DCS GUIDE
KA-50 BLACK SHARK

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

The **Kamov Ka-50 “Black Shark”** is probably one of the strangest and meanest-looking machines in the whole aviation industry. While the A-10C is often being associated as the flagship of developer Eagle Dynamics, people often forget that before the Hog started flying in the skies of Georgia, the Black Shark was actually the first fully clickable high-fidelity module released for DCS.

Many people give up learning the Shark: it’s a cramped, cluttered cockpit with different systems that aren’t that familiar to westerners like myself. Lots of tutorials are scattered all across the web, some of them old, obsolete and done in Minecraft-worthy 480p resolution (gasp!). Aye, the Ka-50 was released in 2008, people.

“But why should I care for a franken-copter like the Shark, Chuck?” Good question. In a nutshell, the Ka-50 is probably one of the most interesting machines in flight sim history. Not only does it have an unconventional design, but it also has a level of depth that makes the whole experience very rewarding. Helicopters like the Huey are all about flying the thing: it’s a very “physical” experience. However, modern choppers like the Ka-50 have stability augmentators that allow the pilot to have a much smoother flying experience. You can do some absolutely crazy stuff in it if you wish, but features like the Auto-Hover and the autopilot mean that you can concentrate on weapon employment rather than “keep fighting against the machine”. The Ka-50 is a wild beast that can easily be tamed if you try it for yourself. In the hands of a skilled pilot, it can become a deadly force to be reckoned with.

So do yourself a favor, would ya? Try it! There is plenty to do in the Shark and there is always something to do no matter your level of proficiency. There is plenty of great single-player content like the Georgian Oil War campaign and the Republic DLC campaign. You can also take it online and fly missions with your friends in multiplayer.

I hated the Shark at first sight, cursing the gods for not being an AH-64 Apache instead. I was glad a friend told me to **stop being a wuss** and fly the damn thing. Now, I feel like a complete badass flying at treetop level, dodging power lines and unleashing Vikhr missiles, volleys of 122 mm rockets and 30 mm cannon fire. I’m having a total blast. The Black Shark is without the shadow of a doubt a force to be reckoned with.

Like Shia Labeouf says… **DO IT! JUST… DO IT!**

By the mid-1970s, the Soviet Defense Ministry leadership determined that the Mi-24 “Hind” attack helicopter (then the backbone of the Soviet Army Aviation) was not meeting Army requirements. The attempt to develop a multi-role helicopter resulted in deficiencies in the aircraft's weight and dimension as well as its flight performance. This in turn led to decreased combat efficiency. Additionally, in late 1972 the U.S. commenced the AAH program that resulted in the development of Bell's YAH-63 and Hughes' YAH-64. The latter, designated “Apache”, was approved for mass-production and now serves as the U.S. Army’s primary attack helicopter.

Following these developments, the Central Committee of the Communist Party and the Council of Ministers of the Soviet Union passed a resolution on the development of a new-generation combat helicopter that could be fielded with the Soviet Army Aviation in the 1980s. The prospective helicopter's primary purpose was to destroy the armored forces close to the forward edge of battle area (FEBA). This resolution pitted competing programs run by N.I. Kamov and Ml. Mil's design bureaus against each other such that only one of them would be selected for series production. At that time, both developers had already gained valuable experience in designing and producing rotary-wing aircraft.

The design of the new Army combat helicopter, designated V-80 (later, Ka-50), began at the Kamov Helicopter Plant in January 1977. The program was run by the head of the design bureau, Chief Designer Sergei Mikheyev, who was later to become Designer General. Various aerodynamic configurations were considered for the future helicopter; however, the choice was made to use the Kamov's coaxial configuration due to its unique advantages. The substantial reduction in the power loss provided a hefty increase in main rotor thrust compared to a single-rotor configuration. This resulted in a higher static ceiling when the same power-level was used to power a coaxial-rotor versus a single-rotor configuration.

КАМОВ KAMOV

The Vikhr Anti-tank Guided Missile (ATGM) system, developed by the Tula design bureau (headed by Designer General Arkady Shipunov), was chosen to be the main weapons system for the V-80. The Vikhr ATGM system's distinctive feature is its laser guidance system that is coupled with an automatic target tracking system. This ensures high-accuracy irrespective of target range. The missile's range exceeds that of the Chaparral, Roland, and Rapier anti-aircraft missile systems. The combination of impact and proximity fuzes with a powerful shaped charge/fragmentation warhead enables the Vikhr to be used to kill both armored ground vehicles and aerial targets.

A launch-and-leave (fire and forget) targeting system was developed by the Zenith mechanical optics plant in Krasnogorsk. The Shkval automatic TV sight was developed in two variants – one for the Su-25T attack aircraft and one for the V-80 attack helicopter. The Leningrad-based Electroavtomatika scientific production association was tasked with the development of the Rubicon unified sight/navigation/flight system for the single-seat helicopter.

One of the program priorities was to enhance the helicopter's survivability. With this goal in mind, the configuration and systems' arrangement were chosen, assemblies designed, and structural materials tested. The helicopter lacked a very vulnerable tail rotor as well as an intermediate and tail reduction gearbox and control rods. A single crewman allowed the designers to increase cockpit protection. The following measures to enhance pilot survivability were taken:

- The engines were placed on both sides of the airframe to prevent a single hit from destroying both engines
- The helicopter could fly on a single engine in various modes
- The cockpit was armored and screened with combined steel/aluminum armor and armored Plexiglas
- The hydraulic steering system compartment was armored and screened
- Vital units were screened by less important ones
- Self-sealing fuel tanks were filled with polyurethane
- Composites were used to preserve the helicopter's efficiency when its load-carrying elements are damaged
- A two-contour rotor-blade spar was developed
- Control rod diameter was increased by positioning most of them inside the armored cockpit
- The powerplant and compartments adjacent to the fuel tanks were fire-protected
- The transmission is capable of operating for 30 minutes if the oil system is damaged
- The power supply systems, control circuits, etc. were made redundant and placed on opposite sides of the airframe
- Individual protection is provided to the pilot

In designing the V-80, special attention was paid to the choice of a cannon. The designers chose the 2A42 30 mm single-barrel cannon, developed by the Tula design bureau, headed by V.P. Gryazev. The 2A42 is a thing of macabre beauty. The cannon was initially intended for infantry fighting vehicles like the BMP-2. The V-80 designers faced the challenge of mounting the cannon on the helicopter in such a manner that it would retain its high accuracy. This also had to be balanced with the cannon’s primary deficiency – its heavy weight as compared to other aircraft-cannons.

The decision was made to mount the cannon close to the helicopter’s center of gravity on the right side of the airframe between the frames supporting the main gearbox - the strongest area of the airframe. Such a configuration reduced the recoil impact on the airframe and it provided the maximum level of accuracy. The restriction on the cannon's angle of rotation in the horizontal plane was compensated for by the coaxial-rotor’s ability to turn at any speed with its angular speed matching that of modern-day aircraft cannons. Thus, the coarse horizontal aiming of the cannon can be accomplished by yawing the helicopter's airframe.

In addition to the ATGM and cannon systems, the Soviet military also wanted to equip the new helicopter with a large array of other weapons. As a result, the V-80's weapons suite was bolstered with rocket pods, UPK-23-250 cannon pods, bombs, KMGU canisters, and the possibility to mount air-to-surface and air-to-air missiles in the future.

The aerodynamic symmetry and the lack of cross-linkages within the flight control system helped simplify flying the helicopter. A coaxial helicopter has fewer restrictions on side-slipping angles, angular speeds, and acceleration within the entire speed range. Additionally, there are relatively low moments of inertia due to the coaxial-rotor helicopters' compact size. Another unique feature of the V-80 design was it being a single seat aircraft with no provision for a dedicated weapons operator. This was compensated for by incorporating a highly automated targeting/navigation suite. The feasibility of building a single-seat combat helicopter was validated by the experience drawn from the operation of fixed-wing attack aircraft and fighter-bombers whose pilots were tasked with piloting, navigation, and weapon employment.

Kamov designers believed that combining the duties of flying, navigation, target detection, and tracking could be automated to a degree that a single crew member could perform all functions. Further, it was not expected that this would cause an excessive psychological and physical strain on the pilot. A single-person crew would provide the benefits of weight reduction, better flight performance, reduce training costs and reduce the number of possible combat casualties.

Needless to say, the Ka-50 remains one of the great technological achievements in modern aviation history.

Ka-50 “Legacy” vs Ka-50 “Black Shark III”

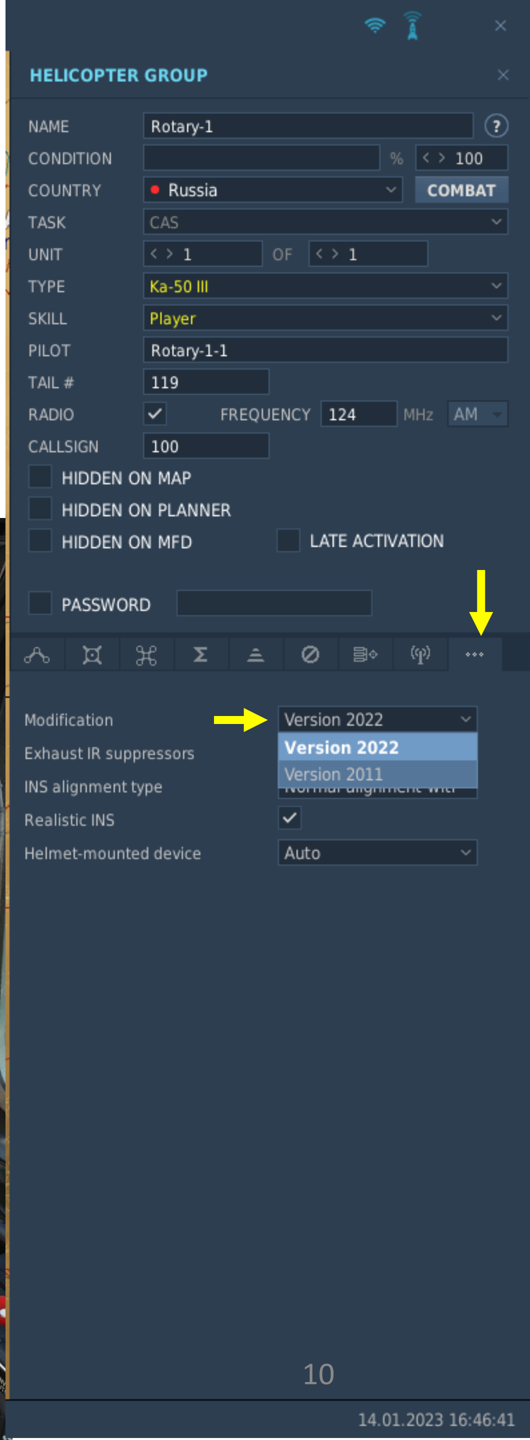
Throughout the guide, you will see certain sections that refer to the Ka-50 “Legacy” and Ka-50 “Black Shark III” versions. The “Legacy” is the original version of the DCS Ka-50 released back in 2008 (and updated as “Black Shark II” in 2011). An expansion to the module was released in 2022, which includes a new Igla air-to-air missile, a new INS (Inertial Navigation System) simulation, a new 3D model, a new ODS (Onboard Defense System) integrated with a Missile Warning System, and various improvements to different systems across the board. Green and red tags as shown below specify whether a section is applicable exclusively to a version, and the absence of a tag means that the section is applicable to either version.

Ka-50 “Legacy” vs Ka-50 “Black Shark III”

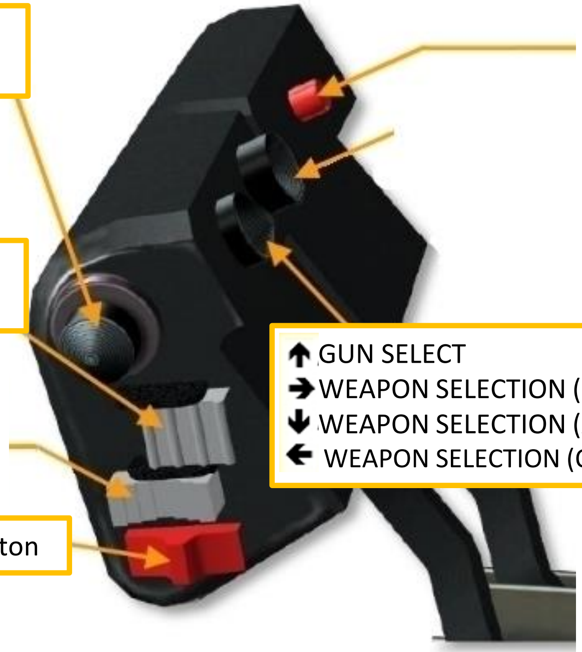
The Mission Editor has an option to allow you to fly the “Black Shark III” expansion either with 2011 legacy systems or 2022 systems.

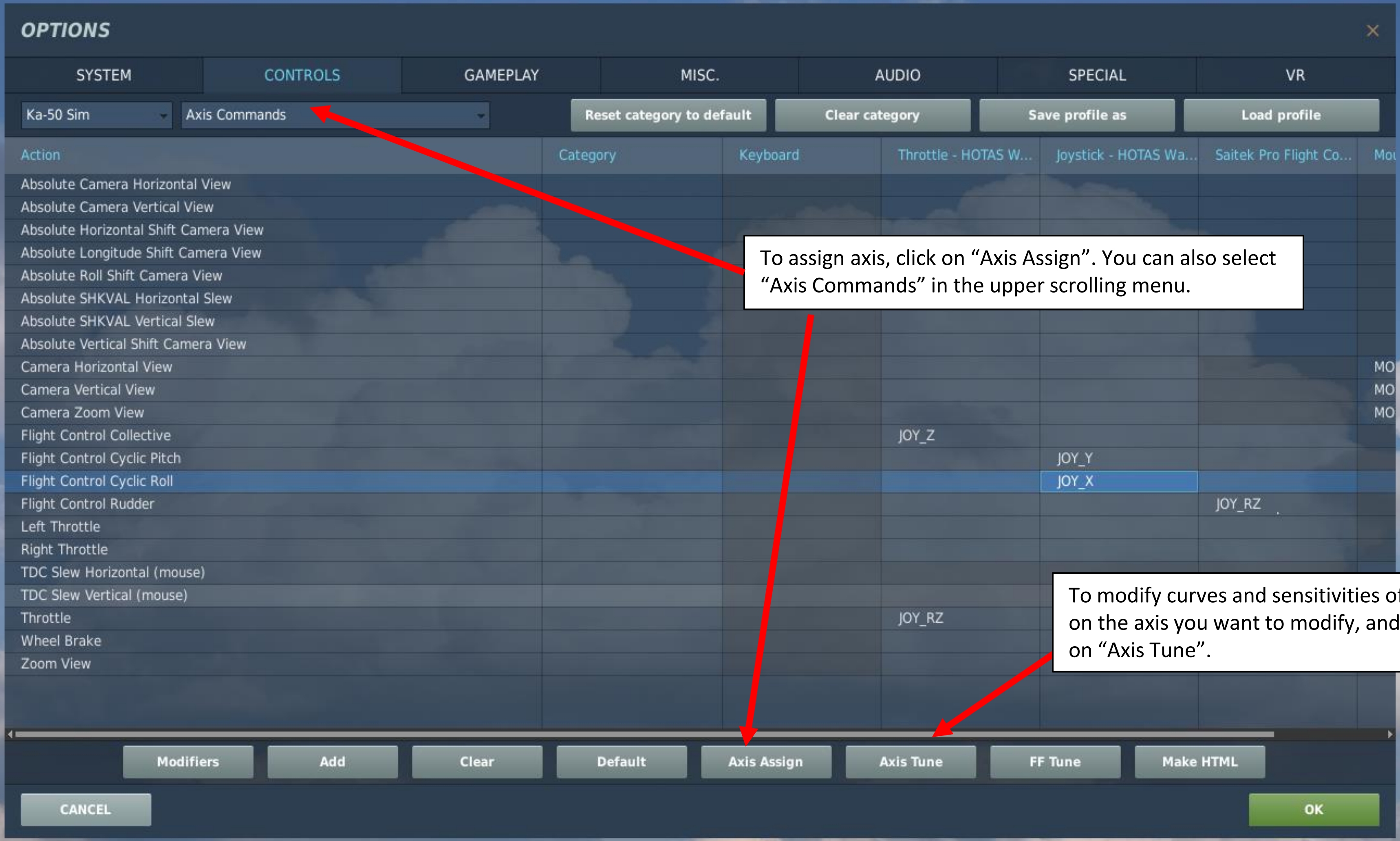
Ka-50 Legacy (2011 Variant)

Ka-50 Black Shark III (2022 Variant)



Controls Setup





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".

Controls Setup

BIND THE FOLLOWING AXES:

- CYCLIC PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 85, CURVATURE AT 21)
- CYCLIC ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 85, CURVATURE AT 21)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 14)
- COLLECTIVE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 11)
- THROTTLE (CORRECTOR) – CONTROLS ENGINE RPM

NOTES ABOUT CONTROLS

If you are more familiar with airplanes than with helicopters, you might not be quite familiar with a "collective" and a "cyclic". In a prop aircraft, you generally set your engine to a given RPM by changing the propeller's pitch, and you throttle up and down to change your thrust. Rudder pedals are used to change the orientation of your vertical stab.

In a helicopter, it's the opposite. You set your throttle to a given setting, and you change your thrust with your **collective**, which changes the pitch of your rotor/propeller's blades. Unlike most helicopters, the Ka-50 has an actual rudder instead of a tail rotor. This is because of the coaxial rotors, which lateral forces cancel each other (more on that in the "Principles of Helicopter Flight" section). The **cyclic**, on the other hand, is used just like a regular stick on a plane. The cyclic modifies the orientation of swashplates, to which are attached push rods that define the orientation of the rotor.

In very simple terms, you could say that the collective is used like a throttle on a plane, the throttle is used like a RPM setter on a plane, and the cyclic is used like a joystick on a plane.

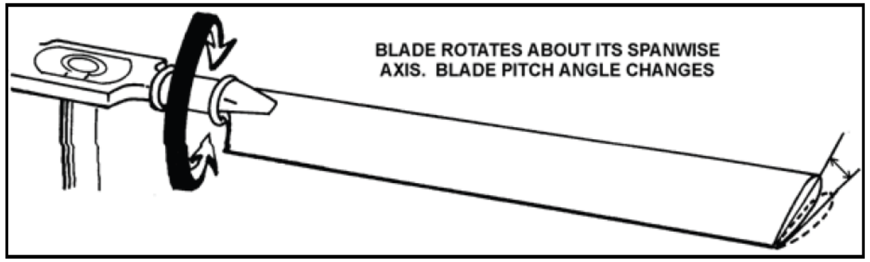
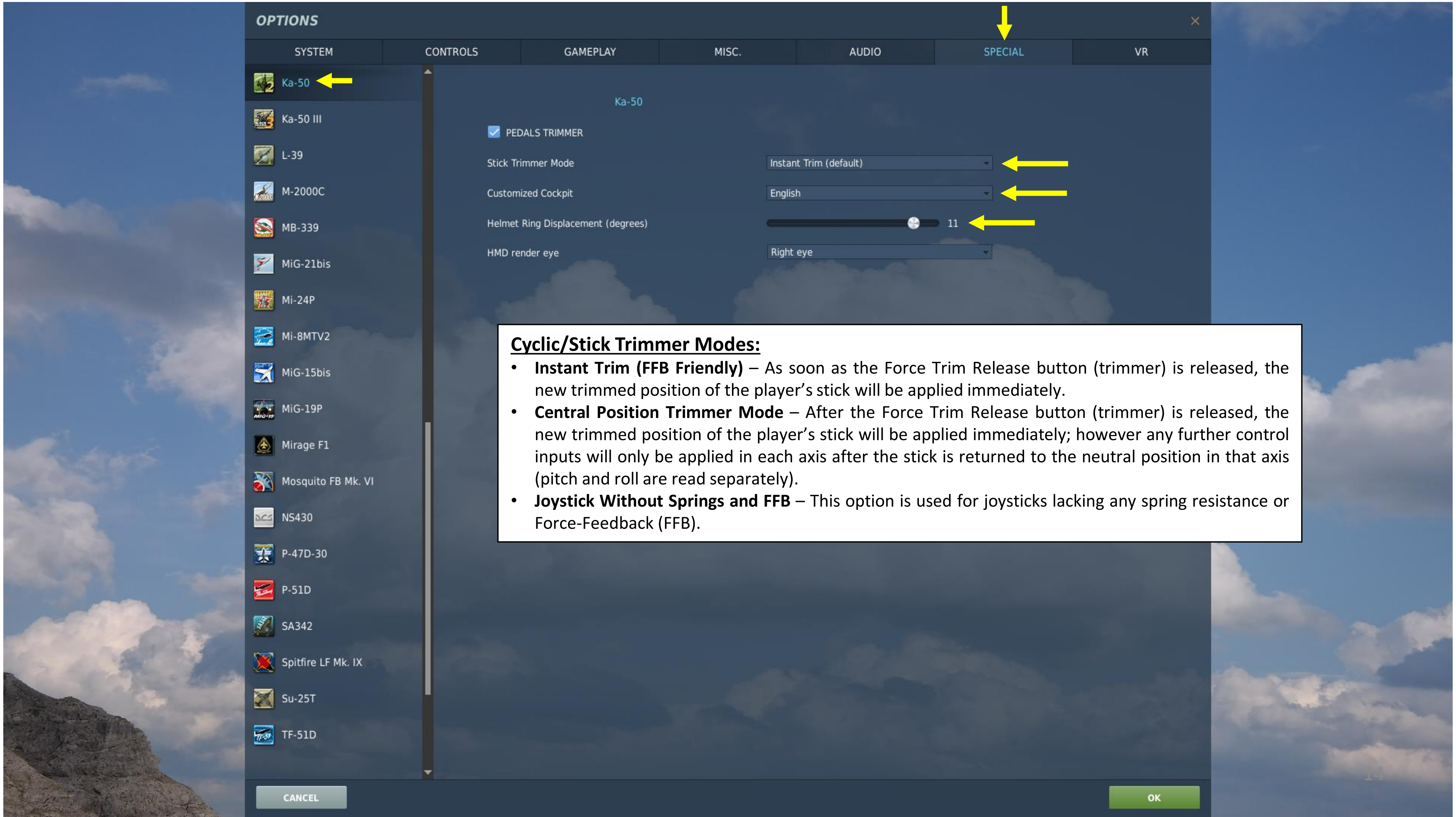


Figure 1-17. Feathering

Ka-50 Black Shark Legacy Variant Only

In the Special Options Tab of the Ka-50 (Legacy Variant), I recommend using the following settings:

- Pedals Trimmer – Enabled (ticked)
- Stick Trimmer Mode – Instant Trim (Default)
- Customized Cockpit: English
- Helmet Ring Displacement: 11 deg



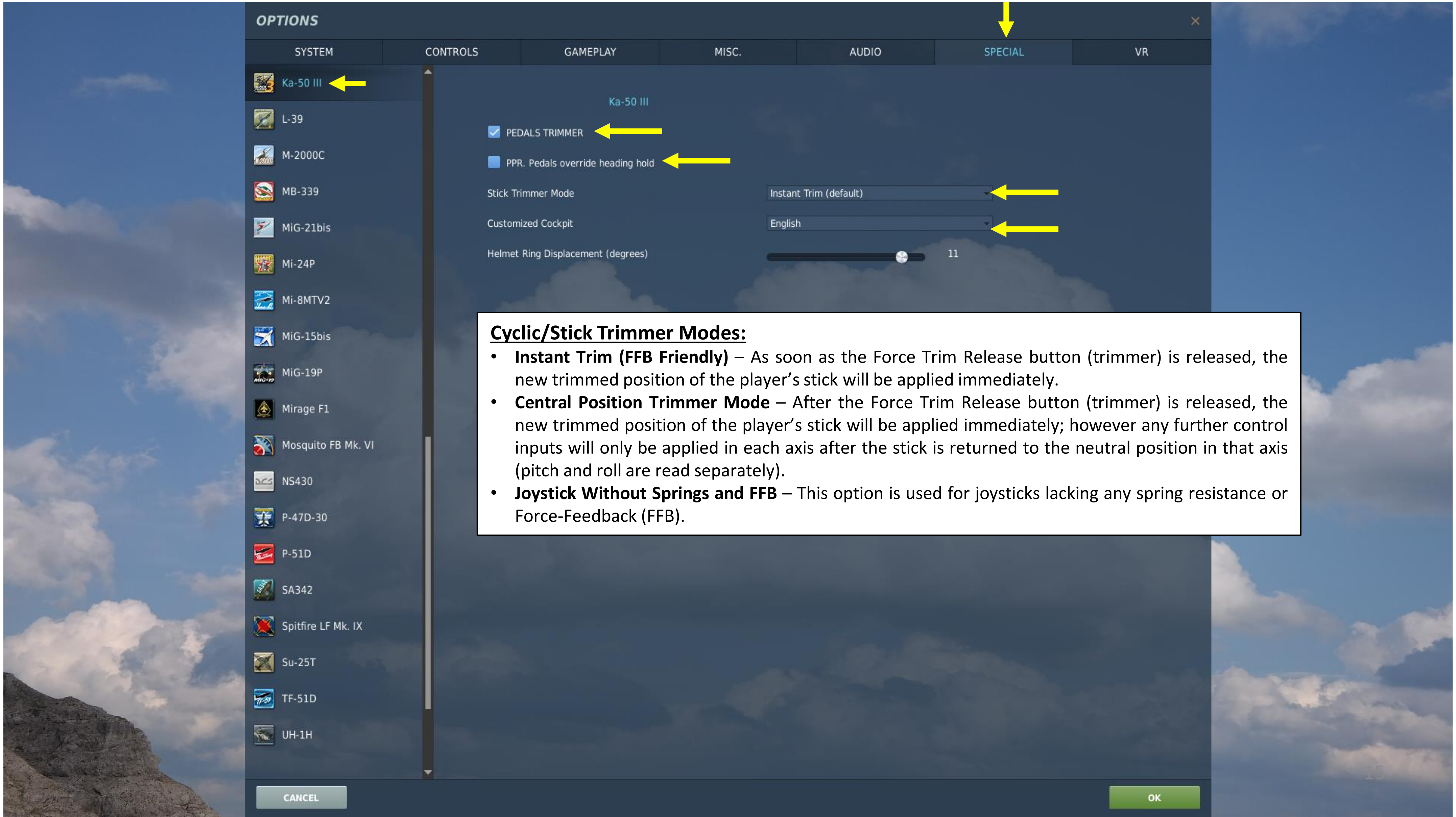
Cyclic/Stick Trimmer Modes:

- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately; however any further control inputs will only be applied in each axis after the stick is returned to the neutral position in that axis (pitch and roll are read separately).
- **Joystick Without Springs and FFB** – This option is used for joysticks lacking any spring resistance or Force-Feedback (FFB).

Ka-50 Black Shark III Expansion Only

In the Special Options Tab of the Ka-50 III (Expansion Variant), I recommend using the following settings:

- Pedals Trimmer – Enabled (ticked)
- PPR Pedals override heading hold – Disabled (not ticked)
- Stick Trimmer Mode – Instant Trim (Default)
- Customized Cockpit: English
- Helmet Ring Displacement: 11 deg

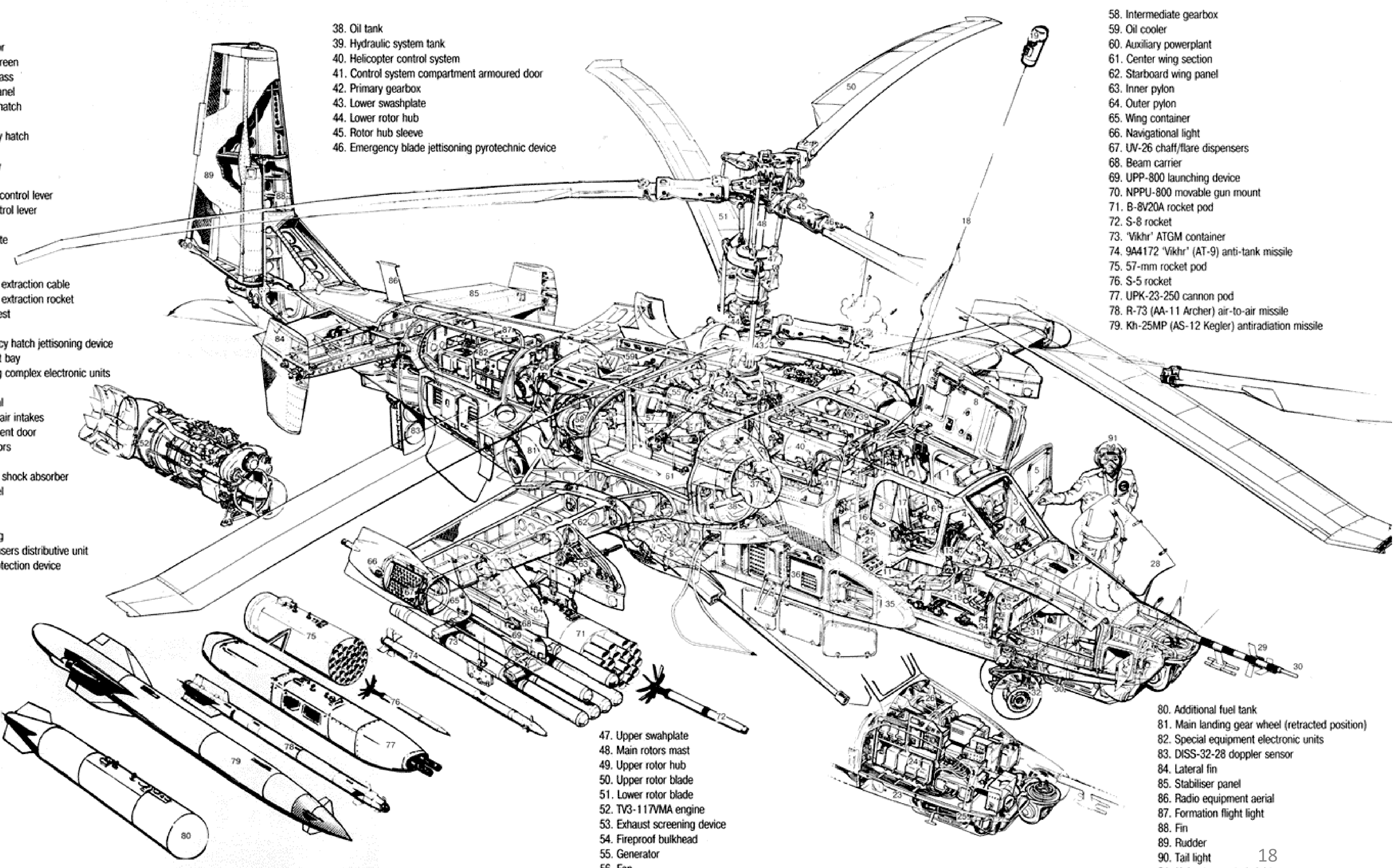


Cyclic/Stick Trimmer Modes:

- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately; however any further control inputs will only be applied in each axis after the stick is returned to the neutral position in that axis (pitch and roll are read separately).
- **Joystick Without Springs and FFB** – This option is used for joysticks lacking any spring resistance or Force-Feedback (FFB).

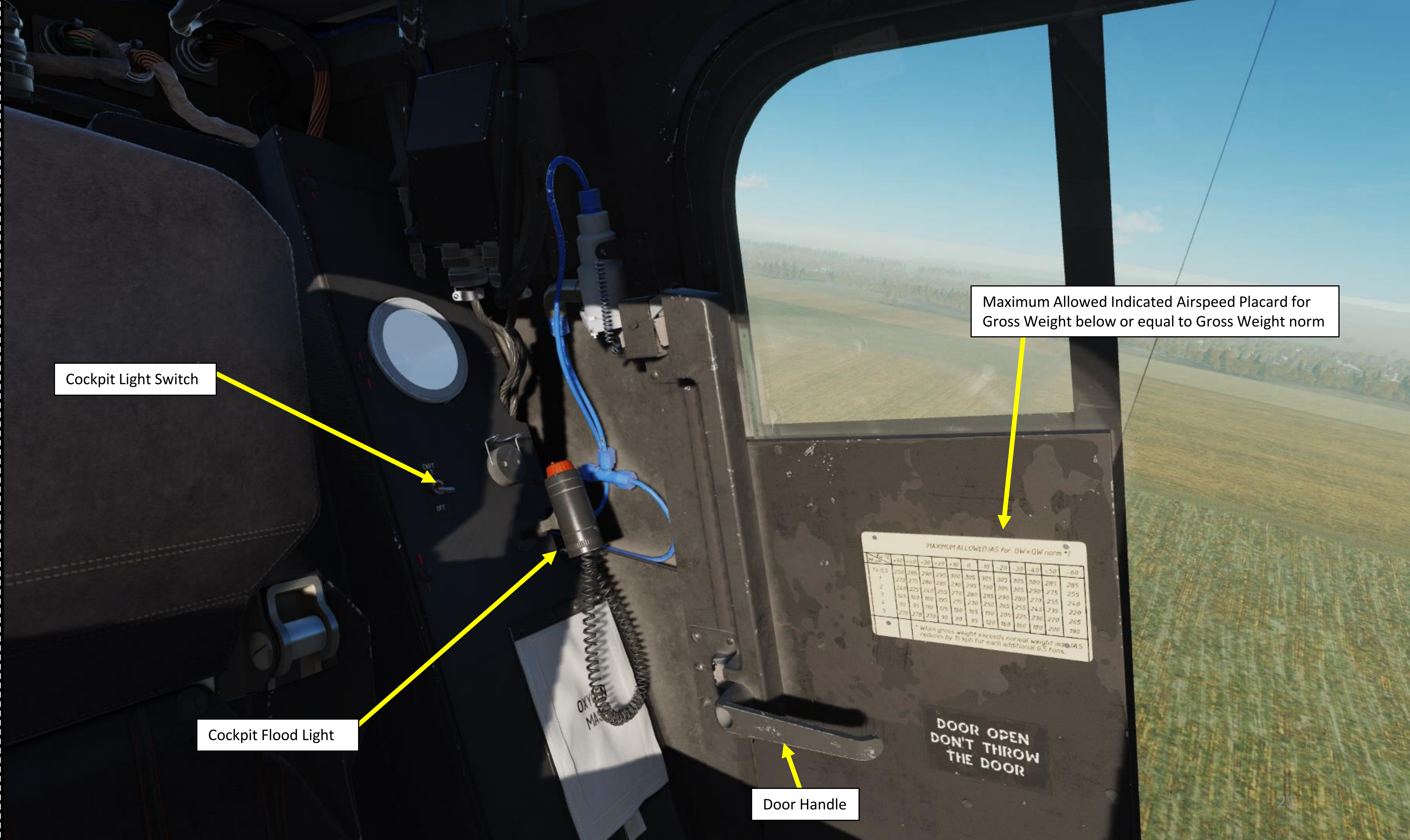

CLEAR
SEND MEM
RESET PROG
STOP
START
FIRE EXTINGUISHER SYSTEM
FUEL PUMPS

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



1. Pilot cockpit
2. Cockpit entry door
3. Armoured windscreen
4. Side armoured glass
5. Side armoured panel
6. Side emergency hatch
7. Rear-view mirror
8. Upper emergency hatch
9. Instrument panel
10. Head-up display
11. Control panels
12. Collective pitch control lever
13. Cyclic pitch control lever
14. Control pedal
15. Under pedal plate
16. Control panels
17. Control rod
18. Ejection system extraction cable
19. Ejection system extraction rocket
20. Pilot seat backrest
21. X-ray meter
22. Upper emergency hatch jettisoning device
23. Nose equipment bay
24. 'Shkval' sighting complex electronic units
25. Gun sight
26. IFF system aerial
27. Cooling system air intakes
28. Nose compartment door
29. Angle rate sensors
30. Pitot static tube
31. Nose gear strut shock absorber
32. Nose gear wheel
33. Sealed lead
34. Jack unit
35. Starboard fairing
36. Electric power users distributive unit
37. Engine dust-protection device
38. Oil tank
39. Hydraulic system tank
40. Helicopter control system
41. Control system compartment armoured door
42. Primary gearbox
43. Lower swashplate
44. Lower rotor hub
45. Rotor hub sleeve
46. Emergency blade jettisoning pyrotechnic device
47. Upper swahplate
48. Main rotors mast
49. Upper rotor hub
50. Upper rotor blade
51. Lower rotor blade
52. TV3-117VMA engine
53. Exhaust screening device
54. Fireproof bulkhead
55. Generator
56. Fan
57. Connecting shaft
58. Intermediate gearbox
59. Oil cooler
60. Auxiliary powerplant
61. Center wing section
62. Starboard wing panel
63. Inner pylon
64. Outer pylon
65. Wing container
66. Navigational light
67. UV-26 chaff/flare dispensers
68. Beam carrier
69. UPP-800 launching device
70. NPPU-800 movable gun mount
71. B-8V20A rocket pod
72. S-8 rocket
73. 'Vikhr' ATGM container
74. 9A4172 'Vikhr' (AT-9) anti-tank missile
75. 57-mm rocket pod
76. S-5 rocket
77. UPK-23-250 cannon pod
78. R-73 (AA-11 Archer) air-to-air missile
79. Kh-25MP (AS-12 Kegler) antiradiation missile
80. Additional fuel tank
81. Main landing gear wheel (retracted position)
82. Special equipment electronic units
83. DISS-32-28 doppler sensor
84. Lateral fin
85. Stabiliser panel
86. Radio equipment aerial
87. Formation flight light
88. Fin
89. Rudder
90. Tail light
91. Helmet-mounted sight

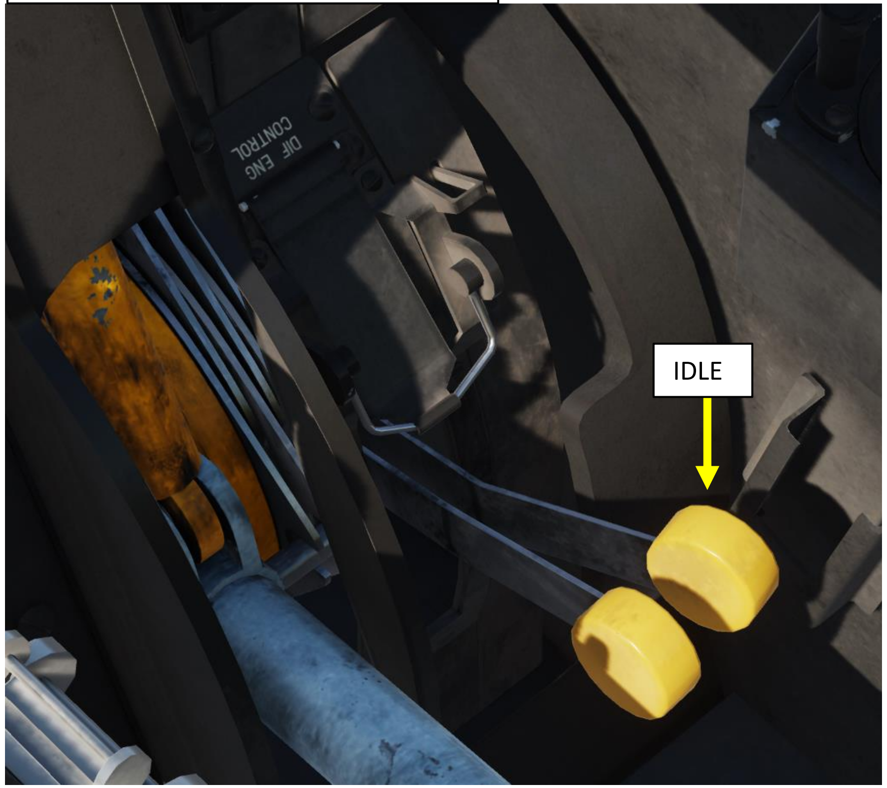

KA-50
DOOR OPEN
DON'T THROW
THE DOOR


Cockpit Light Switch
Cockpit Flood Light
Maximum Allowed Indicated Airspeed Placard for Gross Weight below or equal to Gross Weight norm
Door Handle
DOOR OPEN DON'T THROW THE DOOR


Flood Light
Engine Cut-Off Valve Levers
• UP: OPEN
• DOWN: CLOSED
Engine Throttle Levers
• FULLY UP: MAX
• MIDDLE UP: AUTO
• MIDDLE DOWN: GOVERNOR FAIL
• FULLY DOWN: IDLE
Rotor Brake Lever
• UP: ENGAGED
• DOWN: DISENGAGED
Collective

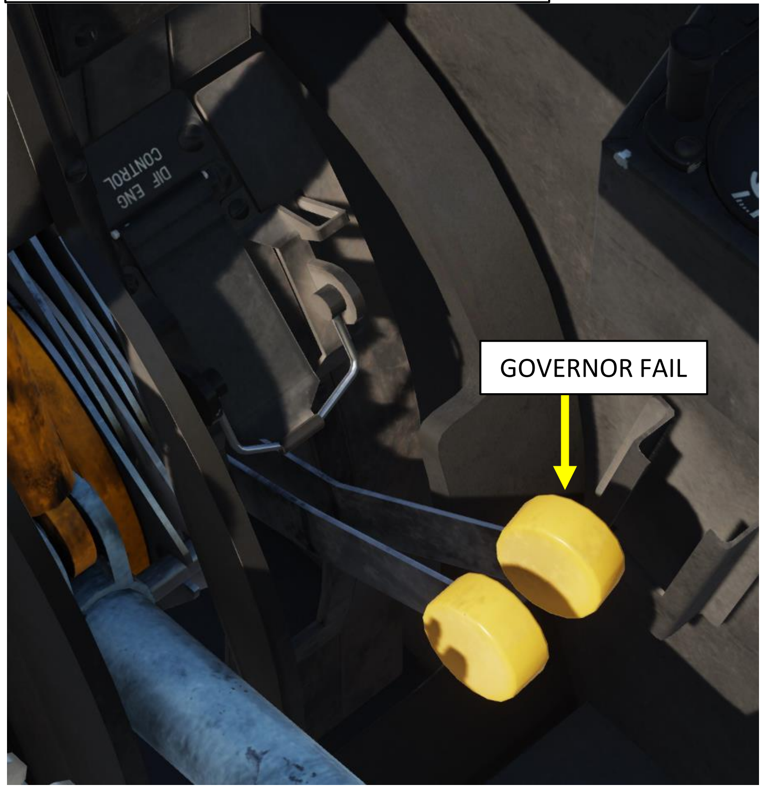
Engine Throttle Levers
- ***FULLY DOWN: IDLE***

IDLE mode is used to perform start-up procedures and most system functional tests.



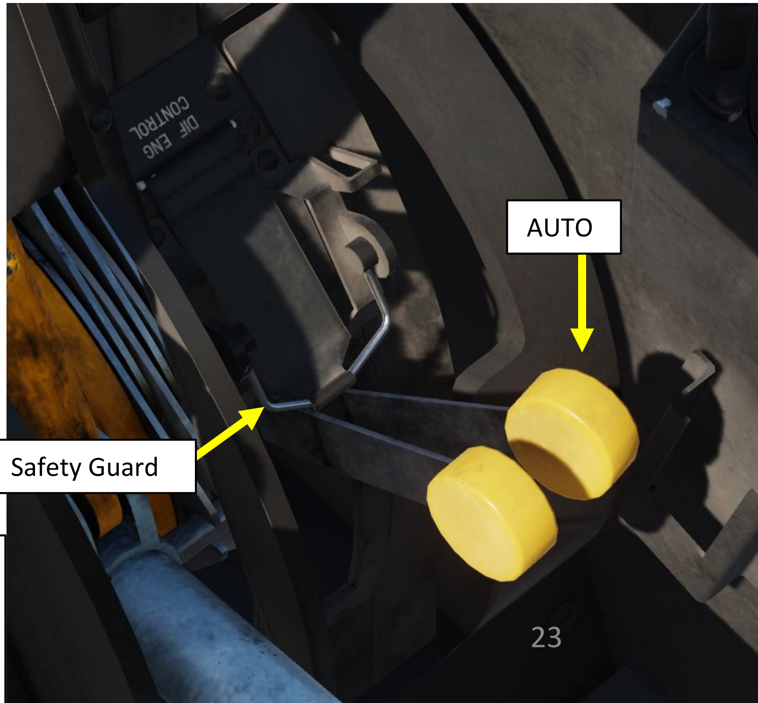
Engine Throttle Levers
- ***MIDDLE DOWN: GOVERNOR FAIL***

Needed in case of failure of the power turbine's RPM governor to avoid engine overspeed.



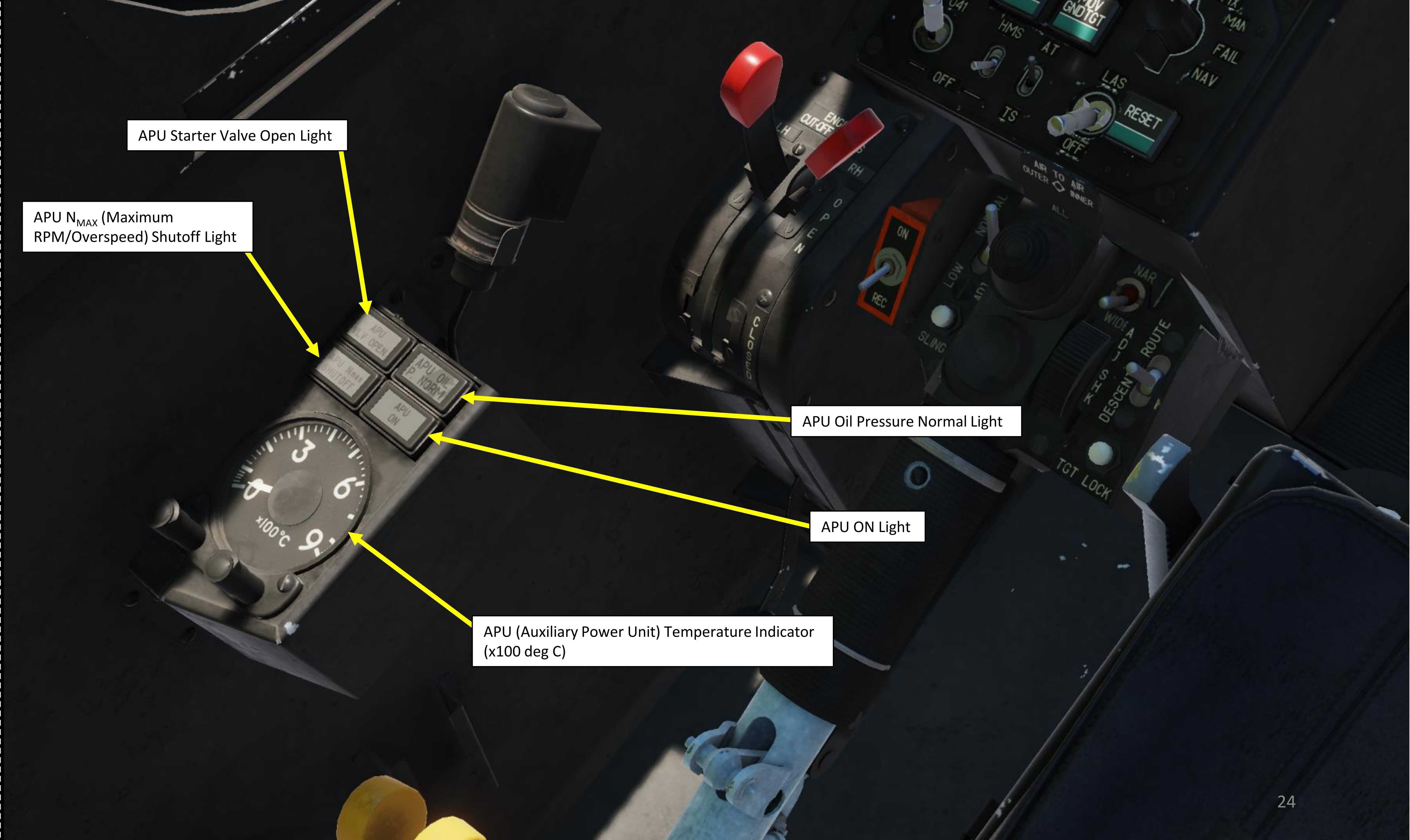
Engine Throttle Levers
- ***FULLY UP: MAX***

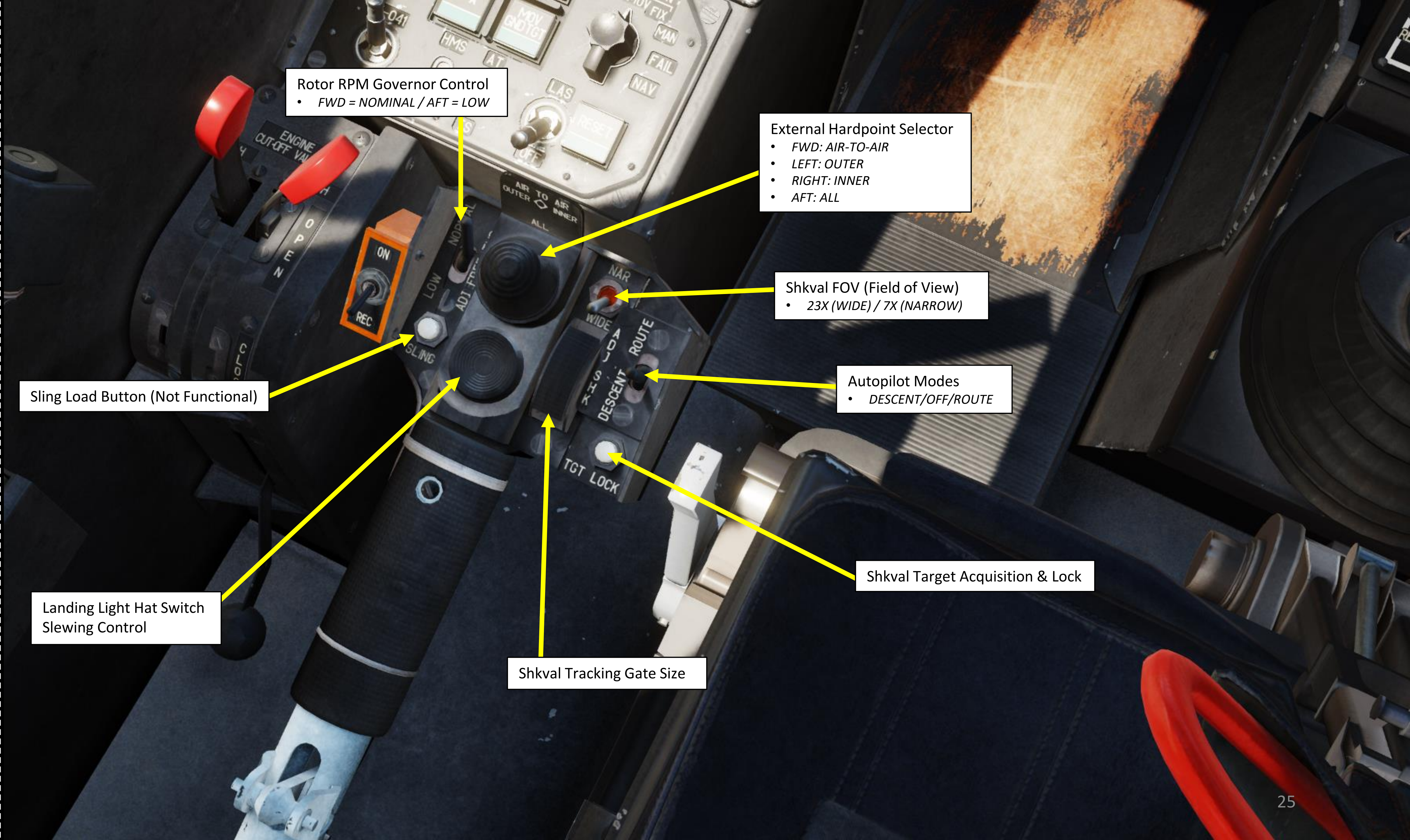
Intended to ensure maximum power of one engine in case of failure of the other engine (OEI, One Engine Inoperative)



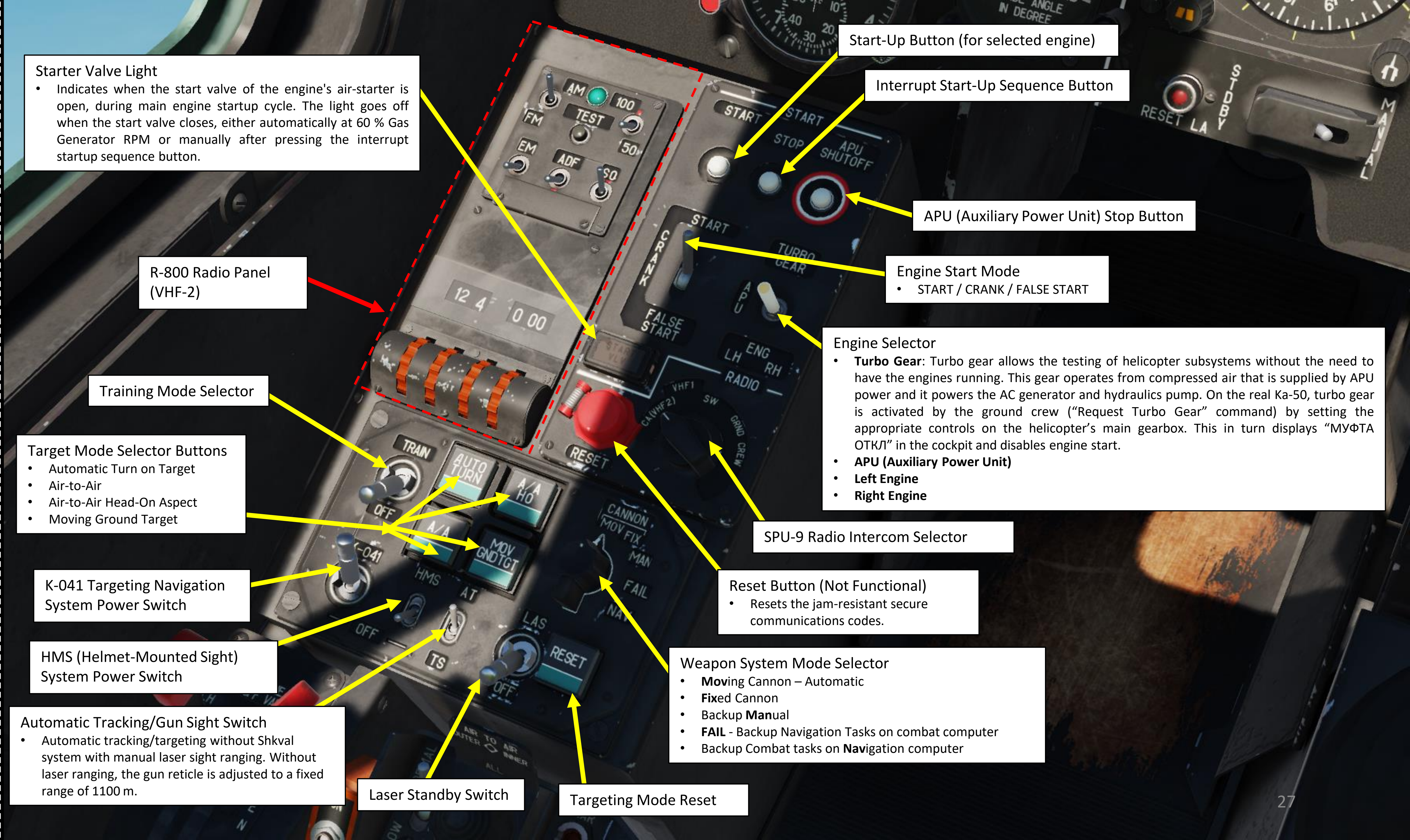
Engine Throttle Levers
- ***MIDDLE UP: AUTO***

AUTO is the main mode during normal engine operation. All flights must be performed at this mode except for specific emergencies.

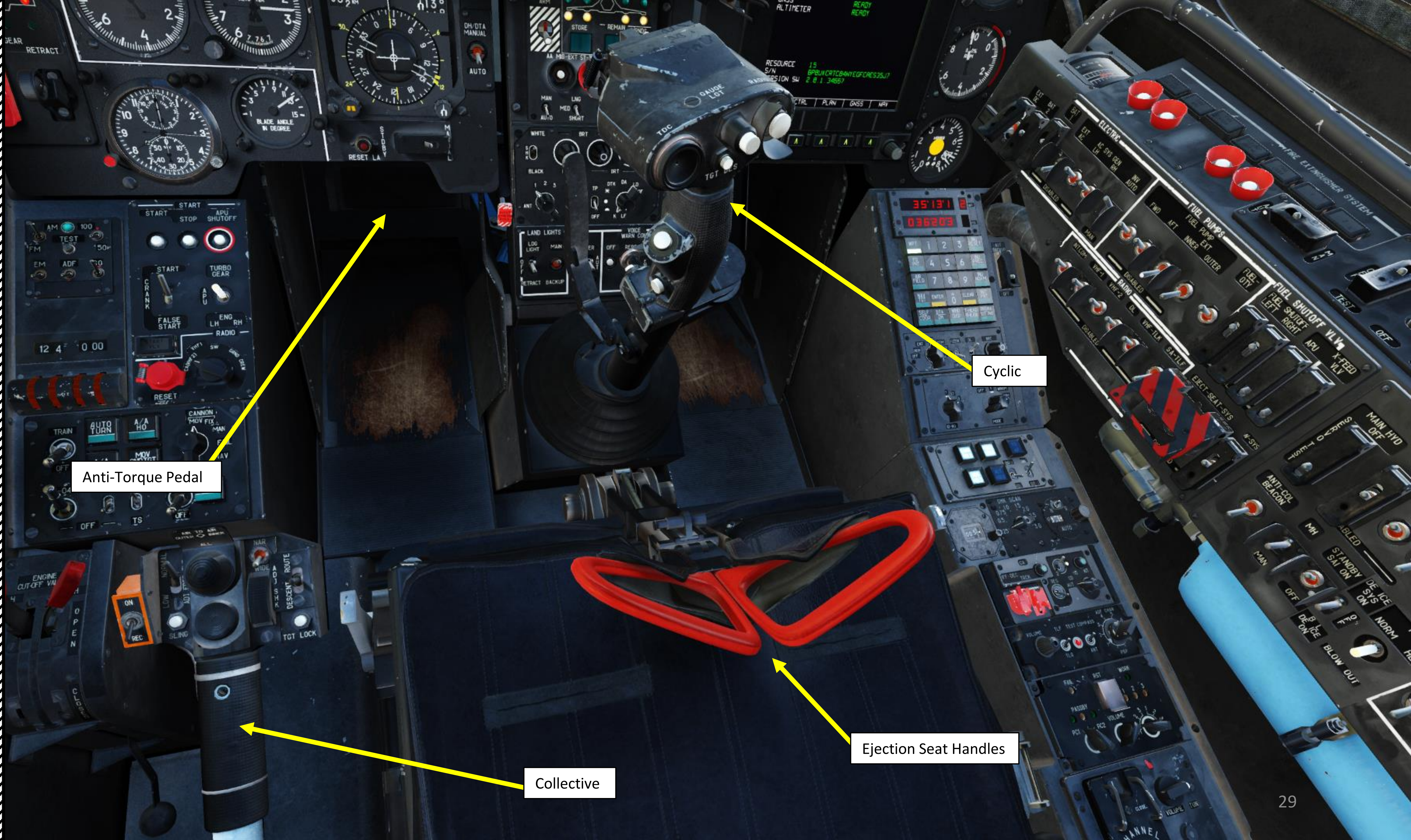

APU Starter Valve Open Light
APU N_{MAX} (Maximum RPM/Overspeed) Shutoff Light
APU Oil Pressure Normal Light
APU ON Light
APU (Auxiliary Power Unit) Temperature Indicator (x100 deg C)

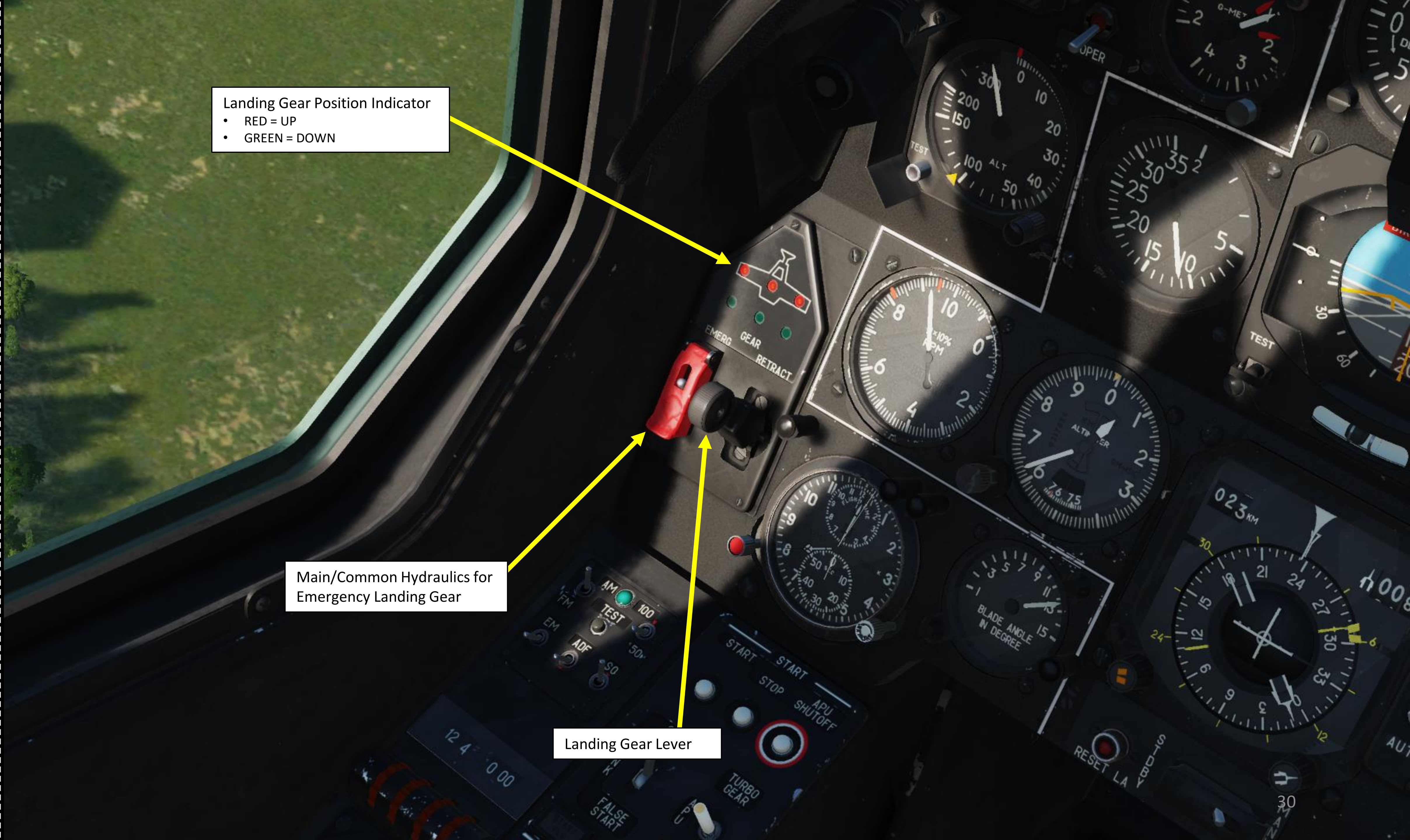

Rotor RPM Governor Control
• FWD = NOMINAL / AFT = LOW
External Hardpoint Selector
• FWD: AIR-TO-AIR
• LEFT: OUTER
• RIGHT: INNER
• AFT: ALL
Shkval FOV (Field of View)
• 23X (WIDE) / 7X (NARROW)
Autopilot Modes
• DESCENT/OFF/ROUTE
Sling Load Button (Not Functional)
Landing Light Hat Switch Slewing Control
Shkval Tracking Gate Size
Shkval Target Acquisition & Lock

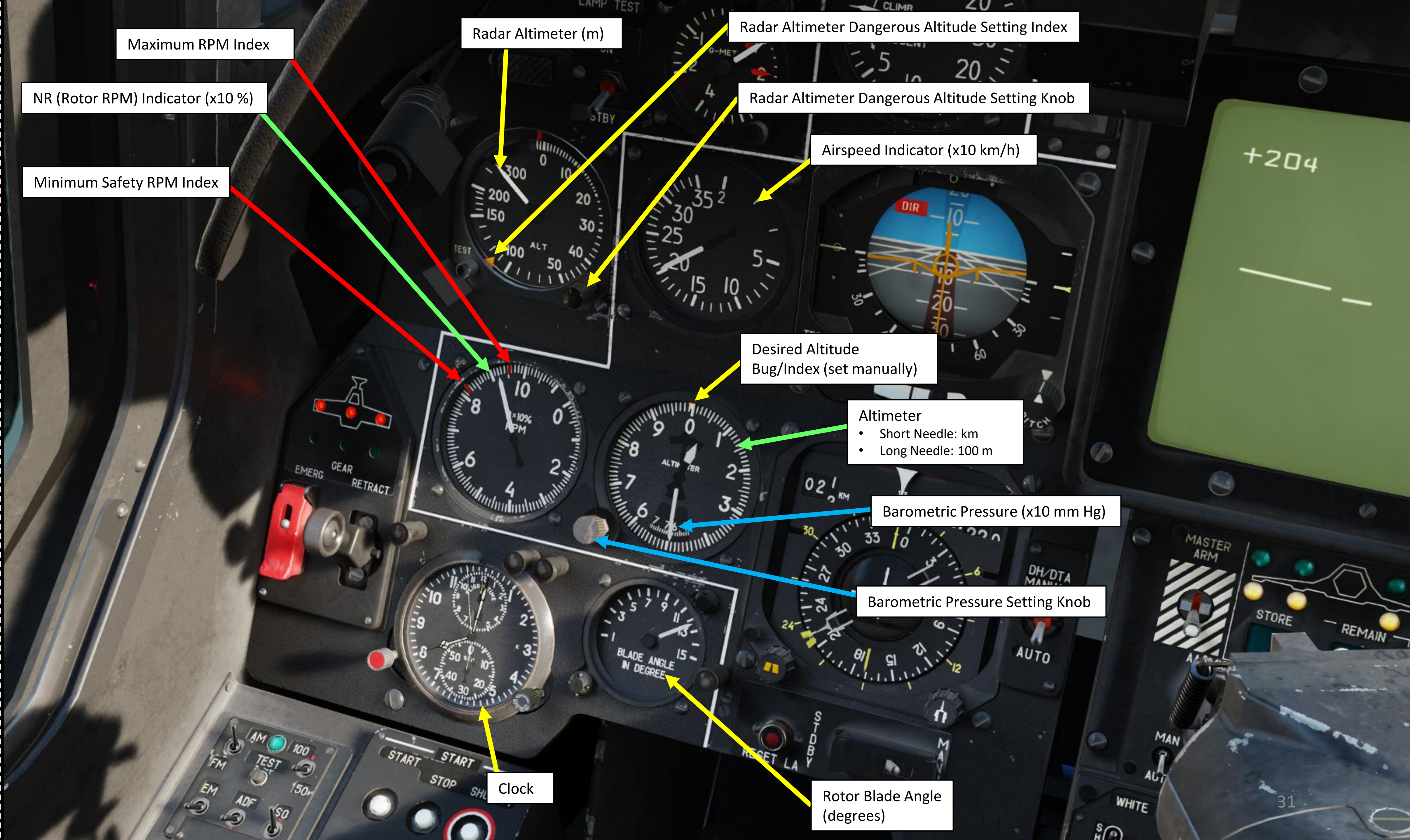
Collective Brake – Assign Altitude Lever
(also referred as Collective Clutch Lock/Release Button)

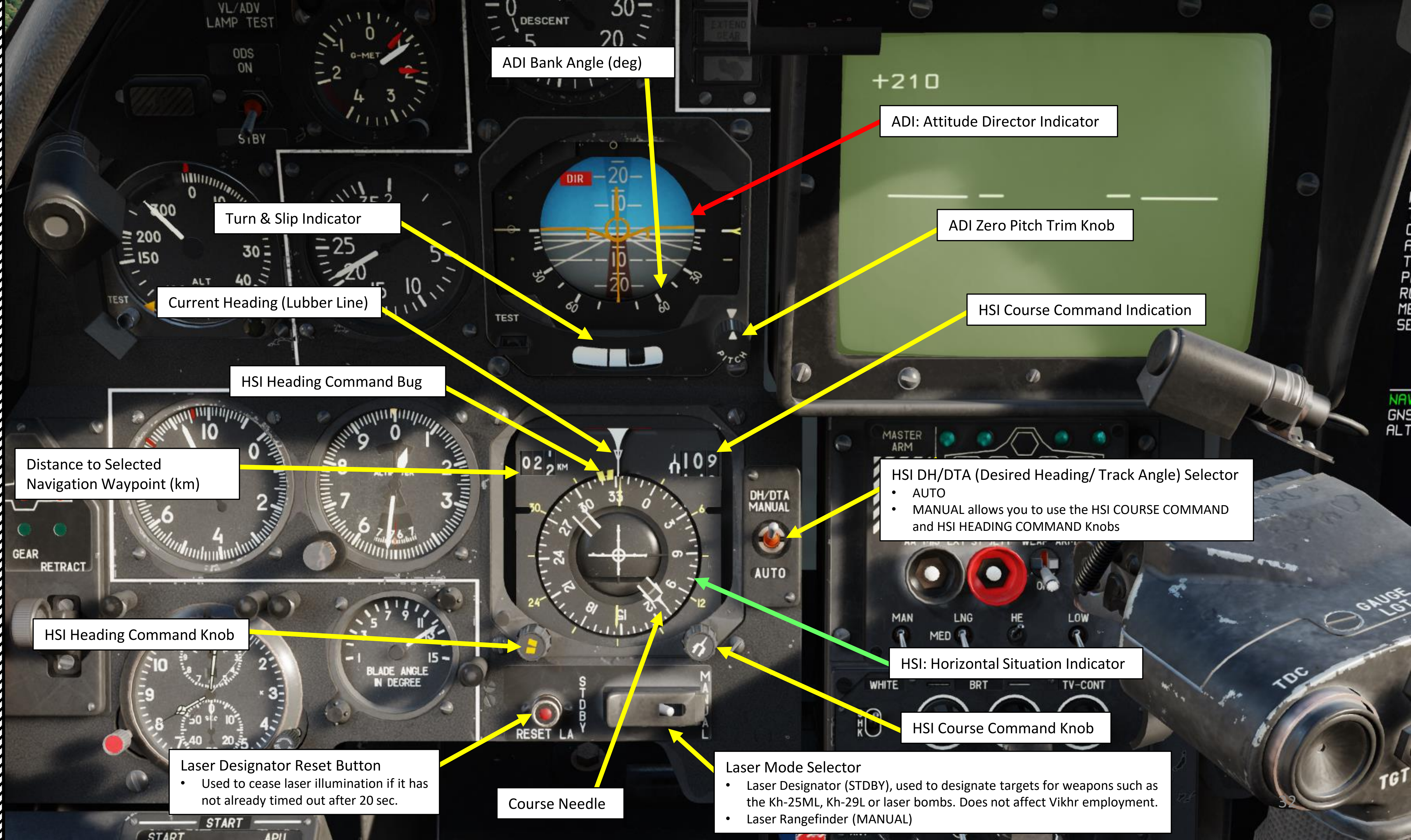

Starter Valve Light
• Indicates when the start valve of the engine's air-starter is open, during main engine startup cycle. The light goes off when the start valve closes, either automatically at 60 % Gas Generator RPM or manually after pressing the interrupt startup sequence button.
R-800 Radio Panel (VHF-2)
Training Mode Selector
Target Mode Selector Buttons
• Automatic Turn on Target
• Air-to-Air
• Air-to-Air Head-On Aspect
• Moving Ground Target
K-041 Targeting Navigation System Power Switch
HMS (Helmet-Mounted Sight) System Power Switch
Automatic Tracking/Gun Sight Switch
• Automatic tracking/targeting without Shkval system with manual laser sight ranging. Without laser ranging, the gun reticle is adjusted to a fixed range of 1100 m.
Laser Standby Switch
Targeting Mode Reset
Start-Up Button (for selected engine)
Interrupt Start-Up Sequence Button
APU (Auxiliary Power Unit) Stop Button
Engine Start Mode
• START / CRANK / FALSE START
Engine Selector
• **Turbo Gear**: Turbo gear allows the testing of helicopter subsystems without the need to have the engines running. This gear operates from compressed air that is supplied by APU power and it powers the AC generator and hydraulics pump. On the real Ka-50, turbo gear is activated by the ground crew (“Request Turbo Gear” command) by setting the appropriate controls on the helicopter’s main gearbox. This in turn displays “МУФТА ОТКЛ” in the cockpit and disables engine start.
• **APU (Auxiliary Power Unit)**
• **Left Engine**
• **Right Engine**
SPU-9 Radio Intercom Selector
Reset Button (Not Functional)
• Resets the jam-resistant secure communications codes.
Weapon System Mode Selector
• **Mov**ing Cannon – Automatic
• **Fix**ed Cannon
• Backup **Man**ual
• **FAIL** - Backup Navigation Tasks on combat computer
• Backup Combat tasks on **Nav**igation computer


STOP
START
BRT
TEST
GRID
NIGHT
BLADE ANGLE IN DEGREE
GAUGE LGT
RADIO
SEARCH
MAP
FPL
SUSP
ARC
ELECTRIC


Anti-Torque Pedal
Cyclic
Ejection Seat Handles
Collective


Landing Gear Position Indicator
• RED = UP
• GREEN = DOWN
Main/Common Hydraulics for Emergency Landing Gear
Landing Gear Lever


Maximum RPM Index
Radar Altimeter (m)
Radar Altimeter Dangerous Altitude Setting Index
NR (Rotor RPM) Indicator (x10 %)
Radar Altimeter Dangerous Altitude Setting Knob
Airspeed Indicator (x10 km/h)
Minimum Safety RPM Index
Desired Altitude Bug/Index (set manually)
Altimeter
• Short Needle: km
• Long Needle: 100 m
Barometric Pressure (x10 mm Hg)
Barometric Pressure Setting Knob
Clock
Rotor Blade Angle (degrees)


ADI Bank Angle (deg)
ADI: Attitude Director Indicator
Turn & Slip Indicator
ADI Zero Pitch Trim Knob
Current Heading (Lubber Line)
HSI Course Command Indication
HSI Heading Command Bug
Distance to Selected Navigation Waypoint (km)
HSI DH/DTA (Desired Heading/ Track Angle) Selector
• AUTO
• MANUAL allows you to use the HSI COURSE COMMAND and HSI HEADING COMMAND Knobs
HSI Heading Command Knob
HSI: Horizontal Situation Indicator
HSI Course Command Knob
Laser Designator Reset Button
• Used to cease laser illumination if it has not already timed out after 20 sec.
Course Needle
Laser Mode Selector
• Laser Designator (STDBY), used to designate targets for weapons such as the Kh-25ML, Kh-29L or laser bombs. Does not affect Vikhr employment.
• Laser Rangefinder (MANUAL)

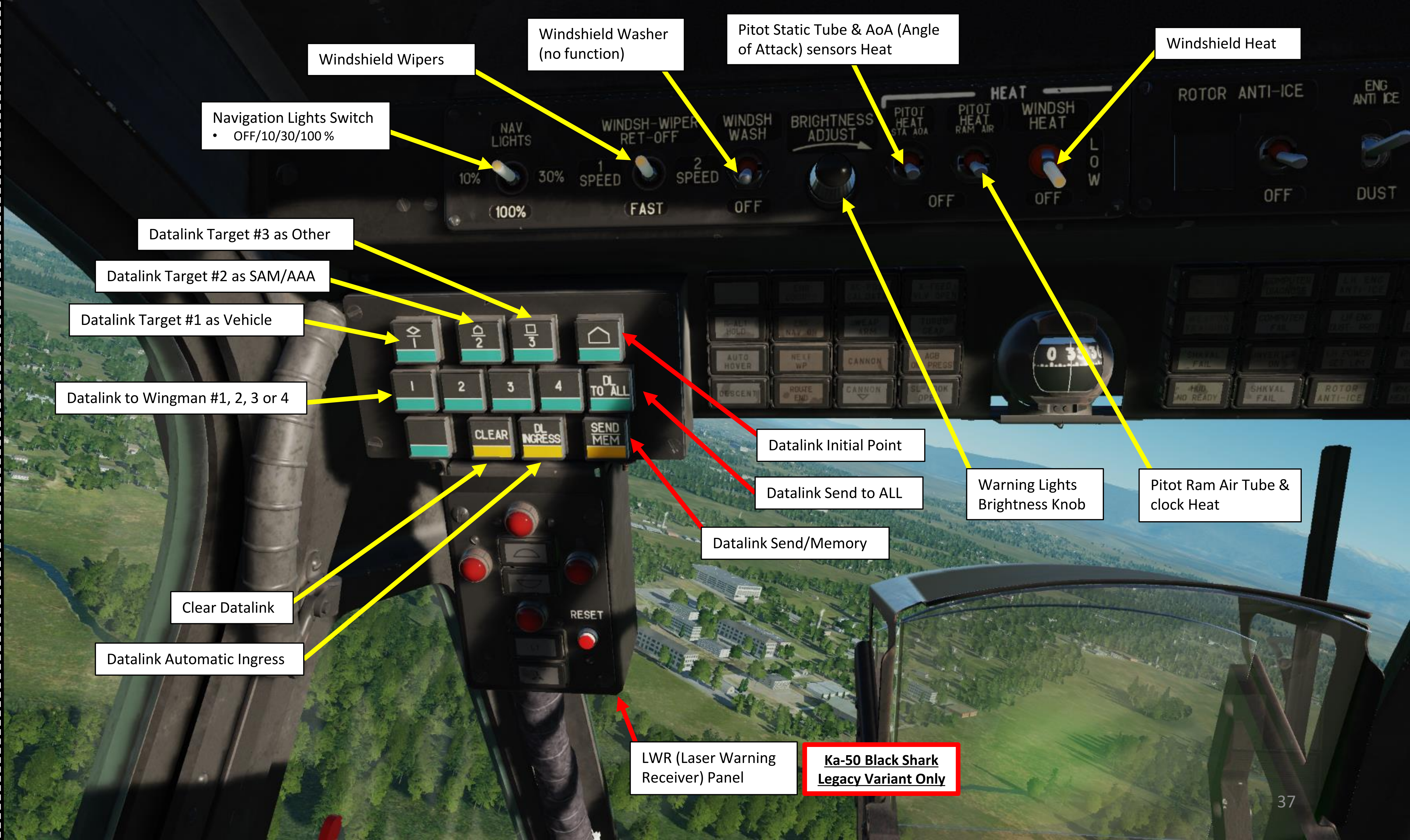

ODS (Onboard Defense System) Mode Selector Switch
• UP = ODS ON (Combat Mode)
• DOWN = STBY (Standby Mode)
Ka-50 Black Shark III Expansion Only (2022 variant)
Accelerometer (g)
Vertical Velocity Indicator (m/s)
BRT
TEST
GRID
DAY
NIGHT
VL/ADV LAMP TEST
ODS ON
STBY
CLIMB
DESCENT
DIR
+210
MENU
DATA
NAVIGATION DATA
TOPO DATA
COMPANY ROUTES
ADDITIONAL INFO
TERRAIN DATA
PERF
ROUTES
METEO
SEA CHARTS

Caution Lights Panel

LH ENG OVERSPD Left engine turbine overspeed	**RH ENG OVERSPD** Right engine turbine overspeed	**OVER-G** Excessive G is being pulled
LH ENG VIBR Left engine vibration excessive	**RH ENG VIBR** Right engine vibration excessive	**IAS MAX** Aircraft is exceeding maximum airspeed
MAIN GRBX • Minimum Main Gearbox Pressure • Main Gearbox Oil Overheat • Oil Metallic Chip Detected	**FIRE** Fire Detected	**IFF FAIL** Identify-Friend-or-Foe System Failure


Wiper
RESET PROG
L8
STOP
START
BRT
TEST
GRID
NIGHT


Magnetic Compass


Windshield Wipers
Windshield Washer (no function)
Pitot Static Tube & AoA (Angle of Attack) sensors Heat
Windshield Heat
Navigation Lights Switch
• OFF/10/30/100 %
Datalink Target #3 as Other
Datalink Target #2 as SAM/AAA
Datalink Target #1 as Vehicle
Datalink to Wingman #1, 2, 3 or 4
Datalink Initial Point
Datalink Send to ALL
Warning Lights Brightness Knob
Pitot Ram Air Tube & clock Heat
Datalink Send/Memory
Clear Datalink
Datalink Automatic Ingress
LWR (Laser Warning Receiver) Panel
Ka-50 Black Shark Legacy Variant Only

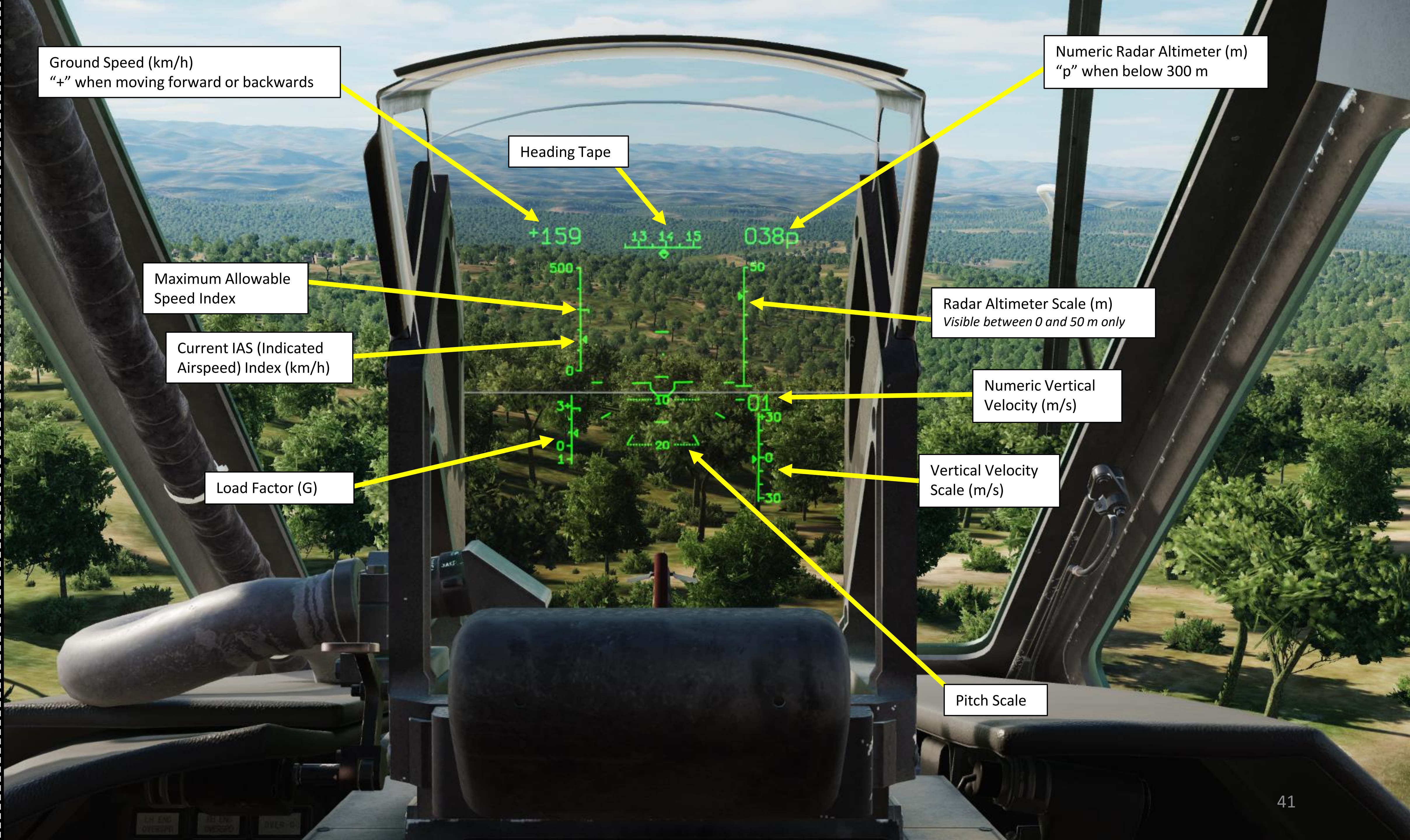

Left Pitot Heat Indicator Light
• Illuminates when pitot heat control button is pressed and the pitot tube heat system is operating normally
Engine Anti-Ice/Dust Protection Switch
Right Pitot Heat Indicator Light
• Illuminates when pitot heat control button is pressed and the pitot tube heat system is operating normally
Ventilation Switch (not functional)
UV-26 Countermeasures Panel
Numbers = Flare Dispensing Parameters
Quantity/Program Selector
Flare interval (time-delay between flare release)
Reset Program
Start Countermeasure Program
Rotor Anti-Ice Switch
Pitot Heat Test Switch
Flare side deployment
• Left/Both/Right
Number of flare sequences options
Salvo: set number of flares dispensed per salvo
Stop Countermeasure Program
HEAT
PITOT HEAT RAM AIR
WINDSH HEAT
LOW
OFF
ROTOR ANTI-ICE
ENG ANTI ICE
DUST
PITOT HEAT
LH STATIC AOA TEST RAM AIR RH
VENT TWO
OFF
ONE
FWD TANK PUMP ON
AFT TANK PUMP ON
064
SIDE
QUANT-NUM
L.4,5(12), 6,7(15),8
L6,8, 7(0,25C) 9(0,5C)
L8
RESET PROG
STOP
START
CONTINUOUS
AUTOCONTR

Caution Lights Panel

	ENR COURSE Route navigation with course following is enabled	**AC-POS CAL DATA** Aircraft position is roughly calculated using air data systems information	**X-FEED VLV OPEN** Fuel is shared between tanks (crossfeed ON)
R ALT HOLD Radar altitude-hold autopilot mode is ON	**ENR NAV ON** Route navigation with direct flight to steerpoint is enabled	**WEAP ARM** Weapons Armed	**TURBO GEAR** Accessory gearbox disconnected from rotor drive
AUTO HOVER Hover autopilot mode is ON	**NEXT WP** Notification of passing one waypoint and advancing to the next	**CANNON** Cannon has been slewed away from boresight position	**AGB OIL PRESS** Accessory Gearbox oil pressure is normal (before start)
DESCENT Controlled descent autopilot mode is ON	**ROUTE END** Last waypoint reached notification; end of flight plan	**CANNON (DOWN ARROW)** Cannon has been slewed downward away from boresight position	**SL-HOOK OPEN** Sling Load lock (hook) is open

Caution Lights Panel

MASTER ARM ON Master Arm is ON	**COMPUTER DIAGNOSE** On-board computers running in diagnostic mode	**LH ENG ANTI-ICE** Left engine de-icing active	**RH ENG ANTI-ICE** Right engine de-icing active	**FWD TANK PUMP ON** Forward fuel tank has pressure	**AFT TANK PUMP ON** Aft fuel tank has pressure
WEAPON TRAINING Training mode for guided weapons is ON	**COMPUTER FAIL** Failure of one or more central computers	**LH ENG DUST-PROT** Left engine dust protector is active	**RH ENG DUST-PROT** Right engine dust protector is active	**LH VLV CLOSED** Left engine fuel valve is closed	**RH VLV CLOSED** Right engine fuel valve is closed
SHKVAL FAIL Helmet-Mounted Sight malfunction detected	**INVERTER ON** Electrical DC/AC inverter is ON	**LH POWER SET LIM** Left engine was limited by the electronic engine governor and prevented an overspeed	**RH POWER SET LIM** Right engine was limited by the electronic engine governor and prevented an overspeed	**LH OUTER TANK PUMP** Left outer fuel tank has pressure	**RH OUTER TANK PUMP** Right outer fuel tank has pressure
HUD NO READY Heads-Up Display failure (or not ready during system warm-up)	**SHKVAL FAIL** SHKVAL targeting system failure detected	**ROTOR ANTI-ICE** Rotor de-icing system is active	**WINDSHIELD HEATER ON** Windshield heater is ON	**LH INNER TANK PUMP** Left inner fuel tank has pressure	**RH INNER TANK PUMP** Right inner fuel tank has pressure


Ground Speed (km/h)
"+" when moving forward or backwards
Heading Tape
Numeric Radar Altimeter (m)
"p" when below 300 m
Maximum Allowable Speed Index
Current IAS (Indicated Airspeed) Index (km/h)
Radar Altimeter Scale (m)
Visible between 0 and 50 m only
Numeric Vertical Velocity (m/s)
Load Factor (G)
Vertical Velocity Scale (m/s)
Pitch Scale
+159
13 14 15
038p
500
0
50
-01
+30
0
-30
3
1
10
20


BRT
TEST
GRID
DAY
NIGHT
Heads-Up Display Sun Filter Lever
(Filter OFF)


BRT
TEST
GRID
DAY
NIGHT
Heads-Up Display Sun Filter Lever
(Filter ON)


Heads-Up Display Sun Filter
BRT
TEST
GRID
DAY
NIGHT


HUD (Heads-Up Display) Brightness Control Knob
HUD test button
Shkval Targeting Display Screen
HUD mode Day/Night/Reticle
BRT
TEST
GRID
DAY
NIGHT


EKRAN Display
SAI: Standby Attitude Indicator
SAI Caging Knob
Flood Light
ABRIS AMMS (Advanced Moving Map System)
ABRIS Power Switch
ABRIS Brightness Control Knob
ABRIS Cursor Control Knob
• Pushed or Rotated

EKRAN Display Window

- *The internal diagnostic and warning system communicates audio and text messages to the pilot via the EKRAN-32-03 display.*

Depending on the number of controlled parameters, Flight Control mode can be divided into four stages:

1. *From EKRAN start to engines start-up.*
2. *From engines start to take off and landing to EKRAN powered off.*
3. *Flight.*
4. *Print the last 64 signals that occurred in flight and eight seconds after landing.*

First stage

The first stage begins the moment the EKRAN is turned on and ends when either engine cut-off valve is placed in the OPEN position or a throttle lever is moved to the AUTO position. To avoid premature failure indication during startup, only a few engine and gearboxes parameters indication are engaged.

Second stage

*The second stage starts when either throttle lever is placed in the AUTO position and ends at takeoff (engagement of the landing gear handle). All data of the monitored systems, components, and modes are engaged except for those turned on at takeoff. After landing, the " ДОКУМЕНТ" (**DOCUMENT**) message is printed on the EKRAN display and the second stage of EKRAN operation will continue until all helicopter power is shut off.*

Third stage

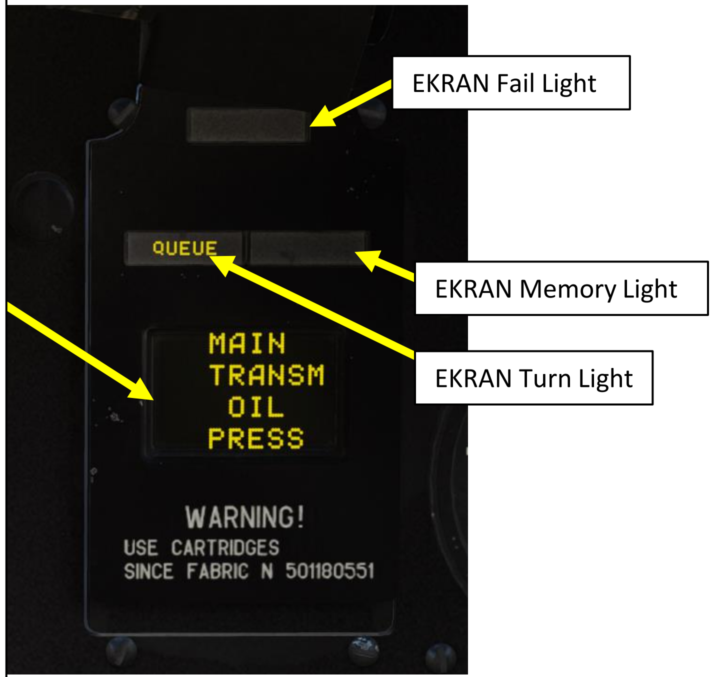
*The third stage, FLIGHT, begins at lift-off (engagement of the landing gear handle) and the recording of the takeoff time is calculated from the turning on of the EKRAN and the appearance of the "РЕЙС" (**FLIGHT**) message on the EKRAN display. When in the FLIGHT stage, all system, component, and mode monitoring data is connected to the EKRAN, and only part of the data is indicated on the display. The rest of the data is recorded in EKRAN memory. 11 emergency messages are indicated by red lights on the emergency message lamps. Additionally, an audio message of the emergency will be played twice. Messages played on the display with frame change are accompanied by the audio message "СМОТРИ ЭКРАН" (**WATCH EKRAN**). If the "ВКЛ АВАР" (ON EMERG) switch (on the bottom of center panel) is placed in the EMERG position, the voice messages corresponding to the stored messages will play. This stage ends eight seconds after landing (landing gear compression).*

Fourth stage

*The Fourth stage consists of the automatic printing to tape of the digital codes of the last 64 messages that occurred during the FLIGHT stage. This begins eight seconds after landing and is indicated by the display of the **DOCUMENT** message on the EKRAN display. The print-out lasts for about 20 seconds and ends the fourth stage. The second stage continues until all the power on the helicopter is shut off. Messages recorded on tape and in the memory continue in all stages of operation, while print from the memory is possible only for signals that occurred during the FLIGHT stage.*

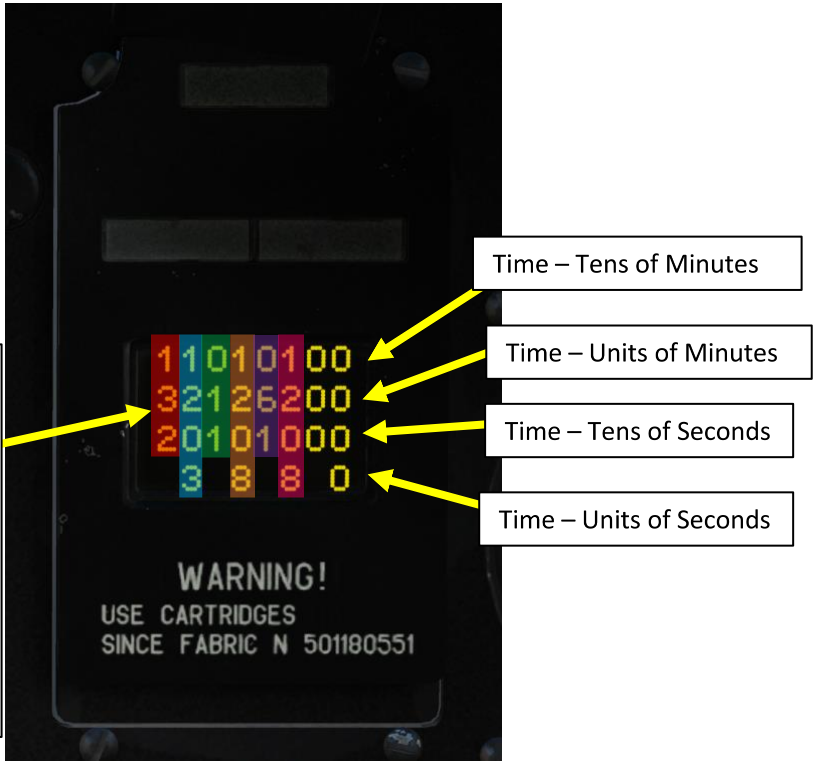
Message Priority

*Messages are sent to the display after prioritization. In case of a simultaneous collection of messages, the one with the highest priority is displayed, and the "ОЧЕРЕДЬ" (**ORDER**) message appears. Every new recording to memory of a message is followed by a flashing MWL (Master Warning Light). Messages can be reviewed by contiguously pressing the MWL. After the first MWL press, the flashing mode disengages; after the second press, the message displayed on the EKRAN goes to memory, which displays a "ПАМЯТЬ" (**MEMORY**) light on the EKRAN display and then the next signal is displayed. After all messages are reviewed, the MEMORY light goes off; the last signal remains on the EKRAN display.*



<u>EKRAN Signal Digital Message Code</u>

- *Digital messages are displayed during print in the following format: message code (three digit number) – time of receiving the signal (four digit number).*
- *In this example:*
  - *The **first message has code 132**, the time of receiving 12 minutes, 03 seconds after turning on the EKRAN*
  - *The **second message has code 011**, time of receiving is 12 minutes, 08 seconds after turning on the EKRAN.*
  - *The **third message has code 061**, time of receiving is 12 minutes, 08 seconds after turning on the EKRAN.*



EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
1	1	ПРИНЯТЬ ЦУ	RECEIVE DL TARGET	Information about incoming target via data link
2	2	ОСНОВНАЯ ГИДРО	MAIN HYDRO	Main hydraulic system failure
3	3	ОБЩАЯ ГИДРО	COMMON HYDRO	Common hydraulic system failure
4	4	ВЫПУСТИ ШАССИ	EXTEND GEAR	Landing gear is not down and locked. Low level flight with descend and IAS below 30.0 km/h
5	5	ДАВЛЕНИЕ МАСЛА ГЛАВ РЕД	MAIN GEARBOX OIL PRESS	Minimum main gearbox oil pressure
6	6	ТЕМП МАСЛА ГЛАВ РЕД	MAIN GEARBOX OIL TEMP	Main gearbox oil overheat
7	7	СТРУЖКА ГЛАВ РЕД	MAIN GEARBOX CHIP	Main gearbox chip
10	8	ВКЛЮЧИ ЗАП КОД ОТВЕТЧИК	TURN ON BACKUP TRANSP	Turn on backup code of IFF
11	9	СЕТЬ НА АККУМУЛ	ELEC ON ACCUM	Helicopter is on battery bus
30	24	РАБОТАЙ С ИТ	USE TV	K-041 targeting system failure, use the TV channel of the Shkval
31	25	ВКЛЮЧИ РУ РАБОТАЙ С КИ-ИТ	TURN ON MAN ATCK USE HUD-TV	Combat computer failure during ATGM (Air-to-Ground Missile) launch

EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
34	28	ВКЛЮЧИ РЗН	TURN ON NAV BACKUP	Navigation computer failure. Turn navigation tasks backup.
14	12	ОТКАЗ СУО-РС	WPN CTRL ROCKET FAILURE	Rockets control failure
247, 250	13	ОТКАЗ ППУ	GUN DRIVE FAILURE	Gun drive system failure. Gun control system failure.
16	14	ПЕРЕДНИЙ БАК 110	FORWARD TANK 110	Forward fuel tank low fuel level.
17	15	ЗАДНИЙ БАК 110	REAR TANK 110	Rear fuel tank low fuel level.
20	16	ОБЛЕДЕН ВКЛЮЧИ ПОС ВИНТ	TURN ON ROTOR ANTIICE	Icing detected
21	17	РАДИО ВЫСОТОМ	RADAR ALT	Radio (radar) altimeter failure.
22	18	КУРСО-ВЕРТИК	INU	Inertial navigation unit failure.
23	19	ОТКАЗ ЭЗУ-Ц	DL MEMORY FAILURE	Datalink computer memory failure.
24	20	ВКЛЮЧИ СЕТКУ РАБОТАЙ С НПУ	TURN ON SBY RTCL USE FIX GUN	K-041 targeting system gun steering connection component failure.
25	21	РАБОТАЙ С НПУ	USE FIX GUN	K-041 targeting system gun steering control channel failure
26	22	ОТКАЗ ТЕЛЕКОДА	DATALINK FAILURE	Data link failure

EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
40	31	ВКЛЮЧИ ПРЕОБРАЗ	TURN ON INVERTER	Switch inverter to manual
44	35	ОТКАЗ ЛР-РЭП	LWS FAILURE	LWS (Laser Warning System) all channels failure
45	36	ДАВЛЕНИЕ МАСЛА ЛЕВ РЕД	LEFT GEARBOX OIL PRESS	Left gearbox minimum oil pressure
46	37	ТЕМПЕР МАСЛА ЛЕВ РЕД	LEFT GEARBOX OIL TEMP	Left gearbox oil overheat
47	38	СТРУЖКА ЛЕВ РЕД	LEFT GEARBOX CHIP	Left gearbox chip
50	39	ДАВЛЕНИЕ МАСЛА ПРАВ РЕД	RIGHT GEARBOX OIL PRESS	Right gearbox minimum oil pressure
51	40	ТЕМПЕР МАСЛА ПРАВ РЕД	RIGHT GEARBOX OIL TEMP	Right gearbox oil overheat
52	41	СТРУЖКА ПРАВ РЕД	RIGHT GEARBOX CHIP	Right gearbox chip
53	42	ДАВЛЕНИЕ МАСЛА ПРИВОДОВ	DRIVE OIL PRESS	Accessory gearbox minimum oil pressure
54	43	ВКЛЮЧИ БЛОКИР СУО	TURN ON ARM SYS SAFE SW	Weapon system users are off

EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
55	44	РЕЗЕРВ АВИА ГОРИЗОНТ	STANDBY ATTITUDE IND	SAI (Standby Attitude Director Indicator) failure
56	44	ОТКАЗ ОБОГРЕВА ПВД ЛЕВ	LEFT PROBE HEAT FAILURE	Left pitot heating failure
57	44	ОТКАЗ ОБОГРЕВА ПВД ПРАВ	RIGHT PROBE HEAT FAILURE	Right pitot heating failure
60	45	ИК-ВСП	AIR DATA SYS	Air data system failure
61	46	ДИСС	DOPPLER NAV SYS	Doppler device for ground speed and drift angle failure
41	32	НЕСХОД ИЗДЕЛИЯ	HUNG WEAPON	Weapon not launched (hung store)
42	33	ОТКЛЮЧИ СОЭП-РЭП	TURN OFF L-140	Turn off L-140
62	47	КАНАЛ КУРСА	HEADING INVALID	Heading channel failure
63	48	НЕТ СЧИСЛЕН КООРД	NAV POS INVALID	Navigation coordinates calculation failure
64	49	СБОЙ РАСЧЕТА МАРШРУТА	ROUTE NAV FAILURE	Route navigation failure
65	50	ЭЗУ-Н	NAV DATA MEMORY FAILURE	Navigation computer memory failure

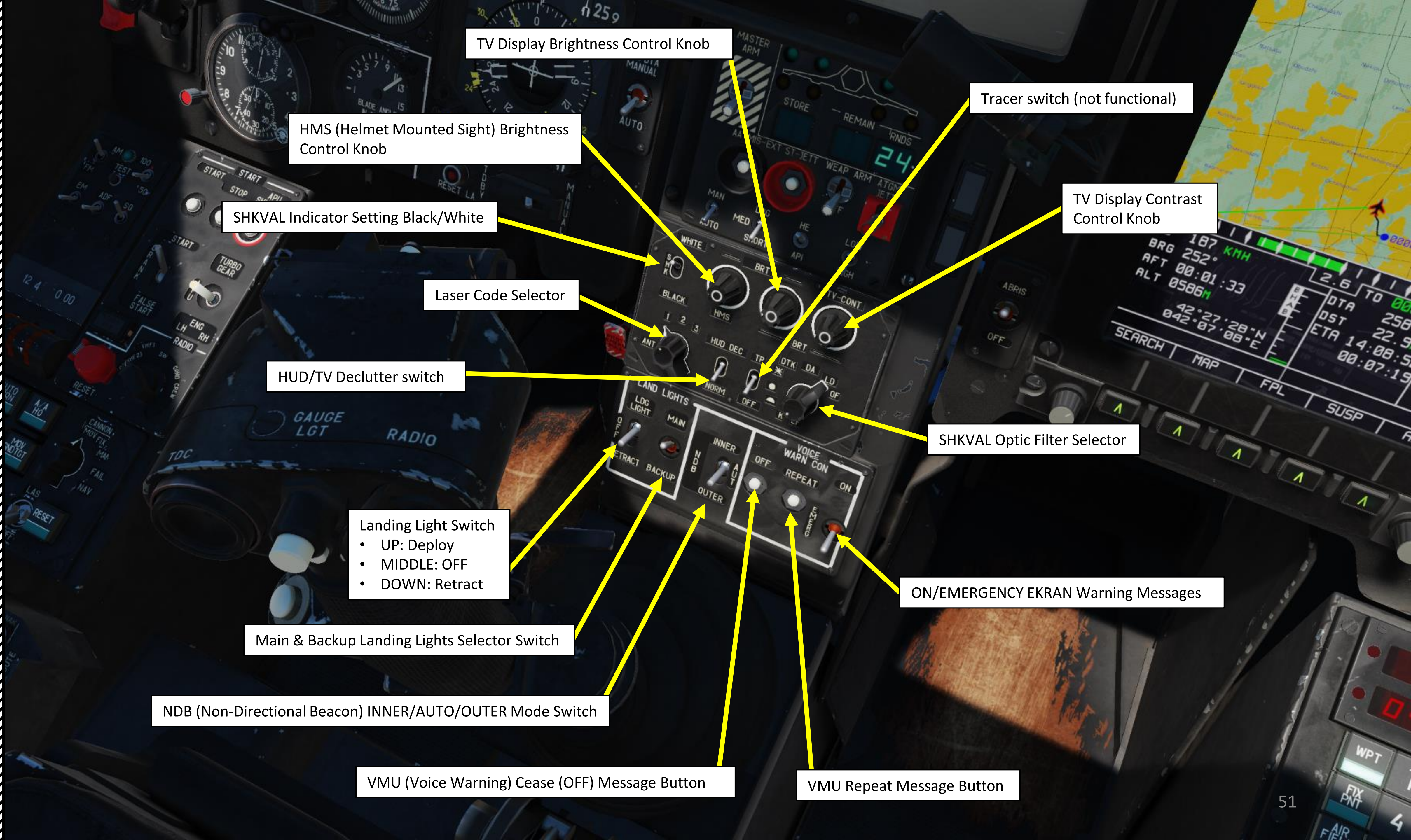
EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
66	51	ПРОВЕДИ КОРРЕКЦ КООРД	PERFORM NAV POS FIX	Enter area coordinates for correction (within a radius of approx. 18 km of the fix point)
67	52	ЛЕВ ГЕНЕР	LEFT GEN	Left generator failiure
70	53	ПРАВ ГЕНЕР	RIGHT GEN	Right generator failure
71	54	ЛЕВ ВЫПРЯМИТ	LEFT DC RECTIF FAILURE	Left rectifier failure
72	55	ПРАВ ВЫПРЯМИТ	RIGHT DC RECTIF FAILURE	Right rectifier failure
73	56	ЭЛЕКТРОН РЕГУЛЯТ ЛЕВ ДВ	LEFT ENG GOVERNOR	Left engine electronic engine goveror failure
74	57	ЭЛЕКТРОН РЕГУЛЯТ ПРАВ ДВ	RIGHT ENG GOVERNOR	Right engine electronic engine governor failure
43	34	ОТКАЗ ЛТЦ-РЭП	CMD FAILURE	UV-26 flare dispenser failure
35	29	РАЗГЕРМ КАБИНЫ	LOW COCKPIT PRESS	Cockpit depressurization
76	59	НЕТ НАДДУВА ГИДРО	NO HYDRO PRESS	No hydraulic tanks boost pressure
36	29	ОТКАЗ СКВ	AIRCOND FAILURE	Cockpit air conditioning and ventilation system failure

EKRAN Messages

Number in Catalogue	Priority	Message (Rus)	Message (Eng)	Description
37	30	ОТКАЗ ПОС ВИНТОВ	ROTOR ANTIICE FAILURE	Rotor anti-ice system failure
77	60	ПРЕДЕЛ ВИБРАЦИЯ ЛЕВ ДВ	HI VIBR LEFT ENG	Left engine critical vibrations
100	61	ПРЕДЕЛ ВИБРАЦИЯ ПРАВ ДВ	HI VIBR RIGHT ENG	Right engine critical vibrations
142	62	ОТКАЗ РЕГИСТР	FLIGHT DATA REC FAILURE	Flight data recorder failure
102	63	ЭЗУ-Б	WPN CTRL MEMORY FAILURE	Turn on combat tasks backup
103	64	СТРУЖКА ЛЕВ ДВ	LEFT ENG CHIP	Left engine oil chip detected
104	65	СТРУЖКА ПРАВ ДВ	RIGHT ENG CHIP	Right engine oil chip detected
105	66	ДАВЛЕНИЕ МАСЛА ЛЕВ ДВ	LEFT ENG OIL PRESS	Left engine minimal oil pressure
106	67	ДАВЛЕНИЕ МАСЛА ПРАВ ДВ	RIGHT ENG OIL PRESS	Right engine minimal oil pressure
107	68	НЕТ СТОПОРА ППУ	NO GUN STOP LCK	Steering gun lock failure

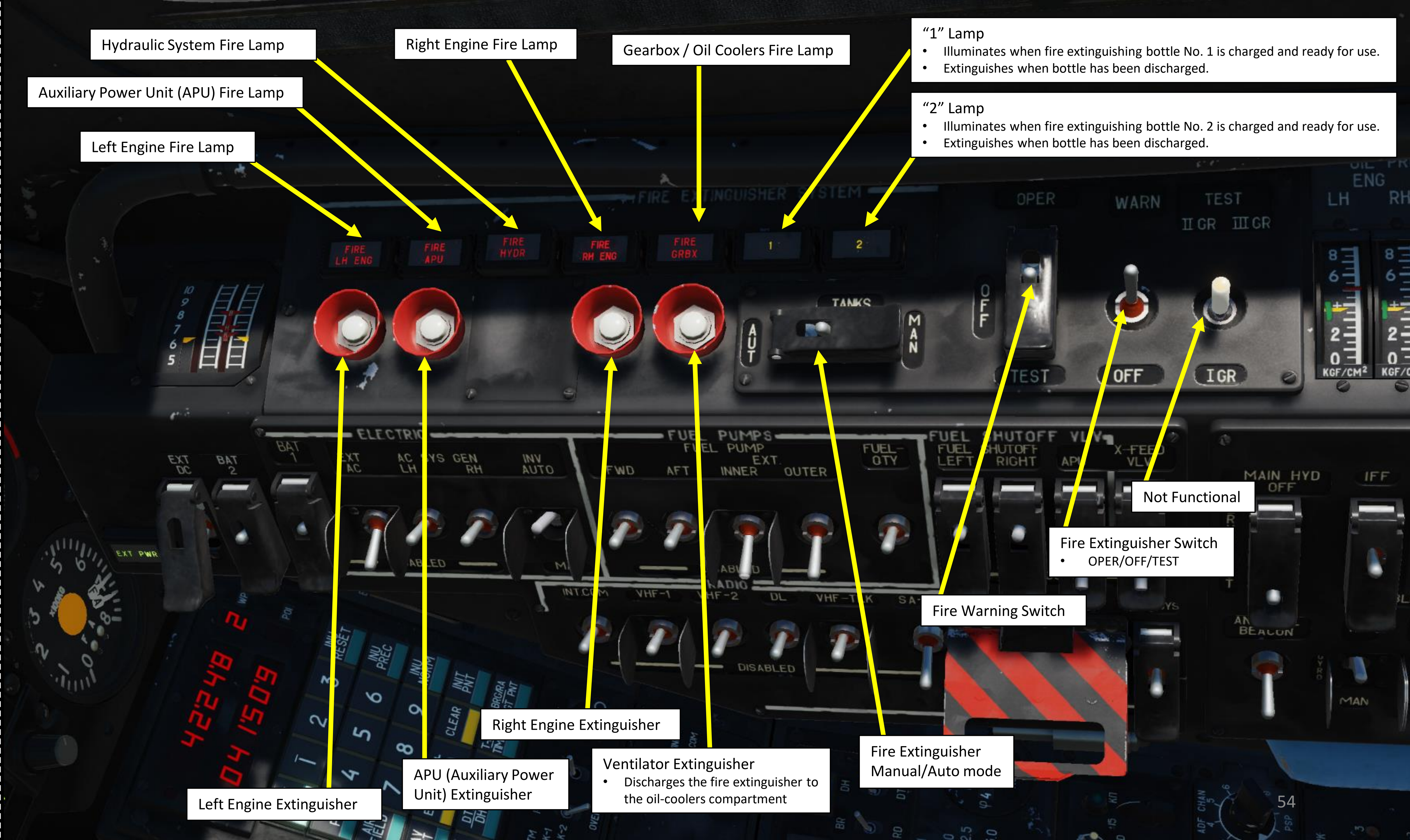

Weapon Indicators
Master Arm Switch
• UP = Master ARM ON
Jettison Weapon Arming Switch
Emergency Jettison of Air-to-Air Missiles
Vikhr ATGM (Air-to-Ground Missile) Jettison
Manual/Auto Weapon control switch
Low/High Cannon Rate of Fire switch
• Low Rate: 300 rounds/min
• High Rate: 600 rounds/min
HE/API (High Explosive/Armor-Piercing Incendiary) cannon round selector switch
Long/Medium/Short range cannon mode
Jettison All External Stores (except Vikhr missiles)


TV Display Brightness Control Knob
Tracer switch (not functional)
HMS (Helmet Mounted Sight) Brightness Control Knob
TV Display Contrast Control Knob
SHKVAL Indicator Setting Black/White
Laser Code Selector
HUD/TV Declutter switch
SHKVAL Optic Filter Selector
Landing Light Switch
• UP: Deploy
• MIDDLE: OFF
• DOWN: Retract
ON/EMERGENCY EKRAN Warning Messages
Main & Backup Landing Lights Selector Switch
NDB (Non-Directional Beacon) INNER/AUTO/OUTER Mode Switch
VMU (Voice Warning) Cease (OFF) Message Button
VMU Repeat Message Button

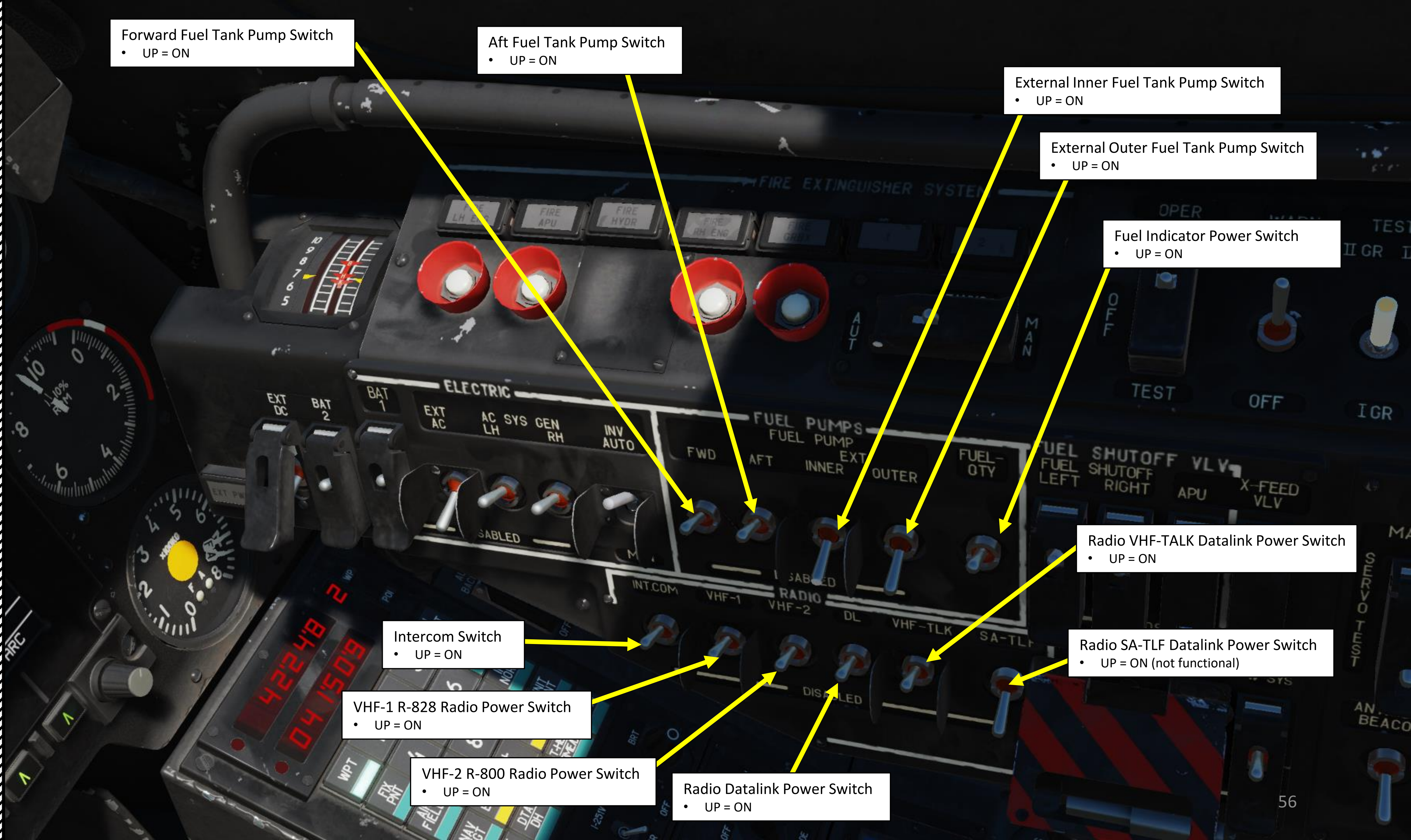

Engine EGT (Exhaust Gas Temperature) Test STOP Button
Engine EGT (Exhaust Gas Temperature) Test RUN Button
EGT (Exhaust Gas Temperature) x 100 deg C
• Left Indication: Left Engine
• Right Indication: Right Engine
EGT (Exhaust Gas Temperature) x 10 deg C
Engine Tachometer (% RPM)
NGG (Gas Generator Turbine/Compressor Speed)
• RPM of each engine turbine (100 % is 19,537 RPM)
• Needle 1: Left Engine
• Needle 2: Right Engine
Fuel Indicator (x100 kg)
• **П (F)**: Forward Tank Needle
• **З (A)**: Aft Tank Needle
ENGINE EGT TEST
RUN
STOP
EGT
ARC

Engine Power Indicator

- Yellow Index: Right/Left current Engine Power
- B Index: Takeoff power reference
- H Index: Max continuous power reference
- K Index: Cruise power reference


Hydraulic System Fire Lamp
Right Engine Fire Lamp
Gearbox / Oil Coolers Fire Lamp
"1" Lamp
• Illuminates when fire extinguishing bottle No. 1 is charged and ready for use.
• Extinguishes when bottle has been discharged.
"2" Lamp
• Illuminates when fire extinguishing bottle No. 2 is charged and ready for use.
• Extinguishes when bottle has been discharged.
Auxiliary Power Unit (APU) Fire Lamp
Left Engine Fire Lamp
Not Functional
Fire Extinguisher Switch
• OPER/OFF/TEST
Fire Warning Switch
Right Engine Extinguisher
Ventilator Extinguisher
• Discharges the fire extinguisher to the oil-coolers compartment
Fire Extinguisher Manual/Auto mode
APU (Auxiliary Power Unit) Extinguisher
Left Engine Extinguisher


DC Ground Power Switch
• UP = ON
Battery 2 Switch
• UP = ON
Battery 1 Switch
• UP = ON
AC Ground Power Switch
• UP = ON
Left AC Generator Switch
• UP = ON
Right AC Generator Switch
• UP = ON
DC/AC Inverter Switch
• UP = AUTO
• MIDDLE = OFF
• DOWN = MANUAL


Forward Fuel Tank Pump Switch
• UP = ON
Aft Fuel Tank Pump Switch
• UP = ON
External Inner Fuel Tank Pump Switch
• UP = ON
External Outer Fuel Tank Pump Switch
• UP = ON
Fuel Indicator Power Switch
• UP = ON
Radio VHF-TALK Datalink Power Switch
• UP = ON
Radio SA-TLF Datalink Power Switch
• UP = ON (not functional)
Intercom Switch
• UP = ON
VHF-1 R-828 Radio Power Switch
• UP = ON
VHF-2 R-800 Radio Power Switch
• UP = ON
Radio Datalink Power Switch
• UP = ON
ELECTRIC
FUEL PUMPS
FWD
AFT
INNER
OUTER
FUEL-QTY
RADIO
INT.COM
VHF-1
VHF-2
DL
VHF-TLK
SA-TLF

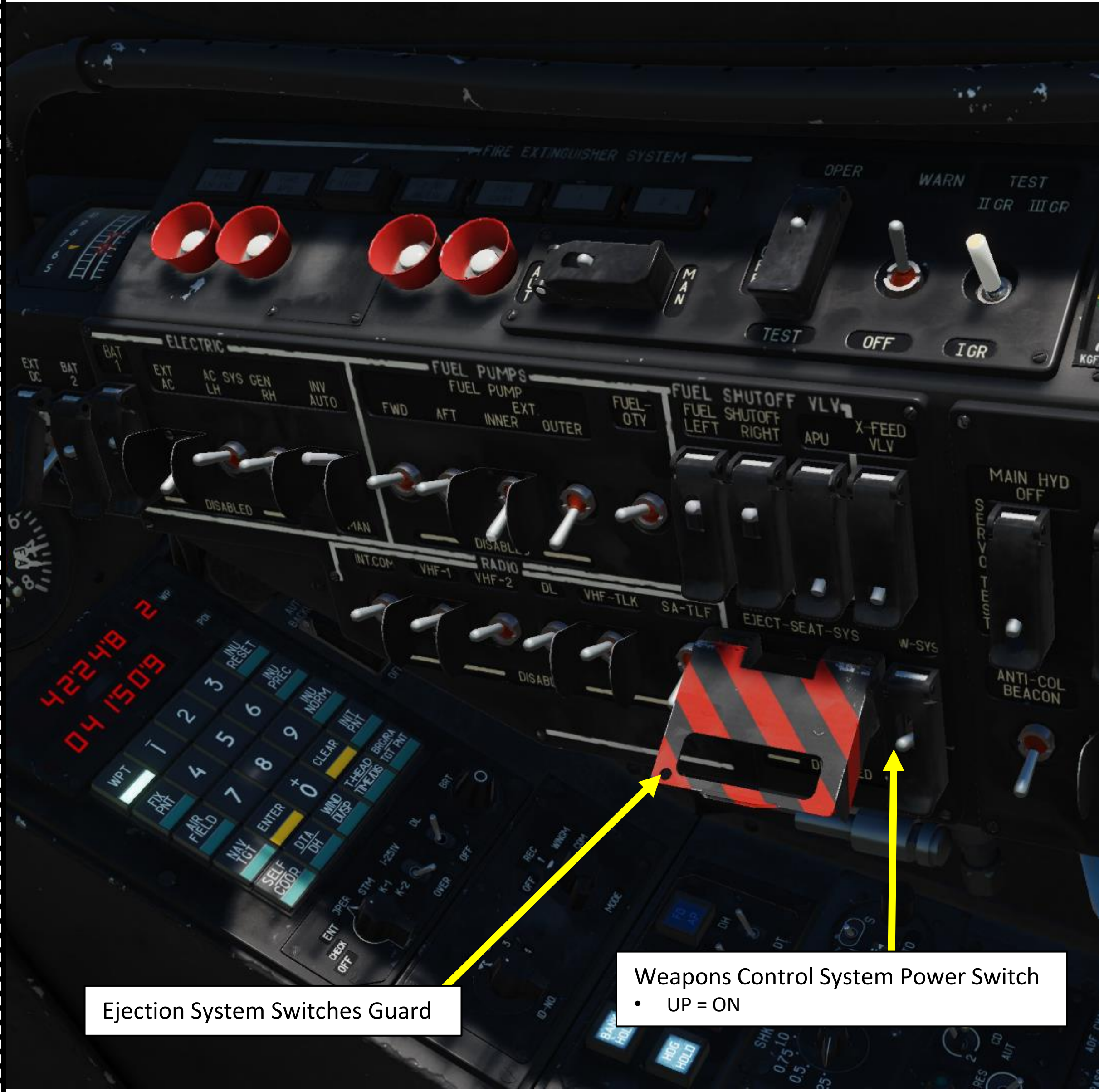
APU (Auxiliary Power Unit) Fuel Shutoff Valve Switch
- UP = Valve OPEN

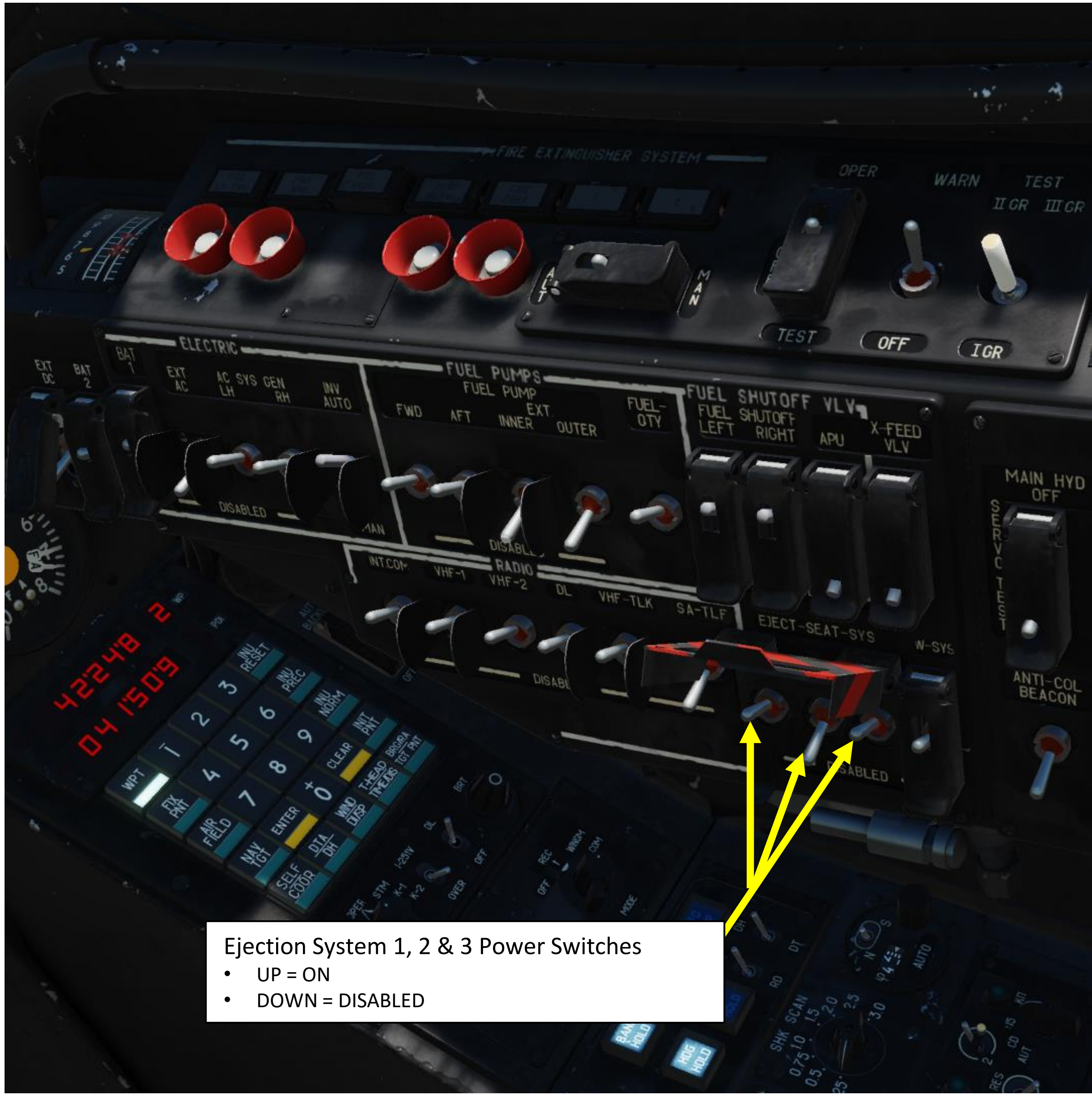
Fuel Crossfeed Valve Switch
- UP = Valve OPEN

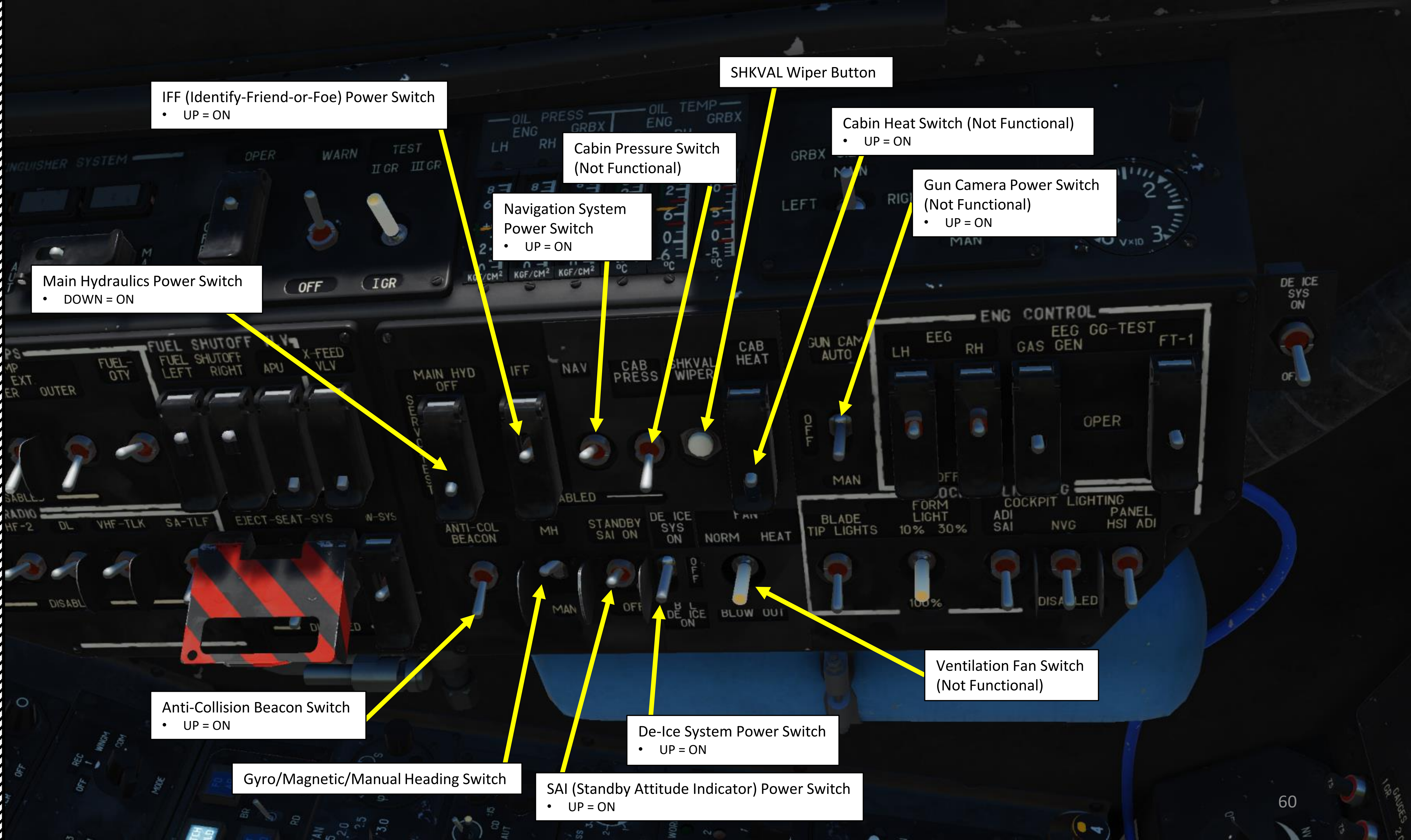
Left Engine Fuel Shutoff Valve Switch
- UP = Valve OPEN

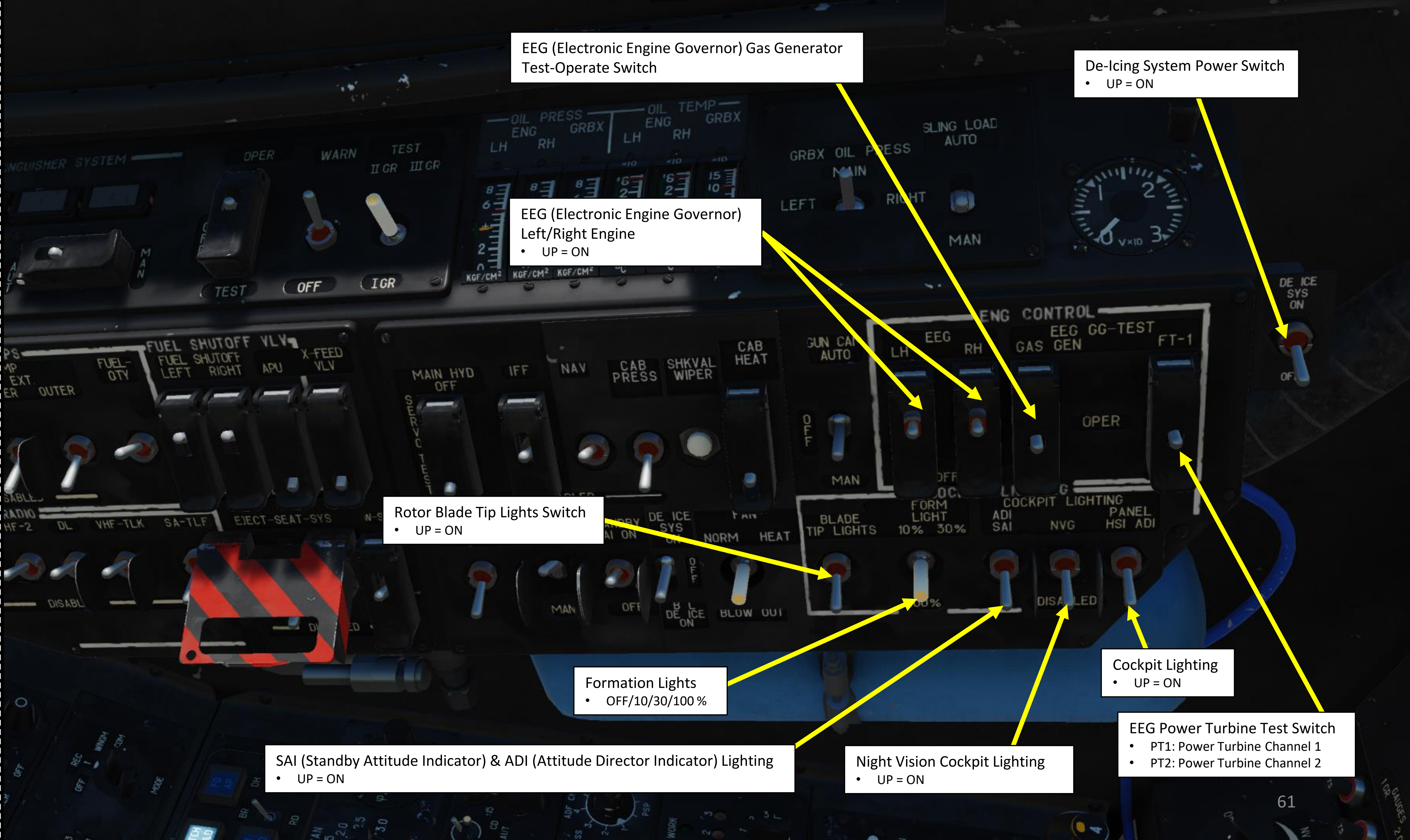
Right Engine Fuel Shutoff Valve Switch
- UP = Valve OPEN

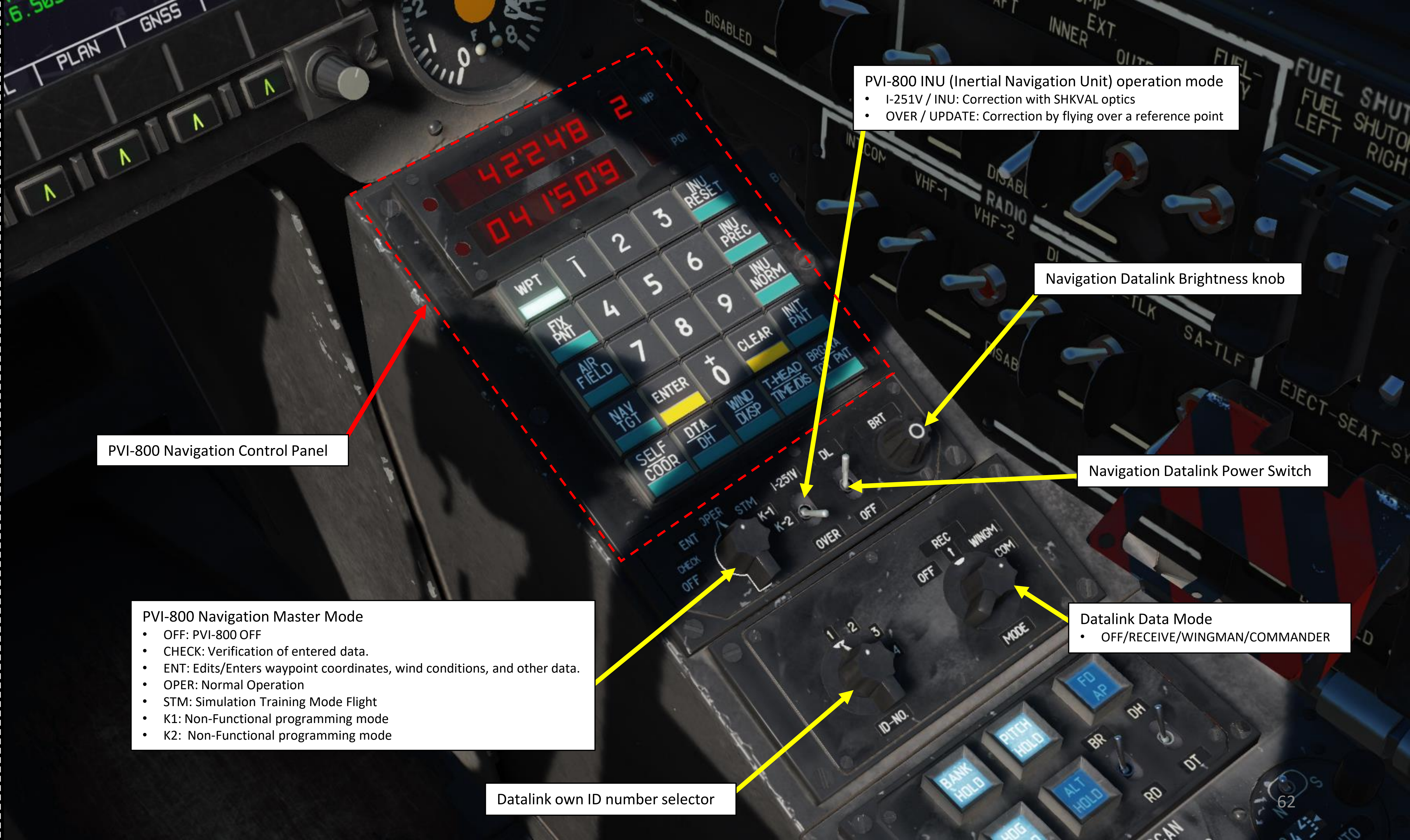

Left Engine, Right Engine and Transmission Gearbox Oil Temperature (deg C)
Left Engine, Right Engine and Transmission Gearbox Oil Pressure (kg/cm²)
Voltmeter (x10 Volts)
Gearbox Oil Pressure Indicator Selector
• Main/Left/Right
Sling Load Auto/Manual Switch


Ejection System Switches Guard
Weapons Control System Power Switch
• UP = ON


Ejection System 1, 2 & 3 Power Switches
• UP = ON
• DOWN = DISABLED


IFF (Identify-Friend-or-Foe) Power Switch
• UP = ON
SHKVAL Wiper Button
Cabin Heat Switch (Not Functional)
• UP = ON
Cabin Pressure Switch (Not Functional)
Navigation System Power Switch
• UP = ON
Gun Camera Power Switch (Not Functional)
• UP = ON
Main Hydraulics Power Switch
• DOWN = ON
Ventilation Fan Switch (Not Functional)
Anti-Collision Beacon Switch
• UP = ON
De-Ice System Power Switch
• UP = ON
Gyro/Magnetic/Manual Heading Switch
SAI (Standby Attitude Indicator) Power Switch
• UP = ON


EEG (Electronic Engine Governor) Gas Generator Test-Operate Switch
De-Icing System Power Switch
• UP = ON
EEG (Electronic Engine Governor) Left/Right Engine
• UP = ON
Rotor Blade Tip Lights Switch
• UP = ON
Formation Lights
• OFF/10/30/100 %
SAI (Standby Attitude Indicator) & ADI (Attitude Director Indicator) Lighting
• UP = ON
Night Vision Cockpit Lighting
• UP = ON
Cockpit Lighting
• UP = ON
EEG Power Turbine Test Switch
• PT1: Power Turbine Channel 1
• PT2: Power Turbine Channel 2


PVI-800 INU (Inertial Navigation Unit) operation mode
• I-251V / INU: Correction with SHKVAL optics
• OVER / UPDATE: Correction by flying over a reference point
Navigation Datalink Brightness knob
Navigation Datalink Power Switch
PVI-800 Navigation Control Panel
Datalink Data Mode
• OFF/RECEIVE/WINGMAN/COMMANDER
PVI-800 Navigation Master Mode
• OFF: PVI-800 OFF
• CHECK: Verification of entered data.
• ENT: Edits/Enters waypoint coordinates, wind conditions, and other data.
• OPER: Normal Operation
• STM: Simulation Training Mode Flight
• K1: Non-Functional programming mode
• K2: Non-Functional programming mode
Datalink own ID number selector

PVI-800 Keypad
- 1 to 9 / ENTER / CLEAR

PVI-800 Upper Display Window

Selected Waypoint (WP) Display

POI (Point of Interest) Display
- Airfield number, fixed point, target point, or correction point display

PVI-800 Lower Display Window

INU RESET Button
- Inertial Navigation Unit reset for in-flight alignment (no function).

WPT Button
- Waypoint Mode selects a waypoint from the flight plan

INU PREC Button
- Inertial Navigation Unit precise alignment. Alignment takes about 30 minutes to complete.

FIX PNT Button
- Selects a reference point for an INU (Inertial Navigation Unit) update

INU NORM Button
- Inertial Navigation Unit normal alignment function.

AIRFIELD Button
- Selects an airfield for RTB (Return to Base) mode and displays the coordinates of one of two airfields. Airfield 1 is your takeoff location and airfield 2 is your landing location.

INIT PNT Button
- Displays initial coordinate point and allows you to enter a new one.

NAV TGT Button
- Selects a target point (TP) for ingress and allows you to enter coordinates for new TPs. Up to 10 TPs can be saved.

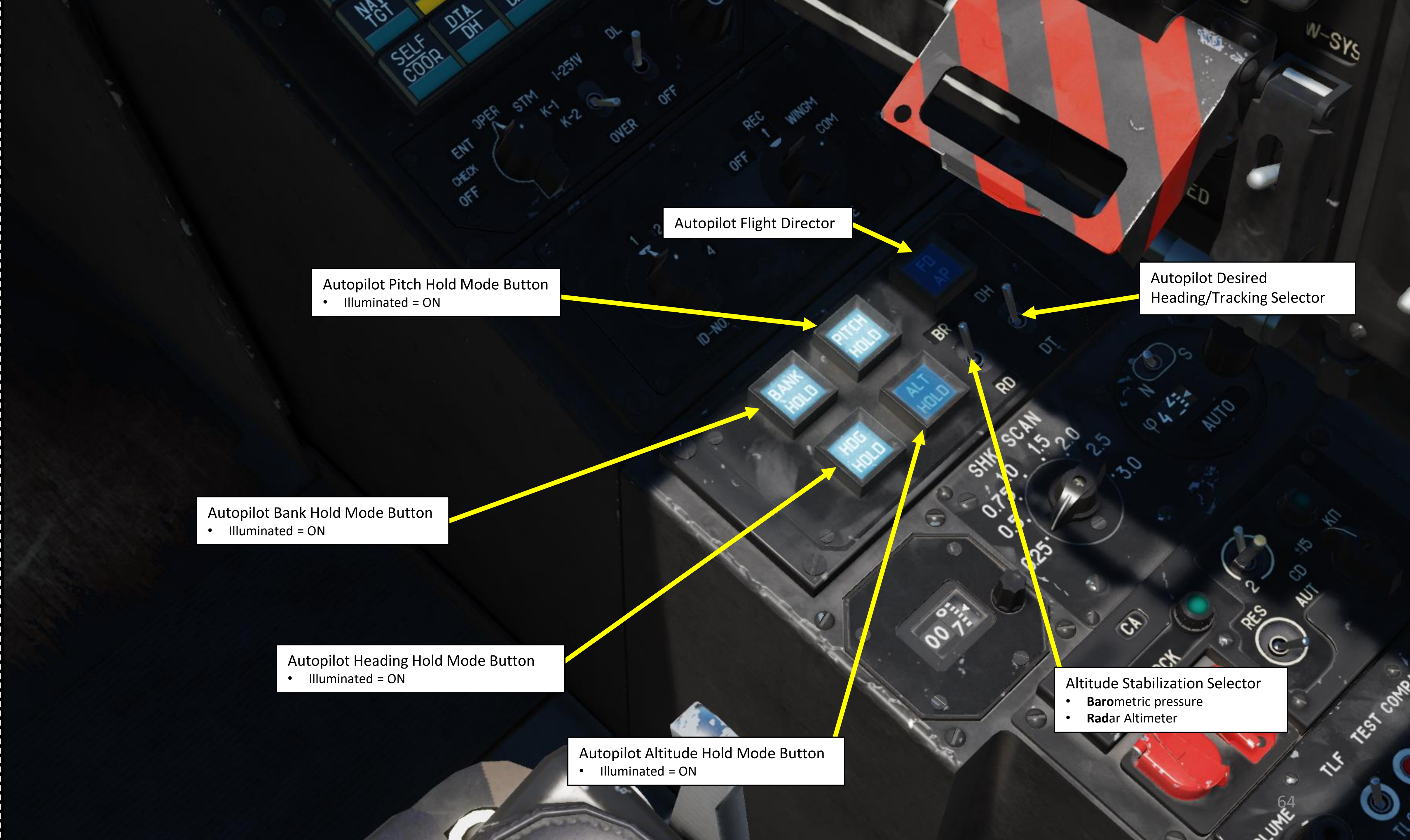
BRG/RA / TGT PNT Button
- Indication of bearing and range to target point in the Ingress mode.

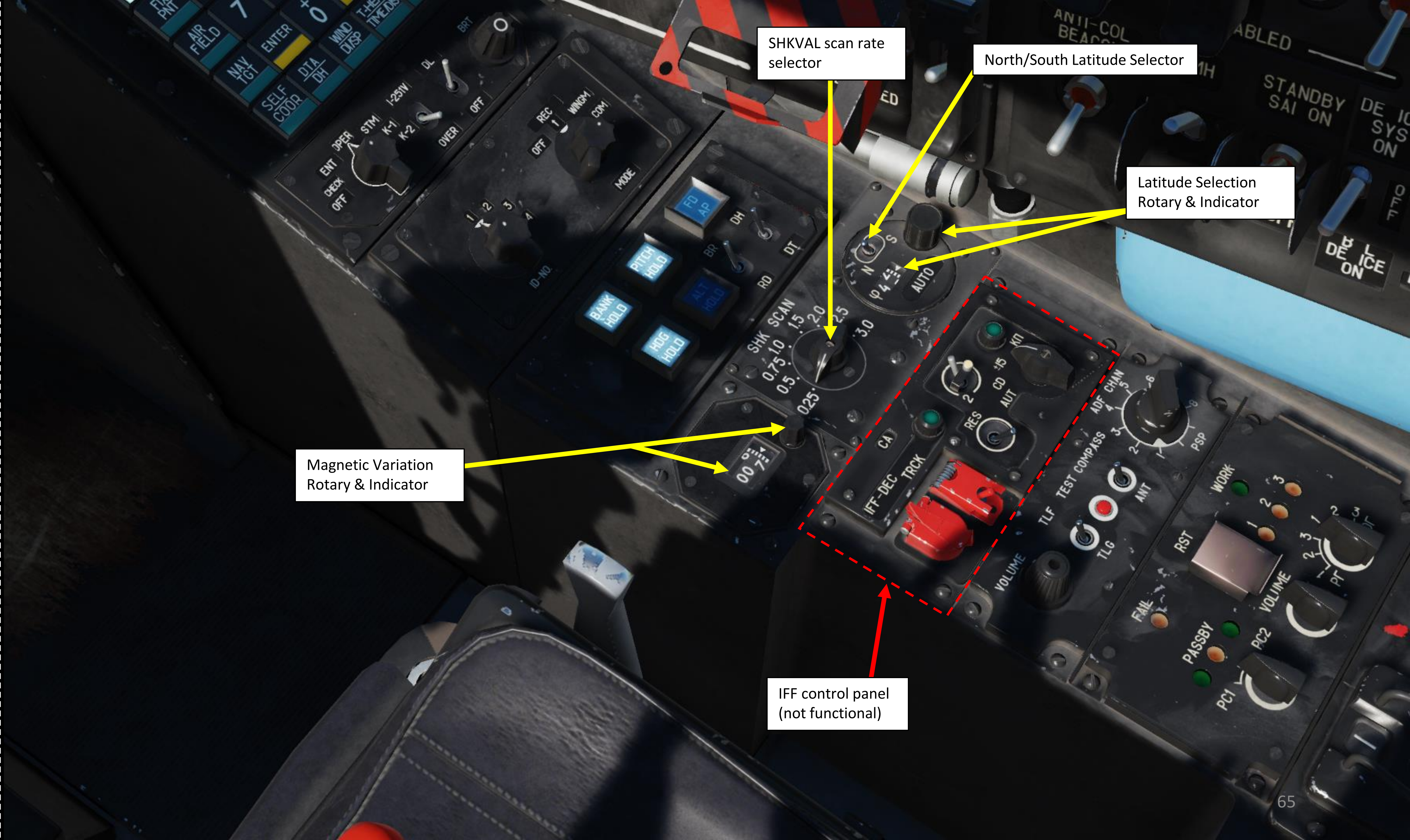
SELF COOR Button
- Displays Ownship coordinates

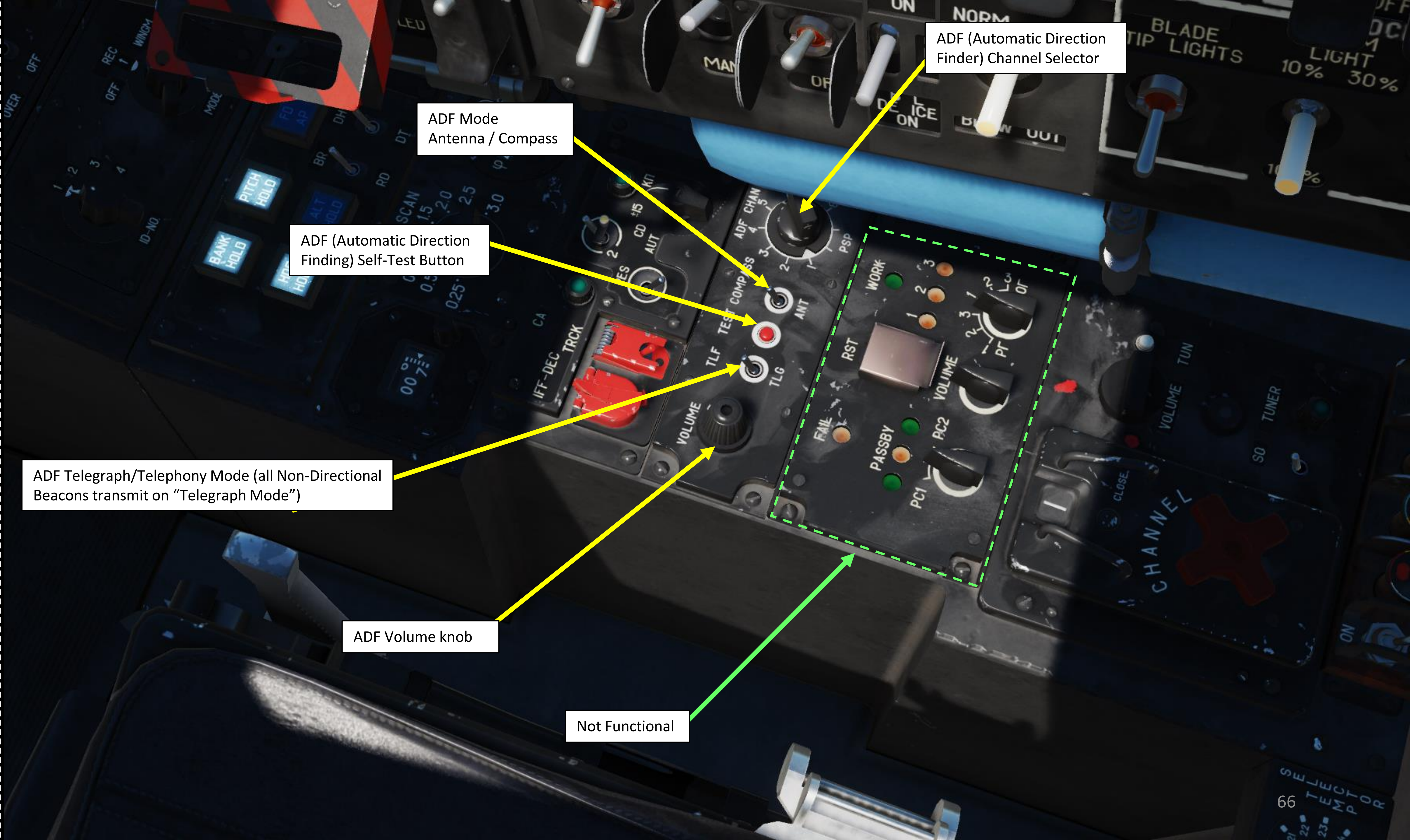
T-HEAD / TIME/DIS Button
- Indication of True Heading, Time and Distance to final waypoint in the Waypoint, reference, airfield and target modes.

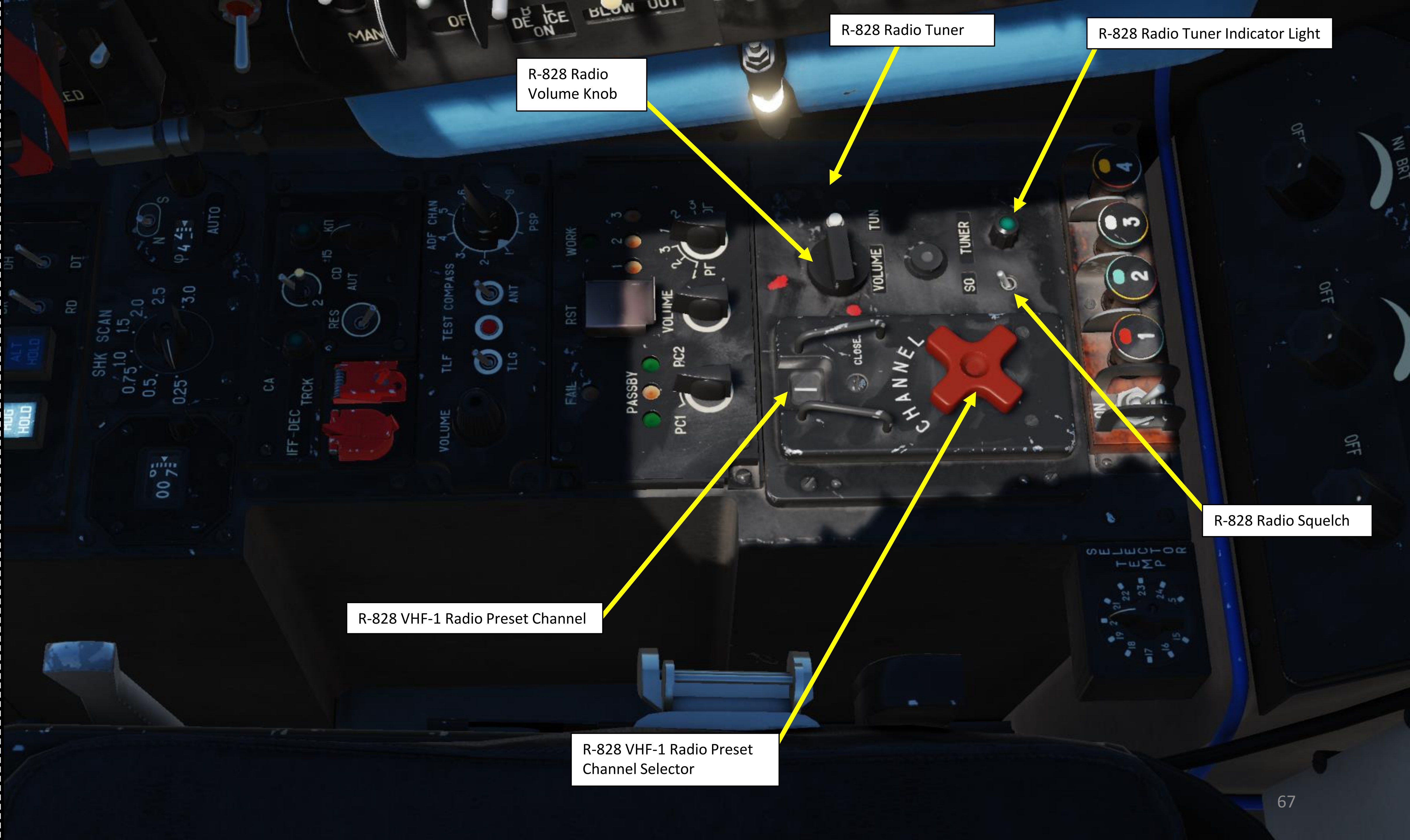
DTA/DH Button
- Indication of DTA (Desired Track Angle) or DH (Desired Heading), time and distance to current waypoint in the Waypoint, Reference Airfield, and Target navigation modes.

WIND DI/SP Button
- Indication of wind direction (FROM) and wind speed (m/s).

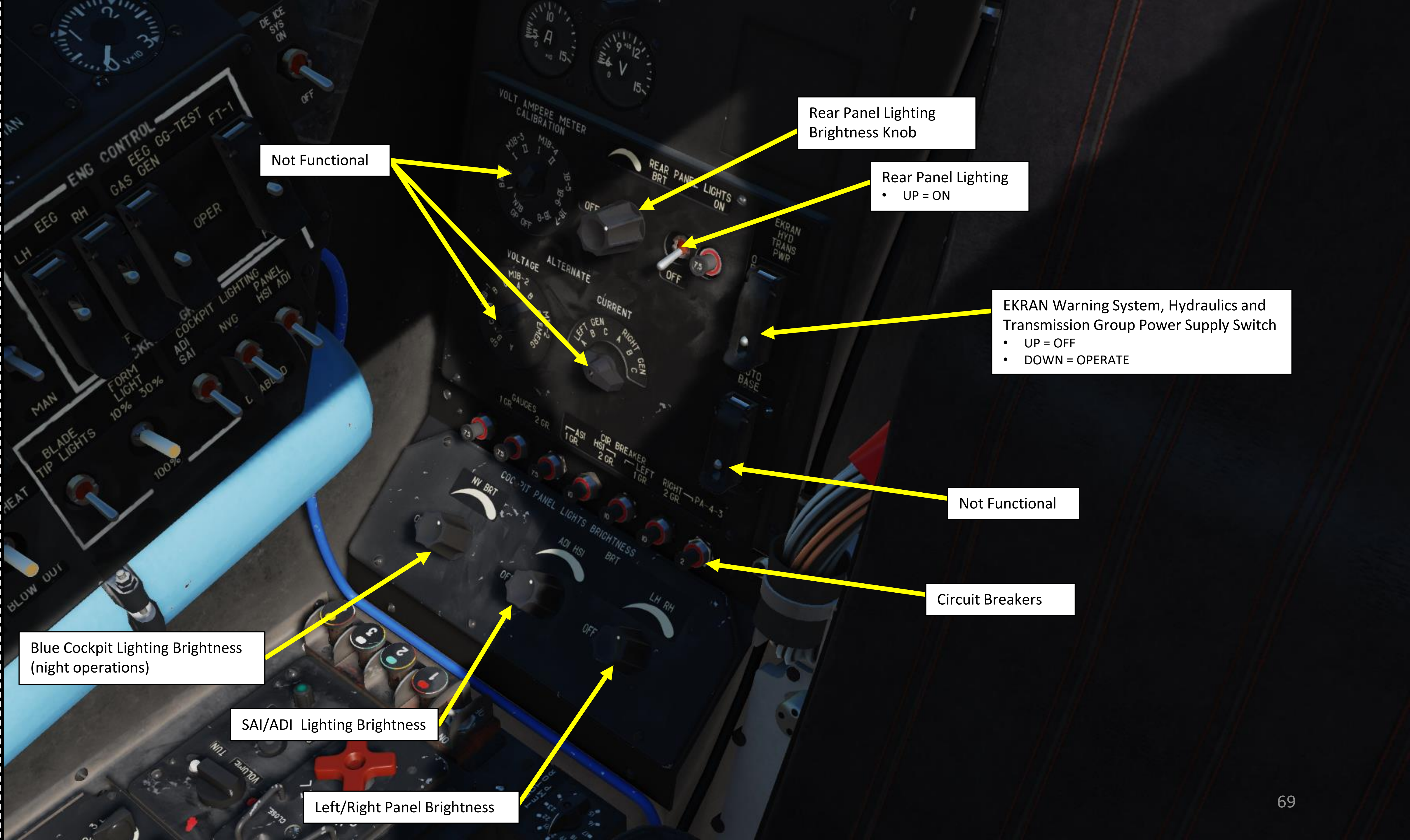

Autopilot Flight Director
Autopilot Pitch Hold Mode Button
• Illuminated = ON
Autopilot Desired Heading/Tracking Selector
Autopilot Bank Hold Mode Button
• Illuminated = ON
Autopilot Heading Hold Mode Button
• Illuminated = ON
Altitude Stabilization Selector
• **Baro**metric pressure
• **Rad**ar Altimeter
Autopilot Altitude Hold Mode Button
• Illuminated = ON
PITCH HOLD
BANK HOLD
ALT HOLD
HDG HOLD
FD AP
BR
RD
DH
DT

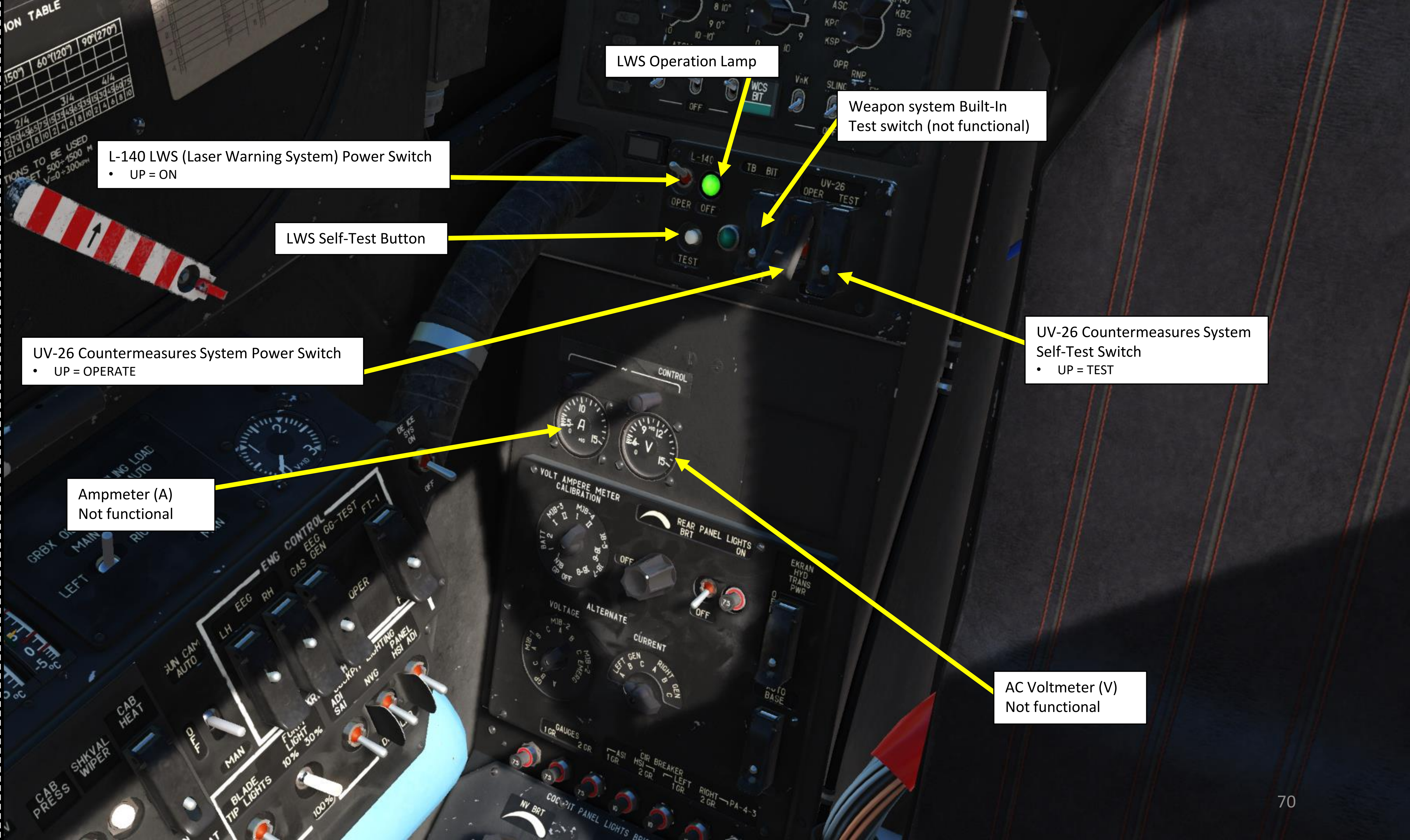

SHKVAL scan rate selector
North/South Latitude Selector
Latitude Selection Rotary & Indicator
Magnetic Variation Rotary & Indicator
IFF control panel (not functional)

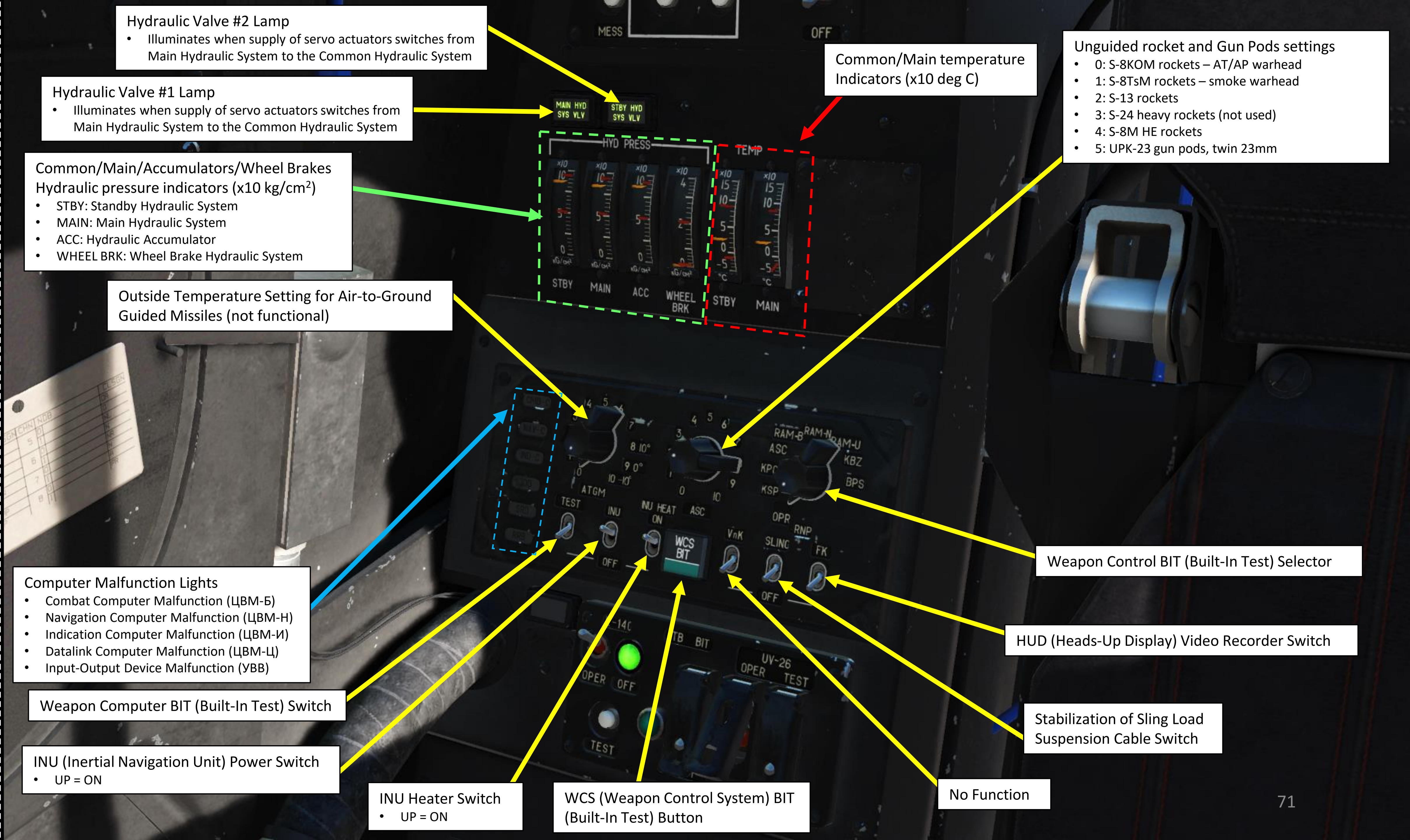

ADF (Automatic Direction Finder) Channel Selector
ADF Mode Antenna / Compass
ADF (Automatic Direction Finding) Self-Test Button
ADF Telegraph/Telephony Mode (all Non-Directional Beacons transmit on “Telegraph Mode”)
ADF Volume knob
Not Functional

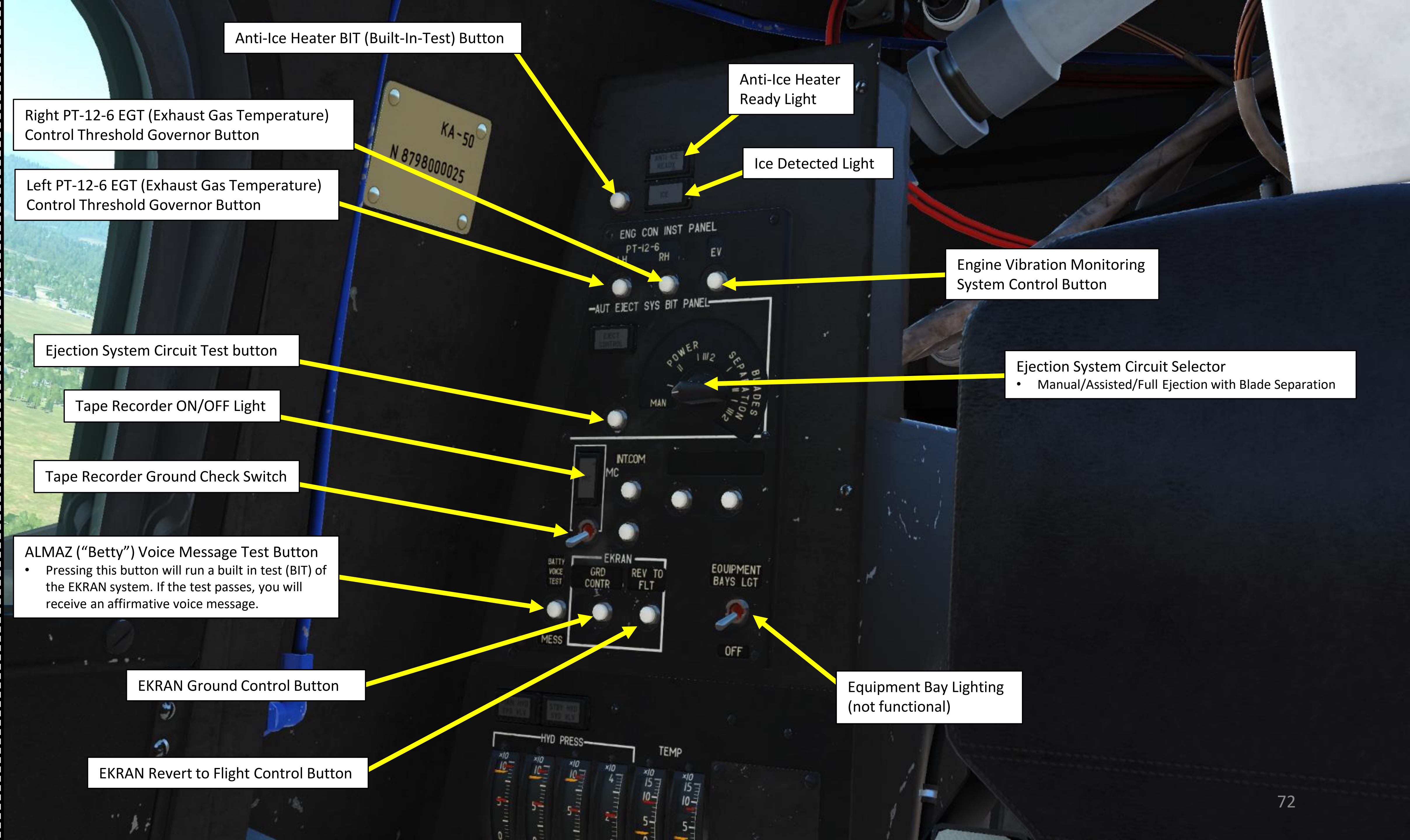

R-828 Radio Tuner
R-828 Radio Tuner Indicator Light
R-828 Radio Volume Knob
R-828 Radio Squelch
R-828 VHF-1 Radio Preset Channel
R-828 VHF-1 Radio Preset Channel Selector

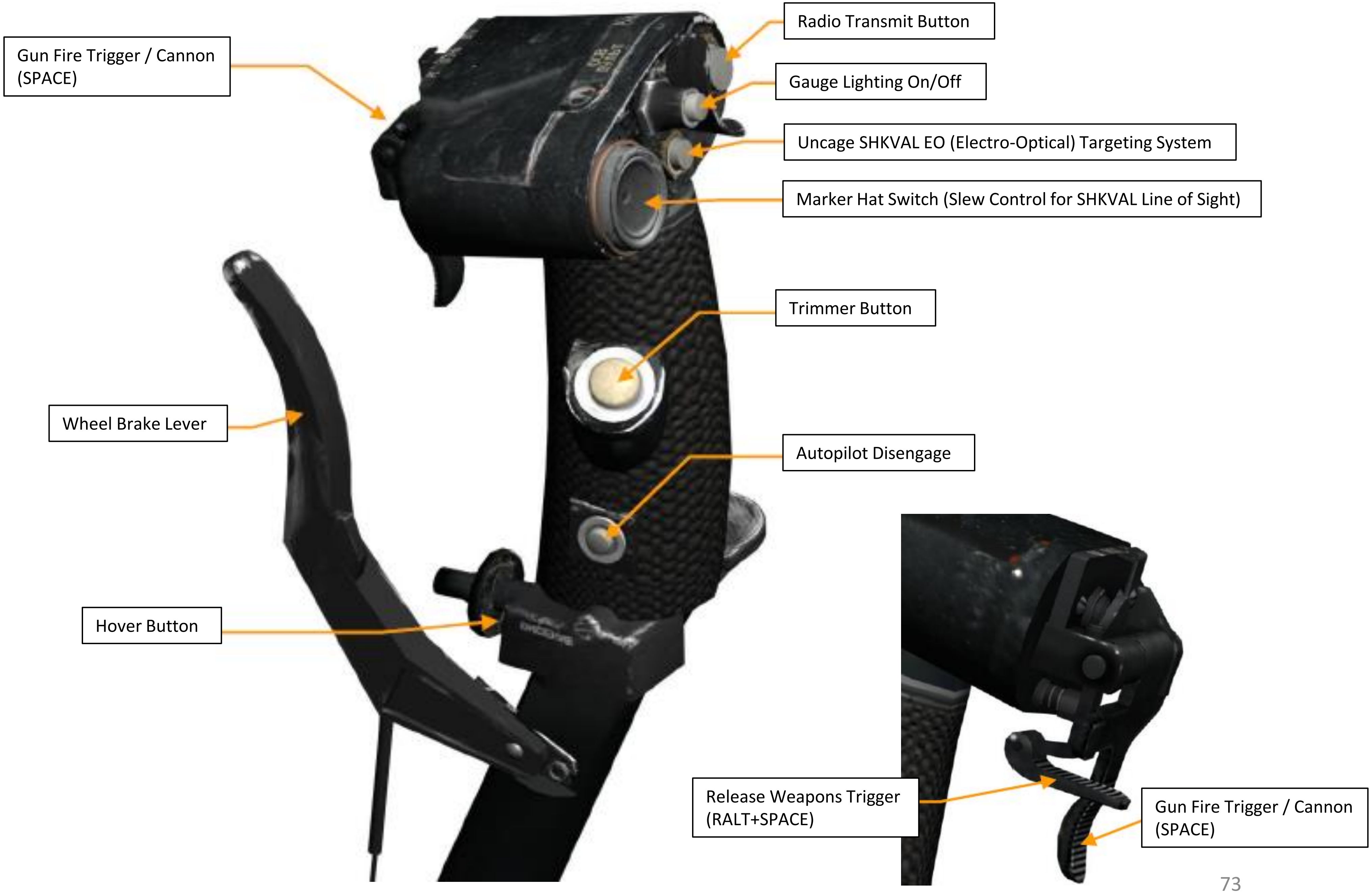

Signal Flare Launch Buttons
Signal Flare Power Switch
• FWD = ON
Cabin Temperature Tuner

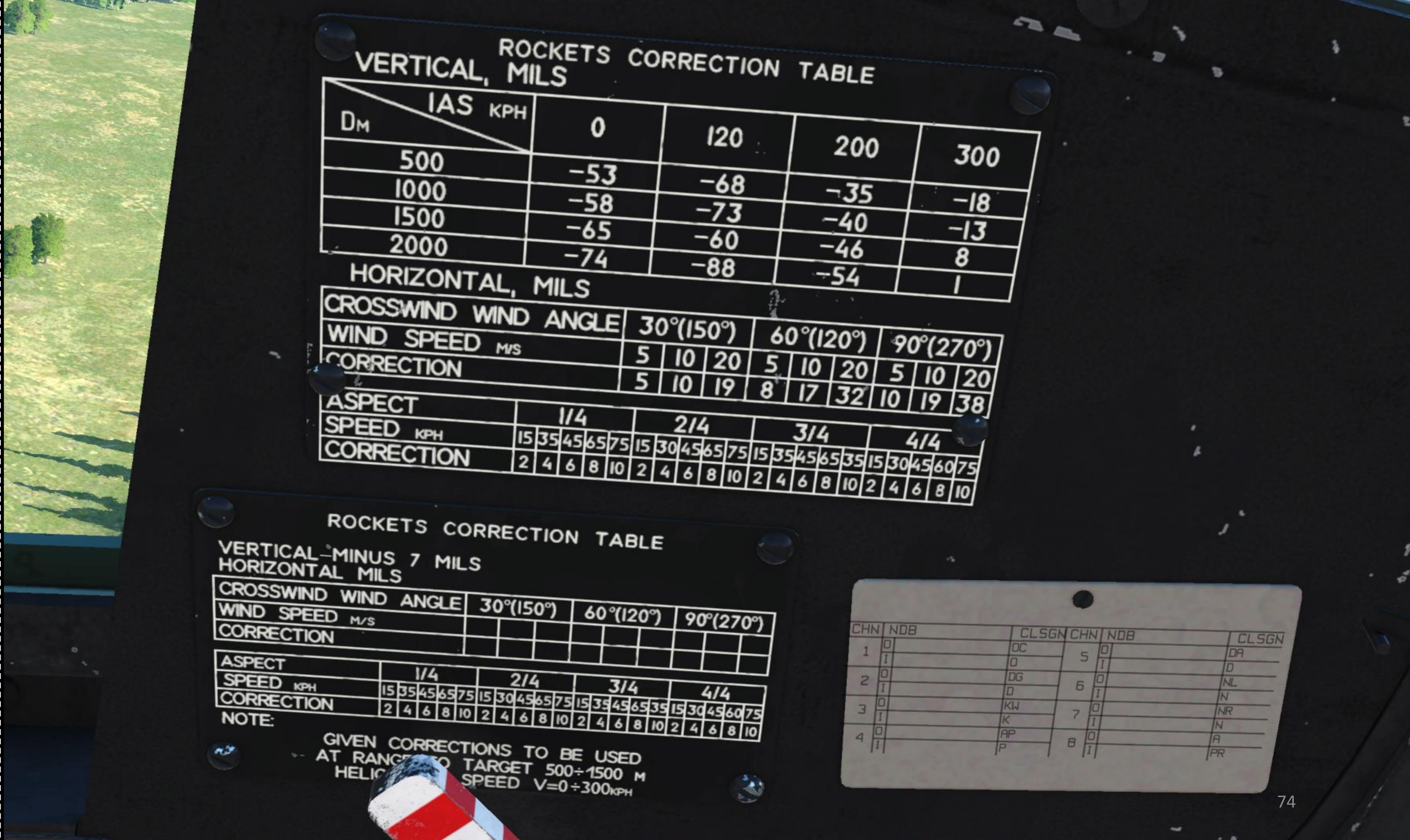

Rear Panel Lighting Brightness Knob
Not Functional
Rear Panel Lighting
• UP = ON
EKRAN Warning System, Hydraulics and Transmission Group Power Supply Switch
• UP = OFF
• DOWN = OPERATE
Not Functional
Circuit Breakers
Blue Cockpit Lighting Brightness (night operations)
SAI/ADI Lighting Brightness
Left/Right Panel Brightness


LWS Operation Lamp
Weapon system Built-In Test switch (not functional)
L-140 LWS (Laser Warning System) Power Switch
• UP = ON
LWS Self-Test Button
UV-26 Countermeasures System Power Switch
• UP = OPERATE
UV-26 Countermeasures System Self-Test Switch
• UP = TEST
Ampmeter (A) Not functional
AC Voltmeter (V) Not functional


Hydraulic Valve #2 Lamp
• Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System
Hydraulic Valve #1 Lamp
• Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System
Common/Main/Accumulators/Wheel Brakes Hydraulic pressure indicators (x10 kg/cm²)
• STBY: Standby Hydraulic System
• MAIN: Main Hydraulic System
• ACC: Hydraulic Accumulator
• WHEEL BRK: Wheel Brake Hydraulic System
Outside Temperature Setting for Air-to-Ground Guided Missiles (not functional)
Common/Main temperature Indicators (x10 deg C)
Unguided rocket and Gun Pods settings
• 0: S-8KOM rockets – AT/AP warhead
• 1: S-8TsM rockets – smoke warhead
• 2: S-13 rockets
• 3: S-24 heavy rockets (not used)
• 4: S-8M HE rockets
• 5: UPK-23 gun pods, twin 23mm
Computer Malfunction Lights
• Combat Computer Malfunction (ЦВМ-Б)
• Navigation Computer Malfunction (ЦВМ-Н)
• Indication Computer Malfunction (ЦВМ-И)
• Datalink Computer Malfunction (ЦВМ-Ц)
• Input-Output Device Malfunction (УВВ)
Weapon Computer BIT (Built-In Test) Switch
INU (Inertial Navigation Unit) Power Switch
• UP = ON
INU Heater Switch
• UP = ON
WCS (Weapon Control System) BIT (Built-In Test) Button
No Function
Stabilization of Sling Load Suspension Cable Switch
HUD (Heads-Up Display) Video Recorder Switch
Weapon Control BIT (Built-In Test) Selector
MAIN HYD SYS VLV
STBY HYD SYS VLV
HYD PRESS
STBY
MAIN
ACC
WHEEL BRK
TEMP
STBY
MAIN
ATGM
ASC
TEST
INU
INU HEAT ON
WCS BIT
OFF
OPR
RNP
SLING
FK
UV-26
OPER
TEST


Anti-Ice Heater BIT (Built-In-Test) Button
Anti-Ice Heater Ready Light
Right PT-12-6 EGT (Exhaust Gas Temperature) Control Threshold Governor Button
Ice Detected Light
Left PT-12-6 EGT (Exhaust Gas Temperature) Control Threshold Governor Button
Engine Vibration Monitoring System Control Button
Ejection System Circuit Test button
Ejection System Circuit Selector
• Manual/Assisted/Full Ejection with Blade Separation
Tape Recorder ON/OFF Light
Tape Recorder Ground Check Switch
ALMAZ ("Betty") Voice Message Test Button
• Pressing this button will run a built in test (BIT) of the EKRAN system. If the test passes, you will receive an affirmative voice message.
EKRAN Ground Control Button
Equipment Bay Lighting (not functional)
EKRAN Revert to Flight Control Button


Gun Fire Trigger / Cannon (SPACE)
Radio Transmit Button
Gauge Lighting On/Off
Uncage SHKVAL EO (Electro-Optical) Targeting System
Marker Hat Switch (Slew Control for SHKVAL Line of Sight)
Trimmer Button
Wheel Brake Lever
Autopilot Disengage
Hover Button
Release Weapons Trigger (RALT+SPACE)
Gun Fire Trigger / Cannon (SPACE)

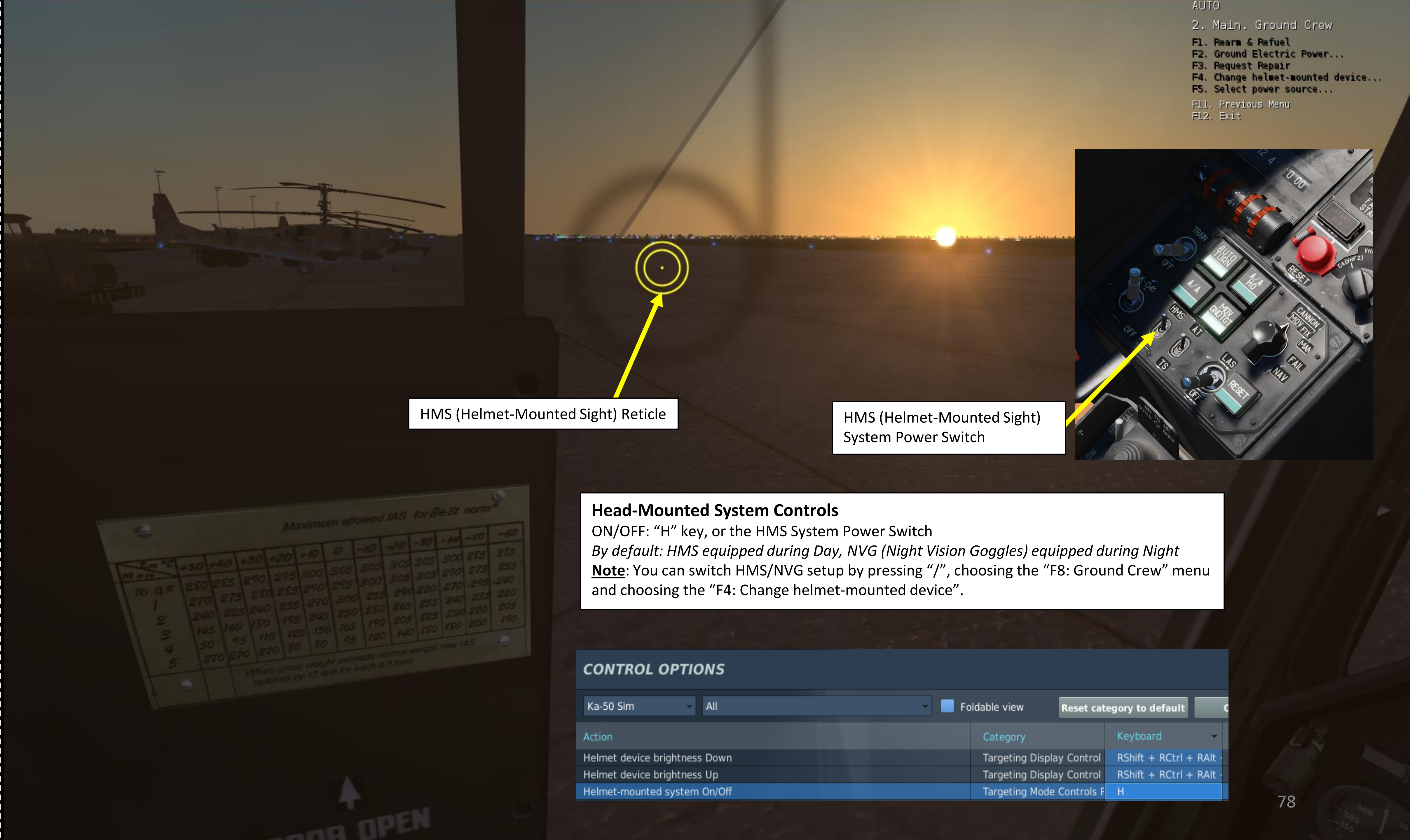

ROCKETS CORRECTION TABLE
VERTICAL, MILS
DM IAS KPH 0 120 200 300
500 −53 −68 −35 −18
1000 −58 −73 −40 −13
1500 −65 −60 −46 8
2000 −74 −88 −54 1
HORIZONTAL, MILS
CROSSWIND WIND ANGLE 30°(150°) 60°(120°) 90°(270°)
WIND SPEED M/S 5 10 20 5 10 20 5 10 20
CORRECTION 5 10 19 8 17 32 10 19 38
ASPECT 1/4 2/4 3/4 4/4
SPEED KPH 15 35 45 65 75 15 30 45 65 75 15 35 45 65 35 15 30 45 60 75
CORRECTION 2 4 6 8 10 2 4 6 8 10 2 4 6 8 10 2 4 6 8 10
ROCKETS CORRECTION TABLE
VERTICAL–MINUS 7 MILS
HORIZONTAL MILS
CROSSWIND WIND ANGLE 30°(150°) 60°(120°) 90°(270°)
WIND SPEED M/S
CORRECTION
ASPECT 1/4 2/4 3/4 4/4
SPEED KPH 15 35 45 65 75 15 30 45 65 75 15 35 45 65 35 15 30 45 60 75
CORRECTION 2 4 6 8 10 2 4 6 8 10 2 4 6 8 10 2 4 6 8 10
NOTE:
GIVEN CORRECTIONS TO BE USED
TARGET 500÷1500 M
SPEED V=0÷300KPH
CHN NDB CLSGN
1 O DC
I D
2 O DG
I D
3 O KW
I K
4 O AP
I P
CHN NDB CLSGN
5 O DA
I D
6 O NL
I N
7 O NR
I N
8 O A
I PR


Mirrors
ROTOR ANTI-ICE
ENG ANTI ICE
DUST
PITOT HEAT
LH STATIC AOA RAM AIR RH
VENT TWO OFF ONE
NAV LIGHTS
WINDSH-WIPER RET-OFF
WINDSH WASH
BRIGHTNESS ADJUST
HEAT
WINDSH HEAT
START
STOP
RESET PROG
SIDE
QUANT-NUM


Outside Air Temperature (deg C)
OUTSIDE AIR TEMPERA
°C
×10
NAV LIGHTS
10%
30%
100%
WINDSH-WIPER RET-OFF
1 SPEED
2 SPEED
FAST
WINDSH WASH
OFF
BRIGHTNESS ADJUST
HEAT
PITOT HEAT
WINDSH HEAT
OFF
OFF
LOW
ROTOR ANTI-ICE
OFF
ENG ANTI ICE
DUST
PITOT HEAT
VENT TWO
OFF
ONE

HMS (Helmet-Mounted Sight) Reticle
- *ON/OFF: "H" key, or the "HMS System Power Switch"*

HMS (Helmet-Mounted Sight) System Power Switch



HMS (Helmet-Mounted Sight) Reticle

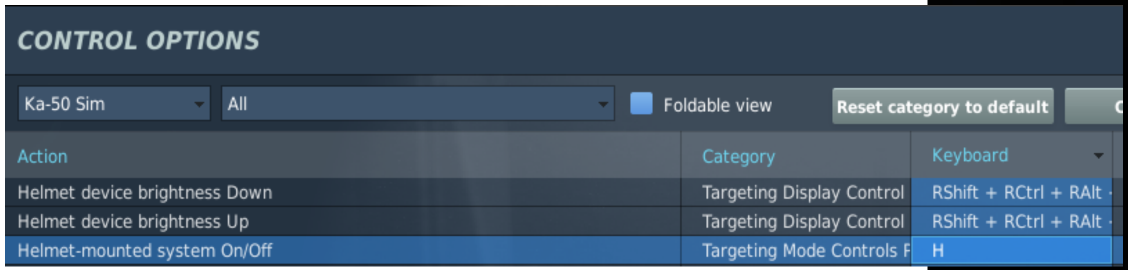
HMS (Helmet-Mounted Sight) System Power Switch

Head-Mounted System Controls
ON/OFF: “H” key, or the HMS System Power Switch
By default: HMS equipped during Day, NVG (Night Vision Goggles) equipped during Night
Note: You can switch HMS/NVG setup by pressing “/”, choosing the “F8: Ground Crew” menu and choosing the “F4: Change helmet-mounted device”.

CONTROL OPTIONS

Ka-50 Sim | All | Foldable view | Reset category to default

Action	Category	Keyboard
Helmet device brightness Down	Targeting Display Control	RShift + RCtrl + RAlt
Helmet device brightness Up	Targeting Display Control	RShift + RCtrl + RAlt
Helmet-mounted system On/Off	Targeting Mode Controls F	H

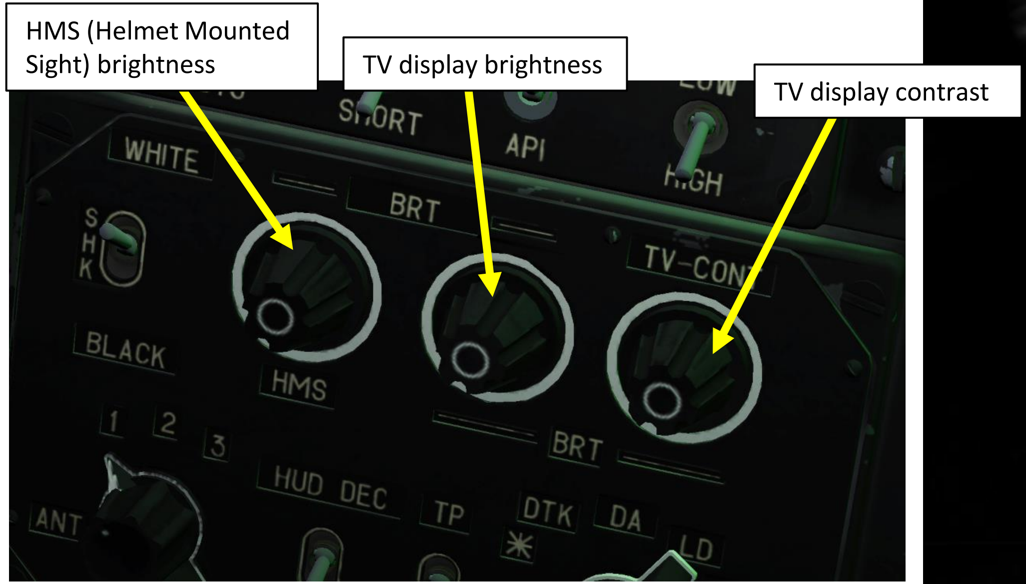


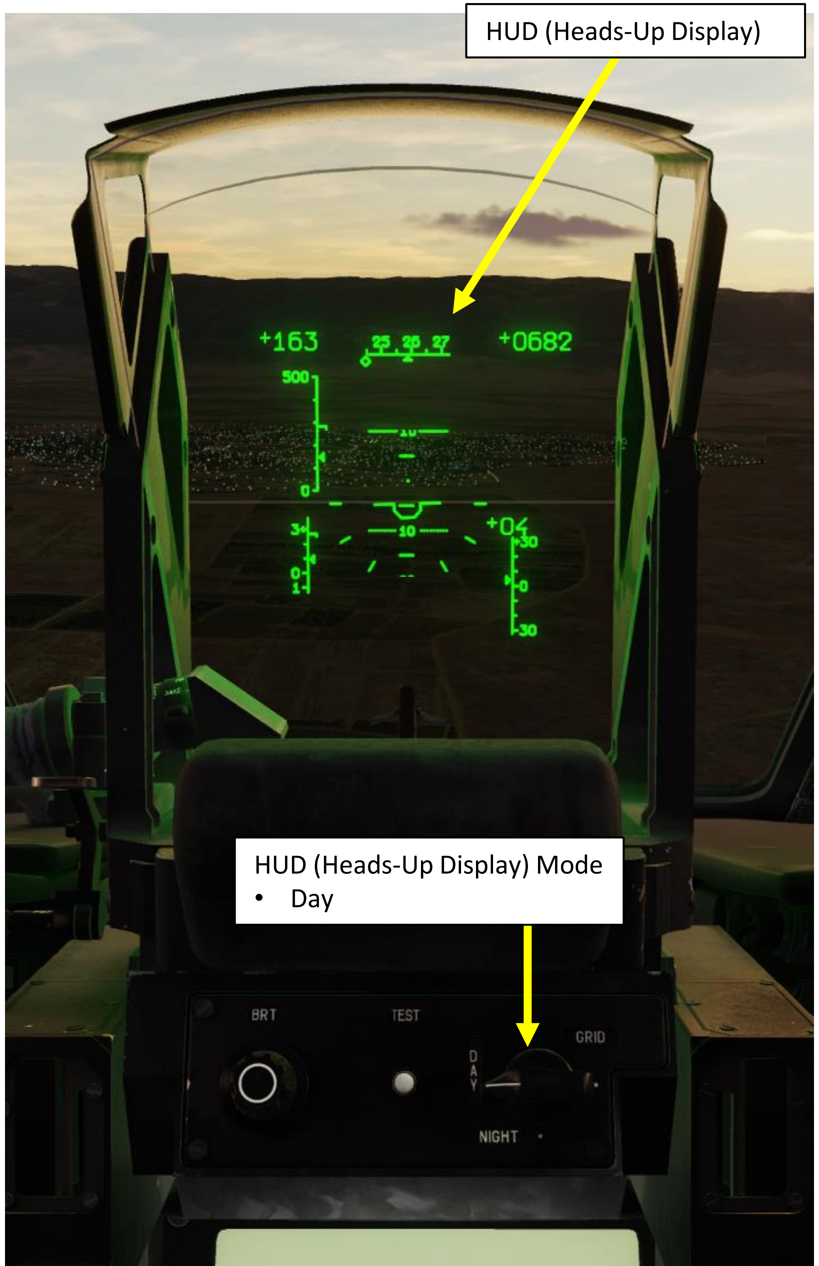
Night Vision Goggles Controls

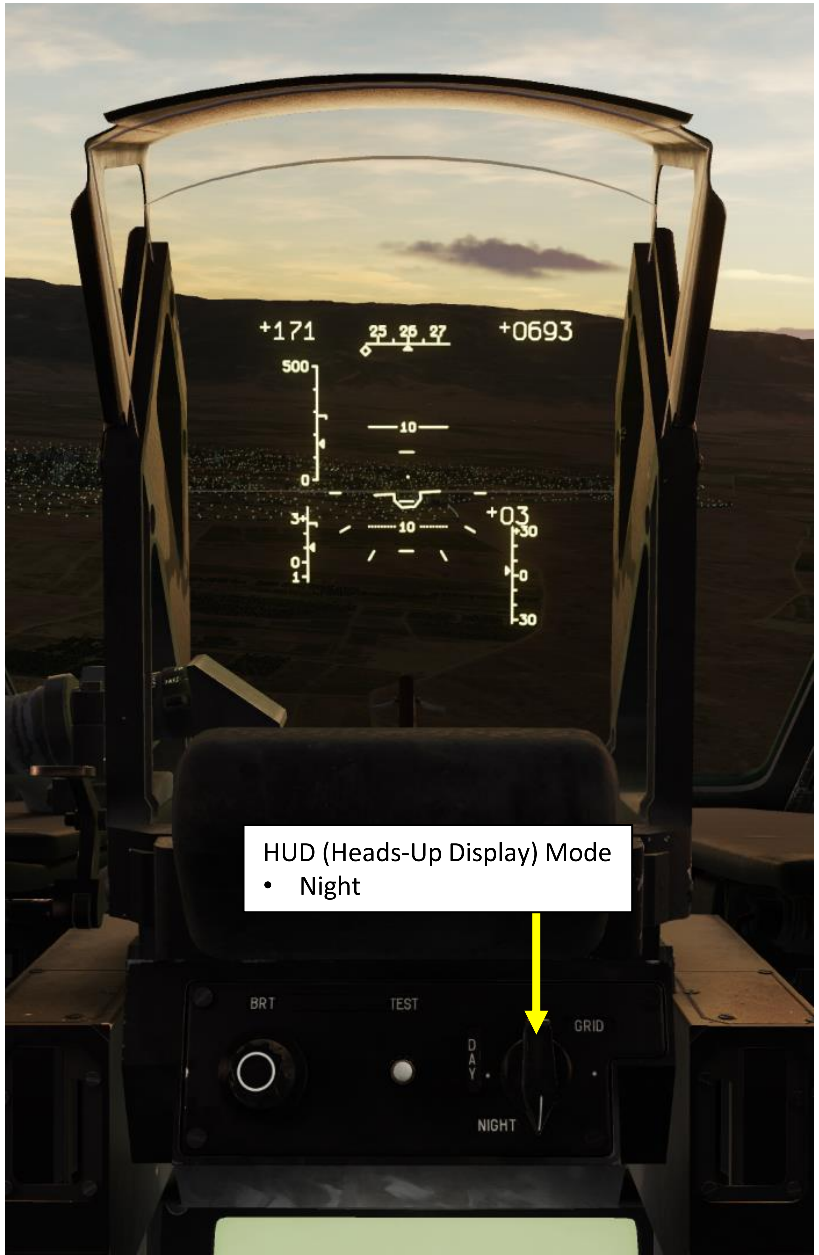
- ON/OFF: “H” key
- Brightness UP: RALT+RCTRL+RSHIFT+]
- Brightness DOWN: RALT+RCTRL+RSHIFT+[

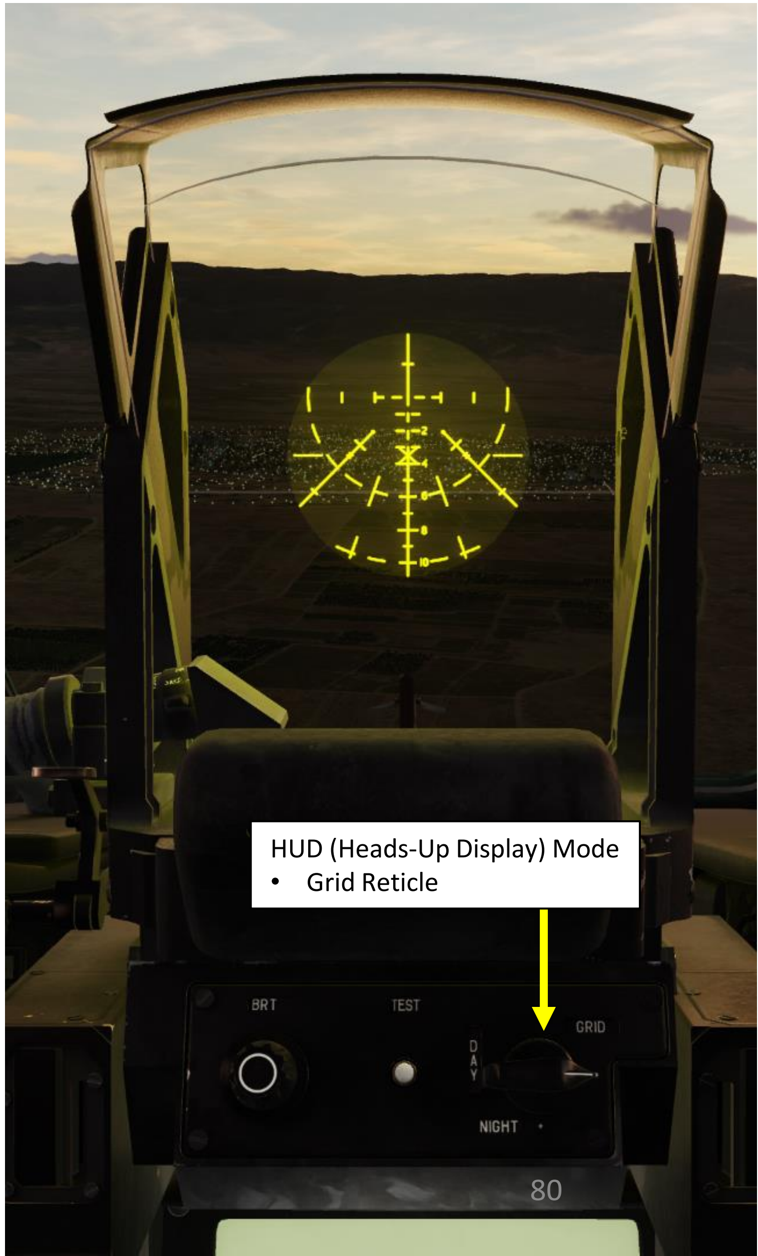
By default: HMS equipped during Day, NVG (Night Vision Goggles) equipped during Night

Note: You can switch HMS/NVG setup by pressing “/”, choosing the “F8: Ground Crew” menu and choosing the “F4: Change helmet-mounted device”.




HUD (Heads-Up Display)
HUD (Heads-Up Display) Mode
• Day
BRT
TEST
GRID
DAY
NIGHT

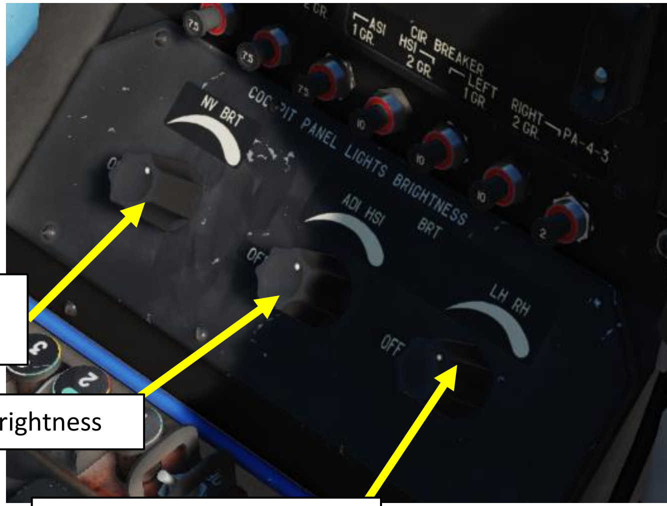

HUD (Heads-Up Display) Mode
• Night
BRT
TEST
GRID
DAY
NIGHT


HUD (Heads-Up Display) Mode
• Grid Reticle
BRT
TEST
GRID
DAY
NIGHT

Cockpit Lighting
- UP = ON

SAI (Standby Attitude Indicator) & ADI (Attitude Director Indicator) Lighting
- UP = ON

Night Vision Cockpit Lighting
- UP = ON



Blue Cockpit Lighting Brightness (night operations)

SAI/ADI Lighting Brightness

Left/Right Panel Brightness


Flashlight Control
• LCTRL+LALT+L

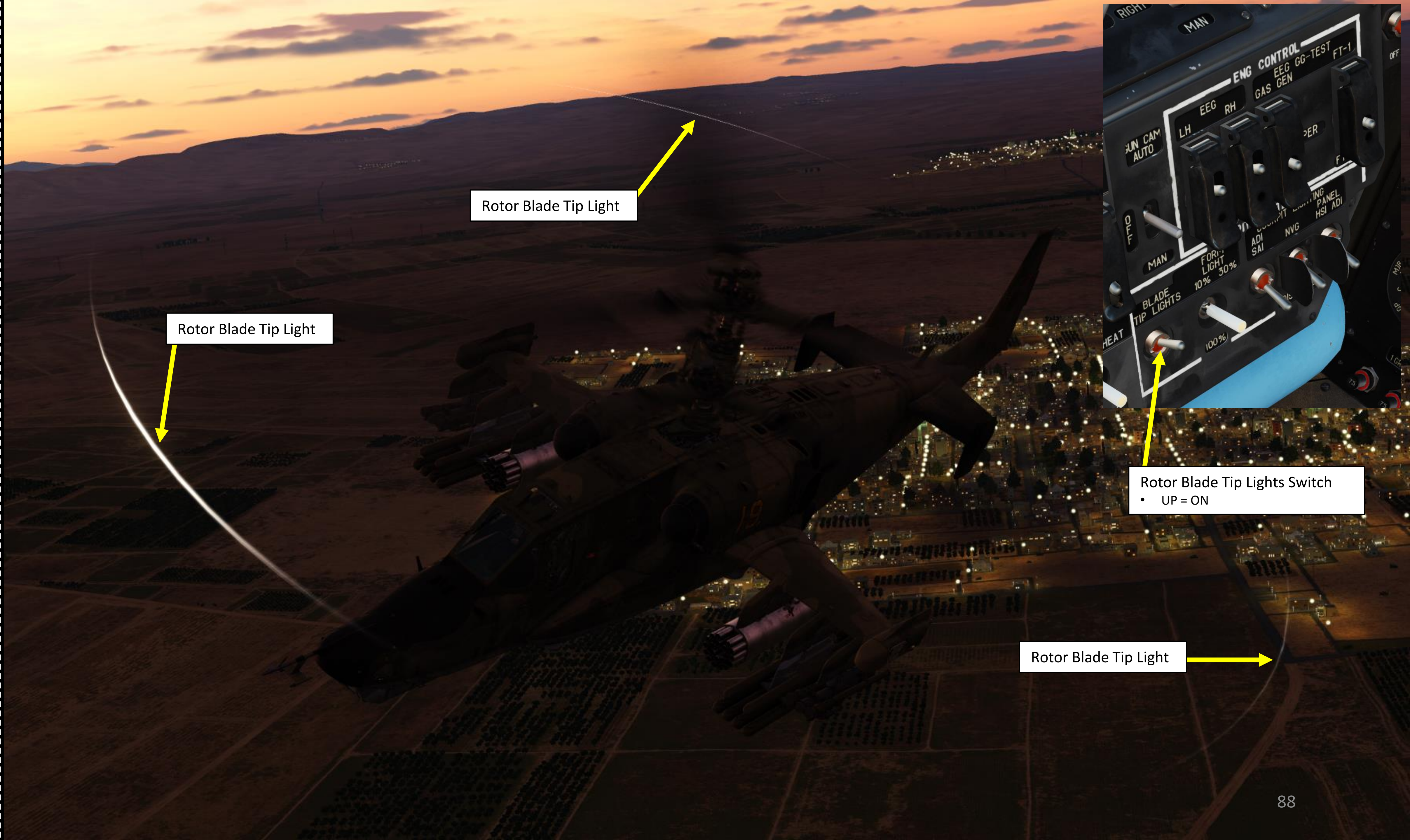

19

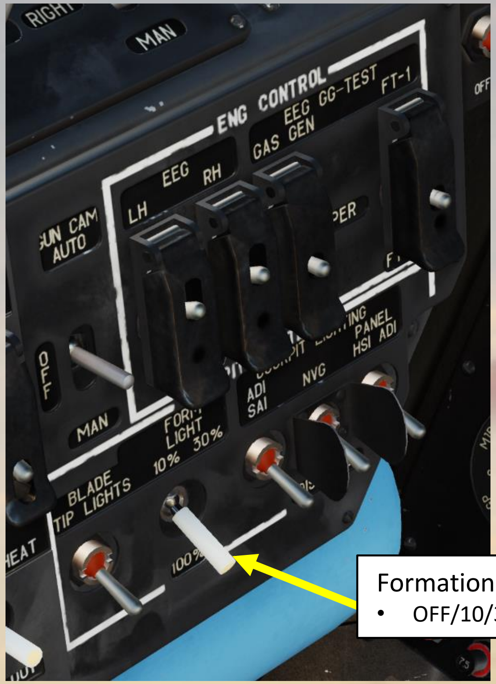

19
Signal Flare Cartridge Dispenser
UV-26 Countermeasure Flare Cartridge Dispenser


Pitot Tube


Engine Exhaust Infrared
Signature Suppressor

Engine Inlet & Particle Separator System
(Dust Protection Device)


Rotor Blade Tip Light
Rotor Blade Tip Light
Rotor Blade Tip Lights Switch
• UP = ON
Rotor Blade Tip Light
ENG CONTROL
BLADE TIP LIGHTS


MAN
ENG CONTROL
EEG
GAS GEN
GG-TEST
FT-1
LH
RH
OFF
MAN
BLADE TIP LIGHTS
FORM LIGHT
10%
30%
100%
ADI
SAI
NVG
PANEL
HSI ADI
Formation Lights
• OFF/10/30/100 %


Formation Lights
19

Anti-Collision Beacon Switch
- UP = ON

Anti-Collision Beacon

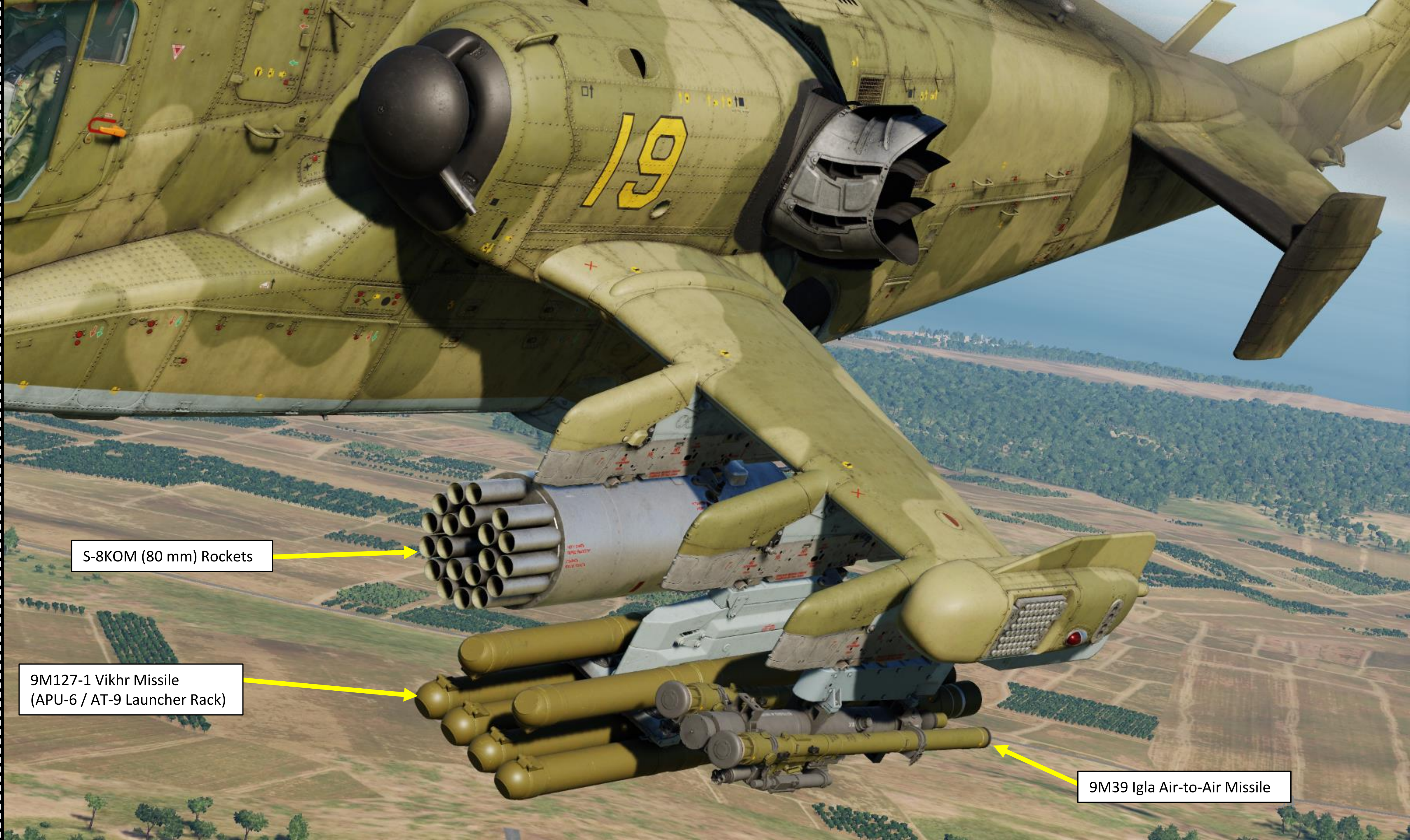
Navigation Lights Switch
- Left click toggles between OFF/10/30/100 %
- Right click sets switch UP to a momentary position and is used to send visual 'coded' signals (Morse code for example) to other aircraft and ground units in the case of radio communication failure.


Landing Light Hat Switch
Slewing Control


Landing Light Switch
• UP: Deploy
• MIDDLE: OFF
• DOWN: Retract
Main & Backup Landing Lights Selector Switch


Backup Landing Light
Main Landing Light

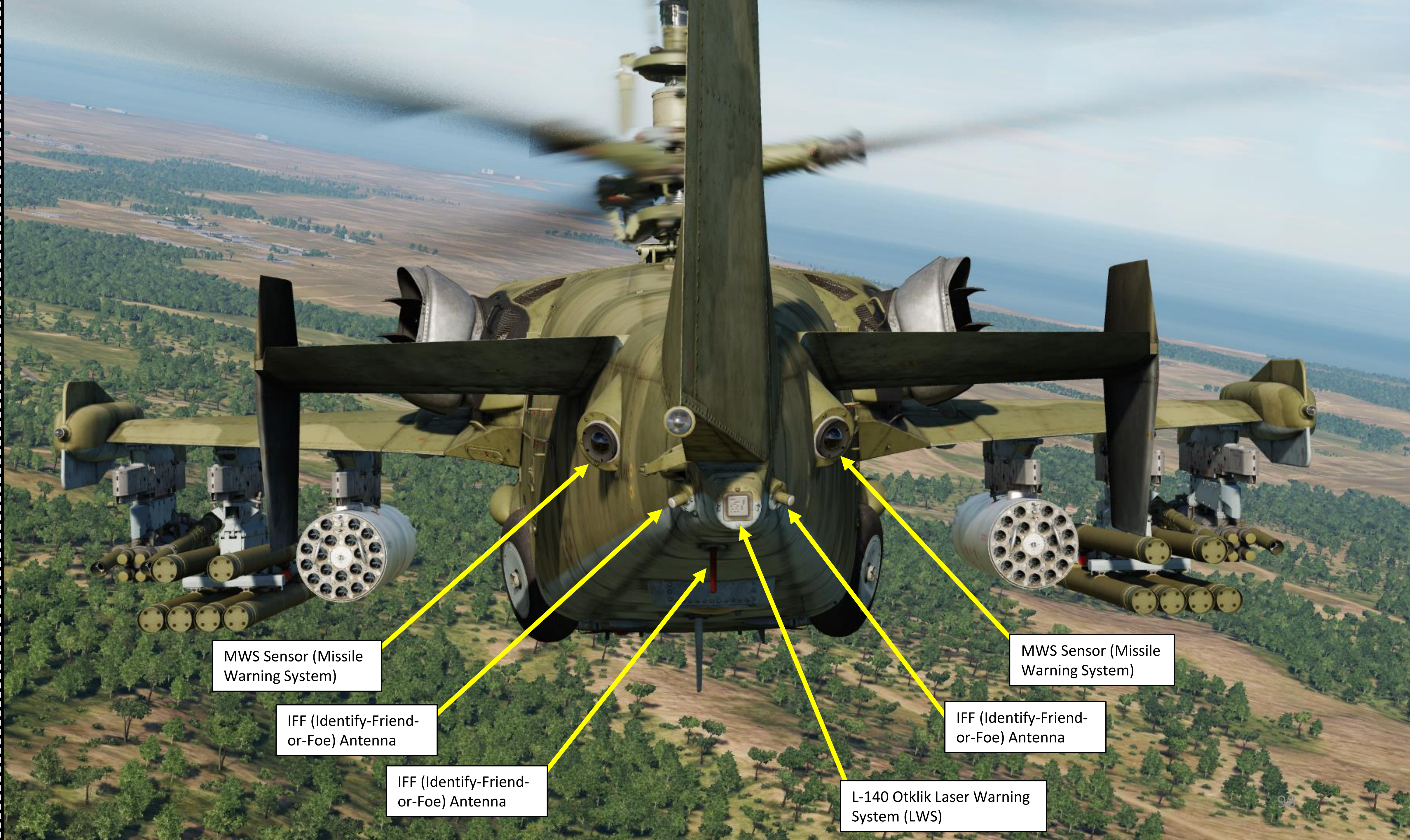

Retractable Landing Gears
(Hydraulically actuated)


S-8KOM (80 mm) Rockets
9M127-1 Vikhr Missile
(APU-6 / AT-9 Launcher Rack)
9M39 Igla Air-to-Air Missile


2A42 30 mm Cannon


I-251V Shkval-V Electro-Optical Targeting System


IFF (Identify-Friend-or-Foe) Antenna
IFF (Identify-Friend-or-Foe) Antenna
IFF (Identify-Friend-or-Foe) Antenna
MWS Sensor (Missile Warning System)
MWS Sensor (Missile Warning System)
L-140 Otklik Laser Warning System (LWS)

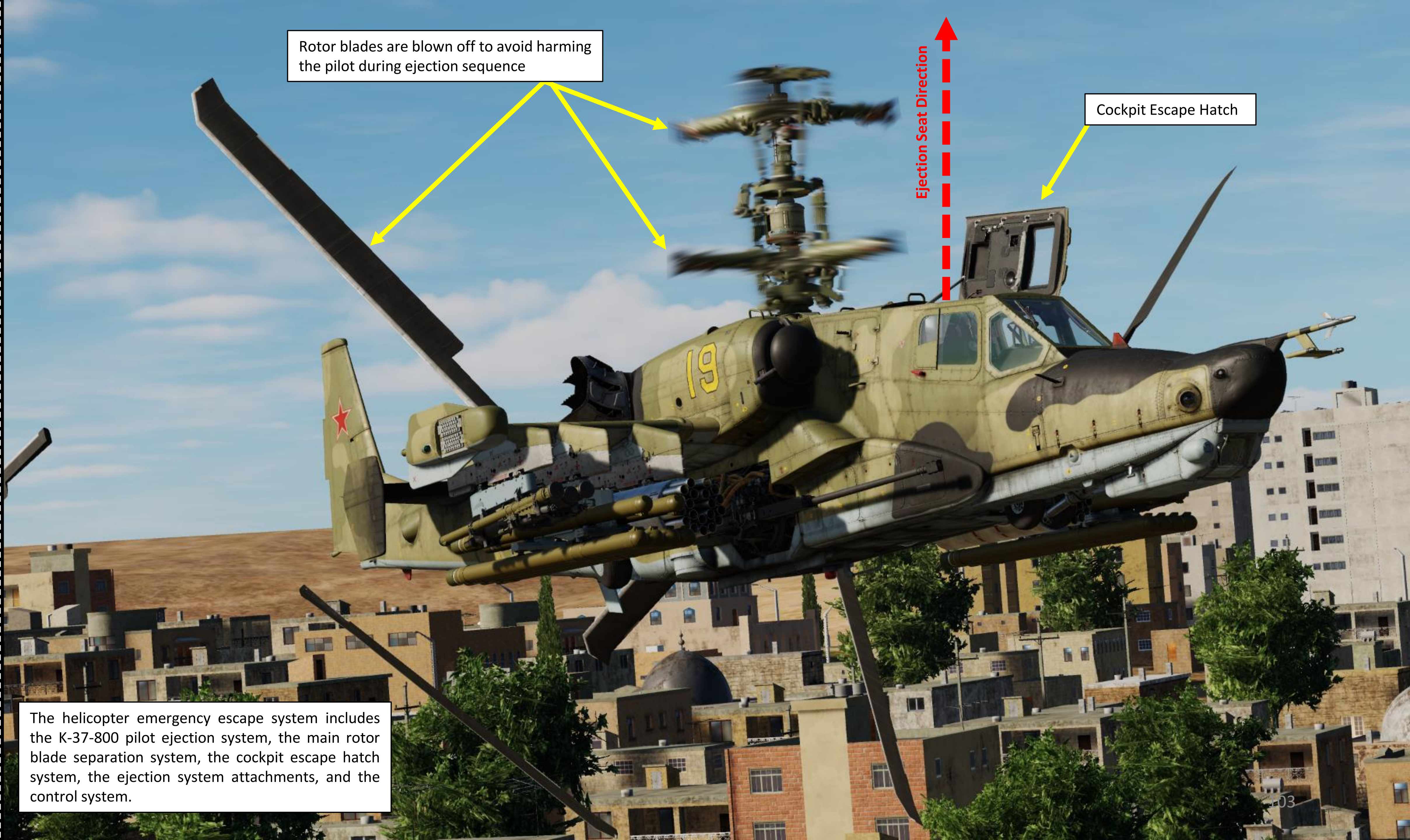

MWS Sensor (Missile Warning System)
IFF (Identify-Friend-or-Foe) Antenna
IFF (Identify-Friend-or-Foe) Antenna
L-140 Otklik Laser Warning System (LWS)
IFF (Identify-Friend-or-Foe) Antenna
MWS Sensor (Missile Warning System)


Doppler Radar High Frequency Unit


APU (Auxiliary Power Unit)
Exhaust Port


Radio Communication Antenna (Aerial)
Radio Communication Antenna (Aerial)

The Ka-50 is equipped with an ejection seat system, which is rather uncommon for helicopters.

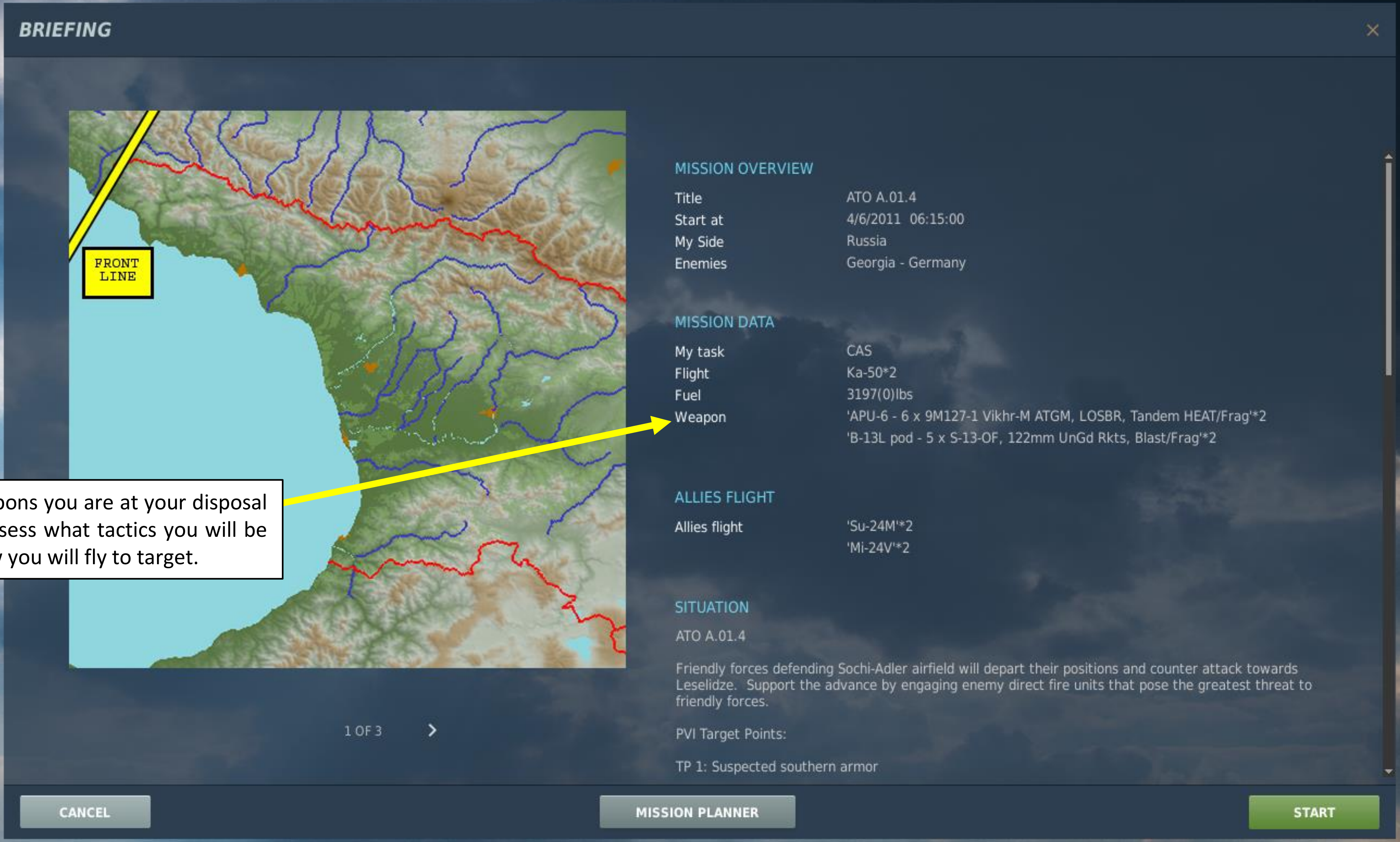


The helicopter emergency escape system includes the K-37-800 pilot ejection system, the main rotor blade separation system, the cockpit escape hatch system, the ejection system attachments, and the control system.

To open or close service hatches, use “LCTRL+W” binding.


Some Awesome Shoes

Pre-flight procedures in the Ka-50 can be quite an extensive subject. For each mission, you should read the briefing carefully and look for specific information as shown in the great **Georgian Oil War** campaign.



Knowing what weapons you are at your disposal will allow you to assess what tactics you will be able to use and how you will fly to target.

SAM radar range radius, watch out!

Target Points will be useful to help you with navigation

Make sure the objective is crystal clear in your mind

Look for SAM site locations and enemy positions.

Make an assessment of what you are likely to face based on intel and plan your mission accordingly.

COLD START PROCEDURE OVERVIEW

- A – Before Start-Up
- B – APU (Auxiliary Power Unit) Start
- C – Engine Start
- D – After Start-Up


FIRE EXTINGUISHER SYSTEM
FUEL PUMPS
FUEL SHUTOFF VLV
APU
X-FEED VLV
MAIN HYD OFF
EJECT-SEAT-SYS
WARN
TEST
OFF
IGR
STOP
START

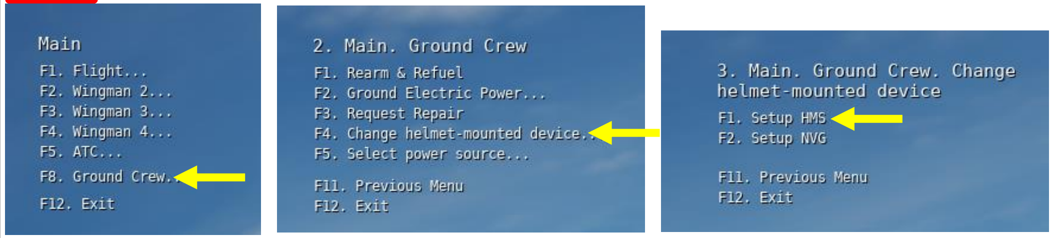
A – BEFORE START-UP

To open or close service hatches, use “LCTRL+W” binding.

A – BEFORE START-UP

1. Contact ground crew to re-arm and refuel as required by the mission. Via the ground crew interface, you can also select either the HMS (Helmet Mounted Sight) or NVG (Night Vision Goggles) loadout by pressing « \ », then pressing F8 (Ground Crew), and either F1 (HMS) or F2 (NVG).
    - For day operations, the Helmet-Mounted Sight is recommended.
2. Close side door using RCTRL+C.

1

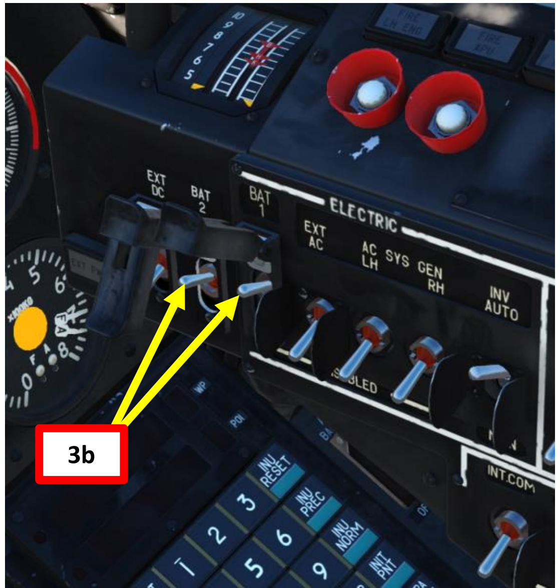


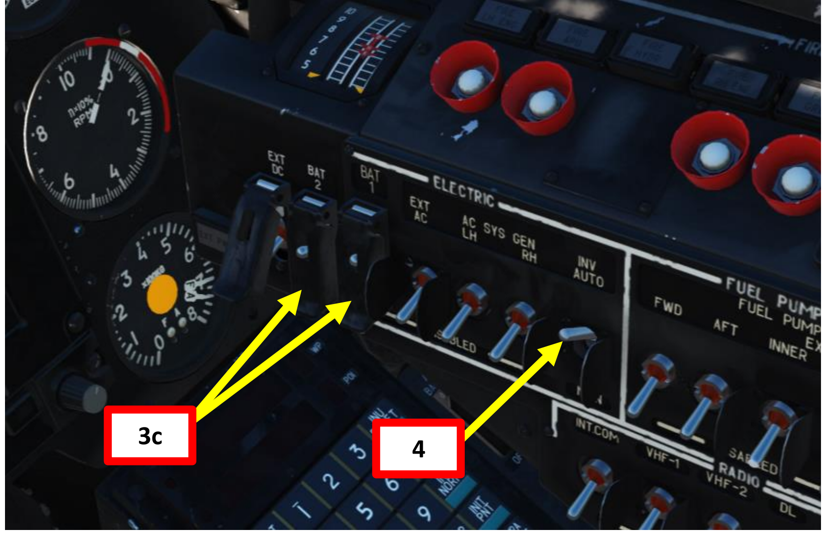
2a

2b

A – BEFORE START-UP

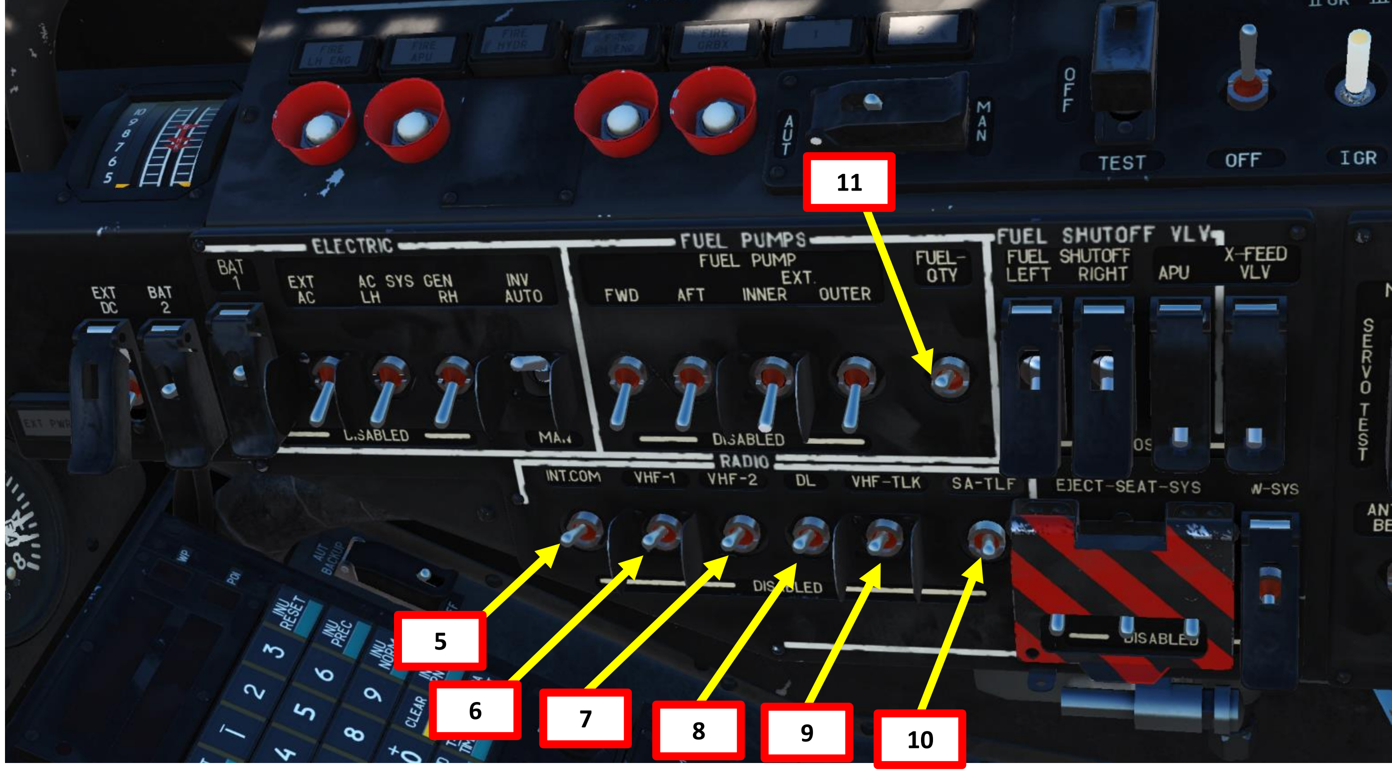
3. Set Battery switches 1 & 2 – ON (UP)
    - Set cover UP, set switch UP, then set cover DOWN
4. Set Inverter switch – AUTO (UP)

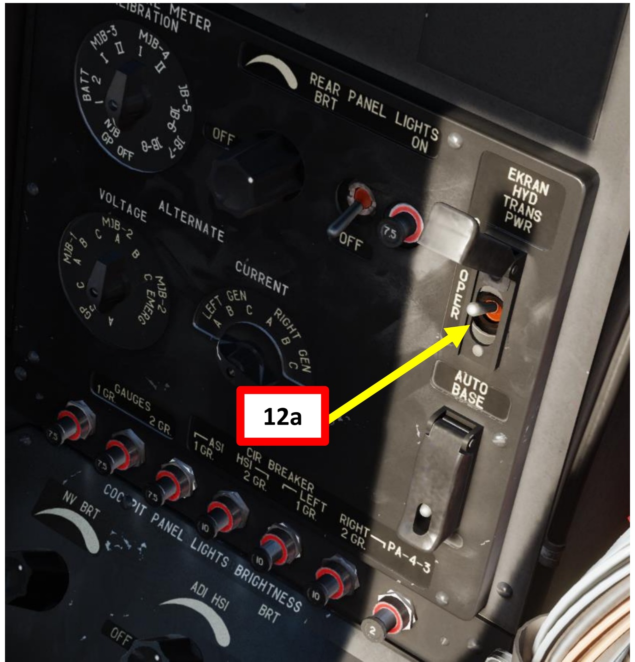


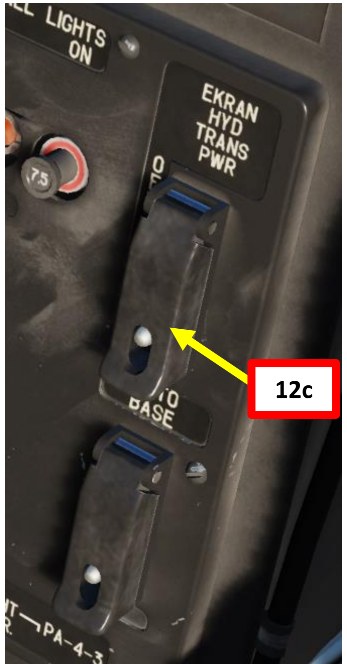


A – BEFORE START-UP

5. Set Intercom switch – ON (UP)
6. Set R-828 VHF-1 Radio Power switch – ON (UP)
7. Set R-800 VHF-2 Radio Power switch – ON (UP)
8. Set DL (Datalink) Power switch – ON (UP)
9. Set VHF-TLK switch – ON (UP)
10. Set SA-TLF switch – ON (UP)
11. Set Fuel Quantity switch – ON (UP)
12. Set EKRAN-HYDRO switch – ON (DOWN)
    - Set cover UP, set switch DOWN, then set cover DOWN
    - This switch provides power to EKRAN Warning System, hydraulics, and transmission group control sensors.

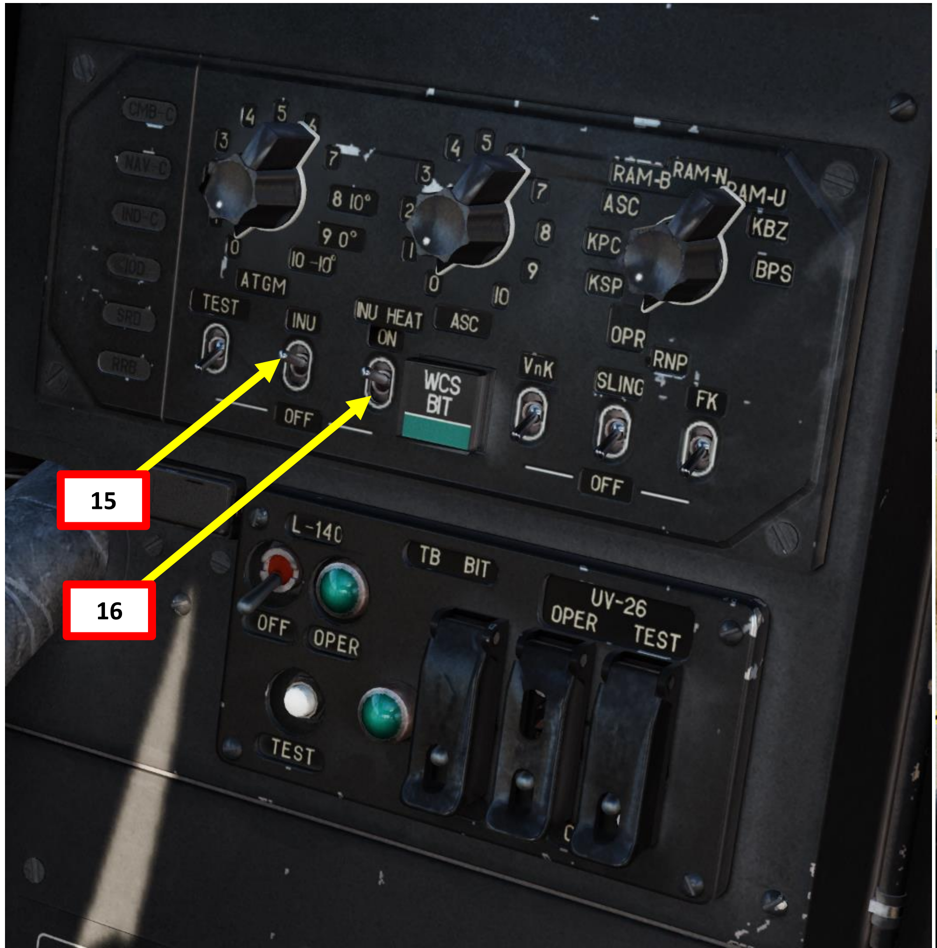






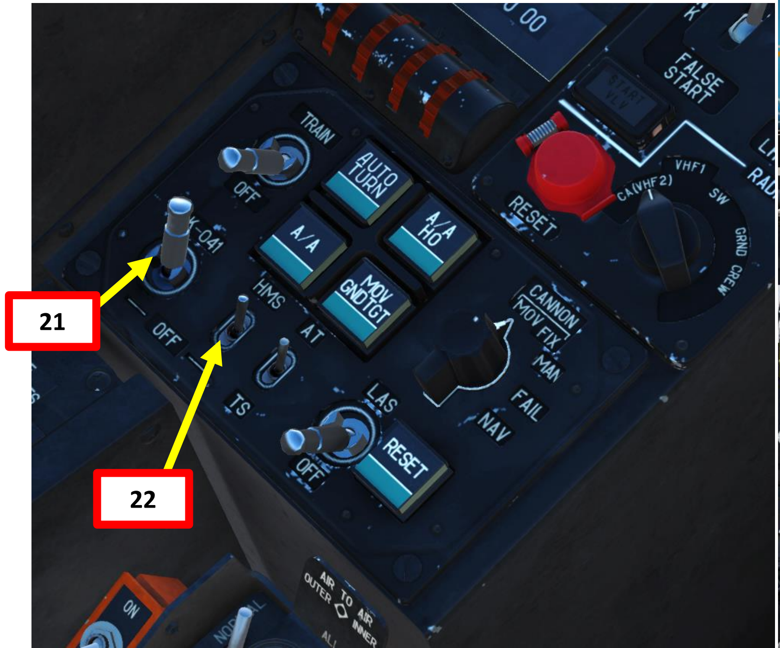
A – BEFORE START-UP

13. We will perform an Accelerated Alignment of INU (Inertial Navigation Unit) and K-041 targeting system, which should take approx. 3 to 4 minutes.
14. Set PVI-800 NAV MODE selector to OPER
15. Set INU (Inertial Navigation Unit) switch – ON (UP)
16. Set INU (Inertial Navigation Unit) Heat Switch – ON (UP)
17. Set PVI-800 NAV SYSTEM switch – ON
18. Set SAI (Standby Attitude Indicator) switch – ON (UP)
19. Press Master Caution light to turn it the warning OFF



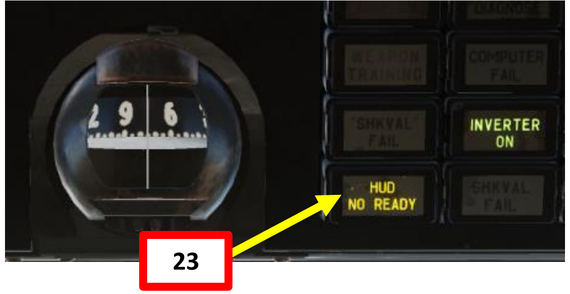
A – BEFORE START-UP

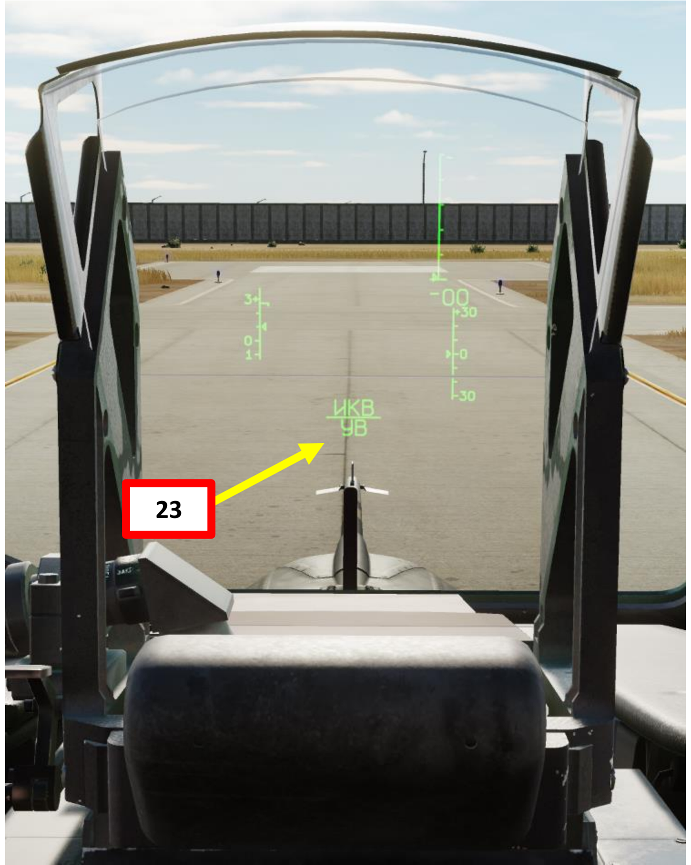
20. Set ABRIS (AMMS, Advanced Moving Map System) Power switch – ON (UP)
    - Start-up sequence takes about 120 seconds
21. Set K-041 Targeting System switch – ON (FWD)
22. Set HMS (Helmet-Mounted system) switch – ON (FWD)

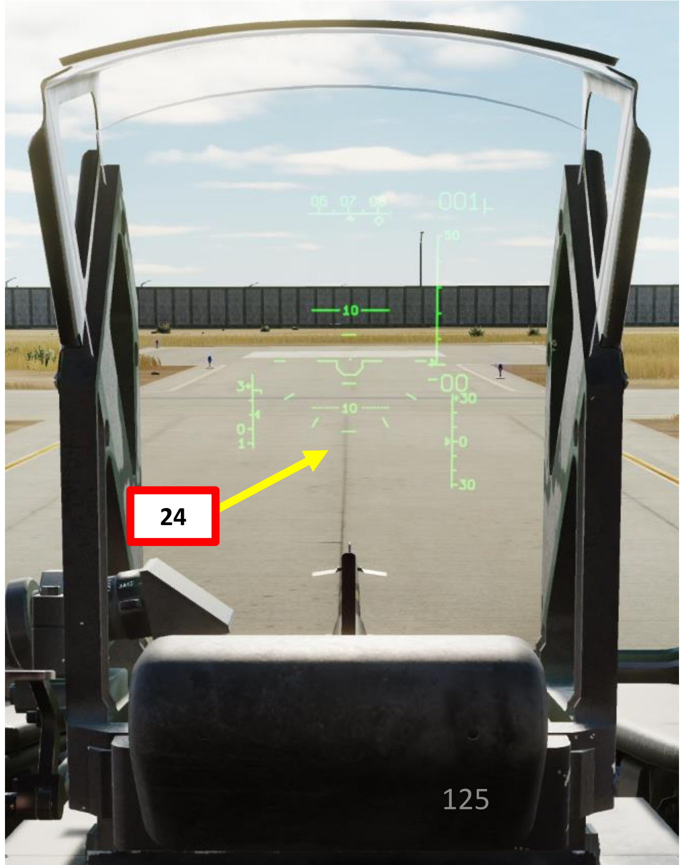


A – BEFORE START-UP

23. While navigation systems, the Heads-Up Display (HUD) and targeting systems are powering up, the HUD will display the symbol “ИКВ/УВ” and the overhead panel will display the “HUD NO READY” caution.
24. After approx. 3 minutes, the accelerated INU (Inertial Navigation Unit) alignment process should be completed.
    - The “ИКВ/УВ” (INU/AA) symbol will disappear from the HUD and the INU will switch to operational mode.
    - The flashing indicator lights on the Flight Mode Control Panel labeled К, Т, Н will switch off
    - The alarm flag labeled КС will disappear from the HSI, which will then display the heading values taken from the onboard computer
    - The alarm flag labeled АГ will disappear from the INU, which will then display the aircraft’s parking roll and pitch values.

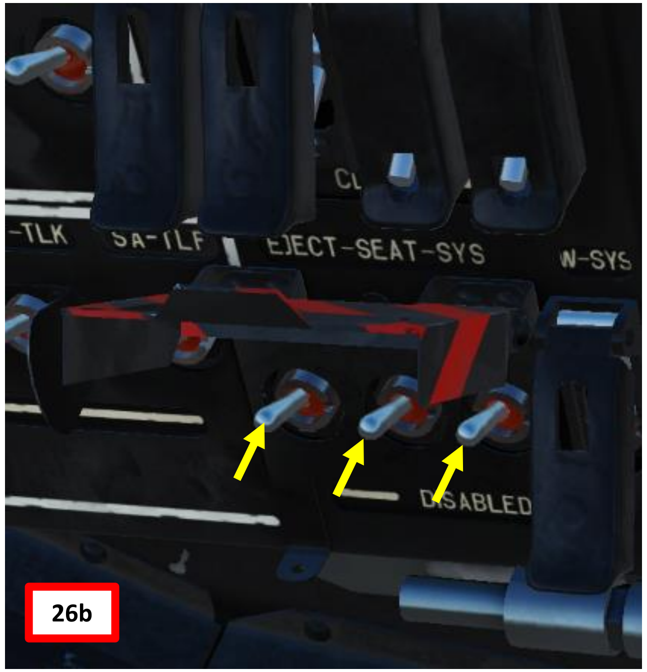






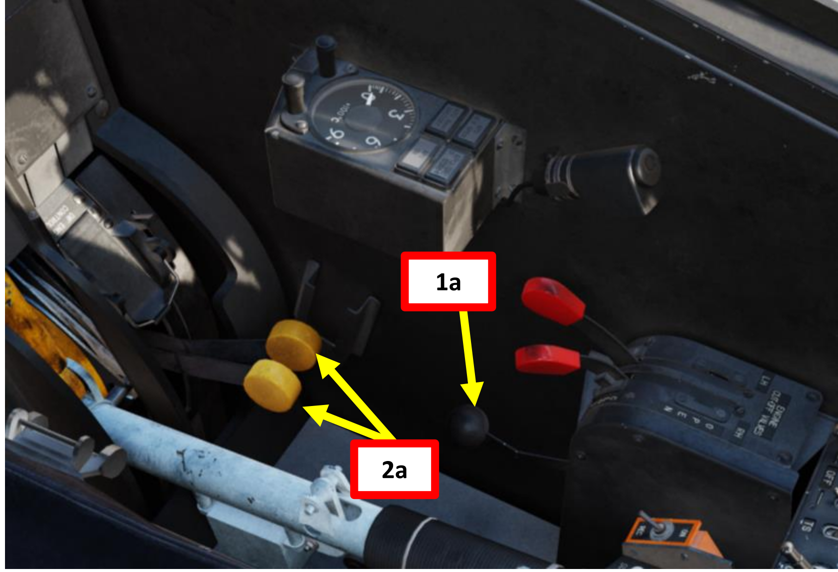
A – BEFORE START-UP

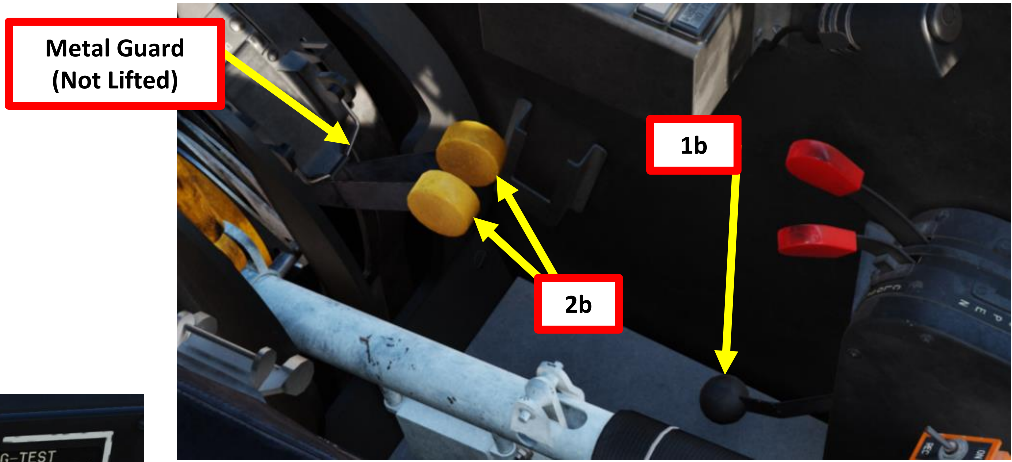
25. Set Fire Extinguisher switch – OPER
    - Set cover UP, set switch to OPER, then set cover DOWN
26. Arm Ejecting System Power switches – UP
    - Flip cover UP, set three switches UP, flip cover DOWN



B – APU (AUXILIARY POWER UNIT) START

1. Disengage rotor brake – DOWN position
2. Set throttle to AUTO (UP, just prior to lifting the metal guard).
   - *Note: Normally, we would leave throttles at IDLE (DOWN) first, start the engines, then back to AUTO… but for simplicity we will set them at AUTO from the beginning.*
3. Set Forward and Aft fuel pumps – ON (UP)
4. Set Left (Fwd), right (Aft) and APU fuel tank shutoff valves – OPEN (UP)
   - Set cover UP, set switch UP, then set cover DOWN
5. Set Left and Right EEG (Electronic Engine Governor) switches – ON (UP)
   - Set cover UP, set switch to ON, then set cover DOWN

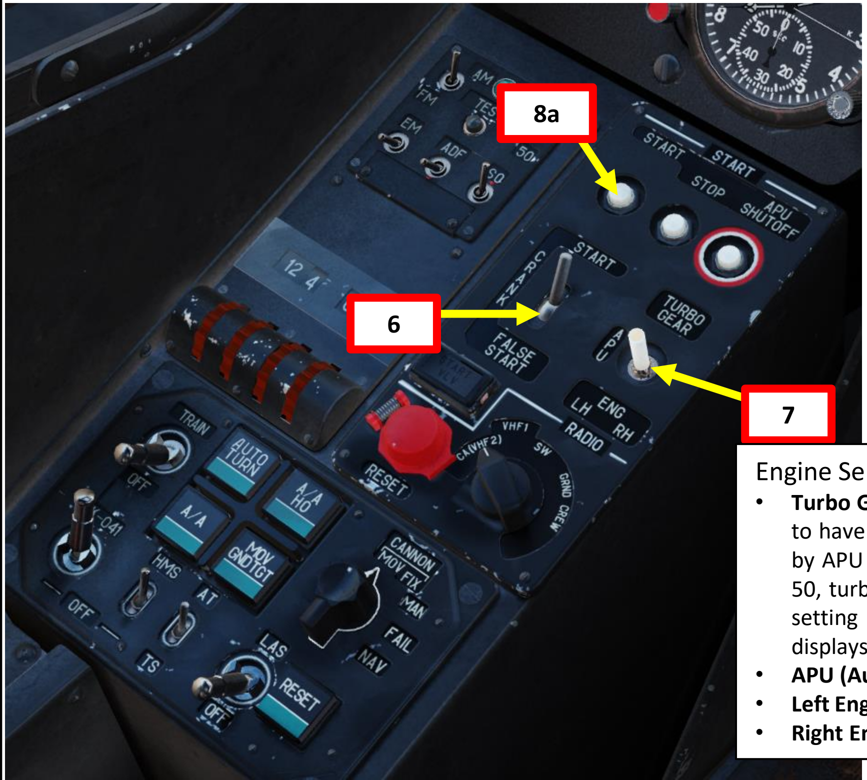




B – APU (AUXILIARY POWER UNIT) START

6. Startup/Crank/False Start switch – START
7. Turbo Gear/APU/Left Engine/Right Engine switch – set to APU (centered position)
8. Press START button for 2-3 sec to start APU (Auxiliary Power Unit). Once the APU is started, the air pressure generated by it will be used to drive the engine pneumatic starter.
    - APU start is completed within about 20-30 seconds in normal temperature conditions, but can take up to 1 minute in very cold conditions.
    - Once APU is running/operational:
        - APU EGT (Exhaust Gas Temperature) should stabilize to approx. 600 deg C (no more than 720 deg C)
        - APU OIL P NORM indication should be illuminated
        - APU ON indication should be illuminated as well.
    - Note: APU warm up, with no air bleeding, should take one minute before using it for main engine starts.

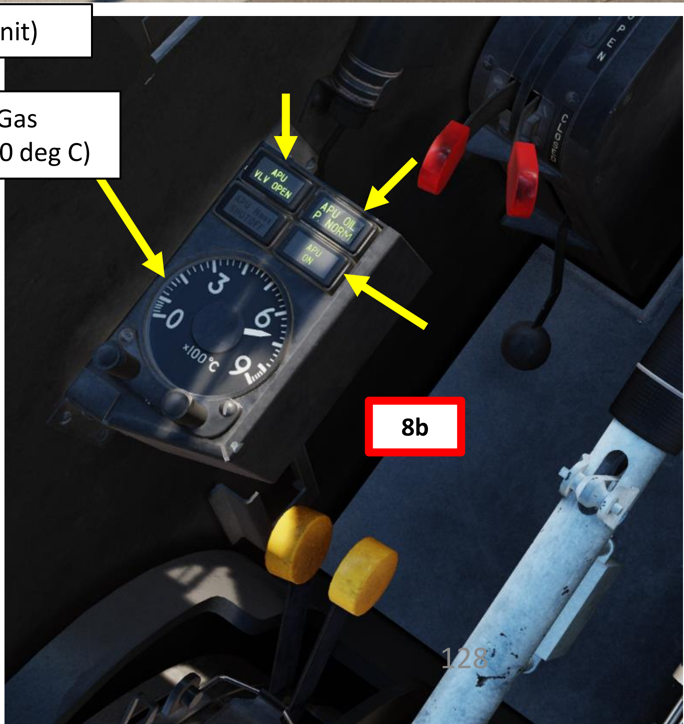
Exhaust Nozzle of Operating APU (Auxiliary Power Unit)



Engine Selector

- **Turbo Gear**: Turbo gear allows the testing of helicopter subsystems without the need to have the engines running. This gear operates from compressed air that is supplied by APU power and it powers the AC generator and hydraulics pump. On the real Ka-50, turbo gear is activated by the ground crew (“Request Turbo Gear” command) by setting the appropriate controls on the helicopter’s main gearbox. This in turn displays “МУФТА ОТКЛ” in the cockpit and disables engine start.
- **APU (Auxiliary Power Unit)**
- **Left Engine**
- **Right Engine**

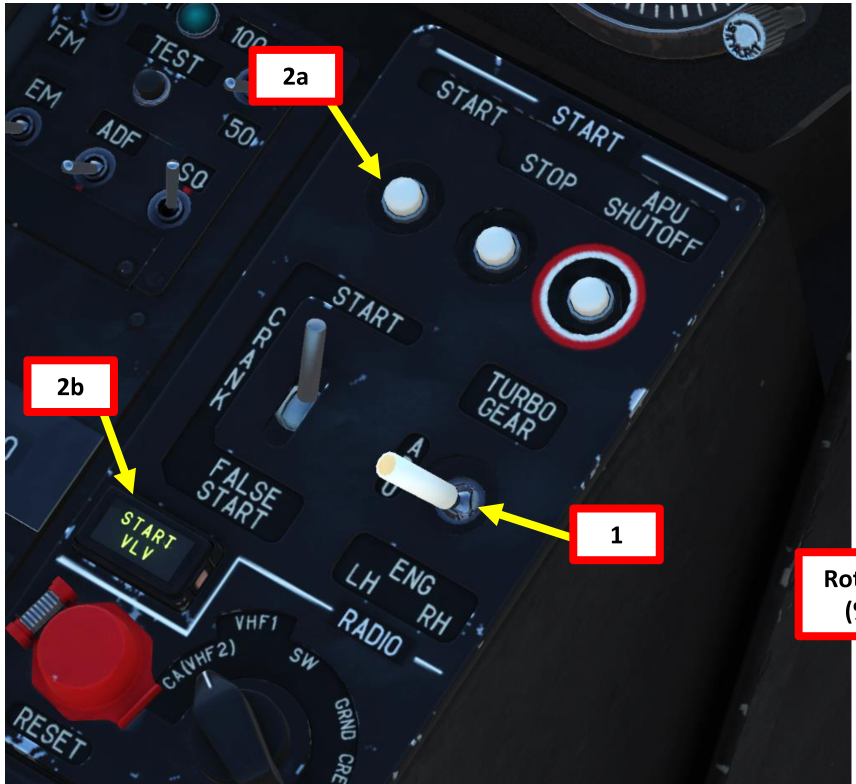
APU EGT (Exhaust Gas Temperature) (x100 deg C)

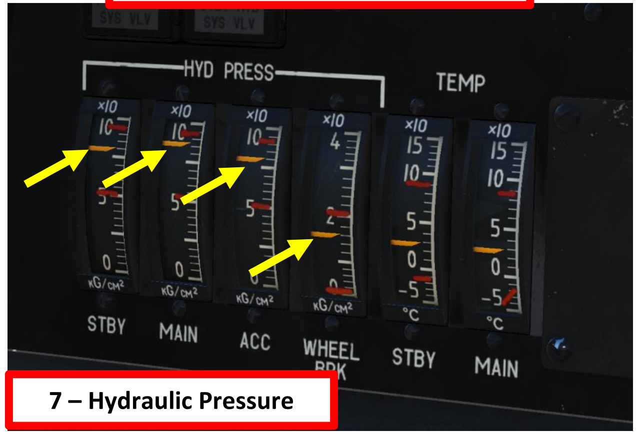


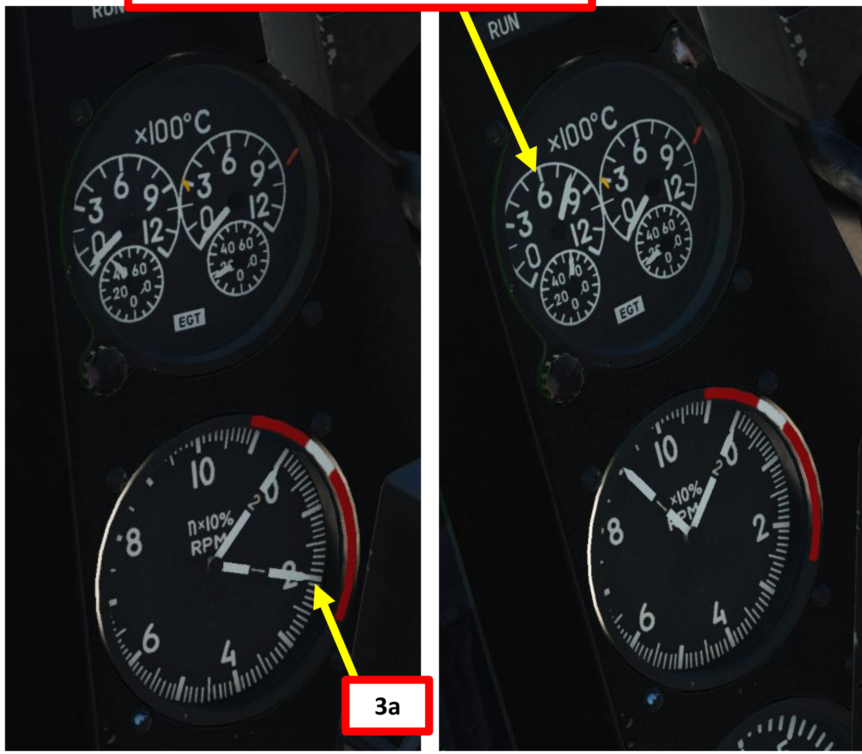
C – ENGINE START

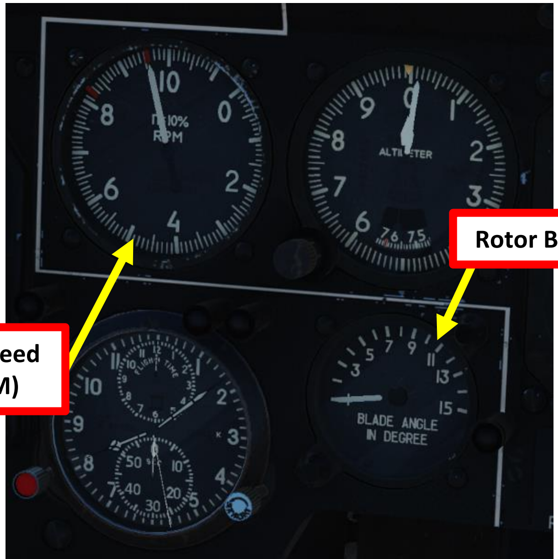
C – ENGINE START

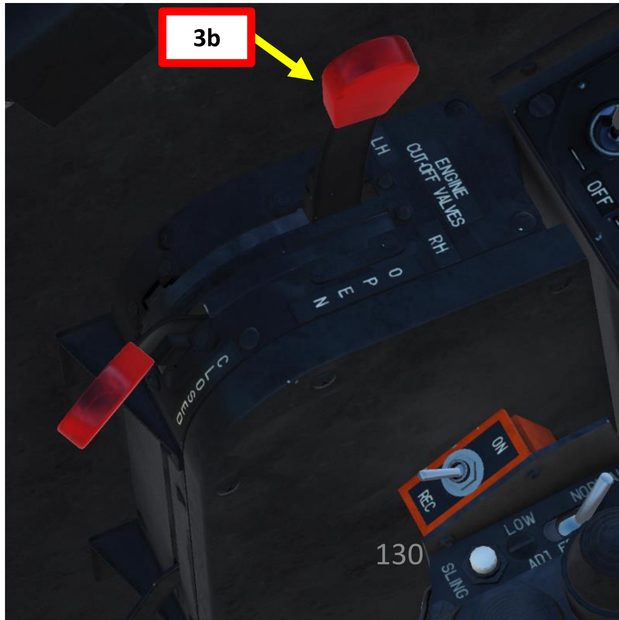
1. Turbo Gear/APU/Left Engine/Right Engine switch – set to LEFT engine
2. Press START button for 2-3 sec to start LEFT engine. START VLV light indicates the start valve is open.
3. When Left Engine's Gas Generator Speed reaches 20 % RPM, open LEFT engine shutoff valve (left red lever UP)
4. Confirm EGT (Exhaust Gas Temperature), engine oil pressure and transmission gearbox oil pressure increase. Monitor oil temperature accordingly.
5. Rotors motion should initiate at Gas Generator RPM of no more than 25% (visual confirmation by looking at the nearest blade)
6. Starter will disengage at Gas Generator RPM between 60 and 65%. Monitor this with the START light going off.
7. Confirm that hydraulic fluid pressure increases in all systems.





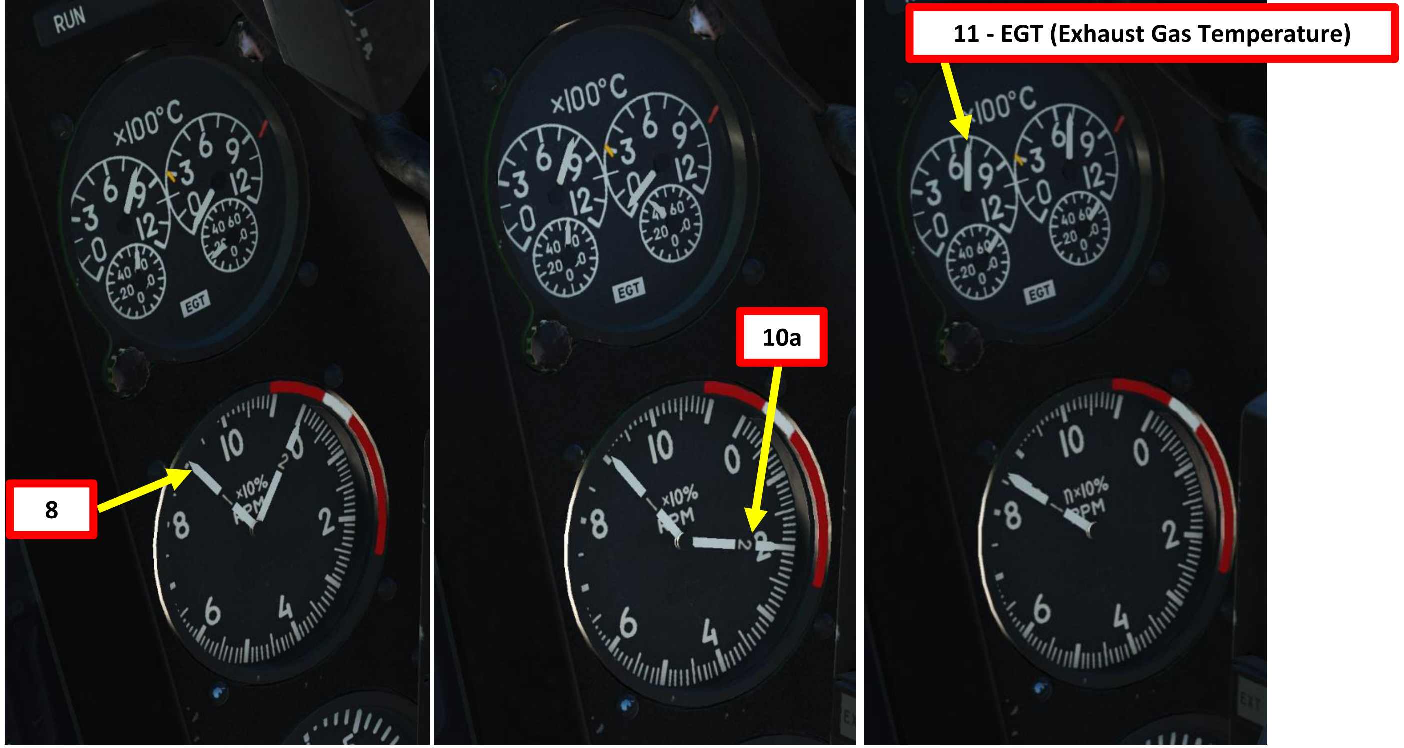


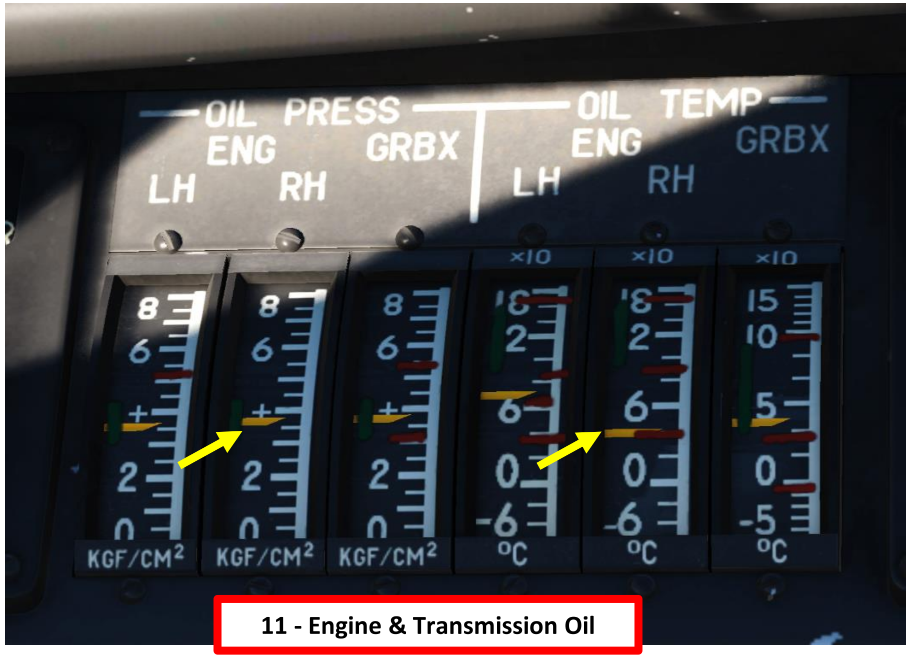


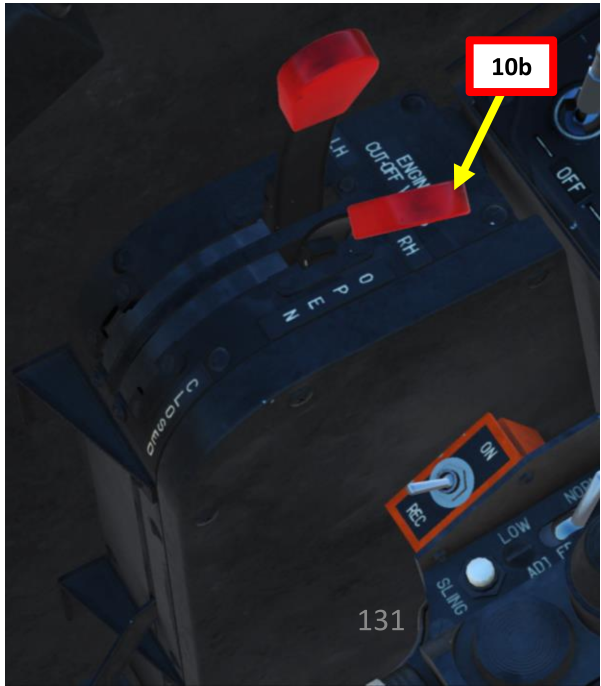


C – ENGINE START

8. When Left Engine’s Gas Generator Speed stabilizes over 60 % RPM, you are ready for right engine start-up. Set Turbo Gear/APU/Left Engine/Right Engine switch to RIGHT engine.
9. Press START button for 2-3 sec to start RIGHT engine. START VLV light indicates the start valve is open.
10. When Right Engine’s Gas Generator Speed reaches 20 % RPM, open RIGHT engine shutoff valve (right red lever UP)
11. Confirm EGT (Exhaust Gas Temperature), engine oil pressure increase. Monitor oil temperature accordingly.
12. Starter will disengage at Gas Generator RPM between 60 and 65%. Monitor this with the START light going off.

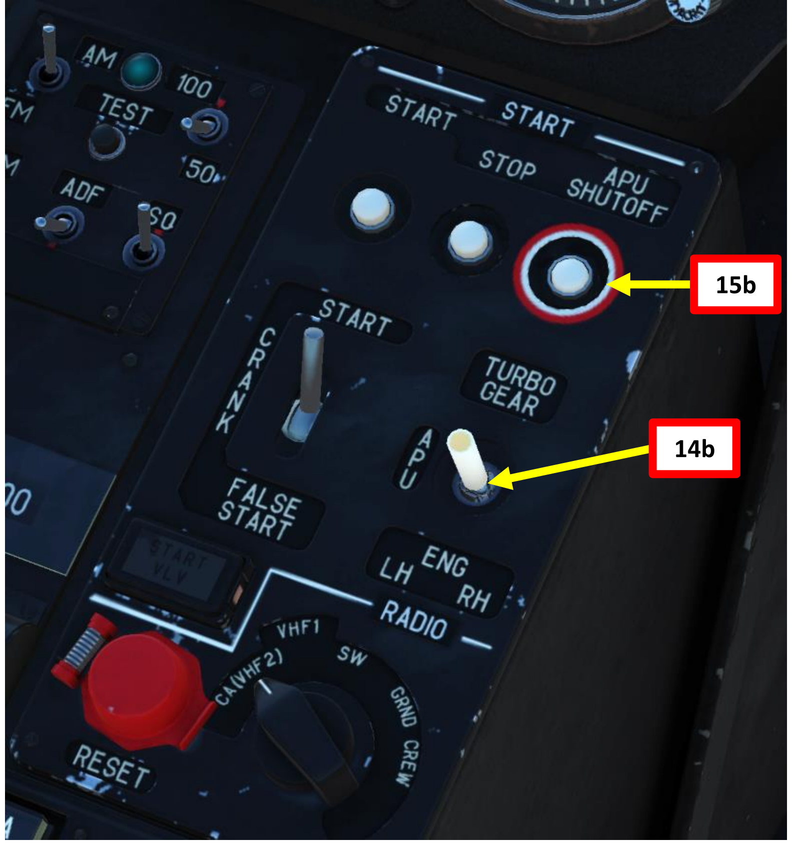


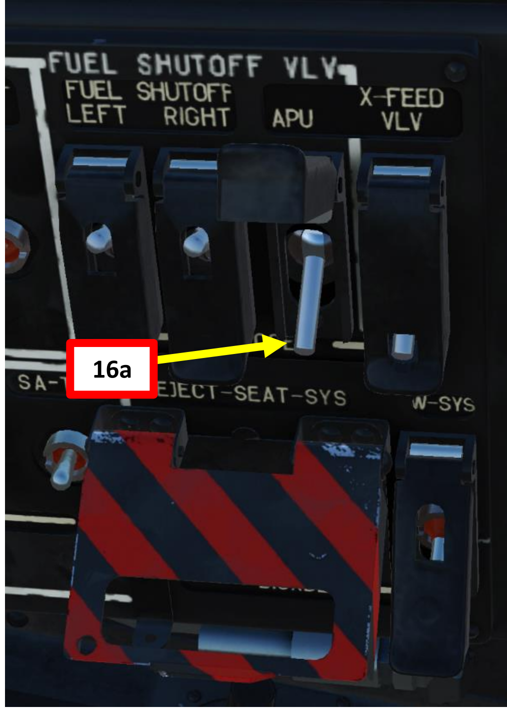




C – ENGINE START

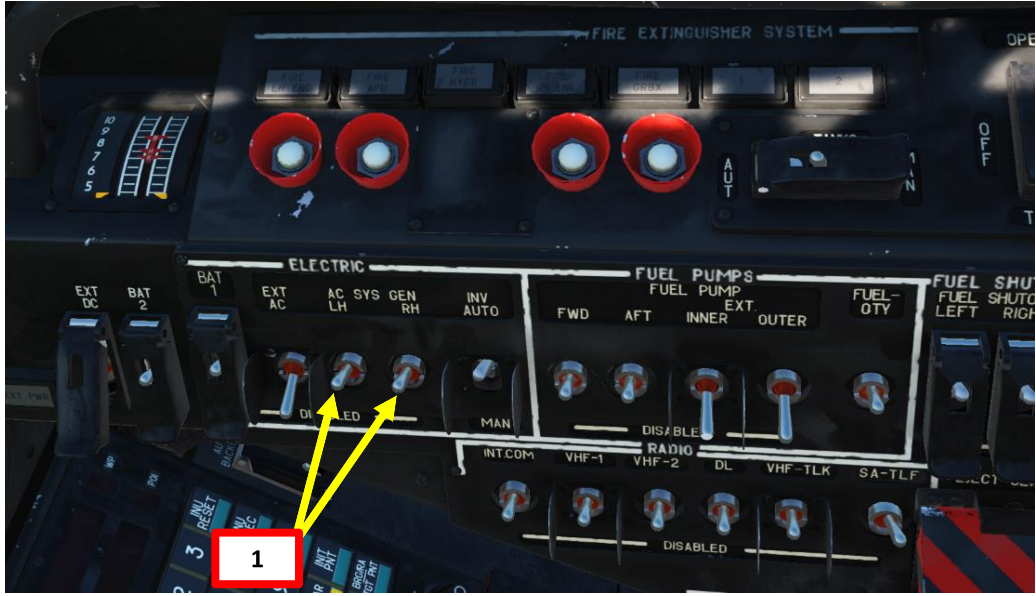
13. Verify that Rotor Speed stabilizes around 95-100 % RPM.
14. When Right Engine's Gas Generator Speed stabilizes over 60 % RPM, set Turbo Gear/APU/Left Engine/Right Engine switch to central position
15. Press APU SHUTOFF button when both engines are at IDLE power or above.
16. Set APU fuel tank shutoff valve – CLOSED (DOWN)
    - Set cover UP, set switch DOWN, then set cover DOWN





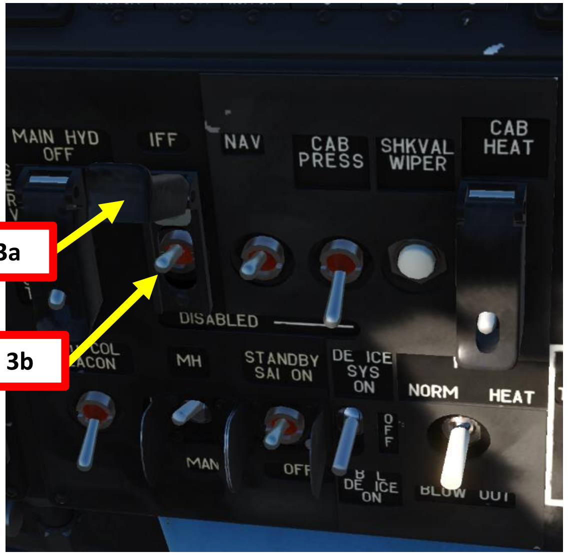
D – AFTER START-UP

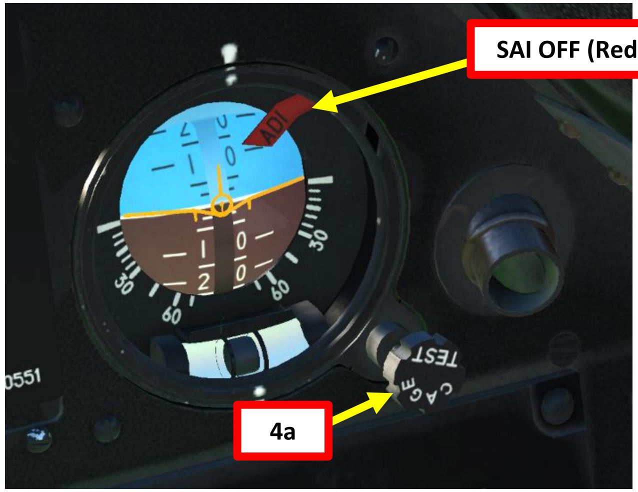
1. Set LEFT and RIGHT AC Generators – ON (UP).
2. If Helmet-Mounted Sight (HMS) display appears and you want to stow it, press "H" toggle it.

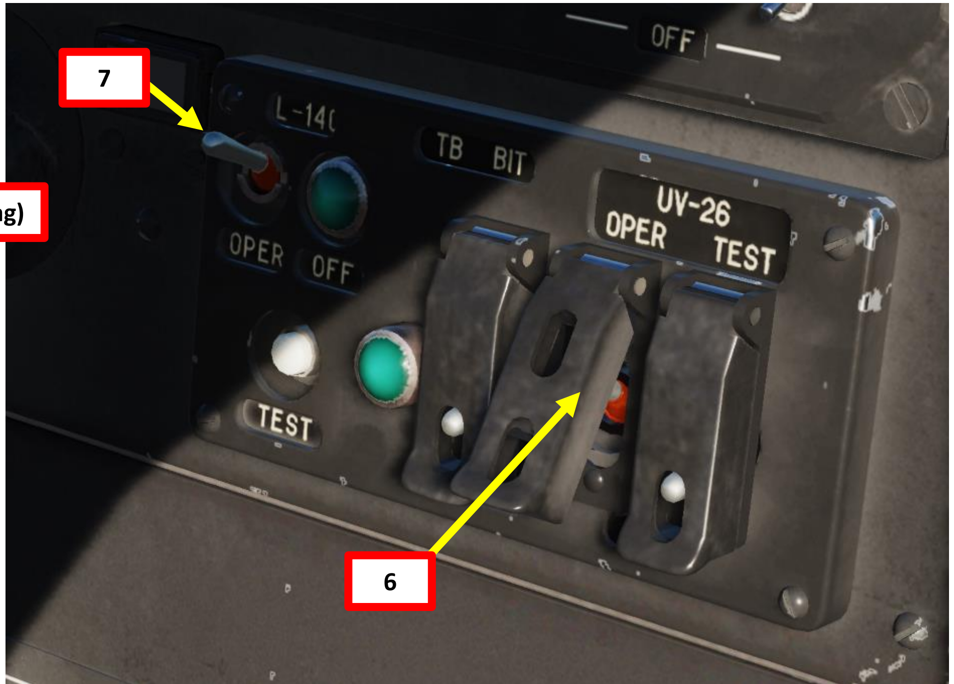


D – AFTER START-UP

3. Set IFF (Identify-Friend-or-Foe) switch – ON (UP)
4. Uncage Standby ADI (Attitude Director Indicator) by scrolling mousewheel on the caging knob.
5. Set Engine Dust Protection system switch – ON (DOWN)
    - Only if required since it decreases available engine power.
6. Set UV-26 Countermeatures power switch – ON (UP)
7. Set L-140 Laser Warning Receiver power switch – ON (UP)

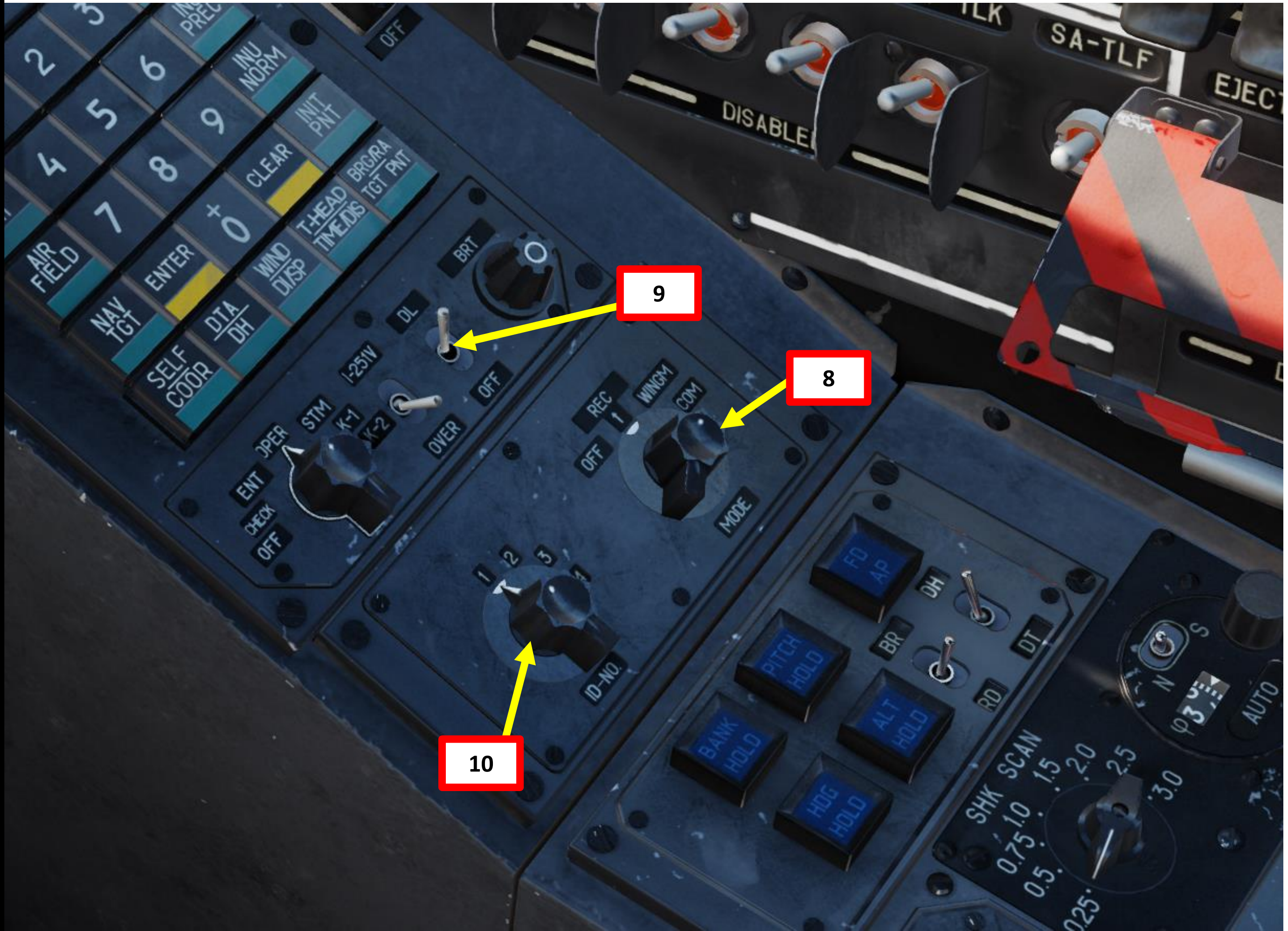


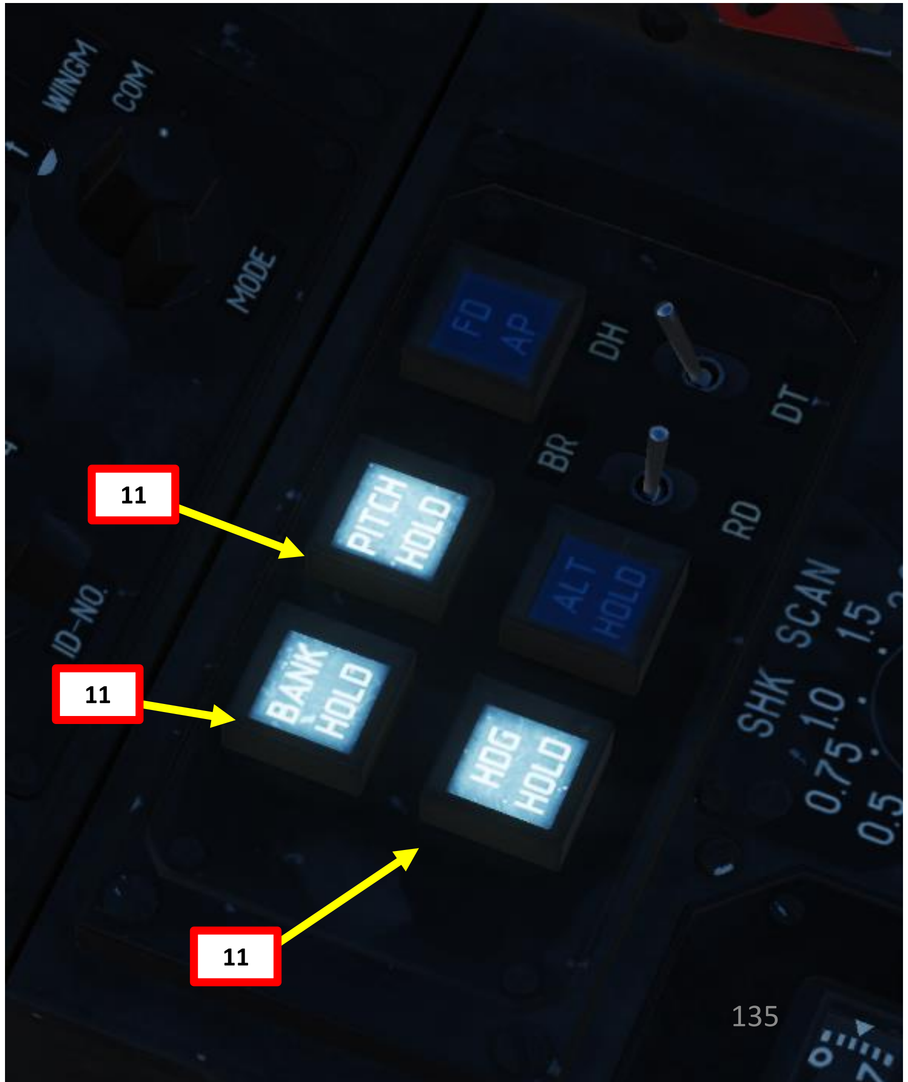




D – AFTER START-UP

8. Set PVI-800 Operating Mode Selector – As Desired (COM)
9. Set Navigation Datalink Power switch to ON (FWD)
10. Set PVI-800 Datalink Identification Number (ID) to 1.
11. Engage BANK (K), PITCH (T) and HDG HOLD/YAW (H) stability augmentator channels.





D – AFTER START-UP

12. Select NAV page on the ABRIS.

D – AFTER START-UP

13. Set Interior and Exterior Light Switches – As desired.

Ka-50 Black Shark III Expansion Only

D – AFTER START-UP

14. Access the ODS (Onboard Defense System) Page on the ABRIS by pressing the button next to NAV/ARC/HSI repeatedly until you access the ODS page.
15. Once the aircraft has been powered up and the generators are online, the power-up sequence of the ODS (Onboard Defense System) starts automatically. Whenever the ODS system is switched on, it must first undergo a 3-minute long built-in test prior to normal operation with the sign "ODS NOT READY" shown in upper-right corner of the ABRIS ODS page.

Ka-50 Black Shark III Expansion Only

D – AFTER START-UP

16. After "ODS NOT READY" message, "MWS NOT READY" (Missile Warning System) is shown during MWS power-up sequence.
17. Once ODS built-in test is complete, the Onboard Defense system goes in "ODS STANDBY" since this is the Onboard Defense System Switch position by default.
18. Pressing the button next to MENU repeatedly until you access the NAV page.

Ka-50 Black Shark III
Expansion Only

D – AFTER START-UP

19. Select countermeasure operation mode with the ODS (Onboard Defense System) switch.
    - ODS ON (ODS Switch UP): Countermeasure system will automatically deploy flares if a missile is heading your way.
    - STANDBY (ODS Switch DOWN): Countermeasure system will not automatically deploy flares if a missile is heading your way.

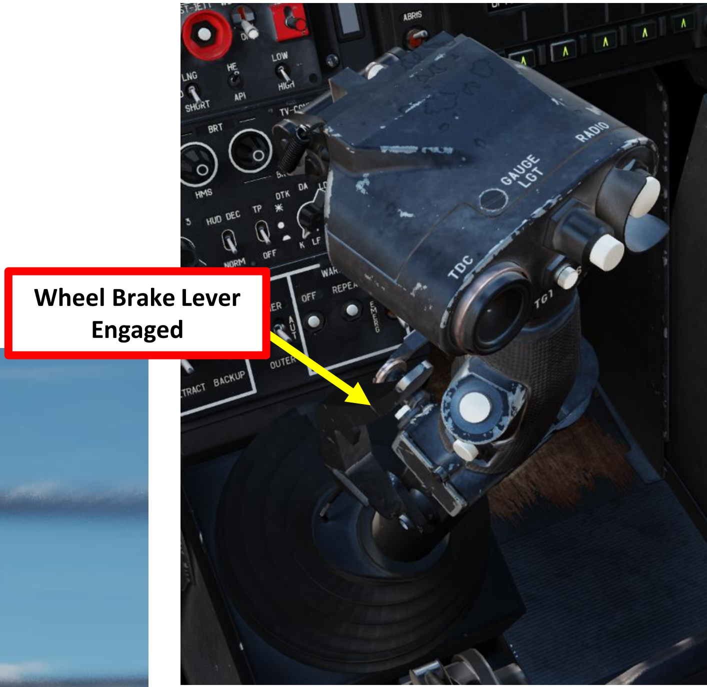

19

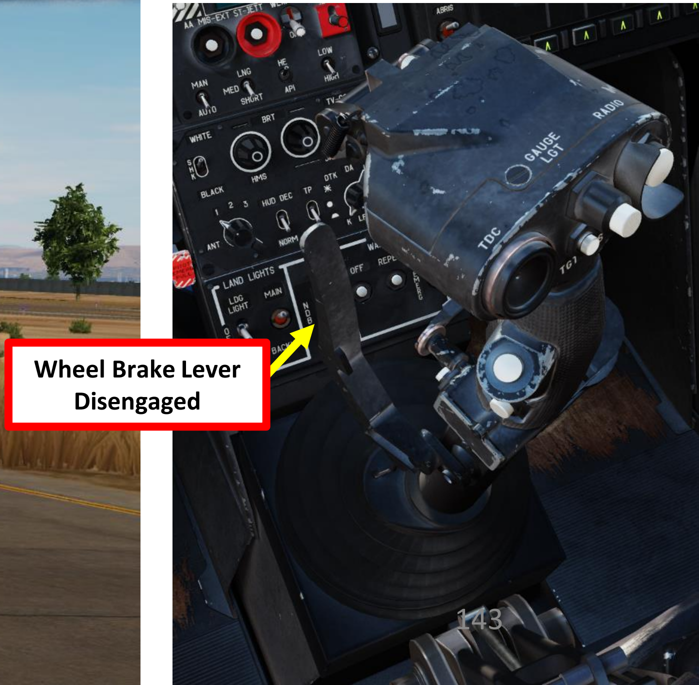
PART 6 – TAXI & TAKEOFF

TAXI

Taxiing in the Ka-50 is very simple:

1. Release parking brake by tapping the Wheel Brake lever.
2. Gently tilt the cyclic forward while increasing the pitch of the main rotors with the collective. The helicopter will start moving forward.
3. Once the aircraft is moving, bring the collective back down.
4. Steer the helicopter on the ground with anti-torque pedals in the direction of turn.
5. Keep taxi speed below 20 km/h with inputs to the cyclic and the wheel brakes.





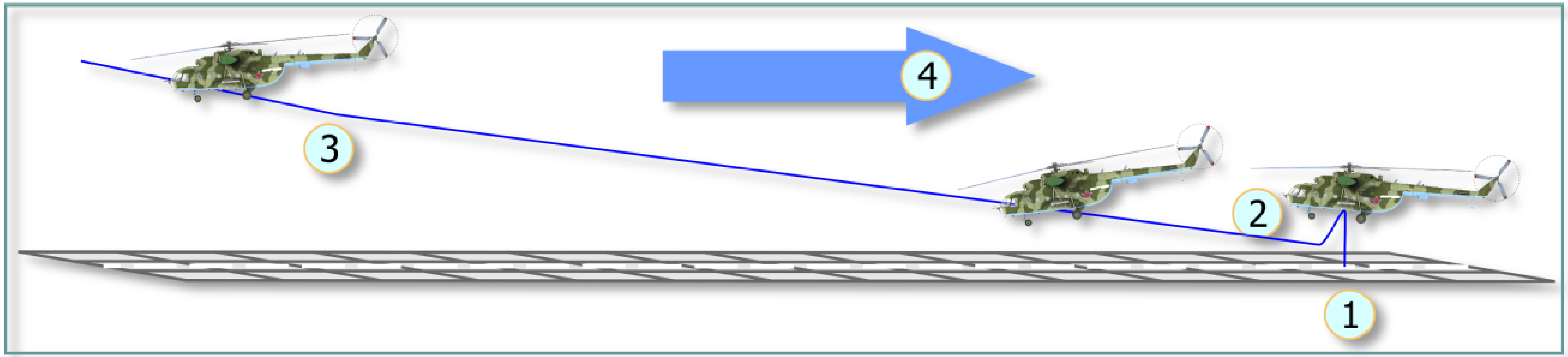
HOW TO HOVER

1. While most single-rotor helicopters require anti-torque pedal input to hover, this isn't the case with the Ka-50 due to its coaxial-rotor configuration. Reactive moments of a coaxial-rotor are compensated for by the counter-rotational forces canceling out each other. This removes the need for any additional forces like a tail rotor. The coaxial-rotors' reactive moments are compensated automatically throughout the flight, thus requiring little input compensation by the pilot.
2. Center anti-torque pedals to stay centered and avoid drifting.
3. Use cyclic to remain straight and level (slightly forward input).
4. Raise collective very gently to initiate a hover.
5. Hold the "TRIMMER" button (on your cyclic) and your stick will remember that "hover" position. Keep in mind that trim works a bit differently from a plane's trimming.
6. Anticipate the rotorcraft's reaction when you trim.
7. Adjust controls "gently" to counter-act wind pushing or turning the aircraft.

TAKEOFF

NOTE: There are many ways to takeoff in a Ka-50. The best way is generally a function of your loadout, weight and mission.

1. Check that all your engine gauges (RPM, pressure & temperature) are within nominal parameters.
2. Check to see if all your flight instruments all set up properly.
3. Once you have performed a hover check and are lined up with the runway centerline, you are ready for takeoff.
4. Settle the helicopter into a 5-10 meters hover by increasing the collective and compensating with the cyclic.
5. Push nose slightly forward to start gaining horizontal speed. No collective input should be required since you are already in a hover state. This is the normal takeoff and the safest procedure. You can also attempt a maximum performance takeoff, which will be more taxing on the rotor blades and can end in tragedy if you are too heavily loaded or the environmental conditions don't allow for it. I recommend using the normal takeoff since you are very unlikely to fly at empty weight. You're better off being safe than sorry.
6. NORMAL TAKEOFF: Keep accelerating and you will start generating more and more translational lift, naturally climbing. Try to maintain an airspeed of 100-120 km/h when climbing. This is basically like a running/rolling takeoff.

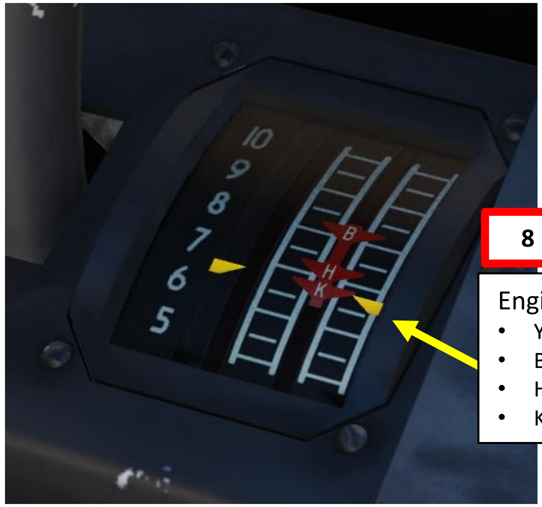


Vertical Takeoff with Acceleration In Ground Effect

TAKEOFF

TAKEOFF

7. Once an airspeed of 70 km/h is reached, at an altitude of at least 15 meters, raise the landing gear.
8. After taking off, lower collective to reduce engine power to cruise setting.
9. Turn off the Dust Protection by setting Engine Dust Protection system switch – OFF (MIDDLE position).



8

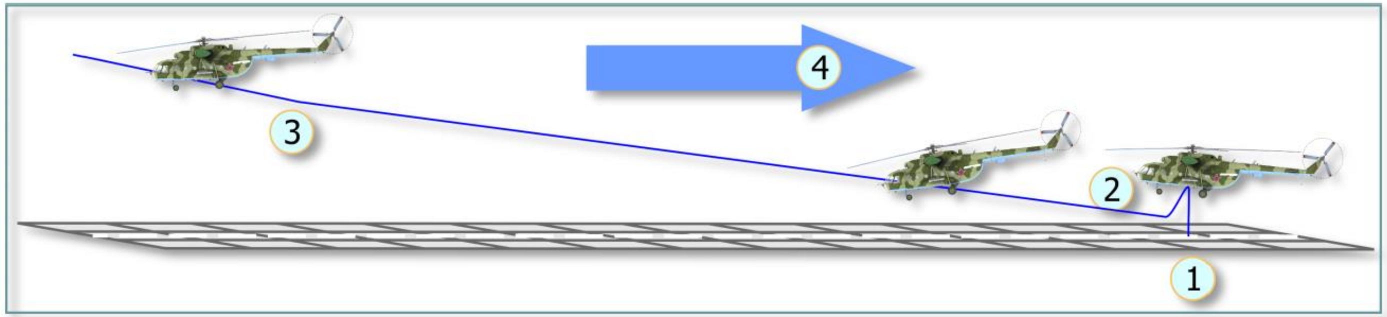
Engine Power Indicator
- Yellow Index: Right/Left current Engine Power
- B Index: Takeoff power reference
- H Index: Max continuous power reference
- K Index: Cruise power reference

9

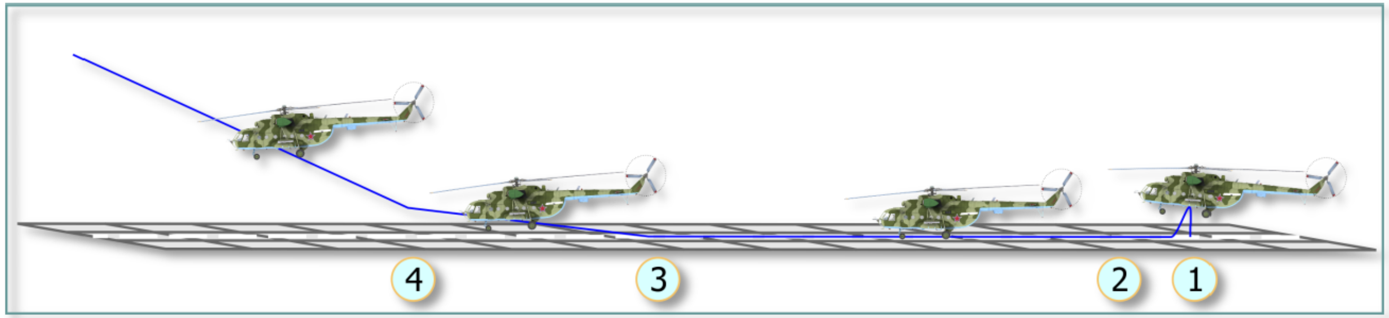
7a
Landing Gear Extended

7b
Landing Gear In Transition

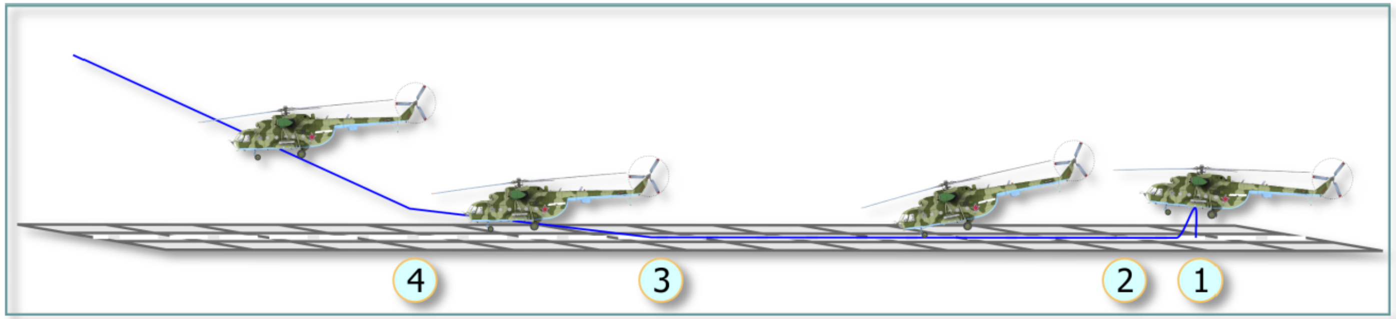
7c
Landing Gear Retracted



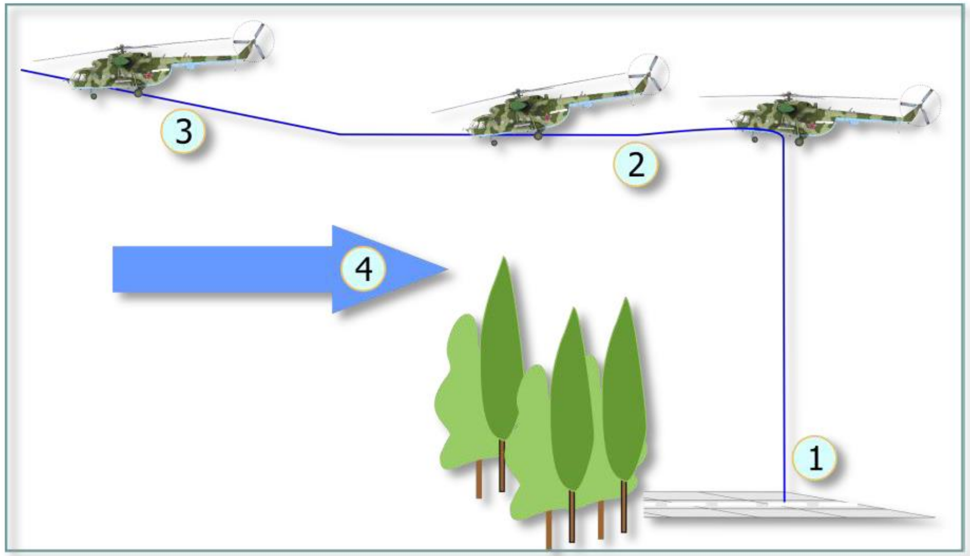
Vertical Takeoff with Acceleration In Ground Effect



Running Takeoff



Running Nose Gear Takeoff



Vertical Takeoff with Acceleration Out of Ground Effect

PART 7 – LANDING

VISUAL LANDING

NOTE: When you think about it, a helicopter is usually landed like an aircraft: you maintain a descent rate, reach a touchdown point and pull back on your cyclic to bleed speed and come to a full stop. There are many different types of approaches. Your approach and landing type will depend on the type of LZ (landing zone) and the type of mission you are doing.

1. Start descent from 400 m. Fly towards a reference point on the runway. Pay particular attention to the Vortex Ring State (state in which the helicopter is settling in its own downwash and gets sucked down, which is caused by a flight profile of forward flight less than ETL (Effective Translational Lift, helicopter is slower than 70 km/h), rate of descent of 300ft/min or more and at least 20% power applied). VRS is further explained in the "Principles of Helicopter Flight" section.
2. Maintain 100-120 km/h for a descent rate between 3 and 5 m/s
3. Deploy Landing Gear and turn on the Dust Protection switch.
4. You should reach your reference point in a 10 m hover. Use your cyclic to come to a full stop, and raise your collective to "cushion" the sudden drop caused by the loss of translational lift (which is caused by the loss of airspeed).
5. Once you have come to a full stop in a 10 m hover, deploy landing gear and **then** you can slowly reduce collective to safely land on the ground.

NOTE: It takes a lot of practice to be able to counter the different flight states you will go through when coming for an approach and landing. This is why performing hover power checks before takeoff is very useful: it helps you master the hover state.

Good tutorial on landing by Teach Yourself DCS:
https://www.youtube.com/watch?v=YDZQgCdYh4Y&index=3&list=PLpWui61PBlo2_RfPRrWVQk1jtIlBSE-FO

VISUAL LANDING

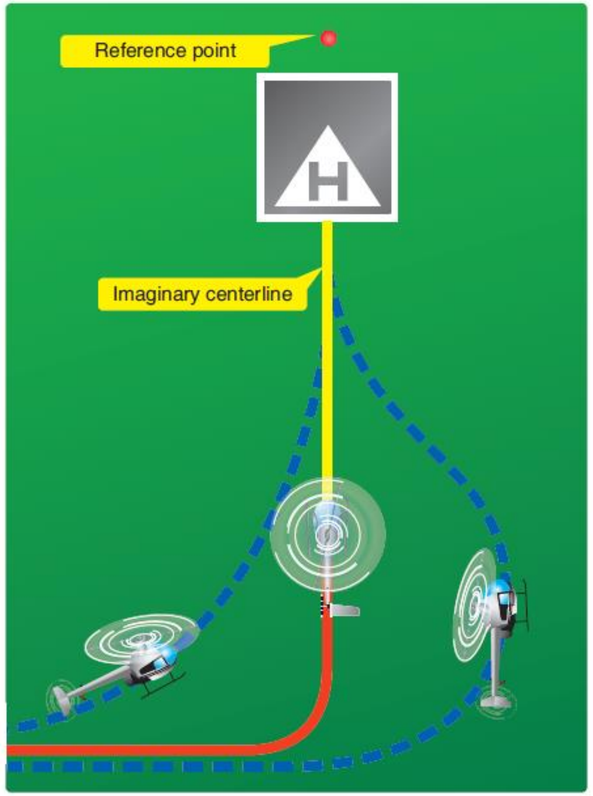
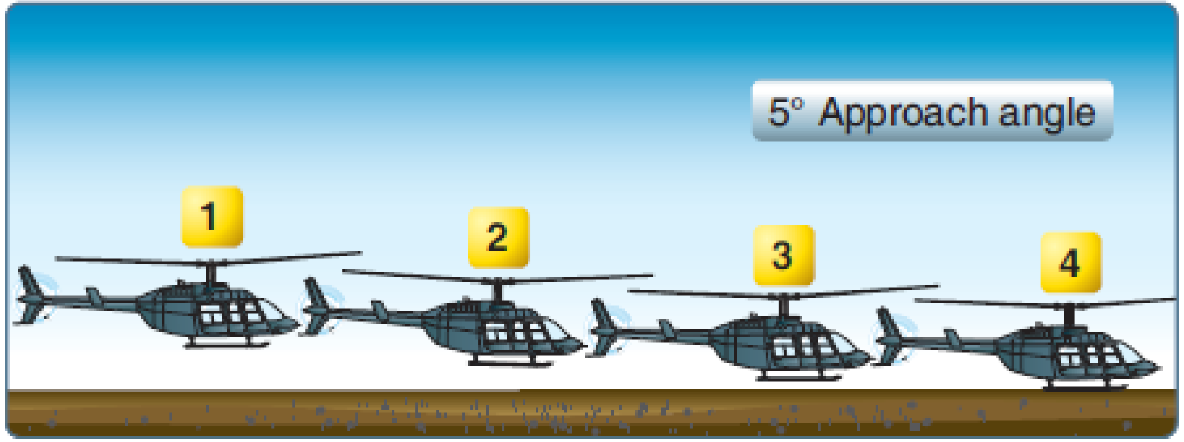
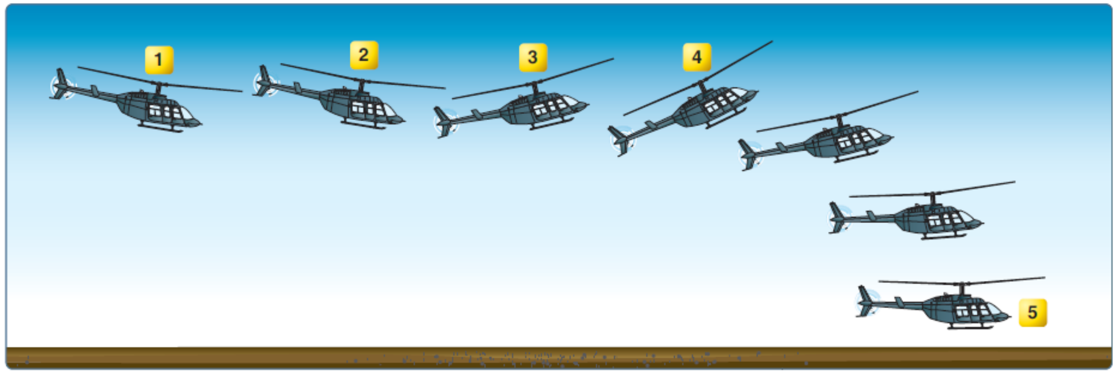


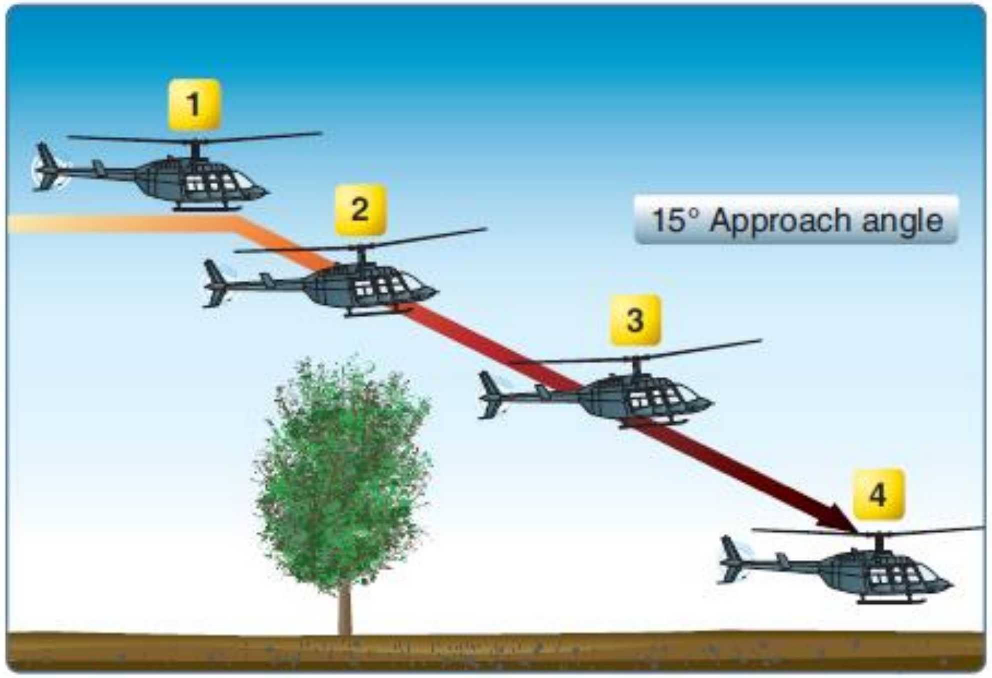
Figure 9-20. *Plan the turn to final so the helicopter rolls out on an imaginary extension of the centerline for the final approach path. This path should neither angle to the landing area, as shown by the helicopter on the left, nor require an S-turn, as shown by the helicopter on the right.*



Shallow Approach & Running Landing

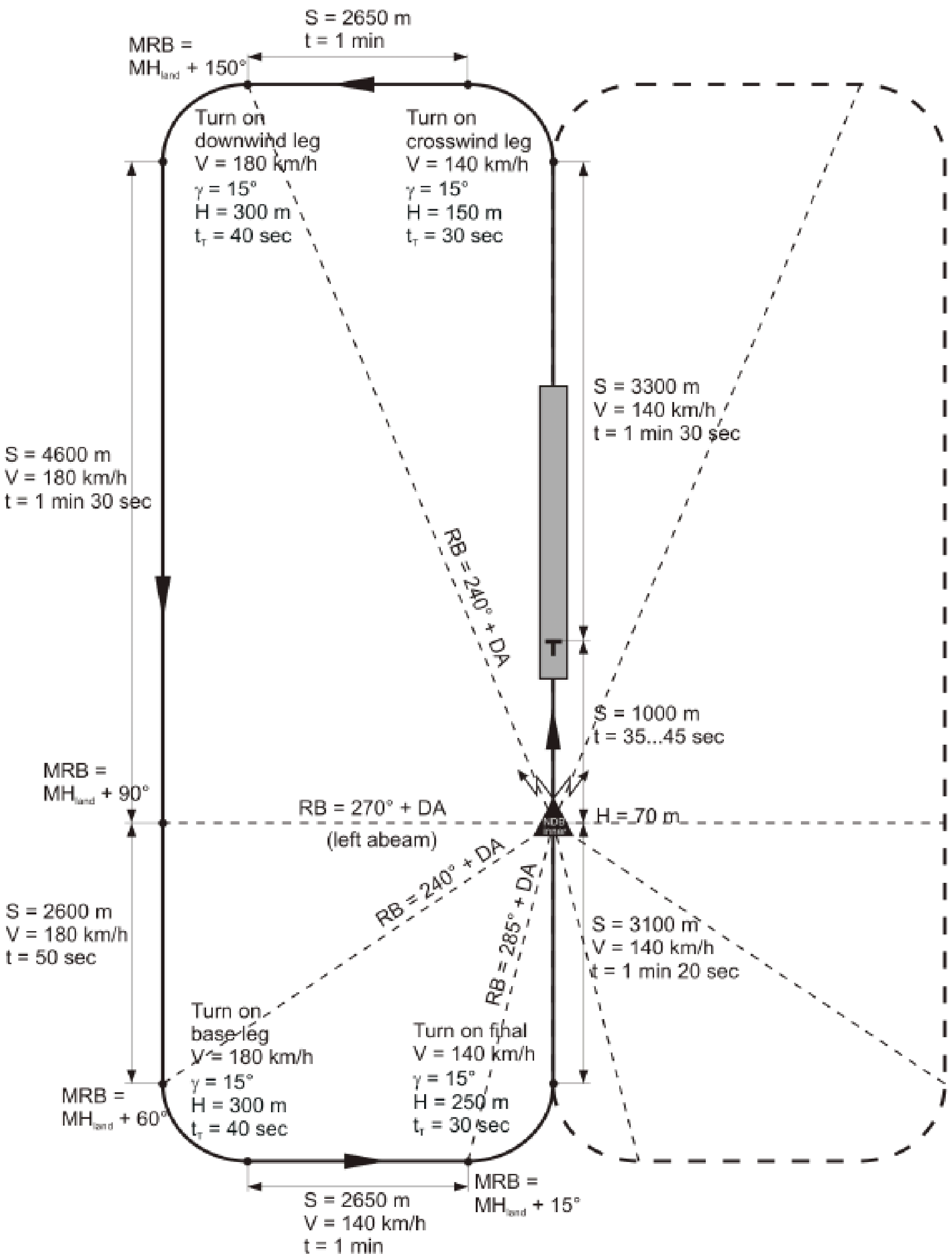


Rapid Deceleration or a Quick Stop

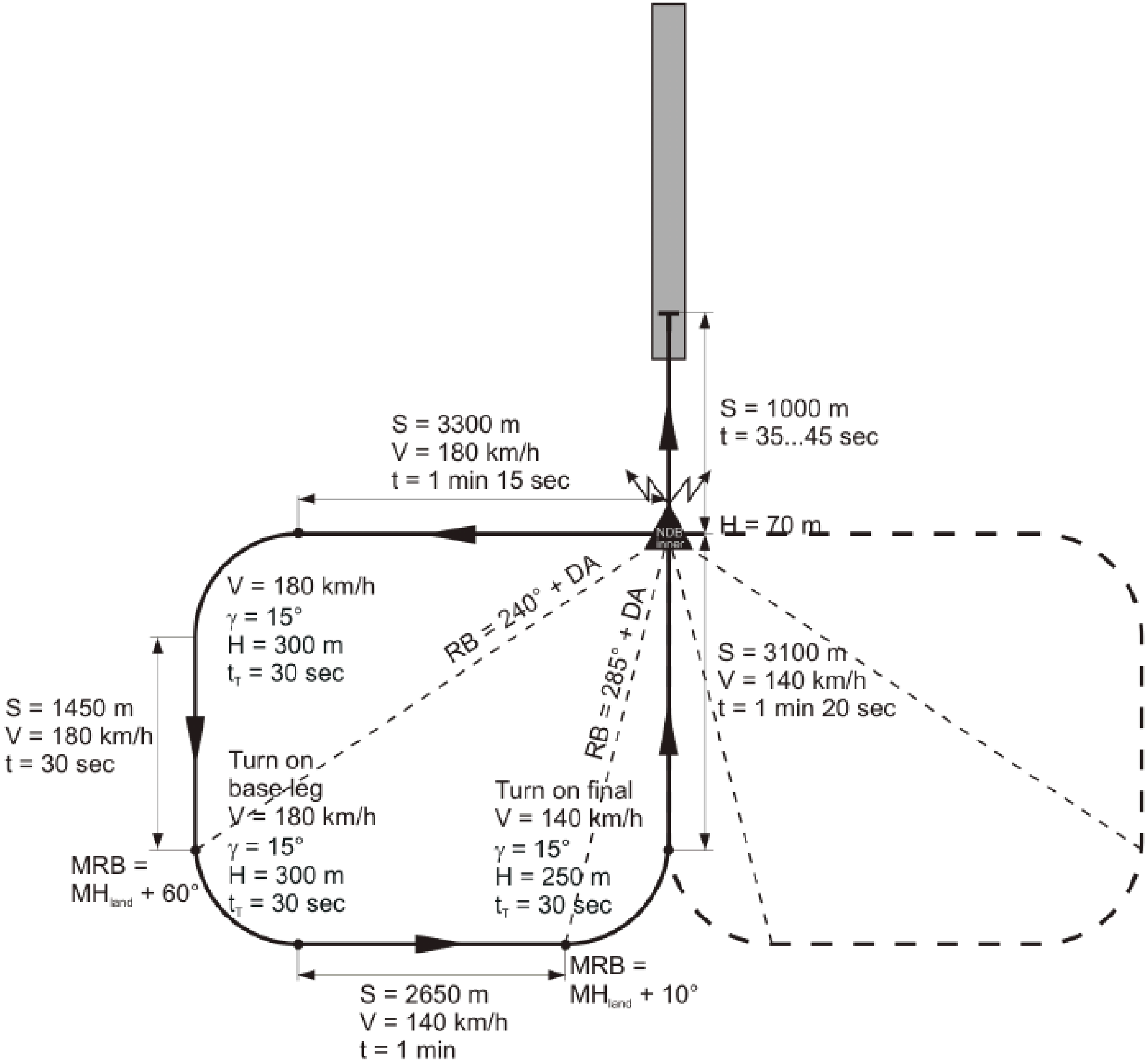


Steep Approach to a Hover

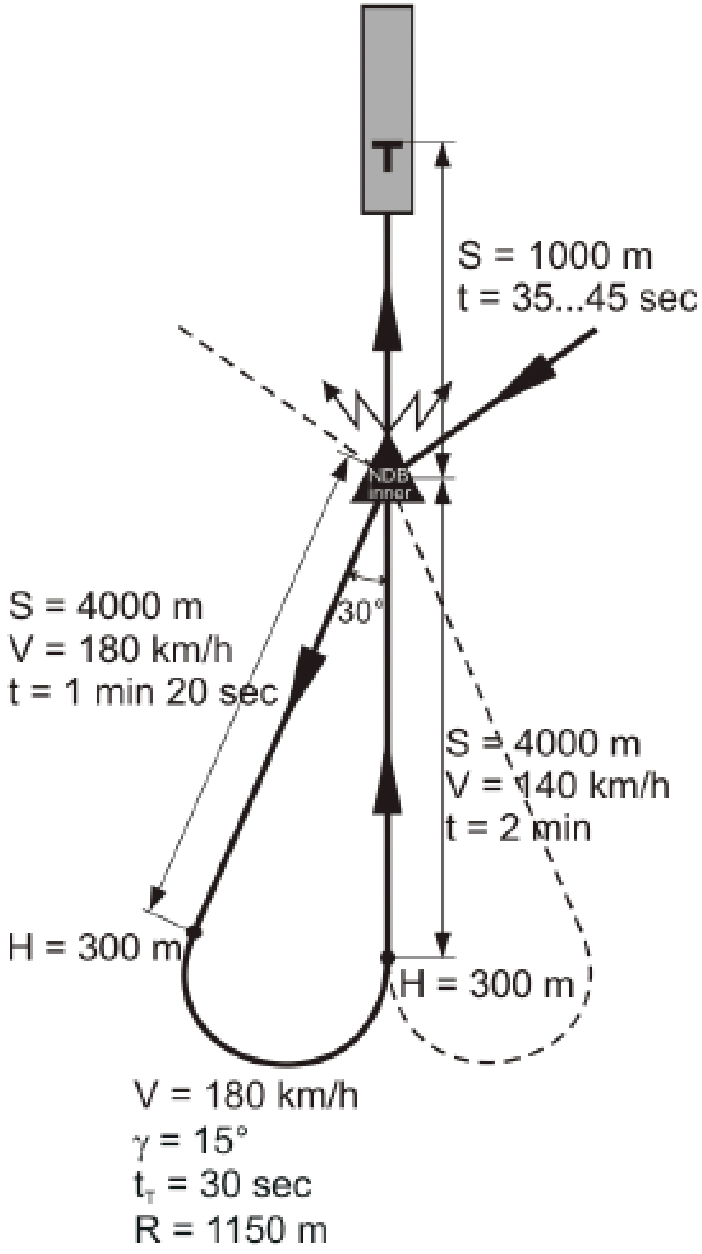
Left-hand Pattern Approach (Large)



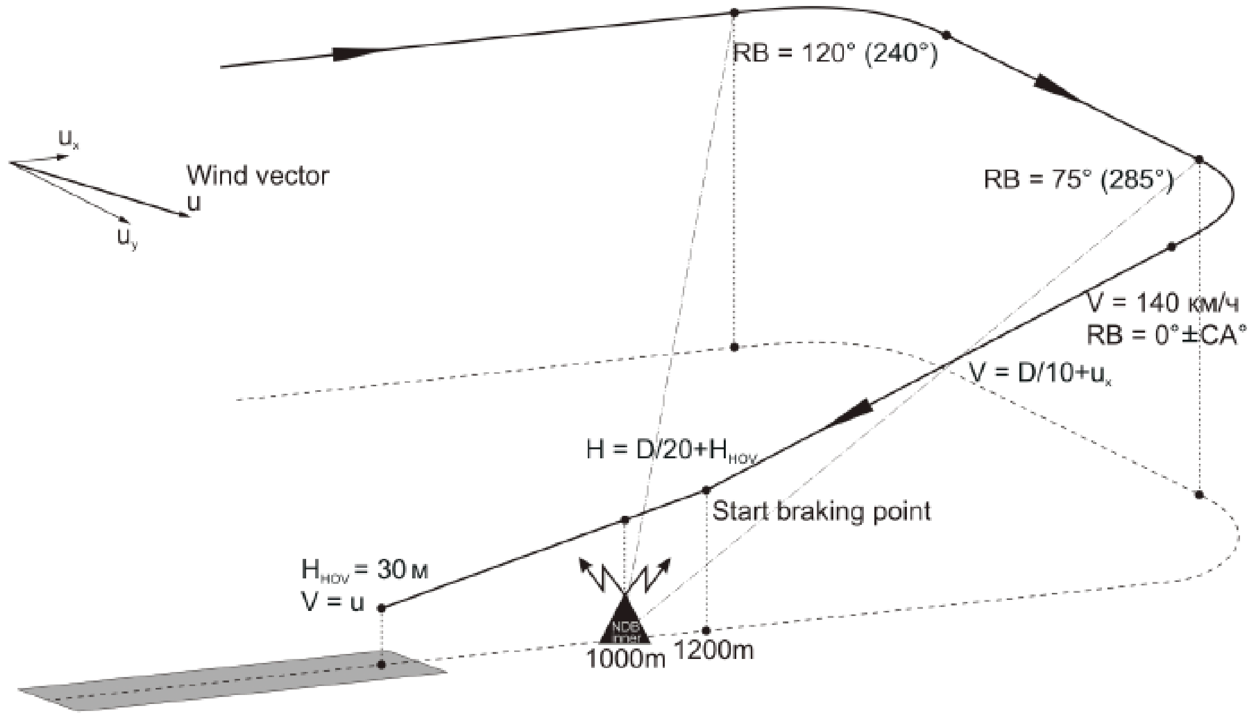
Left-hand Small Pattern Approach



Straight In Approach using Teardrop Procedure Turn



Instrument NDB (Non-Directional Beacon) Approach



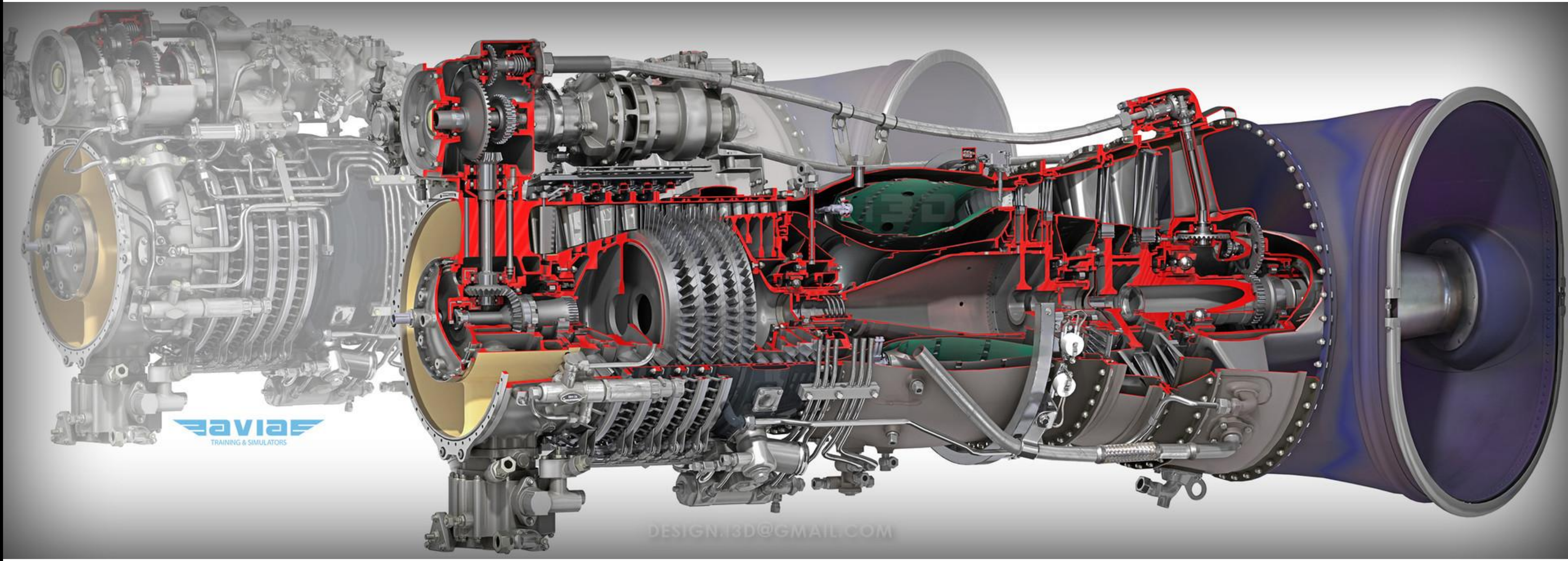
SECTION STRUCTURE

1 – POWERPLANT
1.1 – Klimov TV3-117VMA Turboshaft Engines

The Ka-50 helicopter powerplant consists of two Klimov TV3-117VMA free-turbine turboshaft engines, assisted with the AI-9V APU (Auxiliary Power Unit).

1 – POWERPLANT
1.1 – Klimov TV3-117VMA Turboshaft Engines

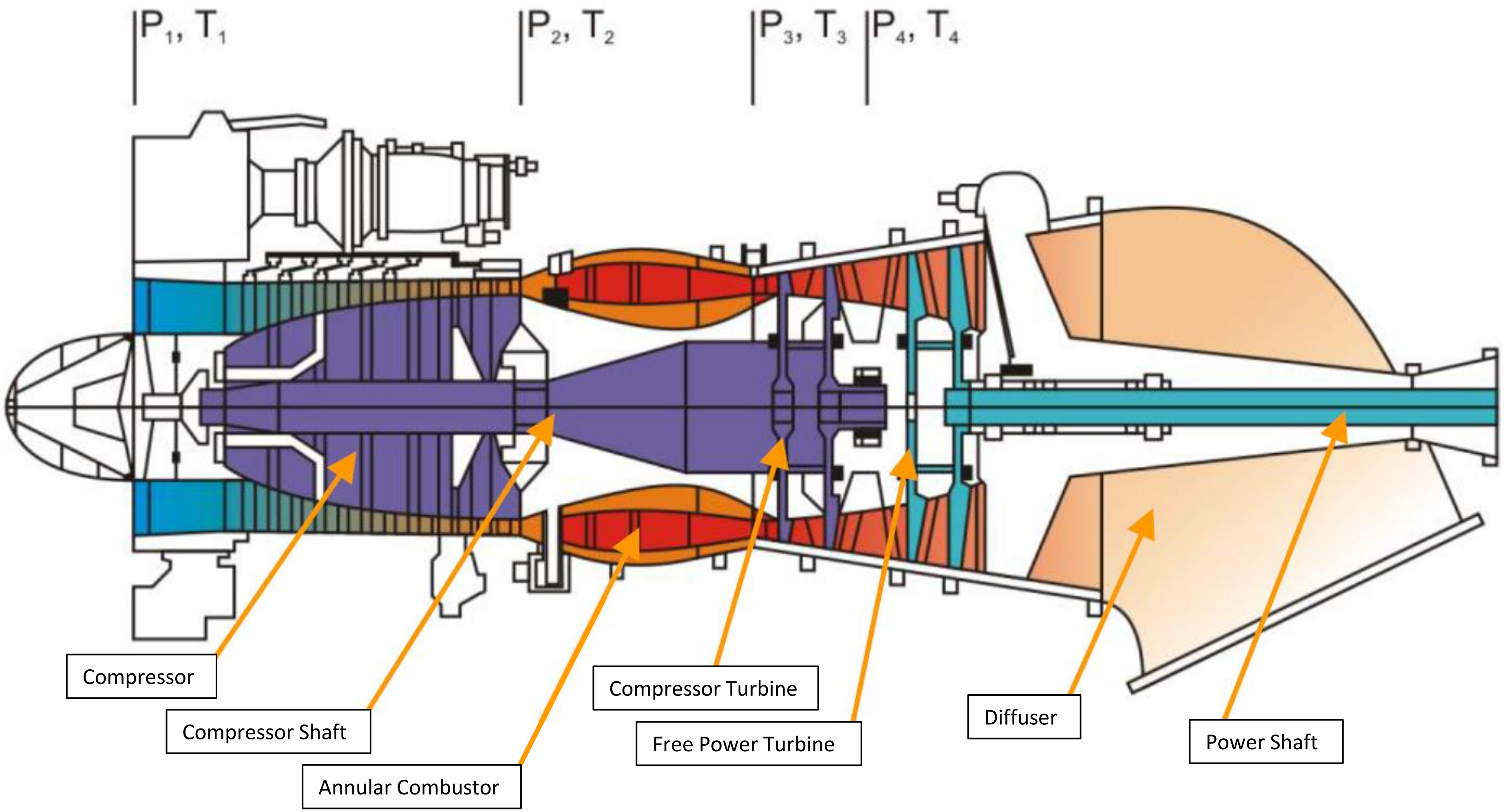
The "VMA" in TV3-117**VMA** stands for "high altitude, modernized“. It was initially designed for the Mi-28 helicopter, and later installed also on Mi-8MT/Mi-17 and Mi-24 models. This engine features an automatic switch to emergency power.



1 – POWERPLANT

1.1 – Klimov TV3-117VMA Turboshaft Engines

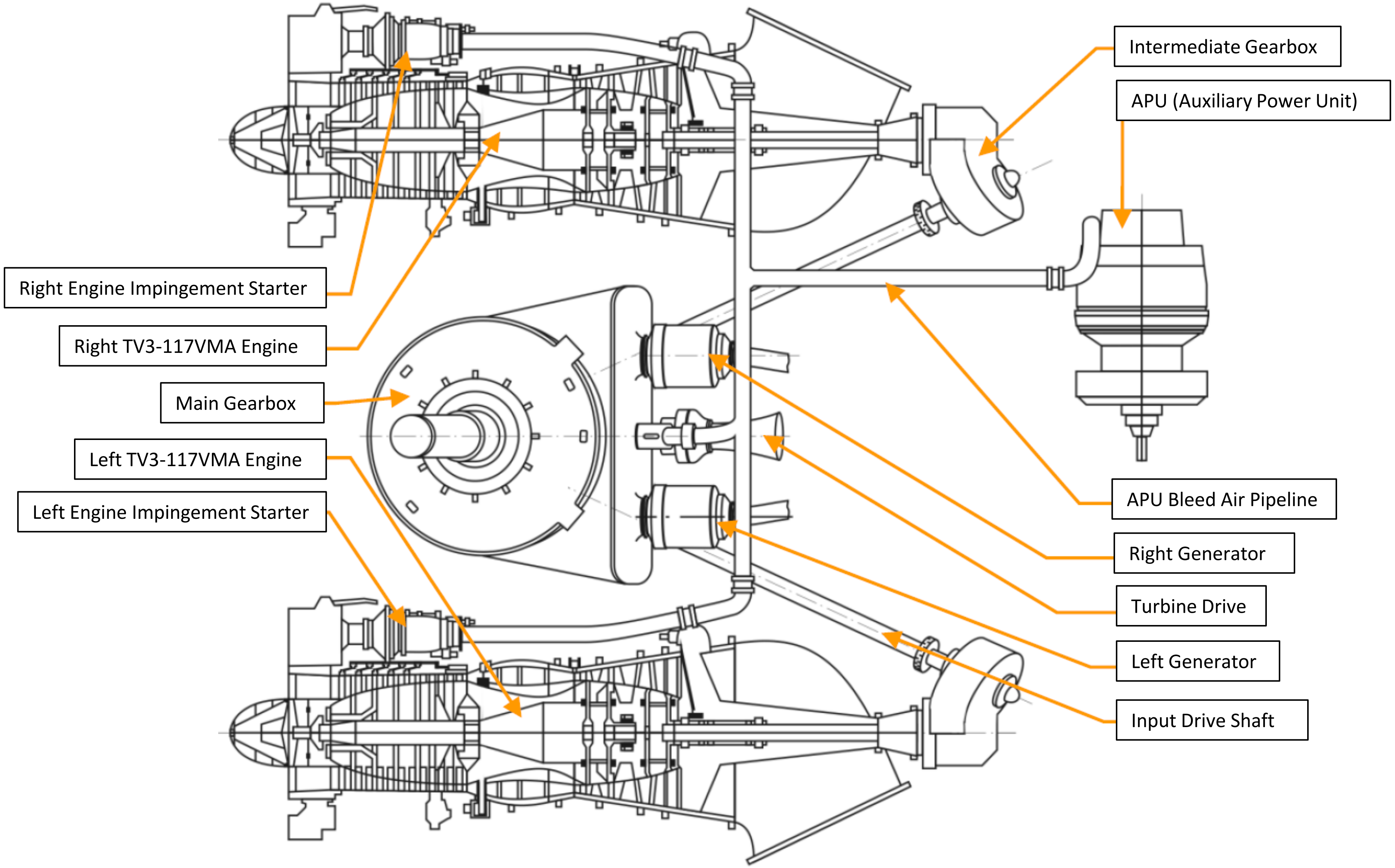
TV3-117VMA Turboshaft Engine



1 – POWERPLANT

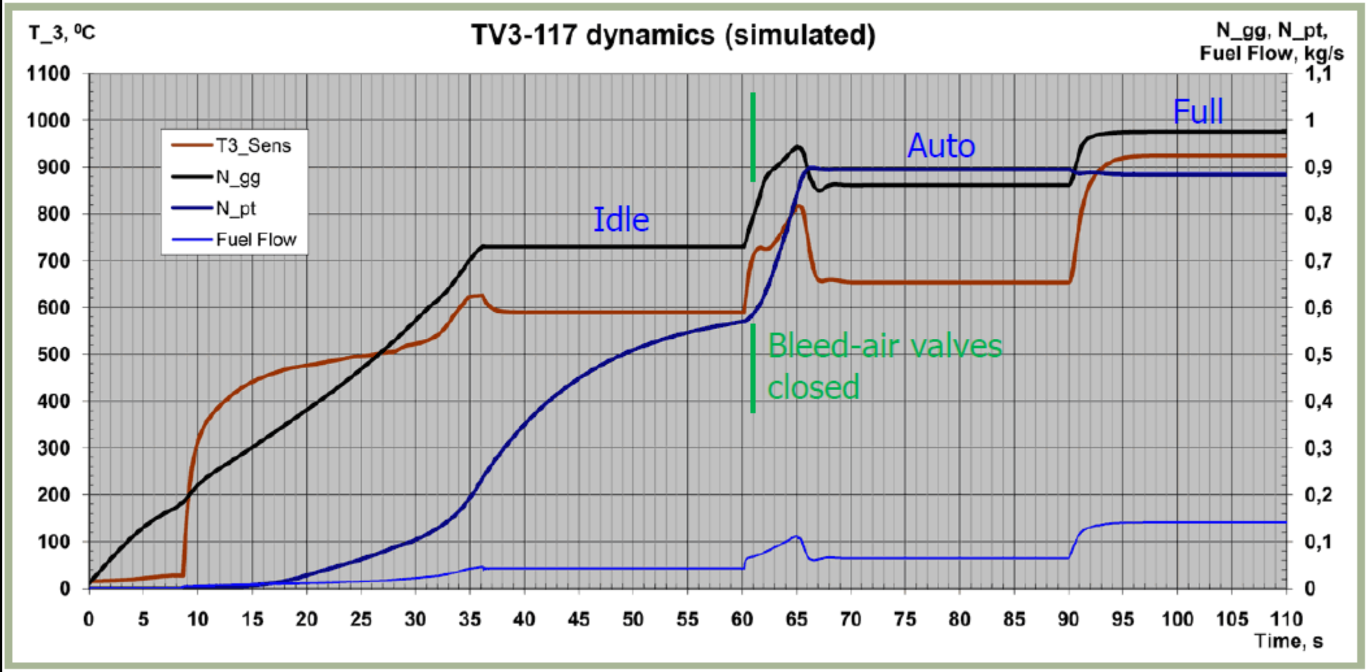
1.1 – Klimov TV3-117VMA Turboshaft Engines

Engine and Power Train

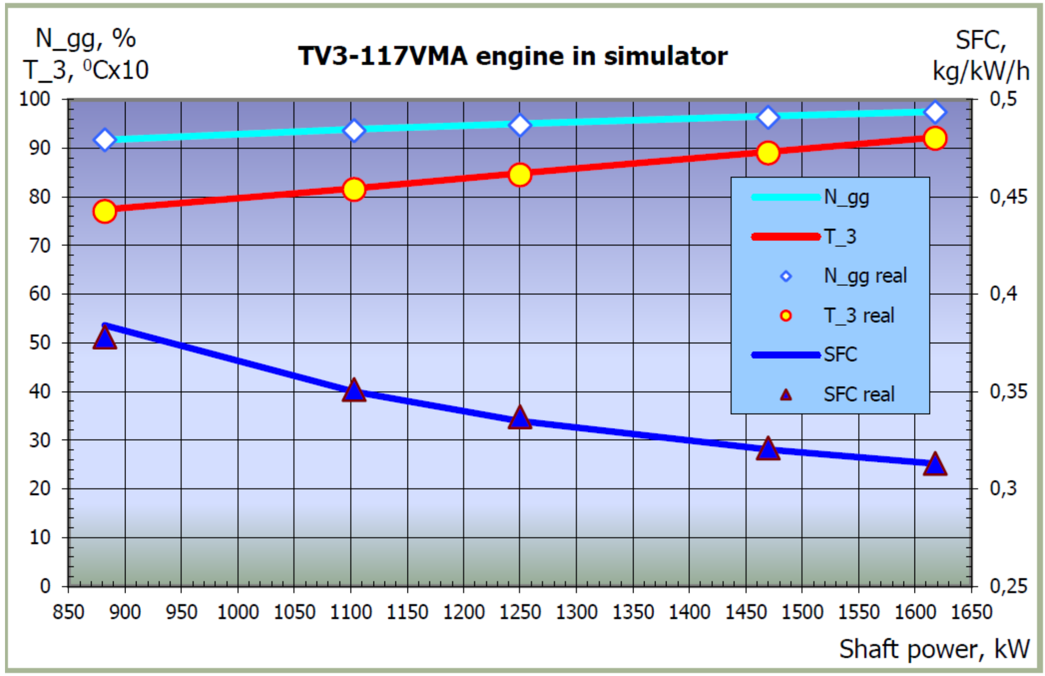


1 – POWERPLANT
1.1 – Klimov TV3-117VMA Turboshaft Engines

TV3-117VMA Engine Dynamics



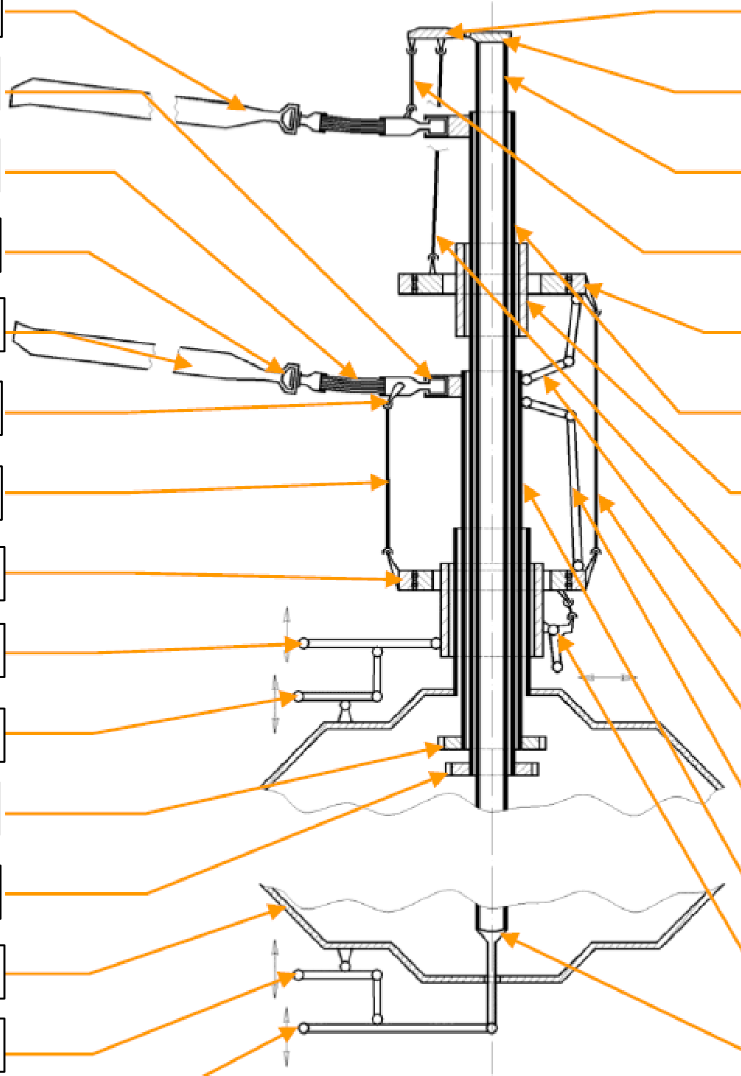
TV3-117VMA Engine Model Diagram



Graph Legend
- N_gg – RPM gas generator (compressor) model
- N_gg real – RPM gas generator (compressor) of real engine
- T_3 – Turbine entry temperature model
- T_3 real – Turbine entry temperature of real engine
- SFC – Specific Fuel Consumption model
- SFC real – Specific Fuel Consumption of real engine
- N_pt – RPM power turbine model

1 – POWERPLANT

1.1 – Klimov TV3-117VMA Turboshaft Engines



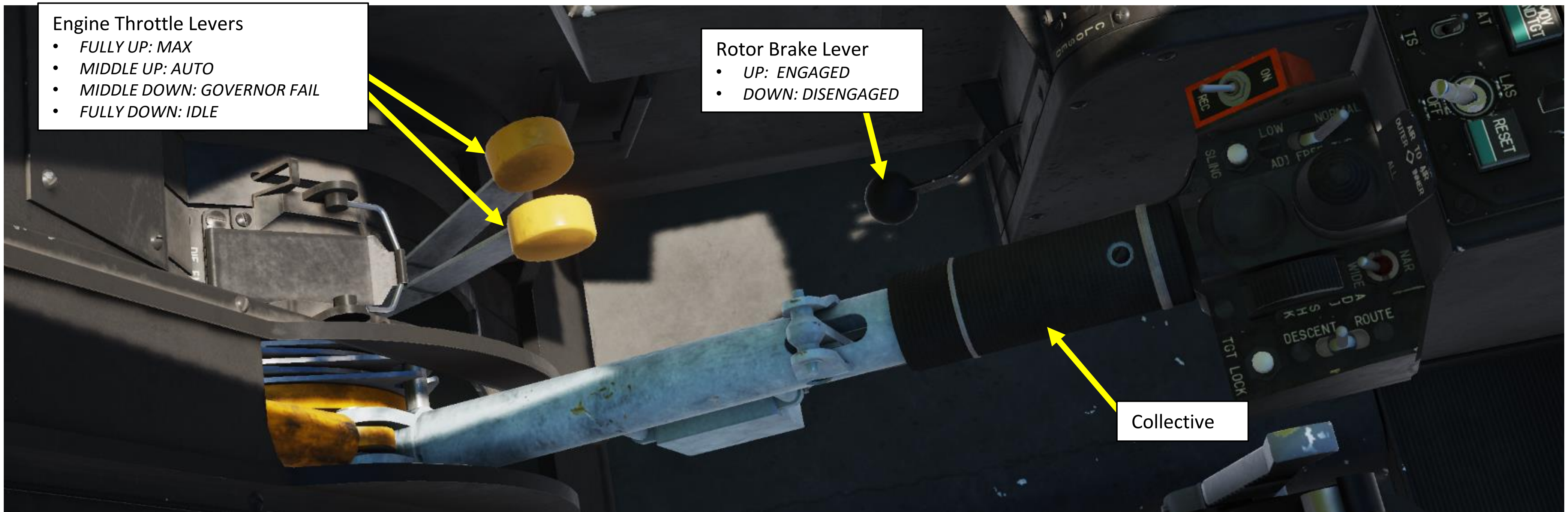
1 – POWERPLANT
1.2 – Engine Controls

Engine control is mostly automated and the pilot typically adjusts power settings with the **collective**.

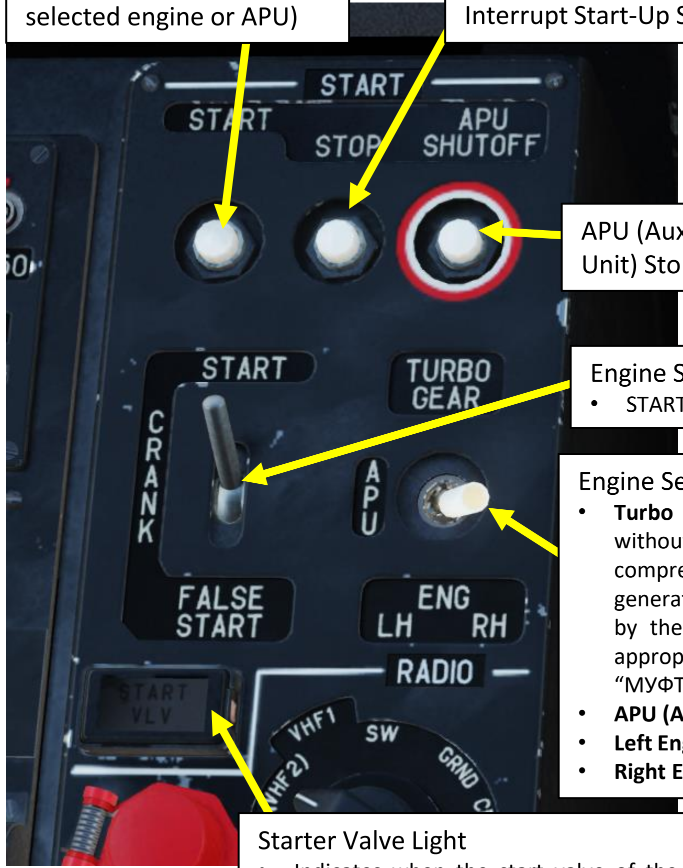
Engine Throttle Levers are generally left to AUTO (Automatic) during general flight, but they can be used during emergency situations.
- **At IDLE** mode are usually performed startup procedures and most of the systems functional tests.
- **GOVERNOR FAIL** is needed in case of failure of power turbine's RPM governor to avoid engine (power turbine) overspeed.
- **AUTO** is the main mode during normal operation of the powerplant. All flights must be performed at this mode, except for specific emergencies.
- **MAX** mode is intended to ensure maximum power of one engine in case of failure of the other engine.

The **Rotor RPM Governor Control switch** on the collective is a control selector for re-adjustment of the free-turbine (rotors) RPM governor in case of abnormal engine behavior.

If one engine fails when the engines are operating at power settings above flight idle, as long as the collective pitch remains unchanged, the droop compensator will engage and automatically bring the operating engine to MAX (or Emergency) Power Setting to maintain the main rotor RPM.



1 – POWERPLANT
1.2 – Engine Controls



Start-Up Button (for selected engine or APU)

Interrupt Start-Up Sequence Button

Engine EGT (Exhaust Gas Temperature) Test STOP Button

Engine EGT (Exhaust Gas Temperature) Test RUN Button

APU (Auxiliary Power Unit) Stop Button

Engine Start Mode
- START / CRANK / FALSE START

Engine Selector
- **Turbo Gear**: Turbo gear allows the testing of helicopter subsystems without the need to have the engines running. This gear operates from compressed air that is supplied by APU power and it powers the AC generator and hydraulics pump. On the real Ka-50, turbo gear is activated by the ground crew ("Request Turbo Gear" command) by setting the appropriate controls on the helicopter's main gearbox. This in turn displays "МУФТА ОТКЛ" in the cockpit and disables engine start.
- **APU (Auxiliary Power Unit)**
- **Left Engine**
- **Right Engine**

Starter Valve Light
- Indicates when the start valve of the engine's air-starter is open, during main engine startup cycle. The light goes off when the start valve closes, either automatically at 60 % Gas Generator RPM or manually after pressing the interrupt startup sequence button.

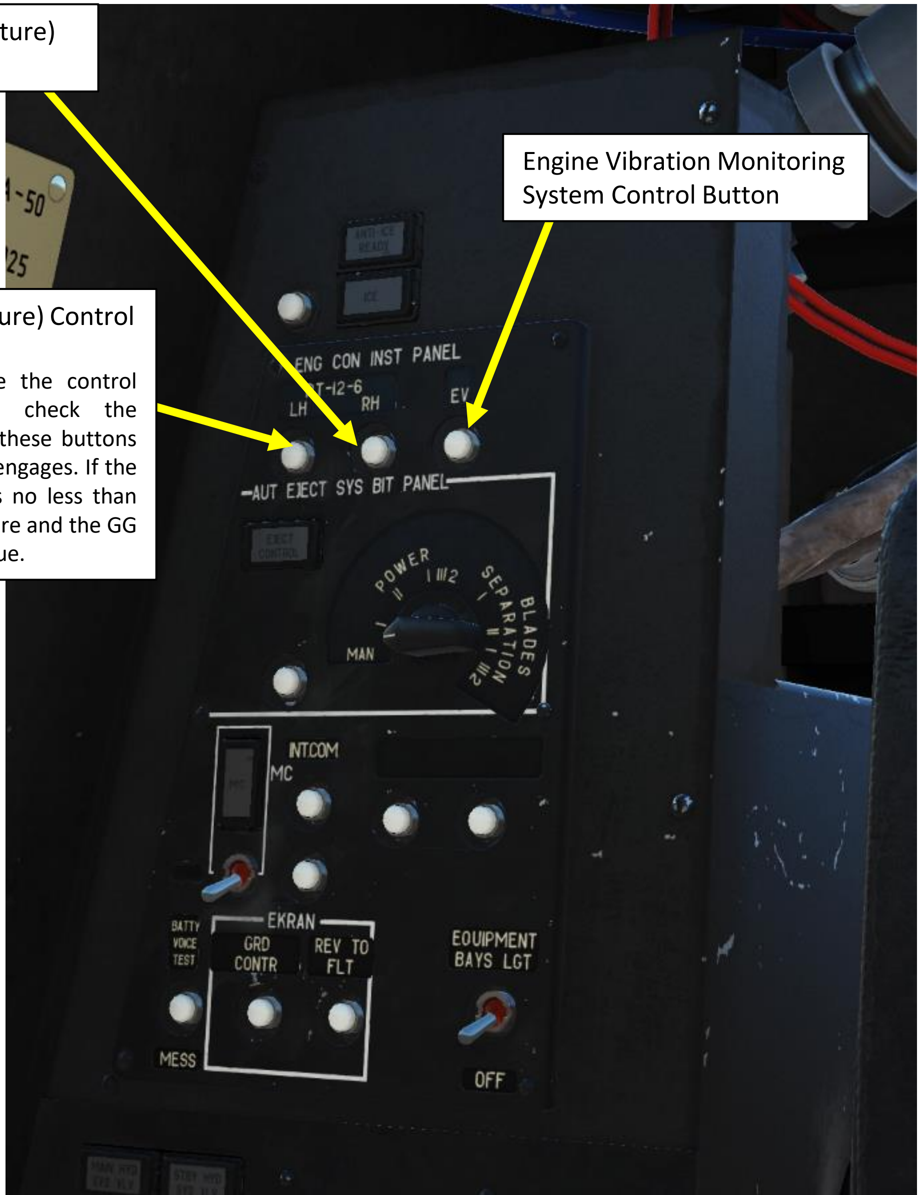
1 – POWERPLANT
1.2 – Engine Controls

Right PT-12-6 EGT (Exhaust Gas Temperature) Control Threshold Governor Button

Engine Vibration Monitoring System Control Button

Left PT-12-6 EGT (Exhaust Gas Temperature) Control Threshold Governor Button

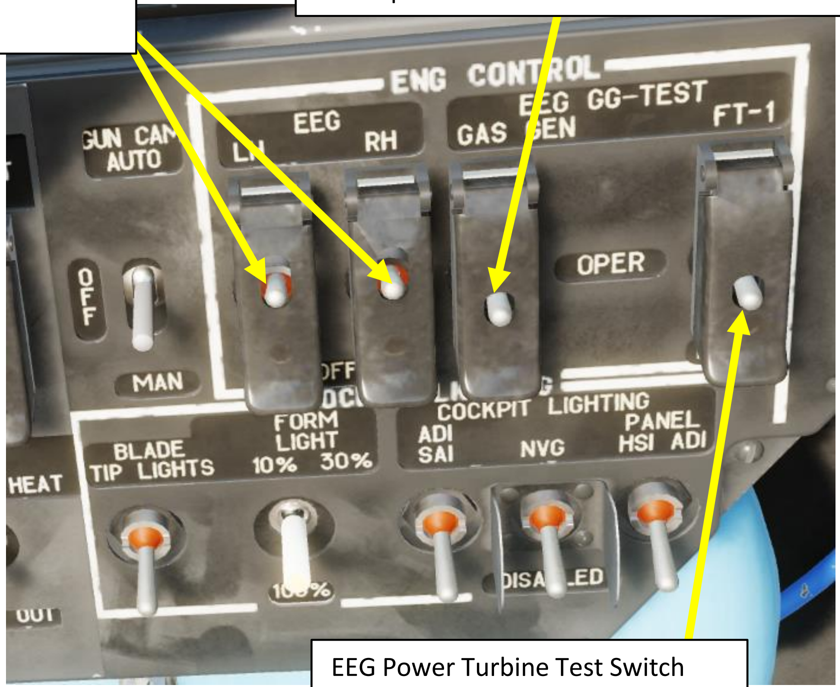
- Left and Right PT-12-6 buttons decrease the control threshold of the EGT governors to check the serviceability of the EEG. When either of these buttons are pressed, the GG contour of the EEG disengages. If the EGT is no less than 850°C and GG RPM is no less than 87%, then the EGT decreases by 30°C or more and the GG RPM decreases to 84% of the maximum value.



EEG (Electronic Engine Governor) Left/Right Engine

- UP = ON

EEG (Electronic Engine Governor) Gas Generator Test-Operate Switch



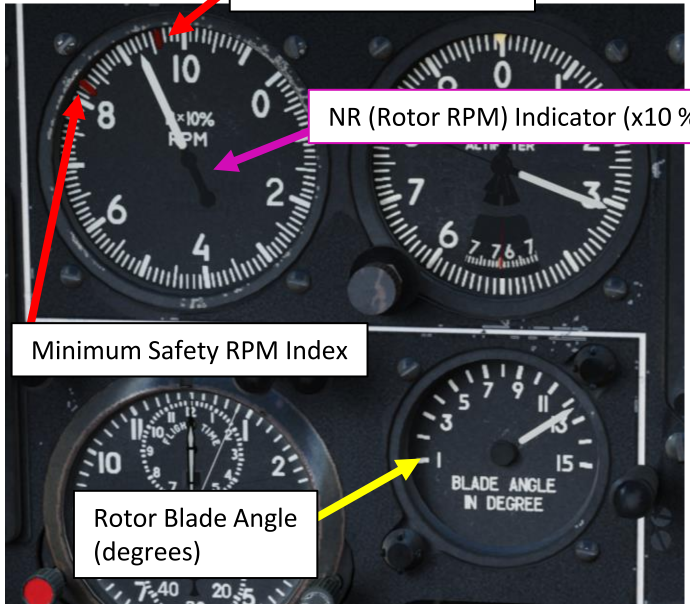
EEG Power Turbine Test Switch

- PT1: Power Turbine Channel 1
- PT2: Power Turbine Channel 2

1 – POWERPLANT
1.3 – Engine Indications

The four engine indications you should keep an eye on at all times are:

- **NGG** (Gas Generator Turbine Speed) – Engine tachometer used to monitor health and power setting of the engine
- **NR** (Rotor Speed) – used to monitor rotor overspeed or underspeed
- **Engine Power Indicator** – used to define reference power settings for different phases of flight
- **EGT (Exhaust Gas Temperature)** – must be monitored to prevent engine overheat

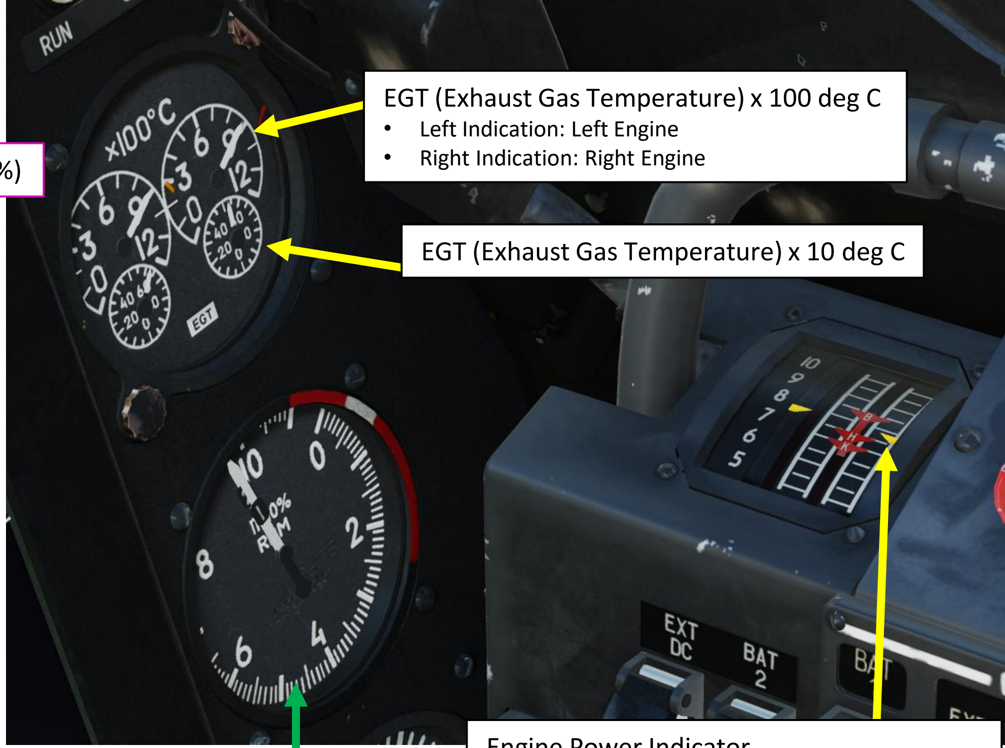


Maximum RPM Index

NR (Rotor RPM) Indicator (x10 %)

Minimum Safety RPM Index

Rotor Blade Angle (degrees)



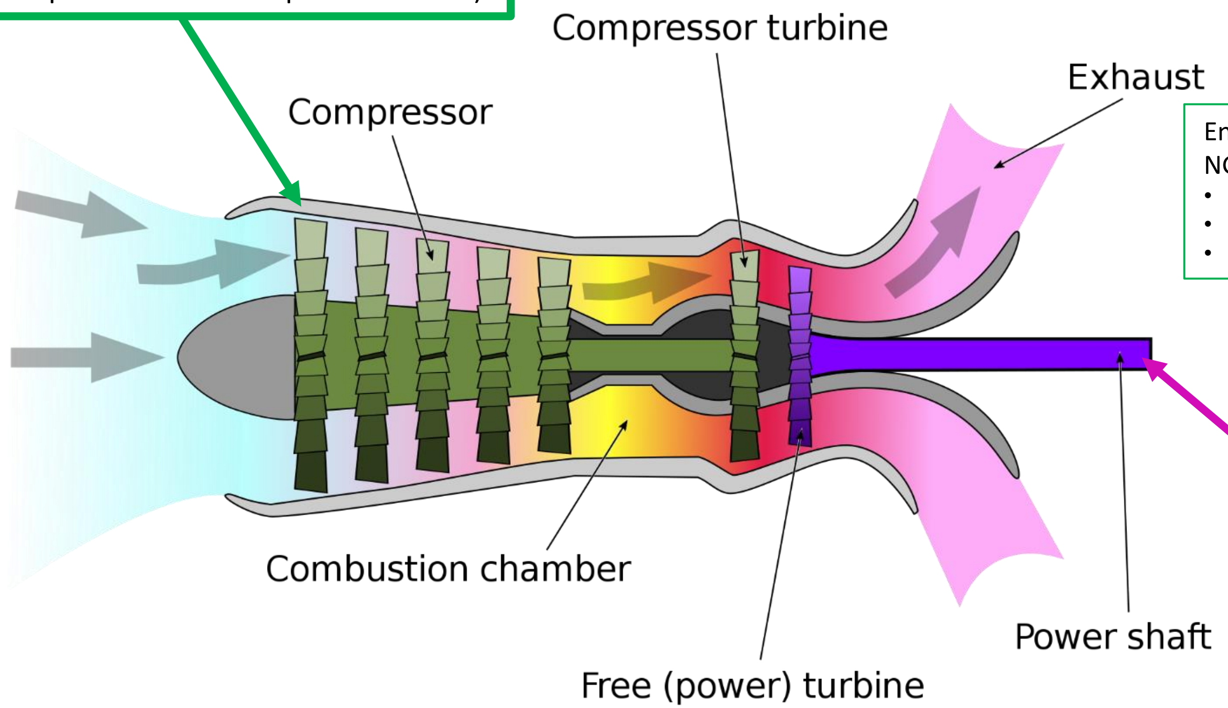
EGT (Exhaust Gas Temperature) x 100 deg C
- Left Indication: Left Engine
- Right Indication: Right Engine

EGT (Exhaust Gas Temperature) x 10 deg C

Engine Tachometer (% RPM)
NGG (Gas Generator Turbine/Compressor Speed)
- RPM of each engine turbine (100 % is 19,537 RPM)
- Needle 1: Left Engine
- Needle 2: Right Engine

Engine Power Indicator
- Yellow Index: Right/Left current Engine Power
- B Index: Takeoff power reference
- H Index: Max continuous power reference
- K Index: Cruise power reference

NGG (Gas Generator Turbine / Compressor Rotation Speed in %RPM)



NP (Free Power Turbine Rotation Speed in %RPM)

Incidentally, since the Power Turbine drives the Main Rotor shaft, in normal operation N2 is equal to the Main Rotor Speed (**NR**, in %RPM)

1 – POWERPLANT
1.3 – Engine Indications

Additionally, engine oil and various transmission gearbox oil indicators must be monitored once in a while to watch for oil leaks (which are often fatal issues if not found quickly, resulting in degraded transmission performance or even catastrophic transmission failure).

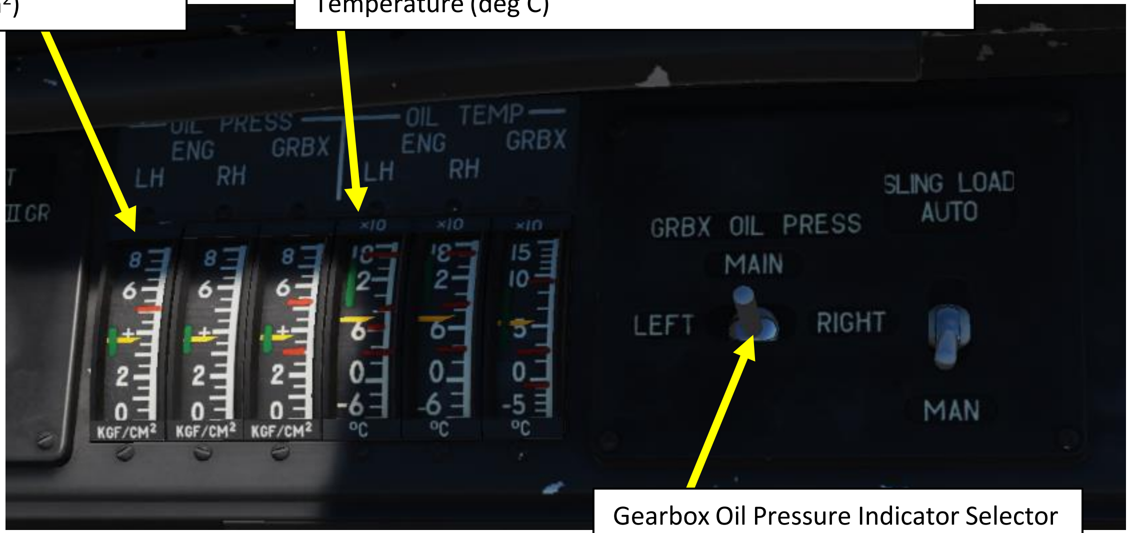
Low Rotor RPM "Zebra" Warning (Push-Light)
- Illuminates if rotor speed is below 85%

Caution Lights Panel

LH ENG OVERSPD Left engine turbine overspeed	**RH ENG OVERSPD** Right engine turbine overspeed
LH ENG VIBR Left engine vibration excessive	**RH ENG VIBR** Right engine vibration excessive
MAIN GRBX • Minimum Main Gearbox Pressure • Main Gearbox Oil Overheat • Oil Metallic Chip Detected	**FIRE** Fire Detected

Left Engine, Right Engine and Transmission Gearbox Oil Pressure (kg/cm²)

Left Engine, Right Engine and Transmission Gearbox Oil Temperature (deg C)



Gearbox Oil Pressure Indicator Selector
- Main/Left/Right

AGB OIL PRESS
- Accessory Gearbox oil pressure is normal (before start)

LH/RH POWER SET LIM (LEFT/RIGHT ENG PWR LIMIT)
- Left/Right engine was limited by the electronic engine governor and prevented an overspeed

1 – POWERPLANT

1.4 – Engine Operation Limits

Engine Operation Limits

Limited Parameter	Value	Reason
Maximum Rotor Speed Up to 190 km/h 190 to 245 km/h 245 to 265 km/h 265 to 280 km/h 280 to 300 km/h	 98 % RPM 95 % RPM 93 % RPM 91 % RPM 90 % RPM	Flutter
Minimum Rotor Speed At Takeoff power During Manoeuvers	 86 % RPM 83 % RPM	
Continuous Operation time for all modes Takeoff - Normal Conditions Takeoff - Emergency Conditions Takeoff - OEI (One Engine Inoperative) Maximum Continuous (Nominal) Idle	 6 min 6 to 30 min 90 min 60 min 20 min	Engine reliability and service life
Maximum NGG (Gas Generator Speed) at takeoff mode	101.15 % RPM	Engine strength and endurance
Maximum EGT (Exhaust Gas Temperature) at the gas-generator turbine inlet Takeoff mode Start-up and Idle Mode	 990 deg C 780 deg C	Engine thermal endurance
Engine Oil Pressure Minimum Maximum	 2 kg/cm^2 4 kg/cm^2	

Gearbox Limits

Limited Parameter	Value	Reason
Gearbox Oil Pressure Minimum at Idle mode Minimum at all other modes	 0.5 kg/cm^2 1.3 kg/cm^2	
Gearbox Oil Temperature Minimum during start-up and idle mode Maximum	 -30 deg C +90 deg C	Gearbox lubrication

1 – POWERPLANT
1.5 – Electronic Engine Governors (EEG)

Two ERD-3VMA electronic engine governors are installed on the Ka-50. Each **Electronic Engine Governor (EEG)** is part of the electronic engine control system and is intended to control the fuel flow at high gas-generator (GG) RPM and to shut down the engine in case of power (free) turbine (PT) over-speed.

Each EEG functionally consists of GG RPM limitation contour and automatic PT (Power Turbine) protection and has the following functions.

For the GG (Gas Generator) contour:

- Maximum GG RPM limitation as a function of the ambient temperature and barometric pressure, with the purpose of maintaining constant takeoff power.
- **Maximum physical GG RPM limitation up to 101%.**
- When the maximum GG RPM has been reached for a given temperature and pressure, the EEG reduces fuel flow via a solenoid valve. Simultaneously, the “ОГРАН РЕЖ ЛЕВ” (**LEFT ENG PWR LIMIT**) or “ОГРАН РЕЖ ПРАВ” (**RIGHT ENG PWR LIMIT**) yellow lights on the overhead panel illuminate.

For the PT (Power Turbine) protection:

- This generates an engine shut down command signal with a flashing Master Warning Light and illumination of the “n ст ПРЕД ЛЕВ ДВИГ” (**LEFT ENG OVRSPD**) and “n ст ПРЕД ПРАВ ДВИГ” (**RIGHT ENG OVRSPD**) red lights on the left portion of the main instrument panel. Simultaneously, the audio message “Раскрутка турбины левого двигателя” (Left engine power turbine over-speed) or “Раскрутка турбины правого двигателя” (Right engine power turbine over-speed) is played.

The control panel for turning EEG off and on is located on the right wall panel.

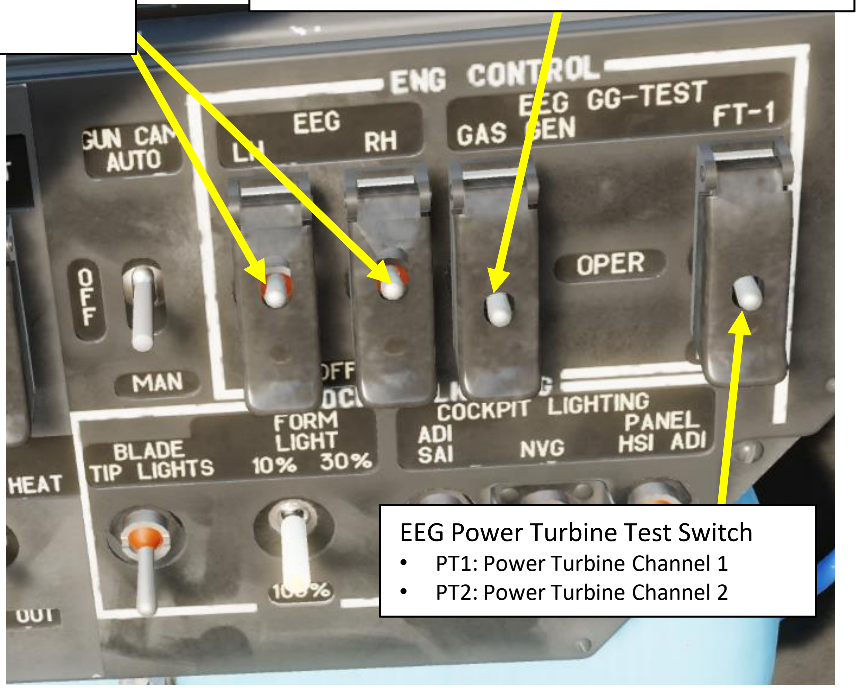
- **EEG LEFT/RIGHT Switches**: turn off and on both EEG’s (left and right engines)
- **EEG (Electronic Engine Governor) Gas Generator Test-Operate Switch**: tests Gas Generator (GG) Channel.
- **EEG Power Turbine Test Switch**: tests both the channels of the PT (Power Turbine) contour.

The “CT-1” (PT-1) and “CT-2” (PT-2) channels operate independently from each other. To generate an **engine shut down signal** it is necessary that **both channels have detected a Power Turbine over-speed with a time difference of no more than 0.2 seconds**. In case of a PT RPM over-limit detection by only one channel, or by both of them but with a time gap of more than 0.2 seconds, the signal is ignored as a false alarm and no action is taken.

If during test mode with an illuminated warning light and a rotor RPM of 86.5%, the selector can be rapidly switched to the other channel (CT-1 – CT-2) without holding it in the middle “РАБОТА” (OPERATION) position; the tested engine will shut down.

EEG (Electronic Engine Governor) Left/Right Engine
- UP = ON

EEG (Electronic Engine Governor) Gas Generator Test-Operate Switch



EEG Power Turbine Test Switch
- PT1: Power Turbine Channel 1
- PT2: Power Turbine Channel 2

LH ENG OVERSPD
Left engine turbine overspeed

RH ENG OVERSPD
Right engine turbine overspeed

LH/RH POWER SET LIM
(LEFT/RIGHT ENG PWR LIMIT)
- Left/Right engine was limited by the electronic engine governor and prevented an overspeed

1 – POWERPLANT
1.5 – Electronic Engine Governors (EEG)

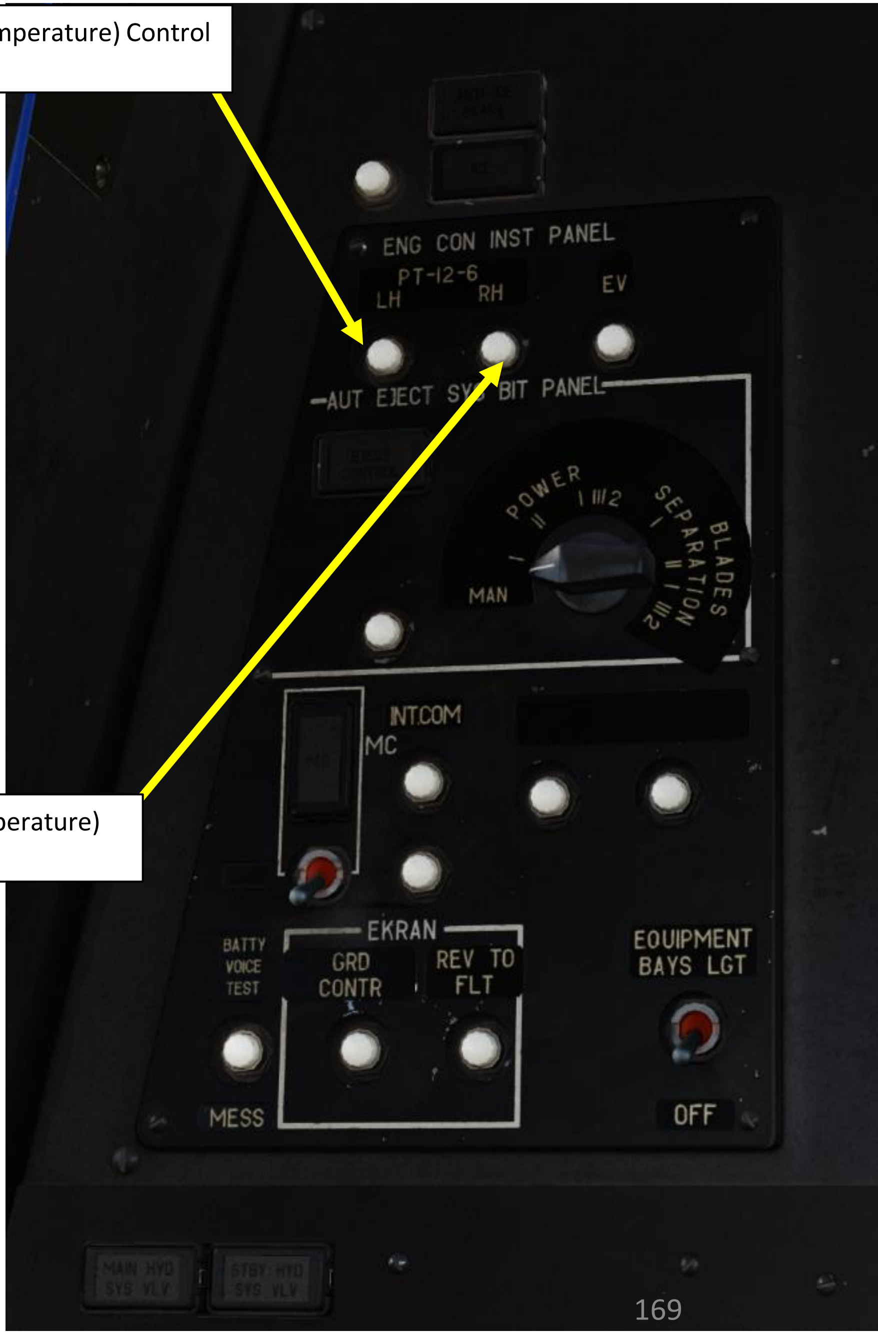
Left and Right PT-12-6 buttons decrease the control threshold of the EGT (Exhaust Gas Temperature) governors to check the serviceability of the EEG.

When either of these buttons are pressed, the GG contour of the EEG disengages. If the EGT is no less than 850°C and GG RPM is no less than 87%, then the EGT decreases by 30°C or more and the GG RPM decreases to 84% of the maximum value.

Maximum power output of TV3-117 engine is limited by electronic engine governor ERD-3VM. It limits the turbo-compressor RPM and along with RT-6-12 temperature regulator limits gas temperature before the turbine.

Increasing the RPM or temperature severely reduces engine life. Increasing temperature is particularly dangerous because it weakens turbine blades and can lead to their deformation which in turn leads to reduced performance. It can also lead to turbine's catastrophic failure.

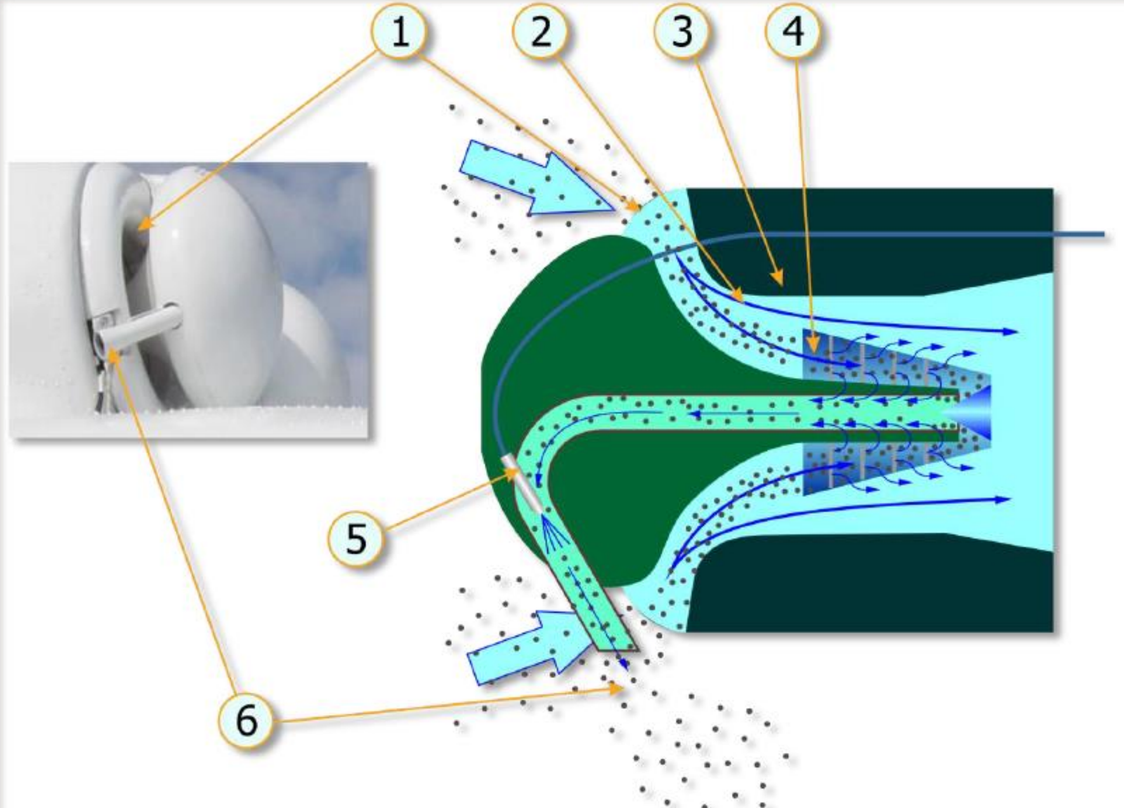
If electronic engine governor fails the collective needs to be controlled carefully so that ОГРАН. РЕЖ. indicator does not light up when RT-6-12 temperature regulator is still functional (it works only in indication mode when engine governor is off). If RT-6-12 fails the only way to maintain engine operation within limits is by checking engine status gauges in particular ensuring that the gas temperature is below 980℃.



1 – POWERPLANT
1.6 – EPD (Engine Dust Protection) System

Flying through dust kicked off by main rotors causes increased engines wear. To prevent it when taking off or flying over the dusty ground the engines dust protection system must be engaged. The amount of dust getting into the engines depends on air flow through them as well as amount of dust kicked by main rotors - therefore until helicopter is ready for takeoff engines should not be operated above idle power setting. The **Engine Dust Protection (EDP) system** protects the engine inlet during taxi, takeoff, and landing at unprepared airstrips and in sandy/dusty environments. In addition, the system provides electrical and bleed air anti-ice heating.

The system mounts on the front of the engine, in place of the nose cone assembly. Each engine has an independent particle separator system. The system begins to operate when bleed air is supplied to the ejector by opening the flow control valve. When the system is running, suction pulls contaminated air into the **inlet duct passages (1)**. Centrifugal forces throw the dust particles toward the **aft dome surface (2)** where they are driven by the air flow through the **separator baffles (4).** The main portion of the air, with the dust removed, passes through the duct to the **engine air inlet (3)**. The contaminated air (dust concentrate) is pulled into the **dust ejector duct (5)** and **discharged overboard (6)**.



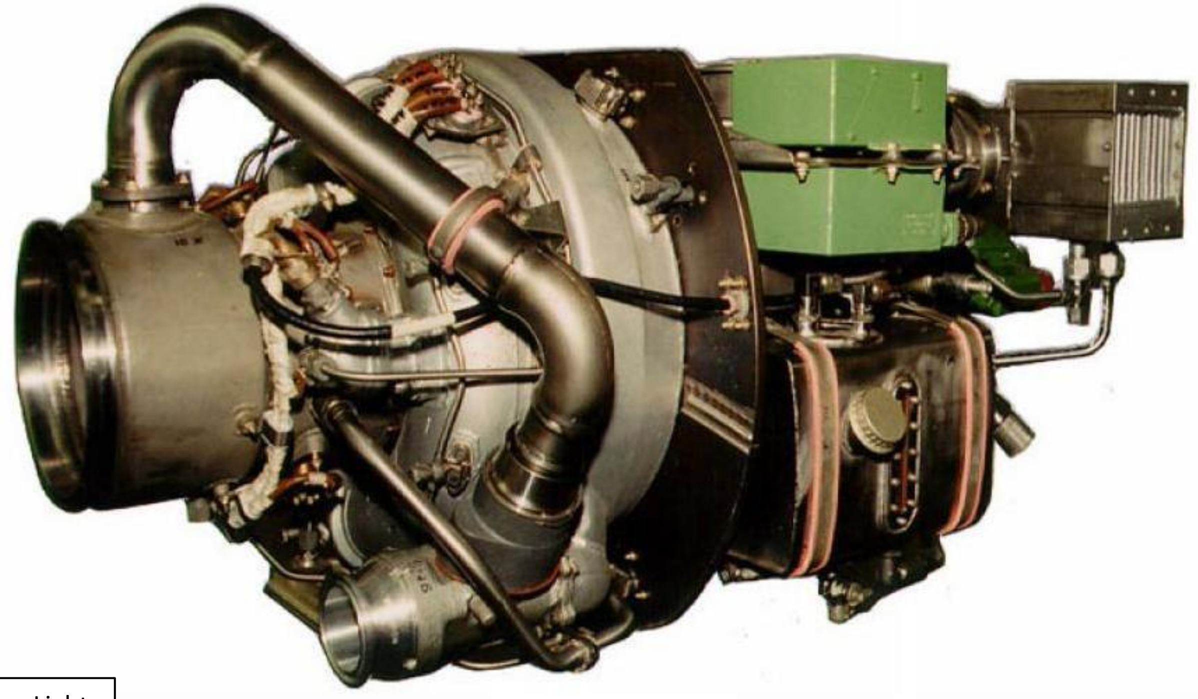
Air Inlet Particle Separator System Functional Diagram

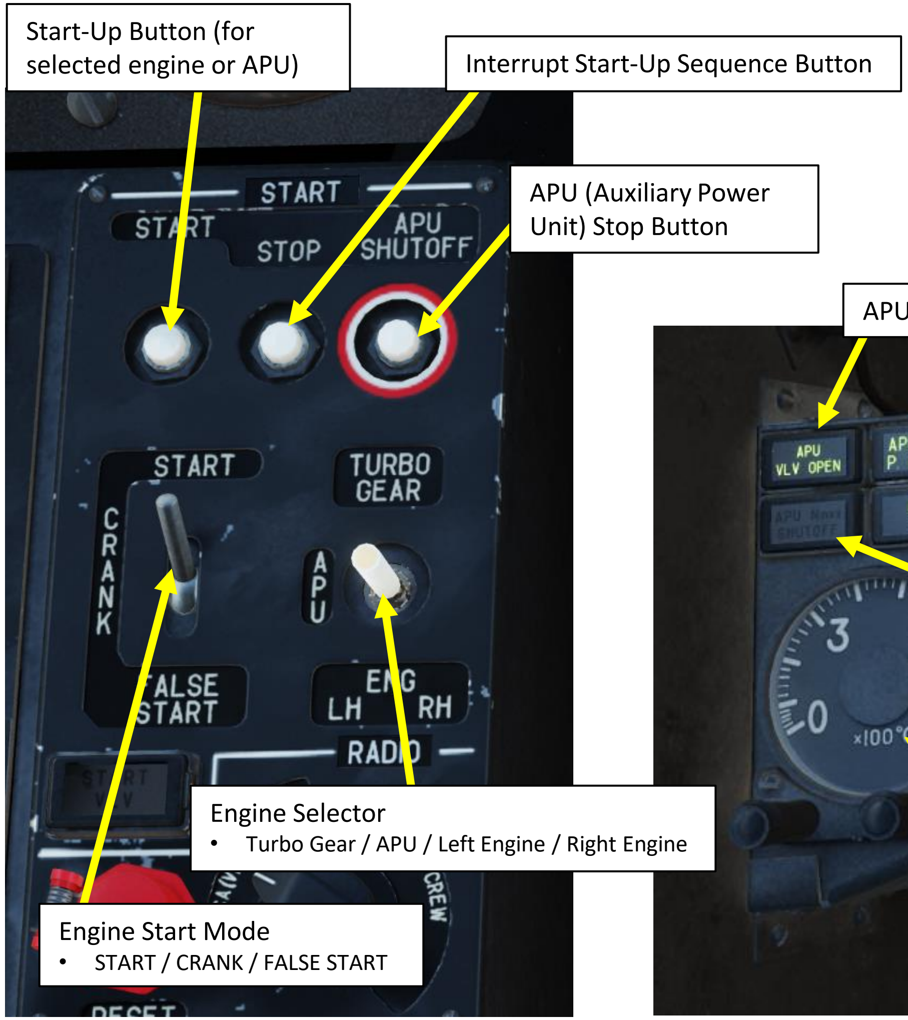
1 – POWERPLANT
1.6 – EPD (Engine Dust Protection) System

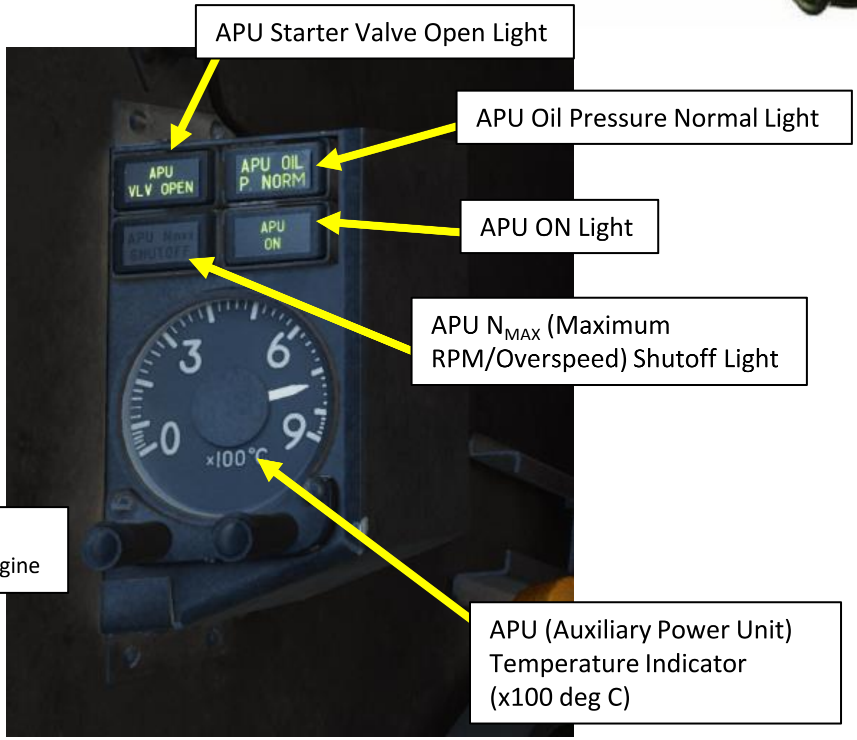
The dust protection system can be armed by setting the **Engine Anti-Ice/Dust Protection Switch** to the **DUST** (DOWN) position. Keep in mind that the dust protection system consumes engine bleed air, which **reduces available engine power** by about 100 Horsepower (or about 4.5 % power). In other words, the dust protector system should be used sparingly in order to keep as much power available during flight.

2 – IVCHENKO AI-9 APU (AUXILIARY POWER UNIT)

The Engine Start system requires pressurized bleed air to spool up the starter. The Ivchenko AI-9 Auxiliary Power Unit (APU) is basically a smaller engine that provides this air pressure for the engine starter. It also provides electrical power if required for ground operations where the engine generators are OFF.







2 – IVCHENKO AI-9 APU (AUXILIARY POWER UNIT)

3 – FUEL SYSTEM

3.1 – Fuel System Overview

The Ka-50 fuel system supplies the helicopter's engines and APU, and it consists of fuel tanks, fuel lines, a fuel flush system, and various control devices.

The fuel tanks consist of main and external tanks. The main tanks include forward and rear soft tanks. External fuel tanks can be located on all four external hard/wet-points, up to two on each side. The external fuel tanks on the left side of the aircraft are connected to the rear main tank and external tanks on the right side are connected to the forward main tank. The forward tank supplies fuel to the left engine while the rear tank supplies fuel to the right engine. The Auxiliary Power Unit (APU) is fed from the rear main tank. A crossfeed valve is installed between the engines fuel supply lines. When the crossfeed valve is open, either main fuel tank can provide fuel to either engine.

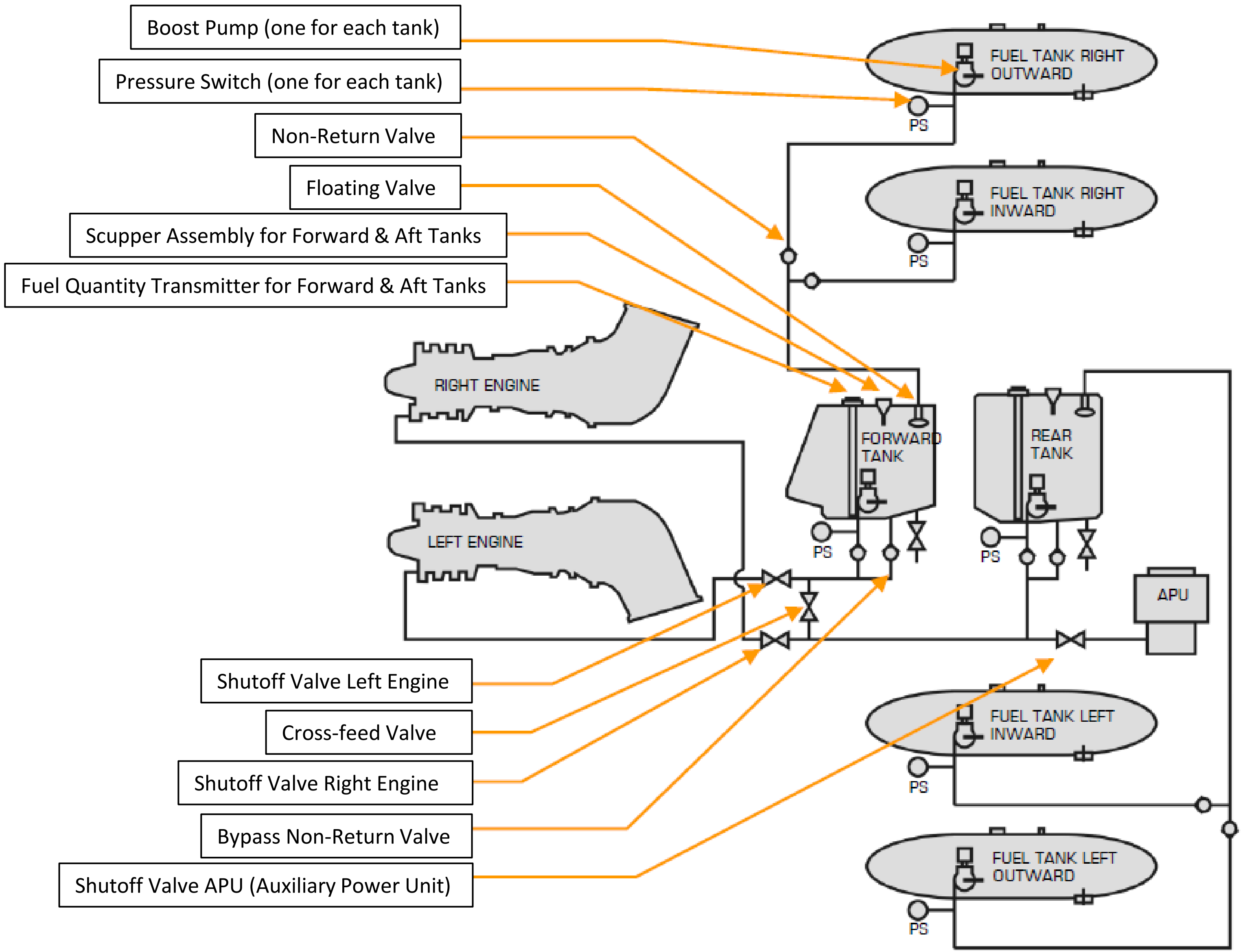
Fuel is directly supplied from the main fuel tanks to the engines and APU, and the main fuel tanks are in turn directly supplied by the external fuel tanks. As such, the external fuel tanks will run empty before the main fuel tanks fall below 100% of capacity. To avoid fuel flowing from the main tanks to the external tanks, non-returning valves are placed on the fuel lines between them.

Fuel pumps are turned on and off manually by setting the boost pump controls in the cockpit. The boost pump indicator lamps are located on the front top indicator panel.

Overall fuel system reliability is enhanced in part due to:

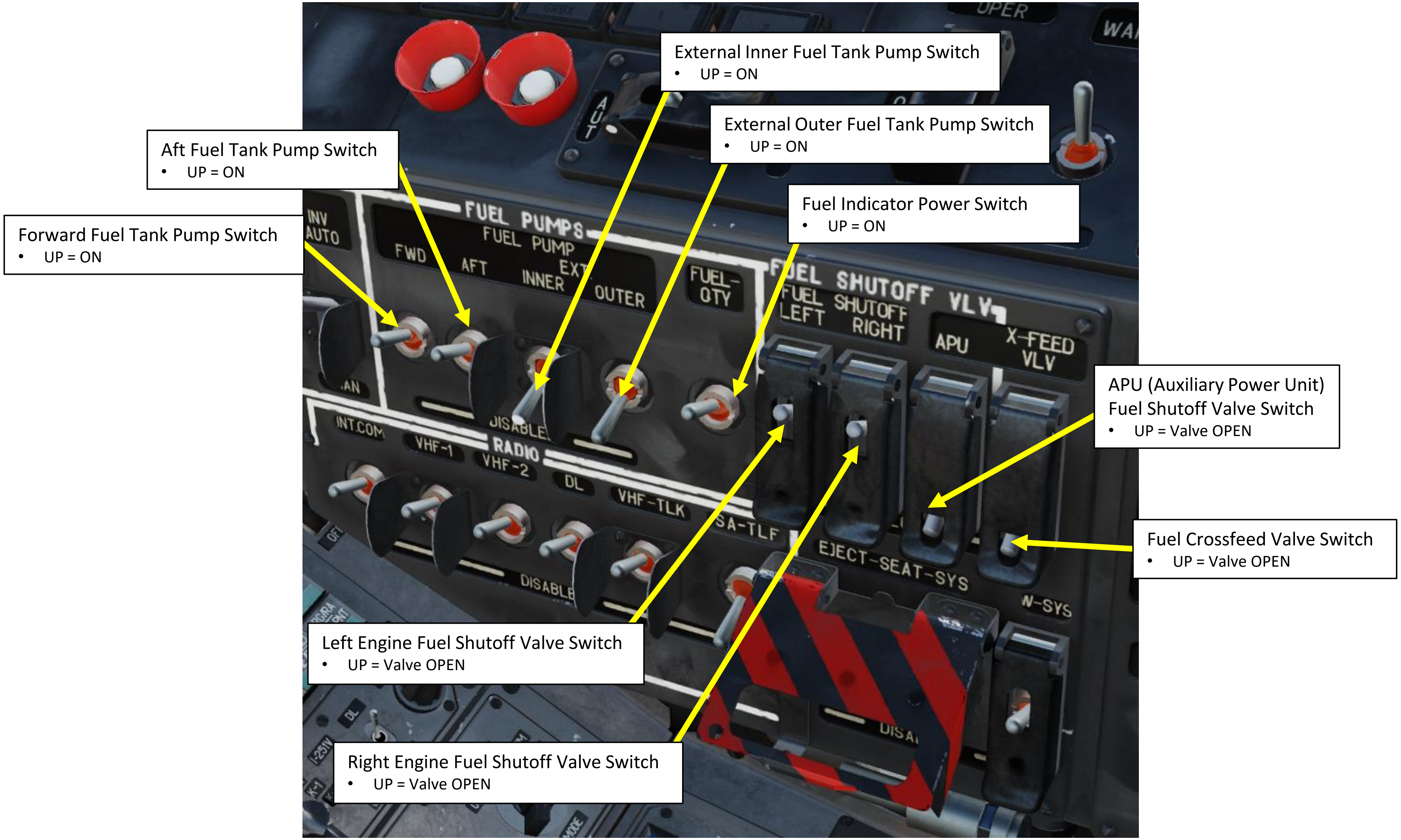
- The fuel pumps are connected to an emergency electrical bus that is fed from the onboard batteries. Thus, fuel supply will continue, even if the electric generators fail.
- The fuel pumps located in the engines are able to pump fuel from tanks through bypass non-returning valves. Thus, the engines will continue to receive fuel, even if the fuel tank pumps have failed.

Fuel System Overview



3 – FUEL SYSTEM

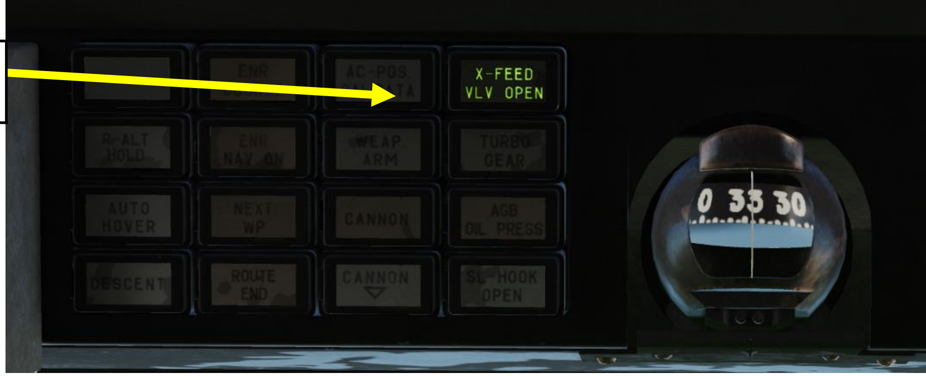
3.2 – Fuel System Controls



3 – FUEL SYSTEM
3.2 – Fuel System Controls

The **crossfeed valve** allows fuel supply of one engine from all tanks, in case of other engine's failure or both engines/APU supply from one tank in case of loss of fuel from the other tank (rupture by enemy fire). It's normally closed and should be open in case one of the above mentioned events occurs. It is recommended to **open the cross feed valve upon warning for 110 kg fuel quantity remaining** in any of the tanks.

X-FEED VLV OPEN
Fuel is shared between tanks (crossfeed ON)



Fuel Crossfeed Valve Switch
- UP = Valve OPEN

3 – FUEL SYSTEM
3.3 – Fuel Tanks

Total Fuel Quantity – Main Tanks FULL: 1450 kg
- Forward tank: 705 kg
- Aft tank: 745 kg

Total Fuel Quantity – Main Tanks + All External Tanks FULL: 3210 kg
- PTB-450 External Fuel Tanks contain 440 kg of fuel each

Minimum Emergency Fuel Quantity
- Forward tank: 110 kg
- Rear Tank: 110 kg

Fuel Indicator (x100 kg)
- **П (F)**: Forward Tank Needle
- **З (A)**: Aft Tank Needle

3 – FUEL SYSTEM
3.4 – Fuel Quantity Indicator & Warning Lamps

The fuel quantity indicator measures the remaining fuel in the front and rear tanks. The meter is demarcated from 0 to 800 kilograms.

- Note: the fuel quantity indicator does not include external fuel tank quantity.

When the remaining fuel quantity becomes critical in one of the main tanks, the master warning light will flash and the EKRAN system will display:

- “ПЕРЕДНИЙ БАК 110 кг” / FORWARD TANK 110. This warning means “Forward tank has 110 kg remaining”.
- “ЗАДНИЙ БАК 110 КГ” / AFT TANK 110. This warning means “Aft tank has 110 kg remaining”.

Fuel Indicator (x100 kg)

- **П (F)**: Forward Tank Needle
- **З (A)**: Aft Tank Needle

Fuel Indicator Power Switch

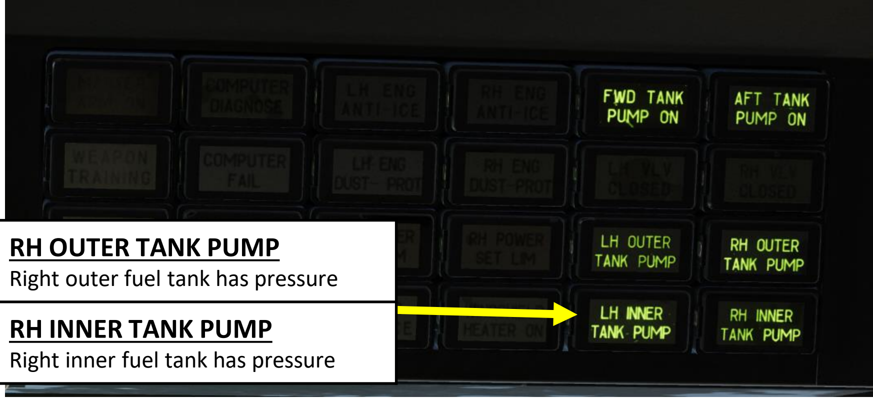
- UP = ON

3 – FUEL SYSTEM
3.5 – External Fuel Tank (Drop Tank) Operation

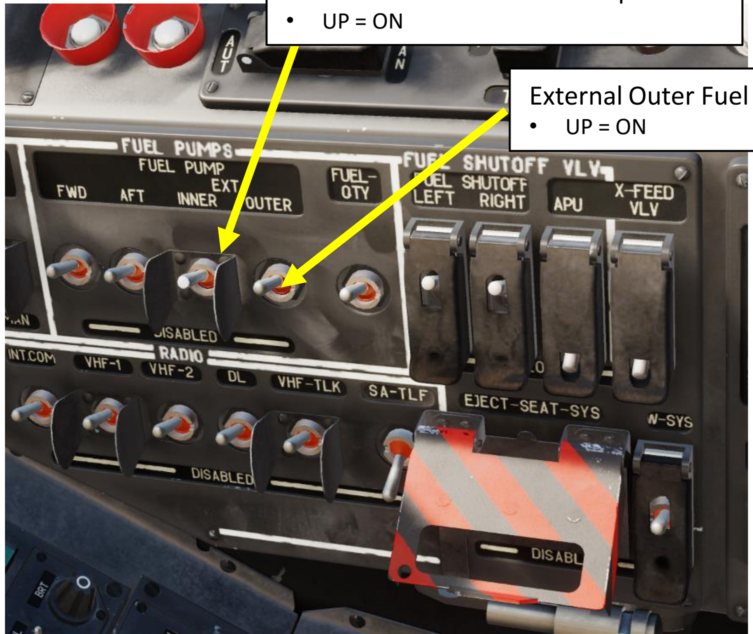
To consume fuel from external fuel tanks, set the **External Inner/Outer Fuel Tank Pump Switches ON (UP)** depending on which pylons they are installed. The fuel quantity indicator does not include external fuel tank quantity.

Fuel is directly supplied from the main fuel tanks to the engines and APU, and the main fuel tanks are in turn directly supplied by the external fuel tanks. As such, the external fuel tanks will run empty before the main fuel tanks fall below 100% of capacity. To avoid fuel flowing from the main tanks to the external tanks, non-returning valves are placed on the fuel lines between them.

When **no fuel is left** in the external tanks, the **appropriate indicator lamps will turn off**:
- “БАК ЛЕВ ВНЕШ” – LH OUTER TANK PUMP
- “БАК ПРАВЫЙ ВНЕШ” – RH OUTER TANK PUMP
- “БАК ЛЕВ ВНУТР” – LH INNER TANK PUMP
- “БАК ПРАВЫЙ ВНУТР” – RH INNER TANK PUMP



LH OUTER TANK PUMP Left outer fuel tank has pressure	**RH OUTER TANK PUMP** Right outer fuel tank has pressure
LH INNER TANK PUMP Left inner fuel tank has pressure	**RH INNER TANK PUMP** Right inner fuel tank has pressure



External Inner Fuel Tank Pump Switch
- UP = ON

External Outer Fuel Tank Pump Switch
- UP = ON

PTB-450 External Outer Fuel Tank (440 kg)

PTB-450 External Inner Fuel Tank (440 kg)

3 – FUEL SYSTEM
3.5 – External Fuel Tank (Drop Tank) Operation

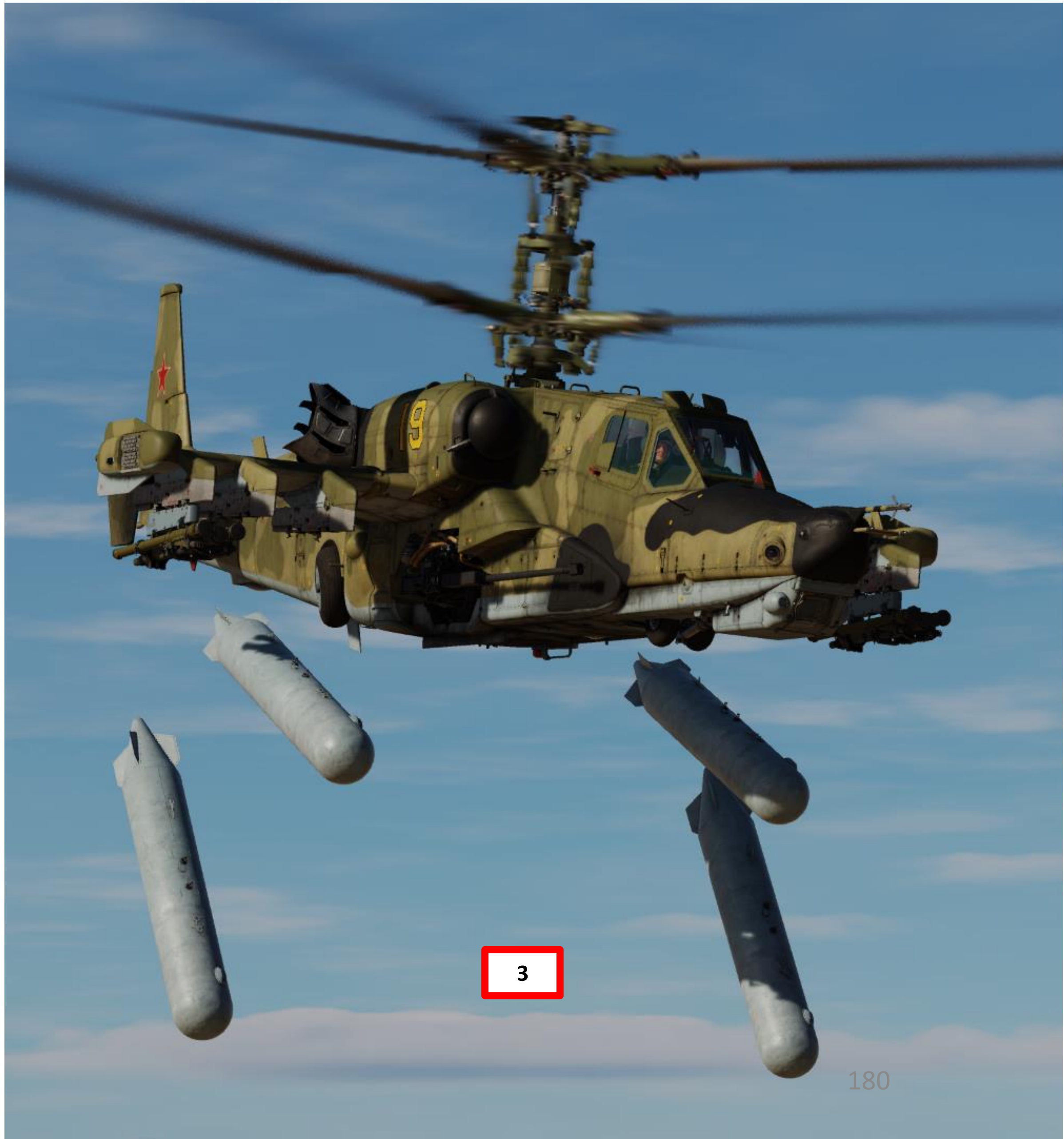
Emergency jettison of external tanks is performed by pressing the "АВАР-СБРОС" (**Emergency jettison**) button on the central panel.

1

Jettison All External Stores (except Vikhr missiles)

2

3



3

4 – HYDRAULIC SYSTEM

The Ka-50 hydraulic system is used to provide hydraulic power to various helicopter systems. This consists of two subsystems:

- The **main hydraulic system** supplies the flight control servo actuators for pitch, bank, yaw, and collective. In case of a common system failure, it also ensures emergency landing gear extension.
- The **common hydraulic system** supplies the landing gear extend/retract system, the main wheels brakes, and cannon steering. In case of a main system failure, it supplies the flight control servo actuators.

Switching hydraulic supply between the main and common system is automatic. It can also be manually set by the “ОСН ГИДРО ОТКЛ” (MAIN HYDRO OFF, or the **Main Hydraulics Power Switch**) switch and is indicated by the “КЛАПАН 1 ГИДРО”, “КЛАПАН 2 ГИДРО” (**MAIN HYD SYS VLV**, **STBY HYD SYS VLV**) lights that are located on the control panel above the pressure indicators.

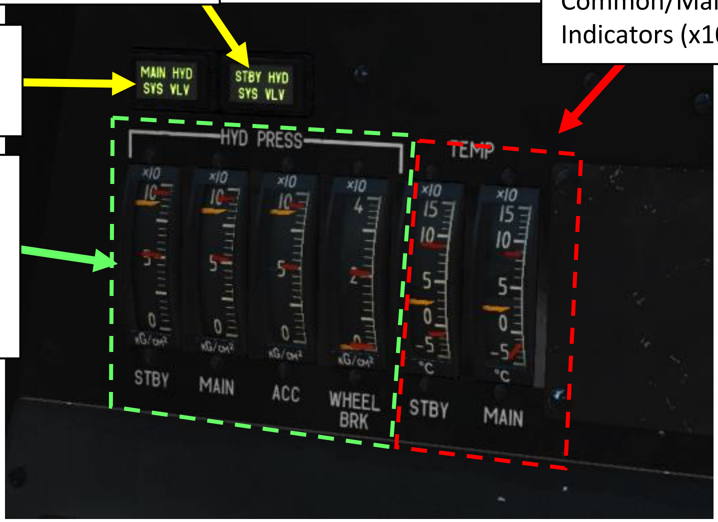
Main Hydraulics Power Switch
- DOWN = ON

Hydraulic Valve #2 Lamp
- Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System

Hydraulic Valve #1 Lamp
- Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System

Common/Main/Accumulators/Wheel Brakes Hydraulic pressure indicators (x10 kg/cm²)
- STBY: Standby Hydraulic System
- MAIN: Main Hydraulic System
- ACC: Hydraulic Accumulator
- WHEEL BRK: Wheel Brake Hydraulic System

Common/Main temperature Indicators (x10 deg C)



EKRAN Warning System, Hydraulics and Transmission Group Power Supply Switch
- UP = OFF
- DOWN = OPERATE

4 – HYDRAULIC SYSTEM

Each system consists of a hydraulic pump, a hydraulic fluid tank, filters, valves, pipes, and control elements. The pressure source for both systems is provided by variable displacement pumps. The main system's pump is mounted on the left accessory gearbox of the main gearbox, and it operates when the rotors are driven by the engines and also when in autorotation. The common system's pump is mounted on the aft accessory gearbox of the main gearbox, and it operates when the rotors are turning or when the APU is on.

There are hydraulic accumulators in each system to prevent pressure oscillations. In the brake system there is a separate accumulator to power the parking brakes (for up to 2 hours) after engines shut down, or power the brakes during taxi in case of a common system failure. The main system's tank has a capacity of 13 liters and the common system tank has a capacity of 17 liters.

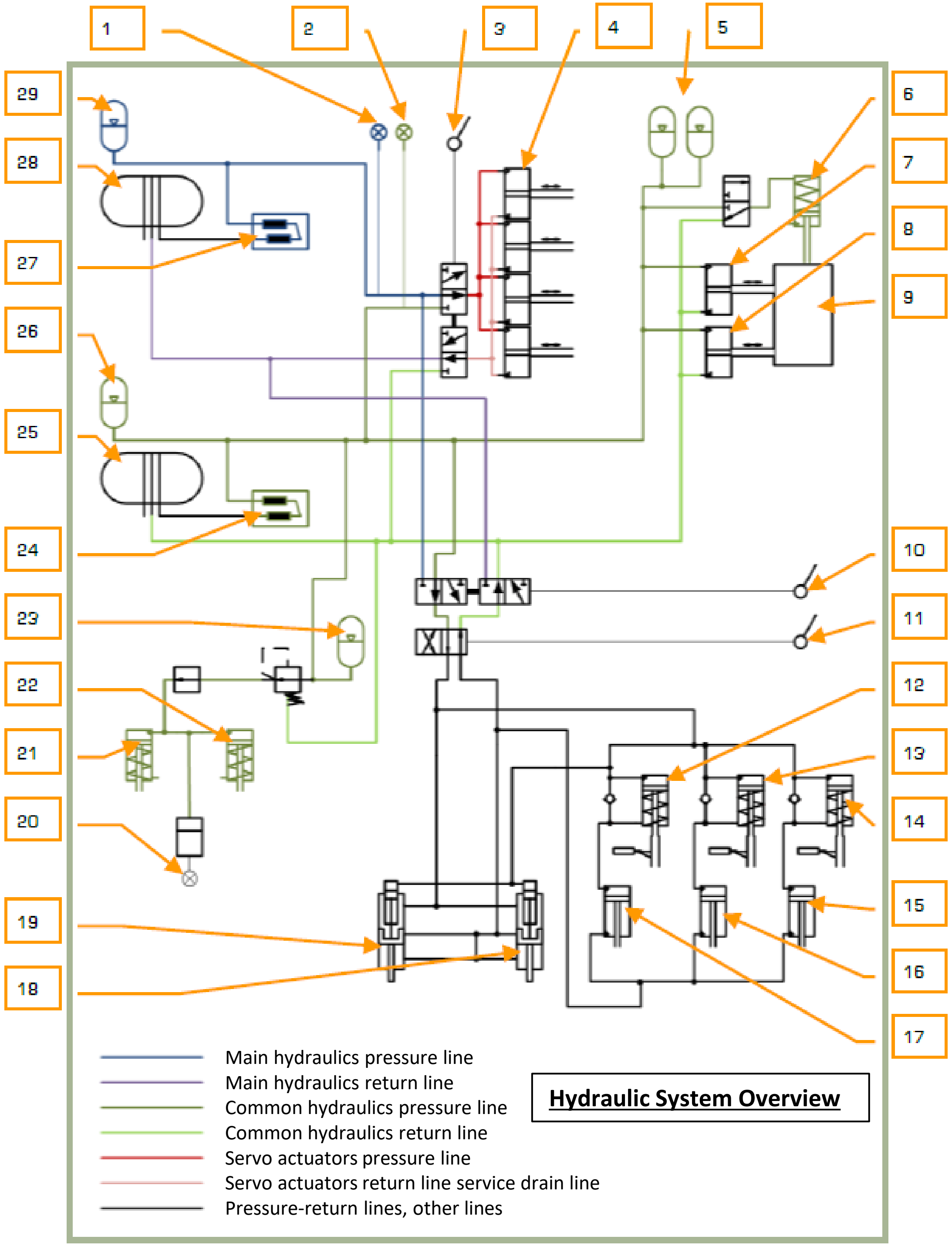
Hydraulic system control is through fluid pressure and temperature indicators and the pressure switches. The indicators are located on the upper part of the cockpit control panel. The indicators include marks that specify the operating range of each indicator:

- Main and common systems pressure indicators. Marks for 64 and 90 kgf/cm2
- Accumulator pressure. Marks for 60 and 90 kgf/cm2
- Brake system pressure indicator. Marks for 0 and 22 kgf/cm2
- Systems fluid temperature indicators. Marks for -10°C and +90°C
- Pressure operating range 65 and 90 kgf/cm2
- Fluid temperature in flight no more than +85°C

Pressure switches are installed in:

- Flight controls servo actuators to indicate pressure drop
- Wheel brake system to indicate pressure drop in the accumulator
- In the tanks pressurization line

4 – HYDRAULIC SYSTEM



Hydraulic System Overview

1. Main hydraulic system pressure indicator
2. Common hydraulic system pressure indicator
3. Servo actuators main-common hydraulics switch
4. Servo actuators. Pitch and bank actuators, yaw actuator and collective actuator
5. Moving gun hydraulic accumulators
6. Moving gun stop lock
7. Moving gun vertical actuator
8. Moving gun horizontal actuator
9. Moving gun
10. Emergency gear selector switch
11. Retract/Extend gear lever
12. Left gear lock check valve
13. Nose gear lock check valve
14. Right gear lock check valve
15. Left gear actuator
16. Nose gear actuator
17. Right gear actuator
18. Right gear door actuator
19. Left gear door actuator
20. Brakes pressure indicator
21. Left wheel brake actuator
22. Right wheel brake actuator
23. Brakes hydraulic accumulator
24. Common system pump
25. Common system tank
26. Common system accumulator
27. Main system pump
28. Main system tank
29. Main system accumulator

5 – ELECTRICAL SYSTEM

The Ka-50 electrical system includes:

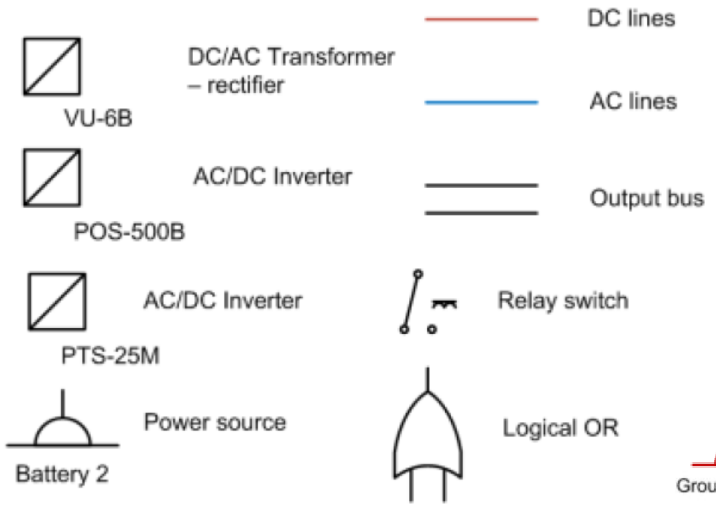
- 115/200 V AC main power supply
- Emergency AC power supply
- DC power supply
- External power supply

Electrical system controls are located on the wall panel, the instruments are located on the control panel, and the cautions are located on the overhead panel and EKRAN display.

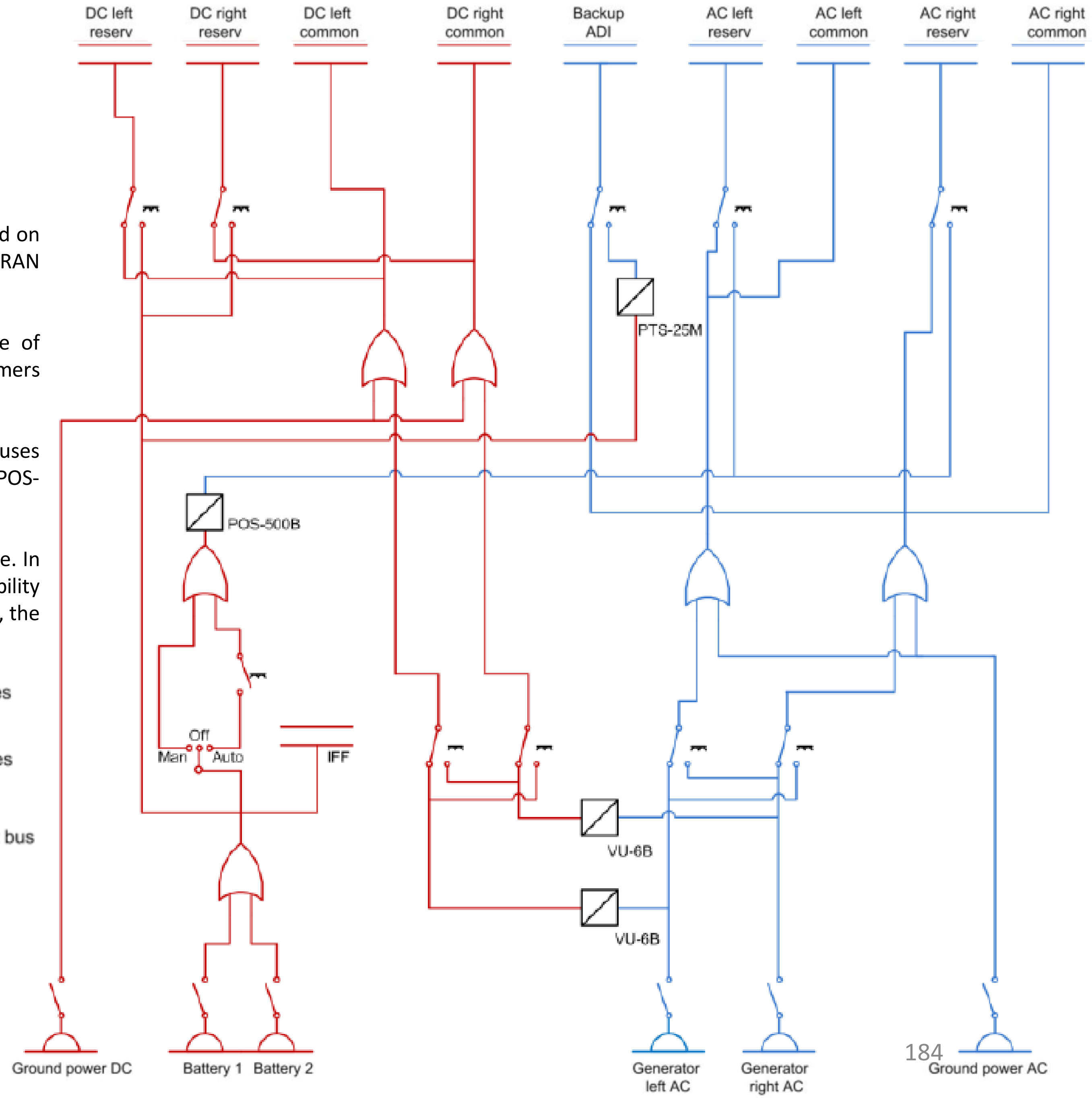
Main electrical power supply consists of a 3-phased AC current with a voltage of 115/200 V. The power source for this is two 3-phased AC generators. 27V DC consumers are supplied by two rectifiers, each operating with one of the two generators.

To ensure flight safety in case of main power failure, there are emergency buses supplied by the batteries. In this case, ~115V AC is provided by the static inverter POS-500B, supplying the emergency AC buses.

External AC power supply can be connected to a plug on the left side of the fuselage. In its absence, electrical power can be provided by the batteries. To test the serviceability of the equipment on the ground with inoperative engines and lack of ground power, the AC generators are used when the turbo-gear is switched on.



Electrical Power Supply Overview



5 – ELECTRICAL SYSTEM

Main AC Power Supply System

The system includes two separate generator channels on the left and right sides of the helicopter. The power source includes two 115/200 V synchronized 3-phased AC generators installed in the rear gearbox, and are driven either by the main gearbox or the turbo-gear.

The left generator is switched to the CDU-1 (Central Distribution Unit) and the right to the CDU-2, which supplies the buses that feed the consumers. In case one generator fails, its buses are automatically switched to the buses of the serviceable generator.

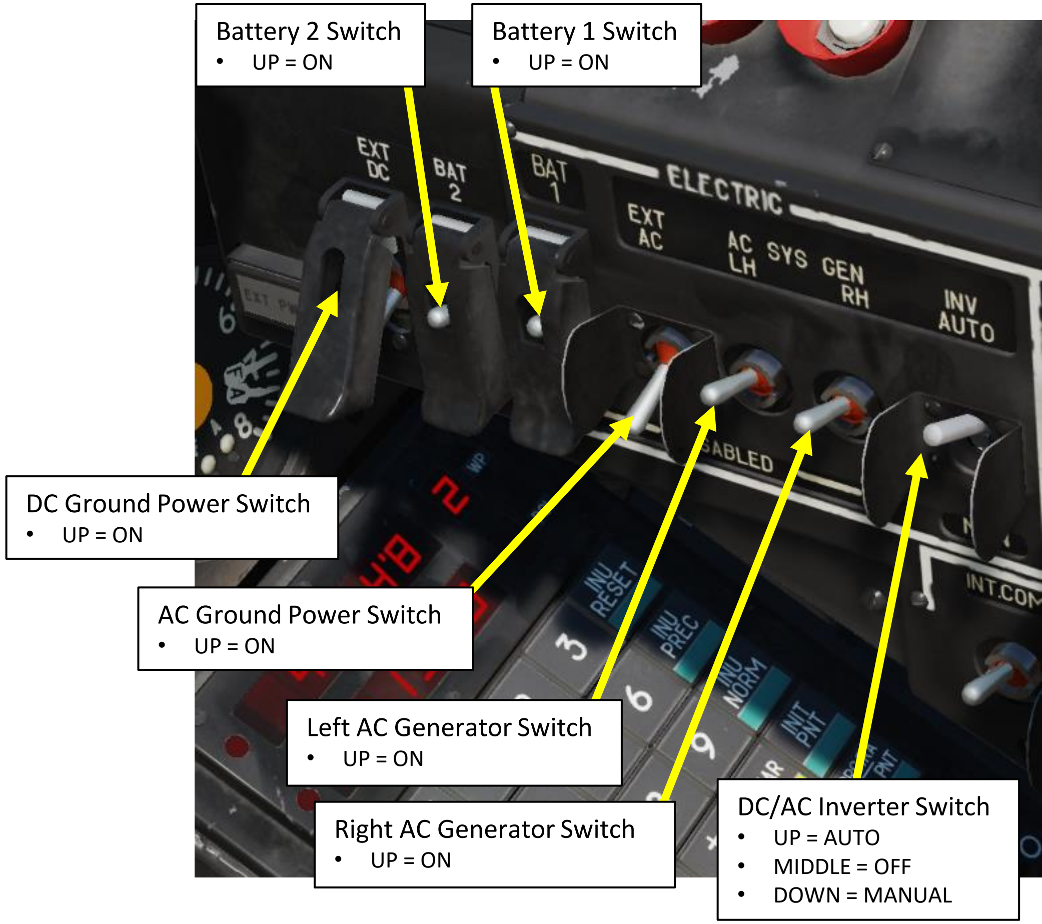
The generators are started by the “ЭНЕРГЕТИКА ~ТОК” (AC Ground Power), “ГЕН ЛЕВ” (Left AC Generator), and “ГЕН ПРАВ” (Right AC Generator) switches, when the rotor RPM is stable above 83-85% or with the turbo-gear operating on ground. When rotor RPM drops below 80%, the AC generators will automatically turn off.

Emergency AC Power Supply System

In case of main AC system failure, the AC consumers will be supplied by the static POS-500B inverter. This will transform the 27V DC of the batteries into 115V AC.

The POS-500B inverter supplies the following consumers connected to the emergency bus:
- Radar altimeter
- Power plant’s oil pressure switches
- Fuel quantity indicator, G-load accelerometer, engines RPM and EGT indicators, and vibrations monitoring system
- IFF equipment
- Warning and indications systems
- Audio tones for rotor RPM drop
- Emergency instrument panels illumination

The stand-by artificial horizon is supplied by a separate static POS-25M inverter that uses DC input from the batteries. In case both generators fail, this list is expanded with the inclusion of DC emergency bus consumers.
To ensure the automatic activation of the POS-500B inverter, the “ЭНЕРГЕТИКА ~ТОК” (AC Ground Power) “ПРЕОБР” (Inverter) selector must be in the “АВТ” (AUTO) position.



5 – ELECTRICAL SYSTEM

DC Power Supply System

The DC power system consists of two independent channels, installed on the left and right sides of the fuselage.

Each channel includes a VU-6B rectifier, CDU-3 for the left and CDU-4 for the right channel.
In case a CDU channel fails, the buses of the failed channel are switched to the serviceable CDU channel automatically. This ensures a backup to the power supply.

Two batteries are installed in the Ka-50, thus ensuring autonomous engine startup and emergency bus supply if both generators fail. The IFF responder is supplied directly by these batteries.
In the CDU-3 and CDU-4 are two buses.

- Bus No. 1 is for emergencies, which in case both rectifiers fail, power is supplied by the batteries.
- Bus No. 2 is for bus disconnection, in case both rectifiers fail and are disconnected.

The following power consumers are supplied by the DC emergency buses (in case both generators and rectifiers fail):

- POS-500B inverter to supply the AC consumers
- Communication equipment: VHF radios, intercom
- Radar altimeter
- IFF responder
- Weapon control system
- Power plant and hydraulic system indicators
- Fuel quantity indicator, fuel pumps, and shut-off valves
- PTS-25 inverter to supply the standby horizon
- Lights
- Pitot heating
- Warning and indication systems and EKRAN system

The batteries are activated by the “ЭНЕРГЕТИКА =ТОК” (DC Ground Power), “BAT1” (Battery 1) and “BAT2” (Battery 2) switches on the right wall panel. The rectifiers are automatically turned on when there is an external power source or the generators are online.

6 – ANTI-ICE SYSTEM

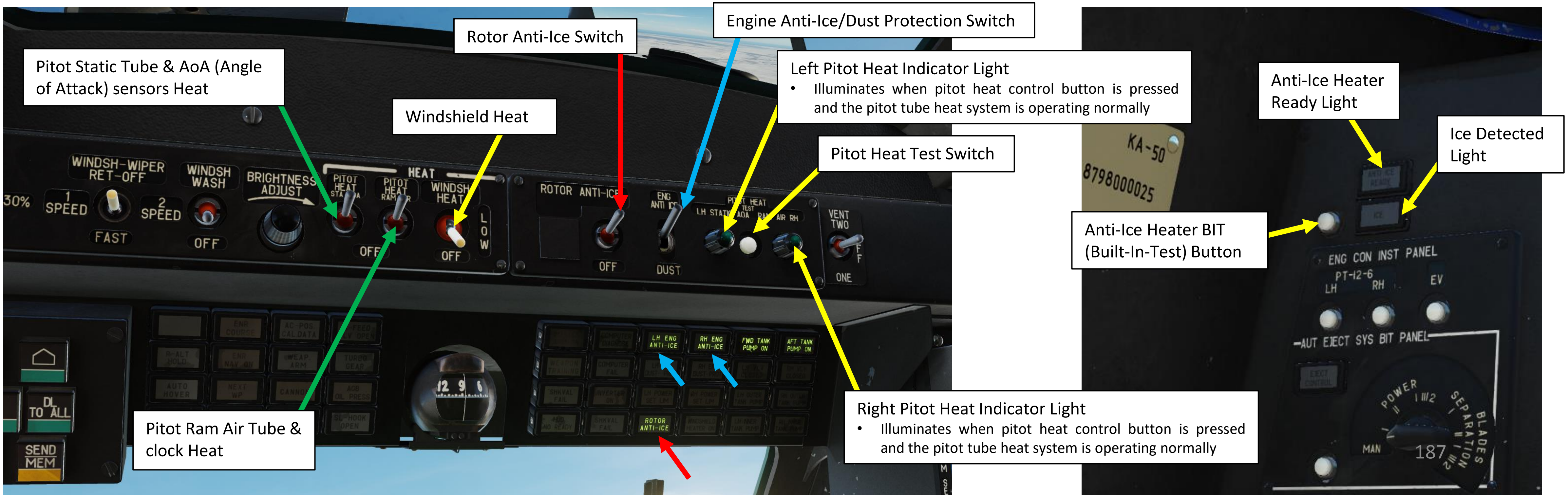
When flying at temperatures below 0°C there is a danger of ice forming on various components of helicopter.

Engine inlet icing leads to reduced inlet cross-section area thus reducing the air flow and causing compressor to operate closer to its dynamic gas stability limit (stall line). Reduced air flow reduces also engine power. Reduced power causes automatic regulators to increase fuel flow which increases temperature before turbo-compressor which again leads to compressor operating closer to stability limit. If the icing is severe enough the engine can stall. Generally it will occur if the engine increases its power (spools up) when the gas temperature is rising as additional fuel is injected in the combustion chamber. The icing occurs due to free water presence in the air when the temperature is below 0°C . The icing also depends on helicopter's airspeed and amount of free water present in the air. The first **indication of inlet icing is increased temperature before turbo-compressor**.

To prevent inlet icing the **engine anti-icing system** needs to be engaged by setting the **Engine Anti-Ice/Dust Protection Switch to ENG ANTI-ICE (UP)**.

Ice forming on rotor blades changes their air-dynamic properties, reducing thrust and causing increased engine power output required to maintain required RPM. To prevent ice accretion on rotor blades, set the **Rotor Anti-Ice Switch ON (UP)**.

Pitot and AoA (Angle of Attack) sensors icing. Ice buildup on pitot causes incorrect readings on barometric indicators (air speed indicator, vertical speed indicator, barometric altitude indicator). In extreme cases it can render them completely inoperable. The same problem can occur to AoA sensors – icing will prevent free rotation of its components. When outside conditions are such that ice buildup can occur the **heaters for pitot and AoA sensors should be turned on (switches UP)**.



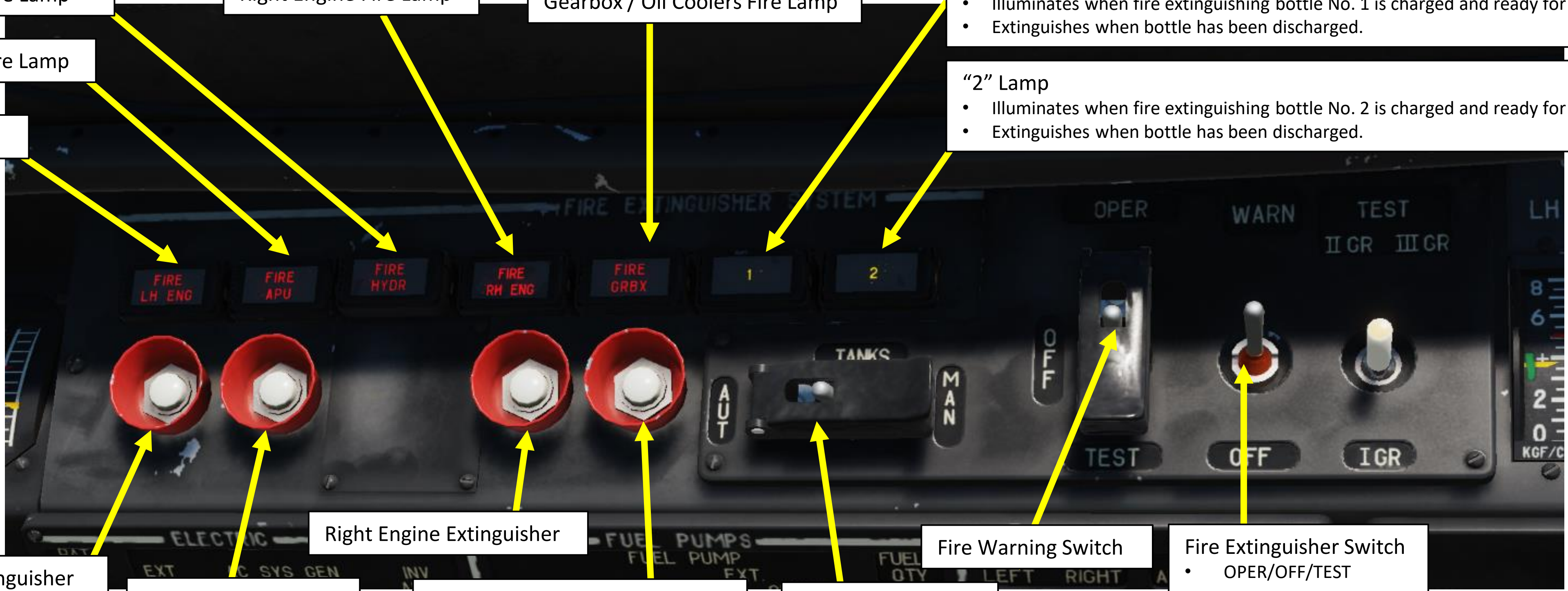
7 – FIRE PROTECTION SYSTEM

7.1 – General Description

The Ka-50 has an extensive suite of fire monitoring and fire extinguisher systems that are controlled from the fire extinguisher panel. Each fire extinguisher system uses fire retardant contained within a pressurized bottle to flood the desired compartment.

Fire in the power plant compartment is indicated by:

- Illumination and flashing of the Master Warning Light (MWL) and the “ПОЖАР” (Fire) light on the instrument panel will light.
- Voice Message Unit (VMU) message about fire in one of the compartments.
- Illumination of the wall panel (fire extinguishing system) red fire lights. Each light is labeled according to the compartment where a fire has been detected: “ПОЖАР ЛЕВ ДВИГ” (Left engine fire), “ПОЖАР ВСУ” (APU fire), “ПОЖАР ПРАВ ДВИГ” (Right engine fire) and “ПОЖАР ВЕНТИЛ” (Oil cooling fan fire).



7 – FIRE PROTECTION SYSTEM
7.2 – Operation

When a fire has been detected, take the following actions:

1. Check for the illumination of the yellow light "1" on the wall panel. A "1" indicates that an automatic discharge of the first extinguishing sequence has been selected if the Fire Extinguisher Activation Mode Switch is set to AUTO.
2. If the automatic system hasn't worked, engage it manually by pressing the corresponding button underneath the "ПОЖАР ЛЕВ ДВИГ" (Left engine fire), "ПОЖАР ВСУ" (APU fire), "ПОЖАР ПРАВ ДВИГ" (Right engine fire), or "ПОЖАР ВЕНТИЛ" (Oil cooling fan fire) warning light.

2a Fire Detected Caution Light

2b **Fire extinguisher activation mode (Manual/Auto mode) switch.**

- Normally it's in the ("АВТ") automatic mode which means that in case of fire bottle "1" will be automatically discharged.
- If bottle "1" doesn't discharge automatically you can do it manually by pressing the button of the corresponding compartment. When the switch is in MANUAL ("РУЧН") position you can discharge bottle "2" but only manually, by pressing the button of the corresponding compartment.

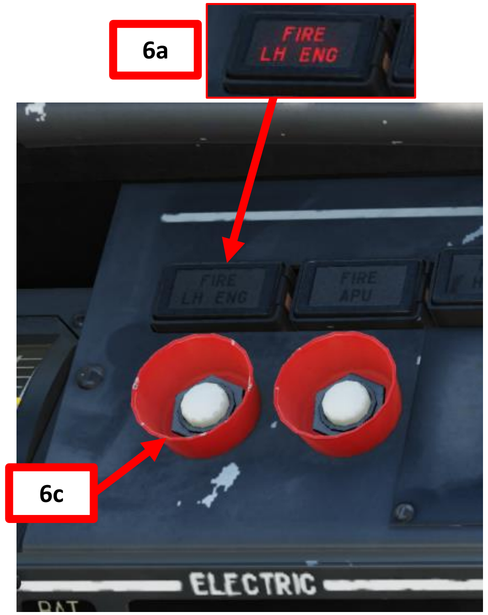
2a

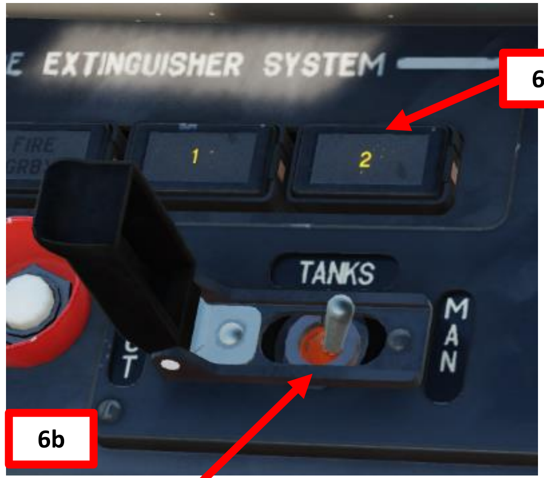
1

2c

7 – FIRE PROTECTION SYSTEM
7.2 – Operation

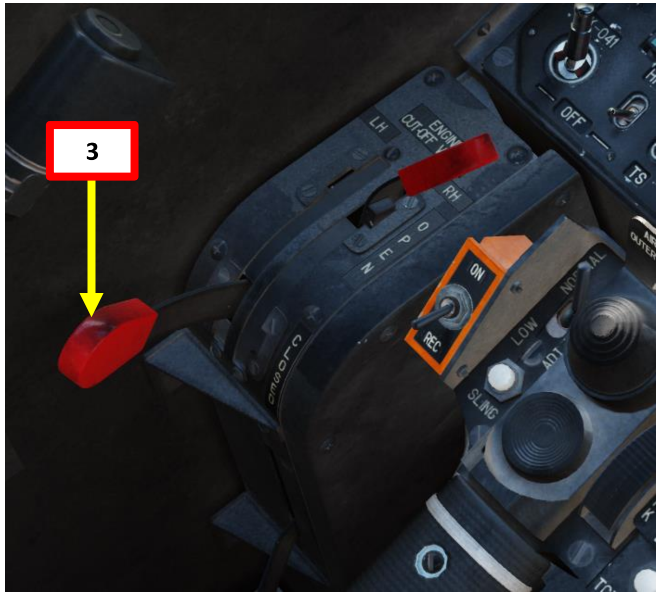
3. If a fire is detected in any of the engine compartments, shut down the engine in the compartment where the fire has been detected by closing the Engine Cut-Off Valve Levers (AFT) and the Fuel Shut-off valves (switch DOWN). Continue the flight by operating on a single engine.
4. In case of a fire in the APU compartment, shut down the APU by pressing the “ОСТАНОВ ВСУ” (Stop APU) button and close the APU Shut-off valve (switch DOWN).
5. Confirm that the fire has been extinguished by checking that the “ПОЖАР” (Fire) and Master Warning lights going out.
6. If after the 1st automatic sequence discharge the “ПОЖАР” (Fire) light and the Master Warning light are still illuminated, discharge the 2nd sequence by switching the Fire Extinguisher Activation Mode selector to MAN position (which selects the second extinguishing agent bottle) and press the corresponding button under the light that is indicating a fire. A yellow “2” light will illuminate, indicating the discharge of the 2nd extinguisher.
7. Use extreme caution when operating the cut-off and the shut-off valves to avoid shutting down the serviceable engine.
8. After the fire has been eliminated, it is advised that you do not start an engine in whose compartment a fire has been detected.

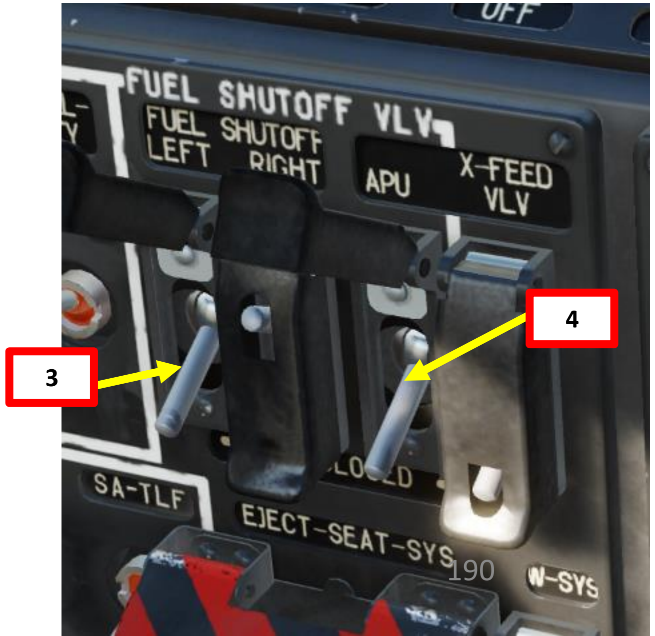




Fire extinguisher activation mode (Manual/Auto mode) switch.

- Normally it's in the (“ABT”) automatic mode which means that in case of fire bottle "1" will be automatically discharged.
- If bottle "1" doesn't discharge automatically you can do it manually by pressing the button of the corresponding compartment. When the switch is in MANUAL (“РУЧН”) position you can discharge bottle "2" but only manually, by pressing the button of the corresponding compartment.





7 – FIRE PROTECTION SYSTEM
7.2 – Operation

9. If the fire elimination is unsuccessful, attempt an emergency landing.
10. If an emergency landing is not possible, eject.

HELICOPTER SERVICE LIMITS

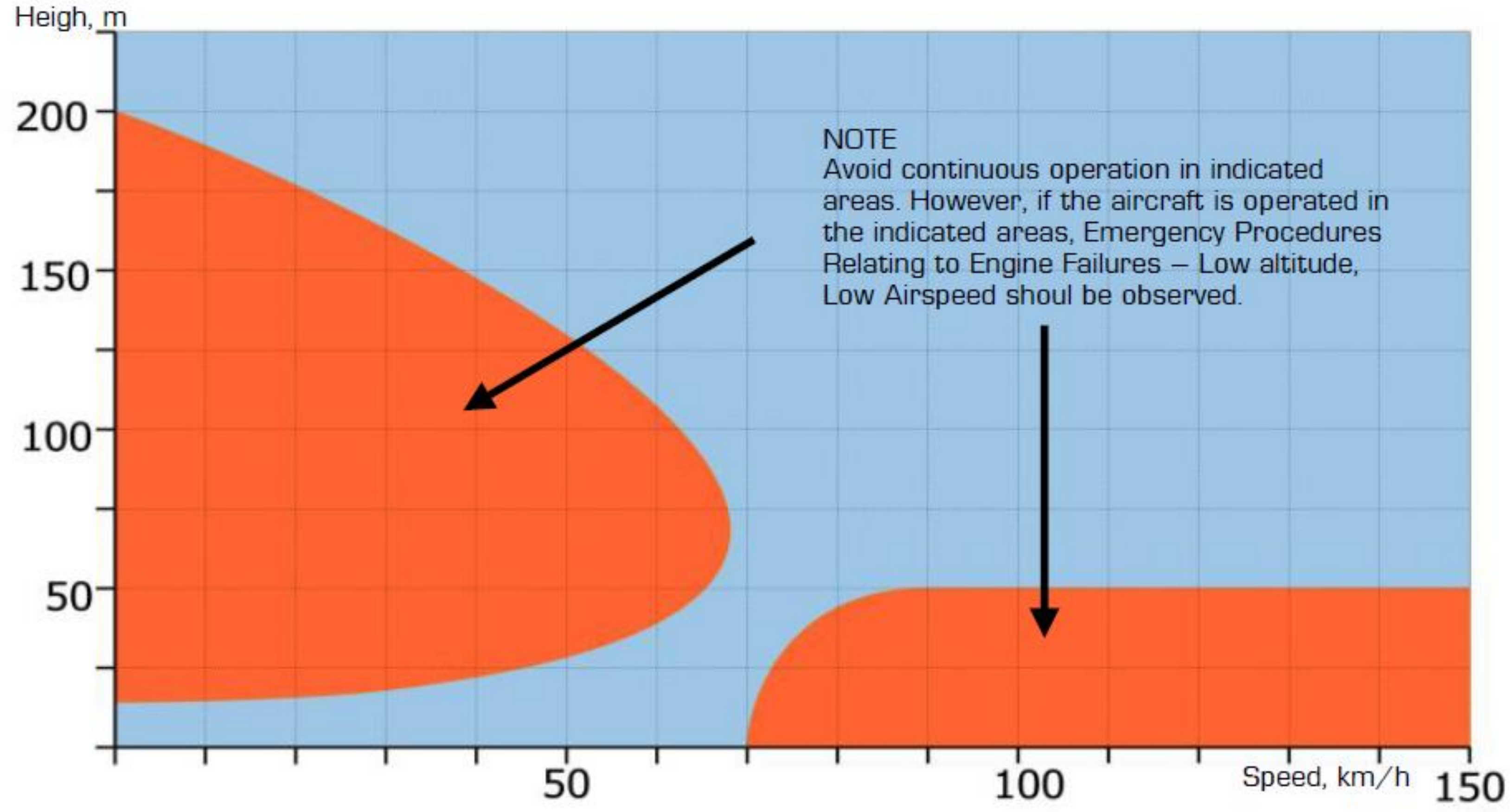
Service Limits Overview

Limited Parameter	Value	Reason
Maximum Takeoff & Landing Weight	10800 kg	Airframe and landing gear strength
Maximum Ferry Takeoff & Landing Weight	11900 kg	Airframe and landing gear strength
Maximum Airspeed		
Indicated airspeed in gear-up and gear-down configuration	300 km/h	Blade's stall, flutter and strength
During landing gear extension/retraction indicated airspeed	200 km/h	Landing gear doors strength
Ground speed at touchdown	80 km/h	Nose gears shimmy
Vertical Speed in descent (glide) at 50 km/h		Avoid entering vortex ring state
Above 200 m radar altimeter (true) altitude	5 m/s	
Below 200 m radar altimeter (true) altitude	3 m/s	
Maximum Wind Speed		Controllability
For taxi – Head wind	20 m/s	
For taxi – Crosswind and tailwind	10 m/s	
For takeoff & landing	10 m/s	
Pitch-up and pitch-down maximum angle	60 deg	
Maximum bank angle	65 deg	
G-load factor		
Maximum up to 250 km/h (indicated airspeed)	3.0 G	Airframe Strength
Minimum	0 G	Minimum clearance between lower rotor blades and fuselage
Maximum for ferry configuration	1.5 G	

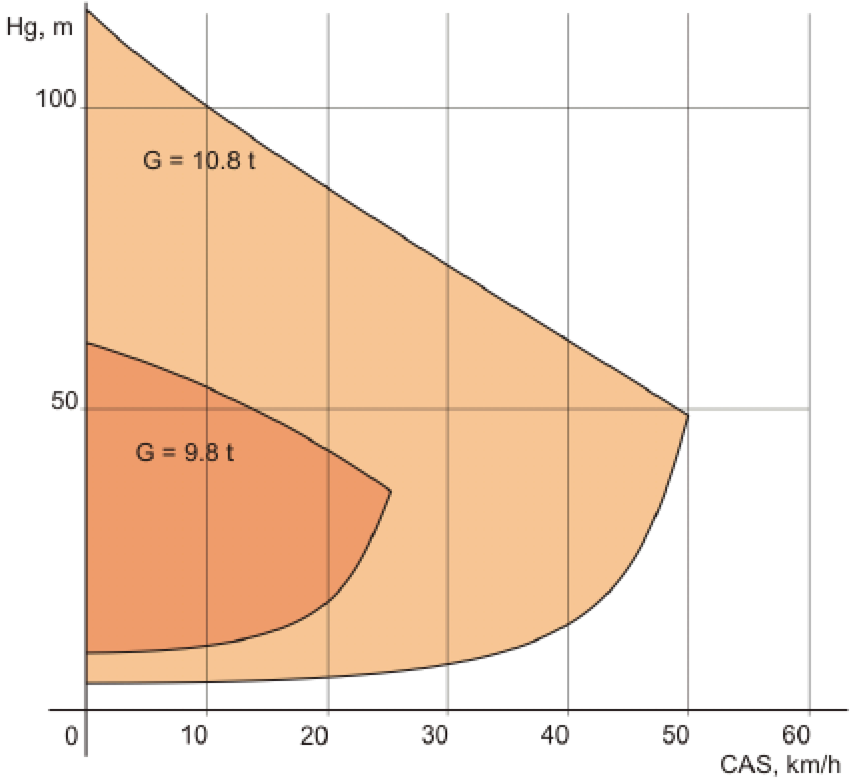
FLIGHT ENVELOPE: HEIGHT VS SPEED & "DEAD MAN'S CURVE"

All helicopters carry an operator's manual that has an airspeed versus altitude chart similar to this one. The shaded area on this chart must be avoided. It is often referred to as the "dead man's curve" and "avoid curve". Proper manoeuvres for a safe landing during engine failure cannot be accomplished in these areas.

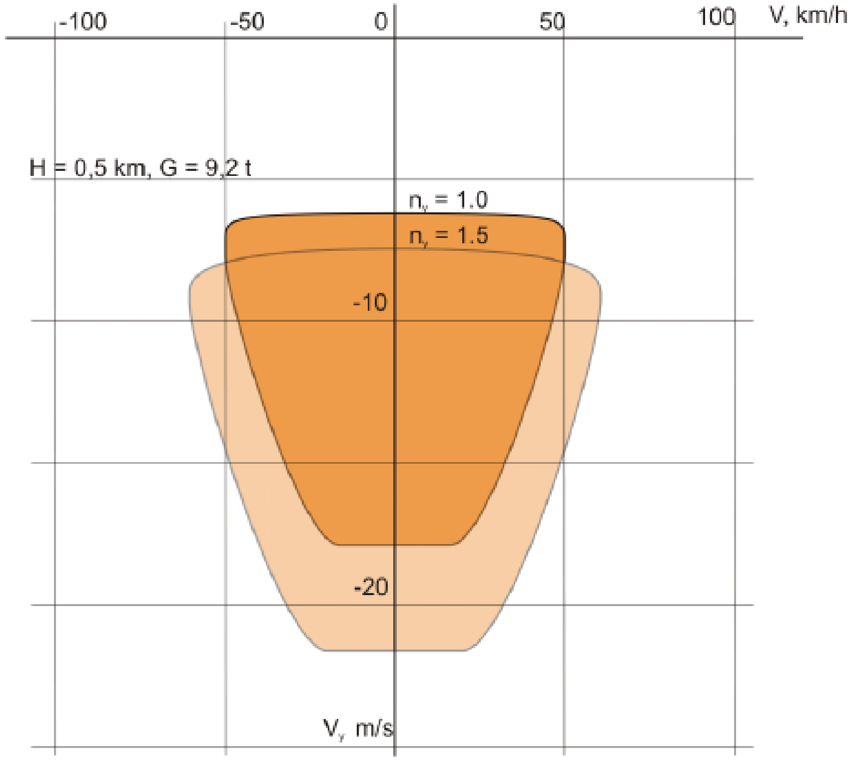
Height-Velocity Diagram



Critical Altitude-Velocity Zone



Vortex Ring Safety Zones



MAXIMUM ALLOWED IAS for GW ≤ GW norm *)

t_M °C / M KM	+50	+40	+30	+20	+10	0	-10	-20	-30	-40	-50	-60
To 0,5	250	285	290	295	300	305	305	305	305	300	285	285
1	270	275	280	285	290	295	300	305	305	290	275	255
2	240	225	240	255	270	280	285	290	280	270	255	240
3	145	160	180	195	215	230	250	265	255	245	235	220
4	90	95	110	125	150	165	190	205	225	230	220	205
5	270	270	270	90	80	95	120	160	160	180	200	190

* When gross weight exceeds normal weight ma[illegible] IAS reduces by 15 kph for each additional 0.5 tons.

FLIGHT CONTROLS

The Ka-50 helicopter's controls are connected to the rotor assemblies via one-way hydraulic augmentation. Moving the cockpit controls thus allows the rotor blades to generate and control imbalances in the lifting force, which cause the aircraft to be propelled in the desired direction along any combination of the three axial directions: longitudinal, lateral, and vertical. Deflecting the cyclic control in the longitudinal and(or) lateral directions will tilt the rotor swashplate mechanisms accordingly, to create a "feathering" effect that increases the pitch angle of the rotor blades more sharply on one side of the aircraft than on the other. This uneven rotor blade pitch generates a differential lift that is stronger on one side, tilting and propelling the aircraft in the desired direction.

The two "wings" that carry weapon pylons are also peculiar; at high speeds, these wings generate a significant amount of lift, which can either be used to go faster or to reduce the engine power required to maintain the current attitude.

FLIGHT CONTROLS

The **cyclic** is your primary means of controlling helicopter attitude. Just like a fixed-wing aircraft, pushing and pulling the stick affects aircraft pitch and moving the stick side to side inputs roll. Unlike a fixed-wing aircraft though, you will generally pitch the helicopter forward to initiate forward flight and pull the stick back to slow down or even fly backwards.

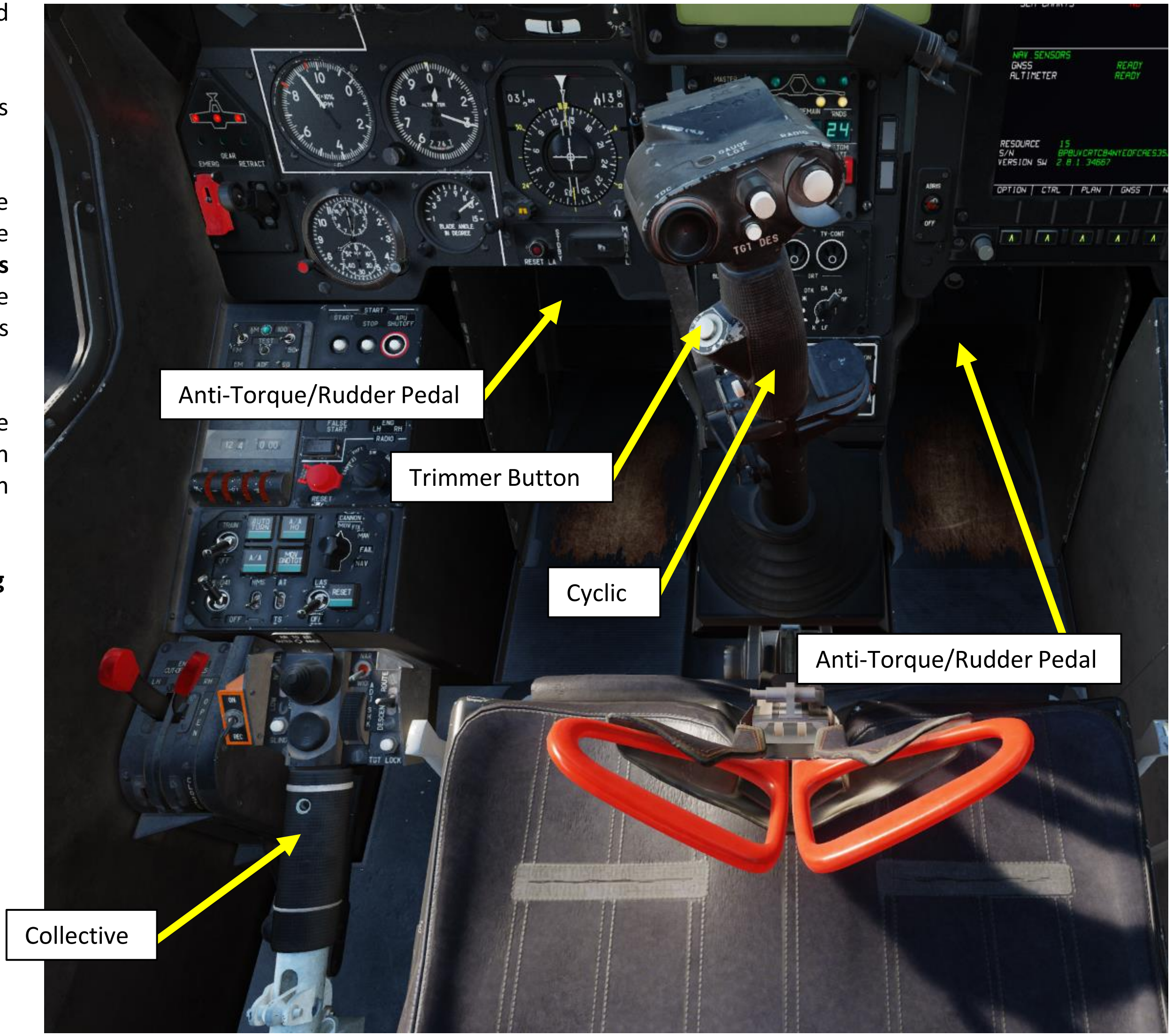
The **collective** adjusts engine power and controls the pitch of the rotor blades, which affects lift generated by the main rotor.

Pressing on the left or right **rudder pedal** (also referred as "**anti-torque pedal**") increases the collective rotor blade pitch on one rotor, while simultaneously decreasing the rotor blade pitch of the other rotor. In this way, the total lift is maintained, but a **differential torque is created between the unbalanced contra-rotating upper and lower rotors**, which rotates the aircraft in azimuth. Pressing on one of the rudder pedals also tilts the helicopter's aerodynamic tail rudder in the same (left or right) direction.

Each flight control (i.e. cyclic, collective, and rudder) is independently connected to the mechanical rotor assemblies and tail rudder control surface. Each control is provided with hydraulic augmentation to reduce the pilot steering force required to control the helicopter in every direction.

In addition to the fight controls described above, the aircraft controls are fitted with **trimming mechanisms**. These are for:

- Providing an opposite feedback force through the controls to the pilot, linearly proportional to the distance of the control deflection, to imitate conventional aircraft aerodynamic controls.
- Balancing the "neutral" position of the controls, so that the feedback force is absent when the controls are centered.



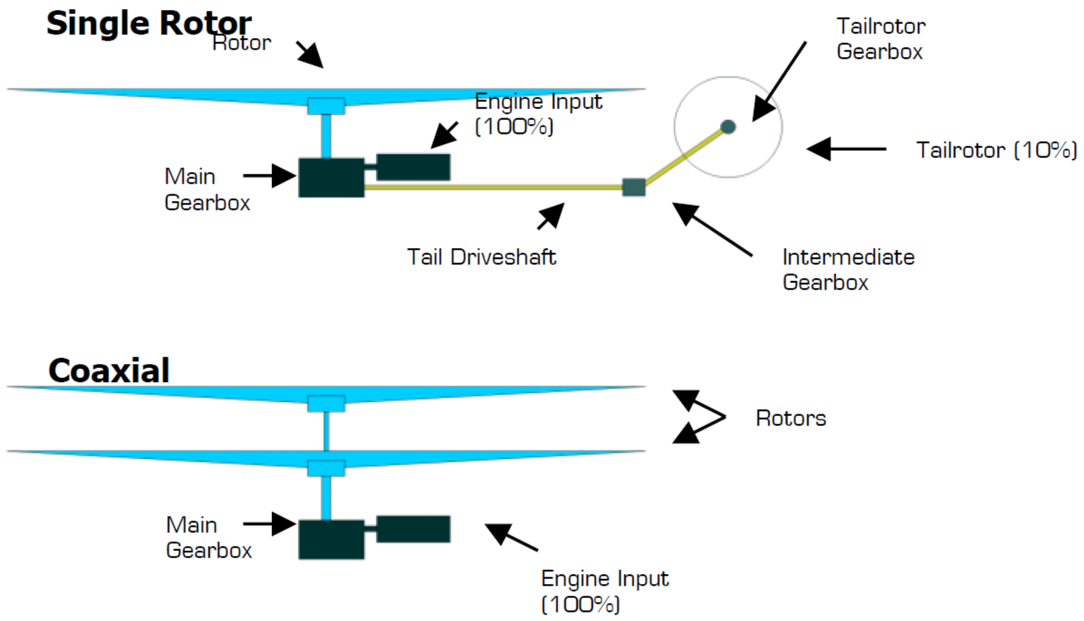
HOW COAXIAL ROTORS DIFFER FROM "TRADITIONAL" HELICOPTERS

The coaxial rotor configuration of the Ka-50 is special because it embodies a principle of reactive moment compensation that is fundamentally different from that of the single-rotor configuration. To compensate for the reactive moment of the single-rotor helicopter's main rotor, an anti-torque tail rotor is necessary. However, reactive moments of a coaxial-rotor are compensated for by the counter-rotational forces canceling out each other. This removes the need for any additional forces like a tail rotor. The coaxial-rotors' reactive moments are compensated automatically throughout the flight, thus requiring little input compensation by the pilot.

A peculiarity of a coaxial-rotor with zero reactive moment in balanced flight is that the pilot's pedal inputs create a disparity between the upper and lower reactive moments of the engines. This resulting summary reactive moment can then be used for yaw directional control.

The reactive moment compensation method employed in a single-rotor helicopter requires the pilot's constant attention. To achieve balanced flight, the pilot needs to adjust the tail rotor's side forces; this puts the helicopter to a certain disadvantage compared to a coaxial design. The counter-rotation of coaxial rotors leads to a significant reduction in power that is required to hover the helicopter.

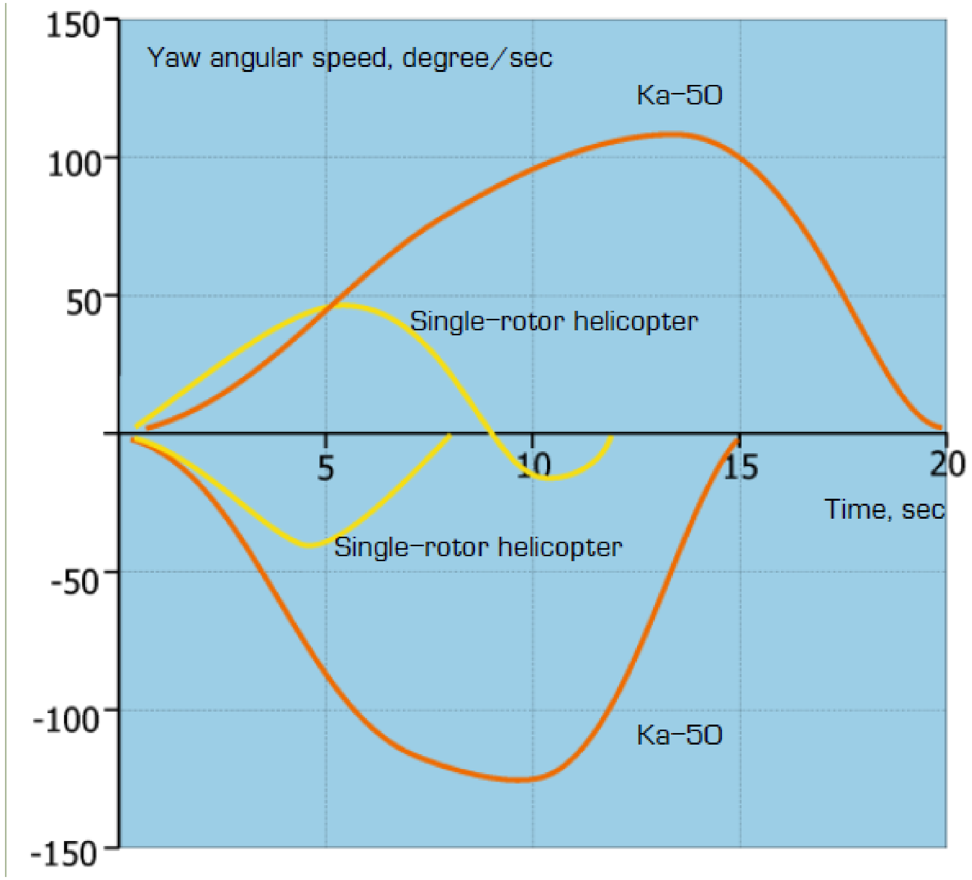
Coaxial and single rotor helicopters drive train



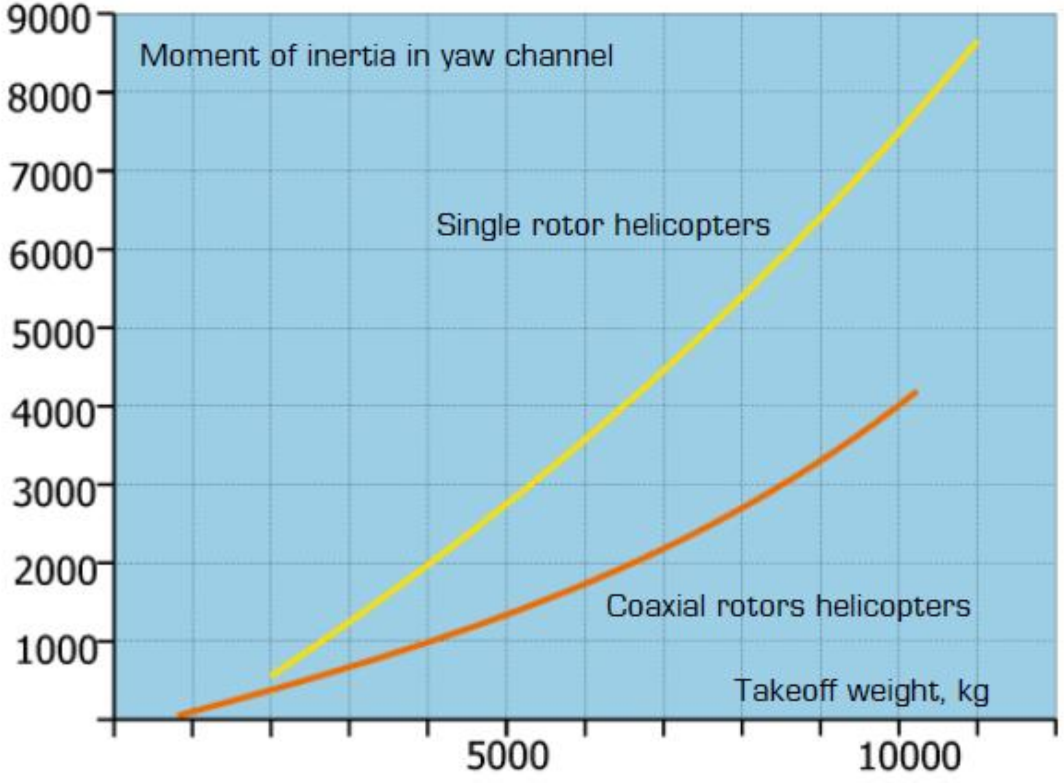
HOW COAXIAL ROTORS DIFFER FROM "TRADITIONAL" HELICOPTERS

Believe it or not, there are actually advantages to using a coaxial rotor configuration. We could talk about it for hours, but I will let these two graphs speak for themselves.

Yaw Angular Speed in the Hover



Coaxial-Rotor and Single-Rotor Helicopters' Moment of Inertia



TRIMMING

A lot of people are having difficulties flying the Black Shark because they do not understand all the small aerodynamic phenomenon that define the Ka-50's manoeuvering abilities.

Froogle goes in a lot of detail about the art of flying the Ka-50. He explains the **importance of trimming** since many mistakes happen because of the peculiar aerodynamics of the Black Shark. You trim by basically holding down the trim switch (make sure you have one mapped in your controls) until you come to a stable state, and THEN release the trim button. You can reset trim by using the "Trim Reset" button.

Flying the Ka-50
https://www.youtube.com/watch?v=aH4tSiU7TCE

Mastering the Trim
https://www.youtube.com/watch?v=aH4tSiU7TCE

A very nice tutorial by Erik "EinsteinEP" Pierce explaining the trim on the Shark
http://www.simhq.com/_air13/air_428a.html

THE MYSTERY OF TRIM

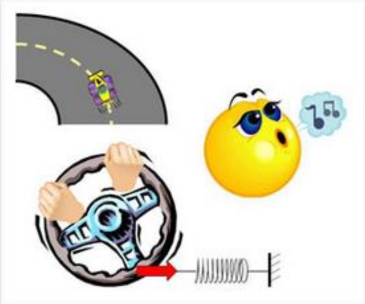
Tutorial taken from Erik "EinsteinEP" Pierce's article on SIMHQ

Just Push the Button

Imagine driving a car at a constant speed around a perfectly circular track. To make the constant turn, you have to hold the steering wheel in the proper position, turning it against the straightening tendency of the wheels on the road surface. If, because of the size of the track, the speed you were driving, etc., the required force was 50 lbs (~23 kg), or more, how long do you think you could keep this up before your arms felt like they had turned to rubber?

Driving a Circular Track

Now imagine that you were to drive the same course in car with a spring installed to the steering column that pulled the steering wheel in one direction. If we designed the spring so that it had just the right tension and was installed in just the right place, the spring could apply all the force needed to keep the wheel in the right position. You could literally drive hands-off all the way around the course. In reality, you would still need to provide minute corrections as the car's heading was perturbed by the uneven road surface, wind, etc., but the effort would be minimal and you could probably drive until you ran out of gas without your arms giving up on you.



Driving a Circular Track with a Spring

If you were driving in any condition other than the one that the spring was designed for (faster or slower, bigger or smaller track, straight road, etc.), either the spring wouldn't be helping enough or you'd be fighting its input. However, if a spring were installed that allowed you to adjust tension in real-time, then you could minimize the control force needed for any driving condition. This is the essence of control system trim.

Over the years, aircraft designers have come up with some very clever methods to implement trim, from springs and weights to tabs and cables and pulleys to complex computer algorithms and electronic servos. Some methods, like the one used in the Kamov Ka-50 helicopter simulated in the DCS: Black Shark simulation, are much more complicated than our spring example, and require additional explanation and some hands-on experimentation to really understand.

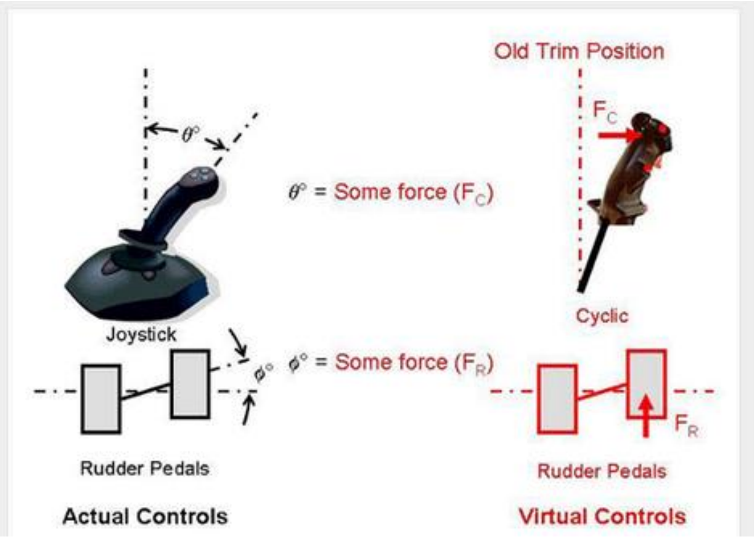
In the Ka-50, just like in our spring example, control system trim is accomplished by adjusting stuff "behind the scenes" to the pilot so that the pressure needed to be applied to the flight controls is reduced to zero. The actual workings of the Ka-50's trim system (aka the Trimmer) involve electromagnets, hydraulic controls, and a bunch of other "magic" stuff, but you don't need to understand these mechanics to know how to use the Trimmer.

No Easy Explanation

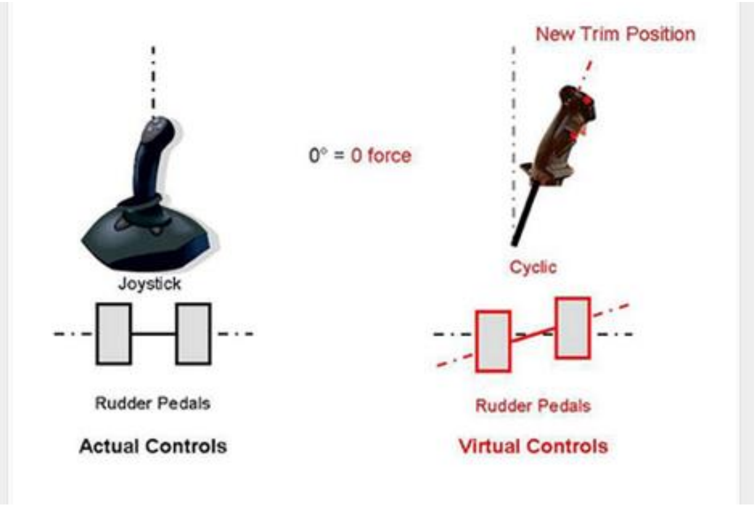
If a pilot finds they have to constantly hold back pressure on the cyclic control stick to keep the Ka-50's nose at the right attitude, they can press (then release) the Trimmer button while holding the cyclic steady in a position that gives the desired attitude. This action causes the control system to readjust itself, just like the spring with adjustable tension in our previous example, so that no additional force is required to keep the stick in that position. This is referred to as "trimming", "re-centering", or even "re-zeroing" the controls. Whatever you choose to call it, it means that you don't have to hold pressure on the controls to maintain the desired attitude for a given flight condition.

THE MYSTERY OF TRIM

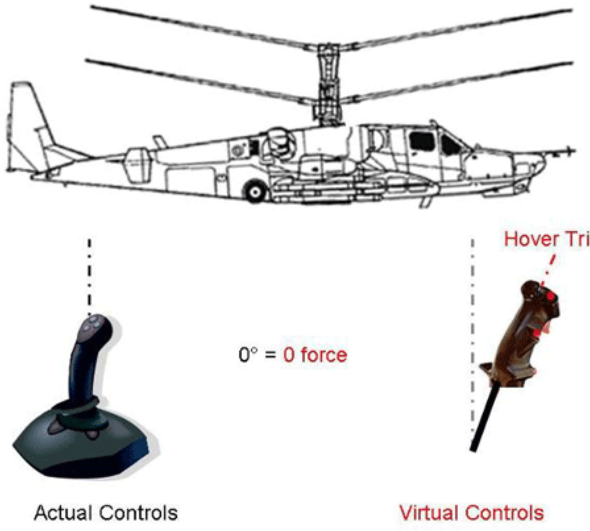
Tutorial taken from Erik “EinsteinEP” Pierce’s article on SIMHQ



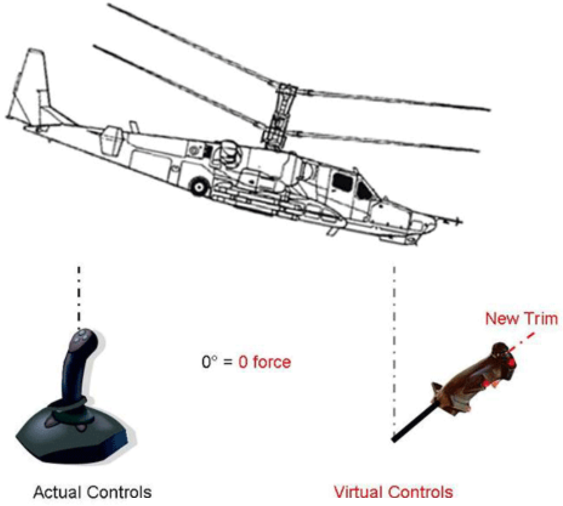
Before Trimming



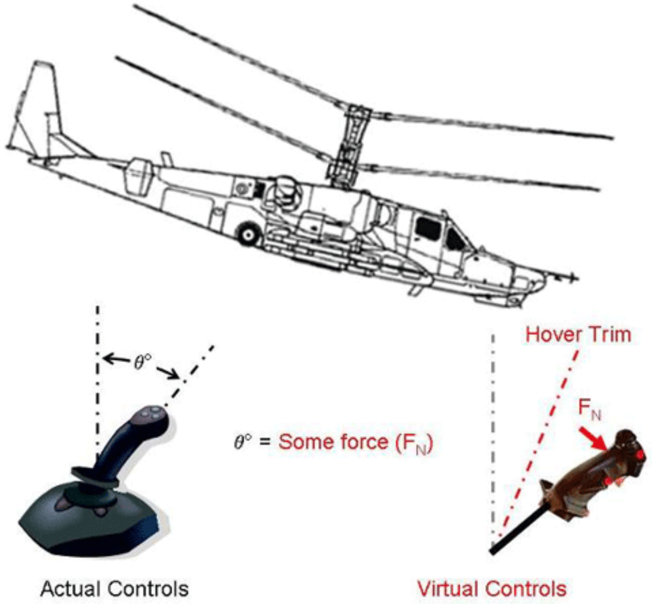
After Trimming



Trimmed for Hover



Trimmed for Acceleration



Pitch Down for Forward Flight

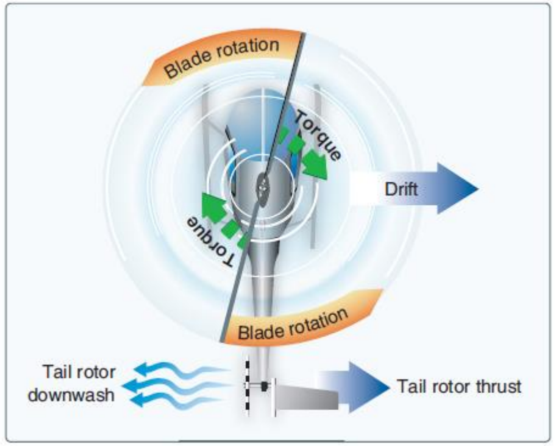
FORCES: TORQUE, TRANSLATIONAL & VERTICAL LIFT

IN A NUTSHELL…

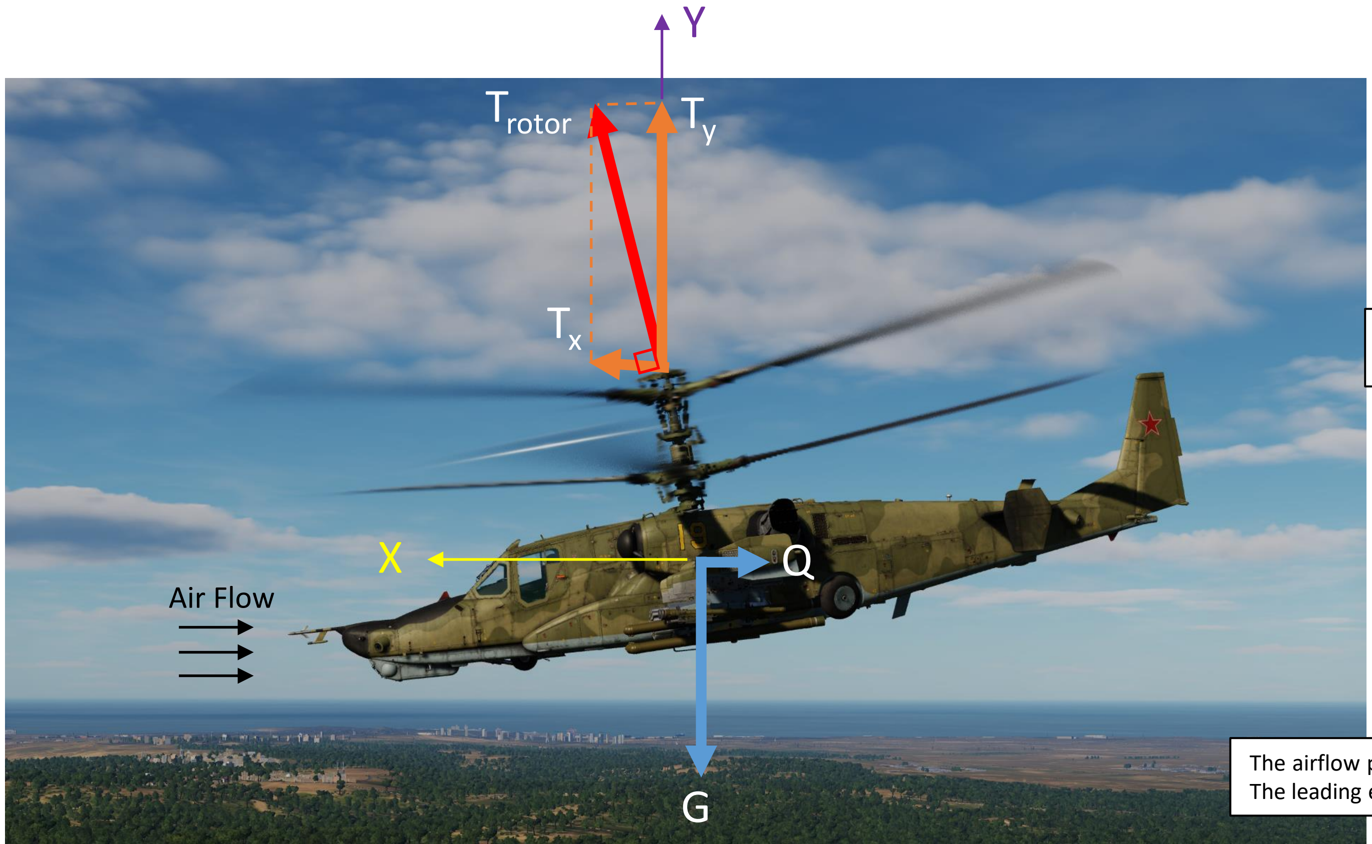
In a hover, you will most likely generate vertical lift only since the lift vector is pointing upwards. However, if you push your nose down and gain horizontal speed, you will notice that you will generate much more lift as you gain speed. This is called "**Translational Lift**": your blades gain much more lift efficiency as you accelerate.

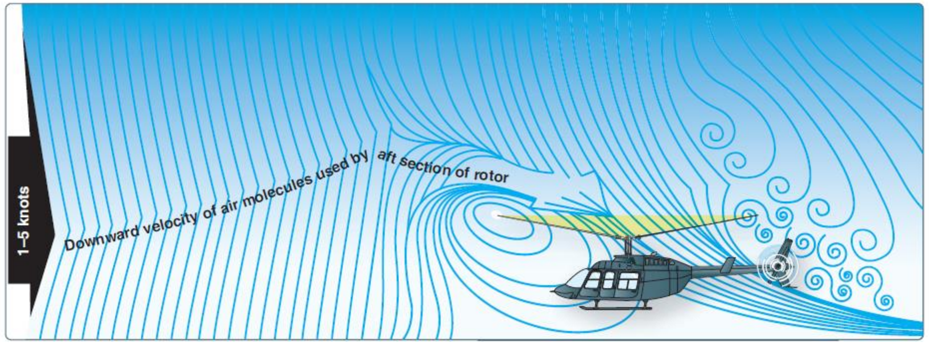
You might also wonder why you need to apply right pedal when you are hovering. This is simply to counter the **torque** created by the main rotor blades' rotation in the yaw axis. In a prop airplane, the torque will force you to use pedal on takeoff to stay straight. The same principle applies for a helicopter, but in a different axis.

Translating tendency is a left lateral movement of the helicopter that is a combination of tail rotor thrust and main rotor torque; translating tendency is countered with right cyclic.

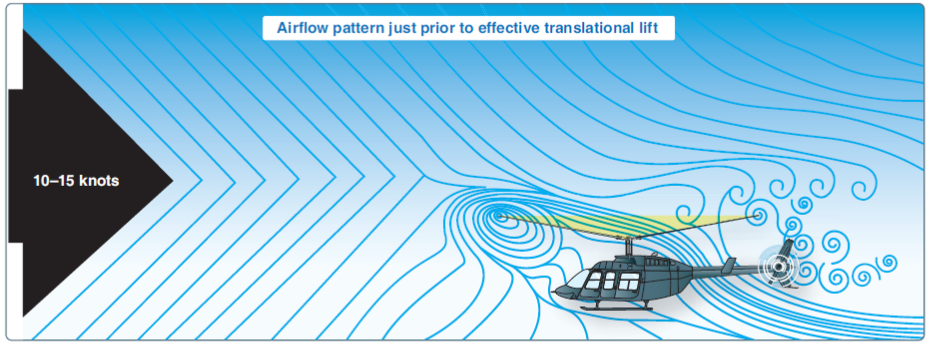


A tail rotor is designed to produce thrust in a direction opposite torque. The thrust produced by the tail rotor is sufficient to move the helicopter laterally.





The airflow pattern for 1-5 knots of forward airspeed. Note how the downwind vortex is beginning to dissipate and induced flow down through the rear of the rotor system is more horizontal.



The airflow pattern for 10-15 knots. At this increased airspeed, the airflow continues to become more horizontal. The leading edge of the downwash pattern is being overrun and is well back under the nose of the helicopter.

RETREATING BLADE STALL & DISSYMMETRY OF LIFT

In forward flight, the relative airflow through the main rotor disk is different on the advancing and retreating side. The relative airflow over the advancing side is higher due to the forward speed of the helicopter, while the relative airflow on the retreating side is lower. This dissymmetry of lift increases as forward speed increases. To generate the same amount of lift across the rotor disk, the advancing blade flaps up while the retreating blade flaps down. This causes the AOA to decrease on the advancing blade, which reduces lift, and increase on the retreating blade, which increases lift.

At some point as the forward speed increases, the low blade speed on the retreating blade, and its high AOA cause a stall and loss of lift. Retreating blade stall is a major factor in limiting a helicopter’s never-exceed speed (VNE) and its development can be felt by a low frequency vibration, pitching up of the nose, and a roll in the direction of the retreating blade. High weight, low rotor rpm, high density altitude, turbulence and/or steep, abrupt turns are all conducive to retreating blade stall at high forward airspeeds. As altitude is increased, higher blade angles are required to maintain lift at a given airspeed.

Thus, retreating blade stall is encountered at a lower forward airspeed at altitude. Most manufacturers publish charts and graphs showing a VNE decrease with altitude.

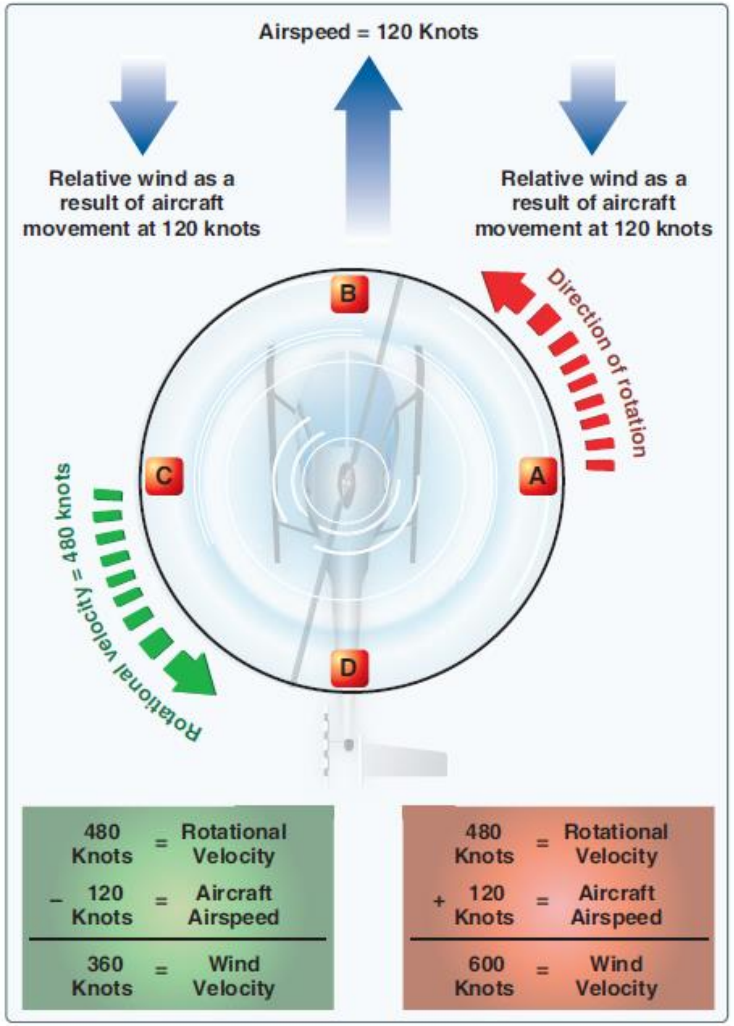


Figure 2-33. *Airflow in forward flight.*

IN A NUTSHELL…

Did you ever wonder why your helicopter can never stay straight when you center your cyclic stick? The reason why you always need to hold your stick to your left and towards you is because the lift generated by your rotor blade is not equal everywhere on your blades. Therefore, the lift profile is **not symmetric.** “Lift dissymmetry” is just other fancy ways to refer to this phenomenon.

“Retreating Blade Stall” is a major factor in limiting a helicopter's maximum forward airspeed. Just as the stall of a fixed wing aircraft wing limits the low-airspeed flight envelope, the stall of a rotor blade limits the high-speed potential of a helicopter.

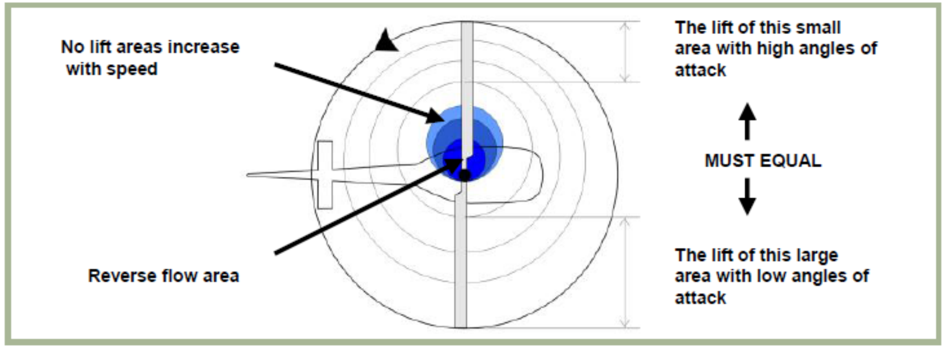


Figure 3.8. Normal Cruise Lift Pattern

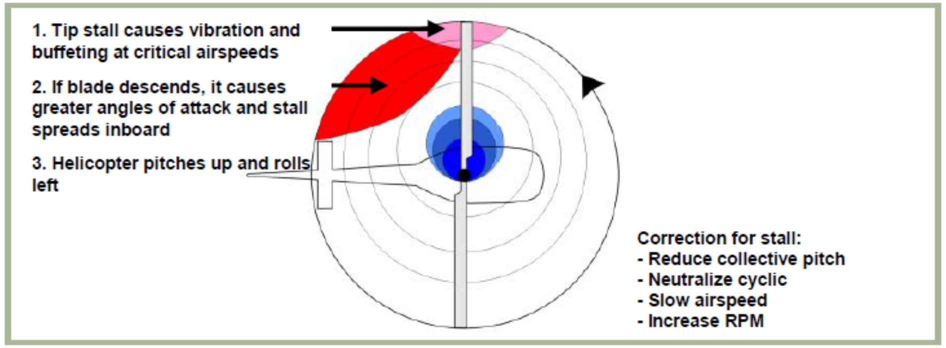


Figure 3.9. Lift Pattern at Critical Airspeed

OGE VS IGE: UNDERSTANDING GROUND EFFECT

Ground effect is the increased efficiency of the rotor system caused by interference of the airflow when near the ground. The air pressure or density is increased, which acts to decrease the downward velocity of air. Ground effect permits relative wind to be more horizontal, lift vector to be more vertical, and induced drag to be reduced.

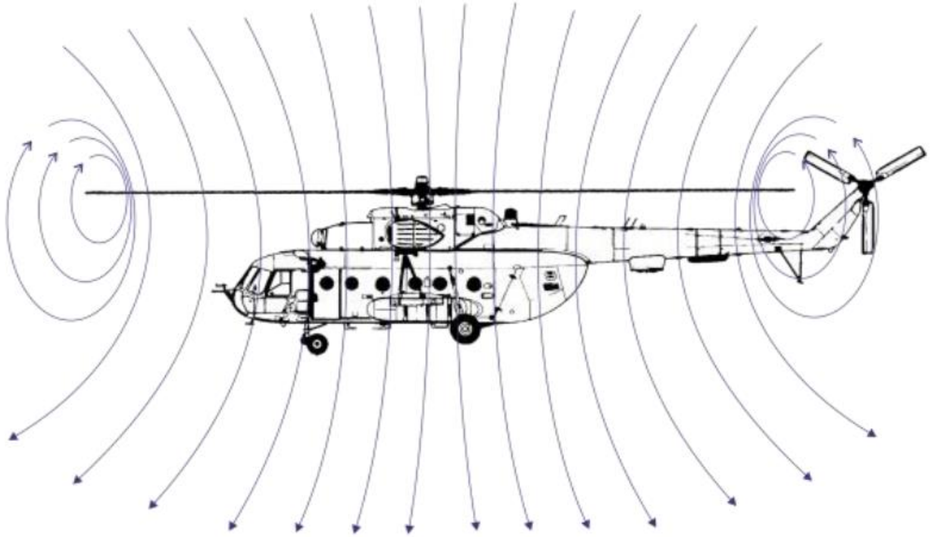
These conditions allow the rotor system to be more efficient. Maximum ground effect is achieved when hovering over smooth hard surfaces. When hovering over surfaces as tall grass, trees, bushes, rough terrain, and water, maximum ground effect is reduced. Rotor efficiency is increased by ground effect to a height of about one rotor diameter (measured from the ground to the rotor disk) for most helicopters. Since the induced flow velocities are decreased, the AOA is increased, which requires a reduced blade pitch angle and a reduction in induced drag. This reduces the power required to hover IGE.

The benefit of placing the helicopter near the ground is lost above IGE altitude, which is what we call OGE: Out of Ground Effect.

IN A NUTSHELL…

Ground Effect is what gives you additional lift when you are flying close to the ground. A hover, for instance, is much easier to maintain close to the ground torque-wise since ground effect is nullified at higher altitudes.

Ground effect is specially important on missions where you need to fly NOE (Nap-Of-Earth, where even lawnmowers dare not set foot).



Airflow when Out of Ground Effect (OGE) (Mi-8)

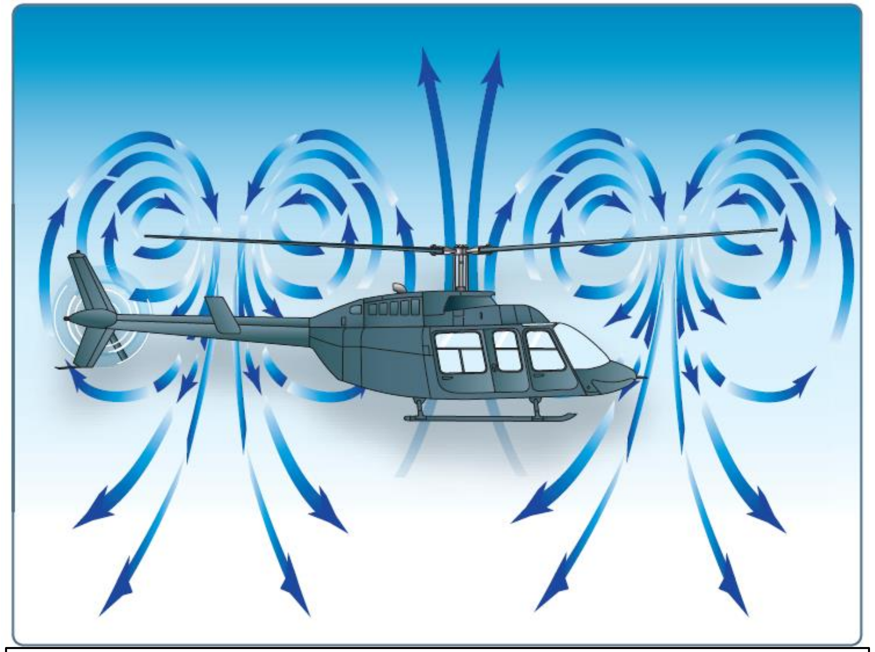
Airflow when In Ground Effect (IGE) (Mi-8)

VORTEX RING STATE (VRS)

Vortex ring state describes an aerodynamic condition in which a helicopter may be in a vertical descent with 20 percent up to maximum power applied, and little or no climb performance. The term “settling with power” comes from the fact that the helicopter keeps settling even though full engine power is applied.

In a normal out-of-ground-effect (OGE) hover, the helicopter is able to remain stationary by propelling a large mass of air down through the main rotor. Some of the air is recirculated near the tips of the blades, curling up from the bottom of the rotor system and rejoining the air entering the rotor from the top. This phenomenon is common to all airfoils and is known as tip vortices. Tip vortices generate drag and degrade airfoil efficiency. As long as the tip vortices are small, their only effect is a small loss in rotor efficiency. However, when the helicopter begins to descend vertically, it settles into its own downwash, which greatly enlarges the tip vortices. In this vortex ring state, most of the power developed by the engine is wasted in circulating the air in a doughnut pattern around the rotor.

A fully developed vortex ring state is characterized by an unstable condition in which the helicopter experiences uncommanded pitch and roll oscillations, has little or no collective authority, and achieves a descent rate that may approach 6,000 feet per minute (fpm) if allowed to develop.



Vortex Ring State

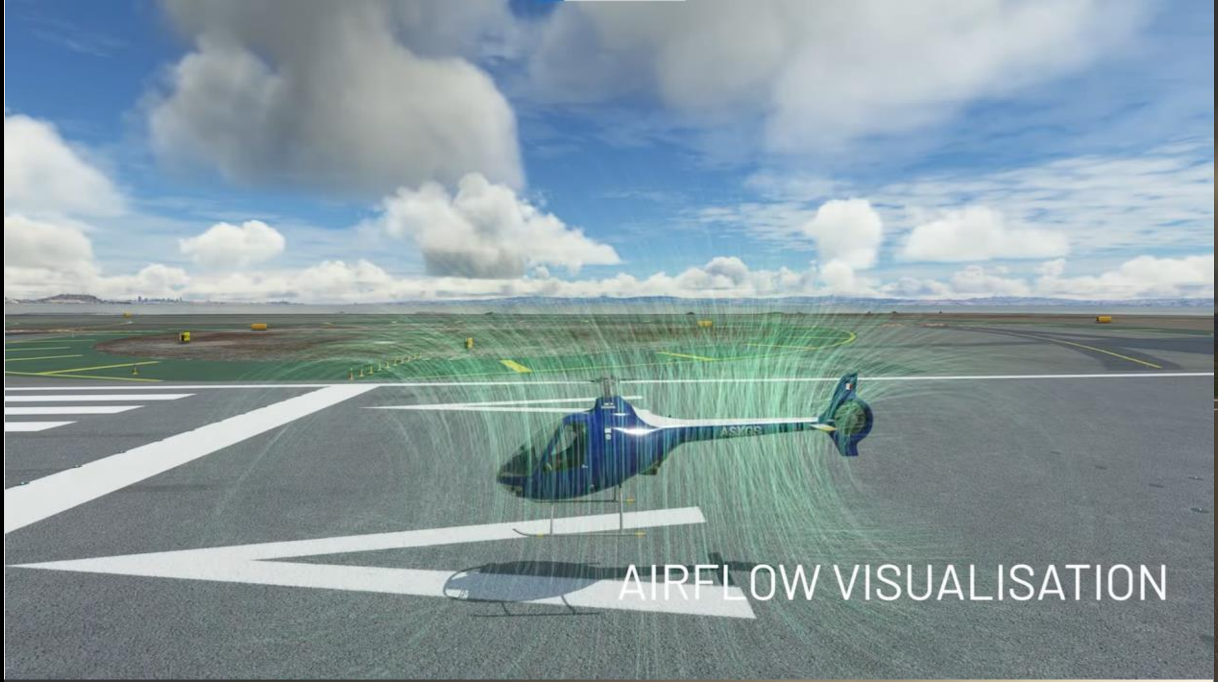
WHY SHOULD YOU CARE?

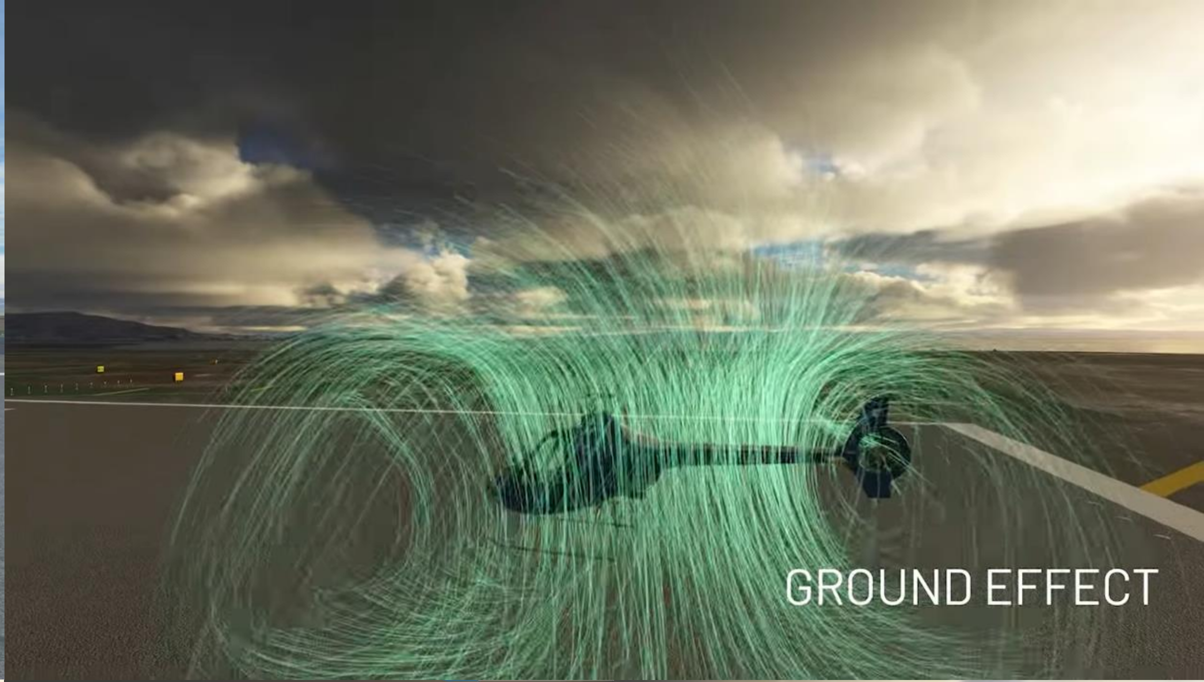
One of the biggest issues new pilots have is that they do not understand what VRS is, what it does, why it happens and how to counter it. In simple terms, your sink/descent rate is greater than -5 m/s, you will experience a sudden loss of lift that will cause you to drop like a rock. More often than not, VRS happens when you are trapped in a column of disrupted air created by your own rotor blades, and this (unfortunately) often occurs at the most critical part of flight: on **LANDING.**

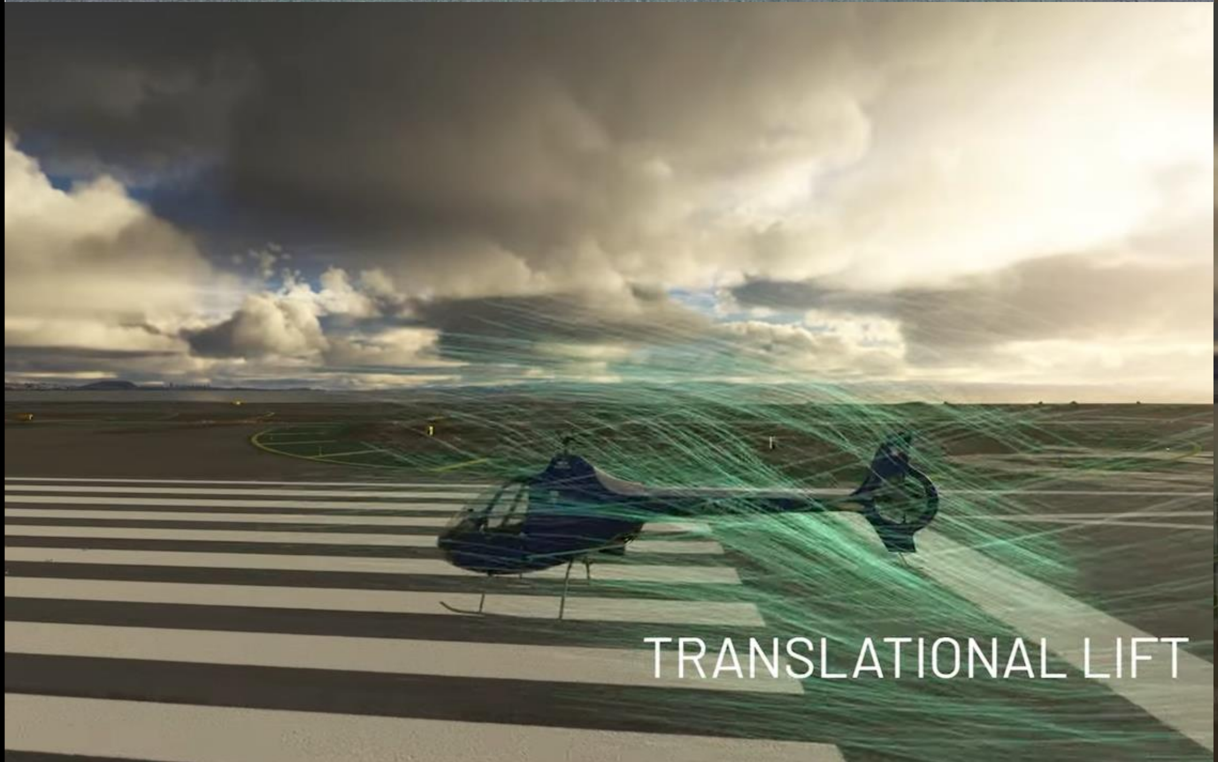
Oh, now I’ve got your attention? Good. One of the biggest problems Peter Pilots experience is to land their chopper. Even in real life, there are many pilots who do what we call a “hard landing” because they did not anticipate correctly the sudden loss of lift caused by VRS. A hard landing is when you impact the ground at a vertical speed that is too great, which causes structural damage to the landing gear, and possibly other structural components. The helicopter is not a total loss, but it will require extensive inspection and repairs, which costs time, money, and temporarily deprives the operator from one of its main sources of income.

Countering VRS is easy if you pay attention to your airspeed and descent rate. Once you enter VRS, raising the collective (which is instinctively what someone would do) will do nothing at best, or aggravate the situation at worst. To reduce the descent rate, you need to get out of that column of disrupted air. **You counter VRS by pointing the nose down (or in any direction) to pick up some speed and get away from these nasty vortices**.

Note: Many pilots confuse VRS with the inertia of your machine. If you come in too fast and raise your collective too slowly, it is to be expected that you will crash.


AIRFLOW VISUALISATION


GROUND EFFECT


TRANSLATIONAL LIFT


RING VORTEX

AUTOROTATION

Autorotation is a flight state where your engine is disengaged from the rotor system and rotor blades are driven solely by the upward flow of air through the rotor. It can be caused by engine malfunction or engine failure.

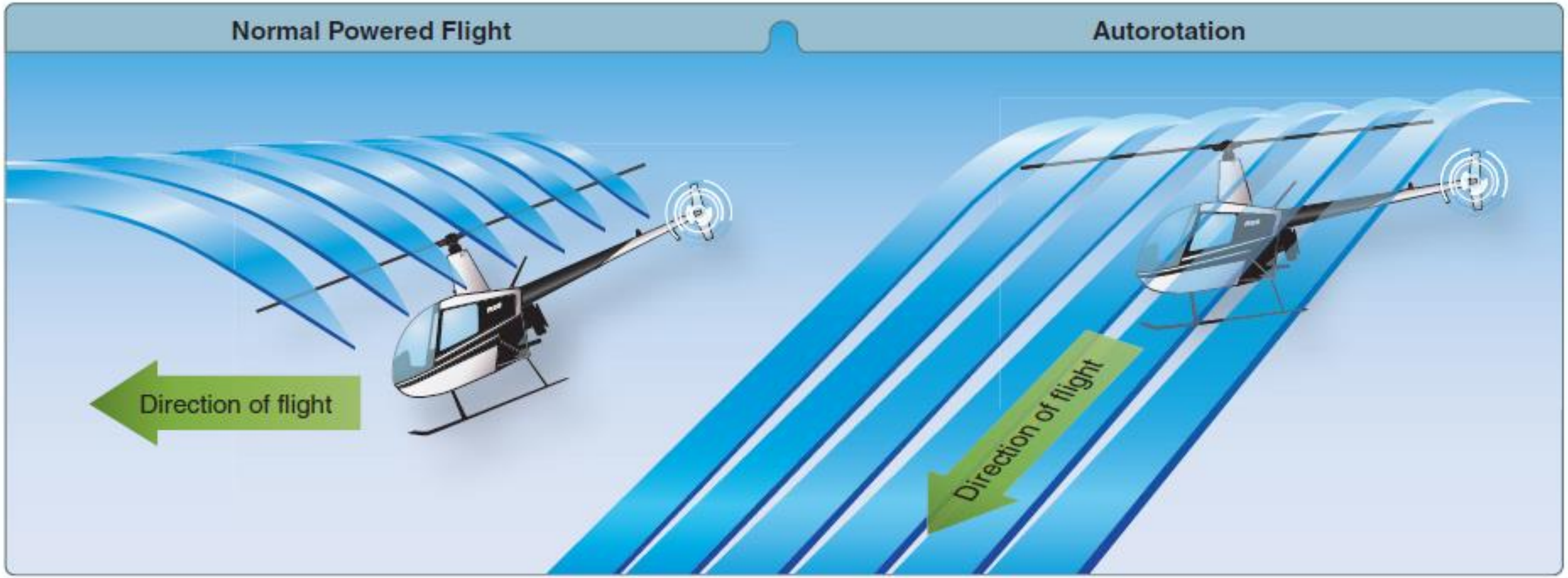


Figure 11-1. *During an autorotation, the upward flow of relative wind permits the main rotor blades to rotate at their normal speed. In effect, the blades are "gliding" in their rotational plane.*

AUTOROTATION – CORRECTIVE ACTIONS

WHY SHOULD YOU WANT TO SIMULATE AUTOROTATION?

Real life does not come with a "re-spawn" button. Life is imperfect: there is always a chance that you could lose engine power for a million reasons. In the world of DCS, odds are that you will be sent on dangerous (read: SUICIDAL) missions. There are very high chances that you will be fired upon. With so much crap flying in the air, you are bound to get zinged by something. This is why if you enter in an autorotation state, you MUST know what you do.

HOW TO SIMULATE AUTOROTATION

Autorotation can be simulated if you reduce your throttle to IDLE (hold PAGE DOWN until you get to IDLE position). Train yourself to deal with autorotation and you will be surprised to see how much better your flying will become.

AUTOROTATION RECOVERY EXAMPLE:

1. Find a good place to land first and make sure you are at an altitude of 1000 m or more.
2. Simulate engine loss of power by moving the throttle levers to the STOP position by pressing "PAGE DOWN" twice.
3. Push TRIM RESET switch
4. Apply left rudder to center the helicopter, lower collective and pull up cyclic to compensate for sudden RPM loss: make sure the power turbine reaches 86% RPM at the very least.
5. Adjust cyclic for a constant descent at 110-130 km/h
6. Maintain 86%-90% RPM and 110-130 km/h airspeed.
7. Once condition at step 6) is respected , continue descent, deploy landing gear (very important!) and do not touch throttle.
    a) At 30 m AGL, apply aft cyclic to level out and decelerate. Descent rate should be around 3-5 m/s.
    b) At 10 m ft AGL, start flaring very gently and raise collective with decision to cushion the landing: not too fast, not too slow.
    c) Use wheel brakes if necessary

Here is a video demonstration of a **powered autorotation recovery**
LINK: https://www.youtube.com/watch?v=2jvQLRkU24M

Here is a video demonstration of an **autorotation recovery without engine power**
LINK: https://www.youtube.com/watch?v=4sPb9adtq_I

SECTION STRUCTURE

1 – INTRODUCTION TO SENSORS

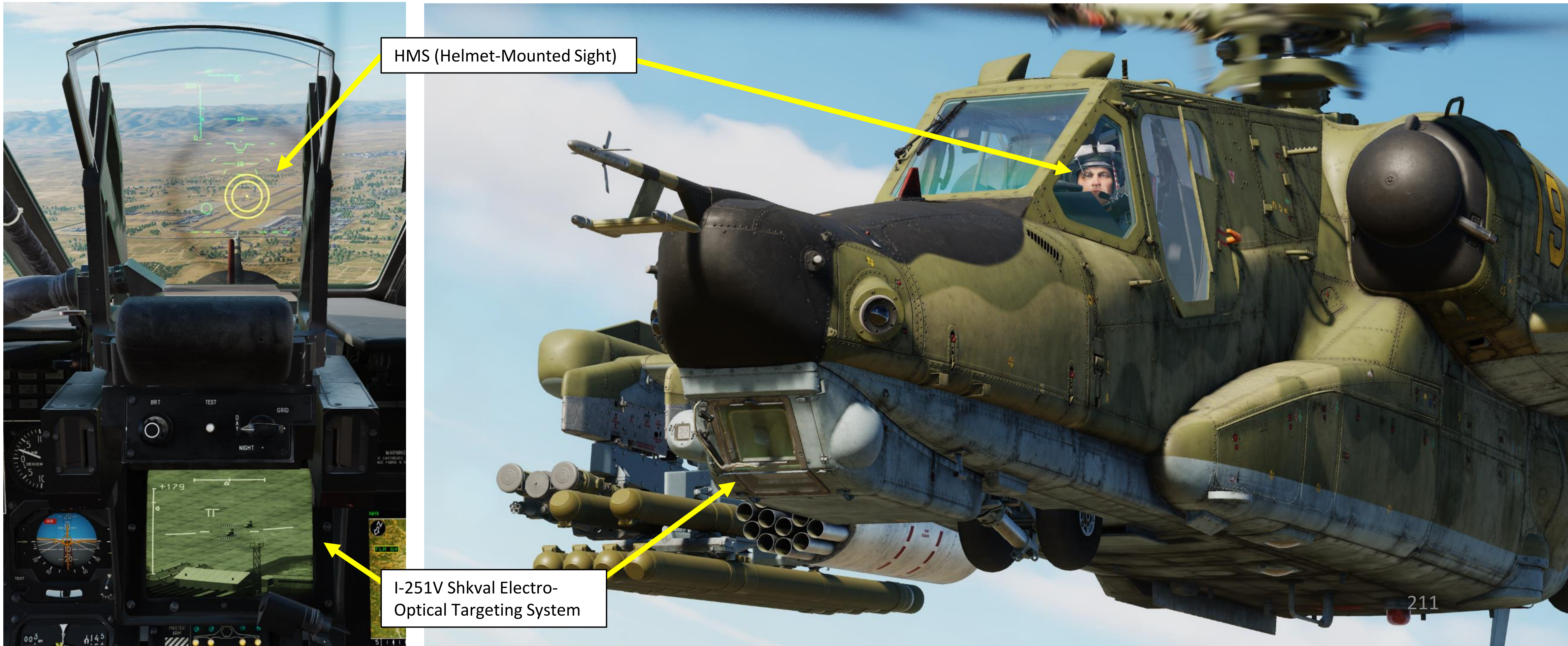
The Black Shark has two main sensors available at its disposal.

I-251V "Shkval" Electro-Optical Targeting System

- The Shkval targeting system is basically the "eyes" of your Ka-50. You use it to spot targets and designate (lock) them with a laser. What the SHKVAL sees is displayed on the TV screen.

HMS (Helmet-Mounted System)

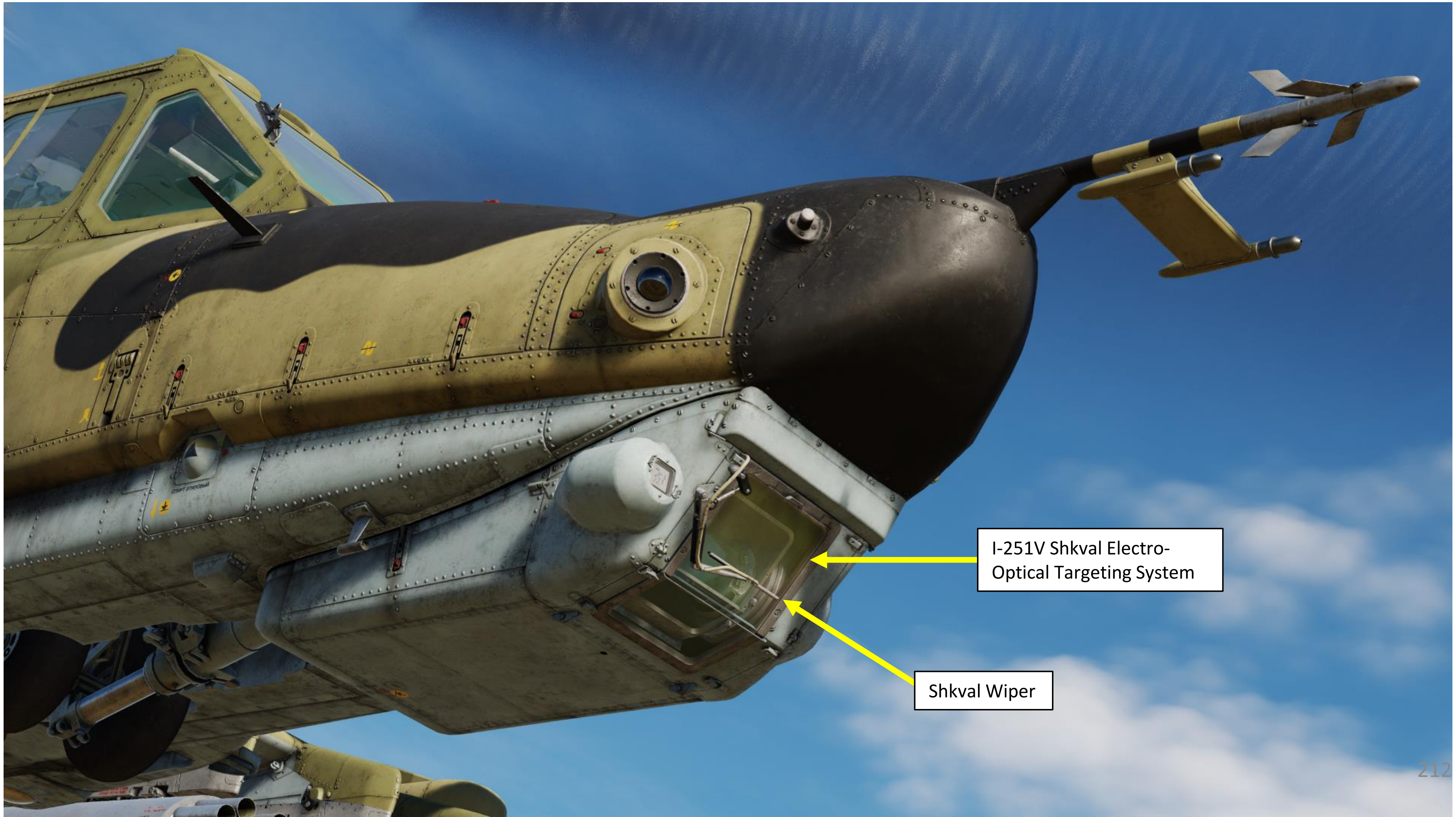
- The HMS allows the Shkval to track where your helmet is facing. This is useful if you want to quickly shift the helicopter towards a new target.



2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.1 – Introduction

The I-251V (И-251) "Shkval" electro-optical targeting system is designed to detect targets via electro-optical imagery that provides 7x and 23x magnification under visual, daylight conditions. It can then process that information and use it for automated targeting and weapons delivery. The Shkval-V protective glass cover is equipped with defrosting liquid sprinklers and wipers.



2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.1 – Introduction

As part of the K-041 Weapons and Navigation Control System, the targeting system provides:

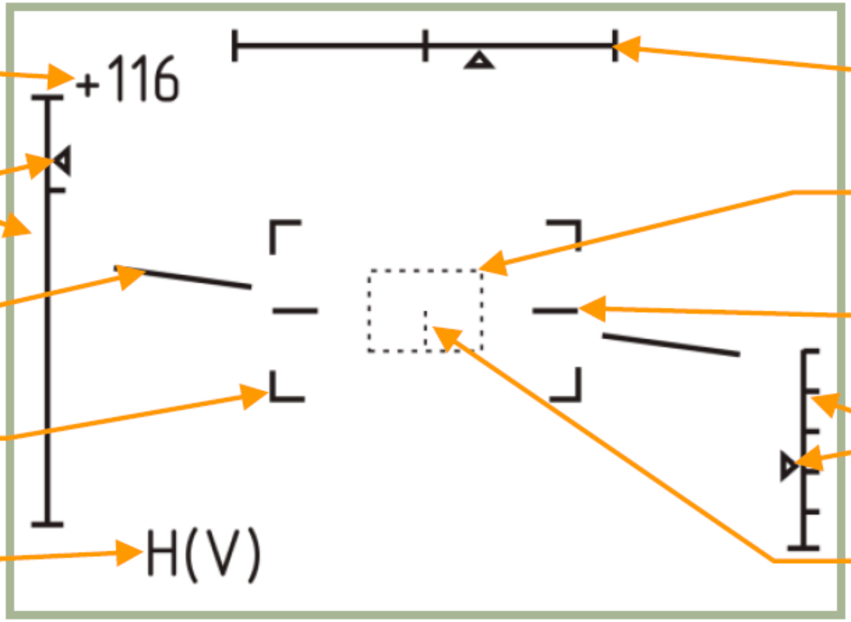
- Target detection via the IT-23 (ИТ-23) television monitor (TVM) and automatic, inertial, or manual (by use of a hat switch) tracking of moving and stationary ground targets; this includes small targets such as tanks.
- Supports guidance of Vikhr air-to-ground missile against moving and stationary targets.
- Targeting and employment of the on-board automatic cannon in either slaved or boresighted modes of operation.
- Targeting and employment of unguided rockets.
- Calculation of range, azimuth and elevation angles of designated point (Target Point).
- Entry of a target's angular coordinates (Reference Point) and range information into the Weapons and Navigation Control System for the display of targeting information on the TVM. This can also be used for automatic target tracking and weapons employment, as well as correction of helicopter INS coordinates and acquisition of target coordinates (Target Point).
- Visual display of the target area on the TVM at 7x or 23x magnification with superimposed targeting information.

The system is electro-optical-based and is responsible for displaying target imagery on the TVM. The system has two selectable fields of view: wide angle (2.7 x 3.6) deg, with a 7x magnification factor, and narrow angle (0.7 x 0.9) deg, with a 23x magnification factor.

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.2 – Display

IT-23 (ИТ-23) Television Monitor (TVM)

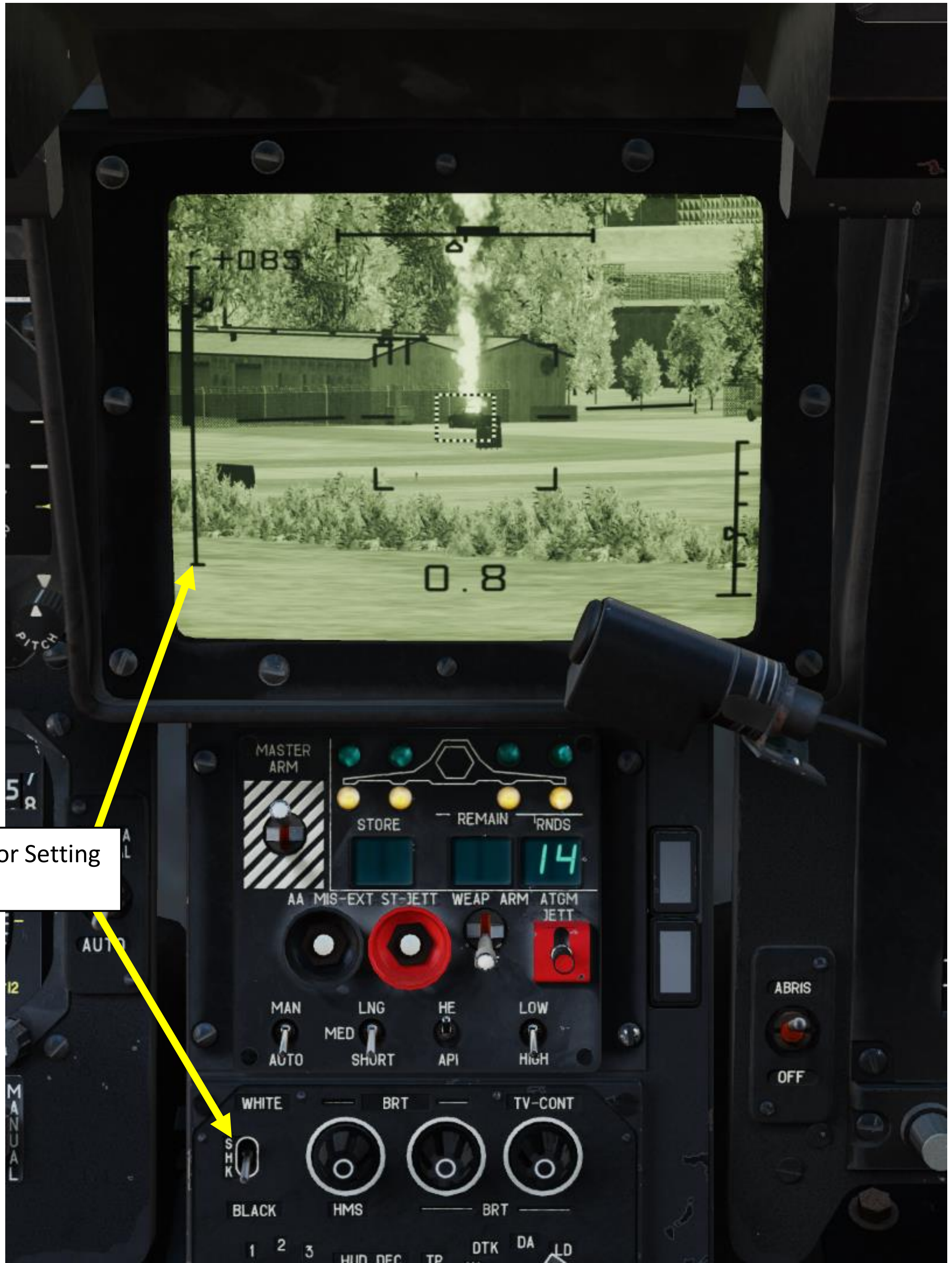


2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.2 – Display

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.2 – Display

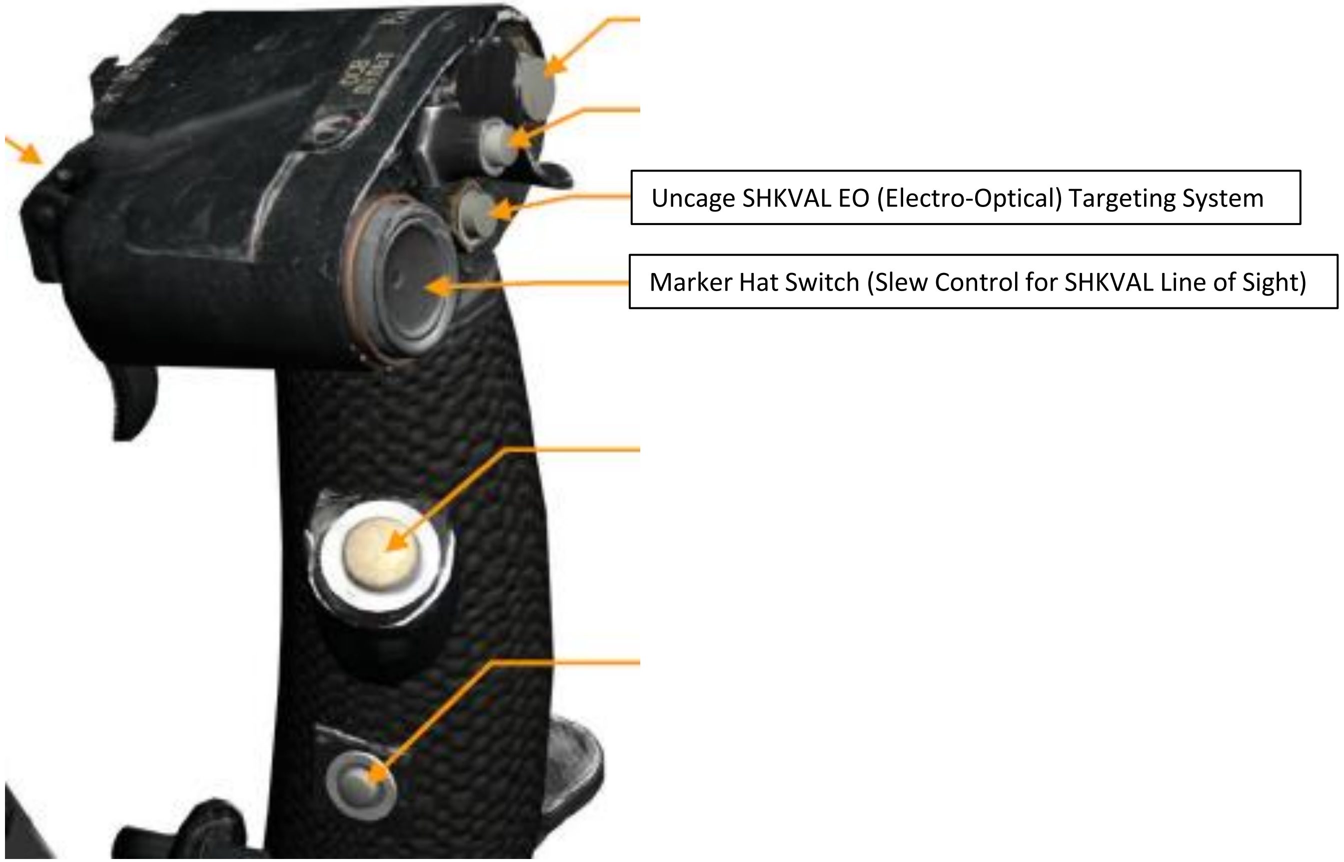
SHKVAL Indicator Setting White

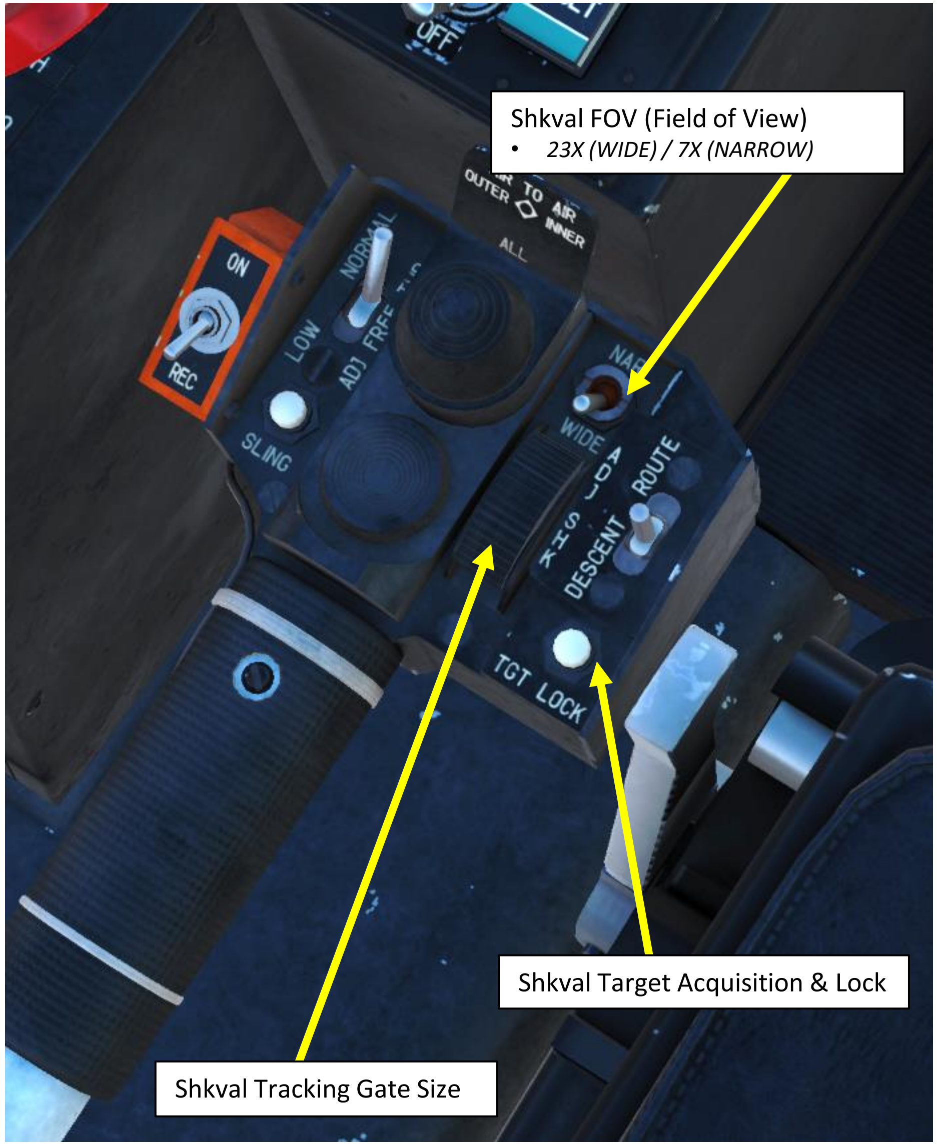


SHKVAL Indicator Setting Black

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

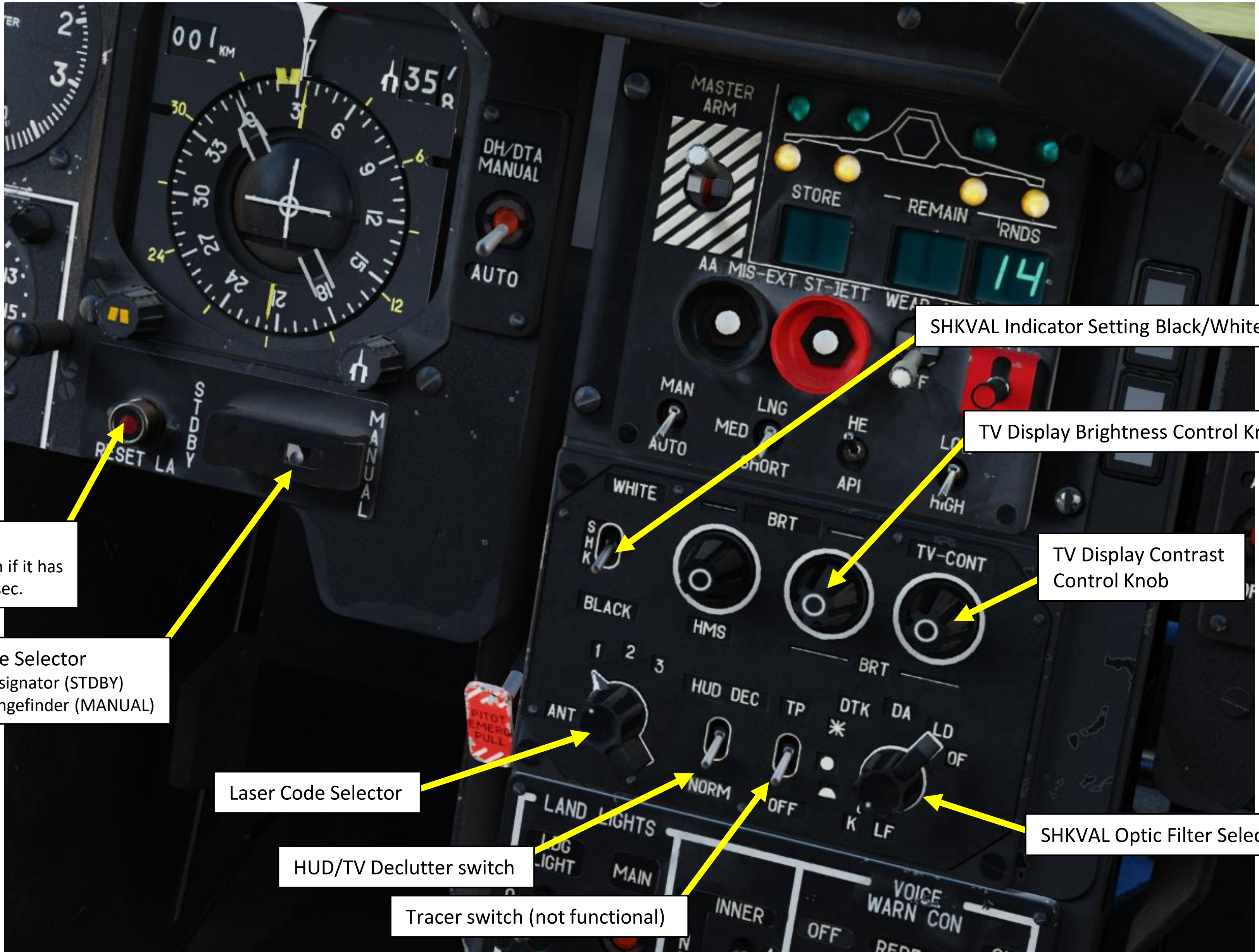
2.3 – Controls





2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.3 – Controls



SHKVAL Indicator Setting Black/White

TV Display Brightness Control Knob

TV Display Contrast Control Knob

Laser Designator Reset Button
- Used to cease laser illumination if it has not already timed out after 20 sec.

Laser Mode Selector
- Laser Designator (STDBY)
- Laser Rangefinder (MANUAL)

Laser Code Selector

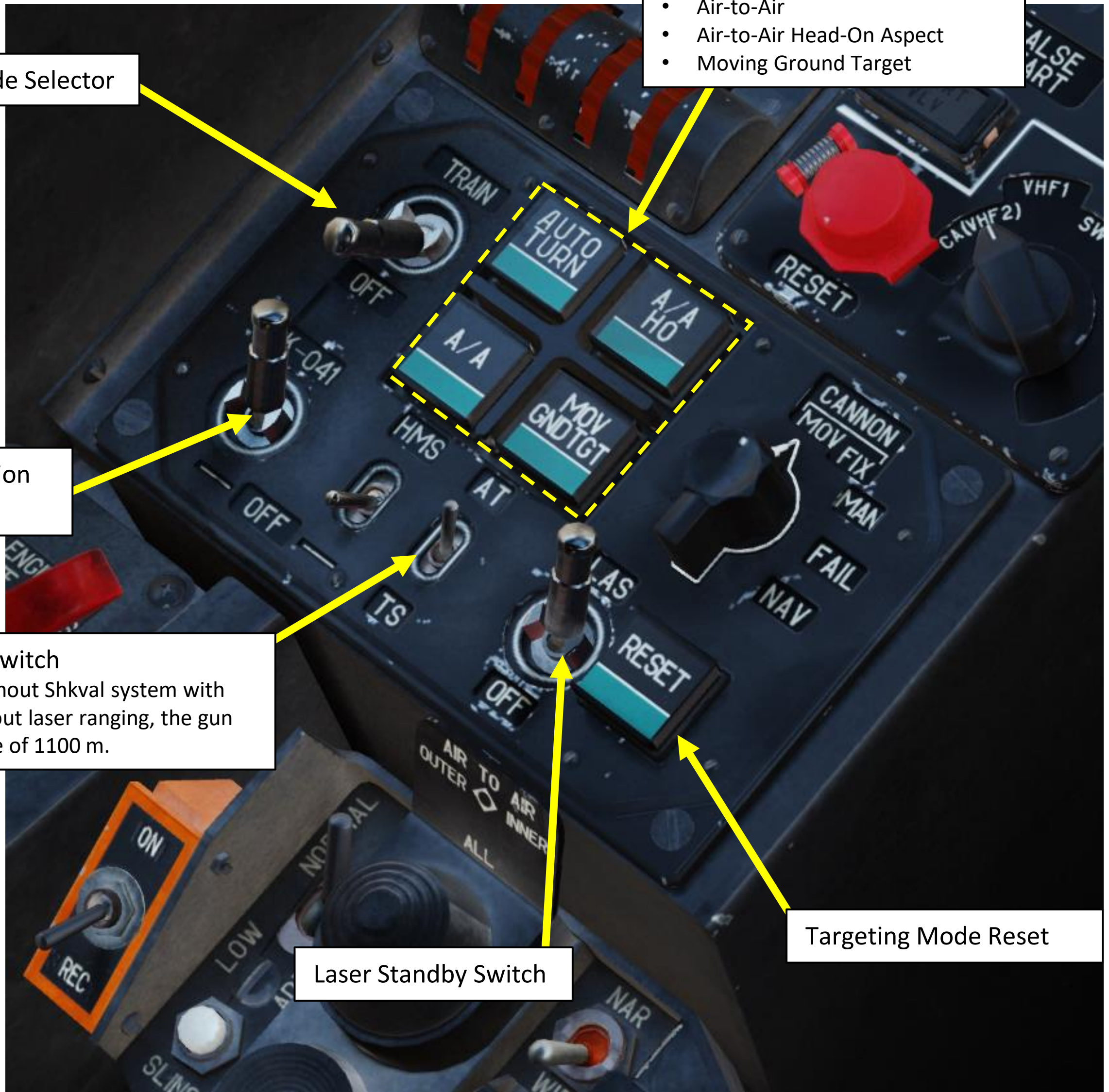
SHKVAL Optic Filter Selector

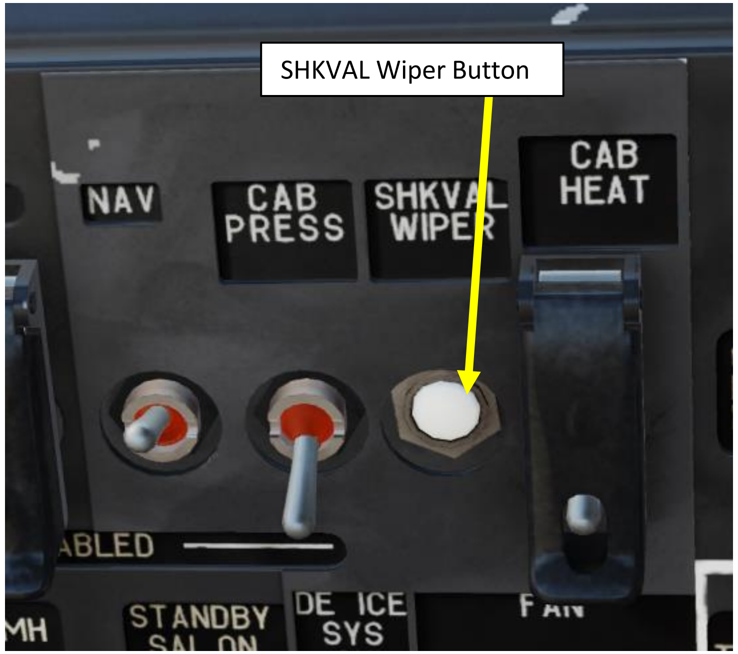
HUD/TV Declutter switch

Tracer switch (not functional)

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

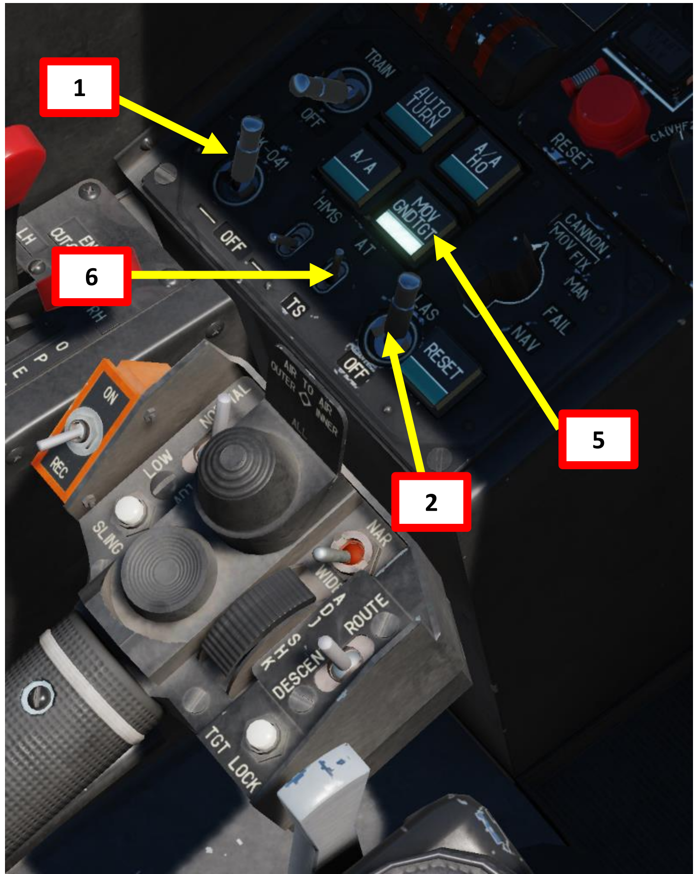
2.3 – Controls

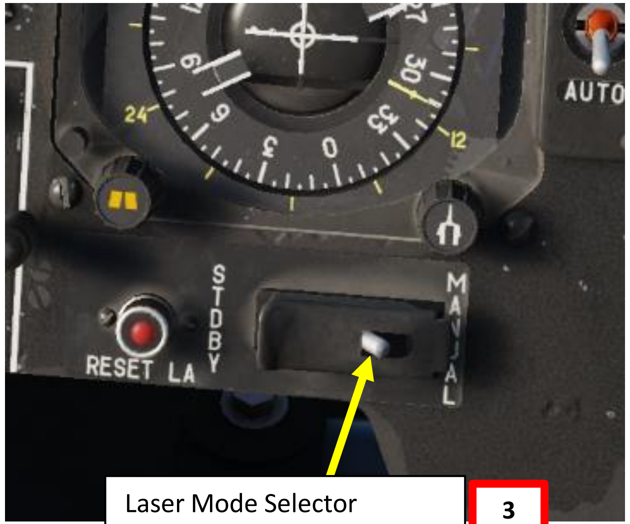




2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.4 – Shkval Power-Up and Designation/Lock Procedure

1. Verify that K-041 Targeting Navigation System Power Switch is ON (FWD).
2. Laser Power switch ON (FWD)
3. Set Laser Mode Selector as desired:
    - Set to MANUAL (RIGHT position) if you want to perform laser rangefinding
    - Set to STDBY (LEFT position) if you want to perform a laser designation to guide a Vikhr missile.
4. Set Laser Code – As desired. This is useful in order to avoid having multiple laser designators with the same code/PRF (Pulse Repetition Frequency) in the same area, which can confuse missiles tracking these lasers.
5. Select “MOVING GROUND TARGET” button if tracking a moving target
6. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.





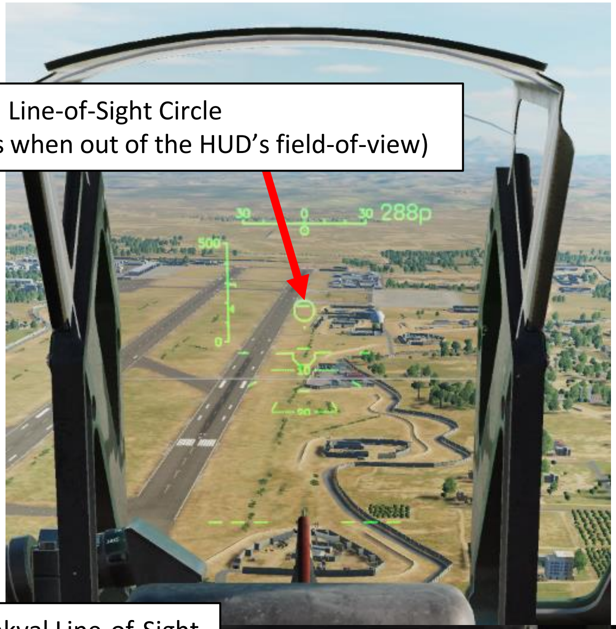
Laser Mode Selector
- Laser Designator (STDBY)
- Laser Rangefinder (MANUAL)

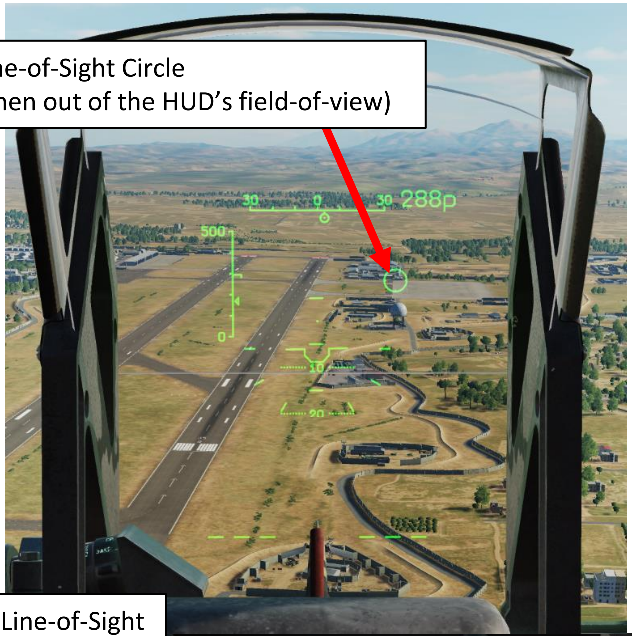
3

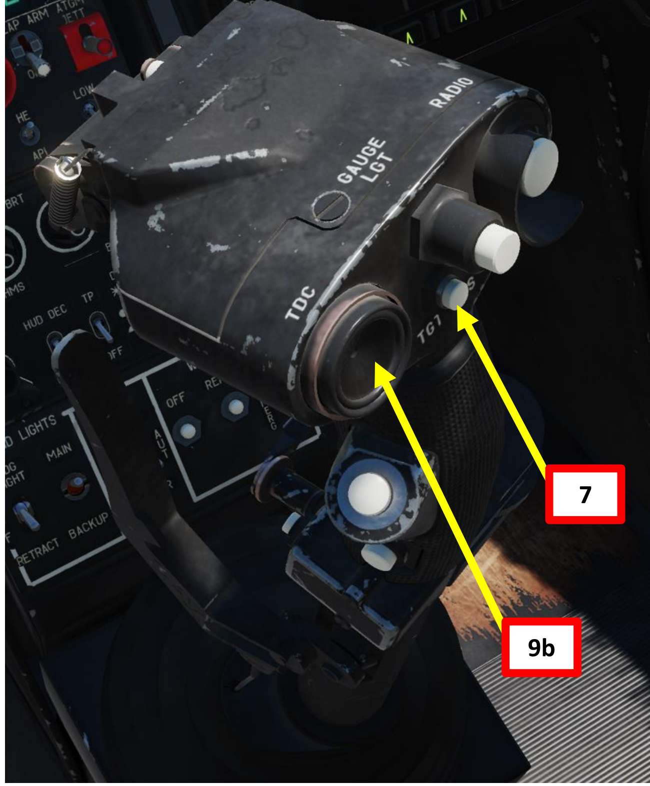
2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

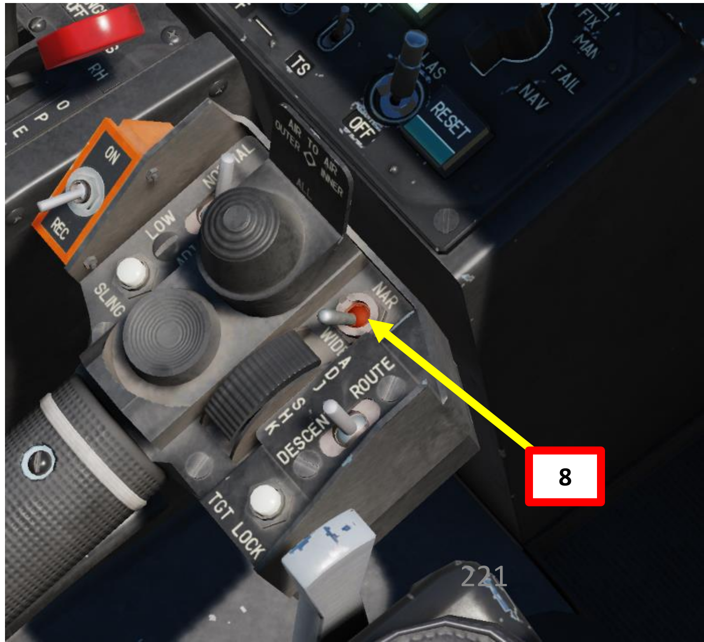
2.4 – Shkval Power-Up and Designation/Lock Procedure

7. Uncage SHKVAL by pressing “O” (Shkval Uncage Button). Reticle will be boresighted at the center of your Heads-Up Display.
8. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding.
9. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”





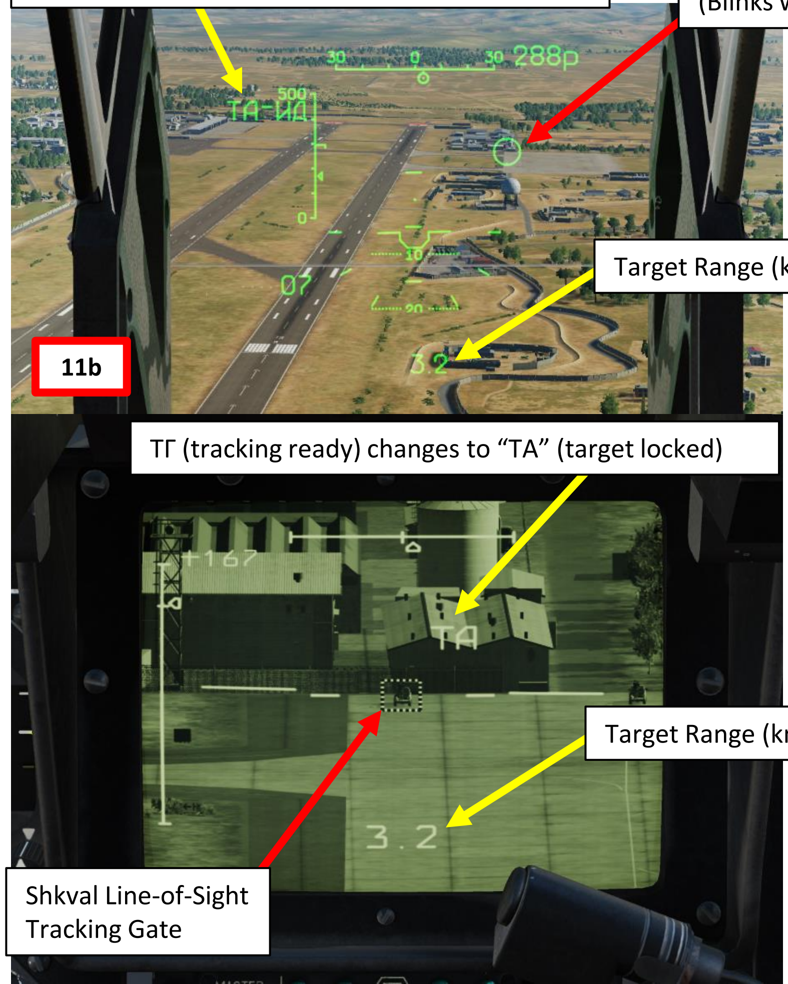


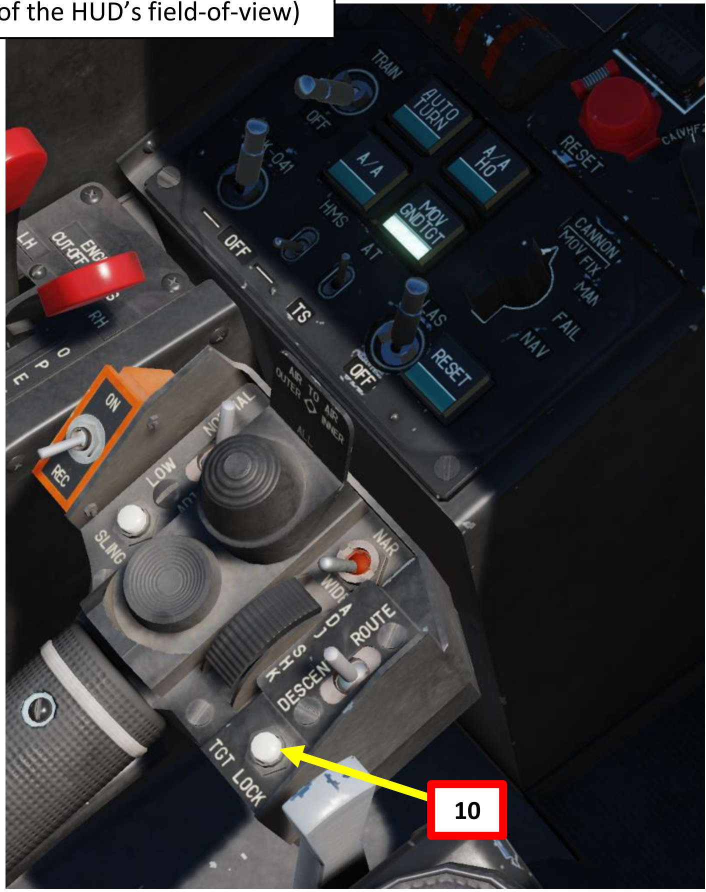


2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.4 – Shkval Power-Up and Designation/Lock Procedure

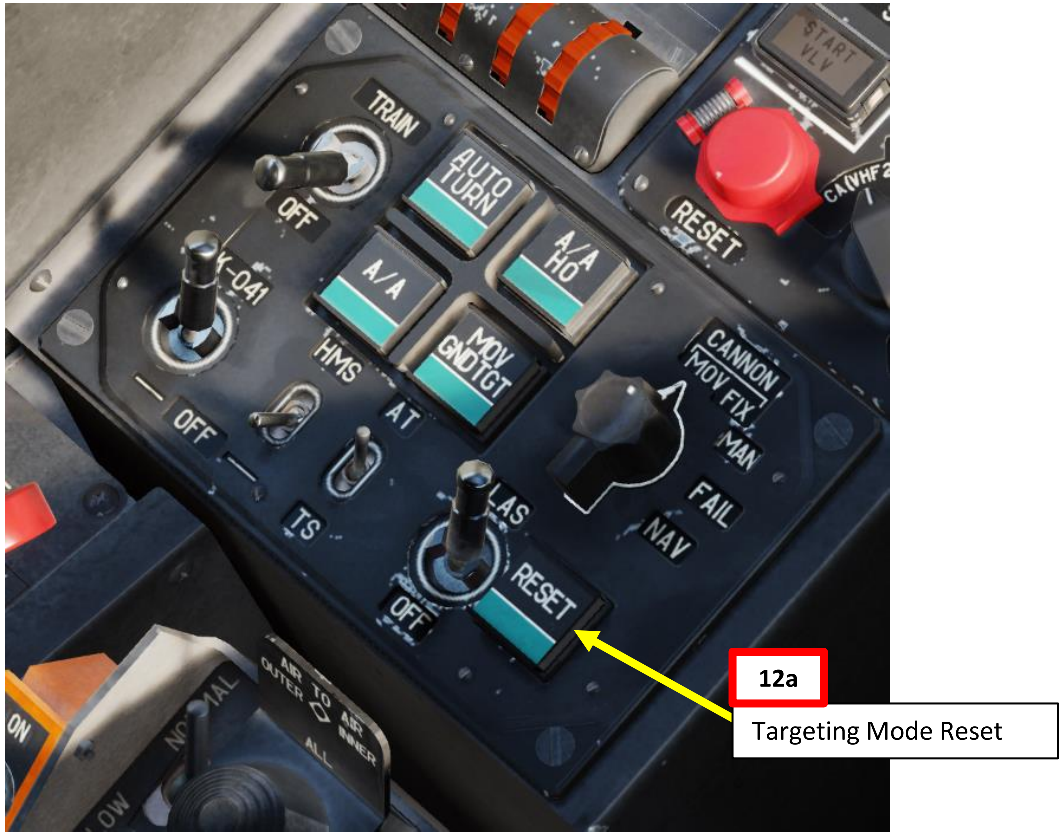
10. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button. This will lock a target based on contrast.
11. When the Lock Target button is pressed, the laser rangefinder is turned on for approximately three seconds; the HUD displays the “**ИД**” symbol and shows remaining time until range-finding will be complete. Range information will be displayed in km.
    - If laser mode is set to MANUAL (RIGHT position), the Shkval will perform laser rangefinding.
    - If laser mode is set to STDBY (LEFT position), the Shkval will perform a laser rangefinding and a laser designation, which can be used to guide a Vikhr missile.
        - “**ТА-ИД**” symbol indicates “Auto-tracking target – range-finding”.
        - “**ТА**” symbol indicates “Target Locked”





2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.4 – Shkval Power-Up and Designation/Lock Procedure

12. To un-designate target, press the Targeting Mode Reset button. This will boresight the Shkval reticle and disengage any other Shkval mode engaged.



2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.5 – Integration with HMS, ABRIS and HUD

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM

2.6 – Shkval Limitations

Despite being a relatively precise sensor, the Shkval has a few limitations that you should consider, as listed in the limitations table below.

- The Shkval has limitations in effective laser designation/rangefinder capabilities and target tracking.
- Excessive use of the laser will “burn it out”, meaning it can become inoperative after using it for too long. Only use laser designation or rangefinding when required.
- Unlike most modern targeting pods, the Shkval’s TV has **no infrared vision capabilities**, which means it is difficult to use during night operations if there are no light sources near the target.

I-251V Shkval Service Limitations	
Laser Rangefinder Distance Measuring Effective Range	0.6 - 9.9 km
Permitted Laser Rangefinder operation mode for one flight. Important Note: Each serie consists of 16 cycles of 10 seconds with 5 sec interval between the cycles.	5 series
Interval between lasing series	30 minutes
Maximum bank angle when tracking a target in AT (Automatic Tracking) mode	+/- 45 deg
Maximum pitch angle when tracking a target in AT (Automatic Tracking) mode	+/- 50 deg
Angular velocities range • In Yaw: • In Pitch: • In Roll:	 +/- 30 deg +/- 20 deg +/- 60 deg

2 – I-251V SHKVAL ELECTRO-OPTICAL TARGETING SYSTEM
2.6 – Shkval Limitations

Using of the Shkval at night is still possible in illuminated areas, but the visibility can become severely restricted.

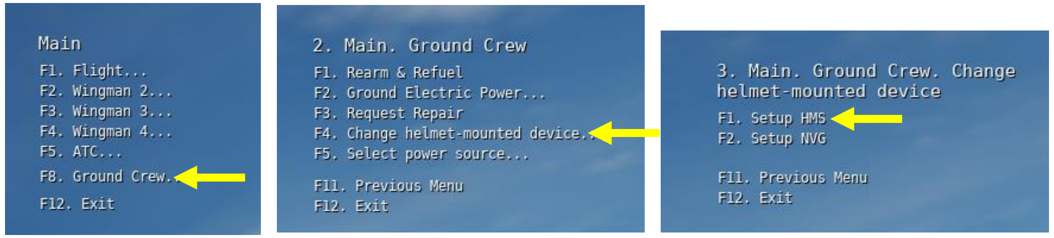
3 – HMS (HELMET MOUNTED SIGHT)
3.1 – Components

The Helmet-Mounted Sight (HMS) determines the angular coordinates of the line of sight to a visually acquired target (tracked via the pilot's head position) and then outputs targeting commands to the K-041 Weapons and Navigation Control System. This in turn can cue the electro-optical targeting system to the target. The HMS directs the targeting system according to the line of sight coordinates of the helicopter's coordinate system.

When integrated with the Weapons and Navigation Control System, the HMS provides preliminary guidance to the target for employment of air-to-ground missiles, the onboard automatic cannon, or unguided rockets. To **toggle the HMS ON or OFF, press the "H" key.**

3 – HMS (HELMET MOUNTED SIGHT)
3.1 – Components

Via the ground crew interface, you can also select either the HMS (Helmet Mounted Sight) or NVG (Night Vision Goggles) loadout by pressing « \ », then pressing F8 (Ground Crew), and either F1 (HMS) or F2 (NVG). The HMS and NVGs are mutually exclusive

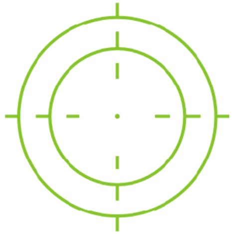


3 – HMS (HELMET MOUNTED SIGHT)
3.2 – Symbology

HMS Operative Mode

Conditions:

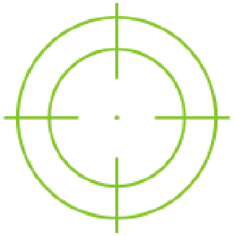
- Automatic weapon system control mode enabled (AC).
- HMS within Shkval’s gimbal limits.
- Shkval’s tracking system doesn’t engage.
- “ЦУ” (Uncage Shkval, designate target) button on the cyclic stick is not pressed.



HMS Processing Mode

Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS within Shkval’s gimbal limits.
- Shkval’s tracking system is not engaged.
- “ЦУ” (Uncage Shkval, designate target) button has been pressed and the displacement angle between HMS and Shkval LOS is more than 2°.



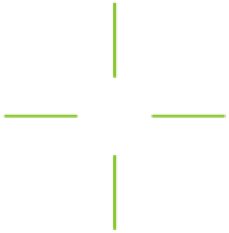
HMS Lock Mode

Conditions (Set No. 1):

- Automatic weapon system control mode enabled (AC).
- HMS within Shkval’s gimbal limits.
- “ЦУ” (Uncage Shkval, designate target) button has been pressed and the displacement angle between HMS and Shkval LOS is more than 2°.
- Shkval has been un-caged and cued to the HMS. With release of the “ЦУ” (Uncage Shkval, designate target) button, Shkval transitions to “ТГ” (Tracking system ready) mode with laser ranging.

Conditions (Set No. 2):

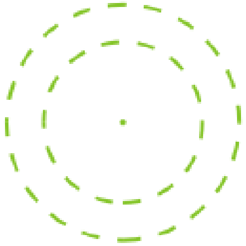
- Automatic weapon system control mode enabled (AC).
- HMS within Shkval’s gimbal limits.
- TA (Shkval’s tracking system engaged).



HMS Launch Authorized Mode

Conditions:

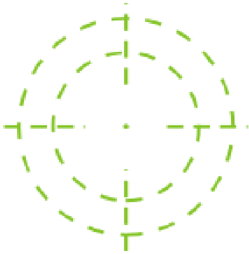
- Automatic weapon system control mode enabled (AC).
- HMS within Shkval’s gimbal limits.
- Weapon Launch Authorized



HMS Overlimit Mode

Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS is beyond the Shkval’s gimbal limits (+/- 30 deg).
- “ЦУ” (Uncage Shkval, designate target) button on the cyclic stick is not pressed.



HMS Turn to Target Mode

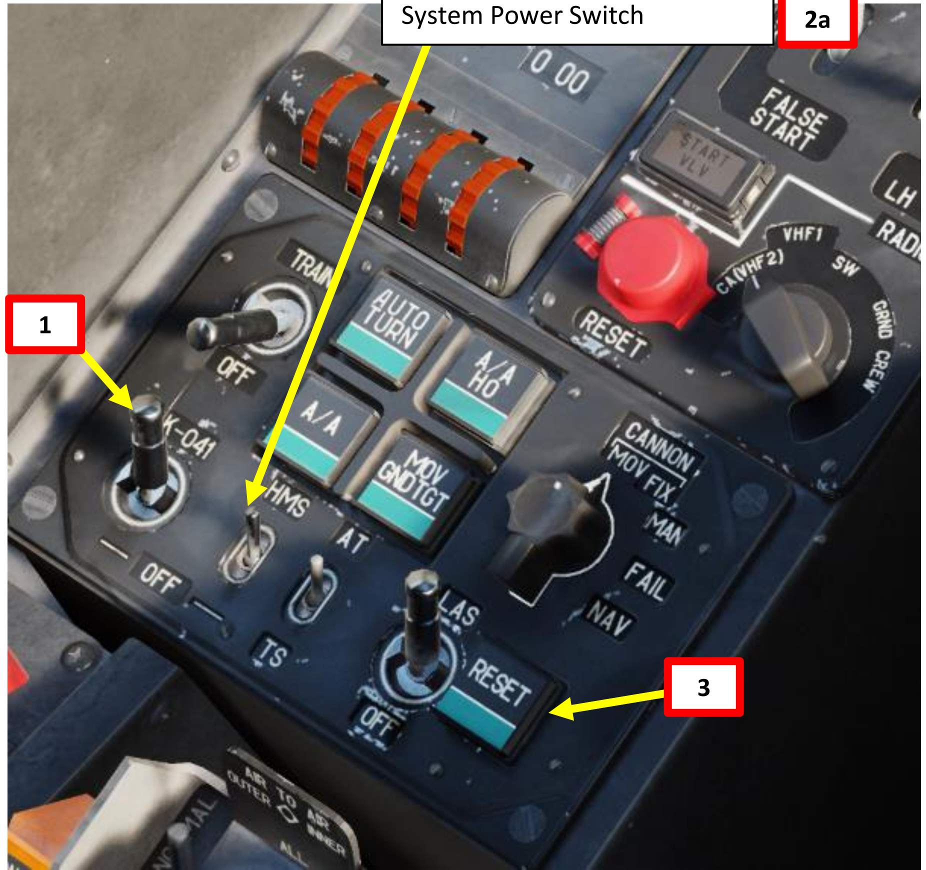
Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS is beyond the Shkval’s gimbal limits (+/- 30 deg).
- “ЦУ” (Uncage Shkval, designate target) button is pressed.
- “АДВ” (Automatic turn to target) mode active.

Note: If a target is beyond of the Shkval’s gimbal limits, it is required to maneuver to bring the target within the targeting system’s scan limits. With “АДВ” (automatic auto turn to target) mode enabled, the helicopter will orient toward the target.

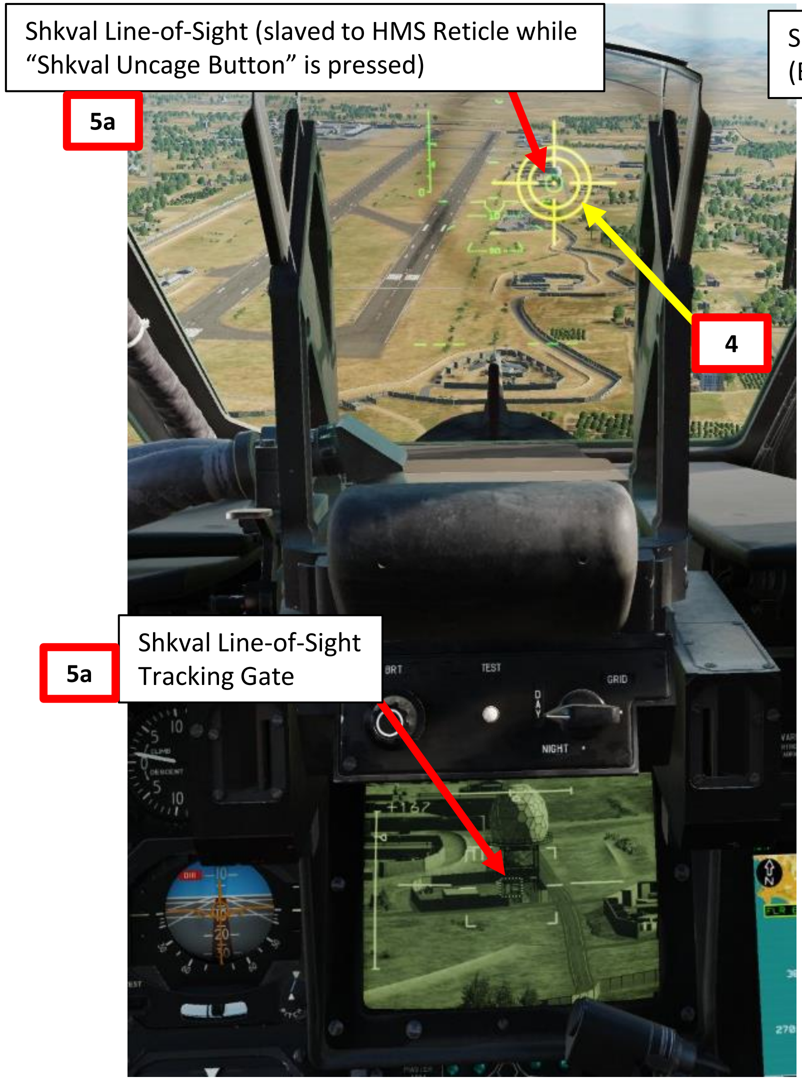
3 – HMS (HELMET MOUNTED SIGHT)
3.3 – Shkval Slaving to HMS

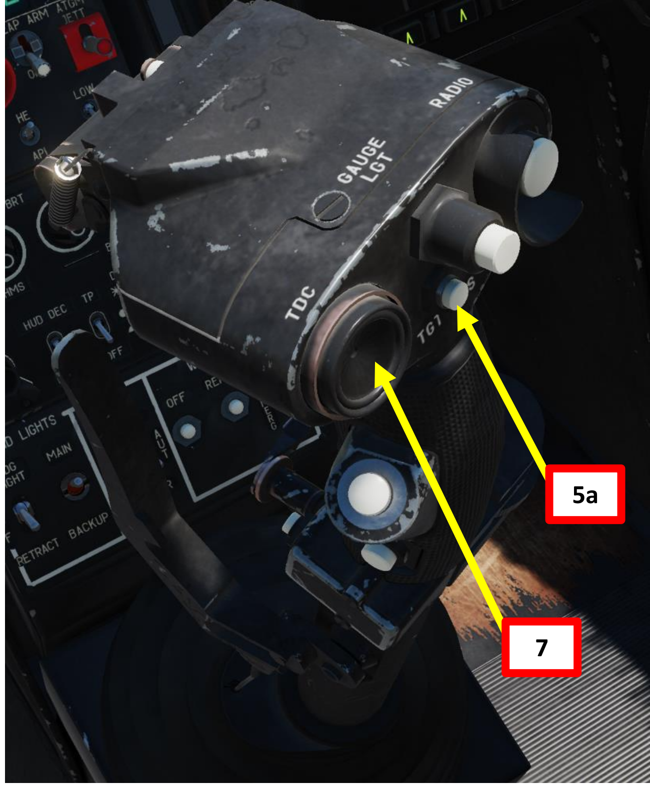
1. Verify that K-041 Targeting Navigation System Power Switch is ON (FWD).
2. Select HMS (Helmet-Mounted Sight) System Power Switch – ON (FWD).
   - Note: You can stow or put on the HMS by pressing the "H" binding.
3. Press the Targeting Mode Reset button to un-designate any target tracked by the Shkval. This will boresight the Shkval reticle and disengage any other Shkval mode engaged.

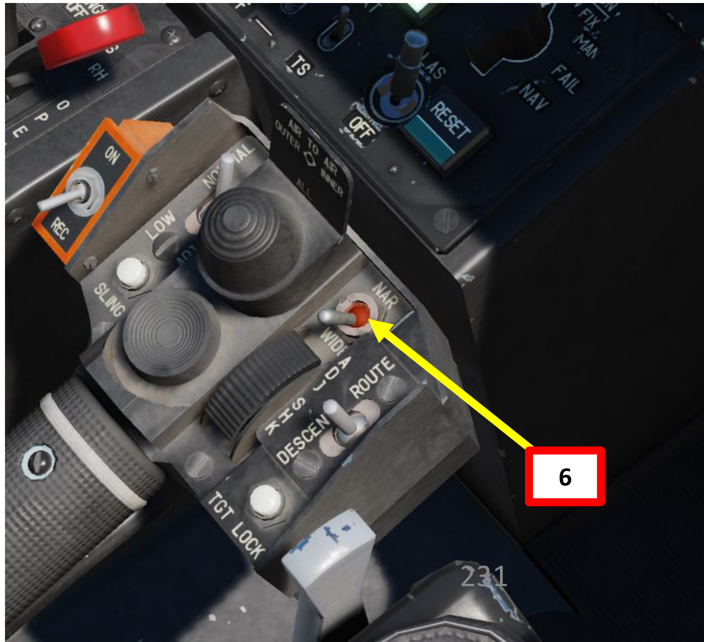


3 – HMS (HELMET MOUNTED SIGHT)
3.3 – Shkval Slaving to HMS

4. Move your head to place the HMS Reticle on the desired target.
5. Uncage SHKVAL by pressing "O" (Shkval Uncage Button). While Shkval Uncage Button is pressed, the Shkval reticle will be slaved automatically to the HMS Reticle. Once Uncage Button is release, the Shkval line-of-sight will remain in place.
6. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
7. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"







SECTION STRUCTURE

1 – INTRODUCTION
1.1 – Armament Introduction

The Black Shark has a great arsenal of weapons at its disposal. Lots of new players tend to get overwhelmed by the whole weapon delivery procedure.

- ***9A4172 VIKHR (AT-9) AIR-TO-GROUND MISSILE***
  - The VIKHR ATGM (air-to-ground missile) is a beam-riding anti-tank missile.
  - Range: min 800 m / max 8000 m

- ***2A4A CANNON***
  - A 30-mm auto-cannon similar to the one mounted on the BMP-2 IFV (Infantry Fighting Vehicle). One of its particularities is that it can rotate and track targets with the SHKVAL, which allows you to fire on targets very precisely if you know how to use it. It is powered by the helicopter's hydraulic drive system, and the semi-rigid mount allows the cannon to be deflected from -2°30' to +9° in azimuth and from +3°30' to -37° in elevation.

- ***ROCKETS/GUNPODS/BOMBS***
  - The Black Shark can be equipped with UPK-23 gun pods, FAB-250 bombs, KMGU-2 Sub-Munition Dispenser, 80 mm S-8 rockets and 122 mm S-13 rockets.

- ***AIR-TO-AIR 9M39 IGLA INFRARED SEEKER MISSILES***
  - The Igla missile is designed to destroy subsonic airborne targets. The missile's flight speed can reach up to 570-600 meters per second and has an effective range of 6 kilometers. The "Igla" has high G-load and average resistance to aircraft countermeasures.

1 – INTRODUCTION
1.2 – Armament Overview

CANNON, EXTERNAL GUNPOD & ROCKETS

NAME	DESCRIPTION	GOOD AGAINST
2A4A 30 mm Auto-Cannon	Shipunov flexible 30 mm auto-cannon, guided by Shkval. Minimum Range: 800 m / Maximum Range: 2 km 240 AP-T (Armor-Piercing Tracer) + 230 HE-T (High-Explosive Incendiary Tracer) rounds.	Soft Ground Targets
UPK-23-250 23 mm Gun Pod	GSh-23L Gryazev-Shipunov 23 mm dual barrel auto-cannon (250 rounds)	Soft Ground Targets
B-8V2OA Rocket Pod	20 x S-8KOM 80 mm Unguided Rockets	Soft Ground Targets
BL-13L1 Rocket Pod	5 x S-13OF 122 mm Unguided Rockets	Soft Ground Targets

BOMBS (UNGUIDED)

NAME	DESCRIPTION	GOOD AGAINST
FAB-250/500	250/500 kg general purpose bombs	Single Ground Targets
KMGU-2	96 x AO-25RT Cluster Munitions	Clusters of targets

1 – INTRODUCTION
1.2 – Armament Overview

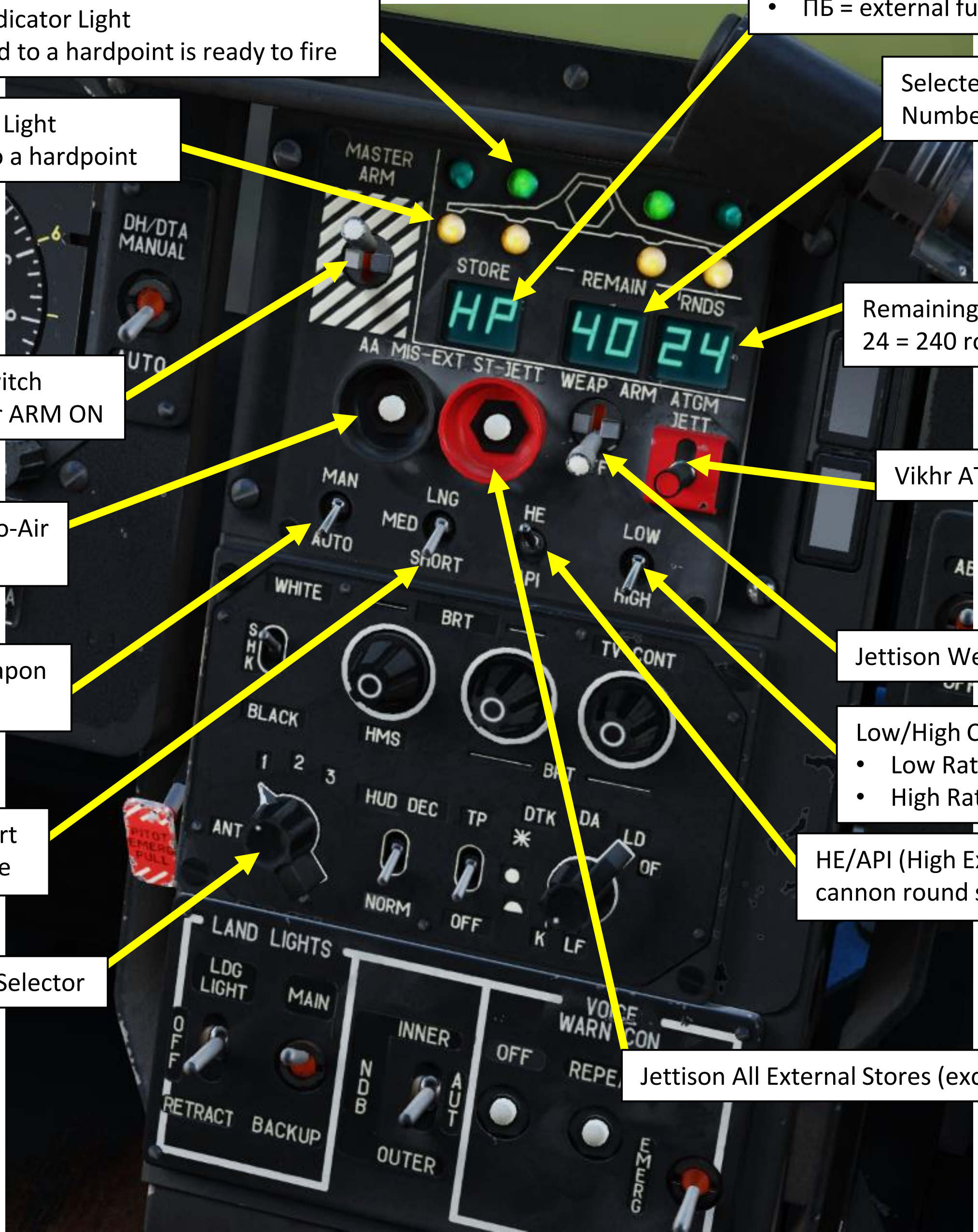
AIR-TO-GROUND MISSILE

NAME	RANGE MIN / MAX	DESCRIPTION	GOOD AGAINST
9A4172 Vikhr (AT-9)	800 m / 8 km	Beam-riding anti-tank missile, can be used on both air and ground targets. The missile is guided by the Shkval laser. In practice, effective range is closer to 7 km due to the Shkval's effective lasing range.	Ground Targets
KH-25ML Karen (AS-10)	500 m / 10 km	Semi-Active Laser-Guided air-to-surface missile. The missile is guided by the Shkval laser. In practice, effective range is closer to 7 km due to the Shkval's effective lasing range.	Hard Targets

AIR-TO-AIR MISSILES

NAME	RANGE MIN / MAX	DESCRIPTION	GOOD AGAINST
9M39 Igla	500 m / 6 km	Infrared Seeker, All Aspect.	Aircraft & Helicopters

1 – INTRODUCTION
1.3 – Weapon Interface



Store Type Field Display
- HP = rockets
- ПС = anti-tank missiles
- АБ = bombs
- ПБ = external fuel tanks

Weapon Readiness Indicator Light
Green = store attached to a hardpoint is ready to fire

Weapon Presence Indicator Light
Yellow = store is attached to a hardpoint

Selected Weapons Remaining
Number of selected weapons (rockets or Vikhr) remaining.

Remaining Cannon Rounds
24 = 240 rounds

Master Arm Switch
- UP = Master ARM ON

Vikhr ATGM (Air-to-Ground Missile) Jettison

Emergency Jettison of Air-to-Air Missiles

Jettison Weapon Arming Switch

Manual/Auto Weapon control switch

Low/High Cannon Rate of Fire switch
- Low Rate: 300 rounds/min
- High Rate: 600 rounds/min

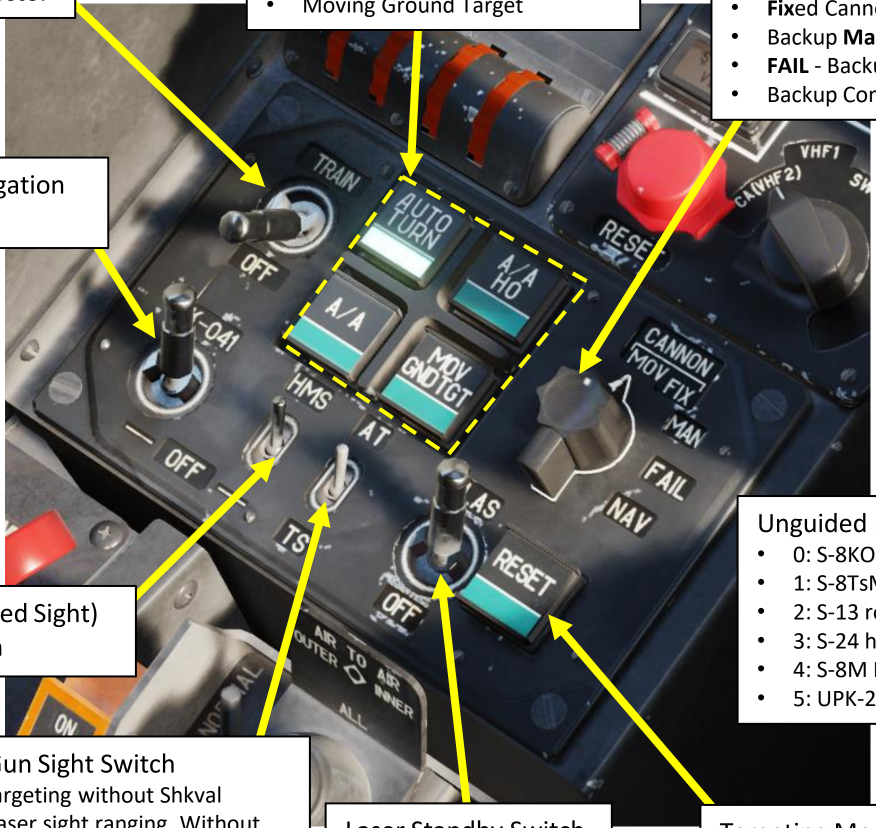
Long/Medium/Short range cannon mode

HE/API (High Explosive/Armor-Piercing Incendiary) cannon round selector switch

Laser Code Selector

Jettison All External Stores (except Vikhr missiles)

1 – INTRODUCTION
1.3 – Weapon Interface



Training Mode Selector

Target Mode Selector Buttons
- Automatic Turn on Target
- Air-to-Air
- Air-to-Air Head-On Aspect
- Moving Ground Target

Weapon System Mode Selector
- **Mov**ing Cannon – Automatic
- **Fix**ed Cannon
- Backup **Man**ual
- **FAIL** - Backup Navigation Tasks on combat computer
- Backup Combat tasks on **Nav**igation computer

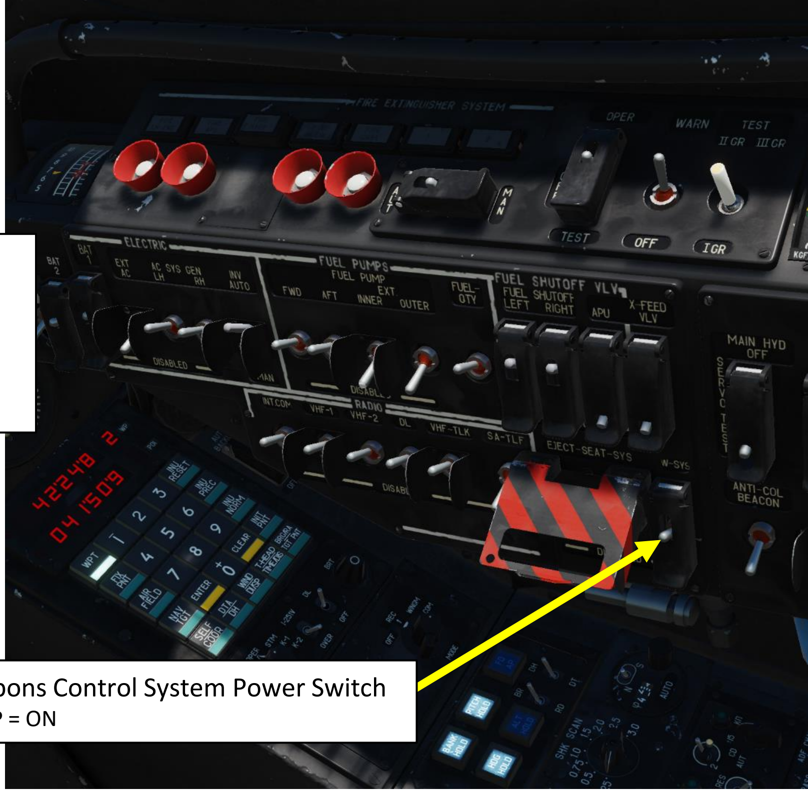
K-041 Targeting Navigation System Power Switch

HMS (Helmet-Mounted Sight) System Power Switch

Automatic Tracking/Gun Sight Switch
- Automatic tracking/targeting without Shkval system with manual laser sight ranging. Without laser ranging, the gun reticle is adjusted to a fixed range of 1100 m.

Laser Standby Switch

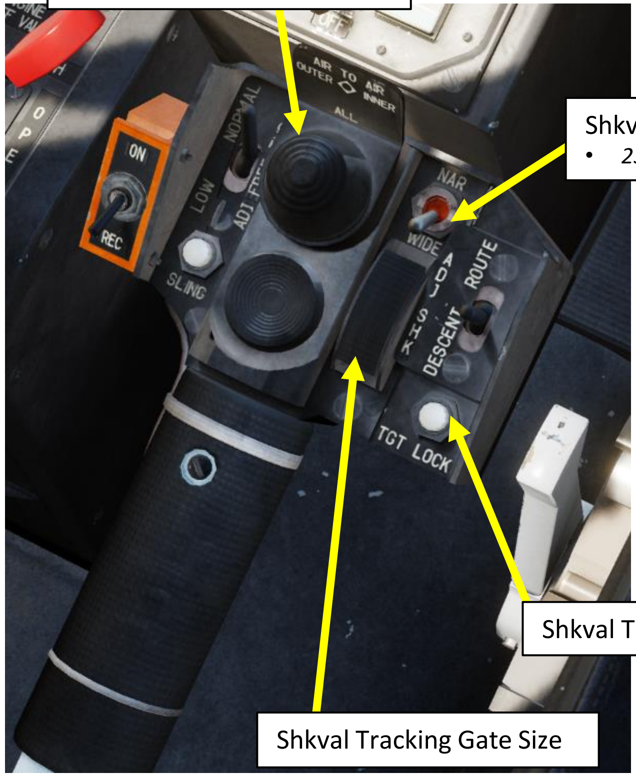
Targeting Mode Reset

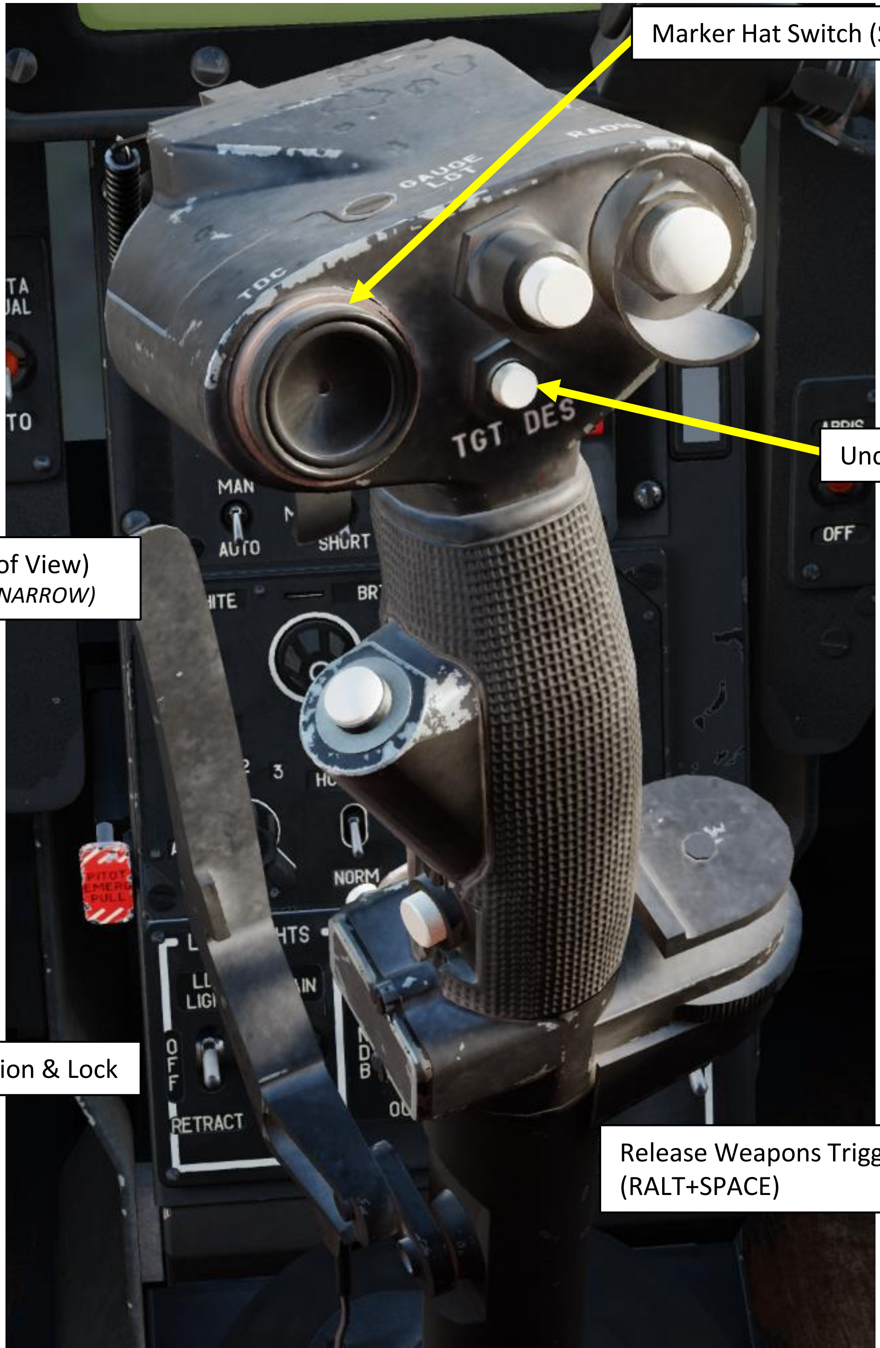


Weapons Control System Power Switch
- UP = ON

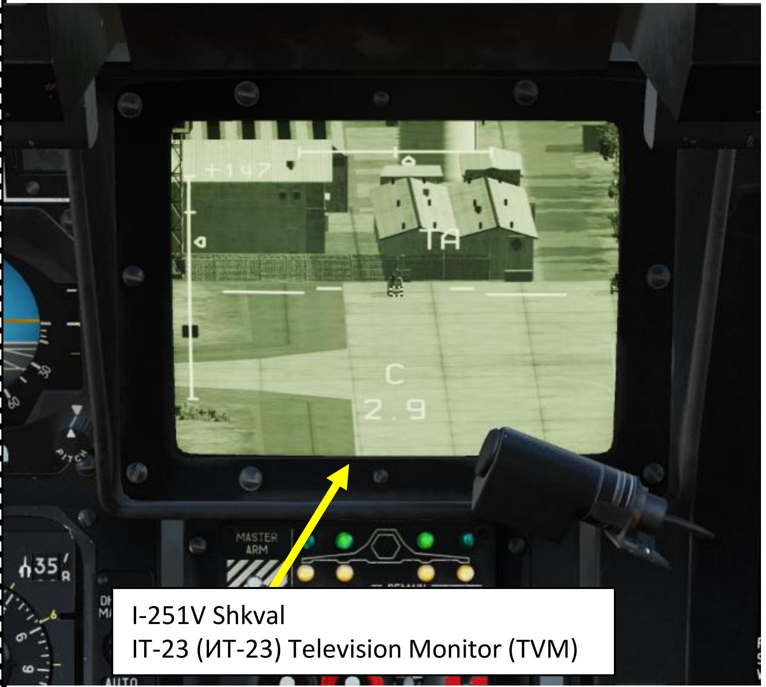
Unguided rocket and Gun Pods settings
- 0: S-8KOM rockets – AT/AP warhead
- 1: S-8TsM rockets – smoke warhead
- 2: S-13 rockets
- 3: S-24 heavy rockets (not used)
- 4: S-8M HE rockets
- 5: UPK-23 gun pods, twin 23mm

1 – INTRODUCTION
1.3 – Weapon Interface

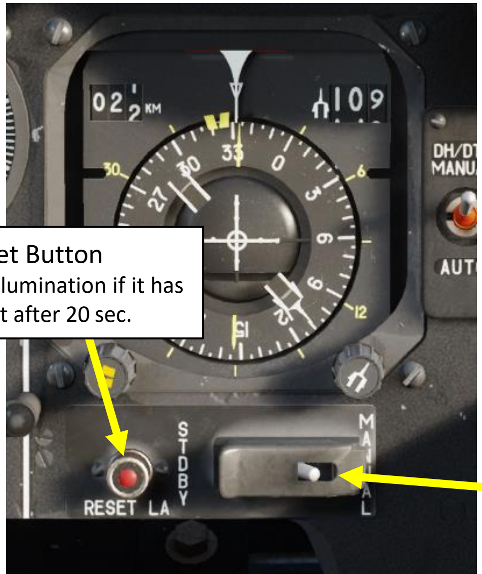




1 – INTRODUCTION
1.3 – Weapon Interface



I-251V Shkval
IT-23 (ИТ-23) Television Monitor (TVM)



Laser Designator Reset Button
- Used to cease laser illumination if it has not already timed out after 20 sec.

Shkval and HUD Display Controls

Laser Mode Selector
- Laser Designator (STDBY), used to designate targets for weapons such as the Kh-25ML, Kh-29L or laser bombs. Does not affect Vikhr employment.
- Laser Rangefinder (MANUAL)

HUD (Heads-Up Display)

HMS (Helmet-Mounted Sight) Reticle

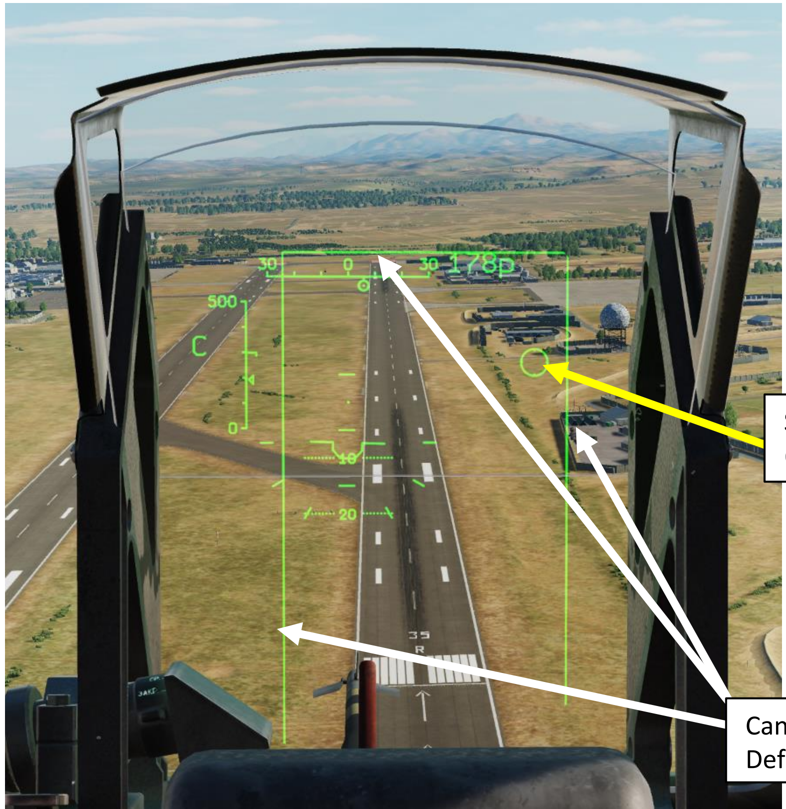
2.1 – 2A42 30 MM AUTO-CANNON

2.1 – 2A42 30 MM AUTO-CANNON
2.1.1 – Cannon Modes

The 2A42 30 mm auto-cannon has two operation modes: MOV (Moving Cannon) and FIX (Fixed Cannon).

- **MOV (Moving Cannon) Mode**: this primary mode of operation allows the gun to aim at a point designated by the Shkval. In this mode, the cannon to be deflected from -2°30' to +9° in azimuth and from +3°30' to -37° in elevation.

Weapon System Mode Selector
- **Mov**ing Cannon – Automatic
- **Fix**ed Cannon
- Backup **Man**ual
- **FAIL** - Backup Navigation Tasks on combat computer
- Backup Combat tasks on **Nav**igation computer



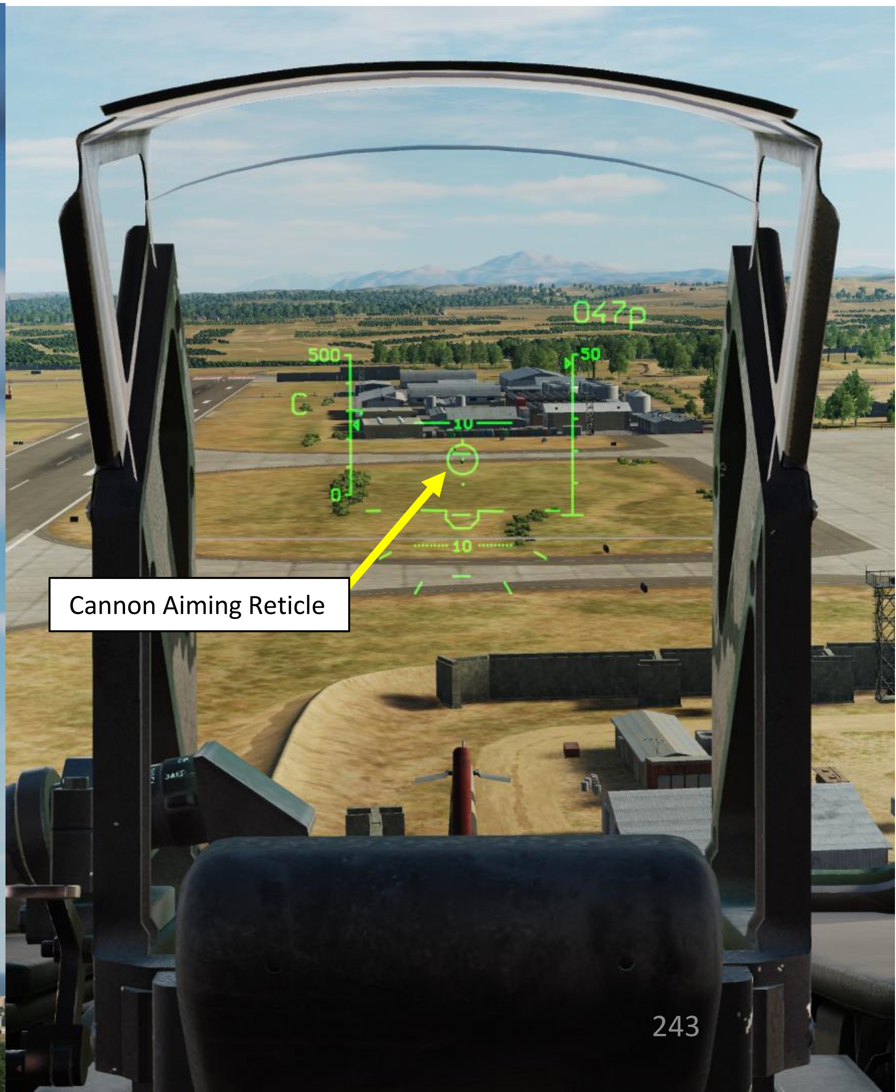
Shkval Aiming Circle (where Cannon is aiming)

Cannon Max Deflection Zone

2.1 – 2A42 30 MM AUTO-CANNON
2.1.1 – Cannon Modes

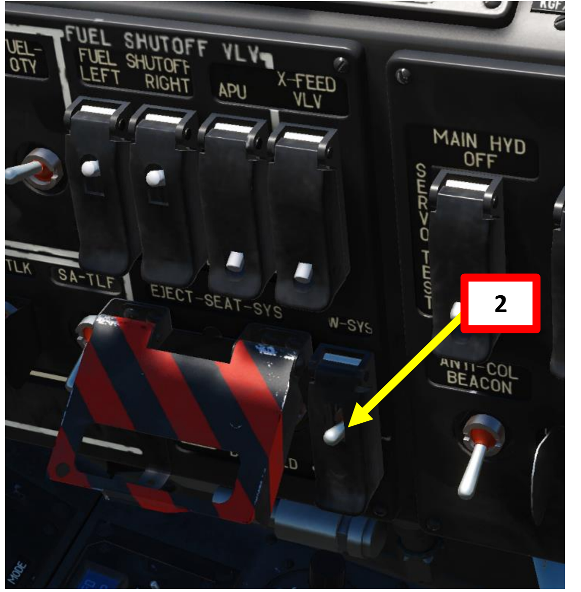
- **FIX (Fixed Cannon) Mode**: fixes the cannon boresight along the zero sight line of the aircraft fuselage. This is generally used in case of a cannon-drive malfunction.

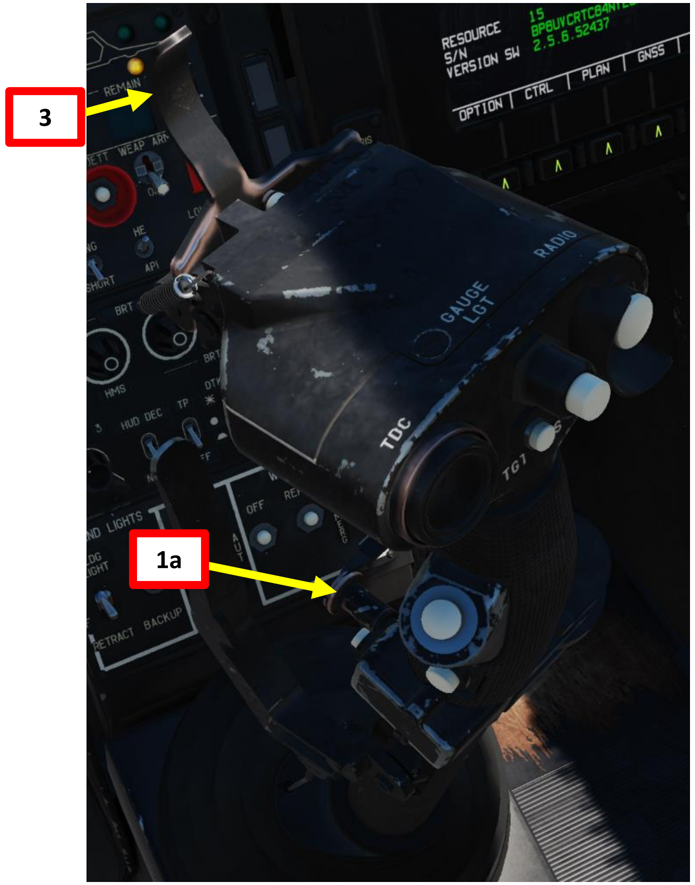
Weapon System Mode Selector
- **Mov**ing Cannon – Automatic
- **Fix**ed Cannon
- Backup **Man**ual
- **FAIL** - Backup Navigation Tasks on combat computer
- Backup Combat tasks on **Nav**igation computer

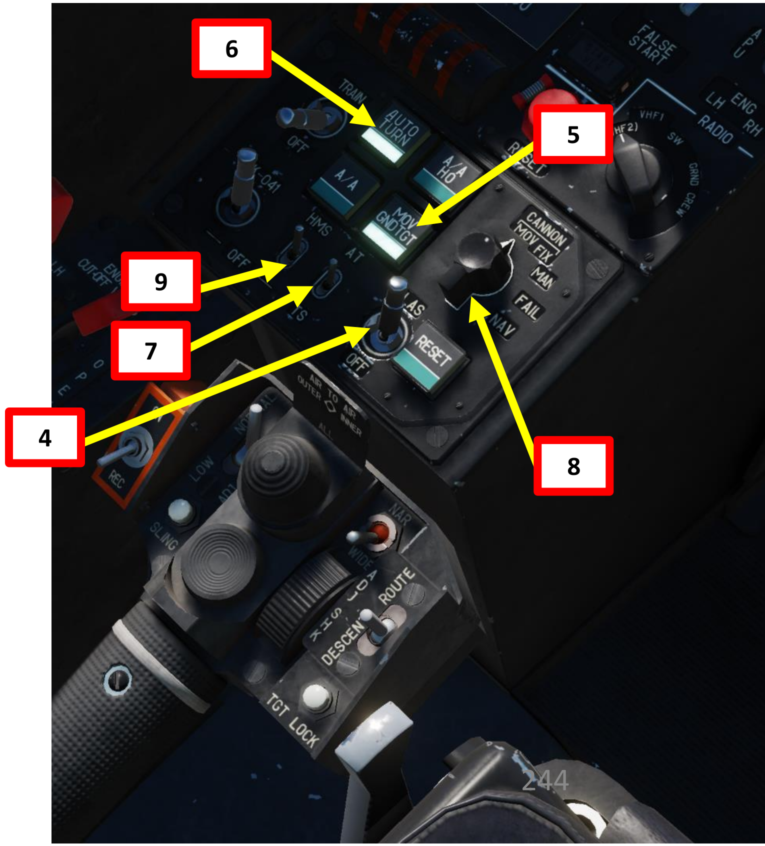


2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

1. (Optional) Auto-Hover switch ON (LALT+T by default) and collective to 75 % / normal operating position.
2. Set Weapons Power switch ON
    - Flip cover UP, switch UP, flip cover DOWN.
3. Flip gun safety switch by pressing “C” (or Gun Select key binding)
4. Laser Power switch ON (FWD)
5. Select “MOVING GROUND TARGET” button if tracking a moving target
6. Select “AUTO-TURN” button if you want the Ka-50 to automatically face the direction you are aiming.
7. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking or MAN for boresighted (unguided) mode.
8. Select MOV mode (or FIX if you are not using the SHKVAL)
9. Set HMS (Helmet Mounted Sight) switch ON (FWD)







2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

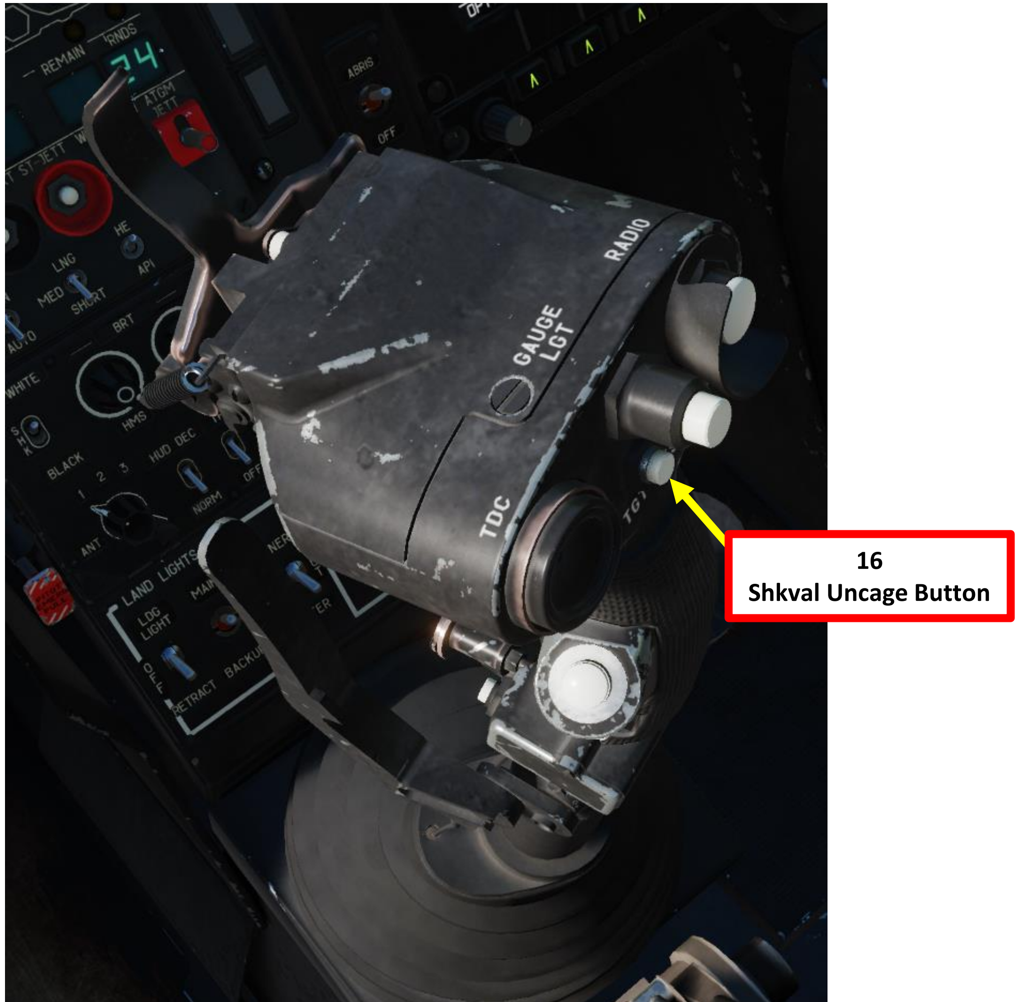
10. Your Helmet Mounted Sight is used to designate the target.
11. Set Master Arm switch ON (UP)
12. Set Weapon Launch Mode: Auto
13. Set Weapon Burst Length: As desired
    - SHORT = 10 / MED-LONG = 20
14. Set Ammunition Type:
    - HE: High-Explosive
    - API: Armor-Piercing Incendiary
15. Set Low/High rate of fire (200/600 RPM) as desired.

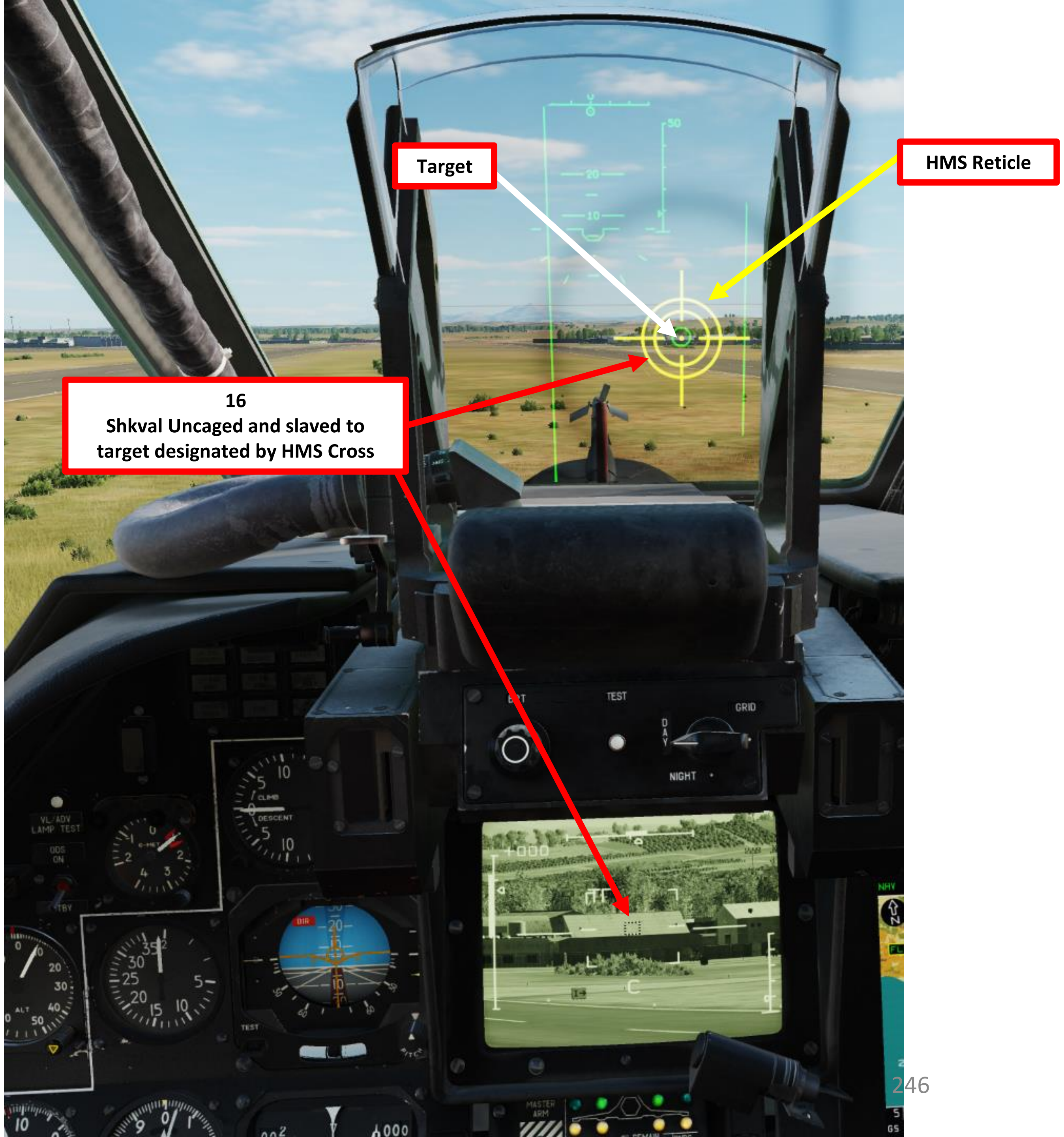
Helmet Mounted Sight Reticle (Gun Not Armed / Safety On)

Helmet Mounted Sight Reticle (Gun Armed / Safety Off)

2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

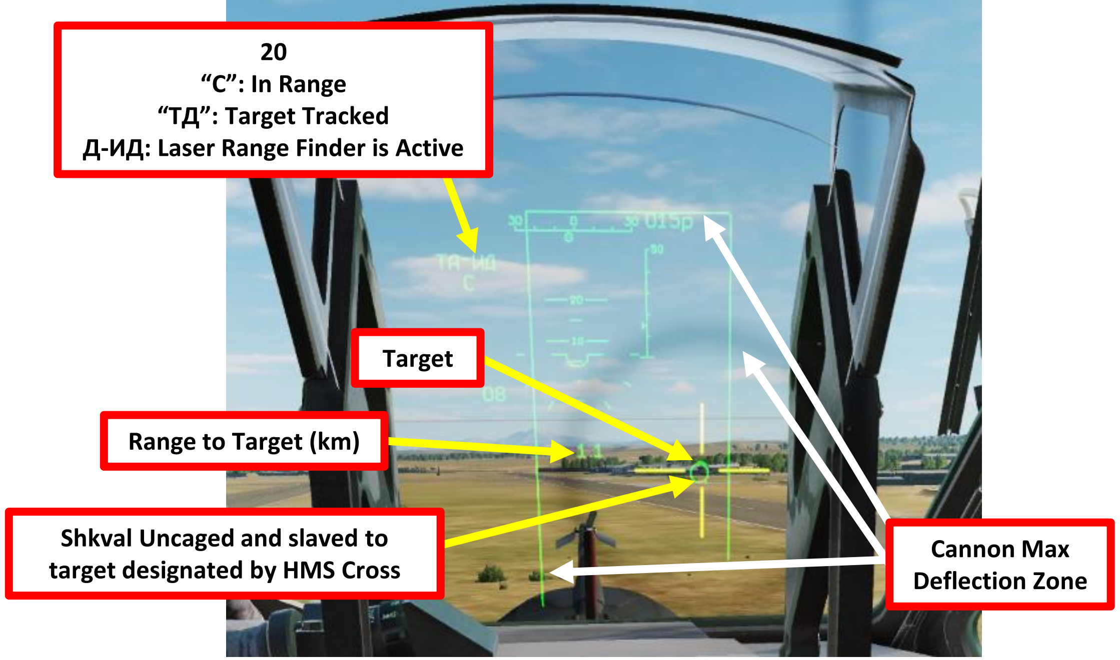
16. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.

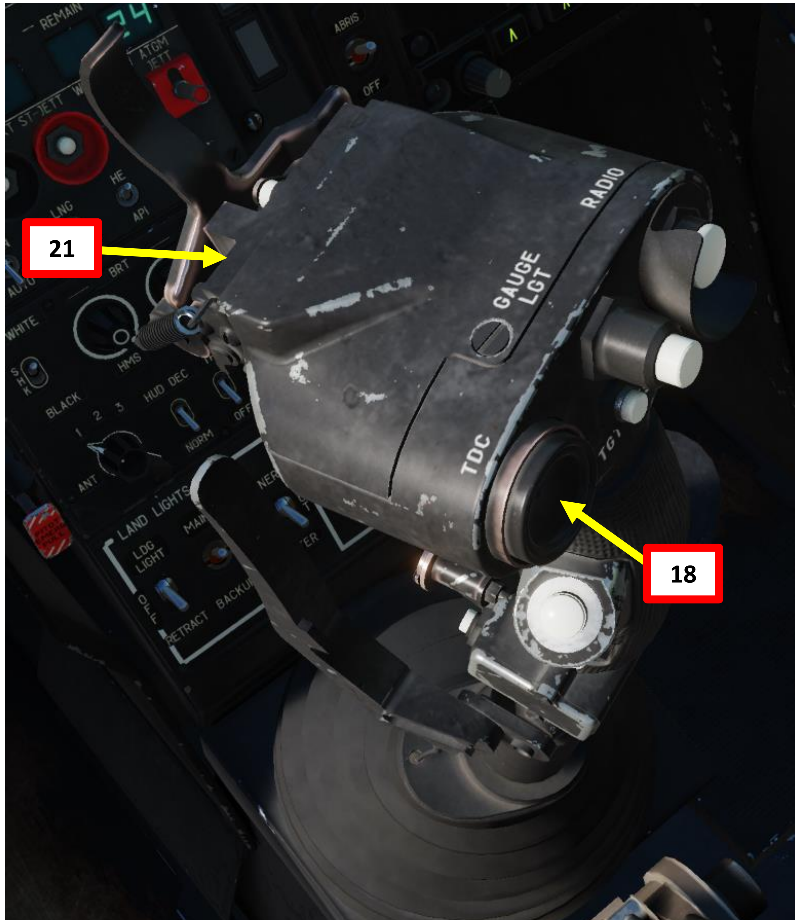


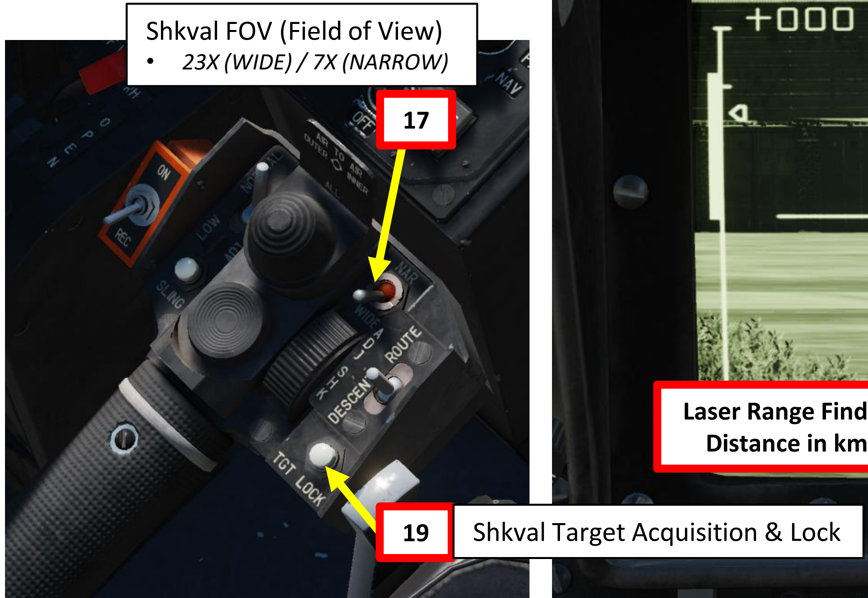


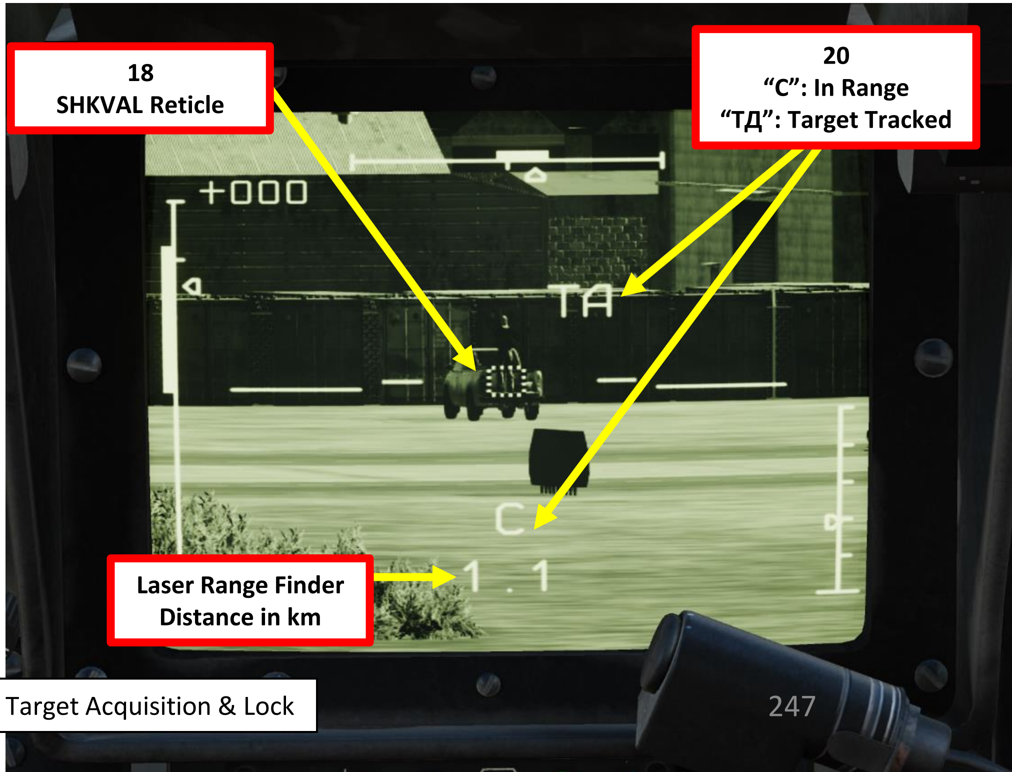
2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

17. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding.
18. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
19. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.
20. Make sure the “C” (In Range to Target) and “TA” (Target is being tracked) indication are visible on the Heads-Up Display and SHKVAL display. Verify that you are within the Cannon Max Deflection Zone (Rectangle)



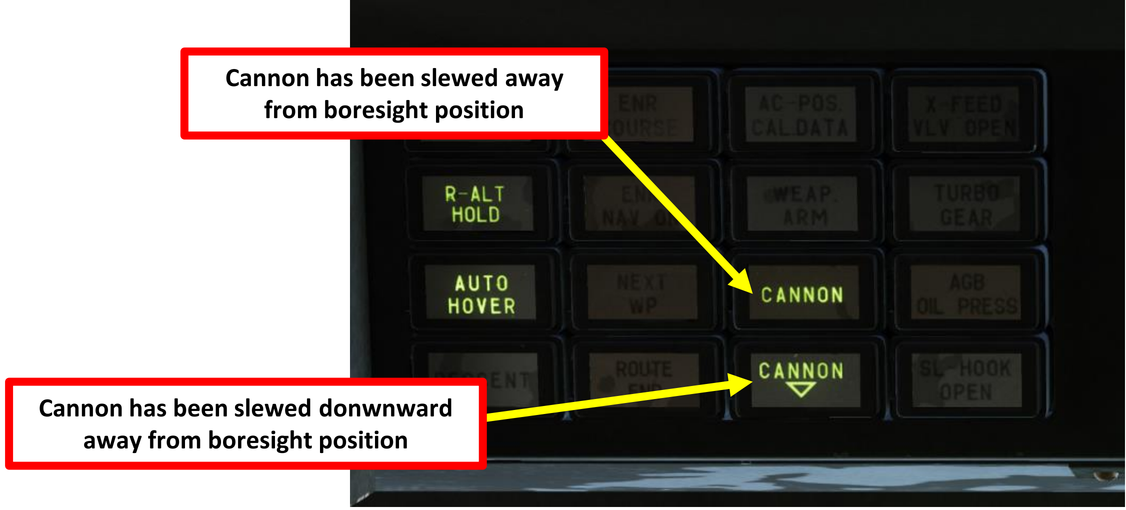


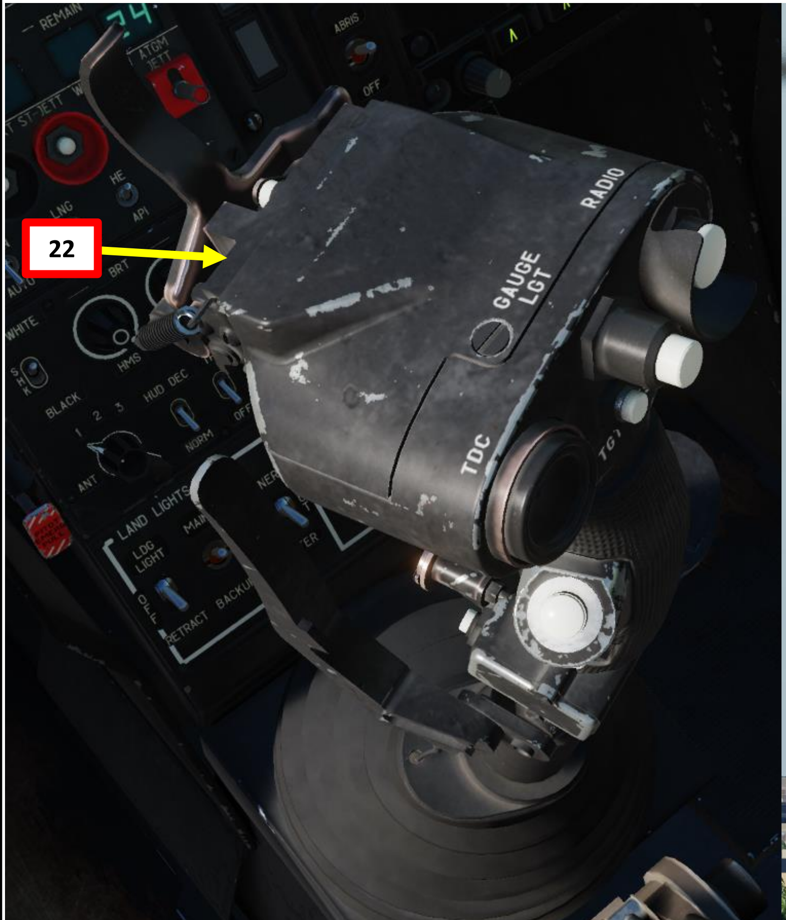




2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

21. Once target is locked with the Shkval, the cannon will aim automatically at the designated target.
22. When target range is between 800 m and 2 km, fire Gun by squeezing the Gun Trigger (“Spacebar” is the “Gun Fire” binding),





2.1 – 2A42 30 MM AUTO-CANNON
2.1.2 – Moving Cannon Mode Tutorial

23. The cannon will fire on the target designated by the SHKVAL. If you are moving and within the cannon max deflection limits, the cannon will keep tracking the target and fire on the same target if you press the trigger again.

2.1 – 2A42 30 MM AUTO-CANNON

2A42 Cannon Employment Parameters	
Minimum Safe Altitude - Hover	10 m
Minimum Safe Altitude – Level Flight With Shkval	30 m
Minimum Safe Altitude – Level Flight Without Shkval	20 m
Maximum Altitude	5,000 m
Maximum Indicated Airspeed	300 km/h
Minimum Target Range	800 m
Maximum Target Range	2,000 m
Pitch Angle	±60°

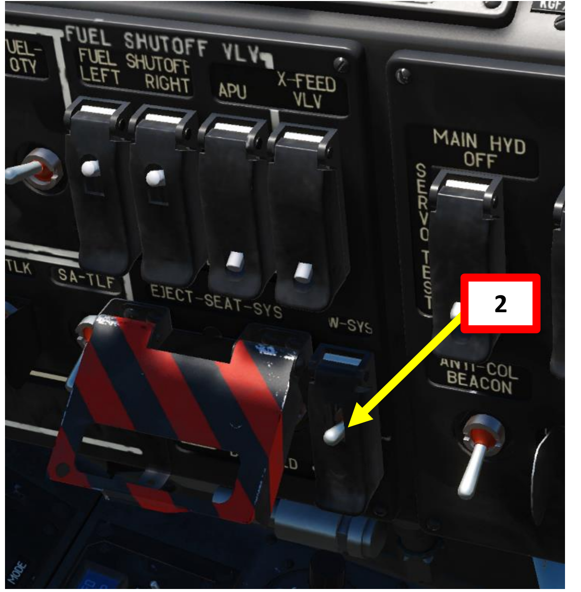
2.2 – AIR-TO-GROUND MISSILES

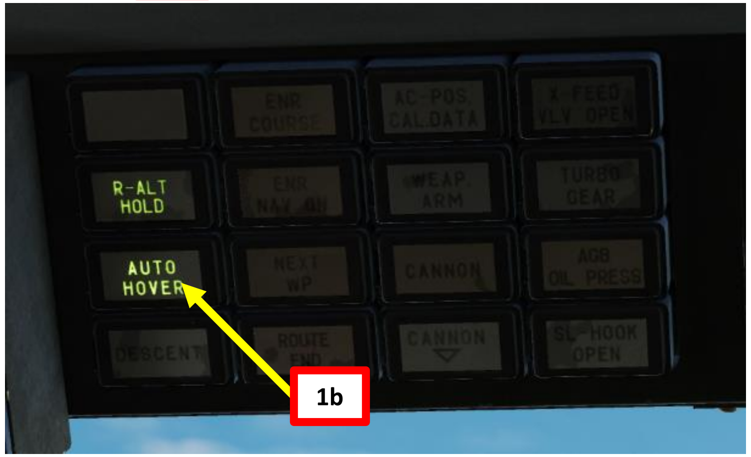
2.2.1 – 9A4172 Vikhr (AT-9) Missile

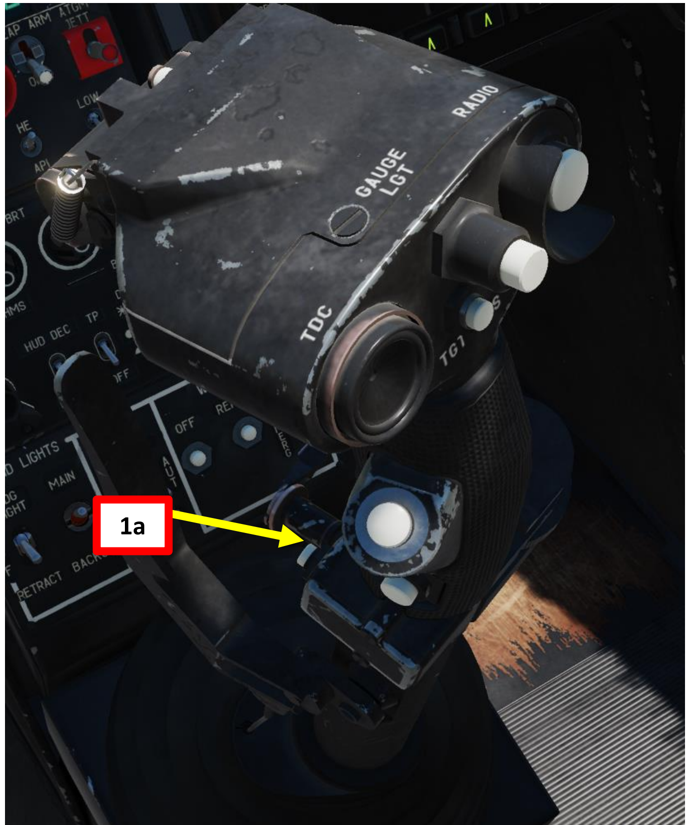
2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

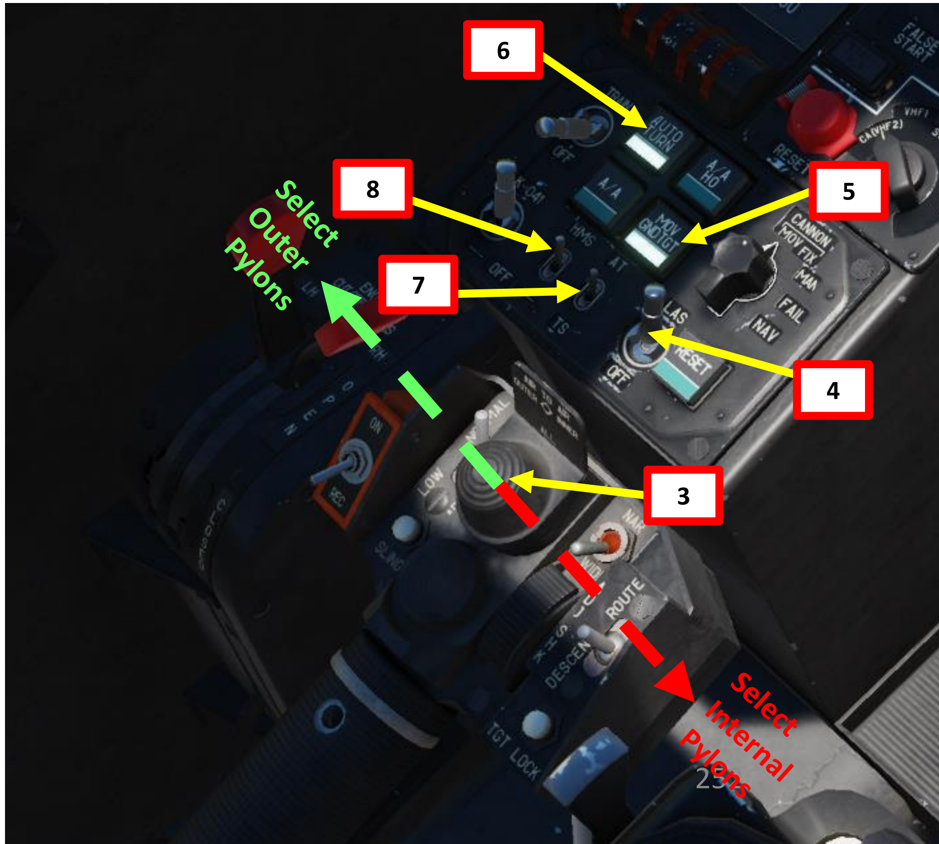
1. (Optional) Auto-Hover switch ON (LALT+T by default) and collective to 75 %/normal operating position.
2. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
3. Set collective weapon hat switch to the LEFT to select VIKHR missile (outer pylons if equipped as such)
4. Set Laser Power switch ON (FWD)
5. Select "MOVING GROUND TARGET" button if tracking a moving target
6. Select "AUTO-TURN" button if you want the Ka-50 to automatically face the direction you are aiming.
7. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
8. Set HMS (Helmet Mounted Sight) switch ON (FWD)
9. Set Laser Mode Selector to STDBY.
10. Set Laser Code Selector – As desired.

Laser Mode Selector
- Laser Designator (STDBY)
- Laser Rangefinder (MANUAL)







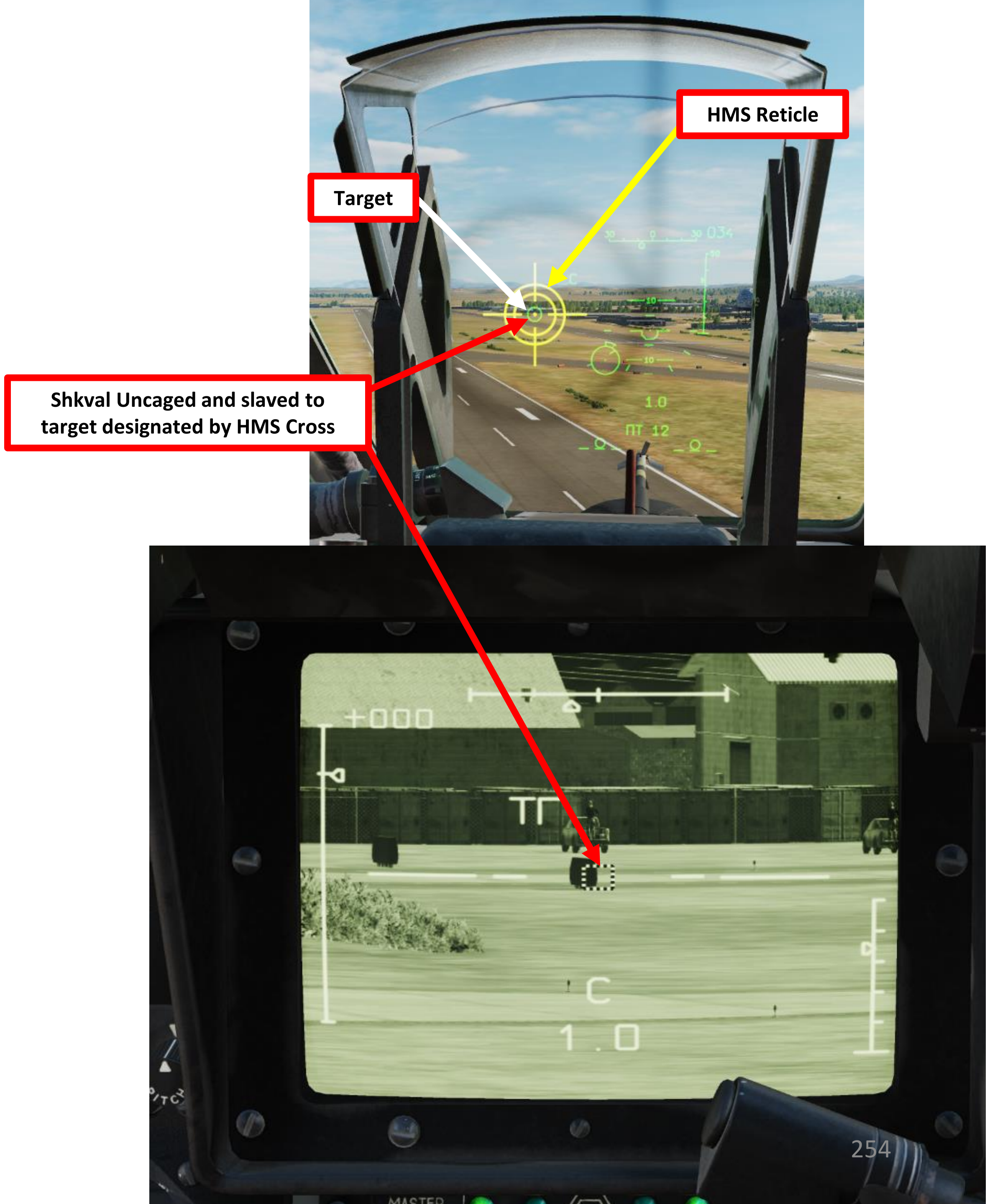


2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

11. Your Helmet Mounted Sight will be used to designate the target.
12. Set Master Arm switch ON (UP)
13. Set Weapon Launch Mode: Manual
    - NOTE: I recommend using MANUAL (DOWN) since it allows you to fire to targets that are farther than what you can reach in AUTO.
14. Set Weapon Burst Length
    - SHORT = 1 missile launched
    - MED or LONG = 2 missiles launched

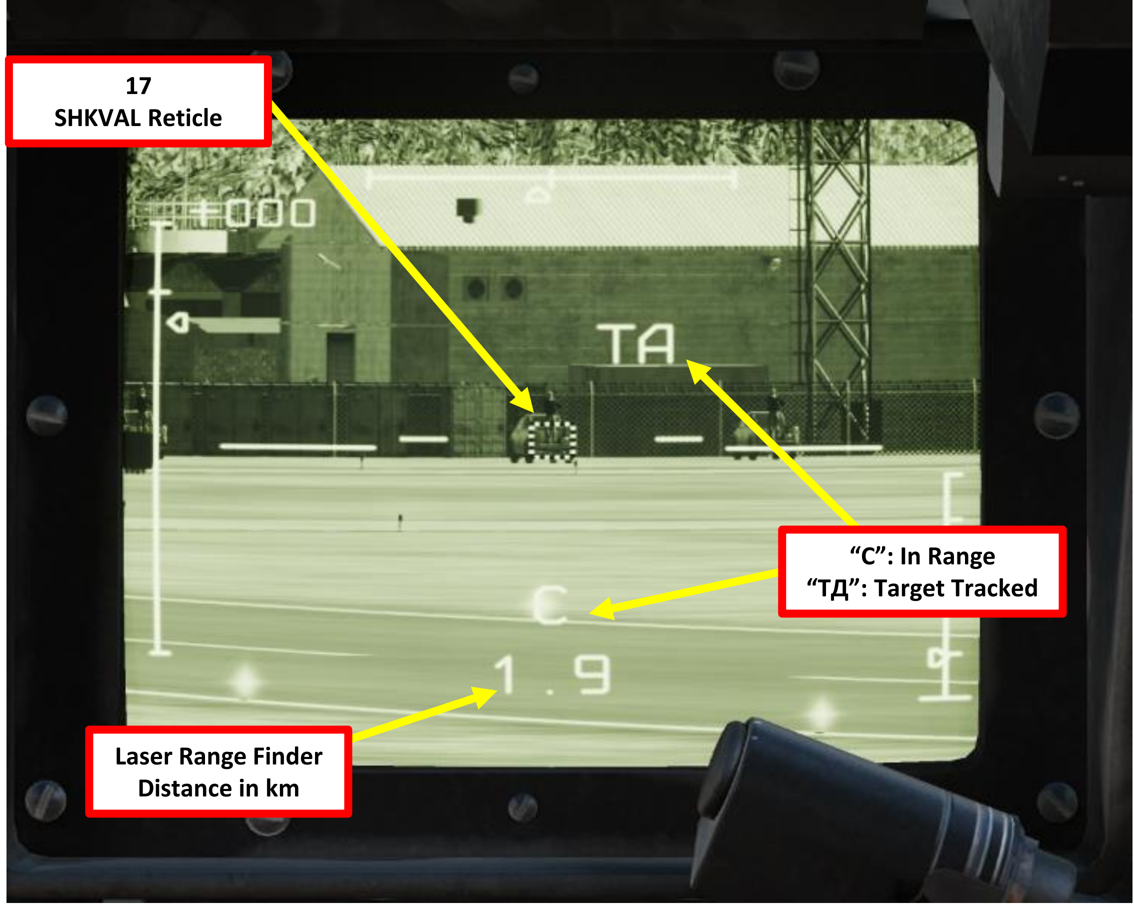
2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

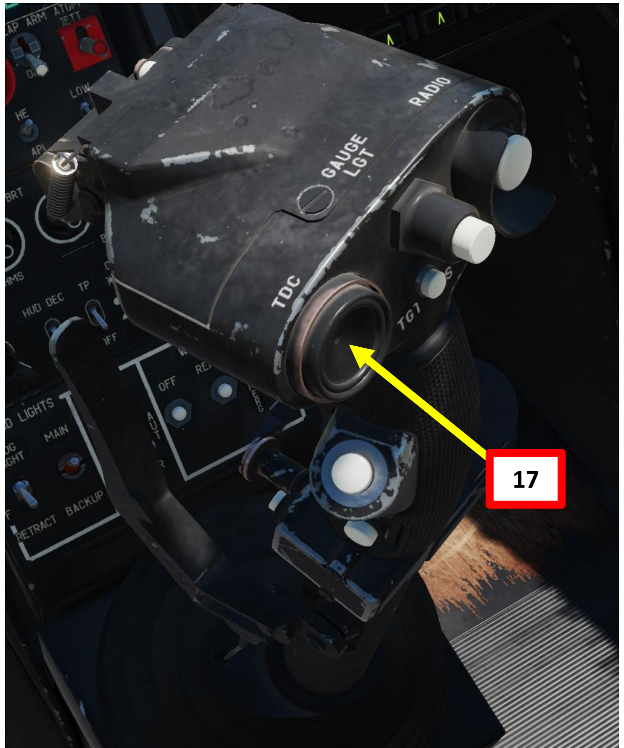
15. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.



2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

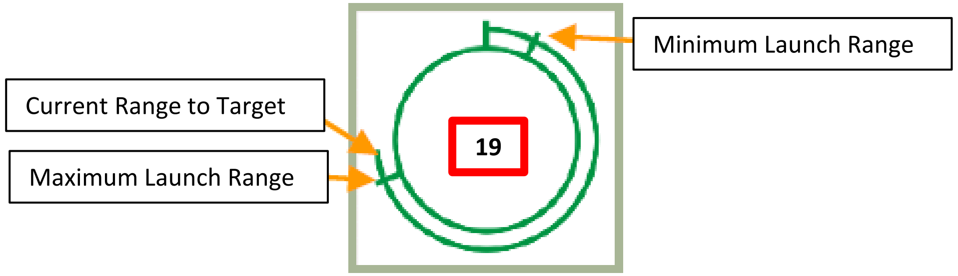
16. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
17. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
18. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.

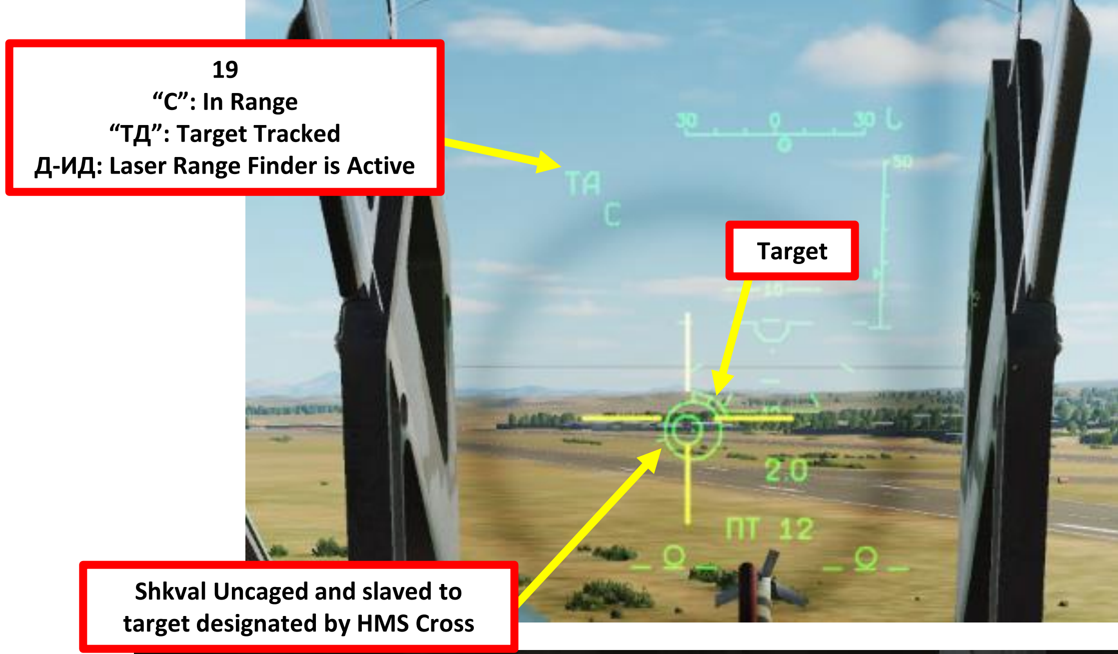


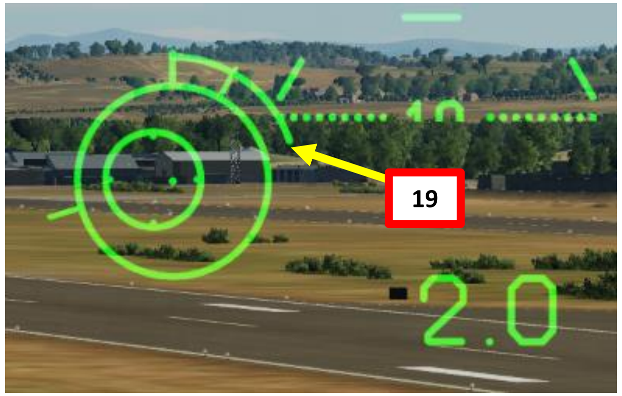


2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

19. Make sure the “C” (In Range to Target) and “TA” (Target is being tracked) indication are visible on the Heads-Up Display and SHKVAL display. Verify that you are within acceptable launch range (less then 8 km).
20. Launch VIKHR missile using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the missile has launched; this usually takes about one full second.





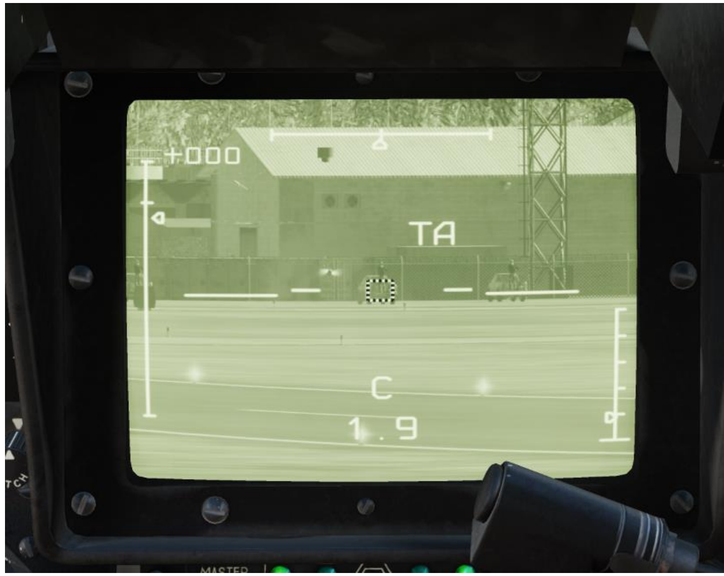


2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

21. When the weapon release button is pressed, the missile laser-beam control channel is automatically activated. The Vikhr will track the laser and home on the target. While the Vikhr missile is in flight, maintain the helicopter's current heading such that it does not exceed the Shkval's angular gimbal limits. Try to avoid high angular velocity that can cause missile to lose the laser-guidance beam.

“C”: In Range
“ТД”: Target Tracked
Д-ИД: Laser Range Finder is Active
ТД-ИУ: Auto-tracking target – laser-beam control

Remaining Time Until Vikhr Strikes Target + 6 Seconds



2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

2.2 – AIR-TO-GROUND MISSILES
2.2.1 – 9A4172 Vikhr (AT-9) Missile

Note: If **engaging air-to-air targets with the Vikhr like helicopters**, you should know that the Vikhr missile has proximity fuzes that are used for this very purpose.

To use the Vikhr's proximity fuze that will detonate the warhead with a near miss, turn on the **"ВЦ" (Air-to-Air) Target Mode button** from the Targeting Mode Control Panel.

Depending on the target's aspect (attack hemisphere), it may be necessary to adjust the missile's proximity fuze delay.

- If performing a pursuit or side attack, fuze adjustment is not required.
- If attacking at high aspect (in the Head-on hemisphere) it is necessary to decrease the fuze delay in order to increase hit probability. From the Targeting Mode Control Panel, press the **"ППС" (Air-to-Air Head-On Aspect) Target Mode button** to do so.

VIKHR Missile Employment Parameters	
Minimum Safe Launch Altitude – Hover	10 m
Minimum Safe Launch Altitude – Forward Flight	50 m
Maximum Launch Altitude - Barometric	4,000 m
Maximum Launch Altitude – Practical/All Speeds	3,000 m
Minimum Range to Target	800 m
Maximum Range to Target	8,000 m

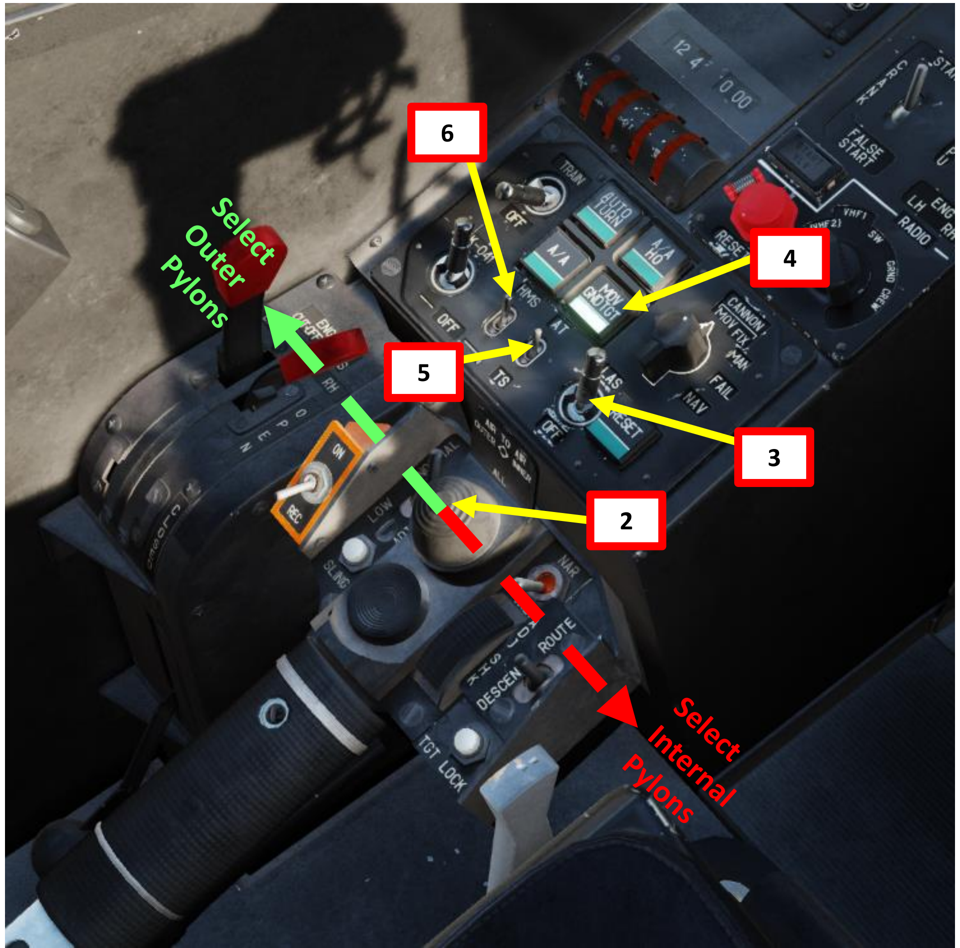
Target Mode Selector Button Air-to-Air

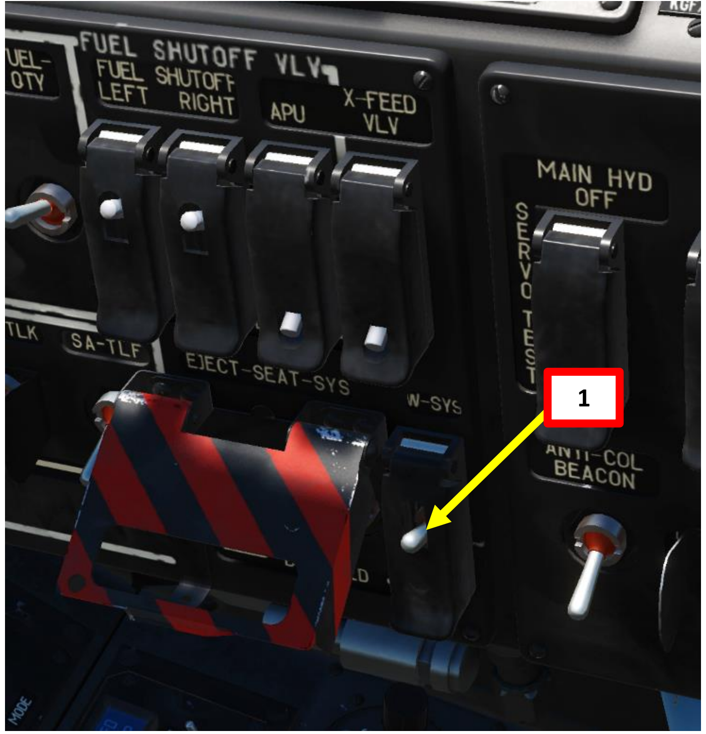
Target Mode Selector Button Air-to-Air Head-On Aspect

2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the LEFT to select KH-25ML missile (outer pylons if equipped as such)
3. Set Laser Power switch ON (FWD)
4. Select "MOVING GROUND TARGET" button if tracking a moving target
5. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
6. Set HMS (Helmet Mounted Sight) switch ON (FWD)
7. Set Laser Mode Selector to STDBY.
8. Set Laser Code Selector – As desired.

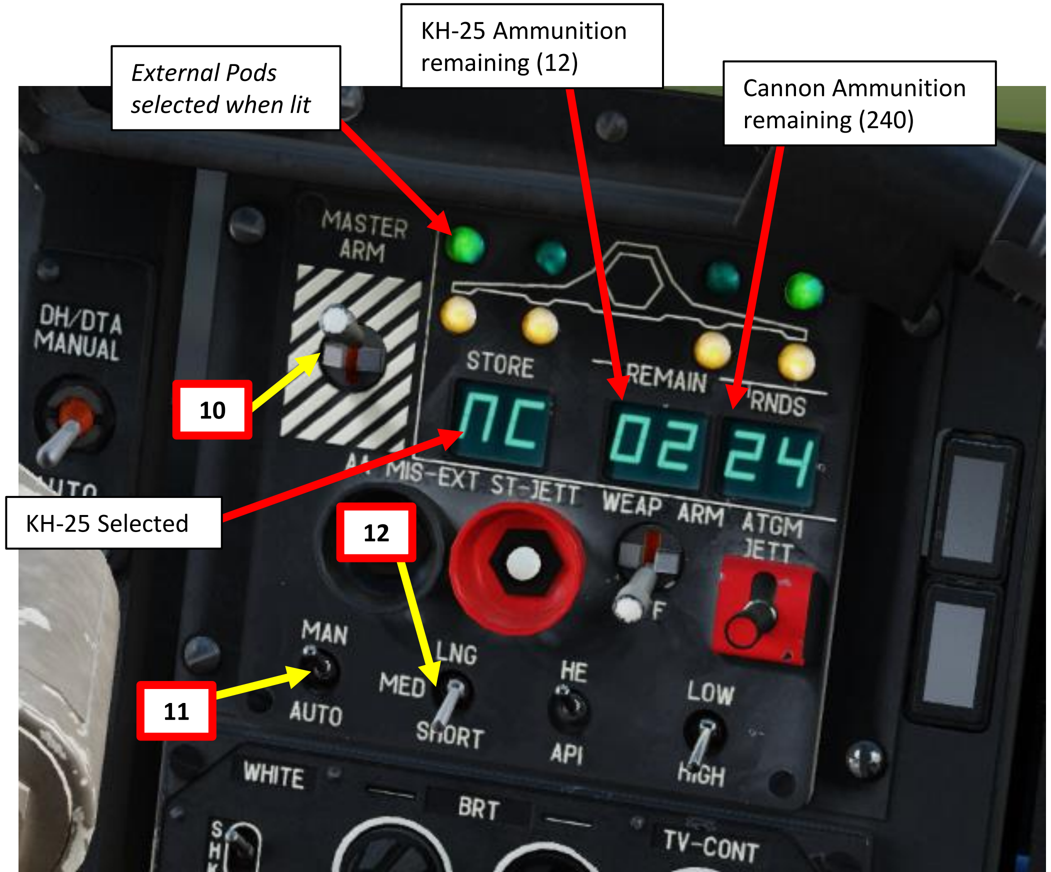




Laser Mode Selector
- Laser Designator (STDBY)
- Laser Rangefinder (MANUAL)

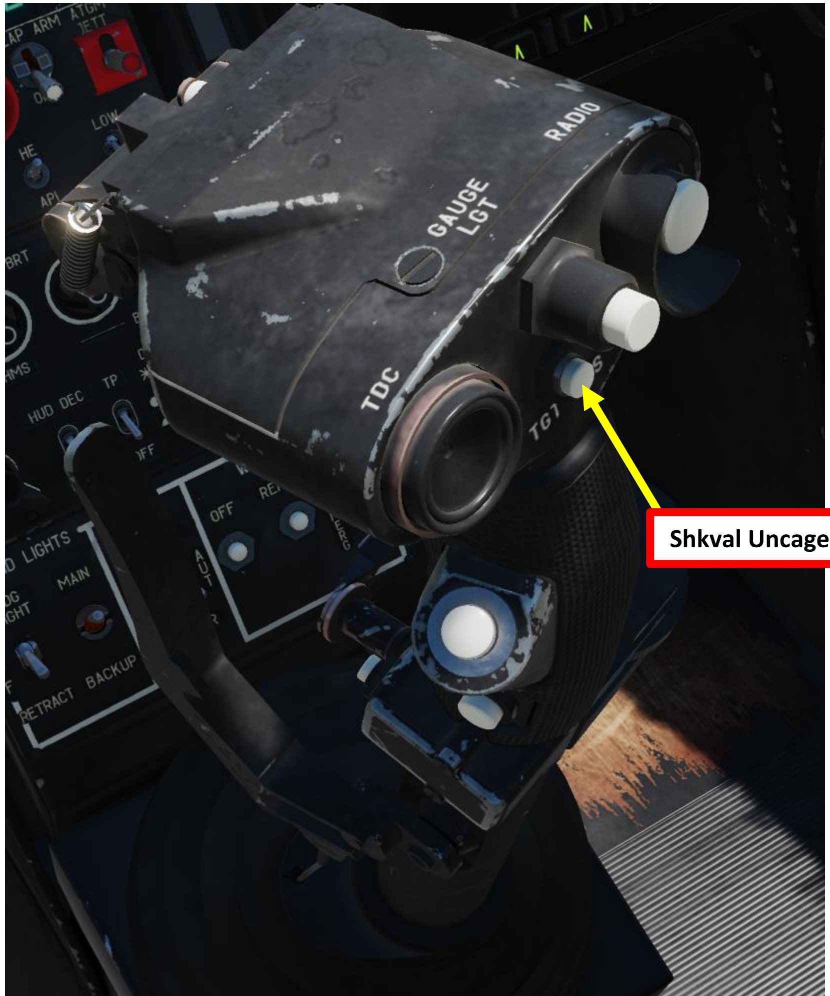
2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

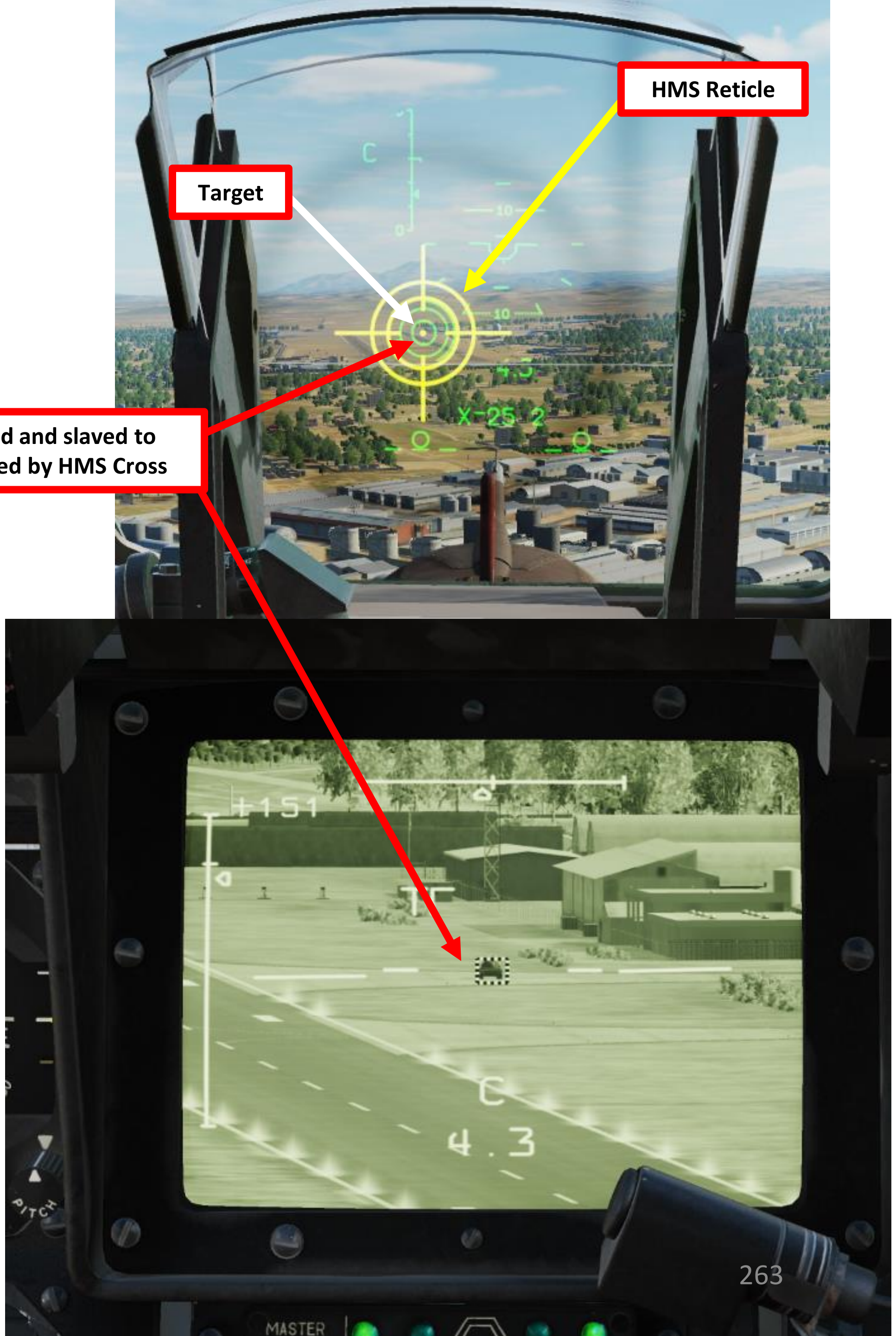
9. Your Helmet Mounted Sight will be used to designate the target.
10. Set Master Arm switch ON (UP)
11. Set Weapon Launch Mode: Manual
    - NOTE: I recommend using MANUAL (DOWN) since it allows you to fire to targets that are farther than what you can reach in AUTO.
12. Set Weapon Burst Length
    - SHORT = 1 missile launched
    - MED or LONG = 2 missiles launched



2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

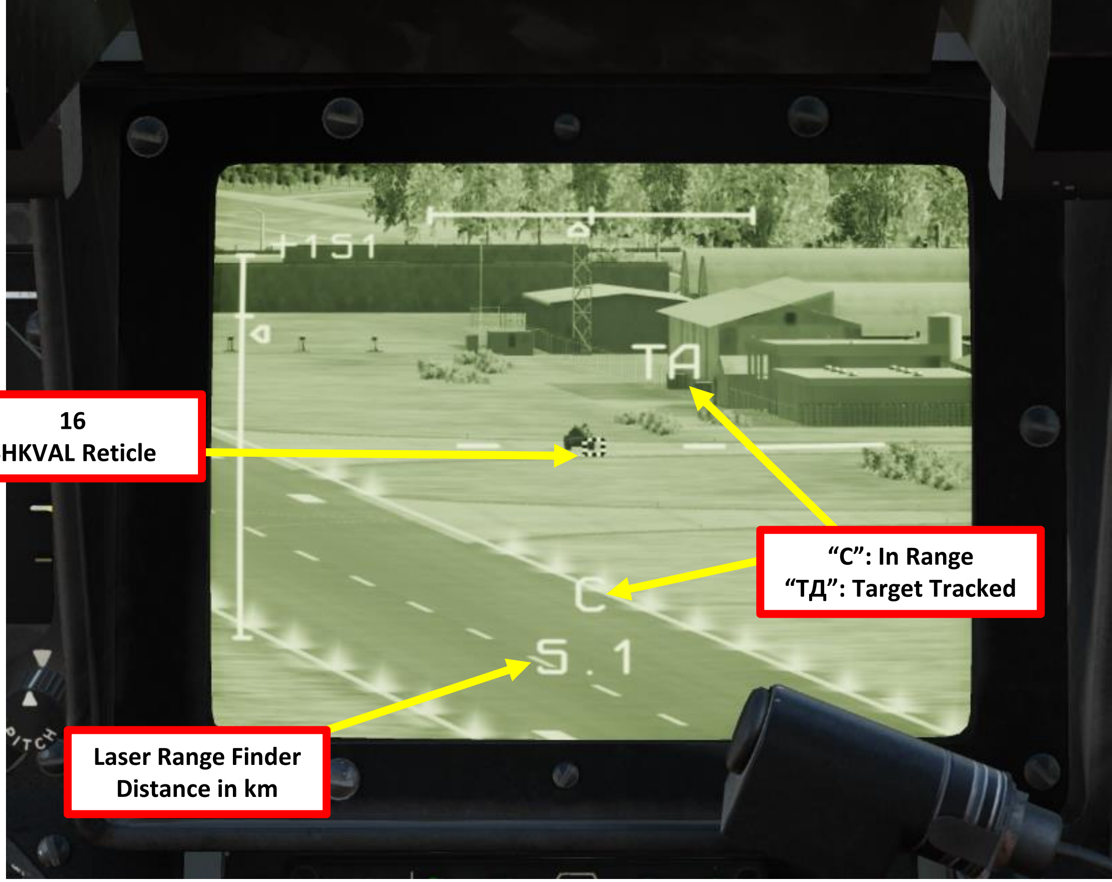
13. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing "O" or using custom binding.

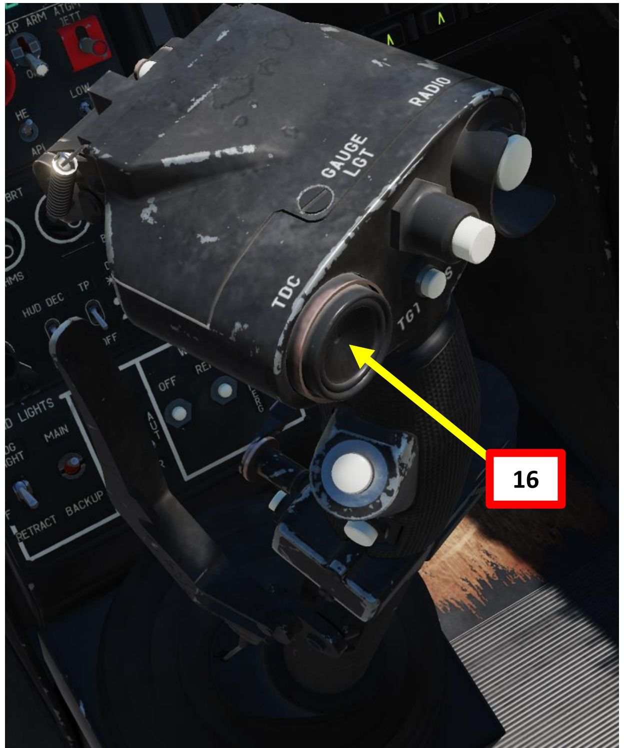




2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

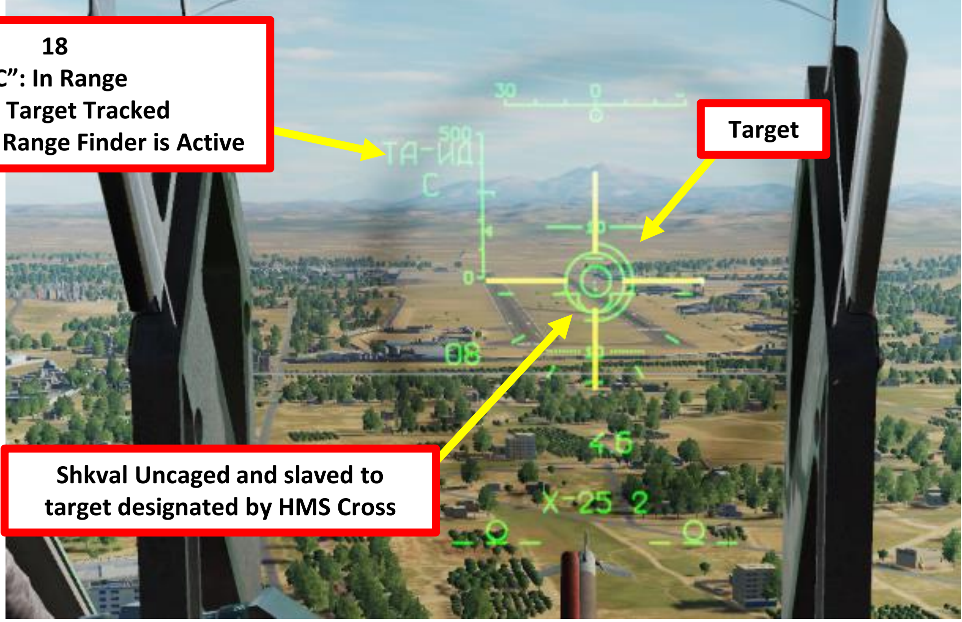
15. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding.
16. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
17. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.

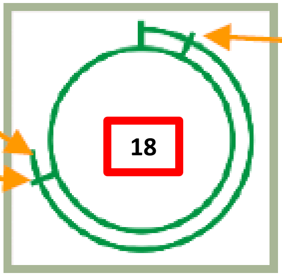


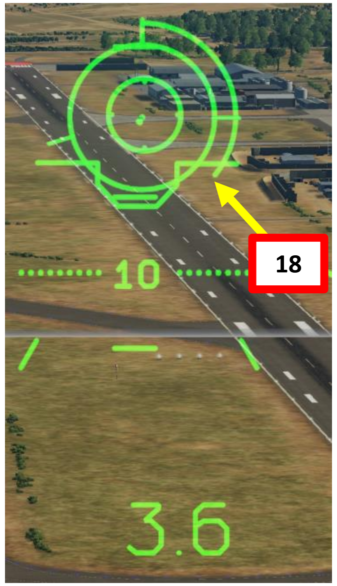


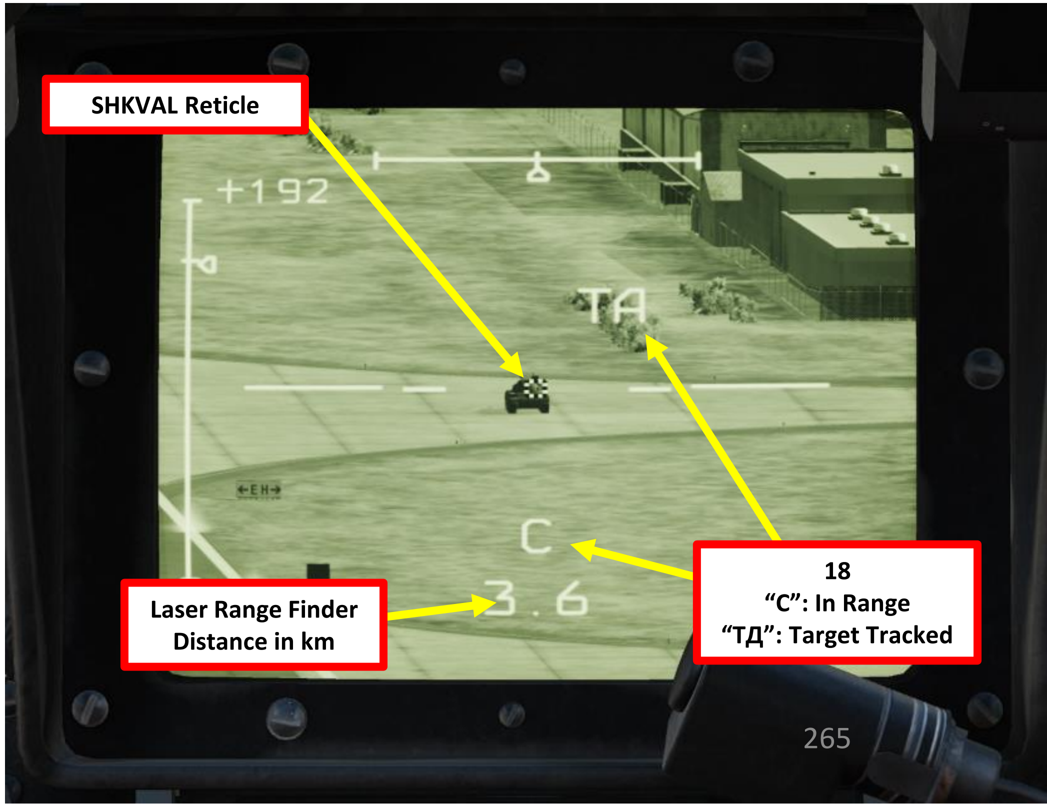
2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

18. Make sure the "C" (In Range to Target) and "TA" (Target is being tracked) indication are visible on the Heads-Up Display and SHKVAL display. Verify that you are within acceptable launch range (less then 10 km).
19. Fly at 120 km/h in forward flight minimum to avoid missile smoke ingestion cause an engine loss of power.
20. Launch KH-25 missile using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the missile has launched; this usually takes about one full second.







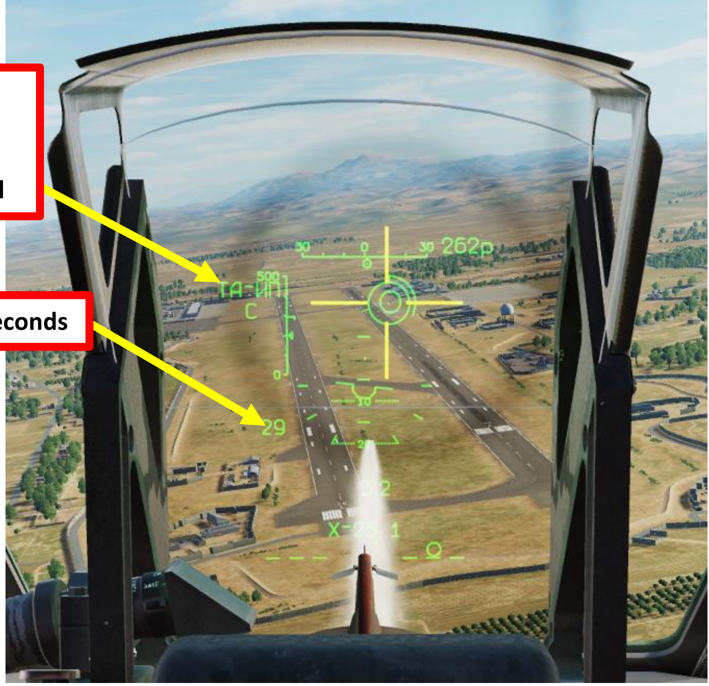


2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile

21. When the weapon release button is pressed, the missile laser-beam control channel is automatically activated. The KH-25 will track the laser and home on the target. While the KH-25 missile is in flight, maintain the helicopter's current heading such that it does not exceed the Shkval's angular gimbal limits. Try to avoid high angular velocity that can cause missile to lose the laser-guidance beam.

"C": In Range
"ТД": Target Tracked
Д-ИД: Laser Range Finder is Active
ТД-ИУ: Auto-tracking target – laser-beam control

Remaining Time Until KH-25 Strikes Target + 6 Seconds



2.2 – AIR-TO-GROUND MISSILES
2.2.2 – KH-25ML Karen (AS-10) Missile



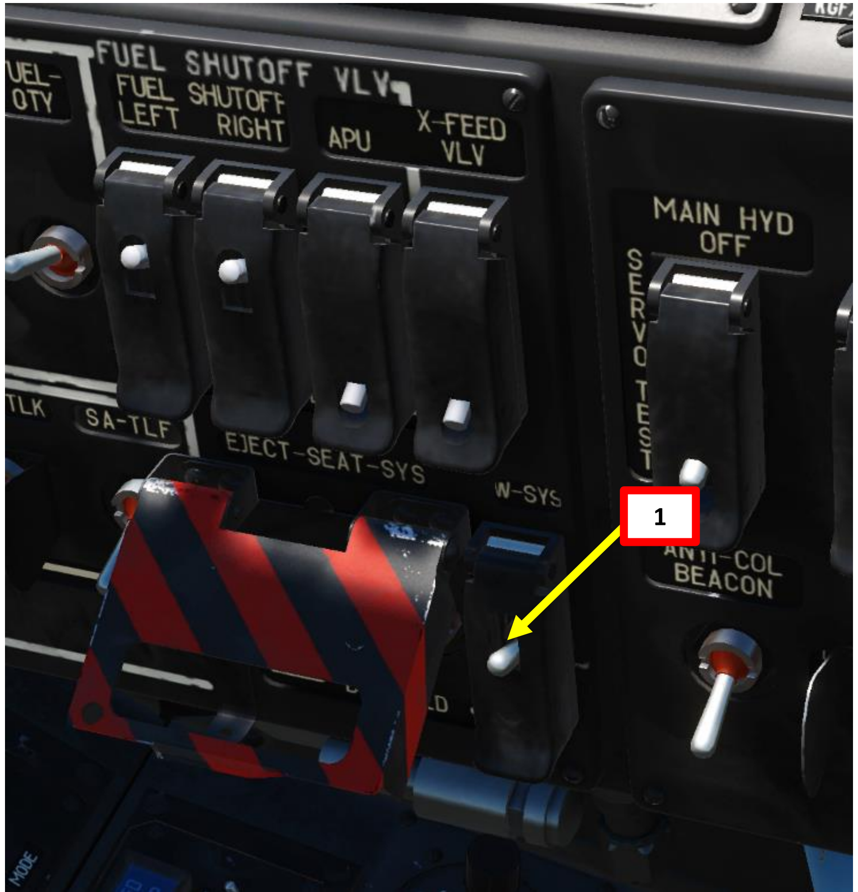

2.3 – UNGUIDED ROCKETS

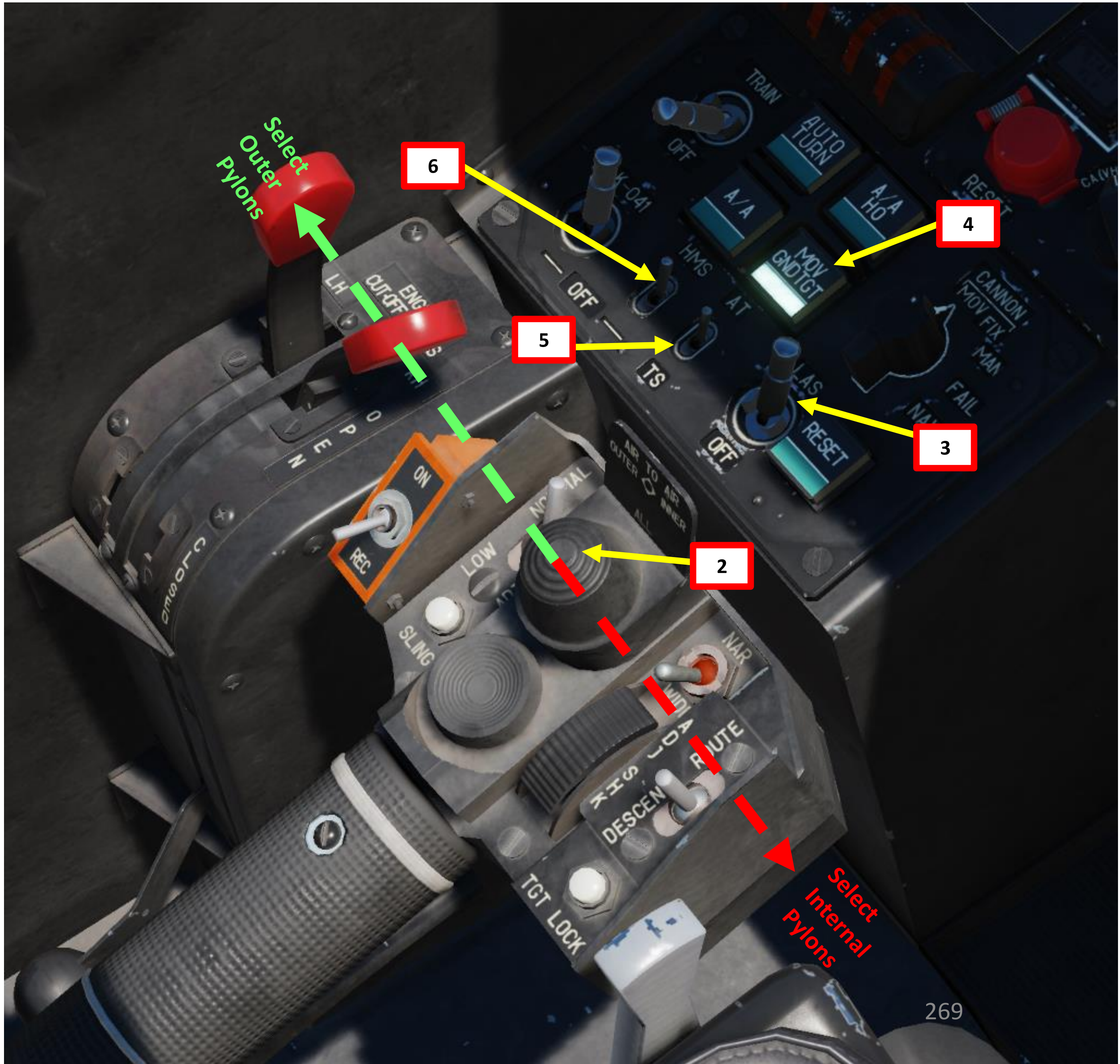
2.3.1 – S-8 (20 x 80 mm) Rockets

2.3 – UNGUIDED ROCKETS

2.3.1 – S-8 (20 x 80 mm) Rockets

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select rocket pods (inner pylons if equipped as such)
3. Laser Power switch ON (FWD)
4. Select “MOVING GROUND TARGET” button if tracking a moving target
5. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
6. Set HMS (Helmet Mounted Sight) switch ON (FWD)



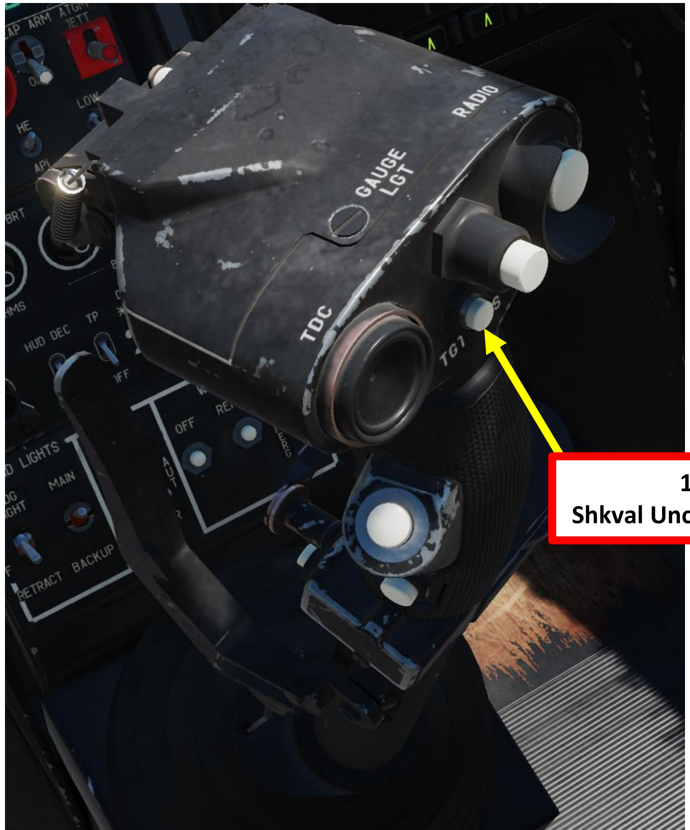


2.3 – UNGUIDED ROCKETS
2.3.1 – S-8 (20 x 80 mm) Rockets

7. Set Master Arm switch ON (UP)
8. Select rocket type
   - **0: S-8KOM rockets with AT /AP warhead**
   - 1: S-8TsM rockets (smoke warhead)
   - 2: S-13 rockets
   - 3: S-24 heavy rockets (not implemented in DCS)
   - 4: S-8M HE rockets
   - 5: UPK-23 gun pods, twin 23mm
9. Select Weapon Burst Length
   - SHORT = 1 pair / MED = 5 pairs / LONG = 10 pairs

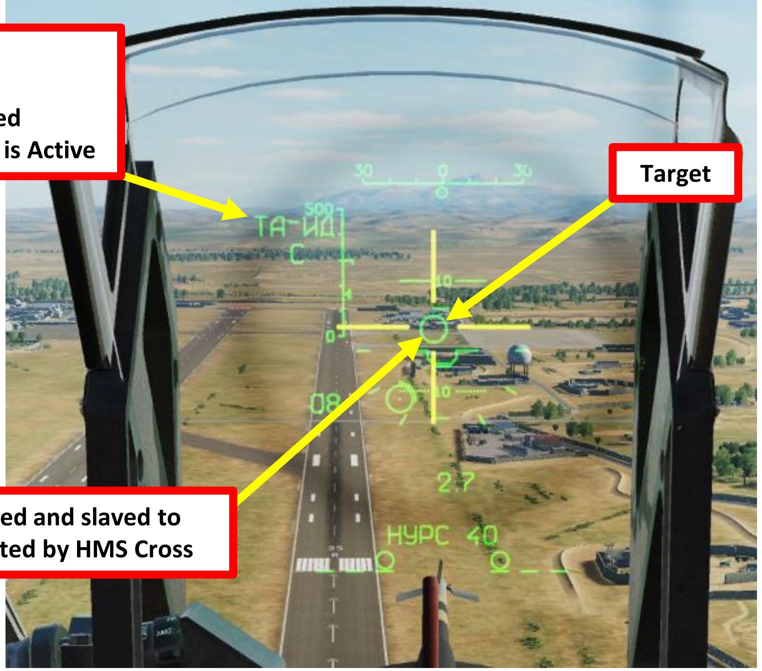
2.3 – UNGUIDED ROCKETS
2.3.1 – S-8 (20 x 80 mm) Rockets

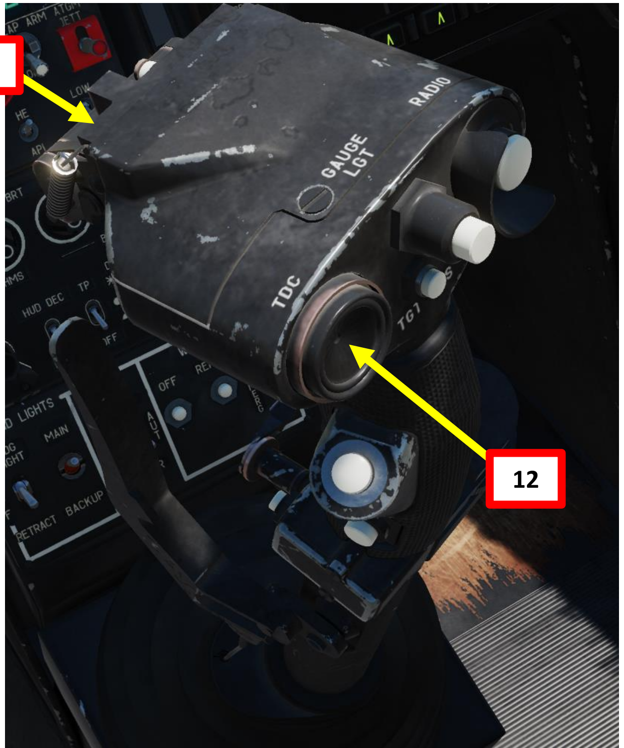
10. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing "O" or using custom binding.

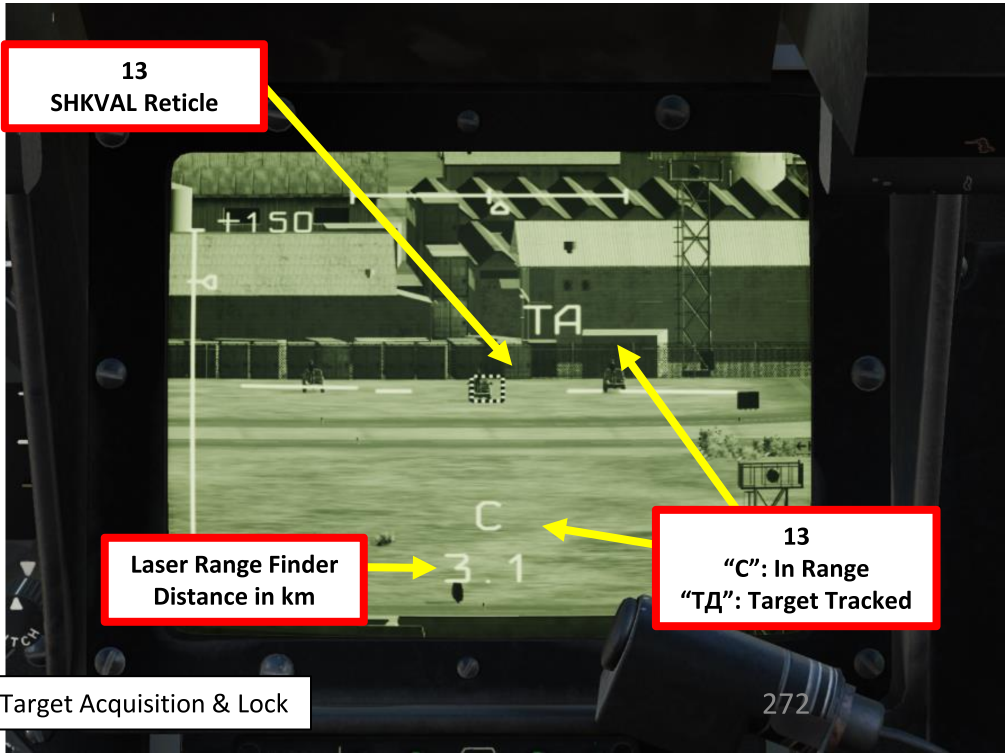


2.3 – UNGUIDED ROCKETS
2.3.1 – S-8 (20 x 80 mm) Rockets

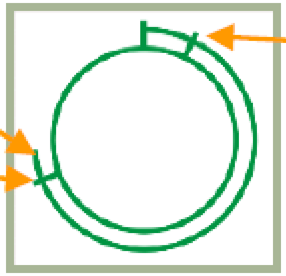
11. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
12. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
13. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.
14. Fly towards target and fire when the two circles on the HUD are aligned.
15. Make sure to fly in forward flight in order to avoid missile smoke ingestion, which can cause an engine loss of power.
16. Launch rockets using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the rocket has launched; this usually takes about one full second.

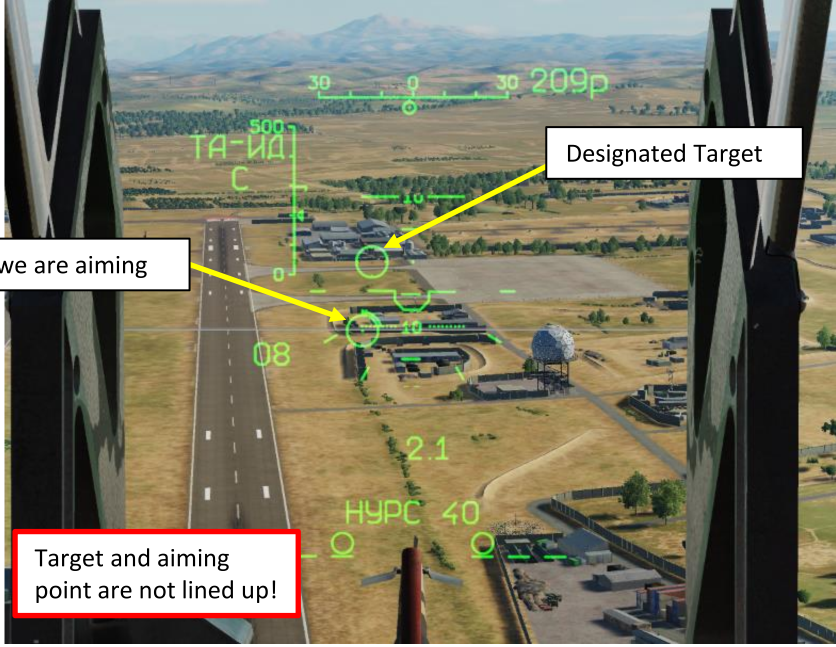






2.3 – UNGUIDED ROCKETS
2.3.1 – S-8 (20 x 80 mm) Rockets



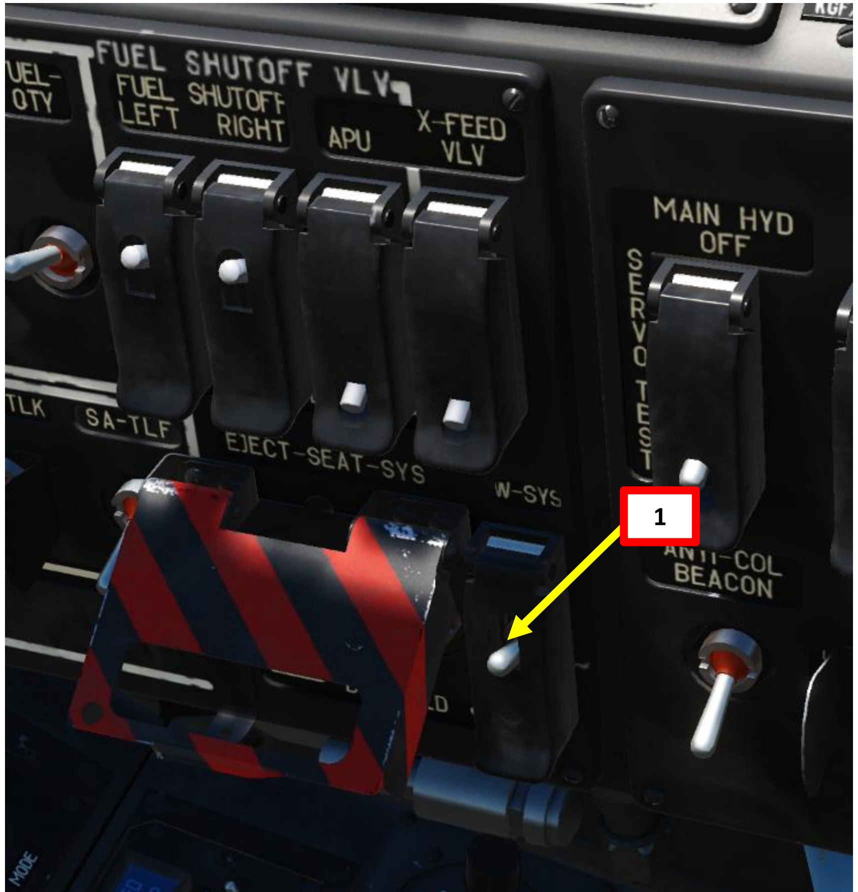


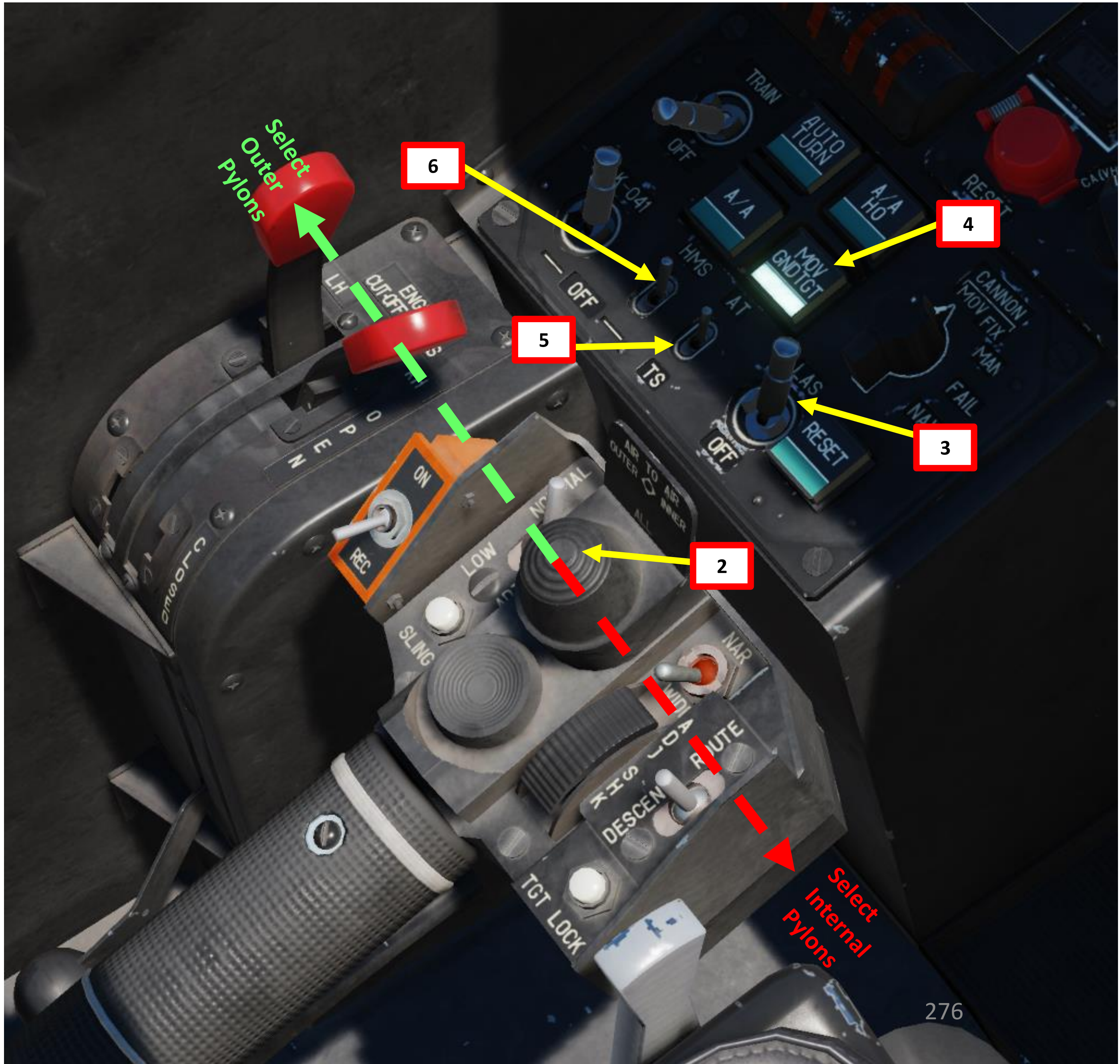
2.3 – UNGUIDED ROCKETS
2.3.1 – S-8 (20 x 80 mm) Rockets

2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets

2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets

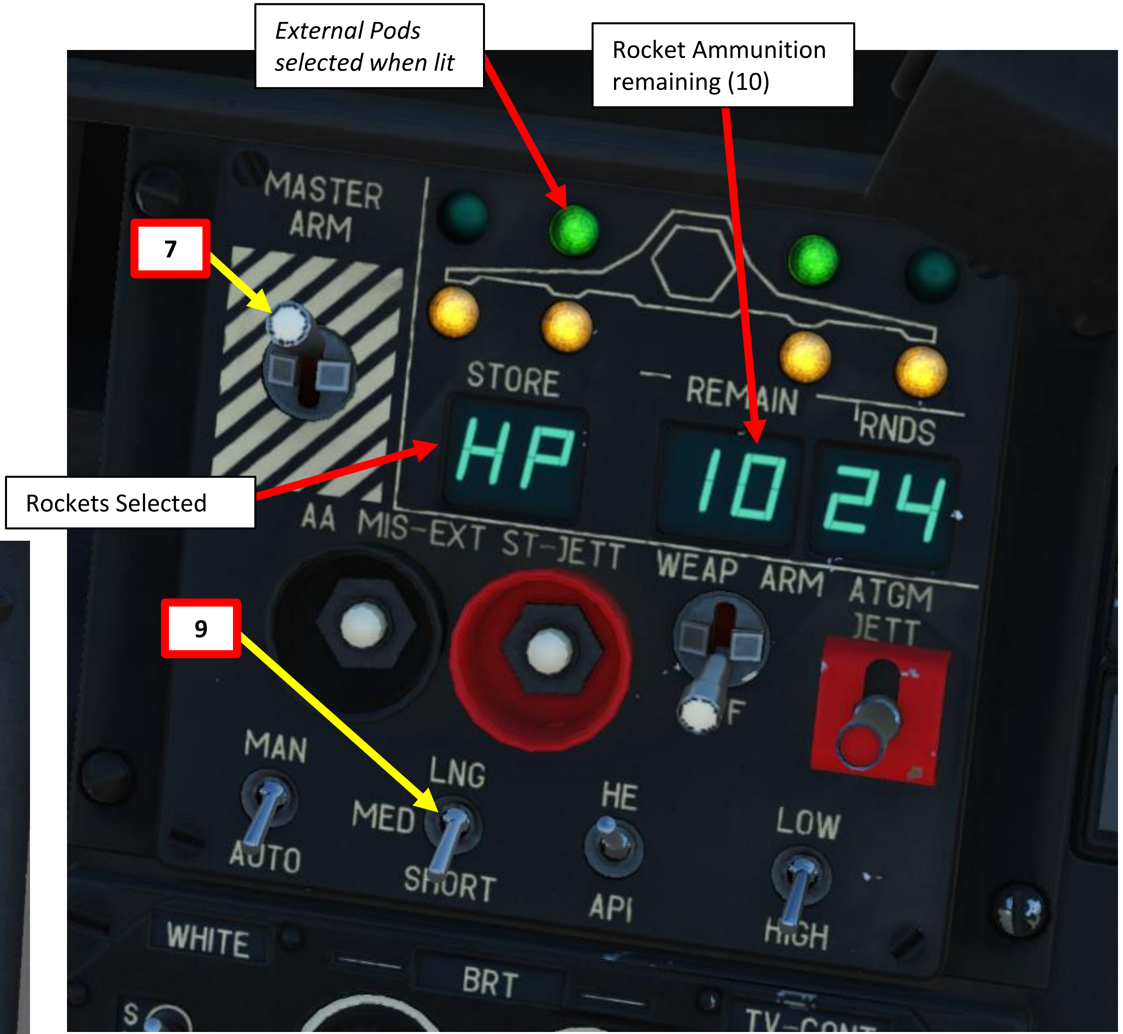
1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select rocket pods (inner pylons if equipped as such)
3. Laser Power switch ON (FWD)
4. Select "MOVING GROUND TARGET" button if tracking a moving target
5. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
6. Set HMS (Helmet Mounted Sight) switch ON (FWD)





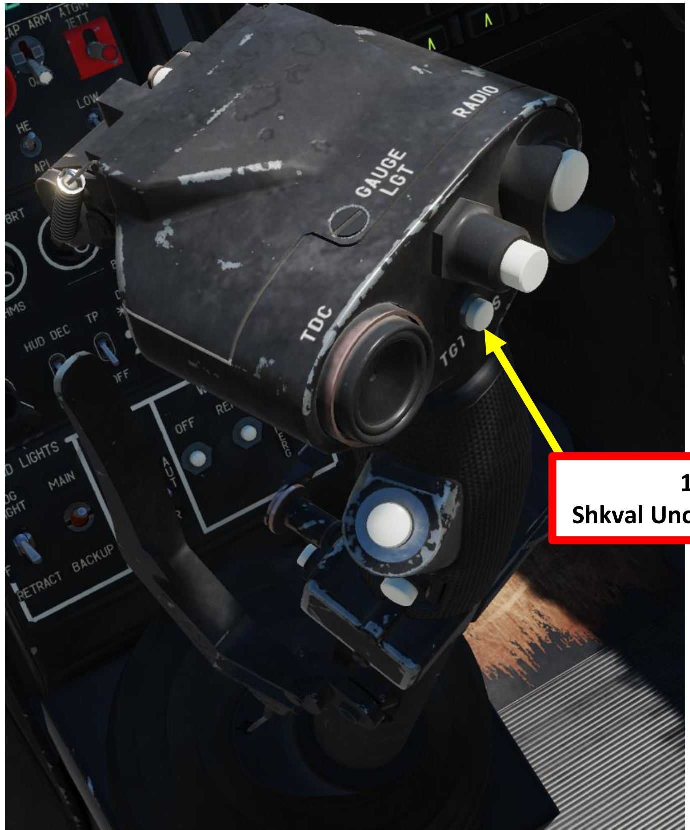
2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets

7. Set Master Arm switch ON (UP)
8. Select rocket type
    - 0: S-8KOM rockets with AT /AP warhead
    - 1: S-8TsM rockets (smoke warhead)
    - **2: S-13 rockets**
    - 3: S-24 heavy rockets (not implemented in DCS)
    - 4: S-8M HE rockets
    - 5: UPK-23 gun pods, twin 23mm
9. Select Weapon Burst Length
    - SHORT = 1 pair / MED = 5 pairs / LONG = 10 pairs



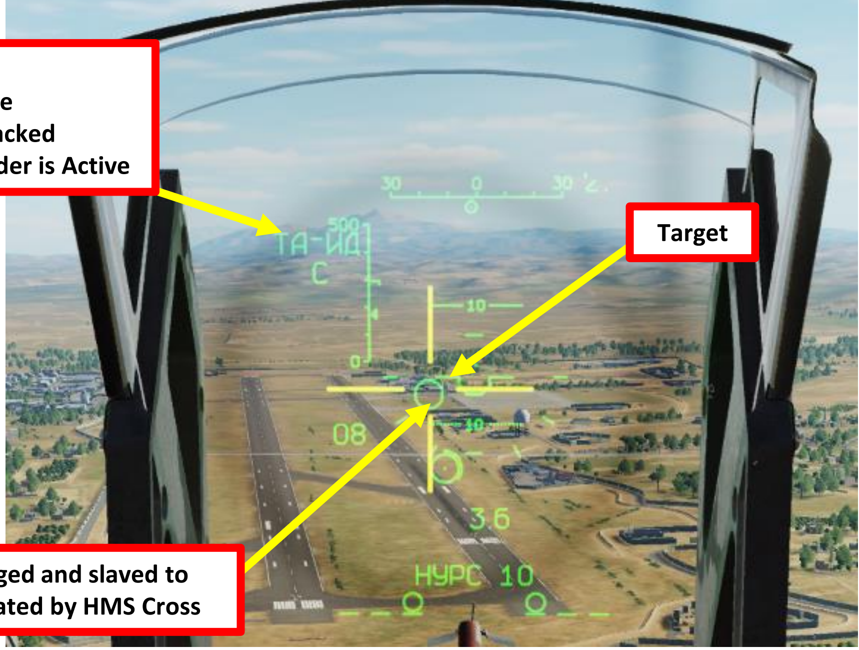
2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets

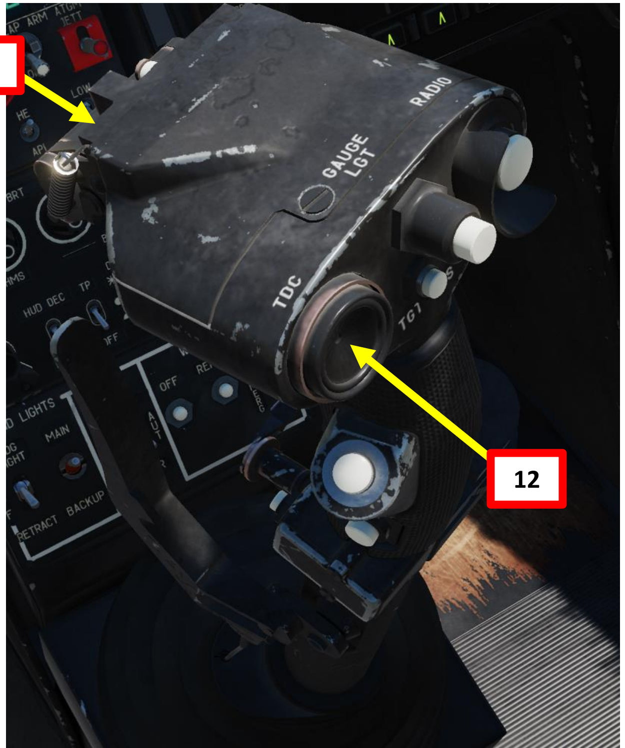
10. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.



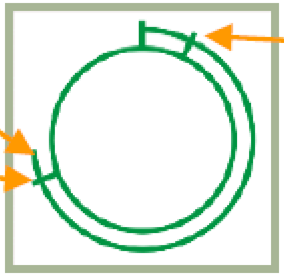
2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets

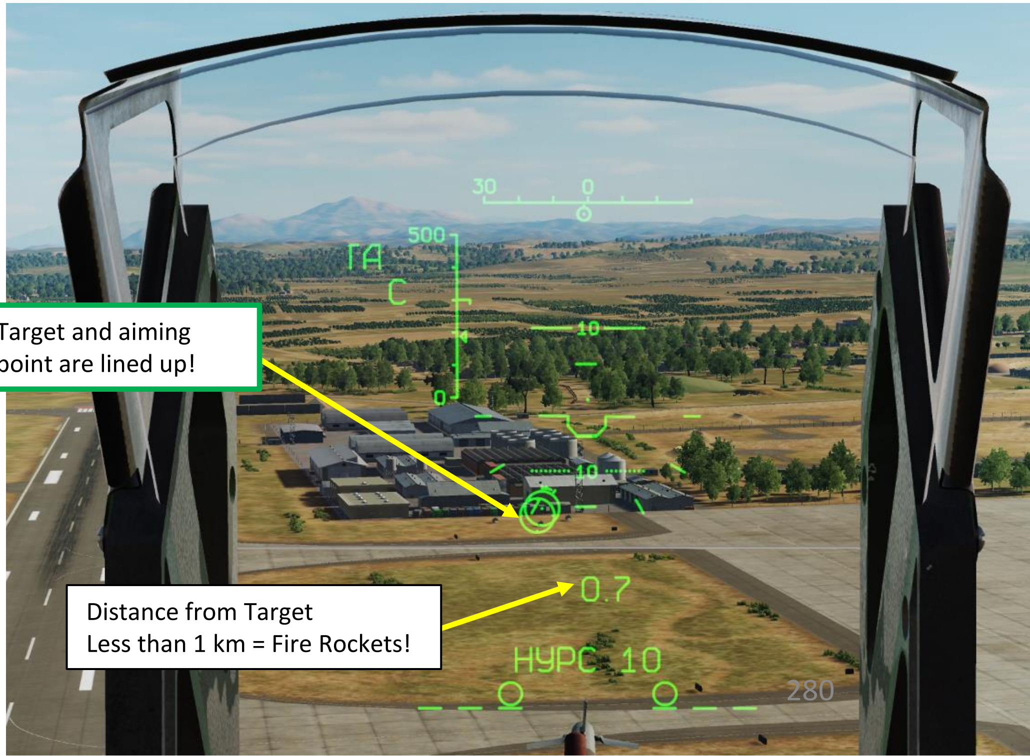
11. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
12. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
13. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.
14. Fly towards target and fire when the two circles on the HUD are aligned.
15. Make sure to fly in forward flight in order to avoid missile smoke ingestion, which can cause an engine loss of power.
16. Launch rockets using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the rocket has launched; this usually takes about one full second.





2.3 – UNGUIDED ROCKETS
2.3.2 – S-13 (5 x 122 mm) Rockets



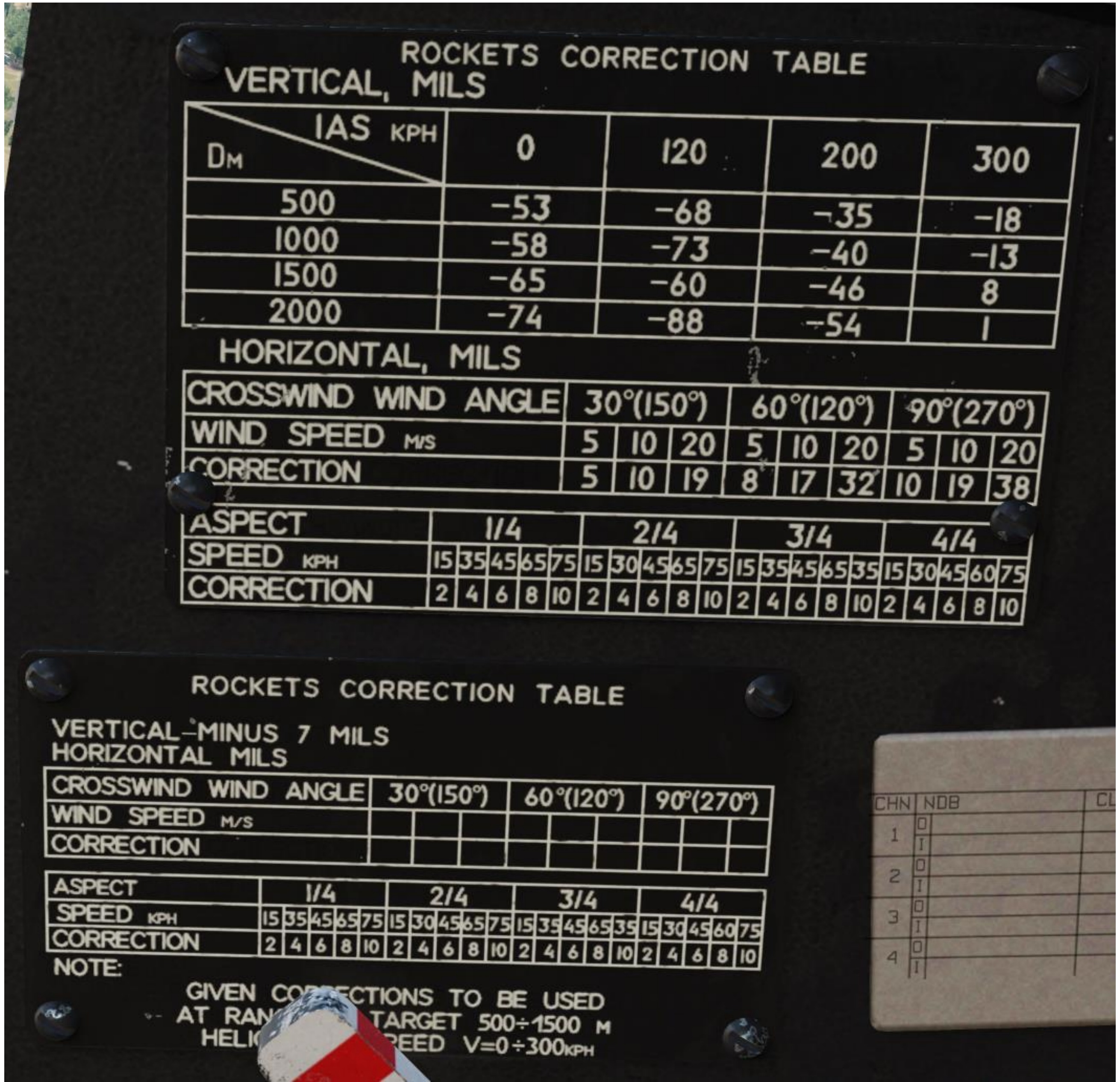


2.3 – UNGUIDED ROCKETS

2.3.2 – S-13 (5 x 122 mm) Rockets

2.3 – UNGUIDED ROCKETS

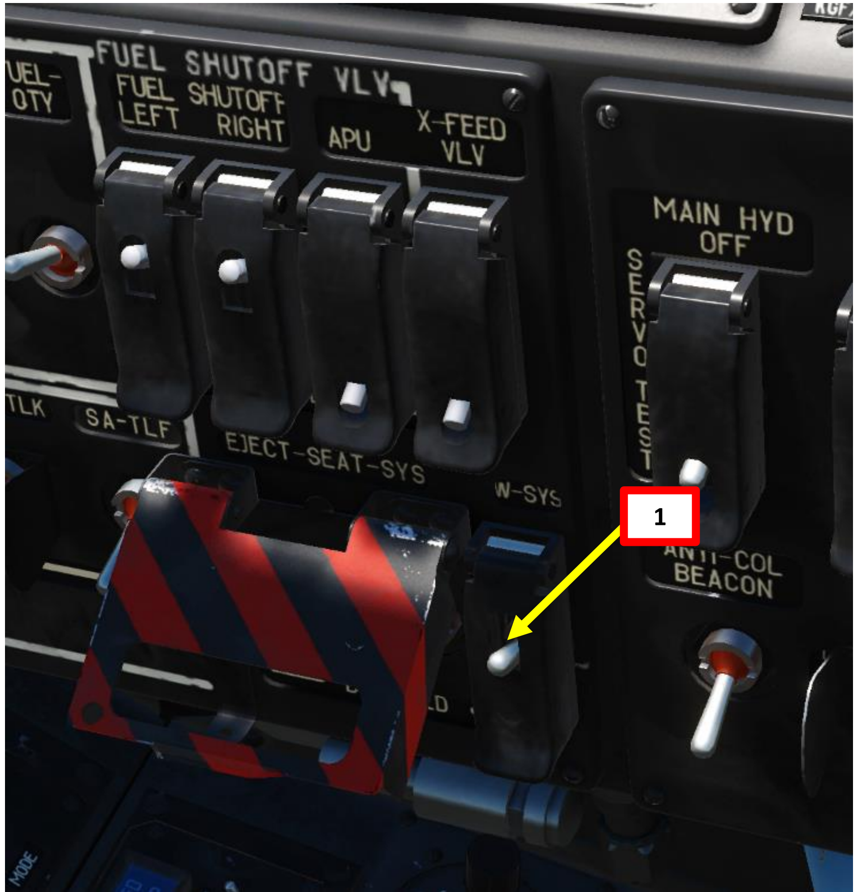
2.3.3 – Rocket Correction Table

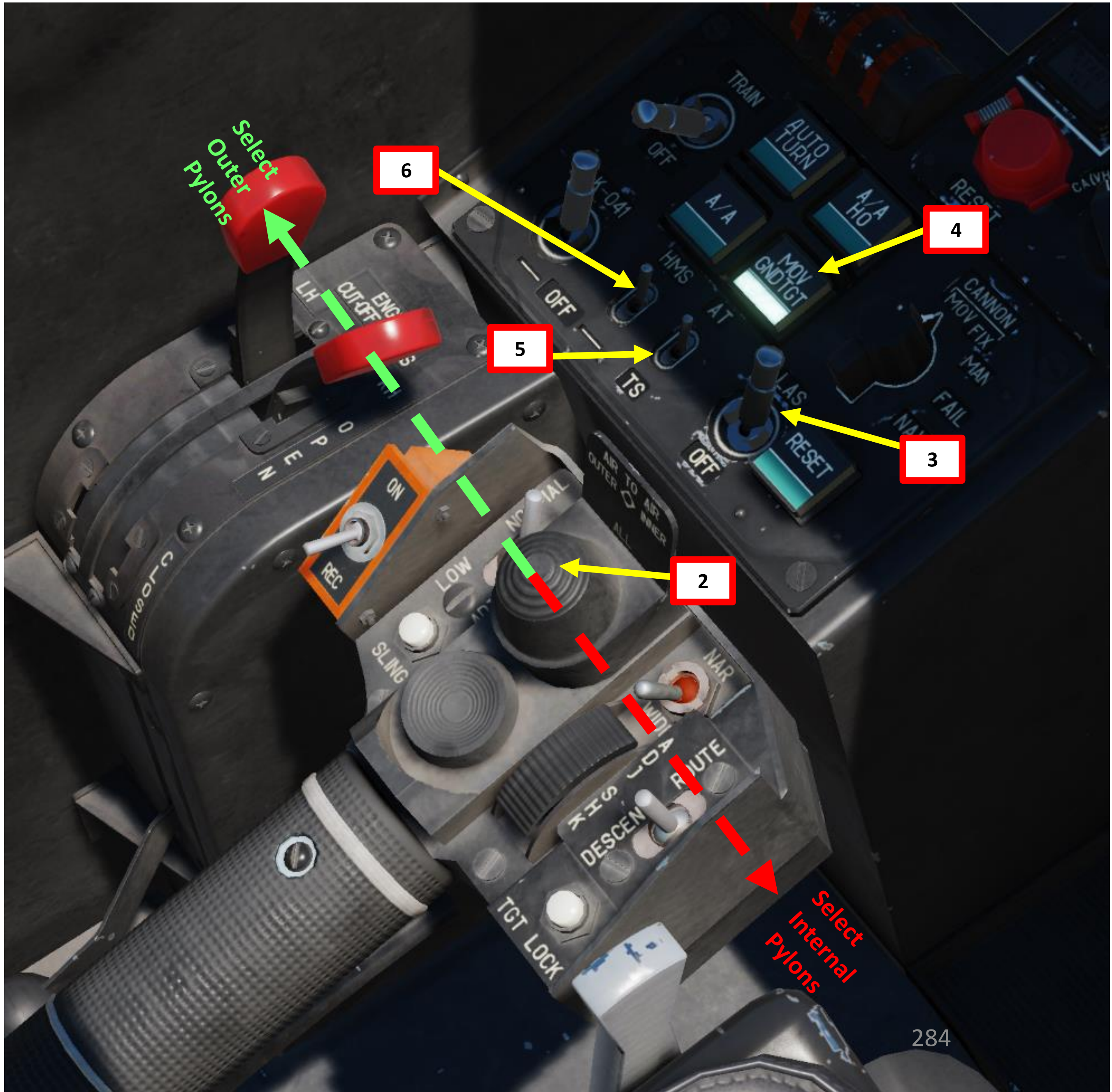


2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select UPK-23 pods (inner pylons if equipped as such)
3. Laser Power switch ON (FWD)
4. Select “MOVING GROUND TARGET” button if tracking a moving target
5. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
6. Set HMS (Helmet Mounted Sight) switch ON (FWD)



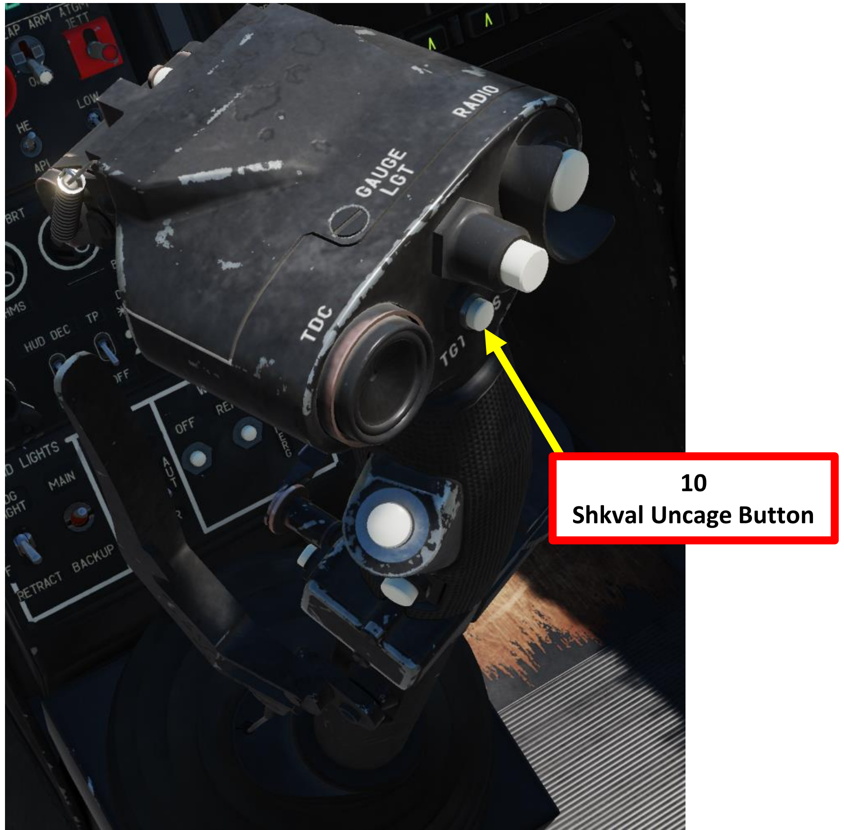


2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

7. Set Master Arm switch ON (UP)
8. Select UPK-23-250 pods
   - 0: S-8KOM rockets with AT /AP warhead
   - 1: S-8TsM rockets (smoke warhead)
   - 2: S-13 rockets
   - 3: S-24 heavy rockets (not implemented in DCS)
   - 4: S-8M HE rockets
   - **5: UPK-23 gun pods, twin 23mm**
9. Select Weapon Burst Length
   - SHORT / MED / LONG

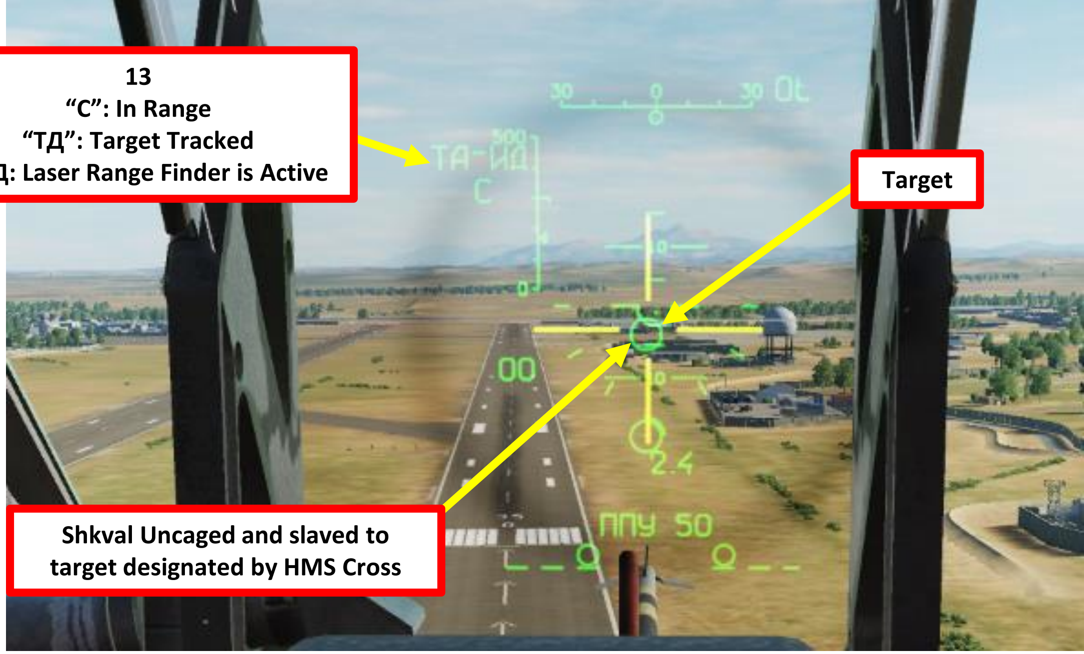
2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

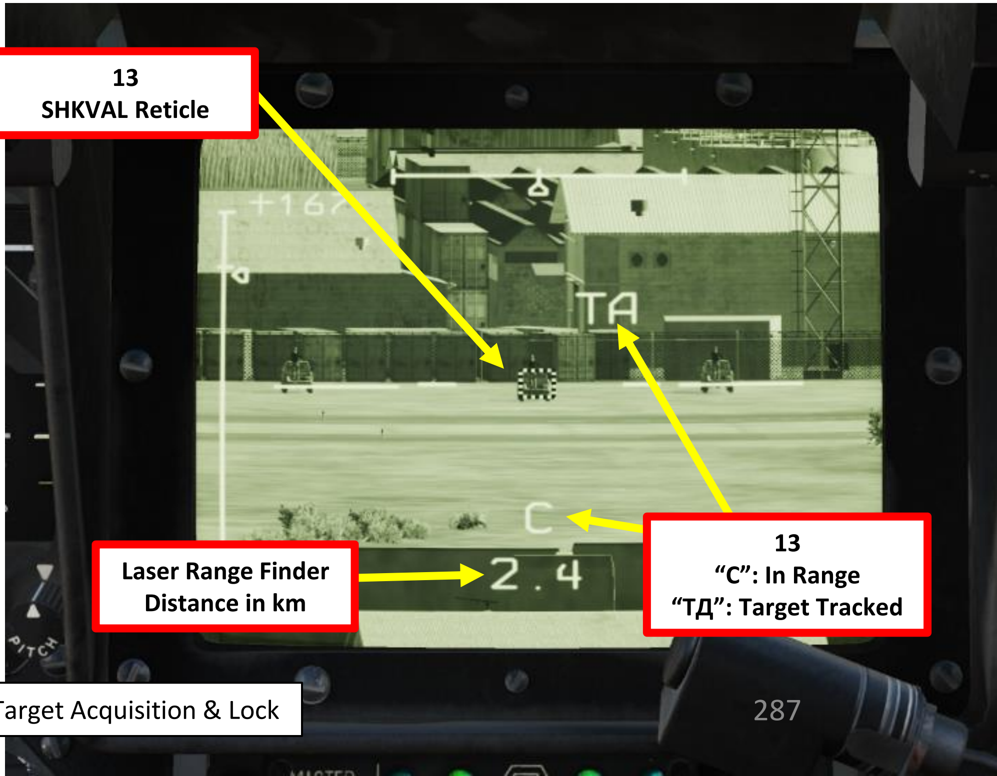
10. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.

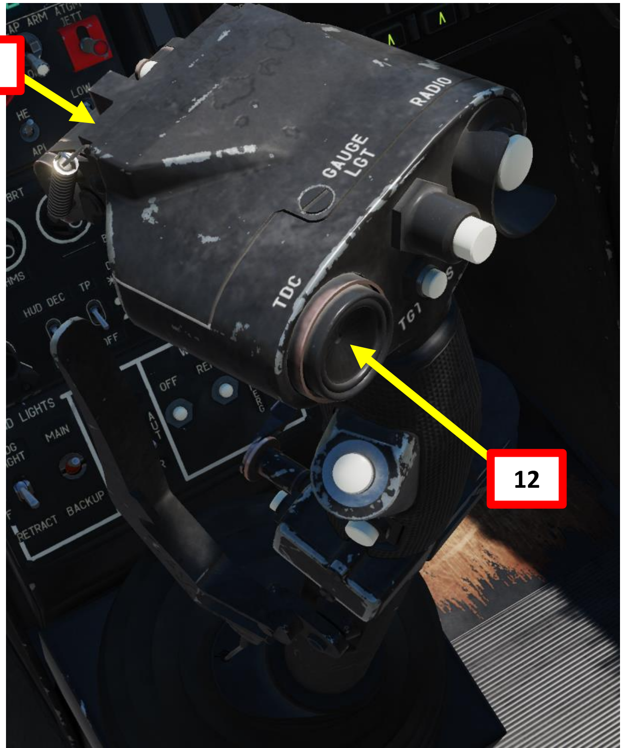


2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

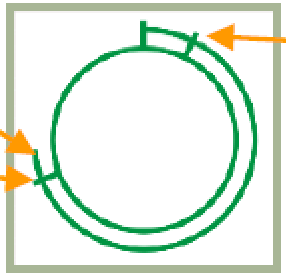
11. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
12. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
13. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.
14. Fly towards target and fire when the two circles on the HUD are aligned.
15. Fire gunpods using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the gunpods have fired.

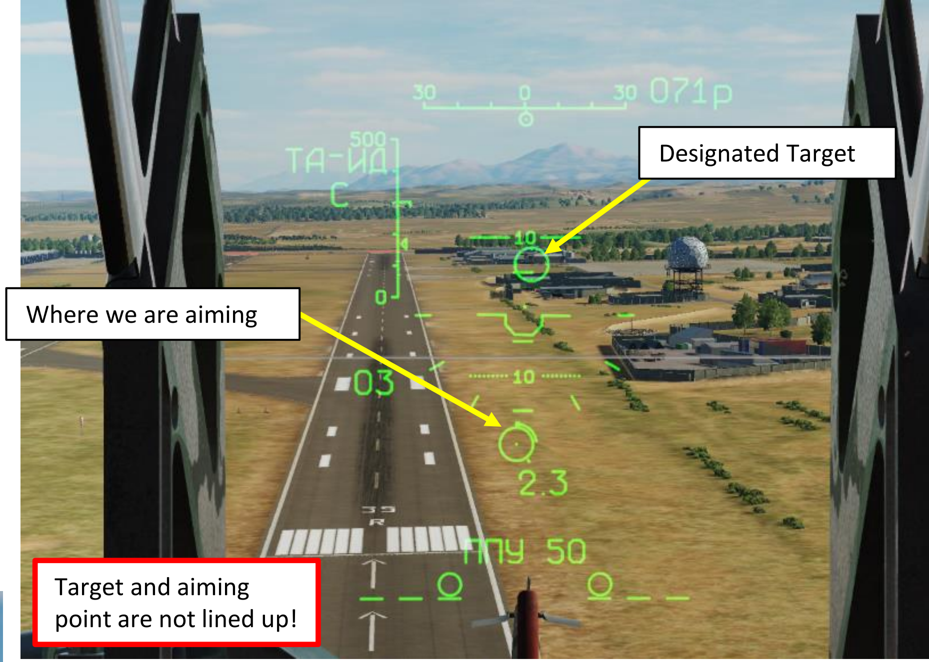


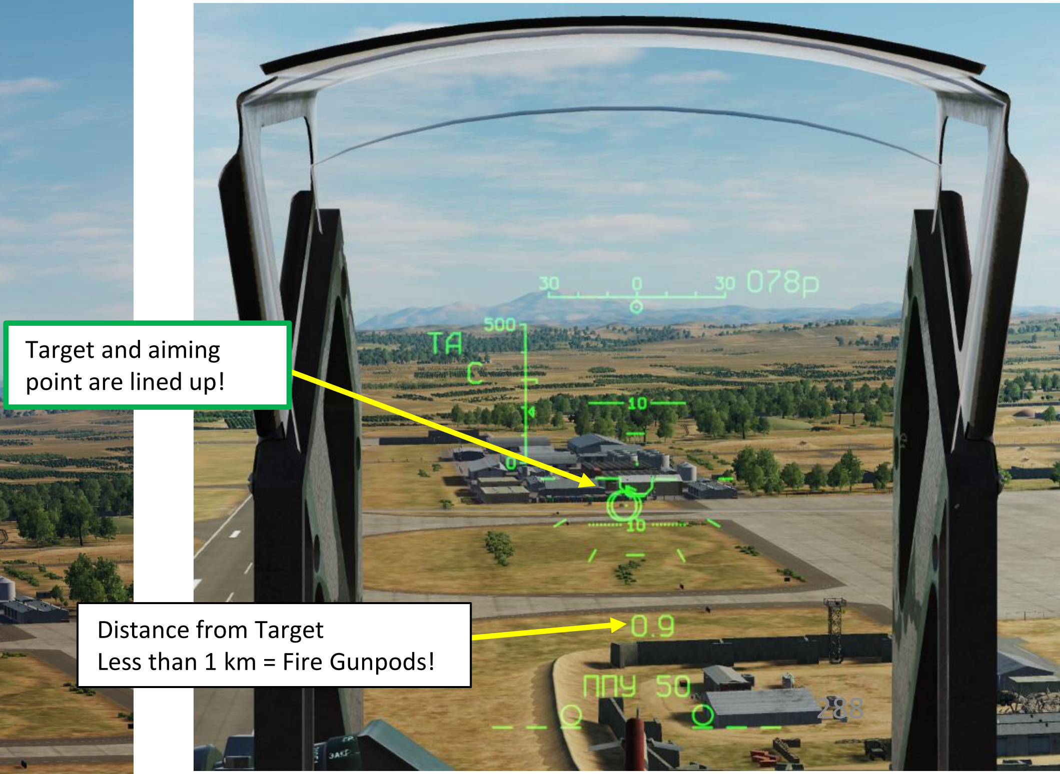




2.4 – UPK-23-250 23 MM AUTO-CANNON PODS





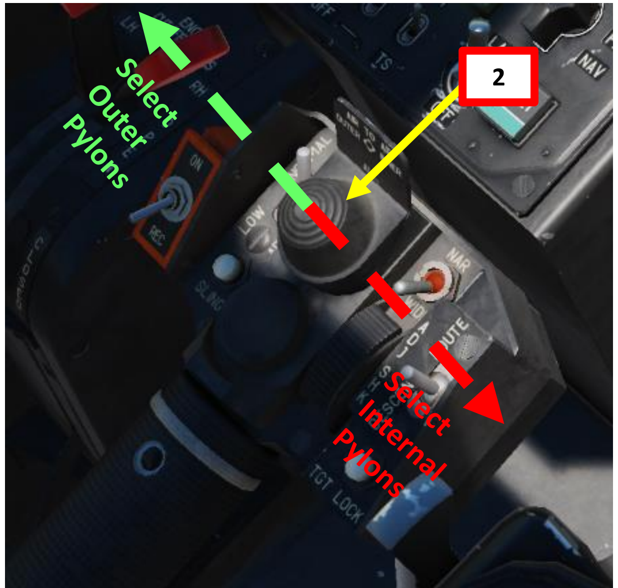


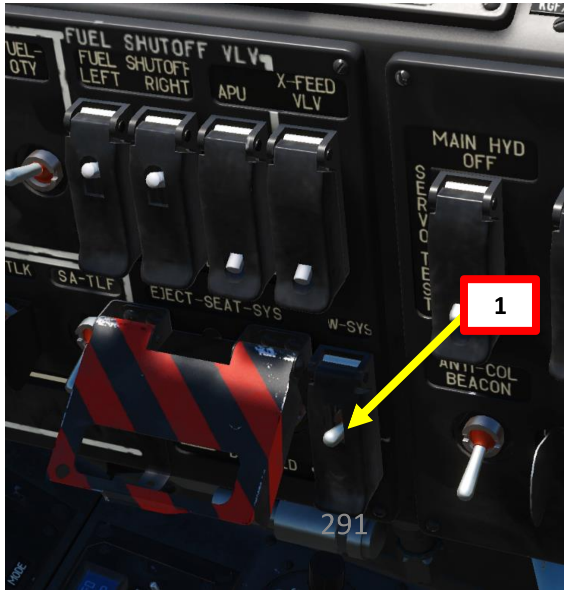
2.4 – UPK-23-250 23 MM AUTO-CANNON PODS

2.5 – FAB-250 BOMBS

2.5 – FAB-250 BOMBS

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select bomb hardpoints (inner pylons if equipped as such)
3. Set Master Arm switch ON (UP)
4. When making a bombing run, avoid any banking and side slips, and stay higher than 200 m. When below 200 m, the release of bombs is blocked.
5. Press and keep the “Release Weapons button” held for more than 1.5 sec to drop ordnance (RAlt+Spacebar)



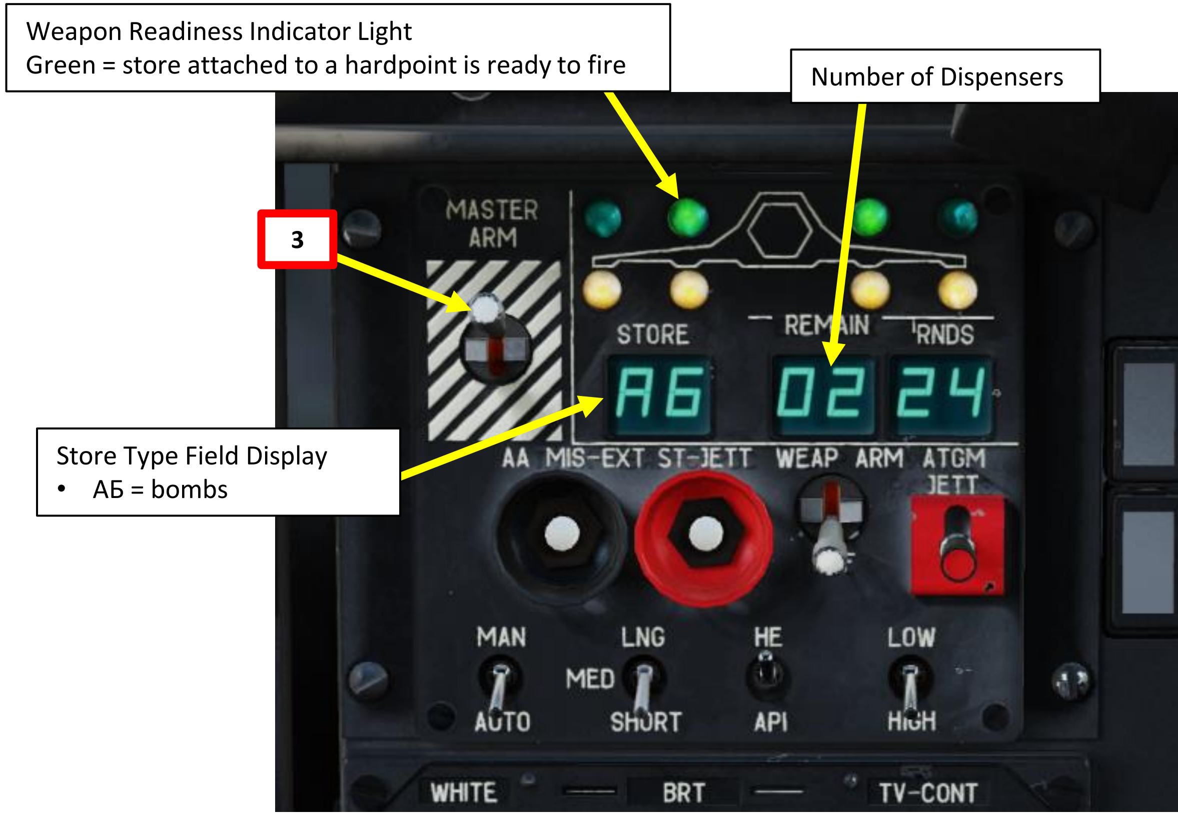


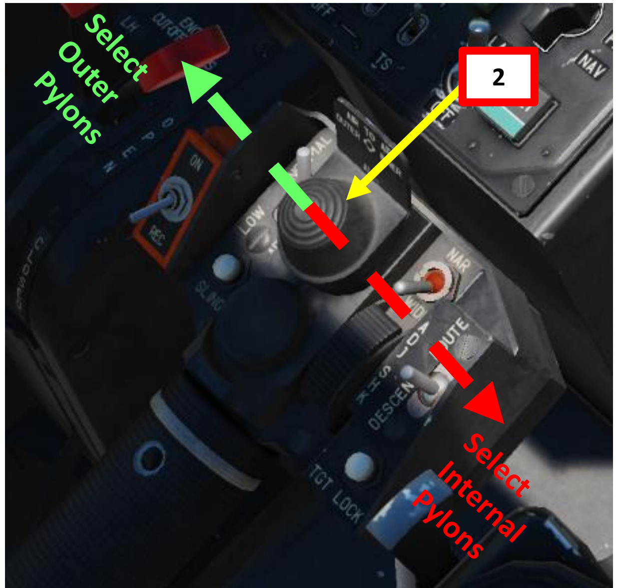
2.5 – FAB-250 BOMBS

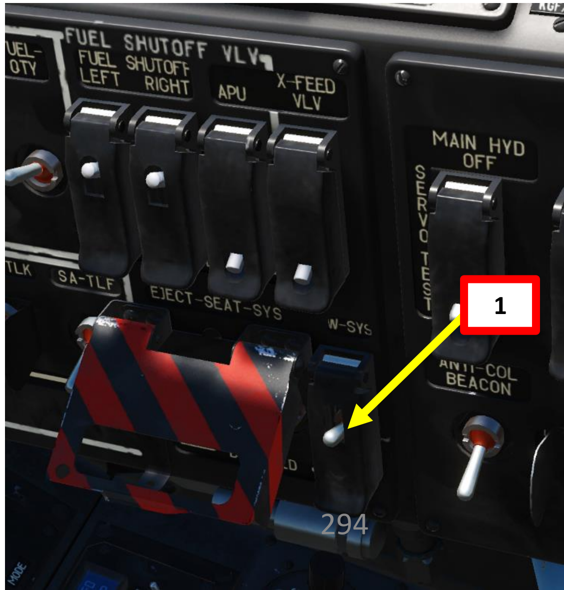
2.6 – KMGU-2 CLUSTER SUB-MUNITIONS DISPENSERS

2.6 – KMGU-2 CLUSTER SUB-MUNITIONS DISPENSERS

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select bomb hardpoints (inner pylons if equipped as such)
3. Set Master Arm switch ON (UP)
4. When making a bombing run, avoid any banking and side slips, and stay higher than 200 m. There is however no minimum release altitude for the KMGU dispenser.
5. Press and keep the “Release Weapons button” held for more than 1.5 sec to drop ordnance (RAlt+Spacebar)
6. The release of sub-munitions from the KMGU dispensers takes place after 1.5 seconds after pressing the weapon release button.



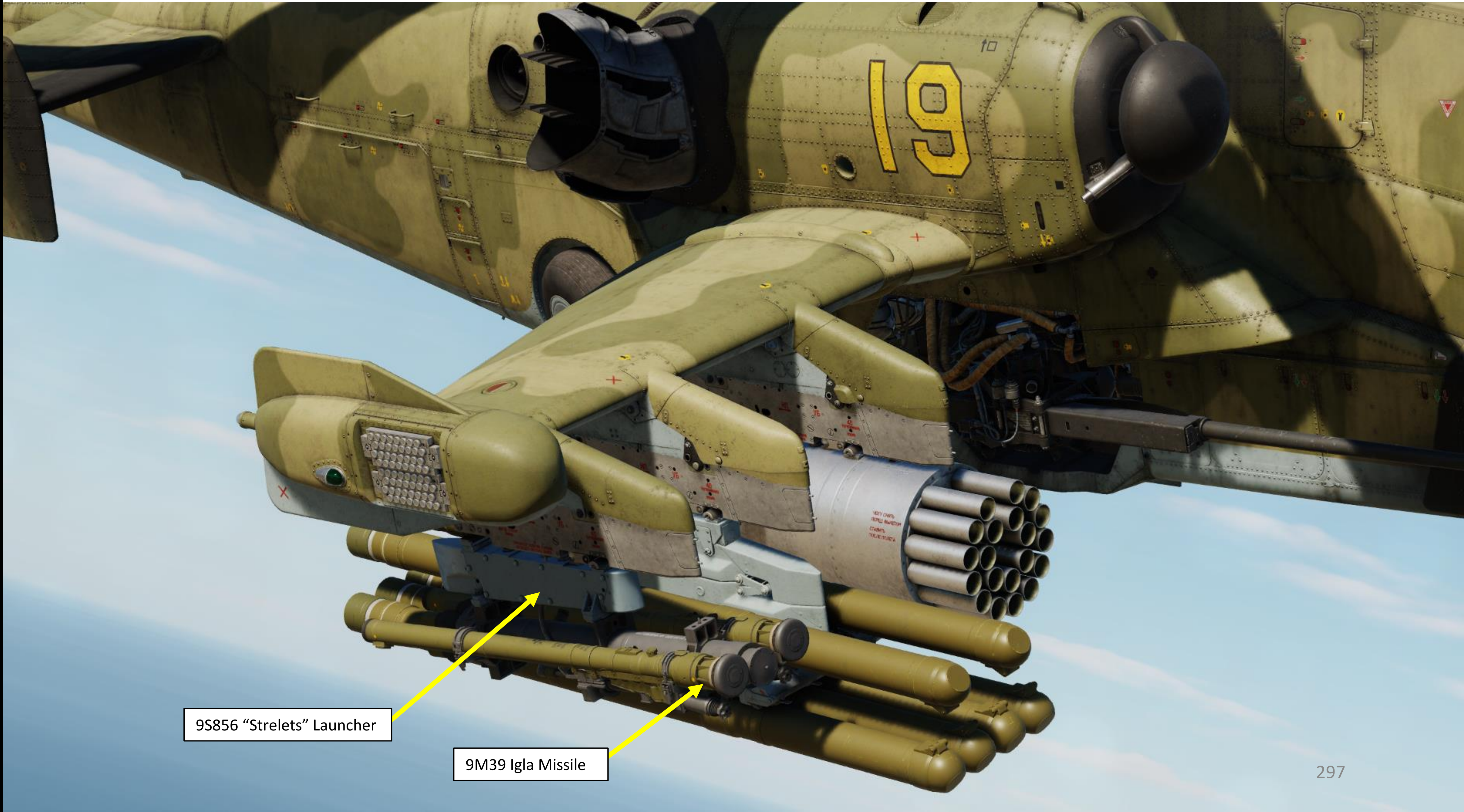




2.6 – KMGU-2 CLUSTER SUB-MUNITIONS DISPENSERS

2.6 – KMGU-2 CLUSTER SUB-MUNITIONS DISPENSERS

2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)



2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.1 – Semi-Automatic vs Manual Mode

Missile launch may be performed in one of two modes: **Semi-Automatic** and **Manual**.

Missile launch mode is selected by setting the mode select switch "**MAN/AUTO Weapon Control Switch**" on the central panel to the desired mode.

Semi-automatic mode is selected with the MAN/AUTO switch set to "**AUTO**". In semi-automatic mode, the seeker head is automatically uncaged once the missile is connected to its power source.

Manual mode is selected with the MAN/AUTO switch set to "**MAN**". In manual mode, the seeker head is **uncaged only once the Shkval Target Acquisition & Lock button is pressed**.

Manual/Auto Weapon control switch

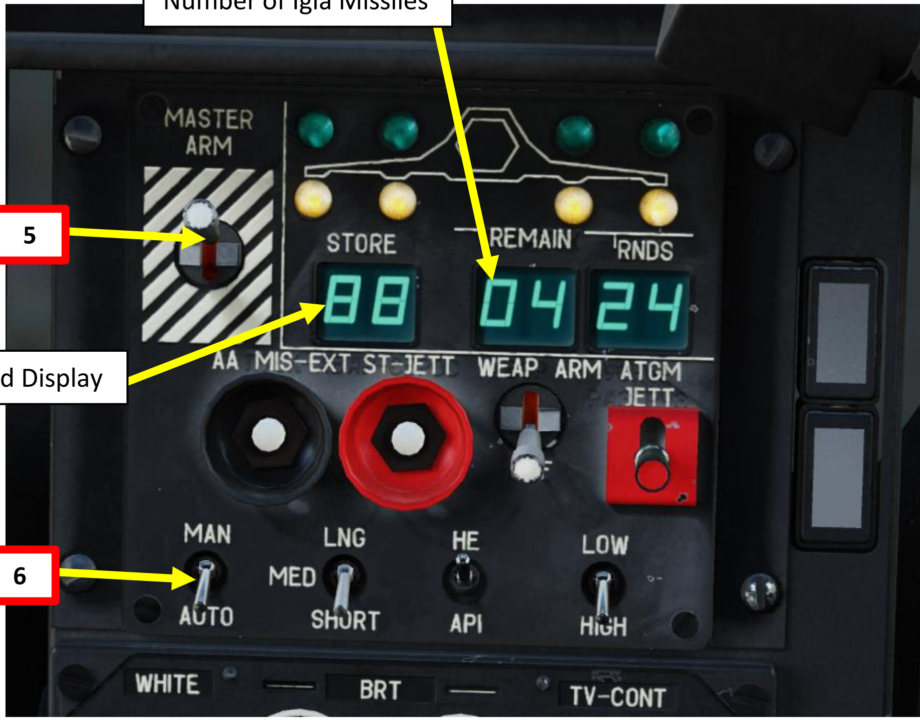
Shkval Target Acquisition & Lock

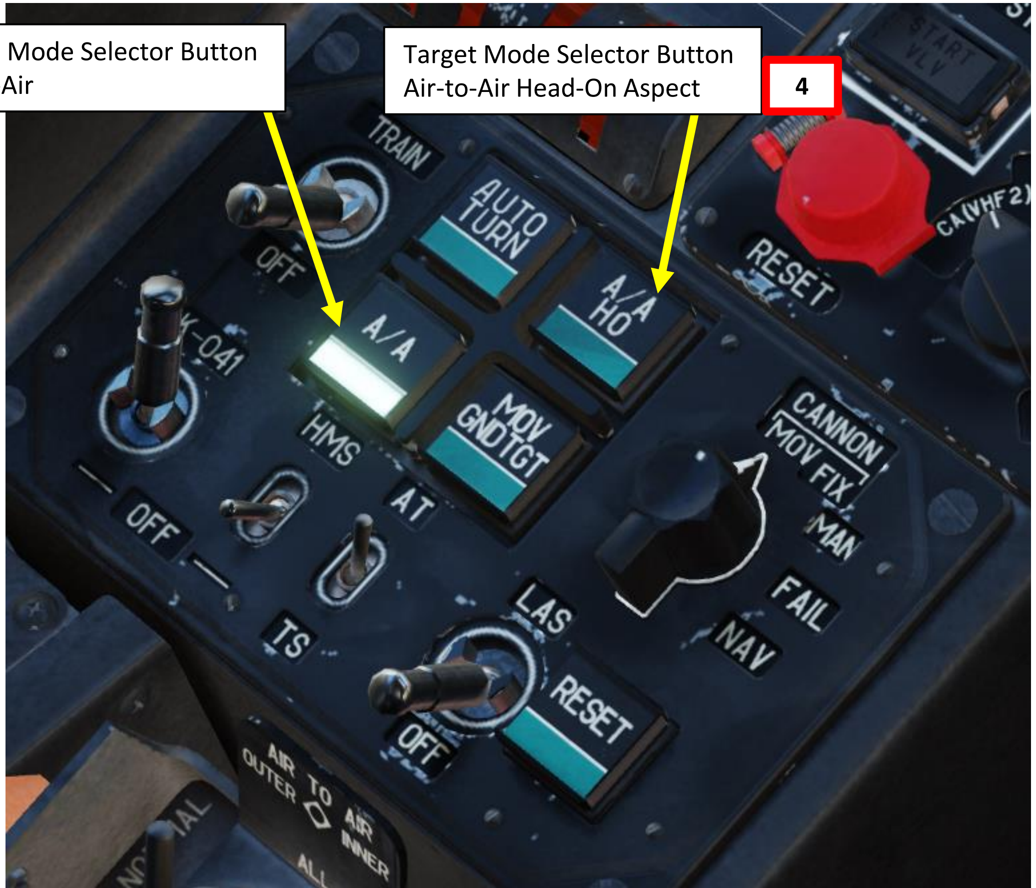
2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)

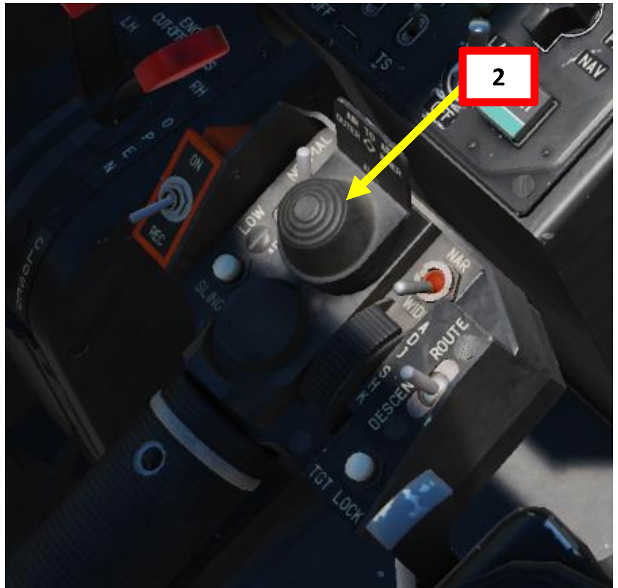
2.7.2 – Semi-Automatic Mode Tutorial

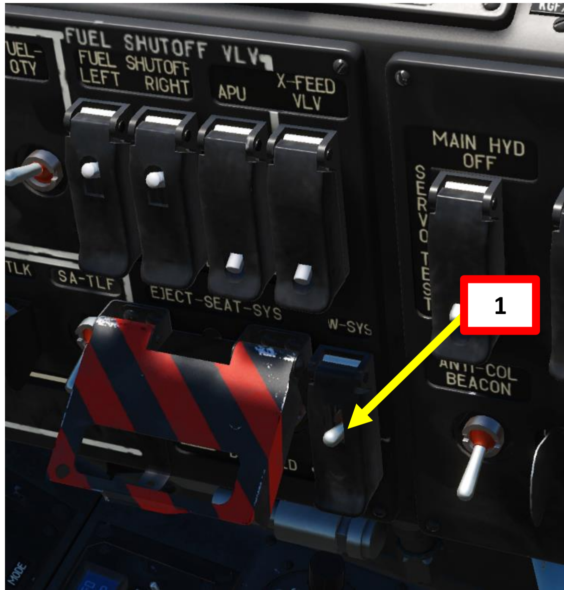
Ka-50 Black Shark III Expansion Only

1. Set Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the FWD (Air-to-Air) position to select Igla missile launchers.
3. Once Igla missiles are selected, the A/A (Target Mode Selector Button – Air-to-Air) will illuminate.
4. If attacking a target with a head-on aspect, select Target Mode Selector Button for Air-to-Air Head-On Aspect (A/A HO) if necessary.
5. Set Master Arm switch ON (UP)
6. Set Weapon Launch Mode: AUTO (Semi-Automatic).
   - In semi-automatic, the seeker head is automatically uncaged once the missile is connected to its power source.





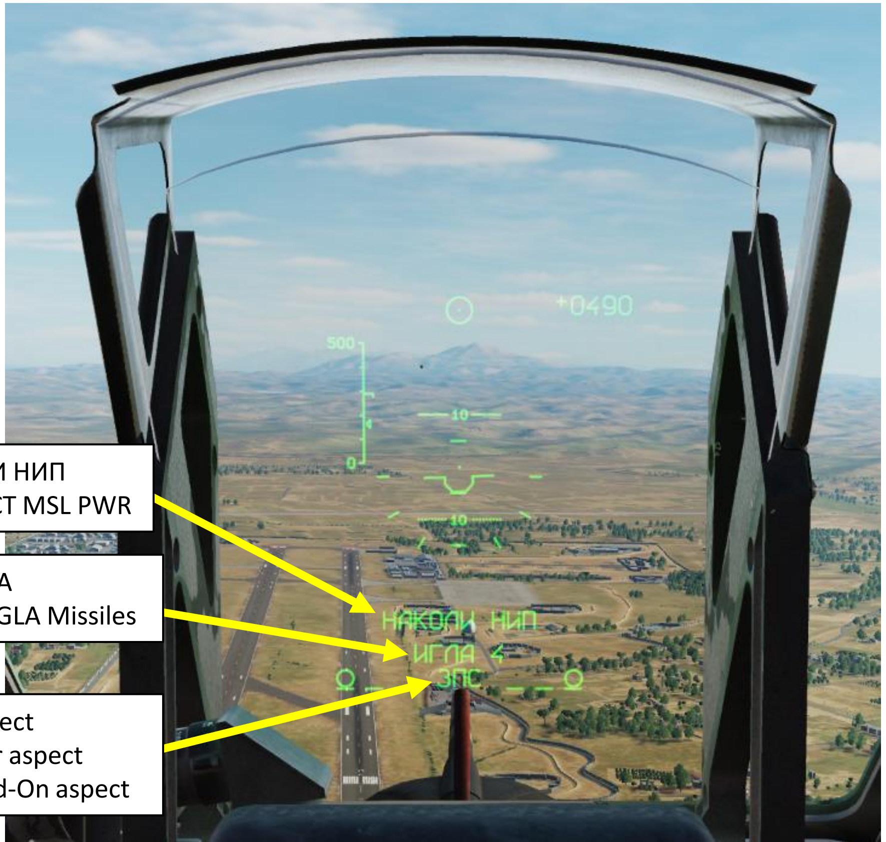


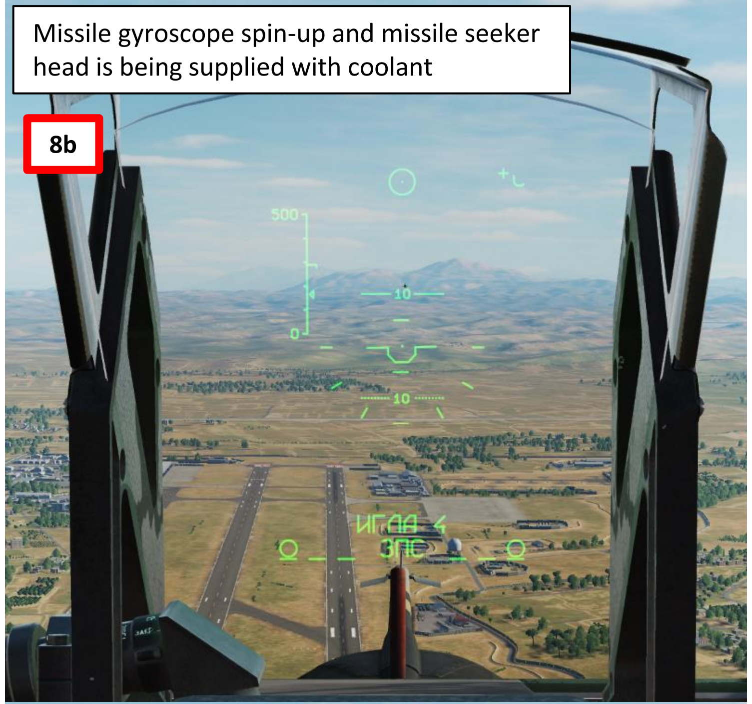


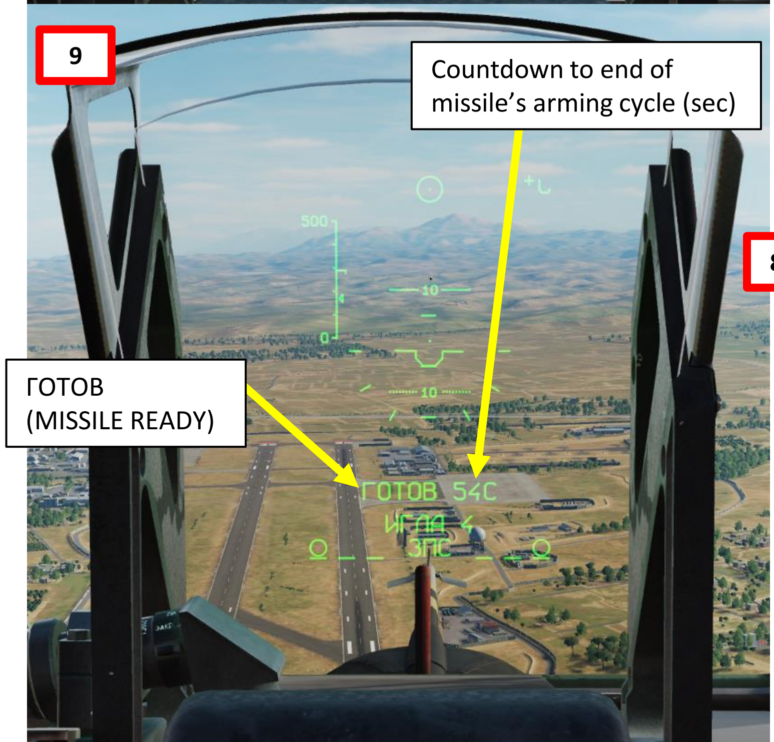
Ka-50 Black Shark III Expansion Only

2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.2 – Semi-Automatic Mode Tutorial

7. Upon missile selection, the HUD (Heads-Up Display) will then display “IGLA”, along with a visual representation of the missiles on the aircraft’s hardpoints and the remaining number of missiles. Additionally, the command “НАКОЛИ НИП” (CONNECT MSL PWR) will be displayed.
8. Press the “Release Weapons button” (RAlt+Spacebar) to connect missile power and initiate the missile arming cycle.
9. Once 5 seconds have passed after gyroscope spin-up and the missile’s seeker head being supplied with coolant, the “НАКОЛИ НИП” (CONNECT MSL PWR) message on the HUD will be replaced with the message “ГОТОВ” (READY), along with a countdown to the end of the missile’s arming cycle. The arming cycle will last no longer than 55 seconds assuming the aircraft has both ground power supply units available on the launch modules.



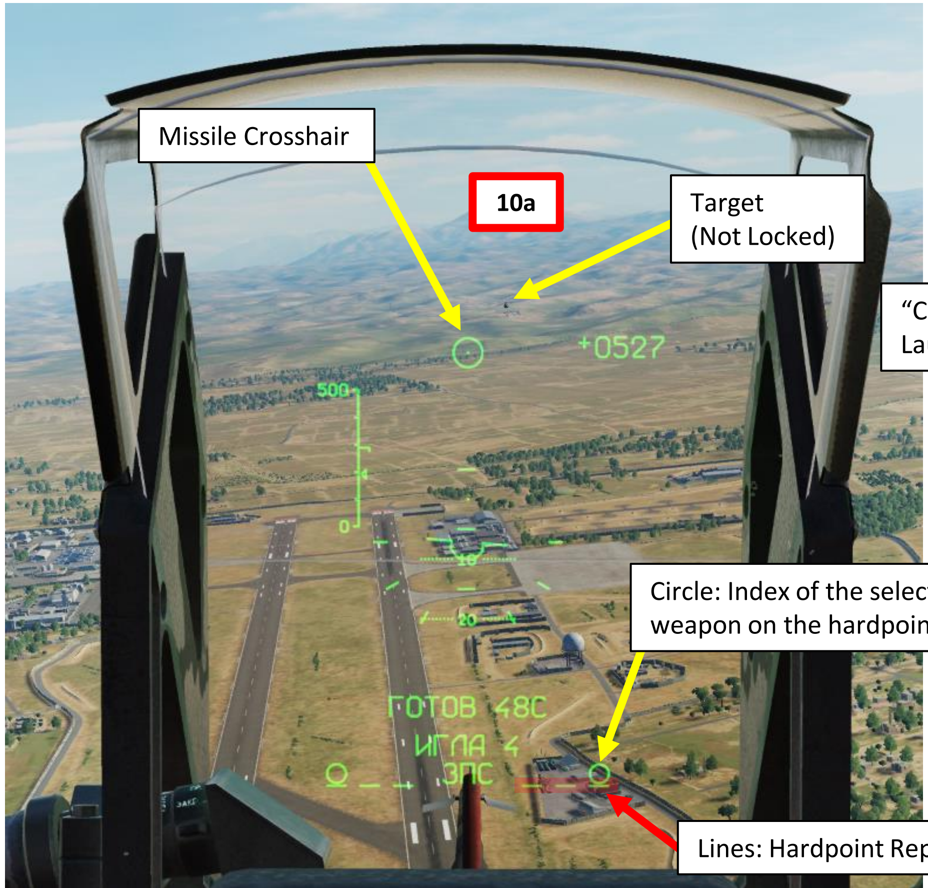


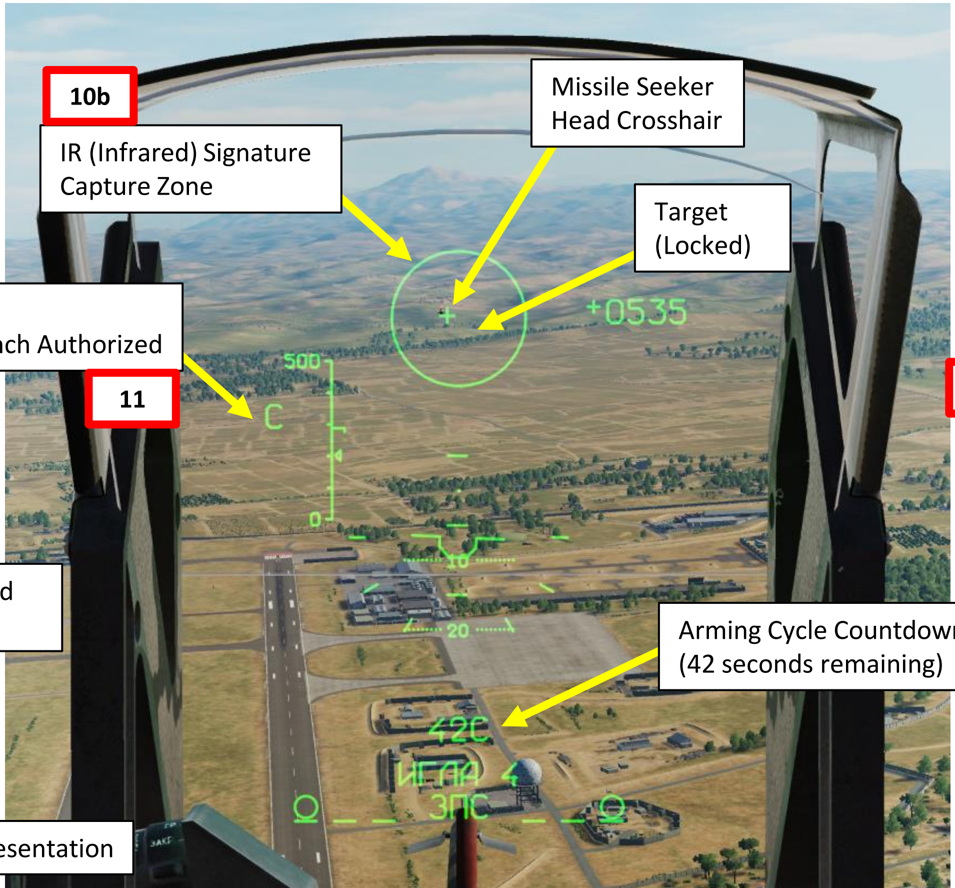


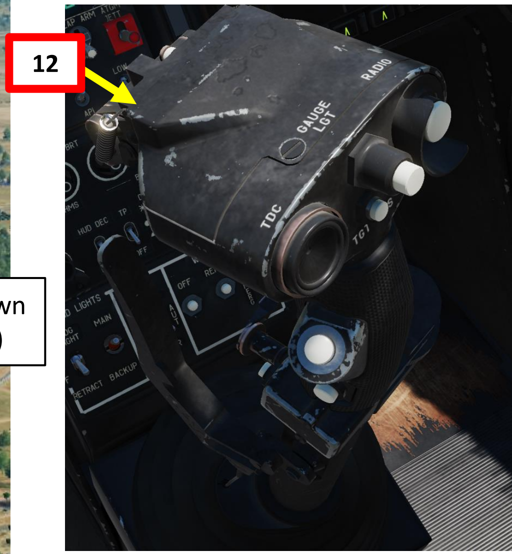
Ka-50 Black Shark III Expansion Only

2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.2 – Semi-Automatic Mode Tutorial

10. While the countdown is active, bring the crosshair over your target. If the target has a large enough IR (Infrared) signature to be recognized by the seeker, the missile will achieve target lock in 1-2 seconds.
    - The crosshair is located at the zero point of the HUD along the aircraft's fuselage axis. It displays the target lock zone of the missile seeker with a field of view angle of 1° and will remain until target lock is acquired.
11. Once target lock is achieved, the HUD will display the command "C" (FIRE) on the left-hand side, while the missile arming cycle countdown will continue to be displayed. The size of the target lock zone on the HUD will increase to 4°. The crosshair, represented by a 0.6°-small cross, will move along with the seeker head's direction of view.
12. Press the "Release Weapons button" (RAlt+Spacebar) to fire missile.







2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.2 – Semi-Automatic Mode Tutorial

Ka-50 Black Shark III Expansion Only

Ka-50 Black Shark III Expansion Only

2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.2 – Semi-Automatic Mode Tutorial

Notes about Missile Coolant:

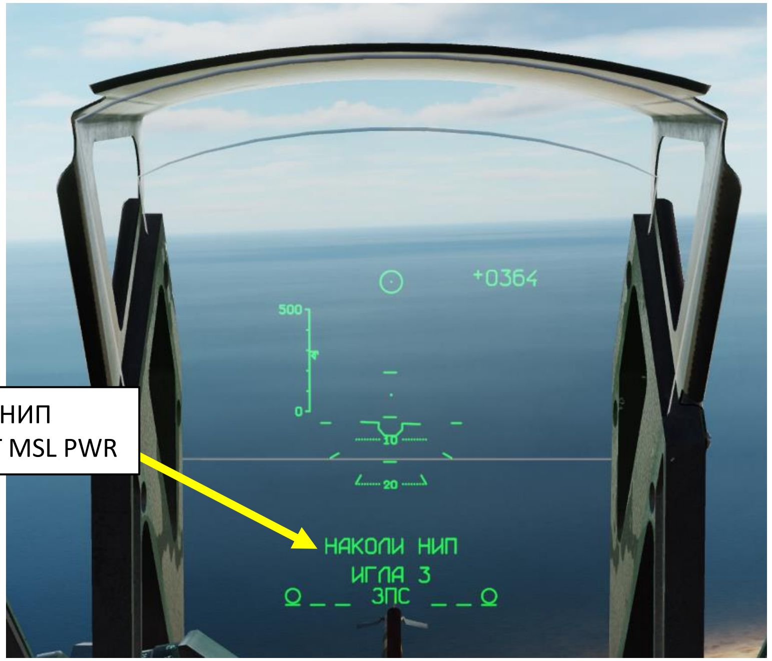
“НИП”, also known as the "NIP", is a ground power source and cooling supply that got its name from the ground-based MANPADS version. "НАКОЛИ НИП" translates from Russian as "Pierce Power Supply" and is a term used because of that MANPADS reference. The action consists of a special thrust that pierces the membrane of a nitrogen bottle and presses on the firing pin of the battery to activate the power supply.

The NIP supplies compressed nitrogen to the missile seeker for cooling and provides electric power to the missile during the launch preparation.

- One NIP Power Supply works for 30 seconds.
- Two NIPs are connected to each missile, activated one after another, giving the **total time of preparation and seeker operation up to 55 seconds**.
- If the pilot resets this process with the Targeting Mode RESET button before the second NIP is activated, with more than 30 seconds left, the second NIP will not be used.
- It is possible to use the missile again with the second NIP, with its corresponding time limit of 25 seconds (5 seconds are taken to spin up the gyro and activate the missile etc.).
- After both NIPs have been consumed, the missile is de-energized and can no longer be used.

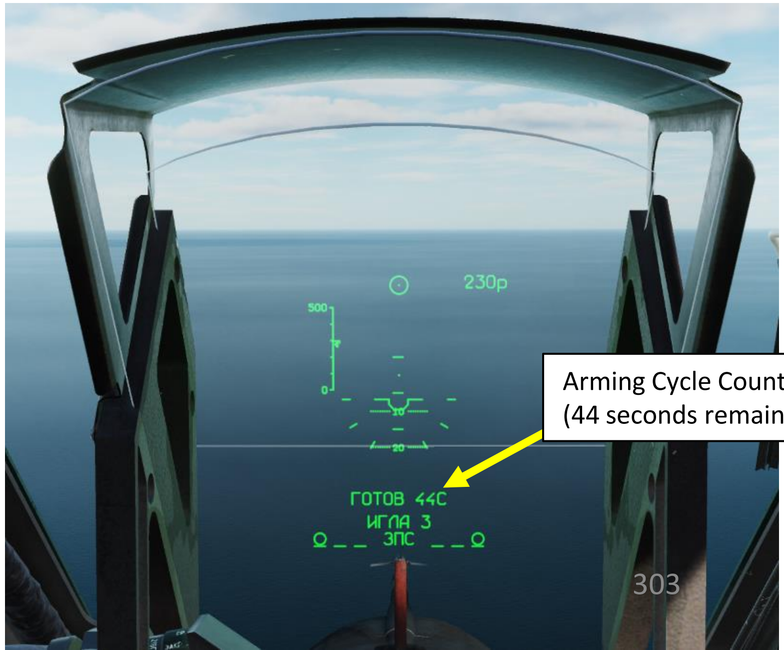
To connect NIP Power Supply, the pilot must press the Release Weapons button (RAlt + SPACE) on the control stick once. Doing so will supply the missile with power and coolant, and the command “НАКОЛИ НИП” (CONNECT MSL PWR) will disappear from the HUD. To abort, press the indicator button labelled “RESET” (Targeting Mode Reset) [Backspace] on the Mode Select Panel to return the missile to its non-armed state.

НАКОЛИ НИП
CONNECT MSL PWR



Release Weapons Button (RALT+SPACE)

Targeting Mode Reset



Arming Cycle Countdown (44 seconds remaining)

Ka-50 Black Shark III Expansion Only

2.7 – 9M39 IGLA AIR-TO-AIR MISSILE (IR SEEKER)
2.7.2 – Semi-Automatic Mode Tutorial

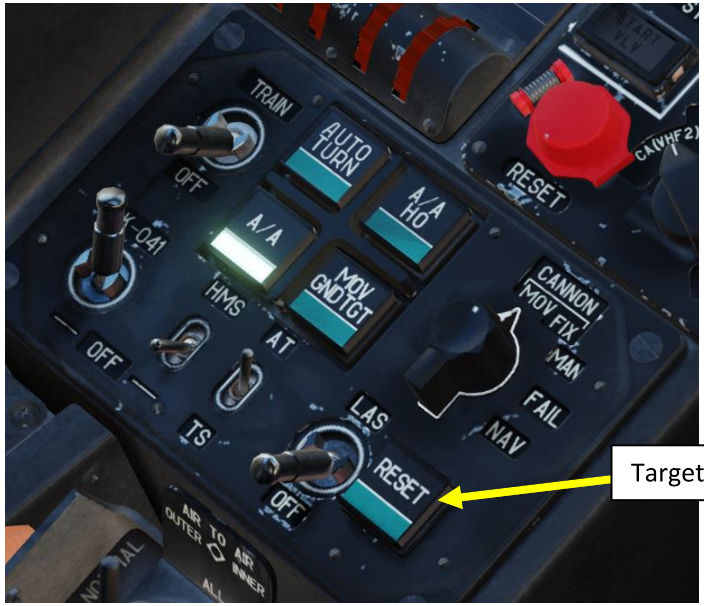
Notes about Missile Operation:

- Should the target move beyond the IR signature capture zone, or if the pilot presses “Target Mode RESET” on the Targeting Mode Control Panel, the “C” (FIRE) command will be replaced again with the message “ГОТОВ” (READY), while the IR signature capture zone will shrink back to 1°. The pilot must once again maneuver to place the crosshair over the target and wait for target lock.

- Once 55 seconds have elapsed without the missile being launched, the coolant is expended and the missile becomes trashed/wasted. Then, the Weapon Control System will automatically select the next available missile, indicated by “НАКОЛИ НИП” (CONNECT MSL PWR) reappearing on the HUD. The indicator for the missile that reached the end of its arming cycle will disappear.

- Should the pilot have to launch another missile after the first, they must once again perform the launch procedure from the beginning.

- Press “Targeting Mode RESET” on the Targeting Mode Control Panel to exit air-to-air missile mode.



3 – ORDNANCE JETTISON
3.1 – External Stores Emergency Jettison

The “АВАР СБРОС” (Emergency launch button, labelled “**Jettison All External Stores**” in the English cockpit) is used to jettison all external stores except “Vikhr” air-to-ground missile.

The **Jettison Weapon Arming Switch** determines if the weapon will be armed prior to being jettisoned (UP = ARMED, DOWN = DISARMED).

- Note: the “**Emergency Jettison of Air-to-Air Missiles**” button has no function.

1 Jettison Weapon Arming Switch

Emergency Jettison of Air-to-Air Missiles (No Function)

Emergency Jettison All External Stores (except Vikhr missiles) 2

Extinguished Lights – Jettisoned Pylons 4

3 – ORDNANCE JETTISON
3.2 – Vikhr Missile Jettison

When the **Vikhr ATGM (Air-to-Ground Missile) Jettison switch** is held UP, all Vikhr missiles will launch quickly off the launcher with no guidance.

Vikhr ATGM (Air-to-Ground Missile) Jettison

SECTION STRUCTURE

Ka-50 Black Shark Legacy Variant Only

1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT
1.1 – L-140 Otklik Laser Warning System (LWS)
1.1.1 – Components

The **L-140 Otklik laser detection system** detects laser range finders and laser guidance systems. You can think of it as a RWR (radar warning receiver) but for lasers.

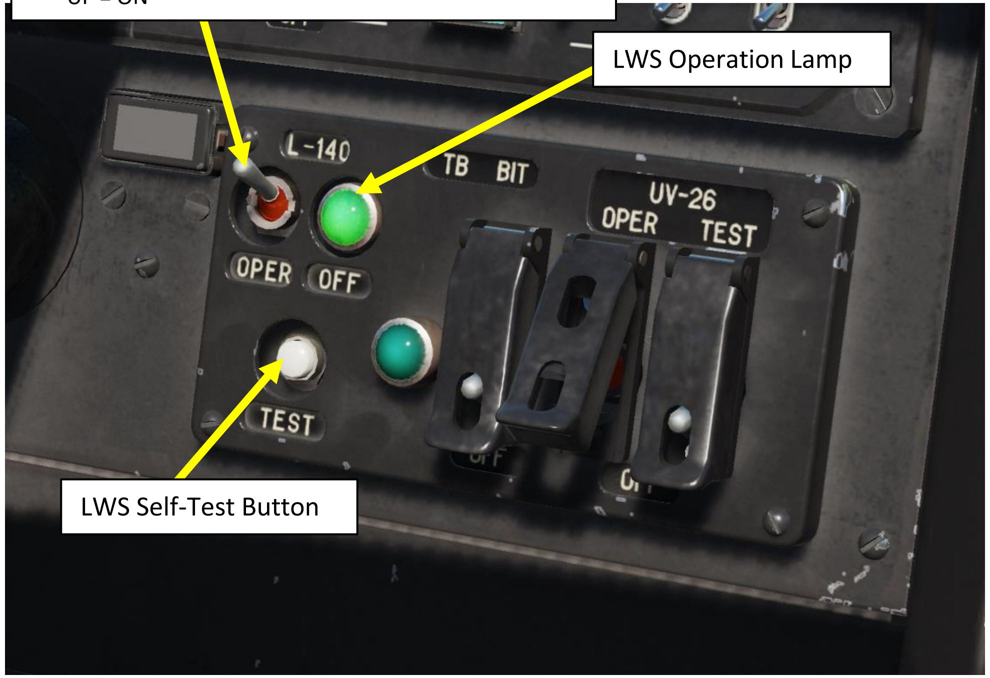
1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT

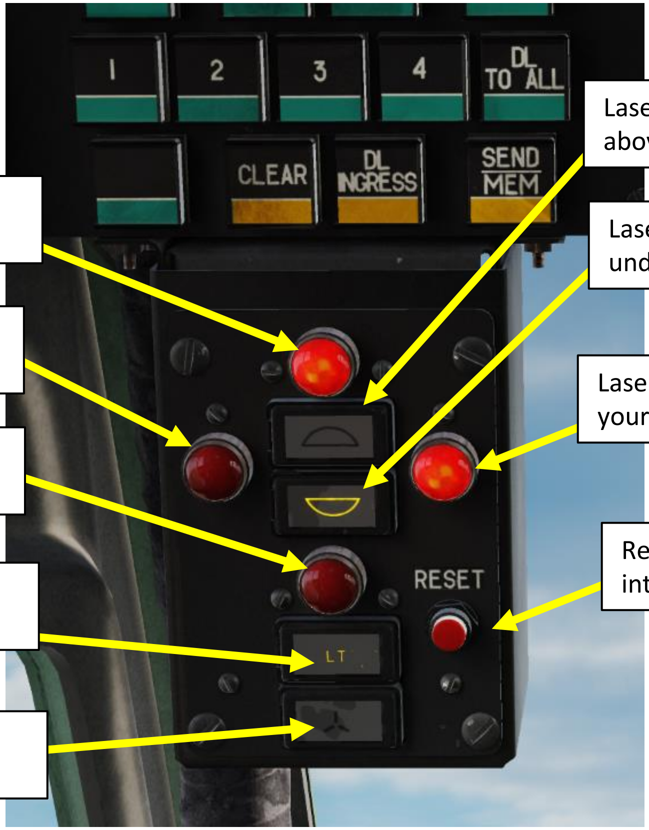
1.1 – L-140 Otklik Laser Warning System (LWS)

1.1.1 – Components

- The system is powered on using the L-140 LWS Power Switch.
- The Laser Lock Lights will give you an indication of the direction of the laser.
- An aural warning is also audible "Warning, Under Attack!" when being lased.
- Main battle tanks and other combat ground vehicles will often use their laser range finders to input accurate target range data into their fire control systems before firing. A warning on the LWS is a sure indication that a ground vehicle or other helicopter is targeting you.
- Note that tank crews of many armed forces are trained to use their main guns as an anti-helicopter weapon and will engage you if you are within 1,500 meters and present them a non-crossing target. Other vehicles, such as ATGM (Air-to-Ground Missile) launchers, will also engage you but at even longer ranges. Additionally, many vehicles have secondary machine guns that they will use to engage you when in close range.

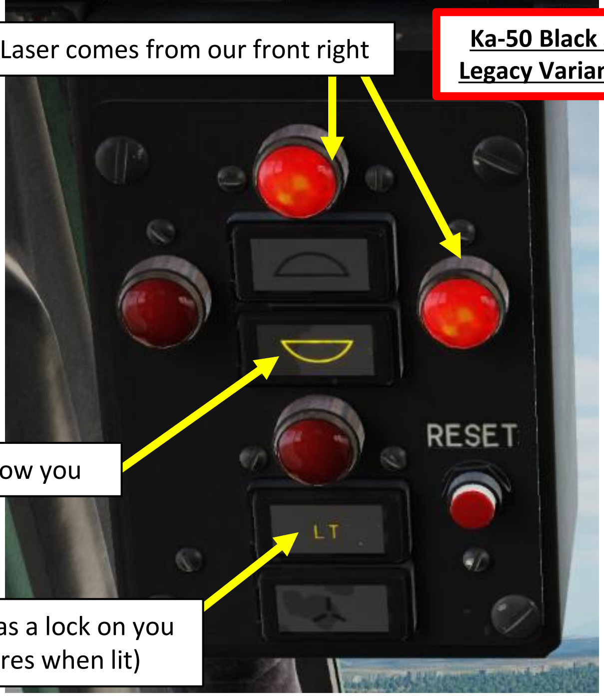
Ka-50 Black Shark Legacy Variant Only





1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT
1.1 – L-140 Otklik Laser Warning System (LWS)
1.1.2 – Laser Warning Example

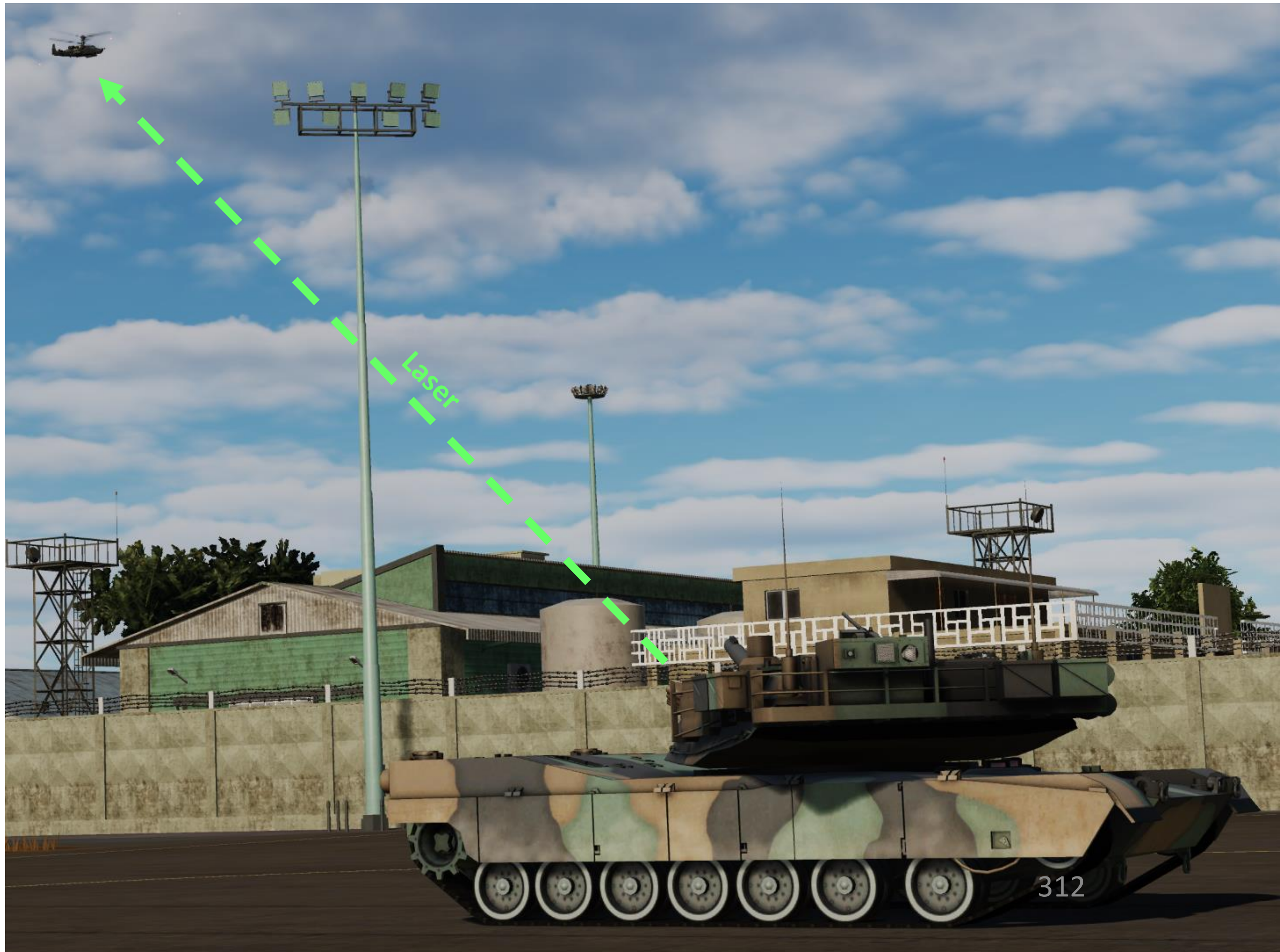
In this example, a tank is using its laser range finder to fire its machinegun. The tank is at our front right and below us. The general rule of thumb when seeing/hearing a LWS warning is to perform evasive actions and pop flares. A missile will head your way soon after.



1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT
1.1 – L-140 Otklik Laser Warning System (LWS)
1.1.2 – Laser Warning Example

Ka-50 Black Shark Legacy Variant Only

Main Battle Tank (using Laser Range Finder)



Ka-50 Black Shark Legacy Variant Only

1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT

1.2 – UV-26 Countermeasures Flare Dispensers

The UV-26 system is used to dispense infrared flare decoys and dipole reflectors are carried in two 26 mm cartridge pods that are fixed to the wing tips. Each pod contains 64 cartridges.

UV-26 Settings Panel (Countermeasure Programming)

UV-26 Countermeasure Flare Cartridge Dispenser

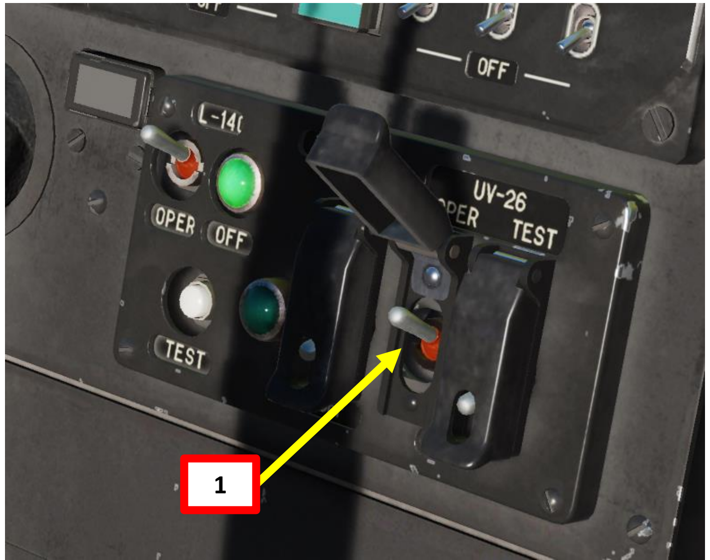
1 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK LEGACY” (2011) VARIANT

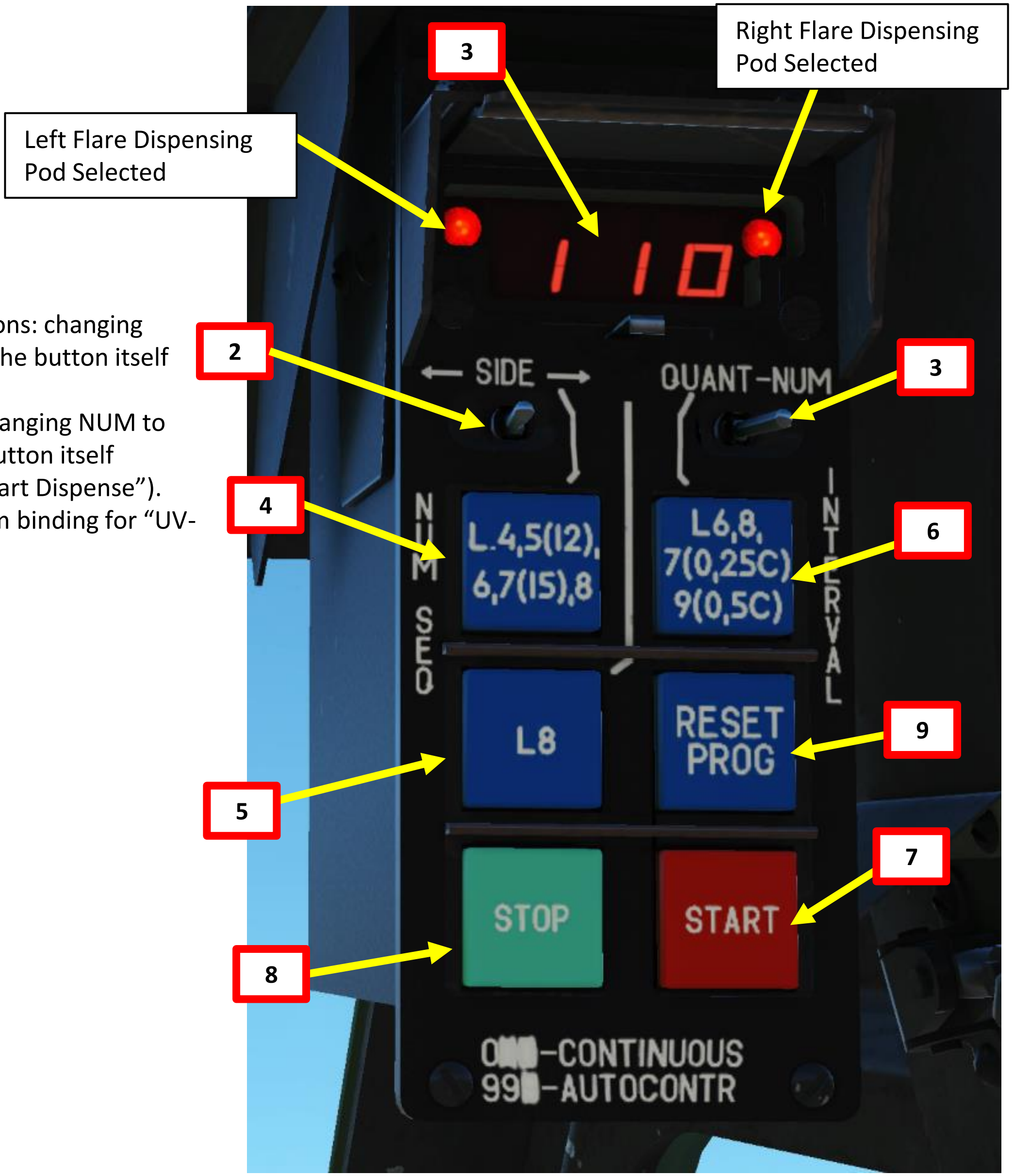
1.2 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark Legacy Variant Only

To program and deploy flares:

1. Power on UV-26 system (UP)
2. Select which flare pod side you will deploy your flares from (Left, Middle (both sides) or Right)
3. Check Remaining Flare Quantity (left) and then Select Program Number (right)
    - First Number: Number of flare dispensing sequences per program
    - Second Number: Number of flares per dispensing sequence
    - Third Number: Number of seconds between sequences
4. Press NUM to cycle between number of flare dispensing sequences per program (first number). Exceptions: changing NUM to “5” will in fact do “12” sequences and NUM to “7” will in fact do “15” sequences, as written on the button itself
5. Press SAL to cycle between number of flares per dispensing sequence (second number)
6. Press INTERVAL to cycle between number of seconds between dispensing sequences (third number). Changing NUM to “7” will in fact set a “0.25 sec” delay and NUM to “9” will in fact set a“0.5 sec” delay, as written on the button itself
7. Dispense flares by pressing the CMD START button (“Insert” key binding or custom binding for “UV-26 Start Dispense”).
8. (Optional) You can interrupt flare program by pressing CMD STOP button (“Delete” key binding or custom binding for “UV-26 Stop Dispense”)
9. (Optional) You can reset program by pressing the RES PROG button.





1 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK LEGACY" (2011) VARIANT

1.2 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark Legacy Variant Only

Example of Program 333:

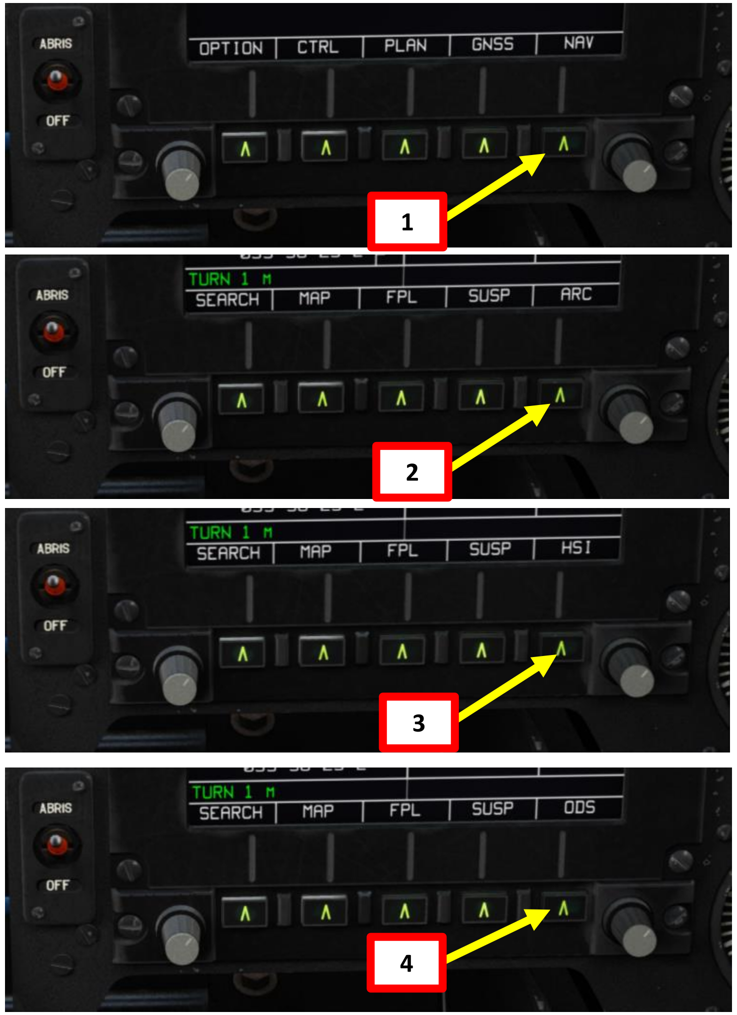
- 3 flares dropped per pod, 3 sequences, 3 seconds between each sequence

2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

2.1 – ODS (Onboard Defense System)

The ODS (Onboard Defense System) is a page used for both the LWS (Laser Warning System) and MWS (Missile Warning System). To access the ODS page, you can press repeatedly on the button next to the NAV/ARC/HSI menu until you get to the ODS menu.

Whenever the aircraft detects a laser with the LWS or a missile is detected by the MWS, the ODS page appears dynamically to give you relevant information. The ODS Mode Selector Switch allows you to select the operation mode: Combat or Standby.



ODS (Onboard Defense System) Page

ODS (Onboard Defense System) Mode Selector Switch
- UP = ODS ON (Combat Mode)
- DOWN = STBY (Standby Mode)

6

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.1 – ODS (Onboard Defense System)

The Onboard Defense System has two modes of operation: **ODS ON (Combat, or "Arm" Mode)** and **STBY (Standby Mode)**.

- In **ODS ON (Combat) mode**, the system will automatically bring up the onboard defense system page on the ABRIS display as soon as a missile launch or laser illumination is detected by the sensors. The pilot will hear a voice warning regarding the threat, which will be indicated (along with its azimuth marks) on the display panel's range circle. When a missile launch is detected, a voice warning will sound to alert the pilot, and the system will automatically begin to deploy IR countermeasures.
- In **STBY (Standby) mode**, unlike in combat mode, there is no automatic deployment of the IR countermeasures. The deployment of the IR countermeasures has to be carried out manually by the pilot.

The release mode for IR (Infrared) countermeasures (flares) can be modified via the UV-26 settings panel, located in the right-hand side of the upper instrument panel.

When executing a combat mission or entering a combat zone, set the system to **ODS ON (COMBAT/ARM) mode** by using the **ODS selector switch** located at the left-hand side of the instrument panel.

ODS (Onboard Defense System) Page in COMBAT (ARM) Mode

ODS (Onboard Defense System) Mode Selector Switch
- UP = ODS ON (Combat Mode)

ODS (Onboard Defense System) Page in STANDBY (STBY) Mode

ODS (Onboard Defense System) Mode Selector Switch
- DOWN = STBY (Standby Mode)

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

2.1 – ODS (Onboard Defense System)

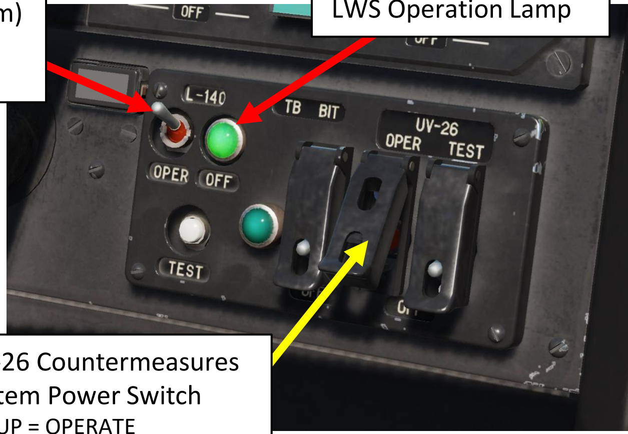
The Onboard Defense System integrates three main components:

- The Laser Warning System (LWS)
- The Missile Warning System (MWS)
- The UV-26 Countermeasure Dispensing System

This provides the Ka-50 the capability to automatically release countermeasures if a missile is launched in your direction, which is pretty neat and drastically improves your survivability.

Laser Lock / Missile Warning Light

ODS (Onboard Defense System) Mode Selector Switch
- UP = ODS ON (Combat Mode)
- DOWN = STBY (Standby Mode)



L-140 LWS (Laser Warning System) Power Switch
- UP = ON

LWS Operation Lamp

UV-26 Countermeasures System Power Switch
- UP = OPERATE

UV-26 Settings Panel (Countermeasure Programming)

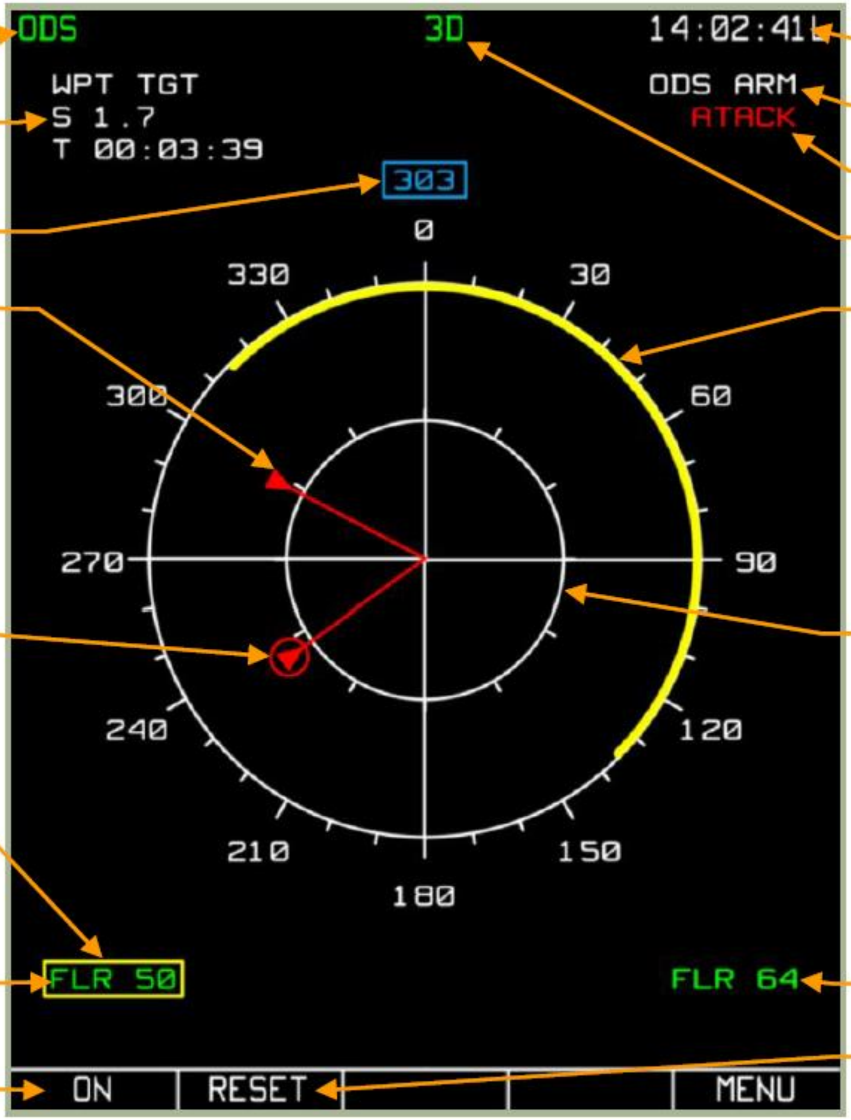
ODS (Onboard Defense System) Page

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.1 – ODS (Onboard Defense System)

Ka-50 Black Shark III Expansion Only

ODS (Onboard Defense System) Page



System Status Bar (Mode Indicator)

Navigation Information
- Current Waypoint
- Distance to waypoint (km)
- ETA (Estimated Time of Arrival) to Waypoint

Current Heading

Detected Threat (Missile)

Main Threat Indicator Ring

Countermeasures Deployed (indicated by yellow frame)

Port-side/Left Countermeasures Type (Flare) & Remaining Quantity

Defense System ON/OFF Button

Current Time

System Status (OFF, STANDBY, or COMBAT)

Attack Detection Indicator

GNSS Location Tracking Status

Laser Illumination Indicator
- Covers four 90 degree sectors.
- A solid yellow arc indicates that the laser is in ranging mode
- A flashing yellow arc indicates that the laser is in weapon guidance mode.

Range Circles with Azimuth Marks

Starboard-side/Right Countermeasures Type (Flare) & Remaining Quantity

RESET Button – Resets the lase illumination indicator

2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

2.1 – ODS (Onboard Defense System)

The NAV page also displays an overlay with the same information displayed on the Onboard Defense System Page.

ODS (Onboard Defense System) Page

ODS Overlay on NAV Page

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT
2.2 – L-140 Otklik Laser Warning System (LWS)
2.2.1 – Components

The **L-140 Otklik laser detection system** detects laser range finders and laser guidance systems. You can think of it as a RWR (radar warning receiver) but for lasers.

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.2 – L-140 Otklik Laser Warning System (LWS)

2.2.1 – Components

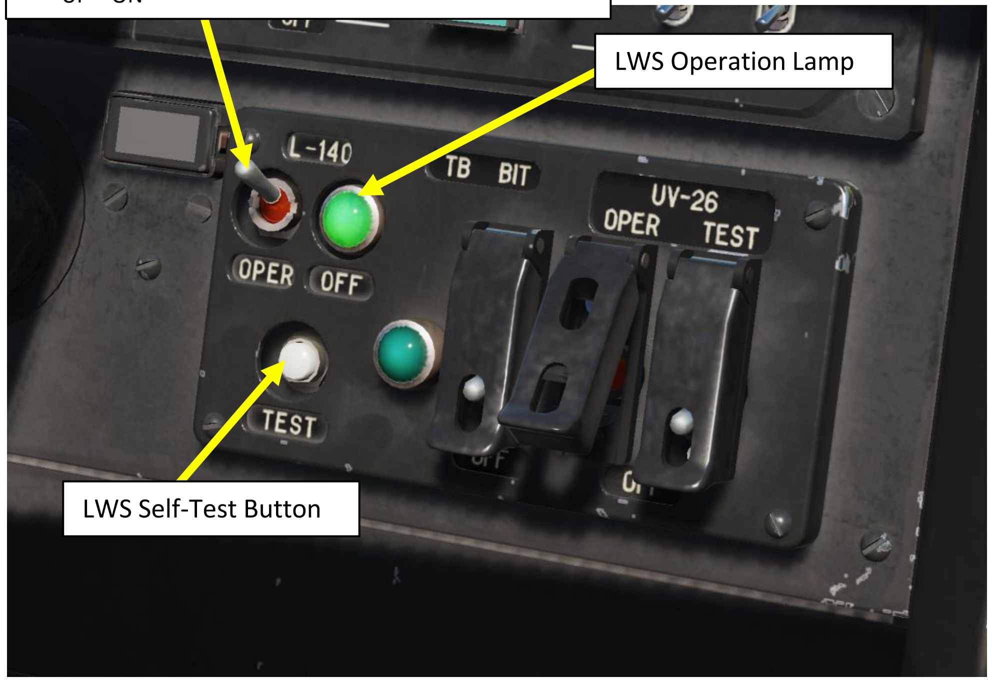
Ka-50 Black Shark III Expansion Only

- The system is powered on using the L-140 LWS Power Switch.
- The ODS (Onboard Defense System) page will dynamically appear once a laser is detected and give you an indication of the direction of the laser using a yellow **Laser Illumination Indicator Arc**.
- A **solid laser illumination arc** indicates the **laser is in ranging mode**.
- A **flashing laser illumination arc** indicates that the **laser is in weapon guidance mode**.
- An aural warning is also audible "Warning, Under Attack!" when being lased.
- Main battle tanks and other combat ground vehicles will often use their laser range finders to input accurate target range data into their fire control systems before firing. A warning on the LWS is a sure indication that a ground vehicle or other helicopter is targeting you.
- Note that tank crews of many armed forces are trained to use their main guns as an anti-helicopter weapon and will engage you if you are within 1,500 meters and present them a non-crossing target. Other vehicles, such as ATGM (Air-to-Ground Missile) launchers, will also engage you but at even longer ranges. Additionally, many vehicles have secondary machine guns that they will use to engage you when in close range.

Laser Lock / Missile Warning Light

L-140 LWS (Laser Warning System) Power Switch
- UP = ON

LWS Operation Lamp



LWS Self-Test Button

Laser Illumination Indicator
- Covers four 90 degree sectors.
- A solid yellow arc indicates that the laser is in ranging mode
- A flashing yellow arc indicates that the laser is in weapon guidance mode.

2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT
2.2 – L-140 Otklik Laser Warning System (LWS)
2.2.2 – Laser Warning Example

In this example, a tank is using its laser range finder to fire its machinegun. The tank is to our rear right quadrant. The general rule of thumb when seeing/hearing a LWS warning is to perform evasive actions and pop flares. A missile will head your way soon after.

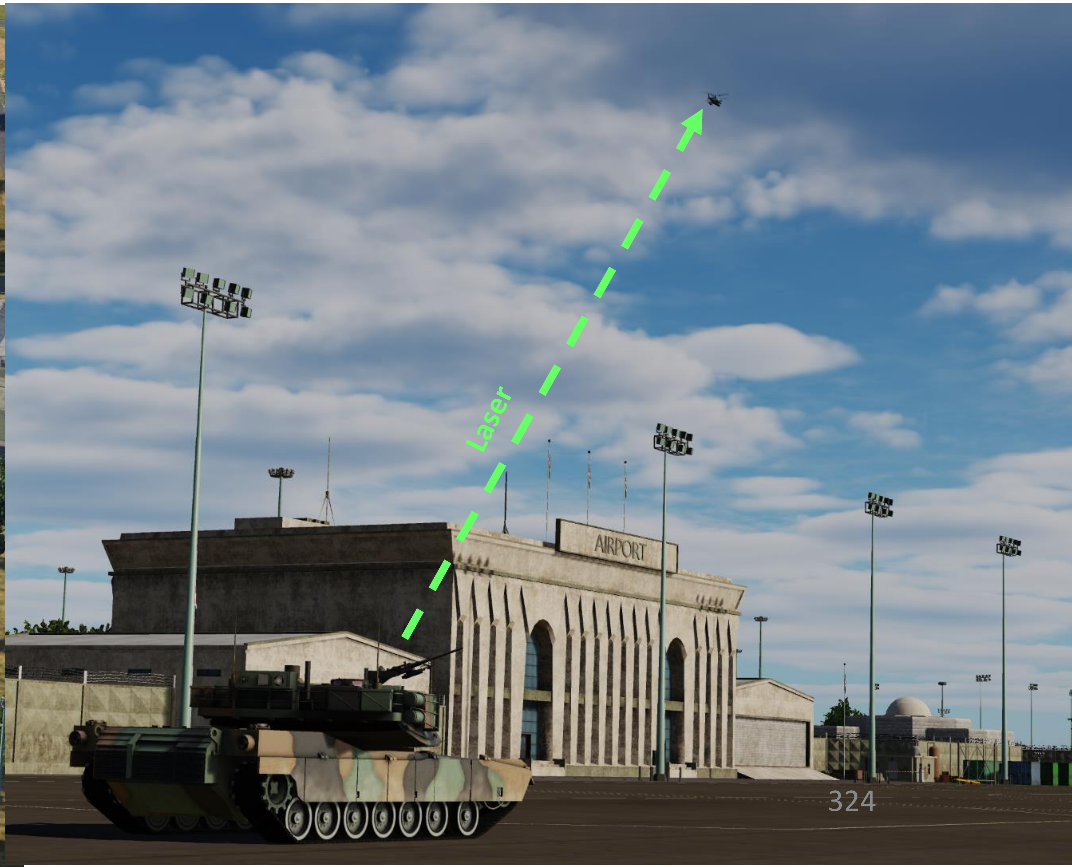
Laser Lock / Missile Warning Light

Laser Illumination Indicator
- Covers four 90 degree sectors.
- A solid yellow arc indicates that the laser is in ranging mode
- A flashing yellow arc indicates that the laser is in weapon guidance mode.

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT
2.2 – L-140 Otklik Laser Warning System (LWS)
2.2.2 – Laser Warning Example

Ka-50 Black Shark III Expansion Only

Main Battle Tank (using Laser Range Finder)



2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.3 – Missile Warning System (MWS)

Ka-50 Black Shark III Expansion Only

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.3 – Missile Warning System (MWS)

2.3.1 – Components

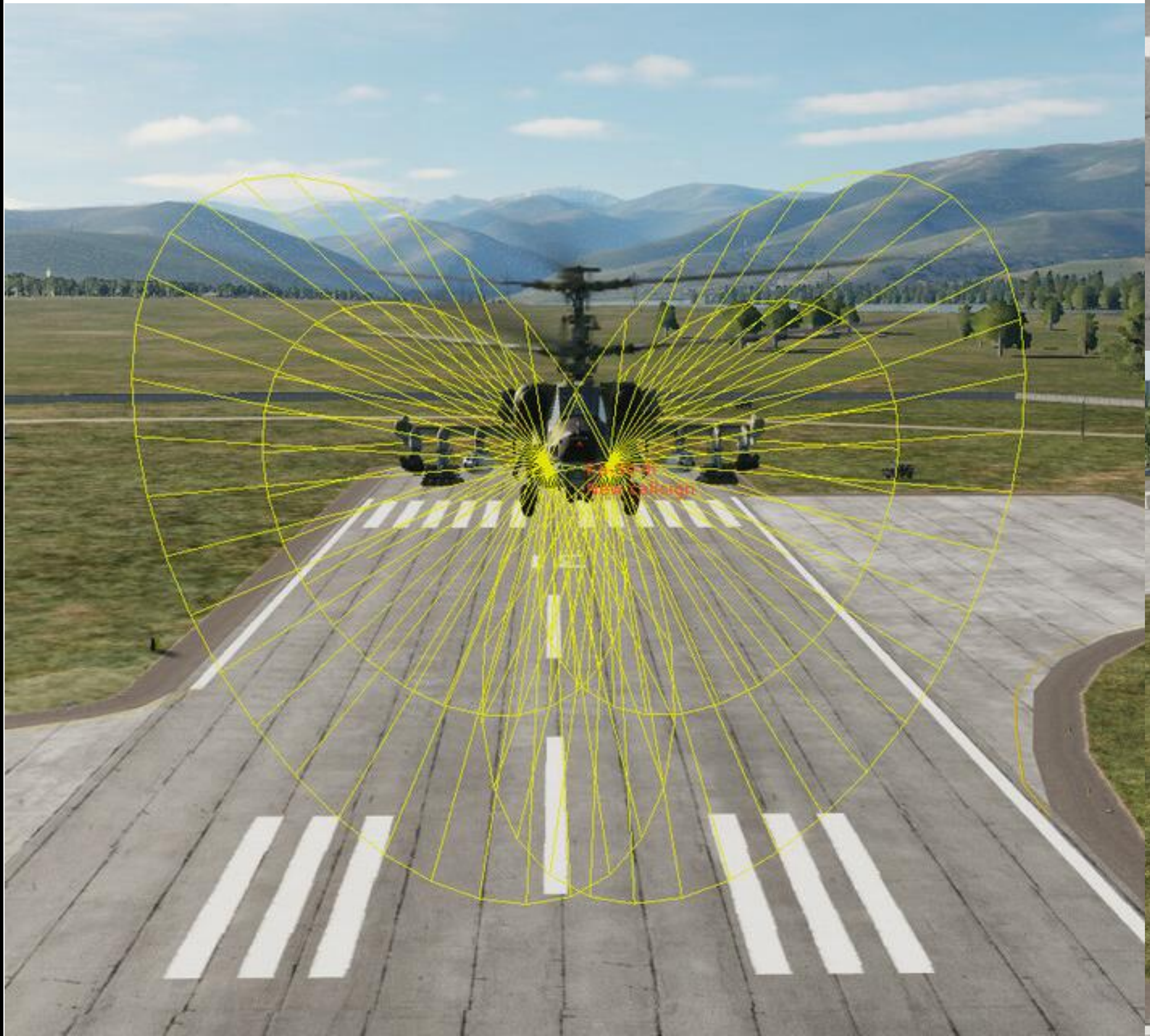
The MWS (Missile Warning System) is a network of four sensors that provide you information when a missile launch is detected. It is integrated with the countermeasure dispensing system, which can automatically drop flares once the missile is in the air.

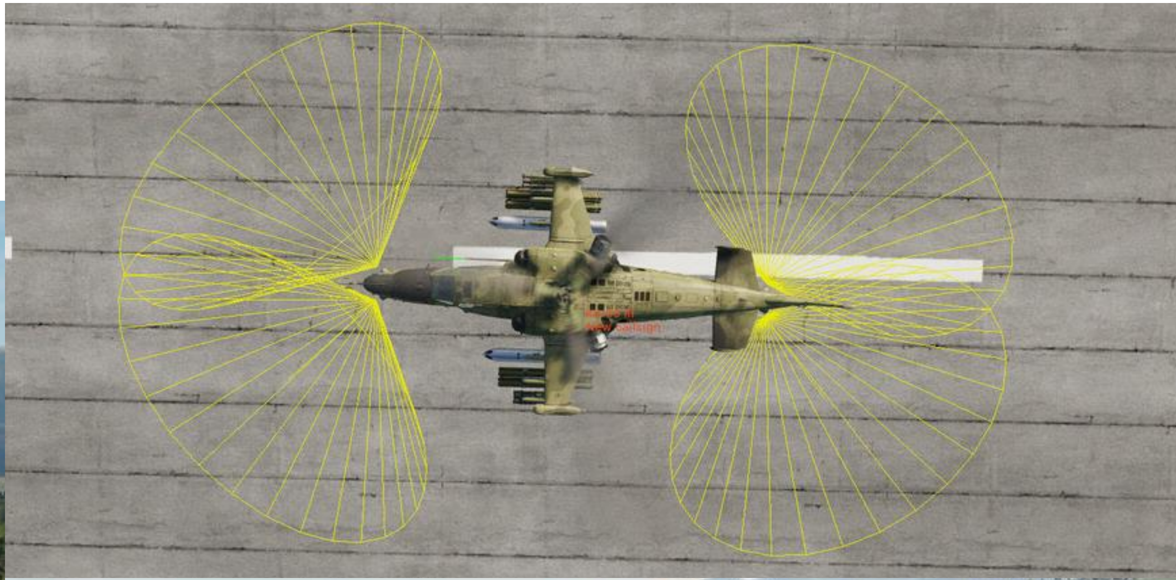
2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

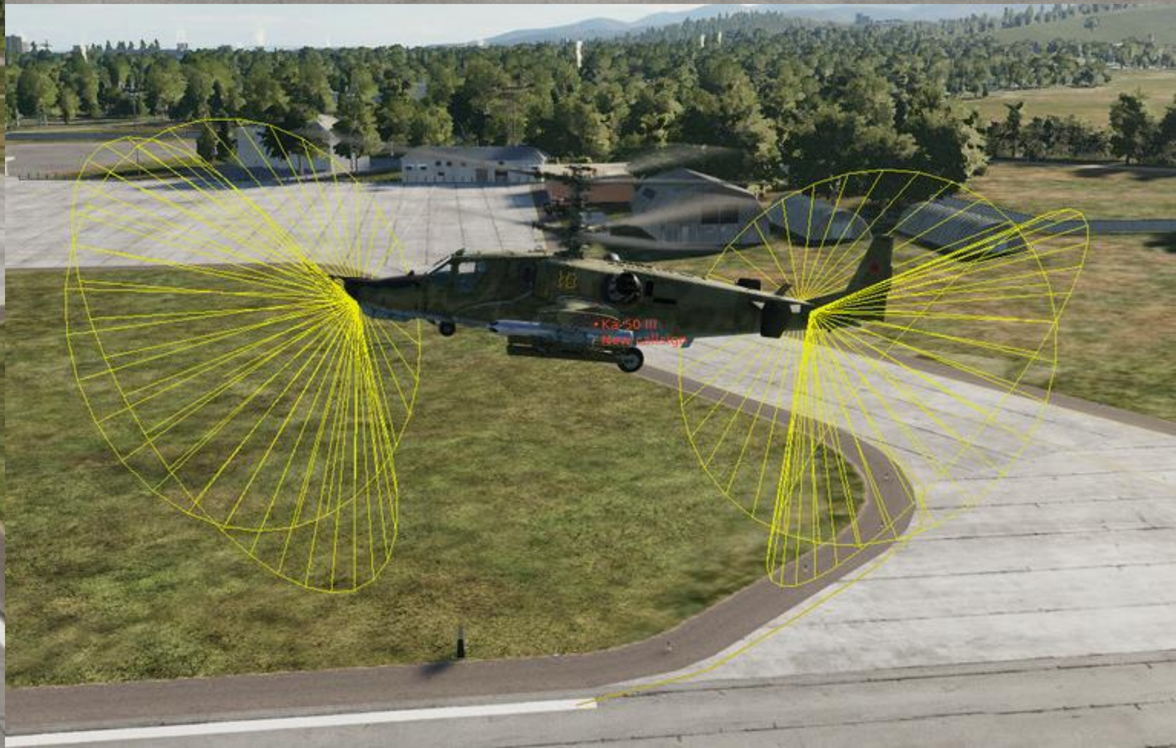
2.3 – Missile Warning System (MWS)

2.3.1 – Components

The missile warning system covers the areas shown in yellow.







2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.3 – Missile Warning System (MWS)

2.3.1 – Components

The MWS symbology is displayed on the ODS (Onboard Defense System). The operation mode of the Onboard Defense System is determined by the position of the ODS Mode Selector Switch.

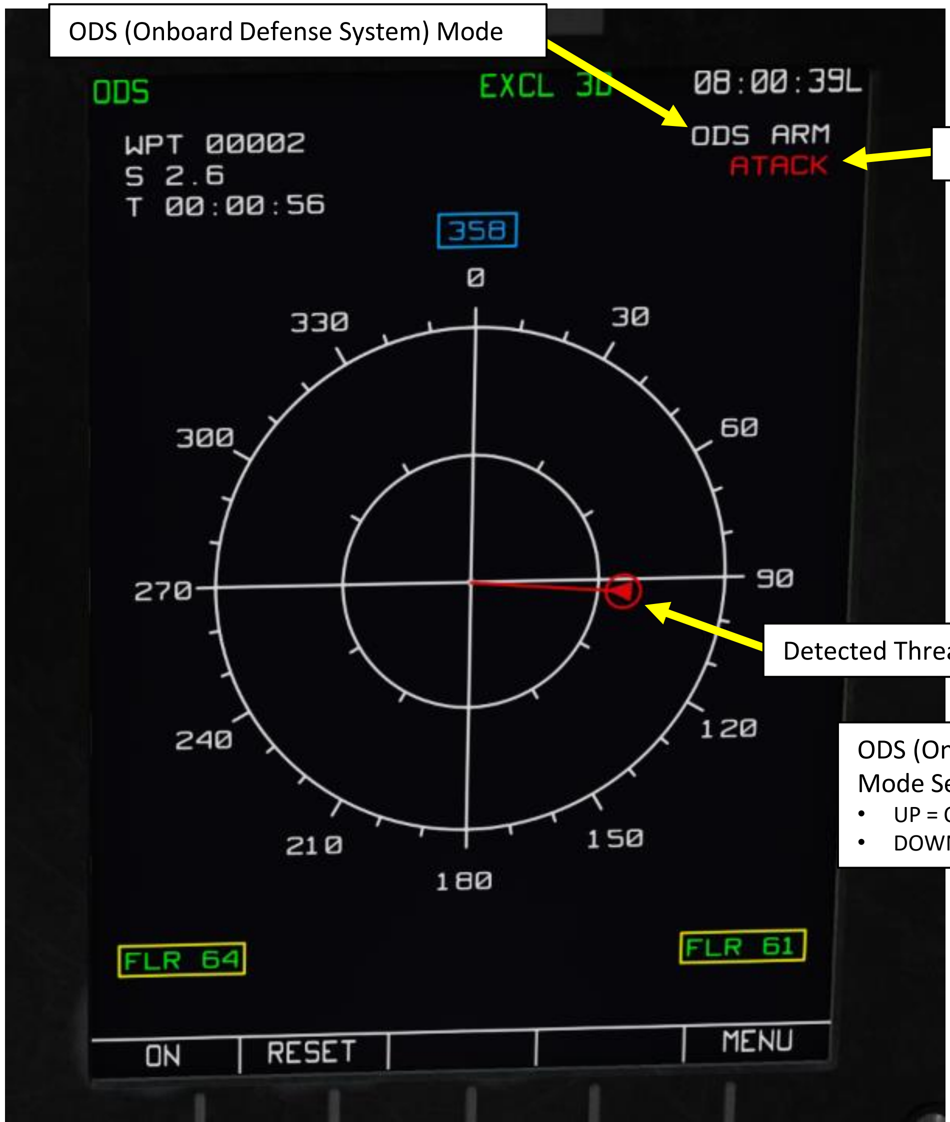
As mentioned previously, the ODS has two modes of operation: **ODS ON (Combat, or "Arm" Mode)** and **STBY (Standby Mode)**.

- In **ODS ON (Combat) mode**, the system will automatically bring up the onboard defense system page on the ABRIS display as soon as a missile launch or laser illumination is detected by the sensors. The pilot will hear a voice warning regarding the threat, which will be indicated (along with its azimuth marks) on the display panel's range circle. When a missile launch is detected, a voice warning will sound to alert the pilot, and the system will automatically begin to deploy IR countermeasures.
- In **STBY (Standby) mode**, unlike in combat mode, there is no automatic deployment of the IR countermeasures. The deployment of the IR countermeasures has to be carried out manually by the pilot.

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT
2.3 – Missile Warning System (MWS)
2.3.2 – Missile Warning Example

In this example, a Stinger missile has been fired at us. The missile is to our right. The general rule of thumb when seeing/hearing a MWS warning is to perform evasive actions and pop flares.



Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

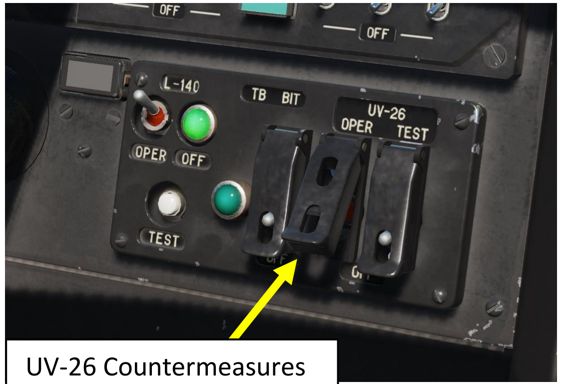
2.3 – Missile Warning System (MWS)

2.3.2 – Missile Warning Example

When set to **ODS ON (COMBAT/ARM) mode**, the system will automatically launch IR countermeasures depending on the position of the **UV-26 Left/Right Dispenser Side selector switch**.

If the **UV-26 Left/Right Dispenser Side selector switch** is set to the middle position, the system will automatically select which side it will deploy the IR countermeasures (left or right.) If a missile is incoming from either the front or rear hemisphere (within a range of ±30 degrees from the helicopter axis,) the system will deploy IR countermeasures from both left and right simultaneously.

If the **UV-26 Left/Right Dispenser Side selector switch** is set to the left or right side, then the system will deploy IR countermeasures from left or right, respectively.



UV-26 Countermeasures System Power Switch
- UP = OPERATE

UV-26 Left/Right Dispenser Side Selector

ODS (Onboard Defense System) Mode Selector Switch
- UP = ODS ON (Combat Mode)
- DOWN = STBY (Standby Mode)

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

2.4 – UV-26 Countermeasures Flare Dispensers

The UV-26 system is used to dispense infrared flare decoys and dipole reflectors are carried in two 26 mm cartridge pods that are fixed to the wing tips. Each pod contains 64 cartridges.

UV-26 Countermeasure Flare Cartridge Dispenser

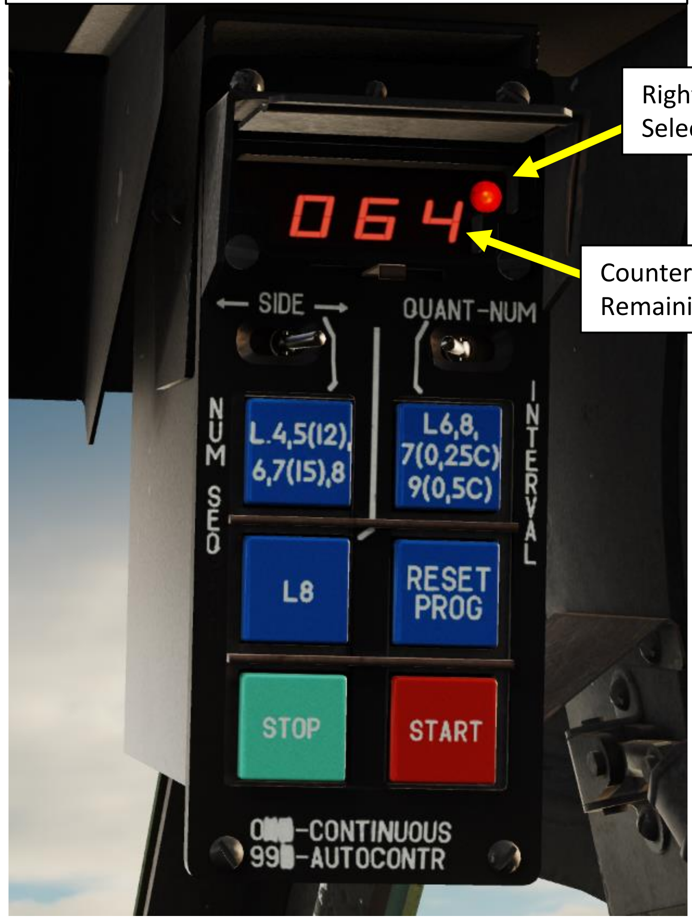
2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.4 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark III Expansion Only

Flare counters are available on both the UV-26 Settings Panel and on the ODS (Onboard Defense System) page.

UV-26 Settings Panel
(Countermeasure Programming)



Right Countermeasures Selected

Countermeasures Remaining Quantity

ODS (Onboard Defense System) Page

Countermeasures Deployed
(indicated by yellow frame)

Port-side/Left Countermeasures Type (Flare) & Remaining Quantity

Starboard-side/Right Countermeasures Type (Flare) & Remaining Quantity

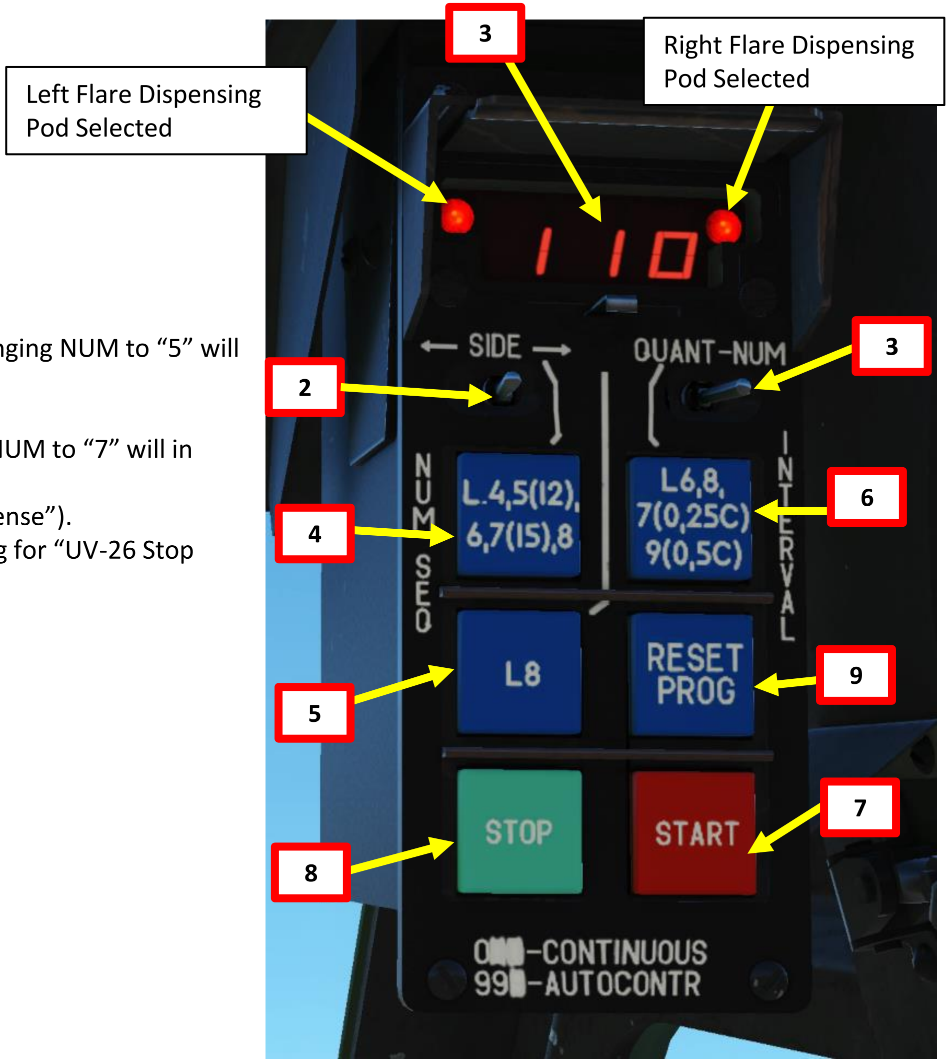
2 – DEFENSIVE SYSTEMS – KA-50 “BLACK SHARK III EXPANSION” (2022) VARIANT

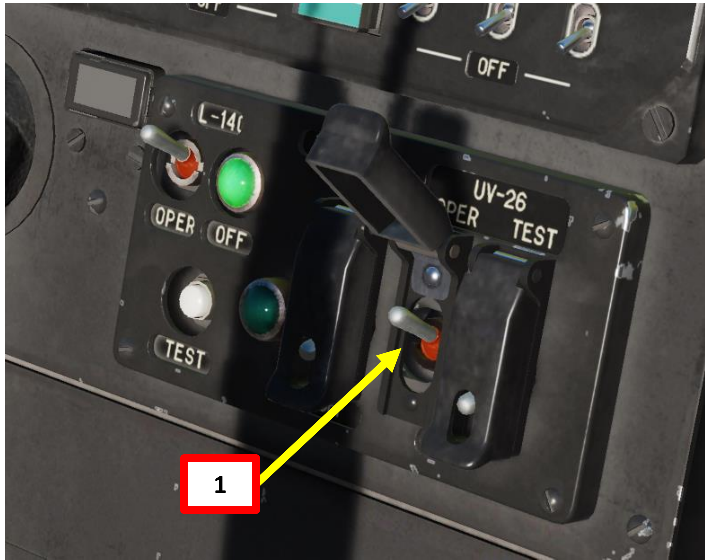
2.4 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark III Expansion Only

To program and deploy flares:

1. Power on UV-26 system (UP)
2. Select which flare pod side you will deploy your flares from (Left, Middle (both sides) or Right)
3. Check Remaining Flare Quantity (left) and then Select Program Number (right)
   - First Number: Number of flare dispensing sequences per program
   - Second Number: Number of flares per dispensing sequence
   - Third Number: Number of seconds between sequences
4. Press NUM to cycle between number of flare dispensing sequences per program (first number). Exceptions: changing NUM to “5” will in fact do “12” sequences and NUM to “7” will in fact do “15” sequences, as written on the button itself
5. Press SAL to cycle between number of flares per dispensing sequence (second number)
6. Press INTERVAL to cycle between number of seconds between dispensing sequences (third number). Changing NUM to “7” will in fact set a “0.25 sec” delay and NUM to “9” will in fact set a“0.5 sec” delay, as written on the button itself
7. Dispense flares by pressing the CMD START button (“Insert” key binding or custom binding for “UV-26 Start Dispense”).
8. (Optional) You can interrupt flare program by pressing CMD STOP button (“Delete” key binding or custom binding for “UV-26 Stop Dispense”)
9. (Optional) You can reset program by pressing the RES PROG button.





2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

2.4 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark III Expansion Only

Example of Program 333:

- 3 flares dropped per pod, 3 sequences, 3 seconds between each sequence

Ka-50 Black Shark III Expansion Only

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT

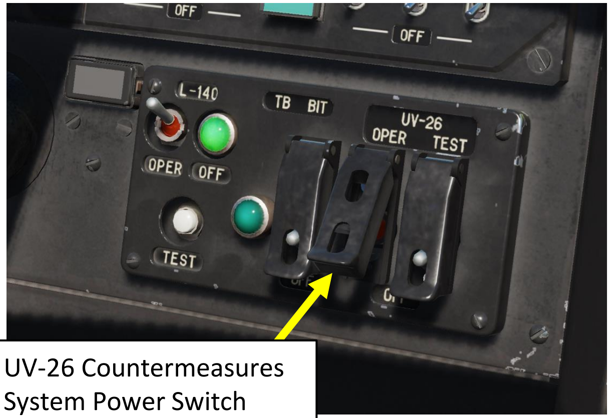
2.4 – UV-26 Countermeasures Flare Dispensers

The UV-26 countermeasures system is integrated with the MWS (Missile Warning System). When set to **ODS ON (COMBAT/ARM) mode**, the system will automatically launch IR countermeasures depending on the position of the **UV-26 Left/Right Dispenser Side selector switch**.

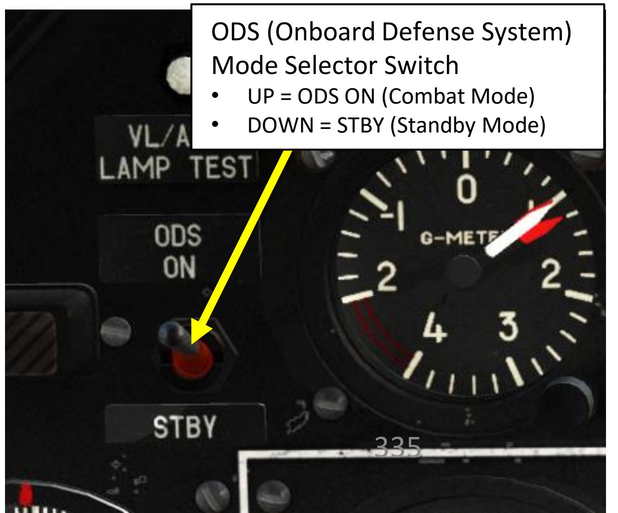
If the **UV-26 Left/Right Dispenser Side selector switch** is set to the middle position, the system will automatically select which side it will deploy the IR countermeasures (left or right.) If a missile is incoming from either the front or rear hemisphere (within a range of ±30 degrees from the helicopter axis,) the system will deploy IR countermeasures from both left and right simultaneously.

If the **UV-26 Left/Right Dispenser Side selector switch** is set to the left or right side, then the system will deploy IR countermeasures from left or right, respectively.

UV-26 Left/Right Dispenser Side Selector



UV-26 Countermeasures System Power Switch
- UP = OPERATE



ODS (Onboard Defense System) Mode Selector Switch
- UP = ODS ON (Combat Mode)
- DOWN = STBY (Standby Mode)

2 – DEFENSIVE SYSTEMS – KA-50 "BLACK SHARK III EXPANSION" (2022) VARIANT
2.4 – UV-26 Countermeasures Flare Dispensers

Ka-50 Black Shark III Expansion Only

WHAT IS DATALINK?

The Data Link uses the R-800 radio to transmit and receive information from one helicopter to another. This means that if you want to use the Data Link in multiplayer with other players, your **R-800 radio needs to be on the same channel frequency as your wingmen** **(See Radio Tutorial Section)**. Think of Data Link as a fancy cell phone that you can communicate on and exchange various information on.

WHAT IS DATALINK?

The data link control panel is located on the left side of the overhead panel. It is integrated with the Weapons Control System (WCS) and its purpose is to send and receive information about targets on the battlefield to and from other flight members. The pilot can select a target type, exchange target data with other flight members, and assign targets and initial points to wingmen.

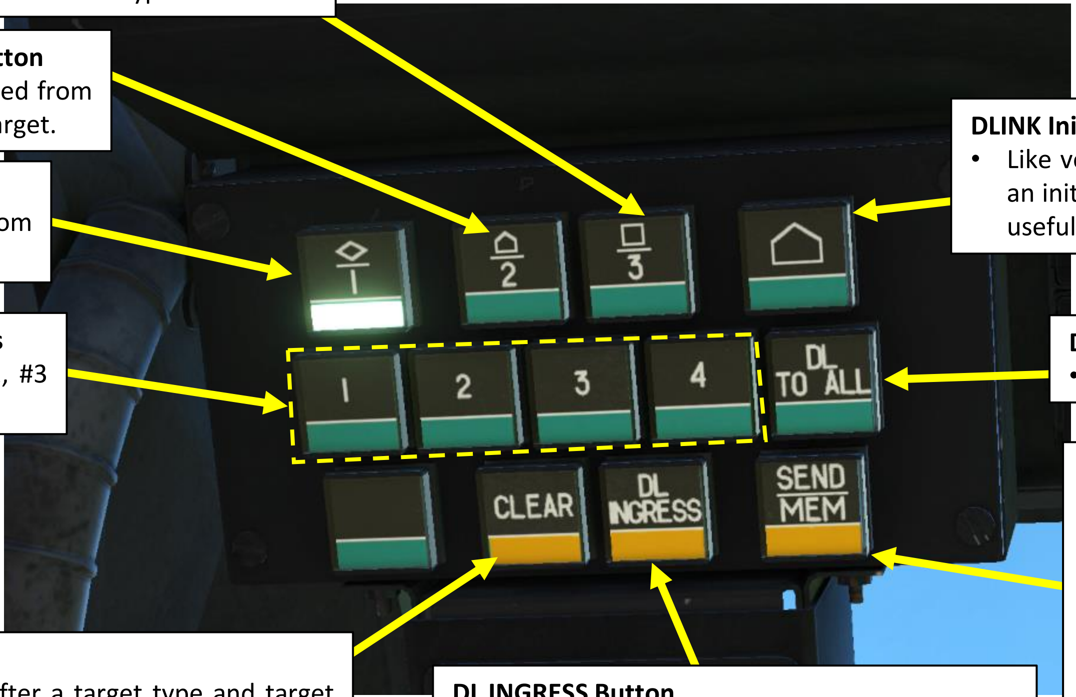
Richard Cole's Datalink Tutorial
https://www.youtube.com/watch?v=U1CFOcTsvGI

DLINK Target #3 as Other Type Button
- Indicates the target to send (or received from a wingman) is a target other than a vehicle or air defense type.

DLINK Target #2 as SAM or AAA Type Button
- Indicates the target to send (or received from a wingman) is an air defence type of target.

DLINK Target #1 as Vehicle Type Button
- Indicates the target to send (or received from a wingman) is a vehicle type of target.

DLINK to Wingman #1, #2, #3 and #4 Buttons
- Sends datalink target to wingman #1, #2, #3 or #4.



DLINK Initial Point Button
- Like vehicles, air defences and other, you may send and receive an initial point to and from wingmen via the datalink. This can be useful for communicating a battle position or ambush point.

DLINK to All Button
- Sends datalink target to all wingmen of the flight.

SEND MEM Button
- Datalink Send/Memory. After you have selected the target type and a datalink receiver, you may press this button to send the information over the datalink network.
- Additionally, when you receiver datalink data from another flight member, pressing this button will accept the data/assignment.

CLEAR Button
- Clear Datalink. After a target type and target receiver has been entered, this button can be pressed to clear the information.

DL INGRESS Button
- Datalink automatic ingress to target. This button activates functionality to automatically point the aircraft in the direction of the assigned data linked target.

WHAT IS DATALINK?

Datalink symbology is displayed on the NAV page. The symbols are a function of what data type has been set when transmitting the target.

Datalink Symbology on NAV Page

/1 – Combat vehicle, Armor

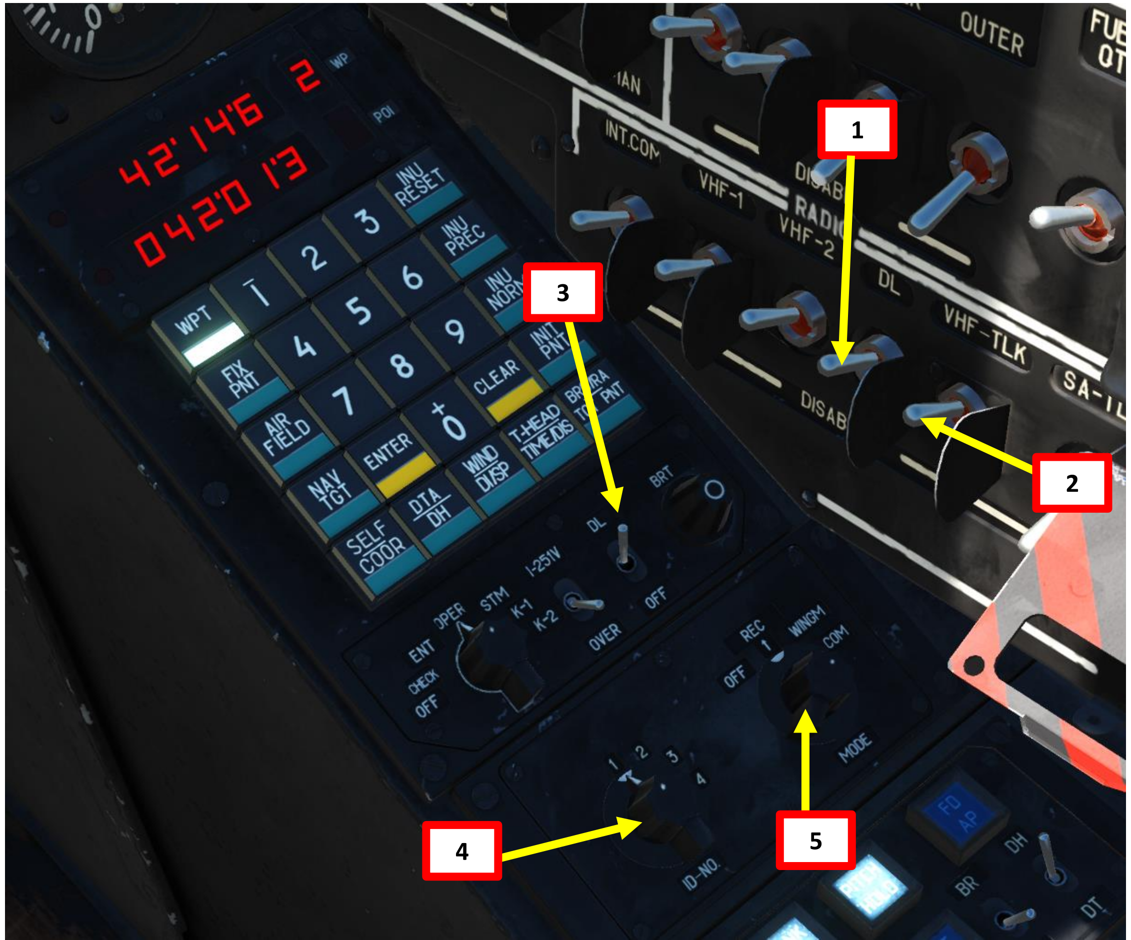
/2 – AAA/SAM

/3 – Other

– Ingress Point

DATALINK SETUP

1. Set Data Link Power switch – ON (UP)
2. Set VHF TLK – ON (UP)
3. Set Data Link switch – ON (FWD)
4. Set your own Identification Number (ID 1 for flight leader, 2, 3 or 4 for wingmen)
5. Set Data Link mode to COM (Commander) if you are the flight lead or WINGM (Wingman) if you are a wingman.
6. Set ABRIS to the NAV page
7. Laser power switch – ON (FWD)



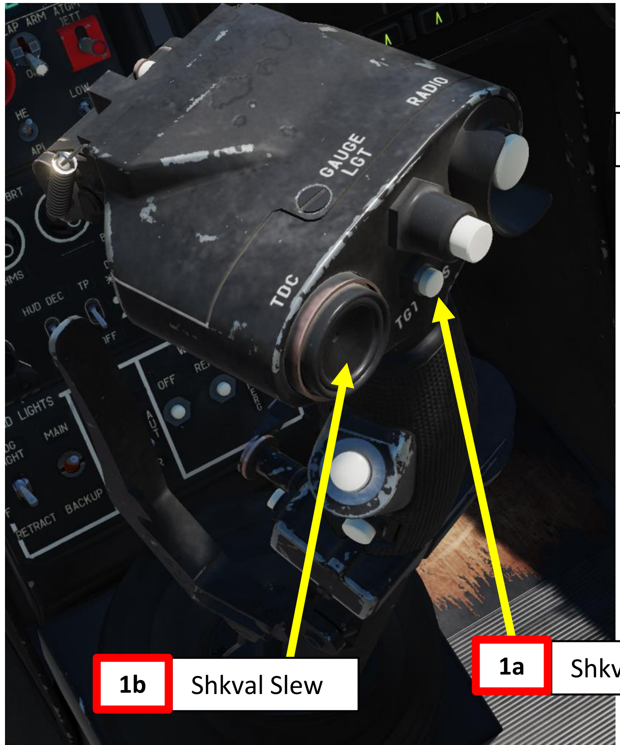
TRANSMITTING DATA

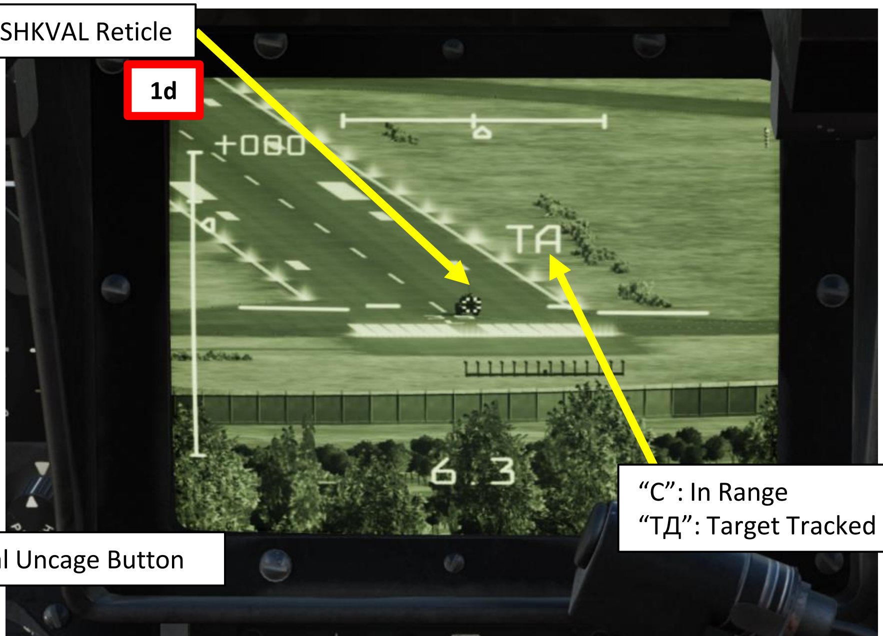
If you ever have a juicy target and want to let your buddies know about it, you can use the Datalink to send your wingmen that information. This is done in three steps:

- Acquire target with the Shkval and store its information in the ABRIS
- Reset Shkval Targeting System
- Send target information to your wingmen through the Datalink network

To send information:

1. Find a target using the SHKVAL (see Sensors section) and lock your target using the Shkval Target Acquisition & Lock button ("Enter"). For this example, we'll take a truck.
2. Press the appropriate Target Type button (which will be flashing).
3. Press the SEND-MEM button to store the target in your ABRIS system.
4. Press the Shkval Reset Button. The Shkval screen will go blank.





TRANSMITTING DATA

To send information:

5. Press the appropriate Target Type button (which will be flashing) to cycle through stored targets. The target icon will be flashing on the ABRIS screen.
6. Select who you want to send this information to (middle row). I recommend sending it to ALL. You can also send it individually using the DLINK to Wingman #1, #2, #3 and #4 Buttons.
7. Press the SEND-MEM button to send the information to your wingmen. They will have a notification in their own ABRIS that a new target can be stored in their ABRIS.

NOTE: the SEND-MEM button will flash if your wingman has not received the transmission properly.

RECEIVING DATA – "WATCH EKRAN, YOU'VE GOT MAIL!"

When you receive information from someone, you will see two buttons flash on the datalink panel and hear Betty say "watch EKRAN!". The top row is the target type (as seen previously, in this case we have a vehicle) and the second row is who sends you this information (wingman #2). You can store multiple targets of a same type. Each time you press on a Target Type button, you will cycle through the different targets you have stored in your ABRIS (the target icon will flash on the ABRIS screen).

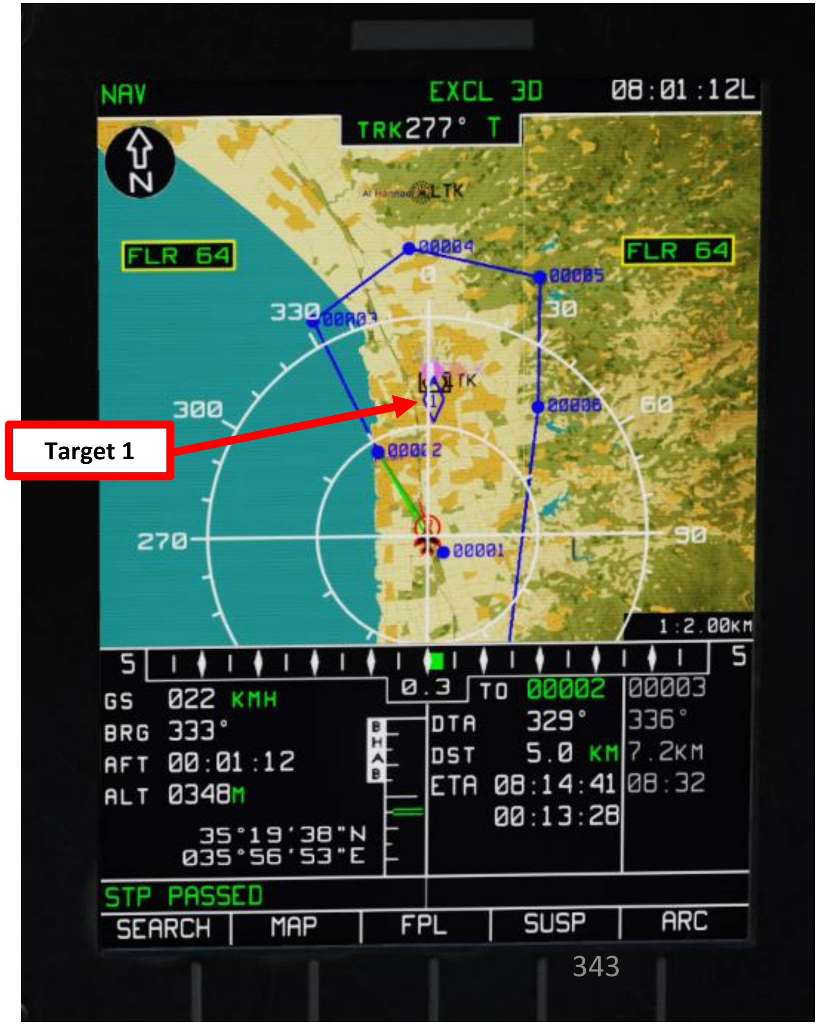
1. To store information:

a) Press the SEND-MEM button to store the target in your ABRIS system.

2. To delete information:

a) Press on the flashing target type button (top row) until you select the desired target (check on ABRIS)

b) Press the CLEAR button to delete the target from your ABRIS system.

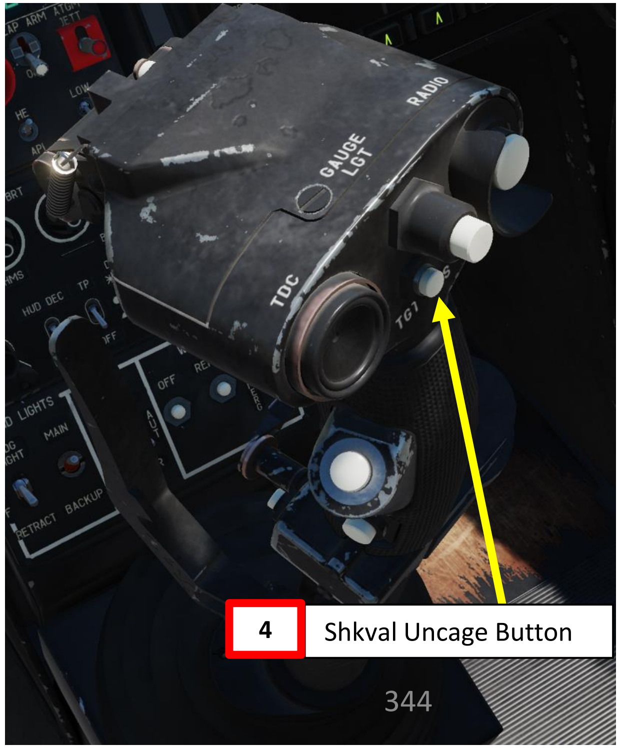


I HAVE TARGET COORDINATES STORED… NOW WHAT?

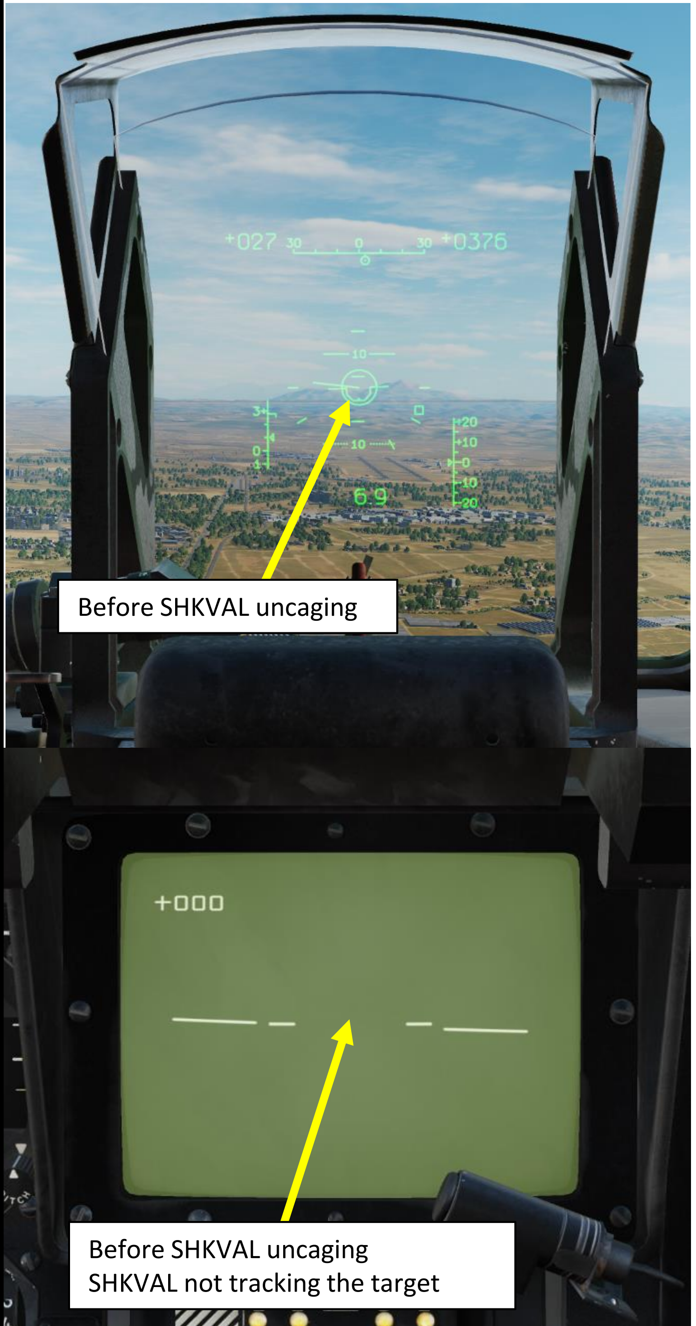
Once you have received information on different targets (which are GPS coordinates), you can actually slew your SHKVAL and lock a target! Your wingmen can do the same with the information you send them.

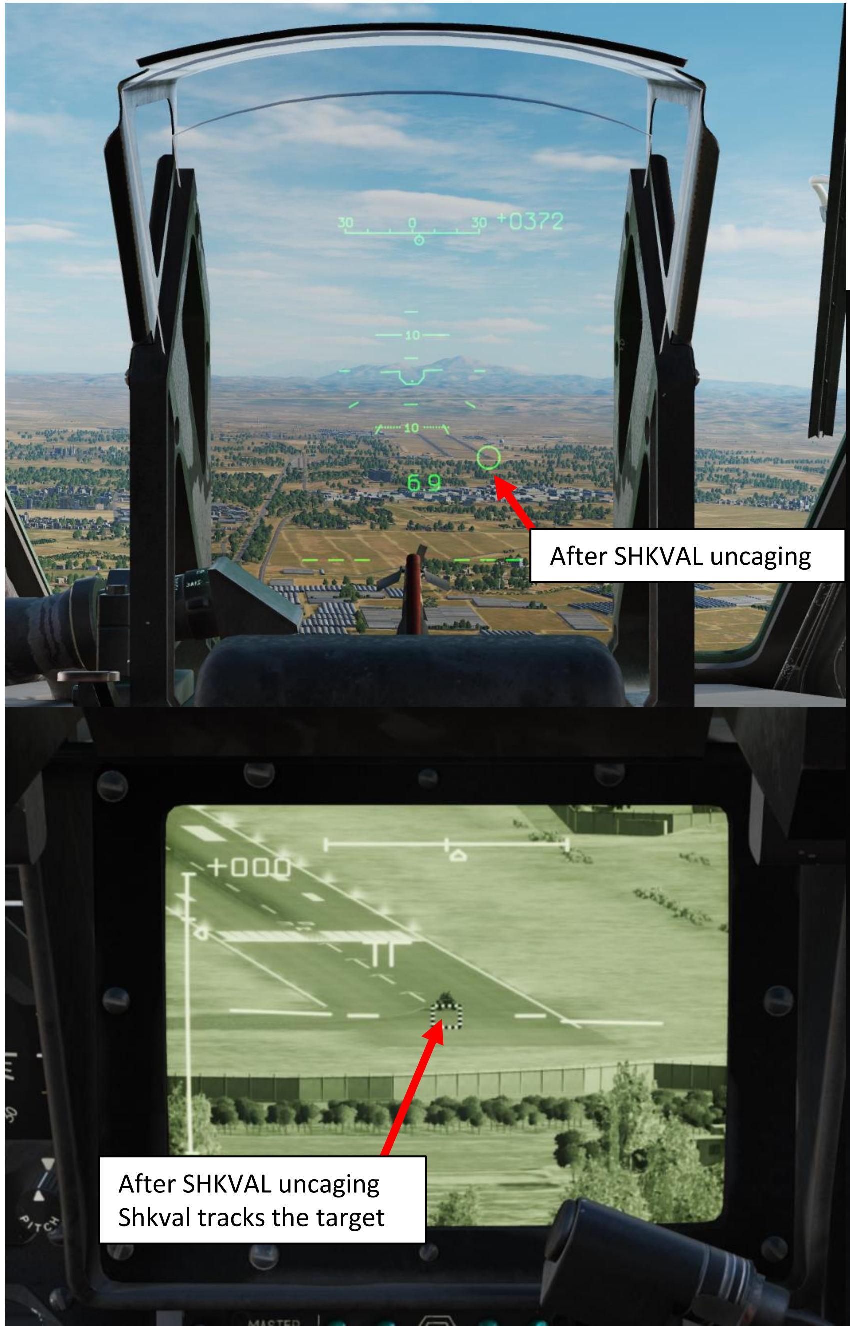
To lock a target stocked in Data Link:

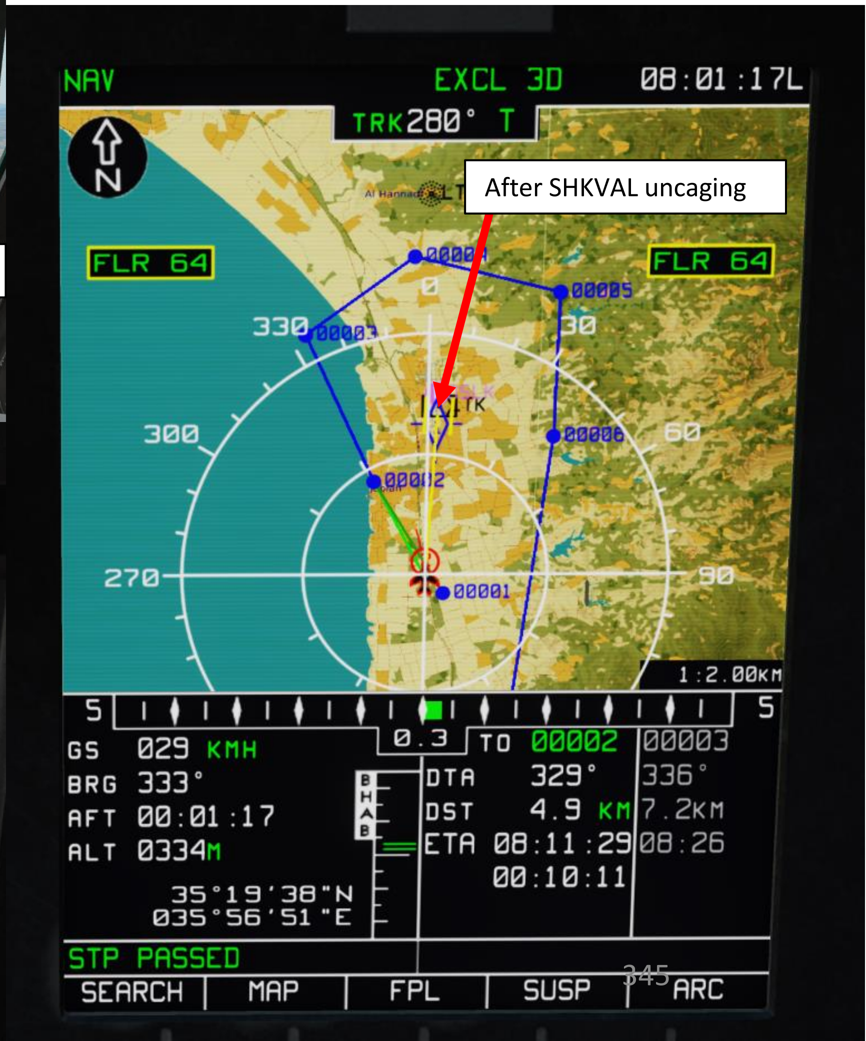
1. Press the Targeting Mode Reset button.
2. Press the appropriate Target Type button (which will be flashing) as many times as it takes to cycle through the targets stocked in your ABRIS system. Use your ABRIS icons to figure out which target you are selecting.
3. Press the DL-INGRESS button to select this Datalink target. Button will light up once pressed.
4. Uncage SHKVAL by pressing “O” and your SHKVAL will be automatically slewed to the target selected.
5. Make slewing adjustments with your SHKVAL to select the right coordinates (sometimes they are a bit off target) as shown in previous section.
6. Lock target using “Enter” and fire VIKHR missiles as shown in previous section.



I HAVE TARGET COORDINATES STORED… NOW WHAT?





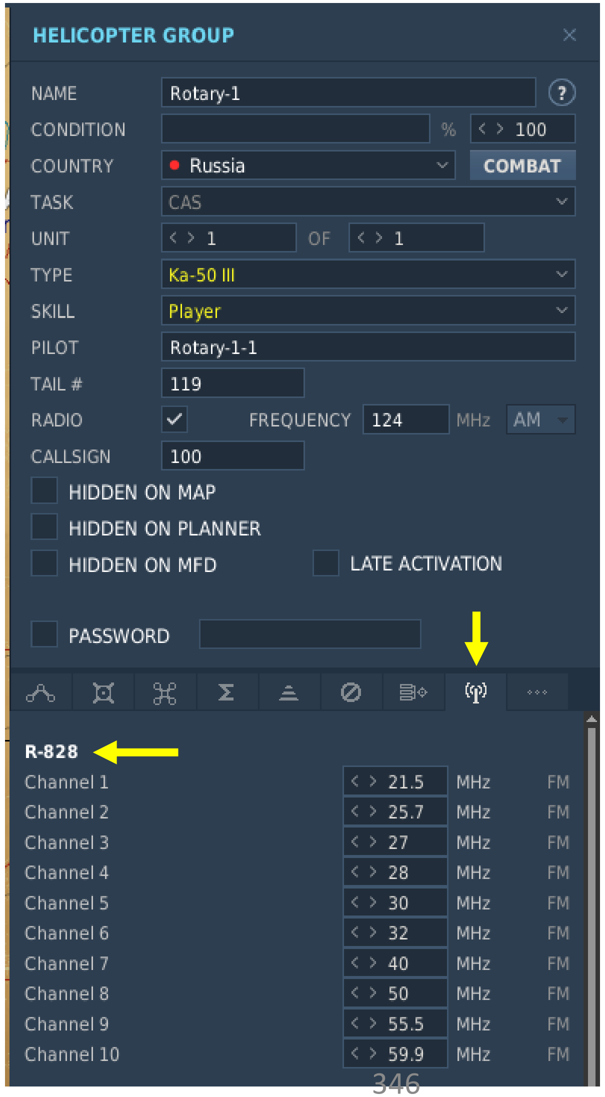


RADIO SYSTEM OVERVIEW

Radio Set	Frequency Range
R-800L1 VHF/UHF (VHF-2)	VHF: 100-149.975 MHz UHF: 220 to 399.975 MHz
R-828 VHF-1	20 to 59.975 MHz

You have two radios you can use:

- The **R-800L1 VHF/UHF radio** control system (VHF-2) is used for air-to-air communications and ATC calls.
- The **R-828 VHF-1** radio control system is used for FAC (Forward Air Controller) and ground unit communications. It contains 10 preset channels, which are pre-programmed via the Mission Editor.
- The **SPU-9 intercom** panel allows you to select which radio you want to transmit on.



DCS Table of Frequencies

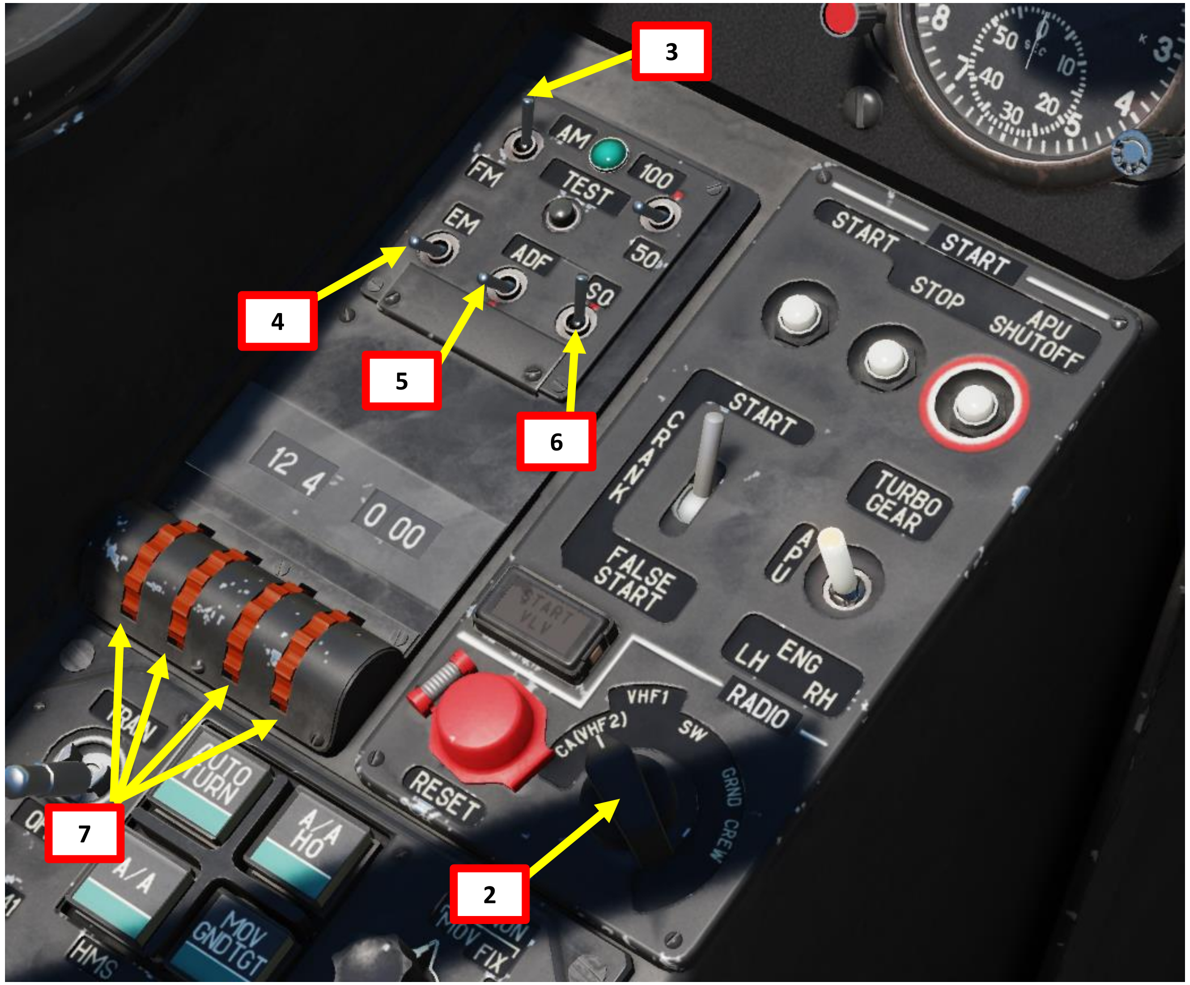
Airfield	ICAO Code	Reference	Runway(s)	Tower	ID	Alt	ILS	TACAN
Anapa	URKA	04°59'36"N, 37°20'19"E	04-22; 2900m	121.0	01	04		
Batumi	UGSB	41°36'58"N, 41°35'31"E	13-31; 2400m	131.0	11	13	**13**, 110.3	16X BTM (135.90 MHz)
Beslan	URMO	43°12'26"N, 44°35'19"E	10-28; 3000m	141.0	21	17		
Gelendzhik	URKG	44°33'54"N, 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)

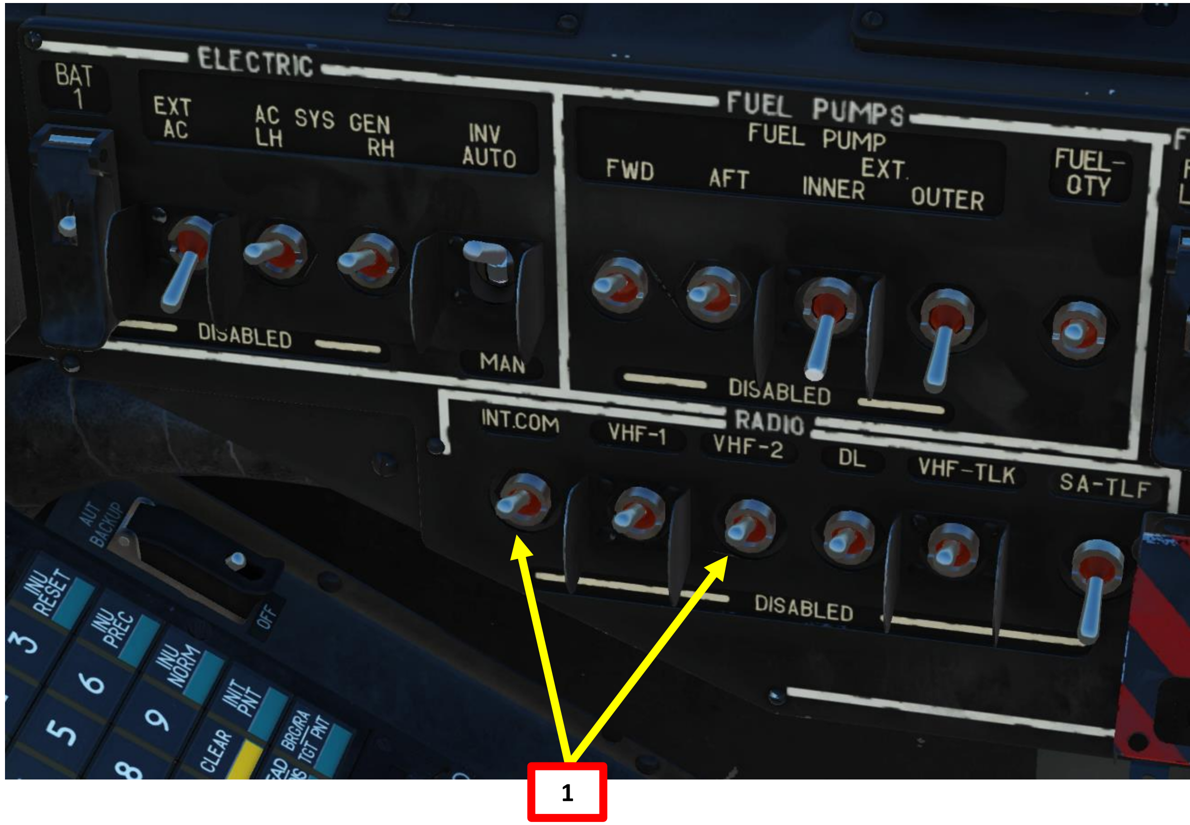
Runway = runway designations, west to east; runway length in meters
Alt = nearest alternate airfield ID
ILS = **runway designation**, ILS frequency
Credits: Shu77; HiJack; vJaBoG32

R-800L1 VHF/UHF COMMAND RADIO SET (VHF-2)

1. INT-COM and VHF-2 switches – ON (UP)
2. On Intercom panel, select VHF-2 radio.
3. On R-800 control panel, set AM/FM switch to desired position (AM generally used for Control Towers since FM is 108 MHz or lower)
4. On R-800 control panel, set Guard (Emergency) Channel to OFF (DOWN) position.
5. On R-800 control panel, set ADF to OFF (DOWN) position.
6. On R-800 control panel, set Squelch to ON (UP) position.
7. Select desired channel with the four thumb wheels.
8. Use "SPU-9 PTT (Push-to-Talk)" button on the cyclic ("RALT+/" binding) to communicate.

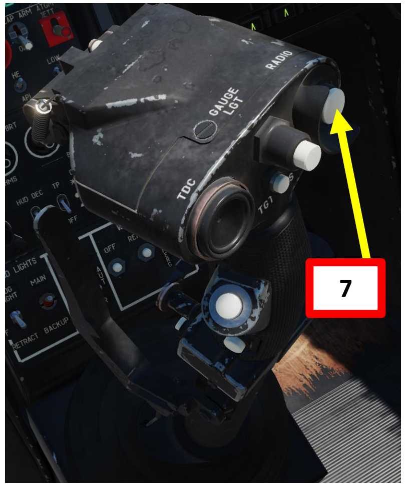
NOTE:
If you want to communicate with ground crews (to change loadout for instance), make sure the Intercom panel described in step 2 is set to GRND CREW. You will communicate with the wired telephone outside your cockpit.

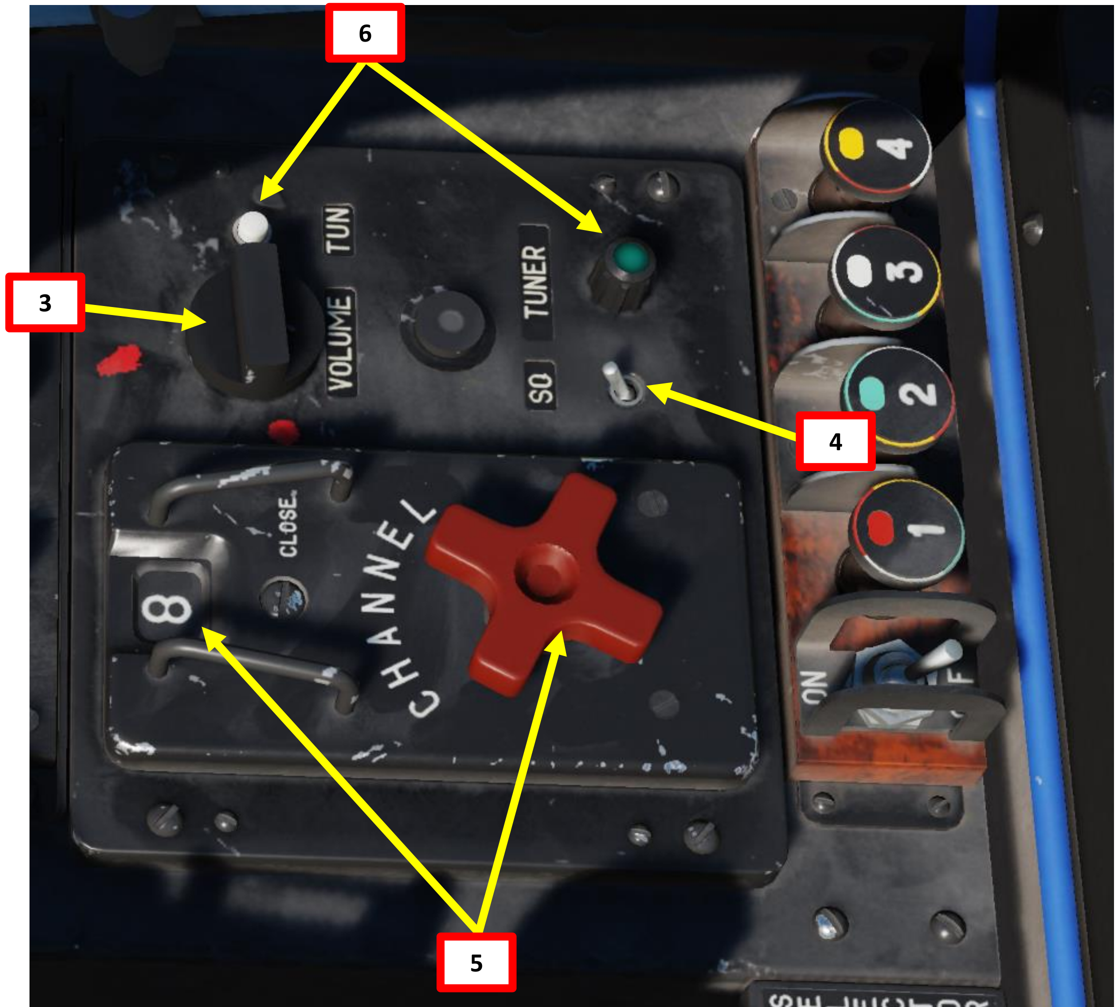


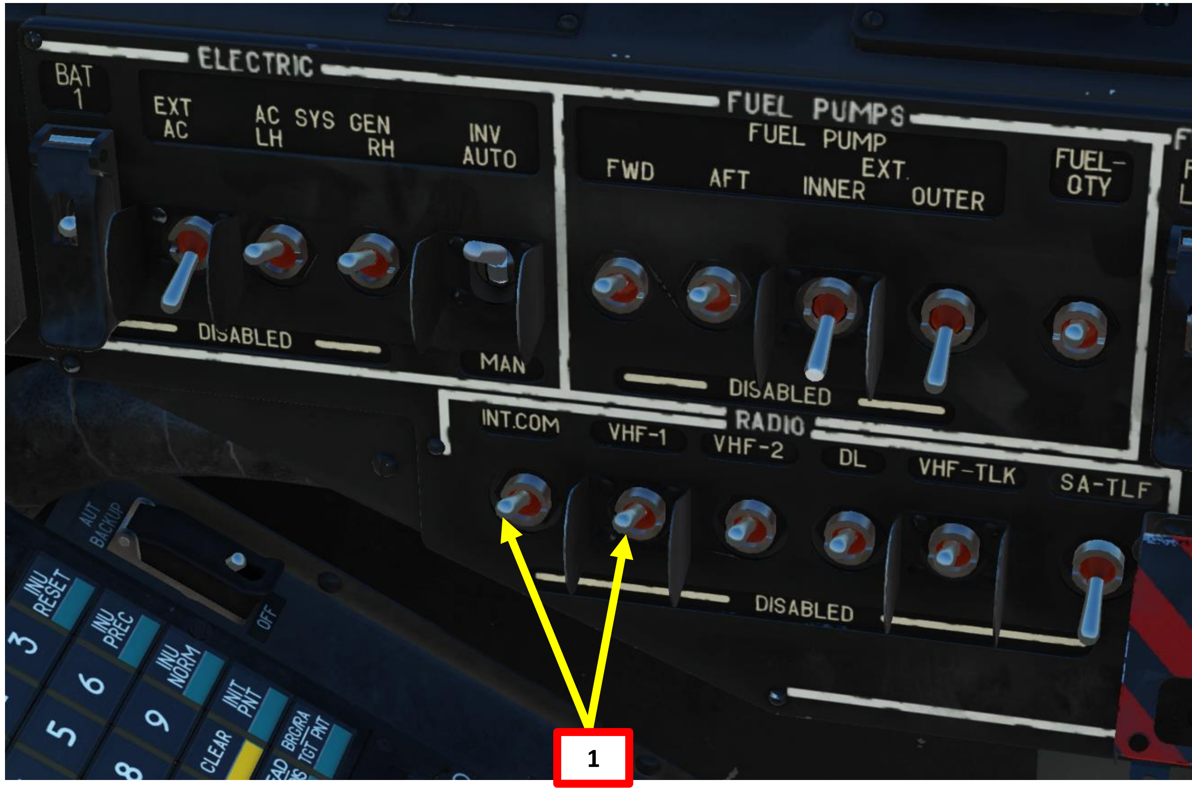


R-828 VHF-1 RADIO SET

1. INT-COM and VHF-1 switches – ON (UP)
2. On Intercom panel, select VHF-1 radio.
3. On R-828 control panel, set volume to maximum.
4. On R-828 control panel, set Squelch to ON (FWD) position.
5. On R-828 control panel, select desired preset channel.
6. On R-828 control panel, press Automatic Tuner button. TUNING light will illuminate once radio is set.
7. Use “SPU-9 PTT (Push-to-Talk)” button on the cyclic (“RALT+/” binding) to communicate.







SECTION STRUCTURE

1 – INTRODUCTION TO NAVIGATION IN THE KA-50

Navigating in the Ka-50 may appear daunting at first, but there are plenty of tools to help you find your way around.

The ABRIS works pretty much like a satellite GPS (global positioning system). It is designed to supplement other onboard navigation systems and to accomplish aerial navigation through: route preparation and planning, map support in all the sortie phases, processing of information from the navigational sensors, output of information to interfaced systems, navigation calculations, tactical situation display, and data link of target coordinates.

The PVI-800 works in parallel with the ABRIS navigation system, but whereas the ABRIS uses satellite navigation system inputs, the PVI-800 uses data from the Inertial Navigation Unit (INU). 6 waypoints (WP) and 10 target points (TP) can be stored in the PVI-800 navigation system. Each WP and TP coordinate is loaded into the navigation computer from the Mission Editor or manually while in flight.

We will see together how to use these systems to navigate, but more in-depth features are explained in the original Eagle Dynamics Black Shark flight manual (see references).

PRODUCER'S NOTES TUTORIALS:

ABRIS
PART 1: https://www.youtube.com/watch?v=-7Pt-xeag74
PART 2: https://www.youtube.com/watch?v=a2gSw1ACDsQ

NAVIGATION WITH THE PVI-800
PART 1: https://www.youtube.com/watch?v=Fy3U2KtqBhM
PART 2: https://www.youtube.com/watch?v=XH7eIR3r1BQ
PART 3: https://www.youtube.com/watch?v=WCYCMX1_Z_M

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

The ABRIS is designed to supplement other onboard navigation systems, like the PVI-800, and to accomplish aerial navigation through: route preparation and planning, map support in all the sortie phases, processing of information from the navigational sensors, output of information to interfaced systems, navigation calculations, tactical situation display, and data link of target coordinates.

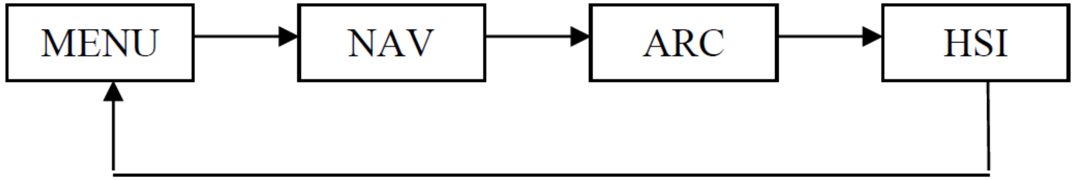
The ABRIS provides:

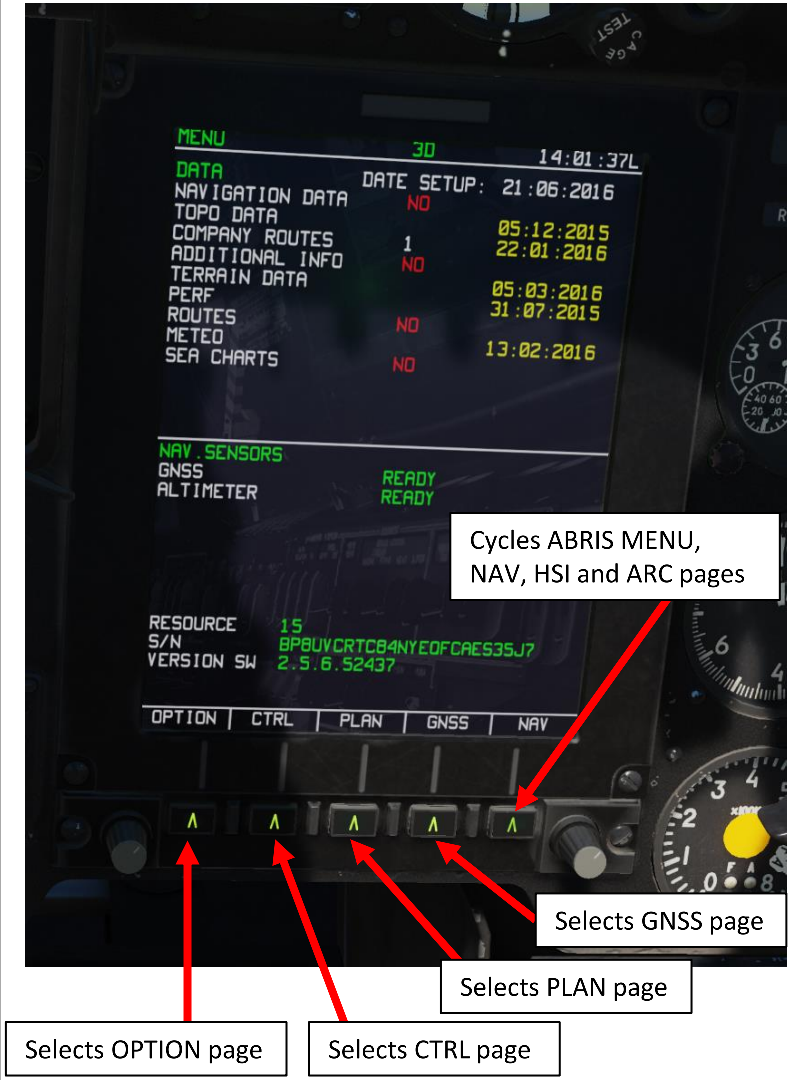
- Storage and presentation of electronic, topographic maps on the color display and the ability to electronically update and reload multiple map data-sets.
- Continuous determination of ownship “ACFT” position coordinates and display of the ACFT position on the moving map (on a scale suitable for the operator).
- Creation and display of flight plan information for tasks in different sortie phases.
- Creation of a flight route, the recording of the route in the database, and being able to load a route from the database.
- Ability to quickly modify a route while in-flight.
- The reception and display of information from interfaced systems and the output of information to other interfaced systems.

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

The ABRIS has four main pages (and other less important pages) that you can cycle through by pressing the rightmost button: the MAIN MENU, NAV (navigation), HSI and ARC.

We will not go through these pages in detail since the Black Shark manual already does it much better than I ever could.





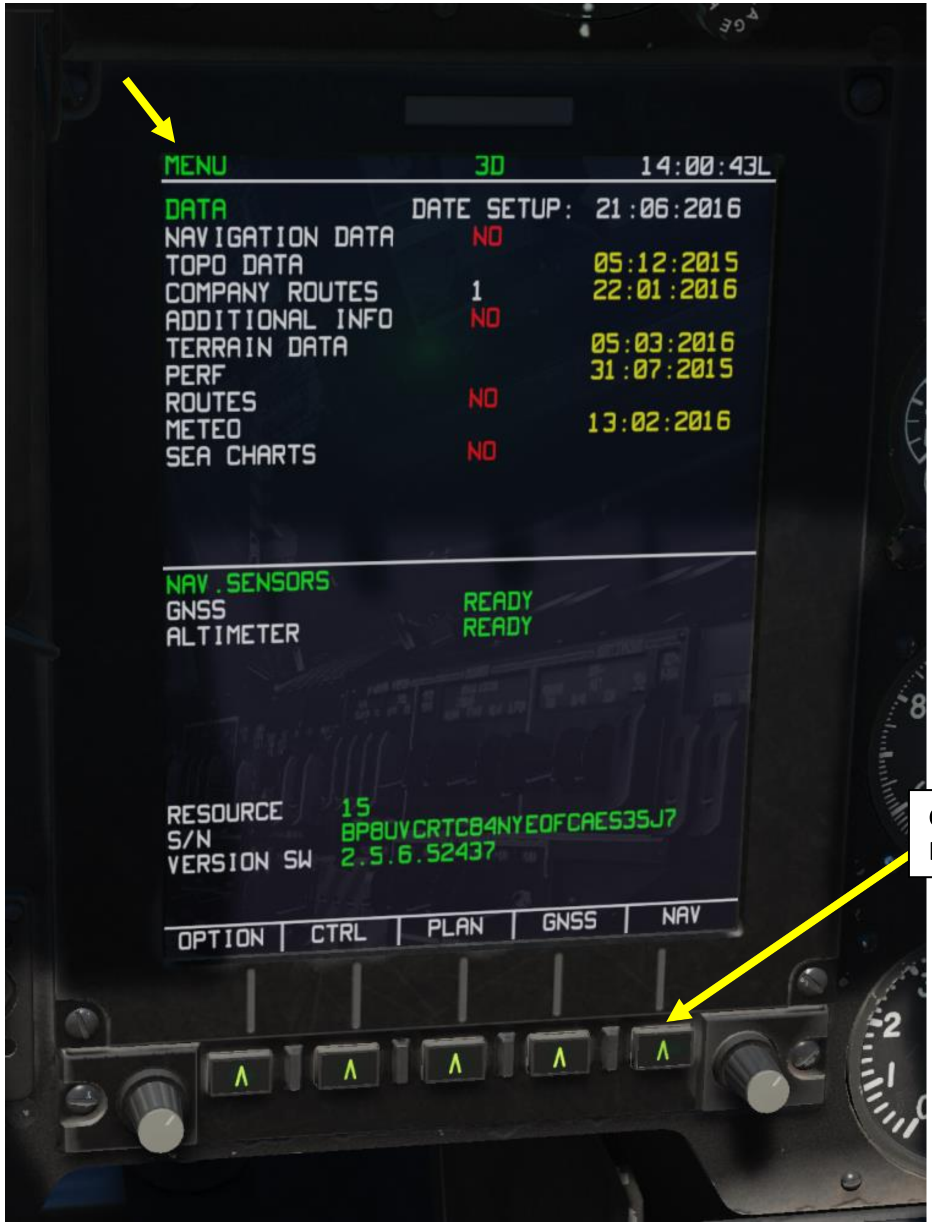
Pages	Description
MAIN	Main Menu data
NAV (Navigation)	Navigation data
ARC (Automatic Radio-Compass)	Automatic Radio-Compass data
HSI (Horizontal Situation Indicator)	Horizontal Situation Indicator data
OPTION (sub-mode)	Sets options and affects all the modes of ABRIS operation and is stored in non-volatile memory. In the OPTION sub-mode, there are five sub-modes that can be displayed by pressing the SETUP button. • MAIN – Main options • UNITS –Set the type of measurement units that are displayed • PERF – Enter aircraft parameters in the non-volatile memory • SIGNAL – Adjust time intervals for alert generation alarms • CHARTS – Adjust map display content
CTRL (sub-mode)	From the CONTROL sub-mode page you can switch to the following sub-modes: MSG (messages), K-041 (targeting system), and DTB (database).
PLAN (sub-mode)	The PLAN sub-mode is used for route planning and correction and is a useful tool for when you need to modify the flight plan after new intelligence on enemy positions becomes available.
GNSS (sub-mode)	The Global Navigation Satellite System (GNSS) sub-mode of the MENU operating mode is intended to assess the status of the satellite navigational system (number of tracked and processed satellites, geometric factor, signal/noise ratio for each of the processed satellites, etc.).

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

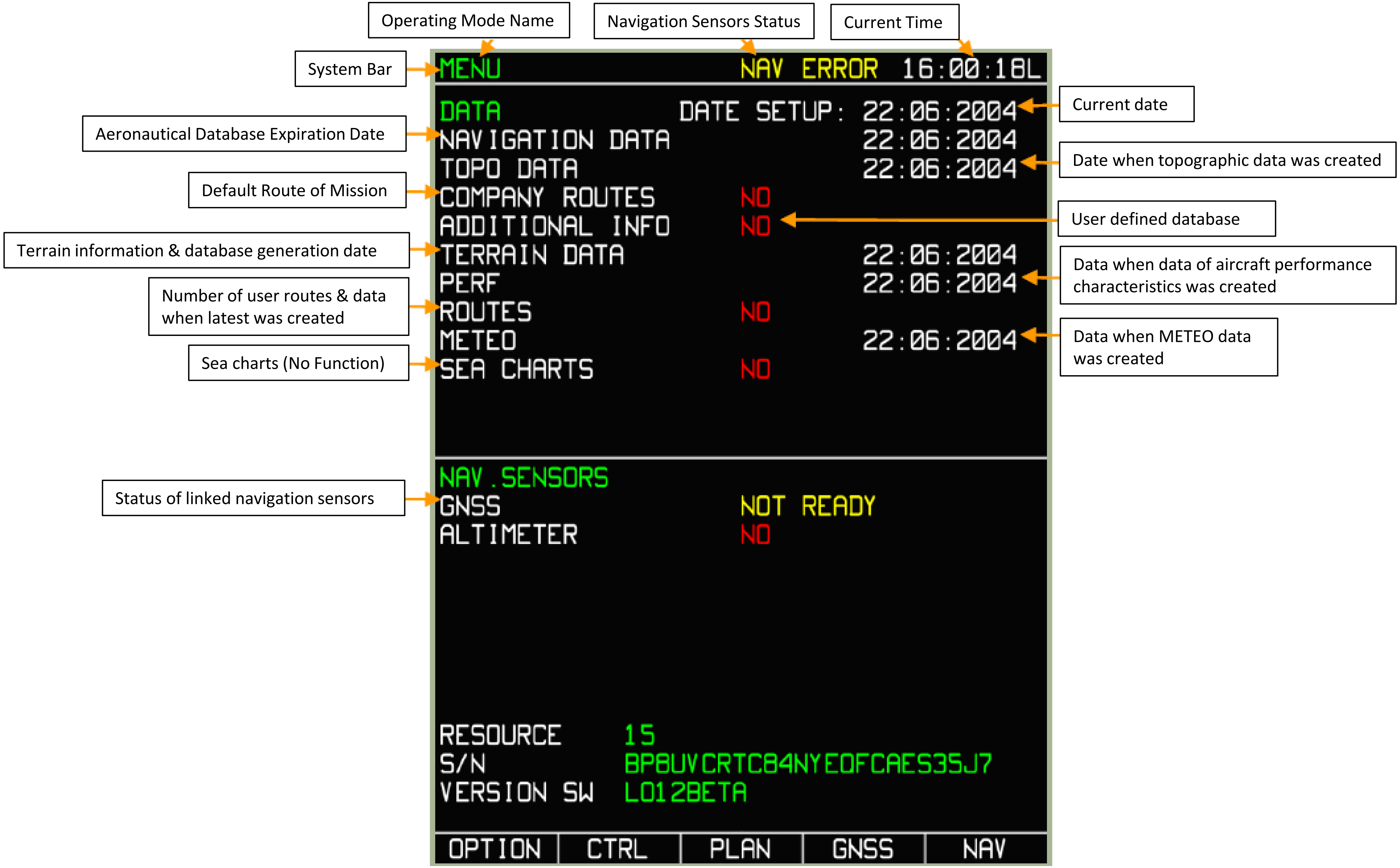
2.2 – ABRIS MAIN MENU

The MAIN MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).



Cycles ABRIS MENU, NAV, HSI and ARC pages

2.2 – ABRIS MAIN MENU



2.3 – ABRIS NAVIGATION (NAV) MENU

The NAV MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

MAP FSK (Function Select Key)

- Allows you to scale up or down (zoom) the map and display information and ERBL (Estimated Range & Bearing Line)

SEARCH FSK (Function Select Key)

- Searches navigation points through database

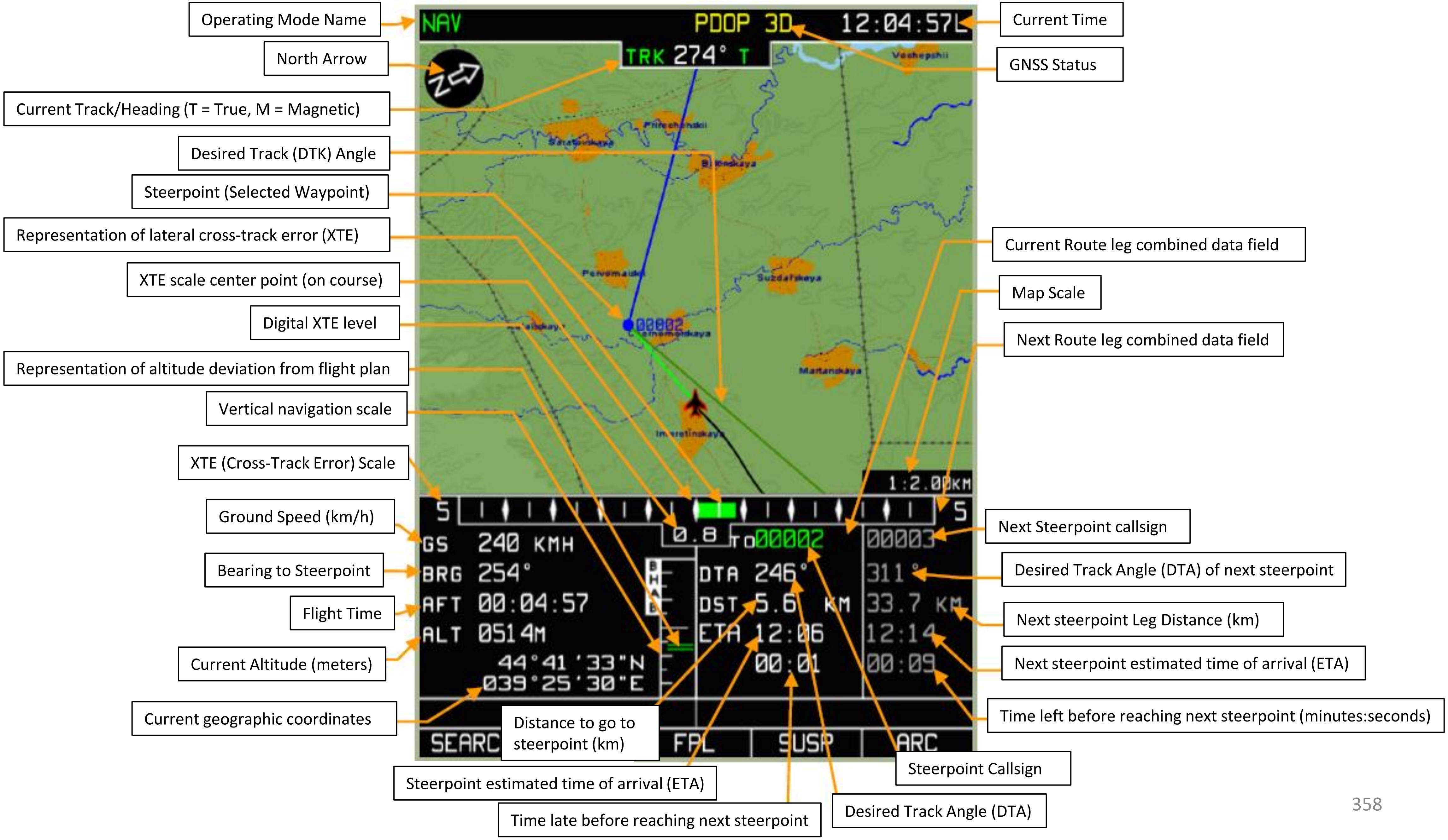
Flight Plan (FPL) sub-mode displays flight information in a tabular form, provided there is an active route loaded. In addition to viewing a route, this sub-mode enables re-targeting of the aircraft to a specified waypoint. The FPL page displays the following information:

- Waypoint name
- Waypoint coordinate
- DTK/DMTK/MC (Desired Track, Desired Magnetic Track, Magnetic Course) of the route leg
- Route leg length
- WPT OVER altitude
- WPT ETO
- Estimate flight time of each leg
- Comments for each leg

The Suspend (SUSP) FSK button will cycle through the waypoints in the active route. The Waypoint selected becomes your steerpoint and a green line will connect your current position to it.

Cycles ABRIS MENU, NAV, HSI and ARC pages

2.3 – ABRIS NAVIGATION (NAV) MENU



2.3 – ABRIS NAVIGATION (NAV) MENU

ERBL (Estimated Range/Bearing Line) Function

The ERBL function is a sub-function of the ABRIS NAV menu. Its main use is to… err… estimate the range and bearing of a point in relationship to your aircraft or another point in space. Kind of self-explanatory, eh?

1. Select NAV page of the ABRIS
2. Select MAP function of the NAV page
3. Press on the FSK (Function Select Key) under INFO
4. Press on the FSK under ERBL

2.3 – ABRIS NAVIGATION (NAV) MENU

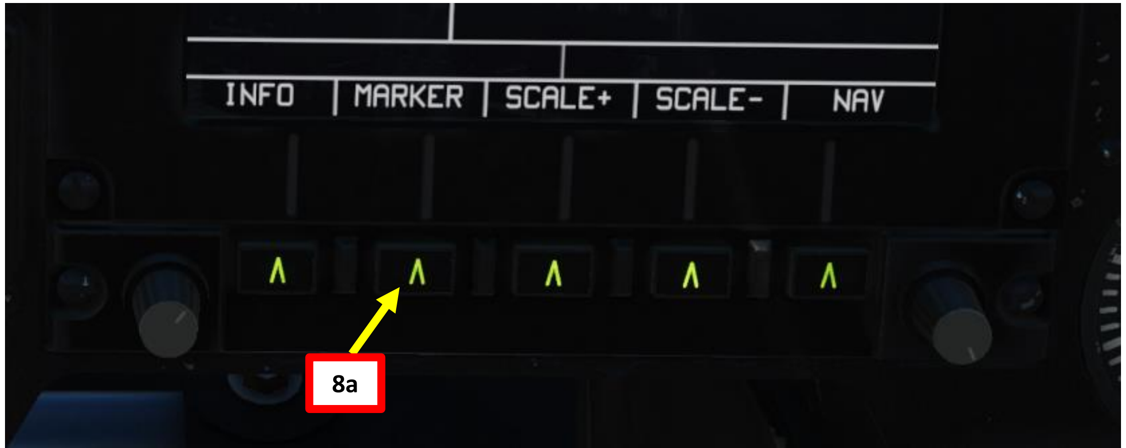
ERBL (Estimated Range/Bearing Line) Function

5. A red cursor will appear on the moving map.
6. You can move the cursor by:
   - Horizontally: scrolling the mousewheel over the Cursor knob
   - Vertically: scrolling the mousewheel over the Cursor knob while holding the right mouse button.
7. The Estimated Range/Bearing Line will be drawn between you and the cursor. The following information will be displayed:
   - ERB: Marker (Cursor in our case) coordinates
   - BRG: Bearing to the measured leg beginning point, set initially to the aircraft position
   - DST: Distance from leg beginning to the current marker position (Cursor in our case)
   - ALT: Altitude
   - MVR: Magnetic Declination Value for the area where the active marker (Cursor in our case) is positioned

2.3 – ABRIS NAVIGATION (NAV) MENU

ERBL (Estimated Range/Bearing Line) Function

8. If you press the FSK under "MARKER", a marker will be drawn on your current Cursor position.
9. If you move the Cursor using the Cursor knob controls, the Estimated Range/Bearing Line will be drawn between the previous cursor location (marker) and the new cursor location.
10. Information on the ERBL and the marker (MRK) will be displayed.
11. To exit the ERBL function, press the FSK under NAV.

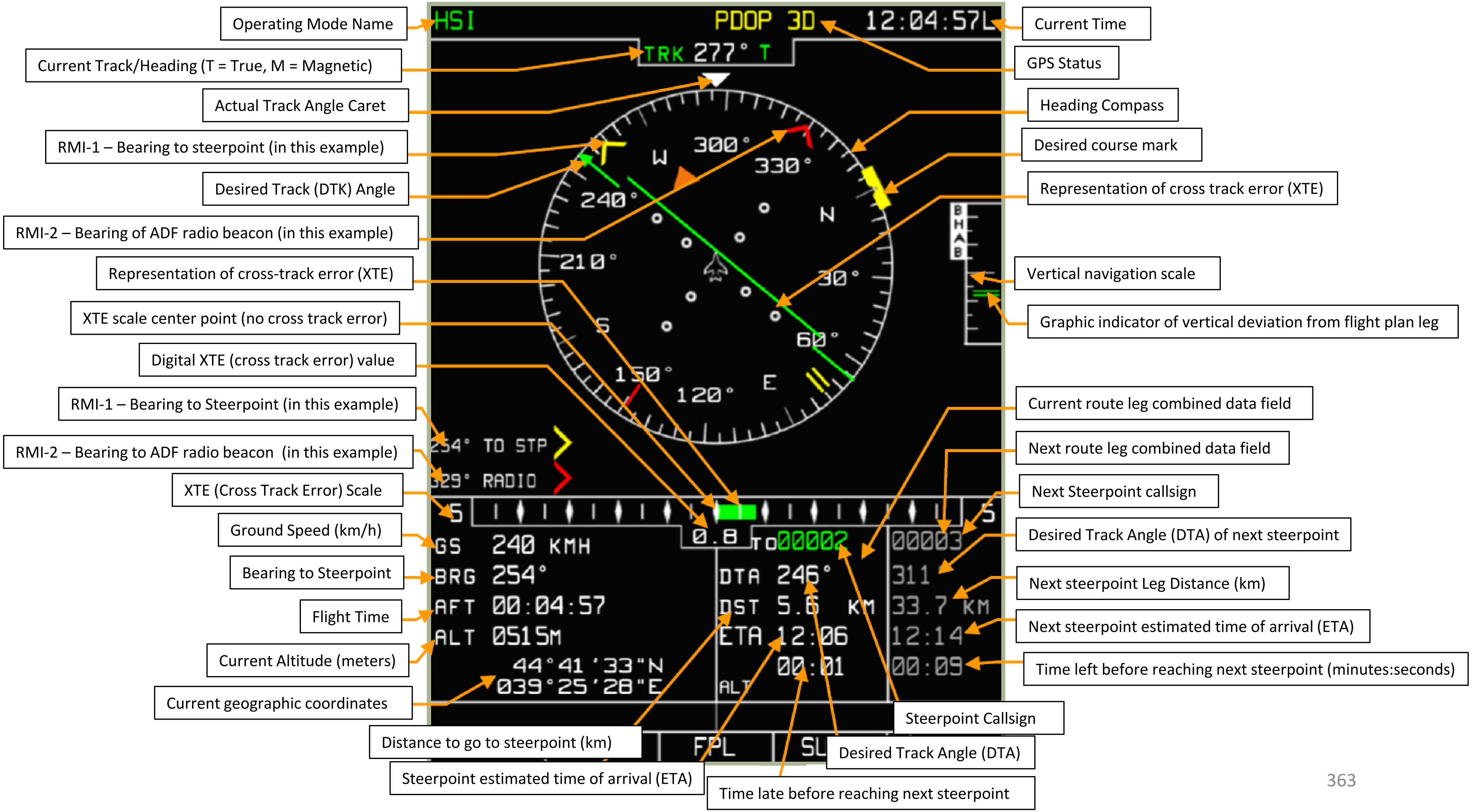


2.4 – ABRIS HSI (HORIZONTAL SITUATION INDICATOR) MENU

The HSI MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

Cycles ABRIS MENU, NAV, HSI and ARC pages

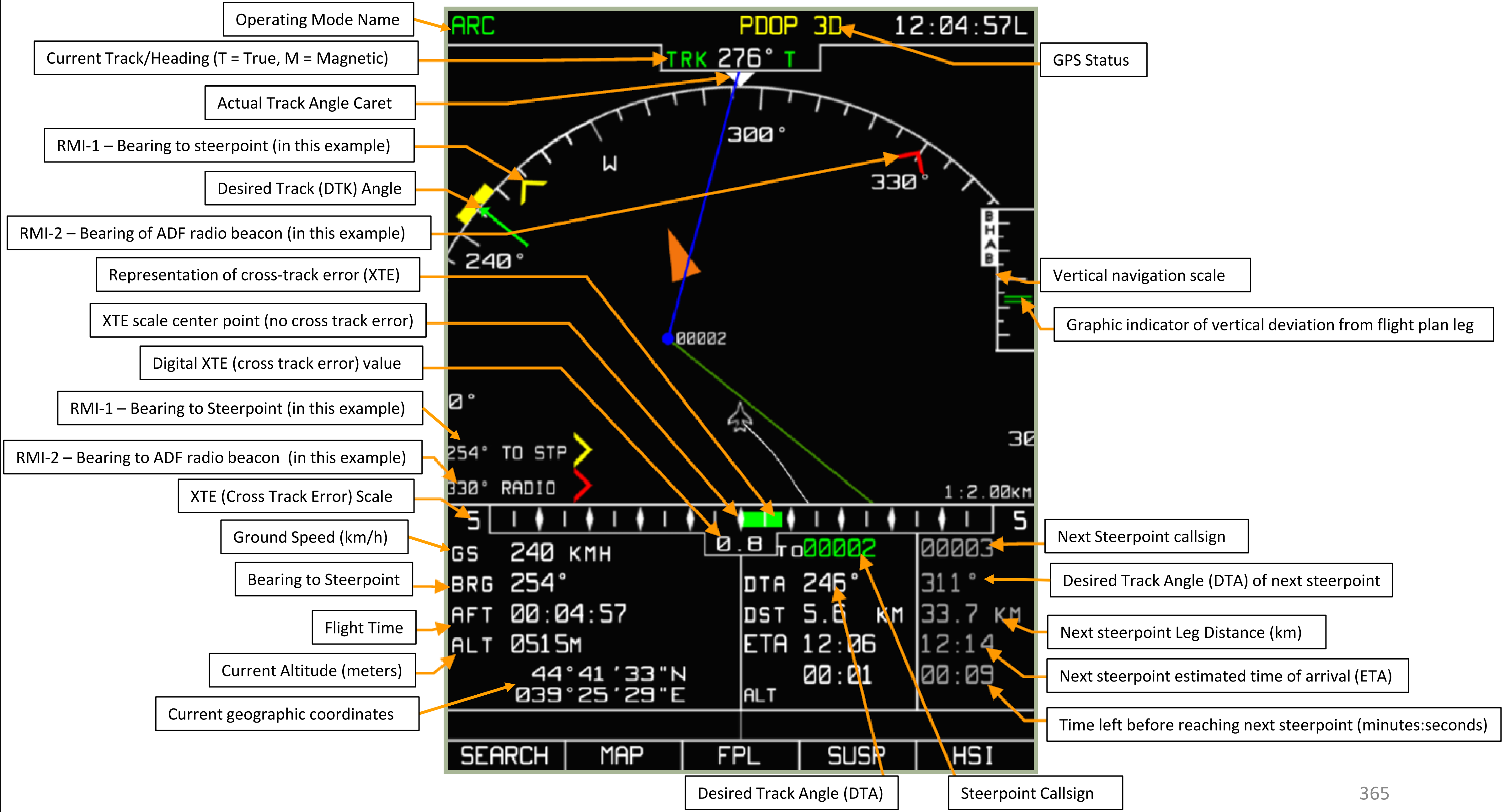
2.4 – ABRIS HSI (HORIZONTAL SITUATION INDICATOR) MENU



2.5 – ABRIS ARC (AUTOMATIC RADIO-COMPASS) MENU

The ARC MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

2.5 – ABRIS ARC (AUTOMATIC RADIO-COMPASS) MENU

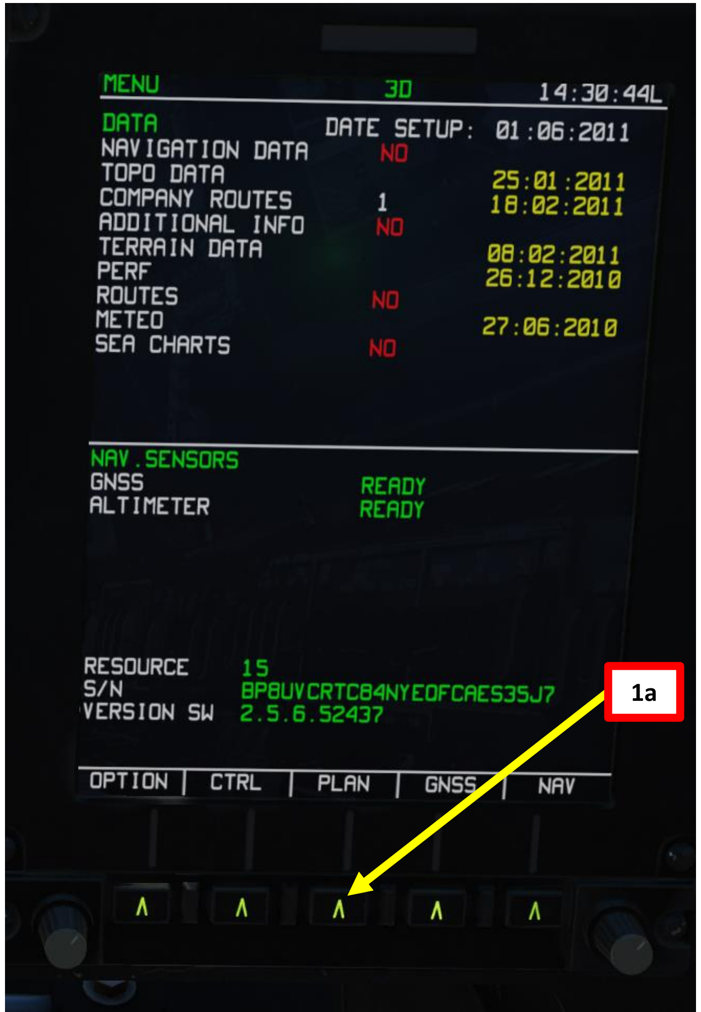


2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

Creating a Flight Plan can be useful to link waypoints together and make a coherent mission plan.

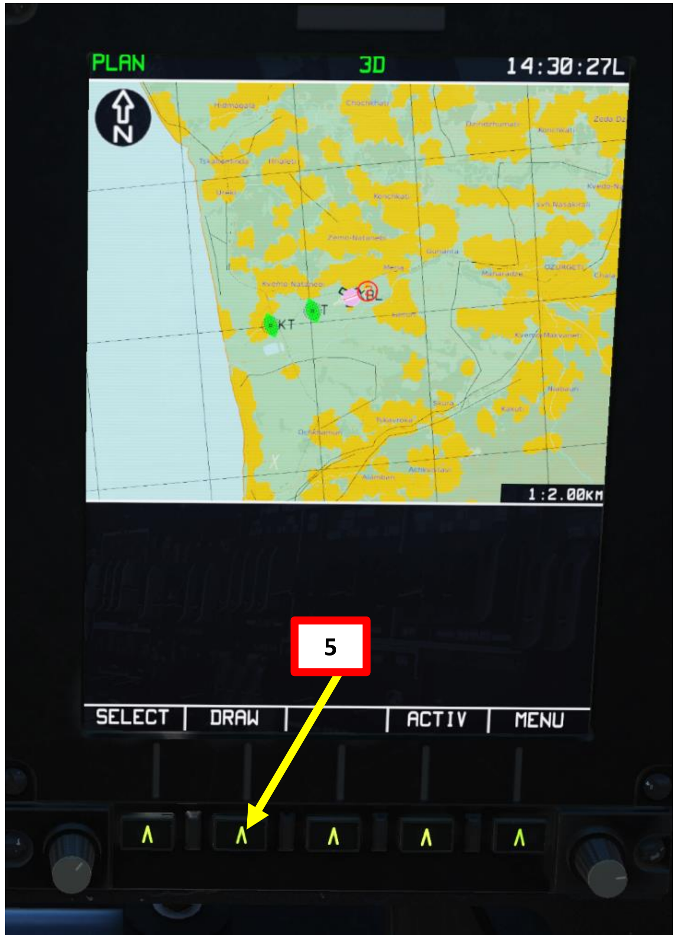
1. From the MAIN MENU, select PLAN page of the ABRIS
2. Press on the FSK (Function Select Key) under SELECT
3. Scroll mousewheel over the ABRIS Cursor knob to set the white selection box over UNLOAD.
4. Right Click (Push) on the ABRIS Cursor knob to unload the current flight plan.

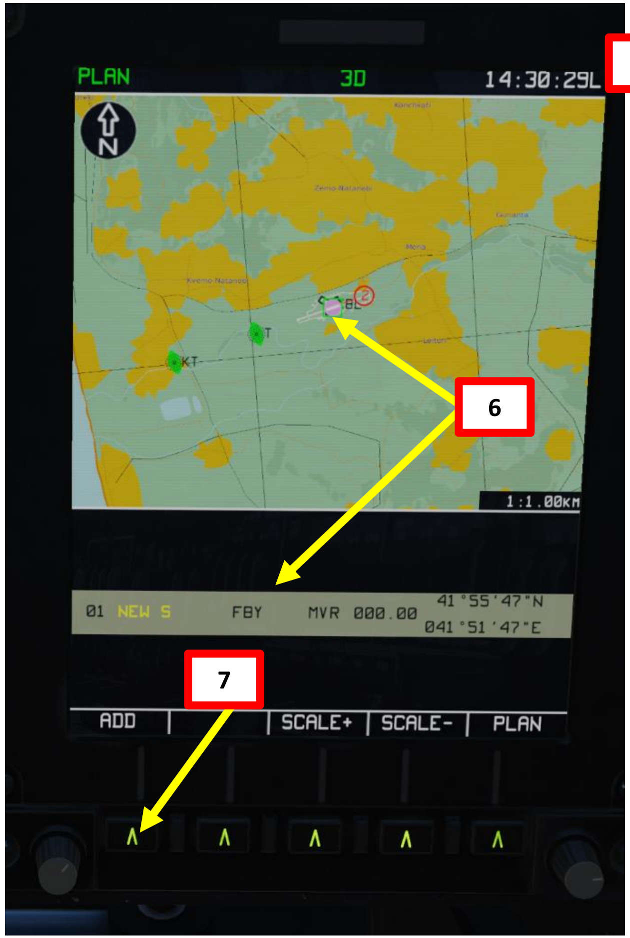


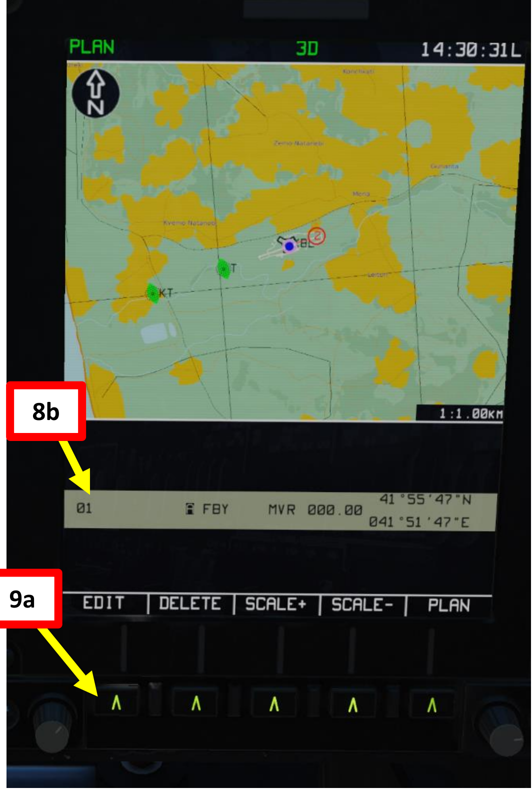
2.6 – ABRIS FLIGHT PLAN MENU

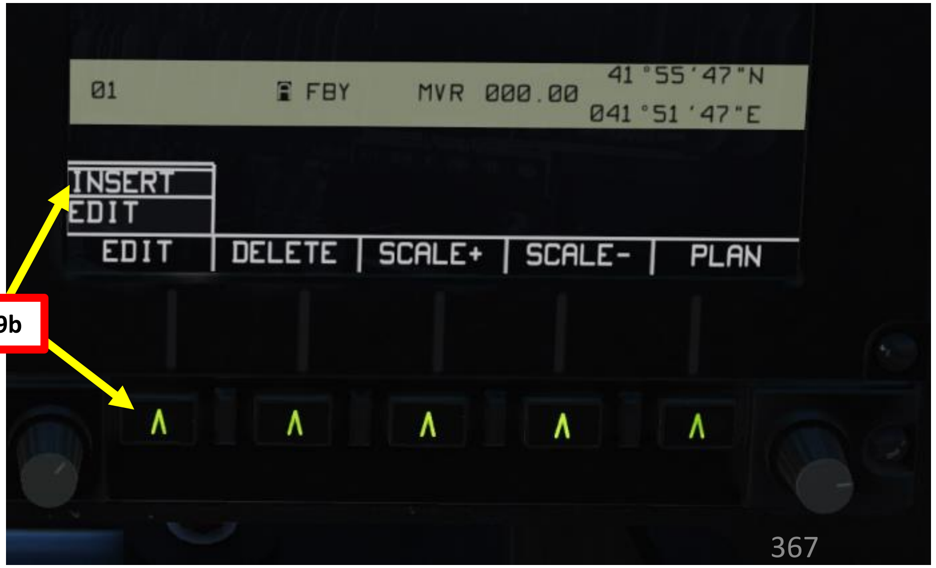
Flight Plan Creation Function

5. Press on the FSK (Function Select Key) under DRAW.
6. A Waypoint will automatically be created on the current aircraft location.
7. Press on the FSK under ADD to add this waypoint to the Flight Plan.
8. You can name the waypoint as you want using the ABRIS Cursor knob, but we will use the automatically generated waypoint name for now. Press on the FSK under ENTER.
9. Press on the FSK under EDIT, then press it a second time to select INSERT.





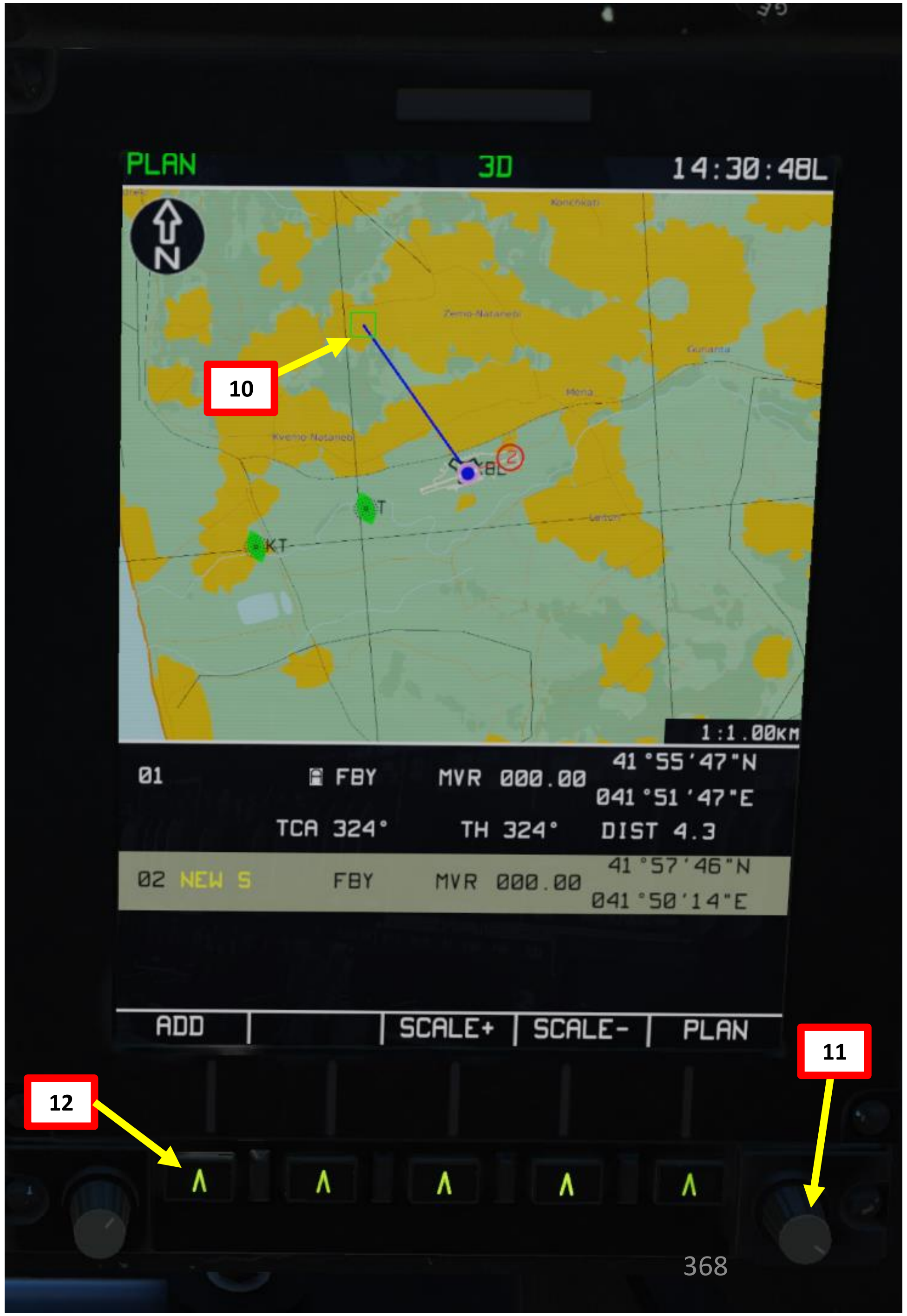




2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

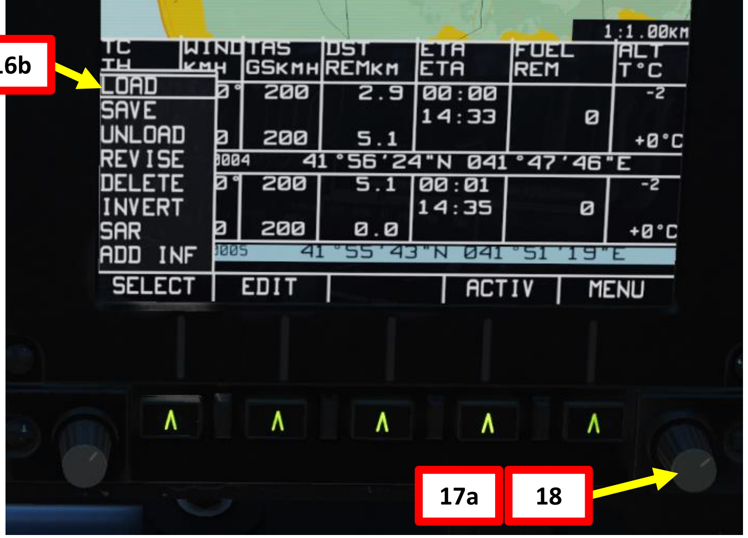
10. A green cursor will appear on the moving map. This represents your desired waypoint location.
11. You can move the cursor by:
    - Horizontally: scrolling the mousewheel over the Cursor knob
    - Vertically: push the Cursor knob (right click), then scrolling the mousewheel over the Cursor knob.
12. Once you are satisfied with the waypoint location, press on the FSK under ADD to add this waypoint to the Flight Plan.
13. Press on the FSK under ENTER.
14. Repeat previous steps to add more waypoints.

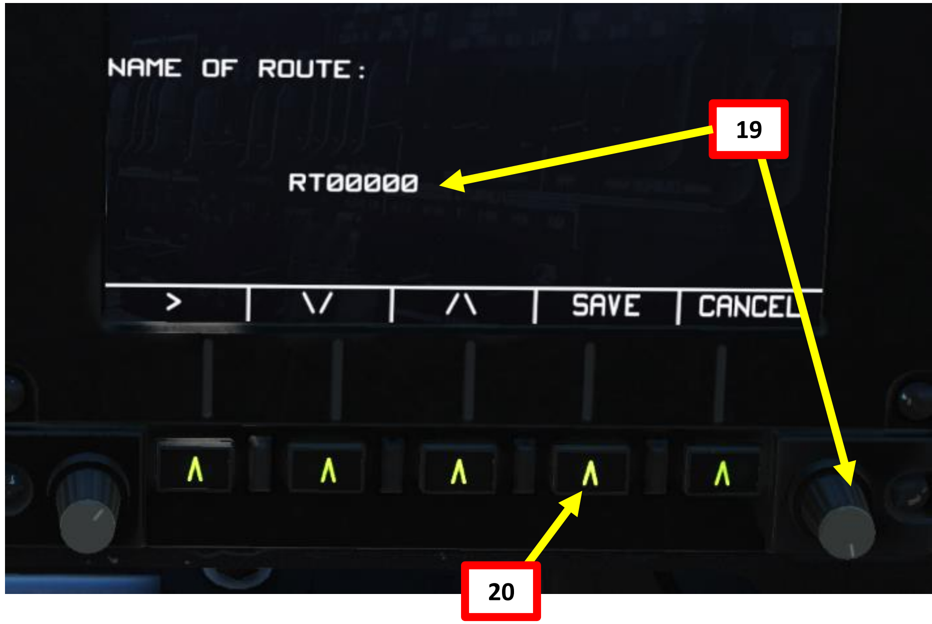


2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

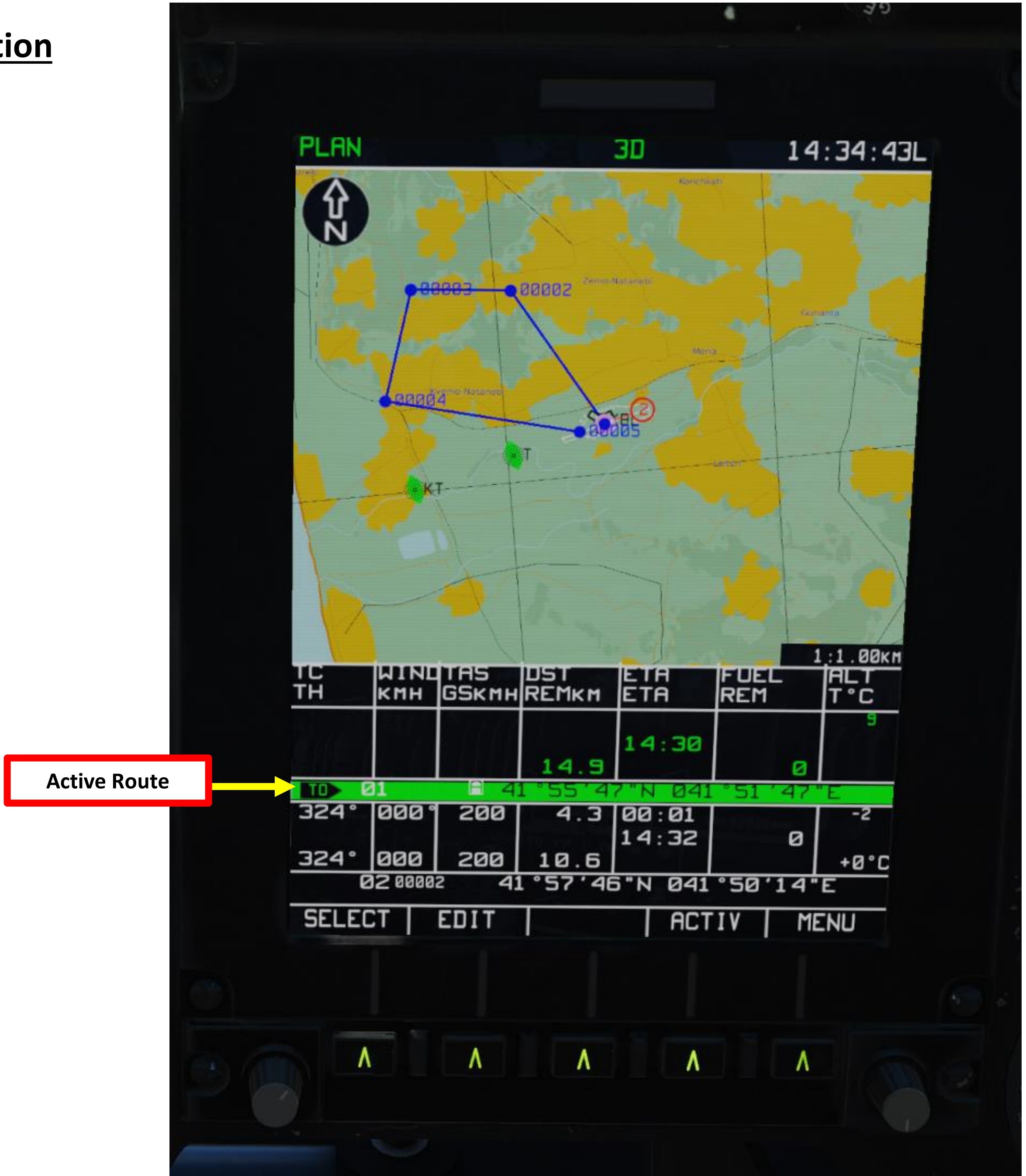
15. Once you are satisfied with your flight plan, press FSK (Function Select Key) under PLAN to return to the Flight Plan page.
16. Press FSK under SELECT.
17. Scroll mousewheel over the ABRIS Cursor knob to set the white selection box over SAVE.
18. Right Click (Push) on the ABRIS Cursor knob to enter the Route Name menu.
19. Use ABRIS Cursor knob to set the Route Name as desired. We will leave it as is.
20. Press FSK under SAVE to save the flight plan.





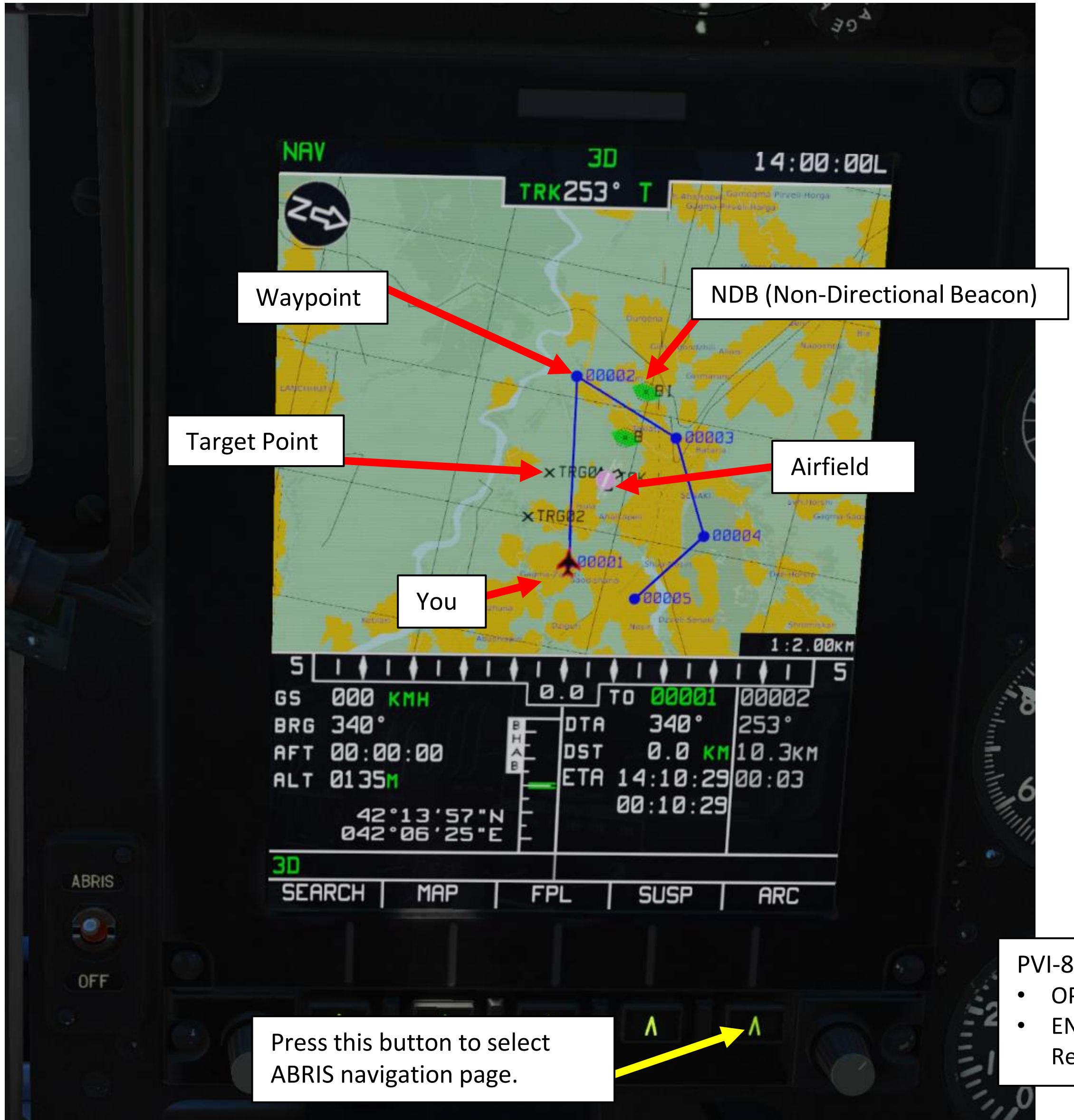
2.6 – ABRIS FLIGHT PLAN MENU

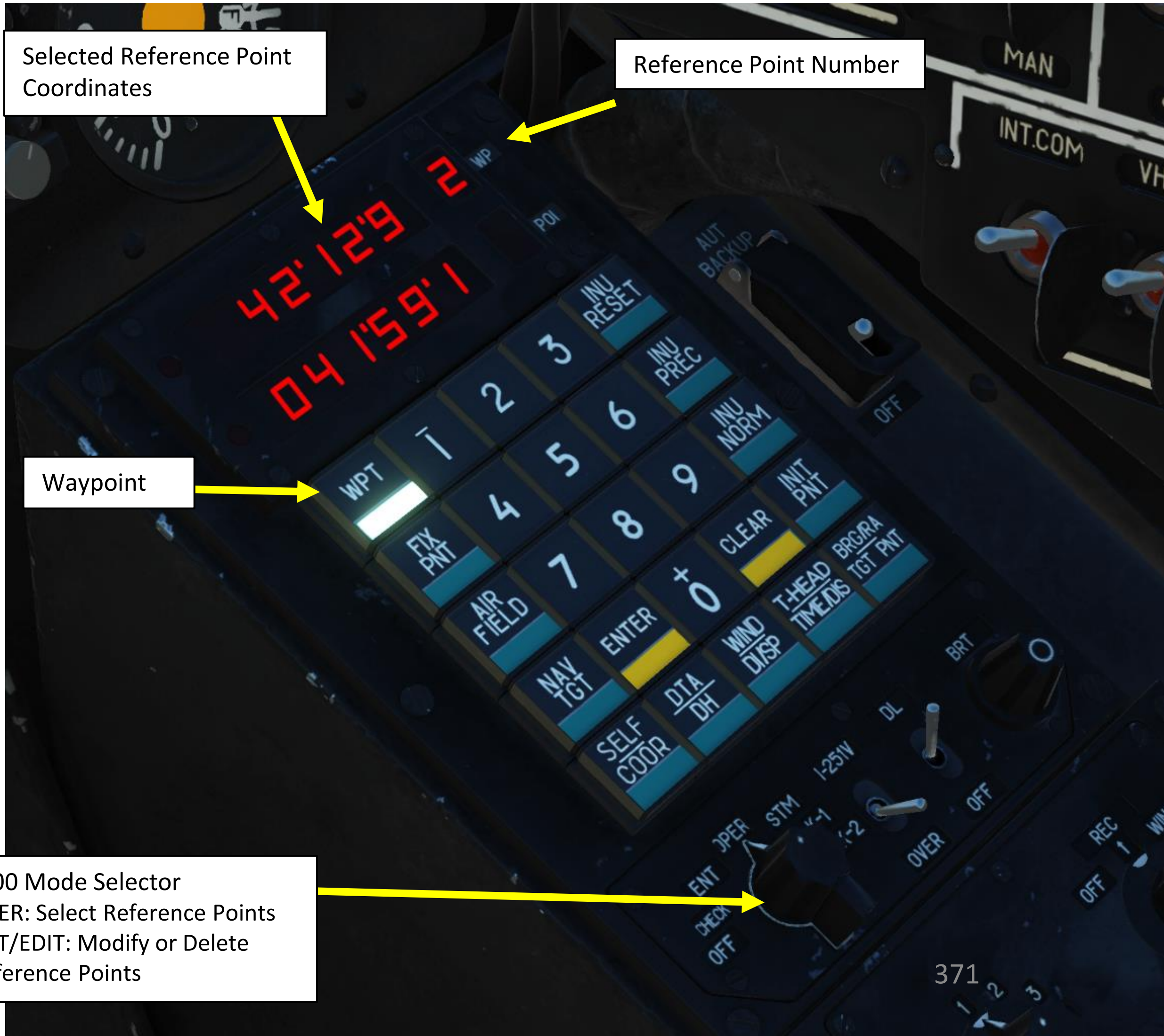
Flight Plan Creation Function



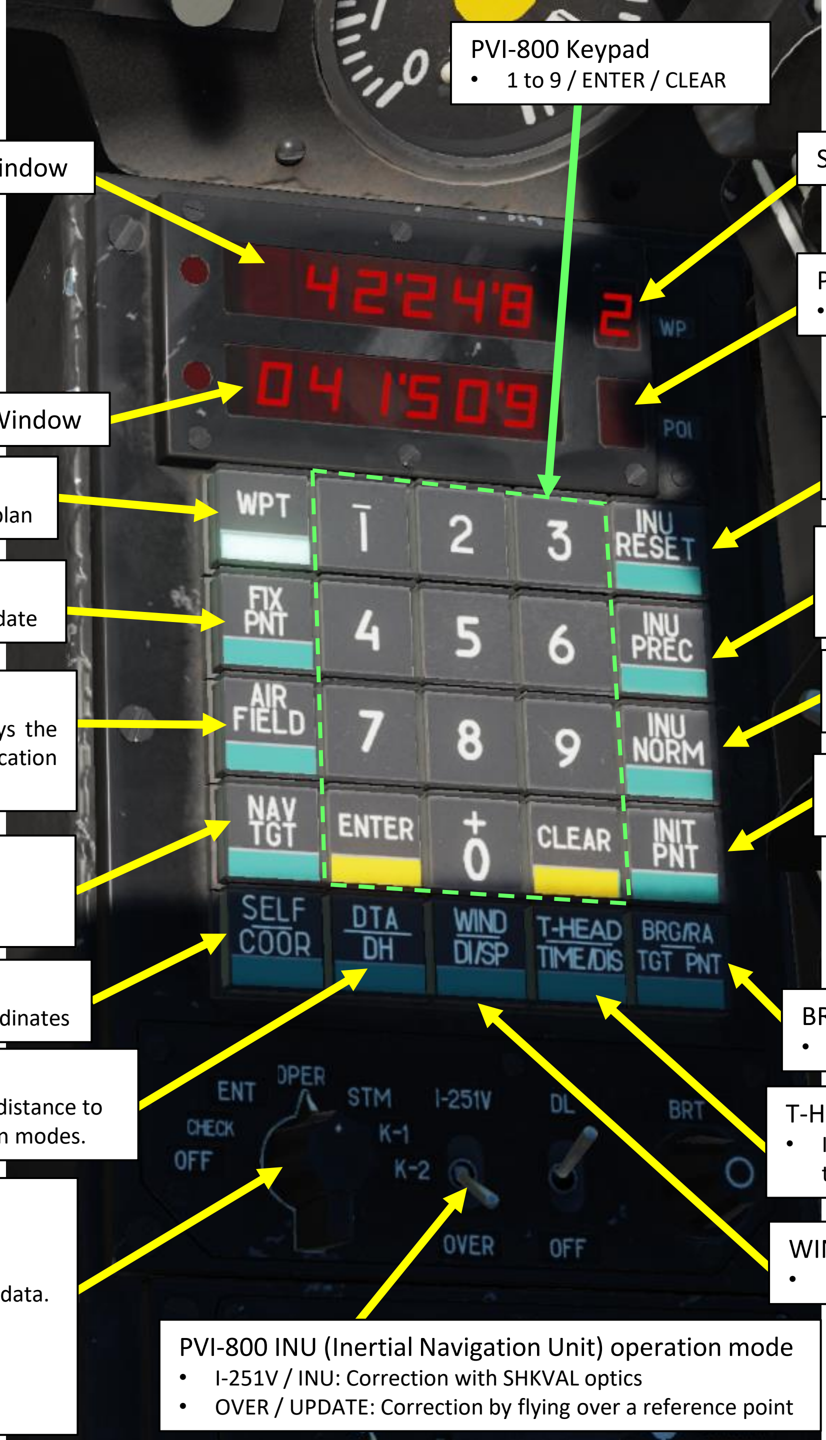
3 – PVI-800 NAVIGATION SYSTEM

Missions are generally planned using waypoints (implemented via the Mission Editor itself, even if you can manually set them if you so wish). In the PVI-800, a number of navigation reference points are stocked: Waypoints, Fixed Points, Airfields, and Navigation Targets. The information stocked in the PVI-800 system can be displayed on the ABRIS display.





3 – PVI-800 NAVIGATION SYSTEM



PVI-800 Keypad
- 1 to 9 / ENTER / CLEAR

PVI-800 Upper Display Window

Selected Waypoint (WP) Display

POI (Point of Interest) Display
- Airfield number, fixed point, target point, or correction point display

PVI-800 Lower Display Window

INU RESET Button
- Inertial Navigation Unit reset for in-flight alignment (no function).

WPT Button
- Waypoint Mode selects a waypoint from the flight plan

FIX PNT Button
- Selects a reference point for an INU (Inertial Navigation Unit) update

INU PREC Button
- Inertial Navigation Unit precise alignment. Alignment takes about 30 minutes to complete.

AIRFIELD Button
- Selects an airfield for RTB (Return to Base) mode and displays the coordinates of one of two airfields. Airfield 1 is your takeoff location and airfield 2 is your landing location.

INU NORM Button
- Inertial Navigation Unit normal alignment function.

INIT PNT Button
- Displays initial coordinate point and allows you to enter a new one.

NAV TGT Button
- Selects a target point (TP) for ingress and allows you to enter coordinates for new TPs. Up to 10 TPs can be saved.

SELF COOR Button
- Displays Ownship coordinates

BRG/RA / TGT PNT Button
- Indication of bearing and range to target point in the Ingress mode.

DTA/DH Button
- Indication of DTA (Desired Track Angle) or DH (Desired Heading), time and distance to current waypoint in the Waypoint, Reference Airfield, and Target navigation modes.

T-HEAD / TIME/DIS Button
- Indication of True Heading, Time and Distance to final waypoint in the Waypoint, reference, airfield and target modes.

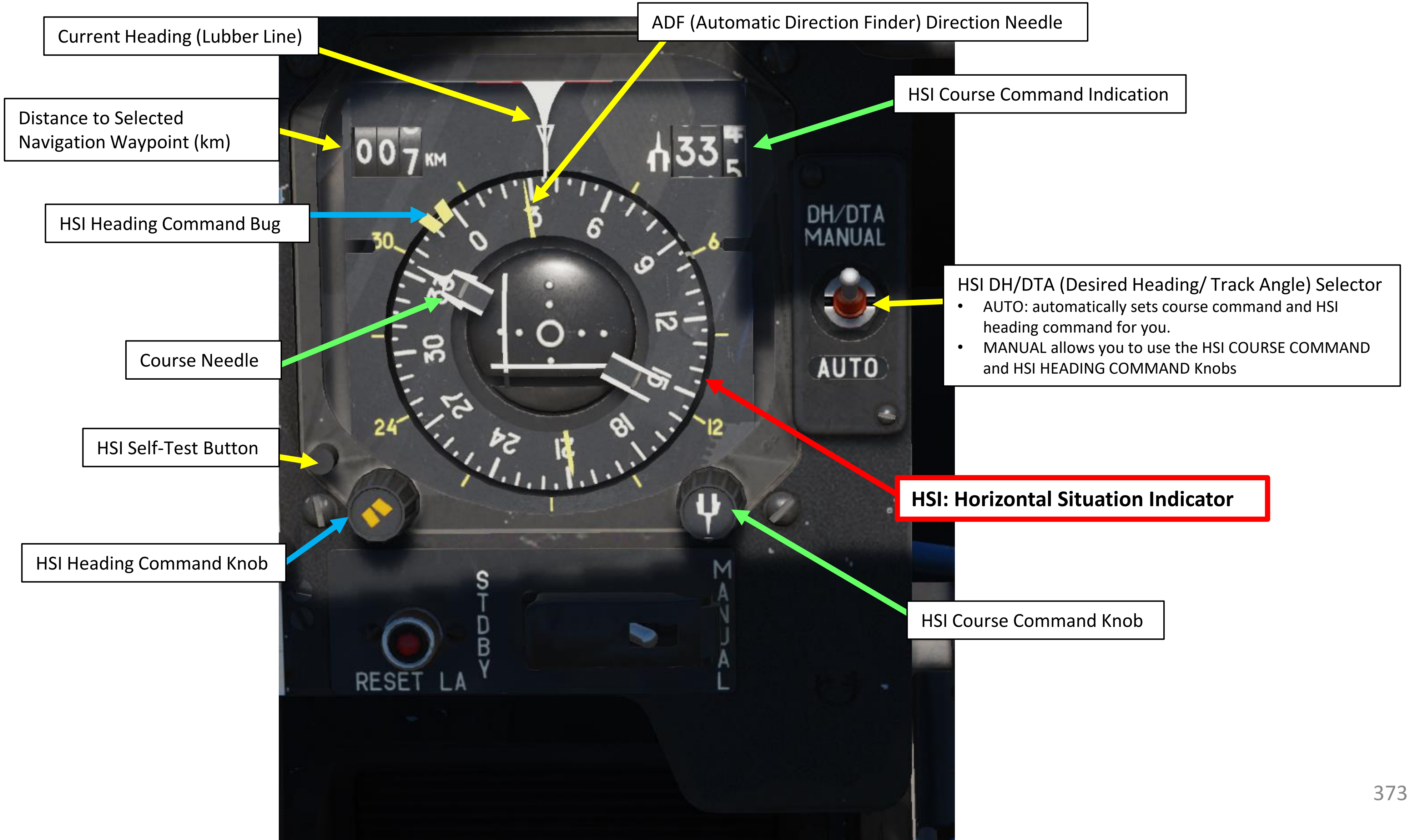
PVI-800 Navigation Master Mode
- OFF: PVI-800 OFF
- CHECK: Verification of entered data.
- ENT/EDIT: Edits/Enters waypoint coordinates, wind conditions, and other data.
- OPER: Normal Operation
- STM: Simulation Training Mode Flight
- K1: Non-Functional programming mode
- K2: Non-Functional programming mode

WIND DI/SP Button
- Indication of wind direction (FROM) and wind speed (m/s).

PVI-800 INU (Inertial Navigation Unit) operation mode
- I-251V / INU: Correction with SHKVAL optics
- OVER / UPDATE: Correction by flying over a reference point

4 – HSI (HORIZONTAL SITUATION INDICATOR)

The Horizontal Situation Indicator (HSI) displays aircraft heading, offset from the assigned flight path, and position relative to a selected navigation reference that may be a steerpoint, fixed point, radio beacon, or airfield. Although primary navigation data may be displayed on the HUD, the HSI provides additional information for precise navigation.



5 – NAVIGATION POINT TYPES

Missions are generally planned using waypoints (implemented via the Mission Editor itself, even if you can manually set them if you so wish). In the PVI-800 navigation system, a number of navigation reference points are stocked in the PVI-800 system, and can be displayed on the ABRIS display.

- **Waypoints**
  - Waypoints are pre-planned navigational points of reference for you to follow on route to your area of operation. You can create new ones, edit their coordinates and create flight plans with them. It is important to understand that any waypoint can be set as the current steerpoint.

- **Steerpoint**
  - A Steerpoint is the waypoint currently selected for navigation.

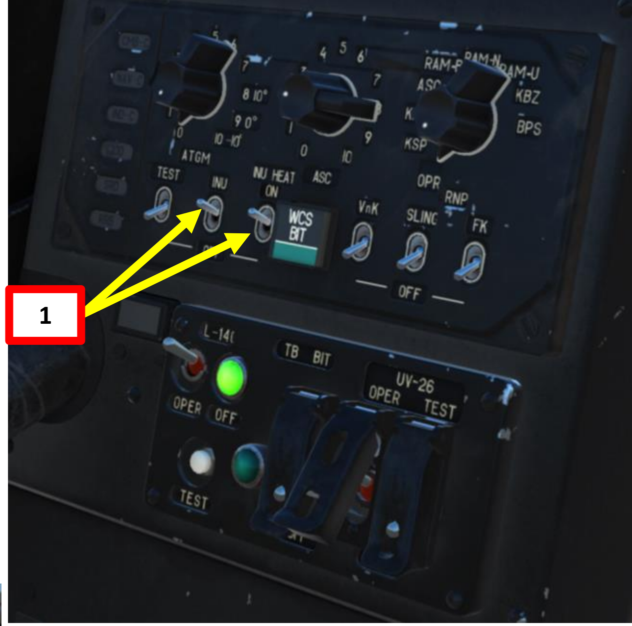
- **Target Points / Navigation Targets**
  - Target points are similar to markpoints, which are used to "mark" a point of interest, whether flying over an interesting area or an enemy sighting. You can create up to 10 target points.

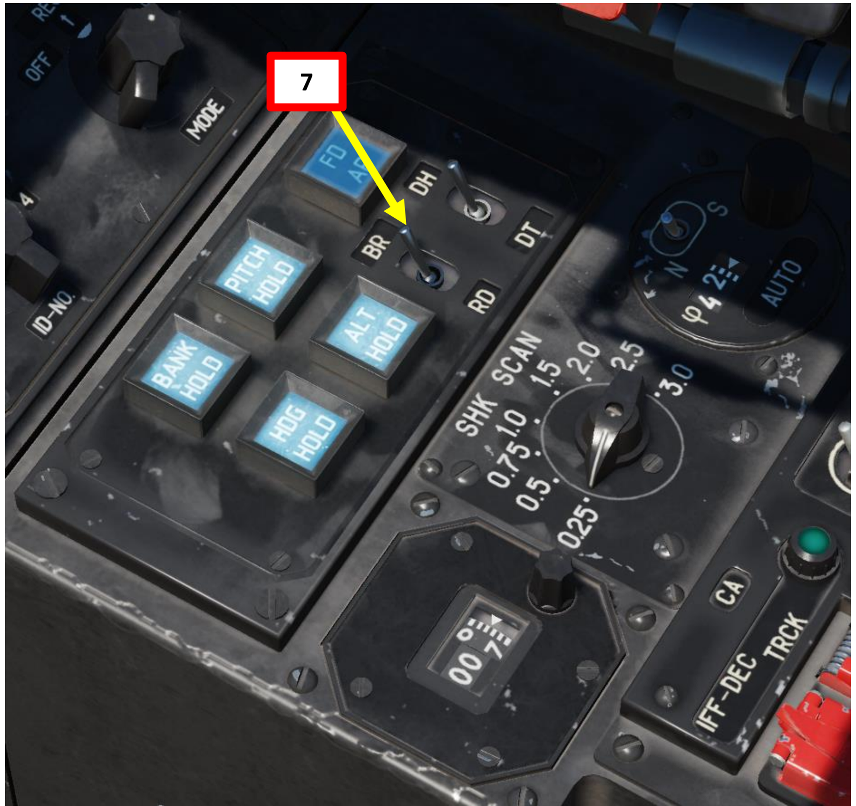
- **Fixed Points**
  - Fixed points (also called “fix”) are reference points used to re-align your INU (Inertial Navigation Unit), which accumulates error/drift over time.

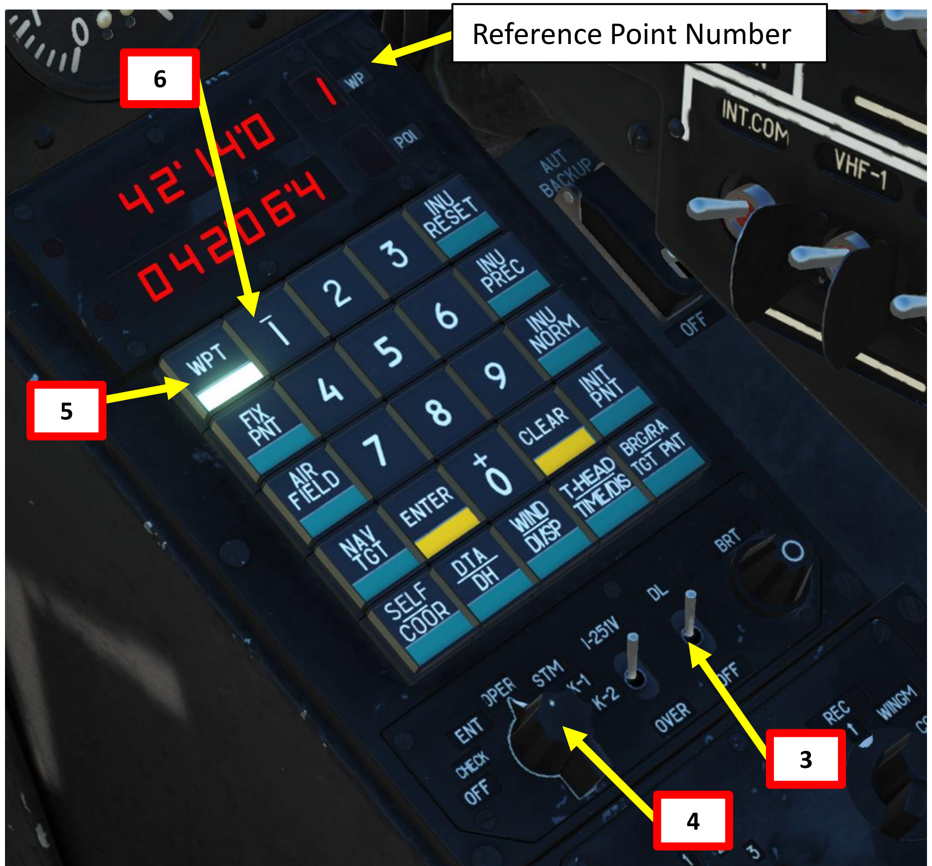
6.1 – WAYPOINT NAVIGATION (+ AUTOPILOT USAGE)

1. Turn on INU system power switch (UP) and INU Heat switch (UP)
2. Set GYRO mode (middle position)
3. Turn PVI-800 system ON (FWD)
4. Set PVI-800 mode to OPER to select a desired waypoint
5. Select desired waypoint type (in our case, we will select WPT to select a waypoint)
6. Select preset waypoint number (in our case we will select Waypoint 1)
7. Select BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.

NOTE: You can navigate towards Target Points, Fixed Points or Airfields if you want. You just need to select the right reference point type.



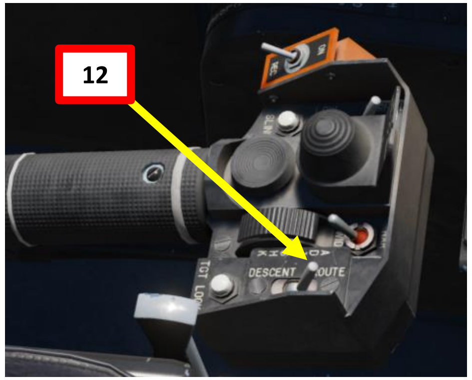


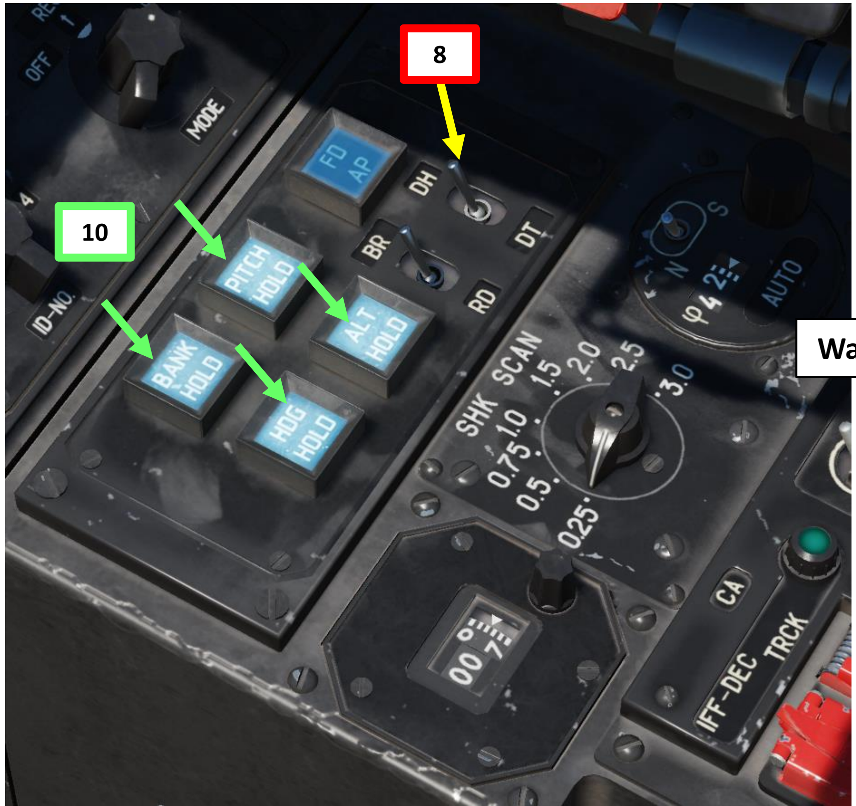


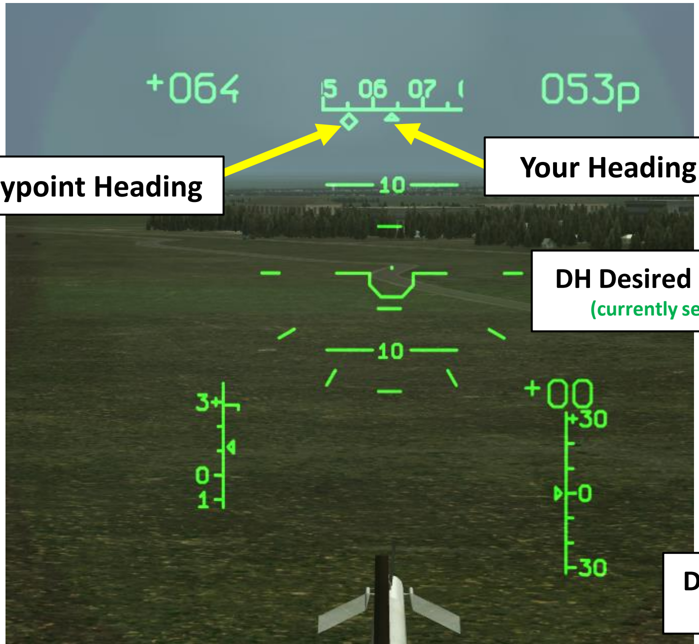
6.1 – WAYPOINT NAVIGATION (+ AUTOPILOT USAGE)

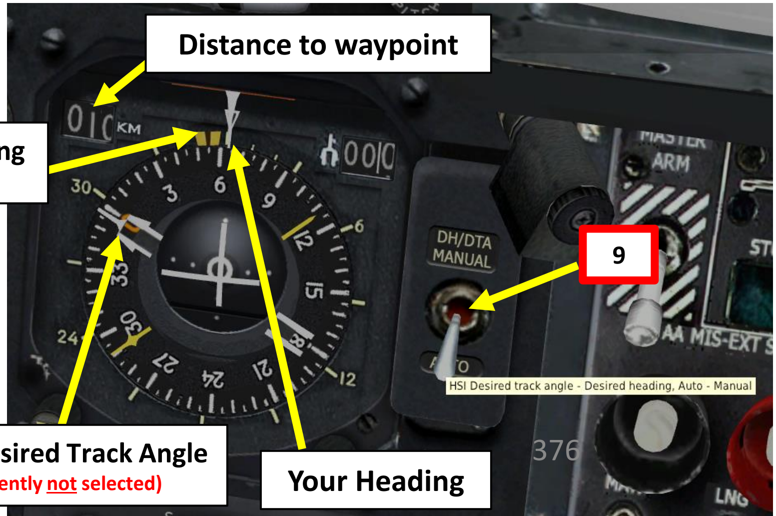
8. Select DH (Desired Heading) if you want the autopilot to steer straight to the waypoint or DT (Desired Tracking) if you prefer the auto-pilot to steer you towards the tracking line to the waypoint.
9. Set DH/DTA to AUTO (DOWN).
10. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. Take note that the "autopilot" are in fact used as "dampers".
11. Fly towards the waypoint until you have a decent airspeed, press the TRIM switch to maintain constant airspeed. You can use the HUD heading indicator or the HSI to help you. Align yourself at + or – 15 degrees from desired heading.
12. Engage Route Mode on your collective (Shortcut: "R" for Route and/or "D" for Descent) to engage autopilot. Aircraft will steer itself to the selected waypoint.
13. Once you have reached a waypoint, the autopilot will automatically steer the helicopter towards the next stocked waypoint on the list.
14. Disengage Route Mode on collective by pressing "R" to disengage autopilot (should be in middle position).

Example: Desired Tracking VS
Desired Heading Towards Waypoint 2



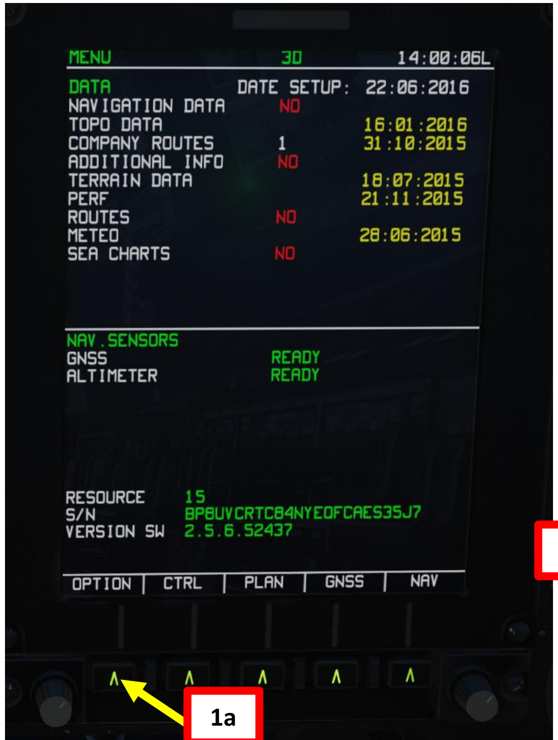




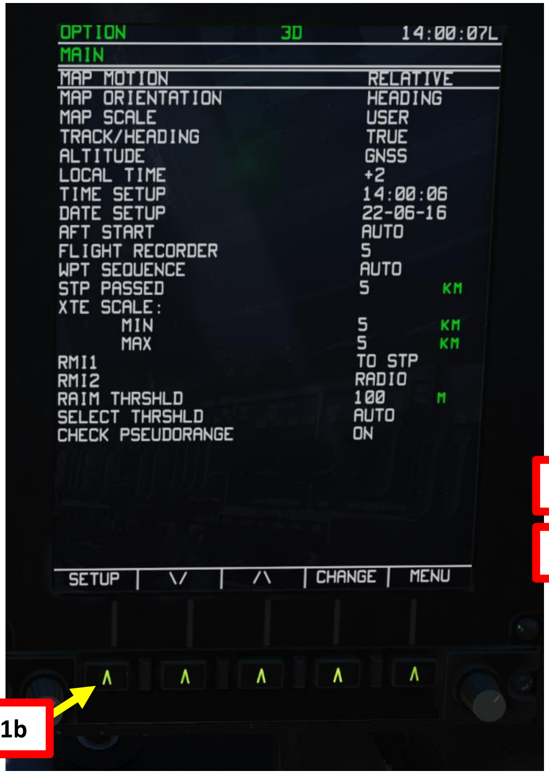


6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

1. In ABRIS Options –> Setup page, select UNITS menu and set LATITUDE and LONGITUDE to DECIMAL system as shown on pictures.
2. Go back to ABRIS main menu and go to NAV menu.
3. Select "Edit" mode for the PVI-800.



1a



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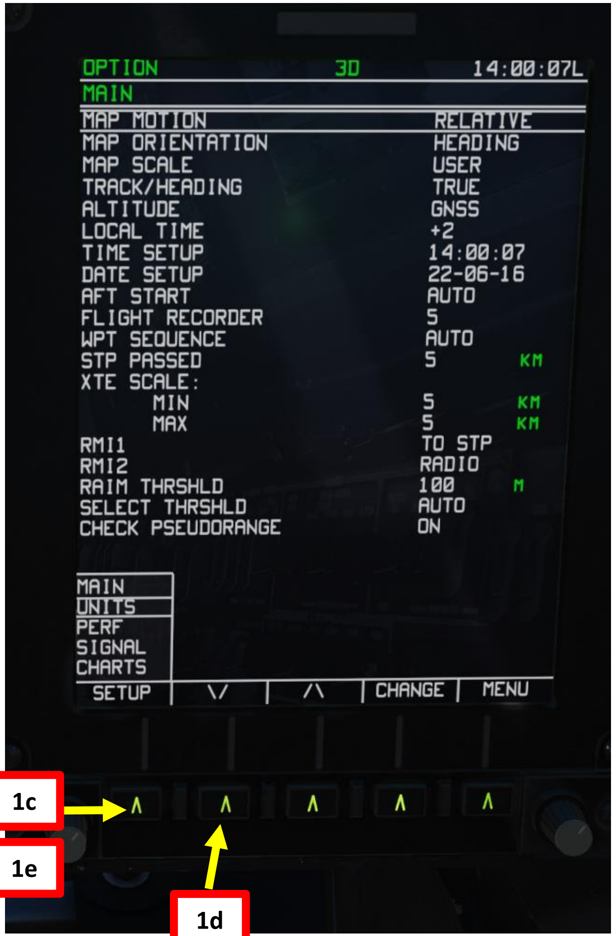

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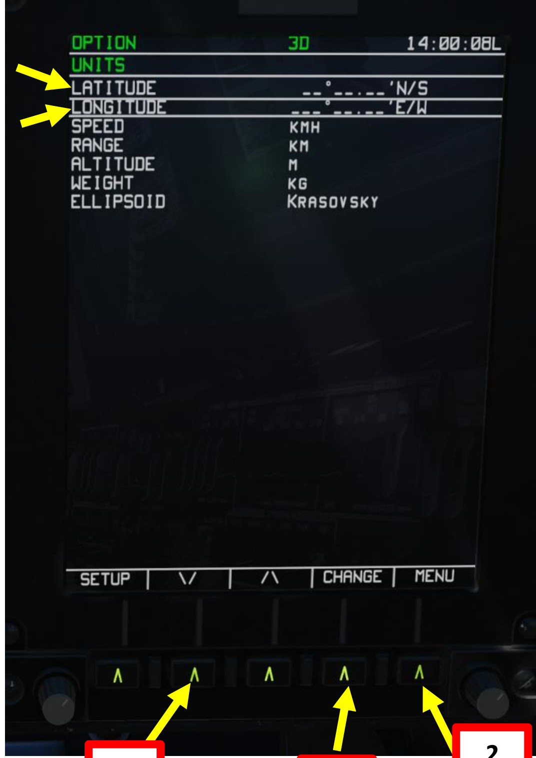


1g

1f

1h

2

3

6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

4. In the ABRIS NAV menu, click on “INFO” menu. You will obtain a red cursor that you can move by controlling horizontal movement with “using mousewheel to rotate knob” and vertical movement with “using mousewheel while right-clicking on knob”. Coordinates will be shown on the ABRIS.
5. **Alternatively**, you can also track Airports, VORs or NDBs. For example, to obtain the coordinates of an airport, click “Search” and scroll mousewheel on the knob to select desired sub-menu. Click on “search” again once desired menu has been selected. If we choose “Airport”, we can scroll down a list of airports using the same knob (and the mousewheel) and select for example Sukhumi-Barbushara by clicking the “Info” menu again. Coordinates will be shown on the ABRIS.

6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

6. Press WPT (or the type of reference point you want to enter) and the WPT number you want to change or add (in our case we will choose "WPT 2").
7. Read the coordinates carefully and type them in. Here is how you should enter them:
   What you read: **42 51 6**7 **041 07 4**7
   What you must actually enter: 042 516 0 041074.
   <u>You can see that we didn't include the two sevens since the PVI-800 doesn't need this level of coordinate precision.</u>
8. Press "Enter" and you're good to go! If you made a mistake, press "Reset" and start over.
9. OPTIONAL: You can click on "To" to let the ABRIS draw a path to the waypoint.

Here are great tutorials by Banjo:

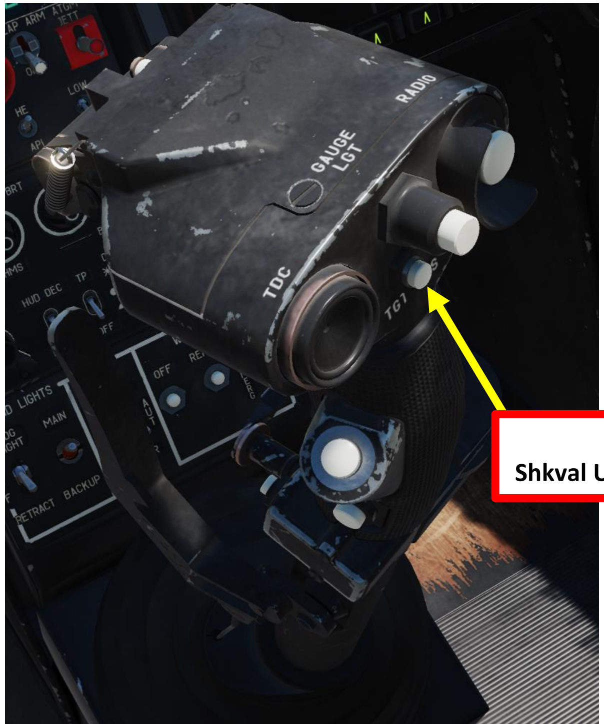
Creating/Editing Flight Plans:
https://www.youtube.com/watch?v=4pQEkjxl6aQ&index=10&list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0

Creating Nav Targets:
https://www.youtube.com/watch?v=qv6lzVYQF98&list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0&index=11

7.1 – TARGET POINT CREATION

7.1.1 – Fly-Over Method

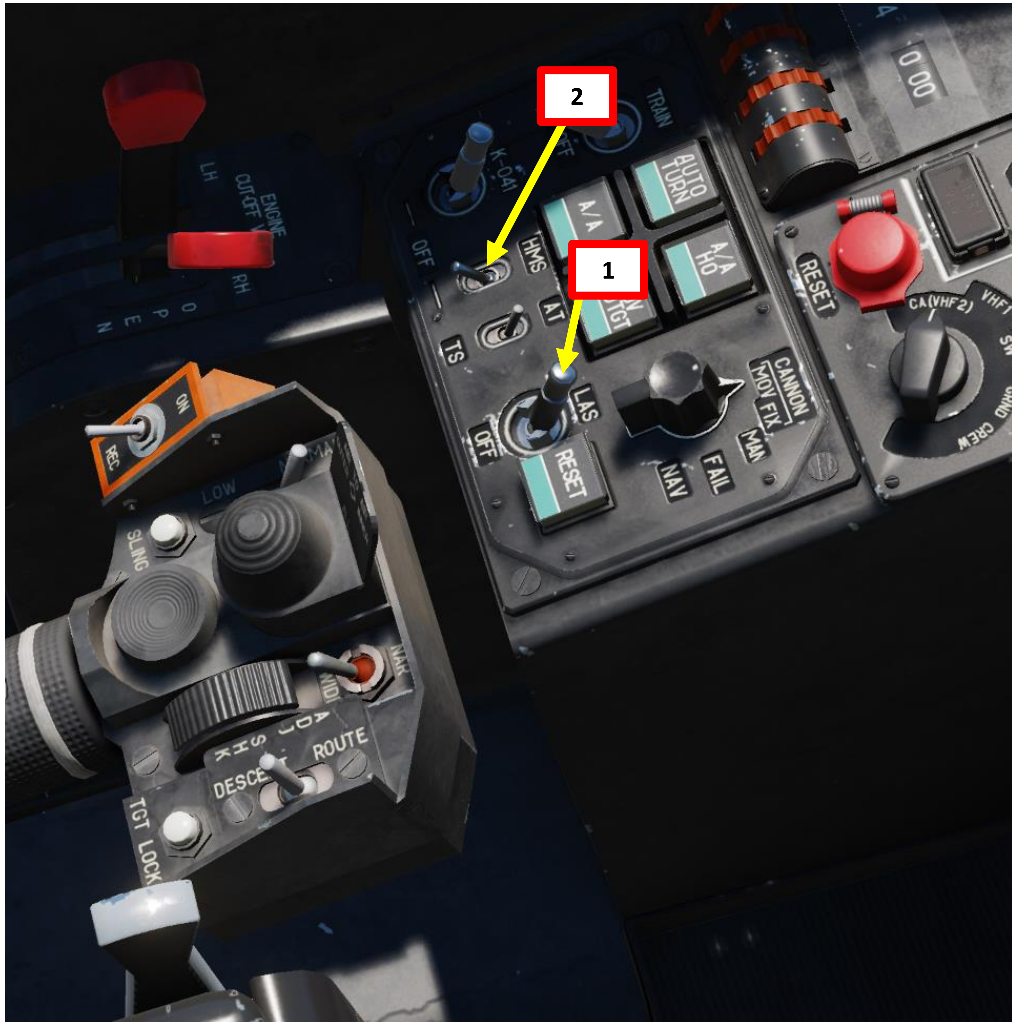
1. Set the Mode selector dial on the Navigation Control panel to the EDIT/ENTER position.
2. Set INU Operation Mode switch to the “OVER” (Over-fly) position.
3. Press NAV TGT (Target point) push-light.
4. Select the Target Point number you wish to assign from the key pad (1 to 10). We will choose Target Point 1.
5. Once above the target, press the “Uncage SHKVAL/Designate target” button on the cyclic and the helicopter’s coordinates will be appear on the Navigation Control panel display.
6. Press the ENTER button on the Navigation Control panel and the fly-over coordinates will be entered as a Target Point in the navigation system.
7. After creating the Target Point, set the Mode selector dial on the Navigation Control panel to the OPERATE position. Coordinates for the target point are now stored in NAV TGT / Target Point 1.

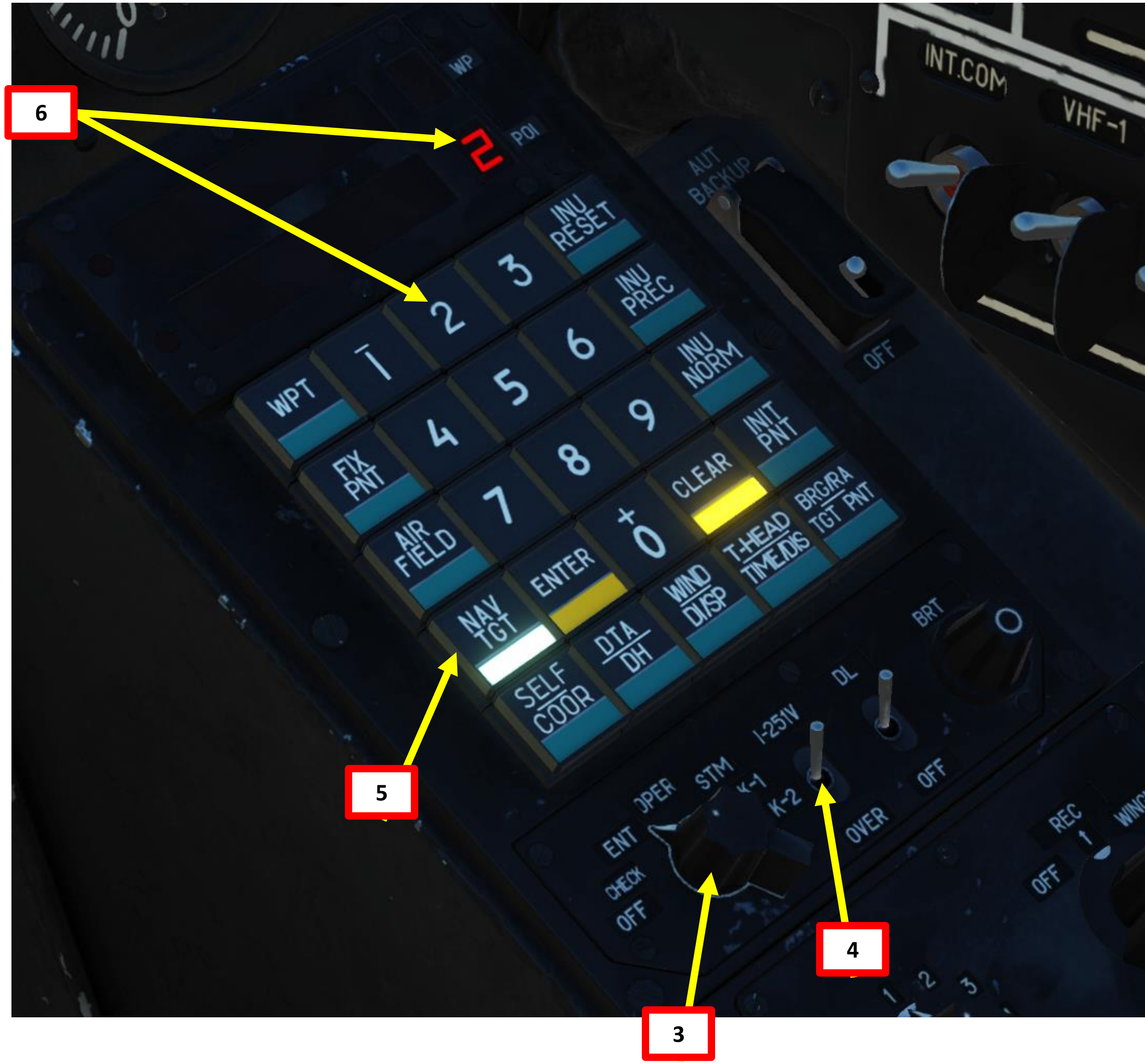


7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

1. Laser Power switch ON (FWD)
2. Ensure the HMS (Head-Mounted Sight) switch is OFF.
3. Set the Mode selector dial on the Navigation Control panel to the EDIT/ENTER position.
4. Set INU Operation Mode switch to the “И-251В” (I-251V Shkval) position.
5. Press NAV TGT (Target point) push-light.
6. Select the Target Point number you wish to assign from the key pad (1 to 10). We will choose Target Point 2.

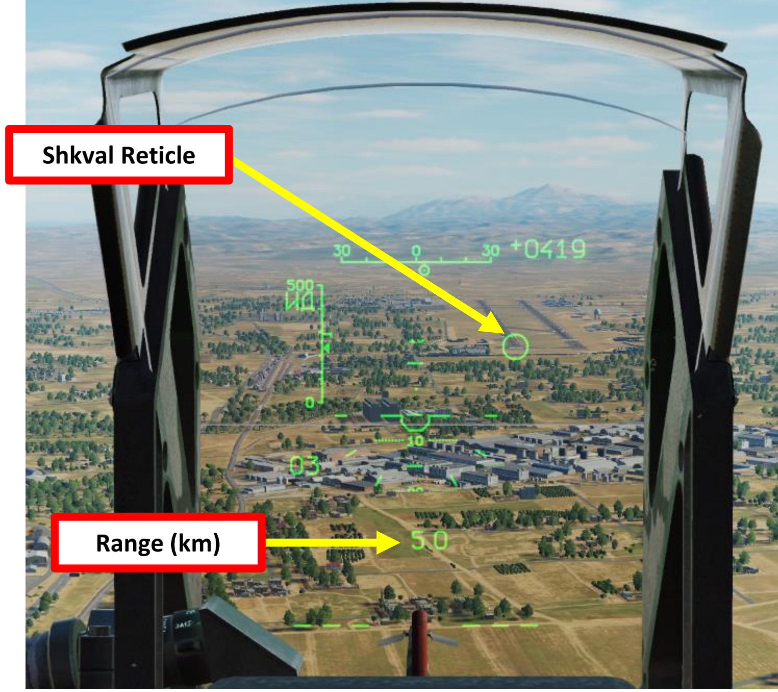


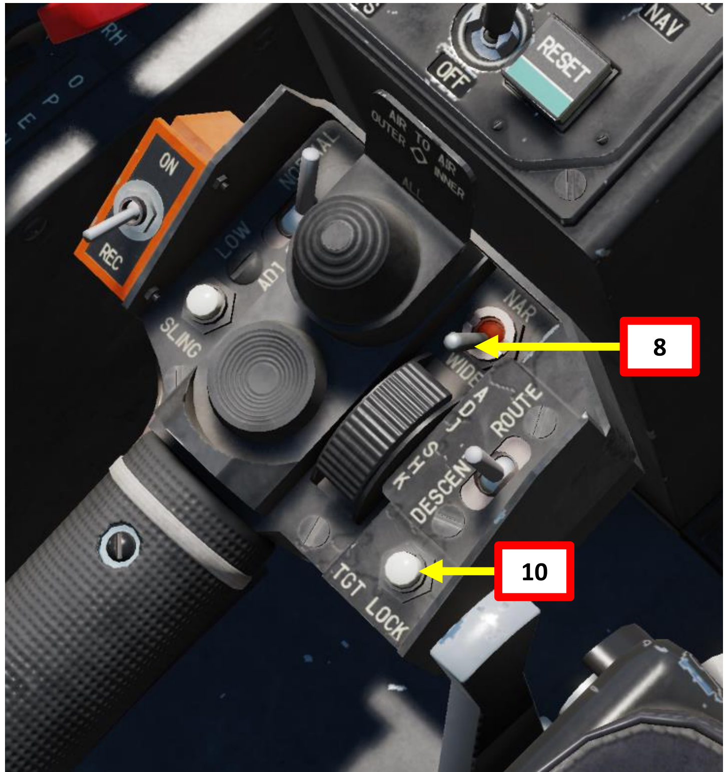


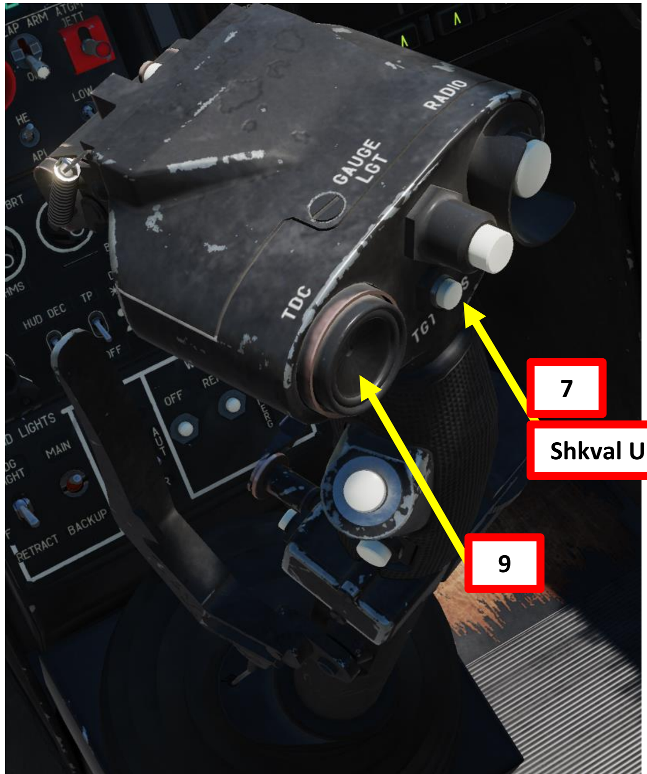
7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

7. Press the “Uncage SHKVAL/Designate target” button on the cyclic
8. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding
9. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
10. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.



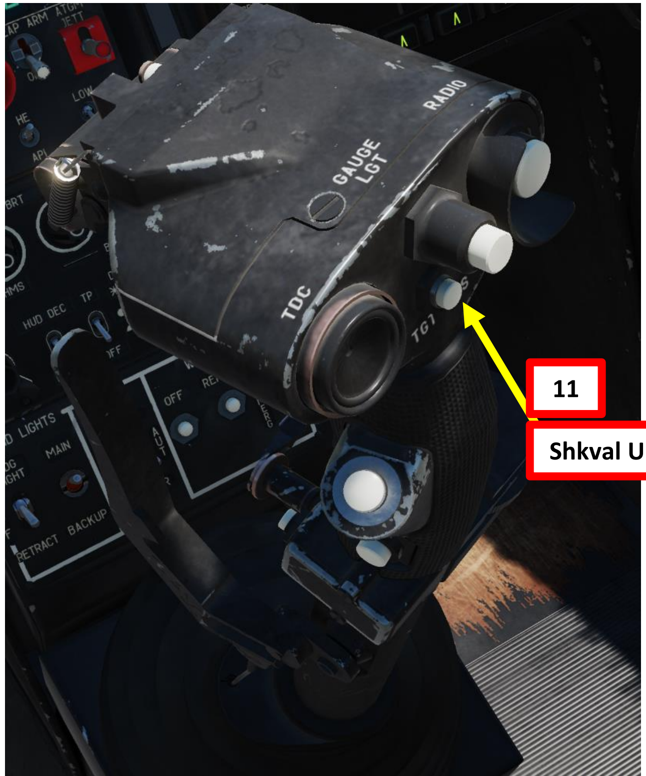


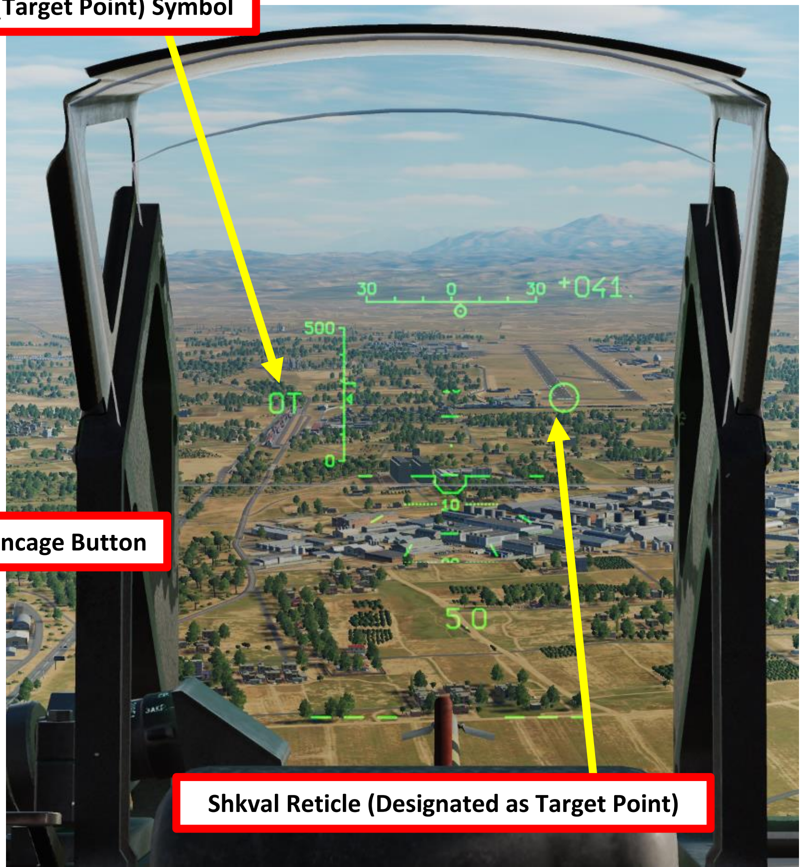


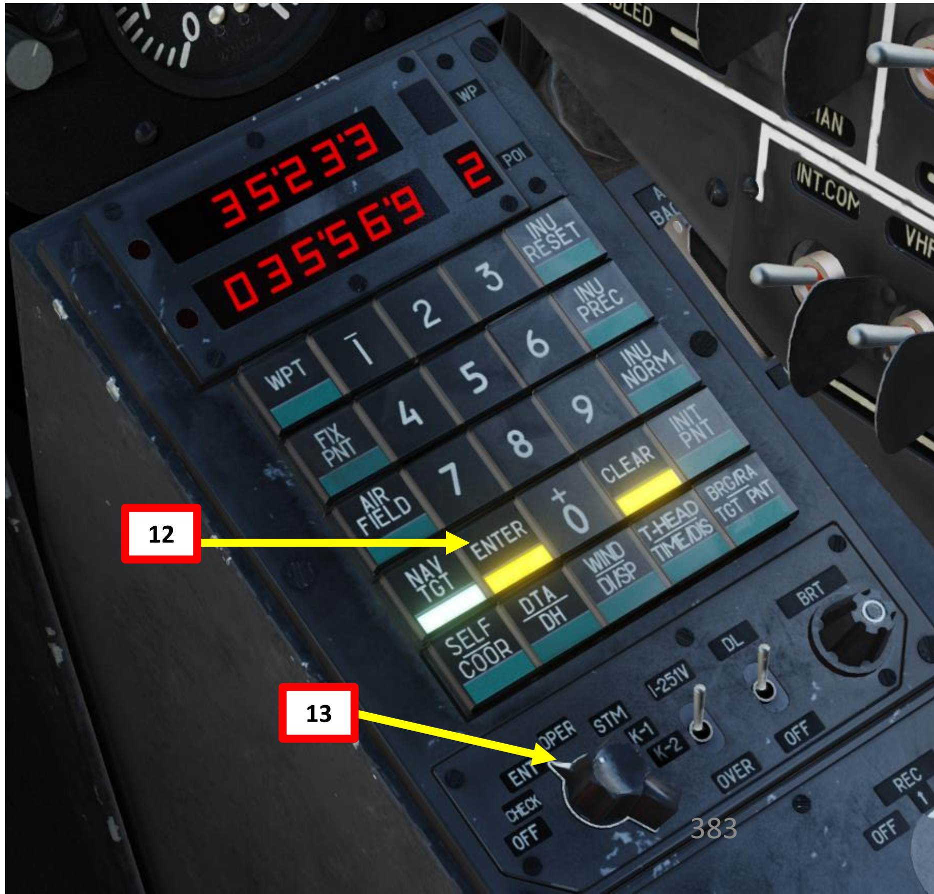
7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

11. Press “Uncage SHKVAL/Designate target” button on the cyclic a second time and the target’s coordinates will appear on the Navigation Control panel display. The “OT” (Target point) symbol will display on the HUD.
12. Press the ENTER button on the Navigation Control panel and the derived coordinates will be entered as the Target Point coordinates in the navigation system. The “OT” (Target point) symbol on the HUD will go out.
13. After creating the Target Point, set the Mode selector dial on the Navigation Control panel to the OPERATE position. Coordinates for the target point are now stored in NAV TGT / Target Point 2.
14. On the Targeting Mode Controls panel, press the “СБРОС” (Targeting mode reset) button.

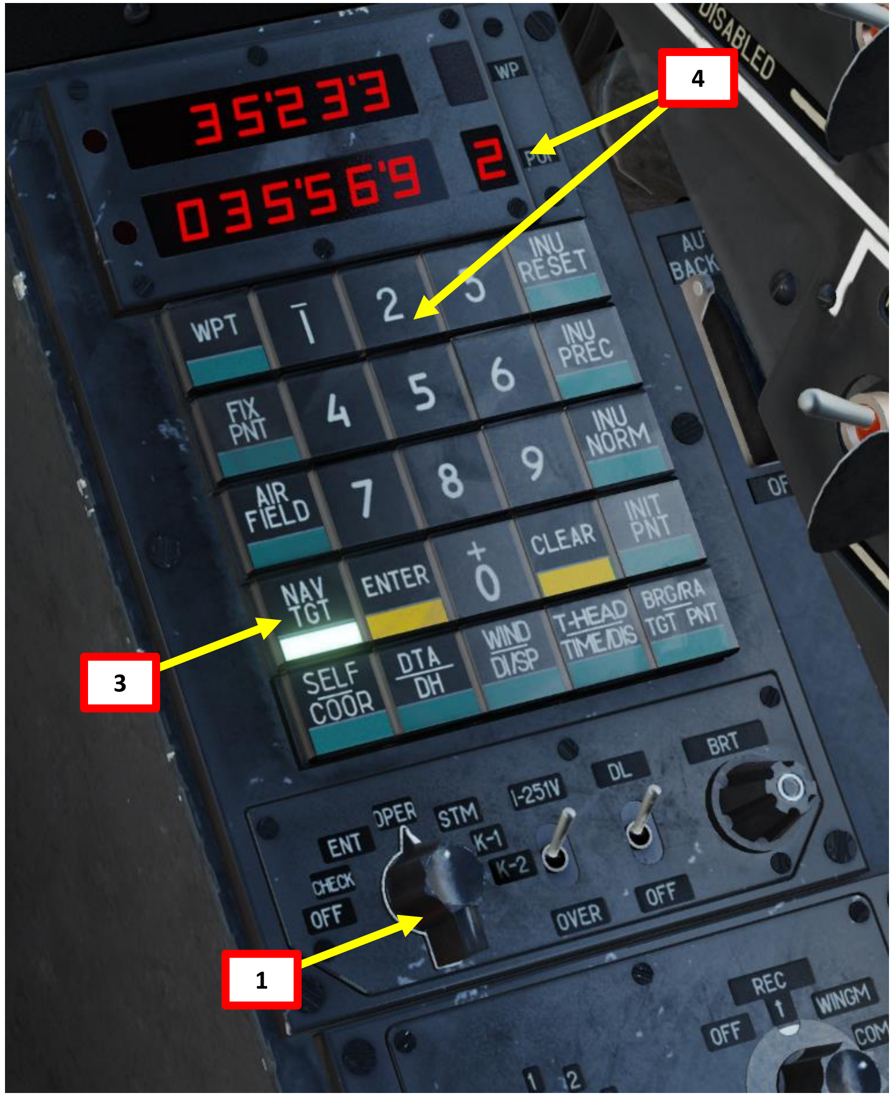


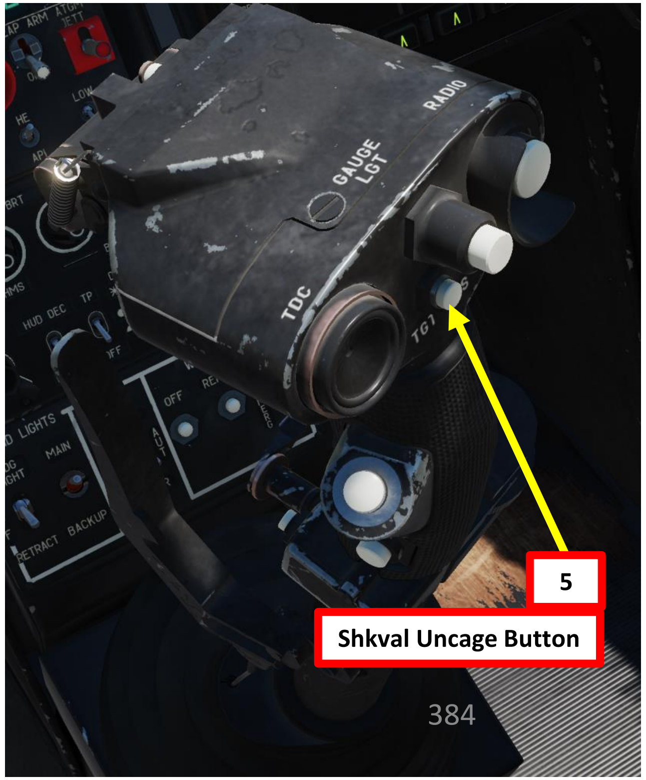




7.2 – USING TARGET POINTS

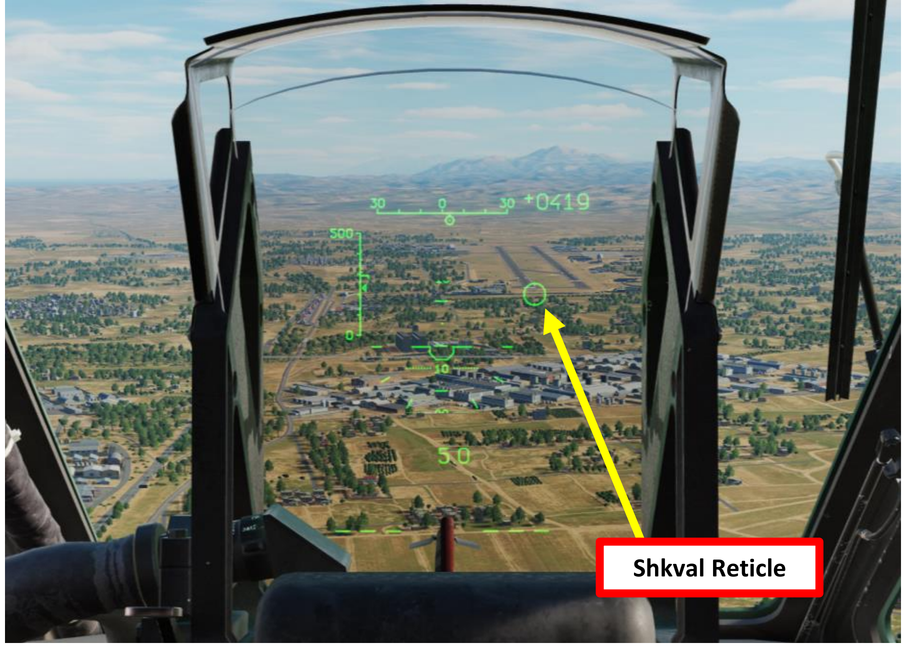
1. Set the Mode selector dial on the Navigation Control panel to the OPERATE position.
2. On the Targeting Mode Controls panel, press the “СБРОС” (Targeting mode reset) button.
3. Press NAV TGT (Target point) push-light.
4. Select the Target Point number you wish to use from the key pad (1 to 10). We will choose Target Point 2.
5. Press the “Uncage SHKVAL/Designate target” button on the cyclic
6. The SHKVAL will be slaved to the selected Target Point





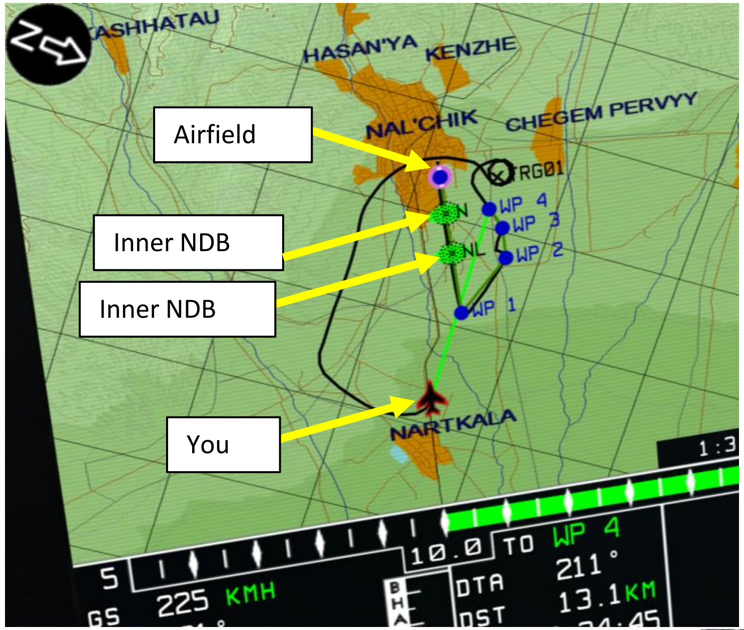
7.2 – USING TARGET POINTS

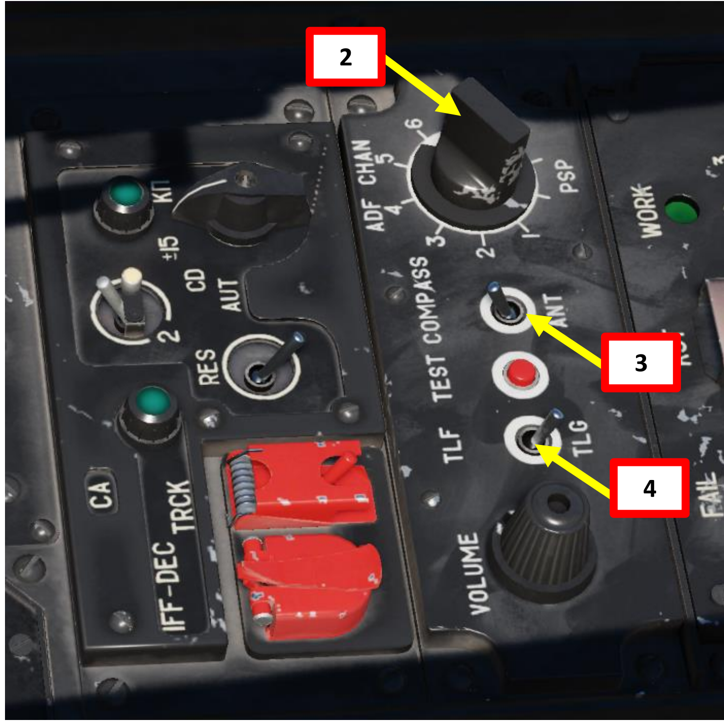
7. The Target Point selected will be visible on the Heads-Up Display, Shkval TV and on the ABRIS NAV page.

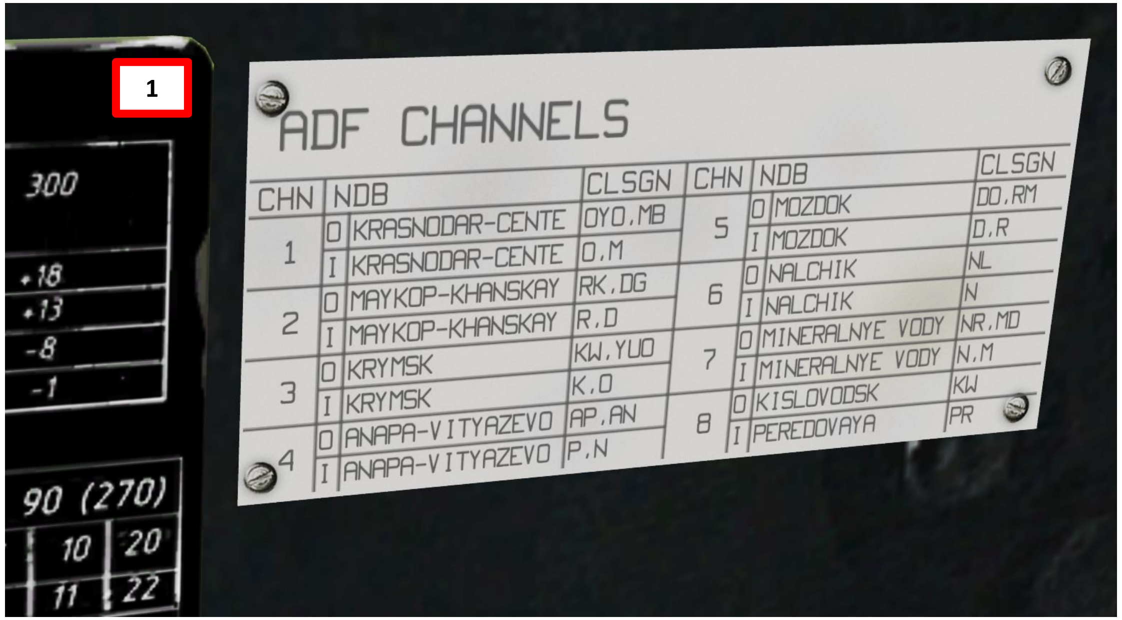


8 – ADF (AUTOMATIC DIRECTION FINDING) NAVIGATION

1. Find which NDB (Non-Directional Beacon) you want to navigate to by consulting the ADF (Automatic Directional Finder) Channels table on the right side of the cockpit. In this example, we will go to NALCHIK's outer NDB on ADF Channel 6, noted "NL" on the ABRIS screen. Take note that Outer NDBs (O) and Inner NDBs (I) are tracked separately.
2. Set desired ADF preset channel ("6" in our case).
3. Set ADF mode to COMPASS. ANTENNA mode can be used to make sure that you track the right NDB by hearing the morse code signal (each NDB has its own code).
4. Set ADF receiver mode to TLG (Telegraph). TLF (Telephony) is not used by any of the NDBs in-game.
5. Select ADF mode: INNER will track the inner NDB, while OUTER will select the outer NDB. "AUTO" will track the closest NDB.







ADF CHANNELS

CHN		NDB	CLSGN	CHN		NDB	CLSGN
1	O	KRASNODAR-CENTE	OYO,MB	5	O	MOZDOK	DO,RM
	I	KRASNODAR-CENTE	O,M		I	MOZDOK	D,R
2	O	MAYKOP-KHANSKAY	RK,DG	6	O	NALCHIK	NL
	I	MAYKOP-KHANSKAY	R,D		I	NALCHIK	N
3	O	KRYMSK	KW,YUO	7	O	MINERALNYE VODY	NR,MD
	I	KRYMSK	K,O		I	MINERALNYE VODY	N,M
4	O	ANAPA-VITYAZEVO	AP,AN	8	O	KISLOVODSK	KW
	I	ANAPA-VITYAZEVO	P,N		I	PEREDOVAYA	PR

8 – ADF (AUTOMATIC DIRECTION FINDING) NAVIGATION

6. Steer the helicopter manually towards the NDB marker using the HSI (Horizontal Situation Indicator)

You can confirm what you see on the HSI by looking at the ABRIS! Isn't that awesome?
(Yes it is… shut up!)

Current Heading
Must be aligned with yellow needle

6

Radio Beacon Bearing
(Yellow needle)

Airfield

Inner NDB

Inner NDB

You

Ka-50 Black Shark III Expansion Only

9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.1 – INU Drift

The Inertial Navigation Unit (INU) has a tendency to gradually accumulate errors 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 4 km after 1 hour of flight. Errors in coordinate calculations will affect flight path and determination of target locations. 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.

When planning a flight path in the mission editor, INU reference points need to be set up (**up to 4 reference points** maximum). 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 of "FIX PNT" type), are used to re-align your INU. Typically, you want to have these fixed points setup before entering a combat zone.

How do you know when to re-align, though? Well, the navigation system tells you to re-align on a reference point (fix) a bit in advance; **once you are within 18 km of a reference point**, the EKRAN will sound an audio cue and display "ПРОВЕДИ КОРРЕКЦ КООРД" (**PERFORM NAV POS FIX**).

9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.1 – INU Drift

The effects of INU drift can have a significant impact on certain aircraft systems, which directly alter your ability to complete the mission. Here are a few examples of how it can affect you.

- Slaving the Shkval to a target point can slave it to an entirely different location than the intended target.
- The Autopilot is affected for heading modes or in situations where it must follow a navigation route.
- Navigation point and target point coordinates are offset from their real location, which can complicate navigation to targets, or even getting back to the home base in poor visibility conditions.
- Datalink targets sent from your wingmen are basically coordinates pointing to a point in space. Offset coordinates means they won't be of much use if the error is too significant.

9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.1 – INU Drift

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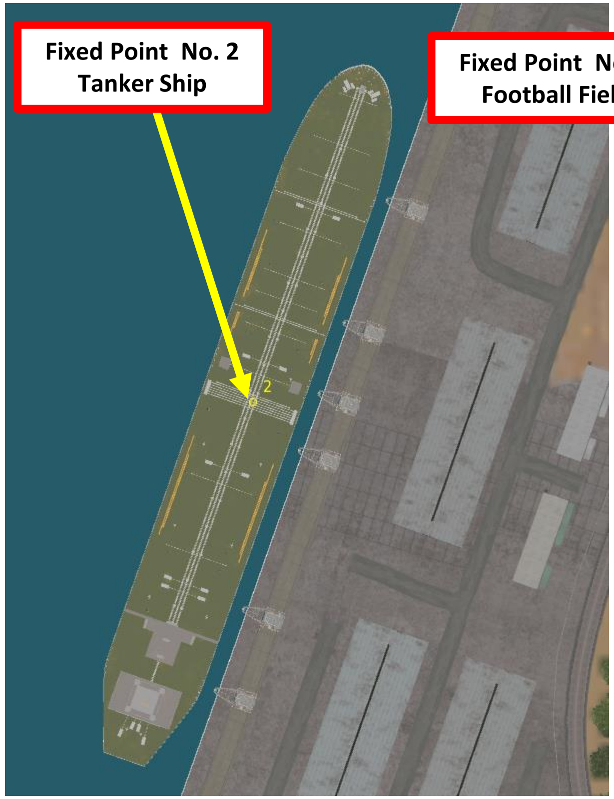
For fixed points, it is recommended to use locations that stand out in the terrain – buildings, towers, bridges, road crossings, and river merge points that are easily located along the route. You can either have them pre-programmed via the Mission Editor, or you can also enter coordinates manually in a similar fashion to a Waypoint.

In the following sections, we will perform coordinate corrections:

1. Using the Overfly Fix method with a fixed point set on a football field.
2. Using the Shkval method with a fixed point set on a tanker ship.



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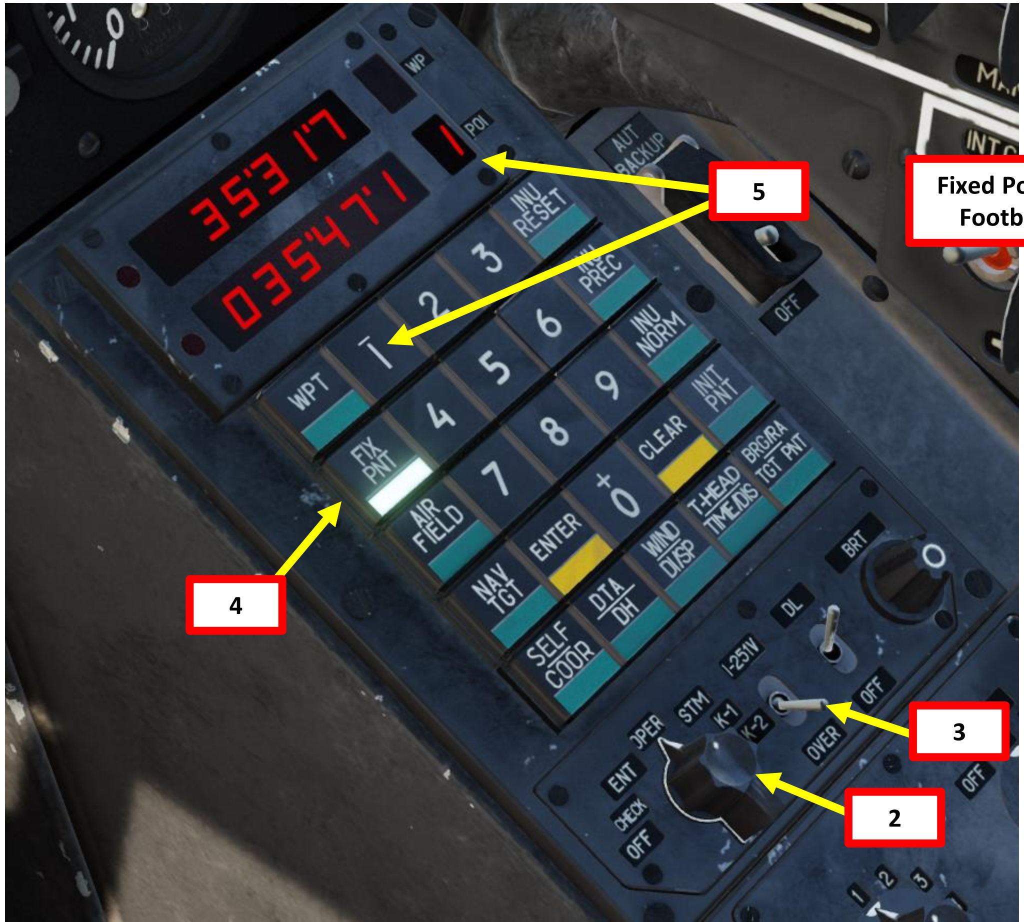
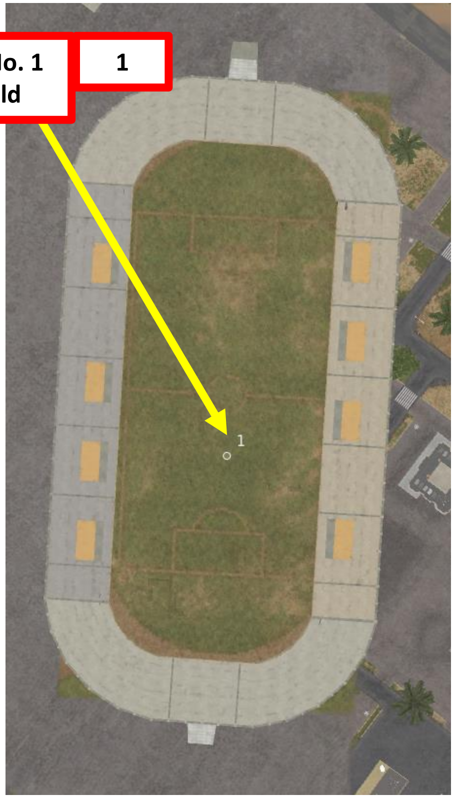
9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.2 – Coordinate Corrections Using Overfly Fix Method

1. In this example, Fixed Point No. 1 (IFX01) has already been entered in our database; it points to the middle of a football field in Latakia, which is an obvious visual cue that we can easily fly over to re-align our navigation system.
2. Set the Mode selector dial on the Navigation Control panel to the OPER (Operate) position.
3. Set INU Operation Mode switch to the “OVER” (Over-fly) position.
4. Press FIX PNT (Fixed point) push-light.
5. Select the Fixed Point number you wish to use to re-align with from the key pad (1 to 4). We will choose Fixed Point 1.
6. Once you are within 18 km of a reference point, the EKRAN will sound an audio cue and display “ПРОВЕДИ КОРРЕКЦ КООРД” (PERFORM NAV POS FIX).



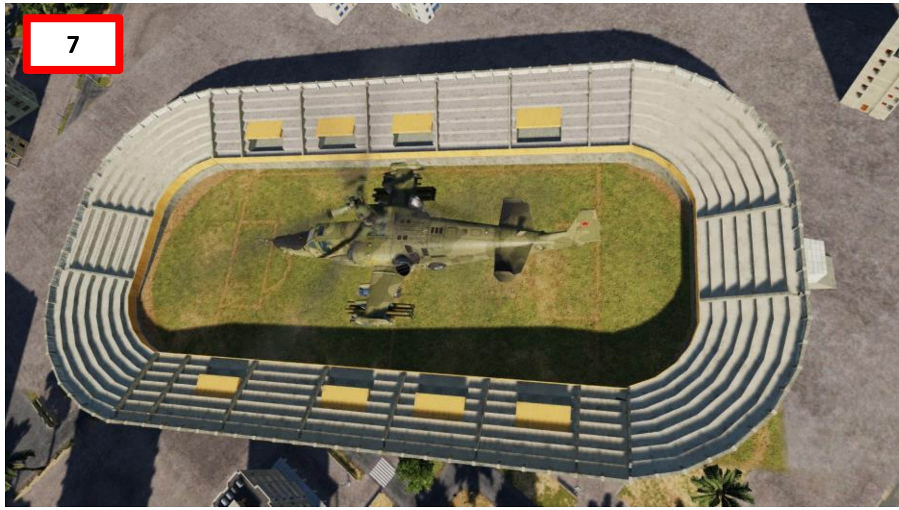


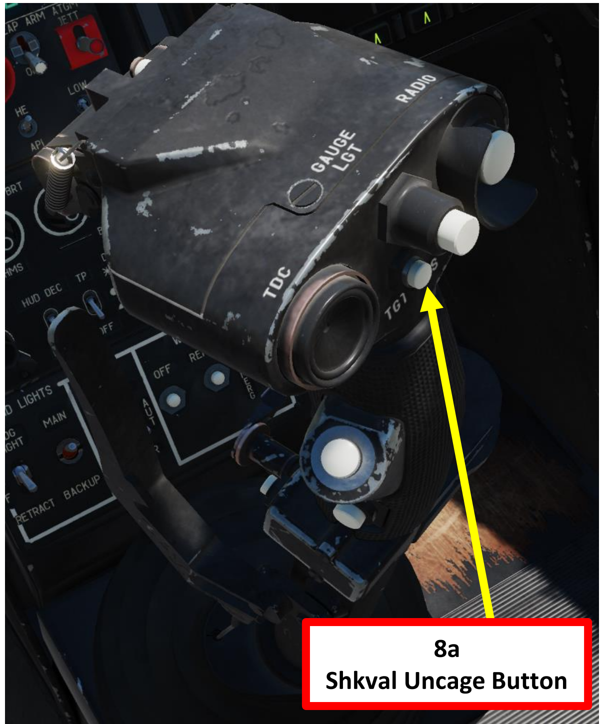
9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.2 – Coordinate Corrections Using Overfly Fix Method

Ka-50 Black Shark III Expansion Only

7. Fly directly over the fixed point No. 1 position (football field).
8. Once over the fixed point, press the “Uncage SHKVAL/Designate target” button on the cyclic. This will synchronize the aircraft’s coordinates with the coordinates of the reference point.
9. The FIX PNT button backlight will switch off, and the selected reference point number will no longer be displayed on the indicator panel. That’s it, you have corrected your coordinates!





9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.2 – Coordinate Corrections Using Overfly Fix Method

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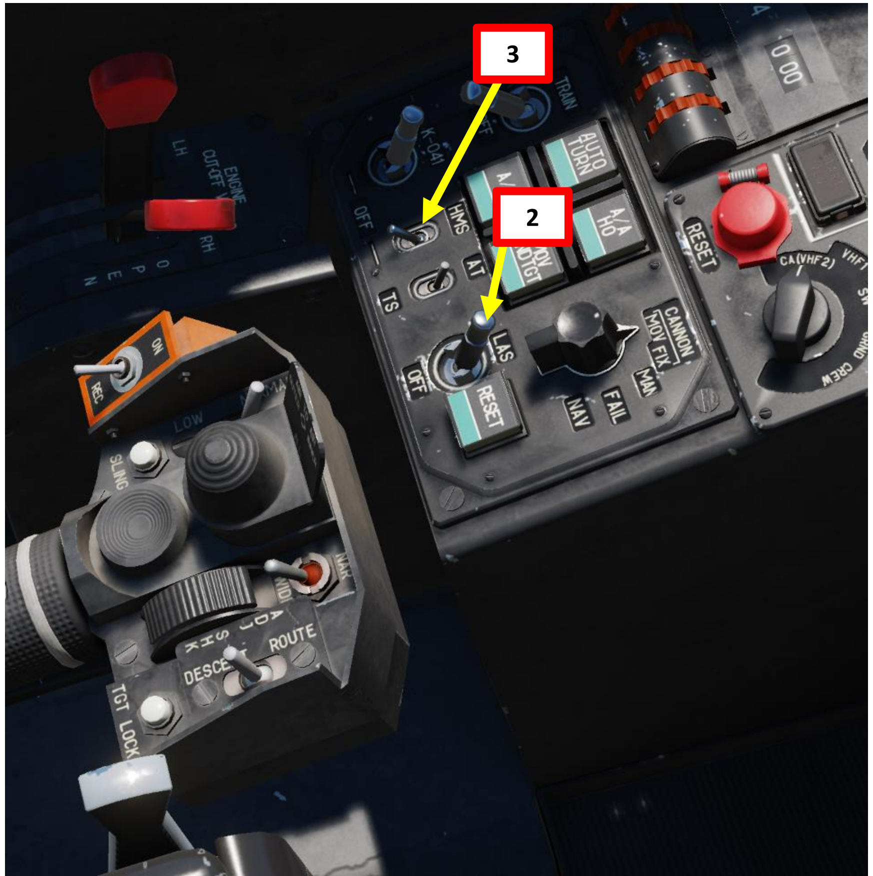
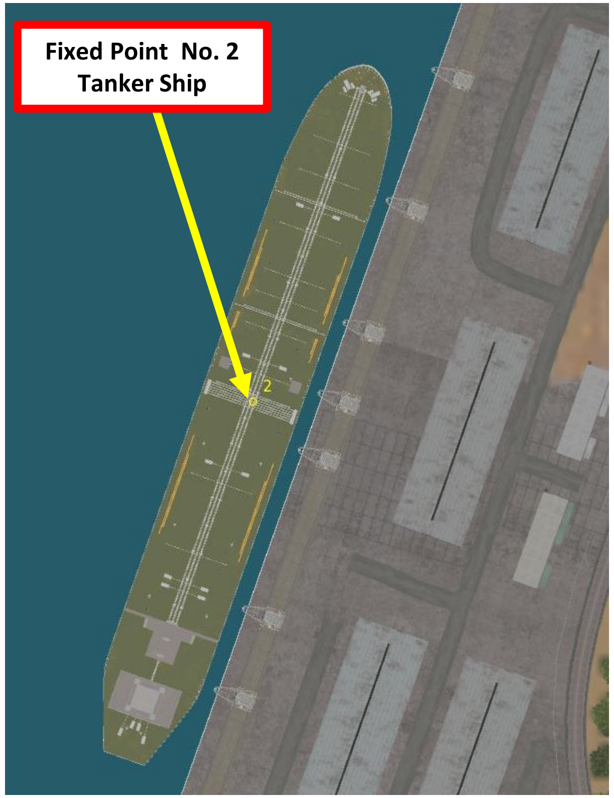
Ka-50 Black Shark III
Expansion Only

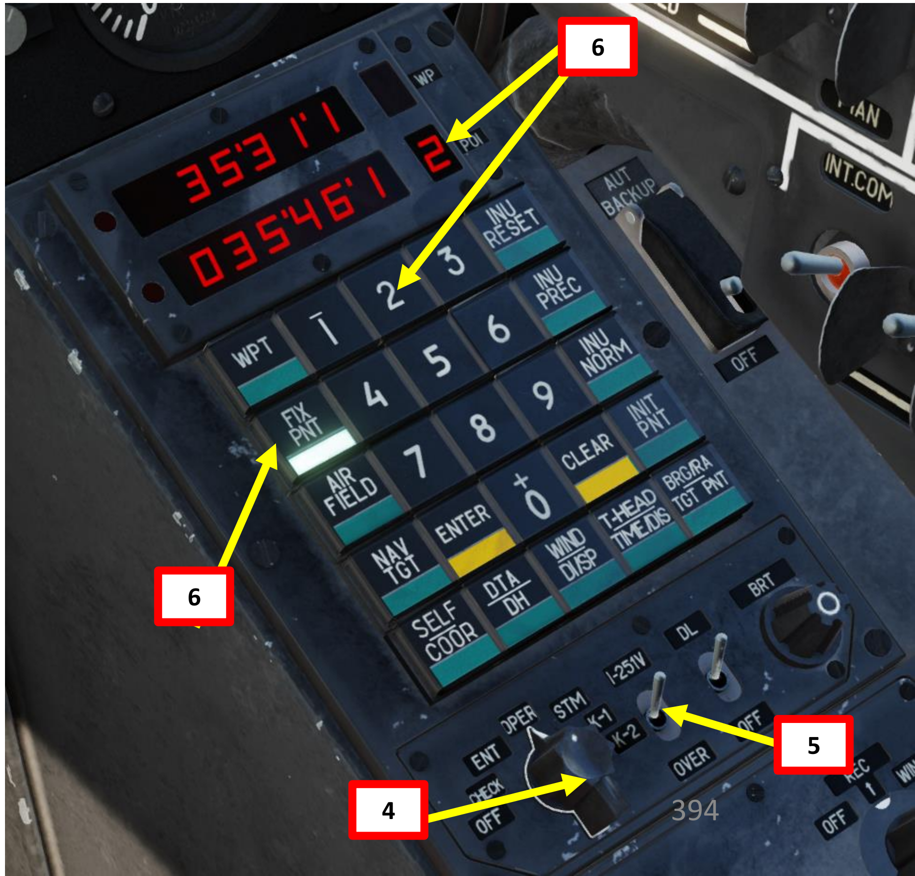
9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.3 – Coordinate Corrections Using Shkval Method

1. In this example, Fixed Point No. 2 (IFX02) has already been entered in our database; it points to the middle of a tanker ship in the harbor of Latakia, which is an obvious visual cue that we can easily designate with our Shkval sensor to re-align our navigation system.
2. Laser Power switch ON (FWD)
3. Ensure the HMS (Head-Mounted Sight) switch is OFF.
4. Set the Mode selector dial on the Navigation Control panel to the OPER (Operate) position.
5. Set INU Operation Mode switch to the “И-251В” (I-251V Shkval) position.
6. Press FIX PNT (Fixed point) push-light.
7. Select the Fixed Point number you wish to use to re-align with from the key pad (1 to 4). We will choose Fixed Point 2.





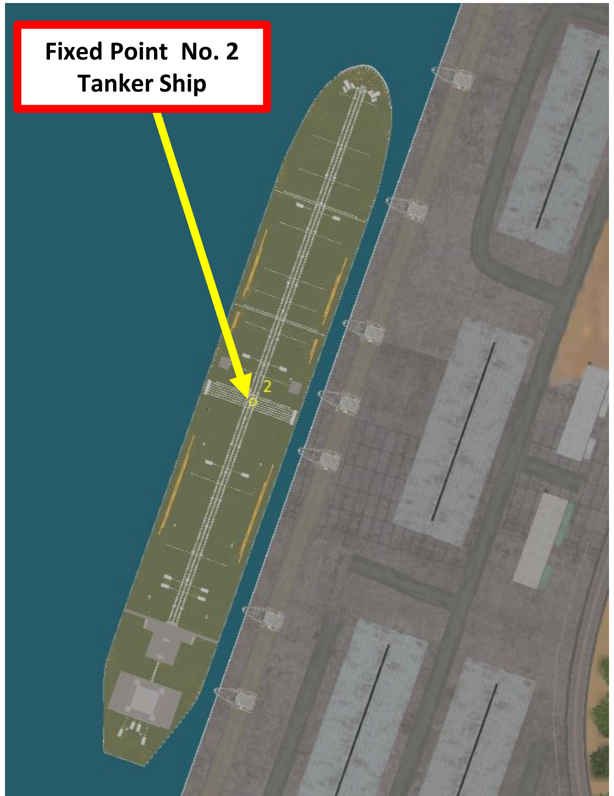


9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.3 – Coordinate Corrections Using Shkval Method

Ka-50 Black Shark III Expansion Only

8. Once you are within 18 km of a reference point, the EKRAN will sound an audio cue and display “ПРОВЕДИ КОРРЕКЦ КООРД” (PERFORM NAV POS FIX).

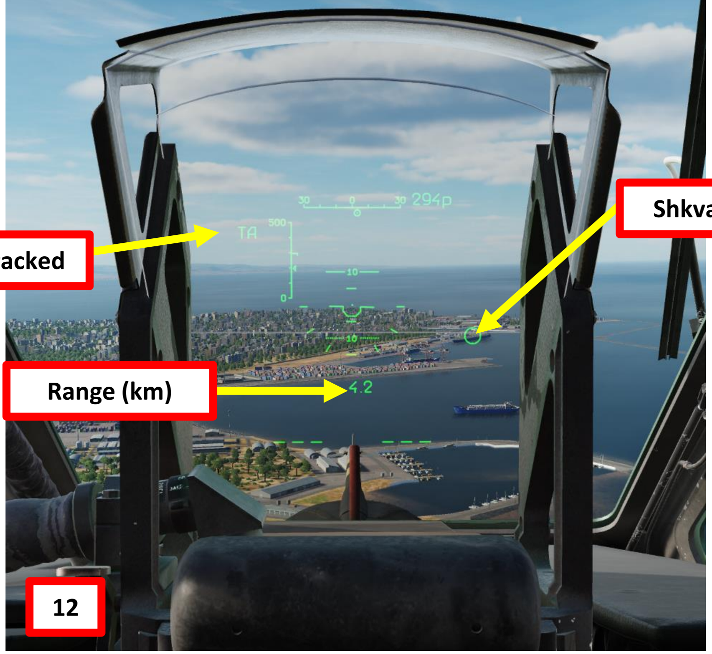


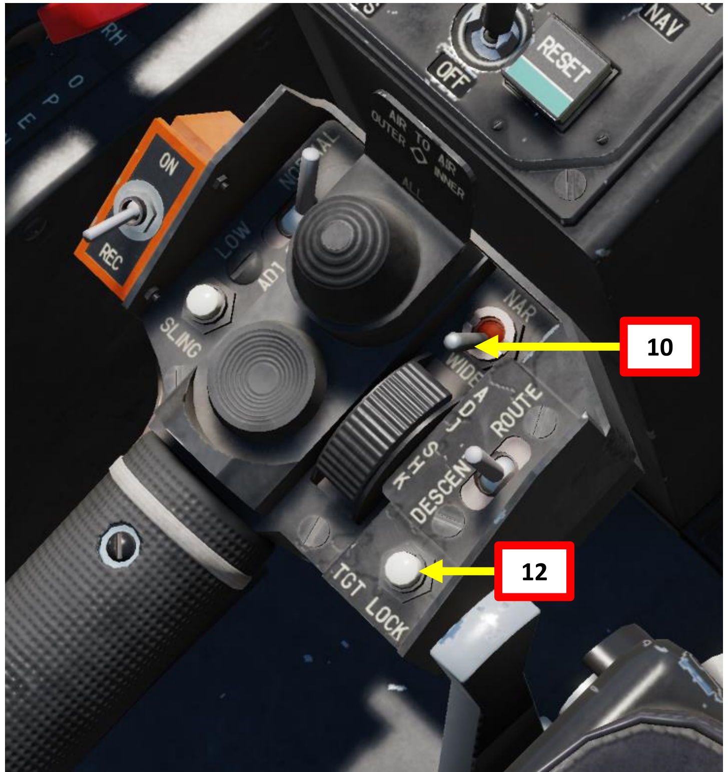
9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

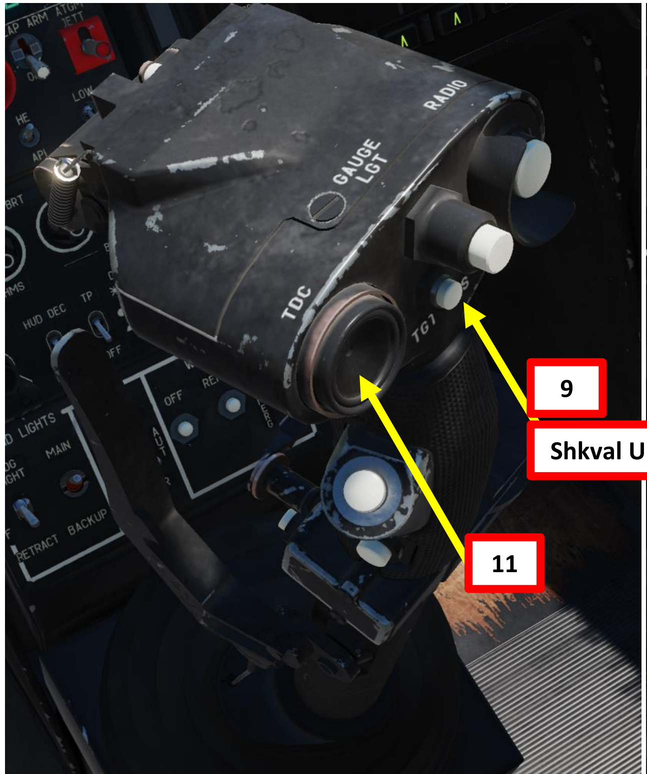
9.3 – Coordinate Corrections Using Shkval Method

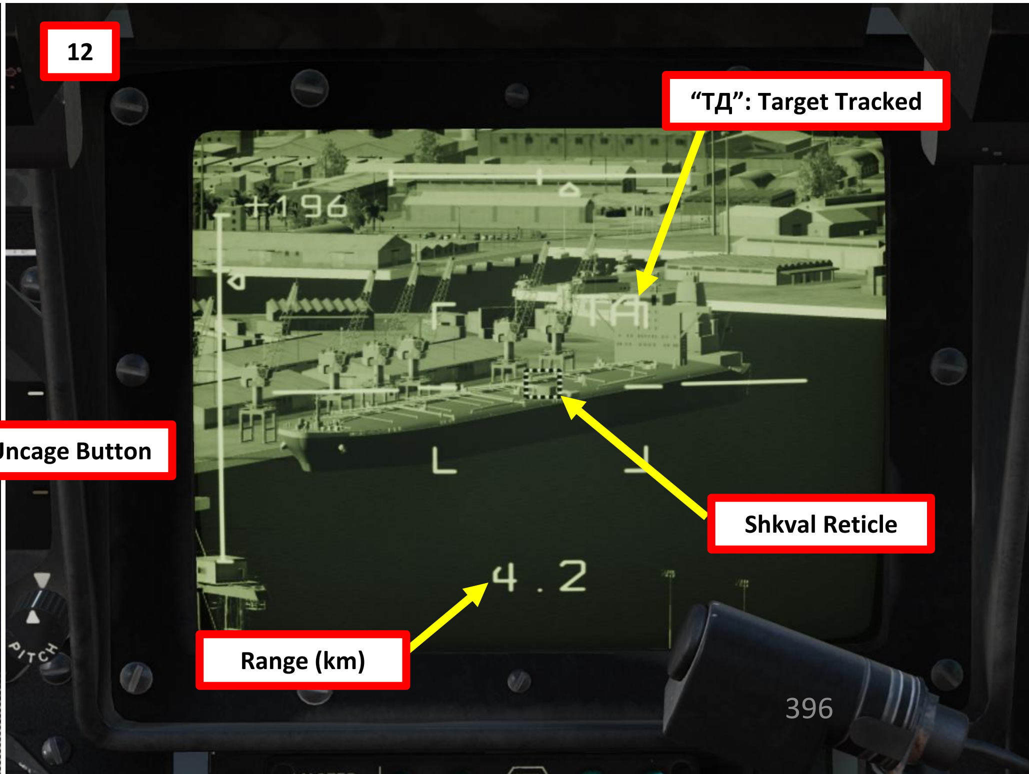
Ka-50 Black Shark III Expansion Only

9. Press the “Uncage SHKVAL/Designate target” button on the cyclic
10. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding
11. Slew SHKVAL reticle on Fixed Point No. 2 (the tanker ship defined earlier, which will act as our reference point) using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
12. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.
13. Confirm that the “ТД” indication is visible and that target is being tracked and ranged properly by the Shkval’s laser rangefinder.







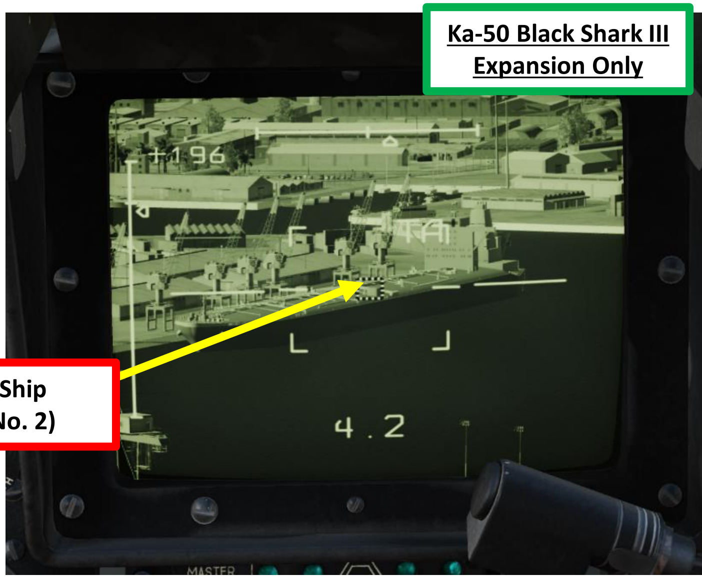


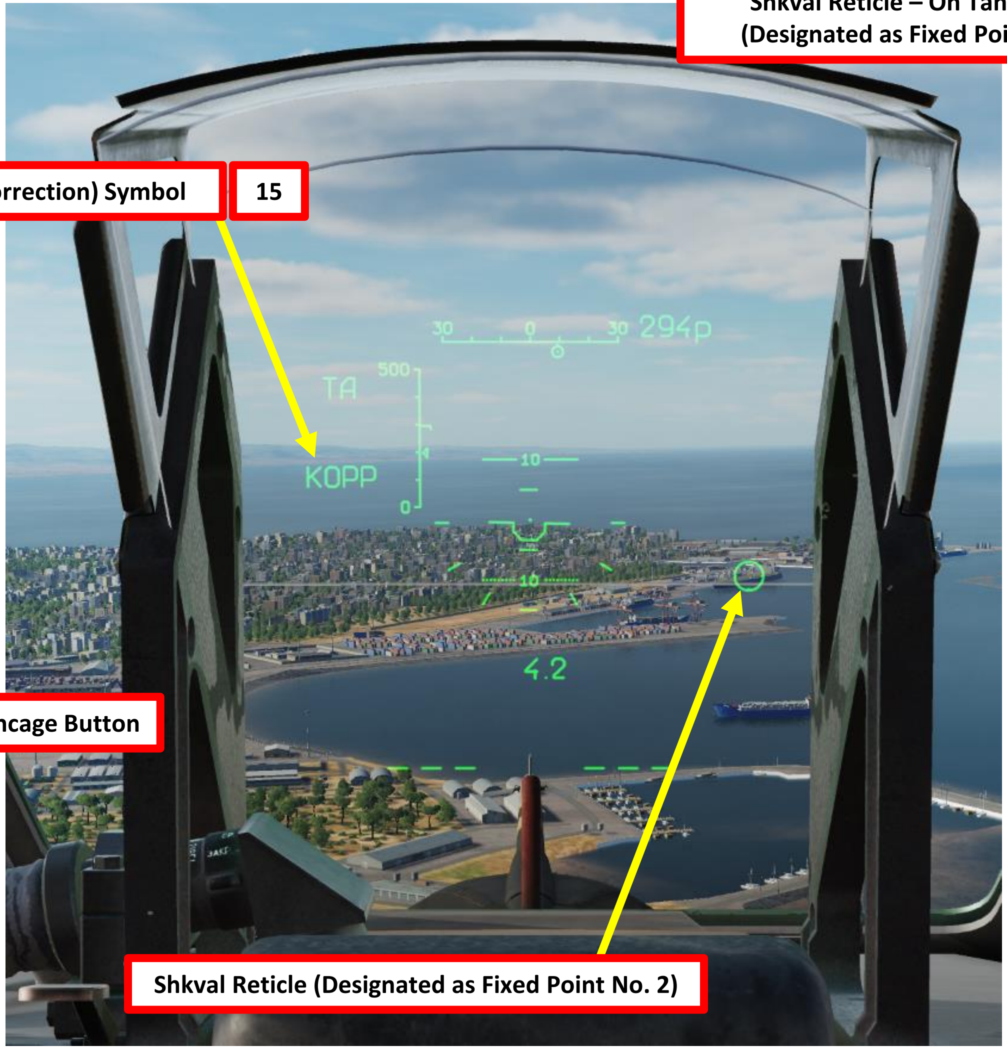
9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

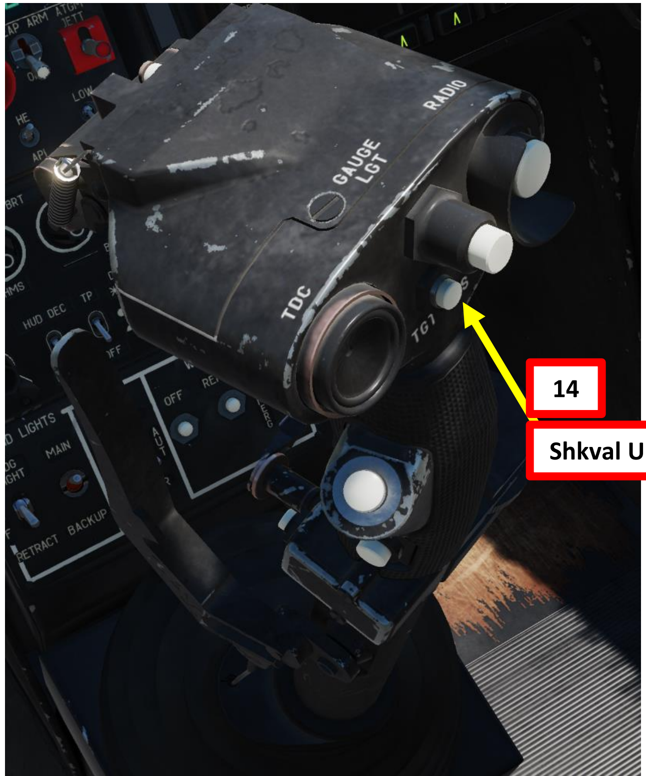
9.3 – Coordinate Corrections Using Shkval Method

14. Press “Uncage SHKVAL/Designate target” button on the cyclic a second time and the target’s coordinates will appear on the Navigation Control panel display. This will perform the coordinate correction procedure.
15. Having previously pressed the “Uncage SHKVAL/Designate target” acquires the values for the slant range and the sighting angles of the reference point. The corrected coordinates of the helicopter are calculated based on the value of these parameters and the known coordinates of the reference point. During the calculation, the HUD will display the “KOPP” (Correction) message.

Ka-50 Black Shark III Expansion Only





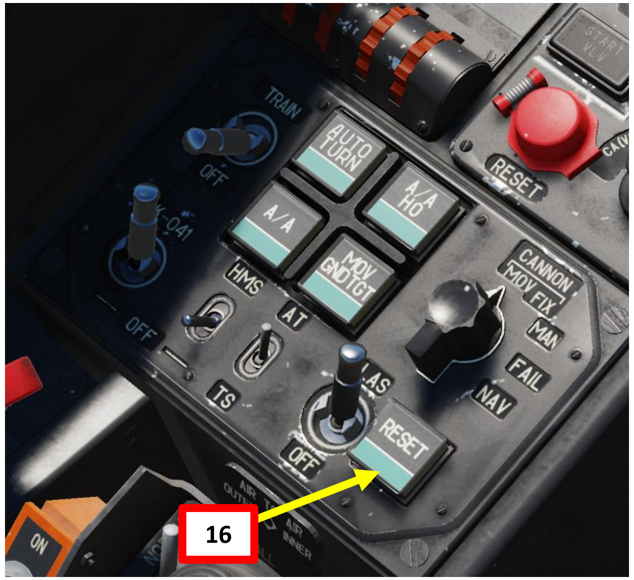


Ka-50 Black Shark III Expansion Only

9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.3 – Coordinate Corrections Using Shkval Method

16. On the Targeting Mode Controls panel, press the “СБРОС” (Targeting mode reset) button. This will clear the “КОРР” (Correction) message from the HUD.
17. The coordinates of the target designated by the Shkval (tanker ship) are now synchronized with the coordinates of the reference point (Fixed Point No. 2).
18. The FIX PNT button backlight will switch off, and the selected reference point number will no longer be displayed on the indicator panel. That’s it, you have corrected your coordinates!



9 – INU (INERTIAL NAVIGATION UNIT) DRIFT & NAVIGATION FIX

9.3 – Coordinate Corrections Using Shkval Method

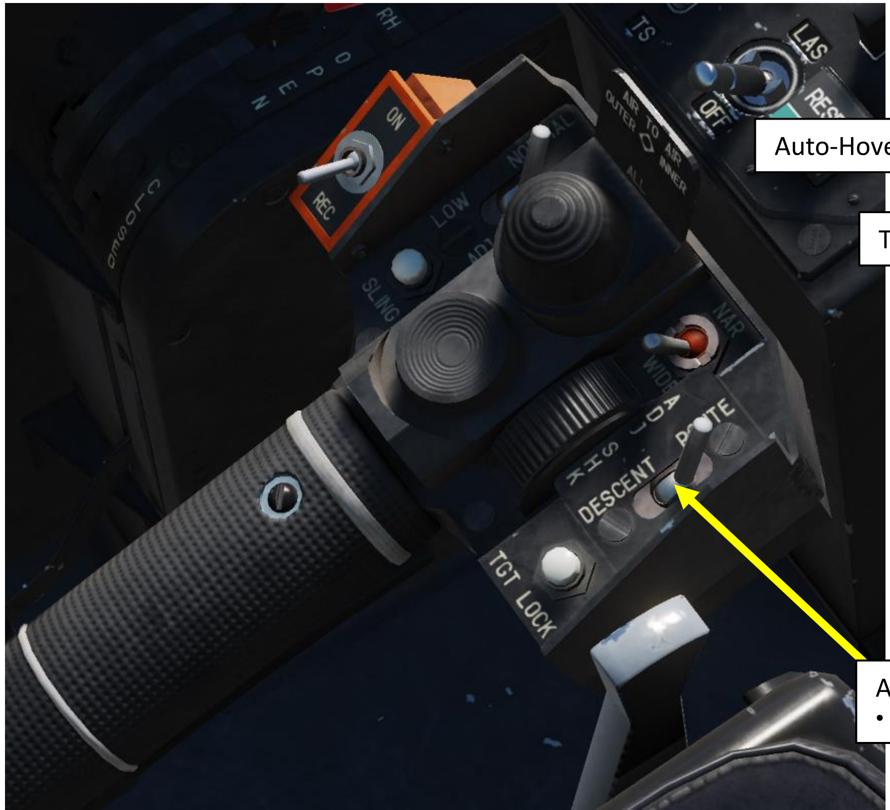
AUTOPILOT CHANNELS & CONTROLS

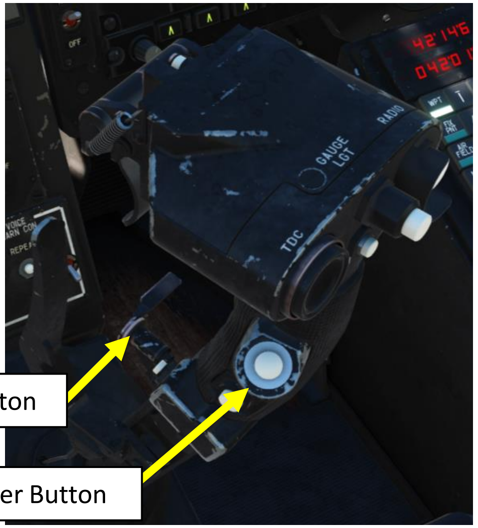
The autopilot has four push-lights that control their respective channels:
- Bank/Roll
- Pitch
- Heading
- Altitude

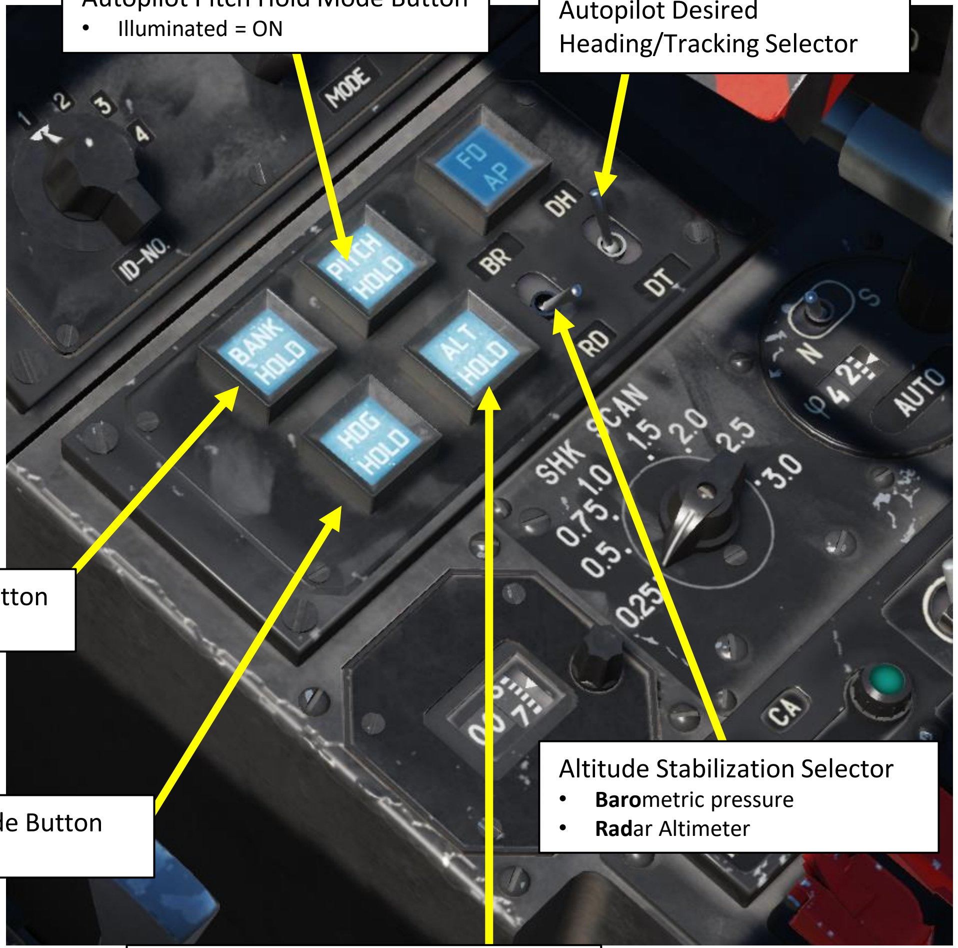
Autopilot modes themselves are selected with the Autopilot Modes Selector Switch on the collective.

The way to use the Trimmer button in conjunction with the autopilot channels:
1. Engage desired autopilot channels (typically you would pick BANK, PITCH and HDG)
2. Press and hold the Trimmer button
3. While maintaining the trimmer button, execute your maneuver
4. One you've reached steady state, let go the trimmer button.
5. The autopilot will attempt to keep the helicopter in the attitude when the trimmer button was released.

This prevents "fighting the Autopilot", reduces exerted force and removes the "sticky" feeling.





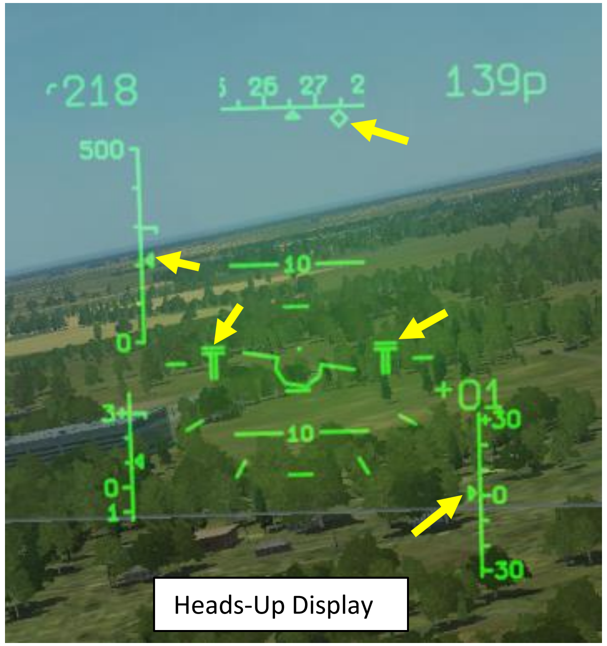


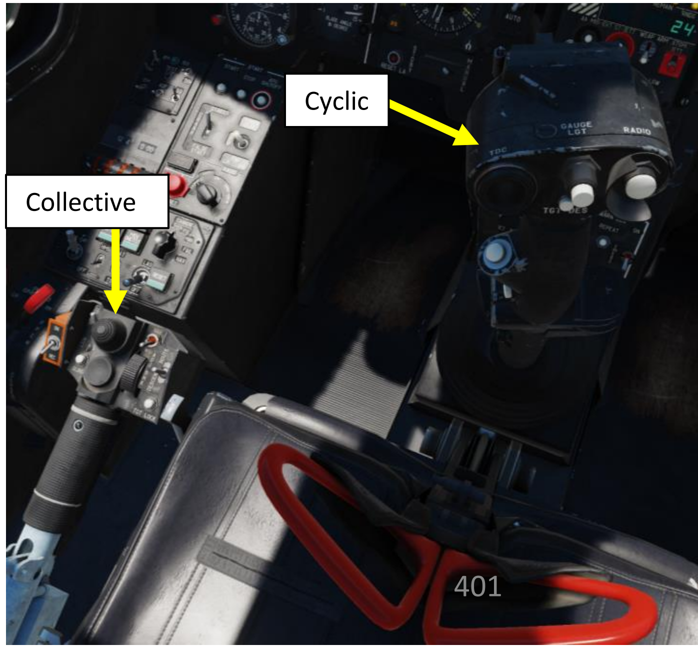
FLIGHT DIRECTOR

The Flight Director mode gives you steering commands on the Heads-Up Display and ADI (Attitude Director Indicator) in order to follow your selected flight plan / waypoint.

To activate the Flight Director, press **the Autopilot Flight Director Push-Light** (active when illuminated).

- The desired airspeed is maintained by changing the pitch angle (with cyclic)
- The desired altitude is changed by adjusting engine power (with collective).
- When flying with director control, it is necessary to set the pitch and bank angles with the cyclic in reference to the aircraft datum.
- Use collective pitch adjustments to decrease the altitude director to the minimum. If the altitude director is "increasing" up, it's necessary to increase the collective pitch; if it's going down, decrease it.

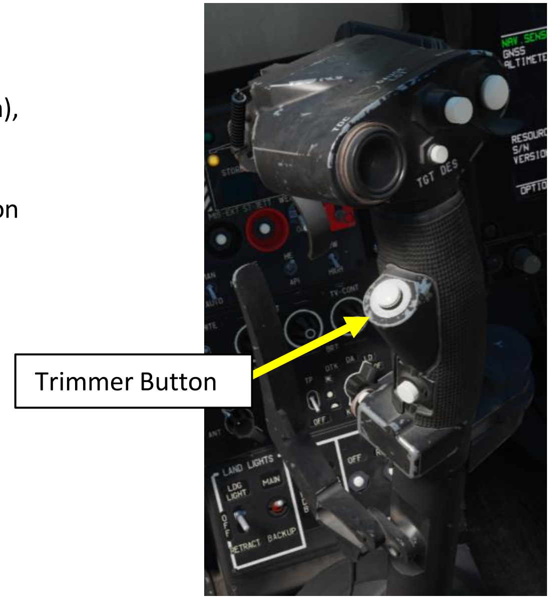


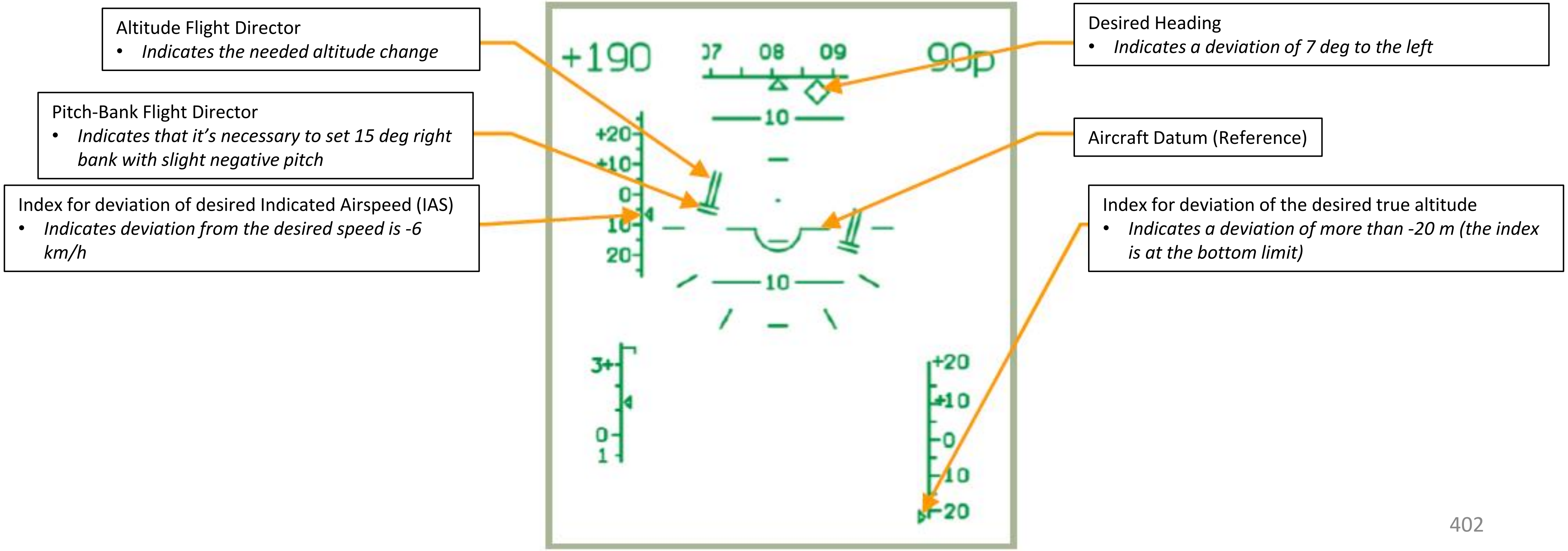


FLIGHT DIRECTOR

In this example given below, the pilot must set a right bank of 15° with a small negative pitch (see 2), reach the desired speed (see 3, deviation -6 km/h), and increase collective pitch to gain the desired altitude (see 1 and 6, true altitude deviation more than -20 m).

- To set a new airspeed and altitude, it is necessary to **press and hold the trim button and change the speed and altitude**. Then release the trim button and the current values of the airspeed and altitude are set as desired.





SUMMARY OF AUTOPILOT FUNCTIONS

1 – Route Mode

This mode makes the helicopter follow the active flight plan (series of waypoints).

2 – Hover Mode

To hover automatically over a ground-point after decelerating to near-zero airspeed, you can engage HOVER mode.

3 – Vertical Descent Mode

If while in HOVER mode it is necessary to decrease altitude, you can use the VERTICAL DESCENT mode.

4 – Altitude Hold / Collective Brake

Enables altitude hold. The altitude source depends on the position of the “Baro/Radar Altitude” switch. To change your altitude when in Altitude Hold mode, the collective brake lever is used.

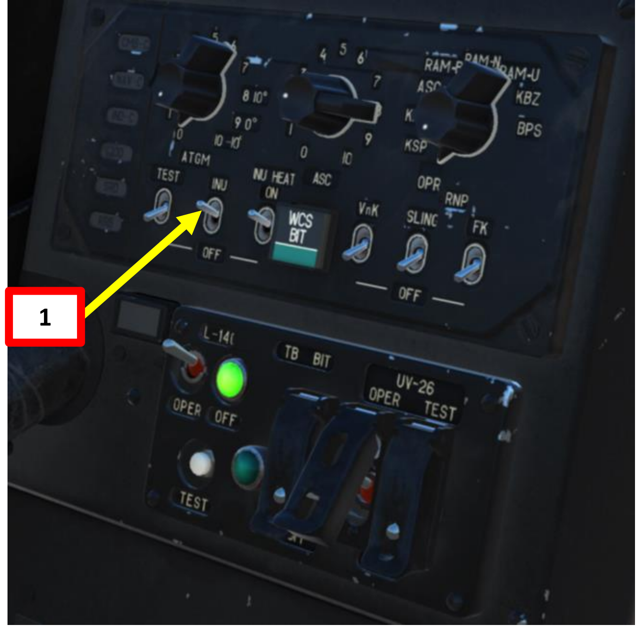
5 – Autopilot Coupling with HMS (Helmet-Mounted Sight)

The AUTO TURN function can make the autopilot turn the helicopter towards a point designated by the HMS (Helmet-Mounted Sight).

1 – ROUTE MODE

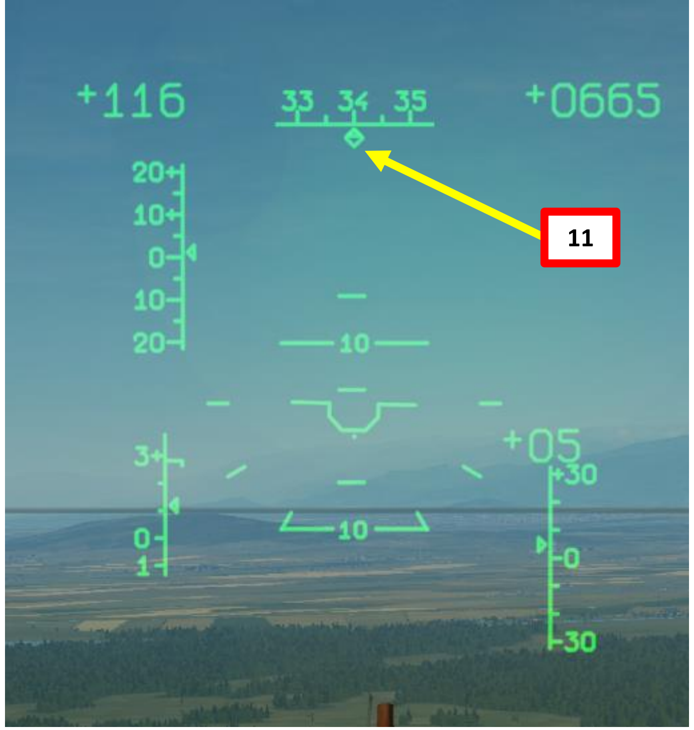
In this example, the autopilot will follow a route already programmed in the PVI-800 (see Navigation Section).

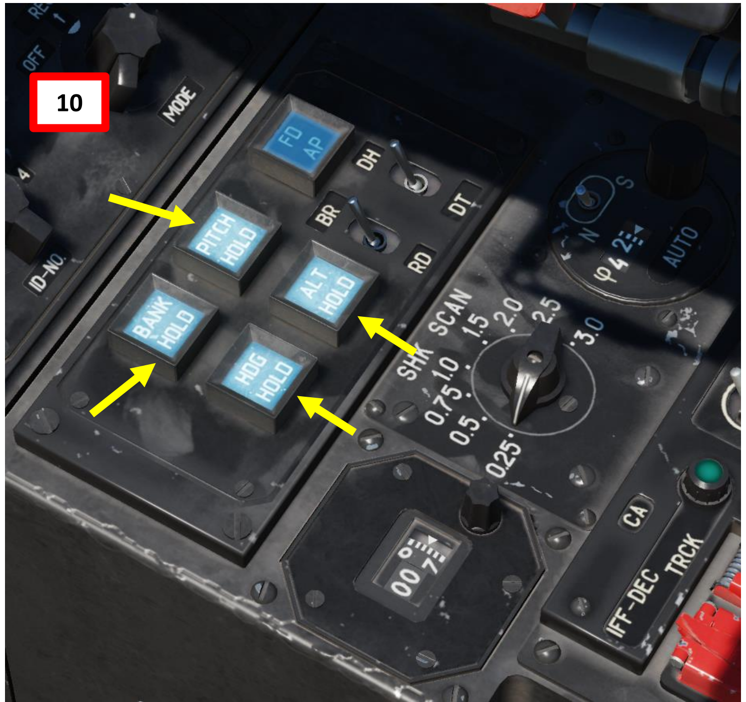
1. Turn on INU system power switch (UP)
2. Set GYRO mode (middle position)
3. Turn PVI-800 system ON (FWD)
4. Set PVI-800 mode to OPER to select a desired waypoint
5. Select desired waypoint type (in our case, we will select WPT to select a waypoint)
6. Select preset waypoint number (in our case we will select Waypoint 2)
7. Set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
    - Using barometric pressure ensures that the altitude is maintained regardless of terrain (but it means you could potentially crash into a hill if you do not watch your altitude).
    - Using radar altitude does not guarantee the helicopter will maintain a constant altitude, but it guarantees the helicopter will maintain a constant height above ground level.
8. Select DH (Desired Heading) if you want the autopilot to steer straight to the waypoint or DT (Desired Tracking) if you prefer the auto-pilot to steer you towards the tracking line to the waypoint.
9. Set DH/DTA to AUTO (DOWN).

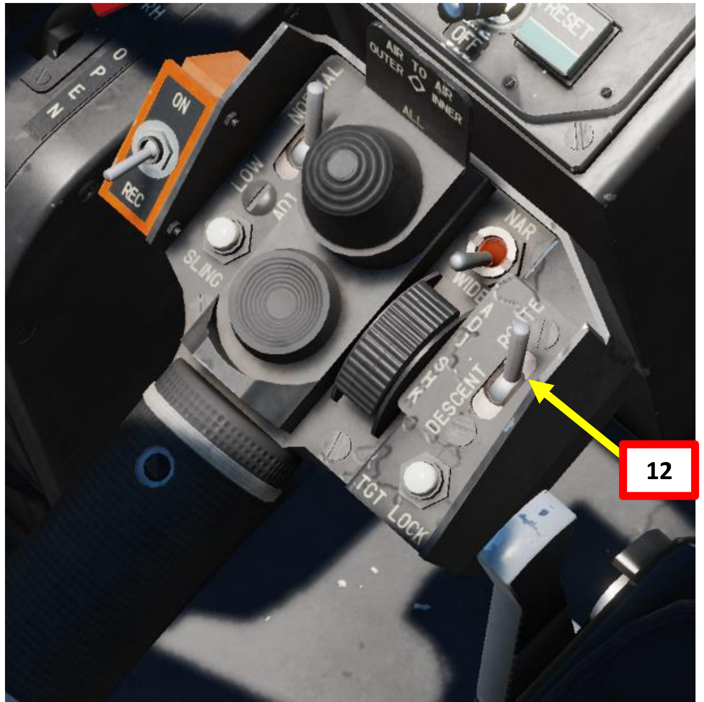


1 – ROUTE MODE

10. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. Take note that the "autopilot" are in fact used as "dampers".
11. Fly towards the waypoint until you have a decent airspeed, press the Trimmer switch to maintain constant airspeed. You can use the HUD heading indicator or the HSI (Horizontal Situation Indicator) to help you. Align yourself at + or – 15 degrees from desired heading.
12. Engage Route Mode on your collective using the "ROUTE/DESCENT" switch (Shortcut: "R" for Route and/or "D" for Descent) to engage autopilot. The switch should be set Forward. The autopilot route mode will steer the helicopter automatically to initiate a turn to the first waypoint with a bank angle up to 15°.







1 – ROUTE MODE

13. The “ENR COURSE” light indicates route navigation with course following is enabled, the “ENR NAV ON” light indicates route navigation with direct flight to steerpoint is enabled, the “NEXT WP” light indicates a notification of passing one waypoint and advancing to the next.
14. Once you have reached a waypoint, the autopilot will automatically steer the helicopter towards the next stocked waypoint on the list.
15. 250 m before the last waypoint saved in the flight plan, the ROUTE END light will illuminate. 2 km after passing the last WP, the ROUTE Mode disengages, the ROUTE END light goes off, and the helicopter stabilizes on its current heading.
16. Disengage Route Mode on collective by pressing “R” to disengage autopilot (“ROUTE/DESCENT” switch should be in middle OFF position).

1 – ROUTE MODE

<u>Note on using Route Mode without having a navigation task selected:</u>

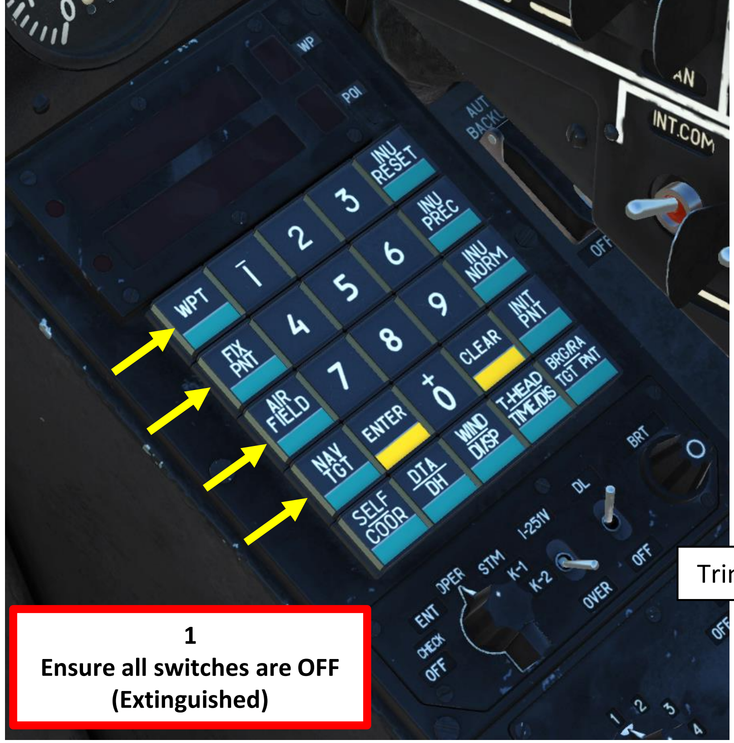
If a navigation task is not selected (meaning that no waypoint, target, or airfield is selected from the Navigation panel) it is possible to engage Route mode to maintain your current flight path. Thus, current flight path parameters like pitch, roll, yaw, and altitude are saved in the navigation system.

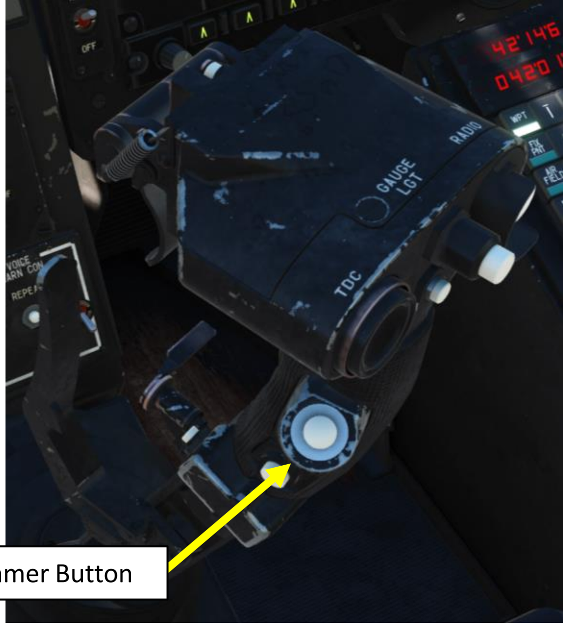
<u>To engage Route mode without a task:</u>

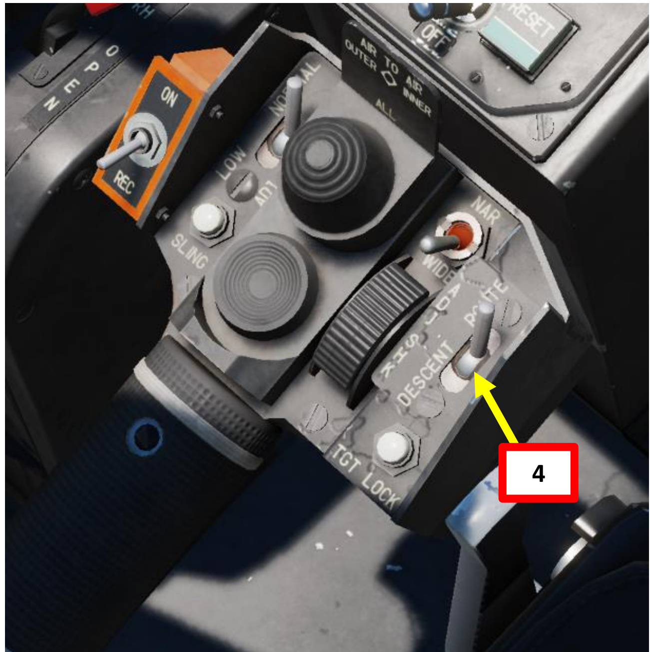
1. Switch off all task buttons on the Navigation panel: Waypoints, Targets, and Airfields.
2. The position of the Desired Heading – Desired Track Angle switch does not influence navigation.
3. Stabilize the helicopter in level flight with the desired speed.
4. Engage ROUTE mode by setting the "ROUTE/DESCENT" switch on the collective to the ROUTE position and the helicopter will hold current flight parameters and bearing.

<u>For changing flight parameters it is necessary to:</u>

a) Press and hold the Trimmer on the cyclic stick.
b) Set new flight input (bearing, pitch and speed).
c) Release the Trimmer button.



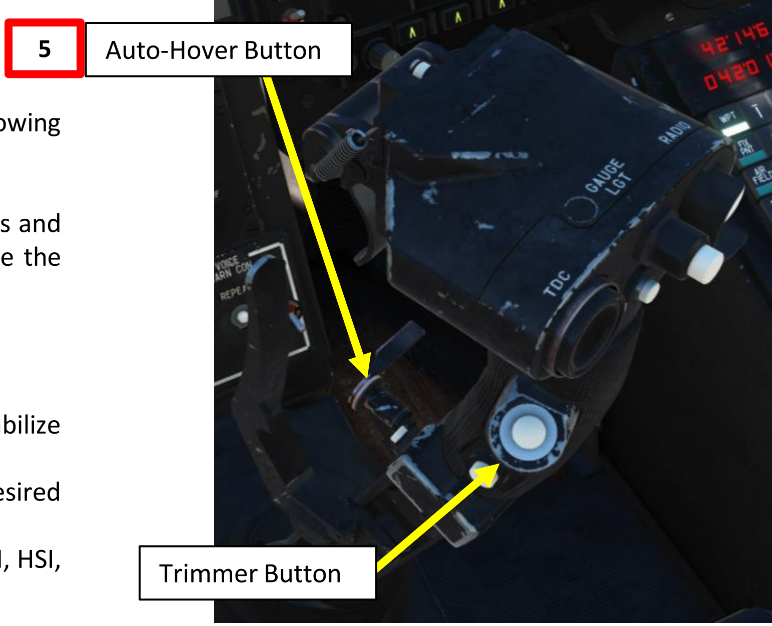


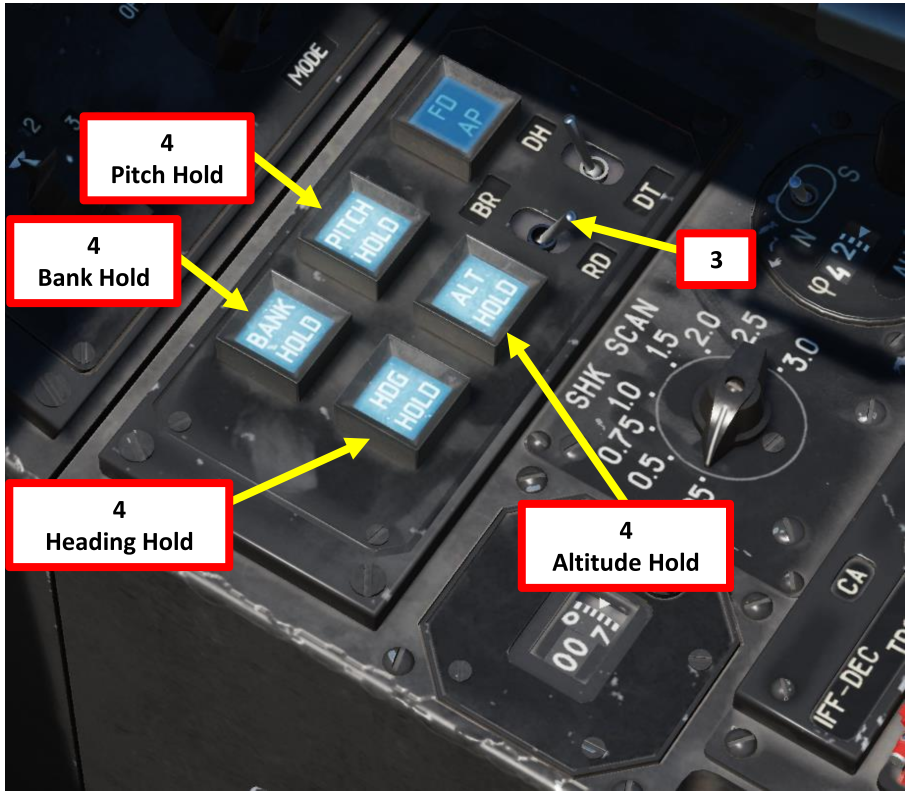


2 – HOVER MODE

To hover automatically over a ground-point after decelerating to near-zero airspeed, you can engage HOVER mode using the following procedure:

1. To enter hover mode the aircraft must be travelling at no faster than 25-30 km/h. To lose airspeed pitch the aircraft up 10 degrees and trim the aircraft using the trimmer system ("T" key binding). Control your altitude using the collective as the new pitch will cause the aircraft to start climbing in altitude, keep the aircraft from climbing or from descending faster than 3 m/s.
2. Set the "ROUTE/DESCENT" switch on the collective to the neutral position (OFF).
3. Set Altitude Stabilization selector to RD (Radar Altimeter).
4. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold + Altitude Hold).
5. Press the "HOVER" button on the cyclic and this will illuminate the HOVER light on the overhead panel. The helicopter will then stabilize above the hover point; radar altitude stabilization mode will engage; and the RALT HOLD light will illuminate on the overhead panel.
6. To change aircraft direction, disengage the Heading/Yaw Hold Autopilot Channel, use rudder pedals to steer the aircraft in the desired direction, then engage Heading/Yaw Hold Autopilot Channel again. The new aircraft heading will be used as a reference.
7. To disengage the Hover mode, press the HOVER button on the cyclic again and the HOVER light and all hover indications on the ADI, HSI, and HUD will be removed.



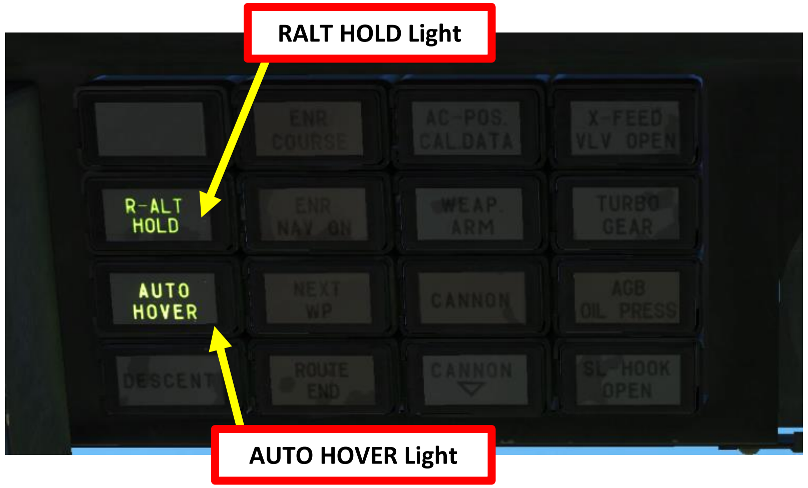


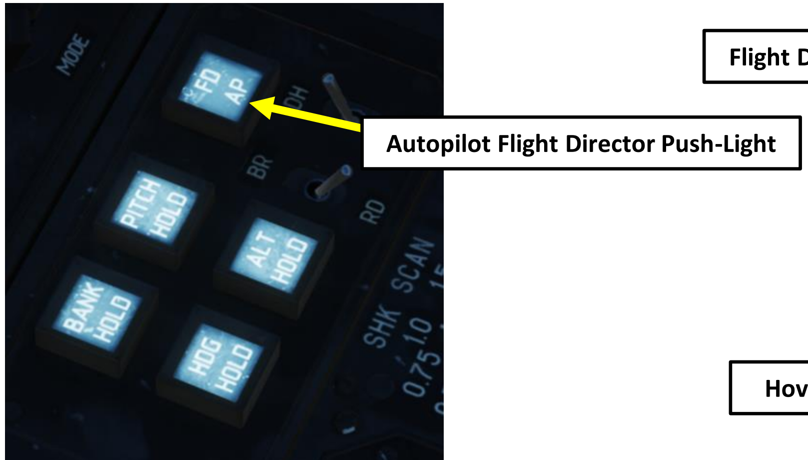
2 – HOVER MODE

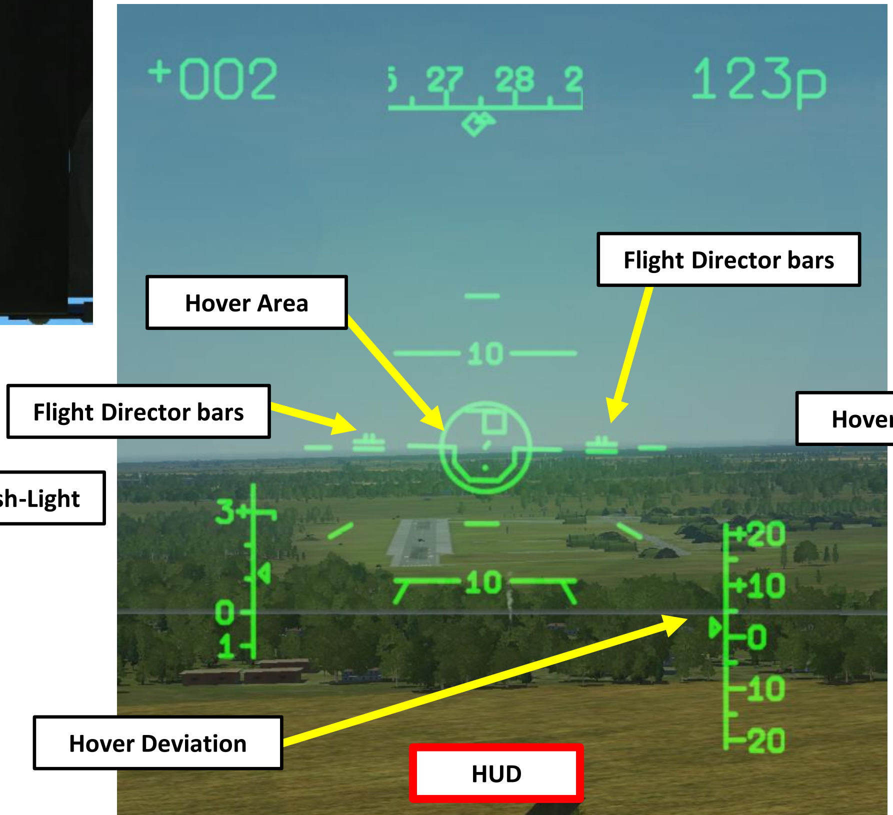
If there is any deviation from the initial hover point, the helicopter will automatically return to its initial position.

When HOVER mode is enabled, the following flight indications are provided:

- On the Attitude and Director Indicator (ADI) – Deviation from the set altitude and lateral position at Hover initiation is indicated by the pitch and bank flight directors.
- On the Horizontal Situation Indicator (HSI) – Longitudinal and lateral deviation from the hover point is indicated.
- On the Heads-Up Display (HUD) – Hover area and hover symbol deviation from the set hover altitude; flight directors for bank, pitch and altitude; commands for return to the desired hover point at the desired altitude, and a ground speed vector in any direction are all provided.
    - Note: The FD AP push-light needs to be active for flight director symbology to be visible on the HUD.



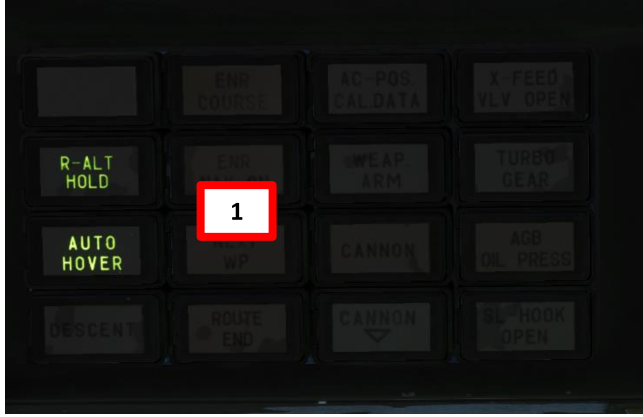


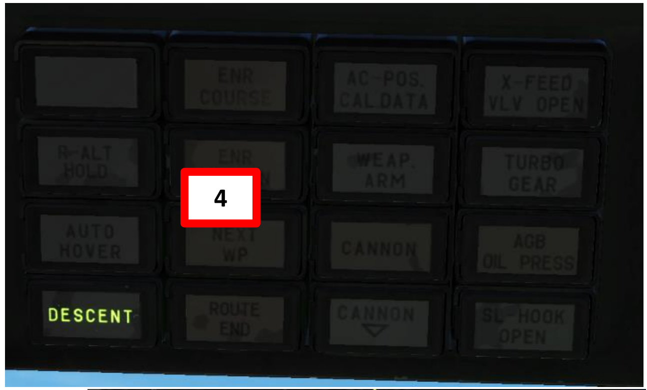


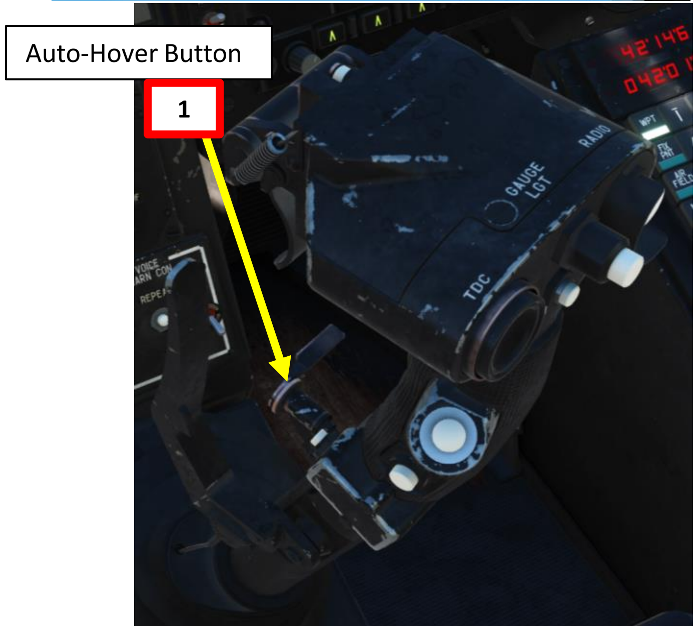
3 – VERTICAL DESCENT MODE

If while in HOVER mode it is necessary to decrease altitude, you can use the VERTICAL DESCENT mode.

1. Settle the aircraft in a hover and engage Auto-Hover has shown previously.
2. Disengage the ALT HOLD autopilot channel.
3. Press and hold the "ROUTE/DESCENT" switch on the collective in the DESCENT position ("D" binding).
4. When this is done, the HOVER light and the RALT HOLD light will go off and the DESCENT light will turn on.
5. The helicopter will initiate a vertical descent with a sink rate of up to 2 m/s while stabilizing its position at the hover point and keeping the hover indication.
6. Upon reaching the desired altitude, set the DESCENT push-button back to neutral and thus cease the descent. The DESCENT light will turn off, the HOVER and RALT HOLD lights will illuminate, and HOVER mode will be implemented at the new altitude.
7. If the push-button is still held in the DESCENT position, the helicopter will descend down to 4 m altitude above ground level; after that the descent is cancelled in order to avoid colliding with the ground.



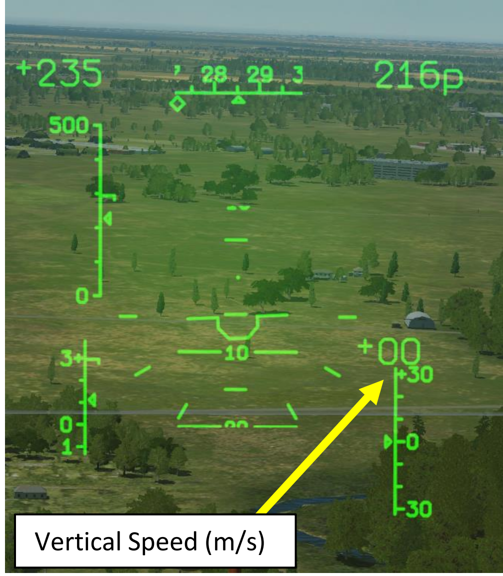


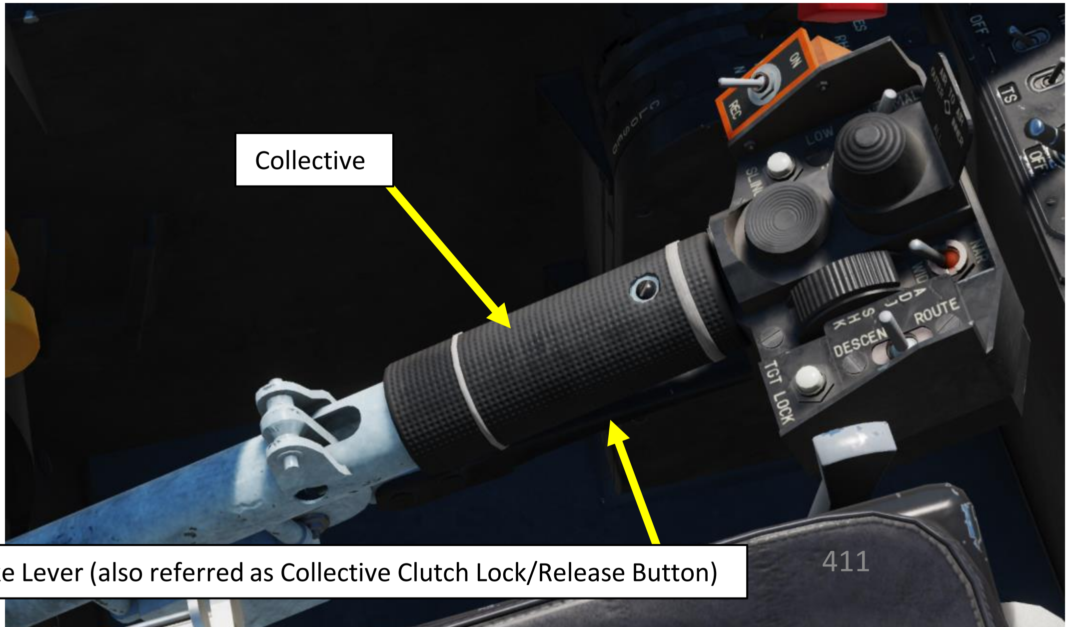


4 – ALTITUDE HOLD / COLLECTIVE BRAKE MODE

The autopilot allows you to hold your current altitude using the “ALT HOLD” button, which maintains the selected altitude at the time of autopilot activation.

1. Set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
    - Using barometric pressure ensures that the altitude is maintained regardless of terrain (but it means you could potentially crash into a hill if you do not watch your altitude).
    - Using radar altitude does not guarantee the helicopter will maintain a constant altitude, but it guarantees the helicopter will maintain a constant height above ground level.
    - The middle position of the BR/RD switch behaves like the last position (BR or RD) which was selected and had an altitude capture event (collective brake squeeze or altitude channel engagement). As an example, if you use RD and switch directly to center position it will act like RD.
2. Fly the helicopter at the desired altitude and reduce vertical speed as much as possible.
3. Press the ALT HOLD push-light. The autopilot will memorize the current altitude reference and try to maintain it based on the Altitude Stabilization mode selected (RD will maintain the height above ground level, which can cause altitude fluctuations in uneven terrain, and BR will use barometric pressure as a reference, which ensures a level flight but does not protect the helicopter from terrain).
4. If RD Altitude Stabilization is selected, the R ALT HOLD light will illuminate.
5. While ALT HOLD is engaged, you can modify the altitude reference by pressing the Collective Brake lever (“F” binding, also referred as “Collective Clutch Lock/Release Button”) , moving the collective to reach the new altitude reference, then releasing the collective brake lever.





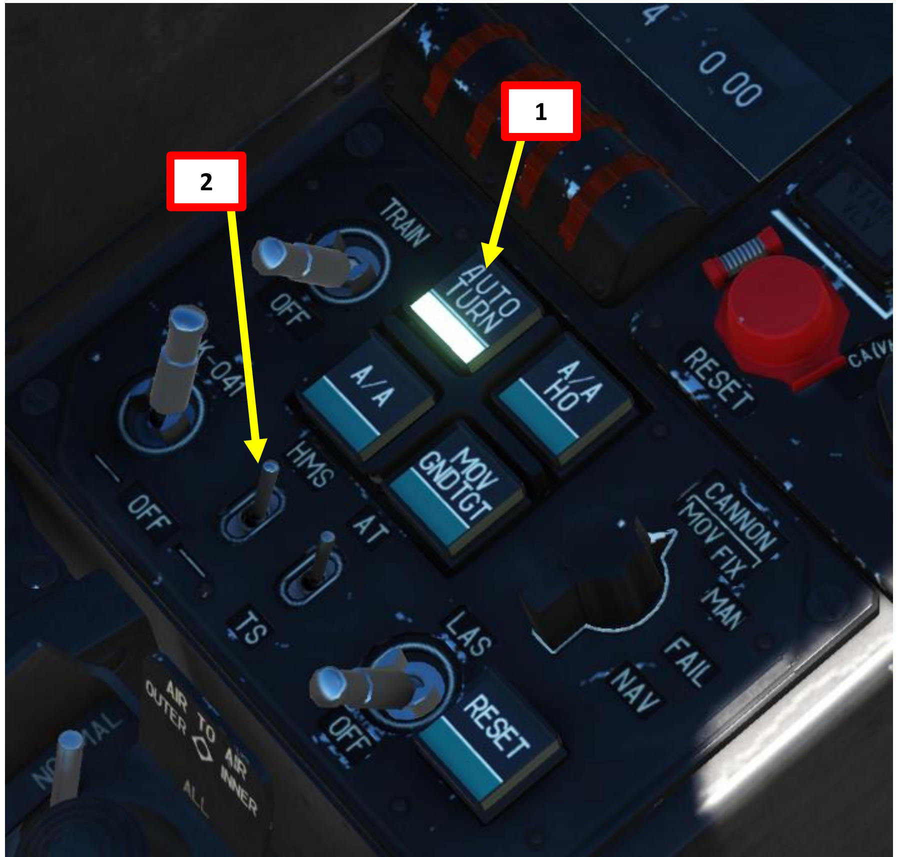
5 Collective Brake Lever (also referred as Collective Clutch Lock/Release Button)

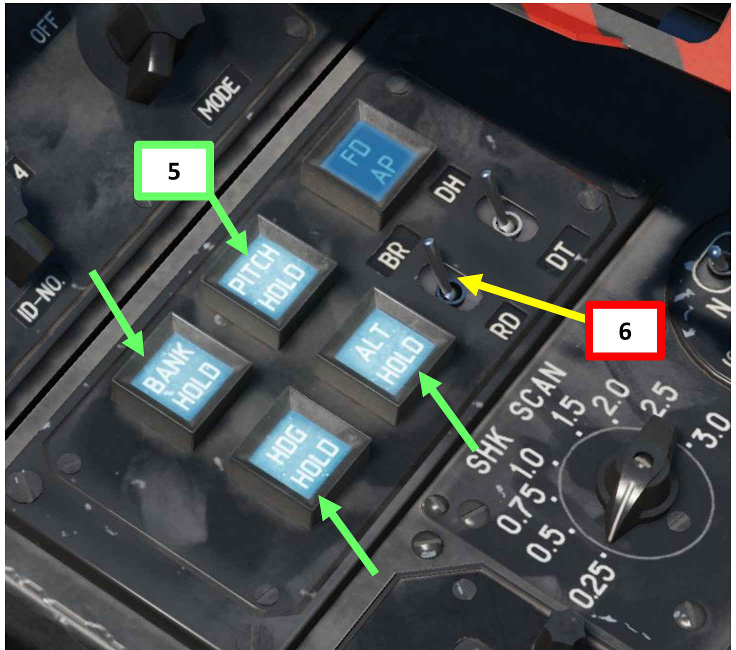
5 – AUTOPILOT COUPLING WITH HMS (HELMET-MOUNTED SIGHT)

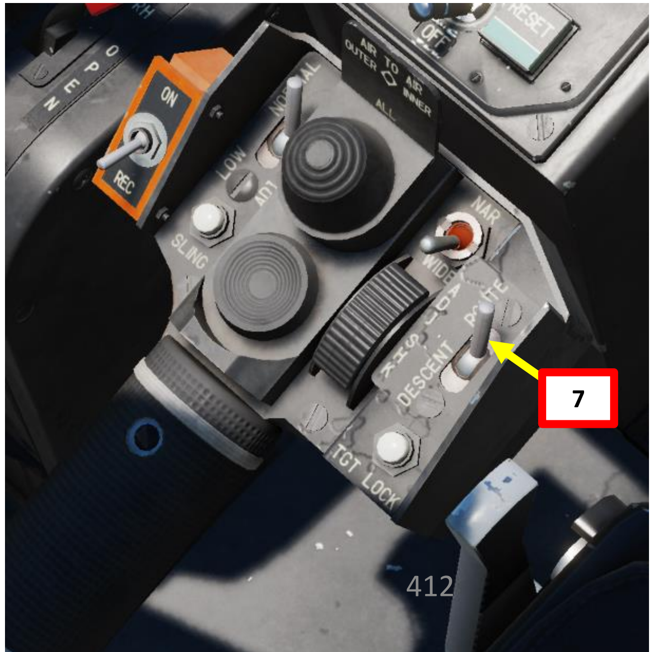
The HMS (Helmet-Mounted Sight) can also be used by the autopilot to guide the helicopter.

1. Select "AUTO-TURN" button. This will allow the Ka-50 to automatically face the direction you are aiming with the HMS when Shkval is uncaged.
2. Set HMS (Helmet Mounted Sight) switch ON (FWD).
3. Switch off all task buttons on the Navigation panel: Waypoints, Targets, and Airfields.
4. Stabilize the helicopter in level flight with the desired speed.
5. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. The one essential mode in our case is Heading/Yaw Hold.
6. If you are using the ALT HOLD mode, set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
7. Engage ROUTE mode by setting the "ROUTE/DESCENT" switch on the collective to the ROUTE position and the helicopter will hold current flight parameters and bearing.

3
Ensure all switches are OFF
(Extinguished)

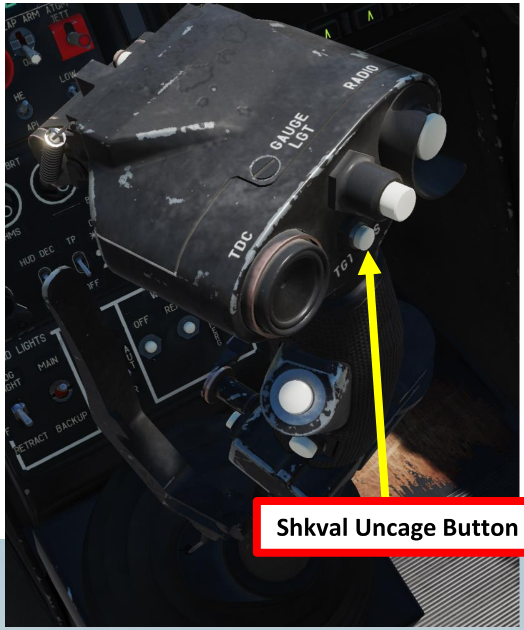






5 – AUTOPILOT COUPLING WITH HMS (HELMET-MOUNTED SIGHT)

8. Move your head to place the HMS (Helmet Mounted Sight) cross on the point you want to fly to, then uncage SHKVAL by pressing "O" or using custom binding.
9. The autopilot will then steer the helicopter towards the point you just designated with the HMS.



COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Flying combat operations in the Ka-50 is an art. There are many, many resources at your disposal, but the main one I recommend is the "10 RULES TO LIVE BY: **DCS Black Shark Tactics Primer"** by Realandsimulatedwars. This is top quality, no-nonsense content and very useful.
Link: http://realandsimulatedwars.yolasite.com/dcs-black-shark-tactics-primer.php

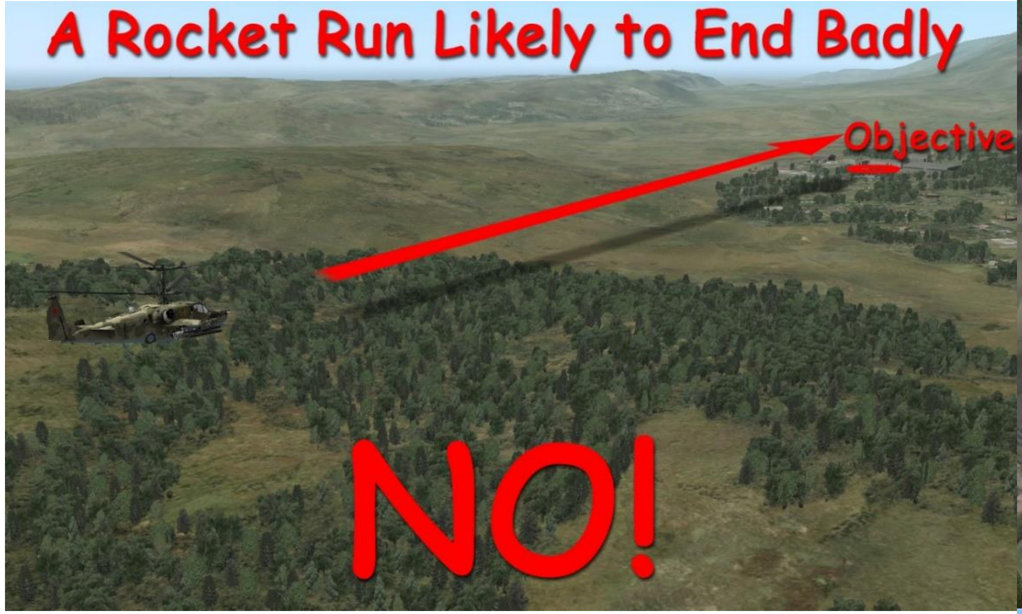
- **Rule #1: Never fly over the objective**
- **Rule #2: Fire munitions from their maximum range**
- **Rule #3: Avoid the "Dead Man's Zone"**
- **Rule #4: New Area = DANGER ZONE!**
- **Rule #5: There is no such thing as too much reconnaissance**
- **Rule #6: Identify your targets**
- **Rule #7: Preserve ammunition**
- **Rule #8: Know the operational situation**
- **Rule #9: Attack the enemy from your maximum munition range and on its flanks**
- **Rule #10: Lack of patience will kill you**

There are other great resources such as **KriegSimulation's "Nap-of-the-Earth" article**
http://kriegsimulation.blogspot.ca/2009/10/dcs-black-shark-nap-of-earth-noe-flying.html

Robdcamp's forum thread on SIMHQ is also enlightening to help you survive AAA threats:
http://simhq.com/forum/ubbthreads.php/topics/2915432/Guide_to_Surving_MANPADS_AAA_a.html#Post2915432

COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Rule #1: Never fly over the objective

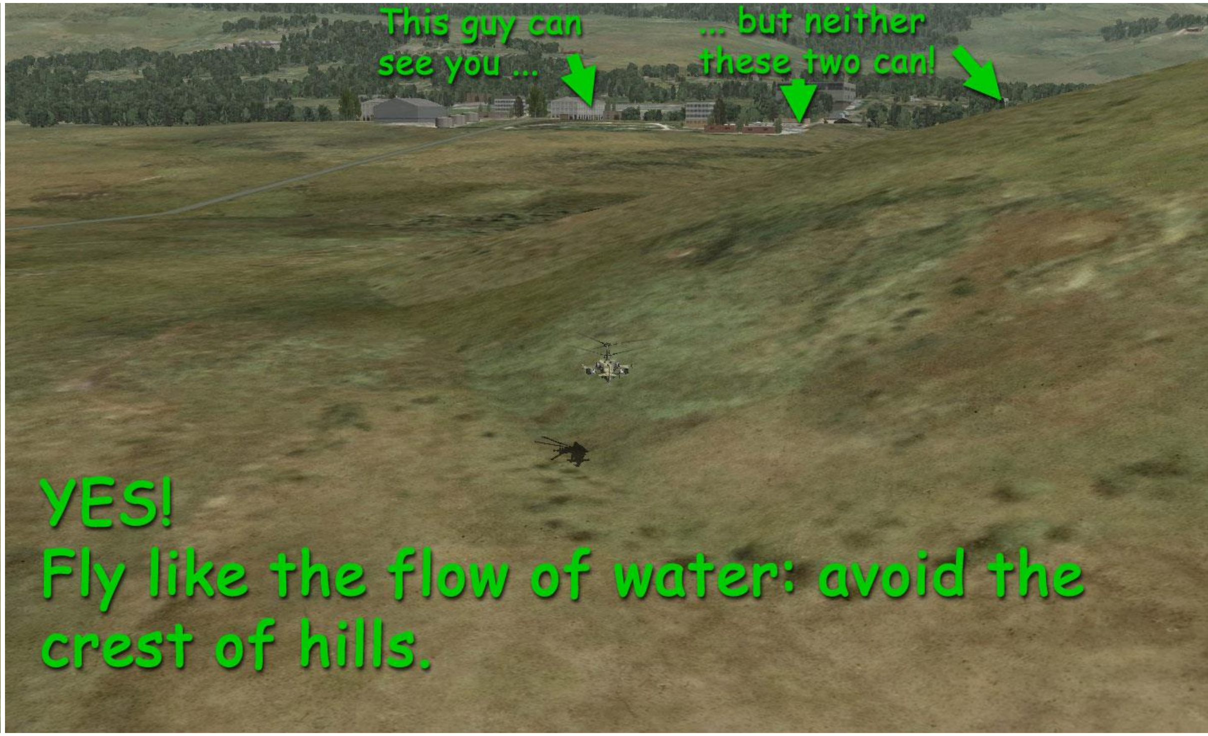


COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Rule #2: Fire munitions from their maximum range

COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Rule #3: Avoid the "Dead Man's Zone"



COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Rule #4: New Area = DANGER ZONE!
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Rule # 6: Identify your targets
Rule #7: Preserve ammunition
Rule #8: Know the operational situation
Rule #9: Attack the enemy from your maximum munition range and on its flanks
Rule #10: Lack of patience will kill you.

OTHER INTERESTING RESOURCES AND USEFUL STUFF

DCS KA-50 BLACK SHARK MANUAL
https://drive.google.com/open?id=0B-uSpZROuEd3TW03aEx3TmpxUnM

FAA HELICOPTER FLYING HANDBOOK
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/

FAA MANUAL CHAPTER 15: NAVIGATION
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2015.pdf

BLACK SHARK WIKI
http://en.wiki.eagle.ru/wiki/DCS_KA-50_BlackShark_(1/2)_Guides,_Tutorials_and_Reference_Documents

BLACK SHARK PRODUCER'S NOTES (COVER YOUR EYES, 480p RESOLUTION)
https://www.youtube.com/playlist?list=PL0CFA7EA40064EAE4

FROOGLE'S YOUTUBE CHANNEL
https://www.youtube.com/watch?v=nWoad9Qolr4

BUNYAP'S YOUTUBE CHANNEL
https://www.youtube.com/playlist?list=PLoiMNu5jyFzTKgp045y5ibDtS4ST9lz9z

BANJO'S YOUTUBE CHANNEL – SHORT, CONCISE AND MEANINGFUL TUTORIALS FOR THE BLACK SHARK
https://www.youtube.com/playlist?list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0

TEACH YOURSELF DCS YOUTUBE CHANNEL
https://www.youtube.com/playlist?list=PLpWui61PBlo2_RfPRrWVQk1jtIlBSE-FO

DCS digital combat series
Ka50 BLACK SHARK 2
INSTANT ACTION
CREATE FAST MISSION
TRAINING
MISSION
CAMPAIGN
REPLAY
MULTIPLAYER
MISSION EDITOR
CAMPAIGN BUILDER
ENCYCLOPEDIA
OPTIONS
LOGBOOK
MODULE MANAGER
EXIT
A-10C 1.2.16
Bf 109 K-4 1.2.16 beta
C-101EB 1.2.16.1 Beta
CA 1.2.16
F-86F 1.2.16 beta
FC3 1.2.16
Fw 190 D-9 1.2.16
Hawk 1.2.16 Beta
Ka-50 1.2.16
Mi-8MTV2 1.2.16 beta
MiG-15bis 1.2.16 beta
MiG-21Bis 1.2.15
P-40F 1.2.16 Beta
P-51D 1.2.16
Su-25T 1.2.16
TF-51D 1.2.16
UH-1H 1.2.16
THE FIGHTER COLLECTION
Eagle Dynamics
Version: 1.2.16.43180
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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:

- Jake Gunter
- Dfpoor
- ChazFlyz


DCS digital combat series
Chuck_Owl
DCS: Ka-50
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EXIT
F-14B EA
F-16C EA
F-5E
F-86F
F/A-18C EA
FC3
Fw 190 A-8
Fw 190 D-9
I-16
JF-17 EA
Ka-50
Ka-50 III
L-39
M-2000C 2.7.x
Marianas EA
MB-339
Mi-24P EA
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