30 mm revolver cannons (125 rounds each)

ROCKETS

WEAPON	TYPE
MATRA SNEB rocket pod	18 x 68mm unguided rockets per pod

1.2 – ARMAMENT RESTRICTIONS

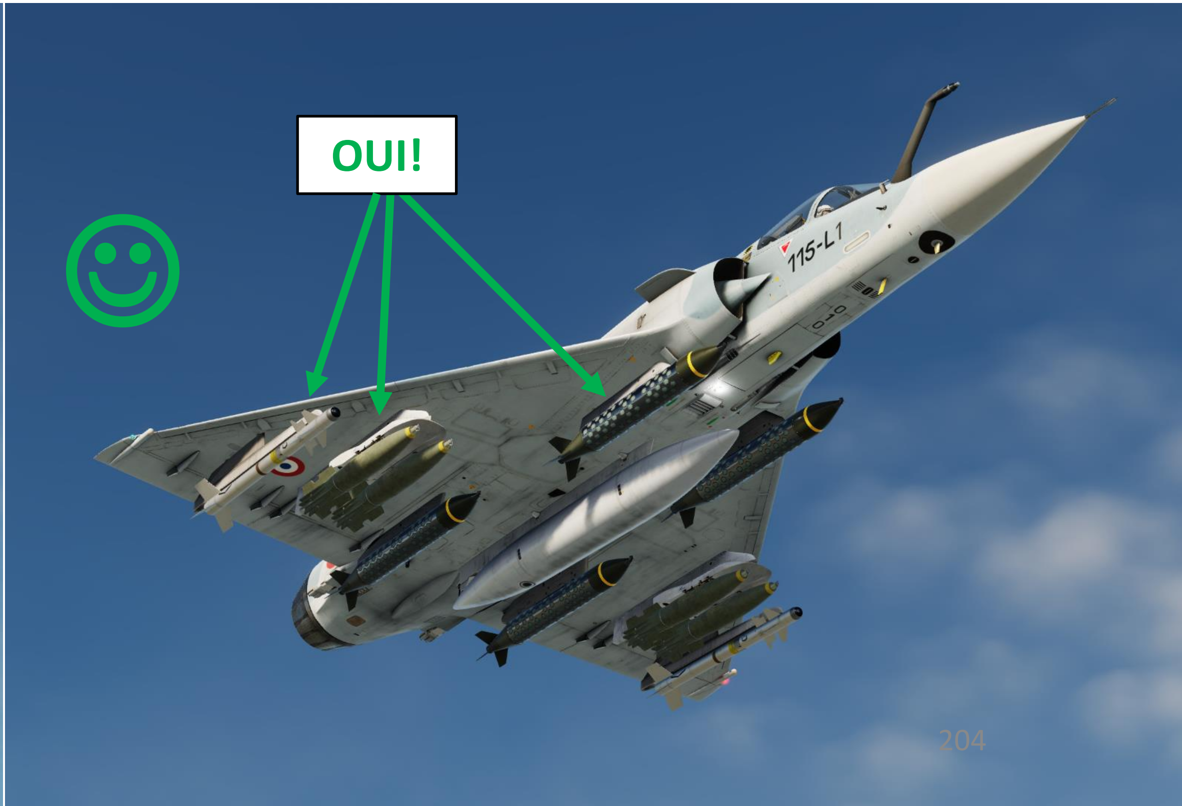
The Mirage 2000C can load a number of different air-to-air missiles and air-to-ground munitions. However, due to limitations of the targeting computer, it is **not possible to mix Super S530D missiles with air-to-ground weapons**, and not possible either to mix different kinds of air-to-ground weapons in non-symmetrical loadouts. Mixing rockets and bombs in asymmetrical loadouts may result in the weapon system not being able to handle the configuration and thus not work properly.

Remember this: **You can mix air-to-ground weapon types as long as the loadout is symmetrical. Asymmetrical loadouts may result in the inability to deliver any munitions.**

STANDARD CONFIGURATIONS

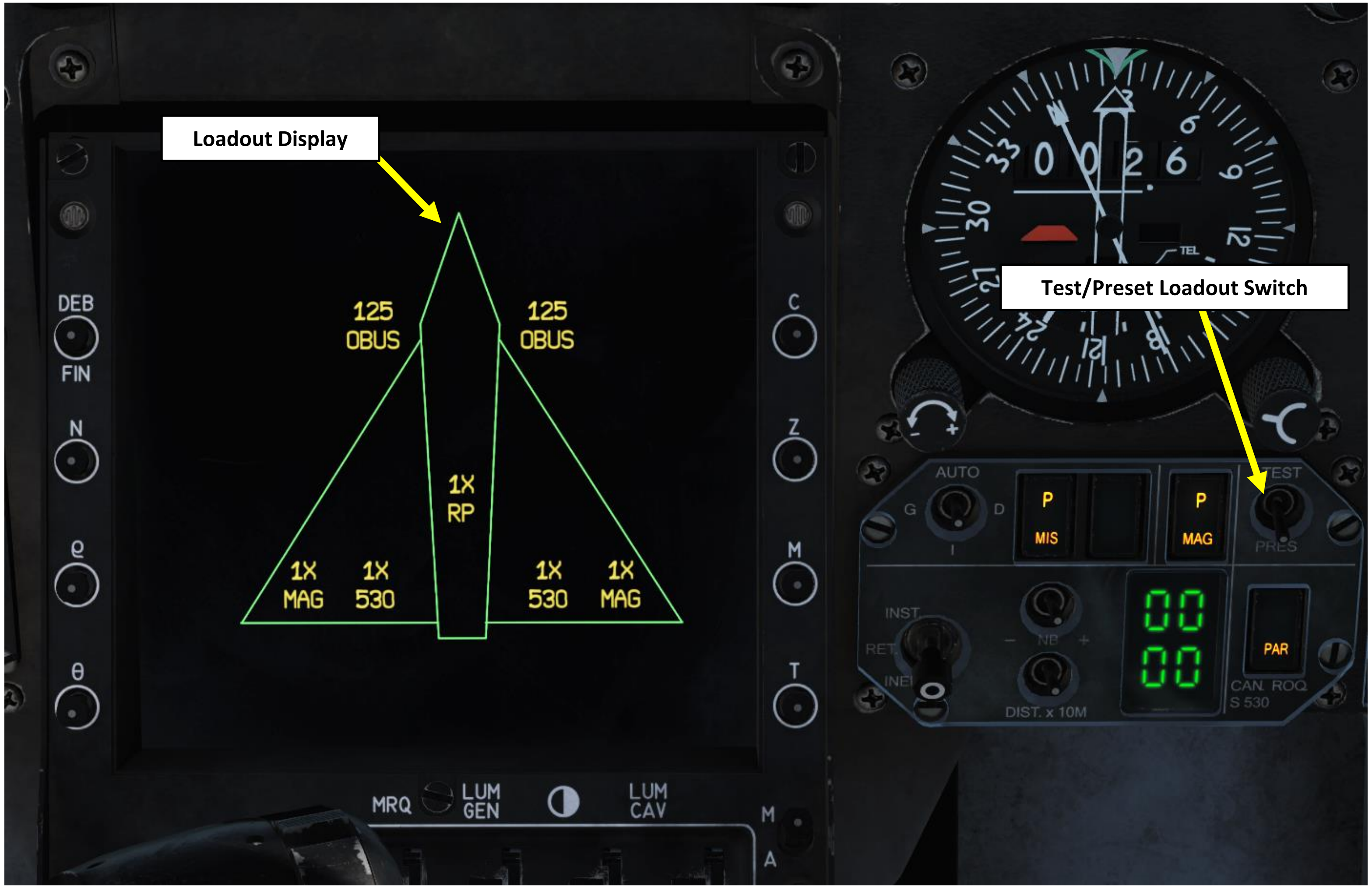
Configuration	Detailed Payload
CLEAN AIRCRAFT	Full internal fuel; guns, brake chute and countermeasures (no extra Eclair pod) loaded
STANDARD AIR TO AIR	Clean + 2x Fox2 + 2x Fox1 + Center fuel tank
STANDARD AIR-TO-GROUND	Clean + 2x Fox2s + 4x Mk-82s + Wings fuel tanks or Clean + 2x Fox2s + 2x GBU-12s (center pylon+adapter) + Wings fuel tanks

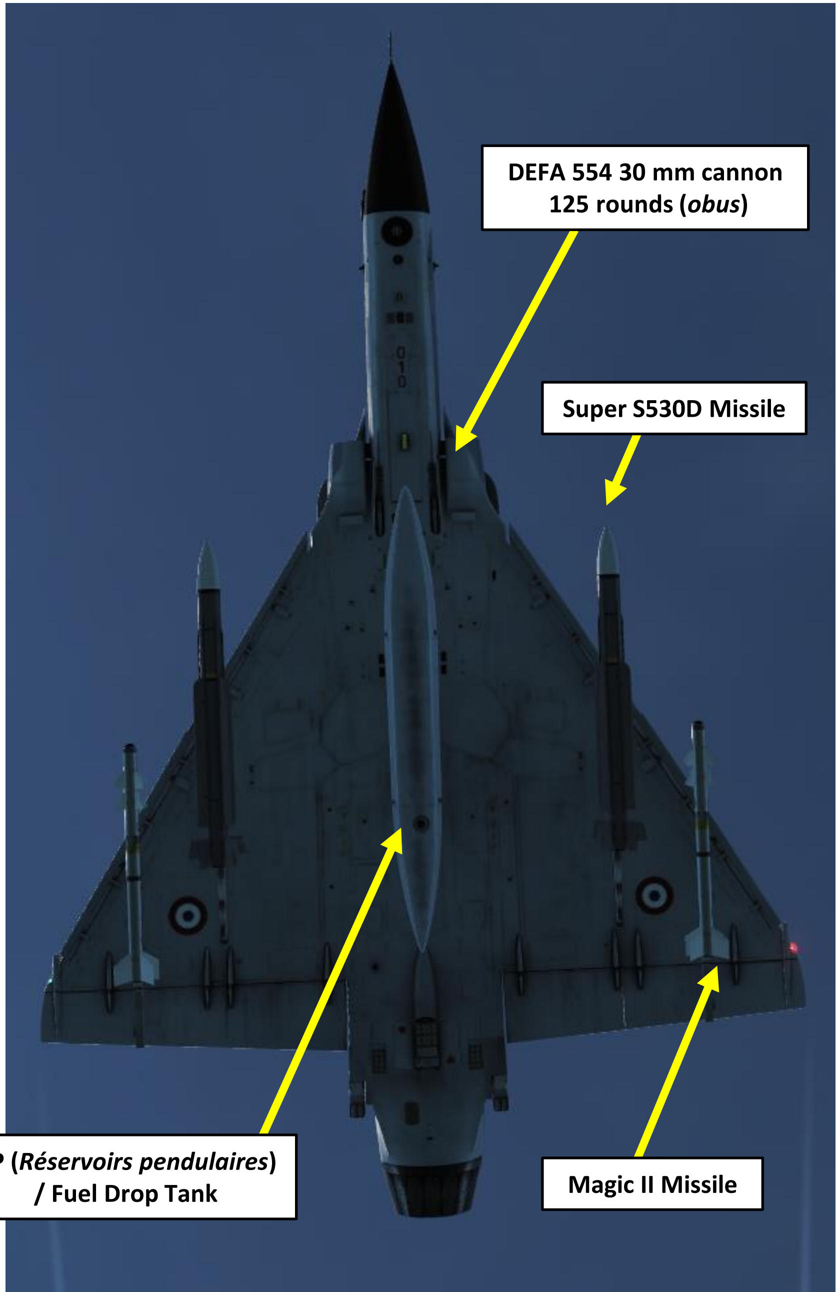
Fox 1: Super S530D Semi-Active Radar Homing Missile
Fox 2: Magic II Infrared-Guided Missile



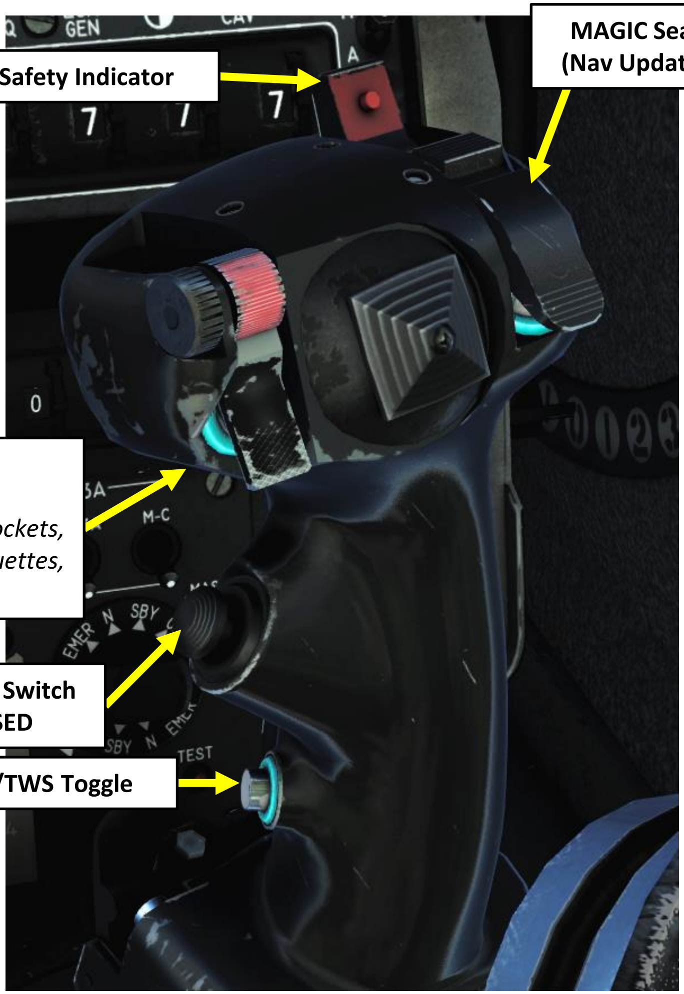
1.3 – VTB Weapon Loadout Display

Setting the Test/Preset Loadout switch to the PRES (DOWN) position displays an aircraft Loadout page, which shows the armament and fuel tanks loaded on the aircraft.





1.4 – WEAPON CONTROLS (REAL AIRCRAFT)



Trigger Safety Indicator

MAGIC Search / Vertical Fix (Nav Update / Magic Unlock)

MiCRoB Trigger (2nd Stage) (Trigger in Front of Stick)
MiCRoB means "missiles, guns, rockets, bombs" (Missiles, cannons, roquettes, bombes)

Weapons System CMD Switch FWD/AFT/DEPRESSED

STT/TWS Toggle

CNM (Cannon/Neutral/Magic) Switch
- LEFT: CNM AA Gun Select
- CENTER: CNM Neutral (PCA Select)
- RIGHT: CNM Magic Select

Magic Slave / Air-to-Ground Designate Button

Target Designator Caret (TDC) Switch DEPRESSED = Radar Lock

1.5 – WEAPON CONTROLS (MY SETUP)

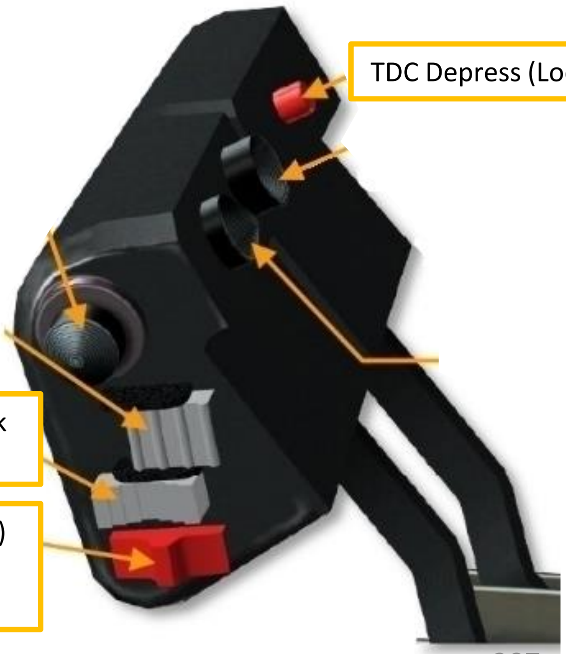
CNM AA GUN (C)
(Grey button on RHS)

MAGIC SLAVE/AG DESIGNATE

MiCRoB Trigger
(2nd Stage) (SPACE)

↑ Weapons System CMD FWD
→
↓ Weapons System CMD AFT
←
P

↑
→ STT/TWS Toggle
↓
← Weapons System CMD DEPRESS



TDC Depress (Lock Target)

← NAV UPDATE / Magic Unlock
→

← CNM NEUTRAL (PCA SELECT)
→ CNM MAGIC

1.6 – VTH MASTER MODES

The VTH (*Visualisation Tête-Haute*, or Heads-Up Display) displays information based on the master mode and sub-mode or option. There are three master modes: **Navigation (NAV), Air-to-Air and Air-to-Ground**. Each master mode one has a number of sub-modes and options. Sub-modes are exclusive and options can be combined between them and with some sub-modes.

- **NAVIGATION MASTER MODE**: Default mode when no weapon is selected or when an air-to-ground weapon is selected but the SNA (*Système de Navigation et d'Attaque,* Navigation & Attack System) is in air-to-ground pre-selected or memorized sub-mode.
  - HEADING ERROR (*Erreur de route*): Default navigation mode, the VTH will display BUT navigation symbology.
  - GROUND (*Roulage*): Automatically displayed when the plane has weight on wheels.
  - APPROACH (*Approche*): Selected with the **APP** button on the PCA (*Poste de Contrôle d'Armement*, Armament Control Panel), used for approaches and landings.
  - RADAR FIX (*Recalage oblique*): Selected with the **OBL** button on the PCA, used to perform an INS radar fix.

  - In NAV master mode, the following options can be selected at the same time:
    - DESIRED HEADING (*Route désirée*): Selected with the **RD** button on the PCA, used for navigation on a BUT while flying on a selected Heading.
    - DESIRED TIME (*Temps désiré*): Selected with the **TOP** button on the PCA, used to arrive to a BUT at a predefined time.

<u>1.6 – VTH MASTER MODES</u>

- **<u>AIR-TO-AIR MASTER MODE</u>**: Displayed when any air-to-air weapon is selected and in police mode.
    - MAGIC: Displayed when the MAGIC II missile is selected.
    - AIR-TO-AIR GUN: Displayed when the gun is selected in air-to-air mode (use the CNM switch (*Canon-Neutre-Missile*)).
    - 530: Displayed when the Super 530D missiles is selected.
    - POLICE: Used to intercept aircraft in peace times. Selected using the **POL** button on the PCA (*Poste de Contrôle d'Armement*, Armament Control Panel).

    - In Air-to-Air master mode, the following option can be selected at the same time:
        - AUTO-LOCK: Indicates the currently selected auto-lock mode. Auto-lock options display information on the currently selected radar auto-acquisition mode (close combat radar modes).

1.6 – VTH MASTER MODES

- **AIR-TO-GROUND MASTER MODE**: Displayed when an air-to-ground weapon is selected on the PCA (*Poste de Contrôle d'Armement*, Armament Control Panel) and the SNA (*Système de Navigation et d'Attaque,* Navigation & Attack System) is in air-to-ground selected sub-mode.
  - AIR-TO-GROUND GUN OR ROCKET: Displayed when the CAS (canon air-sol – air-to-ground gun) or the rockets are selected.
  - CCPI (*Calcul continu du point d'impact* – Continuously calculated impact point): Displayed when a high drag (*freinée*) or very high drag (*hyperfreinée*) bomb is selected.
  - CCPL (*Calcul continu du point de larguage* – Continuously calculated release point): Displayed when a low drag (*lisse*) or guided (*guidée*) bomb is selected.

  - In Air-to-Ground master mode, the following option can be selected at the same time:
    - PI (Point initial – Initial point): Displayed with the PI button when a high drag, very high drag, low drag or guided bomb is selected.

1.7 – TIPS ON WEAPON EMPLOYMENT

The Mirage 2000C is a fly-by-wire aircraft. You should always know what FBW mode you are using. Being in the wrong FBW mode could make you lose a dogfight or rip your wings off during a bomb run. This tip is all the more relevant when employing weapons.

The FBW G limiter switch has two positions:

- **A/A** (UP) is used for an air combat configuration (2 x MAGIC II missiles + 2 x SUPER S530D missiles). This FBW mode will allow you to pull the maximal allowable number of Gs during a dogfight. In other words, the manoeuverability of your aircraft is maximal at this FBW setting.

- **CHARGES** (DOWN) is used for a heavy payload configuration (which includes any number of bombs and external fuel tanks). This FBW mode will restrict the number of Gs you can pull in comparison to the A/A mode. In other words, you will not be as manoeuverable. The reason for this mode is that structural damage can occur if you pull many Gs, which is caused by the heavy payload fixed to the hardpoints. The CHARGES (stores) mode is here to prevent your aircraft from ending in a smoldering ball of flames. When doing dive bomb runs, keep in mind that you will not be able to pull up as much as you would expect when flying in the A/A mode.

A/A:
- Limits load factor for the elevator elastic stop to 9 g (± 0.5 g).
- Limits AOA to 29° or 27° when speeds are under 100 knots
- Limits the roll speed and angular acceleration to 270°/sec.
- Audio warning when alpha ≥29°, or stick at full aft position, or indicated air speed below 100 knots.

CHARGES:
- Limits load factor for the elevator elastic stop to 5.5 g (± 0.5 g).
- Audio warning when alpha >= 20°. The pilot must abide to this limit by himself.
- Limits pilot roll command based on load factor.
- Limits roll angular speed to 150°/sec.

Fly-By-Wire limiter switch
A/A (UP): Air-to-Air Combat – For carrying light loads
CHARGES (DOWN): Stores – For carrying heavy loads

1.8 – BOMB DELIVERY MODES CCRP (*CCPL*) VS CCIP (*CCPI*)

There are 2 ways to deliver a weapon: CCRP or CCIP modes.

CCIP (*CCPI*) mode computes the impact point of the bomb in real time. Unlike traditional dive bombing attacks, the Mirage performs CCIP attacks by flying low and level.

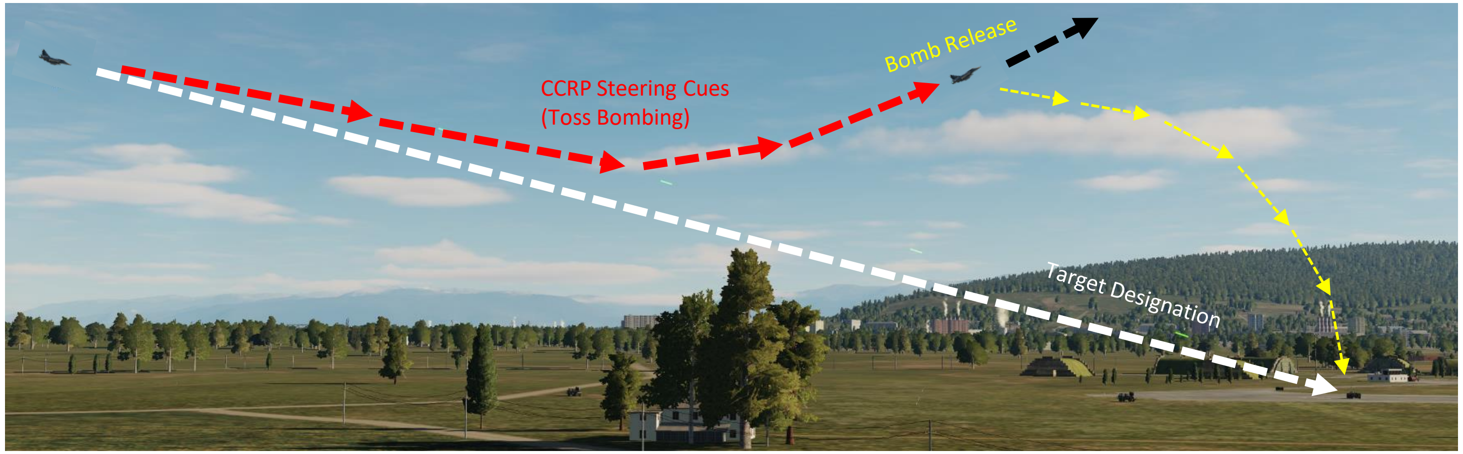
However, dive bombing is a risky business, especially if anti-air defences are surrounding your target. The lower you go, the more vulnerable you are. This is why CCRP release mode was invented.

CCRP (*CCPL*) mode allows you to designate a target in advance, then provide steering cues to help you release the bomb automatically using a "toss bombing" profile. The HUD will tell you when to release your bomb for the target you have designated with your radar. It is a much safer way to release a bomb, but as you may have guessed already, it is less precise. The Mirage 2000C being an interceptor first and foremost, the level of precision achievable has much to be desired. The Mirage 2000D, on the other hand, is much better suited and has the appropriate systems for precision bombing.

Take note that the delivery mode of bombs will be automatically "decided" for you: the Mirage 2000 is designed this way. You cannot choose how your ordnance will be dropped: a MK-82 (low drag) bomb will automatically engage CCRP mode while a MK-82 Snake Eye (high drag) bomb will engage CCIP mode.

CCIP: Continuously Computed Impact Point
CCPI: Calcul Continu du Point d'Impact

BOMBS USING CCIP: MK-82 SNAKE EYES, BLG-66, BAP-100



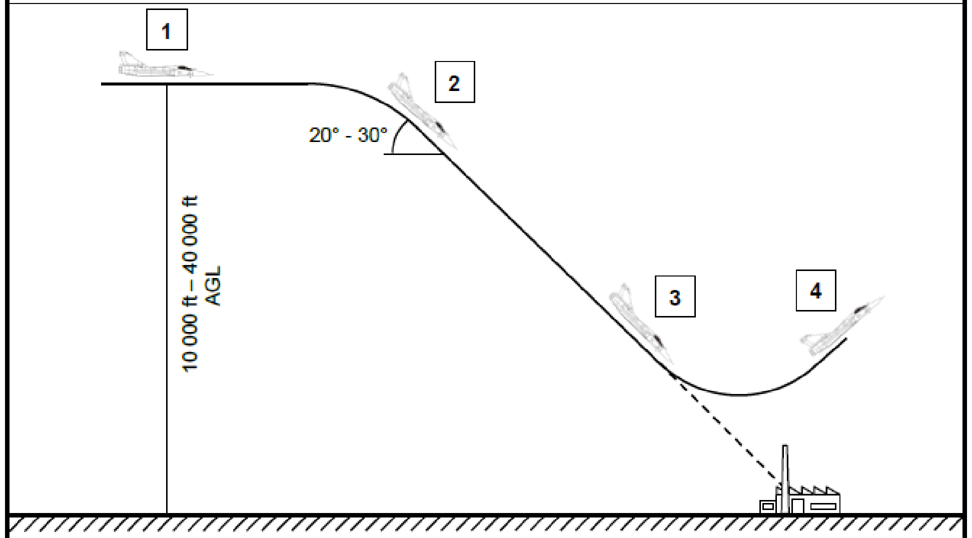
CCRP: Continuously Computed Release Point
CCPL: Calcul Continu du Point de Largage

BOMBS USING CCRP: MK-82, GBU-12, GBU-16, GBU-24

1.8 – BOMB DELIVERY MODES
CCRP (*CCPL*) VS CCIP (*CCPI*)

Source: RAZBAM Manual

CCPL DIVE-DIVE



PROFILE

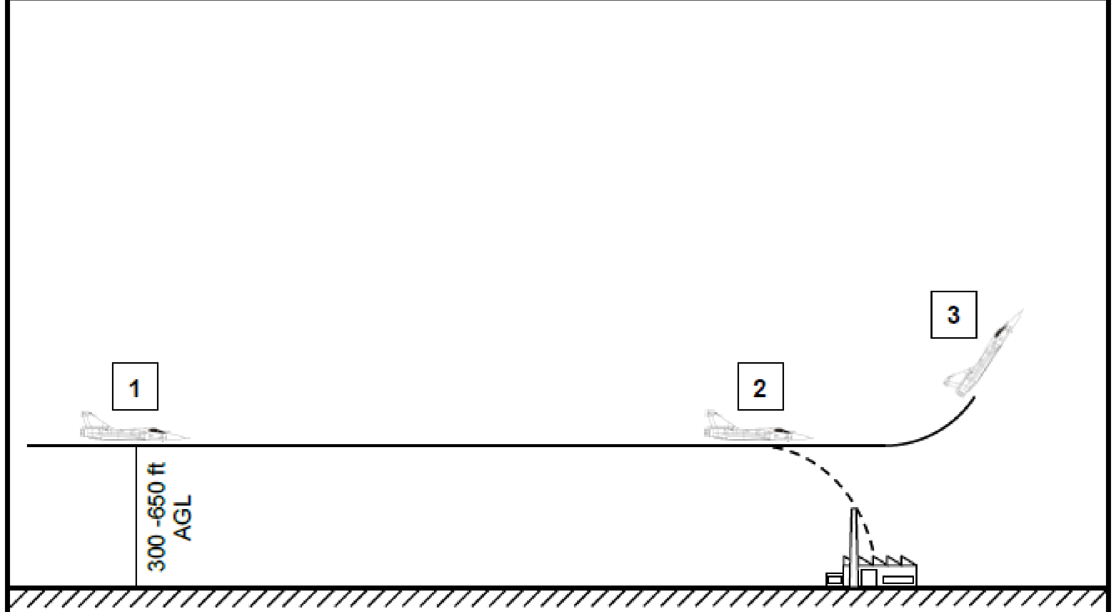
1. Starting between 10 000 ft and 40 000 ft level.
2. Execute a 20° to 30° dive toward the target.
   Keep the speed high during the dive but no faster than Mach 0.95.
3. Fire the rockets or guns between the maximum and minimum range.
4. Before entering the blast area, pull out of the dive and execute a sharp turn out of the target area.

DIVE DISTANCE

Altitude	Dive angle	Distance
10 000 ft	20°	4,5 nm
20 000 ft		9 nm
30 000 ft		13,5 nm
40 000 ft		18 nm
10 000 ft	30°	3 nm
20 000 ft		5,5 nm
30 000 ft		8,5 nm
40 000 ft		11,5 nm

Source: RAZBAM Manual

CCPI

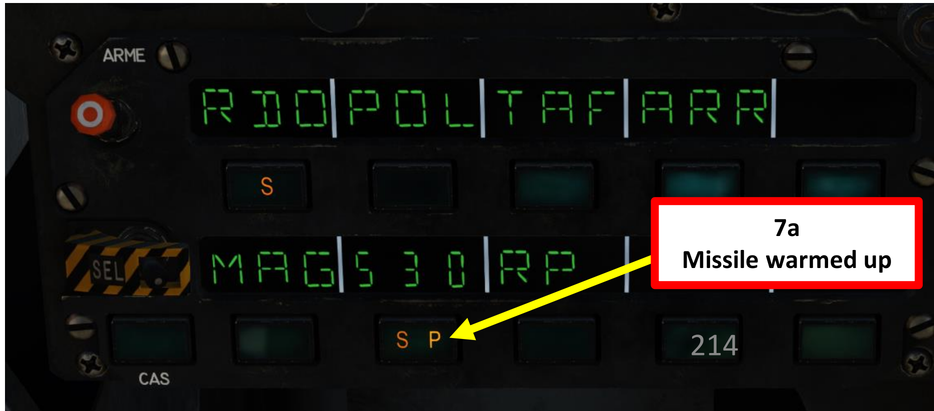


PROFILE

1. Starting around 300 ft and no more than 650 ft AGL and 500 kt.
2. Place the aiming reticle over the intended impact point.
3. Once all the bombs are released, execute a sharp turn out of the target area.

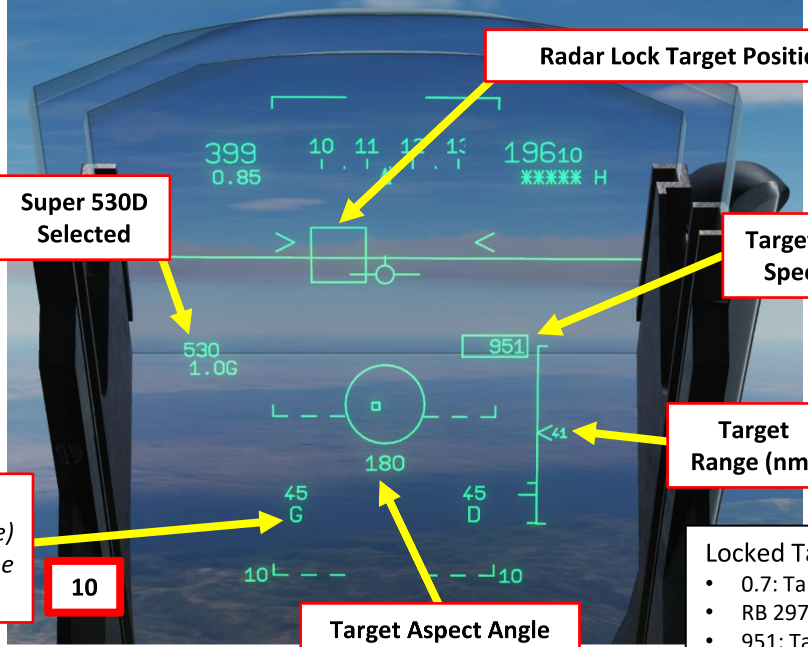
2.1 – SUPER S530D MISSILE

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the S530D missile via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA (*Poste Préparation Armement*, Weapon Configuration Panel), verify that S530 is warmed up. “P” (*Préparation*/Warm-up) blinks during warm-up process after engine start (30 s) and remains illuminated when warm-up is complete. “MIS” indicates that S530 missiles are loaded on the aircraft.
3. On PPA, select which missile to fire (G = Left, I = AUTO, R = Right)
4. On PPA, set S530 salvo mode as desired by pressing the Weapon Salvo Selection Button to toggle between TOT and PAR salvo settings.
   - TOT (Total): While trigger is pressed and held, two missiles are launched at an interval. The second missile will fire 2 seconds after the first if the trigger is held pressed.
   - PAR (Partial): Only 1 missile is fired per trigger press.
5. On PPA, select S530 Fire Selection Mode by pressing the “S530 Fire Selection Button” to toggle between Automatic mode (“AUT” indication is visible) and Manual mode (“AUT” indication is not visible).
   - AUTOMATIC:The weapon fire command act as a weapon release consent, the aircraft fire the missile when the condition provides a good probability of kill.
   - MANUAL: The weapon fire command fires the missile when pressed regardless of the probability of kill computed.
6. On the PCA, turn Master Arm switch to ARME (UP)
7. Select 530 missile by pressing the “530” button. A “S” indication shows that the missile is selected. A “P”(*Prêt*) indicates that the missile is warmed up and ready to be used.
8. Turn on Radar Power by setting switch to **EM**ISSION.
   - Consult previous chapter for radar operation parameters.



2.1 – SUPER S530D MISSILE

9. Detect target using vertical antenna and radar range controls. Radar will be in Bar Search (RECH) mode by default.
10. Pre-select PIC mode by using the STT/TWS Toggle button on the stick. The VTB (Heads-Down Display) should indicate "PIC" on the bottom right corner of the display.
11. Slew TDC (Target Designator Caret) on the radar contact you want to lock.
12. Depress TDC to lock the target.
13. Radar will switch from Bar Search to PSIC/STT (Single Target Track) mode, indicated by a track line and tracking information on the upper portion of the VTB.
14. If you press the STT/TWS Toggle button after locking, you will toggle between TWS and STT (Single Target Track, PIC) modes at will. This step is not required.
15. Target will have a square box on it on the HUD and radar will enter STT/PIC (Single Target Track) mode.



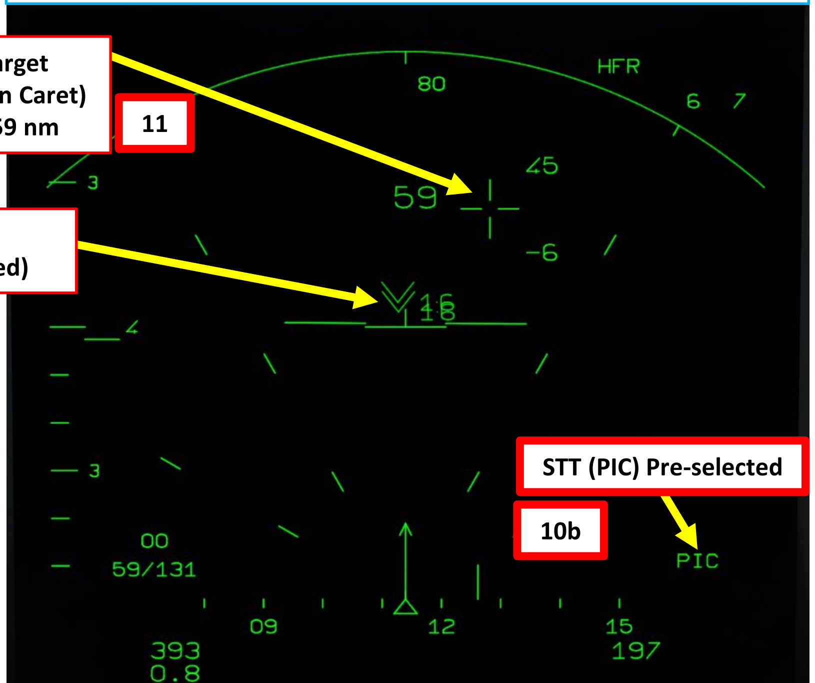
Radar Lock Target Position Box
15
Super 530D Selected
Target Closure Speed (kts)
Target Range (nm)
Super 530D Missile Status
Indicates the presence of the left (G – gauche) and right (D – droit) missiles. Flashes when the missiles are not ready.
10
Target Aspect Angle

Locked Target Data
- 0.7: Target Speed (Mach)
- RB 297: Target Heading (direction flown by target)
- 951: Target closure speed (kts)
- Target Altitude (200 = 20000 ft)

11
12

10a
STT/TWS Toggle

RADAR IN BAR SEARCH MODE



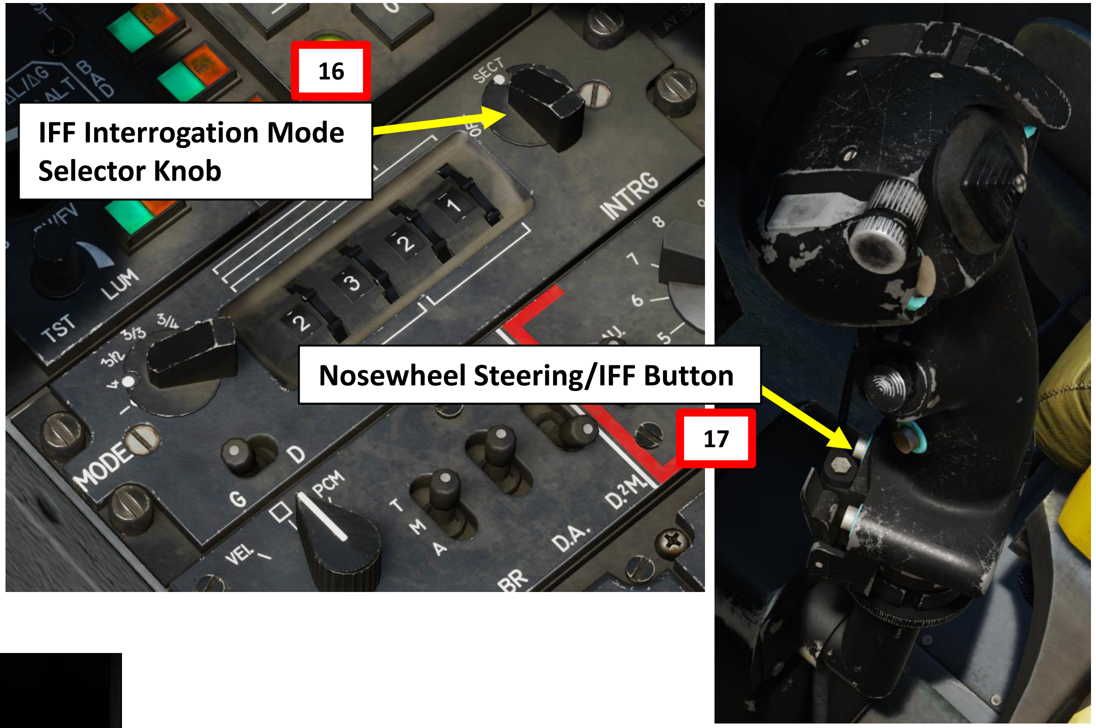
TDC (Target Designation Caret) Range: 59 nm
11
Target (Not Locked)
STT (PIC) Pre-selected
10b

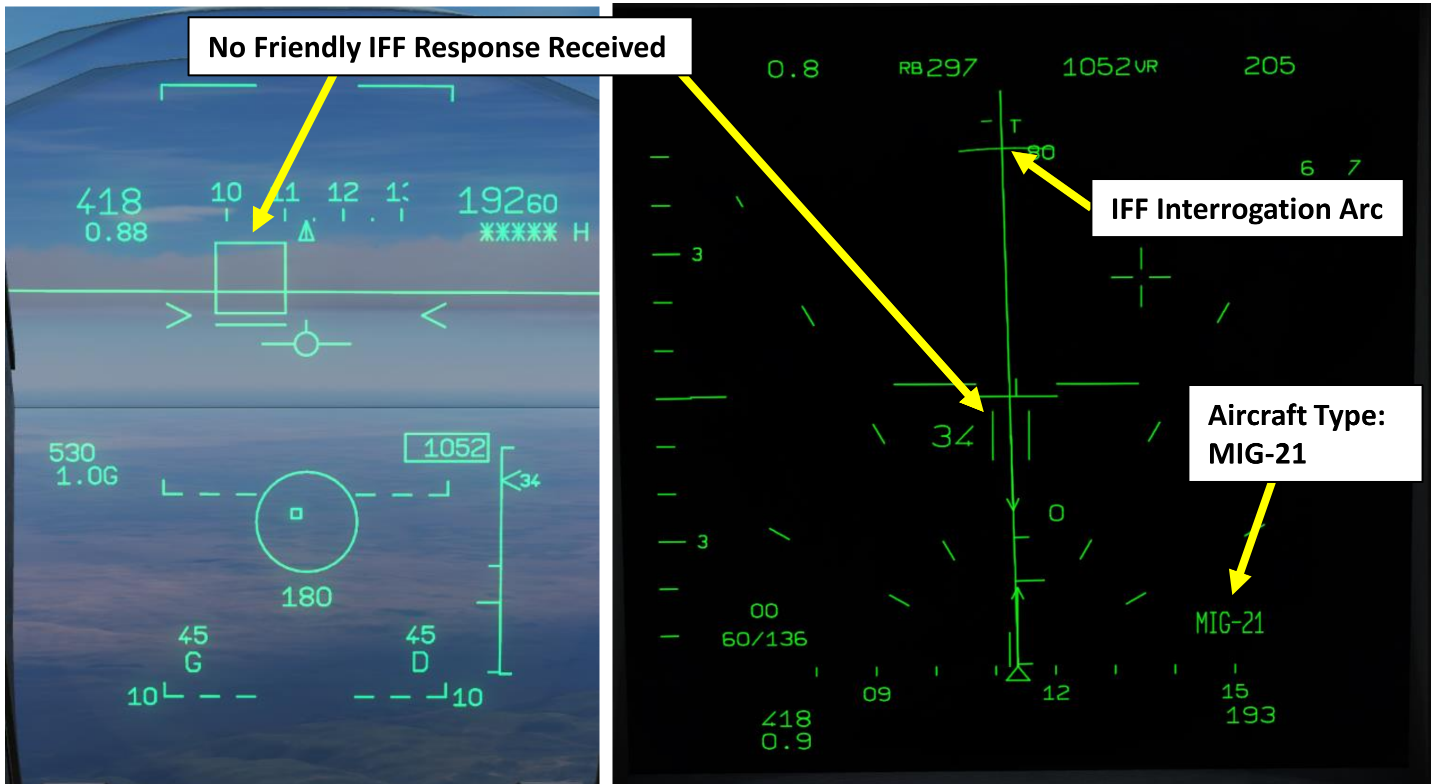
RADAR IN PSIC/STT LOCK MODE

Target Locked
13

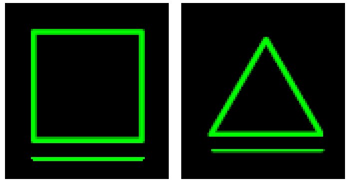
2.1 – SUPER S530D MISSILE

16. Set IFF Power Switch to either SECT (Sectoral, middle position) or FULL (rightmost position), as desired.
    - SECT (Sectorié – Sectored): The interrogation is sent in a 20° arc around the TDC (Target Designation Caret).
    - CONT (Continue – Full): The interrogation is sent in the full search pattern, within the limits of its azimuth setting and orientation.
17. Press the NWS/IFF button (keyboard shortcut: “S”) to interrogate. The IFF interrogation is maintained as long as the command is pressed and last at least a complete scan pattern.
18. The IFF antenna is placed on the radar antenna and thus follow its azimuth and elevation. Its field of interrogation is 10° wide. With the radar in bar search (only with the PRF set to HFR or ENT) or PSID, the execution of an interrogation is represented by a doubling of the radar range marker arc. The size of the interrogation arc is dependent on the position of IFF interrogation mode on the IFF interrogator panel.
19. When an IFF interrogation is requested, the arc is dashed until the interrogation is effective. When interrogation is effective, the arc is displayed full. With IFF interrogation mode in CONT, it lasts only 0.5 sec while in SECT, the interrogation is effective is only when the radar antenna is oriented in the requested interrogation azimuth.
20. Keep interrogating sporadically in order to be 100 % sure you are firing at an enemy. Below 35 nm, the IFF system should be able to determine which aircraft type you are locking.

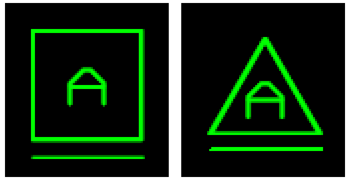




IFF Interrogation In Progress & IFF Correlation (PSIC/STT)

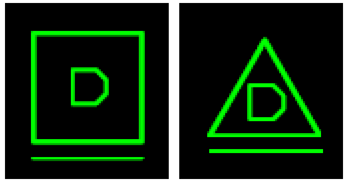


Indicates that radar target is being interrogated by the IFF system



Indicates that radar target has replied as a friend to the IFF interrogation.

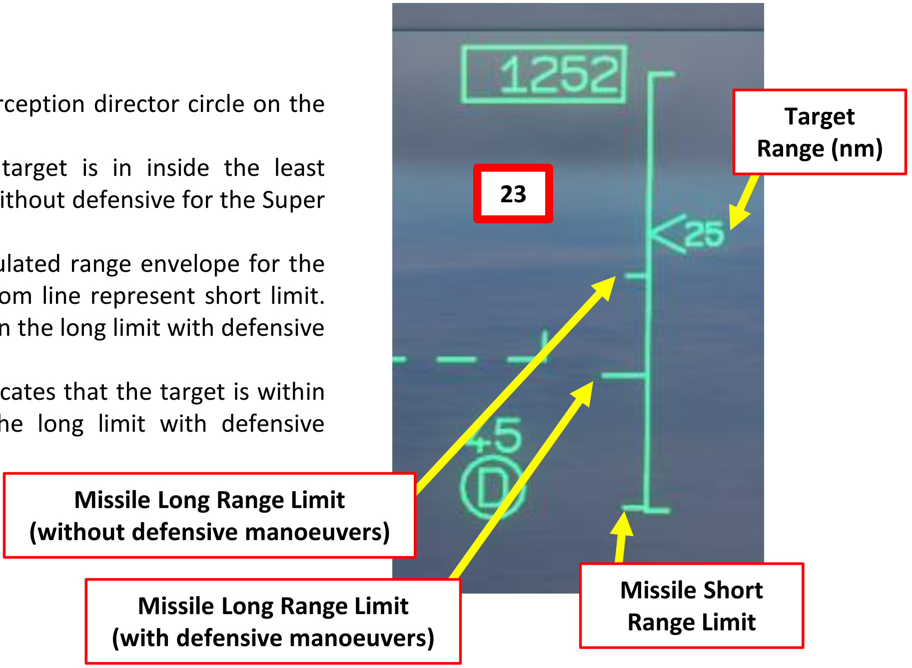
“A” stands for “Ami”, or “Friendly”.

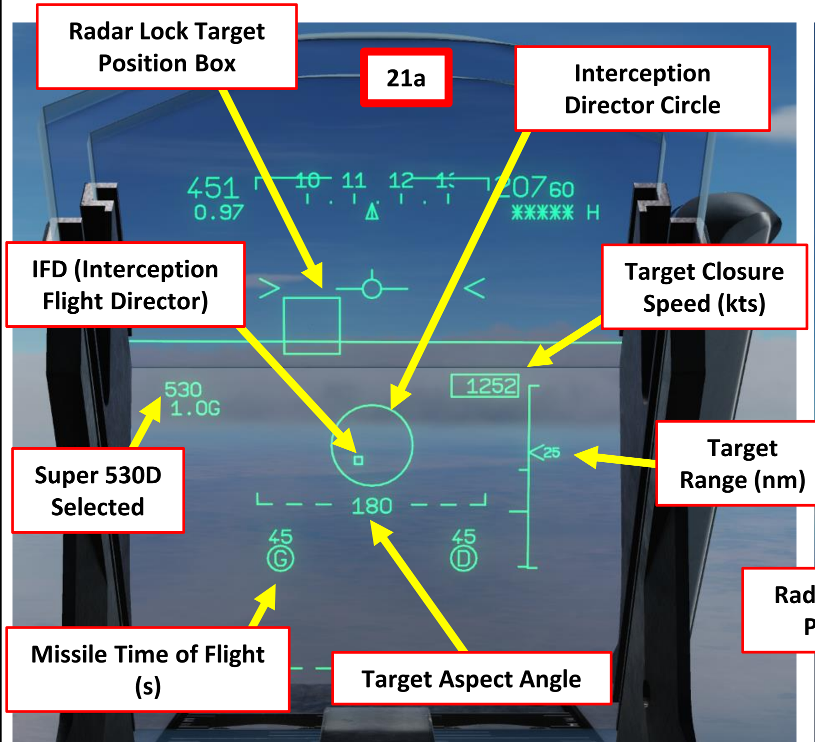


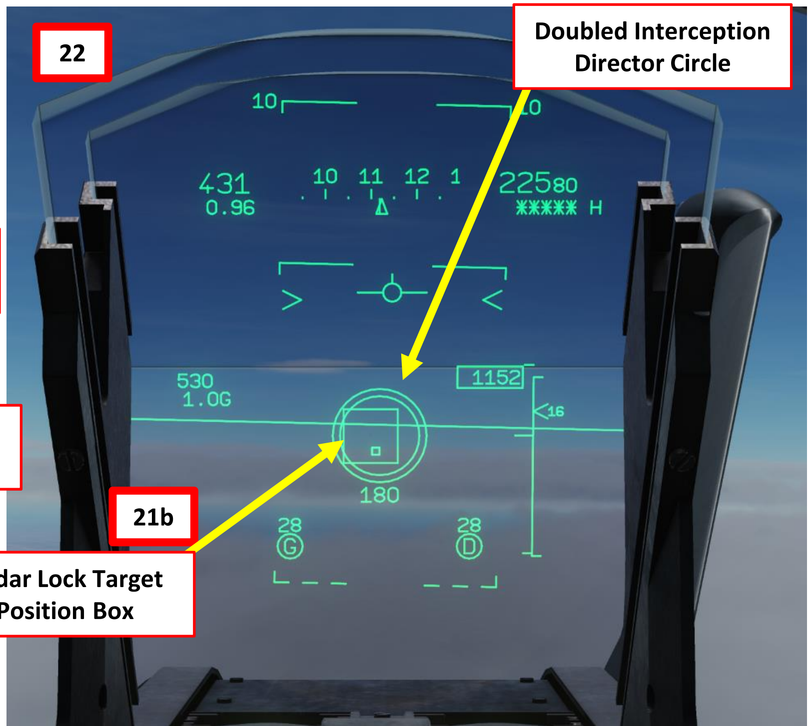
Indicates that the radar has received a friendly reply from the target, but the position of the IFF replying aircraft does not correspond to the target position.

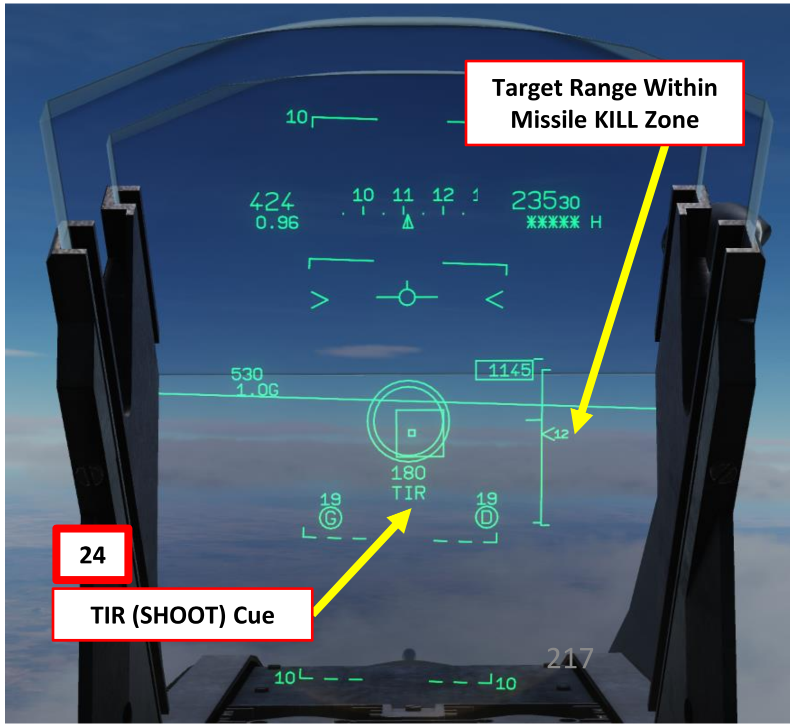
2.1 – SUPER S530D MISSILE

21. As you approach the target, fly the aircraft to place the interception director circle on the radar lock target position box.
22. A doubled interception director circle indicates that the target is in inside the least restrictive firing domain, meaning closer than the long limit without defensive for the Super 530D.
23. The radar range scale on the VTH represents the radar calculated range envelope for the 530s. The 2 top lines represent the long limits and the bottom line represent short limit. The long limit without defensive maneuvers line is thicker than the long limit with defensive maneuvers.
24. When the TIR (SHOOT) indication appears on the VTH, it indicates that the target is within the most restrictive firing domain, meaning closer that the long limit with defensive maneuvers for the Super 530D. You can fire the missile.



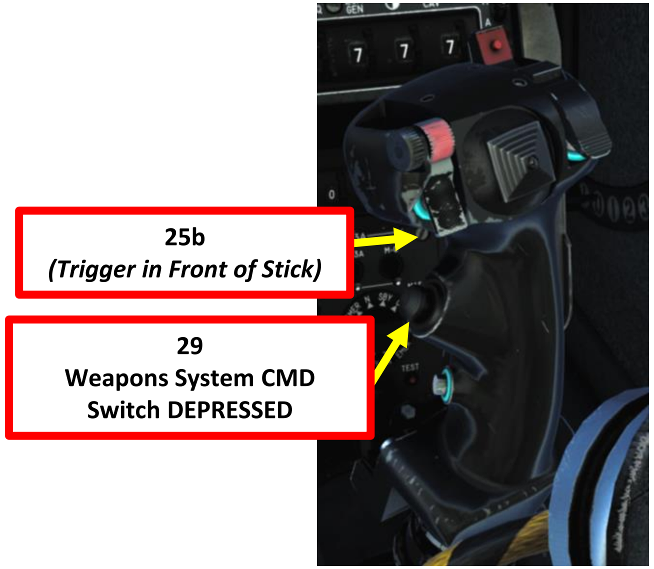






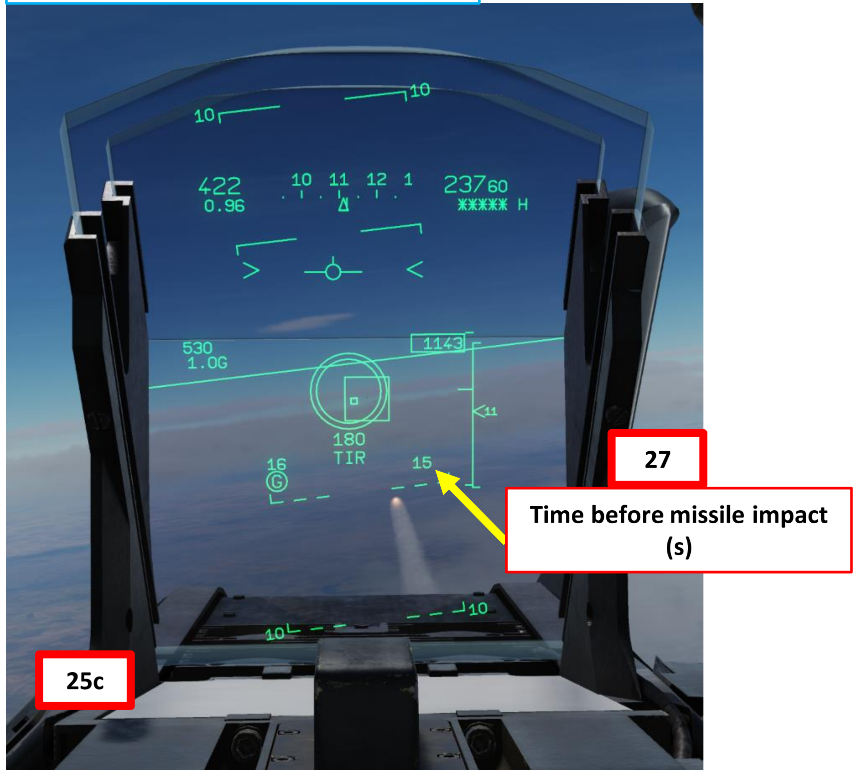
2.1 – SUPER S530D MISSILE

25. Press and hold MiCRoB Trigger (2nd Stage) for at least 2 seconds (SPACE by default) when missile is within KILL (no escape) range.
26. There is a time delay between the moment the trigger is pressed to the instant the missile is launched; this is both a security measure and a time needed to feed the missile computer with data for launch. Note: **When pressing MiCRoB Trigger (2nd Stage) from TWS (PID) mode, the radar will automatically switch to STT (PIC) mode, and only then the missile will launch**.
27. Once missile is fired:
    - Radar mode will switch from PSIC/STT to PSIC/STT SUPER 530 for 50 seconds. This mode change is indicated by the missile's time of flight changing to the missile's time to impact. The time in seconds indicates the remaining time before the missile reaches the target as calculated by the aircraft. If 2 missiles have been fired, only the last one will have an accurate time to impact calculation, the first missile time to impact will switch to a count down from the last calculated value.
    - Engine RPM will automatically decrease to prevent an engine flameout, which could be caused by ingestion of the smoke released by the missile launch. RPM will increase back to normal values a few seconds later.
28. Maintain radar lock for as long as the missile is in the air: the Super S530 will be guided by your radar. Since missile homing is semi-active, radar lock needs to be maintained in order to keep the missile tracking the target correctly. Once fired, Super S530D Missile battery life is about 45 seconds.
29. You can unlock target with the HOTAS Weapons System CMD switch DEPRESSED on the stick.



Missile Not Launched Yet (PSIC Mode)

Missile Launched (PSIC S530 Mode)



2.1 – SUPER S530D MISSILE

P = Prêt
(Ready)

2.2.1 – MAGIC II MISSILE SEARCH MODES

The MAGIC II missile can use different search modes. These mods are not to be confused with radar modes; the search patterns we will explore here are based on the MAGIC missile's seeker head.

- If MAGIC missile is selected with the CNM (Cannon/Neutral/Magic) (CNM) switch RIGHT and MAG PCA (Armament Control Panel) button is not pressed (displays MAG), the Magic seeker will **default** to the **Vertical Wide Search** mode. Pressing the **Nav Update / Magic Unlock (Magic Search / Vertical Fix)** button will toggle search mode to **Vertical Narrow Search** mode.

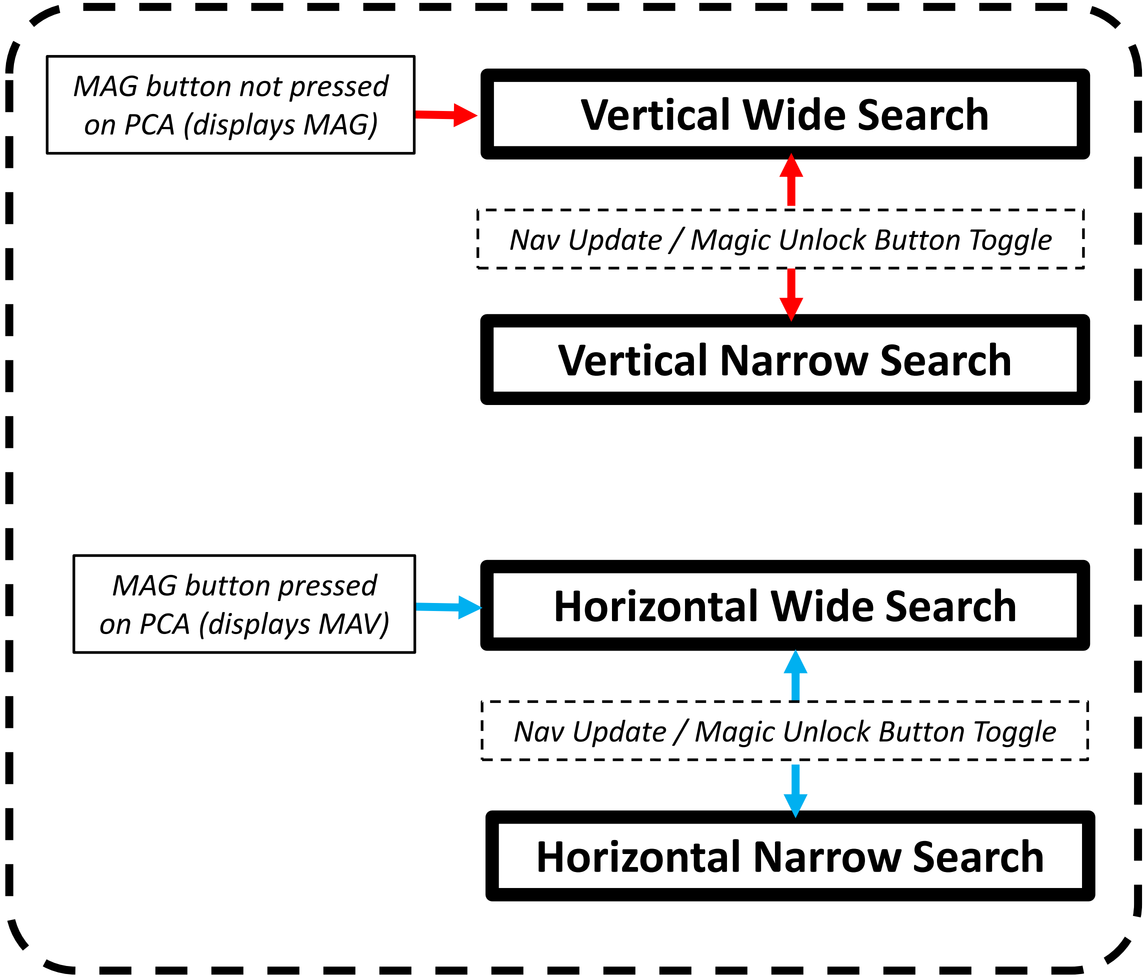
- If MAGIC missile is selected with the CNM (Cannon/Neutral/Magic) (CNM) switch RIGHT and MAG PCA (Armament Control Panel) button is pressed (displays MAV), the Magic seeker will **default** to the **Horizontal Wide Search** mode. Pressing the **Nav Update / Magic Unlock (Magic Search / Vertical Fix)** button will toggle search mode to **Horizontal Narrow Search** mode. Pressing the **MAG PCA button again** (changing from MAV to MAG) will toggle search mode to either Vertical Wide or Vertical Narrow Search mode based on what Horizontal Mode was selected.

Depending on the selected search pattern, acquiring lock may take a few seconds, as the seeker has to complete the whole pattern. The larger the search zone, the longer it may last. Vertical Narrow Search allows for the shortest lock time.

CNM (Cannon/Neutral/Magic) Switch
- **LEFT: CNM AA Gun Select**
- **CENTER: CNM Neutral (PCA Select)**
- **RIGHT: CNM Magic Select**

Magic Search / Vertical Fix (Nav Update / Magic Unlock)

Magic II Missile Search Modes



Visible on VTH (Heads-Up Display)

MAG Button on PCA (not pressed)

MAG Button on PCA (pressed), displays MAV selected

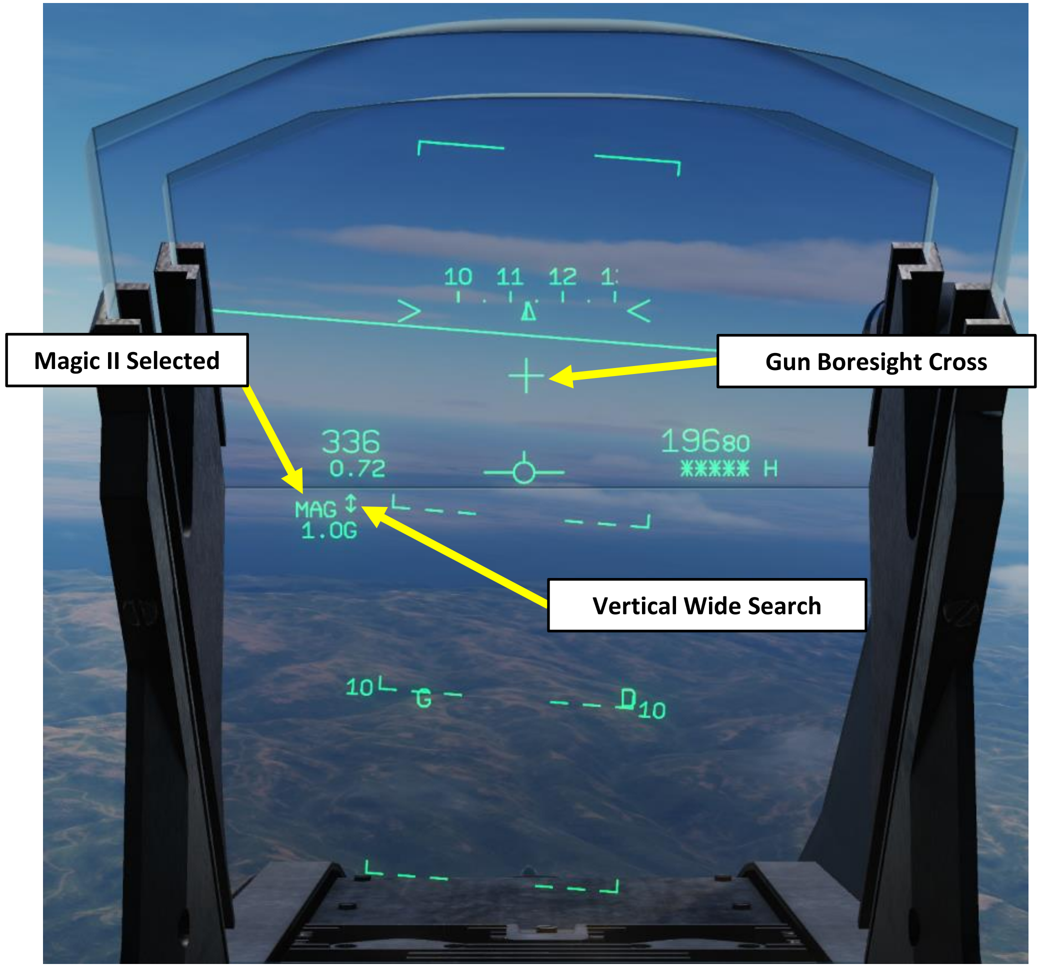
2.2.1 – MAGIC II MISSILE SEARCH MODES

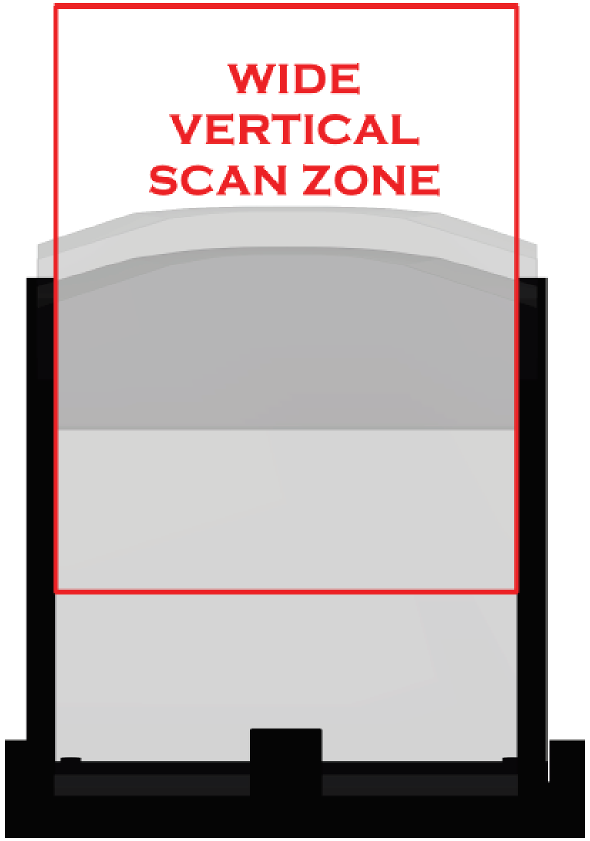
Vertical Wide Search

Vertical Wide Scan is a 18 deg wide and 37 deg tall rectangle-shaped search sector with its bottom located 6.5 deg below the gun cross position. This search sector is selected by default when the MAGICs or air-to-air guns are selected. It is represented on the VTH by the MAGIC search sector symbology, a vertical double arrow right of the selected sub-mode.

SELECTION METHOD

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile.
2. By default, the Magic II missile's Vertical Wide Search mode will be selected.





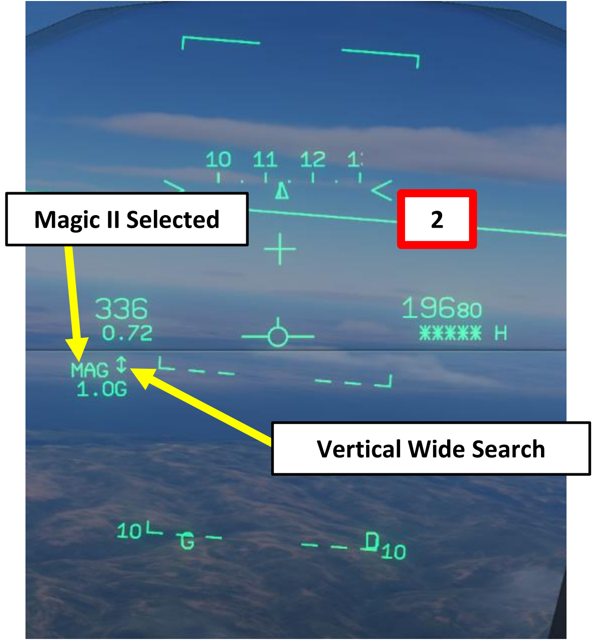
2.2.1 – MAGIC II MISSILE SEARCH MODES

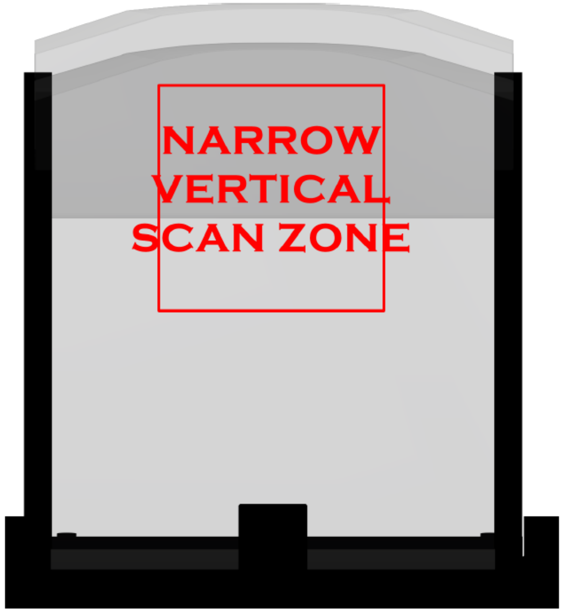
Vertical Narrow Search (from Vertical Wide Search)

Vertical Narrow Search is a 7° wide x 7° tall box cantered around the gun cross. A box is displayed indicating the HUD area where the seeker is searching, and is removed upon missile lock.

SELECTION METHOD 1 (from missile selection):

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile.
2. By default, the Magic II missile's Vertical Wide Search mode will be selected.
3. Press the MAGIC Search / Vertical Fix (Nav Update/ Magic Unlock) button to toggle the Magic II missile's search mode to Vertical Narrow Search.



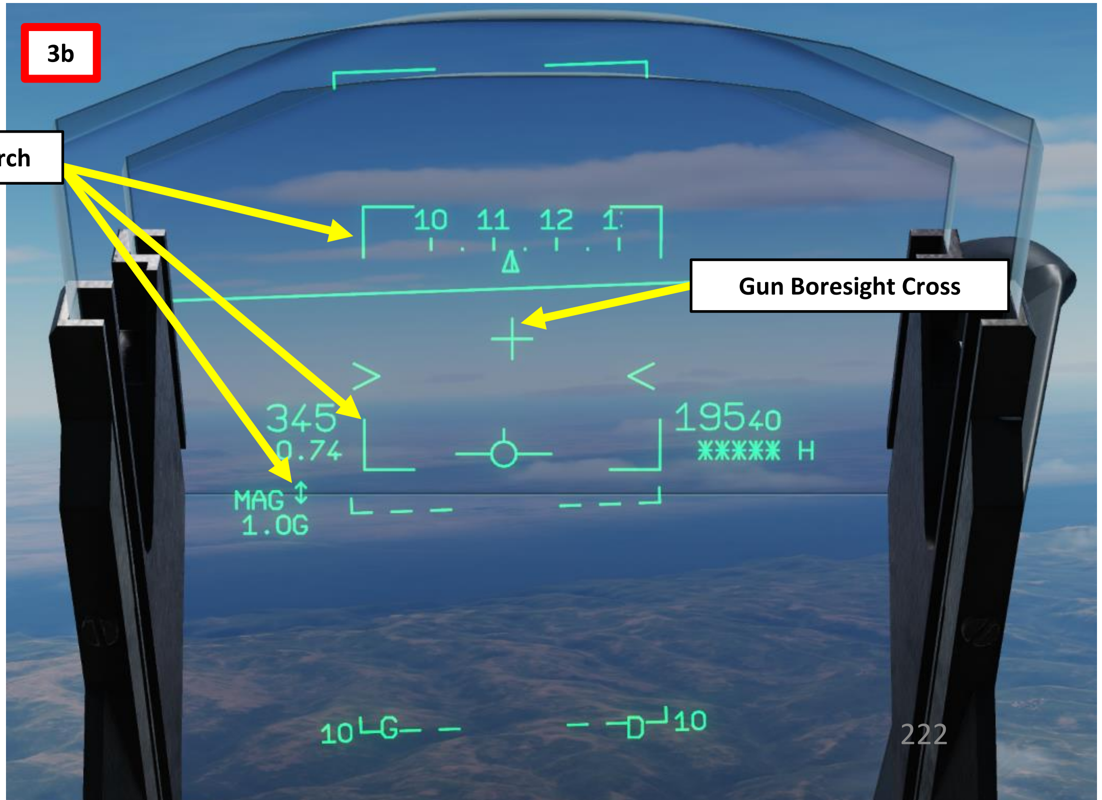


CNM (Cannon/Neutral/Magic) Switch
- LEFT: CNM AA Gun Select
- CENTER: CNM Neutral (PCA Select)
- RIGHT: CNM Magic Select

1

MAGIC Search / Vertical Fix
(Nav Update / Magic Unlock)

3a



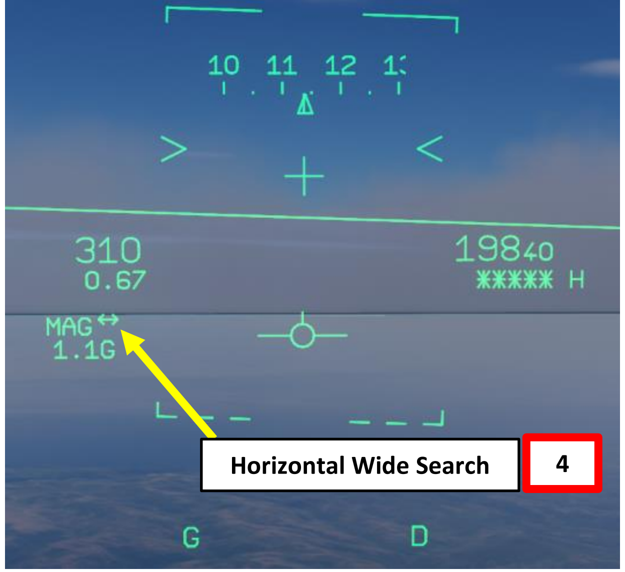
2.2.1 – MAGIC II MISSILE SEARCH MODES

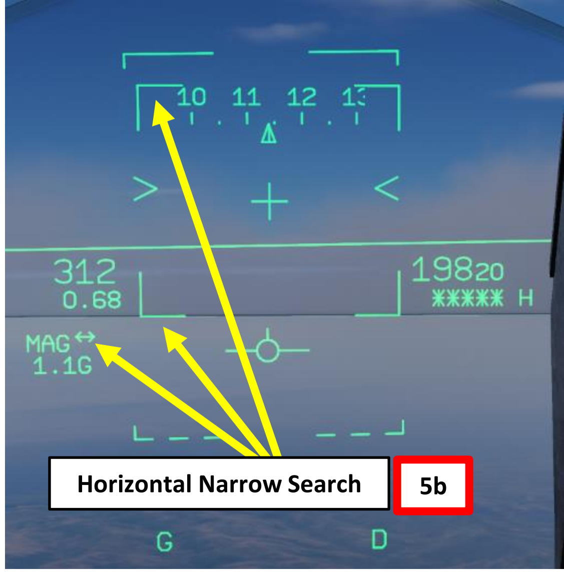
Vertical Narrow Search (from Horizontal Wide Search)

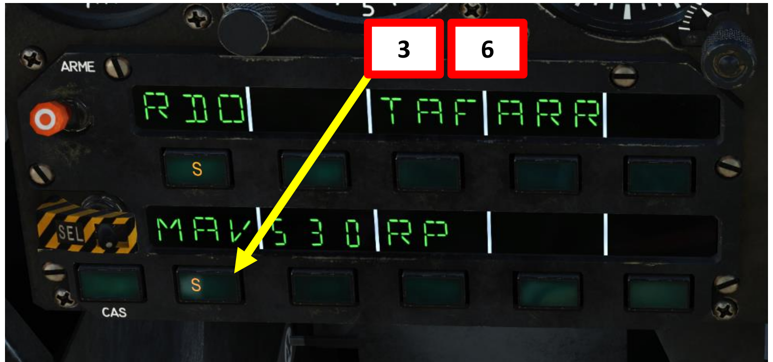
Vertical Narrow Search is a 7° wide x 7° tall box cantered around the gun cross. A box is displayed indicating the HUD area where the seeker is searching, and is removed upon missile lock.

SELECTION METHOD 2 (from a Horizontal Mode):

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile.
2. On PCA, press the MAG button.
3. Once MAG is selected, the MAG indication will switch to MAV (MAGIC *Veille* / Background Search). MAV mode allows the MAGIC missile to perform a contact acquisition search pattern when the MAGICs or air-to-air guns are not selected.
4. By default, Horizontal Wide Search Mode will be selected.
5. Press the MAGIC Search / Vertical Fix (Nav Update/ Magic Unlock) button to toggle the Magic II missile's search mode to Horizontal Narrow Search.
6. On PCA, press the MAV button. The Magic search mode will switch from Horizontal Narrow to Vertical Narrow.







1

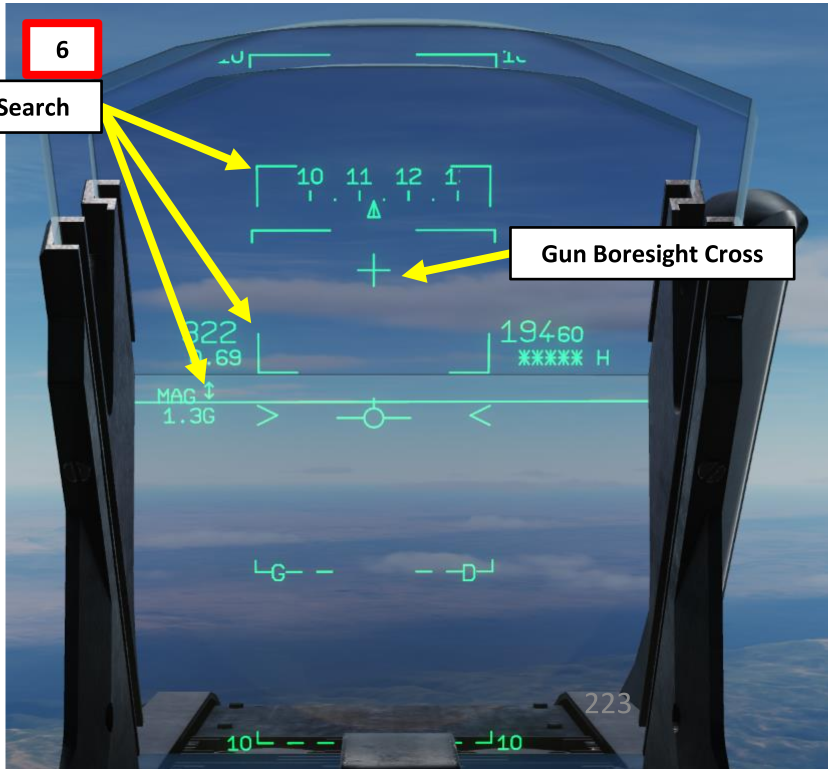
CNM (Cannon/Neutral/Magic) Switch
- LEFT: CNM AA Gun Select
- CENTER: CNM Neutral (PCA Select)
- RIGHT: CNM Magic Select

5a

MAGIC Search / Vertical Fix
(Nav Update / Magic Unlock)

6

Vertical Narrow Search



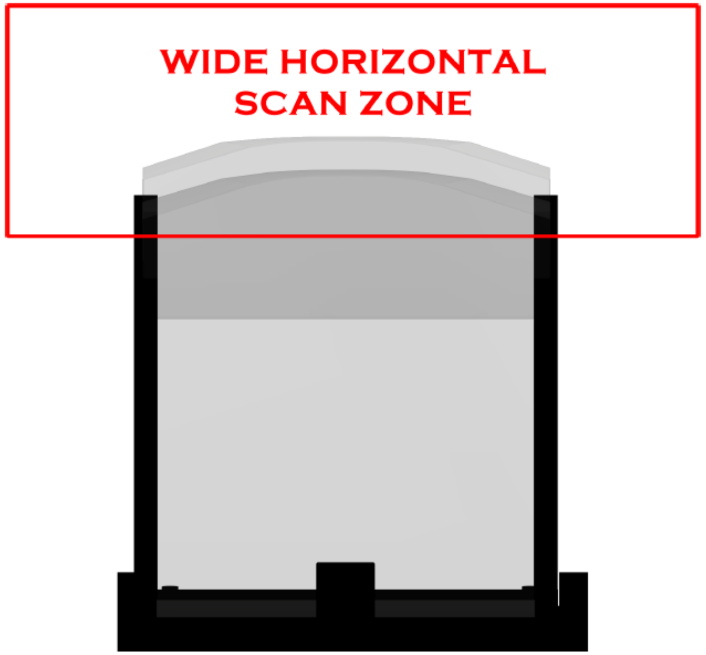
2.2.1 – MAGIC II MISSILE SEARCH MODES

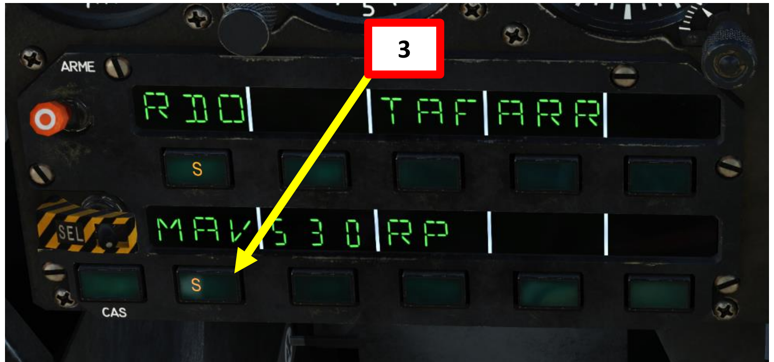
Horizontal Wide Search

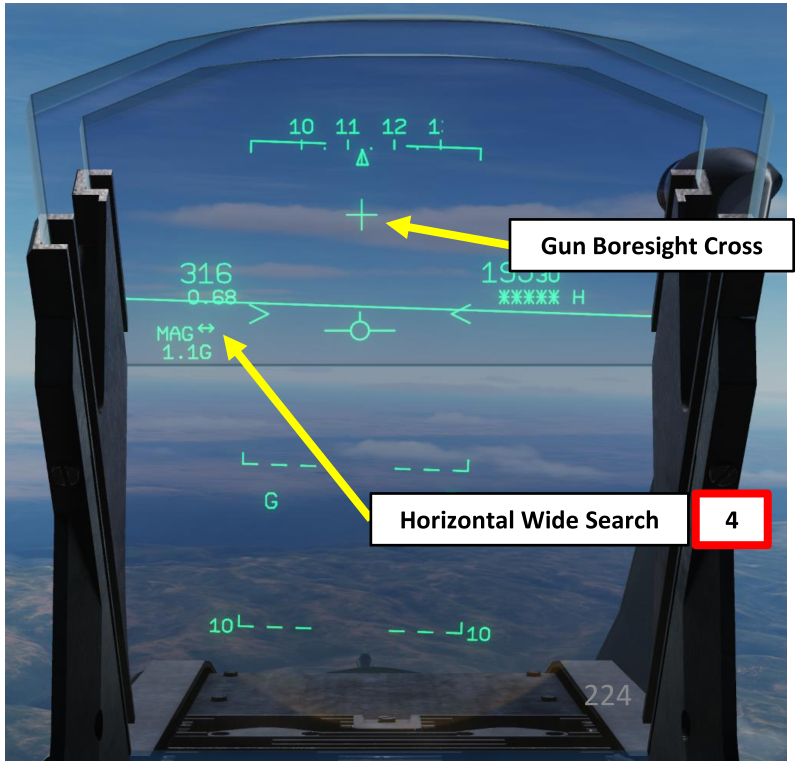
Horizontal Wide Scan is a 68° wide and 14° tall search zone with its bottom located 2° above the gun cross position. With only one missile available, the search zone is smaller: 35° wide and 14° tall. It is similar to the radar BAH Scan. This is the default mode whenever MAG PCA button is selected. Note that parts of the zone extend beyond the HUD on both sides.

SELECTION METHOD

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile.
2. On PCA, press the MAG button.
3. Once MAG is selected, the MAG indication will turn to MAV (MAGIC *Veille* / Background Search). MAV mode allows the MAGIC missile to perform a contact acquisition search pattern when the MAGICs or air-to-air guns are not selected.
4. By default, Horizontal Wide Search Mode will be selected.







2.2.1 – MAGIC II MISSILE SEARCH MODES

Horizontal Narrow Search

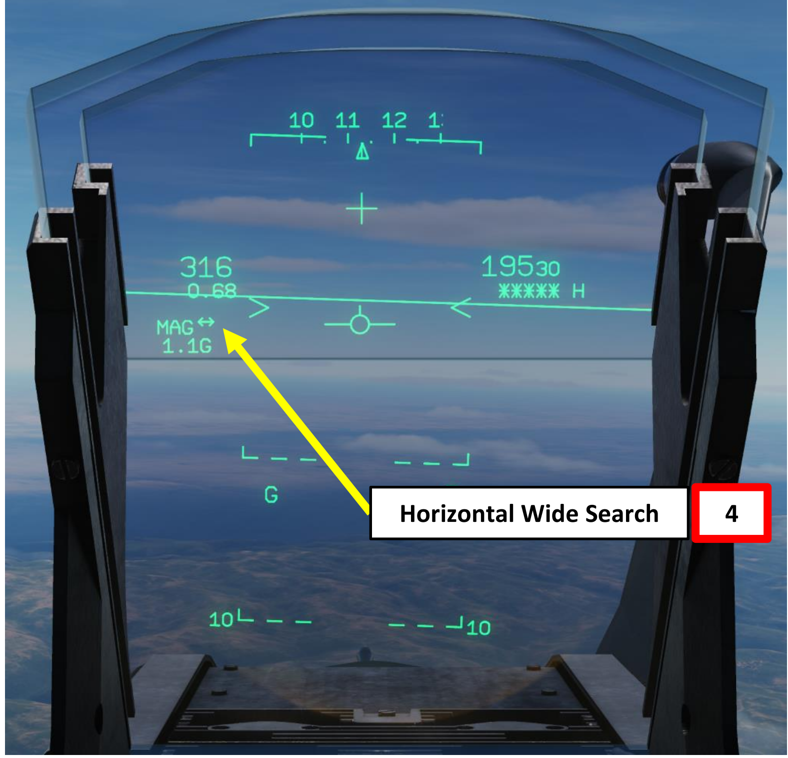
Horizontal Narrow Scan is a 7° wide x 7° tall box cantered around the gun cross. A box is displayed indicating the HUD area where the seeker is searching, and is removed upon missile lock. This mode is very similar to the Vertical Narrow Search mode.

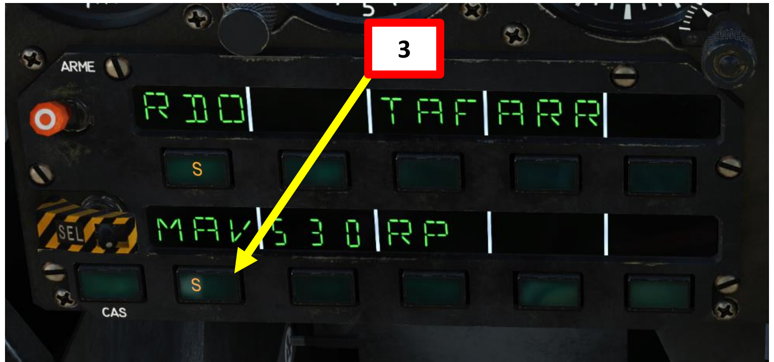
SELECTION METHOD

1. MAGIC missile is **not required** to be selected with CNM (CNM (Cannon/Neutral/Magic)) switch.
2. On PCA, press the MAG button.
3. Once MAG is selected, the MAG indication will turn to MAV (MAGIC *Veille* / Background Search). MAV mode allows the MAGIC missile to perform a contact acquisition search pattern when the MAGICs or air-to-air guns are not selected. .
4. By default, Horizontal Wide Search Mode will be selected.
5. Press the MAGIC Search / Vertical Fix (Nav Update/ Magic Unlock) button to toggle the Magic II missile's search mode to Horizontal Narrow Search.

5a

MAGIC Search / Vertical Fix (Nav Update / Magic Unlock)



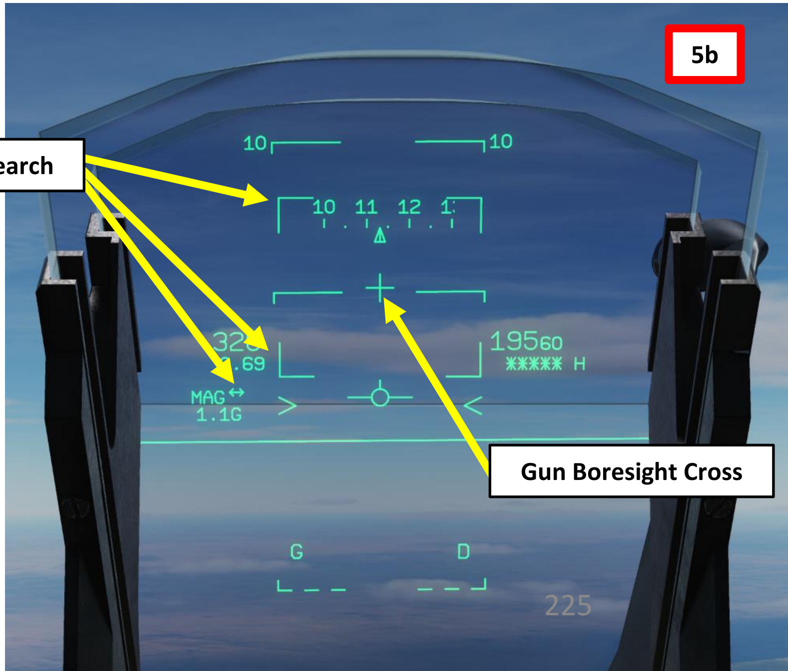


1

CNM (Cannon/Neutral/Magic) Switch
- LEFT: CNM AA Gun Select
- CENTER: CNM Neutral (PCA Select)
- RIGHT: CNM Magic Select

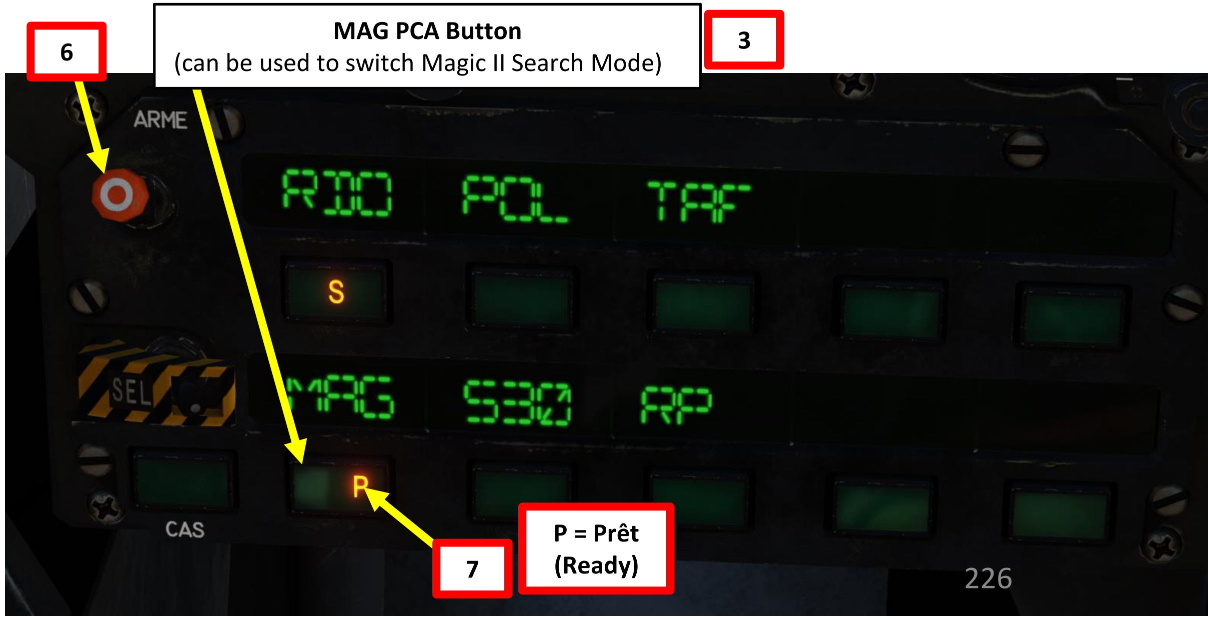
5b

Horizontal Narrow Search



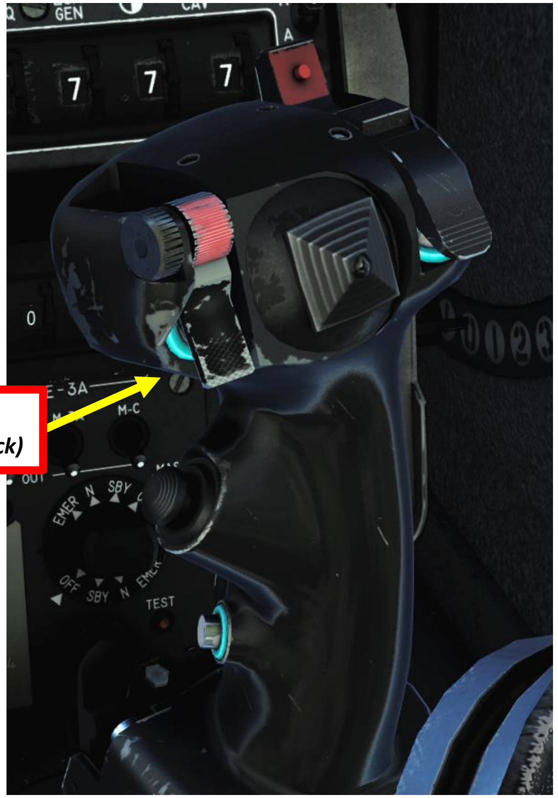
2.2.2 – MAGIC II MISSILE (NO RADAR)

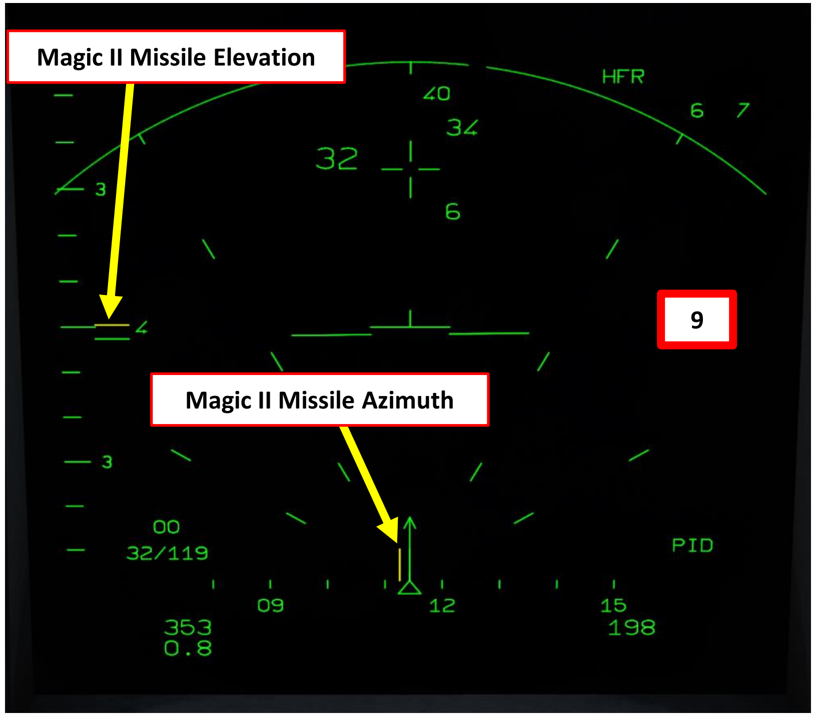
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile.
2. By default, the Magic II missile's Vertical Wide Search mode will be selected.
3. (Optional) If desired, select another Magic II Search Mode as per section 2.2.1 (MAGIC Search / Vertical Fix button (also referred as « NAV Update / Magic Unlock » button) and PCA MAG button can be used to that effect). This is as per your own personal preference.
4. On PPA (*Poste Préparation Armement*, Weapon Configuration Panel), verify that MAG (Magic II) is warmed up. "P" (*Prêt*/Ready) blinks during warm-up process after engine start (34 s) and remains illuminated when warm-up is complete. A warmed-up MAGIC missile seeker consumes coolant supply (nitrogen). There is enough supply to keep the seeker heads active for 90 minutes, after that time the seekers become warm rendering the missiles useless. Each time the preparation is reactivated (switched ON) will shorten the coolant supply by 10 minutes.
5. On PPA, select which missile to fire (G = Left, I = AUTO, R = Right)
6. On the PCA, turn Master Arm switch to ARME (UP)
7. Confirm that MAGIC II missile is selected properly: a "P" indication on the PCA "MAG" button shows that the missile is Ready (*Prêt*).

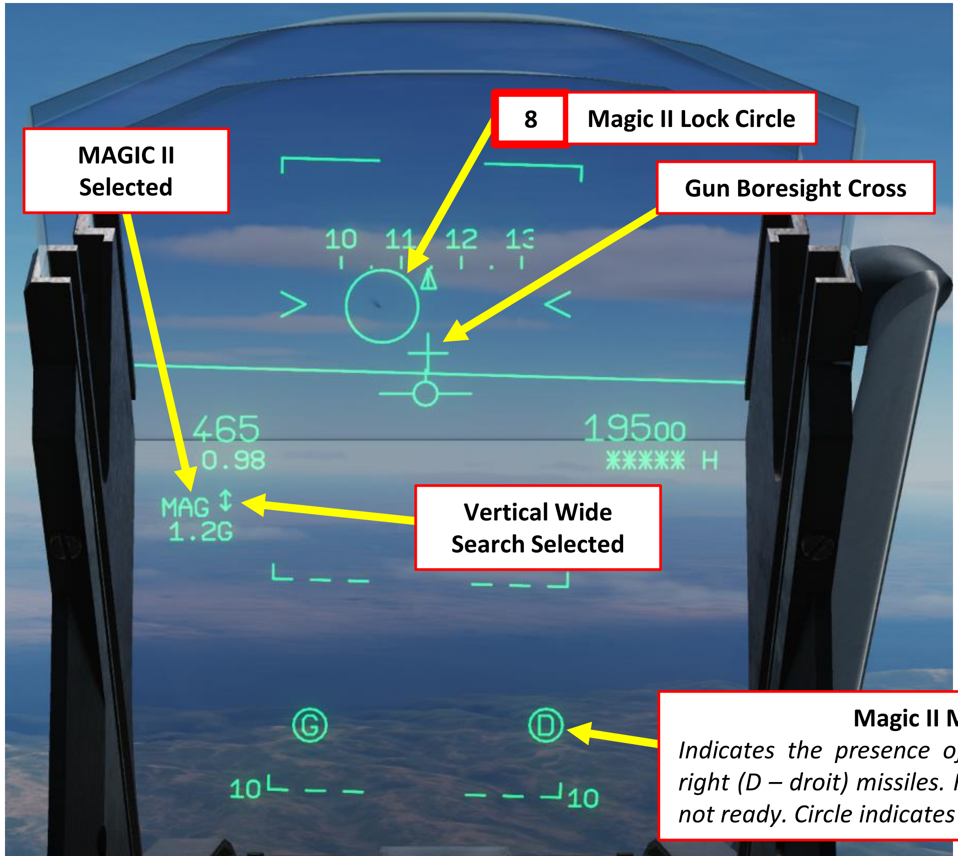


2.2.2 – MAGIC II MISSILE (NO RADAR)

8. To lock the seeker, place the HUD gun cross on the target. If the infra-red signature is sufficient, the seeker will automatically lock. Missile tone will be heard when missile is tracking IR signature. Target will be marked and tracked by a small circle on HUD.
9. On the VTB, the MAGIC azimuth is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the heading scale. The MAGIC elevation is also displayed in yellow when the missile is locked and indicates the direction of the lockrelative to the elevation scale.
10. Fire missile (Press and hold MiCRoB Trigger (2nd Stage), SPACE by default).
11. Once missile is fired, the engine RPM will automatically decrease to prevent an engine flameout, which could be caused by ingestion of the smoke released by the missile launch. RPM will increase back to normal values a few seconds later.
12. To de-select Magic, on the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select other weapons via the PCA or with the CNM (Cannon/Neutral/Magic) switch.





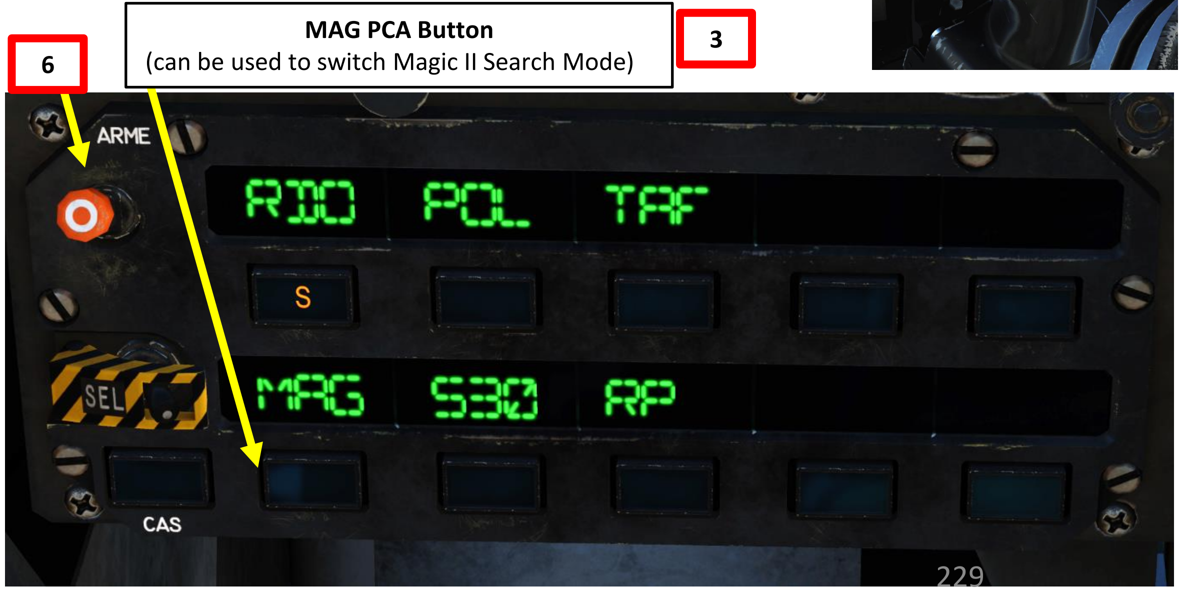


Magic II Missile Status
Indicates the presence of the left (G – gauche) and right (D – droit) missiles. Flashes when the missiles are not ready. Circle indicates missiles are ready to fire.

2.2.2 – MAGIC II MISSILE (NO RADAR)

2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

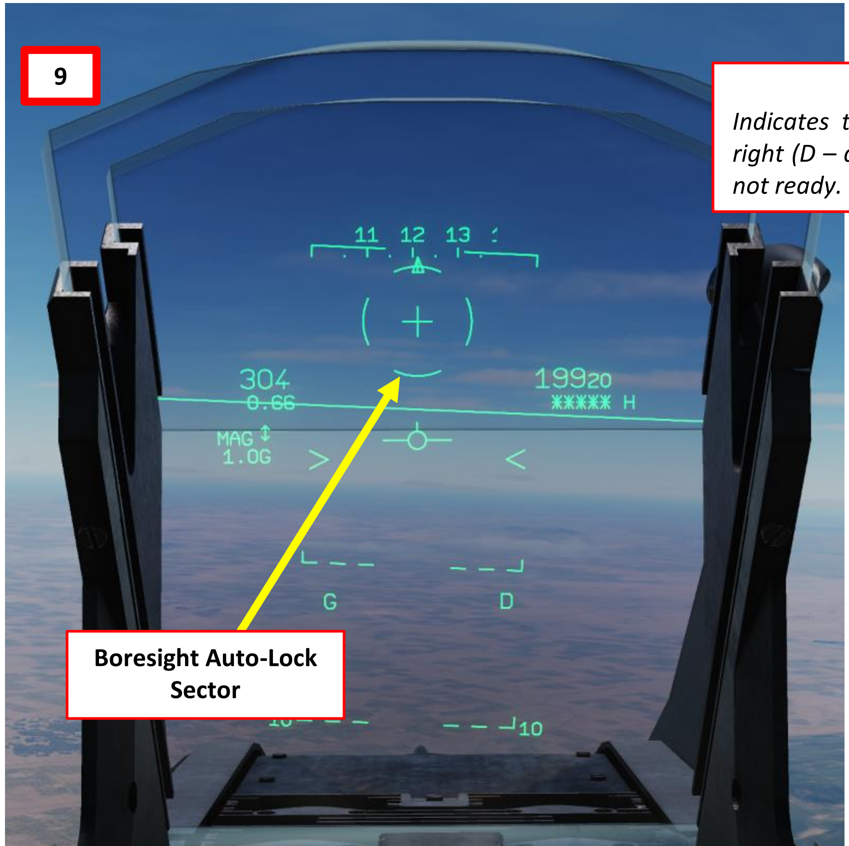
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to RIGHT position (MAGIC SELECT). This will select the Magic II missile and set the HUD (Heads-Up Display) in the appropriate mode.
2. By default, the Magic II missile's Vertical Wide Search mode will be selected.
3. (Optional) If desired, select another Magic II Search Mode as per section 2.2.1 (MAGIC Search / Vertical Fix Button (also referred as « NAV Update / Magic Unlock » button) and PCA MAG button can be used to that effect). This is as per your own personal preference.
4. On PPA (*Poste Préparation Armement*, Weapon Configuration Panel), verify that MAG (Magic II) is warmed up. "P" (*Prêt*/Ready) blinks during warm-up process after engine start (34 s) and remains illuminated when warm-up is complete. A warmed-up MAGIC missile seeker consumes coolant supply (nitrogen). There is enough supply to keep the seeker heads active for 90 minutes, after that time the seekers become warm rendering the missiles useless. Each time the preparation is reactivated (switched On) will shorten the coolant supply by 10 minutes.
5. On PPA, select which missile to fire (G = Left, I = AUTO, R = Right)
6. On the PCA, turn Master Arm switch to ARME (UP)
7. Turn on Radar Power by setting switch to **EM**ISSION.
   - Consult previous chapter for radar operation parameters



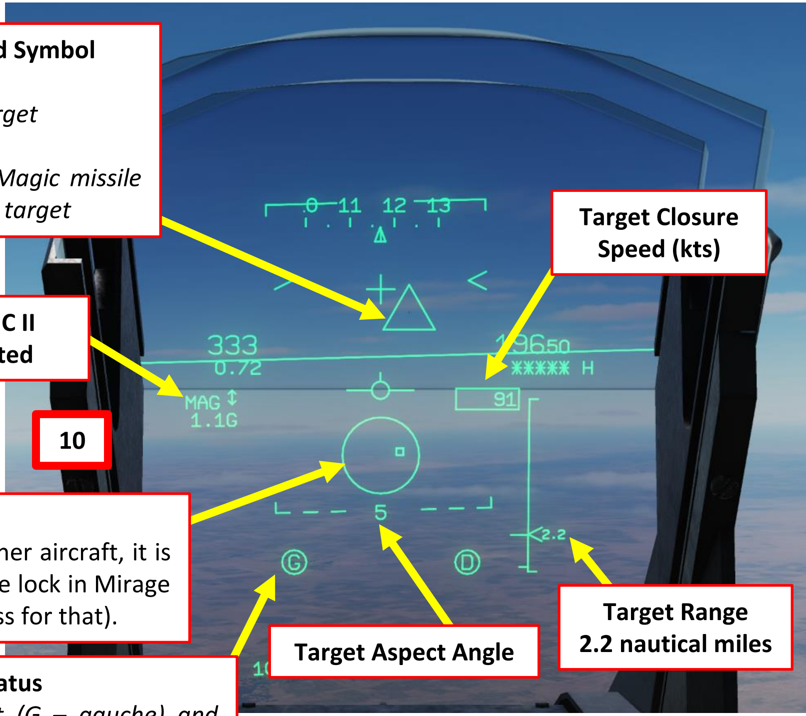
2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

8. Pressing the Weapons System CMD switch FWD to toggle between close combat radar modes BORESIGHT and VERTICAL mode.
   - If Magic II missile is selected, pressing the Weapons System CMD switch FWD will toggle between BORESIGHT and Vertical mode.
   - Horizontal modes (BA2 and BAH) are cycled by using the Weapons System CMD Switch AFT
9. When boresight is selected, the radar will be set at a range of 10 nautical miles and it will automatically PSIC/STT lock on the closest contact it can detect within the boresight auto-lock sector.
10. The radar will be set at a range of 10 nautical miles and it will automatically PSIC/STT lock on the closest contact it can detect. You can also lock using the long-range radar modes by using TDC DEPRESS control. A square will appear on locked target (or a triangle if the Magic II missile gets a lock as well).
11. The seeker for Magic II missile is not visible until you get a solid lock. The same is true for the growling sound - it can only be heard after acquiring a lock and not during the search phase.
12. On the VTB, the MAGIC azimuth is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the heading scale. The MAGIC elevation is also displayed in yellow when the missile is locked and indicates the direction of the lock relative to the elevation scale.

8
Weapons System CMD Switch



9
Boresight Auto-Lock Sector



Target Radar Locked Symbol
SQUARE
- *Radar Lock on target*

TRIANGLE:
- *Both radar and Magic missile are locked on the target*

Target Closure Speed (kts)

MAGIC II Selected

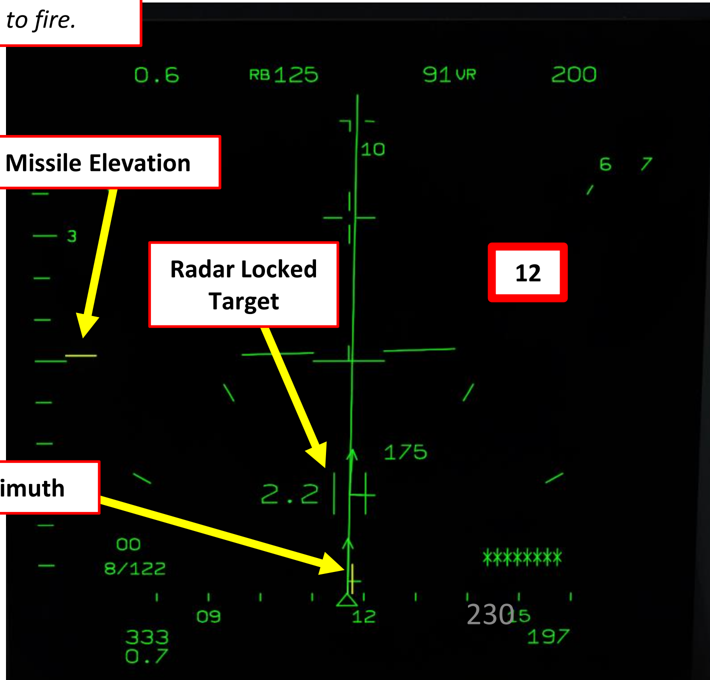
10

Flight Director Ring
Contrary to many other aircraft, it is not used to attain the lock in Mirage (you use the gun cross for that).

Target Aspect Angle

Target Range
2.2 nautical miles

Magic II Missile Status
Indicates the presence of the left (G – gauche) and right (D – droit) missiles. Flashes when the missiles are not ready. Circle indicates missiles are ready to fire.



Magic II Missile Elevation

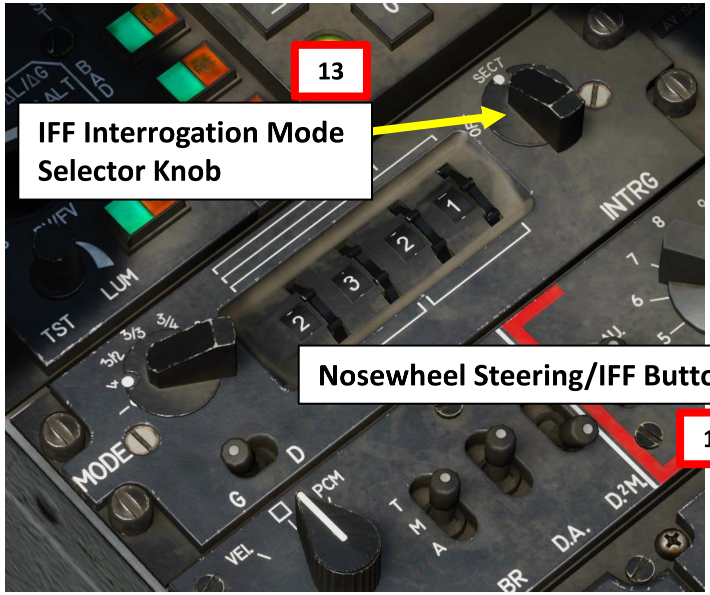
Radar Locked Target

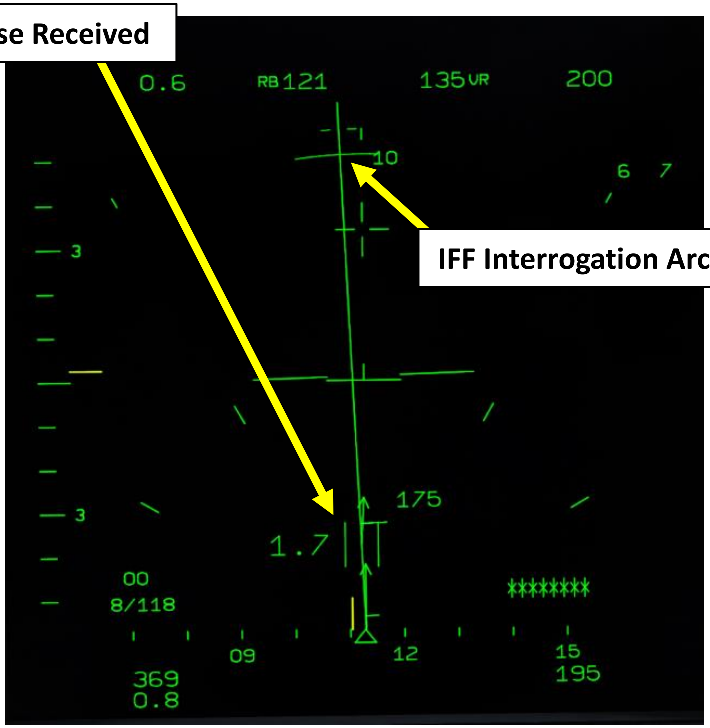
12

Magic II Missile Azimuth

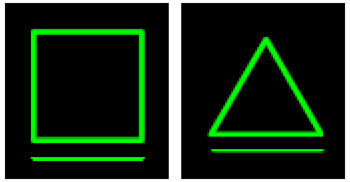
2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

13. Set IFF Power Switch to either SECT (Sectoral, middle position) or FULL (rightmost position), as desired.
    - SECT (Sectorié – Sectored): The interrogation is sent in a 20° arc around the TDC (Target Designation Caret).
    - CONT (Continue – Full): The interrogation is sent in the full search pattern, within the limits of its azimuth setting and orientation.
14. Press the NWS/IFF button (keyboard shortcut: “S”) to interrogate. The IFF interrogation is maintained as long as the command is pressed and last at least a complete scan pattern.
15. The IFF antenna is placed on the radar antenna and thus follow its azimuth and elevation. Its field of interrogation is 10° wide. With the radar in bar search (only with the PRF set to HFR or ENT) or PSID, the execution of an interrogation is represented by a doubling of the radar range marker arc. The size of the interrogation arc is dependent on the position of IFF interrogation mode on the IFF interrogator panel.
16. When an IFF interrogation is requested, the arc is dashed until the interrogation is effective. When interrogation is effective, the arc is displayed full. With IFF interrogation mode in CONT, it lasts only 0.5 sec while in SECT, the interrogation is effective is only when the radar antenna is oriented in the requested interrogation azimuth.
17. Keep interrogating sporadically in order to be 100 % sure you are firing at an enemy. Below 35 nm, the IFF system should be able to determine which aircraft type you are locking, but at the engagement ranges of the Magic II… you are better off performing a visual identification of the target instead.

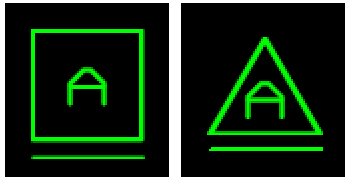




IFF Interrogation In Progress & IFF Correlation (PSIC/STT)

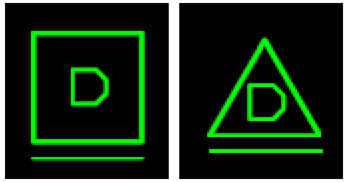


Indicates that radar target is being interrogated by the IFF system



Indicates that radar target has replied as a friend to the IFF interrogation.

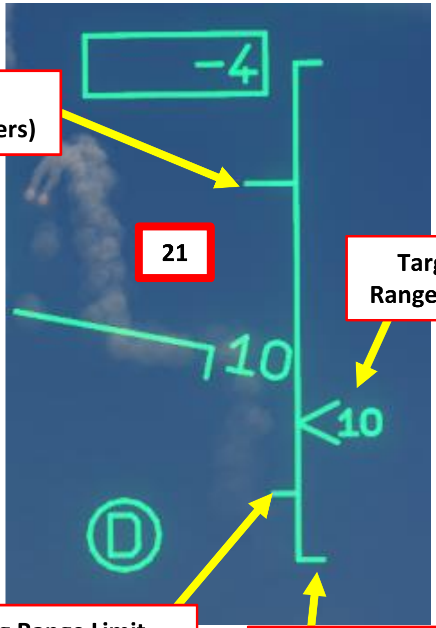
“A” stands for “Ami”, or “Friendly”.

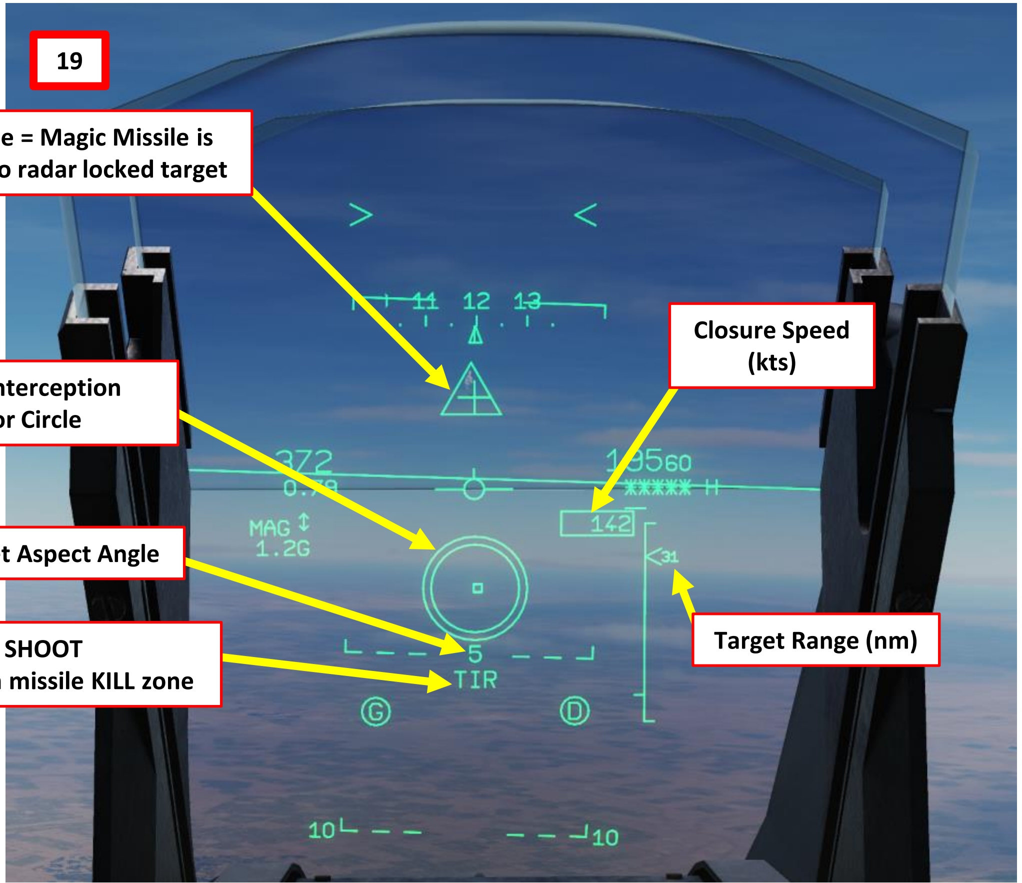


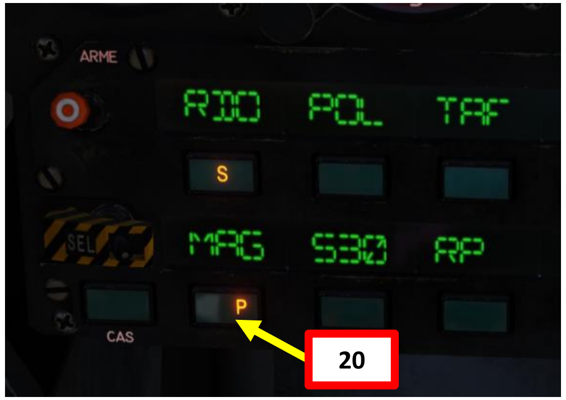
Indicates that the radar has received a friendly reply from the target, but the position of the IFF replying aircraft does not correspond to the target position.

2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

18. Press the Air-to-Ground Designate / Magic Slave Switch to slave the Magic II seeker to the target locked on radar. The seeker uncages and looks in the same direction as the radar, providing IR lock on the target.
19. When the Magic's seeker head is tracking a heat signature, a continuous sound is heard in the helmet. The Magic's circle will then switch to a triangle, indicating that the Magic Missile is slaved to a radar locked target.
20. Confirm that MAGIC II missile is selected properly: a "P" indication on the PCA "MAG" button shows that the missile is Ready (*Prêt*).
21. When the target is between the long limit without defensive maneuvers and the long limit with defensive maneuvers the interception director circle is doubled. Take note that when firing on a target flying away from the shooter aircraft, both long limits will overlap.

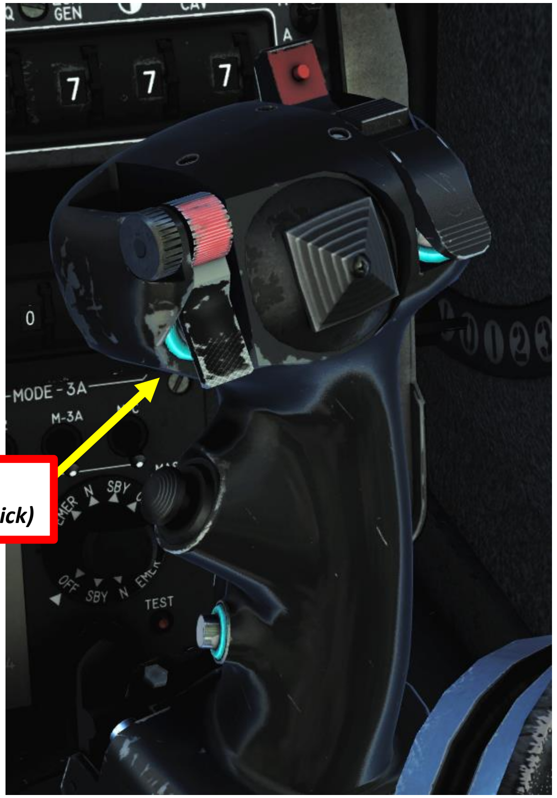


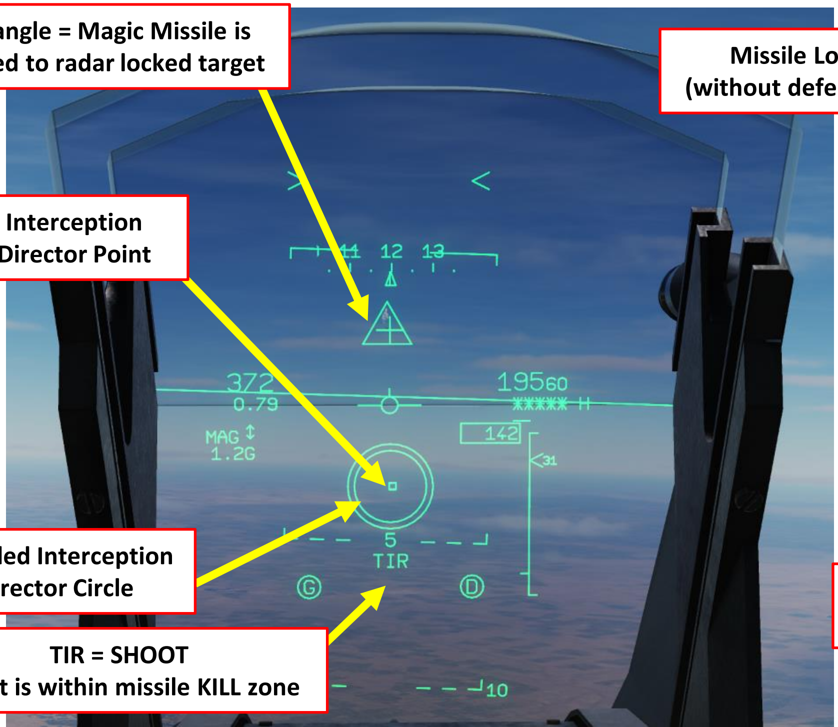


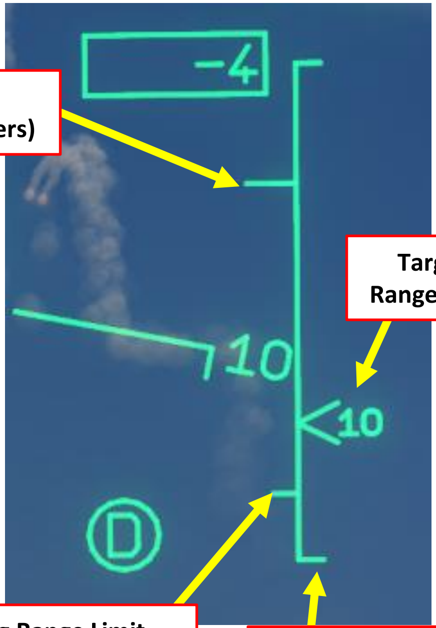


2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

22. The best firing conditions are achieved when:
    - The missile is fired while the target is in the most restrictive firing domain and the interception director point is centered inside the circle, this will result in the maximum probability of kill (PK) to the missile.
    - A missile fired with the target outside the most restrictive firing domain but still inside the long range limit without defensive maneuvers can still hit depending on the target actions while the missile is in flight, the PK depends on the closeness of the target to the most restrictive firing domain.
    - Note 1: A missile fired while the target is outside the long range limit without defensive maneuvers will result in a very low PK as the missile might self-destruct or stall before reaching the target.
    - Note 2: Firing closer that the short limit will also result in a low PK as the missile most likely won't have enough time to arm itself and/or maneuver to the target.
23. Fire missile (Press and hold MiCRoB Trigger (2nd Stage), SPACE by default) when missile is within KILL (no escape) range.
    - When in KILL zone, you will see a double circle + TIR (shoot) message on the HUD
24. Once missile is fired, the engine RPM will automatically decrease to prevent an engine flameout, which could be caused by ingestion of the smoke released by the missile launch. RPM will increase back to normal values a few seconds later.
25. To de-select Magic, on the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select other weapons via the PCA or with the CNM (Cannon/Neutral/Magic) switch.



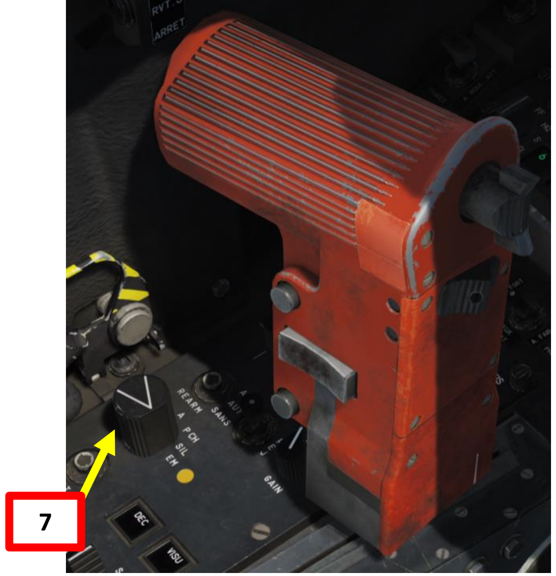


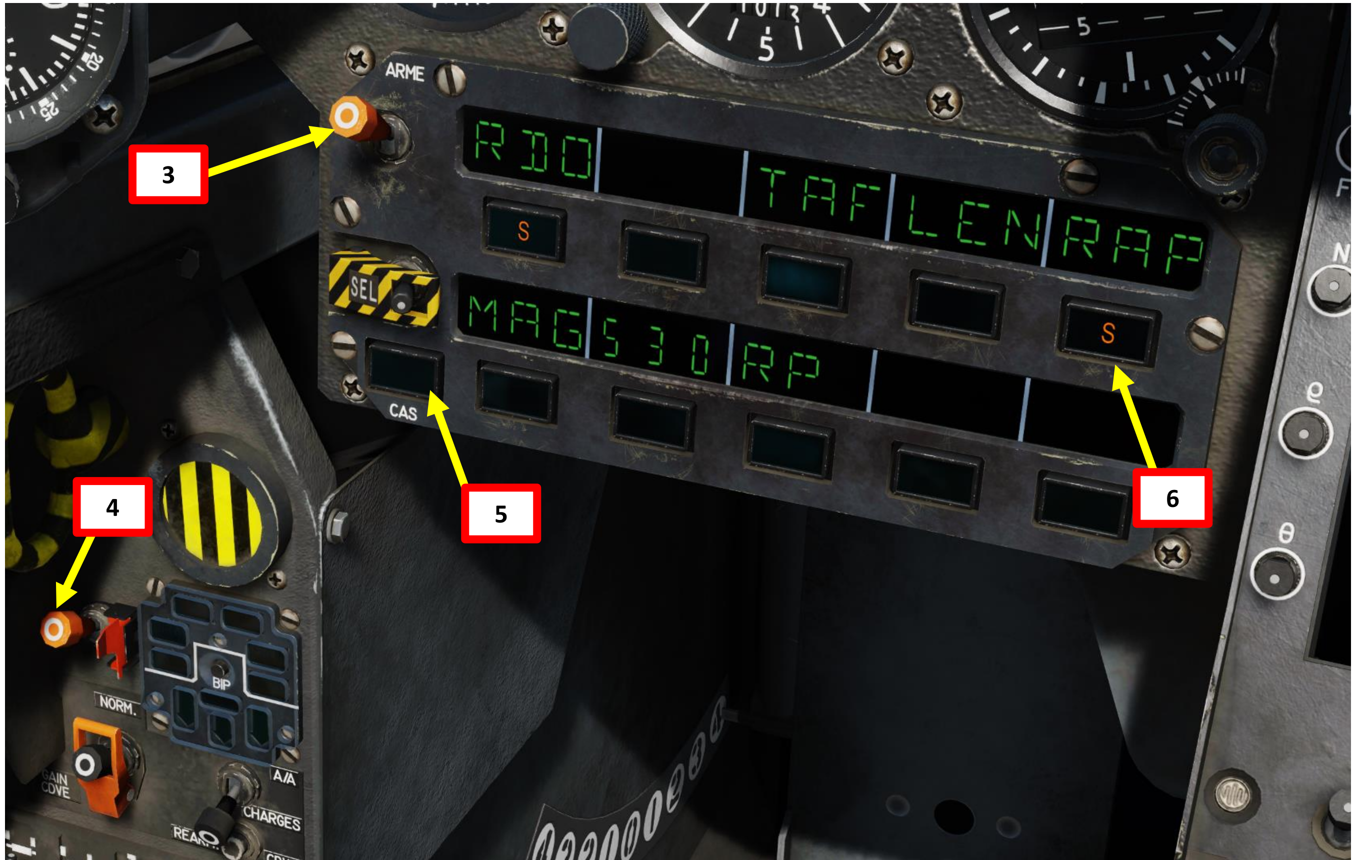


2.2.3 – MAGIC II MISSILE (WITH SHORT RANGE RADAR)

2.3.1 – AIR-TO-AIR GUNS TUTORIAL (WITH RADAR)

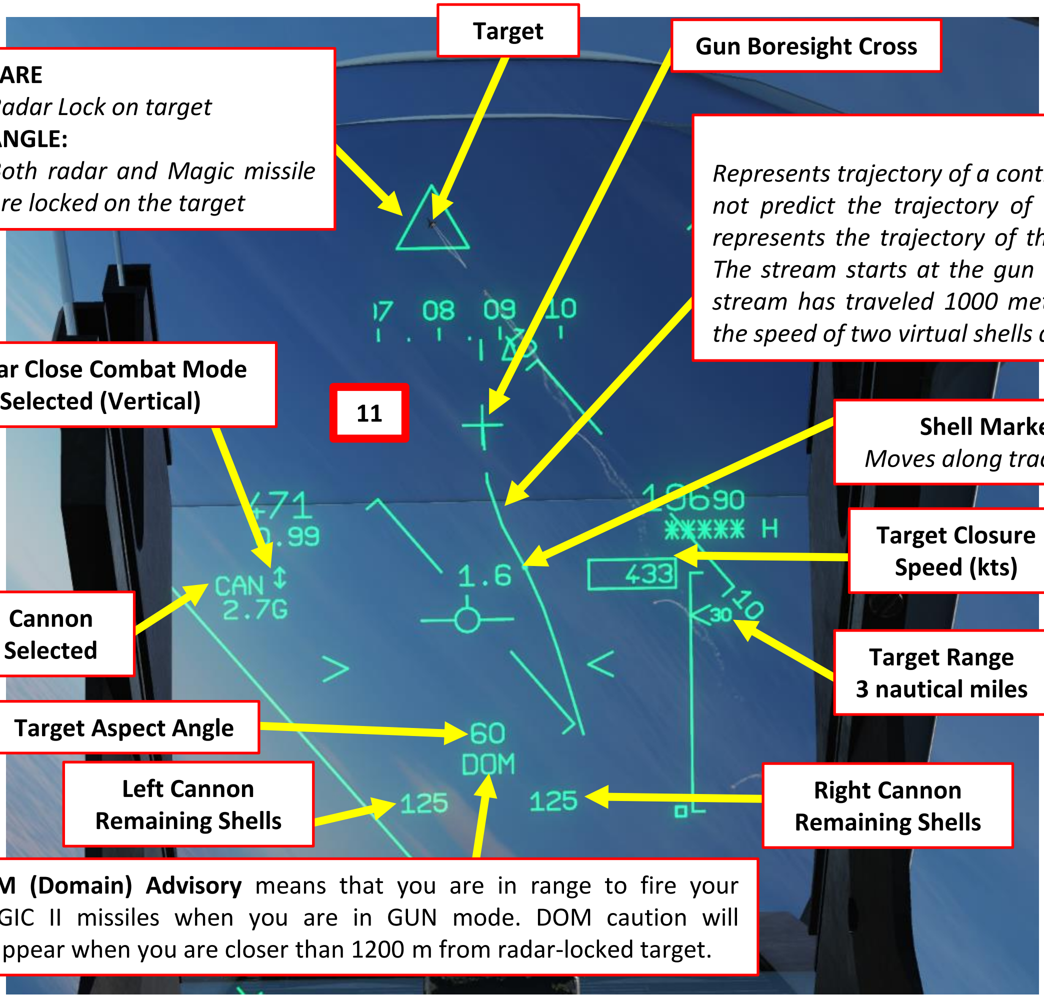
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to LEFT position (AA GUN SELECT). This will select the cannon in Air-to-Air Mode.
2. On PPA, select gun firing mode
   - PAR (Partial) = 0.5 or 1 sec burst / TOT (Total) = continuous fire
   - Salvo duration is set by the ground crew (see kneeboard).
3. Set Master Arm switch to ARME (UP)
4. Arm Cannon Switch (UP)
5. Verify the cannon is in Air-to-Air mode; CAS (Canon Air-Sol / Air-to-Ground) button on the PCA should **NOT** display P (Air-to-Ground Ready) Mode.
6. Select desired fire rate. "S" indicates the fire rate selected.
   - RAP = *Rapide* (High Rate of Fire) / LEN = *Lent* (Slow Rate of Fire)
7. Turn on Radar Power by setting switch to EMISSION.

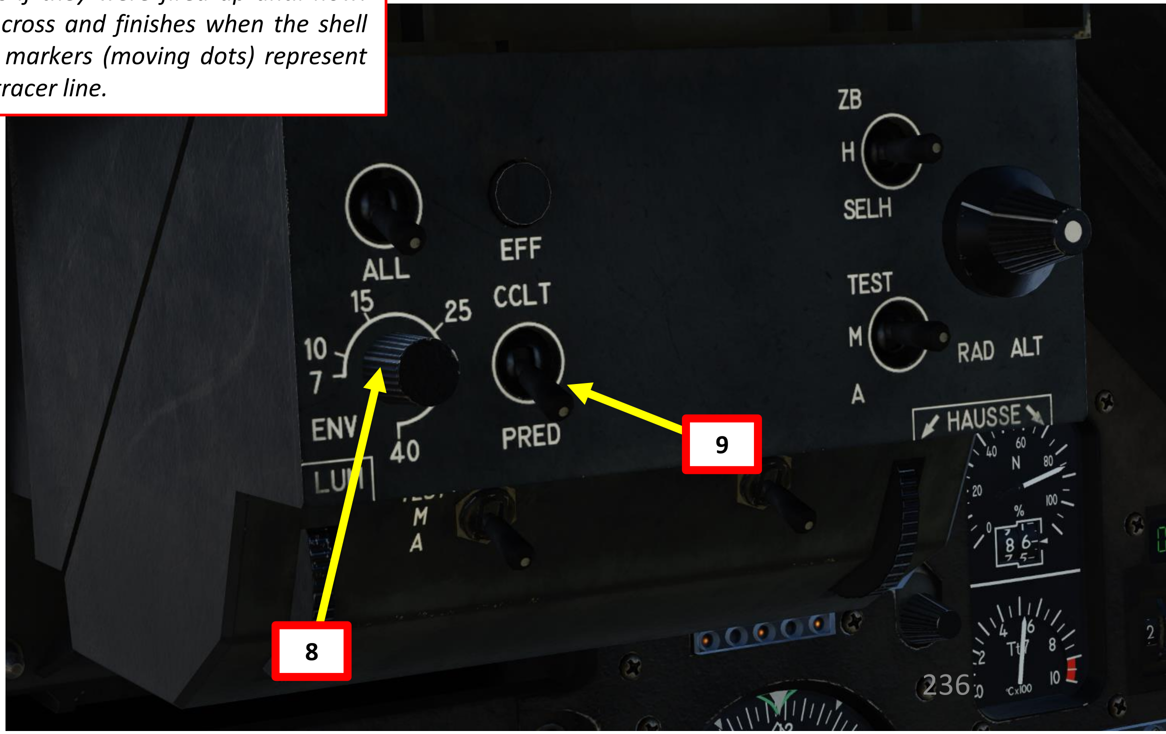




2.3.1 – AIR-TO-AIR GUNS TUTORIAL (WITH RADAR)

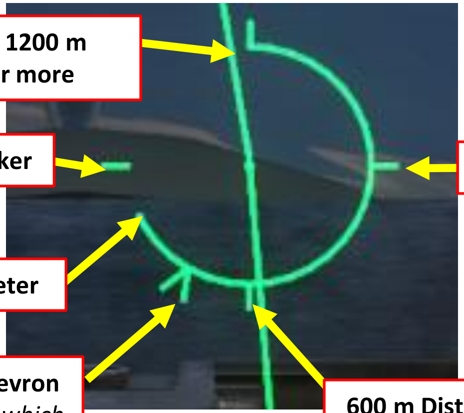
8. Use *Envergure*/Wingspan knob to set the target's wingspan. In this example, we set the wingspan to 11 meters for a MiG-29.
9. Set Gun VTH Mode to PRED (*Prédictif*, Predictive Shoot Incitation). The Shoot incitation symbology will be displayed with a radar lock and the correct geometry between the aircraft and the target.
10. Pressing the Weapons System CMD switch FWD to toggle between close combat radar modes BORESIGHT and VERTICAL mode.
11. When boresight is selected, the radar will be set at a range of 10 nautical miles and it will automatically PSIC/STT lock on the closest contact it can detect within the boresight auto-lock sector.

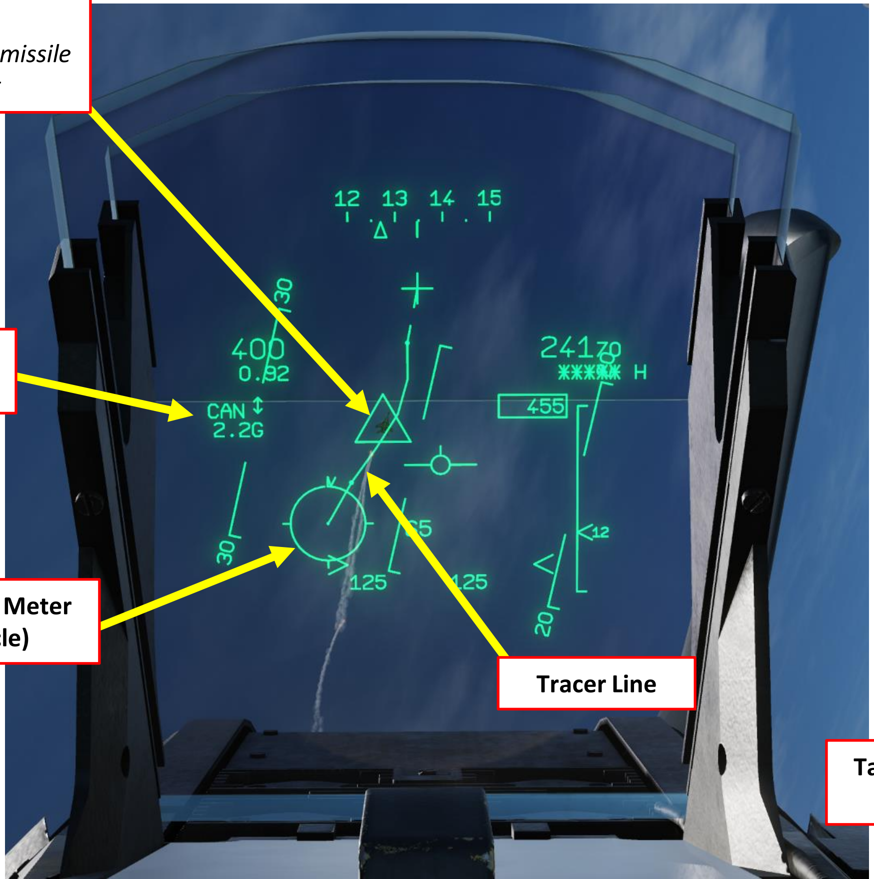


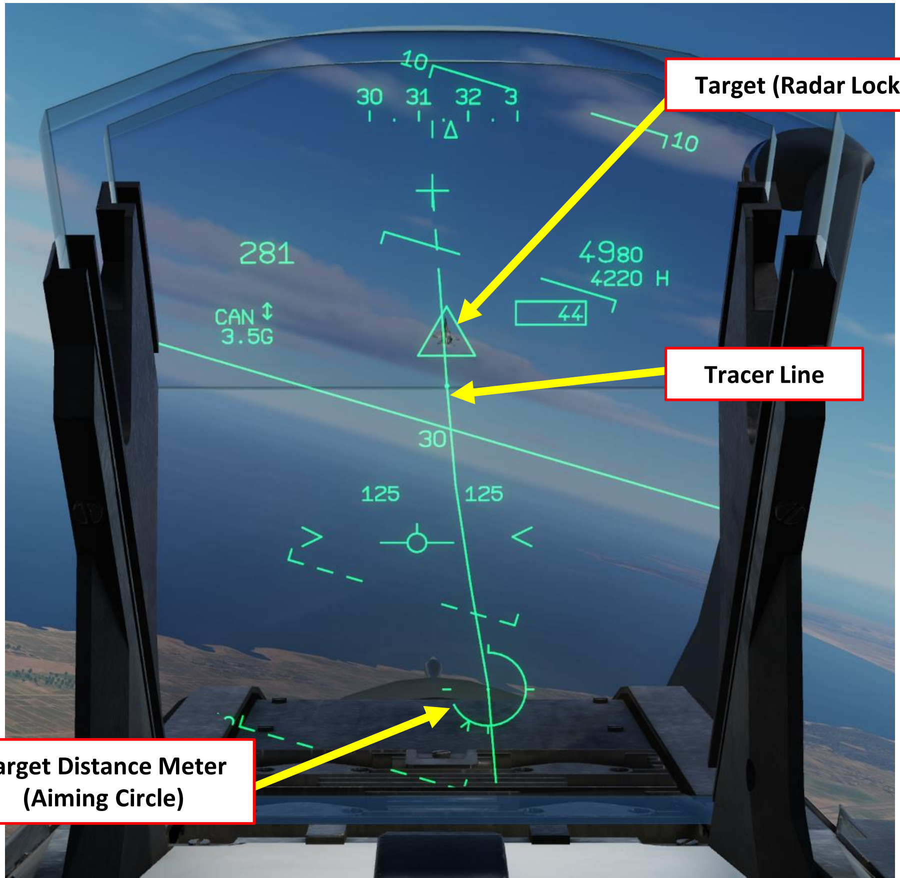


2.3.1 – AIR-TO-AIR GUNS TUTORIAL (WITH RADAR)

12. With the target radar locked, the employment domain is represented by the target distance meter centered around the aiming circle. Displayed relative to the distance meter is the analogue closing speed chevron, which represents the range at which the target will be in 5 seconds. The Target Distance Meter appears when target is less than 1200 m (approx. 1 nm) from you.
13. Air-to-air gun aiming is done by placing the target along the tracer line and making the aiming circle converge with it by closing the distance or increasing the target lead. Since the tracer line and aiming circle are relative to the already fired fictive stream of shells, the guns firing needs to be done one time of flight before the aiming circle is over the target, the time of flight being the time the shells need to reach the target. This means that if the target is sliding along the tracer line, firing when the aiming circle is over the target is too late.

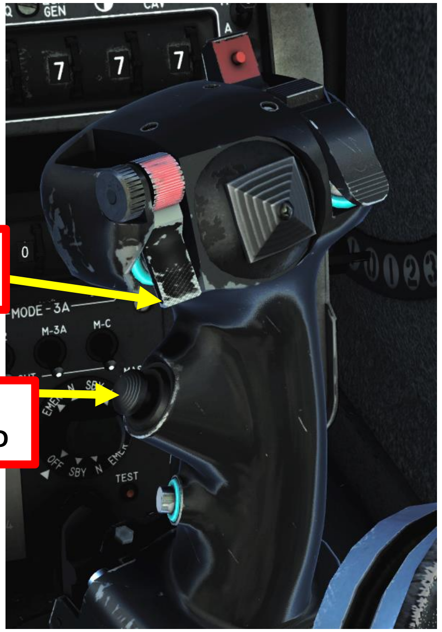


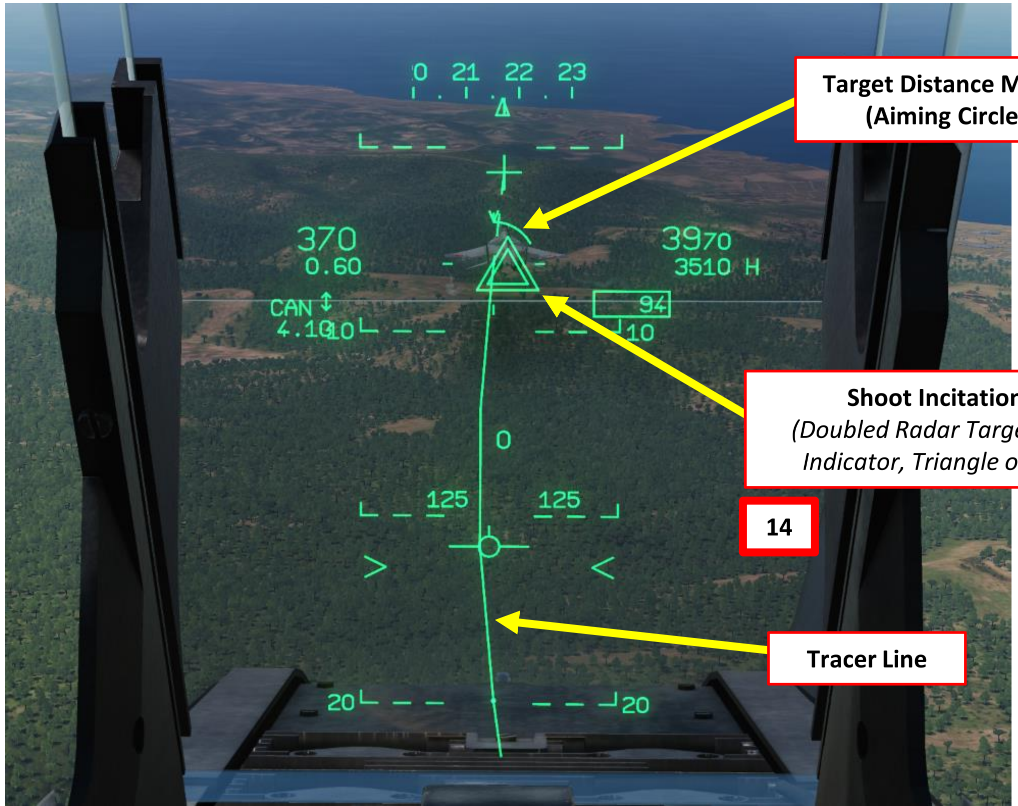


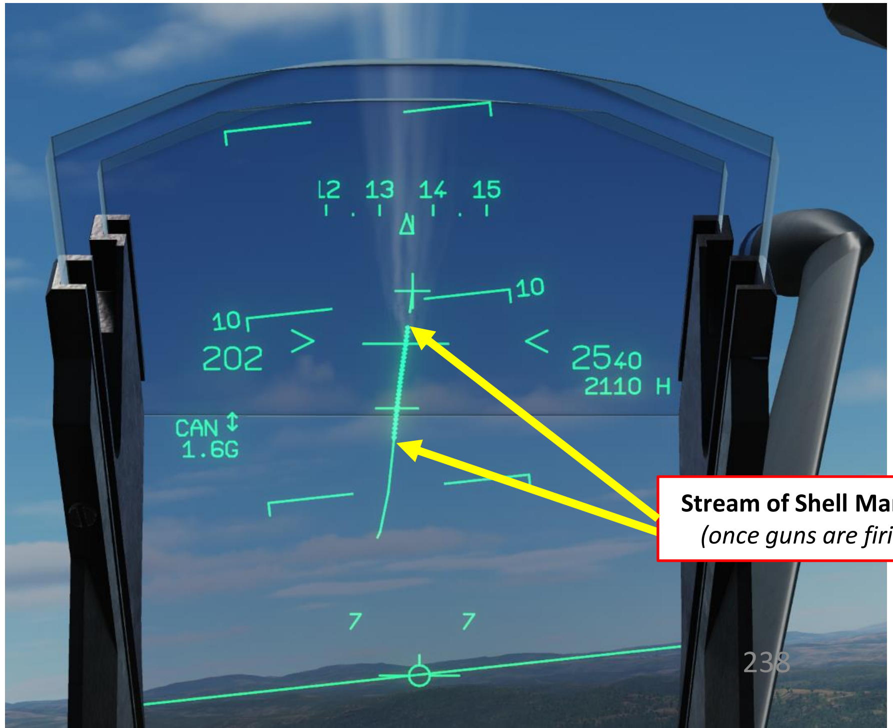


2.3.1 – AIR-TO-AIR GUNS TUTORIAL (WITH RADAR)

14. Steer the aircraft to keep the target along the tracer line and to place the aiming circle near the target until the shoot incitation cue is displayed; the radar target position (square) or MAGIC and radar coincidence (triangle) symbology is doubled when the aiming circle is at one time of flight from the target, indicating a good hit probability.
15. When you are within kill range (300-600 meters from target), your aiming circle is on target and the doubled radar target position indicator is visible, fire guns using the MiCRoB Trigger (2nd Stage), which is set to SPACE by default.
    - Salvo markers (triangles along the tracer line) represent the trajectory of the shell salvo along the tracer line. Salvo markers are visible when the first of second stage of the MiCRoB trigger are pressed.
16. You can unlock target with the HOTAS Weapons System CMD DEPRESSED switch on the stick.
17. To de-select guns, on the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select other weapons via the PCA or with the CNM (Cannon/Neutral/Magic) switch.



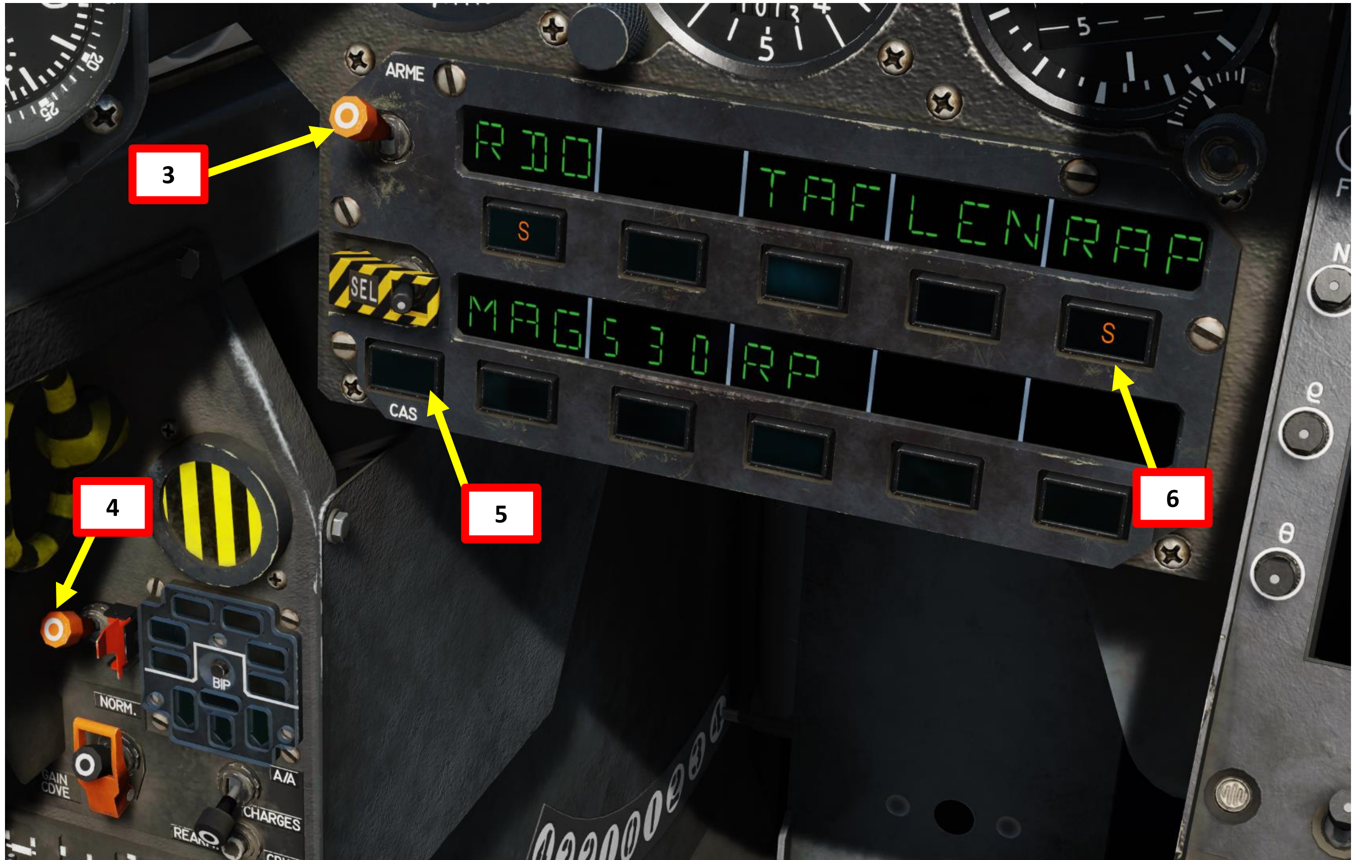




2.3.1 – AIR-TO-AIR GUNS TUTORIAL (WITH RADAR)

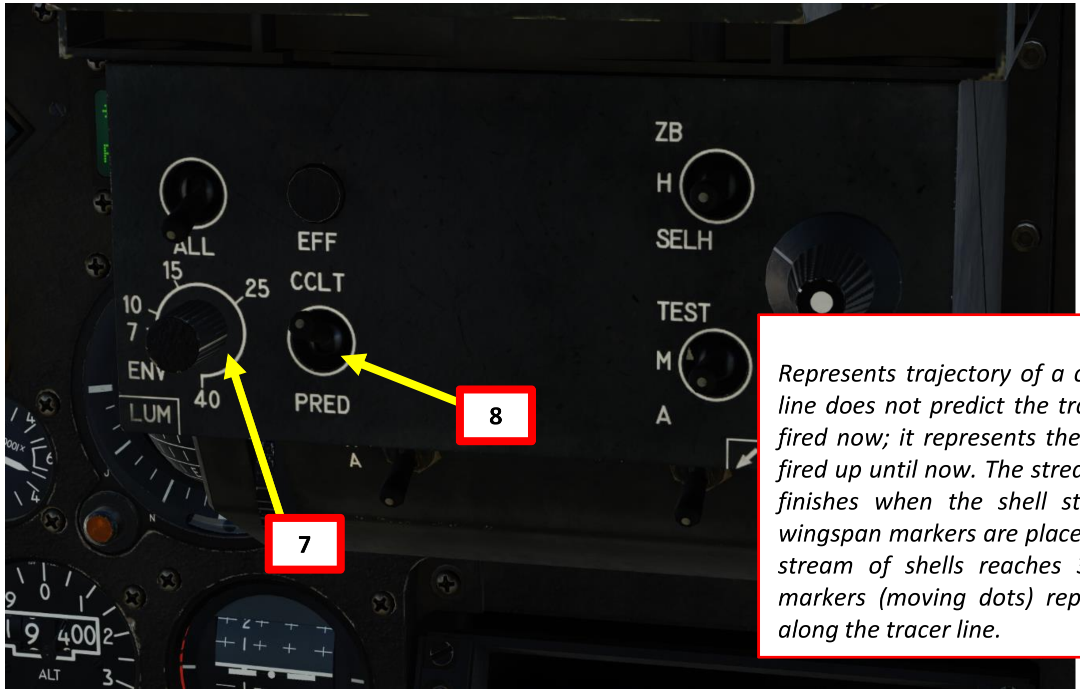
2.3.2 – AIR-TO-AIR GUNS TUTORIAL (NO RADAR)

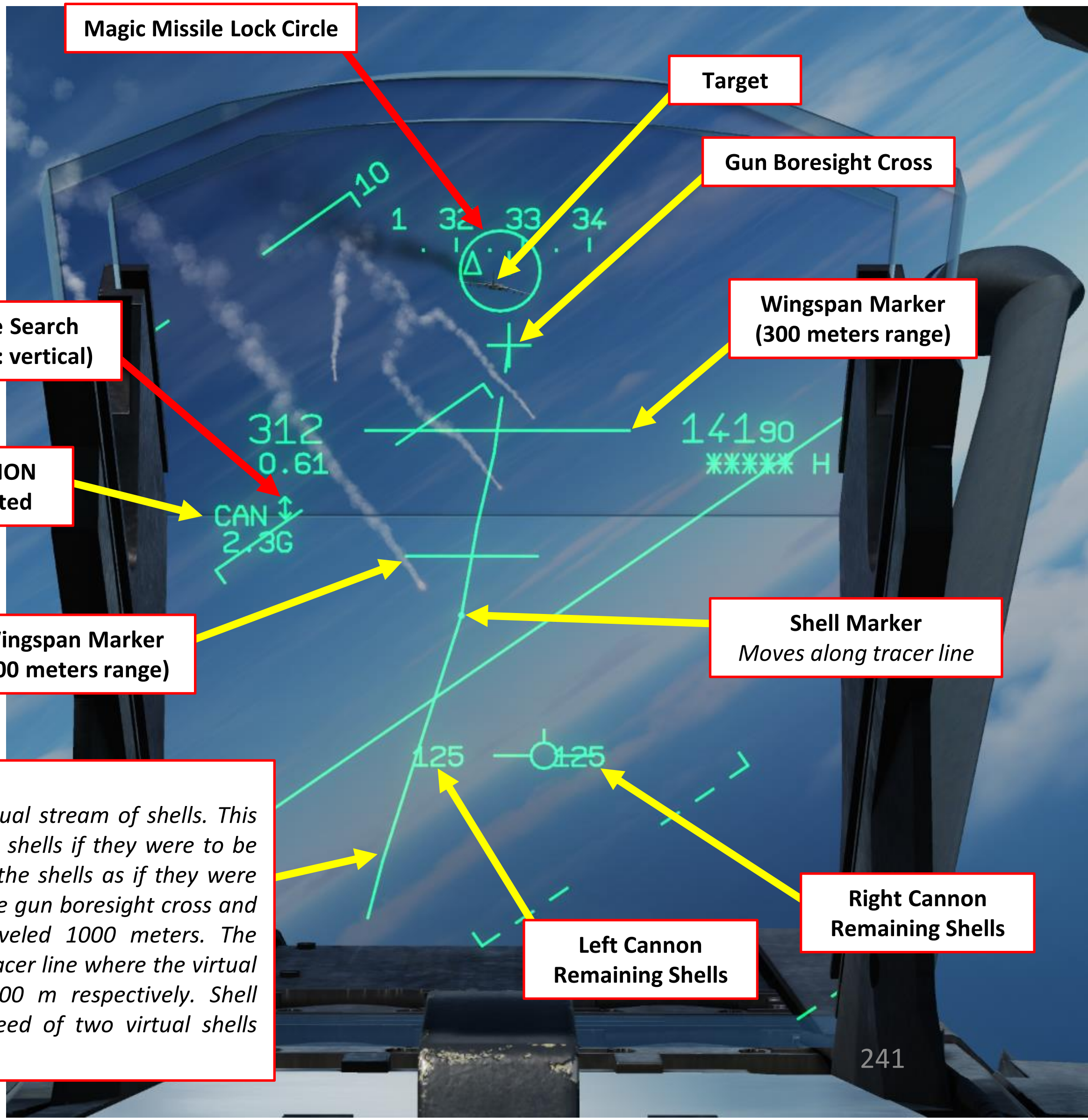
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to LEFT position (AA GUN SELECT). This will select the cannon in Air-to-Air Mode.
2. On PPA, select gun firing mode
   - PAR (Partial) = 0.5 or 1 sec burst / TOT (Total) = continuous fire
   - Salvo duration is set by the ground crew (see kneeboard).
3. Set Master Arm switch to ARME (UP)
4. Arm Cannon Switch (UP)
5. Verify the cannon is in Air-to-Air mode; CAS (Canon Air-Sol / Air-to-Ground) button on the PCA should **NOT** display P (Air-to-Ground Ready) Mode.
6. Select desired fire rate. “S” indicates the fire rate selected.
   - RAP = *Rapide* (High Rate of Fire) / LEN = *Lent* (Slow Rate of Fire)



2.3.2 – AIR-TO-AIR GUNS TUTORIAL (NO RADAR)

7. Use *Envergure*/Wingspan knob to set the target's wingspan. In this example, we set the wingspan to 33 meters for a H-6 bomber.
8. Set Gun VTH Mode to CCLT (Calcul Continu de la Ligne de Traceurs, Continuous Computation of Tracers Line).
9. Without radar, the air-to-air gun aiming is done by placing the target along the tracer line and under the 600 m range wingspan marker. The distance needs to be decreased until the target wingspan has at least the same width as the 600 m range wingspan marker; the target will then be in range. Since the tracer line and wingspan markers are relative to the already fired fictive stream of shells, the guns firing needs to be done one time of flight before the target is between the wingspan markers, the time of flight being the time the shells need to reach the target.



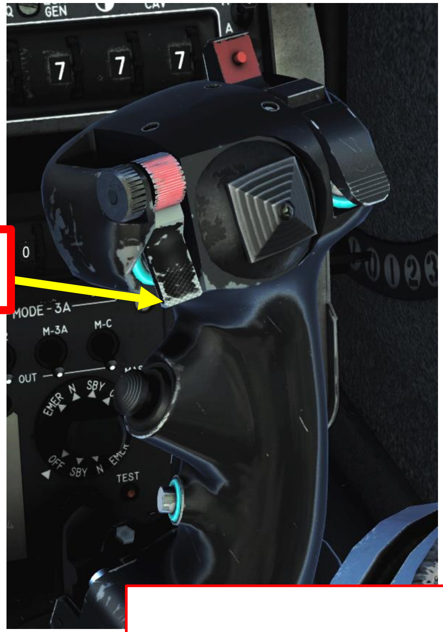


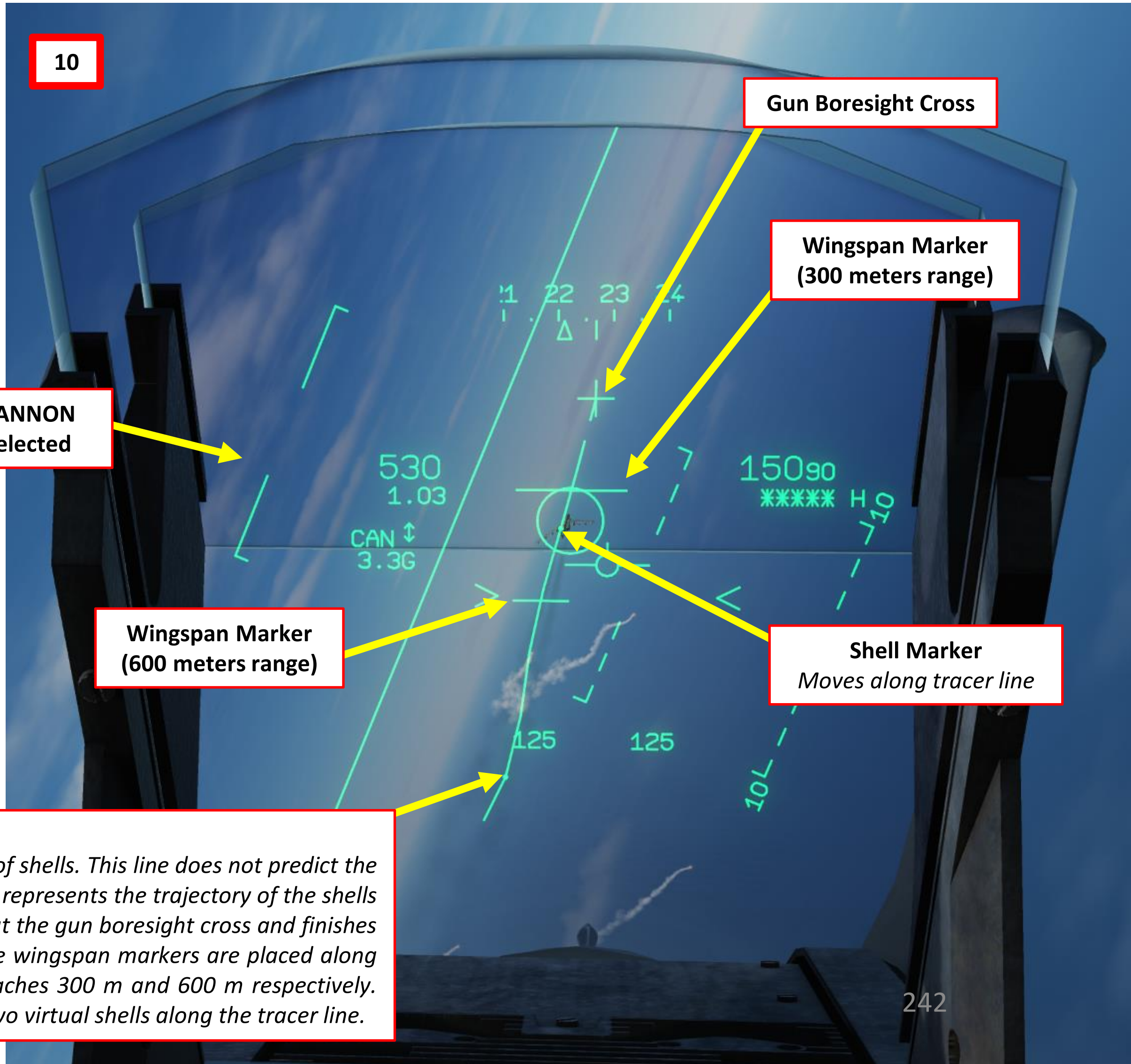
Tracer Line

Represents trajectory of a continuous virtual stream of shells. This line does not predict the trajectory of the shells if they were to be fired now; it represents the trajectory of the shells as if they were fired up until now. The stream starts at the gun boresight cross and finishes when the shell stream has traveled 1000 meters. The wingspan markers are placed along the tracer line where the virtual stream of shells reaches 300 m and 600 m respectively. Shell markers (moving dots) represent the speed of two virtual shells along the tracer line.

2.3.2 – AIR-TO-AIR GUNS TUTORIAL (NO RADAR)

10. Steer the aircraft to fit the target wingspan between the 600 m (short bar) and 300 m (long bar) wingspan markers; target will then be in range. Once the target wingspan has at least the same width as the 600 m wingspan marker, use the shell markers to estimate the shell time of flight to the target. When the target is one time of flight of being between the 2 wingspan markers, fire the guns. Since the range is estimated, it is better to fire a longer salvo and sooner than one time of flight in order to maximize the hit chance.
11. Fire guns using the MiCRoB Trigger (2nd Stage), which is set to SPACE by default.
    - In order to appreciate duration of this time of flight, the shell markers and salvo markers can be used. The shell markers represent the speed of 2 shells along the tracer line and are always displayed while the salvo markers are displayed when the first MiCRoB detent is pressed and represents the full shell salvo.
12. To de-select guns, on the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select other weapons via the PCA or with the CNM (Cannon/Neutral/Magic) switch.

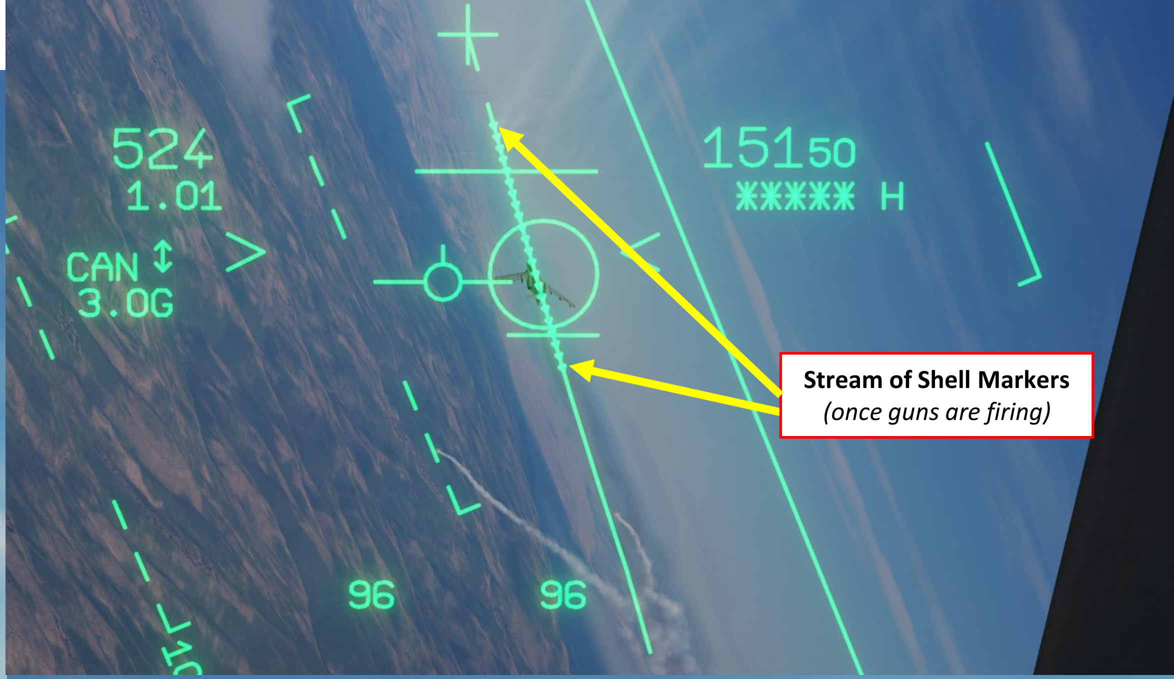




Tracer Line

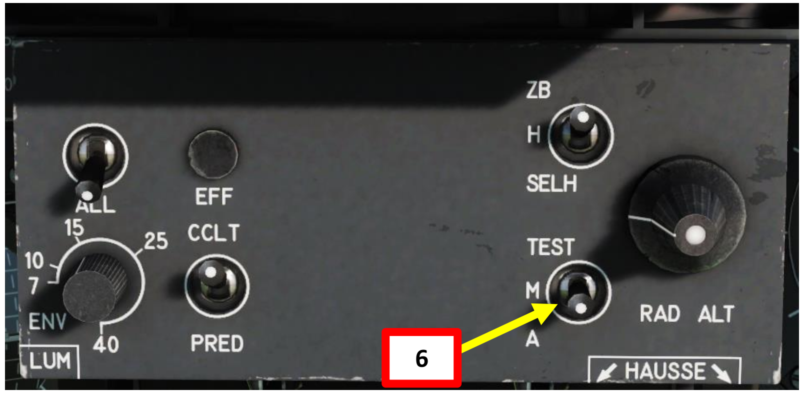
Represents trajectory of a continuous virtual stream of shells. This line does not predict the trajectory of the shells if they were to be fired now; it represents the trajectory of the shells as if they were fired up until now. The stream starts at the gun boresight cross and finishes when the shell stream has traveled 1000 meters. The wingspan markers are placed along the tracer line where the virtual stream of shells reaches 300 m and 600 m respectively. Shell markers (moving dots) represent the speed of two virtual shells along the tracer line.

2.3.2 – AIR-TO-AIR GUNS TUTORIAL (NO RADAR)



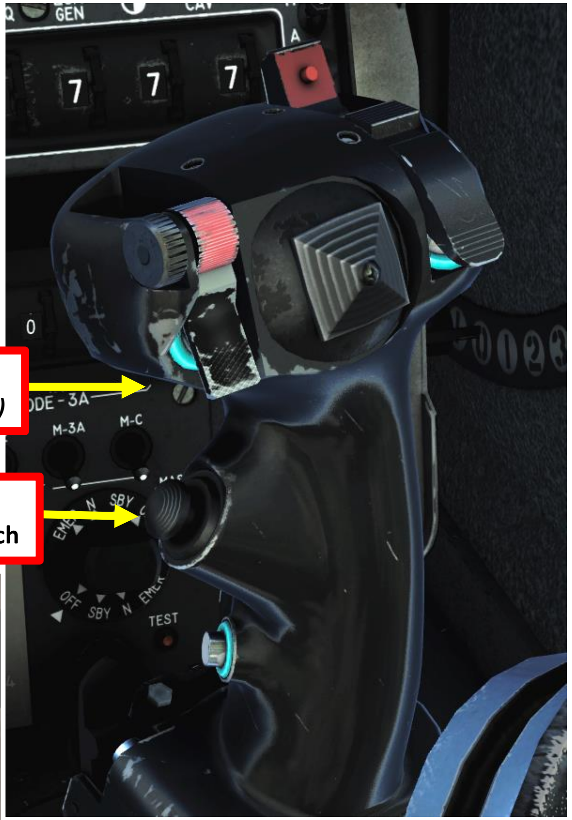
3.1 – ROCKETS TUTORIAL

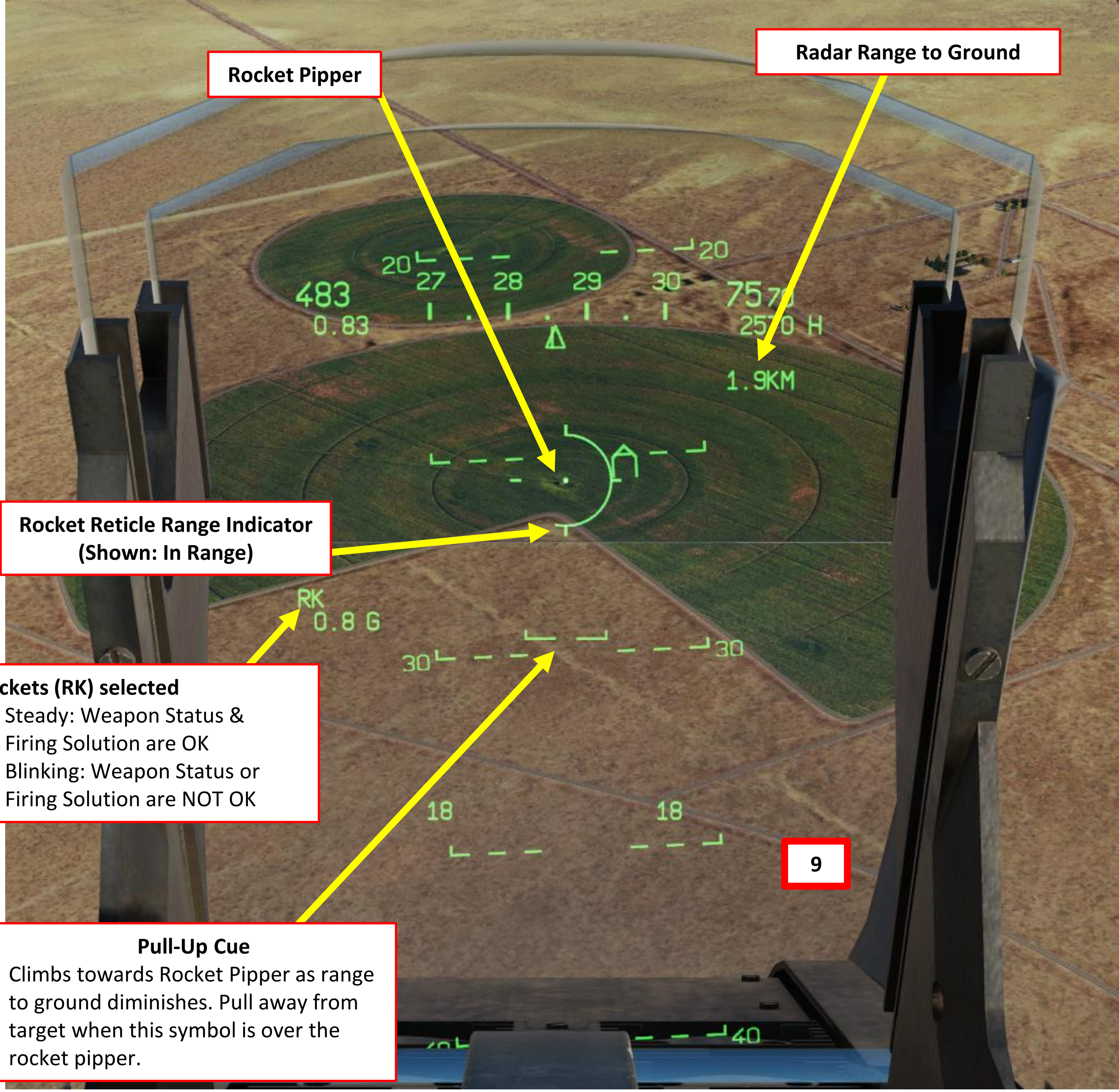
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set firing mode to either PAR (fires single rocket salvo) or TOT (fires all rockets in pods).
3. Set Master Arm switch to ARME (UP)
4. Select RK3 (Rocket) on PCA
5. Ensure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) and RS (*Radio-Sonde*, Altitude Above Ground) buttons are selected (S) on the PCA.
6. Set Radar Altimeter Power switch to **M**ARCHE
7. Turn on Radar Power by setting switch to **EM**ISSION.



3.1 – ROCKETS TUTORIAL

8. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
   - Confirm that “S” (Selected) and “P” (*Prêt*/Ready) lights are illuminated on the armament panel.
9. Align rocket pipper on target at a dive angle of 20-25 degrees. You will be within firing range when the gun reticle range indicator starts decreasing. The pipper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 2400 meters. The 9 o’clock caret depicts the range of 1800 meters, 6 o’clock of 1200 meters and 3 o’clock of 600 meters.
10. When rocket pipper is aligned, press and hold MiCRoB Trigger (2nd Stage) (SPACE by default).
11. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.





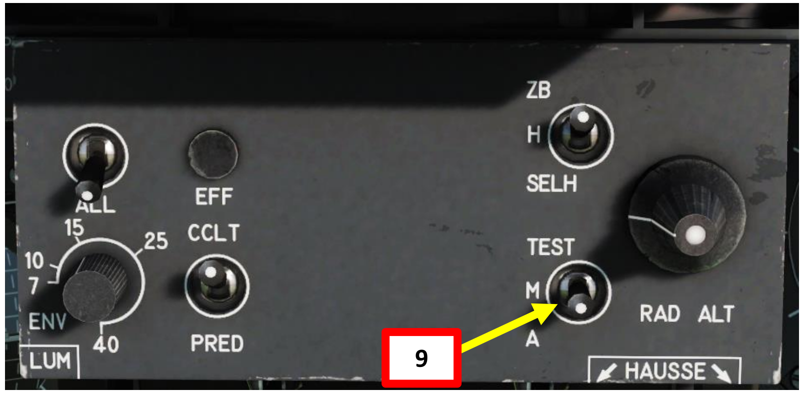
3.1 – ROCKETS TUTORIAL

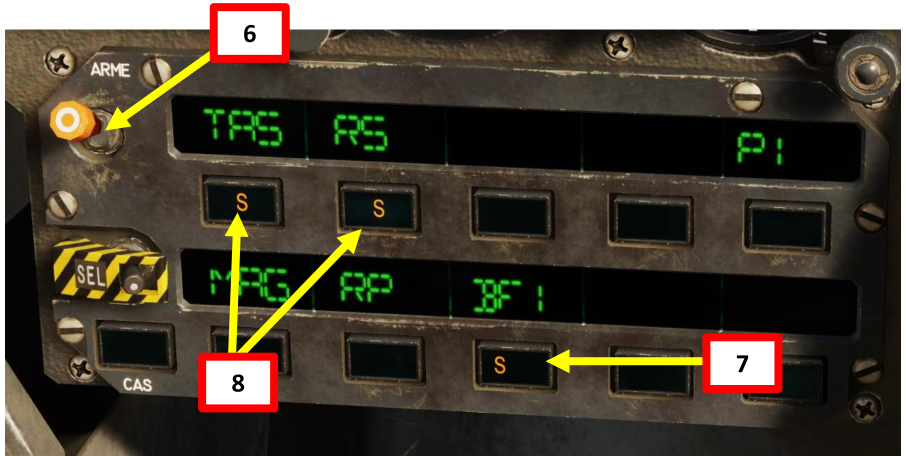
3.1 – ROCKETS TUTORIAL

Note:
Rocket pods can be mounted on inner (*intérieur*) and/or outer (*extérieur*) pylons. They need to be selected manually on the PCA (S = Selected) with the EXT and INT buttons.

3.2 – MK-82SE "SNAKE EYE" BOMBS CCIP TUTORIAL

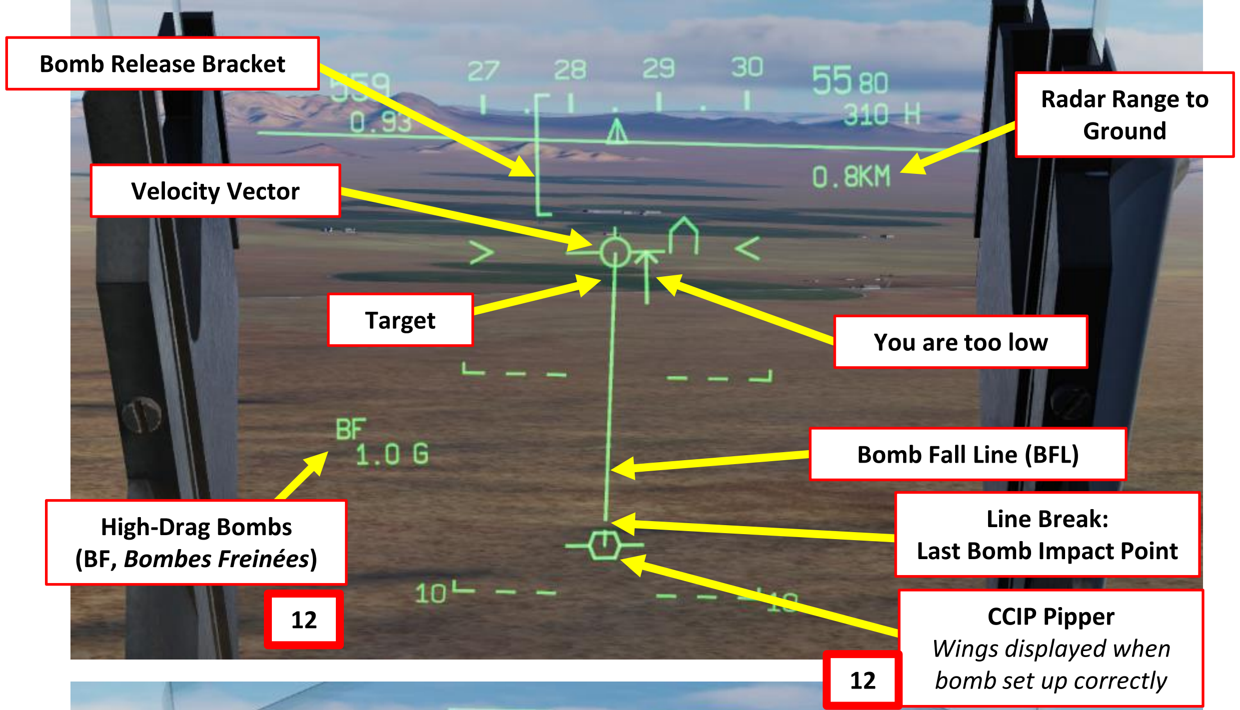
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set fuze selector to either RET (*retardé*/delayed fuze) or INST (instantaneous fuze)
3. On PPA, set number of bombs to be released (04 = 4 bombs). Take note that 00 will not release any bombs.
4. On PPA, set distance between bomb release (02 = 20 m)
5. Adjust seat to see lower part of HUD better.
6. Set Master Arm switch to ARME (UP)
7. Select BF1 (*Bombe Freinée* – High-drag MK-82SE) on PCA
8. Ensure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) and RS (*Radio-Sonde*, Altitude Above Ground) buttons are selected (S) on the PCA.
9. Set Radar Altimeter Power switch to **M**ARCHE

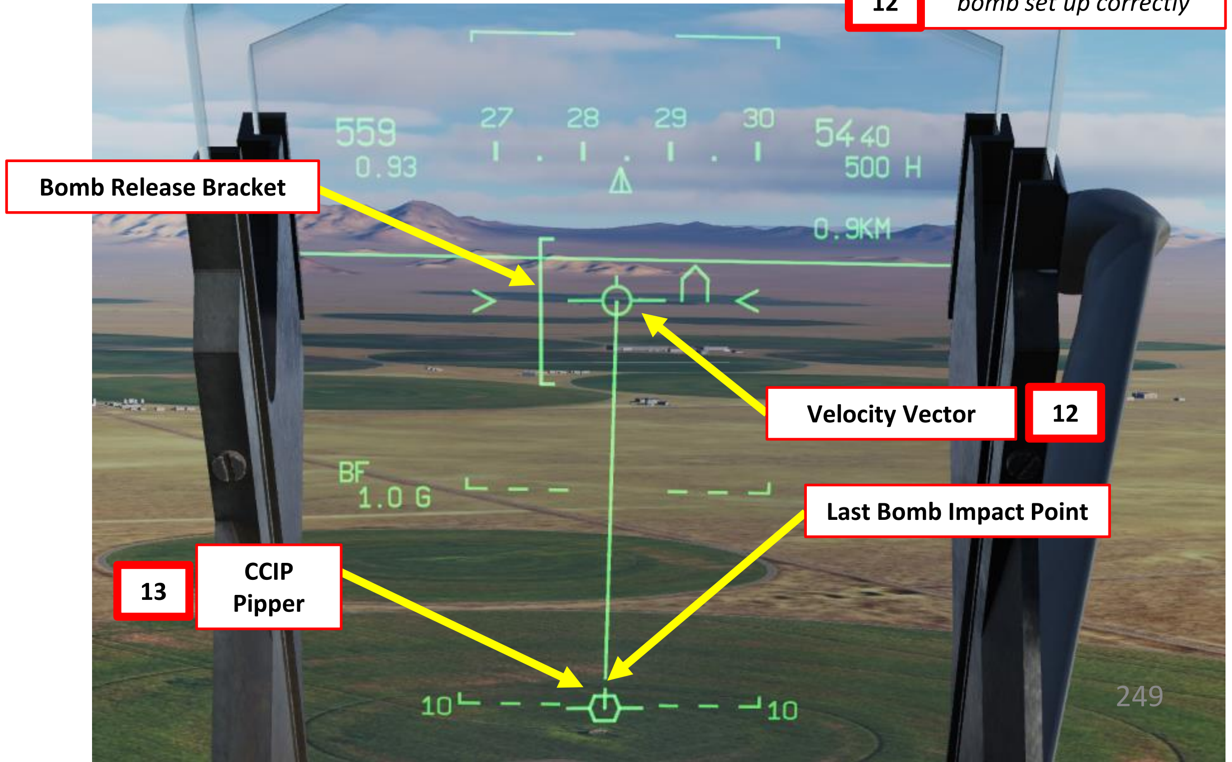




3.2 – MK-82SE "SNAKE EYE" BOMBS CCIP TUTORIAL

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that "S" (Selected) and "P" (*Prêt*/Ready) lights are illuminated on the armament panel.
11. Approach the target by flying low and level. Place the velocity vector within the Bomb Release Bracket (computed based on aircraft pitch and altitude).
12. Align CCIP pipper on target by manoeuvering the aircraft. A valid bomb release status is indicated by "wings" next to CCIP pipper, a steady "BF" indication on the HUD and a "P" indication on the Armament Panel.
13. When CCIP pipper is on target, press and hold MiCRoB Trigger (2nd Stage) for at least 0.5 sec (SPACE by default).
14. Pull up to avoid smacking yourself into the ground and watch the fireworks.
15. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.





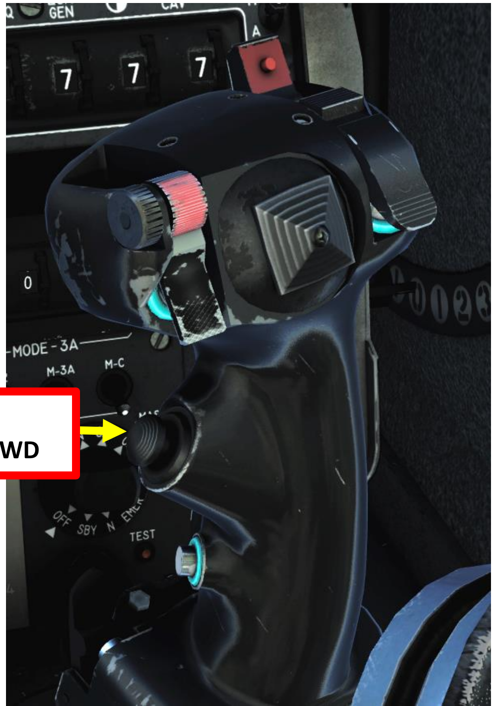
3.2 – MK-82SE "SNAKE EYE" BOMBS
CCIP TUTORIAL

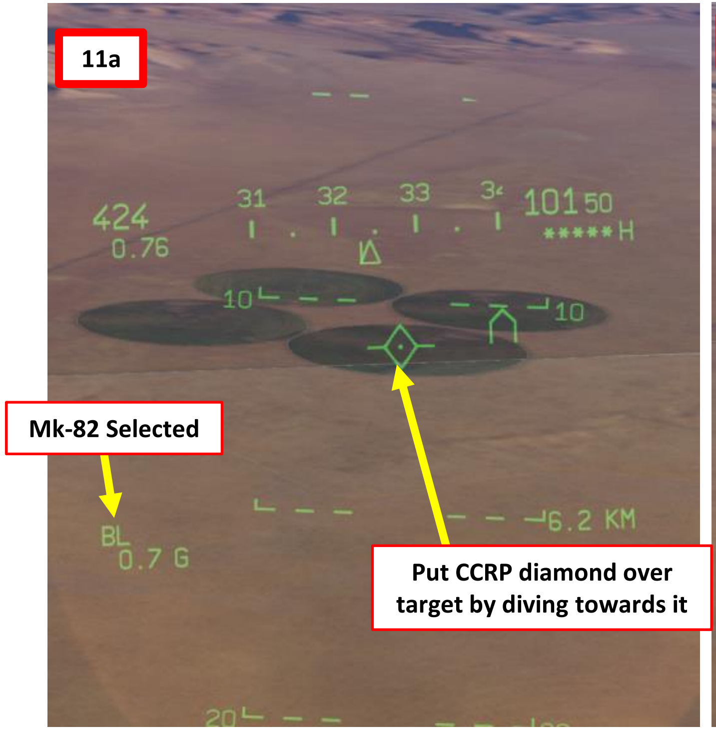
3.3 – MK-82 BOMBS - MANUAL CCRP/CCPL TUTORIAL

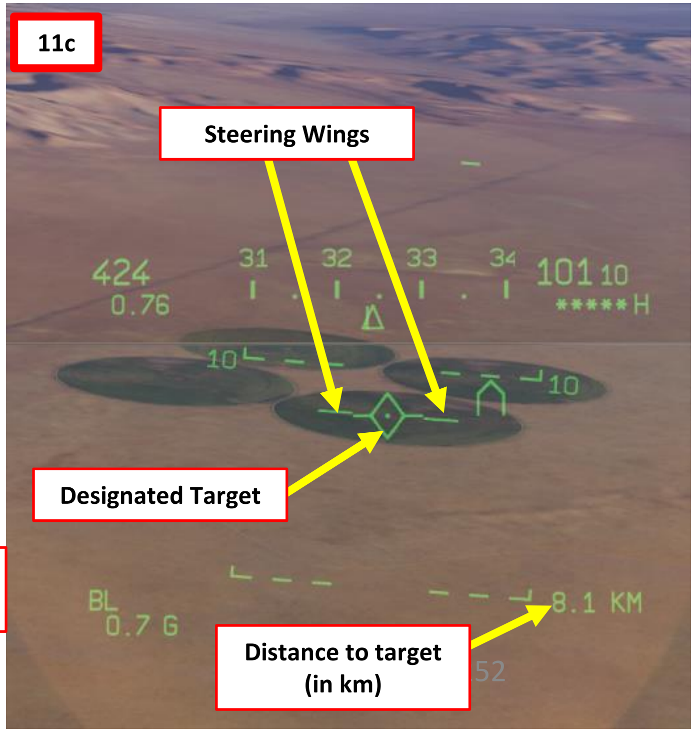
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set fuze selector to either RET (*retardé*/delayed fuze) or INST (instantaneous fuze)
3. On PPA, set number of bombs to be released (00 = single, 04 = 4 bombs). Take note that 00 will not release any bombs.
4. On PPA, set distance between bomb release (02 = 20 m)
5. Adjust seat to see lower part of HUD better.
6. Set Master Arm switch to ARME (UP)
7. Select BL1 (*Bombe Lisse* – Low-drag MK-82) on PCA
8. Make sure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) mode is selected on PCA
9. Turn radar power ON (**EM**ISSION)

3.3 – MK-82 BOMBS - MANUAL CCRP/CCPL TUTORIAL

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that “S” (Selected) and “P” (*Prêt*/Ready) lights are illuminated on the armament panel.
    - A valid bomb release status is indicated by a steady “BL” indication on the HUD and a “P” indication on the Armament Panel. When bomb release status is invalid, “BL” blinks and “P” disappears.
11. Fly to position the CCRP diamond on target for 1 to 2 seconds, wait for the “wings” to appear next to the diamond, and then press the “MAGIC SLAVE/AG DESIGNATE” button on your HOTAS to designate the target. When target is designated, steering wings will appear over the CCRP diamond.
    - Keep in mind that unlike most modern aircraft, the Mirage has no HUD indication to show where the designated/locked ground target is. You will have to make sure the designation with the CCRP diamond is precise enough and use the CCRP cues (CCRP line, steering wings, distance to target) accordingly.

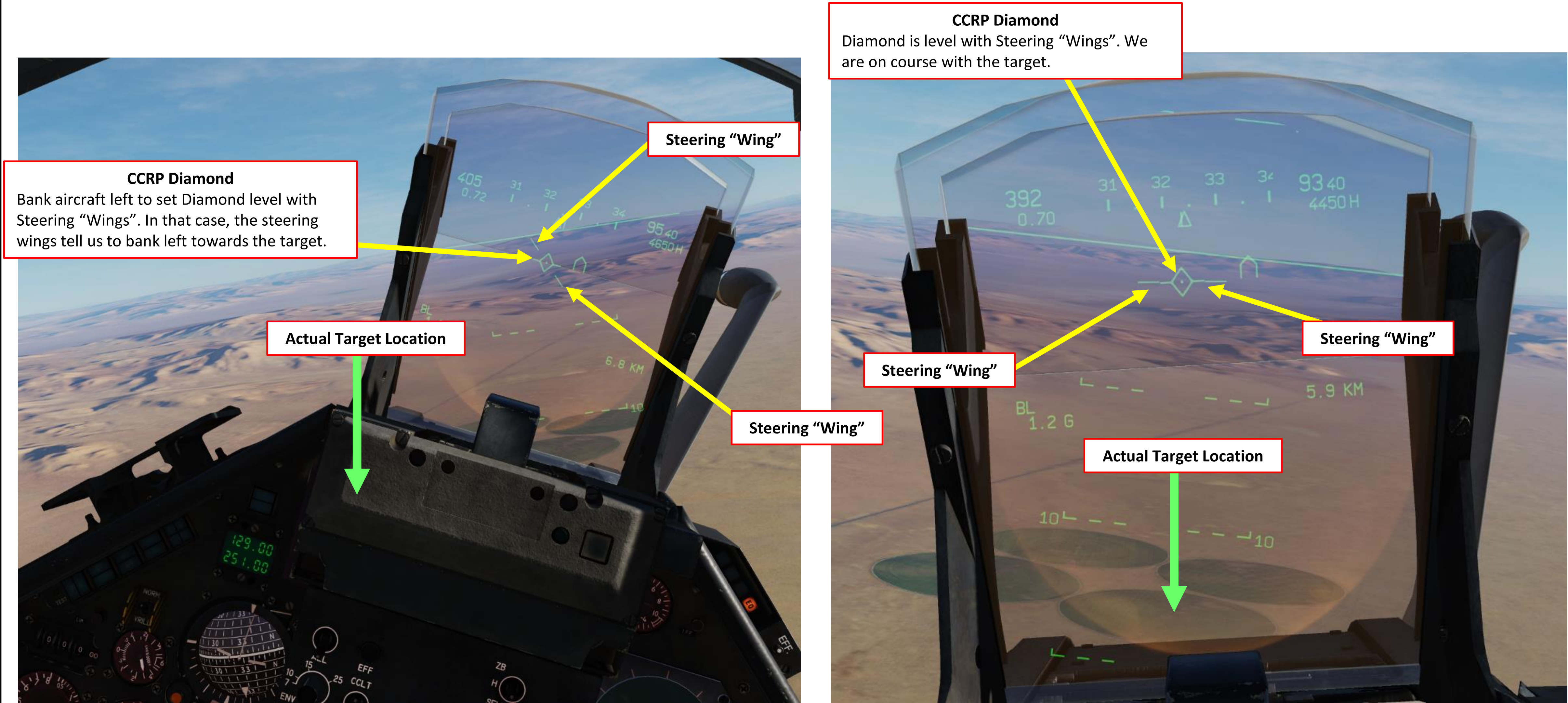






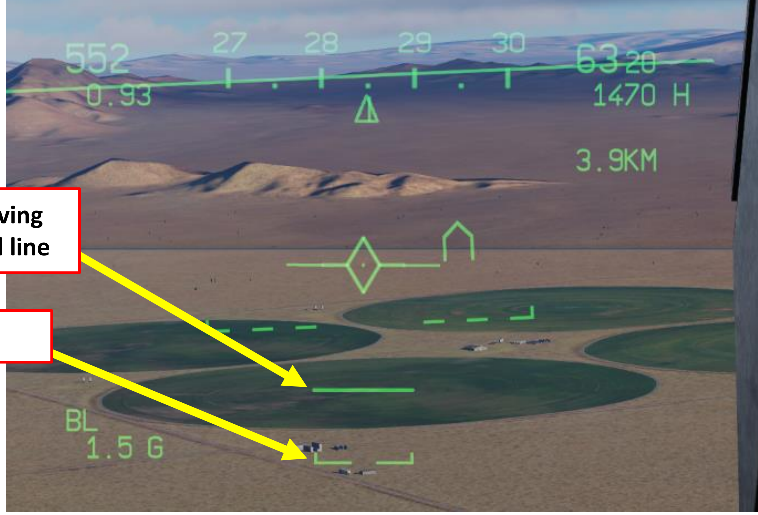
3.3 – MK-82 BOMBS - MANUAL CCRP/CCPL TUTORIAL

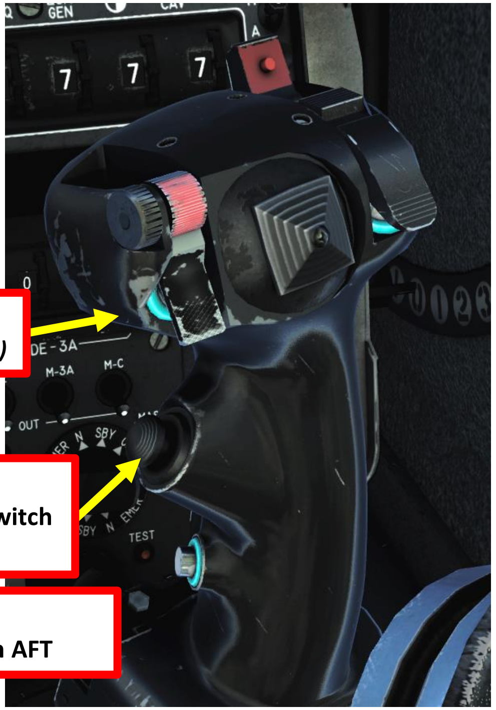
12. Once target is designated, steering wings will appear on the CCRP diamond. They will provide steering cues towards the designated target. Radar range will display the range to target.
13. Fly level towards target (make sure you have at least 2000 ft of clearance).

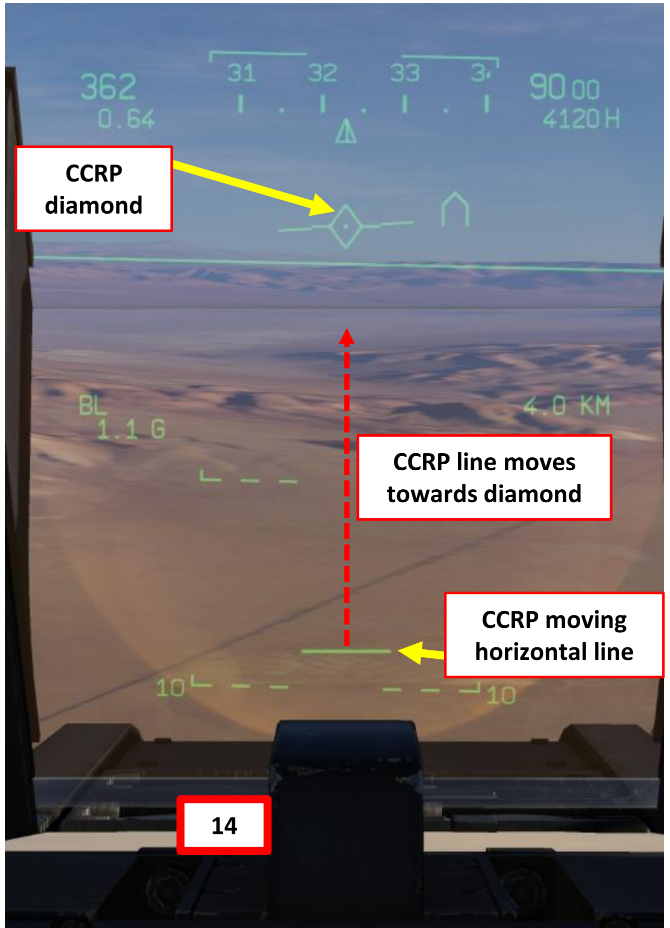


3.3 – MK-82 BOMBS - MANUAL CCRP/CCPL TUTORIAL

14. Horizontal CCRP line will show up when you are 15 seconds from target.
15. When CCRP release cue (horizontal line) appears, press and hold MiCRoB Trigger (2nd Stage) (SPACE by default) until CCRP line is lined up with the diamond reticle. The bombs will automatically be released. In this example, four bombs will be released.
    - If performing a toss bombing profile (flying at low altitude, then pull 6 Gs while pressing the MiCRoB Trigger (2nd Stage)), the CCRP system expects you to be pulling 6 Gs when the CCRP horizontal line crosses the diamond.
16. Observe damage and unlock target (cycle Weapons System CMD switch AFT, then FWD on the stick). Unfortunately, CCRP is not very precise.
17. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.







3.3 – MK-82 BOMBS - MANUAL CCRP/CCPL TUTORIAL

3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP)

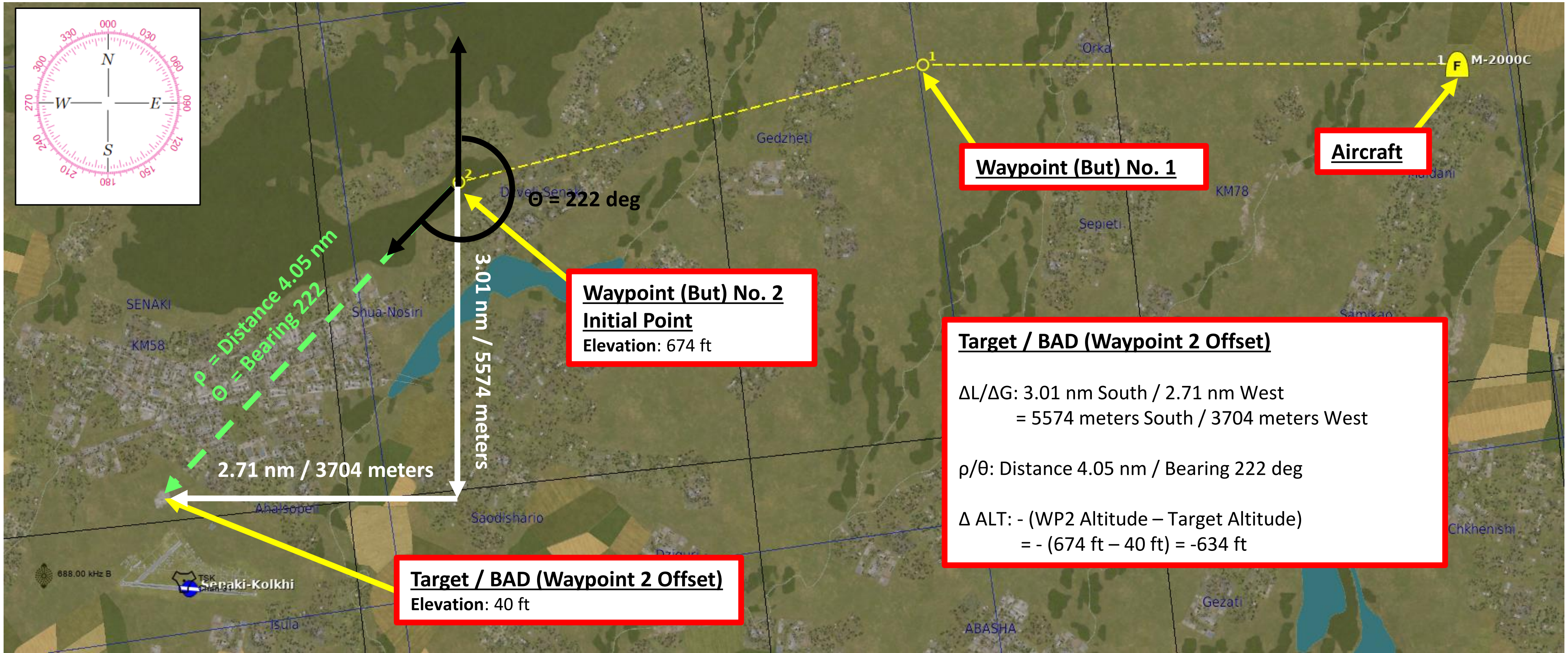
INS Precision bombing is a kind of attack that requires longer and more careful planning and preparation.

However, you don't need to manually designate the target by entering a shallow dive. Moreover, it is not necessary to obtain a visual on the place you want to bomb. The drawback is that the position of the target must be known precisely and inserted as a Waypoint Offset/BAD (*But Additionnel)*, and the INS requires having enough precision. To achieve INS precision, a landmark can be inserted as the waypoint to which the BAD relates and the INS position updated on it during the attack run. This waypoint is called Initial Point (IP).

Selecting IP (Initial Point) on the PCA triggers the appearance of the INS update symbol. It disappears and is replaced by the guidance cues when passing the IP.

Offsets are defined in two ways:

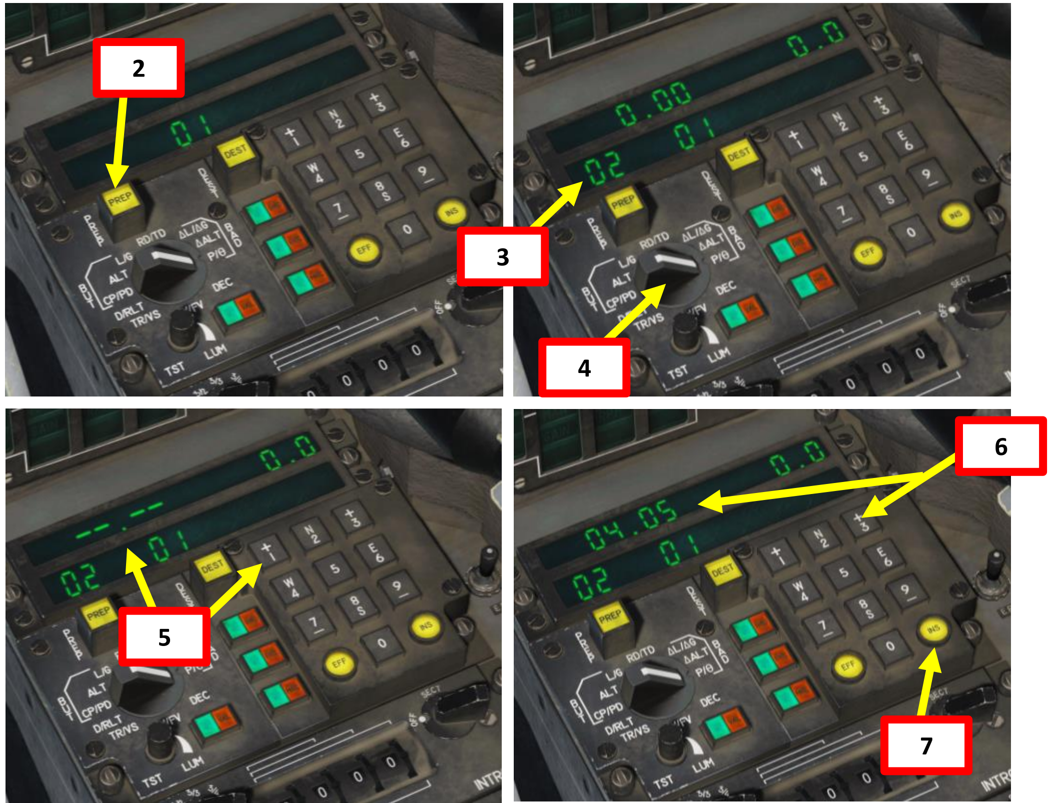
- Entering Longitude (North/South) and Latitude (East/West) offsets (**ΔL/ΔG**) in **kilometers** with an altitude offset Δ ALT (can be entered in meters or ft as desired).
- Entering Polar Coordinate offsets (**ρ** for distance in nautical miles, **θ** for bearing angle) with an altitude offset Δ ALT (can be entered in meters or ft as desired).

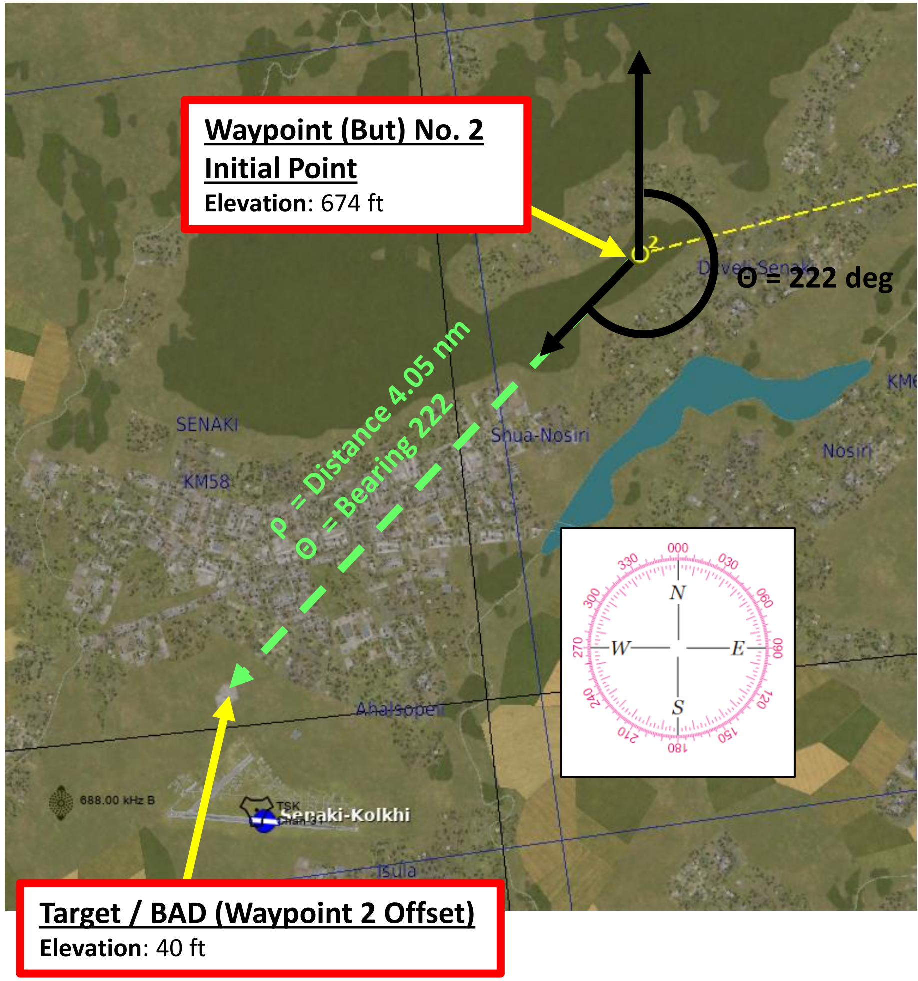


3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP)
WAYPOINT OFFSET (*BAD*) CREATION WITH ρ/θ

In this tutorial, we already have two waypoints set the MIP (Module d'Insertion de Paramètres: Data Cartridge Insertion Module) via the mission editor. Make sure Waypoint 2 coordinates are already entered.

1. Note Distance **(ρ in nautical miles)** and Bearing **(θ in degrees)** offsets**,** with the altitude offset Δ ALT (in ft).
    - **ρ Distance Offset: 4.05 nautical miles FROM Waypoint 2**
    - **θ Bearing Offset: 222 degrees FROM Waypoint 2**
    - **Altitude Offset: -634 ft**
2. Press "PREP" (Preparation) button to edit a waypoint.
3. Press "0" and "2" (02) on the INS numpad to select Waypoint Number 2.
4. Set UNI Parameter Selector Switch to ρ/θ
5. Press "+1" on numpad to select the ρ distance field (left)
6. Press **0405** on numpad to enter ρ distance offset of 4.05 nautical miles
7. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).





Target / BAD (Waypoint 2 Offset)

ρ/θ: Distance 4.05 nm / Bearing 222 deg

Δ ALT: WP2 Altitude – Target Altitude
= 674 ft – 40 ft = 634 ft

3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP)
WAYPOINT OFFSET (*BAD*) CREATION WITH ρ/θ

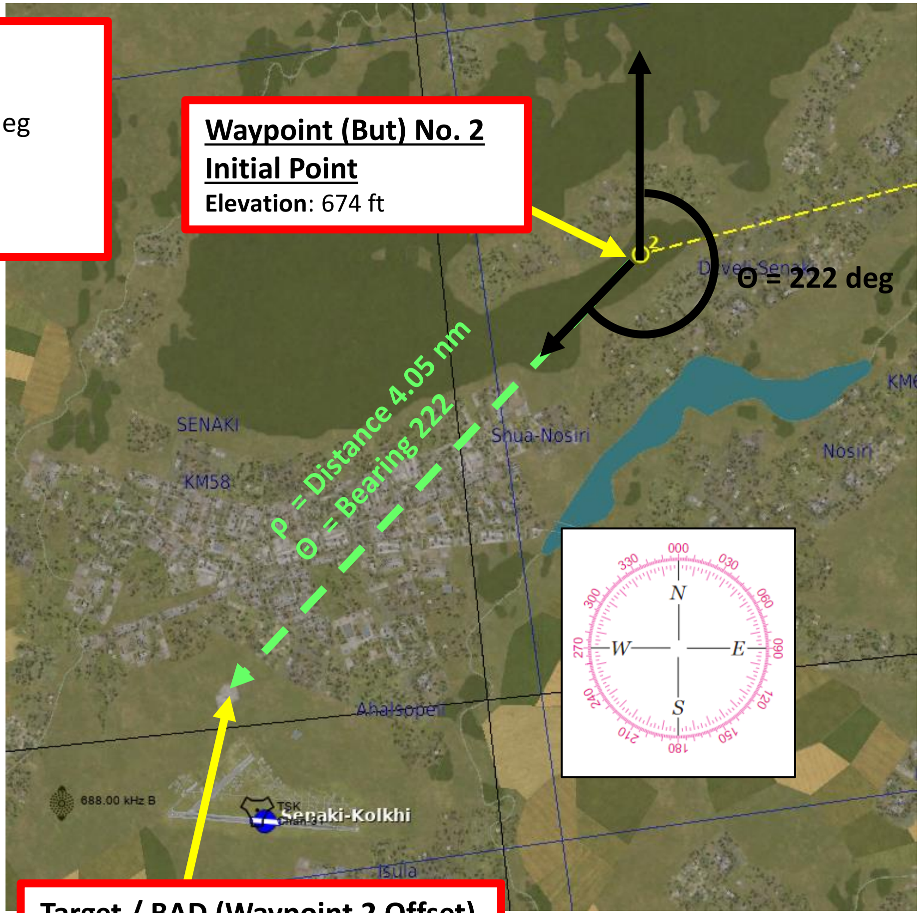
- **ρ Distance Offset: 4.05 nautical miles FROM Waypoint 2**
- **θ Bearing Offset: 222 degrees FROM Waypoint 2**
- **Altitude Offset: -634 ft**

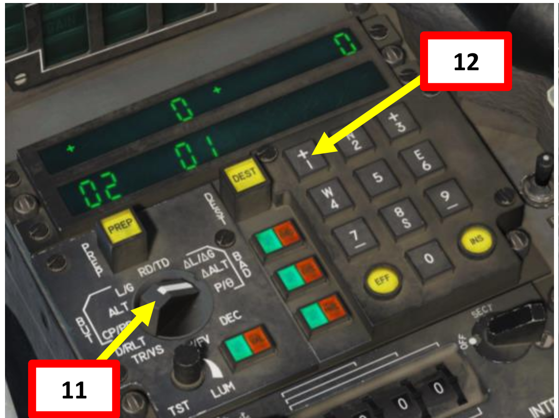
8. Press “+3” on numpad to select the θ bearing field (right)
9. Press **2220** on numpad to enter a θ bearing offset of 222.0 degrees
10. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).
11. Set UNI Parameter Selector Switch to ΔALT
12. Press “+1” on numpad to select the FEET field (left). Right field is deserved for METERS.
13. Press “– " (7) on numpad to select NEGATIVE altitude offset
14. Press **00634** on numpad to enter ALTITUDE offset of -634 meters
15. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).

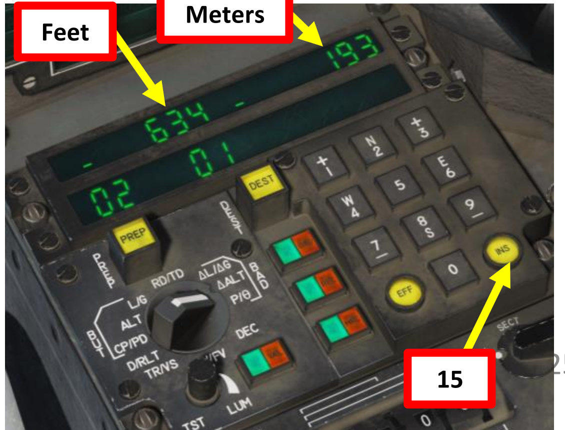
Target / BAD (Waypoint 2 Offset)

ρ/θ: Distance 4.05 nm / Bearing 222 deg

Δ ALT: WP2 Altitude – Target Altitude
= 674 ft – 40 ft = 634 ft





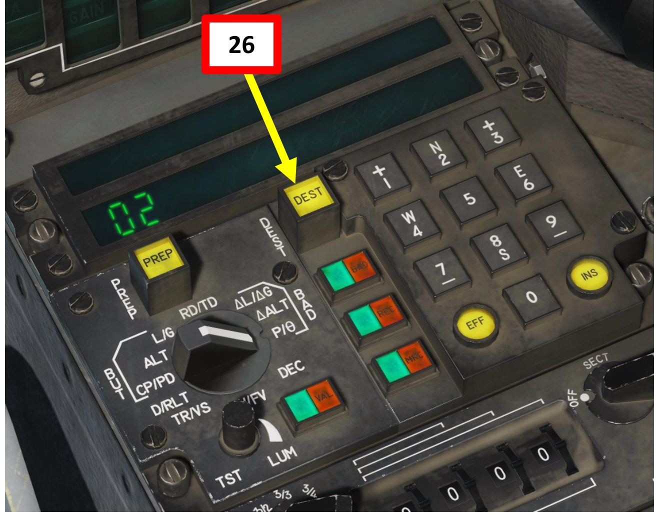


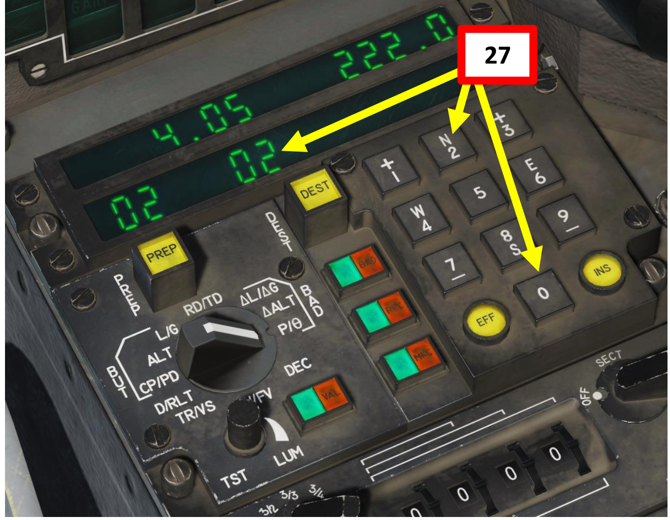
3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP) BOMBING

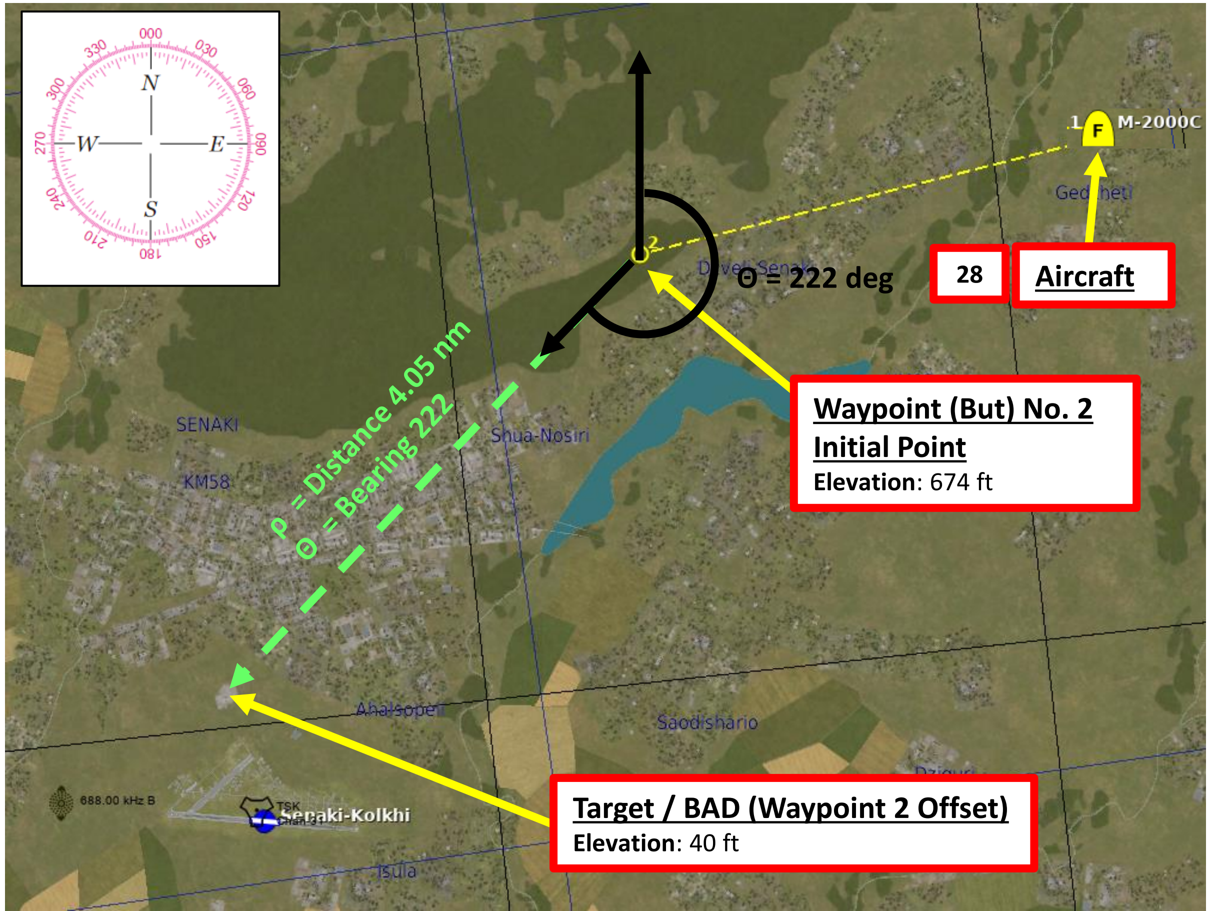
16. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
17. On PPA, set fuze selector to either RET (*retardé*/delayed fuze) or INST (instantaneous fuze)
18. On PPA, set number of bombs to be released (00 = no bombs, 08 = 8 bombs)
19. On PPA, set distance between bomb release (02 = 20 m)
20. Adjust seat to see lower part of HUD better.
21. Set Master Arm switch to ARME (UP)
22. Select BL1 (*Bombe Lisse* – Low-drag MK-82) on PCA
23. Select PI (Point Initial/Initial Point) Mode on PCA
24. Make sure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) mode is selected on PCA
25. Turn radar power ON (**EM**ISSION)

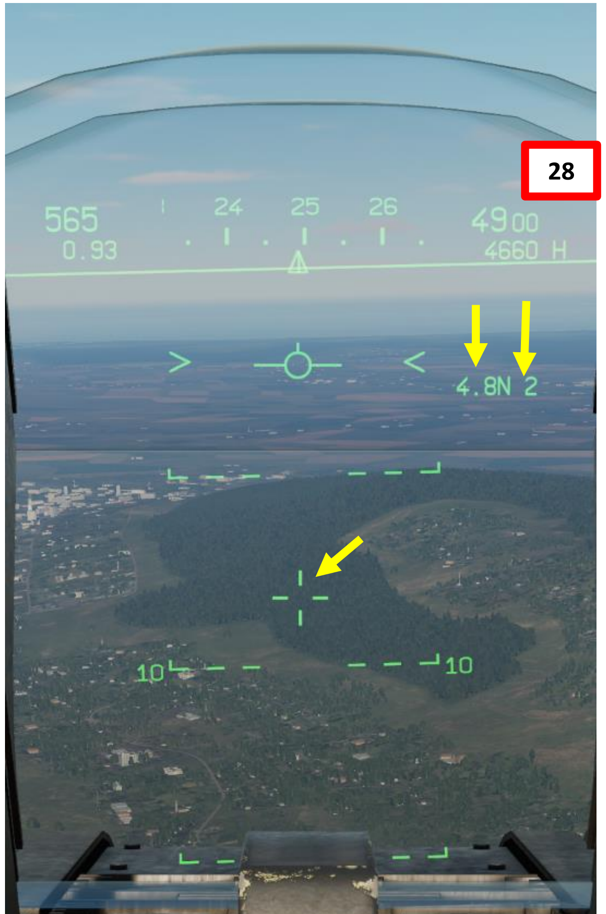
3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP) BOMBING

26. Press “DEST” (Destination) button .
27. Press “0” and “2” (02) on the INS numpad to select Waypoint Number 2 (Reference Waypoint for Initial Point).
28. Fly to Waypoint 2 (Initial Point). Use HUD steering cues and HSI as a reference.



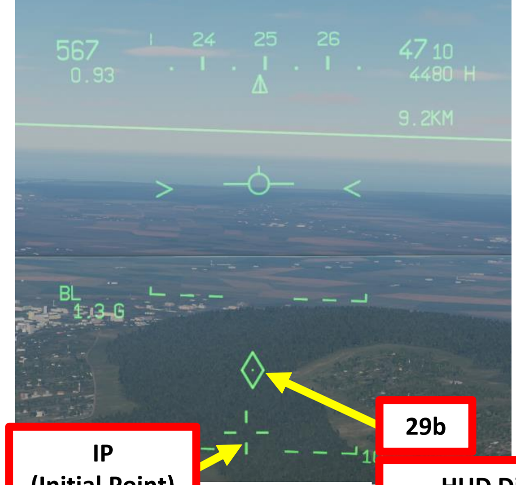


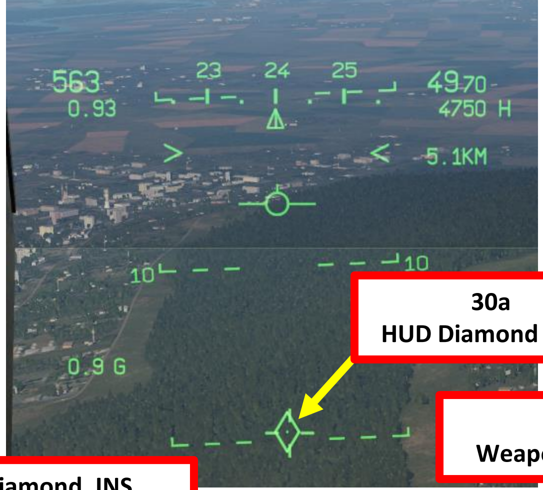


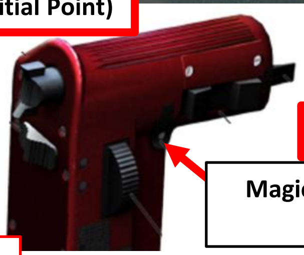


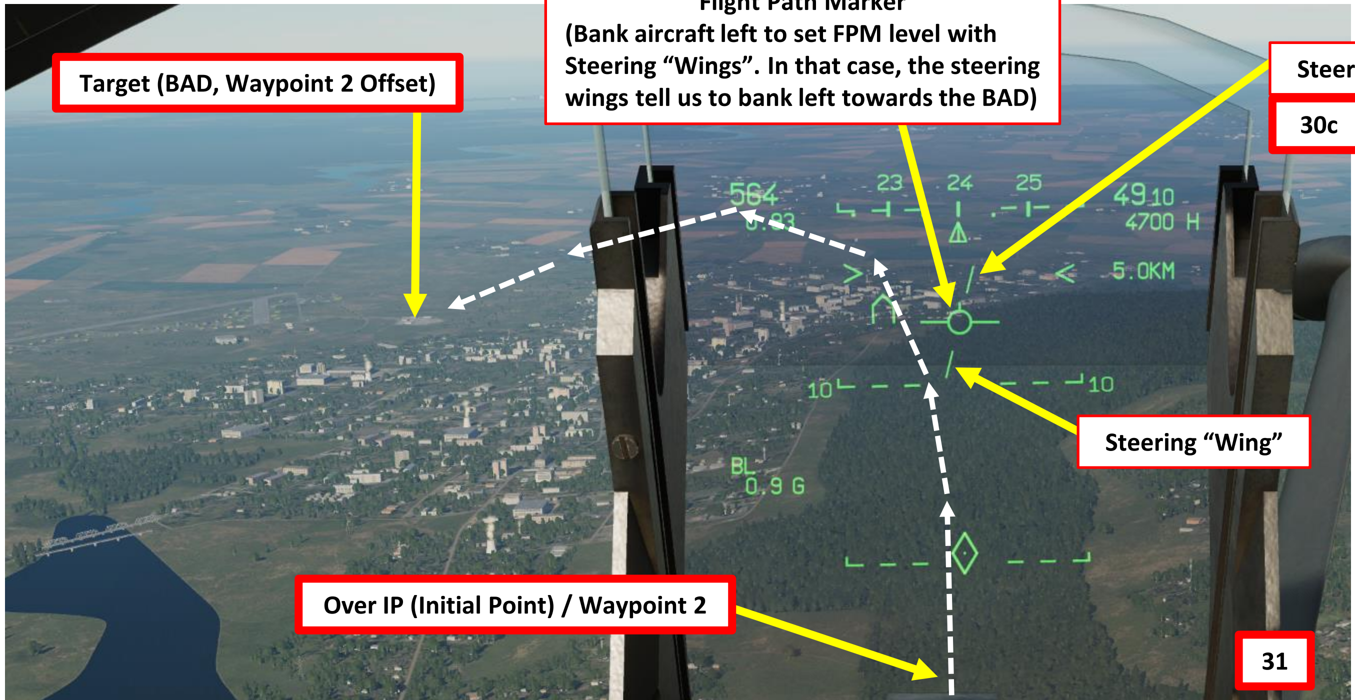
3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP) BOMBING

29. When you are about less than 1 nm from Waypoint 2, set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
30. A designation diamond will appear on the HUD. Steer aircraft to place it on the "real" position of the IP (Initial Point), which should be something recognizable (or, if INS drift is minimal, the cross on the HUD). When diamond is on the correct IP position, press the "MAGIC SLAVE/AG DESIGNATE" button on your HOTAS to designate the IP.
31. When IP is re-designated, wings will appear on the Flight Path Marker (FPM). They will provide steering cues towards the BAD (Waypoint Offset). Radar range will display the range to target, nav cues will shift to BAD position and HSI will display bearing and distance to BAD.
32. As you are almost directly over the IP, follow the navigation cues and turn towards the offset point. Try to keep the wings on your FPM level as you approach your target.



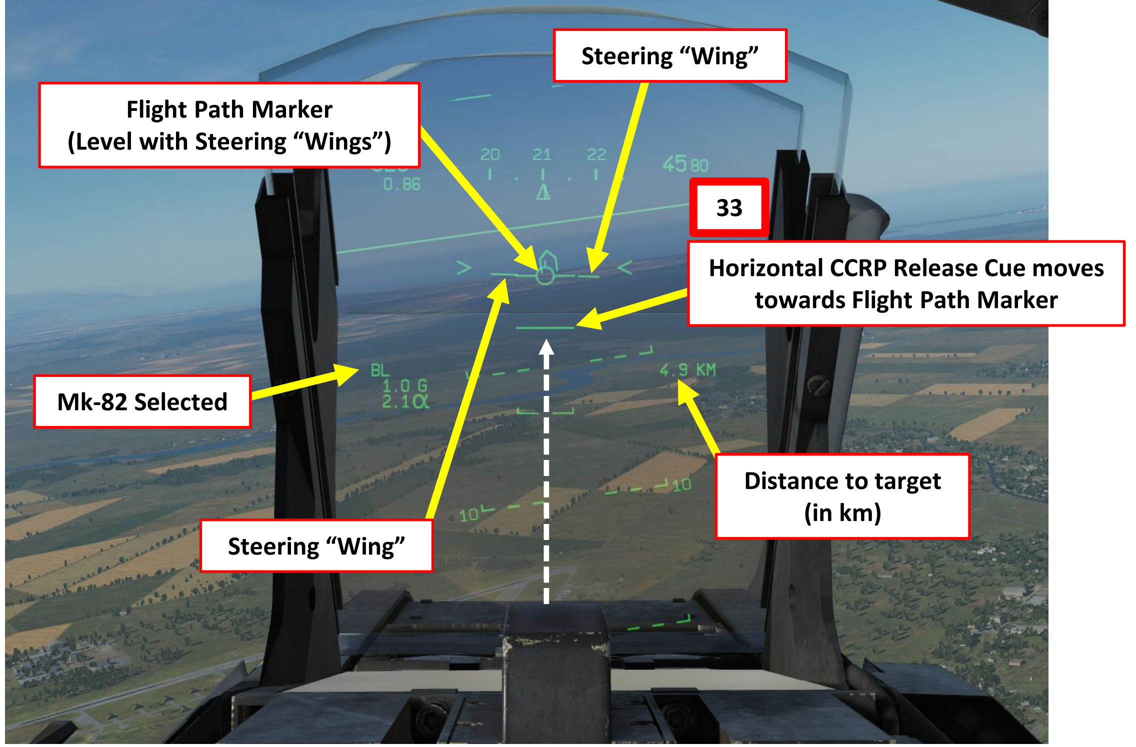






3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP)
BOMBING

33. When you are in range for pull up, release cues appear in the HUD.
34. Fly level towards target (make sure you have at least 2000 ft of clearance).
35. When release cue appears, press and hold MiCRoB Trigger (2nd Stage) (SPACE by default) until CCRP line is lined up with the diamond reticle. The bombs will automatically be released. In this example, eight bombs will be released per trigger press.
36. Observe damage and unlock target (cycle Weapons System CMD switch AFT, then FWD on the stick). Unfortunately, CCRP is not very precise.
37. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.

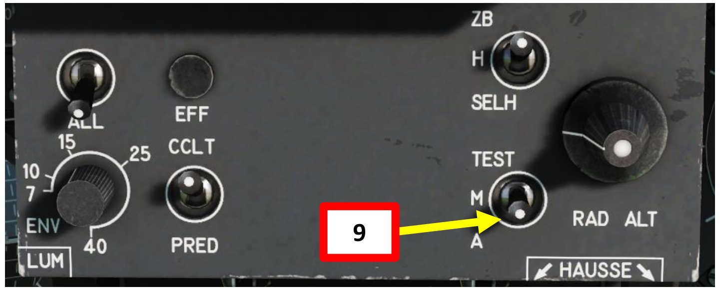


3.4 – MK-82 BOMBS
INS PRECISION BOMBING TUTORIAL (CCRP)

3.5 – BLG-66 "BELOUGA" CLUSTER BOMBS CCIP TUTORIAL

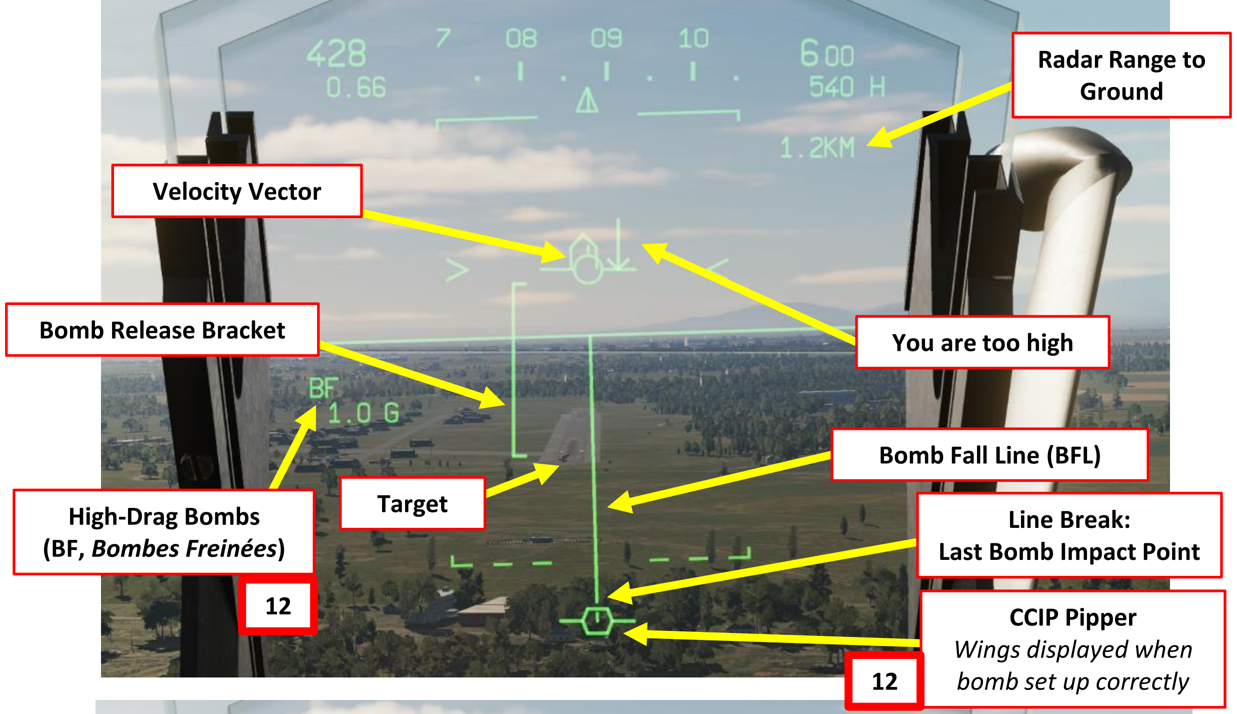
Basically, the Belouga cluster bombs are used just like Snake Eyes and use the CCIP release mode by default. The Belougas are used against soft targets (non-protected or lightly armoured). After release, the bomb ejects a large amount of small sub-munitions that cover a large area and detonate on impact. Therefore, they must be dropped high enough to permit sub-munitions deployment.

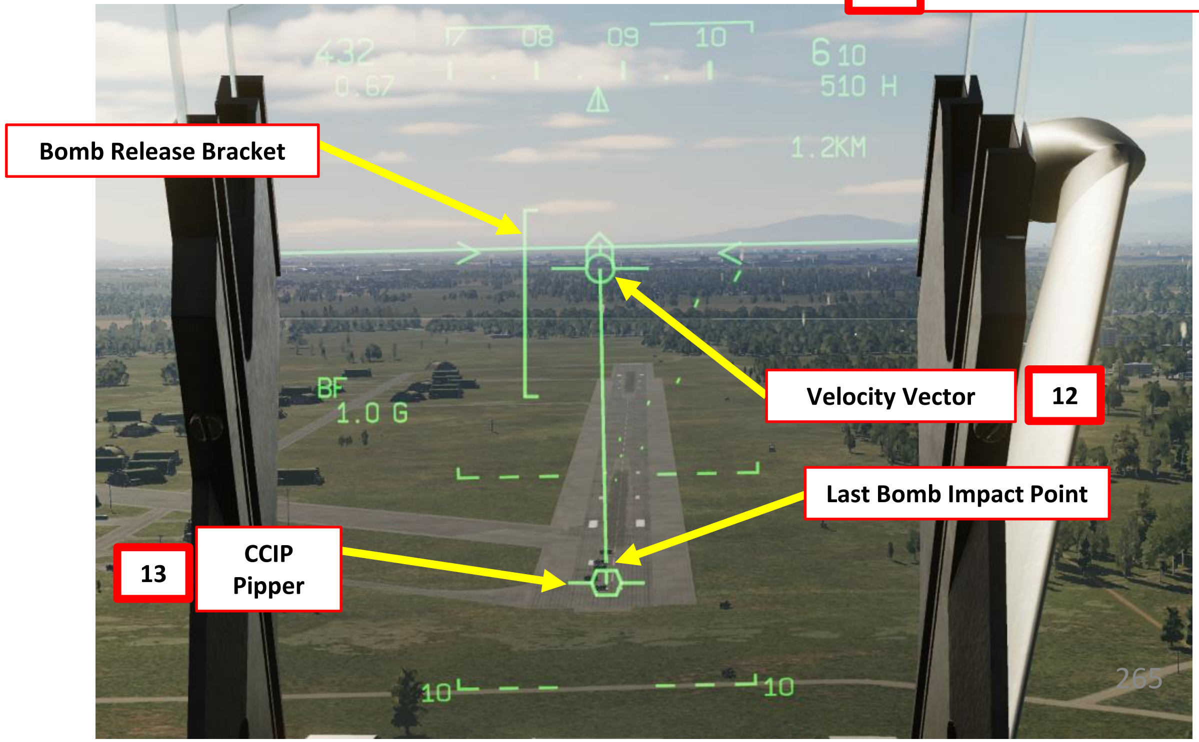
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set fuze selector to either RET (long dispersion area) or INST (short dispersion area)
3. On PPA, set number of bombs to be released (04 = 4 bombs). 00 will not drop any bombs.
4. On PPA, set distance between bomb release (02 = 20 m)
5. Adjust seat to see lower part of HUD better.
6. Set Master Arm switch to ARME (UP)
7. Select BF6 (*Bombe Freinée* – High-drag BLG-66 Belouga) on PCA
8. Ensure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) and RS (*Radio-Sonde*, Altitude Above Ground) buttons are selected (S) on the PCA.
9. Set Radar Altimeter Power switch to **M**ARCHE



3.5 – BLG-66 "BELOUGA" CLUSTER BOMBS CCIP TUTORIAL

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that "S" (Selected) and "P" (*Prêt*/Ready) lights are illuminated on the armament panel.
11. Approach the target by flying low and level. Place the velocity vector within the Bomb Release Bracket (computed based on aircraft pitch and altitude).
12. Align CCIP pipper on target by manoeuvering the aircraft. A valid bomb release status is indicated by "wings" next to CCIP pipper, a steady "BF" indication on the HUD and a "P" indication on the Armament Panel.
13. When CCIP pipper is on target, press and hold MiCRoB Trigger (2nd Stage) for at least 0.5 sec (SPACE by default).
14. Pull up to avoid smacking yourself into the ground and watch the fireworks.
15. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.



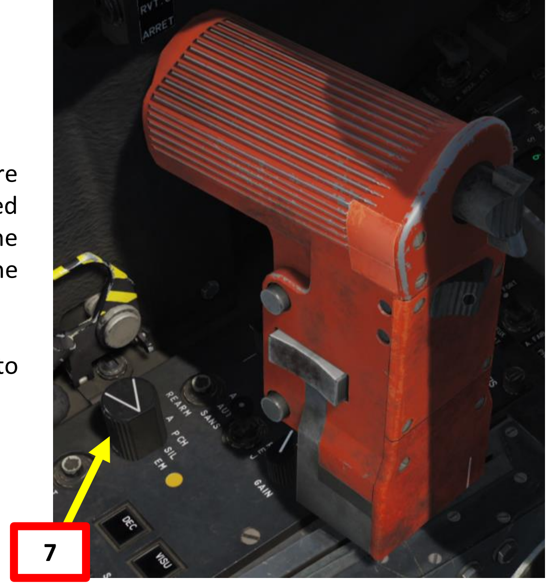


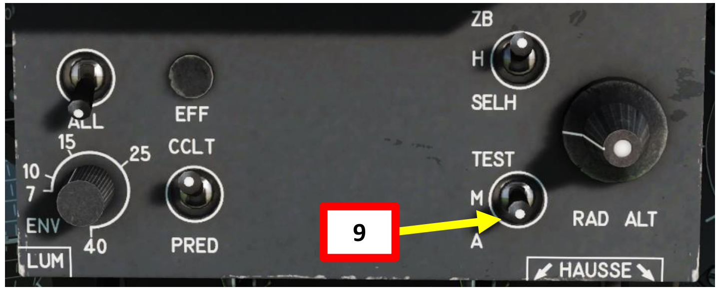
3.5 – BLG-66 "BELOUGA" CLUSTER BOMBS
CCIP TUTORIAL

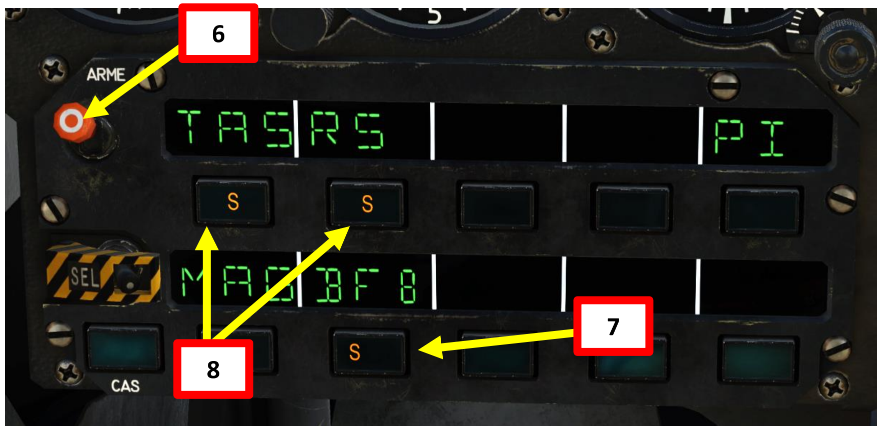
3.6 – BAP-100 ANTI-RUNWAY PENETRATION BOMBS CCIP TUTORIAL

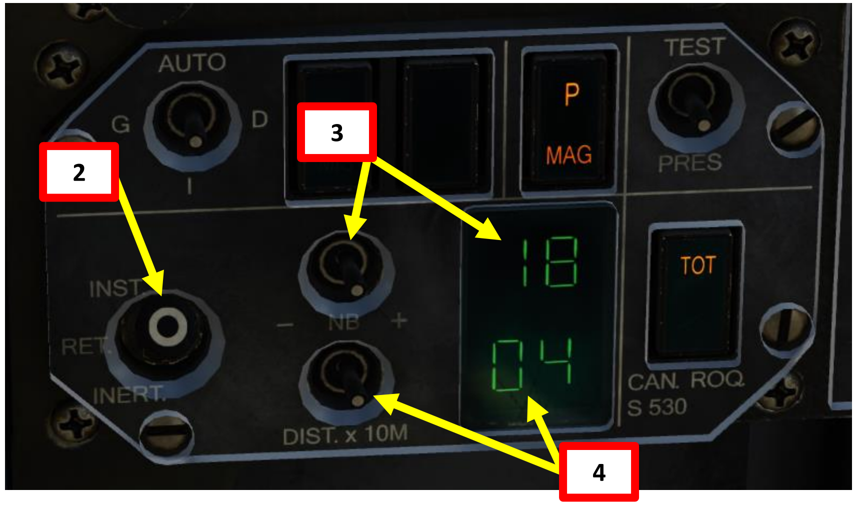
Basically, the BAP-100s (*Bombe Anti-Piste*, 100 mm) are unguided, high-drag, rocket assisted anti-runway bombs. They are delivered just like Snake Eyes and use the CCIP release mode by default. The BAP-100 are used against hard/reinforced targets like runways. The Mirage 2000C can carry up to 18 BAP-100 under the fuselage hardpoint. 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.

1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set fuze selector to either RET or INST; both positions arm the retarded fuze.
3. On PPA, set number of bombs to be released (18 = 18 bombs). 00 will not drop any bombs.
4. On PPA, set distance between bomb release (04 = 40 m)
5. Adjust seat to see lower part of HUD better.
6. Set Master Arm switch to ARME (UP)
7. Select BF8 (*Bombe Freinée* – High-drag BAP-100) on PCA
8. Ensure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) and RS (*Radio-Sonde*, Altitude Above Ground) buttons are selected (S) on the PCA.
9. Set Radar Altimeter Power switch to **M**ARCHE



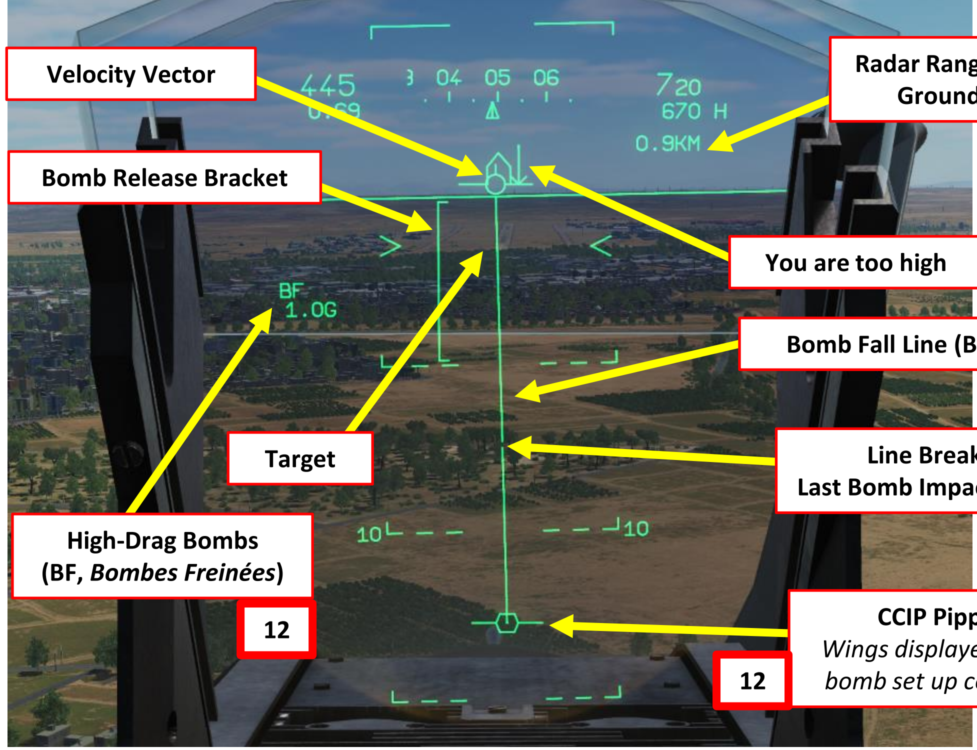


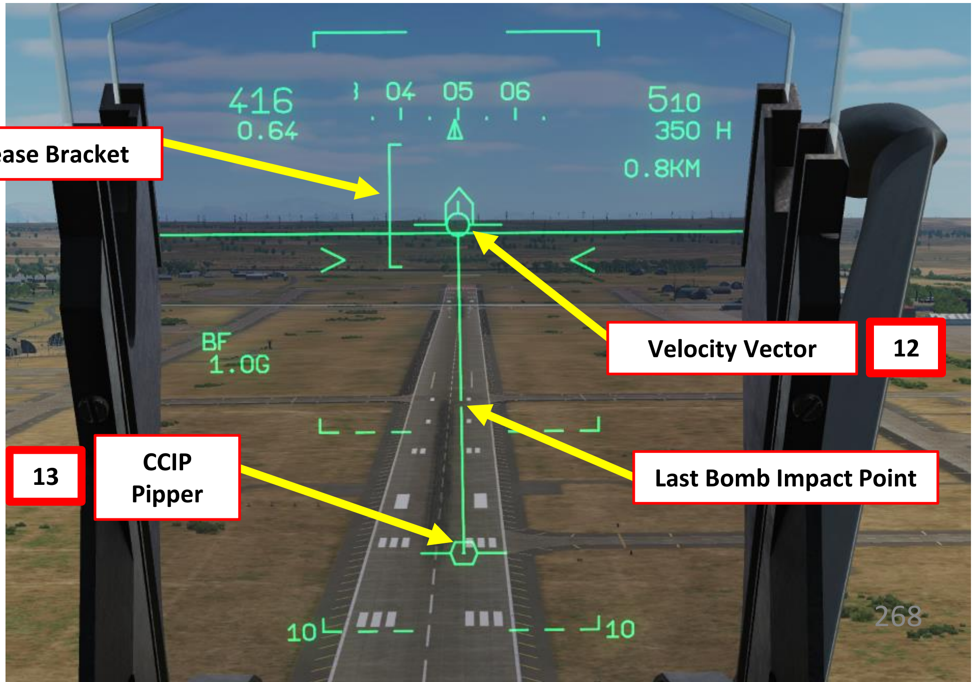




3.6 – BAP-100 ANTI-RUNWAY PENETRATION BOMBS CCIP TUTORIAL

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that “S” (Selected) and “P” (*Prêt*/Ready) lights are illuminated on the armament panel.
11. Approach the target by flying low and level. Place the velocity vector within the Bomb Release Bracket (computed based on aircraft pitch and altitude).
12. Align CCIP pipper on target by manoeuvering the aircraft. A valid bomb release status is indicated by “wings” next to CCIP pipper, a steady “BF” indication on the HUD and a “P” indication on the Armament Panel.
13. When CCIP pipper is on target, press and hold MiCRoB Trigger (2nd Stage) for at least 2 sec (SPACE by default).
14. Just after the bomb is released, the parachute is deployed, separating the bomb from the aircraft and slowing it down. After 3.75 seconds and when the bomb is less than 40° from the vertical, the parachute is jettisoned and the booster is fired, accelerating the bomb to 260 m/s into the ground. After penetration is achieved, the bomb explodes… creating a crater.
15. Pull up to avoid smacking yourself into the ground and watch the fireworks.
16. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.





3.6 – BAP-100 ANTI-RUNWAY PENETRATION BOMBS

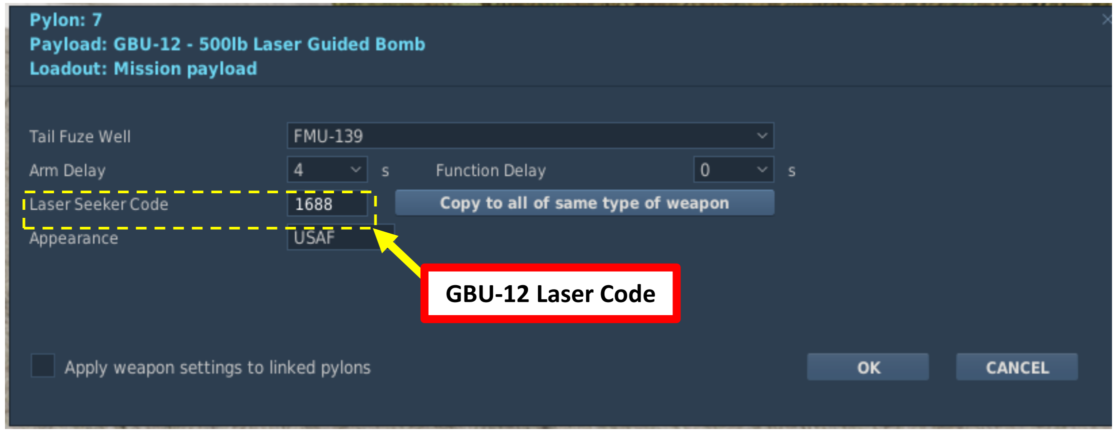
3.6 – BAP-100 ANTI-RUNWAY PENETRATION BOMBS

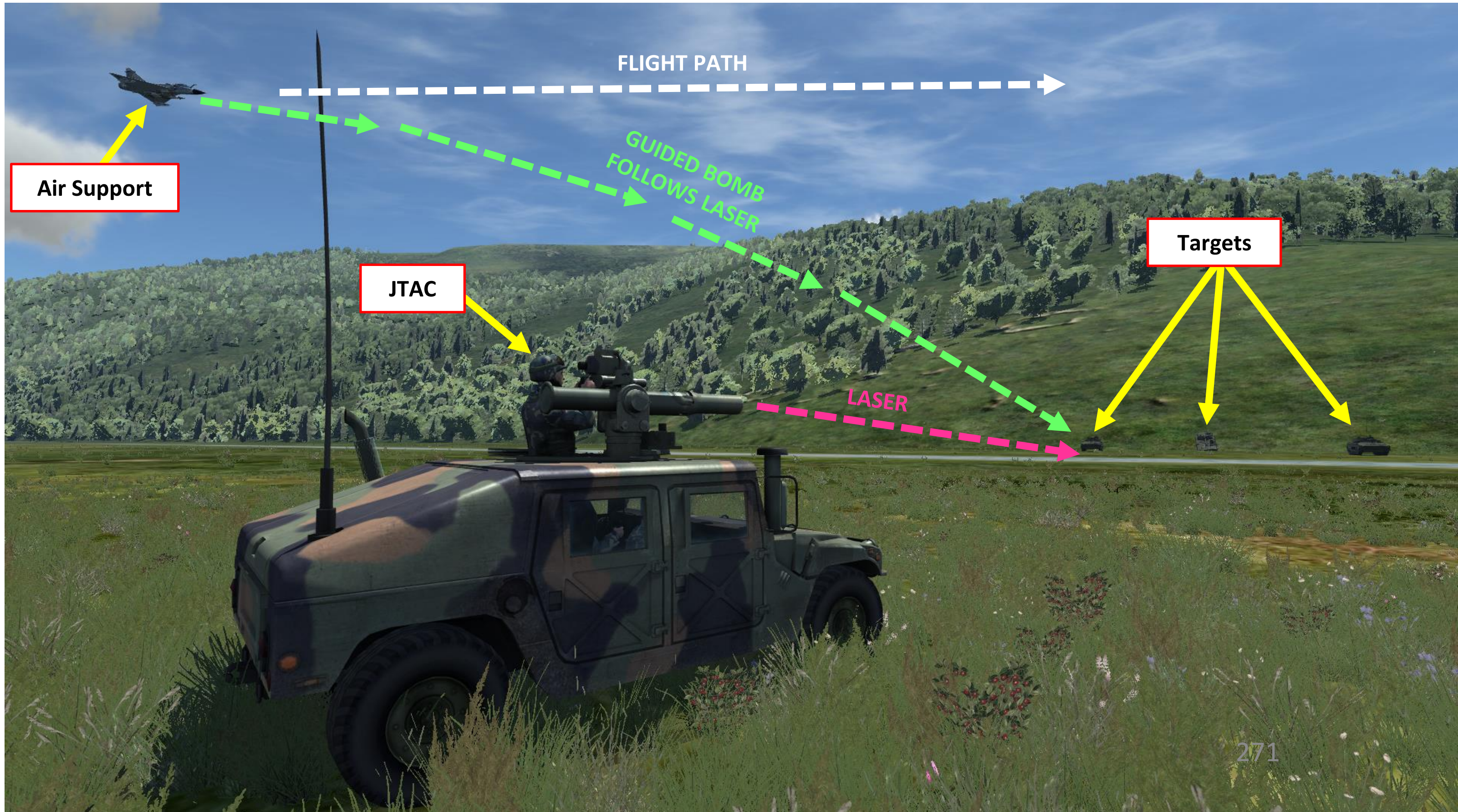
3.7 – GBU-12 LASER-GUIDED BOMBS
BUDDY LASING & JTAC

The Mirage is not only a fighter jet: it can also help support troops on the ground. A JTAC (Joint Terminal Attack Controller) or an aircraft equipped with a Targeting Pod (like an A-10C) can use a laser designator to “paint” a target for you to bomb.

This “buddy lasing” bombing tutorial will be done in 3 steps:

1. Creating the JTAC via the Mission Editor
2. Using proper radio procedures to contact JTAC and get him to paint the target for you with a laser designator
3. Drop the ordnance using a CCRP release mode since we will be using the GBU-12 guided bomb.

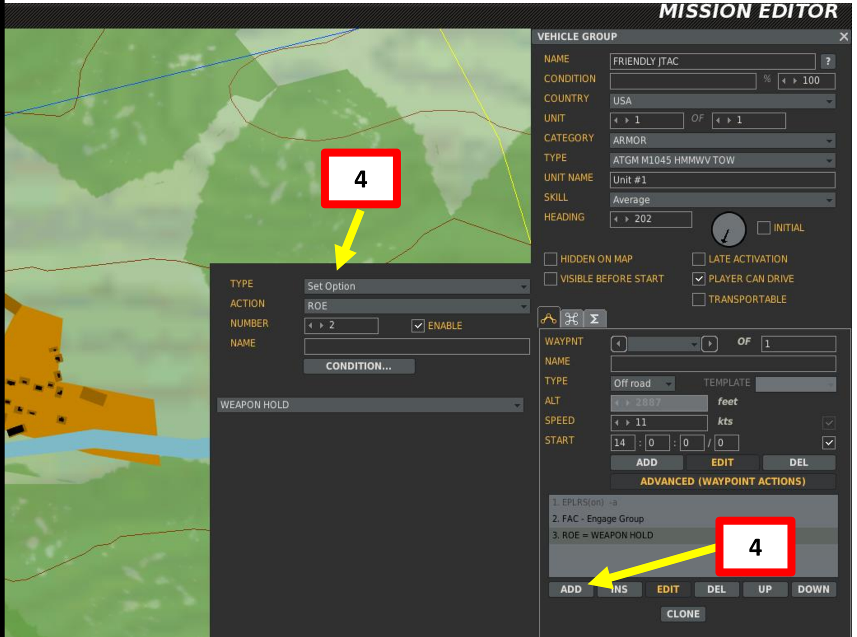


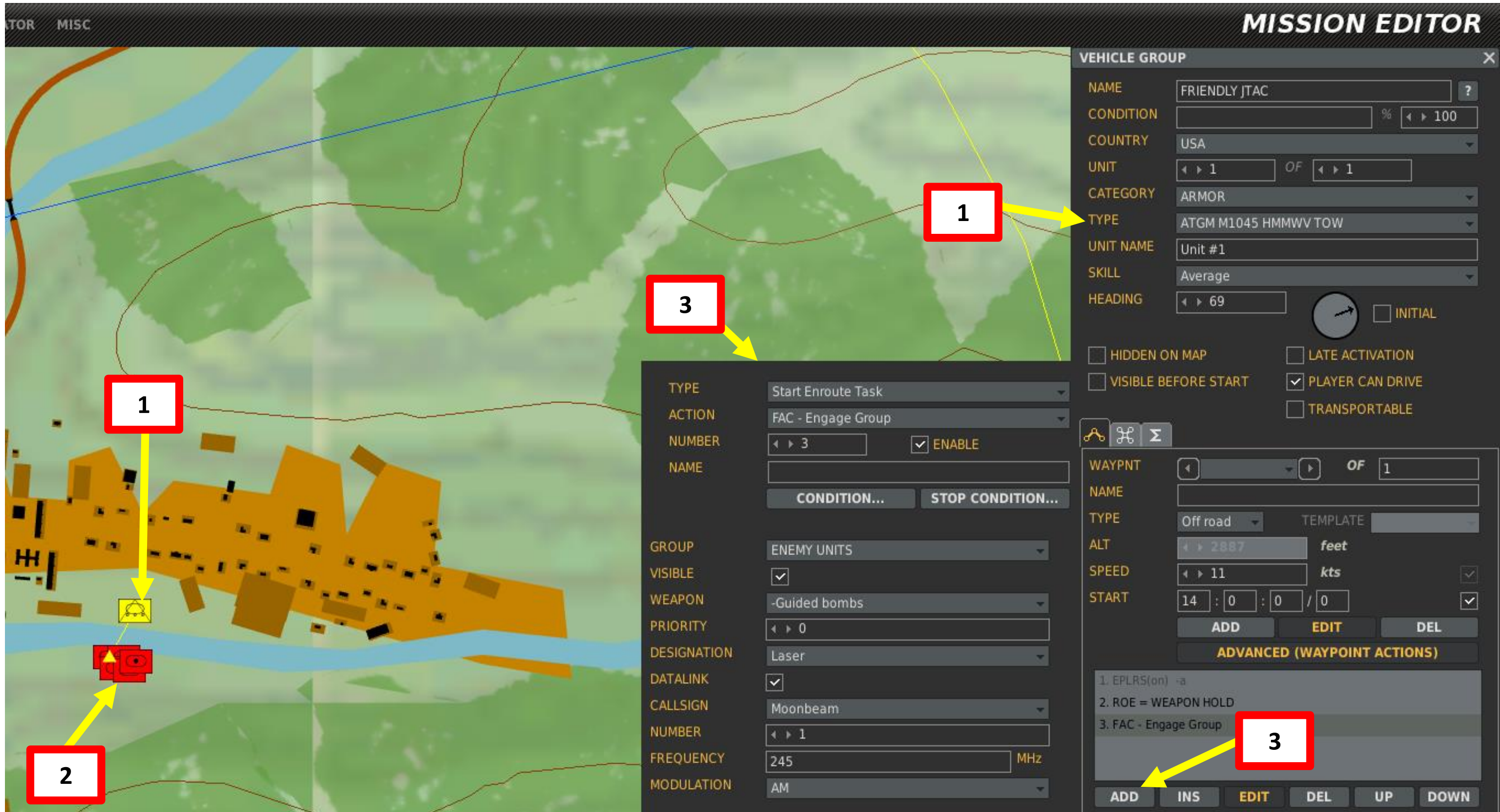


3.7 – GBU-12 LASER-GUIDED BOMBS
BUDDY LASING TUTORIAL - MISSION EDITOR

RLAXOXO's JTAC tutorial for the Mirage
https://www.youtube.com/watch?v=ep7MH3Rmic8

1. In the mission editor, insert a friendly "ATGM M1045 HMMWV TOW" unit. He will be your JTAC.
2. Make sure that you have enemy units placed in the map and that you have given them a name (example: "ENEMY UNITS")
3. Select your JTAC unit, click "ADD", and select TYPE "START ENROUTE TASK" and ACTION "FAC – ENGAGE GROUP".
    1. GROUP = "ENEMY UNITS" (the group we just created)
    2. VISIBLE = CHECKED
    3. WEAPON = GUIDED BOMBS
    4. DESIGNATION = LASER
    5. CALLSIGN = MOONBEAM (or whatever you prefer)
    6. FREQUENCY = 245 MHz (this will be the radio frequency you will use to contact the JTAC)
    7. MODULATION = AM
4. Select your JTAC unit, click "ADD" again and select TYPE = "SET OPTION" and ACTION "ROE".
    1. Set to WEAPON HOLD
5. You can also set the unit to INVISIBLE and IMMORTAL as shown in RLAXOXO's tutorial.

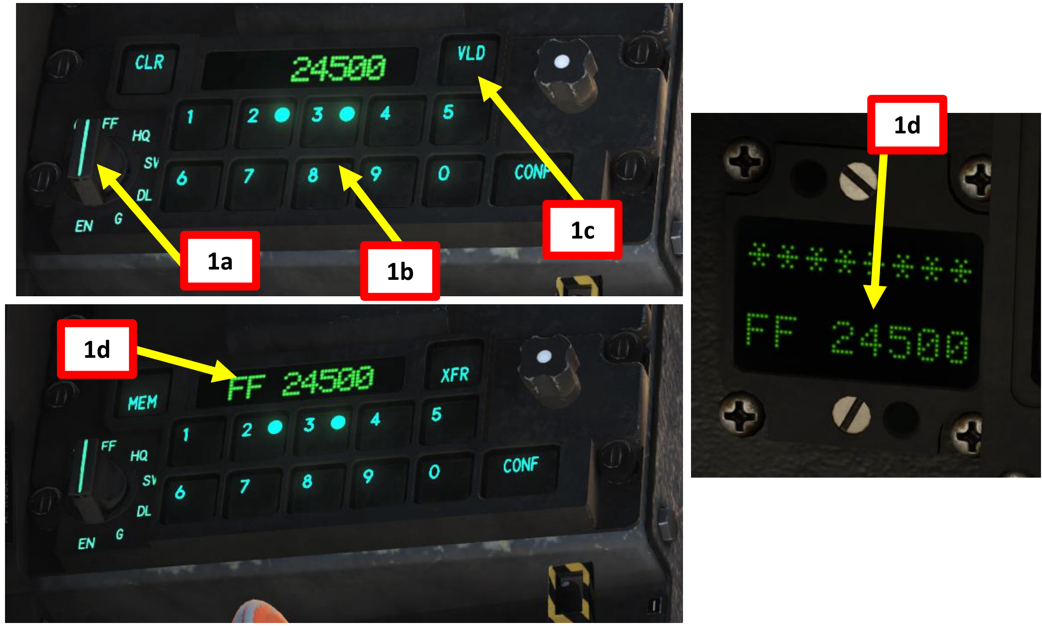


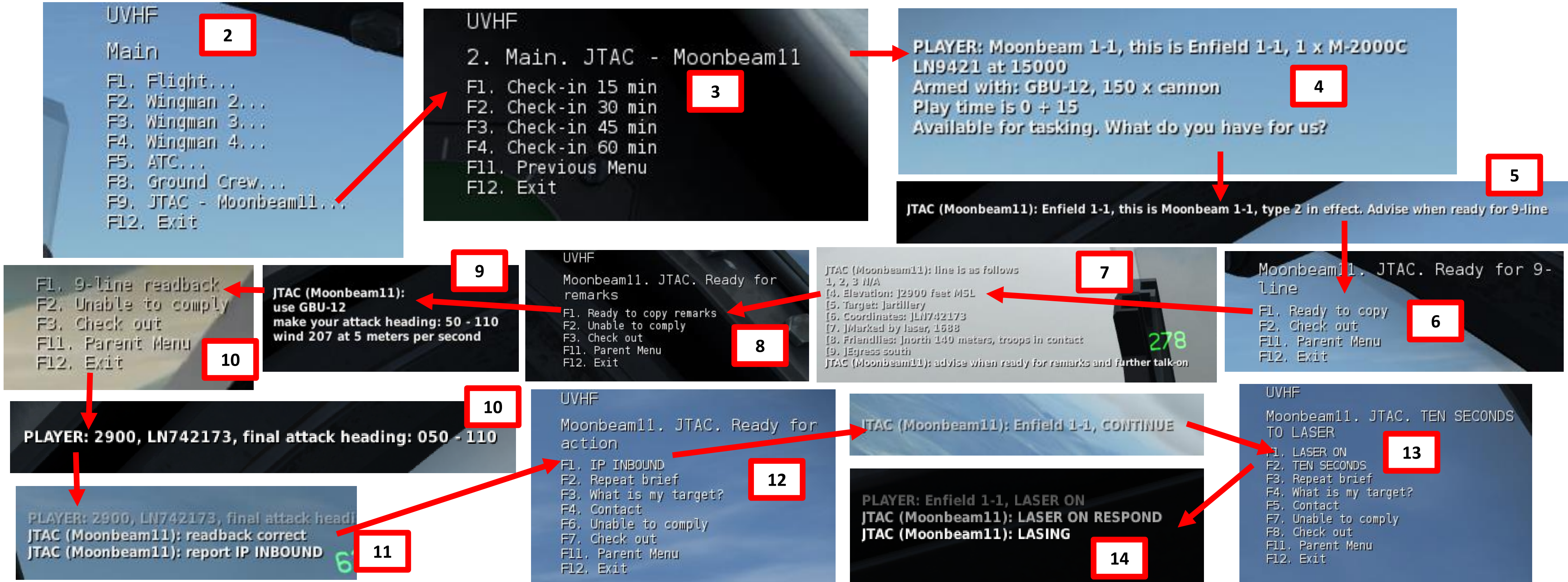


3.7 – GBU-12 LASER-GUIDED BOMBS

BUDDY LASING TUTORIAL - CONTACTING THE JTAC

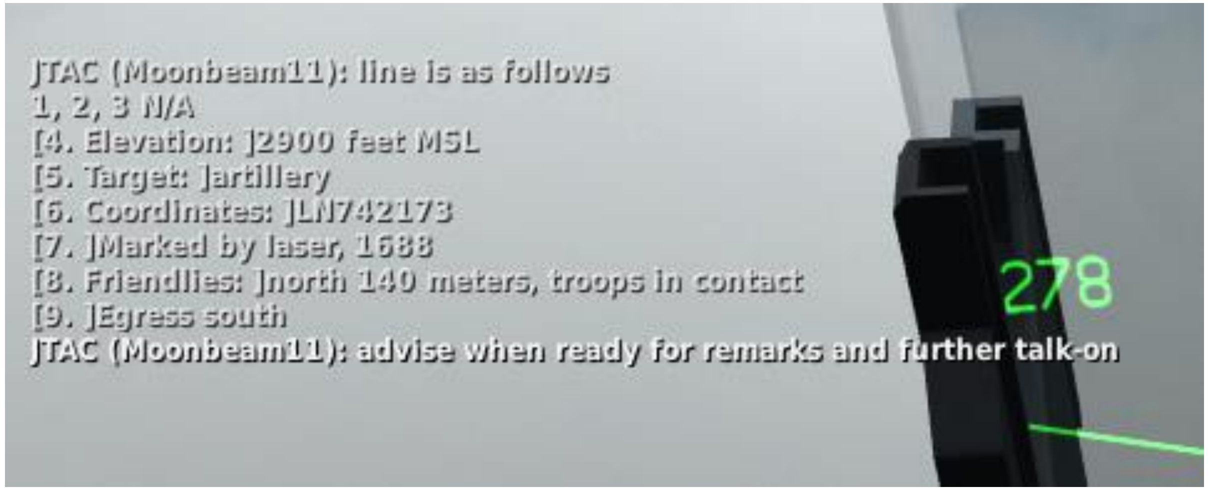
1. Set V/UHF Greenbox Mode switch to **FF (Fixed Frequency)** and set JTAC frequency to 245.00 MHz (enter 24500 on keypad, then press VLD (Validate))..
2. Press "/" to communicate and select JTAC – MOONBEAM (F9) in radio menu.
3. Select "CHECK-IN 15 MIN" (F1)
4. You will contact the JTAC and give him your altitude and ordnance available, plus your time available on station.
5. JTAC will answer "Type 2 in effect" and ask you when you are ready to receive a 9-liner.
6. Select "READY TO COPY" (F1) to receive 9-liner.
7. The JTAC will give you the 9-liner and ask you when you are ready for remarks.
8. Select "READY TO COPY REMARKS" (F1)
9. JTAC will give you remarks.
10. Select "9-LINE READBACK" to repeat the information you have been given and confirm it with the JTAC.
11. JTAC will confirm your readback and request you to tell him when you are inbound.
12. Select "IP INBOUND" (F1), the JTAC will tell you to CONTINUE or ABORT.
13. Select "LASER ON" to request the JTAC to lase targets.
14. Once targets are lased, you may now go on your bomb run.





3.7 – GBU-12 LASER-GUIDED BOMBS
BUDDY LASING TUTORIAL - CONTACTING THE JTAC

What is a CAS (Close Air Support) 9-liner and why is it important? The goal of a 9-liner is to provide you as much information as concisely as possible.

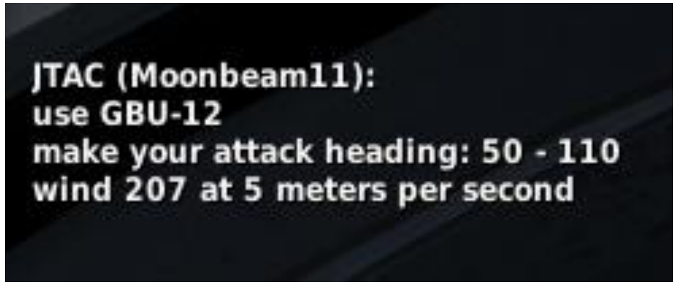


9-Liner

Line 1: IP/BP – Initial Point/Battle Position (N/A in our case)
Line 2: Heading from the IP to the Target (N/A in our case)
Line 3: Distance from the IP/BP to target (N/A in our case)
Line 4: Target elevation – 2900 feet over Mean Sea Level (MSL)
Line 5: Target description: Artillery.
Line 6: Target location: Grid coordinates of target
Line 7: Target Mark Type: Marked by laser on laser code 1688 (this code can be used by the A-10C to lase the target for you)
Line 8: Location of Friendlies: JTAC located 140 meters North of Target
Line 9: Egress semi-cardinal direction when departing from target: South

Remarks

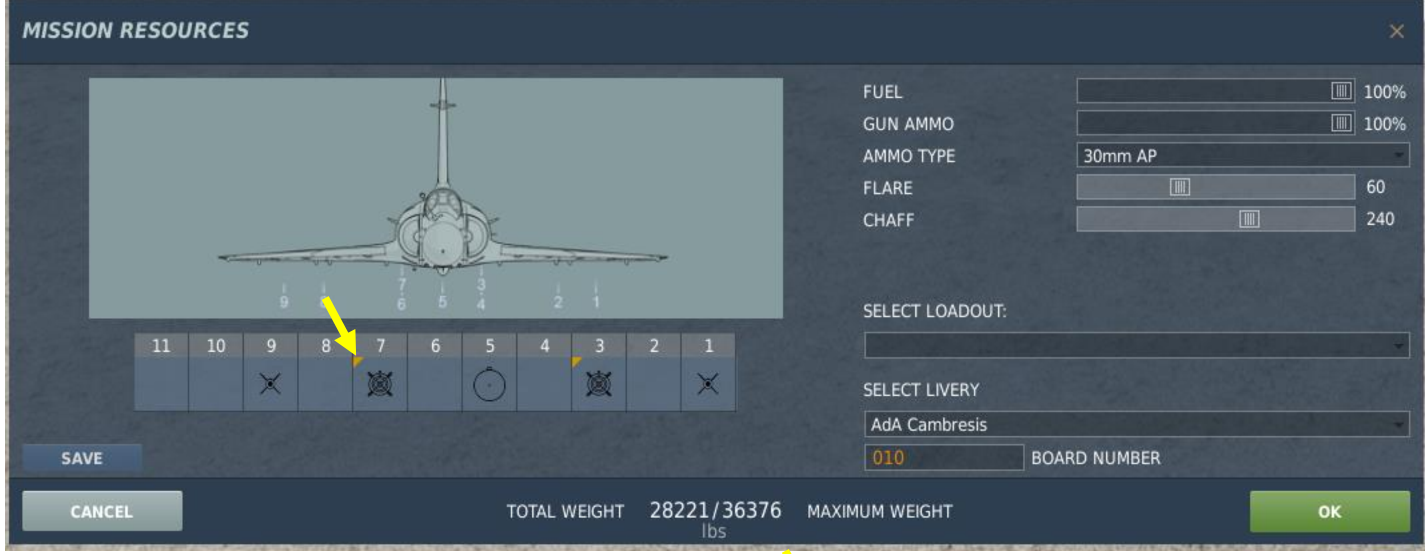
Remarks generally include information about troops in contact or danger close, SEAD support in effect, hazards, weather or other threats. In our case, the JTAC wants us to use GBU-12s

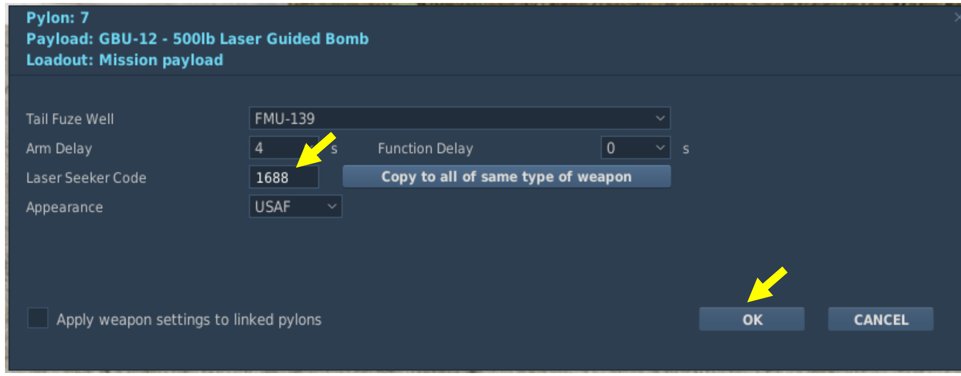


3.7 – GBU-12 LASER-GUIDED BOMBS
RELEASING BOMBS

The GBU-12 laser code can currently be set from the Ground Crew menu. Laser code is changed by clicking on the yellow triangle on the GBU-12 station. If you are flying in multiplayer and do not know your GBU-12 code, you can assume it is “1688” by default.

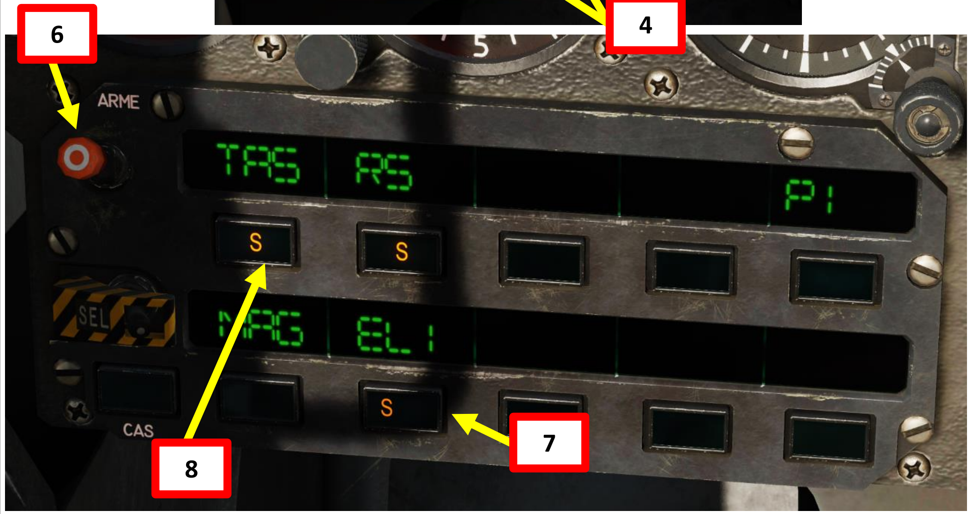
Take note that setting the bomb laser code should be done when the engine is shut down.





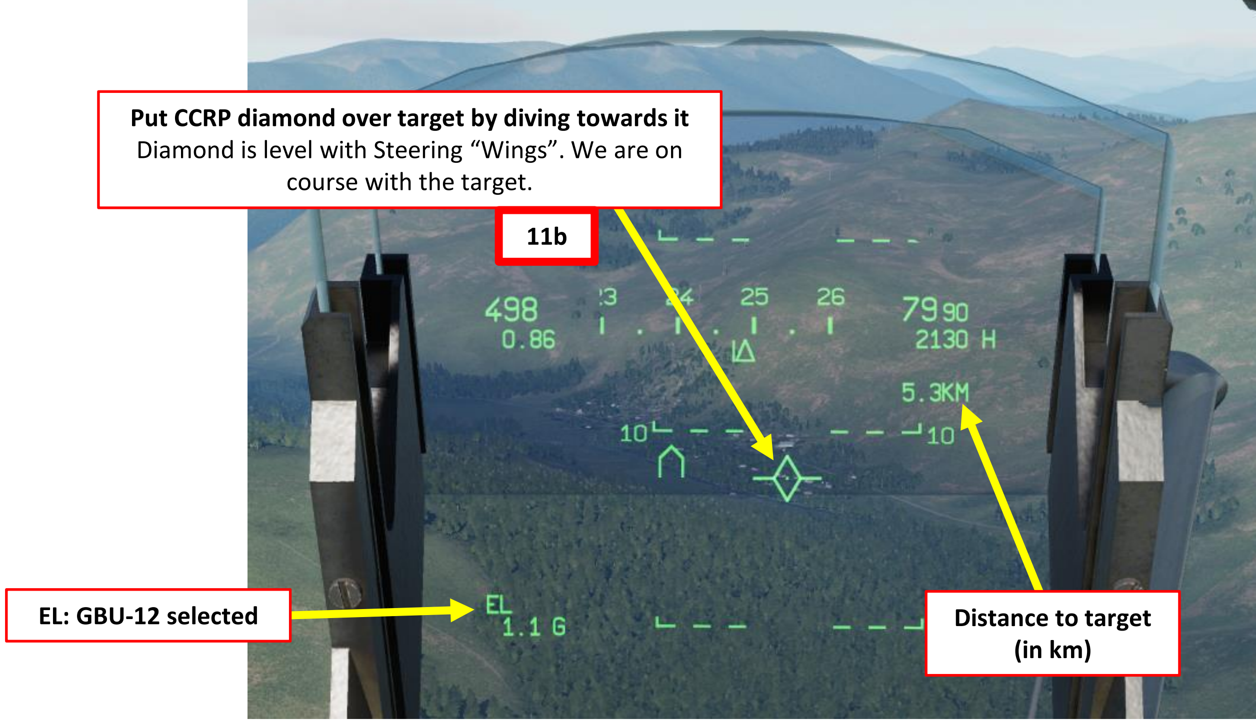
3.7 – GBU-12 LASER-GUIDED BOMBS
RELEASING BOMBS

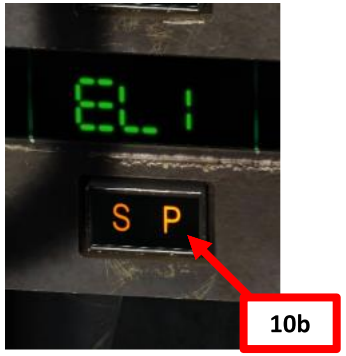
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, set fuze selector to either RET (*retardé*/delayed fuze) or INST (instantaneous fuze)
3. On PPA, set number of bombs to be released (01 = single)
4. On PPA, there is no need to set distance between bomb release since GBU drops are generally done with a single bomb
5. Adjust seat to see lower part of HUD better.
6. Set Master Arm switch to ARME (UP)
7. Select EL1 (GBU-12) on PCA
8. Select TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) mode on PCA
9. Turn radar power ON (**EM**ISSION)

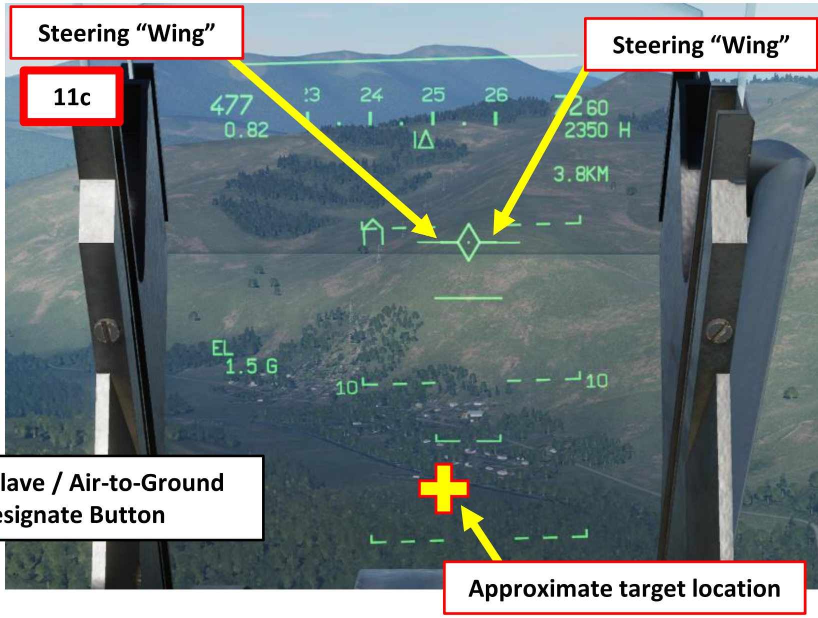


3.7 – GBU-12 LASER-GUIDED BOMBS
RELEASING BOMBS

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that “S” (Selected) and “P” (*Prêt*/Ready) lights are illuminated on the armament panel.
    - A valid bomb release status is indicated by a steady “EL” indication on the HUD and a “P” indication on the Armament Panel. When bomb release status is invalid, “EL” blinks and “P” disappears.
11. Put diamond relatively close to the target (it is usually marked with smoke or the target area) and press the “MAGIC SLAVE/AG DESIGNATE” button on your HOTAS. When approximate location of target is designated, steering wings will appear over the CCRP diamond.
    - Keep in mind that unlike most modern aircraft, the Mirage has no HUD indication to show where the designated/locked ground target is. You will have to make sure the designation with the CCRP diamond is precise enough and use the CCRP cues (CCRP line, steering wings, distance to target) accordingly.
    - While the point you designate is not necessarily on the target itself, the point should be somewhat close to the actual target. The bomb itself will track the laser spot lased by the JTAC independently to your aircraft; the CCRP cues will give you a rough idea of when to launch the GBU-12s, but keep in mind that if you designate way off the bomb will likely not pick up the laser.

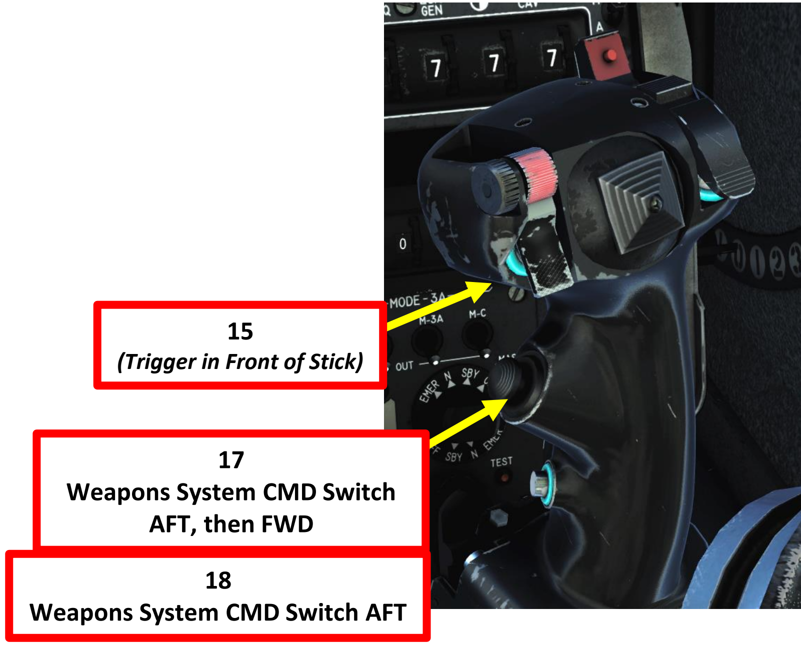


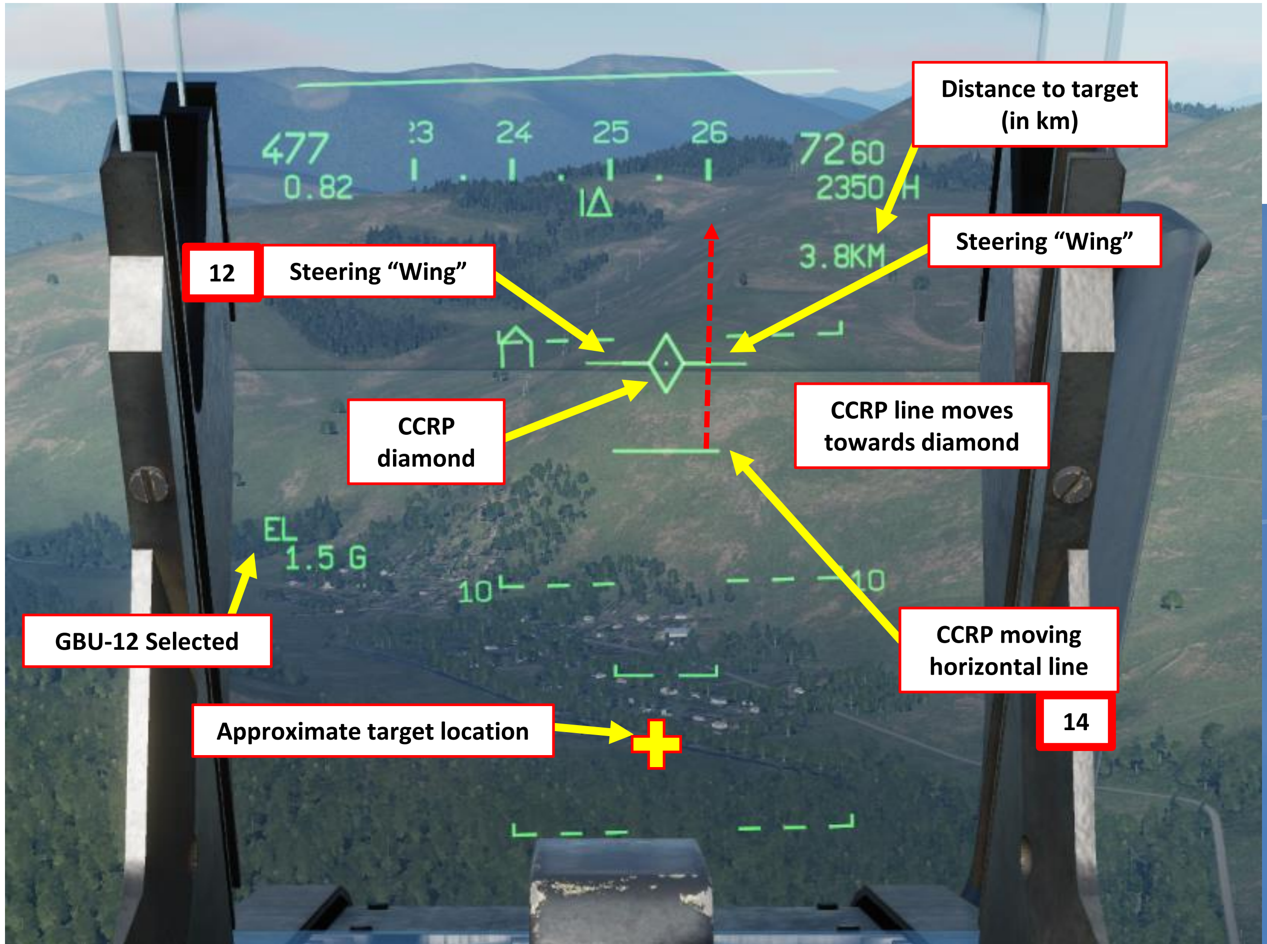




3.7 – GBU-12 LASER-GUIDED BOMBS
RELEASING BOMBS

12. Once target is designated, steering wings will appear on the CCRP diamond. They will provide steering cues towards the designated target. Radar range will display the range to target.
13. Fly level towards target (make sure you have at least 2000 ft of clearance).
14. Horizontal CCRP line will show up when you are 15 seconds from target.
15. When CCRP line is lined up with the diamond reticle, press and hold MiCRoB Trigger (2nd Stage) (SPACE by default).
16. Once GBU-12 is released, the bomb will try to find the JTAC's laser and track it towards the target. The guidance of the GBU-12 now relies on the laser.
17. Observe damage and unlock target (cycle Weapons System CMD switch AFT, then FWD on the stick).
18. You can set Heads-Up Display (HUD) mode back to NAV (Navigation) by pressing the Weapons System CMD AFT switch on the stick.





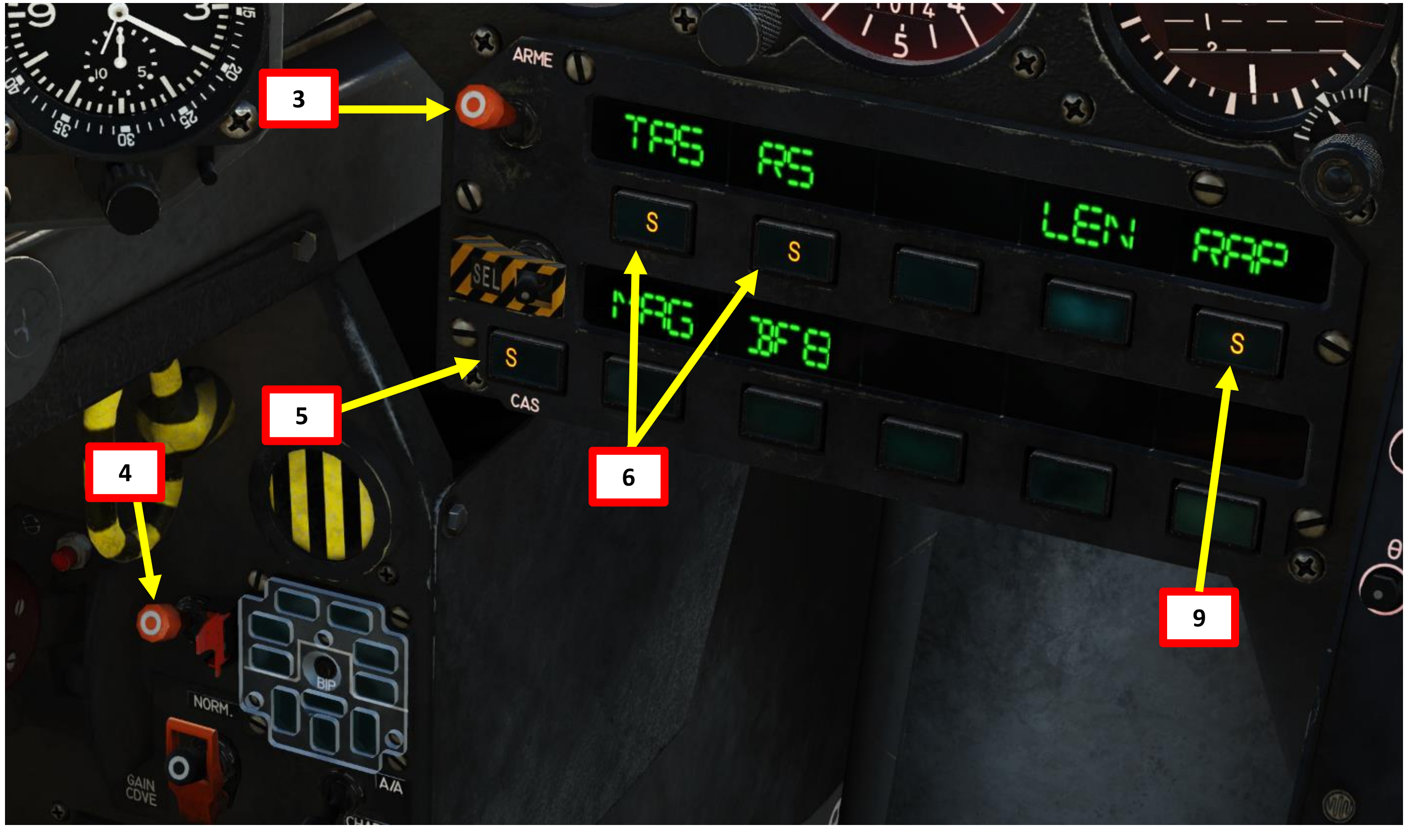
3.7 – GBU-12 LASER-GUIDED BOMBS
RELEASING BOMBS

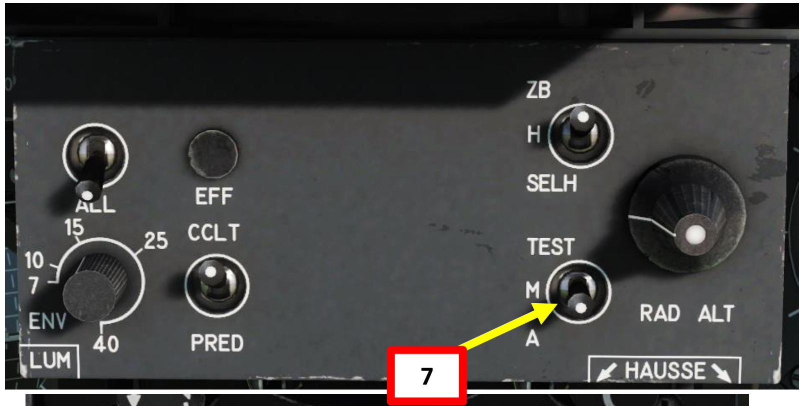
Note 1: Usually, CCRP is not very precise… but with the help of a JTAC and guided bombs, you can perform very precise airstrikes since the bombs is guided by a laser.

Note 2: You can do the same thing in multiplayer with a player in an A-10C or an aircraft equipped with a targeting pod. The Laser Code he will need to use is the code you have set for your GBU-12 previously via the Ground Crew menu (1688 by default).

3.8 – AIR-TO-GROUND GUNS TUTORIAL

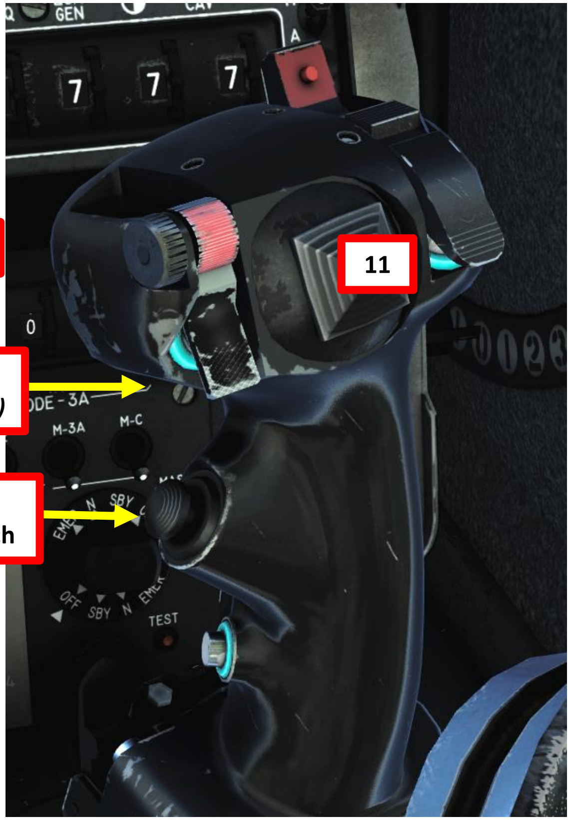
1. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the Cannon in Air-to-Ground Mode via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
2. On PPA, select gun firing mode
   - PAR (Partial) = 0.5 or 1 sec burst / TOT (Total) = continuous fire
   - Salvo duration is set by the ground crew (see kneeboard).
3. Set Master Arm switch to ARME (UP)
4. Arm Cannon Switch (UP)
5. Press the CAS (Canon Air-Sol / Air-to-Ground) button on the PCA to set gun in Air-to-Ground mode. Verify that P (Air-to-Ground Ready) indication is illuminated.
6. Ensure TAS (*Télémétrie Air-Sol*, Air-to-Ground Radar Ranging) and RS (*Radio-Sonde*, Altitude Above Ground) buttons are selected (S) on the PCA.
7. Set Radar Altimeter Power switch to **M**ARCHE
8. Turn on Radar Power by setting switch to **EM**ISSION.
9. Select desired fire rate. "S" indicates the fire rate selected.
   - RAP = *Rapide* (High Rate of Fire) / LEN = *Lent* (Slow Rate of Fire)

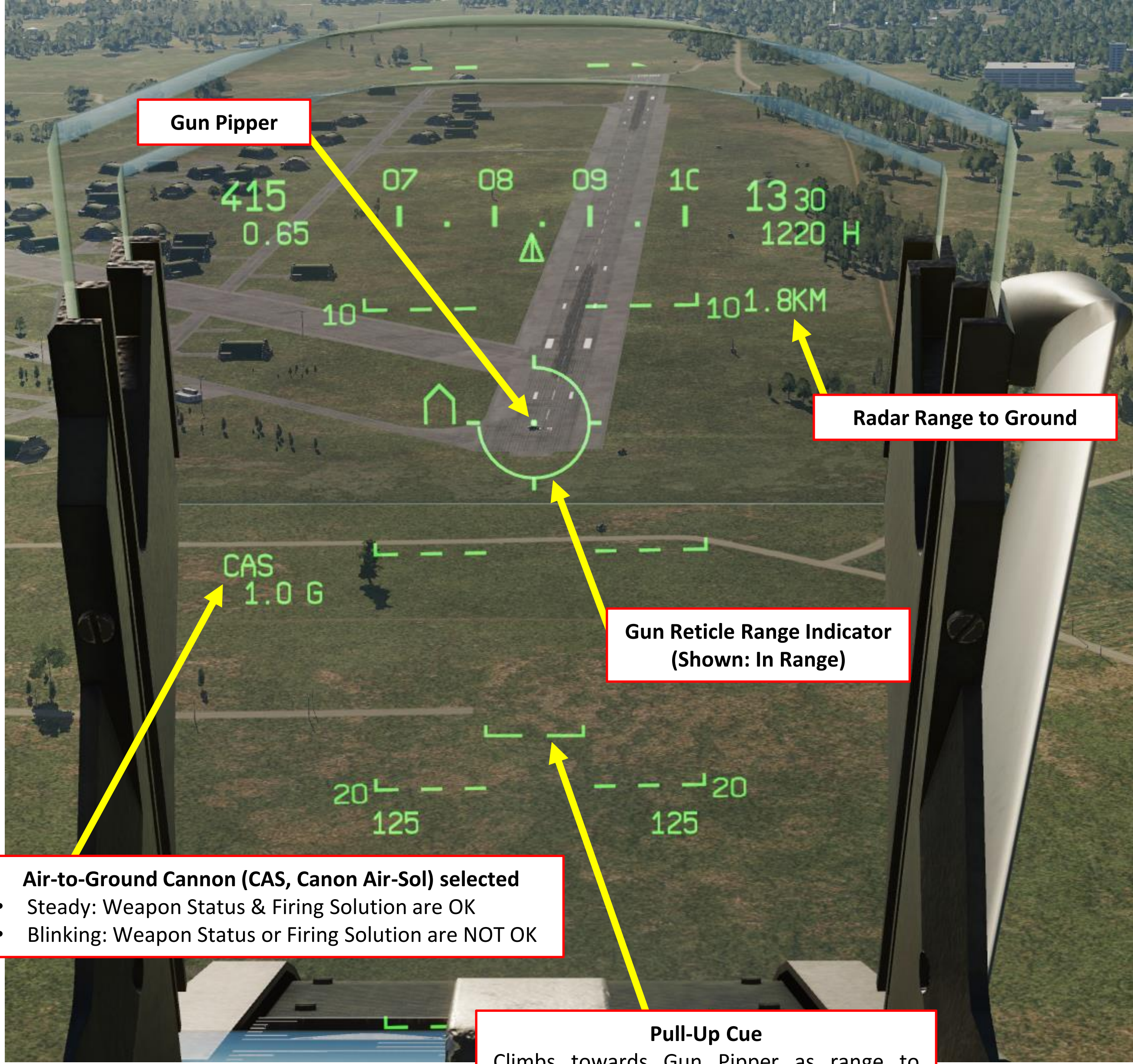




3.8 – AIR-TO-GROUND GUNS TUTORIAL

10. Set Heads-Up Display (HUD) mode to A/G (Air-to-Ground) by pressing the Weapons System CMD FWD switch on the stick. Make sure you have your weapon selected before performing this step or the HUD will switch in Special Air-to-Air Mode.
    - Confirm that "S" (Selected) and "P" (*Prêt*/Ready) lights are illuminated on the armament panel.
11. Align gun pipper on target. You will be within firing range when the gun reticle range indicator starts decreasing. The pipper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 2400 meters. The 9 o'clock caret depicts the range of 1800 meters, 6 o'clock of 1200 meters and 3 o'clock of 600 meters.
12. When in range, fire guns (MiCRoB Trigger (2nd Stage), SPACE by default).
13. To de-select guns, press the CAS (Canon Air-Sol / Air-to-Ground) button on the PCA again. Verify that P (Air-to-Ground Ready) indication extinguishes.



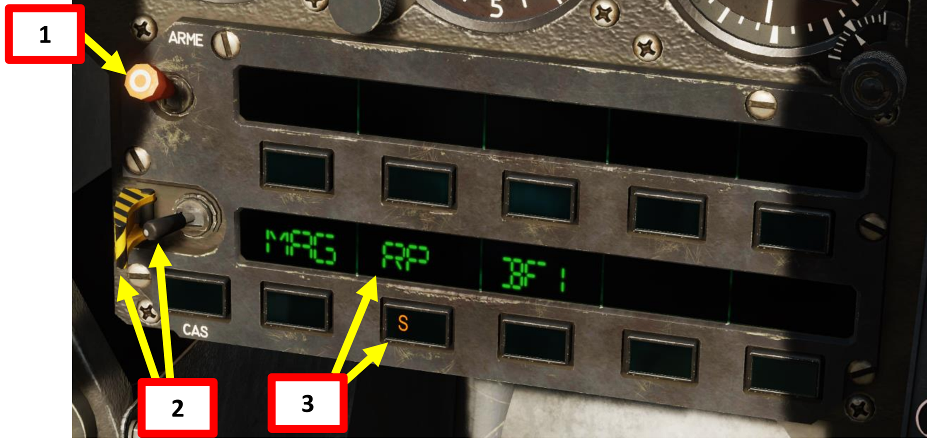


3.8 – AIR-TO-GROUND GUNS TUTORIAL

4.1 – SELECTIVE STORES JETTISON

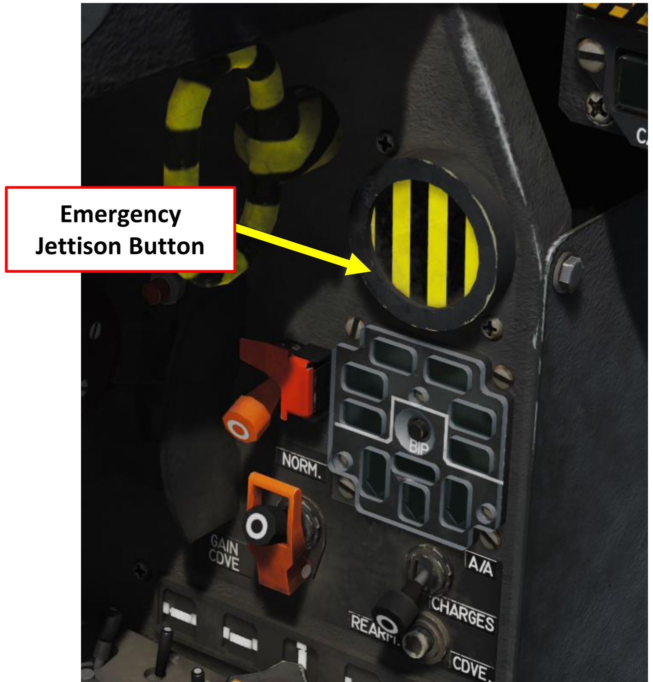
In order to jettison a certain store (an external fuel tank, for instance), proceed as follows:

1. Set Master Arm switch to ARME (UP)
2. Click on Selective Jettison safety cover and set Selective Jettison switch to the left position
3. Click on the store you want to jettison on the PCA (we will select the external fuel tank RP). When selected, a yellow “S” caution will appear.
4. Press the MiCRoB Trigger (2nd Stage), which is SPACE by default. Store will be dropped.
5. Set the Selective Jettison switch to the right and put the safety cover back on.
6. Set Master Arm switch to OFF (DOWN)



4.2 – EMERGENCY STORES JETTISON

The Emergency Jettison button will jettison every store you have (including these expensive SUPER S530D missiles!) except for your two MAGIC II missiles.



4.3 – COMBAT TACTICS

I highly recommend that you check this thread by il_Corleone in order to learn about combat tactics in the Mirage.
Link: https://forum.dcs.world/topic/131888-working-bvr-tactic-against-modern-targets

SECTION STRUCTURE

1 – 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 on 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 SERVAL (*Système Électronique de Reconnaissance et Visualisation d'Alertes)* or 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.

Flares and chaff can be dispensed by the SPIRALE (*Système de Protection Infrarouge et Radar par Leurrage*) system. Additional flares and chaff can be loaded in ÉCLAIR pods for increased capacity.

The Mirage is equipped with a powerful jammer called the SABRE (*Système d'Autoprotection par Brouillage Électromagnétique*). 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. Interestingly, certain jammer modes are so powerful that they also drown your own radar in white noise.

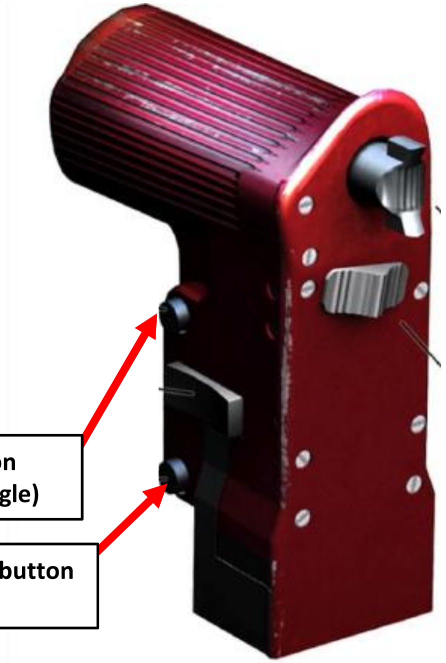
Last but not least, there is also a D2M/DDM, also known as the "*Détection de Départ de Missile*" (MLWS, Missile Launch Warning System). While not installed on the French Mirage 2000C in real life (but they were installed on the Mirage 2000D), Razbam decided to include it as an optional kit.

1 – INTRODUCTION

Here is my recommended control scheme for countermeasures:

Real Aircraft Controls

Decoy PROGRAM Release Switch (Delete)



Jammer Activate Pushbutton (Jammer PCM Override Toggle)

Decoy PANIC Release Pushbutton (Insert)

My Controls

↑
→ Decoy PANIC Release
↓
← Decoy PROGRAM Release
P Jammer PCM Override Toggle

2 – SPIRALE COUNTERMEASURES SYSTEM

Système de Protection Infrarouge et Radar par Leurrage

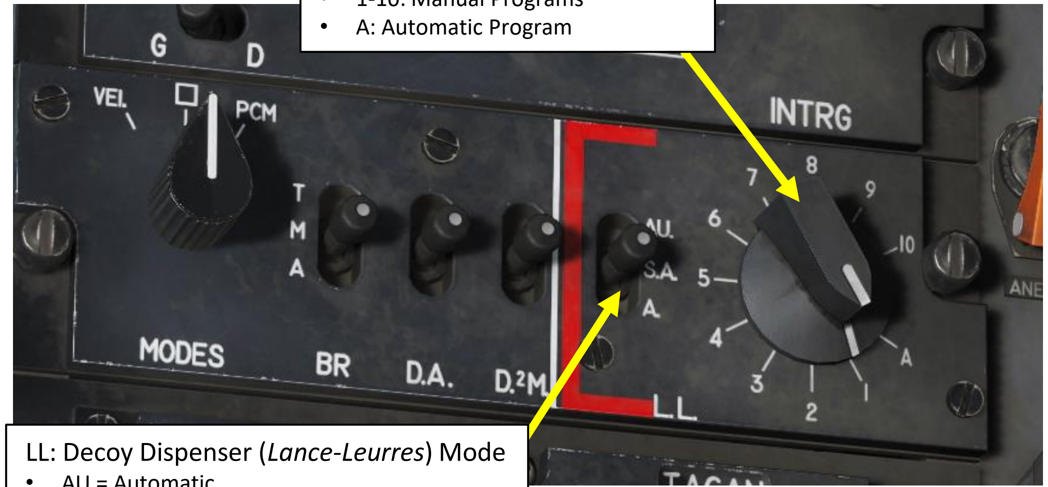
2.1 – Flares & Chaff Controls

The **Decoy Dispenser** has three primary **modes** of operation, which are controlled by the "LL" Program Selector (*Lance-Leurres*, Countermeasure/Decoy Dispenser):

- **A (Arrêt)**: OFF, system is not powered.
- **S.A. (Semi-Automatic)**: The decoy dispenser system is powered ON, countermeasure program is selected manually
  - Program selected on the LL decoy dispenser program selector is done with the **HOTAS Decoy PROGRAM Release** switch
  - Panic program is done with the **HOTAS Decoy PANIC Release** button
- **AU (Automatic)**: The decoy dispenser system is powered ON, countermeasure program is selected automatically and released automatically
  - Release of the program selected on the LL decoy dispenser program selector is done automatically when a radar emitter enters the high threat zone.
  - The system will also automatically release the IR SAM countermeasure program when the D2M system detects a missile launch.

The **Decoy Program Selector** can either select one of 10 manual countermeasure programs. Alternatively, it can also automatically select the countermeasure program to counter the highest radar threat in the "A" (Automatic) position.

Source: RAZBAM Manual



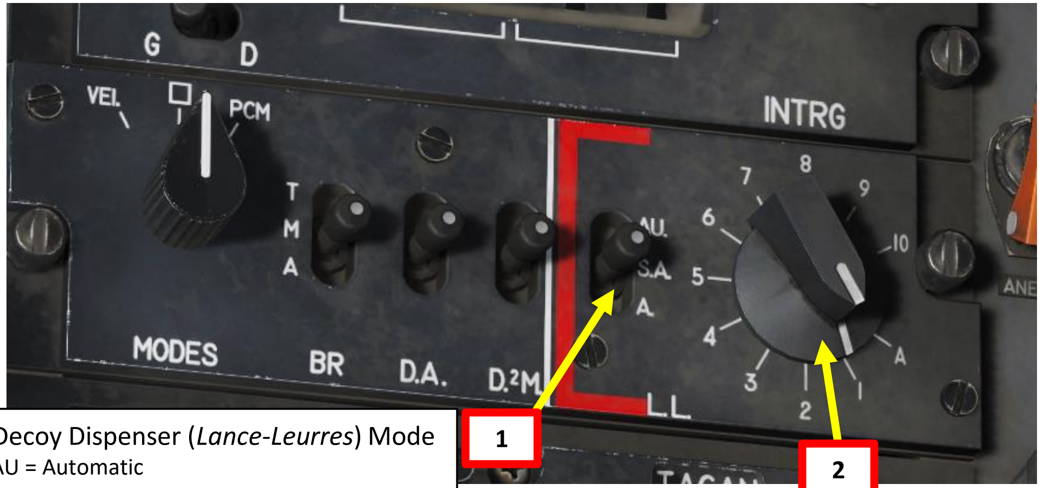
2 – SPIRALE COUNTERMEASURES SYSTEM

Système de Protection Infrarouge et Radar par Leurrage

2.2 – Flares & Chaff Tutorial

Keep in mind that you have very few flares: use them sparingly. The ÉCLAIR pod allows more flares to be equipped. In this example, we will use the Semi-Automatic mode.

1. Select decoy release mode (Semi-Automatic)
2. Select decoy release program using the program selector knob.
3. Deploy countermeasures using either the Decoy Program Release Switch (“Delete” binding) or the Decoy Panic Release Switch (“Insert” binding). These two functions are elaborated in the next sub-section.



1

LL: Decoy Dispenser (*Lance-Leurres*) Mode

- AU = Automatic
- S.A. = Semi-Automatic
- A = OFF

2

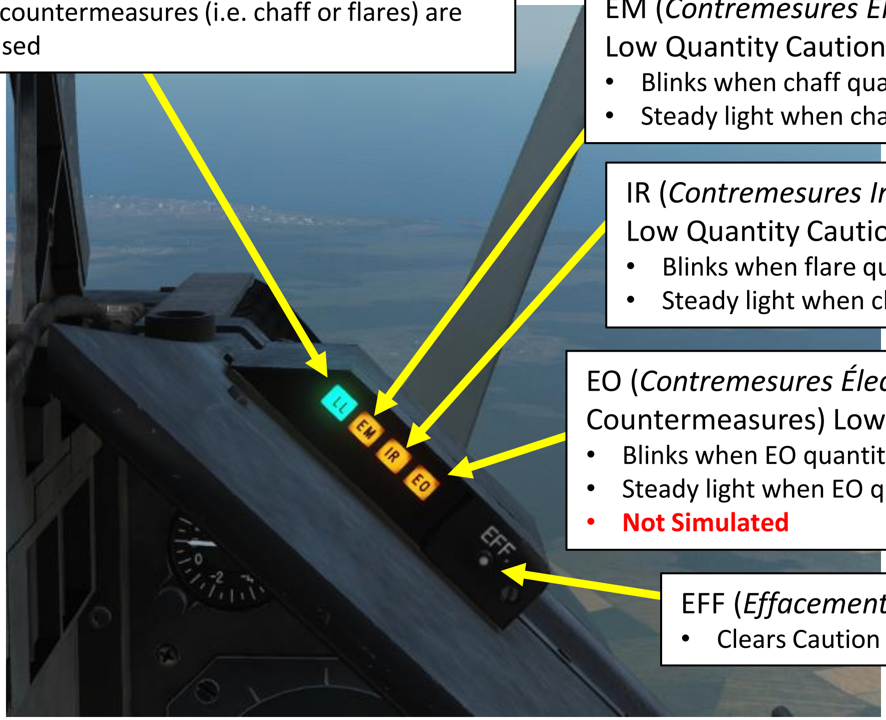
Lance-Leurres (Decoy dispenser) Program Selector

Decoy PROGRAM Release Switch (Delete)

3

3

Decoy PANIC Release Pushbutton (Insert)



Lance-Leurres (Decoy Dispenser) Indicator Light

- Blinks when countermeasures (i.e. chaff or flares) are being dispensed

EM (*Contremesures Électromagnétiques*/Chaff) Low Quantity Caution Light

- Blinks when chaff quantity is low (12 or less)
- Steady light when chaff quantity is 0 (empty)

IR (*Contremesures Infrarouges*/Flares) Low Quantity Caution Light

- Blinks when flare quantity is low (6 or less)
- Steady light when chaff quantity is 0 (empty)

EO (*Contremesures Électro-optiques*/Electro-Optical Countermeasures) Low Quantity Caution Light

- Blinks when EO quantity is low
- Steady light when EO quantity is 0 (empty)
- Not Simulated

EFF (*Effacement*/Erase) Button

- Clears Caution Lights on the ECM Box

2 – SPIRALE COUNTERMEASURES SYSTEM

Système de Protection Infrarouge et Radar par Leurrage

2.2 – Flares & Chaff Tutorial

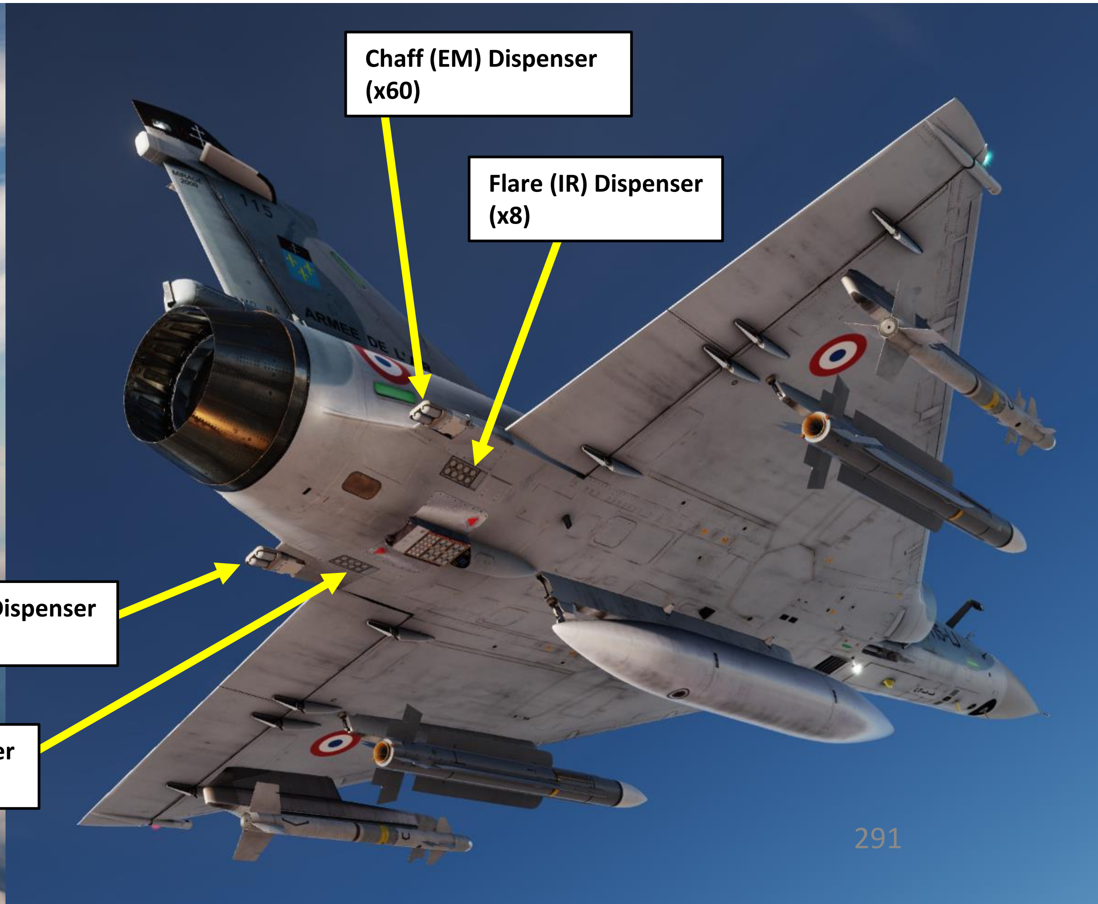
The Spirale system is composed of 2 chaff dispensers and 2 flare dispensers.

Source: RAZBAM Manual

The **chaff** dispensers hold up to 120 aluminum coated glass fiber decoys. These chaffs (**EM**, *Contremesures Électromagnétiques*) are used to confuse radar systems by reflecting radar waves and creating false targets. The Spirale chaff dispensers work with the Sabre and Serval system to cut the chaffs to a specific length corresponding to the threat radar's wavelength, increasing their efficiency.

The **flare** dispensers hold 16 infrared decoys. These flares (**IR**, *Contremesures Infrarouges*) are used to confuse infrared system by providing another heat source to track and guide on.

Note: The Mirage internal and external decoy quantity is fixed and not changeable. The only way to change the decoy quantity is with the installation of the Éclair and Éclair-M pods.



2 – SPIRALE COUNTERMEASURES SYSTEM

Système de Protection Infrarouge et Radar par Leurrage

2.3 – Flares & Chaff Programs

- **BVR 1 to BVR 3 programs (#1, 2, 3)** are to be used when engaging in BVR combat when expecting radar guided missiles. The 3 programs have the same cycle, the only difference is the number of cycles executed.
- **CCM 1 (#4)** is to be used in close combat scenario where infrared missile are expected.
- **CCM 2 (#5)** is to be used in close combat scenario where the expected missile type is unknown.
- **SAM 1 (#6)** is to be used against older SAMs like the SA-02 or SA-06.
- **SAM 2 (#7)** is to be used against newer SAMs like the SA-10 and higher.
- **IR SAM (#8)** is to be used when flying at low altitude and expecting MANPAD of short-range IR guided SAMs.
- **AG Mix (#9)** is to be used during the low altitude penetration of a well defended area, it combines the SAM 2 and IR SAM programs.
- **Flare Jett. (#10)** dumps all the flares in a short-timed burst. Used in case of emergency, not suitable to defend against missiles.

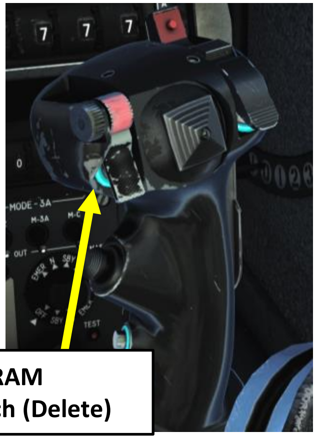
- **PANIC** is to be used when the missile threat is unexpected or unknown. It releases mix of chaff and flares to try and deal with the widest types of threats.

Note: All the programs except the PANIC program can be edited.

Lance-Leurres (Decoy dispenser) Program Selector
- 1-10: Manual Programs
- A: Automatic Program

Source: RAZBAM Manual

Program	Name	Chaff	Flare	Interval	Cycles	Cycle Int.
1	BVR 1	6	0	0.5	1	-
2	BVR 2	6	0	0.5	2	2.0
3	BVR 3	6	0	0.5	3	2.0
4	CCM 1	0	1	-	1	-
5	CCM 2	1	1	-	1	-
6	SAM 1	12	0	0.75	1	-
7	SAM 2	20	0	0.25	1	-
8	IR SAM	0	6	0.25	1	-
9	AG Mix	20	6	0.25	1	-
10	Flare jettison	0	32	0.05	1	-
Panic	Panic	6	3	0.5	1	-



Decoy PROGRAM Release Switch (Delete)

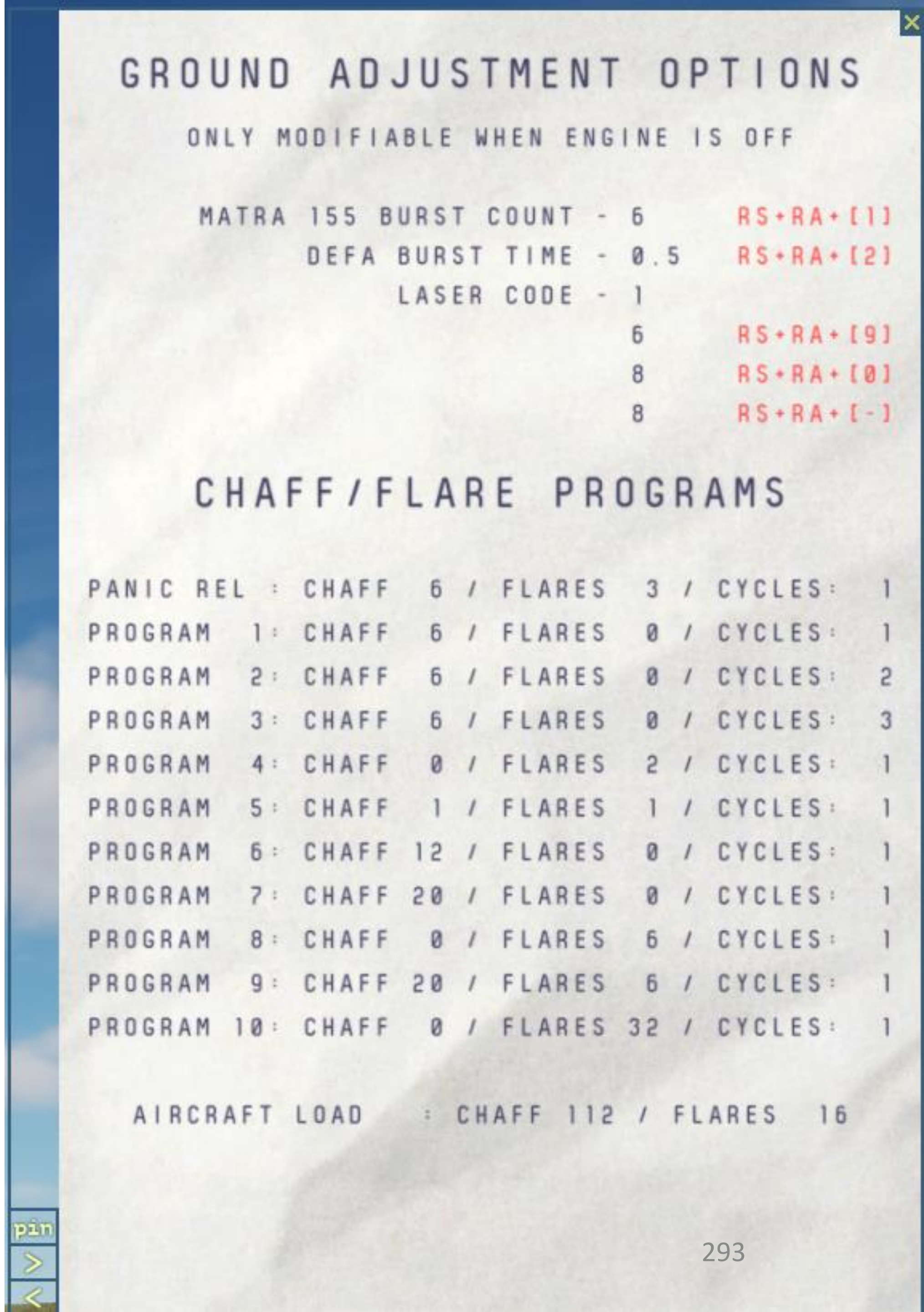
Decoy PANIC Release Pushbutton (Insert)

2 – SPIRALE COUNTERMEASURES SYSTEM

Système de Protection Infrarouge et Radar par Leurrage

2.3 – Flares & Chaff Programs

You can open up your kneeboard using “RSHIFT+K” and cycle through pages using the “[“ and “]” (kneeboard previous/next page bindings) to find the CHAFF/FLARE PROGRAMS SHEET, which will list the countermeasure programs.



3 – ÉCLAIR COUNTERMEASURE POD

The Éclair pod is an add-on countermeasure dispenser that is **attached in place of the drag chute (you cannot have both a drag chute and the Éclair pod at the same time; they are mutually exclusive configurations)**. Two pods are available, the **Éclair** and the **Éclair-M**.

The **Éclair** pod was developed as an emergency solution for the Mirage 2000C deployment in Desert Storm to equip aircraft that were not fitted with the Spirale system. It is composed of 3 countermeasure racks, 2 flares racks containing 8 cartridges and 1 chaff rack containing 16 cartridges. Its configuration is fixed: 16 flares and 16 chaffs.

The **Éclair-M** pod is a more refined version of the Éclair that is composed of 6 countermeasure racks. Each rack can hold either 16 chaffs or 8 flares and any configuration is possible giving is a maximum capacity of 108 chaffs or 48 flares.

This addon is directly integrated with the Spirale system and does not require any special configuration from the cockpit.

Source: RAZBAM Manual

4 – SERVAL / RWR

Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

The Serval (*Système d'Écoute Radar et de Visualisation de l'Alerte*) is the name of the radar warning receiver (DA – *Détecteur d'Alerte*) system. This detection system is passive. It uses signals emitted by other radars to classify and estimate their position and create a picture of the electromagnetic environment of the aircraft.

- The **Serval System is powered on** by setting the **DA (Détecteur d'Alerte) Power switch to the MIDDLE (M, Marche) position**.

DA (*Détecteur d'Alerte*) Power Switch
- T = Test
- M = MARCHE = ON
- A = ARRÊT = OFF

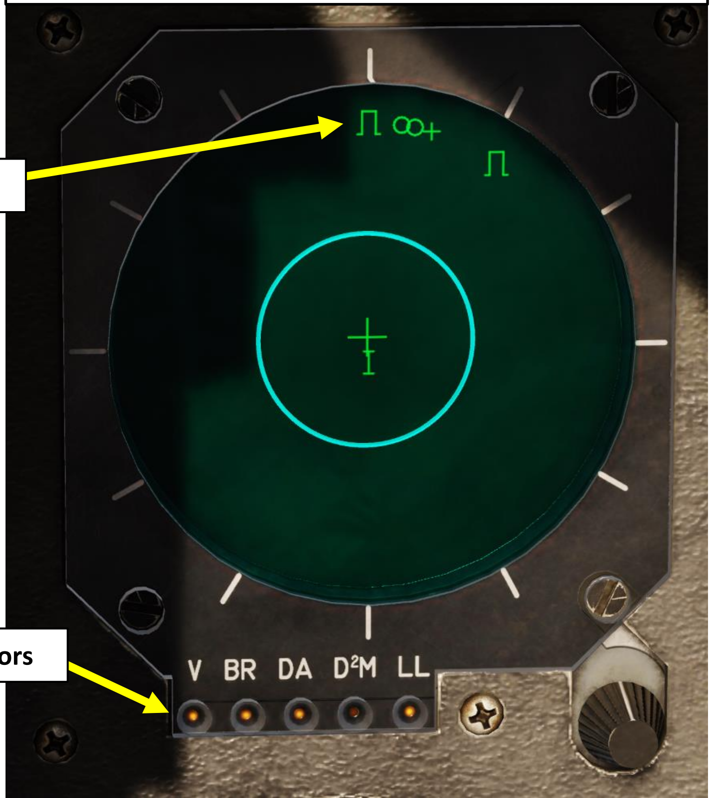
The countermeasure display (VCM – *Visualisation Contre-Mesure*) consists of a threat display, 5 status lights and brightness knob. This instrument serves 2 purposes:

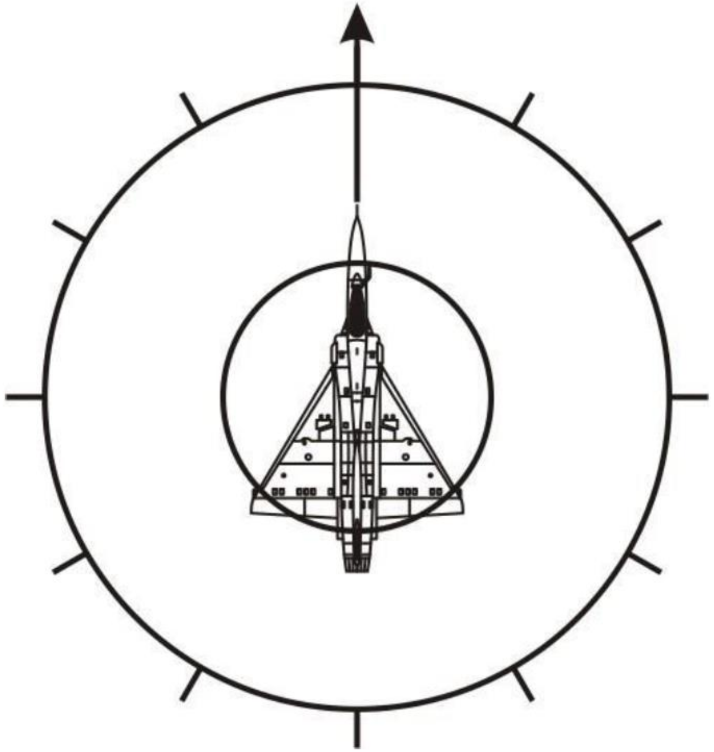
- To display the detected radar and missile threats using the **threat display**.
- To indicate the electronic warfare systems status though the 5 status lights (**Suite Status Indicators**).

The threat display is a top view of the aircraft's electromagnetic environment with the aircraft at its center and the top of the display representing the front of the aircraft.

Source: RAZBAM Manual

VCM (Visualisation Contre-Mesure)
Countermeasure Display





4 – SERVAL / RWR

Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

Radar emitters detected by the Serval are displayed on the screen relative to their position in azimuth and their dangerousness, the higher the closer to the center. This means that the display does not directly indicates the radar emitter range, a radar emitter capable of long-range engagement can be displayed closer to the center of the display than a closer, less capable emitter.

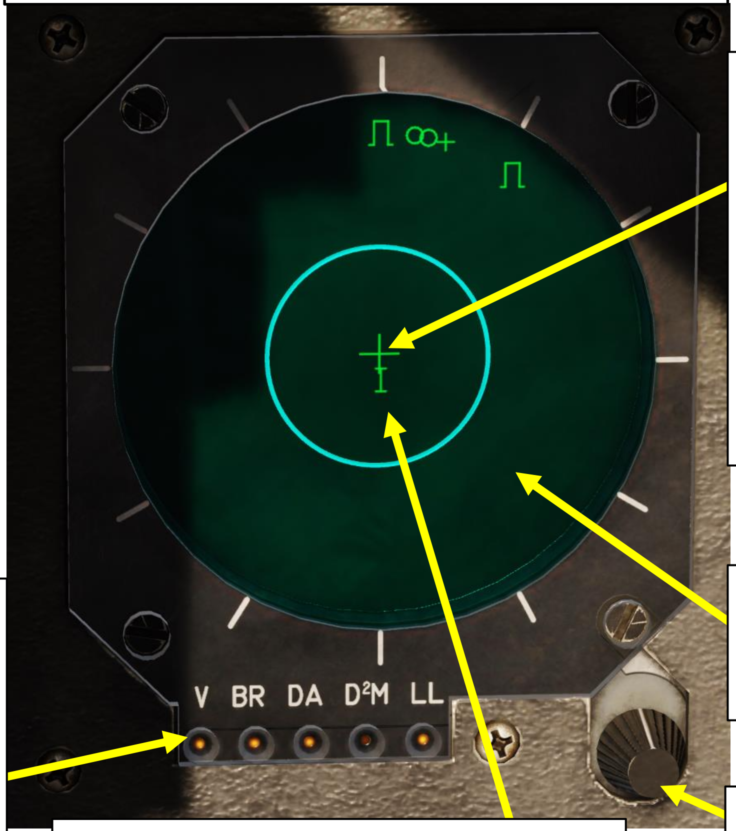
Source: RAZBAM Manual

The Sabre ECM jammer can also detect radar emitters and display them on the threat display if the Serval has not picked them up. Radar emitters can only be detected and displayed directly in the front or rear of the aircraft.

Missile launch warning coming from the D2M are also indicated on the threat display. The displayed radar threats are classified by comparing the signal to a database and then displaying a symbol, number or letter corresponding to the classification.

The threat display is capable of displaying 8 distinct radar threat plus 2 D2M launch warnings at the same time.

VCM (Visualisation Contre-Mesure)
Countermeasure Display



Operation Indicator (Display Status)

- + : Indicates that the threat display is powered and operating normally.
- PCM (*Priorité contre-mesure* – Countermeasure priority):
  - Steady: The Sabre ECM jammer Is currently emitting in countermeasure priority mode.
  - Flashing: The Sabre ECM jammer is inciting the pilot to switch to PCM mode.
- M (*Menace* – Threat): Indicates that a hostile aircraft is less than 10 nm from the aircraft. This information is provided by a CDC (*centre de commandement et de contrôle,* command and control center) though the TAF (*Télé-Affichage*) link.

Low Threat Zone

- Threats displayed in this zone are considered a low threat to the aircraft. This means that according to their type and signal strength, they are not able to employ weapons.

VCM (*Visualisation Contre-Mesure*) Brightness Control Knob

High Threat Zone

- Threats displayed in this zone are considered an immediate high threat to the aircraft, according to their type and signal strength they are within weapon employment range.

Suite Status Indicators

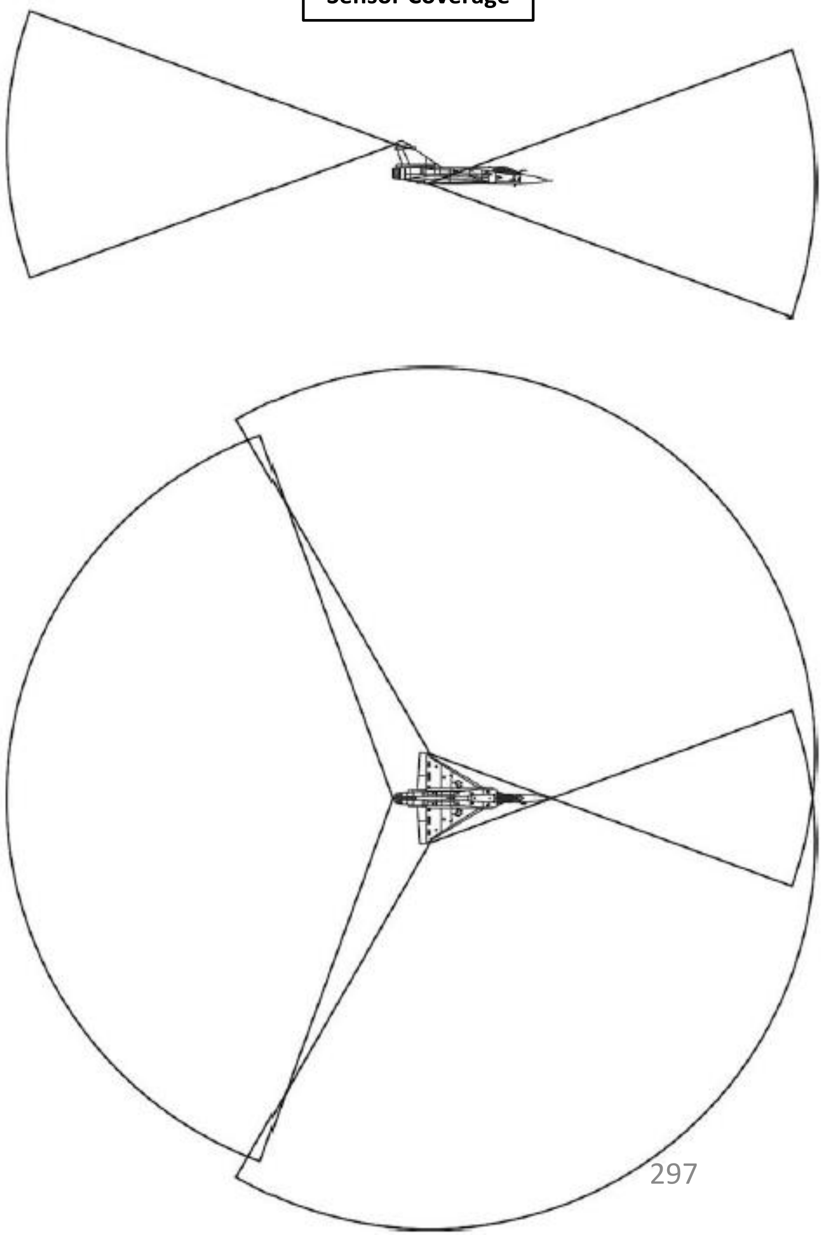
- V (*Veille* – Intelligence gathering): Indicates that Sabre jamming system is powered and recording the aircraft's electromagnetic environment for ELINT purpose.
- BR (*Brouillage* - Jamming): Indicates that the Sabre jammer is actively jamming.
- DA (*Détecteur d'alerte* – Radar warning receiver): Indicates that the Serval system is powered and operating normally.
- D2M (*Détecteur de départ missile* - Missile launch warning system):
  - Steady, indicates that the D2M is powered and operating normally.
  - Blinking, indicates that the D2M is powered but that the sensors are not cooled yet. It can also indicate that the D2M system is not present, that the coolant is depleted or that the system is damaged.
- LL (*Lance-leurres* – Decoy dispenser): Indicates that the Spirale and Éclair systems are powered and operating normally

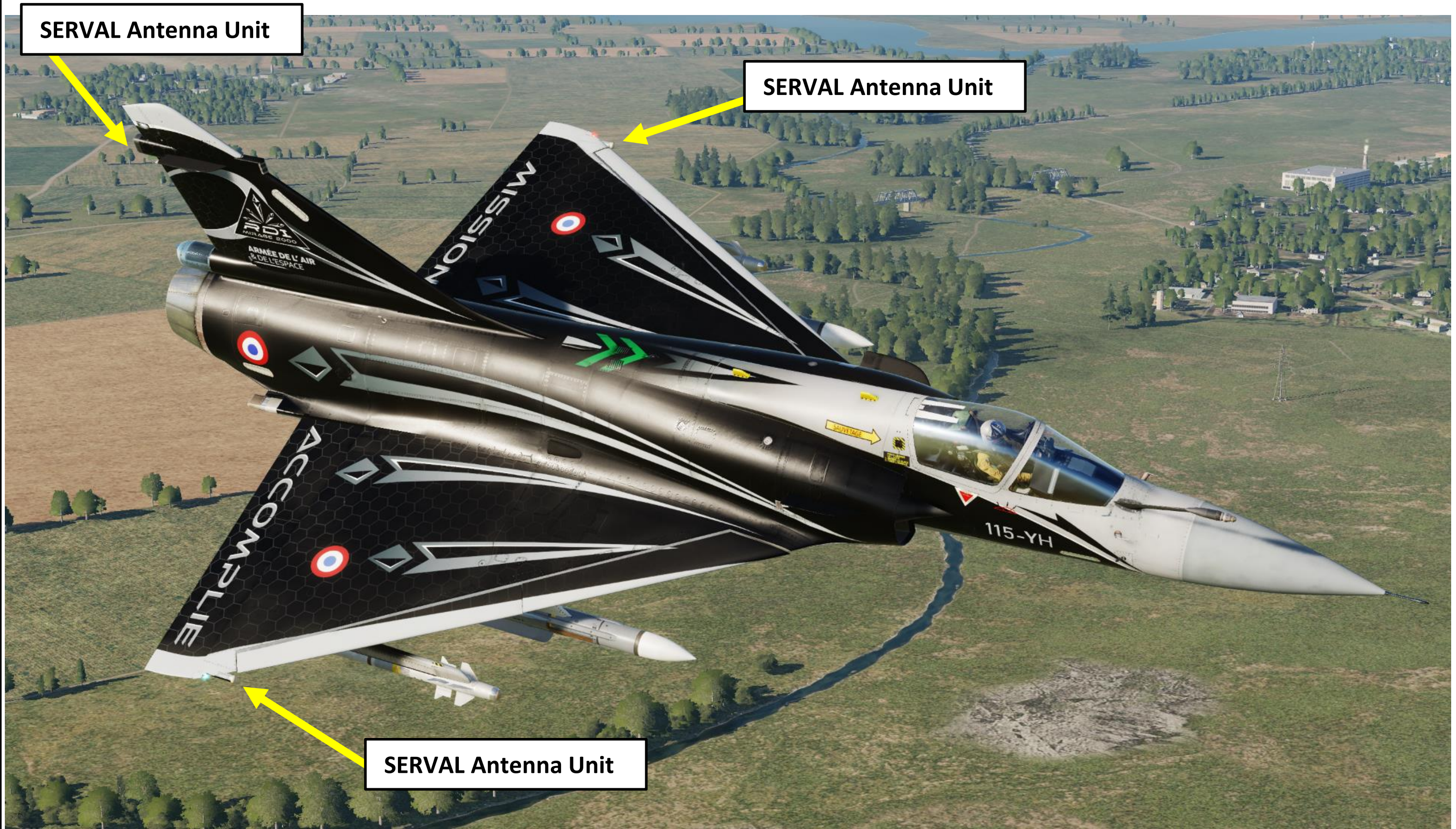
4 – SERVAL / RWR
Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

The Serval system uses 6 antennas that provide a 360 deg horizontal and around ±60 deg vertical coverage.

Source: RAZBAM Manual

Sensor Coverage





4 – SERVAL / RWR

Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

The Serval and Sabre **classification library** allows the system to identify radar emitter based on certain parameters (the radar signal frequency, shape, PRF (Pulse Repetition Frequency)) and then display the threat type on the threat display. Some threats like ships and bomber aircraft radars are regrouped under the same symbol to ease situational awareness.

Source: RAZBAM Manual

AIRBORNE THREATS

SYMBOL	DESCRIPTION
O	AWACS (E-2C, E3, A-50, KJ-2000)
4	F-4E
+	F-15C/F-15E
–	F/A-18C (APG-73)
*	F-16
●	F/A-18A (APG-65)
E	NATO Bomber/Subsonic attacker (S-3, A-6, B-1B, B-52)
F	NATO Supersonic attacker/Light fighter (F-5E, Tornado, AJS-37)
I	Mirage 2000C (RDI)
D	JF-17
T	F-14 (AWG-9)
Y	Mirage 2000-5 (RDY)
⍋	MiG-21 Fishbed
⎍	MiG-23 Flogger
⊥	Mig-25 Foxbat
ᔕ	MiG-31 Foxhound
Ш	Su-30 Flanker-C/Su-34 Fullback
B	Warsaw pact heavy bomber (Tu-22, Tu-95, Tu-142, Tu-160)
S	Su-27 Flanker/Su-33 Flanker-D/J-11 Flanker B+ (N001)
M	MiG-29A/S/G Fulcrum (N019)
V	Warsaw pact supersonic attacker (Su-17, Su-24)

SURFACE THREATS

SYMBOL	DESCRIPTION
A	Anti-aircraft artillery (Guepard, Vulcan, Shilka)
H	Hawk/NASAMS
P	Patriot
R	Roland
C	Early warning
D	SA-13 Dog ear (SA-09, SA-13)
K	P-19 Flate face B (SA-02/SA-03 search radar)
0	SA-10 Grumble/SA-12 Gladiator
1	SA-11 Gadfly
2	SA-02 Guideline (Fan song)
3	SA-03 Goa (Low blow)
5	SA-5 Gammon
6	SA-06 Gainful
8	SA-08 Gecko/SA-15 Gauntlet
9	SA-19 Grison

OTHER THREATS

SYMBOL	DESCRIPTION
N	Ship
U	Unknown
W	Active radar guided missile

4 – SERVAL / RWR

Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

The **threat display symbology** consists of a **threat type symbol**, **number** or **letter** that can be accompanied by complementary symbology that will provide additional information on the threat.

The RWR (VCM) Threat list can be accessed by using "RSHIFT+K" and cycling through pages using the "[" and "]" (kneeboard previous/next page bindings) to the "*Menaces VCM*" page (RWR Threats).

THREAT TYPE (CODE DE LA MENACE):

I — A radar emitter detected by the Serval or Sabre sytems is represented by a symbol, number or letter indicating the threat type.

X — A D.²M. missile launch warning is represented by a X. This letter is not reserved and can also be used to classify a radar emitter.

W — An active radar guided missile is represented by a W. This letter is not reserved and can also be used to classify a radar emitter.

JAMMED THREAT (*Menace brouillée*):

Indicates that this radar emitter is currently being jammed by the Sabre jammer.

JAMMER DETECTION (*Détection brouilleur*):

-Y- — Indicates that the radar emitter has only been detected by the Sabre jammer. This threat can only be displayed directly at the top or bottom of the threat display.

STT THREAT (*Menace PSIC*):

Indicates that the radar emitter is locking the aircraft in STT (*PSIC*). Flashes when the threat is supporting a semi-active radar guided missile.

W — Always displayed and flashes when the radar emitter is classified as an active radar guided missile.

MISSILE ACTIVITY (*Activitée missile*):

M — Displayed flashing to indicates that the radar emitter is supporting a semi-active radar guided missile.

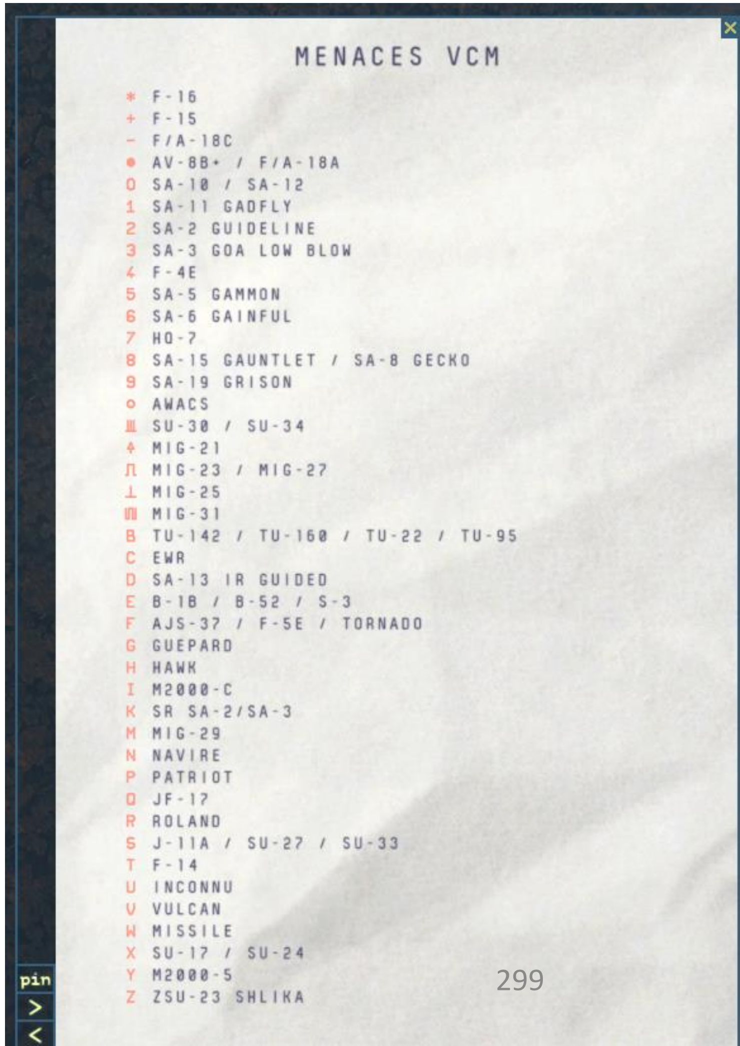
W — Always displayed and flashes when the radar emitter is classified as an active radar guided missile.

HIGH BAND AND LOW BAND (*Bande haute et bande basse*):

X — Indicates that the D.²M. has detected a missile coming from above the aircraft.

X — Indicates that the D.²M. has detected a missile coming from below the aircraft.

Source: RAZBAM Manual



4 – SERVAL / RWR

Système d'Écoute Radar et de Visualisation de l'Alerte / Radar Warning Receiver

The VCM in conjunction with the rest of the EW (Electronic Warfare) suite will provide different **audio warnings** to announce threats to the pilot.

NAME	TONE	DESCRIPTION
NEW THREAT *Nouvelle menace*	1 kHz for 500 ms	Indicates that a new radar emitter has be detected. Also triggered once by the D.A. test.
STT THREAT *Menace PSIC*	1 kHz chopped at 25 Hz for 500 ms	Indicates that a radar emitter is locking the aircraft in STT (PSIC).
MISSILE WARNING *Activitée missile*	1 kHz chopped at 25 Hz for 500 ms repeating after a 500 ms pause OR Continuous 1 kHz chopped at 25 Hz	Indicates that a radar emitter is supporting a semi-active radar guided missile or that an active radar guided missile has been detected.
D.²M. MISSILE WARNING *Alerte missile D.²M.*	3 kHz for 500 ms repeating after a 500 ms for 5 seconds	Indicates that a D.²M. sensor has detected a missile launch.

Source: RAZBAM Manual

5 – SABRE / ECM Jammer

Système d'Autoprotection par Brouillage Électromagnétique / Electronic Countermeasures

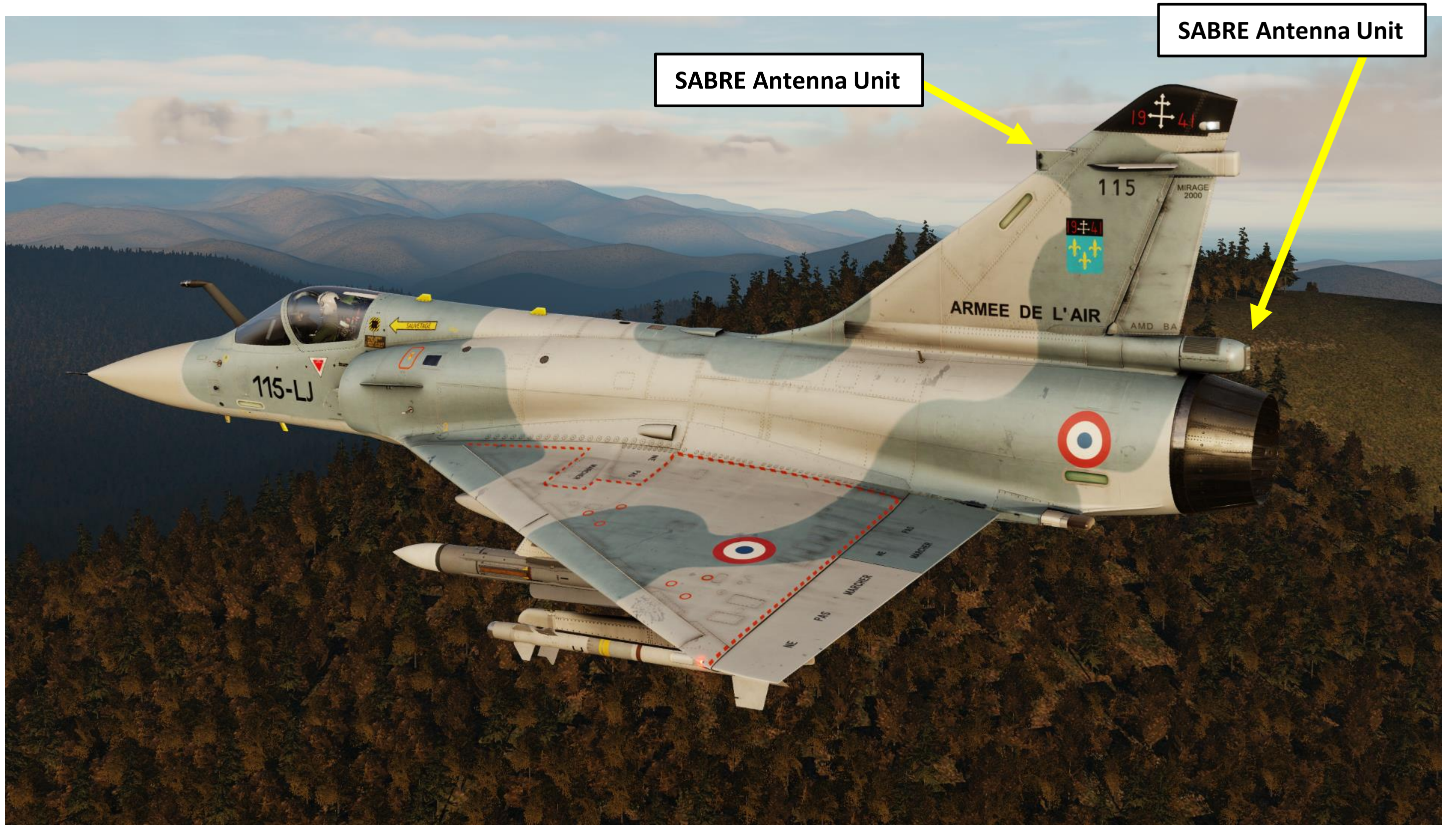
The Sabre (*système d'autoprotection par brouillage électromagnétique*) is a jamming and deception system. The system is composed of an emitter and 2 antennas all located in the tail-fin.

The Sabre can also display detected radar emitters on the VCM (*Visualisation Contre-Mesure*) / RWR (Radar Warning Receiver) threat display if the Serval was not able to detect them or is damaged. Due to the jammer having only two antennas the system is unable to determine the emitters azimuth, only if it is in front or behind the aircraft. Range is determined in the same way as for the Serval.

The Sabre system is highly sophisticated and provide defensive jamming against radar threats. The pilot has minimal control over the system as the way it operates is pre-programmed. Its main use is to protect the aircraft against active and semi-active radar guided missiles by reducing the lock range and confusing the missile or missile supporting system radar.

VCM (Visualisation Contre-Mesure)
Countermeasure Display

Source: RAZBAM Manual



5 – SABRE / ECM Jammer
Système d'Autoprotection par Brouillage Électromagnétique / Electronic Countermeasures

When the **BR (*Brouilleur*, Jammer) Power Switch** is set to M (Marche, ON), the jammer is powered and operates in accordance with the Jammer / ECM Operation Mode Selector position.

With the **Jammer Operation Mode selector** in the [] or PCM position, the jammer will automatically jam radar emitters that are locking the aircraft.

If the **HOTAS jammer PCM Override** Toggle command is pressed (**Jammer Activate Pushbutton**), the jammer is forced to emit in all directions regardless of Jammer / ECM Operation Mode Selector position.

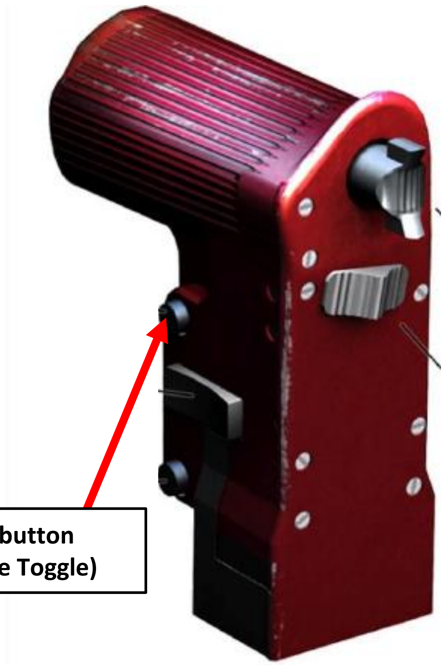
Source: RAZBAM Manual

Operation Indicator (Display Status)

- + : Indicates that the threat display is powered and operating normally.
- PCM (*Priorité contre-mesure* – Countermeasure priority):
  - Steady: The Sabre ECM jammer Is currently emitting in countermeasure priority mode.
  - Flashing: The Sabre ECM jammer is inciting the pilot to switch to PCM mode.
- M (*Menace* – Threat): Indicates that a hostile aircraft is less than 10 nm from the aircraft. This information is provided by a CDC (*centre de commandement et de contrôle,* command and control center) though the TAF (*Télé-Affichage*) link.

Suite Status Indicators

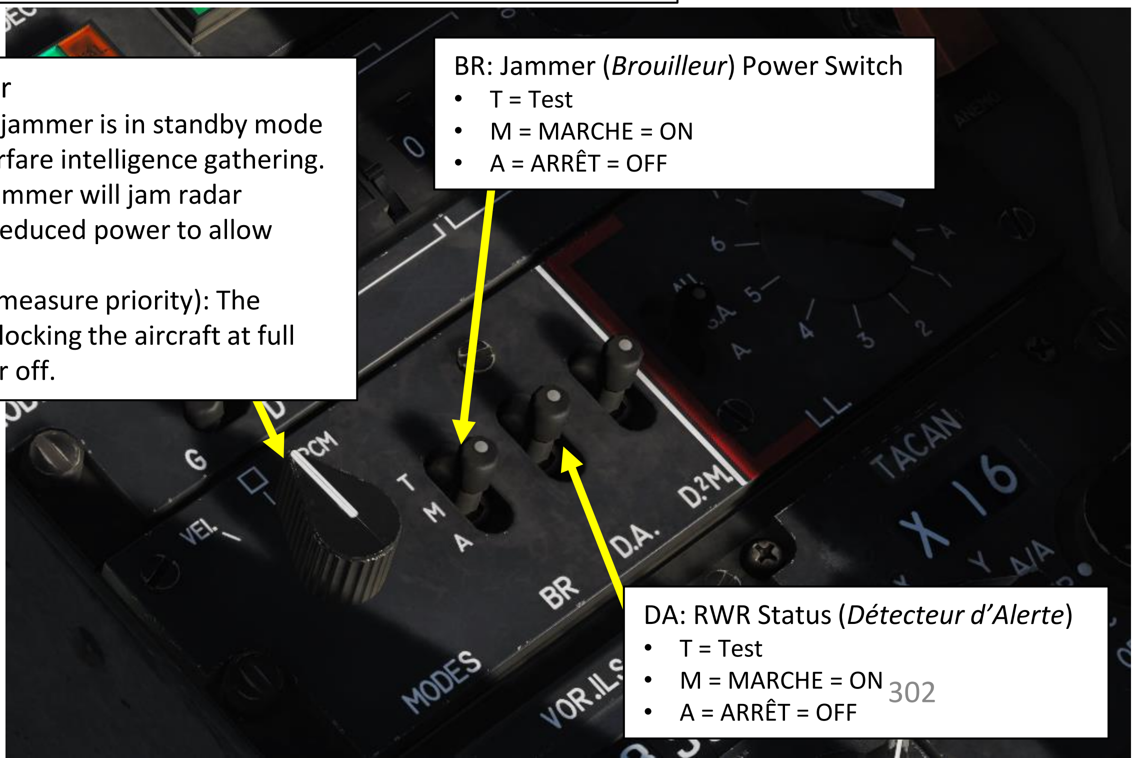
- V (*Veille* – Intelligence gathering): Indicates that Sabre jamming system is powered and recording the aircraft's electromagnetic environment for ELINT purpose.
- BR (*Brouillage* - Jamming): Indicates that the Sabre jammer is actively jamming.



Jammer Activate Pushbutton (Jammer PCM Override Toggle)

Jammer / ECM Operation Mode Selector

- VEI (*Veille* – Intelligence gathering): The jammer is in standby mode and performs background electronic warfare intelligence gathering.
- [] (*Priorité radar* – Radar priority): The jammer will jam radar emitters that are locking the aircraft at reduced power to allow radar operation.
- PCM (*Priorité contre-mesures* – Countermeasure priority): The jammer will jam radar emitters that are locking the aircraft at full power, automatically switching the radar off.



BR: Jammer (*Brouilleur*) Power Switch

- T = Test
- M = MARCHE = ON
- A = ARRÊT = OFF

DA: RWR Status (*Détecteur d'Alerte*)

- T = Test
- M = MARCHE = ON
- A = ARRÊT = OFF

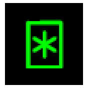
5 – SABRE / ECM Jammer

Système d'Autoprotection par Brouillage Électromagnétique / Electronic Countermeasures

In order to use the Sabre ECM Jammer:

1. Turn SERVAL on by setting the DA (*Détecteur d'Alertes*) switch to **M**ARCHE. The SERVAL (*Système Électronique de Reconnaissance et Visualisation d'Alertes)* or RWR (Radar Warning Receiver) will show you targets that have you on their radar.
2. Turn on the *Brouilleur* (Jammer) setting the BR switch to **M**ARCHE.
3. Select Jammer / ECM Operation Mode Selector as desired:
    - [] (*Priorité radar* – Radar priority): The jammer will jam radar emitters that are locking the aircraft at reduced power to allow radar operation.
    - PCM (*Priorité contre-mesures* – Countermeasure priority): The jammer will jam radar emitters that are locking the aircraft at full power, automatically switching the radar off.
4. With the Jammer / ECM Operation Mode Selector in the [] or PCM position, the jammer will automatically jam radar emitters that are locking the aircraft.
5. To force the jammer to emit in all directions (regardless of Jammer / ECM Operation Mode Selector position), press the HOTAS jammer PCM Override Toggle command (Jammer Activate Pushbutton).

JAMMED THREAT (*Menace brouillée*):

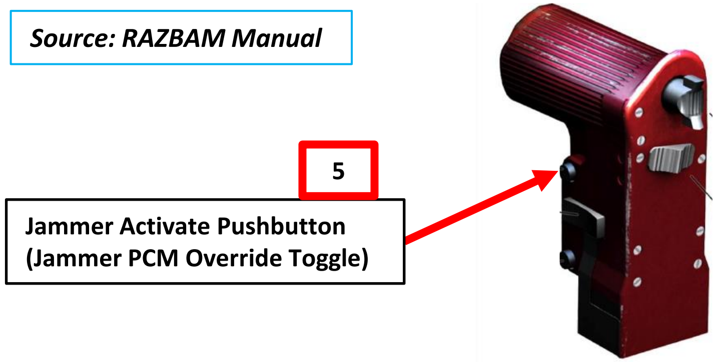


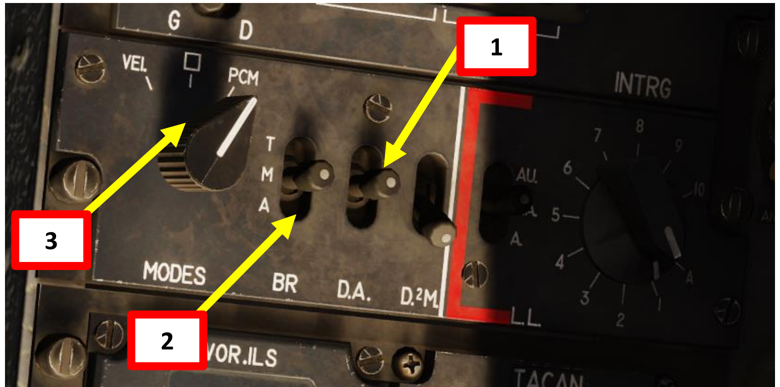
Indicates that this radar emitter is currently being jammed by the Sabre jammer.

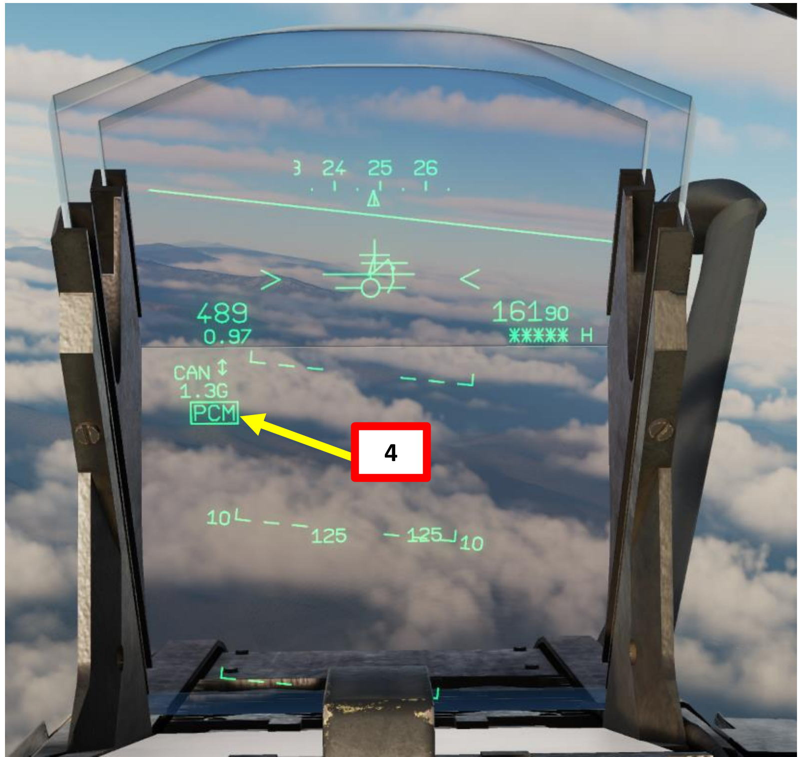
JAMMER DETECTION (*Détection brouilleur*):

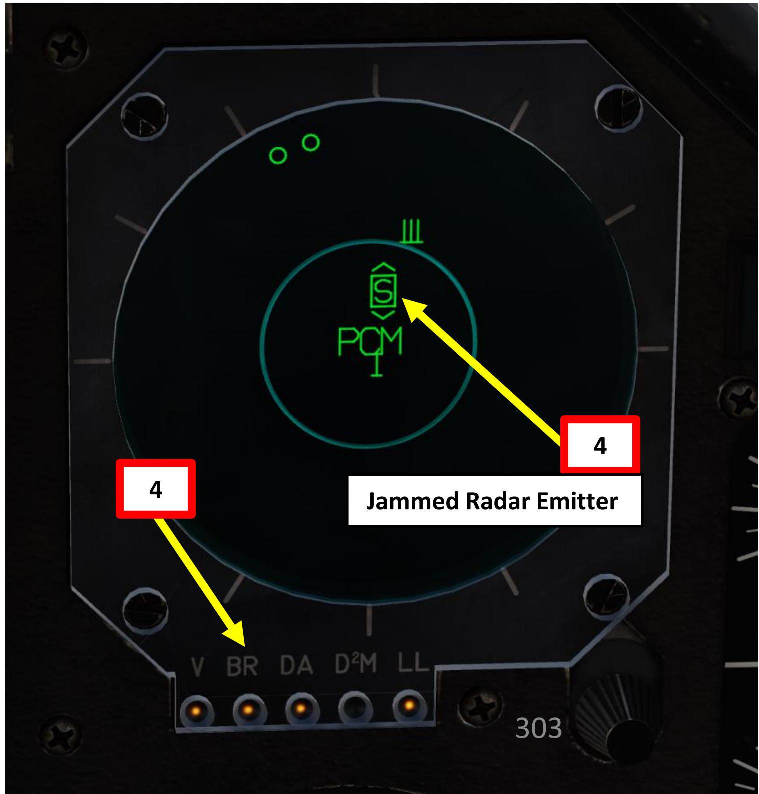
Indicates that the radar emitter has only been detected by the Sabre jammer. This threat can only be displayed directly at the top or bottom of the threat display.

Source: RAZBAM Manual









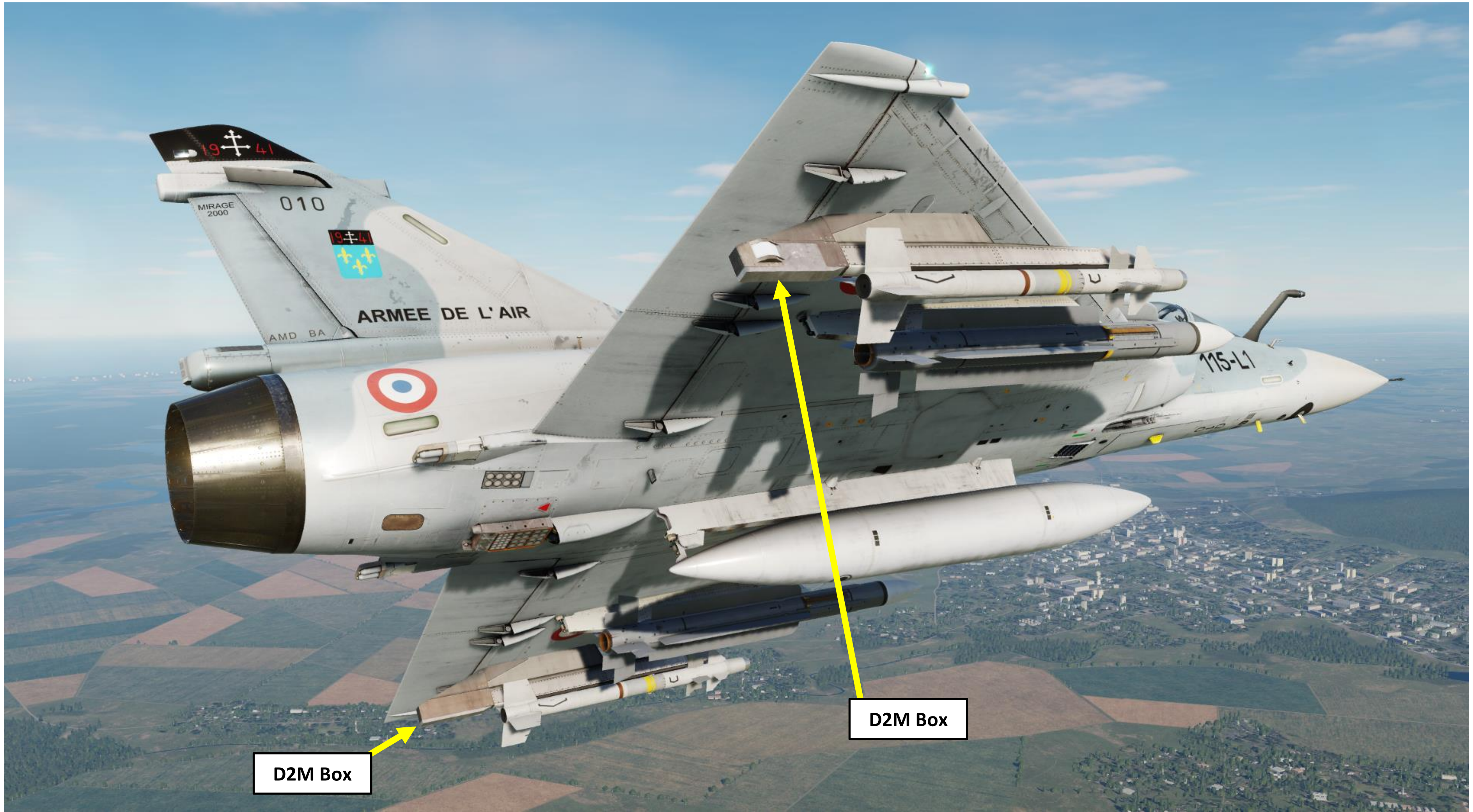
6 – D2M / MLWS

Détecteur de Départ Missile / Missile Launch Warning System

The D2M (Détecteur de Départ Missile) is an optional missile launch warning system (MLWS). The system is composed of 2 infrared sensors located in an addon fairing at the back of the MAGIC II missile pylon.

The D2M uses the infrared light emitted by rocket motors to detect missiles, this means that for the system to detect a missile, its engine needs to be burning. It will detect any burning rocket motor at close range and cannot determine if a missile is aimed at the aircraft or not. This means that friendly missiles shot close might be detected and trigger the system.

Source: RAZBAM Manual



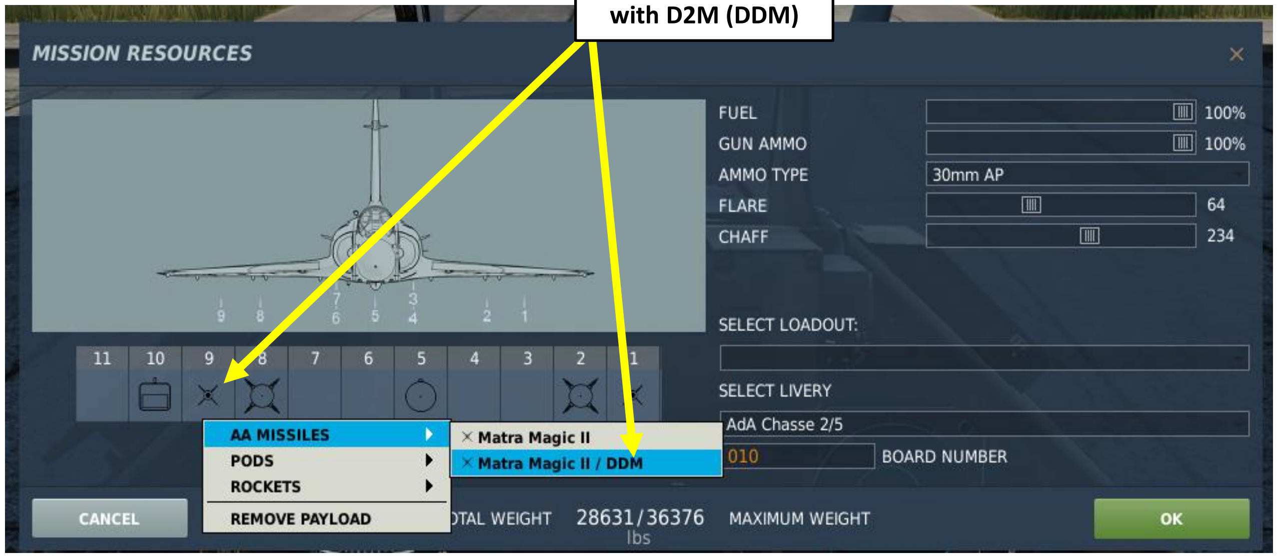
6 – D2M / MLWS

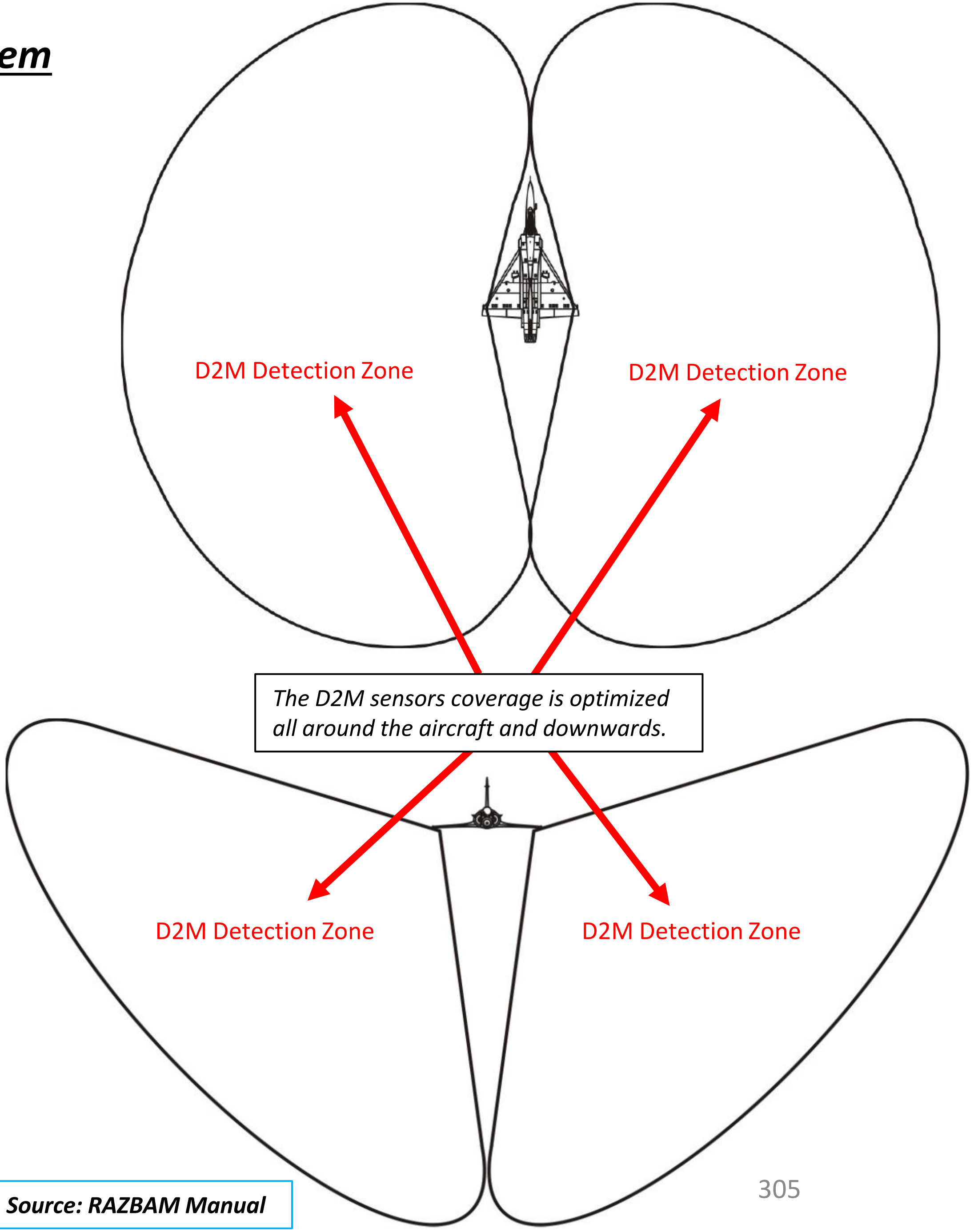
Détecteur de Départ Missile / Missile Launch Warning System

The D2M system is dedicated to MANPAD and short-range IR SAM launch detection, the sensors only cover the area below the aircraft. The D2M is not infaillible: it has blind spots.

In order to have the D2M system available, you need to equip Magic II missile specifically fitted with "DDM" devices. This is done by either equipping "Matra Magic II / DDM" missiles from the ground crew or via the Mission Editor.

Magic II Missile with D2M (DDM)





Source: RAZBAM Manual

6 – D2M / MLWS

Détecteur de Départ Missile / Missile Launch Warning System

1. The D2M system sensors are cooled by using the MAGIC II liquid nitrogen. The D2M system consumption is about the same as the missiles, this means that when both the MAGIC II and the D2M are cooled, the coolant lasts half as long as if only the MAGIC II was cooled.
2. When **turned on with the D2M Switch set to M (Marche, ON)**, the D2M starts a cooling sequence that lasts about 45 seconds and is indicated by the blinking D2M. light on the Suite Status Indicator. During this time the system is not operational.
3. When the D2M detects a burning rocket motor, the VCM will display a “X” symbol in the direction of the detected missile launch. The high and low band bars can also be displayed to indicate the relative altitude position of the threat in relationship to your aircraft. A continuous 3 kHz signal will also be audible.

Source: RAZBAM Manual

HIGH BAND AND LOW BAND (*Bande haute et bande basse*):

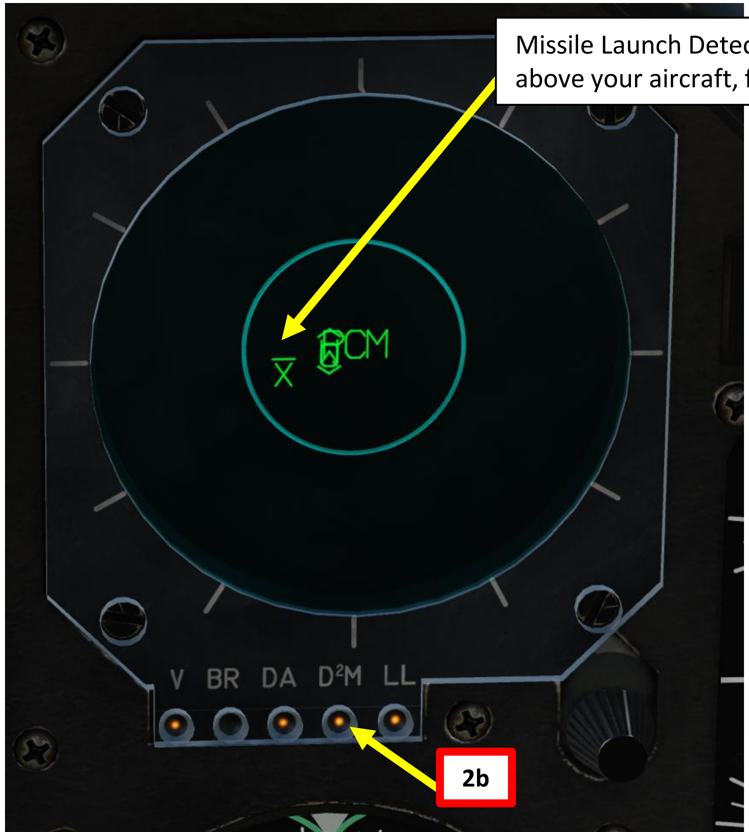
- X: Indicates that the D.²M. has detected a missile coming from above the aircraft.
- X: Indicates that the D.²M. has detected a missile coming from below the aircraft.

THREAT TYPE (CODE DE LA MENACE):

- I: A radar emitter detected by the Serval or Sabre sytems is represented by a symbol, number or letter indicating the threat type.
- X: A D.²M. missile launch warning is represented by a X. This letter is not reserved and can also be used to classify a radar emitter.
- W: An active radar guided missile is represented by a W. This letter is not reserved and can also be used to classify a radar emitter.

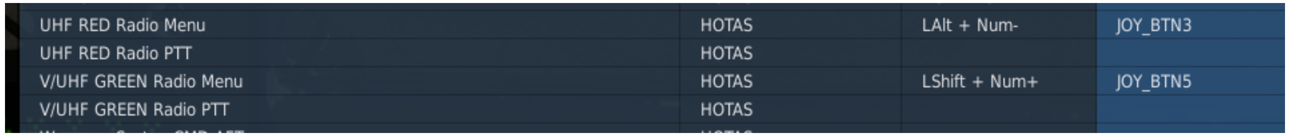
MISSILE ACTIVITY (*Activitée missile*):

- M: Displayed flashing to indicates that the radar emitter is supporting a semi-active radar guided missile.
- W: Always displayed and flashes when the radar emitter is classified as an active radar guided missile.



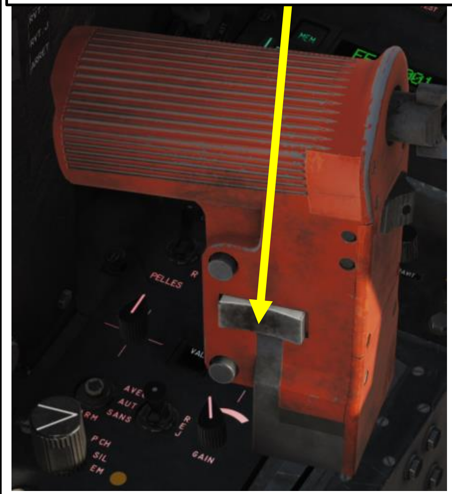
RADIO OVERVIEW

- You have two radios available: a "**Green**" V/UHF radio (COM1) and a "**Red**" TRT ERA 7200 UHF secure voice com radio (COM2). Most encryption functions are not implemented.
- V/UHF COM1 radio is used for communications between two ranges: 118.000 to 149.970 MHz (VHF Range) and 225.000 to 400.000 MHz (UHF Range). It can use both custom and preset channels as well (preset channels can be changed in the mission editor). Preset channel frequencies should be available in mission briefing and on the kneeboard.
- UHF COM2 radio is used for communications between 225.000 and 400.000 MHz. It can **only** use preset channels (preset channels can be changed in the mission editor). Preset channel frequencies should be available in mission briefing.
- Radio transmission is done the Radio Selection Switch, which is divided in two controls: a UHF Red (COM2) Radio Push-to-Talk Control and a V/UHF Green (COM1) Radio Push-to-Talk Control.
- TACAN and VOR/ILS radio beacons will be further explained in the Air Refueling section and the ILS LANDING section.

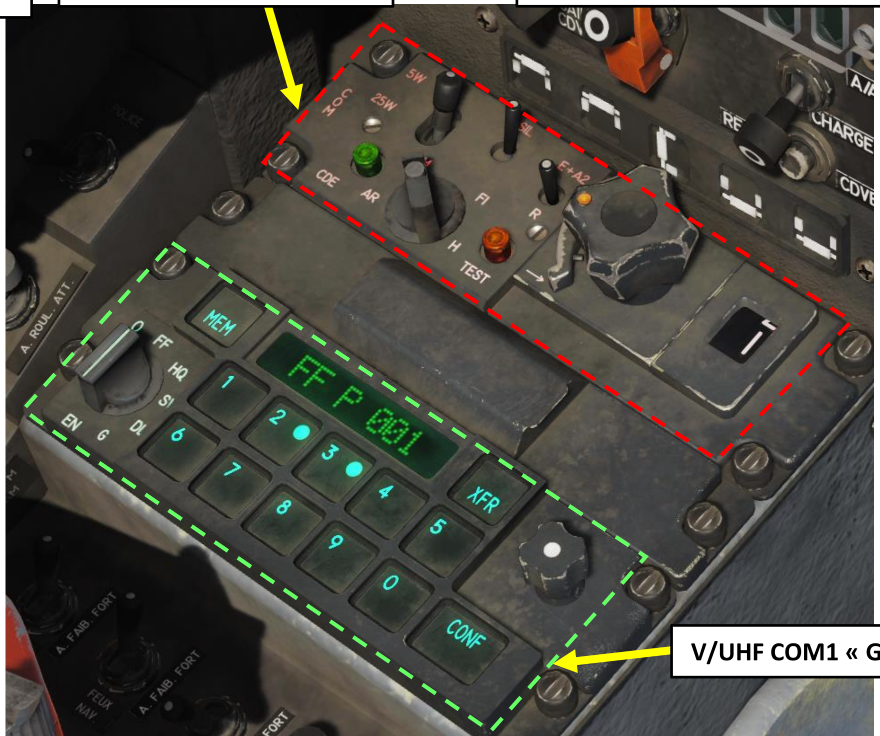


UHF RED Radio Menu	HOTAS	LAlt + Num-	JOY_BTN3
UHF RED Radio PTT	HOTAS		
V/UHF GREEN Radio Menu	HOTAS	LShift + Num+	JOY_BTN5
V/UHF GREEN Radio PTT	HOTAS		

Radio Selection Switch (selects either COM1 or COM2 radio)
- UHF Red COM2 Radio Control
- V/UHF Green COM1 Radio Control



UHF COM2 « Red » Radio

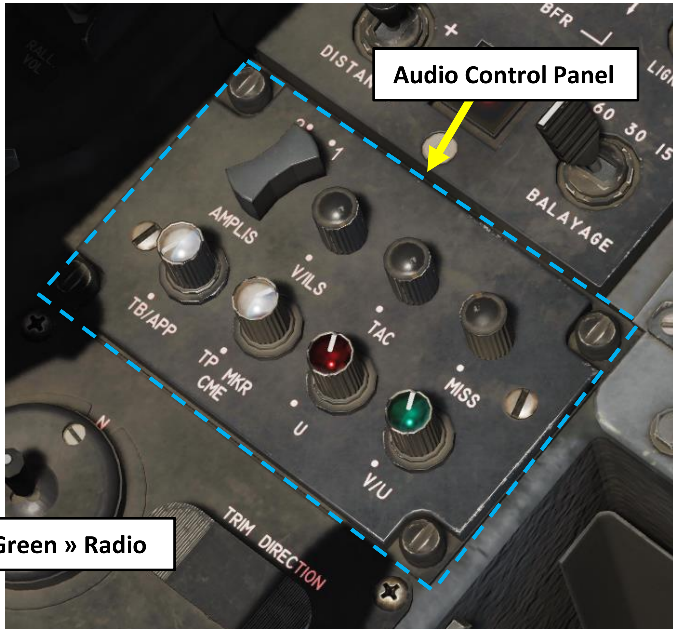


V/UHF COM1 « Green » Radio

UHF COM2 Radio Frequency Repeater (Not Compatible)
V/UHF COM1 Radio Frequency Repeater

V/UHF Radio Receive Light

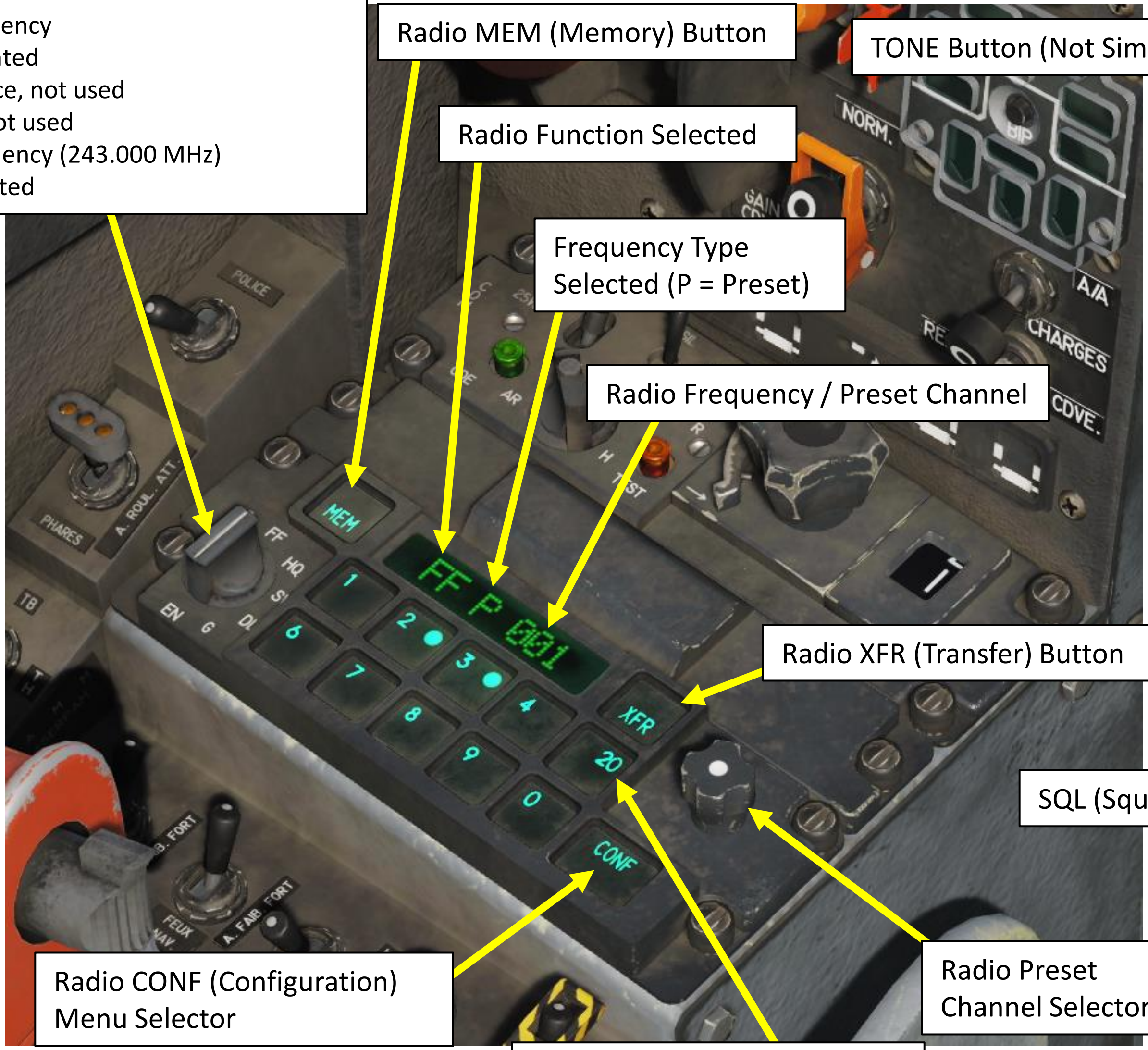
Audio Control Panel

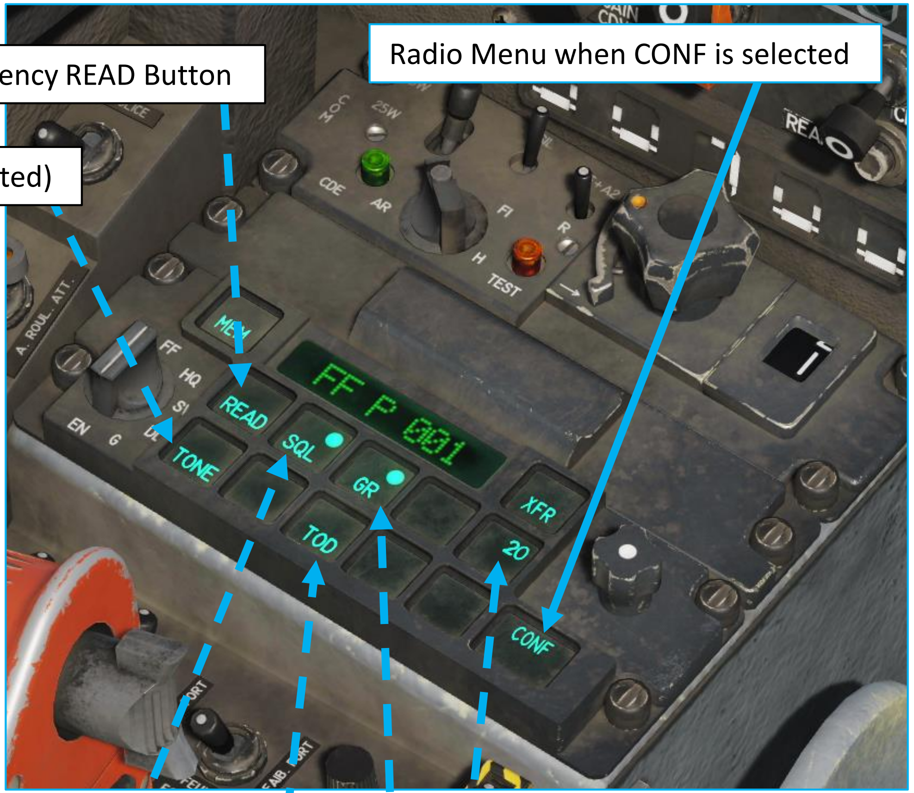


RADIO OVERVIEW (V/UHF COM1)

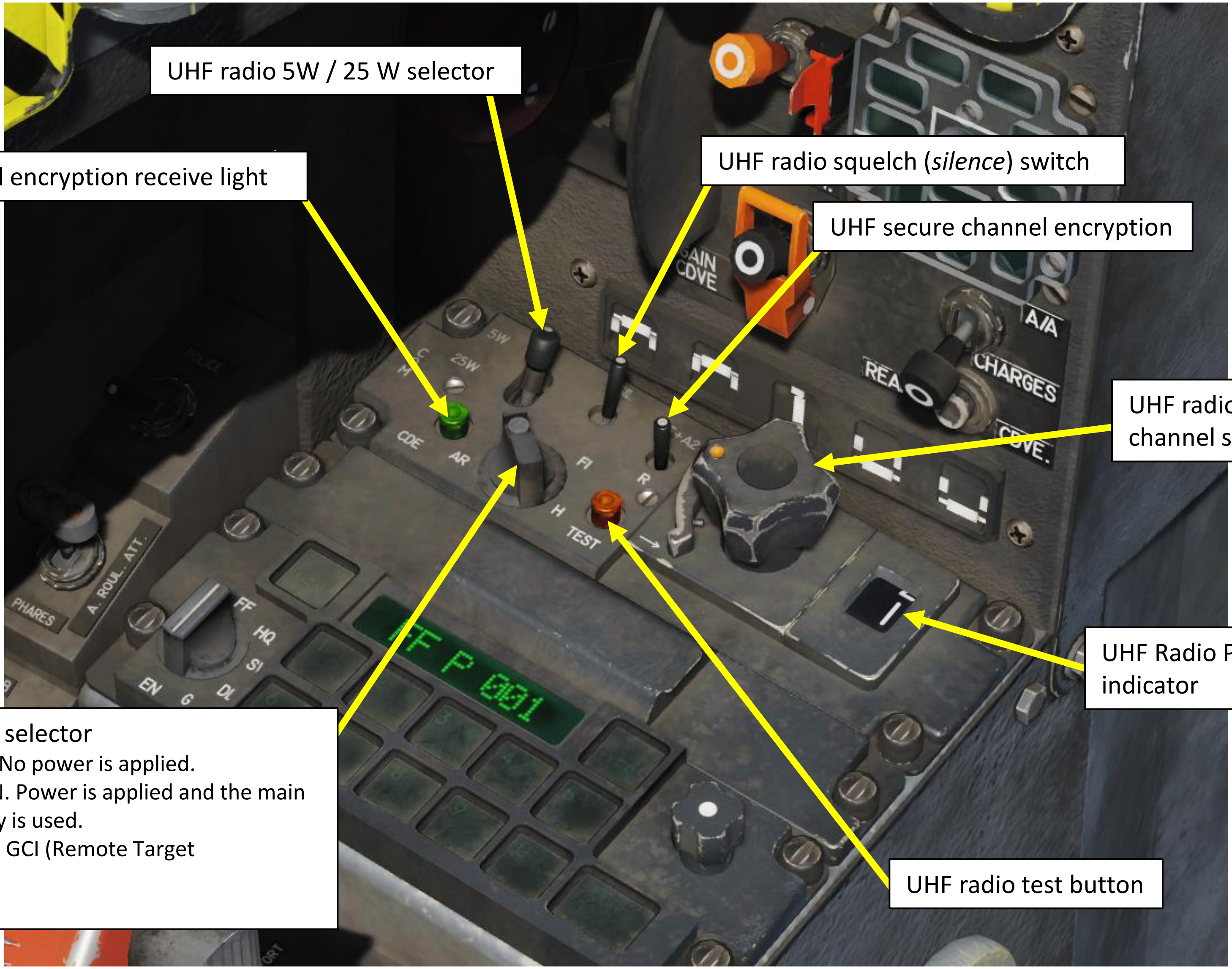
"GreenBox" V/UHF Radio Function Selector

- 0: OFF
- FF: Fixed Frequency
- HQ: Not Simulated
- SV: Secure Voice, not used
- DL: Datalink, not used
- G: Guard Frequency (243.000 MHz)
- EN: Not Simulated

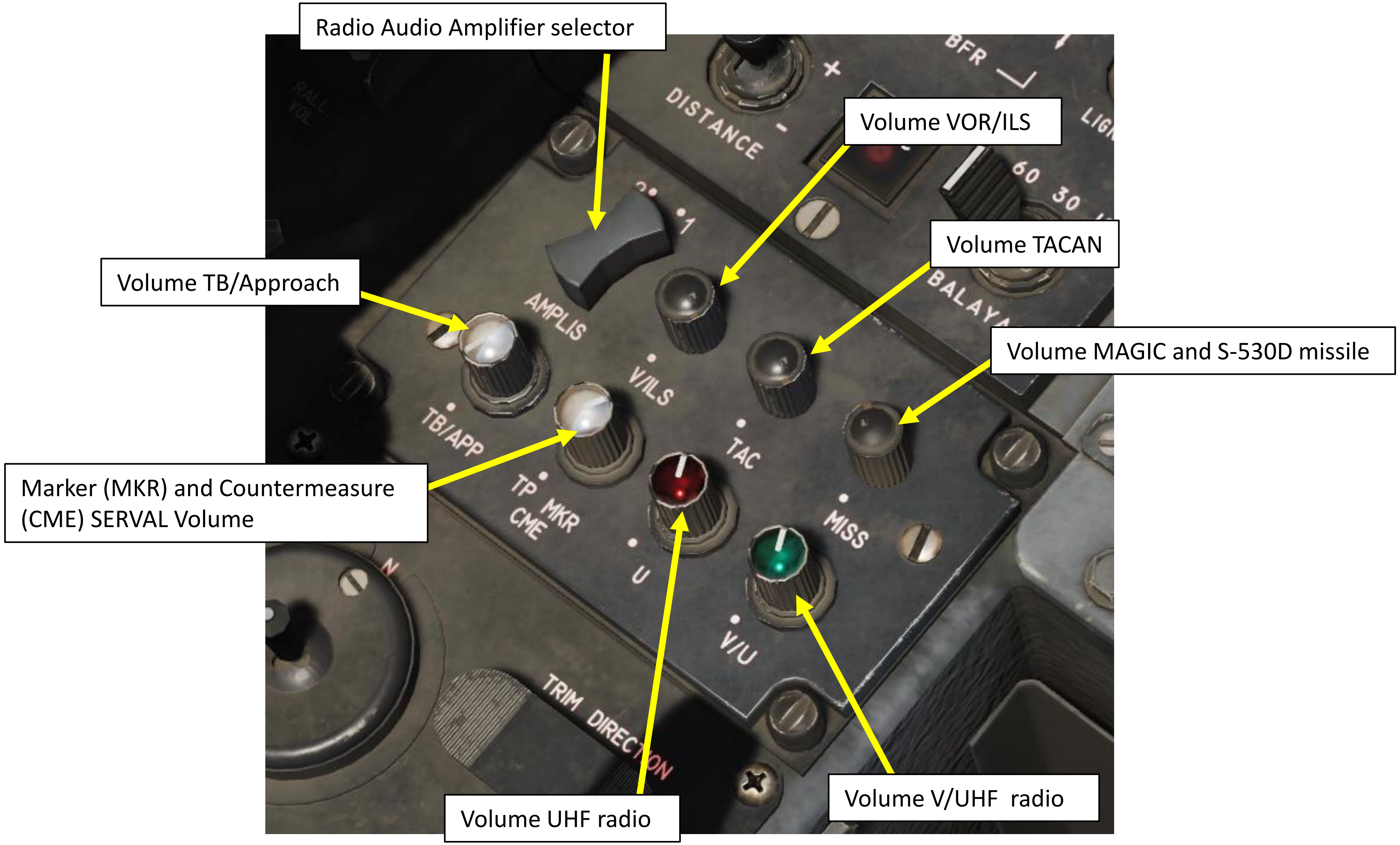




RADIO OVERVIEW (UHF COM2)

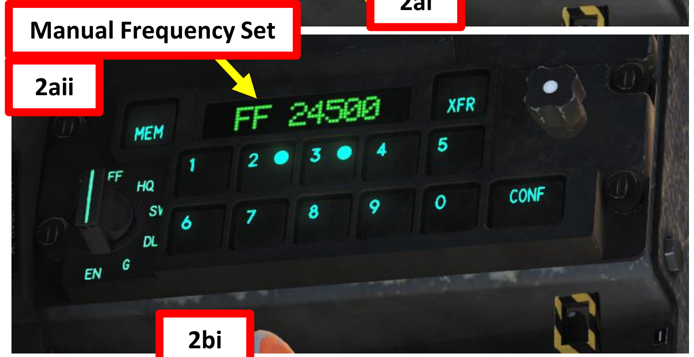


RADIO OVERVIEW (AUDIO CONTROL PANEL)

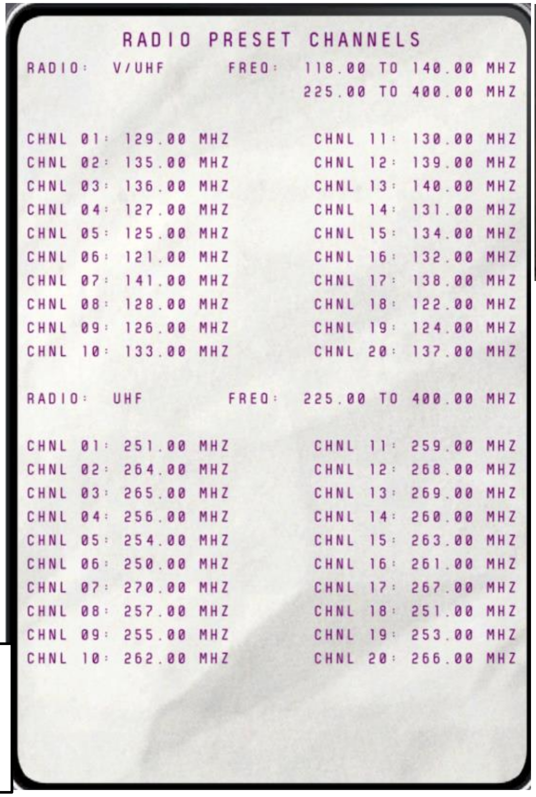


HOW TO USE V/UHF COM1 "GREENBOX" RADIO

1. Set V/UHF Radio Function Selector to FF (*Fixed Frequency*) to turn on the radio.
2. Select desired radio frequency. You can verify frequencies on the COM frequency display.
   a) To choose a manual radio frequency:
      i. Enter frequency on keypad ("24500" would be used for 245.000 MHz)
      ii. Press the VLD (Validate) button.
   b) To choose a preset radio frequency:
      i. Set frequency with the Preset Frequency Tuning knob. "P" means a Preset frequency is selected.
      ii. You can check the frequency by checking the V/UHF COM1 Frequency Repeater. Alternatively, you can also do so by pressing the CONF button, then the READ button (the frequency will then be shown).
3. Select desired audio power amplifier (AMPLIS). Ampli #1 is used by default. Adjust volume as required.
4. To transmit, press the V/UHF GREEN RADIO MENU (**LSHIFT** + **NUMPAD+**) or the V/UHF GREEN RADIO PTT (Push-to-Talk) binding to communicate on the SRS (Simple Radio Standalone) add-on.



Radio Selection Switch (selects either COM1 or COM2 radio)
- UHF Red COM2 Radio Control
- V/UHF Green COM1 Radio Control

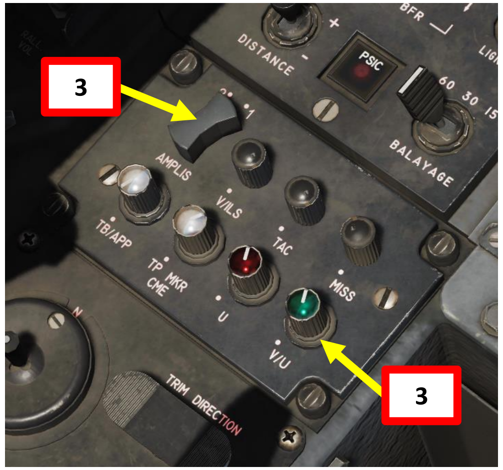

RADIO PRESET CHANNELS

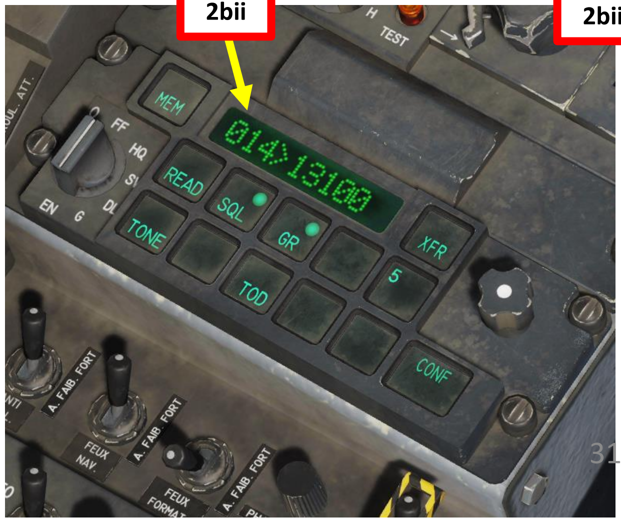
RADIO: V/UHF FREQ: 118.00 TO 140.00 MHZ
225.00 TO 400.00 MHZ

CHNL 01: 129.00 MHZ	CHNL 11: 130.00 MHZ
CHNL 02: 135.00 MHZ	CHNL 12: 139.00 MHZ
CHNL 03: 136.00 MHZ	CHNL 13: 140.00 MHZ
CHNL 04: 127.00 MHZ	CHNL 14: 131.00 MHZ
CHNL 05: 125.00 MHZ	CHNL 15: 134.00 MHZ
CHNL 06: 121.00 MHZ	CHNL 16: 132.00 MHZ
CHNL 07: 141.00 MHZ	CHNL 17: 138.00 MHZ
CHNL 08: 128.00 MHZ	CHNL 18: 122.00 MHZ
CHNL 09: 126.00 MHZ	CHNL 19: 124.00 MHZ
CHNL 10: 133.00 MHZ	CHNL 20: 137.00 MHZ

RADIO: UHF FREQ: 225.00 TO 400.00 MHZ

CHNL 01: 251.00 MHZ	CHNL 11: 259.00 MHZ
CHNL 02: 264.00 MHZ	CHNL 12: 268.00 MHZ
CHNL 03: 265.00 MHZ	CHNL 13: 269.00 MHZ
CHNL 04: 256.00 MHZ	CHNL 14: 260.00 MHZ
CHNL 05: 254.00 MHZ	CHNL 15: 263.00 MHZ
CHNL 06: 250.00 MHZ	CHNL 16: 261.00 MHZ
CHNL 07: 270.00 MHZ	CHNL 17: 267.00 MHZ
CHNL 08: 257.00 MHZ	CHNL 18: 251.00 MHZ
CHNL 09: 255.00 MHZ	CHNL 19: 253.00 MHZ
CHNL 10: 262.00 MHZ	CHNL 20: 266.00 MHZ

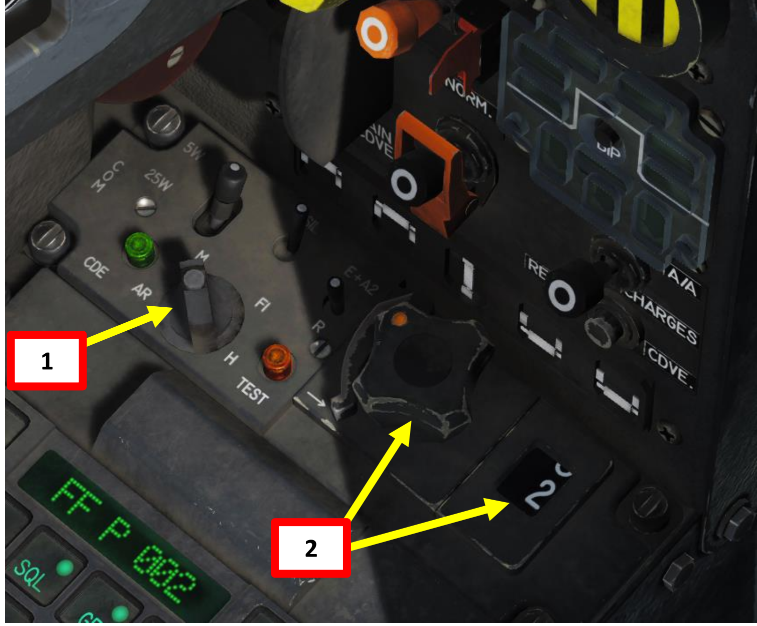


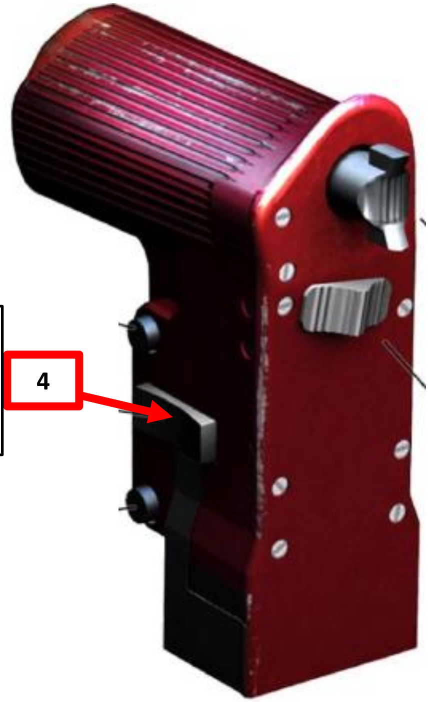


HOW TO USE UHF COM2 RADIO

1. Set UHF COM2 radio to **M**ARCHE (ON)
2. Select desired radio preset frequency. You can verify frequencies on the kneeboard; the COM frequency display is not compatible with the UHF radio.
3. Select desired audio power amplifier (AMPLIS). Ampli #1 is used by default. Adjust volume as required.
4. To communicate, press UHF RED RADIO MENU (**LALT** + **NUMPAD-**) or the UHF RED RADIO PTT (Push-to-Talk) binding to communicate on the SRS (Simple Radio Standalone) add-on.

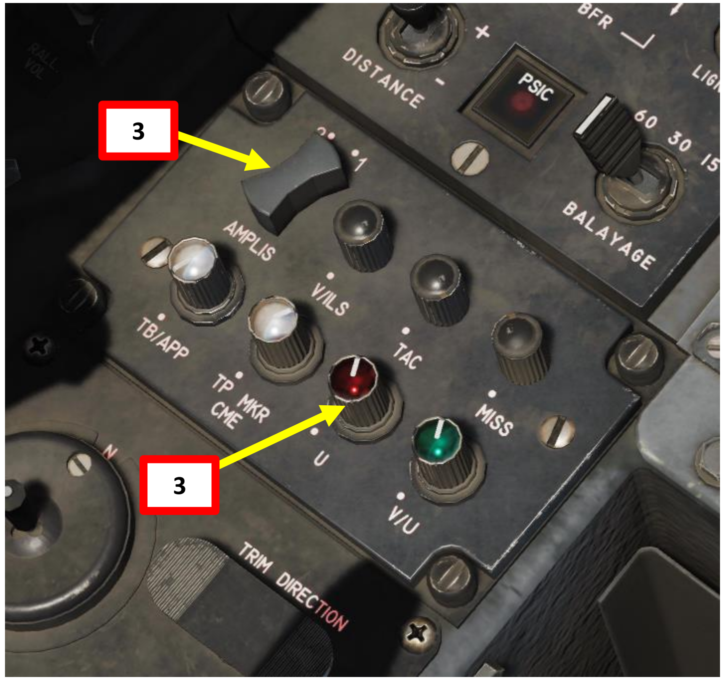
UHF COM2 Frequency Repeater
Noted in asterisks since the Mirage's UHF radio is not compatible with the frequency repeater.

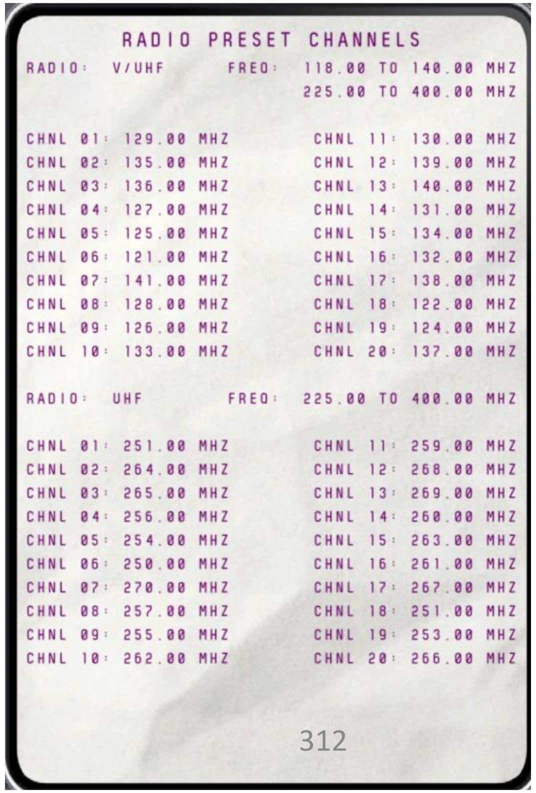




Radio Selection Switch (selects either COM1 or COM2 radio)

- UHF Red COM2 Radio Control
- V/UHF Green COM1 Radio Control





RADIO PRESET CHANNELS

RADIO: V/UHF FREQ: 118.00 TO 140.00 MHZ / 225.00 TO 400.00 MHZ

CHNL 01:	129.00 MHZ	CHNL 11:	130.00 MHZ
CHNL 02:	135.00 MHZ	CHNL 12:	139.00 MHZ
CHNL 03:	136.00 MHZ	CHNL 13:	140.00 MHZ
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CHNL 05:	125.00 MHZ	CHNL 15:	134.00 MHZ
CHNL 06:	121.00 MHZ	CHNL 16:	132.00 MHZ
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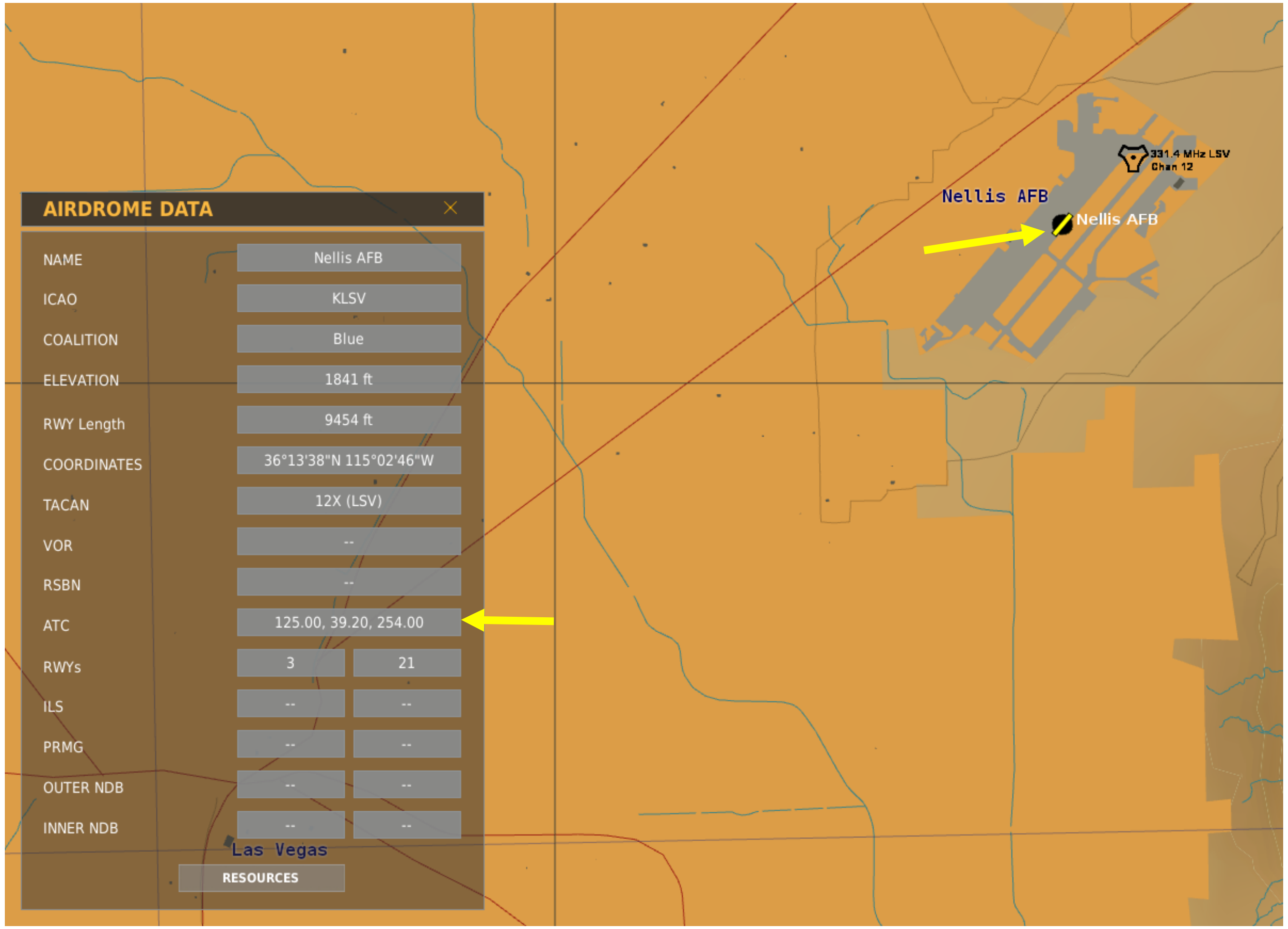
CHNL 08:	128.00 MHZ	CHNL 18:	122.00 MHZ
CHNL 09:	126.00 MHZ	CHNL 19:	124.00 MHZ
CHNL 10:	133.00 MHZ	CHNL 20:	137.00 MHZ

RADIO: UHF FREQ: 225.00 TO 400.00 MHZ

CHNL 01:	251.00 MHZ	CHNL 11:	259.00 MHZ
CHNL 02:	264.00 MHZ	CHNL 12:	268.00 MHZ
CHNL 03:	265.00 MHZ	CHNL 13:	269.00 MHZ
CHNL 04:	256.00 MHZ	CHNL 14:	260.00 MHZ
CHNL 05:	254.00 MHZ	CHNL 15:	263.00 MHZ
CHNL 06:	250.00 MHZ	CHNL 16:	261.00 MHZ
CHNL 07:	270.00 MHZ	CHNL 17:	267.00 MHZ
CHNL 08:	257.00 MHZ	CHNL 18:	251.00 MHZ
CHNL 09:	255.00 MHZ	CHNL 19:	253.00 MHZ
CHNL 10:	262.00 MHZ	CHNL 20:	266.00 MHZ

AIRFIELD FREQUENCIES

You can find airfield ATC frequencies by clicking on their icons in the map (press F10 to show the map).



RADIO FREQUENCIES – AIRFIELDS

LOCATION	FREQUENCY
Anapa	121.0
Batumi	131.0
Beslan	141.0
Gelendzhik	126.0
Gudauta	130.0
Kobuleti	133.0
Kutaisi	134.0
Krasnodar Center	122.0
Krasnodar Pashkovsky	128.0
Krymsk	124.0
Maykop	125.0
Mineral'nye Vody	135.0
Mozdok	137.0
Nalchik	136.0
Novorossiysk	123.0
Senaki	132.0
Sochi	127.0
Soganlug	139.0
Sukhumi	129.0
Tblisi	138.0
Vaziani	140.0

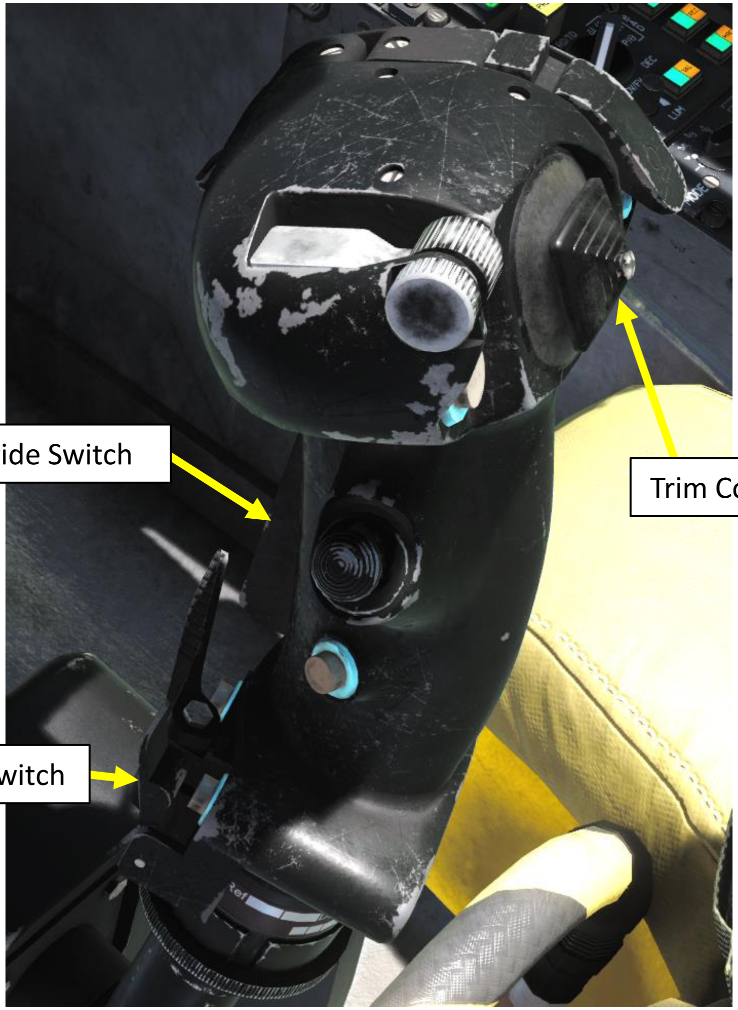
AUTOPILOT OVERVIEW

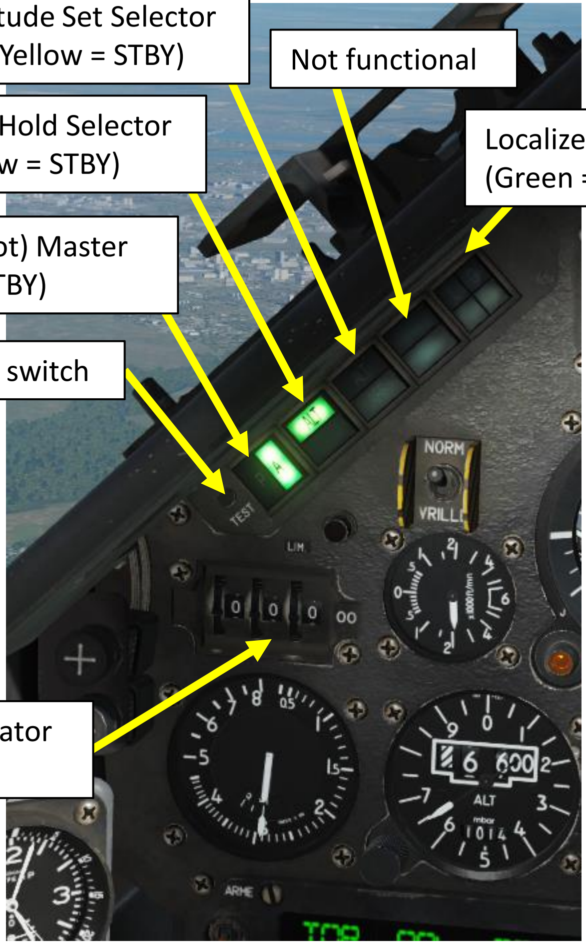
There are three PA (*Pilote Automatique*) auto-pilot modes on the Mirage 2000C.

- HOLD CURRENT ALTITUDE
- HOLD SELECTED ALTITUDE
- LOCALIZER AND GLIDESLOPE HOLD (See ILS Tutorial)

Operational limits

Max altitude	50,000 feet	
Max pitch	40	
Max AOA	18º	
Max Roll	60º (will return to 60º when enabled)	
Minimum speed	200 KIAS	
Minimum altitude	Normal mode:	500 feet
	Localizer and Glideslope hold	200 feet
	Selected altitude hold	1,000 feet





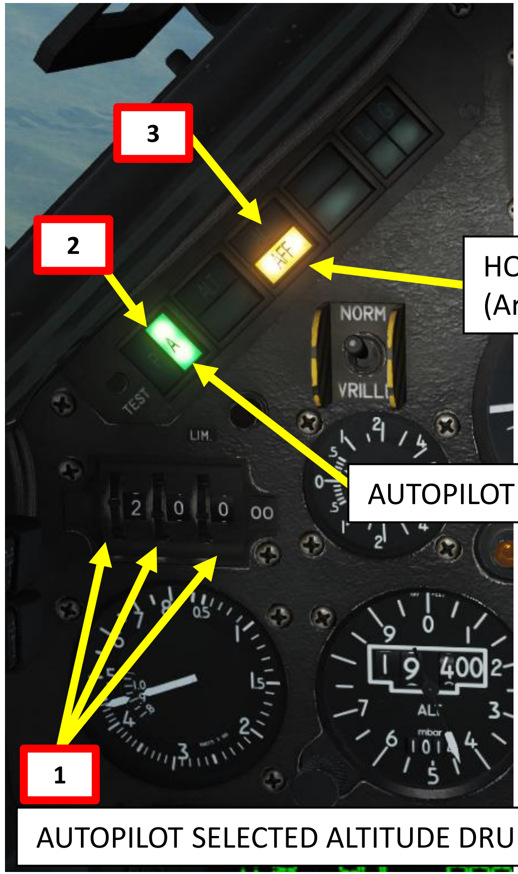
AUTOPILOT TUTORIAL

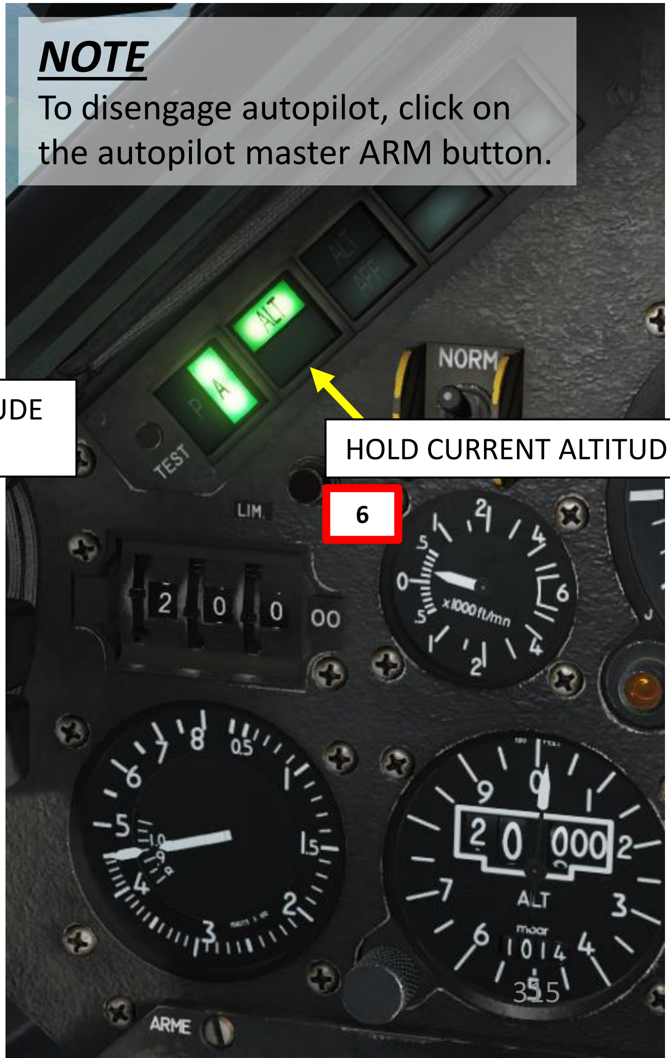
HOLD SELECTED ALTITUDE (ALTITUDE CAPTURE) MODE

1. Click on autopilot selected altitude drums to set your desired holding altitude. The altitude entered is in meters (selected altitude is 5,000 ft on picture).
2. Click on the autopilot master ARM button (light will turn to green (ARMED).
3. Press the HOLD SELECTED ALTITUDE button (AFF amber caution will illuminate).
4. Set the desired flight path angle towards the desired altitude with the trim control hat or by overriding the AP. The autopilot then holds this pitch.
5. When approaching the target altitude, the AP takes flight path angle control for capture (green ALT annunciator lights up)
6. Aircraft will climb/dive to selected altitude and level out once selected altitude has been reached. HOLD CURRENT ALTITUDE button will then turn to green (ACTIVE).

NOTE

To disengage autopilot, click on the autopilot master ARM button.

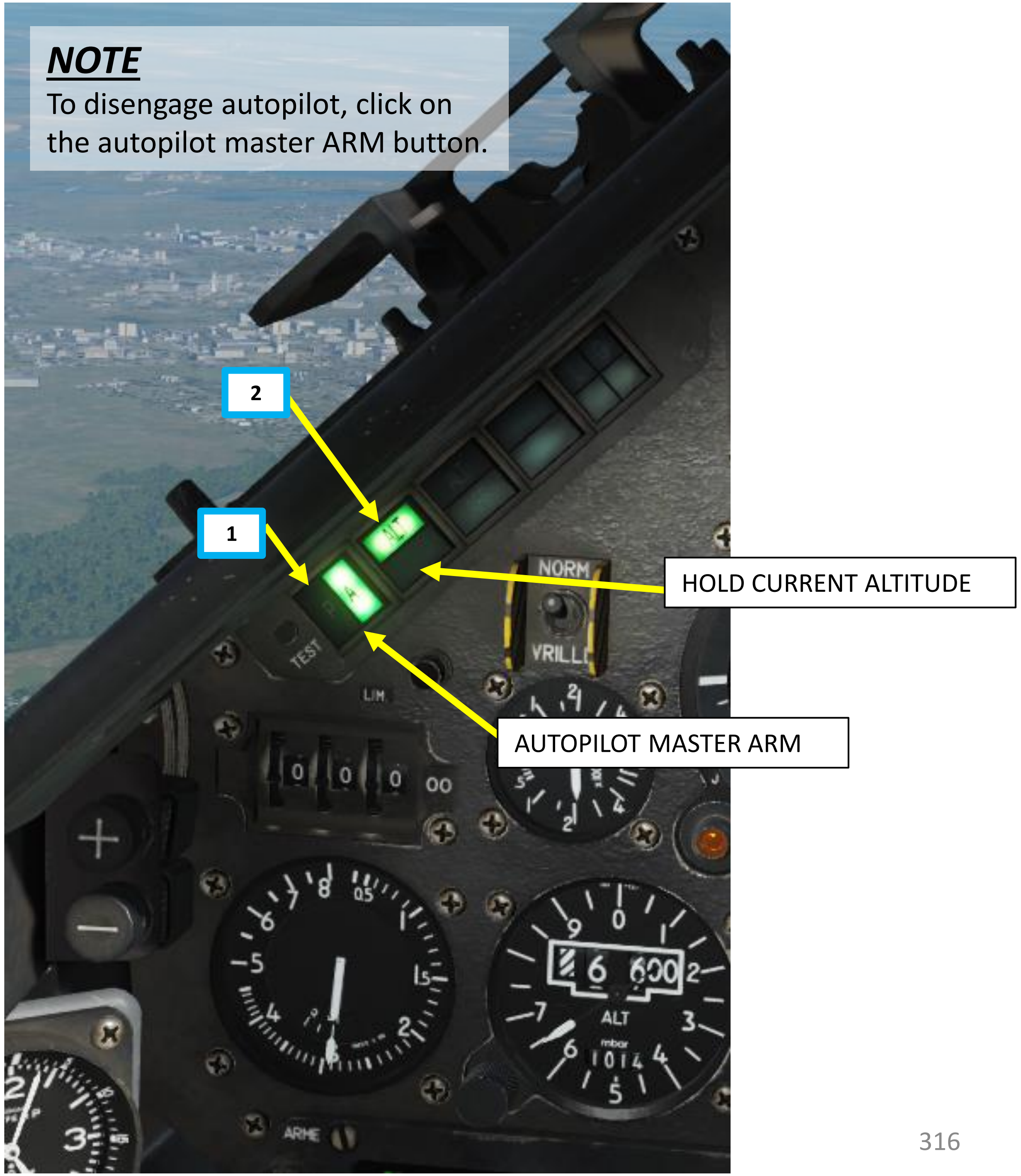




AUTOPILOT TUTORIAL

HOLD CURRENT ALTITUDE MODE

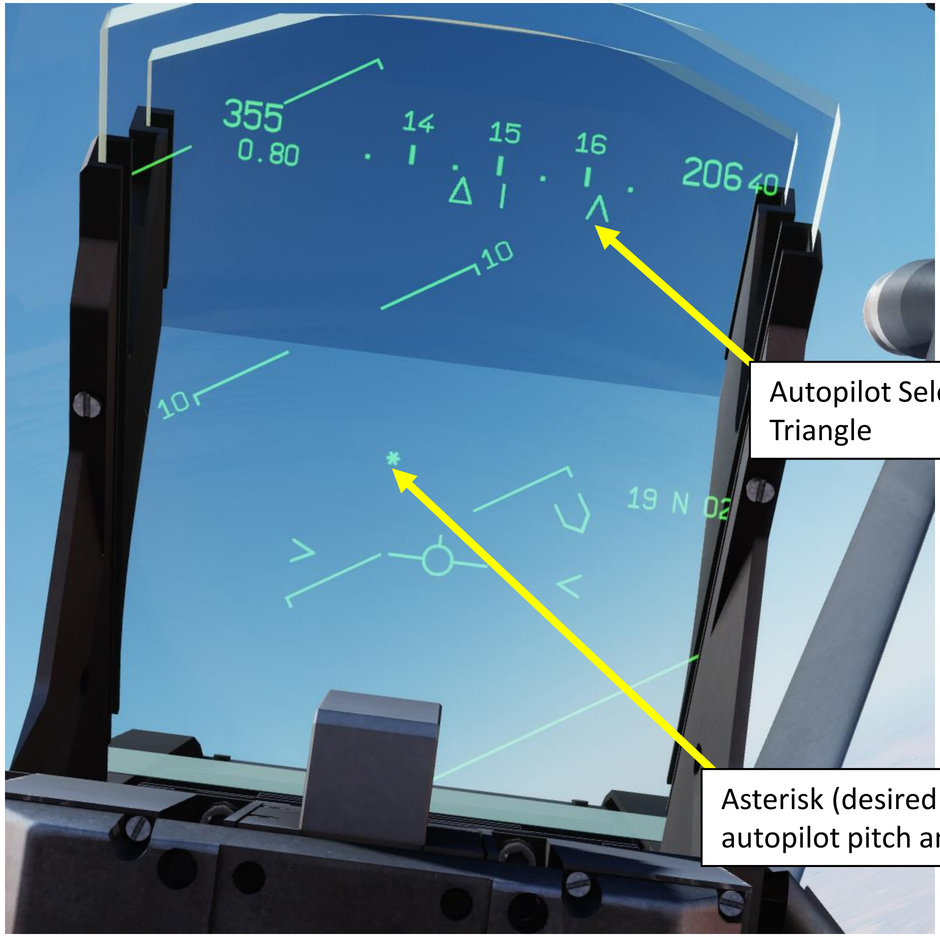
1. Click on the autopilot master ARM button (light will turn to green (ARMED).
2. Click on the HOLD CURRENT ALTITUDE button (light will turn to green (ARMED).
3. Aircraft will level out and maintain current altitude



AUTOPILOT EMPLOYMENT

The Mirage uses a specific way of controlling the aircraft: normally, the pilot engages the autopilot soon after reaching operational limits (passing 200 kts) and then uses the trim hat for navigating, adjusting flight parameters, etc. When the AP is engaged, control stick movements will have no effect unless the AP is deactivated, overridden or stick is moved more than half of its full displacement in any direction.

Trim DOWN	HOTAS	RCtrl + W		JOY_BTN_POV1_U
Trim LEFT	HOTAS	RCtrl + A		JOY_BTN_POV1_L
Trim RIGHT	HOTAS	RCtrl + D		JOY_BTN_POV1_R
Trim RUDDER LEFT	Flight Control	RCtrl + Z		
Trim RUDDER RIGHT	Flight Control	RCtrl + X		
Trim UP	HOTAS	RCtrl + S		JOY_BTN_POV1_D

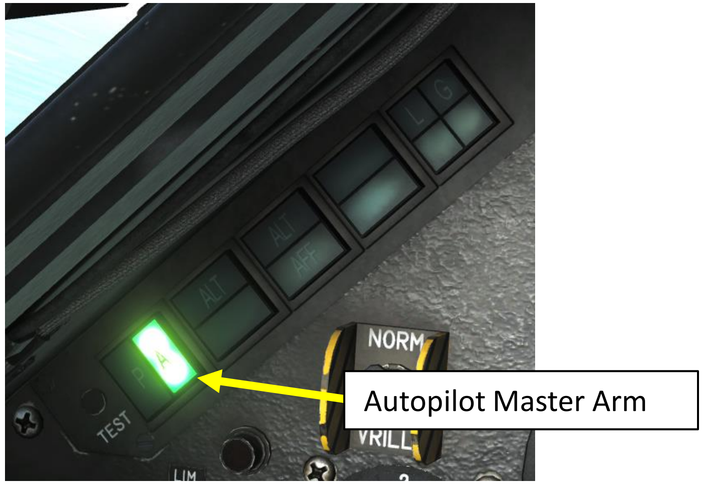


AUTOPILOT EMPLOYMENT

Pressing the **AP Engagement/Master Arm** pushbutton activates the autopilot. Pressing the pushbutton again disengages (deactivates) the AP. Disengagement can also be accomplished by pressing the **AP Disengagement/Disconnect** pushbutton on the control stick, or moving the control stick more than half of its maximum course in any direction.

The AP can be temporarily overridden (paused) by pressing and holding the **AP Standby/Override** pushbutton on the control stick. All active AP mode annunciators light up amber and the aircraft can then be flown manually with the AP in standby. When desired, the AP can be returned to previous operation by releasing the AP Standby/Override pushbutton.

When the AP is engaged, control stick movements will have no effect unless the AP is deactivated, overridden or stick is moved more than half of its full displacement in any direction.



No.	Control Name	Description	Action in Options	Default key
3	**Trim Control**	Trims the aircraft in roll and pitch. When autopilot is engaged, it is use to control the aircraft by setting desired heading and adjusting the flight path.	Trim DOWN Trim LEFT Trim RIGHT Trim UP	RCTRL + W RCTRL + A RCTRL + D RCTRL + S
7	**AP Override Switch**	When autopilot is engaged, maintaining the switch down enables to override the autopilot without setting it off and control manually the aircraft. Releasing the switch re-engages the autopilot.	Autopilot Standby Mode	LALT+A
10	**AP Disconnect Switch**	Disconnects the autopilot	AP Disconnect / Exceed Elastic Limit	LSHIFT + A

NAVIGATION SECTION STRUCTURE

1 – NAVIGATION INTRODUCTION
1.1 - NAVIGATION MASTER MODE

In order for the VTH/HUD to display navigation-related symbology and to have Approach and RD (Desired Route, *Route Désirée*) modes available on the PCA (Armament Control Panel), you have to press the Weapons System CMD Switch AFT to set the Master Mode to NAVIGATION.

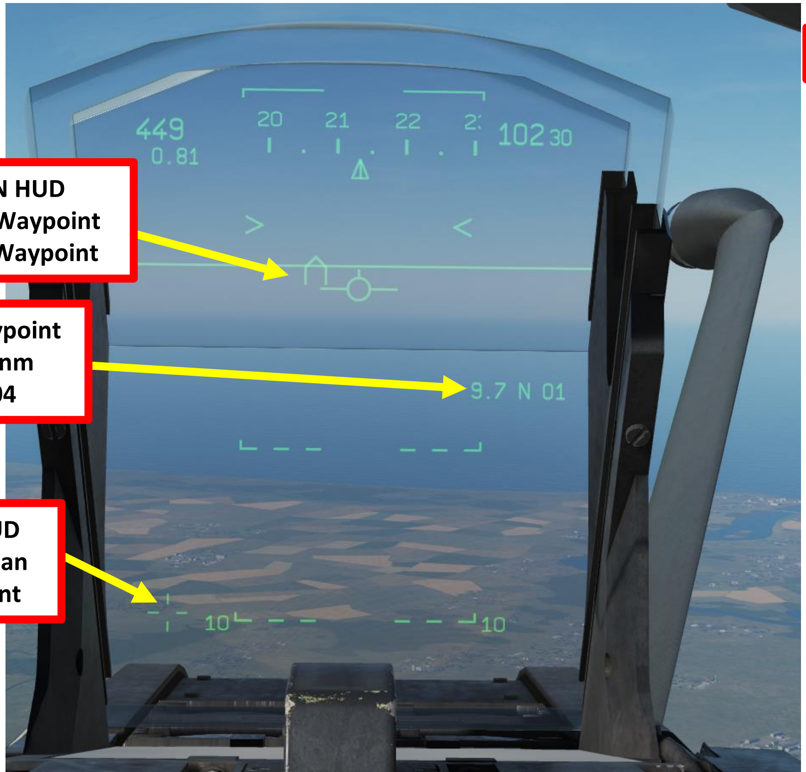
IMPORTANT: Setting the Master Mode to NAVIGATION is a pre-requisite to all navigation examples listed in this section.

1 – NAVIGATION INTRODUCTION
1.2 - NAVIGATION POINT TYPES

There are two main navigation point types use in the Mirage:

- **Waypoints (But)**
  - 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 even create “Waypoint Offsets” (***BAD*, or *But ADitionnel***) if a target location is given to you with range and bearing information in relationship to an existing waypoint (i.e. Bullseye). Bullseye is a pre-determined point in space used as a reference point for flights to relay positions, used as a bearing and distance from Bullseye. The PCN (*Poste Commande de Navigation*, Navigation Control Panel) can store up to 20 waypoints.

- **Markpoints**
  - Markpoints are used to "mark" a point of interest, whether flying over an interesting area or an enemy sighting. You can add a maximum of three markpoints, numbered 91, 92 and 93. Markpoints coordinates cannot be modified or deleted



1 – NAVIGATION INTRODUCTION
1.2 - NAVIGATION POINT TYPES

UNI PREP and DEST Functions

The most important thing to understand and remember is the difference between PREP and DEST functions, as well as Waypoint 00 (zero - zero, which always refers to current position of the aircraft) and other Waypoints. The main difference is as follows:

The **PREP** (preparation) waypoint is used for visualisation and editing. Whenever the PCN displays any waypoint-related data, those are always the data for the current PREP waypoint. In other words, whatever data you input or change there will not have any impact on any of the instruments used for navigating the airplane until the data prepared in PREP is transferred to DEST and hence used for navigation. So, in order to edit any of the waypoints you want to navigate to, you first have to do that in PREP mode before being able to use it as your destination.

The **DEST** (destination) waypoint is being used for navigation. The DEST waypoint data can only be visualised in the HUD, HDD, ADI and IDN. You can't display or edit the DEST data on the PCN, the DEST waypoint is used solely as a source of data for the instruments mentioned above.

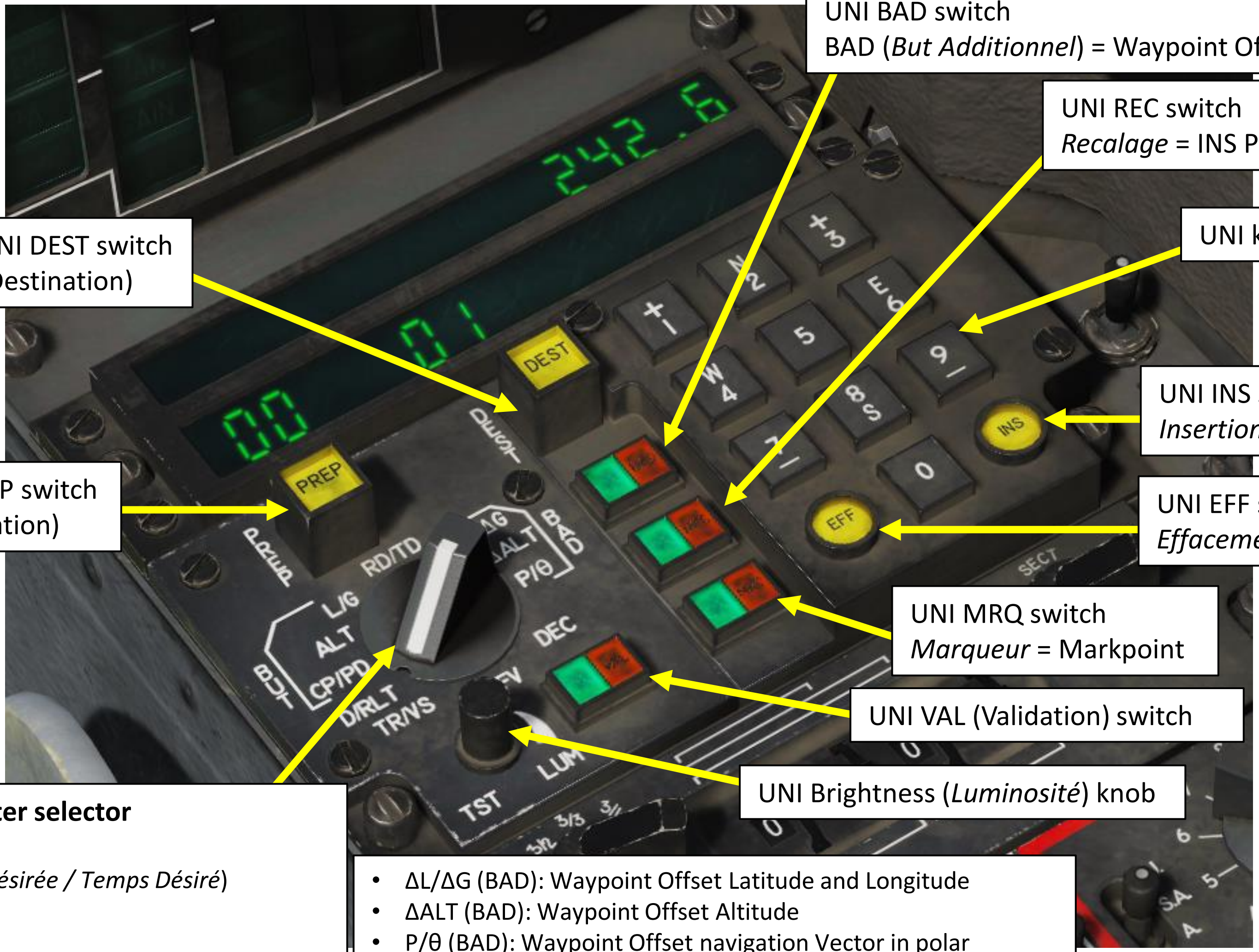
Waypoint ZERO vs Waypoints 1 – 20

There is a similar difference between Waypoint 0 and all the other Waypoints. **Waypoint ZERO is not a real waypoint, but in fact the current position of your aircraft**. Which means that not all of the data that normally is visible on the PCN can be viewed in WP 00 mode. Also, it is important to remember that **WP 00 cannot be edited**. Other Waypoints are normal Waypoints that can be selected as DEST to navigate to them, and/or as PREP to edit/display data about them on the PCN, such as their position (LAT / LONG), elevation, time to get there... etc.

2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)

2.1 – INS INTRODUCTION

The UNI (*Unité de Navigation Inertielle*) or INS (Inertial Navigation System) system is used by the aircraft to know its position in the world. The INS system installed on the Mirage is powerful and flexible enough to allow you to navigate anywhere you want.



UNI (*Unité de Navigation Inertielle*) Parameter selector
UNI = INS (Inertial Navigation System)

- RD/TD: Selected Route / Selected Time (*Route Désirée / Temps Désiré*)
- L/G (*BUT*): Waypoint Latitude and Longitude
- ALT (*BUT*): Waypoint Altitude
- CP/PD (BUT): Runway Heading / Glide Slope
- D/RLT: Distance and Bearing to next waypoint
- TR/VS: Remaining Time / Ground Speed (*Temps Restant / Vitesse au Sol*)

- ΔL/ΔG (BAD): Waypoint Offset Latitude and Longitude
- ΔALT (BAD): Waypoint Offset Altitude
- P/θ (BAD): Waypoint Offset navigation Vector in polar coordinates (distance in nm and Bearing in degrees)
- DV/FV: Wind bearing and speed (*Direction/Force Vent*)
- DEC: Magnetic declination

2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)

2.1 – INS INTRODUCTION

Here is a summary of the data displayed on the UNI.

UNI (*Unité de Navigation Inertielle*) Parameter selector
UNI = INS (Inertial Navigation System)

- RD/TD: Selected Route / Selected Time (*Route Désirée / Temps Désiré*)
- L/G (*BUT*): Waypoint Latitude and Longitude
- ALT (*BUT*): Waypoint Altitude
- CP/PD (BUT): Runway Heading / Glide Slope (*Cap Vrai de Piste / Pente Désirée*)
- D/RLT: Distance and Bearing to next waypoint
- TR/VS: Remaining Time / Ground Speed (*Temps Restant / Vitesse au Sol*)
- ΔL/ΔG (BAD): Waypoint Offset Latitude and Longitude
- ΔALT (BAD): Waypoint Offset Altitude
- P/θ (BAD): Waypoint Offset navigation Vector in polar coordinates (distance in nm and Bearing in degrees)
- DV/FV: Wind bearing and speed (*Direction/Force Vent*)
- DEC: Magnetic declination

DATA SELECTION SUMMARY

	EN Name	FR Name	Type	Signed Unsigned	WP 0	WP 1+
RD/TD	Desired Time and Route	Route Désirée / Temps Désiré	CAN BE EDITED	UNSIGNED	YES	YES
ΔL/ΔG	Setting Offset Point by LAT / LONG difference	-	CAN BE EDITED	SIGNED	NO	YES
Δ ALT	Setting Offset Point by ALTITUDE difference	-	CAN BE EDITED	SIGNED	NO	YES
ρ/θ	Setting Offset Point by polar RHO / THETA	-	CAN BE EDITED	UNSIGNED	NO	YES
DEC	Magnetic Variation	Déclinaison magnétique	READ ONLY	SIGNED	YES	YES
DV/ FV	Wind Direction / Speed	Direction / Force du vent	READ ONLY	UNSIGNED	YES	YES
TR/ VS	Remaining Time / Ground Speed	Temps Restant / Vitesse Sol	READ ONLY	UNSIGNED	YES	YES
D/ RLT	Distance and Bearing	Distance / Relèvement	READ ONLY	UNSIGNED	YES	YES
CP/ PD	Runway Heading / Glideslope	Cap vrai de piste / pente désirée au but	CAN BE EDITED	UNSIGNED	NO	YES
ALT	Waypoint Altitude	Altitude	CAN BE EDITED	SIGNED	YES	YES
L / G	Waypoint Latitude / Longitude	Latitude / Longitude	CAN BE EDITED	SIGNED	YES	YES

Source: RAZBAM Manual

2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE) /* INS (INERTIAL NAVIGATION SYSTEM)

2.2 – INS Drift & Coordinate Correction using a Fix

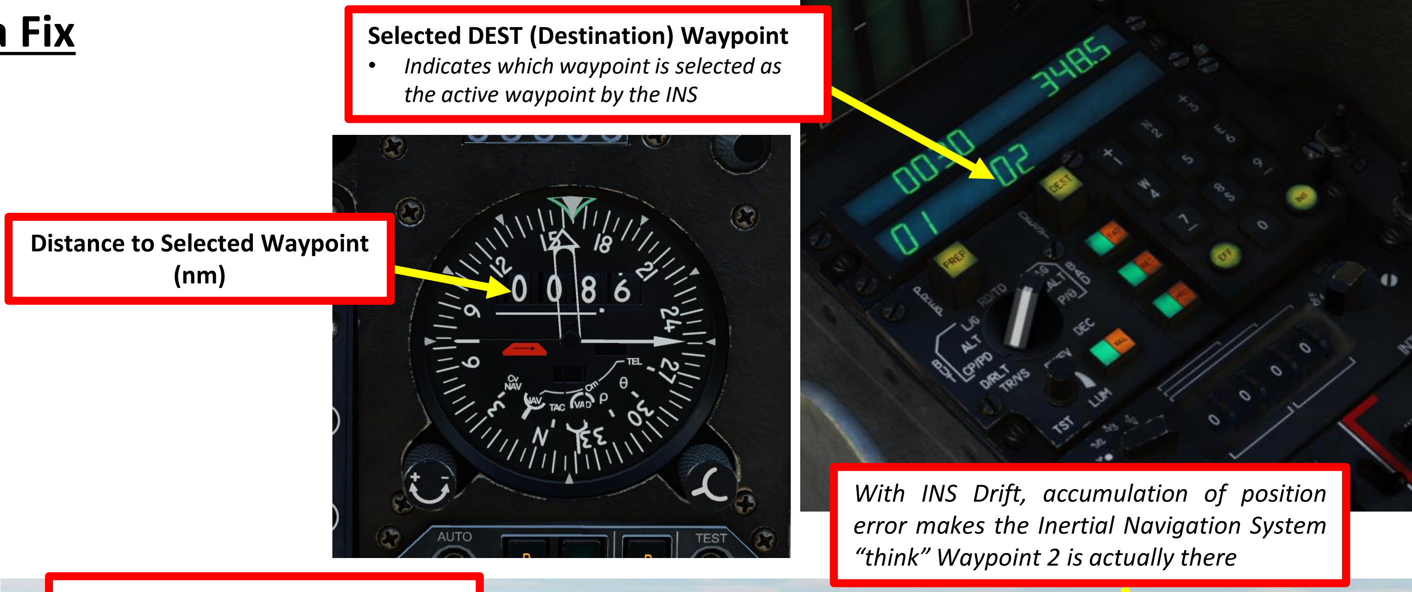
2.2.1 – INS Drift Introduction

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 a few 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, TACAN station or something easy to spot visually. These reference points are called **fixed points (or "fix")**, Fixed points, which are similar in nature to waypoints (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, you can use the Distance to Waypoint Indicator to see the INS-computed distance between the aircraft and selected waypoint.

- If the INS drift is minimal (high accuracy), overflying the expected position of this waypoint should result in a small distance reading, meaning that the geographic coordinates match the INS coordinates.
- If the INS drift is high (low accuracy), overflying the expected position of this waypoint should result in a significantly greater distance reading, meaning that the geographic coordinates do not match the INS coordinates.

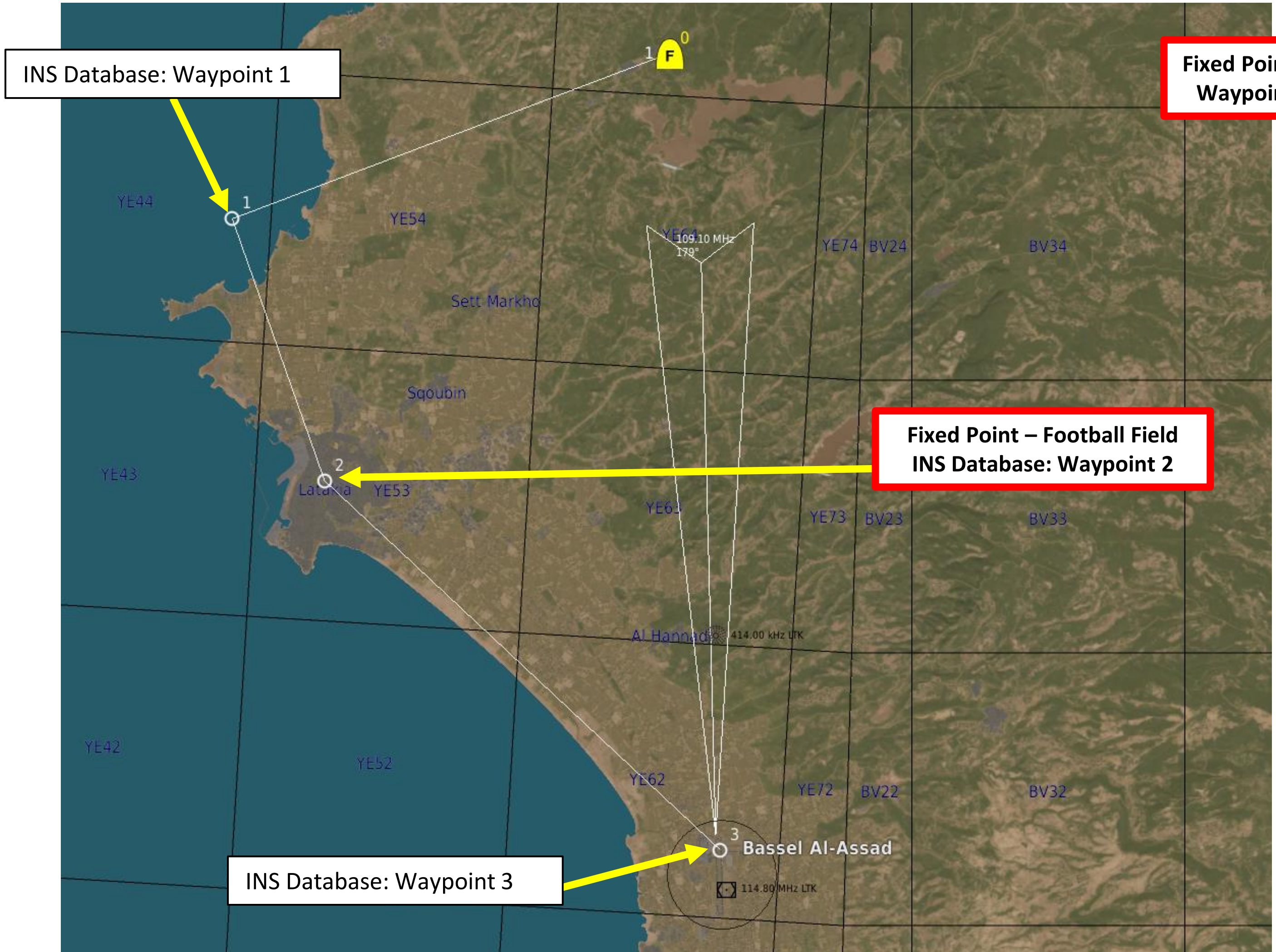


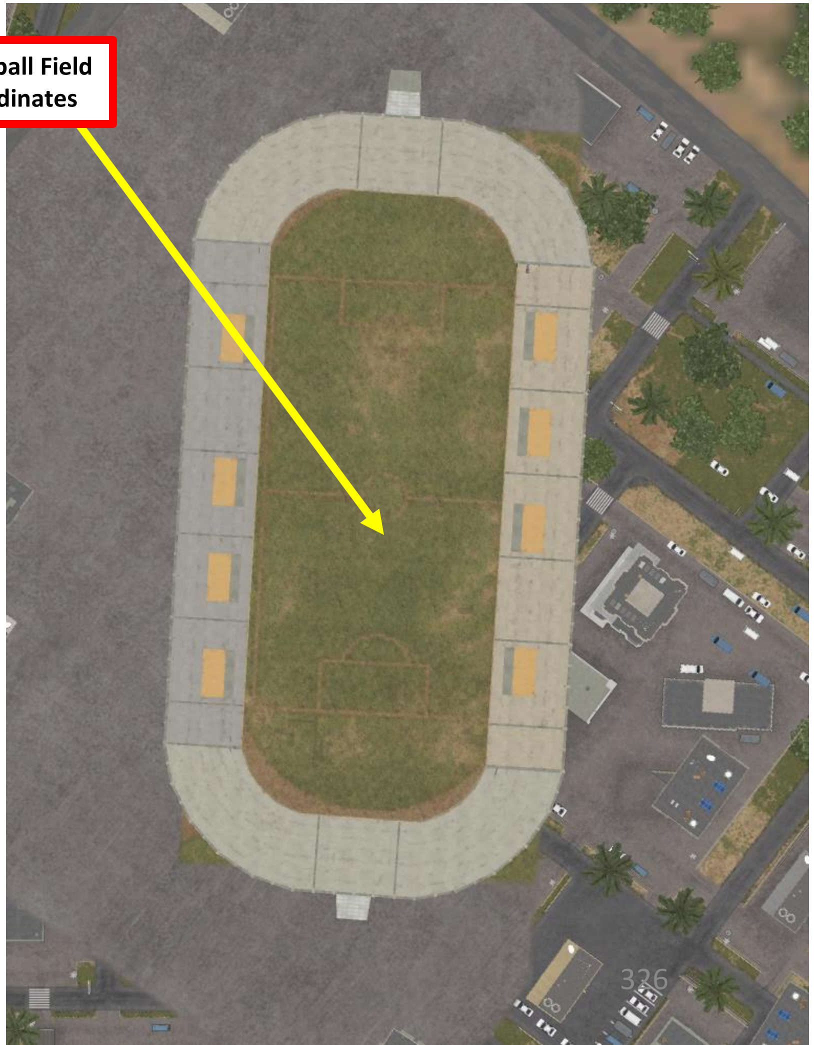
2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)

2.2 – INS Drift & Coordinate Correction using a Fix

2.2.2 – Overfly Fix Method

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 Waypoint 2, which is set over a visual landmark (football field).



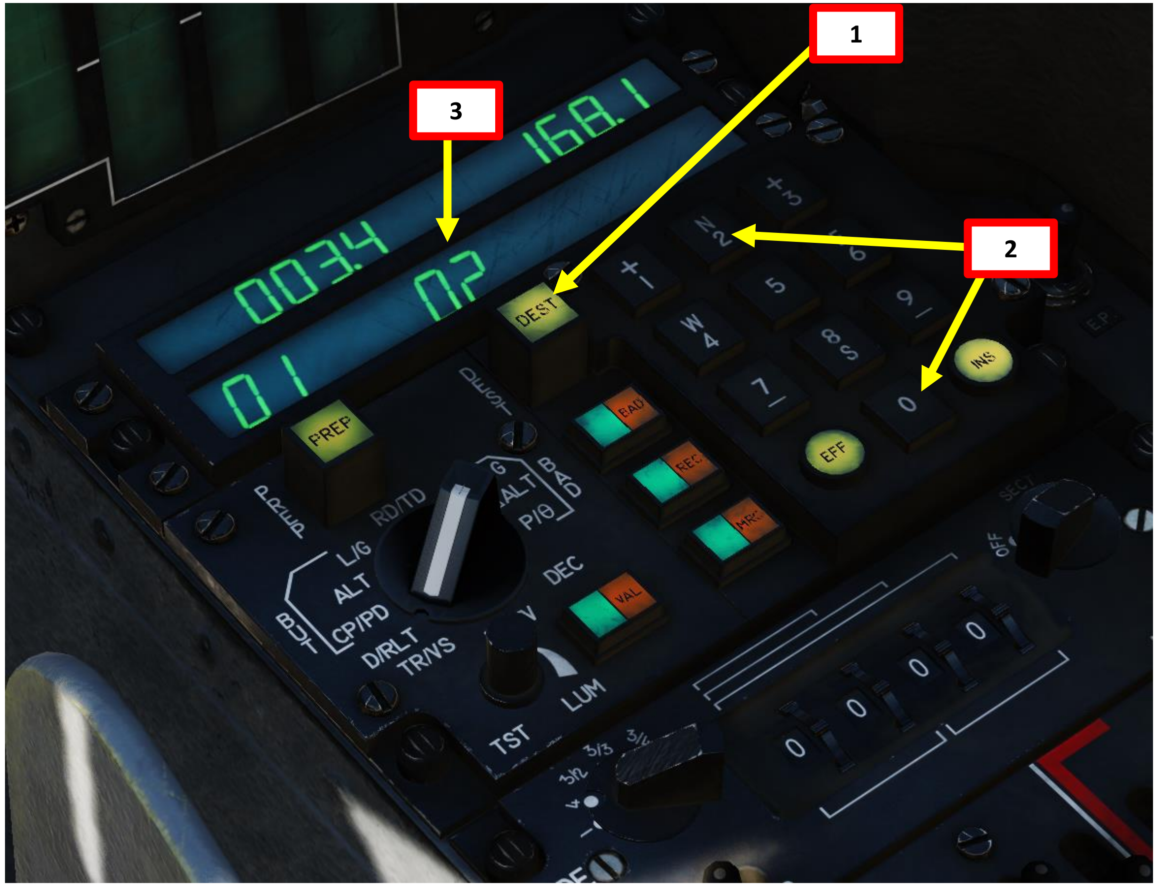


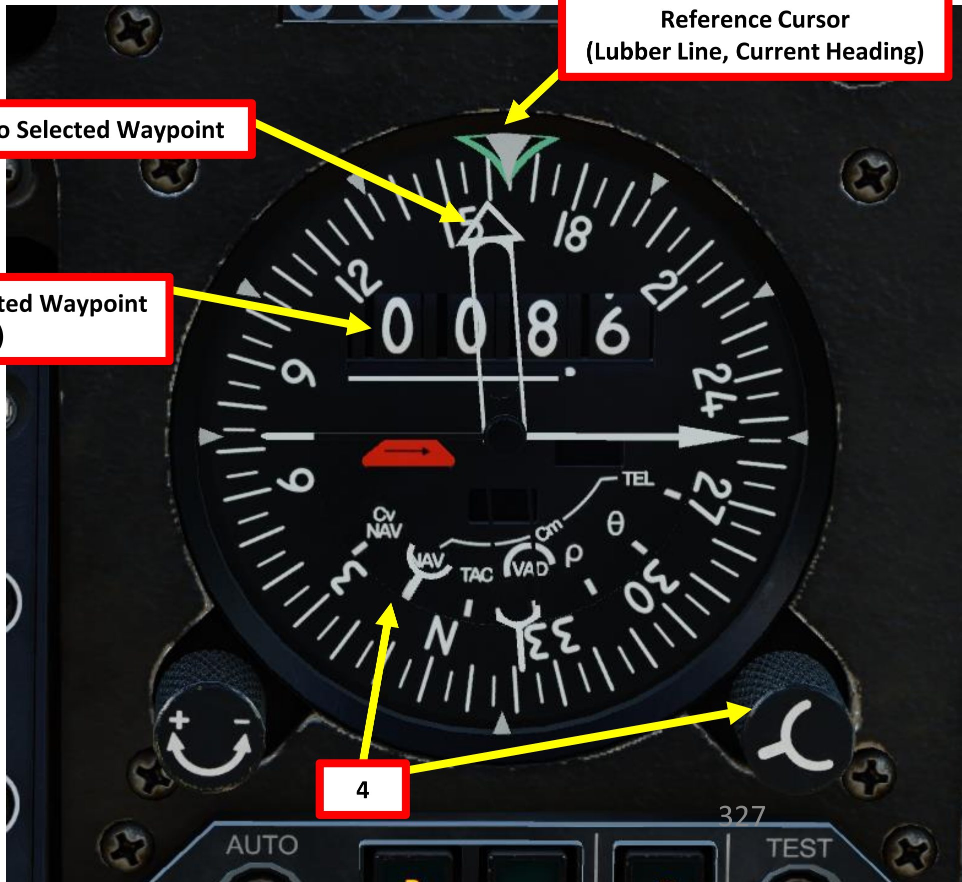
2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)

2.2 – INS Drift & Coordinate Correction using a Fix

2.2.2 – Overfly Fix Method

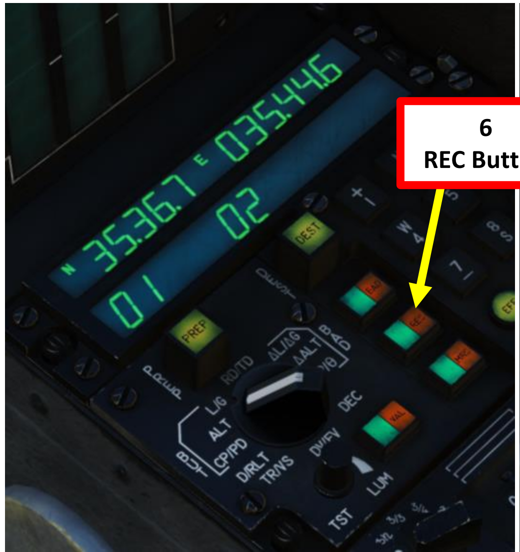
1. Press “DEST” (Destination) button to select a waypoint.
2. Press “0” and “2” (02) on the INS numpad to select Waypoint Number 2.
    - Alternatively, you can use the INS Waypoint Next/Previous buttons.
3. Confirm that the Selected “DEST” Waypoint (Destination) indication shows “2”.
4. Set the HSI (Horizontal Situation Indication) mode to either “CV” (*Cap Vrai*: True Heading) or “CM” (*Cap Magnétique: Magnetic Heading*). We will use Waypoint 2 as the “fixed point”.

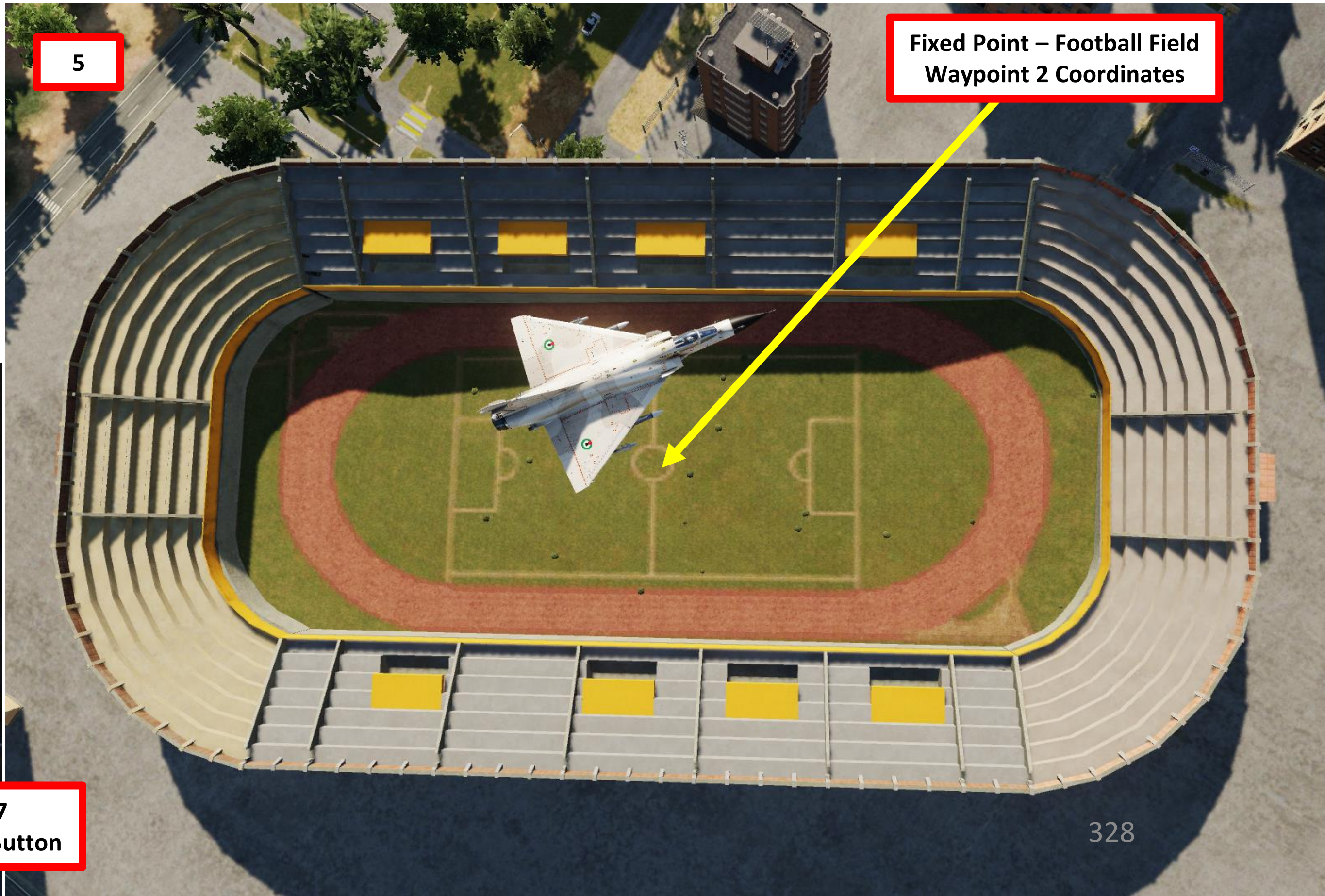




2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.2 – Overfly Fix Method

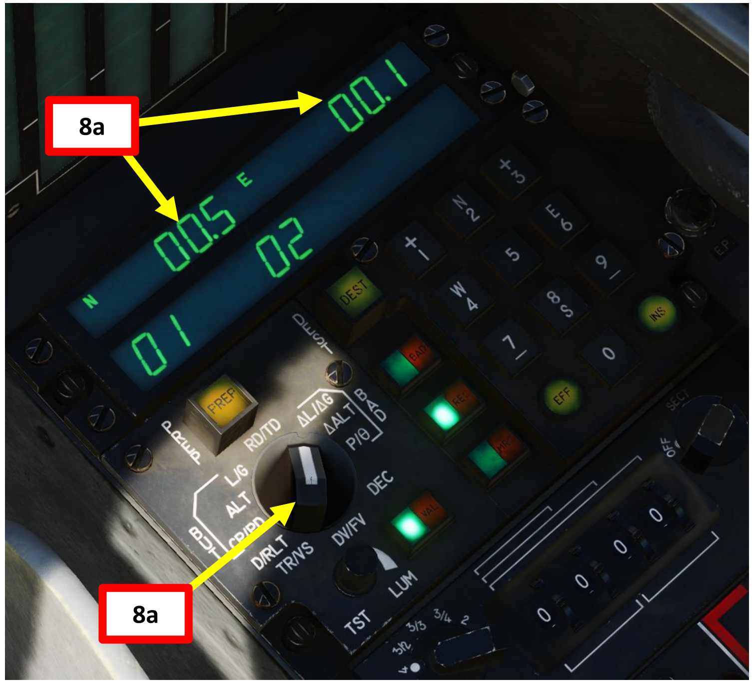
5. Fly directly over the fixed point's geographic position (football field).
6. Once you are over the fixed point, press the REC (*Recalage*, INS Position Update) Button.
   - Note: Alternatively, if the PCA (Armament Control Panel) is in NAV mode and MAV is not selected, the "Magic Unlock / Position update" HOTAS command will also trigger the fix procedure.
7. Once REC key is pressed, the VAL (Validate) key will illuminate if the difference between aircraft and landmark position is less than 15 nautical miles.

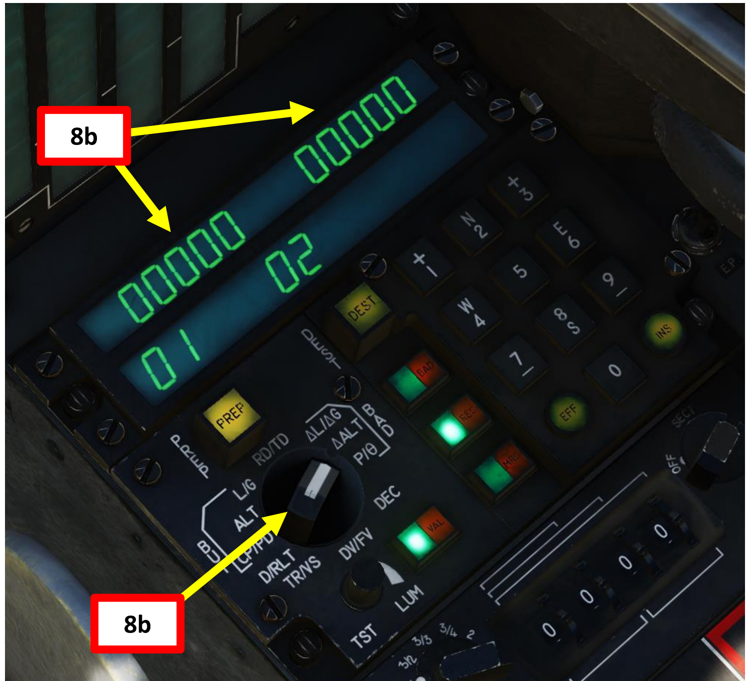


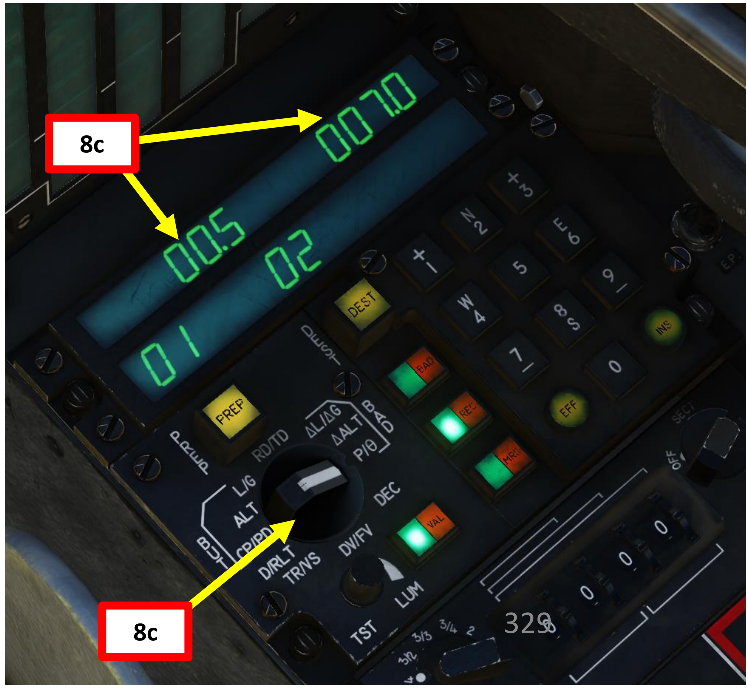


2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.2 – Overfly Fix Method

8. Depending on the parameter selector’s position, the PCN (Navigation Control Panel) will show the following information, which will help you to evaluate the accumulated position error generated by INS drift:
    a) ΔL/ΔG: The left window will show the difference in latitude and the right window will show the difference in longitude between the aircraft’s position at the time the procedure was triggered and the BUT position in kilometer.
    b) ΔALT: The left window will show the altitude difference in meter and the right window will show the altitude difference in feet of the aircraft’s position at the time the procedure was triggered and the BUT position.
    c) ρ/θ: The left window will show the distance in nm and the right window will show the bearing of the aircraft’s position at the time the procedure was triggered and the BUT position.





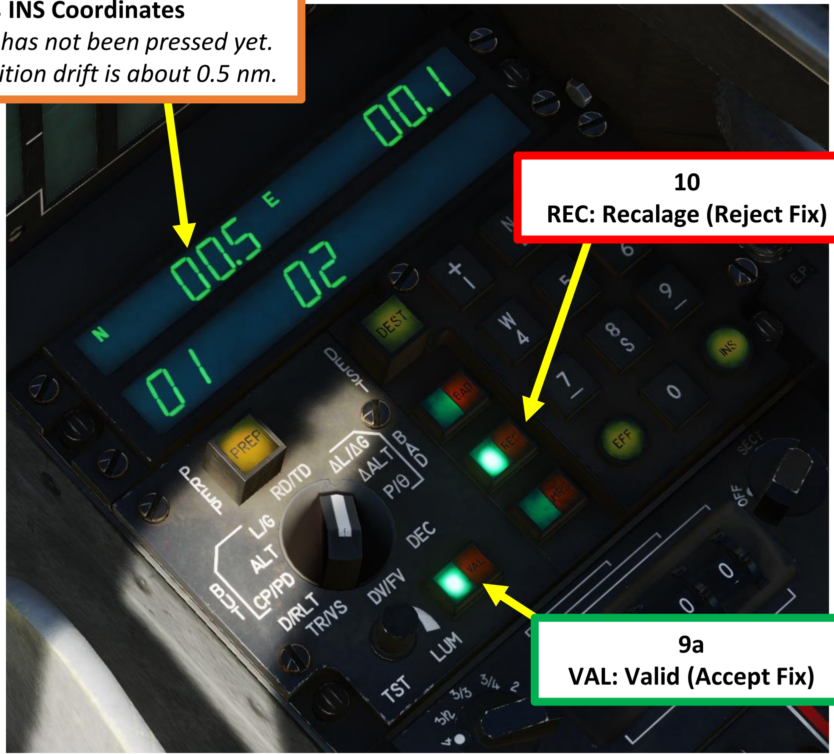


2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.2 – Overfly Fix Method

9. Based on the value of the accumulated error, you can decide to either accept or reject the update. If the accumulated error is reasonable, accept the update by pressing the VAL button.
10. If the accumulated error does not make sense, then reject the update by pressing the REC (*Recalage*) button.
    - Note: If the difference between aircraft and landmark position is more than 15 nautical miles, the VAL key will remain dark and the REC key will flash. In this situation the only possible action is to reject the fix.
11. That's it, you have corrected the INS drift!

Important Note:
- A blind validation can screw up your whole INS position easily since it will modify the whole INS waypoint database and aircraft position. It will also affect INS bias calculations, which will degrade the quality of the INS over multiple flights. INS bias calculations are used to tune the INS, improving its precision… that is until the INS bias values are zeroed when pressing the VAL button.

Distance to the waypoint's INS Coordinates
- *VAL (Validation) button has not been pressed yet.*
- *We see that the INS position drift is about 0.5 nm.*



10
REC: Recalage (Reject Fix)

9a
VAL: Valid (Accept Fix)

Distance to the waypoint's INS Coordinates
- *VAL button has been pressed. INS position is updated to correct accumulated position error.*
- *We see that the INS position drift is close to 0 nm.*

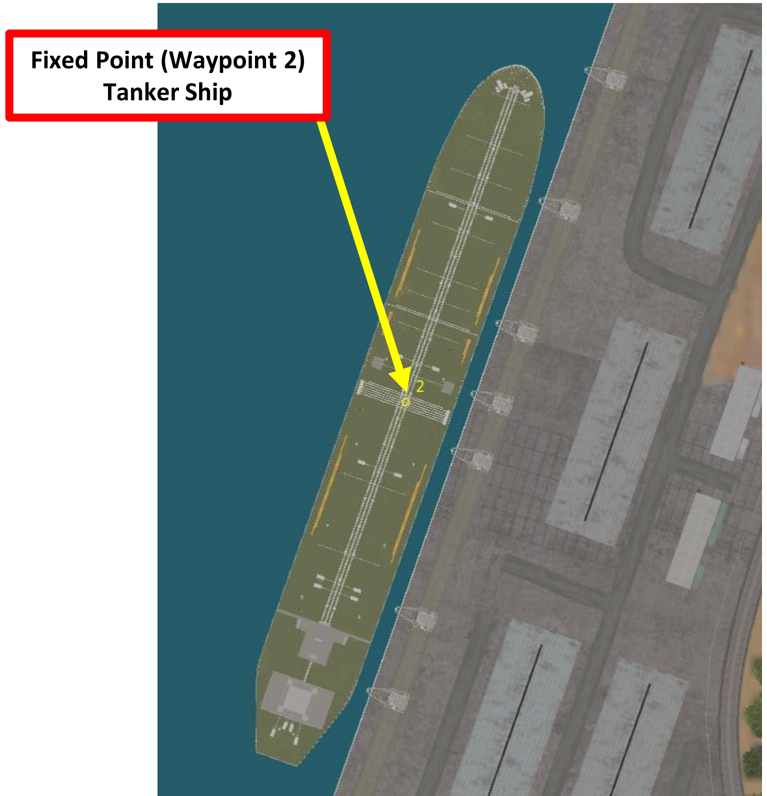
9b
VAL: Valid (Accept Fix)
INS Correction is performed

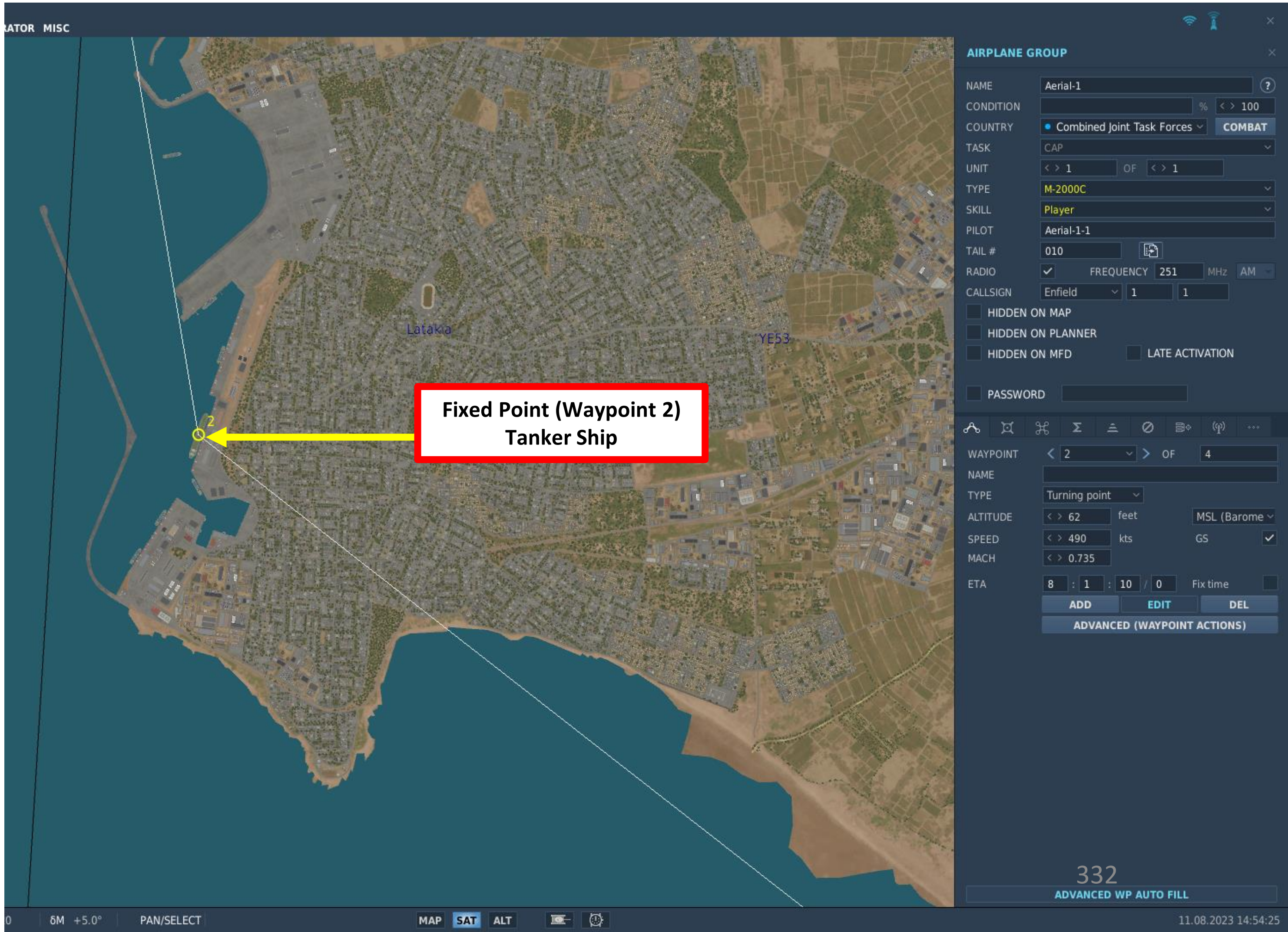
2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.2 – Overfly Fix Method

2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

You can also use radar ranging on a known reference point (fixed point) memorized in the INS database to correct INS drift error. In order to update/re-align the INS position

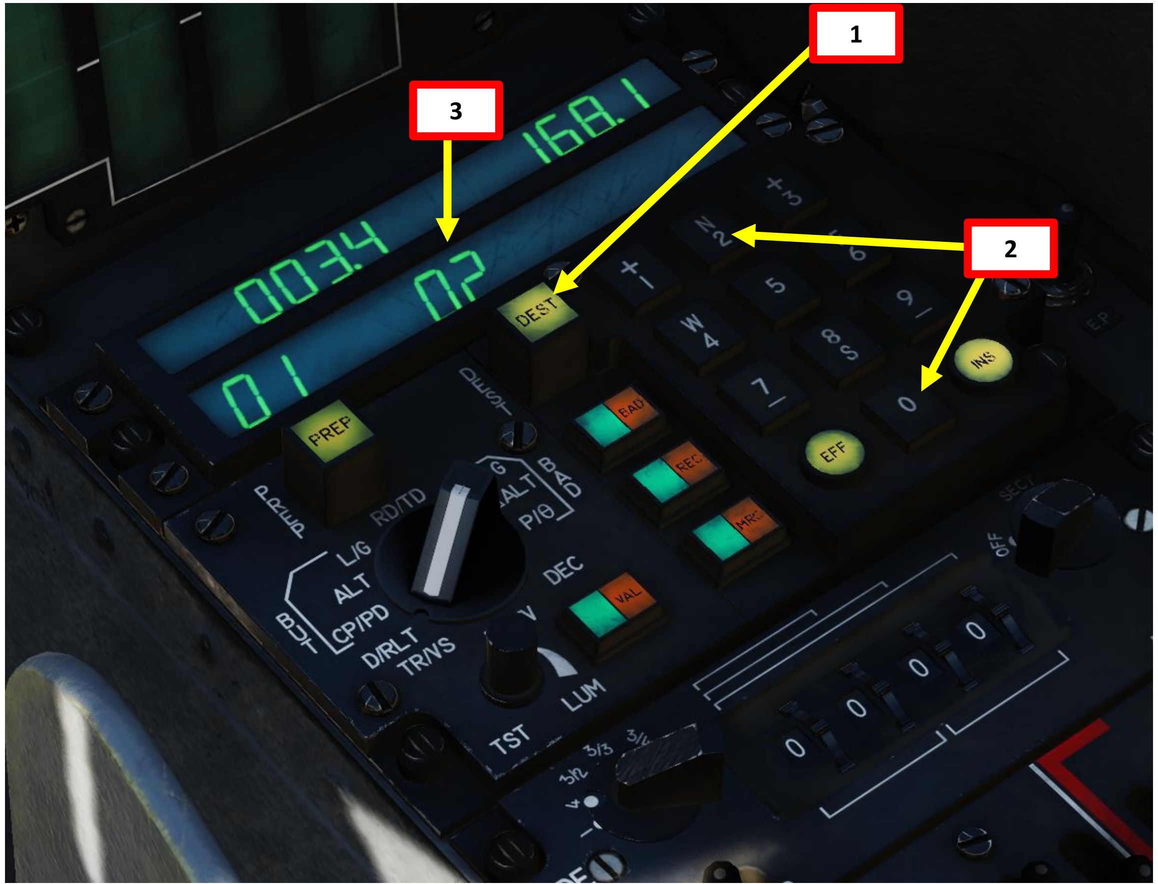
In this example, we will use a Tanker Ship as a reference point. Its coordinates are stored in Waypoint No. 2.

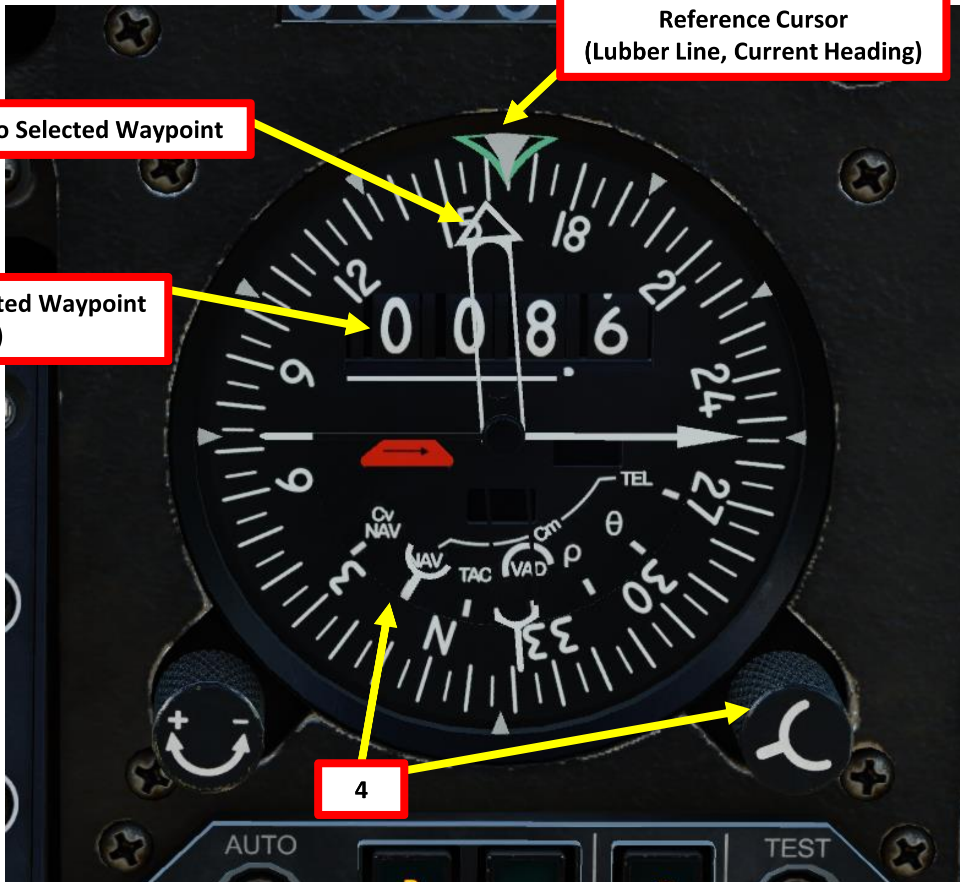




2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

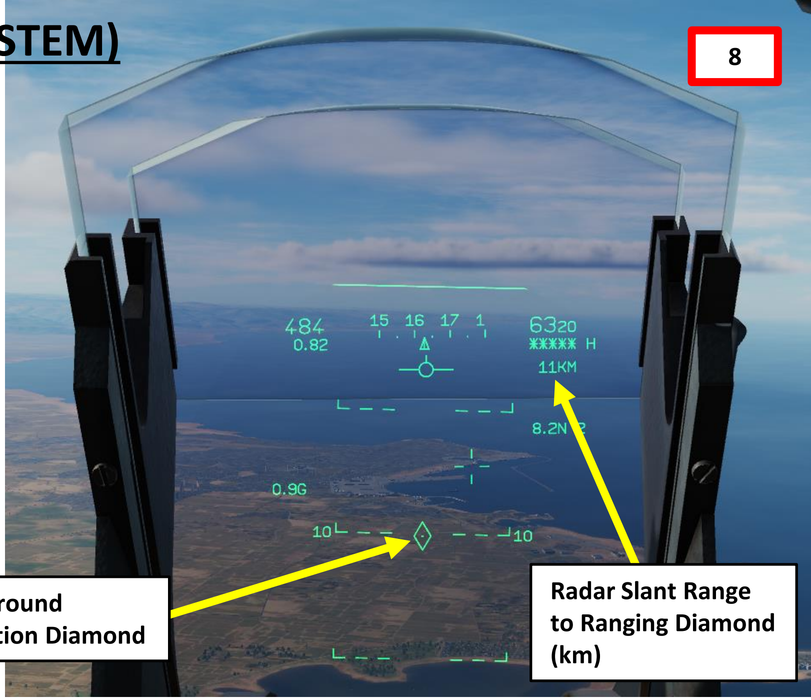
1. Press “DEST” (Destination) button to select a waypoint.
2. Press “0” and “2” (02) on the INS numpad to select Waypoint Number 2.
   - Alternatively, you can use the INS Waypoint Next/Previous buttons.
3. Confirm that the Selected “DEST” Waypoint (Destination) indication shows “2”.
4. Set the HSI (Horizontal Situation Indication) mode to either “CV” (*Cap Vrai*: True Heading) or “CM” (*Cap Magnétique: Magnetic Heading*). We will use Waypoint 2 as the “fixed point”.

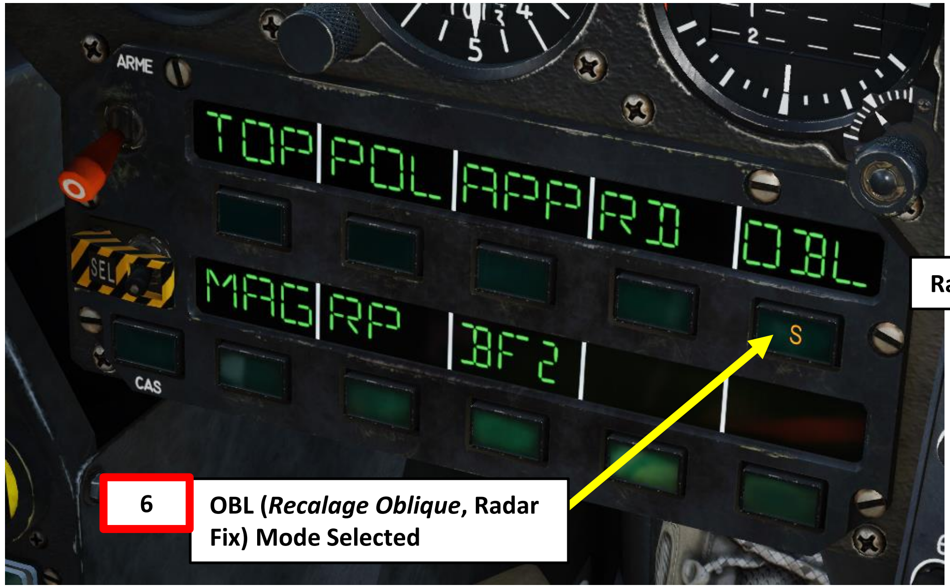


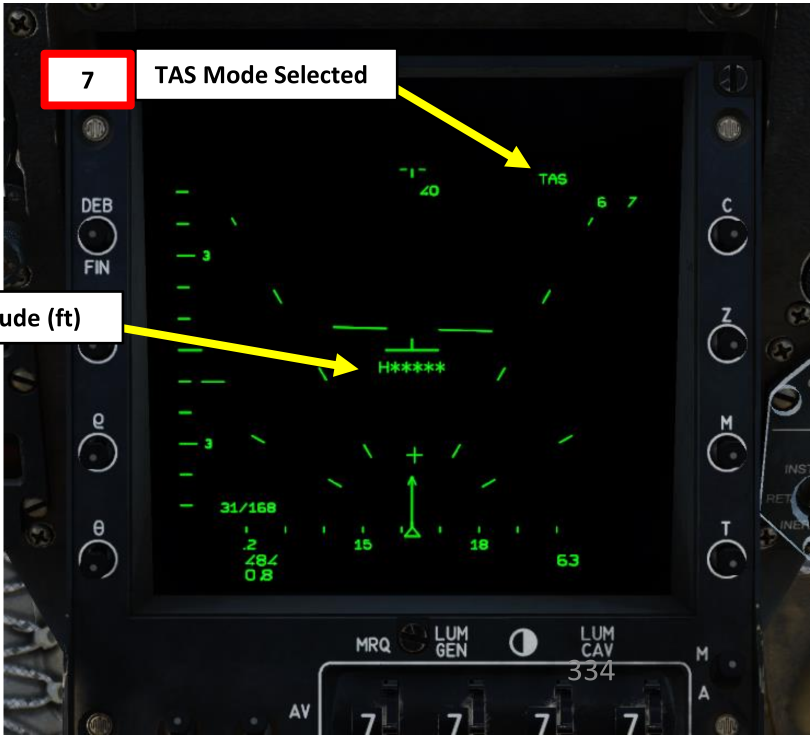


2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

5. On the throttle, set CNM (Cannon/Neutral/Magic) Switch to NEUTRAL/CENTER position (PCA). This will allow you to select the air-to-ground armament via the PCA (*Poste Commande Armement*, Weapon Control Panel) panel.
6. On the PCA panel, select OBL (Recalage Oblique, Radar Fix) Mode. “S” light indicates the mode is selected.
7. Verify the “TAS” indication on the VTB; it means that air-to-ground ranging is selected.
8. The radar will provide slant range information for the designation diamond on the VTH/HUD.



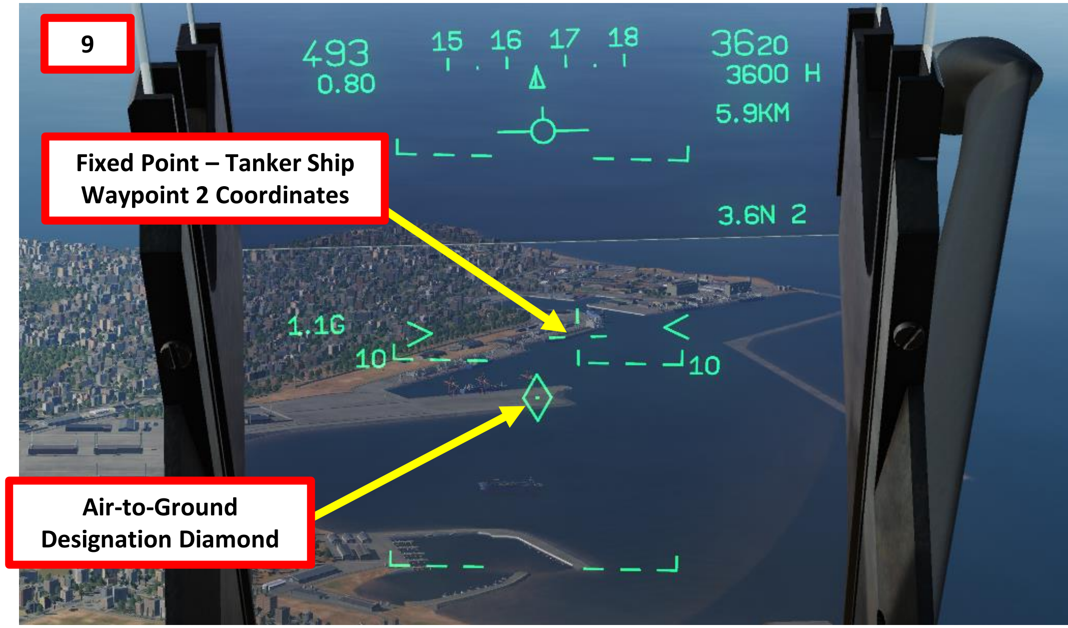


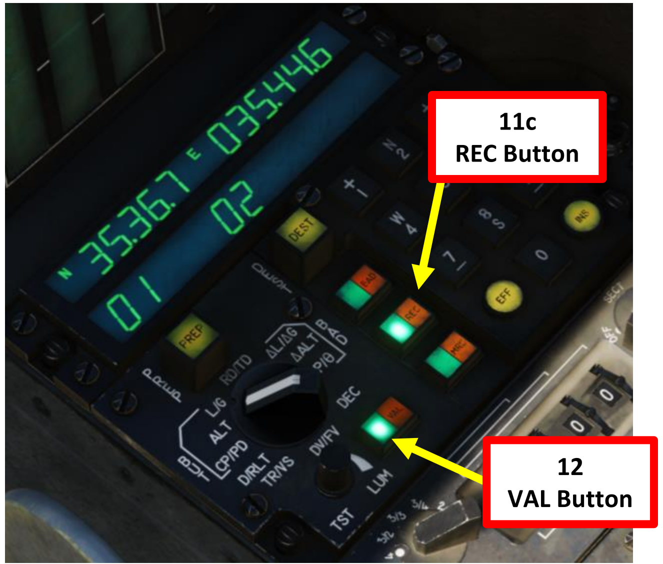


2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

9. Fly towards the fixed point's geographic position (tanker ship).
10. Once you have the fixed point in sight, maneuver the aircraft to put the designation diamond over the surface feature (tanker ship).
11. Once designation diamond is set on the surface feature (tanker ship), press the "Magic Slave / Air-to-Ground Designate Button / Position update" HOTAS button. This will command the "fix" procedure. The REC (*Recalage*, INS Position Update) key will then illuminate.
12. Once REC (*Recalage*, INS Position Update) key is illuminated, the VAL (Validate) key will illuminate as well.

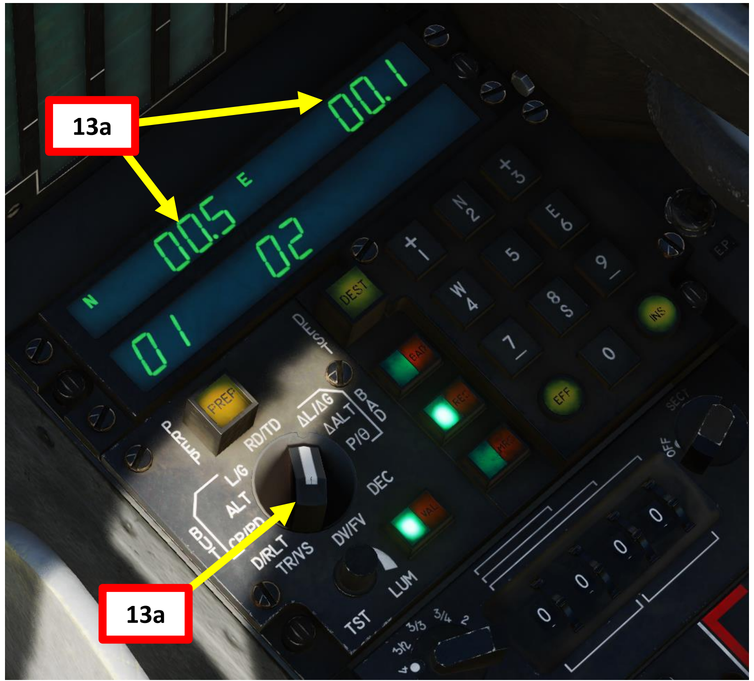
Magic Slave / Air-to-Ground Designate Button
11b

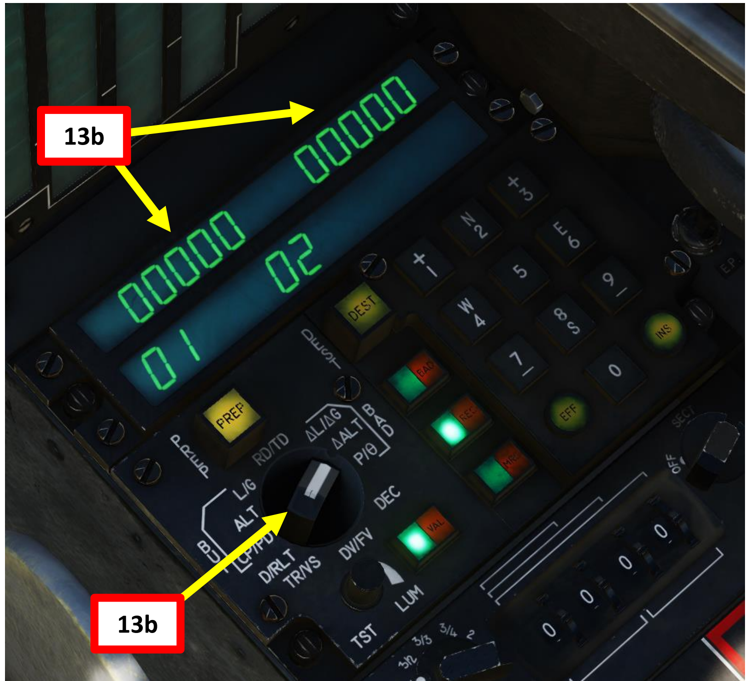


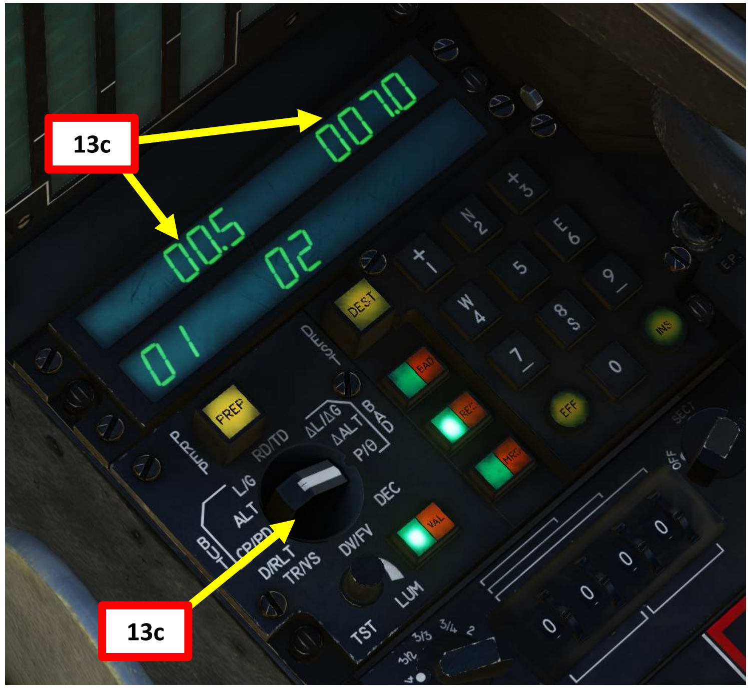


2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

13. Depending on the parameter selector's position, the PCN (Navigation Control Panel) will show the following information, which will help you to evaluate the accumulated position error generated by INS drift:
    a) ΔL/ΔG: the left window will show the difference in latitude and the right window will show the difference in longitude between the radar designated position and the BUT position in kilometer.
    b) ρ/θ: The left window will show the distance in nm and the right window will show the bearing of the radar designated position and the BUT position.
    c) ΔALT: The left window will show the altitude difference in meter and the right window will show the altitude difference in feet of the radar designated position and the BUT position.







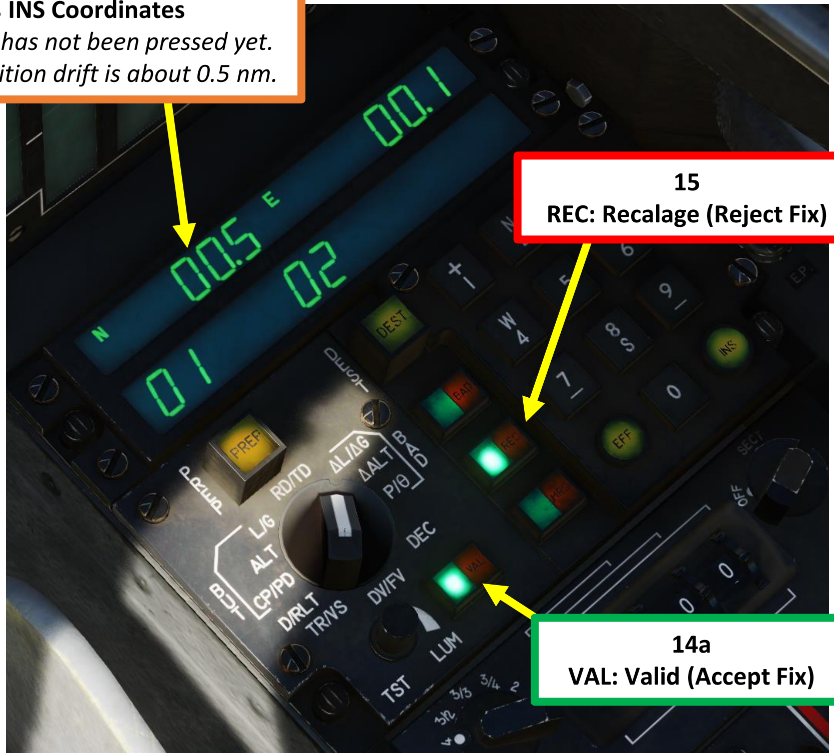
2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

14. Based on the value of the accumulated error, you can decide to either accept or reject the update. If the accumulated error is reasonable, accept the update by pressing the VAL button.
15. If the accumulated error does not make sense, then reject the update by pressing the REC (*Recalage*) button.
    - Note: If the difference between aircraft and landmark position is more than 15 nautical miles, the VAL key will remain dark and the REC key will flash. In this situation the only possible action is to reject the fix.
16. That's it, you have corrected the INS drift!

Important Note:
- A blind validation can screw up your whole INS position easily since it will modify the whole INS waypoint database and aircraft position. It will also affect INS bias calculations, which will degrade the quality of the INS over multiple flights. INS bias calculations are used to tune the INS, improving its precision… that is until the INS bias values are zeroed when pressing the VAL button.

The radar fix will be cancelled if:
- The Master ARM switch is set to ARM.
- The VTH (*Visualisation Tête-Haute*, Heads-Up Display) is set in any other mode than radar fix sub-mode.
- The SNA (*Système de Navigation et d'Attaque,* Navigation & Attack System) is set in any other mode than NAV.

Distance to the waypoint's INS Coordinates
- *VAL (Validation) button has not been pressed yet.*
- *We see that the INS position drift is about 0.5 nm.*



15
REC: Recalage (Reject Fix)

14a
VAL: Valid (Accept Fix)

Distance to the waypoint's INS Coordinates
- *VAL button has been pressed. INS position is updated to correct accumulated position error.*
- *We see that the INS position drift is close to 0 nm.*

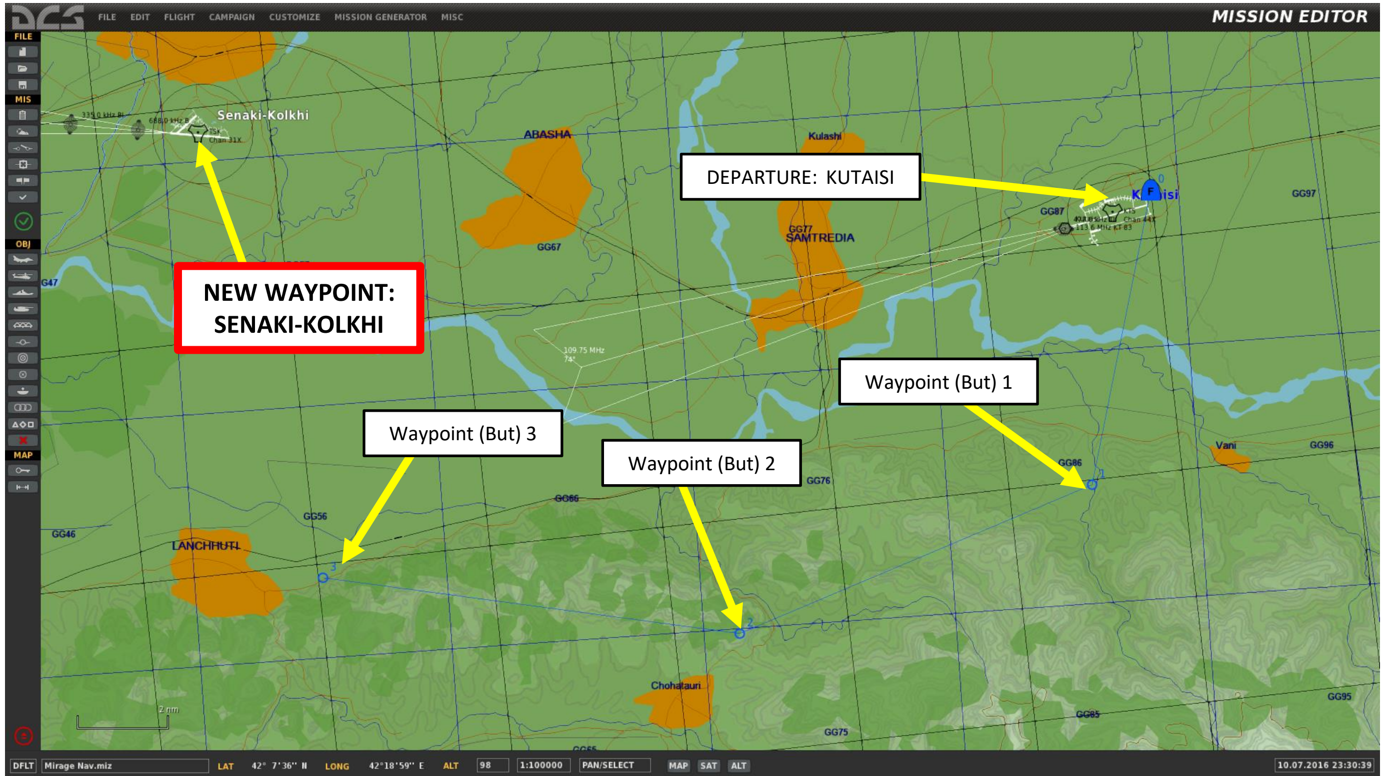
14b
VAL: Valid (Accept Fix)
INS Correction is performed

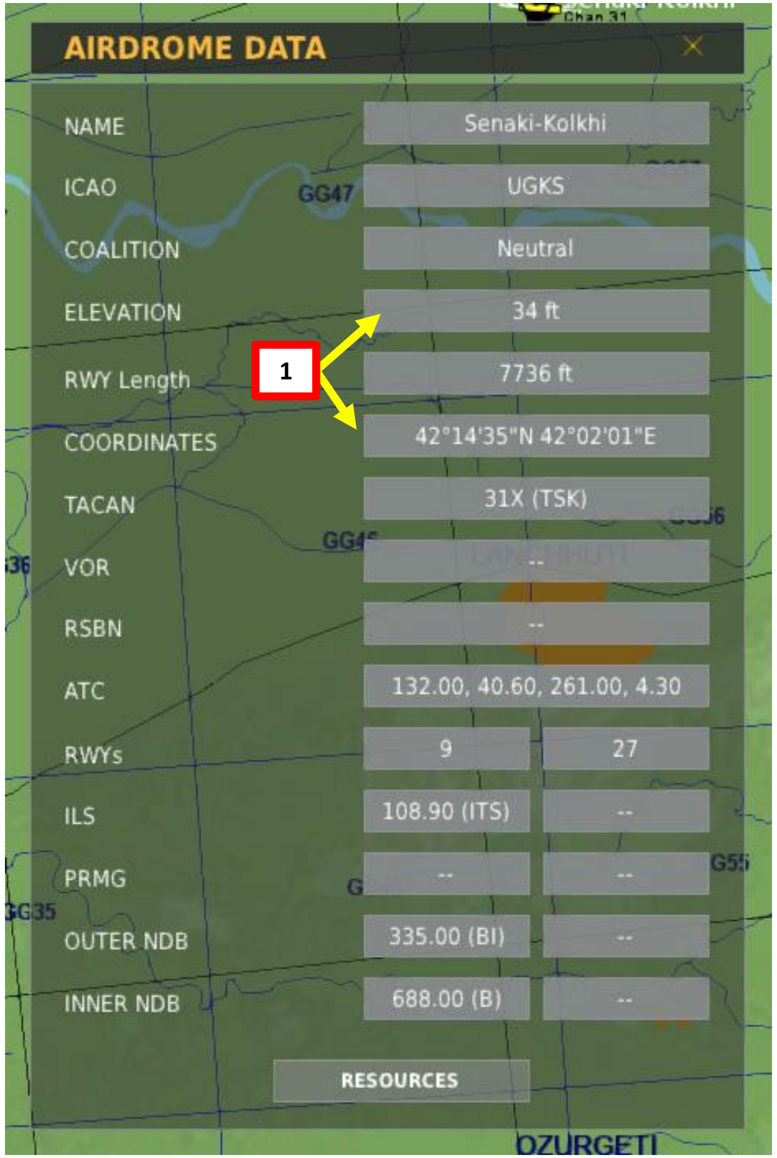
2 – *UNI (UNITÉ DE NAVIGATION INERTIELLE)* / INS (INERTIAL NAVIGATION SYSTEM)
2.2 – INS Drift & Coordinate Correction using a Fix
2.2.3 – Radar Fix Method (*Recalage Oblique*)

3.1 – WAYPOINT (*BUT*) CREATION TUTORIAL

Note: In this tutorial, we already have three waypoints set the MIP (*Module d'Insertion de Paramètres*: Data Cartridge Insertion Module) via the mission editor. We will add a fourth waypoint located at Senaki-Kolkhi. Keep in mind that to add Waypoint #4, we need to have at least three existing waypoints already.

1. Note the LAT-LONG coordinates and ground elevation of the waypoint you want to add. By pressing "F10" and selecting the map, we find:
   SENAKI-KOLKHI COODINATES: 42°14'25'' **N**ORTH 42°02'01''**E**AST.
   ELEVATION: 34 ft
2. The INS system in the Mirage needs the degree, minutes, seconds (") coordinates entered in degree, minutes, decimal-minutes format. As an example:
   42°14'**25**'' NORTH = 42°14.**416** NORTH (MIRAGE INS FORMAT)
   416 = 25 x 1000 / 60 since there are 60 seconds in a minute
   42°02'**01**''EAST = 042°02.**016** EAST (MIRAGE INS FORMAT)
   016 ≈ **16,6** = 1 x 1000 / 60 since there are 60 seconds in a minute





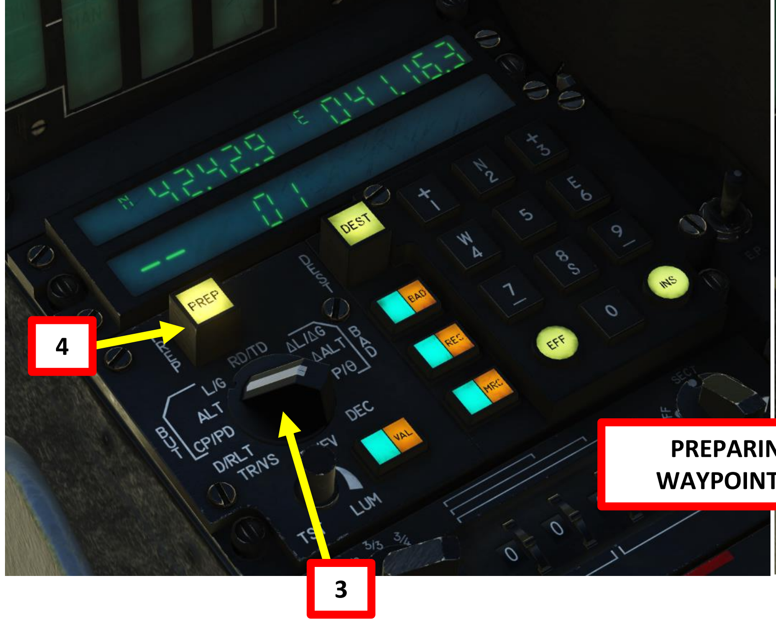
3.1 – WAYPOINT (*BUT*) CREATION TUTORIAL

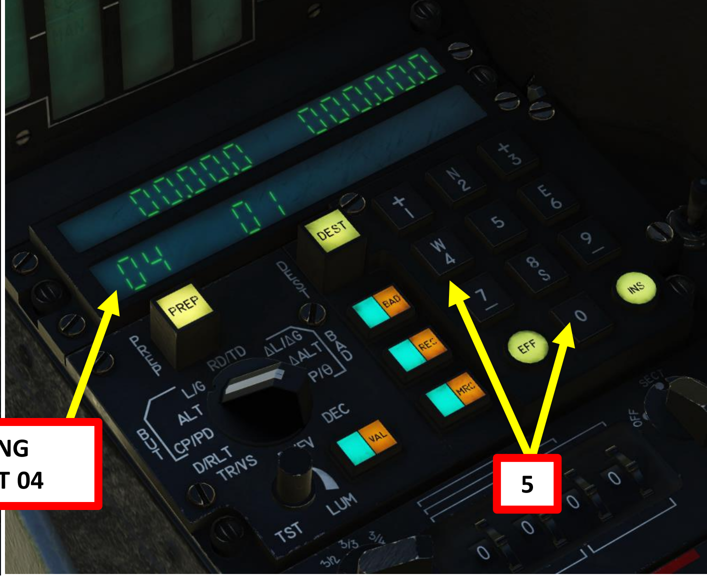
Note: In this tutorial, we already have three waypoints set the MIP (*Module d'Insertion de Paramètres*: Data Cartridge Insertion Module) via the mission editor. We will add a fourth waypoint located at Senaki-Kolkhi. Keep in mind that to add Waypoint #4, we need to have at least three existing waypoints already.

1. Note the LAT-LONG coordinates and ground elevation of the waypoint you want to add. By pressing "F10" and selecting the map, we find:
   SENAKI-KOLKHI COODINATES: 42°14'25'' **N**ORTH 42°02'01''**E**AST.
   ELEVATION: 34 ft

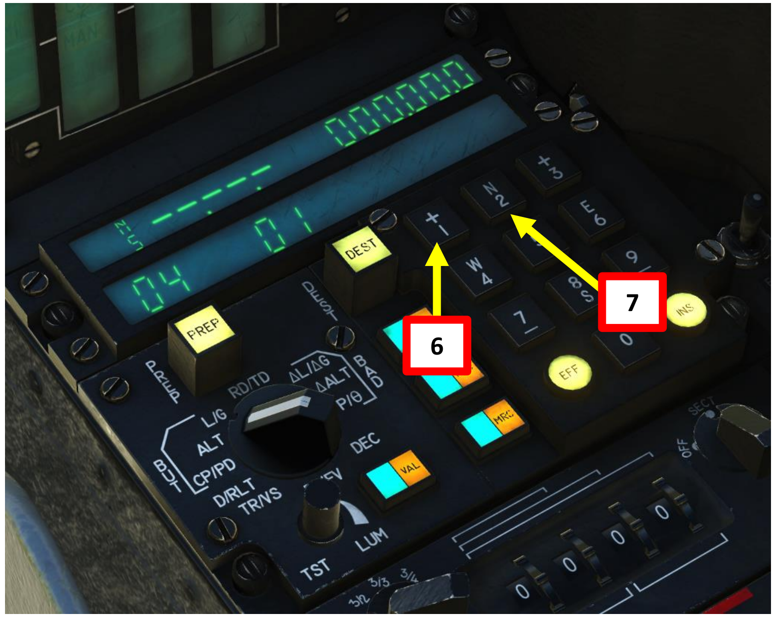
   Note: You can toggle between coordinate display formats on the F10 map by pressing "LALT + Y".

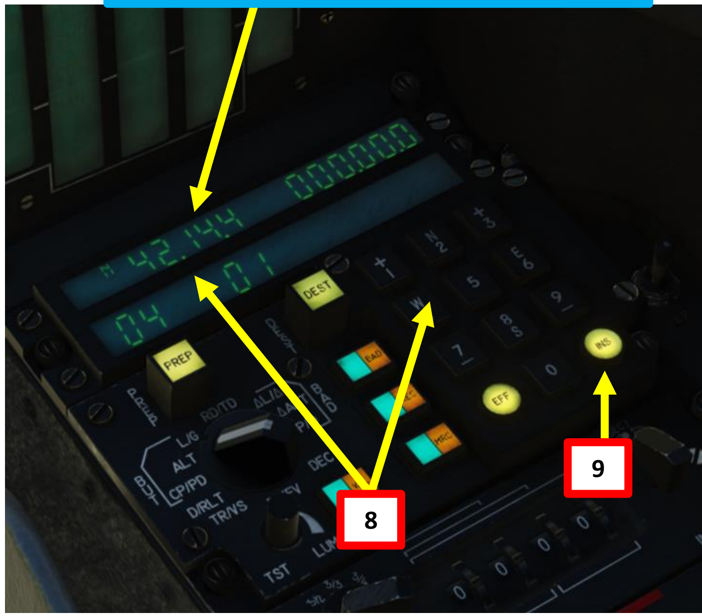
2. The INS system in the Mirage needs the degree, minutes, seconds (") coordinates entered in degree, minutes, decimal-minutes format. As an example:
   42°14'**25**'' NORTH = 42°14.**416** NORTH (MIRAGE INS FORMAT)
   416 = 25 x 1000 / 60 since there are 60 seconds in a minute
   42°02'**01**''EAST = 042°02.**016** EAST (MIRAGE INS FORMAT)
   016 ≈ 16,6 = 1 x 1000 / 60 since there are 60 seconds in a minute
3. Set UNI Parameter Selector Switch to L/G
4. Press "PREP" (Preparation) button to create a waypoint.
5. Press "0" and "4" (04) on the INS numpad to add Waypoint Number 4.
6. Press "+1" on numpad to select the North/South coordinate field (left)
7. Press "N" (2) on numpad to select NORTH coordinates
8. Press **4214416** on numpad to enter NORTH coordinates
9. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).





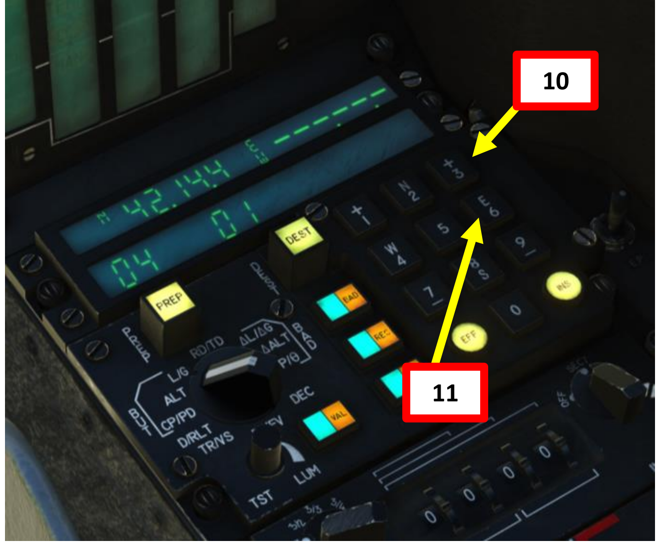
Note: Entering coordinates "42°14.416" will only display "42.14.4" on the data field.

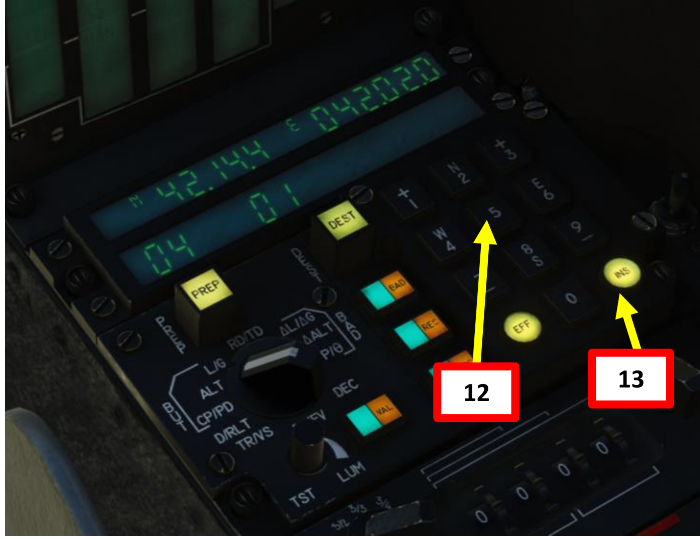




3.1 – WAYPOINT (*BUT*) CREATION TUTORIAL

10. Press “+3” on numpad to select the East/West coordinate field (right)
11. Press “E" (6) on numpad to select EAST coordinates
12. Press **04202016** on numpad to enter EAST coordinates (don't forget 0 at beginning for EAST/WEST coordinates)
13. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).





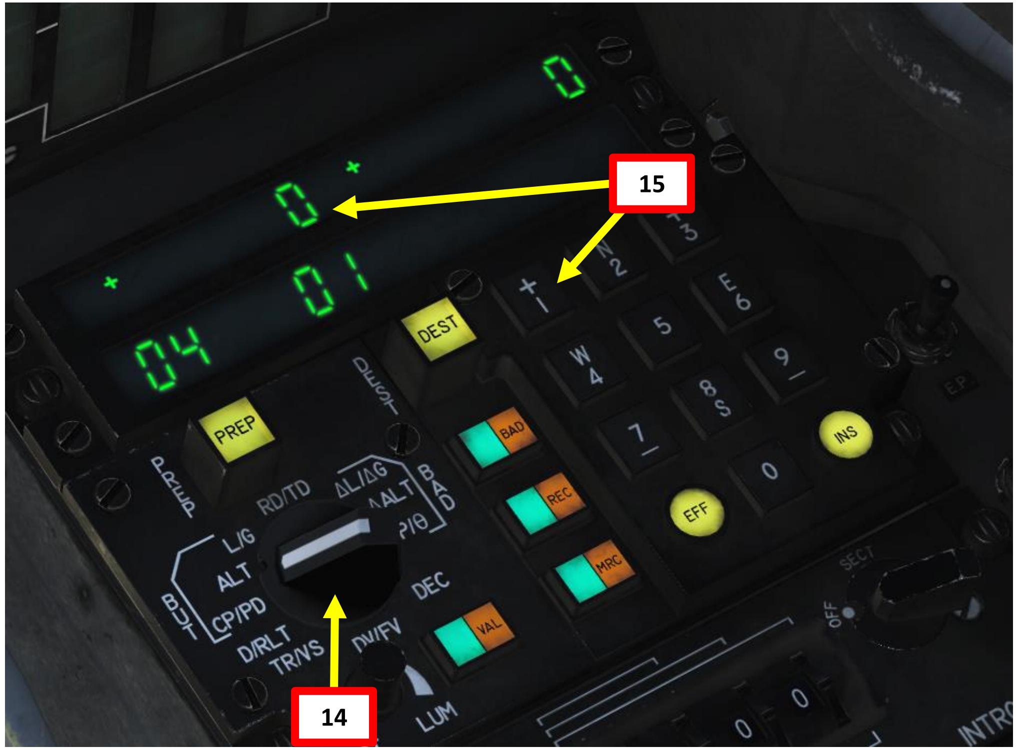
Note: Entering coordinates “042°02.016” will only display “042.02.0” on the data field.

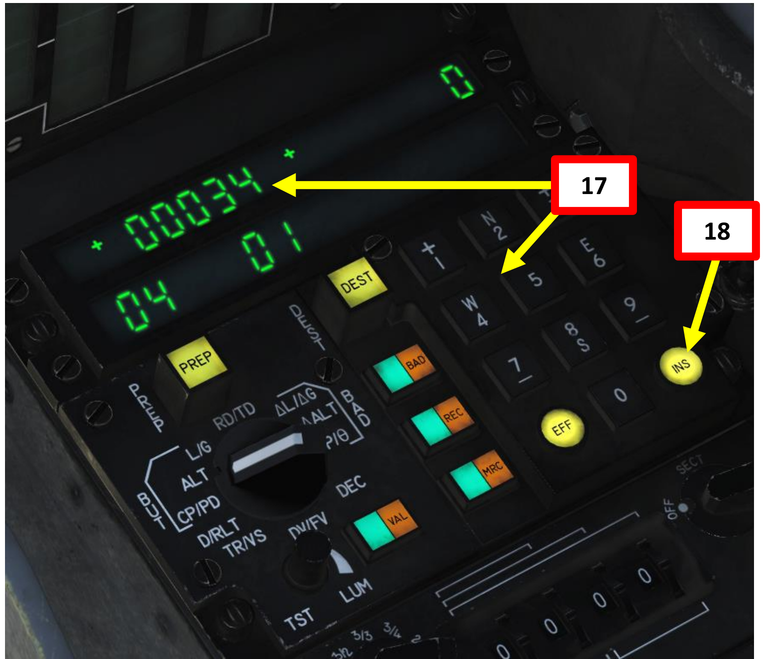
There you go, you have now entered coordinates for a new Waypoint #4!

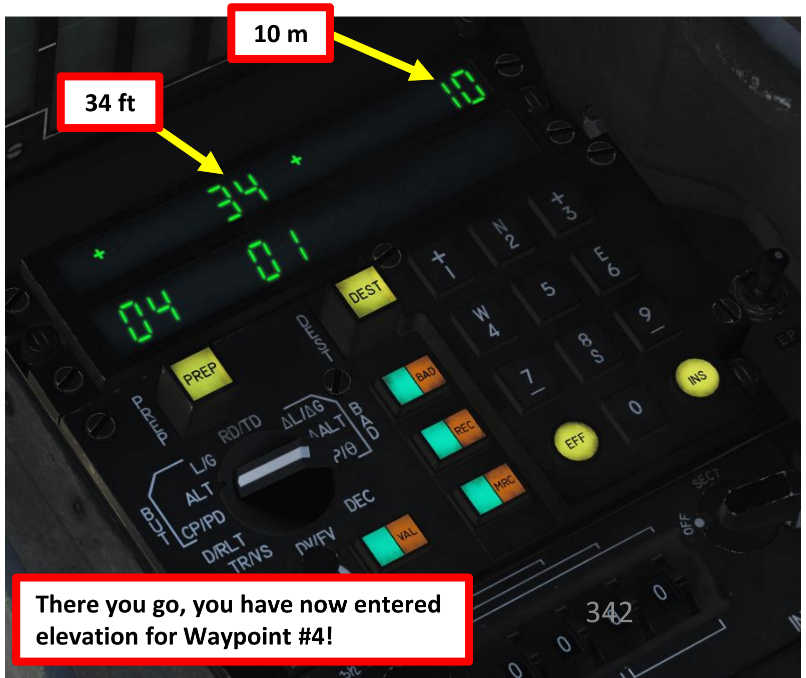
3.1 – WAYPOINT (*BUT*) CREATION TUTORIAL

14. Set UNI Parameter Selector Switch to ALT
15. To enter elevation in feet, select left field by pressing "+1". To enter elevation in meters, select right field by pressing "+3".
16. Press "+1" to enter positive elevation, or press "-7" to enter negative elevation.
17. Enter elevation as follows: "34" for 34 ft.
18. Press INS (Insert) to enter elevation (or EFF to erase if you made a mistake and need to start over).

Note:
To edit waypoints, repeats step 3 to 18.



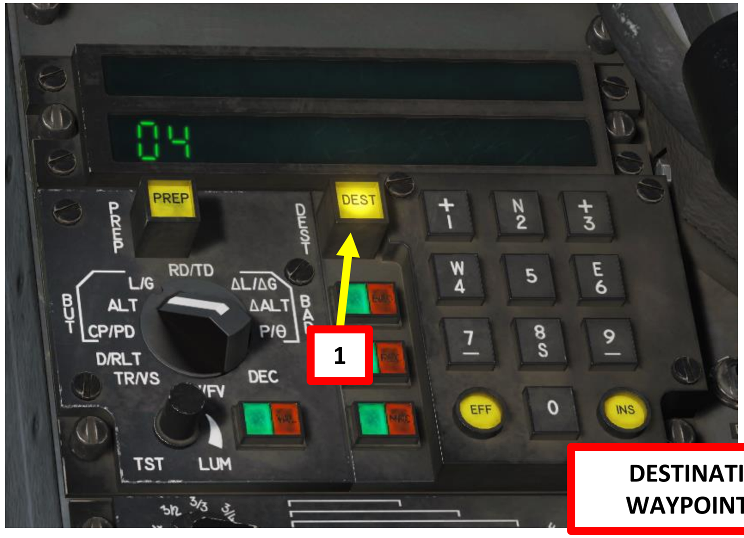


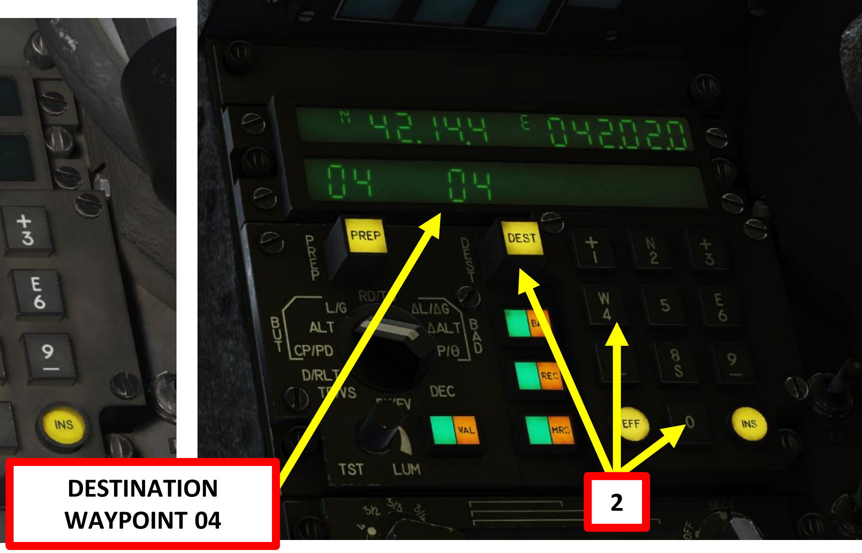


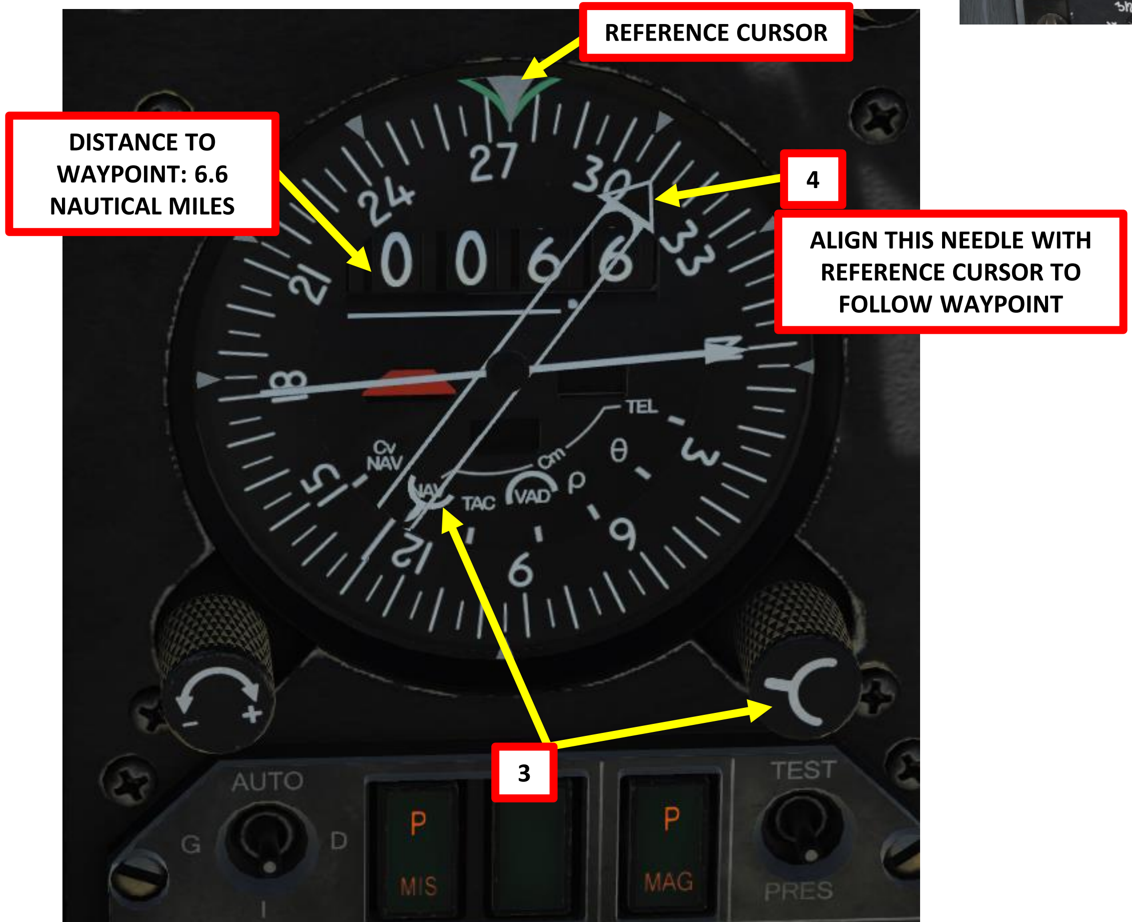
3.2 – WAYPOINT (*BUT*) NAVIGATION TUTORIAL

Note: With our fourth waypoint added in the previous tutorial, we will now navigate to Senaki-Kolkhi using the WAYPOINT (BUT) 04 we just created.

1. Press “DEST” (Destination) button to select a waypoint.
2. Press “0” and “4” (04) on the INS numpad to select Waypoint Number 4. Alternatively, you can use the INS Waypoint Next/Previous buttons.
3. Set the HSI (Horizontal Situation Indication) mode to either “CV” (*Cap Vrai*: True Heading) or “CM” (*Cap Magnétique: Magnetic Heading*)
4. Follow the HSI main needle to your waypoint.





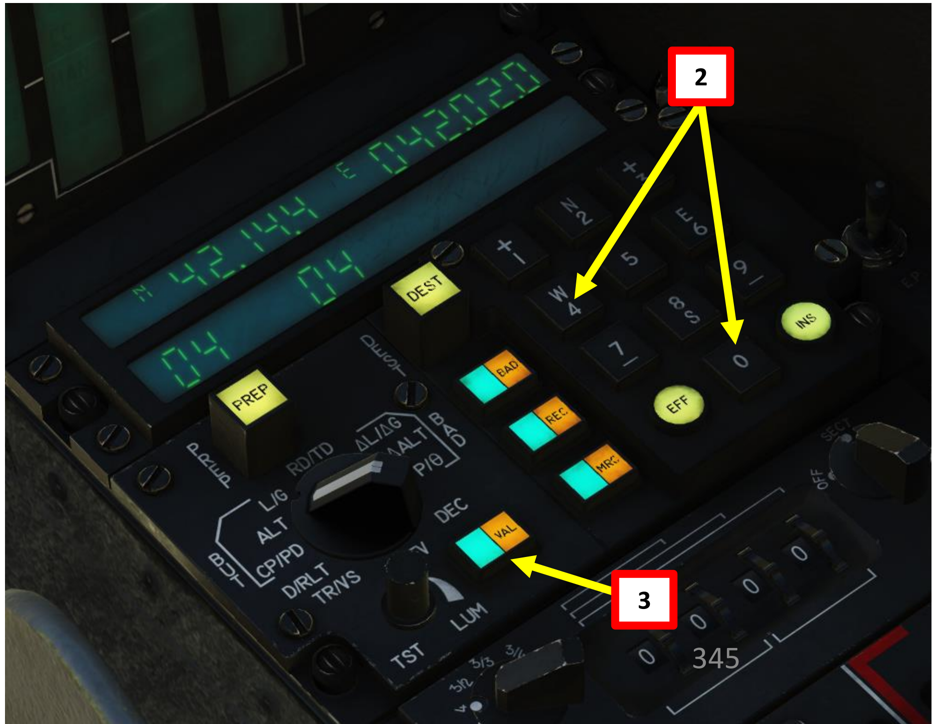


3.2 – WAYPOINT (*BUT*) NAVIGATION TUTORIAL

3.2 – WAYPOINT (*BUT*) NAVIGATION TUTORIAL

You can also visualize the waypoint on the VTB. Here's how:

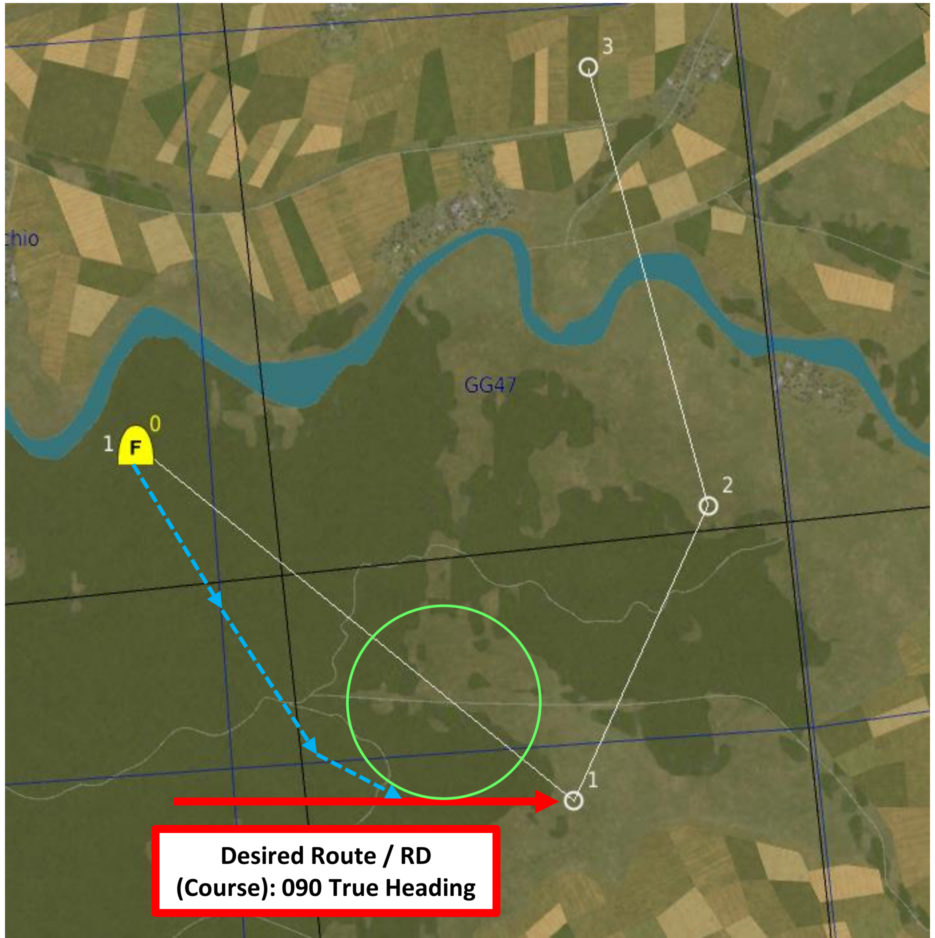
1. Press "PREP" (Preparation) button .
2. Press "0" and "4" (04) on the INS numpad to select Waypoint Number 4.
3. Press the VAL button.
4. If the waypoint is in the selected radar display range and within radar aperture limits (+/- 60 degrees), you will see a number "4" with a "+" sign next to it to indicate the waypoint location. Up to five waypoints may be displayed at the same time.
5. You can remove all waypoints from the VTB by using the ALLEG switch.



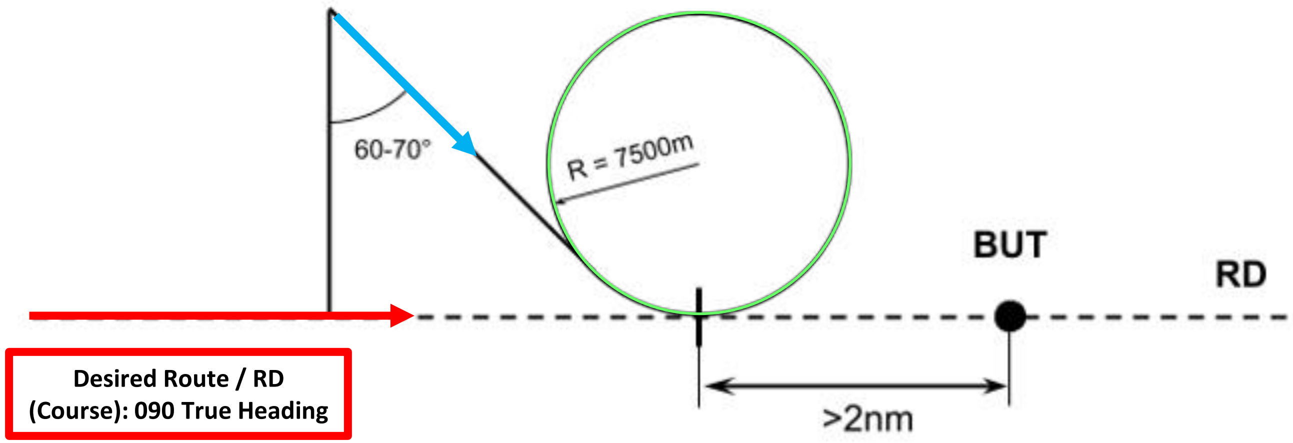
3.3 – DESIRED ROUTE (*ROUTE DÉSIRÉE*) TUTORIAL

The “Route Désirée” (Desired Route) setting allows you to approach a waypoint (*But*) from a specific direction. Symbology on the HUD/VTH will guide you towards the waypoint. In this tutorial, we will set a Desired Route to approach Waypoint 01 from a direction of 090 (True Heading).

Keep in mind that the Desired Route is not very accurate if you set it when you are too close to the Waypoint. The “route” computed by the UNI will also not necessarily be a straight line to the waypoint.

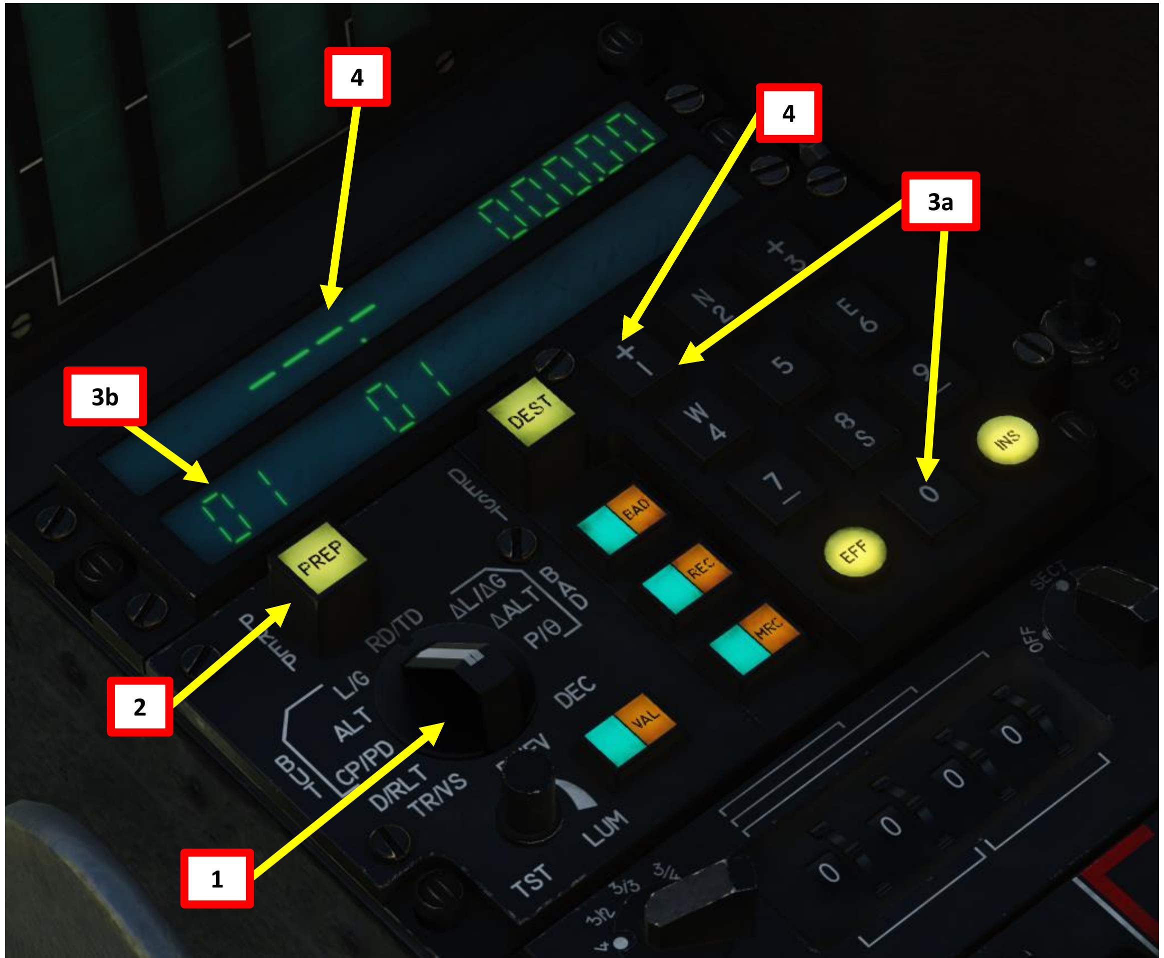


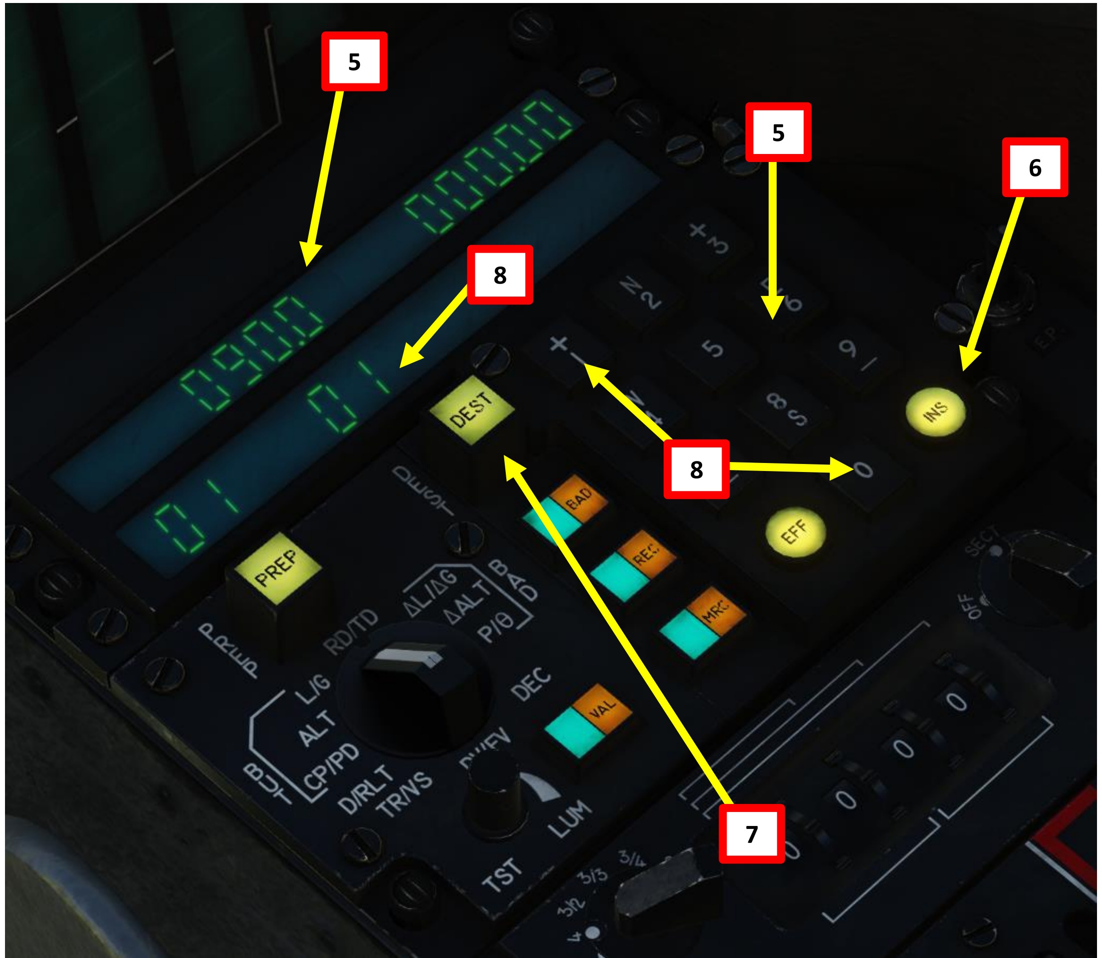
Source: RAZBAM Manual



3.3 – DESIRED ROUTE (*ROUTE DÉSIRÉE*)
TUTORIAL

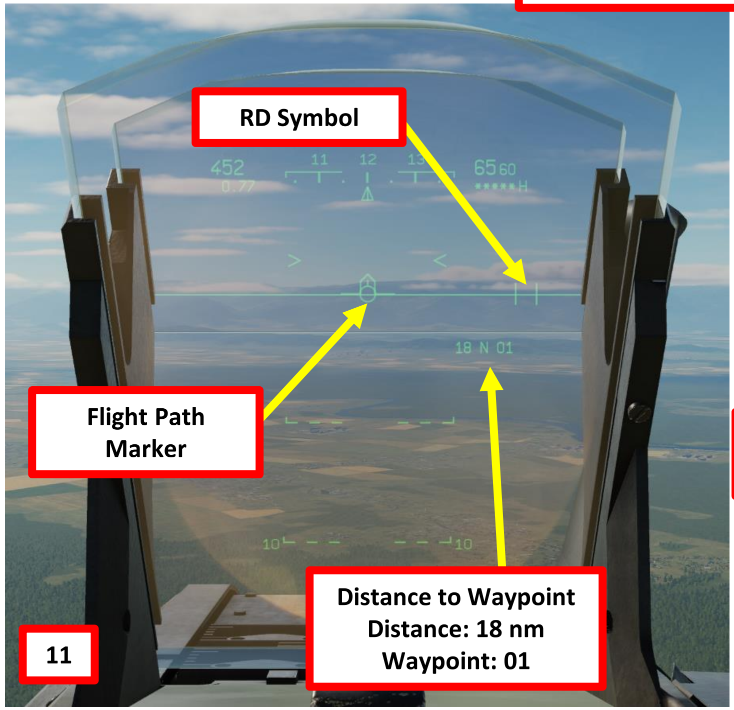
1. Set UNI Parameter Selector Switch to RD/TD (*Route Désirée / Temps Désiré*)
2. Press "PREP" (Preparation) button to edit Waypoint properties.
3. Press "0" and "1" (01) on the INS numpad to select Waypoint Number 01.
4. Press "+1" on numpad to select the Desired Route (Course) field (left)
5. Press **0900** on numpad to enter a desired route true heading to Waypoint 01 of 090.0 degrees.
6. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).
7. Press "DEST" (Destination) button to select a waypoint.
8. Press "0" and "1" (01) on the INS numpad to select Waypoint Number 01.

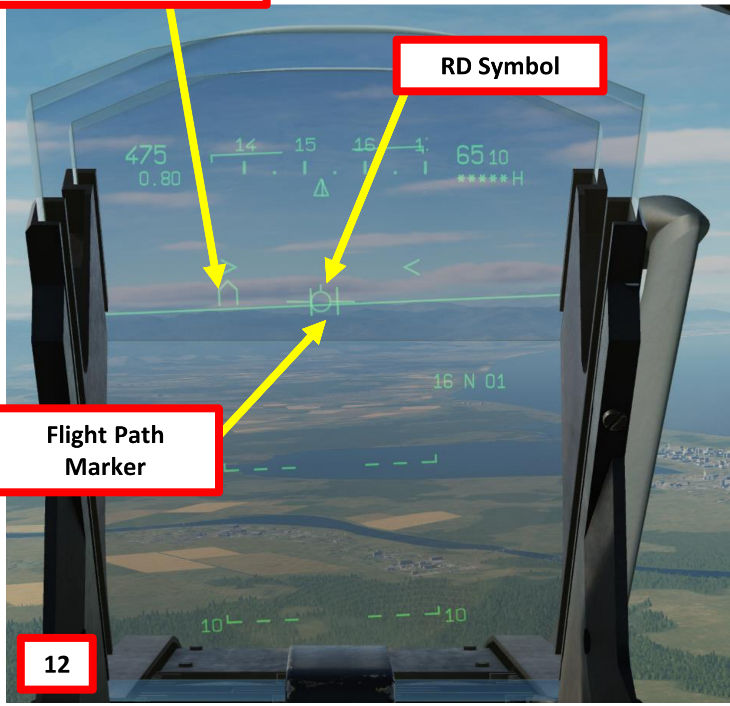




3.3 – DESIRED ROUTE (*ROUTE DÉSIRÉE*) TUTORIAL

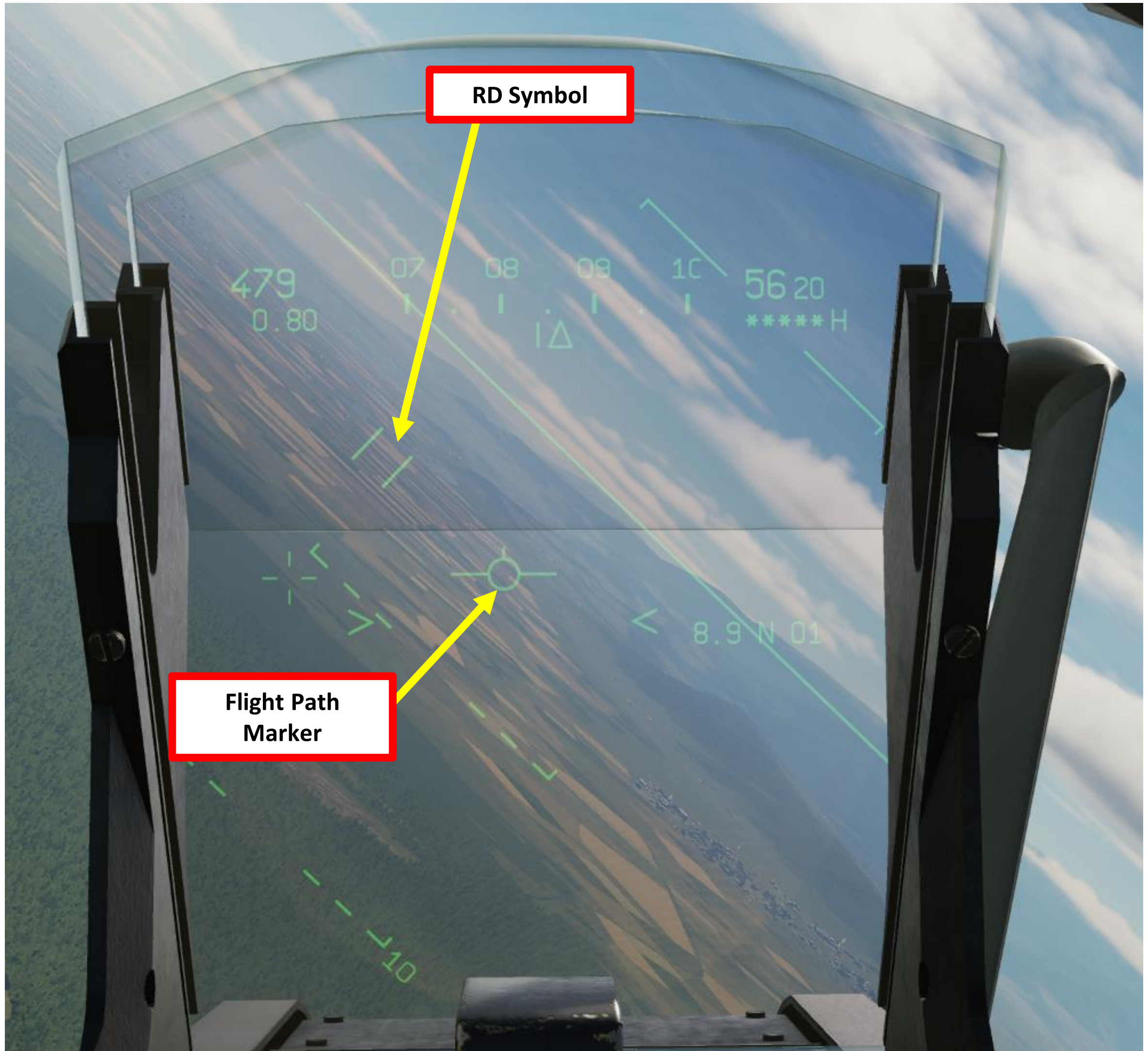
9. Select Navigation Master Mode by setting the Weapons System CMD Switch AFT.
10. Press “RD” button (*Route Désirée*) to display symbology on the HUD/VTH.
11. The RD Symbol (two vertical lines) shows where the Flight Path Marker should be set in order to track the route computed to the waypoint following the heading we entered in the flight computer.
12. Fly the aircraft to align the Flight Path Marker between the two lines of the RD Symbol.
13. The RD Symbol will update its position to make you follow the “desired route”. Keep following it.

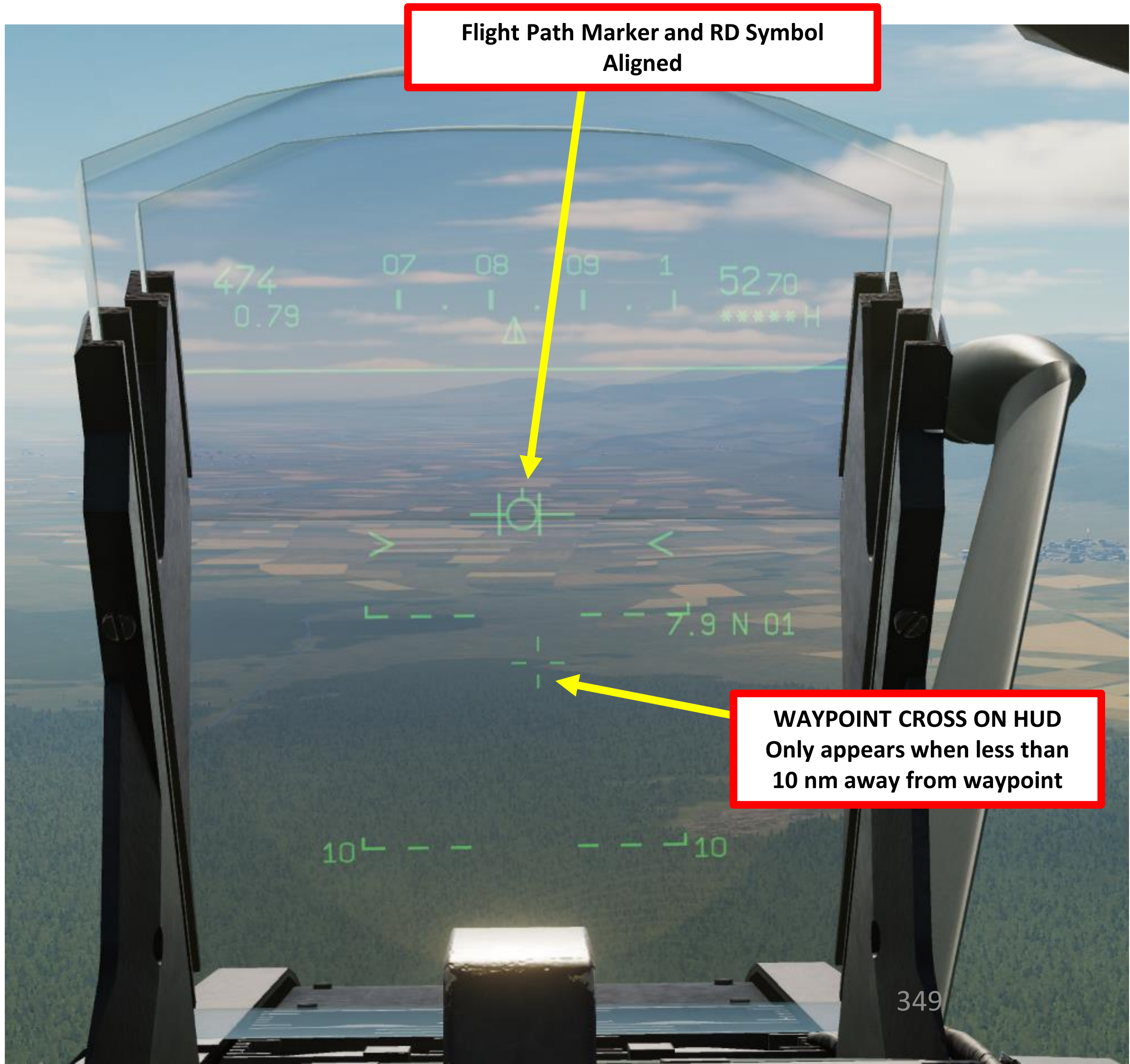




3.3 – DESIRED ROUTE (*ROUTE DÉSIRÉE*) TUTORIAL

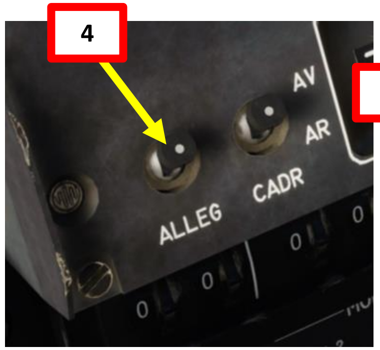
14. The final heading should bring you right to Waypoint 01 with a heading of approximately 090.

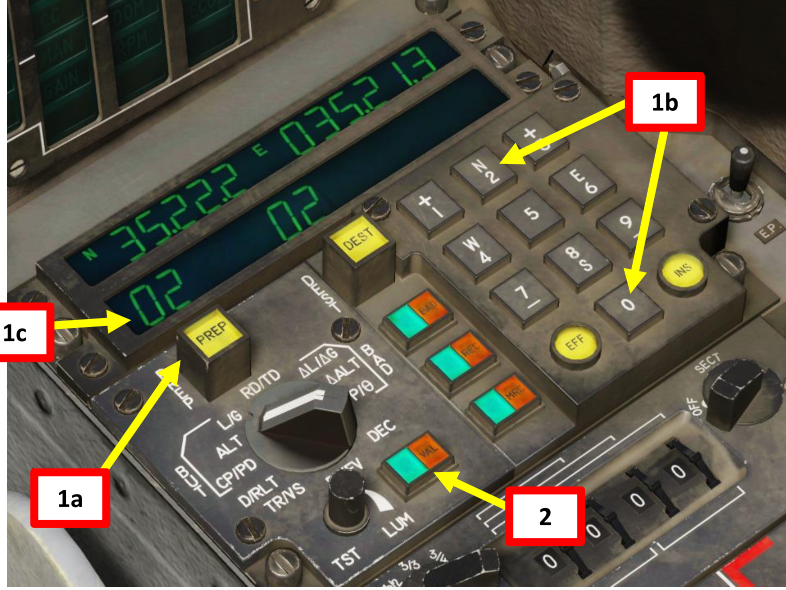




3.4 – TACTICAL WAYPOINT (*BUT TACTIQUE*)

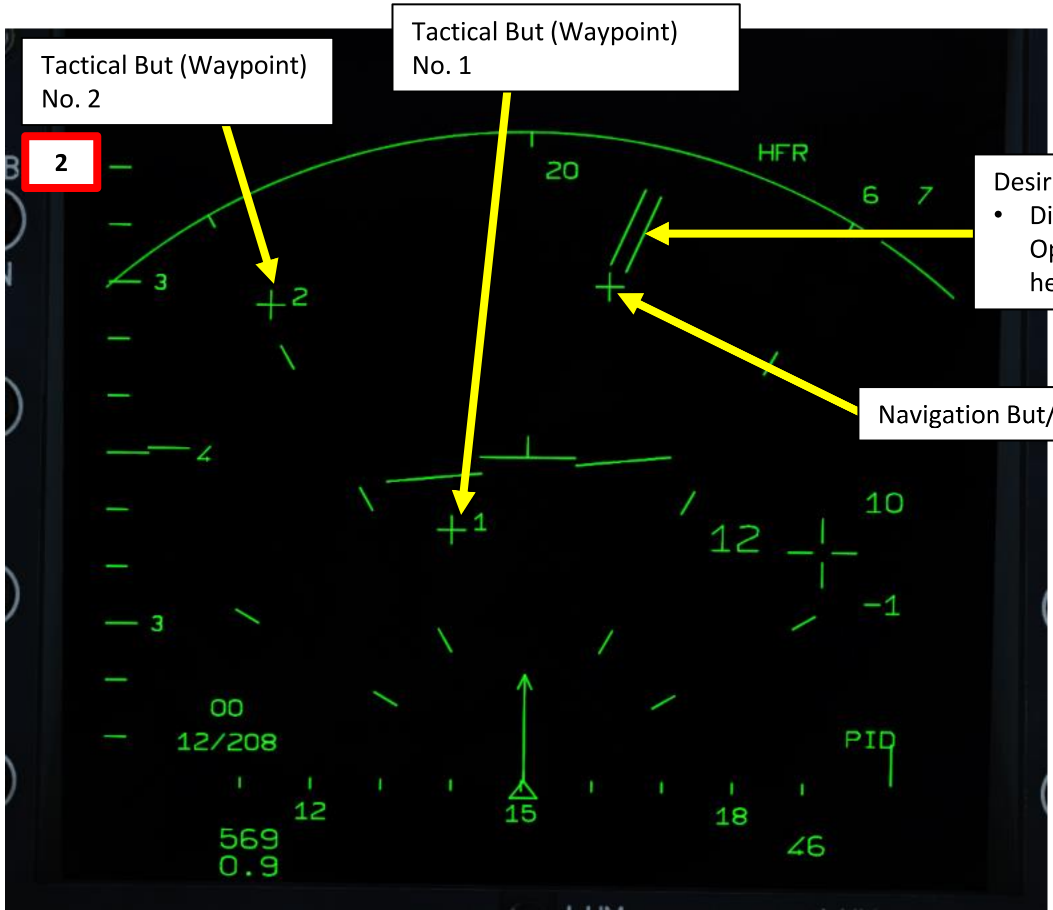
Navigation data is also displayed for Navigation Buts (Waypoints) and Tactical Buts (Waypoints) on the VTB display **if you select the RD (*Route Désirée*, Desired Route) Option**. Tactical buts are basically navigation waypoints that are numbered and that can be displayed on the radar screen to better locate radar contacts in relationship to existing navigation waypoints. Up to five tactical buts can be displayed at once.





To create a But Tactique (Tactical Waypoint) from an existing But (Navigation Waypoint):

1. Select the BUT to display on the VTB as PREP. We will select an existing Waypoint No. 2.
2. Press the VAL button to display the tactical waypoint.
3. Once a tactical waypoint is displayed, it can be removed by doing the same procedure. Trying to add a sixth tactical waypoint will replace the first.
4. All tactical waypoints can be removed at once using the VTB declutter command (*Allègement*).



Desired Heading
- Displayed when the navigation But/Waypoint is displayed, the RD Option is selected and the radar is in PPI mode. It displays the desired heading arrival heading relative to the navigation waypoint.

RD (*Route Désirée*, Desired Route) Option Selected

4.1 – WAYPOINT OFFSET (*BAD*) INTRODUCTION

Waypoint Offsets (also known as *BAD*, *But Additionnel)* are points on the ground (or in space) that are created by using another existing waypoint as a reference. They will be most commonly used for precision bombing or as points of reference given by the ground troops. Another and most widely known example is the use of bullseye call to create an offset point in order to locate your target, friendly units, landmarks etc.

Offsets are defined in two ways:

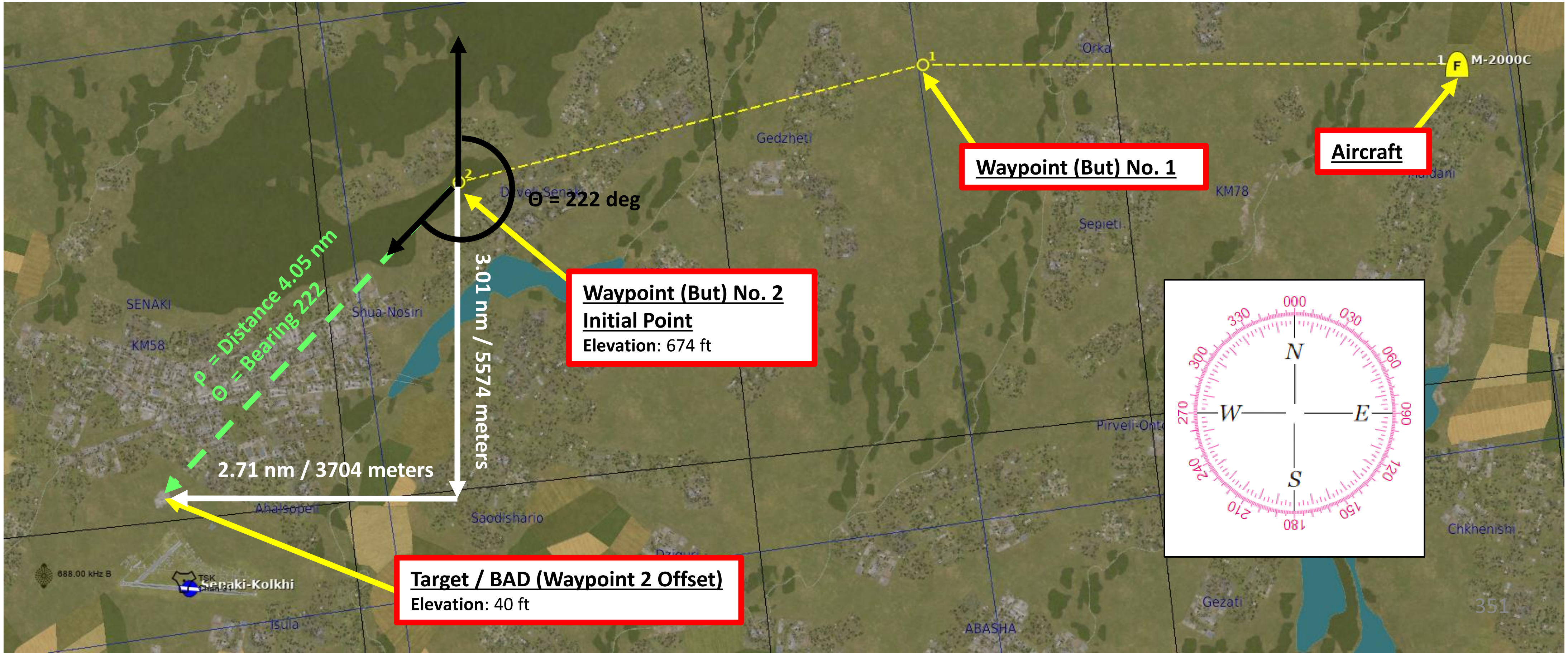
- Entering Longitude (North/South) and Latitude (East/West) offsets (**ΔL/ΔG**) in **meters** with an altitude offset Δ ALT (can be entered in meters or ft as desired).
- Entering Polar Coordinate offsets (**ρ** for distance in nautical miles, **θ** for bearing angle) with an altitude offset Δ ALT (can be entered in meters or ft as desired).

Target / BAD (Waypoint 2 Offset)

ΔL/ΔG: 3.01 nm South / 2.71 nm West
= 5574 meters South / 3704 meters West

ρ/θ: Distance 4.05 nm / Bearing 222 deg

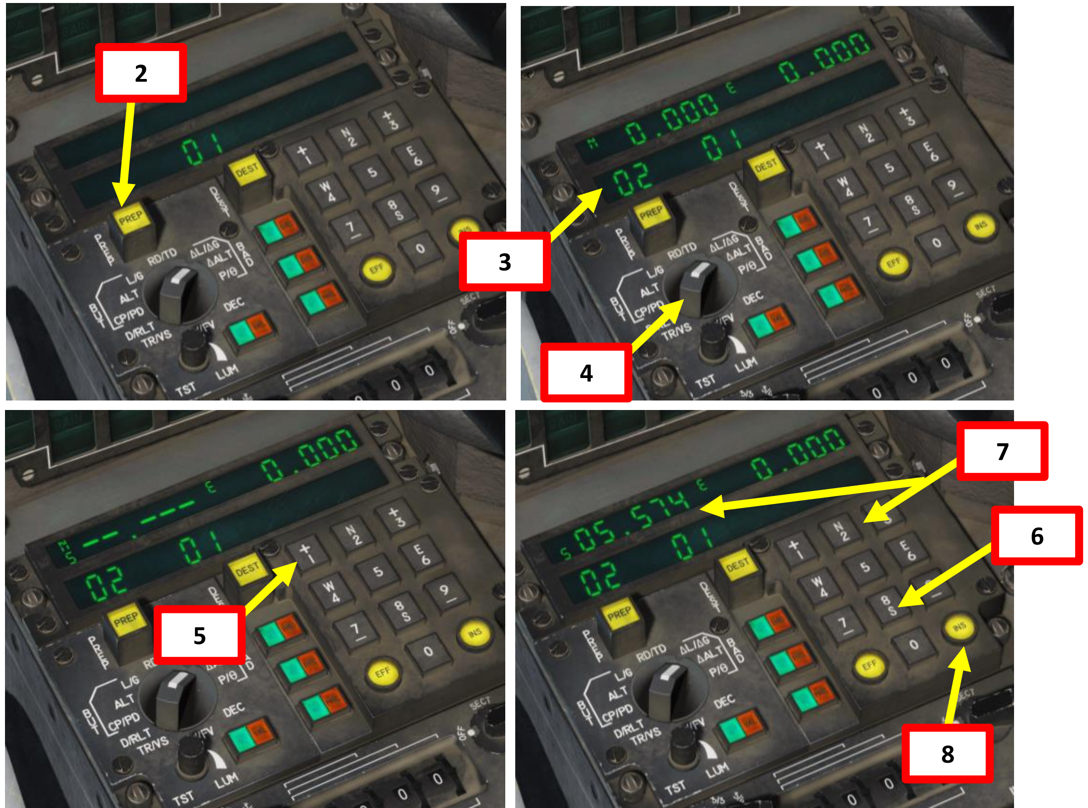
Δ ALT: - (WP2 Altitude – Target Altitude)
= - (674 ft – 40 ft) = -634 ft

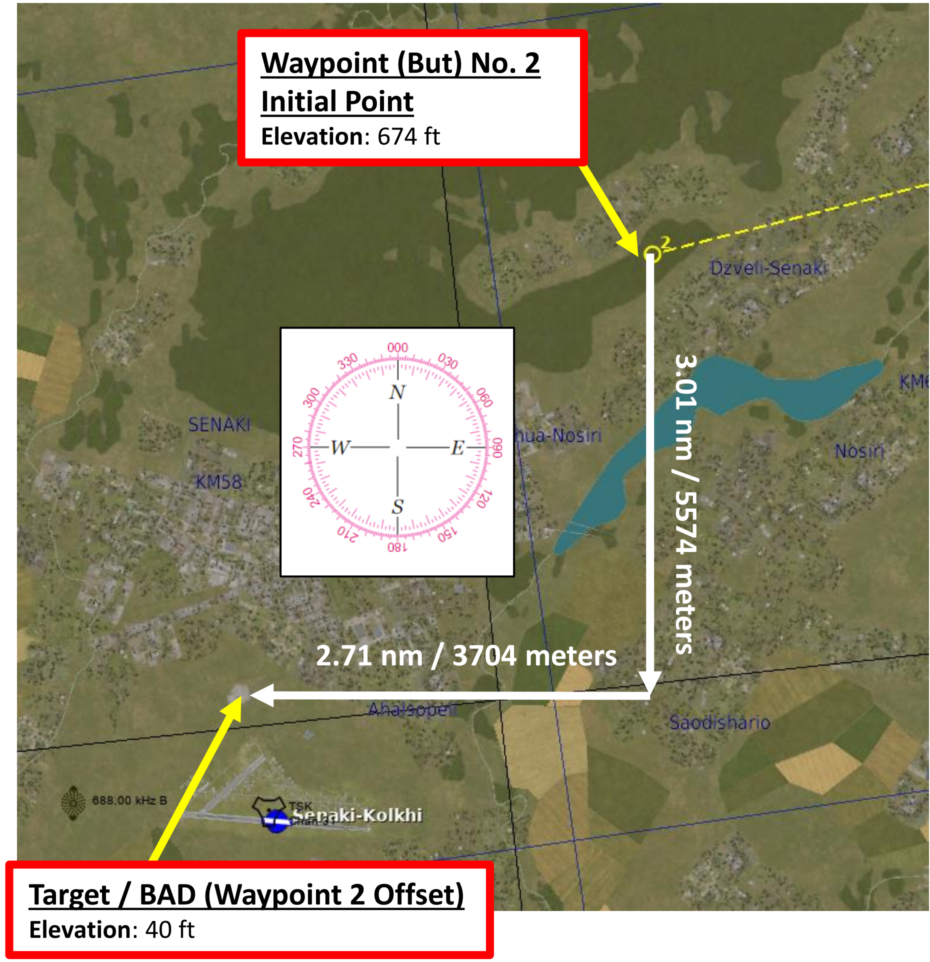


4.2 – WAYPOINT OFFSET (*BAD*) CREATION WITH ΔL/ΔG

In this tutorial, we already have two waypoints set the MIP (Module d'Insertion de Paramètres: Data Cartridge Insertion Module) via the mission editor. Make sure Waypoint 2 coordinates are already entered.

1. Note Longitude (North/South) and Latitude (East/West) offsets (**ΔL/ΔG**) in **meters** with the altitude offset Δ ALT (in ft).
    - **ΔL N/S Offset: 5574 meters South FROM Waypoint 2**
    - **ΔG E/W Offset: 3704 meters West FROM Waypoint 2**
    - **Altitude Offset: -634 ft**
2. Press "PREP" (Preparation) button to create a waypoint.
3. Press "0" and "2" (02) on the INS numpad to select Waypoint Number 2.
4. Set UNI Parameter Selector Switch to ΔL/ΔG
5. Press "+1" on numpad to select the North/South field (left)
6. Press "S" (8) on numpad to select SOUTH offset
7. Press **05574** on numpad to enter SOUTH offset of 5574 meters
8. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).





Target / BAD (Waypoint 2 Offset)

ΔL/ΔG: 3.01 nm South / 2.71 nm West
= 5574 meters South / 3704 meters West

Δ ALT: - (WP2 Altitude – Target Altitude)
= - (674 ft – 40 ft) = -634 ft

4.2 – WAYPOINT OFFSET (*BAD*) CREATION WITH ΔL/ΔG

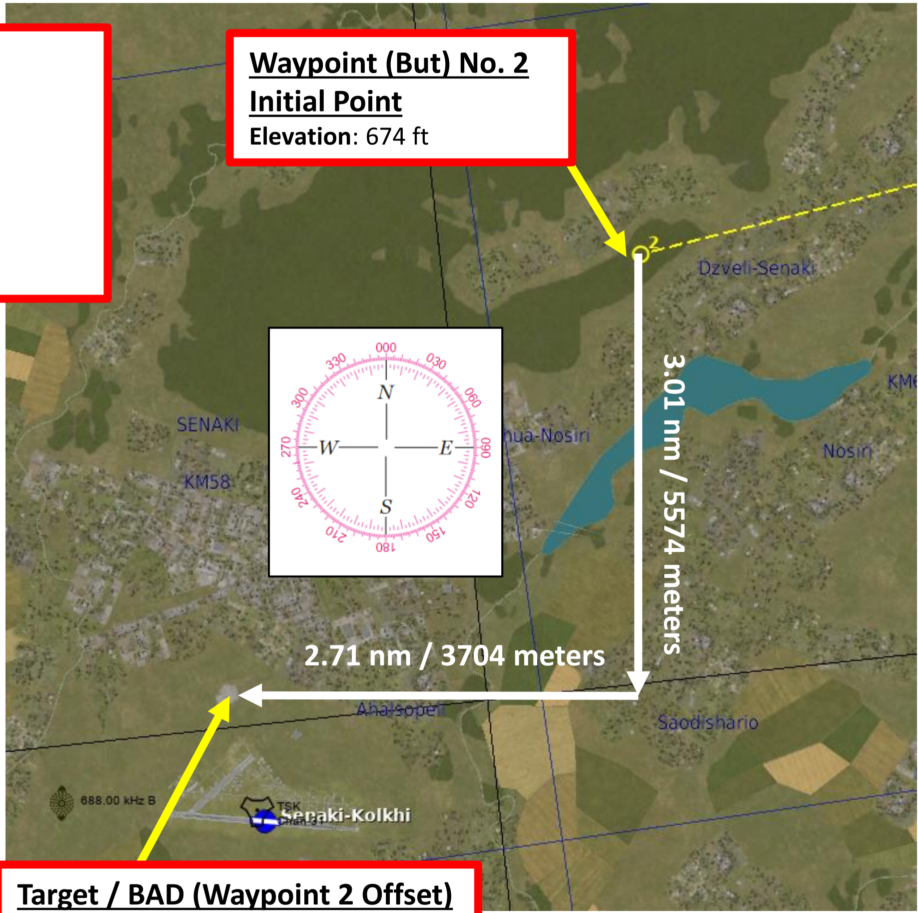
- **ΔL N/S Offset: 5574 meters South FROM Waypoint 2**
- **ΔG E/W Offset: 3704 meters West FROM Waypoint 2**
- **Altitude Offset: -634 ft**

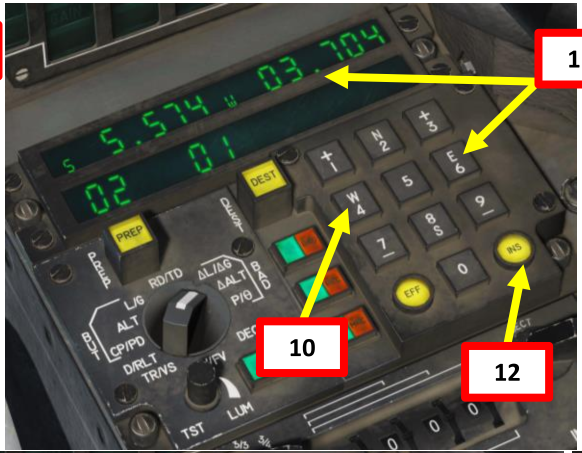
9. Press "+3" on numpad to select the East/West field (right)
10. Press "W" (4) on numpad to select WEST offset
11. Press **03704** on numpad to enter WEST offset of 3704 meters
12. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).
13. Set UNI Parameter Selector Switch to ΔALT
14. Press "+1" on numpad to select the FEET field (left). Right field is deserved for METERS.
15. Press "– " (7) on numpad to select NEGATIVE altitude offset
16. Press **00634** on numpad to enter ALTITUDE offset of -634 meters
17. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).

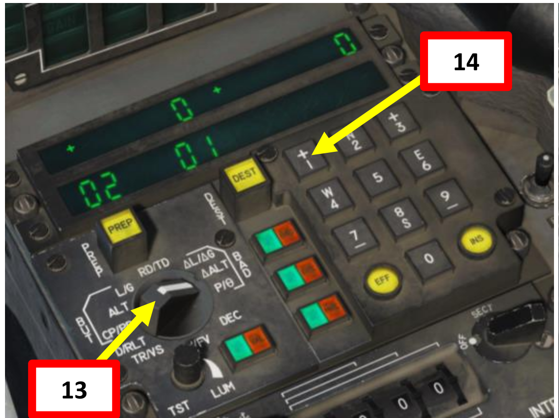
Target / BAD (Waypoint 2 Offset)

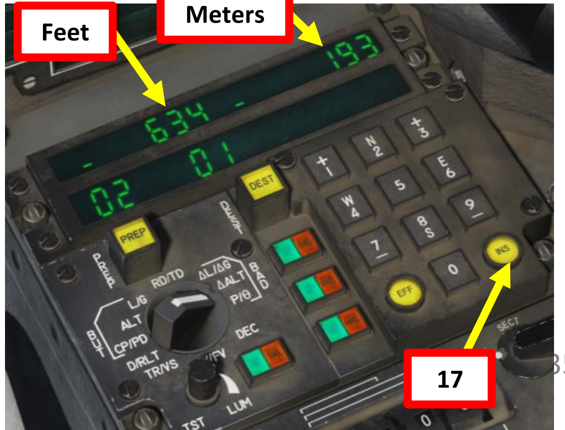
ΔL/ΔG: 3.01 nm South / 2.71 nm West
= 5574 meters South / 3704 meters West

Δ ALT: - (WP2 Altitude – Target Altitude)
= - (674 ft – 40 ft) = -634 ft





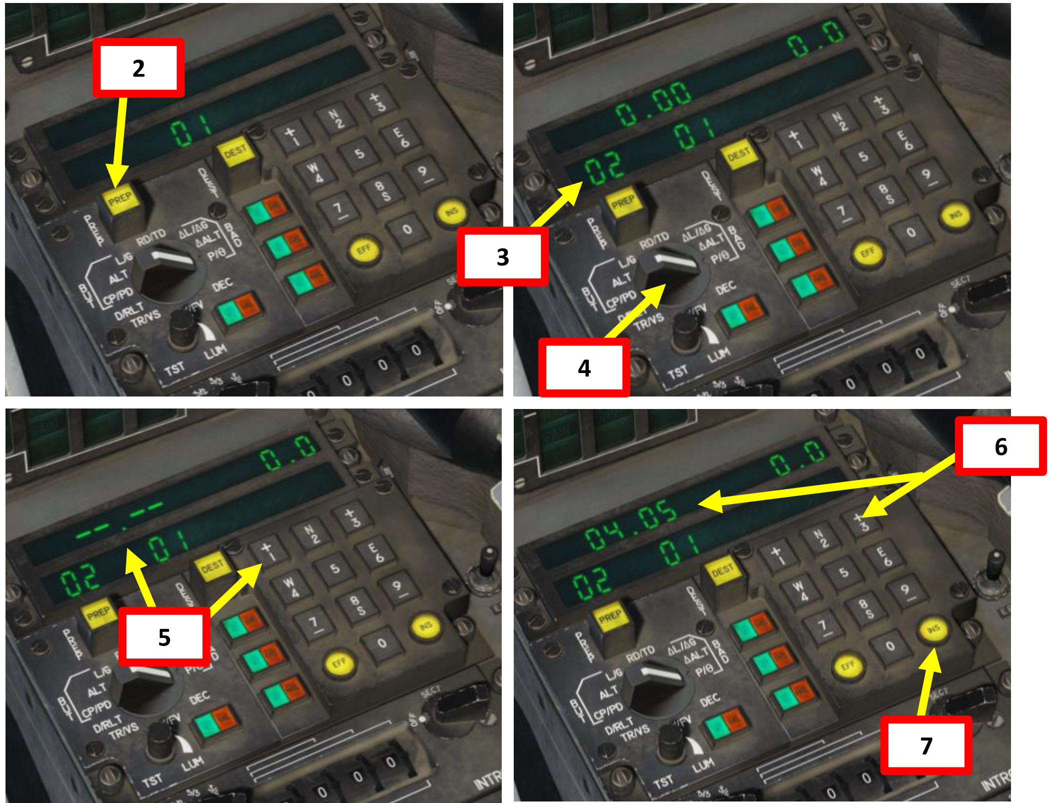


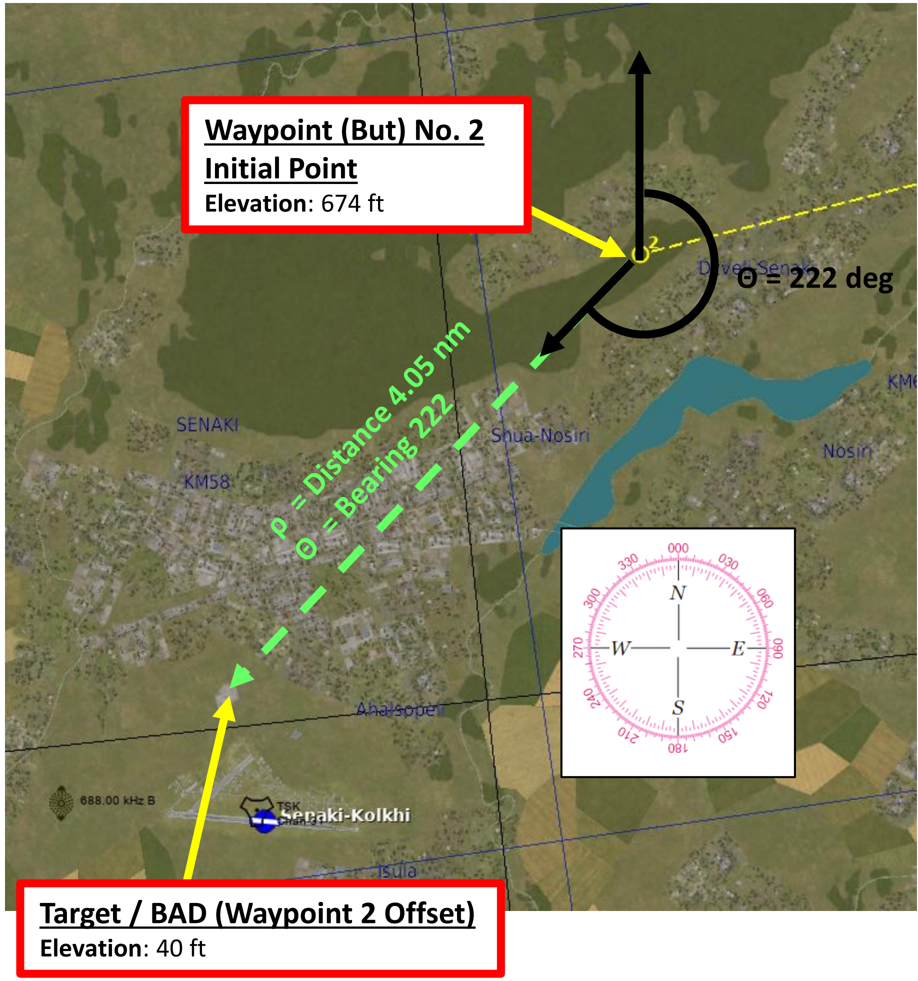


4.3 – WAYPOINT OFFSET (*BAD*) CREATION WITH ρ/θ

In this tutorial, we already have two waypoints set the MIP (Module d’Insertion de Paramètres: Data Cartridge Insertion Module) via the mission editor. Make sure Waypoint 2 coordinates are already entered.

1. Note Distance **(ρ in nautical miles)** and Bearing **(θ in degrees)** offsets**,** with the altitude offset Δ ALT (in ft).
   - **ρ Distance Offset: 4.05 nautical miles FROM Waypoint 2**
   - **θ Bearing Offset: 222 degrees FROM Waypoint 2**
   - **Altitude Offset: -634 ft**
2. Press “PREP” (Preparation) button to create a waypoint.
3. Press “0” and “2” (02) on the INS numpad to select Waypoint Number 2.
4. Set UNI Parameter Selector Switch to ρ/θ
5. Press “+1” on numpad to select the ρ distance field (left)
6. Press **0405** on numpad to enter ρ distance offset of 4.05 nautical miles
7. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).





Target / BAD (Waypoint 2 Offset)

ρ/θ: Distance 4.05 nm / Bearing 222 deg

Δ ALT: WP2 Altitude – Target Altitude
= 674 ft – 40 ft = 634 ft

4.3 – WAYPOINT OFFSET (*BAD*) CREATION WITH ρ/θ

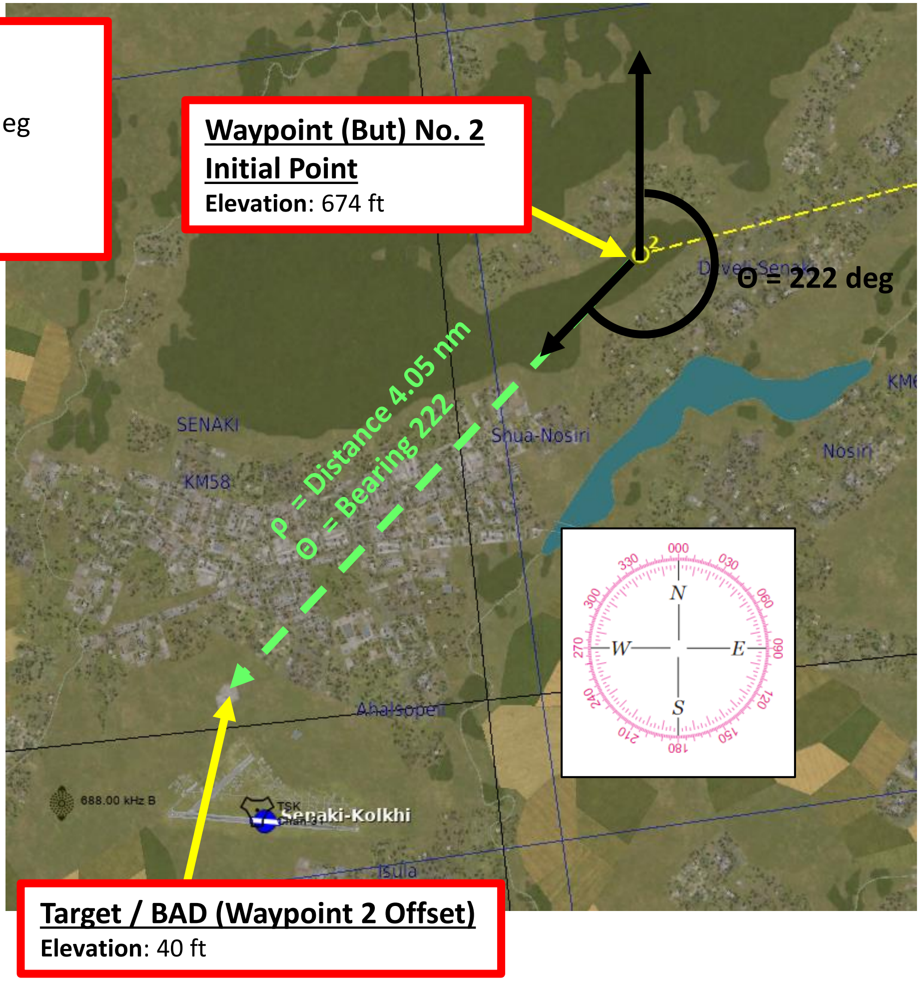
- **ρ Distance Offset: 4.05 nautical miles FROM Waypoint 2**
- **θ Bearing Offset: 222 degrees FROM Waypoint 2**
- **Altitude Offset: -634 ft**

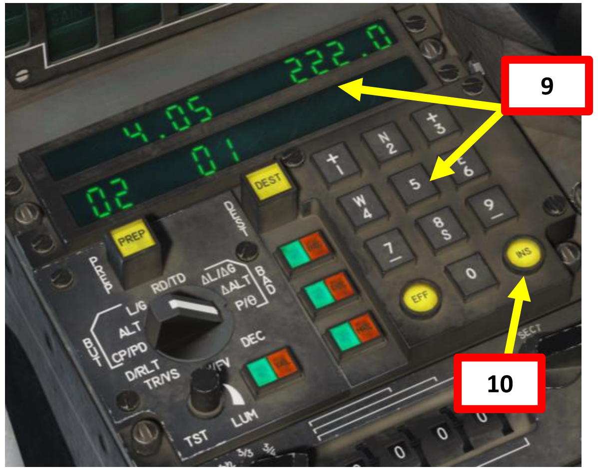
8. Press "+3" on numpad to select the θ bearing field (right)
9. Press **2220** on numpad to enter θ bearing offset of 222.0 degrees
10. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).
11. Set UNI Parameter Selector Switch to ΔALT
12. Press "+1" on numpad to select the FEET field (left). Right field is deserved for METERS.
13. Press "– " (7) on numpad to select NEGATIVE altitude offset
14. Press **00634** on numpad to enter ALTITUDE offset of -634 meters
15. Press INS (Insert) to enter coordinates (or EFF to erase if you made a mistake and need to start over).

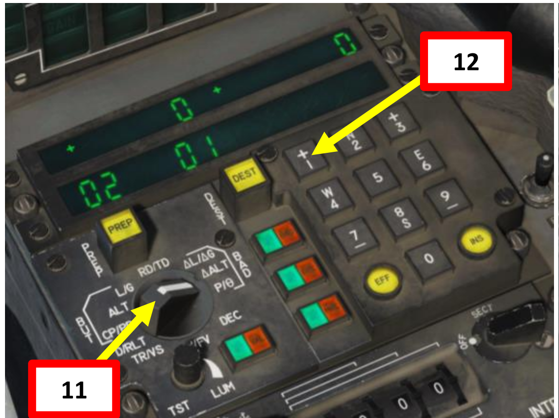
Target / BAD (Waypoint 2 Offset)

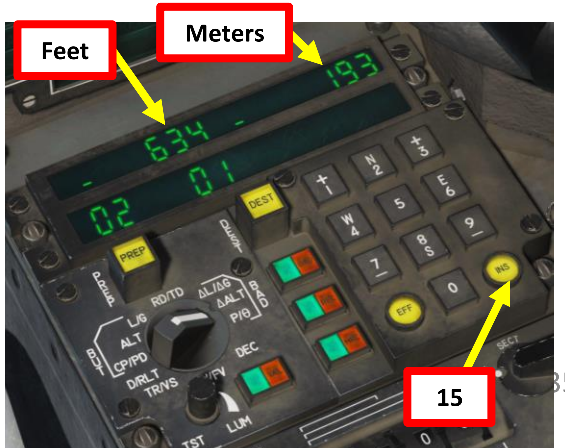
ρ/θ: Distance 4.05 nm / Bearing 222 deg

Δ ALT: WP2 Altitude – Target Altitude
= 674 ft – 40 ft = 634 ft





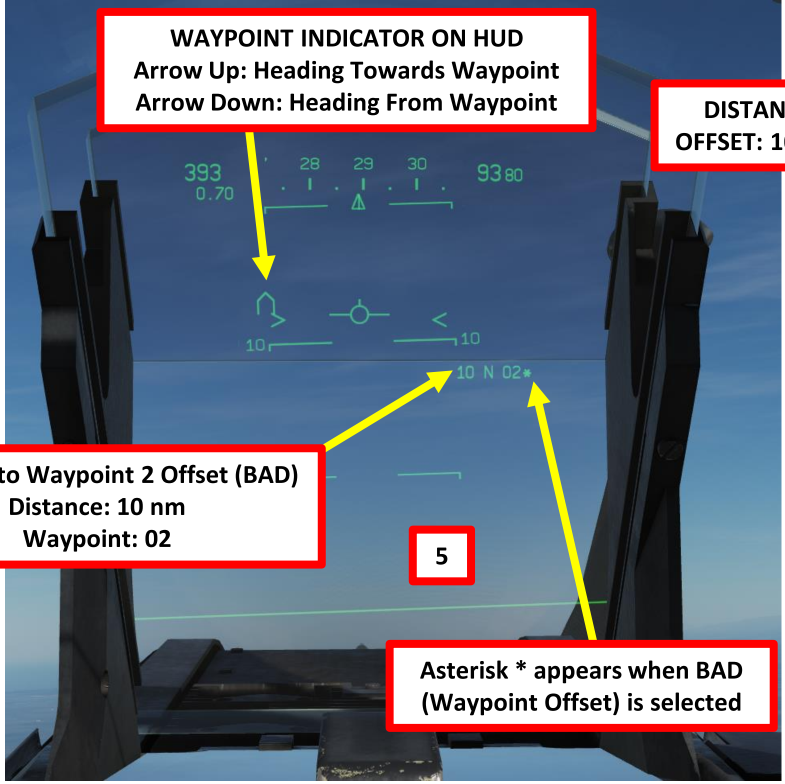


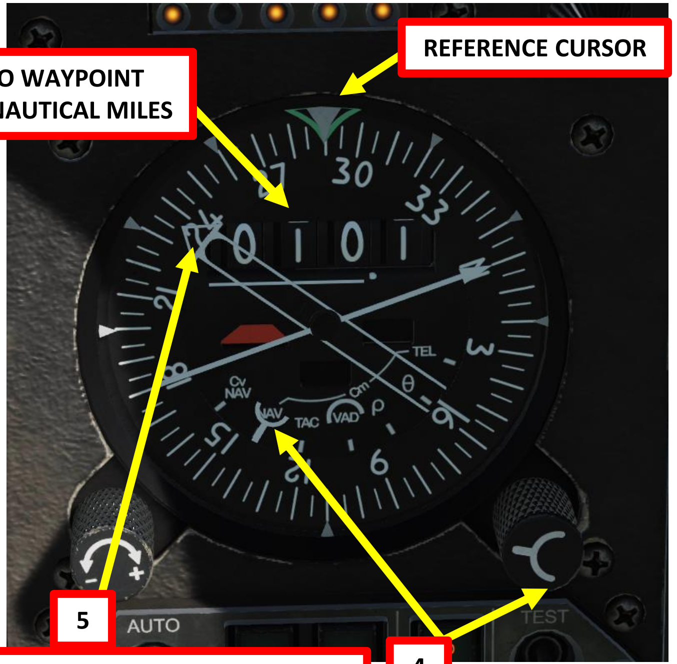


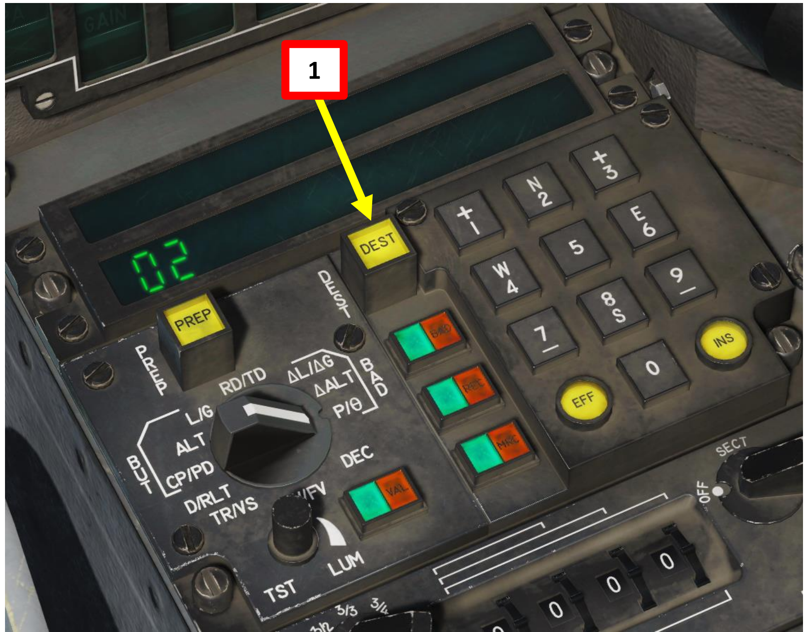
4.4 – WAYPOINT OFFSET (*BAD*) NAVIGATION TUTORIAL

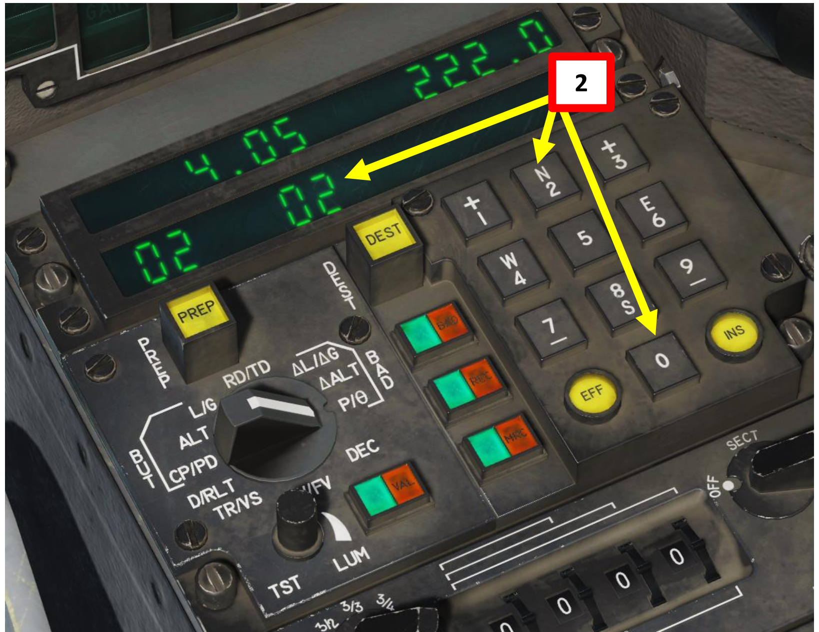
Once Waypoint Offset is created, you can navigate

1. Press "DEST" (Destination) button .
2. Press "0" and "2" (02) on the INS numpad to select Waypoint Number 2 (Reference Waypoint).
3. Press the BAD button. Button will illuminate once selected.
4. Set the HSI (Horizontal Situation Indication) mode to either "CV" (*Cap Vrai*: True Heading) or "CM" (*Cap Magnétique: Magnetic Heading*)
5. Follow the HSI main needle to your waypoint.







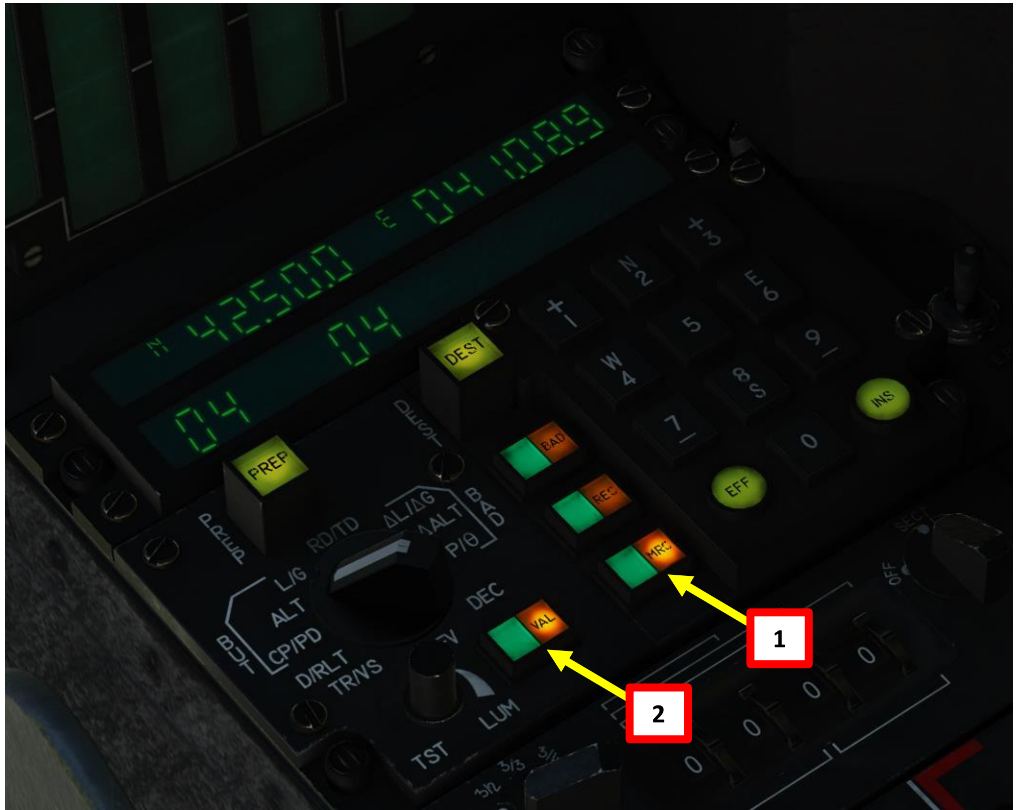


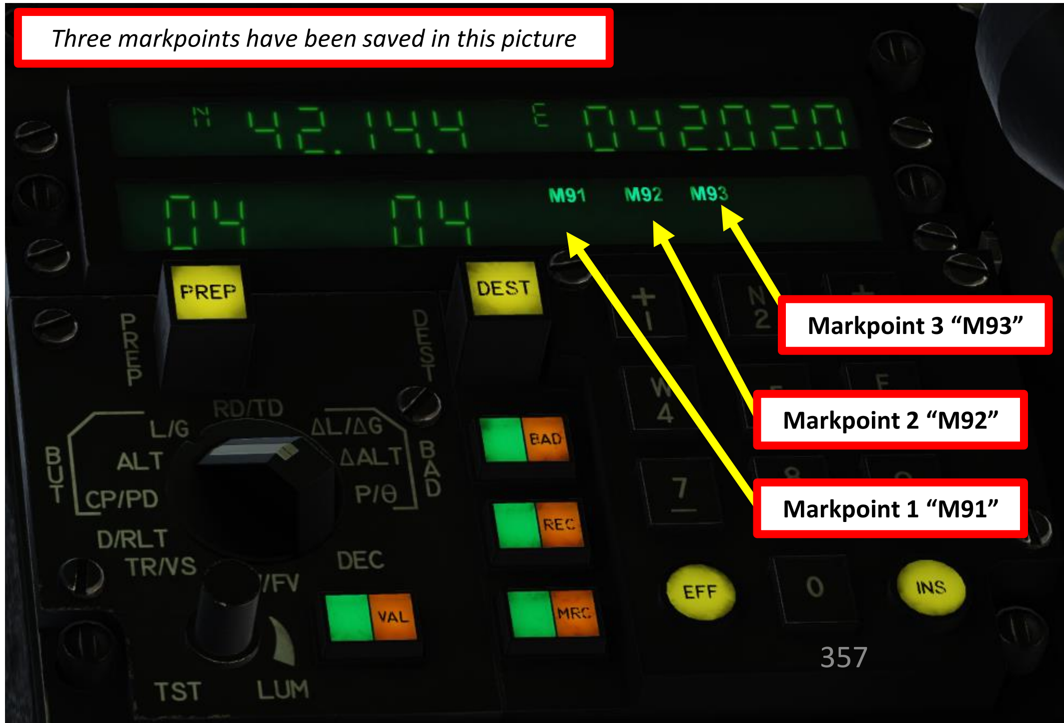
5.1 – MARKPOINTS (*MARQUEURS*)
HOW TO ADD MARKPOINTS

Markpoints (*Marqueurs*) are used to "mark" a point of interest, whether flying over an interesting area or an enemy sighting. They can be selected just like regular Waypoints.

You can add a maximum of three markpoints, numbered 91, 92 and 93. Markpoints coordinates cannot be modified or deleted: choose wisely!

1. As you overfly a point of interest, press the MRQ button to temporarily save the current aircraft coordinates. Both the MRQ and VAL buttons will then illuminate.
2. Press the VAL button to validate the coordinates saved at the moment of the MRQ button press.
3. A new Markpoint will then be created. If no markpoints are created, the “M91” light will then illuminate to tell you that Markpoint No. 91 is now saved in the Inertial Navigation System.
4. Keep in mind that each markpoint you create cannot be deleted or edited. Your second markpoint will be labeled “M92” and your third markpoint will be labeled “M93”.

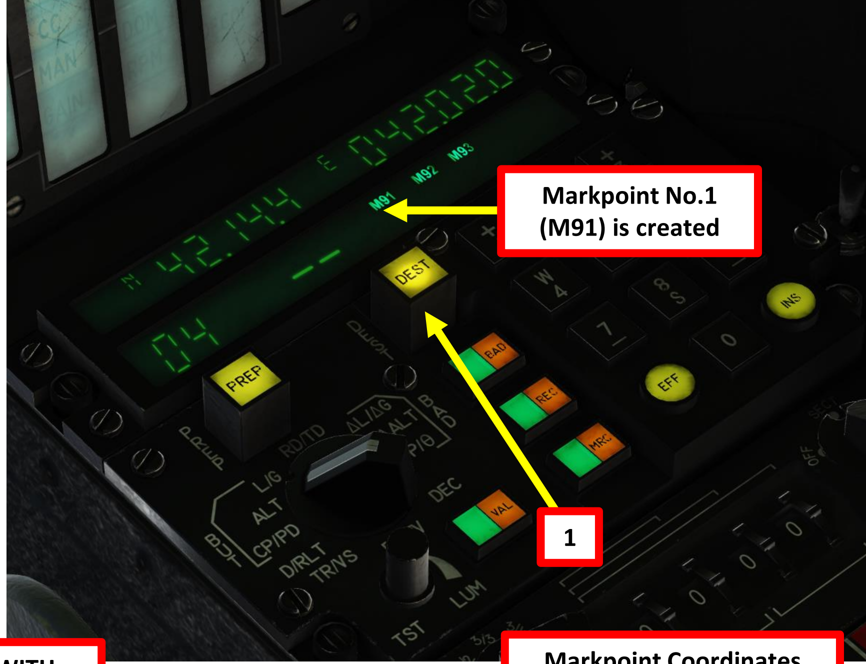


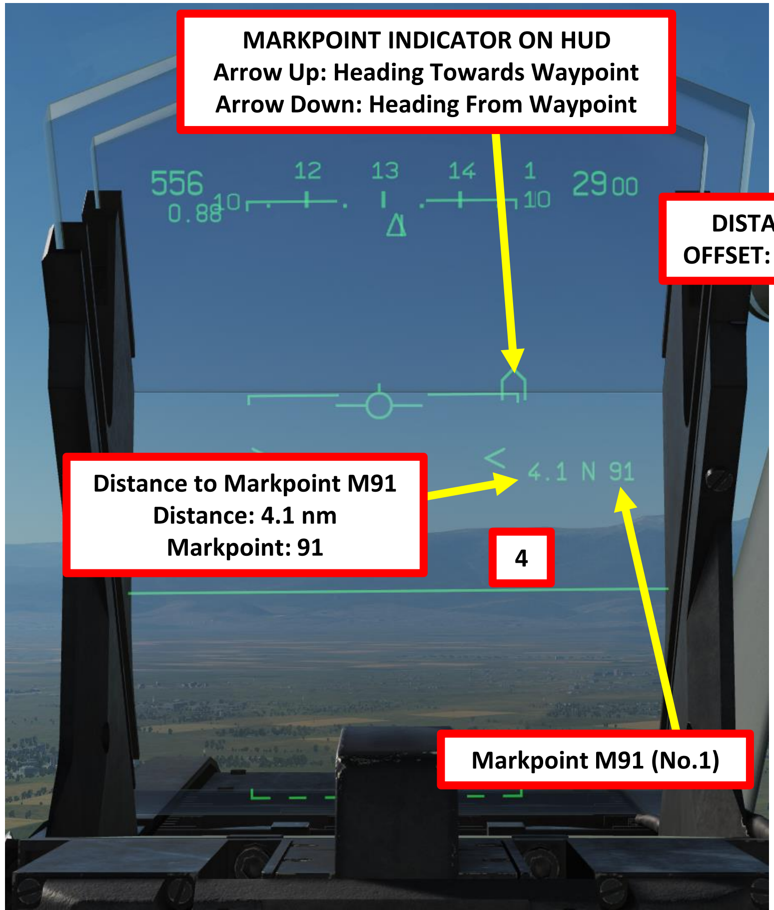


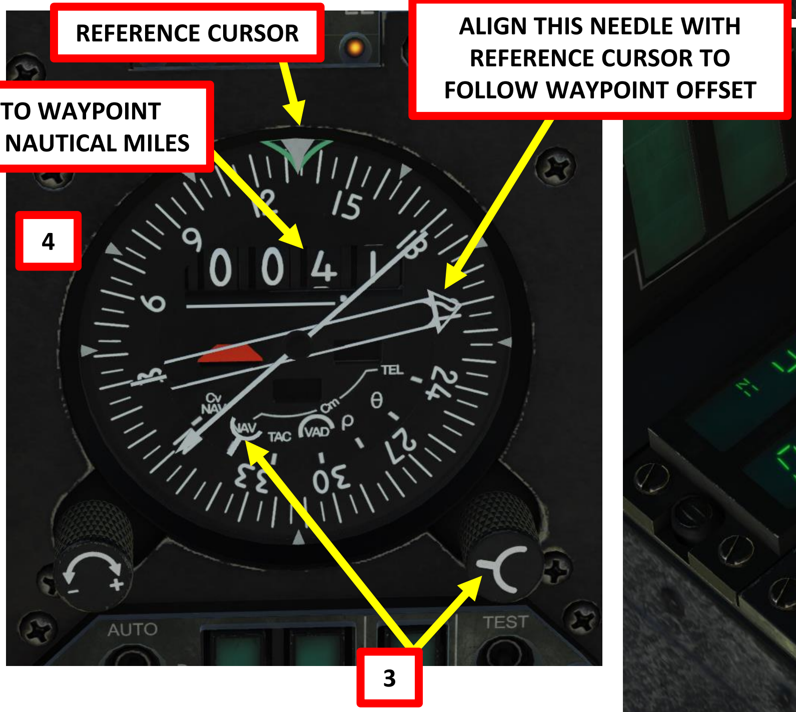
5.2 – MARKPOINTS (*MARQUEURS*)
MARKPOINT NAVIGATION TUTORIAL

You can use markpoints just like regular waypoints.

1. Press "DEST" (Destination) button .
2. To select Markpoint "M91" (Markpoint 1) press "9" and "1" (91) on the INS numpad to select Markpoint Number M91.
3. Set the HSI (Horizontal Situation Indication) mode to either "CV" (*Cap Vrai*: True Heading) or "CM" (*Cap Magnétique: Magnetic Heading*)
4. Follow the HSI main needle to your waypoint.

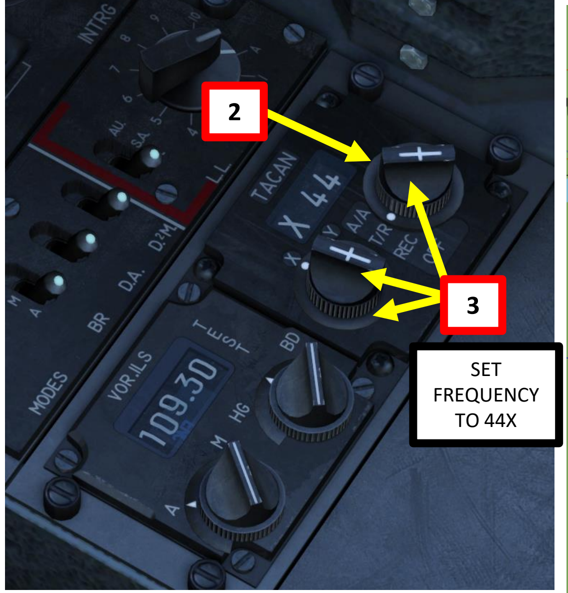


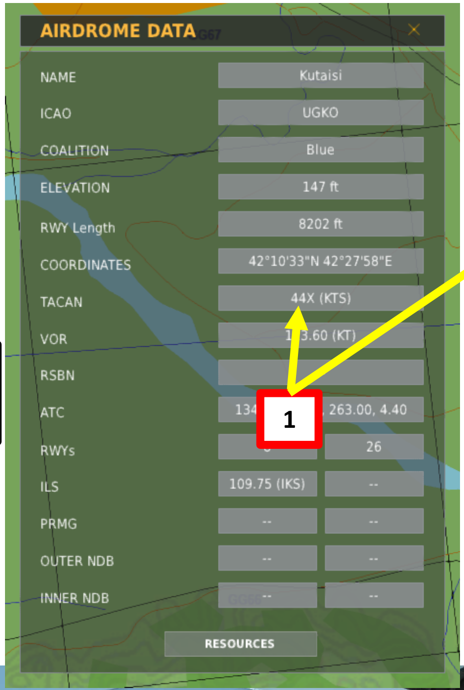


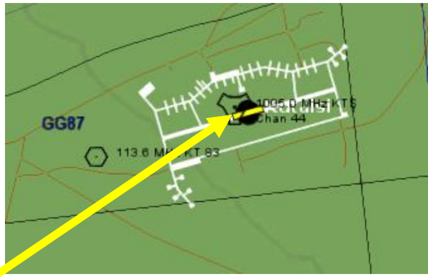


6.1 – TACAN NAVIGATION TUTORIAL

1. Press F10 to display the map, find the TACAN beacon that you want to track and note its frequency. In our case, we will track Kutaisi Airport's TACAN beacon. Its frequency is **44X**.
2. Set TACAN knob to **T/R** (Transmit-Receive)
3. Set TACAN frequency to 44X.
4. Set the HSI (Horizontal Situation Indication) mode to "TAC" (TACAN).
5. Follow HSI needle to the TACAN beacon. Both bearing and range information are available.



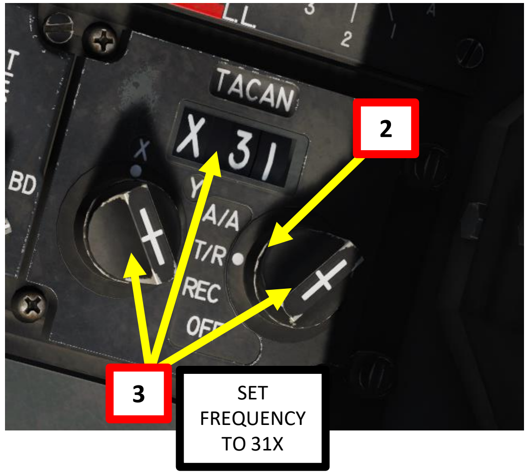


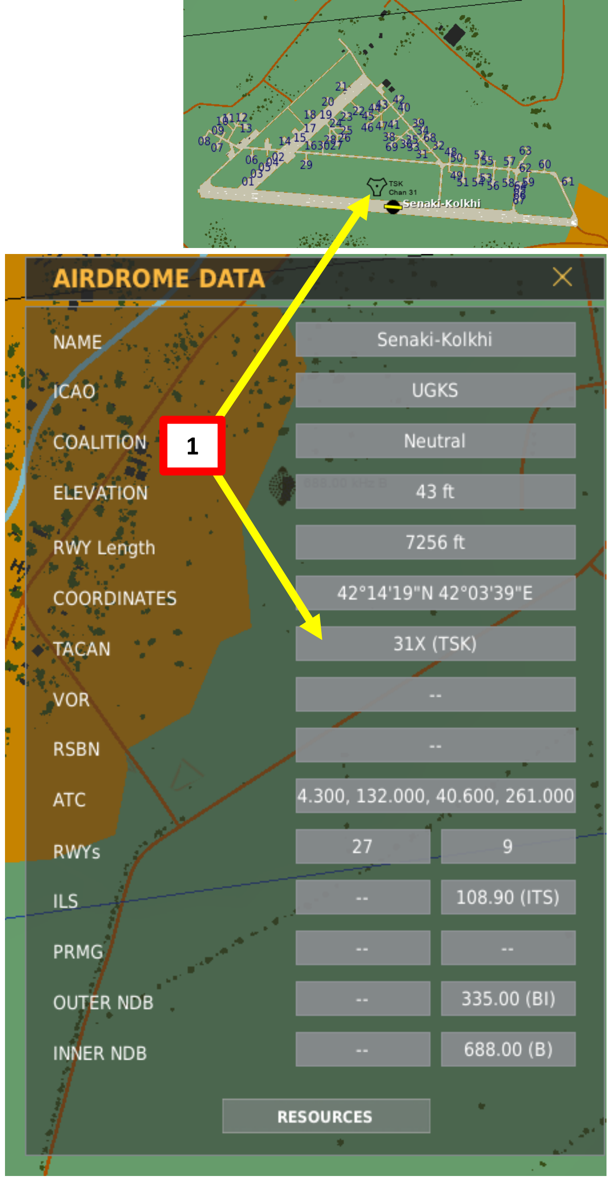


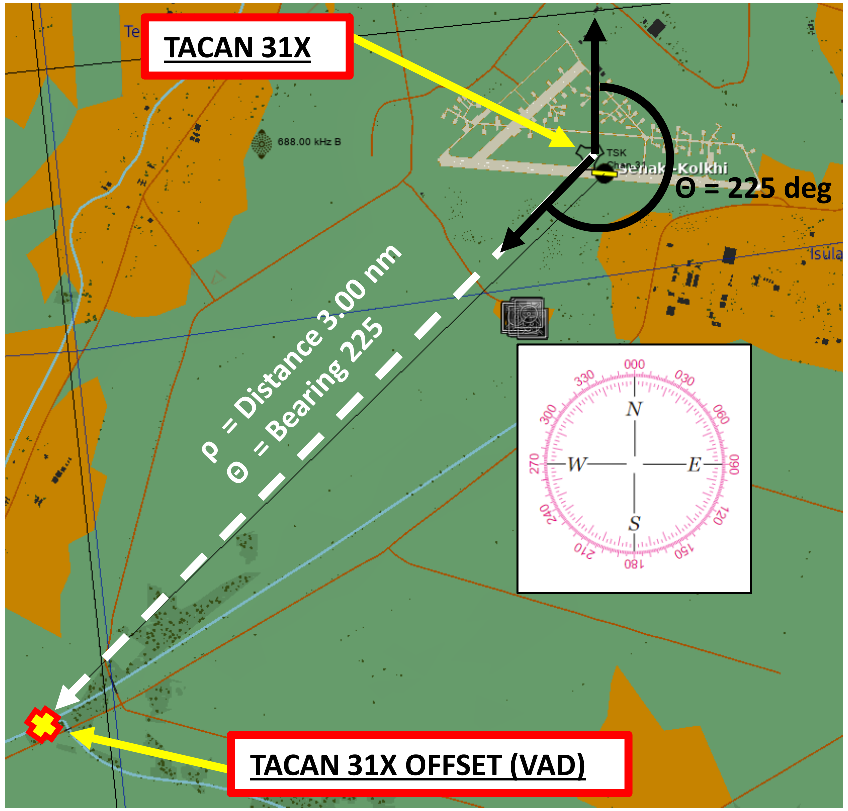
6.2 – TACAN OFFSET (VAD) TUTORIAL

The IDN (Indicateur de Navigation, or Horizontal Situation Indicator (HSI)) has a special navigation mode called VAD (*Vecteur Additionnel* / Additional Vector). The VAD is an offset point calculated from the position of the selected TACAN station.

1. Press F10 to display the map, find the TACAN beacon that you want to track and note its frequency. In our case, we will track Kutaisi Airport's TACAN beacon. Its frequency is **31X**.
2. Set TACAN knob to **T/R** (Transmit-Receive)
3. Set TACAN frequency to 31X.
4. Set the HSI (Horizontal Situation Indication) mode to "TAC" (TACAN) and Check that it is receiving signal from the TACAN station (the DME and Needle 1 flags should not be shown)
5. Our desired TACAN offset VAD is:
   - **ρ Distance Offset: 3.00 nautical miles FROM TACAN 31X**
   - **θ Bearing Offset: 225 degrees FROM TACAN 31X**

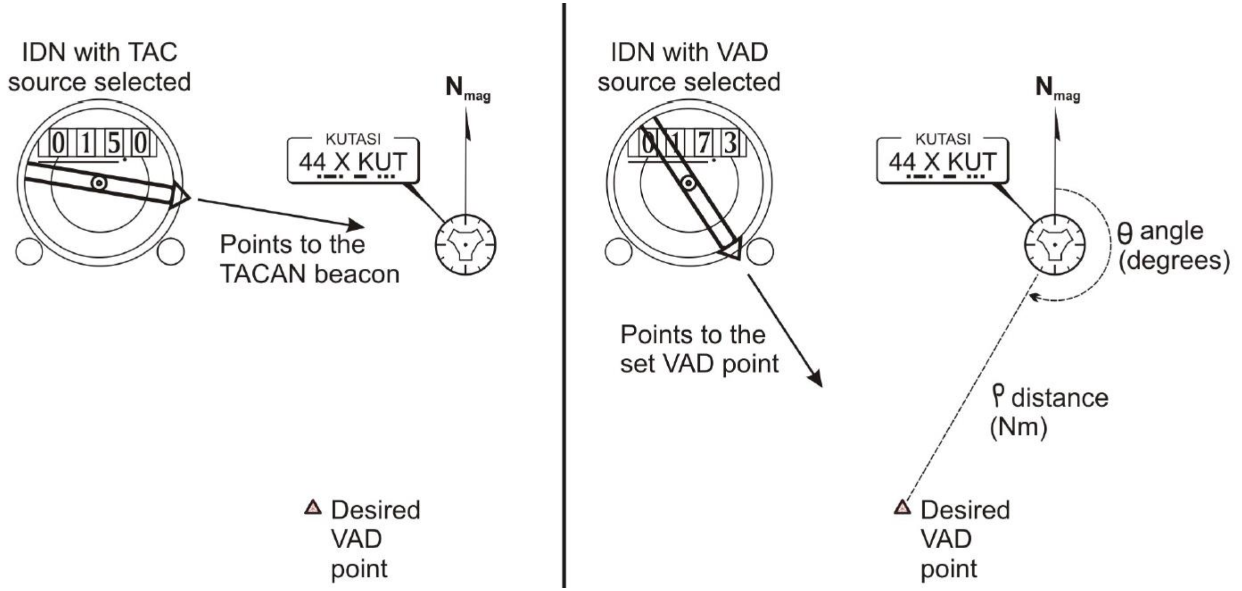


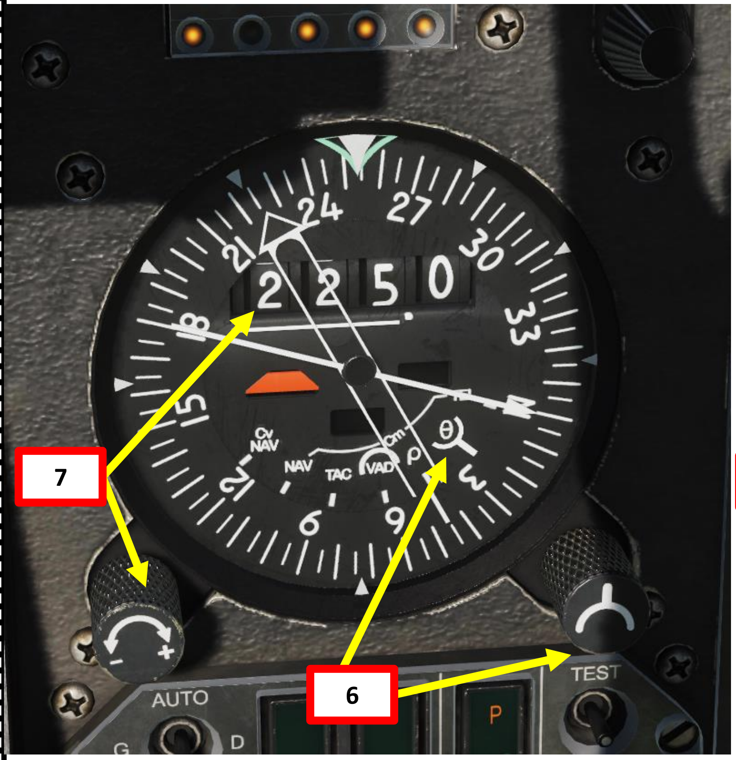


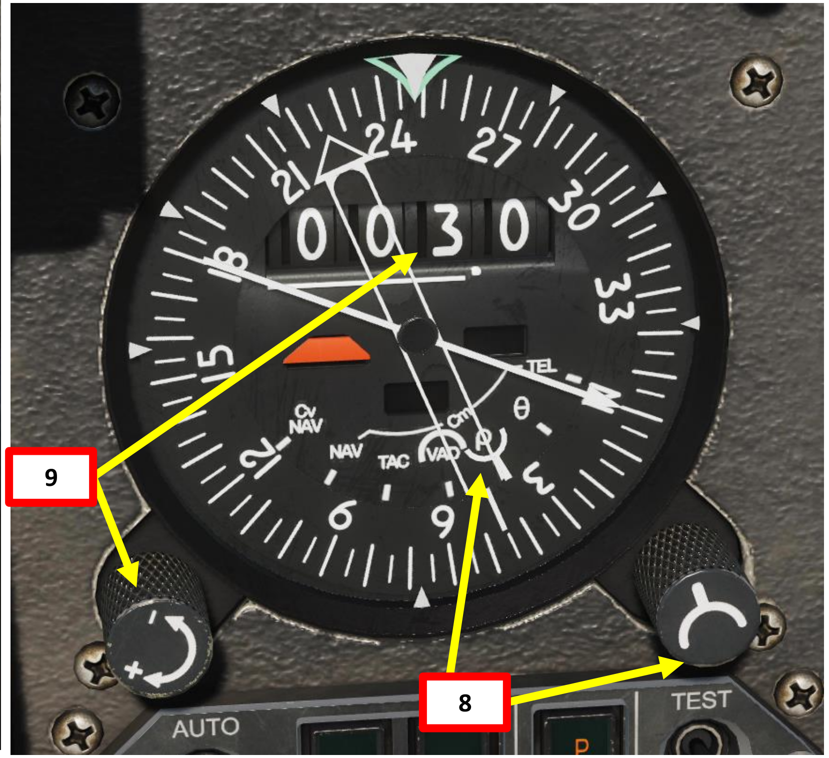


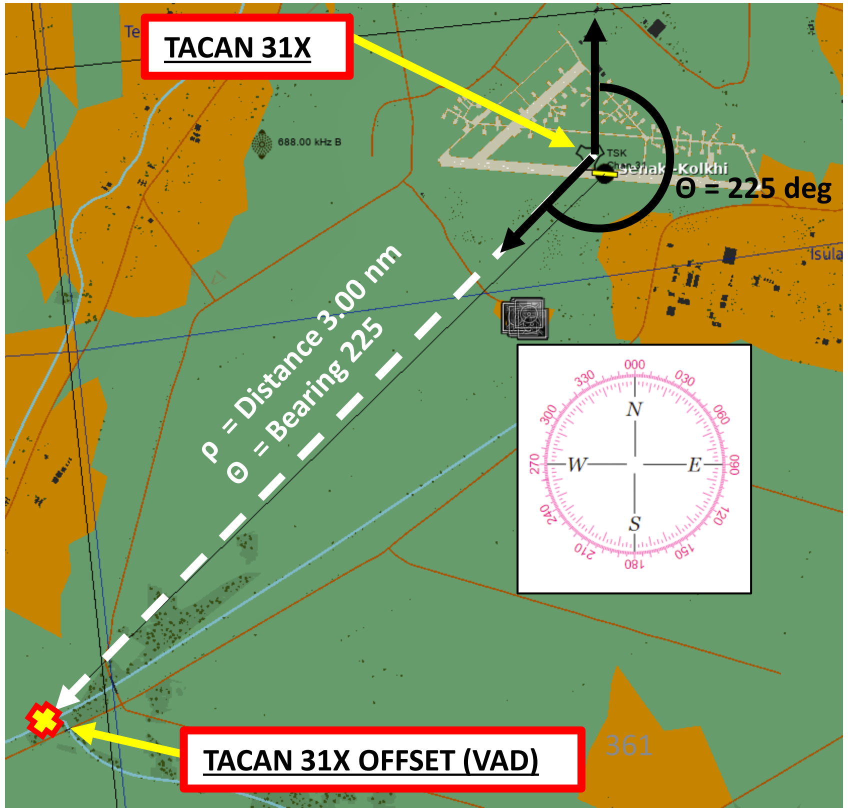
6.2 – TACAN OFFSET (VAD) TUTORIAL

5. Our desired TACAN offset VAD is:
   - **ρ Distance Offset: 3.00 nautical miles FROM TACAN 31X**
   - **θ Bearing Offset: 225 degrees FROM TACAN 31X**
6. Set the HSI in θ (Theta) mode. We will enter offset bearing from TACAN (deg).
7. Enter the desired magnetic bearing (225) from the TACAN station to the VAD by rotating the VAD input knob
8. Set the HSI in ρ (Rho) mode. We will enter offset distance from TACAN (nm).
9. Enter the distance from the TACAN station (3.00 nm) to the VAD (offset point) by rotating the VAD input knob.



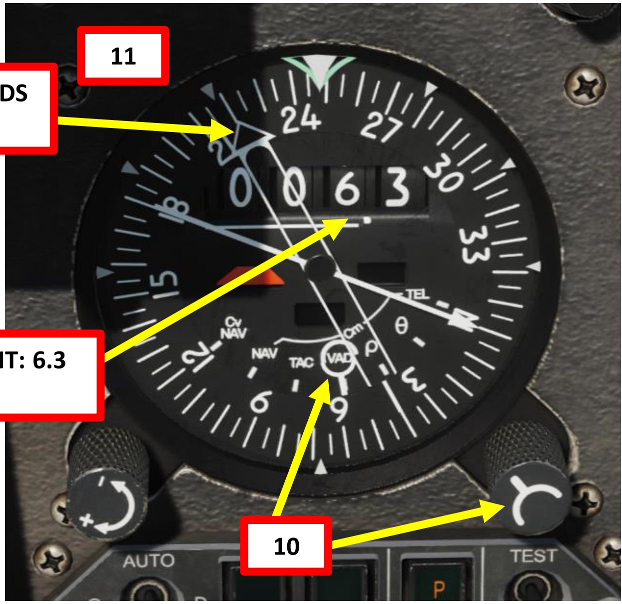


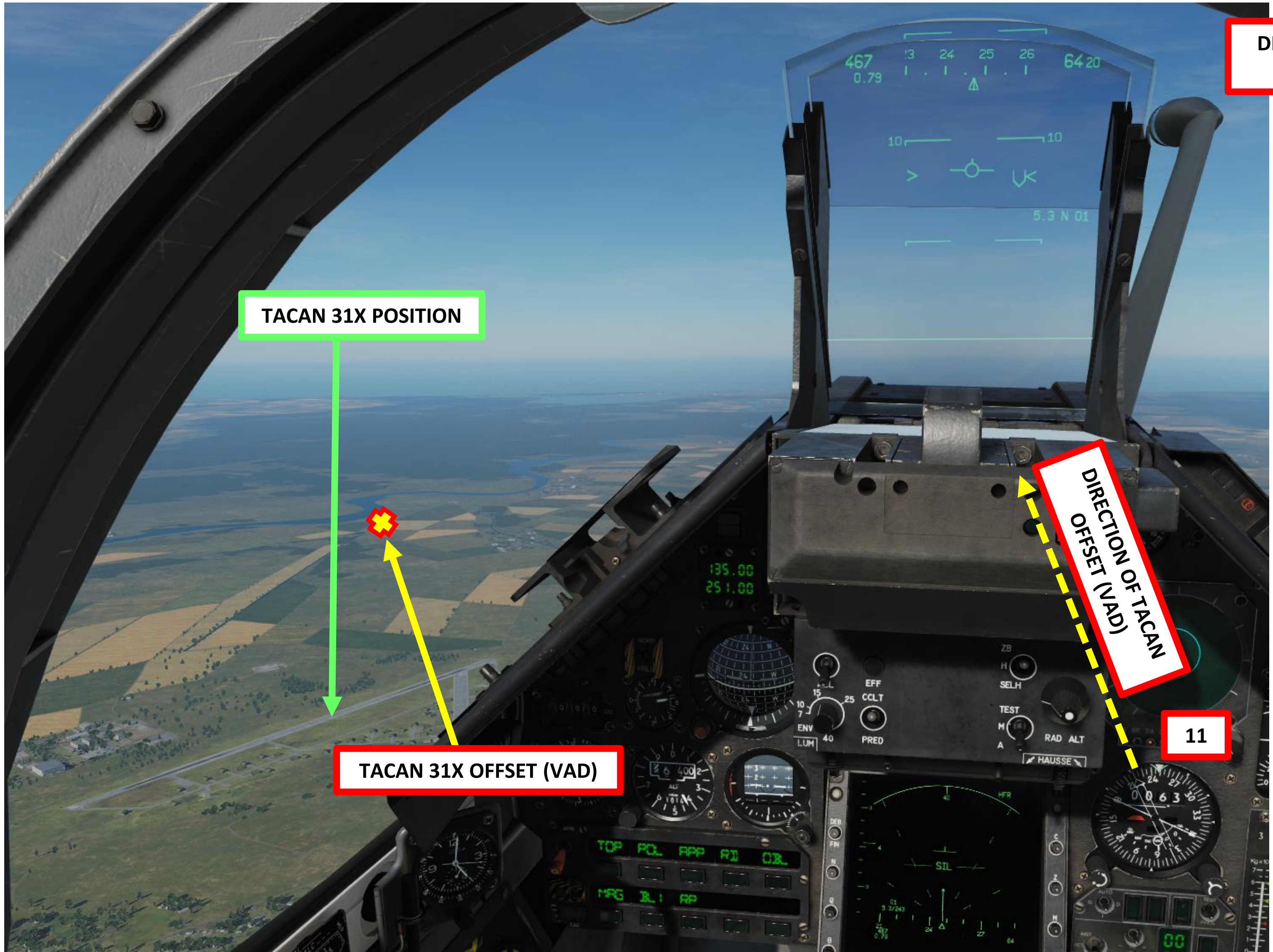


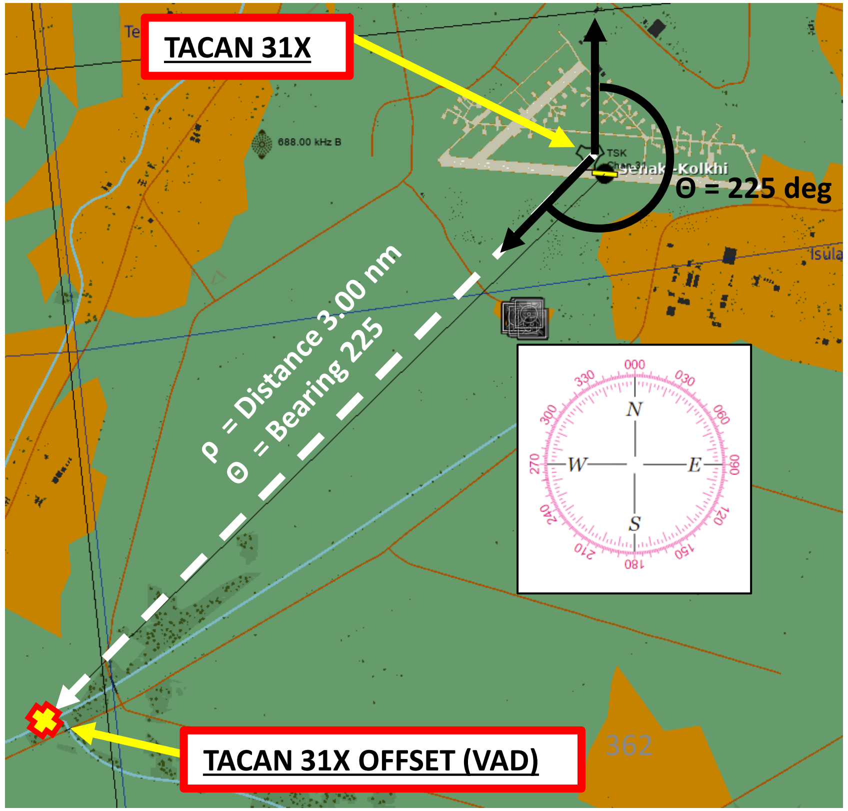


6.2 – TACAN OFFSET (VAD) TUTORIAL

10. Place the HSI in VAD mode. The system will calculate the geographical position of the offset point from the current aircraft position: The Needle 1 indicator will show the magnetic bearing to the Desired VAD point and the DME indicator will show the distance in nautical miles
11. Follow HSI needle to the TACAN beacon. Both bearing and range information are available.

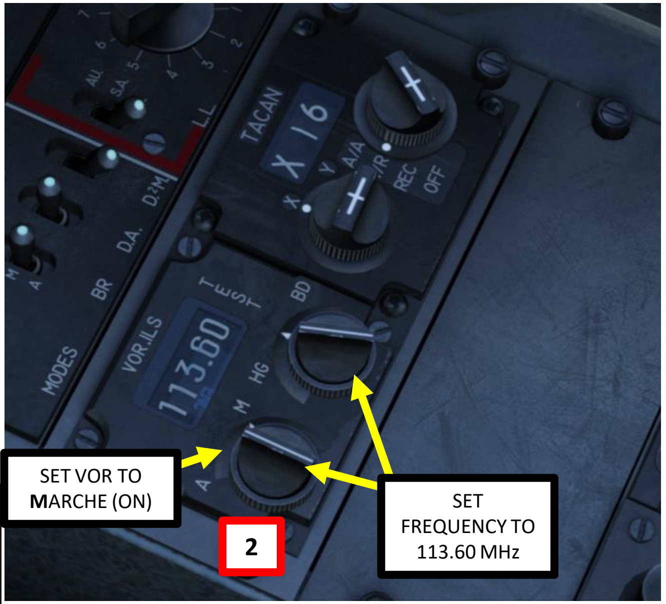


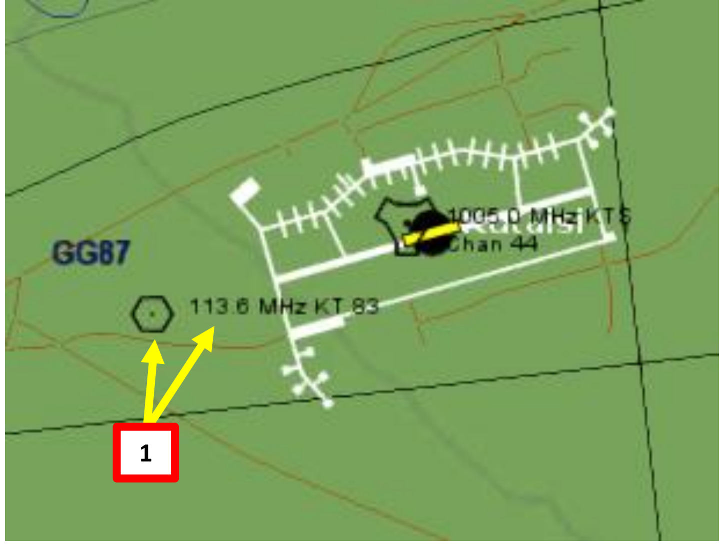


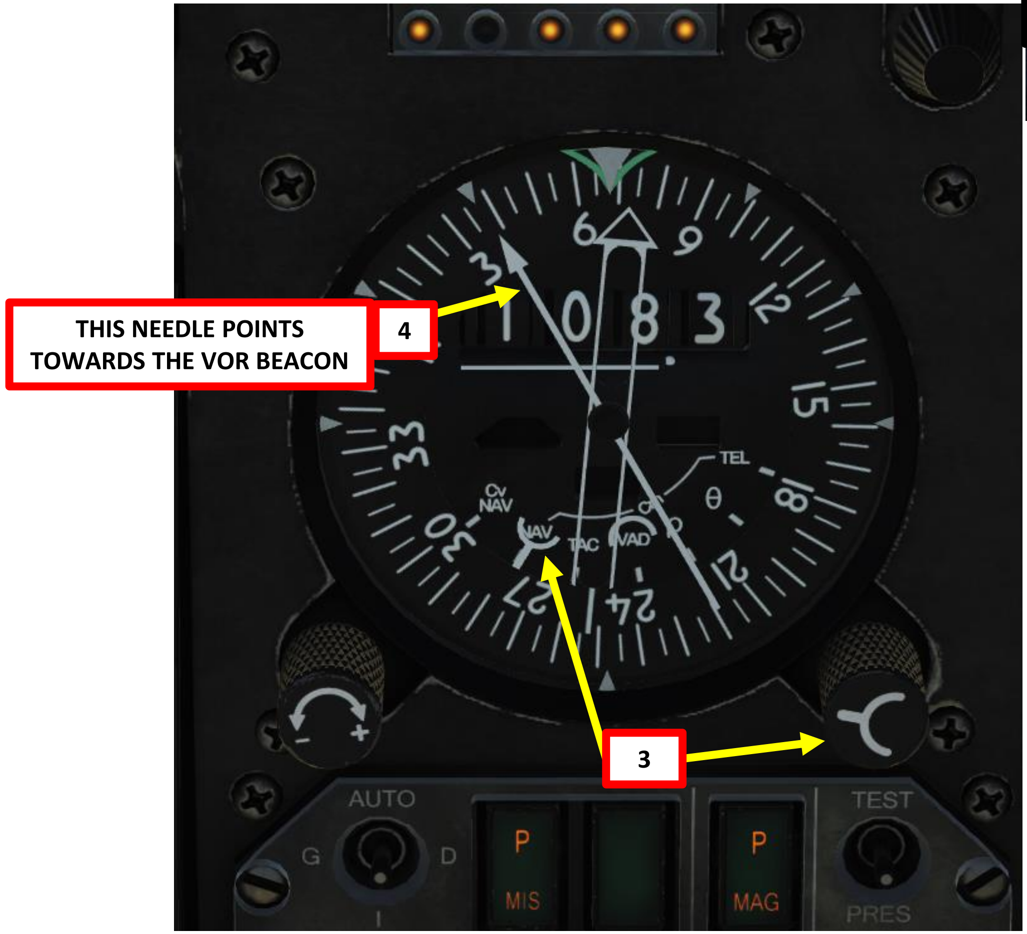


7 – VOR NAVIGATION TUTORIAL

1. Press F10 to display the map, find the VOR beacon that you want to track and note its frequency. In our case, we will track a VOR beacon near Kutaisi. Its frequency is **113.60 MHz**.
2. Set VOR/ILS to **M**ARCHE (ON) using left mouse button and set VOR frequency to 113.60.
3. Set the HSI (Horizontal Situation Indication) mode to either "Cv NAV" (True Heading) or "Cm NAV" (Magnetic Heading).
4. Follow the HSI thin needle to your VOR beacon. Bearing information is available, but no range information.







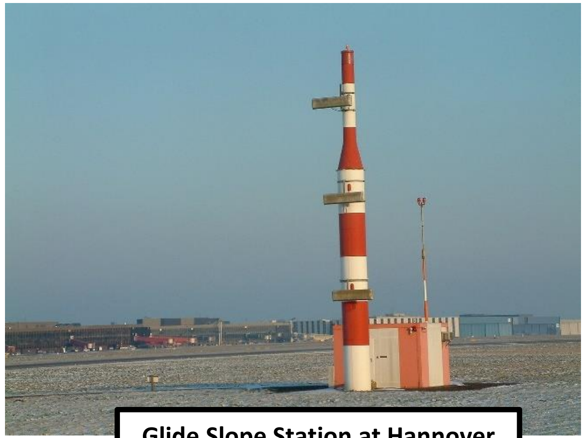
8 – ILS LANDING WITH SYNTHETIC RUNWAY

The ILS (Instrument Landing System) exists to guide you during your approach.

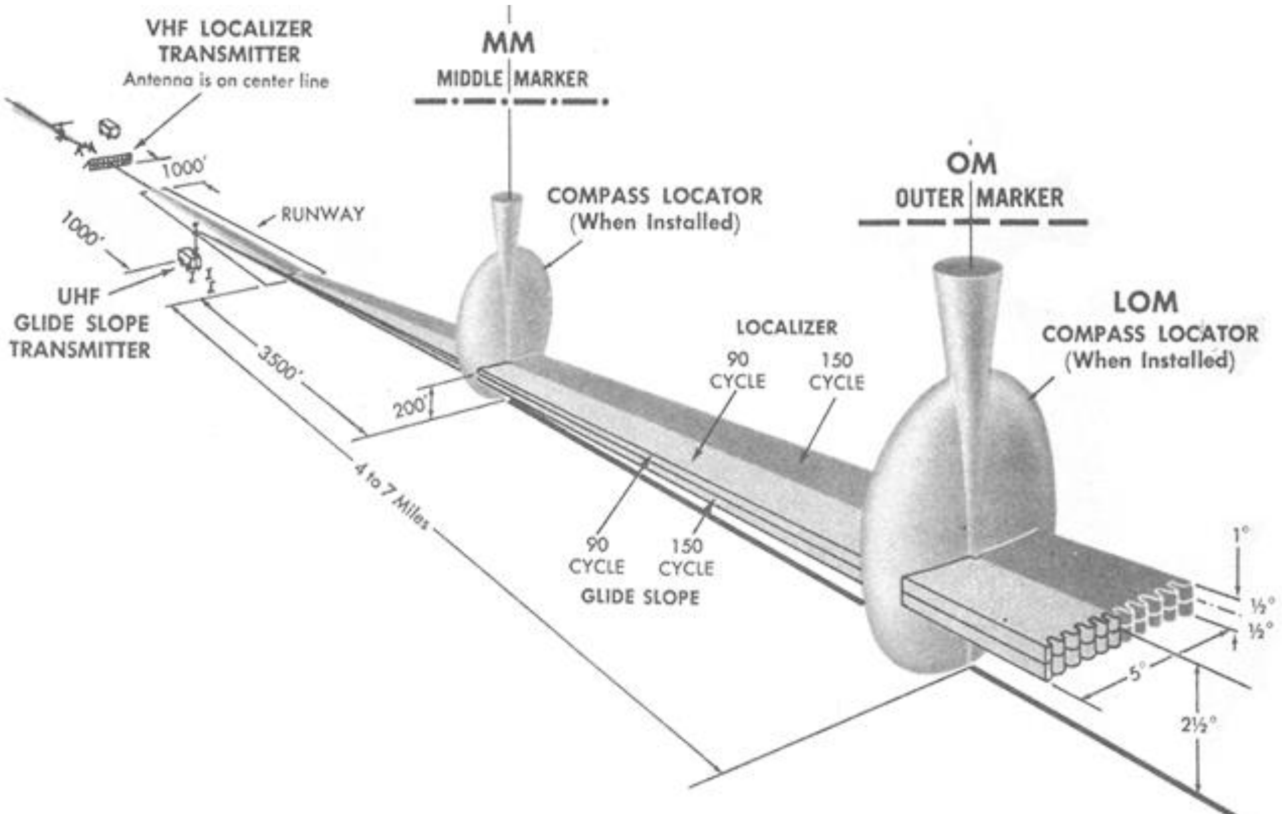
The Localizer is generally an array of antennas that will give you a lateral reference to the center of the runway.

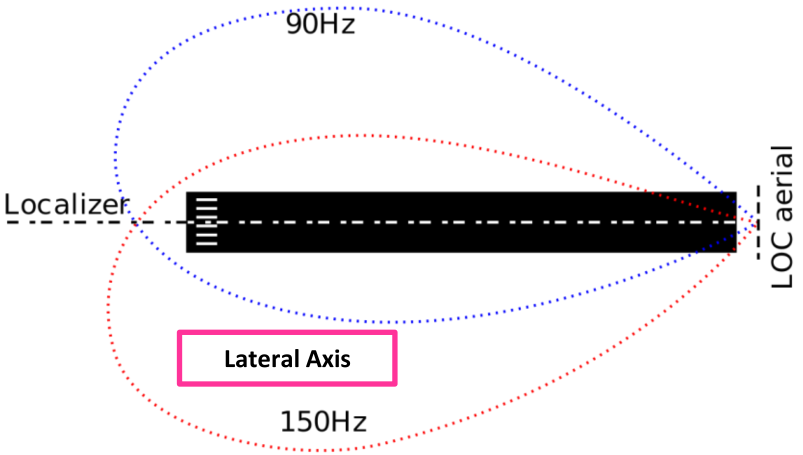
The Glide Slope station will help you determine the descent speed you need in order to not smack the runway in a smoldering ball of fire.


Localizer Array Station at Hannover

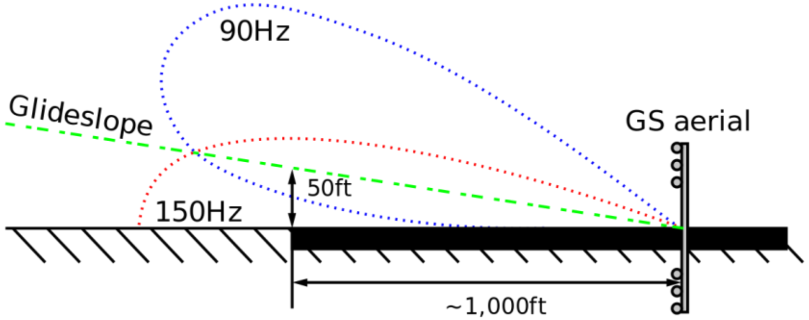

Glide Slope Station at Hannover

Great video explanation of ILS
https://www.youtube.com/watch?v=KVtEfDcNMO8





Lateral Axis

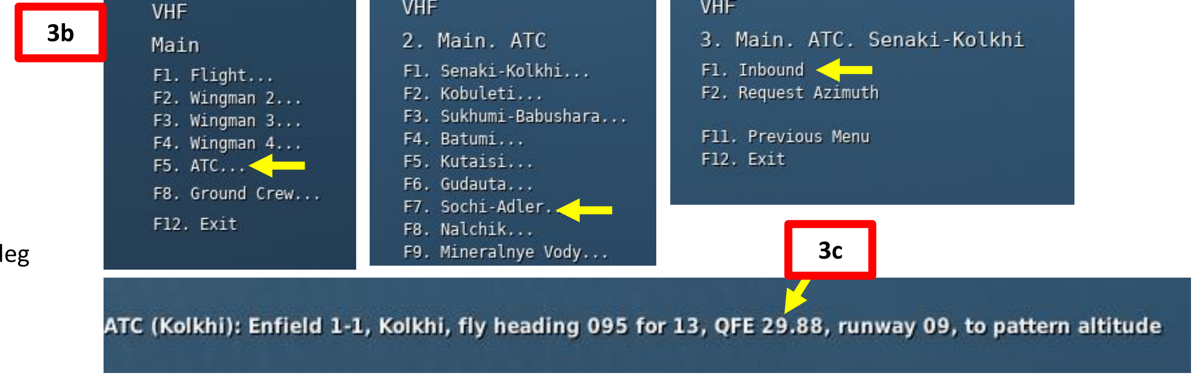


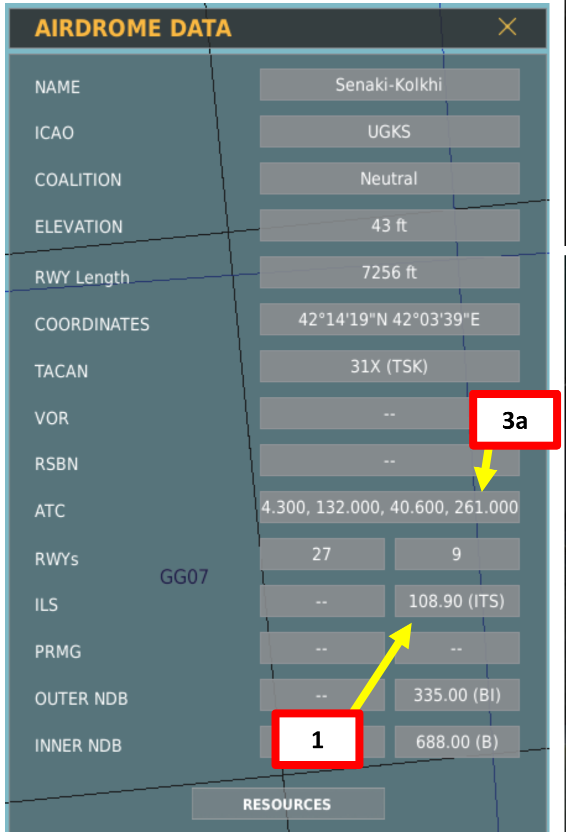
Vertical Axis

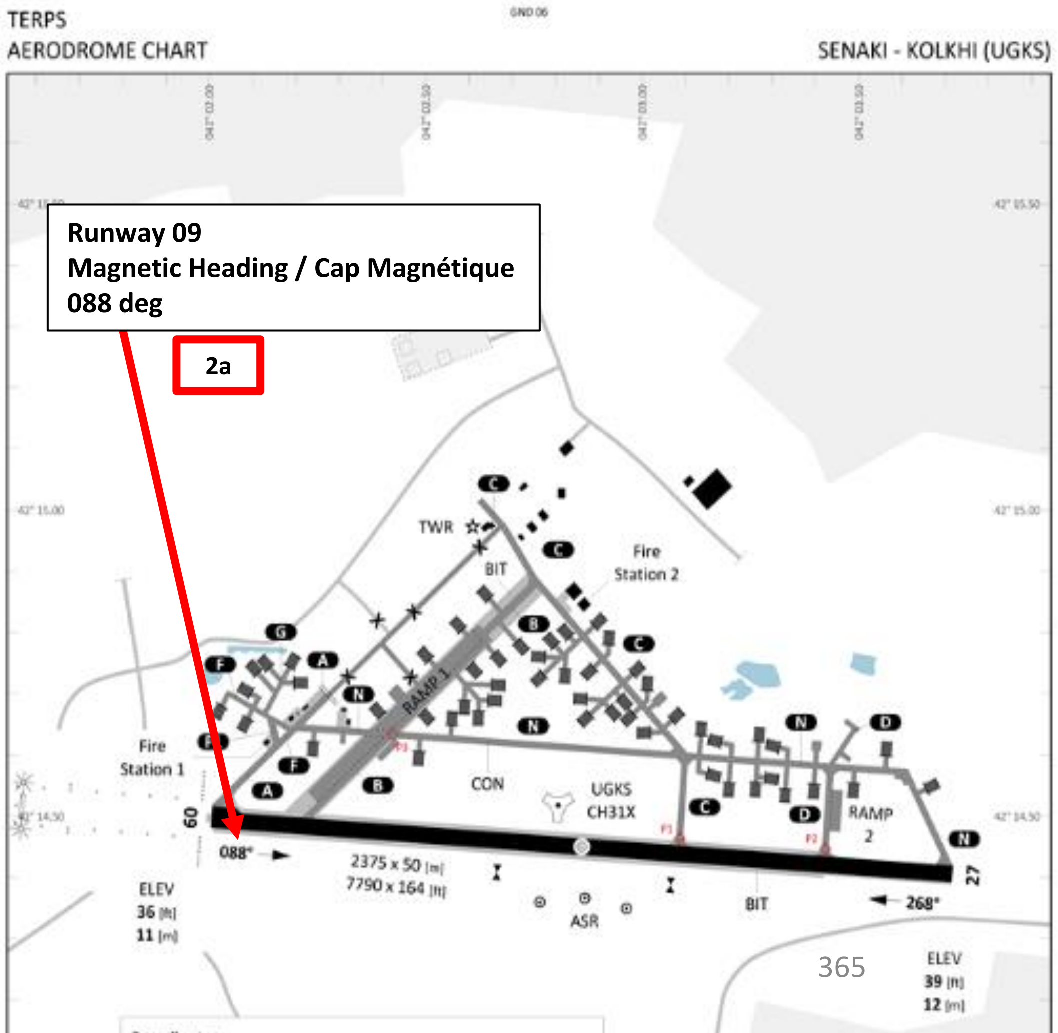
8 – ILS LANDING WITH SYNTHETIC RUNWAY

In order to use the Synthetic Runway, you need to know the following information:

1. **ILS Frequency of the runway** (accessible through F10 map): **108.90 MHz** for Senaki's Runway 09
2. **True** Heading (*Cap Vrai*) of the runway.
    a) Find the Magnetic Heading of the runway on an airfield chart (088 Magnetic in our case)
    b) Find the magnetic declination (set UNI Parameter Selector Switch to DEC), which is +6.6 deg
    c) True Heading = Magnetic Heading + Magnetic Declination
    = 088 + 6.6 = **94.6 deg True Heading**
3. **QFE** (air pressure at the airport's ground level).
    a) Contact the Tower (Frequency is available via F10 map): 261.00 MHz for Senaki Tower
    b) Request Landing (ATC – Senaki-Kolkhi – Inbound)
    c) Tower will give you a QFE Setting: 29.88 in Hg in our case.
    d) Convert QFE setting from inches of Hg into mBar: 29.88 in Hg = **1012 mBar**. See next page for conversion table.







8 – ILS LANDING WITH SYNTHETIC RUNWAY

Here is a quick conversion table to get a QFE setting from inches of Hg into hPa. The Air Traffic Controller within DCS gives a QFE in inches of Mercury, while the barometric pressure setting in the Mirage is in mBar (hPa). Therefore: 29.88 in Hg = **1012 mBar**

4. Set Barometric Pressure Setting on the altimeter to the QFE value in mBar given by the ATC. In our case, we will set a Barometric pressure of 1021 mBar.

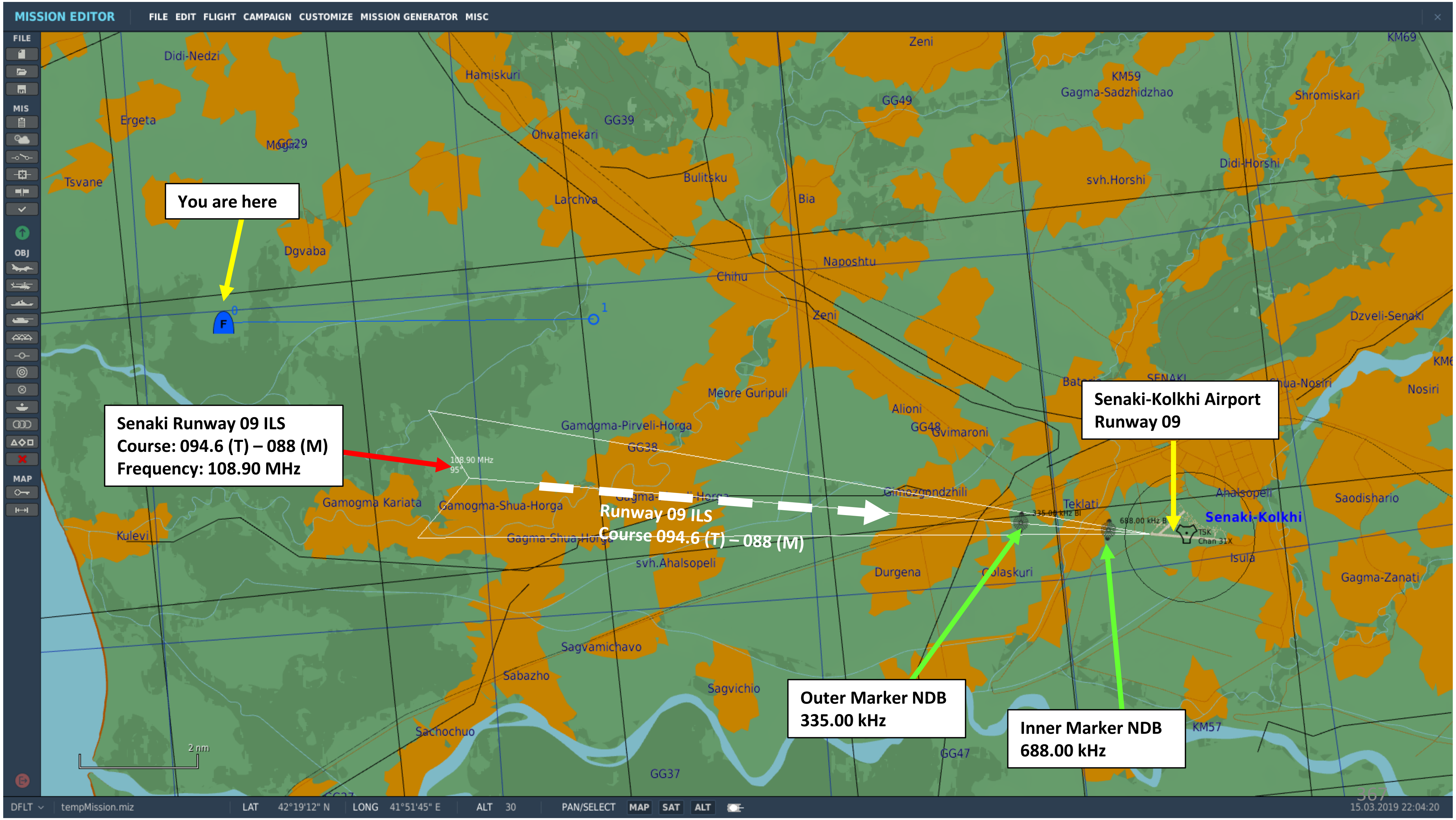
Barometric Pressure Conversion Table

1 in Hg = 33.8639 mBar

1 mBar = 0.02953 in Hg

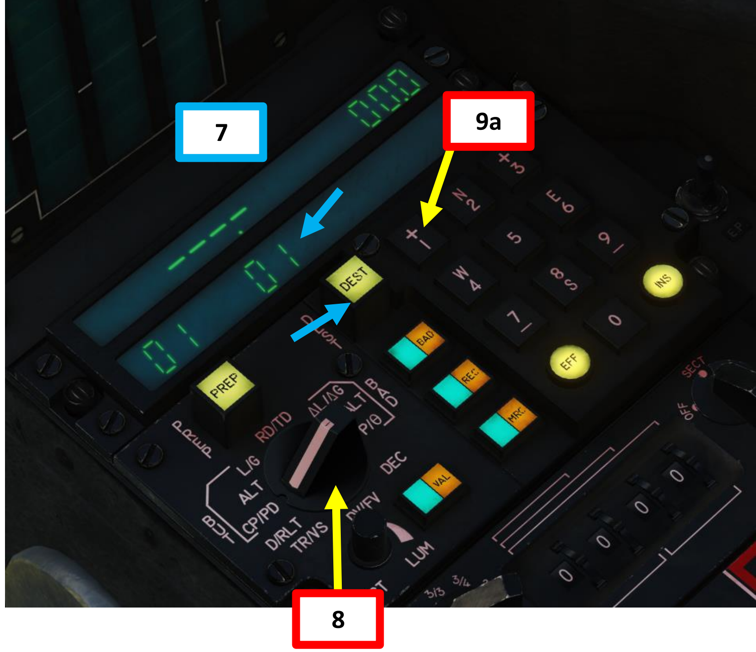
in Hg	mBar	in Hg	mBar	in Hg	mBar	in Hg	mBar
28.05	950	28.79	975	29.53	1000	30.27	1025
28.08	951	28.82	976	29.56	1001	30.30	1026
28.11	952	28.85	977	29.59	1002	30.33	1027
28.14	953	28.88	978	29.62	1003	30.36	1028
28.17	954	28.91	979	2965	1004	30.39	1029
28.20	955	28.94	980	29.68	1005	30.42	1030
28.23	956	28.97	981	29.71	1006	30.45	1031
28.26	957	29.00	982	29.74	1007	30.47	1032
28.29	958	29.03	983	29.77	1008	30.50	1033
28.32	959	29.06	984	29.80	1009	30.53	1034
28.35	960	29.09	985	29.83	1010	30.56	1035
28.38	961	29.12	986	29.85	1011	30.59	1036
28.41	962	29.15	987	29.88	1012	30.62	1037
28.44	963	29.18	988	**29.92**	**1013.25**	30.65	1038
28.47	964	29.21	989	29.94	1014	30.68	1039
28.50	965	29.23	990	29.97	1015	30.71	1040
28.53	966	29.26	991	30.00	1016	30.74	1041
28.56	967	29.29	992	30.03	1017	30.77	1042
28.59	968	29.32	993	30.06	1018	30.80	1043
28.61	969	29.35	994	30.09	1019	30.83	1044
28.64	970	29.38	995	30.12	1020	30.86	1045
28.67	971	29.41	996	30.15	1021	30.89	1046
28.70	972	29.44	997	30.18	1022	30.92	1047
28.73	973	29.47	998	30.21	1023	30.95	1048
28.76	974	29.50	999	30.24	1024	30.98	1049
						31.01	1050

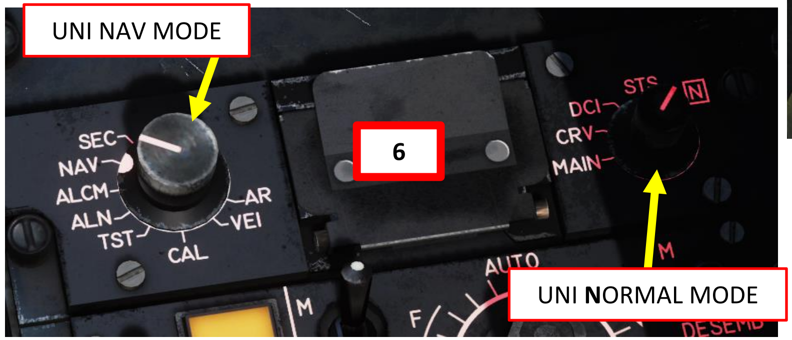
8 – ILS LANDING WITH SYNTHETIC RUNWAY

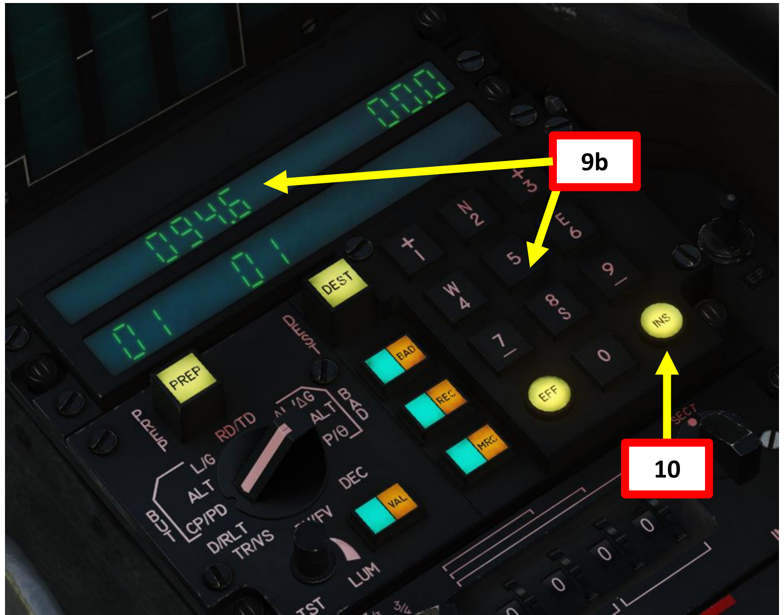


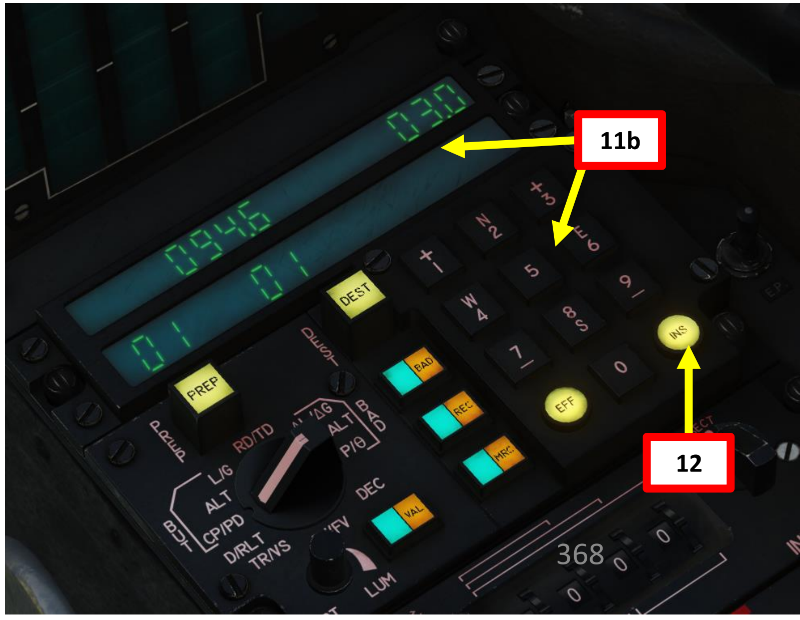
8 – ILS LANDING WITH SYNTHETIC RUNWAY

5. Set VOR/ILS to **M**ARCHE (ON) using left mouse button and set ILS frequency to 108.90 MHz.
6. Ensure UNI/INS Mode is set to “NAV” and “**N**ORMAL”
7. Select any “DEST” waypoint on the PCN (set to 01 in our case).
8. Set UNI Parameter Selector Switch to CP/PD (*Cap Vrai Piste / Pente Désirée*, Runway True Heading / Desired Glide Slope)
9. Enter True Heading to Runway (94.6). Select left field by pressing “+1”, then enter heading as follows: “0946” for Heading 094.6.
10. Press INS (Insert) to enter Runway Heading (or EFF to erase if you made a mistake and need to start over).
11. Enter Desired Glide Slope (3 degrees is standard). Select right field by pressing “+3”, then enter glide slope as follows: “030” for a glide slope of 3.0 degrees.
12. Press INS (Insert) to enter Glide Slope (or EFF to erase if you made a mistake and need to start over).



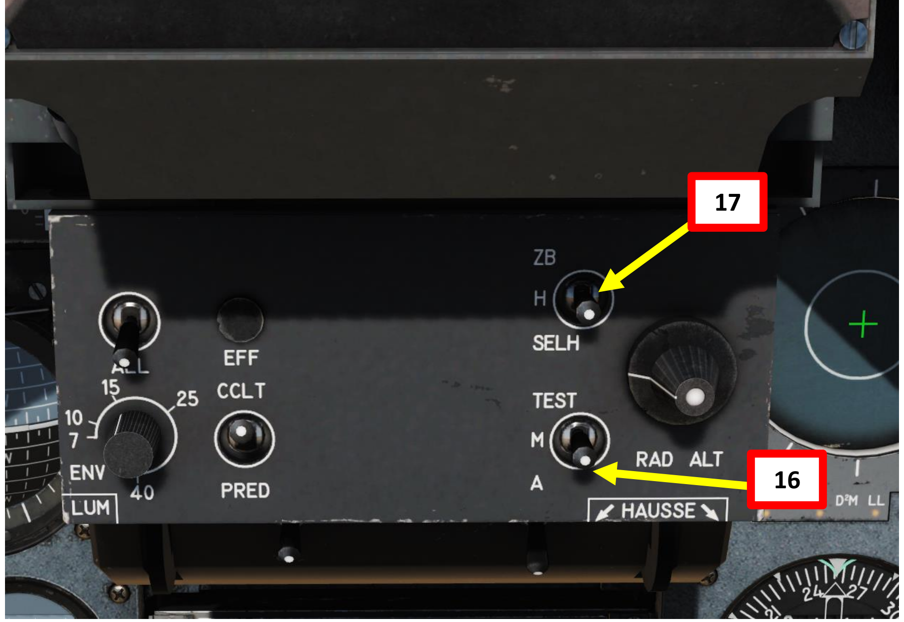


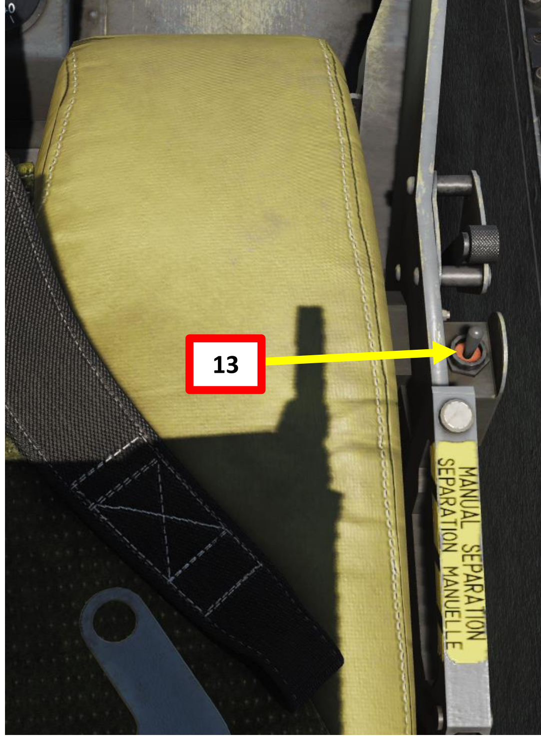


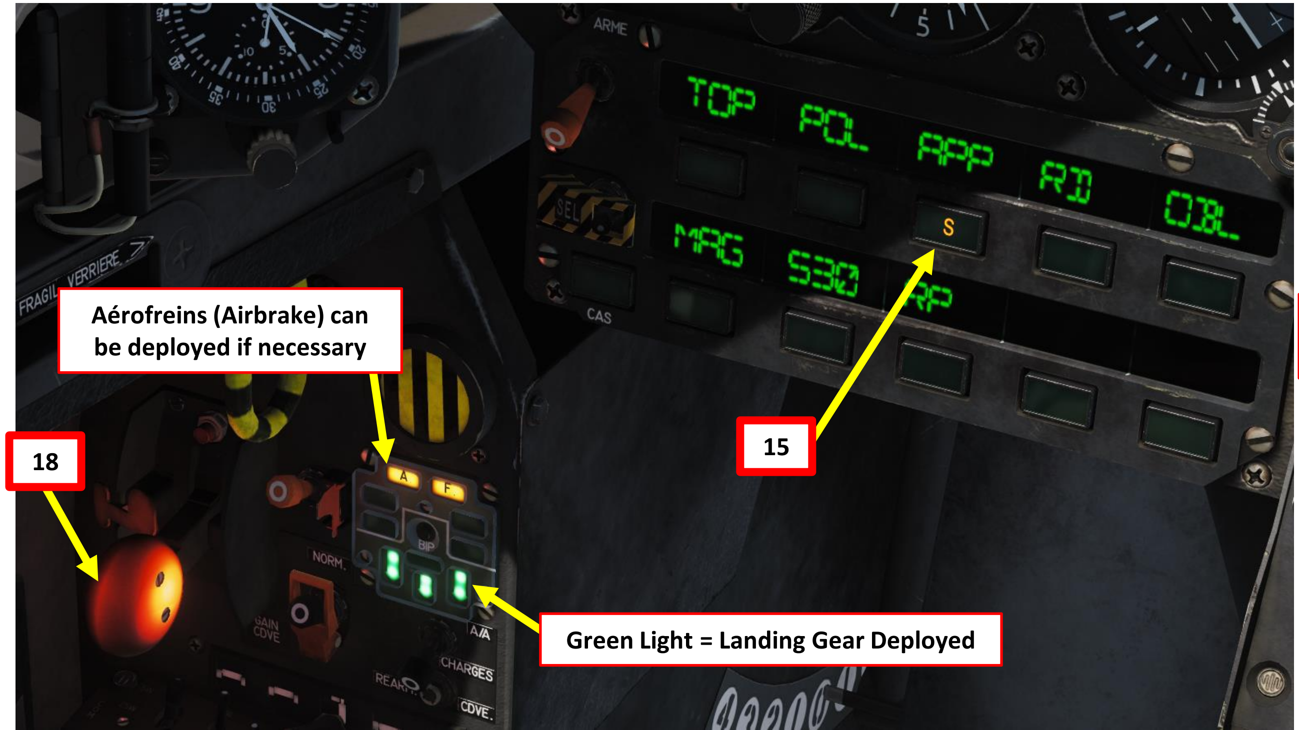


8 – ILS LANDING WITH SYNTHETIC RUNWAY

13. Adjust seat height
14. Select Navigation Master Mode by setting the Weapons System CMD Switch AFT.
15. Select APPROACH mode on PCA (yellow "S" caution when engaged)
16. Set Radar Altimeter Power Switch to M (Marche/ON).
17. Set VTH Mode Switch to H (Height/Radar Altimeter)
18. Deploy landing gear below 230 kts



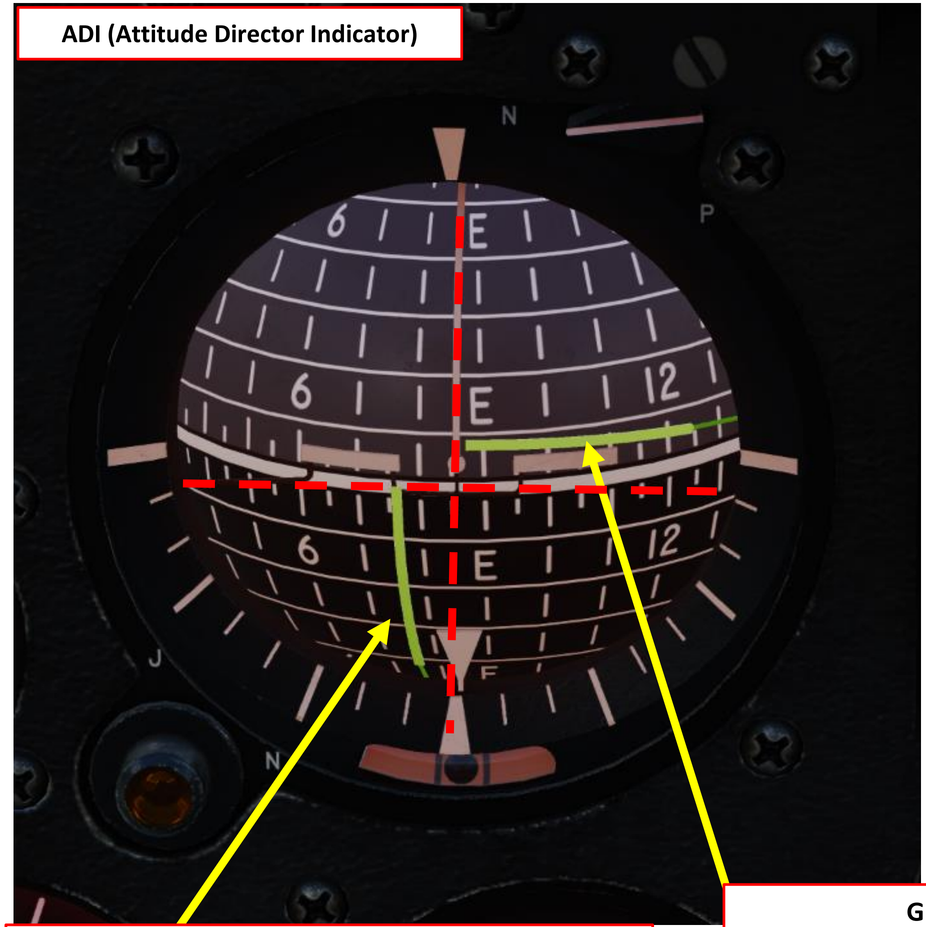


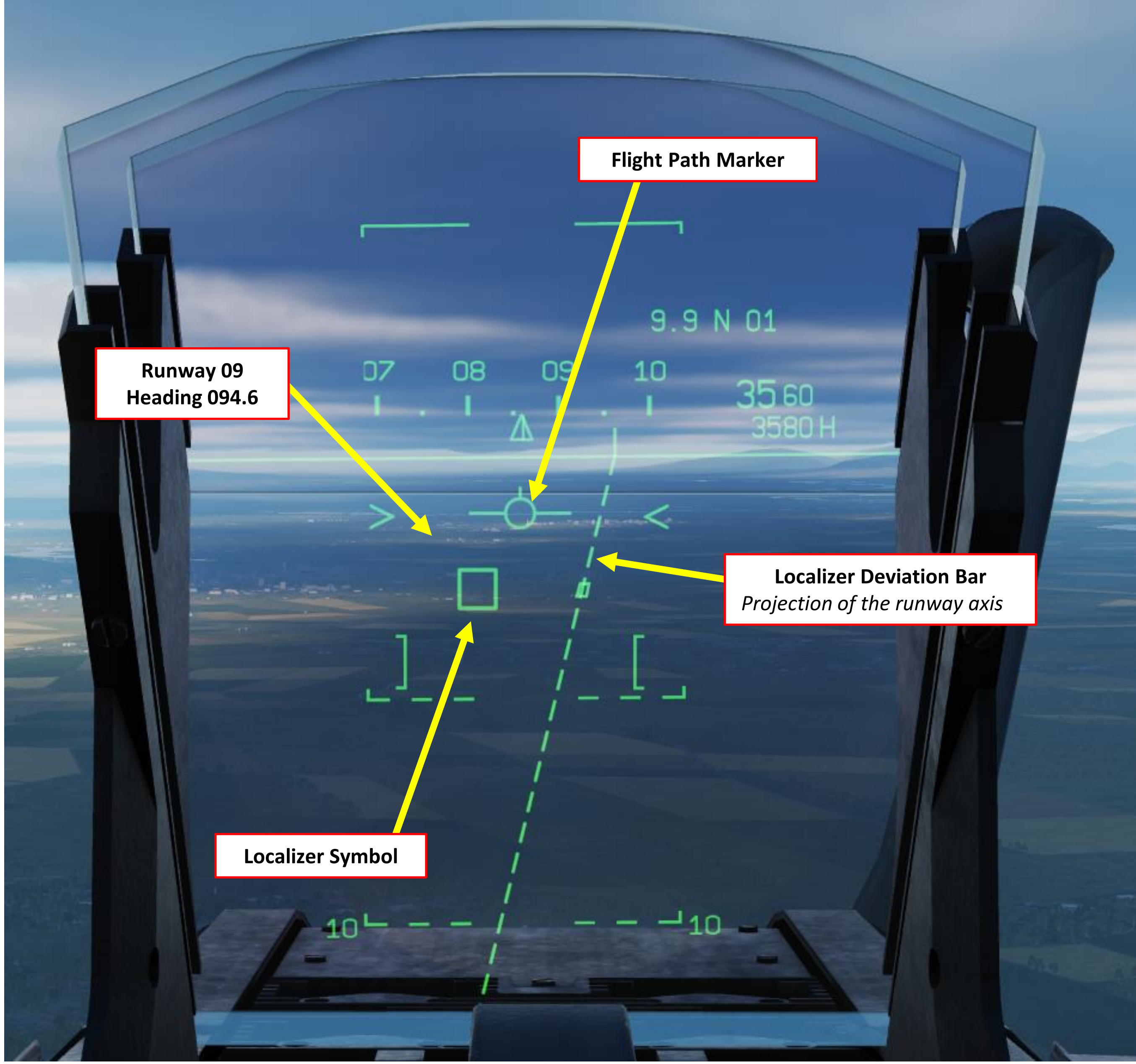


Weapons System CMD Switch Set AFT for NAV Master Mode

8 – ILS LANDING WITH SYNTHETIC RUNWAY

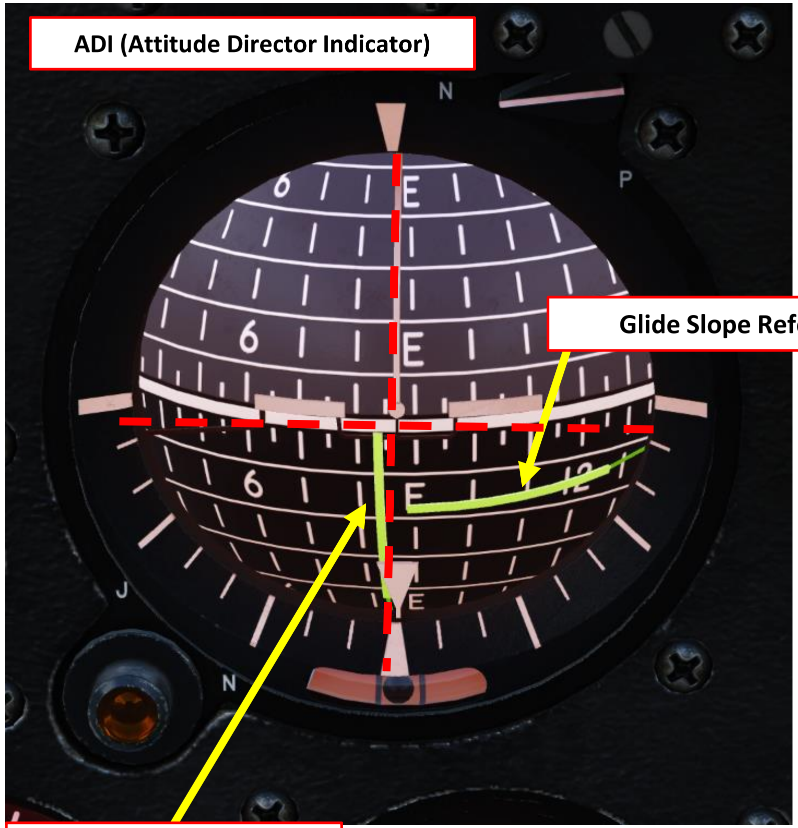
19. This picture displays the logic behind the HUD ILS symbology and the ADI localizer and glide slope deviation bars. The localizer symbol on the HUD is a flight director; you should place the flight path marker on it to steer the aircraft in the correct direction.

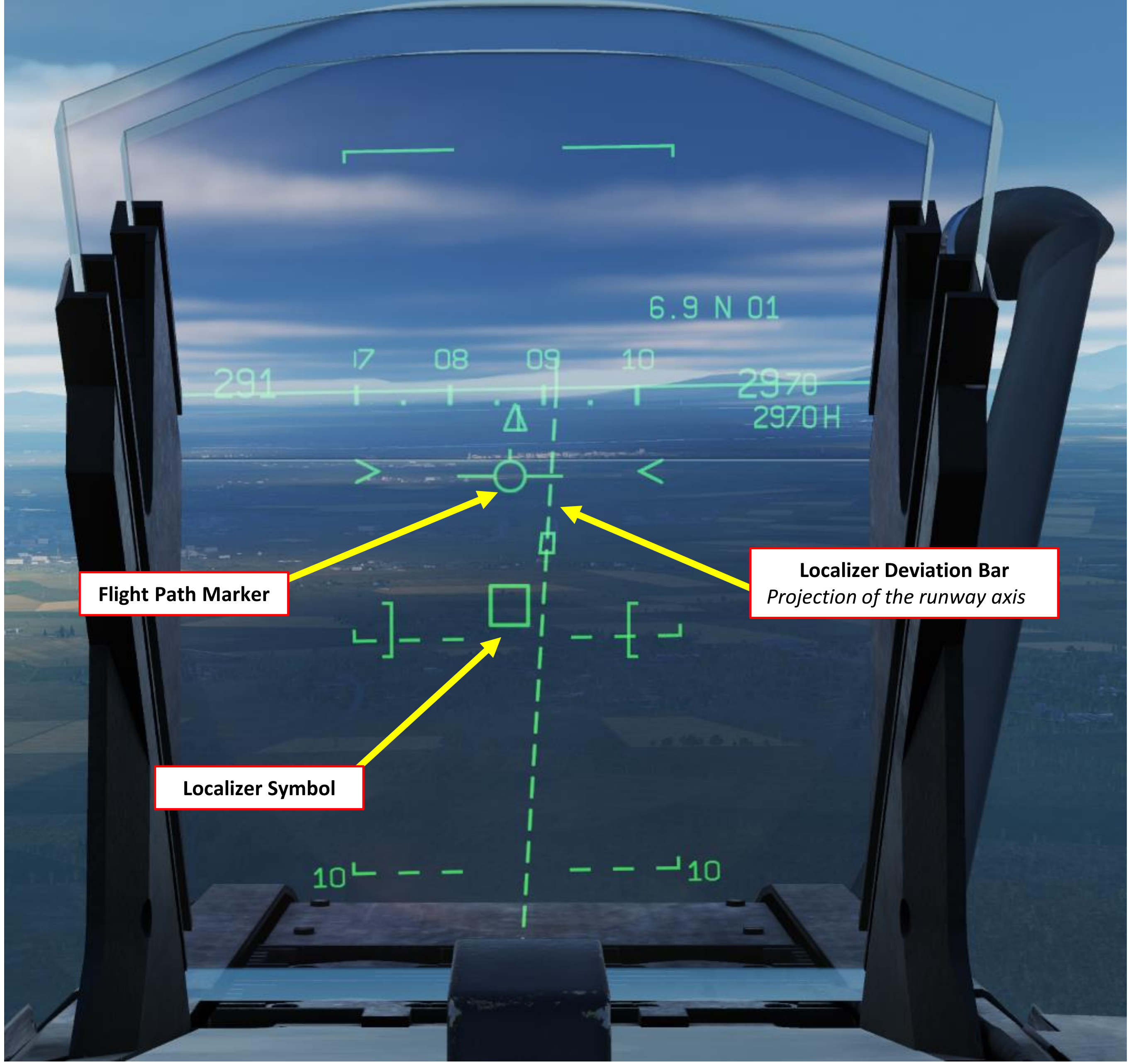




8 – ILS LANDING WITH SYNTHETIC RUNWAY

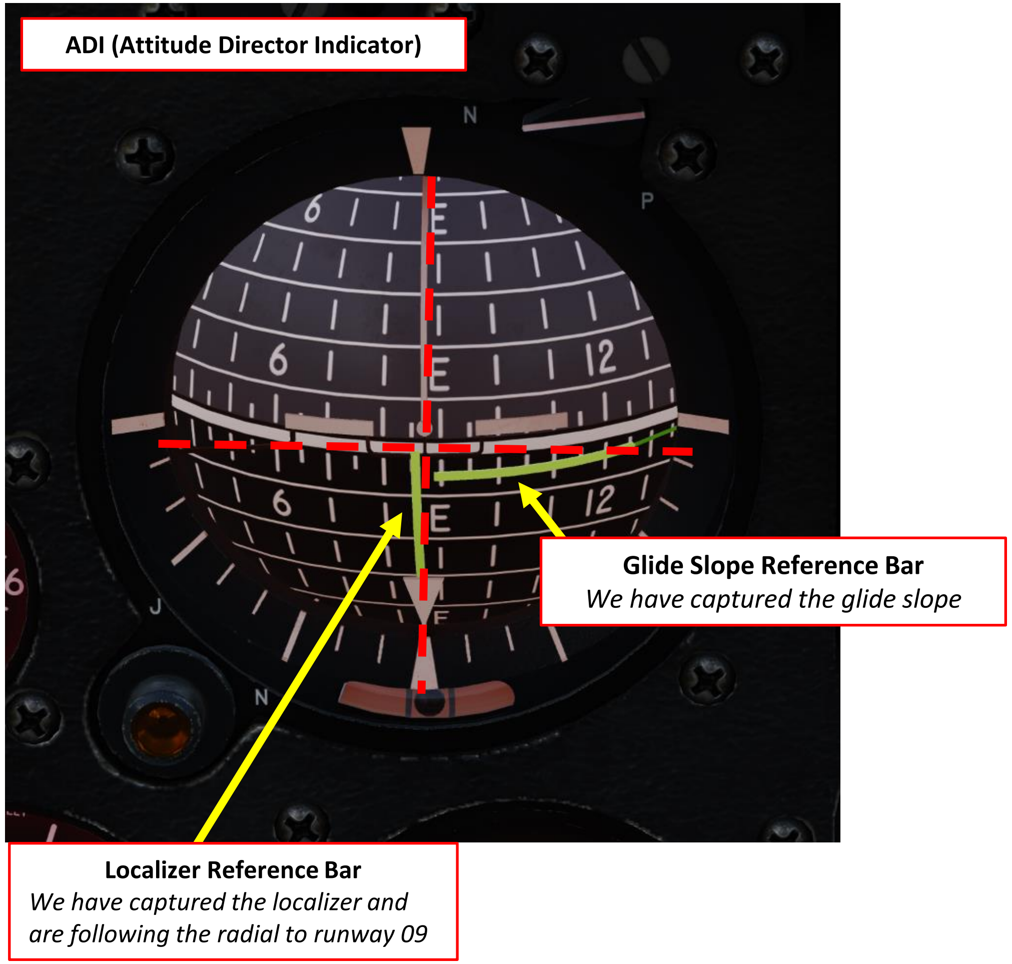
20. Once Approach Mode is selected on the PCA and correct ILS frequency is entered, we will first steer the aircraft to capture the localizer. This can be done by
    - Monitoring the Localizer Reference Bar on the ADI and
    - Monitoring the position of the Localizer Deviation Bar in relationship with the Localizer Symbol on the HUD.
21. Steer the aircraft's Flight Path Marker on the Localizer symbol.

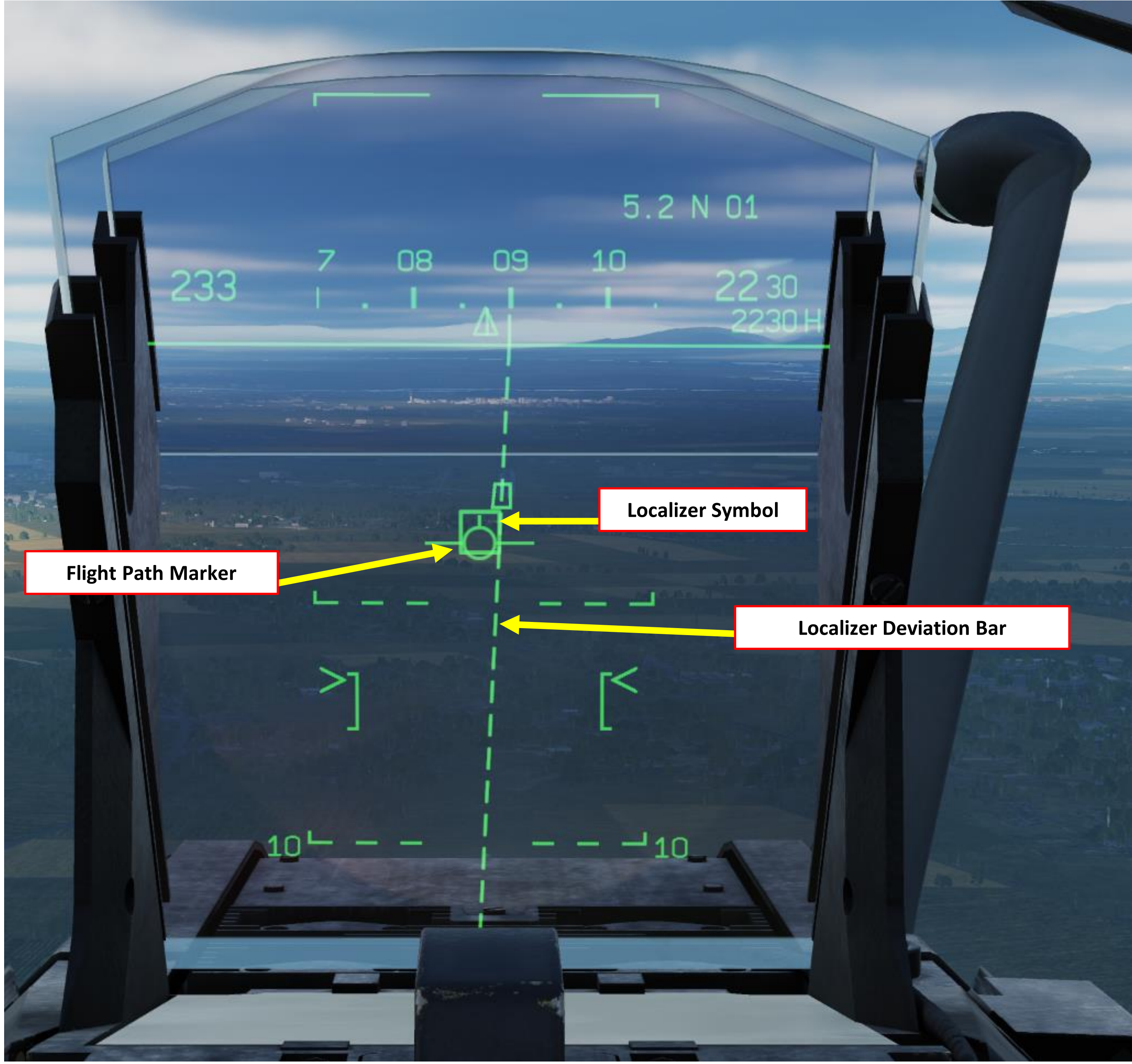




8 – ILS LANDING WITH SYNTHETIC RUNWAY

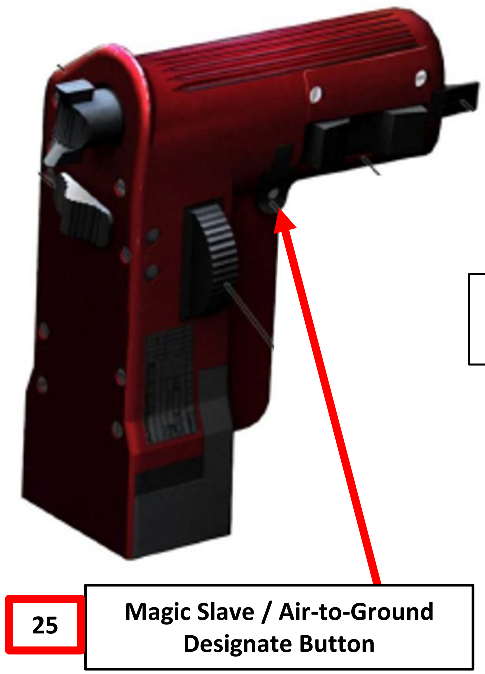
22. Once the localizer is captured and you are following the radial, the Localizer Deviation Bar and Localizer Symbol should be lined up on the HUD. The Localizer Reference Bar on the ADI should also be centered.
23. Use stick to adjust aircraft's vertical trajectory to align the Glide Slope Reference Bar on the ADI with the centerline. You should gradually start seeing the Flight Path Marker moving to the center of the Localizer Symbol on the HUD.

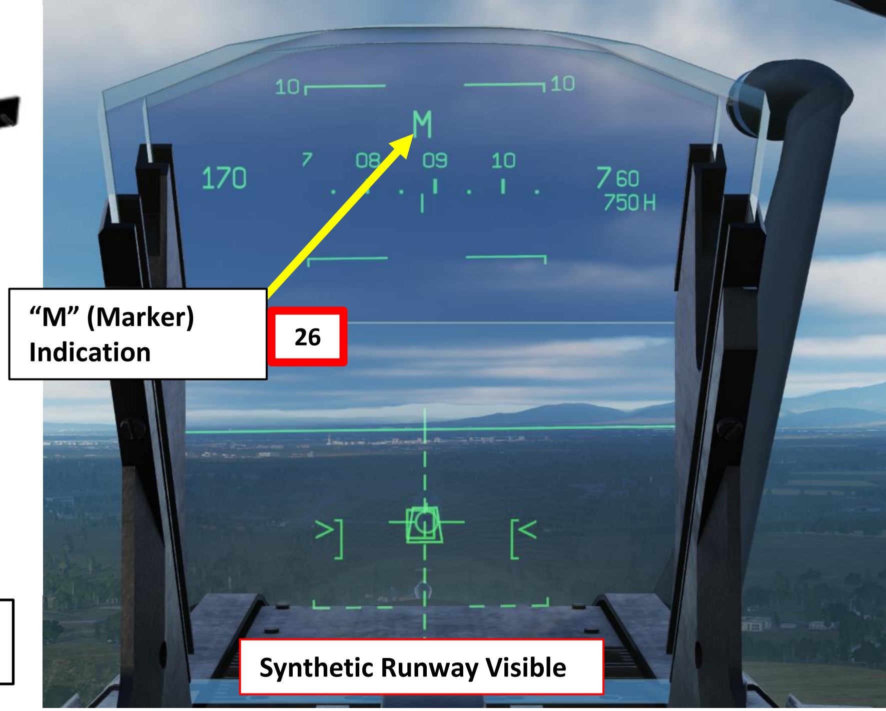


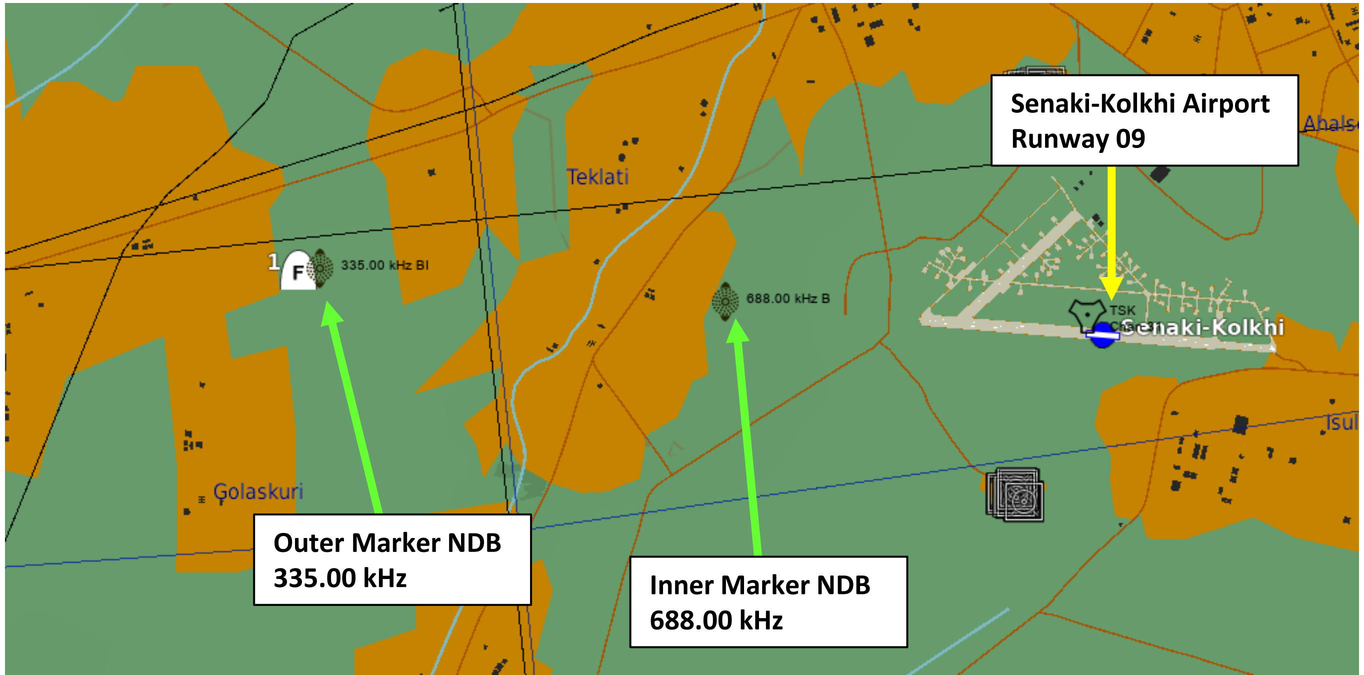


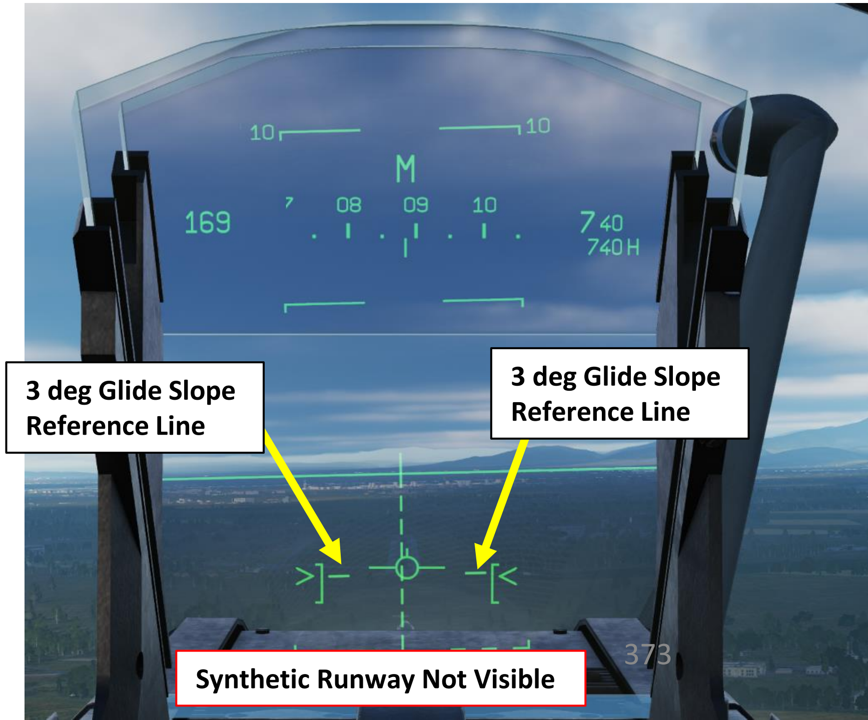
8 – ILS LANDING WITH SYNTHETIC RUNWAY

24. The Synthetic Runway will appear on the HUD if:
    - The INS (Inertial Navigation System) is ON
    - Both localizer and glide slope have been captured
    - Runway is less than 10 nm away
    - Lateral deviation is less than 7 deg
25. If you want to toggle the display of the ILS direction and synthetic runway on the HUD/VTH, press the Magic Slave / Air-to-Ground Designate button on the throttle. This will display reference bars for a 3 deg glide slope instead.
26. When overflying a marker, a "M" symbol will appear on the HUD/VTH.



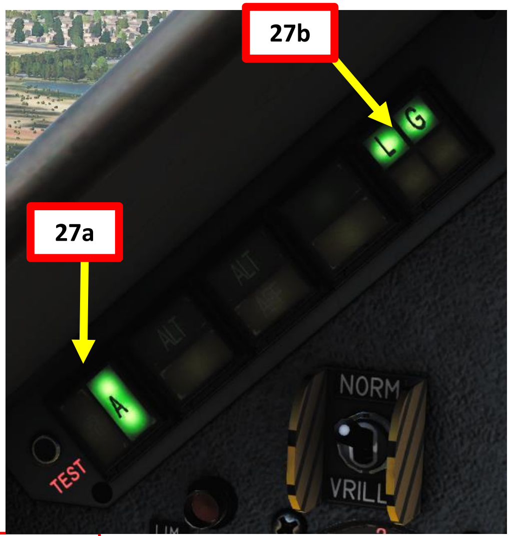


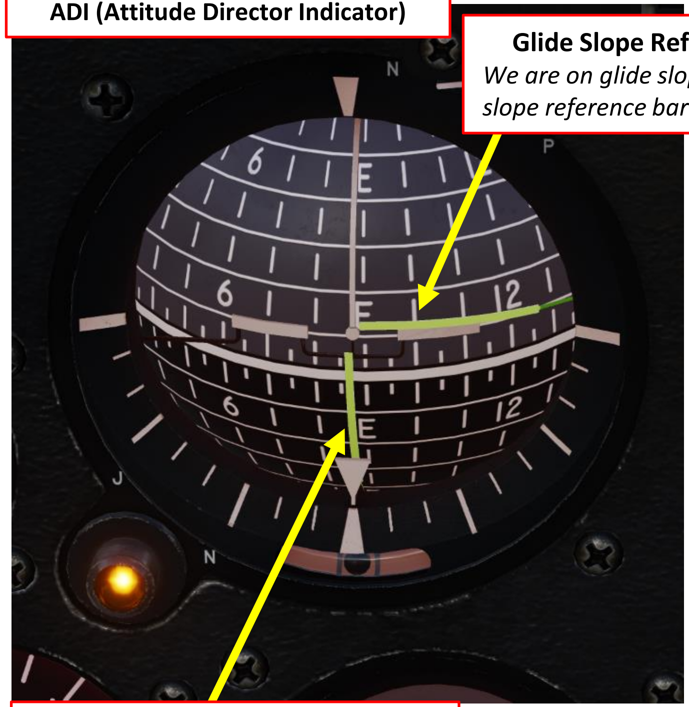


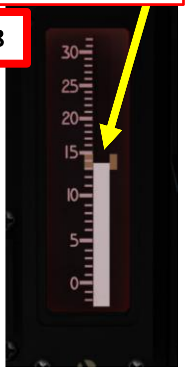


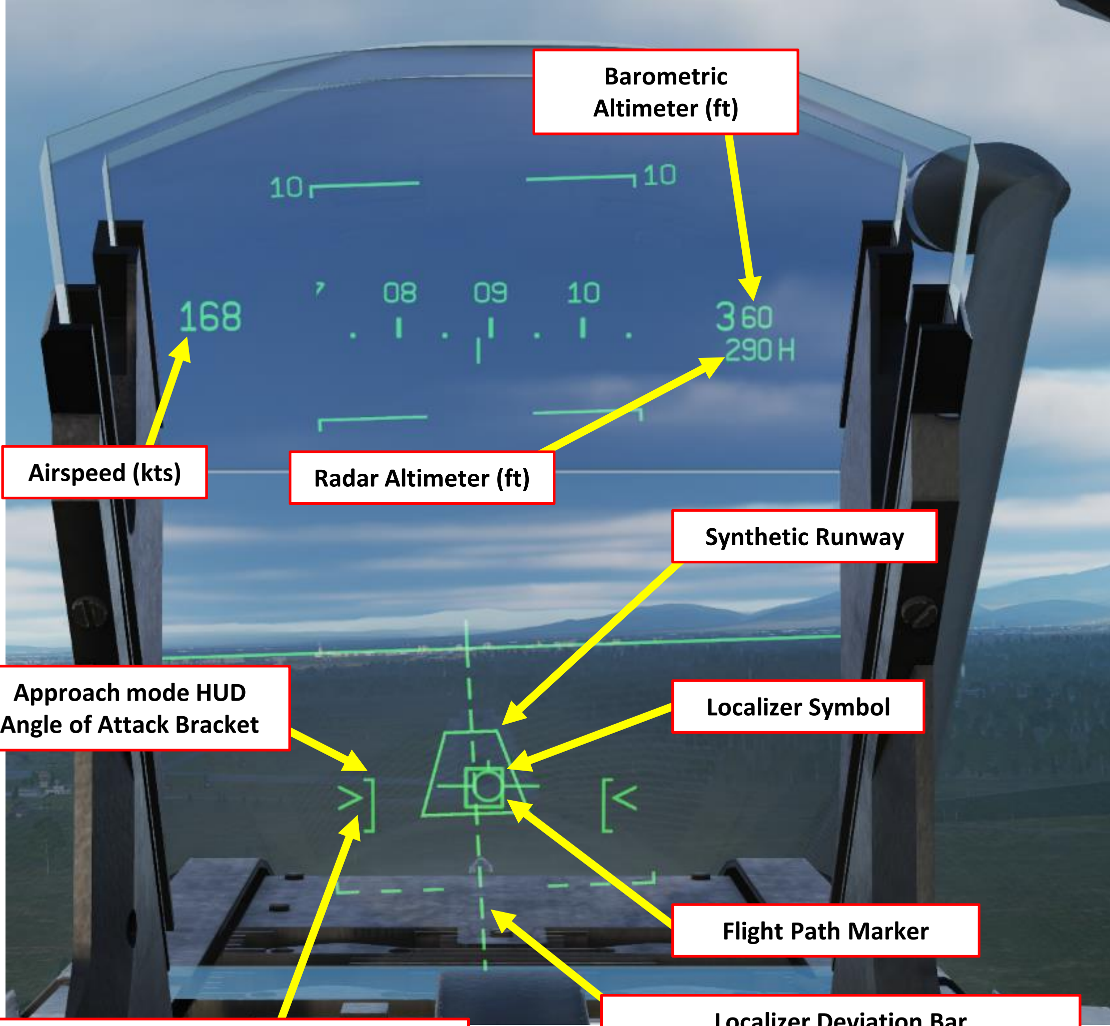
8 – ILS LANDING WITH SYNTHETIC RUNWAY

27. OPTIONAL: If you want, you can press the Autopilot Master Control Switch, then press on the Autopilot ILS Localizer & Glideslope (L/G) Switch. The autopilot will then steer the aircraft to "capture" the localizer and the glide slope. If the aircraft is aligned within 3 degrees of localizer deviation, the autopilot will then keep the aircraft aligned on glide slope and on the localizer.
    - Note: Green means ON, yellow means STANDBY.
28. Adjust throttle to maintain an Angle of Attack between 12 and 14 deg. Keep the acceleration chevrons in the middle of the Approach mode HUD Angle of Attack Bracket.







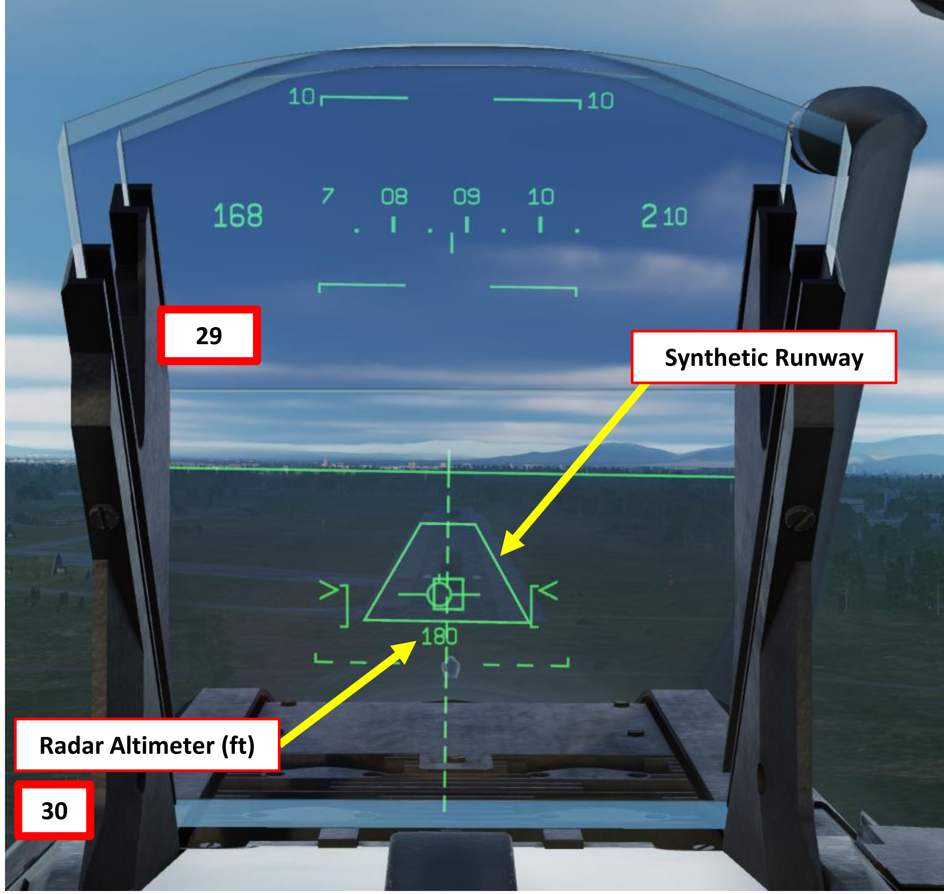


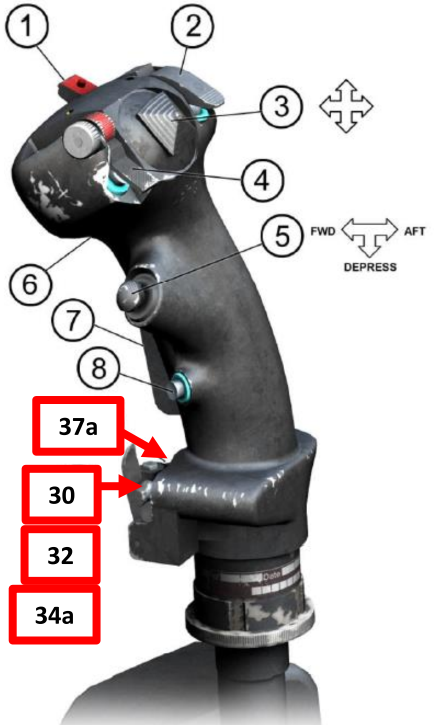
Note: when the L/G autopilot mode is engaged, the fly-by-wire system will try to keep the aircraft on glide slope by changing the aircraft's angle of attack. However, this change in angle of attack will cause the aircraft to slow down; you will need to make sure that the engine power setting is high enough for the aircraft to maintain an acceptable angle of attack (higher thrust will force the fly-by-wire system to decrease the angle of attack, therefore increasing airspeed in the process).

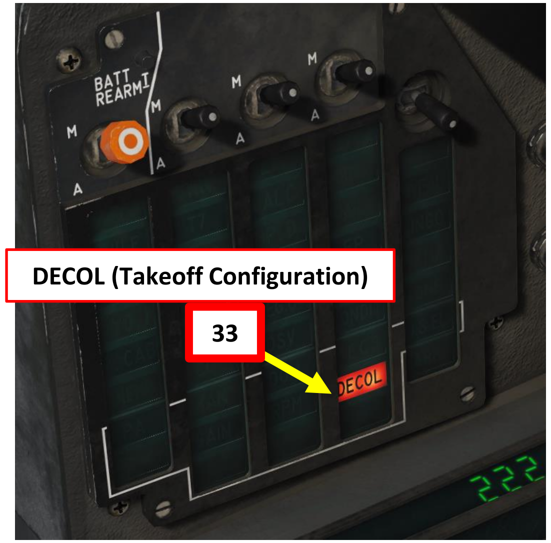
The TLDR version of this is: always keep your hand on the throttle to keep your AoA in check.

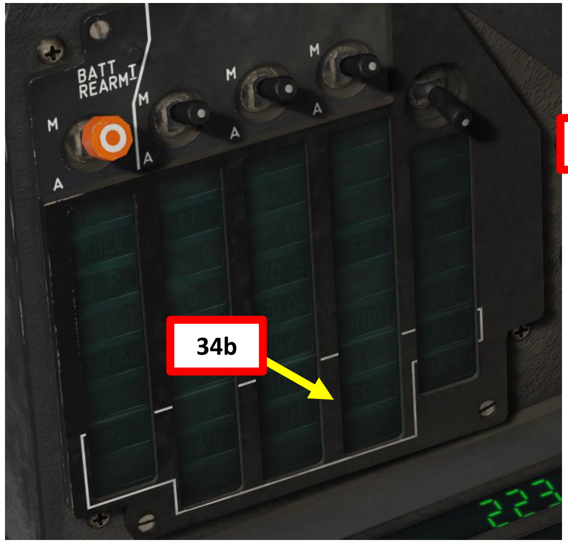
8 – ILS LANDING WITH SYNTHETIC RUNWAY

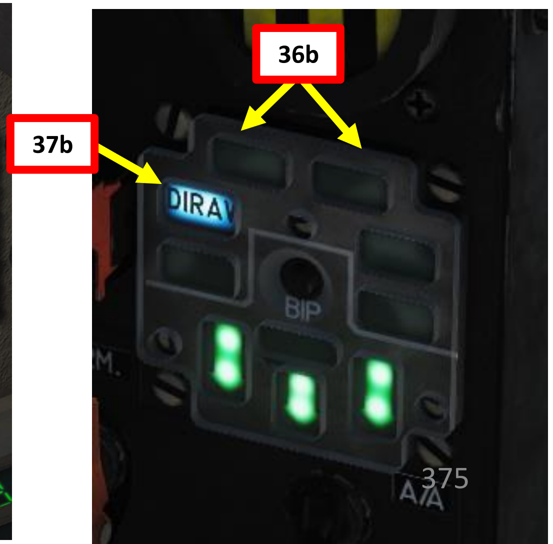
29. When in final approach, you should have your acceleration chevrons between the Approach mode HUD Angle of Attack Bracket and the Flight Path Marker centered in the Localizer Symbol square.
30. When the radar altimeter displays 200 ft AGL, press the Autopilot Standby Mode (AP Disconnect) switch on the stick to disconnect autopilot. **The ILS Autopilot Mode is NOT capable of performing an automatic landing: it is YOUR responsibility to land the plane.**
31. During touchdown, maintain your Angle of Attack to perform an aerobraking landing and set throttle to IDLE. This manoeuver will bleed speed in the process (your delta wing will act as a huge airbrake).
32. Once slowing down to 110 kts, press the Autopilot Standby Mode (AP Disconnect) switch on the stick again to reset trim to allow the nosewheel to descend. An aural sound will be heard when trim is reset.
33. Once the nosewheel touches the ground, the PANNE and DECOL (*Décollage*, Takeoff) cautions will illuminate since the aircraft trim is not set to Neutral.
34. Press the Autopilot Standby Mode (AP Disconnect) switch on the stick to reset trim. The PANNE and DECOL cautions should extinguish, and an aural sound will be heard when trim is reset.
35. Gently apply brakes when you have slowed down under 100 kts.
36. Retract airbrakes (A & F lights out).
37. Engage Nosewheel Steering (DIRAV) when you slowed down under 40 kts.





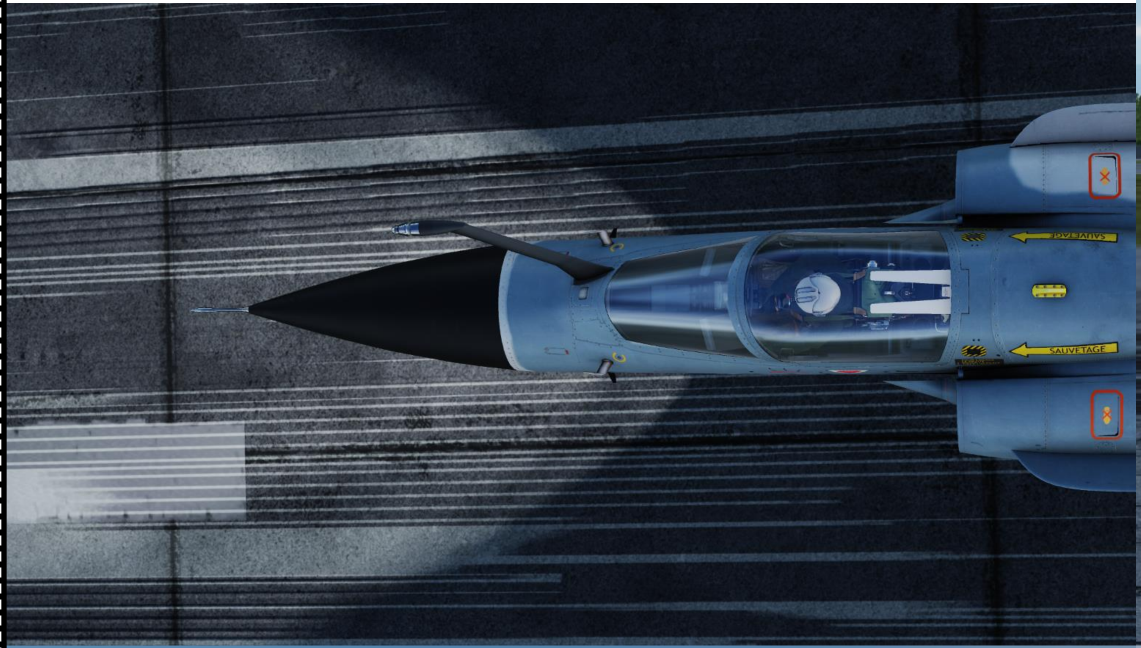






8 – ILS LANDING WITH SYNTHETIC RUNWAY

8 – ILS LANDING WITH SYNTHETIC RUNWAY



8 – ILS LANDING WITH SYNTHETIC RUNWAY

DCS Table of Frequencies

Airfield	ICAO Code	Reference	Runway(s)	Tower	ID	Alt	ILS	TACAN
Anapa	URKA	04°59'36"N, 37°20'19"E	04-22; 2900m	121.0	01	04		
Batumi	UGSB	41°36'58"N, 41°35'31"E	13-31; 2400m	131.0	11	13	**13**, 110.3	16X BTM (135.90 MHz)
Beslan	URMO	43°12'26"N, 44°35'19"E	10-28; 3000m	141.0	21	17		
Gelendzhik	URKG	44°33'54"N, 38°00'25"E	04-22; 1800m	126.0	06	03		
Gudauta	UG23	43°06'09"N, 40°34'01"E	15-33; 2500m	130.0	10	09		
Kobuleti	UG5X	41°55'36"N, 41°51'05"E	07-25; 2400m	133.0	13	12	**07**, 111.5	67X KBL (134.00 MHz)
Kutaisi	UGKO	42°10'30"N, 42°28'05"E	08-26; 2500m	134.0	14	12	**08**, 109.75	44X KTS (110.70 MHz)
Krasnodar C	URKI	45°05'03"N, 38°57'34"E	09-27; 2500m	122.0	02	08		
Krasnodar PKK	URKK	45°01'52"N, 39°08'38"E	05-23R; 3100m 05-23L; 2300m	128.0	08	02		
Krymsk	URKW	44°58'27"N, 38°00'37"E	04-22; 2600m	124.0	04	03		
Maykop	URKH	44°41'22"N, 40°03'08"E	04-22; 3200m	125.0	05	05		
Mineral'nye Vody	URMM	44°12'58"N, 43°06'13"E	12-30; 3900m	135.0	15	16	**12**, 111.7 **30**, 109.3	
Mozdok	XRMF	43°47'26"N, 44°34'44"E	08-27; 3100m	137.0	17	21		
Nalchik	URMN	43°30'29"N, 43°37'30"E	06-24; 2300m	136.0	16	15	**24**, 110.5	
Novoross.	URKN	44°39'36"N, 37°46'25"E	04-22; 1780m	123.0	03	06		
Senaki	UGKS	42°14'31"N, 42°02'08"E	09-27; 2400m	132.0	12	14	**09**, 108.90	31X TSK (109.40 MHz)
Sochi	URSS	43°06'17"N, 40°35'26"E	06-24; 3100m	127.0	07	10	**06**, 111.1	
Soganlug	UG24	41°39'26"N, 44°55'48"E	14-32; 2400m	139.0	19	18		
Sukhumi	UGSS	42°51'21"N ,41°09'17"E	12-30, 2500m	129.0	09	10		
Tblisi	UGTB	41°40'37"N, 44°56'37"E	13-31L; 3000m 13-31R; 2500m	138.0	18	20	**13**, 110.3 **31**, 108.9	
Vaziani	UG27	41°37'09"N, 45°02'10"E	14-32; 2500m	140.0	20	19	**14**, 108.75	22X VAS (108.50 MHz)

Runway = runway designations, west to east; runway length in meters
Alt = nearest alternate airfield ID
ILS = **runway designation**, ILS frequency
Credits: Shu77; HiJack; vJaBoG32

Like the F-16 and F/A-18, the Mirage 2000C is equipped with a fly-by-wire system. **Fly-by-wire** (FBW) is a system that replaces the conventional manual flight controls of an aircraft with an electronic interface. The movements of flight controls are converted to electronic signals transmitted by wires (hence the fly-by-wire term), and flight control computers determine how to move the actuators at each control surface to provide the ordered response. The fly-by-wire system also allows automatic signals sent by the aircraft's computers to perform functions without the pilot's input, as in systems that automatically help stabilize the aircraft, or prevent unsafe operation of the aircraft outside of its performance envelope.

Flying the Mirage feels different from other fighter jets like the F-15. Control surfaces are controlled by a computer: you merely tell the aircraft what you want it to do.

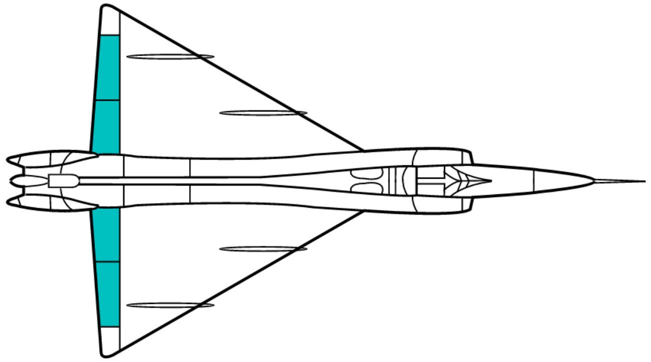
I highly recommend this article about the F-16’s fly-by-wire system. It is very instructive and quite interesting.
http://www.ausairpower.net/AADR-FBW-CCV.html

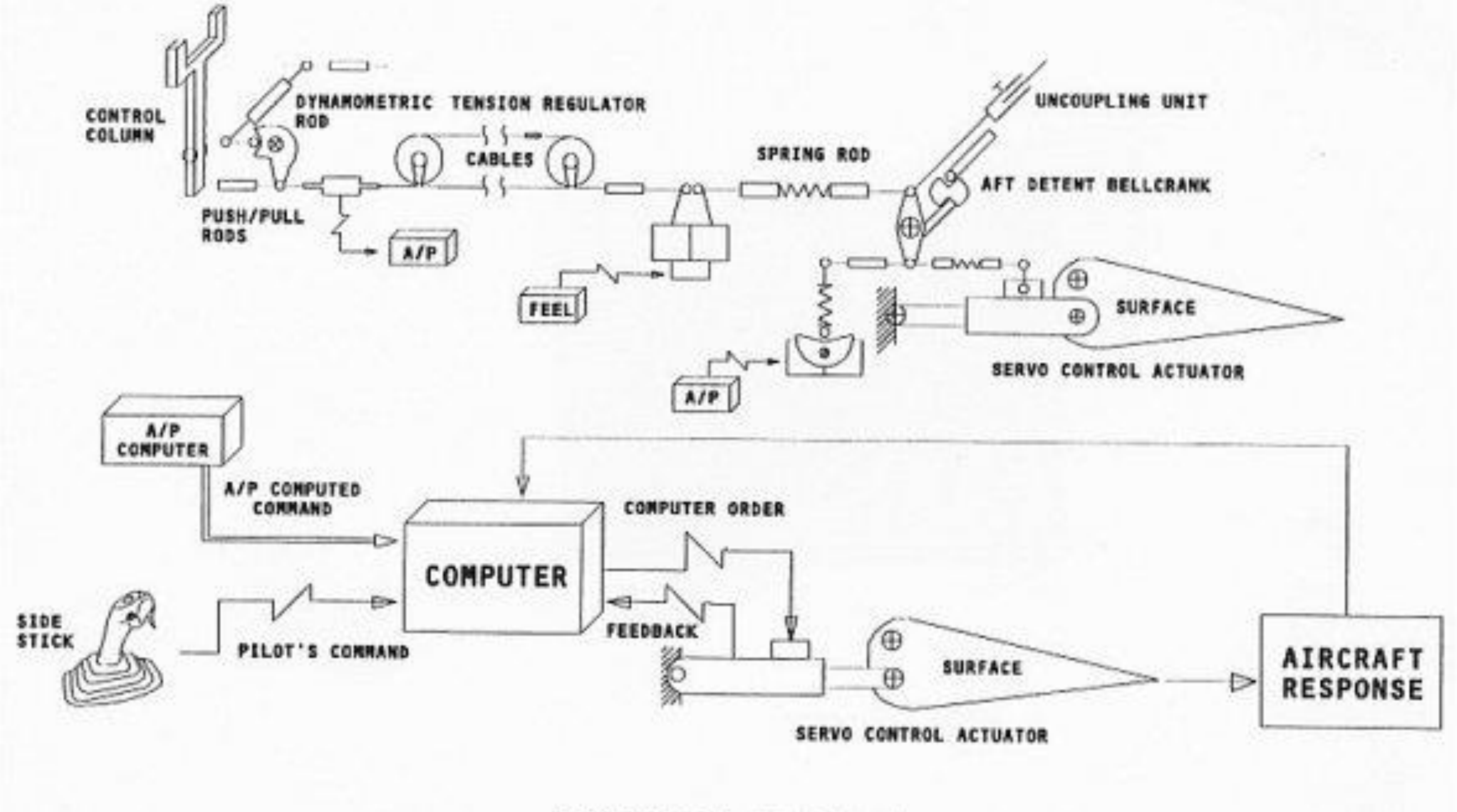
Pilot input on joystick

FLIGHT COMPUTER

Control Laws will determine how control surfaces must be moved in order to reproduce the movement dictated by pilot input on joystick

Electrical signal sent to actuators of control surfaces



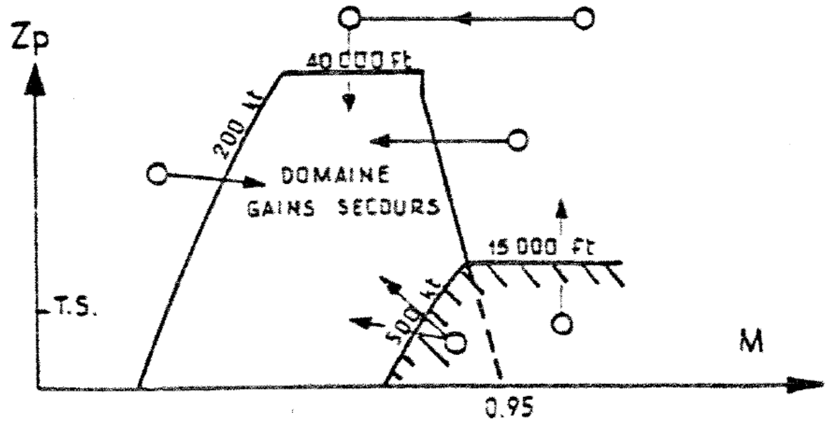


FLY BY WIRE PHILOSOPHY

The FBW G limiter switch has two positions:

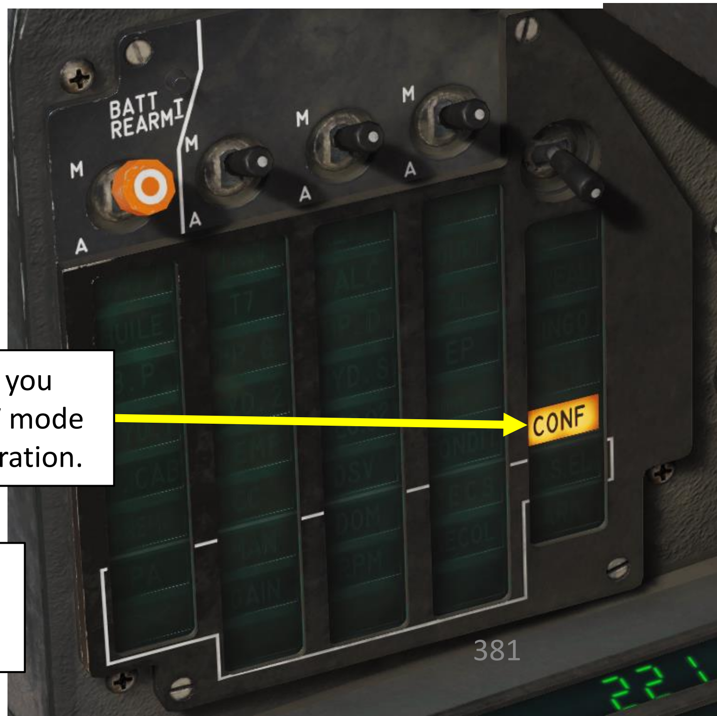
- **A/A** (UP) is used for an air combat configuration (2 x MAGIC II missiles + 2 x SUPER S530D missiles). This FBW mode will allow you to pull the maximal allowable number of Gs during a dogfight. In other words, the manoeuverability of your aircraft is maximal at this FBW setting.
- **CHARGES** (DOWN) is used for a heavy payload configuration (which includes any number of bombs and external fuel tanks). This FBW mode will restrict the number of Gs you can pull in comparison to the A/A mode. In other words, you will not be as manoeuverable. The reason for this mode is that structural damage can occur if you pull many Gs, which is caused by the heavy payload fixed to the hardpoints. The CHARGES (stores) mode is here to prevent your aircraft from ending in a smoldering ball of flames. When doing dive bomb runs, keep in mind that you will not be able to pull up as much as you would expect when flying in the A/A mode.

NOTE:
The Fly-By-Wire Gain switch must remain to NORM at all times. If you set it to GAIN CDVE, you basically turn it into EMERGENCY mode. In most configurations, the aircraft will become unstable and you are very unlikely to be able to recover from that. If you are using the emergency FWB mode, you will only be able to control the aircraft in a very small flight envelope as shown on the graph to the right. Flying with FBW off outside this restricted flight envelope means certain death.



Fly-By-Wire Gain switch
- NORM: Normal Mode
- GAIN CDVE: *Commande de Vol Électrique* (FBW Emergency Mode)

Fly-By-Wire limiter switch
- A/A (UP): Air-to-Air Combat – For carrying light loads
- *CHARGES* (DOWN): Stores – For carrying heavy loads



CONF Caution will indicate that you have selected an incorrect FBW mode for your current weight configuration.

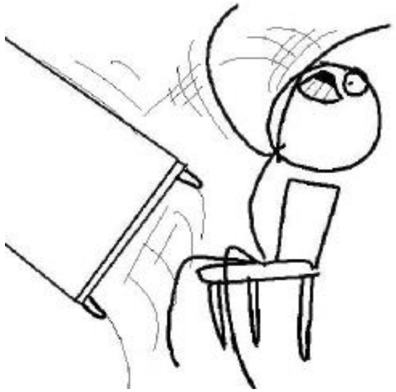
INTRODUCTION

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.

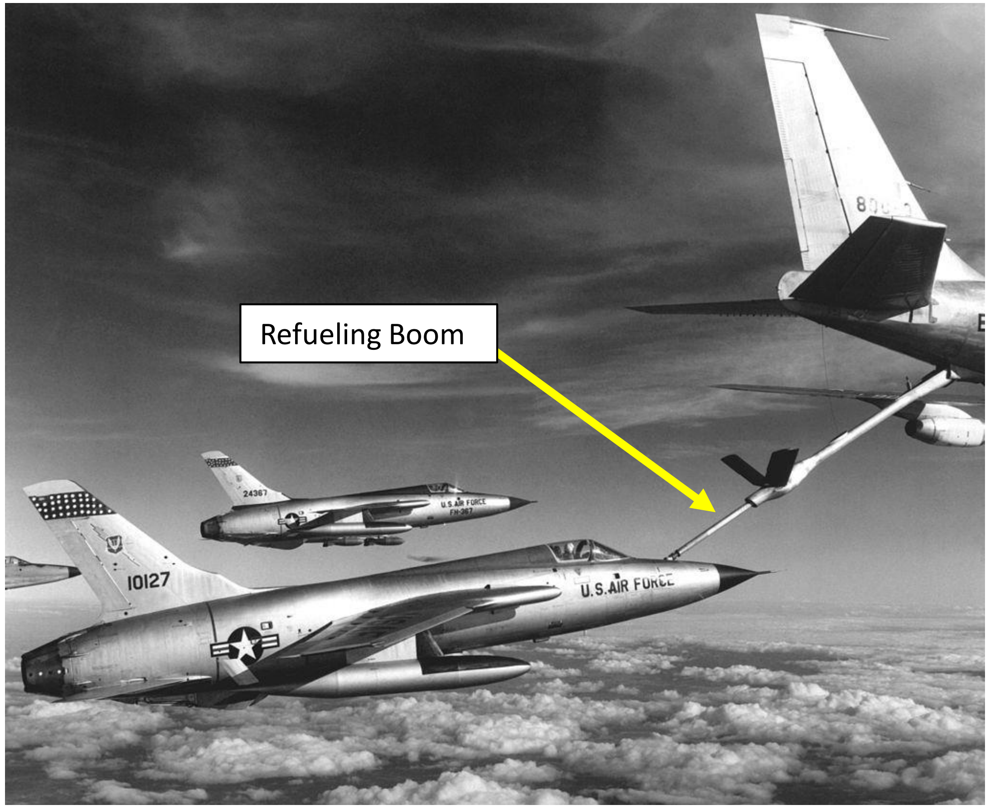


INTRODUCTION

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 Mirage 2000C is equipped with a Probe-and-Drogue system, so air-to-air refueling will only be performed from either an Il-78M, a KC-130, a KC-135 MPRS or a S-3B tanker.

KC-135 MPRS

KC-135 Stratotanker

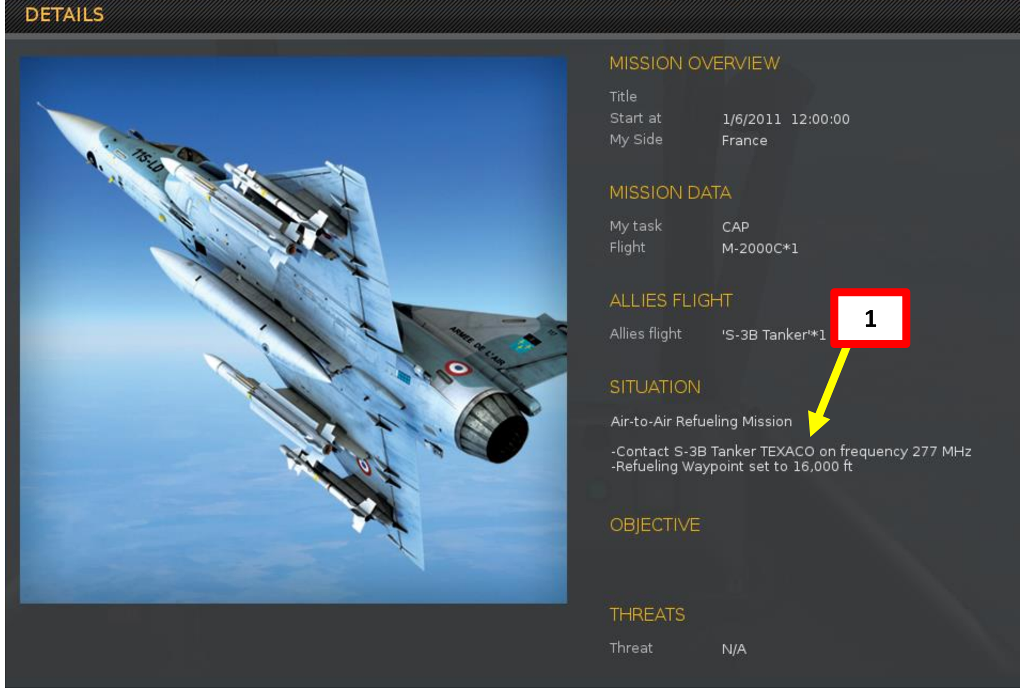
Il-78M

KC-130

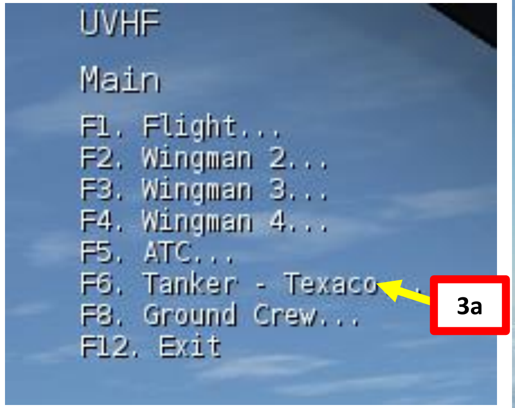
S-3B Viking

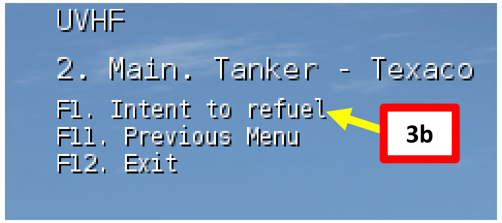
AIR-TO-AIR REFUELING DEMO

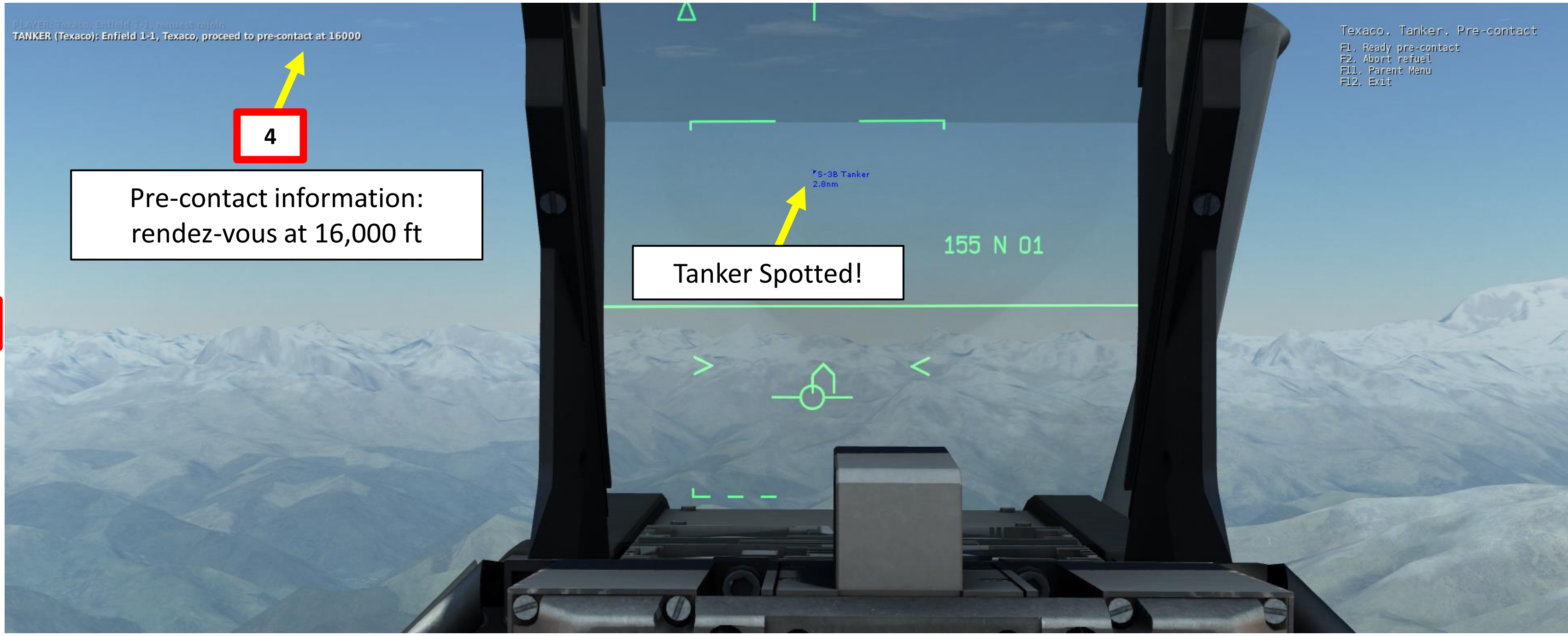
1. Consult mission briefing to know on which radio frequency you need to contact the tanker. In our case, we will use the frequency 277 MHz on the V/UHF radio.
2. Set your radio to 277 MHz and *MARCHE* (ON) and communicate with TEXACO (tanker callsign).
3. Select Tanker – Texaco (F6) communication menu, and then select "Intent to Refuel"
4. TEXACO should give you a pre-contact altitude (in our case 16,000 ft).



Note: Some tankers like the KC-135 are equipped with a TACAN beacon, which can give you a direction to find it easily. However, the S-3B Viking isn't equipped with this navigation beacon. Therefore, you will have to spot the tanker visually (or you could find him on your radar screen, but the aircrew is very likely to start freaking out once they realize they're being radar locked).

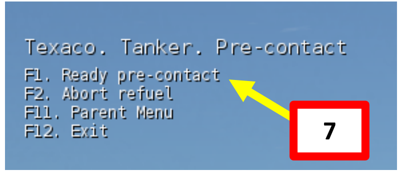


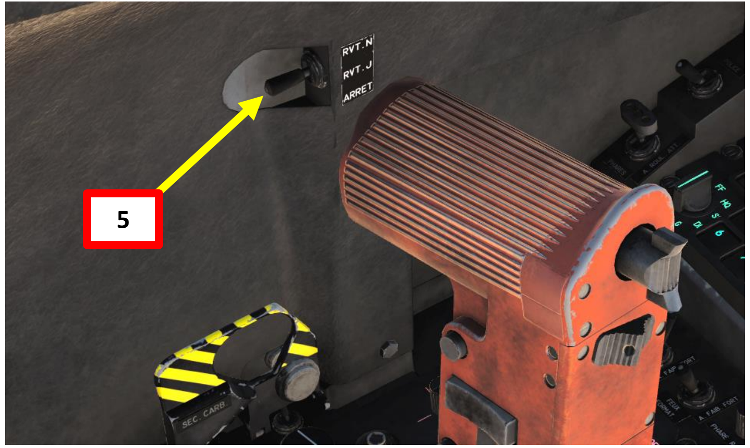




AIR-TO-AIR REFUELING DEMO

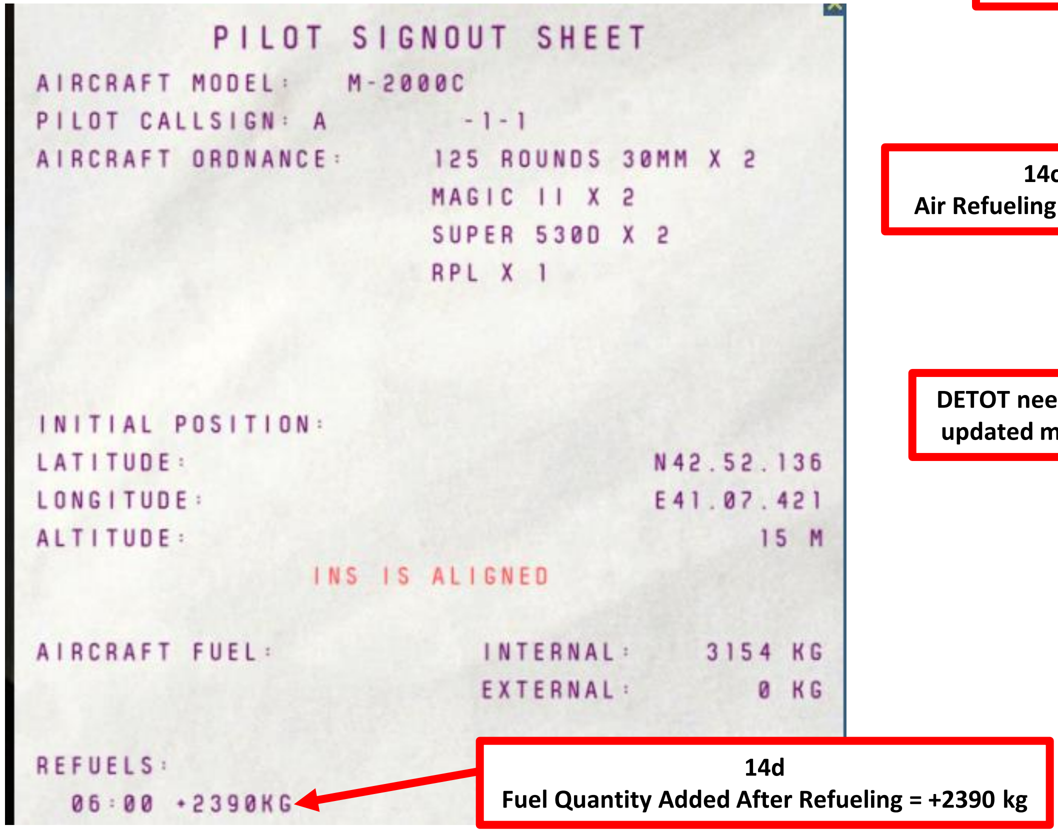
5. Set the Refueling Transfer Switch to RVT-J (ON).
6. When you are less than 0.1 nm away from tanker, position yourself as shown on picture.
7. When in position, use your radio menu to select "Ready Pre-Contact" (F1).
8. The tanker's pilot should answer you with "Cleared Contact" and should deploy his drogue basket and start to accelerate to cruising speed.
9. Fly formation with the tanker and approach the drogue basket very slowly (make sure you remain about 2-3 kts faster than the tanker) with gentle inputs.
10. Insert your probe into the drogue basket.
11. Additional drag should be generated by the drogue once you have contact with the drogue: your aircraft will slightly decelerate. Once the probe is taking fuel, the tanker pilot should tell you "You're taking fuel".
12. Keep formation with the tanker until your refueling is complete.
13. Detach your probe from the basket by throttling down and set the Refueling Transfer Switch DOWN (OFF).





AIR-TO-AIR REFUELING DEMO

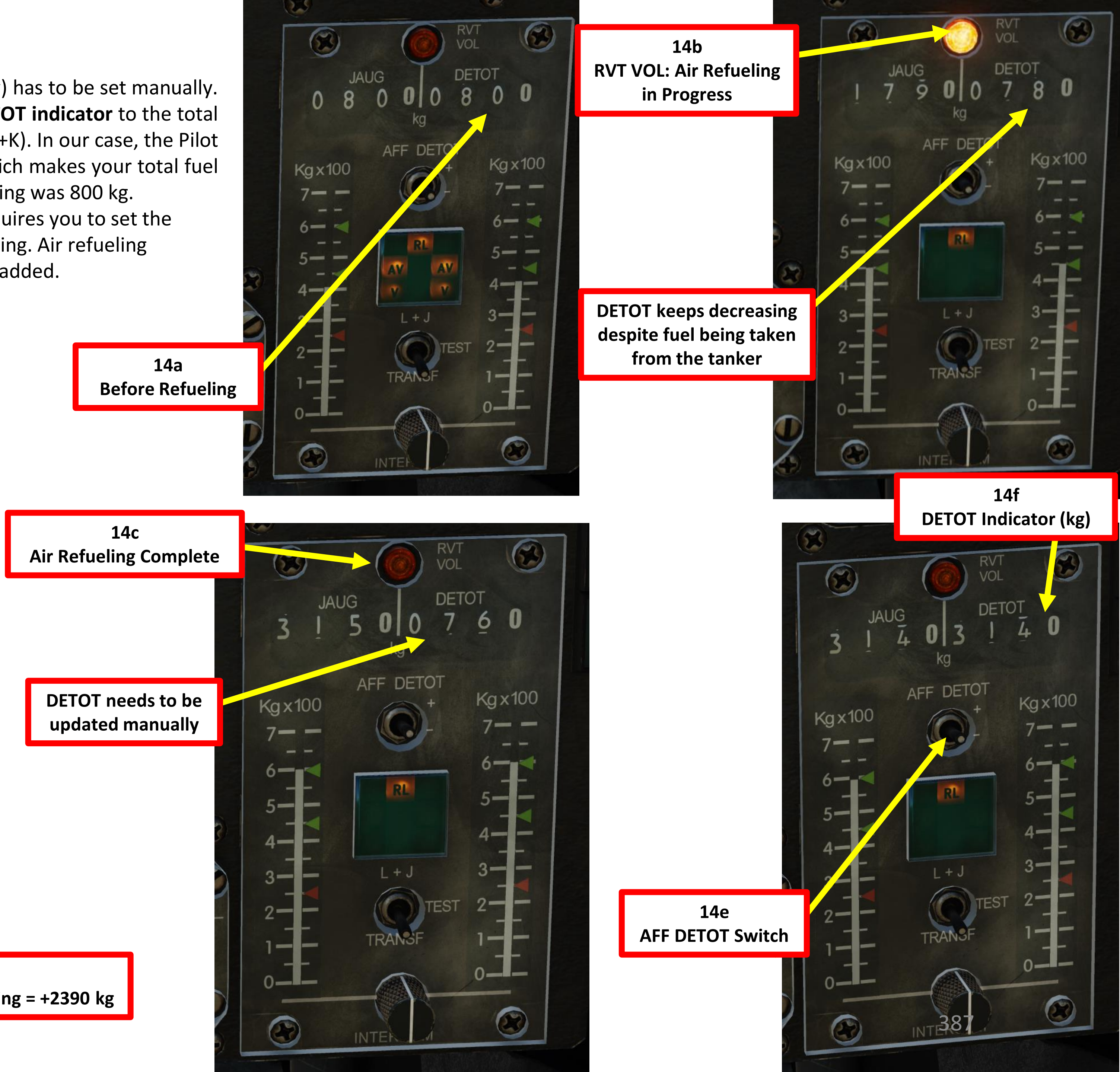
14. After refueling, the DETOT (Détotalisateur, or Total Fuel Quantity) has to be set manually. This is done by **toggling the AFF DETOT switch** +/- to set the **DETOT indicator** to the total fuel as per the value indicated on the Pilot Signout Sheet (RSHIFT+K). In our case, the Pilot Signout Sheet says the fuel taken from the tanker is 2390 kg, which makes your total fuel quantity to 3154 kg since your initial fuel remaining before refueling was 800 kg.
    - This step is very important since refueling the aircraft requires you to set the DETOT quantity if you want to have an accurate fuel reading. Air refueling indicates on your Pilot Signout Sheet how much fuel was added.


PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2
MAGIC II X 2
SUPER 530D X 2
RPL X 1

INITIAL POSITION:
LATITUDE: N42.52.136
LONGITUDE: E41.07.421
ALTITUDE: 15 M
INS IS ALIGNED

AIRCRAFT FUEL: INTERNAL: 3154 KG
EXTERNAL: 0 KG

REFUELS:
06:00 +2390KG



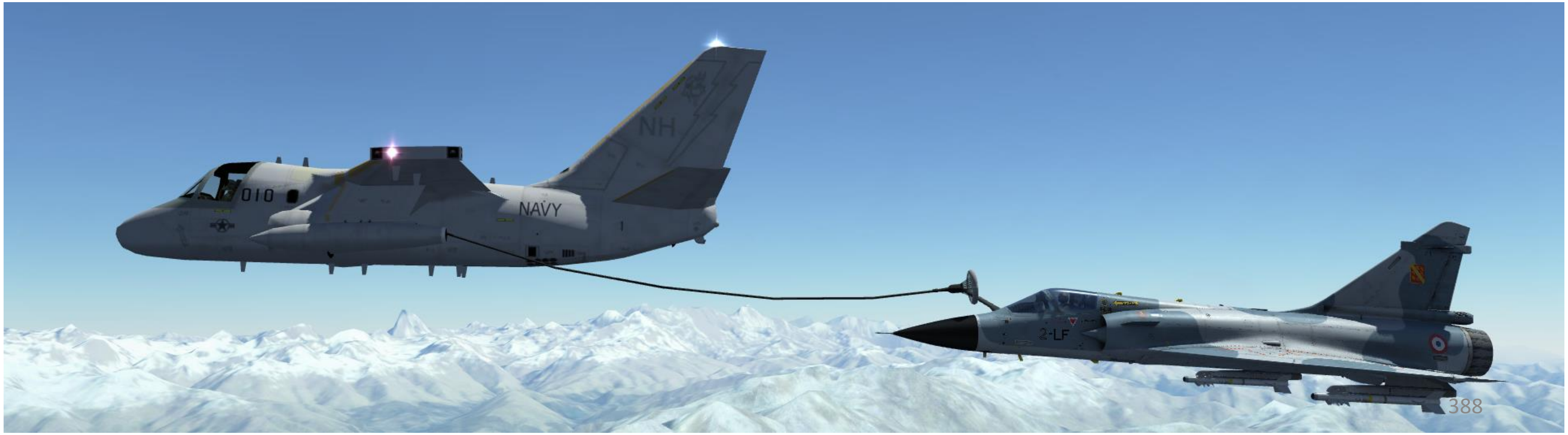
AIR-TO-AIR REFUELING DEMO

Of course, all of this seems much easier said than done. You will very likely do following mistakes:

- Approach too fast and miss the basket
- Oscillate vertically without being able to line up with the basket
- Keep going either too fast or too slow
- Drift left or right
- Overcompensate control inputs
- Fight the Fly-By-Wire system.

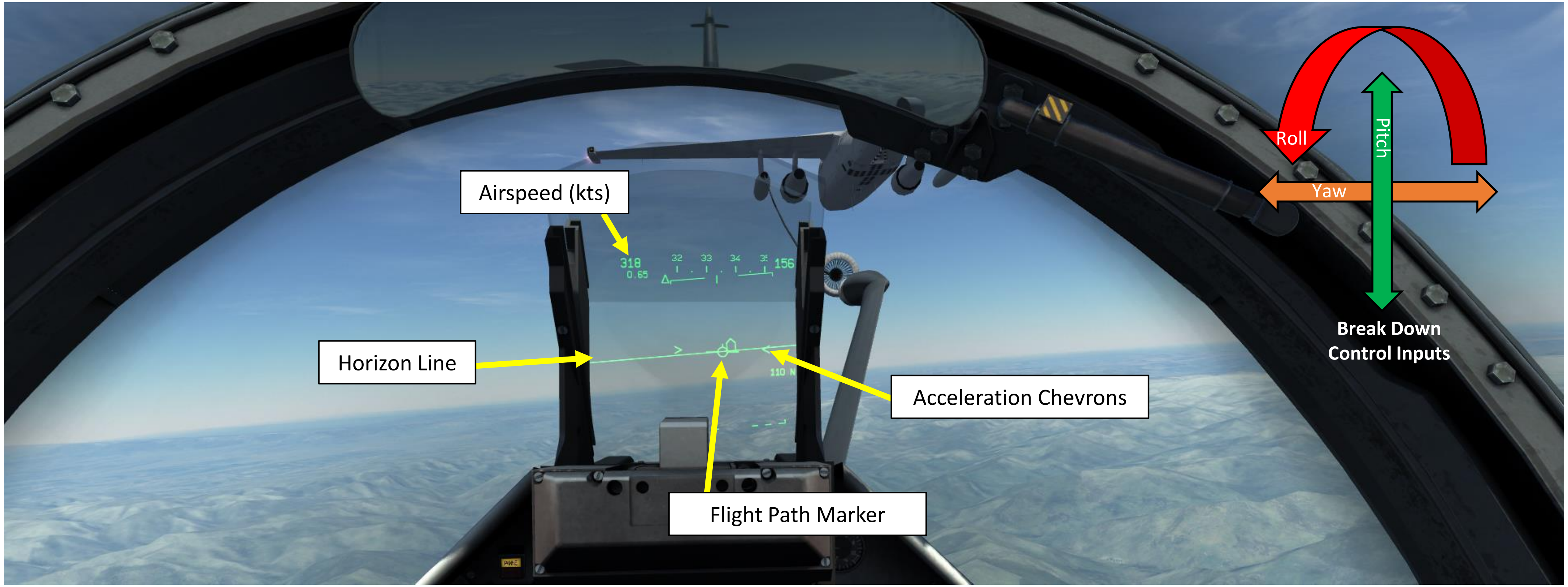
Here are various demos of air-to-air refueling.
- https://www.youtube.com/watch?v=mm6U2WJMZa8
- https://www.youtube.com/watch?v=cjImOHdq2Xk
- https://www.youtube.com/watch?v=7LLgCjUKBug
- https://www.youtube.com/watch?v=rw0mrkXXysw

The next slide will give you a couple of tips to help you catch that basket and slurp that delicious jet fuel like a crack addict.



AIR-TO-AIR REFUELING DEMO – TIPS AND TRICKS

- Remaining **CALM is key** for a successful refueling. If you lose your cool, take a break and try again once you are relaxed. Silk hands and a clear head are needed for that part.
- If you overshoot (or are about to fly past) the tanker, you can bleed speed very fast by deploying your airbrakes. You can go from 400 kts to 300 kts in a matter of seconds.
- **Avoid combining roll, pitch and yaw movements at the same time** when you are tracking the basket. Failing to do so will make you drift vertically and horizontally, which doesn't help at all and may induce PIO (Pilot induced oscillations). Try to stay in the same horizontal plane as much as possible.
- It is easier if you try to "break down" your control inputs in **separate movements**. I try to avoid gunning my throttle, pitching up/down, rolling and using my rudder at the same time. I generally avoid using the rudder and instead focus on using small pitch and roll inputs only in order to make the **aircraft's response predictable**. Combining different control inputs can make the aircraft react in a way that makes it all very difficult for your brain to predict and process. I tend to make sure my plane is **straight and level at first** and that I am more or less lined up with the basket.
- Once I have a satisfying attitude and that the basket is placed approximately as shown on the picture below, **I gradually throttle up** and increase speed to **match the tanker's speed**. In this case, the tanker's speed is 315 kts. Make sure that you keep a constant speed by checking if your **acceleration chevrons** are lined up horizontally with the Flight Path Marker.
- Once my speed matches the tanker's, I can gradually accelerate to a speed that is 2-3 kts faster (318 in our case), **approaching the basket very slowly**. At that part, the ONLY two things I am watching are my **AIRSPEED** and the **BASKET**. Nothing else matters.
- Once I am approaching the basket, I make sure to avoid inducing yawing motion with the rudder pedals. I displace myself with roll and pitch (vertical) stick input only.



RESOURCES

476th vFG M2000C Flight Crew Checklist
http://www.476vfightergroup.com/downloads.php?do=file&id=484

RAZBAM's DCS Mirage 2000C Flight Manual (Work In Progress)
https://www.razbamsimulationsllc.com/dcs-manuals

Manudan93's Mirage 2000C Tutorial (Aircraft Start-Up + Radar Operation + Missile Usage + Landing)
https://www.youtube.com/watch?v=g9x3_PZ-Arw

ThePsbob's ILS Landing Tutorial (with Synthetic Runway)
https://www.youtube.com/watch?v=W75A5nxhiUI

Le Mur du Son - Mirage 2000 Documentary (French)
https://www.youtube.com/watch?v=YjI7Tg75MD8

Firepower – Mirage Fighter Jet Documentary (English)
https://www.youtube.com/watch?v=-QAWIK_RgV0

BVR (Beyond Visual Range) Combat Tactics for the Mirage by il_corleone
https://forum.dcs.world/topic/131888-working-bvr-tactic-against-modern-targets

Les Chevaliers du Ciel movie by Gérard Pirès
Full of corny lines, nonsensical plot, wooden acting… but also full of Mirages!
https://en.wikipedia.org/wiki/Sky_Fighters


À la chasse, bordel!

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:

- ChazFlyz
- Kilanov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digital combat series
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MISSION
CAMPAIGN
MULTIPLAYER
LOGBOOK
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REPLAY
MISSION EDITOR
CAMPAIGN BUILDER
EXIT
Nevada 2.0.0
A-10C 2.0.0
Bf 109 K-4 2.0.0 beta
C-101 2.0.0 Beta
CA 2.0.0
F-86F 2.0.0 beta
FC3 2.0.0
Fw 190 D-9 2.0.0
Hawk 2.0.0 EFM Beta
Ka-50 2.0.0
L-39C 2.0.0
M-2000C 2.0.0 Beta
Mi-8MTV2 2.0.0 beta
MiG-15bis 2.0.0 beta
MiG-21bis 2.0.0
P-51D 2.0.0
Su-25T 2.0.0
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