DCS GUIDE

AJS37 VIGGEN

By Chuck

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

The **Saab AJS37 Viggen** is an aircraft that was developed during the 1960's and entered service in the Swedish Air Force in 1972. It was primarily designed as an attack aircraft with a focus on pre-planned targets, using tactics that would concentrate on a single attack on a target area with the aircraft approaching from very low altitudes (often lower than 50 m AGL) and later withdraw at very high speed. The ground radar makes the AJS-37 very flexible and able to navigate in pretty much any weather conditions, which is a big plus since it's something quite new within the DCS World.

Development work on the type was initiated at Saab in 1952 and, following the selection of a radical delta wing configuration, the resulting aircraft performed its first flight on 8 February 1967 and entered service in 21 June 1971. It was the first canard design produced in quantity. Several distinct variants of the Viggen were produced to perform the roles of strike fighter (AJ37), aerial reconnaissance (SF37), maritime patrol aircraft (SH37) and a two-seat trainer (SK37). In the late 1970s, the all-weather fighter-interceptor aircraft JA37 variant was introduced. In November 2005, the Viggen was retired from service by the Swedish Air Force, the only operator, having been replaced by the newer Saab JAS39 Gripen.

The Viggen was powered by a single Volvo RM8 turbofan. This was essentially a licence-built variant of the Pratt & Whitney JT8D engine that powered commercial airliners of the 1960s, with an afterburner added for the Viggen. The airframe also incorporated a thrust reverser to use during landings and land manoeuvers, which, combined with the aircraft having flight capabilities approaching a limited STOL-like performance, enabled operations from 500 m airstrips with minimal support.

Interestingly, the Viggen was designed to be simple to maintain, even by conscripted flight line mechanics with limited technical training. A single Viggen could be maintained by a team of five conscripts under the supervision of a single chief mechanic. Standard turnaround, including refueling and rearming, took less than ten minutes to perform; while an engine replacement took four hours. Over the long term, the Viggen required 22-man hours per flight hour of maintenance work at the depot level, and nine-man hours per flight hour at the front line.

On a side note, by the mid-1980s, Swedish Viggen JA37 fighter pilots, using the predictable patterns of Lockheed SR-71 Blackbird routine flights over the Baltic Sea, had managed to achieve radar lock-on with radar on the SR-71 on numerous occasions. Despite heavy jamming from the SR-71, target illumination was maintained by feeding target location from ground-based radars to the fire-control computer in the Viggen. The most common site for the lock-on to occur was the thin stretch of international airspace between Öland and Gotland that the SR-71 used on the return flight. The Viggen is the only aircraft to get an acknowledged radar lock on the SR-71.

Saying that the Viggen is "fast" is quite the understatement. It has a superb acceleration and truly unique capabilities that very few aircraft in the world can accomplish. You will be flying at breakneck speeds at ground-level, following a meticulously planned trajectory. Flying the Viggen will show you the value of proper planning; this addition by Heatblur Simulations really opened my eyes by forcing me to take into account things that I would typically not give much of a thought before. For instance, adjusting the altimeter pressure setting is essential; all your reference points on your HUD rely on the altimeter reading, and failing to get to the target fully prepared can often generate situations where your targeting cues are off. More than once, I scratched my head trying to figure out why this bomb release cue hadn't appeared or why it was drifting to the right during my attack run… most of the time, there is a very real, very logical reason behind it.

The Viggen is a challenging aircraft to fly. Not because it is difficult to handle, far from it. The challenge is to learn the tactics to stay alive in a hostile environment crawling with SAM sites while flying 50 meters from the ground. You will learn what "pop-up points" are, why they matter and the advantages of the Viggen in many other areas (such as its thrust reversers, which make the AJS-37 capable of landing on a dusty strip of ground in the middle of nowhere). The Swedish aircraft is the result of a practical design philosophy, sound hit-and-run tactics and technologies that allow the pilot to set many weapon parameters using a very simple interface.

You, dear reader, may look at this guide and gasp at the sheer number of pages. Don't panic: it's nothing close to the whole capabilities of the Viggen. I said don`t panic! The best way to go through this guide is section by section. Learn how to start up the aircraft first, map your controls. Then, learn how to takeoff and land it properly and how to set up and navigate between waypoints. Once you have that figured out, the rest of simply learning how to use the dozen weapons modelled within the sim.

It's fun. It's challenging. You'll fall in love the second the afterburner kicks in.

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

OPTIONS

| SYSTEM | CONTROLS | GAMEPLAY | MISC. | AUDIO | SPECIAL | VR |

AJS37 ▾   Axis Commands ▾   ☑ Foldable view   Reset category to default   Clear category   Save profile as   Load profile

Action	Category	Keyboard ▾	Throttle - HOTAS... ▾	Saitek Pro Flight ... ▾	Joystick - HOTAS ... ▾	T
Absolute Camera Horizontal View						
Absolute Camera Vertical View						
Absolute Horizontal Shift Camera View						
Absolute Longitude Shift Camera View						
Absolute Roll Shift Camera View						
Absolute Vertical Shift Camera View						
Camera Horizontal View						
Camera Vertical View						
Camera Zoom View						
Countermeasure Dispense - Absolute	Countermeasures					
Head Tracker : Forward/Backward						TI
Head Tracker : Pitch						TI
Head Tracker : Right/Left						TI
Head Tracker : Roll						TI
Head Tracker : Up/Down						TI
Head Tracker : Yaw						TI
Master Mode select						
Missile Select Button (IR-RB FRAMSTEGN) - Absolute	Weapons					
Pitch					JOY_Y	
Radar elevation						
Radar MKR Gain				JOY_SLIDER1		
Radar Night Filter - Absolute	Radar					
Radar stick horizontal						
Radar stick vertical						

Modifiers   Add   Clear   Default   Axis Assign   Axis Tune   FF Tune   Make HTML

CANCEL   OK

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".
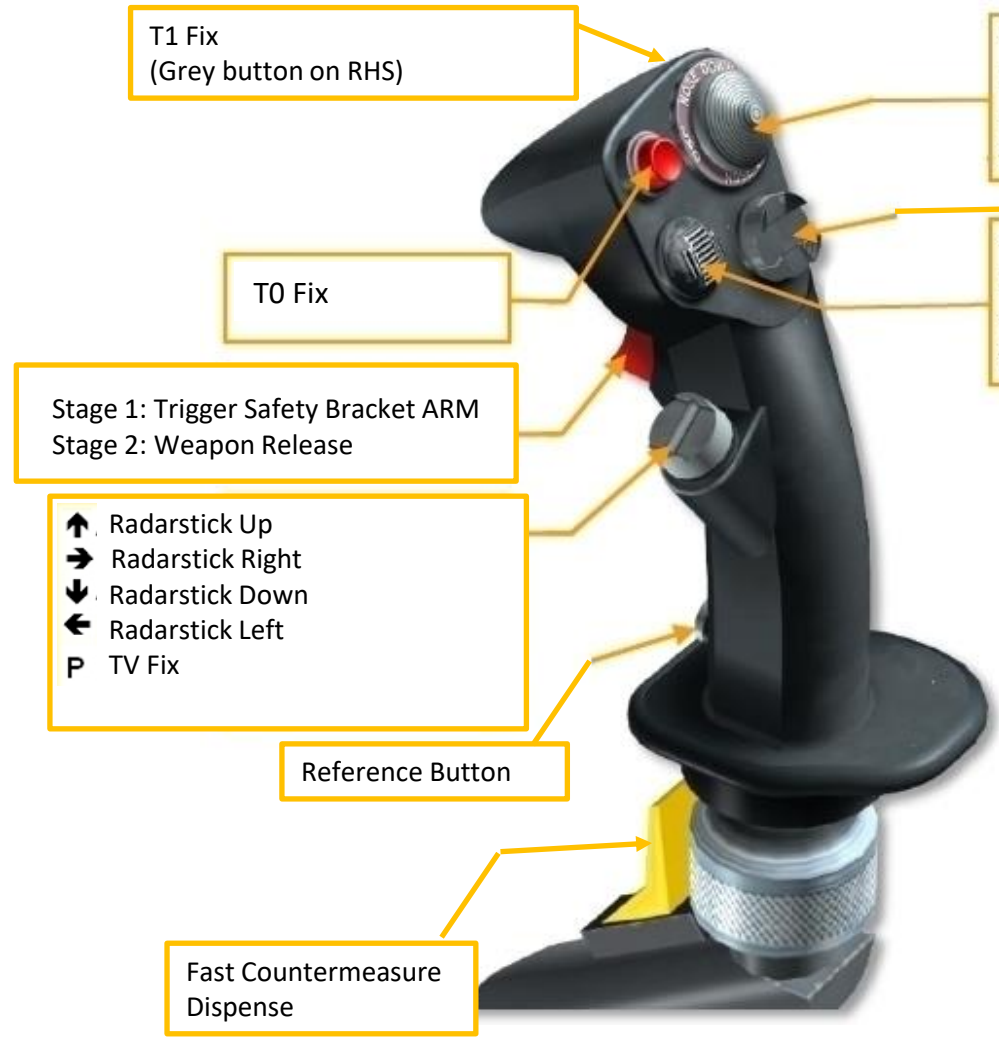
6

Bind the following axes:

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

OPTIONS

SYSTEM	CONTROLS		SPECIAL	VR

AJS37 | Axis Commands | | Save profile as | Load profile

AXIS TUNE PANEL

Deadzone
0

Saturation X
100

Saturation Y
100

Curvature
9

- ☑ Slider
- ☑ Invert
- ☑ User Curve

Axis Tune
JOY_Y

Action			Saitek Pro Flight ...	Joystick - HOTAS ...
Absolute Camera Horizontal View				
Absolute Camera Vertical View				
Absolute Horizontal Shift Camera View				
Absolute Longitude Shift Camera View				
Absolute Roll Shift Camera View				
Absolute Vertical Shift Camera View				
Camera Horizontal View				
Camera Vertical View				
Camera Zoom View				
Countermeasure Dispense - Absolute				
Head Tracker : Forward/Backward				
Head Tracker : Pitch				
Head Tracker : Right/Left				
Head Tracker : Roll				
Head Tracker : Up/Down				
Head Tracker : Yaw				
Master Mode select				
Missile Select Button (IR-RB FRAMSTEGN) - Absolute		Weapons		
Pitch				JOY_Y
Radar elevation				
Radar MKR Gain		JOY_SLIDER1		
Radar Night Filter - Absolute		Radar		
Radar stick horizontal				
Radar stick vertical				

Modifiers | Add

CANCEL | RESET | OK

...une | Make HTML

CANCEL | OK

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WHAT YOU NEED MAPPED

T1 Fix
(Grey button on RHS)

⬆ TRIM NOSE DOWN
➡ TRIM RIGHT WING DOWN
⬇ TRIM NOSE UP
⬅ TRIM LEFT WING DOWN

⬆ RB05 Stick Pitch Up
➡ RB05 Stick Yaw Right
⬇ RB05 Stick Pitch Down
⬅ RB05 Stick Yaw Left

⬆ ZOOM IN SLOW
➡ Obstacle Detection Mode
⬇ ZOOM OUT SLOW
⬅ Memory Mode

T0 Fix

Radar MKR Gain Axis

Stage 1: Trigger Safety Bracket ARM
Stage 2: Weapon Release
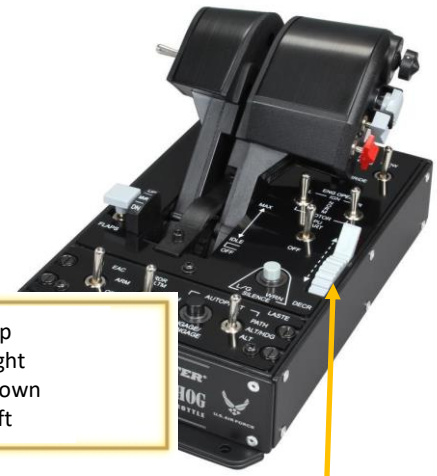
Autothrottle (AFK) Disconnect / IR Missile Fast Select

⬆ Radarstick Up
➡ Radarstick Right
⬇ Radarstick Down
⬅ Radarstick Left
P TV Fix

⬆ FR22 Push-to-Talk
➡
⬇ FR24 Push-to-Talk
⬅ COMMUNICATION MENU

IR Missile Uncage

Reference Button

⬅ Airbrake In

➡ Airbrake Out

⬆ Radar Elevation UP
➡ Radar Range Increase
⬇ Radar Elevation DOWN
⬅ Radar Range Decrease

⬅ A2 Mode (3 pos switch)

➡ A0 Mode (3 pos switch)

Fast Countermeasure Dispense

⬅ Radar Decrease Brightness

➡ Radar Increase Brightness
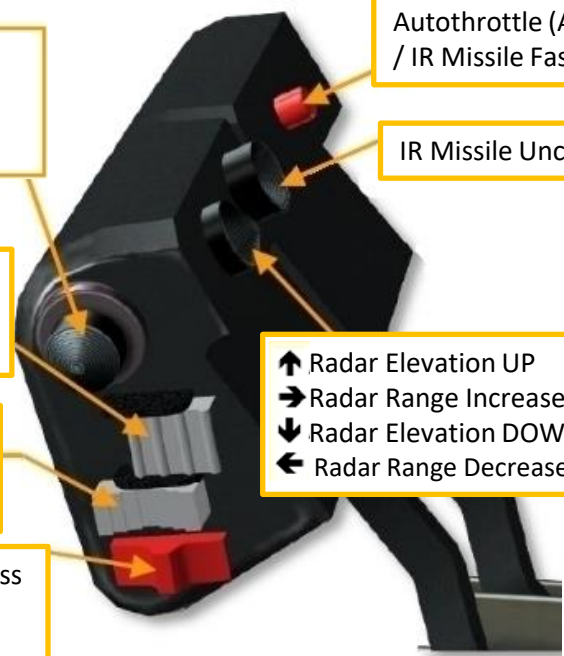
+ TOE BRAKES (MAPPED ON PEDALS)
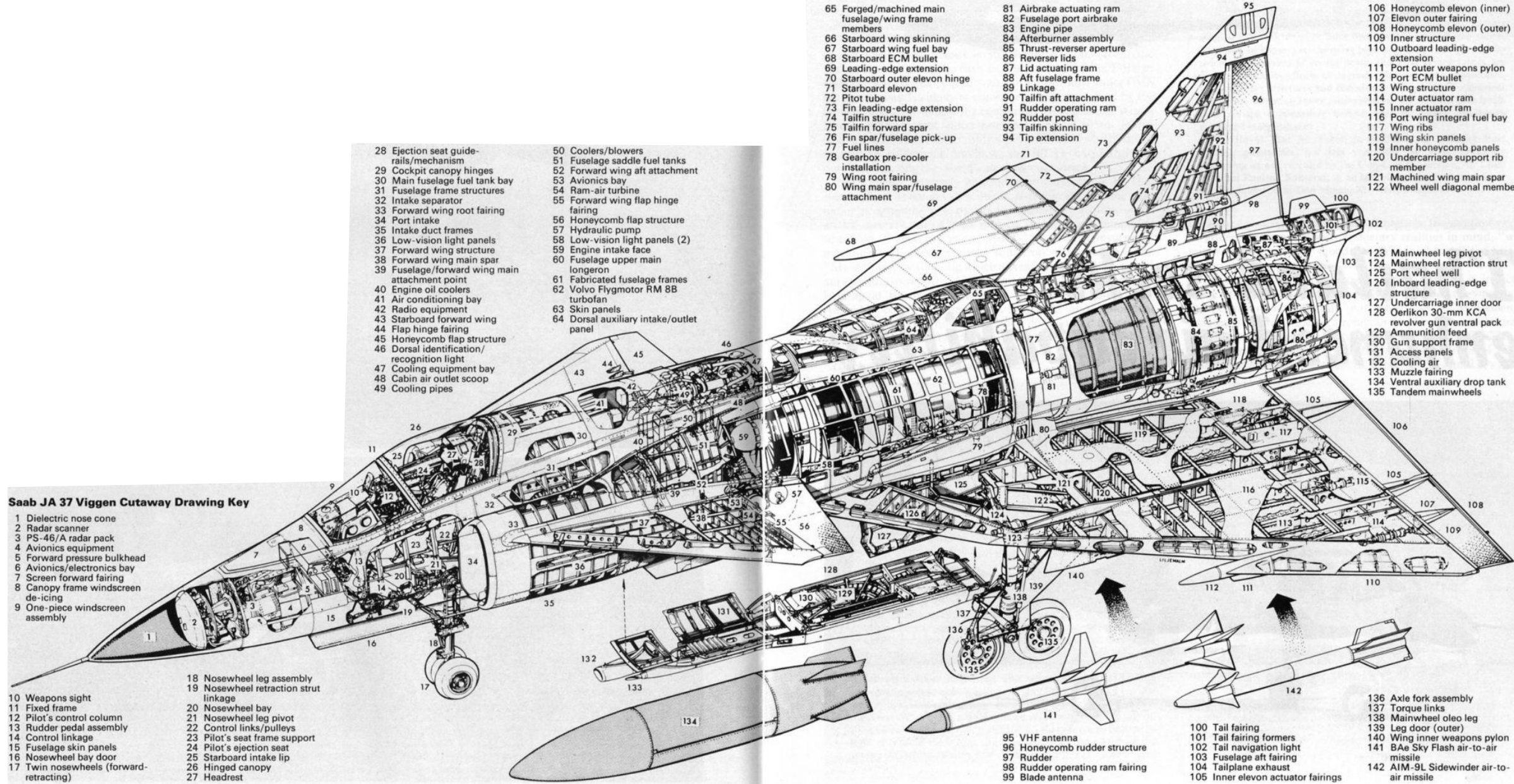
Saab JA 37 Viggen Cutaway Drawing Key

1 Dielectric nose cone
2 Radar scanner
3 PS-46/A radar pack
4 Avionics equipment
5 Forward pressure bulkhead
6 Avionics/electronics bay
7 Screen forward fairing
8 Canopy frame windscreen de-icing
9 One-piece windscreen assembly
10 Weapons sight
11 Fixed frame
12 Pilot's control column
13 Rudder pedal assembly
14 Control linkage
15 Fuselage skin panels
16 Nosewheel bay door
17 Twin nosewheels (forward-retracting)
18 Nosewheel leg assembly
19 Nosewheel retraction strut linkage
20 Nosewheel bay
21 Nosewheel leg pivot
22 Control links/pulleys
23 Pilot's seat frame support
24 Pilot's ejection seat
25 Starboard intake lip
26 Hinged canopy
27 Headrest

28 Ejection seat guide-rails/mechanism
29 Cockpit canopy hinges
30 Main fuselage fuel tank bay
31 Fuselage frame structures
32 Intake separator
33 Forward wing root fairing
34 Port intake
35 Intake duct frames
36 Low-vision light panels
37 Forward wing structure
38 Forward wing main spar
39 Fuselage/forward wing main attachment point
40 Engine oil coolers
41 Air conditioning bay
42 Radio equipment
43 Starboard forward wing
44 Flap hinge fairing
45 Honeycomb flap structure
46 Dorsal identification/recognition light
47 Cooling equipment bay
48 Cabin air outlet scoop
49 Cooling pipes

50 Coolers/blowers
51 Fuselage saddle fuel tanks
52 Forward wing aft attachment
53 Avionics bay
54 Ram-air turbine
55 Forward wing flap hinge fairing
56 Honeycomb flap structure
57 Hydraulic pump
58 Low-vision light panels (2)
59 Engine intake face
60 Fuselage upper main longeron
61 Fabricated fuselage frames
62 Volvo Flygmotor RM 8B turbofan
63 Skin panels
64 Dorsal auxiliary intake/outlet panel

65 Forged/machined main fuselage/wing frame members
66 Starboard wing skinning
67 Starboard wing fuel bay
68 Starboard ECM bullet
69 Leading-edge extension
70 Starboard outer elevon hinge
71 Starboard elevon
72 Pitot tube
73 Fin leading-edge extension
74 Tailfin structure
75 Tailfin forward spar
76 Fin spar/fuselage pick-up
77 Fuel lines
78 Gearbox pre-cooler installation
79 Wing root fairing
80 Wing main spar/fuselage attachment

81 Airbrake actuating ram
82 Fuselage port airbrake
83 Engine pipe
84 Afterburner assembly
85 Thrust-reverser aperture
86 Reverser lids
87 Lid actuating ram
88 Aft fuselage frame
89 Linkage
90 Tailfin aft attachment
91 Rudder operating ram
92 Rudder post
93 Tailfin skinning
94 Tip extension

95 VHF antenna
96 Honeycomb rudder structure
97 Rudder
98 Rudder operating ram fairing
99 Blade antenna

100 Tail fairing
101 Tail fairing formers
102 Tail navigation light
103 Fuselage aft fairing
104 Tailplane exhaust
105 Inner elevon actuator fairings

106 Honeycomb elevon (inner)
107 Elevon outer fairing
108 Honeycomb elevon (outer)
109 Inner structure
110 Outboard leading-edge extension
111 Port outer weapons pylon
112 Port ECM bullet
113 Wing structure
114 Outer actuator ram
115 Inner actuator ram
116 Port wing integral fuel bay
117 Wing ribs
118 Wing skin panels
119 Inner honeycomb panels
120 Undercarriage support rib member
121 Machined wing main spar
122 Wheel well diagonal member

123 Mainwheel leg pivot
124 Mainwheel retraction strut
125 Port wheel well
126 Inboard leading-edge structure
127 Undercarriage inner door
128 Oerlikon 30-mm KCA revolver gun ventral pack
129 Ammunition feed
130 Gun support frame
131 Access panels
132 Cooling air
133 Muzzle fairing
134 Ventral auxiliary drop tank
135 Tandem mainwheels

136 Axle fork assembly
137 Torque links
138 Mainwheel oleo leg
139 Leg door (outer)
140 Wing inner weapons pylon
141 BAe Sky Flash air-to-air missile
142 AIM-9L Sidewinder air-to-air missile

Engine Intake Separator

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Tip: Pilot body can be toggled on/off by pressing "LSHIFT+P"

Mirror

Mirror

Mirror

HUD (Heads-Up Display)

HUD (Heads-Up Display)

HUD Reflector Glass Position Lever (DOWN)

HUD Reflector Glass Position Lever (UP)

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

Airspeed Difference Indicator (Fin)

Flight Path Vector

+5 deg Pitch Reference Line

Pole Tracks

Time Marker Reference Line

Digital Altitude
- In meters if under 1 km
- In km if over 1000 m

Artificial Horizon

Reticle

Altitude Reference Bar = 100 m

Course Scale Reference
(shown: 010)

Radar Altitude Index

-5 deg Pitch Reference Line

Course Scale Reference
(shown: 360)

Time Line

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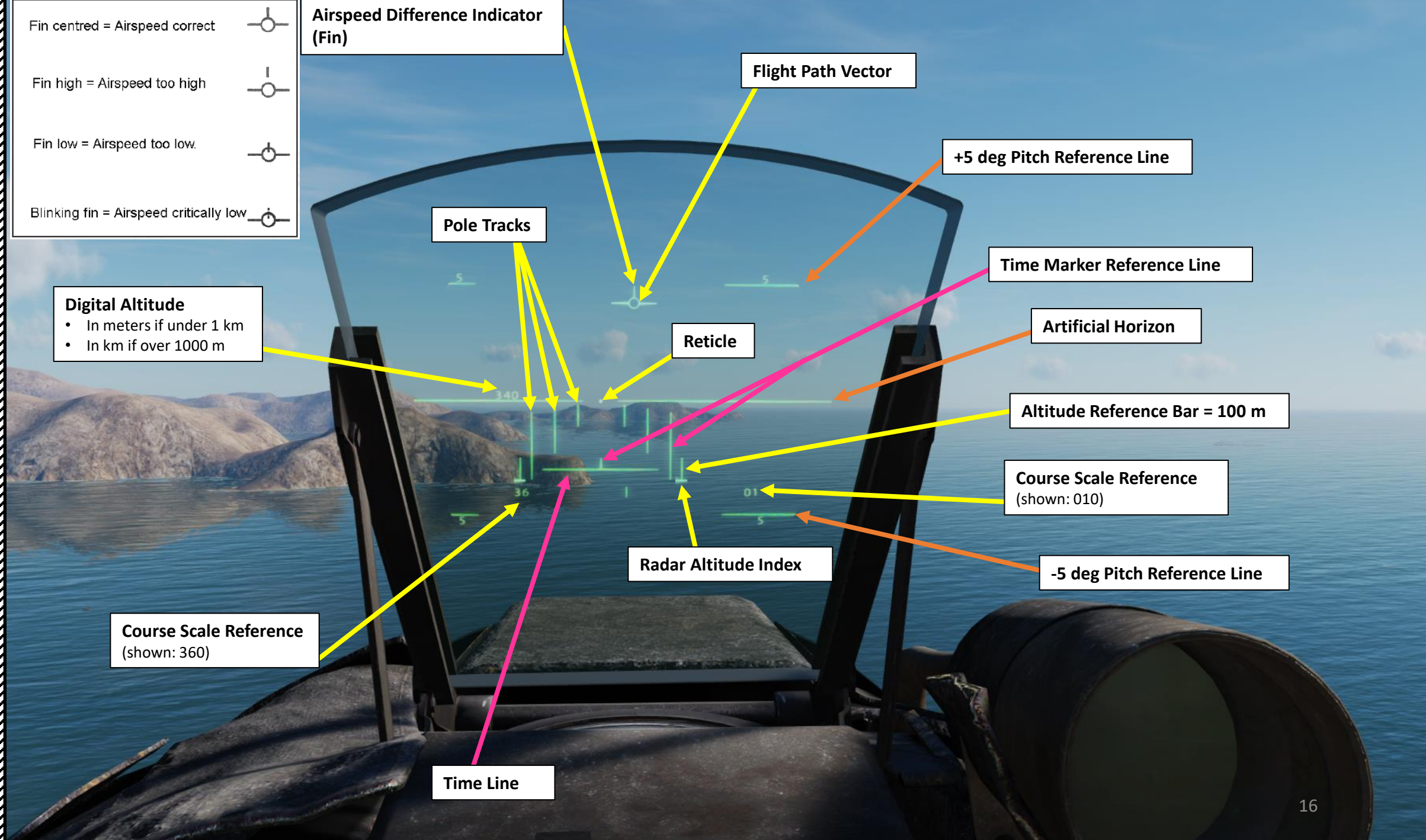
In order to understand how the track poles (vertical bars) work, we will explore three examples. For each of these examples, the **REFERENCE ALTITUDE is set to 500 m**. Take note that you can set your own Reference Altitude by pressing the "Reference Altitude" button mapped on your stick, which will take your current altitude and make it the reference. Reference altitude may differ from waypoint to waypoint too.

The "Pole Tracks" (also called "Post Tracks") must be seen as fenceposts forming a "track". They are used to help you see if you are above, under or at the reference altitude.

TIME: 80   SCORE: 0.00

Case 1
Flying **over** the Reference Altitude

Track poles' upper extremities are under the horizon line.

Altitude: 720 m

270 m over reference altitude

Over Reference Altitude

Use this bar as a 100 m reference
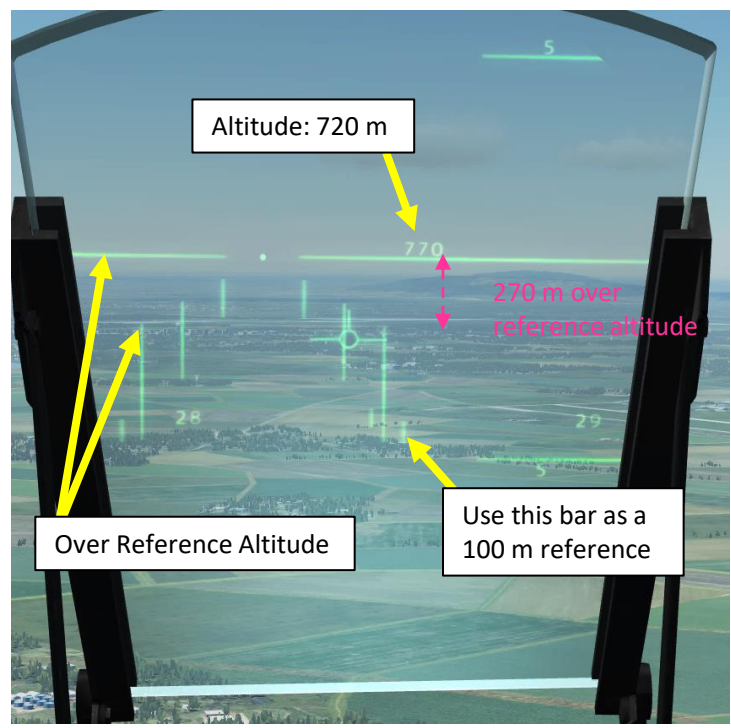
Case 2
Flying **at** the Reference Altitude

Track poles' upper extremities are aligned the horizon line.

Altitude: 500 m

On Reference Altitude
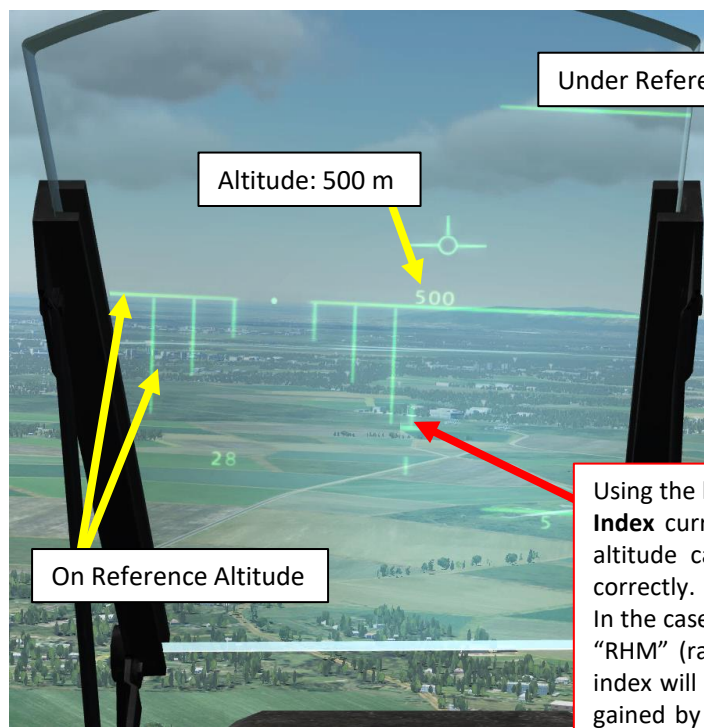
Case 3
Flying **under** the Reference Altitude

Track poles' upper extremities are over the horizon line.

Under Reference Altitude

320 m under reference altitude

Altitude: 180 m
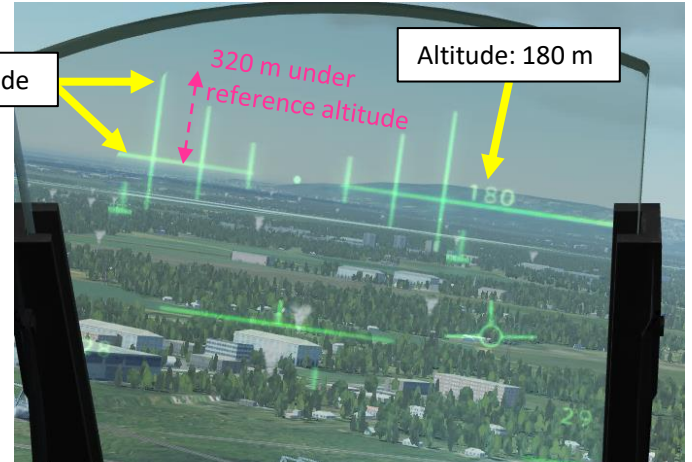
Using the horizontal bar as a cursor and the vertical bar as a 100 m scale, the **Radar Altitude Index** currently displays a difference of 0 m between the radar altimeter and the digital altitude calculated by the CK37 computer. This means the Altimeter Setting is set up correctly.

In the case that the HÖJD CISI switch is selected to the "LD" (barometric pressure) instead of "RHM" (radar altimeter) position AND that the altimeter setting is incorrectly set up, the index will be further up the scale and indicate a mismatch/difference between the altitude gained by the radar altimeter and the one calculated by the flight computer. By adjusting the altimeter setting and checking that the index is moved correctly at the bottom of the scale, you can make the QFE correction by using the radar altitude as a reference.
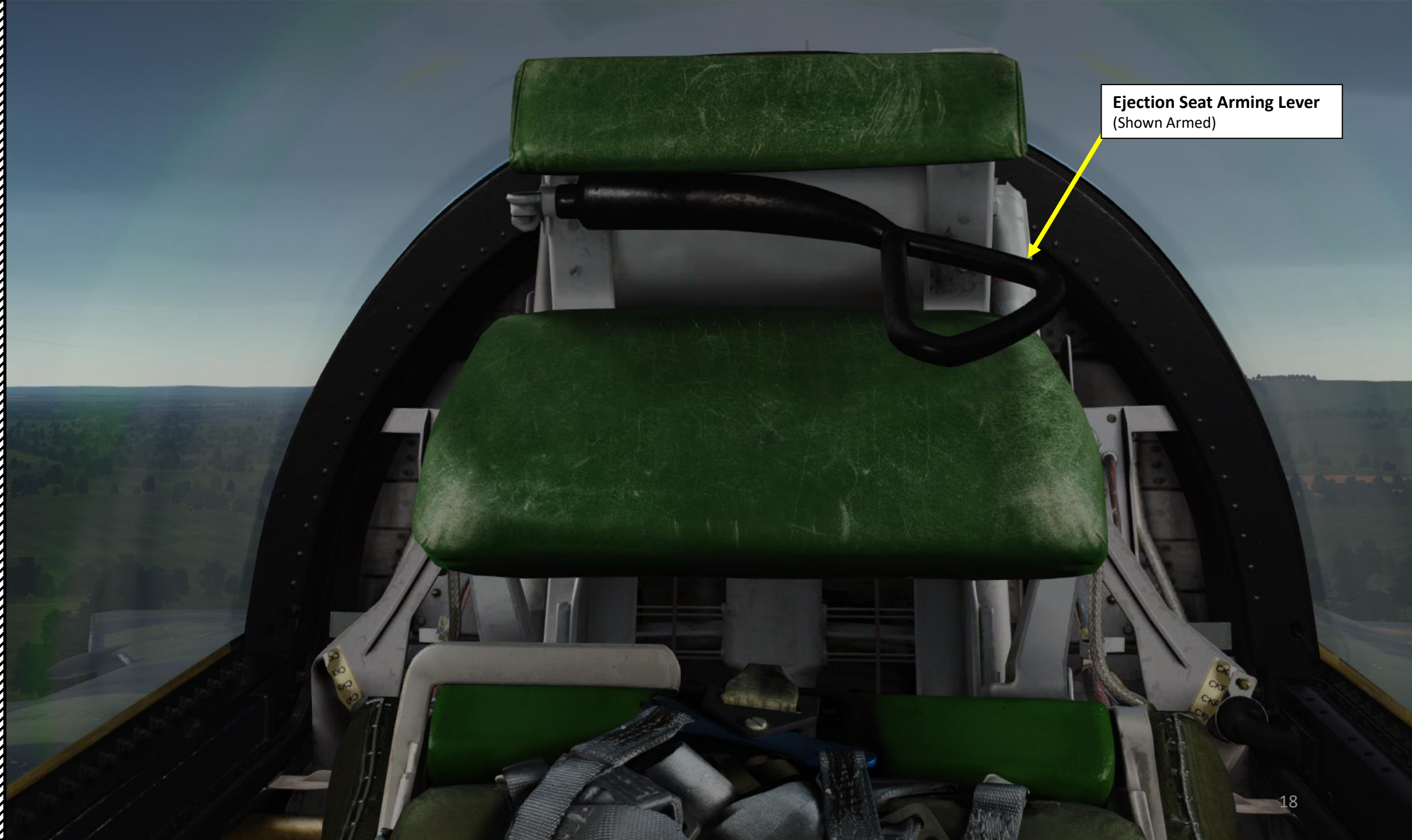
Ejection Seat Arming Lever
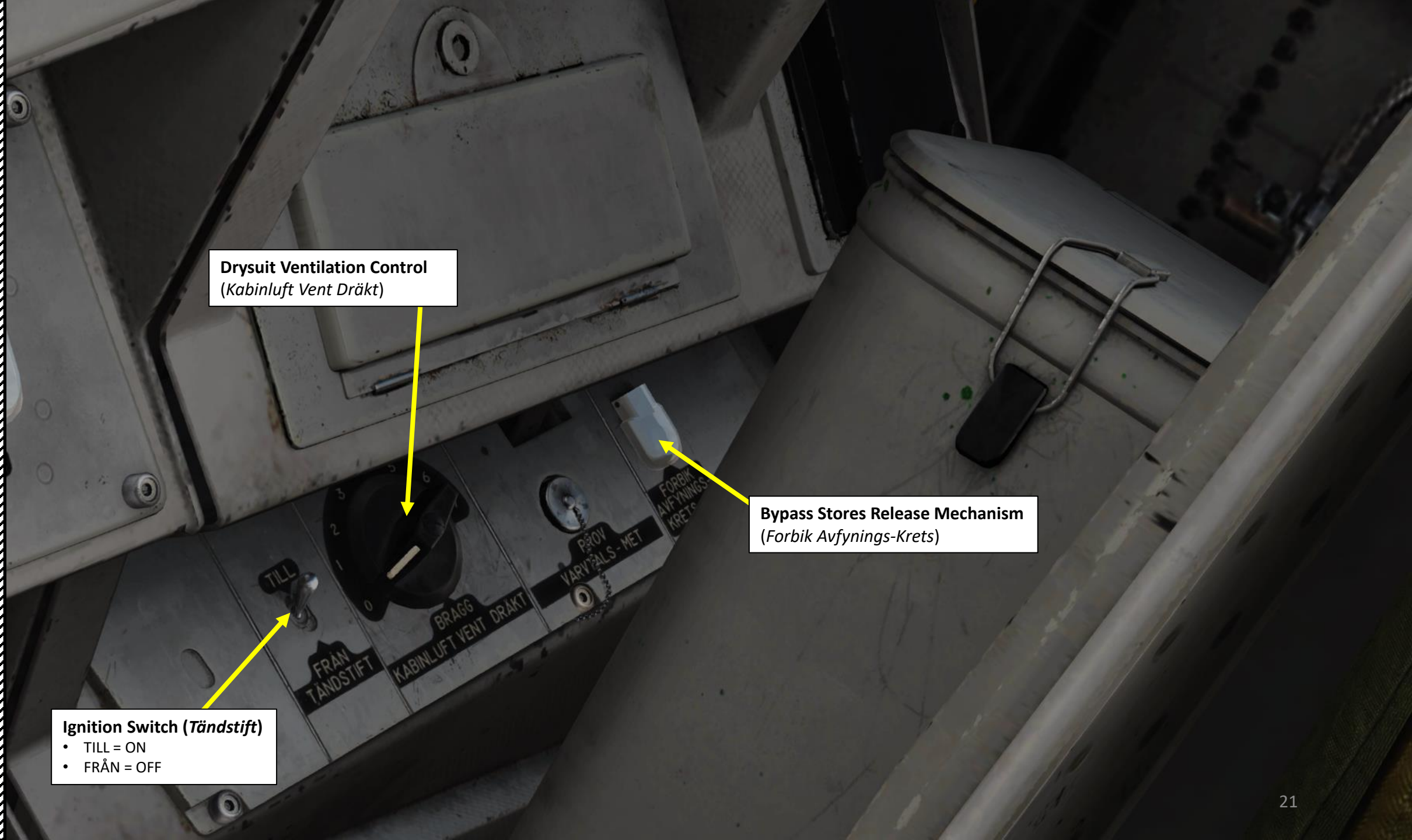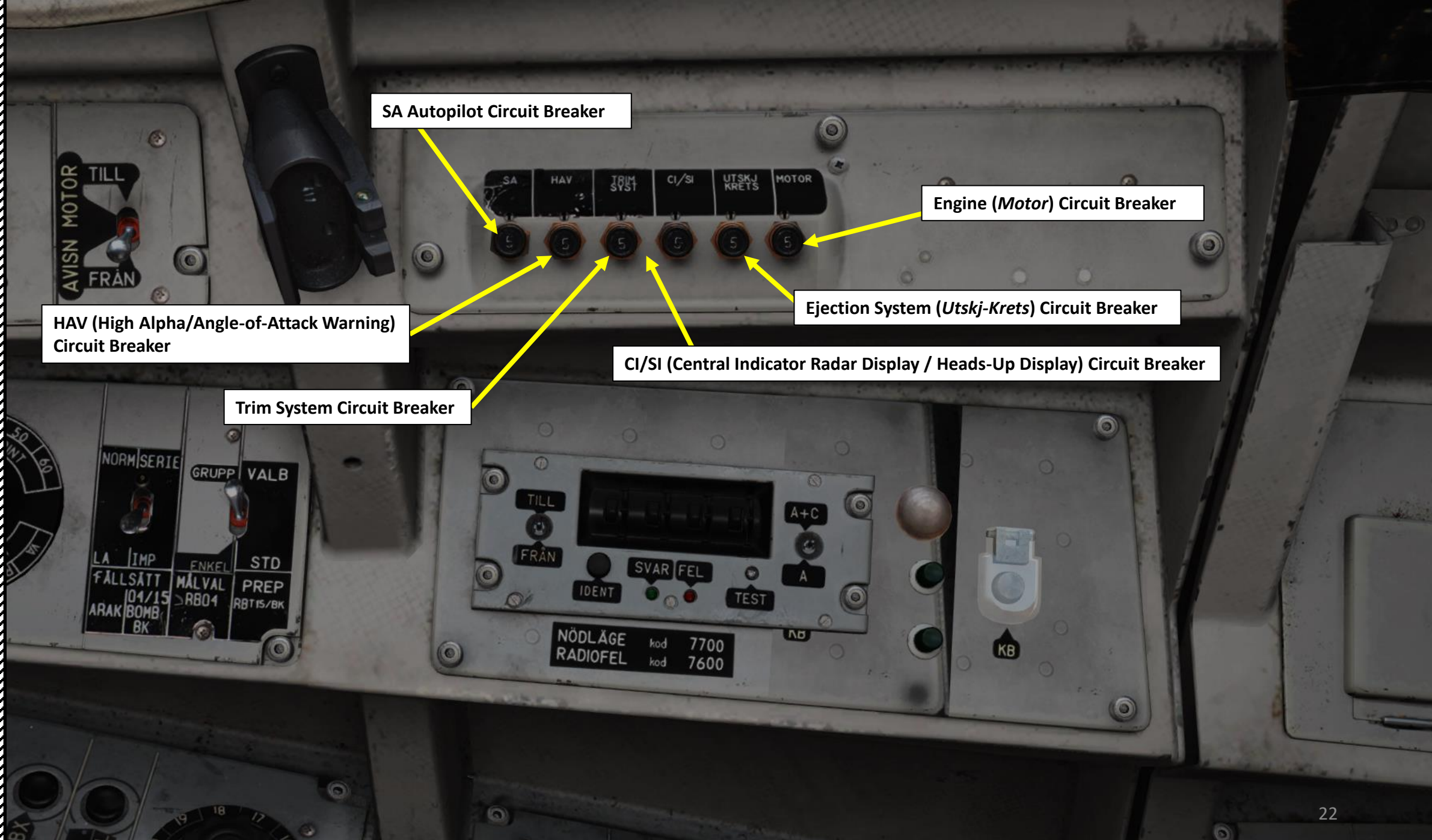(Shown Armed)

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Drysuit Ventilation Control
(*Kabinluft Vent Dräkt*)

Bypass Stores Release Mechanism
(*Forbik Avfynings-Krets*)

Ignition Switch (*Tändstift*)
- TILL = ON
- FRÅN = OFF

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SA Autopilot Circuit Breaker

Engine (*Motor*) Circuit Breaker

HAV (High Alpha/Angle-of-Attack Warning)
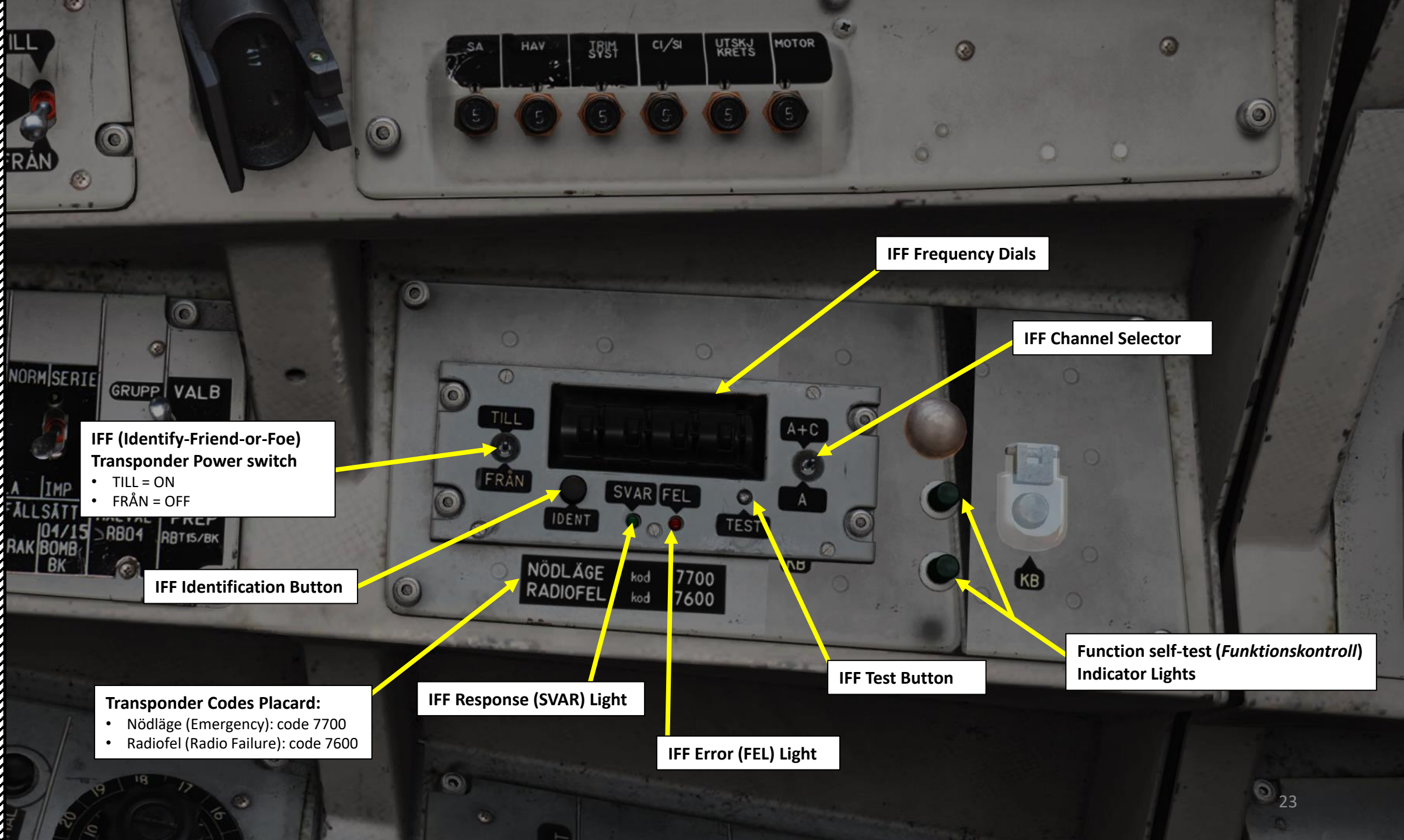Circuit Breaker

Ejection System (*Utskj-Krets*) Circuit Breaker

CI/SI (Central Indicator Radar Display / Heads-Up Display) Circuit Breaker

Trim System Circuit Breaker

IFF Frequency Dials

IFF Channel Selector

IFF (Identify-Friend-or-Foe)
Transponder Power switch
- TILL = ON
- FRÅN = OFF

IFF Identification Button

Function self-test (*Funktionskontroll*)
Indicator Lights

IFF Test Button

IFF Response (SVAR) Light

Transponder Codes Placard:
- Nödläge (Emergency): code 7700
- Radiofel (Radio Failure): code 7600

IFF Error (FEL) Light

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External Fuel Tank Release Button

Targeting Mode (MÅLVAL) / Preparation Switch (RB-04 / RB-15 / BK-90)

Weapon Release Mode Switch

NODF: Emergency Weapons Release Button

Weapon Selector Knob
- **SJÖ /PLAN:** Sets RB 05 for anti-ship fusing or bombs to be dropped in level bomb release.
- **RB75/MARK/DYK:** Selects RB 75, RB 05 is Air-to-Ground fusing, or bombs for dive-bombing.
- **LUFT/RR:** RB-05 in A/A mode, radar bomb release.
- **AKAN JAKT:** Gun pods A/A mode.
- **ATTACK:** Selects the majority of A/G weapon types.
- **IR-RB:** Selects sidewinder missiles. (Can also be selected by a fast selector on the throttle instead)

Sight Mode / Interval Selector Knob

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Pitch Gearing Switch (*TIPP VÄXEL*)
- TILL = ON = Pitch Gearing Automatic Mode
- FRÅN = OFF = Pitch Gearing Landing Mode

Manual Fuel Regulator Switch (*Bransleregl*)
- Manual (UP) / Auto (DOWN)

Indicator System (*Kontroll*) Test Switch

Fuel Tank Pump Switch
- AVST = CLOSED
- NORM = NORMAL

Manual Afterburner Fuel Regulator (LT-KRAN EBK)
- STÄNGD = CLOSED
- ÖPPEN = OPEN

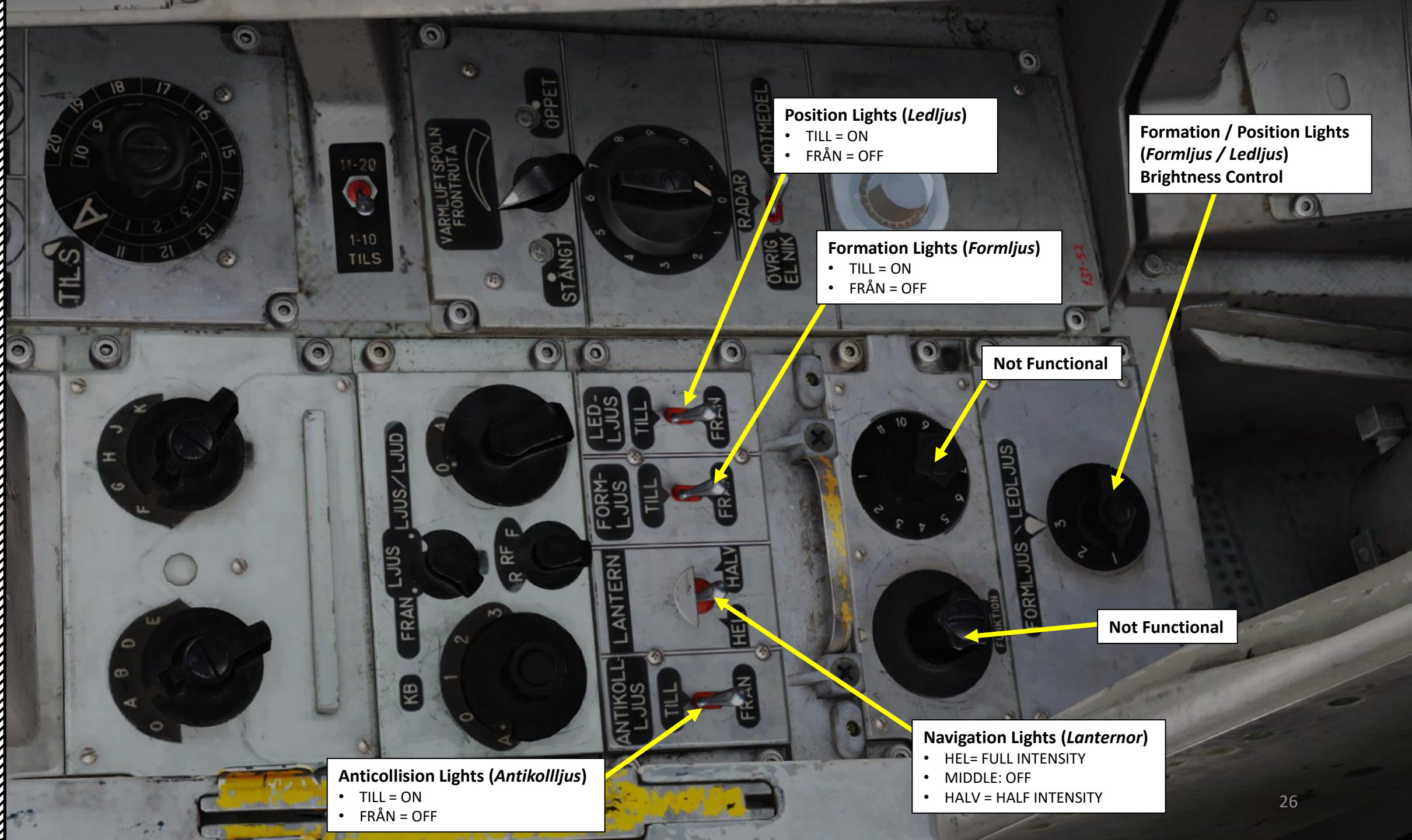**Backup Generator Switch (*Reservström*)**
- TILL = ON
- Från = OFF

Engine Anti-Ice Switch (*AVISN Motor*)
- TILL = ON
- FRÅN = OFF

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Position Lights (*Ledljus*)
- TILL = ON
- FRÅN = OFF

Formation Lights (*Formljus*)
- TILL = ON
- FRÅN = OFF

Formation / Position Lights (*Formljus / Ledljus*) Brightness Control

Not Functional

Not Functional

Navigation Lights (*Lanternor*)
- HEL= FULL INTENSITY
- MIDDLE: OFF
- HALV = HALF INTENSITY

Anticollision Lights (*Antikollljus*)
- TILL = ON
- FRÅN = OFF

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Countermeasure Streak Mode Selector
- 0: Mode 0
- 4: Mode 4

Windscreen Anti-Ice Control (*Varmluftspoln Frontruta*)
- STÄNGT = CLOSED
- ÖPPET = OPENED

Maintenance Test Mode Selector

Jammer Band Selector

Jammer Operation Mode Selector

Magnetic Declination Adjustment Knob (*Kurskorr*)

Radar Warning Receiver (RWR) Mode Selector
- *FRÅN* = OFF
- *LJUS*: Visual Warning Only
- *LJUS/LJUD:* Visual and Audio Warning

Test Switch
- Other Electronics (*ÖVRIG ELEKTRONIK*)
- Radar
- Countermeasures (*Motmedel*)

Countermeasures Mode Selector (*KB*)
- A: Automatic
- 0: Off
- 1: Mode 1
- 2: Mode 2
- 3: Mode 3

Countermeasure Selector
- R: Chaff (*Remsor*)
- RF: Chaff and Flares
- F: Flares (*Facklor*)

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DME (Distance Measuring Equipment) Switch: Legacy Switch (not functional)

RHM Switch: Radar Altimeter Power
- TILL = ON
- FRÅN = OFF

Navigation System Waypoint Selectors
- B1 to B9: Waypoints 1 to 9

Navigation System Waypoint Selector
- BX: selects a BX point (markpoint) (BX1-9)

Navigation System Waypoint Selector
- L/MÅL: landing base or recon target

TILS (Tactical Instrument Landing System) Channel Selector

TILS (Tactical Instrument Landing System) Channel Layer Selector
- 1-10: Channels 1 through 10
- 11-20: Channels 11 through 20

Navigation System Waypoint Selector:
- LS/SKU: Take-off base or tracked target

RB-05 Remote-Controlled Missile Control Knob

Handrest

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Navigation Data Indicators

Navigation INPUT/OUTPUT Selector
- IN: Input
- UT: Output

Navigation Data Keypad (1-9)

CK37 (*Central Kalkylator 37*, or Central Computer 37) Aircraft Computer Control Panel

Navigation Data Clear (*Rensa*) Button
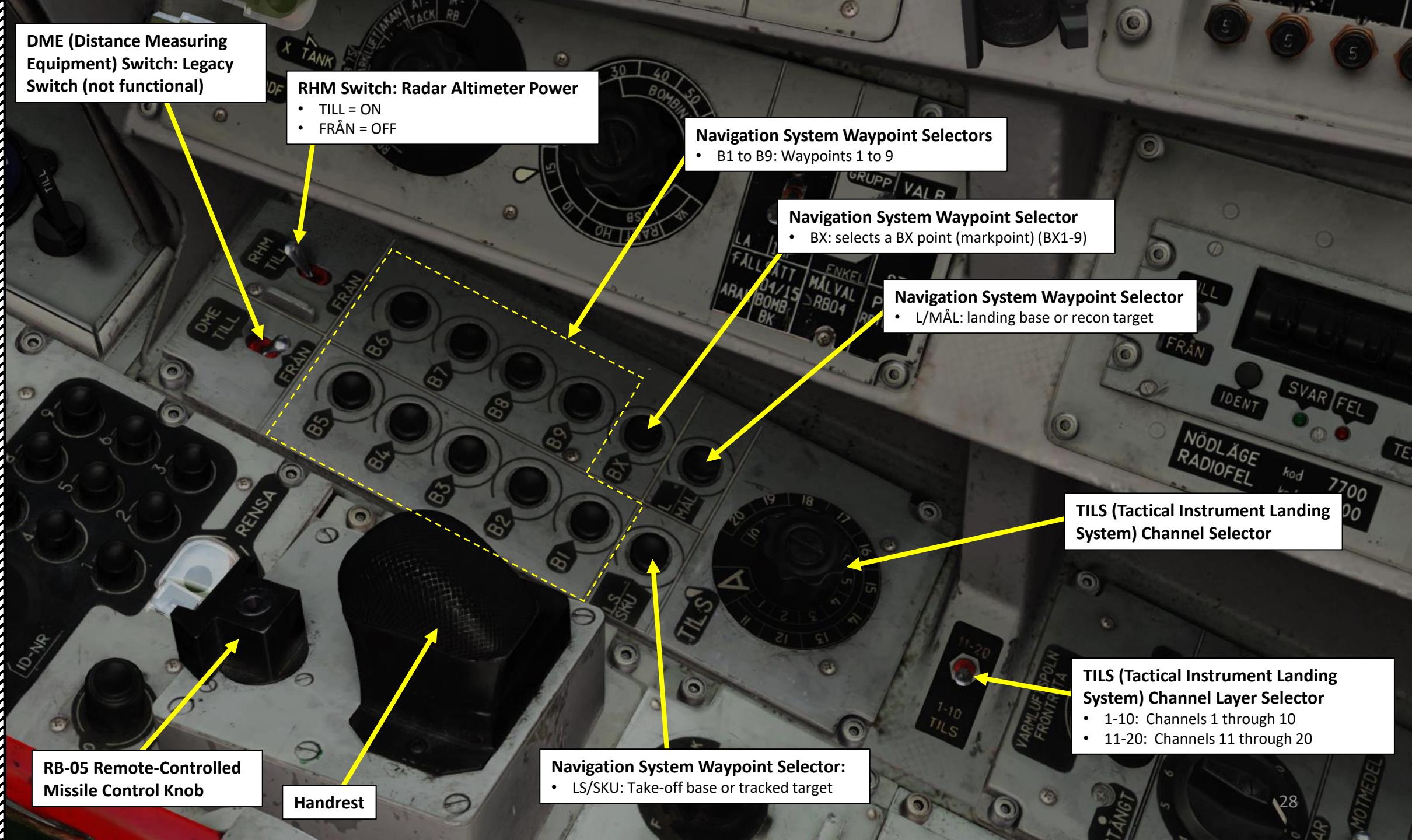
Navigation Data Keypad (0)

Navigation Data Selector (see NAVIGATION section for more details)
- AKT POS: Current Position
- REF LOLA: Reference number or longitude/latitude coordinate position of waypoints
- BANA/GRÄNS: Runway Headings
- VIND/RUTA/MÅL: Wind direction and strength for entered wind.
- TID: Present time, Time on Target, ingress Mach speeds, time for recon targets
- TAKT: Tactical inputs and presets
- ID-NR: Identification number.

Engine Nozzle Position Indicator
(Shown: Afterburner Stage 3)

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

Oxygen Pressure Indicator (kp/cm²)

Oxygen Lever
- TILL (UP) = ON
- DOWN = OFF

Right Warning Panel

SPAK: Autopilot failure	**SYRGAS:** Oxygen valve is OFF or pressure in oxygen bottle is low
HÅLL-FUNK: Autopilot hold function failure	**BRÄ < 24:** Fuel amount is below 24 %
RHM FEL: Radar Altimeter failure	**BRAND GTS:** Gas turbine starter fire
ROLL VÄXEL: Roll Gearing system failure	**TILS:** Status of TILS landing system
CK: CK37 Computer Failure	**NAV-SYST:** Navigation System Failure
KABINHÖJD: Low cabin pressure	**KB-V SLUT:** Left countermeasures pod empty
HUV o STOL: Ejection seat not armed and canopy unlocked when closed	**KB-H/KA SL:** Right countermeasures pod empty / ECM pod failure
TÄNDSYST: Ignition system active	**FACKL SL:** Flares Empty
STARTSYST: Engine starter system active	**MOTVERK:** Status of countermeasures and radar warning system
MAN BR REG: Manual fuel regulator is in Manual mode	**LUFTBROMS:** Airbrakes are extended

FIRE | GEN. EMERG. PWR

FIRE	GEN. EMERG. PWR
1-2 LIGHTS/SUSPECTED FIRE CLOSE A/B, LOWPRESS FUEL VALVE LOWEST POSSIBLE RPM A/C ON FIRE?	MAKE ONE ATTEMPT TO RE-ENGAGE ABORT MISSION IF PROBLEM REMAINS: BACKUP POWER ON ACT AS PER « GEN FAULT » IF STILL NO A/C POWER: GOOD WEATHER, GROUND VISUAL, WINGMAN? FR24, LAND 15 MIN FLY GENTLY

NO	YES
LAND ASAP A/C STOPPED LP FUEL VALVE OFF MAIN POWER OFF EXIT ASAP	EJECT

Emergency Placard Lights Switch
- TILL = ON
- FRÅN = OFF
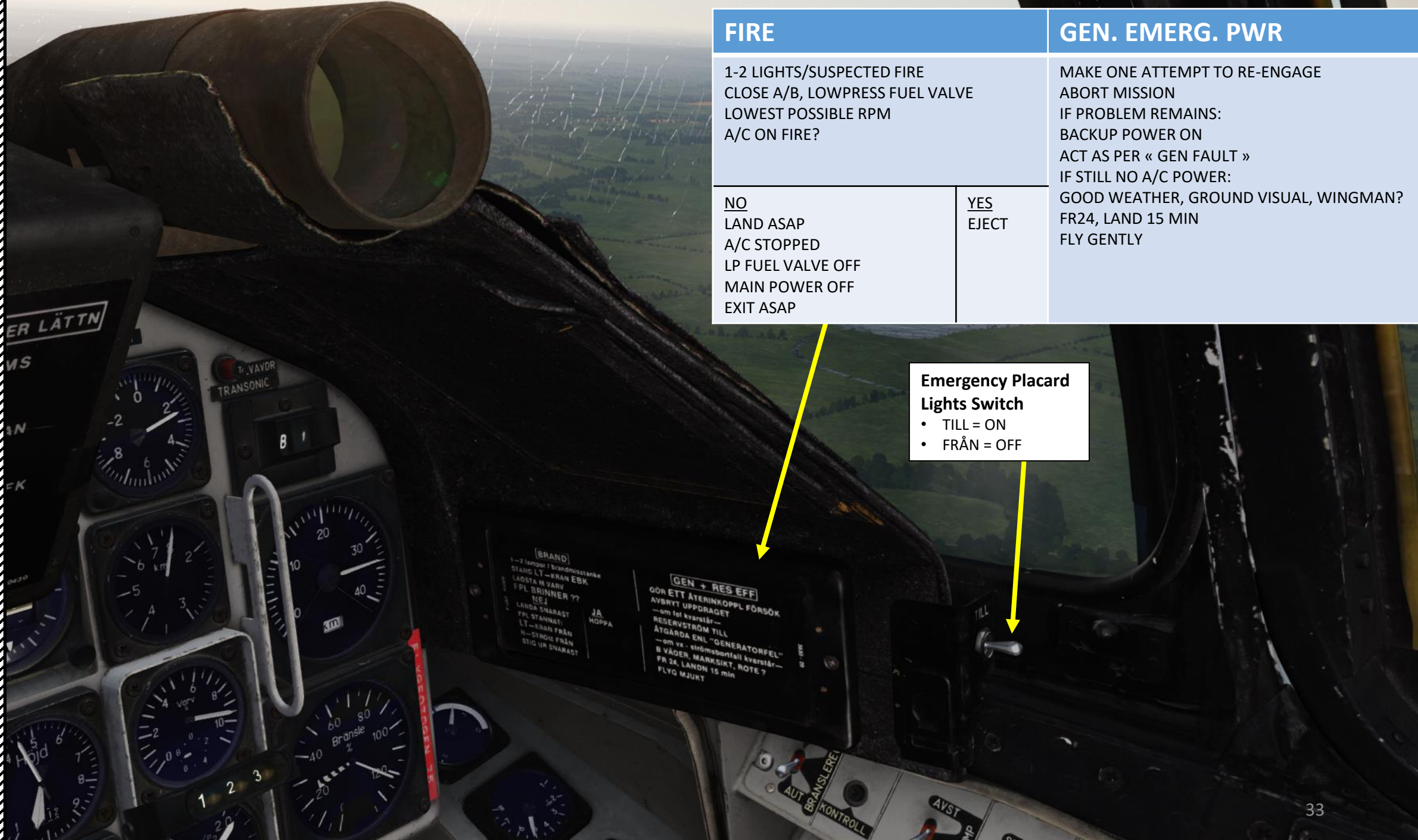
Engine N2 (High-Pressure Turbine) RPM Indicator in % (*Varv*)

Backup Altimeter (HÖJD)
- Thin Needle: x100 m
- Thick Needle: x1000 m

Backup Altimeter Barometric Pressure (QFE) Setting (HPa)
Ex: 1013.25 Hpa = 29.92 in Hg

Afterburner Stage Indicator

Backup Altimeter Pressure (QFE) Setting Knob

Magnetic Course Indicator

Engine Pressure Ratio (EPR) Indicator (Pt7/Pt2, or ratio between engine intake and exhaust pressures)

Fuel Indicator (*Bränsle*)
- **Long Needle**: Fuel Quantity in %
- **Striped Needle**: Fuel Quantity Required to complete the route as planned
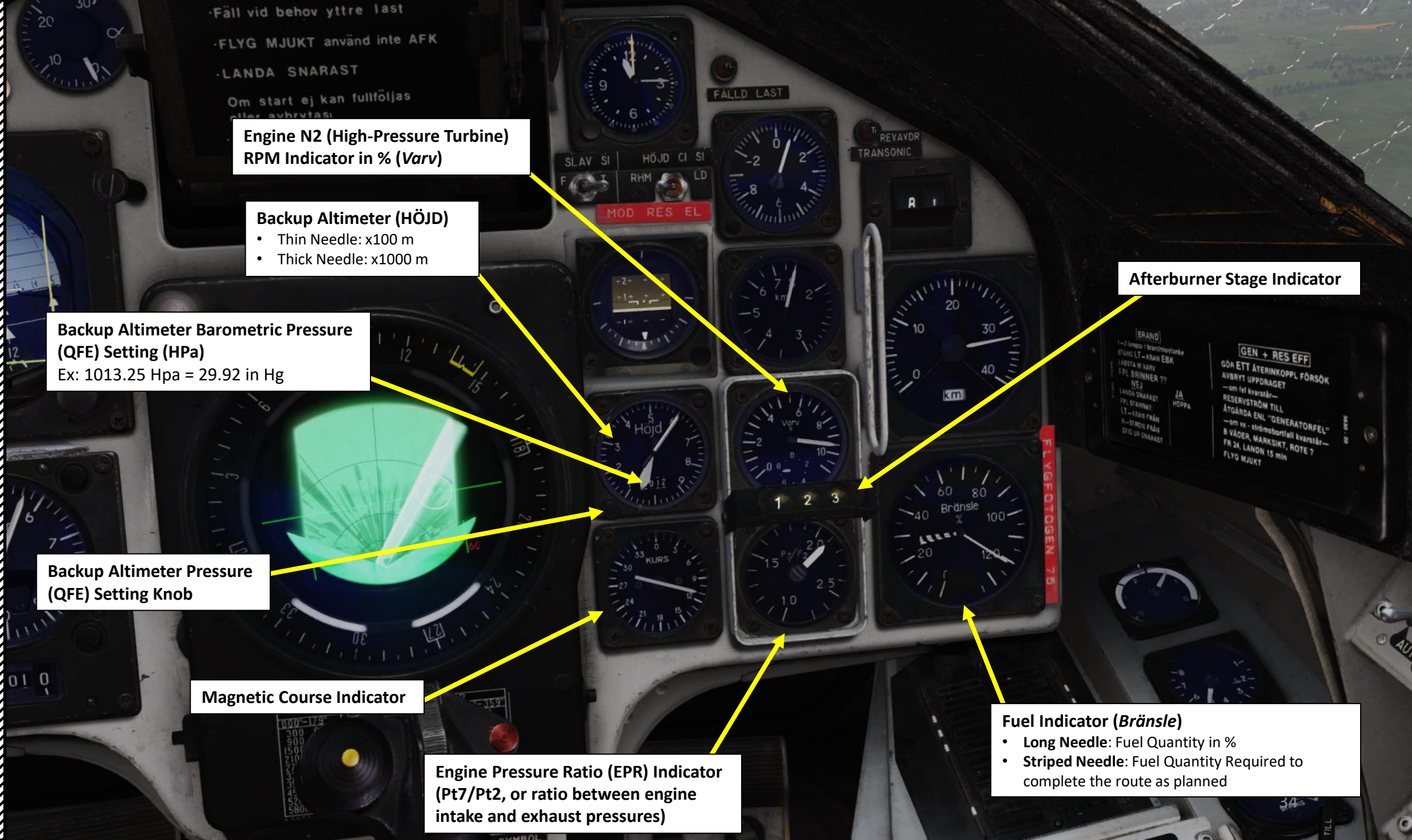
EP-13 Indicator
(Collimated sight for RB75 air-to-ground missile)

Clock

Stores Released Warning Light (*FÄLLD LAST*)

Accelerometer (G)

**Thrust Reduce (REV AVDR) /
Transonic Warning Light**

Destination Indicator
- Selected Waypoint ID in Number and Type

Distance Indicator from Selected Waypoint

HUD/SI (Heads-Up Display) Slave Switch
- F (*FRÅN*): OFF, no HUD slave or LOWNAV mode activated
- T (*TILL*): ON, activates LOWNAV (Decluttered HUD mode) when altitude is lower than 100 m above ground level.

Altitude Source Selector (HÖJD CISI)
- RHM: Radar Altimeter is used as the altitude source
- LD: Barometric Altitude (air pressure sensor) is used as the altitude source

Backup Artificial Horizon

Backup Airspeed Indicator (x100 km/h)

Distance Unit from Selected Waypoint
- KM = in kilometers
- MIL = in Swedish Miles
- Note: 1 Swedish mile = 10 km

DRAGKRAFTSMINSKN EFTER LÄTTN
- Ställ gasspaken i läge MS
— störn kvar —
- BRÄNSLEREGL i läge MAN
- Fäll vid behov yttre last
- FLYG MJUKT använd inte AFK
- LANDA SNARAST
Om start ej kan fullföljas eller avbrytas:
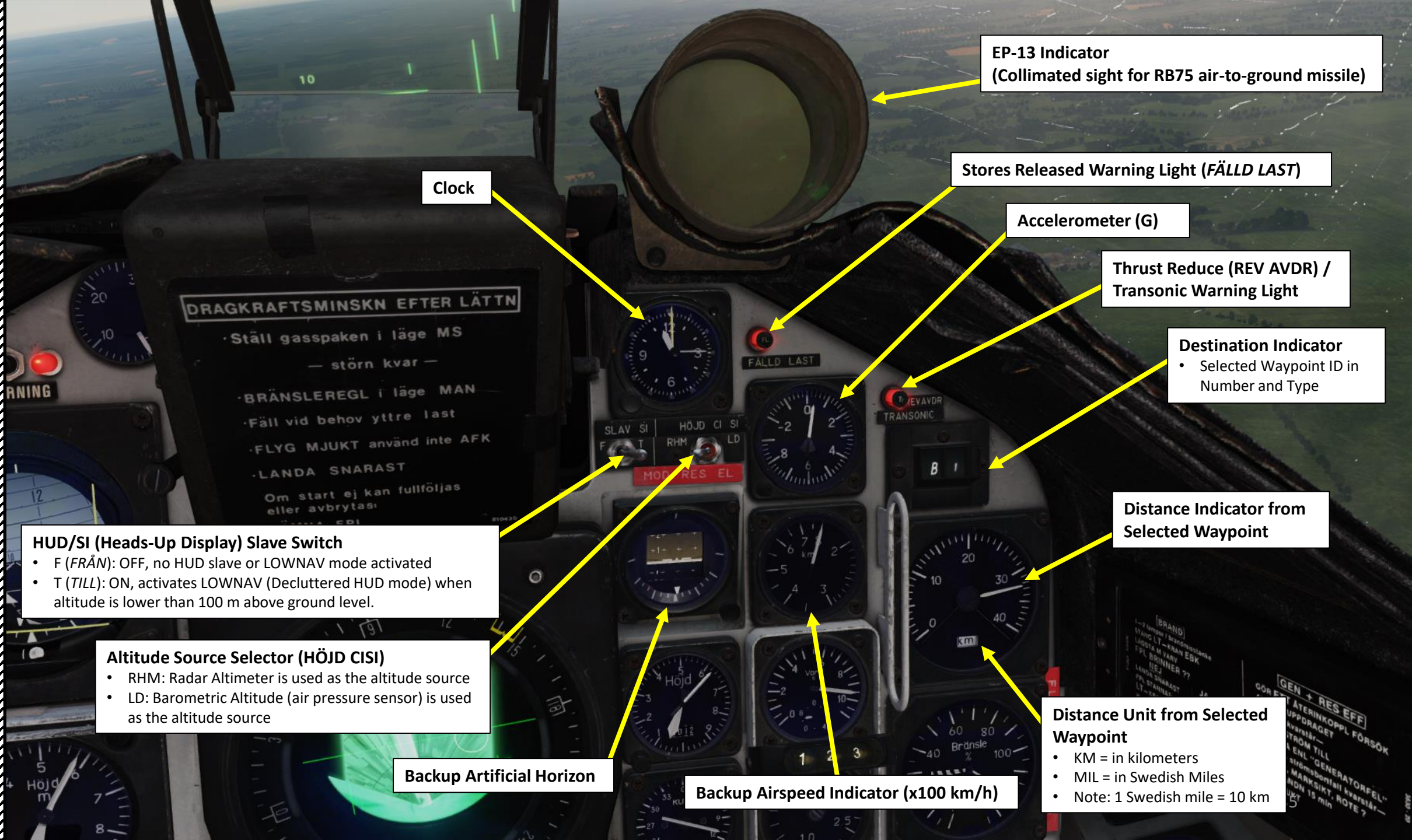
TRANSLATION:
LOSS OF THRUST AFTER TAKEOFF
- THROTTLE TO MAX DRY

IF PROBLEM REMAINS:
- FUEL CONTROL SYSTEM: MAN
- JETTISON STORES IF NECESSARY
- DO NOT USE AUTOPILOT
- FLY GENTLY
- LAND A.S.A.P. (AS SOON AS POSSIBLE)

IF TAKEOFF CANNOT BE ACHIEVED NOR ABORTED:
- LEAVE AIRCRAFT (EJECT)

DRAGKRAFTSMINSKN EFTER LÄTTN

- Ställ gasspaken i läge MS

— störn kvar —

- BRÄNSLEREGL i läge MAN
- Fäll vid behov yttre last
- FLYG MJUKT använd inte AFK
- LANDA SNARAST

Om start ej kan fullföljas
eller avbrytas:
- LÄMNA FPL.

HUVUDVARNING

FALLD LAST

SLAV SI   HÖJD CI SI
F   T   RHM   LD

MOD RES EL

REVAVDR
TRANSONIC

B

AoA (Angle of Attack) Indicator (deg)

Autopilot Mode Selectors/Lights
- *SPAK*: Main dampening mode
- *ATT*: Attitude Hold
- *HÖJD*: Altitude Hold

HUVUDVARNING

DRAGKRAFTSMINSK

·Ställ gasspaken

— störn k

·BRÄNSLEREGL i

·Fäll vid behov yttr

·FLYG MJUKT använ

·LANDA SNARAST

Om start ej kan ful
eller avbrytas:

·LÄMNA FPL.

Vertical Speed Indicator
(Shown: -3 m/s)

Attitude Director Indicator (ADI)

Mach Number

Airspeed Indicator
(x100 km/h)

Slip Ball

MOTORSTOPP

MTG, H‹12
ÅTERSTART 2 s
BRÅ REGL MAN ‹9
—ej varv / temp 20s—
ORD START—STRÖMST
FLYG MJUKT
LANDA SNARAST

PUMPNING
MINSKA
BEHÅLL GA
—ej typenLAVBRYT
—störn kvarstår—
SLÄCK EBK
HÖGST
FLYG M
LANDA

ONORMAL DRAGKRAFT
FLYG MJUKT
FÄLL LAST   FTG, H‹9
BRÅ REGL MAN (AUT)
MAX 570
FÄLL VID BEHOV LAST.

MHz
123 450

Höjd
m

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Autothrottle (AFK) Mode 3 α15.5 Selector Button
- Engages Autothrottle Mode 3, which will make the autothrottle adjust thrust to maintain an airspeed corresponding to an angle of attack of 15.5 deg at 1 G equilibrium. This is used when the shortest landing distance is required.

Master Caution Light (*Huvudvarning*)

Master Caution Reset Button

Autothrottle (AFK) Light
- Illuminated once autothrottle is in use

Master Caution Light (*Huvudvarning*)

Autothrottle (AFK) Mode 3 α15.5 Indicator Light
- Illuminated once autothrottle Mode 3 is in use

HUVUDVARNING

DRAGKRAFTSMINSKN EFTER LÄTTN
- Ställ gasspaken i läge MS
  — störn kvar —
- BRÄNSLEREGL i läge MAN
- Fäll vid behov yttre last
- FLYG MJUKT använd inte AFK
- LANDA SNARAST
- Om start ej kan fullföljas eller avbrytas:
- LÄMNA FPL
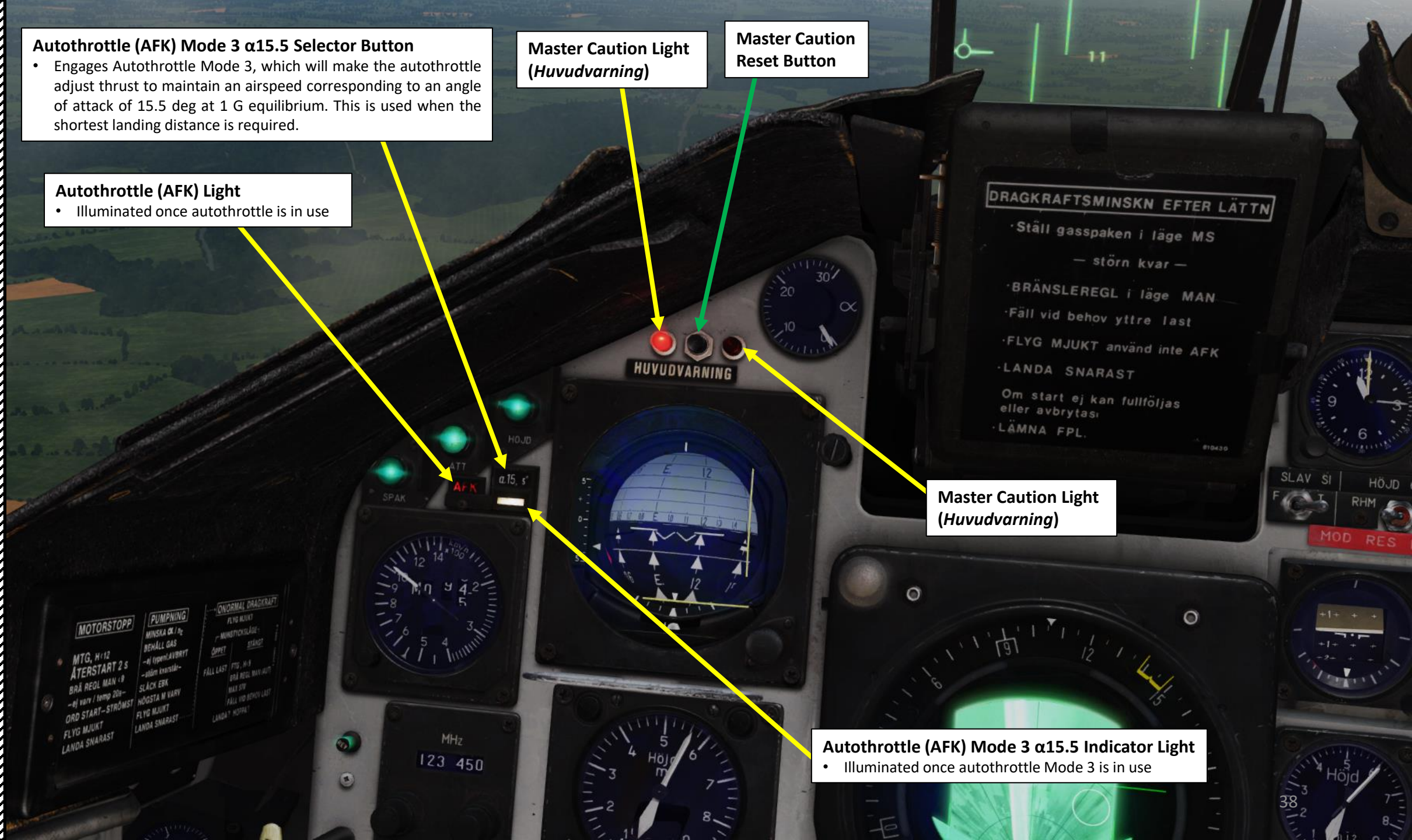
Altitude Warning Light
- Alerts the pilot of an imminent impact with the ground or that the set altitude for the autopilot is no longer kept.

Current Course

Course Index

Central Indicator (CI) Radar Display

Radar Scan Zone Scale
Shown: 60 km

APP-27 Radar Warning Receiver (RWR) Lights

FR22 Radio Frequency Tuner Inner Left

FR22 Radio Frequency Tuner Outer Left

FR22 Primary Radio (VHF/UHF) Frequency Indicator
- VHF: 103.000 – 155.975 MHz
- UHF: 225.00 – 399.95 MHz

FR22 Radio Frequency Tuner Inner Right

Thrust Reverser Light
- Illuminated = Reverser Circuits are active

Altimeter (*HÖJD*)
- Long Needle: x 100 m
- Short Needle: x 1000 m

Thrust Reverser Lever
- PULLED = Armed/Deployed
- PUSHED = Stowed

FR22 Radio Frequency Tuner Outer Right

Altimeter Barometric Pressure (QFE) Setting (HPa)
Ex: 1013.25 Hpa = 29.92 in Hg

FR 22 Radio Frequency Selector
- Left: FM Band
- Right: AM Band

Altimeter Pressure (QFE) Setting Knob

40
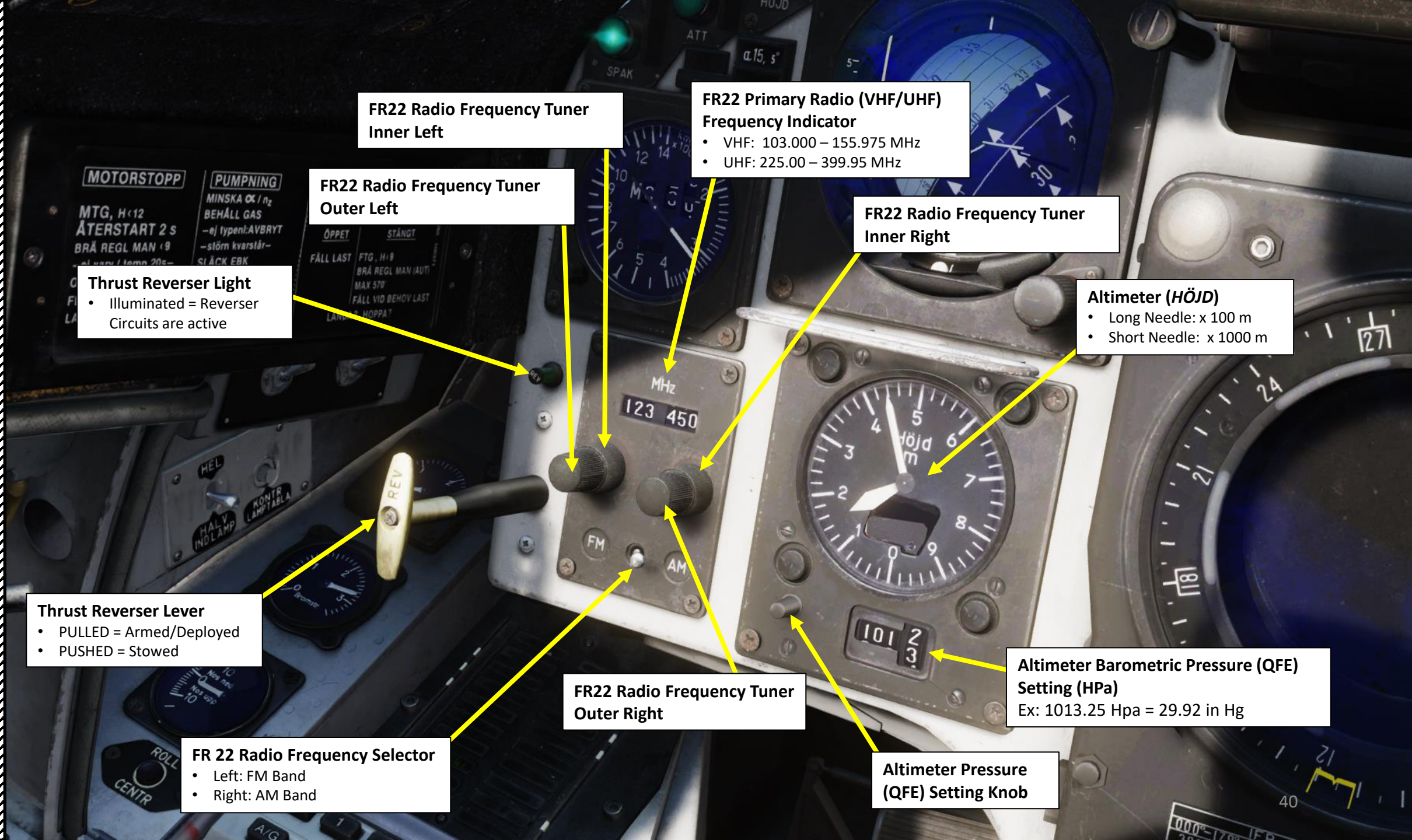
Landing/Taxi (*Strålkast*) Lights Switch
- UP = OFF
- DOWN = ON

Emergency (*Nödbel*) Lights Switch
- UP = OFF
- DOWN = ON

Warning Panel Test Light

Indicator Light Intensity Switch
- HALV: DIMMED
- HEL: FULL)

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IFR			VFR	
000°-179°	180°-359°		000°-179°	180°-359°
	600	6700	1050	1350
300	1200	7300	1700	2000
900	1850	7900	2300	2600
1500	2450	8550	2900	3200
2100	3050	9450	3500	3800
2750	3650	10650	4100	4400
3350	4250	11900	4700	5050
3950	4900	13100	5350	5650
4550	5500	14000	5950	
5200	6100	15550		
5800				

CI SYMBOL

KABINBELYSN

LJUS R
SI x
SI x

Radar Symbology Test Button

Parking Brake Handle
- PULLED: Brake Set
- PUSHED: Brake Released

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ENGINE FAILURE	COMPRESSOR STALL	ABNORMAL THRUST	
GROUND IDLE ALTITUDE < 12 km ENG RESTART (2 sec) MAN FUEL REG < 9 km NO RPM/TEMP in 20 s ? ENG START SWITCH FLY GENTLY LAND ASAP	REDUCE AoA & G MAINTAIN THROTTLE PROBLEM REMAINS: EXTINGUISH A/B MAX POSSIBLE RPM FLY GENTLY LAND ASAP	FLY GENTLY	
		NOZZLE POSITION:	
		OPEN JETTISON STORES (IF REQUIRED)	CLOSED FLIGHT IDLE, ALT <9 MAN FUEL REGULATOR EGT: MAX 570 deg C JETTISON STORES (IF REQUIRED)
		LAND? EJECT?	
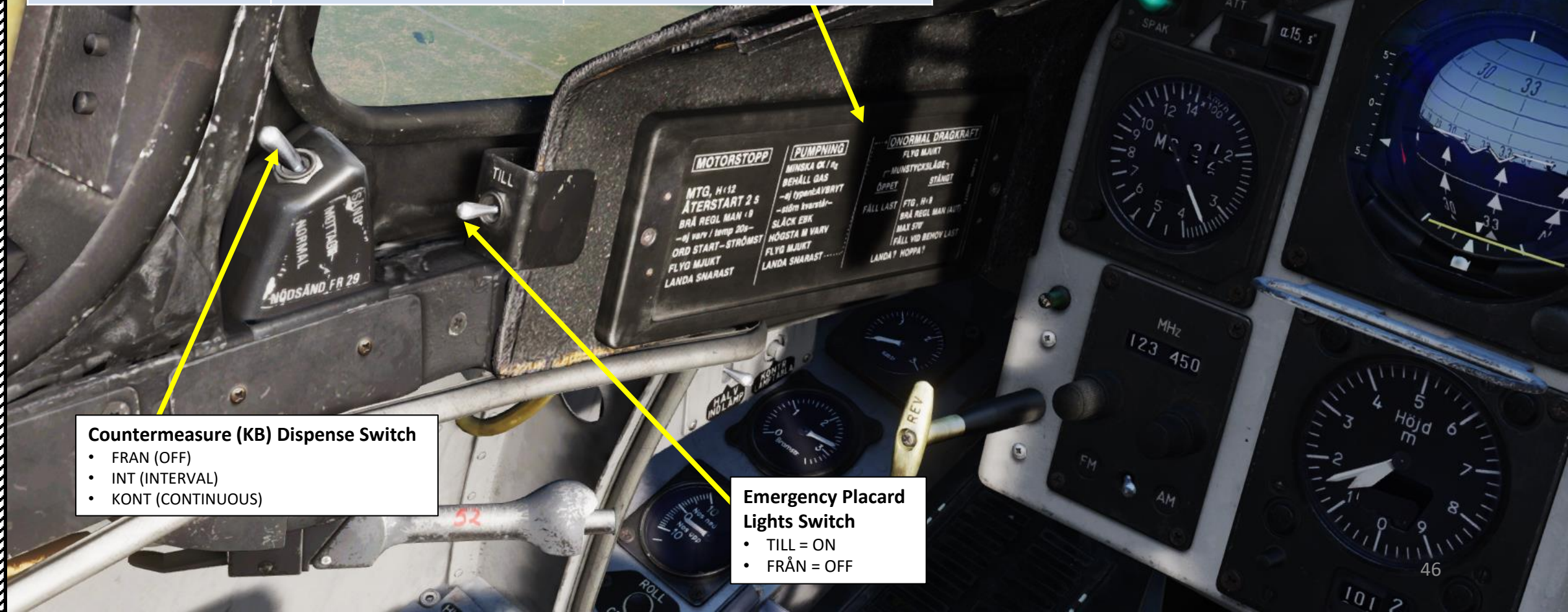
Countermeasure (KB) Dispense Switch
- FRAN (OFF)
- INT (INTERVAL)
- KONT (CONTINUOUS)

Emergency Placard Lights Switch
- TILL = ON
- FRÅN = OFF

46
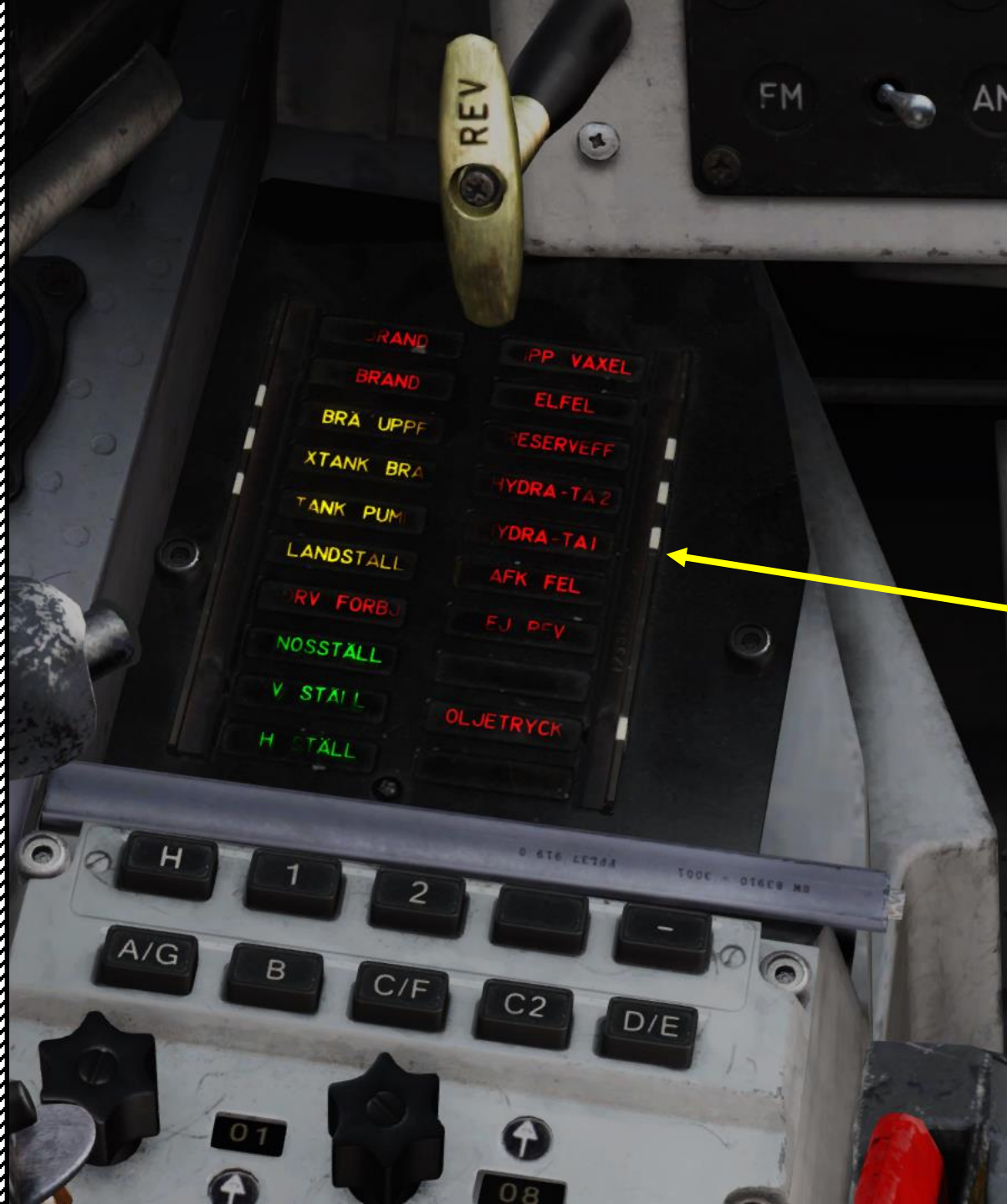
Left Warning Panel

BRAND: Engine Fire	**TIPPVÄXEL:** Pitch gearing in incorrect mode based on current airspeed
BRAND: Engine Fire	**ELFEL:** Electrical Failure
BRÄ UPPF : Low Fuel Pressure Fault	**RESERVEEFF:** Backup hydraulics or backup generator failure
X-TANK BRÄ : External Fuel Tank Feed System Fault	**HYDR-TR 2:** Low pressure in hydraulic system 2
TANK PUMP: Tank Pump System Fault	**HYDR-TR 1:** Low pressure in hydraulic system 1
LANDSTÄLL: Status of landing gear system	**AFK FEL:** Autothrottle failure
FÖRV FÖRBJ: Thrust Reversal inadvisable due to possible fault	**EJ REV:** Thrust reverser failure
NOSSTÄLL: Nose landing gear extended and locked	-
V-STÄLL: Left landing gear extended and locked	**OLJETRYCK:** Low oil pressure
H-STÄLL: Right landing gear extended and locked	**OLJETEMP:** High oil temperature
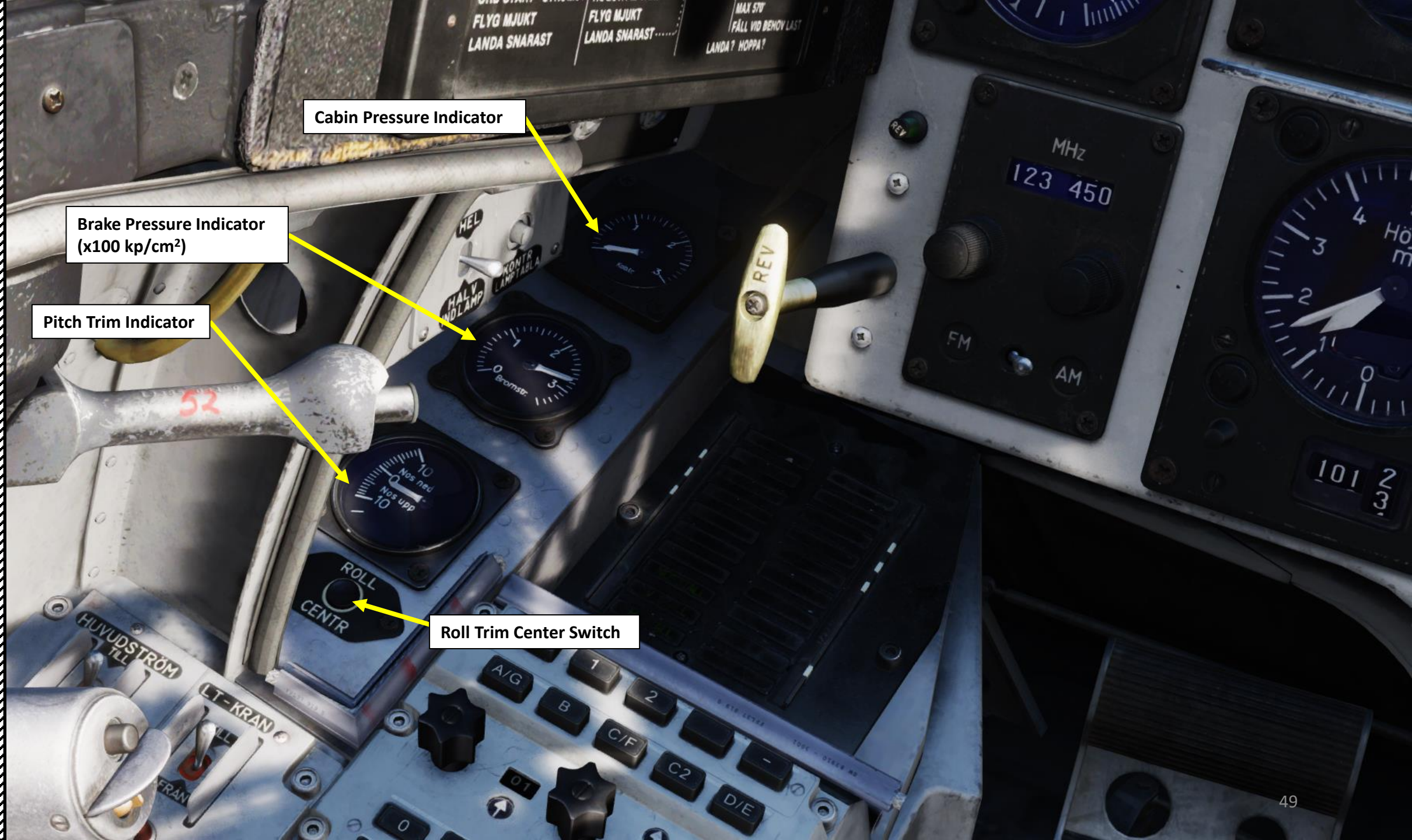
Cabin Pressure Indicator

Brake Pressure Indicator
(x100 kp/cm²)

Pitch Trim Indicator

Roll Trim Center Switch

49
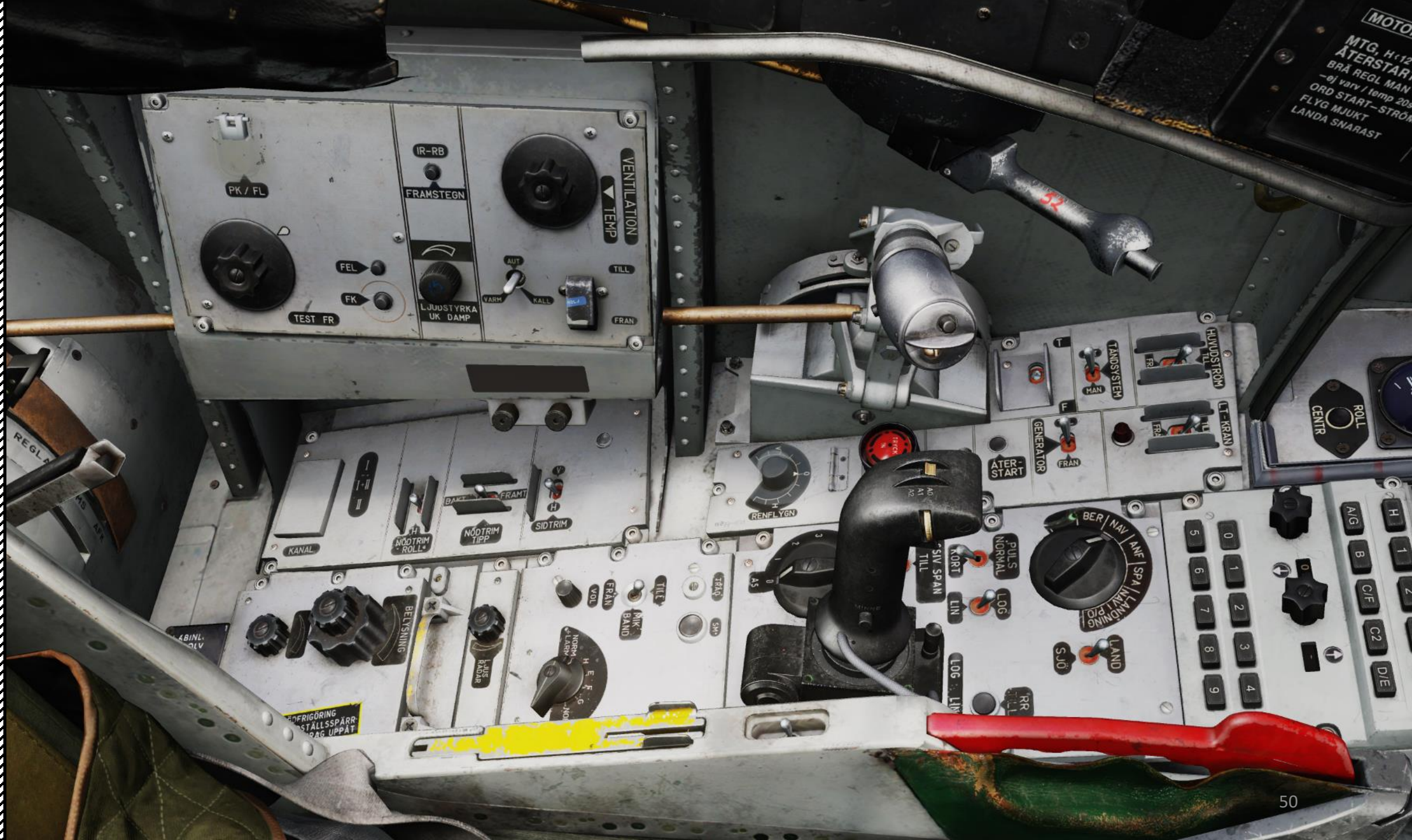
Canopy Control Lever
- AFT: OPEN
- MIDDLE: NEUTRAL
- FWD: CLOSE

Ignition System Selector Switch (*TÄNDSYSTEM*)
- MAN: Manual / AUT: Automatic

Main Electrical Power Switch (*HUVUDSTRÖM*)
- **T**ILL: ON / **F**RÄN: OFF

Low Pressure Fuel Valve Switch (*LT-KRAN*)
- **T**ILL: ON / **F**RÄN: OFF

Starter System Switch
- **T**ILL: ON / **F**RÄN: OFF

Generator Switch
- **T**ILL: ON / **F**RÄN: OFF

Canopy Jettison Button (*NODSKJUT HUV)*

Autopilot yaw correction knob (*RENFLYGNING)*

Low Pressure Fuel Valve (*LT-KRAN*) Warning Light

Radio Group Selector Dial and Indicator

Radio Special Modes Buttons

Radio Base Preset Buttons

Radio Base Selector and Indicator

Radio Group Preset Buttons

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High Pressure Fuel Valve Switch
- Only selectable when throttle is in IDLE or OFF position

Autothrottle (AFK, or *Automatisk Fart Kontroll*) Quick Disconnect Button / Infrared Missile Quick Select Button
(In Front of Throttle, Not Visible)

Countermeasure Quick Release Button

Throttle

Airbrake Switch
- AFT: Deployed
- FWD: Retracted

Infrared Missile Uncage Button

HUVUDSTRÖM
TL
KRAN
LT – KRAN
SYSTEM
MAN
FRAN
GENER
TRYCK IN
A0
A1
A2
NAV / ANF

52
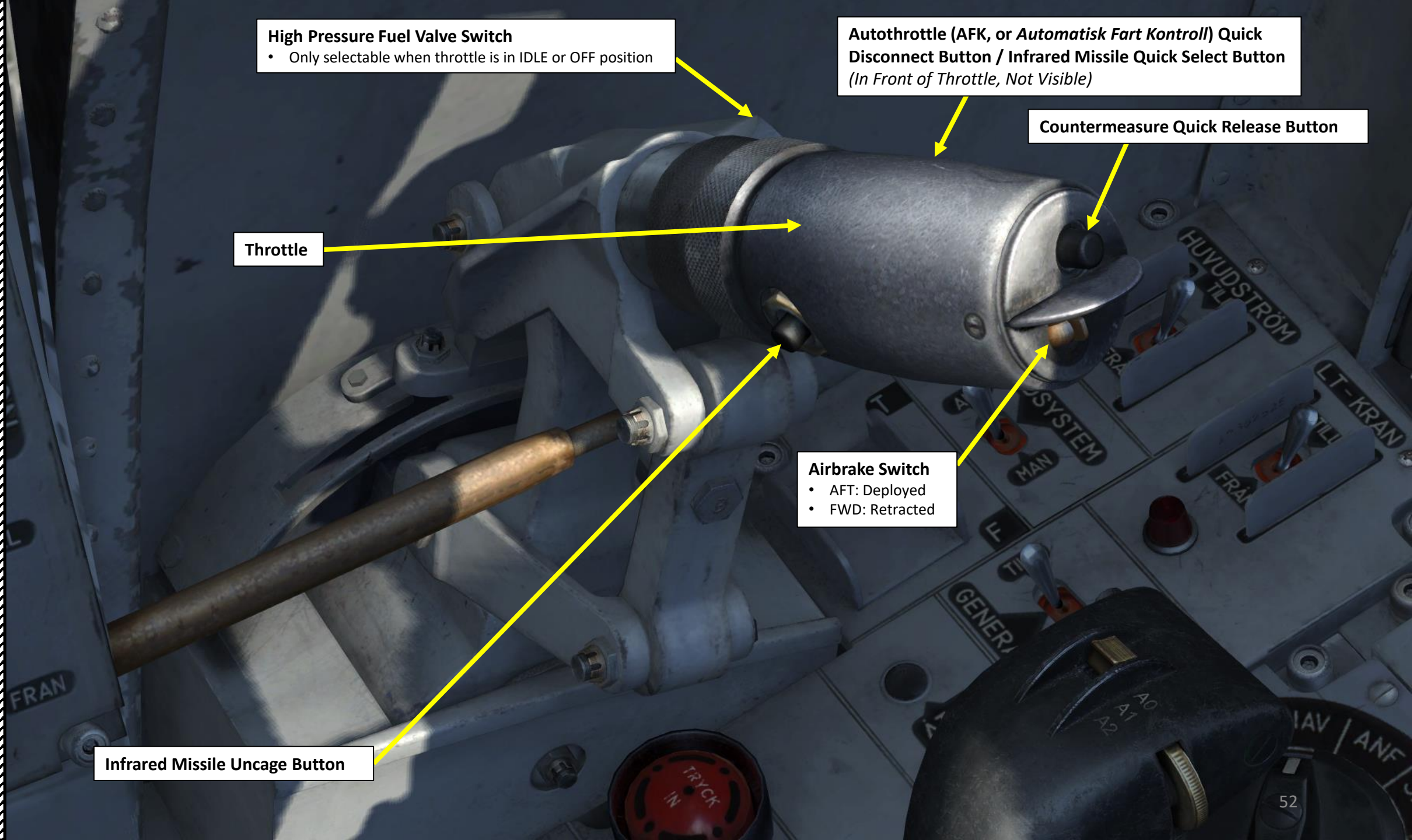
Radar Pulse Length Selector
- NORMAL: Normal
- KORT: Short

Engine Restart Button (*ATERSTART*)

Master Mode Selector
- GREEN ARROW: Used for Maintenance
- BEREDSKAP: Readiness/Standby, pre-warmed state.
- NAV: Radar Display ON (only 180 sec after main generator comes online)
- ANF: *Anflygning*/Attack, radar function dependent on selected weapon
- SPA: *Spaning*/Reconnaissance, used for recce functions.
- LANDN NAV: Navigation Landing, used for instrument approach and TILS approach.
- LANDN P/O: PAR (Precision Approach Radar / Optical), use for visual approach and landing.

Passive Radar Mode Selector
- TILL: ON
- FRÄN: OFF

Radar Altimeter Signal Modulation Selector
- *LAND* (Land)
- *SJÖ* (Sea)

Radar Receiver Processing Mode Selector
Linear / Logarithmic
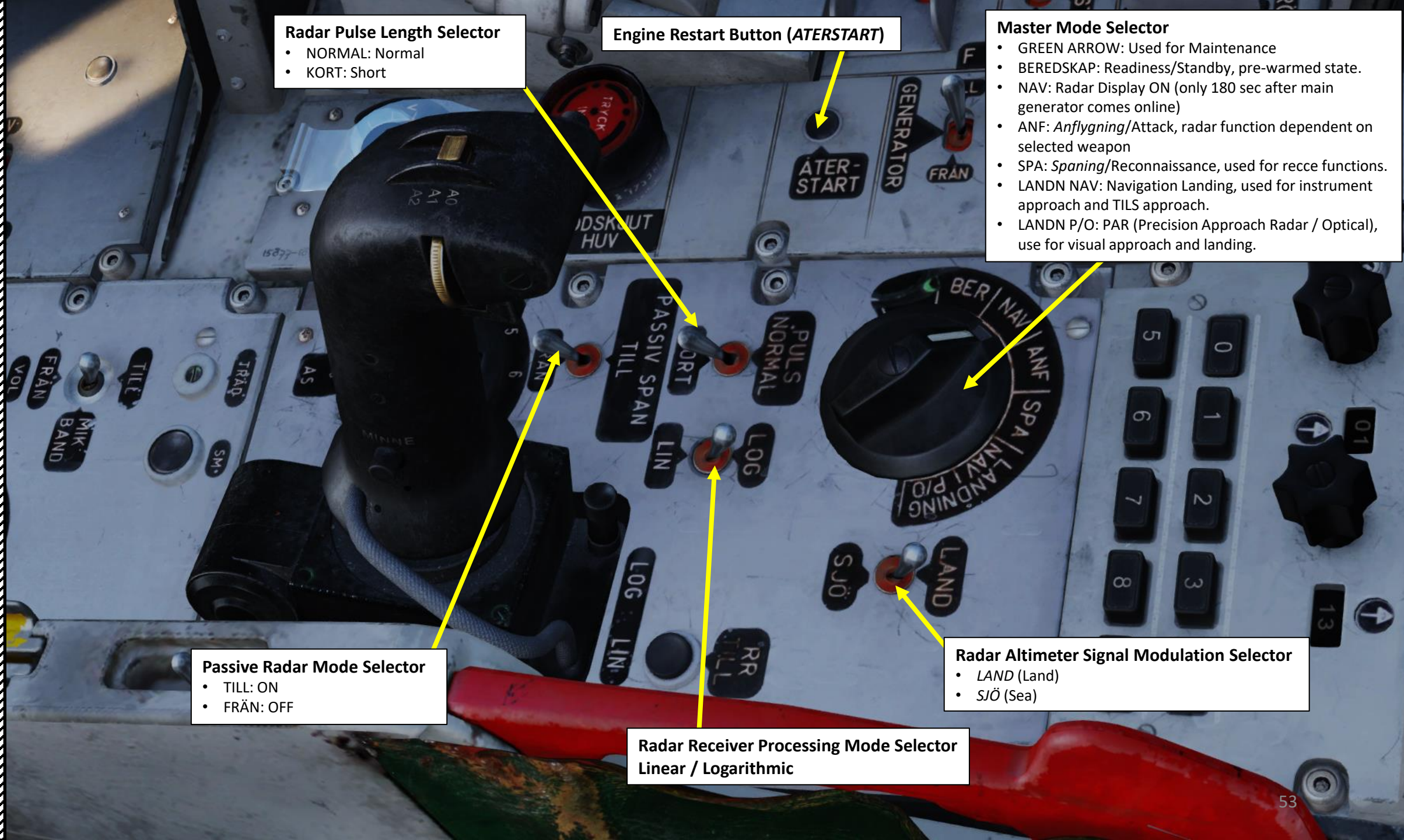
Radar Mode Selector
- A0 (FWD): Radar OFF
- A1 (MIDDLE): Radar ON, Wide Search Mode with Sector PPI
- A2 (AFT): Radar ON, Narrow Search Mode with B-Scope

Radar Terrain Avoidance Selector

Radar Scan Range Selector

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

Radar Antenna Elevation Dial

Radar MKR Potentiometer (Amplification Gain) Dial

Anti-Jamming (AS) Filter Mode Selector

Radar Memory (*Minne*) Mode Button

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Missile select button Infrared-RB (*FRAMSTEGN)*

Master Volume / Sidewinder Tone

EP13 Collimated Sight Contrast Control (*Kontrast*)

EP13 Collimated Sight Brightness Control (*Ljusstyrka*)

Emergency Pitch Trim (*NÖDTRIM TIPP*)
- *FRAMÅT* : Forward
- *BAKÅT* : Aft

Emergency Yaw Trim (S*IDTRIM*)
- *VÄNSTER*: Left
- *HÖGER*: Right

Radio Volume Tuner

Flight Recorder (*MIK BAND*)
- TILL: ON / FRÄN: OFF

Emergency Roll Trim (*NÖDTRIM ROLL*)
- *VÄNSTER*: Left
- *HÖGER*: Right

Ground Intercom Button

FR24 Radio Transmit Button

Left/Right Console Lights Brightness

Radar Brightness Control (*LJUS RADAR*)

FR 24 Backup Radio Mode Selector
- *NORM+LARM:* Normal Mode, but monitoring guard frequency 121.5 MHz
- *H:* Guard Frequency using the FR 24 Backup Radio
- *E/F/G:* Preset emergency channels using FR 24 Backup rad
- *NORM:* Normal FR 22 Main Radio functionality

Flood Lights Brightness (*BELYSNING*)

Instrument Lights Brightness

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Mission Data Cartridge

Autothrottle (AFK, or *Automatisk Fart Kontroll*)
- UP: OFF
- DOWN: ON

Landing Gear Control Lever
- UP: RETRACTED
- DOWN: DEPLOYED

Cabin Air Valve Control
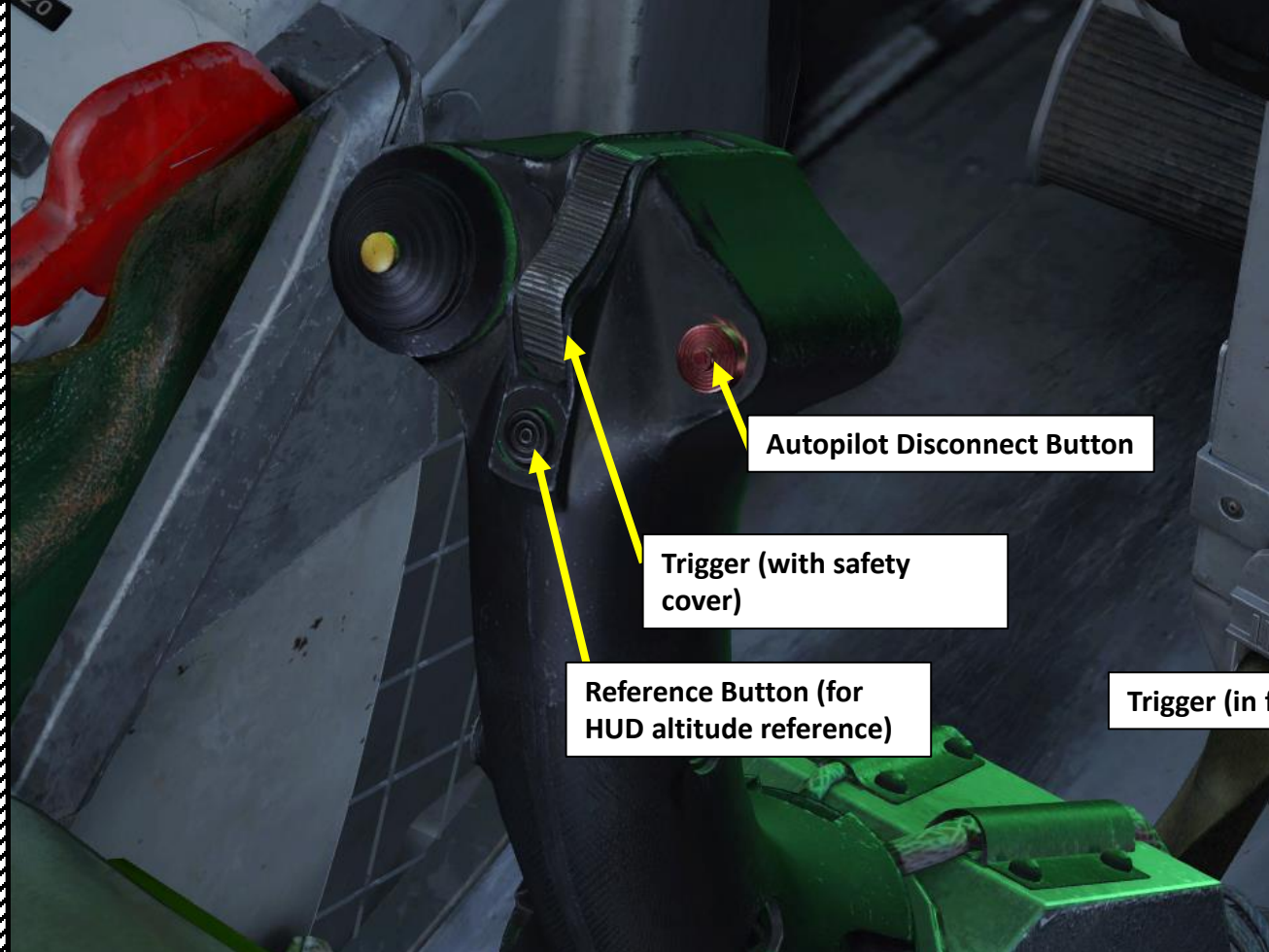
Autopilot Disconnect Button

Trigger (with safety cover)

Reference Button (for HUD altitude reference)
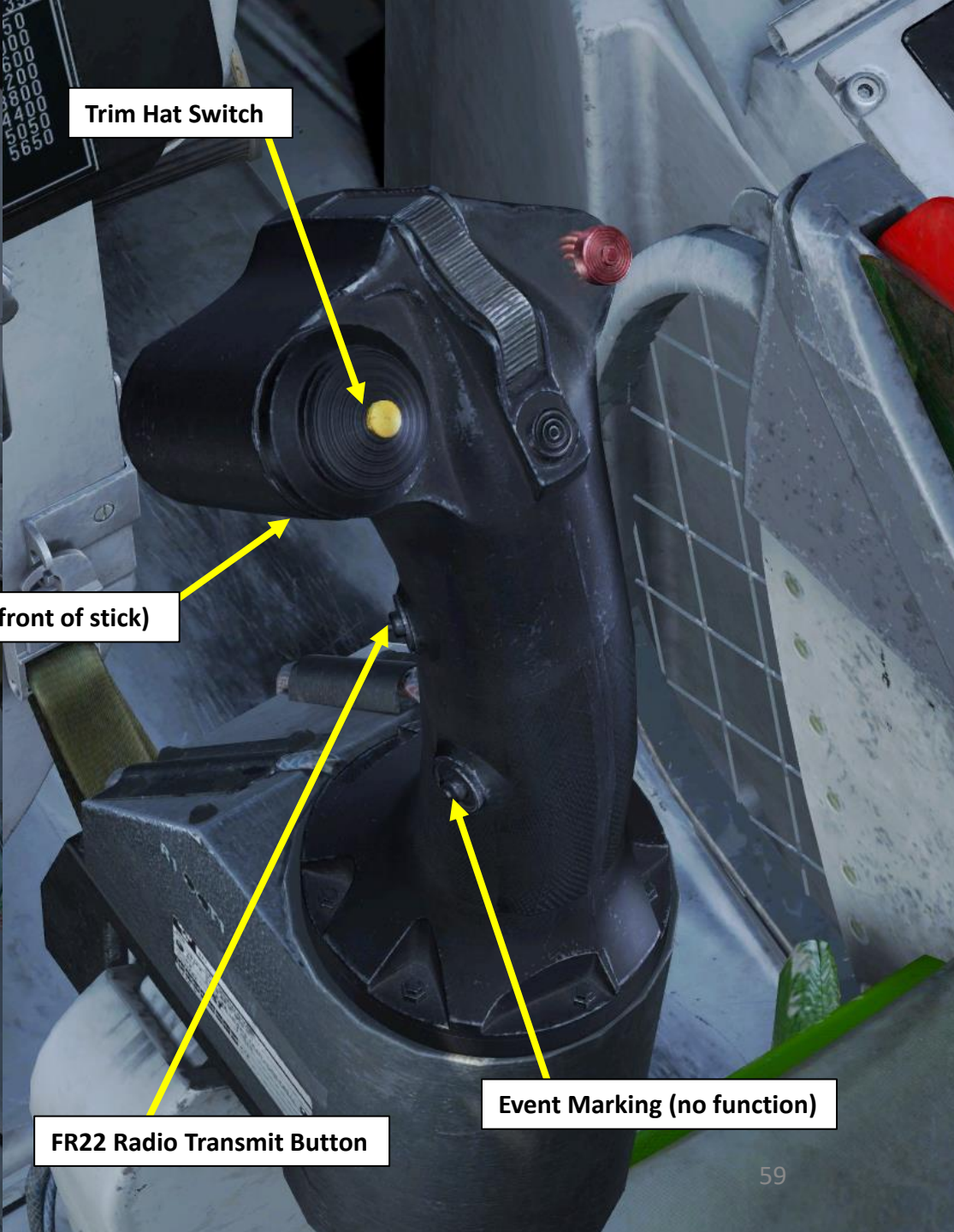
Trim Hat Switch

Trigger (in front of stick)

Event Marking (no function)

FR22 Radio Transmit Button

Safety Bracket

Trigger & Safety Cover

Trigger

SAFE

UNSAFE

Firing

59
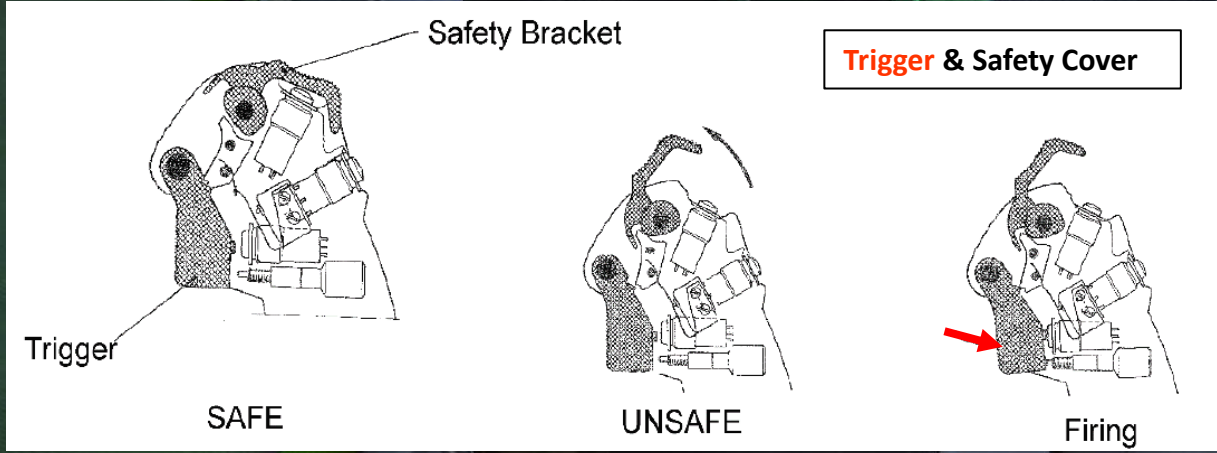
Night Vision Goggles (NVG) Controls:
- *RSHIFT+H: On/Off*
- *RSHIFT+RALT+H: Gain Night Vision Goggles Down*
- *RSHIFT+RCTRL+H: Gain Night Vision Goggles Up*

HUD (Heads-Up Display)
Brightness set for Night Operations

HUD (Heads-Up Display) Brightness Knob
• *Used to adjust HUD for night operations*

Flashlight
Binding: LALT+L

Backup Pitot Tube

APP-27 Radar Warning Receiver (RWR) System Leading Edge Receiver

APP-27 Radar Warning Receiver (RWR) System Rear Receiver

Main Pitot Tube

APP-27 Radar Warning Receiver (RWR) System Leading Edge Receiver

Outer Elevon

Inner Elevon

Rudder

Inner Elevon

Outer Elevon

Canard Flap (Retracted)

Canard

Canard

Canard Flap (Retracted)
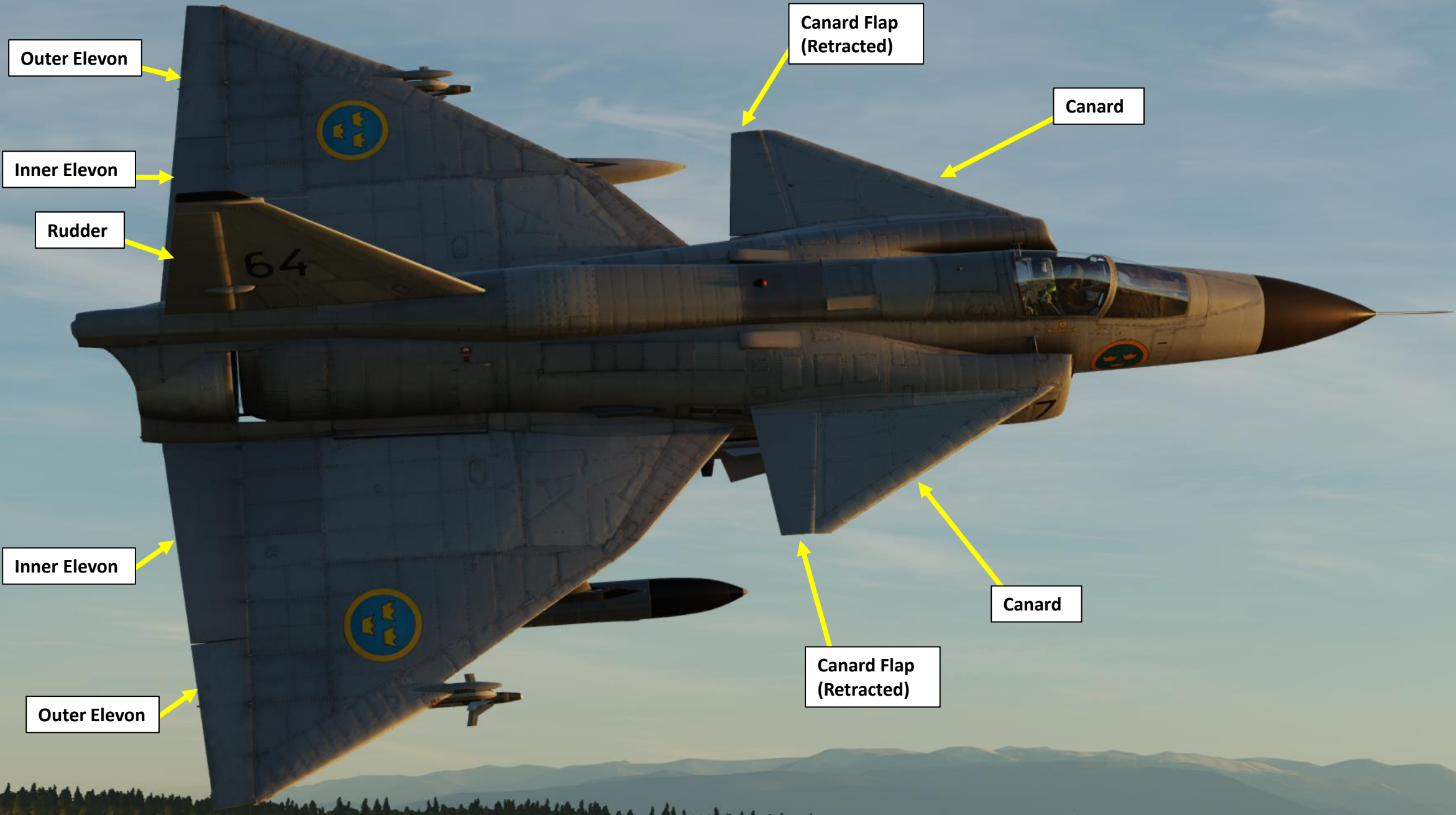
Canard Flap, also known as "Foreplane Flap"
Deployed automatically when landing gear is deployed

Airbrake

Airbrake

Airbrake

Airbrake
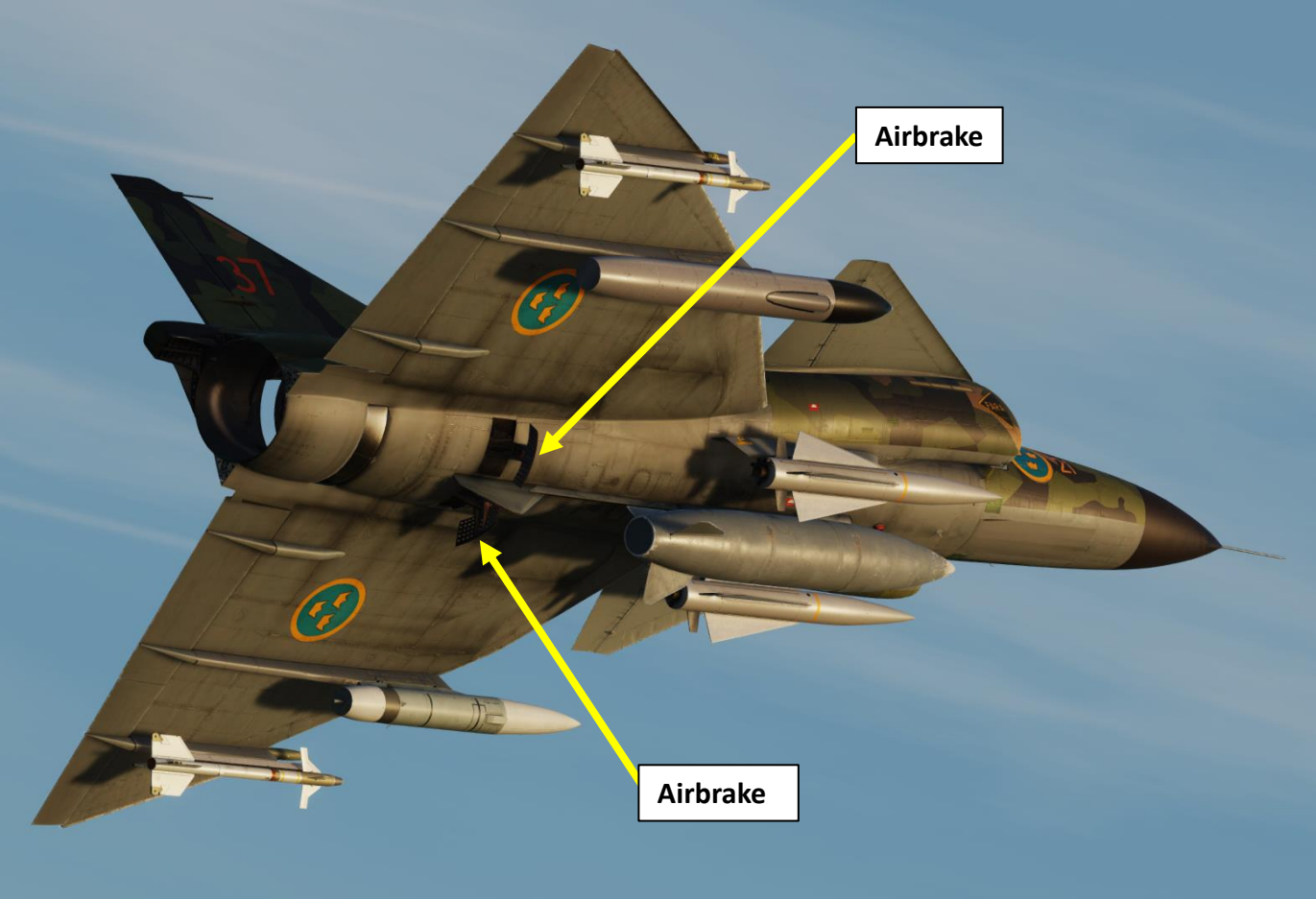
Landing (*Strålkast*) Light
- Located in wheel wells

Landing (*Strålkast*) Light
- Located in wheel wells

Taxi (*Strålkast*) Light
- Located on nose strut
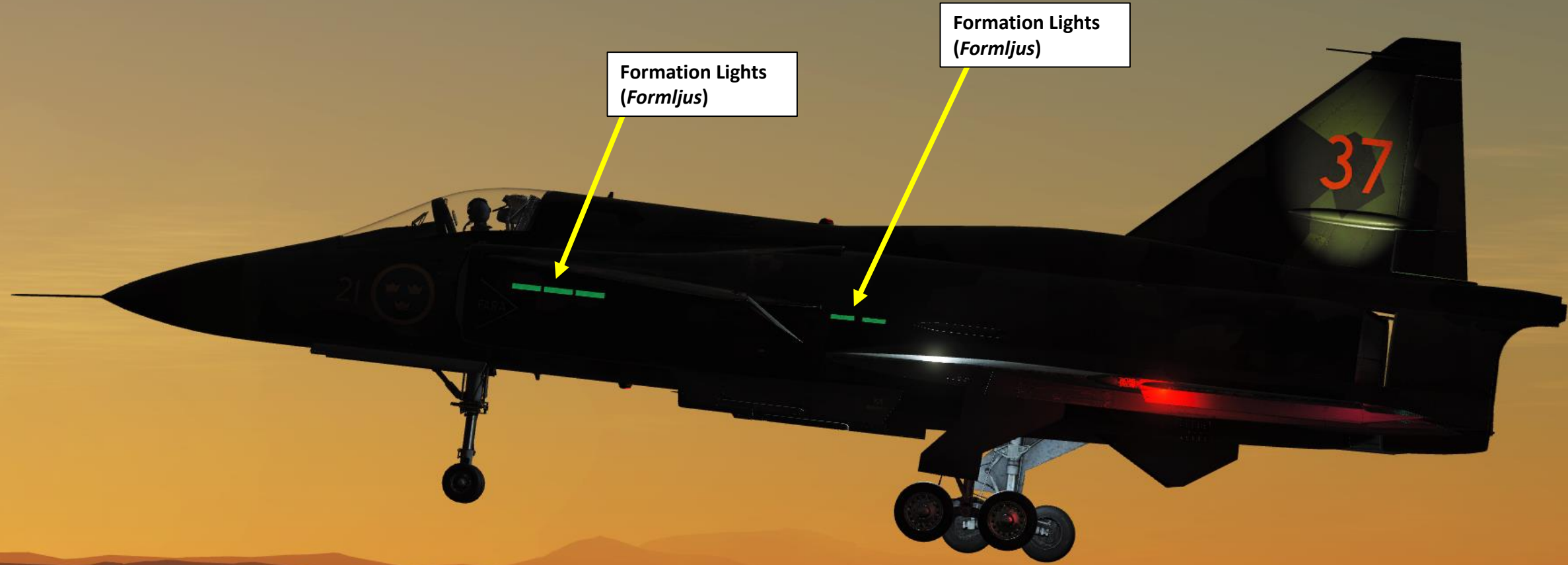
Formation Lights
(*Formljus*)

Formation Lights
(*Formljus*)

Navigation Light
(*Lanternor*)

Navigation Light
(*Lanternor*)

Anticollision Light
(*Antikollljus*)

Anticollision Light (*Antikollljus*)

Position Lights (*Ledljus*)

Navigation Light (*Lanternor*)

Navigation Lights (*Lanternor*)

Position Lights (*Ledljus*)

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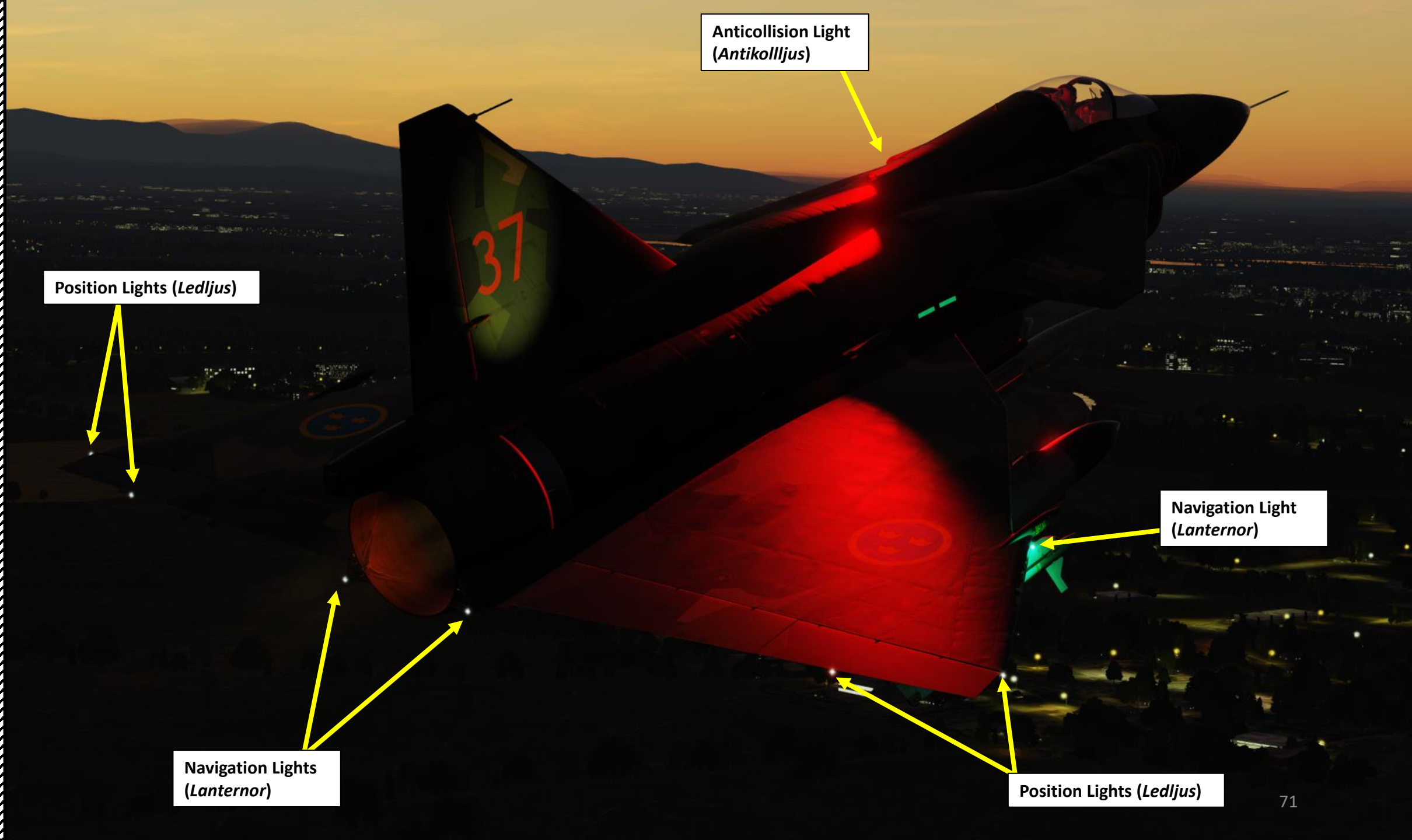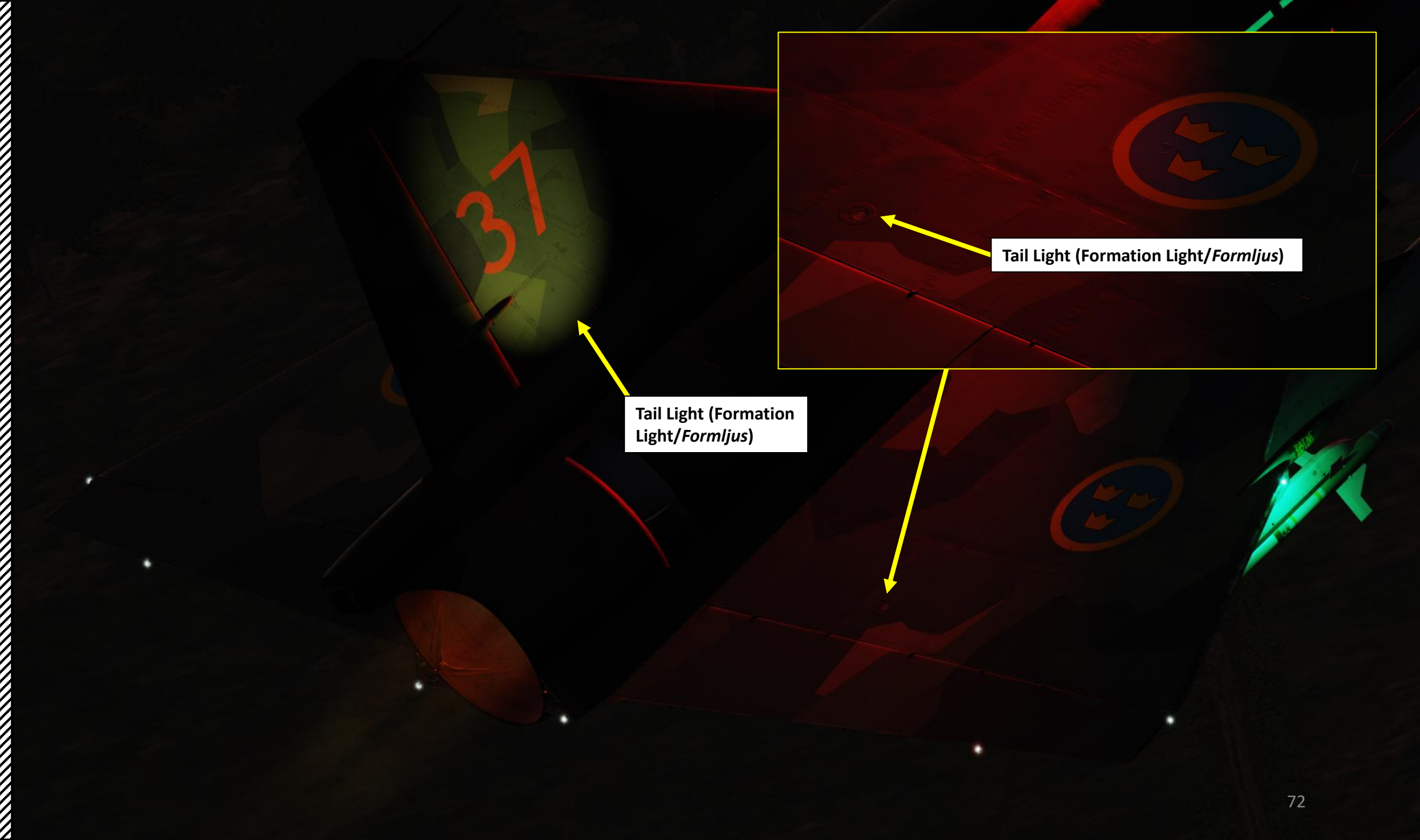
Tail Light (Formation Light/*Formljus*)

Tail Light (Formation Light/*Formljus*)

RAT (Ram Air Turbine, or Backup Generator)

- *RAT extends automatically when the nose wheel is depressed, and is retracted automatically on landing gear retraction, but is not connected as a power source unless required. On loss of power from the generator due to a failure, the RAT is automatically extended*

START-UP

For this tutorial, we will assume that your whole flight plan is already pre-programmed in your Mission Data Cartridge. In other cases where you want to create a flight plan either manually or use an automatically-generated one, see PART 16 – NAVIGATION & TILS LANDING in the FLIGHT PLAN sub-section.

BRIEFING

OBJECTIVE

15 May 1994
0930 local (0430Z)

I. SITUATION
Area of operations: Western Georgia.
Weather: Overcast at 1000m, Rain, Visibility 4000m, 12°C.

Enemy forces:
N/A.

Friendly forces:
SPRINGFIELD 1, AJS-37 72nd Squadron, F7 wing (Sweden).
COLT 1, COLT 2, F-5E from 336 Squadron (Norway).
Chevy C-130 "Hercules".
UZI UH-1H ASR.
STINGRAY Fighter control
Various civilian craft are known to transit the area.

II. MISSION
Naval intelligence wants us to detect and identify Russian ELINT ships. Intelligence suggests that the ship "IVANOV" has been dispatched for this purpose and is patrolling the coast off Georgia.

III. EXECUTION
Your flight, Springfield 1 will patrol the western coast off Georgia. Your task will be to locate the ship "Ivanov" (pictured attached to this briefing). The Ivanov is a modified cargo ship, still visually identical to that of a common freighter, but contains large amounts of electronic (ELINT) and signals intelligence (SIGINT) equipment. She is easily identified by the ISO containers on the upper deck.
Find the ship on radar, and approach her. Visually identify the ship by flying past her at low altitude. Once the ship has been positively identified, return to base. Your wingman will record the necessary data and will report back to fighter control (callsign Stingray).
Your patrol area is already defined in the data cartridge, but can be input manually. Coordinates Corner points for the reconnaissance square is prestored as reference points 9201 – 9204. The patrol area is attached to this briefing.
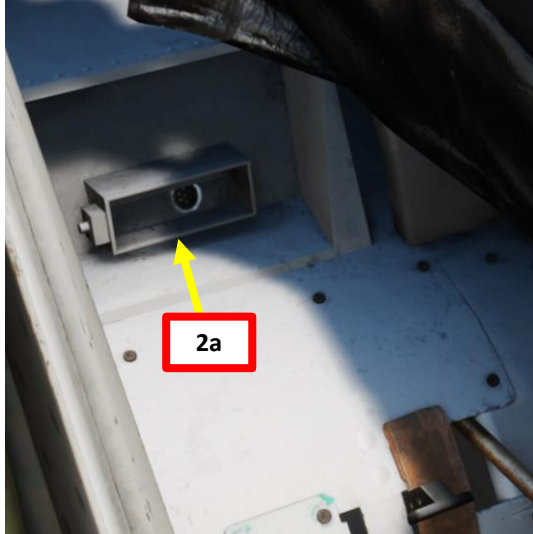
Rules of Engagement: HOLD. Fire only in self-defense.
You are operating out of KUTAISI AIR BASE, which will be your primary departure and landing site.
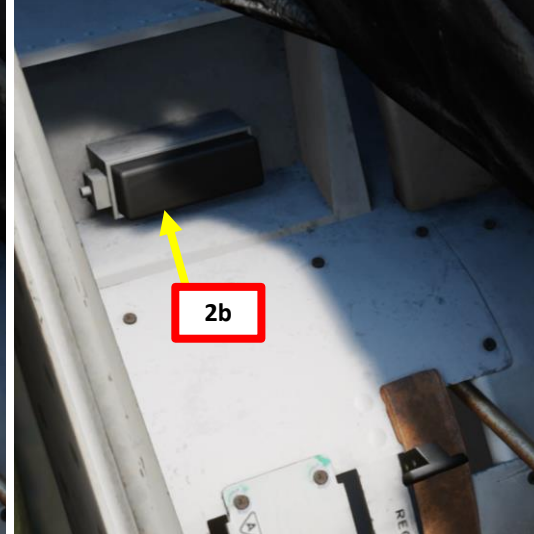
2 OF 2

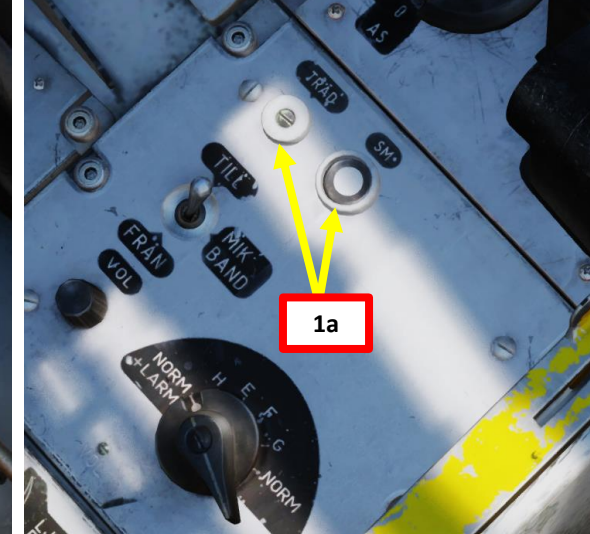CANCEL   MISSION PLANNER   START

START-UP

1. Communicate with ground crew to set ground power ON. This step is **not mandatory**, but recommended.
   a) Press the TRÅD (Ground Intercom) button to communicate with ground crew
   b) Press F8 – Ground Crew
   c) Press F2 – Ground Electric Power
   d) Press F1 – ON
2. Insert Mission Data Cartridge (left side of cockpit, behind pilot seat)
3. Set Main Power switch (HUVUDSTRÖM) to TILL (ON)
4. Set Low Pressure Fuel Valve (LT-KRAN) switch to TILL (ON)
5. Cancel Master Caution Alarm by pressing the HUVUDWARNING button between the caution lights.
6. Set Radar Master Mode to BER (*Beredskap/*Standby)


```
Main

F5. ATC...
F8. Ground Crew...
F9. Viggen Special Menu...
F12. Exit
```

```
2. Main. Ground Crew

F1. Rearm & Refuel
F2. Ground Electric Power
F3. Request Repair

F11. Previous Menu
F12. Exit
```

```
3. Main. Ground Crew. Ground
Electric Power

F1. On
F2. Off

F11. Previous Menu
F12. Exit
```
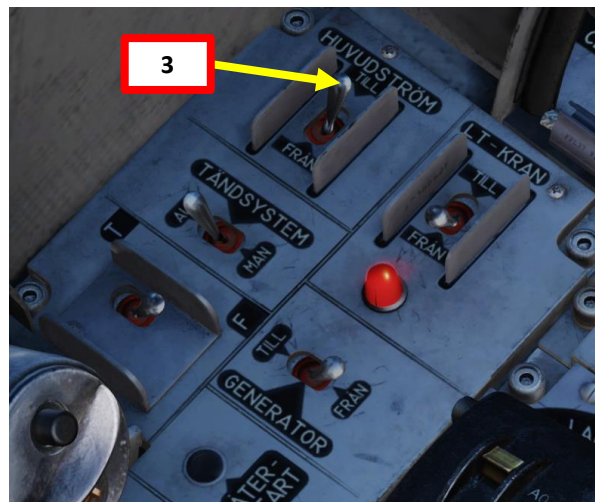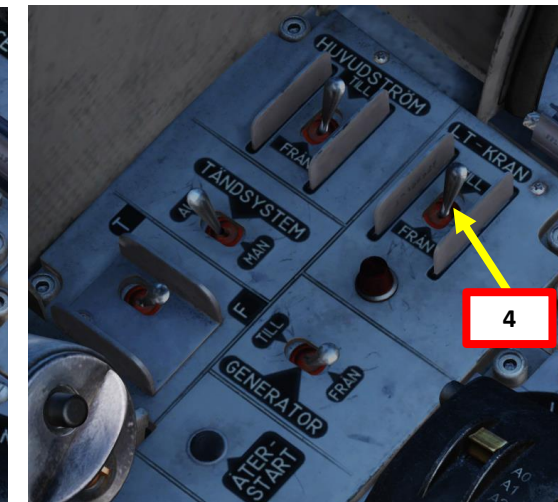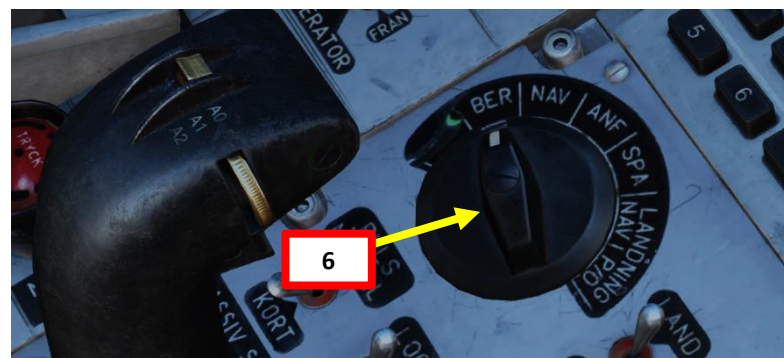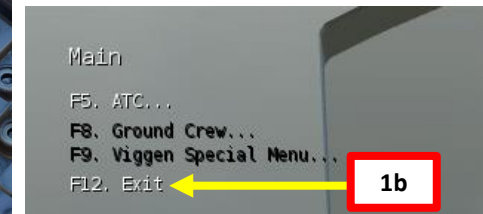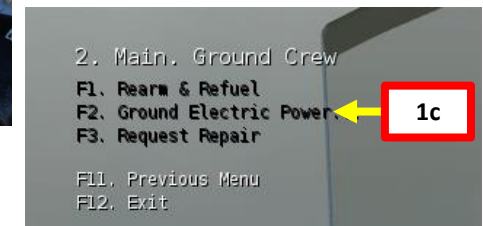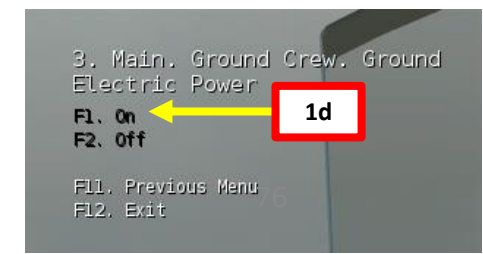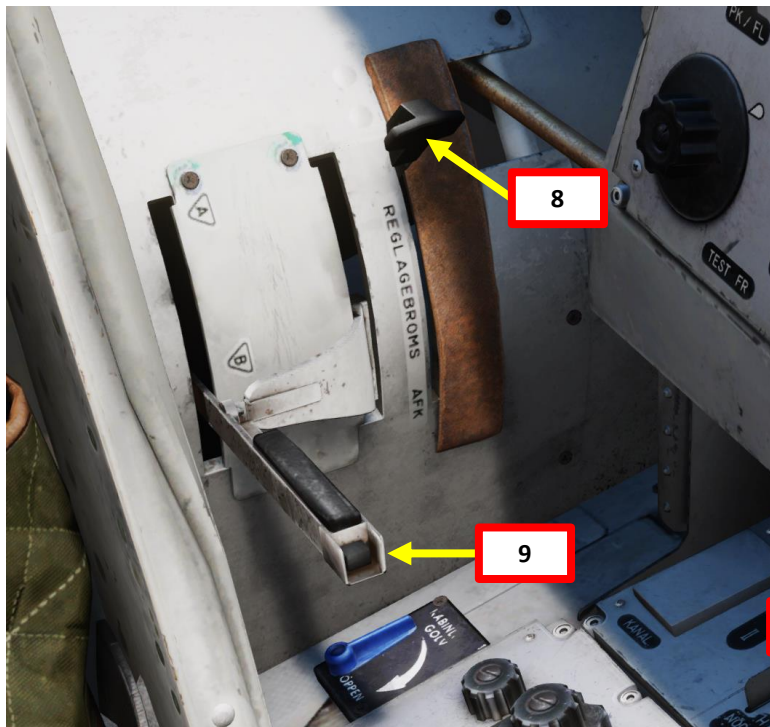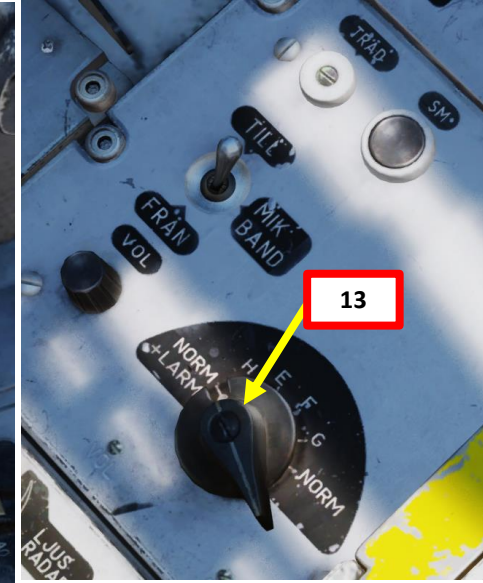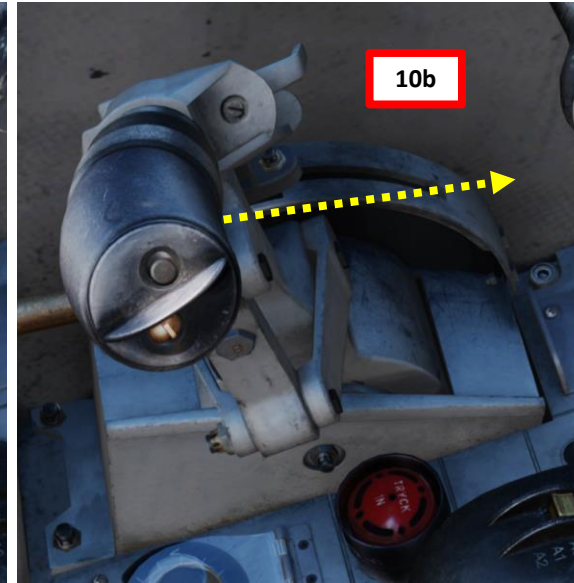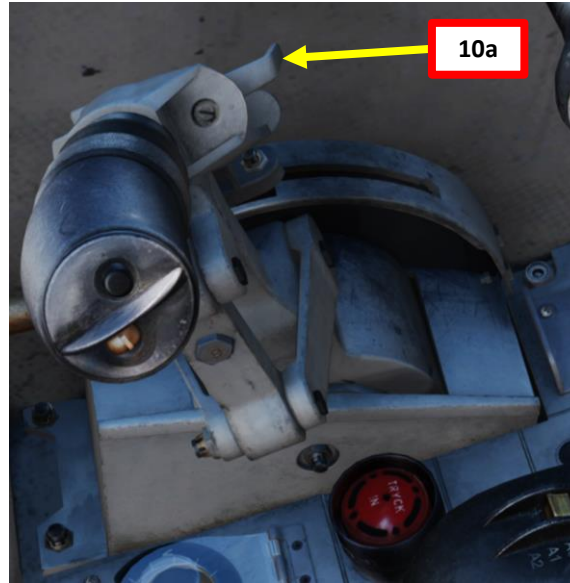
START-UP

7. Press the Warning Lights Test button (KONTR LAMPTABLA) and test that the caution lights are illuminated correctly.

START-UP

8. Make sure Autothrottle (AFK, *Automatisk Fart Kontroll*) is set to OFF (UP)
9. Make sure landing gear lever is set to EXTENDED (DOWN)
10. Set throttle to GROUND IDLE (MTG) position by clicking on the High-Pressure Fuel Valve switch
11. Set Generator switch to ON (TILL).
12. Click on the Autopilot yaw correction cover and set Autopilot yaw correction (*RENFLYGNING*) to 0.
13. Set FR 24 radio switch to NORMAL + GUARD (*NORM+LARM)*.
14. Ensure Thrust Reverser lever is in the STOWED position (pushed).

78
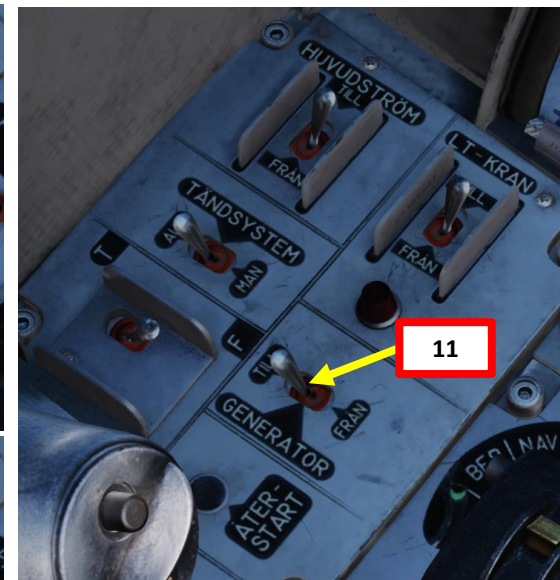
START-UP

15. Check that the ADI (Attitude Director Indicator) is aligned properly.
    • Note: The red warning flag disappears once ground power is connected or when the engine is running and generator power kicks in.
16. Set the HUD (Heads-Up Display) to the LOWER position to ensure takeoff data/symbology is properly displayed.
17. Set HUD slave (SLAV-SI) switch to FRÄN (OFF)
18. Set CI-HUD (HÖJD CI-SI) altitude source selector switch to Barometric Altitude (LD).
19. Pull the Backup Artificial Horizon caging knob to uncage it.
20. Set Main Altimeter Pressure until Altitude (HÖJD) is set to 0.
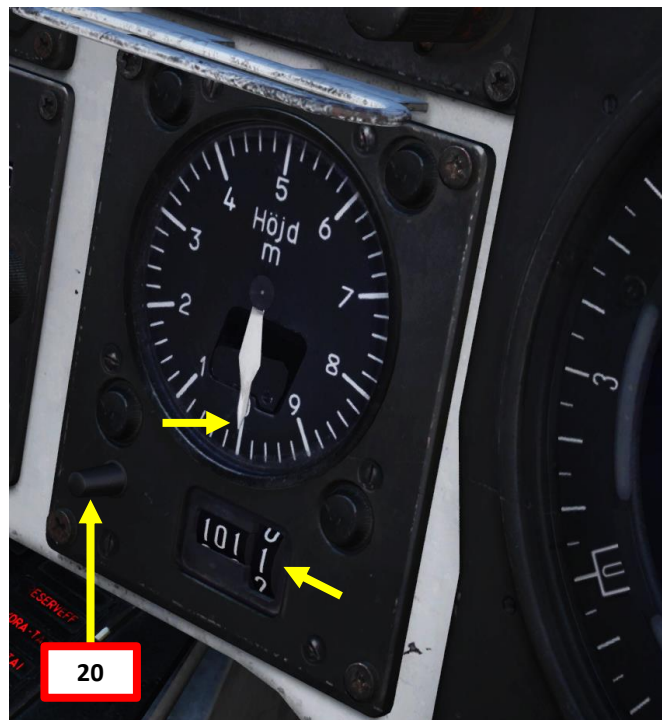21. Set Backup Altimeter Pressure until Altitude (HÖJD) is set to 0.

79
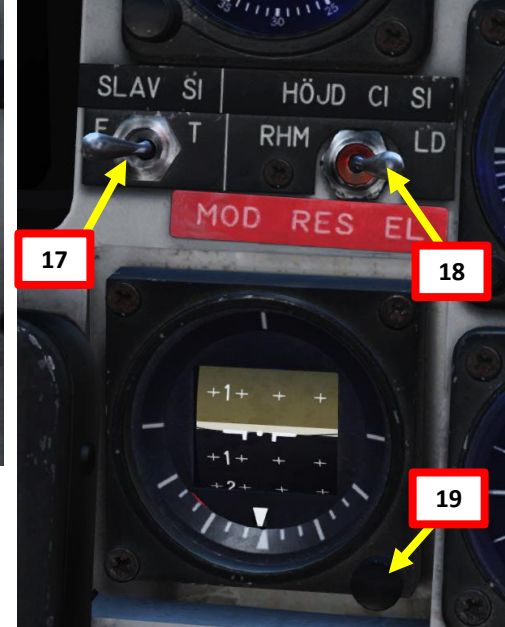
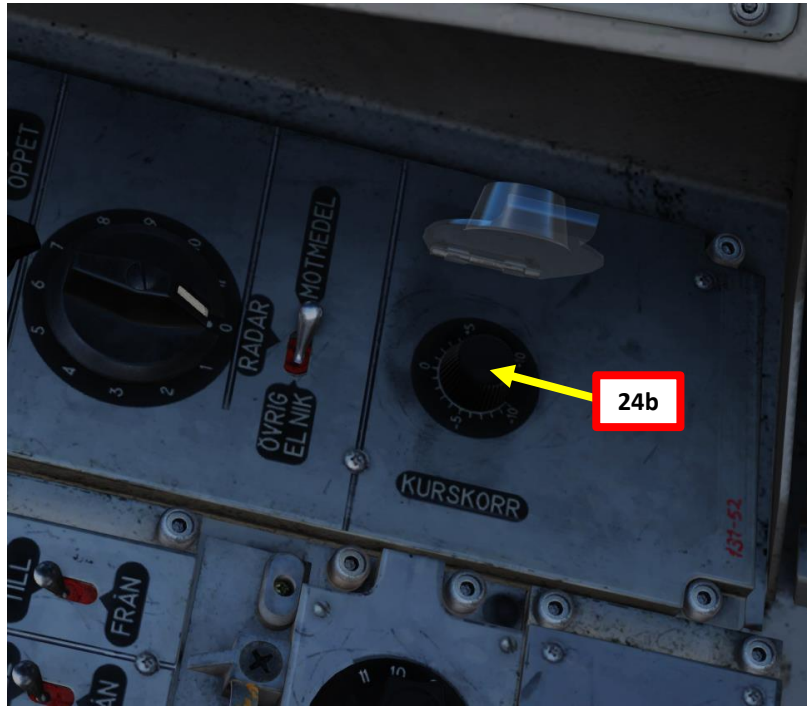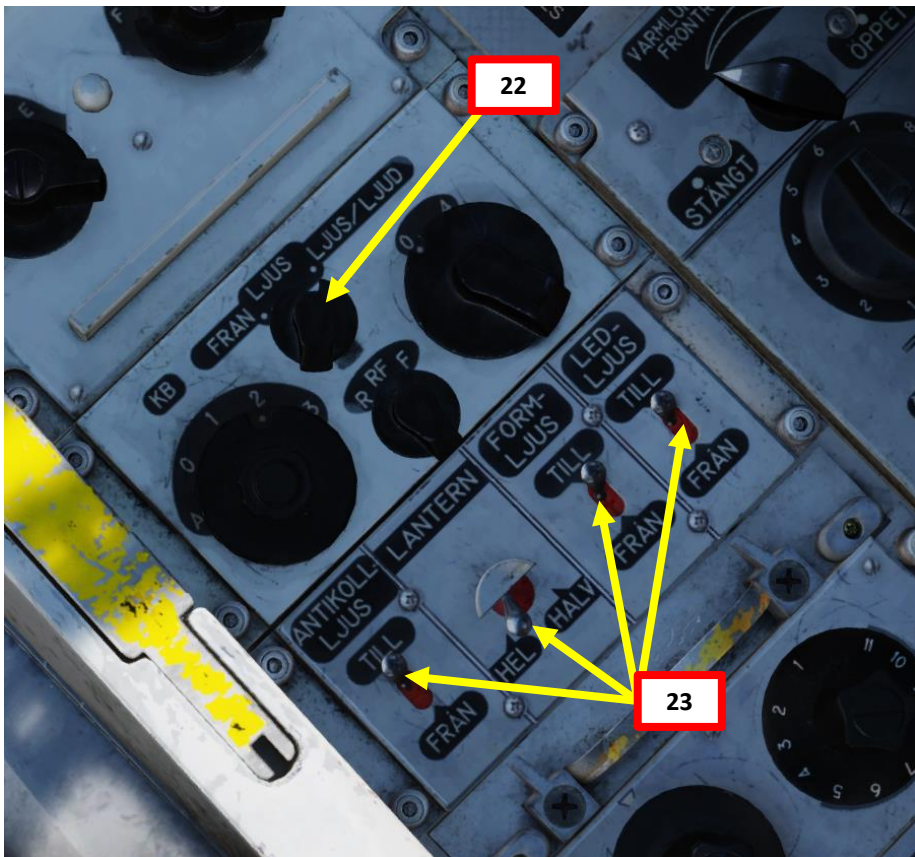## START-UP

22. Set RWR (Radar Warning Receiver) to desired position
   - FRÄN = OFF
   - LJUS = ON: LIGHTS ONLY
   - LJUS + LJUD = ON: LIGHTS + AUDIO
23. Set lights as desired
24. Click on Magnetic Declination cover and set Magnetic Declination to:
   - +6.4 deg for Caucasus
   - +14.2 deg for Nevada.
   - +1.3 deg for Persian Gulf
   - -5 deg for Normandy
   - +0.2 deg for the English Channel
   - +5.2 deg for Syria

80

START-UP

Note: *If you are not using external power from a ground power unit, the aircraft can be started on the battery alone, but only about three times before running out of power.*

25. Before starting engine, verify that:
    a) Throttle is set to GROUND IDLE (MTG) position
    b) Main Power switch (HUVUDSTRÖM) is set to TILL (ON)
    c) Low Pressure Fuel Valve (LT-KRAN) switch is set to TILL (ON)
    d) Generator switch is set to ON (TILL), which will provide electrical power from the engine generator once engine is running.
26. Hold the START switch LEFT to TILL (ON) for 2 second to begin engine start sequence.
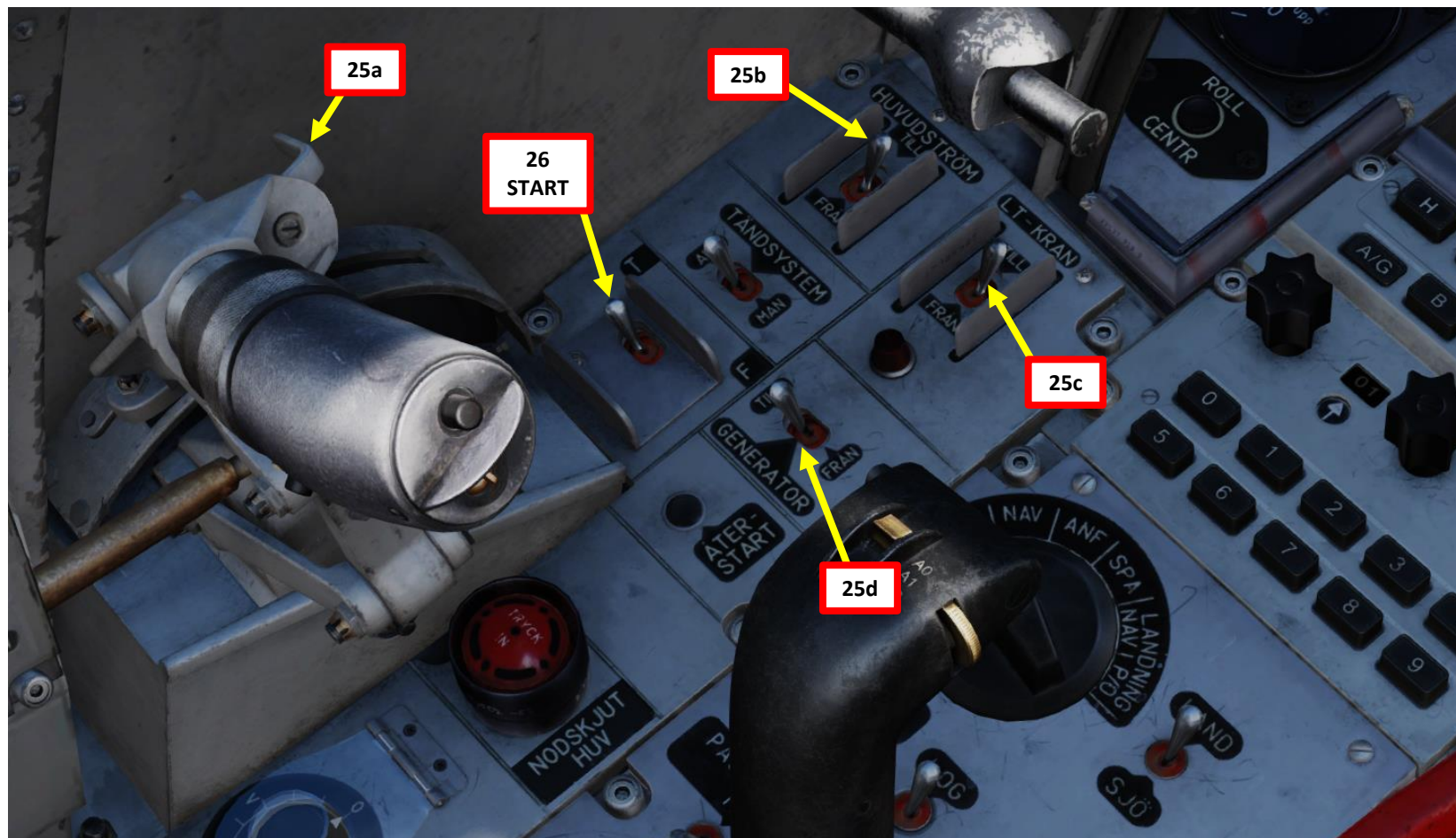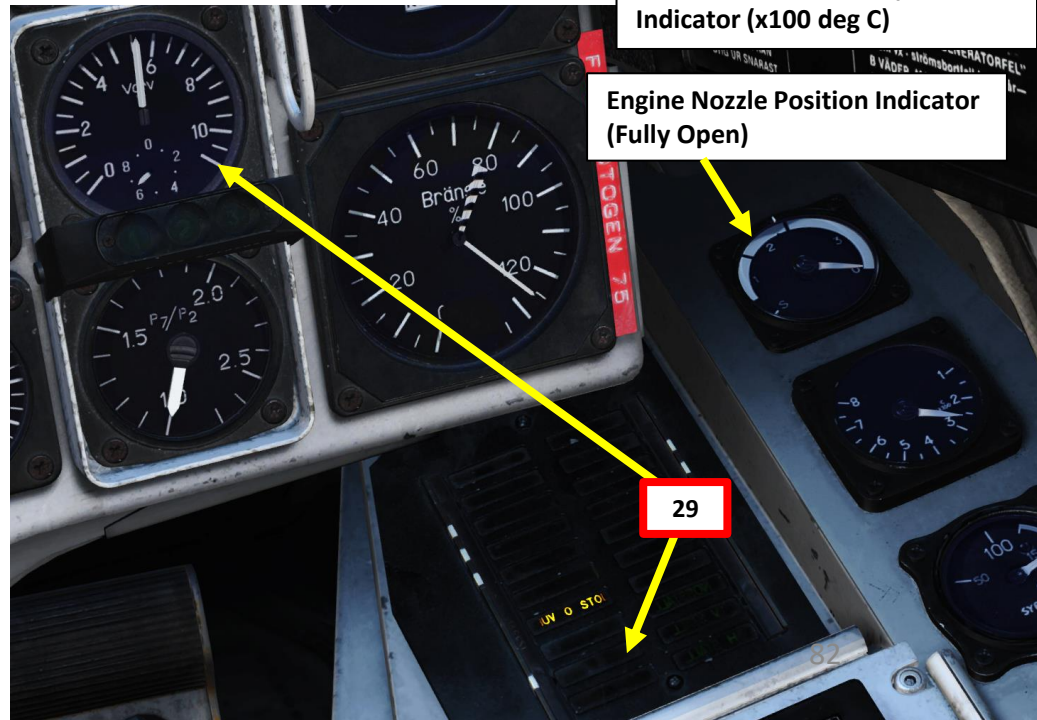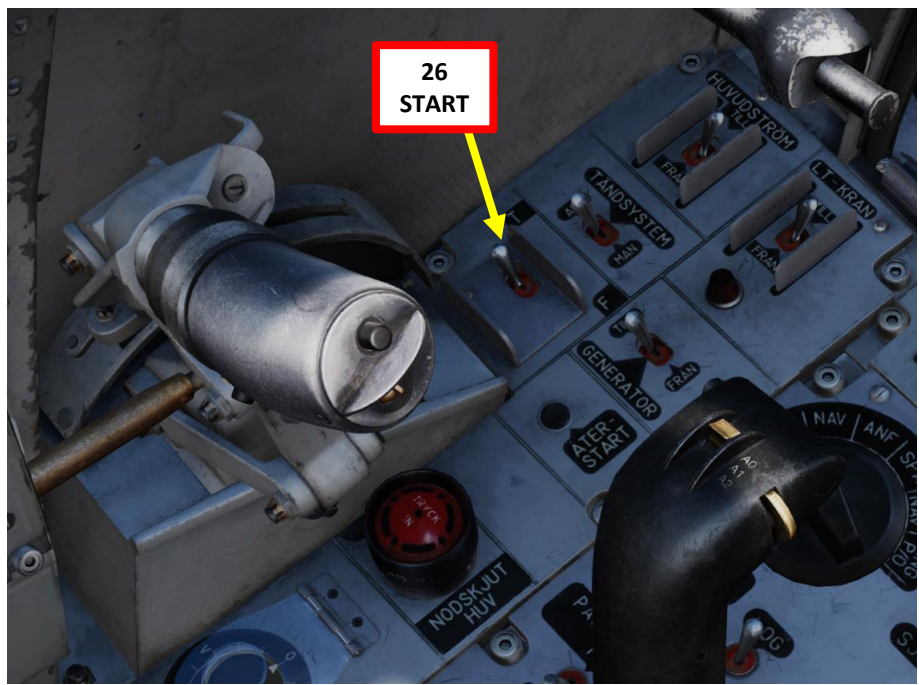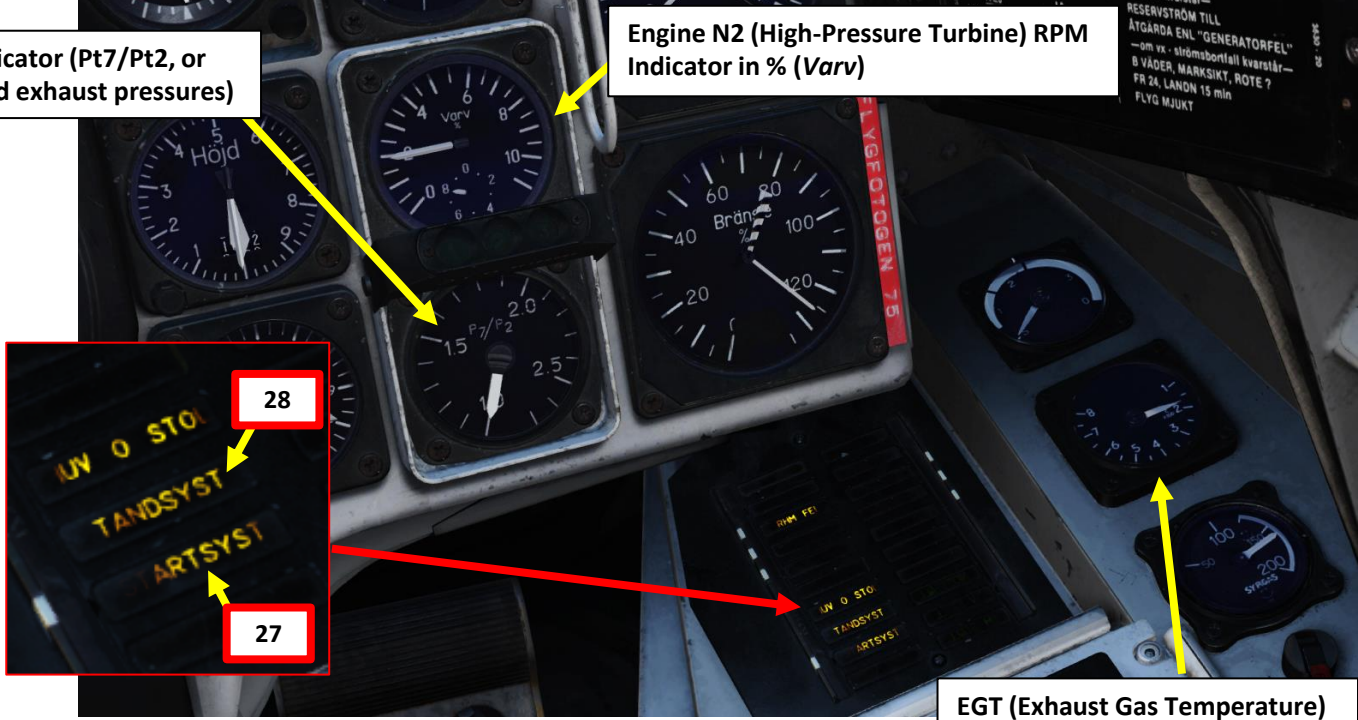
START-UP

Engine Pressure Ratio (EPR) Indicator (Pt7/Pt2, or ratio between engine intake and exhaust pressures)

Engine N2 (High-Pressure Turbine) RPM Indicator in % (*Varv*)

26. Hold the START switch LEFT to TILL (ON) for 2 second to begin engine start sequence.
27. The *STARTSYS* caution will illuminate once start sequence has started. STARTSYS should illuminate within 5 seconds.
28. The *TÄNDSYST* caution should illuminate within 30 seconds, which means that the igniters light up the engine's combustion chamber.
    - *OLJETRYCK* caution (Low Oil Pressure) may be lit maximum of 60 seconds.
    - Ensure maximum start-up EGT (exhaust gas temperature) 400 deg C is not exceeded.
    - If EGT limit is exceeded, set START switch to OFF (F) to abort engine start.
29. Once engine RPM has reached IDLE (around 55-65 % N2), the STARTSYS and *TÄNDSYST* cautions will extinguish.
    - Ensure maximum idle EGT (exhaust gas temperature) 350 deg C is not exceeded.
    - Engine Pressure ratio should stabilize around 1.0
   - Engine Nozzle position should be FULLY OPEN

28

27

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

**26
START**

Engine Nozzle Position Indicator (Fully Open)

29

START-UP

30. Wait for a few seconds until main generator power kicks in and the CK37 Computer panel powers up. We will then start the data transfer (flight plan, starting airport, landing airport) from the data cartridge to the aircraft's CK37 flight computer.

31. Verify that the data cartridge is inserted, then load flight plan data from the mission cartridge by setting the Data Selector knob to **REF/LOLA** (Reference number or longitude/latitude coordinate position of waypoints).

32. Set INPUT/OUTPUT data switch to INPUT.

33. Enter code **9099**. The 4 digit code corresponds to inputting 6+6 digits of longitude and latitude as well as connecting to other information regarding that locations, such as TILS channels or runway headings.

34. Press the LS/SKU Takeoff Base Waypoint selector button to start data transfer process. During data transfer, the entered code 909900 is shown in the data indicator, with the first 9 flashing.
    - A failed transfer is indicated by the first 9 no longer flashing and the display showing 909900.
    - A **successful** transfer is indicated by the data indicator displaying **000000**. The data transfer will then be complete.

35. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

33b

32

33a

31b
REF/LOLA
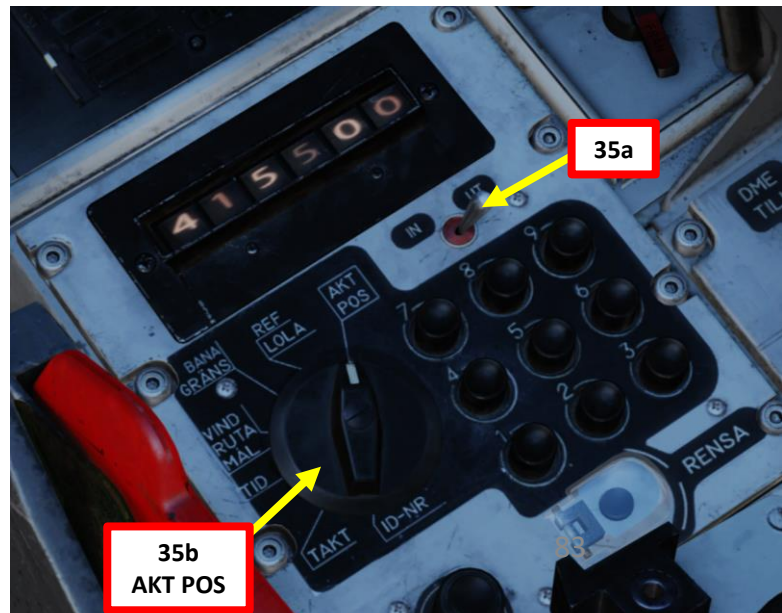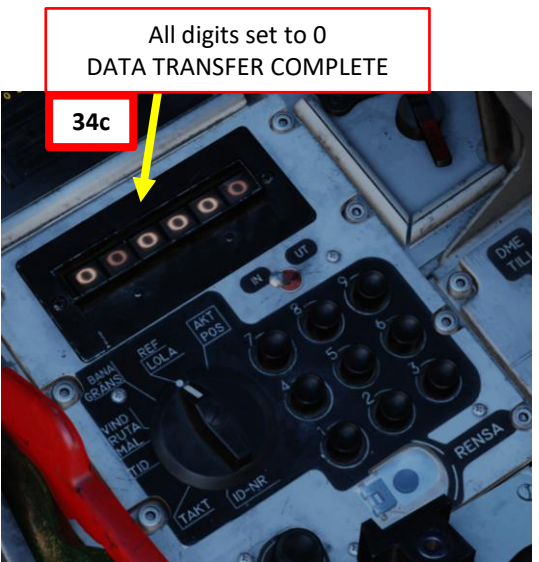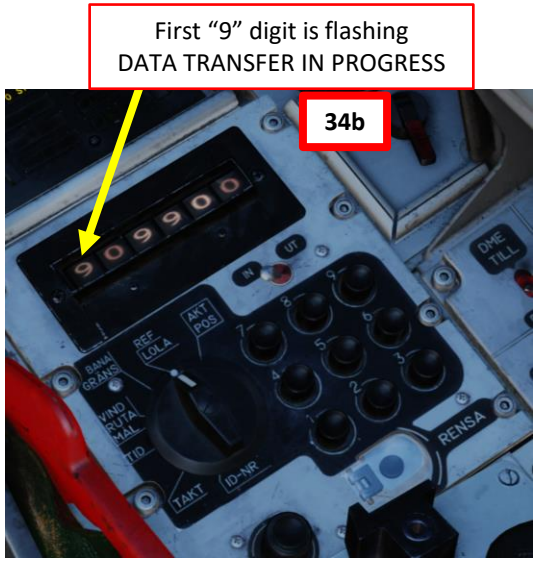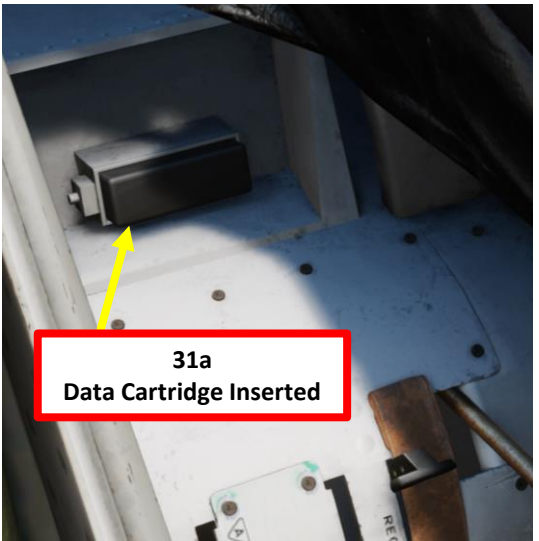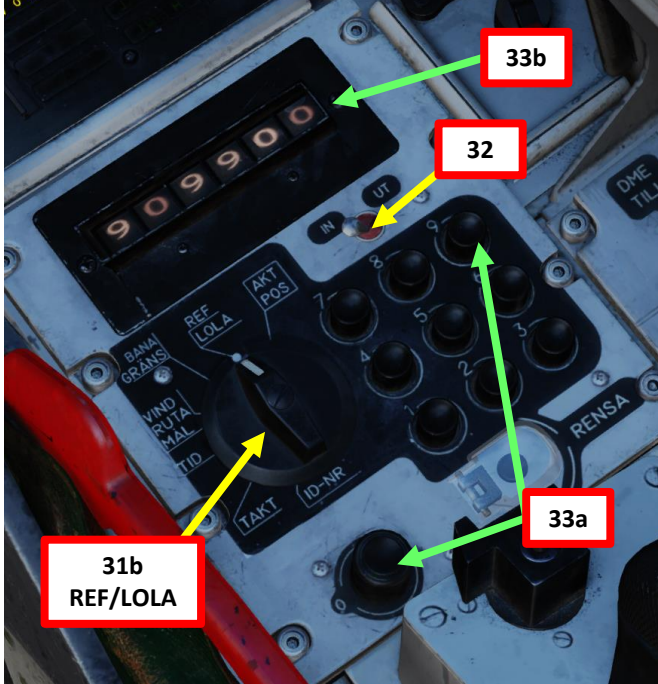
34a
LS/SKU Takeoff Base Selector

31a
Data Cartridge Inserted

First "9" digit is flashing
DATA TRANSFER IN PROGRESS

34b

All digits set to 0
DATA TRANSFER COMPLETE

34c

35a

35b
AKT POS

START-UP

36. Set Canopy Lever FORWARD to CLOSE the canopy.

36a
NEUTRAL

36a
Canopy Open

36b
CLOSE

36b
Canopy Closed

84
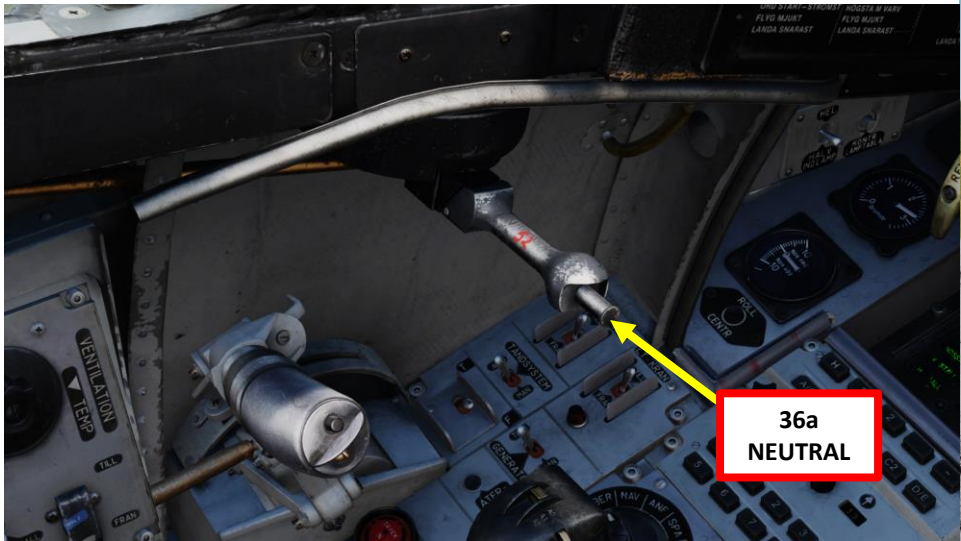
START-UP

37. Arm Ejection Seat using the arming handle.
38. When seat is armed, the HUV O STOL caution should extinguish on the right warning panel.

37a

37a

Ejection Seat DISARMED

37b

38

Ejection Seat ARMED

START-UP

39. Set Oxygen switch to TILL (ON).
40. Set RHM (Radar Altimeter Power) switch to TILL (ON)
41. Set Pitch Trim to 3 deg Nose Up (Nos Upp).
42. Press the System Indicator Test (KONTROLL) button for a few seconds to run automated system tests.
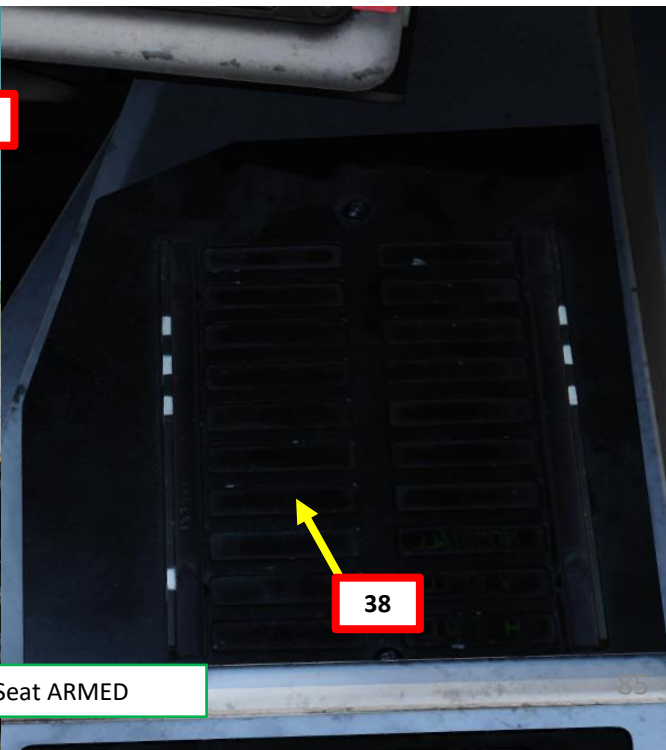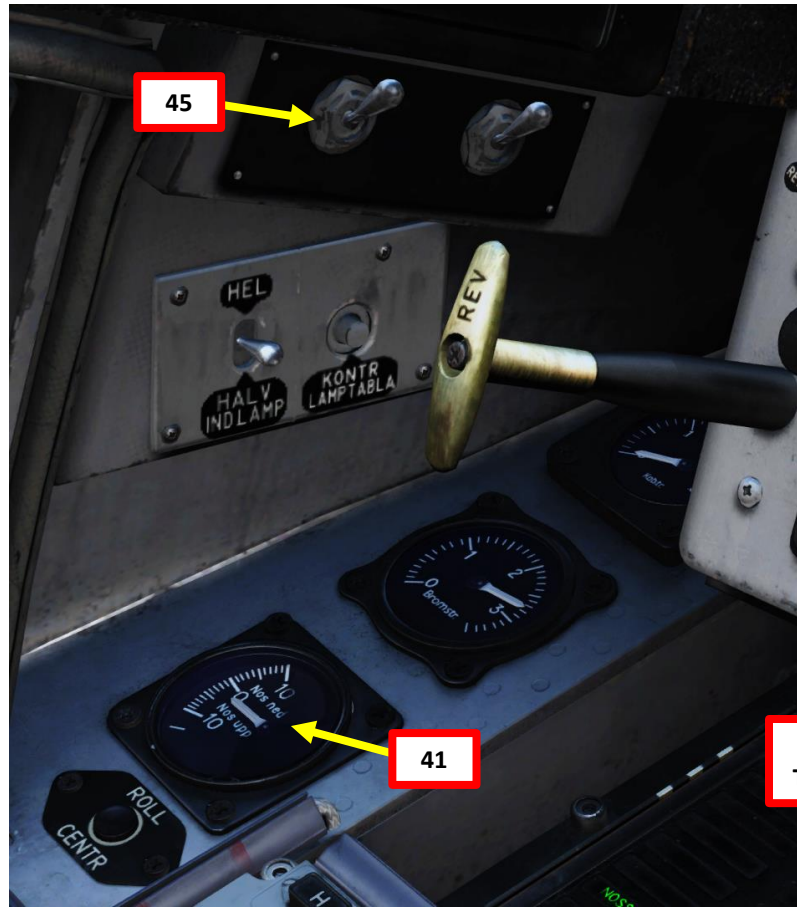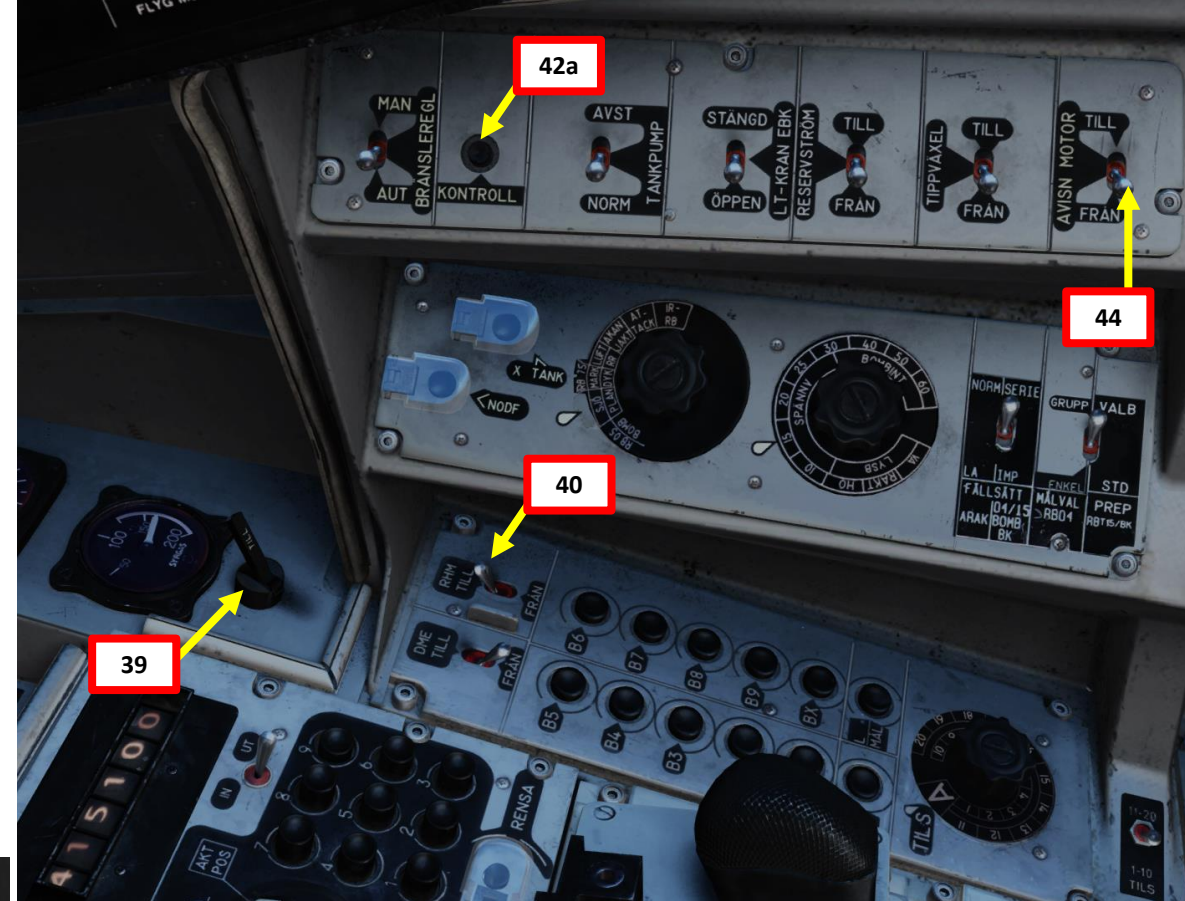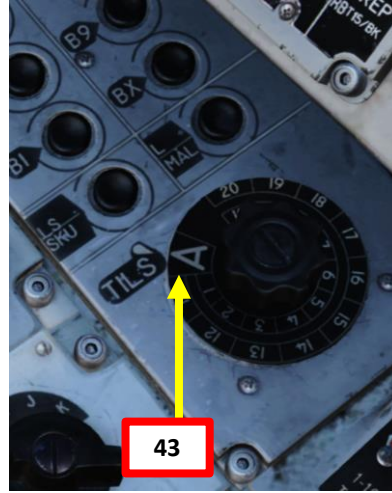43. Set TILS (Tactical Instrument Landing System) Channel Selector to AUTO.
44. If operating in icing conditions, set Engine Anti-Ice switch (*AVISN MOTOR*) to ON (TILL), otherwise leave switch to OFF (FRÄN).
45. Set Taxi/Landing Lights switch to ON (DOWN)

43

42a

44

40

39

45

41

41
Trim Hat Switch

KONTROLL INDICATOR SYSTEM TESTS

42b

- High alpha Warning- two short bursts. Stick vibrates.
- Warning lights BRAND (Fire warning) lit
- Lights LANDSTÄLL (Landing gear warning) <u>not</u> lit.
- Altitude warning light lit with a solid light.
- Indicated fuel 29 ± 3 % and indicator returns to previous setting.
- Data indicator panel shows 1 and current CK-program number.
- FK-light is on (green).

START-UP

46. When ready to taxi/takeoff, set MASTER MODE to NAV to start the HUD in "Takeoff Mode". This step should be done at the earliest 2 minutes before throttle up, to avoid problems with the navigation system. A good practice is to do it just before takeoff.
    - **Note**: The Radar and Central Indicator (CI) will first function 30 seconds after Master Mode Selector is set to NAV, and 180 seconds after the main generator is on. This is due to software initialization.
47. If using external power, communicate with ground crew to set ground power OFF
    a) Press the TRAD (Ground Intercom) button to communicate with ground crew
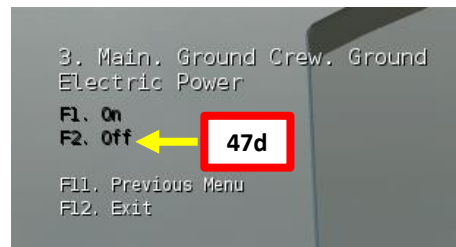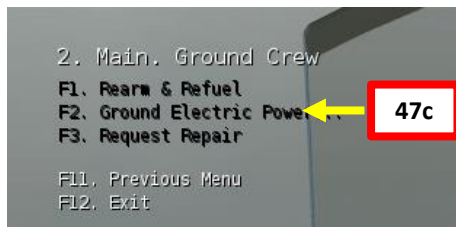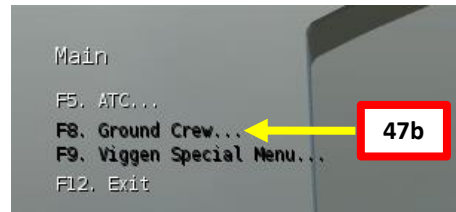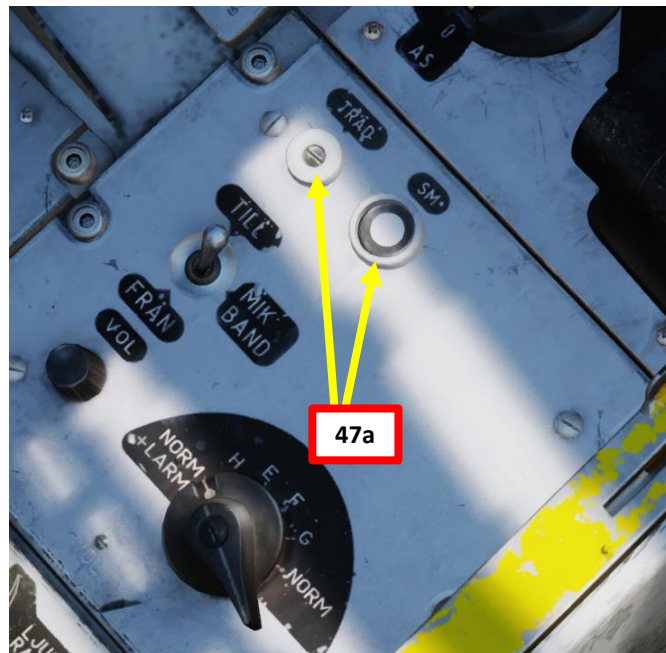   b) Press F8 – Ground Crew
    c) Press F2 – Ground Electric Power
    d) Press F1 – OFF
48. Press brake pedals to release the parking brake.
49. Start taxiing to the runway. Slowly throttle up and taxi to the runway by using the rudder and toe brakes to steer the aircraft.

46

**48a
Parking Brake Engaged**

47a

```
Main

F5. ATC...
F8. Ground Crew...          ← 47b
F9. Viggen Special Menu...
F12. Exit
```

```
2. Main. Ground Crew

F1. Rearm & Refuel
F2. Ground Electric Powe...  ← 47c
F3. Request Repair

F11. Previous Menu
F12. Exit
```

```
3. Main. Ground Crew. Ground
Electric Power

F1. On
F2. Off                      ← 47d

F11. Previous Menu
F12. Exit
```

**48b
Tap Brake Pedals**

**48c
Parking Brake Released**

**48b
Tap Brake Pedals**
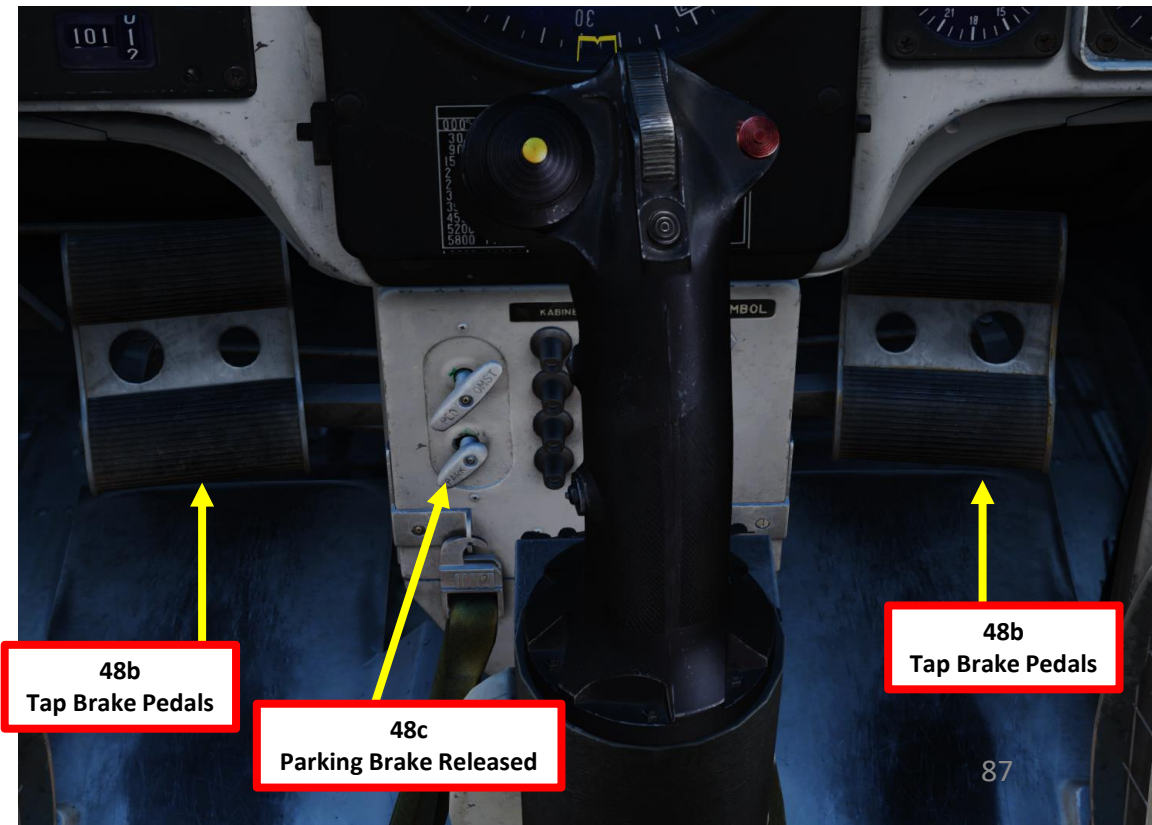
NOTES FOR ROAD BASE RE-ARMING & REFUELING

- When spawning on a Road Base, re-arming and refueling is done differently due to limitations within the DCS engine.
- To change loadout when operating from a Road Base:
  a) Open your kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages) « Ground Crew Settings » page in the « Mobile Ground Crew » sub-section.
  b) Toggle between preset armament loadout profiles by using « LALT + LCTRL + L » binding.
  c) Toggle between preset fuel quantity loadouts by using « LALT + LCTRL + F » binding.
  d) When desired armament and fuel loadouts are set as desired, use « LALT + LCTRL + ENTER » to confirm loadout change.
  e) As ground crew performs re-arming and refueling, a progress in % is visible on the kneeboard page.

Groundcrew settings:

Rb04 left group target: 2
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: ARAK + IR-RB
Safety height: Medium

Mobile ground crew:

Selected loadout [LAlt+LCtrl+L]:
2x Rb24 + 4x ARAK rockets
Selected fuel quantity [LAlt+LCtrl+F]:100% fuel
Relocation: Stay in place [LAlt+LCtrl+R]

Confirm with: [LAlt + LCtrl + Enter]

Data cartridge selected:
0 Mission Editor

Mission plan as defined in the Mission Editor

a

b

c

d

Groundcrew settings:

Rb04 left group target: 2
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: ARAK + IR-RB
Safety height: Medium

Mobile ground crew:

Selected loadout [LAlt+LCtrl+L]:
2x Rb24 + 1x KB + 1x U22/A + 2x Rb05
Selected fuel quantity [LAlt+LCtrl+F]:100% fuel
Relocation: Stay in place [LAlt+LCtrl+R]

Progress: 26%

Data cartridge selected:
0 Mission Editor

Mission plan as defined in the Mission Editor

e

Mobile ground crew:

Selected loadout [LAlt+LCtrl+L]:
2x Rb24 + 1x KB + 1x U22/A + 2x Rb05
Selected fuel quantity [LAlt+LCtrl+F]:100% fuel
Relocation: Stay in place [LAlt+LCtrl+R]

Rearm and refuel complete.

e

89

RUNWAY HEADING CONSIDERATIONS

The CK37 Flight Computer computes your flight plan based on the takeoff base coordinates, waypoints and landing base. When entering a 4-digit REF/LOLA code for the Takeoff Base (LS/SKU), the runway heading is generally already set up properly.

To verify the initial runway heading:
1. Your default runway heading should be available in your kneeboard (RSHIFT+K) page. We will takeoff from Kobuleti's runway 250.
2. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
3. Set INPUT/OUTPUT data switch to OUTPUT.
4. The first four digits (2500) in our case represent the runway heading (250.0). The last two digits (13) represent the TILS (Tactical Instrument Landing System) Channel for the runway TILS unit if available.
5. If you want to use runway 070 instead (reciprocal to 250), press the LS/SKU button and the BANA/GRÄNS field will update to the reciprocal heading of 070.0.

4

5b

3

2

1
Runway Heading: 250
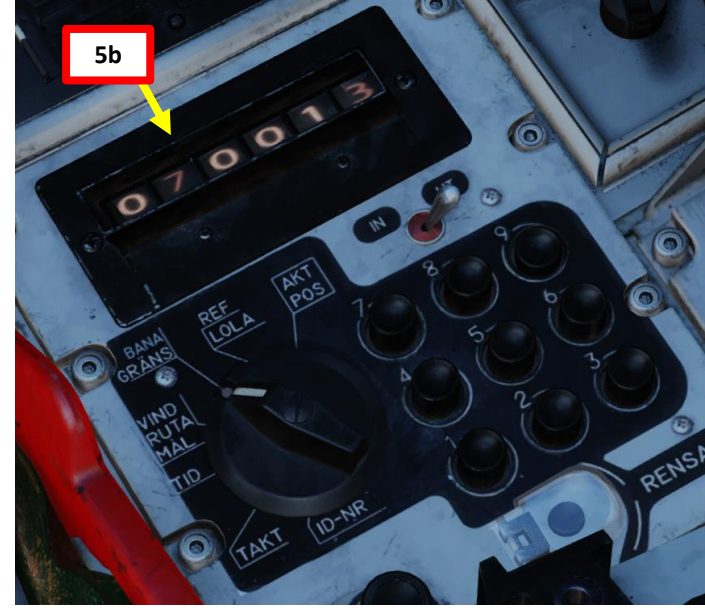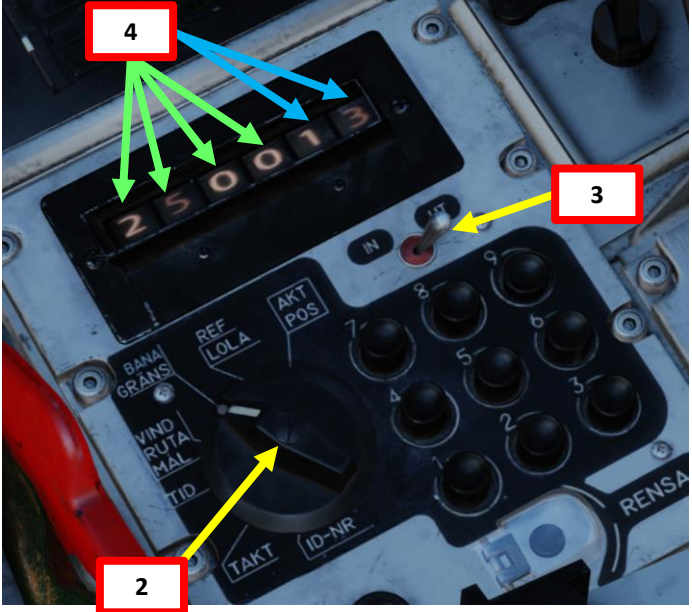
DATE 2016-06-21	MISSION ID tempMission	CALLSIGN 111 Strike	TASK
FUEL WBGHT 5489	LOADOUT 1920	TOTAL WEIGHT 19209	V2 405
ENGINE START TIME 12:25:00	TAKE-OFF TIME 12:30:00	RUNWAY HEADING 20517	QNH 1013.3
WAYPOINT NAME Take-Off Kobuleti			
COURSE (T) 20516	HEADING (M) 363	G/S 500	IAS 499
DISTANCE 0.0	TOF 00:00:00	ETA 12:30:00	QFE 1011.1
ALTITUDE 18	VERTICAL ANGLE 0	FUEL RESERVE 123	BINGO FUEL 73

You

Runway 25

Heading 250

Runway 07

Heading 070

KBL
Chan 67

Kobuleti
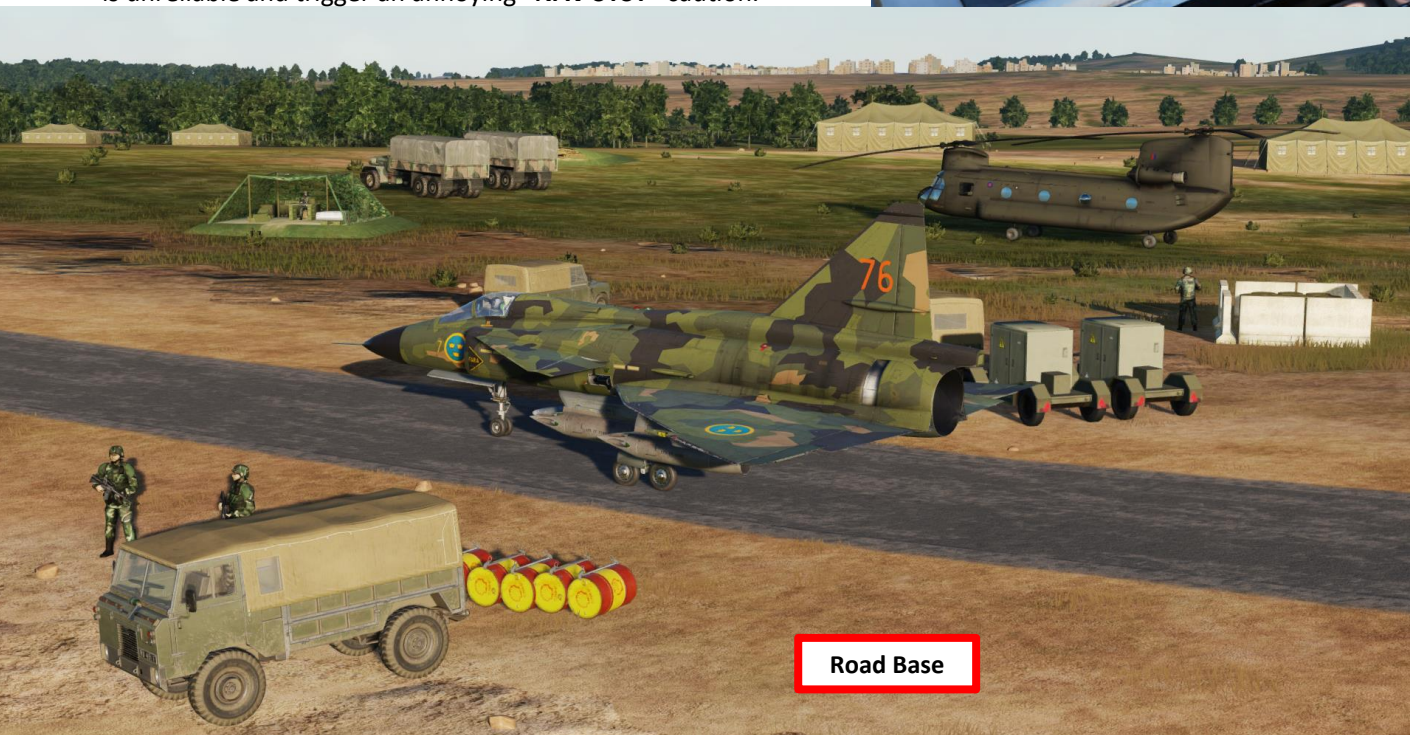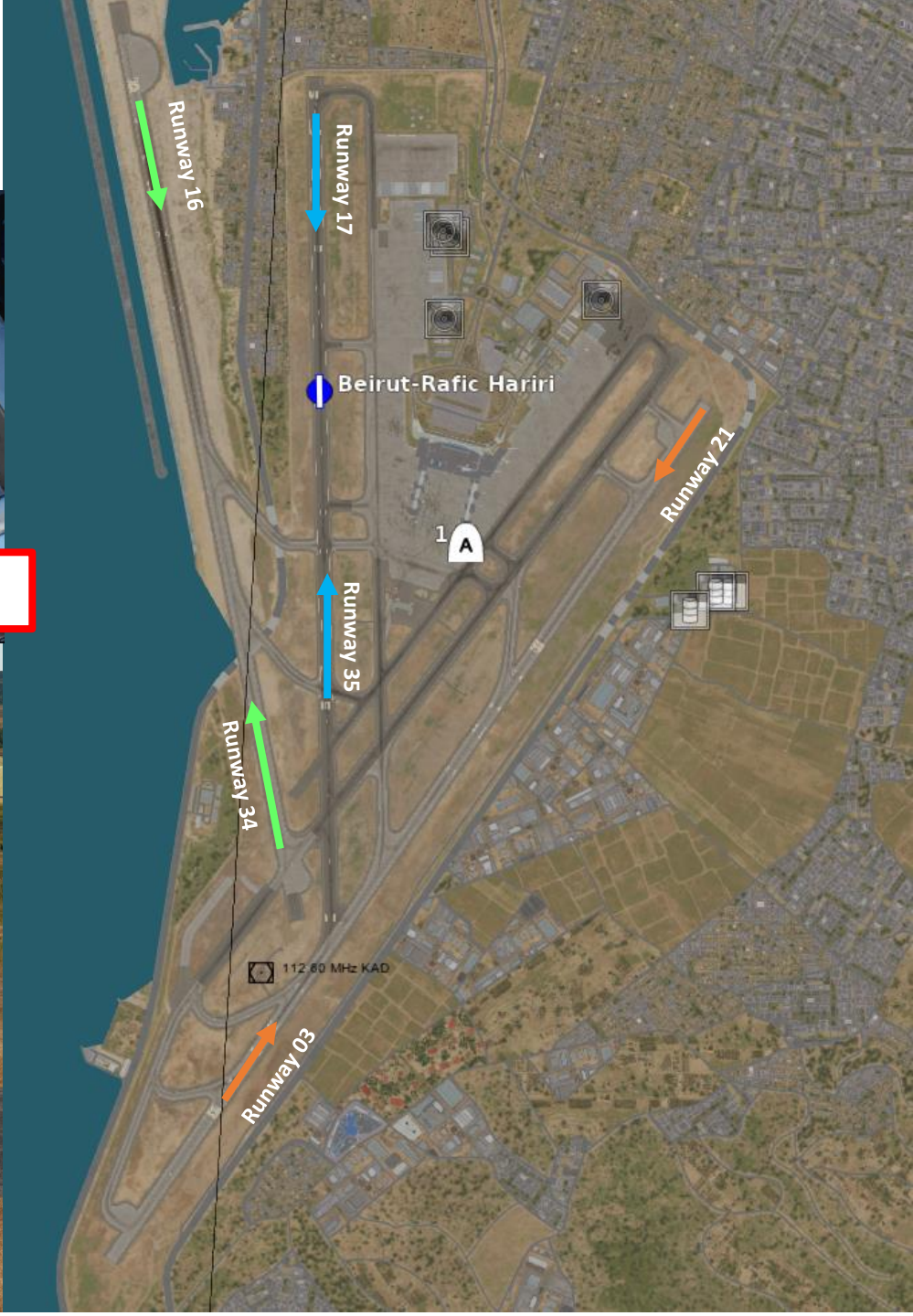
5a
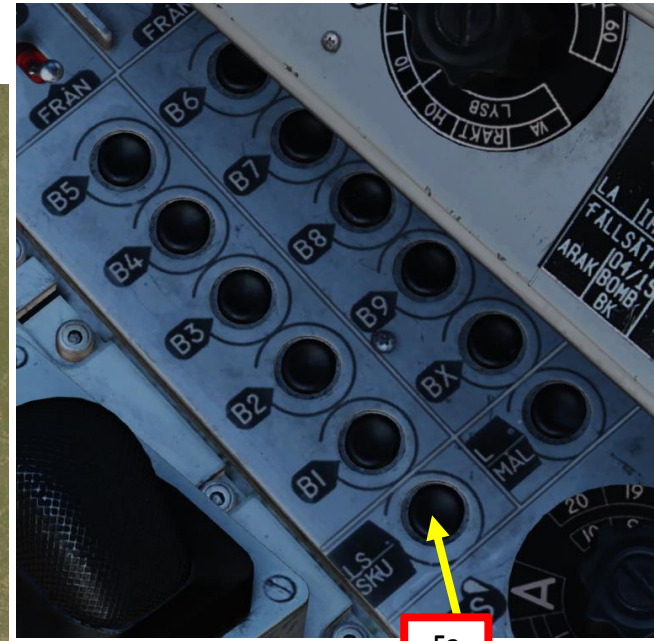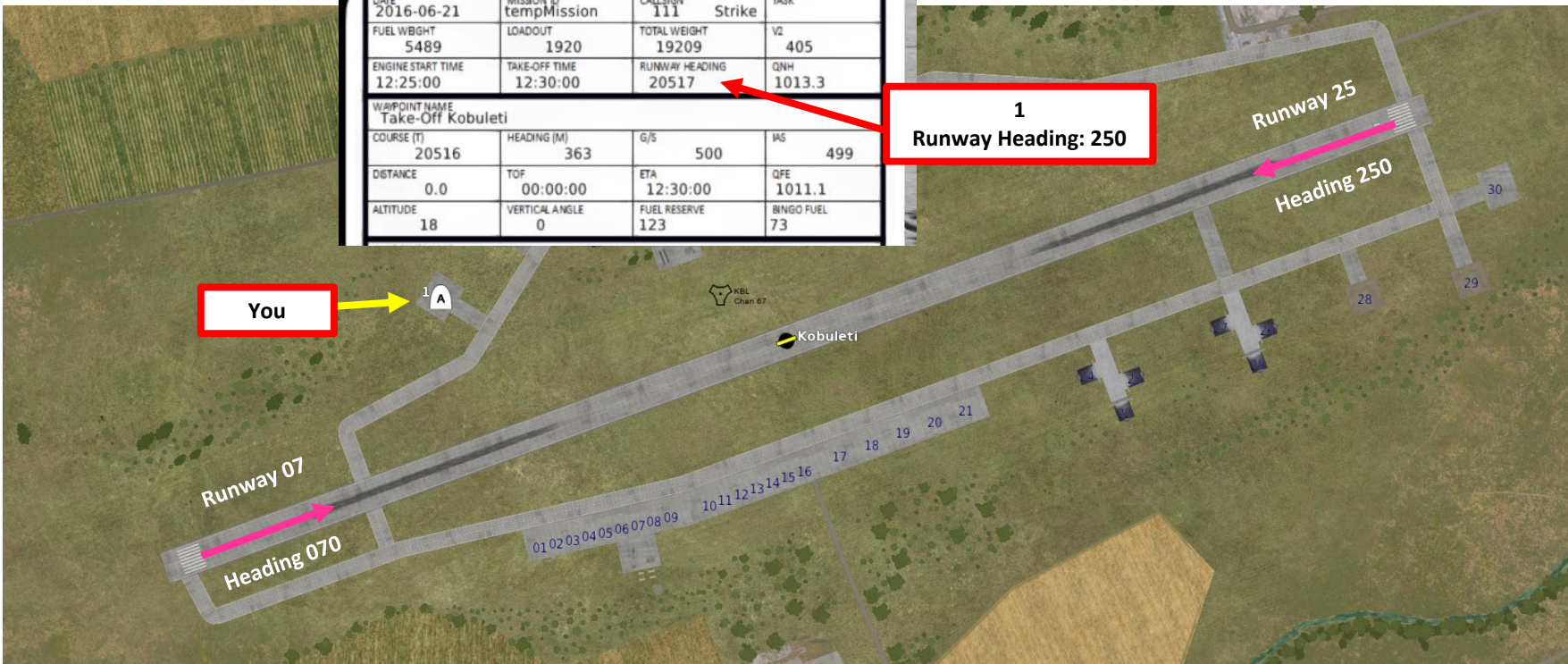
RUNWAY HEADING CONSIDERATIONS

There are cases where the runway heading you want to use might not be set correctly:

- Airports with several runways (like Beirut's Rafic Hariri Airport) may require you to takeoff from another runway than the one preset in the data cartridge due to external factors (bad weather, presence of enemy forces, etc.).
- When operating from a road base (as the Viggen was designed for), the BANA/GRÄNS heading needs to be set manually.

Why should be bother about these specific cases? Well, when taking off from a runway, the CK37's flight computer will switch from the takeoff airport (LS) to the first waypoint (B1) and expect the aircraft's initial heading to match the runway heading (+/- 15 deg). If there is a **mismatch between these two headings greater than 15 deg**, the flight computer will think its navigation system is unreliable and trigger an annoying **"NAV SYST"** caution.

NAV SYST:
Navigation System Failure/Malfunction

Road Base

Runway 16

Runway 17

Beirut-Rafic Hariri

Runway 21

1 A

Runway 35

Runway 34

112.60 MHz KAD

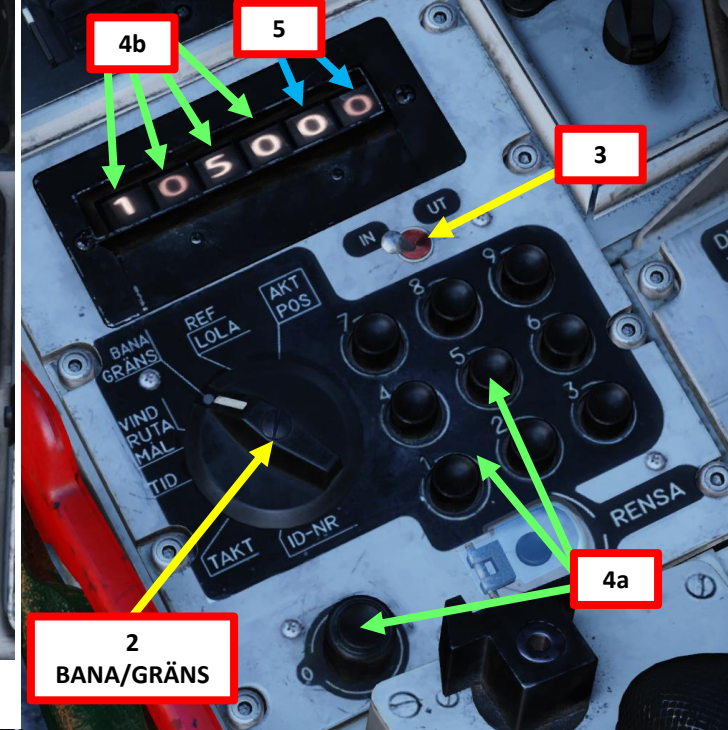Runway 03

RUNWAY HEADING CONSIDERATIONS

Let's take an exanple for a takeoff performed from an offroad base.

To edit a runway heading:
1. Line up with the runway and check your KURS (Magnetic Course) Indicator to determine your current runway heading. In our case, our runway heading is 105.
2. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
3. Set INPUT/OUTPUT data switch to INPUT.
4. Enter the runway heading in a 4-digit form on the CK37 keypad: "**1050**" entered on the keypad represents a runway heading of **105.0.**
5. The last two digits can be left to 00 since there is no TILS (Tactical Instrument Landing System) Unit Channel associated to the runway.
6. Press the LS/SKU Takeoff Waypoint Selector button to enter the BANA/GRÄNS field data, which will update the takeoff runway heading to 105.0.
7. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

1
Current Heading: 105

4b

5

3

4a

2
BANA/GRÄNS
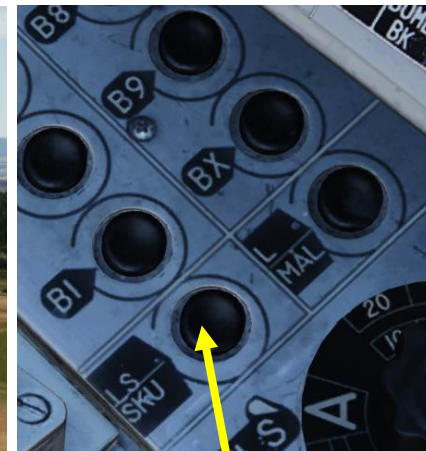
6
LS/SKU Takeoff Base Selector

7a

7b
AKT POS

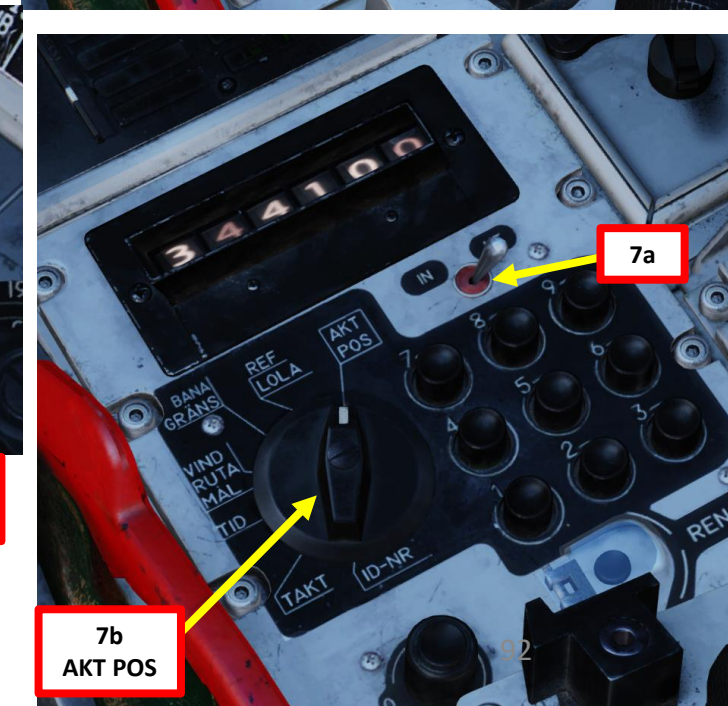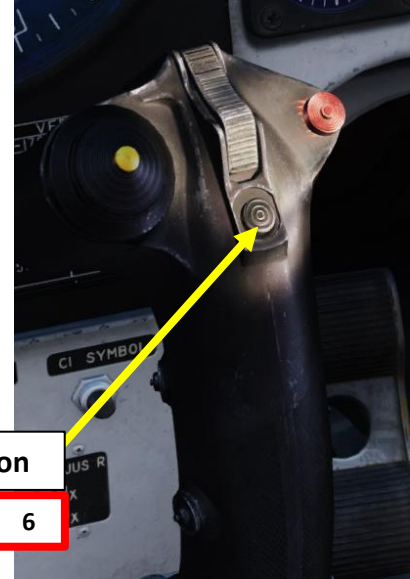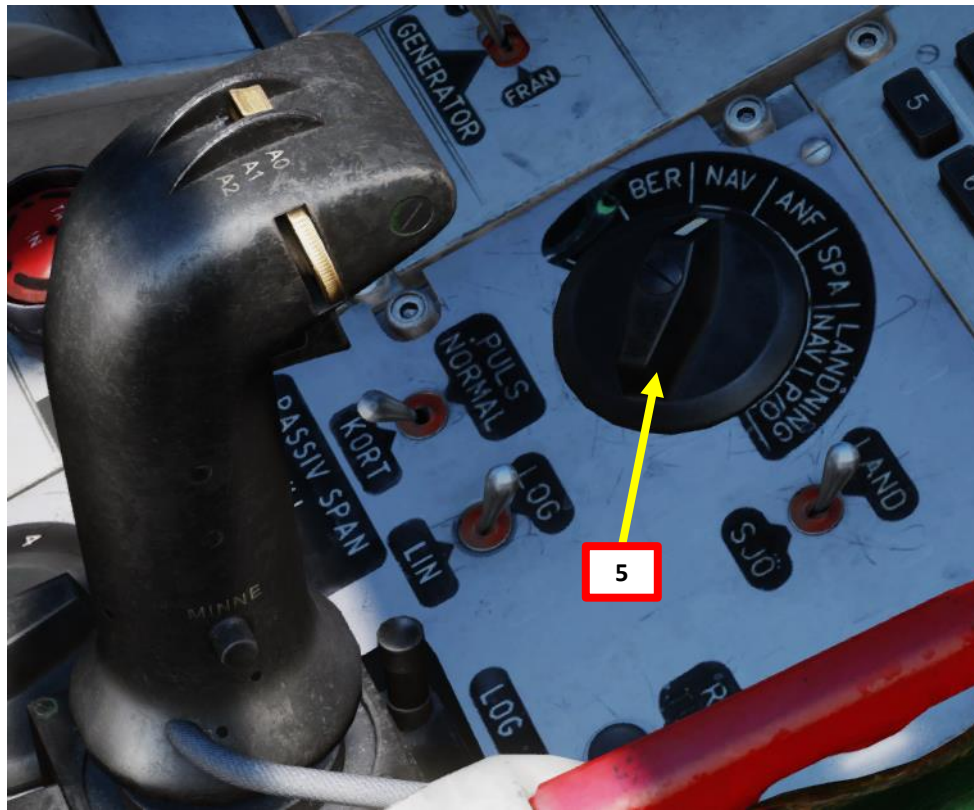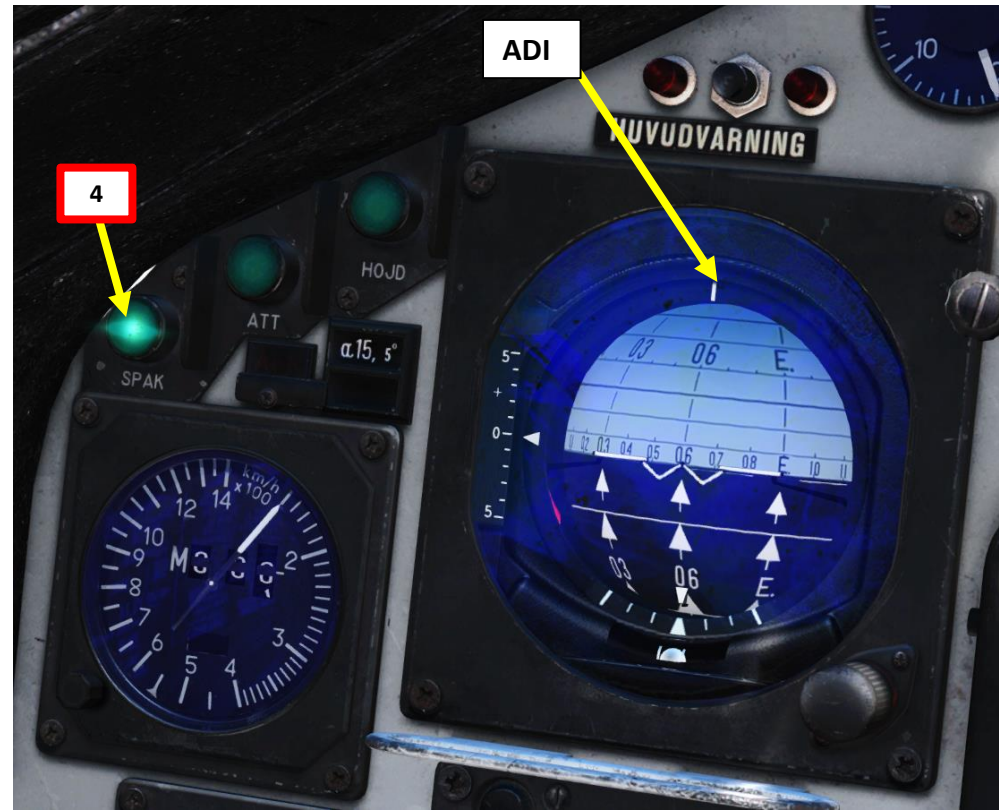# PRE-TAKEOFF CHECKS

1. Slowly throttle up and taxi to the runway by using the rudder and toe brakes to steer the aircraft. Full deflection of rudder gives a nose wheel rotation of about 30°. Turning radius can be reduced by using differential braking.
2. In confined areas, thrust reversal may be used to reverse the aircraft. See THRUST REVERSER sub-section in the ENGINE & FUEL MANAGEMENT section for more details.
3. We will takeoff from Runway 07. Make sure the runway heading is entered properly in the CK37 Flight Computer's BANA/GRÄNS data field, as shown in the RUNWAY HEADING CONSIDERATIONS sub-section presented earlier in this section.
4. Set SPAK Autopilot damper ON (press on the lamp button and it will illuminate)
5. When lined up on the runway, verify MASTER MODE is set to NAV to ensure the Heads-Up Display (HUD) is in "Takeoff Mode". This step should have been done **at the earliest 2 minutes before throttle up**, to avoid problems with the navigation system.
6. If taking off in strong crosswind or slippery runway conditions, press the Reference Button on the stick **once you are carefully lined up on the runway**. This will override the "Automatic Initial Course" function of the flight computer and make the computer manually use the difference in angle between the entered runway heading (BANA/GRÄNS) and the course angle from the ADI (Attitude Director Indicator) for correcting the heading.
   - Note: In normal wind conditions, this step is not necessary and using the Automatic Initial Course is good enough.

Reference Button

6

ADI

4

5

93

TAKEOFF

Engine N2 (High-Pressure Turbine) RPM Indicator in % (*Varv*)

2

Engine Nozzle Position Indicator

1. Apply toe brakes
2. Advance throttle to maximum power without engaging afterburner, and check that EGT (Exhaust Gas Temperature) does not exceed 590 deg C + the outside ambient temperature.
3. Release toe brakes

For STANDARD RUNWAYS:

4. Engage Afterburner ZONE 2.
   a) Throttle up until Zone Indicator displays "2"
   b) Confirm that Exhaust Nozzle Indicator goes to "2"
   c) EPR (Engine Pressure Ratio) should increase above 1.9 or higher if OAT (Outside Air Temperature) is below +15 deg C. If OAT is above +15 deg C, EPR should increase at 1.8 or higher.

Afterburner Zone Indicator

For SHORT RUNWAYS / ROAD BASES:

4. Engage Afterburner ZONE 3.
   a) Throttle up until Zone Indicator displays "3" (Fully Forward)
   b) Confirm that Exhaust Nozzle Indicator goes to "3"

Engine Pressure Ratio (EPR) Indicator (Pt7/Pt2, or ratio between engine intake and exhaust pressures)

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

4

Afterburner Zone 2 Active

Nozzle Zone 2 Open

4

Afterburner Zone 3 Active

Nozzle Zone 3 Open

94
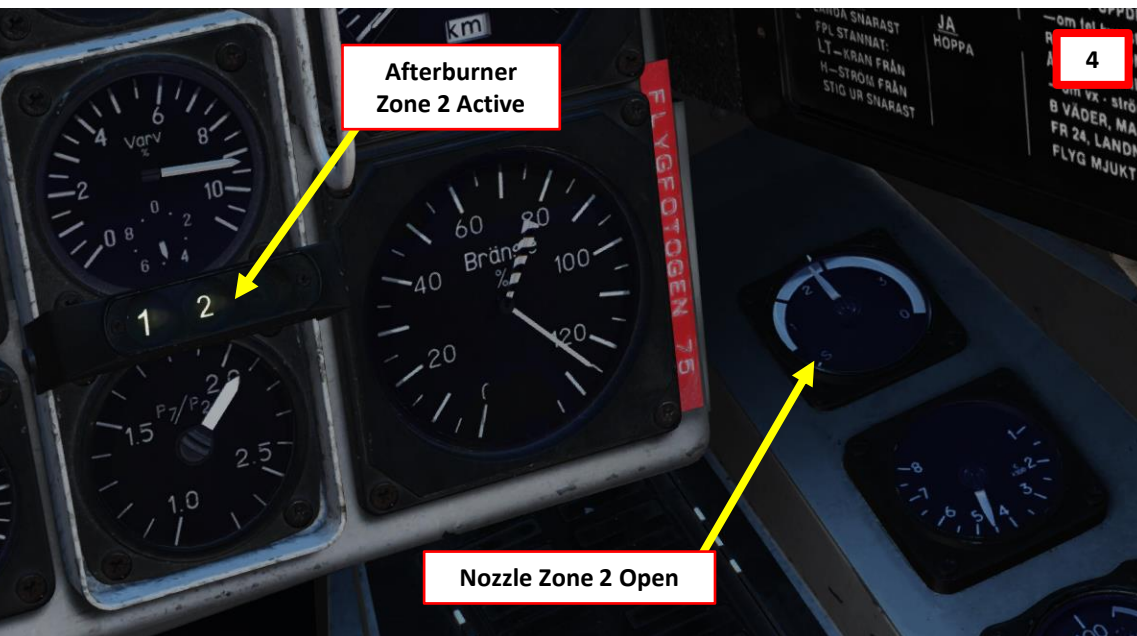
TAKEOFF

5. During the takeoff roll, the RAT (Ram Air Turbine, or Backup Generator) will be automatically extended as a provisional safety measure in case of a sudden loss of electrical power due to an engine or generator failure during the takeoff roll. Upon landing gear retraction, the RAT will automatically be stowed back into its compartment.

TAKEOFF

6. Once the Time / Distance Line reaches the outer markers (airspeed should be around 270 km/h), gently pull back on the stick and begin aircraft rotation.

7. Rotate until the Flight Path Vector is on the same level as the longest pole of the pole track and maintain it there. This will give you a 13 deg nose-up attitude (AoA, Angle of Attack).
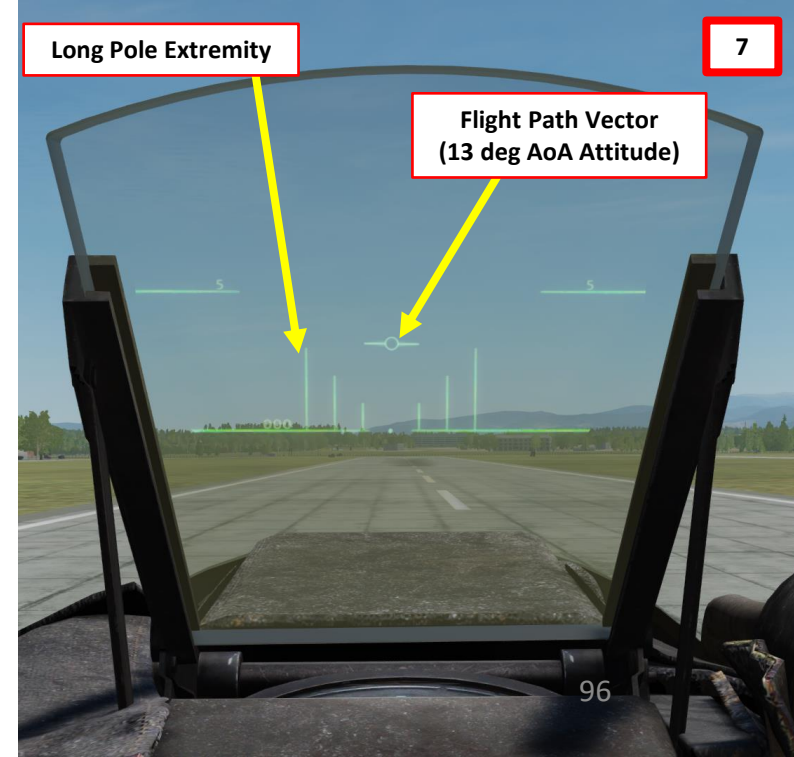

Airspeed: 0 km/h

Airspeed: 270 km/h

6a

Long Pole Extremity

Flight Path Vector
(0 deg AoA Attitude)

Outer Marker Line

Outer Marker Line

Time / Distance Line
Away from Outer Markers

6b

Long Pole Extremity

Outer Marker Line

Outer Marker Line

Time / Distance Line
On Outer Markers = Rotate!

7

Long Pole Extremity

Flight Path Vector
(13 deg AoA Attitude)
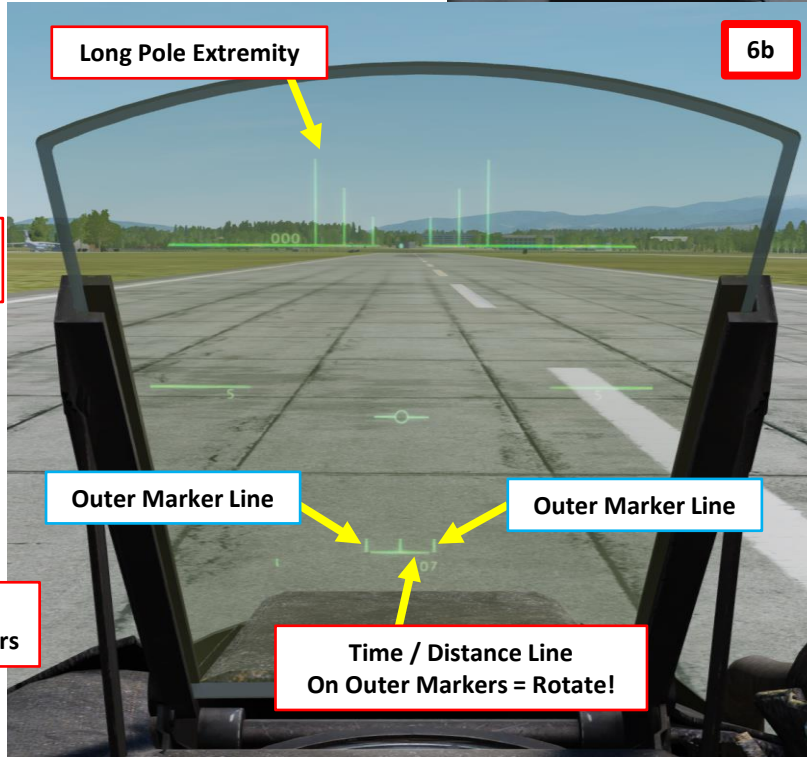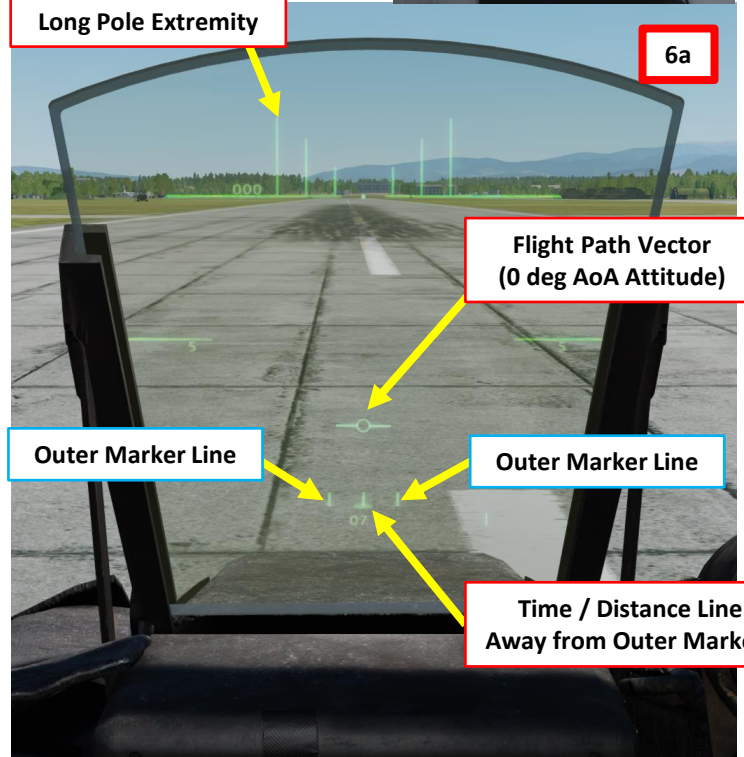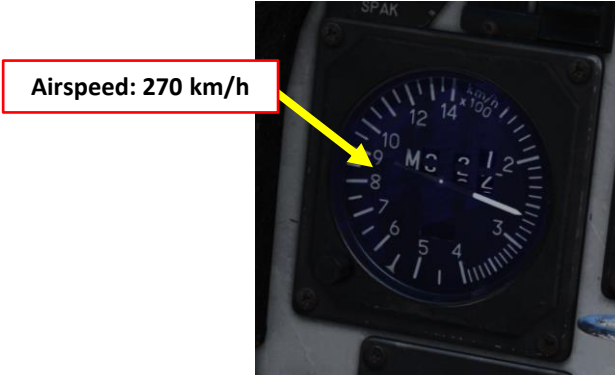
TAKEOFF

8. The HUD will switch automatically from TAKEOFF mode to NAVIGATION mode above 500 m AGL (Above Ground Lever).
9. The selected waypoint will automatically switch to LS (Takeoff Airport) to B1 (first waypoint).

HUD – Takeoff Mode | 8a

9a

LS Takeoff Airfield Selected

HUD – Navigation Mode | 8b

9b

B1 Waypoint Selected

97
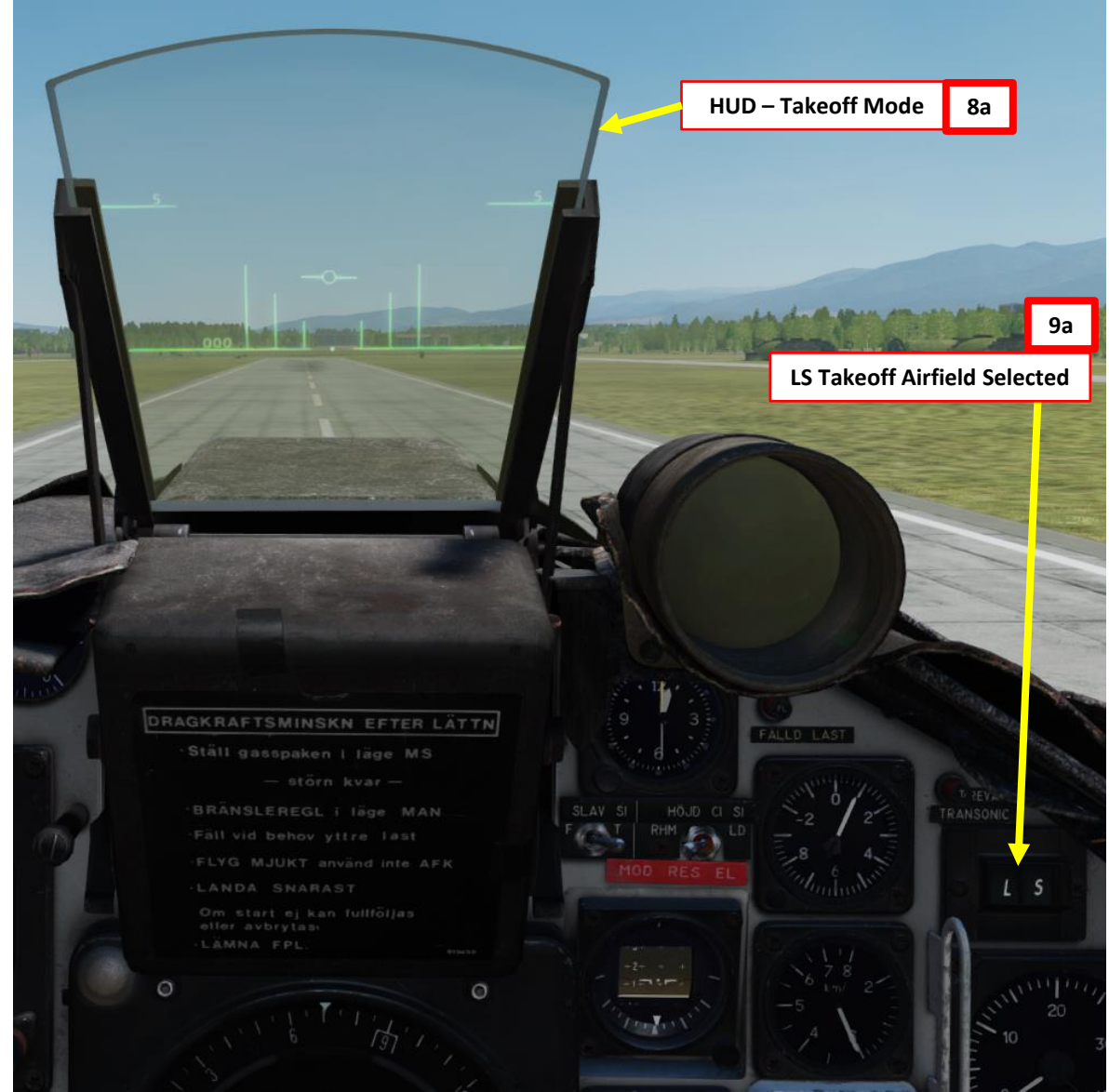
TAKEOFF

10. Above 500 m AGL (Above Ground Level), raise landing gear UP by setting the gear lever UP. The landing gear should be retracted before reaching 600 km/h, or it will likely suffer structural damage.
    - Confirm that landing gear is retracted and locked by making sure the NOSSTÄLL, V-STÄLL and H-STÄLL indicator lights are extinguished.
   - **Important Note**: with Zone 3 afterburner, the aircraft accelerates very quickly and may result in reaching maximum allowed airspeed (600 km/h) with extended landing gear before it has fully retracted.
11. The canard flaps will automatically retract once landing gear is retracted, which will momentarily decrease lift. Keep your hand on the throttle and stick to compensate for any sudden loss of lift.
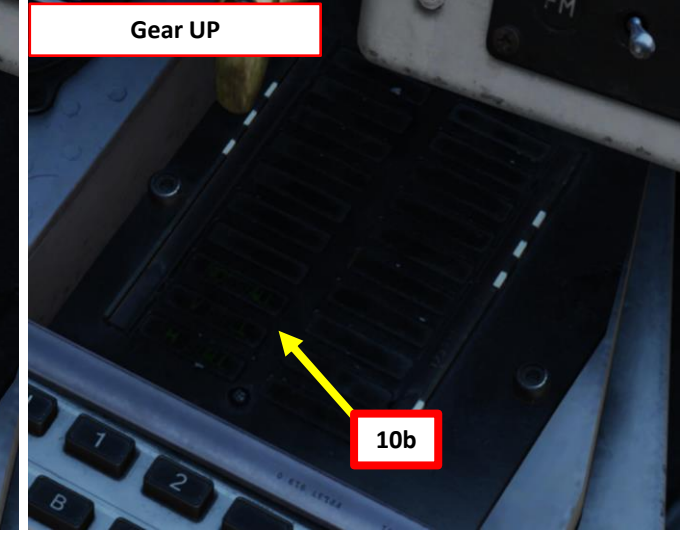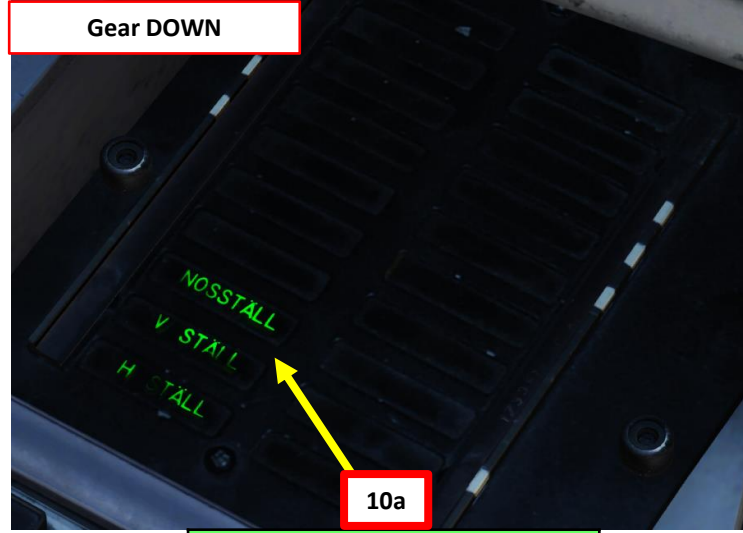
Gear DOWN

10a

Gear UP

10b

NOSSTÄLL: Nose landing gear extended and locked
V-STÄLL: Left landing gear extended and locked
H-STÄLL: Right landing gear extended and locked

Gear DOWN

10a

Gear UP

10b

11a

Gear DOWN
Canard Flap DOWN

11b

Gear UP
Canard Flap UP

98
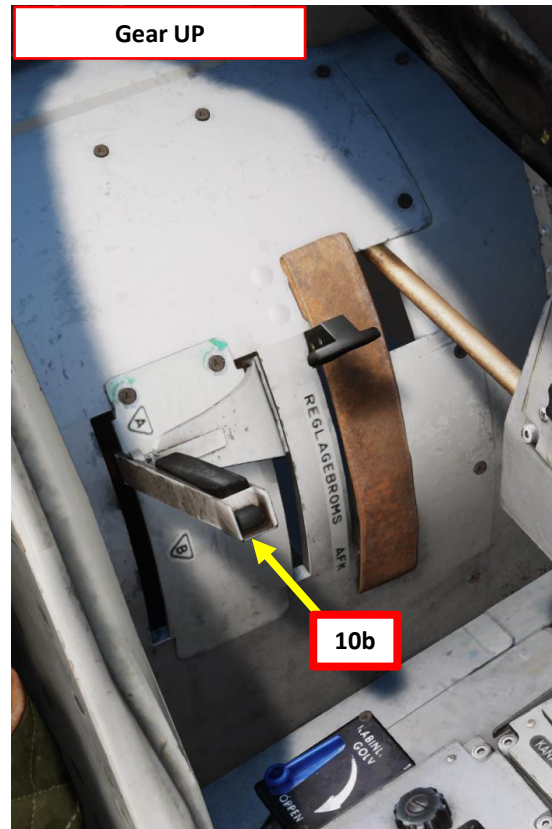
TAKEOFF

12. Elevate HUD (Heads-Up Display) reflector glass to IN-FLIGHT (upper) position.
13. Throttle back to MILITARY POWER (all afterburner zone lights are extinguished) and proceed towards your first waypoint (B1).

HUD DOWN

12a

HUD DOWN

12a

HUD UP

HUD UP
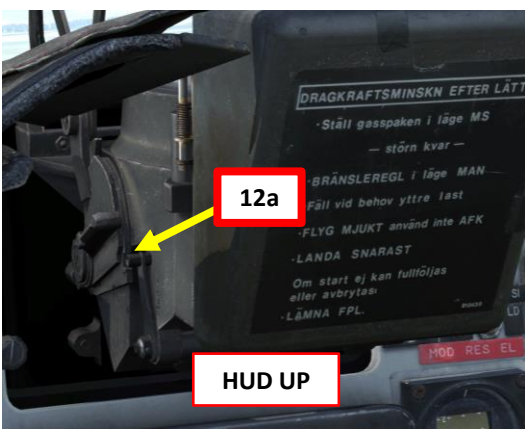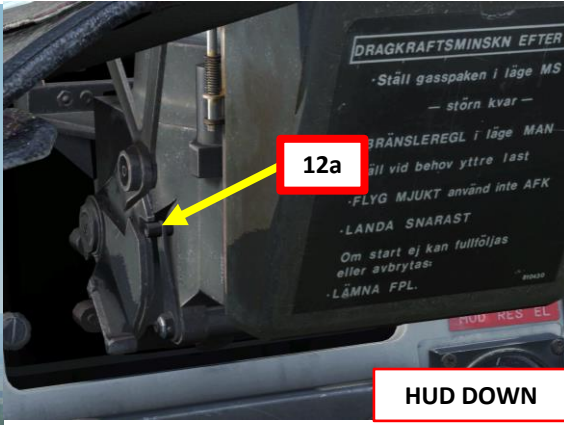
TAKEOFF

HUD SYMBOLOGY DURING TAKEOFF
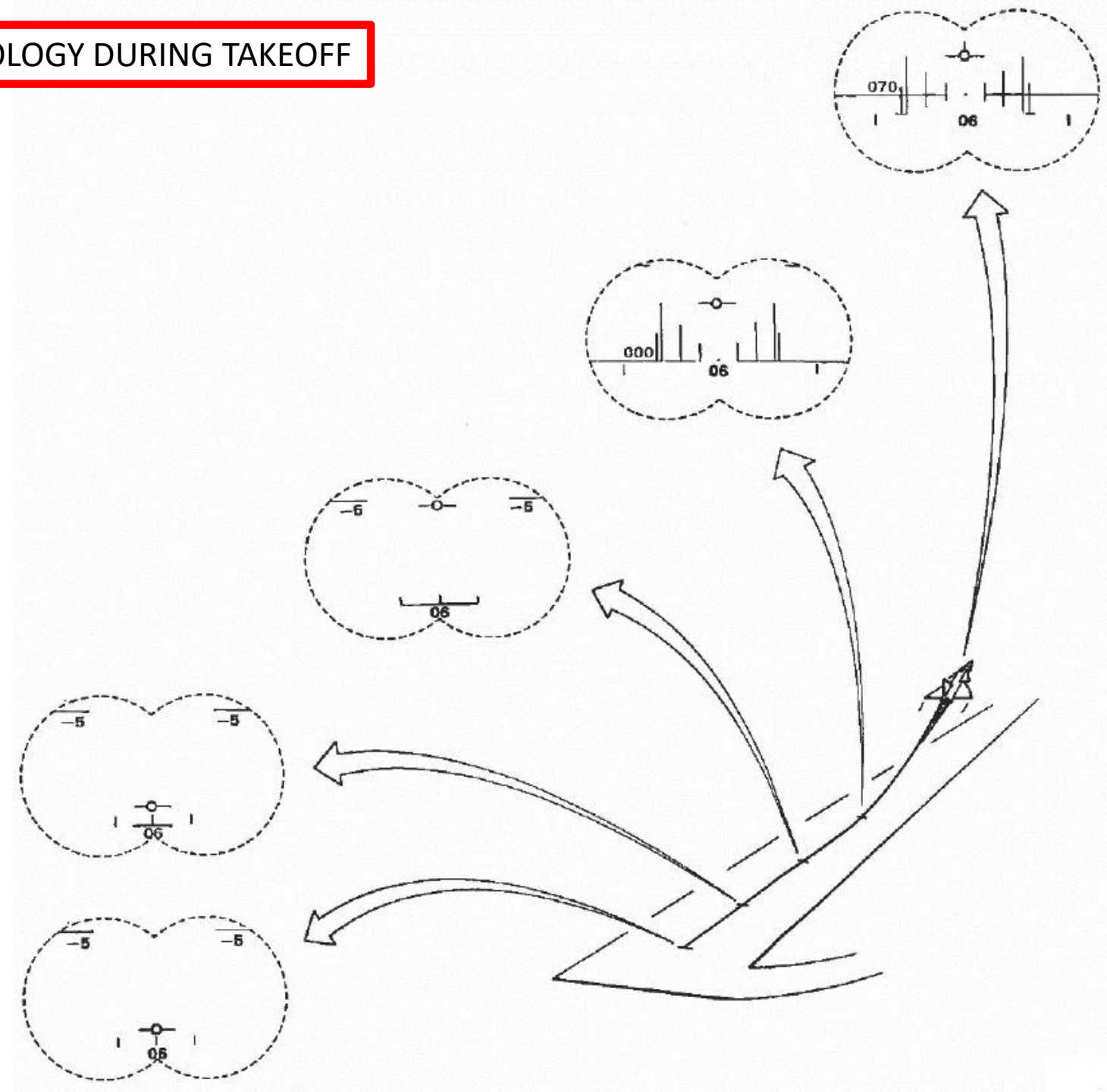
SECTION STRUCTURE

I.   Landing Types

II. Landing Principles

III. Airbase Example – Visual Approach with no reverse thrust
   a) Landing Preparation
   b) Visual Approach – LANDNING P/O
   c) Touchdown with Aerobraking

IV. Road Base Example – Instrument Approach with reverse thrust
   a)   Landing Preparation
   b)   Instrument Approach – LANDNING NAV
   c)   Normal Touchdown with Thrust Reverser

V.   Flip-Flop (Short Approach)

VI. After Landing

I - LANDING TYPES

There are a few different types of approach patterns that can be performed in the Viggen.

Approach towards the airfield begins when a landing waypoint (L1 or L2) in master mode NAV becomes a destination (active waypoint). The destination becomes the center of the chosen runway. The actual landing indication on instruments and steering commands is presented first in LANDNING NAV.

The landing can be done either as a direct approach or an overhead pass.

- A direct approach is one that flies towards the extended runway centerline without overflying the airbase. Normally, the approach is done via the landing waypoint LB. Alternatively, it can be done via a so called "short approach" and where the aircraft lines up on the runway closer to the touchdown point LF.

- During an overhead pass, the pilot overflies the runway in mode NAV before switching to mode LANDNNG NAV and flies towards the extended runway centerline. An overhead pass can also be approached via the landing waypoint LB or by a short approach.

The Master Mode Selector has two settings specifically used for landing.

- NAV: Used for Instrument Approach Landing and TILS (Tactical Instrument Landing System).
- P/O: Precision Approach Radar / Optical, which is used for a visual approach.

APPROACH PATTERNS
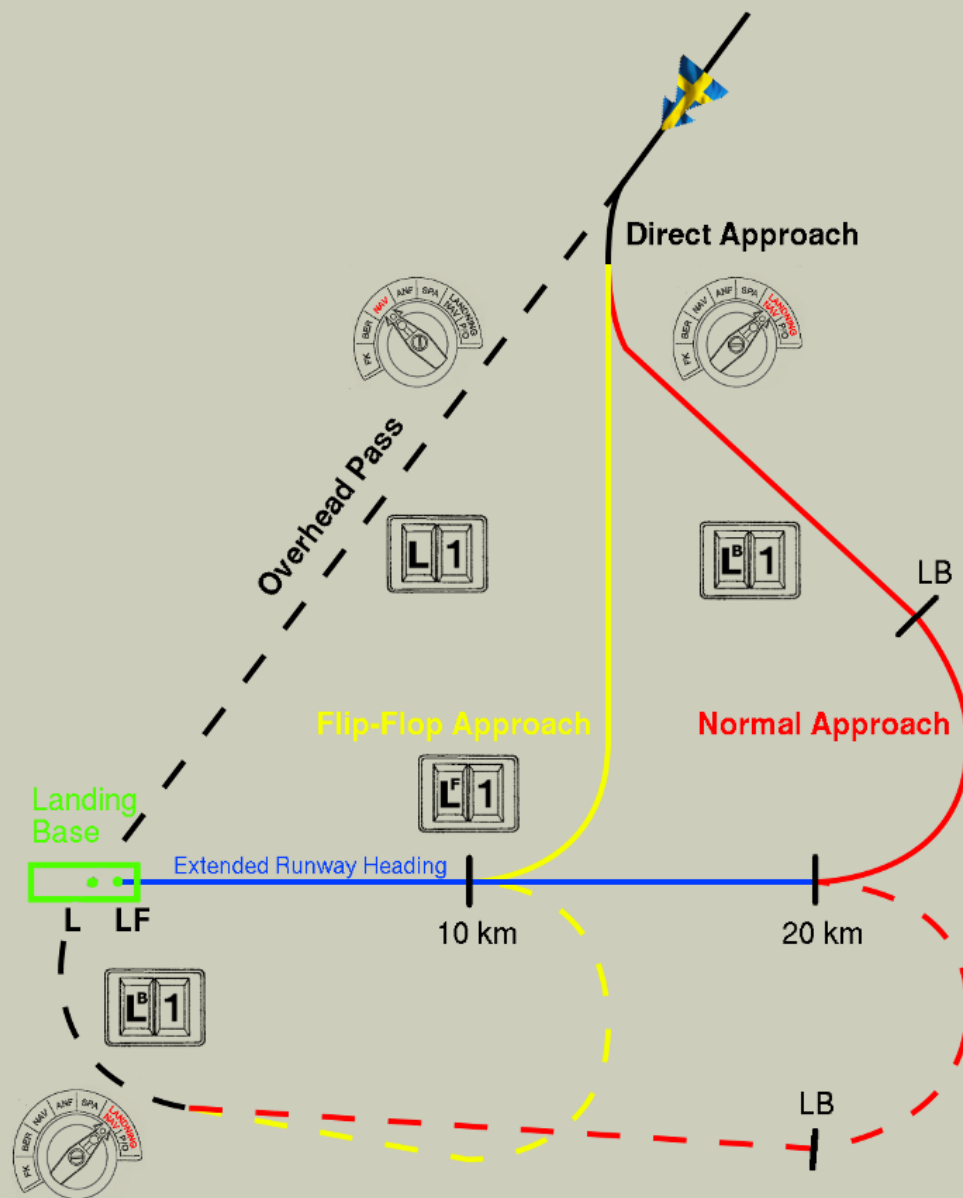
- **Flip-Flop**: LANDNING NAV → LANDING P/O → LANDNING NAV
- **New approach**: LANDNING NAV → NAV → LANDNING NAV

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II - LANDING PRINCIPLES

The Viggen's navigation system can actually guide you to the runway directly with HUD symbology. However, you need the following to be set up properly:

1. A primary landing base (L1).
   a) Airbase can be designated with Longitude/Latitude coordinates entered manually, or
   b) Airbase can be designated with a 4-digit reference code available in your kneeboard "Airbases" page, which contains information about your airbase location, runway heading and TILS (Tactical Instrument Landing System) if available.

2. A runway heading (direction from which you perform the approach)

3. The QFE setting of the landing site (altimeter pressure setting calibrated to the airfield or ground elevation), which will impact barometric altimeter readings

4. If available, a TILS channel (optional).

DATE 1994-06-10	MISSION ID 05 - AJS37 Training visual landing	CALLSIGN 11	TASK Strike
FUEL WEIGHT 2194	LOADOUT 0	TOTAL WEIGHT 13994	V2 346
ENGINE START TIME 00:00:00	TAKE-OFF TIME 00:00:00	RUNWAY HEADING 0	QNH 1033.2

WAYPOINT NAME M0

COURSE (T) 0	HEADING (M) 5	G/S 700	IAS 620
DISTANCE 0.0	TOF 00:00:00	ETA 14:00:00	QFE 1024.1
ALTITUDE 1000	VERTICAL ANGLE 0	FUEL RESERVE 49	BINGO FUEL 18

WAYPOINT NAME B1

COURSE (T) 282	HEADING (M) 287	G/S 700	IAS 620
DISTANCE 31.8	TOF 00:02:43	ETA 04:02:43	QFE 1028.8
ALTITUDE 1000	VERTICAL ANGLE 0	FUEL RESERVE 46	BINGO FUEL 15

WAYPOINT NAME Landing Senaki-Kolkhi

COURSE (T) 274	HEADING (M) 280	G/S 500	IAS 470
DISTANCE 19.7	TOF 00:02:21	ETA 18:07:48	QFE 1031.6
ALTITUDE 13	VERTICAL ANGLE -3	FUEL RESERVE 45	BINGO FUEL 13

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz QM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8Mhz AM C2: 257Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz AM C: 40Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707
A: 4.3Mhz AM B: 132Mhz AM C: 40.6Mhz AM C2: 261Mhz AM
13: Kobuleti (9013) TILS: 13 RWY: 250.027
A: 4.3Mhz AM B: 133Mhz AM C: 40.8Mhz AM C2: 262Mhz AM
14: Kutaisi (9014) TILS: 14 RWY: 253.999
A: 4.4Mhz AM B: 134Mhz AM C: 41Mhz AM C2: 263Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.31
A: 4.4Mhz AM B: 135Mhz AM C: 41.2Mhz AM C2: 264Mhz AM
16: Nalchik (9016) TILS: 16 RWY: 55.471
A: 4.5Mhz AM B: 136Mhz AM C: 41.4Mhz AM C2: 265Mhz AM
17: Mozdok (9017) TILS: 17 RWY: 262.67
A: 4.5Mhz AM B: 137Mhz AM C: 41.6Mhz AM C2: 266Mhz AM
18: Tbilisi-Lochini (9018) TILS: 18 RWY: 127.963
A: 4.6Mhz AM B: 138Mhz AM C: 41.8Mhz AM C2: 267Mhz AM
19: Soganlug (9019) TILS: 19 RWY: 312.256
A: 4.6Mhz AM B: 139Mhz AM C: 42Mhz AM C2: 268Mhz AM
20: Vaziani (9020) TILS: 20 RWY: 135.473
A: 4.7Mhz AM B: 140Mhz AM C: 42.2Mhz AM C2: 269Mhz AM
21: Beslan (9021) TILS: 1 RWY: 93.5424
A: 4.7Mhz AM B: 141Mhz AM C: 42.4Mhz AM C2: 270Mhz AM

III - AIRBASE EXAMPLE
a) Landing Preparation

By default, the Primary Landing Base (L1) is set to be the same airbase as the one you took off from. Each airbase has an assigned « 90XX » code assigned to it. As an example, Senaki-Kolkhi is set to code « 9012 ». All these codes are accessible in your kneeboard.

We will first **select the Senaki-Kolkhi Airbase (Code 9012):**
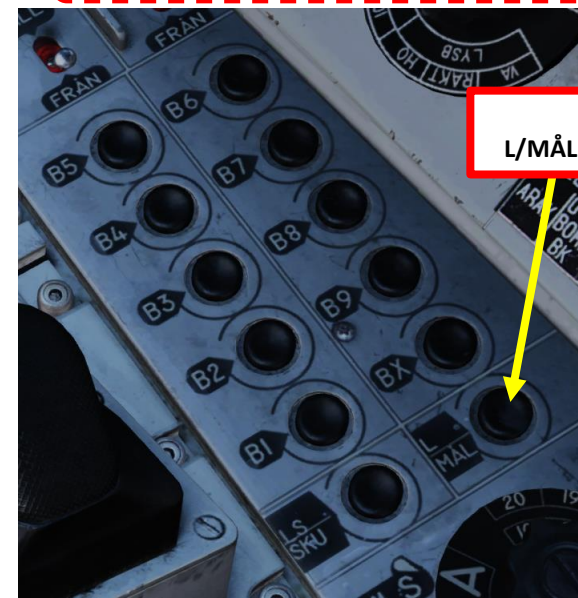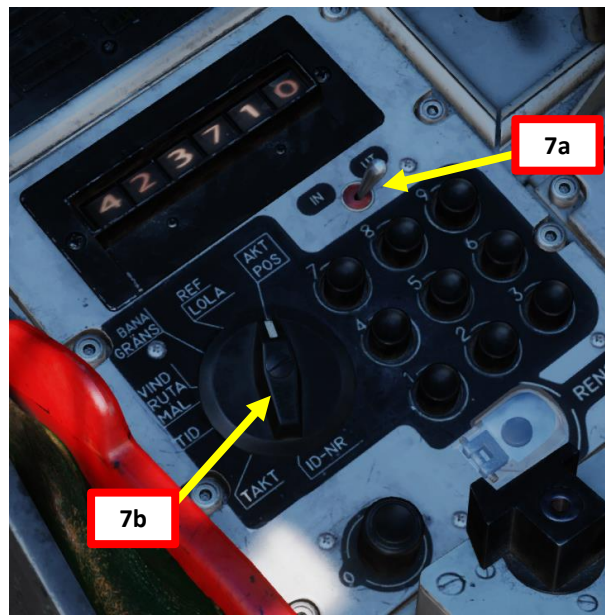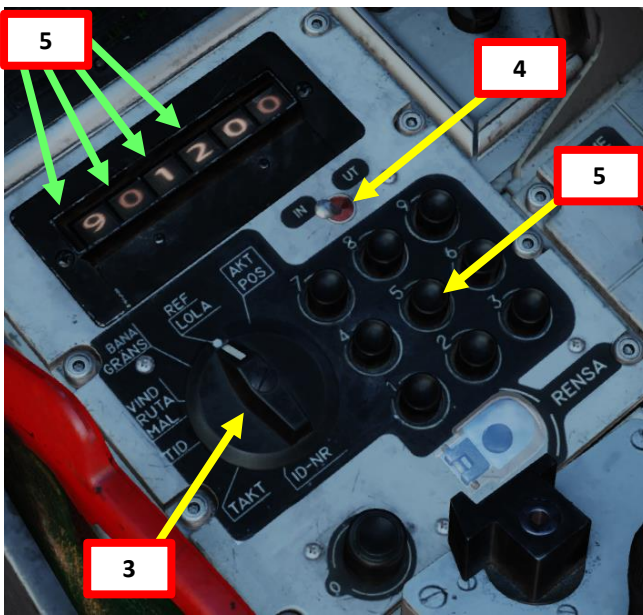
1. Open your kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages) « Airbases » page.
2. In our case, we want to land at Senaki-Kolkhi, which is associated to **code 9012**. Instead of having to input coordinates manually with custom runway headings, all this data is already preset in this code.
3. Set the Data Selector knob to **REF/LOLA** (Reference number or longitude/latitude coordinate position of waypoints).
4. Set INPUT/OUTPUT data switch to INPUT.
5. Enter code **9012**. The 4 digit code corresponds to inputting 6+6 digits of longitude and latitude as well as connecting to other information regarding that locations, such as TILS channels or runway headings.
6. Press the L/MÅL (Landing Airport Selector) button to enter the Airbase coordinates data.
7. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

Airbases: **1**

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8mhz AM C2: 257Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz ... 0Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: ... RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707   **2**
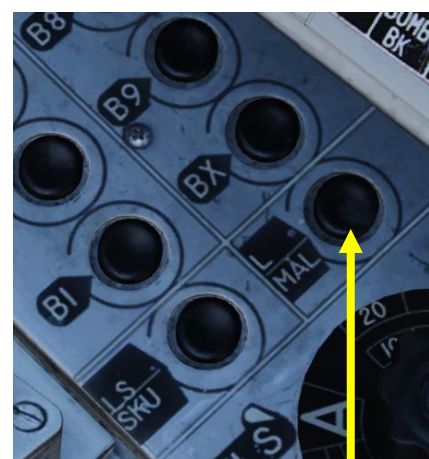A: 4.3Mhz AM B: 132Mhz AM C: 40.6mhz AM C2: 261Mhz AM

6
L/MÅL Landing Base Selector
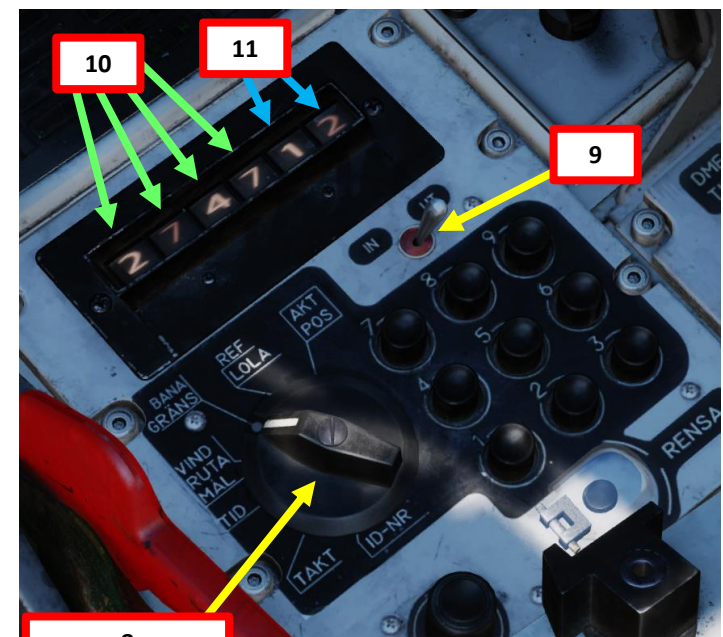
III - AIRBASE EXAMPLE
a) Landing Preparation

We will now **set the direction from which to approach the runway**.

8. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
9. Set INPUT/OUTPUT data switch to OUTPUT.
10. The default runway heading is set in a 4-digit form on the BANA/GRÄNS field data: "**2747**" represents a runway heading of **274.7.**
11. The last two digits (12) are the available TILS (Tactical Instrument Landing System) Unit Channel associated to the runway.
12. If you want to use the reciprocal (opposite) runway heading, press the L/MÅL (Landing Airport Selector) button. The BANA/GRÄNS field data will update the landing runway heading to 094.7. However, in this tutorial we will leave the runway heading to 274.7.
13. Once data transfer is complete, set the Data Selector knob to **AKT POS** (Active Position).

12
L/MÅL Landing Base Selector

9

8
BANA/GRÄNS

Touchdown Point

Senaki-Kolkhi

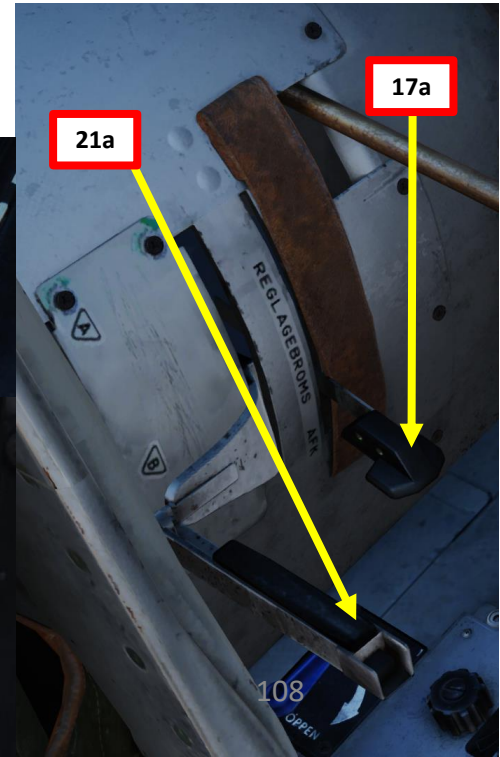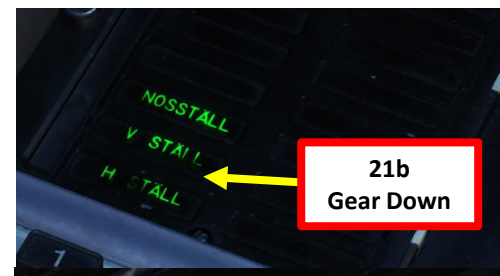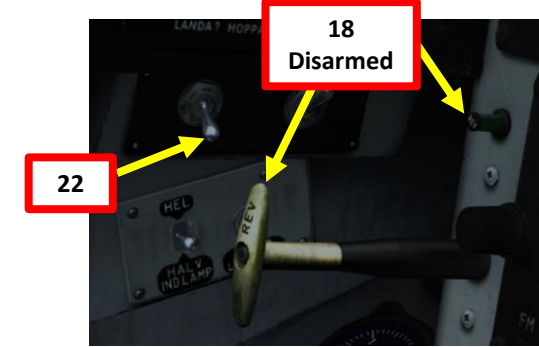**Heading: 274**

13
AKT POS

107

III - AIRBASE EXAMPLE
a) Landing Preparation

14. Look at your kneeboard by pressing "LSHIFT+K" and scroll through the kneeboard pages to the Waypoint Page using "[" and "]" keys. Find your Landing waypoint's QFE if available.
    - In this example, we have a QFE of 1031.6 hPa.
15. Set the Altimeter Setting to 1031.
16. Set HUD to the DOWN (Takeoff/Landing) position and line up with the runway.
17. Reduce airspeed to 550 km/h during approach. This can be done by moving the throttle manually or by engaging the AUTOTHROTTLE lever (DOWN).
18. When using an airbase, odds are that you will have a decent runway length available. If you do not want to use reverse thrust, leave the Thrust Reverser lever disarmed (pushed IN). Otherwise, pull Thrust Reverser lever to arm it.
19. Set HUD/SI Slave Switch to T (*TILL*, ON). This activates LOWNAV (Decluttered HUD mode) when altitude is lower than 100 m above ground level.
20. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
21. Deploy Landing Gear by setting Landing Gear Lever DOWN
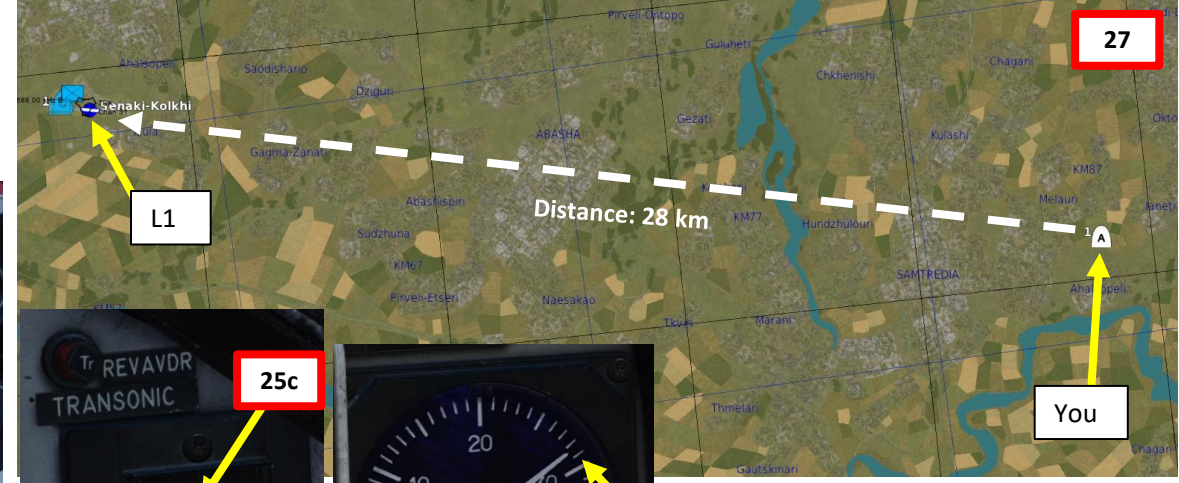22. Set Landing/Taxi (*Strålkast*) Lights Switch – ON (DOWN)

DATE 1994-06-10	MISSION ID 05 - AJS37 Training visual landing	CALLSIGN	TASK 11 Strike
FUEL WBGHT 2194	LOADOUT 0	TOTAL WEIGHT 13994	V2 346
ENGINE START TIME 00:00:00	TAKE-OFF TIME 00:00:00	RUNWAY HEADING 0	QNH 1033.2

WAYPOINT NAME M0
COURSE (T) 0	HEADING (M) 5	G/S 700	IAS 620
DISTANCE 0.0	TOF 00:00:00	ETA 14:00:00	QFE 1024.1
ALTITUDE 1000	VERTICAL ANGLE 0	FUEL RESERVE 49	BINGO FUEL 18

WAYPOINT NAME B1
COURSE (T) 282	HEADING (M) 287	G/S 700	IAS 620
DISTANCE 31.8	TOF 00:02:43	ETA 04:02:43	QFE 1028.8
ALTITUDE 1000	VERTICAL ANGLE 0	FUEL RESERVE 46	BINGO FUEL

WAYPOINT NAME Landing Senaki-Kolkhi
COURSE (T) 274	HEADING (M) 280	G/S 500	IAS 470
DISTANCE 19.7	TOF 00:02:21	ETA 18:07:48	QFE 1031.6
ALTITUDE 13	VERTICAL ANGLE -3	FUEL RESERVE 45	BINGO FUEL 13

14

15

22

18 Disarmed

20
19

21b Gear Down
17b

21a
17a
108

III - AIRBASE EXAMPLE
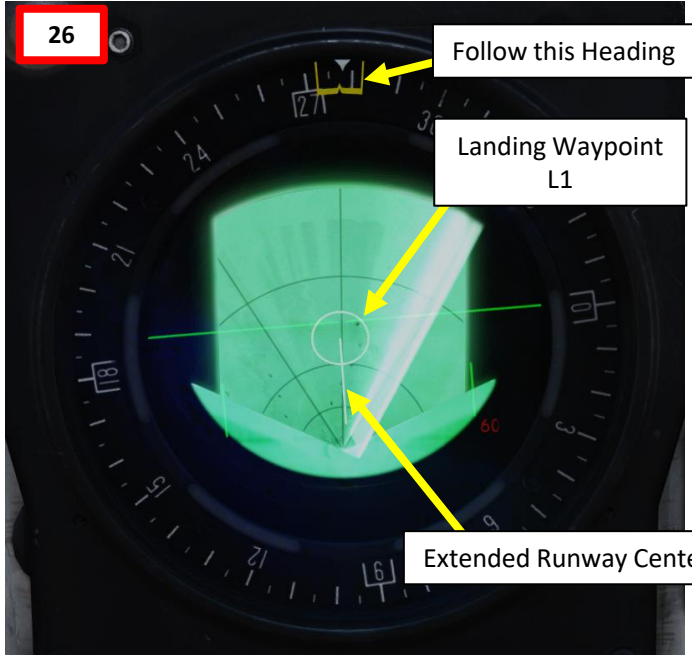## b) Visual Approach (LANDNING P/O)

23. Set Master Mode Selector to NAV (Navigation)
24. Turn radar ON by setting A0/A1/A2 switch to Mode A1 (PPI, or Plan-Position Indicator).
25. Set the Navigation Data selector to AKT POS (Actual Position) and press L/MÅL (Landing Airport Selector) to select landing waypoint L1 (Primary Landing Base).
26. On destination change to the landing waypoint, the central indicator (CI) displays an extended runway centerline of the chosen runway. The line corresponds to 20 km and aligns along the extended runway centerline.
27. Navigate towards Waypoint L1. Steer the aircraft to:
    - Set the ADI (Attitude Director Indicator) lateral steering line to the center
    - Set the HUD's Velocity Vector in the center of the pole tracks
    - Line up with the L1 waypoint's runway line

27

L1

Distance: 28 km

27

You

25a

25c

L1

Distance to L1: 28 km

27

Radar Mode Selector
A0: Radar OFF
A1: Radar ON, Sector PPI

24

23

27

Lateral Steering Line

26

Follow this Heading

Landing Waypoint L1

25b

Extended Runway Centerline

27

Flight Path Vector

109
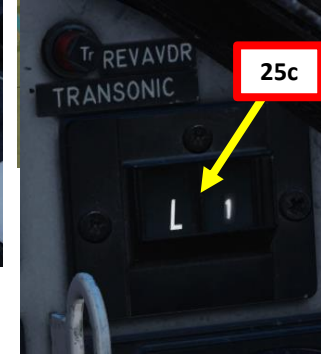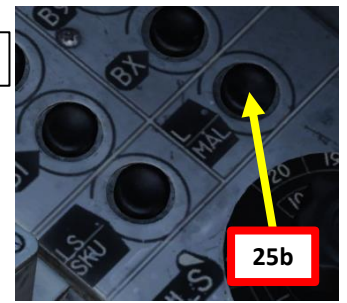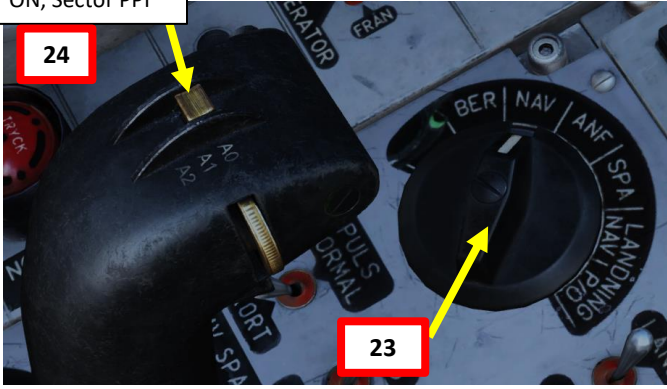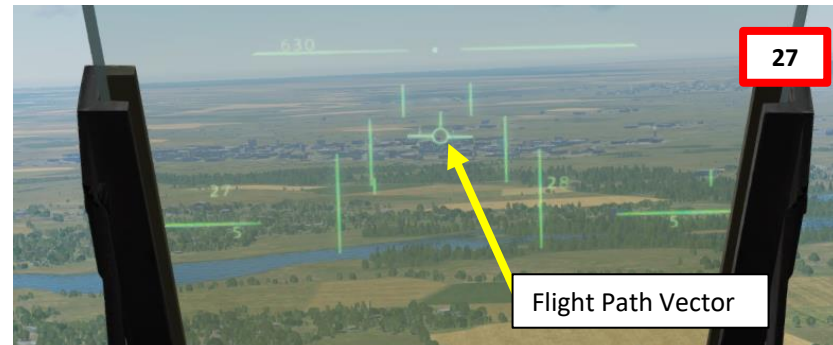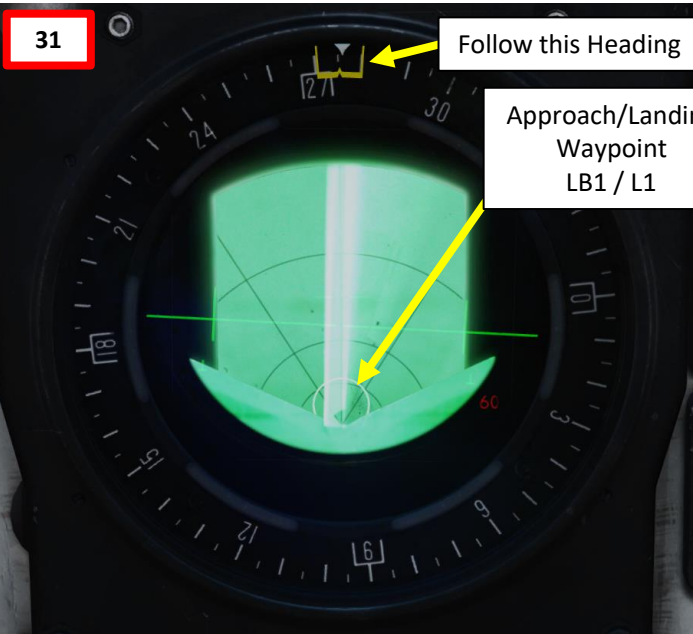
III - AIRBASE EXAMPLE
b) Visual Approach (LANDNING P/O)

28. Maintain airspeed to 550 km/h during approach.
29. When you are within 5 to 10 km from the runway, set Master Mode Selector to LANDNING P/O (Precision Approach Radar / Optical).
30. The Destination Indicator will switch from L1 (Primary Landing Base) to LB1 (Approach Waypoint).
31. On the Central Indicator (CI), the Approach Waypoint is shown. In LANDN P/O mode, the "ring" corresponds to the runway centerpoint, just as it did previously for L1.
32. Navigate towards LB1 (Approach Waypoint).
33. Use the LB1 circle as a reference on the CI display.
34. Take note that no glide slope steering commands are available since we are not using TILS equipment for this approach.
35. Place your Flight Path Vector on the runway and line up the aircraft for the final approach.

29

Distance to L1: 5 km

30

29

29

LB1

Distance: 5 km

You

35

31
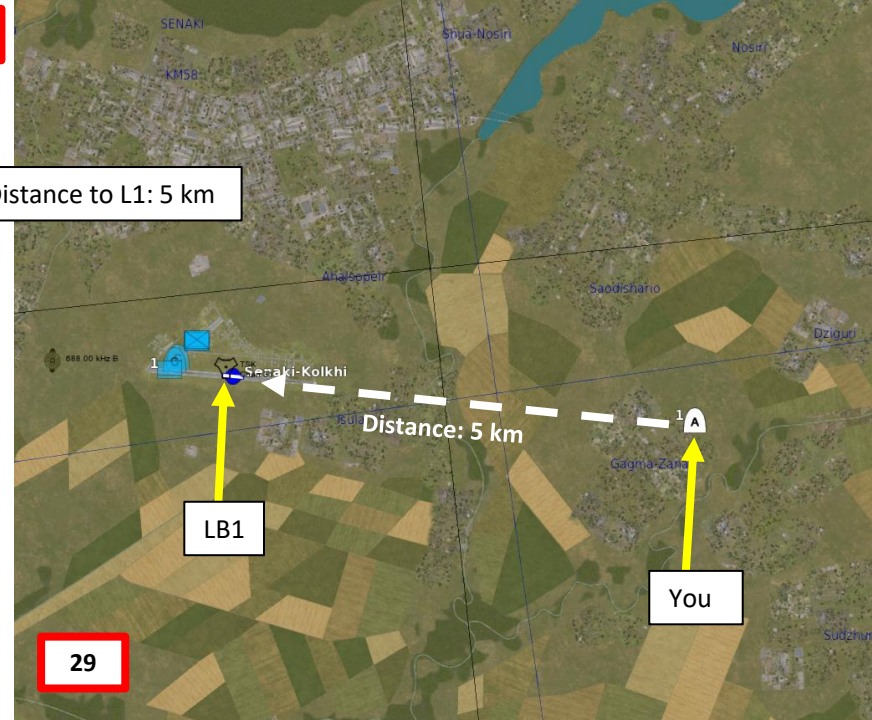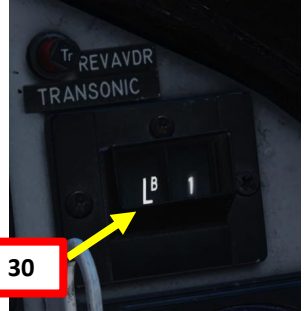
Follow this Heading

Approach/Landing Waypoint LB1 / L1

HUD Symbology in mode LANDN P/O
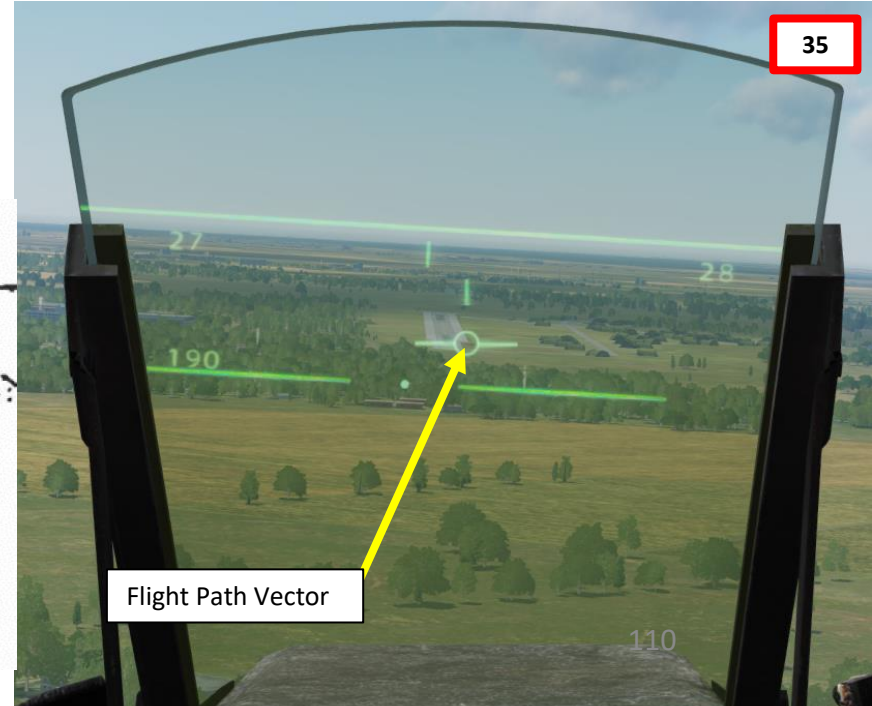
Flight Path Vector

III - AIRBASE EXAMPLE
c) Touchdown with Aerobraking

36. When on final, keep your Flight Path Vector on the runway
37. Maintain a MAXIMAL AoA (Angle of Attack) of 12 deg AoA and aircraft attitude by aligning the descent line on the runway threshold. This will give you a descent angle of 3 deg.
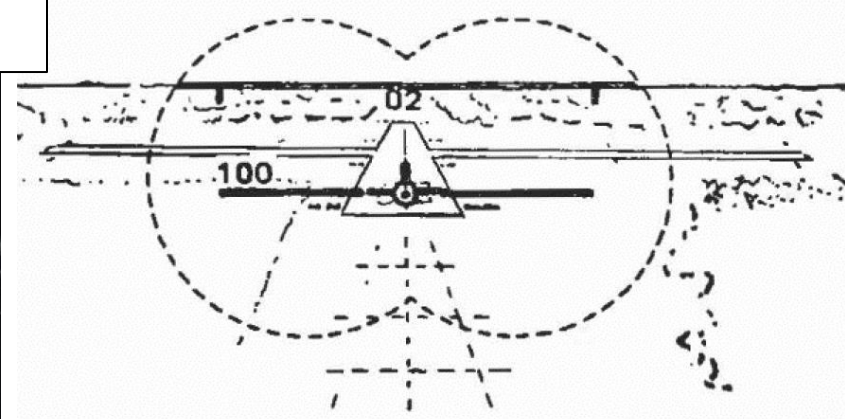   - Note: Do not slow down under 260 km/h.
38. When the radar altitude is less than 15 m AGL (Above Ground Level), the Flight Path Vector changes function to a sink-rate indicator. If the flight path vector is held at the glide path line, the sink rate will not exceed 2.96 m/s. If the radar altimeter is not available, the mode engages at 30 meters altitude. Keep the Flight Path Vector above the lower horizontal line (glide slope line) to ensure a safe vertical speed and smooth touchdown.
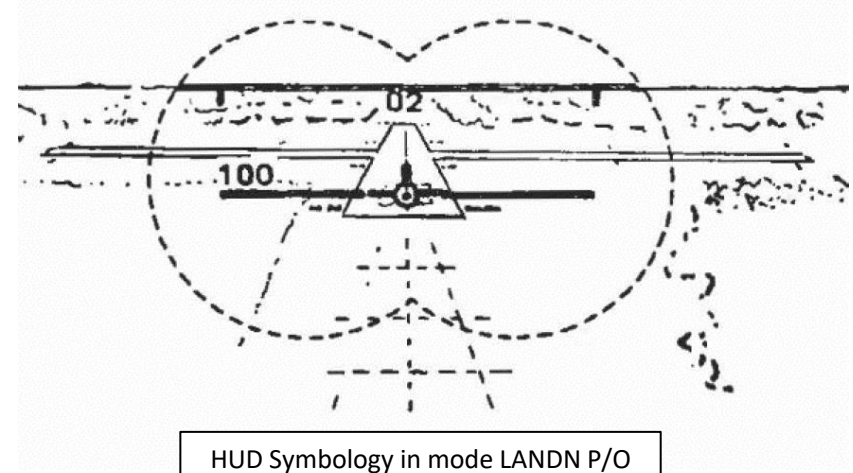
HUD Symbology in mode LANDN P/O
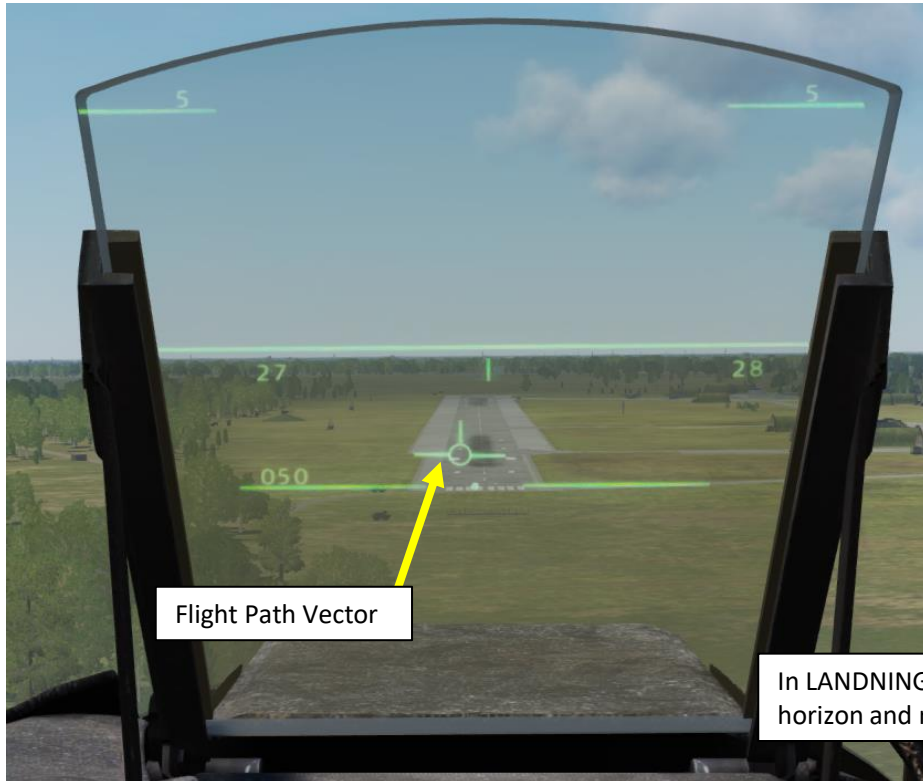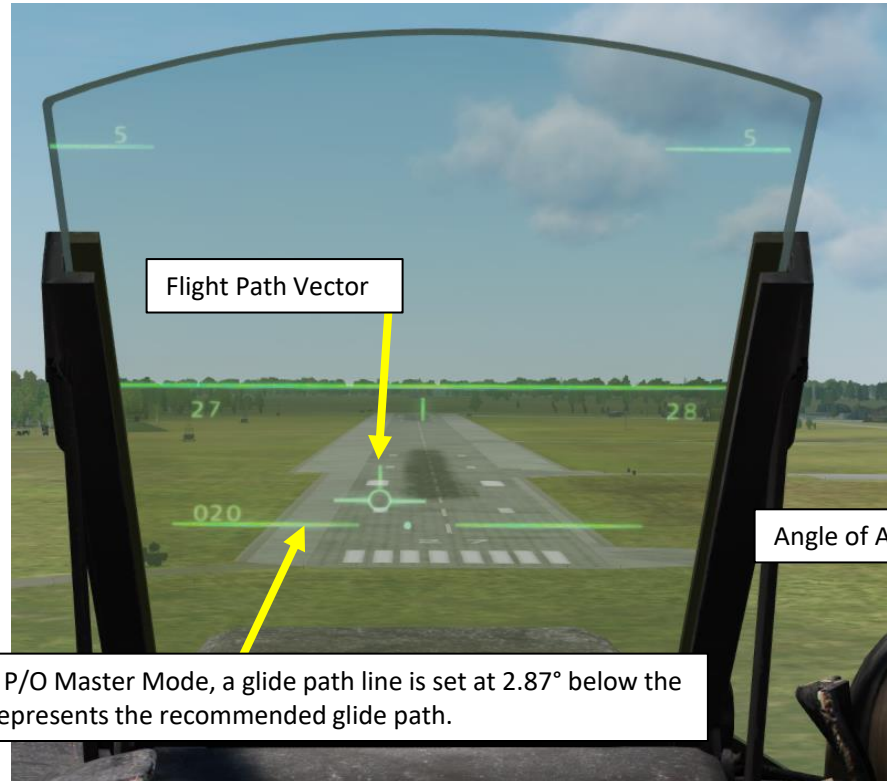
Flight Path Vector

Flight Path Vector

In LANDNING P/O Master Mode, a glide path line is set at 2.87° below the horizon and represents the recommended glide path.

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

Angle of Attack (deg)

HUVUDVARNING

III - AIRBASE EXAMPLE
c) Touchdown with Aerobraking

39. In this particular example, we will not use any reverse thrust and slow down with aerodynamic braking.
40. Prior to touchdown, verify that the thrust reverser lever is set as desired. In our case, since we do not use reverse thrust, thrust reverser lever should be pushed IN and the REV light should be extinguished (indicates reverser circuits are inactive).
41. On touchdown, throttle back to IDLE.
42. Gently pull back on the stick to maintain an angle of attack (AoA) of 16 deg.
43. As your main landing gear wheels touch the ground:
    - The autothrottle will automatically disengage.
44. Lower the nose at around 160 km/h.
45. Steer with the rudder and apply brakes evenly.

40 Disarmed
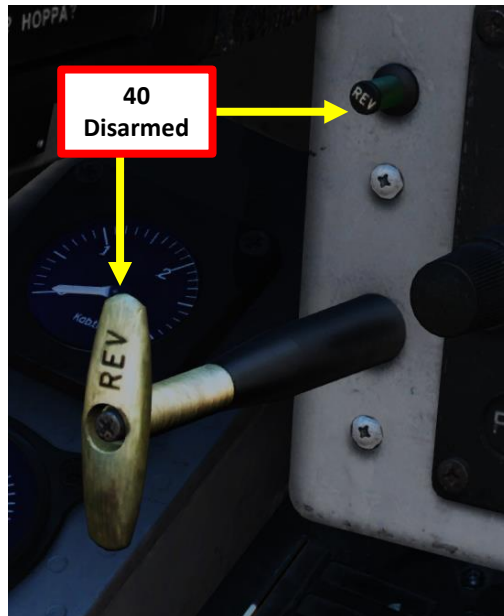
IV – ROAD BASE EXAMPLE
a) Landing Preparation

When landing on a road base, it is important to tell the Flight Computer the heading of the runway manually since no TILS (Tactical Instrument Landing System) equipment is available to give you localizer and glide slope steering information. Instead, we will have to rely on plain latitude/longitude coordinates set on a Primary Landing Waypoint (L1) and a direction from which to approach the runway.

We will first **enter the Road Base coordinates:**

1. Set the Data Selector knob to **REF/LOLA** (Reference number or longitude/latitude coordinate position of waypoints).
2. Set INPUT/OUTPUT data switch to INPUT.
3. We will create the Landing waypoint (L1) set to on the **Road Base**. Using the F10 map, we can see that its coordinates are: **34°41'27" North, 36°06'25" East**.
4. On keypad, enter coordinates in degrees, minutes and seconds for Longitude and Latitude. As an example, coordinates from the F10 map **34°41'27" North (Latitude)**, **36°06'25" East (Longitude)** are entered as **360625344127** (East coord first, North coord second, which might seem counterintuitive if you use the F10 East-North coordinates.).
5. Press the L/MÅL (Landing Airport Selector) button to enter the Road Base coordinates data.
6. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

5
L/MÅL Landing Base Selector
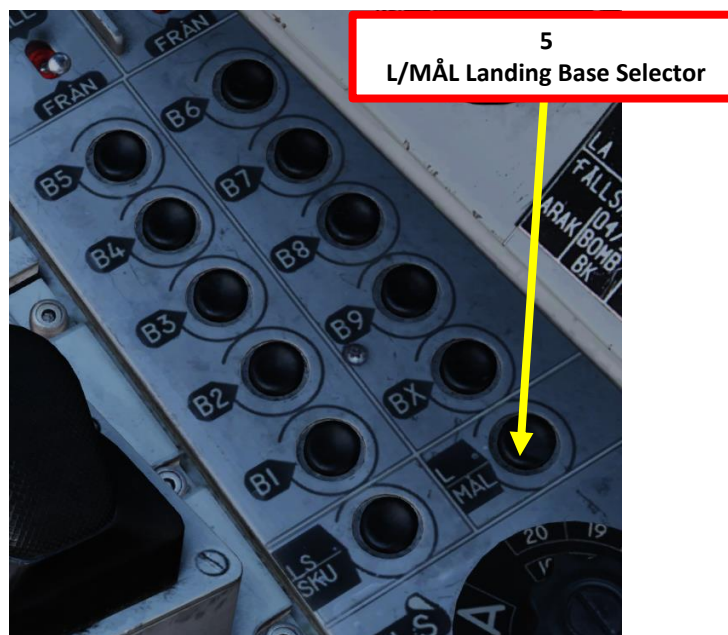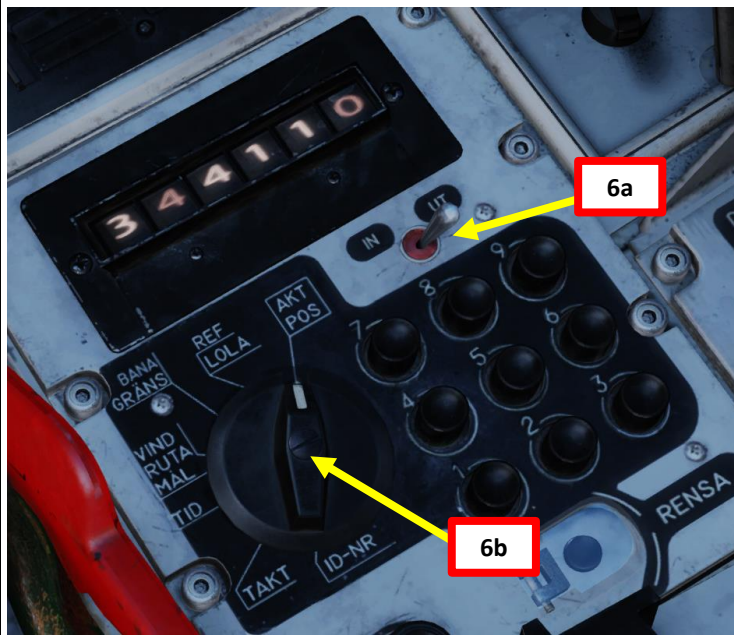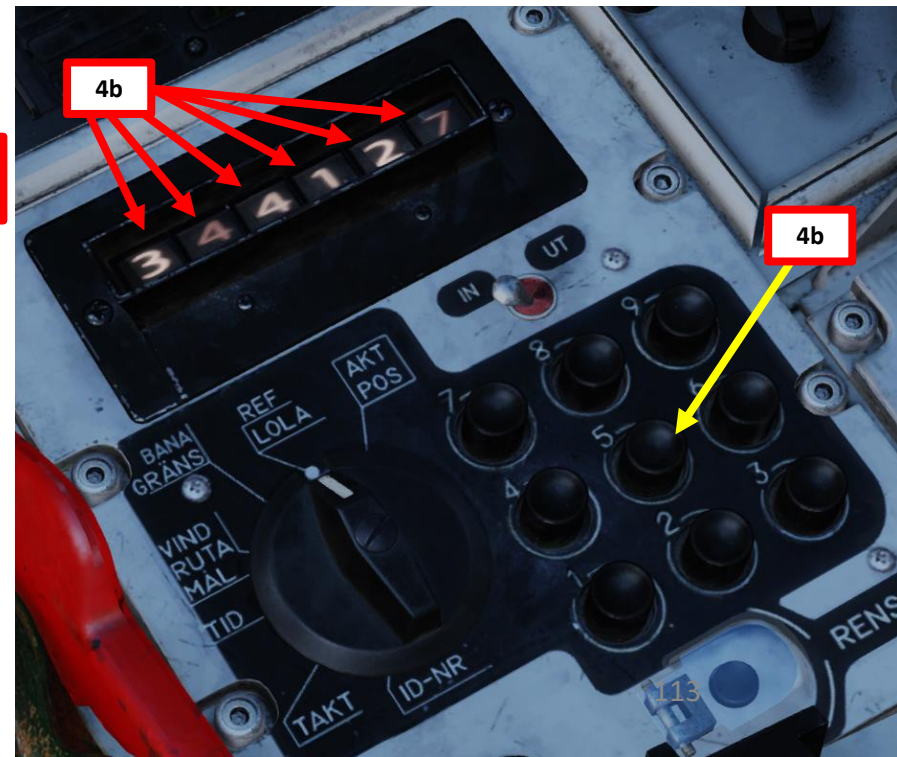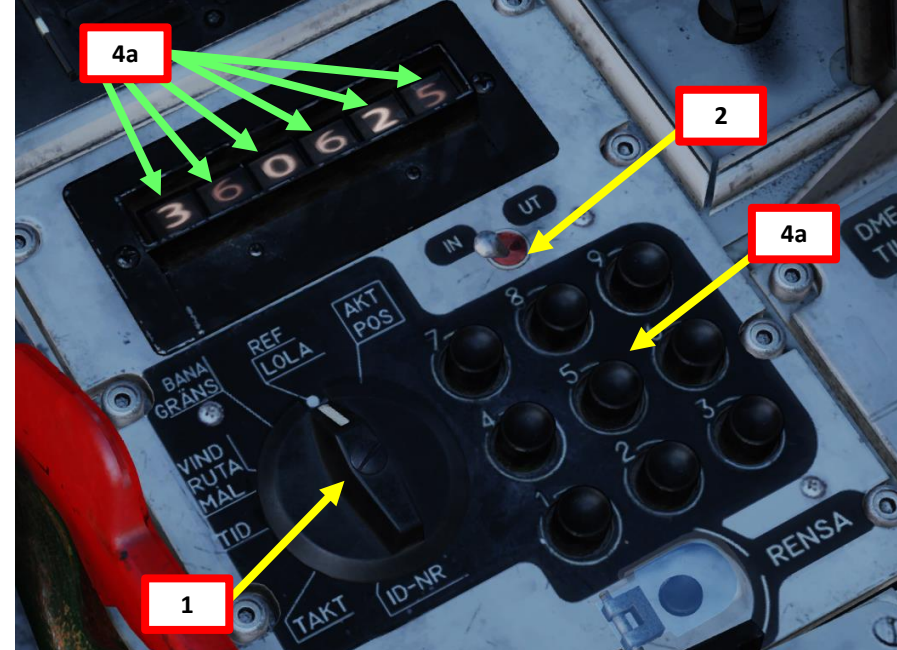
IV – ROAD BASE EXAMPLE
a) Landing Preparation

We will now **set the direction from which to approach the runway**.

7. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
8. Set INPUT/OUTPUT data switch to INPUT.
9. Enter the runway heading in a 4-digit form on the CK37 keypad: "**1050**" entered on the keypad represents a runway heading of **105.0.**
10. The last two digits can be left to 00 since there is no TILS (Tactical Instrument Landing System) Unit Channel associated to the runway.
11. Press the L/MÅL (Landing Airport Selector) button to enter the BANA/GRÄNS field data, which will update the landing runway heading to 105.0.
12. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

9b

10

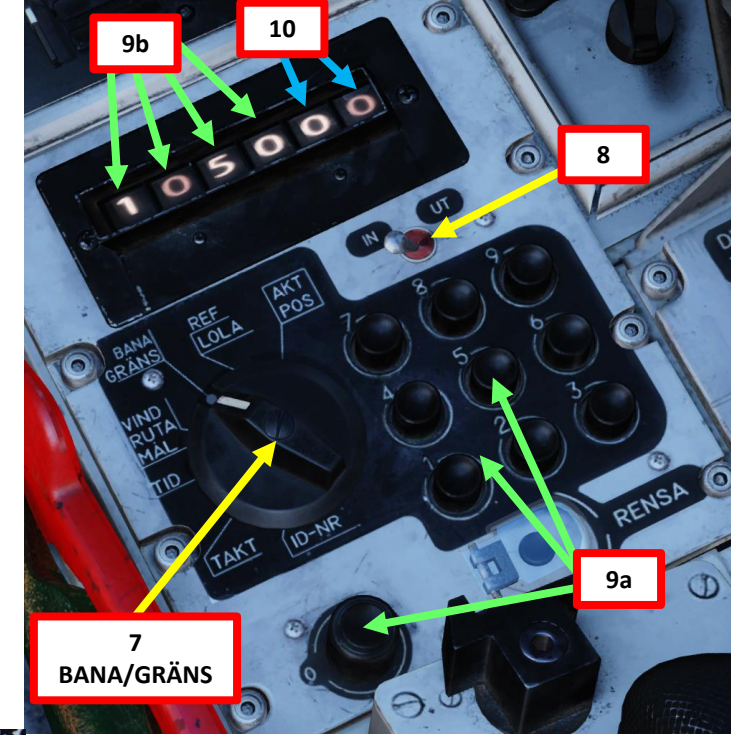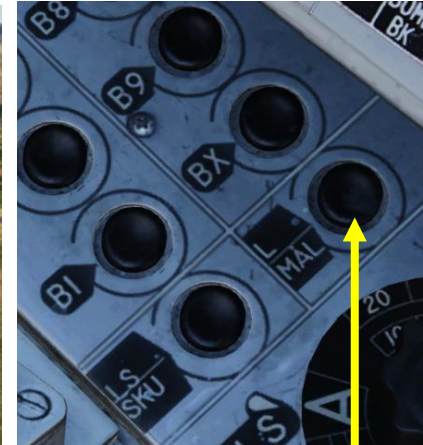8

7
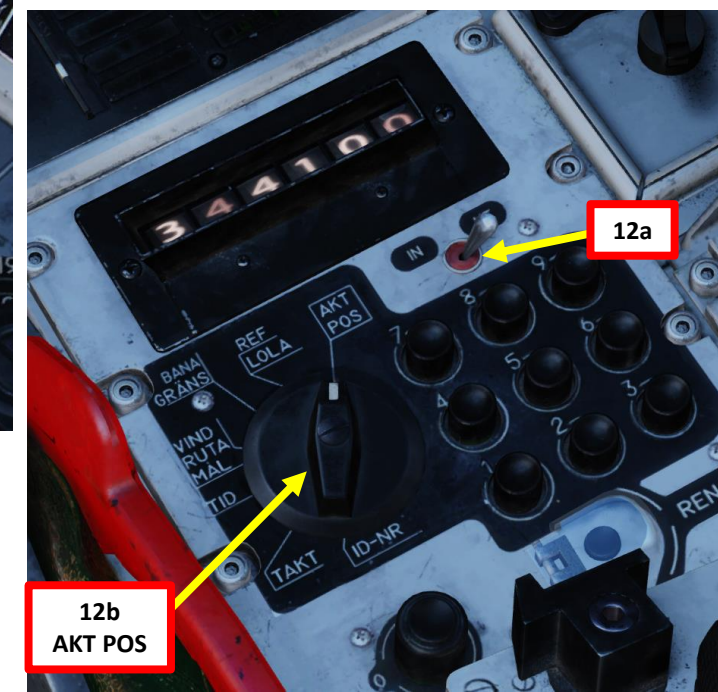BANA/GRÄNS

9a

Touchdown Point

Heading: 105

11
L/MÅL Landing Base Selector

12a

12b
AKT POS

IV – ROAD BASE EXAMPLE
a) Landing Preparation

13. Look at your kneeboard by pressing "LSHIFT+K" and scroll through the kneeboard pages to the Waypoint Page using "[" and "]" keys. Find your Landing waypoint's QFE if available.
    - Note: If the data cartridge has no Landing Point set up with a QFE setting but you initially took off from that same road base, you could use the QFE setting for Takeoff instead as an approximate value.
    - In this example, we have a QFE of 1007.2 hPa.
14. Set the Altimeter Setting to 1007.
15. Set HUD to the DOWN (Takeoff/Landing) position and line up with the runway.
16. Reduce airspeed to 550 km/h during approach. This can be done by moving the throttle manually or by engaging the AUTOTHROTTLE lever (DOWN).
17. When using a road base, odds are that you will have to perform a very short landing. Therefore, I would highly recommend to pull Thrust Reverser lever to arm it.
18. Set HUD/SI Slave Switch to T (*TILL*, ON). This activates LOWNAV (Decluttered HUD mode) when altitude is lower than 100 m above ground level.
19. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
20. Deploy Landing Gear by setting Landing Gear Lever DOWN
21. Set Landing/Taxi (*Strålkast*) Lights Switch – ON (DOWN)
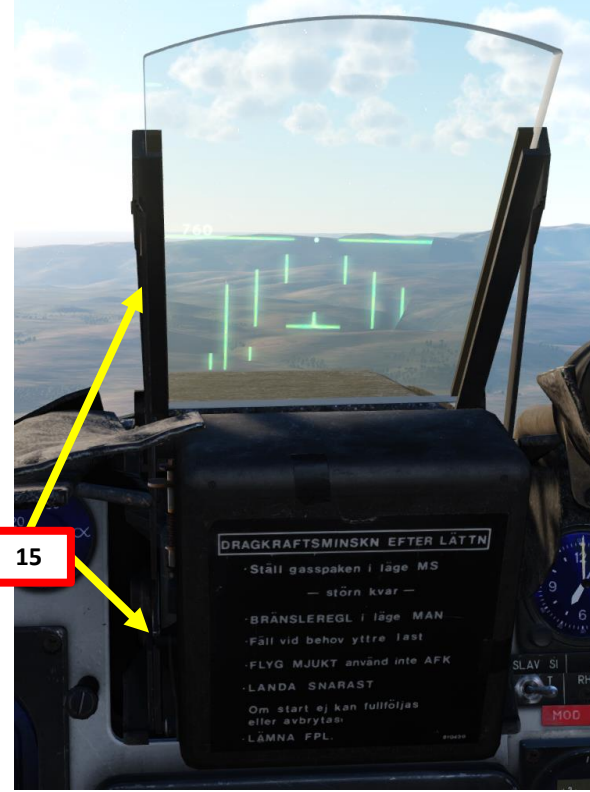
DATE 1982-04-21	MISSION ID AJSSyriaRoadbase	CALLSIGN Enfield 1-1	TASK Strike
FUEL WEIGHT 5489	LOADOUT 774	TOTAL WEIGHT 18063	V2 393
ENGINE START TIME 23:54:34	TAKE-OFF TIME 23:59:34	RUNWAY HEADING 0	QNH 1013.3

WAYPOINT NAME Take-Off			
COURSE (T) 0	HEADING (M) 3	G/S 550	IAS 550
DISTANCE 0.0	TOF 00:00:00	ETA 00:00:00	QFE 1007.2
ALTITUDE 0	VERTICAL ANGLE 0	FUEL RESERVE 123	BINGO FUEL 17

WAYPOINT NAME B1			
COURSE (T) 115	HEADING (M) 119	G/S 550	IAS 550
DISTANCE 6.5	TOF 00:00:43	ETA 00:00:43	QFE 997.7
ALTITUDE 0	VERTICAL ANGLE 0	FUEL RESERVE 122	BINGO FUEL 17

13

15

16a

20a

20b Gear Down

17 Armed

21

19

16b

14

18
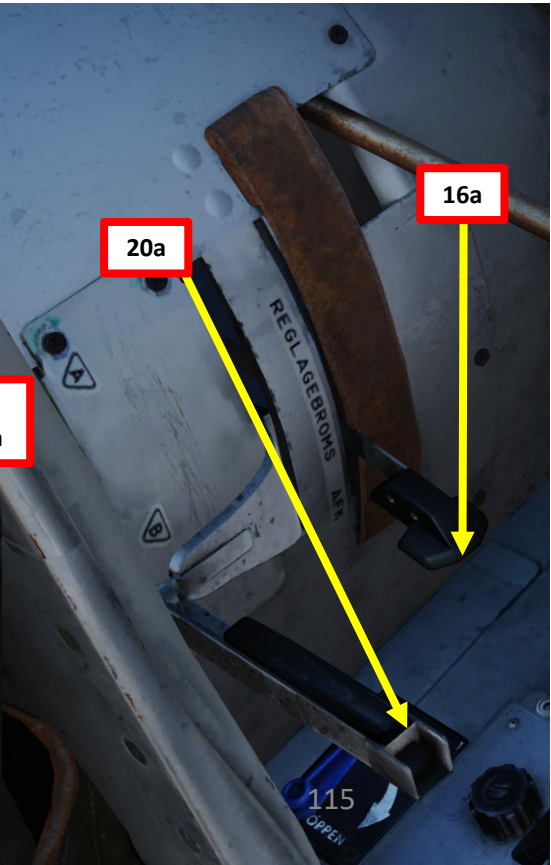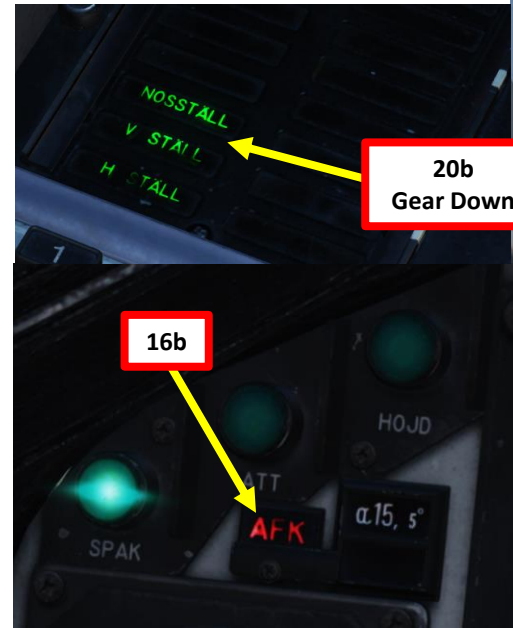
IV – ROAD BASE EXAMPLE
b) Instrument Approach (LANDNING NAV)

The **Approach Waypoint (LB1)** is the point where a straight line from the aircraft tangents the **Approach Circle**. The coordinates for LB1 are continuously calculated by the computer, while the aircraft is turning towards LB1. Thereby, the aircraft will intercept the circle on a tangent.

The approach circle is placed on the side of the extended runway centerline the aircraft is on. The approach circle tangents the extended runway centerline 20 km from the **Touchdown Waypoint (LF1)** and has a radius of 4100 m. The radius of the approach circle corresponds to 550 km/h with a bank angle of 30°.

LB1
Approach Waypoint

Approach Circle

4100 m
Radius

LF1
Touchdown Waypoint

LB1

Extended runway centreline

Approach Circle

L1
Primary Landing Base

Distance: 20 km
Heading 105

20 km

LF1   L1
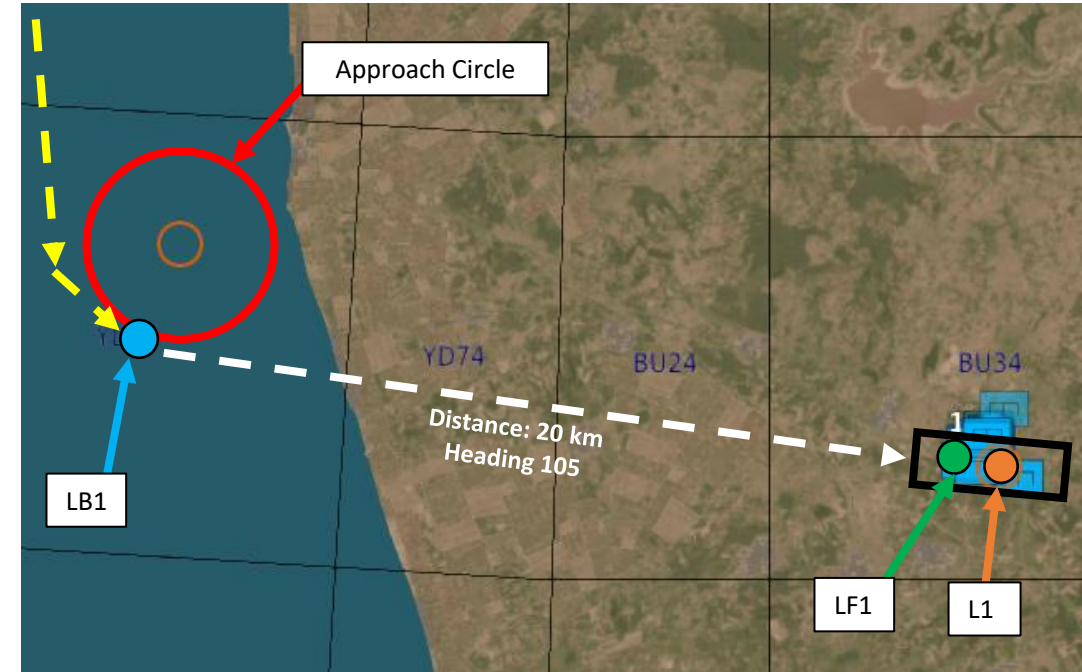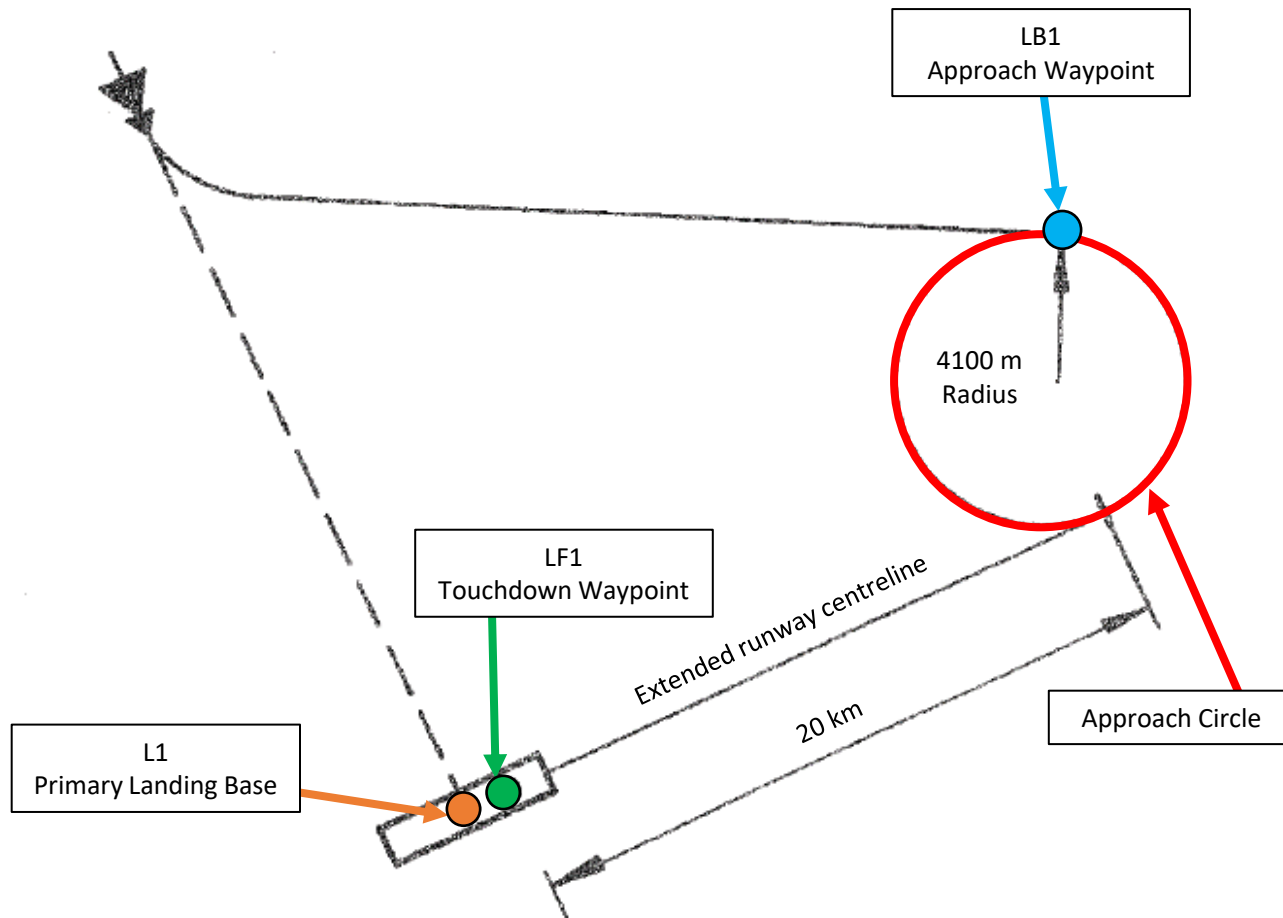
IV – ROAD BASE EXAMPLE
b) Instrument Approach (LANDNING NAV)

22. Set Master Mode Selector to NAV (Navigation)
23. Turn radar ON by setting A0/A1/A2 switch to Mode A1 (PPI, or Plan-Position Indicator).
24. Set the Navigation Data selector to AKT POS (Actual Position) and press L/MÅL (Landing Airport Selector) to select landing waypoint L1 (Primary Landing Base).
25. On destination change to the landing waypoint, the central indicator (CI) displays an extended runway centerline of the chosen runway. The line corresponds to 20 km and aligns along the extended runway centerline.
26. Navigate towards Waypoint L1. Steer the aircraft to:
    • Set the ADI (Attitude Director Indicator) lateral steering line to the center
    • Set the HUD's Velocity Vector in the center of the pole tracks
    • Line up with the L1 waypoint's runway line

Distance to L1:
5 Swedish miles (50 km)

26

24a

Tr REVAVDR
TRANSONIC
L 1

24c

Radar Mode Selector
A0: Radar OFF
A1: Radar ON, Sector PPI

23

22

You

Distance: 50 km

LB1

LF1
L1

26

Lateral Steering Line

Landing Waypoint L1

Follow this Heading

24b

Extended Runway Centerline

25

26

Flight Path Vector
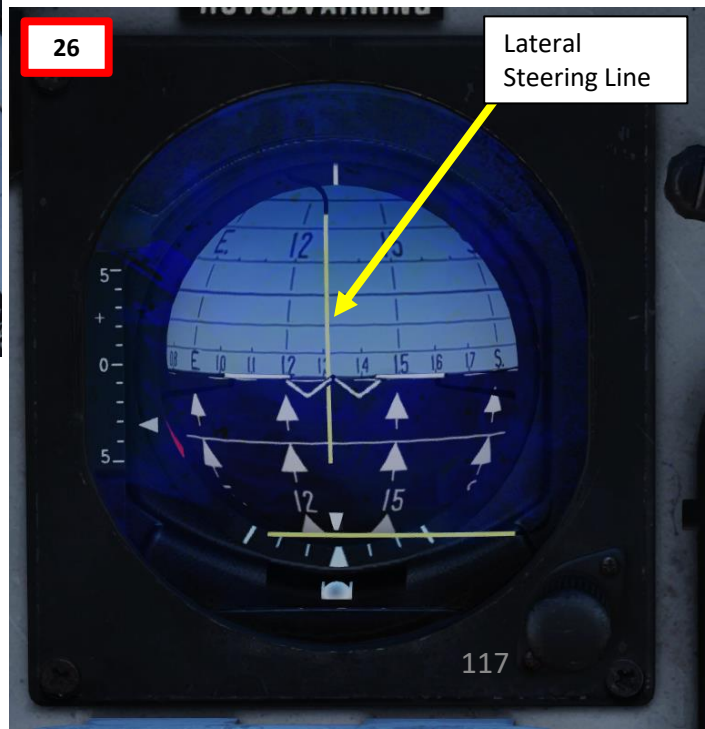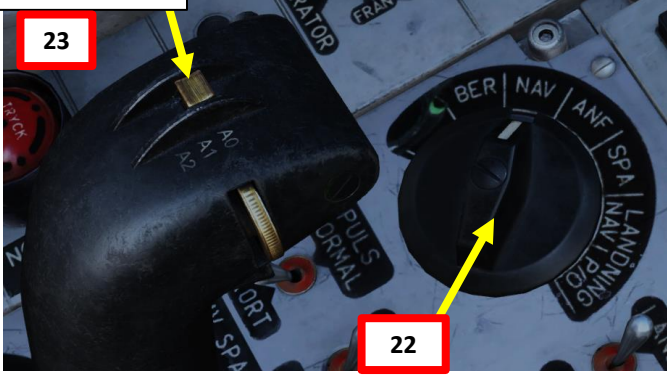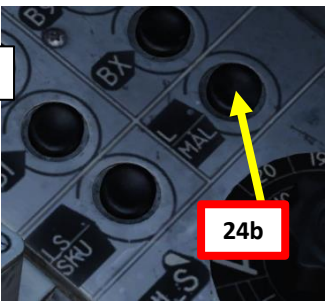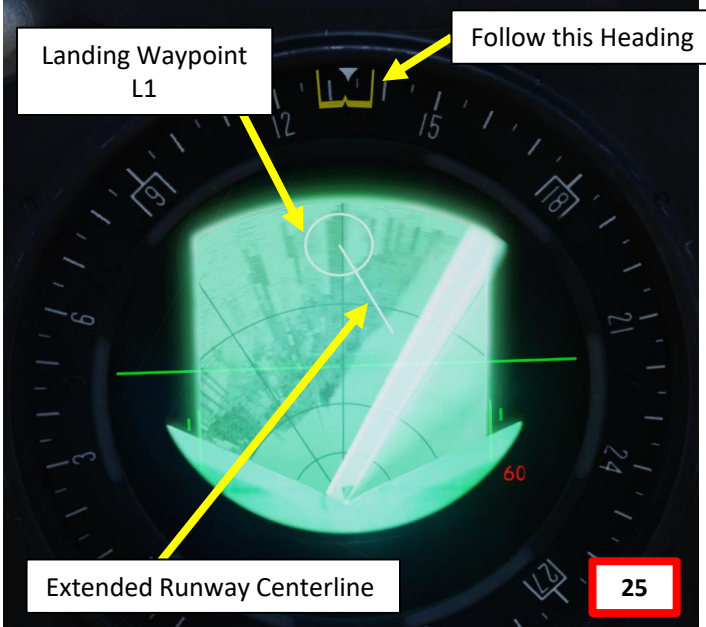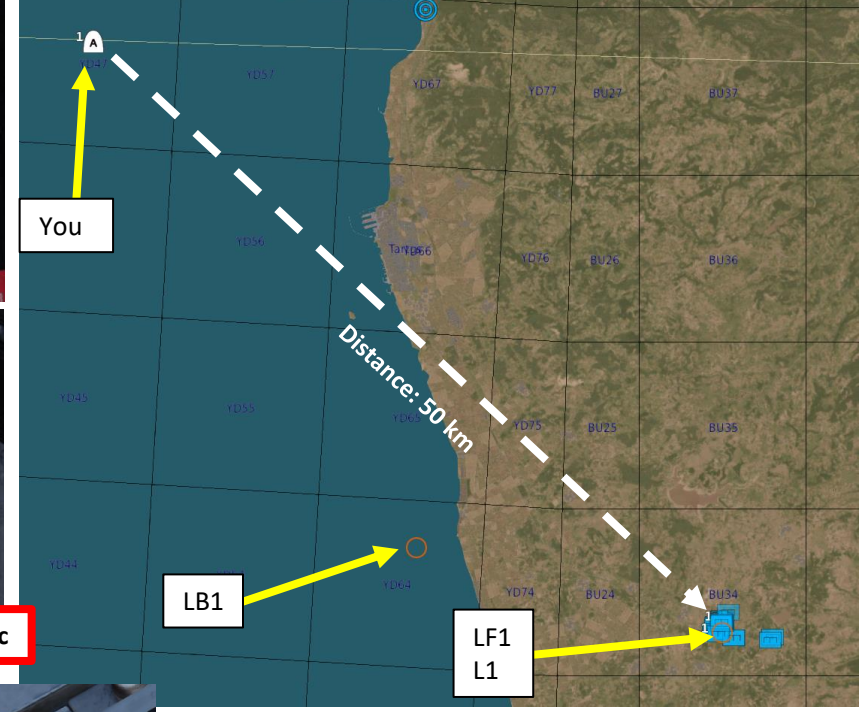
IV – ROAD BASE EXAMPLE
b) Instrument Approach (LANDNING NAV)

27. Maintain airspeed to 550 km/h during approach.
28. Set Master Mode Selector to LANDNING NAV (Instrument Navigation Landing)
29. The Destination Indicator will switch from L1 (Primary Landing Base) to LB1 (Approach Waypoint), which is an automatically computed point to help you line up with the runway 20 km out from the Landing Base.
30. On the Central Indicator (CI), the Approach Waypoint and extended runway centerline are shown, indicating whether a left or right turn onto the runway centerline will be made. Thereby, the "ring" no longer corresponds to the runway centerpoint as it did previously for L1.
31. Navigate towards LB1 (Approach Waypoint). Steer the aircraft to:
    • Set the ADI (Attitude Director Indicator) lateral steering line to the center
    • Set the HUD's Velocity Vector in the center of the pole tracks
32. Use the LB1 circle as a reference on the CI display.
33. On the HUD, the commanded altitude should be your current altitude until the "Time Line" appears on the HUD.
34. The "Time Line" appears 40 seconds before the descent command is given. The descent command is given when the time line reaches the outer markers.
35. The descent command given in the HUD will require you to set the aircraft to follow a 4 deg descent towards an altitude of 500 m.

Distance to LB1: 38 km

31

29

28

You

Distance: 38 km

LB1

LF1

35

34

2,9   30   –5   –5

40 s before descent   Descent

30 Follow this Heading

Approach Waypoint LB1

32

Extended Runway Centerline

Flight Path Vector

31

Outer Marker

Outer Marker

Time Line   **34**

Lateral Steering Line

31

31

118
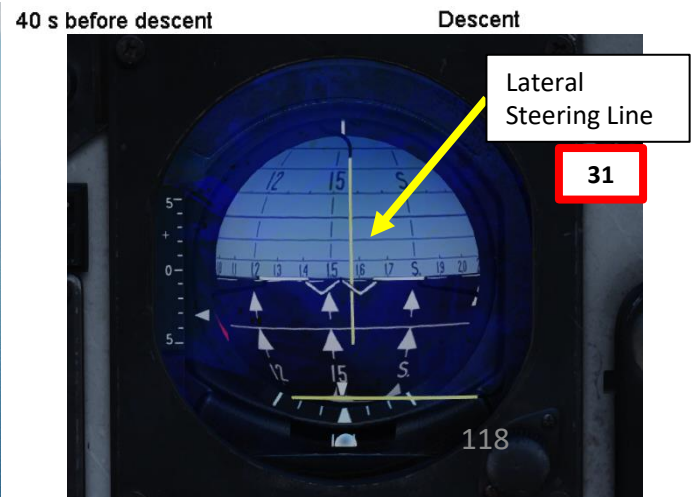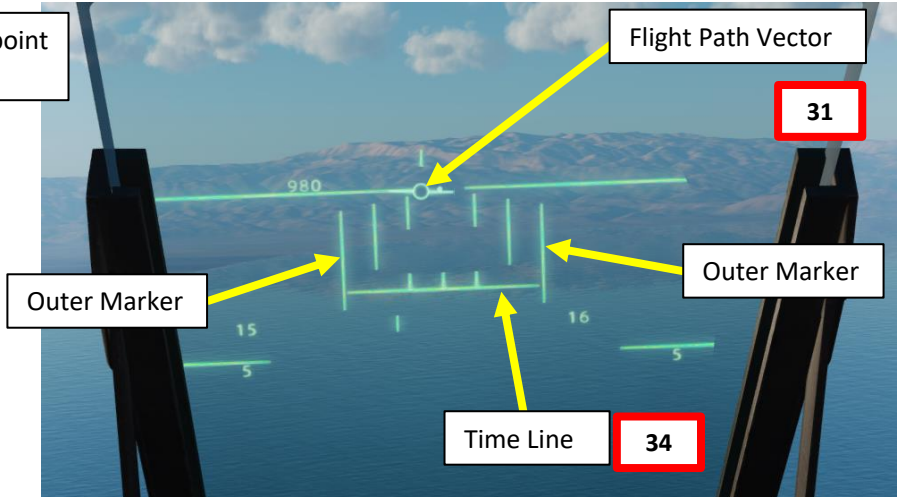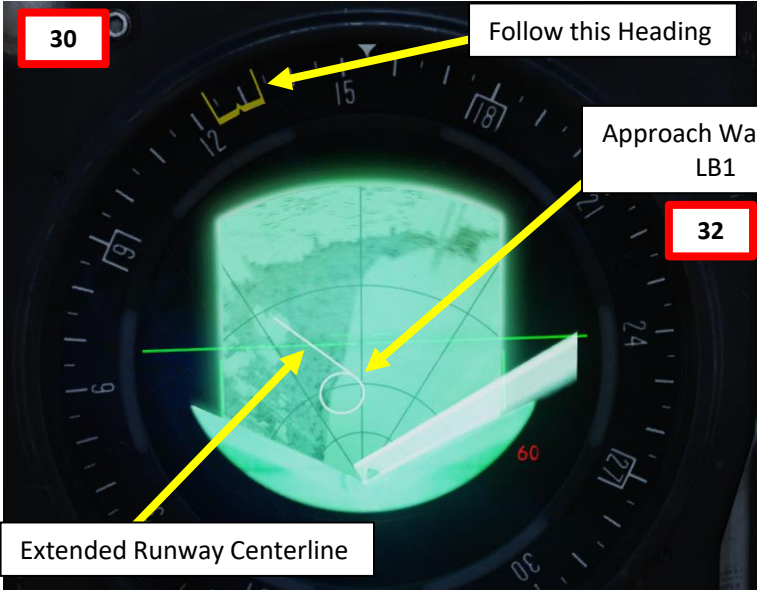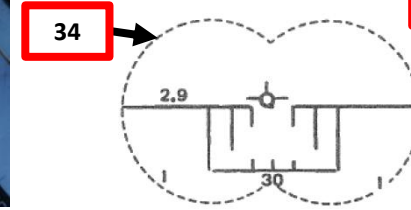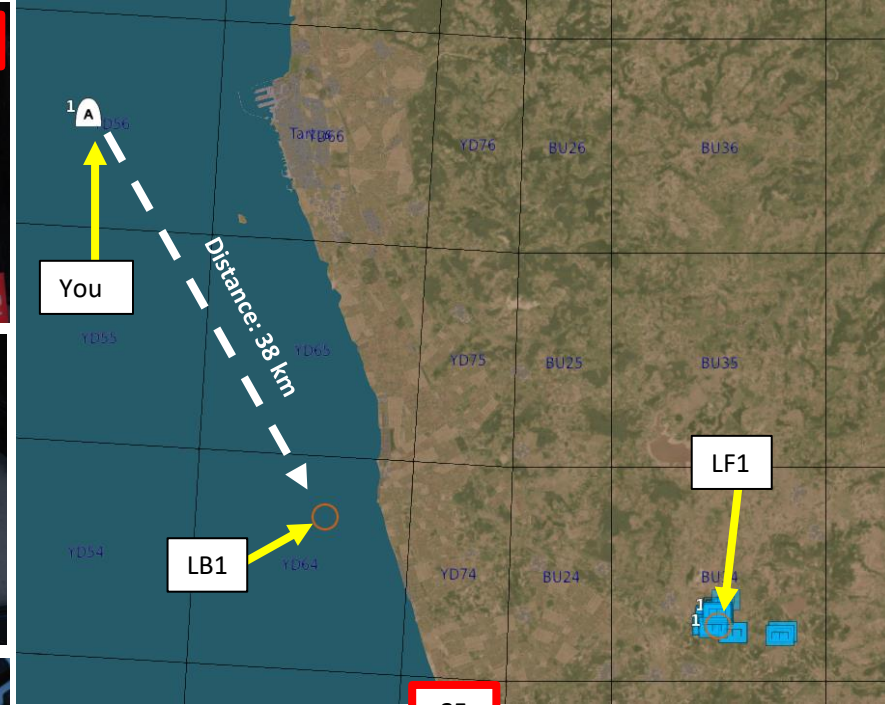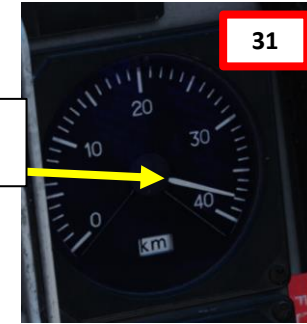
IV – ROAD BASE EXAMPLE
b) Instrument Approach (LANDNING NAV)

36. When the aircraft passes near LB1 (Approach Waypoint), the Destination Indicator will automatically switch to LF1 (Touchdown Waypoint).
37. The central indicator (CI) displays an extended runway centerline of the chosen runway. The line corresponds to 20 km and aligns along the extended runway centerline.
38. Since we are landing on a road base with no TILS (Tactical Instrument Landing System) equipment available, we will Navigate towards LF1 (Touchdown Waypoint). Steer the aircraft to:
    - Set the ADI (Attitude Director Indicator) lateral steering line to the center
    - Set the HUD's Velocity Vector in the center of the pole tracks
39. Take note that no glide slope steering commands are available since we are not using TILS equipment for this approach.

Distance to LF1: 28 km

You

38

Tr REVAVDR
TRANSONIC

L^F 1

36

Current Heading

Distance: 28 km

Distance: 20 km
Heading 105

LB1

LF1

37

Follow this Heading

Touchdown Waypoint
LF1

38

Flight Path Vector

Extended Runway Centerline
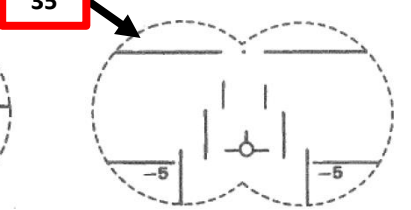
38

Lateral
Steering Line

119
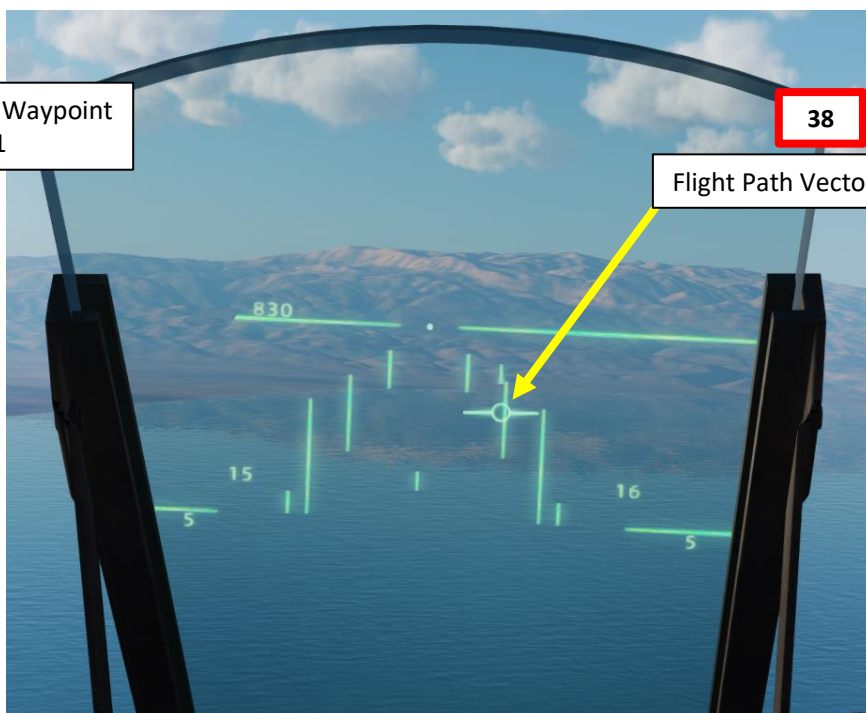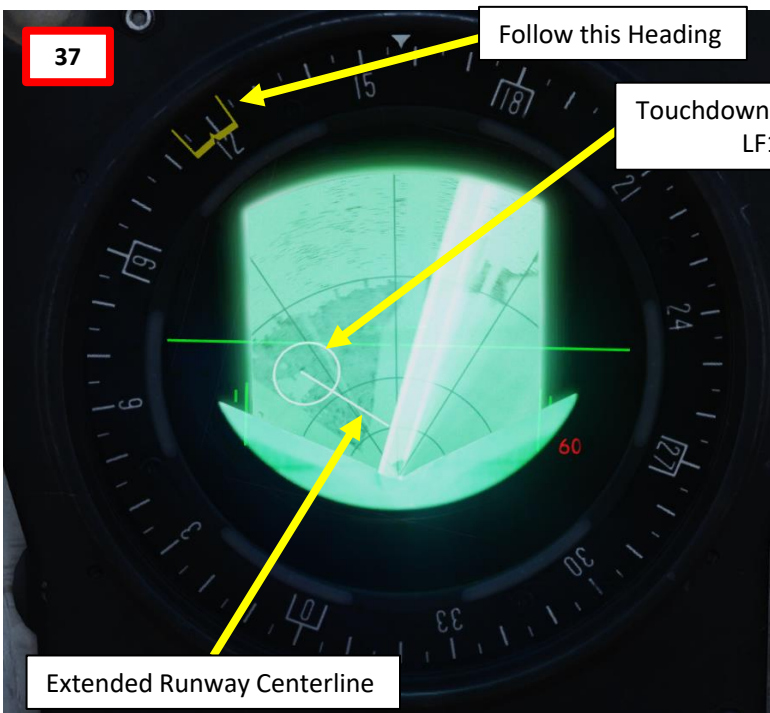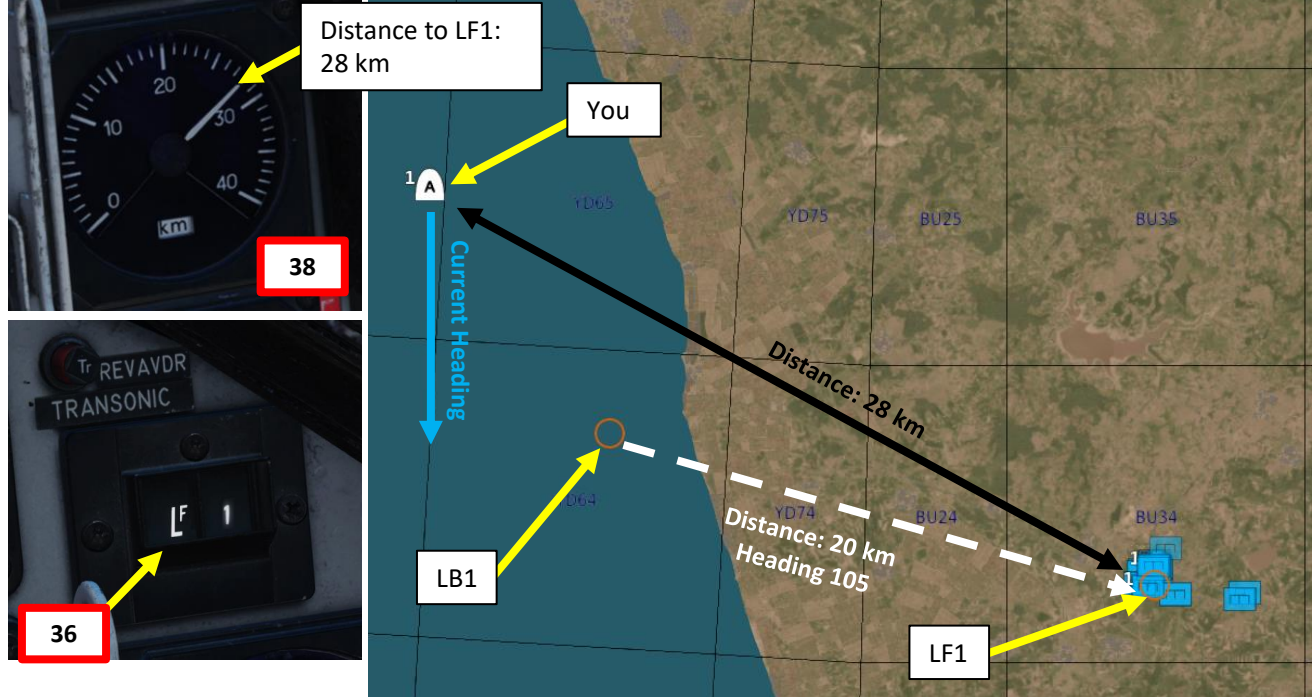
IV – ROAD BASE EXAMPLE
b) Instrument Approach (LANDNING NAV)

40. On the HUD, the commanded altitude should be 500 m until the "Time Line" appears on the HUD.
41. The "Time Line" appears 40 seconds before the descent command is given,
42. Descent command is given when aircraft is 10 km away from LF1 (Touchdown Waypoint), indicated by the time line reaching the outer markers.
43. Place your Flight Path Vector on the runway and line up the aircraft for the final approach.

Distance to LF1: 16 km
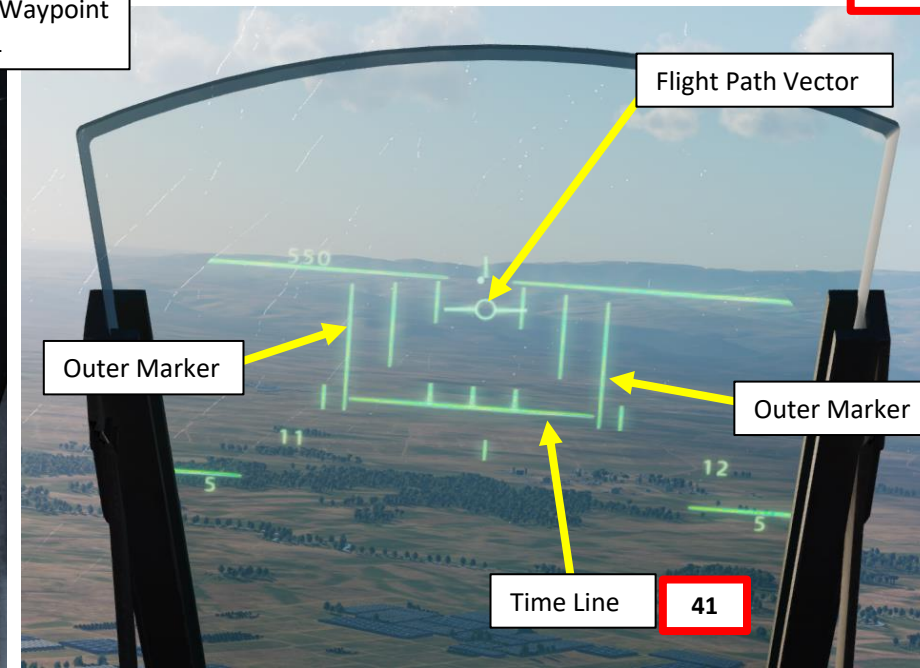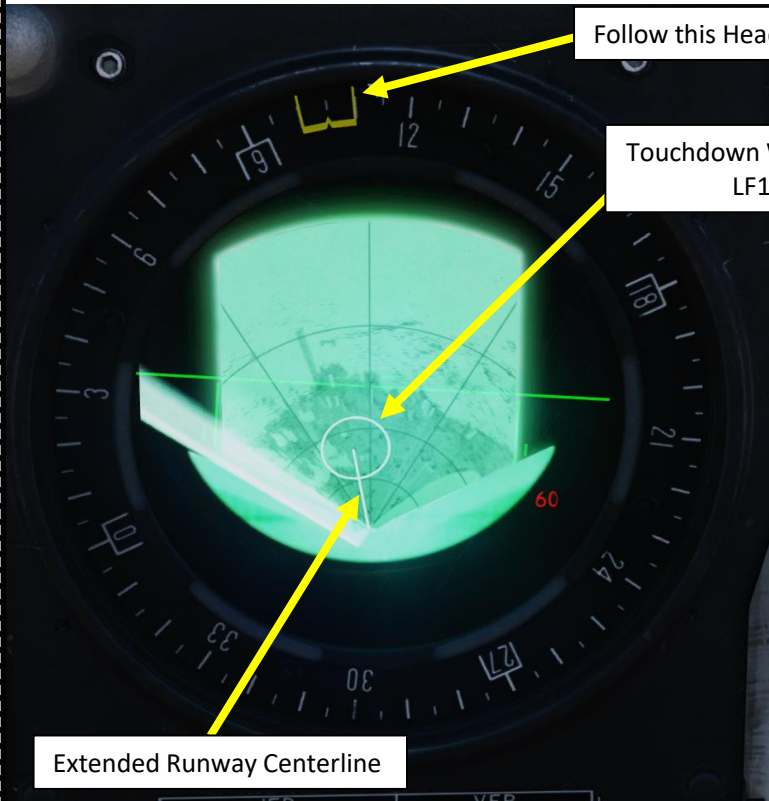
LF 1

LB1

You

¹A

YD64

YD74

BU24

BU34

Distance: 16 km
Heading 105

LF1

41

42

2.9 | 30

−5 | −5

40 s before descent

Descent

Follow this Heading

Touchdown Waypoint LF1

Extended Runway Centerline

Flight Path Vector

Outer Marker

Outer Marker

Time Line

41

Lateral Steering Line

120
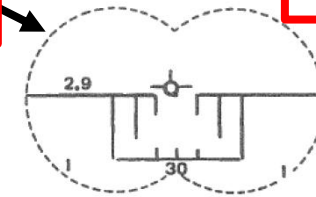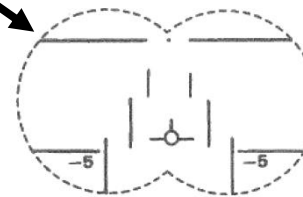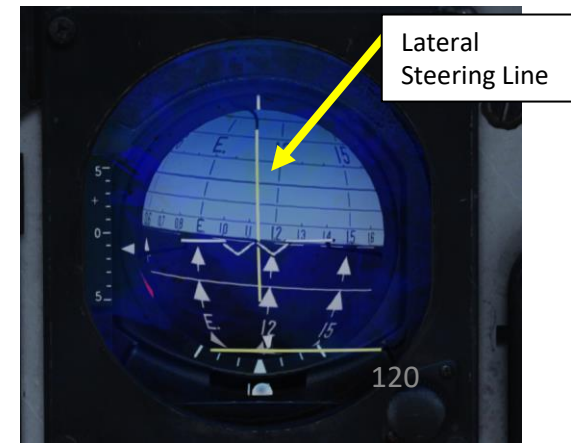
IV – ROAD BASE EXAMPLE
c) Normal Touchdown with Thrust Reverser

44. When on final, keep your Flight Path Vector on the runway
45. Maintain a MAXIMAL AoA (Angle of Attack) of 12 deg AoA and aircraft attitude by aligning the descent line on the runway threshold. This will give you a descent angle of 3 deg.
    - Note: Do not slow down under 260 km/h.
46. When the radar altitude is less than 15 m AGL (Above Ground Level), the Flight Path Vector changes function to a sink-rate indicator. If the flight path vector is held at the glide path line, the sink rate will not exceed 2.96 m/s. If the radar altimeter is not available, the mode engages at 30 meters altitude. Keep the Flight Path Vector above the lower horizontal line (glide slope line) to ensure a safe vertical speed and smooth touchdown.

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

45

Angle of Attack (deg)

Flight Path Vector

44

Flight Path Vector

46

In LANDNING NAV Master Mode, a glide path line is set at 2.87° below the horizon and represents the recommended glide path.
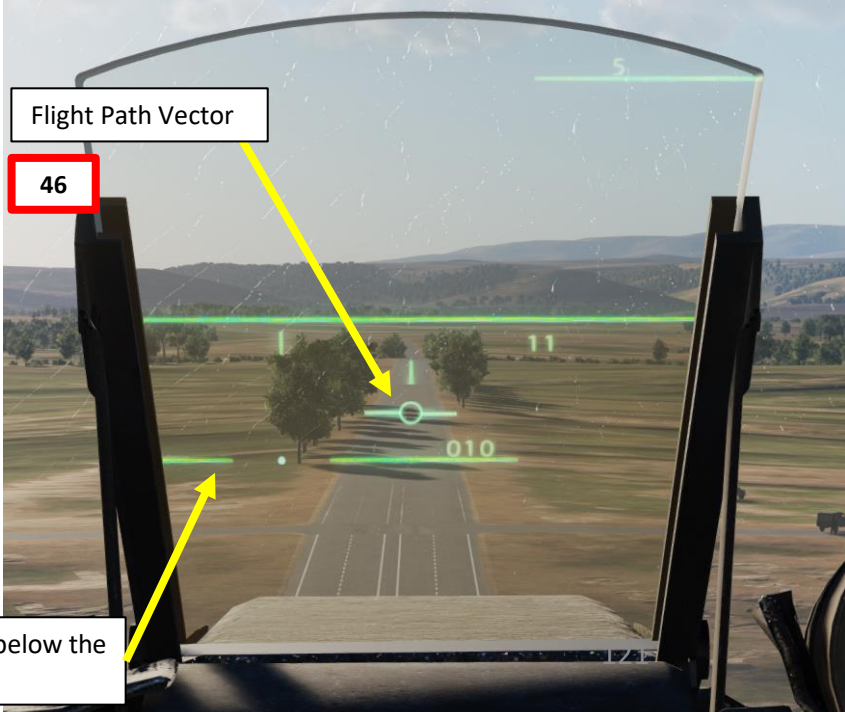
IV – ROAD BASE EXAMPLE
c) Normal Touchdown with Thrust Reverser

47. Prior to touchdown, verify that the thrust reverser lever is ARMED (pulled) and the REV light is illuminated (indicates reverser circuits are active).
48. On touchdown, throttle back to IDLE and resist the urge to pull on the stick. Let the aircraft gently touch the ground by itself.
49. As your main landing gear wheels touch the ground:
     • The autothrottle will automatically disengage.
     • The reverser flaps will close when the main landing gear is depressed but will open again until the nose landing gear is depressed.

47 Armed

122
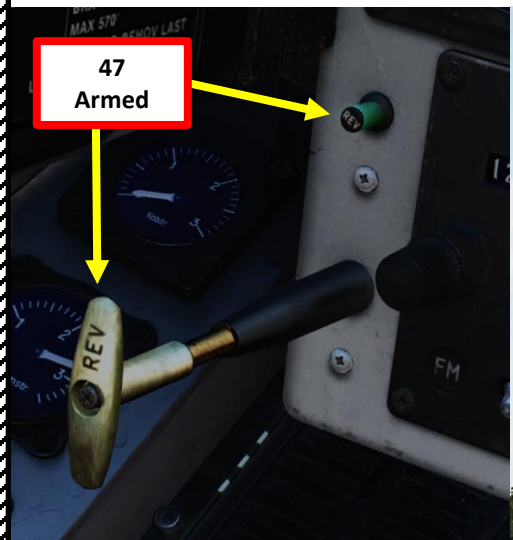
IV – ROAD BASE EXAMPLE
c) Normal Touchdown with Thrust Reverser

50. When your nose landing gear wheel will touches the ground, the thrust reverser flaps will deploy/engage and the thrust reverser system will produce reverse thrust.
    - If thrust reverser is engaged, throttling up will increase REVERSE thrust, which will slow you down even more.
    - Afterburner may not be used during reversal, as this would cause extensive damage to the aircraft.
    - Use of thrust reversal with a large amount of thrust combined with heavy braking will deteriorate the yaw stability of the aircraft.
51. When reversing, **do not apply the brakes** until the aircraft has come to a full stop, as this may cause the aircraft to pivot backwards.
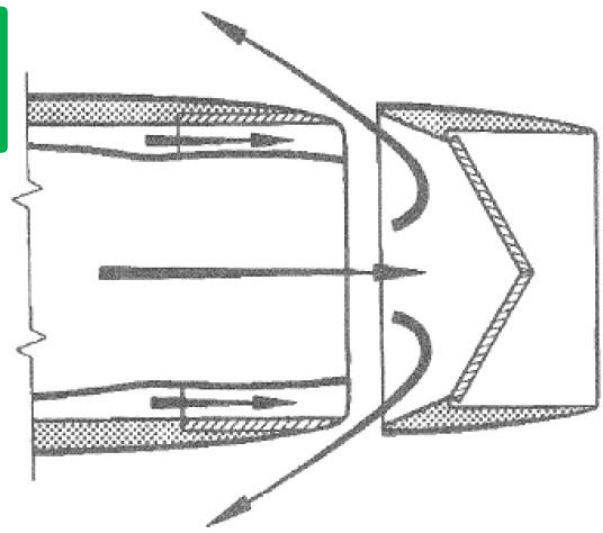
Thrust Reverser System (seen from above)

IV – ROAD BASE EXAMPLE
c) Normal Touchdown with Thrust Reverser

52. During reversal, a special autopilot mode is engaged (provided SPAK is engaged) which automatically applies rudder input to maintain stability.
53. When the REV AVDR / TRANSONIC light illuminates, reduce thrust by gently throttling back to IDLE. This indicator light tells you to REDUCE THRUST.
    • This reduces the risk compressor stalls by ensuring the exhaust gases ejected forward are not ingested by the engine intake, which can potentially cause an engine flameout.
54. Push thrust reverser lever IN to DISARM the thrust reverser. Make sure the REV light extinguishes (indicates reverser circuits are inactive).
55. Taxi back to the parking spot.

54 Disarmed

V – FLIP-FLOP
(Short Approach)

The pilot can choose a short approach by selecting the touchdown point as a destination manually before the landing waypoint LB is selected. This is what we call a "Flip-Flop" approach.

The Touchdown Point (LF1) is selected by moving the Master Mode selector from mode LANDN NAV to LANDN P/O and back to LANDN NAV (a so called "flip-flop"), resulting in a steering command onto the extended runway centerline.

Master Mode
LANDN NAV

Master Mode
LANDN P/O
(Flip!)

Master Mode
LANDN NAV
(Flop!)

L1
Primary Landing Base

LF1
Touchdown Waypoint

LANDN NAV
LB selected

Overhead pass,
NAV. L selected

LANDN NAV- P/O -
LANDN NAV
LF selected

Short Approach (Flip-Flop)
LANDN NAV -> P/O -> LANDN NAV

LF Selected

10 km

LANDN NAV
LB selected

Direct approach

L8

20 km

NAV
L selected

Approach Circle
(Direct Approach)

LB1
Approach Waypoint

125
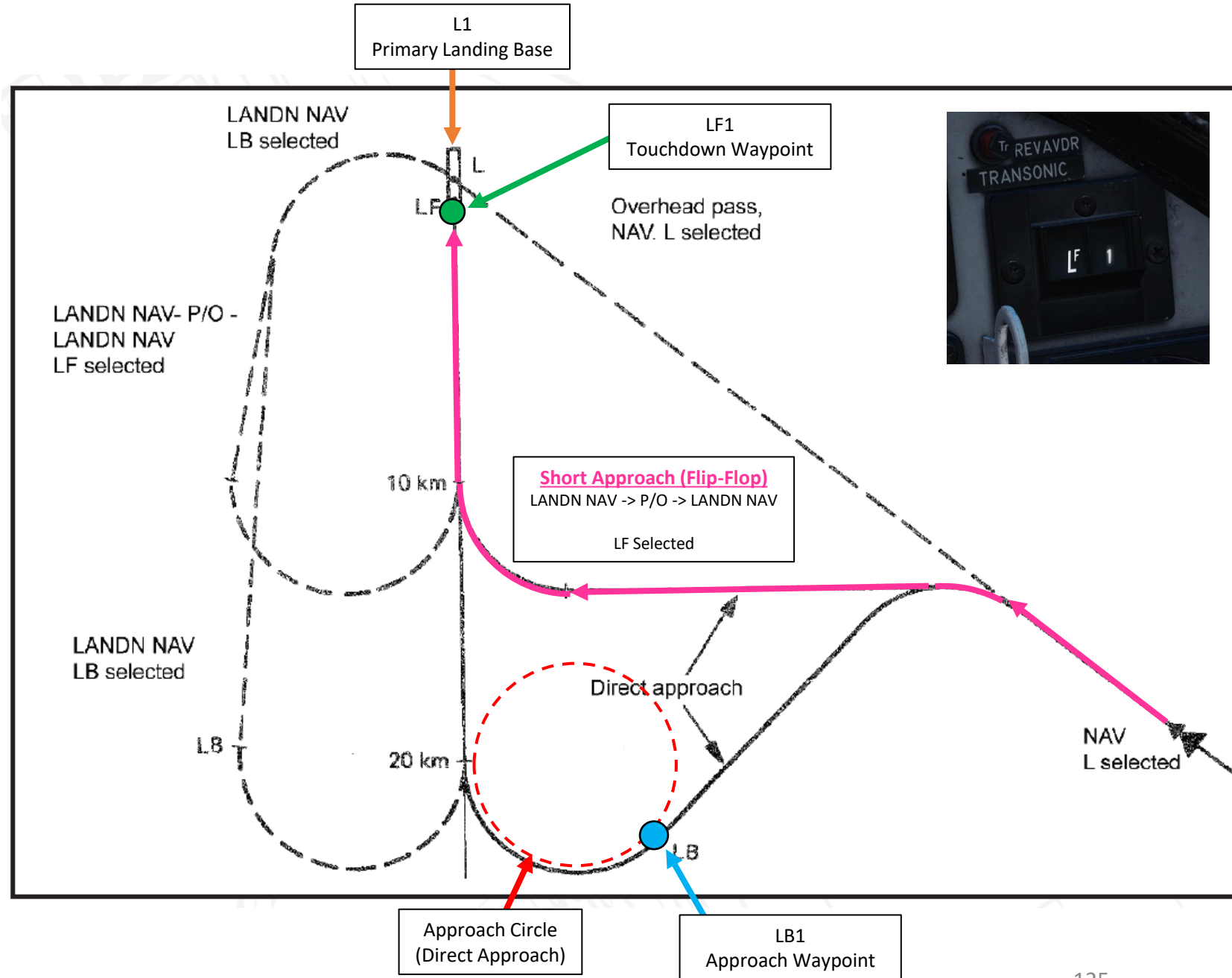
VI - AFTER LANDING

After Landing

a) Once you have landed and come to a full stop, set Master Mode Selector to BER (*BEREDSKAP*, STANDBY). This essentially resets the aircraft back to data entry and takeoff configuration after the sortie. It also puts the radar in STANDBY mode, and the ELINT report also gets compiled.

b) Failing to reset Master Mode to BER might cause issues in subsequent sorties like automatic waypoint functionality or the altitude warning light constantly illuminating (lights in case of a computer or flight data unit error).
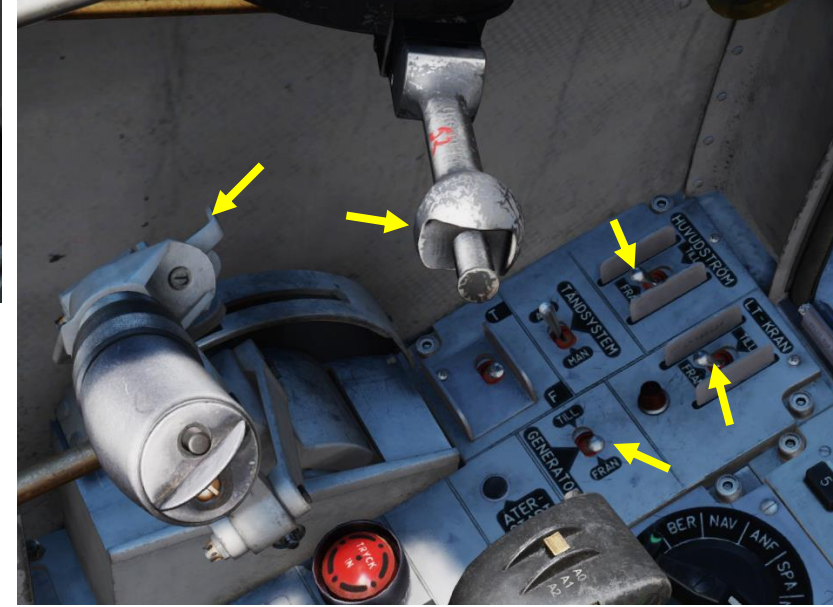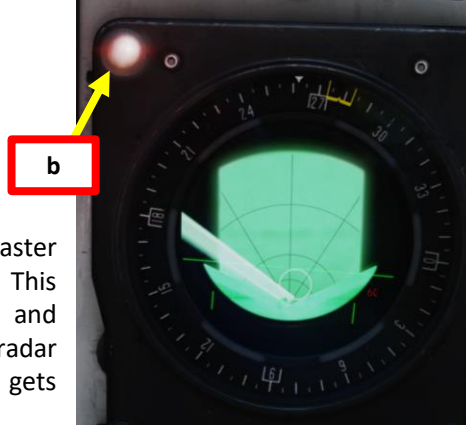
Shutdown Procedure

1. Ejection Seat – SAFE
2. AFK (Autothrottle) Lever – OFF (UP)
3. Generator Switch – OFF
4. Avionics and other systems (RWR, External Lights, etc.) – OFF
5. Oxygen – OFF
6. Low Pressure Fuel Valve (LT-KRAN) – F (OFF)
7. Canopy – OPEN
8. Main Power – OFF
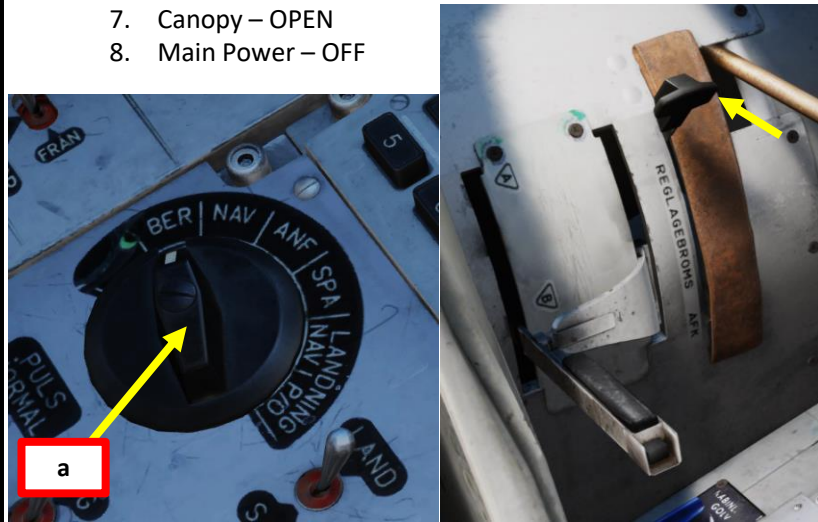
Introduction – The Volvo RM8A Engine

The RM8A (*ReaktionsMotor* 8A) is a licensed-built version of the Pratt & Whitney JT8D-22 airliner engine, heavily modified for supersonic speeds, with a Swedish-designed afterburner. It was produced by Svenska Flygmotor (later known as Volvo Aero). Since the original engine was constructed for subsonic speeds, most parts of the engine had to be re-dimensioned for the higher Mach-speeds in a military aircraft. Fans and turbine were altered, a new burn-chamber designed with a totally new fuel-control system for both engine and afterburner. The power of the engine allows the Viggen to reach speeds of Mach 2.

RM8A Engine Data
- Overall pressure ratio: 16.5:1
- Bypass ratio: 0.97:1
- Thrust Military power (Max dry): 65.6 kN static thrust,
- Thrust Max afterburner Zone III: 115.6 kN static thrust
- Thrust to weight ratio: 5.4:1
- Fan stages: 2
- Low-pressure compressor stages: 4
- High pressure compressor stages: 7
- Combustion chambers: 9

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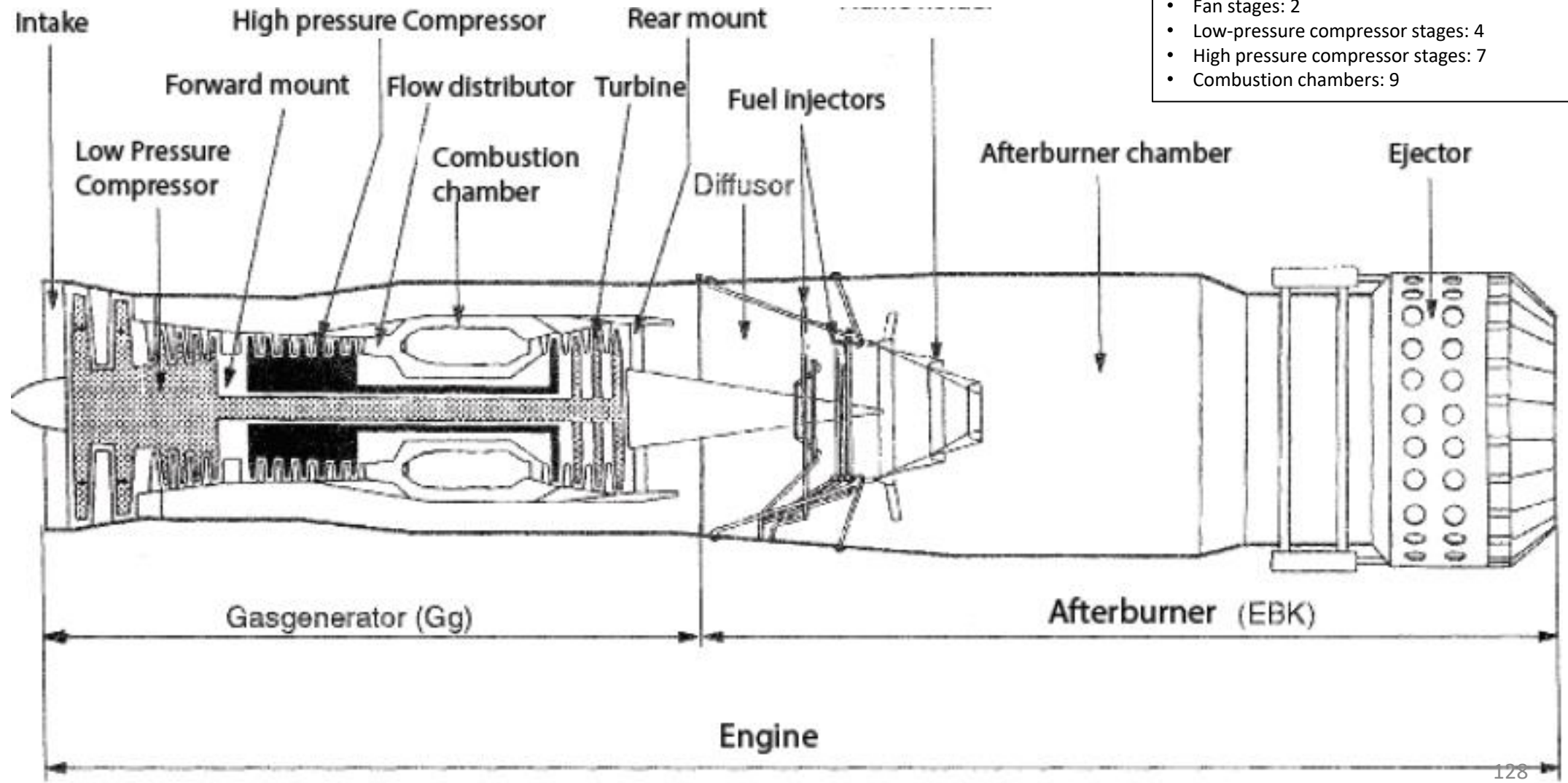
Engine Indications & Parameters

Here is an overview of engine parameters.

Thrust Reduce (REV AVDR) / Transonic Warning Light

Engine N2 (High-Pressure Turbine) RPM Indicator in % (*Varv*)

Afterburner Stage Indicator

Engine Nozzle Position Indicator (Shown: Afterburner Stage 3)

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

Engine Pressure Ratio (EPR) Indicator (Pt7/Pt2, or ratio between engine intake and exhaust pressures)
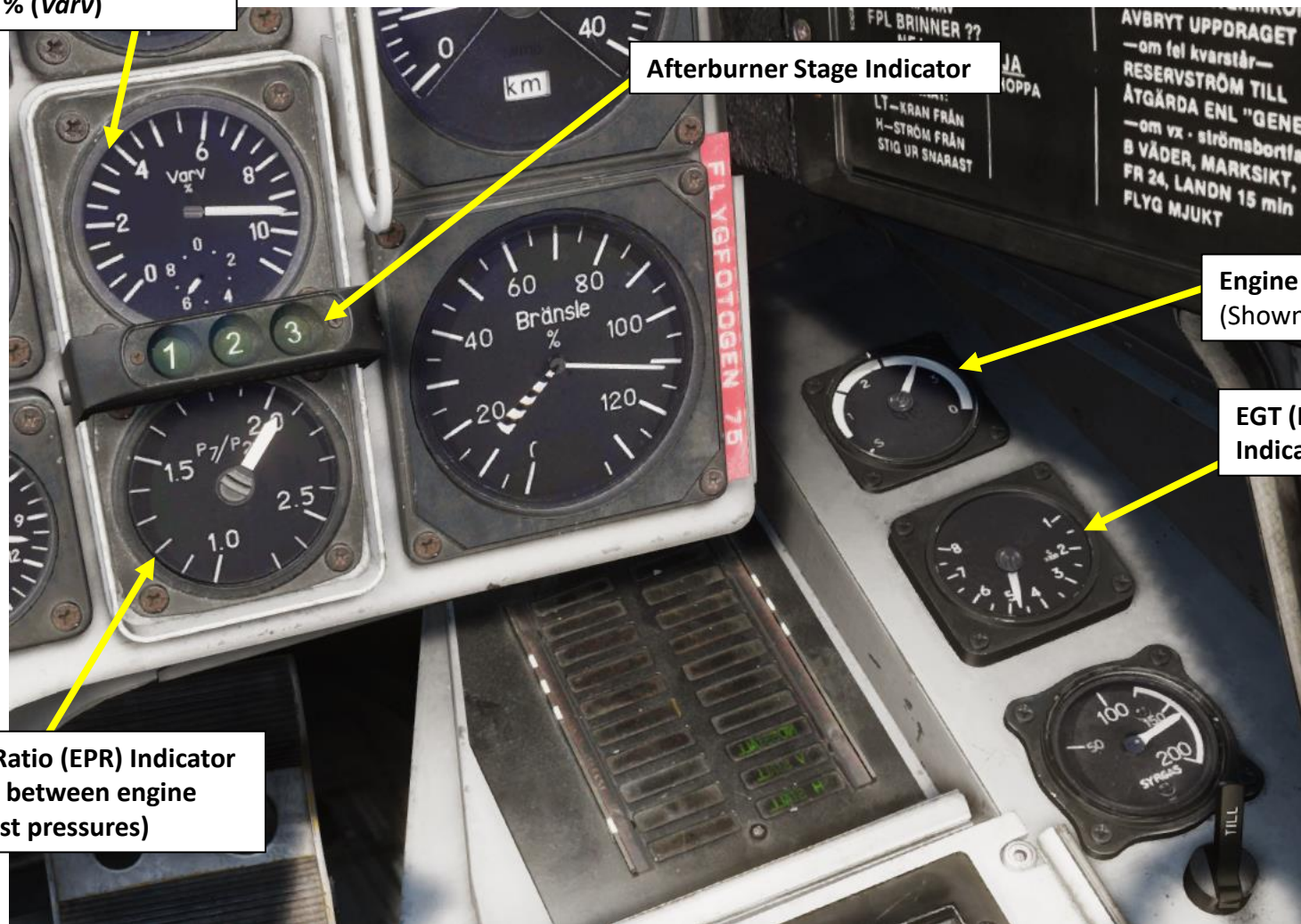
Engine Controls

Here is an overview of engine controls.

Autothrottle (AFK, or *Automatisk Fart Kontroll*) Quick Disconnect Button / Infrared Missile Quick Select Button
(In Front of Throttle, Not Visible)

High Pressure Fuel Valve Switch
- Only selectable when throttle is in IDLE or OFF position

Starter System Switch
- **T**ILL: ON / **F**RÄN: OFF

Ignition System Selector Switch (*TÄNDSYSTEM*)
- MAN: Manual / AUT: Automatic

Engine Restart Button (*ATERSTART*)

Engine Settings

The Viggen throttle is divided into 5 main "zones".

- **OFF**: Throttle is behind a detent, high pressure fuel valve is off. In order to advance the throttle, a small catch on the left side of the handle has to be lifted.
- **Ground idle**. Lowest possible RPM, High pressure fuel valve on.
- **In-flight idle**. Low RPM setting, but high enough to avoid to an excessively long spool up time while airborne.
- **In-flight idle to Military power** (max dry thrust).
- **Afterburner zones 1, 2, and 3**.

Afterburner Stage/Zone Indicator Lights

Thrust Setting Table

Thrust Setting	Core RPM 100 % = 12278 RPM		Thrust	Specific Fuel Consumption	Nominal Exhaust Gas Temperature	Pt7/Pt2 (Pressure Ratio)
	RPM	%	kN	kg/s	deg C	-
Full Zone 3 Afterburner	11950	97.3	115.6	8.253	600	2.06
Full Military	11850	97.3	65.6	1.167	570	2.04
In-Flight IDLE	9080	97.3	14.3	0.267	380	1.21
Ground IDLE	7250	97.3	3.2	0.122	280	1.02

Note: Values will vary with air pressure and ambient temperature and airspeed.

Full Zone 3 Afterburner (AFB)
Zone 3 Afterburner (AFB)
Zone 2 Afterburner (AFB)
Zone 1 Afterburner (AFB)
Full Military Power (MAX)
In-Flight IDLE
Ground IDLE
Throttle OFF

Throttle Positions

⊥ = Detent
= "Soft" detents for throttle positions

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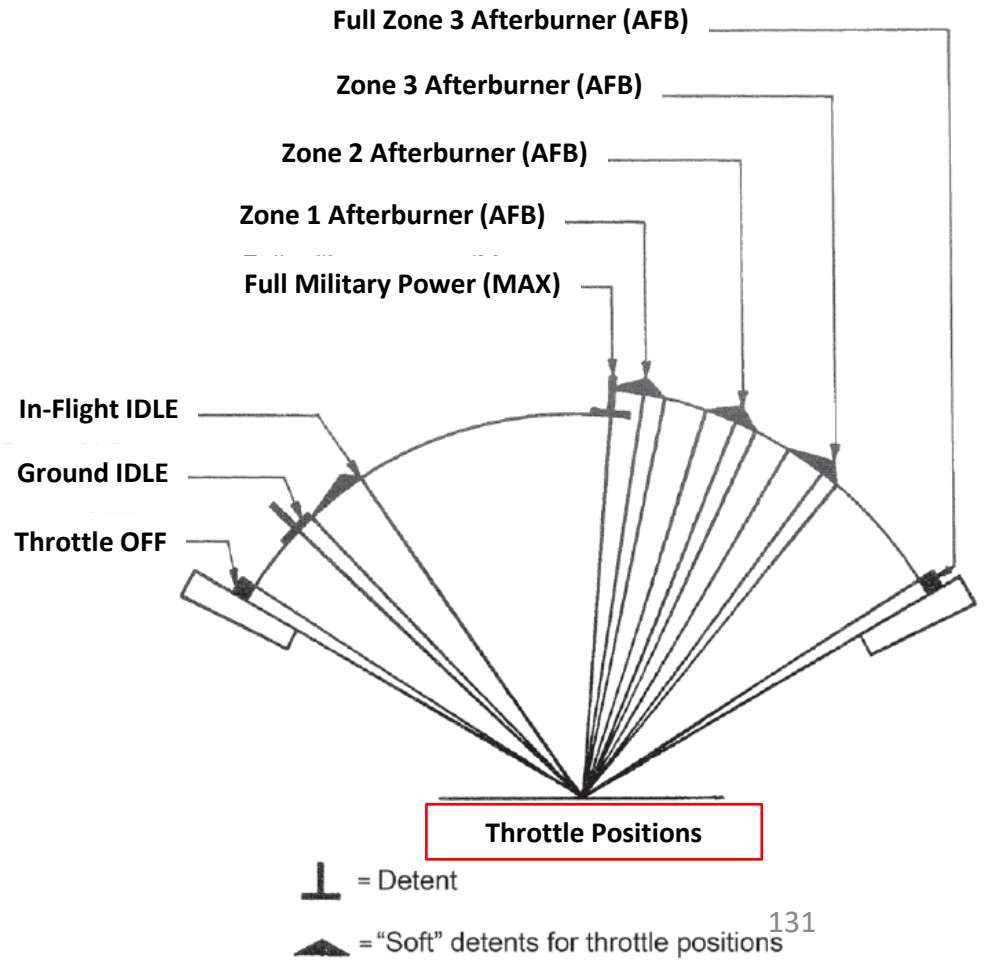
Engine Limits

Here is a summary of engine limitations.

- Maximum Exhaust Gas Temperature: 600 °C.

- Inverted flight is not limited by fuel but rather the engine lubrication system to 10 seconds. Full afterburner is possible during those 10 seconds. The warning OLJETRYCK will appear to indicate low oil pressure after a few seconds of flight with negative G-loads. Failure to restore a positive G-load and engine lubrication may cause engine damage.

OLJETRYCK Caution

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

Afterburner

The afterburner has three distinct zones: 1, 2, and 3. You engage the afterburner by throttling past the afterburner detents past the Full Military Power detent.

- The selected afterburner zone is indicated on the right side of the instrument panel.
- The actual nozzle position is indicated by the nozzle indicator on the right front side panel.

Each zone has a small amount of movement and thrust regulation within it, while still remaining distinct. The third zone has the highest amount of throttle travel to allow smaller adjustments of thrust.

Engine Nozzle Position Indicator
(Shown: Afterburner Stage 3)

Full Zone 3 AFB
Zone 3 AFB
Zone 2 AFB
Zone 1 AFB
Full military power (Max
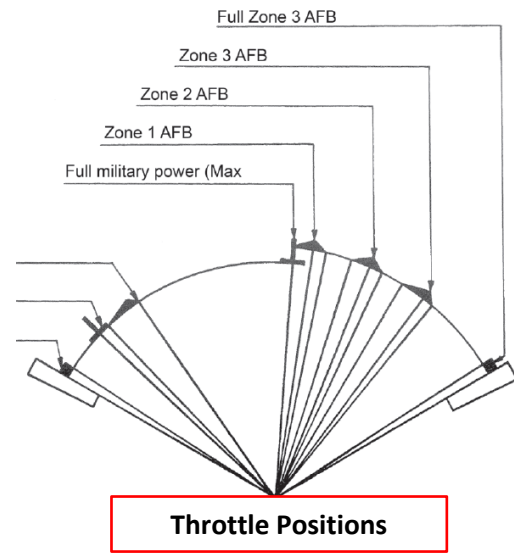
Throttle Positions

Afterburner Stage/Zone Indicator Lights
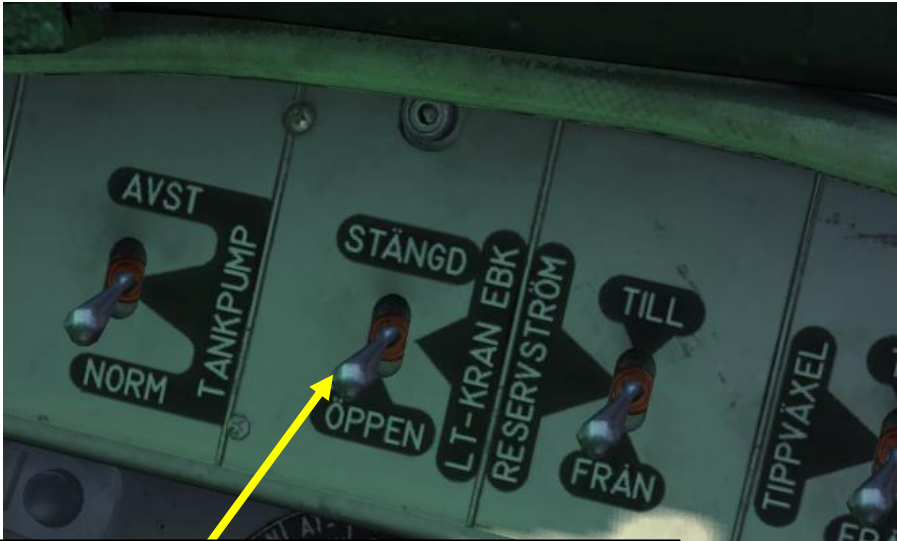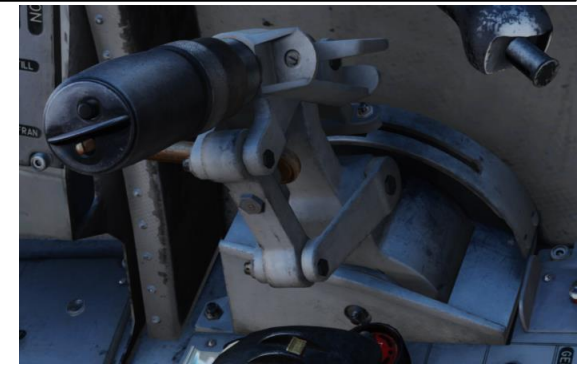
Manual Afterburner Fuel Regulator (LT-KRAN EBK)
- STÄNGD = CLOSED
- ÖPPEN = OPEN

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Thrust Reverser

The thrust reverser is used during landing to direct the thrust forward to significantly shorten the landing distance. The reverser claps close the ejector and instead direct the exhaust forwards and slightly downwards through three slits in the ejector assembly.

The **thrust reverser flaps will close when the right main landing gear is depressed if reversal is pre-selected (done by pulling the REV handle)**. To avoid reversing in an unstable attitude, the reverser flaps will open again after 1 second unless the nose landing gear is compressed. The reverser system will reengage when the nose gear is compressed again. In order to achieve the shortest distance possible, the nose gear should touch the ground as soon as possible after touch down with the main landing gear.

The reversal system is **engaged by pulling the Thrust Reverser (REV) handle**. Pulling the handle while airborne will pre-select reversal.

When the **REV AVDR / TRANSONIC** light illuminates, reduce thrust by gently throttling back to IDLE. This indicator light tells you to REDUCE THRUST. This reduces the risk compressor stalls by ensuring the exhaust gases ejected forward are not ingested by the engine intake, which can potentially cause an engine flameout.
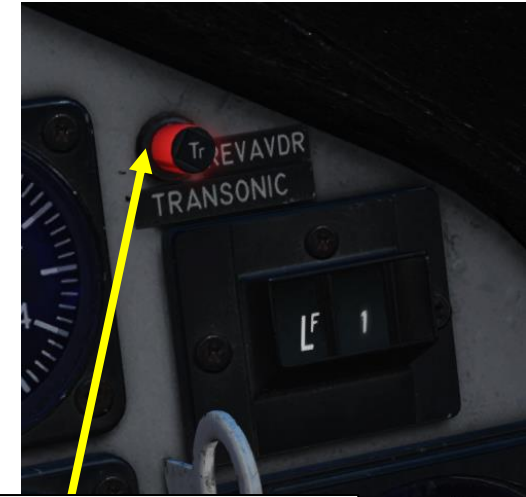
Thrust Reduce (REV AVDR) / Transonic Warning Light

Thrust Reverser Light
- Illuminated = Reverser Circuits are active

Thrust Reverser Handle
- PULLED = Armed/Deployed
- PUSHED = Stowed

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Thrust Reverser

When using the thrust reverser, the throttle function as normally. Due to the thrust being directed partially downwards behind main undercarriage, effectively turning into a fulcrum, the nose will be pressed against the ground. This is to maintain stability, but requires the pilot to pull back on the control stick proportional to the amount of thrust used. In other words, **the further the throttle is moved forwards, the further back the control stick is needed to be pulled in order to lessen the pressure on the nose-gear**. Failure to do so may lead to increased instability as the weight on the rear wheels are reduced during very heavy braking.

Note: Afterburner cannot not be used during thrust reversal as this would cause extensive damage to the aircraft. The fuel flow to the afterburner is inhibited during reversal, disabling the afterburner while the reverser is in use.
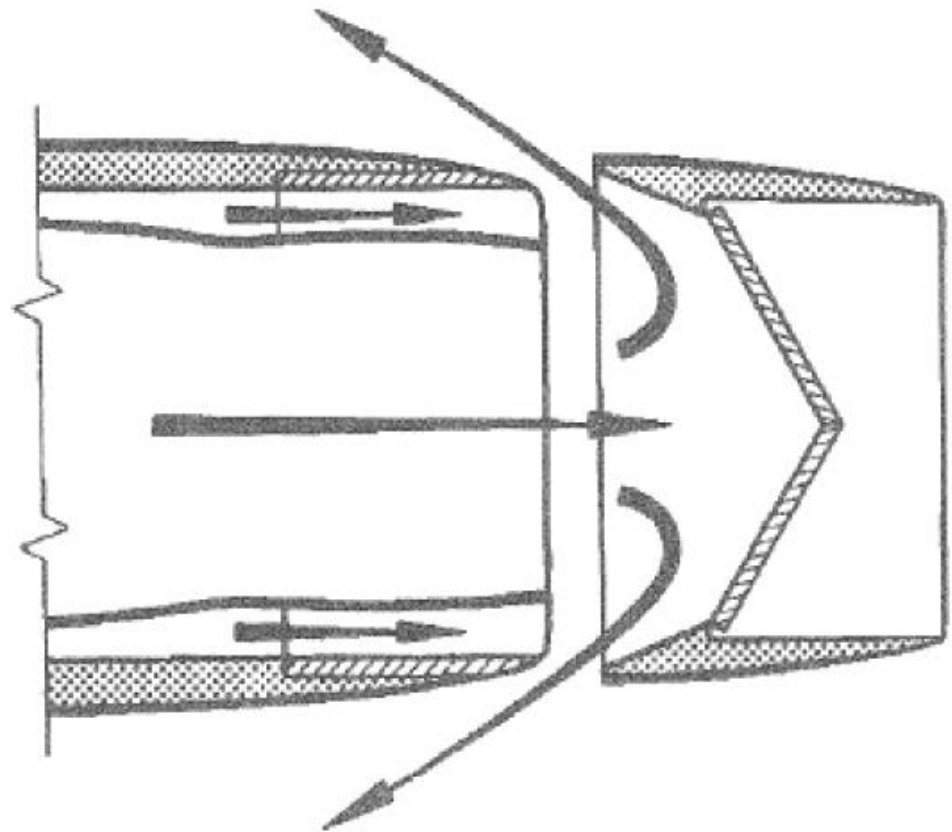
Thrust Reverser System (seen from above)
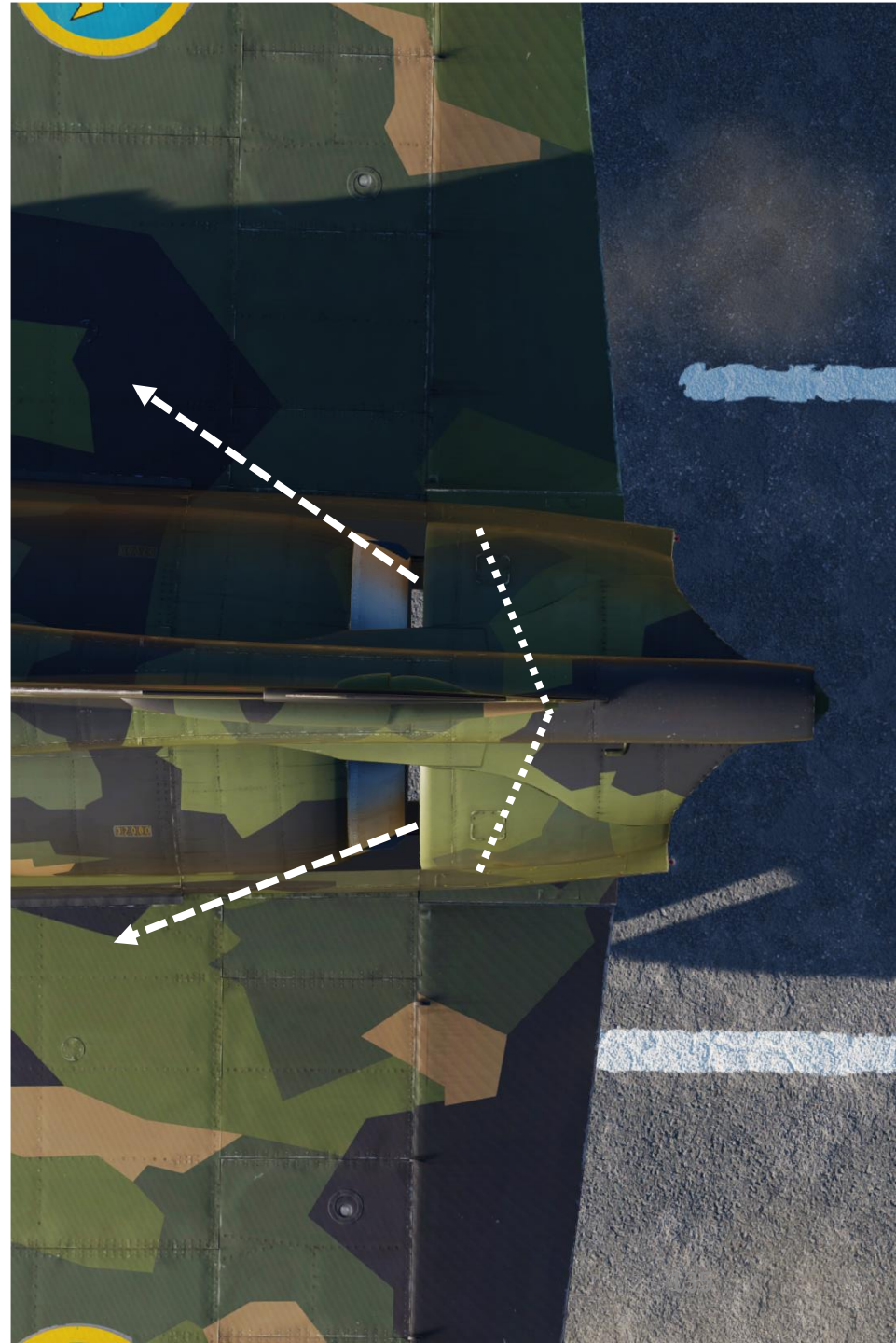
Autothrottle (AFK, *Automatisk Fart Kontroll*)

The Autothrottle (AFK, or *Automatisk Fart Kontroll*) is an automated throttle control system.

Engaging AFK:
- The AFK is manually engaged / disengaged by moving the AFK control lever next to the landing gear handle (far left in cockpit). Moving the lever to the ON position will engage the AFK.

AFK is manually disengaged if:
- The AFK can also be quickly disengaged by pressing the AFK fast disconnect button on the throttle. This will cause the AFK FEL indicator light on the left indicator panel to be lit with a solid glow.

AFK is automatically disengaged if:
- The Main Landing Gear wheels are depressed (touching the ground) or
- You set the Autothrottle lever in the OFF position or
- You push the throttle to afterburner or
- You press the "IR-Missile Fast Select/AFK Disconnect" [LALT+LCTRL+S] button on your throttle

AFK Afterburner Restriction:
- The AFK cannot engage the afterburner. If the afterburner is engaged by the pilot, the AFK is automatically disengaged.

Autothrottle (AFK, or *Automatisk Fart Kontroll*)
- UP: OFF
- DOWN: ON
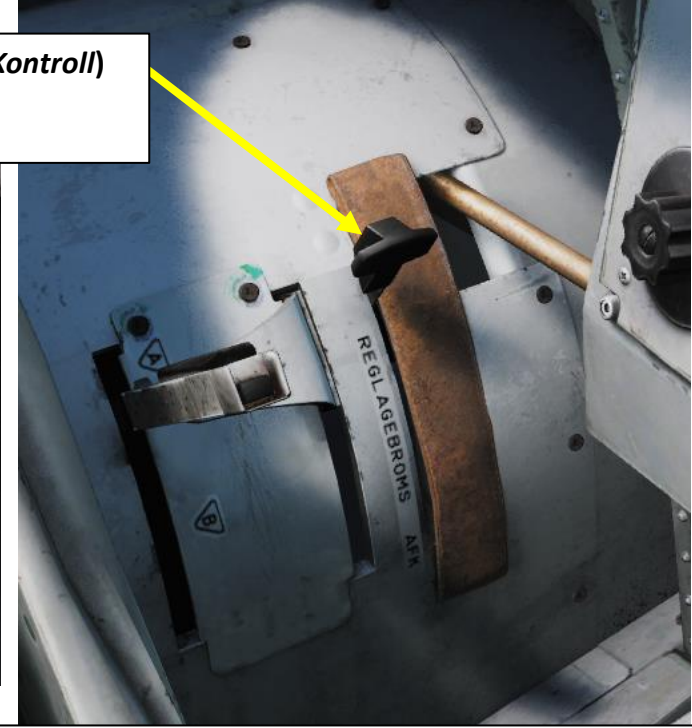
AFK FEL Light

Autothrottle (AFK, or *Automatisk Fart Kontroll*) Quick Disconnect Button / Infrared Missile Quick Select Button *(In Front of Throttle, Not Visible)*

Autothrottle (AFK) Mode 3 α15.5 Selector Button
- Engages Autothrottle Mode 3, which will make the autothrottle adjust thrust to maintain an airspeed corresponding to an angle of attack of 15.5 deg at 1 G equilibrium. This is used when the shortest landing distance is required.

Autothrottle (AFK) Mode 3 α15.5 Indicator Light
- Illuminated once autothrottle Mode 3 is in use

Autothrottle (AFK) Light
- Illuminated once autothrottle is in use

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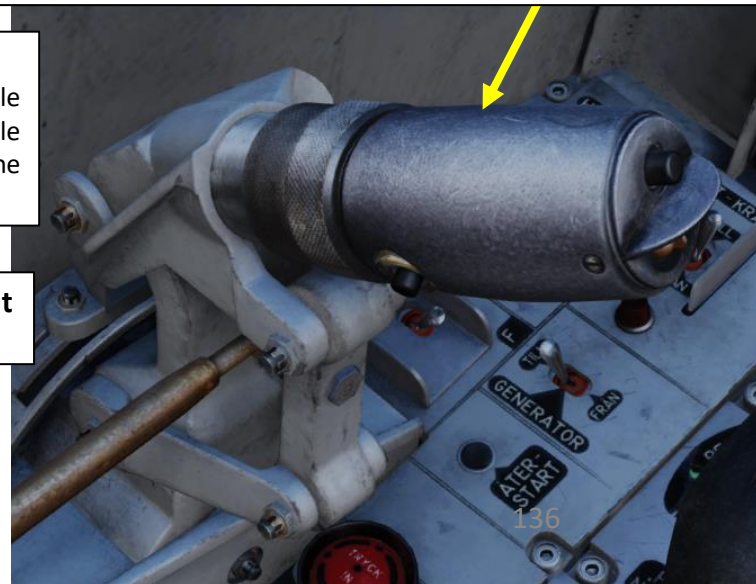
Autothrottle (AFK, *Automatisk Fart Kontroll*)

The AFK has three main modes:

Mode 1
Conditions:
1. Landing gear UP (IN)
2. AFK lever ON (DOWN)

The AFK will adjust the thrust to **maintain 550 km/h indicated airspeed**. This mode can be used beyond the landing phase to maintain a slower cruise airspeed. Combined with the Standard Turn mode of the autopilot, the plane will loiter.

Mode 2
Conditions:
a) Landing gear DOWN (OUT)
b) AFK lever ON (DOWN)

The AFK will adjust thrust to maintain an airspeed corresponding to an angle of attack (AoA or α) 12° at 1 G equilibrium.

Mode 3
Conditions:
a) Landing gear DOWN (OUT)
b) AFK lever ON (DOWN)
c) α 15.5 button ON.

AFK will adjust thrust to maintain an airspeed corresponding to an angle of attack of 15.5 at 1 G equilibrium. This is used when the shortest landing distance is required. Mode 3 can only be used with a very light aircraft (Fuel <40%) due to the high thrust to weight ratio required.
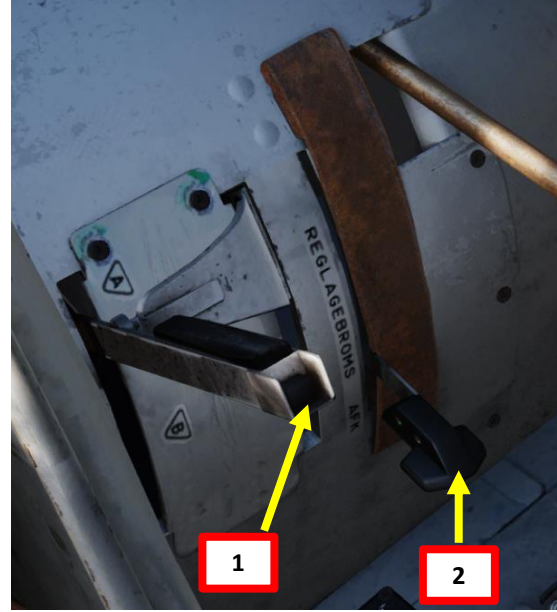
Autothrottle (AFK) Light
- Illuminated once autothrottle is in use
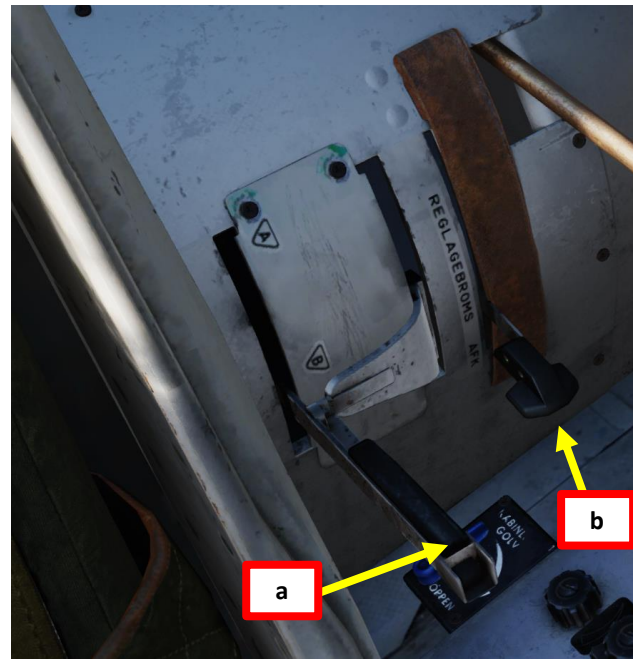
Autothrottle (AFK) Light
- Illuminated once autothrottle is in use

Autothrottle (AFK) Mode 3 α15.5 Indicator Light
- Illuminated once autothrottle Mode 3 is in use

Compressor Stall

The engine is susceptible to compressor stalls and surges during excessively rapid throttle movements, flight at high angles of attack and high altitude flight, or a combination thereof. A compressor stall is a disruption of airflow in the engine, often caused by a change in pressure or turbulent air into the engine. A compressor stall is often detected by a loud bang and/ or a temporary reduction in thrust.

A compressor surge is a more extensive form of a stall in which there is a complete disruption of airflow in the engine which can even lead to air and combusting fuel being propelled forwards out of the inlets! A surge may lead to either a flameout of the combustion chambers or even a catastrophic failure of the engine.

Please note the operating parameters and guidelines in the procedures section on how to avoid compressor surges. Emergency placards for recommended actions are mounted on the left side of the glare shield.

Compressor Stall Initiation
The engine is prone to compressor stalls and surges during:
- Excessively rapid throttle movements
- High angle of attack flight (18+ deg AoA)
- High altitude flight

Compressor Stall Recognition
Here are a few signs to recognize compressor stall. Recover quickly or risk having irreversible damage to your engine.
- Loud "Bang" sound
- Large fluctuations in Engine Pressure Ratio (EPR)
- Fluctuations in Engine N2 (High-Pressure Turbine Speed)
- Sudden loss of thrust

Compressor Stall Recovery
Here is the procedure on how to attempt to recover your engine in case of an engine compressor stall:
1. Recognize a compressor stall by a sudden loss of RPM and "bang" sounds.
2. Reduce AoA (angle of attack) and g-load
3. Maintain throttle at current position
4. If compressor stall persists, reduce throttle below afterburner.

Engine N2 (High-Pressure Turbine) RPM Indicator in % (*Varv*)

Engine Pressure Ratio (EPR) Indicator (Pt7/Pt2, or ratio between engine intake and exhaust pressures)

Engine Flameout – Air Engine Restart Procedure

If all else fails and you end up having an engine flameout, don't panic. Here's what you need to do:

1. Set throttle to Ground IDLE
2. Decrease altitude below 12 km altitude
3. Press the Engine Restart (ÅTERSTART) button for 2 seconds.
4. Set Manual fuel regulator (BRÄNSEREGULATOR) to MANUAL when flying under 9 km altitude.
5. If no RPM or EGT increase within 20 seconds, set the Engine start (TILL = ON) switch (normal engine start procedure).
6. If all else fails, eject as soon as possible. You're pretty much boned. ☺
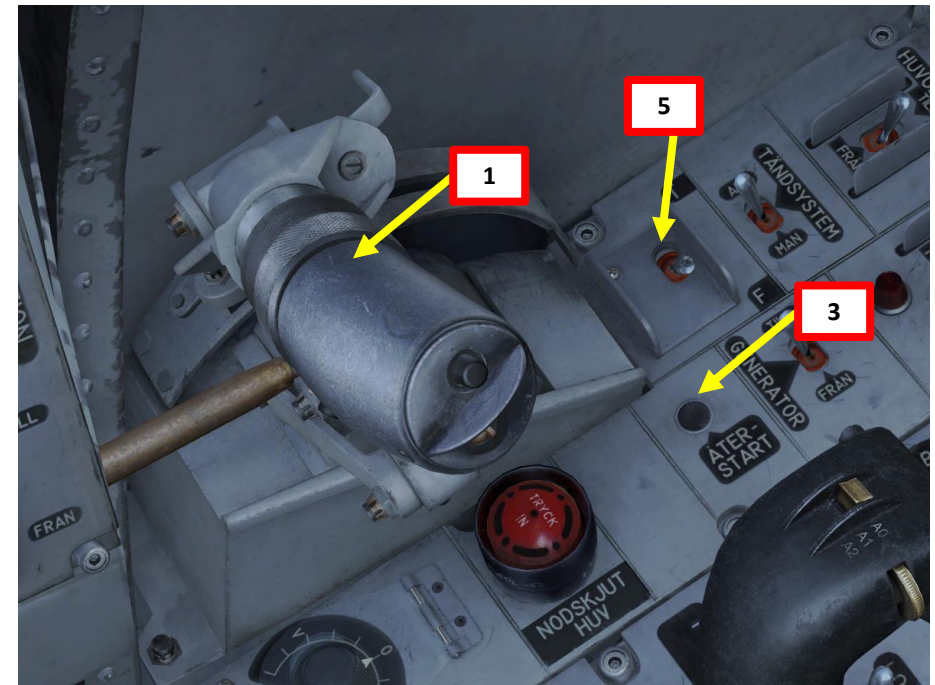
Engine De-Icing

In icing conditions the inlet can be heated to increase the temperature of the intake air in order to avoid ice build-up. The heating system is controlled by the engine Anti-Ice switch (AVISN MOTOR). Due to engine bleed air being tapped for this system, a slight thrust reduction of 1.5 – 3.5% can be expected.
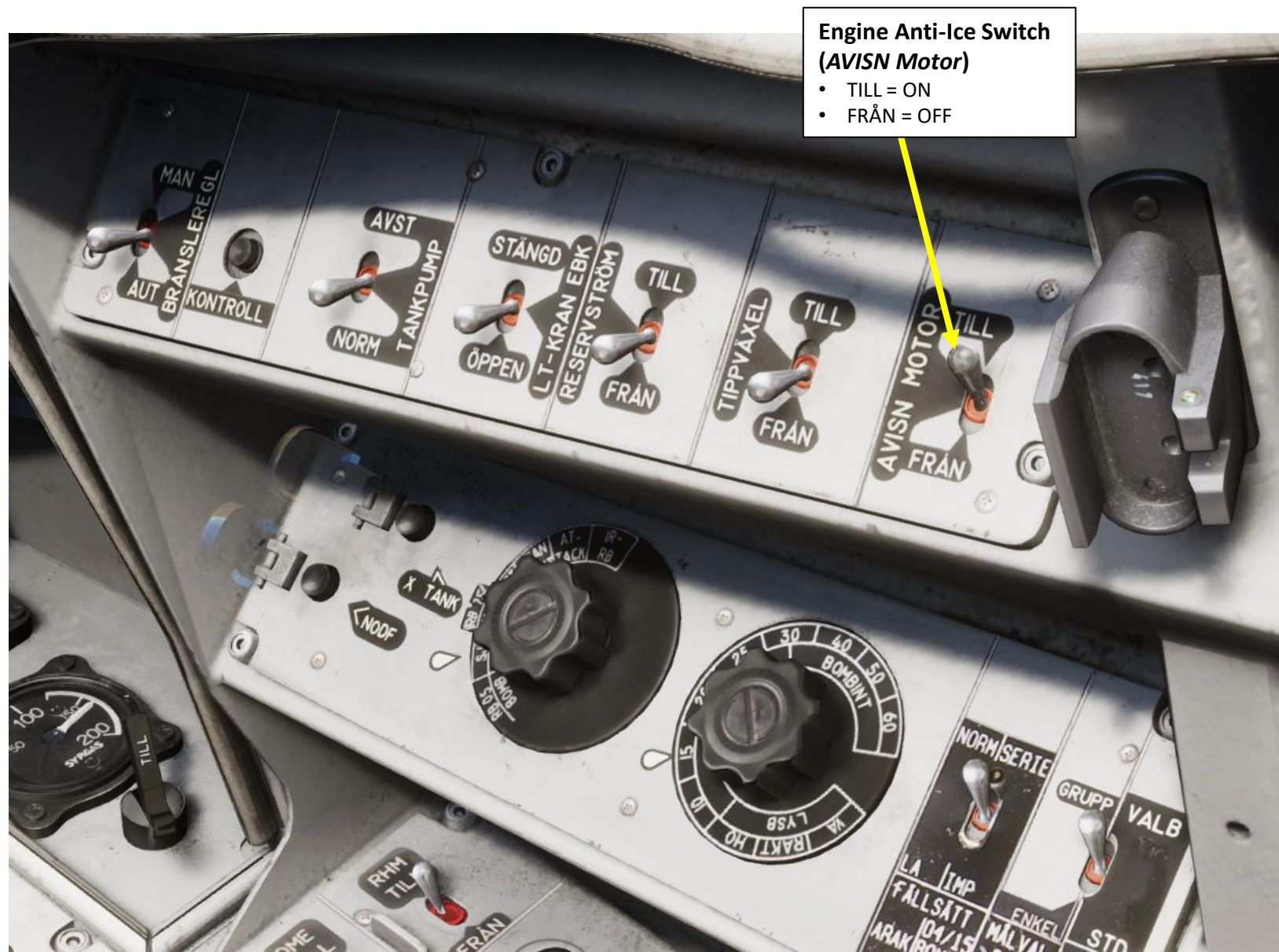
Engine Anti-Ice Switch (*AVISN Motor*)
- TILL = ON
- FRÅN = OFF

Engine Tertiary Air Hatch

The tertiary air hatch provides a small amount of extra thrust at low altitudes by acting as somewhat of a secondary bypass system. Additional air is pulled through the slits and join the compressed air stream. At higher airspeeds this slit is closed by the tertiary air hatch. The hatch opens and closes in about 5 seconds.

The hatch is closed if the following requirements are met;

- Airspeed is greater than Mach 0.65
- Landing gear lever position – Retracted (UP)
- Throttle is below Zone 2 Afterburner detent

Tertiary air hatch. Open / Closed (seen from above).

Open   Closed
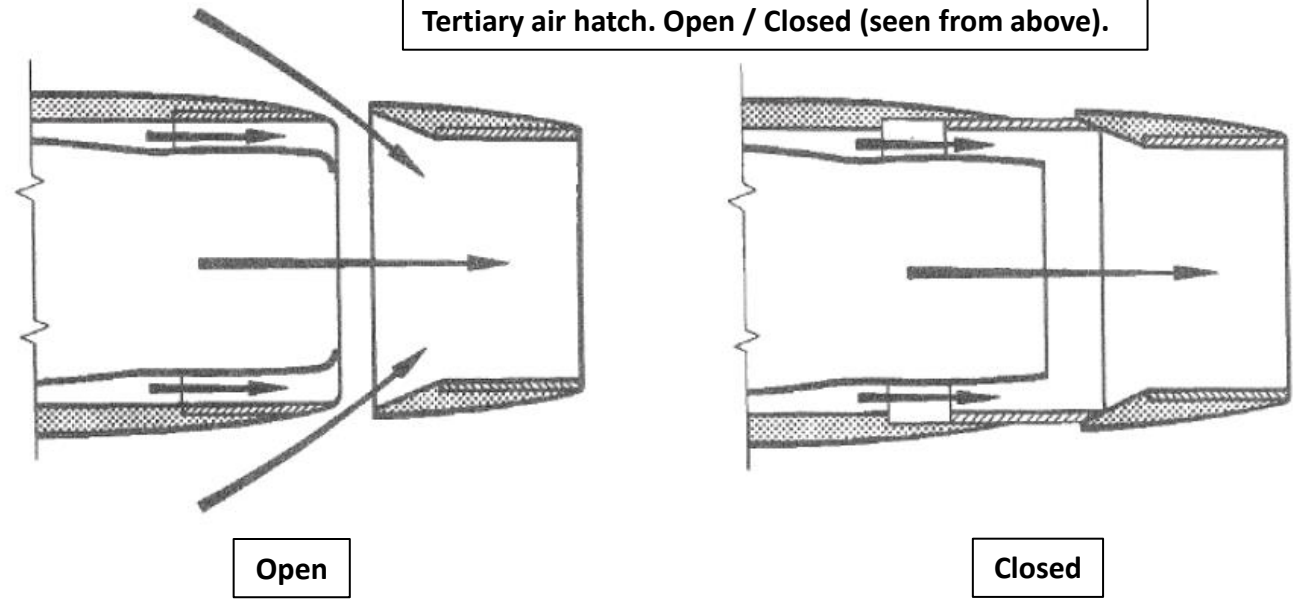
Fuel System Overview

The Viggen has an internal fuel capacity of 4476 kg (9868 lbs). An external fuel tank can be equipped, which has a fuel capacity of 1013 kg (2233 lbs).

The collector tank (No. 1) at the upper center fuselage is the largest of the internal tanks. All fuel to the engine passes through this tank. The tank is divided into a forward and a rear part, each containing about 2 % fuel. The rear has two fuel recuperators, allowing 10 seconds of negative-g flight with full afterburner at low altitude.

Note: 10 seconds is the time limit for the engine lubrication system.

Internal fuel 5525 L = 103.0 % ± 5%
Internal + External drop tank (1250 L) = 127.5% ± 5%.
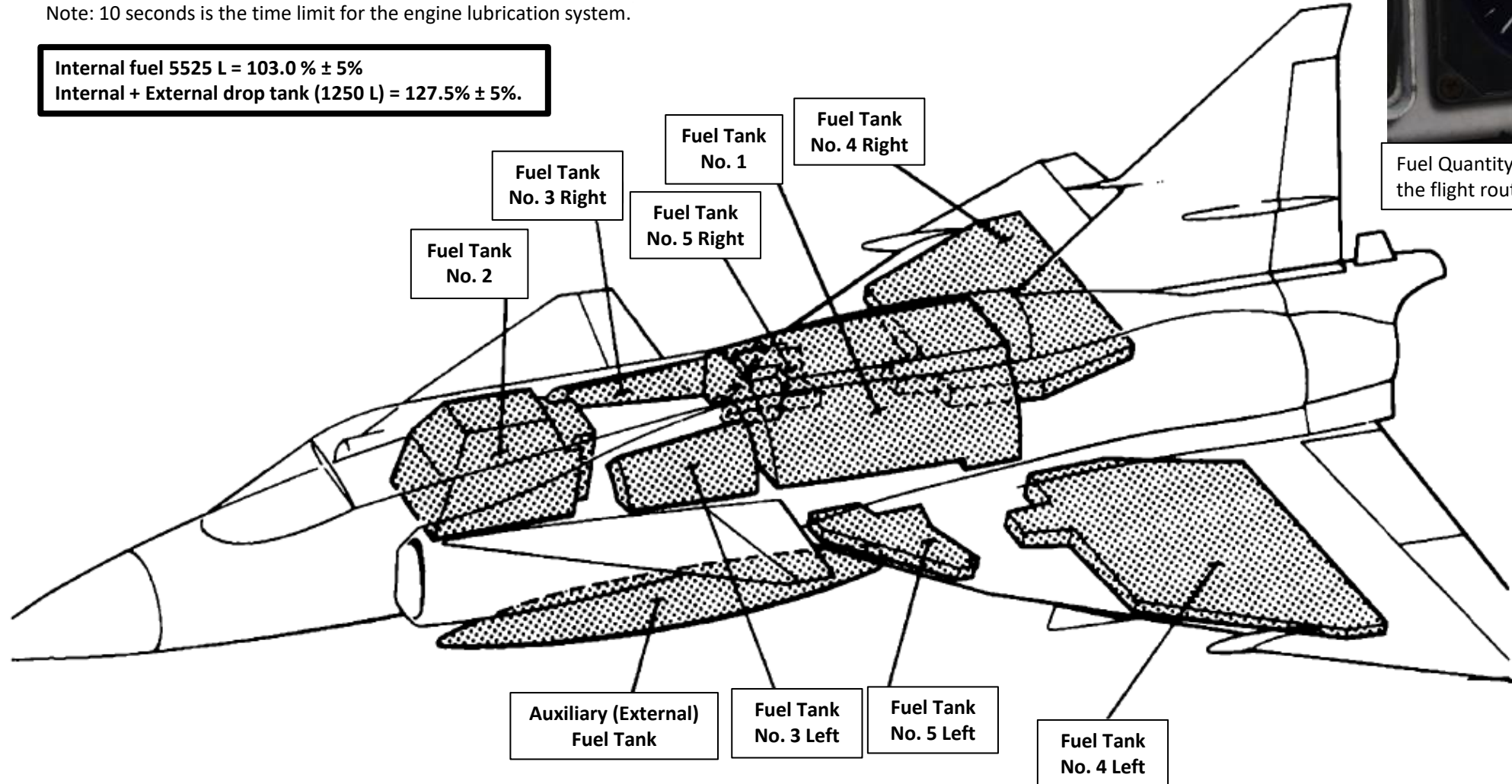
Fuel Quantity Indicator (*Bränsle*)
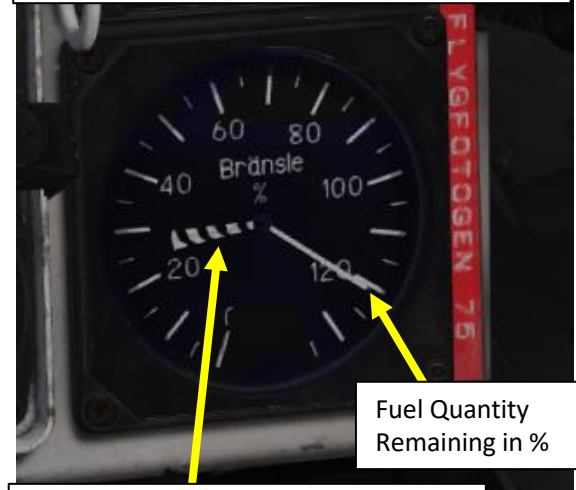
Fuel Quantity
Remaining in %

Fuel Quantity Required to complete
the flight route as planned in %

Fuel Tank
No. 4 Right

Fuel Tank
No. 1

Fuel Tank
No. 3 Right

Fuel Tank
No. 5 Right

Fuel Tank
No. 2

Auxiliary (External)
Fuel Tank

Fuel Tank
No. 3 Left

Fuel Tank
No. 5 Left

Fuel Tank
No. 4 Left

Fuel System Overview

The fuel pumps are AC powered and controlled by the low pressure fuel valve switch LT-Kran (ON / OFF) on the engine panel and tank pump switch TANKPUMP (NORM / OFF) on the right wall console. The afterburner low pressure fuel valve is controlled by the switch LT-KRAN EBK on the right wall console.
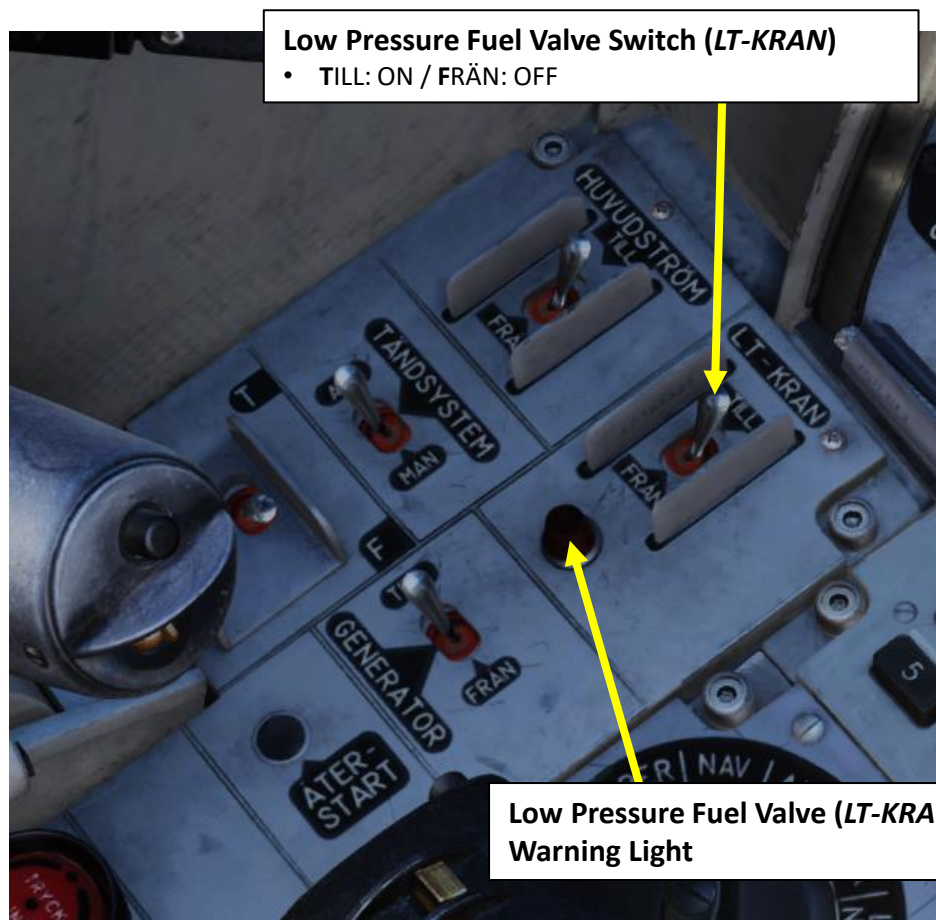
Low Pressure Fuel Valve Switch (*LT-KRAN*)
• **T**ILL: ON / **F**RÄN: OFF

Low Pressure Fuel Valve (*LT-KRAN*) Warning Light
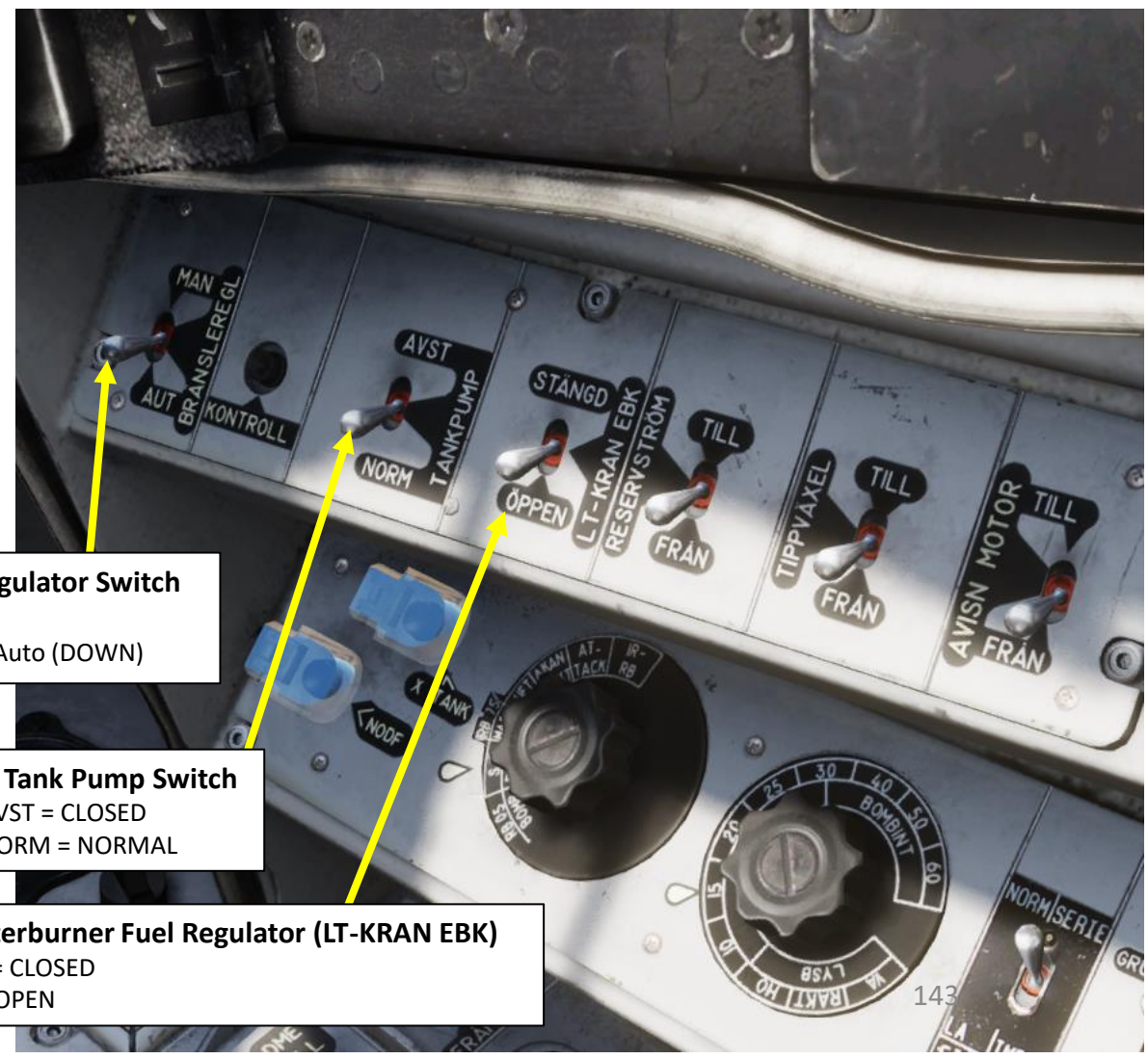
Manual Fuel Regulator Switch (*Bransleregl*)
• Manual (UP) / Auto (DOWN)

Fuel Tank Pump Switch
• AVST = CLOSED
• NORM = NORMAL

Manual Afterburner Fuel Regulator (LT-KRAN EBK)
• STÄNGD = CLOSED
• ÖPPEN = OPEN

Fuel System Warnings

Fuel-related faults are indicated by the following warning lights:

BRÄ UPPF
Indicates low pressure after the flow distributor. A Master Caution alert is triggered.
- Check that LT-KRAN (Low pressure fuel valve) and HUVUDSTRÖM (Main power) are turned on.
- Can occur due to a low hydraulic pressure in system 1 as the pumps run on this circuit.

TANKPUMP
Indicates if the fuel pressure after the tank pumps is too low, which is due to either or both of the two tank pumps having stopped. A Master Caution alert is triggered.

X-TANK BRÄ
Indicates a fault in the external fuel tank. Does not indicate an empty fuel tank. Should be visible below 70% RPM due to lack of pressure.

BRÄ < 24%
Fuel amount warning. Indicates than fuel remaining is less than 24%. Causes a master caution alarm on activation.

BRÄ < 24%

Master Caution Light (*Huvudvarning*)

Master Caution Reset Button

Master Caution Light (*Huvudvarning*)

HUVUDVARNING

BRÄ UPPF

X-TANK BRÄ

TANKPUMP

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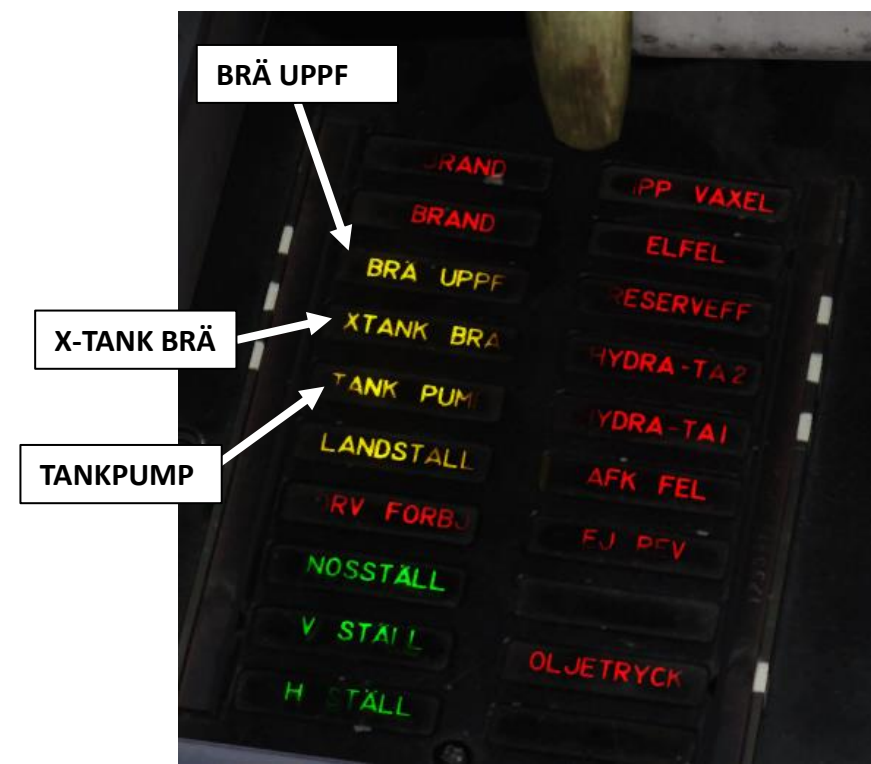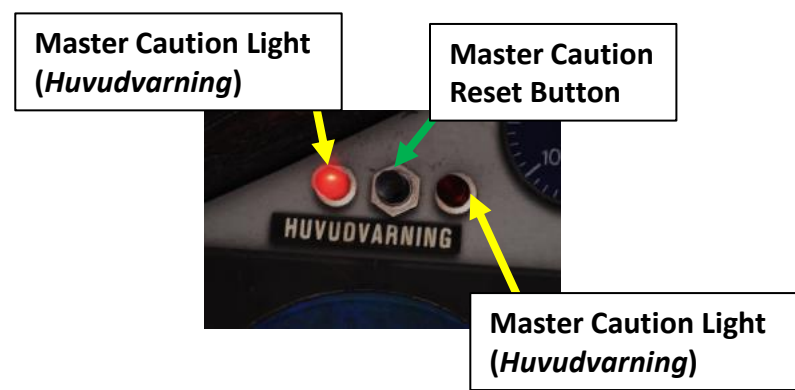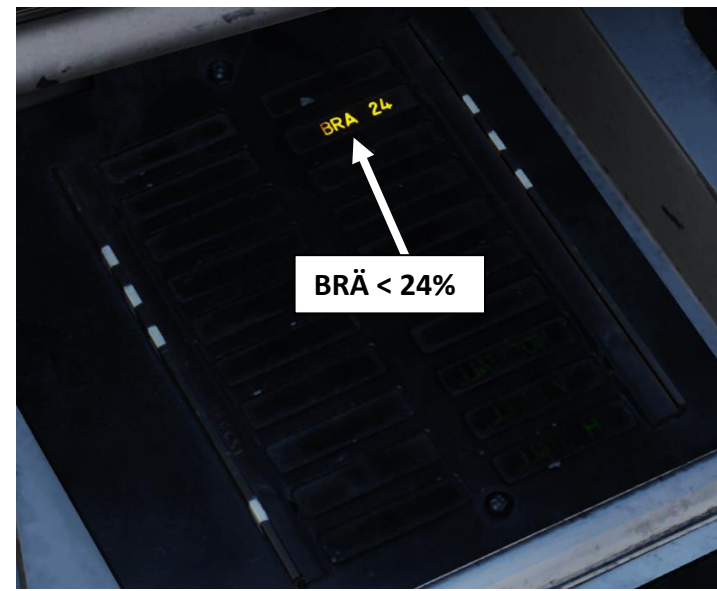
External Fuel Tank

Normally, the external fuel tank is drained first, and thereafter the internal feeding tanks and lastly the collection tank. If fuel consumption is very high (25000 liters/hour) fuel is fed from both the external and internal tanks simultaneously.

When the fuel amount goes below 24% and the landing gear is retracted, the **BRÄ <24** warning light is illuminated along with a master caution alarm. The light remains on for the duration of the flight.

The **X-TANK BRÄ** warning light Indicates a fault in the external fuel tank. Does not indicate an empty fuel tank. Should be visible below 70% RPM due to lack of pressure.

BRÄ < 24%

X-TANK BRÄ

X-TANK (External Tank)
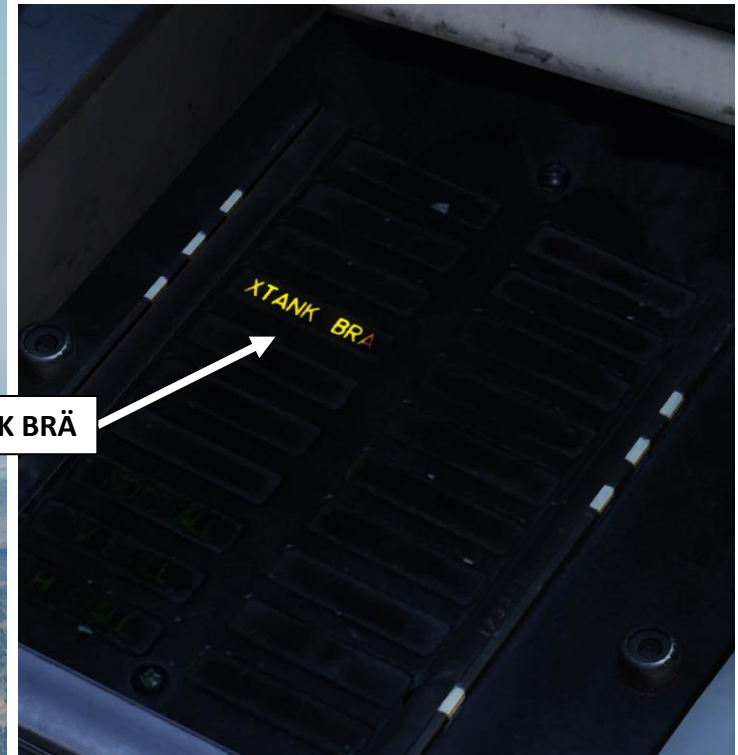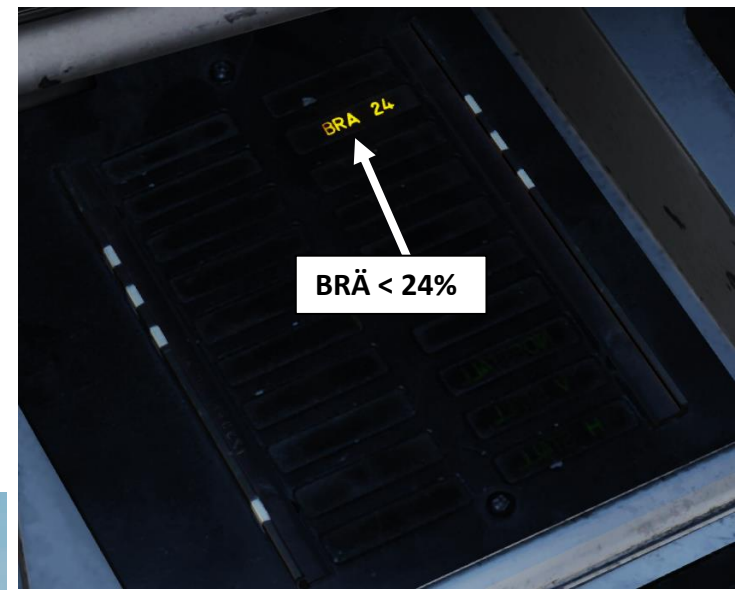
External Fuel Tank Jettison

To jettison the external fuel tank:

1. Flip the guard covering the X-TANK button
2. Press the X-TANK button
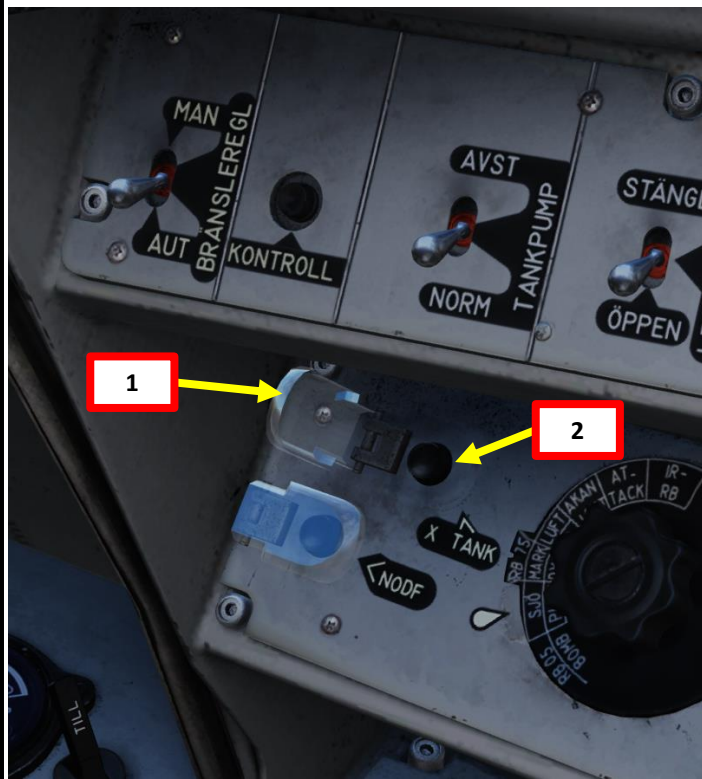
SECTION STRUCTURE

- 1 – PS-37/A Radar Introduction
- 2 – Radar Performance
- 3 – Radar Display
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    - 3.2 – Symbology – B-Scope (A2 Mode)
    - 3.3 – Logarithmic vs Linear display
    - 3.4 – Radar Gain
    - 3.5 – Night Filter
- 4 – Radar Controls
- 5 – Radar Modes
    - 5.1 – A0 Mode
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    - 5.4 – Passive Mode
    - 5.5 – Terrain Avoidance Mode
    - 5.6 – Memory Mode
- 6 – Ground, Air and Sea radar returns
- 7 – Creating a Radar Fix
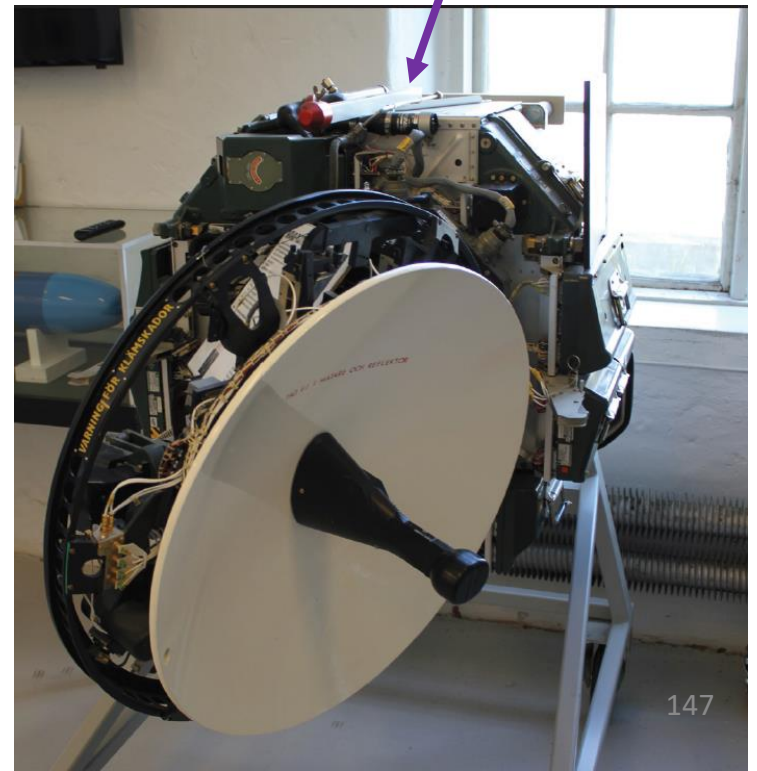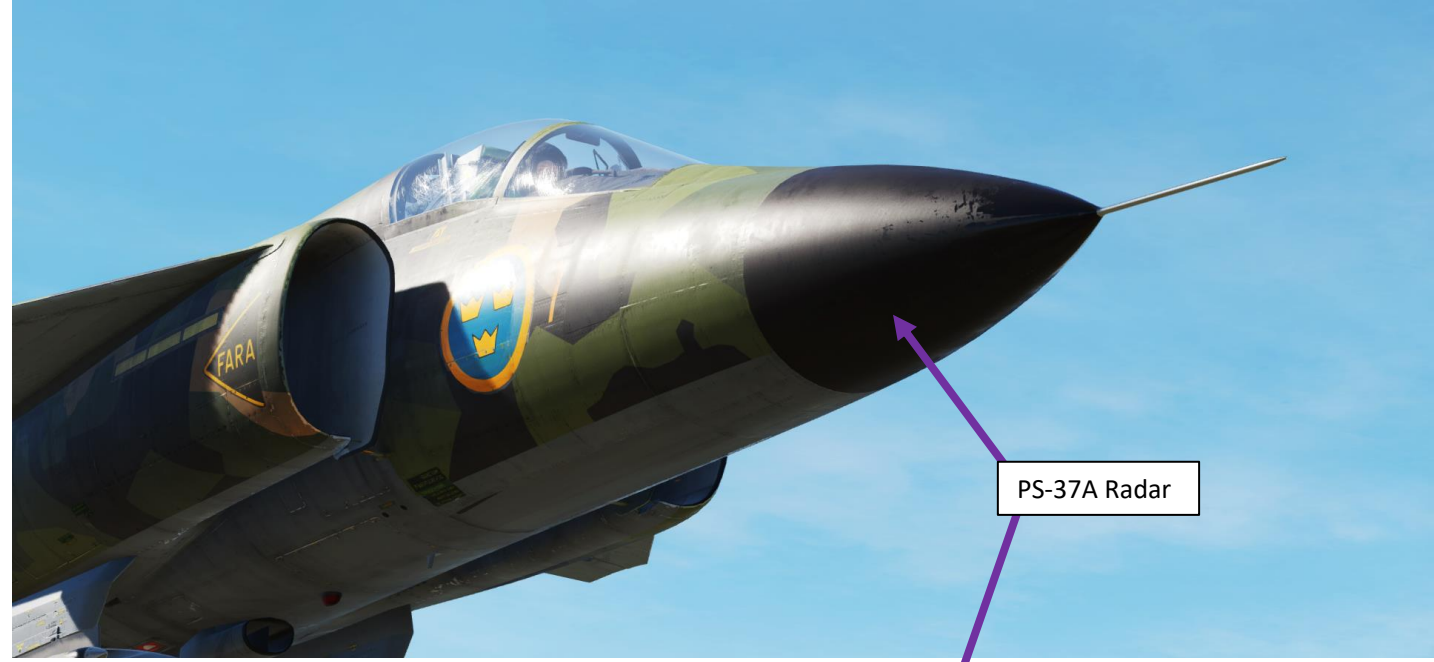
PS-37A Radar

PS-37/A RADAR
1 – Introduction

The PS-37/A radar installed on the Viggen is a ground-mapping radar mainly designed for targeting ships or geographical targets. The radar does not "lock" a target as can be seen on other radar types, but serves to identify the position of terrain features and potential targets. The radar display is mostly unfiltered and will provide a certain amount of "noise". It is up to the pilot to determine what the radar returns correspond to.

To turn on the radar:
1. Set the Master Mode selector to either NAV, SPA, LANDN NAV, or LANDN P/O .
2. Set Radar Mode Selector to either A1 or A2 depending on the desired display mode.

It can be used against ground targets, however its effectiveness is entirely dependent of the contrast and target size. The radar can also be used as a navigation aid and is very closely integrated with the navigation suite. In practice, the radar will be used mainly to navigate in poor-visibility conditions or to perform low-level anti-ship operations. Sounds complicated? Don't worry, **the radar procedures are thoroughly explained in the NAVIGATION and WEAPONS sections of this guide** (doing radar fixes, locking targets, etc.). This section is merely an introduction to the radar to explain what it does and how it works.

Radar Mode Selector

Master Mode Selector

Ship Radar Returns
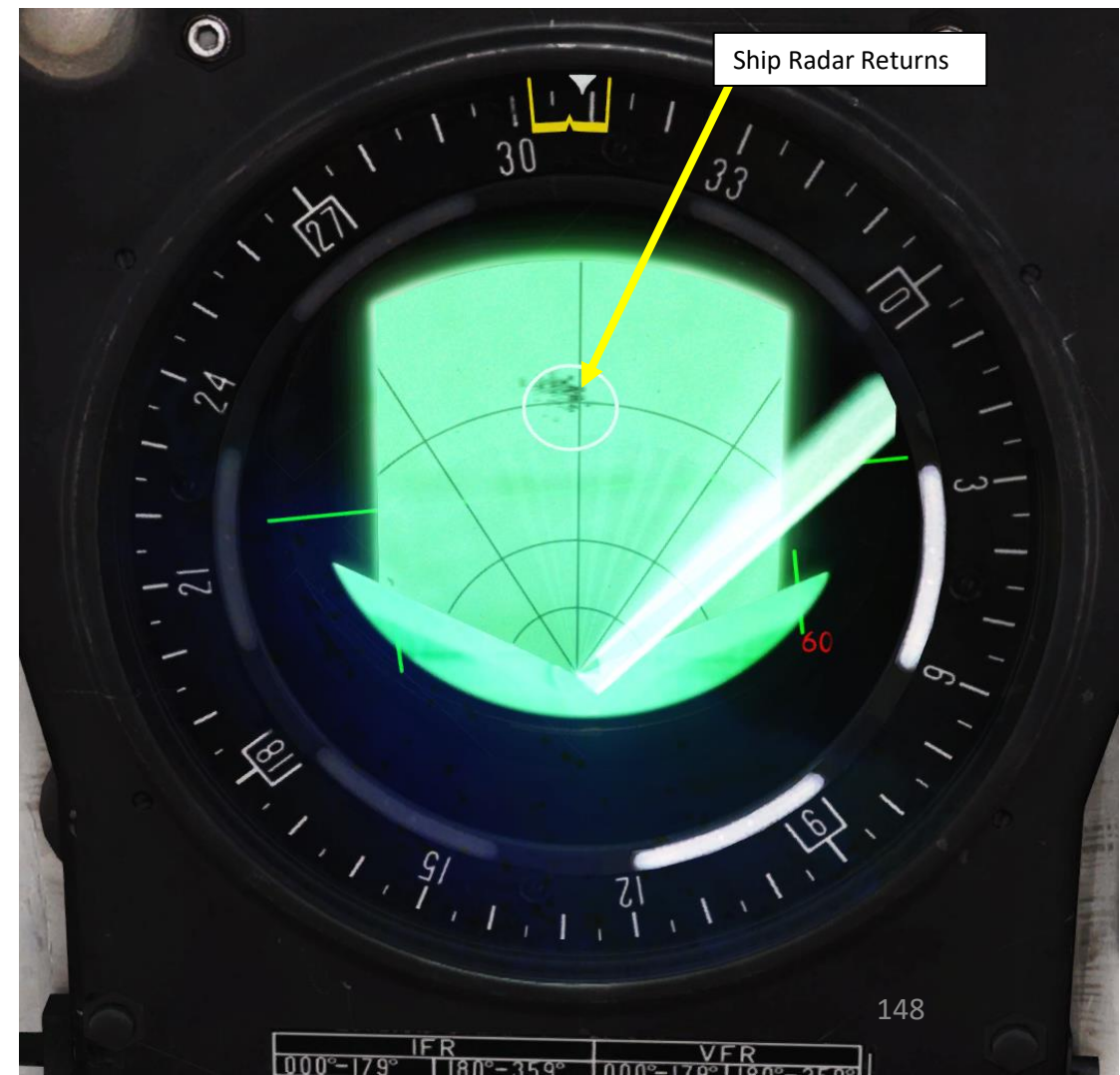
PS-37/A RADAR
2 – Radar Performance

The PS-37/A radar has a range of up to 120 km depending on the flight altitude and the antenna elevation. However, even if the radar can reach 120 km, it doesn't necessarily mean that it will spot everything precisely. That big ship you are looking for might be 120 km away, but your radar might only have radar returns 60 km away.

The radar isn't meant to be a perfect solution to find your target: a thorough flight planning has to be done before you even leave the ground.

Radar Scan Zone Range (120 km)

Range: 120 km
Total Azimuth: 123 deg

Max: -61.5 deg

Max: +61.5 deg

Elevation varies with antenna elevation

Range: 120 km
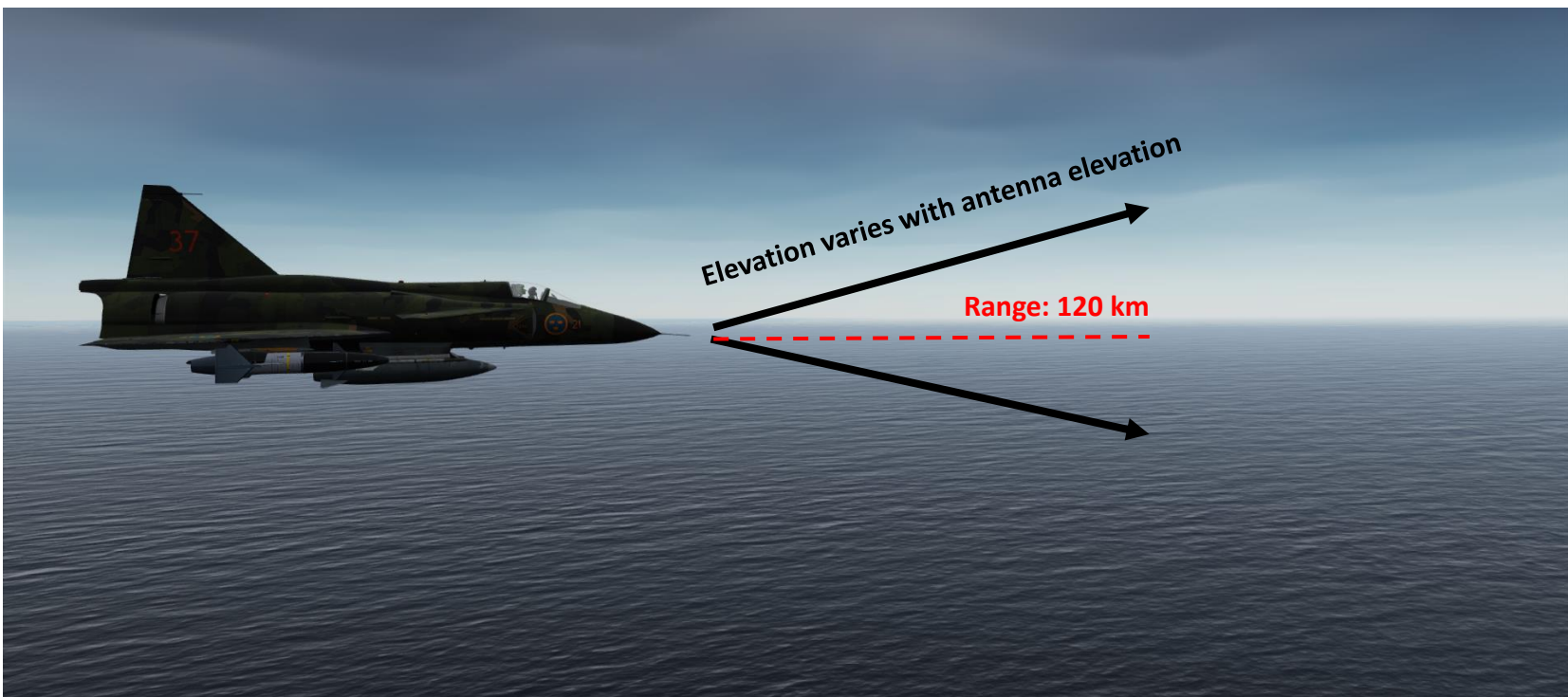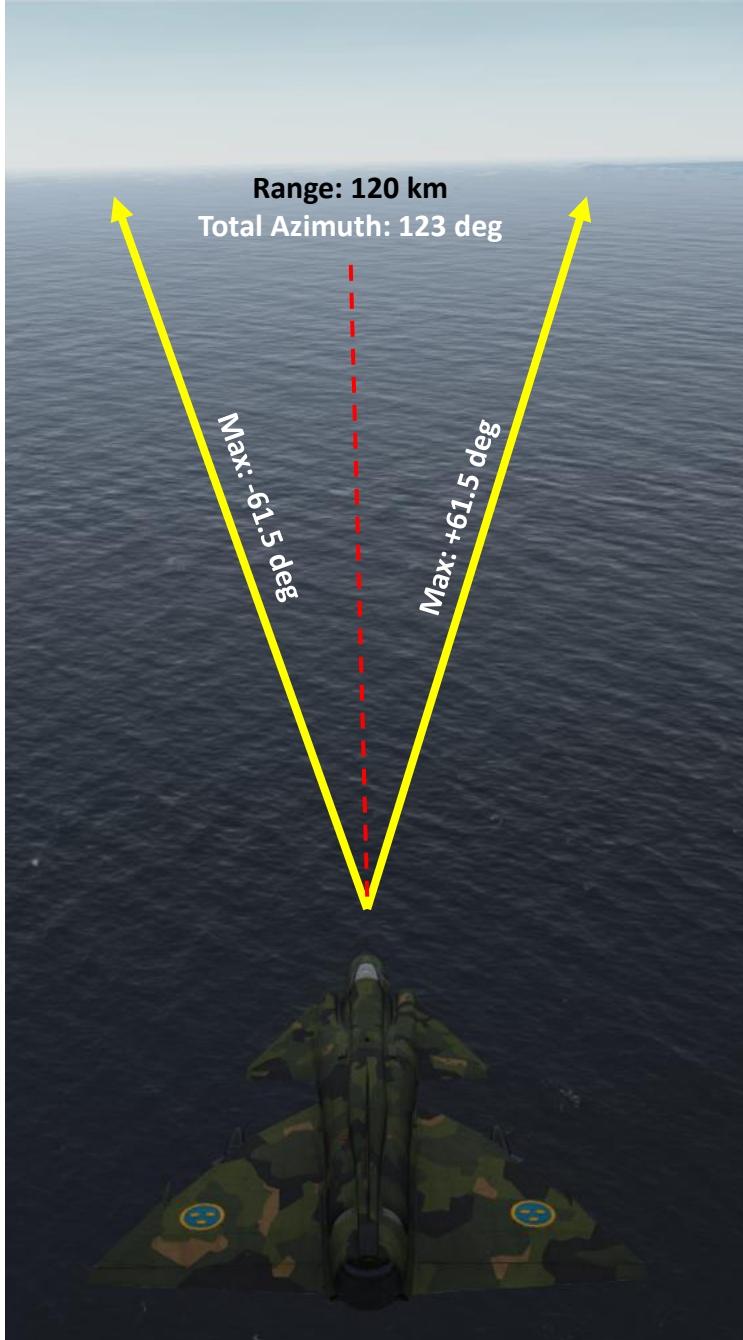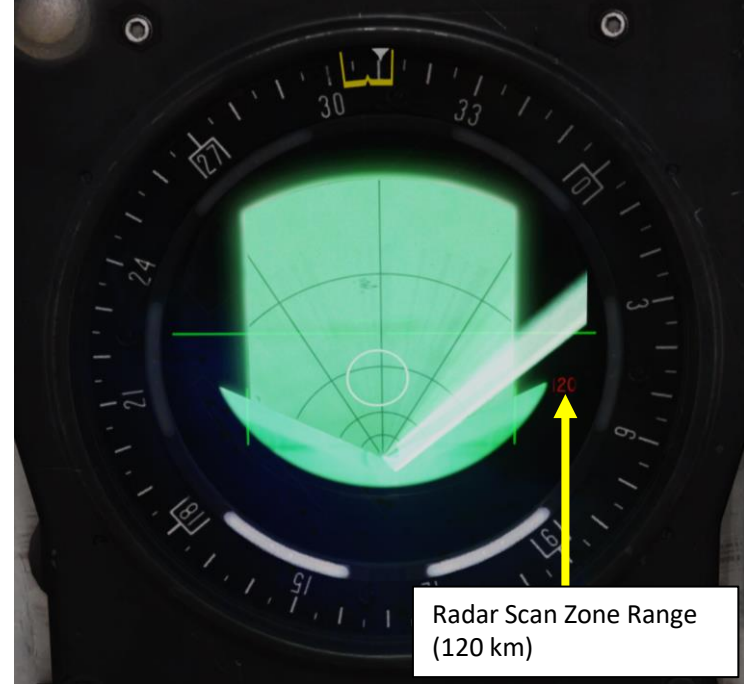
PS-37/A RADAR
2 – Radar Performance

Radar Antenna Elevation and Scan Zone Range

The radar is in most cases automatically steered by the CK37 Flight computer. However, the antenna elevation can during the normal search mode be adjusted ±10° from the set angle by use of the antenna elevation potentiometer on the radar control stick.

- In the Air-to-air search mode a special indicator for the antenna elevation appears above the radar display. The antenna elevation equals +1.5° during air-to-air scan and 0° relative to the horizon in terrain avoidance mode.

- The antenna is steered directly by the CK37 computer during Target ranging. The radar is then steered towards where the reticule on the HUD is pointing.

Scan zone range (km)	Flight altitude (m)	Antenna elevation (relative to the horizon) (±0.5)
15	–	-3.0°
30	> 600	-3.0°
30	< 600	-1.5°
60	> 600	-1.0°
60	< 600	-0.5°
120	–	-0.5°

Radar Scan Range Selector

Radar Antenna Elevation Dial

PS-37/A RADAR
2 – Radar Performance

Radar Antenna Scan Width

The radar dish can be rotated in a cone of 65° and the radar is mounted -5.5° of the aircraft X-axis. Radar scanning width will vary depending on the radar mode used during search mode:

- The **wide program** (A1 Mode / PPI (Plan Polar Indicator)) has a ±61.5° (from x-axis) wide and 3.6° tall arc with a search speed of 110°/s.

- The **narrow program** (A2 Mode / B-Scope) has a ±32° (from x-axis) wide and 3.6° tall arc with a search speed of 60°/s.

Radar Mode Selector
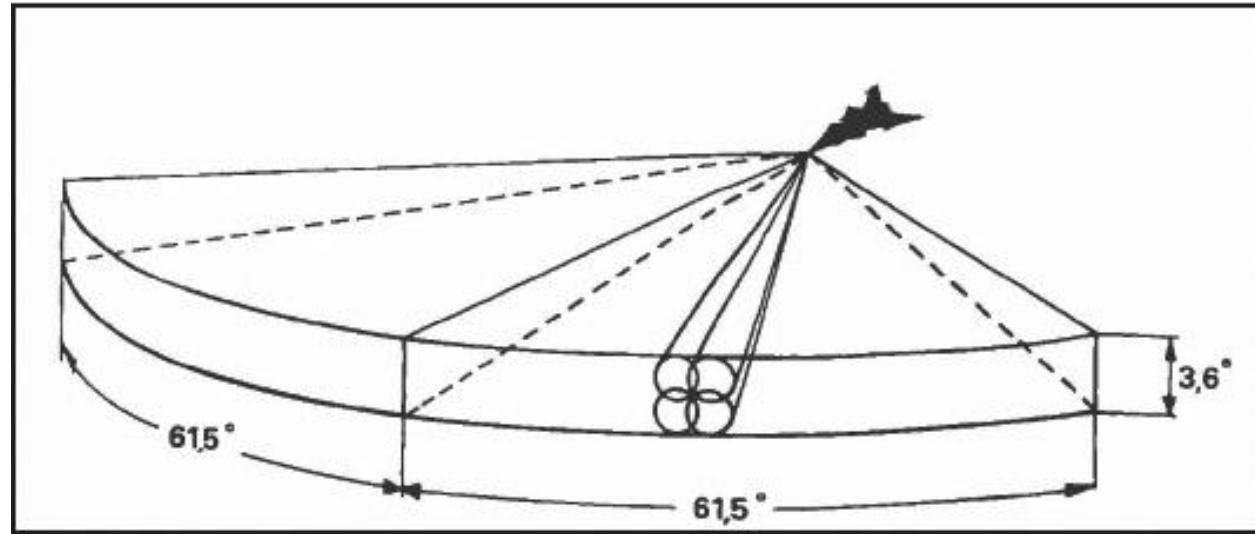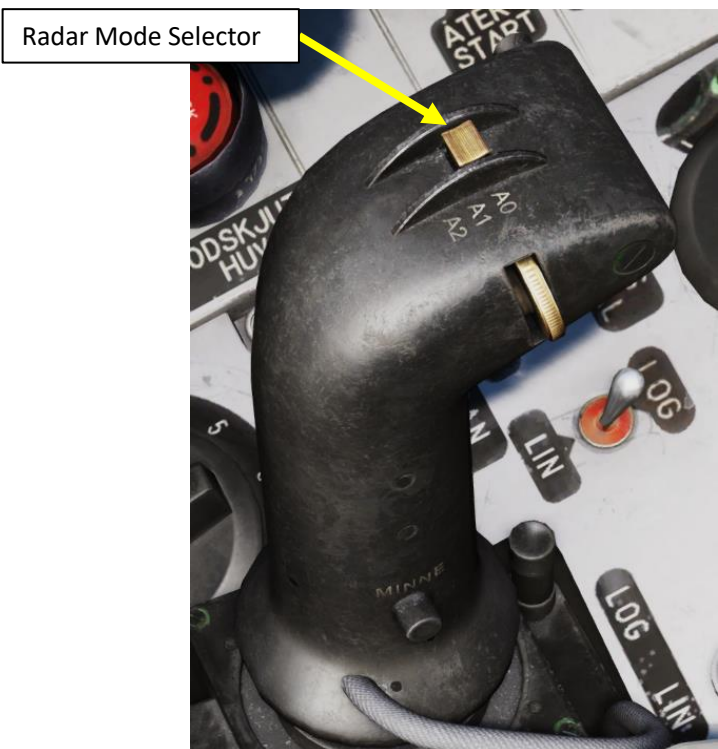
Radar Scan Width – Wide (A1 / PPI Mode)
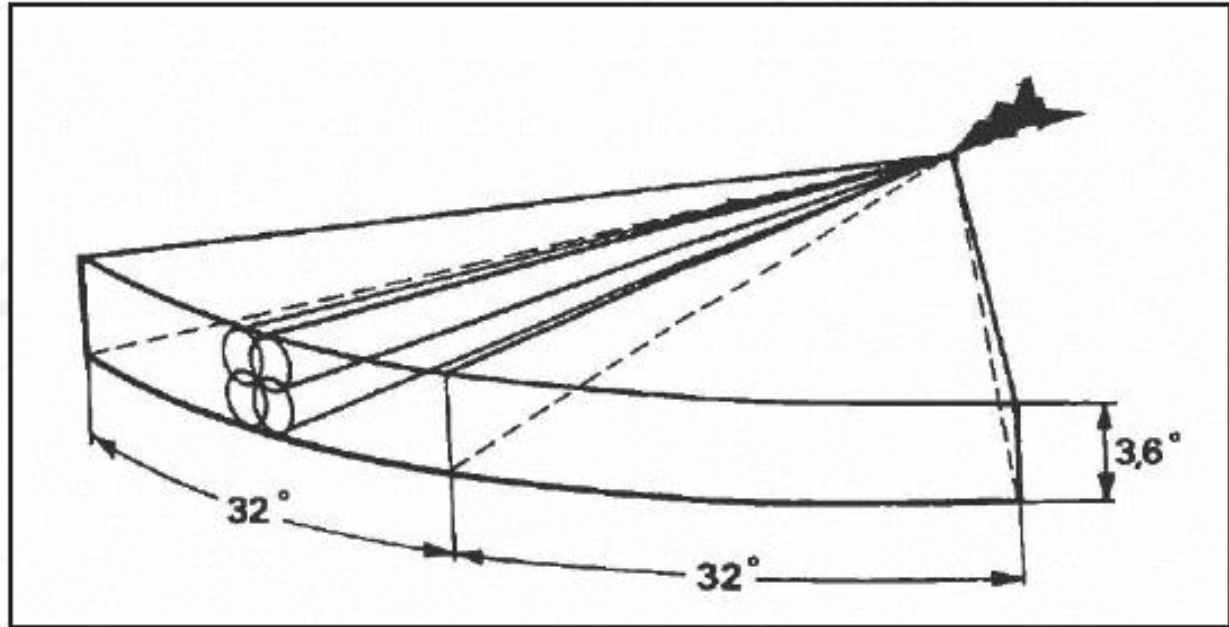
Radar Scan Width – Narrow (A2 / B-Scope Mode)

PS-37/A RADAR
3 – Radar Display
3.1 - Symbology – PPI (A1, Wide)

Radar Mode Selector – A1
(Wide Search with PPI)
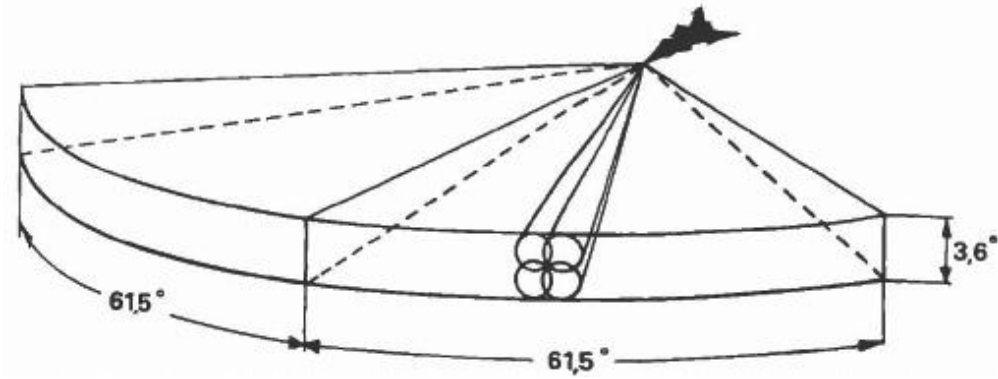
The first display mode available is the "Sector Plan Polar Indicator" (PPI), which provides a polar coordinate system in angle and distance. The distance lines and ±30° lines aid in interpreting the radar picture.

PPI display mode is set when the Radar Mode Selector switch is set to "A1".

In addition to displaying the radar picture, certain flight information such as attitude and altitude are overlaid on the display to maintain orientation when using the radar display.

61,5°

3,6°

61,5°

Antenna Altitude Indicator

Index for Antenna Altitude

Circle Marker

Video Marker

Side Angle Indicator
(-30 deg)

Altitude Indicator

Reference Altitude
= 100 m

Radar Altimeter Index

Range Markers (Distance Lines)
(here 10, 20, 40 and 80 km)

Radar Scan Zone Range
(here 120 km)

Forward

Angle

Side Angle Indicator
(30 deg)

Artificial Horizon

Horizon Reference

Straight Forward Line

120

152
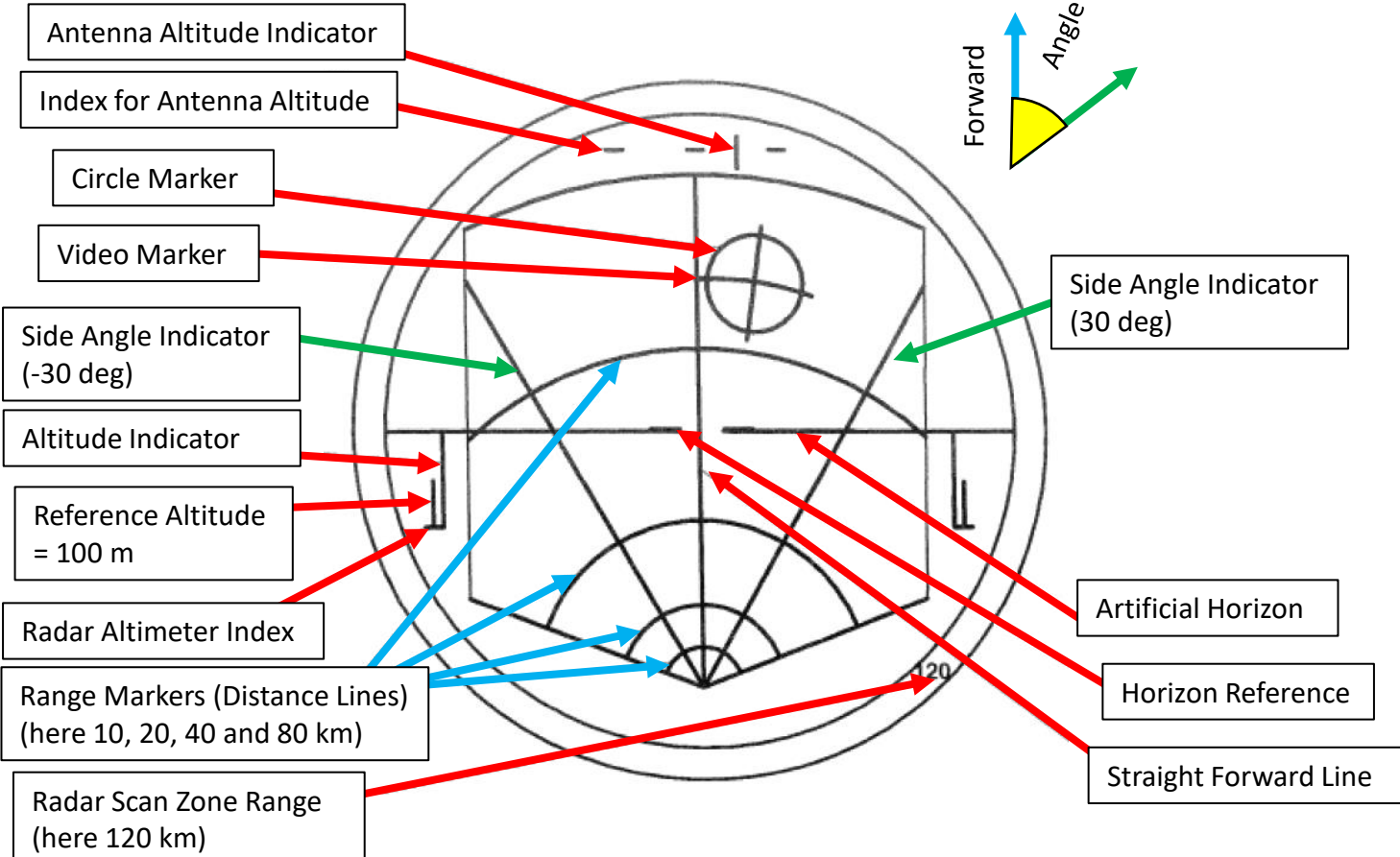
PS-37/A RADAR
3 – Radar Display
3.2 - Symbology – B-Scope (A2, Narrow)

Radar Mode Selector – A2
(Narrow Search with B-Scope)

The second display mode available is the "B-scope", a "zoomed in" top-down view of a particular part of the sector PPI (Plan Polar Indicator). The presentation is that of a perpendicular coordinate system presented in a square. As such, the sector from the PPI will be slightly stretched at the bottom (closest to the aircraft). The B-scope is used when additional detail of a target or area is needed.

B-Scope display mode is set when the Radar Mode Selector switch is set to "A2".

In addition to displaying the radar picture, certain flight information such as attitude and altitude are overlaid on the display to maintain orientation when using the radar display.

3,6°
32°
32°

Forward

Right

Straight forward Line

Reference for Artificial Horizon

Artificial Horizon

Altitude Indicator

Reference Altitude = 100 m

Radar Altimeter Index

Radar Scan Zone Range (here 60 km)

60

153
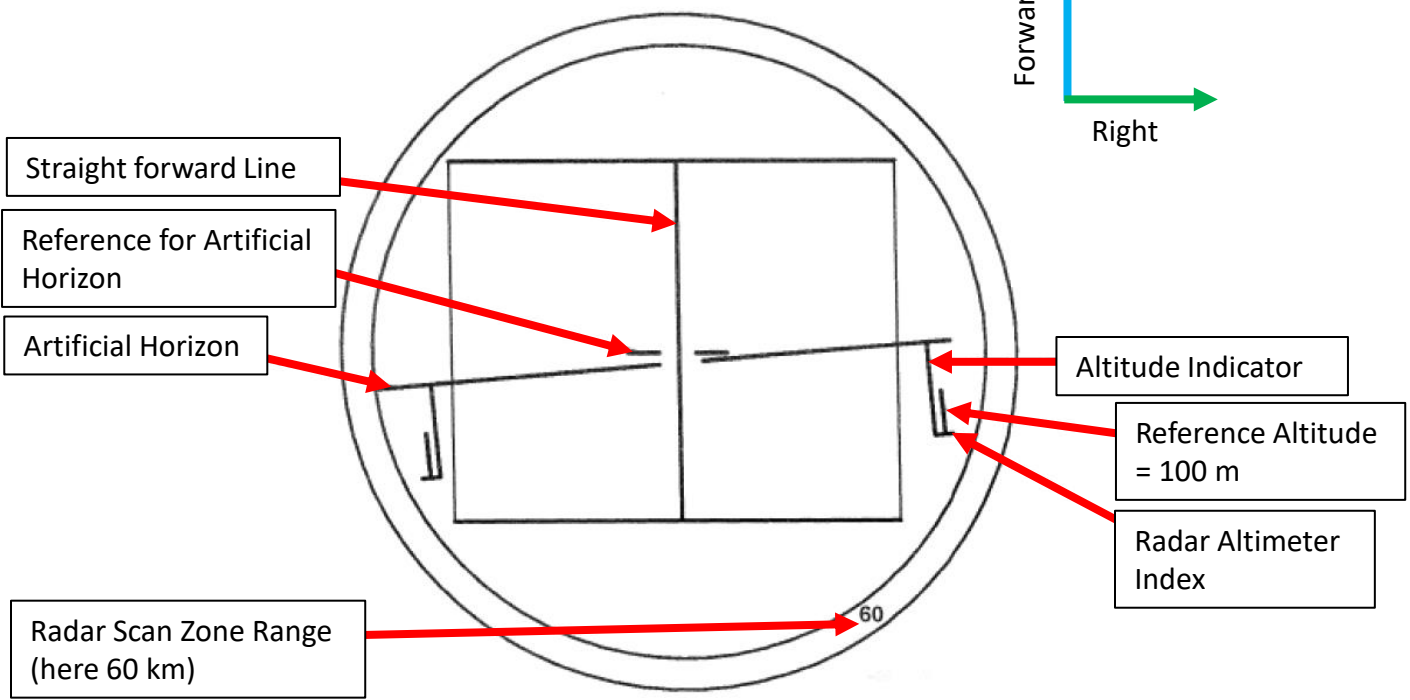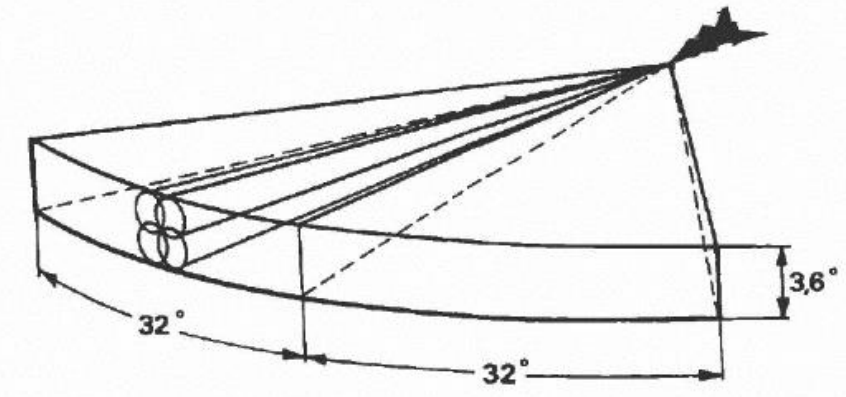
PS-37/A RADAR
3 – Radar Display
3.3 - Logarithmic vs Linear Display

The **Logarithmic** display mode (LOG) is the default mode, where the terrain contacts are more nuanced and different terrain types can be discerned. This gives you a better depiction of terrain elevation variation.

The **Linear** display mode (LIN) is the high contrast mode where the difference between terrain types and elevations are not as important, such as during terrain avoidance or in Air-to-Air modes.
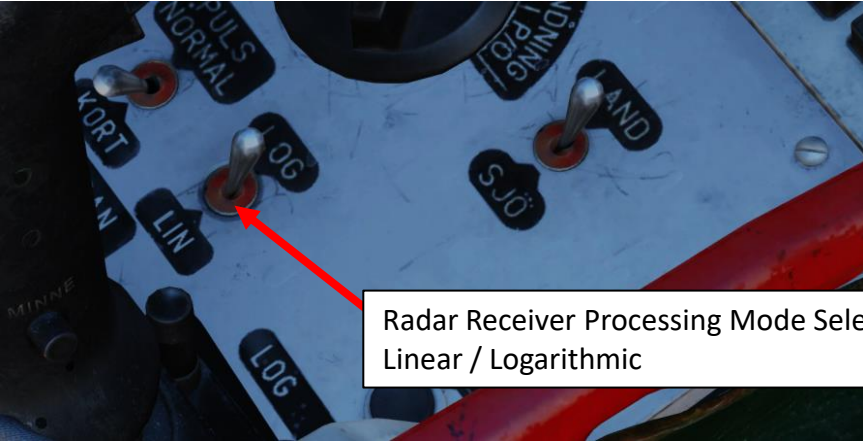
Radar Receiver Processing Mode Selector
Linear / Logarithmic
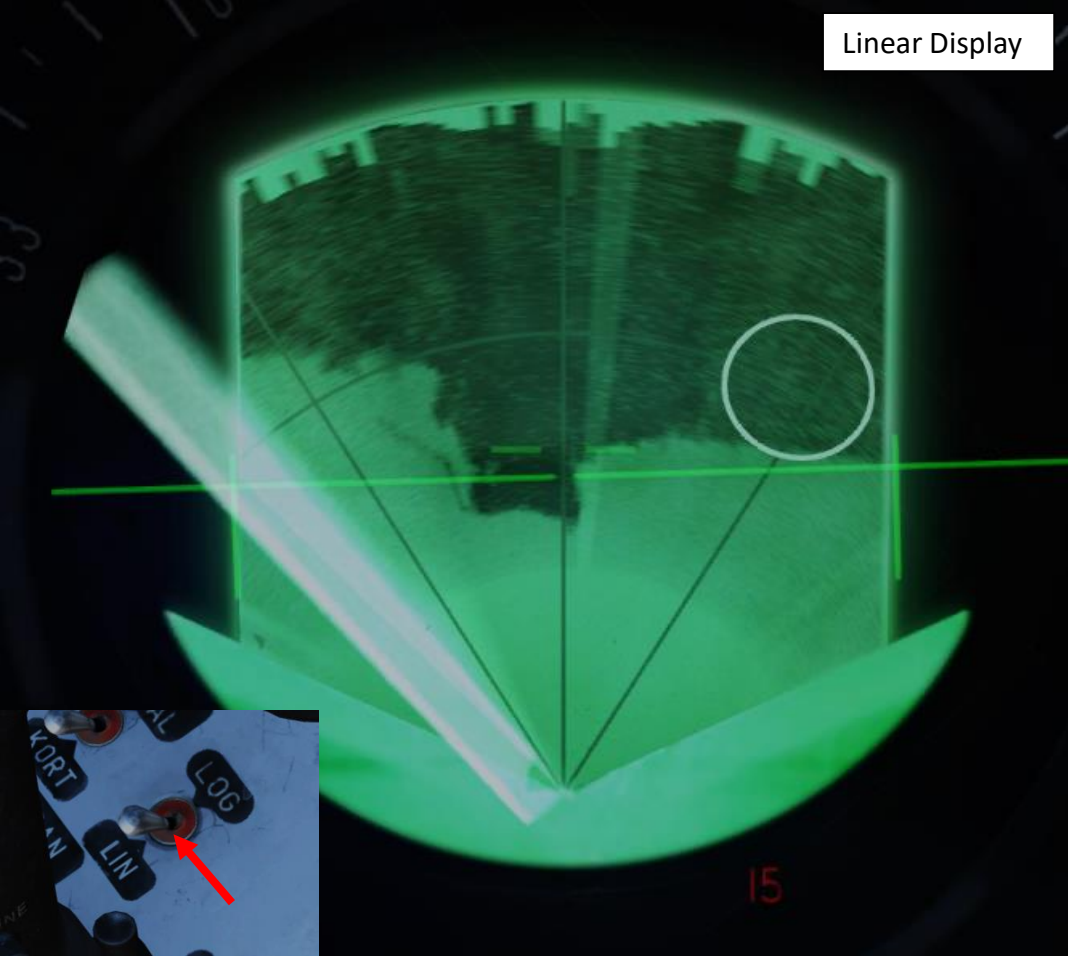
Linear Display

Logarithmic Display

154
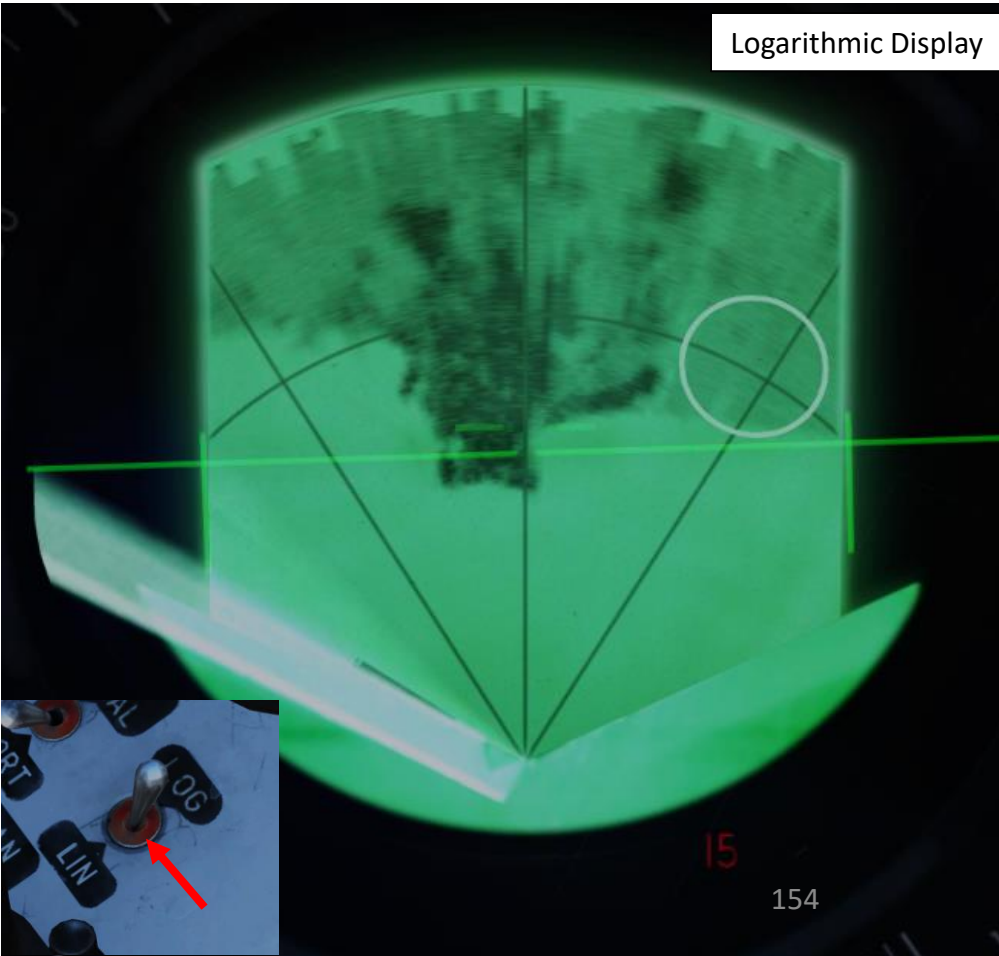
PS-37/A RADAR
3 – Radar Display
3.4 - Radar Gain

The overall amplification gain can be adjusted with the MKR / Radar gain knob on the front of the radar stick base. It has a center snap position that is for good detection of naval contacts.
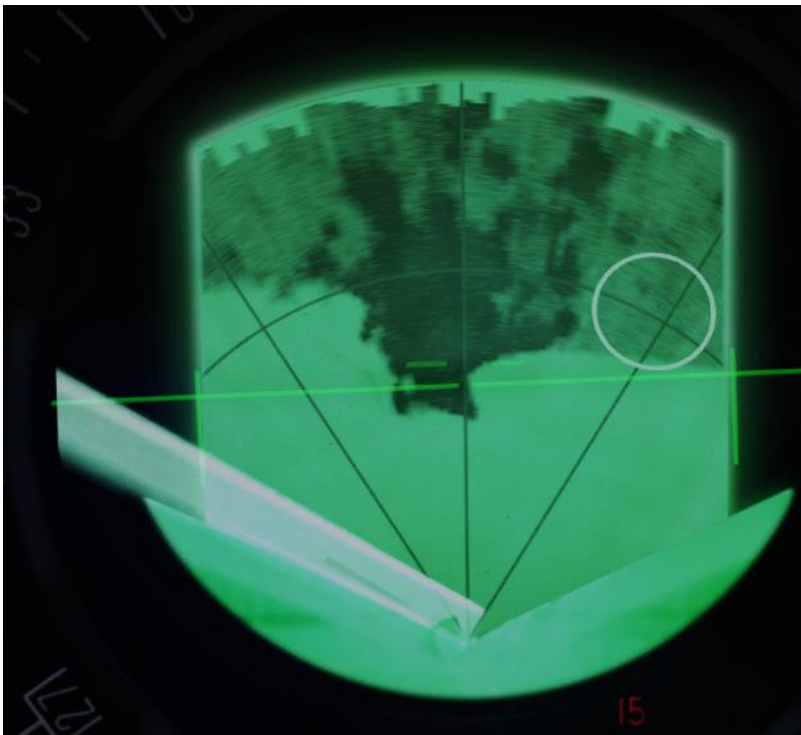
Radar MKR Potentiometer (Amplification Gain) Dial

Lower Gain Setting

Higher Gain Setting

155
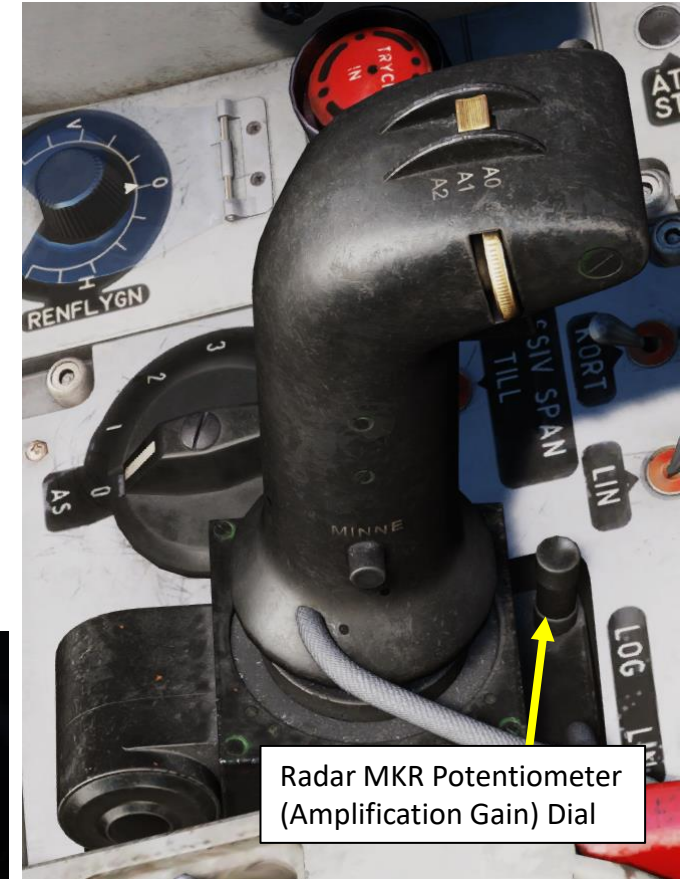
PS-37/A RADAR
3 – Radar Display
3.5 – Night Filter

CONTROL OPTIONS

| AJS37 | All | | Foldable view | Reset category to default |

Action		Category	Keyboard
Radar Night Filter - Down		Radar	RCtrl + RShift + F
Radar Night Filter - Up		Radar	RAlt + RCtrl + F

During night operations, the radar screen may be way too bright to be visible. You can apply night filters of varying intensity by using the "Radar Night Filter Down" and "Radar Night Filter Up" bindings set to "RCTRL+RSHIFT+F" and "RALT+RCTRL+F". The "Radar Brightness Control" knob (LJUS RADAR) can also be used to set the brightness of the screen to a more manageable level.
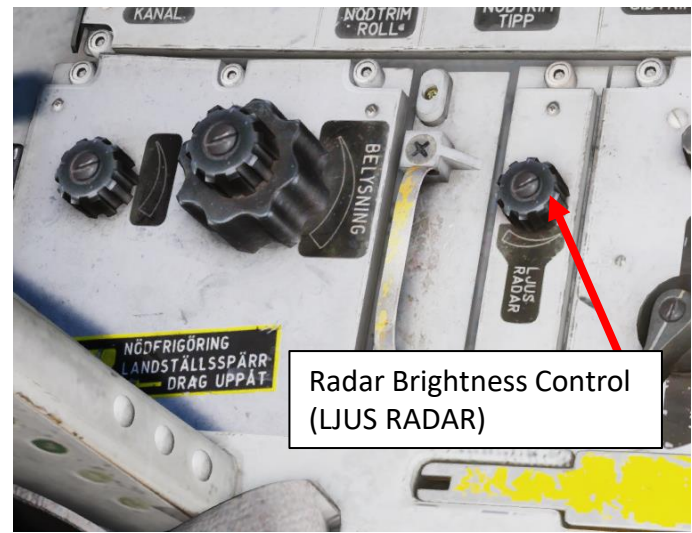
Radar Brightness Control
(LJUS RADAR)

Radar Display at Night
- *Full Brightness*
- *No Night Filter*

CI (Central Indicator) Brightness Control
- *Controlled by "Radar Night Filter Down/Up" bindings*

Radar Display at Night
- *Reduced Brightness*
- *With Night Filter*

PS-37/A RADAR
4 – Radar Controls

Radar Mode Selector
- A0: Radar OFF
- A1: Radar ON, Wide Search Mode with Sector PPI
- A2: Radar ON, Narrow Search Mode with B-Scope

Radar Scan Range Selector

Radar Terrain Avoidance Selector

Radar Stick

Anti-Jamming (AS) Filter Mode Selector

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

Radar Antenna Elevation Dial

Radar MKR Potentiometer (Amplification Gain) Dial

Radar Memory (*Minne*) Mode Button
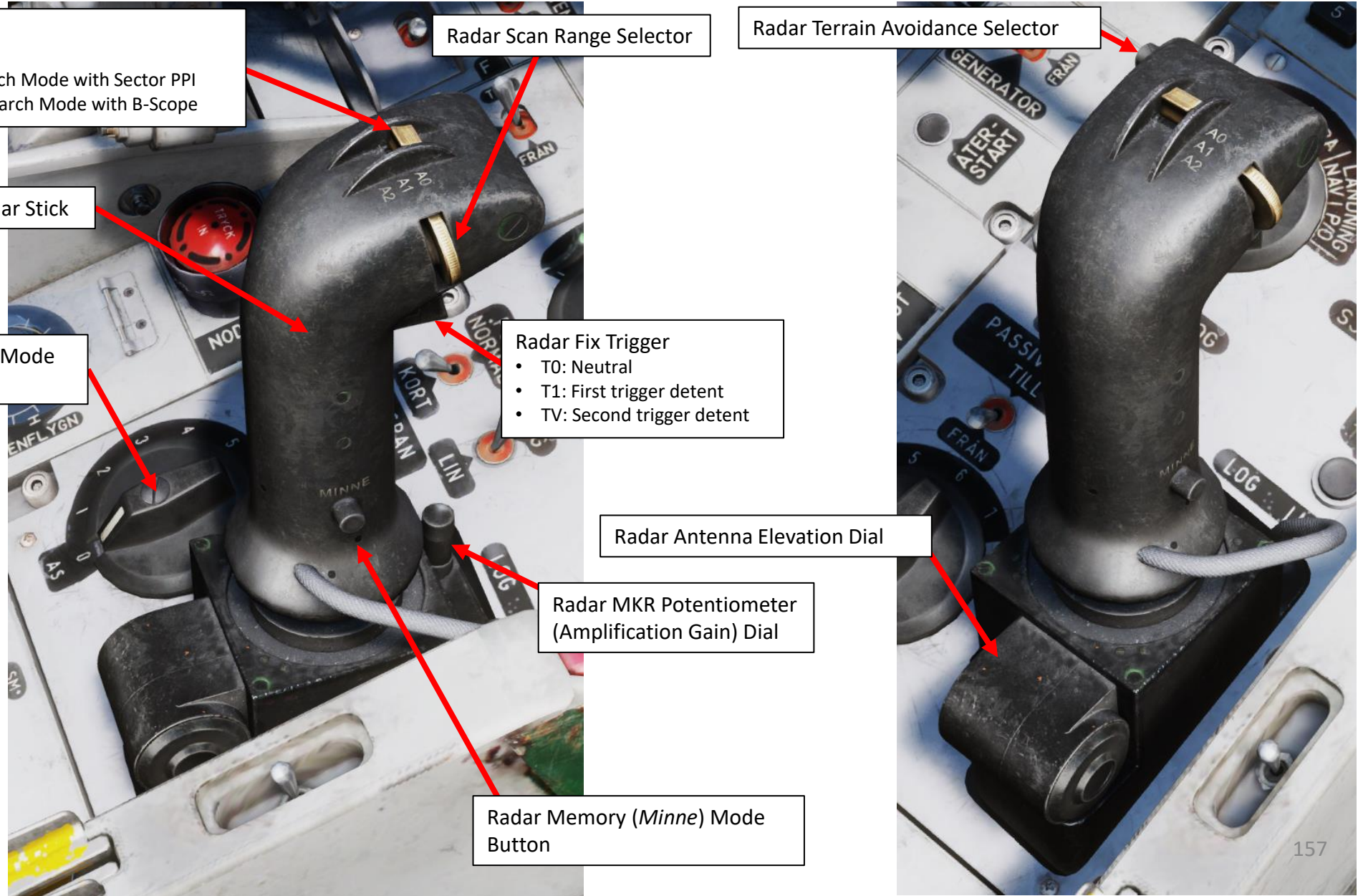
PS-37/A RADAR
4 – Radar Controls

All of these switches are explained in more details in the Flight Manual. At the moment the only controls that really matter to you should be:

- A0/A1/A2 Radar Mode Selector
- Radar Fix Trigger T0/T1/TV
- Radarstick Up/Down/Left/Right
- Radar Range Increase/Decrease
- Radar Antenna Elevation Up/Down
- Radar Terrain Avoidance Selector (also called "Obstacle Detection Mode", sets radar antenna elevation at 0 deg relative to the horizon, which gives you radar returns at your altitude only)
- Radar Memory (*Minne*) Mode

The other controls are interesting, but not essential for standard DCS missions.
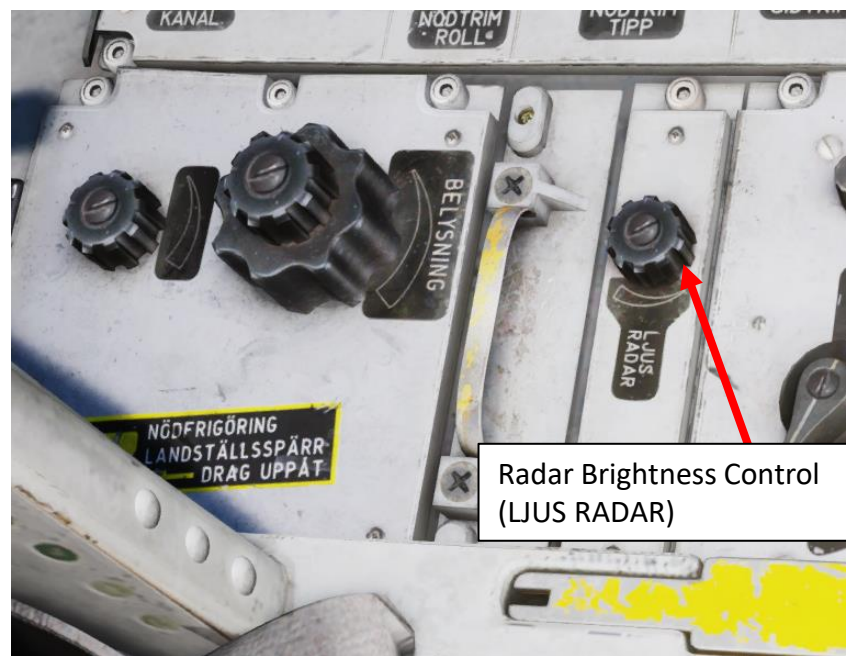
Radar Brightness Control
(LJUS RADAR)
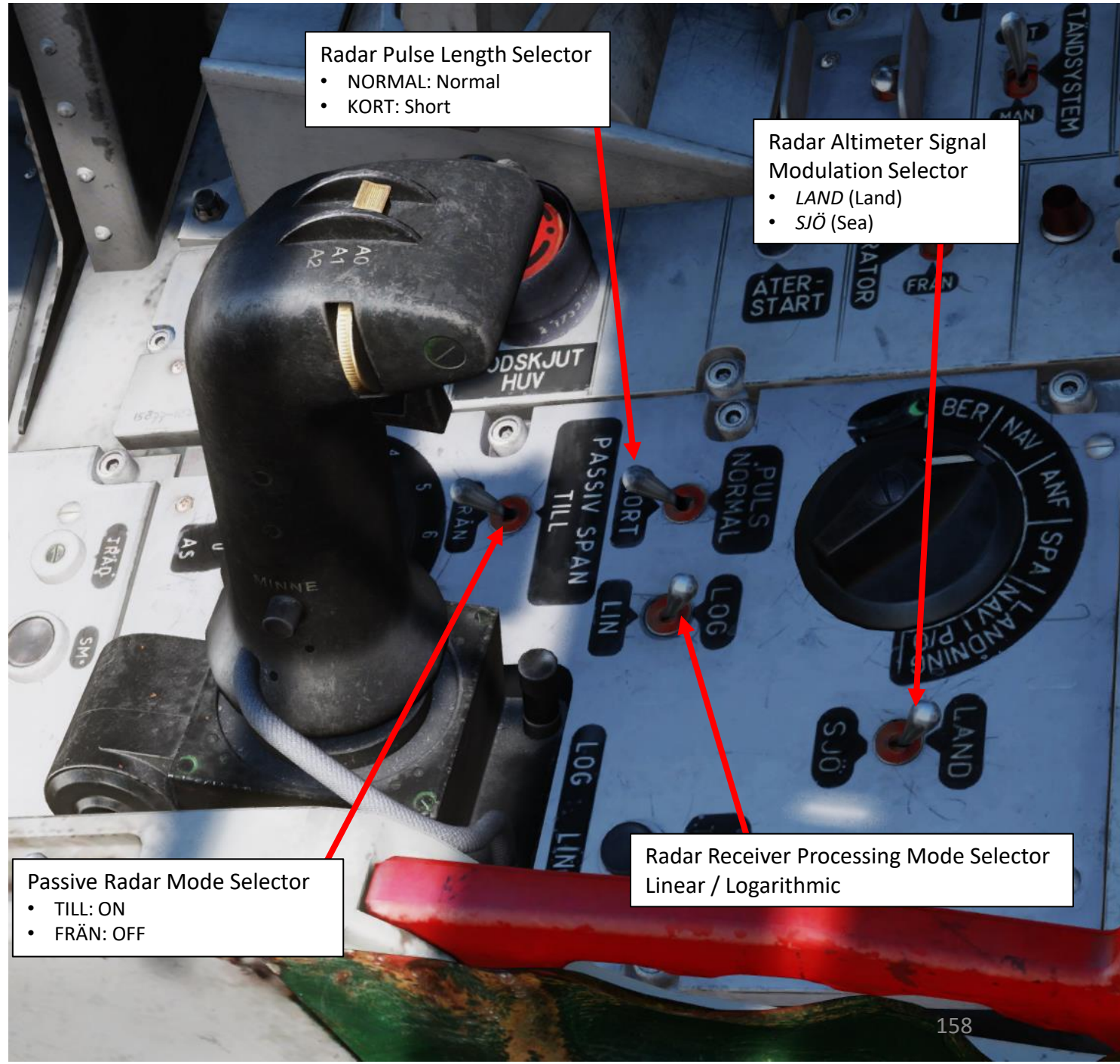
Radar Pulse Length Selector
- NORMAL: Normal
- KORT: Short

Radar Altimeter Signal Modulation Selector
- *LAND* (Land)
- *SJÖ* (Sea)

Passive Radar Mode Selector
- TILL: ON
- FRÄN: OFF

Radar Receiver Processing Mode Selector Linear / Logarithmic

PS-37/A RADAR
4 – Radar Controls
My Radar Control Setup

T1 Fix
(Grey button on RHS)

↑
→
↓
←

Radar MKR Gain Axis

T0 Fix

↑
→ Obstacle Detection Mode
↓
← Memory Mode

↑ Radarstick Up
→ Radarstick Right
↓ Radarstick Down
← Radarstick Left
P TV Fix

↑ Radar Elevation UP
→ Radar Range Increase
↓ Radar Elevation DOWN
← Radar Range Decrease
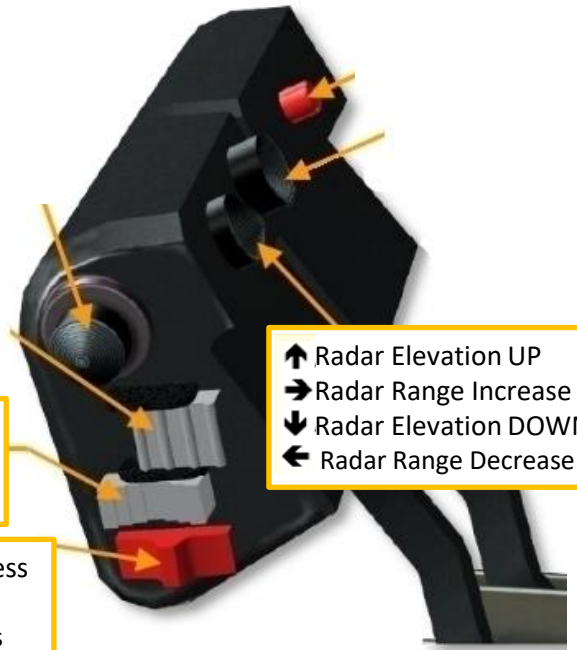
← A2 Mode (3 pos switch)

→ A0 Mode (3 pos switch)

← Radar Decrease Brightness

→ Radar Increase Brightness

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PS-37/A RADAR
5 – Radar Modes
5.1 - A0 Mode

If the radar is in **mode A0** (Radar Mode Switch FWD), the radar display is turned off on the CI (Central Indicator). This can be useful in certain situations where you want to avoid being detected by enemy radar warning receivers.

You can think of using your radar like lighting a flashlight in the dark. Sure, it helps you see better, but other observers can easily figure out where the light source comes from. The same principle applies with a radar; the waves you emit can be tracked by other systems, which can eventually triangulate your location and then relay this information to interceptors.

Radar Mode Selector – A0
OFF

PS-37/A RADAR
5 – Radar Modes
5.2 - A1 Mode

If the radar is in **mode A1** (Radar Mode Switch MIDDLE), the radar displays a "Sector Plan Polar Indicator" (PPI) format, which provides a polar coordinate system in angle and distance. This mode gives you the widest coverage and allows you to create "radar fixes".

Keep in mind that the CI (Central Indicator) radar display will be visible only if the Master Mode selector is set to either NAV, SPA, LANDN NAV or LANDN P/O.

Radar Mode Selector – A1
(Wide Search with PPI)

Master Mode Selector

Forward

Angle

PS-37/A RADAR
5 – Radar Modes
5.3 - A2 Mode

If the radar is in **mode A2** (Radar Mode Switch AFT), the radar displays a B-Scope format which is a "zoomed in" view of a particular part of the sector PPI, as mentioned earlier. The presentation is that of a perpendicular coordinate system presented in a square, providing additional detail of a target or area is needed. This mode gives you the narrowest coverage, but does not allow you to create "radar fixes".

Keep in mind that the CI (Central Indicator) radar display will be visible only if the Master Mode selector is set to either NAV, SPA, LANDN NAV or LANDN P/O.

Radar Mode Selector – A2
(Narrow Search with B-Scope)

Master Mode Selector

Forward

Right
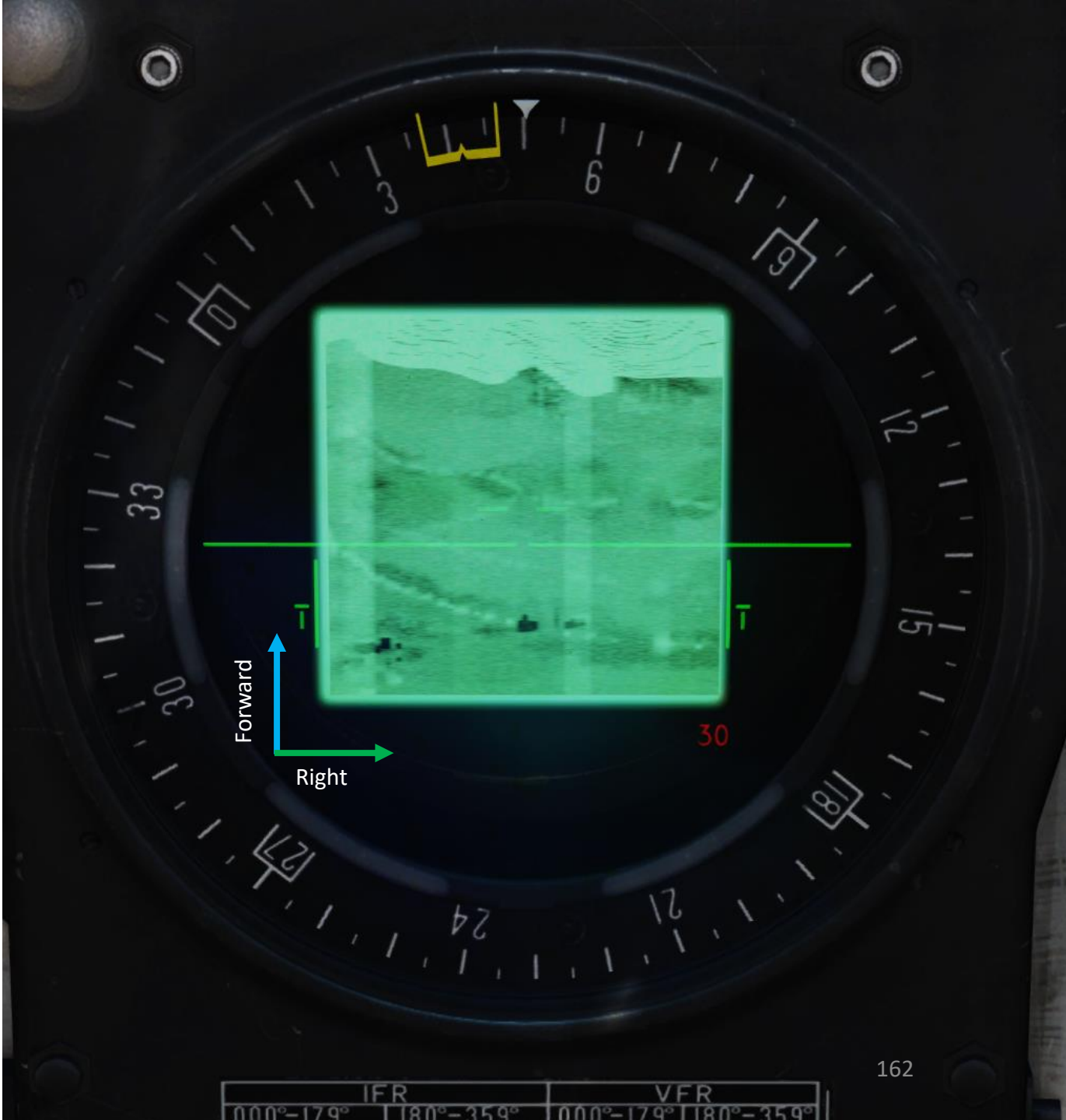
PS-37/A RADAR
5 – Radar Modes
5.4 - Passive Mode

When in Passive Mode, the radar will receive active jamming signals and display the direction from where they are received, but will not emit anything itself. This is useful when trying to estimate the location of ships equipped with jamming devices without triggering enemy radar warning receivers with your own radar.

To set the radar in Passive Mode:
1. Set PASSIV SPAN (Passive Mode) switch to TILL (ON)
2. Set radar mode to **A0** (Radar Mode Switch FWD)
3. The CI (Central Indicator) will display jamming signal directions but not provide any ship radar returns since the radar itself is not emitting.

While in Passive, the radar antenna altitude is set according to the selected scan zone range. Keep in mind that in Passive Mode, the position of the Master Mode selector is irrelevant since the radar does not emit anything.

Radar Mode Selector – A0
OFF / PASSIVE

Passive Radar Mode Selector
- TILL: ON
- FRÄN: OFF

Jamming Signal Direction

Forward

Angle

163
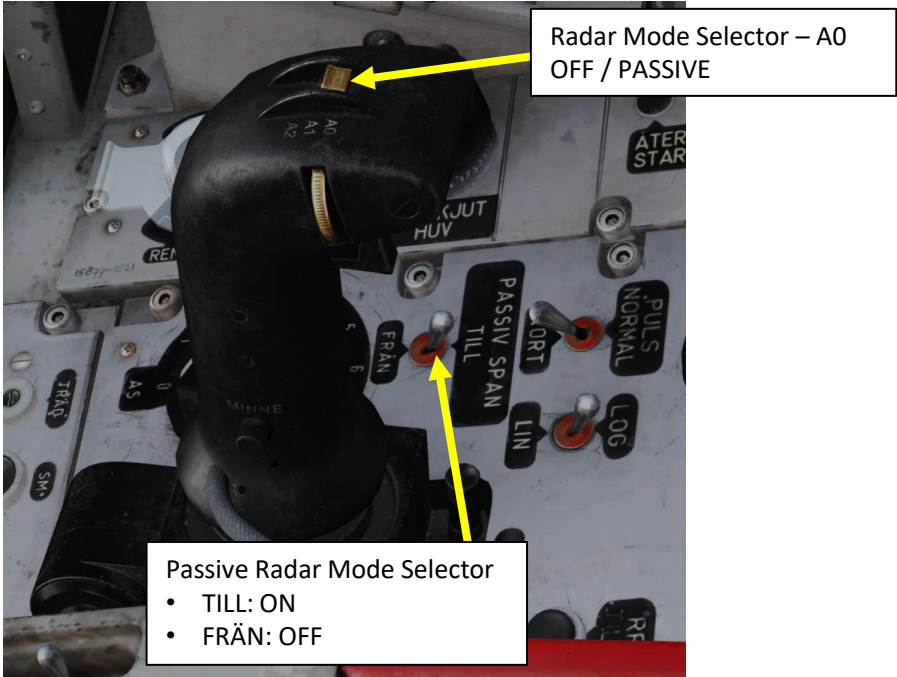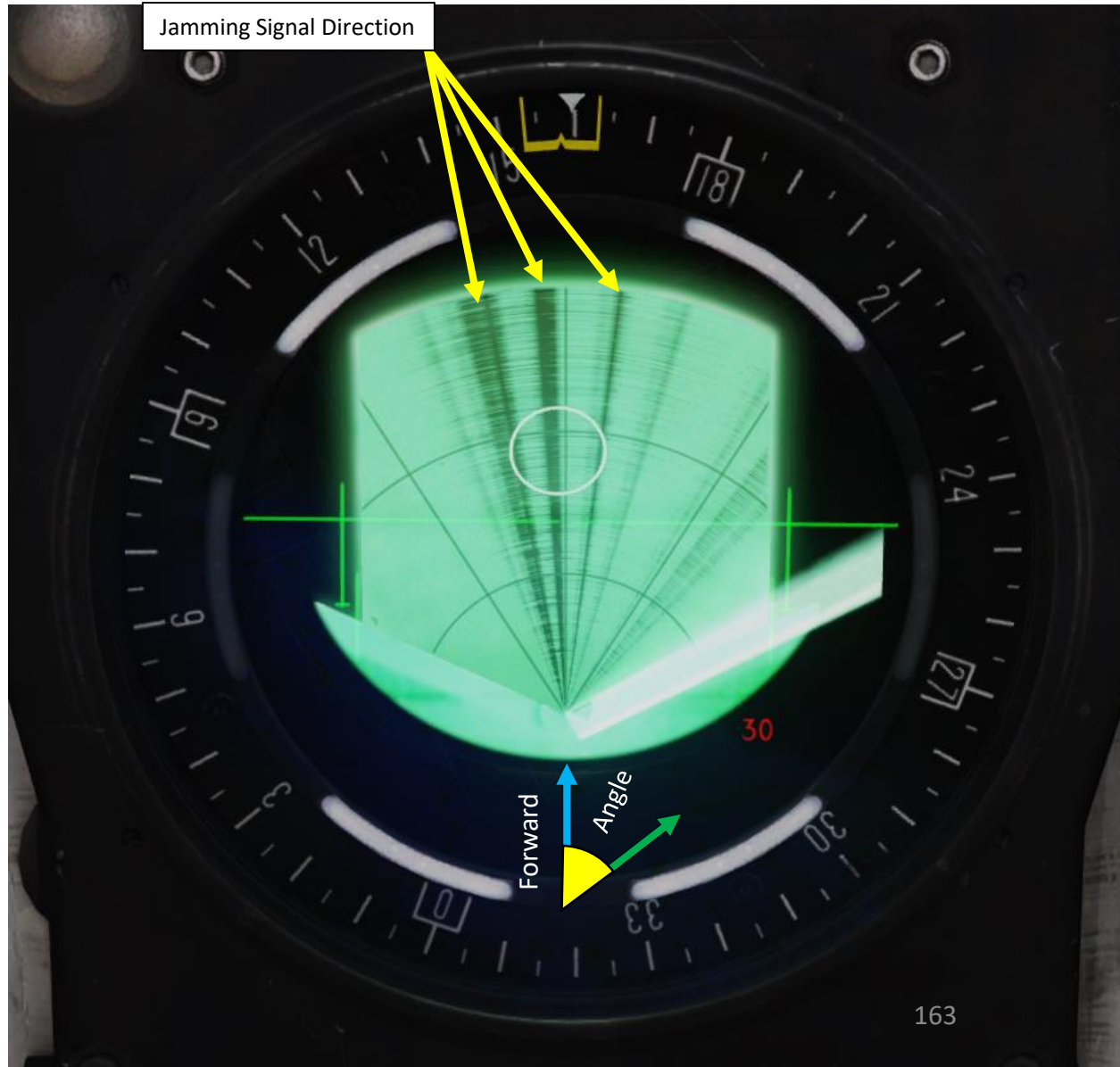
PS-37/A RADAR
5 – Radar Modes
5.5 - Terrain Avoidance Mode

The Terrain Avoidance mode is designed to allow flight at low altitudes in poor visibility. On engaging the mode, the radar antenna will be set to 0° relative to the horizon (assuming the radar antenna elevation potentiometer is set to the middle position) and the antenna beam will be narrow in altitude. This results in the radar **only displaying radar returns at the same altitude as the aircraft**. The negative space (white) thereby is considered obstacle-free, while positive space (black, or radar returns) is terrain that is at or higher than your current altitude.

To set the radar in Terrain Avoidance Mode:
1. Fly level and ensure your radar antenna elevation dial is centered
2. Set radar mode to either **A1** (Radar Mode Switch MIDDLE) or **A2** (Radar Mode Switch AFT)
3. Press the "Radar Terrain Avoidance Selector" button ("Obstacle Detection Mode" binding)
4. "Black/dark green space" represent terrain radar returns.

Keep in mind that the CI (Central Indicator) radar display will be visible only if the Master Mode selector is set to either NAV, SPA, LANDN NAV or LANDN P/O.

Radar Terrain Avoidance Selector

Radar Mode Selector
- A1: Radar ON, Wide Search Mode with Sector PPI
- A2: Radar ON, Narrow Search Mode with B-Scope

Master Mode Selector

Radar Antenna Elevation Dial

Terrain (Radar Returns)

White Space (No Terrain at your current altitude)
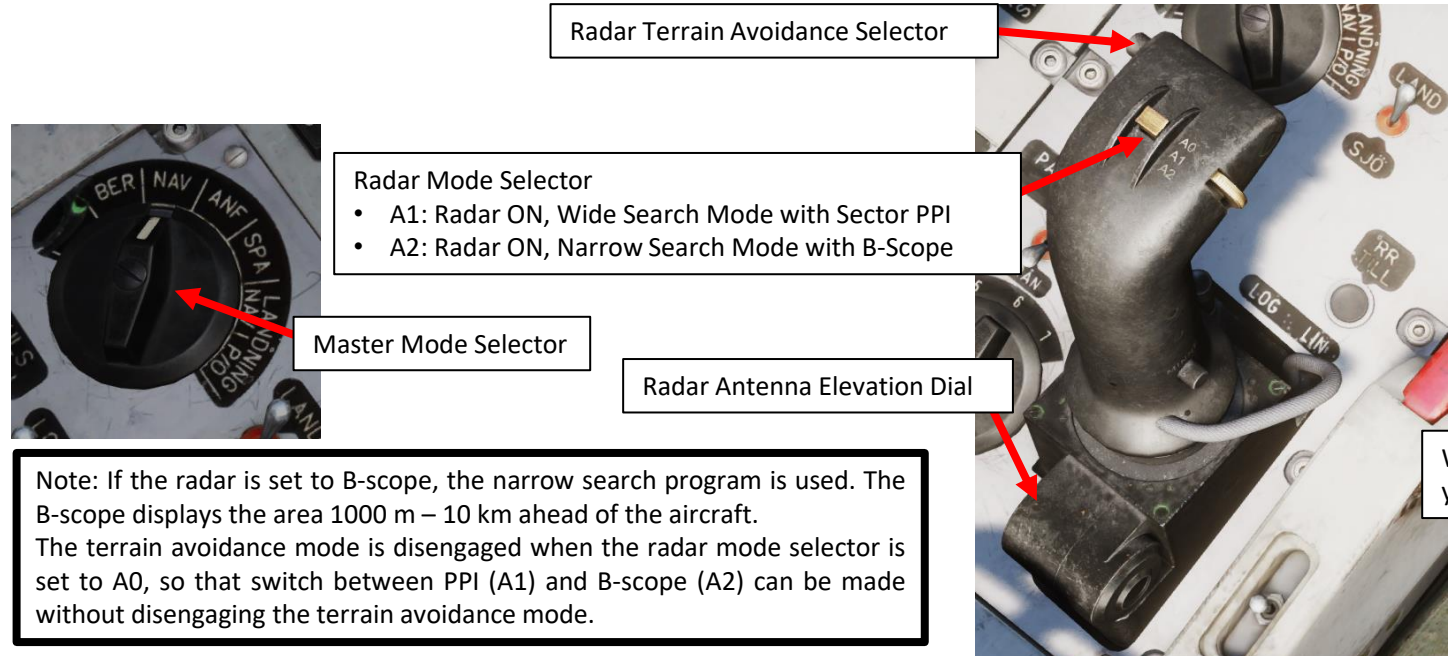
Note: If the radar is set to B-scope, the narrow search program is used. The B-scope displays the area 1000 m – 10 km ahead of the aircraft.
The terrain avoidance mode is disengaged when the radar mode selector is set to A0, so that switch between PPI (A1) and B-scope (A2) can be made without disengaging the terrain avoidance mode.

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PS-37/A RADAR
5 – Radar Modes
5.6 - Memory Mode

When pressing the Memory (*Minne*) Mode button, the radar transmitter will cease to transmit and the current radar picture will be frozen. The displayed picture will last about 30 seconds.

- The normal radar functionality will return:
    - If the radar mode selector is set to A0 or A2, or;
    - if the terrain avoidance mode button is pressed.

- The Memory Mode is used in case you want to study the radar picture, but do not want to keep transmitting radar signals.

Radar Mode Selector
- A0: Radar OFF
- A1: Radar ON, Wide Search Mode with Sector PPI
- A2: Radar ON, Narrow Search Mode with B-Scope

Radar Terrain Avoidance Selector
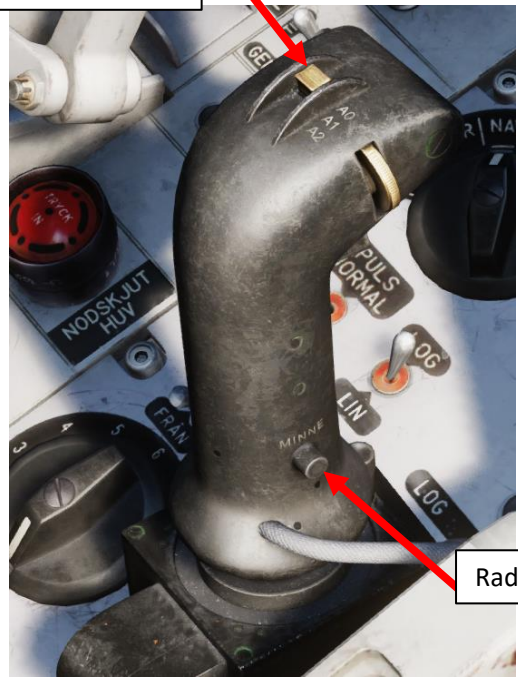
Radar Memory (*Minne*) Mode Button

Fleet of Ships
(Spotted on Radar)

Radar is Scanning

Memory Mode Inactive
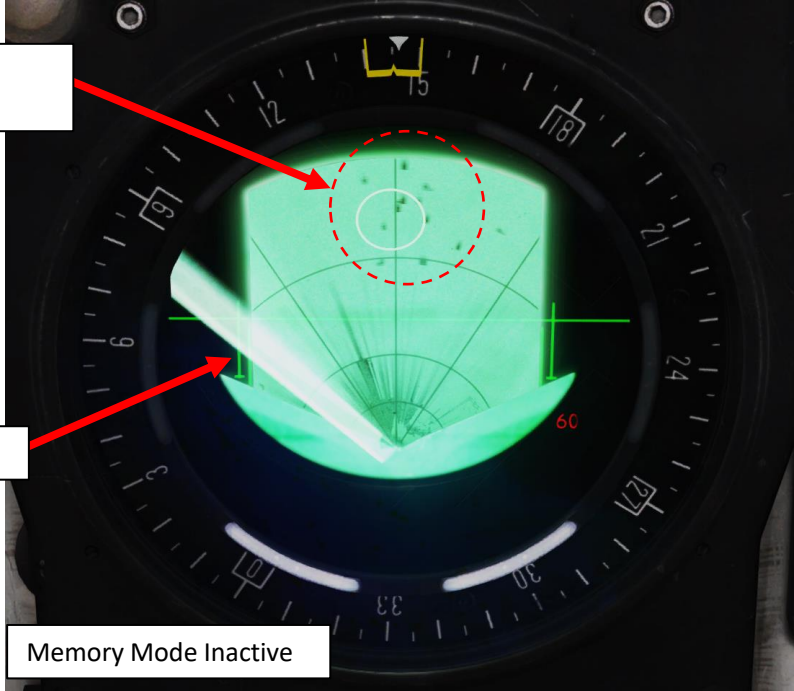
Fleet of Ships
(Memorized on Radar Display)

Memory Mode Active
Radar Display is Frozen for 30 sec
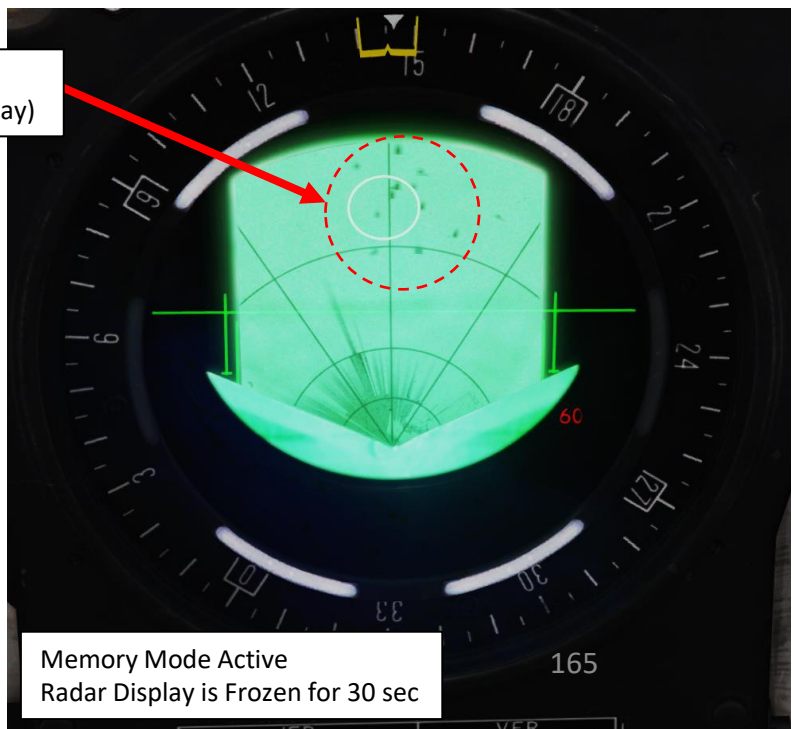
PS-37/A RADAR
6 – Radar Returns

Air-to-Ground Radar Returns

The air-to-ground mapping features of the radar is mostly used for navigation.
Ground radar returns are black / dark green, while water is white / light green.
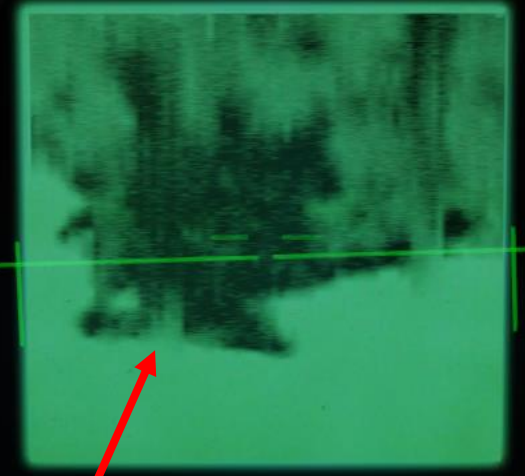
Radar Ground Returns
(B-Scope)
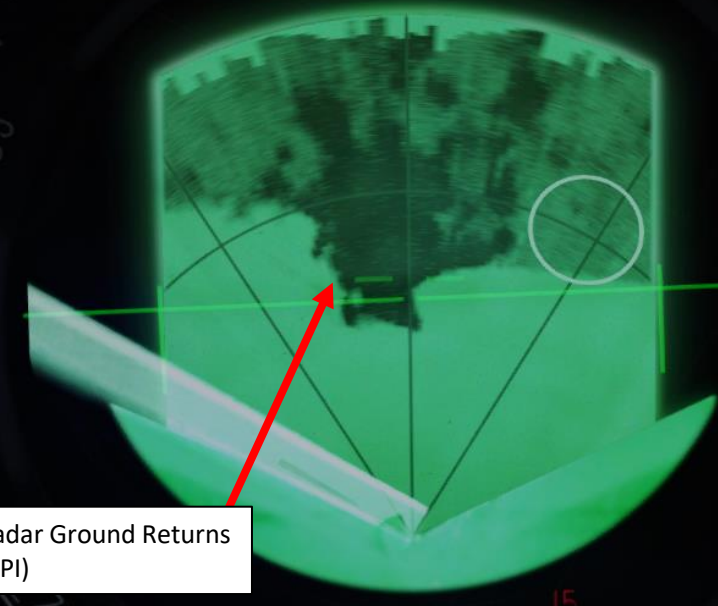
Radar Ground Returns
(PPI)

PS-37/A RADAR
6 – Radar Returns

Air-to-Sea Radar Returns

The radar's primary use for anti-ship operations is to spot ships. Ground and ship radar returns are black / dark green, while water is white / light green.

Radar Ship Contact Returns

Radar Jamming Signals

PS-37/A RADAR
6 – Radar Returns

Radar Mode Selector – A1
(Wide Search with PPI)
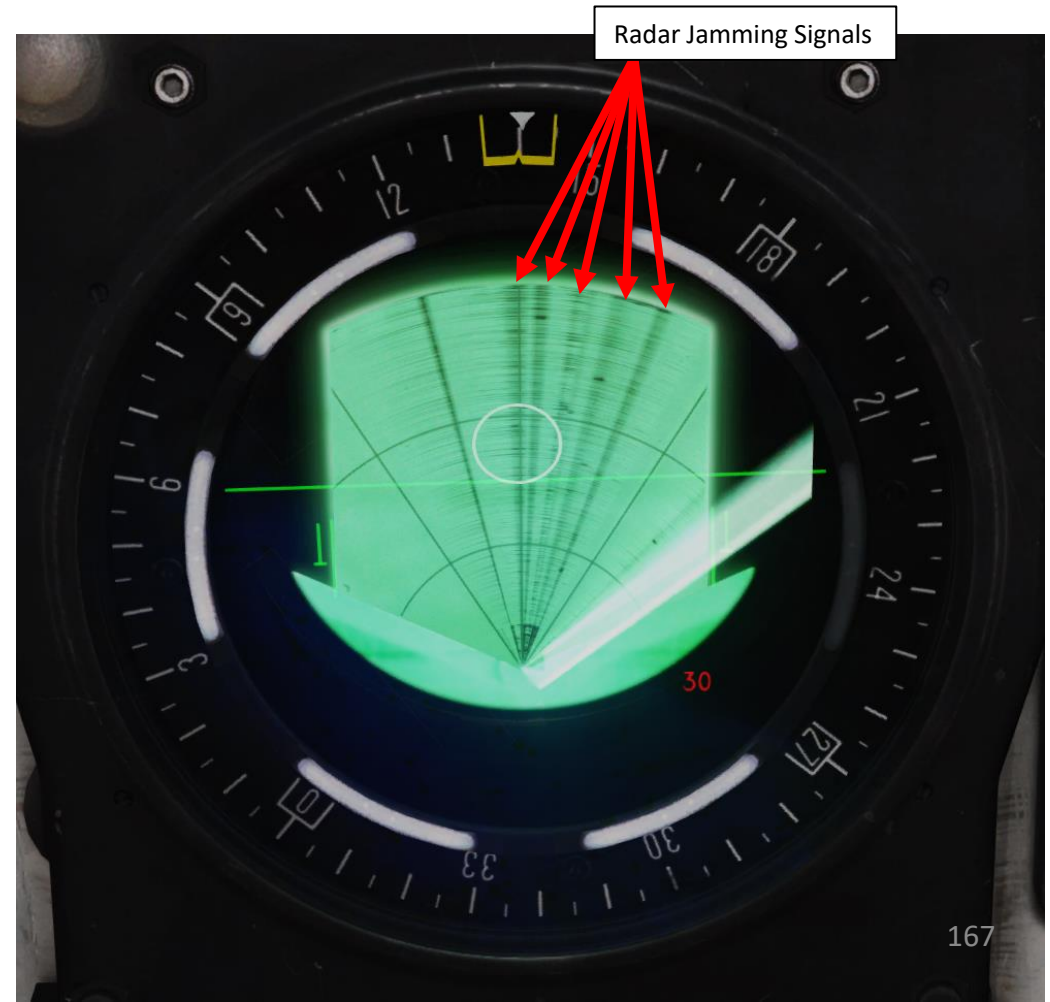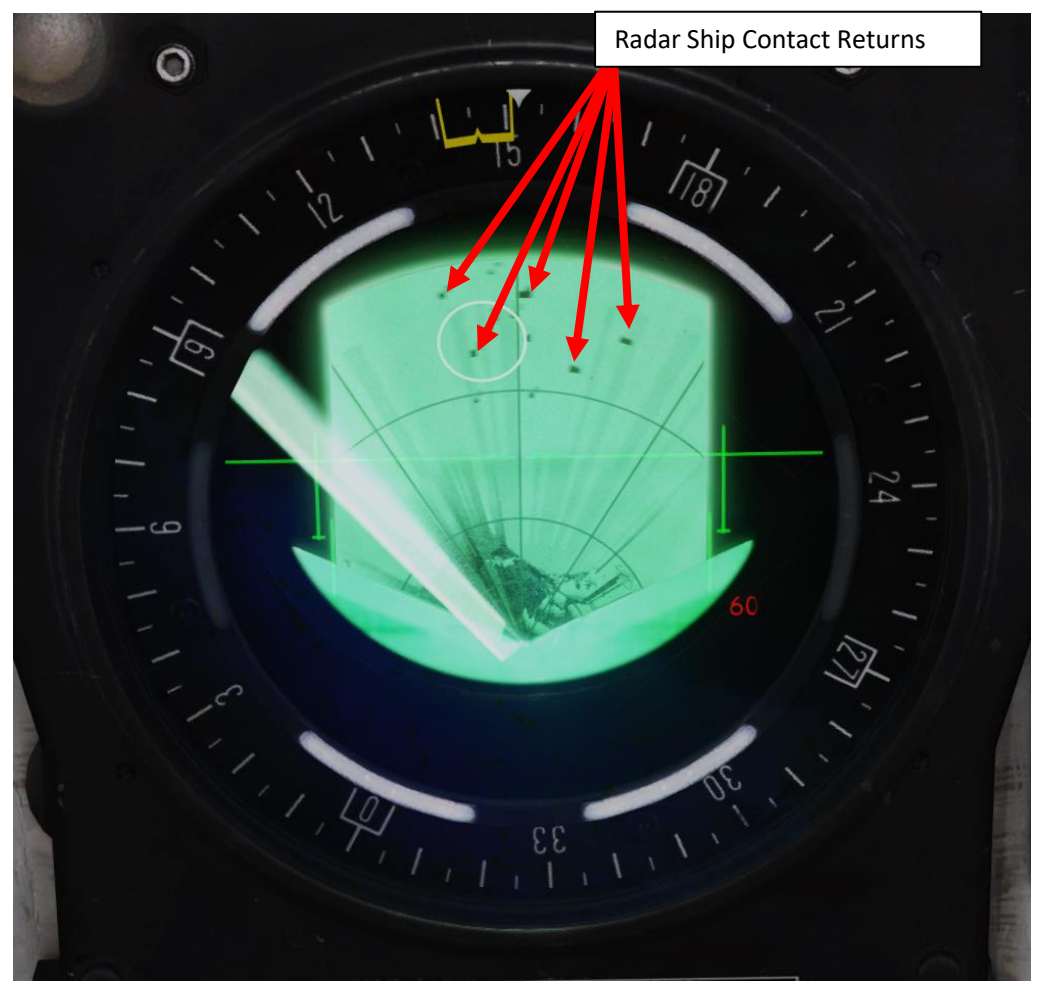
The radar can pick up large airplanes but might not spot smaller ones

Air-to-Air Radar Returns

The radar can be used in a limited air-to-air mode, which is used to roughly determine the position of potential targets. The radar mode is essentially the ground mapping radar but elevated upward. As such, it is unable to display targets as specific symbols or targets, but merely radar returns in an unfiltered form. The performance of the radar is dependent on the contrast between the target aircraft and the ground clutter. The elevation of the radar is centered to +1.5° relative to the horizon, and can be manually elevated using the radar elevation knob. In the air-to-air mode, the antenna elevation indicator is added to the top part of the radar scope indicating the elevation of the beam relative to the 1.5° center. The radar in search mode cannot be used to lock the target. However, the radar can be used for ranging to determine whether the target is within the selected weapon's envelope.

The air-to-air mode is selected by:
1. Setting the weapons selector to any of the air-to-air weapons positions: RB05 LUFT (RB05 A/A), AKAN JAKT (gunpods A/A), or IR-RB (IR missile)
2. Setting the radar mode to either A1 (PPI) or A2 (B-scope)

Weapon Selector

Antenna Altitude/Elevation Indicator

Antenna Altitude Center

Antenna Altitude Low

Antenna Altitude High

Radar Air Contact Returns
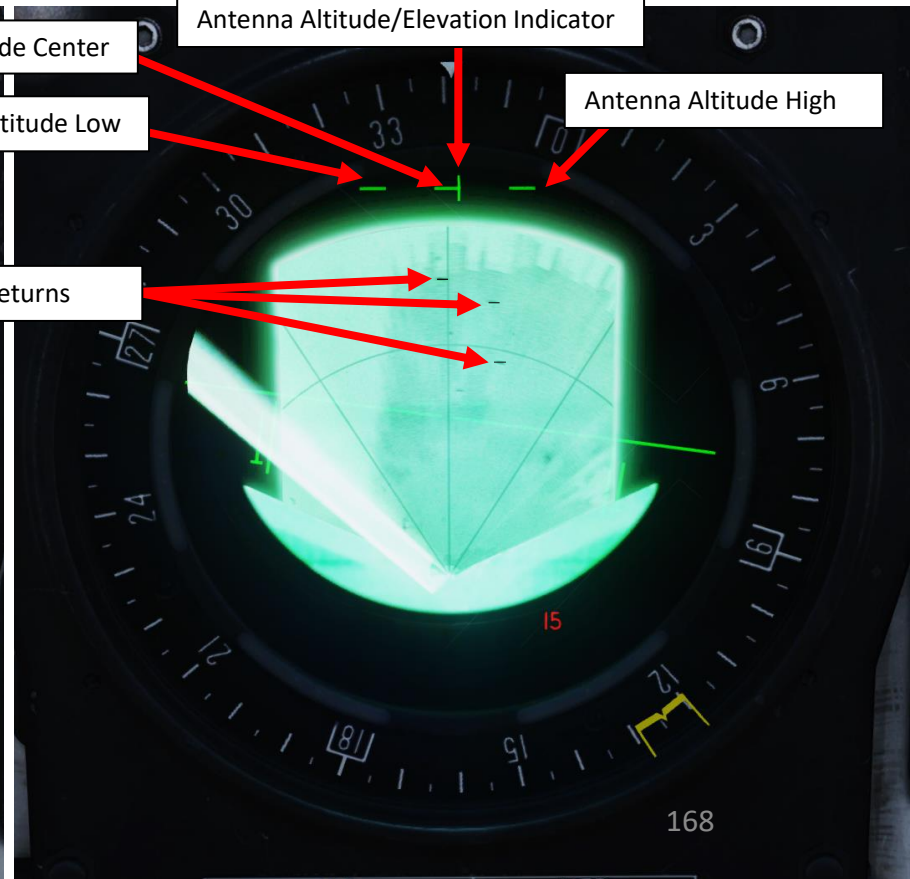
PS-37/A RADAR
7 – Creating a Radar Fix

The radar can also be used to create "fixes". Target fixing with radar is one of the main methods of determining the target position in navigation system for weapons guidance and calculation of release points of weapons. In other words, creating a "radar fix" will allow you to translate/move an existing waypoint over a target (like a ship) that you see on the radar screen.

To perform a radar fix on ships spotted on the radar:

1. Set Master Mode to either NAV or SPA
2. Make sure a valid Target Point M# is selected. As an example, we will use Target Point M2. The existing target point should be relatively close to the expected location of the ships.
3. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
4. You should see the Target Point close to the ships (identified as black spots), but not quite aligned. We will now align the Target Point on a specific ship using a Radar Fix.
5. Press the radar fix trigger to "T1" (first trigger detent). The "M2" waypoint indicator will switch to a flashing "E2", which indicates the radar fix creation is in progress.
6. Move crosshair over target using the radar stick controls
7. Press the radar fix trigger to " TV" (second trigger detent), which will set the radar fix on the target. This will become the new location of target point M2.
- *Check the PART 16 - Navigation to know more about navigation and target radar fixes.*

3 Radar Mode Selector – A1 (Wide Search with PPI)

6a

Radar Stick Control:
- Radarstick Up/Down/Left/Right

Master Mode Selector

1

2 M 2

5b E 2

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

5a

7a

Ships

4 Target Point M2 Original Location

Crosshair **5b**

Crosshair **6b**

Radar Fix (New M2) **7b**
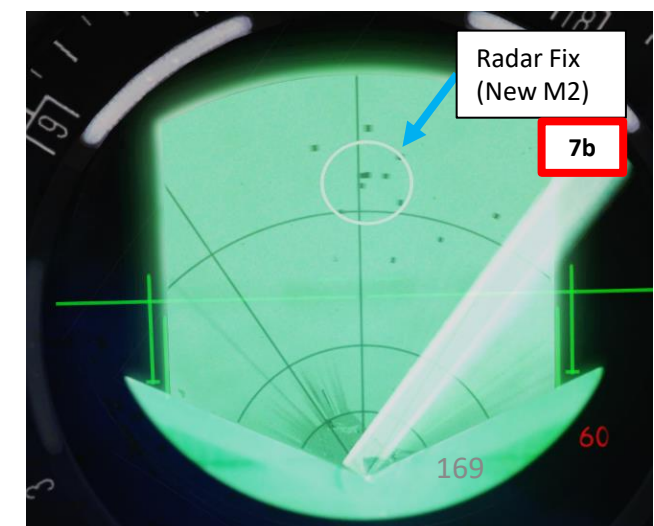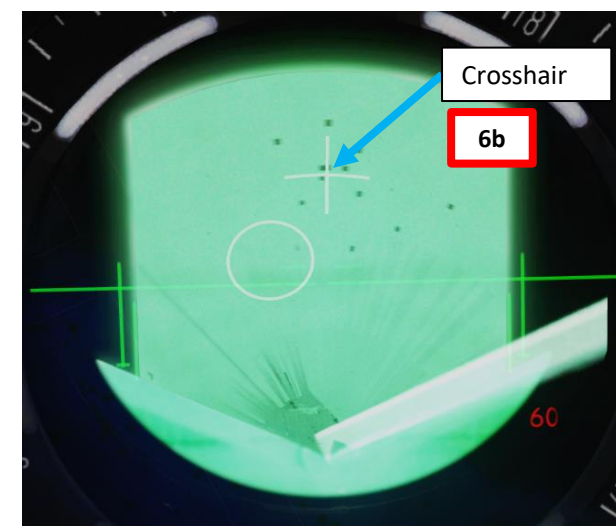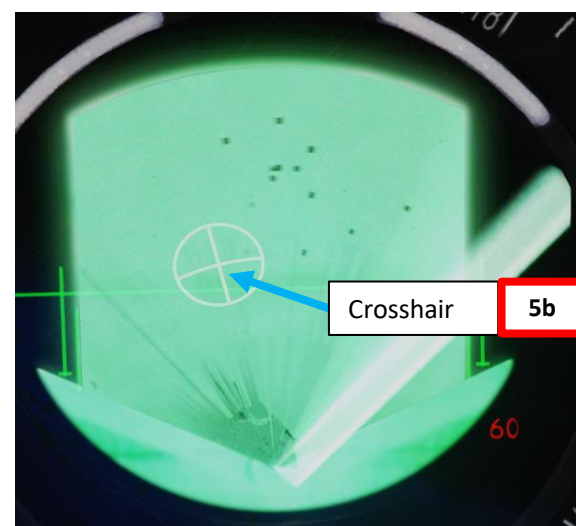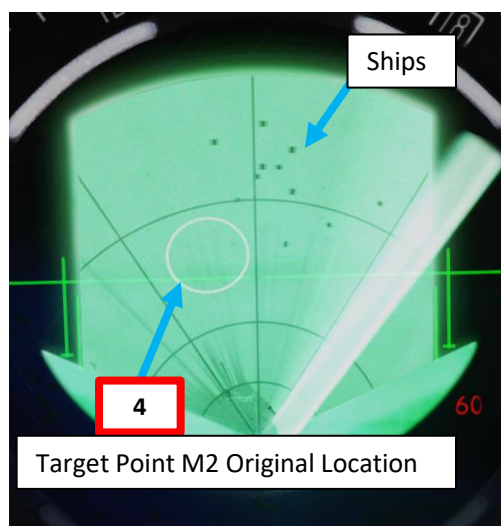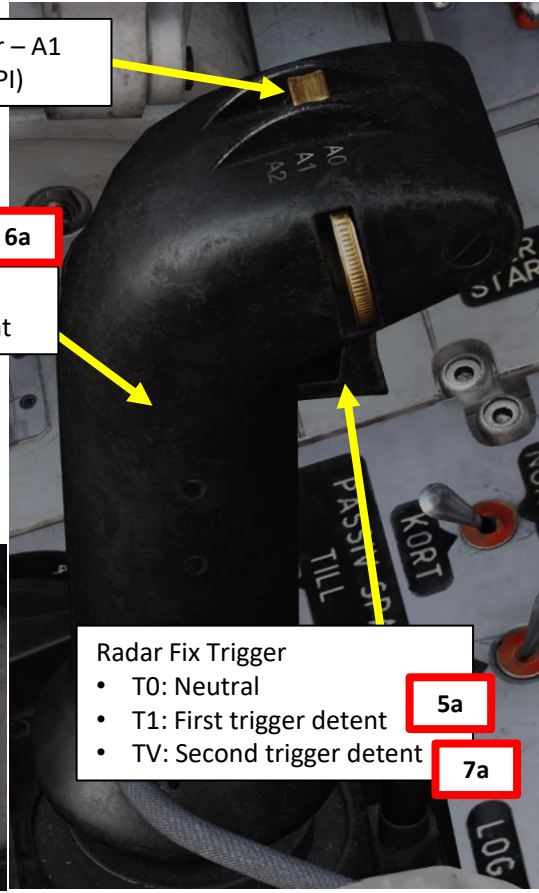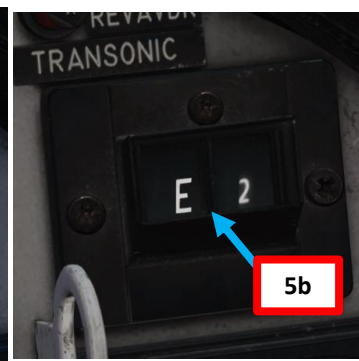
Master Modes Overview

The Master Mode selector determines the primary operating mode of the aircraft. It can select the following modes:

- **FK** (Green Arrow): Function check [no function in DCS].

- **BER** (*Beredskap*, Readiness): Standby mode. Used during start-up and data input prior to taxi.

- **NAV**: Navigation mode. Used during most navigation flying.

- **ANF**: (*Anflygning*, Attack). Used for weapons employment (with certain exceptions).

- **SPA**: (*Spaning*, Reconnaissance). Used for reconnaissance functions.

- **LANDNING NAV**: Navigation Landing. Used for instrument approaches and TILS approaches.

- **LANDNING P/O**: (PAR, Precision Approach Radar / Optical). Used for visual approaches and landings.

Master Mode Selector
- GREEN ARROW (FK)
- BEREDSKAP
- NAV
- ANF
- SPA
- LANDN NAV
- LANDN P/O
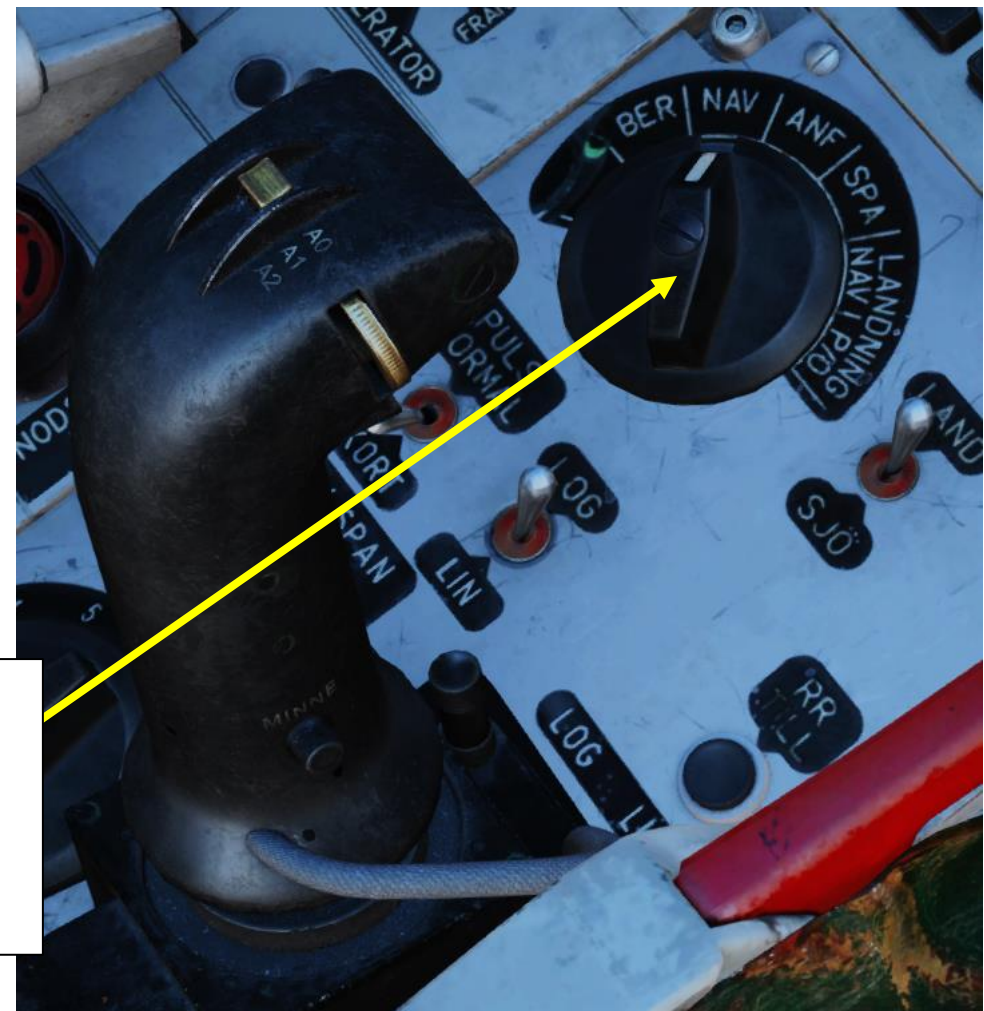
Master Modes
FK & BER (*Beredskap*/Standby) Modes

The **FK (Function Check)** Master Mode, represented by a green arrow, is not simulated in DCS and is mainly used for maintenance.
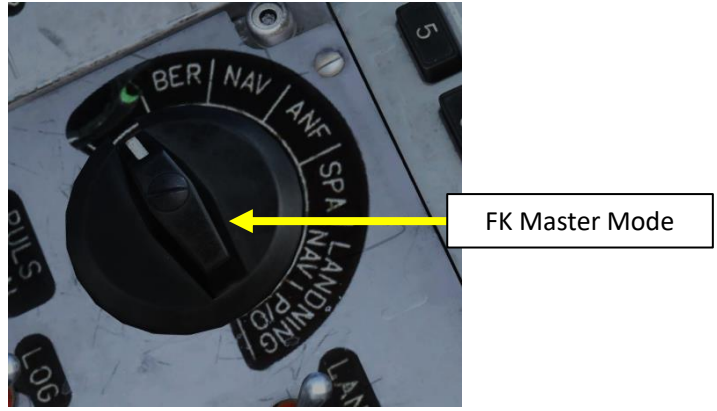
FK Master Mode

The **BER** (*Beredskap*, Readiness) Master mode is used as a "Standby" mode. This mode is mainly used while:
- The aircraft is on the ground prior to taxi, or
- When the aircraft has landed and is taxiing back to the parking slot.

While BER mode is set, the HUD (Heads-Up Display) will not show any symbology.

Setting BER mode is required if you want to compile ELINT (Electronic Intelligence) reports after a reconnaissance mission. Failing to do so after a flight might cause issues for the navigation system as well for subsequent flights.
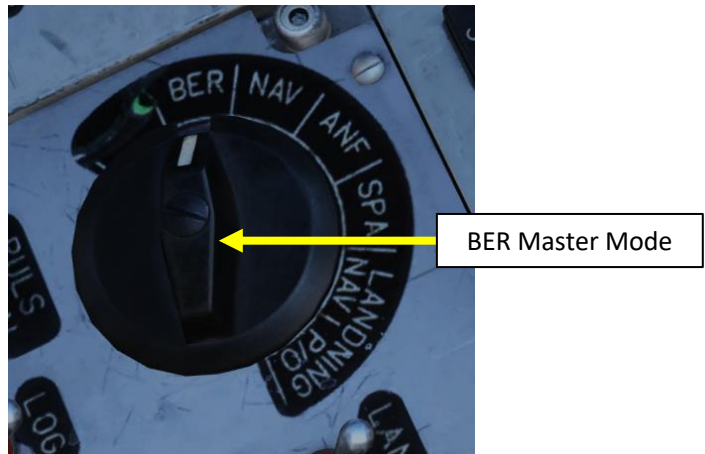
BER Master Mode

Master Modes
NAV (Navigation) Mode

The NAV (Navigation) Master Mode will set your HUD (Heads-Up Display) to show symbology related to navigation, including pole tracks, the velocity vector, the pitch lines and the time line. This mode should be used whenever you are flying and do not need to use weapons yet.

The CI (Central Indicator) will also display waypoint symbols (circles) provided the Radar Mode Selector is set to either A1 (PPI display format) or A2 (B-Scope display format).
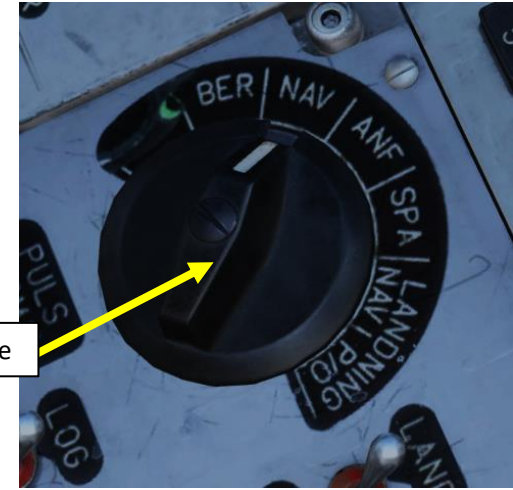
NAV Master Mode

Radar Mode Selector – A1
(Wide Search with PPI)

HUD (Heads-Up Display) in NAV

CI (Central Indicator) in NAV

Waypoint

172

Master Modes
ANF (*Anflygning*/Attack) Mode

The ANF (*Anflygning*/Attack) Master Mode will set your HUD (Heads-Up Display) to show symbology related to attack cues during weapon employment. The HUD symbology will vary depending on the kind of weapon and release mode selected.

In ANF Master Mode and specific weapon delivery modes (for instance ATTACK), the CI (Central Indicator) will not display any radar data. In other weapon delivery modes (for instance RR, radar release) the radar will work. The pilot is expected to already have visually acquired the target by that point.

- For some weapon modes, when in master mode ANF (and the trigger is set to Unsafe), the radar will range the distance to the target if the triangulated range is about ≤ 7000 m.
- Automatic waypoint selection is not available in mode ANF.

HUD (Heads-Up Display) in ANF

CI (Central Indicator) in ANF (Weapon Selector – ATTACK)

ANF Master Mode

Weapon Selector
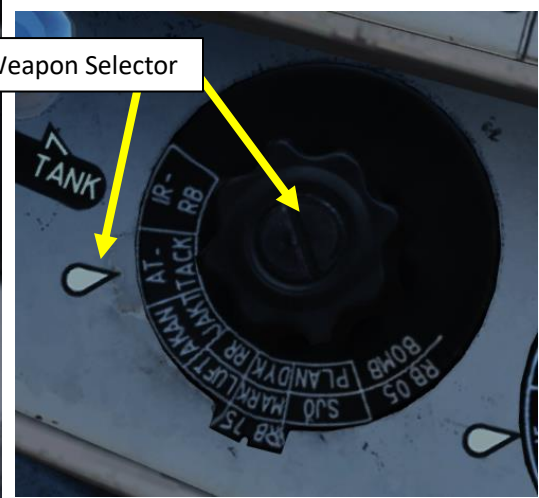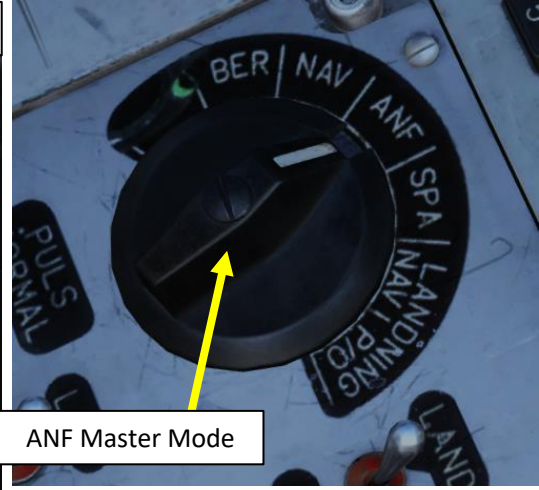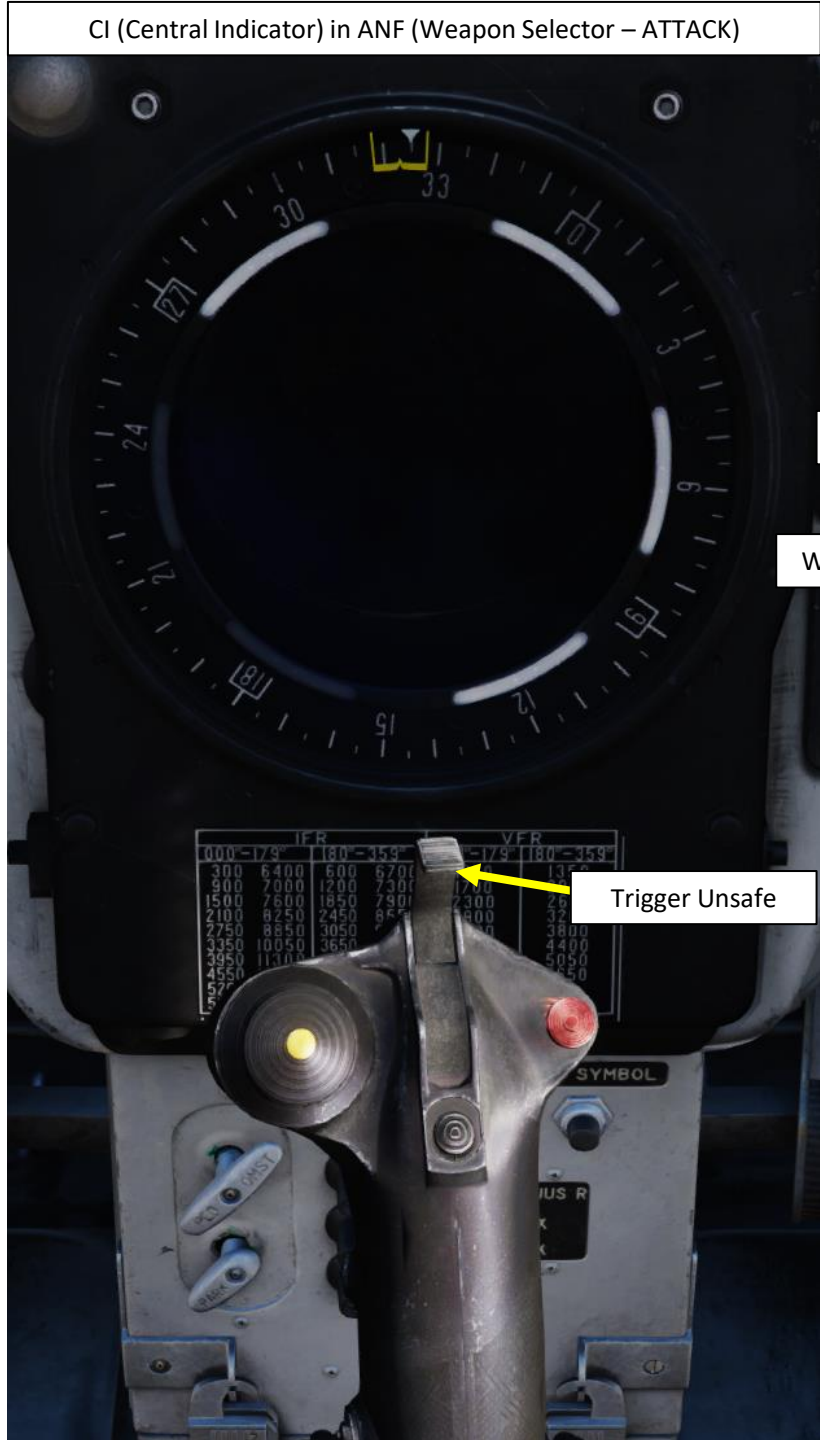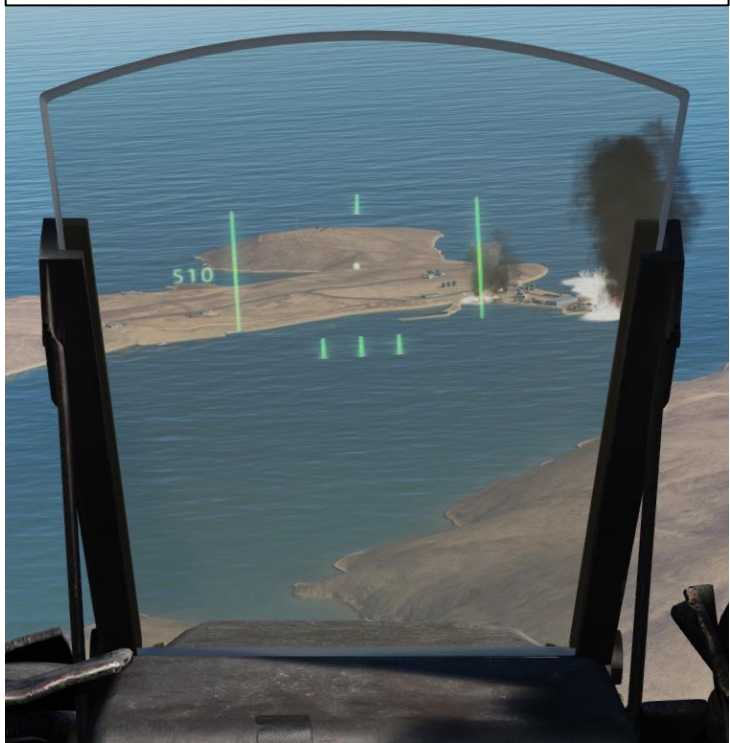
Trigger Unsafe

Master Modes
SPA (*Spaning*/Reconnaissance) Mode

Most of the reconnaissance functions are used in master mode SPA, which stands for "*Spaning*", or "Reconnaissance".

The SPA Master mode allows you to use the two reconnaissance sub-modes:
1. **SPA/ MÅL**: Target measurement sub-mode. Used to determine the position of reconnaissance targets such as ships. Yields a coordinate with a timestamp.
2. **SPA / SKU**: Target tracking sub-mode. Used to determine the course and speed for previously measured targets.

When SPA Master Mode is selected:

- The radar display is in the form of a pre-determined patrol area (usually a square, but can be any other shapes based on the position of the corner points "R").
- Timekeeping is paused
- Airspeed deviation fin is reset.
- Fuel requirement is between the current position to the primary landing base, based on to requirement need to return to base with current parameters along with the set fuel reserve.
- Automatic destination change is inhibited. When changing from mode SPA, the previous destination waypoint will be selected automatically.
- Display on the data panel and destination indicator changes to the reconnaissance mode

Note: More information about SPA is available in the "Reconnaissance (Recce)" section of this document.
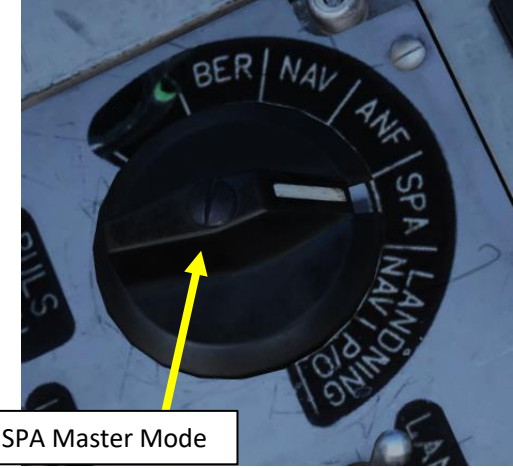
SPA Master Mode

CI (Central Indicator) in SPA

RUTA Marker
(Circle and Line)

120

174
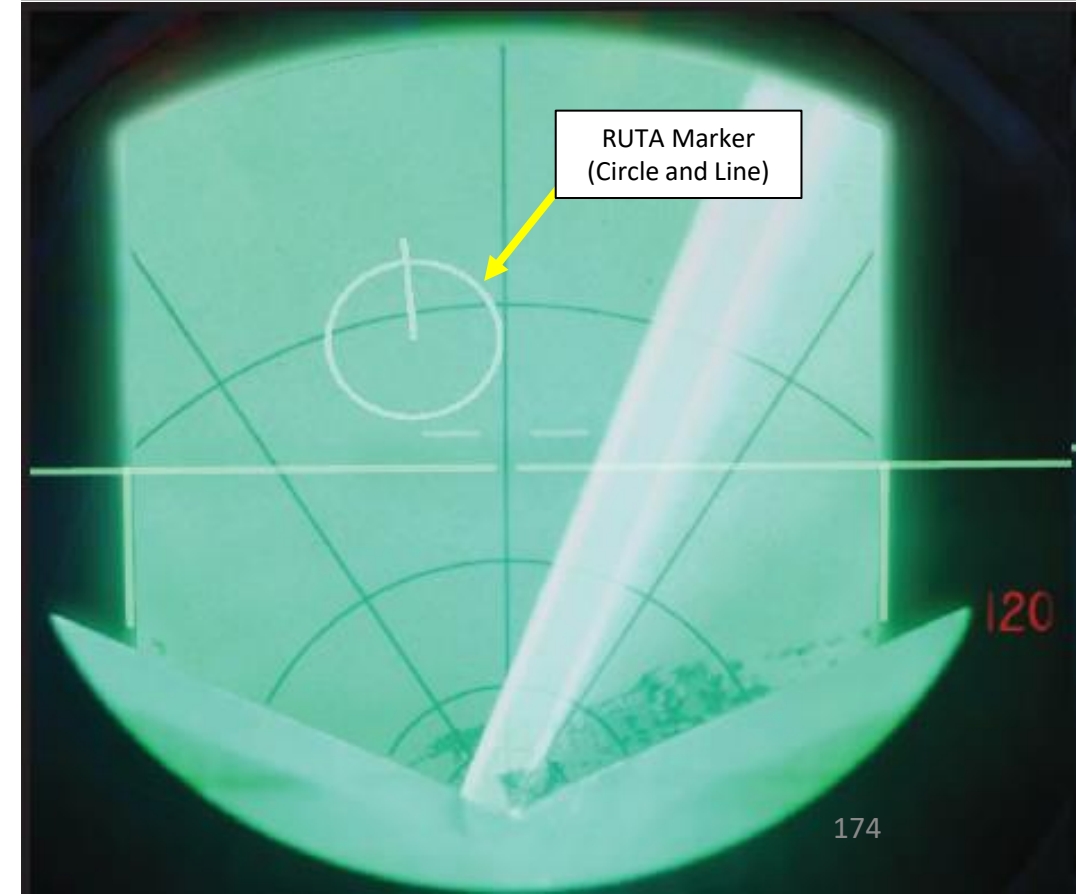
Master Modes
LANDN NAV (Navigation Landing) Mode

The LANDN NAV is used for an instrument approach or a TILS approach. The HUD and CI (Central Indicator) will display symbology related to the type of waypoint selected (LB1, LB2, LF1, or LF2) and where you are during the approach in terms of distance and altitude. This mode is mainly employed to help you during the approach and landing phases in low visibility conditions.

The CI symbology displays an extended runway centerline for both the Approach Waypoint (LB1) and the Touchdown Waypoint (LF1). This runway centerline is derived from the runway heading entered in the CK37 computer via the BANA/GRÄNS mode.

Approach Waypoint (LB1) Selected
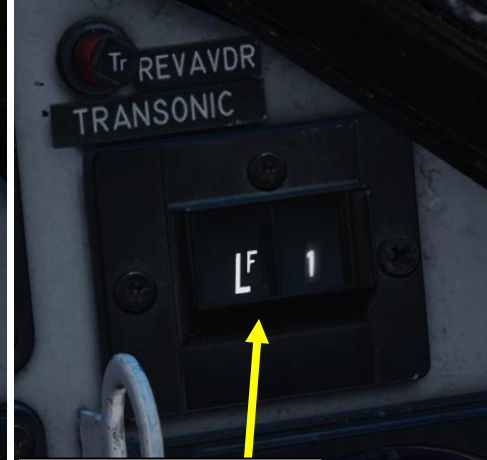
Touchdown Waypoint (LF1) Selected
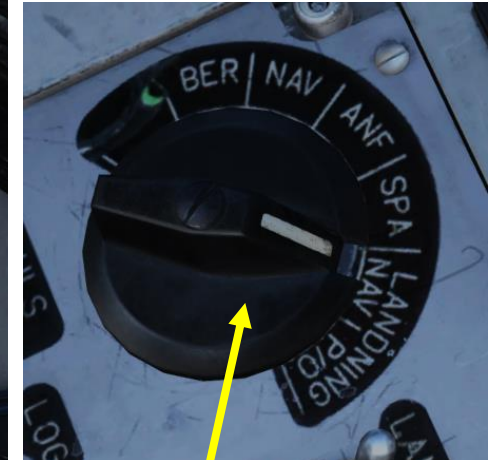
LANDN NAV Master Mode

CI (Central Indicator) in LNDN NAV

Touchdown Waypoint LF1

Extended Runway Centerline
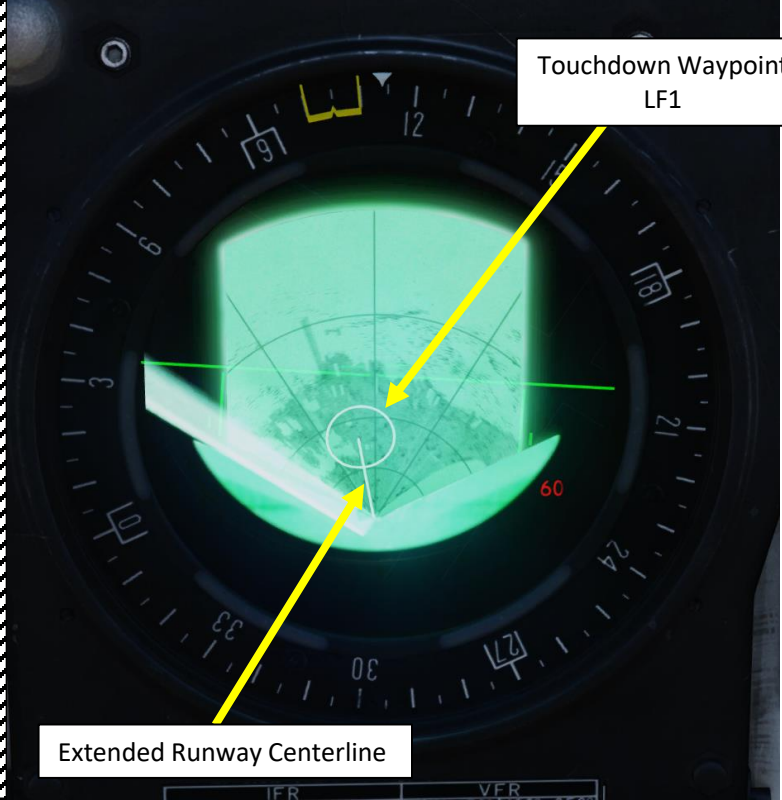
HUD (Heads-Up Display) in LANDN NAV – During Approach
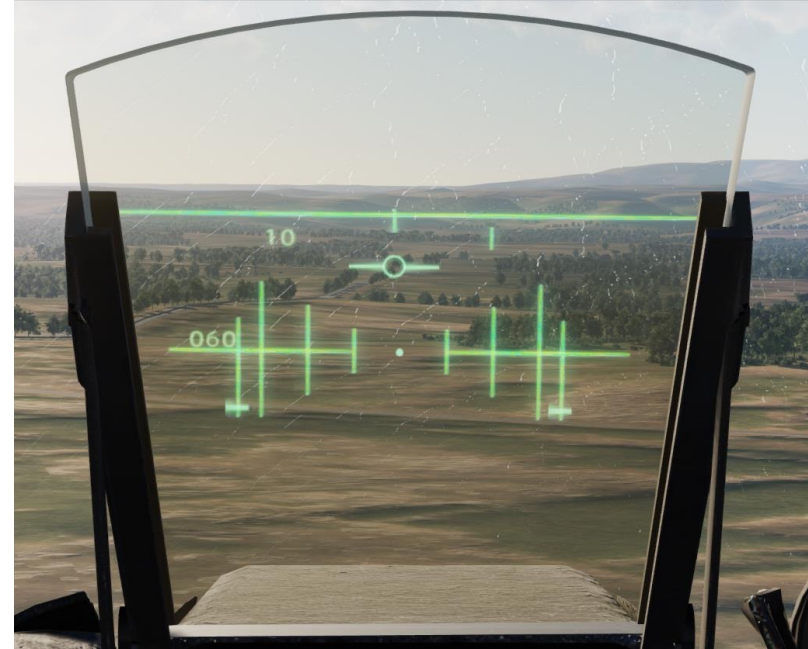
HUD (Heads-Up Display) in LANDN NAV – Prior to Touchdown

Master Modes
LANDN P/O (PAR, Precision Approach Radar / Optical Landing) Mode

The LANDN P/O (which stands for *Precision Approach Radar / Optical Landing*) is used for a visual approach.

The HUD and CI (Central Indicator) will display symbology to guide you once you have visually acquired the landing site. Keep in mind that in that mode, the waypoint visible on the CI has no extended runway line to guide you (unlike the LANDN NAV Master Mode provides).

This mode is mainly employed to help you during the approach and landing phases where visibility is good and you have the runway in sight.
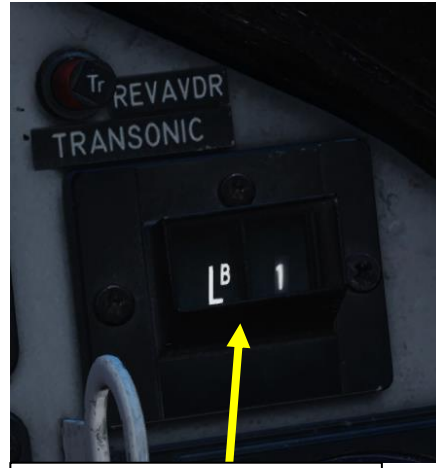
Approach/Landing Waypoint
(LB1) Selected

LANDN P/O Master Mode

HUD (Heads-Up Display) in LANDN P/O

CI (Central Indicator) in LNDN P/O

Approach/Landing Waypoint
LB1 / L1
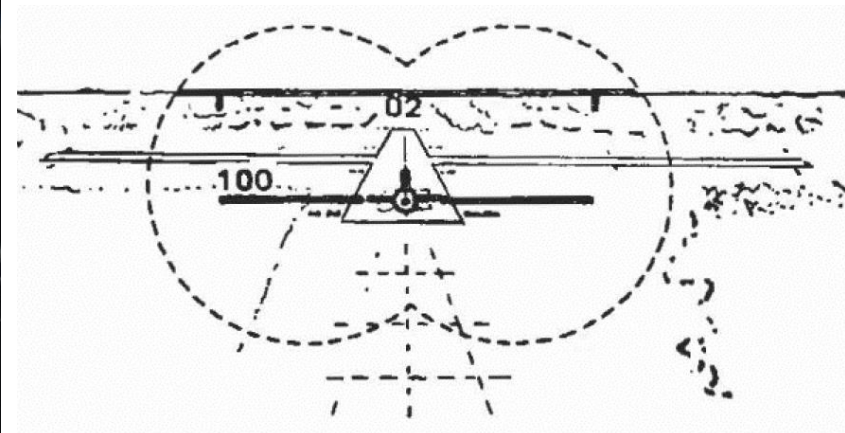
HUD Symbology in mode LANDN P/O

CK37 (*Central Kalkylator 37*) Computer Introduction

The CK37 (Central Kalkylator 37) aircraft computer is one of the first computers mounted to an aircraft. The purpose of the computer is to enable far more advanced avionics and perhaps more importantly, integrated avionics system.

The CK37 can be seen as the central nervous system linking the large number of individual systems together. The computer is programmed to handle primary flight data, presentation for avionics, navigation, as well as sight and weapon calculations.
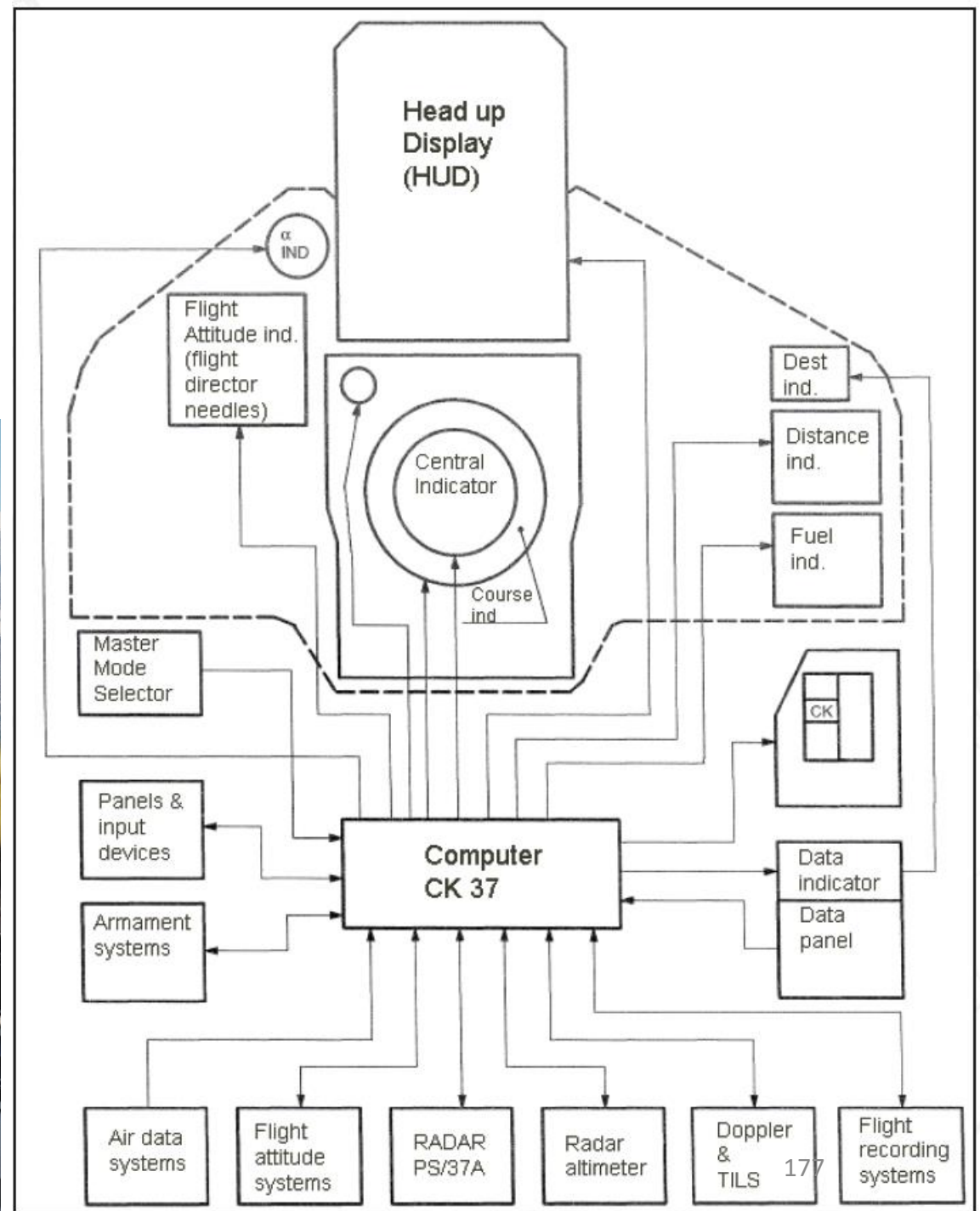
CK37 (*Central Kalkylator 37*) Computer Data Display & Entry Panel

The main interface between the pilot and the CK37 computer is the CK37 Computer Control Panel.

Data selector modes:

- **AKT POS:** Shows current position (UT/ OUT only).
- **REF LOLA:** Used to input reference number or Longitude / Latitude coordinates.
- **BANA / GRÄNS:** Runway headings and TILS channels. Used to set boundaries for waypoints.
- **VIND / RUTA / MÅL:** Wind direction and strength for entered wind. Selection between Doppler-derived wind and entered forecast wind. Positions of corner points for reconnaissance squares.
- **TID**: Current time, Time on Target. Ingress Mach number. Reconnaissance fixes.
- **TAKT**: Mission data, fuel reserve, defining target waypoints and pop-up points. Stand-off data. TERNAV on / off. Used to define certain system settings.
- **ID-NR:** Identification number. Readout of reconnaissance data. Readout of addressed data.

IN / UT (OUT) switch: Toggles between input and output modes in each mode.

RENSA (CLEAR): Can be used on the ground to partially or completely clear all stored data. Can be used during flight to reset fix-correction and target fixes.

CK37 (*Central Kalkylator 37*) Computer Data Display & Entry Panel

CK37 (*Central Kalkylator 37*, or Central Computer 37) Aircraft Computer Control Panel

Navigation Data Indicators

Navigation INPUT/OUTPUT Selector
- IN: Input
- UT: Output

Navigation Data Keypad (1-9)

Navigation Data Clear (*Rensa*) Button
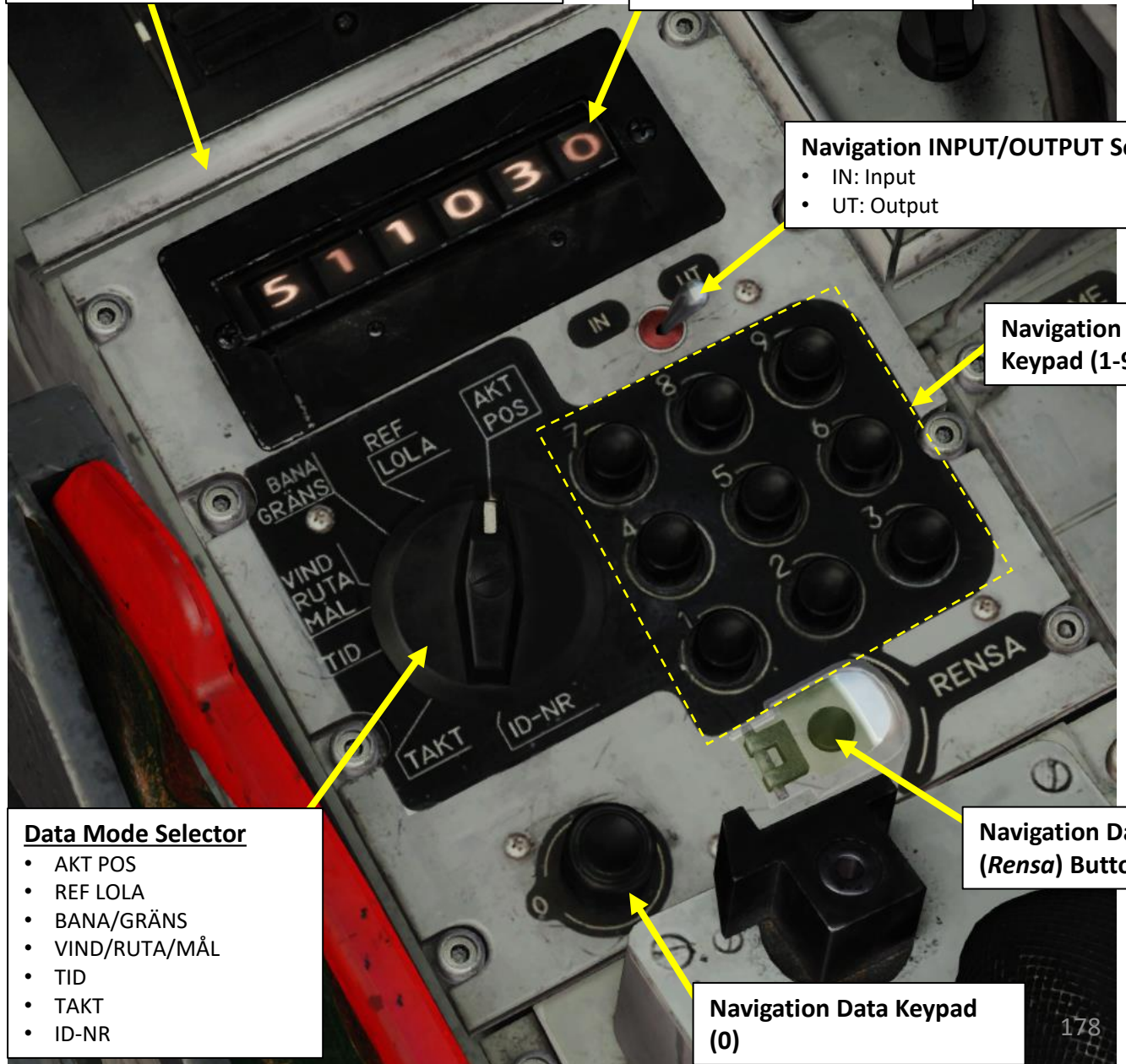
Data Mode Selector
- AKT POS
- REF LOLA
- BANA/GRÄNS
- VIND/RUTA/MÅL
- TID
- TAKT
- ID-NR

Navigation Data Keypad (0)

CK37 (*Central Kalkylator 37*) Computer Data Display & Entry Panel

Waypoint selectors are used in conjunction with the CK37 Computer Control Panel and allow you to select navigation waypoints within the database and edit their properties accordingly.

Waypoint selectors: Used to either select a waypoint or readout the saved coordinates.

- **B1 – B9**: Normal navigation waypoints.
- **BX**: Selects a BX point (BX1-9) in combination with the data panel keypad.
- **L/MÅL**: Landing base or reconnaissance target.
- **LS / SKU**: Take-off base or tracked target (reconnaissance).
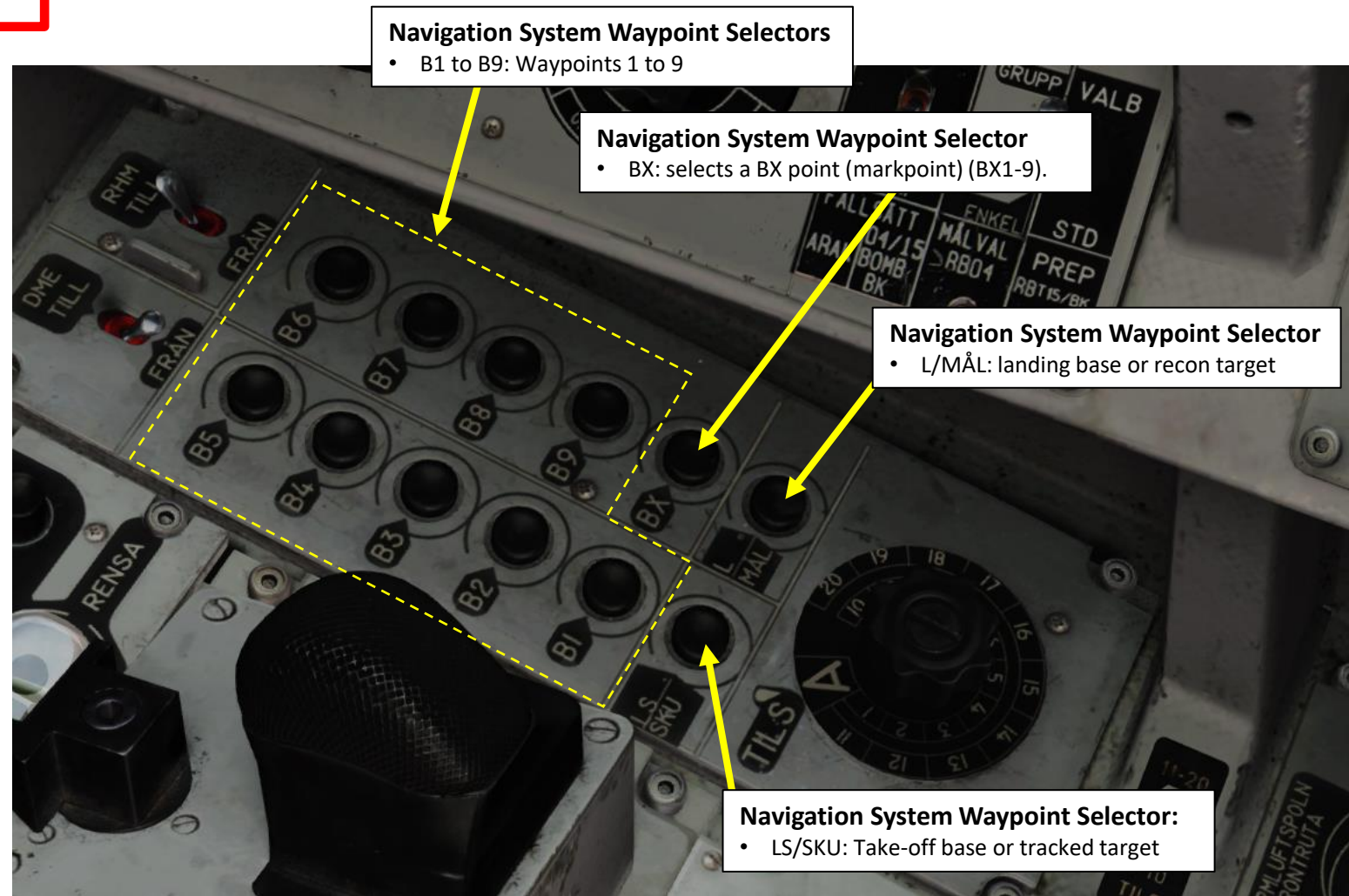
Navigation System Waypoint Selectors
- B1 to B9: Waypoints 1 to 9

Navigation System Waypoint Selector
- BX: selects a BX point (markpoint) (BX1-9).

Navigation System Waypoint Selector
- L/MÅL: landing base or recon target

Navigation System Waypoint Selector:
- LS/SKU: Take-off base or tracked target

CK37 (*Central Kalkylator 37*) Computer Data Input/Output Basics

To input (enter) data within the CK37 computer, the INPUT/OUTPUT selector must be set to IN.

To consult output data from the CK37 computer, the INPUT/OUTPUT selector must be set to UT.

Data Input Procedure

Select Data Mode -> Select IN -> Use keypad to enter data -> Use Waypoint Selector -> Select OUT

Data Output Procedure

Select Data Mode -> Select OUT -> Use Waypoint Selector (if required)
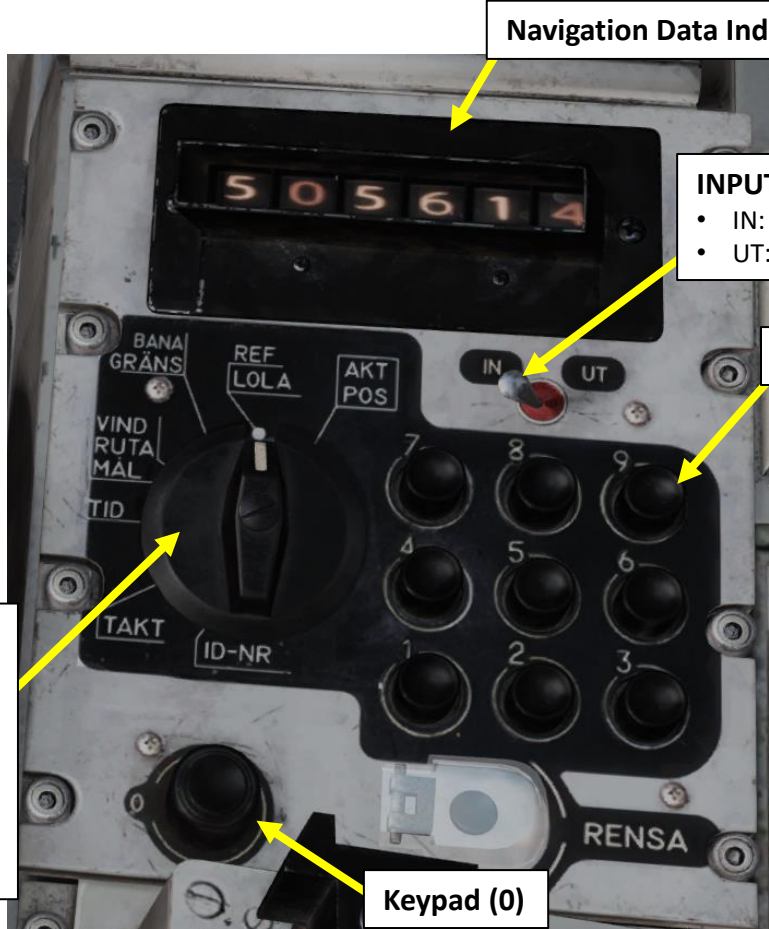
Navigation Data Indicators

INPUT/OUTPUT Selector
- IN: Input
- UT: Output

Keypad (1-9)

Data Mode Selector
- AKT POS
- REF LOLA
- BANA/GRÄNS
- VIND/RUTA/MÅL
- TID
- TAKT
- ID-NR

Keypad (0)

Waypoint Selectors

CK37 (*Central Kalkylator 37*) Computer Computer Address Codes Cheat Sheet

CK37 Input Codes

Mode	Input	Confirm	Function	Parameters
REF LOLA	9099	LS/SKU	Load Data	Data transfer from cartridge.
	90XX	L/MÅL	L1	Reference number XX of landing base L1.
	99XX	L/MÅL	L2	Reference number XX of divert base L2.
	DDMMSS	L/MÅL	Lo/La L1	**Lo**ngitude/**La**titude of landing base L1.
	DDMMSS	B1–B9	Lo/La WP	Lo/La (or Ref.# 9XXX) of WP B1-B9.
	DDMMSS	BX+Y	Lo/La Bx	Lo/La (or Ref.#) of mark point BxY (Y=1-9)
BANA GRÄNS	XXXYZZ	LS/SKU	Takeoff RWY	Heading XXX.Y [deg] and TILS channel ZZ.
	XXXYZZ	L/MÅL	Landing RWY	Heading XXX.Y [deg] and TILS channel ZZ.
	XXXYYY	B1–B9	Boundary Lines	First XXX [deg] and second YYY [deg] line.
VIND RUTA MÅL	XXXYY	LS/SKU	Forecast Wind	Direction XXX [deg] and speed YY [km/h].
	DDMMSS	B1–B9	Lo/La R1-R9	Long/Lat of recon RUTA points R1-R9.
	DDMMSS	L/MÅL+X	Lo/La M1-M9	Long/Lat of recon target M1-M9 (X=1-9).
TID	HHMMSS	LS/SKU	Current Time	HH=hours, MM=minutes, SS=seconds.
	HHMMSS	B1–B9	ToT WP	Time on Target for nav WP.
	HHMMSS	BX	ToT RB15	Time for RB 15F in target area (at Bx8).
	XYY	B1–B9	Ingress v	Ingress speed X.YY Mach at WP.
TAKT	9	B1–B9	Target WP	Turn nav WP into target WP (B3→M3).
	0		Restore Nav WP	Turn target WP into nav WP (M3→B3).
	XXXYY		Pop-up Point	Heading XXX [deg] and distance YY [km].
	21X		Fixed Sight	X=1 on, X=0 off.
	22X		Lead Correct.	X=1 off, X=0 on.
	23X		Lysbomb	Offset distance X=1,2,3 [km].
	25X	LS/SKU	Radar Lock	X=1 before unsafe, X=2 after, X=3 off.
	30XX		Recon Standoff	Recon warning distance XX [km] (00-99).
	51XX		Fuel Reserve	XX [%] at landing base L1 (10-99).
	58X		TERNAV	X=1 on, X=0 off.
TAKT RB15	800000		Single Target	Large search area.
	800001		Confined Area	Multiple targets N, medium search area.
	800002	LS/SKU	**Unconfined**	**Multiple targets A, medium search area.**
	800003		Convoy Attack	Group target, large search area.
	800004		Bearing Attack	Bearing search mode.
TAKT BK90	91XXX	LS/SKU	Appr. Altitude	XXX [m] (030-500), default **60 m**.
	92X		Area Pattern	X=1 long, X=2 wide, X=3 **compact**.

CK37 Output Codes

Mode	Button	Display 1	2	3	4	5	6	Display shows
AKT POS		D	D	M	M	X	Y	Lo/La of current position.
								TERNAV status and position error [km].
REF LOLA								Lo/La or Ref.# of current destination.
	LS/SKU	D	D	M	M	S	S	Lo/La or Ref.# of LS starting base.
	L/MÅL	9	X	X	X	0	0	Lo/La or Ref.# of L1/L2 landing base.
	B1–B9							Lo/La or Ref.# of depressed WP.
	BX+1–9							Lo/La or Ref.# of Bx mark point.
BANA GRÄNS		X	X	X	X	X	X	Output depends on current destination.
	L/MÅL	D	D	D	D	X	X	RWY heading and TILS channel.
	B1–B9	D	D	D	D	D	D	First and second boundary line heading.
VIND RUTA MÅL		D	D	D	X	X	0	Doppler wind direction & speed [km/h].
	LS/SKU	D	D	D	X	X	□	Forecast wind direction & speed [km/h].
	1–9	D	D	M	M	S	S	Lo/La of SPA/MÅL target.
TID		X	H	M	M	S	S	Deviation of ETA with respect to ToT. X=□ ahead, X=9 behind schedule.
		7	H	M	M	S	S	Relative ETA – if no ToT was set.
	LS/SKU	H	H	M	M	S	S	Current time.
	B1–B9	H	H	M	M	S	S	ToT for target WP.
		X	Y	Y	0	0	0	Ingress speed M X.YY for WP.
	BX	H	H	M	M	S	S	ToT for RB 15 at Bx8.
	1–9	H	H	M	M	S	S	Timestamp of SPA/MÅL target.
TAKT		X_7	X_6	X_5	X_3	X_2	X_1	Weapon status on pylon i (X_i=0 empty).
	B1–B9	9	0	0	0	0	0	Depressed WP button is a target WP.
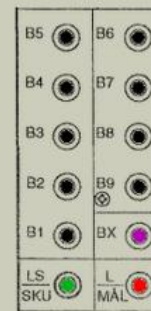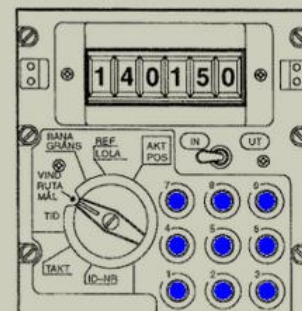
TERNAV status:
0 : inoperable
1 : stand-by mode
2 : rough search mode
3 : fine search mode
4 : operating but not used
5 : operating & sending fixes

Abbreviations:
D = Degrees
H = Hours
M = Minutes
S = Seconds
X,Y = Depending on Context
□ = Empty/Blank

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
AKT POS (Active Position) - INPUT & OUTPUT

AKT POS (Active Position) represents the "Present position" of the aircraft.

- IN/UT Selector set to INPUT: No data displayed

- IN/UT Selector set to OUTPUT: Displays current position as status of navigation system.

    - Digits 1-4: indicate Longitude and Latitude (in degrees and minutes). The data field flashes, alternating between longitude and latitude coordinates.

    - Digit 5: indicates TERNAV status
        - 0: TERNAV inoperable
        - 1: TERNAV OK, but not sending any output (standby mode).
        - 2: TERNAV OK, mode rough search (attempting to orient itself).
        - 3: TERNAV OK, mode fine search (higher resolution, still attempting to orient itself)
        - 4: TERNAV OK and following, but not used.
        - 5: TERNAV OK and operating, system sending automatic fixes to CK37 Flight Computer.

    - Digit 6: indicates the position error in km

AKT POS – OUTPUT

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
AKT POS	No Button Pressed	D	D	M	M	X	Y	• Digits 1-4: Longitude/Latitude of current position in degrees minutes. • Digit 5: TERNAV Status • Digit 6: Position error (km)

TERNAV Status
2 – TERNAV OK, Rough Search

Position Error
1 km

INPUT/OUTPUT Selector
- UT: Output

Longitude
41 deg 55 minutes

AKT POS Selected
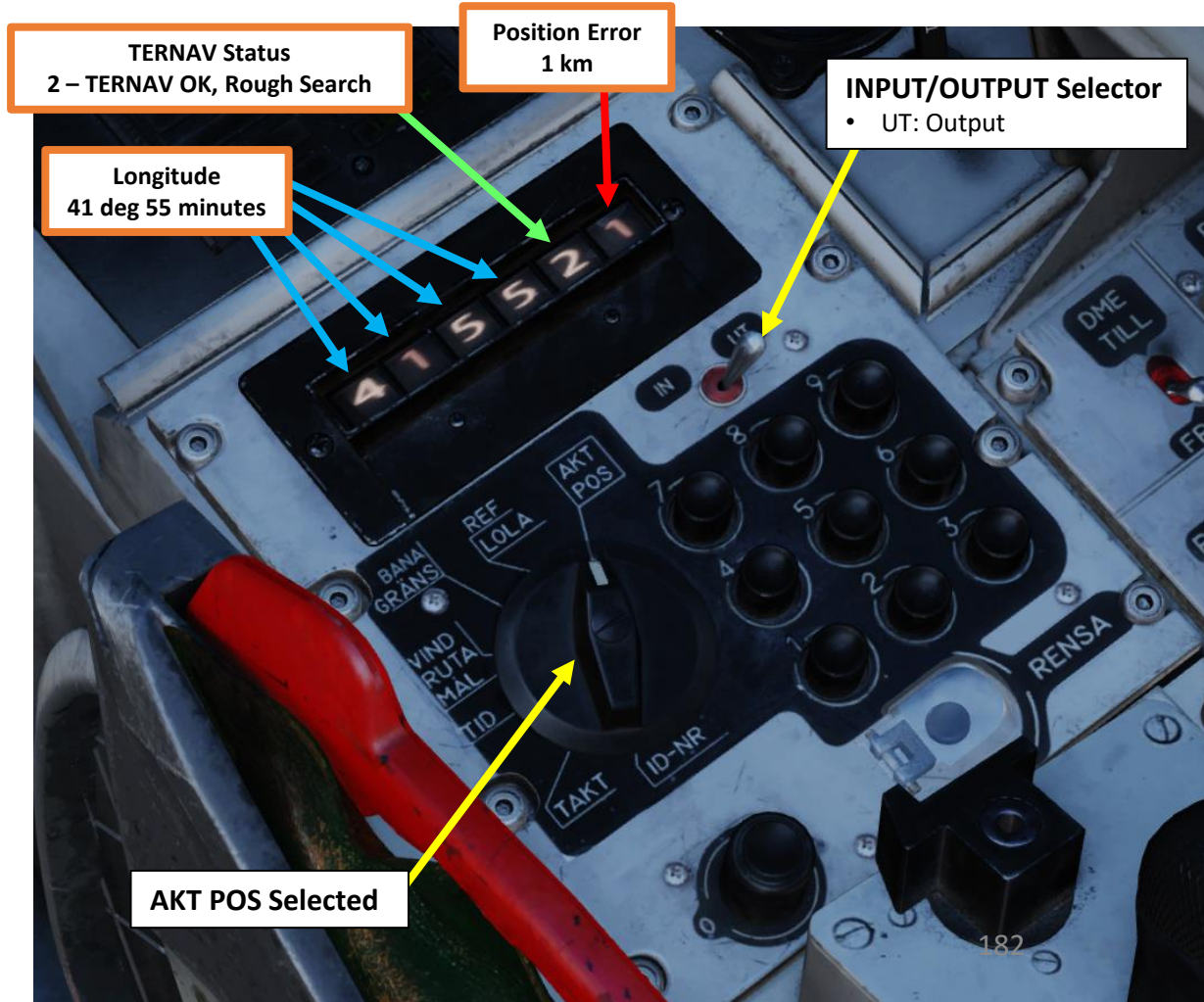
CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
REF/LOLA (Reference Longitude-Latitude) - INPUT

REF LOLA: Reference number or longitude / latitude coordinate positions of waypoints, start base and landing base. Coordinates can either be entered as reference numbers (90XX) for pre-loaded positions or as longitude / latitude coordinates (six digits each in degrees, minutes and seconds).

To input/enter data for a specific waypoint:
1. Set IN/UT Selector to INPUT
2. Use keypad to enter input data (reference code or coordinates)
3. Press Waypoint selector button of your choice (B1, B2, L/MÅL, etc.)
4. Set IN/UT Selector to OUTPUT

Reference Code 9012 (Senaki)

INPUT/OUTPUT Selector
• IN: Input

REF/LOLA Selected

Keypad

Waypoint Selectors

REF/LOLA – INPUT

Mode	INPUT	Waypoint Selector	Function
REF/LOLA	9099	LS/SKU	Transfers navigation data from data cartridge to CK37 computer.
	90XX	L/MÅL	Sets reference number XX of primary landing base L1. Airport reference numbers are available on the kneeboard « Airbases » page. • Example: entering « 9012 » then pressing the « L/MÅL » button would set Senaki-Kolkhi as the primary landing base in the navigation plan.
	99XX	L/MÅL	Sets reference number XX of secondary landing base L2. Airport reference numbers are available on the kneeboard « Airbases » page. • Example: entering « 9911 » then pressing the « L/MÅL » button would set Batumi as the primary landing base in the navigation plan.
	DDMMSS	L/MÅL	Sets longitude/latitude of primary landing base L1 in degrees, minutes, seconds. • Example: Coordinates from the F10 map **34°41'27" North (Latitude), 36°06'25" East (Longitude)** are entered as **360625344127** (East coordinates first, North coordinates second). Press the L/MÅL (Landing Airport Selector) button to enter the coordinates data.
	DDMMSS	B1 to B9	Sets longitude/latitude of selected waypoint (B1 to B9) in degrees, minutes, seconds. • Example: Coordinates from the F10 map **34°41'27" North (Latitude), 36°06'25" East (Longitude)** are entered as **360625344127** (East coordinates first, North coordinates second). Press the B2 (Waypoint 2) button to enter the coordinates data for waypoint 2.
	DDMMSS	BX + Y	Sets longitude/latitude of selected markpoint (BXY) in degrees, minutes, seconds. • Example: Coordinates from the F10 map **34°41'27" North (Latitude), 36°06'25" East (Longitude)** are entered as **360625344127** (East coordinates first, North coordinates second). Press the BX (Markpoint selector) button, then enter "4" on the keypad to enter the coordinates data for markpoint Bx4.

IMPORTANT: The longitude and latitude input is reversed due to the systems design of the computer. Commonly, map coordinates are given in latitude / longitude format (eg. N xx° yy' zz'', E xx° yy' zz''), while the computer's input / output of the CK37 is longitude/ latitude (E xx° yy' zz'', N xx° yy' zz'')

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
REF/LOLA (Reference Longitude-Latitude) – OUTPUT

- IN/UT Selector set to OUTPUT: Displays longitude/latitude coordinates or reference code based on what waypoint selector is selected (press desired Waypoint Selector Button).

  - **Longitude/Latitude format**: indicates Longitude and Latitude (in degrees, minutes, seconds). The data field flashes, alternating between longitude and latitude coordinates.

  - **Reference Code format**: first 4 digits indicate the reference code of the selected airbase or reference point

**Longitude to Waypoint B1
41 deg 30 minutes 51 seconds**

INPUT/OUTPUT Selector
- UT: Output

REF/LOLA Selected

Keypad

Waypoint Selectors

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
REF/LOLA	No Button Pressed							• **Longitude/Latitude coordinates** (degrees minutes seconds) or Reference Code of current destination.
	LS/SKU							• **Longitude/Latitude coordinates** (degrees minutes seconds) or Reference Code of LS (Starting Base).
	L/MÅL	D 9	D X	M X	M X	S 0	S 0	• **Longitude/Latitude coordinates** (degrees minutes seconds) or Reference Code of L1 (Primary Landing Base) or L2 (Secondary Landing Base) if selected
	B1 to B9							• **Longitude/Latitude coordinates** (degrees minutes seconds) or Reference Code of selected waypoint (B1, or B2, or B3, etc.).
	BX + Y Y = 1 to 9							• **Longitude/Latitude coordinates** (degrees minutes seconds) or Reference Code of BxY markpoint (Bx2 as an example).

REF/LOLA – OUTPUT

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CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
REF/LOLA (Reference Longitude-Latitude)

Reference Code/Number

Reference codes/numbers are used for airfields (90XX) and preset reference points (9XXX). They are associated to coordinates already set in the data cartridge.

Reference Code/Number

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8Mhz AM C2: 257Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz AM C: 40Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707
A: 4.3Mhz AM B: 132Mhz AM C: 40.6Mhz AM C2: 261Mhz AM
13: Kobuleti (9013) TILS: 13 RWY: 250.027
A: 4.3Mhz AM B: 133Mhz AM C: 40.8Mhz AM C2: 262Mhz AM
14: Kutaisi (9014) TILS: 14 RWY: 253.999
A: 4.4Mhz AM B: 134Mhz AM C: 41Mhz AM C2: 263Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.31
A: 4.4Mhz AM B: 135Mhz AM C: 41.2Mhz AM C2: 264Mhz AM
16: Nalchik (9016) TILS: 16 RWY: 55.471
A: 4.5Mhz AM B: 136Mhz AM C: 41.4Mhz AM C2: 265Mhz AM
17: Mozdok (9017) TILS: 17 RWY: 262.67
A: 4.5Mhz AM B: 137Mhz AM C: 41.6Mhz AM C2: 266Mhz AM
18: Tbilisi-Lochini (9018) TILS: 18 RWY: 127.963
A: 4.6Mhz AM B: 138Mhz AM C: 41.8Mhz AM C2: 267Mhz AM
19: Soganlug (9019) TILS: 19 RWY: 312.256
A: 4.6Mhz AM B: 139Mhz AM C: 42Mhz AM C2: 268Mhz AM
20: Vaziani (9020) TILS: 20 RWY: 135.473
A: 4.7Mhz AM B: 140Mhz AM C: 42.2Mhz AM C2: 269Mhz AM
21: Beslan (9021) TILS: 1 RWY: 93.5424
A: 4.7Mhz AM B: 141Mhz AM C: 42.4Mhz AM C2: 270Mhz AM

Reference points (1)

9101 45:02:23 037:23:47
9102 45:01:21 037:22:20
9103 44:58:11 037:17:57
9104 44:59:14 037:19:23
9105 41:36:06 041:36:43
9106 41:36:50 041:35:29
9107 41:36:39 041:36:01
9108 41:36:09 041:36:47
9109 43:12:55 044:32:23
9110 43:12:38 044:34:19
9111 43:12:09 044:37:32
9112 43:12:24 044:35:27
9113 44:34:10 038:00:31
9114 44:34:20 038:00:43
9115 43:05:56 040:34:44
9116 41:55:07 041:48:10
9117 41:55:28 041:50:03
9118 41:55:58 041:52:45
9119 41:55:38 041:51:11
9120 41:55:50 041:51:43
9121 45:05:08 039:00:43
9122 45:05:11 038:58:09
9123 45:05:16 038:52:24
9124 45:05:14 038:54:41
9125 45:05:11 038:58:03
9126 45:05:08 038:55:43
9127 45:04:59 038:55:40
9128 45:00:24 039:07:59
9129 45:01:18 039:09:35
9130 45:04:08 039:14:34
9131 45:03:14 039:12:58
9132 45:01:14 039:09:49
9133 45:00:17 038:02:37
9134 44:58:58 038:00:53
9135 44:55:58 037:56:56
9136 44:57:06 037:58:25
9137 44:57:39 037:59:03
9138 44:58:33 038:00:14
9139 44:57:08 037:58:28
9140 44:58:58 038:00:53
9141 44:57:59 037:59:48
9142 42:10:46 042:29:52
9143 42:10:30 042:28:12
9144 42:10:27 042:27:16
9145 42:10:42 042:28:45
9146 KUTAISI 42:10:27 042:27:18
9147 41:42:11 044:54:34
9148 41:41:09 044:55:54
9149 41:39:28 044:58:04
9150 41:40:29 044:56:39

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
BANA/GRÄNS (Runway Heading) - INPUT

BANA / GRÄNS: Inputting runway headings, TILS channels for start and landing bases. Can also be used to insert boundaries for waypoints.

To input/enter landing runway heading & TILS channel data:
1. Set IN/UT Selector to INPUT
2. Use keypad to enter input data (reference code or coordinates)
3. Press Waypoint selector button of your choice (L/MÅL.)
4. Set IN/UT Selector to OUTPUT

Note: Runway heading and TILS channel for the alternate landing site L2 cannot be entered manually.

Mode	INPUT	Waypoint Selector	Function
BANA/GRÄNS	XXXYZZ	LS/SKU	Sets takeoff runway heading **XXX.Y** (deg) and TILS channel **ZZ**. • Example: desired departure runway heading is **274.7** deg, with TILS channel **12**. Type « **274712** » on the keypad, then press the LS/SKU (Starting Airport Selector) button to set the runway heading and TILS channel.
	XXXYZZ	L/MÅL	Sets landing runway heading **XXX.Y** (deg) and TILS channel **ZZ**. • Example: desired landing runway heading is **274.7** deg, with TILS channel **12**. Type « **274712** » on the keypad, then press L/MÅL (Landing Airport Selector) button to set the runway heading and TILS channel.
	XXXYYY	B1 to B9	Sets first boundary (**XXX**, in degrees) line and second boundary (**YYY**, in degrees) line of selected waypoint (B1 to B9). • Example: For Waypoint B1, a first boundary of **300** and a second boundary of **070** are entered as **300070**. Press the B1 (Waypoint 1) button to enter the boundaries for waypoint 1.

Runway heading 274.7

TILS Channel 12

INPUT/OUTPUT Selector
• IN: Input

Keypad

BANA / GRÄNS Selected

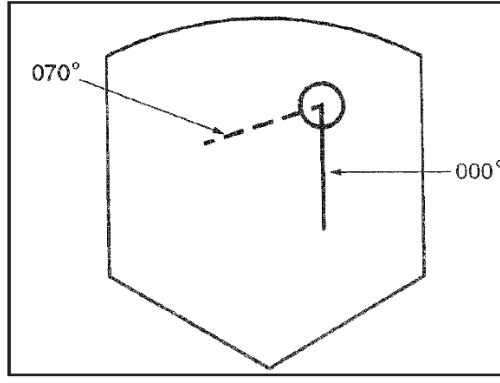**Waypoint Selectors**

Runway Heading: 274.7 – TILS Channel 12
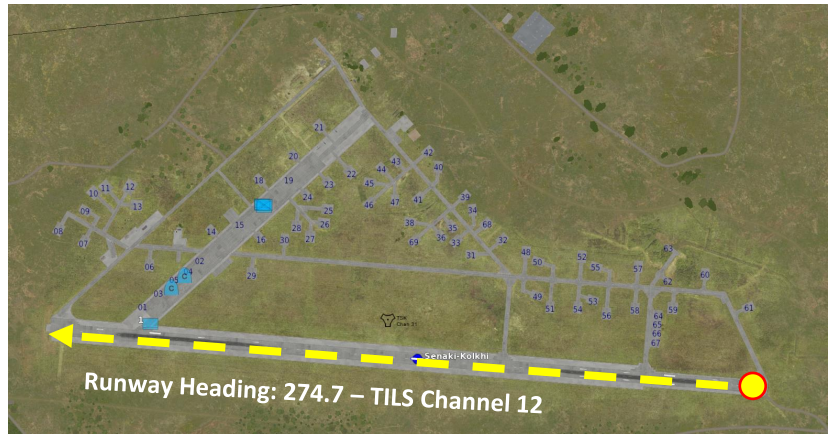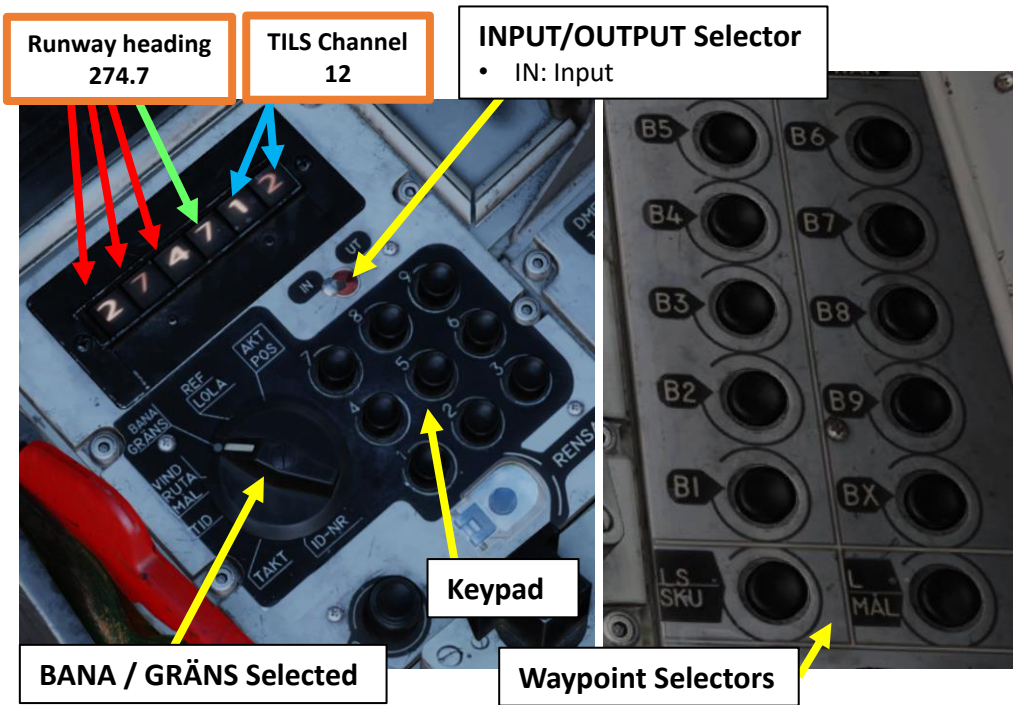
Figure 137. CI symbology of boundary lines.

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
BANA/GRÄNS (Runway Heading) - INPUT

With the data selector in mode BANA / GRÄNS, **boundary lines** can be set on every navigation waypoint (B1-B9), for the purpose of setting for example planned route to a waypoint. Input is made by entering a heading towards the waypoint, similar to how the runway heading is set. The first three digits are for the first line, the last three for the second line. If only one line is desired the last three digits are left blank.

To input/enter boundary lines for a specific waypoint:
1. Set IN/UT Selector to INPUT
2. Use keypad to enter input data. As an example, input "300070" will set a first boundary of 300 (North-West) and a second boundary of 070 (South-West).
3. Press Waypoint selector button of your choice (B1 to B9 only).
4. Set IN/UT Selector to OUTPUT

Second Boundary:
70 deg (South West)

First Boundary
300 deg (North West)

Aircraft Current Heading: 300

First Boundary Line 300

Second Boundary Line 070

INPUT/OUTPUT Selector
• IN: Input

BANA / GRÄNS Selected

Keypad

Waypoint Selectors

Second Boundary:
70 deg (South West)
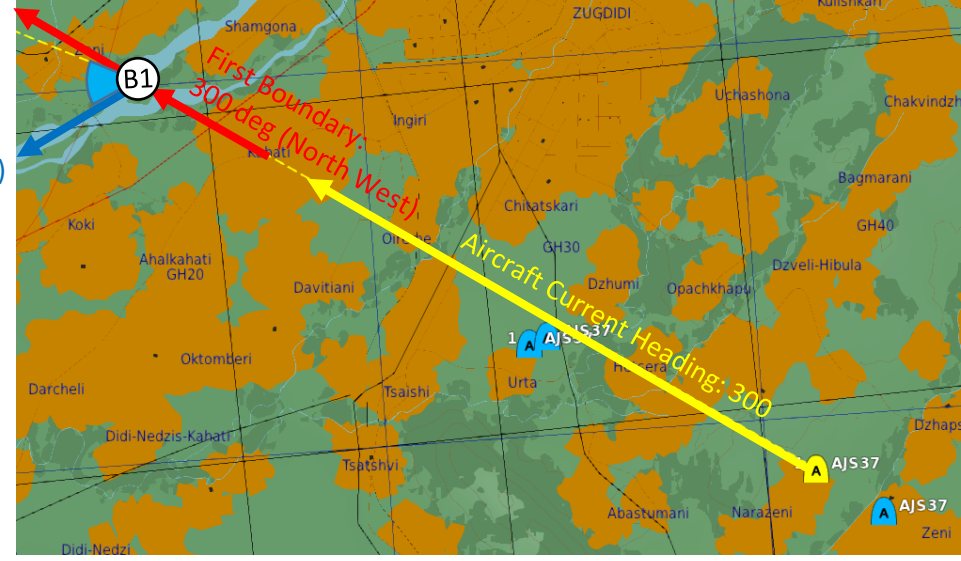
First Boundary:
300 deg (North West)
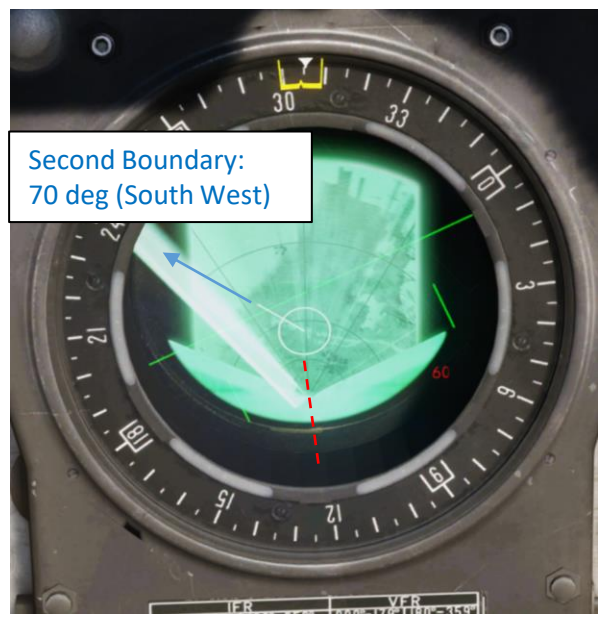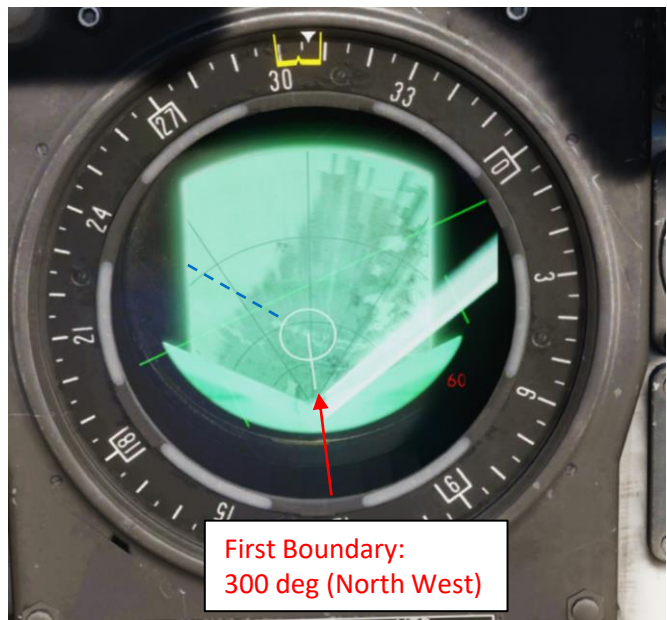
The entered lines are displayed on the destination circle marker on the CI (radar scope) in master modes NAV and SPA and radar mode A0 and A1. If only one line is entered, the line is turned on continually, and if two lines are entered, they will <u>alternate every 2 seconds</u>. The lines disappear if the circle marker is parked against the side of the display area.

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
BANA/GRÄNS (Runway Heading) - OUTPUT

- IN/UT Selector set to OUTPUT:
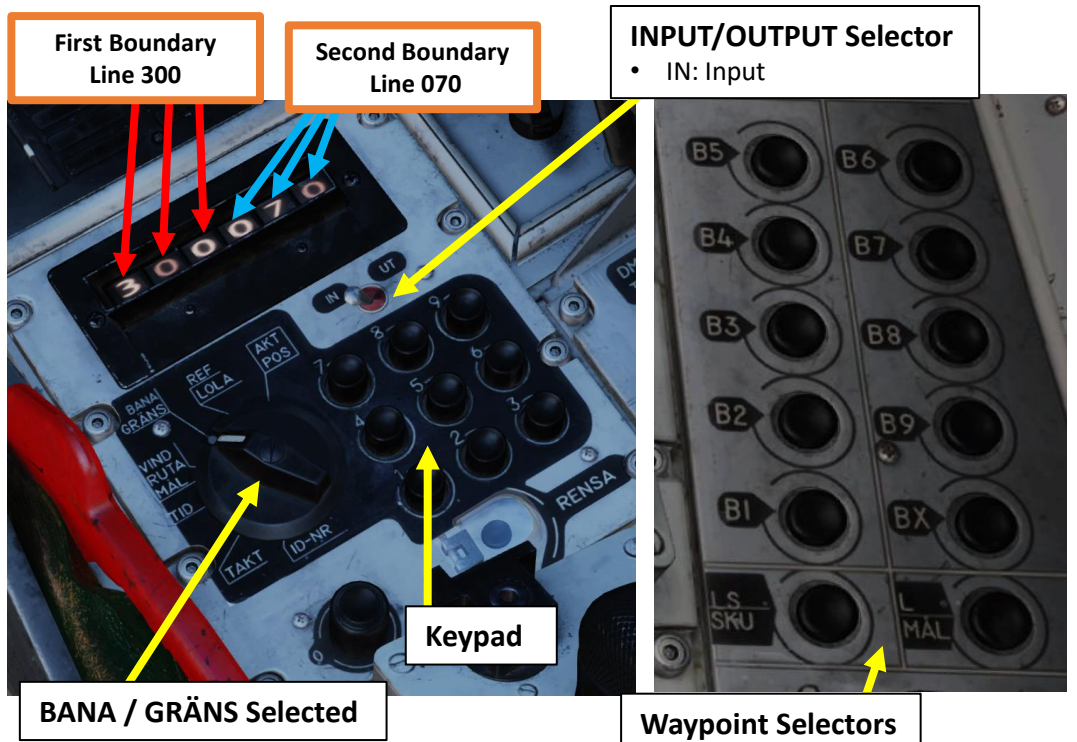 - L/MÅL is pressed: first 4 digits indicate runway heading, and last 2 digits indicate TILS channel for selected landing airport.

  - Navigation Waypoint B1-B9 is pressed: first 3 digits indicate first boundary line heading, while last 3 digits indicate second boundary line heading.

BANA/GRÄNS – OUTPUT

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
BANA/GRÄNS	No Button Pressed	X	X	X	X	X	X	• Output depends on current destination.
	L/MÅL	D	D	D	D	X	X	• Digits 1-4: Runway heading in degrees. A runway heading of 274.7 deg is displayed « 2747 » • Digits 5-6: TILS Channel
	B1 to B9	D	D	D	D	D	D	• Digits 1-3: First boundary line heading (deg) of selected waypoint. • Digit 4-6: Second boundary line heading (deg) of selected waypoint
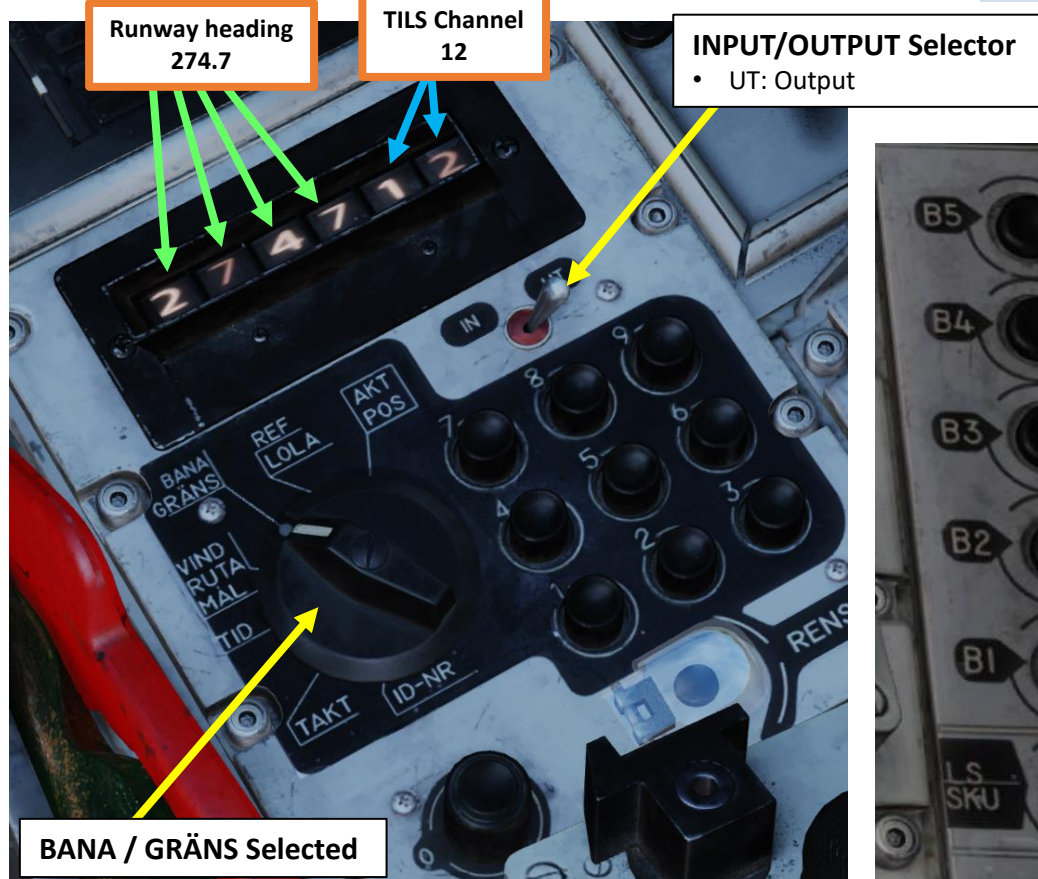
Note: If you want to use the reciprocal (opposite) runway heading, press the L/MÅL (Landing Airport Selector) button while BANA / GRÄNS is selected.

Runway heading 274.7

TILS Channel 12

INPUT/OUTPUT Selector
- UT: Output

BANA / GRÄNS Selected

Waypoint Selectors
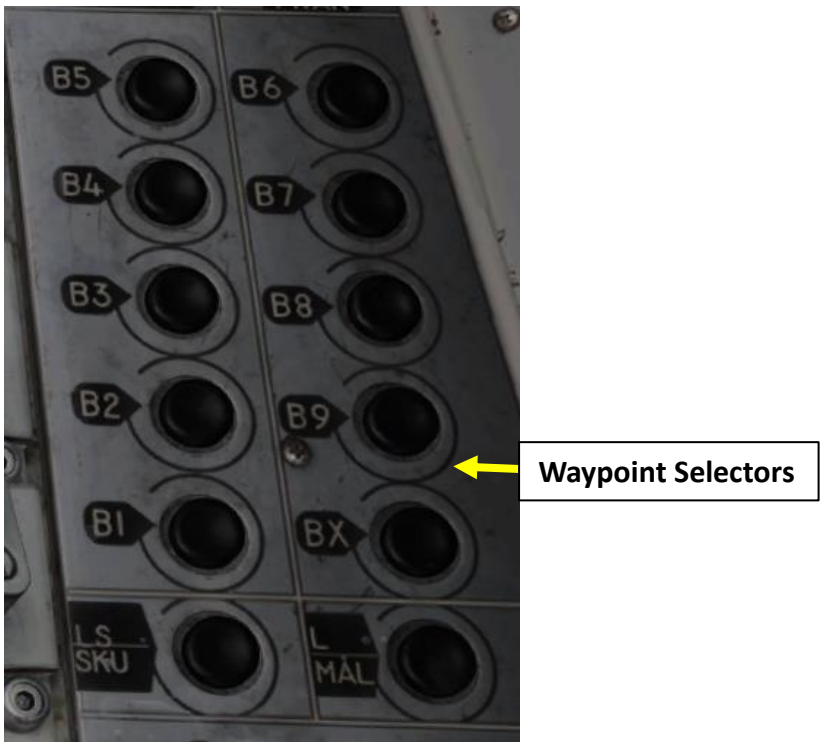
CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
VIND/RUTA/MÅL (Wind Speed / Recon Function) - INPUT

VIND/ RUTA / MÅL: Wind direction and strength for entered wind. Choice between Doppler-derived wind or entered. Position for corners of reconnaissance square and reconnaissance targets.

Normally, the Doppler unit is used for calculating the current wind, but when inputting forecasted wind, the following applies:
- Forecast entered in the air has priority over Doppler wind.
- Forecast entered on the ground does not have priority over Doppler wind. Doppler wind is used when available, but otherwise forecast wind is used.
- Forecast wind is always used for fuel / time calculation during take-off, that is as long as Mach < 0.35.

Inputting forecast wind is done by:
1. Setting the data selector to mode VIND/ RUTA / MÅL.
2. Entering Wind direction (given in degrees) on keypad for the first three digits of the data indicator.
3. Entering Wind speed (given in km/h) keypad for the following two digits. Highest speed is 99 km/h.
4. The input in entered by pressing LS/SKU Waypoint Selector Button

Note: The forecast wind can be reset by setting the wind direction and speed to zero (000000). It is also reset after landing and setting the master mode switch to mode BER.

$$1 \text{ m/s} = 3.6 \text{ km/h}.$$

$$1 \text{ knot} = 1.852 \text{ km/h}$$

VIND/RUTA/MÅL – INPUT

Mode	INPUT	Waypoint Selector	Function
VIND/ RUTA/ MÅL	XXXYY	LS/SKU	Sets forecast wind FROM direction **XXX** (deg) and wind speed **YY** (km/h). • Example: forecast wind heading is from **120** deg with a speed of **15** km/h. Type « **120**15 » on the keypad, then press the LS/SKU (Starting Airport Selector) button to set the departure wind and speed.
	DDMMSS	B1 to B9	Sets longitude/latitude of reconnaissance RUTA points (R1 to R9) in degrees, minutes, seconds. • Example: Coordinates from the F10 map **34°41'27" North (Latitude)**, **36°06'25" East (Longitude)** are entered as **360625**344127 (East coordinates first, North coordinates second). Press the B2 (Waypoint 2) button to enter the coordinates data for RUTA point R2.
	DDMMSS	L/MÅL + X	Sets longitude/latitude of reconnaissance target points (M1 to M9) in degrees, minutes, seconds. • Example: Coordinates from the F10 map **34°41'27" North (Latitude)**, **36°06'25" East (Longitude)** are entered as **360625**344127 (East coordinates first, North coordinates second). Press the L/MÅL button, then "**2**" (Recon Target **M2**) on keypad to enter the coordinates data for reconnaissance target point M2.

Forecast Wind Heading FROM 120

Forecast Wind Speed 15 km/h

INPUT/OUTPUT Selector
• IN: Input
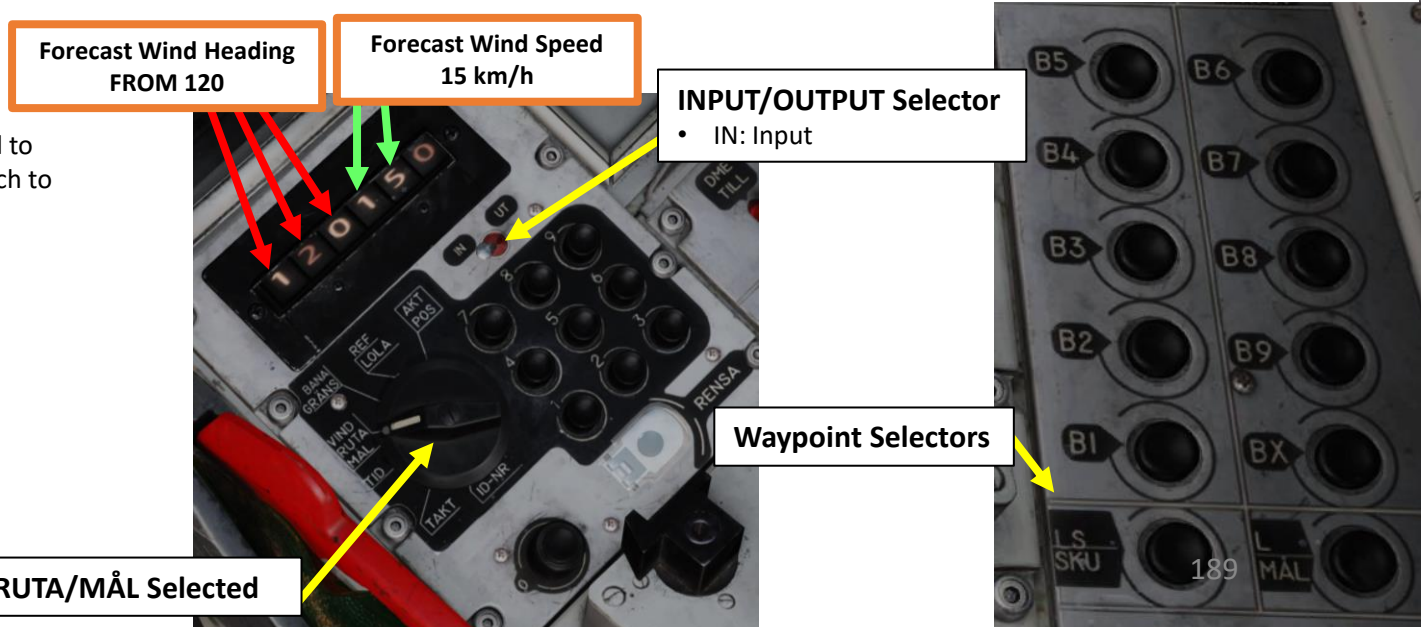
Waypoint Selectors

VIND/RUTA/MÅL Selected

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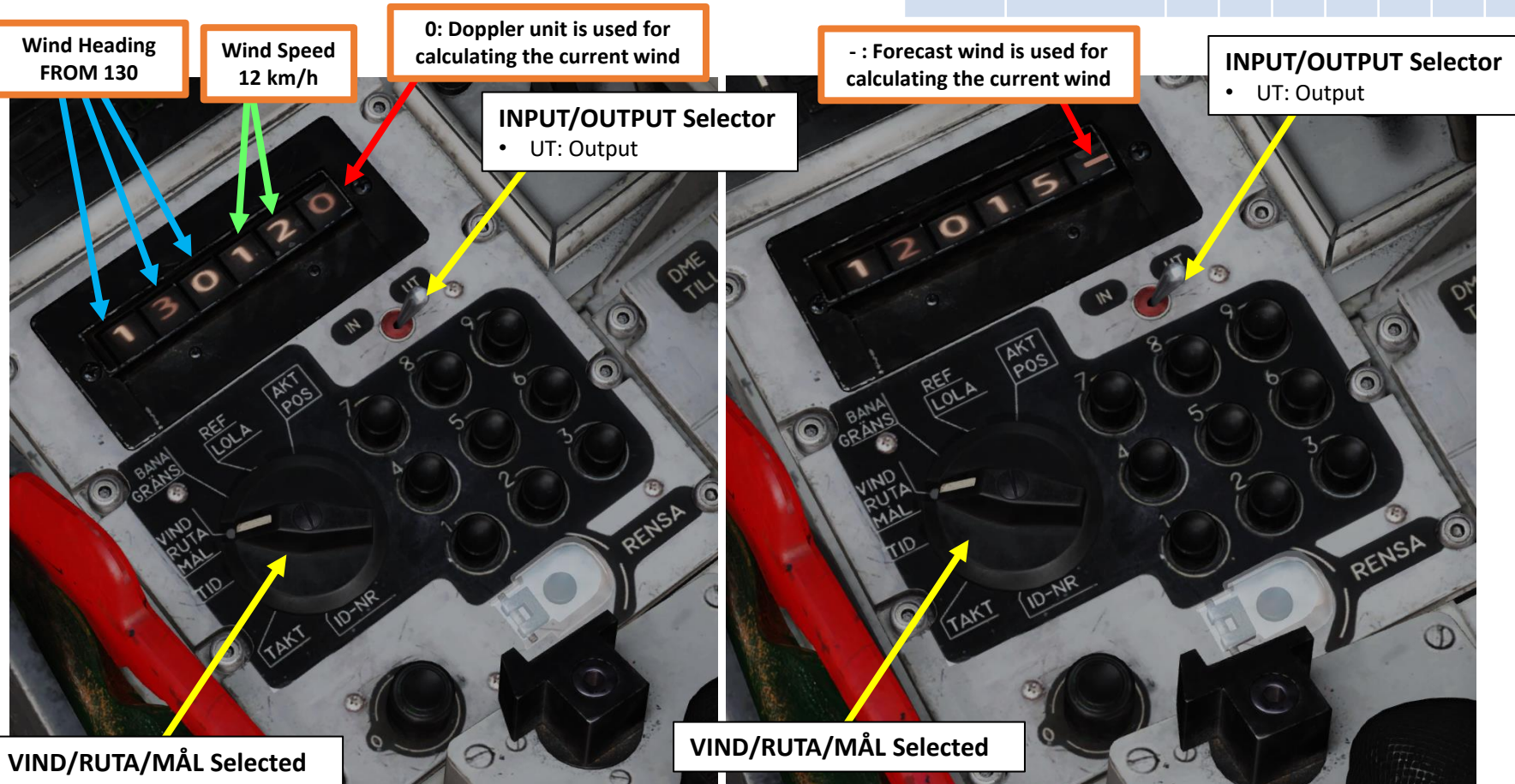## CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
VIND/RUTA/MÅL (Wind Speed / Recon Function) - OUTPUT

- IN/UT Selector set to OUTPUT:
    - Allows you to consult either wind data generated from the doppler unit, or data you already entered from wind forecast reports.
    - Using waypoint selectors B1-B9, you can consult coordinates of the SPA/MÅL target selected.

VIND/RUTA/MÅL – OUTPUT

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
VIND/ RUTA/ MÅL	No Button Pressed	D	D	D	X	X	0	• Digits 1-3: Doppler wind FROM direction in degrees. • Digits 4-5: Doppler wind speed (km/h)
	LS/SKU	D	D	D	X	X	-	• Digits 1-3: Forecast wind FROM direction in degrees. • Digits 4-5: Forecast wind speed (km/h)
	B1 to B9	D	D	M	M	S	S	• Longitude/Latitude coordinates (degrees minutes seconds) of SPA/MÅL target selected.

Wind Heading FROM 130

Wind Speed 12 km/h

0: Doppler unit is used for calculating the current wind

INPUT/OUTPUT Selector
- UT: Output

- : Forecast wind is used for calculating the current wind

INPUT/OUTPUT Selector
- UT: Output

INPUT/OUTPUT Selector
- UT: Output

VIND/RUTA/MÅL Selected

VIND/RUTA/MÅL Selected
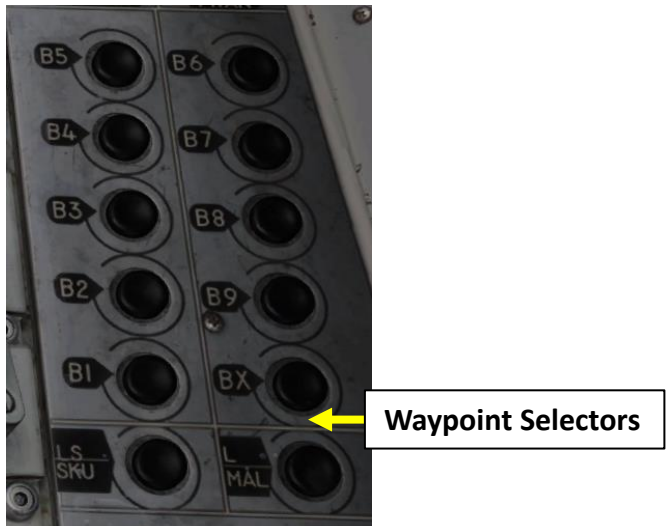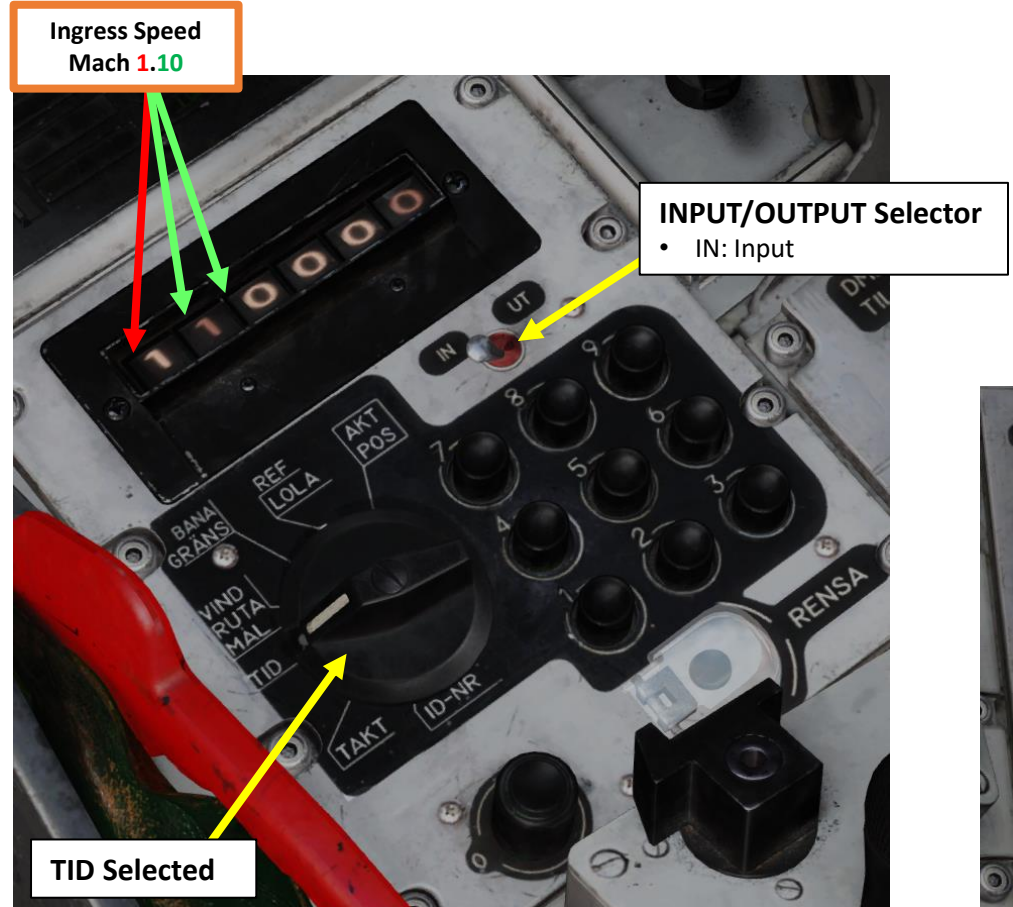
Waypoint Selectors

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CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
TID (Time) - INPUT

TID: Current time, Time on Target, ingress Mach speeds, and time for reconnaissance targets.

Ingress Speed Mach 1.10

INPUT/OUTPUT Selector
- IN: Input

TID Selected

Waypoint Selectors

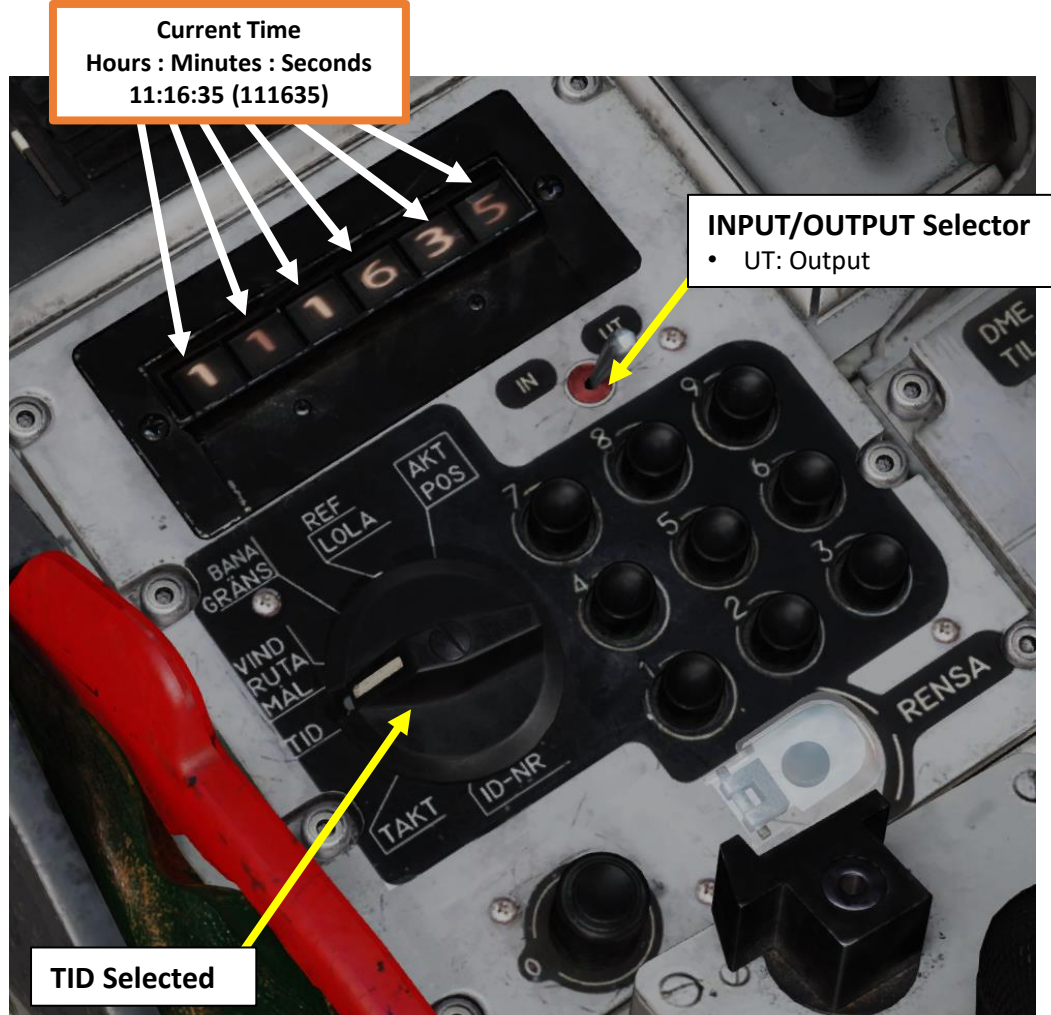|	TID – INPUT		
Mode	**INPUT**	**Waypoint Selector**	**Function**
TID	HHMMSS	LS/SKU	Sets current time in hours (HH), minutes (MM) and seconds (SS). • Example: current time is 10:30:15. Type « **103015** » on the keypad, then press the LS/SKU (Starting Airport Selector) button to set the current time.
	HHMMSS	B1 to B9	Sets ToT (Time on Target) for selected navigation waypoint in hours (HH), minutes (MM) and seconds (SS). • Example: desired Time on Target for waypoint B2 is 10:30:15. Type « **103015** » on the keypad, then press the B2 (Waypoint 2) button to set the time on target at B2.
	HHMMSS	BX	Sets ToT (Time on Target) for RB15F Anti-Ship missile in target area (at Bx8) in hours (HH), minutes (MM) and seconds (SS). • Example: desired Time on Target for RB-15F anti-ship missile in target area Bx8 is 10:30:15. Type « **103015** » on the keypad, then press the "Bx" button, then "8" on the keypad. This will set the time on target at Bx8.
	XYY	B1 to B9	Sets ingress speed X.YY Mach at selected waypoint. • Example: desired ingress speed at waypoint B2 is Mach **1.10**. Type « **110** » on the keypad, then press the B2 (Waypoint 2) button to set the ingress speed at this specific waypoint.

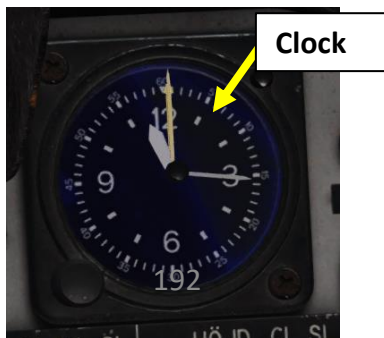## CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
TID (Time) - OUTPUT

- IN/UT Selector set to OUTPUT:
  - Allows you to consult current time, Time on Target, ingress Mach speeds, and time for reconnaissance targets.

Current Time
Hours : Minutes : Seconds
11:16:35 (111635)

INPUT/OUTPUT Selector
- UT: Output

TID Selected

Clock

Waypoint Selectors

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
TID	No Button Pressed	X	H	M	M	S	S	• ETA (Estimated Time of Arrival) with respect to ToT (Time on Target) is displayed in hours, minutes and seconds on the last 5 digits in the data indicator. If the calculated deviation is behind schedule, this is indicated by a minus sign in front of the time (first digit), and if the aircraft is ahead of schedule, the first digit is empty.
		7	H	M	M	S	S	• Calculated flight time to destination is displayed if no waypoint button is pressed and no Time on Target is set. This mode is indicated by the number seven (7) shown in the first digit on the data indicator.
	LS/SKU	H	H	M	M	S	S	• Current time in hours (HH), minutes (MM), seconds (SS).
	B1 to B9	H	H	M	M	S	S	• ToT (Time on Target) for selected target waypoint in hours (HH), minutes (MM), seconds (SS).
		X	Y	Y	0	0	0	• Ingress speed X.YY Mach at selected waypoint
	BX	H	H	M	M	S	S	• ToT (Time on Target) for RB-15F anti-ship missile in target area Bx8, in hours (HH), minutes (MM), seconds (SS).
	1-9 (keypad)	H	H	M	M	S	S	• Timestamp of SPA/MÅL target selected.

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
TAKT (Tactical) - INPUT

TAKT: Tactical inputs and presets. Fuel reserve, defining target waypoints and setting pop-up points. Stand-off data. Enable / disable TERNAV system.

Note: The entered fuel reserve is displayed by setting the mode TAKT/INPUT and inputting 510000 and then switching to mode TAKT/OUTPUT.
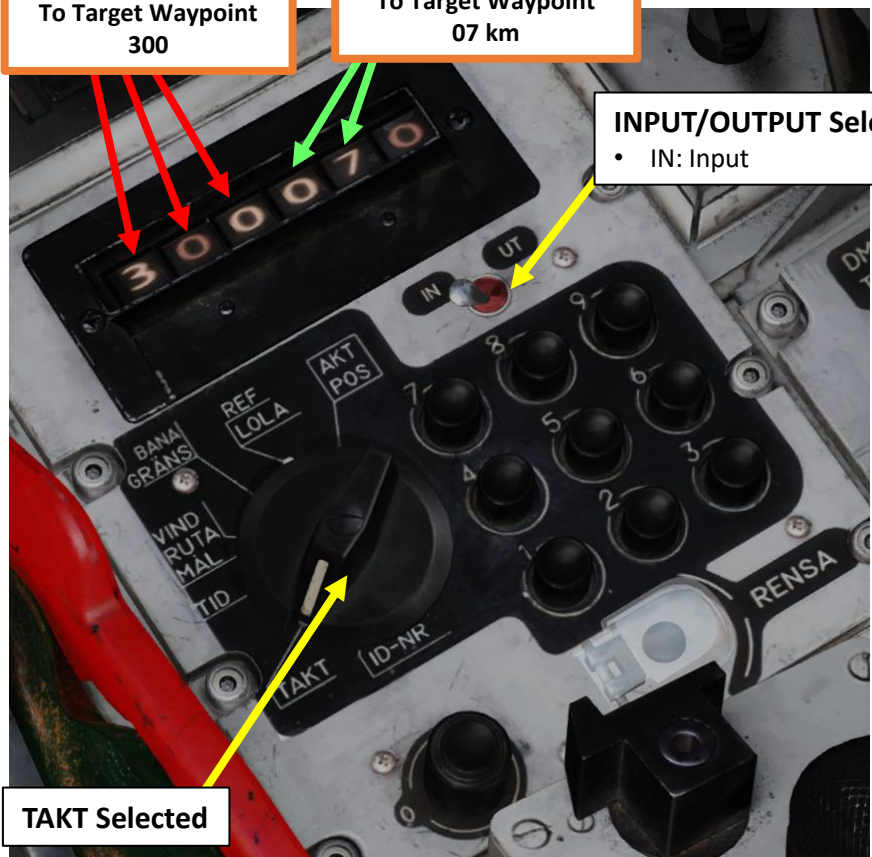
Pop-Up Point Heading To Target Waypoint 300

Pop-Up Point Distance To Target Waypoint 07 km

INPUT/OUTPUT Selector
• IN: Input

TAKT Selected

Waypoint Selectors

TAKT – INPUT

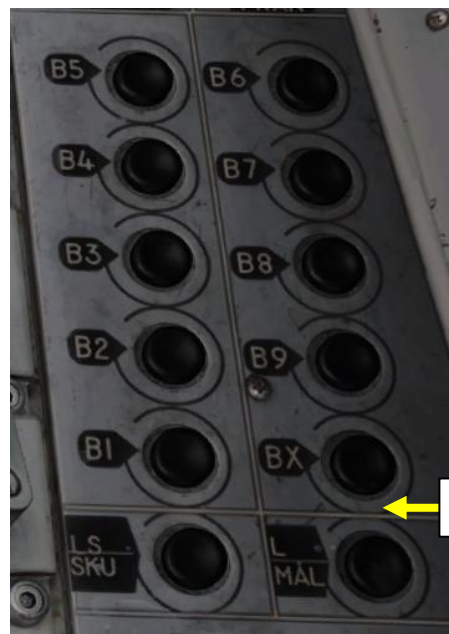| Mode	INPUT	Waypoint Selector	Function
TAKT	9	B1 to B9	Turns a navigation waypoint (B1-B9) into a target waypoint (M1-M9). • Example: We want to set navigation waypoint B3 into a target waypoint M3. Type « **9** » on the keypad, then press the B3 button to set waypoint B3 as a target waypoint M3.
	0		Restores a navigation waypoint (B1-B9) from a target waypoint (M1-M9). • Example: We want to revert target waypoint M3 into a navigation waypoint B3. Type « **0** » on the keypad, then press the B3 button to set target waypoint M3 as a navigation waypoint B3.
	XXXYY		Creates a pop-up point with a heading **(XXX)** and distance **(YY)** in km. A pop-up point (U) is defined by entering the direction and distance **from** the pop-up point (U) **to** the target waypoint (M). • Example: For Pop-Up point U3, the heading from pop-up point U3 to the target waypoint M3 is **300** with a distance of **07** km. The heading/distance offset is entered as **30007** on the keypad. Press the B3 (Waypoint 3) button. Pop-Up point U3 will be created from the offset entered previously in relationship to Target point M3.

Waypoint B3 Target Point M3

HDG 300 7.0 km

Pop-Up Point U3 Located 7 km south of M3 following a heading of 300 (from target's 4 o'clock)

193

CK37 (*Central Kalkylator 37*) Computer
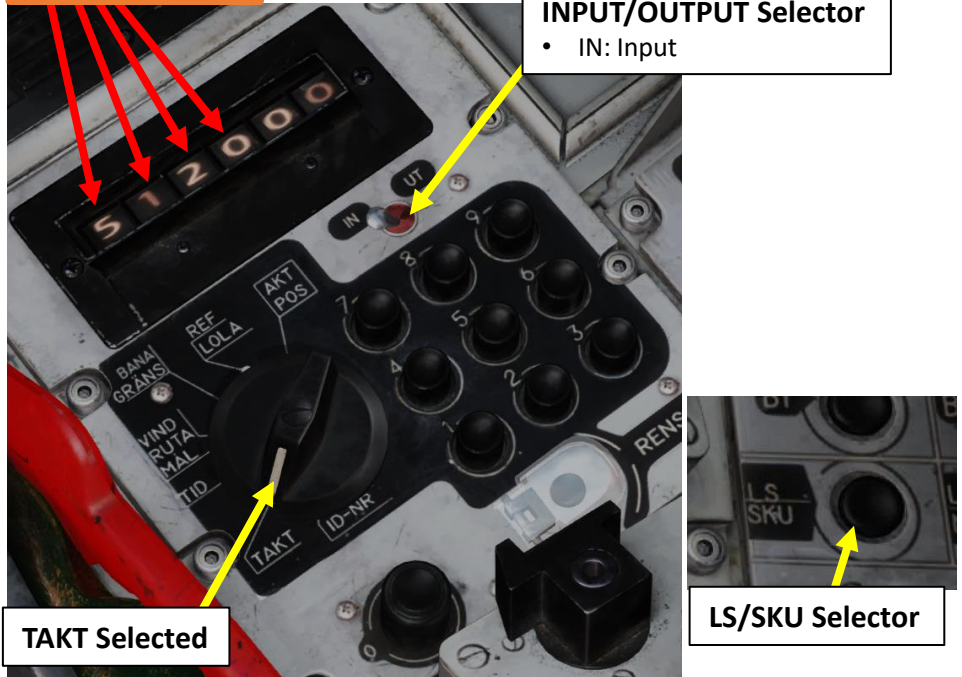## CK37 Modes
TAKT (Tactical) - INPUT

You can also enter a variety of address codes to set parameters like:
- Fixed Sight Option
- Target Motion Measurement (Lead Correction) Option
- Lysbomb (Illumination Bomb) Distance Option (km)
- Radar Lock Option
- Reconnaissance Warning Distance Option (km)
- Fuel Reserve at Landing Base (%)
- Turn ON or OFF the TERNAV (Terrain Navigation) system.

Fuel Reserve at Landing Base L1
5120 (20 %)

INPUT/OUTPUT Selector
- IN: Input

TAKT Selected

LS/SKU Selector

			TAKT – INPUT
Mode	**INPUT**	**Waypoint Selector**	**Function**
TAKT	21X	LS/SKU	Sets Fixed Sight option. The fixed sight corresponds to the backup sight and can be used for AKAN gun pods and ARAK rocket pods, RB75, and bombs. • Enter "211" on the keypad, then press LS/SKU button to turn on fixed sight. • Enter "210" on the keypad, then press LS/SKU button to turn off fixed sight.
	22X		Sets Target Motion Measurement (Lead correction) option. The target motion measurement is used for AKAN gunpods in A/G mode, ARAK rocket pods and bombs for dive-bombing. • Enter "220" on the keypad, then press LS/SKU button to turn on target motion measurement. • Enter "221" on the keypad, then press LS/SKU button to turn off target motion measurement.
	23X		Sets Lysbomb (illumination bomb) offset distance option in km. • Enter "232" on the keypad, then press LS/SKU button to enter an offset distance of 2 km.
	25X		Sets radar lock option. • Enter "251" on the keypad, then press LS/SKU button to use default radar lock mode: Radar lock can be performed before setting the trigger to Unsafe. • Enter "252" on the keypad, then press LS/SKU button to use second radar lock mode: Radar lock can be performed after setting the trigger to Unsafe. • Enter "253" on the keypad, then press LS/SKU button to use third radar lock mode: Radar lock is disabled, sight only uses triangulation for ranging.
	30XX		Sets reconnaissance warning distance option in km. Stand-off distance is just used in the reconnaissance mode to provide a warning from coming too close a reconnaissance target (such as being able to track them beyond visual range). • Enter "3025" on the keypad, then press LS/SKU button to enter recon warning distance of 25 km.
	51XX		Sets fuel reserve at landing base L1 in % (set between 10-99 %). • Enter "5120" on the keypad, then press LS/SKU button to enter Fuel Reserve setting of 20 % total fuel.
	58X		Turns on or off TERNAV (Terrain Navigation) system. TERNAV fixes are completely automatic if the system is operating and the radar altimeter is in use. • Enter "580" on the keypad, then press LS/SKU button to turn ON TERNAV. • Enter "581" on the keypad, then press LS/SKU button to turn OFF TERNAV.

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
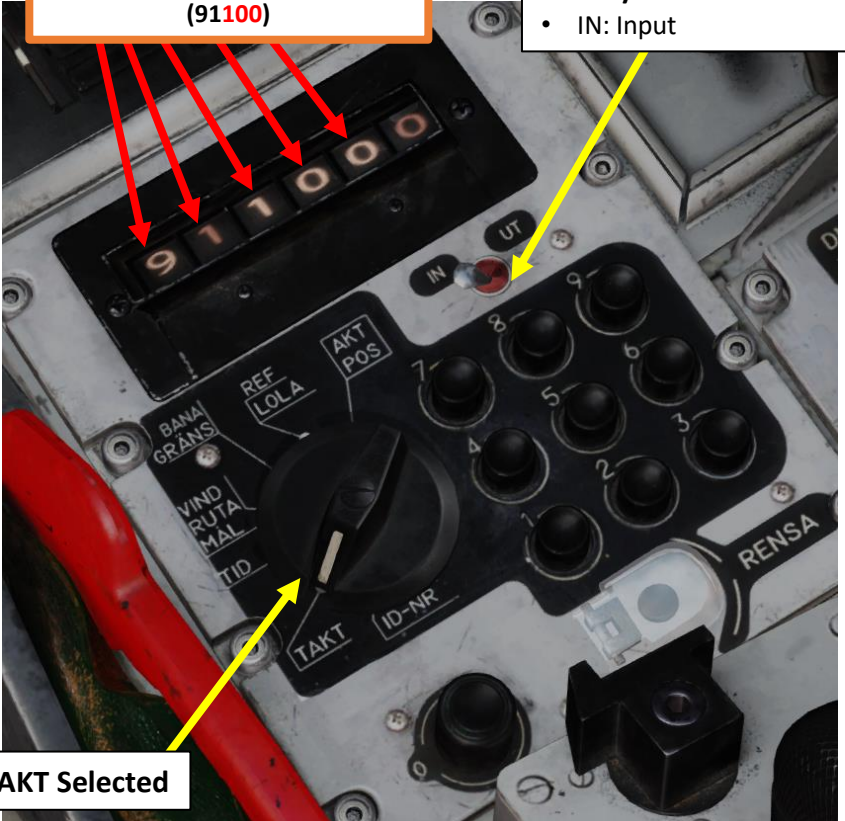### TAKT (Tactical) - INPUT

In addition, the **RB15 anti-ship missile** and **BK90 Mjolnir Cluster Bomb** can also have parameters programmed within the flight computer using computer addresses as shown in the next table.

BK90 Cluster Bomb Approach Altitude 100 meters (91100)

INPUT/OUTPUT Selector
- IN: Input

TAKT Selected

LS/SKU Selector

TAKT – INPUT

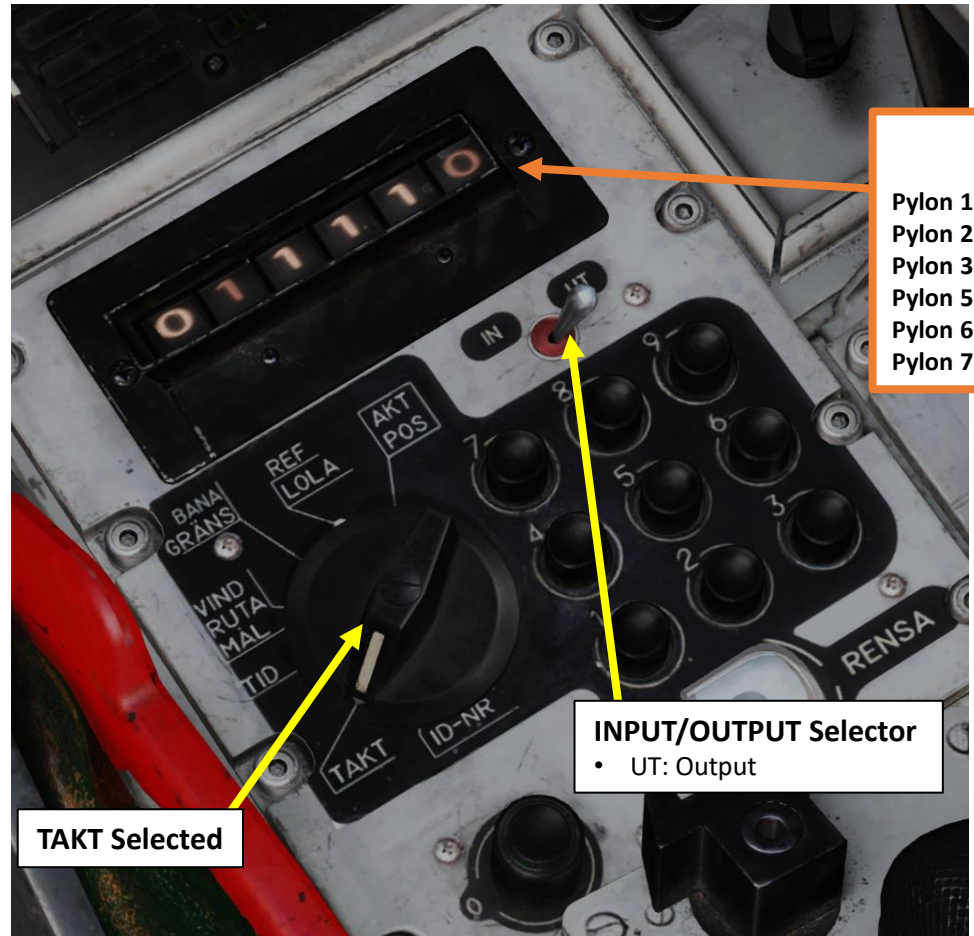| Mode	Weapon	INPUT	Waypoint Selector	Function
TAKT	**RB15 Anti-Ship Missile**	800000	LS/SKU	Selects « Single Target » preset RB15 missile profile, with a large search area.
		800001		Selects « Confined Area Attack » preset RB15 missile profile, with multiple targets N, and a medium search area.
		800002		Selects « Unconfined Area Attack » preset RB15 missile profile, with multiple targets A, and a medium search area.
		800003		Selects « Convoy Attack» preset RB15 missile profile, with a group target and a large search area.
		800004		Selects « Bearing Attack» preset RB15 missile profile, with a bearing search mode.
	BK90 Mjolnir Cluster Bomb	91XXX	LS/SKU	Sets BK90 approach altitude in meters, which is 60 m by default. • Enter "91**100**" on the keypad, then press LS/SKU button to enter BK90 approach altitude of **100** m.
		92X		Sets BK90 bombing area pattern option. • Enter "92**1**" on the keypad, then press LS/SKU button to set a long pattern. • Enter "92**2**" on the keypad, then press LS/SKU button to set a wide pattern. • Enter "92**3**" on the keypad, then press LS/SKU button to set a compact pattern.

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
TAKT (Tactical) - OUTPUT

- IN/UT Selector set to OUTPUT:
  - Allows you to consult weapon station status.

TAKT – OUTPUT

Mode	Button Used	Display Digit						Display Shows
		1	2	3	4	5	6	
TAKT	No Button Pressed	X	X	X	X	X	X	Displays weapon status on each aircraft pylon. • Digit 1: Weapon Status on Pylon 1 (0 = empty) • Digit 2: Weapon Status on Pylon 2 (0 = empty) • Digit 3: Weapon Status on Pylon 3 (0 = empty) • Digit 4: Weapon Status on Pylon 5 (0 = empty) • Digit 5: Weapon Status on Pylon 6 (0 = empty) • Digit 6: Weapon Status on Pylon 7 (0 = empty)
	B1 to B9	9	0	0	0	0	0	• Displays code « 900000 » when depressed Waypoint Selector pressed is a target Waypoint (MX).

Weapon Station Status
011110
Pylon 1 empty (0) – Outer Left Wing
Pylon 2 ready (1) – Inner Left Wing
Pylon 3 ready (1) – Fuselage Left
Pylon 5 ready (1) – Fuselage Right
Pylon 6 ready (1) – Inner Right Wing
Pylon 7 empty (0) – Outer Right Wing

Weapon Status Codes:
- **1 :** Indicates that the pylon has a weapon attached and the weapon is fully functioning and ready to be used.
- **– :** indicates the weapon has an error and is unusable.
- **0 :** Indicates that the weapon has been released.
- **Flashing**: The currently Selected pylon is indicated by a flashing symbol.

INPUT/OUTPUT Selector
- UT: Output

TAKT Selected

MISSION RESOURCES

CK37 (*Central Kalkylator 37*) Computer
CK37 Modes
ID-NR (No Function)

ID-NR: Identification number. Readout of data for reconnaissance targets. Readout of memory addresses. No function in simulator.

SECTION STRUCTURE

- **1 – Introduction**

  - 1.1 – Armament Overview
  - 1.2 – Weapon Loadout Restrictions
  - 1.3 – Armament Station Status
  - 1.4 – Weapon Controls & Interfaces
  - 1.5 – Mission Planning
  - 1.6 – Target Point (M#) and Pop-Up Point (U#) Creation
  - 1.7 – QFE
  - 1.8 – Sighting Mechanics
    - 1.8.1 – Triangulation (Computer Calculated Range)
    - 1.8.2 – Radar Ranging
    - 1.8.3 – Fixed Sight
    - 1.8.4 – Target Motion Measurement
  - 1.9 – Weapon Cheat Sheet

- **2 – Air-to-Ground Weapons**

  - 2.1 – M/71 Bomb
    - 2.1.1 – Bomb Delivery Methods
    - 2.1.2 – Target Approach
    - 2.1.3 – M/71 High Drag Bomb – CCIP Delivery
    - 2.1.4 – M/71 Low Drag Bomb
      - 2.1.4.1 – Level Delivery (CCRP)
      - 2.1.4.2 – Precision Dive Mode (DYK) Delivery
      - 2.1.4.3 – Radar Release (RR) Delivery
      - 2.1.4.4 – Nav Delivery (Waypoint)
  - 2.2 – ARAK M/70B Rockets
    - 2.2.1 – Short Range Release
    - 2.2.2 – Long Range Release

- **2 – Air-to-Ground Weapons**

  - 2.3 – BK-90 MJOLNIR Cluster Munitions
  - 2.4 – RB-75 Air-to-Ground Missile
  - 2.5 – RB-05A Remote-Controlled Missile
  - 2.6 – AKAN 30/55 Gun (Air-to-Ground)
  - 2.7 – LYSBOMB Illumination Bomb

- **3 – Anti-Ship Weapons**

  - 3.1 – RB-04E Anti-Ship Missile
  - 3.2 – RB-15F Anti-Ship Missile

- **4 – Air-to-Air Weapons**

  - 4.1 – AKAN 30/55 Gun (Air-to-Air)
    - 4.1.1 – Radar Ranging Mode
    - 4.1.2 – Wingspan Mode
  - 4.2 – RB-24J / RB-74 IR Air-to-Air Missile
    - 4.2.1 – Without Radar Ranging
    - 4.2.2 – With Radar Ranging

- **5 – Miscellaneous**

  - 5.1 – Stores Jettison

PART 11 – OFFENCE: WEAPONS & ARMAMENT

AJS-37 VIGGEN

MISSILES ("RB" stands for "Robot", Swedish for "Missile")			
WEAPON	**TYPE**	**RANGE**	**NOTES**
RB-04E	Radar-guided anti-ship missile	32 km	Seeker Range: 8 km
RB-15F	Radar-guided anti-ship missile	70 km	More advanced functionalities than RB-04E
RB-05A	Radio-controlled air-to-air/air-to-ground missile	9+ km	Controlled with the RB-05 control unit
RB-75	Air-to-ground missile (AGM-65A Maverick)	22 km	Swedish version of the AGM65A "Maverick" Air-to-Ground Missile, uses the EP-13 collimated sight
RB-24/RB-24J	Infrared-Seeker rear-aspect Air-to-Air missile similar to the AIM-9B/AIM-9P3 Sidewinder	-	Swedish version of the AIM-9P Sidewinder
RB-74	Infrared-Seeker all-aspect Air-to-Air missile similar to the AIM-9L Sidewinder	-	Swedish version of the AIM-9L Sidewinder

BOMBS	
WEAPON	**TYPE**
M/71	120 kg unguided bomb (available in low-drag and high-drag configurations)
BK-90 (*Bombkapsel*) MJOLNIR	605 kg cluster munitions (guided glide cluster bomb)
LYSBOMB	80 kg M/71 Illumination bomb

GUNS	
WEAPON	**TYPE**
AKAN 30/55	30 mm gun pod with 150 rounds

ROCKETS	
WEAPON	**TYPE**
ARAK M/70B	6 x 135 mm unguided rockets per pod

1 – Introduction

1.2 – Weapon Loadout Restrictions

The Viggen was designed to use only **one type of air-to-ground ordnance at once** (with two exceptions). The reason is that when the Ground Crew loads the weapon. there is an external armaments panel where they set the correct positions depending on the loadout of the aircraft (telling the aircraft what it is carrying).

The two exceptions to that rule are:
- A combination of the AKAN 30/55 gun with the RB-75 missile
- A Combination of the AKAN 30/55 gun with the RB-05 missile.

Any valid loadout can be combined with Sidewinder (RB24, RB24J, and RB74) air-to-air missiles.

If you take an invalid loadout of non-compatible weapons, you won't be able to fire anything.

Bombs Only
Valid Loadout

Rockets + Bombs
Invalid Loadout

AKAN Gunpods + RB-75
Valid Loadout

AKAN Gunpods + RB-05
Valid Loadout

1 – Introduction
1.3 – Armament Station Status

The current stores status can be displayed on the data panel.

With the INPUT/OUTPUT selector in position OUT, in any other mode than ID-NR the weapons status will be displayed in the following situations:
1. The Missile selector FRAMSTEGN is pressed
2. Trigger safety unsafe
3. Weapons error (FÄLLD LAST flashing)
4. Data selector in mode TAKT

Missile select button Infrared-RB (FRAMSTEGN)

1
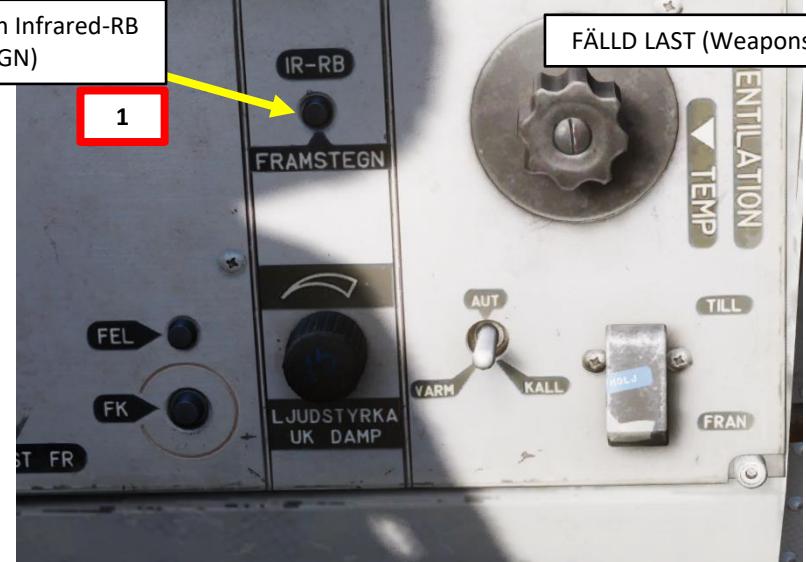
FÄLLD LAST (Weapons Error)

3

Weapon Station Status
011110
Pylon 1 empty (0) – Outer Left Wing
Pylon 2 ready (1) – Inner Left Wing
Pylon 3 ready (1) – Fuselage Left
Pylon 5 ready (1) – Fuselage Right
Pylon 6 ready (1) – Inner Right Wing
Pylon 7 empty (0) – Outer Right Wing

Weapon Status Codes:
- **1 :** Indicates that the pylon has a weapon attached and the weapon is fully functioning and ready to be used.
- **– :** indicates the weapon has an error and is unusable.
- **0 :** Indicates that the weapon has been released.
- **Flashing**: The currently Selected pylon is indicated by a flashing symbol.

MISSION RESOURCES

Trigger UNSAFE

2

INPUT/OUTPUT Selector
- UT: Output

4

TAKT Selected   **4**
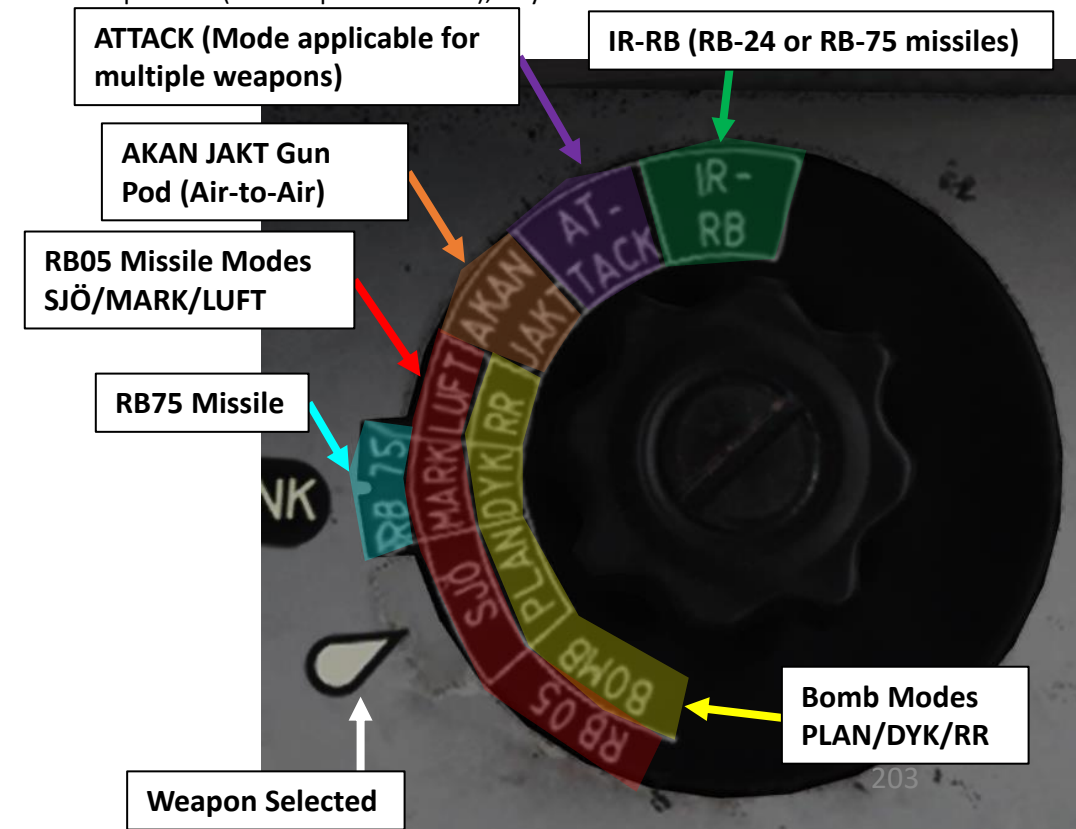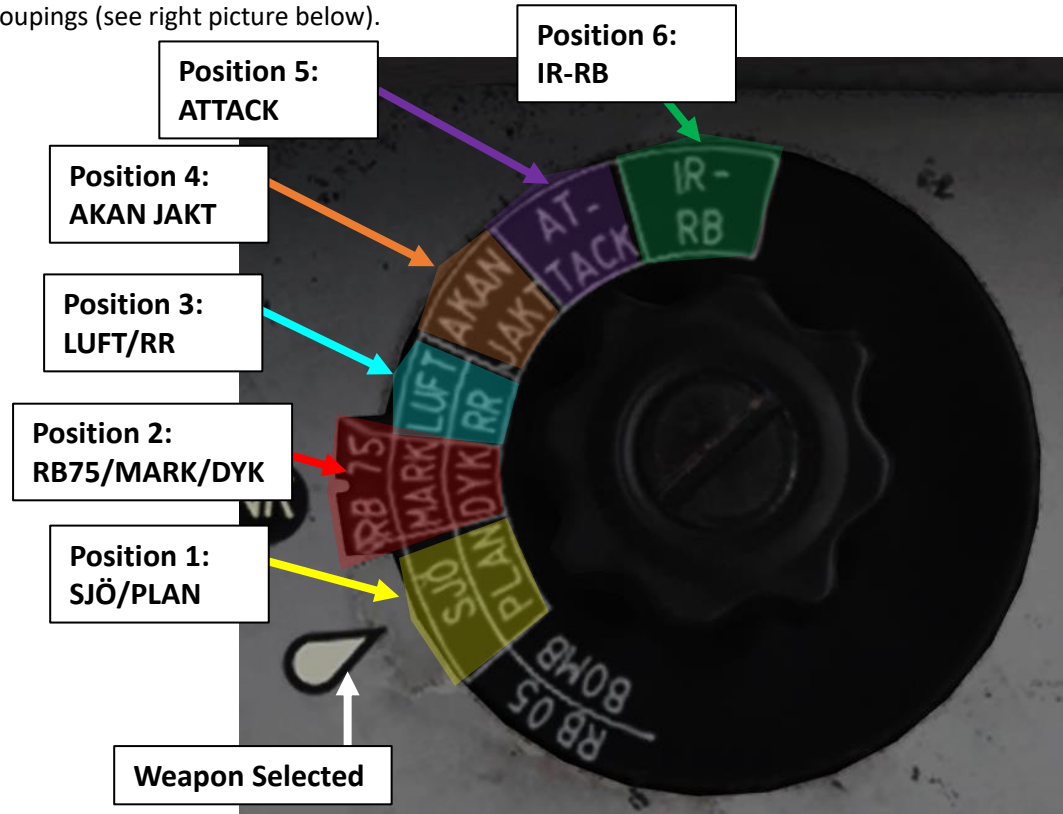
202
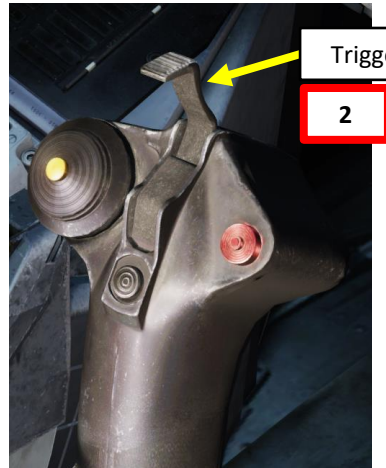
1 – Introduction

1.4 – Weapon Controls & Interfaces

The weapon types are selected via the Weapons Selector dial. Rather than selecting a weapon pylon, it selects a weapon type. The knob has six positions.

Each position of the knob may be used to select multiple types of weapons, however loadout limitations prohibit multiple weapons types on the same position of the knob to be carried. For the example position 2 has RB75/ MARK / DYK. Which would either select the RB 75 missile, the RB 05 in A/G mode, or set the bombs aiming for dive bombing.

- **SJÖ/PLAN**: Sets RB 05 for anti-ship fusing or bombs to be dropped in level bomb release.
- **RB75/MARK/DYK**: Selects RB 75, RB 05 is Air-to-Ground fusing, or bombs for dive-bombing.
- **LUFT/RR**: RB-05 in A/A mode, radar bomb release.
- **AKAN JAKT**: Gun pods air-to-air mode.
- **ATTACK**: Selects the majority of air-to-ground weapon types.
- **IR-RB**: Selects sidewinder missiles. (Can also be selected by a fast selector on the throttle instead)

The selector may seem complicated at first, but there are two ways to interpret it. You can see it in terms of switch position (see left picture below), or you can see it in terms of function groupings (see right picture below).

Position 6: IR-RB
Position 5: ATTACK
Position 4: AKAN JAKT
Position 3: LUFT/RR
Position 2: RB75/MARK/DYK
Position 1: SJÖ/PLAN
Weapon Selected

ATTACK (Mode applicable for multiple weapons)
IR-RB (RB-24 or RB-75 missiles)
AKAN JAKT Gun Pod (Air-to-Air)
RB05 Missile Modes SJÖ/MARK/LUFT
RB75 Missile
Bomb Modes PLAN/DYK/RR
Weapon Selected

1 – Introduction
## 1.4 – Weapon Controls & Interfaces

The Sight Mode / Interval selector, Weapon Release Mode Switch and Targeting Mode (MÅLVAL) / Preparation Switch determine a weapon mode/profile based on what weapon is selected.

Weapon Release Mode Switch
Changes release mode depending on weapon selected:
- RB-04 / RB-15 Missile: Sets either SERIE (series) or IMPULS (single) release of the RB 04 and RB 15 anti-ship missiles
- Rockets: sets sight calculation for the rockets for normal mode (NORM) long range mode (LA)

Targeting Mode (MÅLVAL) / Preparation Switch (RB-04 / RB-15 / BK-90)
Changes targeting/preparation mode depending on weapon selected:
- RB-04 Missile: Missile's radar to focus on either single (ENKEL) or grouped (GRUPP) targets.
- RB-15 Missile: Missile profile is programmed using standard setting values (STD) or custom entered values (VALB) through CK37 computer
- BK-90 Mjolnir: BK-90 flight profile is programmed using standard setting values (STD) or custom entered values (VALB) through CK37 computer
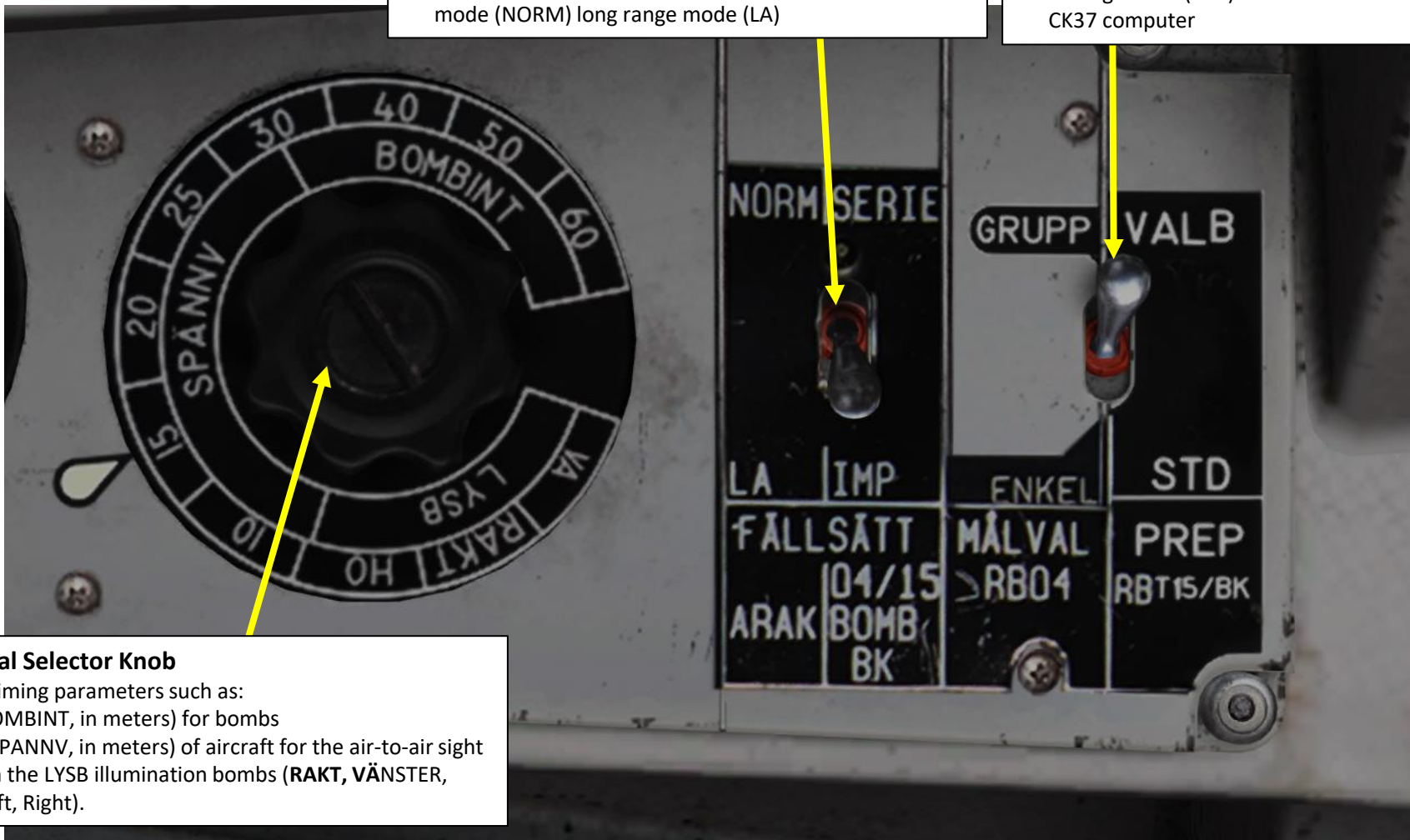
Sight Mode / Interval Selector Knob
Changes some of the aiming parameters such as:
- Impact intervals (BOMBINT, in meters) for bombs
- Wingspan setting (SPANNV, in meters) of aircraft for the air-to-air sight
- Left / right offset on the LYSB illumination bombs (**RAKT, VÄ**NSTER, **HÖ**GER / Center, Left, Right).

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1 – Introduction

1.4 – Weapon Controls & Interfaces

The CK37 Computer Interface is used to program specific parameters for certain weapons (BK-90, RB-15F, LYSBOMB, etc.) using address codes. It is also used to set certain sight modes such as radar ranging.

The Weapon Release trigger is used to launch/fire/release weapons.

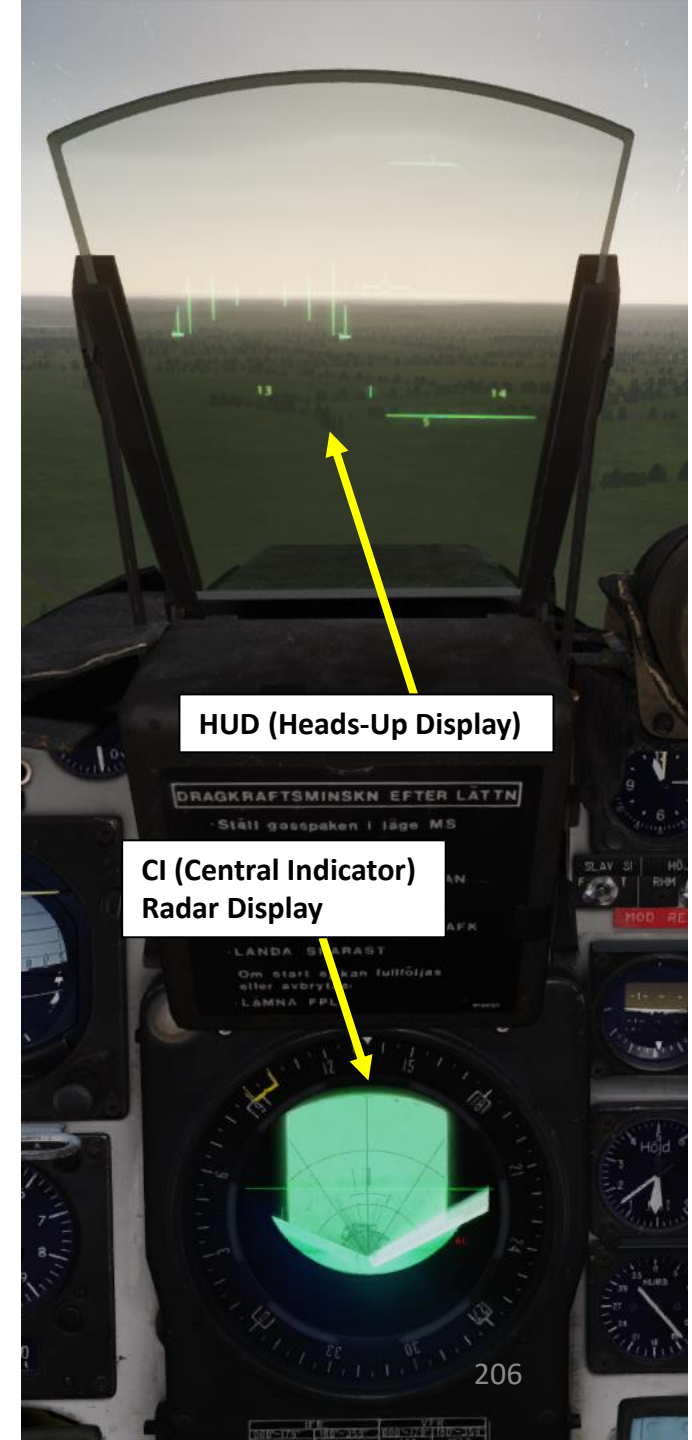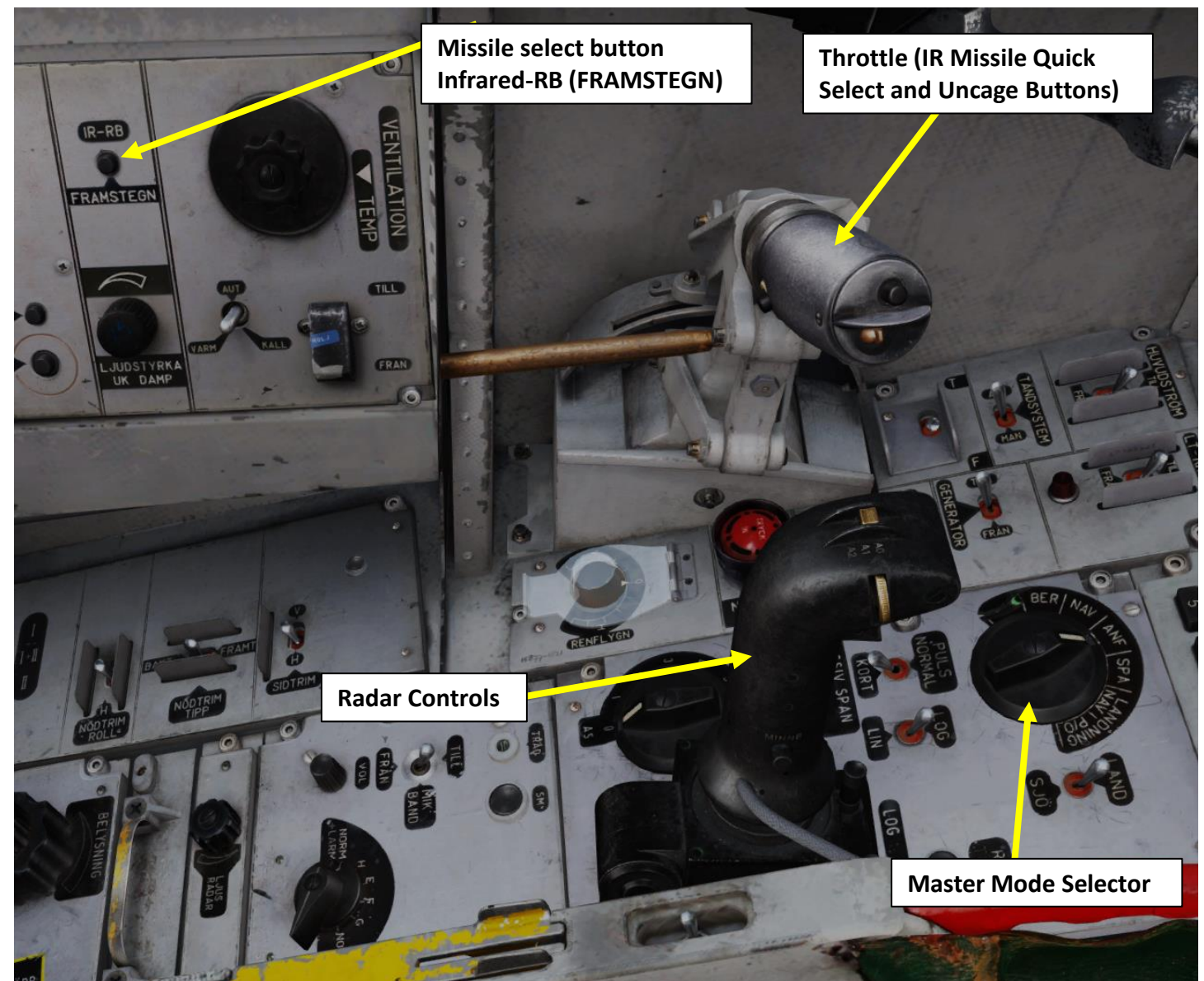The RB-05 Control Unit is used to control the Rb-05 MCLOS (Manual Command to Line of Sight) remote-controlled missile. The control unit is force sensing (stick does not move).

Safety Bracket

Trigger & Safety Cover

Trigger

SAFE   UNSAFE   Firing

CK37 Computer Interface

RB-05 Control Unit

Trigger Safety UNSAFE

Trigger Safety SAFE

Weapon Release Trigger (in front of stick)

205
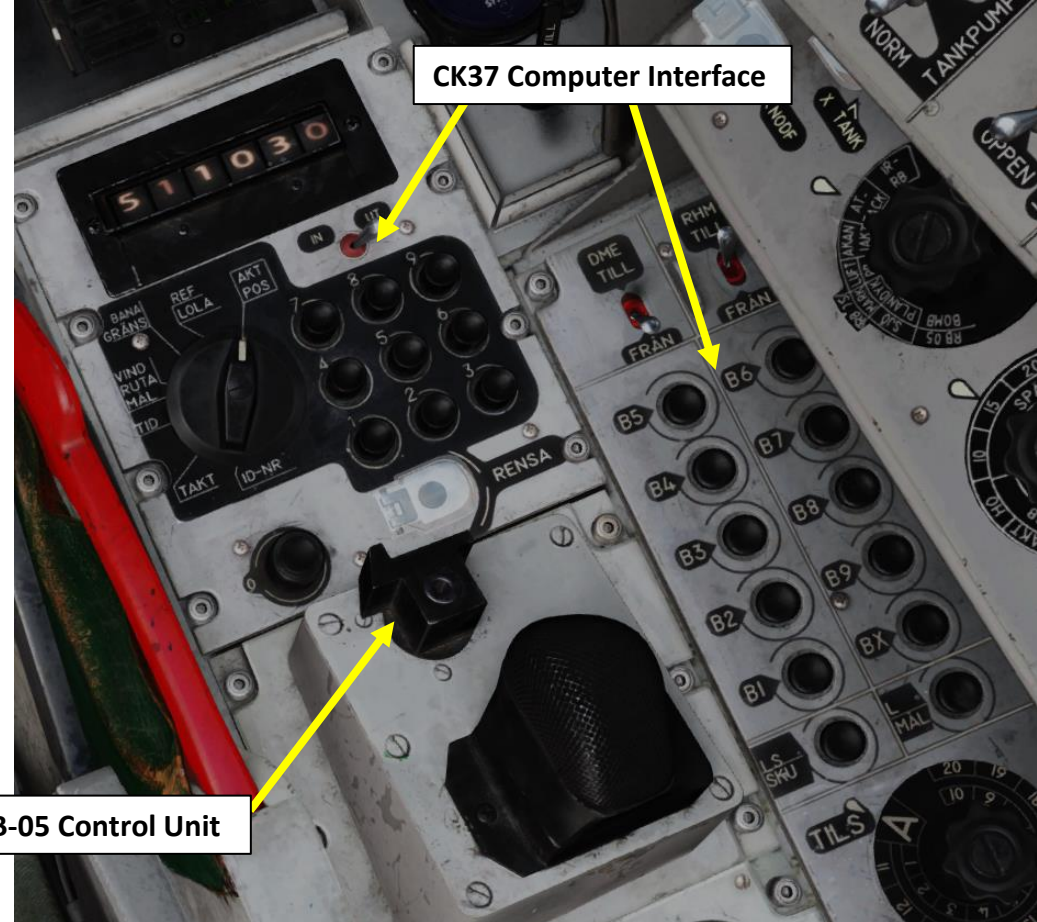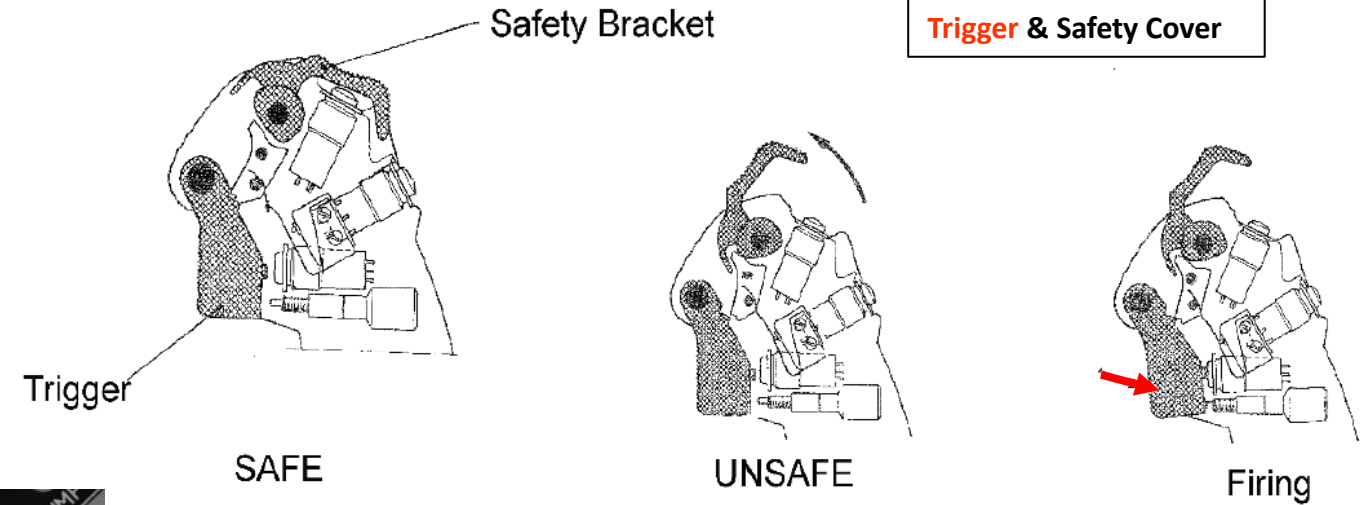
1 – Introduction
1.4 – Weapon Controls & Interfaces

The CI (Central Indicator) and HUD (Heads-Up Display) provide cues to the pilot to know when to release their weapons and find targets. The Radar Control Stick, Master Mode Selector and throttle buttons are also used for certain weapon procedures.

Missile select button
Infrared-RB (FRAMSTEGN)

Throttle (IR Missile Quick Select and Uncage Buttons)

Radar Controls

Master Mode Selector

HUD (Heads-Up Display)

CI (Central Indicator) Radar Display

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1 – Introduction
1.5 – Mission Planning

Operating the Viggen has to be done in a very specific way if you intend to survive your combat operations. The Viggen is meant to fly low, fast, strike hard, and run back home as fast as possible. This means flying at 30 m from the ground most of the time. Why? Because there are two ways to avoid enemy air defenses: by either flying super high and hoping that the bazillion radars and missiles locked on you can't reach you (which is quite unlikely) or by flying low and using terrain to mask your approach. The Viggen is explicitly designed to take the much smarter "ass-to-grass" approach.

To counter air defenses en route to the target, remaining at a low altitude for as long as possible allows the Viggen to avoid radar and visual tracking and the launch envelope of older missile systems designed to be fired at targets overflying the missile site.

Observe the picture of a typical flight plan for a ground strike:
- The Flight Plan has 4 waypoints: B1, B2, B3 (with a target point M3 assigned) and B4.
- Markpoint BX1 is added as a reference point for a secondary target
- The optional pop-up point is attached to the Target point M3 (U3).
- LS is the starting airfield
- L1 is the primary landing base (L1)
- L2 is the secondary landing field (L2.
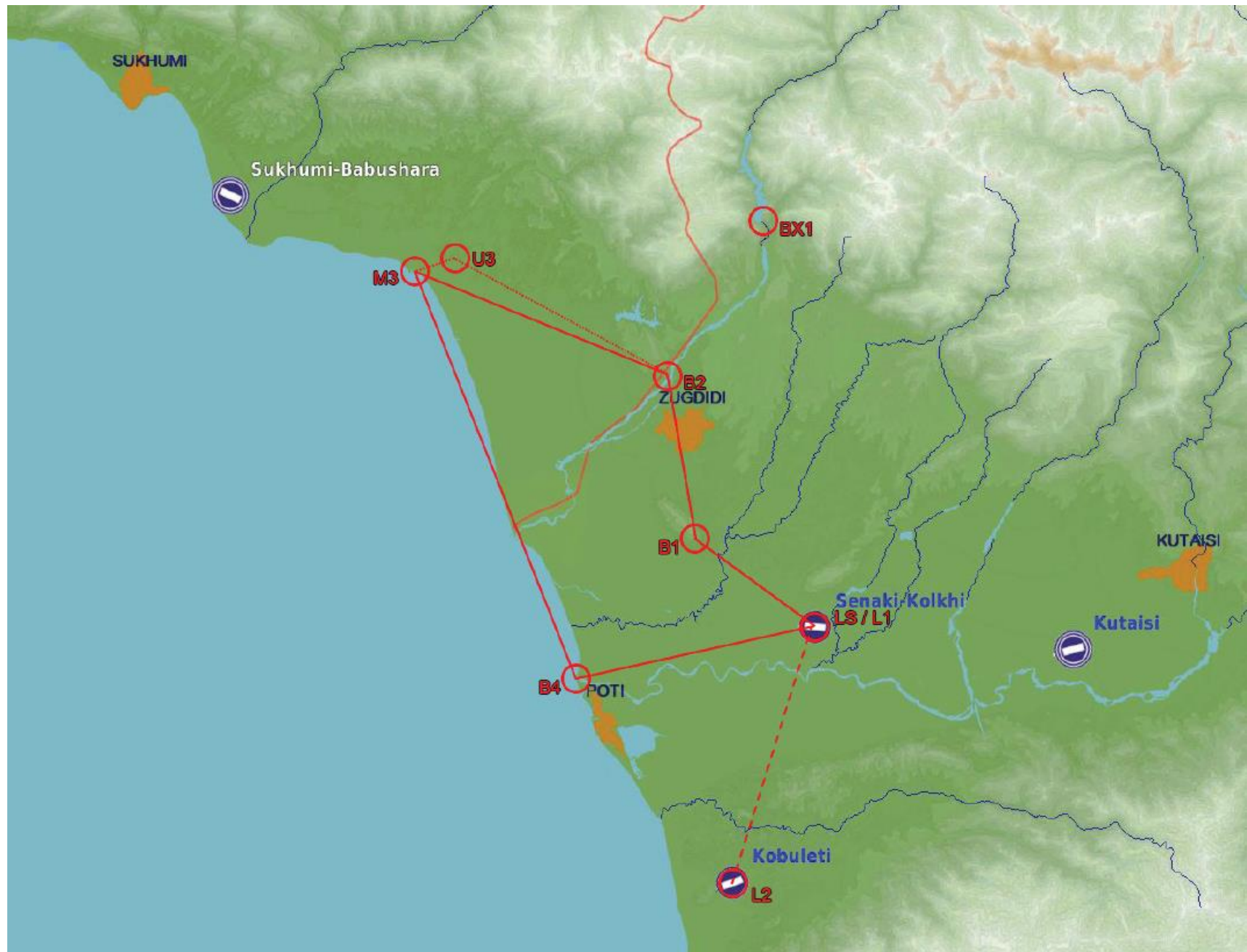
1 – Introduction
1.5 – Mission Planning

You will navigate through various waypoints flying as low as humanly possible until you get to the Target Point (which is where… err… where the target is). However, you can't just blindly fire rockets 10 m from the ground… for that, you need to "pop up" at the very last minute in order to spot your target, get a firing solution, bring the hurt and scram back to base.

In other words, we need to take a normal waypoint, transform it into a Target Point, and then from this Target Point create a Pop-Up point that will use this target point as a reference. Not that complicated now, eh? The Viggen requires more preparation than most aircraft in DCS, but if you spend that extra 5 min on the ground to set up your route properly, it can make your life much easier once you're in the air dodging SAM sites left and right.

Not all missions types require a pop-up point, but in practice setting one up will help you immensely.

750 m

50 m

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)
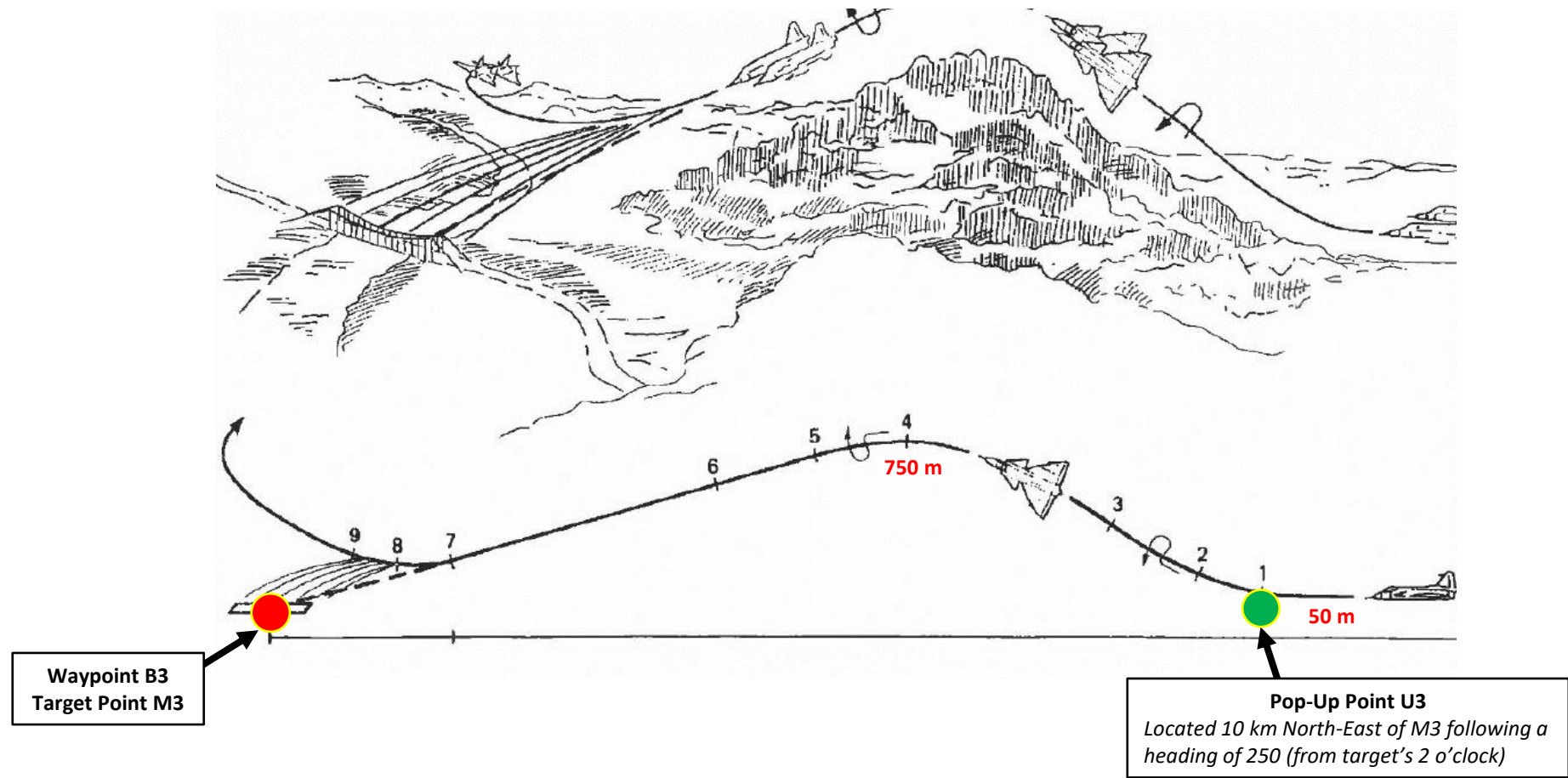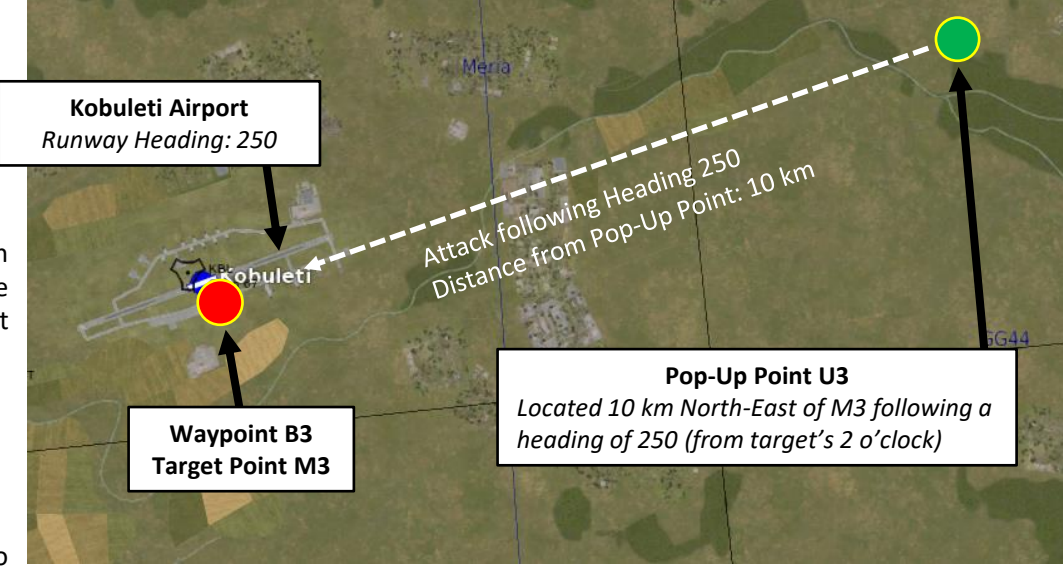
1 – Introduction
1.6 – Target Point (M#) and Pop-Up Point (U#) Creation

A – Target Point Creation (M#)

The fundamental difference between a Target Point M# and a Waypoint B# is that creating a "fix" on a Waypoint (Navigation Fix) will shift the whole navigation coordinate database, while doing so on a Target Point (Target Fix) will only shift the coordinates of that particular Target Point.

A target point M# is created directly from an existing B# waypoint. In this example, we want to create Target Point M3 from the waypoint B3, which will have the same coordinates.

- To create a Target Point M3:
  a) Set Data Selector to TAKT
  b) Set INPUT/OUTPUT Selector to IN
  c) Enter "9" on the keypad
  d) Press the B3 button
  e) Set INPUT/OUTPUT Selector to UT (Output)
  f) Set Data Selector to AKT POS (Active Position)
- To restore a Waypoint from an existing Target Point, use the same procedure listed above, but enter code "0" instead. This will turn M3 back to B3.
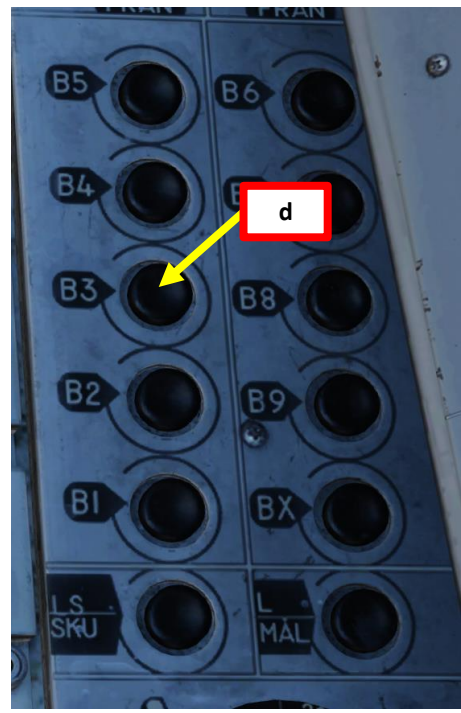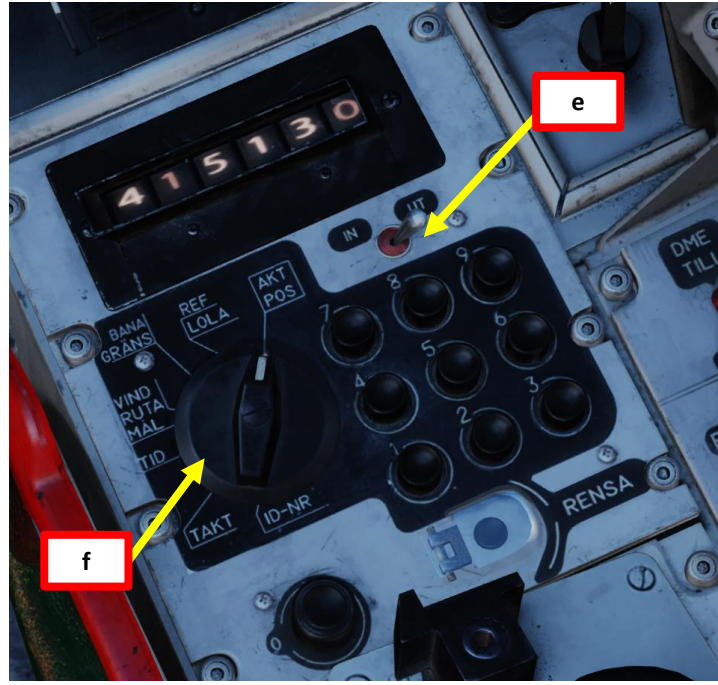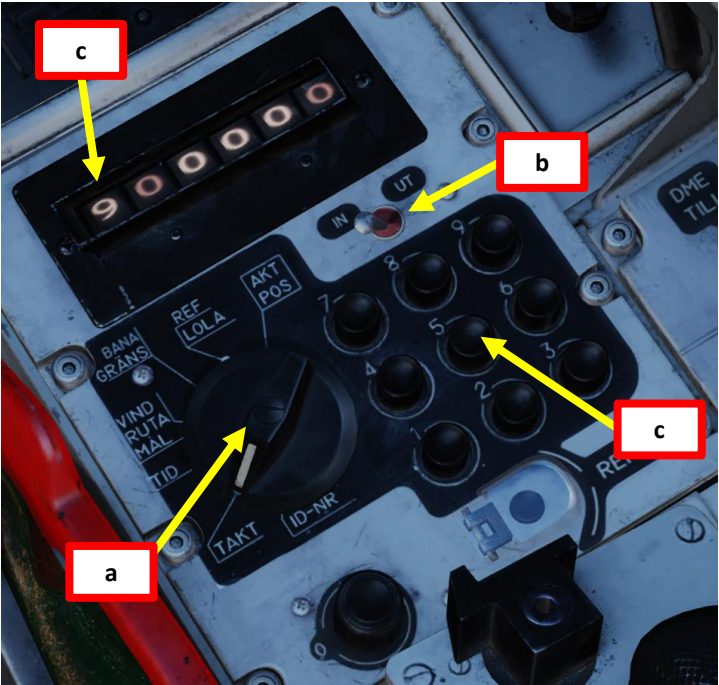
1 – Introduction

1.6 – Target Point (M#) and Pop-Up Point (U#) Creation

B – Pop-Up Point Creation (U#)

Creating a Pop-Up Point requires a bit more work. A pop-up point (U#) is defined by entering the direction and distance **from** the pop-up point (U#) **to** the target waypoint (M#). Think of it as a way to plan the direction of your attack. In this example, we want to create Pop-Up Point U3 in relationship to the Target Point M3. The heading from pop-up point U3 to the target waypoint M3 is **250** with a distance of **10** km.

- To create a Target Point M3:
  - a) Set Data Selector to TAKT
  - b) Set INPUT/OUTPUT Selector to IN
  - c) Enter code "**250**10" on the keypad
  - d) Press the B3 button (Waypoint 3)
  - e) Pop-Up point U3 will be created from the offset entered previously in relationship to Target point M3.
  - f) Set INPUT/OUTPUT Selector to UT (Output)
  - g) Set Data Selector to AKT POS (Active Position)

Kobuleti Airport
Runway Heading: 250

Attack following Heading 250
Distance from Pop-Up Point: 10 km

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

Pop-Up Point Heading To Target Waypoint 250

Pop-Up Point Distance To Target Waypoint 10 km

c

b

c

a

f

g

d

REVAVDR
TRANSONIC

M 3

REVAVDR
TRANSONIC

U 3

210
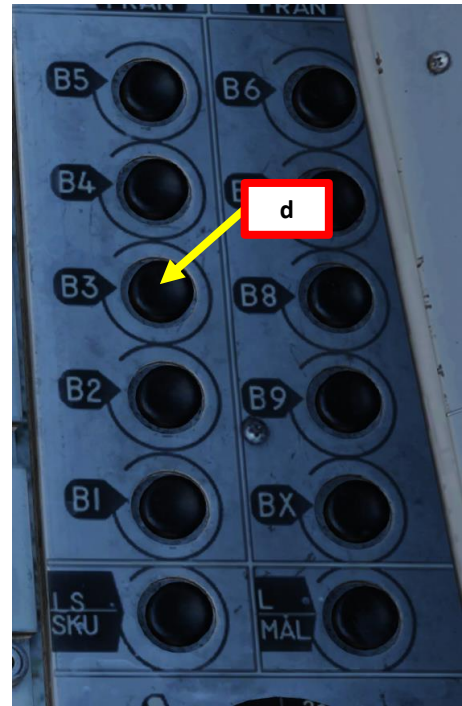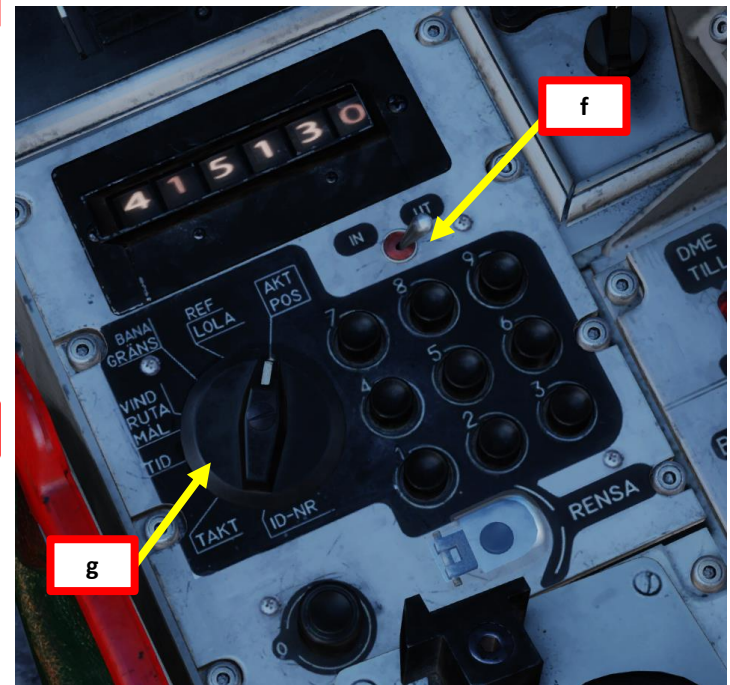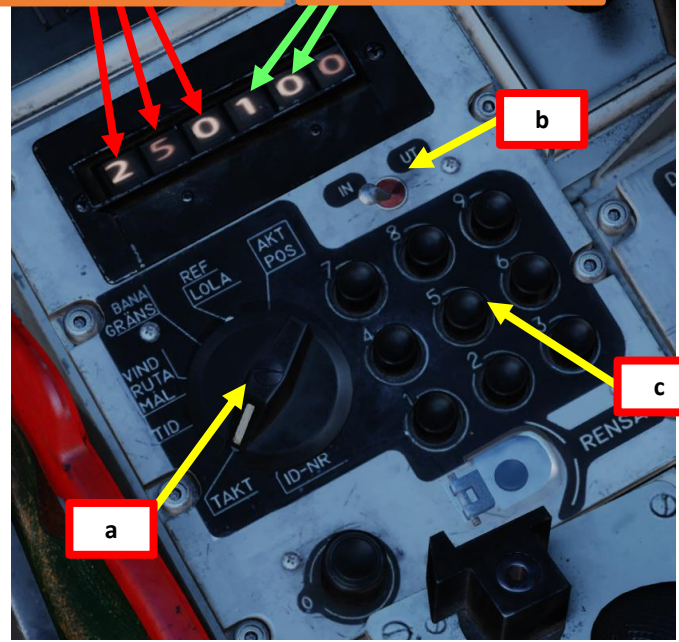
1 – Introduction
1.7 – QFE

Introduction to QFE and QNH

Unlike modern planes, the Viggen's CK37 computer does not have terrain elevation data available. Therefore, weapon release cues rely on either radar ranging or triangulation ranging, which requires altitude data (based on barometric pressure readings derived from the pitot tube).

An **Altimeter setting** is the value of the atmospheric pressure used to adjust the scale of a pressure altimeter so that it indicates the height of an aircraft above a known reference surface. This reference can be the mean sea level pressure, or the barometric pressure at the nearby surface airport or the pressure level of 1,013.25 hectopascals (29.92 inches of Hg, Mercury) which gives the standard flight levels.

QNH is the **"sea-level pressure".** It's used to cause the altimeter to register height above sea level. When sitting on the ground at an airport, dialing QNH into the altimeter will cause it to display the airport's altitude above sea level.
- Note: A barometric altitude with a QNH altimeter setting is sometimes referred to as "Nautical Height".

QFE is the **"air pressure at the current ground level".** It's used to cause the altimeter to register height above the ground (for a certain area). When sitting on the ground at an airport, dialing QFE into the altimeter will cause it to display zero feet.
- Note: A barometric altitude with a QFE altimeter setting is sometimes referred to as "Field Elevation".

Western countries largely standard on using QNH during takeoff and landing. It allows you to accurately know your height above sea level, but you must know the height of the local terrain to know if you are at risk of impacting terrain.

Eastern countries have sometimes standardized on using QFE, which allows you to know your height above the airport by just reading the altimeter.
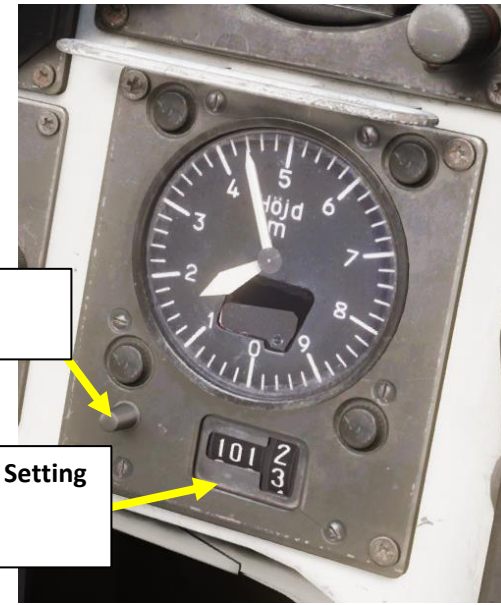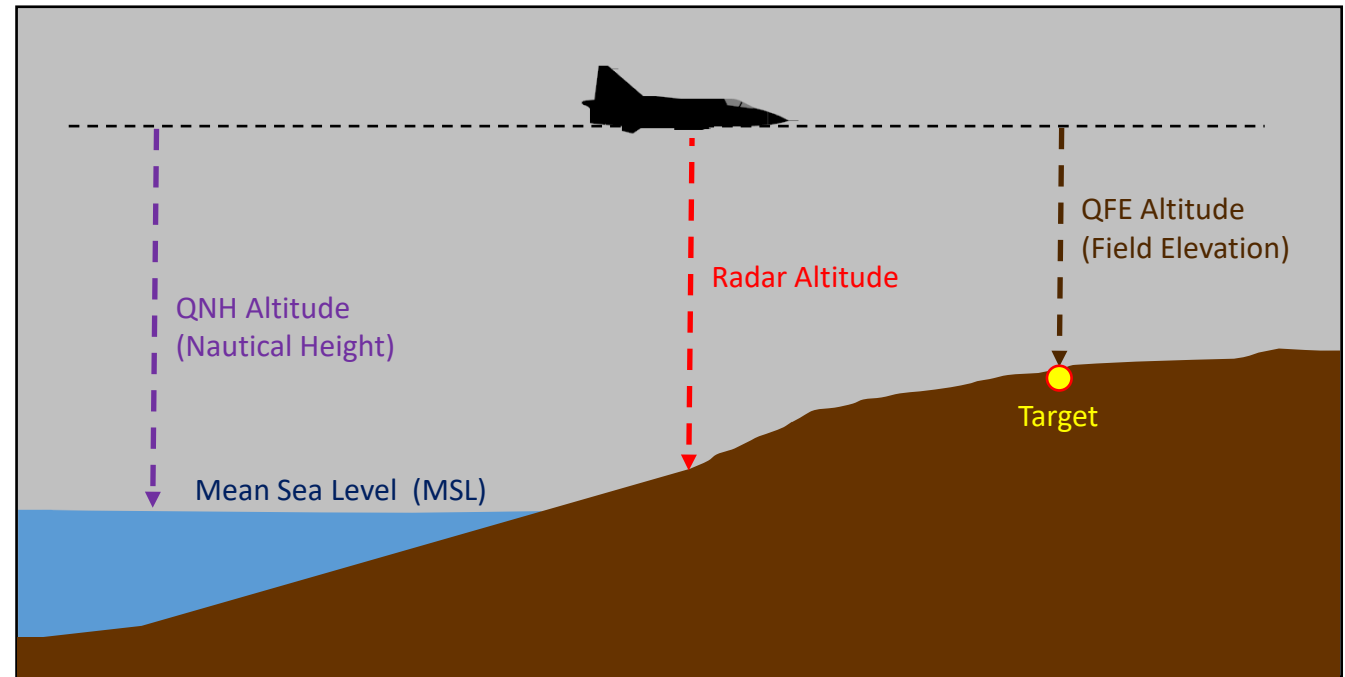
QFE Altitude (Field Elevation)

Radar Altitude

QNH Altitude (Nautical Height)

Target

Mean Sea Level (MSL)

Altimeter Pressure (QFE) Setting Knob

Altimeter Barometric Pressure (QFE) Setting (HPa)
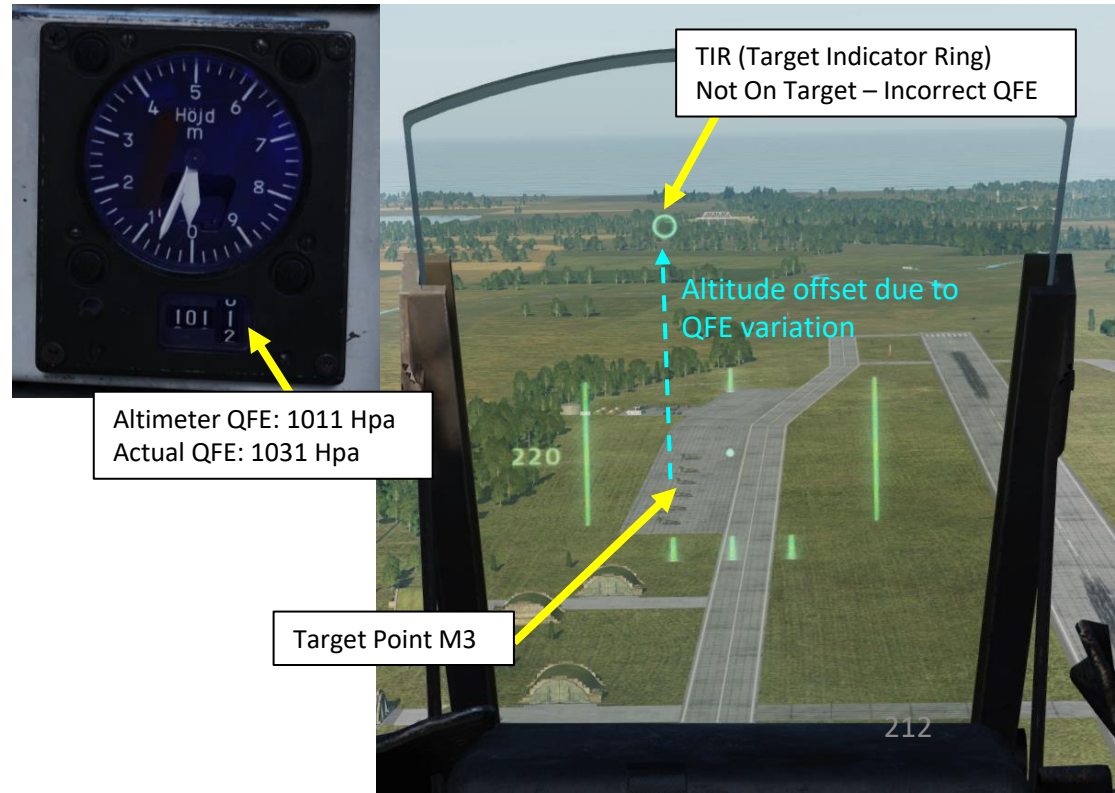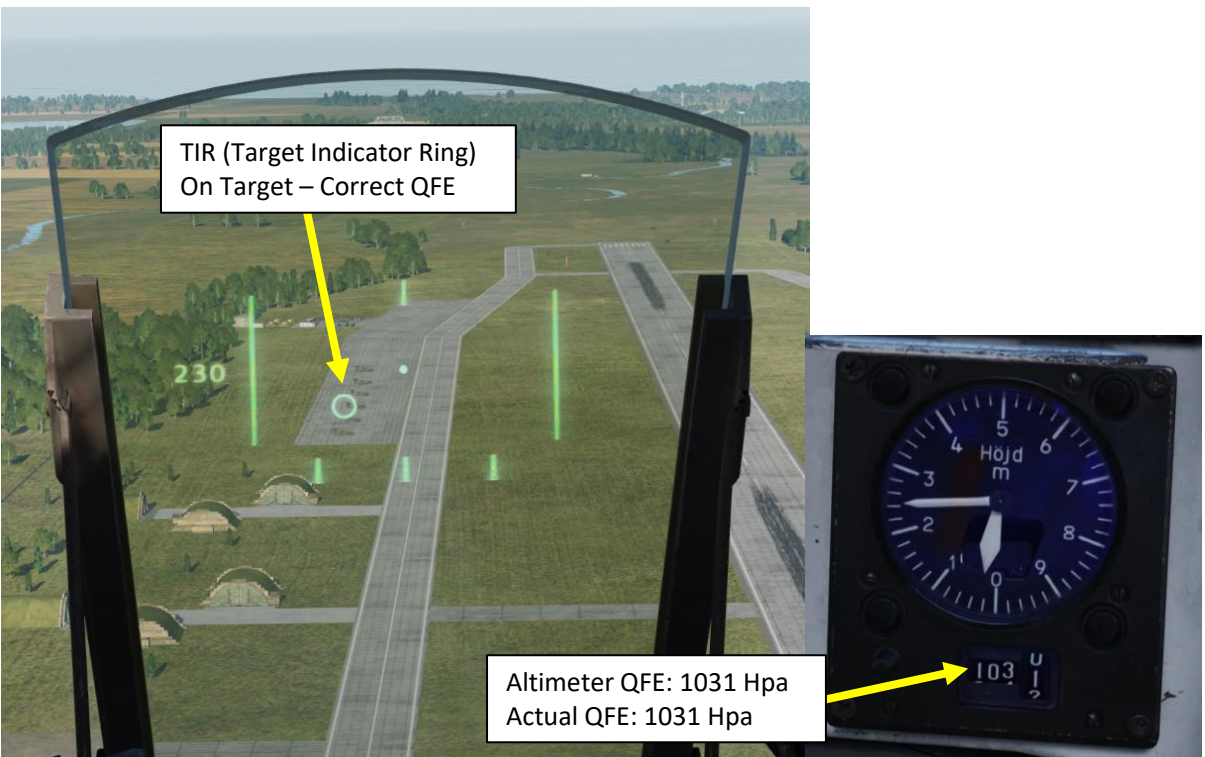Ex: 1013.25 Hpa = 29.92 in Hg

1 – Introduction
1.7 – QFE

QFE Problems

Having a QFE set incorrectly can screw up your HUD symbology when it comes to reference points. See example below.

QFE Accuracy Required

Not Applicable	Low	Medium	High
RB-24 Air-to-Air Missile RB-74 Air-to-Air Missile RB-05A MCLOS Missile RB-75 Air-to-Ground Missile	RB-04E Anti-Ship Missile RB-15F Anti-Ship Missile BK-90 Cluster Munitions	ARAK Rockets AKAN Gunpods	Bombs

WAYPOINT NAME
M3

COURSE (T)	HEADING (M)	G/S	IAS
256	263	630	621

DISTANCE	TOF	ETA	QFE
11.6	00:01:06	07:32:24	1031.1

ALTITUDE			BINGO FUEL
18	Actual QFE Setting at Target Point M3		73

TIR (Target Indicator Ring)
On Target – Correct QFE

Altimeter QFE: 1031 Hpa
Actual QFE: 1031 Hpa

TIR (Target Indicator Ring)
Not On Target – Incorrect QFE

Altitude offset due to QFE variation

Altimeter QFE: 1011 Hpa
Actual QFE: 1031 Hpa

Target Point M3

212

1 – Introduction
1.7 – QFE

There are three main methods to know your QFE setting for a specific target.

Method 1: Kneeboard

When a flight plan (with its respective waypoints) is loaded in the aircraft's CK37 computer, a kneeboard list of QFE values is available for each waypoint. To open kneeboard, press "RSHIFT+K". This is the easiest and most precise method, but you need to know your target location in advance.

Mission Data Cartridge

Altimeter Pressure (QFE) Setting Knob

Altimeter QFE: 1031 Hpa

DATE 2016-06-21	MISSION ID AJS37 Bombing Low Drag Enfield 1-1		CALLSIGN	TASK Strike
FUEL WEIGHT 5489	LOADOUT 1920	TOTAL WEIGHT 19209	V2 405	
ENGINE START TIME 00:00:00	TAKE-OFF TIME 00:00:00	RUNWAY HEADING 0	QNH 1033.2	

WAYPOINT NAME M0			
COURSE (T) 0	HEADING (M) 7	G/S 555	IAS 498
DISTANCE 0.0	TOF 00:00:00	ETA 07:30:00	QFE 952.6
ALTITUDE 914	VERTICAL ANGLE 0	FUEL RESERVE 123	BINGO FUEL 74

WAYPOINT NAME B1			
COURSE (T) 330	HEADING (M) 337	G/S 555	IAS 519
DISTANCE 6.0	TOF 00:00:39	ETA 15:00:39	QFE 1016.5
ALTITUDE 213	VERTICAL ANGLE -7	FUEL RESERVE 122	BINGO FUEL 74

WAYPOINT NAME B2			
COURSE (T) 306	HEADING (M) 313	G/S 555	IAS 541
DISTANCE 5.3	TOF 00:00:34	ETA 22:31:53	QFE 1023.4
ALTITUDE 213	VERTICAL ANGLE 0	FUEL RESERVE 121	BINGO FUEL 73

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

WAYPOINT NAME			
COURSE (T)			IAS
DISTANCE	TOF	ETA	QFE
ALTITUDE	VERTICAL ANGLE	FUEL RESERVE	BINGO FUEL

Actual QFE Setting at Target Point M3

213

1 – Introduction
1.7 – QFE

Method 2: used for Flat Terrain

This second method is best used for target areas with a flat elevation. In that case, we will use the radar altimeter reading to adjust the barometric altimeter setting until the barometric altitude and radar altimeter are the same. In the example below, we know that the correct/real QFE setting at Target Point M3 is 1031 Hpa. However, I deliberately set the QFE to 1037 Hpa to show you how to identify a QFE mismatch.

1. Fly in the target area and engage autopilot HÖJD (Altitude Hold) to maintain a level altitude.
2. Set Master Mode to NAV.
3. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source. You will notice that the radar altitude displayed here is 170 meters above ground level.
4. Now, set Altitude Source Selector (HÖJD CISI) to LD. This will ensure the barometric pressure is used as the primary altitude source. Barometric altitude is affected by your QFE setting.
5. You will notice that the barometric altitude displayed here is 220 meters, which does not match with the radar altitude obtained earlier of 170 meters. This means that the QFE (altimeter setting) used, which is 1037 HPa in our case, is set incorrectly.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	**Actual QFE Setting at Target Point M3**		BINGO FUEL 73

Radar Altitude: 170 meters

3

Barometric Altitude: 220 meters

4
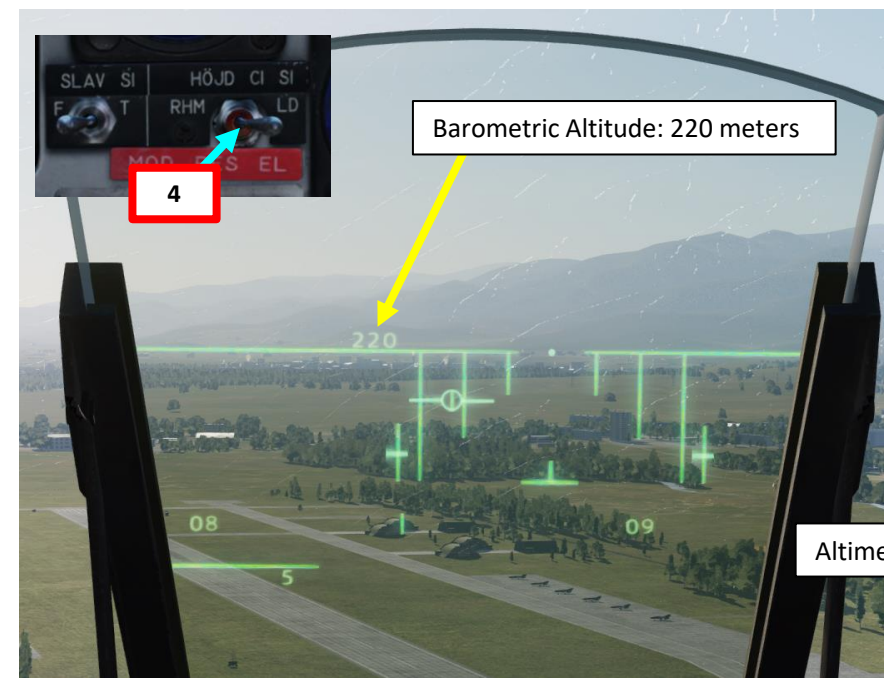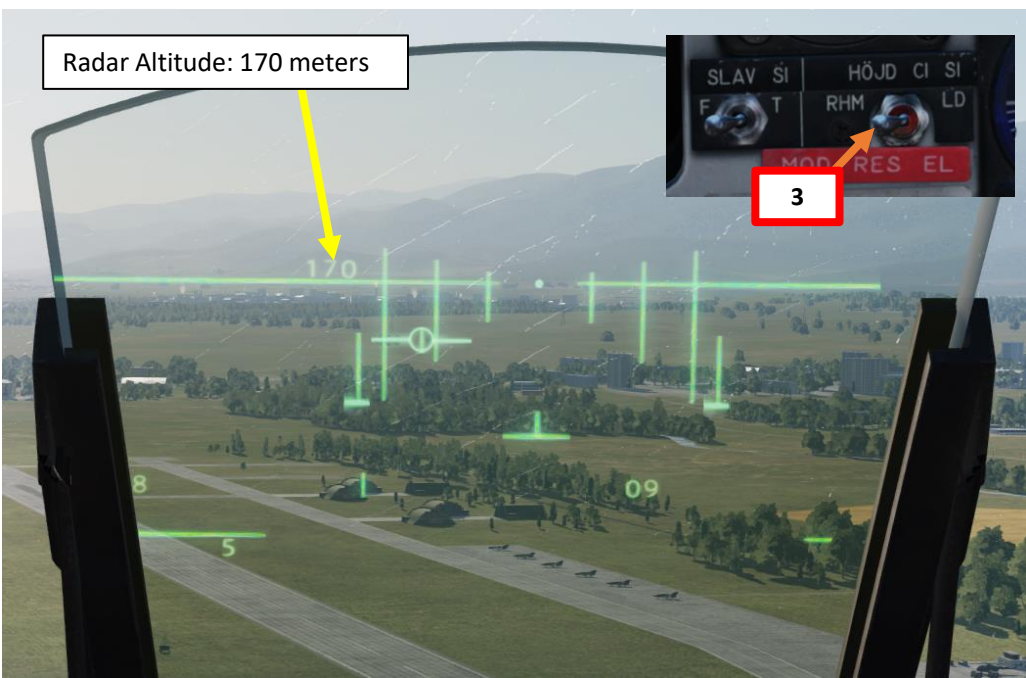
Altimeter QFE: 1037 Hpa

1 – Introduction
1.7 – QFE

Method 2: used for Flat Terrain

6. While overflying the target area, adjust the Altimeter Pressure Setting knob until the horizontal Radar Altitude Index bar is lined up with the bottom of the vertical Altitude Reference bar. When the bars are lined up, the radar altitude and barometric altitude should be roughly the same, meaning that the QFE setting is adjusted for the elevation you just overflew.
7. In our case, the altimeter QFE had to be adjusted to 1031 Hpa.
8. If you want to double-check that the radar altitude and barometric altitude match, set the Altitude Source Selector (HÖJD CISI) back to RHM and compare the altitude value.
9. The QFE setting is now properly adjusted.

Altimeter Pressure (QFE) Setting Knob

6a

Altitude Reference Bar (Vertical)

Altimeter QFE: 1037 Hpa
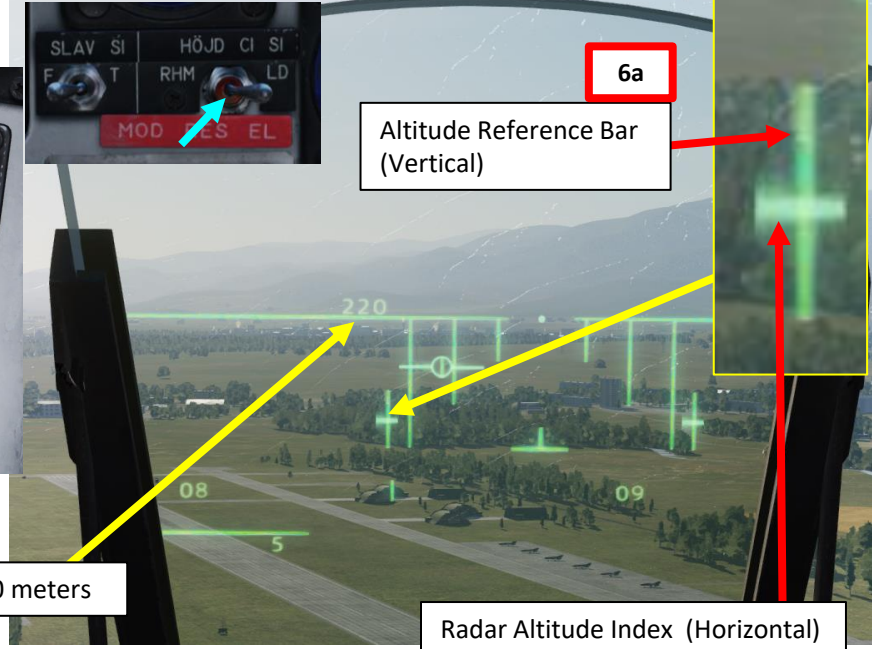
Barometric Altitude: 220 meters

Radar Altitude Index (Horizontal)

Radar Altitude: 170 meters

8

6b Altimeter Pressure (QFE) Setting Knob

Altitude Reference Bar (Vertical)

7 Altimeter QFE: 1031 Hpa
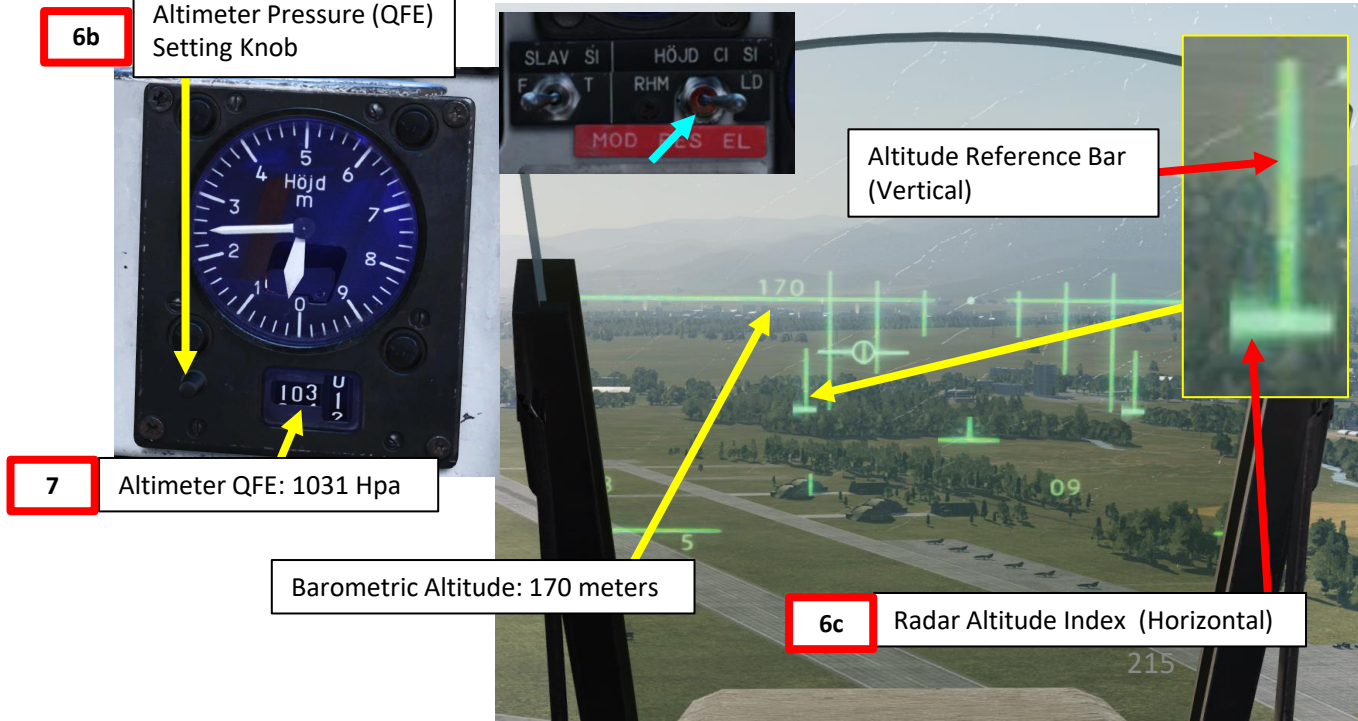
Barometric Altitude: 170 meters

6c Radar Altitude Index (Horizontal)

215

1 – Introduction

1.7 – QFE

Method 3: Using F10 map terrain elevation with airfield QNH

This third method requires a bit of math and the location of the target. We will calculate the QFE value with the QNH value from the starting airfield (assuming it is not too far and that the weather does not change too much).

1. When you are on your takeoff airfield, find the airfield elevation, which is available in the F10 map.
2. In our case, we takeoff from Senaki-Kolkhi, which has an elevation of 43 ft. To convert this elevation from feet into meters, multiply by 0.3:
   - 43 ft x 0.3 m/ft = 13.1 meters
3. Adjust the Altimeter Pressure Setting knob to match the altitude indicated by the altimeter with the airfield elevation (13.1 meters). In our case, we get an elevation of 13.1 meters by setting the altimeter setting knob to 1031.5 Hpa.
4. Therefore, from the airfield elevation, we calculated that the airfield **QNH** (barometric pressure at sea level) is **1031 Hpa**.
   - You could also cheat and find the QNH directly on the kneeboard, which is basically the QFE in the TAKEOFF section.
5. In the F10 map, hover the mouse over the target and write down the **target elevation** (2064 ft in our case). Convert this elevation in meters (2064 ft x 0.3 m/ft = **629 meters**
6. $$QFE = QNH - \frac{(\textit{Target Elevation in meters})}{9.3}$$

   $$QFE = 1031.5 \, Hpa - \frac{(629 \, m)}{9.3 \, m} = 963.5$$
7. Therefore, the **QFE expected at a target** of an elevation of 629 meters is approx. **964 HPa**.
8. For validation purposes, I placed a target point M3 over the target and the QFE is pretty close to what we calculated.

AIRDROME DATA

NAME	Senaki-Kolkhi
ICAO	UGKS
COALITION	Blue
ELEVATION	43 ft
RWY Length	729 ft
COORDINATES	42°14'19"N 42°03'39"E
TACAN	31X (TSK)
VOR	--
RSBN	--
ATC	4.300, 132.000, 40.000, 261.000
RWYs	27 / 9
ILS	-- / 108.90 (ITS)
PRMG	-- / --
OUTER NDB	-- / 335.00 (BI)
INNER NDB	-- / 688.00 (B)

RESOURCES

Altimeter Pressure (QFE) Setting Knob

3

Altimeter QFE: 1031 Hpa

Target
Elevation: 2064 ft / 629 m

APC BTR-80

5

This third

2

Takeoff Airfield
Senaki-Kolkhi
Elevation: 43 ft / 13.1 m

DATE 2016-06-21	MISSION ID tempMission	CALLSIGN Enfield 1-1	TASK Strike
FUEL WEIGHT 5489	LOADOUT 1920	TOTAL WEIGHT 19209	V2 405
ENGINE START TIME 07:25:00	TAKE-OFF TIME 07:30:00	RUNWAY HEADING 20541	QNH 1033.2

WAYPOINT NAME Take-Off Senaki-Kolkhi

COURSE (T) 20541	HEADING (M) 28	G/S 500	IAS 499
DISTANCE 0.0	TOF 00:00:00	ETA 07:30:00	QFE 1031.7
	0	FUEL RESERVE 123	BINGO FUEL 72

Actual QFE Setting at Airfield

WAYPOINT NAME B1

COURSE (T) 95	HEADING (M) 102	G/S 555	IAS 547
DISTANCE 45.2	TOF 00:04:53	ETA 15:04:53	QFE 1025.6
ALTITUDE 213	VERTICAL ANGLE 0	FUEL RESERVE 114	BINGO FUEL 76

WAYPOINT NAME B2

COURSE (T) 48	HEADING (M) 55	G/S 555	IAS 524
DISTANCE 40.4	TOF 00:04:22	ETA 22:44:08	QFE 946.4
ALTITUDE 750	VERTICAL ANGLE 1	FUEL RESERVE 107	BINGO FUEL 77

WAYPOINT NAME M3

| COURSE (T) 328	HEADING (M) 156	G/S -386	IAS -1039
DISTANCE 44.1	TOF 00:00:00	ETA 07:32:24	QFE 962.8
ALTITUDE 1062	VERTICAL ANGLE 0	FUEL RESERVE 99	BINGO FUEL 75

8

1 – Introduction
1.7 – QFE

Method 3: Using F10 map terrain elevation with airfield QNH

9. Adjust the Altimeter Pressure Setting knob to 964 Hpa and the HUD symbology during bombing should be properly set up for the target.

Target
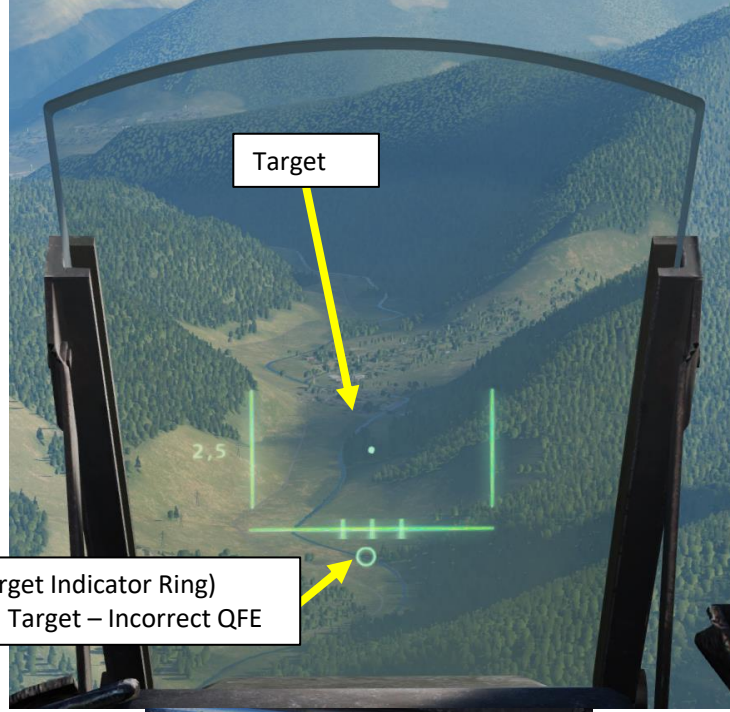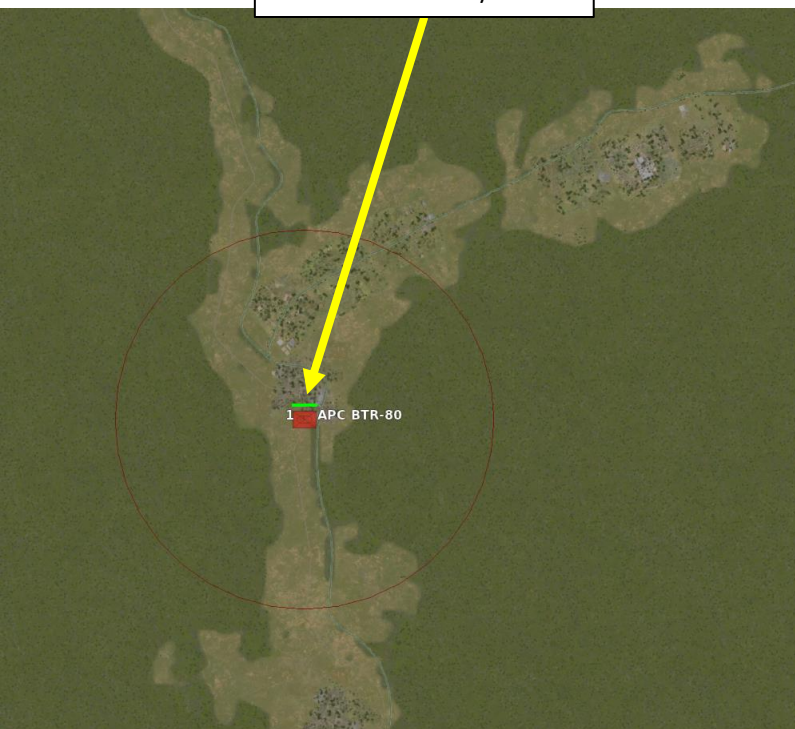
TIR (Target Indicator Ring)
Not On Target – Incorrect QFE

TIR (Target Indicator Ring)
On Target – Correct QFE

Target
Elevation: 2064 ft / 629 m

1 APC BTR-80

9a
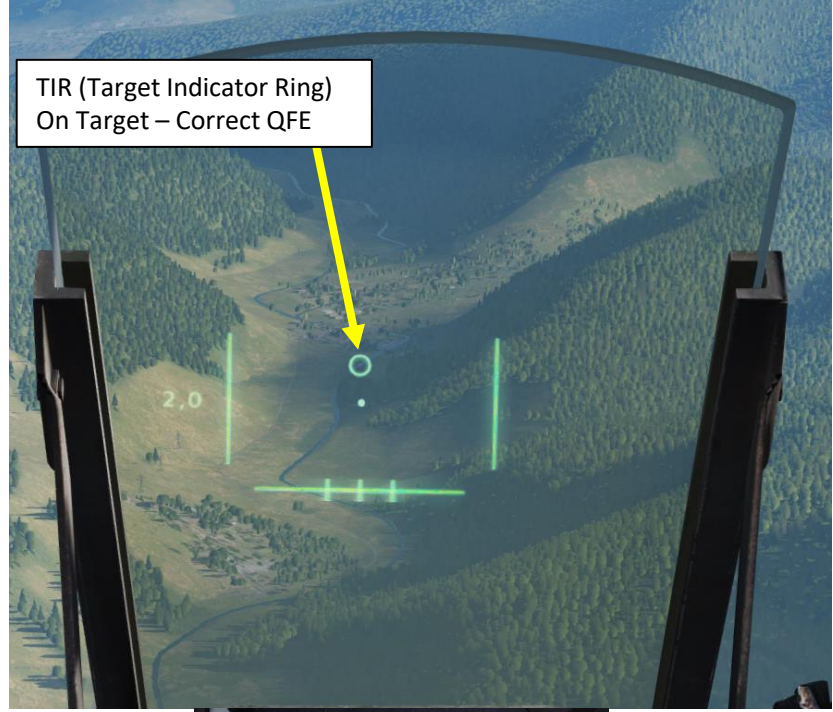
Altimeter QFE: 1031 Hpa
Actual QFE: 964 Hpa

9b

Altimeter QFE: 964 Hpa
Actual QFE: 964 Hpa

217

1 – Introduction
1.8 – Sighting Mechanics
1.8.1 – Triangulation (Computer Calculated Range)

The aircraft can determine its range to target based on a number of manners depending on the weapon type and selected mode. For the unguided weaponry, the distance to target (slant range) is vital for correct sight calculations.

The first ranging method is "triangulation".

- Triangulation is determined by the computer calculating based on the aircraft **barometric altitude** (**which is directly affected by the QFE setting**) and the angle the aiming reticule is pointing relatively to the horizon.
- Errors in the pitch angle from the aircraft instruments or an erroneous altimeter pressure (QFE altitude) setting will yield inaccuracies in the sighting system.
- Ranging is indicated by the distance line appearing at the bottom of the HUD.
- For level release of bombs, the triangulation starts directly when the master mode ANF or if trigger unsafe in master mode NAV independently of the sight angle. The range is not calculated for infinite ranges or negative angles and the sight line in this mode may be hovering around 0°.

Master Mode Selector

Distance Line (Triangulation Ranging)
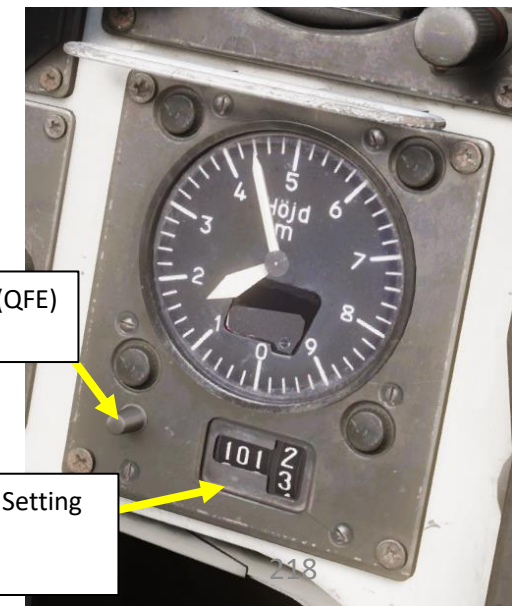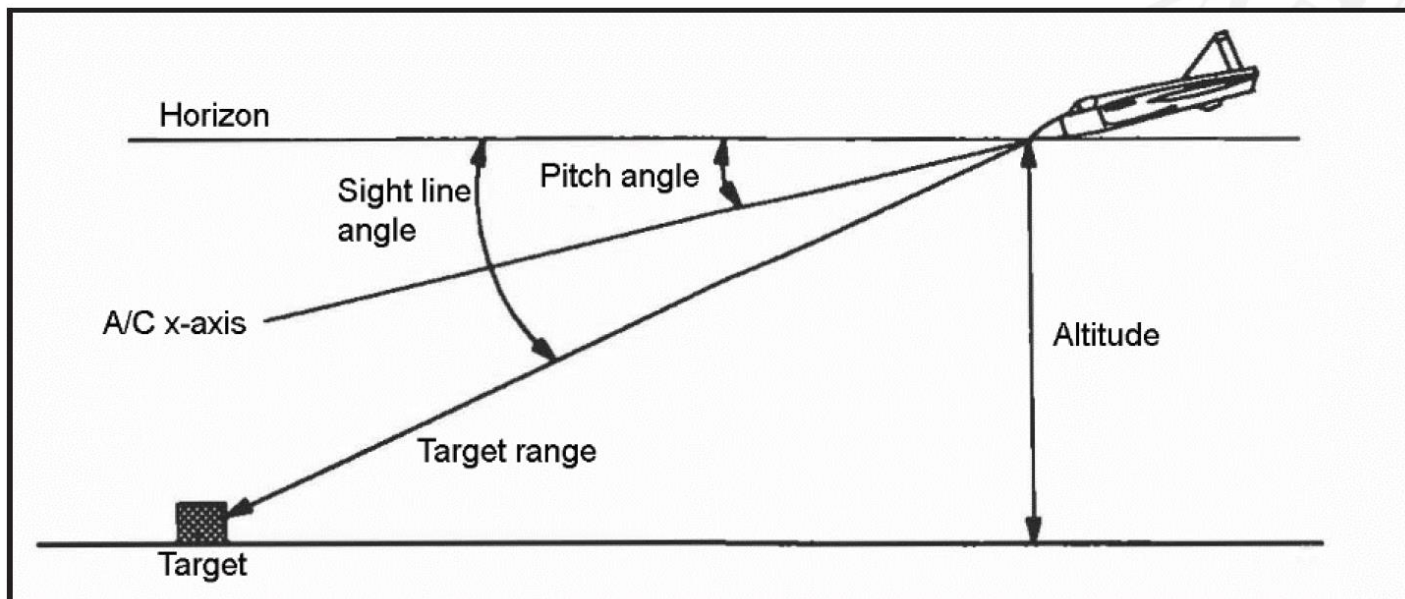
Horizon

Pitch angle

Sight line angle

A/C x-axis

Target range

Altitude

Target

Altimeter Pressure (QFE) Setting Knob

Altimeter Barometric Pressure (QFE) Setting (HPa)
Ex: 1013.25 Hpa = 29.92 in Hg

1 – Introduction
1.8 – Sighting Mechanics
1.8.2 – Radar Ranging

The second ranging method is "radar ranging".

For some weapon modes, when in master mode ANF, the radar will range the distance to the target if the triangulated range is lesser than 7000 m. **Radar ranging is preferable than triangulation due to this increased accuracy and greater flexibility with varying terrain elevation**.

- Radar ranging is indicated by the "fin" appearing in the HUD above the sight dot.
- The radar will range to the spot that the sight reticule (dot) is aiming at.
- As the radar will determine more or less the exact distance to the aiming point, yielding far more accurate sight calculations (particularly against inclined ground) than triangulation based on QFE.
- In modes DIVEBOMB, ARAK (rocket pods), AKAN A/G (gun pods in air-to-ground) and RB75 (AGM-65) the radar range may be used before trigger unsafe, assuming the bank angle is less than 45°.
- In LEVEL BOMB the trigger must first be unsafe. If the bank angle is more than 45°, radar ranging is enabled after the aircraft has a bank angle less than 45°.
- If radar ranging is used, no radar display is shown in the Central Indicator for the duration of its use.

A note on Fixed Ranging:

Radar ranging may not occur due to an excessively shallow angle (sight angle less than 5° from the horizon). The computer will then calculate the firing solution based on a **fixed range** of 1400 meters. Range, firing commands or pull-up warnings are not given and must be estimated by the pilot.

CI (Central Indicator)
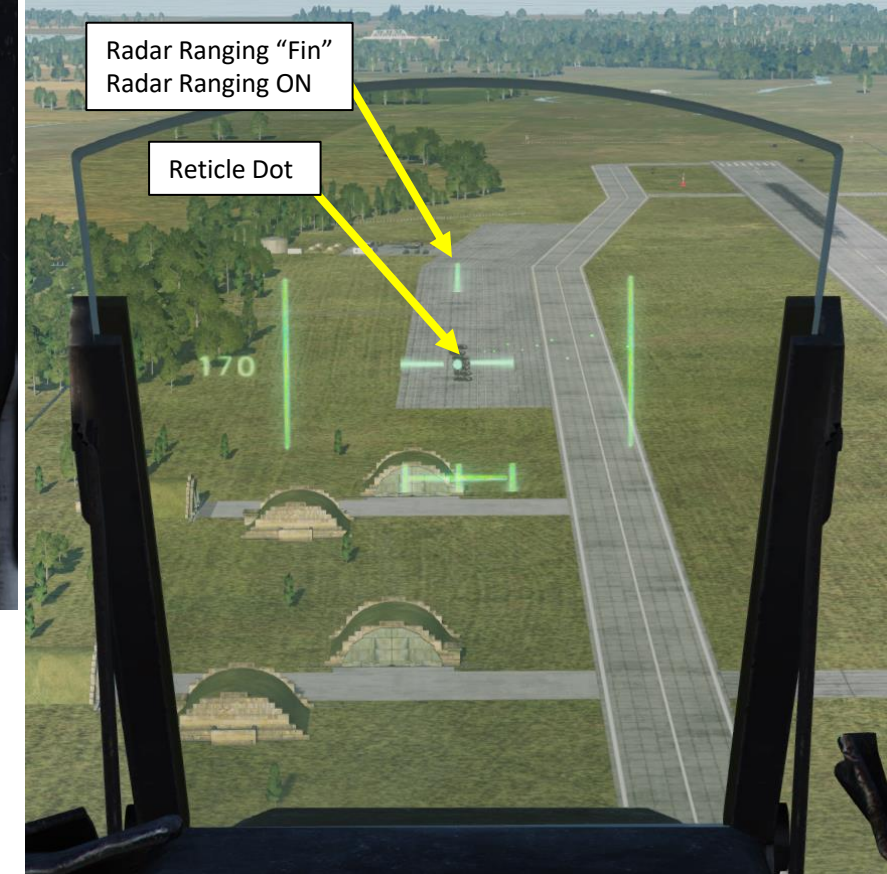
Radar Ranging "Fin"
Radar Ranging ON

Reticle Dot

Master Mode Selector

1 – Introduction
1.8 – Sighting Mechanics
1.8.2 – Radar Ranging

Radar Ranging is enabled by default. However, it can be disabled if you want.

To set Radar Ranging Option OFF:
   a) Set Data Selector to TAKT
   b) Set INPUT/OUTPUT Selector to IN
   c) Enter code "253" on the keypad
   d) Press LS/SKU button
   e) Set INPUT/OUTPUT Selector to UT (Output)
   f) Set Data Selector to AKT POS (Active Position)
   g) Triangulation Ranging will now be used by default.

To set Radar Ranging Option back to ON, use the same procedure listed above, but enter code "251" instead. This option is the one set by default in the aircraft.

Reticle Dot (with Wings)

No Radar Ranging "Fin"
Radar Ranging OFF
Triangulation is used

410

Radar Ranging OFF

c
b
253000

c
a
TAKT

e
420430
f
TAKT

B5 B6
B4 B7
B3 B8
B2 B9
B1
LS SKU   d
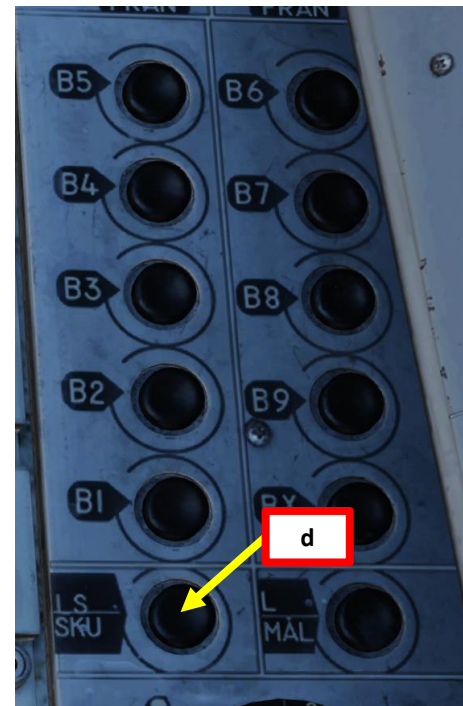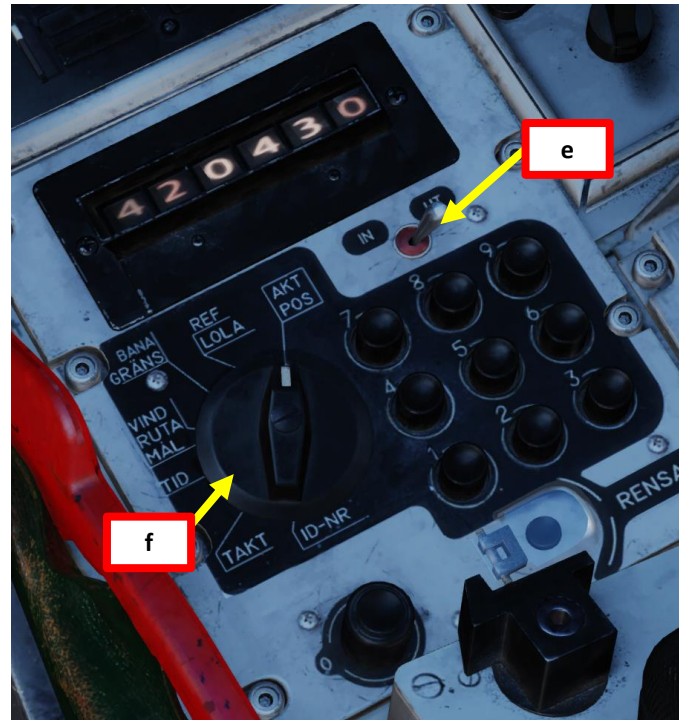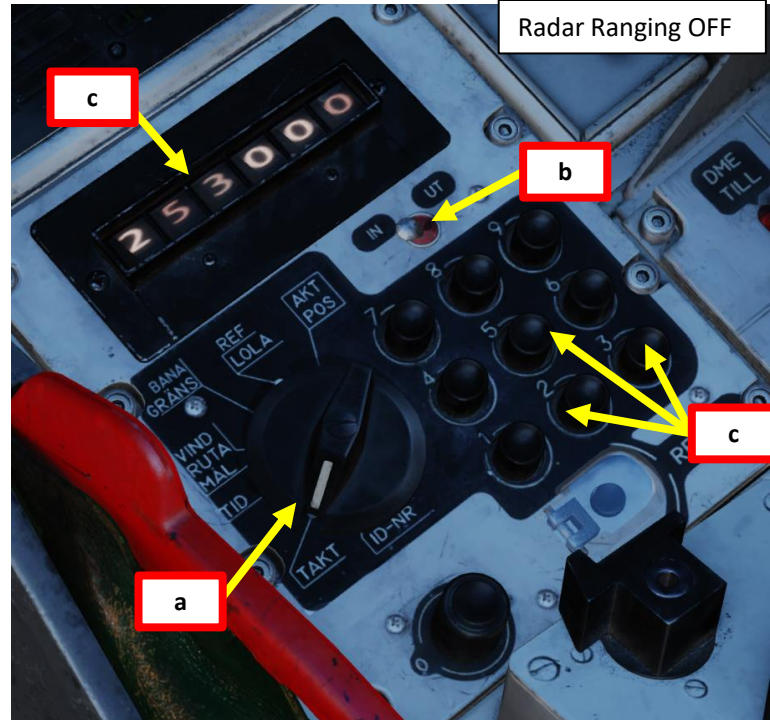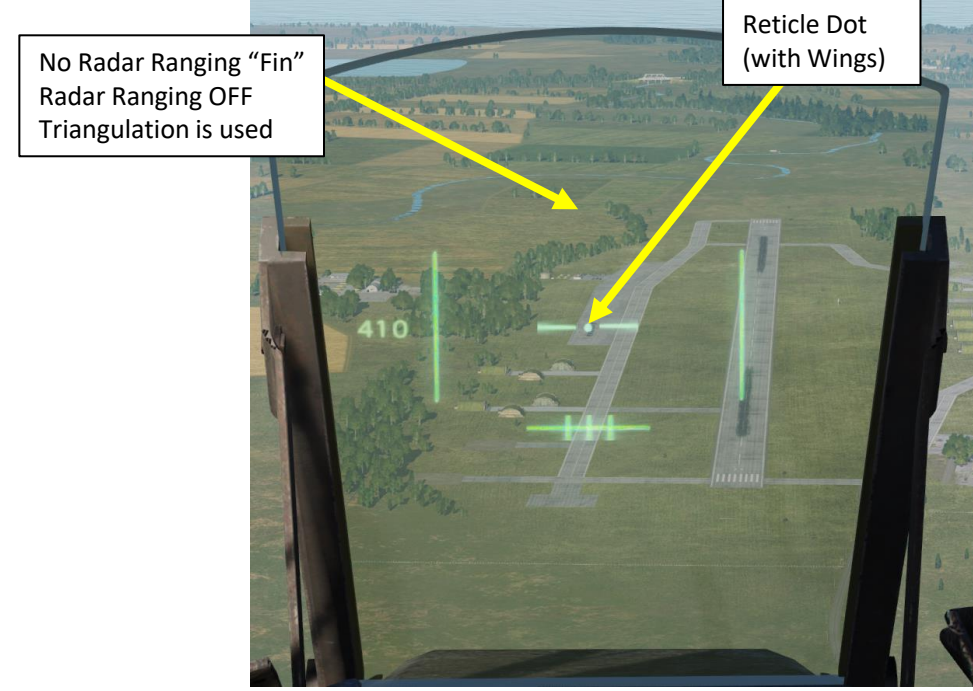
1 – Introduction
1.8 – Sighting Mechanics
1.8.3 – Fixed Sight

In case of primary data failure (main pitot system, for example), or if the mode is selected manually, a **fixed sight** will be displayed.

- In "Fixed" sight mode, only a single ring depressed to a specific angle is shown.
- The sight ring is 0.5° in diameter, which corresponds to 8.7 milliradians.
- The pilot will have to fly according to the parameters below in order to hit the target aimed at using the sight.
- The "Fixed Sight" option is disabled by default.

Fixed Sight Ring

1 – Introduction
1.8 – Sighting Mechanics
1.8.3 – Fixed Sight

The Fixed Sight is disabled by default. However, it can be enable if you want.

To set Fixed Sight Option ON:
- a) Set Data Selector to TAKT
- b) Set INPUT/OUTPUT Selector to IN
- c) Enter code "211" on the keypad
- d) Press LS/SKU button
- e) Set INPUT/OUTPUT Selector to UT (Output)
- f) Set Data Selector to AKT POS (Active Position)
- g) Triangulation Ranging will now be used by default.

To set Fixed Sight Option back to OFF, use the same procedure listed above, but enter code "210" instead.

Fixed Sight Ring

Fixed Sight OFF (Radar Ranging)

Fixed Sight ON

Fixed Sight ON

c

b

a

e

f

c

d

222
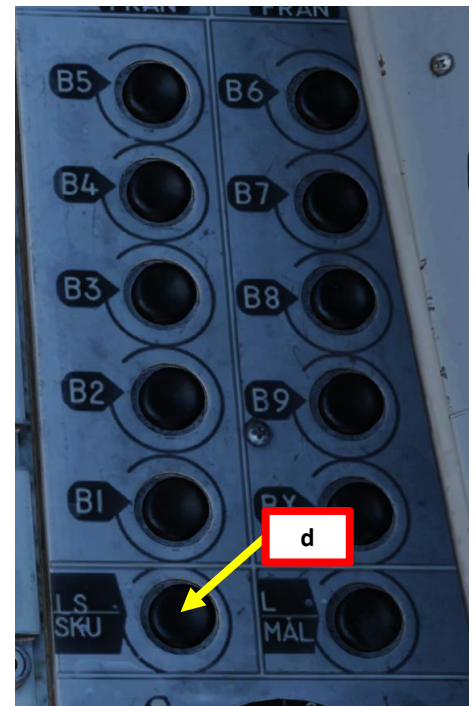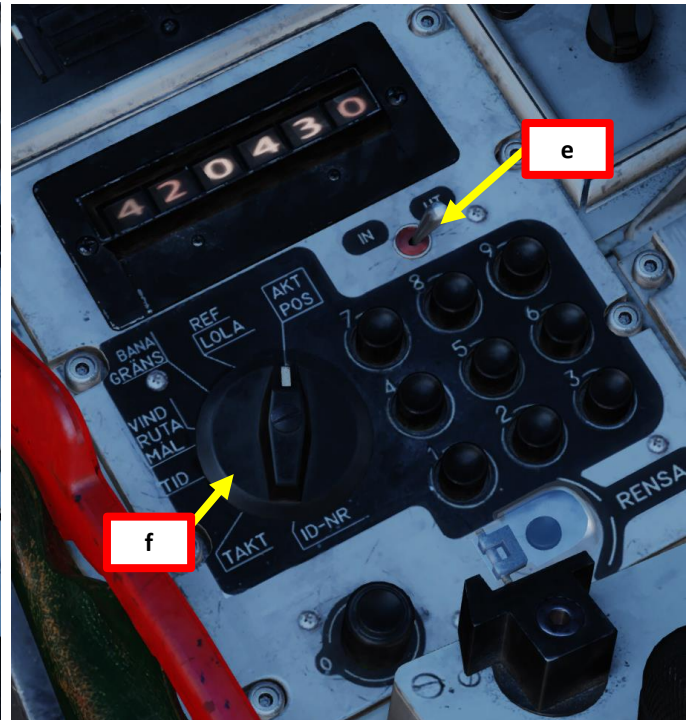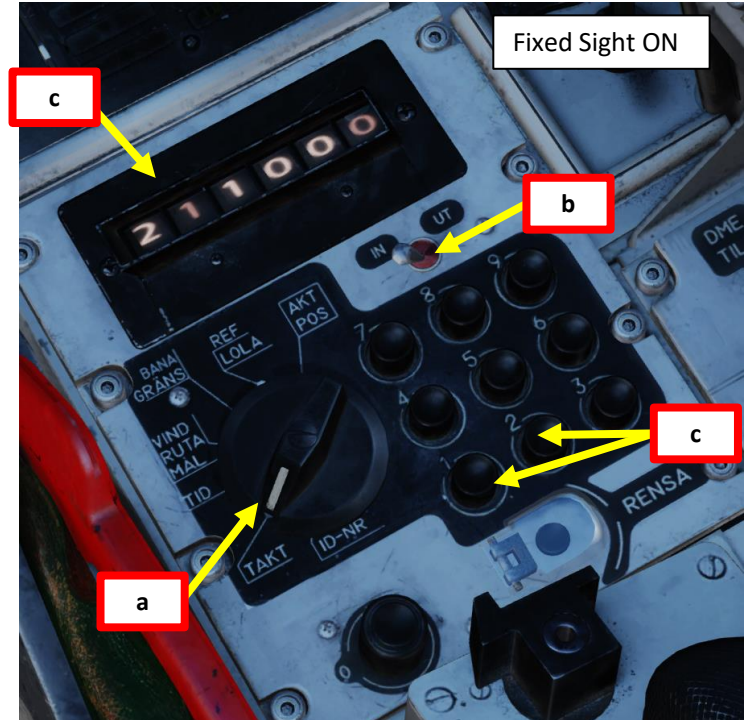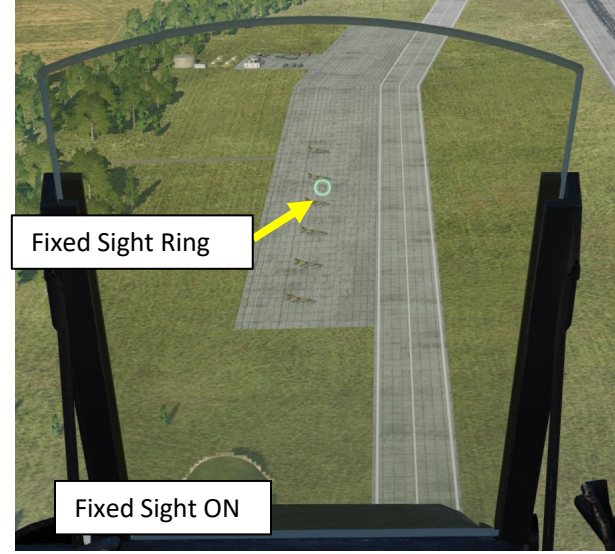
1 – Introduction
1.8 – Sighting Mechanics
1.8.3 – Fixed Sight

The sight depression indicated below is the amount of degrees offset from the aircraft x-axis (vertical the direction the aircraft nose is pointing).

Gunpod A/G (AKAN ATTACK)

Sight depression 2.3°

Dive angle 7°,

Speed: M0.8,

Distance 1500 metres.

Rocket pods (ARAK)

Sight depression 2.8° with altitude fusing

Sight depression 2.3° without altitude fusing

Dive angle 7°,

Speed M0.8,

Distance 1500 metres.

Rb 75 (AGM65)

Sight depression 1.3°

Same as normal sight use

Rb 24J / 74 (Aim-9 Sidewinder), RB05 A/A

Sight depression 0° (if on inner wing and fuselage pylons)

Sight depression 0.8° (if on outer wing pylons)

Same as normal sight use.

Gun pods A/A (AKAN JAKT)

Sight depression 1.5°

Own aircraft: M 0.8,

Target airspeed: M 0.55,

Distance 500 metres.

Illumination bombs (LysB)

Popup with 5G after popup point and release 5 seconds after popup. Bombs released directly after trigger pulled with and interval of 150 ms.

General purpose Bombs (120kg M/71)

Precision / fast release.

Sight depression 3.8°

M0.8

Dive angle 7°

Corresponds to an impact interval of 20 metres with 16 bombs without brake chutes

Level / Radar / NAV release

Sight depression 5.0°

Optimised for altitude 120 m, M 0.8, no dive angle and a release distance of 1500 metres.

Direct release / CCIP

Sight depression 5.0°

With and without brake chute. Same as Level /Radar /NAV

1 – Introduction
1.8 – Sighting Mechanics
1.8.4 – Target Motion Measurement

There is a function of the gun sight that can take into account the target speed. The sight is used to calculate lead on the target by using the movement of the sight dot over the ground.

- After setting the trigger safety to unsafe, the motion of the reticule during around 3 seconds will be added to the firing solution. Therefore it is important to be properly sighted onto the target before opening the trigger safety.
- The pilot has to be careful to keep the reticule on the target to avoid sighting errors.
- This mode only applies if ARAK rockets / AKAN Gunpod in air-to-ground mode in master mode ANF and the SB/71 bombs in sub-mode Precision release of Dive-bombing (DYK/ ANF).

Target Motion Measurement OFF (Default Setting)

Target Motion Measurement is **has marginal accuracy improvements at best and the option is set to OFF by default**. However, if you want to set Target Motion Measurement Option ON:

   a) Set Data Selector to TAKT
   b) Set INPUT/OUTPUT Selector to IN
   c) Enter code "220" on the keypad
   d) Press LS/SKU button
   e) Set INPUT/OUTPUT Selector to UT (Output)
   f) Set Data Selector to AKT POS (Active Position)

To set Target Motion Measurement Option OFF, use the same procedure listed above, but enter code "221" instead. This option is the one set by default in the aircraft.

Target Motion Measurement ON

224
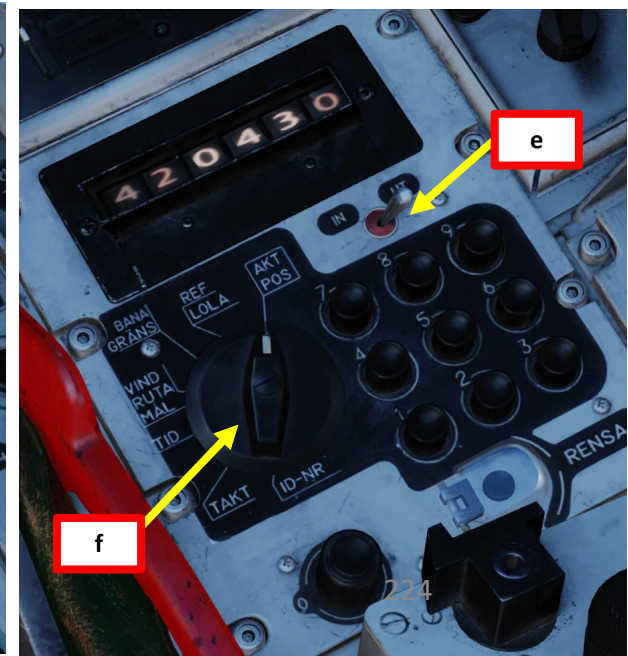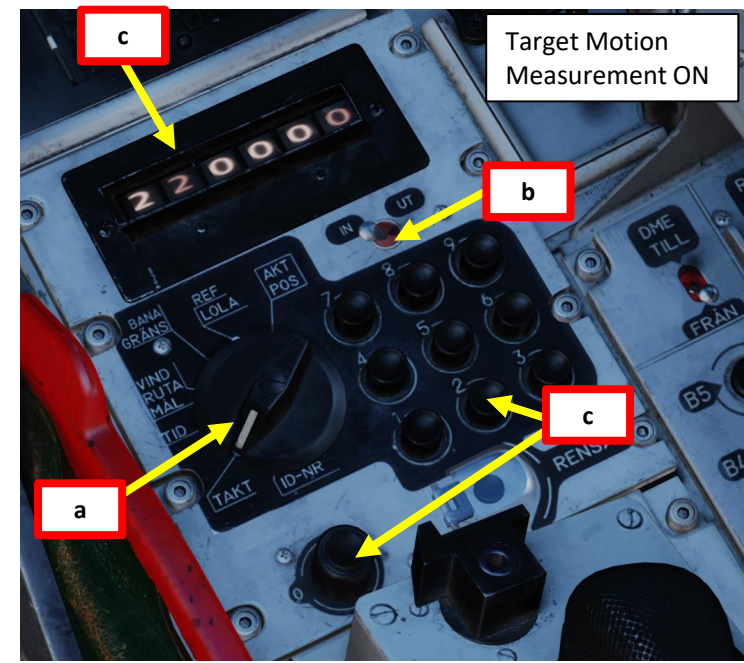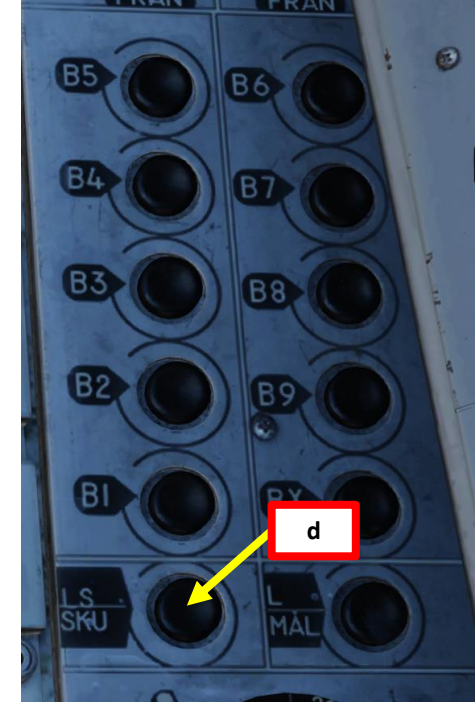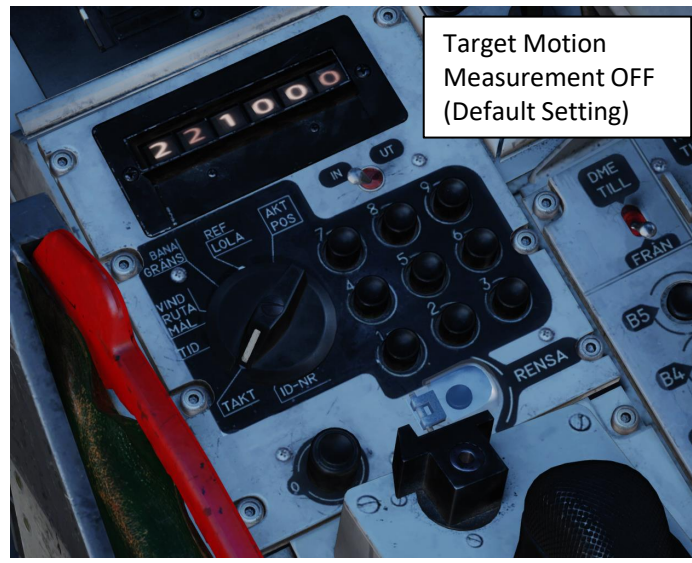
1 – Introduction

1.9 – Weapon Cheat Sheet

Don't want to go through this whole section?
Here's a cheat sheet for you!

Master Mode Selector

Weapon Selector
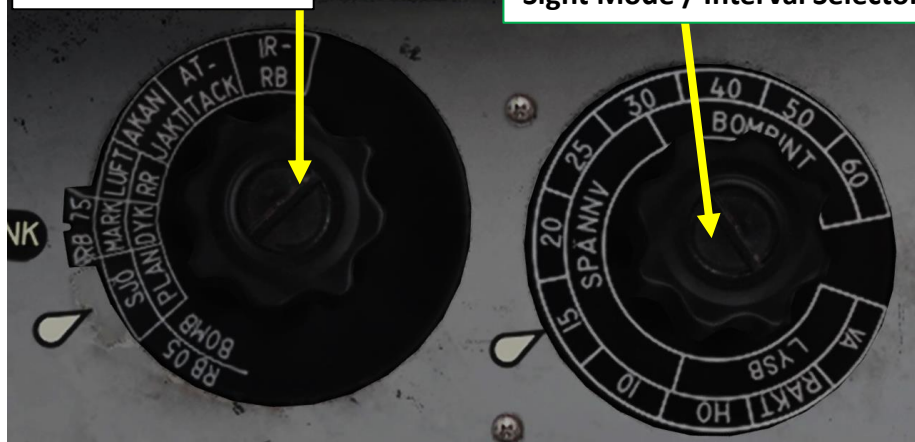
Sight Mode / Interval Selector Knob

Weapon Release Mode Switch
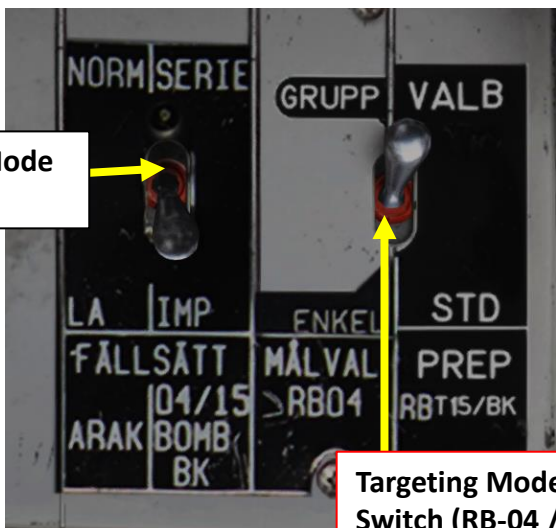
Targeting Mode (MÅLVAL) / Preparation Switch (RB-04 / RB-15 / BK-90)

Weapons Chart

Weapon	Delivery	Weapon Selector	Master Mode	Release Mode Sel.	Misc
ARAK	Normal	ATTACK	ANF†	SERIE	
	Long		ANF	IMPULS	
AKAN	AA	AKAN JAKT	ANF	SERIE	Target Wingspan
	AG	ATTACK	ANF†		
M/71	Level	BOMB PLAN	ANF		⊙
	Direct		NAV		⊙ Low Drag Bombs
	CCIP				⊙ High Drag Bombs
	Precision	BOMB DYK	ANF		⊙
	Quick		NAV		
	Radar	BOMB RR	ANF		⊙
	NAV/TOSS		NAV		
Lysbomb	AG	ATTACK	ANF†		VÄ=← RAKT=↓ HÖ=→ 23X X=1,2,3 km
RB 04	Single	ATTACK	ANF†	IMPULS	ENKEL
	Series			SERIE	ENKEL or GRUPP
RB 05	Ground	RB 05 MARK	ANF		
	Naval	RB 05 SJÖ			
	Aerial	RB 05 LUFT			Target Wingspan
RB 15	Quick	ATTACK	NAV	IMPULS=one SERIE=both	STD (single target)
	Standard		ANF		
	80000X				VALB+80000X X=0-4
RB 75	AG	RB 75	ANF		
BK 90	Single	ATTACK	ANF†	IMPULS	STD=60 m VALB+91XXX
	Series			SERIE	92X X=1=⊡⊡, 2=⊡⊡, 3=⊡
RB 24/74	AA (IR)	IR-RB	ANF		Target Wingspan

Colorcode: **Targeting Mode Selector**, **Sight Mode Selector**, **TAKT/IN Code**.

† = ANF or Nav and Trigger unsafe.

⊙ = Sight Mode Selector to desired interval.

Note:
- The **only valid** mixed AG weapon loadouts are RB 75 plus AKAN **or** RB 05 plus AKAN gunpod.
- Any weapon type can be combined with countermeasures pods and/or RB 24/74 AA missiles.

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb
2.1.1 – Bomb Delivery Methods

The Viggen has many different release modes available.

- **PLAN Modes**
    - **Level Release Sub-Mode**: Used for low drag bombs, releases bombs while flying level. This technique is similar to a CCRP (Continuously Computed Release Point) release for modern attack aircraft.

    - **Direct Release Sub-Mode**: Used for formation bombing when following. No sight display is used and release is made on the command of the formation leader.

    - **CCIP (Continuously Computed Impact Point) Sub-Mode**: Used for high drag bombs, releases bombs while either flying level or in a dive. Impact points are shown on the HUD, and pilot can choose where to land his bombs. Reference waypoint is not required, but QFE setting is required.

- **DYK (Dive Bombing) Modes**
    - **Precision Release Sub-Mode**: Performs a diving attack, with increased accuracy from radar ranging. Using radar ranging takes a little more time to setup when compared to the Quick Release sub-mode.

    - **Quick Release Sub-Mode**: Performs a diving attack. Ranging is only performed via triangulation (radar ranging is inhibited), which allows a faster lineup on the target.

- **RR (Radar Release) Modes**
    - **Radar Release Sub-Mode**: Target is acquired and designated by using the radar in low visibility conditions.

    - **NAV Release Sub-Mode**: Target is preset on a navigation waypoint, which is used as a reference to strike the target. The delivery method is generally performed by flying level, similarly to a Level Release delivery.

    - **TOSS Release Sub-Mode**: TOSS bombing is used for target areas that are too well protected to fly over. The is released in a sharp climb, resulting in the bomb being "tossed", leading to a measure of stand-off ability. This method is not very precise.

Carpet Bombing in Direct Mode

227

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.1 – Bomb Delivery Methods

Here is an overview of different delivery modes for bombs and their respective selection methods.

```
                              ANF ────────────────► Level Release Mode
                               ▲
                               │
              PLAN ─────────► ┌─┴─┐         NO ─ ─ ─ ─ ─ ─ ─ ─► Direct Release Mode
                               │            ▲
                              NAV ──────────┤
                                            ▼
                                           YES ─ ─ ─ ─ ─ ─ ─ ─► CCIP Release Mode


                              ANF ────────────────► Precision Release Mode
                               ▲
   BOMB ─────► DYK ────────────┤
                               ▼
                              NAV ────────────────► Quick Release Mode


                              ANF ────────────────► Radar Release (RR) Mode
                               ▲
              RR              ─┤
          (Radar Release) ─────┤
                               ▼
                              NAV ────────────────► NAV Release
                                                     or TOSS Release Mode
```

Weapon Selector Mode   *Master Mode*   *Drag Chute on Bomb?*   *Release Mode*
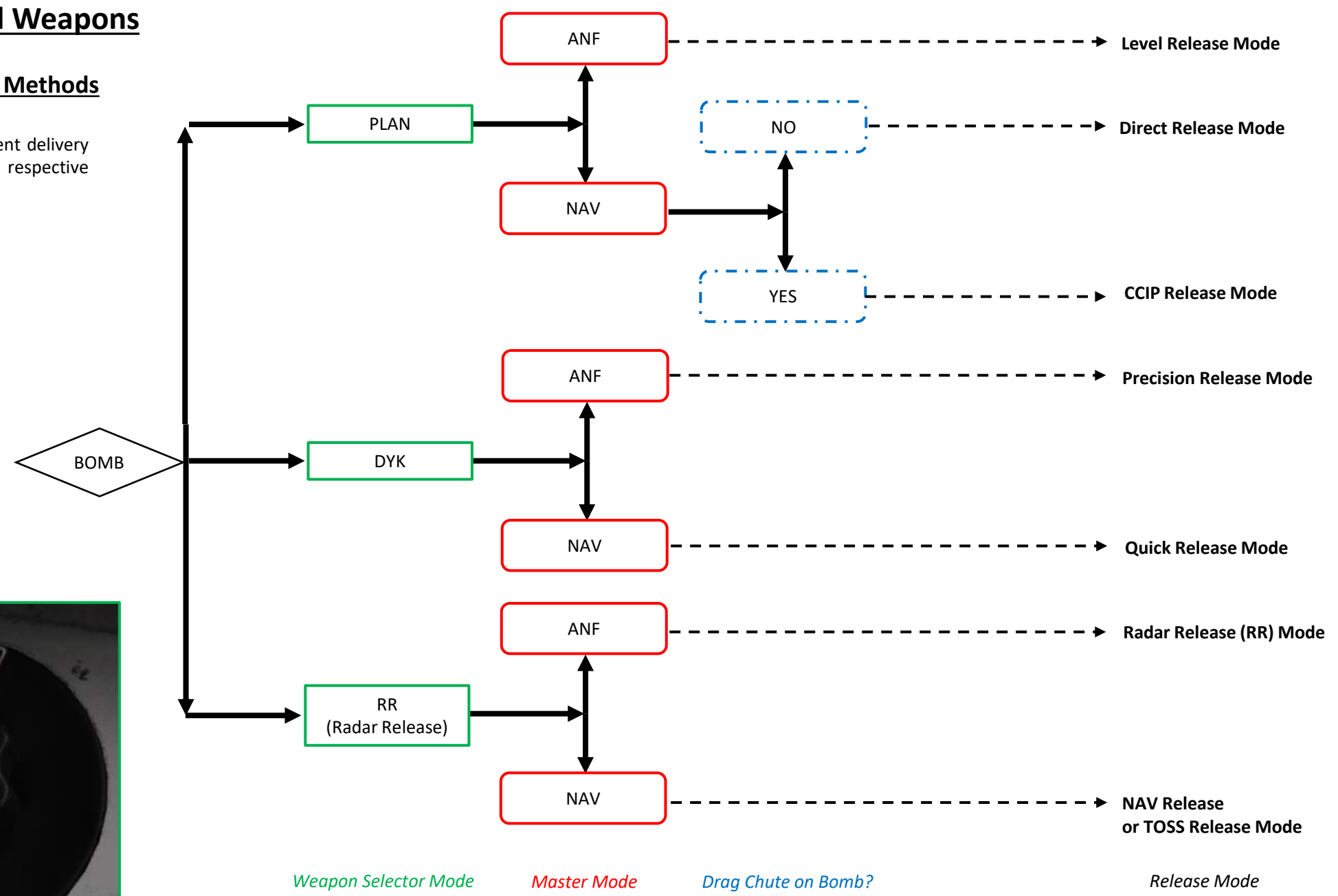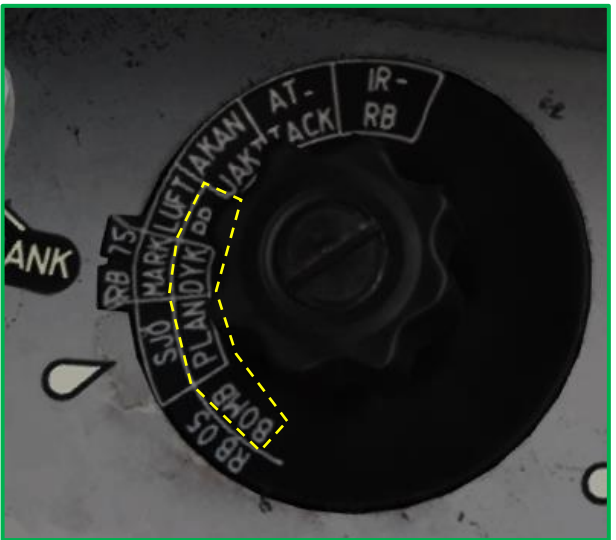
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.1 – Bomb Delivery Methods

M/71 bombs have pre-defined release safety altitudes, also known as "Commanded Altitudes". These settings are set by the crew chief during loading, or preset via the Mission Editor. These commanded values are based on experience and testing and are not backed in any literature.
- **LOW Setting** – 200 meters
- **MEDIUM Setting** – 400 meters
- **HIGH Setting** – 600 meters

The CK37 Computer determines the bomb trajectory based on a release on the Commanded Altitudes in delivery modes PLAN and RR (Radar Release), therefore I would highly recommend to fly at or just above these altitudes.

The CK37 will not release bombs in these modes under the commanded altitude, but releasing bombs above these altitudes is permitted. However, higher altitudes will lead to poorer performance and may be outside of the release envelope.
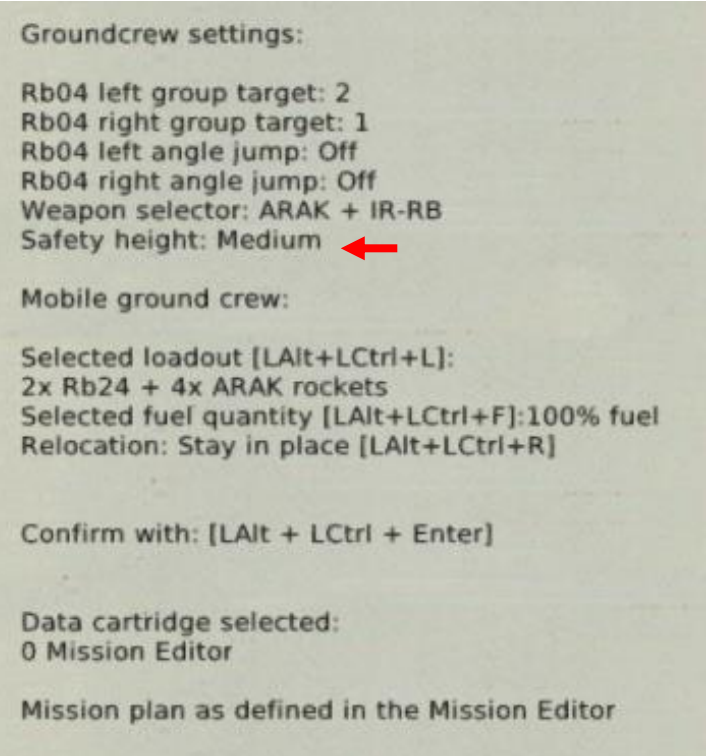
If you want to know the altitude setting for your bombs, you can do this while on the ground. Open your kneeboard:
1. Use "RSHIFT+K" to open
2. Use "[" and "]" to scroll pages)
3. Check the « Ground Crew Settings » page

Groundcrew settings:

Rb04 left group target: 2
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: ARAK + IR-RB
Safety height: Medium ←

Mobile ground crew:

Selected loadout [LAlt+LCtrl+L]:
2x Rb24 + 4x ARAK rockets
Selected fuel quantity [LAlt+LCtrl+F]:100% fuel
Relocation: Stay in place [LAlt+LCtrl+R]

Confirm with: [LAlt + LCtrl + Enter]

Data cartridge selected:
0 Mission Editor

Mission plan as defined in the Mission Editor

AIRPLANE GROUP

NAME	Aerial-1
CONDITION	% < > 100
COUNTRY	● Sweden COMBAT
TASK	Ground Attack
UNIT	< > 1 OF < > 1
TYPE	AJS37
SKILL	Player
PILOT	Aerial-1-1
TAIL #	010
RADIO	✓ FREQUENCY 305 MHz AM
CALLSIGN	Enfield 1 1

☐ HIDDEN ON MAP
☐ HIDDEN ON PLANNER
☐ HIDDEN ON MFD   ☐ LATE ACTIVATION

Additional properties for aircraft

RB-04 Group Target Selection	Random
RB-04 Angle Jump Target Selectic	None
Weapon safety height	Low
Cartridge restrictions	Allow all 229

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.2 – Target Approach (applicable to all bomb tutorials)

In the following M/71 bomb tutorials, we will use the following approach:

- **First segment**: We will follow waypoints B1 and B2 by maintaining a radar altitude of 50 m AGL (Above Ground Level)
- **Second segment**: Using a pop-up point is by no means mandatory, but since we know the targets are lined up parallel to the runway heading, we can use the Pop-Up Point U3 (generated in relationship from Target Point M3) to approach the target from an optimal direction.
- **Third segment**: Fly from the Pop-Up Point U3 towards the Target Point M3 at the required safety altitude, then perform attack.

**Waypoint B3
Target Point M3**

Runway Heading 250

Targets

Approaching the Target

Kobuleti Airport
Runway Heading: 250

Attack following Heading 250
Distance from Pop-Up Point: 10 km

Waypoint B2

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

Waypoint B1

**Waypoint B3
Target Point M3**

Click link to go to:
M/71 High Drag Bomb – CCIP Delivery Tutorial
M/71 Low Drag Bomb – Level (CCRP) Delivery Tutorial
M/71 Low Drag Bomb – Precision Dive Mode (DYK) Delivery Tutorial
M/71 Low Drag Bomb – Radar Release (RR) Delivery Tutorial
M/71 Low Drag Bomb – Nav Delivery (Waypoint) Tutorial

Your Position

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.3 – M/71 High Drag Bomb – CCIP Delivery

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to 150 m, line up the CCIP pipper on the target, the release bombs when ready. This technique does not require a pre-planned navigation point, and it allows you to bomb any target of opportunity. However, keep in mind that the barometric pressure setting must be set correctly, which requires a QFE setting value from the kneeboard. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

CCIP (Continuously Computed Impact Point) is traditionally associated to dive bombing, but in the Viggen's case it is much safer to perform the attack while flying level.

CCIP Bombing Profile

(4) (3) (2) (1)

150 m

50 m

High Drag Bombs

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)
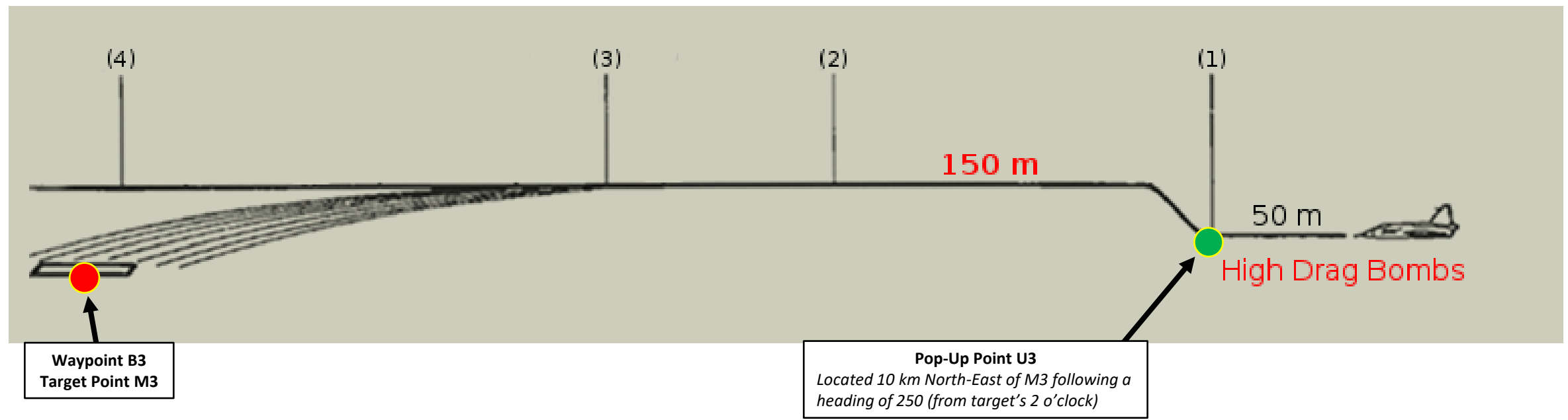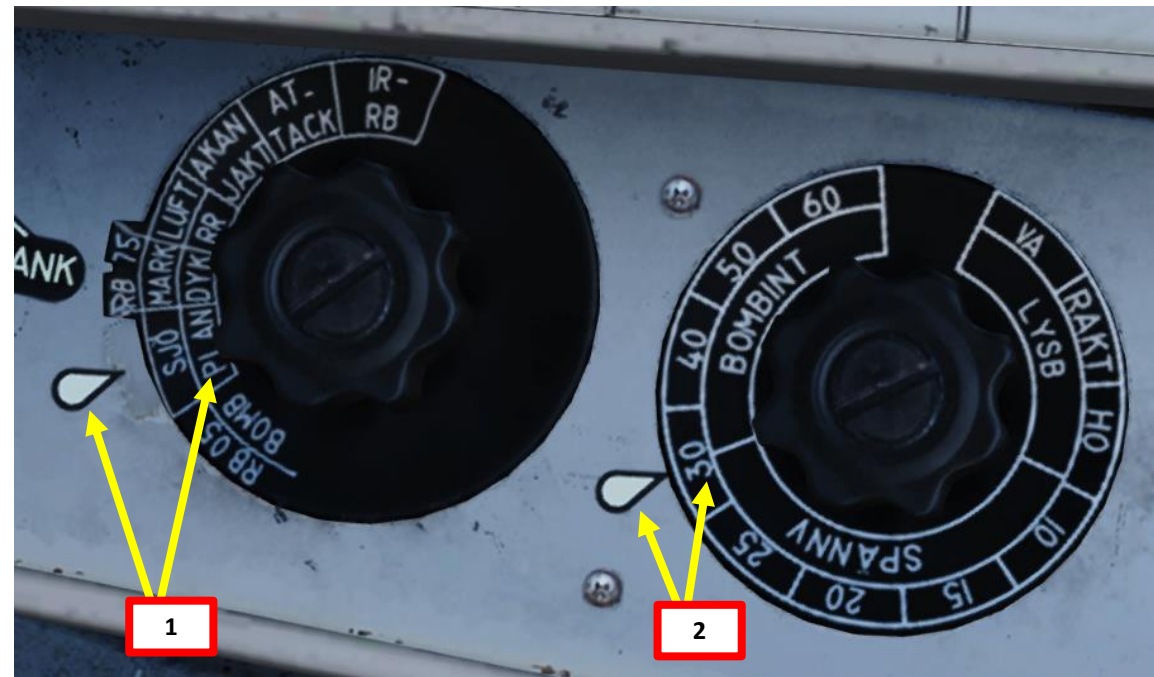
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb
2.1.3 – M/71 High Drag Bomb – CCIP Delivery
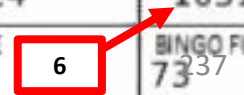
B – Weapon Setup

1. Set Weapon selector to BOMB PLAN.
2. Set Sight Mode / Interval selector as desired. We will set it to 30 meters.
   - 10-30 meters interval will result in uniform destruction
   - 40-60 meters will cover a long area, but objects between impacts will be marginally affected
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

4 **5**

3

7

1 **2**

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

6

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.3 – M/71 High Drag Bomb – CCIP Delivery

C – Perform Attack

Distance to Selected Waypoint (km)

8. Set Data Selector to AKT POS - OUTPUT.
9. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
10. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
11. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    - Climb to an altitude of approximately 150 m above ground level (AGL).
    - Accelerate between Mach 0.8 and 0.9.
    - Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
12. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
13. The "Time Line" appears when you are 40 seconds away from target. This is the moment where you line up the target and start the bombing run.

10

11

12

9

10

50 m altitude reference

11

150 m altitude reference

13 Time Line

8b

8a

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.3 – M/71 High Drag Bomb – CCIP Delivery

C – Perform Attack

14. Set Trigger to UNSAFE by clicking on the stick's safety cover.
15. HUD Symbology now provides symbology applicable to bomb release cues.
16. Set target between the dot (first bomb drop point) and the circle (last bomb drop point) on the HUD and drop bombs by pressing and holding the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates.

Trigger SAFE
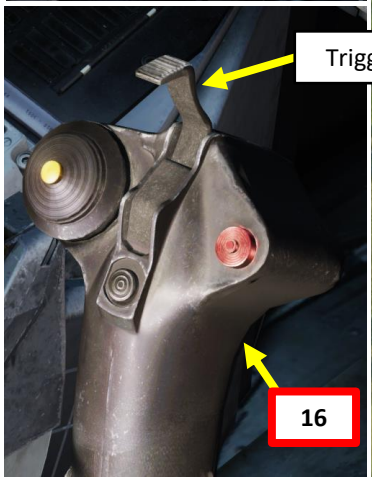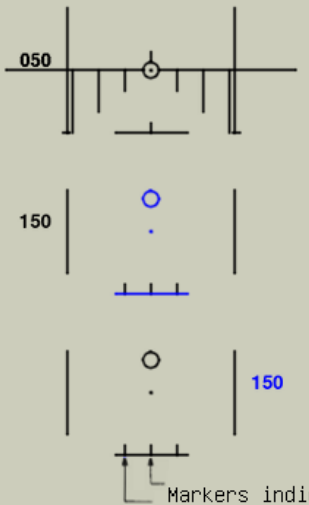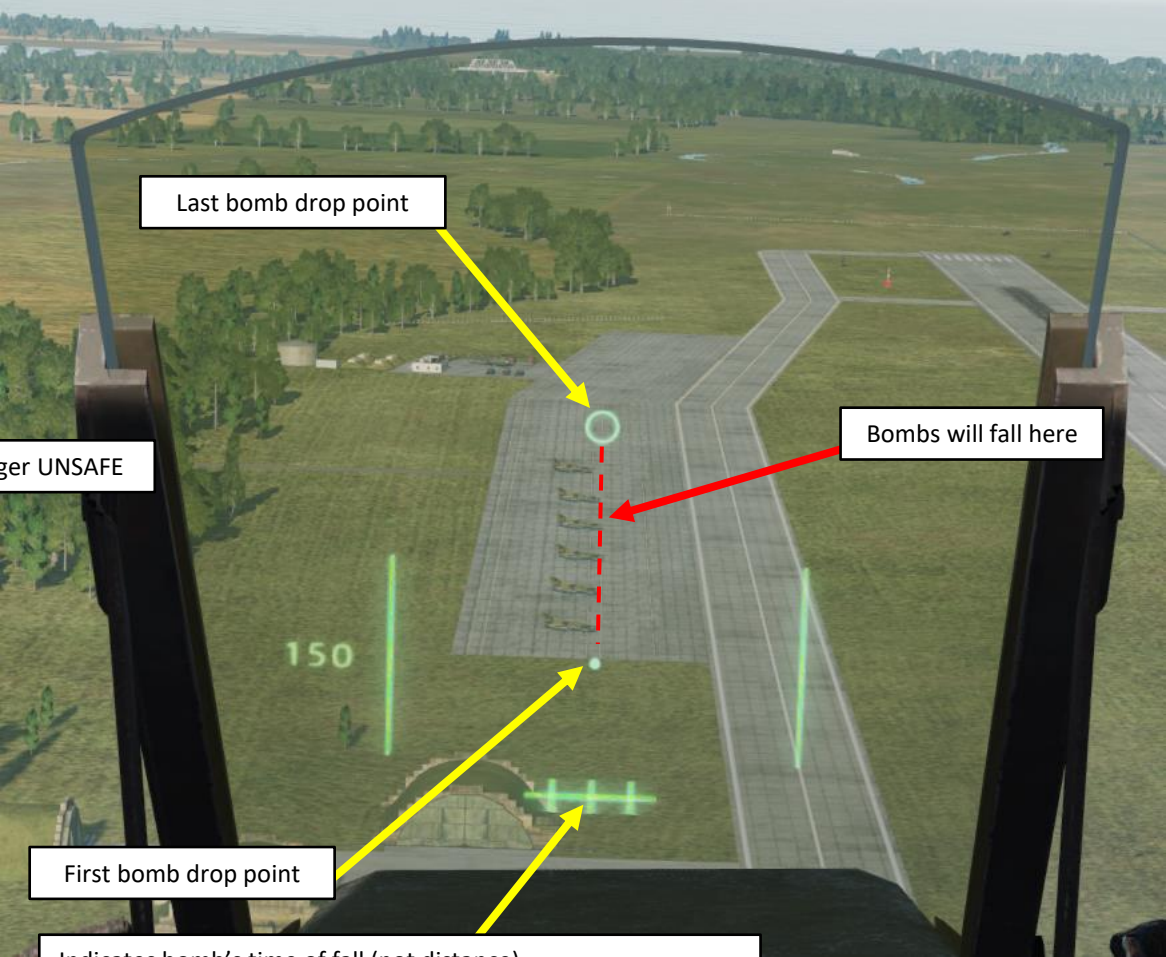
Trigger UNSAFE

16

Last bomb drop point

Bombs will fall here

First bomb drop point

Indicates bomb's time of fall (not distance).
Outer markers signify minimum time of full for armed bombs.

Illuminates when all bombs are dropped

FALLD LAST

050

150

(1) Master mode **NAV**. Weapon selector **BOMB PLAN**.
Set target **QFE**. Sight mode selector to desired interval.
Pop-up to release altitude (here **150 m**).

150

(2) Trigger UNSAFE. Put targets between **reticule** and **circle**.
Distance line indicates bomb's time of fall not distance.
Markers signify minimum time of fall for armed bombs.

150 (3) Pull and hold trigger. **Altitude numbers** shift right.
Release trigger when **FÄLLD LAST** illuminates.

Markers indicate arming time.

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.3 – M/71 High Drag Bomb – CCIP Delivery

C – Perform Attack

17. Evade and pull up with 5 G. Alternatively, you can also dive back on the deck to minimize the risk of being detected.
18. Set the trigger to SAFE by clicking on the stick's safety cover.

Trigger SAFE
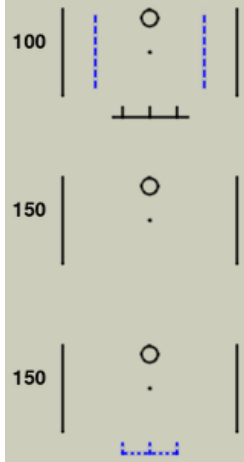
100	(*)	**Flashing vertical lines**: Fragmentation zone warning. **Pull up**.
150	(*)	**Hidden distance line**: Time of fall > max (16 sec). **Loose altitude**.
150	(*)	**Flashing distance line**: Time of fall < arming time (5.2 sec) **Evade** and perform a new attack run if possible.

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.1 – Level Delivery (CCRP)

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to 200 m, line up the target, use radar ranging to provide ranging information, and then release bombs based on release cues.

This technique does not require a pre-planned navigation point. However, keep in mind that the barometric pressure setting **must** be set correctly **if you want to have a valid TIR** (Target Indicator Ring), which requires a QFE setting value from the kneeboard. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

You can also choose to **not use a pre-planned navigation point**, but in that case you will not have any TIR (Target Indicator Ring) over the target and will have to designate the target using the Reticle Dot. In that situation, you **do not need to set the QFE value**.

CCRP (Continuously Computed Release Point) is pretty much a synonym for level bombing, which is very effective on static targets.

Level Bombing Profile

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)
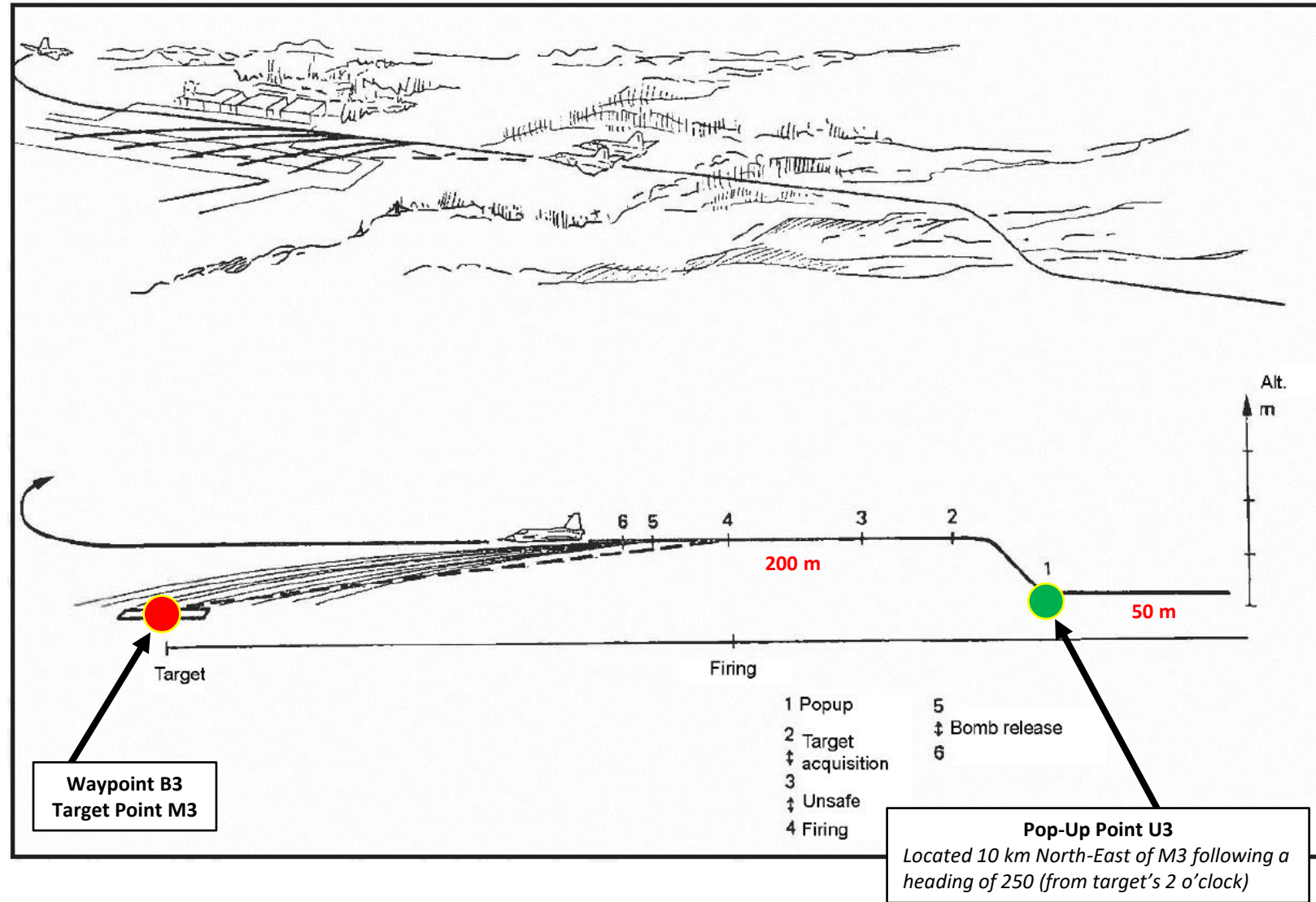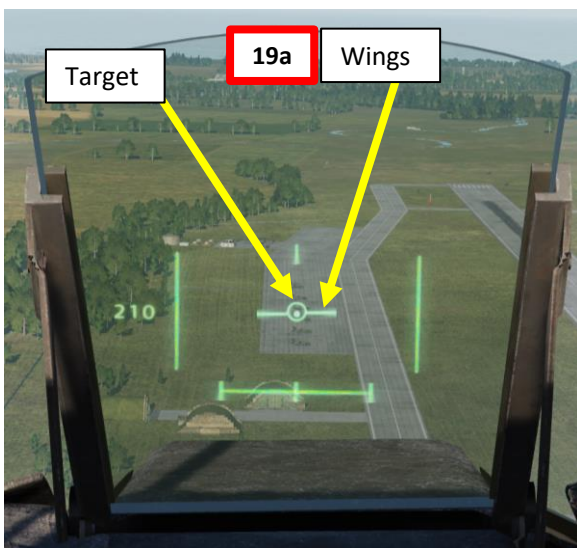
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.1 – Level Delivery (CCRP)

B – Weapon Setup

1. Set Weapon selector to BOMB PLAN.
2. Set Sight Mode / Interval selector as desired. We will set it to 30 meters.
   - 10-30 meters interval will result in uniform destruction
   - 40-60 meters will cover a long area, but objects between impacts will be marginally affected
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

237

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.1 – Level Delivery (CCRP)

C – Perform Attack

Distance to Selected Waypoint (km)

8. Set Data Selector to AKT POS - OUTPUT.
9. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
10. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
11. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    • Climb to an altitude of approximately 200 m above ground level (AGL).
    • Accelerate between Mach 0.8 and 0.9.
    • Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
12. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
13. The "Time Line" appears when you are 40 seconds away from target. This is the moment where you line up the target and start the bombing run.

10

11

12

9

200 m altitude reference

11

10

50 m altitude reference

13   Time Line

8b

8a

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.1 – Level Delivery (CCRP)

C – Perform Attack

14

14. Set Master Mode to ANF (*Anflygning*/Attack).
15. HUD Symbology now provides symbology applicable to bomb release cues such as the TIR (Target Indicator Ring), which appears on the target.
16. Steer the aircraft to align the reticle dot with the TIR (Target Indicator Ring) or on the target itself if TIR is unavailable. Once the TIR and the reticle dot are aligned, confirm that radar ranging is being performed ("fin" should be visible).
17. **While TIR (or target) and reticle dot are aligned**, set Trigger to UNSAFE by clicking on the stick's safety cover. This will mark the target and provide more accurate ranging information.
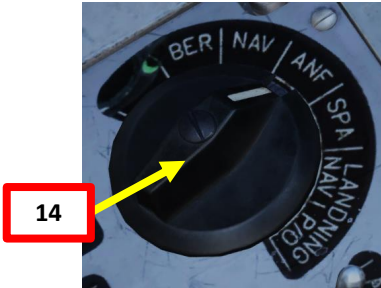
(1) Master mode **NAV**. Weapon selector **BOMB PLAN**.
Set target **QFE**. Sight mode selector to desired impact interval. Pop-up to commanded (safety) altitude (here **200 m**).

(2) Master mode **ANF**. Target indicator ring (**TIR**) appears on target. Begin alignment of TIR and reticule.

(3) Radar ranging is used indicated by **fin**.
Trigger UNSAFE when reticule is on target. TIR disappears.
Trigger unsafe signal marks the target.
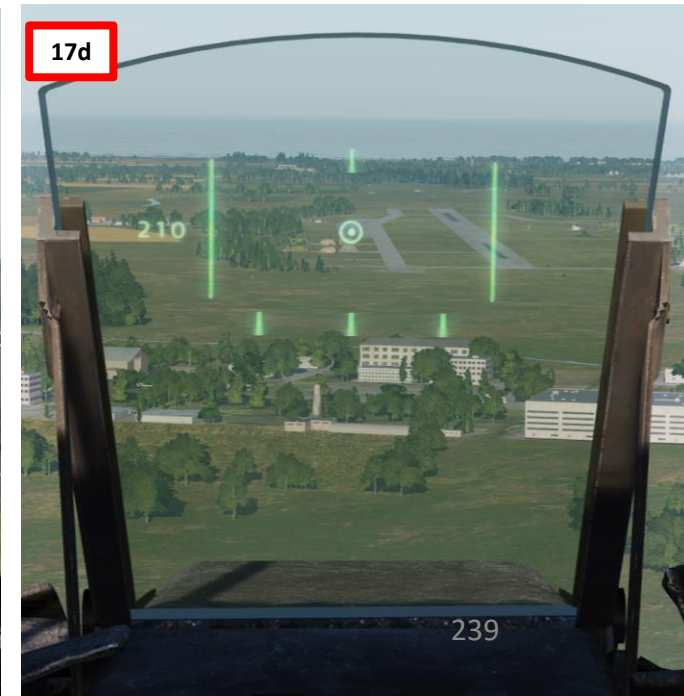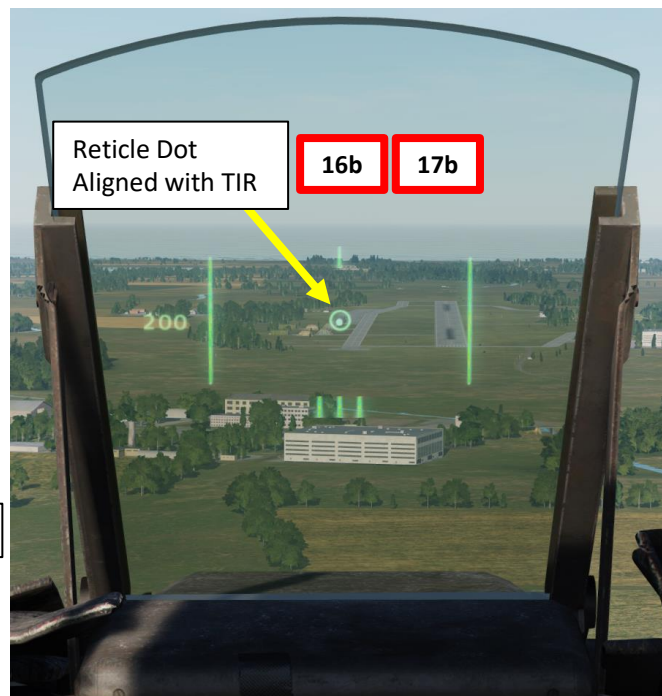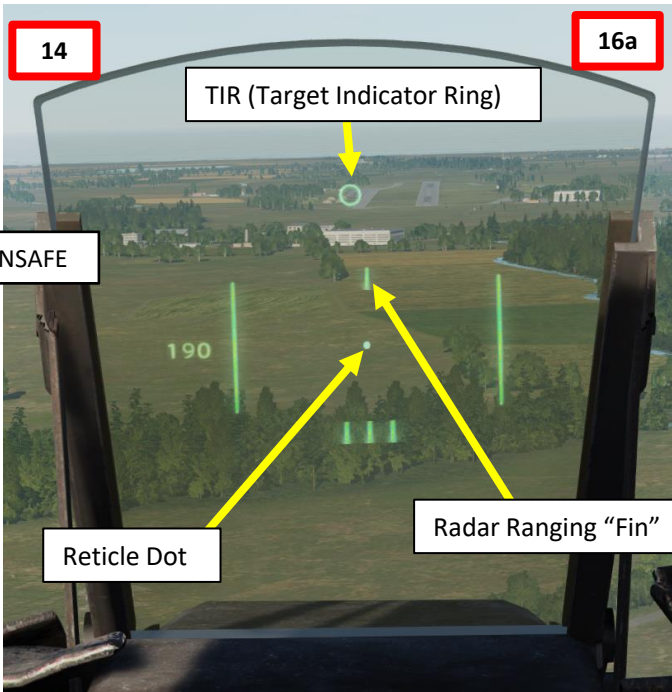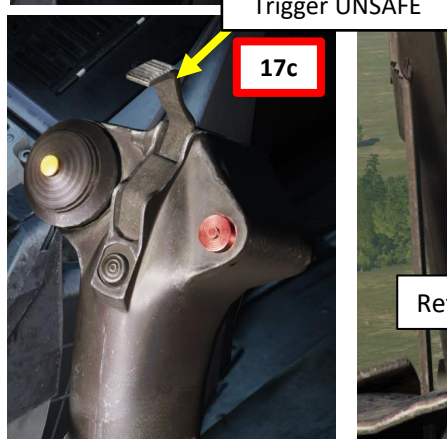
Trigger SAFE
17a

Trigger UNSAFE
17c

14
16a

TIR (Target Indicator Ring)

Reticle Dot
Aligned with TIR
16b **17b**

17d

Radar Ranging "Fin"

Reticle Dot

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2 – Air-to-Ground Weapons
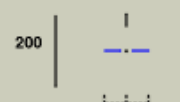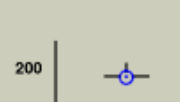
2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.1 – Level Delivery (CCRP)

C – Perform Attack

18. The Distance Line (Firing Warning) will flash 2 seconds before the release point.
19. When wings appear on the HUD (0.5 seconds before the release point), press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates.
20. While the trigger is held, the HUD symbology will act as a means to line up for an accurate release. The "ring" denotes the steering order, which is what you need to follow to maintain altitude. Steer the aircraft to place the reticle dot inside the steering order ring.

(4) Firing warning: Distance line flashes 2 sec before release point.

(5) Firing signal: Wings appear 0.5 s before latest release point. Pull and hold trigger.

(6) Trigger still held. Altitude numbers shifted to right side. Ring now denotes the steering oder.

(7) On last release impulse, steering order flashes. Release trigger when and FÄLLD LAST illuminates.

(8) Follow steering order by placing reticule inside ring.
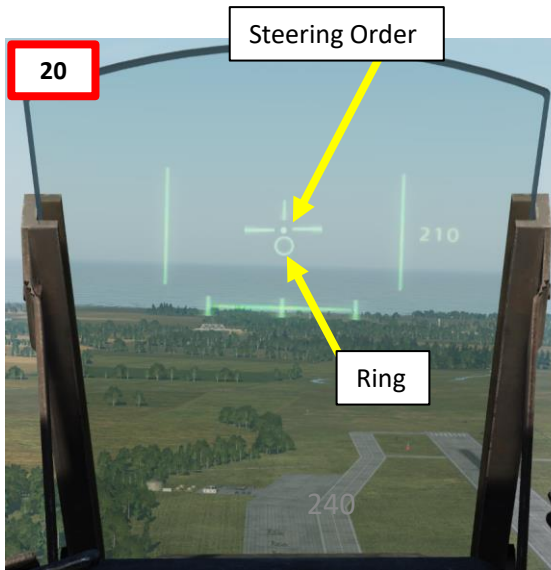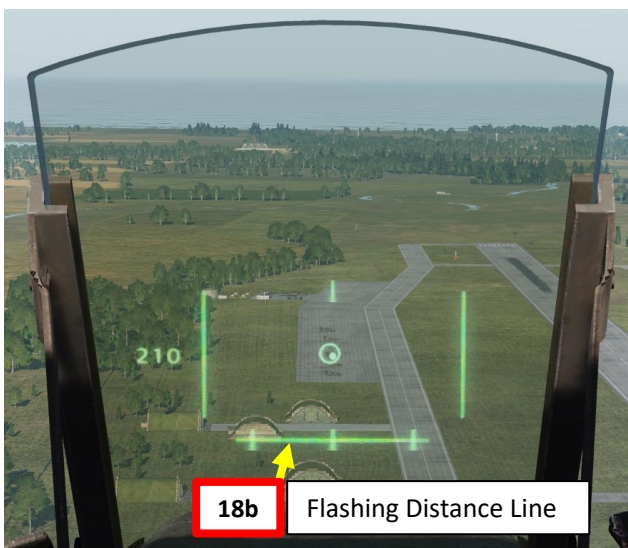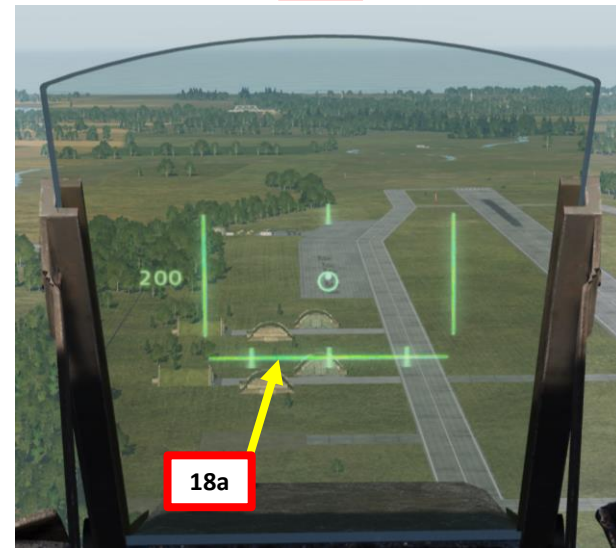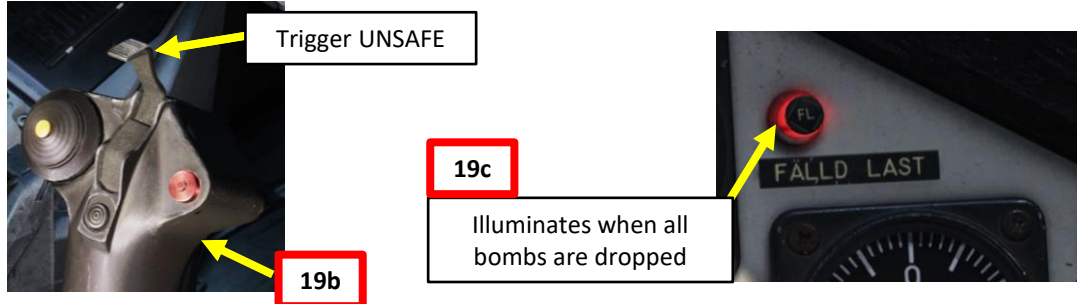
Trigger UNSAFE

19c

19b

Illuminates when all bombs are dropped

FÄLLD LAST

18a

18b — Flashing Distance Line

Target

19a — Wings

20

Steering Order

Ring

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.1 – Level Delivery (CCRP)

C – Perform Attack

Trigger SAFE

21. Once all bombs are dropped, set Trigger to SAFE by clicking on the stick's safety cover.
22. Set Master Mode to NAV and resume flight.
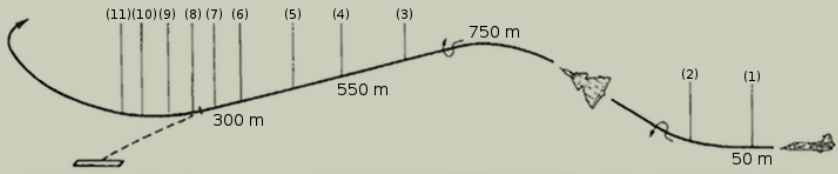
2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.2 – Precision Dive Mode (DYK) Delivery

One of the most precise bomb delivery methods involves dive bombing (DYK). The two main methods are the Precision DYK release and the Quick DYK release. Both methods are almost identical, the difference being that the Precision Mode uses radar ranging (Master Mode to ANF) while the Quick release does not (Master Mode to NAV).
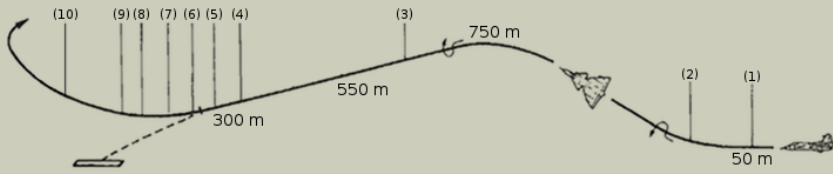
In our case, we will use the Precision DYK release mode.
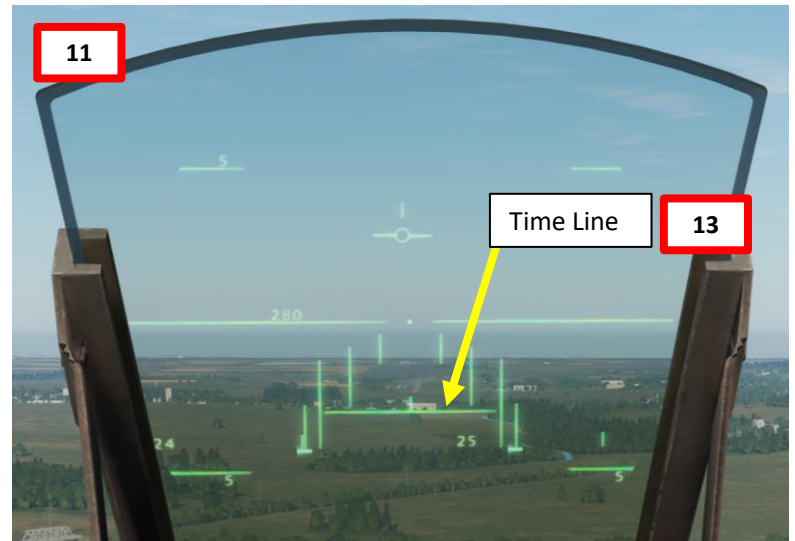

SB71 Dyk Bombing: Precision Mode

(1) Master mode **NAV**. Weapon selector **BOMB DYK**.
Set target **QFE**. Sight mode selector to desired impact interval.
Fly towards pop-up point (create one if necessary).

(2) **Pull up** at pop-up point and go master mode to **ANF**.
HUD symbology changes.
Target indicator ring (**TIR**) appears on target.

(3) **Ranging via triangulation** if sightline relative to horizon > 5˚.
Distance line appears. Start aligning **reticule** and **TIR**.

(4) **Radar ranging used** indicated by **fin**, if parameters are met.

(5) **Trigger UNSAFE** when **reticule** is stable on target. TIR disappears.
Trigger unsafe signal marks the target. Doppler wind frozen.

(6) **Firing warning:**
Distance line flashes 2 sec before latest firing range.

(7) **Firing signal: Wings** appear **0.5 sec** before latest firing range.
Pull and hold trigger.

(8) **Trigger still held. Altitude numbers** shifted to right side.
Ring denotes **steering order**.

(9) **Follow steering order** by placing **reticule** inside **ring**.
Trigger still held.

(10) **Flashing 2˚ poles** indicate that **steering order was not followed.**
Take evasive action.

(11) **Steering order disappears** once last bomb is release.
Release Trigger when **FÄLLD LAST** illuminates.
Trigger SAFE, master mode **NAV**, leave area.

SB71 Dyk Bombing: Quick Release

(1) Master mode **NAV**. Weapon selector **BOMB DYK**.
Set target **QFE**. Sight mode selector to desired impact interval.
Fly towards pop-up point (create one if necessary).

(2) **Pull up** at pop-up point and go **trigger UNSAFE**.
Radar ranging and target motion measurement is inhibited.

(3) **Ranging via triangulation** if sightline relative to horizon > 5˚.
Distance line appears. Begin aligning **reticule** and target.

(4) **Firing warning:**
Distance line flashes 2 sec before latest firing range.

(5) **Firing signal: Wings** appear **0.5 sec** before latest firing range.
Pull and hold trigger.

(6) **Trigger still held. Altitude numbers** shifted to right side.
Ring denotes **steering order**.

(7) **Follow steering order** by placing **reticule** inside **ring**.
Trigger still held.

(8) **Flashing 2˚ poles** indicate that **steering order was not followed.**
Take evasive action.

(9) **Steering order disappears** on last bomb is release.
Release trigger when **FÄLLD LAST** illuminates.

(10) **Trigger SAFE.** Designation changes to **NAV** mode automatically.
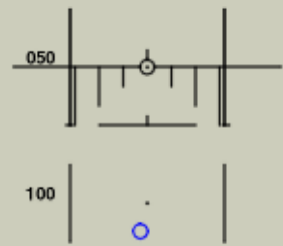
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to 750 m, roll 180 deg down to maintain visual with the target, then roll 180 deg up to line up the target and begin your diving attack. In our case, we will use radar ranging to provide ranging information, and then release bombs based on release cues.

This technique does not require a pre-planned navigation point. However, keep in mind that the barometric pressure setting **must** be set correctly, which requires a QFE setting value from the kneeboard, which is obtained from an existing waypoint. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

Precision Dive Bombing (DYK) Profile
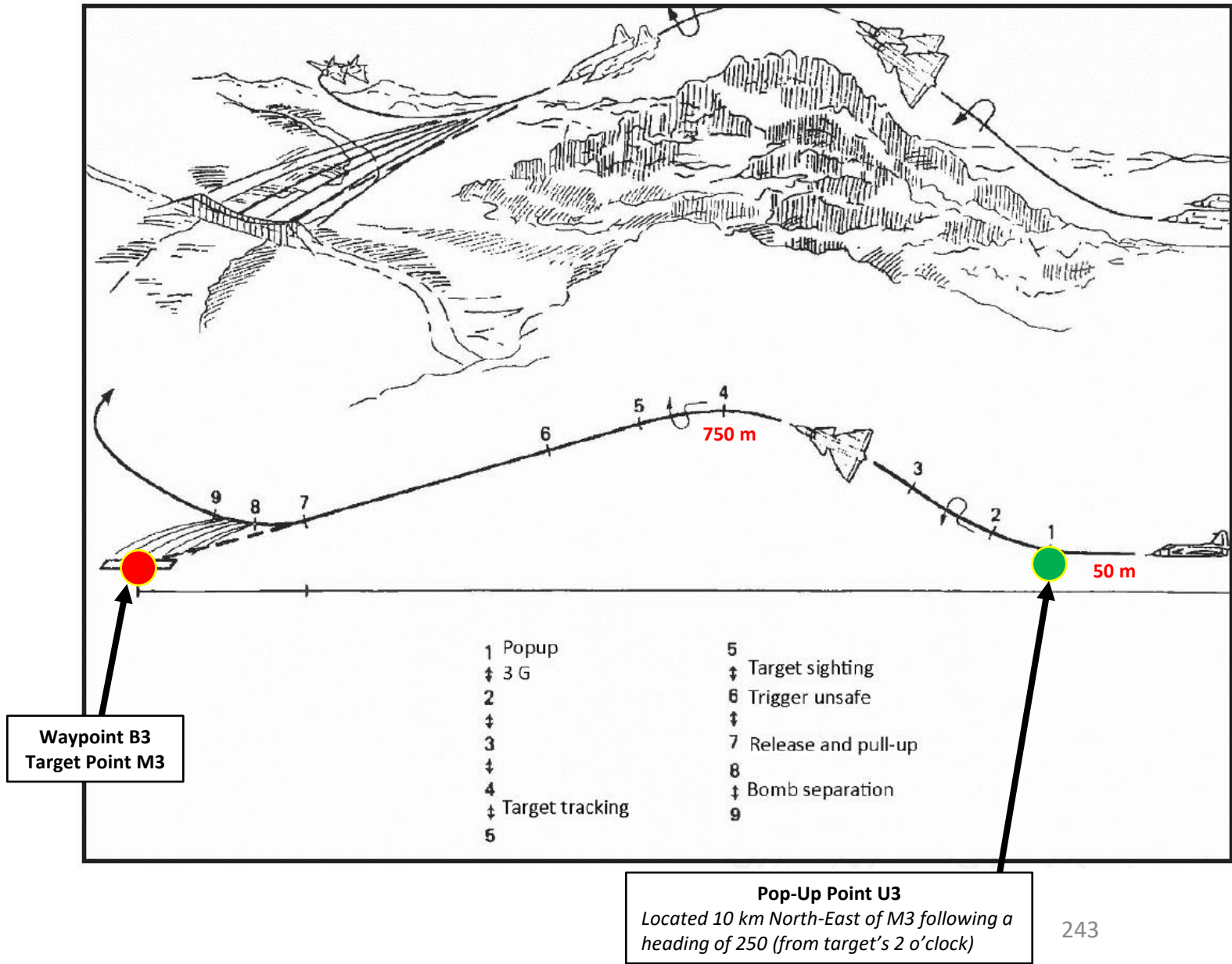
1 Popup
‡ 3 G
2
‡
3
‡
4
‡ Target tracking
5

5
‡ Target sighting
6 Trigger unsafe
‡
7 Release and pull-up
8
‡ Bomb separation
9

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

243

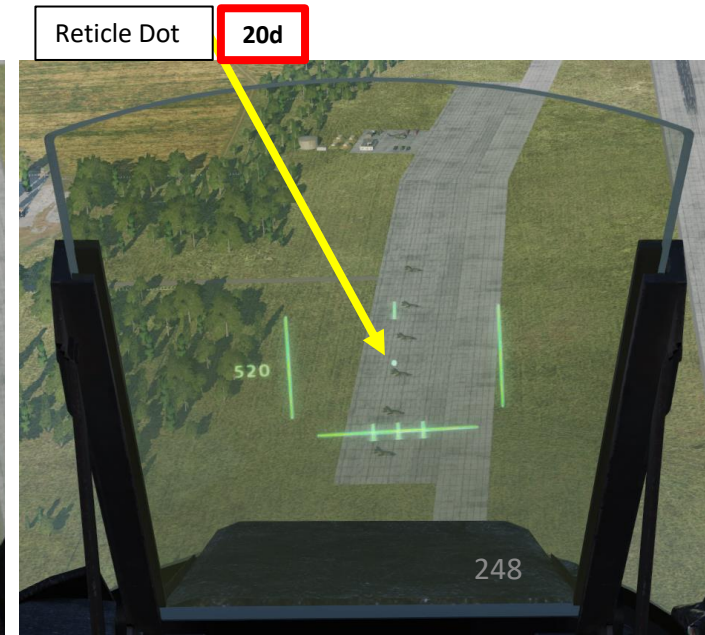## 2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

B – Weapon Setup

1. Set Weapon selector to BOMB DYK.
2. Set Sight Mode / Interval selector as desired. We will set it to 15 meters.
   - 10-30 meters interval will result in uniform destruction
   - 40-60 meters will cover a long area, but objects between impacts will be marginally affected
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

244

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

Distance to Selected Waypoint (km)

8. Set Data Selector to AKT POS - OUTPUT.
9. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
10. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
11. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    - Climb to an altitude of approximately 750 m above ground level (AGL).
    - Accelerate between Mach 0.8 and 0.9.
    - Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
12. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
13. The "Time Line" appears when you are 40 seconds away from target.

10

11

12

9

8b

10

11

Time Line

13

50 m altitude reference

8a

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

14. Set Master Mode to ANF (*Anflygning*/Attack).
15. HUD Symbology now provides symbology applicable to bomb release cues such as the TIR (Target Indicator Ring), which appears on the target.

14a

Master Mode - NAV

14b

TIR (Target Indicator Ring)

Master Mode - ANF

050

100

Master mode **NAV**. Weapon selector **BOMB DYK**.

(1) Set target **QFE**. Sight mode selector to desired impact interval.
Fly towards pop-up point (create one if necessary).

Pull up at pop-up point and go master mode to **ANF**.

(2) HUD symbology changes.
Target indicator ring (**TIR**) appears on target.

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

16. Pull up at Pop-Up point and climb to 750 m.
17. When at the top of the climb, throttle back to IDLE, then roll on the target and acquire visually the TIR (Target Indicator Ring). Pulling the stick while being inverted will avoid pulling negative Gs during the dive, which can potentially cause an engine flameout since negative Gs starve the engine of fuel.
18. When target is acquired, roll back to a non-inverted attitude and dive on the target.

Altitude (meters)
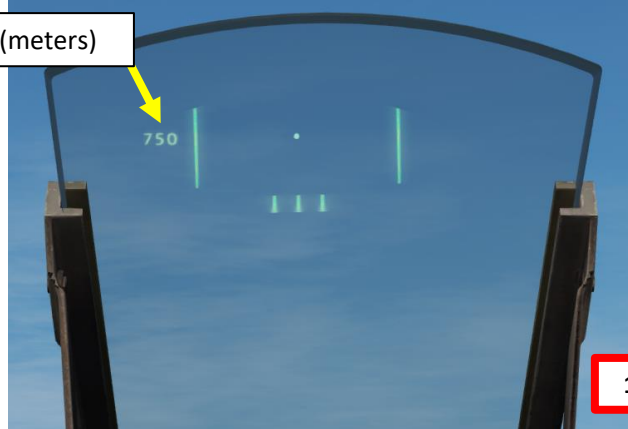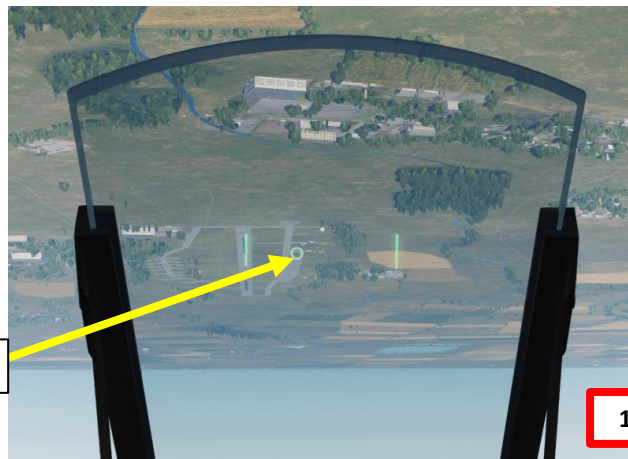
TIR (Target Indicator Ring)

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

19. During the dive, steer the aircraft to align the reticle dot with the TIR (Target Indicator Ring). Once the TIR and the reticle dot are aligned, confirm that radar ranging is being performed ("fin" should be visible).

20. **While TIR and reticle dot are aligned**, set Trigger to UNSAFE by clicking on the stick's safety cover. This will mark the target and provide more accurate ranging information. The TIR should disappear.

21. Keep the reticle dot on the target (not the TIR, which is the waypoint location and might not be accurate).

(3) Ranging via triangulation if sightline relative to horizon > 5°. Distance line appears. Start aligning reticule and TIR.

(4) Radar ranging used indicated by fin, if parameters are met.

(5) Trigger UNSAFE when reticule is stable on target. TIR disappears. Trigger unsafe signal marks the target. Doppler wind frozen.

Trigger SAFE

20a

Trigger UNSAFE

20c

TIR (Target Indicator Ring)

19a

Reticle Dot

Radar Ranging "Fin"

Reticle Dot Aligned with TIR

19b   20b

Reticle Dot

20d
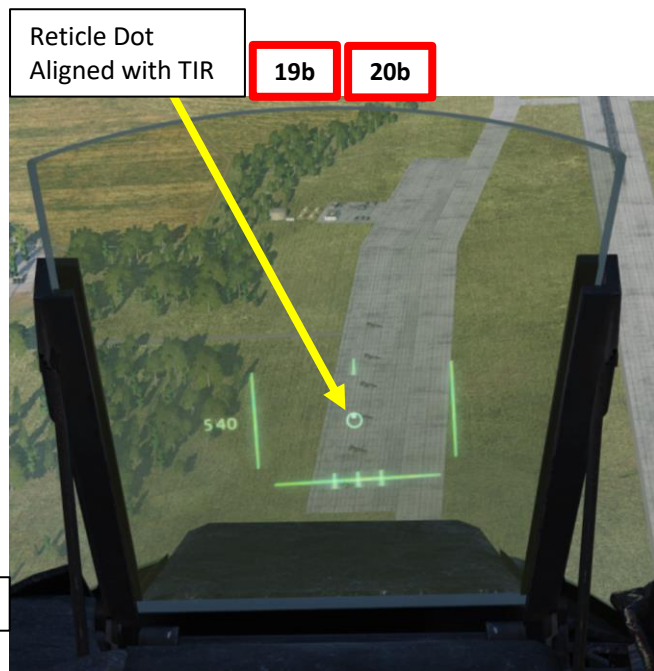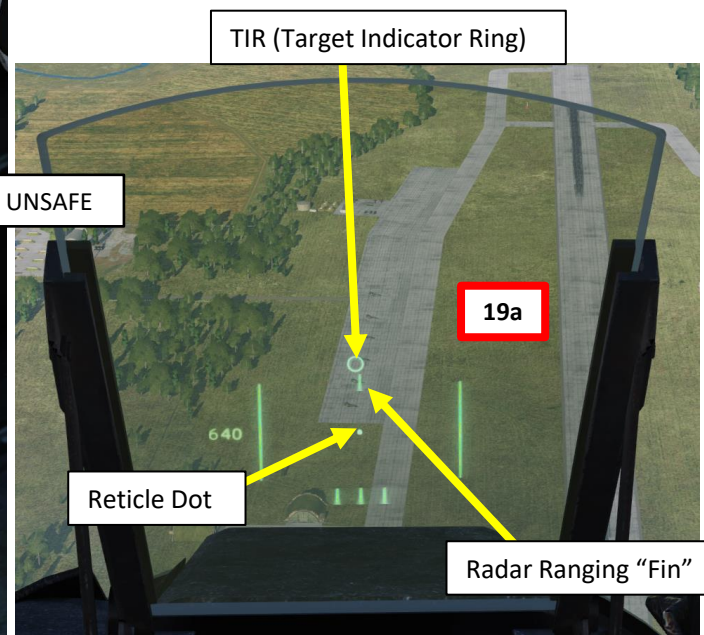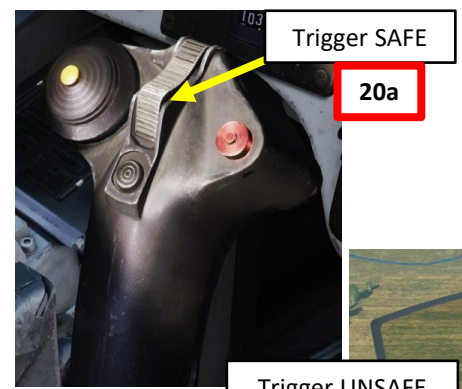
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

22. The Distance Line (Firing Warning) will flash 2 seconds before the release point.
23. When wings appear on the HUD (0.5 seconds before the release point), press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates.
24. While the trigger is held, the HUD symbology will act as a means to line up for an accurate release. The "ring" denotes the steering order, which is what you need to follow to maintain altitude. Steer the aircraft to place the reticle dot inside the steering order ring.

Trigger UNSAFE

23b

23d

Illuminates when all bombs are dropped

FÄLLD LAST

(6) Firing warning:
Distance line flashes 2 sec before latest firing range.

(7) Firing signal: Wings appear 0.5 sec before latest firing range.
Pull and hold trigger.

(8) Trigger still held. Altitude numbers shifted to right side.
Ring denotes steering order.

(9) Follow steering order by placing reticule inside ring.
Trigger still held.

(10) Flashing 2° poles indicate that steering order was not followed.
Take evasive action.

(11) Steering order disappears once last bomb is release.
Release Trigger when FÄLLD LAST illuminates.
Trigger SAFE, master mode NAV, leave area.

22 Flashing Distance Line

Target

Wings

23a

23c

24

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.2 – Precision Dive Mode (DYK) Delivery

C – Perform Attack

25. Once all bombs are dropped (FALLD LAST (STORES RELEASED) light illuminates), pull up 4 G and evade blast radius.
26. Set Trigger to SAFE by clicking on the stick's safety cover.
27. Set Master Mode to NAV and resume flight.

Trigger SAFE

250

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to 200 m. You will use the radar to find an approximate location of the target, line up the target, then fly the aircraft to place the "3 km Firing Range line" on the target spotted on the CI (Central Indicator).
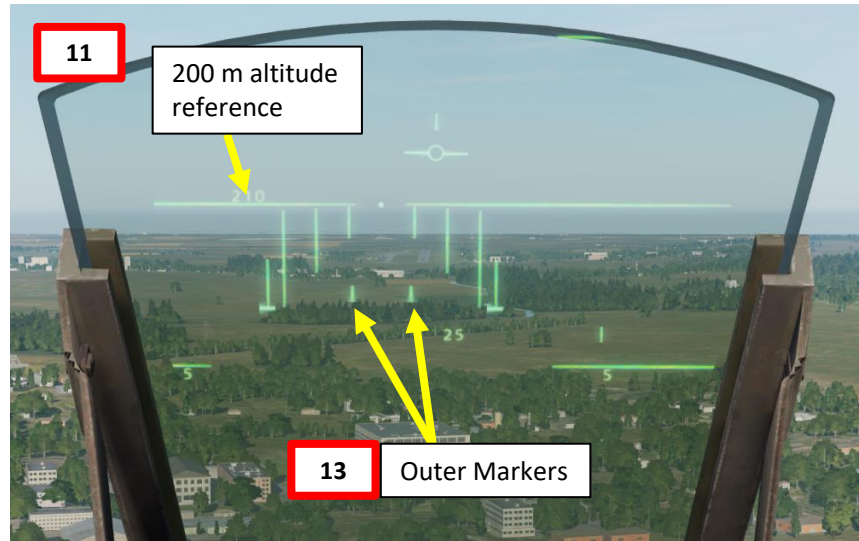
The Radar Central Indicator is the primary aiming tool.

When holding the trigger, the radar will memorize the location of the target designated, then release bombs based on release cues. This technique does not require a pre-planned navigation point, but since it is a mode best used in low visibility conditions, it is not well suited for moving targets. Keep in mind that the barometric pressure setting must be set correctly, which requires a QFE setting value from the kneeboard. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

The radar release (RR) delivery mode is mostly used in situations where a target is not necessarily on a preset waypoint, visibility is low and the only way to spot the target is with the radar. This is mostly effective on static targets of a significant size that can provide radar returns.

Radar Release (RR) Bombing Profile
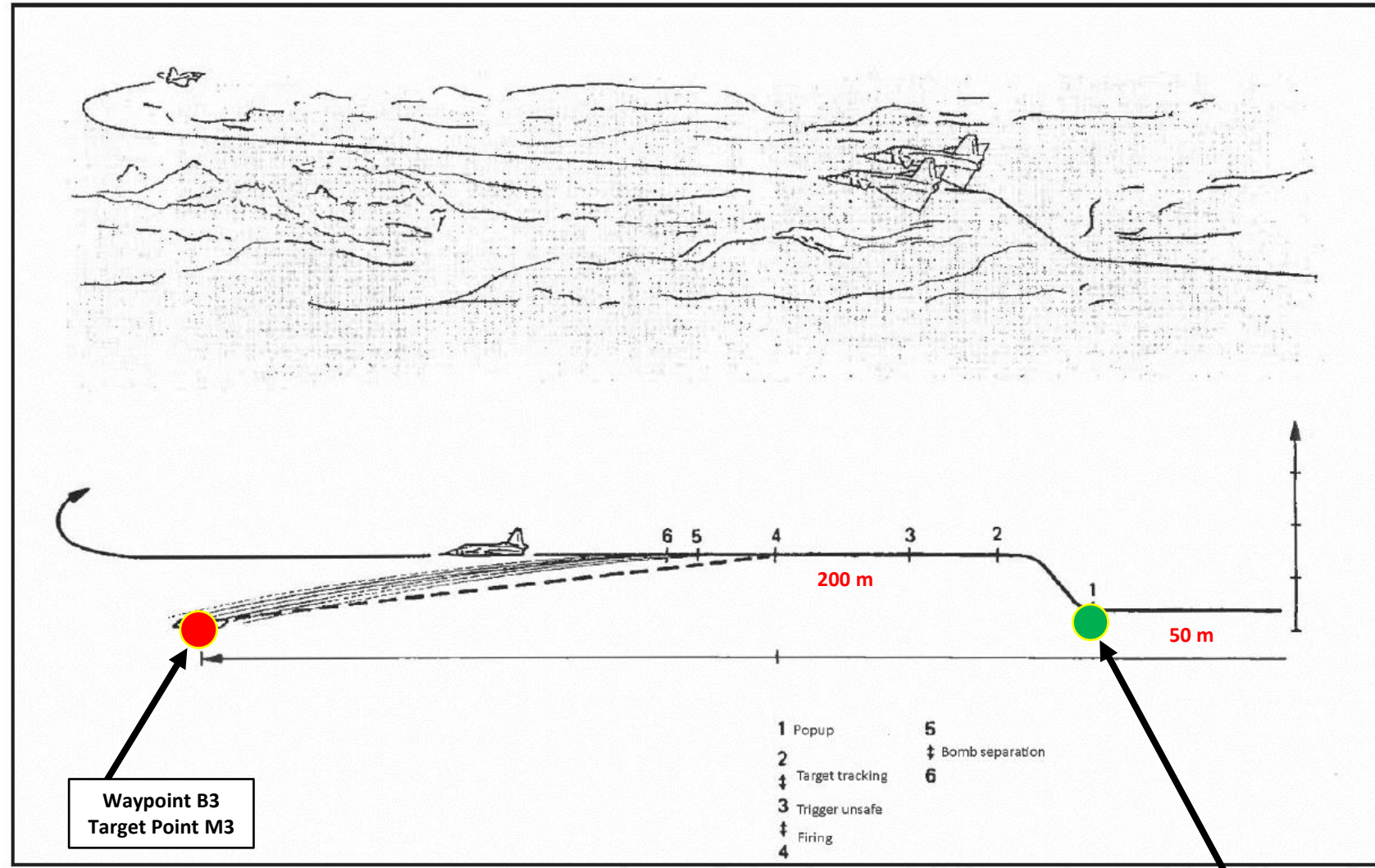
Waypoint B3
Target Point M3

1 Popup
2 Target tracking
3 Trigger unsafe
4 Firing
5 Bomb separation
6

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

200 m

50 m

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

A – Planning

It should be noted that the symbology on the CI (Central Indicator) radar display will change based on the Master Mode selected and the radar mode selected.

The target's location should be known in advance so you know what to look for. In our example, we know the target is located on the southern apron of the Kobuleti airfield. We will use a geographical approximation to guide our Firing Range line.

In other situations where the terrain is flat and the target's radar returns are easily visible (a bunker in the middle of the desert or a ship, for instance), you can use radar returns to guide the Firing Range line.

Master mode: NAV
Radar mode: A1 (PPI)
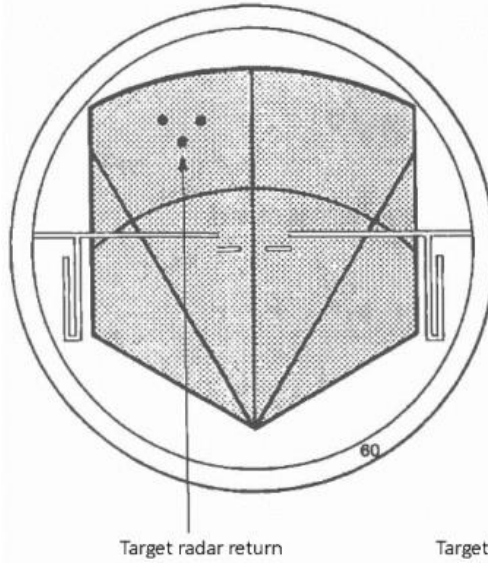
Target radar return

Master mode: ANF
Radar mode: A1 (PPI)
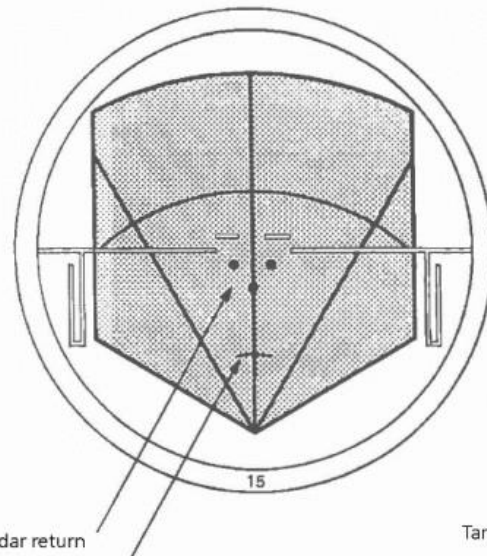
Target radar return

Firing range line (3 km)

Master mode: ANF
Radar mode: A2 (B-scope)
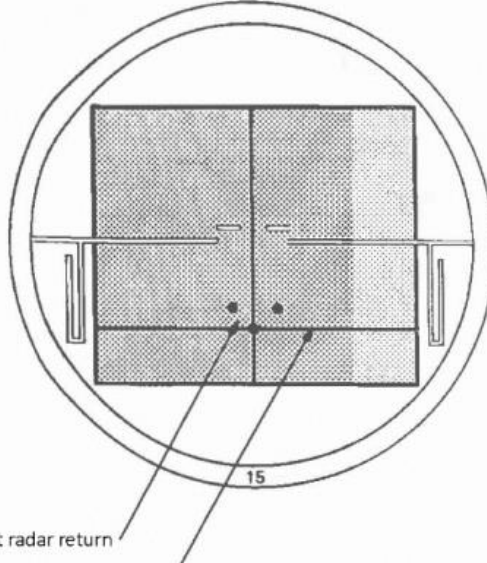
Target radar return

Firing range line (3 km)

Radar Mode Selector
A0 / A1 / A2
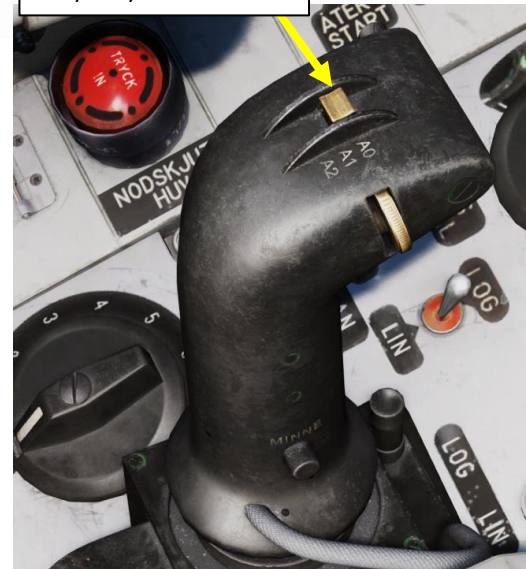
Master Mode Selector

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.3 – Radar Release (RR) Delivery

B – Weapon Setup

1. Set Weapon selector to BOMB RR.
2. Set Sight Mode / Interval selector as desired. We will set it to 30 meters.
   - 10-30 meters interval will result in uniform destruction
   - 40-60 meters will cover a long area, but objects between impacts will be marginally affected
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

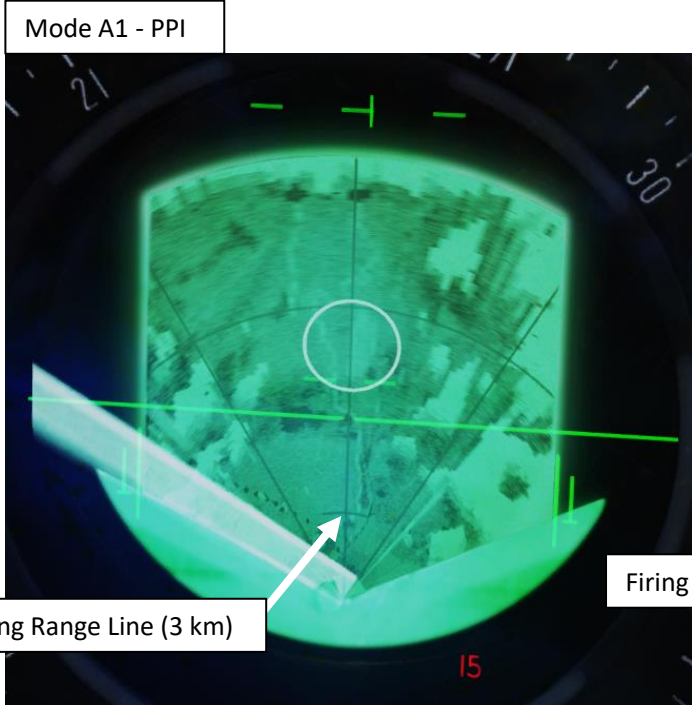| WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

C – Perform Attack

8. Set Data Selector to AKT POS - OUTPUT.
9. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
10. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
11. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    - Climb to an altitude of approximately 200 m above ground level (AGL).
    - Accelerate between Mach 0.8 and 0.9.
    - Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
12. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
13. When you are 15 km away from target, this is the moment where you line up the target and start the bombing run. Outer Markers will be visible on the HUD when you are following a Target Point (M3) instead of a Navigation Waypoint (B2).

Distance to Selected Waypoint (km)

10

11

12

9

10

50 m altitude reference

11

200 m altitude reference

13 Outer Markers
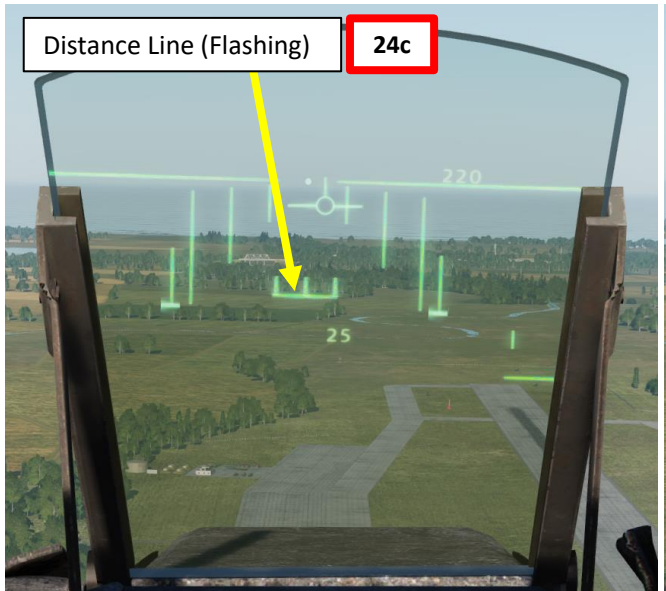
8b

8a

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.3 – Radar Release (RR) Delivery

C – Perform Attack

14. Set Radar Mode Switch to A1 (PPI).
15. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
16. Progressively adjust radar display range to 15 km.
17. Set Master Mode to ANF (*Anflygning*/Attack).
18. The Firing Range Line should now appear 3 km ahead of your current position on the Central Indicator.
19. Steer the aircraft to place the Firing Range Line over the target.

Radar – NAV Master Mode

16b → I5

Radar Mode Selector A1 — **14**

16a

Radar Scan Range Selector

15 Radar MKR Potentiometer (Amplification Gain) Dial

15 Radar Brightness Control (LJUS RADAR)
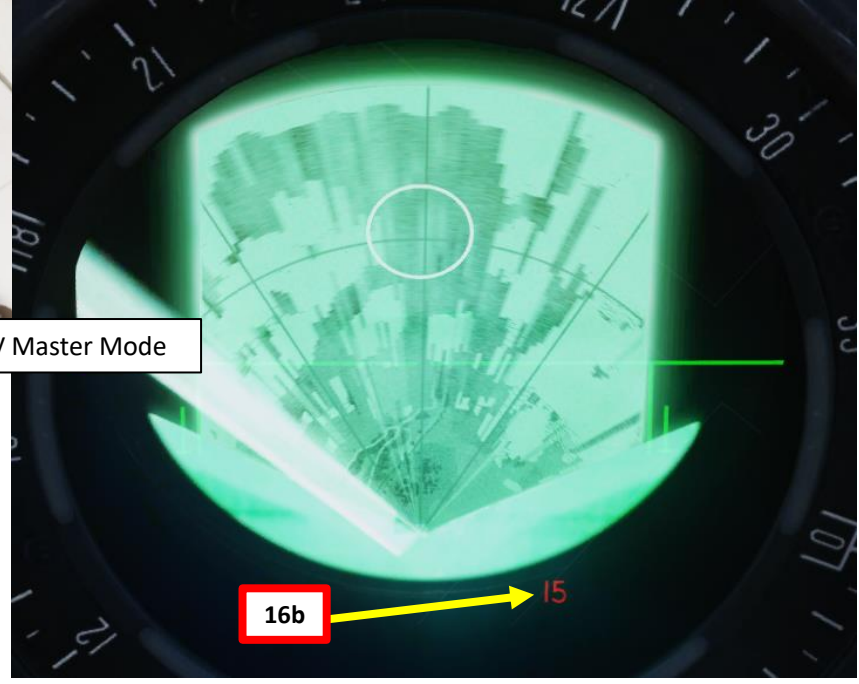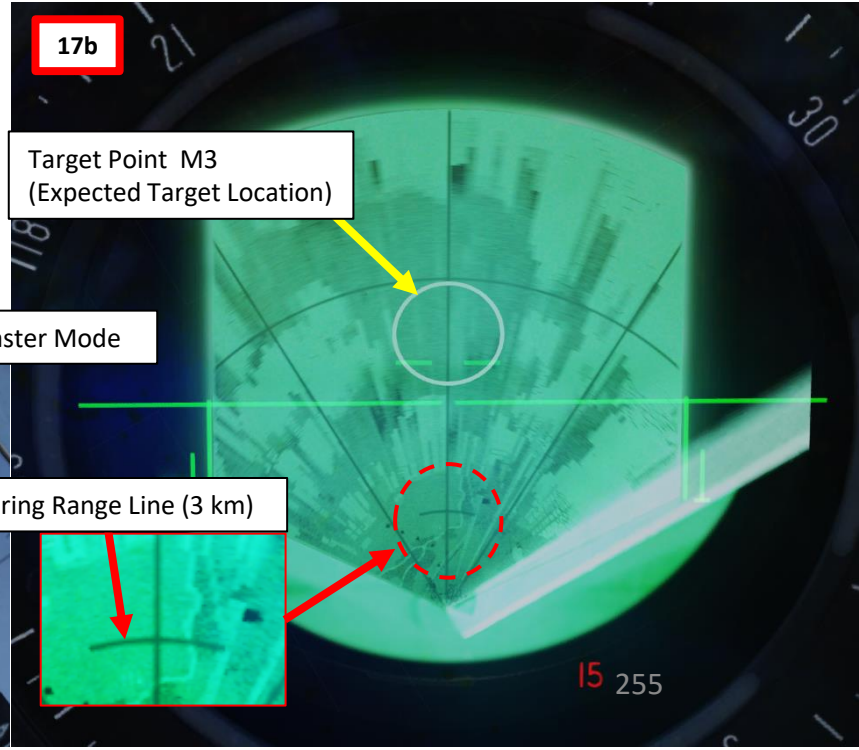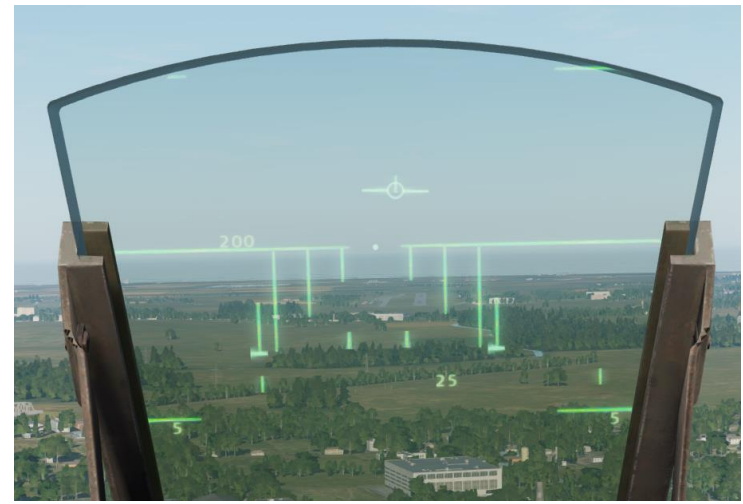
17b

Target Point M3 (Expected Target Location)
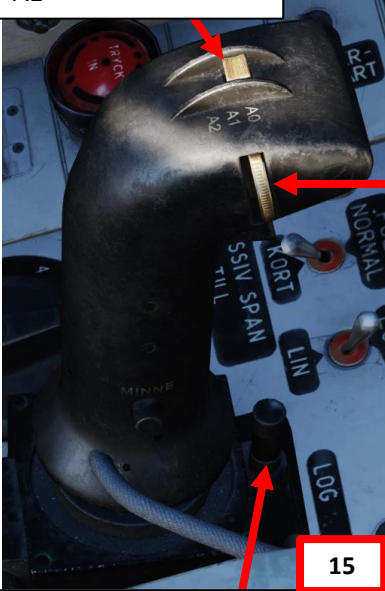
Radar – ANF Master Mode

17a

Firing Range Line (3 km)

I5 255

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

C – Perform Attack

Trigger UNSAFE

20

23b
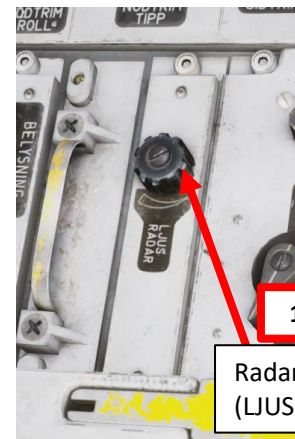
20. Set Trigger to UNSAFE by clicking on the stick's safety cover
21. When you are about 10 km from the target, set radar mode selector to A2 (B-Scope). This will give you a more readable radar picture.
22. Steer the aircraft to align the Firing Range Line over the expected target location (or radar ground return if available).
23. **When target and Firing Range Line are aligned**, press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates. This will mark the target and the radar will provide aiming cues in relationship to it.
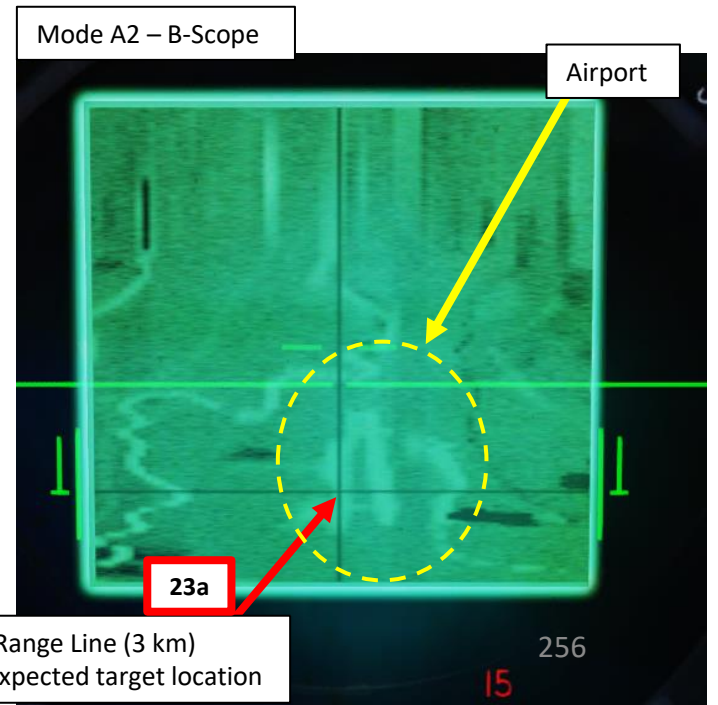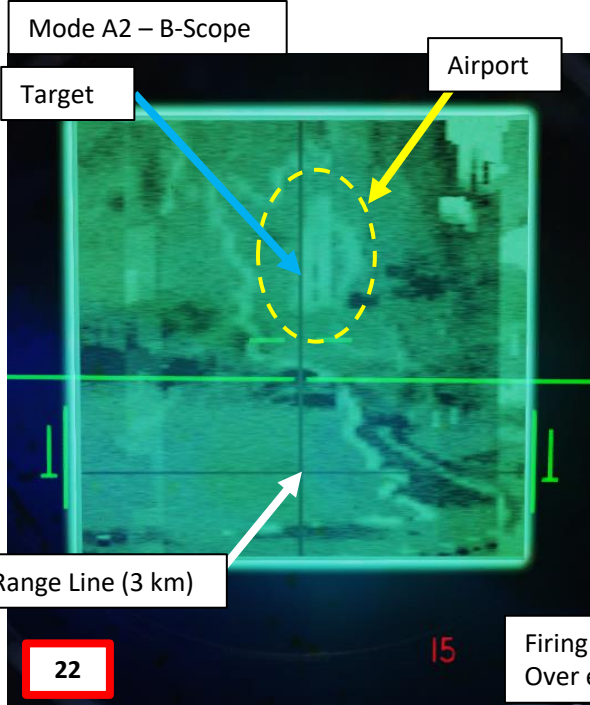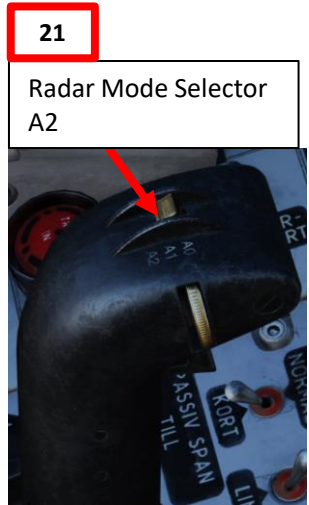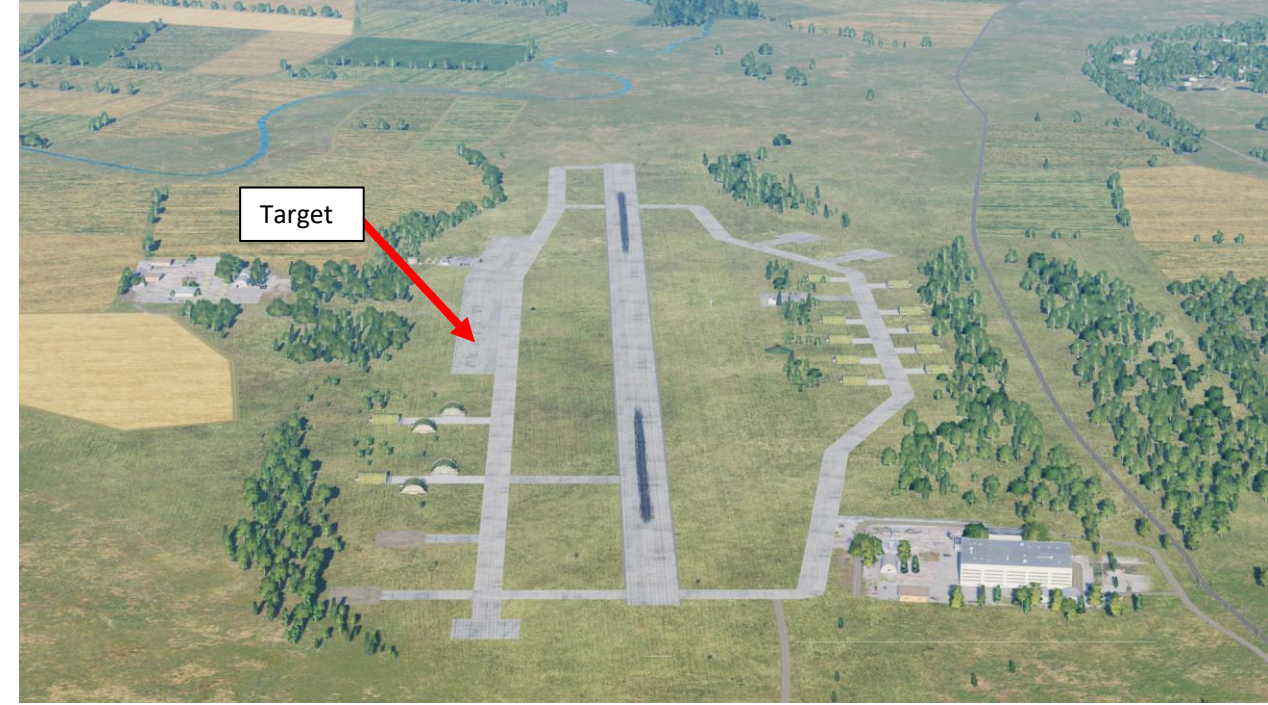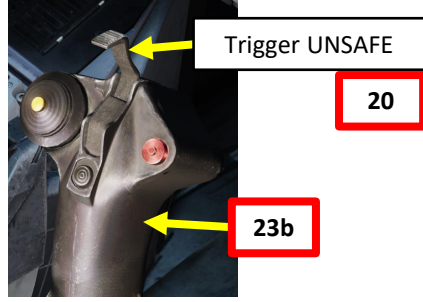
Target

21

Radar Mode Selector A2

Mode A1 - PPI

Firing Range Line (3 km)

Mode A2 – B-Scope

Target

Airport

Firing Range Line (3 km)

22

Mode A2 – B-Scope

Airport

23a

Firing Range Line (3 km)
Over expected target location

256

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

C – Perform Attack

24. While Weapon Release trigger is held, the Distance Line (Firing Warning) will flash 2 seconds before the release point. The bombs will automatically release.
25. When Distance Line is fully extended and FALLD LAST (STORES RELEASED) light illuminates, all bombs have been dropped.

075 (2) Climb to commanded (safety) altitude (here **200 m**).
Master mode **ANF**.
Gradually decrease **radar range to 15 km** when closing in.
Trigger UNSAFE.

200 (3) **Pull and hold trigger** when target radar return passes the firing range line at **3 km**.
Distance line appears. **Altitude numbers** shift right.

200 (4) **Distance line flashes 2 sec** before bomb release.
Trigger still held.

200 (5) **Distance line fully extended** signifies all stores dropped.
Release trigger when **FÄLLD LAST** illuminates.

Trigger UNSAFE

24a

25

Illuminates when all bombs are dropped

FÄLLD LAST

Distance Line (Not Flashing) **24b**

Target

Distance Line (Flashing) **24c**

Distance Line (Fully Extended) **25**

257

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.3 – Radar Release (RR) Delivery

C – Perform Attack

Trigger SAFE

26. Once all bombs are dropped, set Trigger to SAFE by clicking on the stick's safety cover.
27. Set Master Mode to NAV and resume flight.

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.4 – Nav Delivery (Waypoint)

You can use a navigation point as a reference to deliver bombs. The two main methods are the NAV release and the TOSS release, which is less accurate. In our case, we will use NAV release.

SB71 RR Bombing: Nav Release

(6) (5) (4) (3)   (2) (1)

200 m

50 m

050 (1) Master mode **NAV**. Weapon selector **BOMB RR**. Markers appear.
Set target **QFE**. Sight mode selector to desired interval.
Radar mode **A0**.
Bombs will be released on (target) waypoint.

075 (2) Distance line appears.
Climb to commanded (safety) Altitude (here **200 m**).
Trigger UNSAFE.

200 (3) Distance line flashes 2 sec before release.
Pull and hold trigger. Altitude numbers shift to right.

200 (4) Release in **0.5 sec**.
Trigger still held.

200 (5) Distance line fully extended signifies all stores dropped.
Release trigger when FÄLLD LAST illuminates.

200 (6) **Trigger SAVE.** Designation changes to **NAV** automatically.
Leave the area.

SB71 RR Bombing: TOSS Release

Airspeed   Max pull-up dist.
M 0.80   4.4 km
M 0.85   4.6 km
M 0.90   4.8 km

(6)(5) (4)   (3)   (2)   (1)

50 m

M7   4.5 km   B6

050 (1) Master mode **NAV**. Weapon selector **BOMB RR**. Markers appear.
Careful visual fix on waypoint (here B6).
Carefully set target altimeter pressure **QFE**.
Sight mode selector to desired impact interval.

050 (2) Flight path vector over **target** or reticule.
Distance line appears.
HUD is wind compensated.

050 (3) Distance line indicates less than maximum release range
for current airspeed.

075 (4) **Pull-up with 4G** at **~4.5 km** distance to target WP.
Maximum pull-up distance depends on current airspeed.

+5   +5
100 (5) Trigger UNSAFE once **angle of climb reaches ~5°**.
Pull and hold trigger.
Bombs are released at ~12° to 15° climb.

+5   +5
600 (6) **Release trigger** when FÄLLD LAST illuminates.
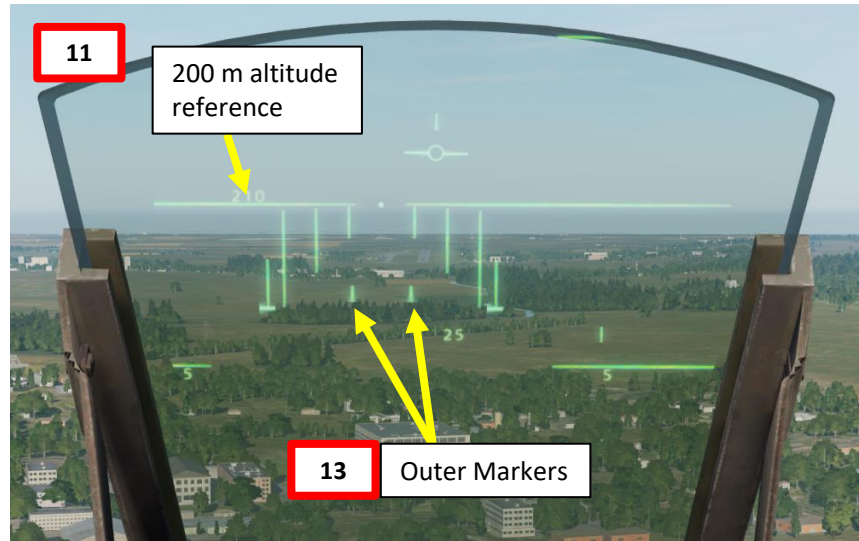**Trigger SAVE.** Up, up and away!

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.4 – Nav Delivery (Waypoint)

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to 200 m, line up the target, use the navigation computer's waypoint as a reference for ranging, and then release bombs based on release cues.

This technique requires a pre-planned navigation point, therefore it is not well suited for moving targets. However, keep in mind that the barometric pressure setting must be set correctly, which requires a QFE setting value from the kneeboard. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

This method is very similar to the CCRP (Continuously Computed Release Point) release mode, which itself is pretty much a synonym for level bombing. This approach is very effective on static targets.

NAV Bombing Profile

1 Popup
2 Target tracking
3 Trigger unsafe
4
5 Bomb separation
6 Firing

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

200 m

50 m
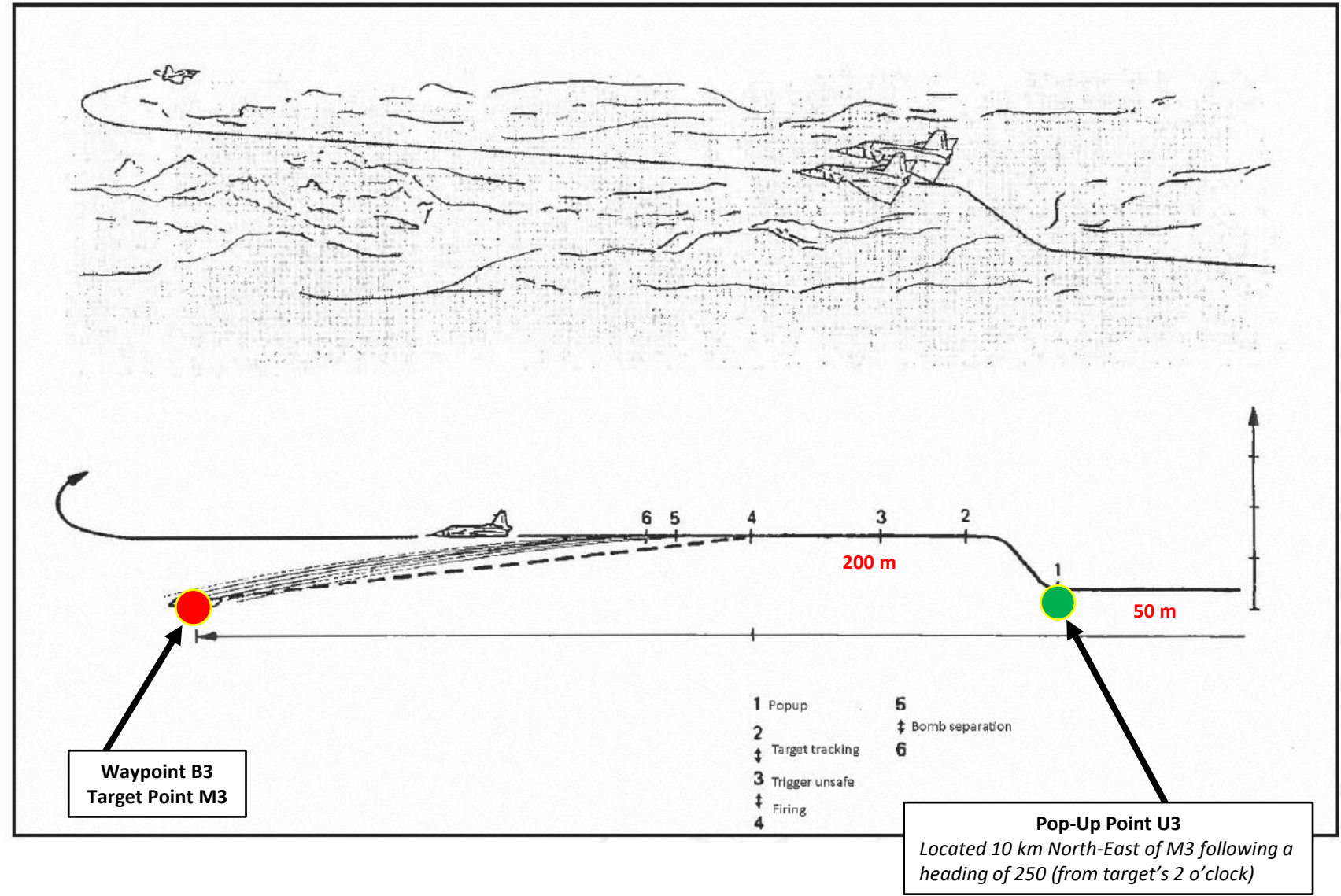
2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.4 – Nav Delivery (Waypoint)

B – Weapon Setup

1. Set Weapon selector to BOMB RR.
2. Set Sight Mode / Interval selector as desired. We will set it to 30 meters.
   - 10-30 meters interval will result in uniform destruction
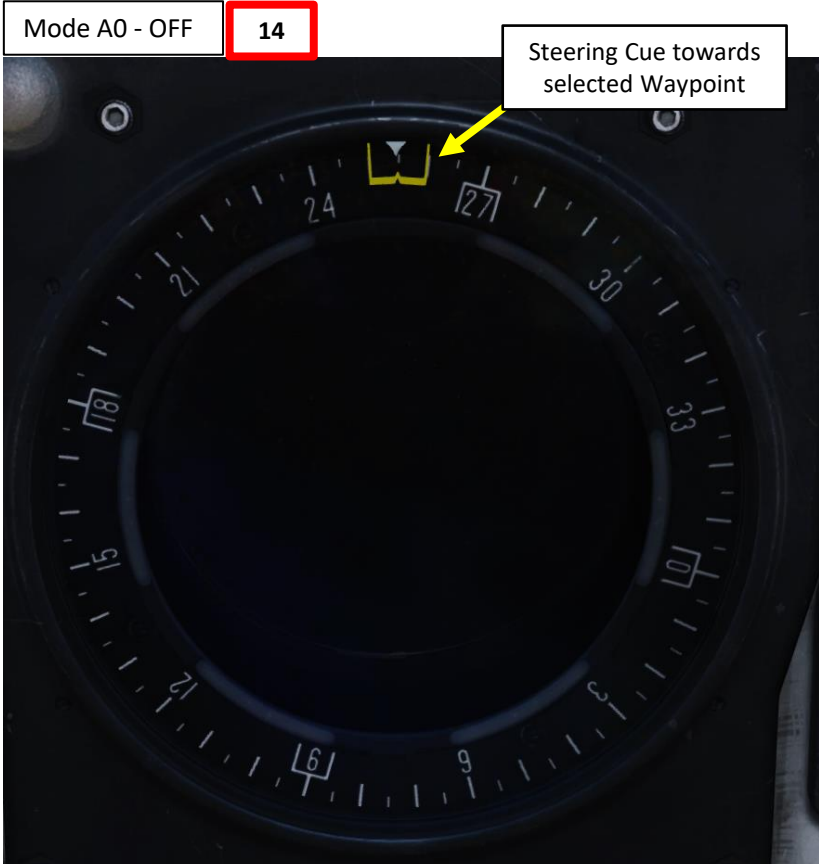   - 40-60 meters will cover a long area, but objects between impacts will be marginally affected
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.4 – Nav Delivery (Waypoint)

C – Perform Attack

Distance to Selected Waypoint (km)

8. Set Data Selector to AKT POS - OUTPUT.
9. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
10. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
11. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    • Climb to an altitude of approximately 200 m above ground level (AGL).
    • Accelerate between Mach 0.8 and 0.9.
    • Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
12. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
13. When you are 10 km away from target, this is the moment where you line up the target and start the bombing run. Outer Markers will be visible on the HUD when you are following a Target Point (M3) instead of a Navigation Waypoint (B2).

50 m altitude reference

200 m altitude reference

Outer Markers

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.4 – Nav Delivery (Waypoint)

C – Perform Attack

14. Set Radar Mode – A0 (OFF)
15. Steer the aircraft to center the velocity vector between the pole tracks.
16. Once you are approx. 5 km from the target, the Distance Line appears.
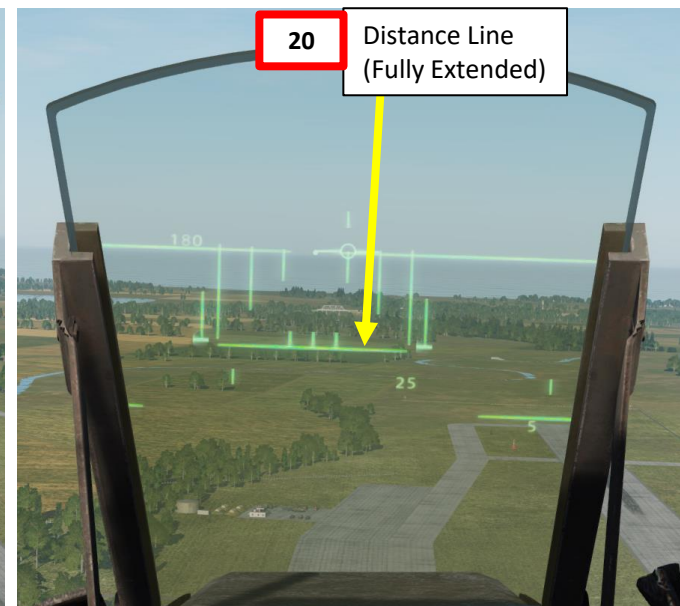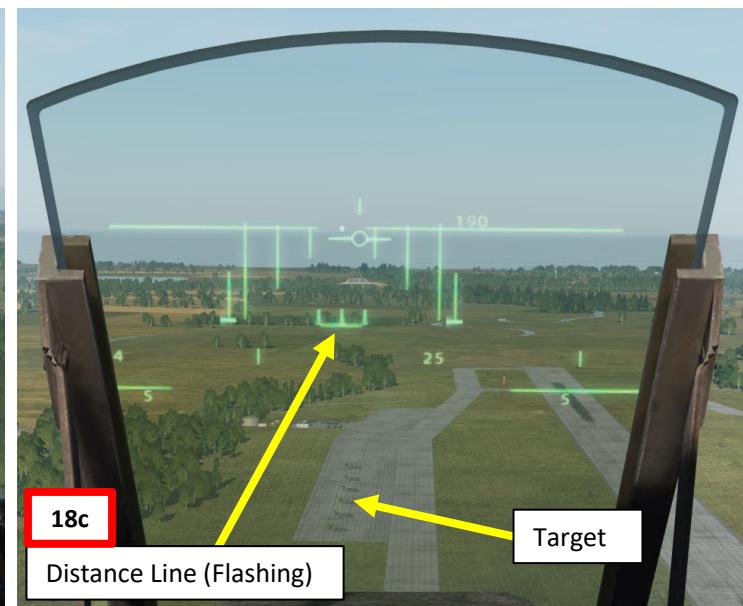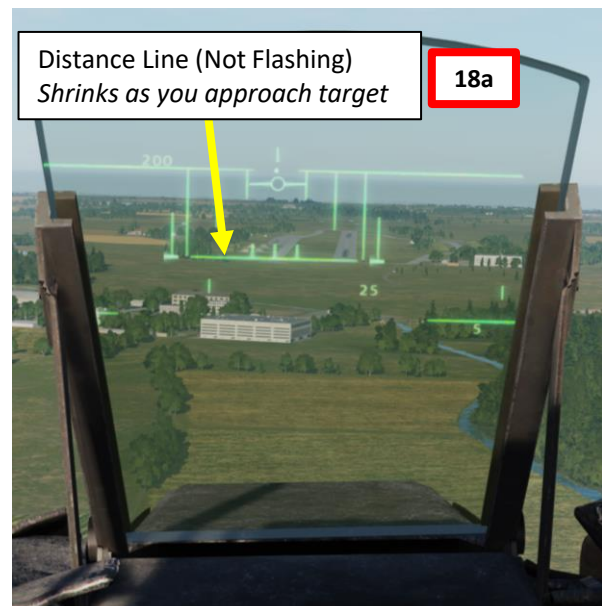17. Set Trigger to UNSAFE by clicking on the stick's safety cover.
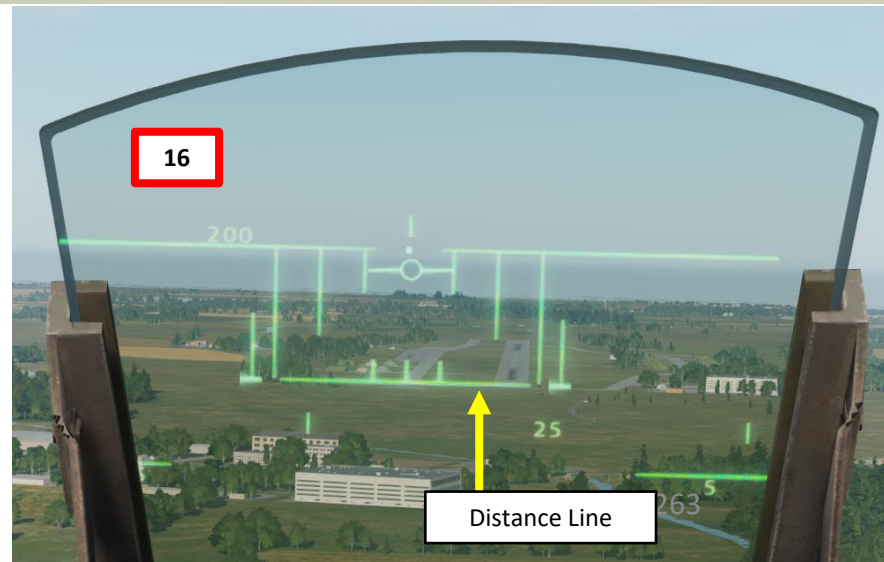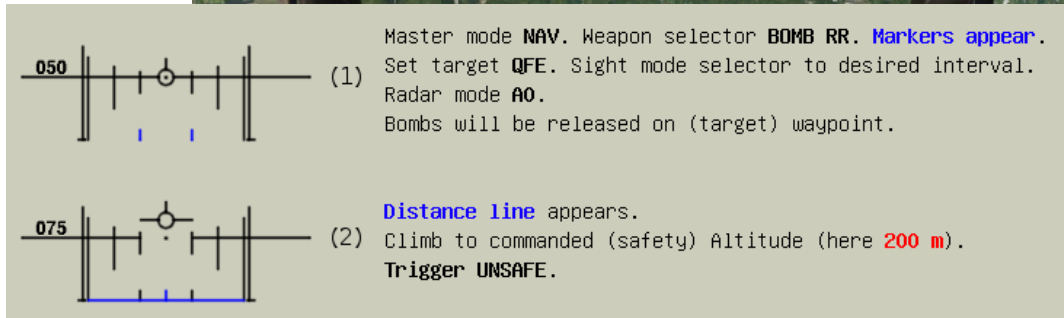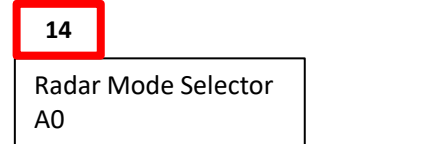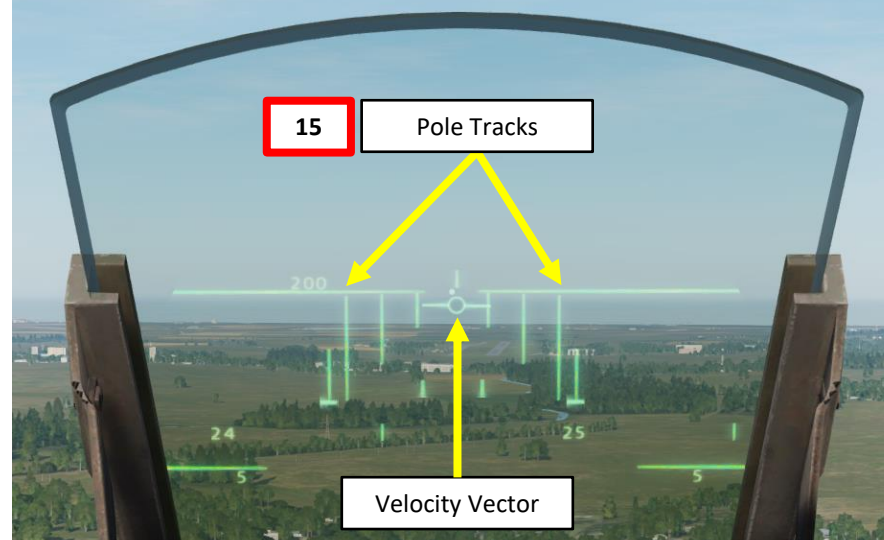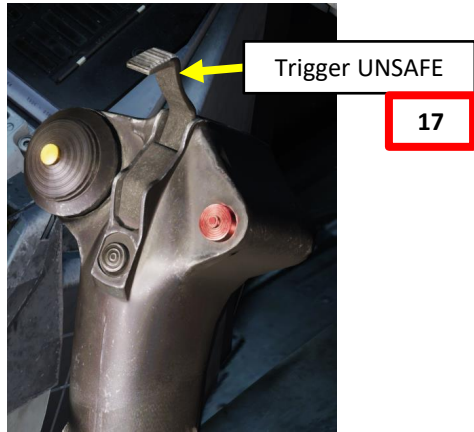
Trigger UNSAFE

17

15 | Pole Tracks

Velocity Vector

Mode A0 - OFF | **14**

Steering Cue towards selected Waypoint

14

Radar Mode Selector A0

(1) Master mode **NAV**. Weapon selector **BOMB RR**. Markers appear.
Set target **QFE**. Sight mode selector to desired interval.
Radar mode **AO**.
Bombs will be released on (target) waypoint.

(2) Distance line appears.
Climb to commanded (safety) Altitude (here 200 m).
Trigger UNSAFE.

16

Distance Line

2 – Air-to-Ground Weapons
2.1 – M/71 Bomb
2.1.4 – M/71 Low Drag Bomb
2.1.4.4 – Nav Delivery (Waypoint)

C – Perform Attack

18. **When the Distance Line flashes (2 sec prior to release)**, press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates.
19. While Weapon Release trigger is held, the Distance Line (Firing Warning) will shrink until you reach the release point. The bombs will automatically release.
20. When Distance Line is fully extended and FALLD LAST (STORES RELEASED) light illuminates, all bombs have been dropped.

075   (2)   **Distance line** appears.
Climb to commanded (safety) Altitude (here **200 m**).
Trigger UNSAFE.

200   (3)   **Distance line** flashes **2 sec** before release.
Pull and hold trigger. **Altitude numbers** shift to right.

200   (4)   **Release** in **0.5 sec**.
Trigger still held.

200   (5)   **Distance line fully extended** signifies all stores dropped.
Release trigger when **FÄLLD LAST** illuminates.

Trigger UNSAFE

18b

20

Illuminates when all bombs are dropped

FÄLLD LAST

Distance Line (Not Flashing)
Shrinks as you approach target

18a

20

Distance Line (Fully Extended)

18c

Target

Distance Line (Flashing)

2 – Air-to-Ground Weapons

2.1 – M/71 Bomb

2.1.4 – M/71 Low Drag Bomb

2.1.4.4 – Nav Delivery (Waypoint)

C – Perform Attack

21. Once all bombs are dropped, set Trigger to SAFE by clicking on the stick's safety cover.
22. Set Master Mode to NAV and resume flight.

Trigger SAFE
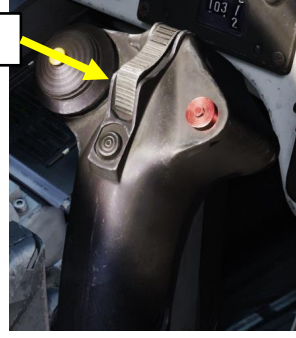
2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets

2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.1 – Short Range Release

In the following rocket attack tutorial, we will use the following approach:

- **First segment**: We will follow waypoints B1 and B2 by maintaining a radar altitude of 50 m AGL (Above Ground Level)
- **Second segment**: Using a pop-up point is by no means mandatory, but since we know the targets are lined up parallel to the runway heading, we can use the Pop-Up Point U3 (generated in relationship from Target Point M3) to approach the target from an optimal direction.
- **Third segment**: Fly from the Pop-Up Point U3 towards the Target Point M3 at the required safety altitude, then perform attack.

Waypoint B3
Target Point M3

Runway Heading 250

Targets

Approaching the Target

Kobuleti Airport
Runway Heading: 250

Attack following Heading 250
Distance from Pop-Up Point: 10 km

Waypoint B2

Waypoint B1

Waypoint B3
Target Point M3

Pop-Up Point U3
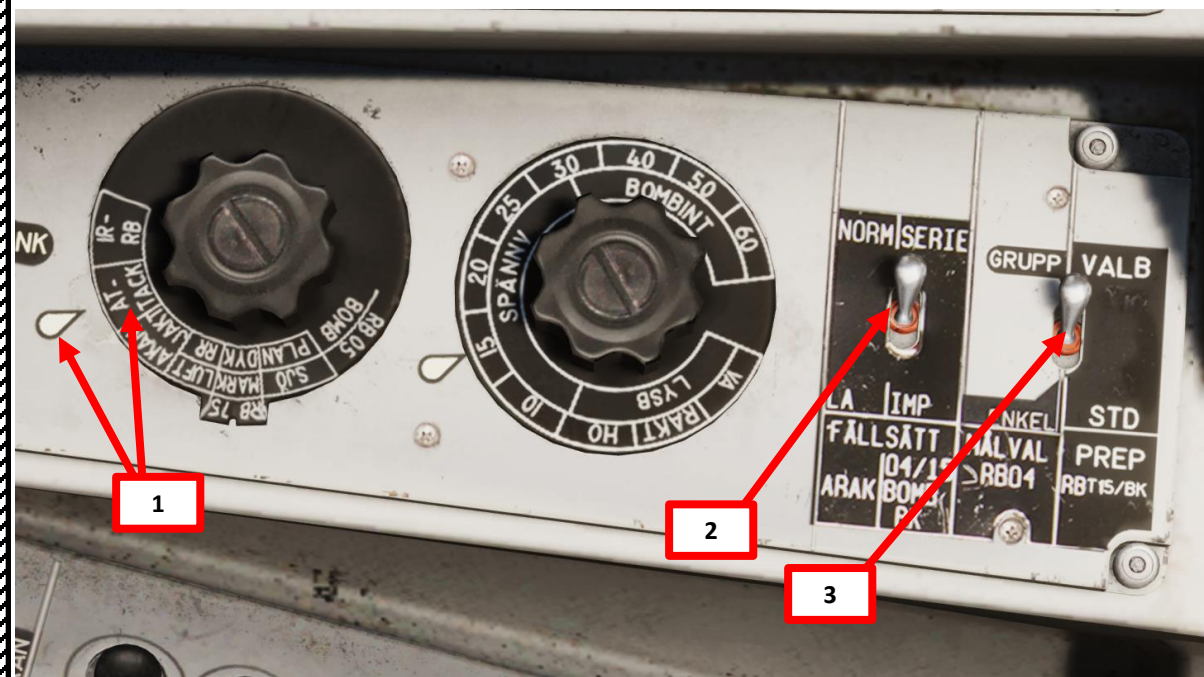*Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)*

Your Position

AJS 37

267
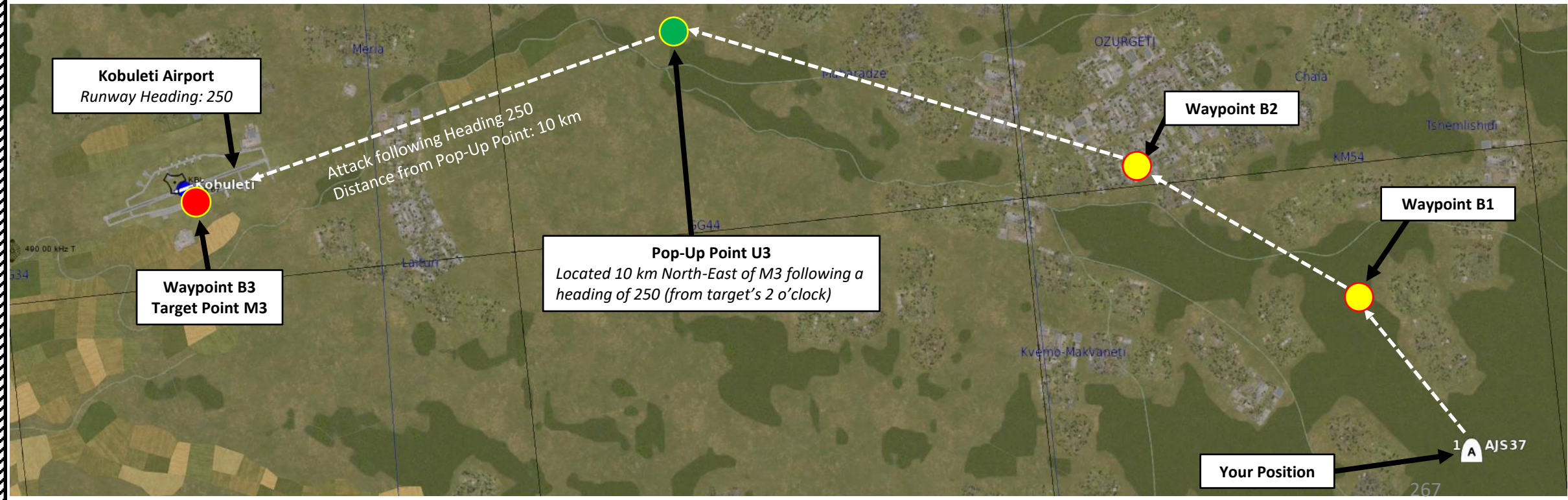
2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to an altitude that allows you to obtain good visibility over the target (500+ m). Then, perform a shallow dive and line up the target for your attack. In our case, we will use radar ranging to provide ranging information, and then fire our rockets based on release cues.

This technique does not require a pre-planned navigation point. However, keep in mind that the barometric pressure setting should be set correctly, which requires a QFE setting value from the kneeboard, which is obtained from an existing waypoint. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

Rocket Attack Profile
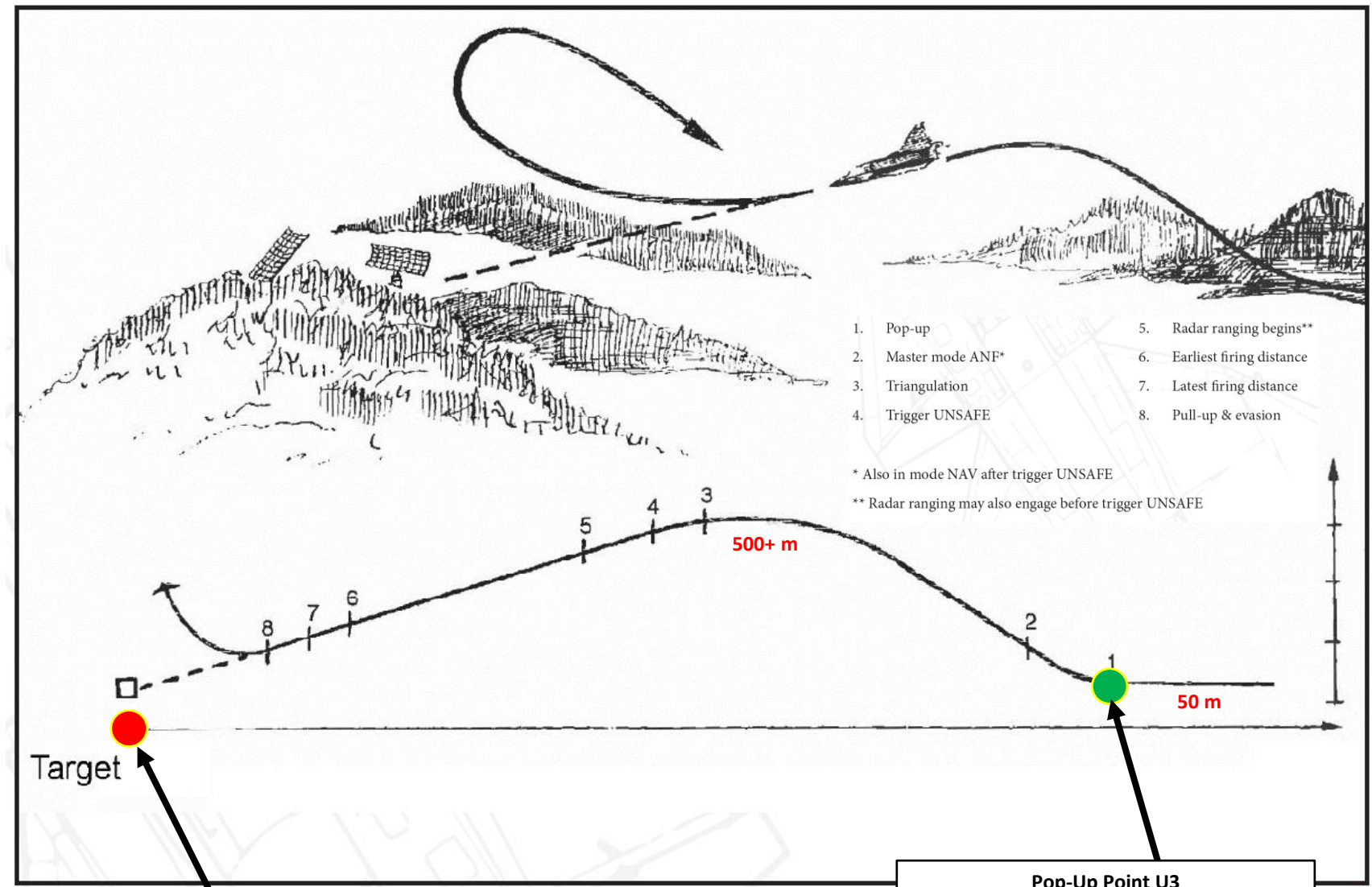
1. Pop-up
2. Master mode ANF*
3. Triangulation
4. Trigger UNSAFE
5. Radar ranging begins**
6. Earliest firing distance
7. Latest firing distance
8. Pull-up & evasion

* Also in mode NAV after trigger UNSAFE

** Radar ranging may also engage before trigger UNSAFE

500+ m

50 m

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Weapon Release Mode selector to SERIE (UP).
3. Set Targeting Mode (MÅLVAL) / Preparation Switch as desired:
   - ENKEL (DOWN): Single Rocket fired per pod upon trigger press.
   - GRUPP (UP): Fires all rockets per pod upon trigger press. This is what we will use.
4. Set the HUD to the LOWER position to ensure HUD data is properly displayed during the rocket run.
5. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
6. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
7. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
8. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

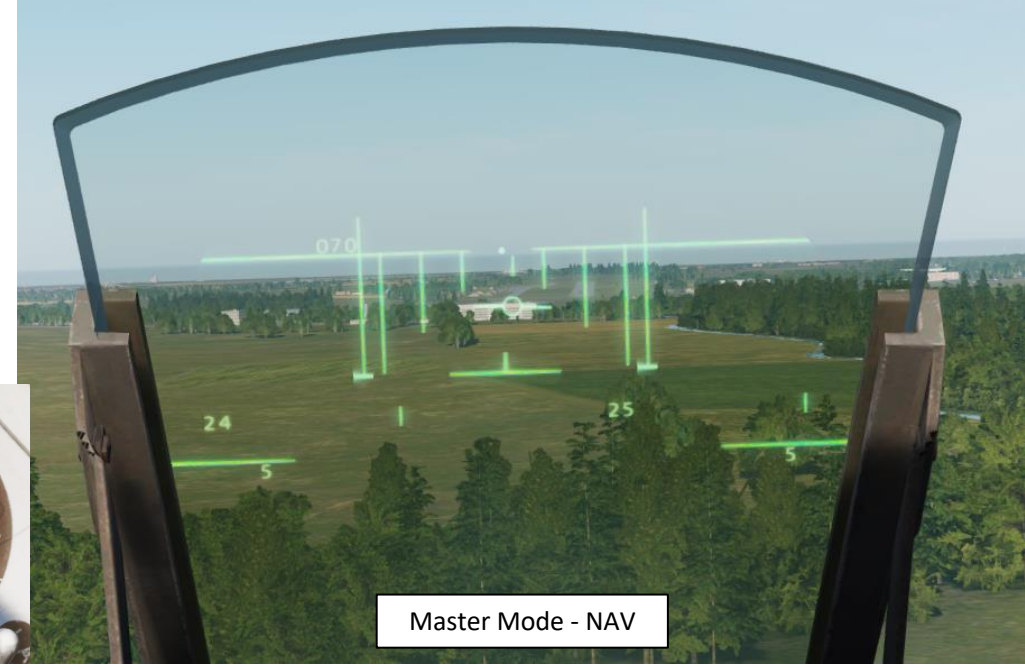| WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

B – Weapon Setup

9. **(Optional)** Set Target Motion Measurement option as desired. Since it has marginal accuracy improvements at best and the option is set to OFF by default, I recommend **leaving it to OFF,** which is what we will do for this tutorial.
   - To set Target Motion Measurement Option ON:
     a) Set Data Selector to TAKT
     b) Set INPUT/OUTPUT Selector to IN
     c) Enter code "220" on the keypad
     d) Press LS/SKU button
     e) Set INPUT/OUTPUT Selector to UT (Output)
     f) Set Data Selector to AKT POS (Active Position)
   - To set Target Motion Measurement Option OFF, use the same procedure listed above, but enter code "221" instead. This option is the one set by default in the aircraft.

The Target Motion Measurement option allows the gunsight to take into account the target speed. The sight is used to calculate lead on the target by using the movement of the sight dot over the ground.

Target Motion Measurement OFF (Default Setting)

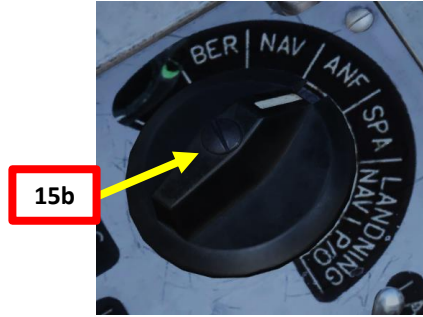Target Motion Measurement ON

2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.1 – Short Range Release

C – Perform Attack

Distance to Selected Waypoint (km)

12

13

14
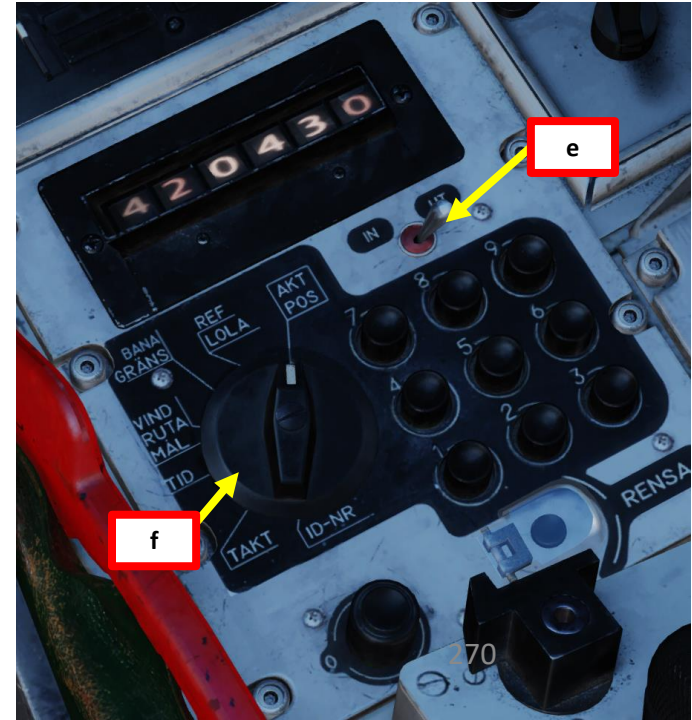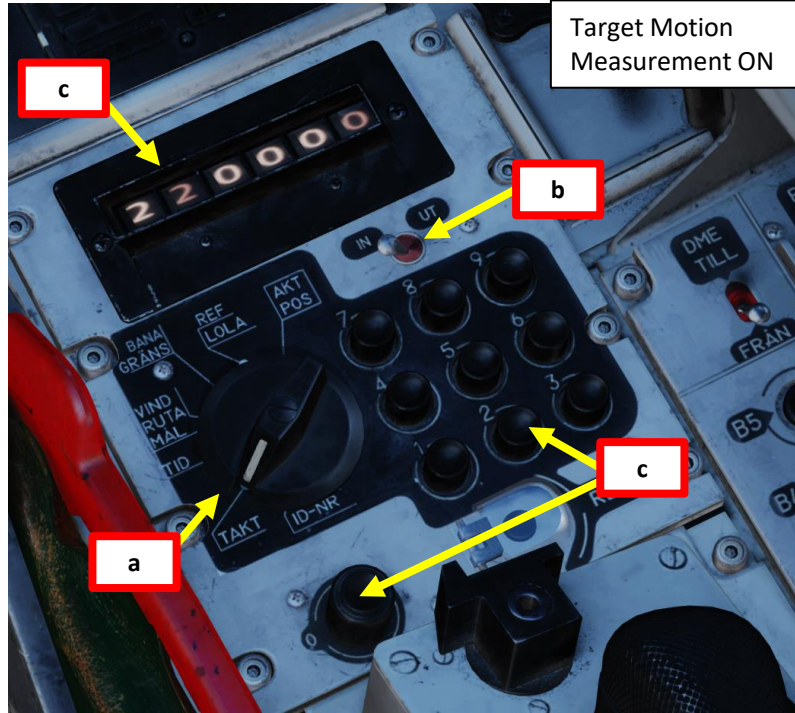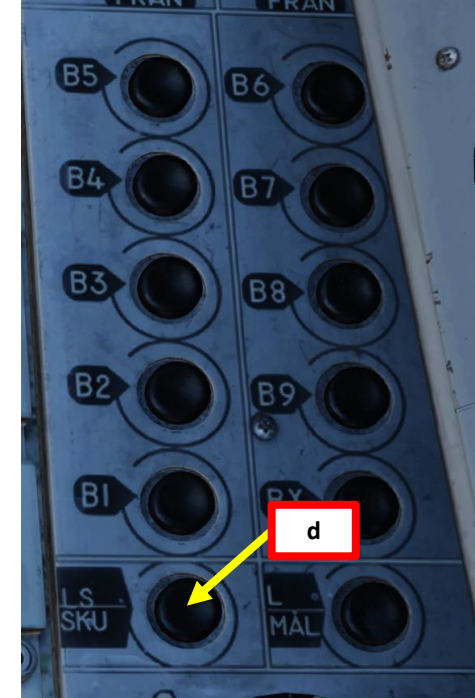
10. Set Data Selector to AKT POS - OUTPUT.
11. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
12. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
13. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    - Climb to an altitude of approximately 500 m above ground level (AGL) or more.
    - Accelerate between Mach 0.8 and 0.9.
    - Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
14. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
15. The "Time Line" appears when you are 40 seconds away from target.

11

10b

12
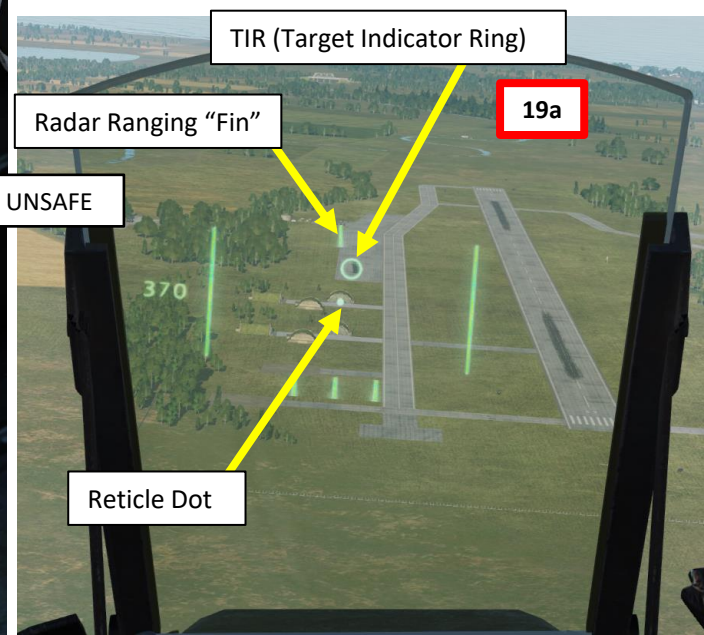
50 m altitude reference

13

Time Line

15

10a
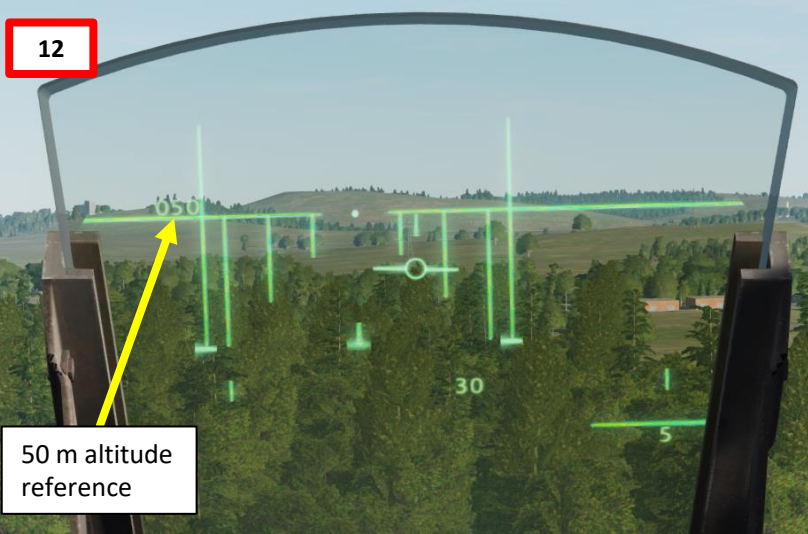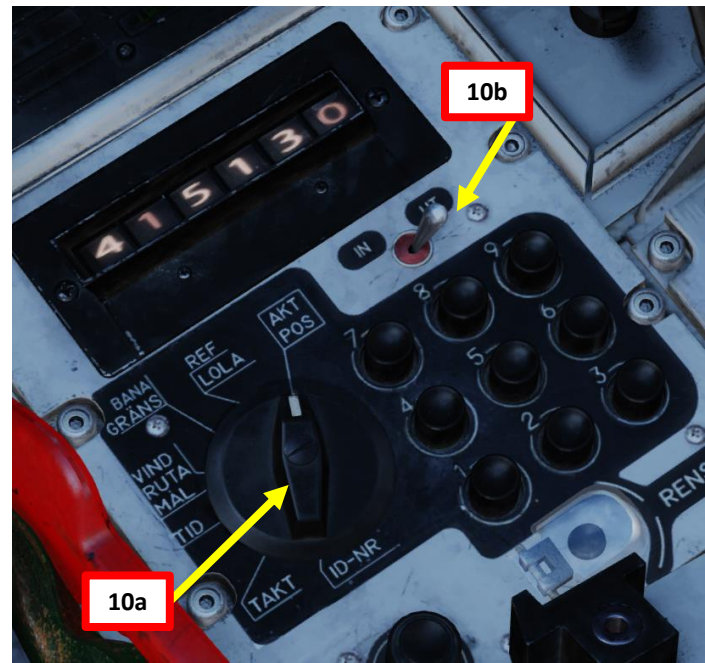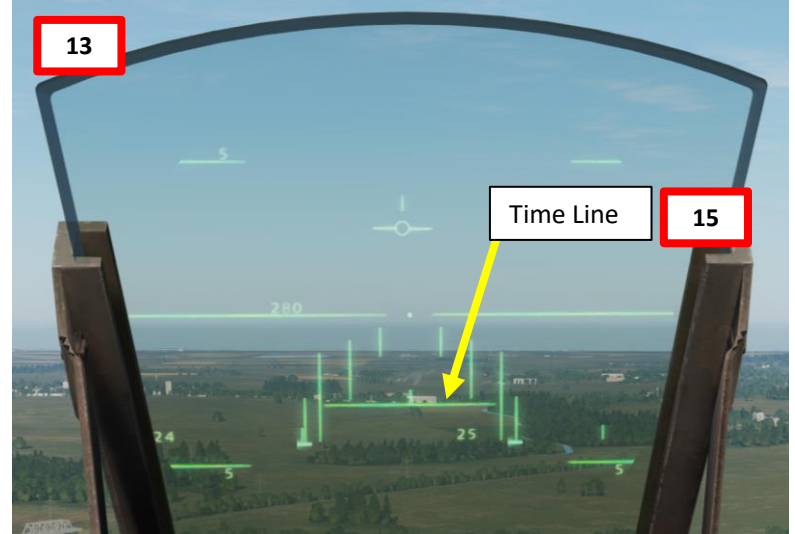
2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

C – Perform Attack

16. Set Master Mode to ANF (*Anflygning*/Attack). HUD Symbology now provides symbology applicable to rocket release cues such as the TIR (Target Indicator Ring), which appears on the target.

15a

Master Mode - NAV

15b

Pull up at pop-up point and go master mode to ANF.

(2) HUD symbology changes.

Target indicator ring (TIR) appears on target.

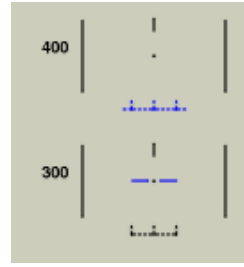TIR (Target Indicator Ring)

Master Mode - ANF

2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.1 – Short Range Release

C – Perform Attack

17. Pull up at Pop-Up point and climb to 500 m or more.
18. When at the top of the climb, throttle back to IDLE, then start a dive to acquire visually the TIR (Target Indicator Ring).

Altitude (meters)

TIR (Target Indicator Ring)

370

2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

C – Perform Attack

19. During the dive, steer the aircraft to align the reticle dot with the TIR (Target Indicator Ring). Once the TIR and the reticle dot are aligned, confirm that radar ranging is being performed ("fin" should be visible).
20. **While TIR and reticle dot are aligned**, set Trigger to UNSAFE by clicking on the stick's safety cover. This will mark the target and provide more accurate ranging information. The TIR should disappear.
21. Keep the reticle dot on the target.

(3) Ranging via triangulation if sightline relative to horizon > 5°. Distance line appears. Start aligning reticule and TIR.

(4) Radar ranging used indicated by fin, if parameters are met.

(5) Trigger UNSAFE when reticule is stable on target. TIR disappears. Trigger unsafe signal marks the target. Doppler wind frozen.

Trigger SAFE
20a

TIR (Target Indicator Ring)
19a

Radar Ranging "Fin"

Trigger UNSAFE
20c

Reticle Dot

Reticle Dot Aligned with TIR
19b **20b**

Reticle Dot
20d

2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.1 – Short Range Release

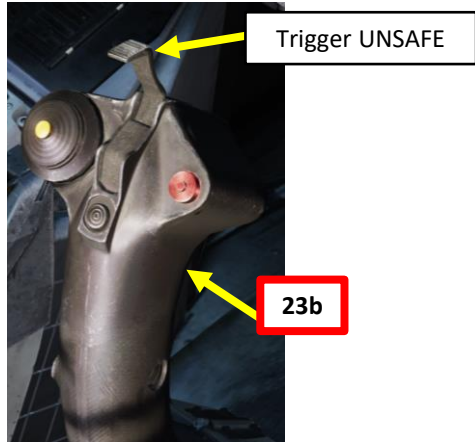### C – Perform Attack

22. The Distance Line (Firing Warning) will flash 2 seconds before the firing/release point.
23. When wings appear on the HUD (0.5 seconds before the release point), press and hold the Weapon Release trigger until all rockets are fired.

(6) Firing warning:
Distance line flashes 2 sec before latest firing range.

(7) Firing signal: Wings appear 0.5 sec before latest firing range.
Pull and hold trigger.

Trigger UNSAFE

23b

22   Flashing Distance Line

Target   Wings

23a
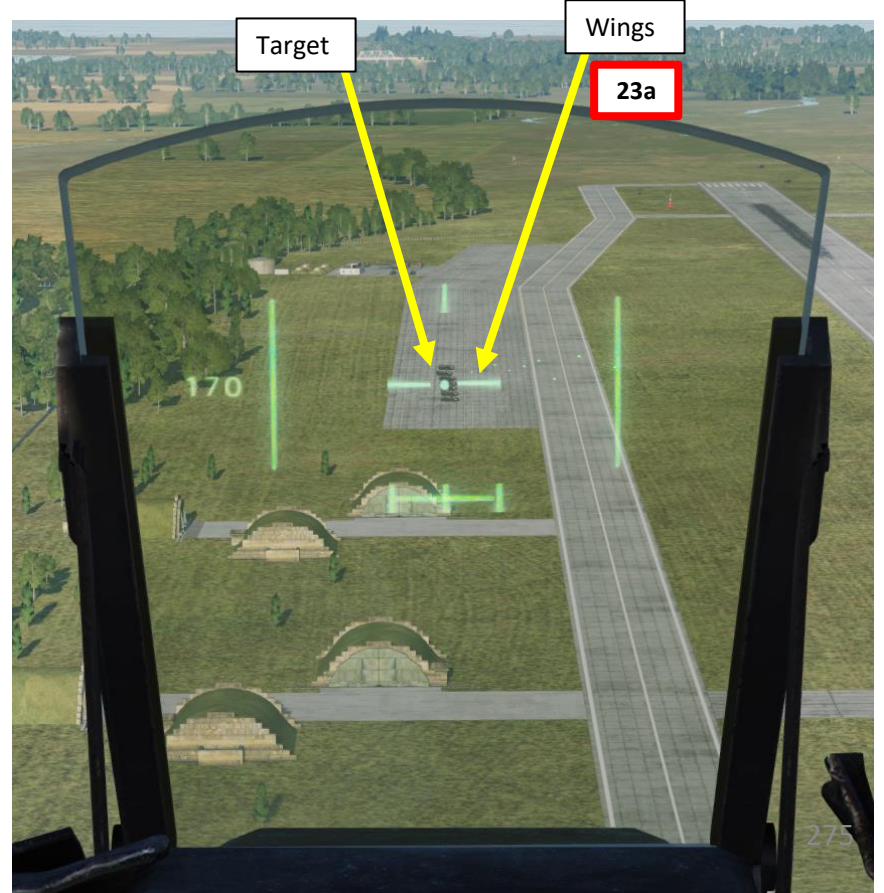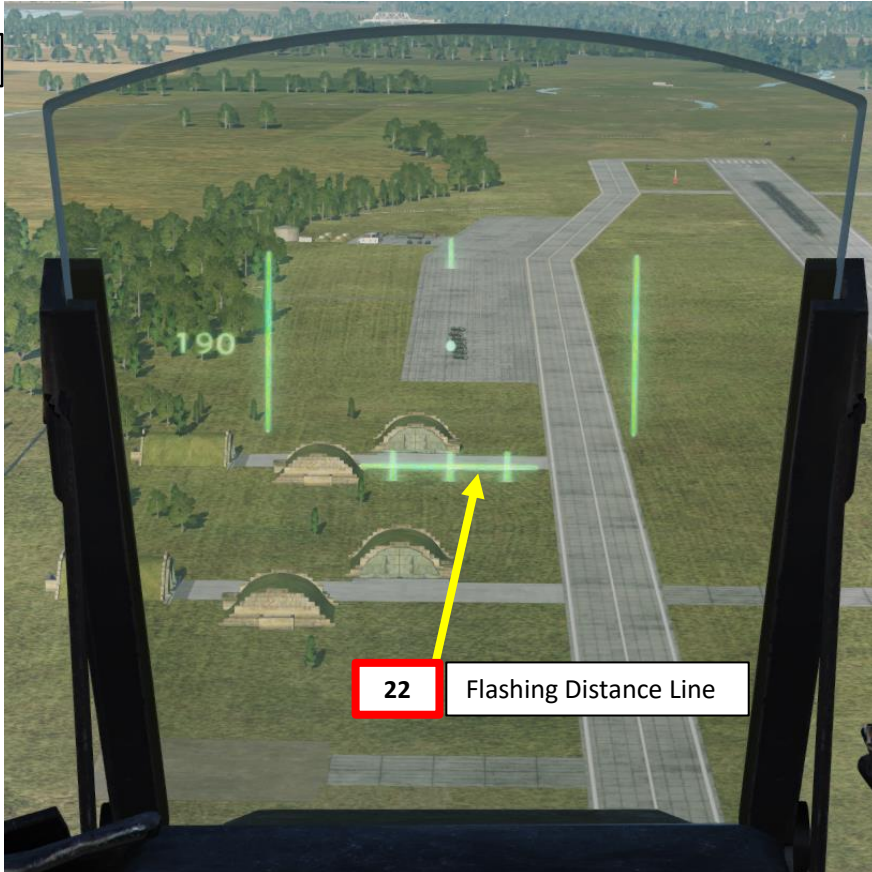
2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets
2.2.1 – Short Range Release

C – Perform Attack

24. Once all rockets are fired, pull up 5 G and evade blast radius.
25. Set Trigger to SAFE by clicking on the stick's safety cover.
26. Set Master Mode to NAV and resume flight.

Trigger SAFE
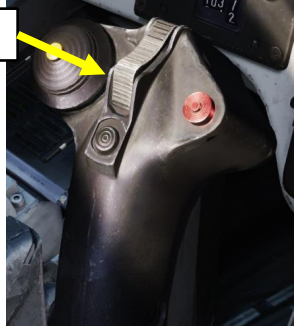
2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.2 – Long Range Release

The Long Range rocket release mode is almost identical to the Short Range release method. The main difference is that you are firing off the rockets from much farther away (to the detriment of precision), which forces you to disable radar ranging. The tutorial is pretty much the same as the Short Range Release tutorial, except for the following differences:

- **Difference 1**: Set Weapon Release Mode selector to IMPULSE (DOWN).
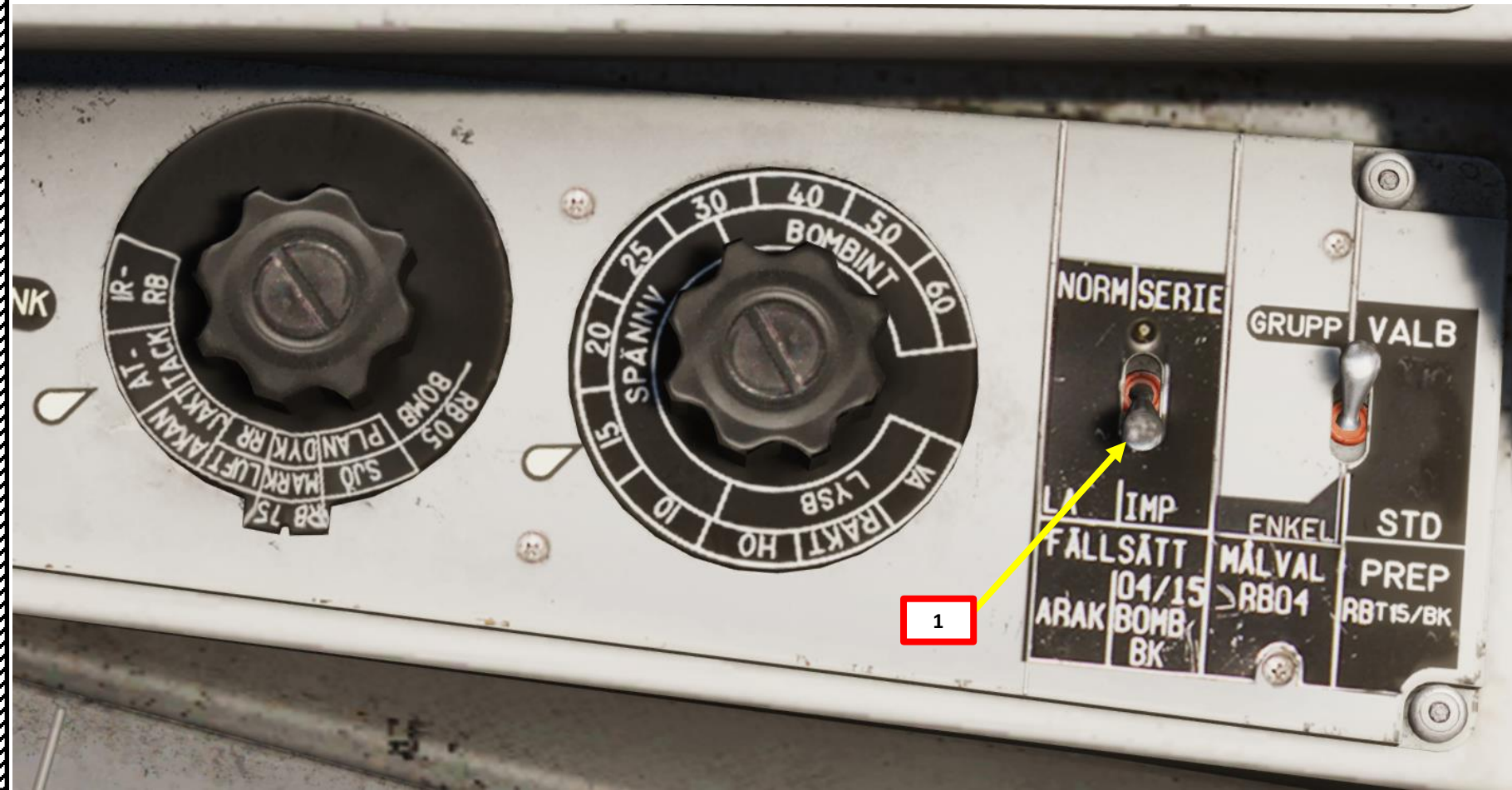
2 – Air-to-Ground Weapons
2.2 – ARAK M/70B Rockets
2.2.2 – Long Range Release

- **Difference 2**: Target Motion Measurement option must be disabled. Fortunately, it is disabled by default. See previous tutorial to see how to de-activate it manually.

- **Difference 3**: Radar Ranging must be disabled since we want the HUD sight to only use triangulation for ranging.
    - To set Radar Ranging Option OFF:
        a) Set Data Selector to TAKT
        b) Set INPUT/OUTPUT Selector to IN
        c) Enter code "253" on the keypad
        d) Press LS/SKU button
        e) Set INPUT/OUTPUT Selector to UT (Output)
        f) Set Data Selector to AKT POS (Active Position)
    - To set Radar Ranging Option back to ON, use the same procedure listed above, but enter code "251" instead. This option is the one set by default in the aircraft.
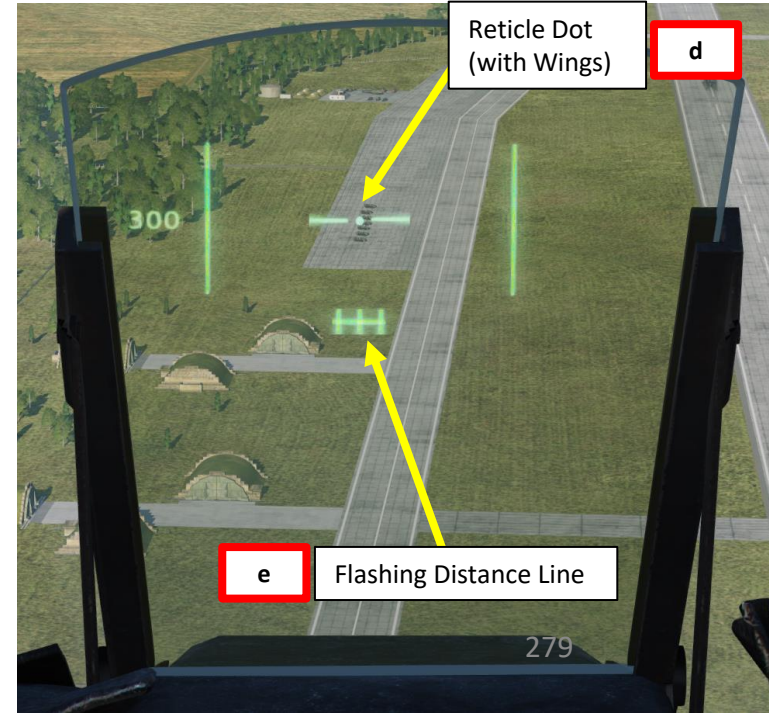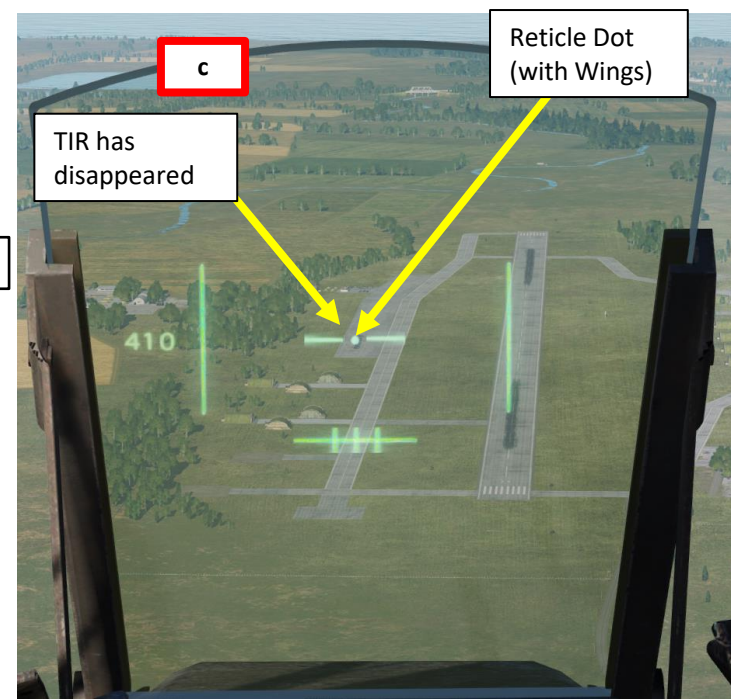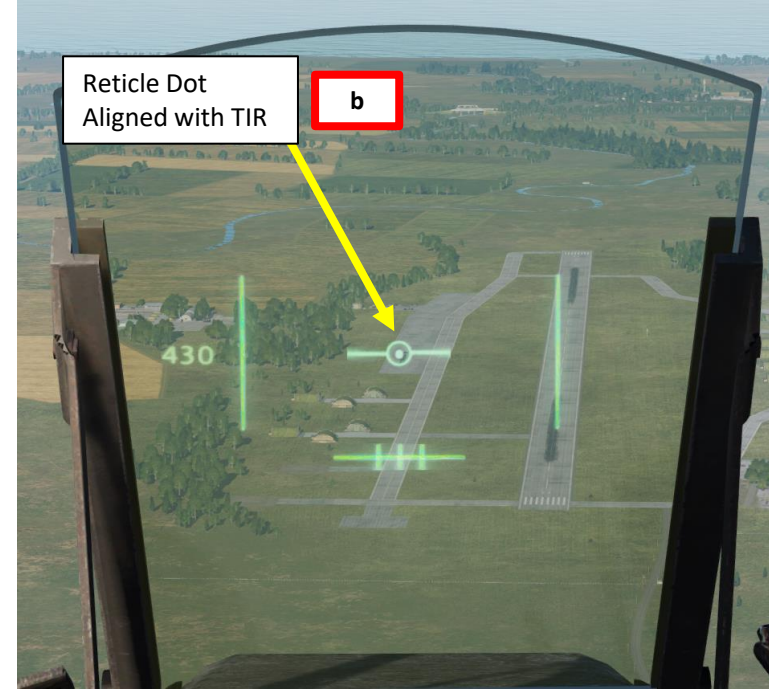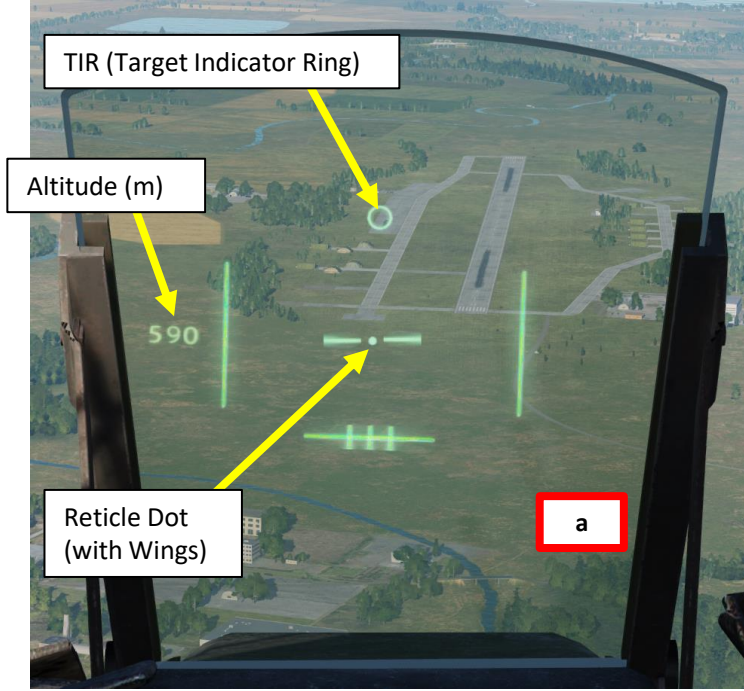
Target Motion Measurement OFF (Default Setting)
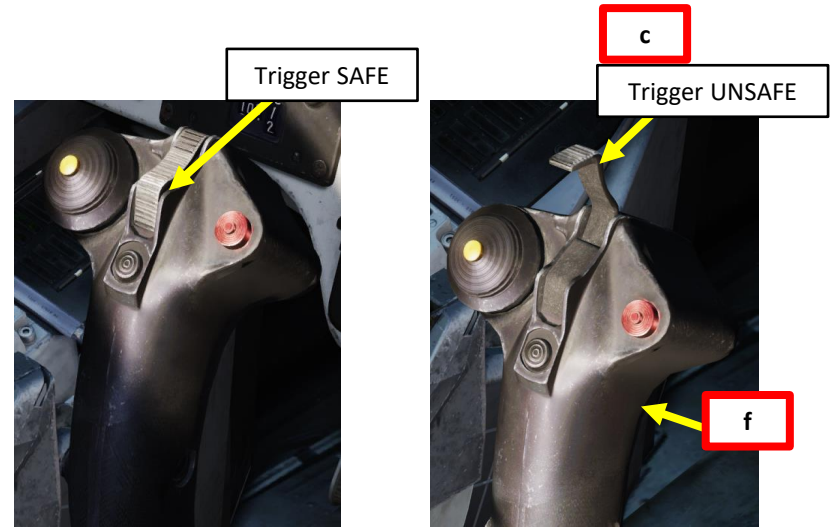
Radar Ranging OFF
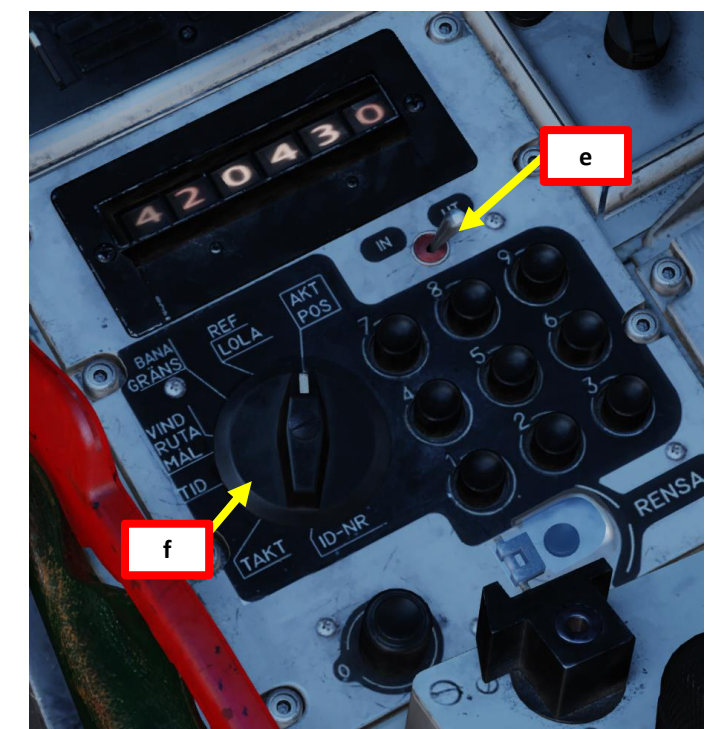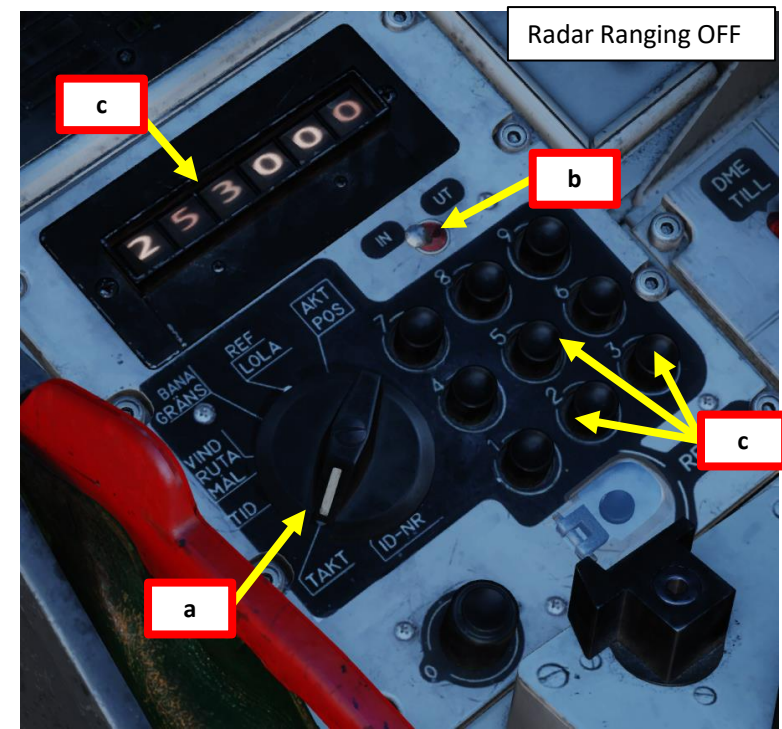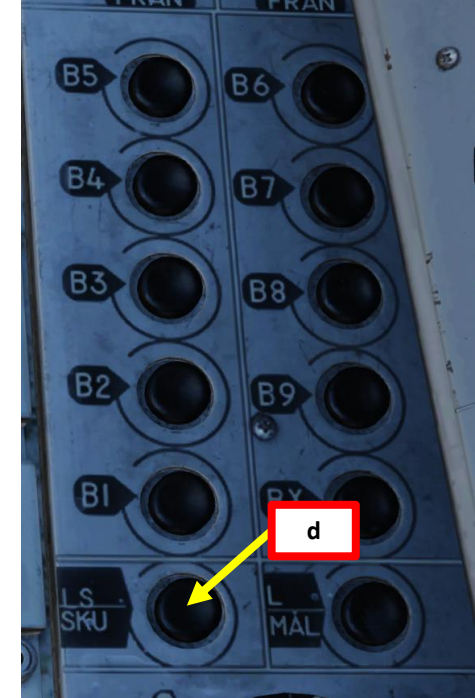
2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.2 – Long Range Release

- **Difference 4**: The symbology on the HUD for the reticle is different from the Short Range Release mode.
    a) When you are entering the dive, the reticle will display a pair of wings as well. Take note that these wings will not appear if you are in level flight.
    b) Line up the reticle's center dot with the TIR (Target Indicator Ring).
    c) **While TIR and reticle dot are aligned**, set Trigger to UNSAFE by clicking on the stick's safety cover. This will mark the target and provide more accurate ranging information. The TIR should disappear.
    d) Keep the reticle dot on the target.
    e) The Distance Line (Firing Warning) will flash 2 seconds before the firing/release point.
    f) Hold the Weapon Release trigger until all rockets are fired.

Trigger SAFE

c

Trigger UNSAFE

f

TIR (Target Indicator Ring)

Altitude (m)

Reticle Dot (with Wings)

a

Reticle Dot Aligned with TIR

b

Reticle Dot (with Wings)

c

TIR has disappeared

Reticle Dot (with Wings)

d

e

Flashing Distance Line

279

2 – Air-to-Ground Weapons

2.2 – ARAK M/70B Rockets

2.2.2 – Long Range Release

```
ARAK AG Long Range
  (1) Weapon selector ATTACK.
  (2) Set altimeter pressure to target QFE.
  (3) Release mode switch IMPULS.
  (4) Disable target motion measurement (TAKT/IN 221).
  (5) Disable radar ranging (TAKT/IN 253)
  (6) Master mode ANF.
  (7) Trigger UNSAFE when reticule is on target and stable.
      This marks the target.
  (8) Pull trigger on firing signal (wings are displayed).
  (9) Pull up with 5G and evade.
 (10) Trigger SAFE and master mode NAV.
```

Note: The ARAK/AKAN AG attack profile and HUD symbology is very similar to DYK bombing.

2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions
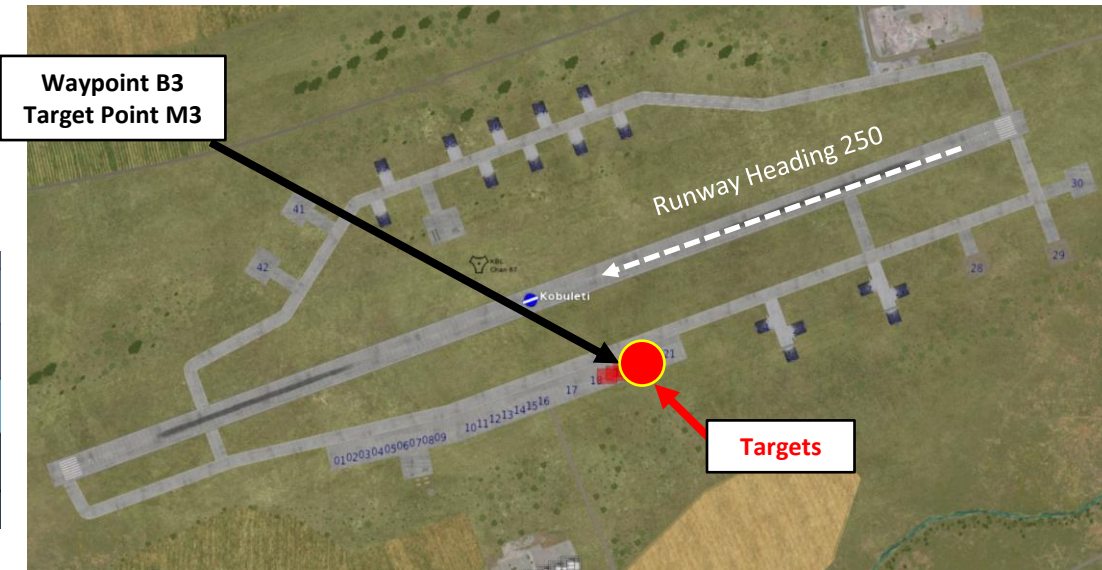
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

In the following BK-90 (*Bombkapsel* 90) Mjolnir attack tutorial, we will follow waypoints B1 and B2, and then use Target Point M3 to estimate the range to the target. **Using a waypoint is mandatory** since the BK-90 requires a reference point to release its cluster bomblets over.
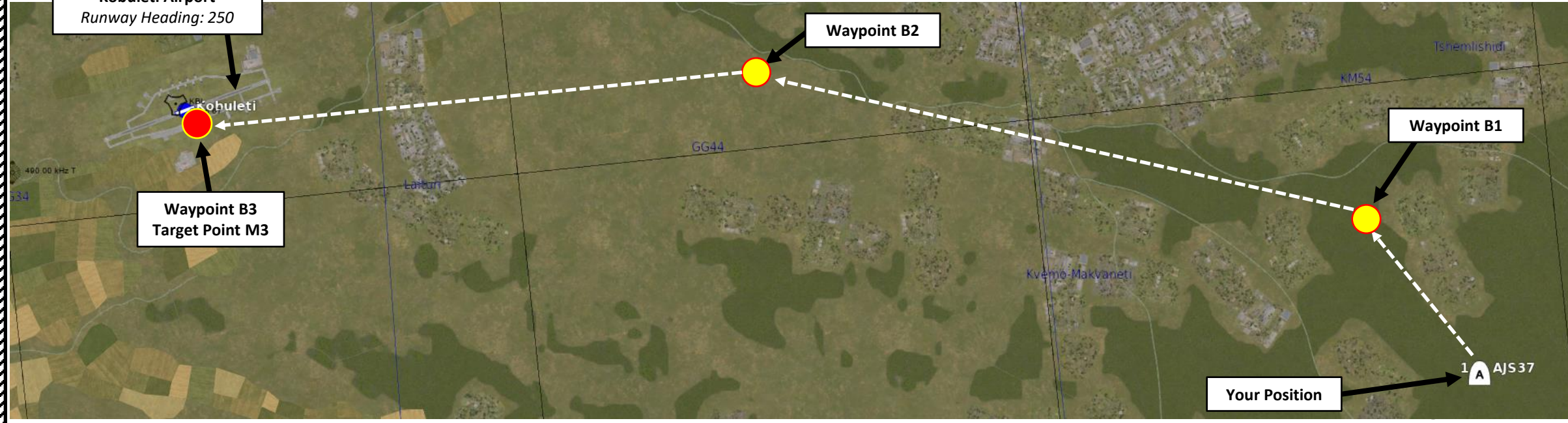
Take note that different types of submunitions can be loaded:
- **MJ1**: High explosive / fragmenting submunitions
- **MJ2**: Armor-piercing submunitions
- **MJ1-MJ2**: Mix of MJ1 and MJ2 sub-munitions

	✕ BK90 MJ1
	✕ BK90 MJ1-MJ2
	✕ BK90 MJ2
AA MISSILES ▶	⊢•⊣ RB-04E (for A.I.) with launcher
AG MISSILES ▶	⊢•⊣ RB-04E with launcher
BOMBS ▶	⌀ RB-15F (for A.I.) with launcher
PODS ▶	⌀ RB-15F with launcher
ROCKETS ▶	▥ RB-75 with launcher
	▥ RB-75B with launcher
REMOVE PAYLOAD	▥ RB-75T with launcher

Waypoint B3 Target Point M3

Runway Heading 250

Targets

Approaching the Target

Kobuleti Airport *Runway Heading: 250*

Waypoint B2

Waypoint B1

**Waypoint B3 Target Point M3**

Your Position

2 – Air-to-Ground Weapons

2.3 – BK-90 MJOLNIR Cluster Munitions

A – Planning

The attack consists of approaching the target at a speed and altitude within the BK90 release envelope. The range of the weapon is based on the release airspeed and altitude. Release is possible between Mach 0.6 – Mach 0.9 at altitudes between 50 - 500 m AGL (Above Ground Level). Once launched, the BK90 will glide with its inertial force at release (it has no propellant) and will track the target coordinates by itself and follow the flight profile programmed (approach altitude can be programmed between 50 – 500 m AGL and attack altitude is always 60 m AGL).

This technique requires a pre-planned navigation point. However, keep in mind that the barometric pressure setting should be set correctly, which requires a QFE setting value from the kneeboard, which is obtained from an existing waypoint.
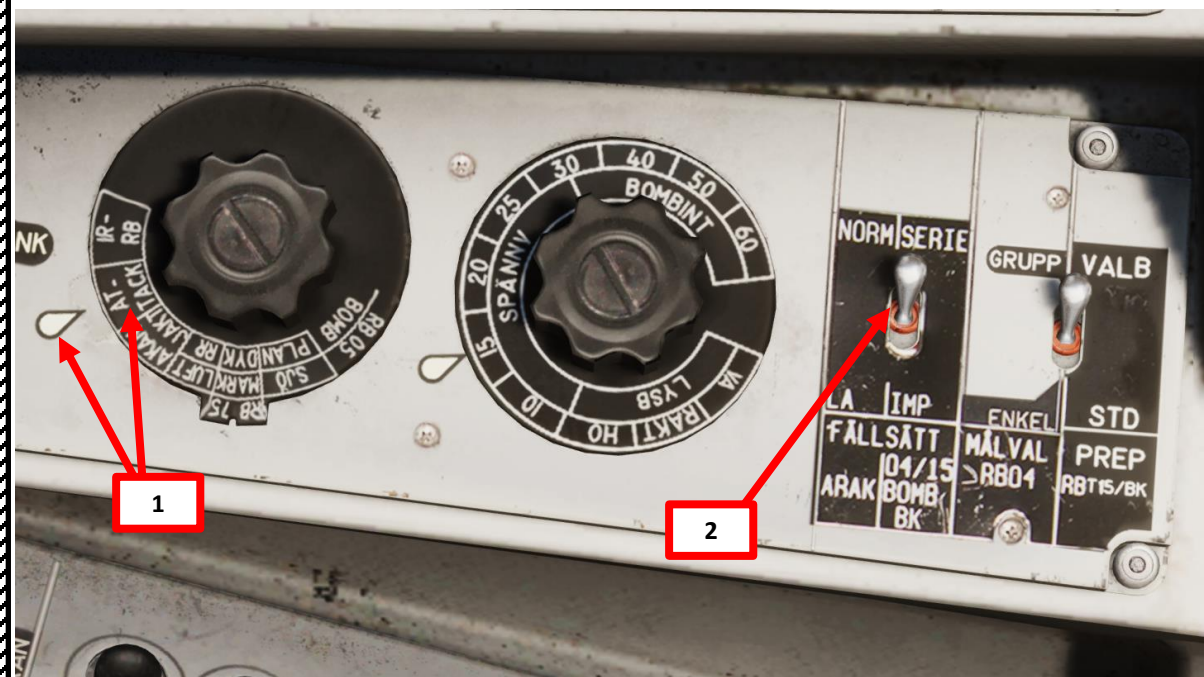

BK-90 Attack Profile

283
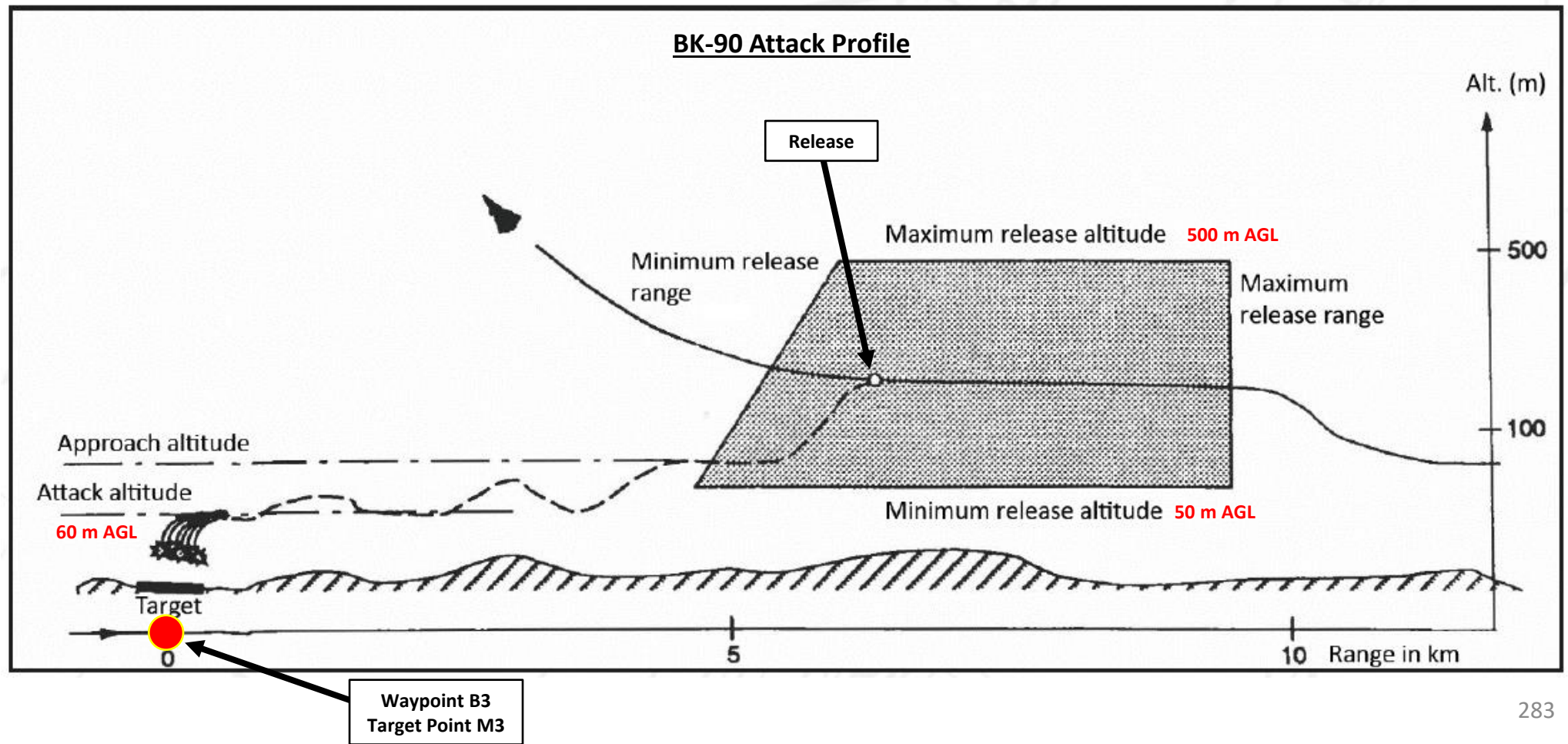
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Weapon Release Mode selector as desired:
   - SERIE (UP): Releases both BK90s per trigger press
   - IMPULSE (DOWN): Releases a single BK90 per trigger press
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

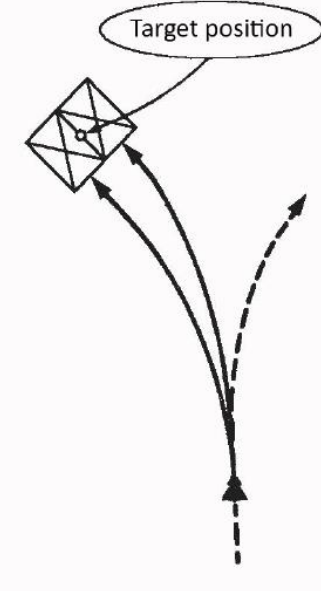| WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

2 – Air-to-Ground Weapons
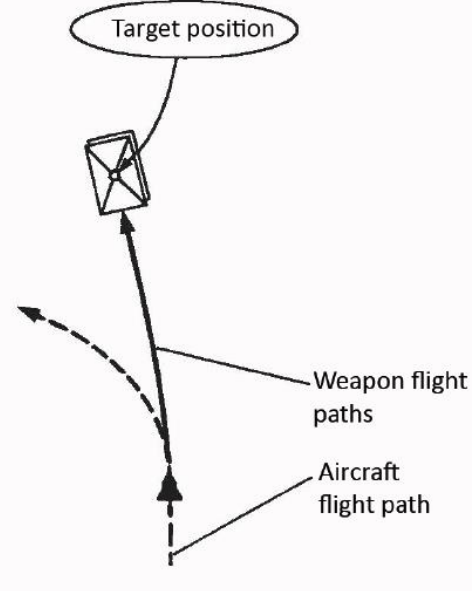## 2.3 – BK-90 MJOLNIR Cluster Munitions

B – Weapon Setup

8. Set bombing area option as desired, which should be determined from your approach direction and the layout of the targets.
   a) Set Data Selector to TAKT
   b) Set INPUT/OUTPUT Selector to IN
   c) Enter code for the desired bombing area on the keypad
      • "921000" for the Long Area option
      • "922000" for the Wide Area option
      • "923000" for the Compact Area option
   d) Press LS/SKU button
   e) Set INPUT/OUTPUT Selector to UT (Output)
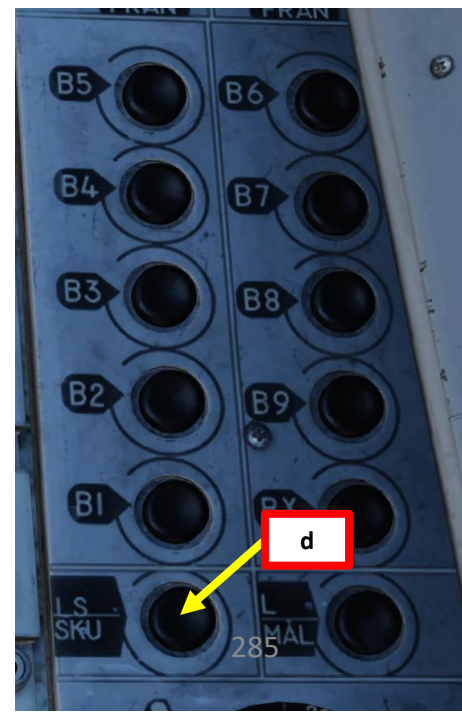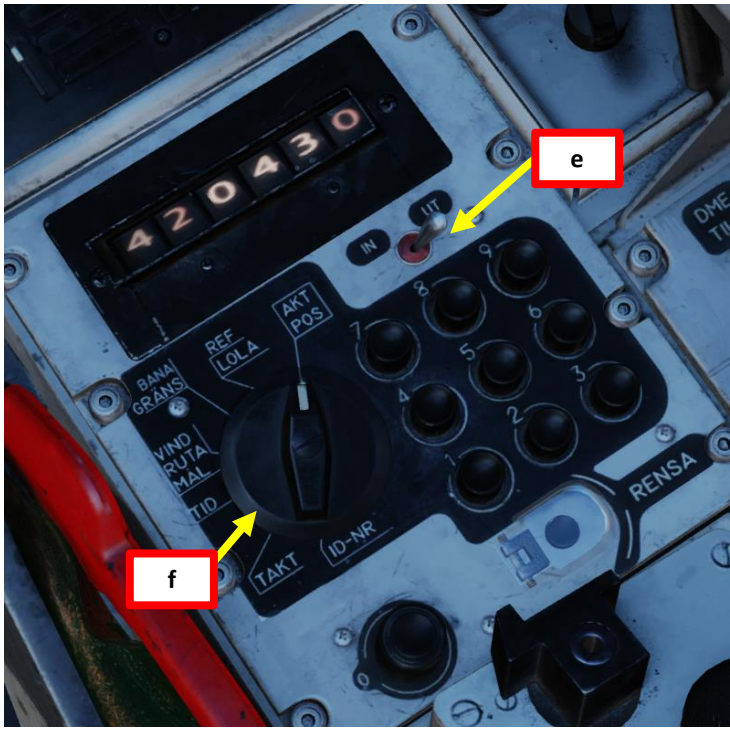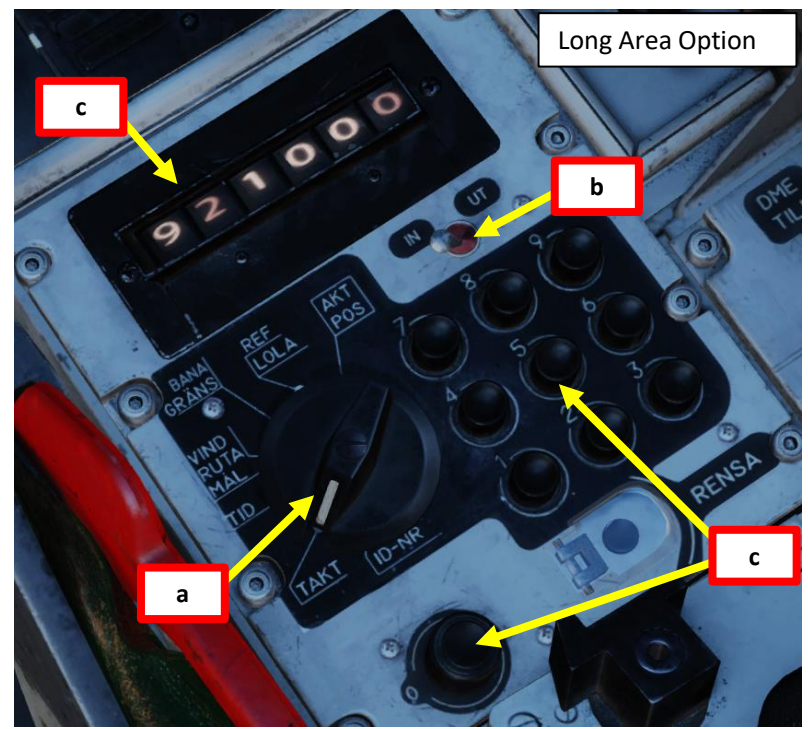   f) Set Data Selector to AKT POS (Active Position)
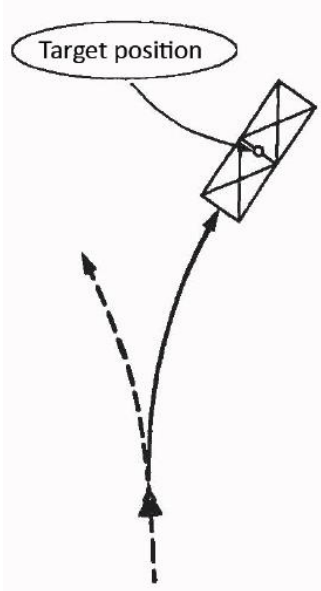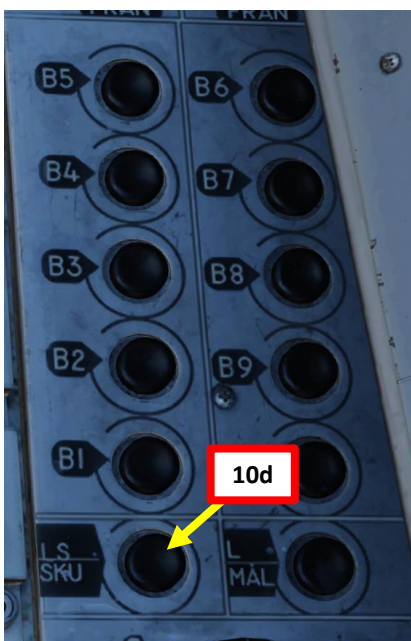

Long area   Wide area   Compact area

Target position — Weapon flight paths — Aircraft flight path
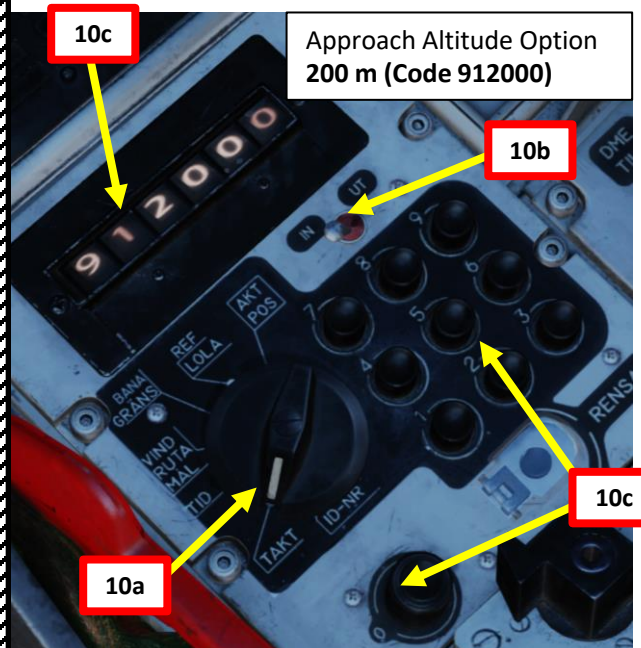

Long Area Option

2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

B – Weapon Setup

BK 90 "Mjölner"

Properties:
Tubes : 24
MJ1 : 72 HE
MJ2 : 24 AP
Weight: 605 kg

9. Set BK90 Mode Selector as desired:
   - STD (DOWN): Uses 60 m approach altitude (default)
   - VALB (UP): Uses programmable approach altitude. This is what we will use.
10. If BK90 Mode Selector is set to VALB (Selectable), program BK90 approach altitude option as desired, which should be determined from the terrain layout between the release point and the target in order to avoid the BK90 colliding with an obstacle.
    a) Set Data Selector to TAKT
    b) Set INPUT/OUTPUT Selector to IN
    c) Enter 91 address code for the desired approach altitude on the keypad, which should be between 50 m (min) and 500 m (max).
       - "91**100**0" sets **100** m
       - "91**200**0" sets **200** m
       - "91**500**0" sets **500** m
    d) Press LS/SKU button
    e) Set INPUT/OUTPUT Selector to UT (Output)
    f) Set Data Selector to AKT POS (Active Position)

> **Note: As of 2020-12-08, the approach altitude VALB setting is disabled. Use STD instead.**

9

10c

Approach Altitude Option
200 m (Code 912000)

10b

10e

10c

10a

10f

10d

Release altitude 100 m

M 0.9
M 0.8
M 0.7

Release altitude 300 m

M 0.9
M 0.8
M 0.7

286
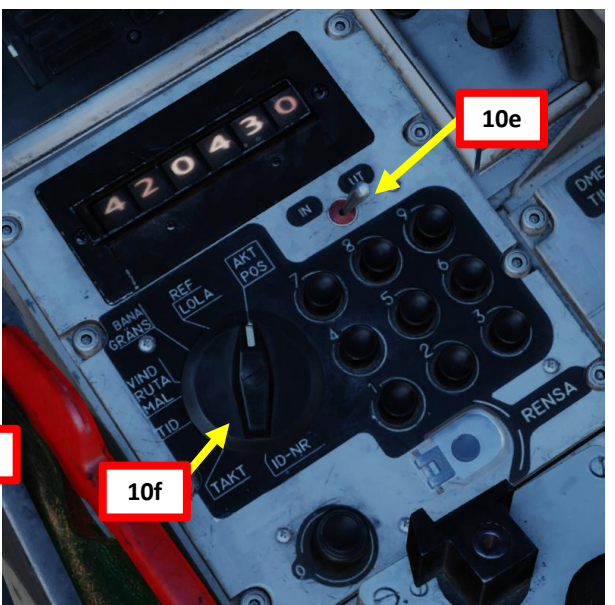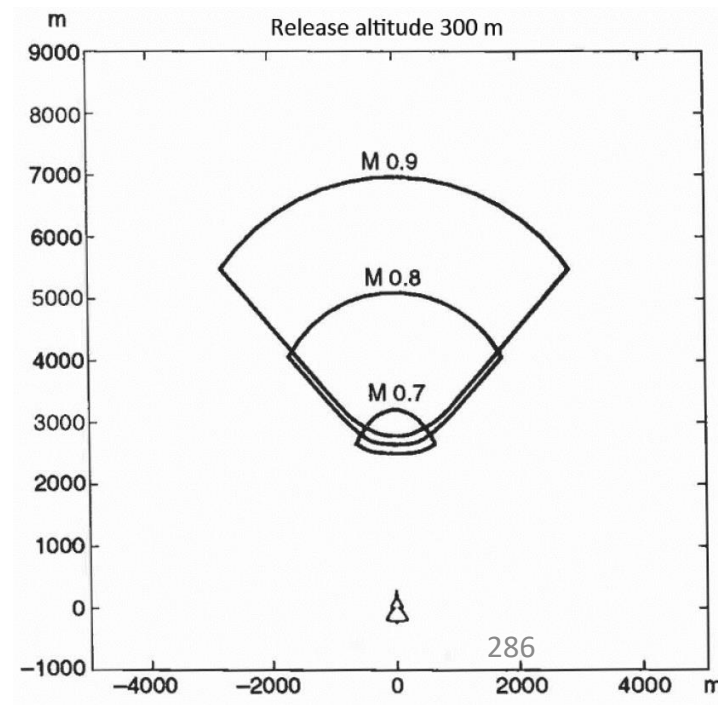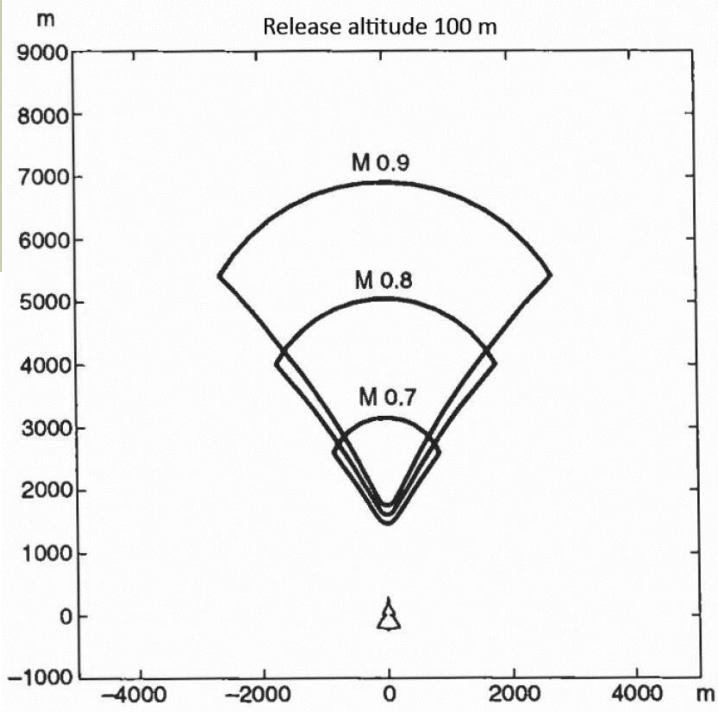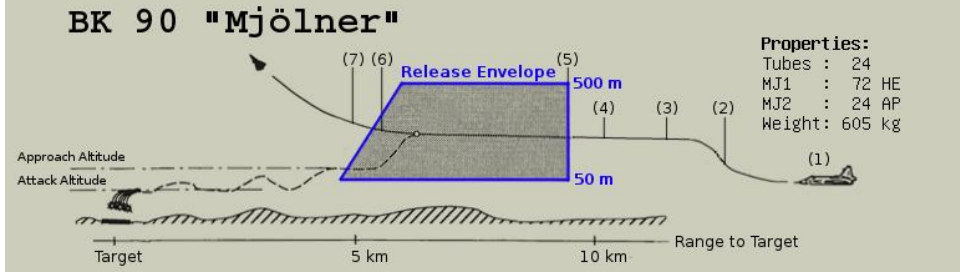
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

C – Perform Attack

11. Navigate to M3 (Target Point)
12. Set Master Mode to ANF (*Anflygning*/Attack).
13. HUD Symbology now provides symbology applicable to BK90 release cues.
14. Climb to safety altitude (slightly above the approach altitude of 200 m) and maintain airspeed between Mach 0.6 and Mach 0.9.
15. HUD marker lines indicate that the BK90 release envelope is continuously being computed.
    - Note: The kinetic energy (speed) of the weapon determines the flight envelope of the weapon as it is not self-propelled. The aircraft airspeed and altitude at the moment of release will determine the size of the weapon's flight envelope.
16. HUD flashing marker lines indicate that a course correction is required.

BK90 Release Envelope (Range / Altitude)

| 14 |

12
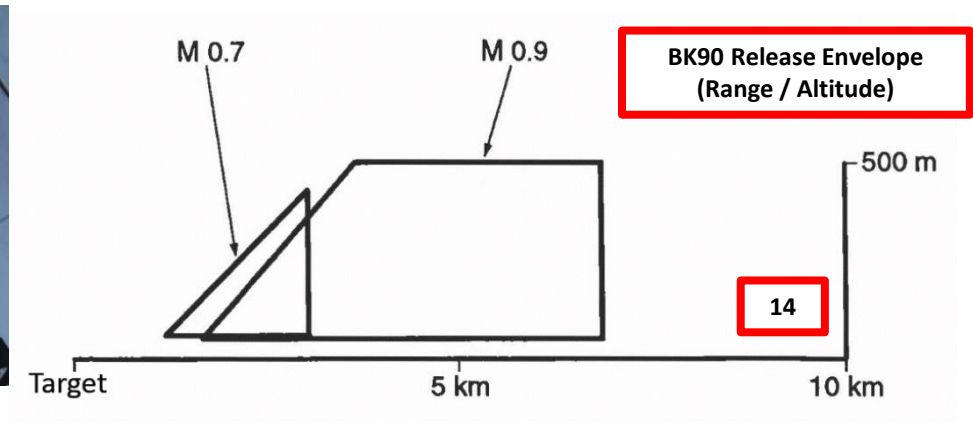
Master mode **NAV**. Weapon selector **ATTACK**.
Set target **QFE**.
(1) Release mode selector **IMPULS** (single) or **SERIE** (both).
Targeting mode selector **STD** or **VALB** for addresses 91/92.
If required, set approach alt (91XXX) and pattern (92X).

Climb to safety altitude (here **200 m**). Speed ~M **0.6–0.9**.
(2) Master mode **ANF**.
Marker lines: continuous calculation of release envelope.
Marker lines flash: course correction is required.

11

Tr REVAVDR
TRANSONIC

M 3

11

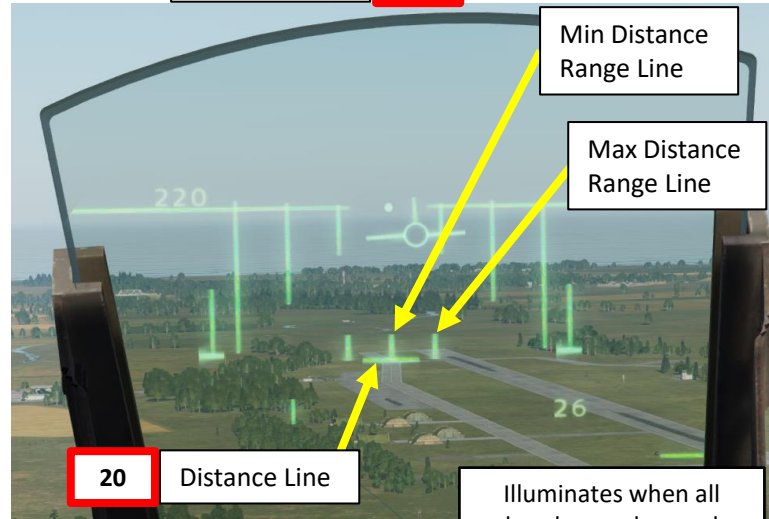Distance to Selected Waypoint (km)

Master Mode - NAV

11

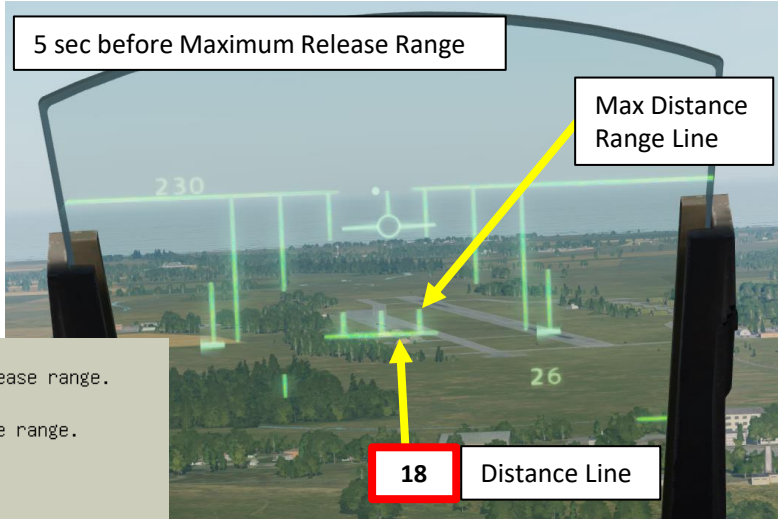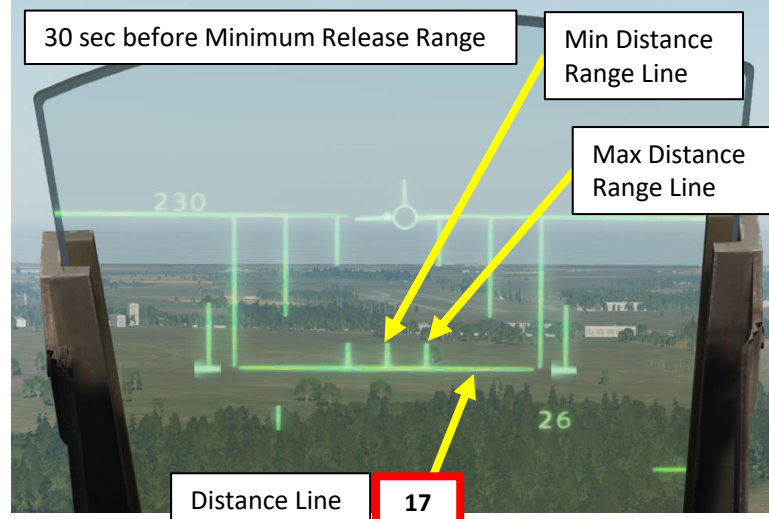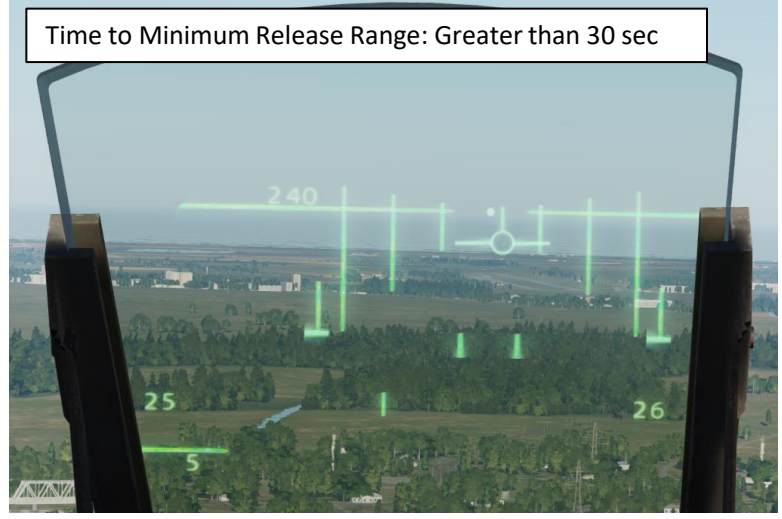Master Mode - ANF

15

Marker Lines
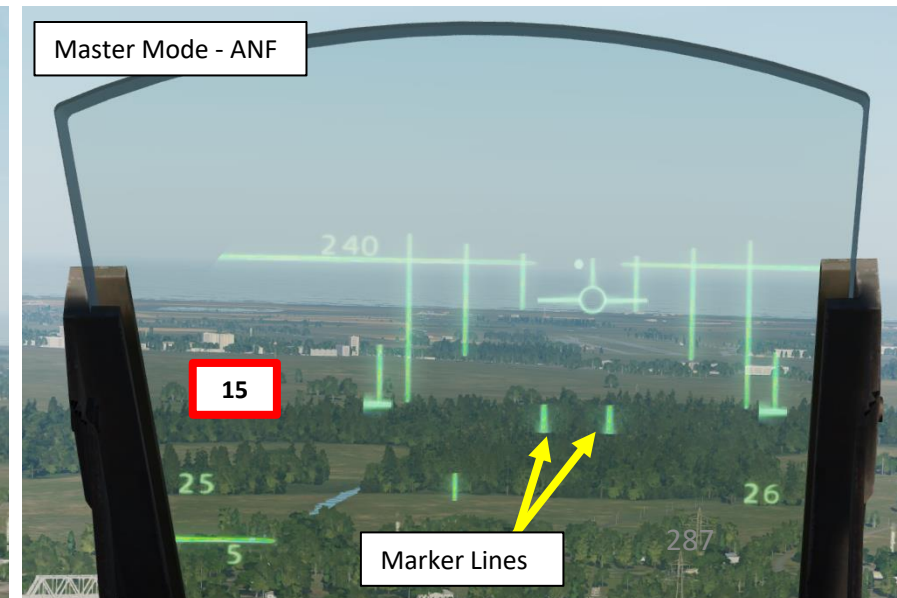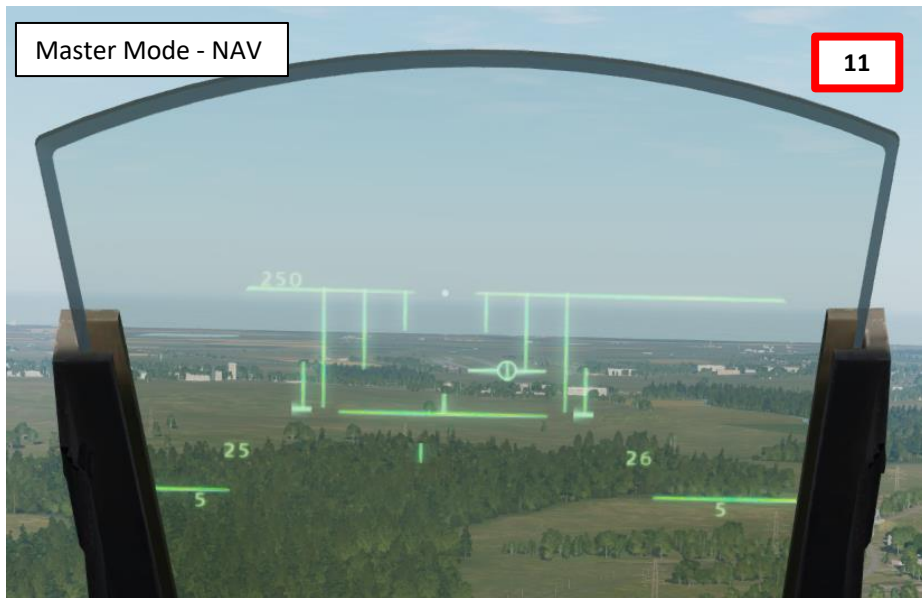
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

C – Perform Attack

17. The Distance Line (Firing Warning) appears 30 sec before the minimum release range is reached.
    - Each degree pole represents 10 seconds.
    - Outer markers indicate maximum release range
    - Inner markers indicate minimum release range
18. The Distance Line will shrink as you approach the acceptable release range.
19. When the Distance Line is on the Max Release Range marker, the time between the min and max release range is 10 seconds.
20. When Distance Line is between the Max Release Range marker and the Min Release Range marker, set Trigger to UNSAFE by clicking on the stick's safety cover.
21. Press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates.

Time to Minimum Release Range: Greater than 30 sec

30 sec before Minimum Release Range

Min Distance Range Line

Max Distance Range Line

Distance Line

17

5 sec before Maximum Release Range

Max Distance Range Line

Min Distance Range Line

Max Distance Range Line

18 Distance Line

20 Distance Line

Illuminates when all bombs are dropped

21b
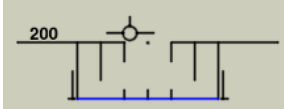
(3) Distance line appears 30 sec before minimum release range. Each degree pole represents 10 seconds. Outer and inner markers indicate max/min release range.
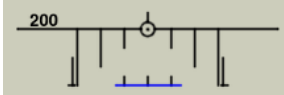
(4) Distance line indicates ~5 sec until max release range. Trigger UNSAFE.
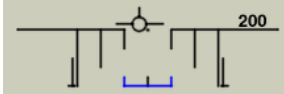
(5) Distance line on maximum release range marker. Pull and hold trigger once distance line inside markers. Time between min and max release range is 10 sec. Release trigger when FÄLLD LAST illuminates.

(6) Flashing distance line: 2 sec until min release range. Pull trigger now or break away.

Trigger SAFE

Trigger UNSAFE

20

21a
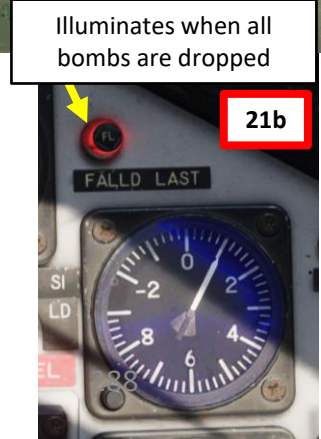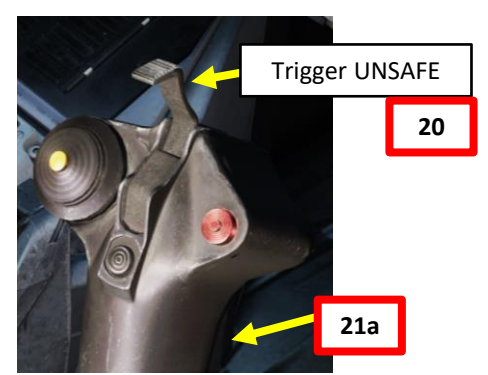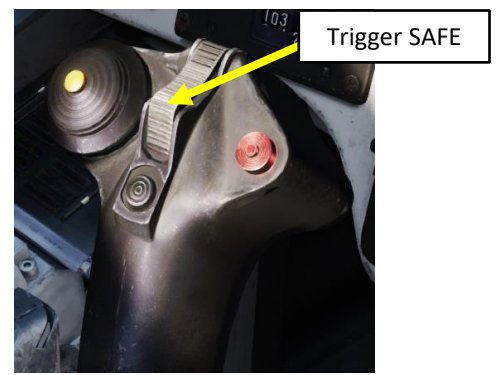
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

C – Perform Attack

22. The weapon will guide itself to the target. It will maintain the approach altitude programmed previously, then dive to the attack altitude of 60 m. When BK90 is over the target, bomblets will be released.
23. Once all BK90s are launched, pull away and evade blast radius.

30 s

t

2 s

2 s $t < 3$ s

Target movement through the weapon release envelope

Maximum release range

30 s

Minimum release range
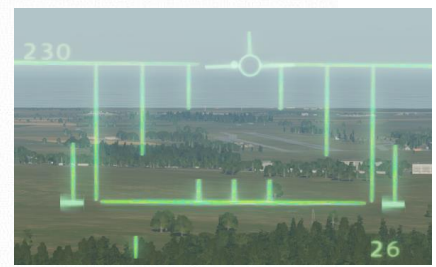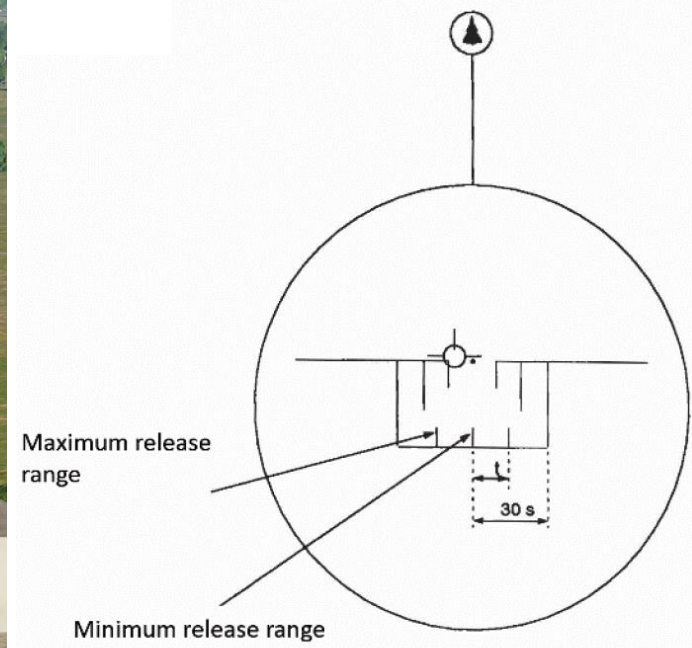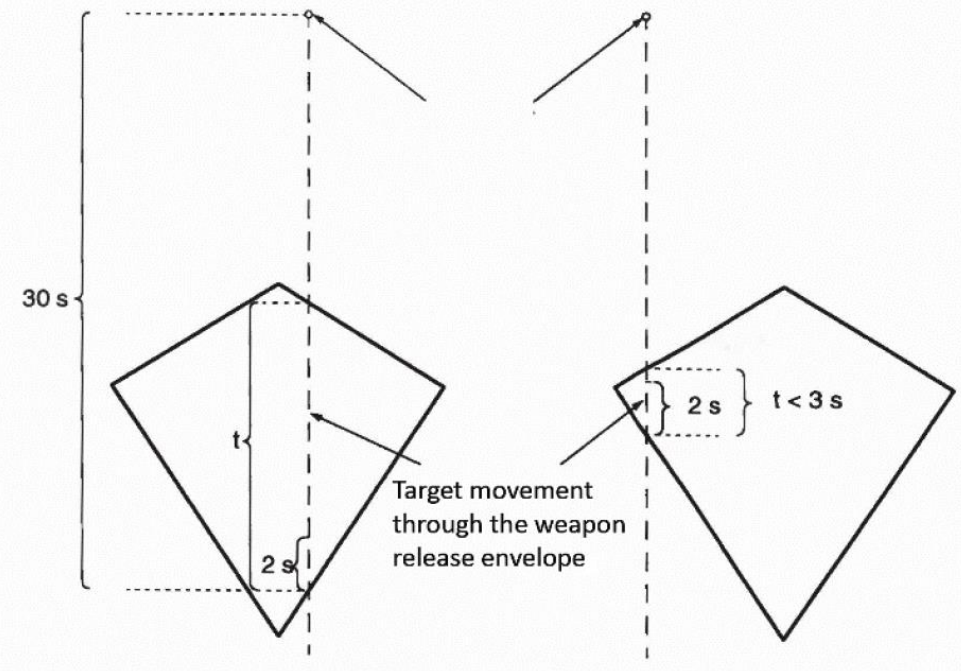
2 – Air-to-Ground Weapons
2.3 – BK-90 MJOLNIR Cluster Munitions

C – Perform Attack

24. Set Trigger to SAFE by clicking on the stick's safety cover.
25. Set Master Mode to NAV and resume flight.

Trigger SAFE

2 – Air-to-Ground Weapons
2.4 – RB-75 Air-to-Ground Missile

2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

In the following Maverick attack tutorial, we will follow waypoints B1 and B2, and then use Target Point M3 to estimate the range to the target. **Using a waypoint is not mandatory**, but it helps you positioning the aircraft in an attitude that will respect the missile's seeker limits.

xxJohnxx Tutorial for RB-75: https://www.youtube.com/watch?v=n_qSjIW8BxY&

Waypoint B3
Target Point M3

Runway Heading 250

Targets

Approaching the Target

Kobuleti Airport
Runway Heading: 250

Waypoint B2

Waypoint B1

Waypoint B3
Target Point M3
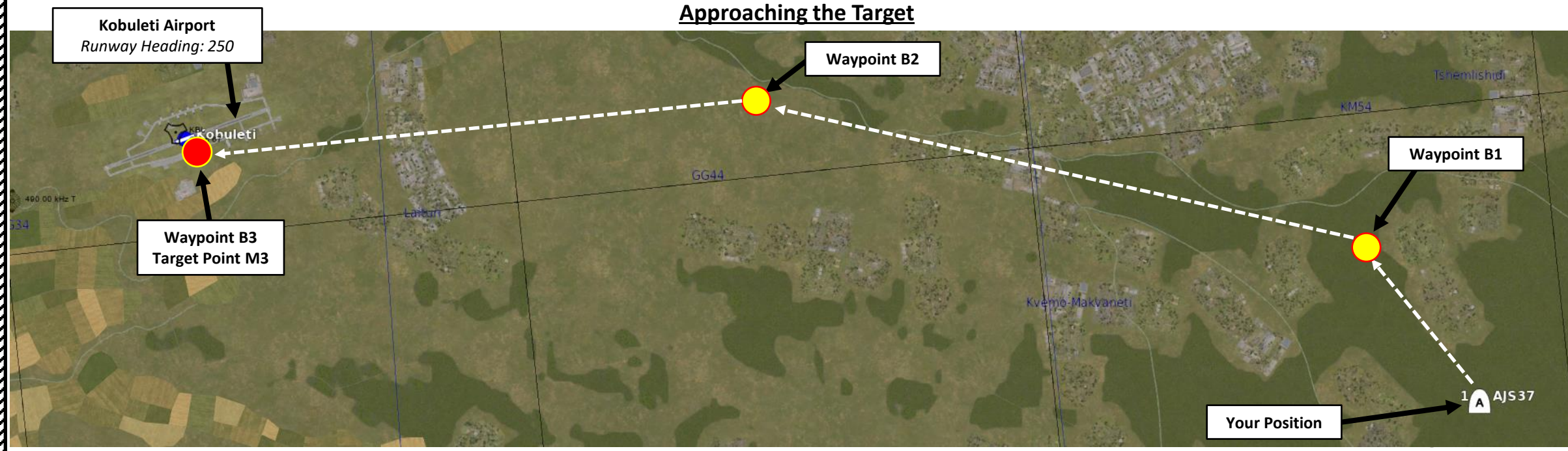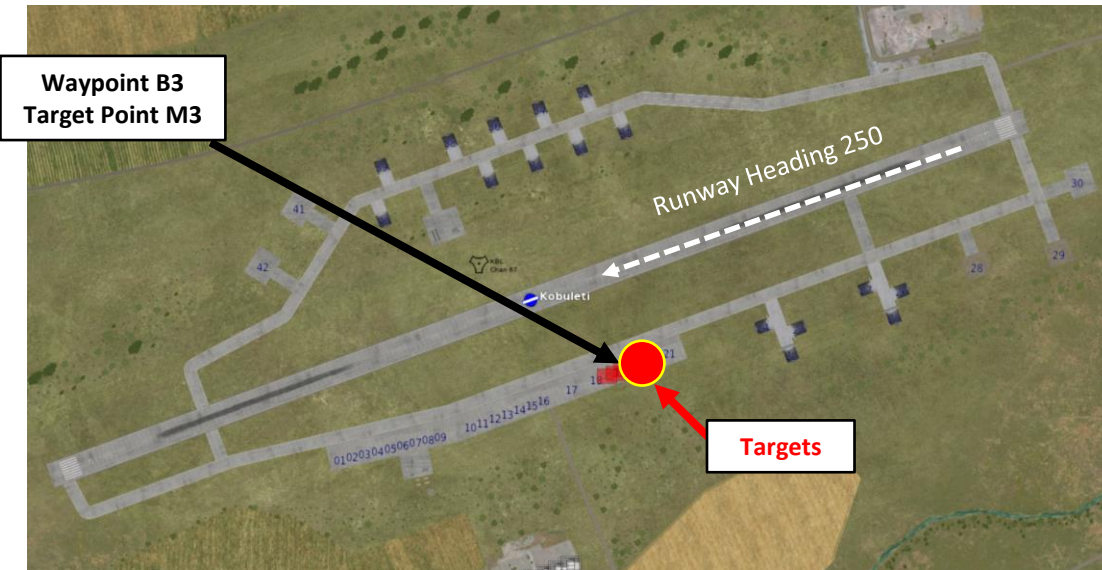
Your Position

2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

A – Weapon Setup

1. Set Weapon selector to RB75.
2. Set the HUD to the LOWER position to ensure HUD data is properly displayed during attack run.
3. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
4. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
5. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
6. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME			
M3			
COURSE (T)	HEADING (M)	G/S	IAS
256	263	630	621
DISTANCE	TOF	ETA	QFE
11.6	00:01:06	07:32:24	1031.1
ALTITUDE	VERTICAL ANGLE	FUEL RESERVE	BINGO FUEL
18	-1	118	73

293
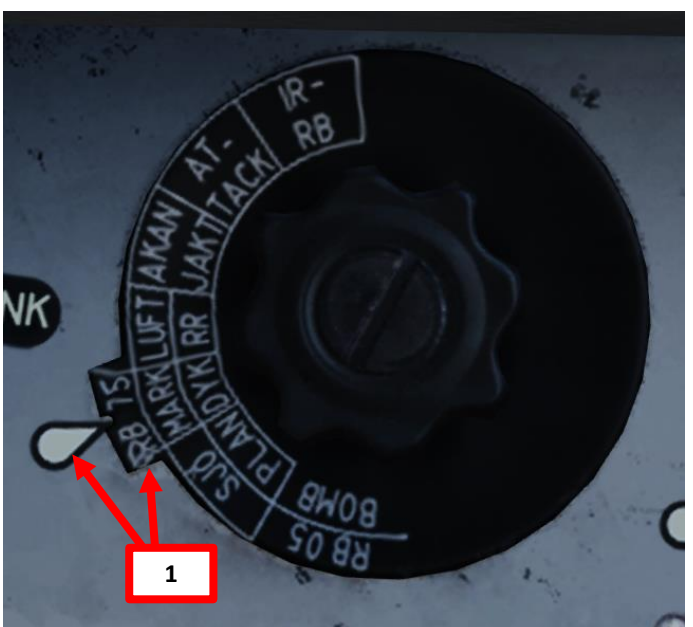
2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

B – Lock Target

7. Set Data Selector to AKT POS - OUTPUT.
8. Navigate to M3 (Target Point)
9. Set Master Mode to ANF (*Anflygning*/Attack).
10. HUD Symbology now provides symbology applicable to RB-75 release cues such as the TIR (Target Indicator Ring), which appears on the target.
11. When you are about 15 km to target, set the trigger to UNSAFE by clicking on the stick's safety cover.

Trigger SAFE

Trigger UNSAFE

Distance to Selected Waypoint (km)

8

9

7b

TIR (Target Indicator Ring)

Reticle Dot (Missile Boresight)

780

7a
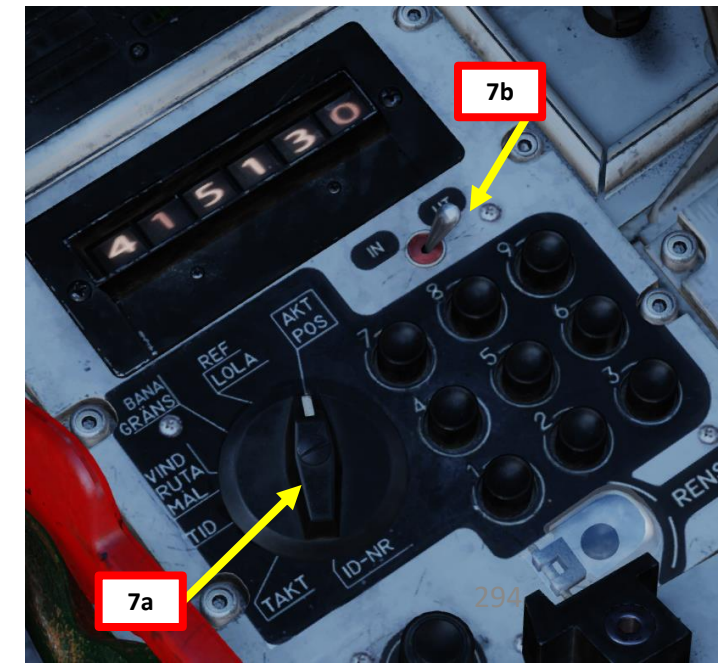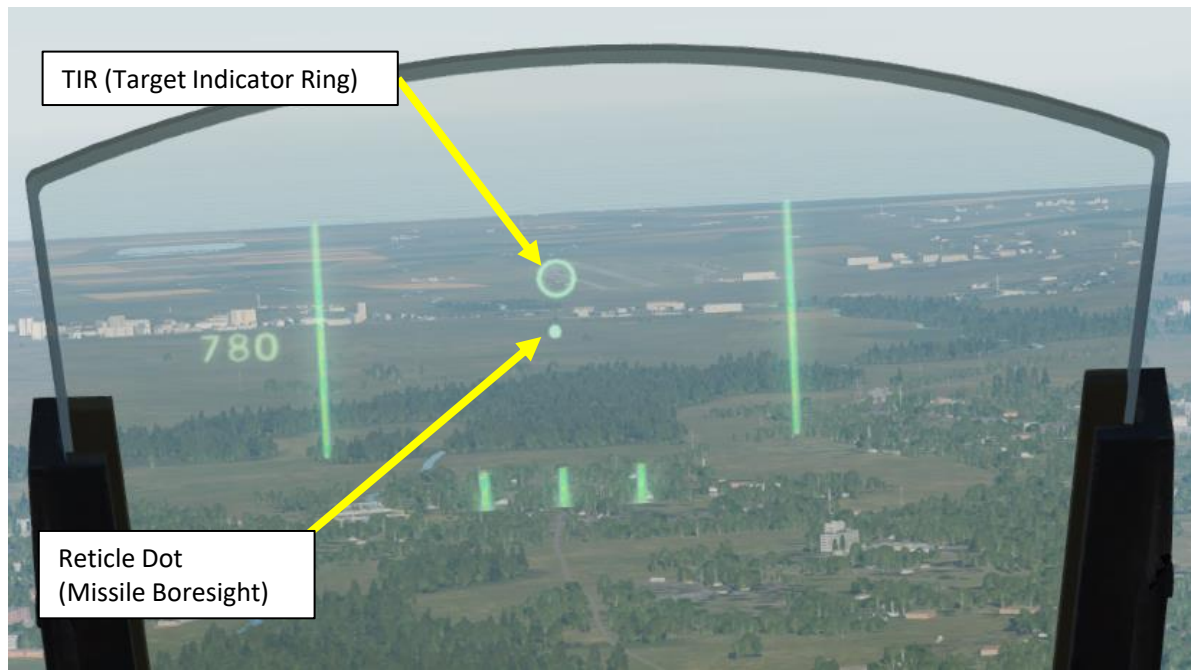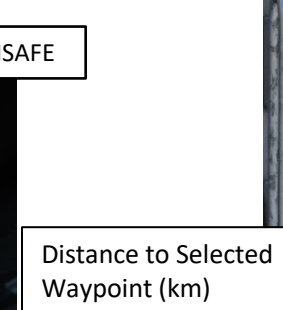
```
(3) Master mode selector ANF. HUD symbology changes:
    - Target ring indicator appears on target waypoint.
    - Distance line indicates distance to target.
    - Outer markers indicate max release range.
```

200

2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

B – Lock Target

12. Select desired EP13 Collimator Display Mode using the A0/A1/A2 Mode Selector Switch.
    - A0 (FWD) – Black on White
    - A1 (MIDDLE) – White on Black
    - A2 (AFT) – Automatic Selection

Radar Mode Selector
- A0: Black On White
- A1: White On Black
- A2: Automatic Selection

EP-13 Collimated Sight
A1 – White on Black

EP-13 Collimated Sight
A0 – Black on White
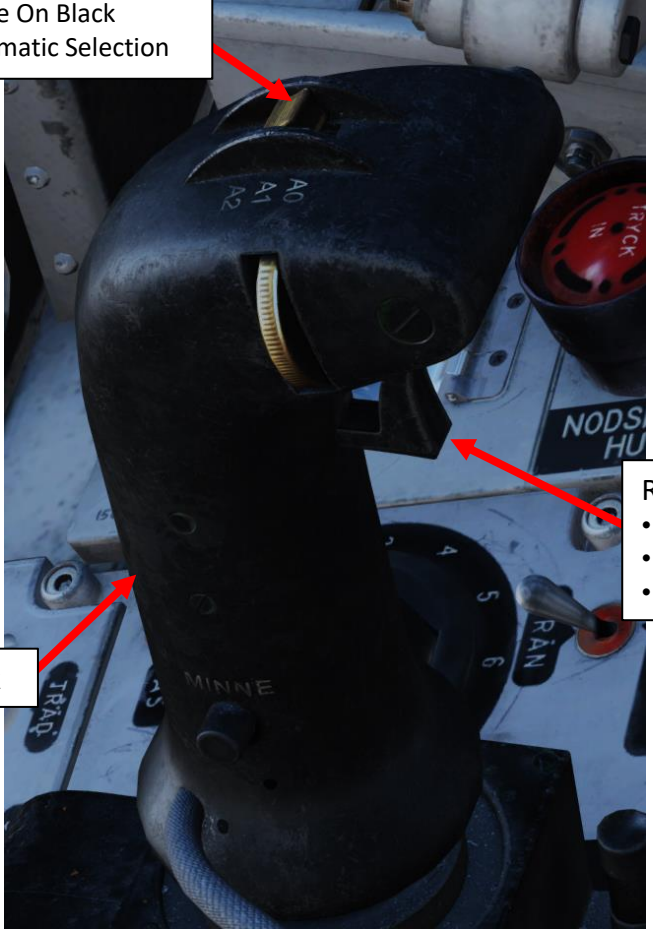
Radar Fix Trigger
- T0: Neutral – Missile is Boresighted
- T1: First trigger detent – Missile Seeker is Slewable
- TV: Second trigger detent – Missile Lock

Radar Stick
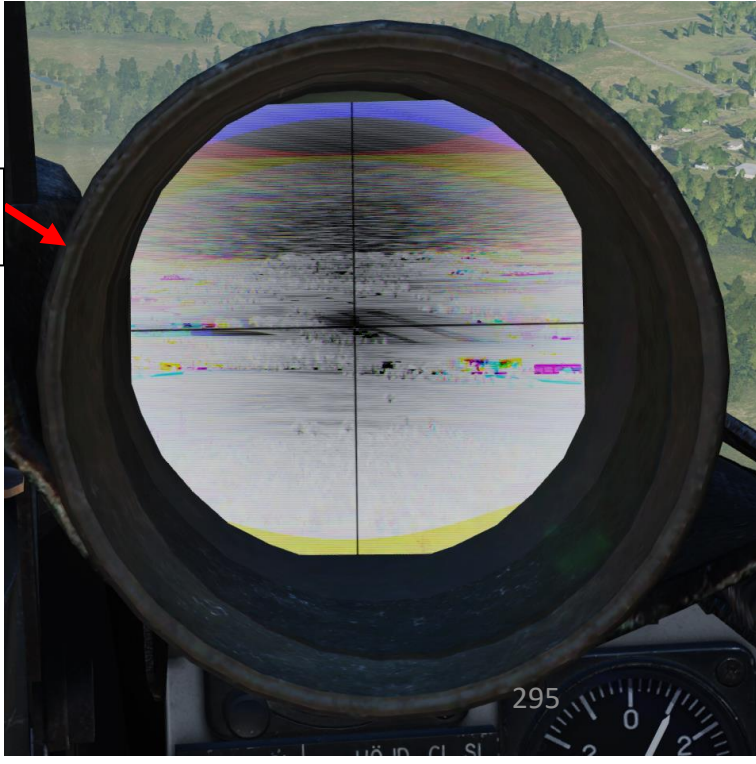
2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

B – Lock Target

13. It is possible that the EP13 Collimated Sight is too bright for your current setting. Adjust Collimated Sight contrast (Kontrast) and brightness (Ljusstyrka) as required by using the "EP13 Brightness DOWN/UP" and "EP13 Contrast DOWN/UP" bindings.
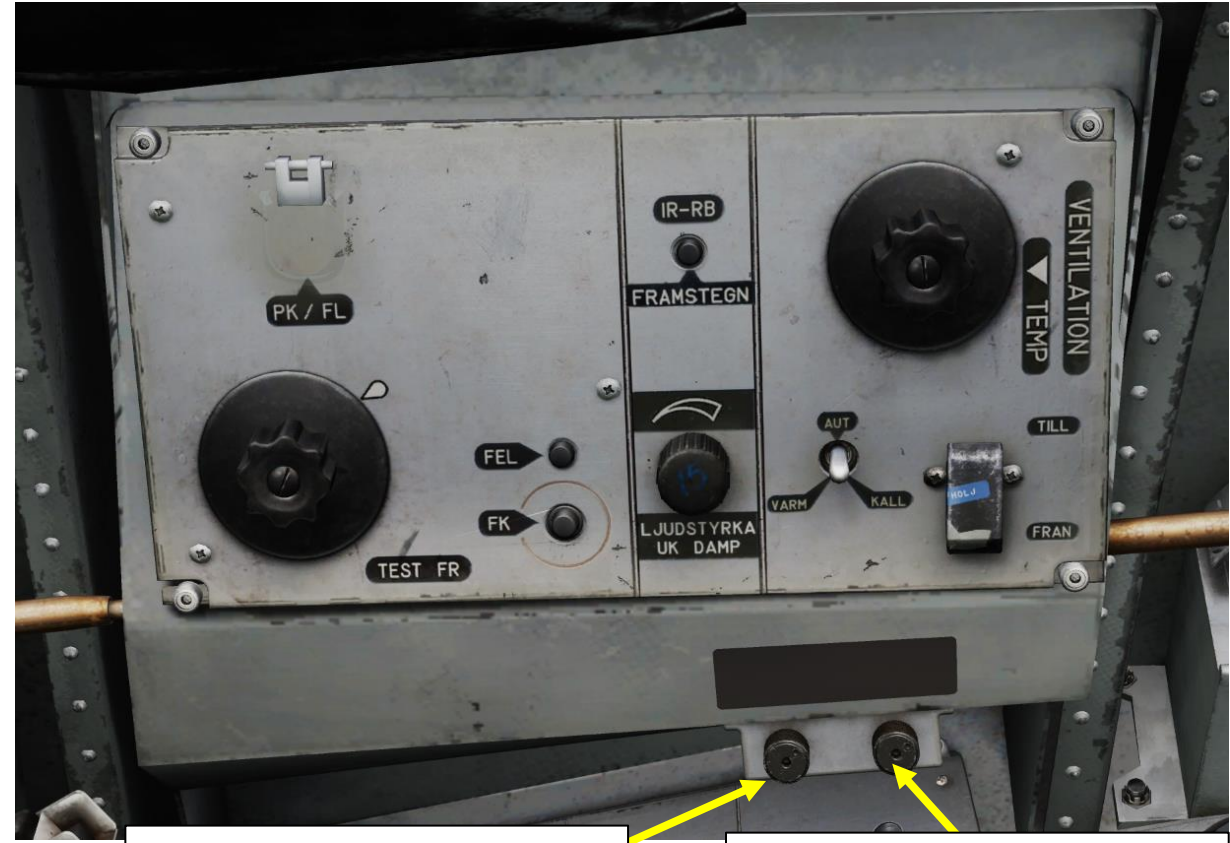
EP13 Collimated Sight Contrast Control (*Kontrast*)

EP13 Collimated Sight Brightness Control (*Ljusstyrka*)

2 – Air-to-Ground Weapons

2.4 – RB-75 Air-to-Ground Missile

B – Lock Target

14. Set T0 (Trigger Neutral) to boresight the missile.
15. Steer the aircraft to align the dot reticle on the target area, shown by the TIR (Target Indicator Ring) on the HUD. The steering dot is roughly lined up with the missile boresight.
16. Press T1 (Trigger First Detent) to make the missile slewable on the EP-13 Collimated Sight.
17. Move missile crosshair over target using the "Radarstick Up/Down/Left/Right" controls mapped to your stick
18. Press TV (Trigger Second Detent) to lock the missile seeker head on the target. If you lock something by mistake, set T0 (Trigger Neutral) and restart lock process.

Reticle Dot Aligned with TIR **15**

Targets

Missile Crosshair (Boresighted) **15**

Radar Stick **17**

Launchable within a 15° cone
5° field of view
Slewable within a 30° cone
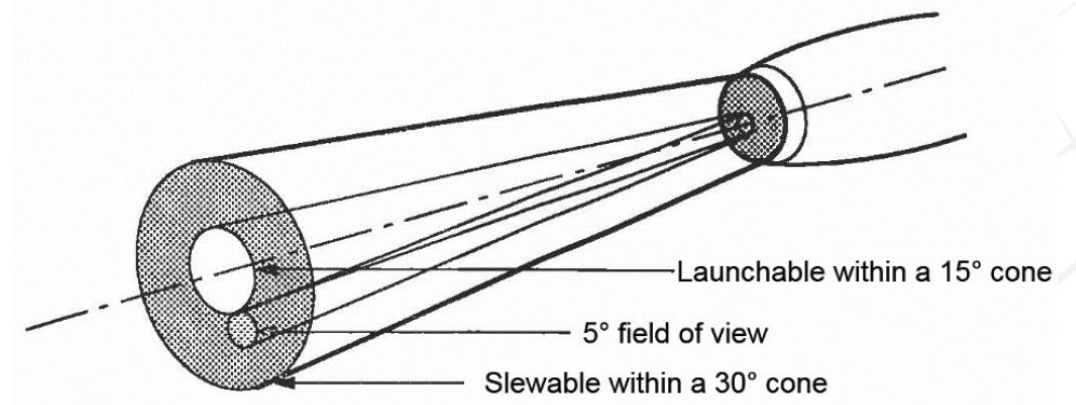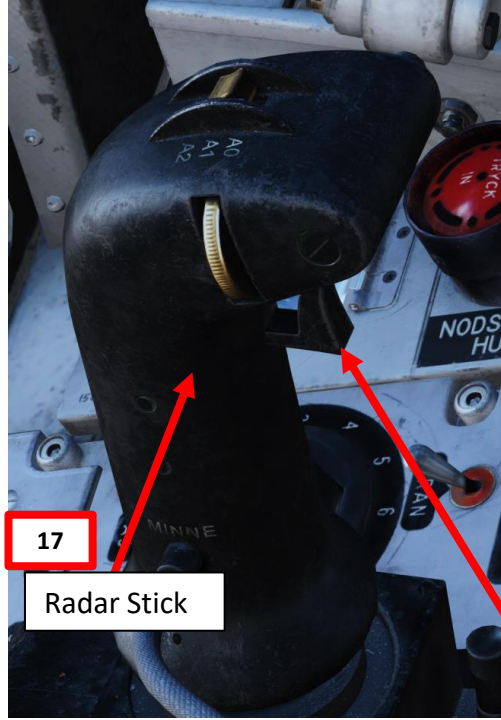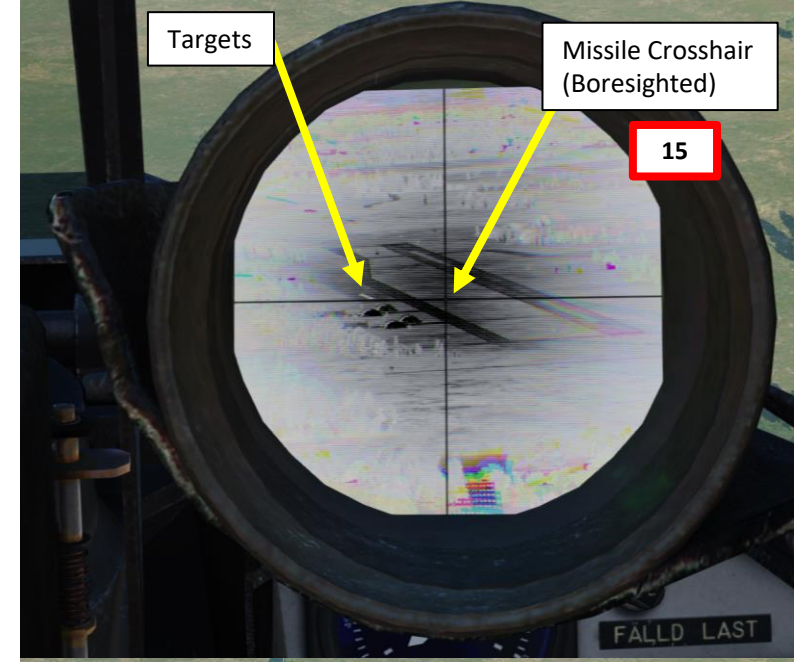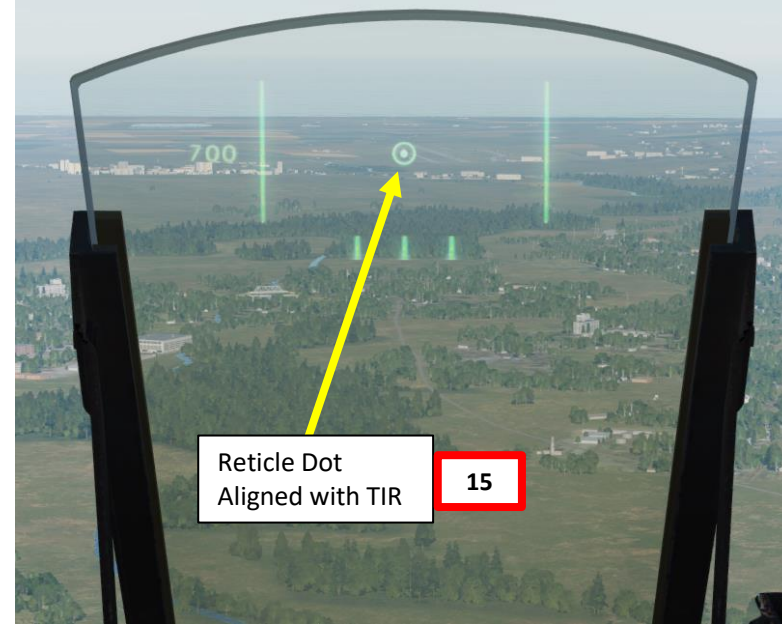
The missile has a field of view of 5° and a total slewable cone of 30°. The missile can be fired within a cone of 15° from the center.

Radar Fix Trigger
- T0: Neutral – Missile is Boresighted **14**
- T1: First trigger detent – Missile Seeker is Slewable **16**
- TV: Second trigger detent – Missile Lock **18**

Missile Crosshair (Slewed, and Locked on Target) **17**
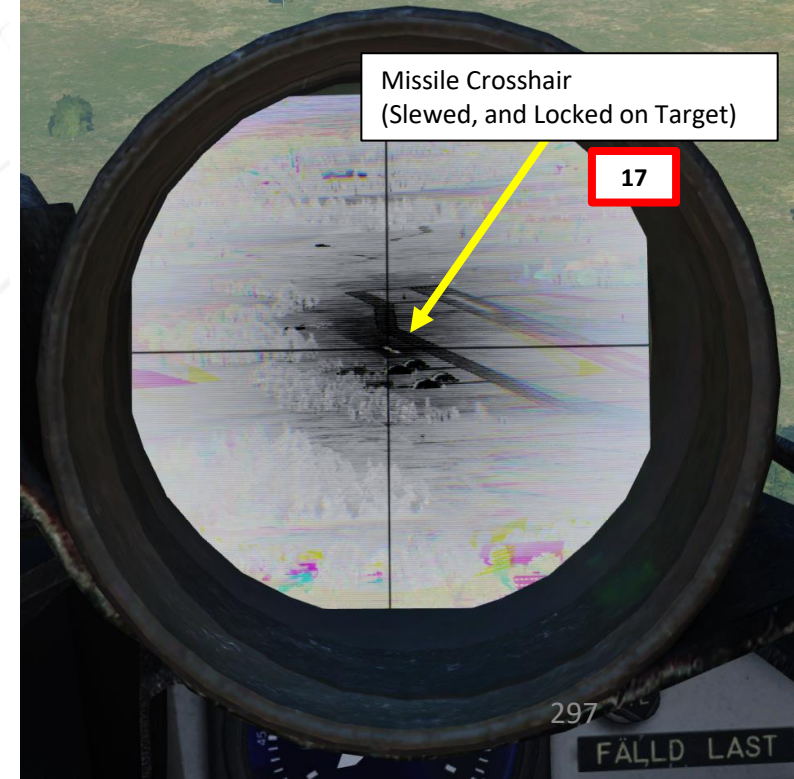
2 – Air-to-Ground Weapons
2.4 – RB-75 Air-to-Ground Missile

C – Perform Attack

19. Once target is locked by the RB-75 seeker head, press the Weapon Release trigger to fire the missile.

19

Target (Locked)

Missile Crosshair
(Slewed, and Locked on Target)
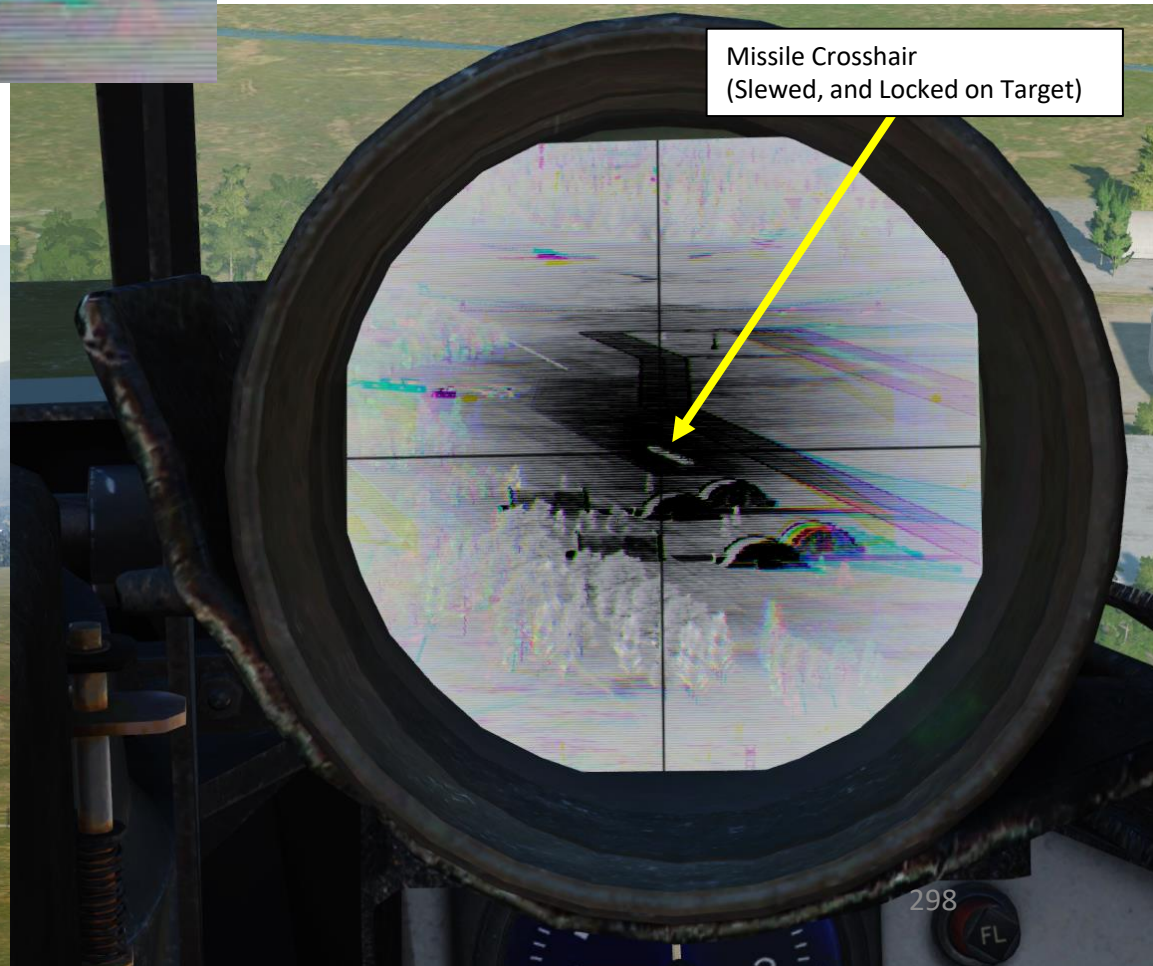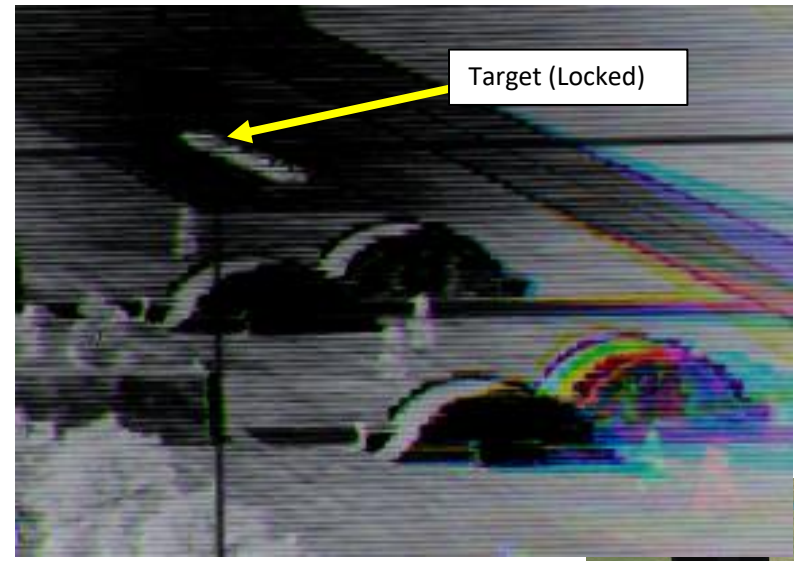
2 – Air-to-Ground Weapons
2.4 – RB-75 Air-to-Ground Missile

C – Perform Attack

20. Once RB-75 missile is fired, pull away and evade blast radius.
21. Set Trigger to SAFE by clicking on the stick's safety cover.
22. Set Master Mode to NAV and resume flight.

- Note: Next missile is selected by setting the trigger from UNSAFE to SAFE or by pressing the IR-RB FRAMSTEGNING button.
- Note 2: When selecting a new missile, don't forget to Set T0 (Trigger Neutral) to boresight the missile.
- Note 3: Missile can be used in NAV master Mode. Activation is performed by setting trigger to UNSAFE.
- Note 4: Actual RB-75 lock range depends on target size and weather conditions.
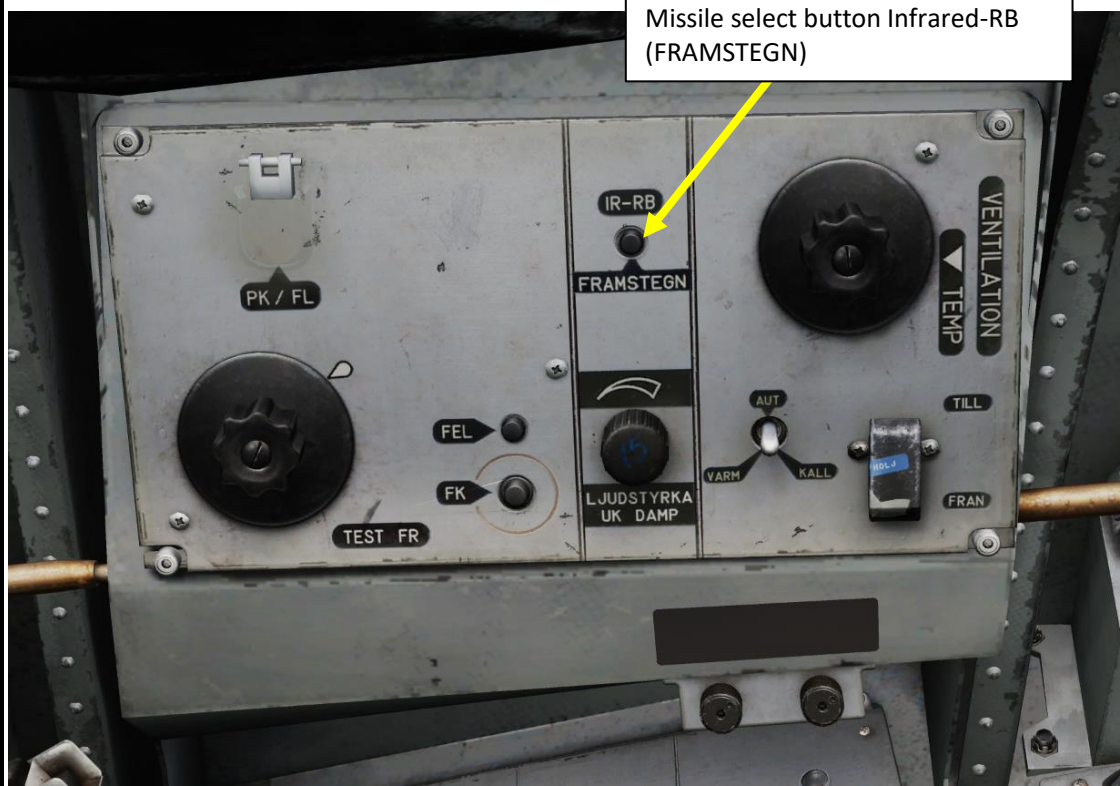
Missile select button Infrared-RB (FRAMSTEGN)

2 – Air-to-Ground Weapons
2.5 – RB-05A Remote-Controlled Missile

2 – Air-to-Ground Weapons
2.5 – RB-05A Remote-Controlled Missile

In the following rocket attack tutorial, we will fly towards the Target Point M3 and use it as a reference point to know when to launch the missile since it has a limited range.

Approaching the Target

Your Position

1 A AJS 37

Waypoint B1

Waypoint B2

Oil rig

Waypoint B3
Target Point M3
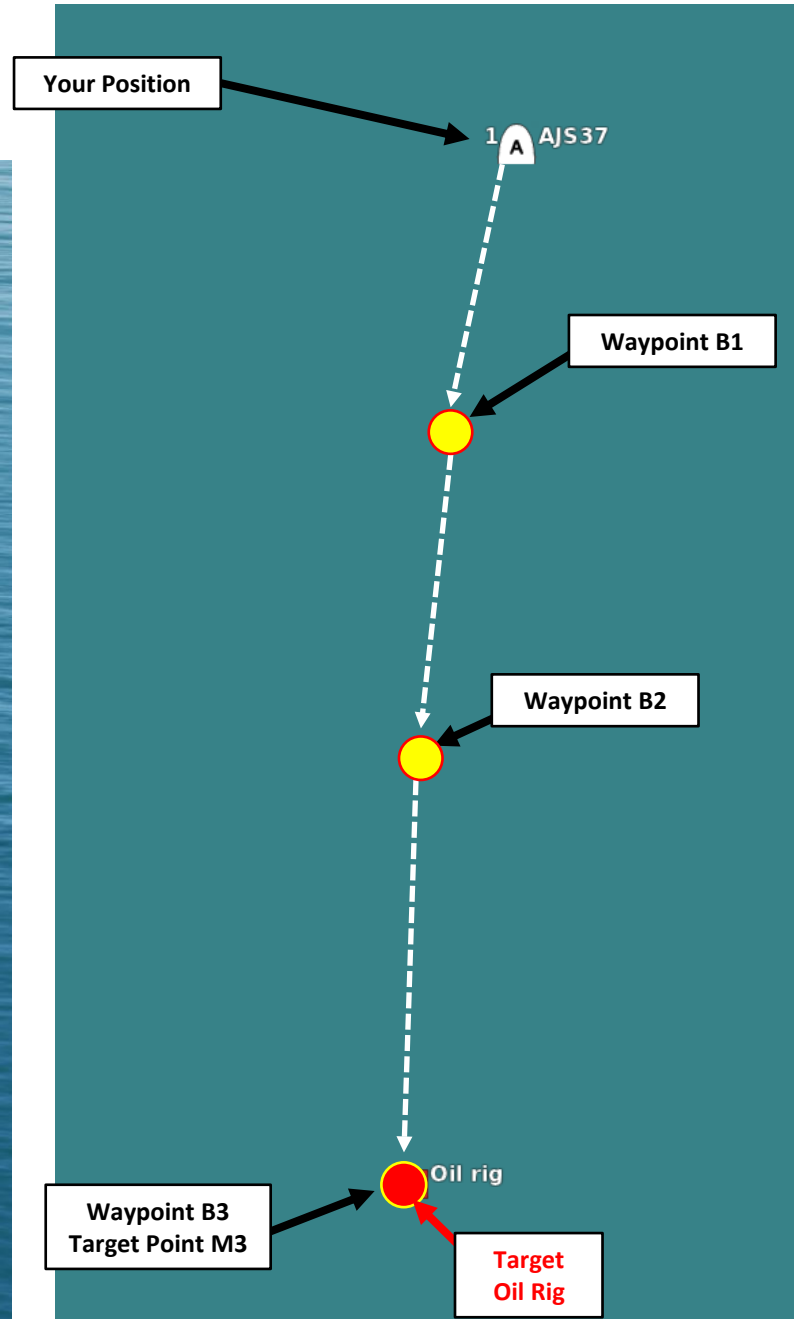
Target
Oil Rig

2 – Air-to-Ground Weapons

2.5 – RB-05A Remote-Controlled Missile

A – Weapon Setup

1. Set Weapon selector as required:
   - **RB05 MARK**: Suited for ground targets, missile detonates just before impact.
   - **RB05 SJÖ** (Sea): Suited for naval targets, missile detonates on impact with a small delay.
   - **RB05 LUFT**: Suited for aerial targets. Missile will detonate within 6 meters of an aircraft.
2. Fly towards the target and engage autopilot ATT (Attitude Hold) or HÖJD (Altitude Hold) if desired.
3. Set Master Mode Selector to ANF (Anflygning/Attack). HUD Symbology will not change compared to NAV Master Mode.

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2 – Air-to-Ground Weapons

2.5 – RB-05A Remote-Controlled Missile

B – *Perform Attack*

4. Fly towards Target Point M3 and consult the Distance Indicator to estimate the range to the target.
5. Once you are within 10 km of the target, you may fire the missile and guide it. It is important to be within this range since the battery on the missile only lasts 40 seconds once the trigger is set to UNSAFE.
6. Set Trigger to UNSAFE by clicking on the stick's safety cover.
7. After the trigger is set to unsafe, the missile activates its battery. The missile has to be fired within 40 seconds or the missile will be unusable.
8. Press the Weapon Release trigger to fire the missile.

Distance to Selected Waypoint (km)

4

4

Target

Trigger SAFE   **6**

Trigger UNSAFE

8
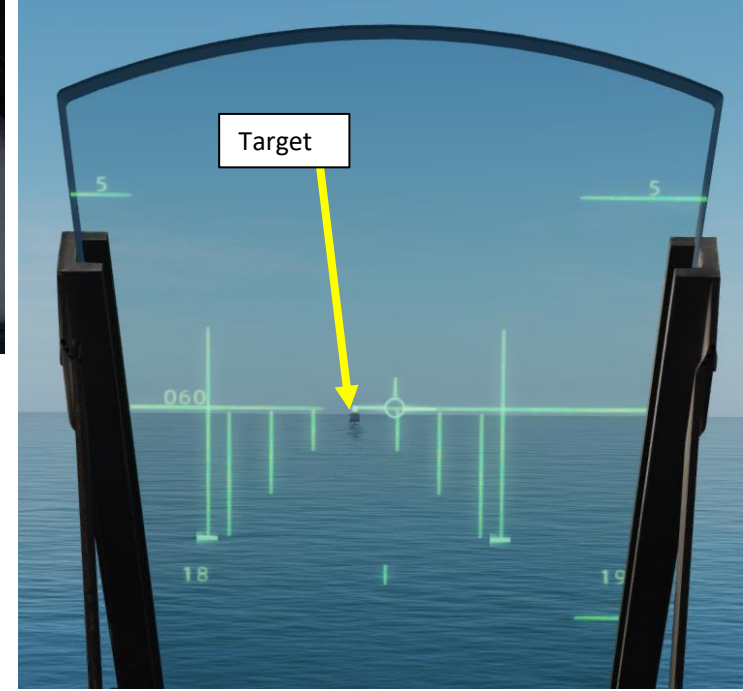
2 – Air-to-Ground Weapons
2.5 – RB-05A Remote-Controlled Missile

B – Perform Attack

9. Once missile is fired, steer the missile remotely using the "RB 05 Stick Pitch Up/Pitch Down/Yaw Left/Yaw Right" controls. You have to look at the smoke trail and missile flare to estimate its trajectory visually.
10. Once missile impacts the target, pull away and evade blast radius.
11. Set Trigger to SAFE by clicking on the stick's safety cover.
12. Set Master Mode to NAV and resume flight.

Missile Flare

9

Missile Flare

Target
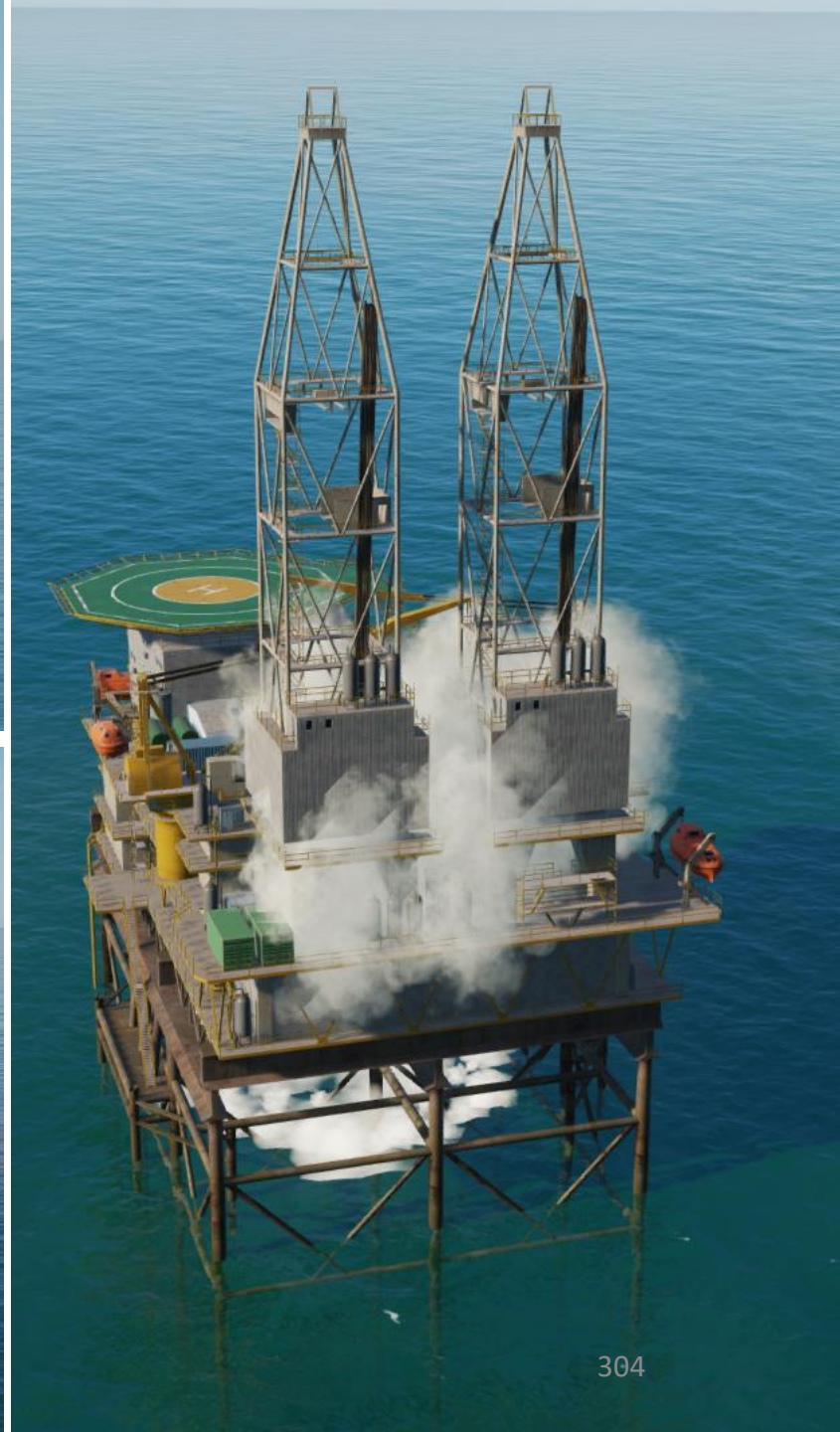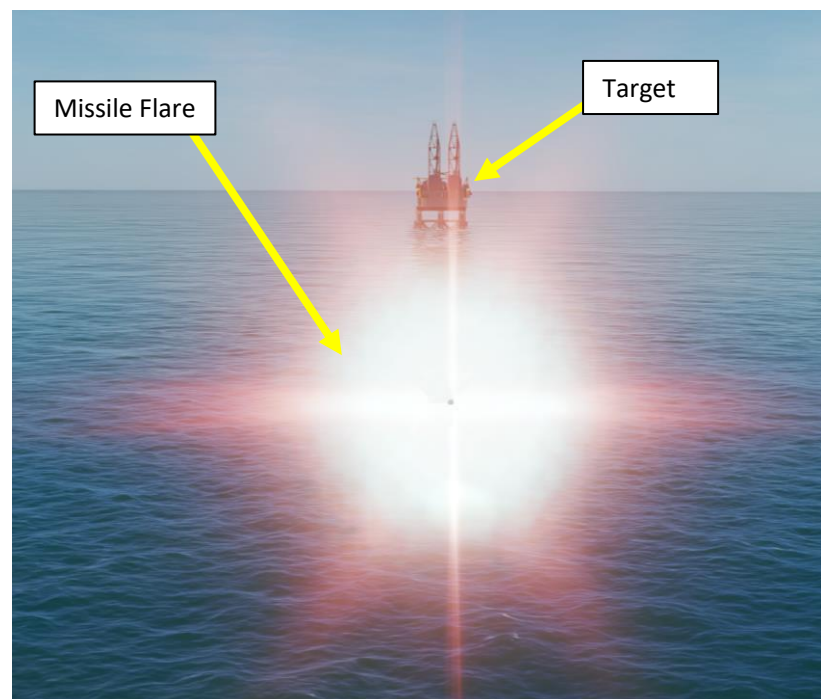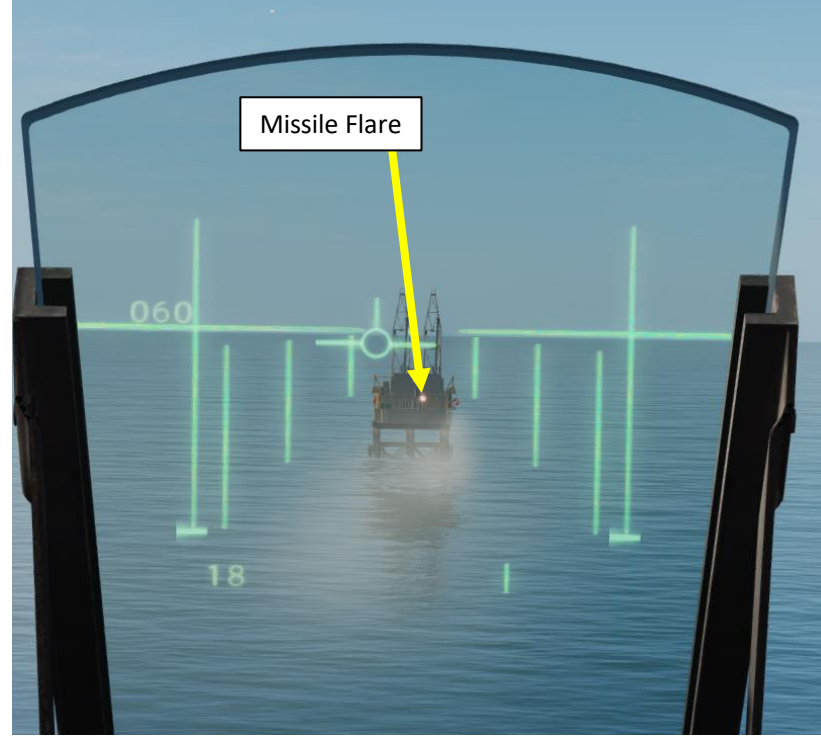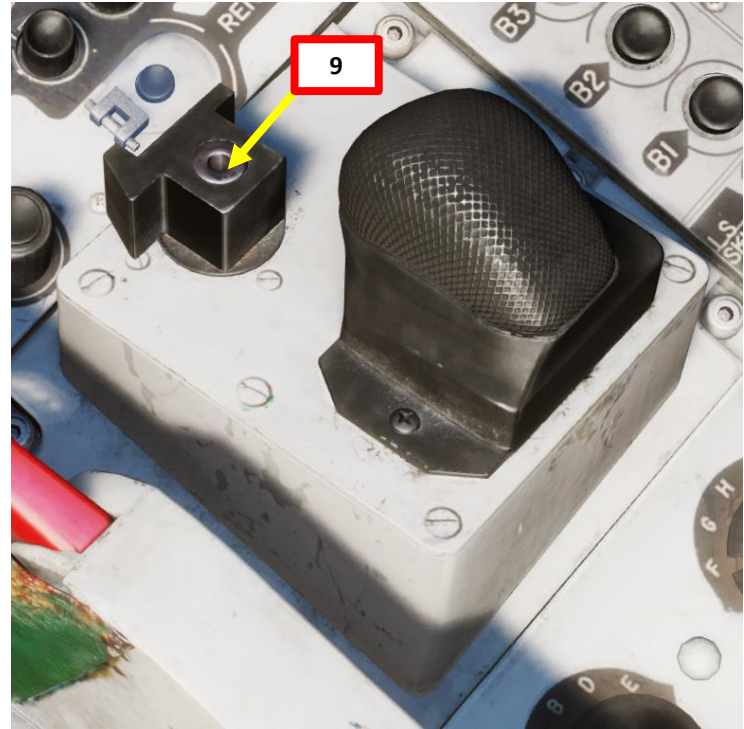
2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)

2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

In the following rocket attack tutorial, we will use the following approach:

- **First segment**: We will follow waypoints B1 and B2 by maintaining a radar altitude of 50 m AGL (Above Ground Level)
- **Second segment**: Using a pop-up point is by no means mandatory, but since we know the targets are lined up parallel to the runway heading, we can use the Pop-Up Point U3 (generated in relationship from Target Point M3) to approach the target from an optimal direction.
- **Third segment**: Fly from the Pop-Up Point U3 towards the Target Point M3 at the required safety altitude, then perform attack.

**Waypoint B3
Target Point M3**

Runway Heading 250

Targets

Approaching the Target

Kobuleti Airport
Runway Heading: 250

Attack following Heading 250
Distance from Pop-Up Point: 10 km

Waypoint B2

Waypoint B1

**Waypoint B3
Target Point M3**

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

Your Position

AJS 37

306
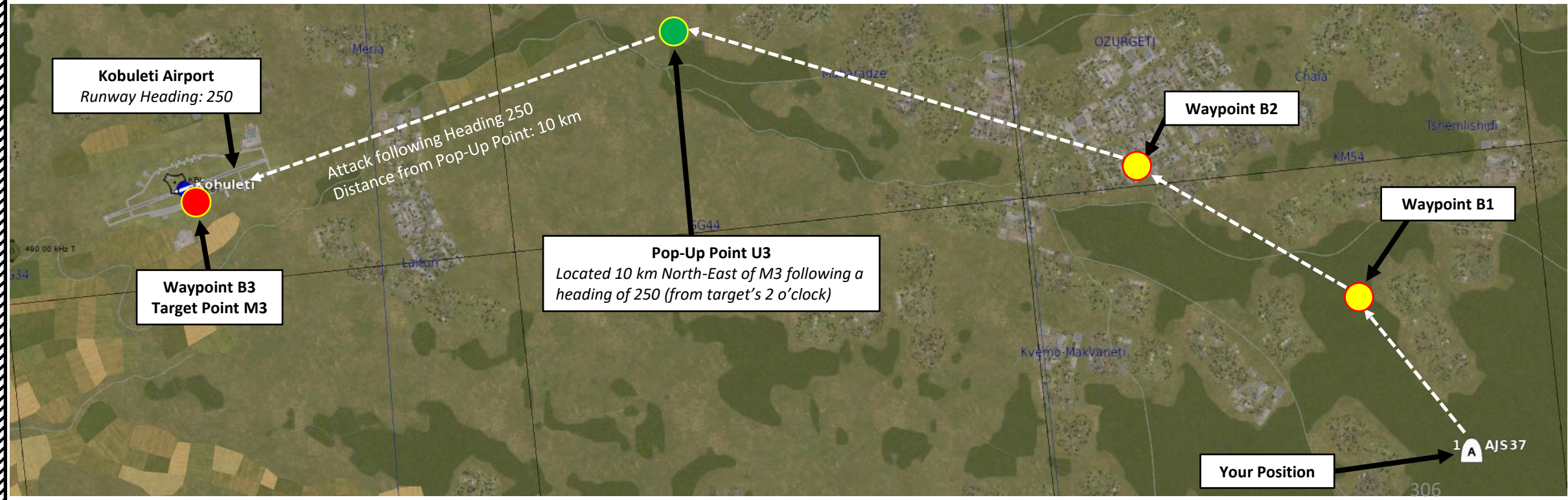
2 – Air-to-Ground Weapons

2.6 – AKAN 30/55 Gun (Air-to-Ground) Short Range Strafing

A – Planning

The attack consists of approaching the target at low level (50 m), then pull up to an altitude that allows you to obtain good visibility over the target (500+ m). Then, perform a shallow dive and line up the target for your attack. In our case, we will use radar ranging to provide ranging information, and then fire our gun based on release cues.

This technique does not require a pre-planned navigation point. However, keep in mind that the barometric pressure setting should be set correctly, which requires a QFE setting value from the kneeboard, which is obtained from an existing waypoint. This value can only be obtained from an existing waypoint in the vicinity of the target where the target elevation is about the same as the waypoint's.

Gun Attack Profile
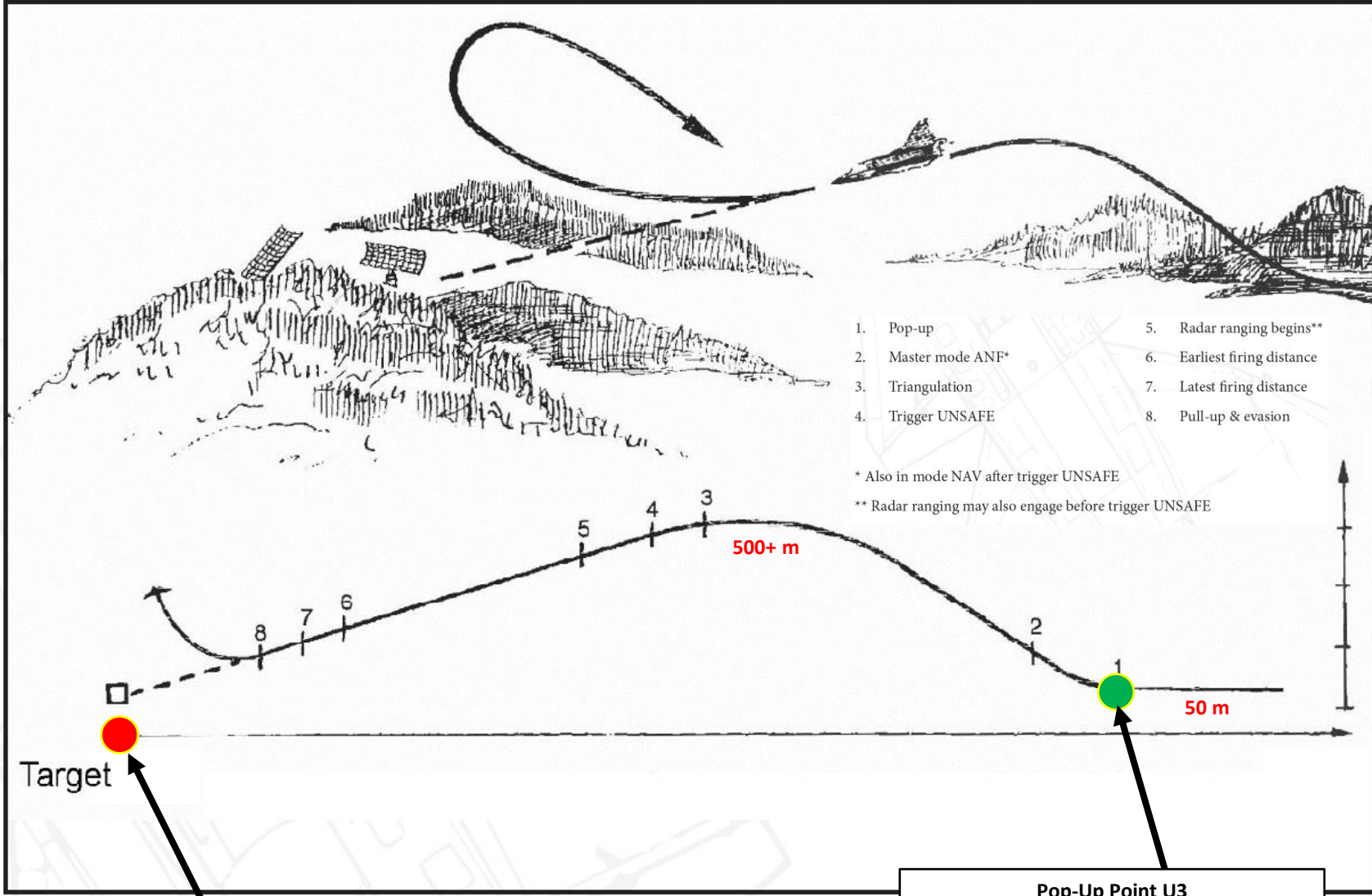
1. Pop-up
2. Master mode ANF*
3. Triangulation
4. Trigger UNSAFE
5. Radar ranging begins**
6. Earliest firing distance
7. Latest firing distance
8. Pull-up & evasion

* Also in mode NAV after trigger UNSAFE

** Radar ranging may also engage before trigger UNSAFE

500+ m

50 m

Target

Waypoint B3
Target Point M3

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Weapon Release Mode selector to SERIE (UP).
3. Set the HUD to the LOWER position to ensure HUD data is properly displayed during attack run.
4. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
5. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
6. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
7. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

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2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

B – Weapon Setup

The Target Motion Measurement option allows the gunsight to take into account the target speed. The sight is used to calculate lead on the target by using the movement of the sight dot over the ground.

8. **(Optional)** Set Target Motion Measurement option as desired. Since it has marginal accuracy improvements at best and the option is set to OFF by default, I recommend **leaving it to OFF,** which is what we will do for this tutorial.
   - To set Target Motion Measurement Option ON:
     a) Set Data Selector to TAKT
     b) Set INPUT/OUTPUT Selector to IN
     c) Enter code "220" on the keypad
     d) Press LS/SKU button
     e) Set INPUT/OUTPUT Selector to UT (Output)
     f) Set Data Selector to AKT POS (Active Position)
   - To set Target Motion Measurement Option OFF, use the same procedure listed above, but enter code "221" instead. This option is the one set by default in the aircraft.

Target Motion Measurement OFF (Default Setting)

Target Motion Measurement ON

309

2 – Air-to-Ground Weapons

2.6 – AKAN 30/55 Gun (Air-to-Ground)

Short Range Strafing

C – Perform Attack

9. Set Data Selector to AKT POS - OUTPUT.
10. Set Master Mode to NAV. HUD Symbology will display pole tracks (navigation data) and steer you towards the selected waypoint.
11. Fly to Waypoint B2. Maintain an altitude of 50 m AGL to ensure you are being masked by surrounding terrain.
12. Once you cross Waypoint 2 (B2) and the Destination Indicator switches from B2 to U3 (Pop-Up point to line you up with the Target Point M3):
    - Climb to an altitude of approximately 500 m above ground level (AGL) or more.
    - Accelerate between Mach 0.8 and 0.9.
    - Note: If no pop-up point is programmed, the Destination Indicator switches from B2 to M3 (Target Point) directly instead.
13. Once you pass the pop-up point, the Destination Indicator will switch from U3 (Pop-Up Point) to M3 (Target Point).
14. The "Time Line" appears when you are 40 seconds away from target.

Distance to Selected Waypoint (km)
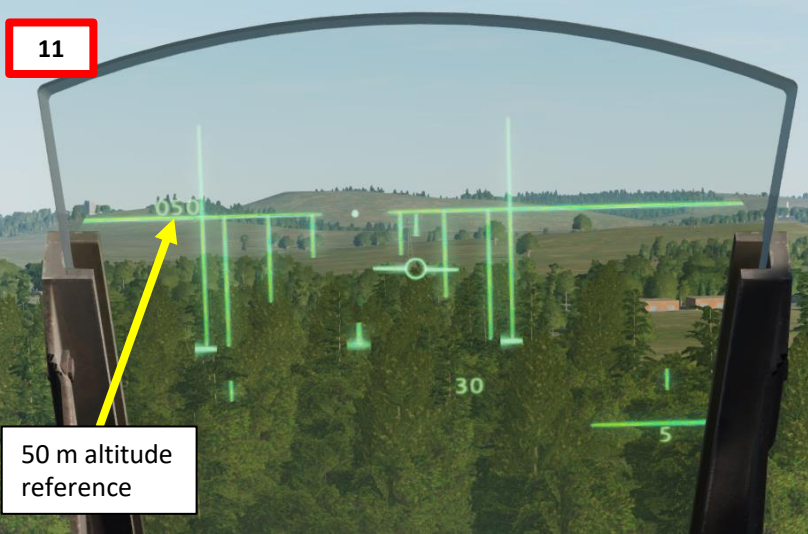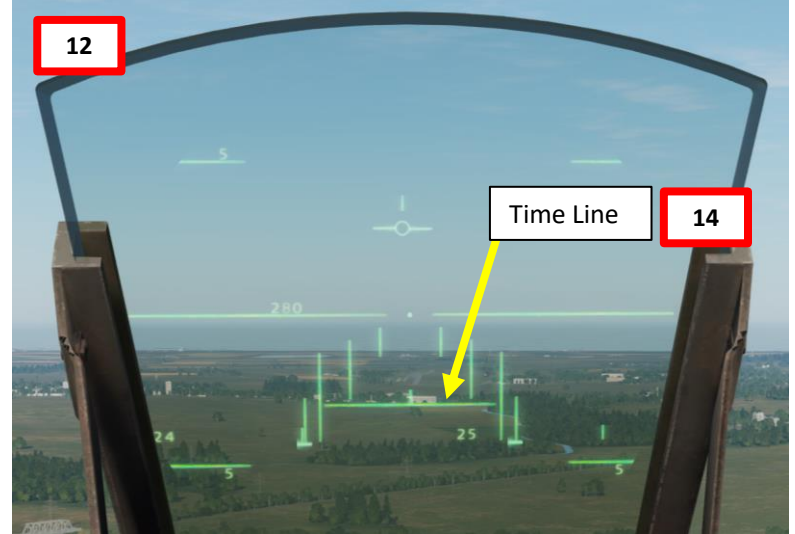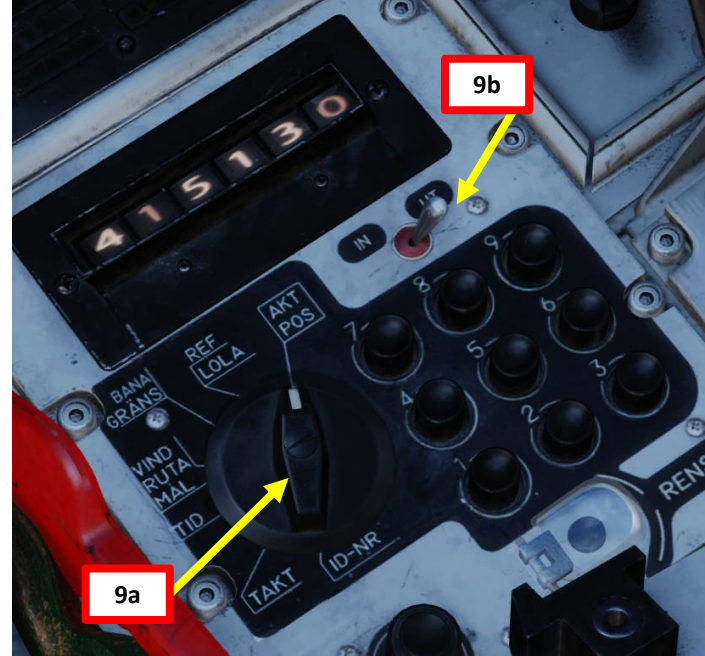
11

12

13

10

9b

11

12

Time Line   14

50 m altitude reference

9a

2 – Air-to-Ground Weapons

2.6 – AKAN 30/55 Gun (Air-to-Ground)

Short Range Strafing

C – Perform Attack

15. Set Master Mode to ANF (*Anflygning*/Attack).
16. HUD Symbology now provides symbology applicable to aiming and firing cues such as the TIR (Target Indicator Ring), which appears on the target.

15a

Master Mode - NAV

15b

Pull up at pop-up point and go master mode to **ANF**.

(2) HUD symbology changes.

Target indicator ring (**TIR**) appears on target.

100

TIR (Target Indicator Ring)

Master Mode - ANF

2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

C – Perform Attack

17. Pull up at Pop-Up point and climb to 500 m or more.
18. When at the top of the climb, throttle back to IDLE, then start a dive to acquire visually the TIR (Target Indicator Ring).

Altitude (meters)

TIR (Target Indicator Ring)

18

2 – Air-to-Ground Weapons
2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

C – Perform Attack

19. During the dive, steer the aircraft to align the reticle dot with the TIR (Target Indicator Ring). Once the TIR and the reticle dot are aligned, confirm that radar ranging is being performed ("fin" should be visible).
20. **While TIR and reticle dot are aligned**, set Trigger to UNSAFE by clicking on the stick's safety cover. This will mark the target and provide more accurate ranging information. The TIR should disappear.
21. Keep the reticle dot on the target.

(3) **Ranging via triangulation** if sightline relative to horizon > 5°. **Distance line** appears. Start aligning **reticule** and **TIR**.

(4) **Radar ranging used** indicated by **fin**, if parameters are met.

(5) **Trigger UNSAFE** when **reticule** is stable on target. TIR disappears. Trigger unsafe signal marks the target. Doppler wind frozen.

Trigger SAFE
20a

Trigger UNSAFE
20c

TIR (Target Indicator Ring)
19a

Radar Ranging "Fin"

Reticle Dot

Reticle Dot Aligned with TIR
19b | 20b

Reticle Dot
20d

2 – Air-to-Ground Weapons

2.6 – AKAN 30/55 Gun (Air-to-Ground)

Short Range Strafing

C – Perform Attack

22. The Distance Line (Firing Warning) will flash 2 seconds before the firing/release point.
23. When wings appear on the HUD (0.5 seconds before the release point), press and hold the Weapon Release trigger to fire your guns.

| 400 | | (6) | Firing warning:
Distance line flashes 2 sec before latest firing range. |
| 300 | | (7) | Firing signal: Wings appear 0.5 sec before latest firing range.
Pull and hold trigger. |

Trigger UNSAFE
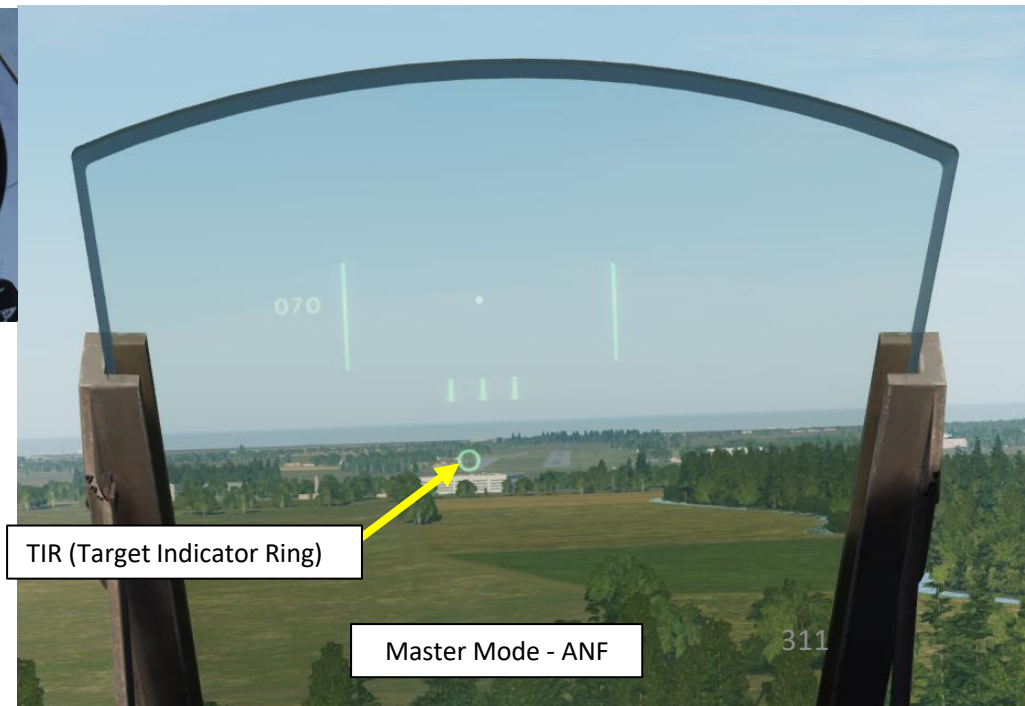
23b

22 Flashing Distance Line

Target

Wings

23a

190

170
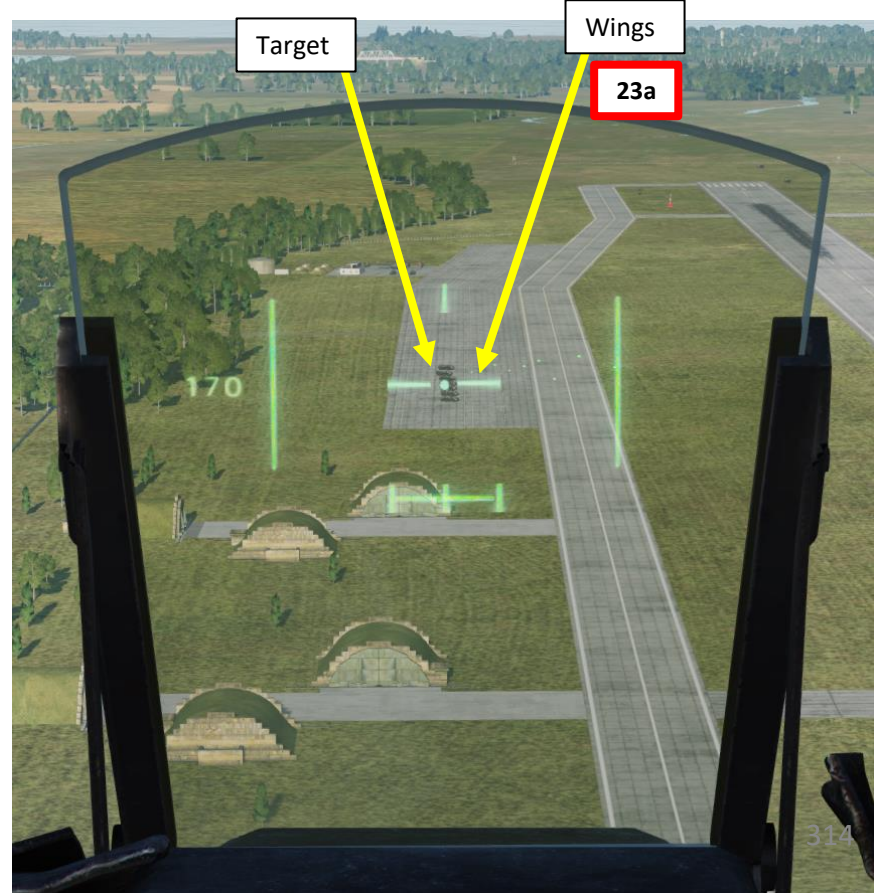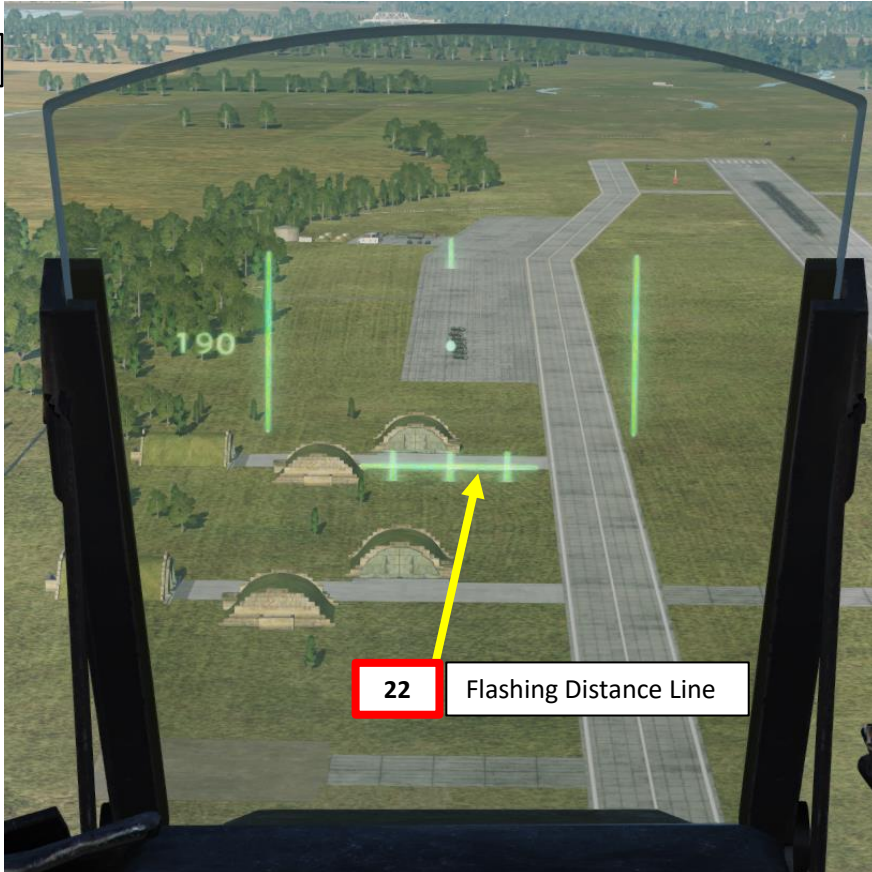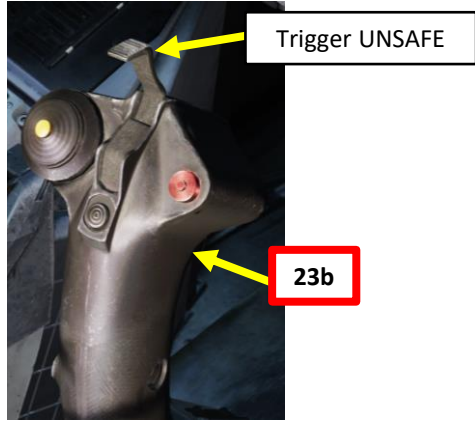
2 – Air-to-Ground Weapons

2.6 – AKAN 30/55 Gun (Air-to-Ground)
Short Range Strafing

C – Perform Attack

24. Once you have performed your strafing run, pull up 5 G and evade.
25. Set Trigger to SAFE by clicking on the stick's safety cover.
26. Set Master Mode to NAV and resume flight.

Trigger SAFE

2 – Air-to-Ground Weapons
2.7 – LYSBOMB Illumination Bomb

2 – Air-to-Ground Weapons
2.7 – LYSBOMB Illumination Bomb

In the following tutorial, we will follow waypoints B1 and B2, and then use Target Point M3 to estimate the range to the target. **Using a waypoint (or radar fix) is mandatory** since the LYSBOMB requires a reference point to give you cues to perform your toss "bombing".

The LYSBOMB themselves have no destruction capabilities… they are meant to provide illumination for a certain amount of time. You can choose to drop the LYSBOMBs either directly on the target, but in certain cases you can also use an offset point to the left or right of the target point. Why? Because illumination flares flying right over a target can blind other pilots and hamper their ability to aim with their own sensors.

Waypoint B3
Target Point M3

Runway Heading 250

Offset Distance:
1 km LEFT
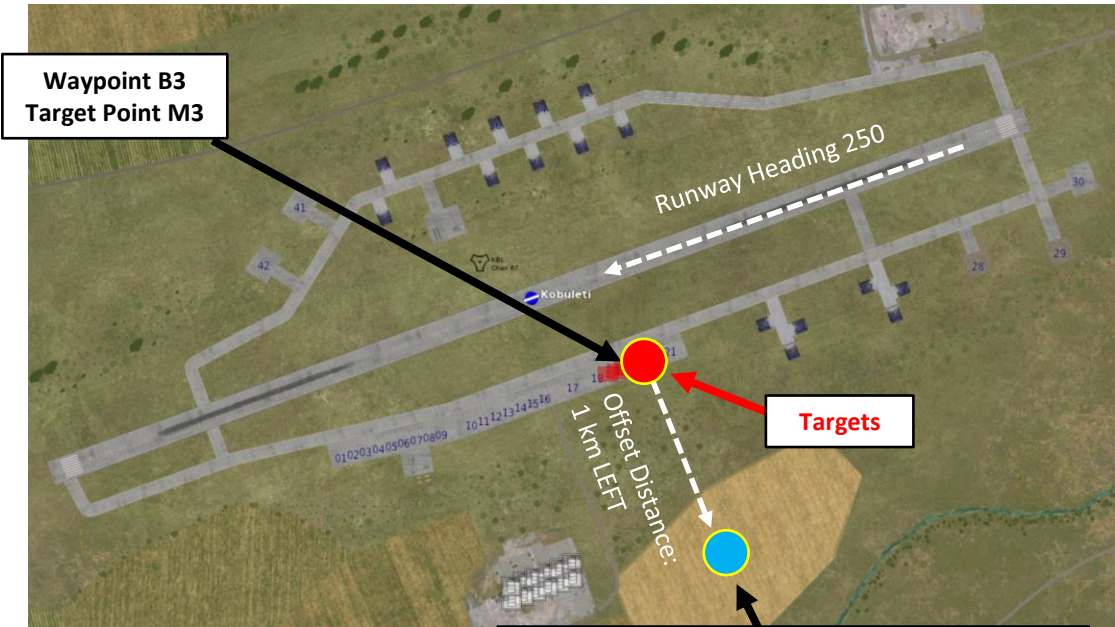
Targets

Offset Point
(where we want the illumination bombs to fall)

Approaching the Target
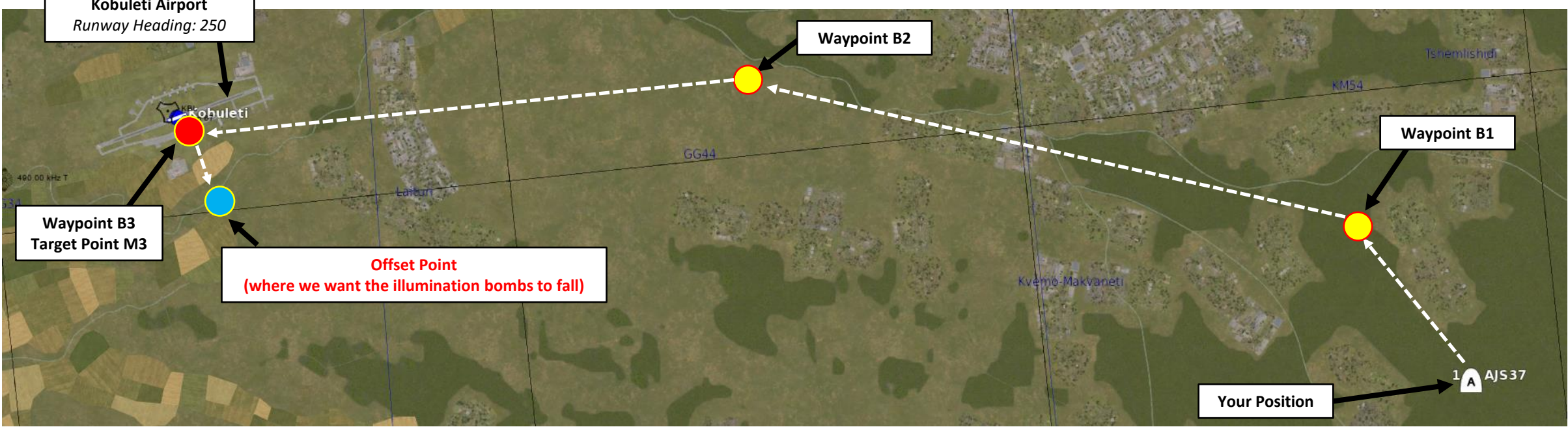
Kobuleti Airport
Runway Heading: 250

Waypoint B2

Waypoint B1

Waypoint B3
Target Point M3

Offset Point
(where we want the illumination bombs to fall)

Your Position

2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

A – Planning

The attack consists of approaching the target at a speed of Mach 0.9 and an altitude of 150 m AGL (Above Ground Level). Once you reach the pull-up point (not to be confused with a pop-up point), pull back on the stick and maintain +4G while holding the trigger. The illumination bombs will release automatically and be tossed towards the target point (provided no offset is programmed).

This technique requires a pre-planned navigation point. However, keep in mind that the barometric pressure setting should be set correctly, which requires a QFE setting value from the kneeboard, which is obtained from an existing waypoint.

LYSBOMB Toss Attack Profile

Lysbomb Employment

Properties:
Descent : 5 m/s
Ill.Time: 170 s
Luminos.: 3 Mcd
Flare   : 25 kg
Weight   : 80 kg

(5) (4) (3) (2) (1)

150 m

50 m
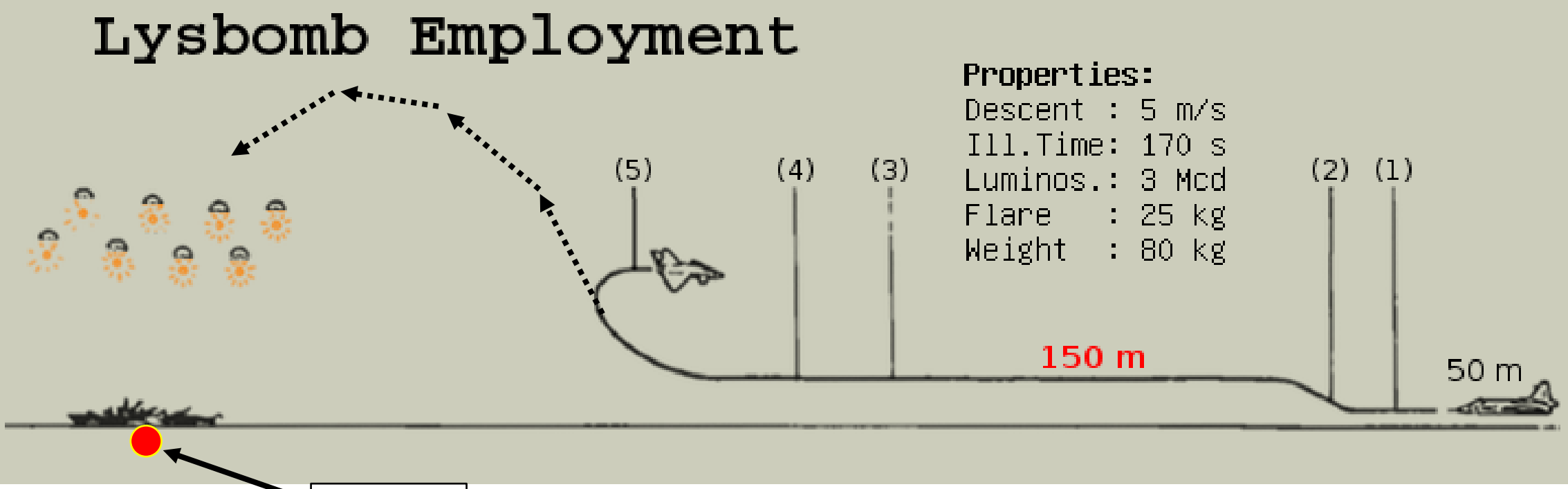
Waypoint B3
Target Point M3

2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Sight Mode / Interval selector to set offset point as desired. Since we want the flare to be dropped LEFT of the Target Point M3, we will select **VÄ.**
   - **LYSB RAKT**: Flares will be placed on top of the target (Target Point M3).
   - **LYSB VÄ**NSTER **(LEFT)**: Flares offset left of the target with the programmed offset distance
   - **LYSB HÖ**GER **(RIGHT)**: Flares offset left of the target with the programmed offset distance
3. Set Weapon Release Mode selector - SERIE (UP).
4. Set the HUD to the LOWER position to ensure HUD data is properly displayed during bombing run.
5. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
6. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
7. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
8. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 256	HEADING (M) 263	G/S 630	IAS 621
DISTANCE 11.6	TOF 00:01:06	ETA 07:32:24	QFE 1031.1
ALTITUDE 18	VERTICAL ANGLE -1	FUEL RESERVE 118	BINGO FUEL 73

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2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

B – Weapon Setup

9. If Sight Mode selector is set to **VÄ** (LEFT Offset**)** or **HÖ** (RIGHT Offset), program the offset distance as desired. In our case, we will set a left offset of 1 km.
   a) Set Data Selector to TAKT
   b) Set INPUT/OUTPUT Selector to IN
   c) Enter 23 address code for the desired offset distance, which is either 1, 2 or 3 km. We will set 1 km.
      • "231" sets **1** km offset distance
      • "232" sets **2** km offset distance
      • "233" sets **3** km offset distance
   d) Press LS/SKU button
   e) Set INPUT/OUTPUT Selector to UT (Output)
   f) Set Data Selector to AKT POS (Active Position)

Waypoint B3
Target Point M3

Direction of Attack

Targets

Offset Distance:
1 km LEFT

Offset Point
(where we want the illumination bombs to fall)
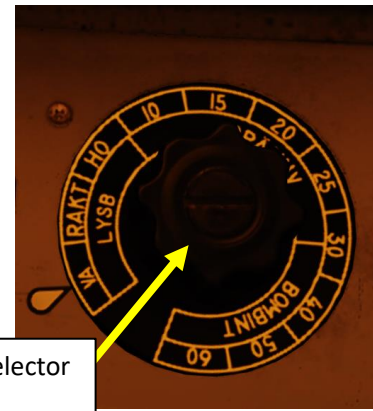
Sight Mode Selector
VÄ (LEFT)
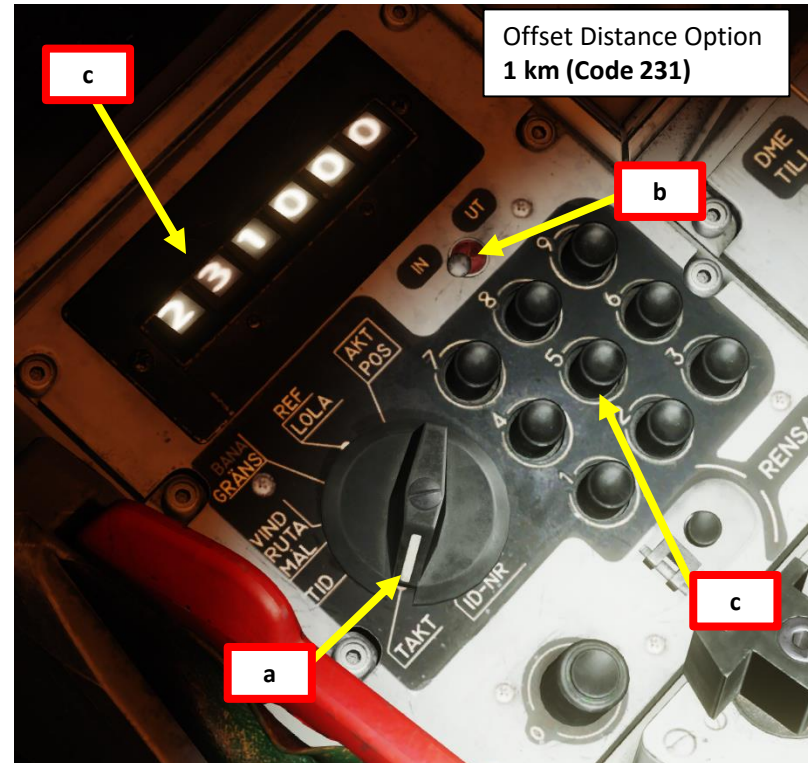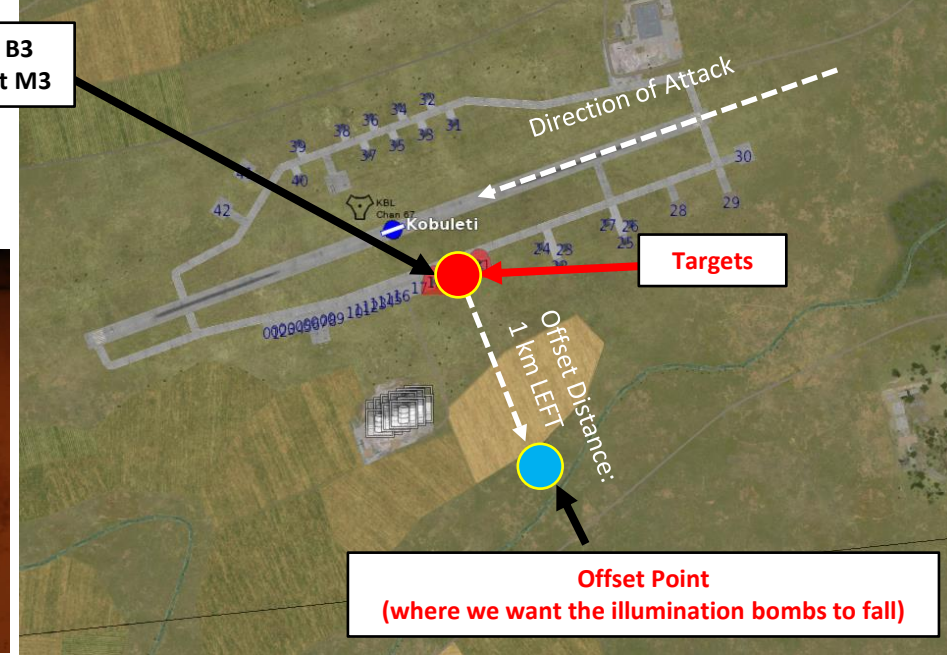
Offset Distance Option
1 km (Code 231)

c

b

c

a

e

f

B5 B6
B4 B7
B3 B8
B2 B9
B1 BX

d

LS
SKU   L
       MÅL
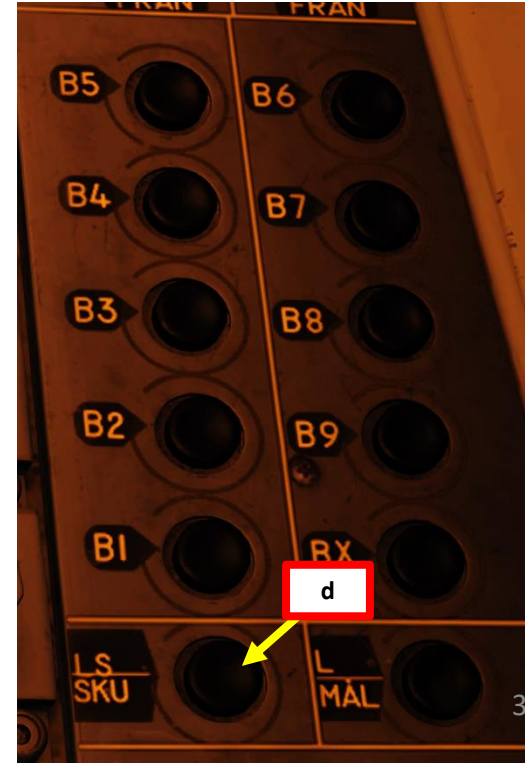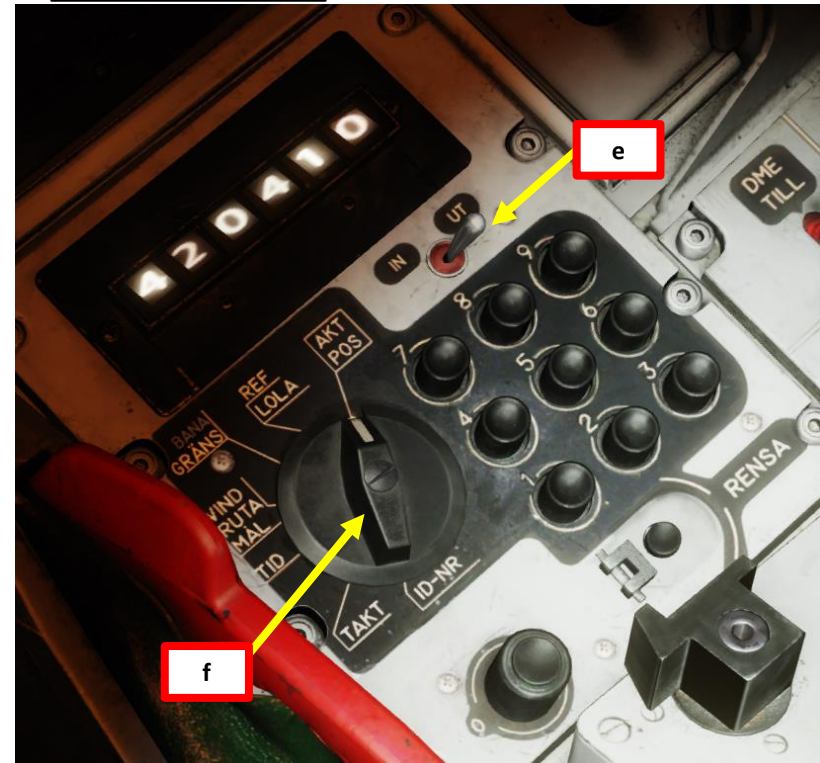
2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

C – Perform Attack

10. Navigate to M3 (Target Point)
11. Set Master Mode to ANF (*Anflygning*/Attack).
12. HUD Symbology now provides symbology applicable to LYSBOMB release cues.
13. Climb to **command altitude of 150 m (AGL)** and maintain airspeed at **Mach 0.9** (VERY IMPORTANT). Throttle should be set somewhere between Afterburner Zone 1 and Zone 3 (Full Throttle).
14. Markers on the HUD indicate distance to pull-up point where you will initiate the "toss". Do not confuse this for a pop-up point.
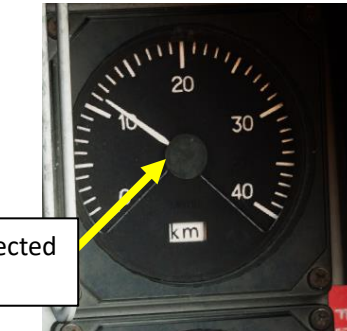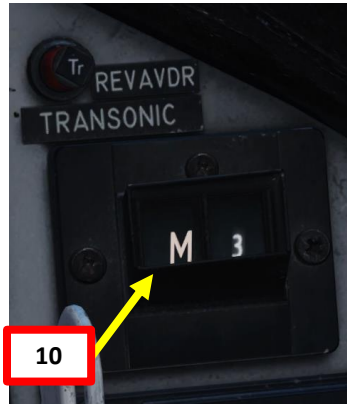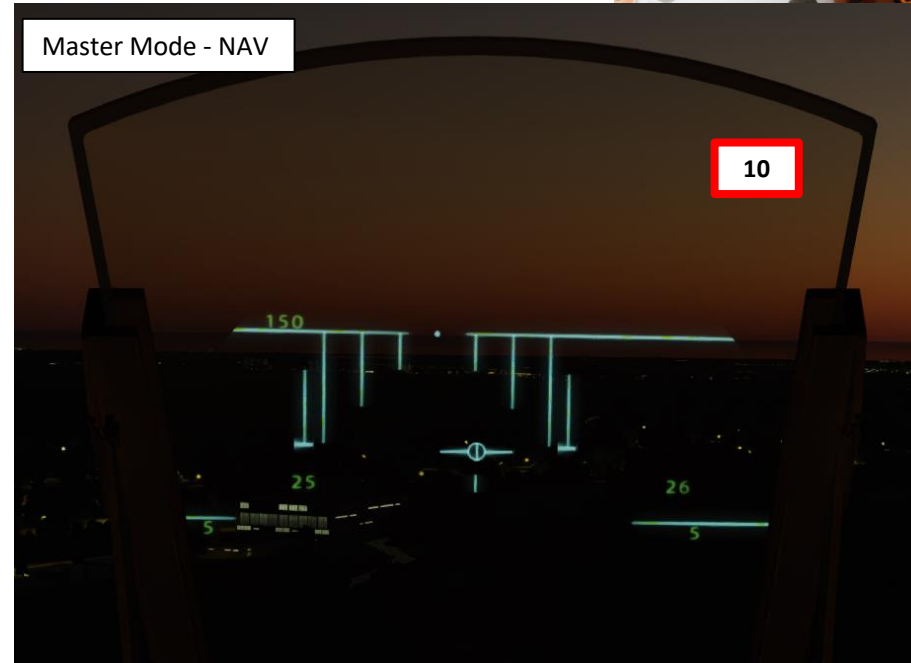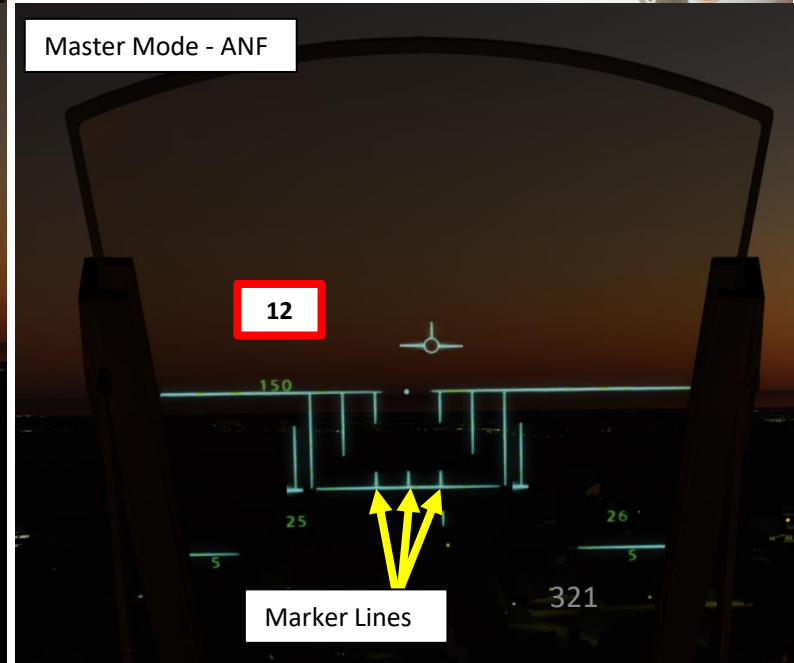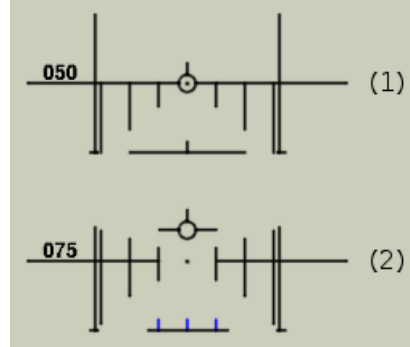
(1) Master mode **NAV**. Weapon selector **ATTACK**.
Set target **QFE**.
Sight mode selector to **VÄ** (left), **RAKT** (top), **HÖ** (right).
If necessary perform a radar target fix.

(2) Master mode **ANF**.
Climb to commanded altitude of **150 m**.
Perform attack run at constant **M 0.9**.
Markers appear and indicate distance to pull-up point.
Trigger UNSAFE.

11

Master Mode - NAV

10

Master Mode - ANF

12

10

Distance to Selected Waypoint (km)

Marker Lines

2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

C – Perform Attack

15. The Distance Line starts shrinking as you approach the pull-up point. **Maintain 150 m AGL and Mach 0.9.**
16. Set Trigger to UNSAFE by clicking on the stick's safety cover.
17. When the Distance Line flashes, this indicates that you are 4 seconds away from the pull-up point. DO NOT START PULLING UP YET.
18. Throttle up to MAX afterburner (Zone 3). This is to ensure you do not lose too much speed during the pull-up phase, which can cause your illumination bombs to fall short or fail to gain enough altitude before deploying their parachutes.
19. When the Distance Line becomes fully extended, this indicates that you are 1 second away from the pull-up point.
20. Press and hold the Weapon Release trigger.
21. Count 1 second, then pull back on the stick to perform a constant 4 G pull.

Altitude (m)

Marker Lines

15

Distance Line

17

Distance Line (Flashing)

Distance Line (Fully Extended)

19
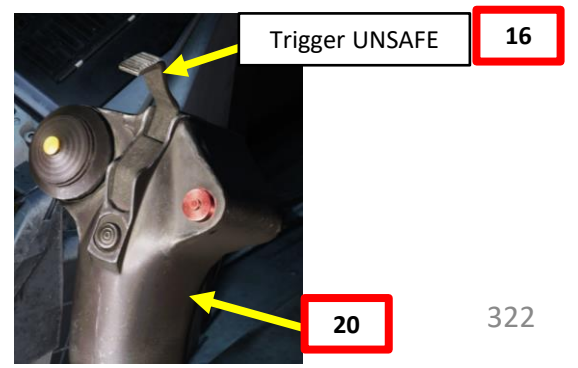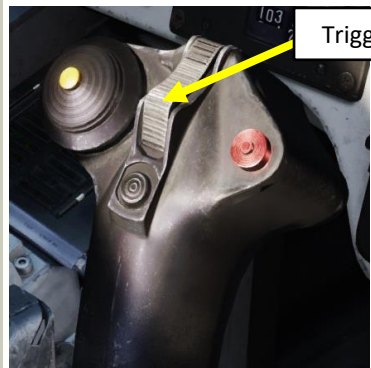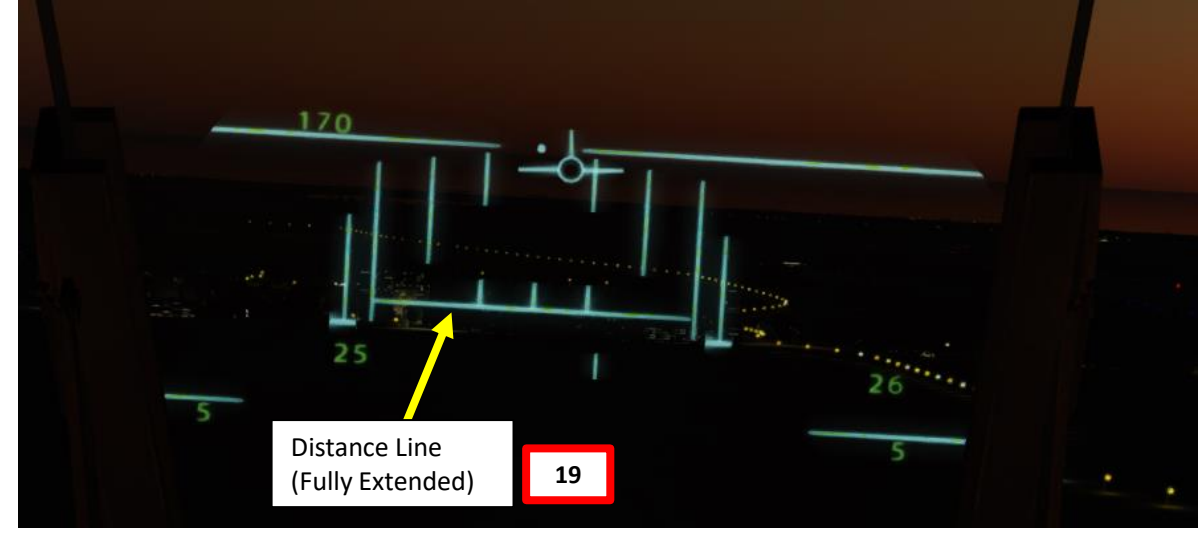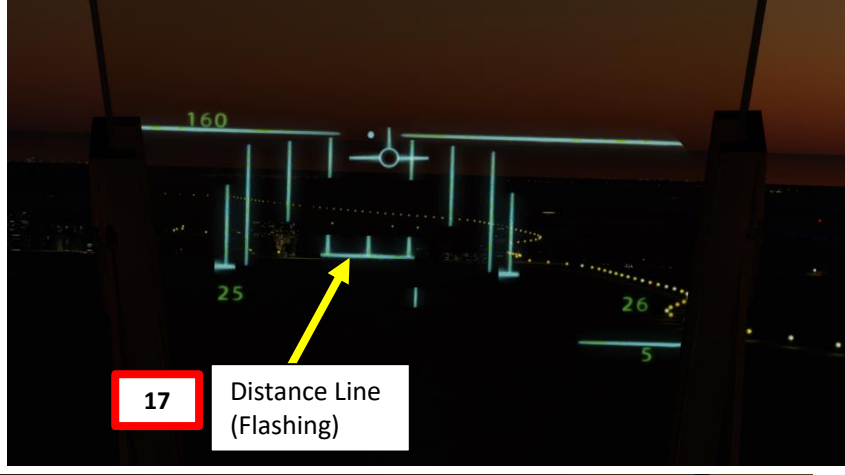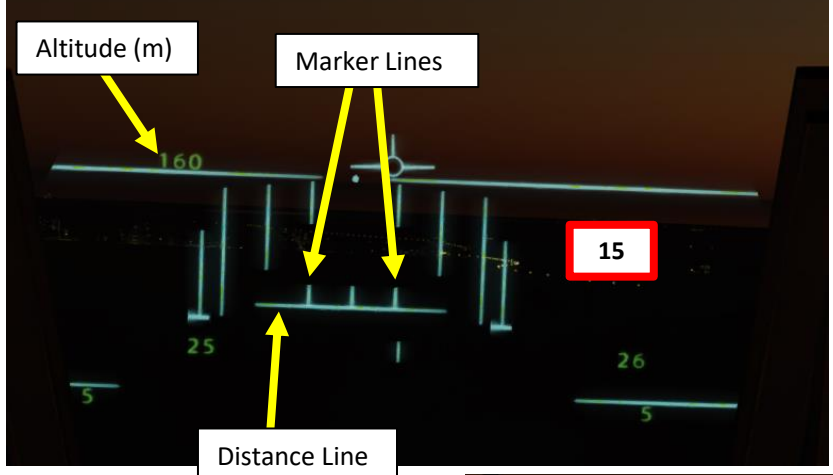
```
075  Master mode ANF.
     Climb to commanded altitude of 150 m.
(2)  Perform attack run at constant M 0.9.
     Markers appear and indicate distance to pull-up point.
     Trigger UNSAFE.

150
(3)  Distance line flashes 4 sec before pull-up point.
     Trigger pulled and held. Altitude numbers shift right.

150
(4)  Distance line fully extended: pull-up in 1 sec.
     Pull-up with 4G according to ADI flight director needles.
     Release trigger when FÄLLD LAST illuminates.
```

Trigger SAFE

Trigger UNSAFE   **16**

20

2 – Air-to-Ground Weapons
2.7 – LYSBOMB Illumination Bomb

C – Perform Attack

22. During the pull-up phase, monitor the accelerometer to gauge how many Gs you are pulling (+4 G is the ideal setting).
23. Fly according to the ADI (Attitude Director Indicator) flight director needles to maintain a correct trajectory. They should be centered.
24. Keep the Weapon Release trigger pressed and hold it until the FÄLLD LAST (STORES RELEASED) light illuminates. This indicates that the illumination bombs have been released.
25. Illumination bombs will climb, then descend near the offset point, deploying parachutes to allow them a descent rate of 5 m/s. You can expect an illumination time of approx. 170 seconds before the illumination flares reach the ground and extinguish.
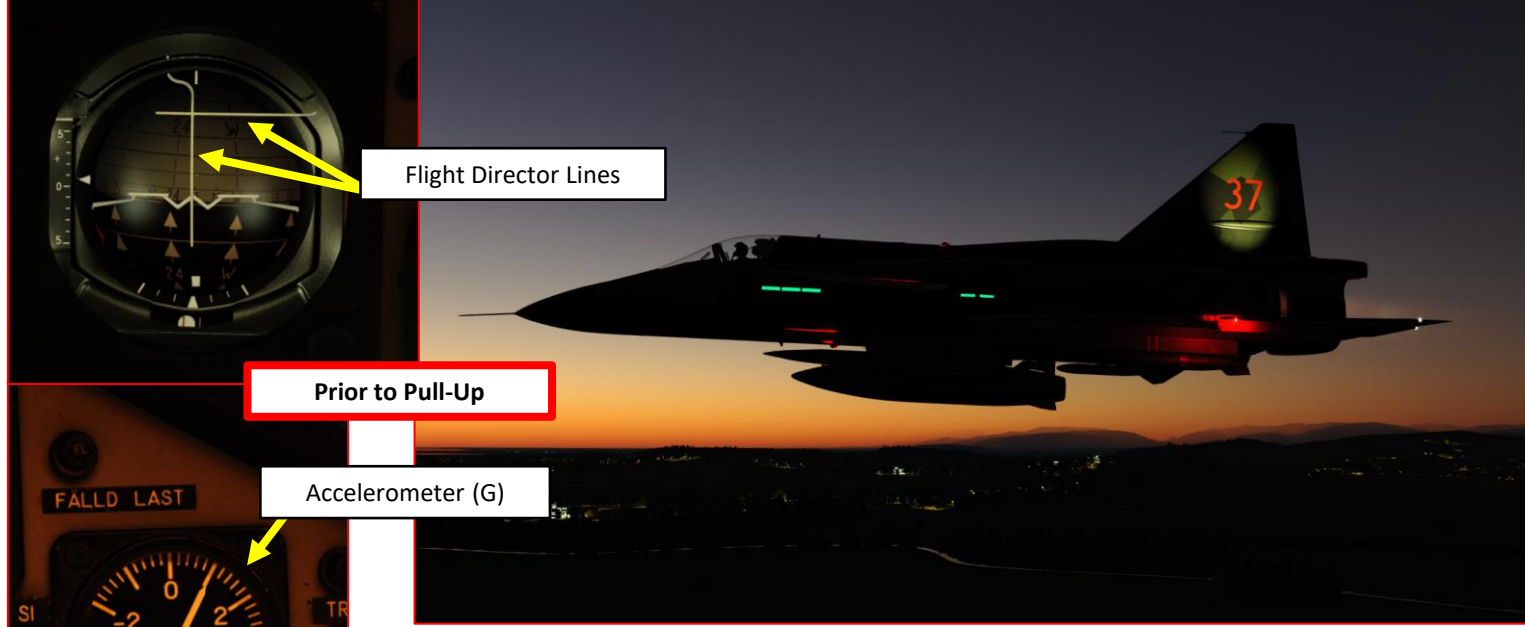
Flight Director Lines

Prior to Pull-Up

Accelerometer (G)

FÄLLD LAST
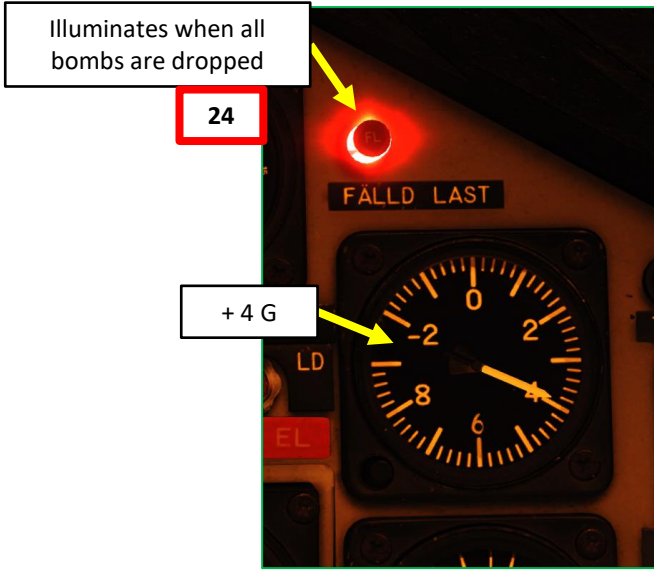
Illuminates when all bombs are dropped

24

+ 4 G

During Pull-Up

Illumination Bombs are being tossed during 4G Pull
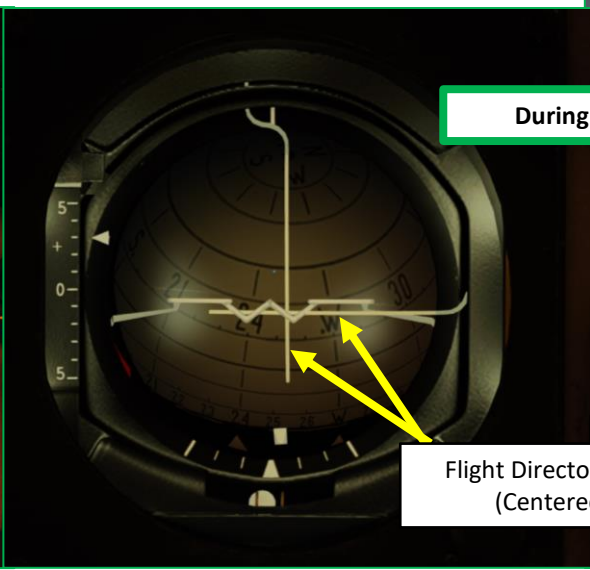
Flight Director Lines (Centered)

323

2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

C – Perform Attack

26. Once all illumination bombs are launched, pull away and evade target.
27. Set Trigger to SAFE by clicking on the stick's safety cover.
28. Set Master Mode to NAV and resume flight.

Trigger SAFE

Illumination Bombs

Offset Point
1 km left of Target Point M3

Target
Target Point M3

324
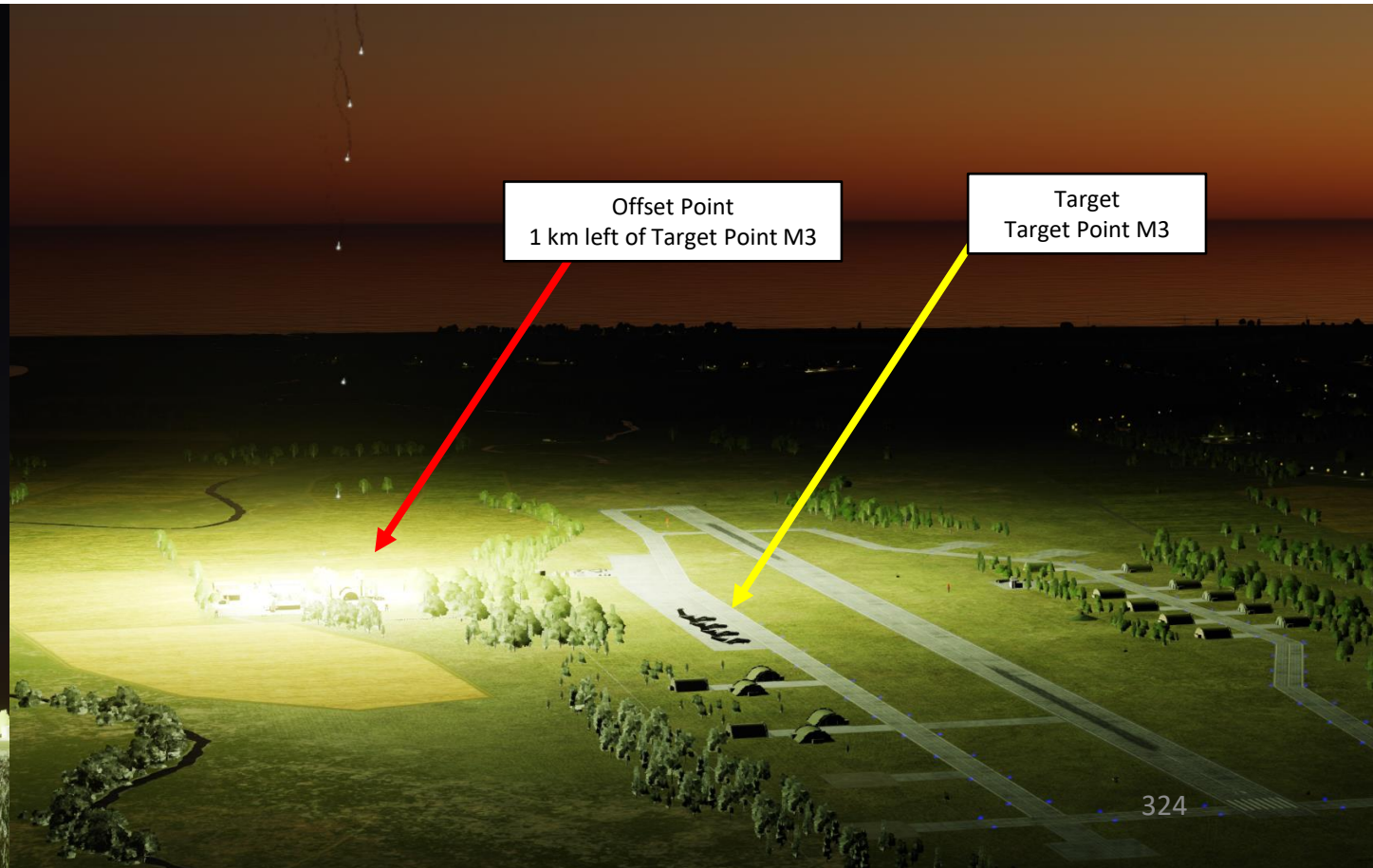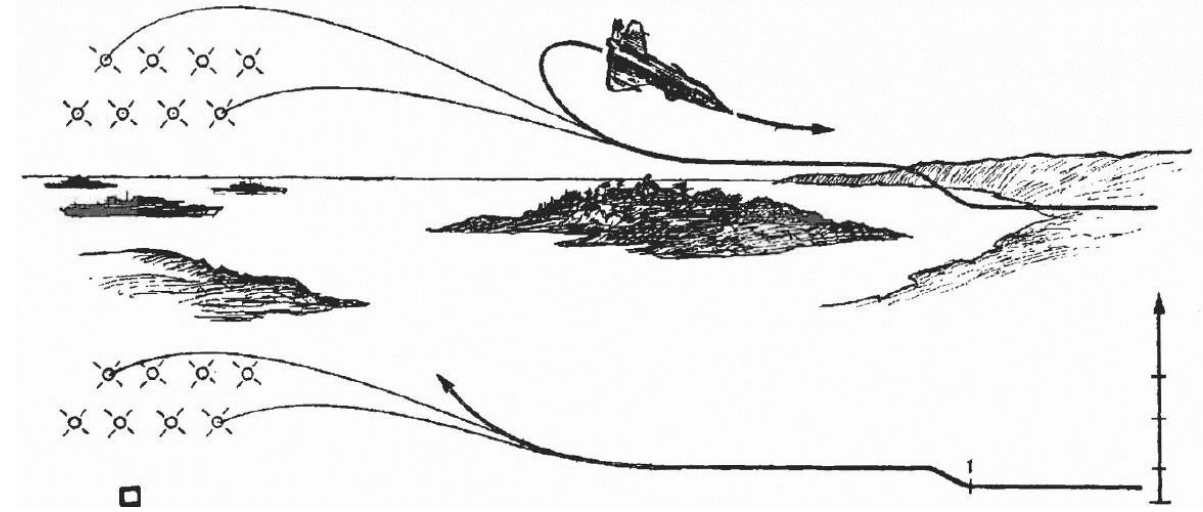
2 – Air-to-Ground Weapons

2.7 – LYSBOMB Illumination Bomb

D – Note on Radar Fix Employment

It is possible to use a radar fix to use as a reference point to release illumination bombs. This is very useful for naval targets.

The radar target fix in illumination bomb mode is a normal target fix, but the offset distance will automatically be added (if sight mode selector is set to Left or Right). If the sight mode selector is set to RAKT, no offset will be used. Steering commands to the offset point is shown of the HUD and the ADI. If using a radar target fix on a target waypoint, an illumination bomb fix is made. The fix is offset with the pre-set offset distance and direction.

Before fix

Fix mode selector T1
Video marker over target

After target fix.
Circle marker indicates
the offset distance
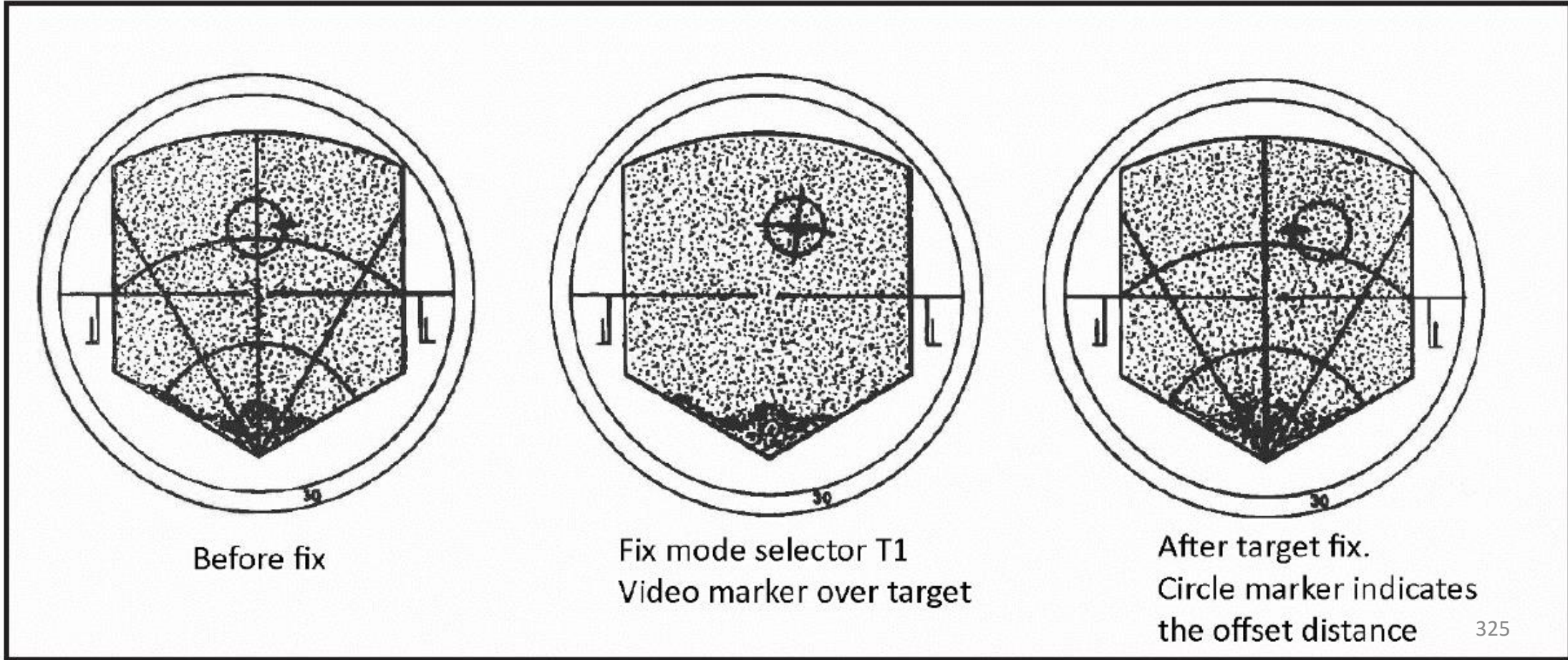
3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

In the following attack tutorial, we will follow waypoints B1 and B2, and then use Target Point M3 to estimate the range to the target. **Using a waypoint is not mandatory** since the RB-04E can be launched at any time. However, a waypoint (or target fix) will provide you with range information to the target, which is critical in order to know when to launch the anti-ship missile.

The anti-ship missile should **not** be launched when flying over land. Why? Well, when the missile is released, it will dive to a barometric altitude of 10 meters above mean sea level (AMSL). This missile logic has the side-effect of sending the missile straight into the ground if the elevation is more than 10 meters above the sea level.

Approaching the Target
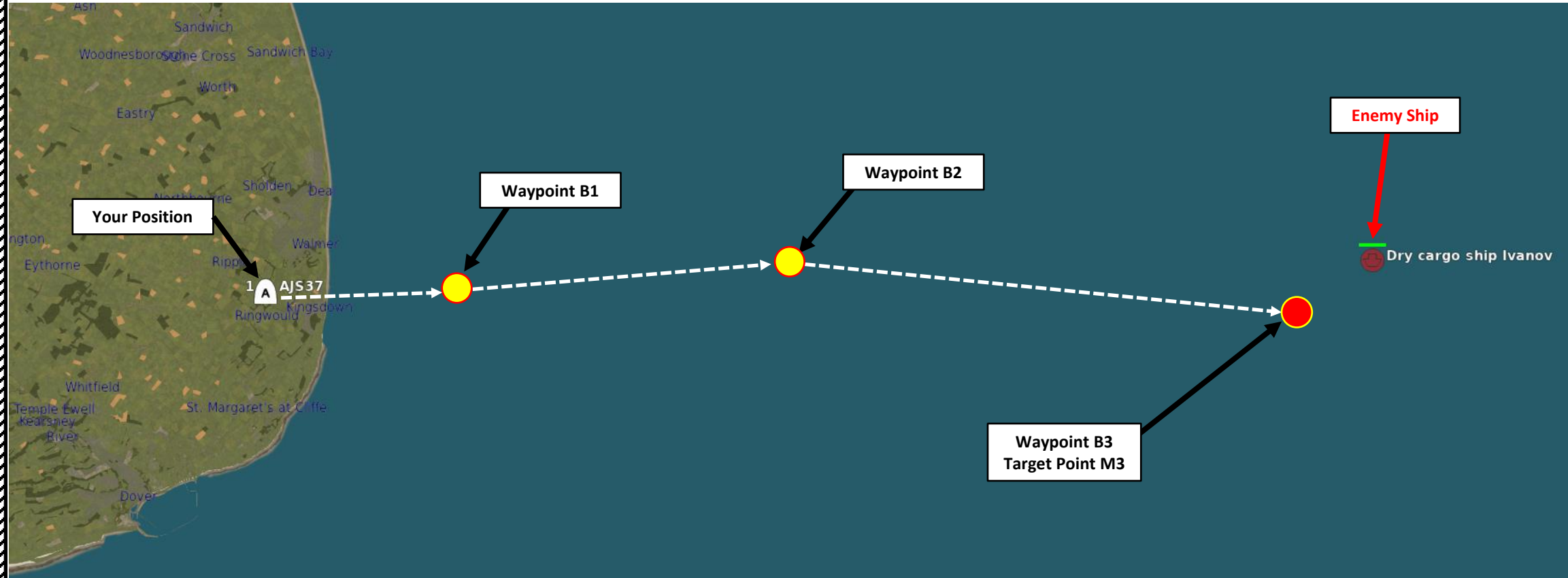
3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

A – Planning: SINGLE TARGET

The RB-04E travels in the direction it is initially pointing when release. It will not track a waypoint/target point in particular. The missile direction is determined by pointing the nose of the aircraft at the desired target.

The missile will **not** track a target with your own aircraft's PS-37 radar. In fact, the missile is equipped with its own on-board radar, which is used to spot ships, acquire them and attack them on its own, steering the missile in the process once a valid target is acquired by the missile. The RB04E's radar has a 8 km (4.32 nm) range and a field of view of +/- 28 deg.

The missile logic is different based on whether you are attacking a single target or a group of targets. **In the case of a single target, the missile will head towards the first ship its radar acquires.**

Ship Contact on Radar

RB-04E Missile

Targeting Mode (MÅLVAL) / Preparation Switch
ENKEL: Single Target

28 deg

28 deg

RB04 Missile Radar Range: 8 km
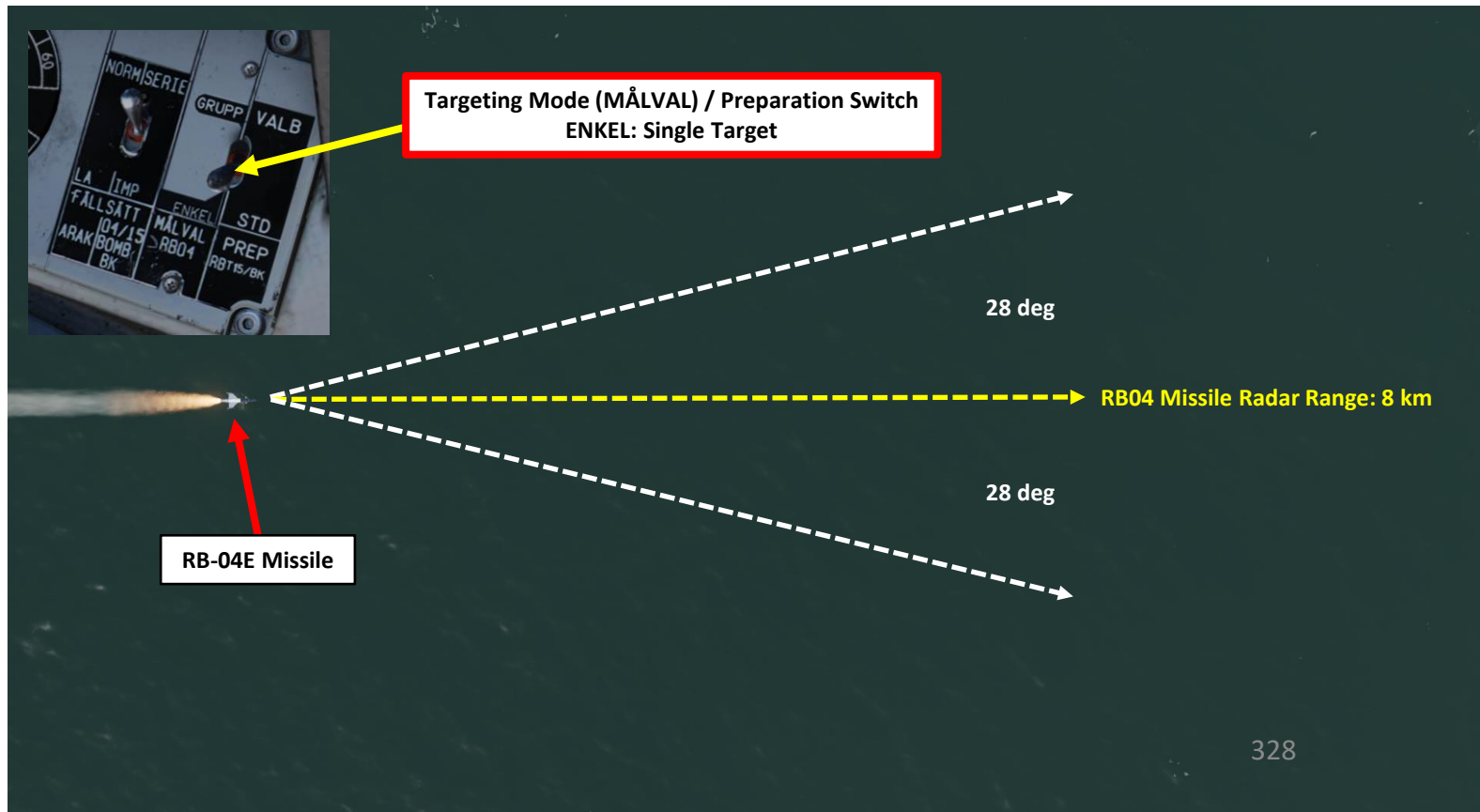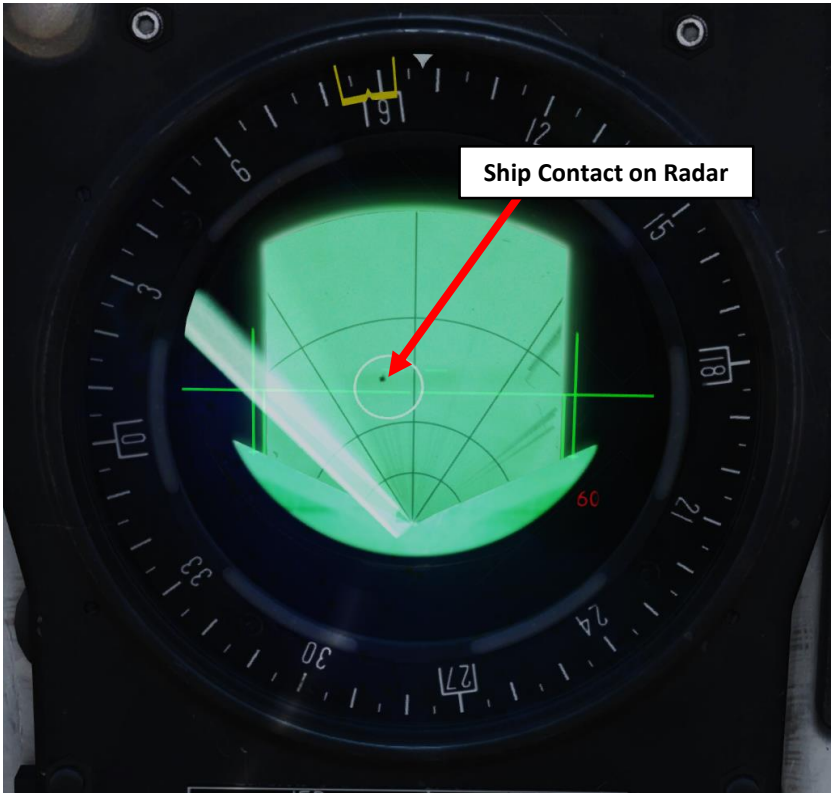
3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

A – Planning: GROUP TARGET

If you are attacking a ship convoy and want to use the Group Target setting, you need to be very careful: the definition of a "group" as seen by the missile is very specific. The prerequisites for a "group" are that **three or more contacts must be within 2700 meters (1.46 nm) of each other in depth**. If unable to determine a group, **the missile may ignore the targets entirely**. If you are not sure about the spacing of the ships, you can still use the ENKEL (Single) setting instead.

In this example, there are three sets of ships. However, only one of these sets is considered as a "group" by the missile.

- **A is not a group**: three ships are within 2.7 km of each other but they are not in depth in relationship to the missile's trajectory.

- **B is not a group**: three ships are in depth in relationship to the missile's trajectory, but they are further away than 2.7 km from each other.

- **C is a group**: three ships are within 2.7 km of each other and are located in depth in relationship to the missile's trajectory.

**Targeting Mode (MÅLVAL) / Preparation Switch
GRUPP: Group Target**

RB-04E Missile

A

Within 2.7 km

28 deg

28 deg

**RB04 Missile
Radar Range: 8 km**

C

Within 2.7 km

More than 2.7 km

B

Drawing Not To Scale

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3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

A – Planning: GROUP TARGET

In this case, the missile approaches the formation from the "beam" and detects a group of ships (A,B, and C) that are within 2.7 km of each other. Ships A and B constitute a group on their own, however the third ship will be included in that group. With this beam aspect onto the formation, ship A becomes row 1, ship B becomes row 2 and so on. The missiles will then select the targets according to the pre-programmed setting. If the missile would be launched from ahead of the ships (from the top in the picture above), ships Y, B, X would be the group instead. Therefore, plan your attacks on formations accordingly.
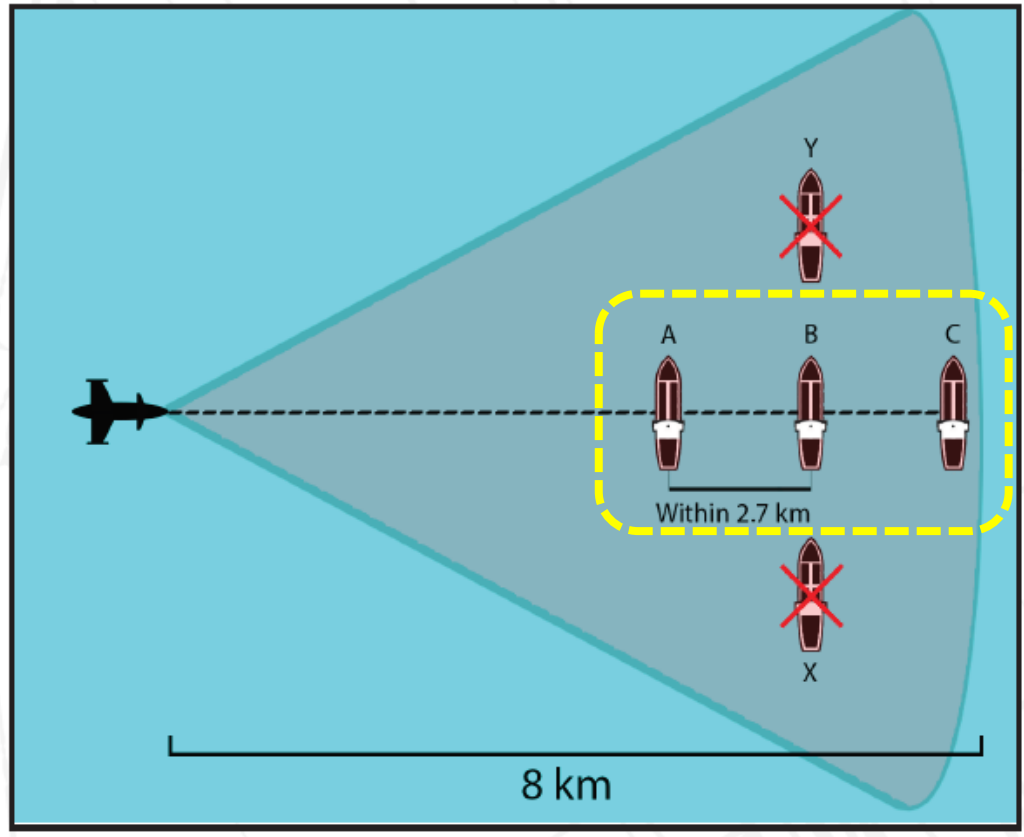
In this case, the missile is unable to determine a group, and will therefore continue to fly until it either finds a suitable group or crashes due to lack of kinetic energy. **While in GRUPP setting, the missile ignores single targets.**
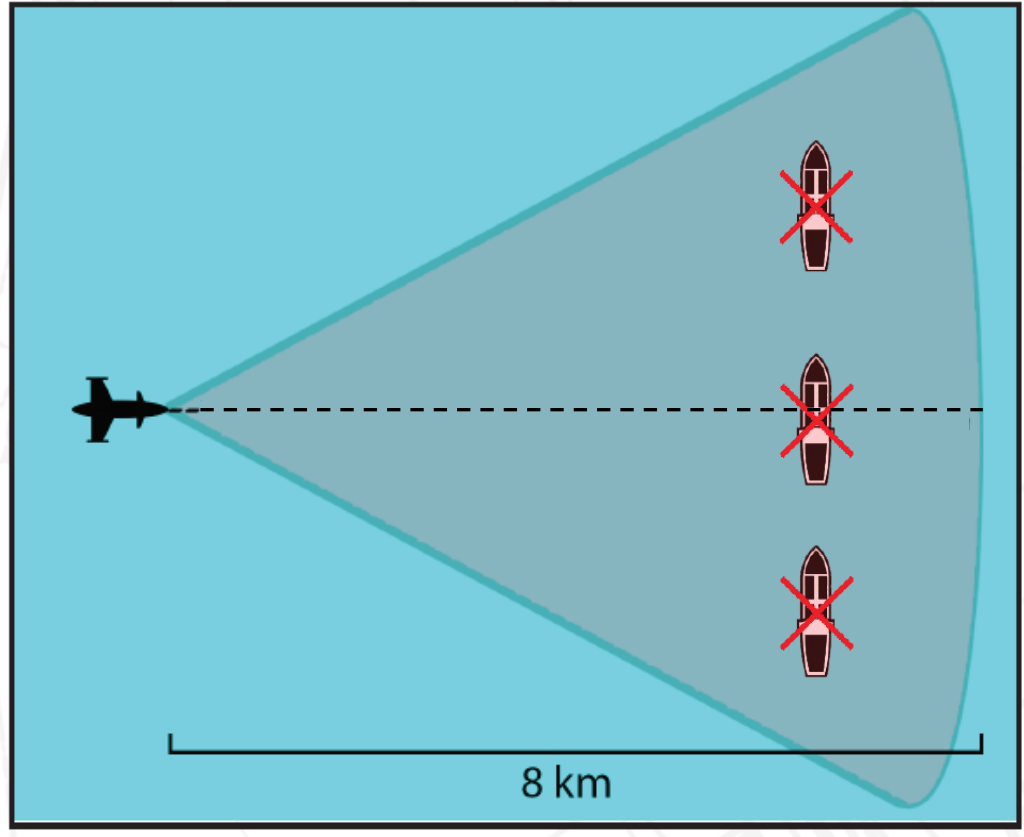
3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

A – Planning: GROUP TARGET

In group mode, the missiles can be pre-programmed on the ground to be assigned to specific rows in a larger convoy formation (such as missiles selecting the second "column" of ships. This is done through the Mission Editor.

RB04 Setting: Group Target Selection

This option pre-programmed in the missile sets which "row" of targets are selected for each missile. The Viggen can equip two RB04 missiles.

- *First and Third*: Missile 1 will select the first row, Missile 2 will select the third row.
- *First and Second*: Missile 1 will select the first row, Missile 2 will select the second row.
- *Second and Third*: Missile 1 will select the second row, Missile 2 will select the third row.
- *Random*: Missiles will be randomly assigned (preferable option).

RB04 Setting: Angle Jump

This option can be use to force the missile to select the second column detected by the seeker (usually to the right from the perspective of the missile) in order to spread out which column is selected by multiple missiles when released by aircraft on the same approach vector. This is generally only useful when attacking very large ship formations with multiple aircraft at the same time in multiplayer.

- *None*: Missiles will select the first valid group detected.
- *Left*: The left missile will select another column.
- *Right*: The right missile will select another column.
- *Both*: Both missiles will select another column.

Due to the nature of the missile seeker, it is strongly recommended to attack in a wide formation, and preferably from multiple angles to prevent multiple missiles hitting the same ship.
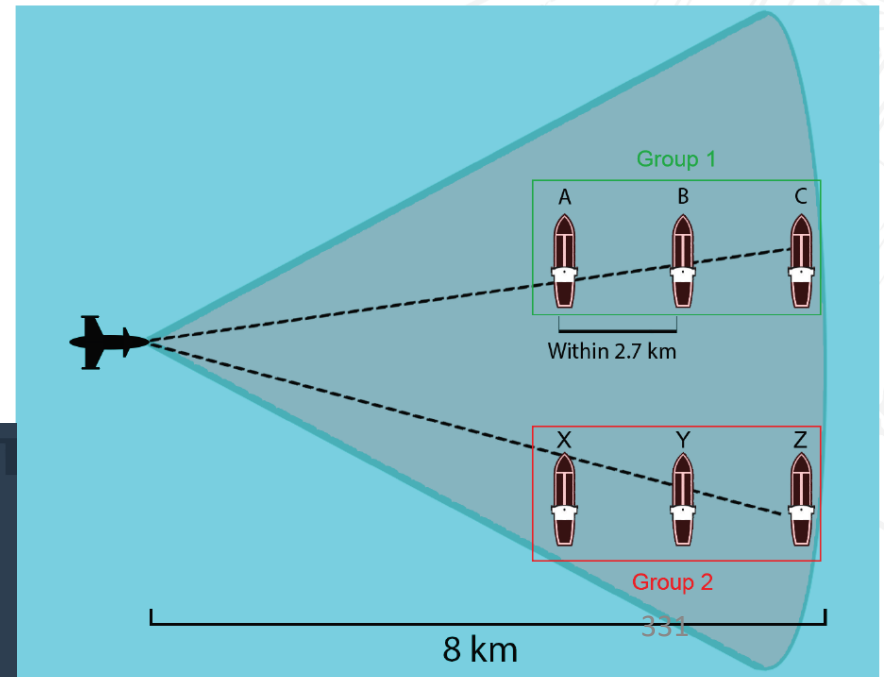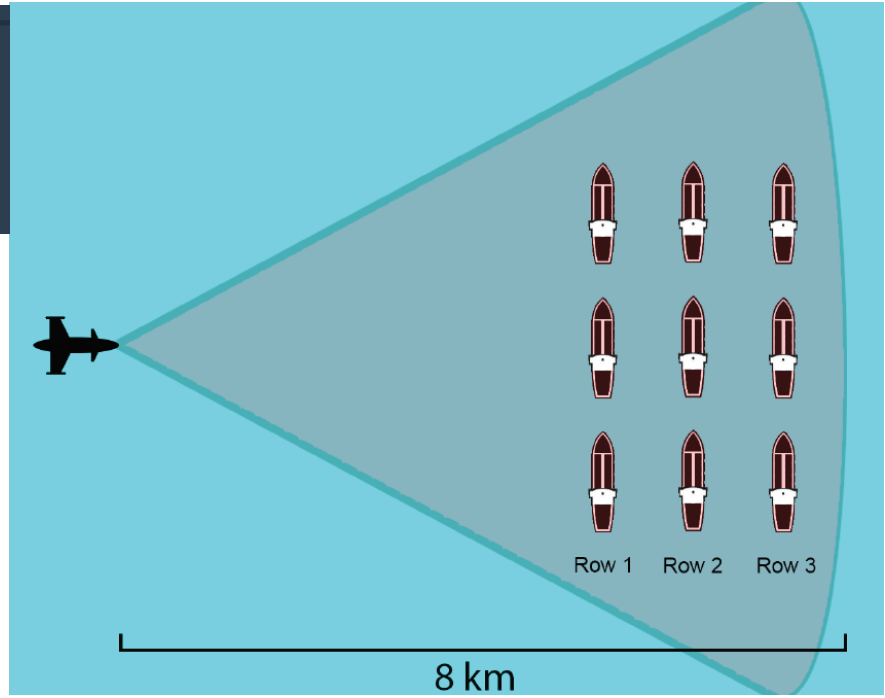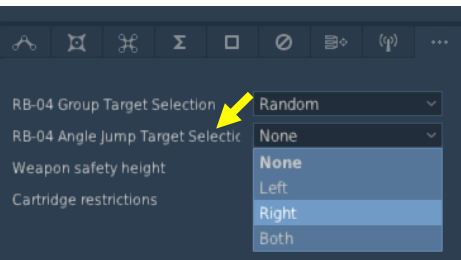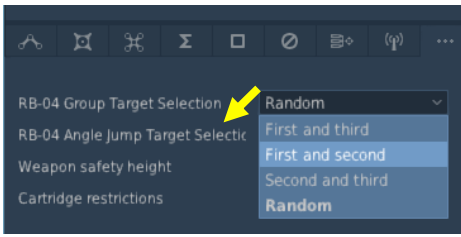
3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Weapon Release Mode selector as desired:
   - SERIE (UP): Releases both RB04 missiles
   - IMPULSE (DOWN): Releases a single RB04 missile
3. Set Targeting Mode (MÅLVAL) / Preparation Switch as desired:
   - ENKEL (DOWN): Single Target Program. This is what we will use.
   - GRUPP (UP): Group Target Program. Only use if you know there are enough ships close enough (within 2.7 km) for the missile to consider as a "group" (see sub-section A).
4. Set the HUD to the LOWER position to ensure HUD data is properly displayed during attack run.
5. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
6. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
7. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
8. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.
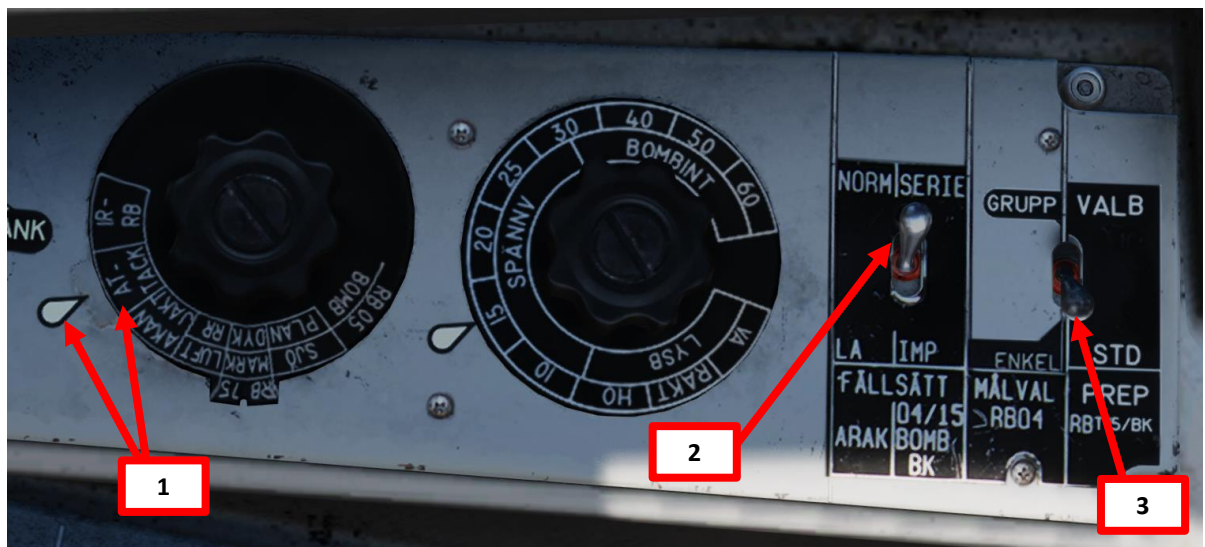
WAYPOINT NAME M3			
COURSE (T) 87	HEADING (M) 87	G/S 554	IAS 492
DISTANCE 15.1	TOF 00:01:38	ETA 15:03:04	QFE 1013.3
ALTITUDE 0	VERTICAL ANGLE -8	FUEL RESERVE 118	BINGO FUEL 17

3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

C – Search Target & Perform Target Fix with Radar

9. Set Data Selector to AKT POS - OUTPUT.
10. Navigate to M3 (Target Point). The existing waypoint should be relatively close to the expected location of the ships.
11. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
12. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
13. Adjust radar display range as required.
14. Set Master Mode to ANF (*Anflygning*/Attack).
15. Extra markers are now displayed to indicate the 24 and 12 km range on the CI (Central Indicator) display.
16. HUD Symbology now provides symbology applicable to missile release cues.
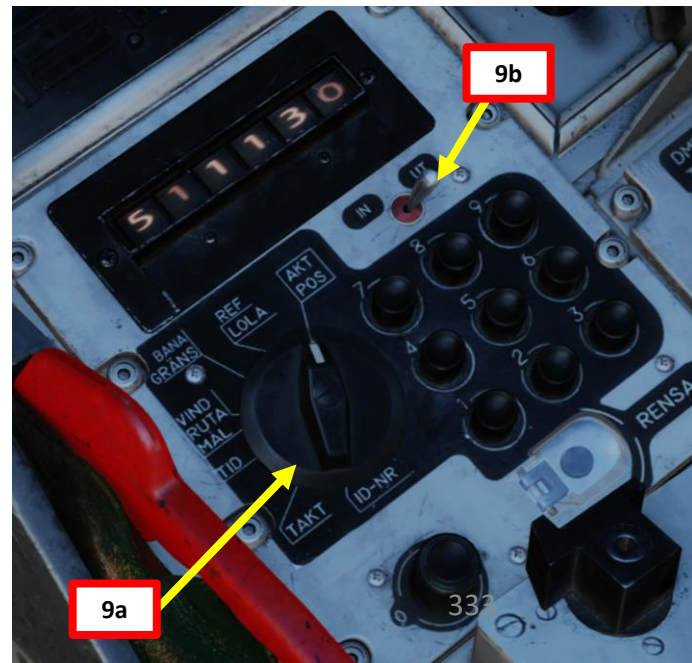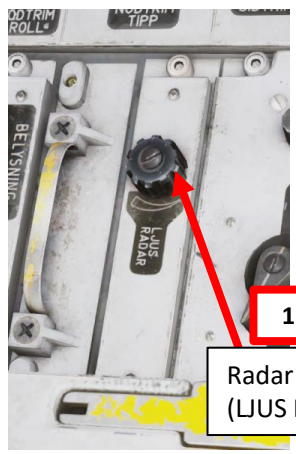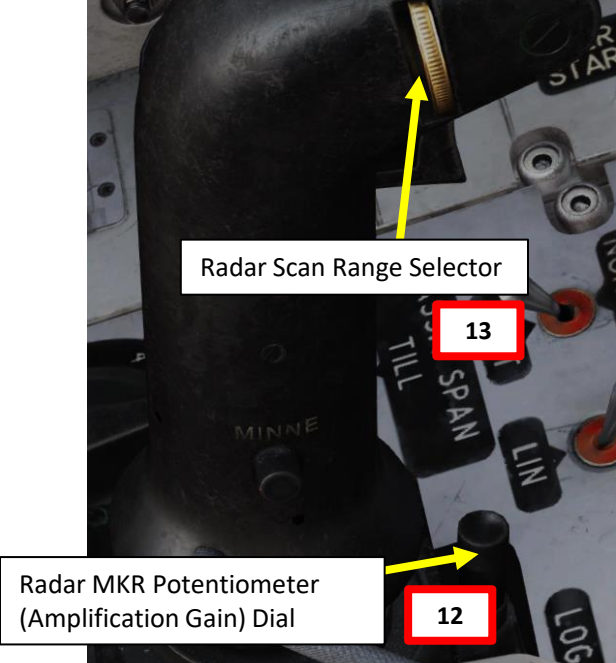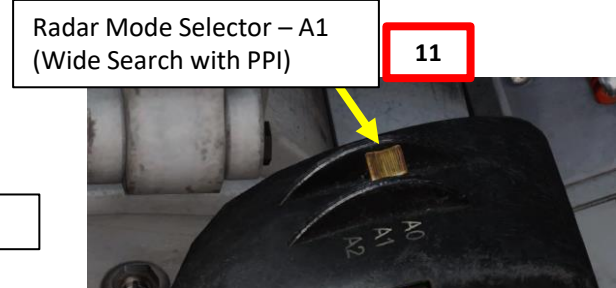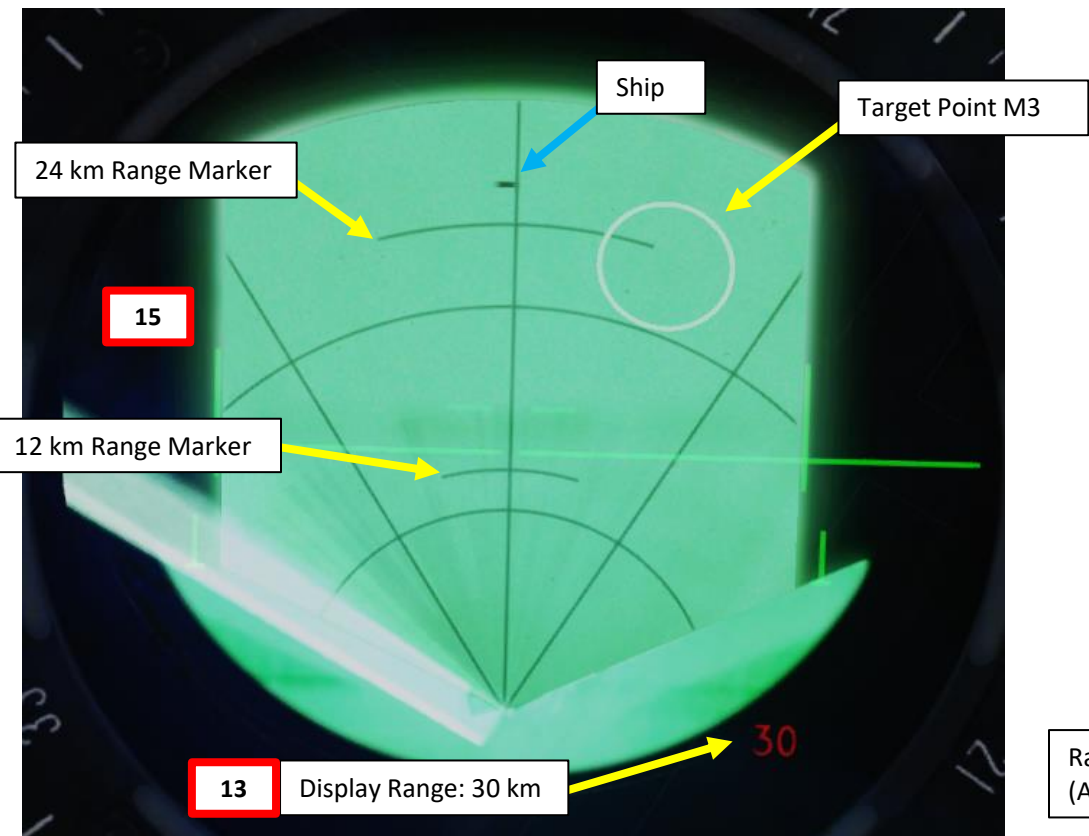
10

Distance to Selected Waypoint (km)

10

14

Radar Mode Selector – A1 (Wide Search with PPI)

11

12

Radar Brightness Control (LJUS RADAR)

Ship

Target Point M3

24 km Range Marker

15

12 km Range Marker

9b

Radar Scan Range Selector

13

Radar MKR Potentiometer (Amplification Gain) Dial

12

13 Display Range: 30 km

9a

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3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

C – Search Target & Perform Target Fix with Radar

17. You should see the Target Point close to the ship (identified as black spots), but not quite aligned. We will now align the Target Point M3 on a the ship using a Target Fix.
18. Press the radar fix trigger to "T1" (first trigger detent).
19. Move crosshair over target using the radar stick controls
20. Press the radar fix trigger to " TV" (second trigger detent), which will set the target fix on the target. This will become the new location of waypoint M3.
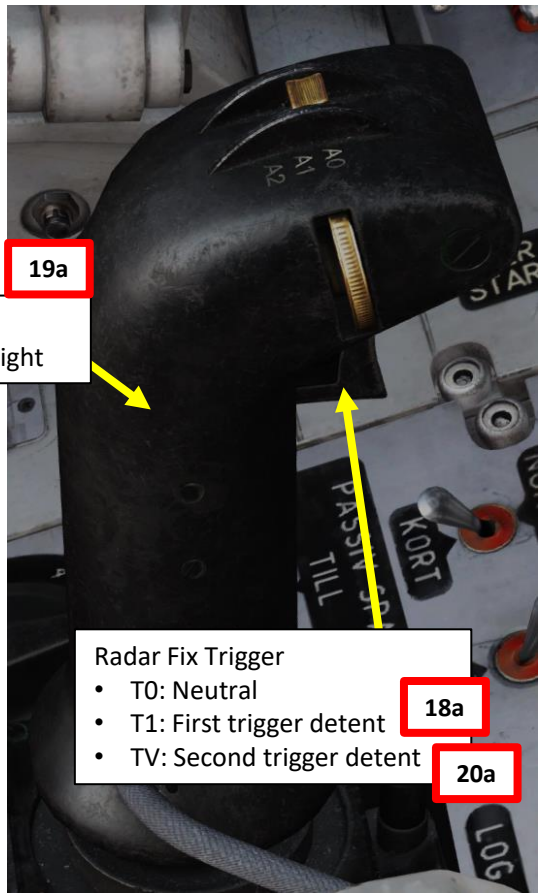
19a

Radar Stick Control:
* Radarstick Up/Down/Left/Right

Radar Fix Trigger
* T0: Neutral
* T1: First trigger detent   **18a**
* TV: Second trigger detent   **20a**

Ship

17

Waypoint M3 Original Location

Crosshair

18b

Crosshair   **19b**

Target Fix (New M3)

20b
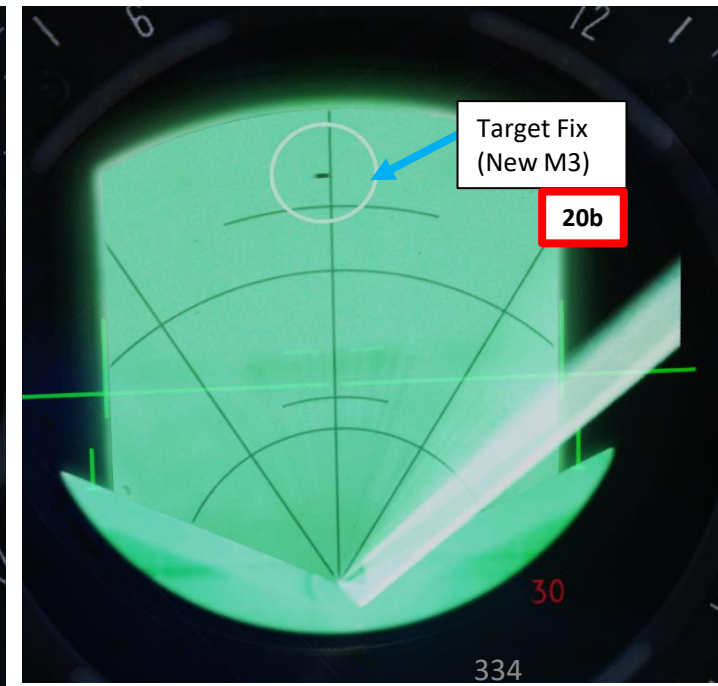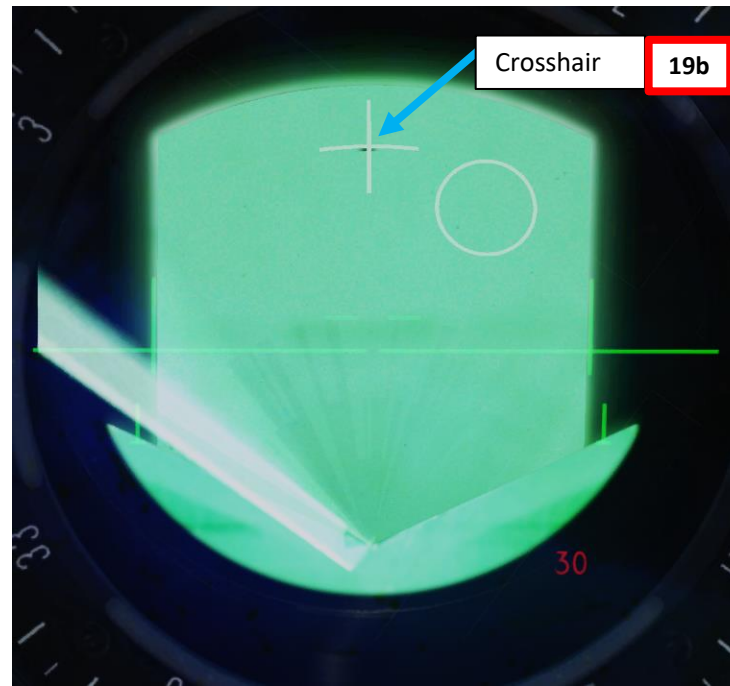
3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

D – Perform Attack

21. When the missiles are selected in ATTACK mode and Master Mode is ANF, the commanded altitude is set to 240 meters on the HUD.
22. Fly towards the target and engage autopilot HÖJD (Altitude Hold) if desired (strongly recommended).
23. Fly aircraft between 50 and 425 meters AMSL (above mean sea level). Flying below this altitude will cause the missiles to hit the water.
24. Steer aircraft in the direction of the ship; this is the direction the missile will take once launched. The velocity vector should be centered between the pole tracks.
25. The "Distance Line" appears when you are 40 seconds away from the maximum release distance. The Outer markers indicate the maximum firing range.

```
(7) Align flight path vector on target and fly within release envelope 50-425 m.
    Commanded altitude is 240 m.
(8) Master mode selector ANF. HUD symbology changes:
    - Distance line appears when 40 sec remain
      until max release distance.
    - Outer markers indicate maximum firing range.
```

Pole Tracks

Velocity Vector

24

22

Max Range
Outer Marker Lines

Altitude (m)

25

Distance Line
(Fully Extended, Out of Range)

335
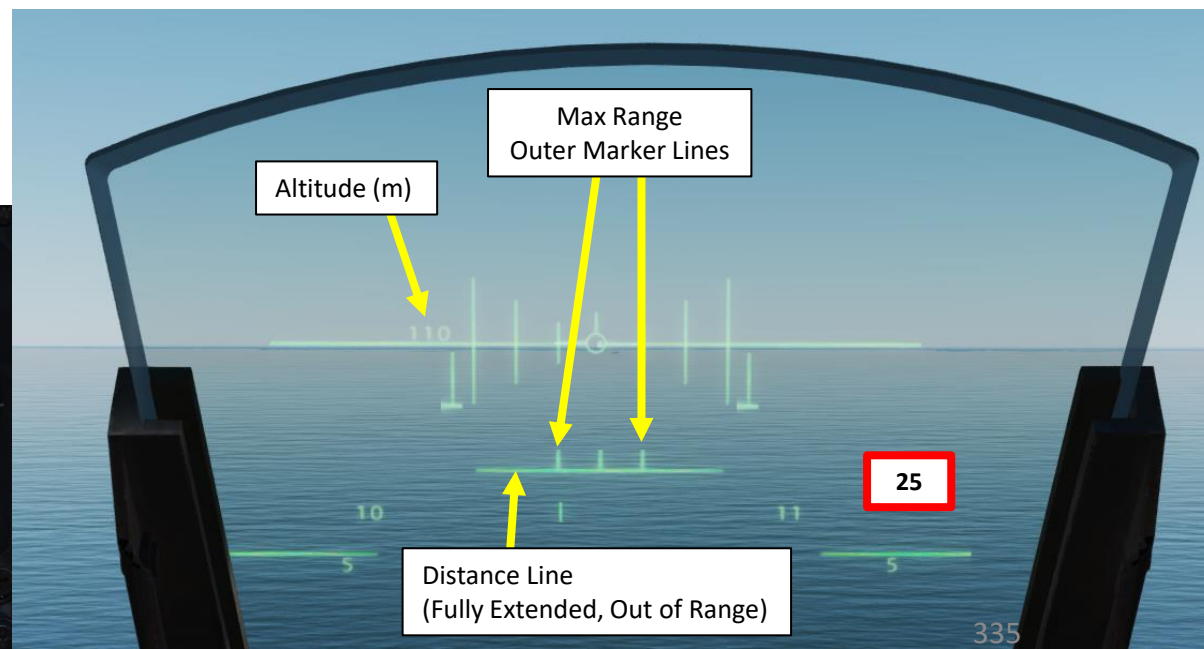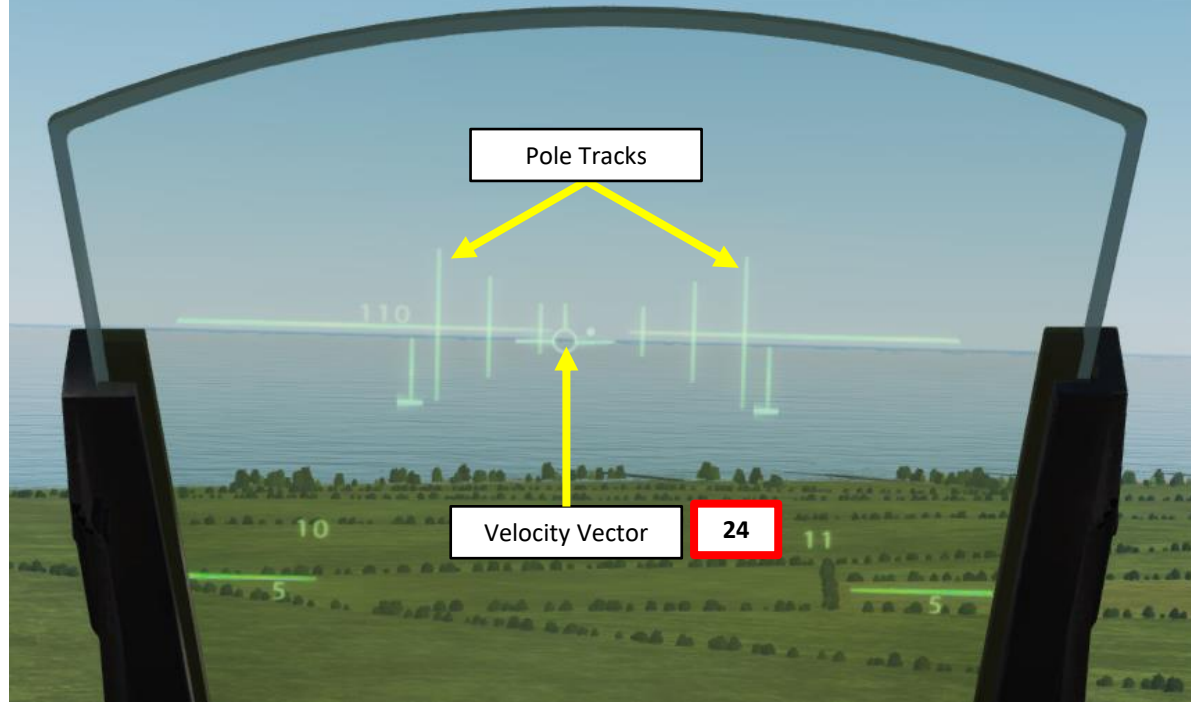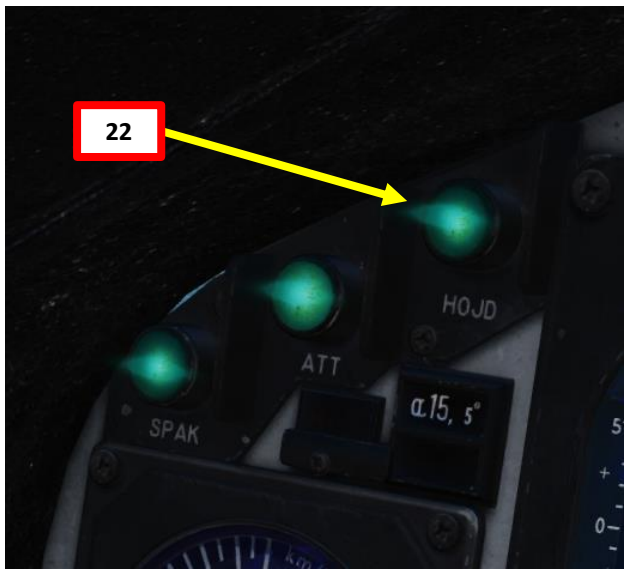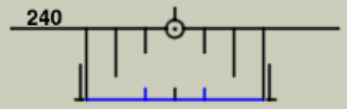
3 – Anti-Ship Weapons

3.1 – RB-04E Anti-Ship Missile

D – Perform Attack

26. Set Trigger to UNSAFE by clicking on the stick's safety cover.
27. When the Distance Line shrinks to within the launch zone (inside the Outer Markers), you are within the acceptable launch zone. This zone is generally within 20 km to the target.
    - Note: if the Distance Line is flashing, this means that you are about to reach the minimum release zone. You are about to be too close to the target.
28. Press and hold the Weapon Release trigger to launch the missile.
29. Keep the Weapon Release trigger pressed and hold it until the FALLD LAST (STORES RELEASED) light illuminates. This indicates that the missile has been released.

Trigger SAFE

Trigger UNSAFE

26

28

24 km Range Marker

Ship (Out of Range)

12 km Range Marker

27a

Out of Max Range

Max Range Outer Marker

Max Range Outer Marker

Distance Line (Out of Range)

24 km Range Marker

Ship (In Range)

12 km Range Marker

27b

Within Max Range

Max Range Outer Marker

Max Range Outer Marker

Distance Line (In Range)

336
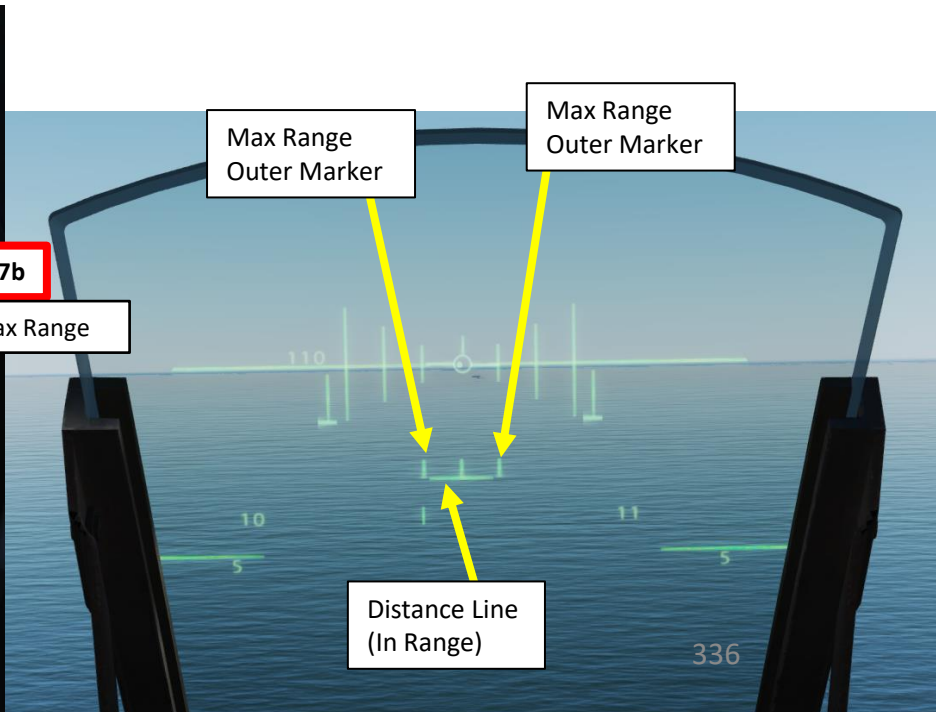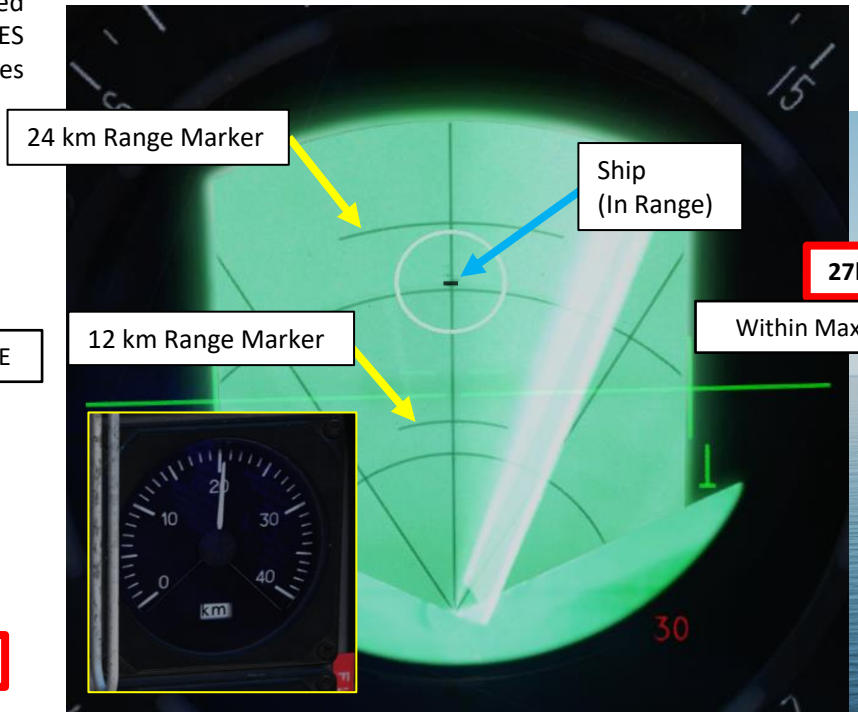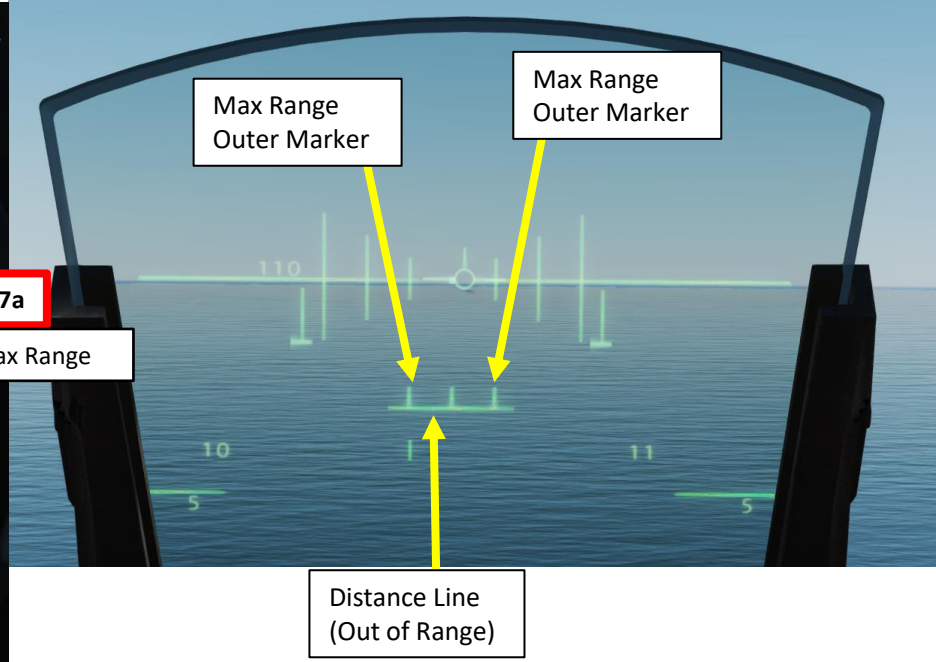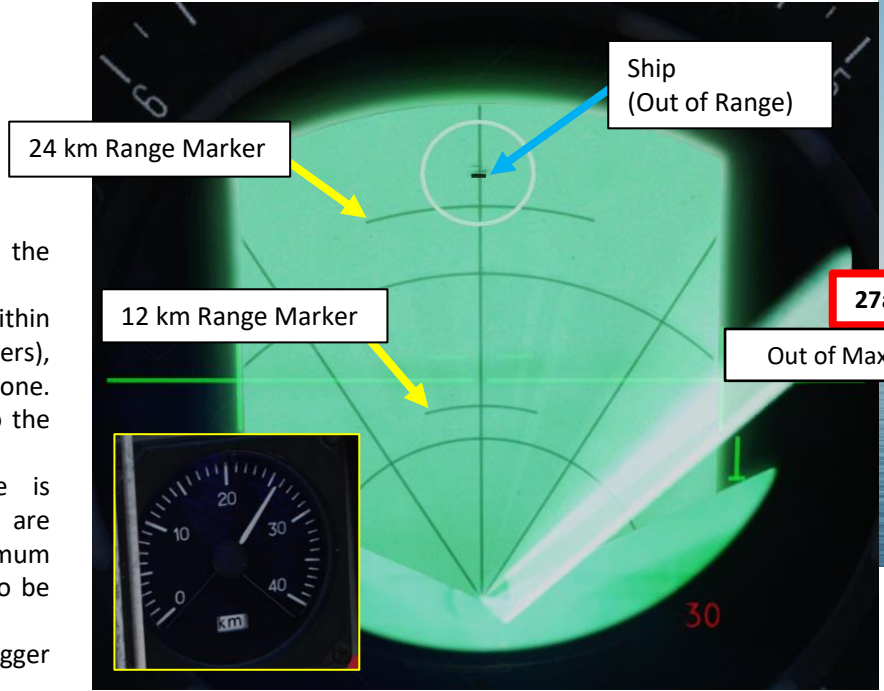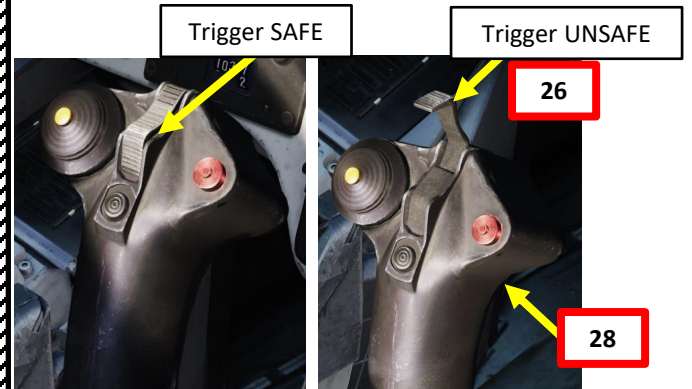
3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

D – Perform Attack

30. Upon release, the missile will descend to 10 meters AMSL (Above Mean Sea Level) and fly towards the target area, provided that the aircraft was flying in that direction at the time of launch.
    - Note 1: When released in series the missiles will separate slightly and ignite the rockets with a delay. The second missile is released 2 seconds after the first.
    - Note 2: On missile release, a forceful trim change in roll occurs in the aircraft, which is easily countered by stick input. With the attitude / altitude hold function enabled, this trim change is dampened and negligible.
31. When FALLD LAST (STORES RELEASED) light illuminates, the missile has been launched.
32. The RB-04 missile's radar will detect the ships from approximately 8 km with a detection width of ± 28 deg.
33. Once all missiles are launched (FALLD LAST (STORES RELEASED) light illuminates), pull away from the target.
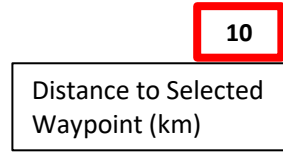
Illuminates when missile is released

3 – Anti-Ship Weapons
3.1 – RB-04E Anti-Ship Missile

D – Perform Attack

34. Since we fired both missiles in SERIES, they will both converge on the first ship detected by their on-board radar until impact.
35. Set Trigger to SAFE by clicking on the stick's safety cover.
36. Set Master Mode to NAV and resume flight.

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

The RB-15F Anti-Ship missile is one of the most advanced weapons in DCS. Why? Because it is a missile that can be programmed to do pretty much whatever you want it to do. The concept of the RB-15 is that you should be able to fire (and forget) the missile from as far as possible, and then the missile will follow a set of specific mark points (Bx6, Bx7, Bx8, Bx9) until it reaches the target (boom). These mark points can be preset in the mission editor (which makes your life easier), or they can be set manually one by one, or they can be automatically generated using a certain method that we will see in this tutorial. The Mark Points Bx are reserved for this missile; here is what their functions are.

- **Bx6**: Descent Point. This is where the missile will start its descent towards mark point Bx7 (Course Change Point).
- **Bx7**: Course Change Point. This is where the missile will turn towards the target.
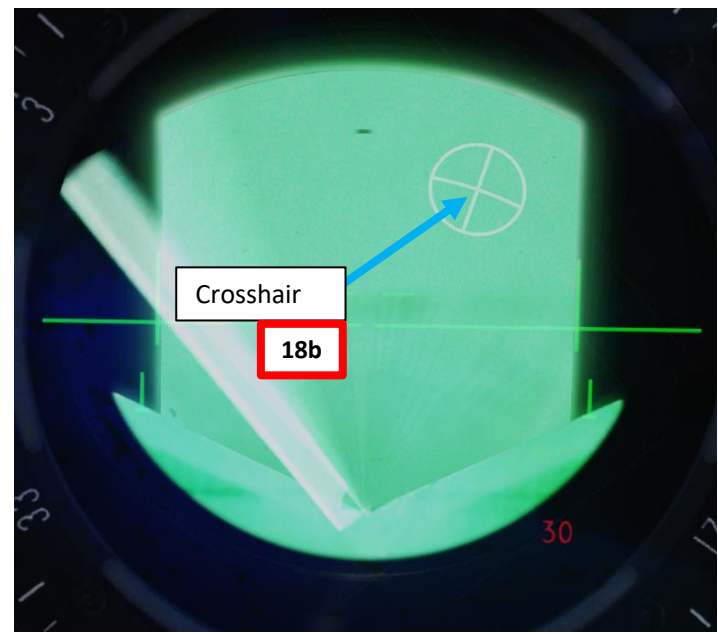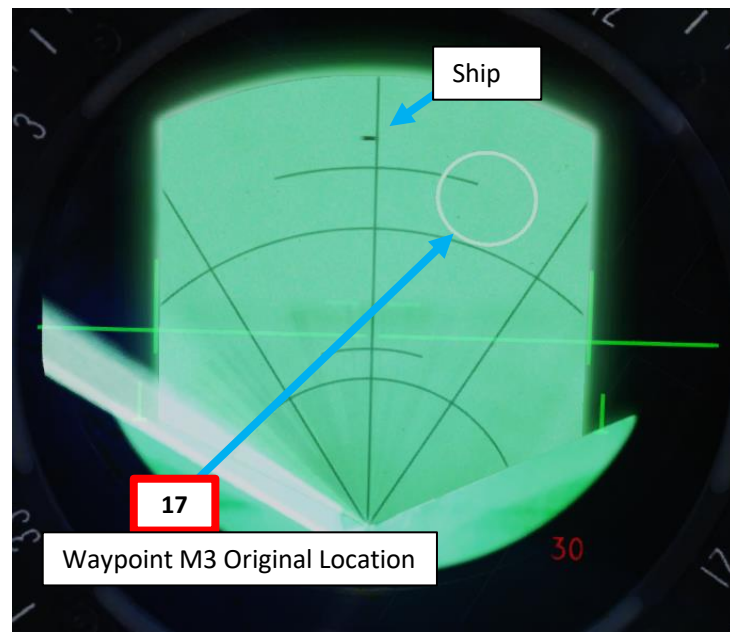- **Bx8**: Assumed Target position (ATP). This is where the naval target is expected to be, and where the missile will strike.
- **Bx9**: Missile auto-destruction point. If a ship is docked in a port or near civilians, the missile can be programmed to self-destruct in case it misses the target. Since we are not scumbags, this point should be placed before the missile goes crashing straight into an orphanage.

xxJohnxx Tutorial for RB-15F (Basic): https://www.youtube.com/watch?v=rmb6V5yDcGw

xxJohnxx Tutorial for RB-15F (Advanced): https://www.youtube.com/watch?v=Te2y1V-hu5A
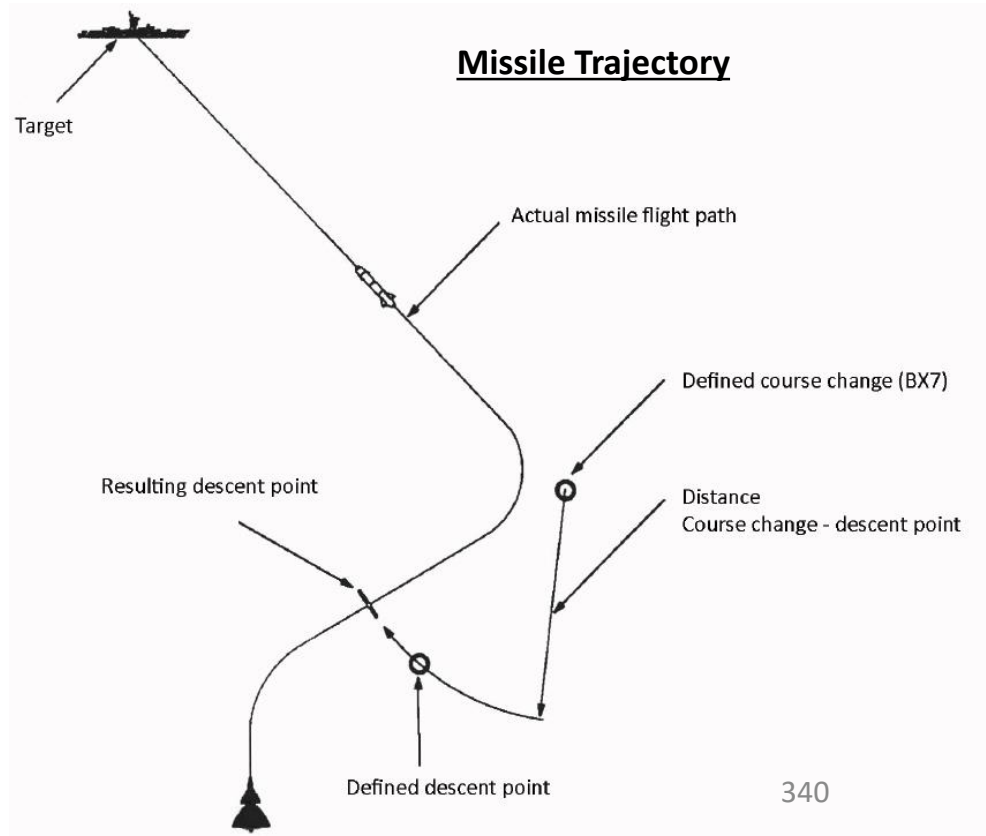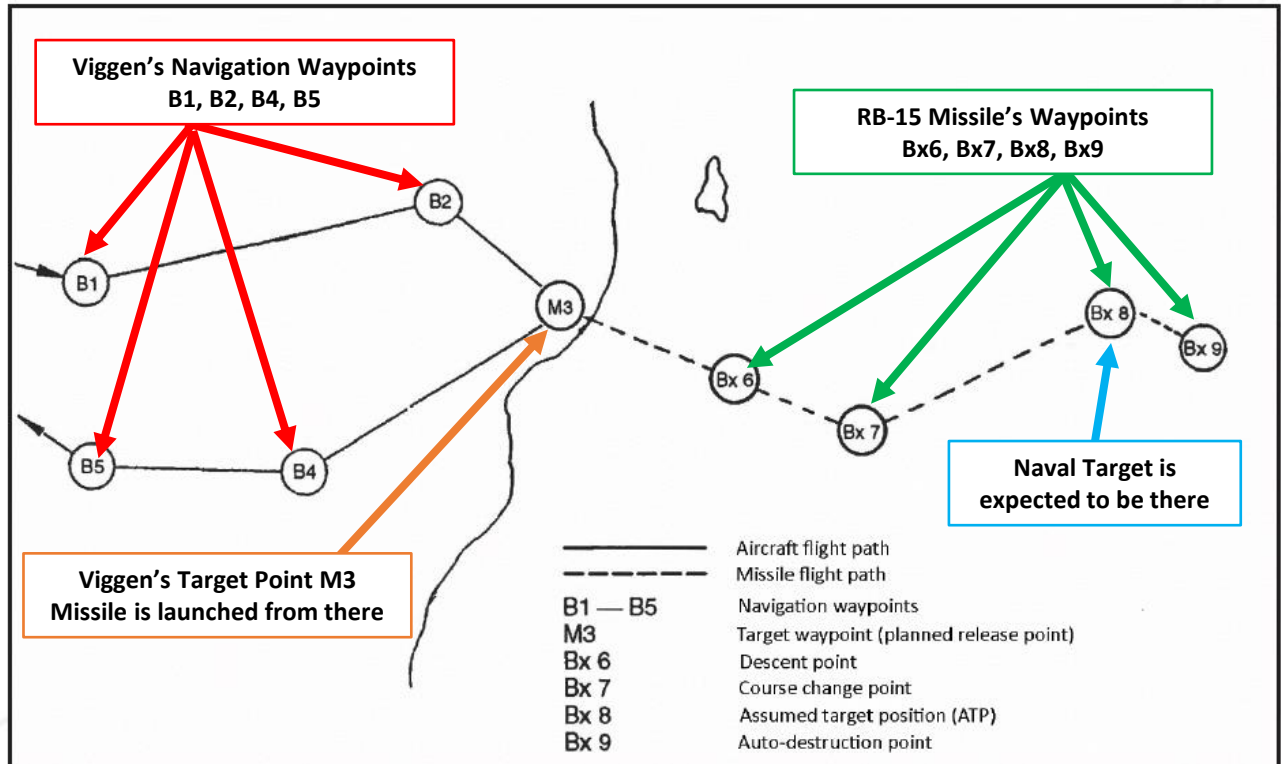
Missile Trajectory

340

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

In the following attack tutorial, we will follow waypoints B1 and B2, and then use Target Point M3 to launch the missile to the target at Bx8. **Using a waypoint is not mandatory** since the RB-15 can be launched at any time in "Quick Mode". However, a waypoint (or target fix) will provide you with range information to the target, which is critical in order to know when to launch the anti-ship missile.

Unlike the RB-04E, the RB-15F can be launched when flying over land since it will only descend when reaching the Descent Point Bx6.

It should be noted that the RB15 missile has a maximum range of 70 km (about 37.5 nm). Plan your Bx points accordingly.

Approaching the Target

Waypoint B2

Waypoint Bx9
Self-Destruction Point

Enemy Ship

Waypoint B1

Your Position

Waypoint Bx6
Descent Point

Aircraft Flight Path

Missile Flight Path

Waypoint B5

Waypoint B4

Waypoint Bx8
ATP (Assumed Target Position)

Waypoint B3
Target Point M3
Missile Launched from here

Waypoint Bx7
Course Change Point

341
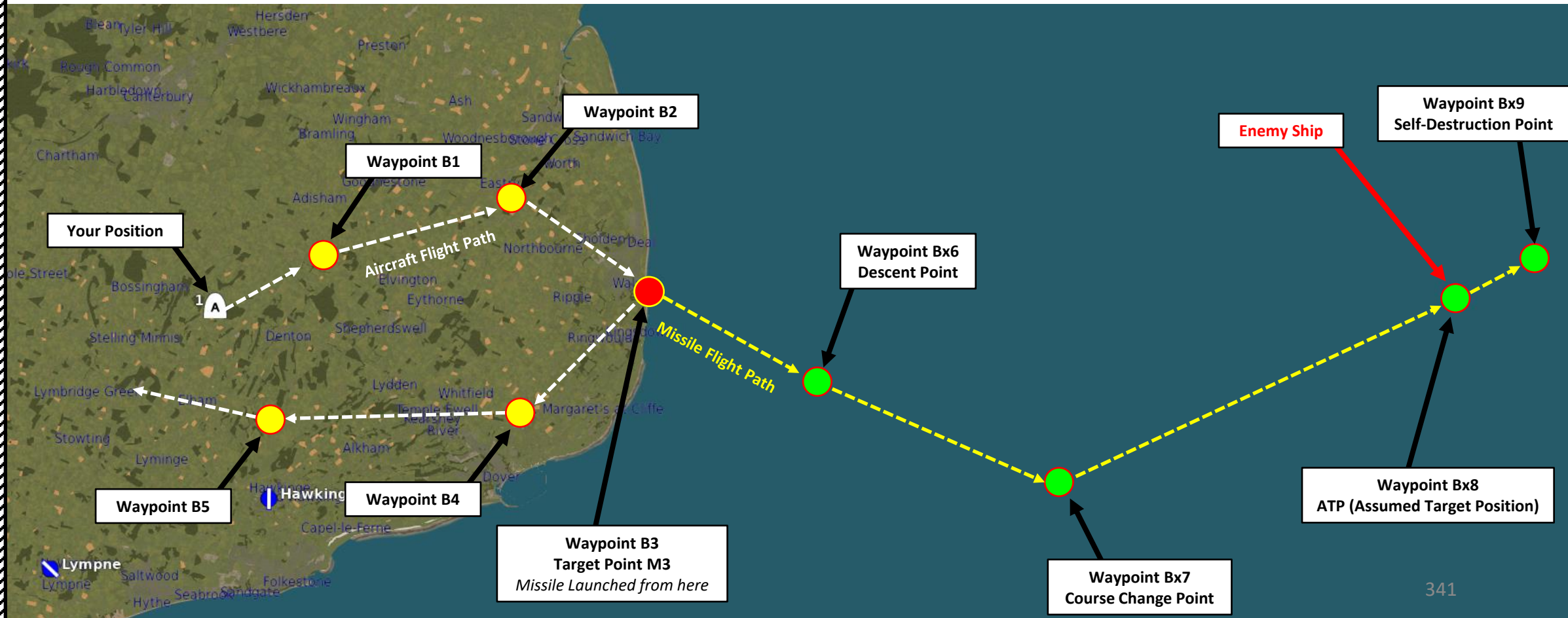
3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

A – Planning: MISSILE TRAJECTORY

There are four main methods of creating the waypoints used by the missile:
1. Designating the ATP (Assumed Target Position) on Waypoint BX8 with a target fix, which will automatically generate other waypoints for the missile. This is the method we will use.
2. Creating marker labels on the F10 map (see PART 17 - DATA CARTRIDGE section), then loading the data cartridge. This isn't always an option if the target is not visible on the map.
3. Using the Mission Editor's Navigation Target Points. Keep in mind that this has to be done by the mission creator prior to the flight, which isn't always an option.
4. Entering waypoint coordinates manually for BX6, BX7, BX8 and BX9 from the CK37 computer keypad. This one is a hassle and is practically never used in DCS.
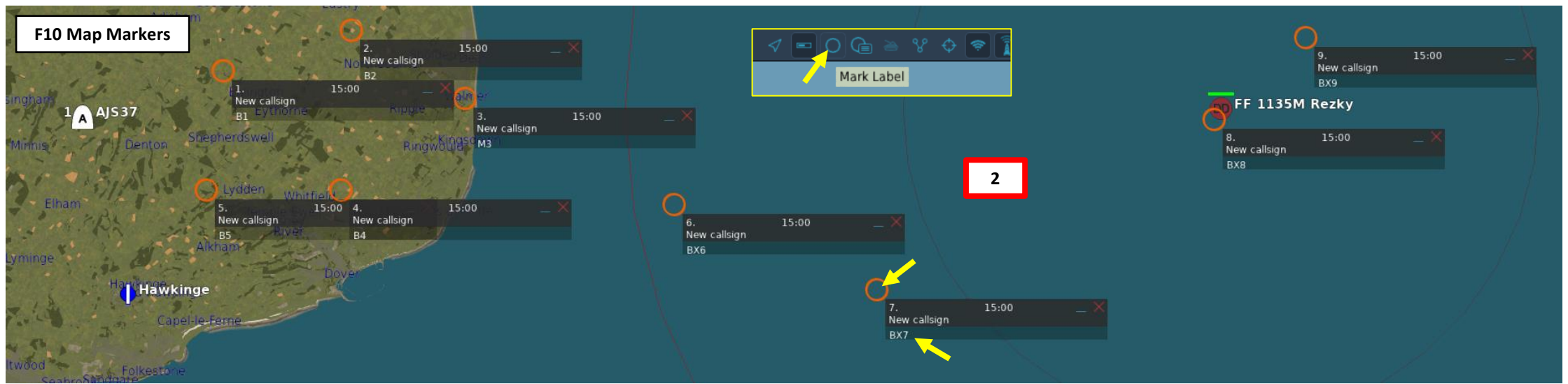
3 – Anti-Ship Weapons
3.2 – RB-15F Anti-Ship Missile

B – Weapon Setup

1. Set Weapon selector to ATTACK.
2. Set Weapon Release Mode selector as desired:
   - SERIE (UP): Releases both RB15 missiles
   - IMPULSE (DOWN): Releases a single RB15 missile
3. Set Targeting Mode (MÅLVAL) / Preparation Switch as desired:
   - STD (DOWN): Missile guidance and seeker are programmed with standard values. Missile will search for targets near the ATP (Assumed Target Position) and lock the target closest to the ATP (Area / Single target mode). **This is what we will use**.
   - VALB (UP): Selectable Program. Missile guidance and seeker are programmed with values in addresses 81-88 that the pilot has set.
4. Set the HUD to the LOWER position to ensure HUD data is properly displayed during attack run.
5. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
6. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
7. Read QFE of Target from Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages), which is located on Waypoint B3 (M3).
8. Set altimeter pressure to the QFE of the Target. Failing to do this step will cause the weapons release symbology on the HUD to be unusable.

WAYPOINT NAME M3			
COURSE (T) 109	HEADING (M) 109	G/S 244	IAS 217
DISTANCE 6.2	TOF 00:01:31	ETA 15:03:04	QFE 1012.8
ALTITUDE 4	VERTICAL ANGLE -18	FUEL RESERVE 120	BINGO FUEL 16

3 – Anti-Ship Weapons
3.2 – RB-15F Anti-Ship Missile

C – Advanced Missile Programming (Optional, used with VALB)

If you have set up the Targeting Mode (MÅLVAL) / Preparation Switch to VALB (UP), you can program a number of missile profile characteristics.

Targeting Mode (MÅLVAL) / Preparation Switch
VALB: Program Selectable

Missile Seeker Modes

- *AREA search*
  - Used when the target position (ATP) is known. The missile will search within an area near the ATP. Size of the area can be pre-set via the addressed data in four categories, precision, small, medium and large. Search altitude of the missile is dependent on the set area size. If the distance to the ATP is less than 2 km, mode CLOSE is automatically engaged.
- *BEARING*
  - Used when only the bearing to target is known. Radar will sweep in an increasing arc from a narrow search up to ±35°. Search range is about 6- 24 km. Search altitude is always 30 meters.
- *CLOSE*
  - Similar to BEARING, but with reduced range (2- 20km). Seeker will lock on the first detected target.

Note: The seeker search sweep can be limited sideways by inputting data. The entered lines are set in distance left or right of the missile's search centerline in whole kilometers (1 - 15). Boundary lines are parallel to the centerline and is used to electronically block contact outside of this line.

****

Target Selection Modes

- *Single target*
  - The missile will lock the target closest to the ATP in mode AREA. If in mode BEARING the target closest to the search centerline is selected.
- *Multiple targets (N)*
  - Missile will at random select one of the three targets closest to the ATP.
- *Multiple targets (A)*
  - Missile will at random select any of the detected targets.
- *Group targets*
  - Missile will determine a group of ships that are within 3 km of each other. From this group, a target is selected at random.
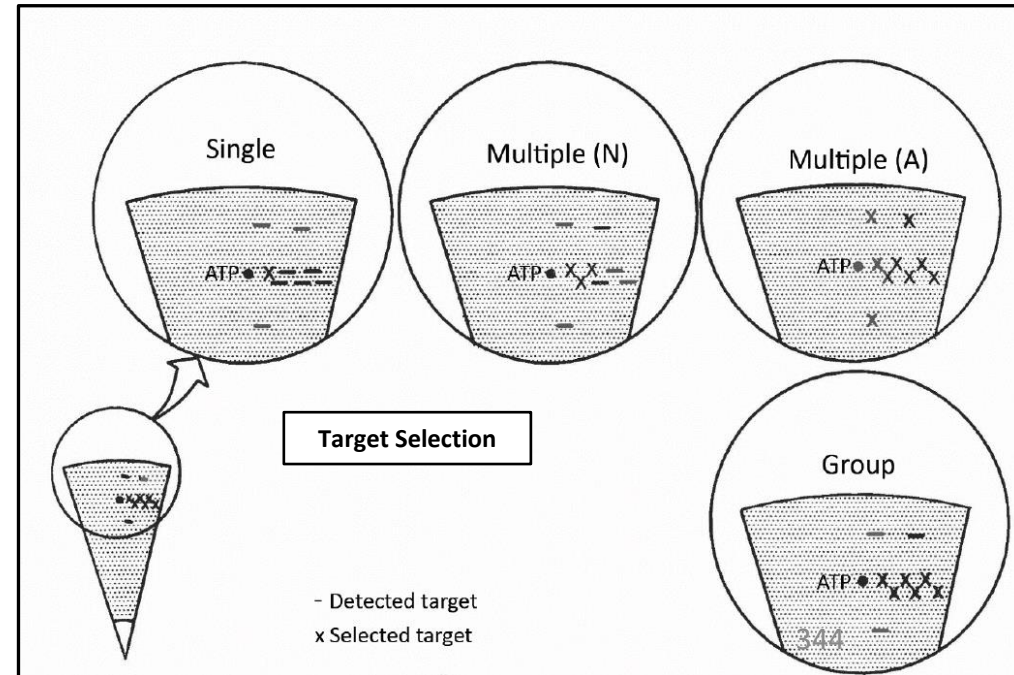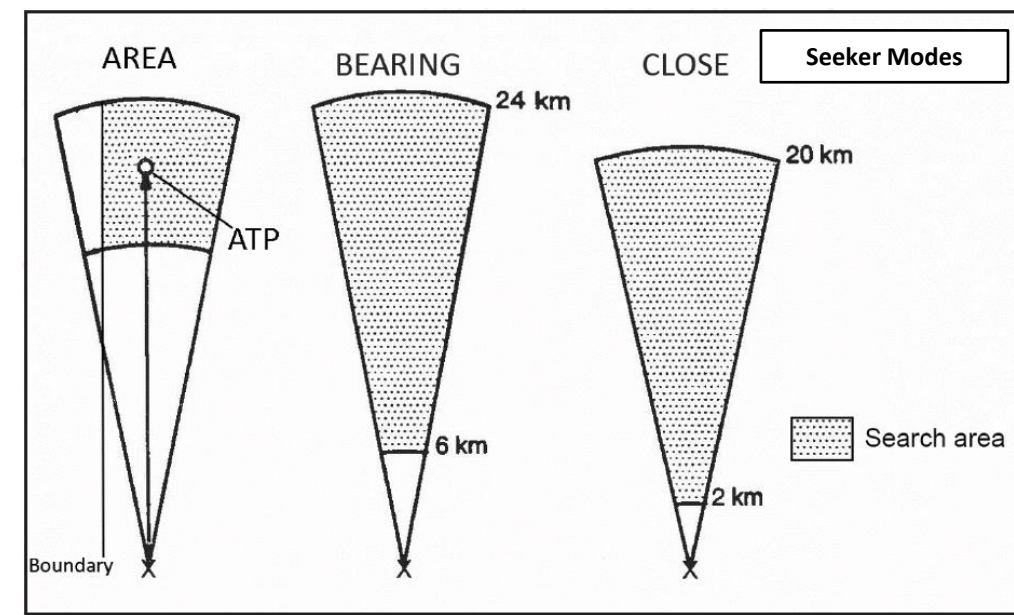
Seeker Modes

Target Selection

3 – Anti-Ship Weapons
3.2 – RB-15F Anti-Ship Missile

C – Advanced Missile Programming (Optional, used with VALB)

There are preset missile attack profile/programs that you can use.

- 800000 (same program as using STD on targeting selector switch):
  - Single target, large search area.
- 800001: Confined area attack.
  - Multiple targets N, medium area search.
- 800002: Unconfined area attack.
  - Multiple targets A, medium area search.
- 800003: Convoy attack.
  - Group target, large area search.
- 800004: Bearing attack.
  - Bearing search mode.

To select a preset profile for the missile:
  a) Set Data Selector to TAKT
  b) Set INPUT/OUTPUT Selector to IN
  c) Enter code for desired program on the keypad. In our case, we will use "800001" for a Confined Area attack.
  d) Press LS/SKU button
  e) Set INPUT/OUTPUT Selector to UT (Output)
  f) Set Data Selector to AKT POS (Active Position)
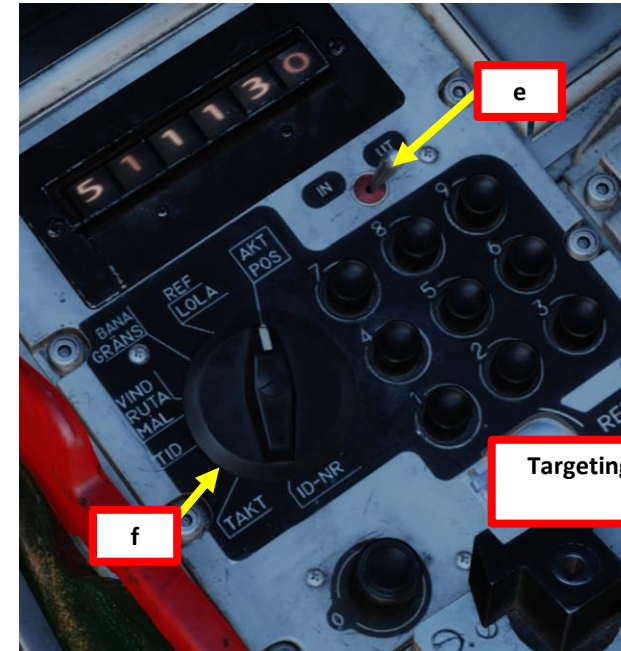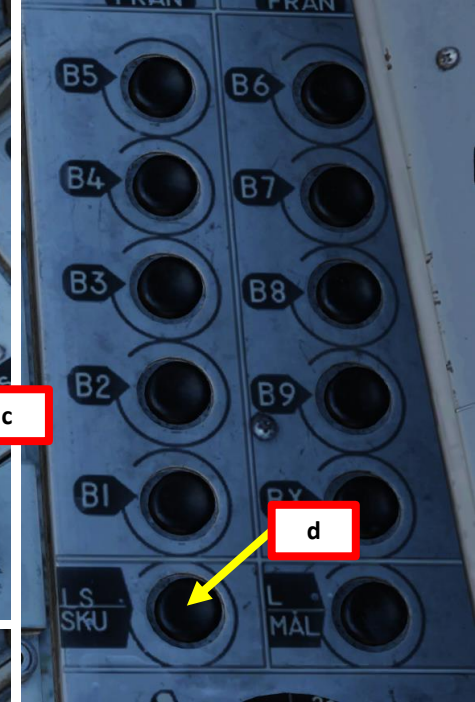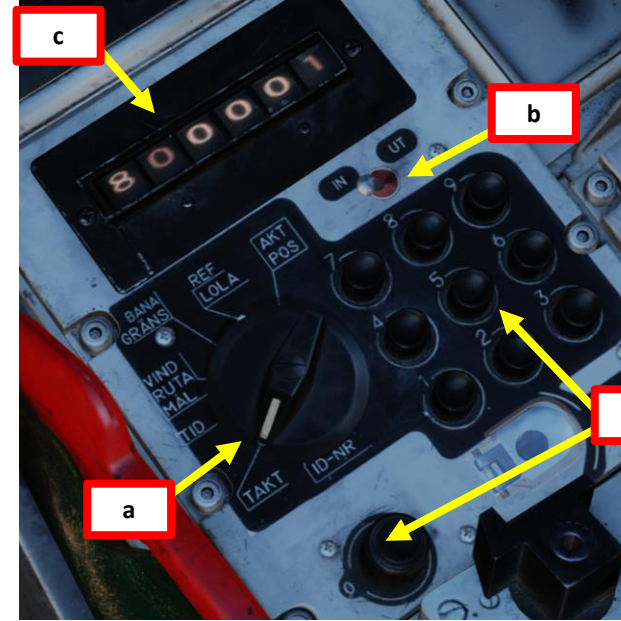
**Targeting Mode (MÅLVAL) / Preparation Switch
VALB: Program Selectable**

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

Note: Standard value (STD) in bold in the address tables.

C – Advanced Missile Programming (Optional, used with VALB)

If you want to customize these preset profiles, you can do so by entering codes in the CK37 computer in a similar manner.

Address 81 (81XXXX) / Target Selection / Standard (STD) code set to 810111

3rd Digit X: Single Target (Standard)	0 = YES / 1 = NO
4th Digit X: Multiple Target N	0 = YES / 1 = NO
5th Digit X: Multiple Target A	0 = YES / 1 = NO
6th Digit X: Group Target	0 = YES / 1 = NO

Example: We want to use the Group Target option. Set TAKT – INPUT, enter « 811110 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT.

Address 83 (83XXXX) / Seeker Modes / Standard (STD) code set to 830000

3rd Digit X: Altitude after descent point (Bx6) sea skimming (Standard)	0 = YES / 1 = NO (30 meters above sea level)
4th Digit X: Area / Bearing Search Option	0 = AREA SEARCH / 1 = BEARING SEARCH
5th Digit X: No Function	Set to 0
6th Digit X: No Function	Set to 0

Example: We want to use the sea skimming + Bearing Search option. Set TAKT – INPUT, enter « 830100 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT.

Address 84 (84XXXX) / Search Area Size / Standard (STD) code is set to 841110

3rd Digit X: Precise Search Area	0 = YES / 1 = NO
4th Digit X: Small Search Area	0 = YES / 1 = NO
5th Digit X: Medium Search Area	0 = YES / 1 = NO
6th Digit X: Large Search Area (Standard)	0 = YES / 1 = NO

Example: We want to use the Precise Search Area option. Set TAKT – INPUT, enter « 840111 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT.

Address 85 (85XXXX) / Boundary Line / Standard (STD) code set to 851100

3rd Digit X: Boundary Line Left	0 = YES / 1 = NO
4th Digit X: Boundary Line Right	0 = YES / 1 = NO
5th Digit X and 6th Digit X: Distance from 01 to 15 km (2 digits)	Distance in km (2 digits)

Example: We want to use a left boundary line option with a distance of 12 km. Set TAKT – INPUT, enter « 850112 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT.

Address 86 (86XXXX) / Target Approach / Standard (STD) code set to 861000

3rd Digit X: Target approach from 10 m above sea level (no = sea skimming)	0 = YES / 1 = NO (sea skimming)
4th Digit X, 5th Digit X, 6th Digit X: No Function	Set to 0

Example: We want the missile to approach the target from 10 m above sea level. Set TAKT – INPUT, enter « 860000 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT.

Address 87 (87XXXX) / Wind Direction

3rd Digit X, 4th Digit X, 5th Digit X: Wind Direction in Target Area (000 – 360 degrees, 3 digits)	3-digit wind direction
6th Digit X: No Function	Set to 0

Example: We want to use set the Wind Direction to 250. Set TAKT – INPUT, enter « 872500 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT. If not added here, the wind direction is sourced from the aircraft (either programmed wind or Doppler readings).

Address 88 (88XXXX) / Wind Speed/Strength

3rd Digit X and 4th Digit X: Wind strength/speed in km /h (00-99 km/h, 2 digits)	2-digit wind speed
5th Digit X and 6th Digit X: No Function	Set to 0

Example: We want to use set the Wind Direction to 25 km/h. Set TAKT – INPUT, enter « 882500 » on the keypad, then press LS/SKU. Set AKT POS – OUTPUT. If not added here, the wind strength is sourced from the aircraft (either programmed wind or Doppler readings).

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

D – Search Target & Perform Target Fix with Radar

9. Set Data Selector to AKT POS - OUTPUT.
10. Navigate to M3 (Target Point). The existing waypoint should be where you will launch the missile.
11. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
12. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
13. Adjust radar display range as required.
14. Set Master Mode to ANF (Anflygning/Attack).

14

10

Distance to Selected Waypoint (km)

10

Radar Mode Selector – A1 (Wide Search with PPI)

11

12

Radar Brightness Control (LJUS RADAR)

Ship

Target Point M3 (Missile Launch)

Radar Scan Range Selector

13

9b

13 Display Range: 60 km

Radar MKR Potentiometer (Amplification Gain) Dial

12

9a

347
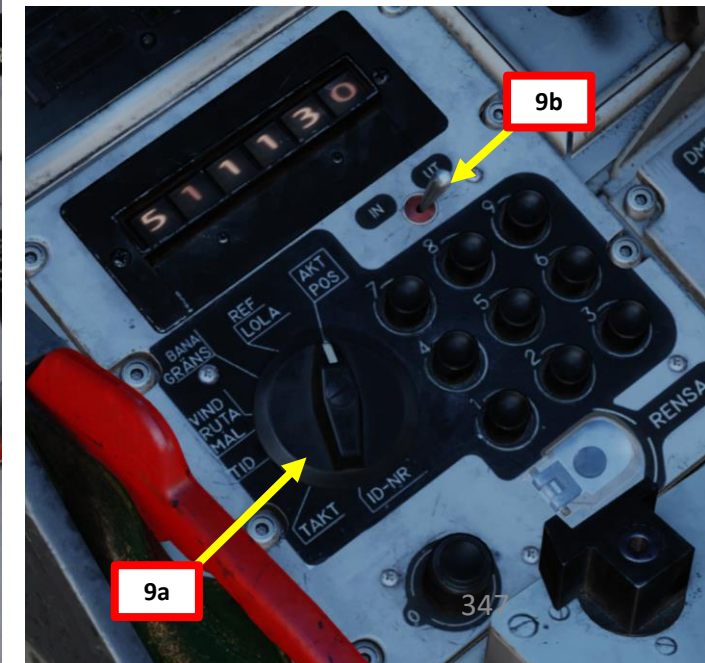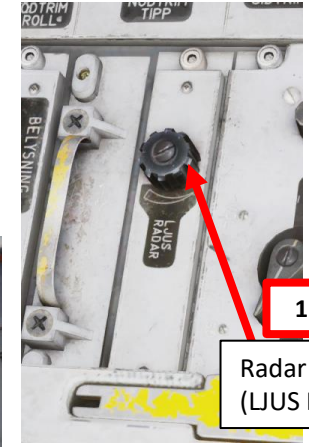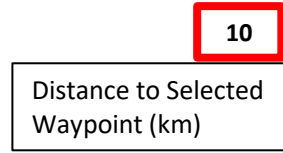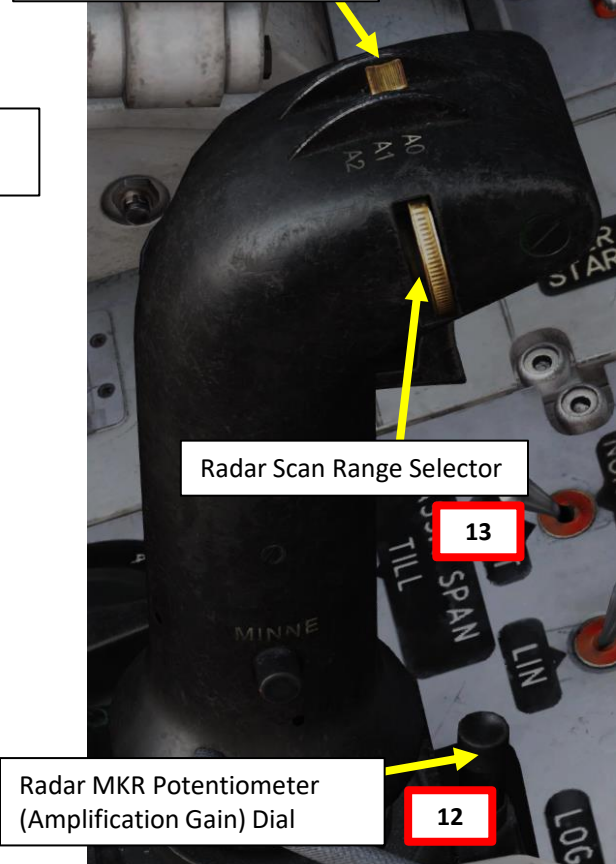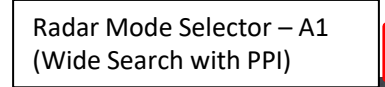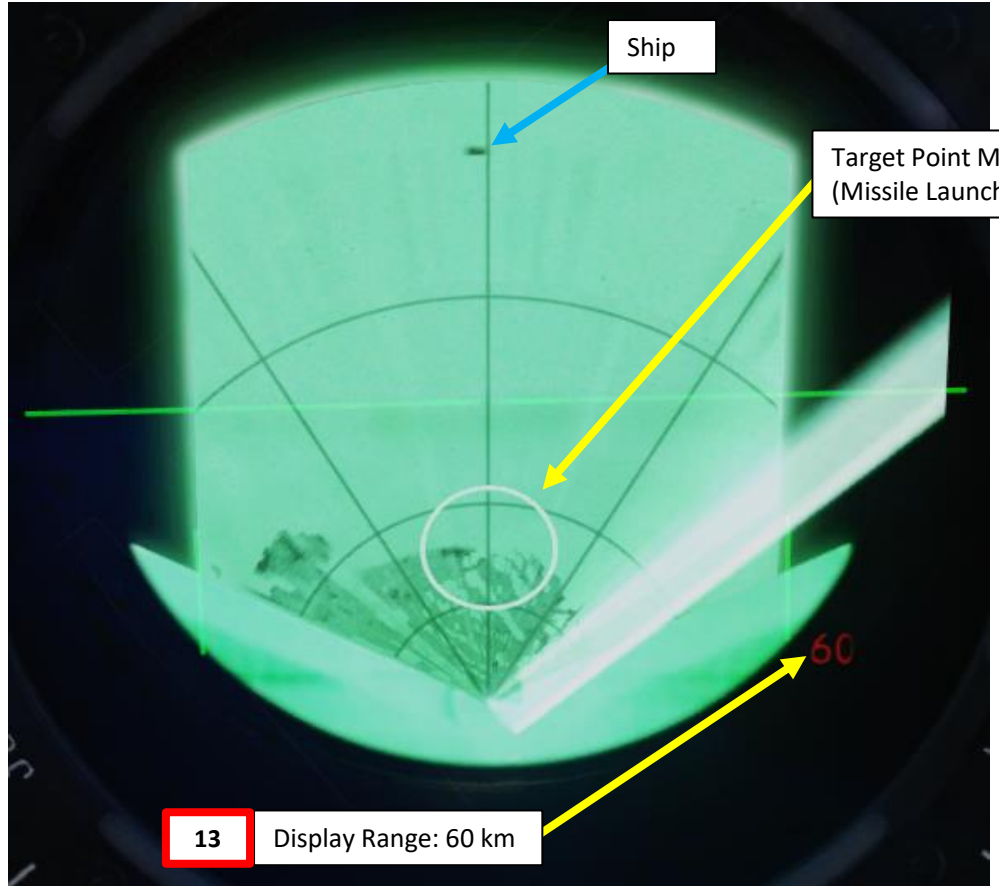
3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

D – Search Target & Perform Target Fix with Radar

15. In our case, the ATP (Assumed Target Position) Bx8 is not yet defined.
16. Double-check that data Selector is set to AKT POS – OUTPUT, then press the "BX" button, then enter "8" on the keypad. This will select the ATP (Assumed Target Position) Waypoint Bx8.
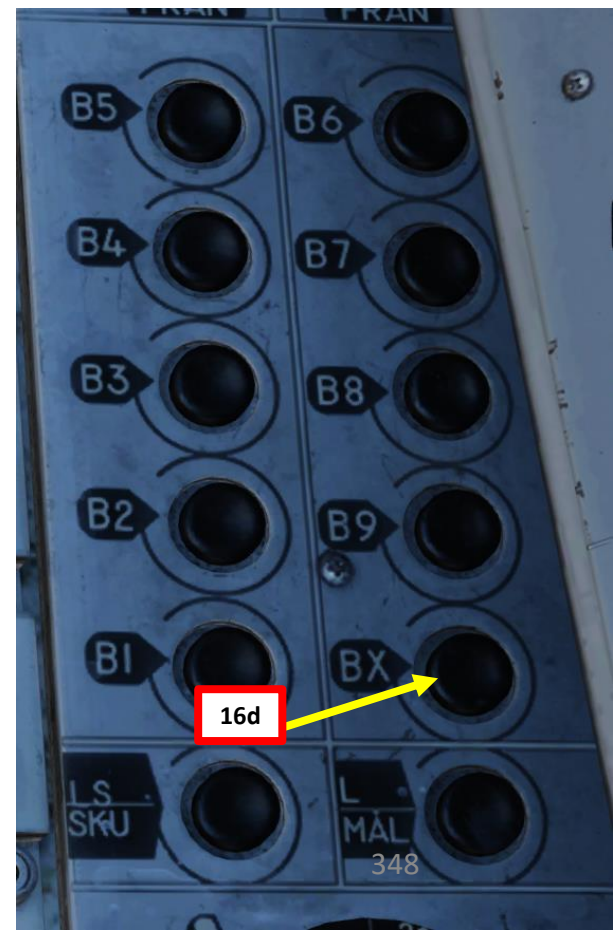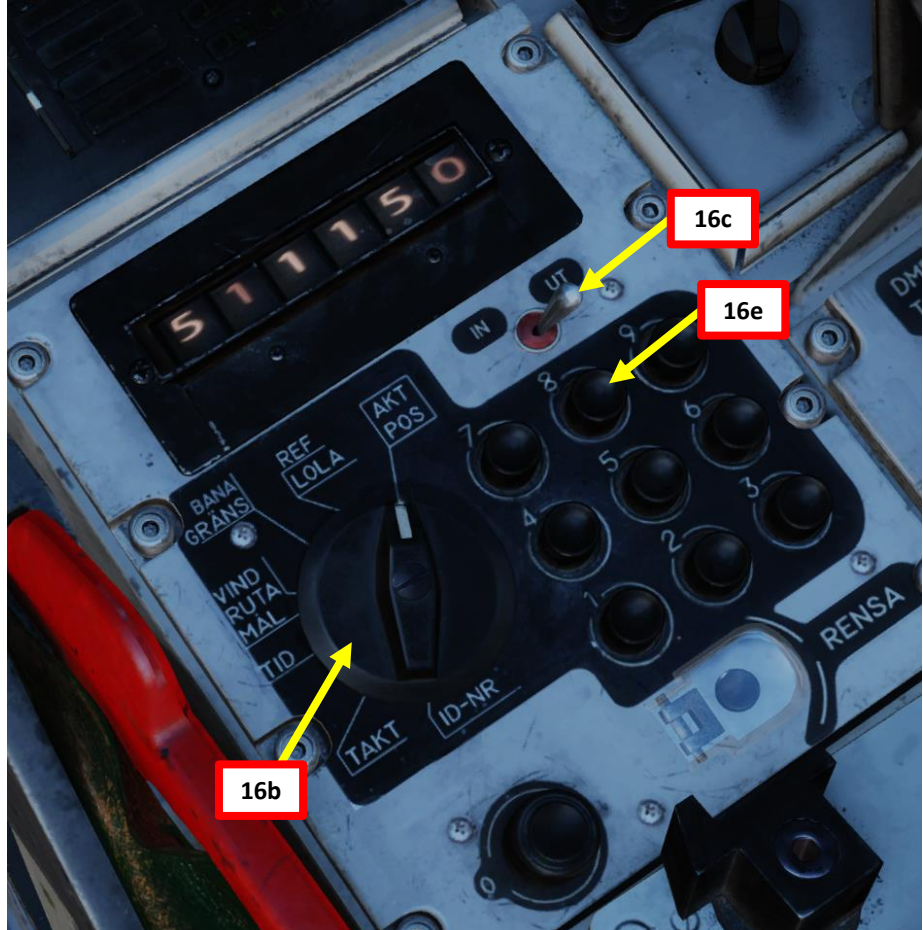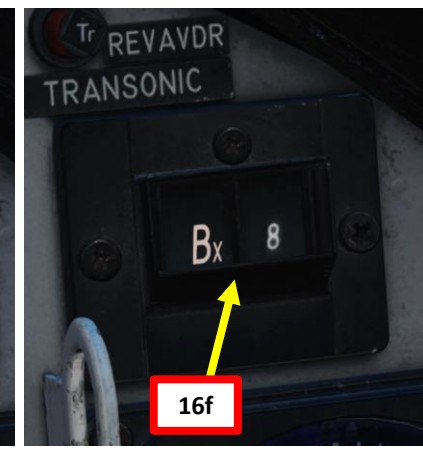
16a

16f

16c

16e

16b

16d

348

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

D – Search Target & Perform Target Fix with Radar

17. Once you have spotted a ship on the radar, we will designate the ATP (Assumed Target Position, Bx8) using a Target Fix.
18. Verify that radar range display is sufficient to see the target. 60 or 120 km is generally a good range.
19. Press the radar fix trigger to "T1" (first trigger detent).
20. A crosshair will appear in the middle of your display. Move crosshair over target using the radar stick controls
21. Press the radar fix trigger to " TV" (second trigger detent), which will set the target fix on the target. This will become the new location of ATP Bx8.

Note: Radar fixing Bx8 subsequent times will automatically move Bx7 and Bx6 by the same direction/distance.

20a

Radar Stick Control:
- Radarstick Up/Down/Left/Right
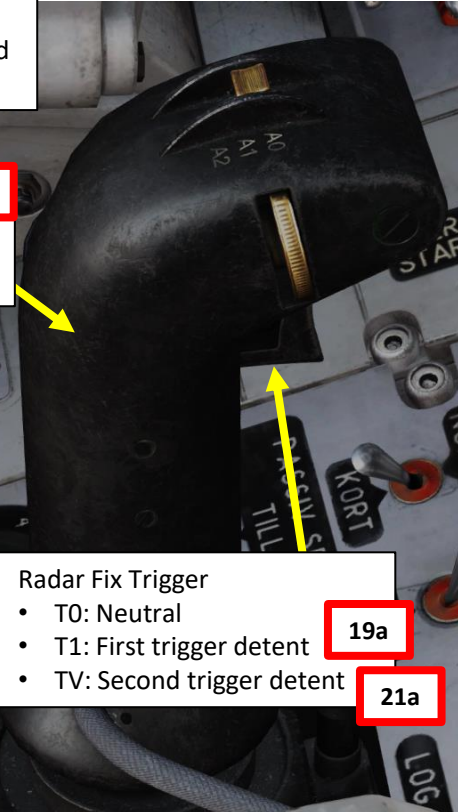
Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent   **19a**
- TV: Second trigger detent   **21a**
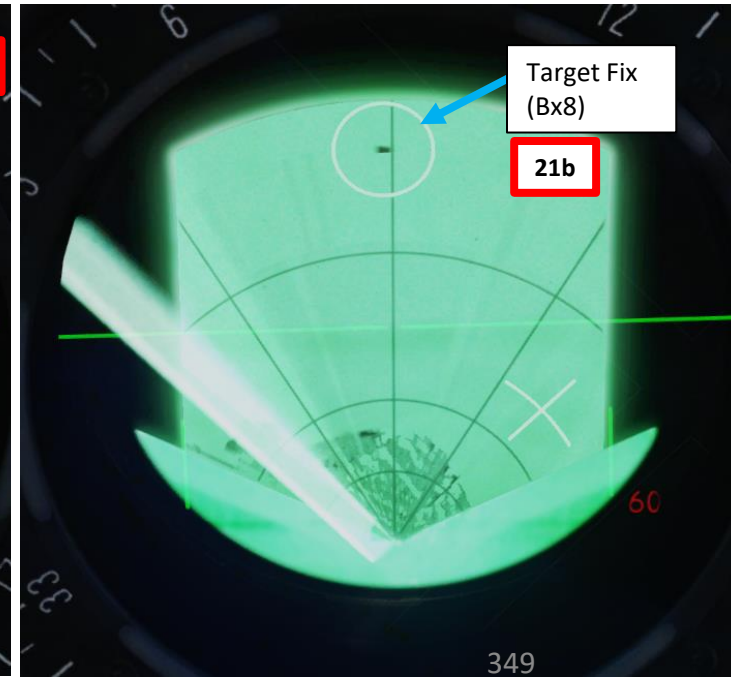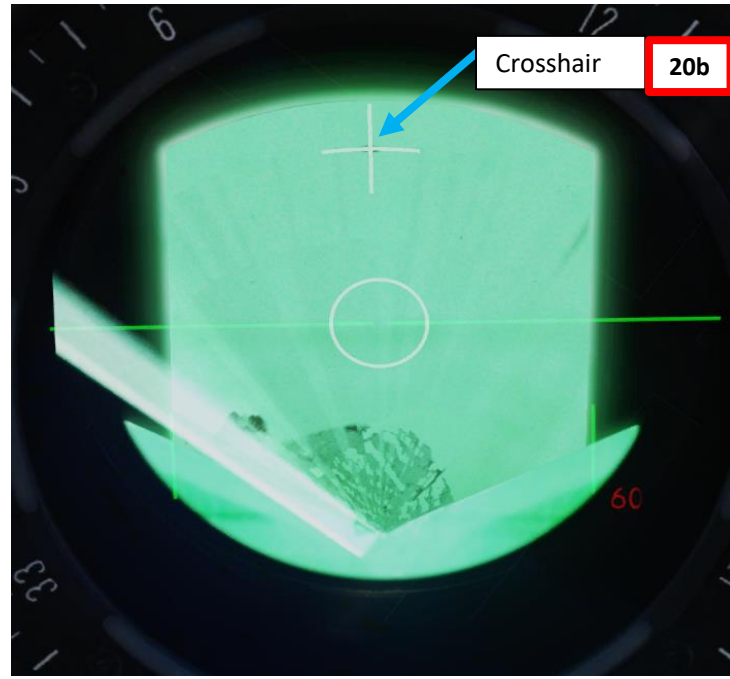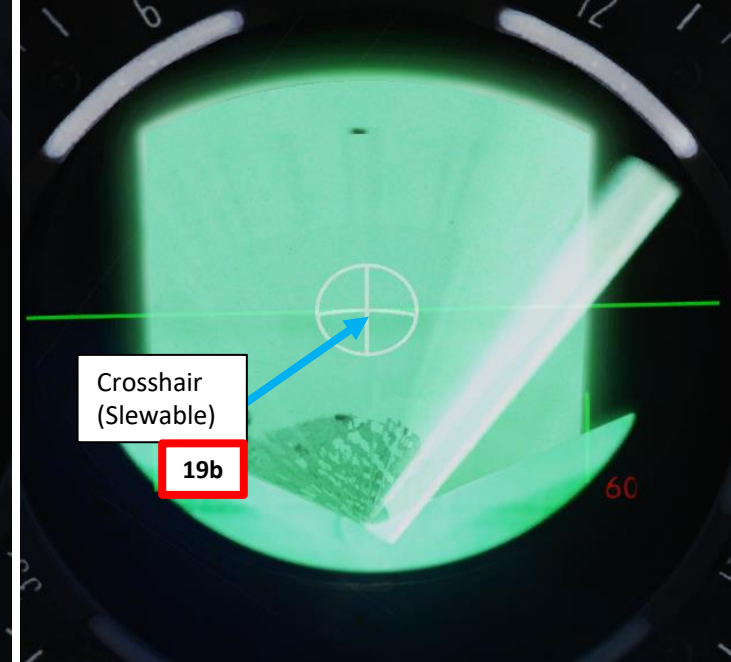
17 Ship

Waypoint M3

Crosshair (Slewable)

19b

Crosshair   **20b**

Target Fix (Bx8)

21b

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

E – Adjust Course Change Point (Bx7) & Descent Point (Bx6) (Optional)

22. Once you have designated the ATP (Assumed Target Position, Bx8), waypoints Bx6 (Descent Point), Bx7 (Course Change Point) and Bx9 (Self-Destruct Point) will automatically be generated. However, only Bx7 (Course Change Point) will be visible as a cross.
23. In theory, we could go for the attack run right now, but what if we're not happy with the auto-generated waypoints? What if the missile trajectory is too long for our taste? In that case, we can offset their location using the same Target Fix procedure we performed previously.
24. Let's change the location of the Course Change Point (Bx7). Double-check that data Selector is set to AKT POS – OUTPUT, then press the "BX" button, then enter "7" on the keypad. This will select the Course Change Point Waypoint Bx7.
25. Press the radar fix trigger to "T1" (first trigger detent).
26. A new crosshair will appear over the current location of Bx7. Move crosshair to desired location using the radar stick controls
27. Press the radar fix trigger to " TV" (second trigger detent), which will change the location of Course Change Point Bx7.
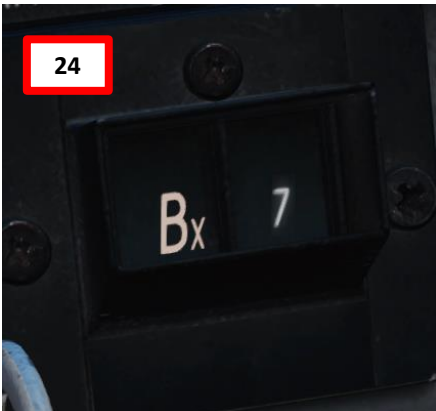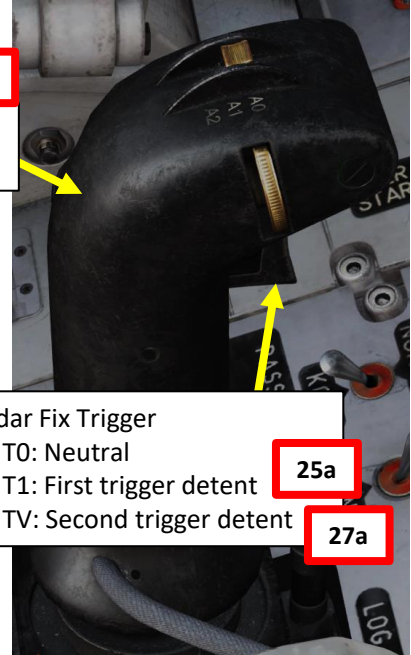
26a

Radar Stick Control:
• Radarstick Up/Down/Left/Right

24

Bx 7

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent **25a**
• TV: Second trigger detent **27a**

ATP (Assumed Target Position, Bx8)
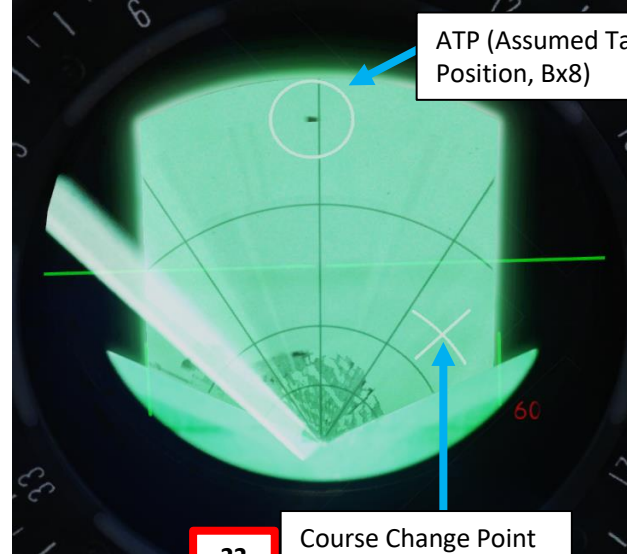
Crosshair (Slewable) **25b**

22 Course Change Point (Bx7)

New Course Change Point (Bx7)

Crosshair (new location) **26b**
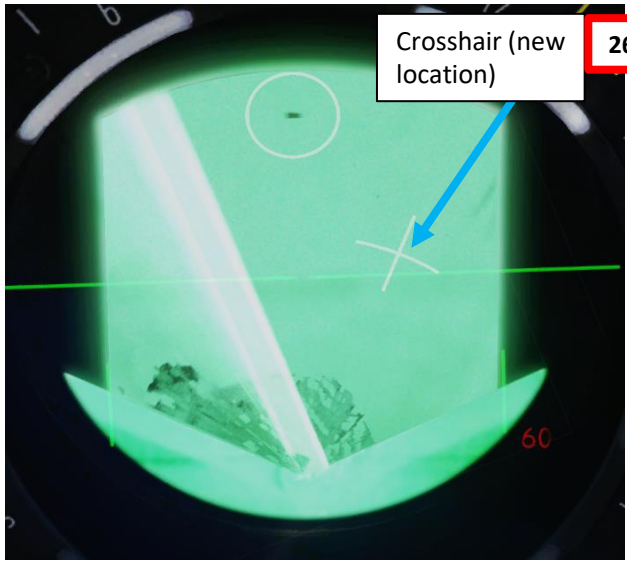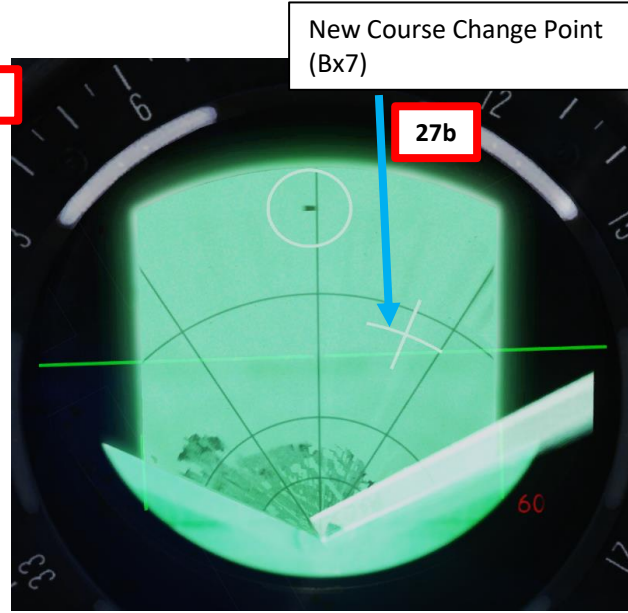
27b

The course change point BX7 cannot be placed too close to the target. The cross marker is steerable towards the target up to the minimum distance away.

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

E – Adjust Course Change Point (Bx7) & Descent Point (Bx6) (Optional)

28. Now, let's change the location of the Descent Point (Bx6). Double-check that data Selector is set to AKT POS – OUTPUT, then press the "BX" button, then enter "6" on the keypad. This will select the Descent Point Waypoint Bx6.
29. Press the radar fix trigger to "T1" (first trigger detent).
30. A new crosshair will appear over the current location of Bx6. Move crosshair to desired location using the radar stick controls. Keep in mind that you can only move the cursor in **one direction** since Bx6 must be on the axis between your aircraft and the Course Change Point Bx7.
31. Press the radar fix trigger to " TV" (second trigger detent), which will change the location of Descent Point Bx6. The new location of Bx6 will be hidden in order to not clutter the radar display.
32. Now that Bx8, Bx7 and Bx6 are set up correctly, let's attack!

30a

Radar Stick Control:
• Radarstick Up/Down/Left/Right

28

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent **29a**
• TV: Second trigger detent
31a

28

ATP (Assumed Target Position, Bx8)

29b

Bx6 Crosshair (Slewable)

Course Change Point (Bx7)

Course Change Point (Bx7)

31b

Bx6 Crosshair (new location) **30b**

Bx6 (hidden, new location)
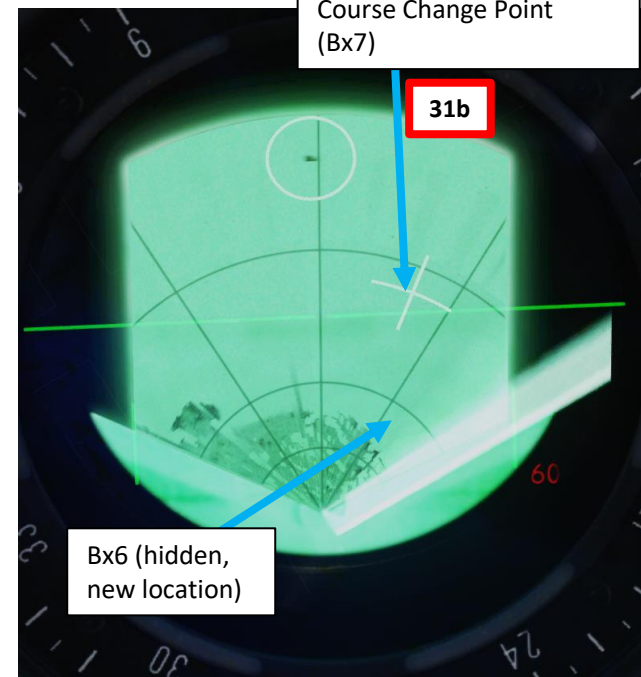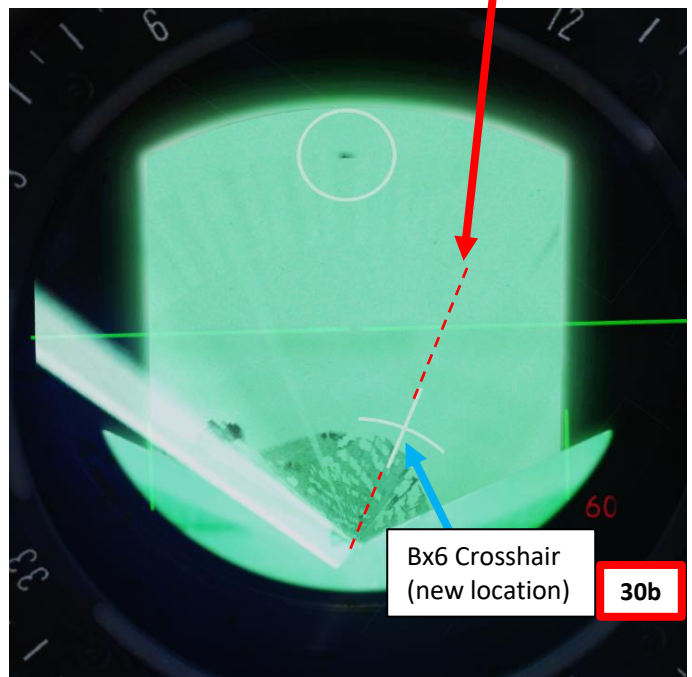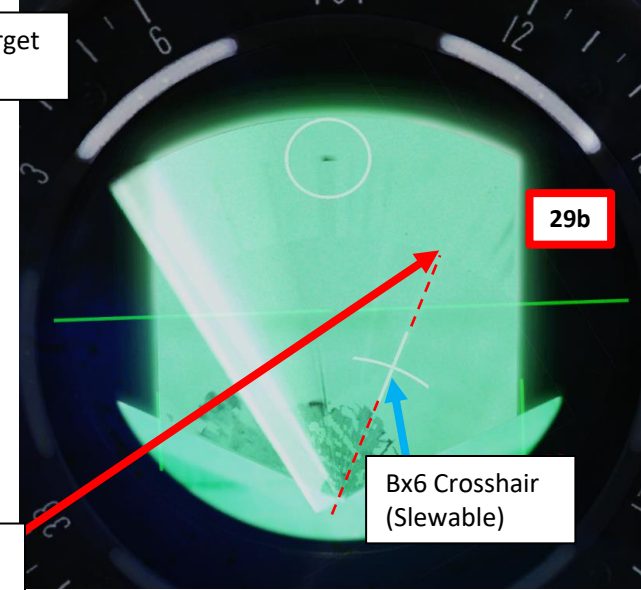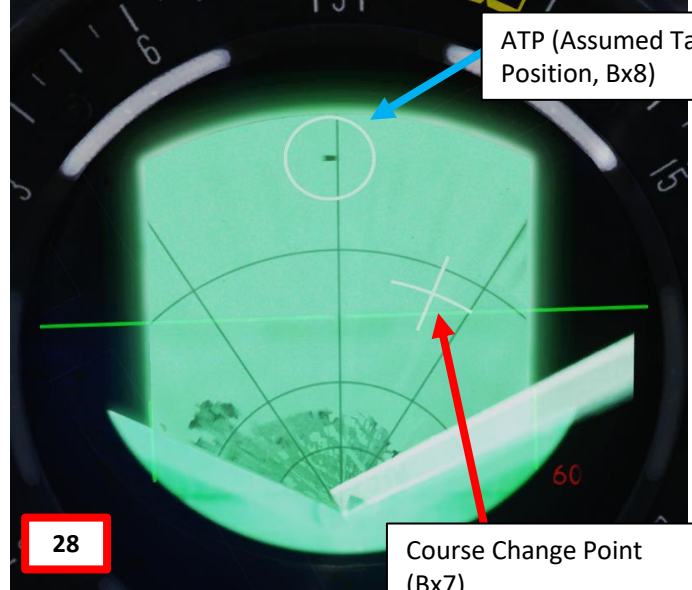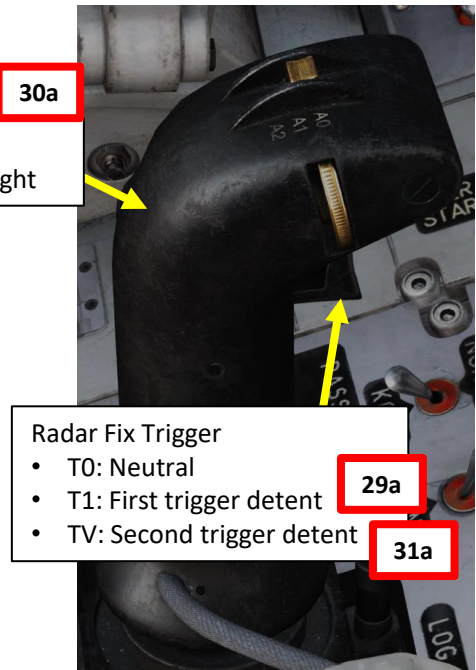
It is not possible to place the descent point (BX6) either too close to the aircraft, too close to the target or during the course change.

3 – Anti-Ship Weapons
3.2 – RB-15F Anti-Ship Missile

F – Perform Attack

33. Fly aircraft between 50 and 2000 meters AMSL (above mean sea level). Flying below this altitude will cause the missiles to hit the water.
34. The "Distance Line" appears when you are 40 seconds away from the maximum release distance. The Outer markers indicate the maximum firing range.
35. You can either track M3 (where you will launch the missile) or Bx8 (Assumed Target Position) directly… but the Distance Line will always indicate range in relationship to Bx8.
36. Set Trigger to UNSAFE by clicking on the stick's safety cover.
37. When the Distance Line shrinks to within the launch zone (inside the Outer Markers), you are within the acceptable launch zone. This zone is generally within 20 km to the target.
    • Note: if the Distance Line is flashing, this means that you are about to reach the minimum release zone. You are about to be too close to the target.
37. Press and hold the Weapon Release trigger to launch the missile.
38. Keep the Weapon Release trigger pressed and hold it until the FALLD LAST (STORES RELEASED) light illuminates. This indicates that the missile has been released.

(8) Master mode selector **ANF**. HUD symbology changes:
- **Distance line** appears when **40 sec** remain until max release distance.
- **Outer markers** indicate maximum firing range.

Illuminates when missile is released

38

Max Range Outer Marker

Max Range Outer Marker

Altitude (m)

Distance Line (In Range)

37

ATP (Assumed Target Position, Bx8)

Trigger SAFE

Trigger UNSAFE

36

Waypoint M3 (Missile Launch Point)

Course Change Point (Bx7)

38

352
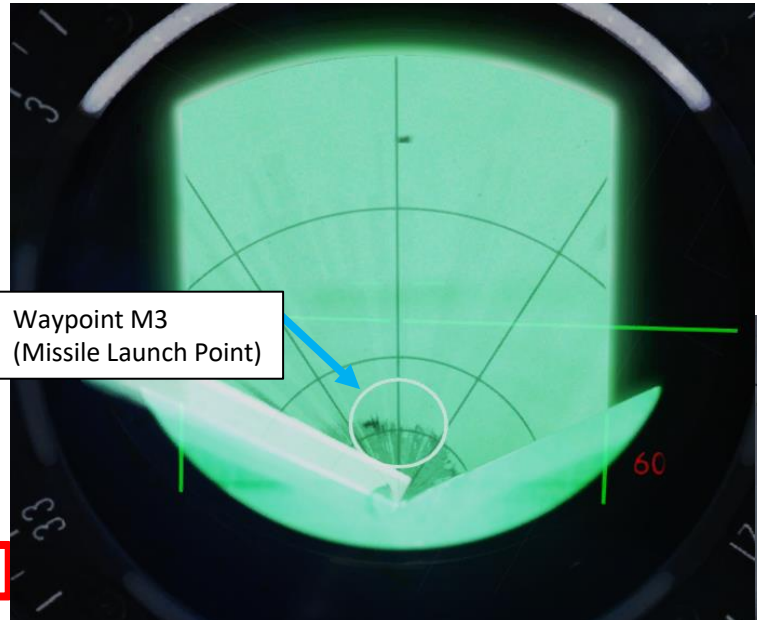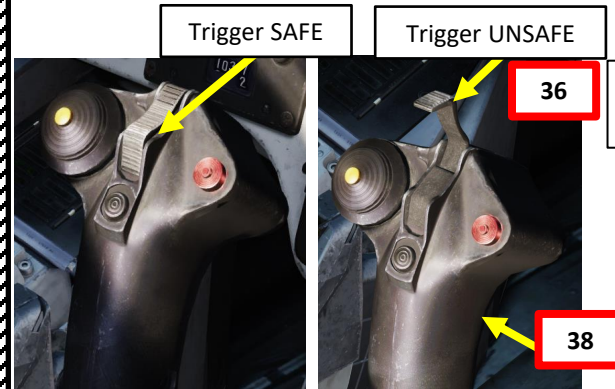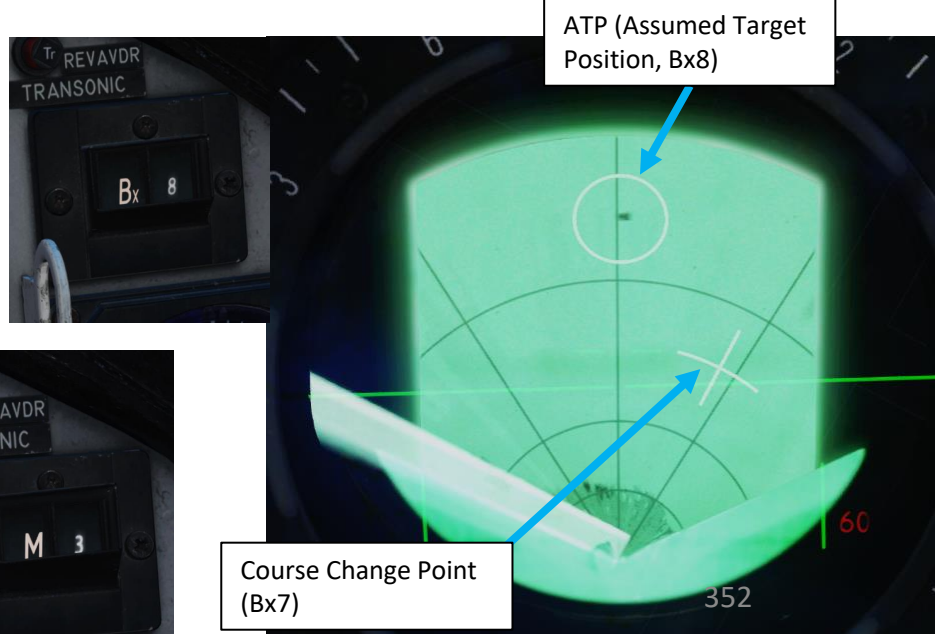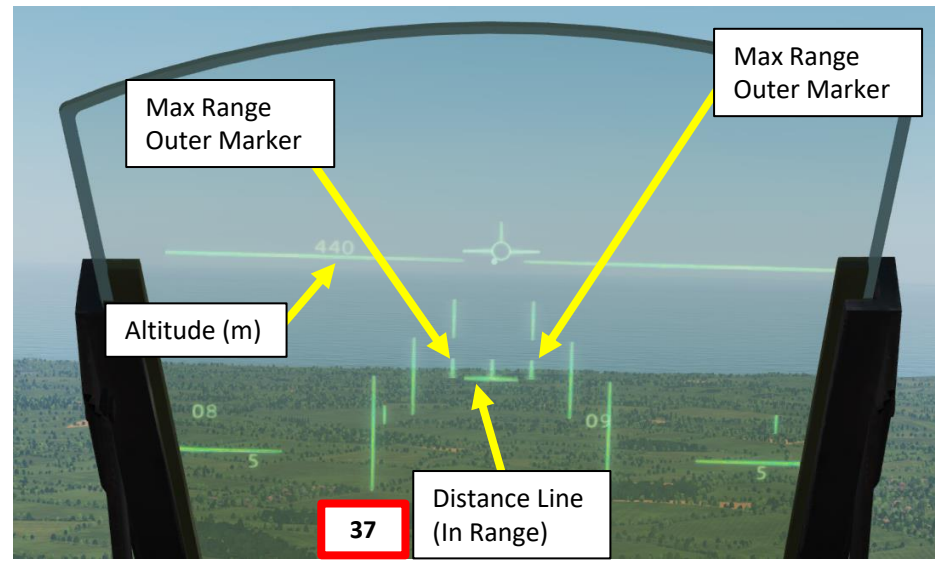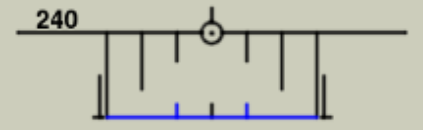
3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

F – Perform Attack

39. Upon release, the missile maintains its release altitude until the descent.
    - Note 1: When released in series the missiles will separate slightly and spool up the turbojet propelling the missile. The second missile is released 2 seconds after the first.
    - Note 2: On missile release, a forceful trim change in roll occurs in the aircraft, which is easily countered by stick input. With the attitude / altitude hold function enabled, this trim change is dampened and negligible.
40. On reaching the descent point, the missile will descend to the relevant altitude dependent on the position of the missile in the flight profile and the programmed data.
    - Flight over land: 80 m AGL, or release altitude (if released below 80m) – 20 m (minimum of 10 m AGL).
    - Flight over sea: 30 meters.
    - Search altitude: 10, 15 or 30 meters dependent on search mode.
    - Sea-skimming: Selected by default via the TAKT input. Missile will fly at the lowest possible altitude.
41. The missile will then steer towards the Course Change Point, then straight to the target.

Altitude Warning Light
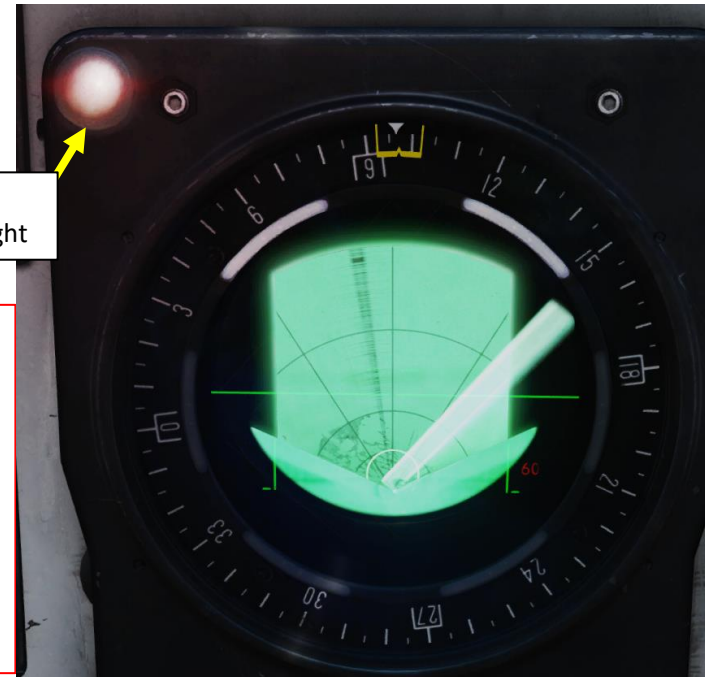
CAUTION:
Regardless of release mode (ANF or NAV/ SPA) the light will be lit with a solid light in case a CK error or Primary data error (primary pitot system). In mode ANF, the light will be lit if:
- Target position (Bx8) not defined
- Set course change is > 135°
- The sum of the ordered course changes is > 135°
- Missile time of flight to the self-destruct point (Bx 9) is < 30 seconds.

In all these cases, release is inhibited when the altitude warning light is lit.

3 – Anti-Ship Weapons
3.2 – RB-15F Anti-Ship Missile

F – Perform Attack

42. Pull away from the target and evade.
43. Set Trigger to SAFE by clicking on the stick's safety cover.
44. Set Master Mode to NAV and resume flight.

3 – Anti-Ship Weapons

3.2 – RB-15F Anti-Ship Missile

G – A few words about Quick Mode

If the trigger is set to UNSAFE in Master mode NAV or SPA, the "Quick" release mode is selected. In this mode, the missile is released and will immediately start searching for targets within the ±35° radar cone, between 2 and 20 km forwards. The first target detected will be locked. Here is a quick overview of the procedure:

1. Set Master Mode to NAV or SPA
2. Set Weapon selector to ATTACK
3. Set Trigger to UNSAFE by clicking on the stick's safety cover.
4. Press and hold the Weapon Release trigger until the FALLD LAST (STORES RELEASED) light illuminates. This indicates that the missile has been released.
5. Seeker is in CLOSE search mode (searches for targets within the ±35° radar cone, between 2 and 20 km forwards).
6. First detected target is locked.

Note: The quick/bearing only mode will make the missile fly very high during the search, which makes it extremely vulnerable to SAMs (Surface-to-Air Missiles).
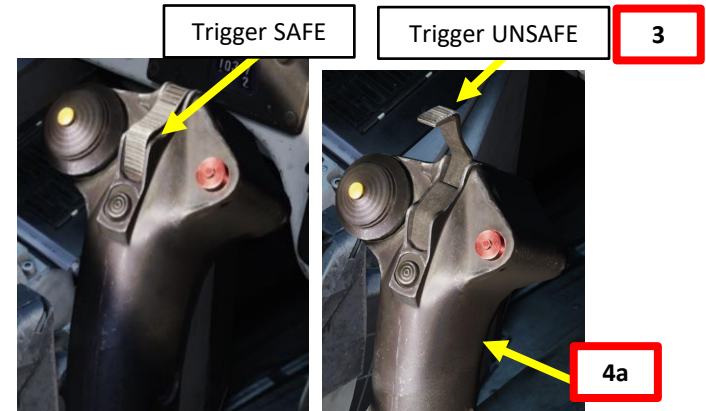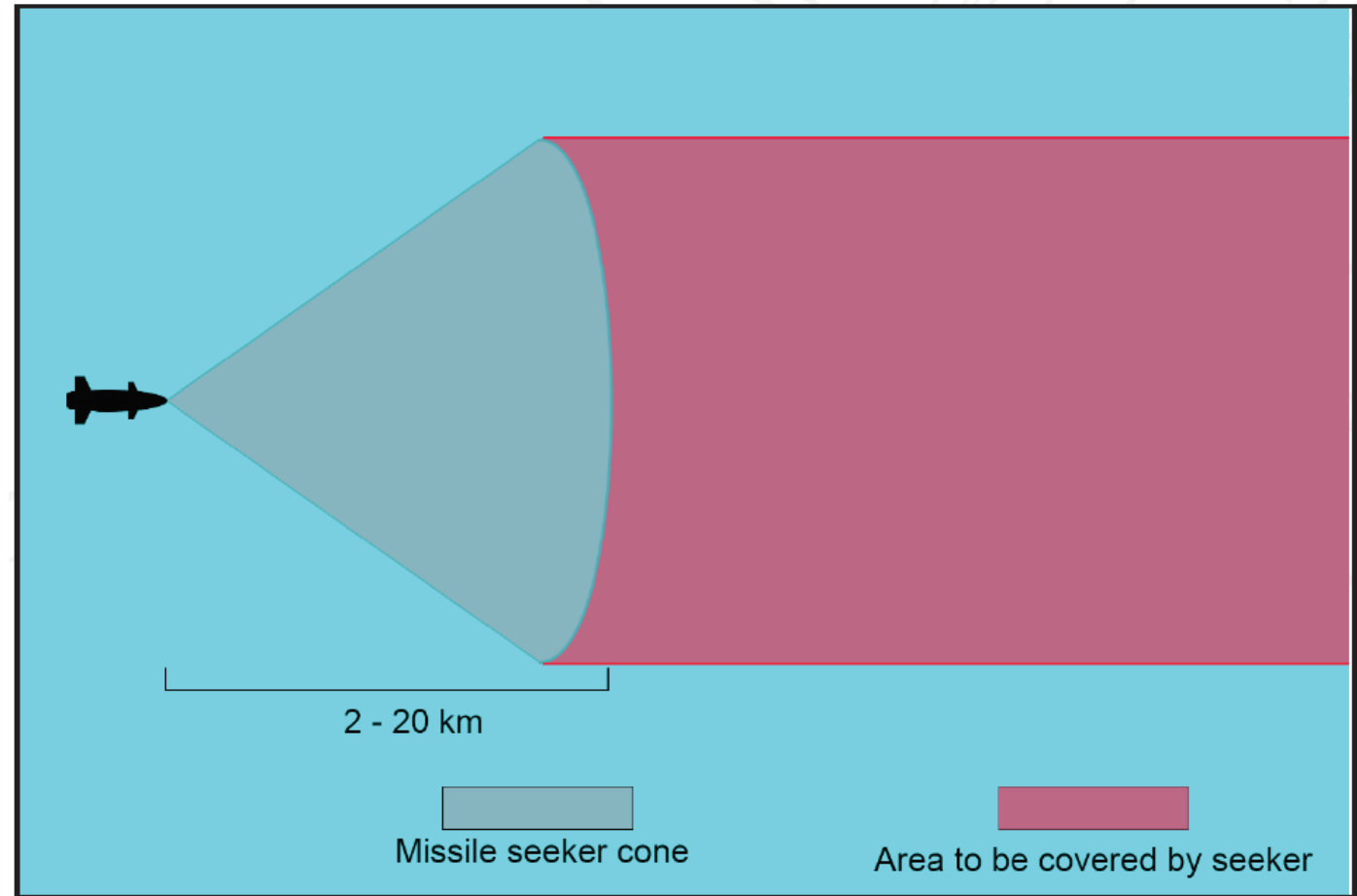
2 - 20 km

Missile seeker cone

Area to be covered by seeker

1

2

Trigger SAFE

Trigger UNSAFE

3

4a

Illuminates when missile is released

FÄLLD LAST

4b

4 – Air-to-Air Weapons
4.1 – AKAN 30/55 Gun (Air-to-Air)
4.1.1 – Radar Ranging Mode

1. Set Weapon Selector to AKAN JAKT (Gunpods air-to-air)
2. Set Master Mode to ANF (Anflygning/Attack).
3. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
4. Set the trigger to UNSAFE by clicking on the stick's safety cover.
5. When you have a target in visual, steer aircraft to place the reticle dot on the target.
6. Press the radar fix trigger to "T1" (first trigger detent) to attempt to acquire a radar lock.
7. When radar lock is obtained, HUD symbology will display a Distance Line.

3 Radar Mode Selector – A1 (Wide Search with PPI)

Trigger SAFE

Trigger UNSAFE

4

2

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent **6**
• TV: Second trigger detent

Radar Ranging "Fin"

Target

5

Altitude (km)

1

Max Range Outer Marker Line

Reticle Dot

Max Range Outer Marker Line

7

Distance Line (Out of Range)
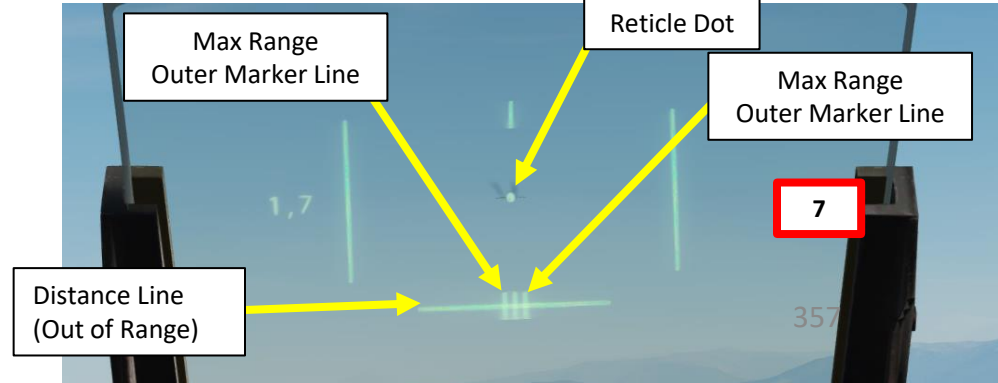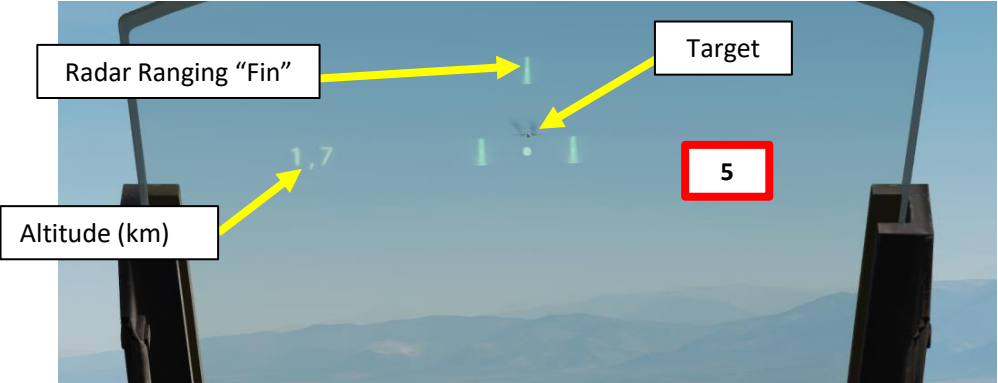
4 – Air-to-Air Weapons

4.1 – AKAN 30/55 Gun (Air-to-Air)

4.1.1 – Radar Ranging Mode

8. Distance Line will shrink as you approach the target. Sight calculates for 500 meters range to target. Rescaling of the distance line from 8 km to 2 km occurs at 2 km distance. Keep in mind that **you have to lead the target manually if it is manoeuvering**.

9. When Reticle Dot is on the target and Distance Line is between the Max Range Outer Markers, press Weapon Release trigger to fire gunpods.

Trigger UNSAFE

9

Reticle Dot

8

Distance Line (Out of Range)

Reticle Dot

9

Distance Line (In Range)
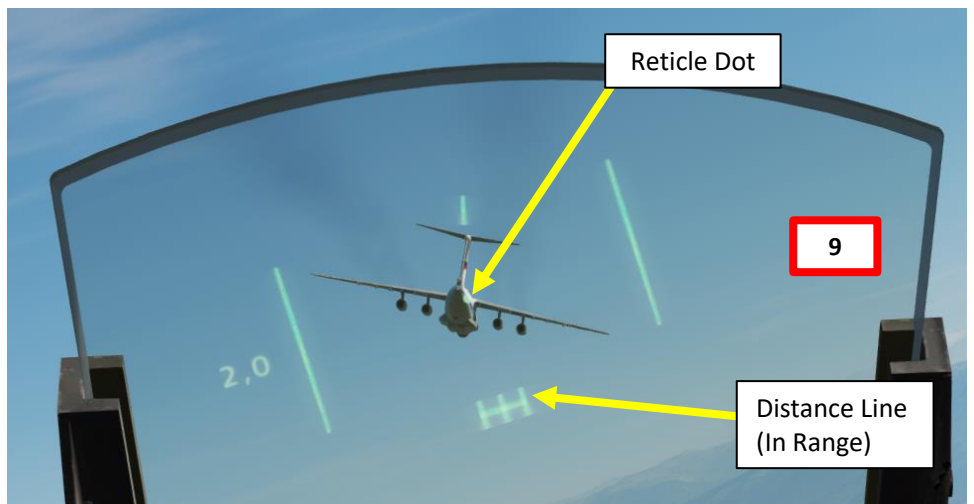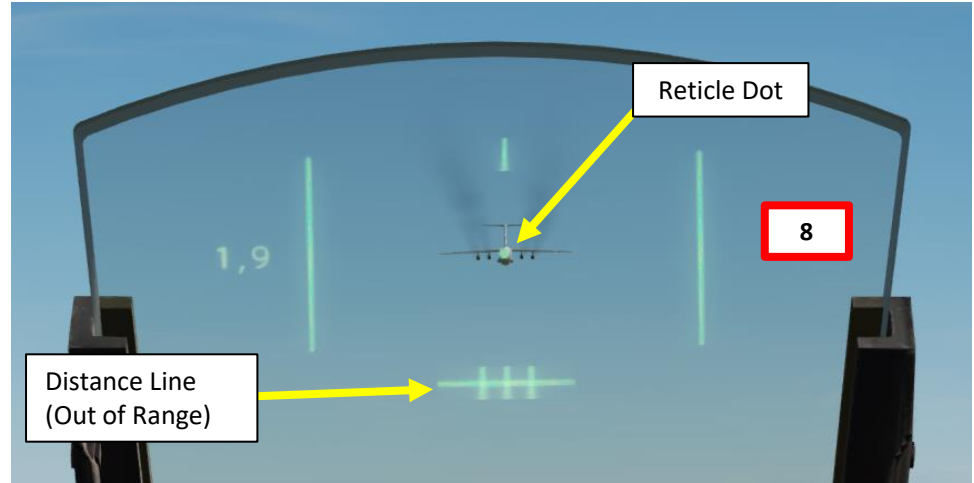
4 – Air-to-Air Weapons
4.1 – AKAN 30/55 Gun (Air-to-Air)
4.1.2 – Wingspan Mode

1. Set Weapon Selector to AKAN JAKT (Gunpods air-to-air)
2. Set Master Mode to ANF (Anflygning/Attack).
3. Set the trigger to UNSAFE by clicking on the stick's safety cover.
4. Set Sight Mode Selector to the wingspan of the target you want to engage. As an example, an Il-76 has a wingspan of 50 meters.
5. The HUD Air-to-Air gun symbology will change based on the wingspan setting.

1

Trigger SAFE   Trigger UNSAFE

3

2

4a

Wingspan 15 meters

Altitude (km)

Wingspan 15 meters

4b

Wingspan 50 meters

Wingspan 50 meters
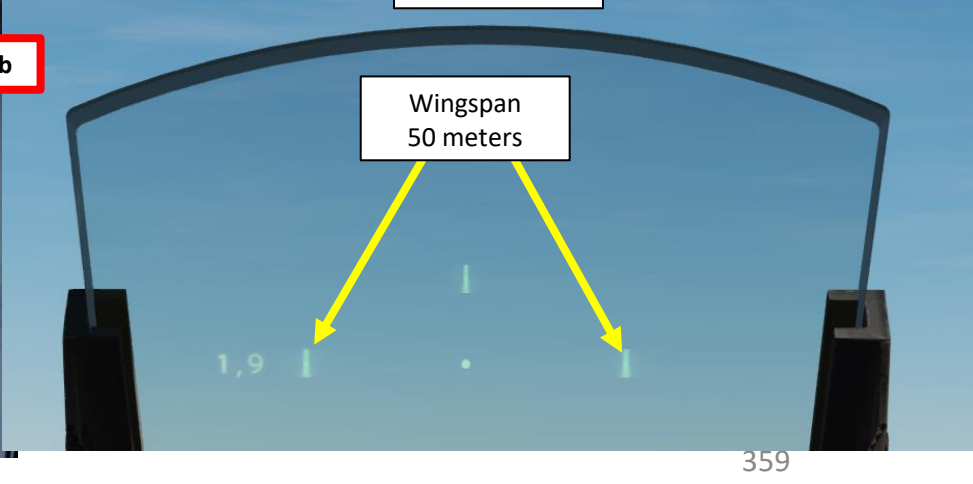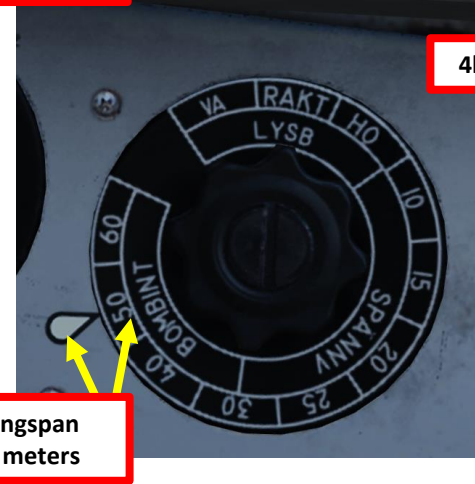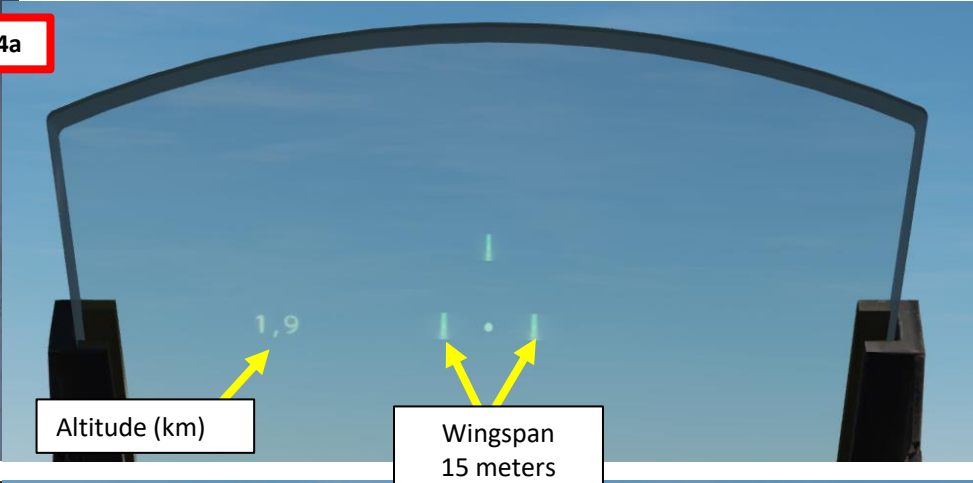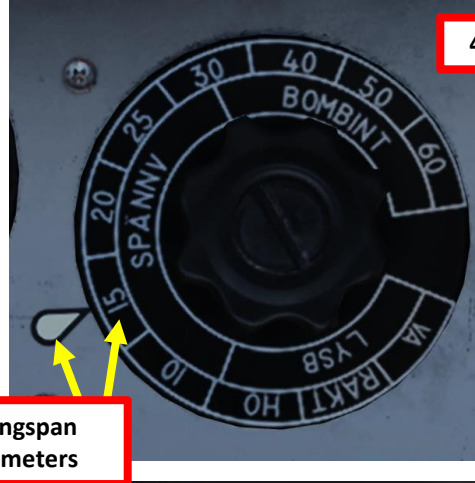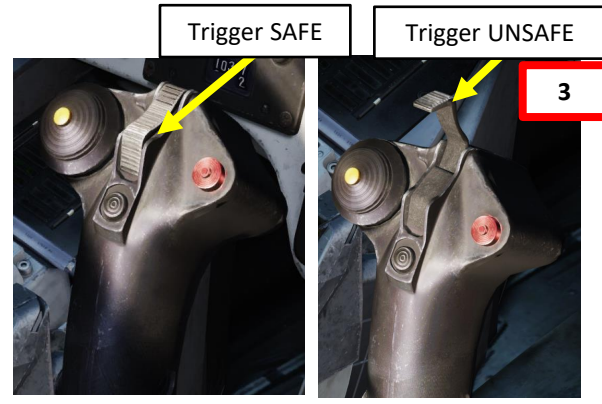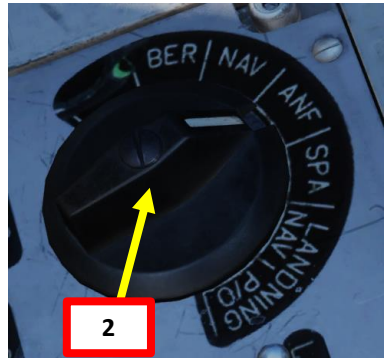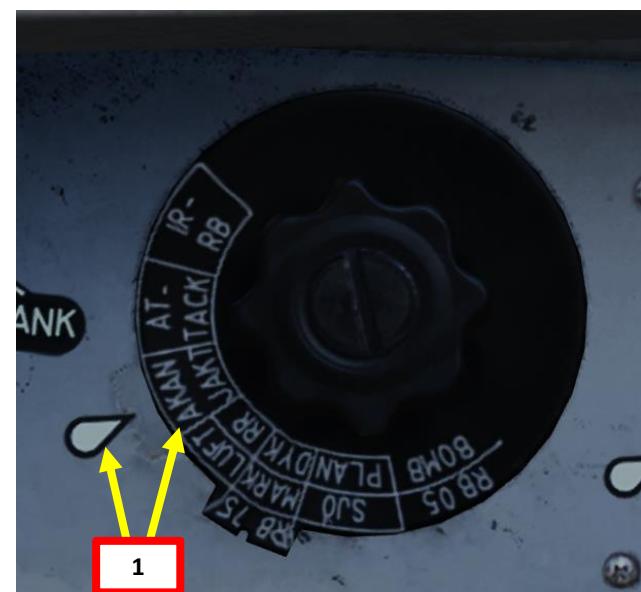
4 – Air-to-Air Weapons

4.1 – AKAN 30/55 Gun (Air-to-Air)

4.1.2 – Wingspan Mode

6. When you have a target in visual, steer aircraft to place the reticle dot on the target.
7. The wingspan markers in the HUD represents the wingspan of the set target size at a distance of 500 meters. Keep in mind that **you have to lead the target manually if it is manoeuvering**.
8. When Reticle Dot is on the target and the target's wingtips fit on the Wingspan markers, press Weapon Release trigger to fire gunpods.

Trigger UNSAFE

8

Reticle Dot

Wingspan Marker (50 m)

Wingspan Marker (50 m)

8
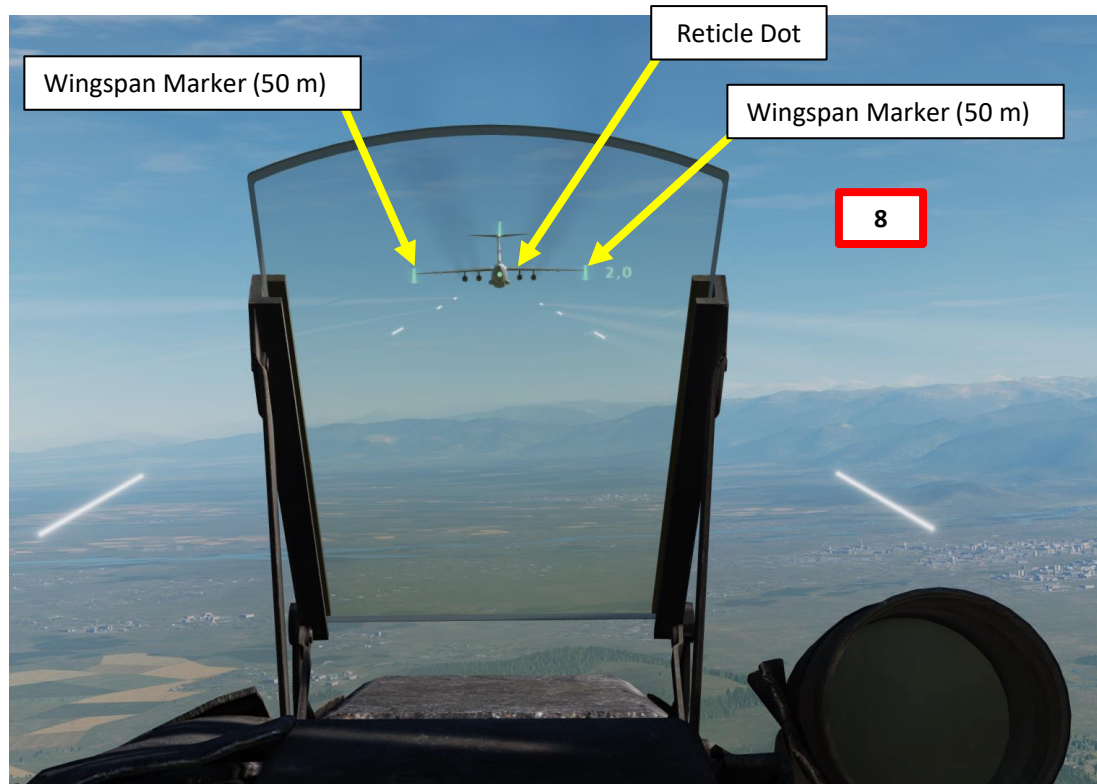
4 – Air-to-Air Weapons

4.2 – RB-24J / RB-74 IR Air-to-Air Missile

The AJS-37 can carry two variants of the AIM-9 Sidewinder; the older, rear-aspect RB 24J (AIM-9P) and the all-aspect RB 74 (AIM-9L). The missile can be aimed with or without using the radar to determine the range to target. The main difference between the RB 24J and the RB 74 is the sensitivity of the seeker. The RB 74 is an all-aspect missile where it can lock an aircraft from the front-aspect as well, rather than only from behind an aircraft like the older rear-aspect RB 24J.

4 – Air-to-Air Weapons

4.2 – RB-24J / RB-74 IR Air-to-Air Missile

4.2.1 – Without Radar Ranging

1. Select Weapon. This can be done in two ways:
   a) Set Weapon Selector to IR-RB, or
   b) Press the AFK Quick Disconnect / Infrared Missile Quick Select Button (in front of throttle). Each press of the button will cycle the next selected missile.
2. Set Master Mode to ANF (Anflygning/Attack).
3. Set the trigger to UNSAFE by clicking on the stick's safety cover.
4. (Optional) Adjust Sidewinder Tone Volume as required
5. (Optional) If desired, select desired missile station by pressing the Missile Select Button IR-RB (*FRAMSTEGN*). The blinking "1" on the CK37 data panel will indicate which station is selected.

Blinking "1"
Selected Missile Station

5

Missile select button
Infrared-RB
(*FRAMSTEGN)*

5

Master Volume /
Sidewinder Tone

4

Autothrottle (AFK, or *Automatisk Fart Kontroll*) Quick Disconnect Button / Infrared Missile Quick Select Button
(In Front of Throttle, Not Visible)

1b

2

Trigger SAFE

Trigger UNSAFE

3

1a

4 – Air-to-Air Weapons

4.2 – RB-24J / RB-74 IR Air-to-Air Missile

4.2.1 – Without Radar Ranging

6. When you have a target in visual, steer aircraft to place the target within the missile boresight area (markers).
7. When missile is selected, a low-pitch growling audio tone will be sent from the seeker.
8. When growling audio tone goes to a higher pitch, it indicates that a target's heat signature is detected.
9. Press the IR Missile Uncage button on the throttle to uncage the missile. When uncaged, the locked target will be indicated by the Infrared Target Ring (ITR). The ITR is restricted to ±6° horizontally and ±10 ° vertically on the HUD, however the seeker may be locked on a target outside of the display area. The pilot will have to estimate the position of the target based on the position of the ITR.
10. When Infrared Target Ring (ITR) is on the target, press and hold Weapon Release trigger to fire missile.
11. Note: The missile will have difficulty tracking a target if the aircraft is under an excessively high G-load. This is indicated by the "wings" of the flight path vector appearing. Maximum G-load for the RB 24J / 74 launch is 6 G.

Target

Missile Boresight **6**

11

Missile Over-G Wings

Trigger UNSAFE

Infrared Missile Uncage Button **9a**

10

Missile Uncaged
ITR (Infrared Target Ring)

9b
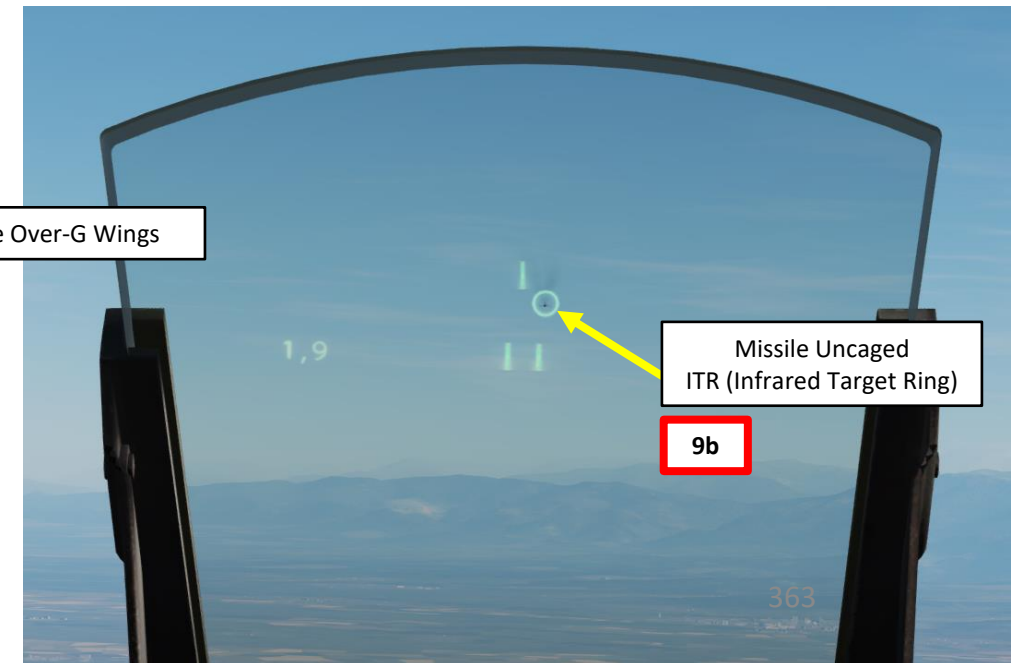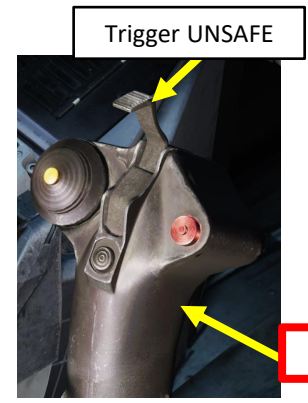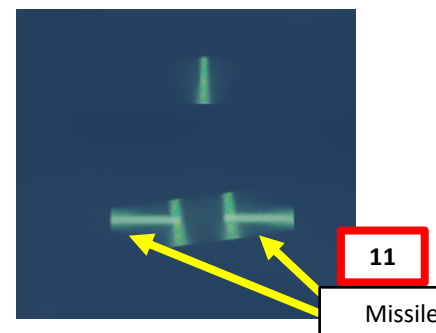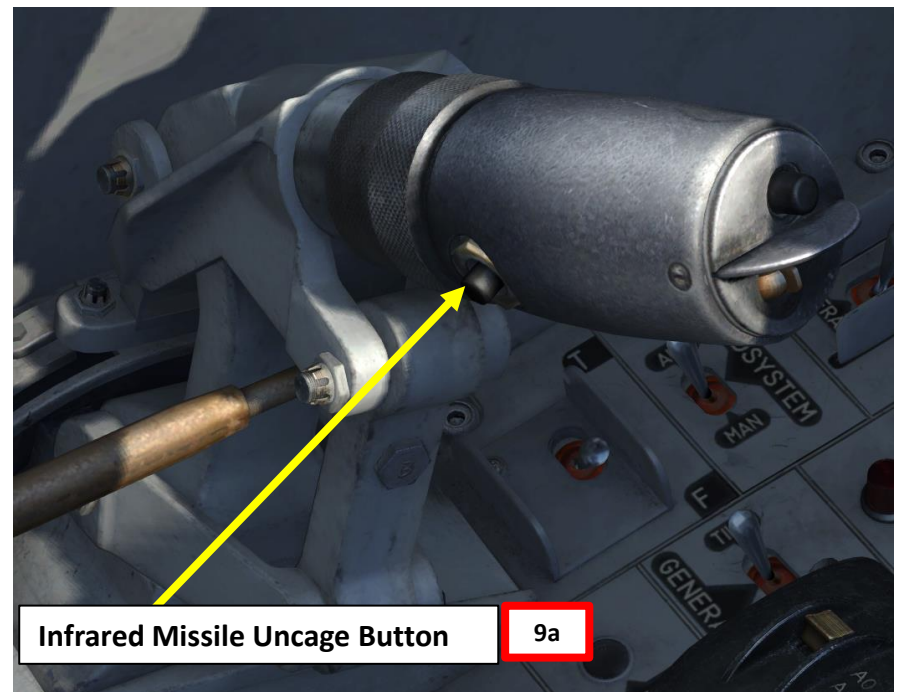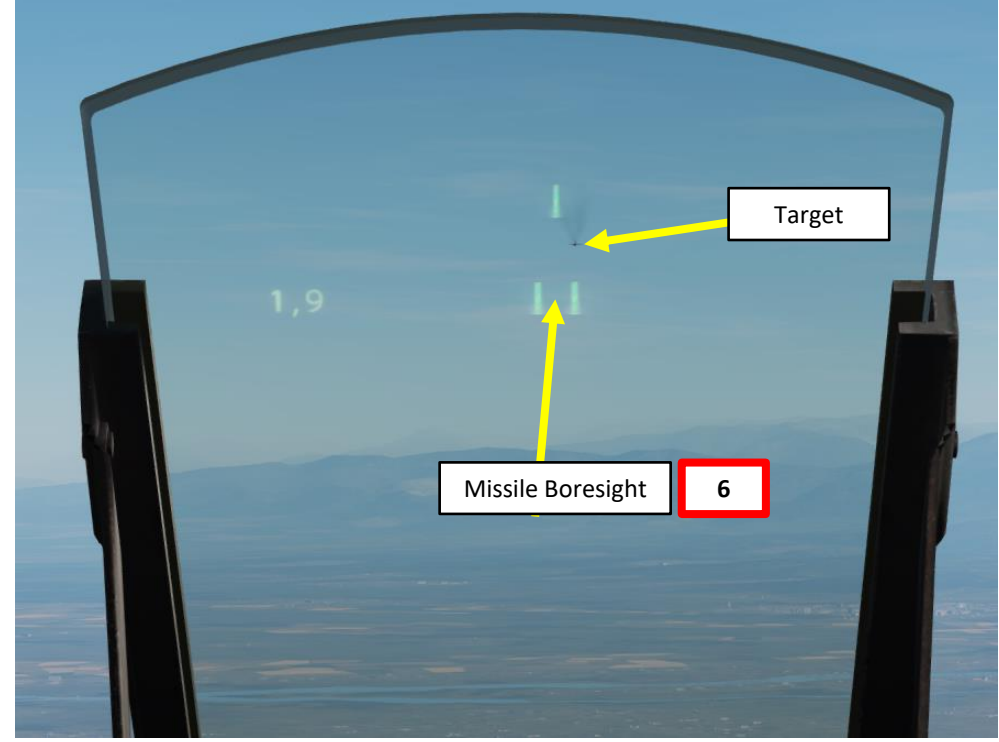
4 – Air-to-Air Weapons

4.2 – RB-24J / RB-74 IR Air-to-Air Missile

4.2.1 – Without Radar Ranging

4 – Air-to-Air Weapons
4.2 – RB-24J / RB-74 IR Air-to-Air Missile
4.2.2 – With Radar Ranging

1. Select Weapon. This can be done in two ways:
   a) Set Weapon Selector to IR-RB, or
   b) Press the AFK Quick Disconnect / Infrared Missile Quick Select Button (in front of throttle). Each press of the button will cycle the next selected missile.
2. Set Master Mode to ANF (Anflygning/Attack).
3. Set the trigger to UNSAFE by clicking on the stick's safety cover.
4. (Optional) Adjust Sidewinder Tone Volume as required
5. (Optional) If desired, select desired missile station by pressing the Missile Select Button IR-RB (*FRAMSTEGN*). The blinking "1" on the CK37 data panel will indicate which station is selected.

Blinking "1"
Selected Missile Station

5

Missile select button
Infrared-RB
(*FRAMSTEGN*)

5

Master Volume /
Sidewinder Tone

4

Autothrottle (AFK, or *Automatisk Fart Kontroll*) Quick Disconnect Button / Infrared Missile Quick Select Button
(In Front of Throttle, Not Visible)

1b

2

Trigger SAFE   Trigger UNSAFE

3

1a

4 – Air-to-Air Weapons
4.2 – RB-24J / RB-74 IR Air-to-Air Missile
4.2.2 – With Radar Ranging

6. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
7. When you have a target in visual, steer aircraft to place the missile boresight markers on the target.
8. Press the radar fix trigger to "T1" (first trigger detent) to attempt to acquire a radar lock.
9. When radar lock is obtained, HUD symbology will display a Distance Line.
10. Distance Line will shrink as you approach the target. Sight calculates for 2500 meters range to target. Rescaling of the distance line from 8 km to 4 km occurs at 4 km distance.

6 Radar Mode Selector – A1 (Wide Search with PPI)
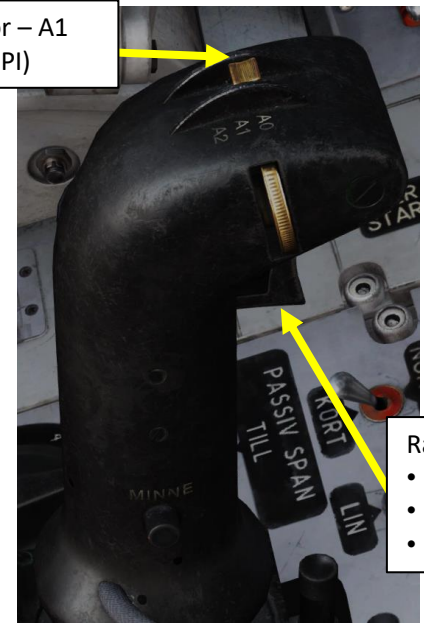
Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent **8**
- TV: Second trigger detent

7 Missile Boresight Markers

Altitude (km)

9 Radar Ranging "Fin"

Reticle Dot

Distance Line (Out of Range)

Max Range Outer Marker Lines

Target

Reticle Dot **10**

Max Range Outer Marker Line

Distance Line (In Range)

Max Range Outer Marker Line
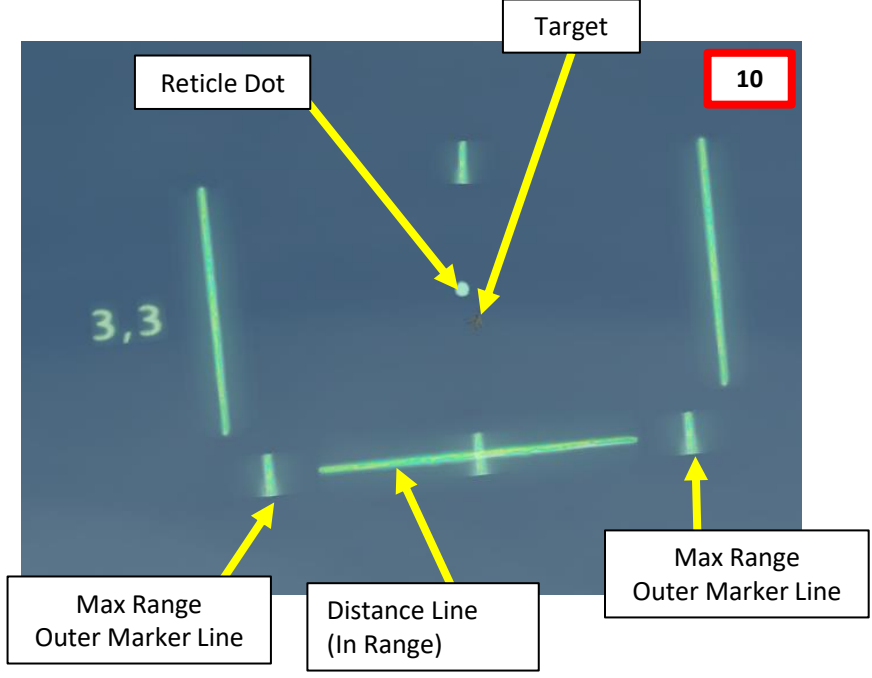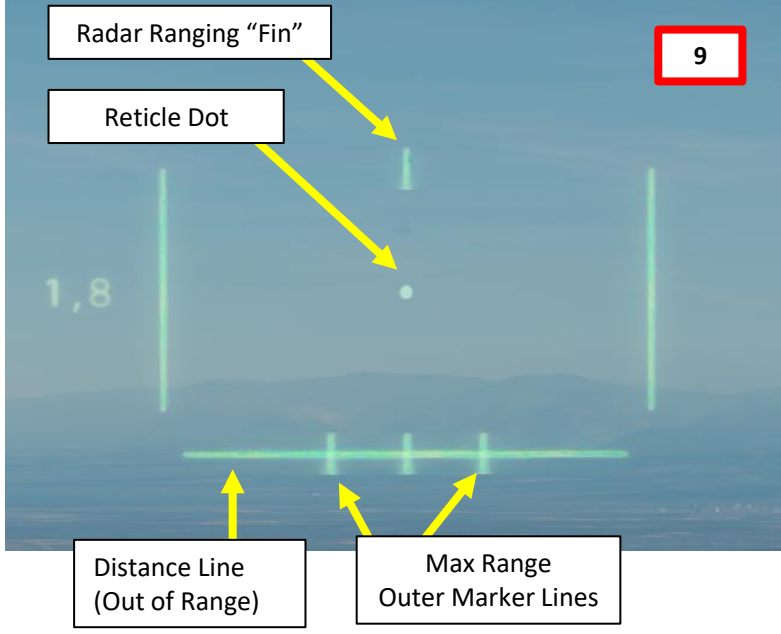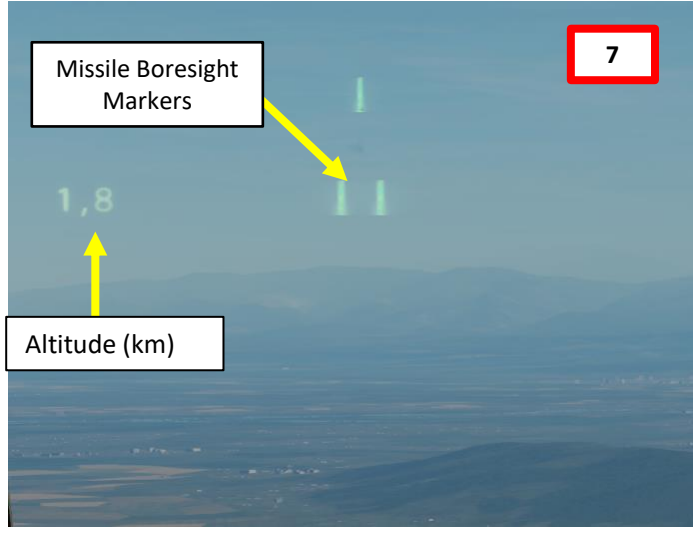
4 – Air-to-Air Weapons

4.2 – RB-24J / RB-74 IR Air-to-Air Missile

4.2.2 – With Radar Ranging

11. When missile is selected, a low-pitch growling audio tone will be sent from the seeker.
12. When growling audio tone goes to a higher pitch, it indicates that a target's heat signature is detected.
13. When you have a target in visual, steer aircraft to place the Reticle Dot on the target.
14. Press the IR Missile Uncage button on the throttle to uncage the missile. When uncaged, the locked target will be indicated by the Infrared Target Ring (ITR). The ITR is restricted to ±6° horizontally and ±10 ° vertically on the HUD, however the seeker may be locked on a target outside of the display area. The pilot will have to estimate the position of the target based on the position of the ITR.
15. When Infrared Target Ring (ITR) is on the target and Distance Line is between the Max Range Outer Markers, you are in range for a missile launch.
16. Press and hold Weapon Release trigger to fire missile.
17. Note: The missile will have difficulty tracking a target if the aircraft is under an excessively high G-load. This is indicated by the "wings" of the flight path vector appearing. Maximum G-load for the RB 24J / 74 launch is 6 G. A Flashing distance line indicates the minimum firing range has been passed (500 m).
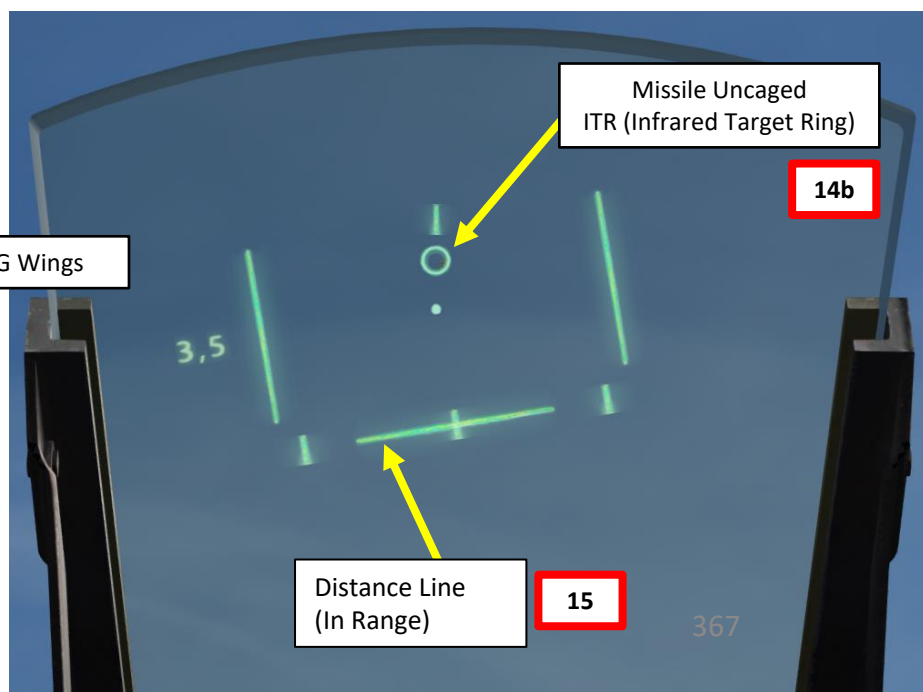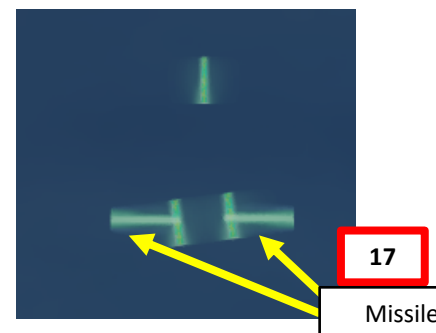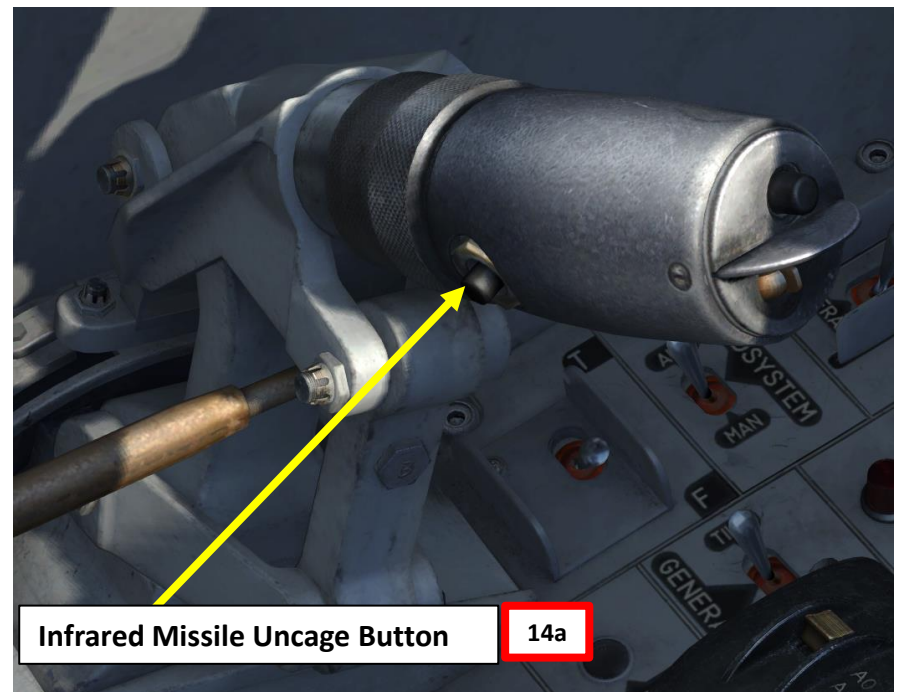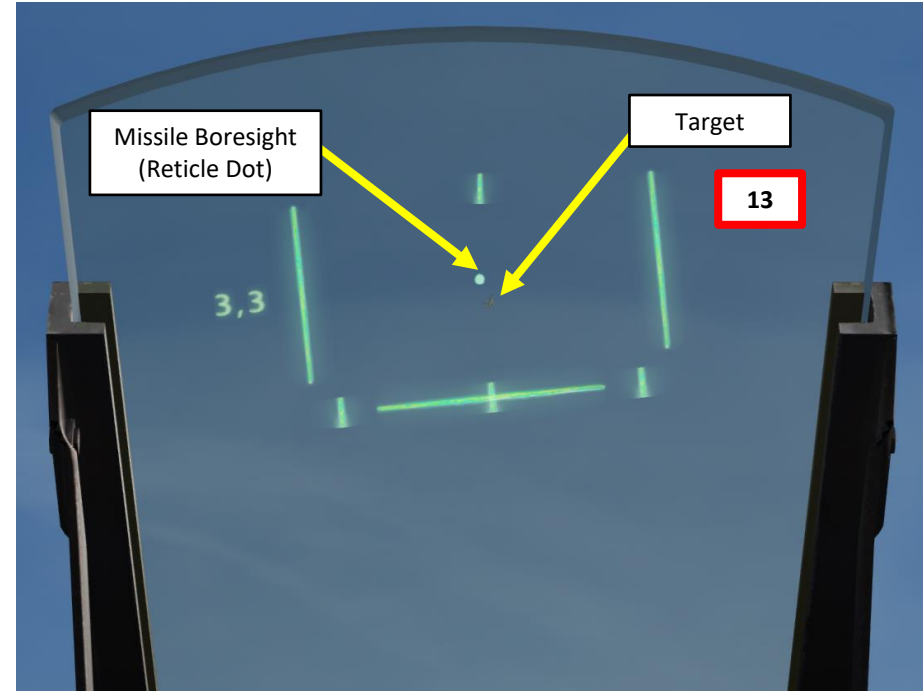
Missile Boresight (Reticle Dot)

Target

13

3,3

Missile Uncaged ITR (Infrared Target Ring)

14b

3,5

17

Missile Over-G Wings

Trigger UNSAFE

Distance Line (In Range)

15

16

Infrared Missile Uncage Button

14a

4 – Air-to-Air Weapons
4.2 – RB-24J / RB-74 IR Air-to-Air Missile
4.2.2 – With Radar Ranging

5 – Miscellaneous
5.1 – Stores Jettison

1. **To Jettison External Tank (X-TANK):**
   a) Flip cover switch of the X-TANK button.
   b) Press the X-TANK button.

2. **To Jettison External Stores:**
   a) Flip cover switch of the NODF (*NÖDFÄLLNING VAPEN*) button.
   b) Press the NODF button.
   c) This jettisons all on-board weapon stores with the exception of RB24J in the outer wing pylons and the bomb racks (bombs are released without being armed).
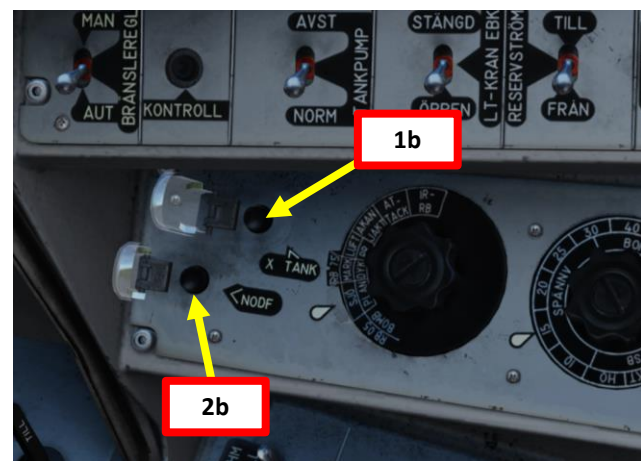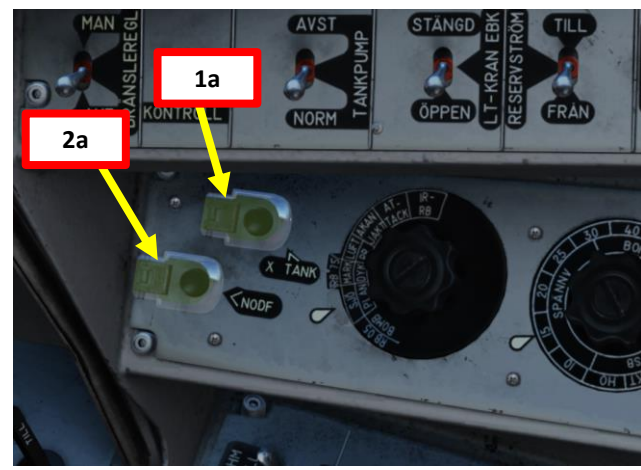
COUNTERMEASURES – INTRODUCTION

Countermeasures are very simple to use in the Viggen. You have three countermeasure types at your disposal: flares, chaff and an ECM (Electronic Countermeasure) jammer. We will explore together what is used against what, and how.

Missiles can generally track you using 2 things: radar signature (radar waves are sent on you and you reflect them, which is called a "radar signature") and heat signature (like the exhaust of your engines). Countermeasures will only be effective against the kind of weapon it was meant to counter; a heat-seeking missile will not care if you deploy electronic countermeasures against it since it tracks heat, not radar signatures. This is why it is important to know what is attacking you in order to counter it properly. This is what the RWR (Radar Warning Receiver) is for: to help you know what is firing at you so you can take the adequate action to counter it.

- **Flares** are used against missiles that track heat (infrared or IR) signatures. Instead of going for the heat signature generated by your engines, a missile will go for a hotter heat source like flares.
- **Chaff** is a form of "passive" jamming. Passive (reflected) jamming is when a deceptive object or device reflects radar waves. Chaff is simply a bundle of small pieces of metal foil with reflective coating, which creates clusters of radar signatures that prevent a radar to get a solid lock on the aircraft itself.

The Viggen is equipped with countermeasure systems that are contained in two pods: the **KB countermeasure pod**, which contains chaff and flares, and the U22 (old) or **U22/A (modernized) ECM pod** that will act as a radar jammer.

Keep in mind that you need to equip these pods if you want to use them and that they cannot be jettisoned. Placing them under your wings will take valuable space and prevent you from carrying additional armament: use your judgement on what you need and what you don't need. The outcome remains the same though: if you forget to equip these pods, your only way to defend yourself will be to dive at treetop level and dodge those SAM sites and missiles.

U22 ECM Jammer Pod

KB Chaff/Flare Countermeasures Dispenser Pod

371
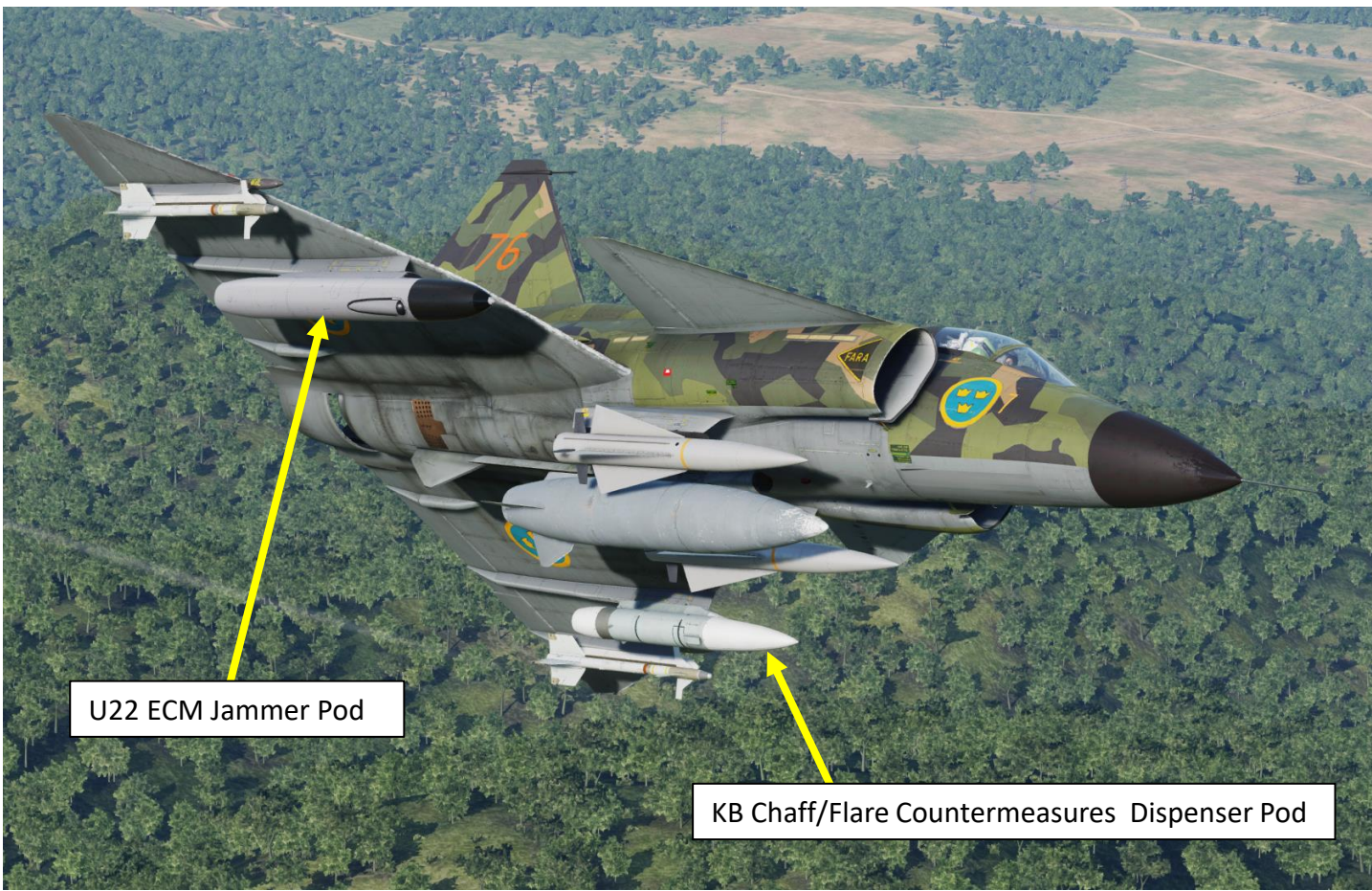
COUNTERMEASURES – FLARES & CHAFF TUTORIAL

To deploy chaff and flare:

1) Set desired countermeasure program mode
   - Manual modes will drop chaff or flares or both based on your program
   - Automatic mode will drop chaff only if a radar has locked you

2) Press the Fast Countermeasure Dispense for quick release OR the Countermeasure (KB) Dispense Switch to INT or KONT.

2

Countermeasure Quick Release Button

Countermeasure (KB) Dispense Switch
OFF / INT / KONT

2

Fast Countermeasure Dispense
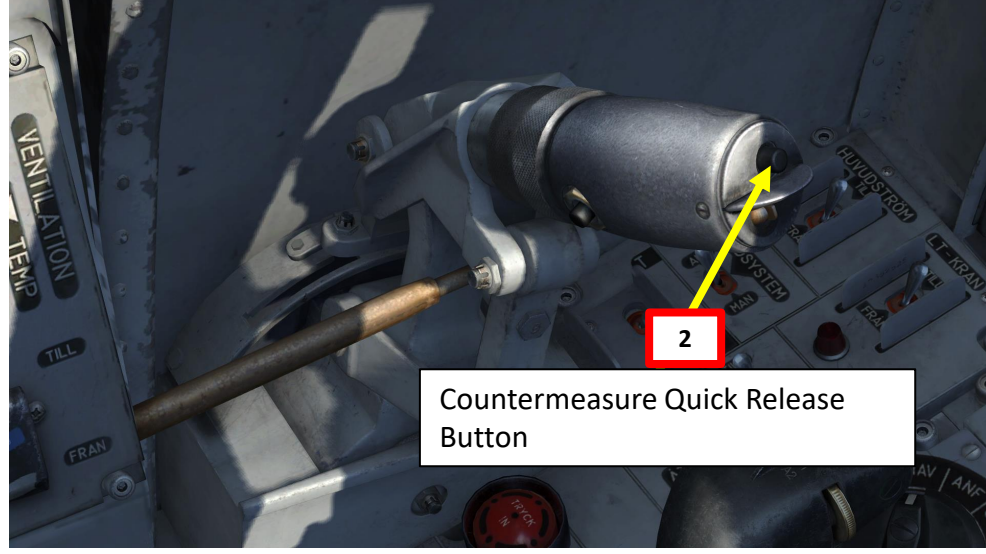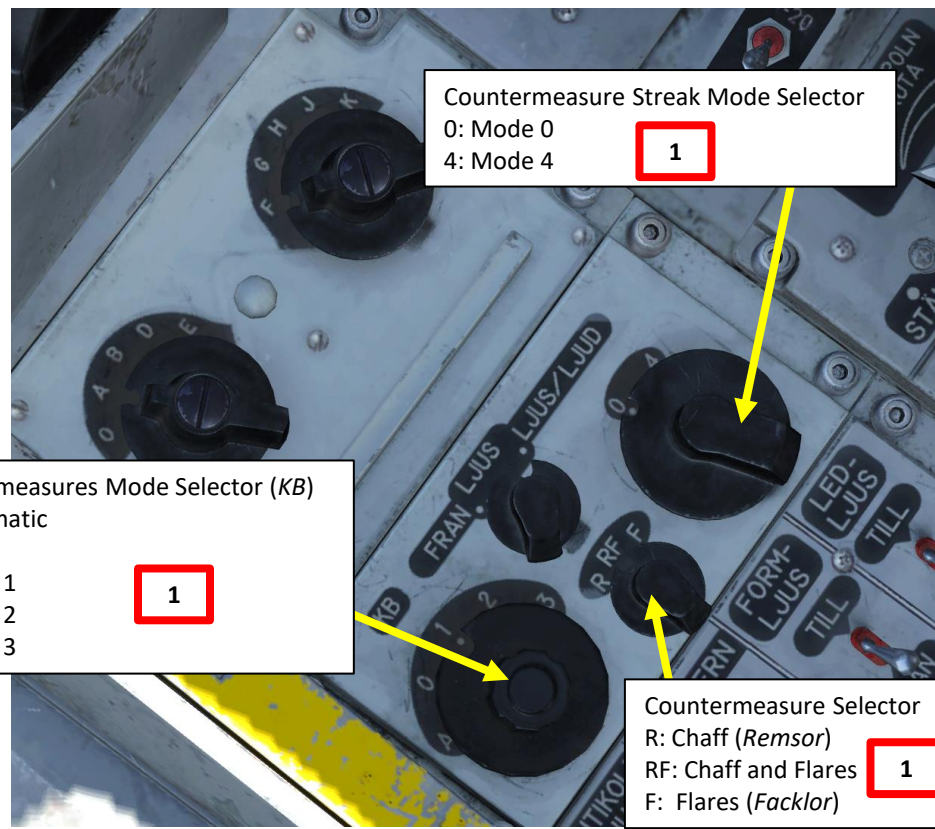
Countermeasure Streak Mode Selector
0: Mode 0
4: Mode 4

1

Countermeasures Mode Selector (*KB*)
A: Automatic
0: Off
1: Mode 1
2: Mode 2
3: Mode 3

1

Countermeasure Selector
R: Chaff (*Remsor*)
RF: Chaff and Flares
F: Flares (*Facklor*)

1

COUNTERMEASURES – FLARES & CHAFF PROGRAMS

Program	What does it do?
P1: Chaff Rapid Release *Set KB Mode Selector – 1* *Set Streak Selector – 0* *Set Countermeasure Selector – R+F* *Set Countermeasure KB switch – FRAN (OFF)*	Releases chaff and flares rapidly for 1.5 min
P2: Chaff Rapid Release (default quick release) *Set KB Mode Selector – 2* *Set Streak Selector – 0* *Set Countermeasure Selector – R+F* *Set Countermeasure KB switch – INT or KONT*	Releases chaff and flares at 2 second intervals and 2.5 second pauses for 3.5 min. Interval repeated as long as KB release switch is held.
P3: Slow Release *Set KB Mode Selector – 3* *Set Streak Selector – 0* *Set Countermeasure Selector – R+F* *Set Countermeasure KB switch – INT or KONT*	Releases chaff and flares at a fifth of the speed of program P1 – Chaff Rapid Release for 8 min (8 min if two pods are equipped since the two pods will release in parallel, not in series as in program P4)
P4: Slow Streak Release *Set KB Mode Selector – 3* *Set Streak Selector – 0* *Set Countermeasure Selector – R+F* *Set Countermeasure KB switch – INT or KONT*	Releases chaff and flares at a fifth of the speed of program P1 – Chaff Rapid Release for 8 min (16 min if two pods are equipped since the pods release in series, not in parallel as in program P3)
Quick Release *Press Countermeasure Quick Release button on throttle*	Uses Program P2 – Chaff Rapid Release when pressing the Quick Release button on the throttle
Automatic *Set KB Mode Selector – A* *Set Streak Selector – 0* *Set Countermeasure Selector – R+F* *Set Countermeasure KB switch – INT or KONT*	Releases chaff automatically using Program P2 – Chaff Rapid Release when the RWR detects a radar lock in targeting mode.

Chaff

Flare

Countermeasure Streak Mode Selector
0: Mode 0
4: Mode 4

Countermeasure (KB) Dispense Switch
OFF / INT / KONT

Countermeasures Mode Selector (*KB*)
A: Automatic
0: Off
1: Mode 1
2: Mode 2
3: Mode 3

Countermeasure Selector
R: Chaff (*Remsor*)
RF: Chaff and Flares
F: Flares (*Facklor*)
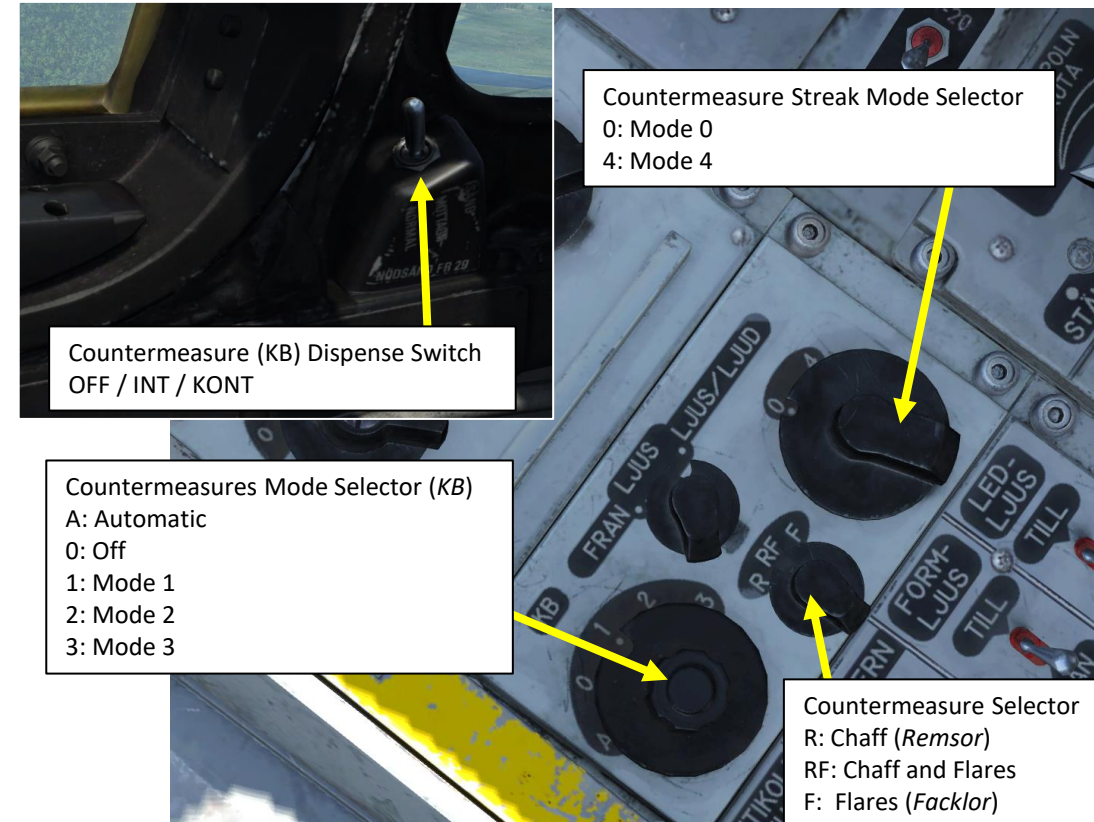
COUNTERMEASURES – FLARES & CHAFF PROGRAMS

KB Countermeasures Pod

Sheet by FunkyFranky

Program	KBM	Streak	CFS	KBR	f_{chaff}	f_{flare}	T_{chaff}/sec
P1 rapid	1	0	R/R+F	I/K	$1.1\overline{6}$	—	90
P2 medium	2	0		I/K	0.50	—	210
P3 slow	3	0		I/K	0.22	—	480
P4 slow streak	3	4		FRÅN	0.22	—	480 / 960
Auto APP-27	A	0	R/R+F	I/K	0.50	—	210
Auto U22/A				K	$1.1\overline{6}$	—	90
Quick (QRB)			R		0.50	—	210
			R+F		0.50	0.5	210 / 72
			F		—	0.5	72

KBM=**KB M**ode selector (A=automatic, 0=off, mode=1,2,3).
CFS=**C**haff/**F**lare **S**elector (R=Chaff, F=Flare, R+F=Chaff+Flare).
KBR=**KB R**elease switch on canopy frame (I=INT, K=KONT).
QRB=**Q**uick **R**elease **B**utton on throttle. Quick release overrules other programs.
f = chaff/flare release frequency in Hz. T = total/max release time.
Each KB pod contains 36 flares and 105 chaff bundles by default.
Colorcode: Release Activation Switch, Carrying two KB pods, T_{flare}/sec.

RWR (RADAR WARNING RECEIVER)

The RWR (Radar Warning Receiver) works very simply: radar locks are identified on the Course Indicator in a top-down view. Simply set the mode using the LJUS or LJUS/LJUD to set the warning method (by sound and visual marker or by visual marker only).

Radar Warning Receiver (RWR) Mode Selector
- *FRÅN* = OFF
- *LJUS*: Visual Warning Only
- *LJUS/LJUD:* Visual and Audio Warning

You are being detected by a radar from this direction
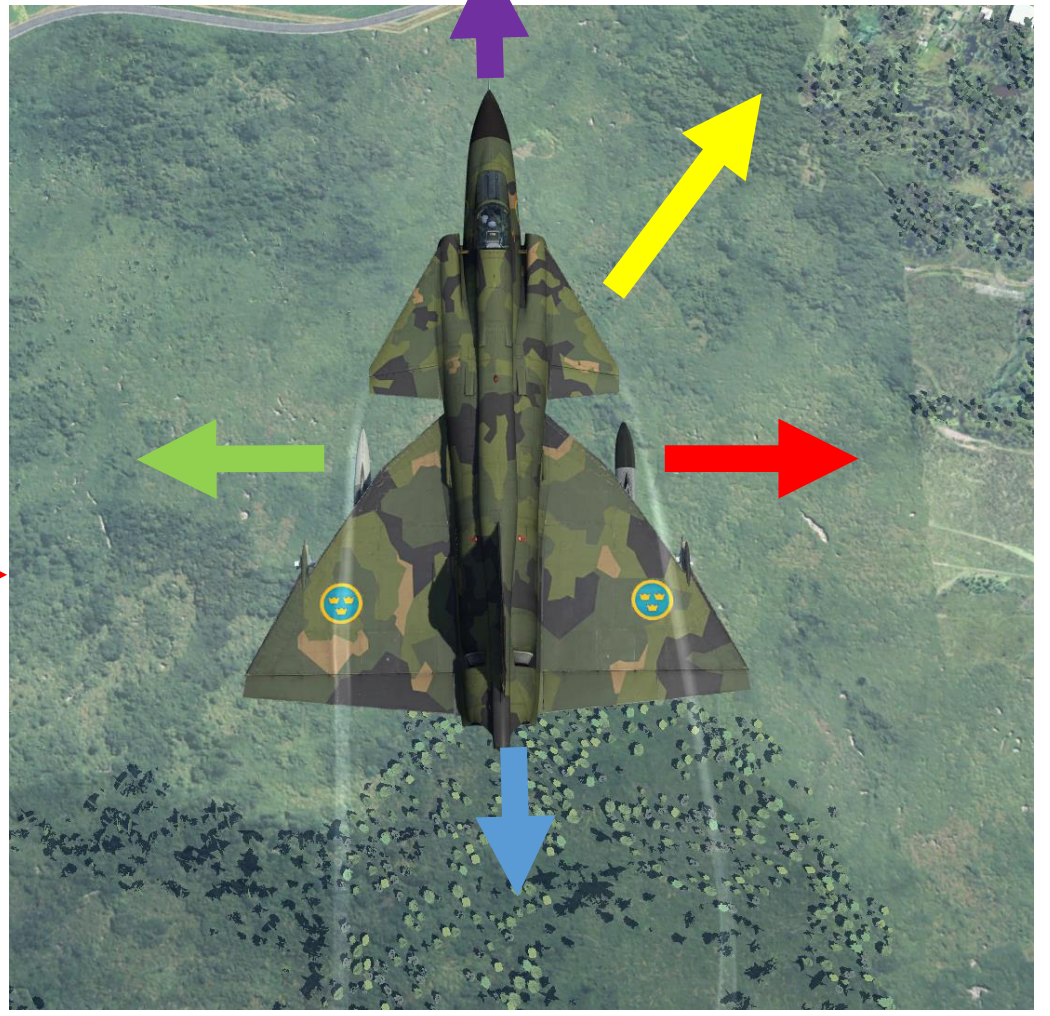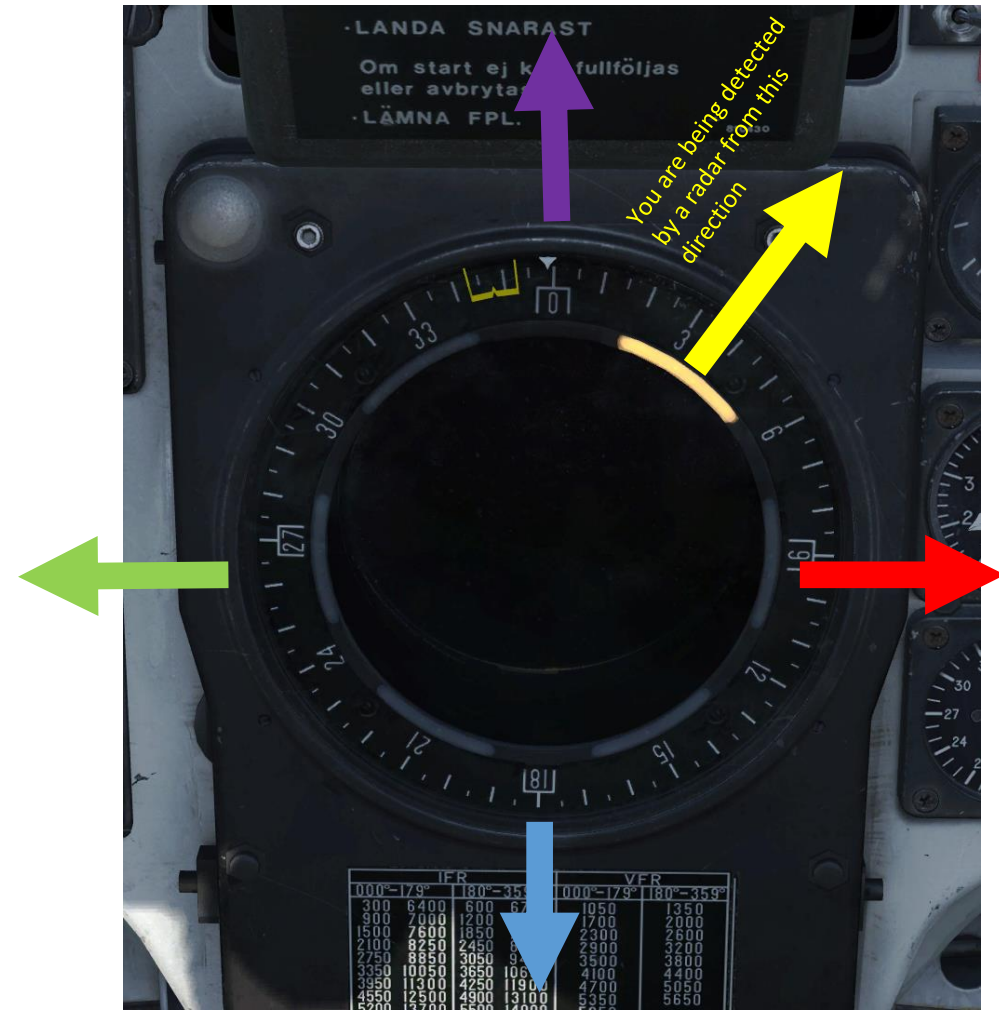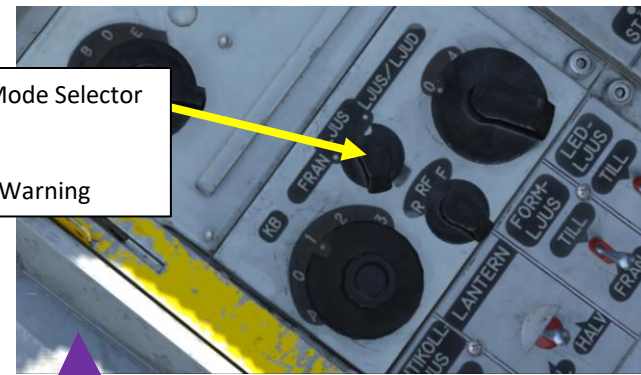
RWR (RADAR WARNING RECEIVER) – WHAT'S THAT SOUND?

Have you ever wondered what kind of sound corresponded to what? Well, wonder no more! There is a very cool tool at http://www.viggentools.se/ that allows you to generate RWR sounds and listen to the bleeps and bloops of the Viggen's noisy RWR.

RWR tone generator

Volume

Highlight PRF Freq.

Airborne

- **Stop** AJS37 Viggen
- **Play** E-2D
- **Play** E-3A
- **Play** A-50
- **Play** MiG-21bis - Emitter 1
- **Play** MiG-21bis - Emitter 2
- **Play** MiG-21bis - Emitter 3
- **Play** MiG-29S - Emitter 1
- **Play** MiG-29S - Emitter 2
- **Play** MiG-29S - Emitter 3
- **Play** Su-27 - Emitter 1
- **Play** Su 27 - Emitter 2
- **Play** Su 27 - Emitter 3
- **Play** F-15C - Emitter 1
- **Play** F-15C - Emitter 2
- **Play** F-15C - Emitter 3
- **Play** Mirage-2000C - Emitter 1
- **Play** Mirage-2000C - Emitter 2
- **Play** Mirage-2000C - Emitter 3

Ground

- **Play** Kub - SA-6 - Search
- **Play** Kub - SA-6 - Tracking
- **Play** Buk - SA-11 - Search A
- **Play** Buk - SA-11 - Search B
- **Play** Buk - SA-11 - Tracking
- **Play** S-125 - SA-3 - Emitter 1
- **Play** S-125 - SA-3 - Emitter 2
- **Play** Tunguska - SA-19 - Search
- **Play** Tunguska - SA-19 - Tracking
- **Play** Tor - SA-15 - Emitter 1
- **Play** Tor - SA-15 - Emitter 2
- **Play** S-300PS - SA-10 - SR 5N66M
- **Play** S-300PS - SA-10 - SR 64H6E
- **Play** S-300PS - SA-10 - Tracking
- **Play** Osa - SA-8 - Tracking
- **Play** ZSU-24-4 Shilka - Tracking
- **Play** Hawk - SR AN/MPQ-55
- **Play** Hawk - SR AN/MPQ-50
- **Play** Hawk - Search
- **Play** Hawk - Tracking
- **Play** Roland - EWR
- **Play** Roland - Search
- **Play** Roland - TR ADS
- **Play** Vulcan - Tracking
- **Play** Gepard - Tracking
- **Play** Patriot - Search
- **Play** Patriot - Tracking
- **Play** EWR

Naval

- **Play** FFL 1124.4 Grisha - Search
- **Play** FFL 1124.4 Grisha - Tracking
- **Play** CV Admiral Kuznetsov - Search
- **Play** CV Admiral Kuznetsov - Tracking
- **Play** FSG 1241.1MP Molniya - Search
- **Play** FSG 1241.1MP Molniya - Tracking
- **Play** CG 1164 Moskva - Search
- **Play** CG 1164 Moskva - Tracking
- **Play** FFG 11540 Neustrashimy - Search
- **Play** FFG 11540 Neustrashimy - Tracking
- **Play** CGN 1144.2 Pyotr Velikiy - Search
- **Play** CGN 1144.2 Pyotr Velikiy - Tracking
- **Play** FF 1135M Rezky - Search
- **Play** FF 1135M Rezky - Tracking
- **Play** CG-60 Normandy - Search
- **Play** CG-60 Normandy - Tracking
- **Play** FFG-7CL Oliver Hazzard Perry - Search
- **Play** FFG-7CL Oliver Hazzard Perry - Tracking
- **Play** CVN-70 Carl Vinson - Search
- **Play** CVN-70 Carl Vinson - Tracking

ECM Jammer Pods

The U22 and U22/A pods are the electronic countermeasure (ECM) or "jammer" pods designed to interfere with hostile radar systems to inhibit tracking and locking functions for self-protection purposes. The pods cannot be jettisoned. The pods are of a repeater type, meaning that they will only emit when receiving a signal, thereby operating largely automatically.

The ECM pods exists in two versions. U22 (previously called KA) is the older pod with only ECM features. U22/A is a more recent (mid 1990's) update with a more modern cooling system as well as various improvements such as limited electronic intelligence (ELINT) gathering.

The U22 pods are directional in their emission envelopes, the pod can emit in a cone of ± 60° gyro stabilized horizontally and about ± 45° vertically.

U22/A ECM Jammer Pod

ECM Jammer (U22/A Pod)

To operate the U22/A Jammer:

1. The pod requires 3 minutes of pre-heating in mode A (Automatic) or B (Pre-Heat/Standby) before it can start emitting.
2. With the mode selector in mode B, the pod will automatically emit when illuminated by a radar from the frontal aspect.
3. During emission, the MOTVERK indicator light appears. If a fault occurs in the pod, the indicator KB-H/KA SL light flashes. This warning is cancelled by pressing the master caution reset button. Doing so will automatically attempt a restart of the pod.

The U22/A is a slightly improved version of the U22 pod, with expanded capabilities:
- New cooling system.
- Added data cartridge.
- Increased sensitivity.
- Silent recording functionality for electronic intelligence (ELINT) purposes. The pod will record incoming radar signals which can be used to determine the type and position of emitters via triangulation.
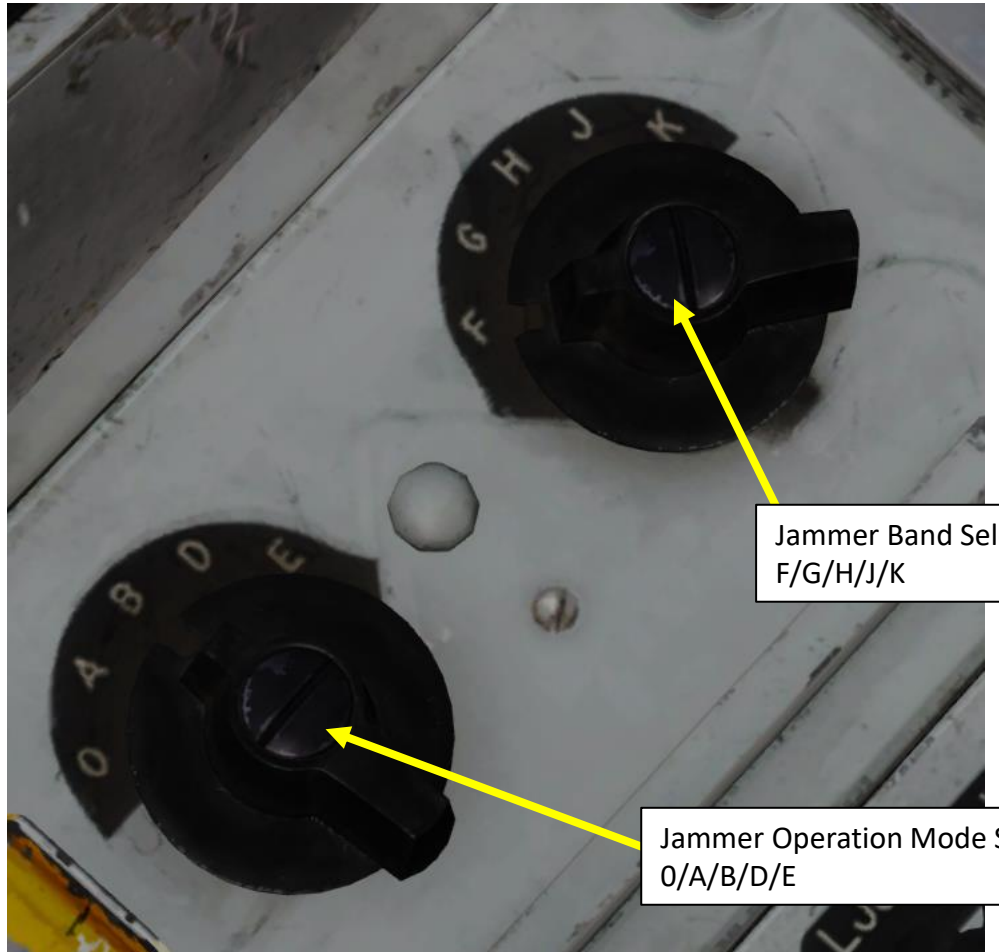
Jammer Band Selector
F/G/H/J/K

Jammer Operation Mode Selector
0/A/B/D/E
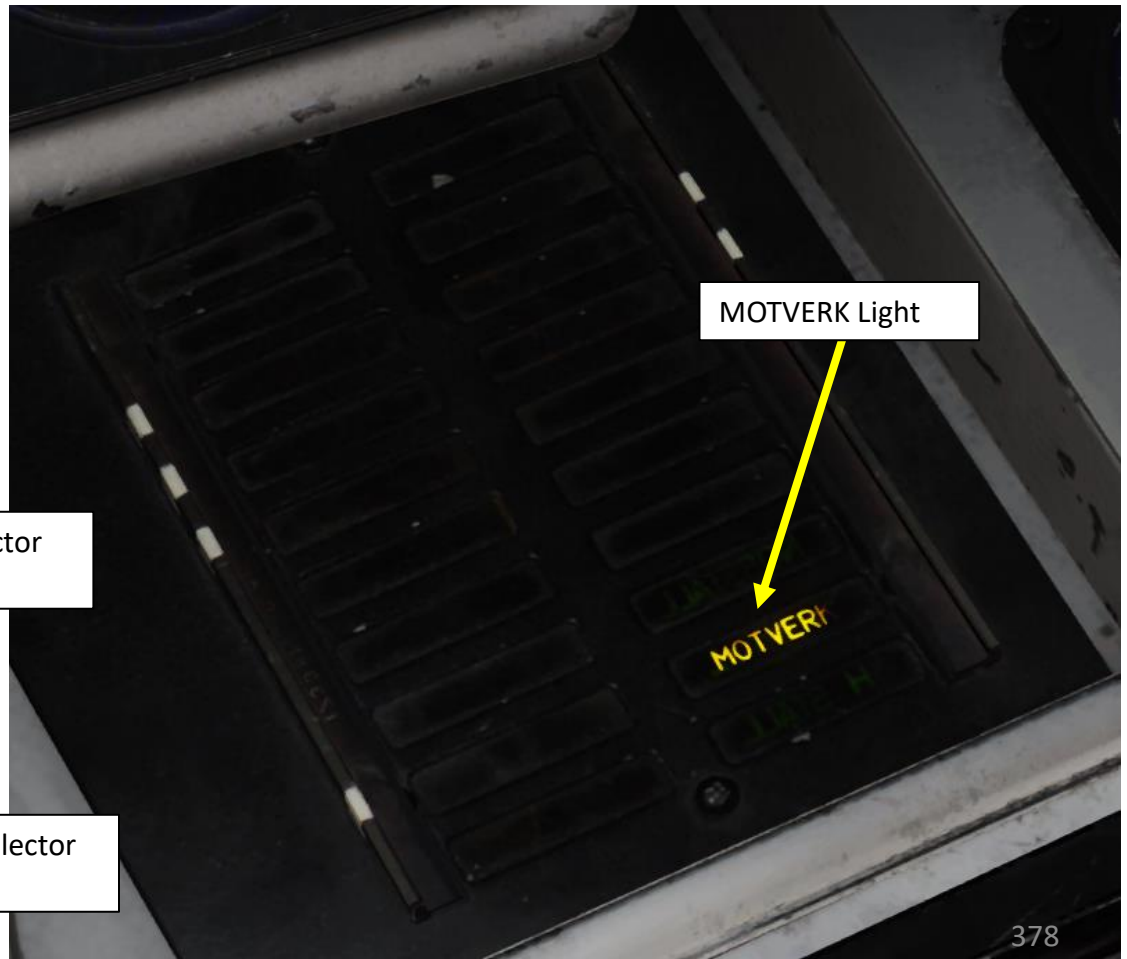
MOTVERK Light

ECM Jammer (U22/A Pod)

The ECM (Electronic Countermeasure) jammer can be used by combining the two selectors. The jammer has the following functions:

- OFF Mode: Pod is disabled

- Preheat Mode: Pod is being preheated and prepared for use.

- Silent Recording Mode: Pod will receive and record incoming signals and will not emit any jamming signals.

- Active Emission Mode: Pod will emit jamming signals and attempt to drown scanning radar emitters with white noise.

Sheet by FunkyFranky

U22/A ECM Pod

U22/A	Mode	Band	Function
Off	0	—	Pod is disabled.
Pre-heat	A	F	3 min pre-heating before pod can emit.
Silent recording	A	G	Receive and record with low sensitivity.
		H/J	Receive and record with high sensitivity.
		K	Auto sensitivity cycling between G and J.
Active emission	B/D/E	F/G/H J/K	Auto emission when illuminated from front.
U22			
Off	0	—	Pod is disabled.
Pre-heat	A/B	—	3 min pre-heating before pod can emit.
Active emission	A	—	Auto emission when illuminated from front.
Stand-by	B	—	Stand-by mode. No active emission.

Jammer Band Selector
F/G/H/J/K

Jammer Operation Mode Selector
0/A/B/D/E
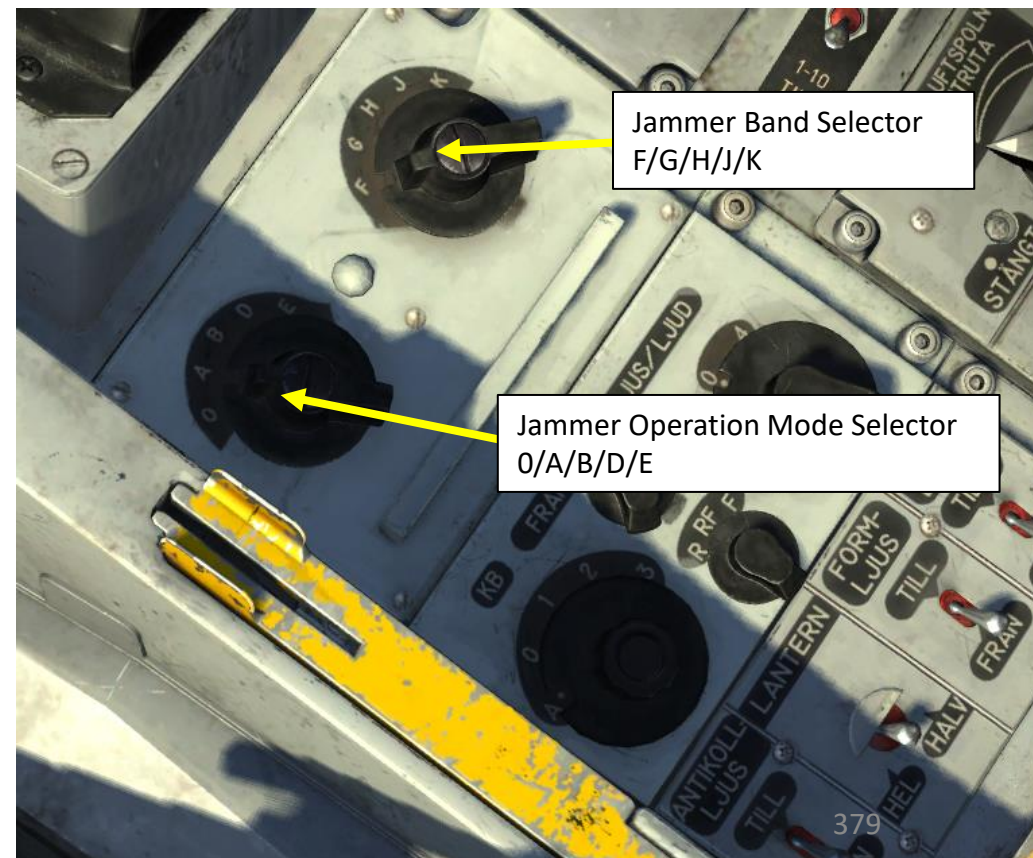
ECM Jammer (U22 Pod)

To operate the U22 Jammer:

1. The pod requires 3 minutes of pre-heating in mode A (Automatic) or B (Pre-Heat/Standby) before it can start emitting.
2. With the mode selector in mode A, the pod will automatically emit when illuminated by a radar from the frontal aspect.
3. During emission, the MOTVERK indicator light appears. If a fault occurs in the pod, the indicator KB-H/KA SL light flashes. This warning is cancelled by pressing the master caution reset button. Doing so will automatically attempt a restart of the pod.

U22 ECM Jammer Pod
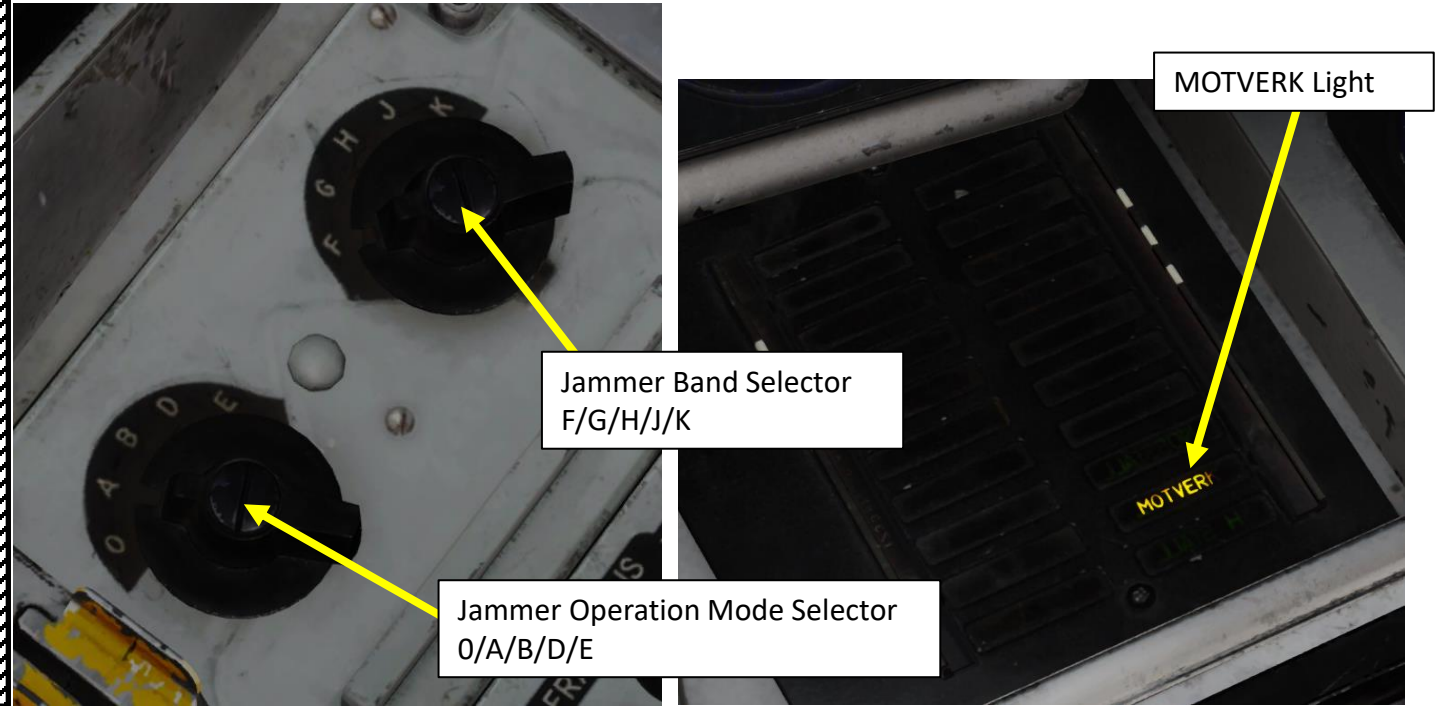
MOTVERK Light

Jammer Band Selector
F/G/H/J/K

Jammer Operation Mode Selector
0/A/B/D/E

Resulting mode	U22 mode selector mode	U22 bandwidth selector mode
Off	0	No function
Preheat	A	F
Silent recording	A	G H J K
Active emission	B	F G H J K
Active emission	D	F G H J K
Active emission	E	F G H J K

Aircraft Limits

- Minimum turning radius on ground (centerline): 9.50 m.

- Minimum turning radius on ground (wingtip) 15.45 m.

- Service ceiling: 20,000 m.

- Take-off speed: 200- 310 km/h.

- Touch-down speed: 220- 310 km/h.

- Maximum tire speed rating (max allowed speed with wheels on ground: 320 km/h indicated.

- Maximum allowed airspeed, extended gear: 600 km/h Indicated.

- Maximum airspeed: Mach 2 or 1350 km/h indicated.

- Range (Internal fuel): 1700 km.

- Range (External tank): 2100 km.

- Max Allowed G: 7G (6 G during peacetime). Can be exceeded but not allowed.

- Max Allowed Time in Negative G: 10 seconds

Best Fuel Economy Airspeeds at Altitude	
Altitude	Airspeed (Mach)
0 m / 0 ft	M 0.55
3000 m / 10000 ft	M 0.66
6000 m / 20000 ft	M 0.76
9000 m / 30000 ft	M 0.86
10000 m / 33000 ft	M 0.9

GSA (*GrundStyrAutomat*) – Flight Controls System

The AJS-37 flight control system is divided into two main components operating in parallel.

The first component is a the mechanical control system called GSA (*GrundStyrAutomat*), which is a system of mechanical linkages from the control stick to the hydraulic servos. A series of differentials and gearboxes serves to change control surface deflection with airspeed and altitude.

The second component is the input from the autopilot system called SA06 (*Styrautomat* 06), which interfaces with the outer elevons and the rudder servo, which will control the aircraft (in conjunction with the mechanical input). The control system is essentially two levels of systems working together, one being the mechanical system and the other being the autopilot inputs.

Rudder

The rudder is controlled by the rudder pedals and by the autopilot inputs. The rudder is trimmed by the potentiometer SID-TRIM. During the Autopilot modes ATT and HÖJD, the trim is automatically controlled by the autopilot.

Emergency Yaw Trim (*SIDTRIM*)
- *VÄNSTER*: Left
- *HÖGER*: Right
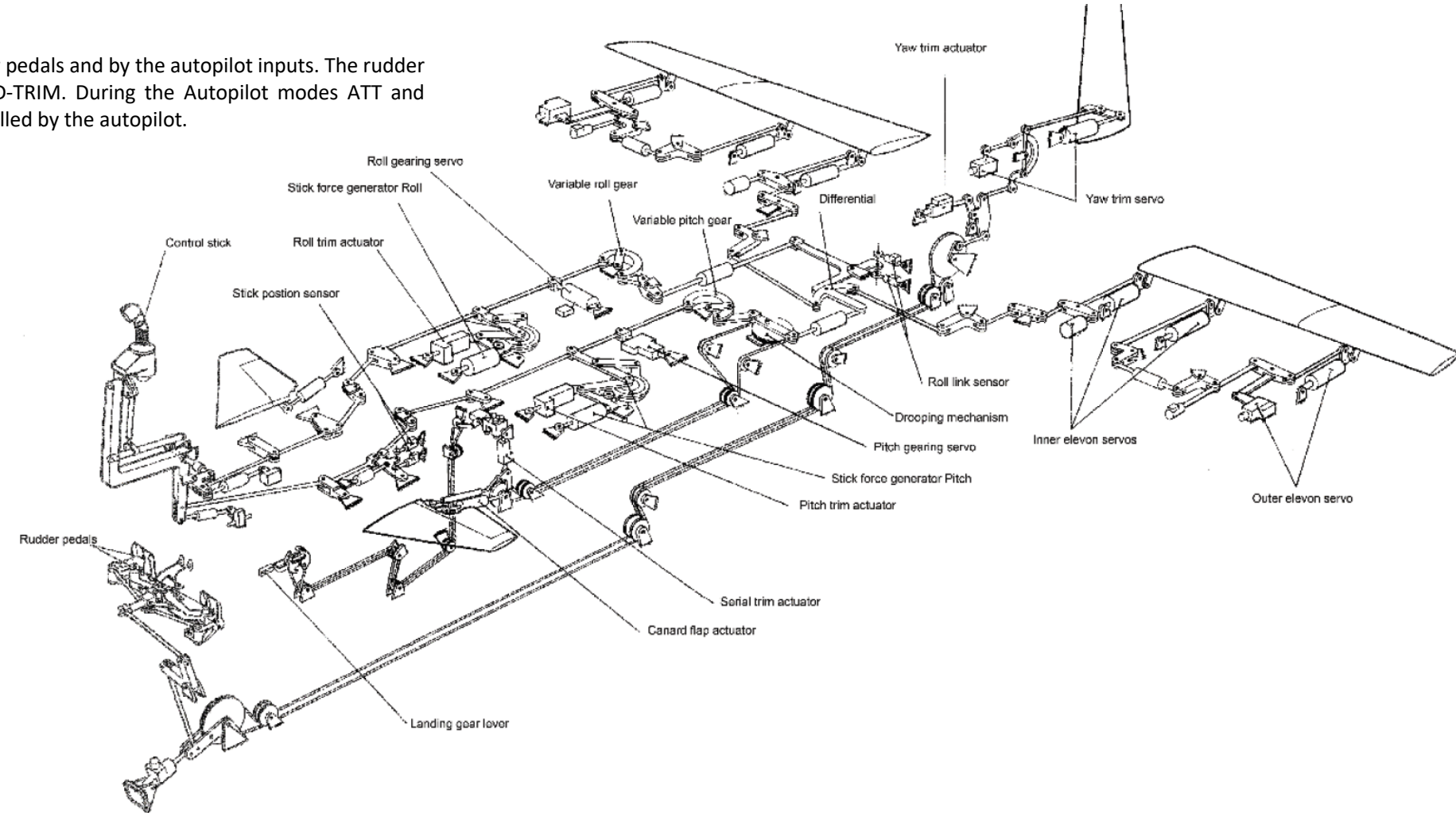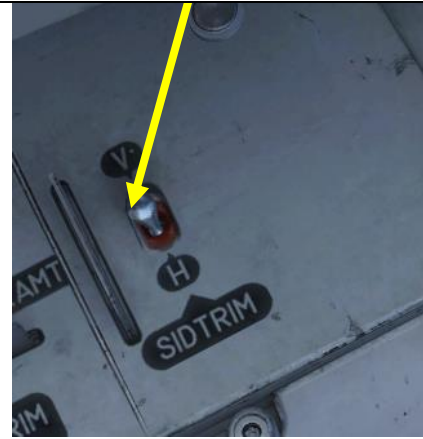
GSA (*GrundStyrAutomat*) – Flight Controls System

Pitch Gearing

In order to have a greater range of control of pitch at different airspeeds, the pitch system is fitted with a variable gearing. The gearing is designed to change the relationship between stick input and the control surface deflection with decreasing surface deflection for a given value of stick input in regards to the increased control surface effectiveness with higher airspeeds.

- The **pitch gearing is based on altitude and airspeed** information provided by the backup pitot system mounted on the fin.
- In case of **failure or error, the pilot is alerted by the light "TIPP VÄXEL"** (Pitch gearing) on the left indicator panel.
- The pitch gearing can in this case be set manually to the landing mode, by setting the switch TIPP VÄXEL (Pitch gearing) from automatic (AUTO) to landing mode (LANDN). The warning light will remain on.

The system is hydraulically powered by the second hydraulic system (HYD SYST 2). In case of hydraulic failure, the warning TIPP VÄXEL will not appear, unless the TIPP VÄXEL switch is set to landing mode.

Roll Gearing

Similar to the pitch gearing, the roll gearing is designed to change the necessary stick input for roll movement **at different airspeeds**. As opposed to the pitch gearing with a more variable gearing over a larger range, the roll gearing has **two distinct modes, low-speed and high speed**. The change between low and high-speed modes is **automatic** and occurs when the aircraft passes 350 km/h and takes about 5 seconds.

In order to increase safety, the change function is based on two sources, one sensor in the flight data unit (using the main Pitot tube) and one in the fin-mounted backup Pitot tube system. The logic is as follows:
- If the landing gear lever is in position IN, both sources need to show an airspeed of less than 350 km/h in order to engage the low-speed mode.
- In case the landing gear lever is in position OUT, only one of the sensors need to indicate less than 350 km/h in order to engage low-speed mode.
- In the case that the two pitot tube systems are not indicating the same value, the roll gearing will enter high-speed mode if the landing gear is retracted and low-speed if landing gear is extended.
- In case of failure, the warning light ROLL VÄXEL will appear on the right indicator panel.
- In case of hydraulic failure the warning ROLL VÄXEL will not appear. In case of a hydraulic system 2 failure, the gearing will leak and slowly move towards the high-speed mode.

TIPPVÄXEL: Pitch gearing in incorrect mode based on current airspeed

ROLL VÄXEL: Roll Gearing system failure

Pitch Gearing Switch (*TIPP VÄXEL*)
- TILL = ON = Pitch Gearing Automatic Mode
- FRÅN = OFF = Pitch Gearing Landing Mode
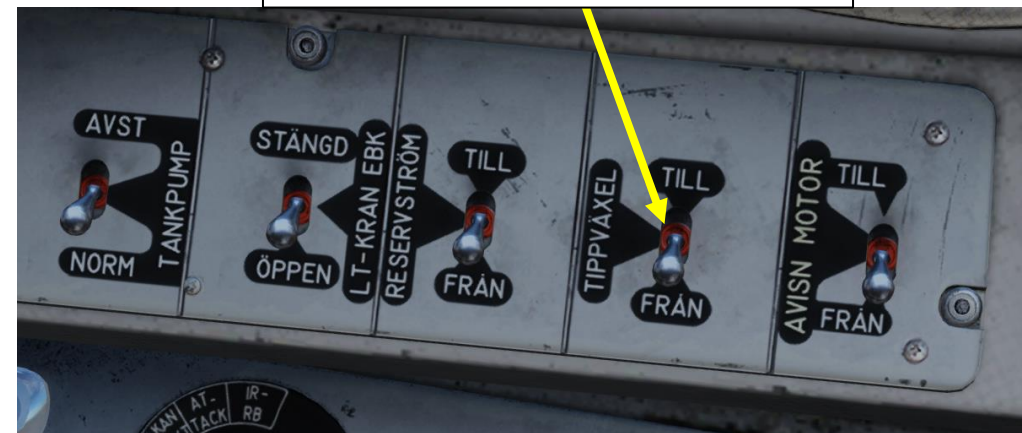
Trim Controls

The aircraft lacks trim tabs and instead operates by moving the neutral position of the control stick. The trim is operated by a small **trim hat switch on the control stick**.

During the autopilot modes ATT and HÖJD (attitude or altitude hold) the normal trim system is disabled. The trim in these modes is instead controlled by the autopilot, automatic trimming. The trim hat switch instead is used for operating the autopilot.

Pitch trim is indicated by the trim indicator on the front left side panel. Indicates trim setting in ± 10° nose up (Nos upp) / nose down (Nos ned).

In case of a failure of the normal trim system, there is an **emergency trim** system. The switches NÖDTRIM TIPP (emergency pitch trim) and NÖDTRIM ROLL (emergency roll trim) control pitch and roll emergency trim respectively. Once the emergency trim system has been activated, the normal trim hat on the control stick can only be operated if the circuit breaker TRIMSYST (right side CB panel) is cycled.

Emergency Pitch Trim (*NÖDTRIM TIPP*)
- *FRAMÅT* : Forward
- *BAKÅT* : Aft

Emergency Yaw Trim (*SIDTRIM*)
- *VÄNSTER*: Left
- *HÖGER*: Right

Emergency Roll Trim (*NÖDTRIM ROLL*)
- *VÄNSTER*: Left
- *HÖGER*: Right
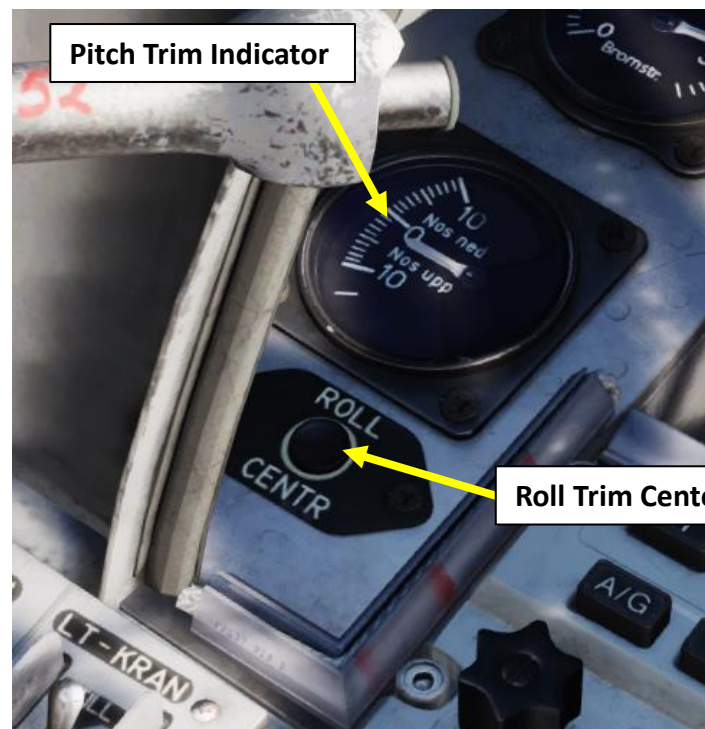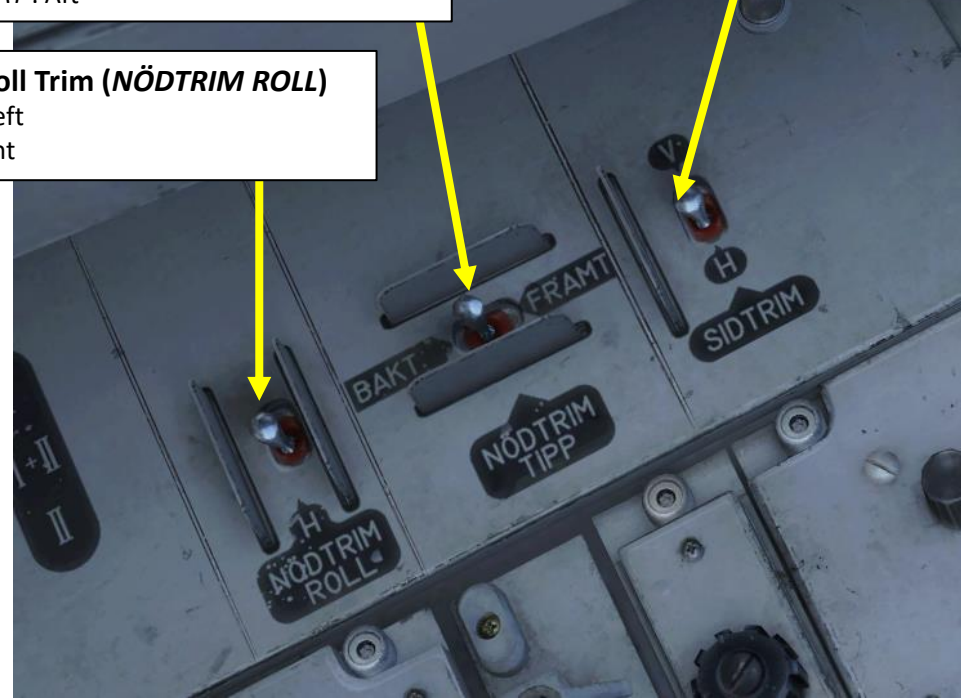
Trim Hat Switch

Pitch Trim Indicator

Roll Trim Center Switch

Autopilot Mode Selectors/Lights
- *SPAK*: Main dampening mode
- *ATT*: Attitude Hold
- *HÖJD*: Altitude Hold

384
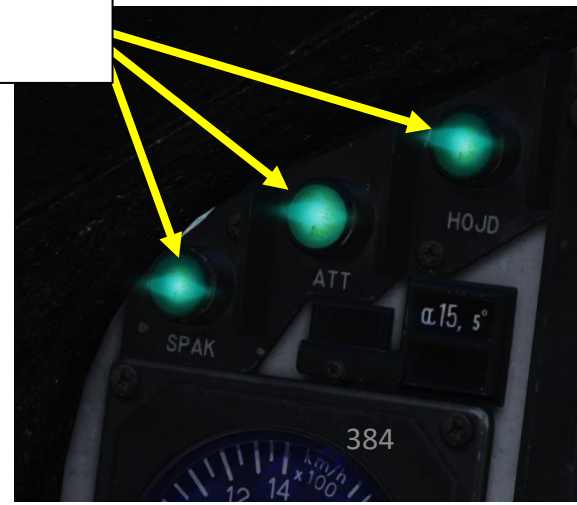
HAW (High Alpha Warning System)

In order to avoid excessive angles of attack, the pilot is warned when the angle of attack (AoA or α) exceeds or quickly approaches the angle of attack limit. The pilot is warned by a **vibrating membrane in the control stick** as well as a **pulsating audio tone**.

The HAW system can be toggled by the HAW circuit breaker (HAV) on the circuit breaker panel.

HAW Maximum Angle of Attack

Landing gear lever position	Autopilot mode GSA and SPAK	Autopilot mode ATT and HÖJD
IN	18°	15°
OUT	15°	15°
OUT and AFK (Autothrottle) mode 3 (α 15.5)	18°	15°
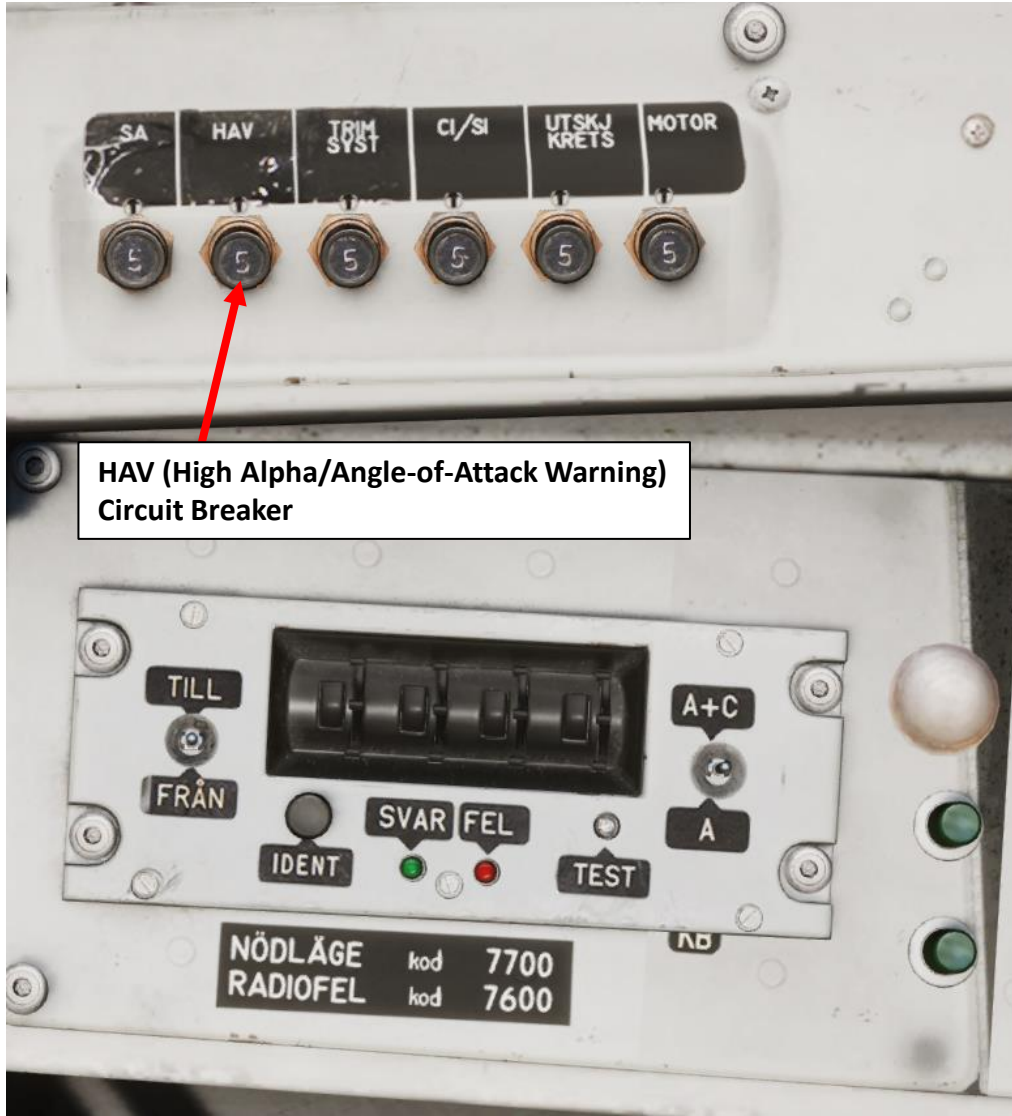
HAV (High Alpha/Angle-of-Attack Warning) Circuit Breaker

AoA (Angle of Attack) Indicator (deg)

385

Ground Collision / Altitude Warning System

The altitude warning functionality of the aircraft is designed to alert the pilot of an imminent impact with the ground or that the set altitude for the autopilot is no longer kept. There are three main types of warnings.

- Elevation change warning
- Ground collision warning
- Altitude hold warning (2 sub modes)

All altitude warnings are given in the form of a indicator light (red) on the top left of the Central Indicator as well as flashing reference poles and radar altitude indexes on the CI and HUD. Additionally, the indicator light warnings are used for other functions such as during use of the RB 04, RB 15 and BK90.

Elevation Change Warning

Elevation change warning is received when the altitude source selector HÖJD CISI is in mode LD and the barometric altitude is used. When the radar altitude is less than 150 m and at the same time less than half of the computer calculated altitude the warning is received. This is to alert the pilot of a sudden change in elevation below the aircraft.
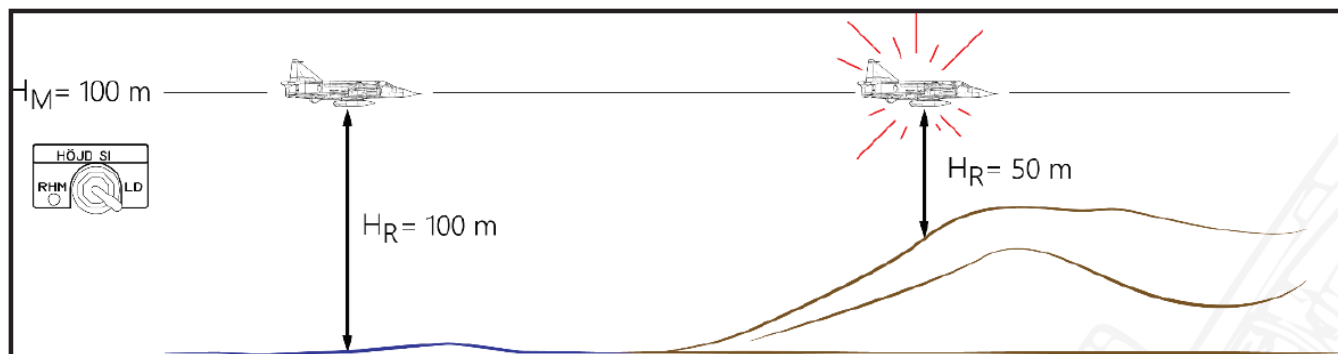
H_M= 100 m

H_R= 100 m

H_R= 50 m

Altitude Source Selector (HÖJD CISI)
- RHM: Radar Altimeter is used as the altitude source
- LD: Barometric Altitude (air pressure sensor) is used as the altitude source

Altitude Warning Light

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Ground Collision / Altitude Warning System

Ground Collision Warning

Ground collision warning is received when the radar is used (mode A1 or A2) when the calculated altitude and descent rate is such that the aircraft will impact the ground within 7 seconds. If the radar altimeter is available, the warning is always based on the radar altitude.

This warning is inhibited during aiming against ground targets, as well as when the landing gear is extended and the ground calibrated altitude is less than 50 meters.

7 s

H_M
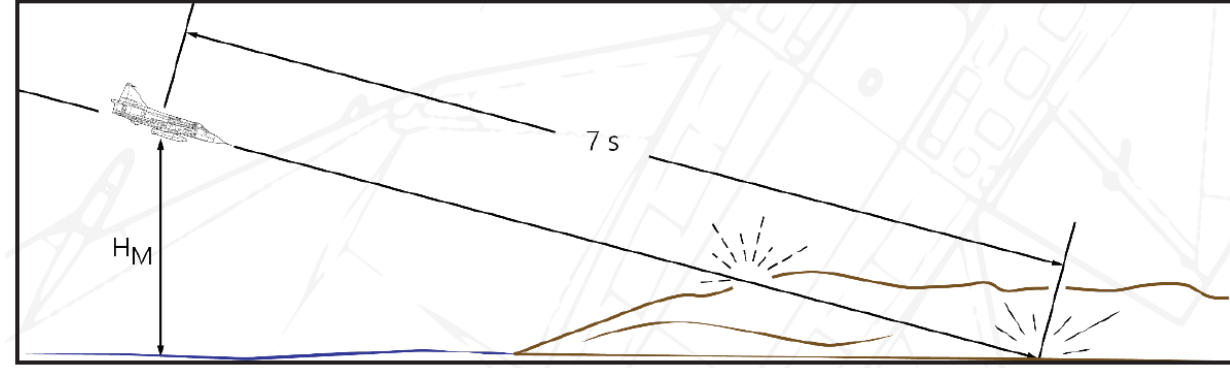
Radar Mode Selector
A1: Radar ON, Sector PPI

Altitude Source Selector (HÖJD CISI)
- RHM: Radar Altimeter is used as the altitude source
- LD: Barometric Altitude (air pressure sensor) is used as the altitude source

Altitude Warning Light

FR22 V/UHF Radio

FR22 Radio Overview

- The **V/UHF FR22 radio** is used for communications between 103 and 155.975 MHz (VHF) and communications between 225.00 and 399.95 MHz (UHF). It can use both custom and preset channels as well (preset channels can be changed in the mission editor). Preset channel frequencies should be available in mission briefing. The Manual Frequency Control Panel can be used if the "–" button is selected.
- The FR 22 is powered by the main power supply from the generator (and ground power).
- The functionalities of both FR 22 and FR 24 radios are done through the FR24 mode selector.
    - NORM: FR22 main radio
    - H: Guard Frequency (121.5 MHz)
    - E, F, G: FR 24 backup radio, presets emergency channels
- You can transmit using the "FR22 Push-to-Talk" key binding.

FR22 Radio Transmit Button

FR22 Control Panel
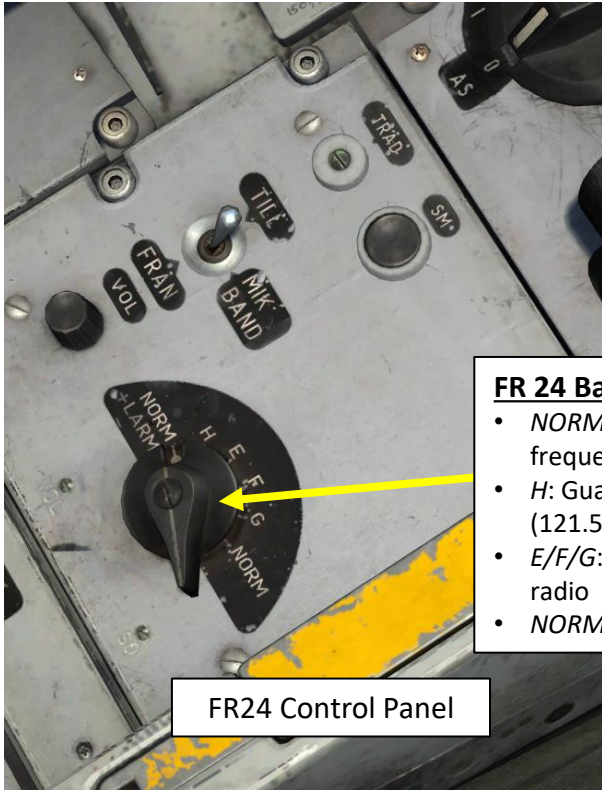
FR22 Manual Frequency Control Panel

FR 24 Backup Radio Mode Selector
- *NORM+LARM:* Normal Mode, but monitoring guard frequency 121.5 MHz
- *H*: Guard Frequency using the FR 24 Backup Radio (121.5 MHz)
- *E/F/G*: Preset emergency channels using FR 24 Backup radio
- *NORM*: Normal FR 22 Main Radio functionality

FR24 Control Panel

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FR22 V/UHF Radio

FR22 Radio Overview

The FR22 may seem complicated at first, but it's not that difficult once you know what different buttons are used for.

- RED: Special Preset Channels. Used for special communication channels (i.e. JTAC).

- BLUE: Base Preset Channels. Used to communicate with the ATC (Air Traffic Controllers). Button A/G typically selects a channel in the VHF range while the C/F typically selects a channel in the UHF range.

- YELLOW: Group Preset Channels. Used to communicate with other flights (i.e. AWACS, allied fighters, etc).

- The Manual Frequency Control Panel can be used if the "–" button is selected.

  See Grunf's explanation of the radio:
  https://forums.eagle.ru/showpost.php?p=3053305&postcount=6

FR22 Manual Frequency Control Panel

FR22 Radio Transmit Button

FR22 V/UHF Radio

FR22 Channel Types

SPECIAL CHANNELS (Preset)

- **H** : Guard Frequency (121.5 MHz)
- **1** : Special Channel 1, used for wingman.
- **2** : Special Channel 2, used for wingman.
- **Blank** (should be a 3) : Special Channel 3, used for wingman.
- **–** : Manually Dialed Frequency (see Manual Frequency Control Panel)

BASE CHANNELS (Preset)

- **ROTARY** : Used to select a preset Airbase
- **A/G** : Used to select sub-channel A for a selected airbase (rotary).
- **B** : Used to select sub-channel B for a selected airbase (rotary).
- **C/F**: Used to select sub-channel C for a selected airbase (rotary).
- **C2**: Used to select sub-channel C2 for a selected airbase (rotary).
- **D/E**: Used to select sub-channel D for a selected airbase (rotary).

Example: Selecting Rotary 1 and pressing A/G button will select Channel A of Airbase Anapa-Vityazevo, which is 121 MHz.

GROUP CHANNELS (Preset)

- **ROTARY** : Used to select a preset group
- **1** : Sub-Group Channel 1…
- **2** : Sub-Group Channel 2…

Example: Selecting Rotary 1 and pressing the 1 button will select the first group, first aircraft, which is the AWACS (E-3A). Selecting Rotary 2 and pressing the 1 button will select the second group, first aircraft, which is an F-15C.

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 41.5002
A: 121Mhz AM B: 38.4Mhz AM C: 250Mhz AM C2: 3.7Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 267.003
A: 122Mhz AM B: 38.6Mhz AM C: 251Mhz AM C2: 3.8Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 42.0001
A: 123Mhz AM B: 38.8Mhz AM C: 252Mhz AM C2: 3.8Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 219.52
A: 124Mhz AM B: 39Mhz AM C: 253Mhz AM C2: 3.9Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 219
A: 125Mhz AM B: 39.2Mhz AM C: 254Mhz AM C2: 3.9Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 39.9997
A: 126Mhz AM B: 39.4Mhz AM C: 255Mhz AM C2: 4Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 242.005
A: 127Mhz AM B: 39.6Mhz AM C: 256Mhz AM C2: 4Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 47.0052
A: 128Mhz AM B: 39.8Mhz AM C: 257Mhz AM C2: 4.1Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.485
A: 129Mhz AM B: 40Mhz AM C: 258Mhz AM C2: 4.1Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 331.003
A: 130Mhz AM B: 40.2Mhz AM C: 259Mhz AM C2: 4.2Mhz AM
11: Batumi (9011) TILS: 11 RWY: 125.585
A: 131Mhz AM B: 40.4Mhz AM C: 260Mhz AM C2: 4.2Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 94.7002
A: 132Mhz AM B: 40.6Mhz AM C: 261Mhz AM C2: 4.3Mhz AM
13: Kobuleti (9013) TILS: 13 RWY: 70
A: 133Mhz AM B: 40.8Mhz AM C: 262Mhz AM C2: 4.3Mhz AM
14: Kutaisi (9014) TILS: 14 RWY: 74.0009
A: 134Mhz AM B: 41Mhz AM C: 263Mhz AM C2: 4.4Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.3
A: 135Mhz AM B: 41.2Mhz AM C: 264Mhz AM C2: 4.4Mhz AM
16: Nalchik (9016) TILS: 16 RWY: 55.5066
A: 136Mhz AM B: 41.4Mhz AM C: 265Mhz AM C2: 4.5Mhz AM
17: Mozdok (9017) TILS: 17 RWY: 82.7639
A: 137Mhz AM B: 41.6Mhz AM C: 266Mhz AM C2: 4.5Mhz AM
18: Tbilisi-Lochini (9018) TILS: 18 RWY: 307.999
A: 138Mhz AM B: 41.8Mhz AM C: 267Mhz AM C2: 4.6Mhz AM
19: Soganlug (9019) TILS: 19 RWY: 132.277
A: 139Mhz AM B: 42Mhz AM C: 268Mhz AM C2: 4.6Mhz AM
20: Vaziani (9020) TILS: 20 RWY: 135.485
A: 140Mhz AM B: 42.2Mhz AM C: 269Mhz AM C2: 4.7Mhz AM
21: Beslan (9021) TILS: 21 RWY: 93.5
A: 141Mhz AM B: 42.4Mhz AM C: 270Mhz AM C2: 4.7Mhz AM

Radio channels:

Special 1: 127.5 AM
Special 2: 264 AM
Special 3: 265 AM
E: 254 AM
F: 250 AM
G: 270 AM
H: 121.5 AM

Groups:

1-1 E-3A Pilot #006 251 AM
2-1 F-15C Pilot #003 119 AM
3-1 F-15C Pilot #005 126 AM

FR22 Manual Frequency Control Panel

MHz
123 450
FM   AM

FR22 V/UHF Radio

FR22 Radio Example: Transmit on a Manual Frequency

1. Set FR24 Backup Radio Mode Selector to NORM or NORM+LARM. This will select FR22 radio.
2. Adjust radio volume as required.
3. We want to select a manual frequency. Press the Minus "–" selector button to override other selected FR22 channels.
4. Select AM or FM band selector as required (normally most frequencies used in DCS are on AM).
5. Use the Manual Frequency tuning knobs to set the manual frequency.
6. Transmit by pressing the FR22 Radio Transmit Button.

FR22 Manual Frequency

5 Tunes 1st and 2nd digits

5 Tunes 3rd digit

4 AM/FM Band Selector

Tunes 5th and 6th digits   Tunes 4th digit

5   **5**

3

2

1

FR22 Radio Transmit Button   **6**

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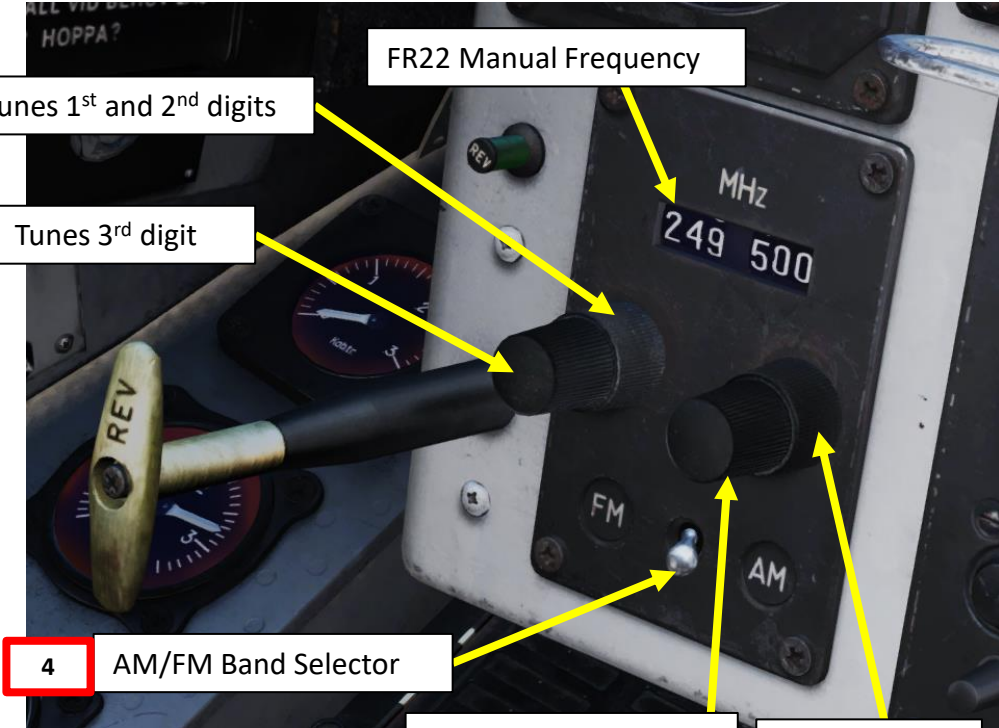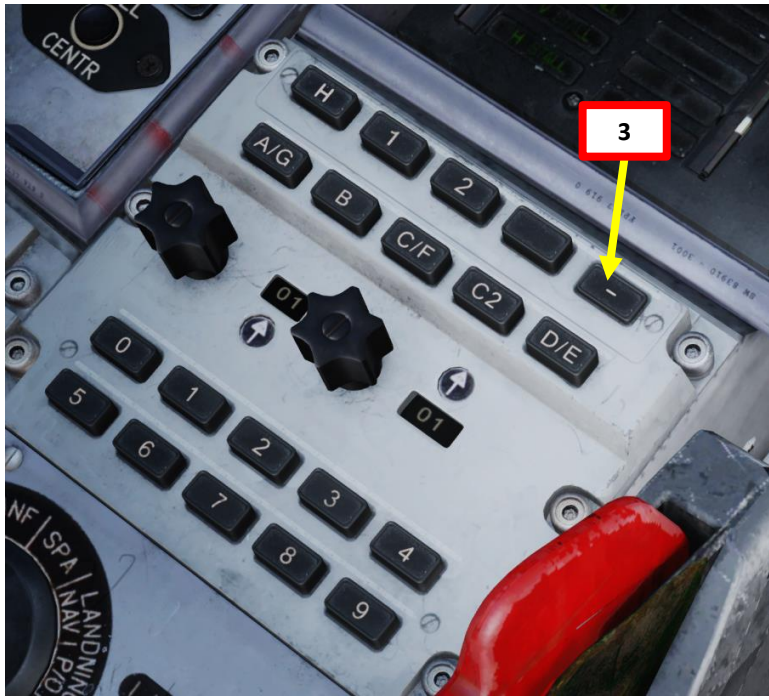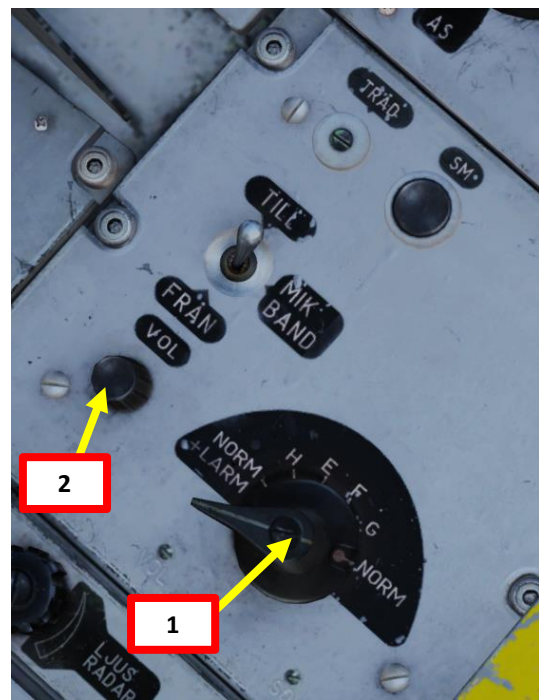
FR22 V/UHF Radio

FR22 Radio Example: Transmit on a Group Channel

The group selector is used to set one of the different preset channels, normally used for contacting fighter controllers or inflight communication. Channels are chosen by setting the dial on the left, then pressing one of the 0-9 buttons on the lower half of the panel to set the chosen channel on the dial.

1. Set FR24 Backup Radio Mode Selector to NORM or NORM+LARM. This will select FR22 radio.
2. Adjust radio volume as required.
3. We want to select Group 2-1, which is set to a F-15 pilot on frequency 119.000 AM. Set the Group Selector rotary to 02.
4. Set Sub-Group to "1" by pressing the "1" button. This will override other selected FR22 channels.
5. Transmit by pressing the FR22 Radio Transmit Button.

Group 2-1 →

Groups:

1-1 E-3A Pilot #006 251 AM
2-1 F-15C Pilot #003 119 AM
3-1 F-15C Pilot #005 126 AM
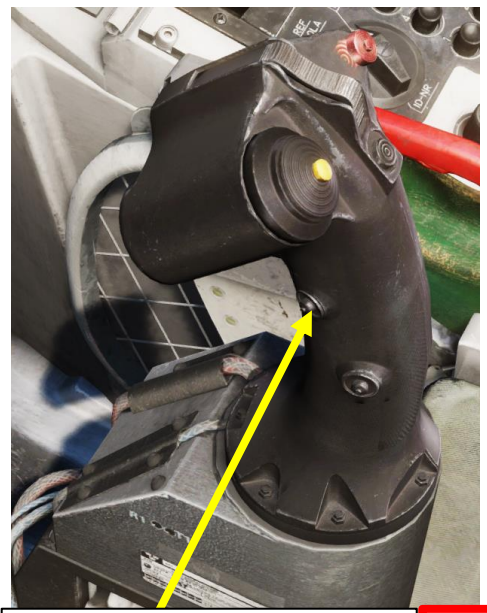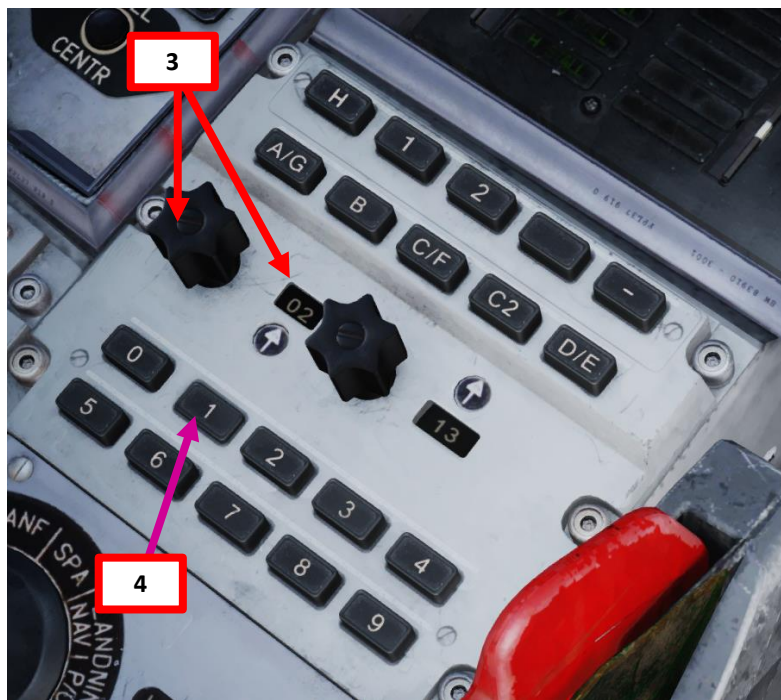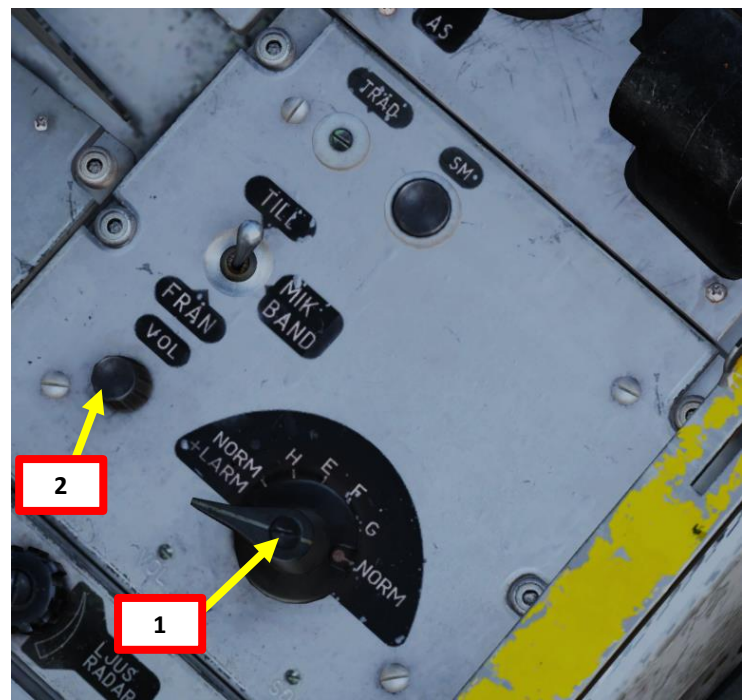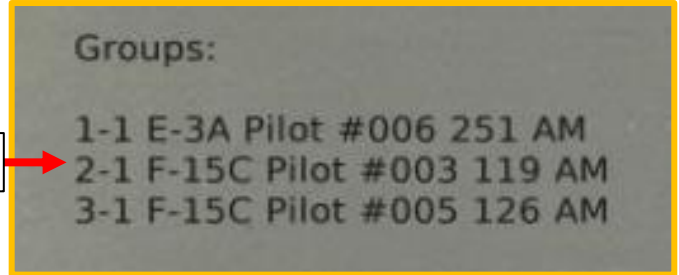
FR22 Radio Transmit Button   5

FR22 V/UHF Radio

FR22 Radio Example: Transmit on a Base Channel

The base selector is used to select preset frequencies for contacting Air Traffic Control. Frequencies are selected by moving the right dial to the corresponding airport / airbase number. The letter buttons (A/G, B, C/F, C2, D/E) on the second row are used to select the different channels for that airbase / airport. Every sixth position of the selector knob will display the mode ALLM (*Allmän* / Common) which will change the function of the letter channel selectors to correspond to the FR24 channels G, F, E. Refer to the in-game kneeboard for airfield frequencies and their corresponding channels.

1. Set FR24 Backup Radio Mode Selector to NORM or NORM+LARM. This will select FR22 radio.
2. Adjust radio volume as required.
3. We want to communicate with Anapa. Its base number is "1", and we can choose between four preset frequencies (A, B, C, C2). We want preset frequency A (121.000 AM). Set the Base Selector rotary to 01.
4. Set Base Channel to preset A (121 MHz) by pressing the "A/G" button. This will override other selected FR22 channels.
5. Transmit by pressing the FR22 Radio Transmit Button.

5

FR22 Radio Transmit Button

2

1

4

3

Base 1 – Sub-Channel A

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 41.5002
A: 121Mhz AM B: 38.4Mhz AM C: 250Mhz AM C2: 3.7Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 267.003
A: 122Mhz AM B: 38.6Mhz AM C: 251Mhz AM C2: 3.8Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 42.0001
A: 123Mhz AM B: 38.8Mhz AM C: 252Mhz AM C2: 3.8Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 219.52
A: 124Mhz AM B: 39Mhz AM C: 253Mhz AM C2: 3.9Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 219
A: 125Mhz AM B: 39.2Mhz AM C: 254Mhz AM C2: 3.9Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 39.9997
A: 126Mhz AM B: 39.4Mhz AM C: 255Mhz AM C2: 4Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 242.005
A: 127Mhz AM B: 39.6Mhz AM C: 256Mhz AM C2: 4Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 47.0052
A: 128Mhz AM B: 39.8Mhz AM C: 257Mhz AM C2: 4.1Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.485
A: 129Mhz AM B: 40Mhz AM C: 258Mhz AM C2: 4.1Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 331.003
A: 130Mhz AM B: 40.2Mhz AM C: 259Mhz AM C2: 4.2Mhz AM
11: Batumi (9011) TILS: 11 RWY: 125.585
A: 131Mhz AM B: 40.4Mhz AM C: 260Mhz AM C2: 4.2Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 94.7002
A: 132Mhz AM B: 40.6Mhz AM C: 261Mhz AM C2: 4.3Mhz AM
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14: Kutaisi (9014) TILS: 14 RWY: 74.0009
A: 134Mhz AM B: 41Mhz AM C: 263Mhz AM C2: 4.4Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.3
A: 135Mhz AM B: 41.2Mhz AM C: 264Mhz AM C2: 4.4Mhz AM
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A: 139Mhz AM B: 42Mhz AM C: 268Mhz AM C2: 4.6Mhz AM
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A: 140Mhz AM B: 42.2Mhz AM C: 269Mhz AM C2: 4.7Mhz AM
21: Beslan (9021) TILS: 21 RWY: 93.5
A: 141Mhz AM B: 42.4Mhz AM C: 270Mhz AM C2: 4.7Mhz AM

FR24 VHF AM Radio

FR24 Radio Overview

- The **VHF AM FR 24 radio** is used as a backup radio for fixed preset channels (E, F and G), which includes an emergency guard channel (121.5 MHz). communications between 225.00 and 399.95 MHz (UHF). It can only use preset channels (preset channels can be changed in the mission editor). Preset channel frequencies should be available in mission briefing.
- The FR 24 radio is powered by the main battery.
- The functionalities of both FR 22 and FR 24 radios are done through the FR24 mode selector.
    - NORM: FR 22 main radio
    - H: Guard Frequency (121.5 MHz)
    - E, F, G: FR 24 backup radio, presets emergency channels
- You can transmit using the "FR24 Push-to-Talk" and key binding.
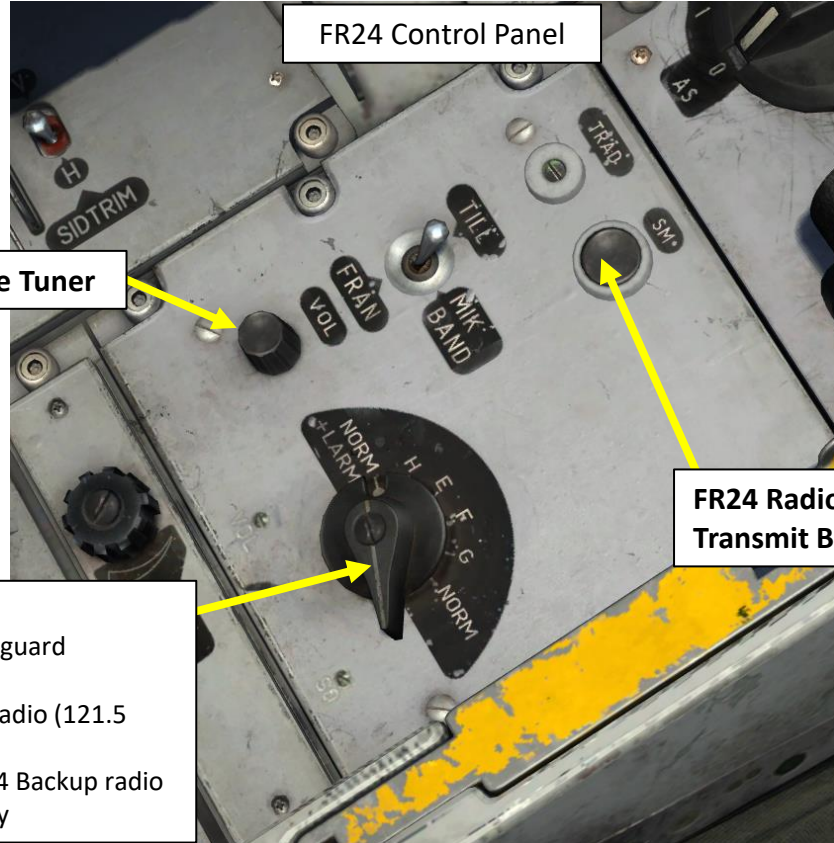
FR24 Control Panel

Radio Volume Tuner

FR24 Radio Transmit Button

FR 24 Backup Radio Mode Selector
- *NORM+LARM:* Normal Mode, but monitoring guard frequency 121.5 MHz
- *H*: Guard Frequency using the FR 24 Backup Radio (121.5 MHz)
- *E/F/G*: Preset emergency channels using FR 24 Backup radio
- *NORM*: Normal FR 22 Main Radio functionality

AIRPLANE GROUP

NAME	Aerial-1	
CONDITION	%	< > 100
COUNTRY	● Sweden	COMBAT
TASK	Ground Attack	
UNIT	< > 1	OF < > 1
TYPE	AJS37	
SKILL	Player	
PILOT	Aerial-1-1	
TAIL #	010	
RADIO	✓ FREQUENCY 305	MHz AM
CALLSIGN	Enfield 1	1

☐ HIDDEN ON MAP
☐ HIDDEN ON PLANNER
☐ HIDDEN ON MFD   ☐ LATE ACTIVATION

RADIO PRESETS

Radio frequencies

Special 1	< > 305	MHz	AM
Special 2	< > 264	MHz	AM
Special 3	< > 265	MHz	AM
E	< > 125	MHz	AM
F	< > 121	MHz	AM
G	< > 141	MHz	AM
H (LARM/GUARD)	< > 121.5	MHz	AM

FR24 VHF AM Radio

FR24 Radio Example

1. Set FR24 Backup Radio Mode Selector to the desired preset frequency (E, F or G).
2. Adjust radio volume as required.
3. Transmit by pressing the FR24 Radio Transmit Button.
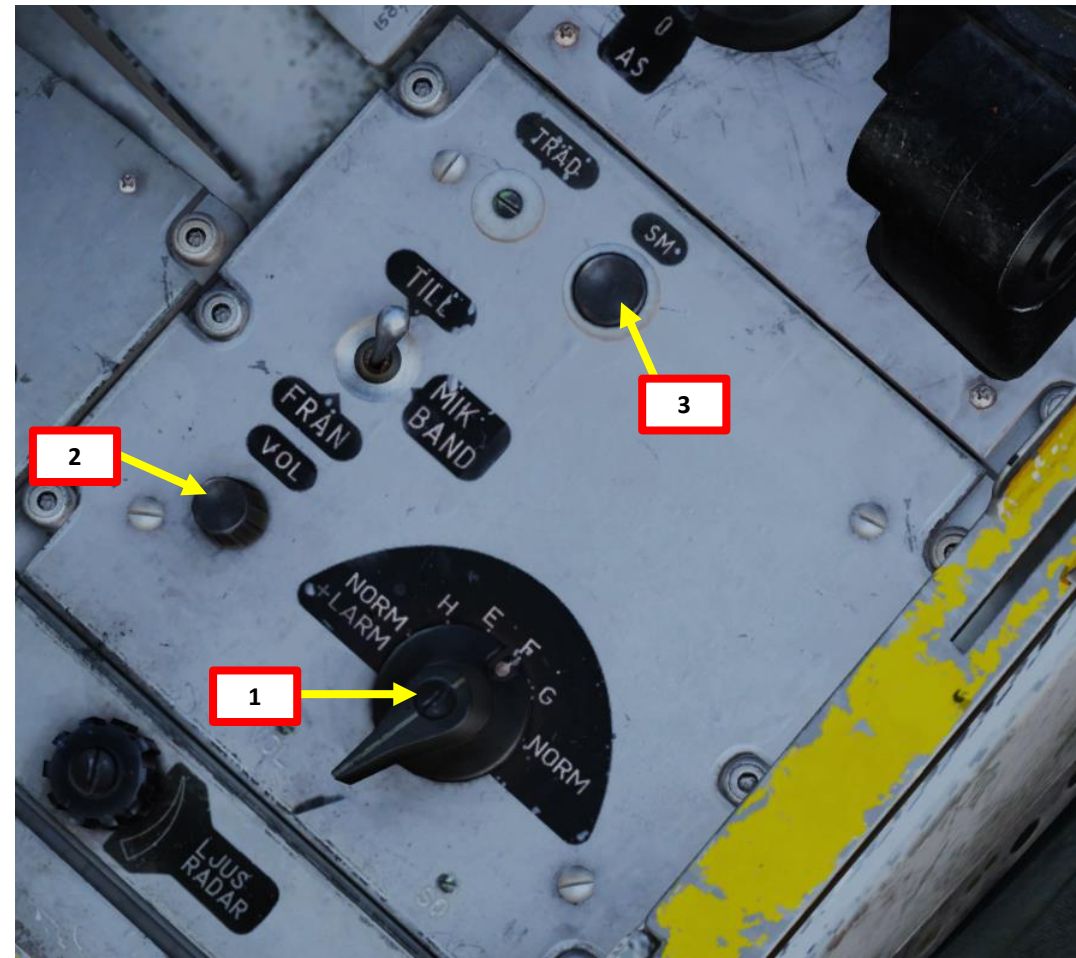
AIRFIELD FREQUENCIES (BASE PRESETS)

You can find airfield ATC frequencies by opening the kneeboard (RSHIFT+K) and by cycling through pages using [and].

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 41.5002
A: 121Mhz AM B: 38.4Mhz AM C: 250Mhz AM C2: 3.7Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 267.003
A: 122Mhz AM B: 38.6Mhz AM C: 251Mhz AM C2: 3.8Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 42.0001
A: 123Mhz AM B: 38.8Mhz AM C: 252Mhz AM C2: 3.8Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 219.52
A: 124Mhz AM B: 39Mhz AM C: 253Mhz AM C2: 3.9Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 219
A: 125Mhz AM B: 39.2Mhz AM C: 254Mhz AM C2: 3.9Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 39.9997
A: 126Mhz AM B: 39.4Mhz AM C: 255Mhz AM C2: 4Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 242.005
A: 127Mhz AM B: 39.6Mhz AM C: 256Mhz AM C2: 4Mhz AM
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A: 128Mhz AM B: 39.8Mhz AM C: 257Mhz AM C2: 4.1Mhz AM
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A: 129Mhz AM B: 40Mhz AM C: 258Mhz AM C2: 4.1Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 331.003
A: 130Mhz AM B: 40.2Mhz AM C: 259Mhz AM C2: 4.2Mhz AM
11: Batumi (9011) TILS: 11 RWY: 125.585
A: 131Mhz AM B: 40.4Mhz AM C: 260Mhz AM C2: 4.2Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 94.7002
A: 132Mhz AM B: 40.6Mhz AM C: 261Mhz AM C2: 4.3Mhz AM
13: Kobuleti (9013) TILS: 13 RWY: 70
A: 133Mhz AM B: 40.8Mhz AM C: 262Mhz AM C2: 4.3Mhz AM
14: Kutaisi (9014) TILS: 14 RWY: 74.0009
A: 134Mhz AM B: 41Mhz AM C: 263Mhz AM C2: 4.4Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.3
A: 135Mhz AM B: 41.2Mhz AM C: 264Mhz AM C2: 4.4Mhz AM
16: Nalchik (9016) TILS: 16 RWY: 55.5066
A: 136Mhz AM B: 41.4Mhz AM C: 265Mhz AM C2: 4.5Mhz AM
17: Mozdok (9017) TILS: 17 RWY: 82.7639
A: 137Mhz AM B: 41.6Mhz AM C: 266Mhz AM C2: 4.5Mhz AM
18: Tbilisi-Lochini (9018) TILS: 18 RWY: 307.999
A: 138Mhz AM B: 41.8Mhz AM C: 267Mhz AM C2: 4.6Mhz AM
19: Soganlug (9019) TILS: 19 RWY: 132.277
A: 139Mhz AM B: 42Mhz AM C: 268Mhz AM C2: 4.6Mhz AM
20: Vaziani (9020) TILS: 20 RWY: 135.485
A: 140Mhz AM B: 42.2Mhz AM C: 269Mhz AM C2: 4.7Mhz AM
21: Beslan (9021) TILS: 21 RWY: 93.5
A: 141Mhz AM B: 42.4Mhz AM C: 270Mhz AM C2: 4.7Mhz AM

RADIO FREQUENCIES – AIRFIELDS

LOCATION	FREQUENCY
Anapa	121.0
Batumi	131.0
Beslan	141.0
Gelendzhik	126.0
Gudauta	130.0
Kobuleti	133.0
Kutaisi	134.0
Krasnodar Center	122.0
Krasnodar Pashkovsky	128.0
Krymsk	124.0
Maykop	125.0
Mineral'nye Vody	135.0
Mozdok	137.0
Nalchik	136.0
Novorossiysk	123.0
Senaki	132.0
Sochi	127.0
Soganlug	139.0
Sukhumi	129.0
Tblisi	138.0
Vaziani	140.0

AUTOPILOT MODES

The aircraft is fitted with an autopilot, the SA06 (*Styrautomat* 06). The autopilot operates by sending electrical impulses to the outer wing elevons servos and the rudder servo. The function of the autopilot is twofold. The first is to dampen the aircraft movement in all three axes. The second is to stabilize the aircraft in course, attitude and altitude (hold functions).

The three main modes for the autopilot are:
- **SPAK** (Main Dampening)
- **ATT** (Attitude hold)
- **HÖJD** (Altitude hold)

The selected modes are indicated by the three lights on the top left on the instrument panel. The lights also serve as selection buttons. The selected mode is lit when active.

SPAK Mode

SPAK is the **main dampening mode** of the autopilot.
- It is engaged automatically and will continually dampen movement in all three axes (pitch, roll, and yaw) in order to stabilize the aircraft.
- SPAK is the normal operating mode of the autopilot and should be engaged at all times during normal flight.

The force sensor in the control stick sends a proportionate signal to the exerted force exerted to the autopilot, where it is then summarized with the dampening channel from which then pitch and roll impulses are sent to the outer wing elevons. Due to the aerodynamic changes and forces exerted during transonic flight (> Mach 0.93) in mode SPAK, the aircraft will automatically trim the aircraft in pitch via the series trim system to avoid the drastic changes in pitch moment. In mode GSA, there will be a certain amount of "Mach tuck" where the nose will be slightly forced down, requiring pilot input to correct.

Trim Hat Switch

SPAK mode ON

AUTOPILOT MODES

ATT Mode

ATT is the **attitude hold** function.
- Attitude hold is **engaged by pressing the ATT button**
- When engaged the autopilot will attempt to maintain current attitude. The pitch angle can be fine-tuned with the pitch trim on the hat switch.
- Pushing the **trim hat switch up / down** will cause a new reference attitude to be made in pitch. The mode will maintain the pitch angle when it is engaged and will maintain roll angle if the angle is between 7° and 66°.

If the **roll angle is lesser than 7°, the autopilot will enable a course hold** where the autopilot will level the wings and maintain the present course. The pitch angle is unaffected. If the aircraft has drifted from the set course the autopilot will send a signal to the rudder servo and steer the aircraft back onto the set course.

Attitude Hold mode ON

Trim Hat Switch

AUTOPILOT MODES

Standard Turn Mode

If the course hold is engaged (ATT hold mode is engaged and **roll angle is lesser than 7°**), the pilot can use the Standard Turn mode in which the aircraft will maintain a constant bank angle.

- Standard turn is **engaged by pressing the ATT** button, **setting the roll angle to less than 7 deg**, then pushing the **trim hat switch left (LEFT WING DOWN) or right (RIGHT WING DOWN)** depending on the desired turning direction.
- The direction of the turn can be reversed by pressing in the other direction of the present turn twice.

The bank angle is dependent on the airspeed of the aircraft in order to yield a constant turn radius of 4.1 km if the airspeed is less than Mach 0.8. Above Mach 0.8 the turn radius instead becomes a constant g-load of 1.41 G instead.

The change in bank angle causes a slight nose down moment which is countered by a change in pitch movement to maintain altitude.

3 **Trim Hat Switch**

Attitude Hold mode ON

2

1

4

AUTOPILOT MODES

HÖJD Mode

HÖJD is the altitude hold system which is the highest operating autopilot mode, and commands the autopilot to maintain the current barometric altitude as well as attitude hold in roll or course hold depending on the bank angle (same as the parameters of ATT).
- During transonic flight (Mach 0.97 - Mach 1.05) the autopilot enters a special attitude mode (**HÖJD / TRANSSONIK**). This is due to lack of reliable data from the Pitot tube system at such airspeeds. The normal altitude hold mode reengages when leaving these airspeeds.
- The set altitude can be fine-tuned by the **pitch trim hat switch**.

Trim Hat Switch

HÖJD / TRANSSONIK mode ON

Flashing

Flashing

Mach Number

TRANSONIC light

Altitude Hold (HÖJD) mode ON
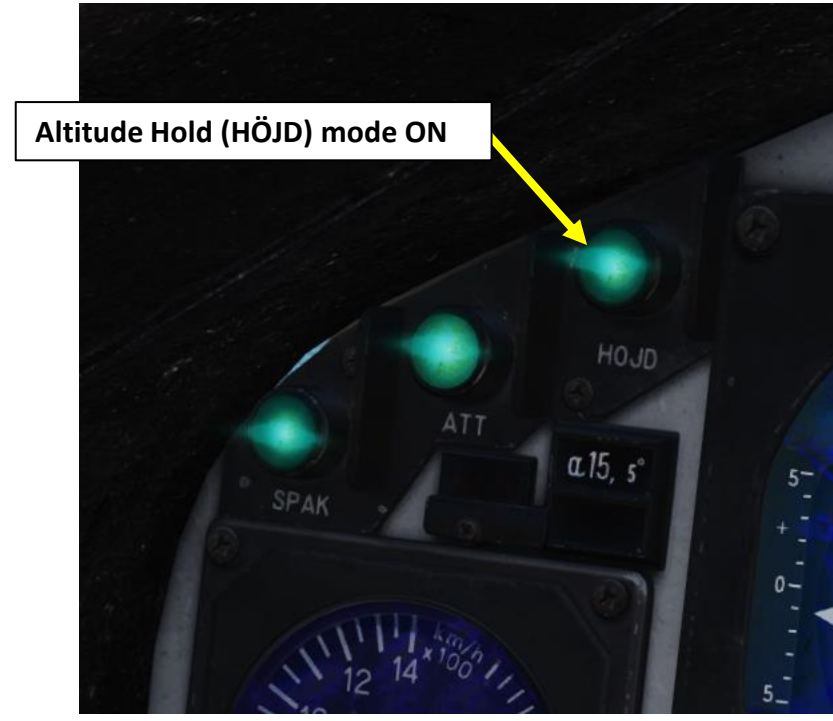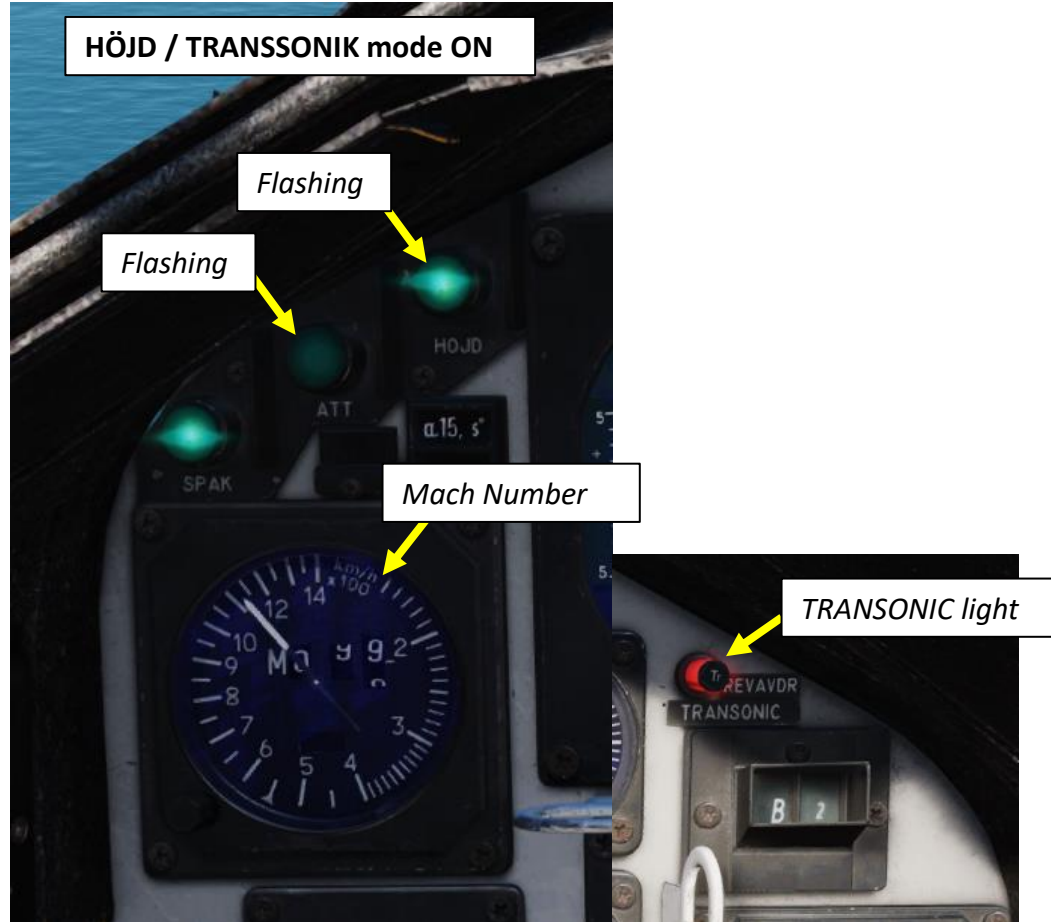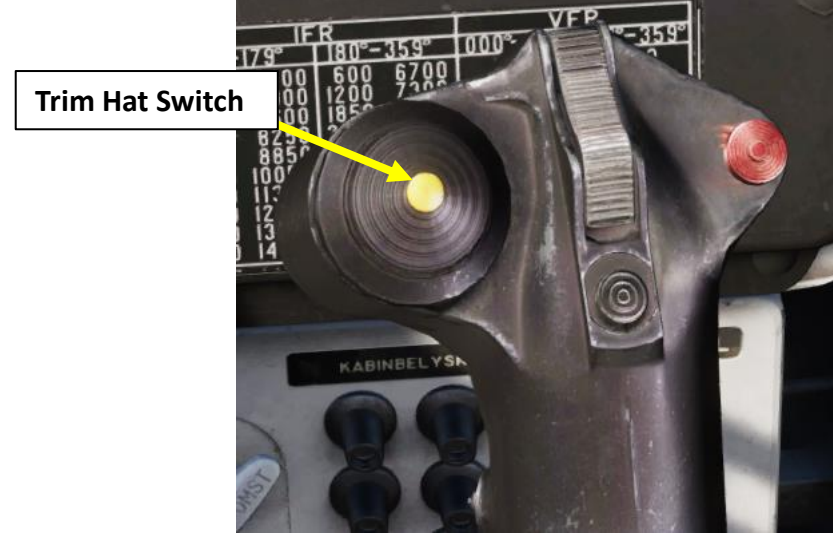
SECTION STRUCTURE

- 1 – Navigation Introduction

- 2 – Navigation System Interfaces
  - o 2.1 – CI (Central Indicator) & Magnetic Compass
  - o 2.2 – HUD (Heads-Up Display / SI)
  - o 2.3 – Waypoint Selector Buttons & Master Mode Selector
  - o 2.4 – CK37 Computer Data Panel
  - o 2.5 – TILS (Tactical Instrument Landing System) Panel

- 3 – Navigation Point Types

- 4 – Flight Plan
  - o 4.1 – Flight Plan Basics
  - o 4.2 – Flight Plan Creation Methods
    - ▪ 4.2.1 – Manual
    - ▪ 4.2.2 – Mission Editor
    - ▪ 4.2.3 – Auto-Generated
    - ▪ 4.2.4 – F10 Map Markers

- 5 – Waypoints (B#)
  - o 5.1 – Create/Edit Waypoints
  - o 5.2 – Navigate to Waypoints
  - o 5.3 – Manual vs Automatic Waypoint Change

- 6 – Target Points (M#)
  - o 6.1 – Create Target Points
  - o 6.2 – Edit/Offset Target Points
  - o 6.3 – Navigate to Target Points

- 7 – Target Pop-Up Points (U#)

- 8 – Markpoints (Bx#)

- 9 – Starting Airfields and Landing Bases (LS, L1, L2)
  - o 9.1 – Selecting Starting Airfield (LS)
  - o 9.2 – Selecting Primary Landing Base (L1)
  - o 9.2 – Selecting Secondary Landing Base (L2)

- 10 – Altitude Reference

- 11 – Time On Target (TOT) & Ingress Speed

- 12 – TERNAV

- 13 – Fixes
  - 13.1 – Introduction
  - 13.2 – Manual Fixes
    - 13.2.1 – Own-Position (Navigation) Fixes
      - a – Visual Fix
      - b – Radar Fix
    - 13.2.2 – Target Fixes
      - a – Visual Fix
      - b – Radar Target Fix
  - 13.3 – Automatic Fixes
    - 13.3.1 – TILS Fix
    - 13.3.2 – TERNAV Fix
    - 13.3.3 – Weapon Impact Fix
    - 13.3.4 – Automatic Initial Fix
  - 13.4 – Fix Clearing

14 – TILS (Tactical Instrument Landing System with Landing Bases)

1 – NAVIGATION INTRODUCTION

The Navigation systems and tools at your disposal are:

TERNAV:
Terrain Navigation system that uses the radar altimeter to detect the terrain contours below the aircraft and complements the normal navigation system, providing minor automatic fixes as the nav systems accumulate drift positional error. It is initiated automatically on engine start-up.

TILS:
The Tactical Instrument Landing System is a simpler, swedish-built version of an ILS (Instrument Landing System) that will assist you in finding the proper way to land on an airfield.

CI (Central Indicator):
The Course Index and Course Ring on the Central Indicator (CI) allows you to know your current heading and find which course to take to fly to your selected waypoint.

Ground Radar Display:
The radar display will help you locate the waypoint you want to navigate to. It will also show you the ground geography and topography with a top-down view of what is in front of you.

ADI (Attitude Director Indicator):
Its yellow lines will tell you your current deviation in terms of altitude and heading in relationship with the waypoint you are flying to.

HUD:
The HUD (Heads-Up Display) can give you a brief view of the general direction you need to fly to in order to align yourself with the selected waypoint.
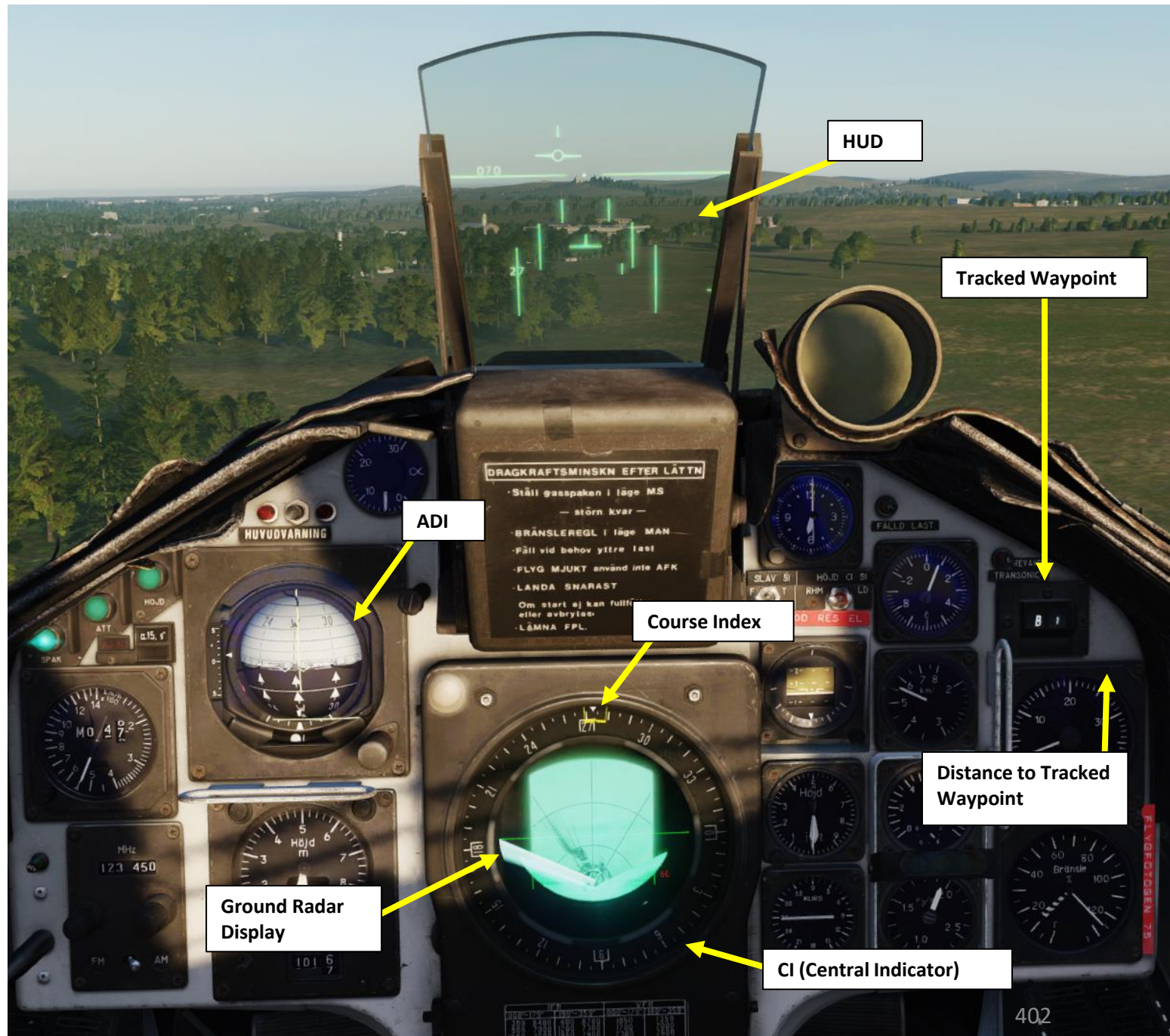
HUD

Tracked Waypoint

ADI

Course Index

Distance to Tracked Waypoint

Ground Radar Display

CI (Central Indicator)

2 – NAVIGATION SYSTEM INTERFACES
2.1 – CI (Central Indicator) & Magnetic Compass

The CI (Central Indicator) is mostly used for the radar display, but it also displays interesting symbology when it comes to waypoints, RUTA patrol route and runway extension lines when performing landing approaches. The radar display interfaces with radar controls and is already explained in-depth in PART 8 – RADAR. The most important thing to remember about the CI when it comes to navigation is the Course Index, which points to your currently selected waypoint. The Magnetic Compass is used as a backup.

Altitude Warning Light
- Alerts the pilot of an imminent impact with the ground or that the set altitude for the autopilot is no longer kept.

Course Index

Current Heading

Central Indicator (CI) Radar Display

Magnetic Course (Compass) Indicator

Radar Mode Selector
- A0: Radar OFF
- A1: Radar ON, Wide Search Mode with Sector PPI
- A2: Radar ON, Narrow Search Mode with B-Scope

Radar (CI) Scan Range Selector

Waypoint

Radar Scan Zone Scale
Shown: 15 km

2 – NAVIGATION SYSTEM INTERFACES
2.2 – HUD (Heads-Up Display / SI)

The HUD/SI (Heads-Up Display) symbology changes with each Master Mode selected.

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

Flight Path Vector

Airspeed Difference Indicator (Fin)

+5 deg Pitch Reference Line

Pole Tracks

Time Marker Reference Line

Artificial Horizon

Reticle

Master Mode Selector (NAV)
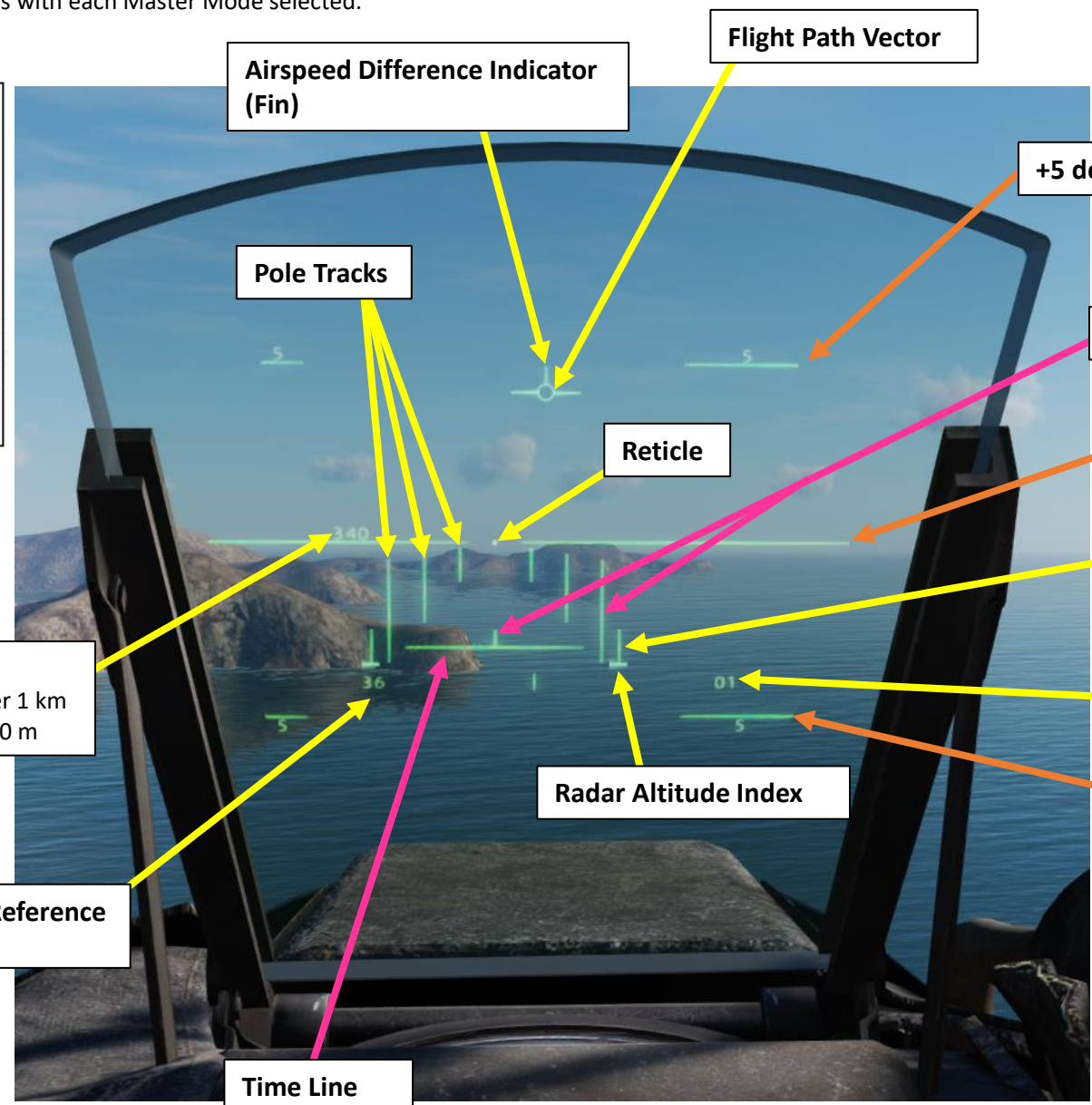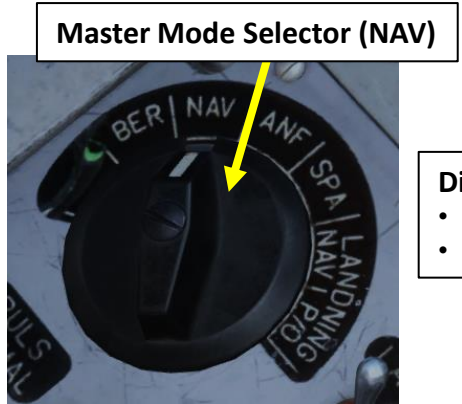
Altitude Reference Bar = 100 m

Digital Altitude
- In meters if under 1 km
- In km if over 1000 m

Course Scale Reference
(shown: 010)

Radar Altitude Index

-5 deg Pitch Reference Line

Course Scale Reference
(shown: 360)

Time Line

2 – NAVIGATION SYSTEM INTERFACES
2.2 – HUD (Heads-Up Display / SI)

When the **HUD Slave (SLAV-SI) switch is ON (TILL)** and the altitude is less than 100 meters above ground level, the LOWNAV (Decluttered HUD Mode) activates.

When the **HUD Slave (SLAV-SI) switch is OFF** (**FRAN**) or the altitude is more than 100 meters above ground level, the normal HUD mode is displayed.

Note: The course scale can be displayed by pressing the **Reference Button** on the stick.

Course Scale

**LOWNAV HUD Display
(HUD SLAV-SI ON)**

**Normal HUD Display
(HUD SLAV-SI OFF)**

Reference Button

405
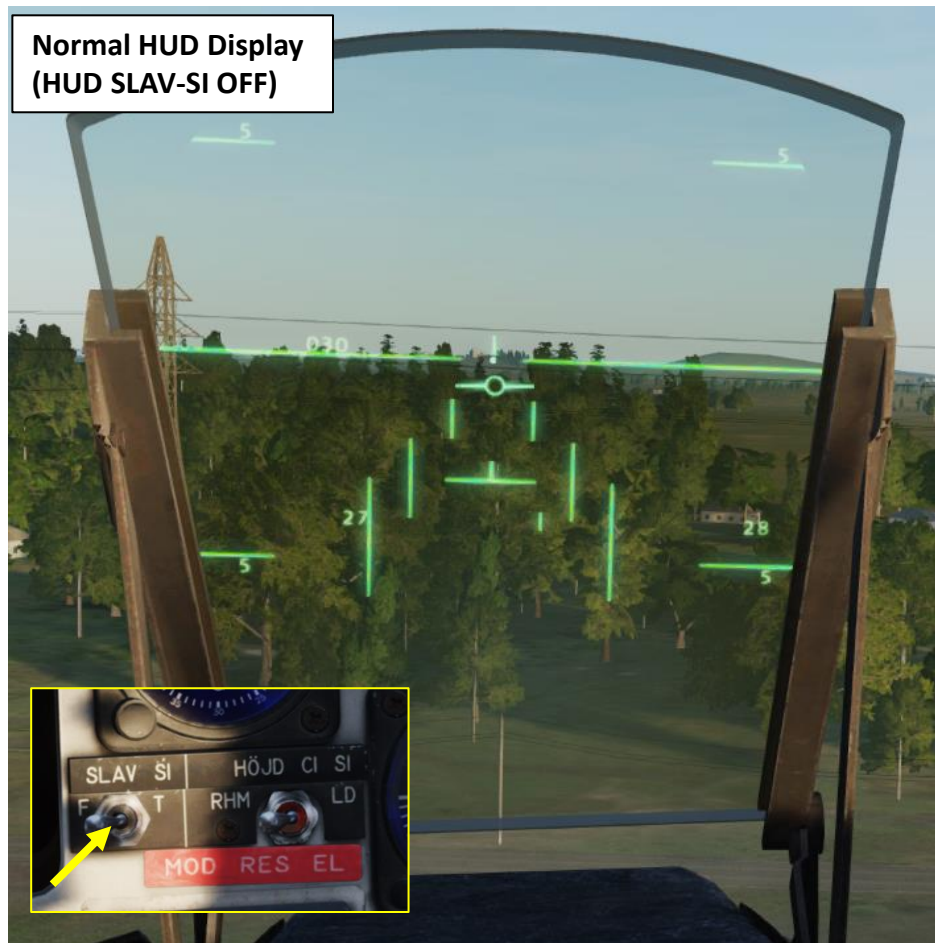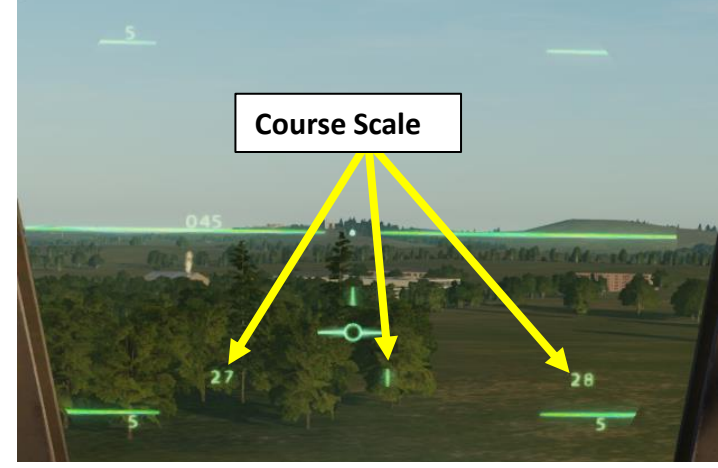
2 – NAVIGATION SYSTEM INTERFACES
2.3 – Waypoint Selector Buttons & Master Mode Selector

The Waypoint Selector buttons allow you to select what destination to navigate to. The Destination Indicator displays what waypoint is selected and how far you are from it. Take note that the function of some of these buttons (LS/SKU and L/MÅL buttons in particular) change based on what Master Mode is selected with the Master Mode Selector.
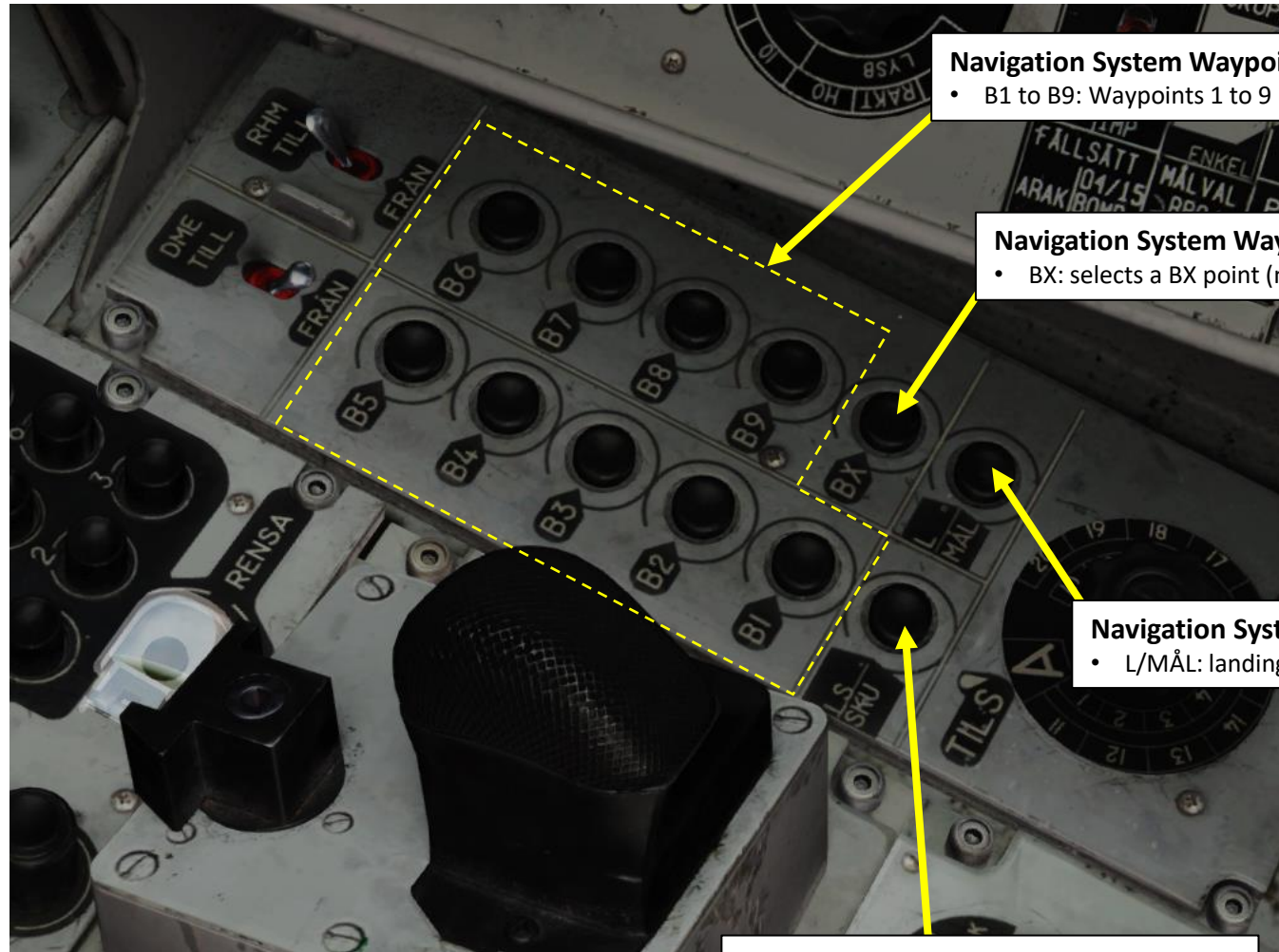
Destination Indicator (Selected Waypoint)

Navigation System Waypoint Selectors
- B1 to B9: Waypoints 1 to 9

Navigation System Waypoint Selector
- BX: selects a BX point (markpoint) (BX1-9)

Distance to Destination (Selected Waypoint)
- KM = in kilometers
- MIL = in Swedish Miles
- Note: 1 Swedish mile = 10 km

Navigation System Waypoint Selector
- L/MÅL: landing base or recon target

Master Mode Selector (NAV)

Navigation System Waypoint Selector:
- LS/SKU: Take-off base or tracked target

2 – NAVIGATION SYSTEM INTERFACES

2.4 – CK37 Computer Data Panel

The CK37 Computer Data Panel is mainly used for:

- Entering new navigation data (INPUT)
- Modifying existing navigation data
- Consulting existing navigation data (OUTPUT)

The type of data displayed is based on the Data Selector.

Navigation Data Indicators

Navigation INPUT/OUTPUT Selector
- IN: Input
- UT: Output

Navigation Data Keypad (1-9)

CK37 (*Central Kalkylator 37*, or Central Computer 37) Aircraft Computer Control Panel

Navigation Data Clear (*Rensa*) Button

Navigation Data Selector
- AKT POS: Current Position
- REF LOLA: Reference number or longitude/latitude coordinate position of waypoints
- BANA/GRÄNS: Runway Headings
- VIND/RUTA/MÅL: Wind direction and strength for entered wind.
- TID: Present time, Time on Target, ingress Mach speeds, time for recon targets
- TAKT: Tactical inputs and presets
- ID-NR: Identification number.
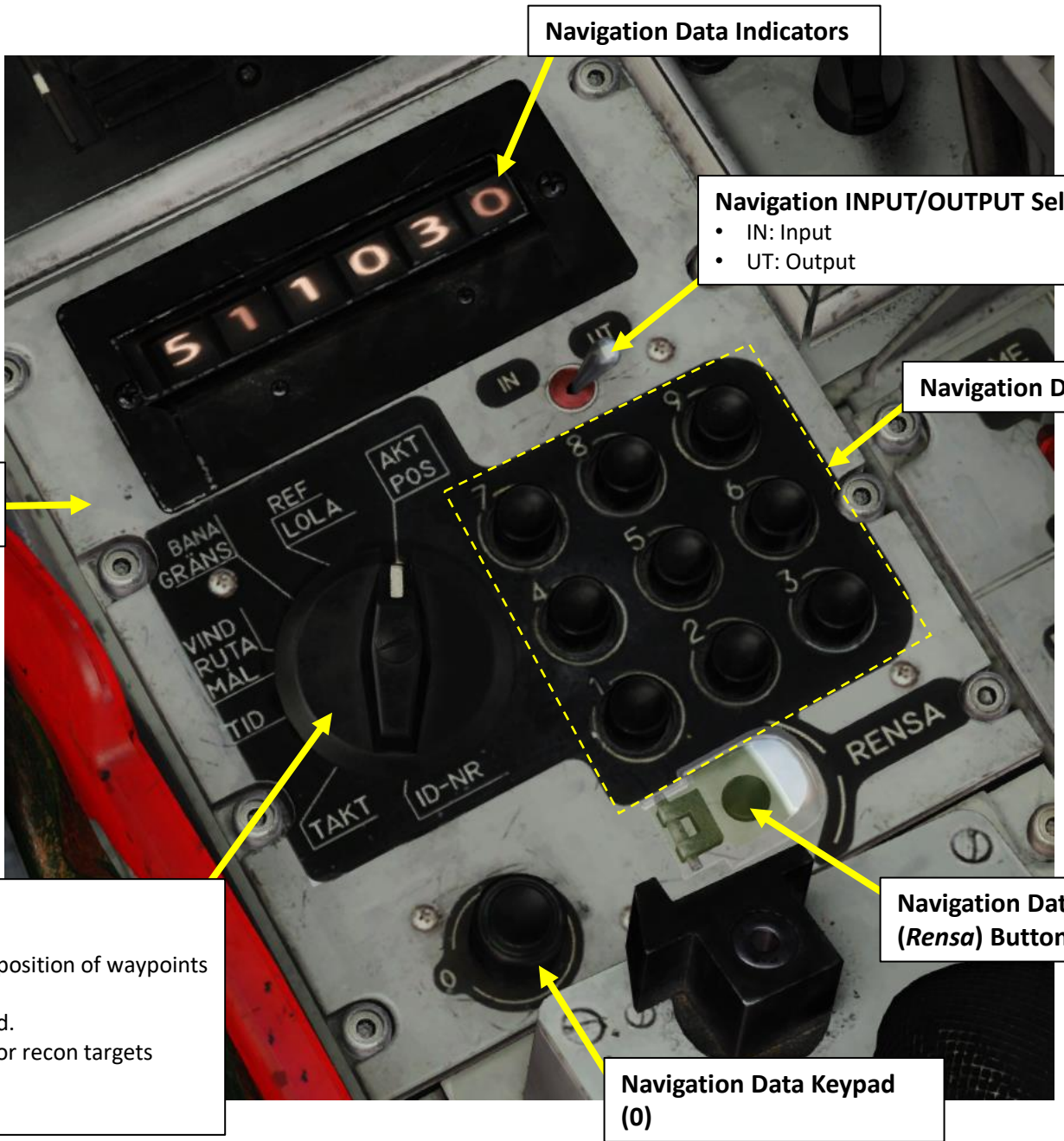
Navigation Data Keypad (0)

2 – NAVIGATION SYSTEM INTERFACES

2.5 – TILS (Tactical Instrument Landing System) Panel

The TILS (Tactical Instrument Landing System) interface is pretty simple.
- The TILS Channel Selector selects a TILS channel manually if not entered into the computer. The "A" position is for "Automatic Selection".
- The TILS Channel Layer selector switch changes the selection from channels 1-10 to 11-20.
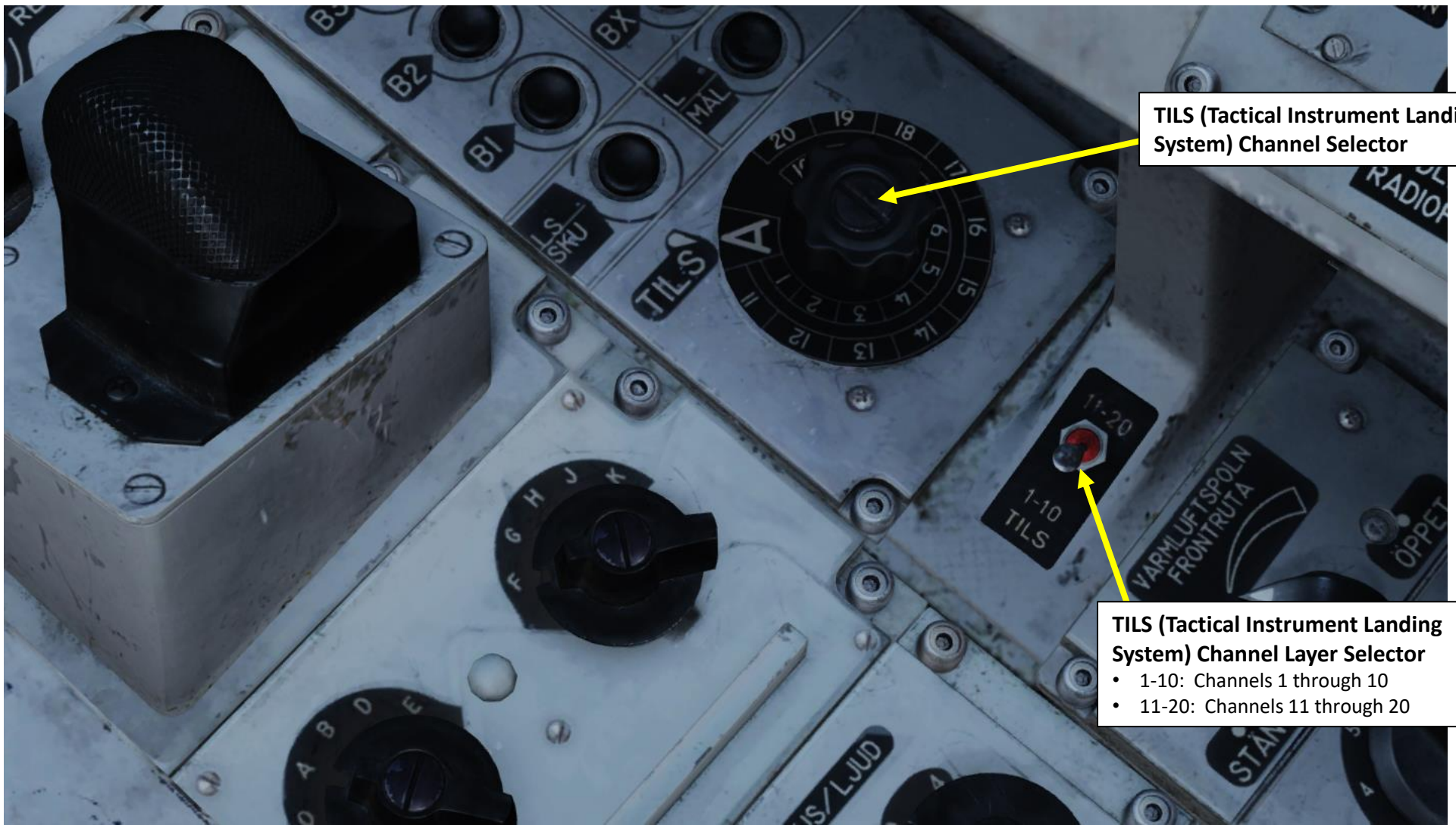
TILS (Tactical Instrument Landing System) Channel Selector

TILS (Tactical Instrument Landing System) Channel Layer Selector
- 1-10: Channels 1 through 10
- 11-20: Channels 11 through 20

3 – NAVIGATION POINT TYPES

The most common navigation reference points you will use are waypoints stored in your flight computer. These waypoints vary in nature and functionality.

Waypoint Types:

- LS: Starting Airfield Waypoint
- B1, B2, B3… : Navigation Waypoint
- BX1, BX2, BX3…: Mark Points (used for RB-15F anti-ship missile or points of interest)
- M1, M2, M3…: Target Points (a customizable navigation waypoint used for ground strikes)
- U1, U2, U3…: Target Pop-Up Points (used in low-level strikes)
- L1: Primary Landing Site
- L2: Secondary Landing Site

Selectors Buttons:

- LS/SKU: Selects the Takeoff Base or Tracked Target (reconnaissance)
- B1-B9: Selects a Normal Navigation Waypoint
- BX: Selects a BX point
- L/MÅL : Selects Primary Landing Base L1 (first press) or Secondary Landing Base L2 (second press)
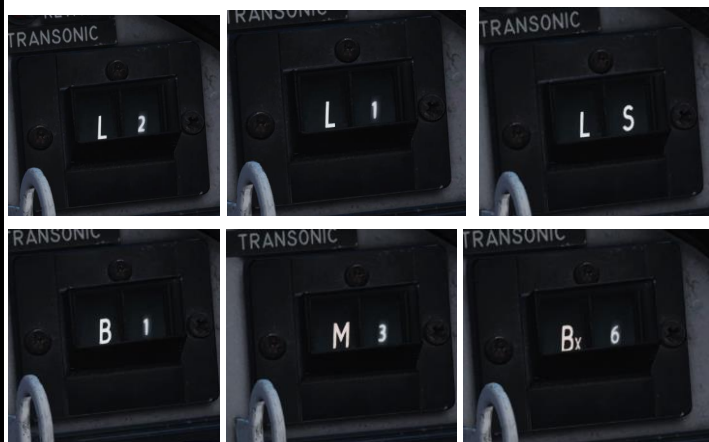
Function	1st digit	2nd digit
Take-off base	L	S
Primary landing base	L	1
Secondary landing base	L	2
Alternate / Reciprocal heading primary landing base	L (Flashing)	1
Alternate / Reciprocal heading secondary landing base	L (Flashing)	2
Landing waypoint (TILS) Primary	LB	1
Landing waypoint (TILS) Primary	LB	2
Touchdown point Primary base	LF	1
Touchdown point Secondary base	LF	2
NAVIGATION		
Navigation waypoints	B	1-9
Target waypoint	M	1-9
Popup point	U (RED)	1-9
Visual fix in progress	E	1-9
Radar fix in progress	E (flashing)	1-9
RECONAISSANCE		
Corner and centre points	R	1-9
Measured targets	M (RED)	1-9
Tracked targets	S (RED)	1-9
Mark points	BX	1-5

BX6-9 are used for RB 15 missile planning and cannot be used by the aircraft for navigation.

4 – FLIGHT PLAN

4.1 – Flight Plan Basics

Flight Plan

Flying the Viggen requires in most situations a flight plan to be created due to its specific mission and attack profile. A typical flight plan consists of the following:

1. Takeoff is performed at a Takeoff Base (LS)

2. The aircraft navigates at low level through waypoints towards the target (B1, B2)

3. A Target Point (M3) is used to perform the attack on the target. A Pop-Up Point U3 can be used as a reference point (in relationship to the target point) to guide your attack direction and the moment at which you climb and perform the attack.

4. The aircraft then follows navigation points (B4) back towards the Primary Landing Base (L1) or the Secondary Landing Base (L2).
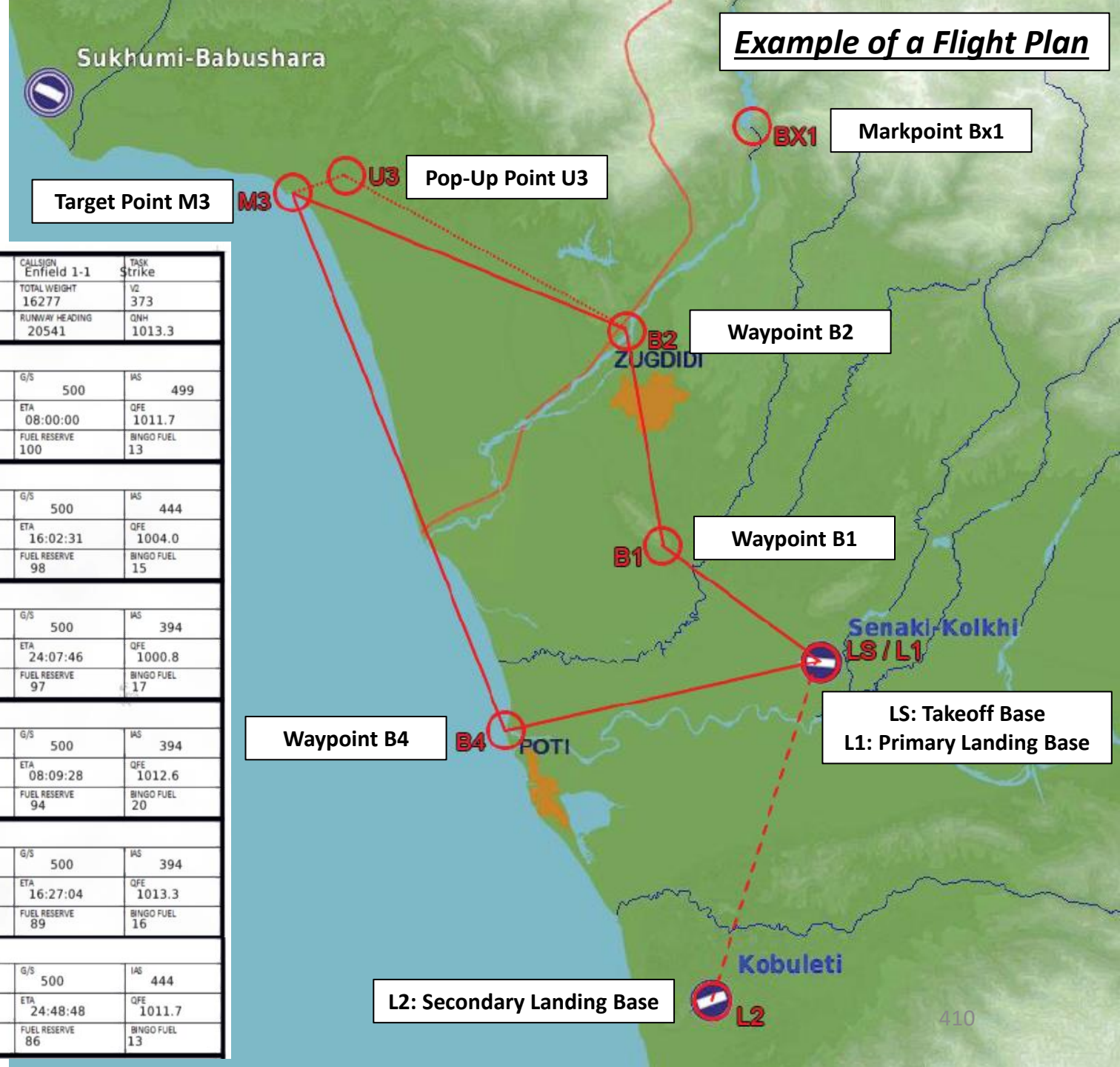
This flight plan is entered in the CK37 Flight Computer through the Data Cartridge, which contains all the information relevant to these navigation reference points.

DATE 2016-06-21	MISSION ID AJS Flight Plan	CALLSIGN Enfield 1-1	TASK Strike
FUEL WEIGHT 4477	LOADOUT 0	TOTAL WEIGHT 16277	V2 373
ENGINE START TIME 07:55:00	TAKE-OFF TIME 08:00:00	RUNWAY HEADING 20541	QNH 1013.3

WAYPOINT NAME Take-Off Senaki-Kolkhi			
COURSE (T) 20541	HEADING (M) 28	G/S 500	IAS 499
DISTANCE 0.0	TOF 00:00:00	ETA 08:00:00	QFE 1011.7
ALTITUDE 13	VERTICAL ANGLE 0	FUEL RESERVE 100	BINGO FUEL 13

WAYPOINT NAME B1			
COURSE (T) 312	HEADING (M) 320	G/S 500	IAS 444
DISTANCE 21.0	TOF 00:02:31	ETA 16:02:31	QFE 1004.0
ALTITUDE 2000	VERTICAL ANGLE 5	FUEL RESERVE 98	BINGO FUEL 15

WAYPOINT NAME B2			
COURSE (T) 335	HEADING (M) 342	G/S 500	IAS 394
DISTANCE 22.8	TOF 00:02:44	ETA 24:07:46	QFE 1000.8
ALTITUDE 2000	VERTICAL ANGLE 0	FUEL RESERVE 97	BINGO FUEL 17

WAYPOINT NAME M3			
COURSE (T) 298	HEADING (M) 305	G/S 500	IAS 394
DISTANCE 35.2	TOF 00:04:13	ETA 08:09:28	QFE 1012.6
ALTITUDE 2000	VERTICAL ANGLE 0	FUEL RESERVE 94	BINGO FUEL 20

WAYPOINT NAME B4			
COURSE (T) 159	HEADING (M) 166	G/S 500	IAS 394
DISTANCE 68.2	TOF 00:08:11	ETA 16:27:04	QFE 1013.3
ALTITUDE 2000	VERTICAL ANGLE 0	FUEL RESERVE 89	BINGO FUEL 16

WAYPOINT NAME Landing Senaki-Kolkhi			
COURSE (T) 68	HEADING (M) 76	G/S 500	IAS 444
DISTANCE 34.6	TOF 00:04:09	ETA 24:48:48	QFE 1011.7
ALTITUDE 13	VERTICAL ANGLE -3	FUEL RESERVE 86	BINGO FUEL 13

Example of a Flight Plan

Markpoint Bx1

Pop-Up Point U3

Target Point M3

Waypoint B2

Waypoint B1

Waypoint B4

LS: Takeoff Base
L1: Primary Landing Base

L2: Secondary Landing Base

4 – FLIGHT PLAN
4.1 – Flight Plan Basics

Economic airspeeds

Altitude (m)	Economic airspeeds (Mach)
0	M 0.55
3000	M 0.66
6000	M 0.76
9000	M0.87
10000	M 0.9

Fuel Calculations

The CK37 flight computer will continually calculate the required fuel to perform the flight. This is displayed as the amount of fuel required from the aircraft's current position to the next destination and the remaining route to the primary landing site (L1), with the amount of fuel required for a landing added.

The striped needle indicates the currently needed amount of fuel to fulfil the planned flight as programmed into the computer. The computer accounts for the increased drag due to weapons and planned flight path and profile, taking into consideration the variables of **ingress speeds** and **wind**. In addition, a preset (but customizable) fuel reserve is added to this calculation. This pre-set amount can be set by the pilot to ensure a greater margin.

Prior to takeoff, a 10 % fuel requirement is added to fuel consumption, which corresponds to about 10 minutes of ground taxi, acceleration to Mach 0.55 and group re-join after take-off. This 10% of fuel is removed from the calculations after takeoff as it is no longer required during flight.

The fuel consumption calculation is based on the most economical airspeed, which is Mach 0.55 at sea level. The most economical airspeed increases with about Mach 0.035 per 1000 meters of altitude.

- Note: If ingress Mach speeds are entered in the flight path, the increased fuel consumption of these waypoints will be added to the fuel requirement. If the current destination is a waypoint after the last target waypoint, the fuel consumption is based on the current altitude and the most economical airspeed.

Fuel Quantity in % (*Bränsle*)

Useful Notes about Fuel Reserve

The fuel reserve is the minimum desired fuel state when reaching the primary landing position (L1). It can be set between 10 and 99%.
- If no reserve is entered the default setting is 10% (the amount of fuel necessary for an approach and landing at the primary landing base).
- If the secondary landing base (L2) is set, an extra fuel reserve is added to account for a flight between L1 and L2 at low altitude and at the economical airspeed as well as the addition of the same calculated fuel use to an approach and landing at the second landing site.
- Input the desired value on Address 51, in percent. E.g. for 30% input 513000 in TAKT. Confirm with LS.
- The set fuel reserve amount is reset on Master mode BER after landing.

Fuel Quantity Required to complete the route as planned

4 – FLIGHT PLAN
4.2 – Flight Plan Creation Methods
4.2.1 – Manual

Waypoints can be added manually by entering their coordinates (or reference numbers) in the CK37 computer Data Panel. Here is an example:

1. We will add a navigation waypoint (B1) set to coordinates: **42°51'08" North, 41°08'35" East**.
2. To add a waypoint (i.e. B1), set Data Selector to REF/LOLA mode.
3. Set INPUT/OUTPUT data switch to INPUT.
4. On keypad, enter coordinates in degrees, minutes and seconds for Longitude and Latitude. As an example, coordinates from the F10 map **42°51'08" North (Latitude)**, **41°08'35" East (Longitude)** are entered as **410835425108** (East coordinates first, North coordinates second, which might seem counterintuitive if you use the F10 East-North coordinates.).
5. When coordinates are entered, the Data Selection field will alternate between the longitude and latitude coordinates you just entered.
6. Press button B1 to save coordinates for new waypoint B1.
7. Set the Data Selector back to AKT-POS in OUTPUT mode.
8. Repeat previous steps for all remaining waypoints of the flight plan.

6 – Waypoint B1 Selector

7a

7b

4

3

4

2

412
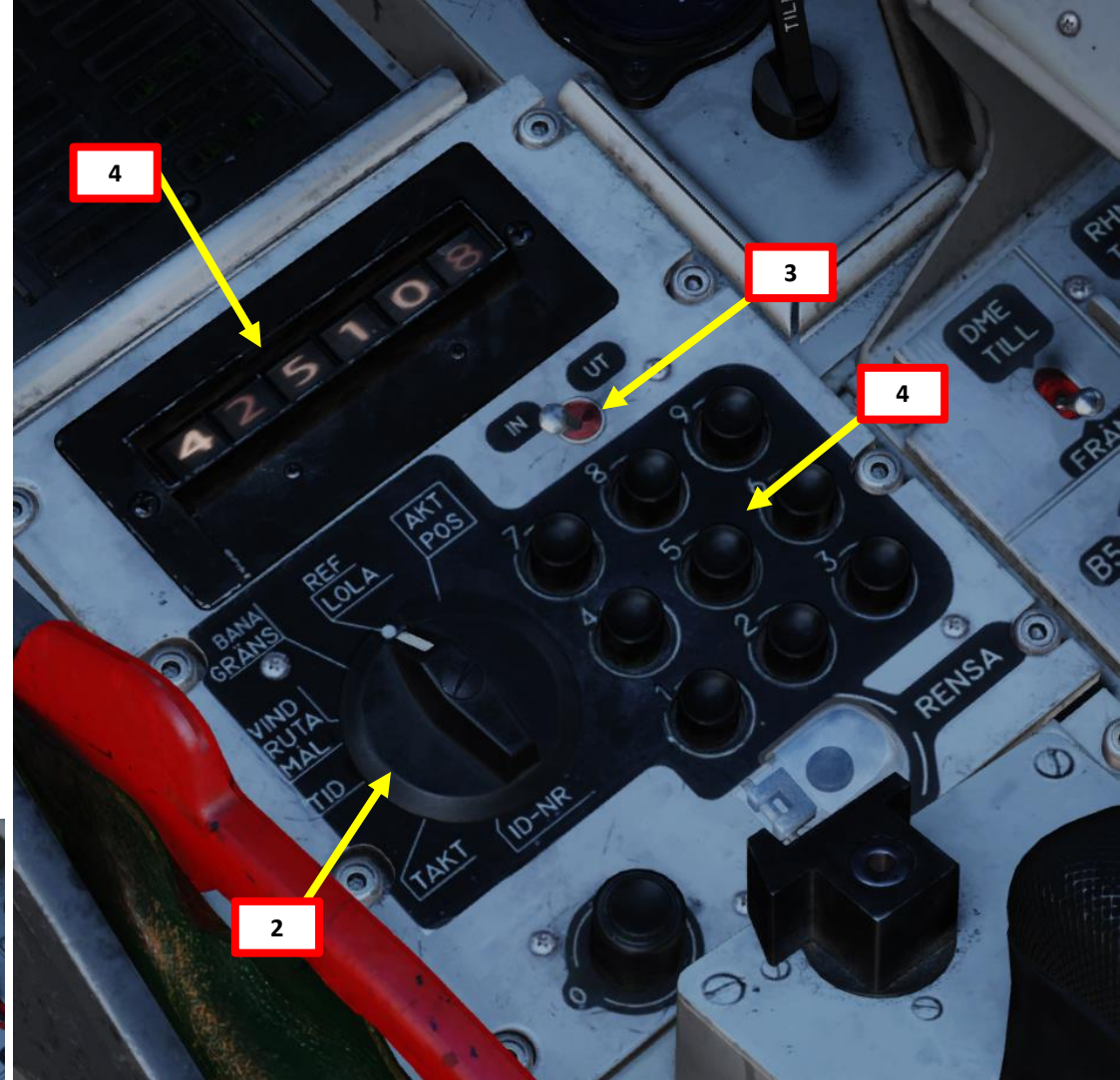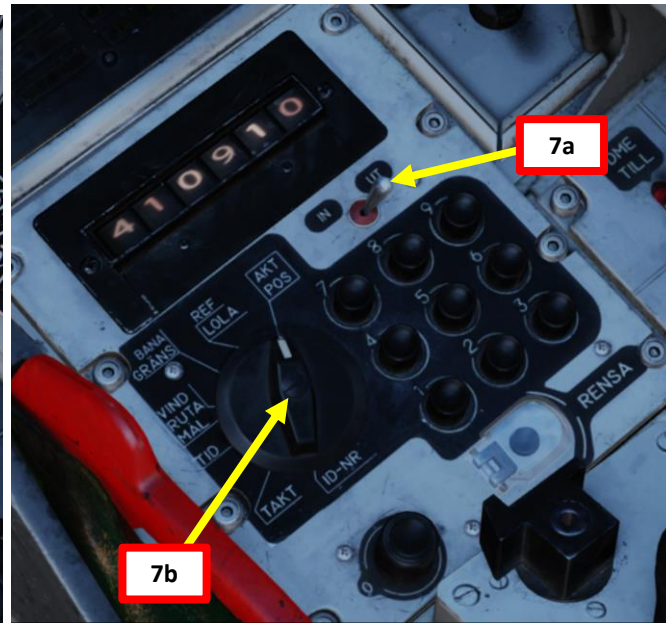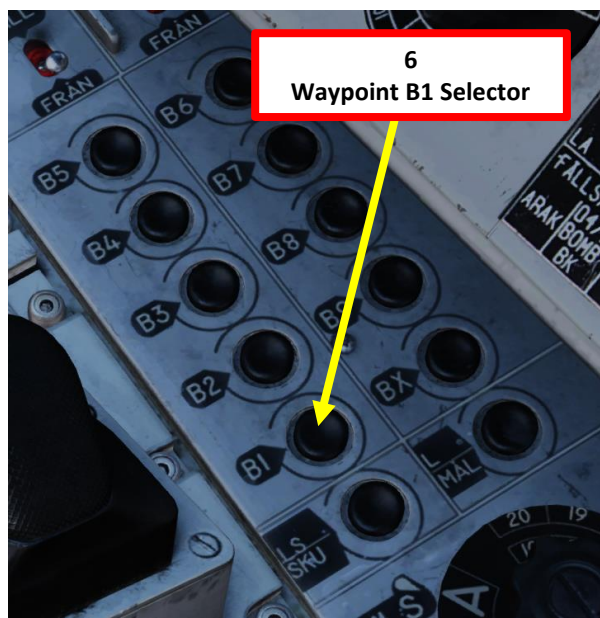
4 – FLIGHT PLAN

4.2 – Flight Plan Creation Methods

4.2.2 – Mission Editor

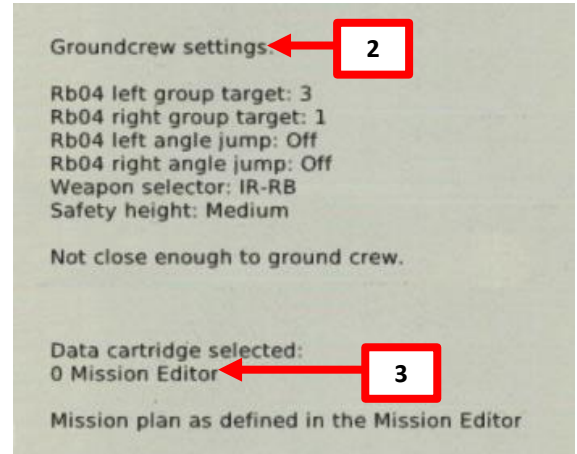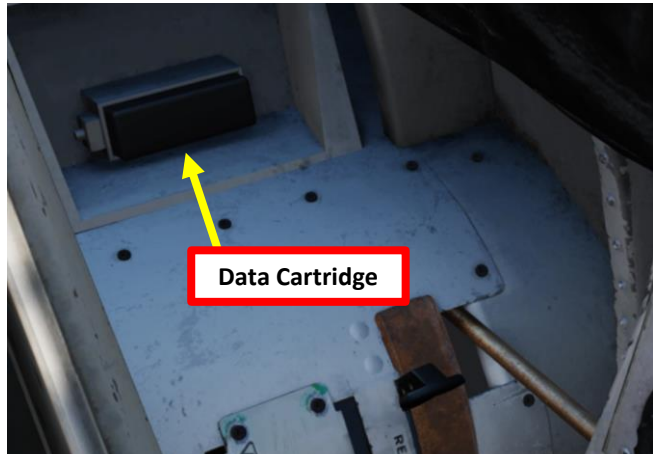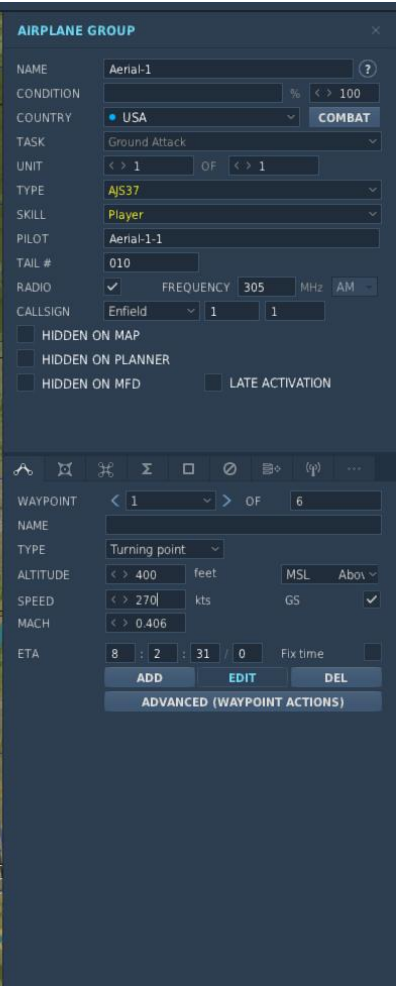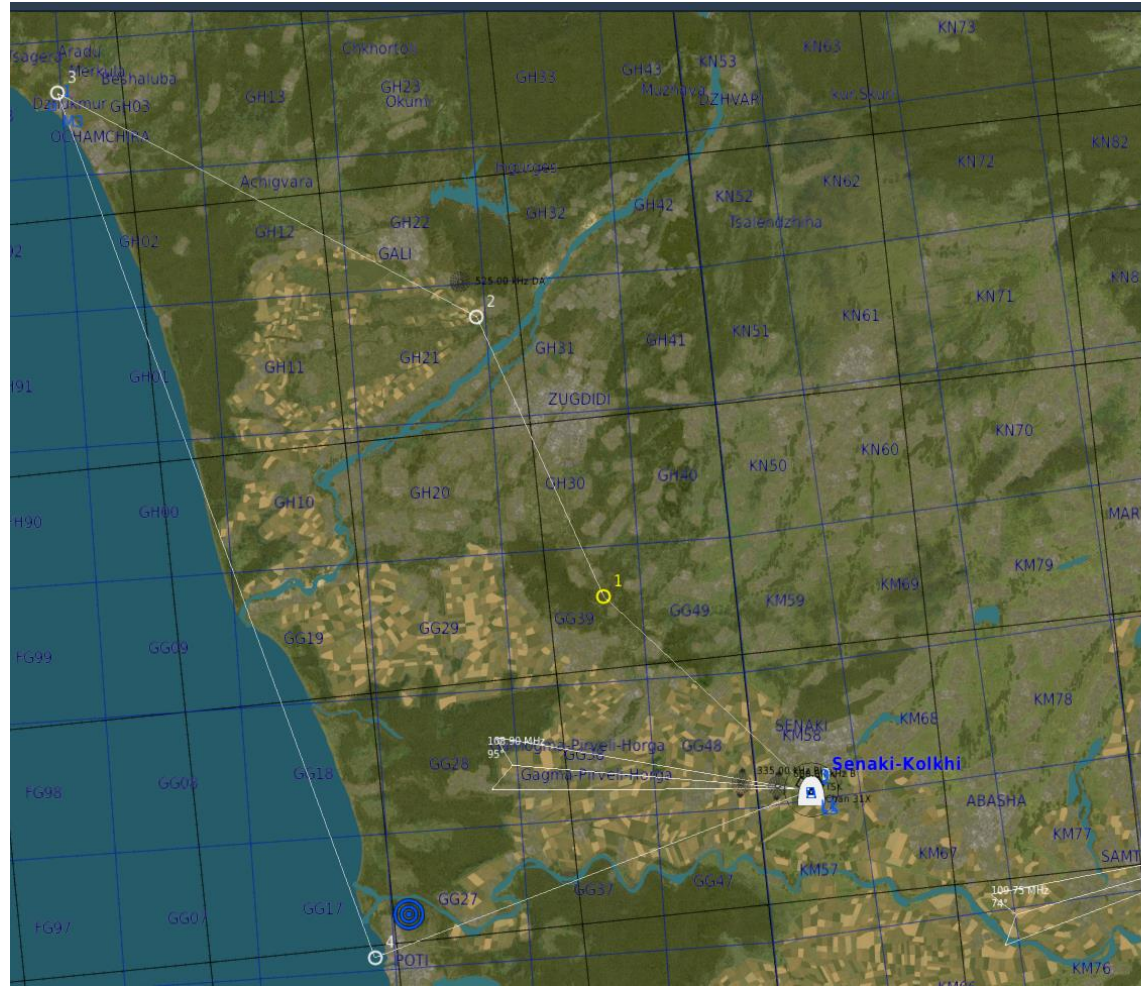A flight plan entered in the Mission Editor is entered pretty much in the same way other flight plans are created for other planes.

However, you need to make sure that the Data Cartridge you are loading during start-up contains data from the Mission Creator. This is further explored in Part 17 – DATA CARTRIDGE, but here is a quick summary.

1. Prior to loading your Data Cartridge, display your kneeboard using the "RSHIFT+K" binding.
2. Cycle through pages using "[" and "]" until you reach the GROUND CREW SETTINGS page.
3. Your current selected data cartridge is indicated.
4. Change data cartridge by using the "LCTRL+LALT+C" binding until you see the "Data Cartridge from Mission Editor" setting.
5. Click on the data cartridge slot to load the new cartridge.
6. Start data cartridge loading procedure as shown in the start-up procedure
   a) Set the Data Selector knob to REF/LOLA
   b) Set INPUT/OUTPUT data switch to INPUT.
   c) Enter code 9099 (Fictional Airport No. 99).
   d) Press the LS waypoint to start data transfer process. The data transfer will be in-progress when the first "9" digit is flashing, and the process will be complete once all digits revert back to "0".
   e) Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT.

Data Cartridge

Groundcrew settings: **2**

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
0 Mission Editor **3**

Mission plan as defined in the Mission Editor

4 – FLIGHT PLAN

4.2 – Flight Plan Creation Methods

4.2.2 – Mission Editor

When created via the Mission Editor, Target Points (M3 in our case) require two specific things to be set up:

- A normal waypoint where the "Fix Time" option is ticked and the "GS" (Ground Speed) option is not ticked.
- A "Navigation Target Point" needs to be created over the normal waypoint with the comment referring to its number. "M3", for instance, is for "Target Point 3".

Without these two points in the Mission Editor, the Flight Plan will recognize the waypoint as a "B3" waypoint instead of a "M3" Target Point.

WAYPOINT NAME			
M3			
COURSE (T)	HEADING (M)	G/S	IAS
298	305	500	444
DISTANCE	TOF	ETA	QFE
35.2	00:04:13	08:09:28	1012.6
ALTITUDE	VERTICAL ANGLE	FUEL RESERVE	BINGO FUEL
5	-3	94	20

Navigation Target Point M3

Normal Waypoint 3
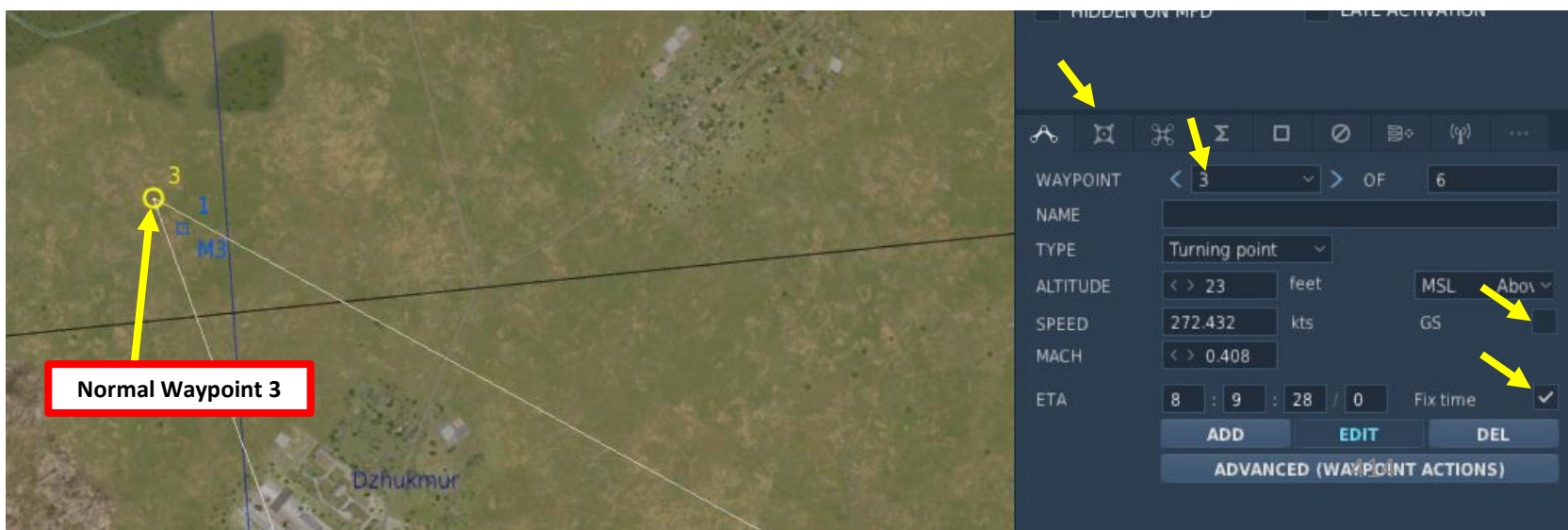
4 – FLIGHT PLAN
4.2 – Flight Plan Creation Methods
4.2.2 – Mission Editor

For Markpoints (Bx#), a "Navigation Target Point" needs to be created with the comment referring to its number. "Bx4", for instance, is for "Markpoint 4".

For RUTA Patrol Corner Points (R#), a "Navigation Target Point" needs to be created with the comment referring to its number. "R1", for instance, is for "RUTA Corner Point 1".

Navigation Target Point Bx4 (Markpoint 4)
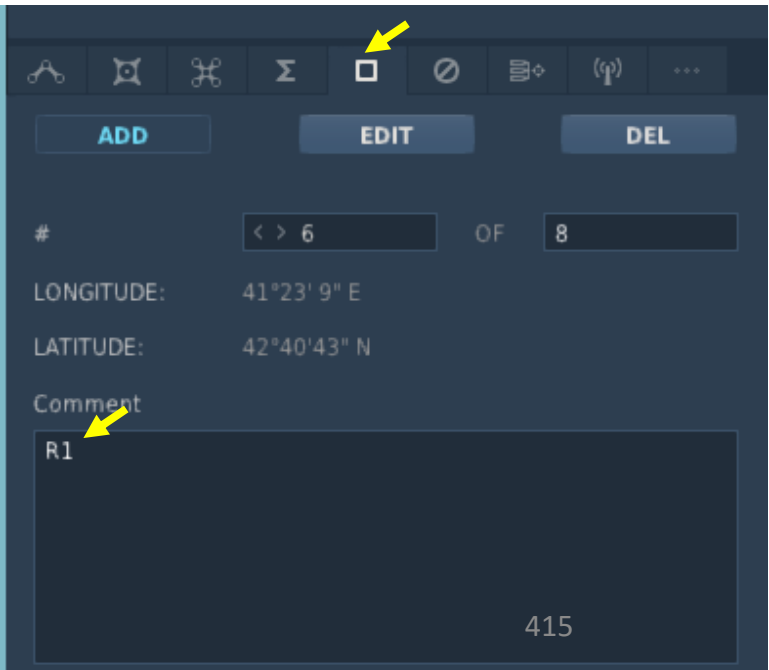
Navigation Target Point R1 (RUTA Corner Point 1)
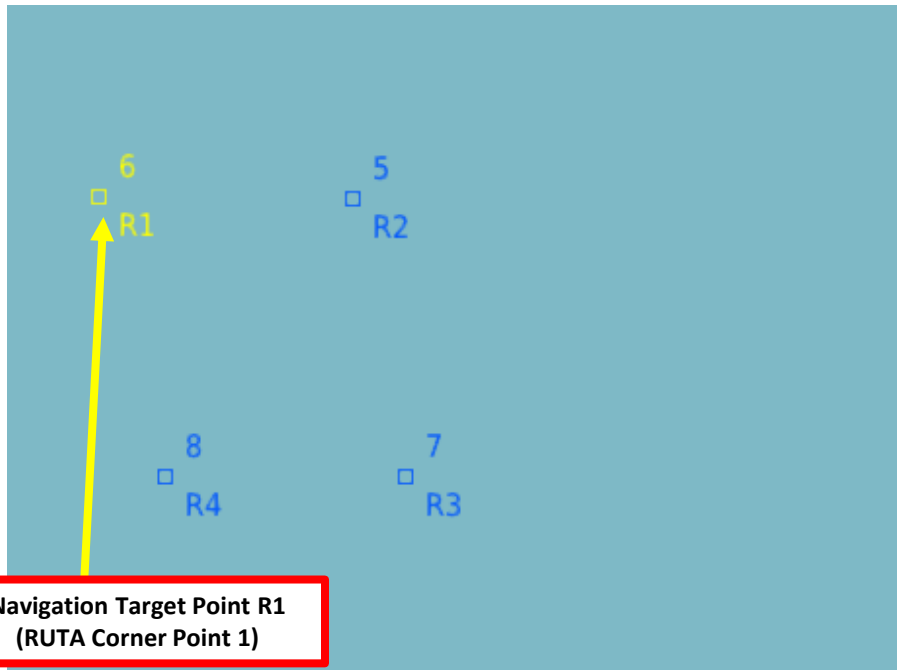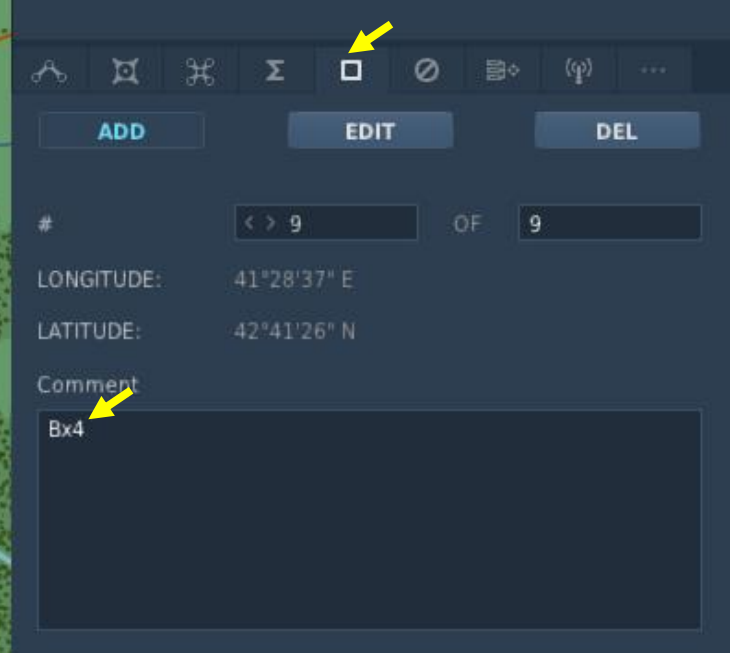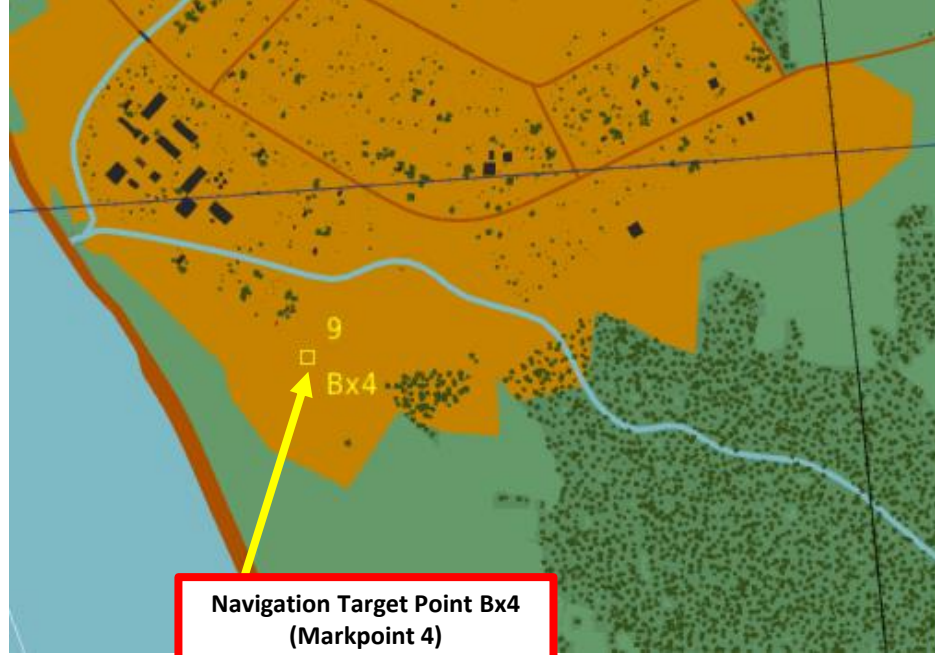
4 – FLIGHT PLAN

4.2 – Flight Plan Creation Methods

4.2.3 – Auto-Generated

A flight plan can be automatically generated from a Target Point M#, or on a specific unit.

However, you need to make sure that the Data Cartridge you are loading during start-up contains data from the Autogenerated mission plan. This is further explored in Part 17 – DATA CARTRIDGE, but here is a quick summary.

1. Prior to loading your Data Cartridge, display your kneeboard using the "RSHIFT+K" binding.
2. Cycle through pages using "[" and "]" until you reach the GROUND CREW SETTINGS page.
3. Your current selected data cartridge is indicated.
4. Change data cartridge by using the "LCTRL+LALT+C" binding until you see the "Data Cartridge from Autogenerated attack" setting. You can select whether the flight plan is generated from:
   a) A marker position on the F10 map, or
   b) An existing unit
5. Click on the data cartridge slot to load the new cartridge.
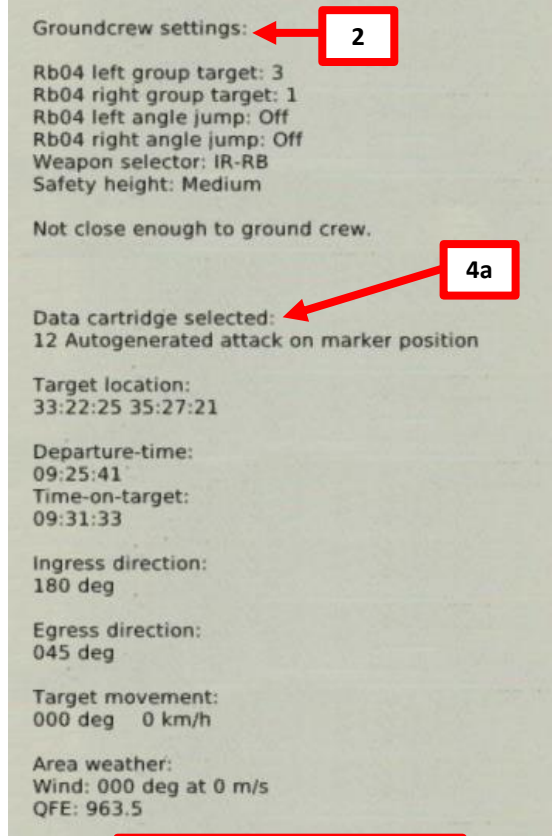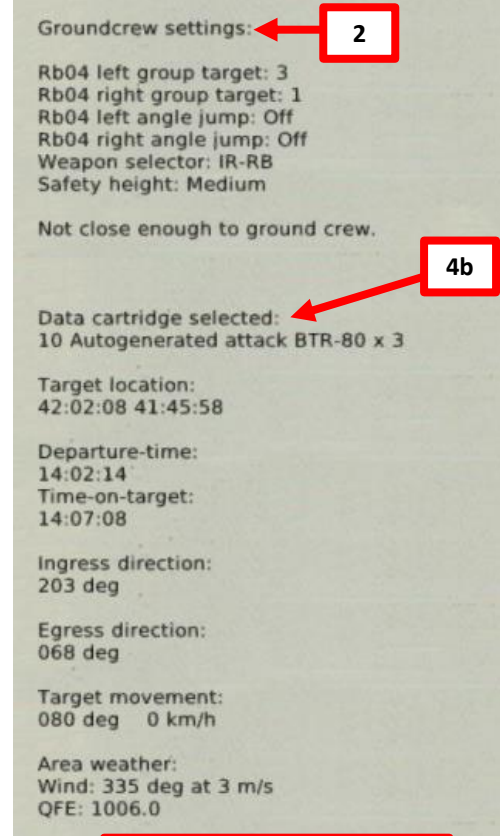6. Start data cartridge loading procedure as shown in the start-up procedure
   a) Set the Data Selector knob to REF/LOLA
   b) Set INPUT/OUTPUT data switch to INPUT.
   c) Enter code 9099 (Fictional Airport No. 99).
   d) Press the LS waypoint to start data transfer process. The data transfer will be in-progress when the first "9" digit is flashing, and the process will be complete once all digits revert back to "0".
   e) Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT.

Data Cartridge

Groundcrew settings: **2**

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

4a

Data cartridge selected:
12 Autogenerated attack on marker position

Target location:
33:22:25 35:27:21

Departure-time:
09:25:41
Time-on-target:
09:31:33

Ingress direction:
180 deg

Egress direction:
045 deg

Target movement:
000 deg   0 km/h

Area weather:
Wind: 000 deg at 0 m/s
QFE: 963.5

Auto-Generated Flight plan from F10 Map Marker

Groundcrew settings: **2**

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

4b

Data cartridge selected:
10 Autogenerated attack BTR-80 x 3

Target location:
42:02:08 41:45:58

Departure-time:
14:02:14
Time-on-target:
14:07:08

Ingress direction:
203 deg

Egress direction:
068 deg

Target movement:
080 deg   0 km/h

Area weather:
Wind: 335 deg at 3 m/s
QFE: 1006.0

Auto-Generated Flight plan from existing unit

MAP   41°55'49"N 41°52'04"E, 59 ft

F10 Map Marker Target Point M3

Mark Label

Kobuleti

KBL
Chan 67

1.   07:30
New callsign
M3

4 – FLIGHT PLAN
4.2 – Flight Plan Creation Methods
4.2.4 – F10 Map Markers

There are cases where you might want to create your own custom flight plan using the F10 map markers directly.

However, you need to make sure that the Data Cartridge you are loading during start-up contains data from the Autogenerated mission plan. This is further explored in Part 17 – DATA CARTRIDGE, but here is a quick summary.
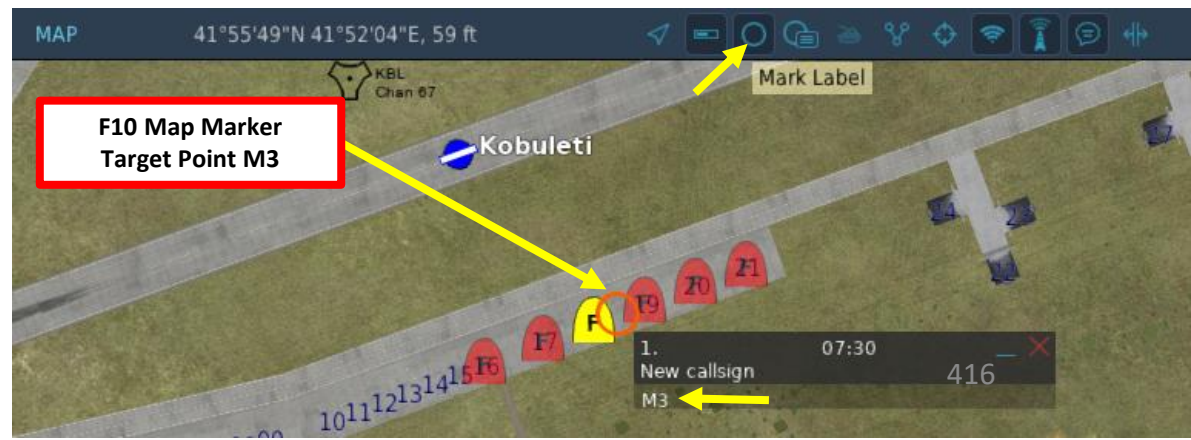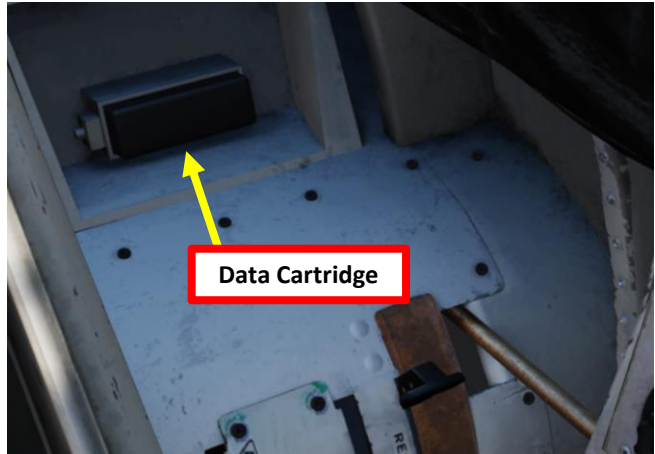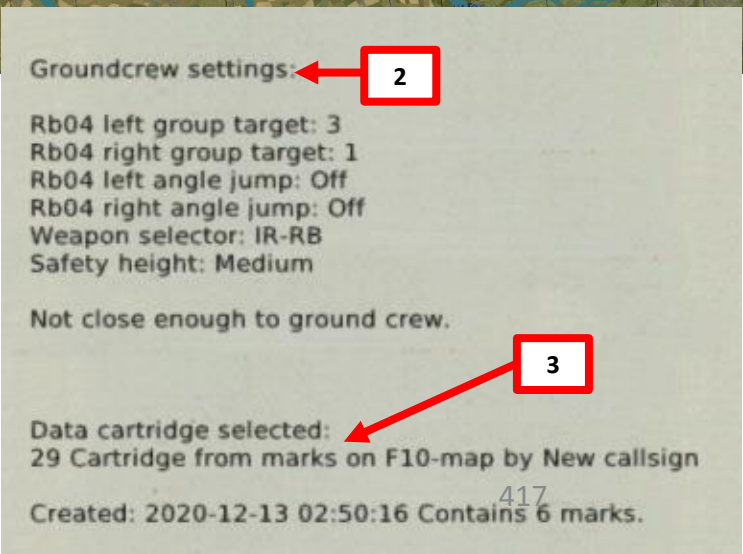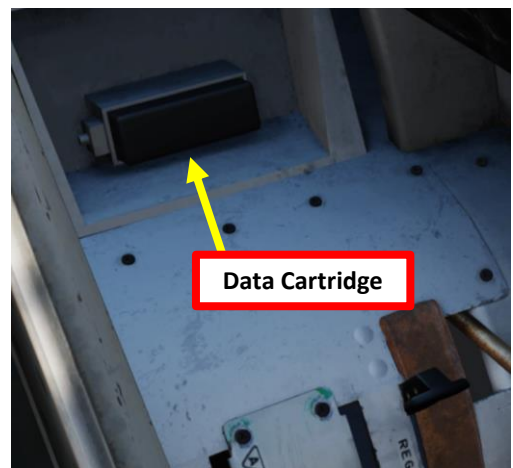
1. Prior to loading your Data Cartridge, display your kneeboard using the "RSHIFT+K" binding.
2. Cycle through pages using "[" and "]" until you reach the GROUND CREW SETTINGS page.
3. Your current selected data cartridge is indicated.
4. Change data cartridge by using the "LCTRL+LALT+C" binding until you see the "Data Cartridge from marks on F10-map by Your Callsign" setting.
   - Interestingly, in multiplayer you can load the flight plan of anyone else that created his own markers in the map. This is useful to easily transfer flight plans to other flight members.
5. Click on the data cartridge slot to load the new cartridge.
6. Start data cartridge loading procedure as shown in the start-up procedure
   a) Set the Data Selector knob to REF/LOLA
   b) Set INPUT/OUTPUT data switch to INPUT.
   c) Enter code 9099 (Fictional Airport No. 99).
   d) Press the LS waypoint to start data transfer process. The data transfer will be in-progress when the first "9" digit is flashing, and the process will be complete once all digits revert back to "0".
   e) Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT.

F10 Map Markers

```
F10 Map Markers Format

Airfields LS L1 L2:
Waypoints B1-9: B1, BP1
Target waypoints M1-9: MP1 MB1 MBP1
Markpoints: BX1-9: BX1
Measured Recce targets M1: M1, MR1
RUTA points R1-9: R1-9
```


Data Cartridge

Groundcrew settings: **2**

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected: **3**
29 Cartridge from marks on F10-map by New callsign

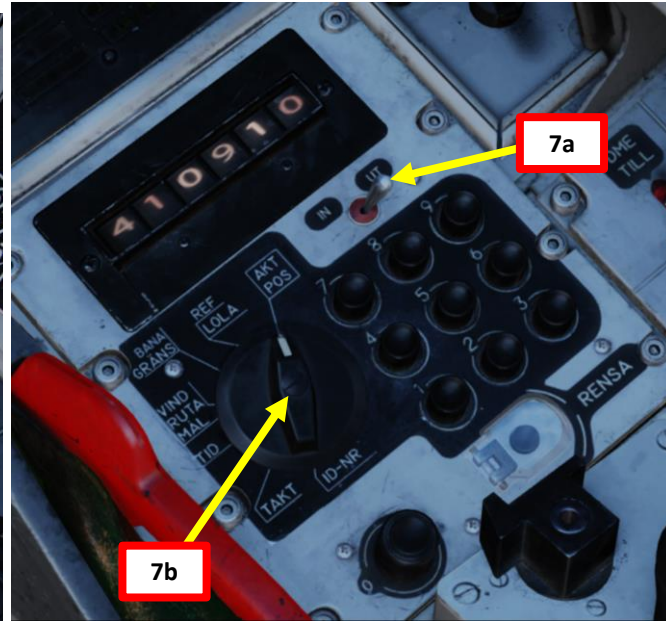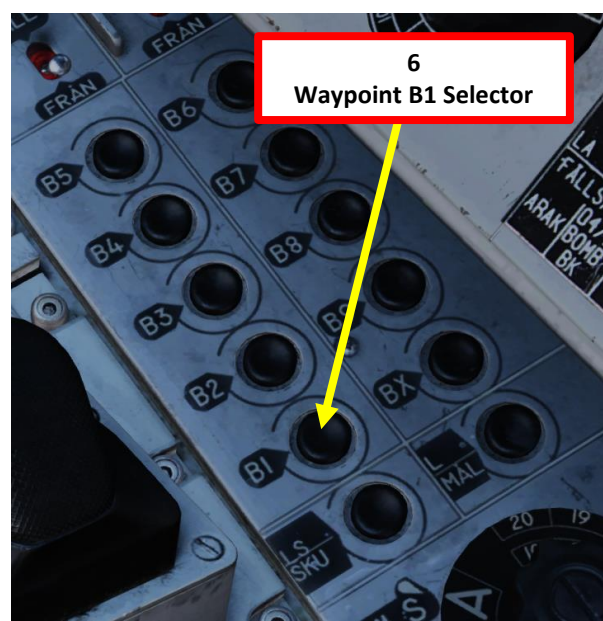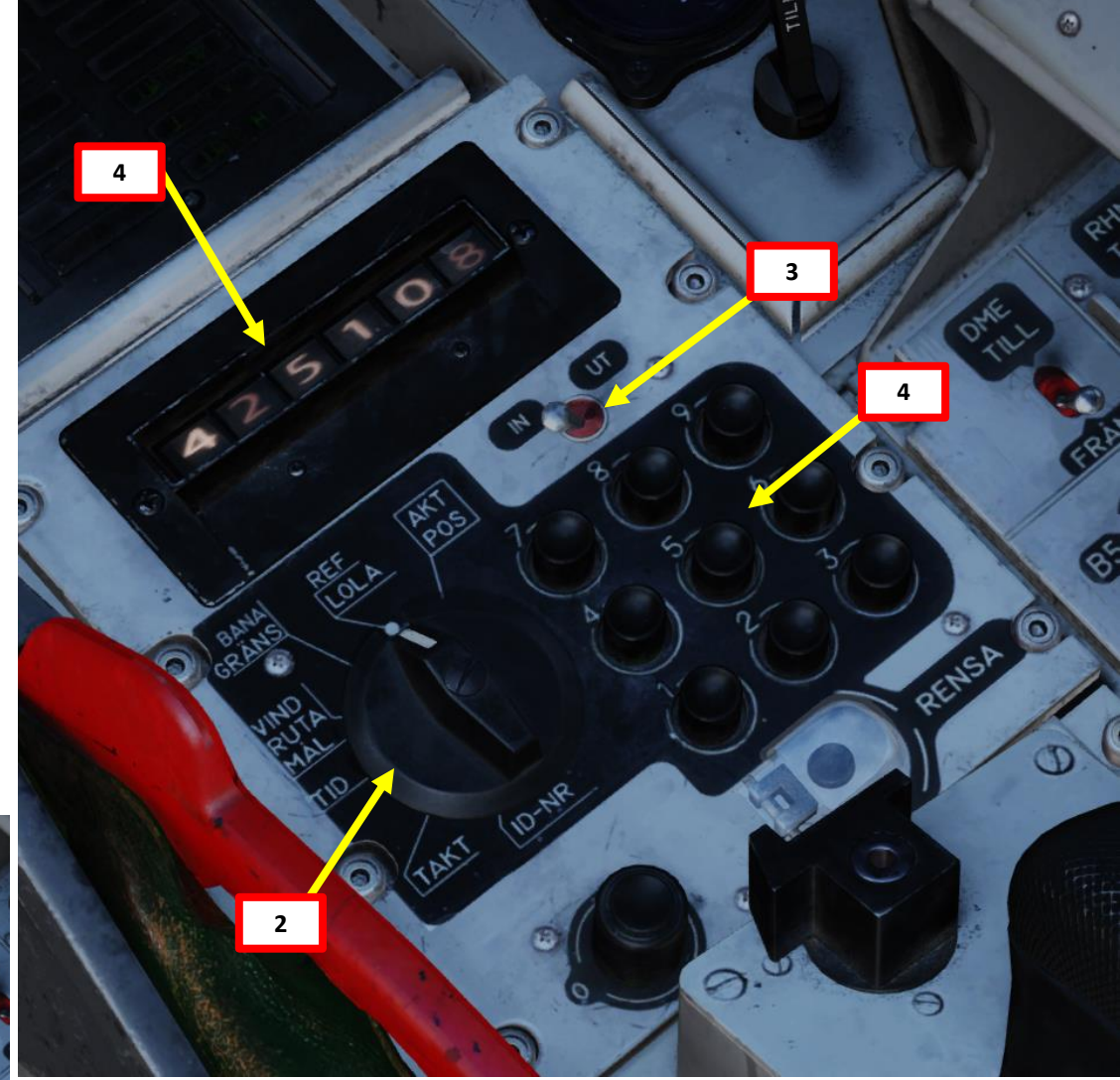Created: 2020-12-13 02:50:16 Contains 6 marks.

5 – WAYPOINTS (B#)
5.1 – Create/Edit Waypoints

To create a waypoint, you can either enter their coordinates or reference numbers in the CK37 computer Data Panel. Here is an example:

1. We will add a navigation waypoint (B1) set to coordinates: **42°51'08" North, 41°08'35" East**.
2. To add a waypoint (i.e. B1), set Data Selector to REF/LOLA mode.
3. Set INPUT/OUTPUT data switch to INPUT.
4. On keypad, enter coordinates in degrees, minutes and seconds for Longitude and Latitude. As an example, coordinates from the F10 map **42°51'08" North (Latitude)**, **41°08'35" East (Longitude)** are entered as **410835425108** (East coordinates first, North coordinates second, which might seem counterintuitive if you use the F10 East-North coordinates.).
5. When coordinates are entered, the Data Selection field will alternate between the longitude and latitude coordinates you just entered.
6. Press button B1 to save coordinates for new waypoint B1.
7. Set the Data Selector back to AKT-POS in OUTPUT mode.

6
Waypoint B1 Selector

7a

7b

5 – WAYPOINTS (B#)
5.1 – Create/Edit Waypoints

Your kneeboard contains « reference numbers », which are codes associated to either an airbase (code starting with 90XX) or specific Reference Points (91XX codes and (92XX codes), which contain the coordinates of preset locations.

For instance, if you want to add a waypoint on the Anapa Airport, you can use the same procedure as listed before, but instead of entering the longitude and latitude coordinates, you can just use code "9001" instead.

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8Mhz AM C2: 257Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz AM C: 40Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707
A: 4.3Mhz AM B: 132Mhz AM C: 40.6Mhz AM C2: 261Mhz AM
13: Kobuleti (9013) TILS: 13 RWY: 250.027
A: 4.3Mhz AM B: 133Mhz AM C: 40.8Mhz AM C2: 262Mhz AM
14: Kutaisi (9014) TILS: 14 RWY: 253.999
A: 4.4Mhz AM B: 134Mhz AM C: 41Mhz AM C2: 263Mhz AM
15: Mineralnye Vody (9015) TILS: 15 RWY: 295.31
A: 4.4Mhz AM B: 135Mhz AM C: 41.2Mhz AM C2: 264Mhz AM
16: Nalchik (9016) TILS: 16 RWY: 55.471
A: 4.5Mhz AM B: 136Mhz AM C: 41.4Mhz AM C2: 265Mhz AM
17: Mozdok (9017) TILS: 17 RWY: 262.67
A: 4.5Mhz AM B: 137Mhz AM C: 41.6Mhz AM C2: 266Mhz AM
18: Tbilisi-Lochini (9018) TILS: 18 RWY: 127.963
A: 4.6Mhz AM B: 138Mhz AM C: 41.8Mhz AM C2: 267Mhz AM
19: Soganlug (9019) TILS: 19 RWY: 312.256
A: 4.6Mhz AM B: 139Mhz AM C: 42Mhz AM C2: 268Mhz AM
20: Vaziani (9020) TILS: 20 RWY: 135.473
A: 4.7Mhz AM B: 140Mhz AM C: 42.2Mhz AM C2: 269Mhz AM
21: Beslan (9021) TILS: 1 RWY: 93.5424
A: 4.7Mhz AM B: 141Mhz AM C: 42.4Mhz AM C2: 270Mhz AM

Reference points (1)

9101 45:02:23 037:23:47
9102 45:01:21 037:22:20
9103 44:58:11 037:17:57
9104 44:59:14 037:19:23
9105 41:36:06 041:36:43
9106 41:36:50 041:35:29
9107 41:36:39 041:36:01
9108 41:36:09 041:36:47
9109 43:12:55 044:32:23
9110 43:12:38 044:34:19
9111 43:12:09 044:37:32
9112 43:12:24 044:35:27
9113 44:34:10 038:00:31
9114 44:34:20 038:00:43
9115 43:05:56 040:34:44
9116 41:55:07 041:48:10
9117 41:55:28 041:50:03
9118 41:55:58 041:52:45
9119 41:55:38 041:51:11
9120 41:55:50 041:51:43
9121 45:05:08 039:00:43
9122 45:05:11 038:58:09
9123 45:05:16 038:52:24
9124 45:05:14 038:54:41
9125 45:05:11 038:58:03
9126 45:05:08 038:55:43
9127 45:04:59 038:55:40
9128 45:00:24 039:07:59
9129 45:01:18 039:09:35
9130 45:04:08 039:14:34
9131 45:03:14 039:12:58
9132 45:01:14 039:09:49
9133 45:00:17 038:02:37
9134 44:58:58 038:00:53
9135 44:55:58 037:56:56
9136 44:57:06 037:58:25
9137 44:57:39 037:59:03
9138 44:58:33 038:00:14
9139 44:57:08 037:58:28
9140 44:58:58 038:00:53
9141 44:57:59 037:59:48
9142 42:10:46 042:29:52
9143 42:10:30 042:28:12
9144 42:10:27 042:27:16
9145 42:10:42 042:28:45
9146 KUTAISI 42:10:27 042:27:18
9147 41:42:11 044:54:34
9148 41:41:09 044:55:54
9149 41:39:28 044:58:04
9150 41:40:29 044:56:39

5 – WAYPOINTS (B#)
5.2 – Navigate to Waypoints

To navigate to Waypoint B1:

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS - OUTPUT
3. Press Waypoint Selector Button B1
4. Destination Indicator and Distance Indicator display what waypoint is selected and how far you are from it (displayed km or in Swedish miles when you are more than 40 km away)
5. Steer aircraft to set the Flight Path Vector between the pole tracks to follow the waypoint. The velocity vector needs to "chase" the center of the pole tracks.
6. The yellow Course Index on the Central Indicator (CI) displays the bearing to the selected waypoint.
7. The vertical yellow bar on the ADI (Attitude Director Indicator) displays lateral deviation from the waypoint.
8. If you set the Radar Mode switch to A1 (MIDDLE), the Central Indicator will display a circle on the waypoint (provided it is within the selected range).
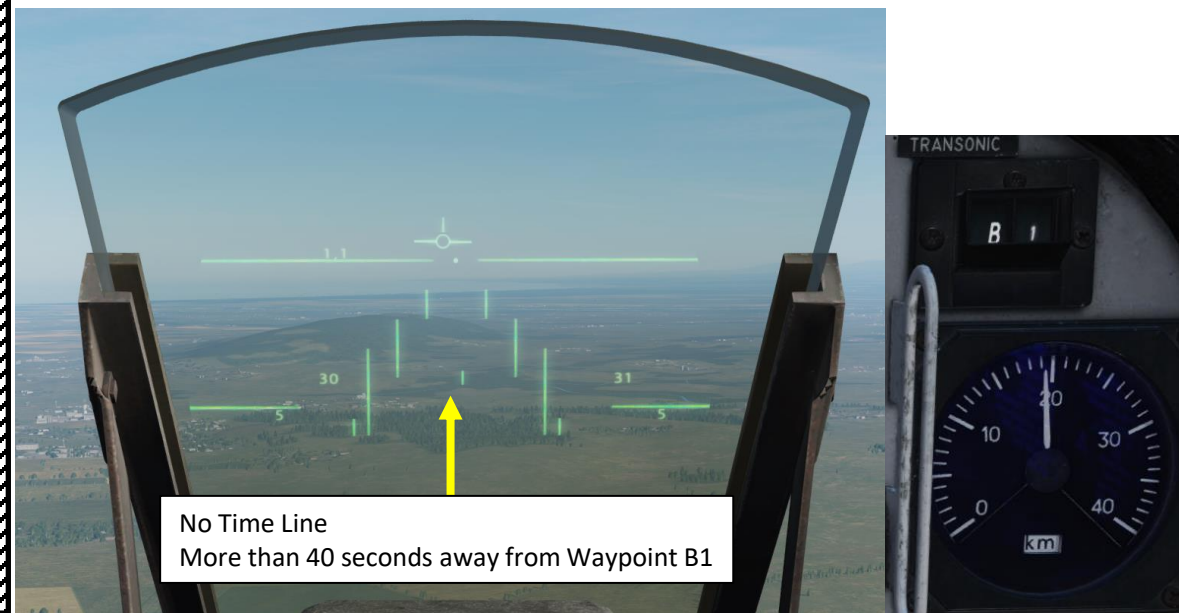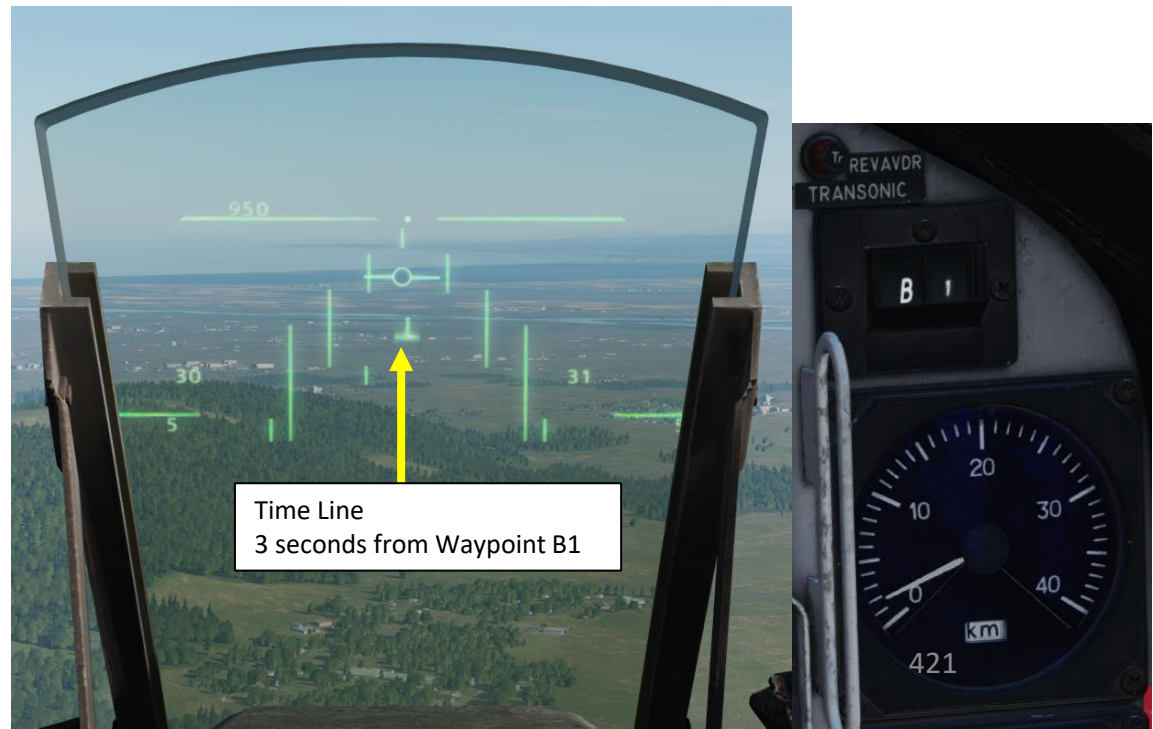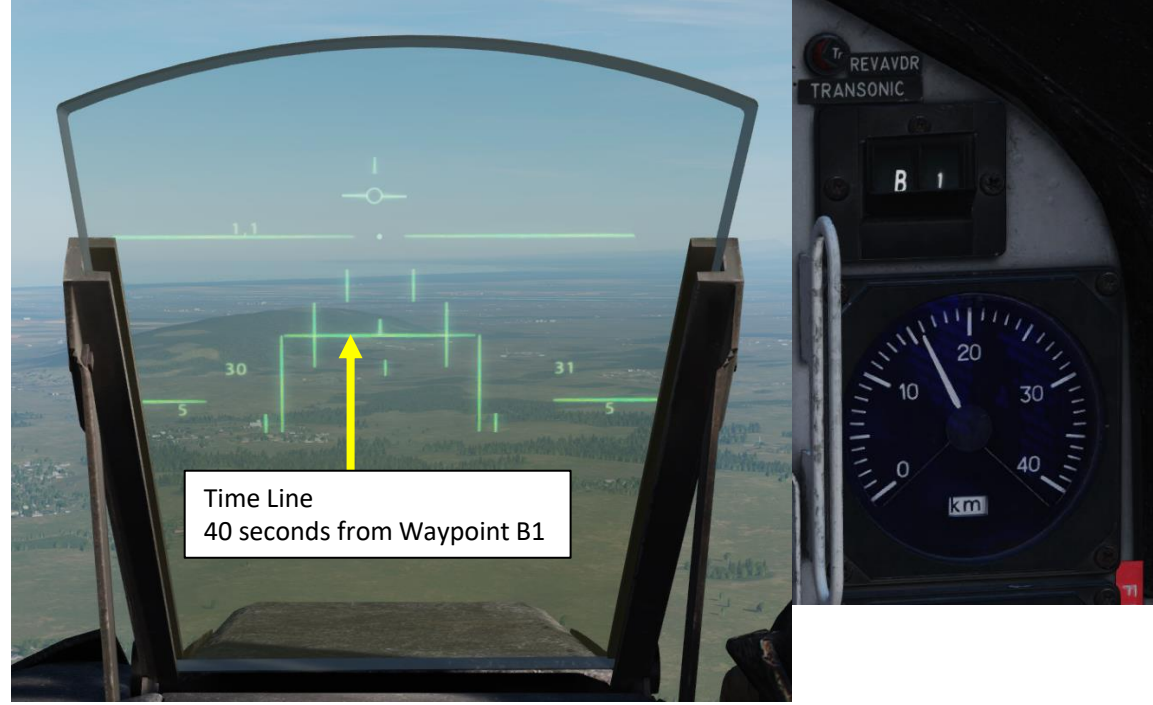
Flight Path Vector

Pole Tracks

Current Heading

Radar Range Selector

8b
Selected Waypoint

CI Range Scale (km)
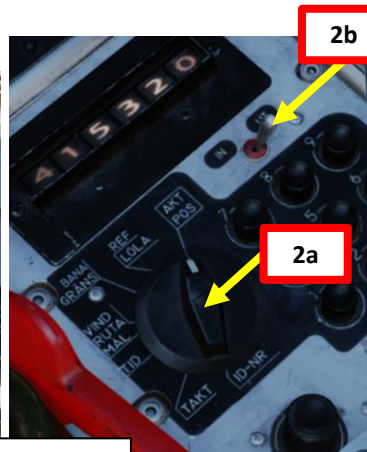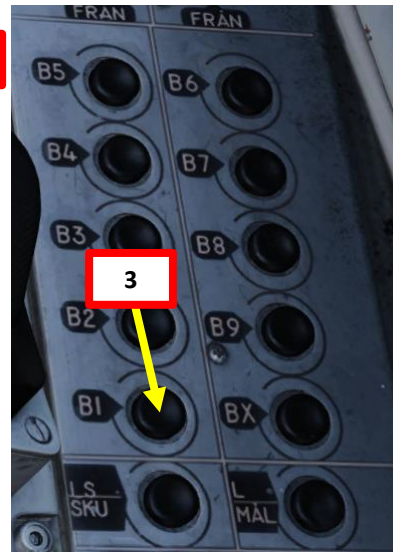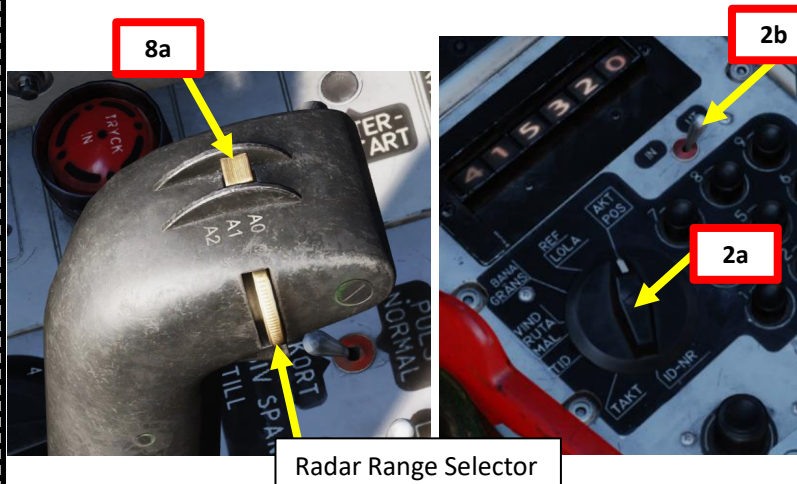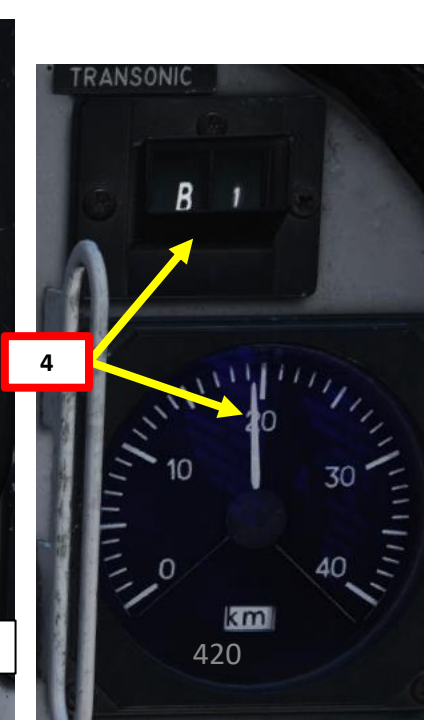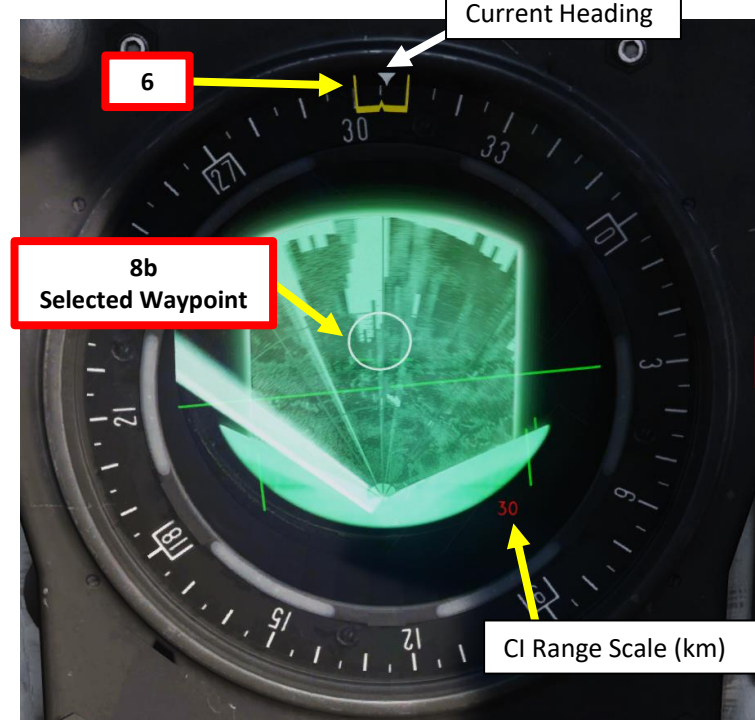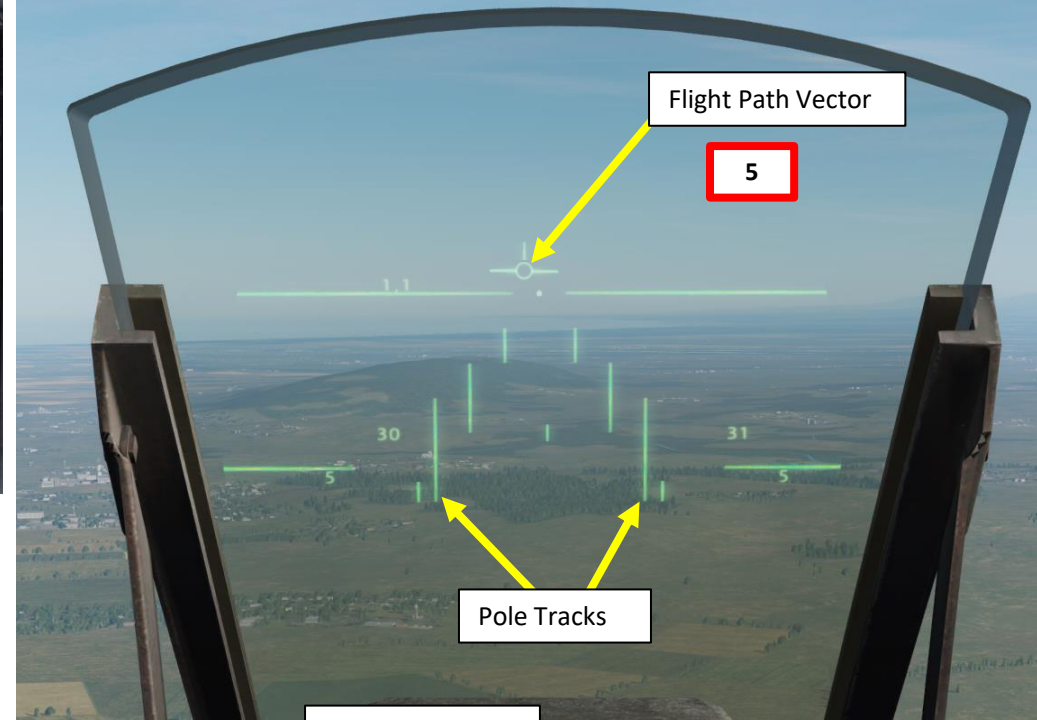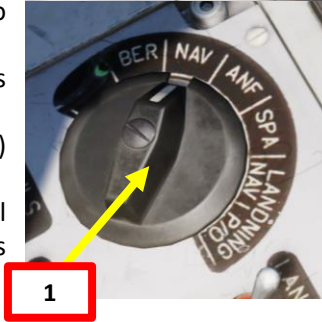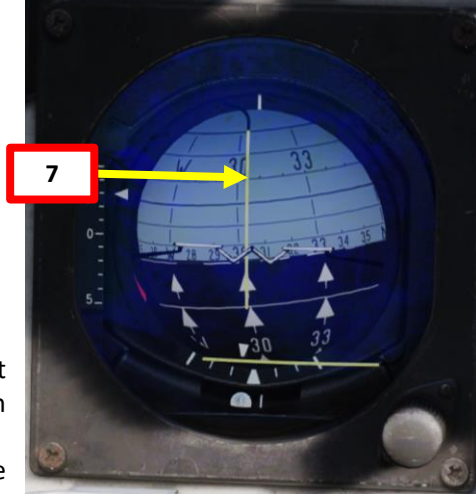
5 – WAYPOINTS (B#)
5.2 – Navigate to Waypoints

The **Distance / Time Line** is used to illustrate the time or distance to an event or waypoint. Markers may appear on the line depending on the mode, to indicate a time or distance for recommended action. The line will grow and shrink depending on the mode.

In **NAV Master Mode**, the Time Line has the following functions:

- **During take-off, Timeline indicates airspeed**. The markers are displaced 2° from the center index. The timeline will grow as airspeed increases. Markers indicate recommended rotation speed.

- A Timeline **without markers**: Indicates time towards destination (current waypoint). The line appears when 6 seconds remains, the line is then stretched 3° from the center index.

- Timeline **with markers** : Indicates time left until an action is expected (as an example, reaching a pop-up point). Markers displaced 1° from center index. The line is fully stretched when 40 seconds remain until action. When the lines' edges merge with the markers, action should be taken.

Time Line
40 seconds from Waypoint B1

No Time Line
More than 40 seconds away from Waypoint B1

Time Line
3 seconds from Waypoint B1

421

5 – WAYPOINTS (B#)

5.3 – Manual vs Automatic Waypoint Change

Automatic Waypoint Change

The system will automatically select the next waypoint when the active waypoint **is overflown or passed within a distance of 3 km**.

- During Master modes ANF (attack) and SPA (Reconnaissance) or NAV with the trigger safety off (mode unsafe), this automatic switch is locked/inhibited. This is to prevent navigation data switching to the next waypoint when you are just about to hit the target.
- Automatic switching does not apply for BX (Markpoints) or Landing waypoints (L1 or L2).

The first waypoint (B1) becomes the destination (active waypoint) automatically after take-off when the aircraft reaches Mach 0.35. This does not apply if the aircraft takes off immediately (without switching to BER) after landing.

Manual Waypoint Change

If AKT POS (Active Position) is selected on the data selector rotary, manual waypoint change can be used.

- Any of the waypoint buttons (**B1-B9, BX, LS, and L/MÅL**) can be used to change to that waypoint.
- If no coordinates are set for that waypoint, the coordinates will be copied from the previous waypoint. If L1 (landing base) has no set coordinates, they will be the same as LS (the designated take-off base).
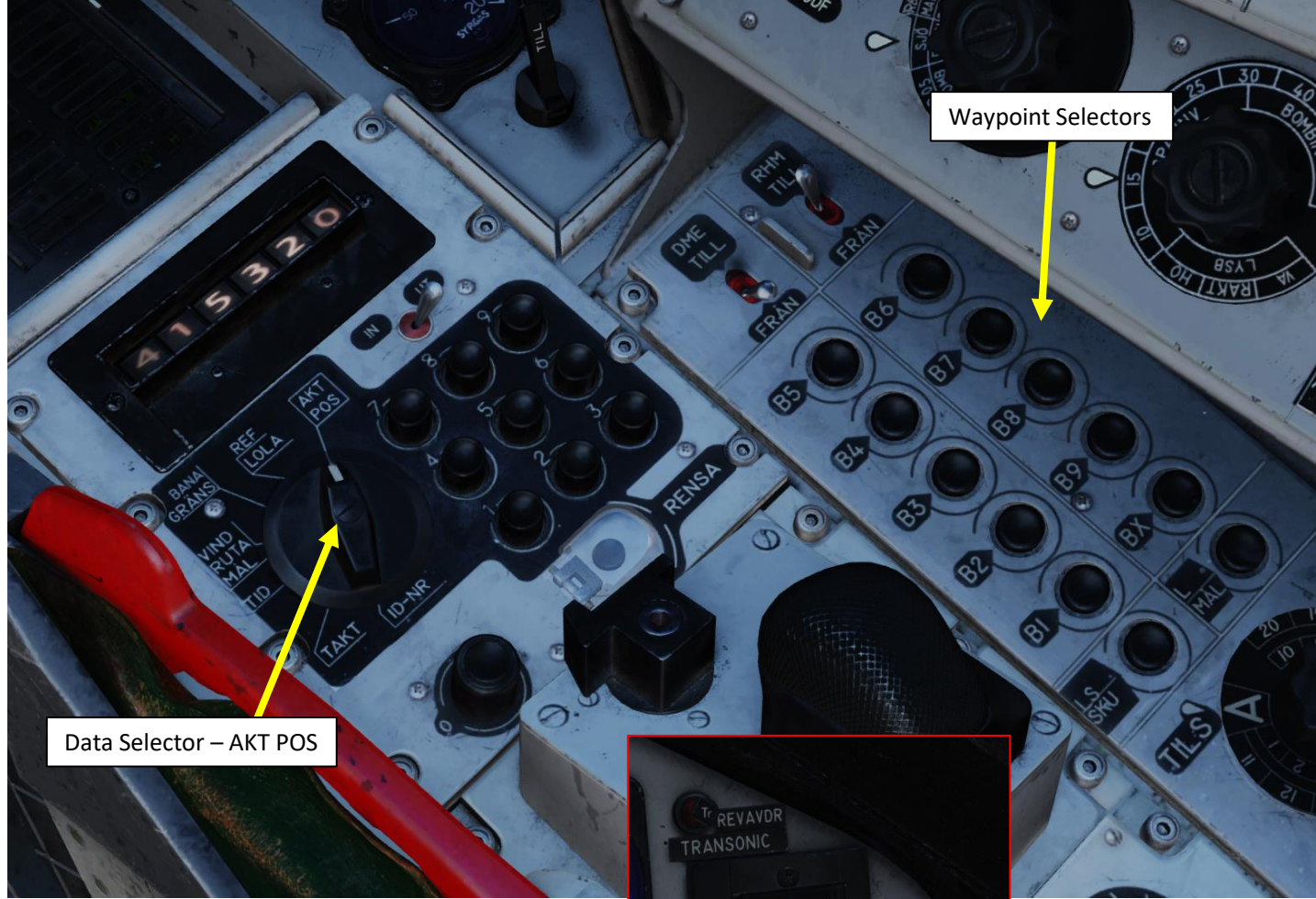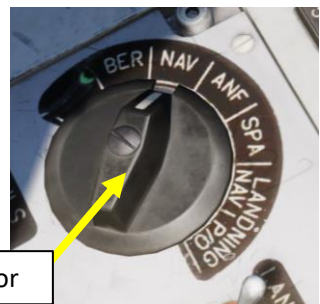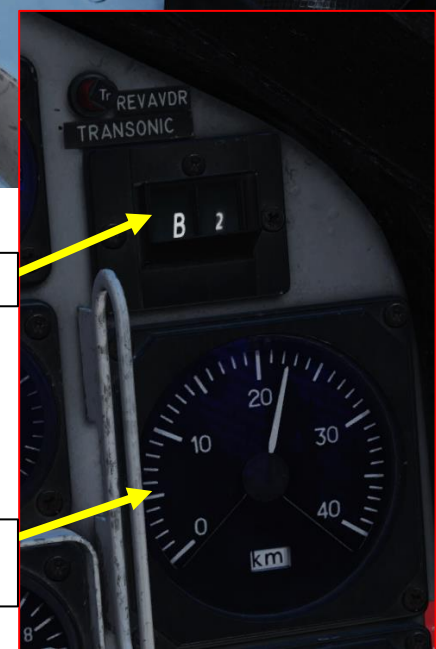
Waypoint Selectors

Data Selector – AKT POS

Trigger (Unsafe)

Master Mode Selector

Destination Indicator

Distance to Selected Waypoint (km)

422

6 – TARGET POINTS (M#)

6.1 – Create Target Points

There is an important distinction between a Waypoint (B1, B2, B3…) and a Target Point (M1, M2, M3…). A waypoint is a fixed point to be used as a navigation reference, while the target point can be used to track targets and aim your weapons, which means that a target point can be modified manually without affecting the other waypoints. Offsetting a waypoint, on the other hand, would offset every other waypoint as well as a means to correct an accumulated drift error (which can be quite inconvenient if you don't want to shift all your other waypoints too).

Generally speaking, you can take a normal waypoint (i.e. Waypoint B3) and change it into a target point (i.e. M3), and vice-versa.

To change a waypoint B3 into a target point M3

1. Set Data Selector to TAKT
2. Set Data Selector to INPUT mode
3. Press "9" on the keypad
4. Press the B3 button. Your selected waypoint indicator will change into "M3".
5. Set Data Selector to OUTPUT mode
6. Set Data Selector to AKT POS (Active Position)

To revert a target point M3 into a waypoint B3

1. Set Data Selector to TAKT
2. Set Data Selector to INPUT mode
3. Press "0" on the keypad
4. Press the B3 button. Your selected waypoint indicator will change into "B3".
5. Set Data Selector to OUTPUT mode
6. Set Data Selector to AKT POS (Active Position)
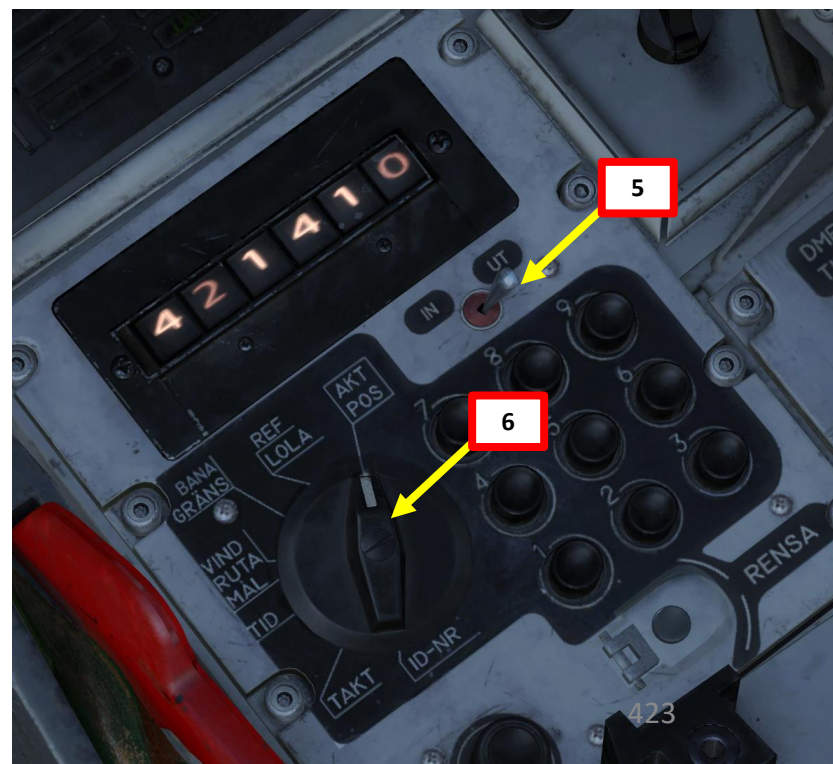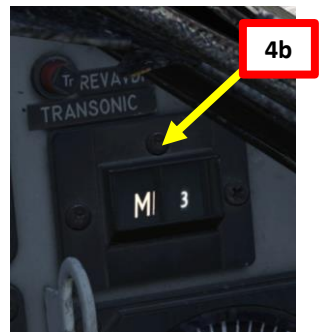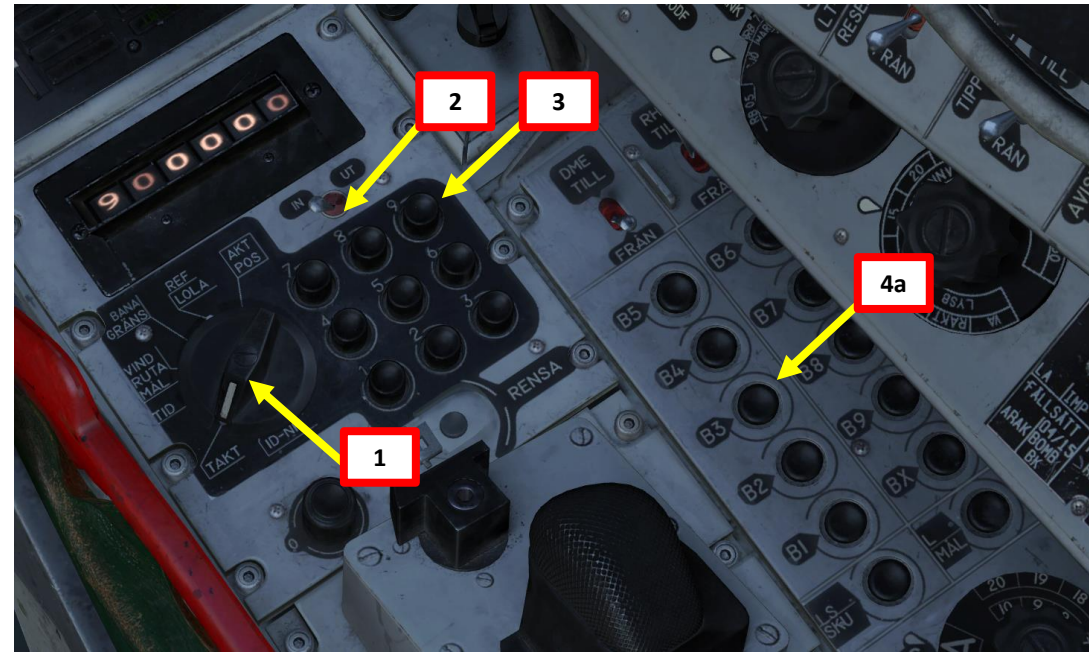
6 – TARGET POINTS (M#)
6.2 – Edit/Offset Target Points

There are situations where a target point is not set up where you want. In this example, we have a Target Point M3 located near the harbor at Calais, but a ship is further down the coast, a few kilometers away from the Target Point.

In this case, we will create a "Radar Fix", which is a fancy term that means that we will offset/move the selected Target Point on the ship.
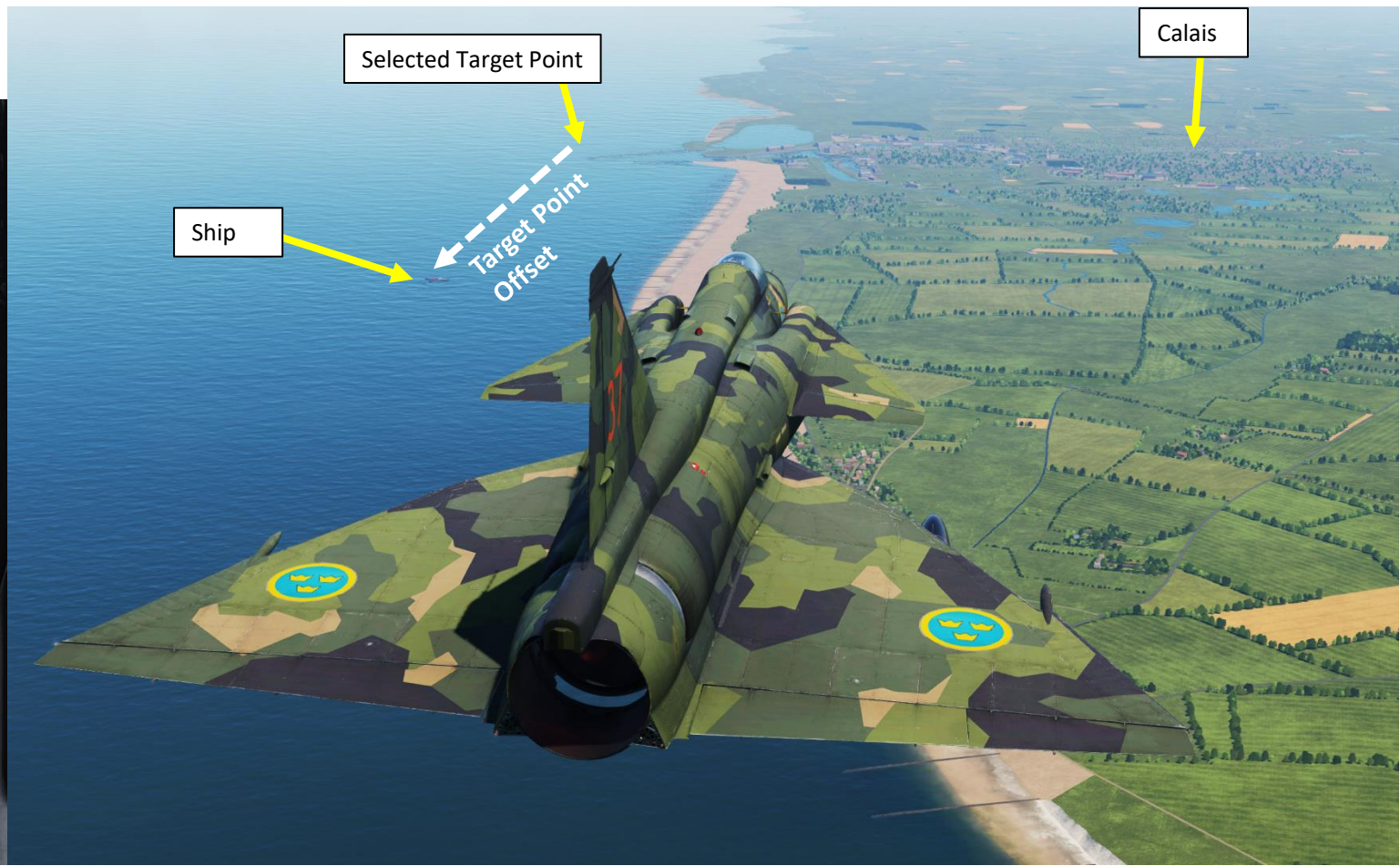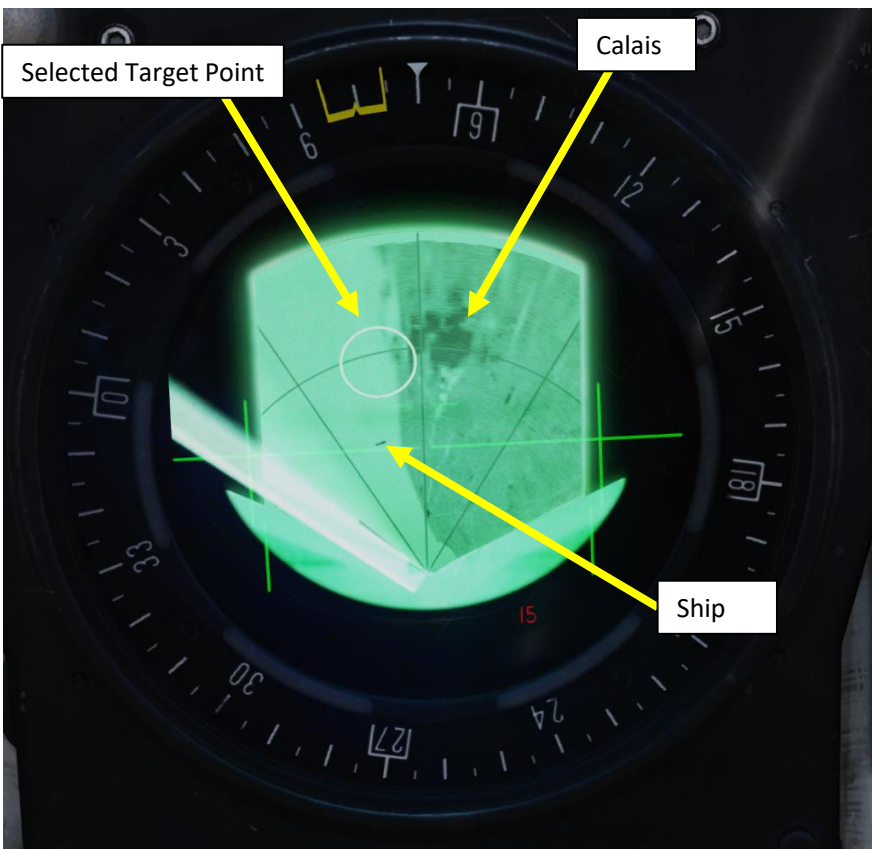
6 – TARGET POINTS (M#)
6.2 – Edit/Offset Target Points

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS - OUTPUT
3. Press Waypoint Selector Button B3 to select Target Point M3
4. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
5. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
6. Adjust radar display range as required.
7. Navigate to M3 (Target Point).
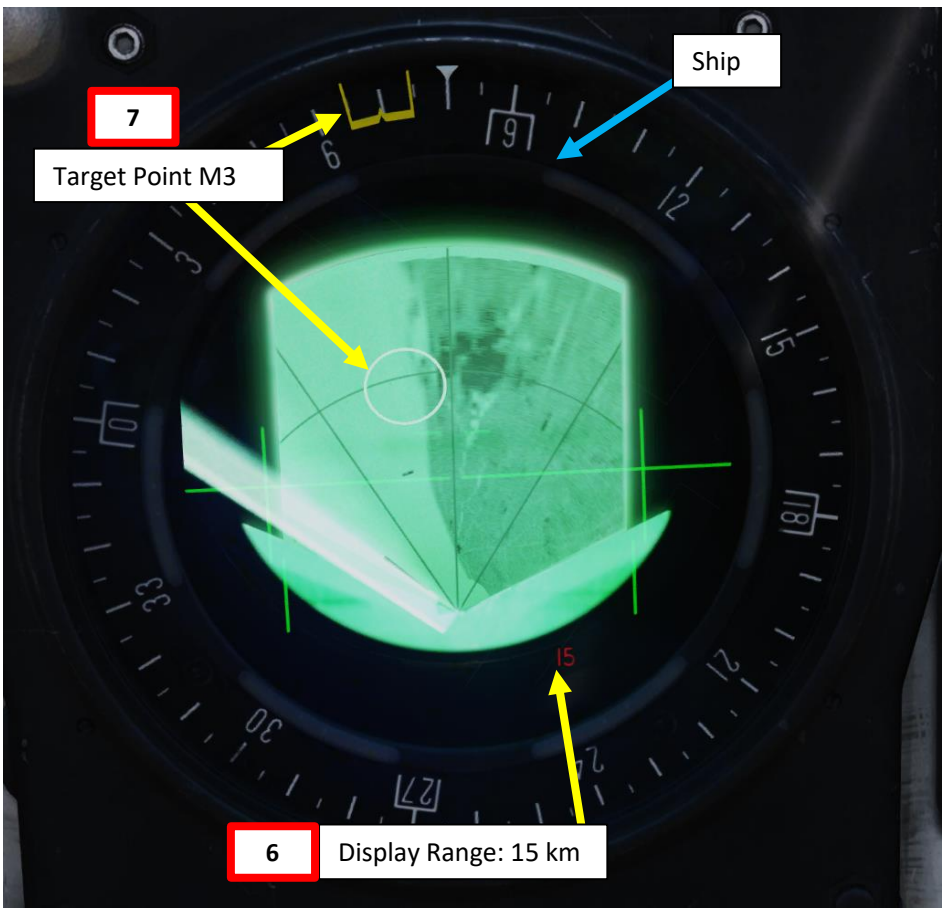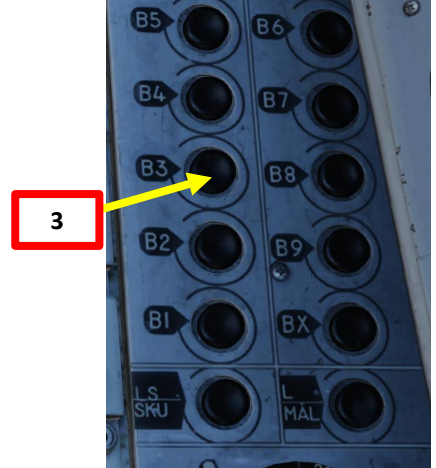
3

1

REVAVDR
TRANSONIC

M 3

10

Radar Mode Selector – A1
(Wide Search with PPI)

4

5

Radar Brightness Control
(LJUS RADAR)

2b

Ship

7

Target Point M3

Radar Scan Range Selector

6

6
Display Range: 15 km

Radar MKR Potentiometer
(Amplification Gain) Dial

5

2a

425
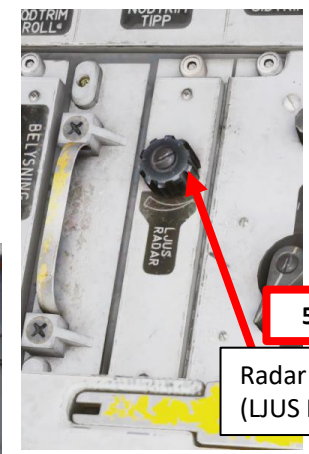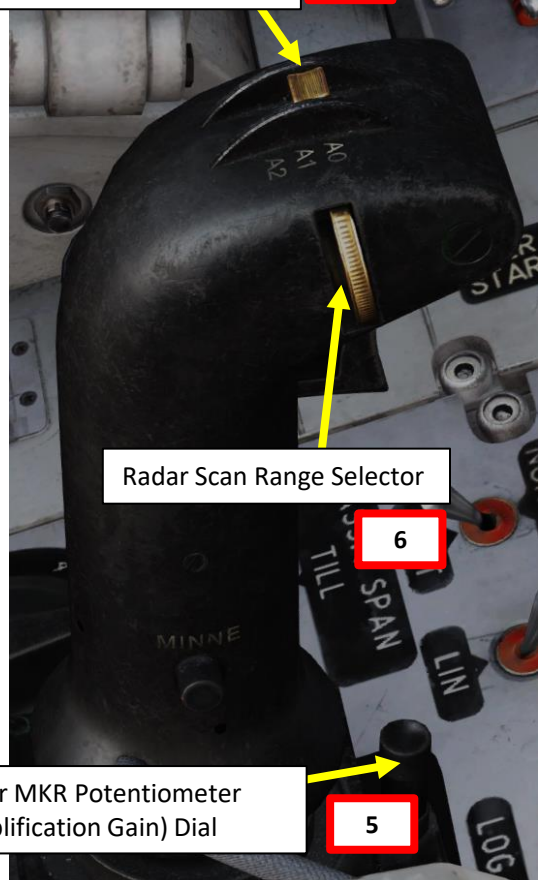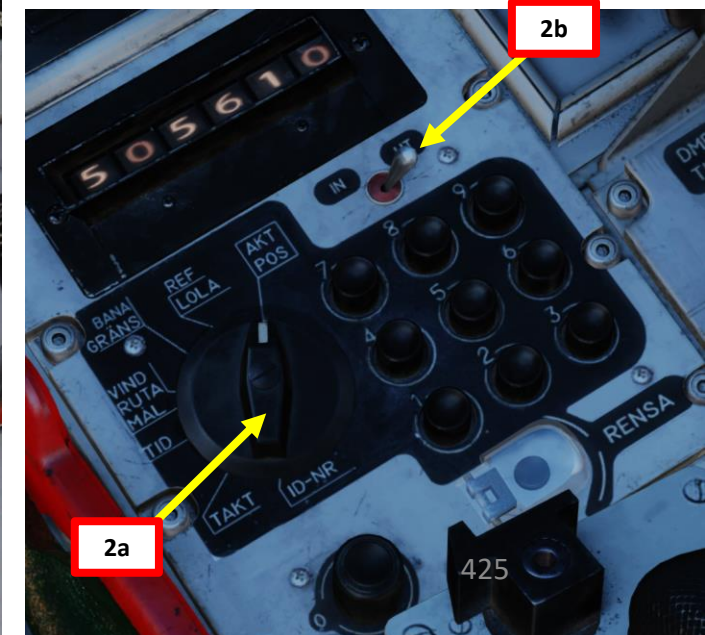
6 – TARGET POINTS (M#)
6.2 – Edit/Offset Target Points

8. You should see the Target Point close to the ship (identified as black spots), but not quite over it. We will now offset the Target Point M3 on the ship using a Radar Target Fix.
9. Press the radar fix trigger to "T1" (first trigger detent). Destination Indicator should display "E".
10. Move crosshair over target using the radar stick controls.
11. Press the radar fix trigger to " TV" (second trigger detent), which will set the target fix on the target. This will become the new location of target point M3.

10a

Radar Stick Control:
• Radarstick Up/Down/Left/Right

9b

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent **9a**
• TV: Second trigger detent **11a**

Ship

8

Target Point M3 Original Location

Crosshair (Slewable)

9b

Crosshair (Slewed) **10b**

Target Fix (New M3)

11b

426
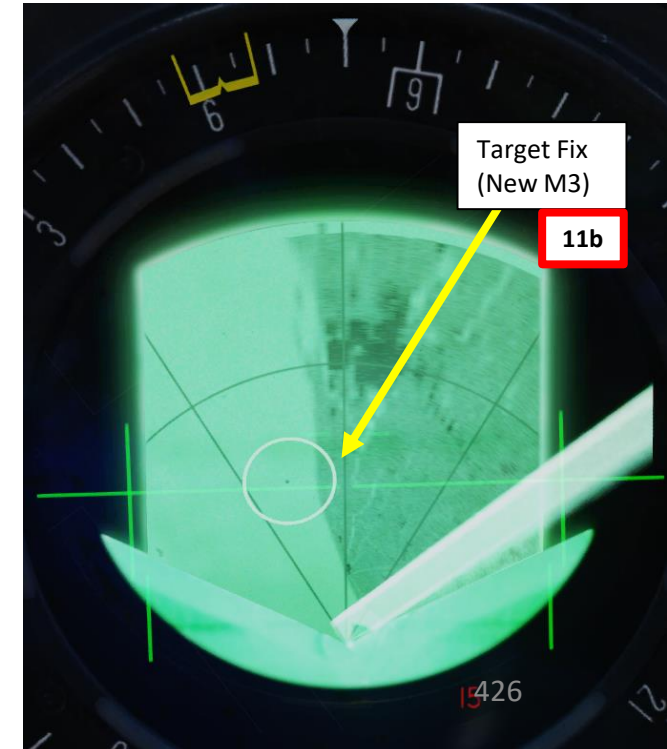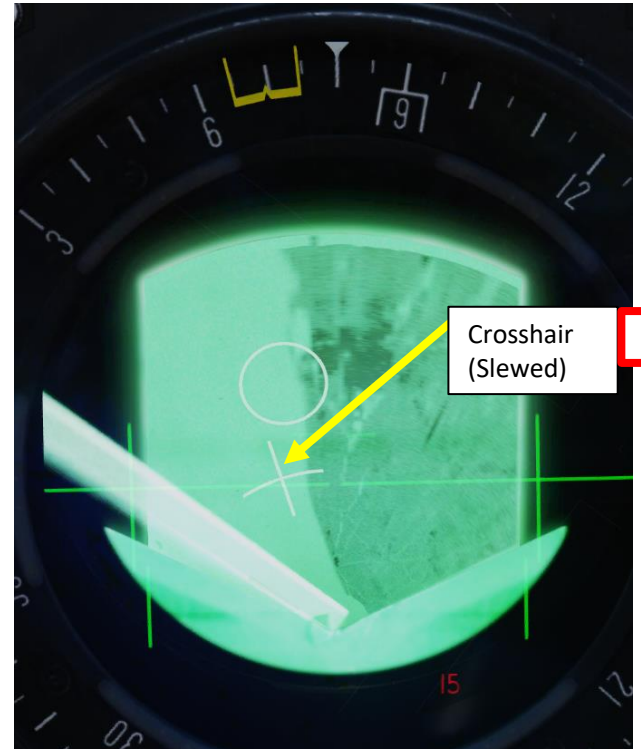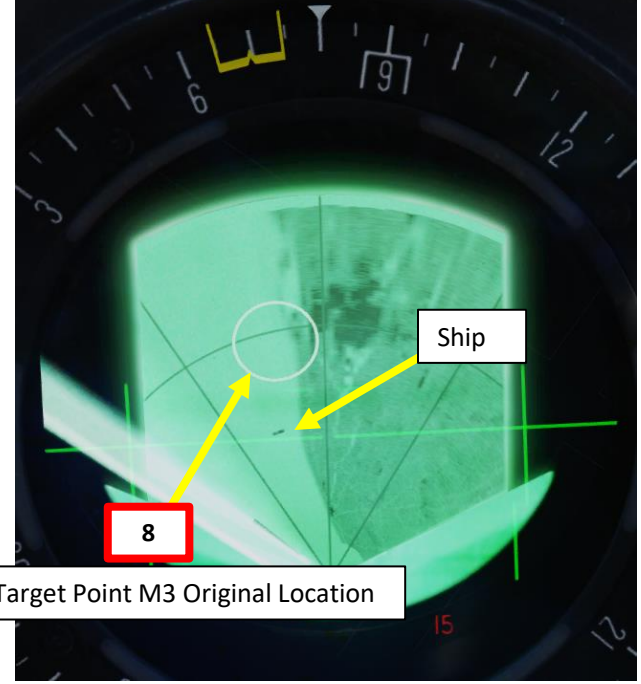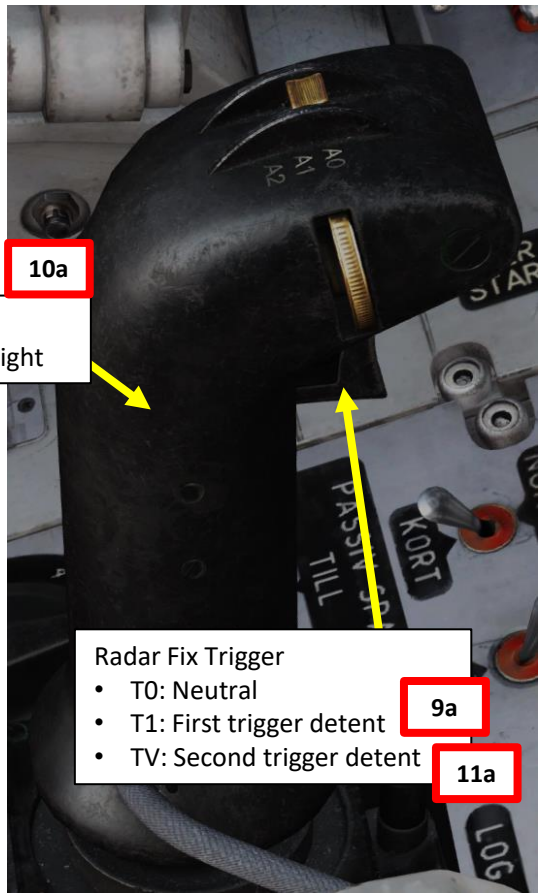
6 – TARGET POINTS (M#)
6.3 – Navigate to Target Points

To navigate to Target Point M3:

1. Set Master Mode to NAV
2. Press Waypoint Selector Button B3
3. Destination Indicator and Distance Indicator display what waypoint is selected and how far you are from it (displayed km or in Swedish miles when you are more than 40 km away)
4. Steer aircraft to set the Flight Path Vector between the pole tracks to follow the waypoint. The velocity vector needs to "chase" the center of the pole tracks.
5. The yellow Course Index on the Central Indicator (CI) displays the bearing to the selected Target Point.
6. The vertical yellow bar on the ADI (Attitude Director Indicator) displays lateral deviation from the waypoint.
7. If you set the Radar Mode switch to A1 (MIDDLE), the Central Indicator will display a circle on the target point (provided it is within the selected range).

6

Flight Path Vector

4

Pole Tracks

Current Heading

5

7b
Selected Target Point

1

2

7a

Radar Range Selector

CI Range Scale (km)

3

M 3
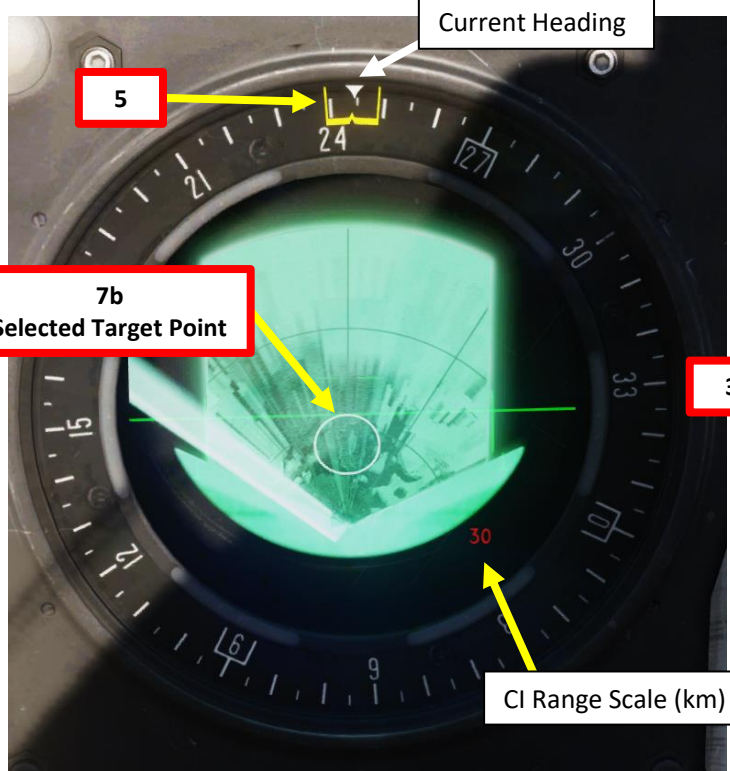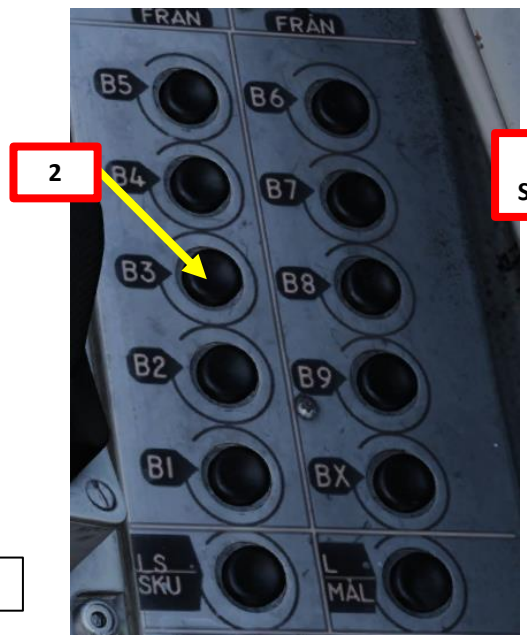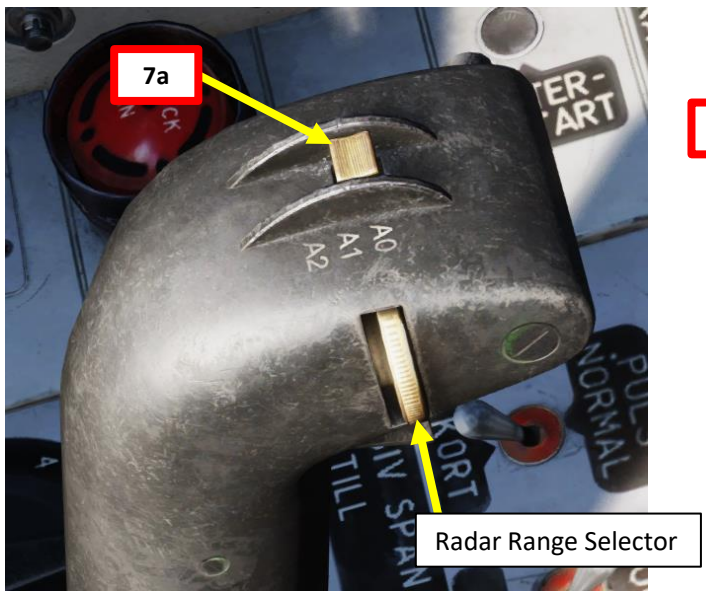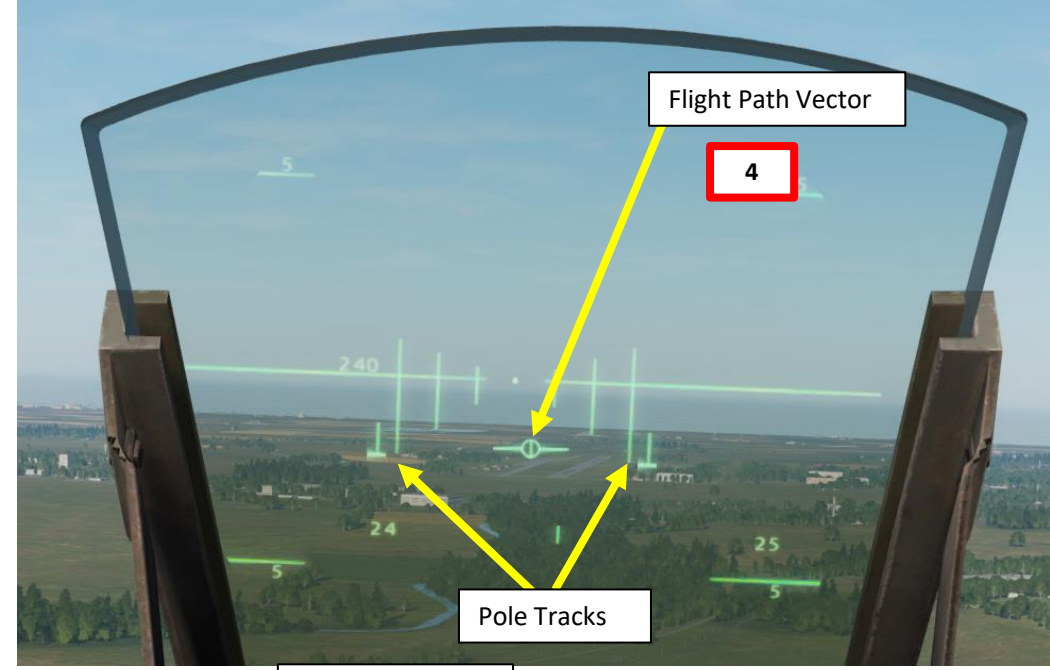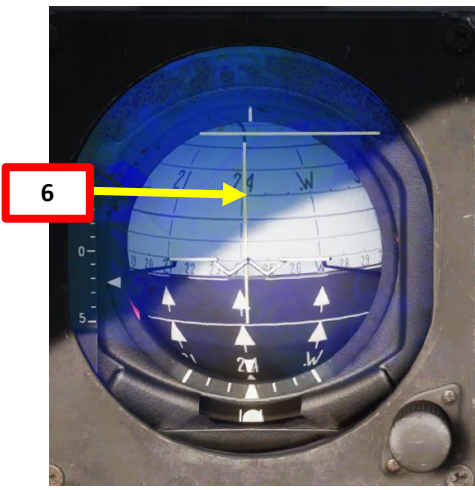
7 – TARGET POP-UP POINTS (U#)

7.1 – Create Target Pop-Up Points

The mission profile of the Viggen generally involves approaching the target at a very low altitude to minimize detection. Just before reaching the target point, the aircraft "pops up" at a designated point, which is called the "pop-up point". A pop-up point (U#) is defined by entering the direction and distance **from** the pop-up point (U#) **to** the target waypoint (M#). Think of it as a way to plan the direction of your attack.

750 m

50 m

**Waypoint B3
Target Point M3**

Pop-Up Point U3
*Located 10 km North-East of M3 following a
heading of 250 (from target's 2 o'clock)*
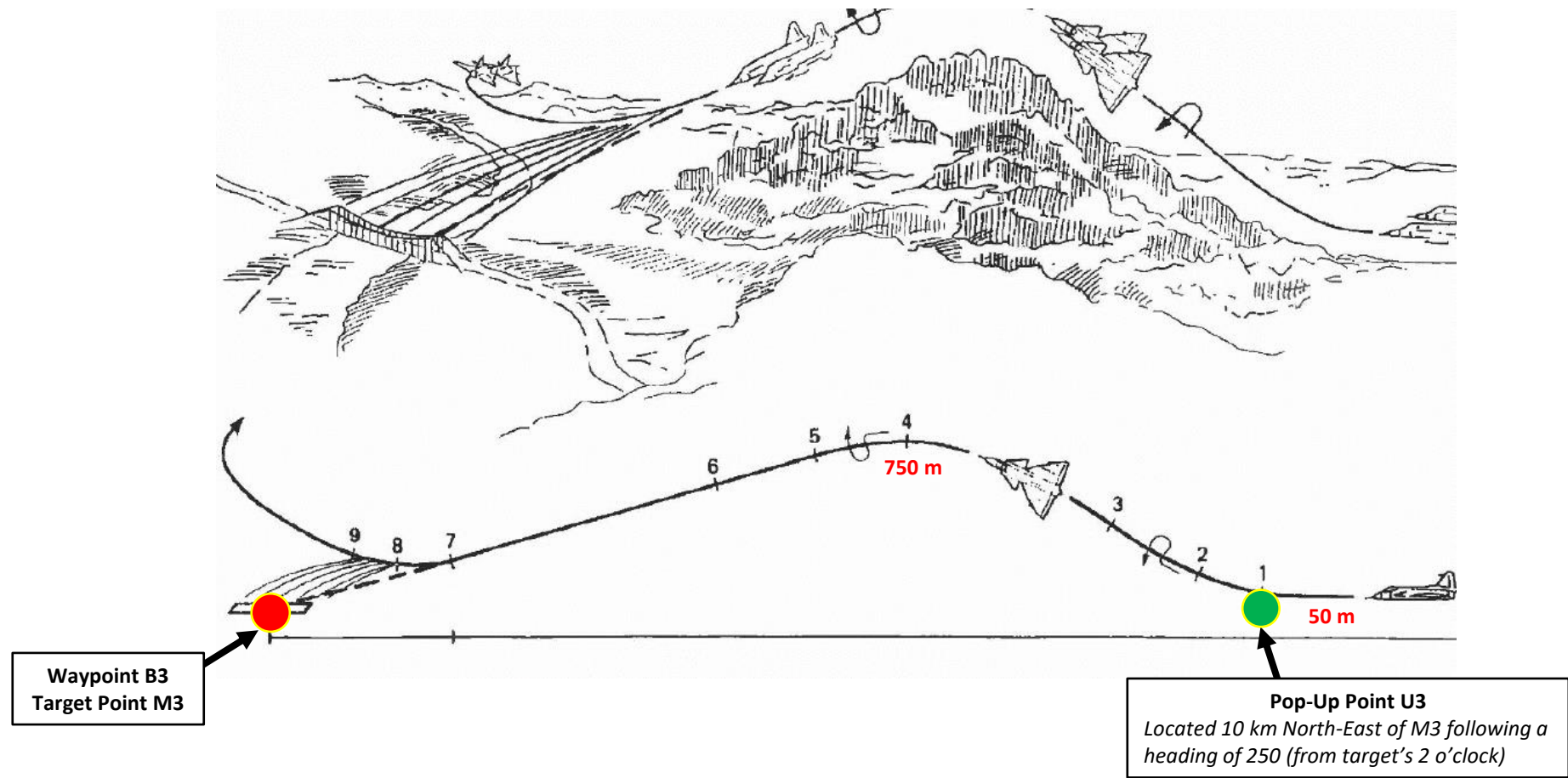
7 – TARGET POP-UP POINTS (U#)

7.1 – Create Target Pop-Up Points

In this example, we want to create Pop-Up Point U3 in relationship to the Target Point M3. The heading from pop-up point U3 to the target waypoint M3 is **250** with a distance of **10** km.

- To create a Target Point M3:
    - a) Set Data Selector to TAKT
    - b) Set INPUT/OUTPUT Selector to IN
    - c) Enter code "**250**1**0**" on the keypad
    - d) Press the B3 button (Waypoint 3)
    - e) Pop-Up point U3 will be created from the offset entered previously in relationship to Target point M3.
    - f) Set INPUT/OUTPUT Selector to UT (Output)
    - g) Set Data Selector to AKT POS (Active Position)

Kobuleti Airport
Runway Heading: 250

Attack following Heading 250
Distance from Pop-Up Point: 10 km

**Waypoint B3
Target Point M3**

Pop-Up Point U3
Located 10 km North-East of M3 following a heading of 250 (from target's 2 o'clock)

**Pop-Up Point Heading To Target Waypoint
250**

**Pop-Up Point Distance To Target Waypoint
10 km**

429
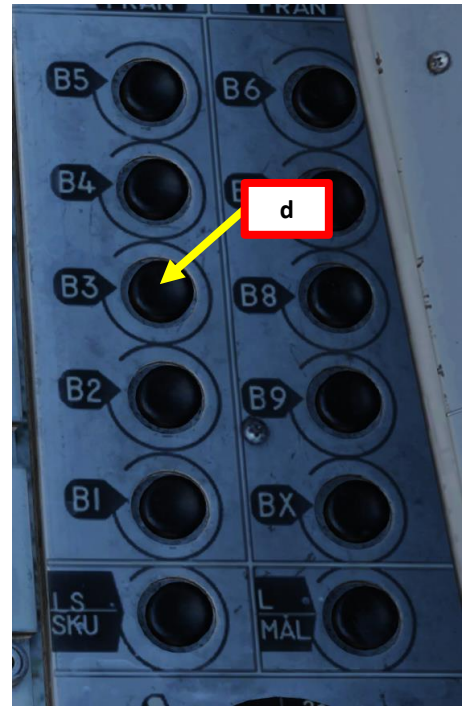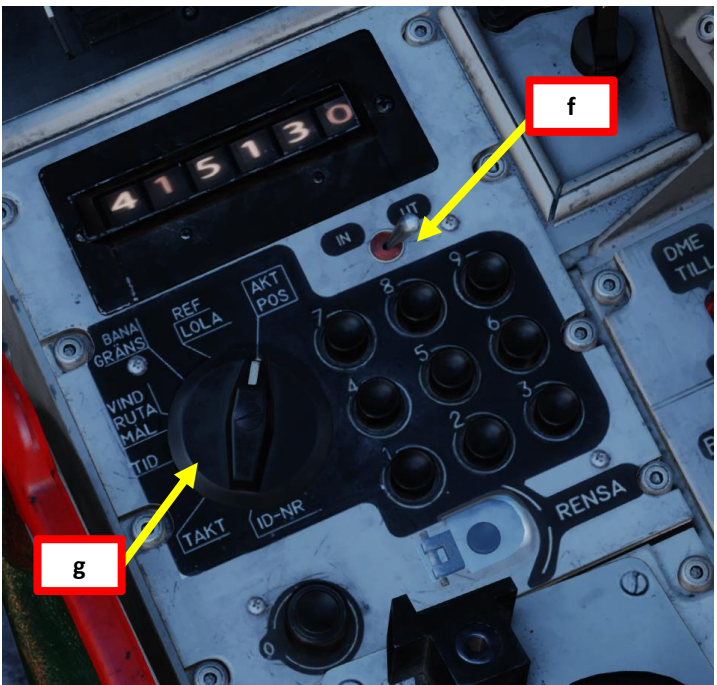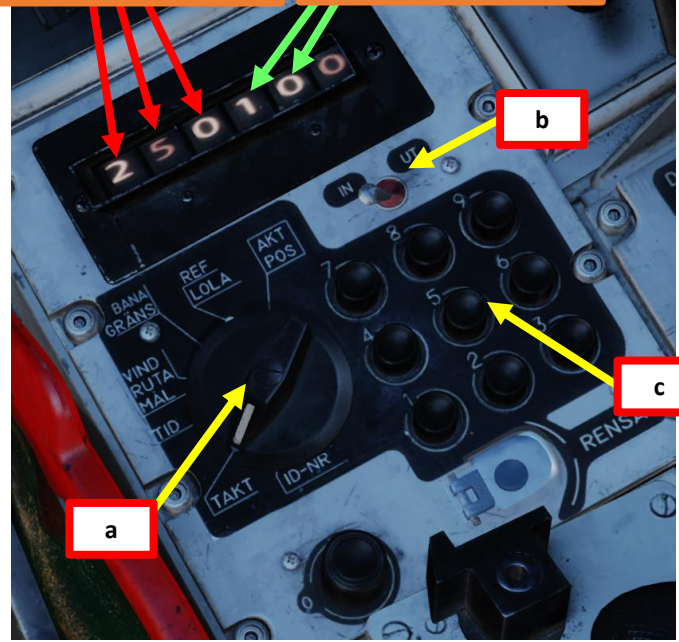
7 – TARGET POP-UP POINTS (U#)
7.2 – Navigate to Target Pop-Up Points

To navigate to a Target Pop-Up Point U3 (set from Target Point M3):

1. Set Master Mode to NAV
2. Press Waypoint Selector Button B3. We will assume M3 is already designated and U3 is also set up correctly.
   - Pressing B3 once will set Destination Indicator to U3, but pressing B3 a second time will switch to M3 directly.
3. Destination Indicator and Distance Indicator display what pop-up point is selected (U3) and how far you are from it (displayed km or in Swedish miles when you are more than 40 km away)
4. Steer aircraft to set the Flight Path Vector between the pole tracks to follow the waypoint. The velocity vector needs to "chase" the center of the pole tracks.
5. The **yellow Course Index** on the Central Indicator (CI) displays the bearing to the Target Point M3: **do NOT confuse this with the bearing to the Pop-Up Point U3**!
6. The vertical yellow bar on the ADI (Attitude Director Indicator) displays lateral deviation from the pop-up point U3.
7. If you set the Radar Mode switch to A1 (MIDDLE), the Central Indicator will display a circle on the Target Point M3: **do NOT confuse this circle with Pop-Up Point U3**, which is **not** shown on the display indicator!
8. When reaching the pop-up point, the destination will automatically switch to Target Point M3.

Flight Path Vector

4

3

Pole Tracks

Current Heading

Course Index
Bearing to Target Point M3

5

7

Target Point M3

Pop-Up Point U3
(Not Displayed)

2

6

1
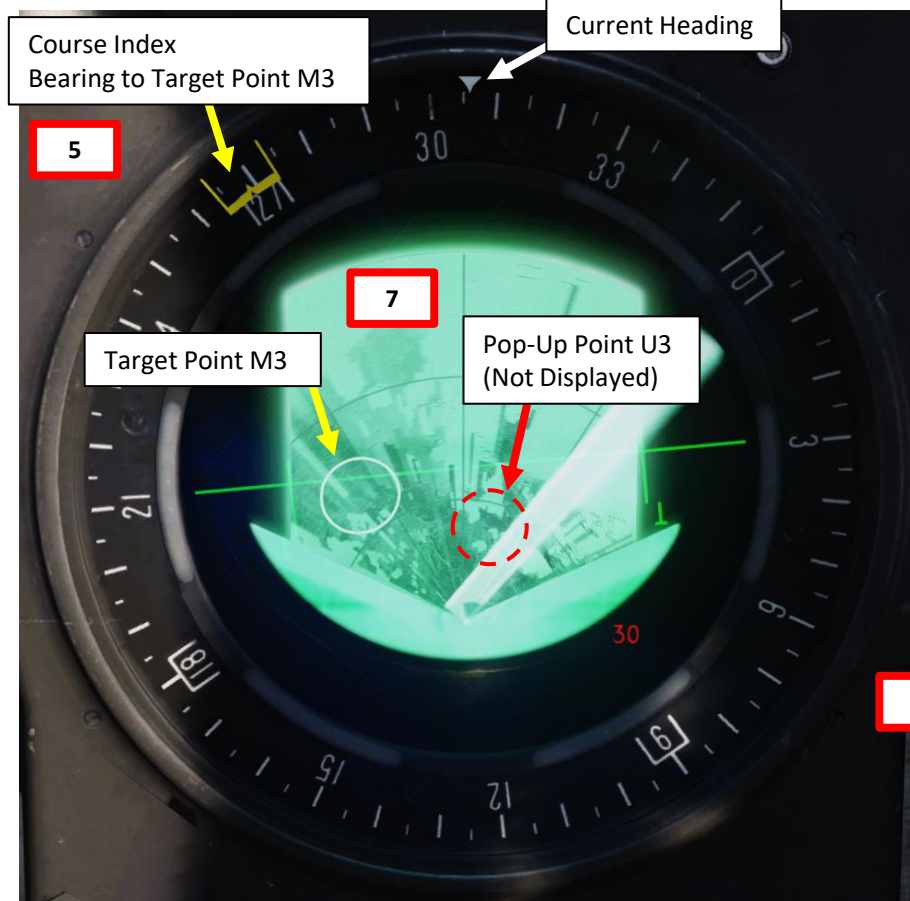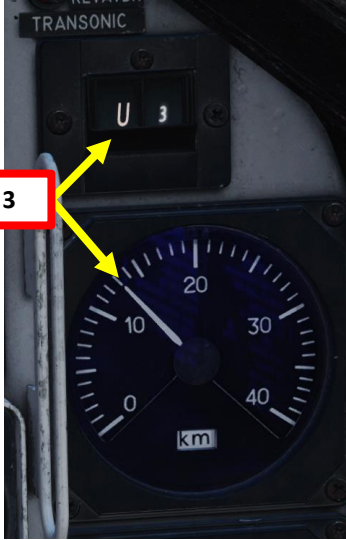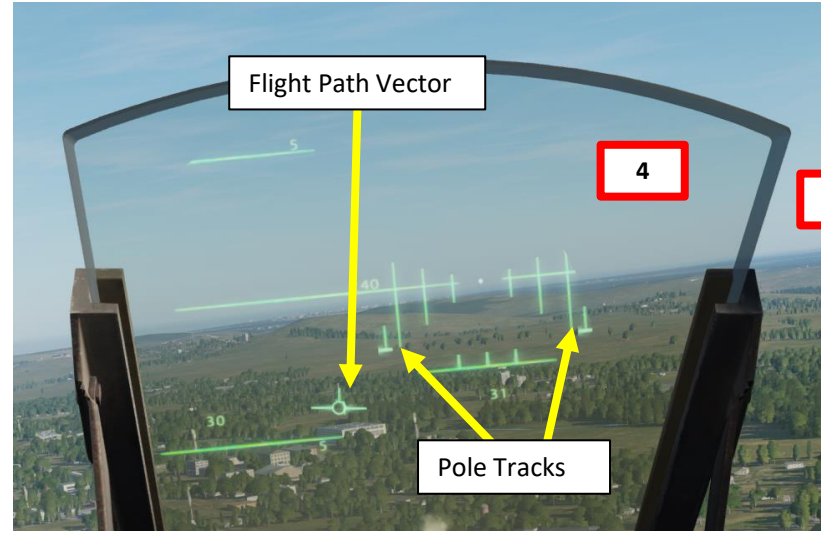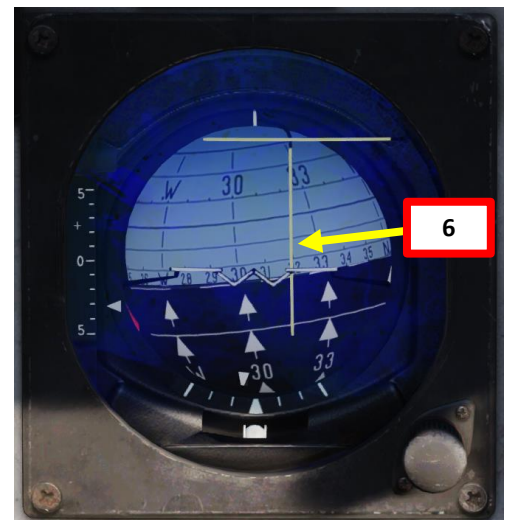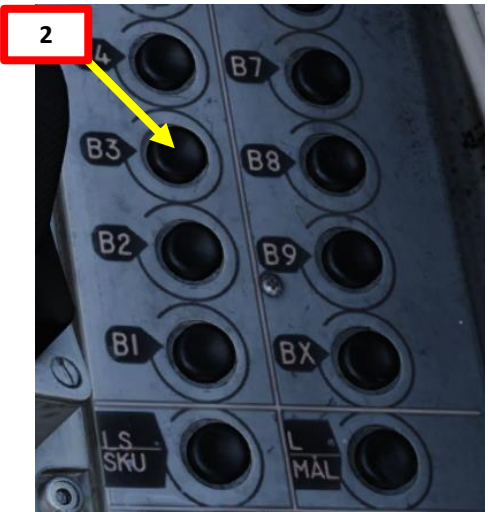
8 – MARKPOINTS (BX#)

Markpoints (Bx1-Bx9) are very similar to Waypoints (B1-B9), but they are used to mark points of interest. Their creation/editing process and navigation procedure are pretty much the same as a regular B# waypoint. However, there are two main differences between the two navigation point types:

1. To select a navigation waypoint B2, the Waypoint Selector "B2" is used. To select a markpoint Bx2, the Waypoint Selector "Bx" is pressed, then "2" is pressed on the keypad.
2. The functionality of Markpoints vary based on their number:
   • Markpoints Bx1 to Bx5 are used to mark points of interest and can be used for navigation.
   • Markpoints Bx6 to Bx9 are reserved for the RB-15F Anti-Ship Missile planning and cannot be used for aircraft navigation.

1a
Markpoint Bx Selector

1b
Pressing "2" on the keypad will select Markpoint Bx2

431
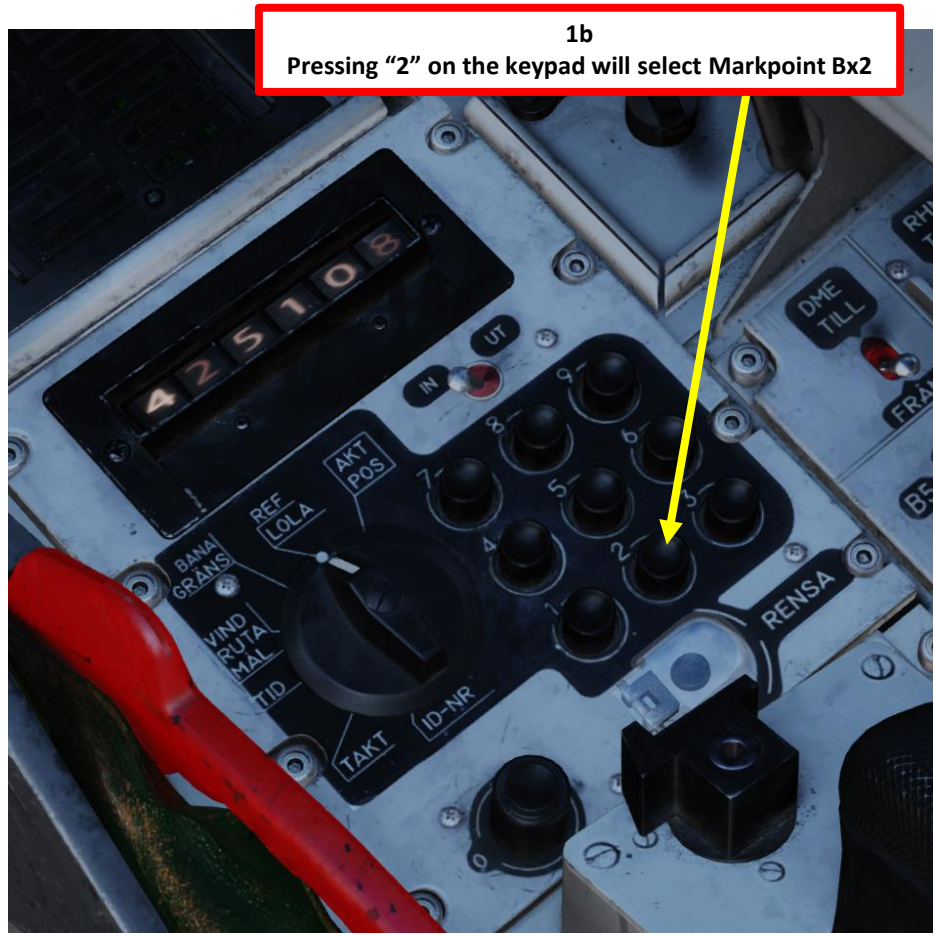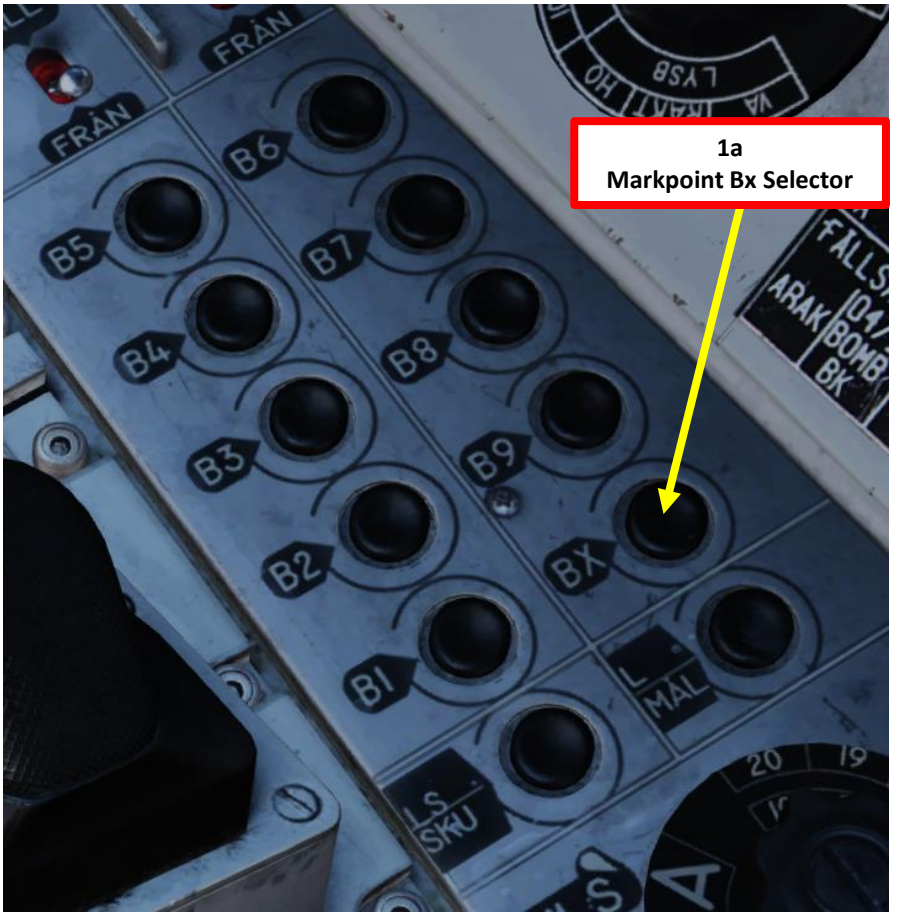
9 – STARTING AIRFIELDS & LANDING BASES (LS, L1, L2)

9.1 – Selecting Starting Airfield (LS)

In DCS, the Starting Airfield (LS) on spawn / mission start will always be entered automatically, but always should be verified.

1. If you set the Data Selector to **REF/LOLA – OUTPUT**, then press the LS/SKU button, a four-digit code will indicate which airbase is used as the starting airfield. These codes available in the kneeboard "Airbases" page (RSHIFT+K). As an example, code "9012" is used for Senaki-Kolkhi.
2. If you set the Data Selector to **BANA/GRÄNS – OUTPUT** (Runway Heading), then press the LS/SKU button:
   - The first four digits (2747) in our case represent the runway heading (274.4).
   - The last two digits (12) represent the TILS (Tactical Instrument Landing System) Channel for the runway TILS unit if available.
   - If you want to use the reciprocal heading of the runway, press LS/SKU a second time and the opposite runway will be used.
   - You can also input custom runway headings manually, as shown in PART 5 – TAXI & TAKEOFF.

9 – STARTING AIRFIELDS & LANDING BASES (LS, L1, L2)

9.2 – Selecting Primary Landing Base (L1)

A primary landing base (L1):
- can be designated with Longitude/Latitude coordinates entered manually, or
- can be designated with a 4-digit reference code available in your kneeboard "Airbases" page, which contains information about your airbase location, runway heading and TILS (Tactical Instrument Landing System) if available.

****

In this example, we will **select the Senaki-Kolkhi Airbase (Code 9012):**

1. Open your kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages) « Airbases » page.
2. In our case, we want to land at Senaki-Kolkhi, which is associated to **code 9012**. Instead of having to input coordinates manually with custom runway headings, all this data is already preset in this code.
3. Set the Data Selector knob to **REF/LOLA** (Reference number or longitude/latitude coordinate position of waypoints).
4. Set INPUT/OUTPUT data switch to INPUT.
5. Enter code **9012**. The 4 digit code corresponds to inputting 6+6 digits of longitude and latitude as well as connecting to other information regarding that locations, such as TILS channels or runway headings.
6. Press the L/MÅL (Landing Airport Selector) button to enter the Airbase coordinates data.
7. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

Airbases: [1]

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8Mhz AM C2: 257Mhz AM
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz AM C: 40Mhz AM C2: 258Mhz AM [2]
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707
A: 4.3Mhz AM B: 132Mhz AM C: 40.6Mhz AM C2: 261Mhz AM

6
L/MÅL Landing Base Selector

9 – STARTING AIRFIELDS & LANDING BASES (LS, L1, L2)

9.2 – Selecting Primary Landing Base (L1)

You can also **set the direction from which to approach the runway**.

8. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
9. Set INPUT/OUTPUT data switch to OUTPUT.
10. The default runway heading is set in a 4-digit form on the BANA/GRÄNS field data: "**2747**" represents a runway heading of **274.7.**
11. The last two digits (12) are the available TILS (Tactical Instrument Landing System) Unit Channel associated to the runway.
12. If you want to use the reciprocal (opposite) runway heading, press the L/MÅL (Landing Airport Selector) button. The BANA/GRÄNS field data will update the landing runway heading to 094.7. However, in this tutorial we will leave the runway heading to 274.7.
13. Once data transfer is complete, set the Data Selector knob to **AKT POS** (Active Position).

12
L/MÅL Landing Base Selector

8
BANA/GRÄNS

9

10

11

Touchdown Point

Senaki-Kolkhi

Heading: 274

13
AKT POS

9 – STARTING AIRFIELDS & LANDING BASES (LS, L1, L2)

9.2 – Selecting Primary Landing Base (L1)

To select L1 (Primary Landing Base):
1. Set Master Mode is set to NAV
2. Set Data Selector is set to AKT POS – OUTPUT
3. Press L/MÅL (Landing Airport Selector) button

Symbology will be visible on:
a) The CI (Central Indicator), but only if Radar Mode A1 is selected.
b) The HUD (Heads-Up Display), with the velocity vector and pole tracks
c) The ADI (Attitude Director Indicator)
d) The Distance Indicator

- Take note that using Master Mode LANDN NAV or LANDN PO will use intermediate waypoints such as LB1 and LF1. See PART 6 – LANDING.

3

2

d

2

a

1

Current Heading

Course Index

a

Landing Waypoint L1

Extended Runway Centerline

b Flight Path Vector

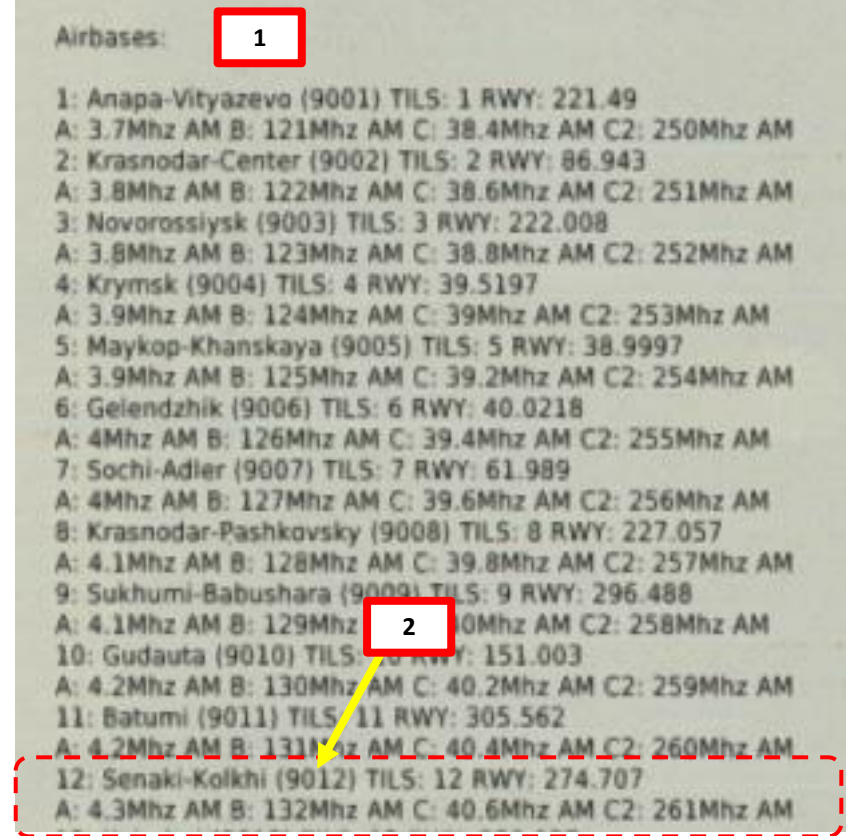Pole Tracks

c
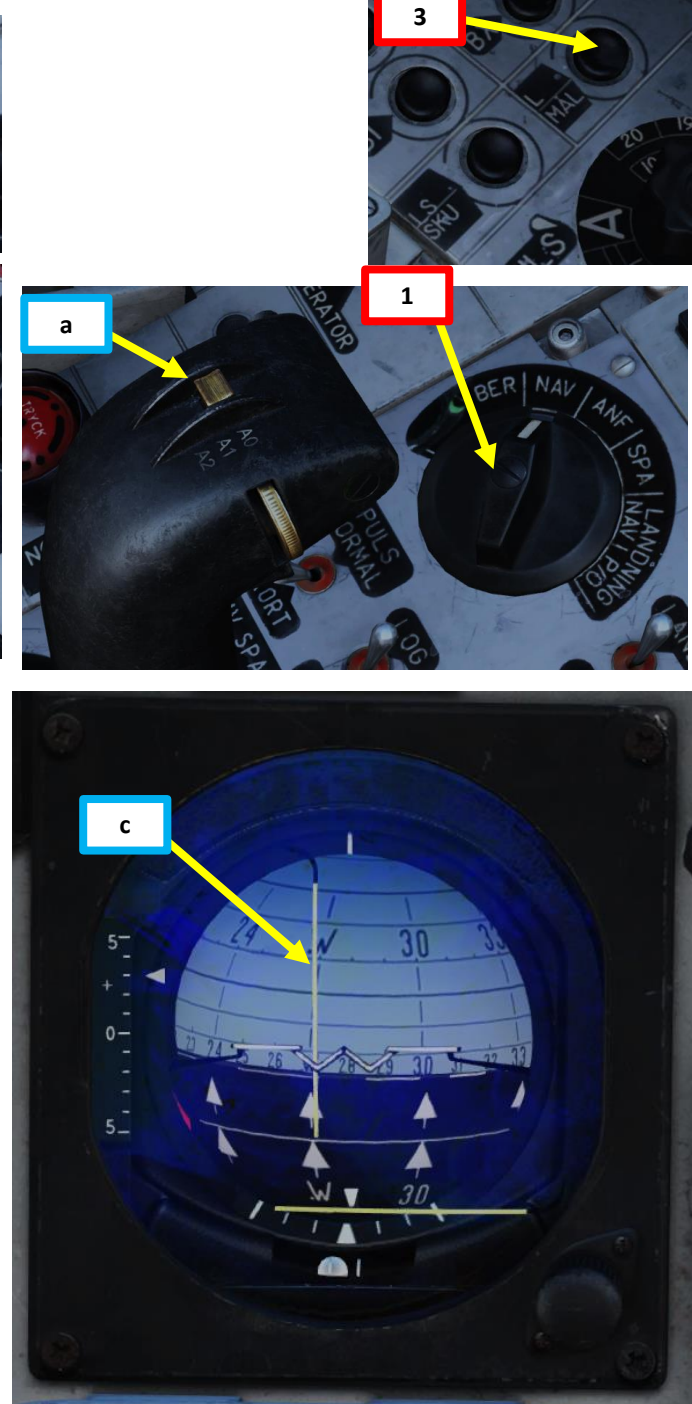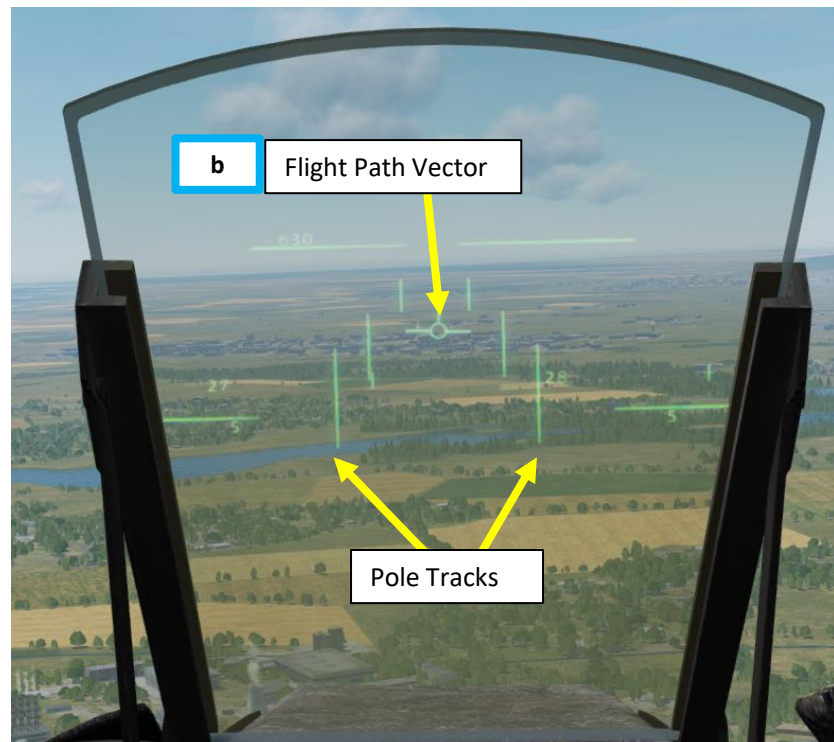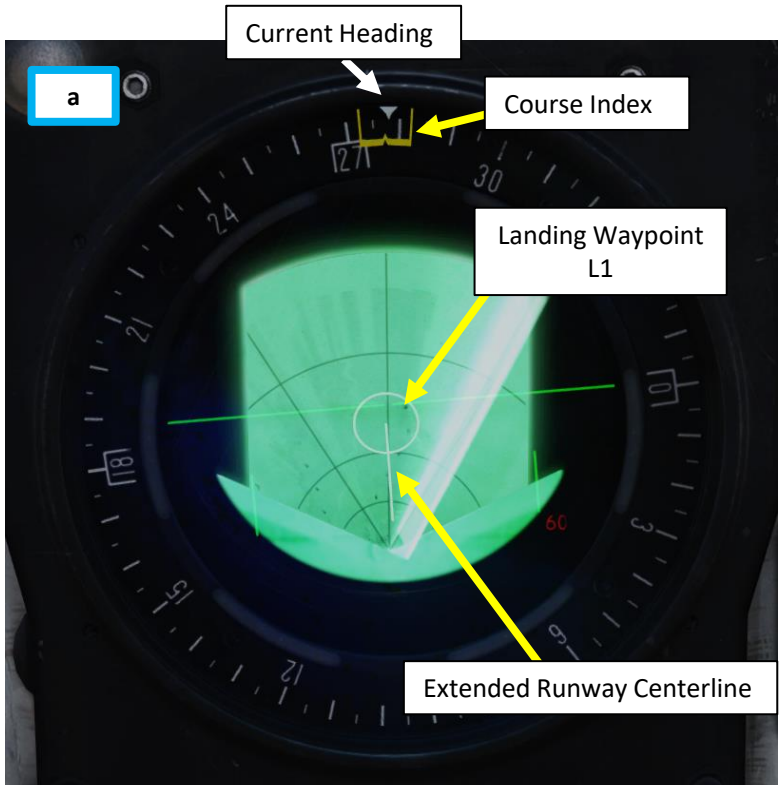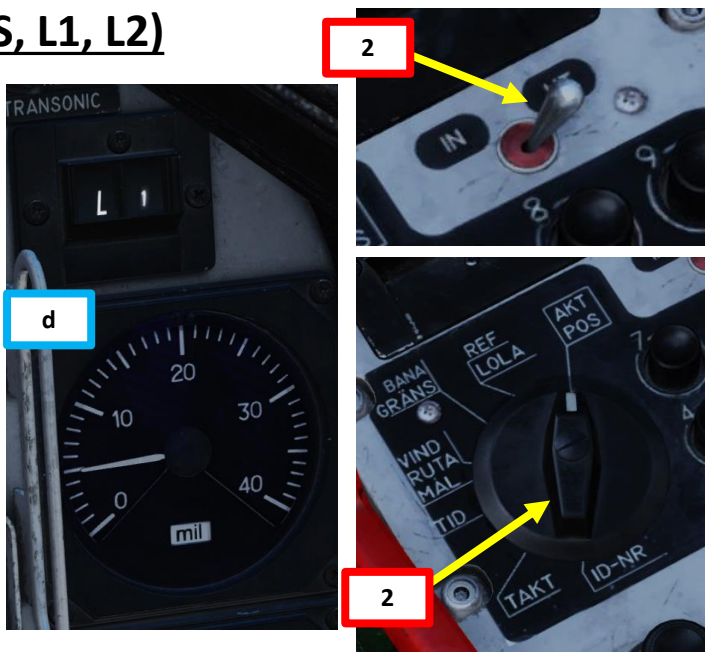
9 – STARTING AIRFIELDS & LANDING BASES (LS, L1, L2)

9.3 – Selecting Secondary Landing Base (L2)

The Secondary Landing Base is used as a backup in case you need to divert to another base. Take note that the **alternate landing base L2 can only be entered as a reference number (99XX),** cannot be entered as longitude and latitude coordinates. Therefore, you cannot use a road base as a secondary landing base.

To select a Secondary Landing Base:

1. Set Master Mode is set to NAV
2. Set Data Selector is set to AKT POS – OUTPUT
3. Press L/MÅL (Landing Airport Selector) button twice.
4. The Destination Indicator will switch from L1 (Primary Landing Base) to L2 (Secondary Landing Base).
5. The symbology will be the same as the one explained in the previous section for the Primary Landing Base L1.

Note about reference code input: Alternate landing bases are entered as 99XX instead of 90XX. Only reference numbers can be used to set the alternate landing site. Example: If entering 9011 on the Caucasus map, Batumi airfield will be set as the primary landing base (L1). If entering 9911 instead, it will be entered as the secondary landing base (L2)

Airbases:

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: ... M
9: Sukhumi-Babushara ...
A: 4.1Mhz AM B: 12...Mhz AM C: 40Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM

L1 Airbase Reference Number 9011 (use 9911 for L2 Secondary Airbase)

Inputting Batumi reference code as a secondary landing base

10 – Altitude Reference

An important feature of the Heads-Up Display is the "Reference Altitude", also known as the "Commanded Altitude".

To set the Altitude Reference / Commanded Altitude:

1. Set Master Mode to NAV.
2. Set HUD mode to "Low Altitude" by setting the SLAV SI switch to FRAN (OFF).
3. Set Altitude Source Selector (HÖJD CISI) as desired
   - **RHM** will ensure the radar altimeter is used as the primary altitude source, and the reference altitude will be compared to the radar altimeter reading, which is affected by uneven terrain elevation even if you are flying level.
   - **LD** will ensure the barometric pressure is used as the primary altitude source, and the reference altitude will be compared to the barometric altimeter reading, which is not affected by terrain elevation.
4. Press the "Reference Button" on the stick to set the "Reference Altitude" to your current altitude.
5. The pole tracks location indicate whether the aircraft is above or below the set reference altitude.

1

4 **Reference Button**

Artificial Horizon

Pole Tracks

Pole Tracks

Digital Altitude
- In meters if under 1 km
- In km if over 1000 m

Reference Altitude set to 200 meters above ground level (AGL), which matches the current altitude

SLAV SI   HÖJD CI SI
F   T   RHM   LD
MOD RES EL

2

3

SLAV SI   HÖJD CI SI
F   T   RHM   LD
MOD RES EL

3
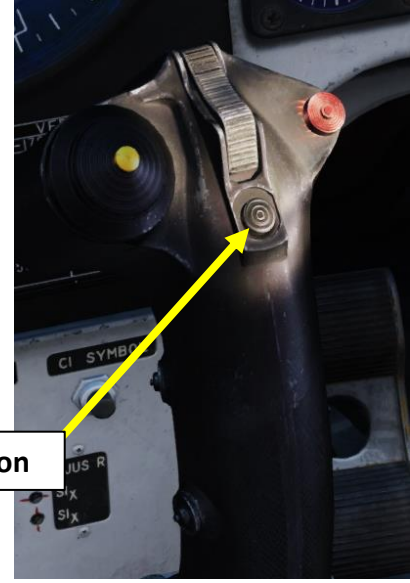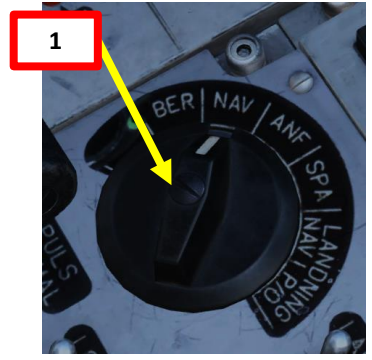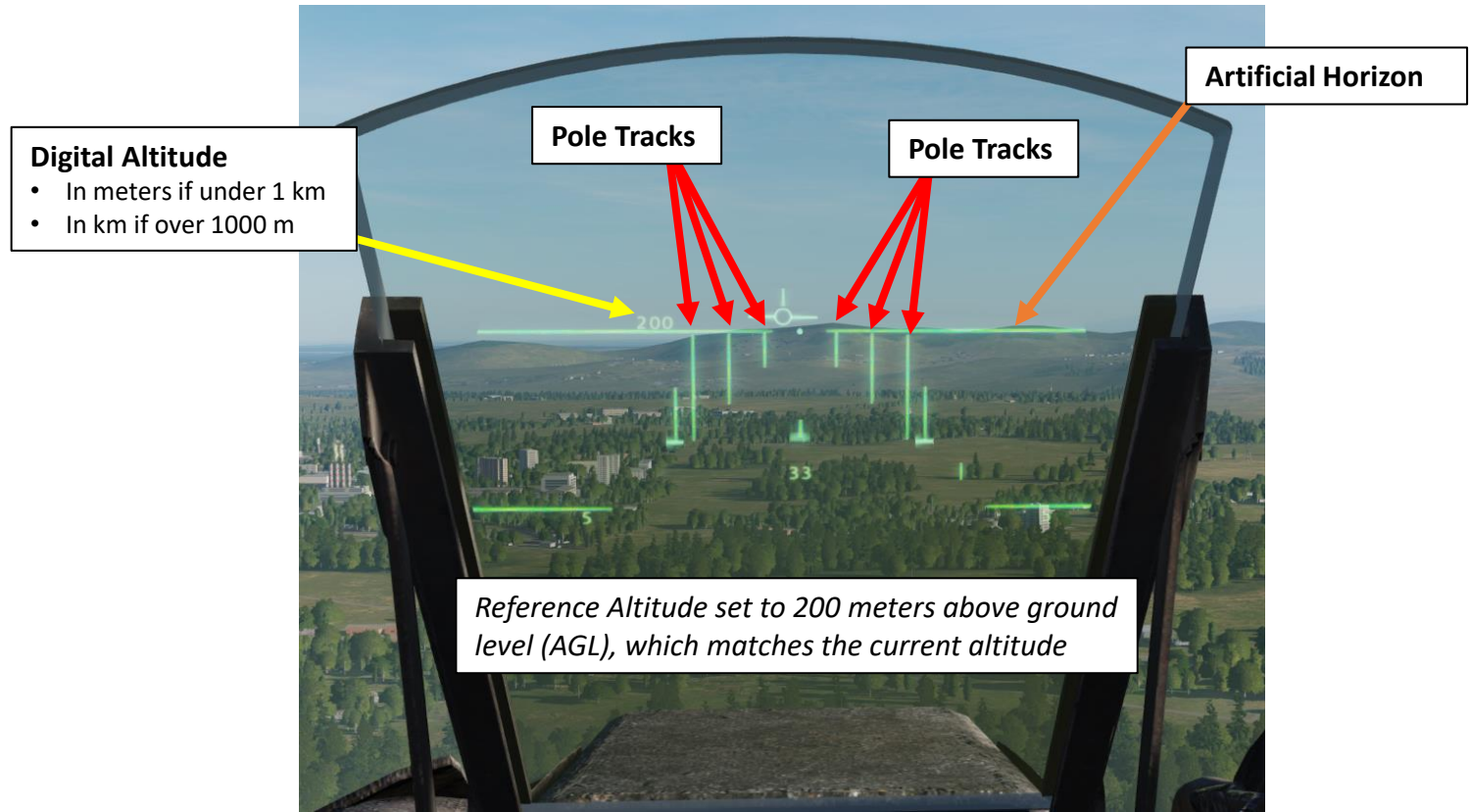
10 – Altitude Reference

When at the **correct altitude the top of the poles are aligned with the artificial horizon**. The pole track consists of three pairs of lines, with 1°, 2°, and 3° in length.

The **length of the altitude reference bar always corresponds to 100 m altitude** and can be used as a frame of reference for the set commanded or reference altitude. The relative length of the reference bar compared to the 3° bar is used to roughly indicate the set reference altitude.

Note: The **reference bar disappears when the set above 500 meters** (as the relative length will be difficult to discern above that altitude).

Altitude Reference Bar = 100 m
Reference Altitude set for 200 m

3 deg bar
Used to indicate set reference altitude, which is 200 m in our case

Aircraft Altitude
- 70 meters AGL
- Below Reference Altitude

Pole Tracks

Aircraft Altitude
- 200 meters AGL
- Matches Reference Altitude

Artificial Horizon

Pole Tracks

Aircraft Altitude
- 250 meters AGL
- Above Reference Altitude

Pole Tracks

Reference Altitude is 200 meters AGL (Above Ground Level) for each of these pictures

11 – Time-On-Target (TOT) & Ingress Speed

Any of the waypoints may be designated a target waypoint. The target waypoints can have designated time on target wherein the desired time where the aircraft is supposed to be on the target can be set. The CK37 flight computer will continually calculate time to the next waypoint and time on target (TOT).

There are two specific parameters that affect the time calculations:
- The **required airspeeds (Mach) for Ingress Points** selected in your flight plan
- The **desired Time On Target (TOT)**

INGRESS SPEED

Ingress points are used to increase the Mach speed in the calculation for a particular phase of the flight that deviates from the optimal economic airspeed at low altitude. Ingress waypoints are used to set a higher airspeed in the assumed combat area that requires a higher airspeed, and can be used for the purposes of ingress and egress, however will be referred to as ingress speeds or waypoints.

As an **example**, we want to set desired ingress speed at waypoint B2 of Mach **1**.**10**.

1. Set Data Selector to TID (Time)
2. Set INPUT/OUTPUT Selector to INPUT
3. Type « **1**10 » on the keypad, then press the B2 (Waypoint 2) button to set the ingress speed at this specific waypoint.
4. Set Data Selector back to AKT POS – OUTPUT

Ingress Speed Mach **1**.**10**

INPUT/OUTPUT Selector
- IN: Input

TID Selected

B2 Waypoint Selector

439
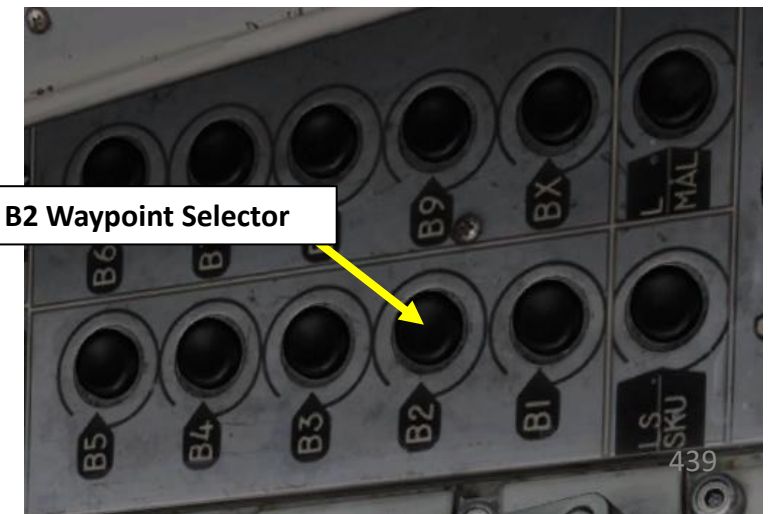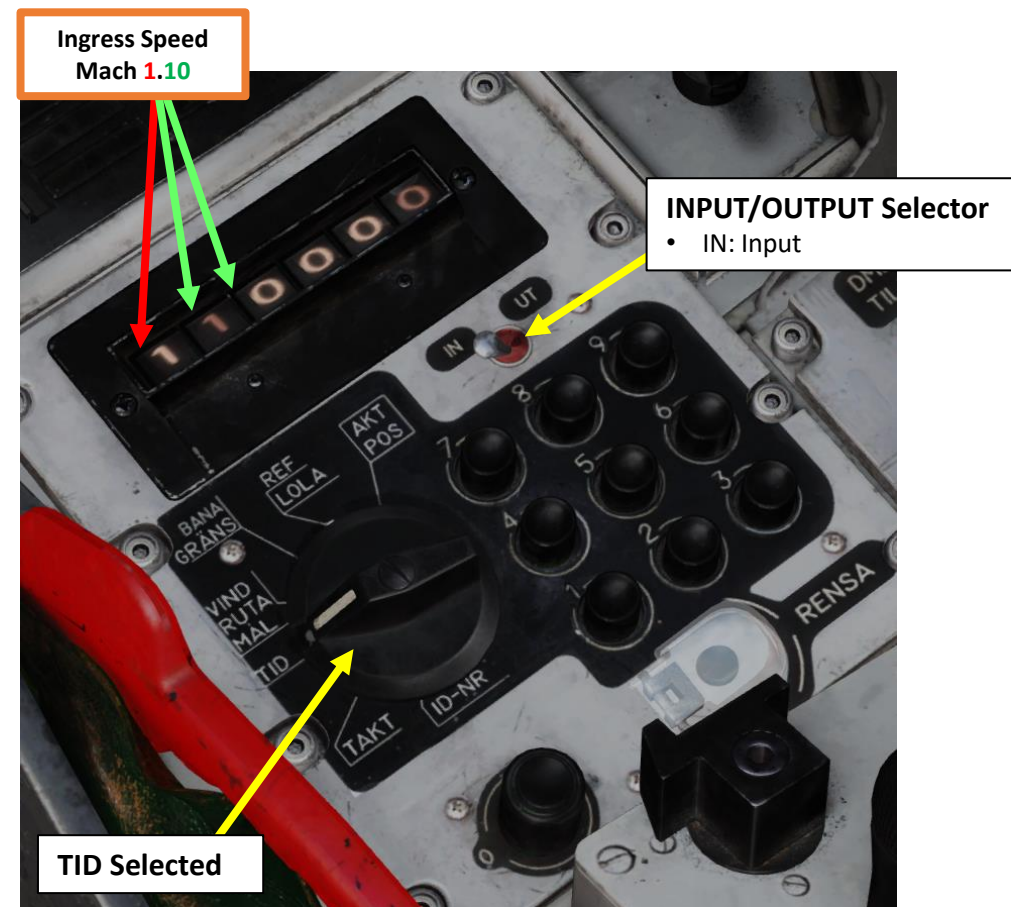
11 – Time-On-Target (TOT) & Ingress Speed

The Mach speed is used for the calculations from the set ingress waypoint to the next set ingress waypoint.
- The last ingress waypoint speed will be applied until the primary landing base.
- If a target waypoint is after the ingress waypoint, the ingress Mach speed will only be applied until the target and economic airspeed after this.

A: Last waypoint with a set speed is a target waypoint
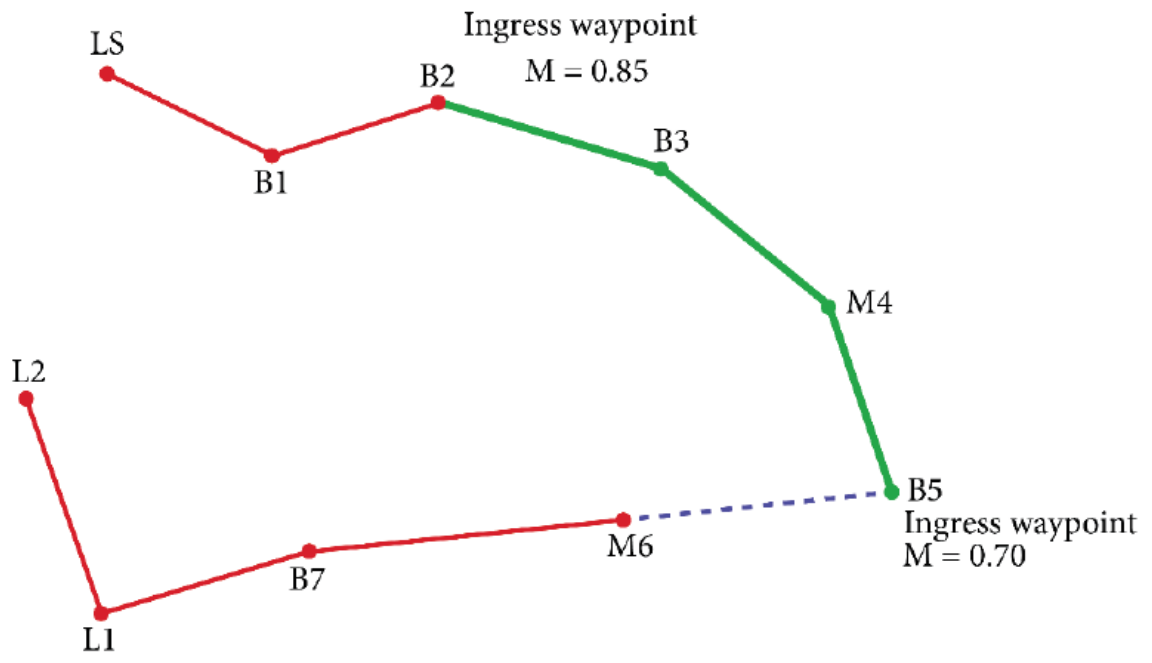
B: Last waypoint with a set speed is an ingress waypoint
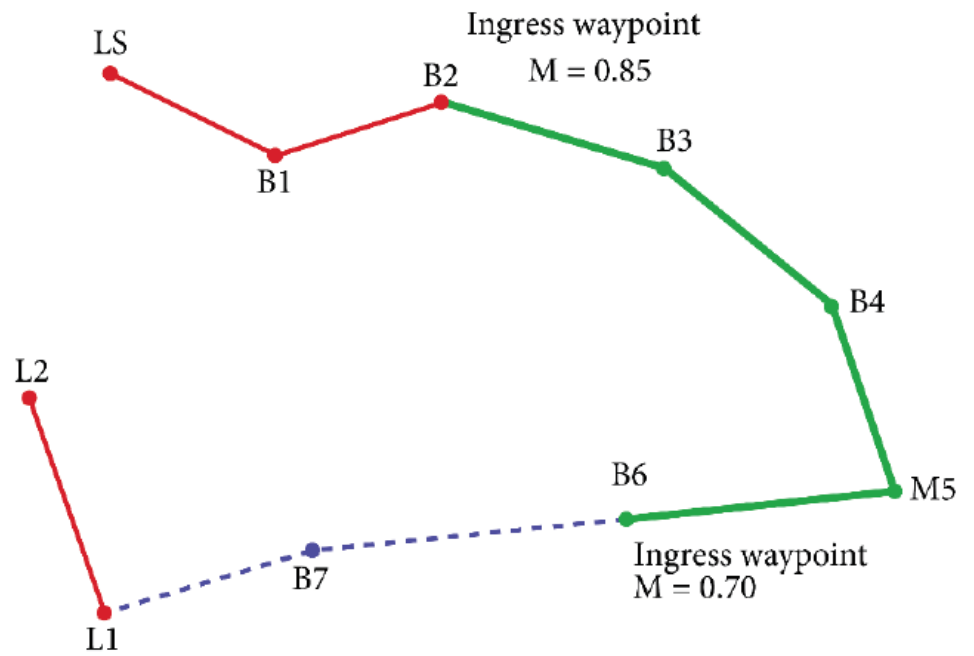
Legs with an economic airspeed (Mach 0.55)

Legs with a set ingress speed (Mach 0.85)

Legs with a set ingress speed of 0.70)

11 – Time-On-Target (TOT) & Ingress Speed

How to set a TOT (Time-On-Target)

To input a required Time-On-Target (TOT):
1. Set Data Selector to TID (Time)
2. Set INPUT/OUTPUT Selector to INPUT
3. If you want to set a TOT of 8:09:28 AM (Hours:Minutes:Seconds) at Target Point M3, type « **080928** » on the keypad, then press the B3 (Target Point M3) button to set the TOT at this specific target point.
4. Set Data Selector back to AKT POS – OUTPUT

How to consult the TOT (Time-On-Target)

To output the set Time-On-Target (TOT) for a specific Target Point:
1. Set Data Selector to TID (Time)
2. Set INPUT/OUTPUT Selector to OUTPUT
3. Press the desired Target Point selector button (B3 for Target Point M3)

Time-On-Target
Hours : Minutes : Seconds
8:09:28 (080928)

INPUT/OUTPUT Selector
• IN: Input

TID Selected

B3 Waypoint Selector
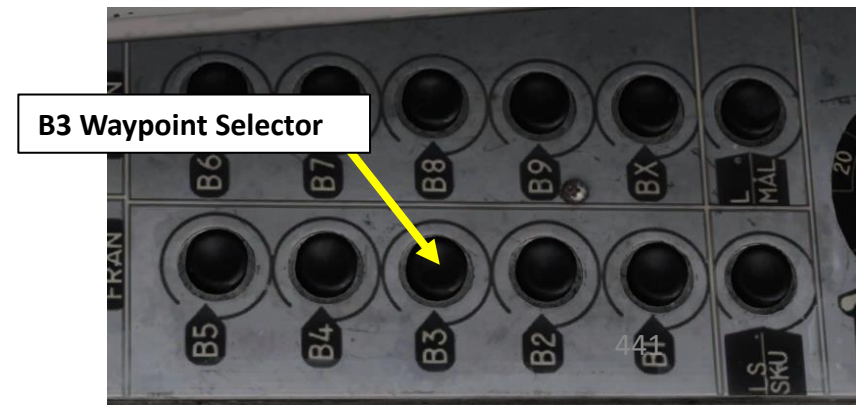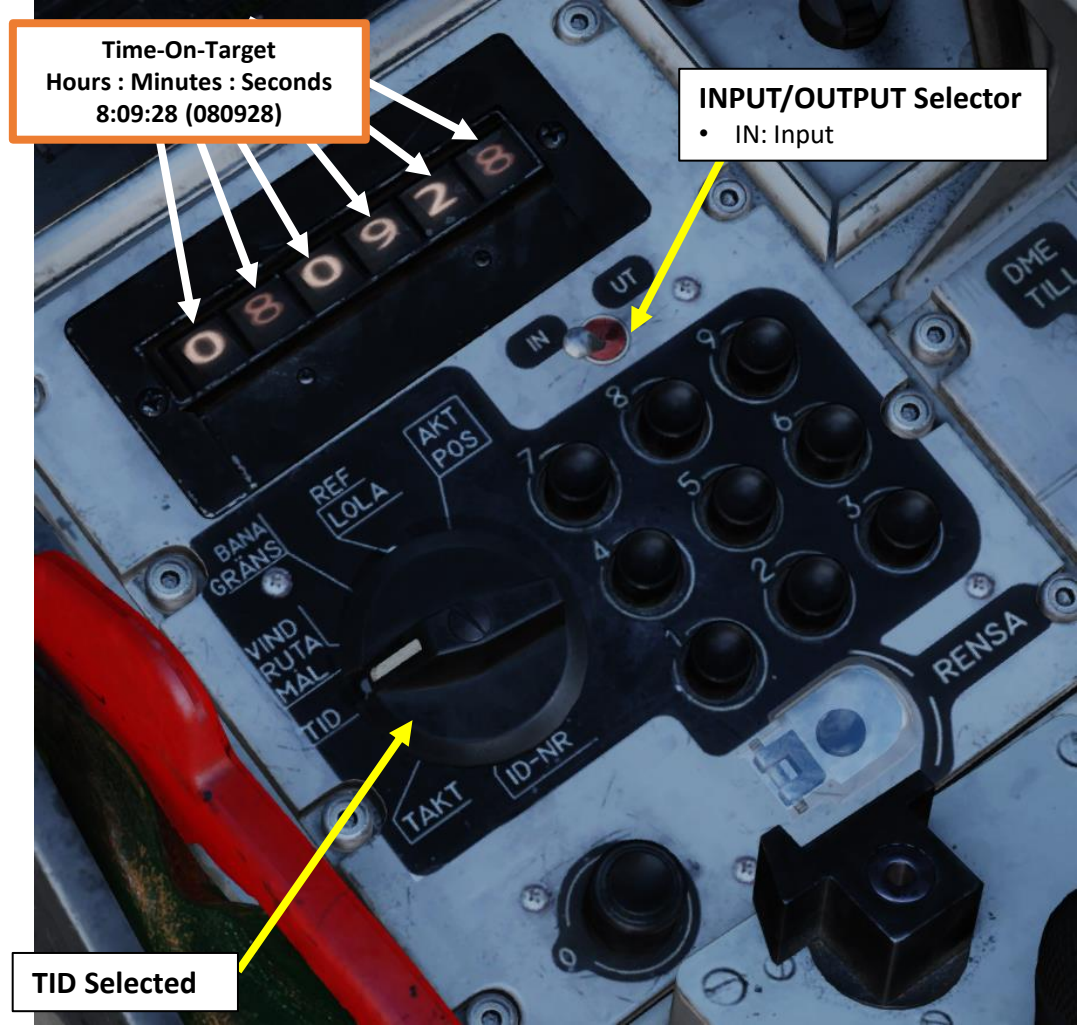
11 – Time-On-Target (TOT) & Ingress Speed

Are you early or are you late?

Flight time to target waypoint

Flight time to target waypoint is the time calculated to fly from the current position to the current destination waypoint with present airspeed and then further along the "navigation polygon" to the next ingress speed waypoint with present airspeed. After the ingress speed waypoint, the ingress airspeeds are used for the flight time calculation for the flight plan (including other target waypoints) until a target waypoint with a set time on target.
- If no time on target is set, the calculation is used until the first target waypoint in the sequence.
- If one of the BX points is selected as the destination, the calculation is for the previous waypoint in the polygon.
- Flying time to target serves as a reference to time error on target calculations, and is only presented if no time on targets are set.
- If a time on target has been set, a timetable deviation is presented instead.

Time Error on Target

Time error on target is the deviation between the calculated time on target and the planned time on target. This is calculated for the closest target waypoint with a set time on target. If no time on target has been set, deviation in not calculated.

Timetable Deviation

The difference between the time it takes to fly the entire route from the current position to the current destination waypoint and then along the navigation polygon as planned, to the target with the planned airspeed and the time that remains to the time on target is called the timetable deviation.

DATE	MISSION ID	CALLSIGN	TASK
2016-06-21	tempMission	Enfield 1-1	Strike
FUEL WEIGHT	**LOADOUT**	**TOTAL WEIGHT**	**V2**
4477	0	16277	373
ENGINE START TIME	**TAKE-OFF TIME**	**RUNWAY HEADING**	**QNH**
07:55:00	08:00:00	20541	1013.3

WAYPOINT NAME			
Take-Off Senaki-Kolkhi			
COURSE (T)	**HEADING (M)**	**G/S**	**IAS**
20541	28	500	499
DISTANCE	**TOF**	**ETA**	**QFE**
0.0	00:00:00	08:00:00	1011.7
ALTITUDE	**VERTICAL ANGLE**	**FUEL RESERVE**	**BINGO FUEL**
13	0	100	13

WAYPOINT NAME			
B1			
COURSE (T)	**HEADING (M)**	**G/S**	**IAS**
312	320	500	444
DISTANCE	**TOF**	**ETA**	**QFE**
21.0	00:02:31	16:02:31	1004.0
ALTITUDE	**VERTICAL ANGLE**	**FUEL RESERVE**	**BINGO FUEL**
2000	5	98	15

WAYPOINT NAME			
B2			
COURSE (T)	**HEADING (M)**	**G/S**	**IAS**
335	342	500	394
DISTANCE	**TOF**	**ETA**	**QFE**
22.8	00:02:44	24:07:46	1000.8
ALTITUDE	**VERTICAL ANGLE**	**FUEL RESERVE**	**BINGO FUEL**
2000	0	97	17

WAYPOINT NAME			
M3			
COURSE (T)	**HEADING (M)**	**G/S**	**IAS**
298	305	500	394
DISTANCE	**TOF**	**ETA**	**QFE**
35.2	00:04:13	08:09:28	1012.6
ALTITUDE	**VERTICAL ANGLE**	**FUEL RESERVE**	**BINGO FUEL**
2000	0	94	20

WAYPOINT NAME			
B4			
COURSE (T)	**HEADING (M)**	**G/S**	**IAS**
159	166	500	394
DISTANCE	**TOF**	**ETA**	**QFE**
68.2	00:08:11	16:27:04	1013.3
ALTITUDE	**VERTICAL ANGLE**	**FUEL RESERVE**	**BINGO FUEL**
2000	0	89	16

11 – Time-On-Target (TOT) & Ingress Speed

Are you early or are you late?

Time Error & Airspeed Deviation Indication

Current time and timekeeping information is displayed in:
- The data panel (just set Data Selector to TID and INPUT/OUTPUT Selector to OUTPUT)
- The HUD (Heads-Up Display) with the Airspeed Deviation Fin.

**Time Error
1 minute 11 seconds late to Target**
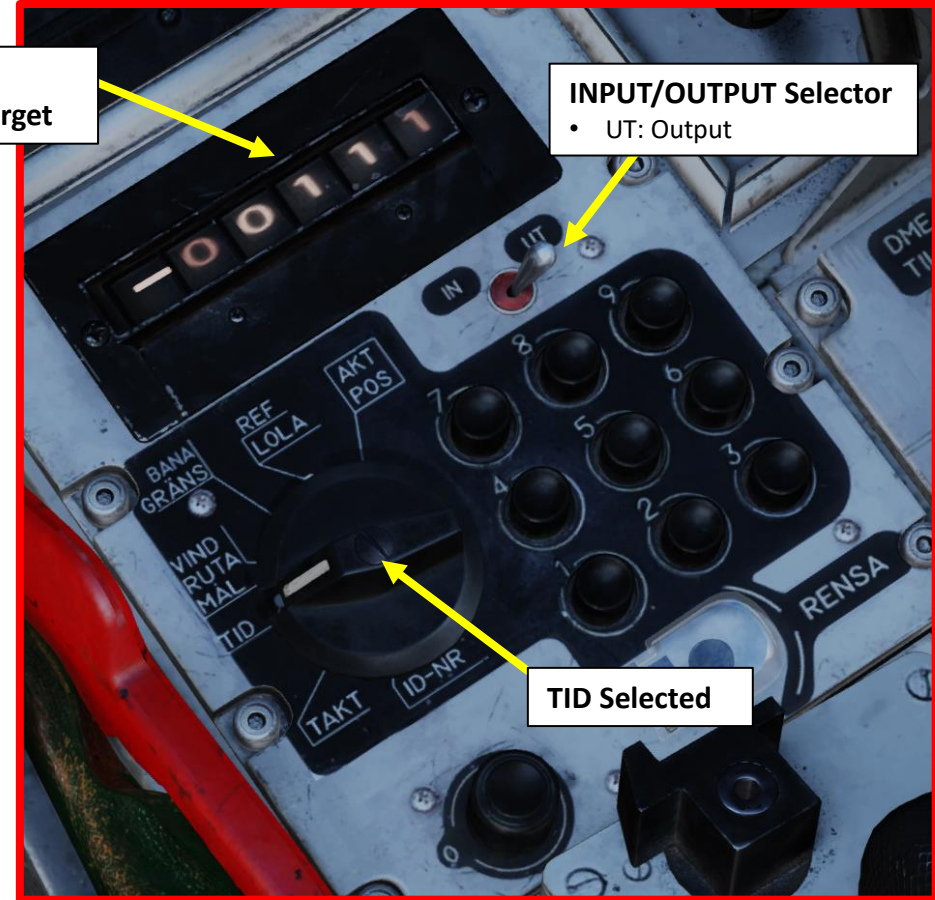
INPUT/OUTPUT Selector
- UT: Output

TID Selected

Airspeed Deviation Fin
A "high" fin indicates a positive time error = too early arrival, reduce airspeed.
A "low" fin indicates a negative time error = too late arrival, increase airspeed.

**Airspeed Deviation Fin
Airspeed Too High**

**Airspeed Deviation Fin
Airspeed Too Low**

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

	h	min	s
Late	- 0	0 1	2 1
Early	0	0 2	3 5

443
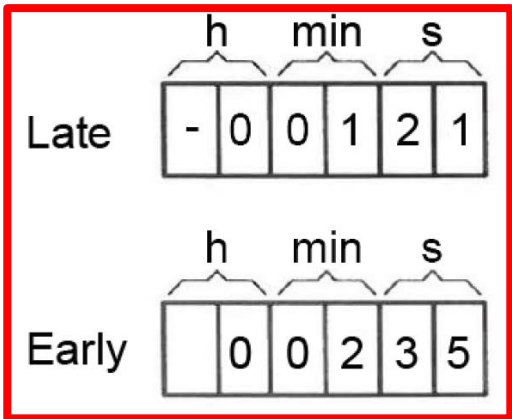
11 – Time-On-Target (TOT) & Ingress Speed

What if no time on target is set? (Time to waypoint mode)

In case at time on target is not set the data panel will display to current flying time to current waypoint based on current airspeed. This is displayed by the number **7** displayed in the first digit.

To display Time To Waypoint, set Data Selector to TID and INPUT/OUTPUT Selector to OUTPUT.

Time To Selected Waypoint
0 hour 3 minutes 39 seconds

INPUT/OUTPUT Selector
• UT: Output
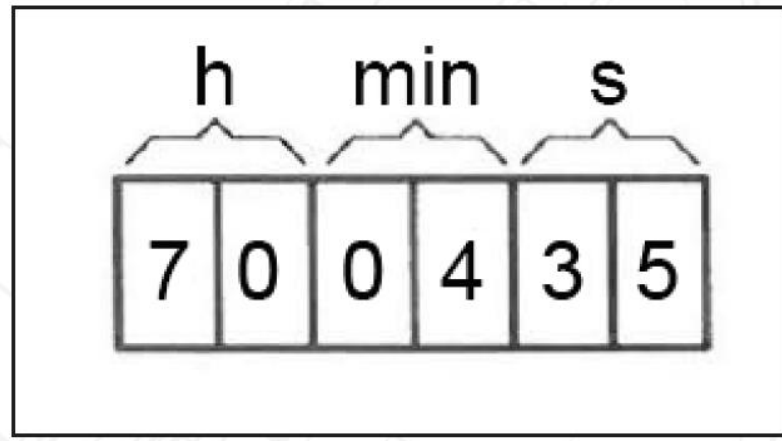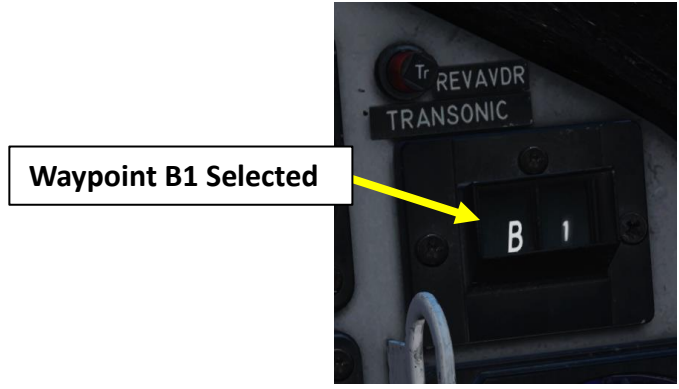
"7" Digit, indicates Time to Waypoint Mode

Waypoint B1 Selected

TID Selected
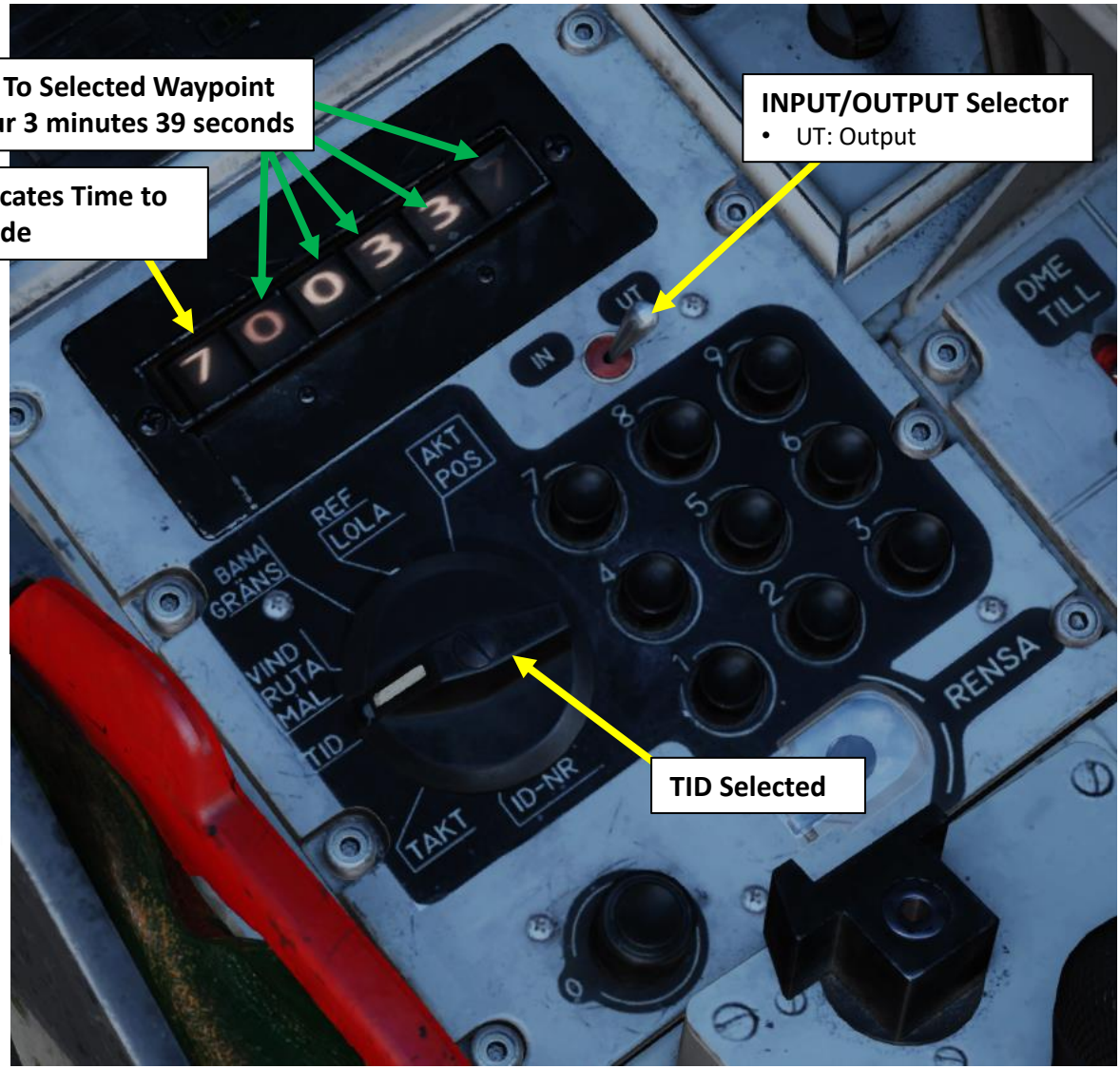
11 – Time-On-Target (TOT) & Ingress Speed

Other Timekeeping Functions

Take-off time

If the aircraft is on the ground and a Time on Target is set, a planned take-off time is indicated. An empty first digit indicate time to throttle-up on take-off and a minus sign indicates the time after take-off should have occurred. Display is very similar to that of the normal readout with a time on target set.

Current time

Current time is displayed if the navigation button LS is pressed and held.

RB 15 timekeeping (missile on target)

The RB 15F missile can be planned to impact the target on a certain time similar to the Time of Target planning. Here, the relevant Time on Target becomes the release point. Input the desired impact time (may differ due to seeker function) on button BX.

8 minutes 19 seconds before takeoff time

INPUT/OUTPUT Selector
• UT: Output
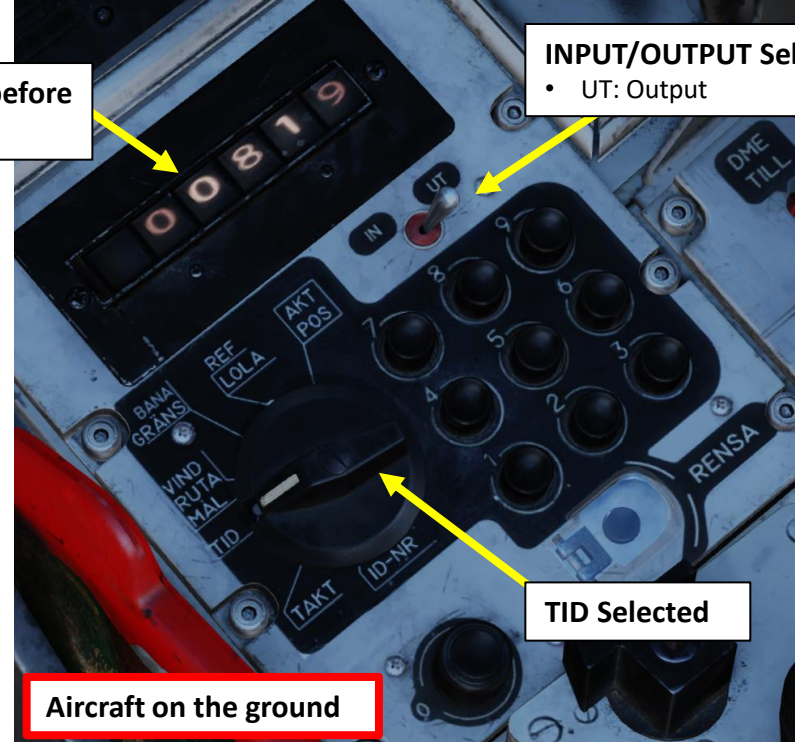
TID Selected

Aircraft on the ground

12 – TERNAV

The TERNAV (Terrain Navigation) system uses the radar altimeter to detect the terrain contours below the aircraft, similar to TERCOM systems used for cruise missiles. These readings are then compared to a digital map sheet stored in the data cartridge. It serves as a parallel complement to the normal navigation system.

The computer will continually observe the aircraft's movement along the terrain and will perform minor automatic fixes. The system also aids in providing an estimate of the current navigation error. Due to the function of the system, varying terrain features or isolated elevations aid in the system's understanding of the aircraft's position.

The system is largely automatic without pilot input and enables automatically on start-up.

To consult TERNAV Status:

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS (Active Position)
3. Set INPUT/OUTPUT Selector to OUTPUT
4. TERNAV information is available on the Data Display

- Digits 1-4: indicate Longitude and Latitude (in degrees and minutes). The data field flashes, alternating between longitude and latitude coordinates.

- Digit 5: indicates TERNAV status
    - 0: TERNAV inoperable
    - 1: TERNAV OK, but not sending any output (standby mode).
    - 2: TERNAV OK, mode rough search (attempting to orient itself).
    - 3: TERNAV OK, mode fine search (higher resolution, still attempting to orient itself)
    - 4: TERNAV OK and following, but not used.
    - 5: TERNAV OK and operating, system sending automatic fixes to CK37 Flight Computer.

- Digit 6: indicates the position error in km

Note: It is possible to turn on or off manually TERNAV (however, it is turned on by default when the aircraft is first powered up). To perform so, set Data Selector to TAKT – INPUT, and then:
- Enter "58**0**" on the keypad, then press LS/SKU button to turn ON TERNAV.
- Enter "58**1**" on the keypad, then press LS/SKU button to turn OFF TERNAV.
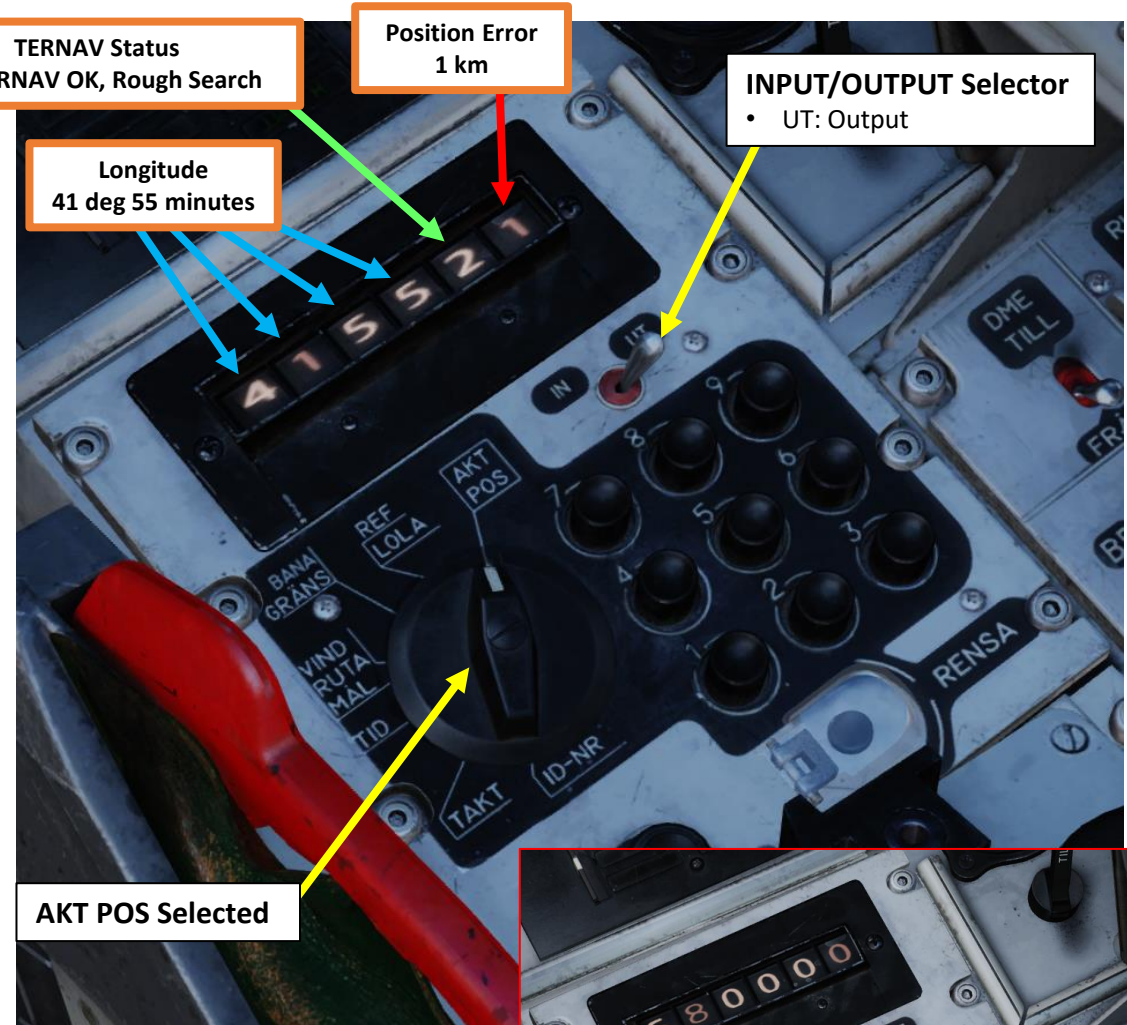
TERNAV Status
2 – TERNAV OK, Rough Search

Position Error
1 km

INPUT/OUTPUT Selector
- UT: Output

Longitude
41 deg 55 minutes

AKT POS Selected

LS/SKU Selector

446

13 – FIXES
13.1 – Introduction

What is a "fix"? You may have heard this term of number of times, especially when it comes to navigation. Simply put, a position fix is a **position derived from measuring in relation to external reference points** (like a landmark, or something easily recognizable).

Navigation systems are not perfect. Minor errors are inherent to the aircraft position and attitude measurements in all the contributing sources and sensors. A **position error** will always exist and eventually increase during the flight. Why should we care about it, then? Well, the aircraft's assumed position will differ from the "real" position of the aircraft, accumulating "drift" in the process. Since the Viggen relies heavily on preset waypoints for navigation and weapon employment, having an increasing error can cause some serious problems if left unchecked.
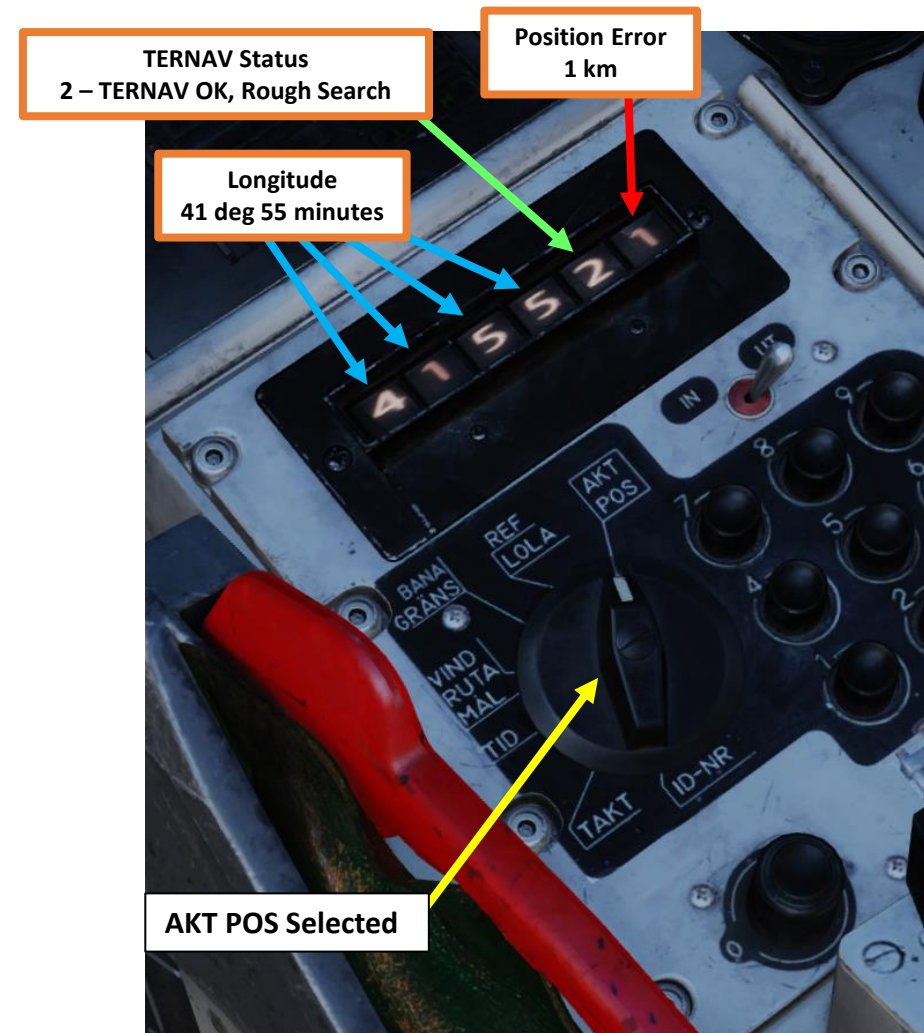
This is where fixes come in: you can update the aircraft position to eliminate (or at least reduce) the position error. While there are systems that automatically and continuously make small error corrections, the most effective way to have a reliable "correction" is to use a "manual fix". Before we dive in the "how", let's clarify a few things first.
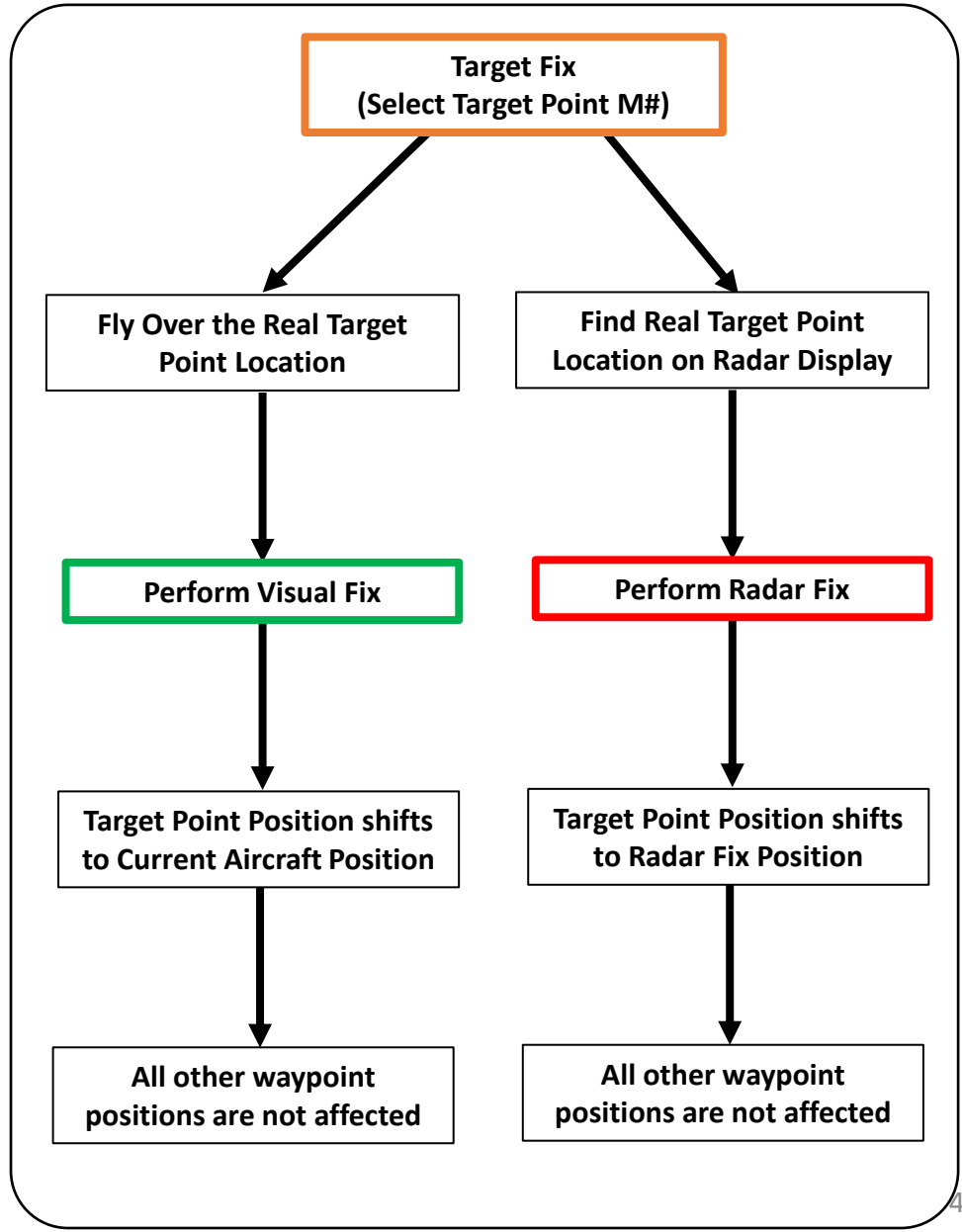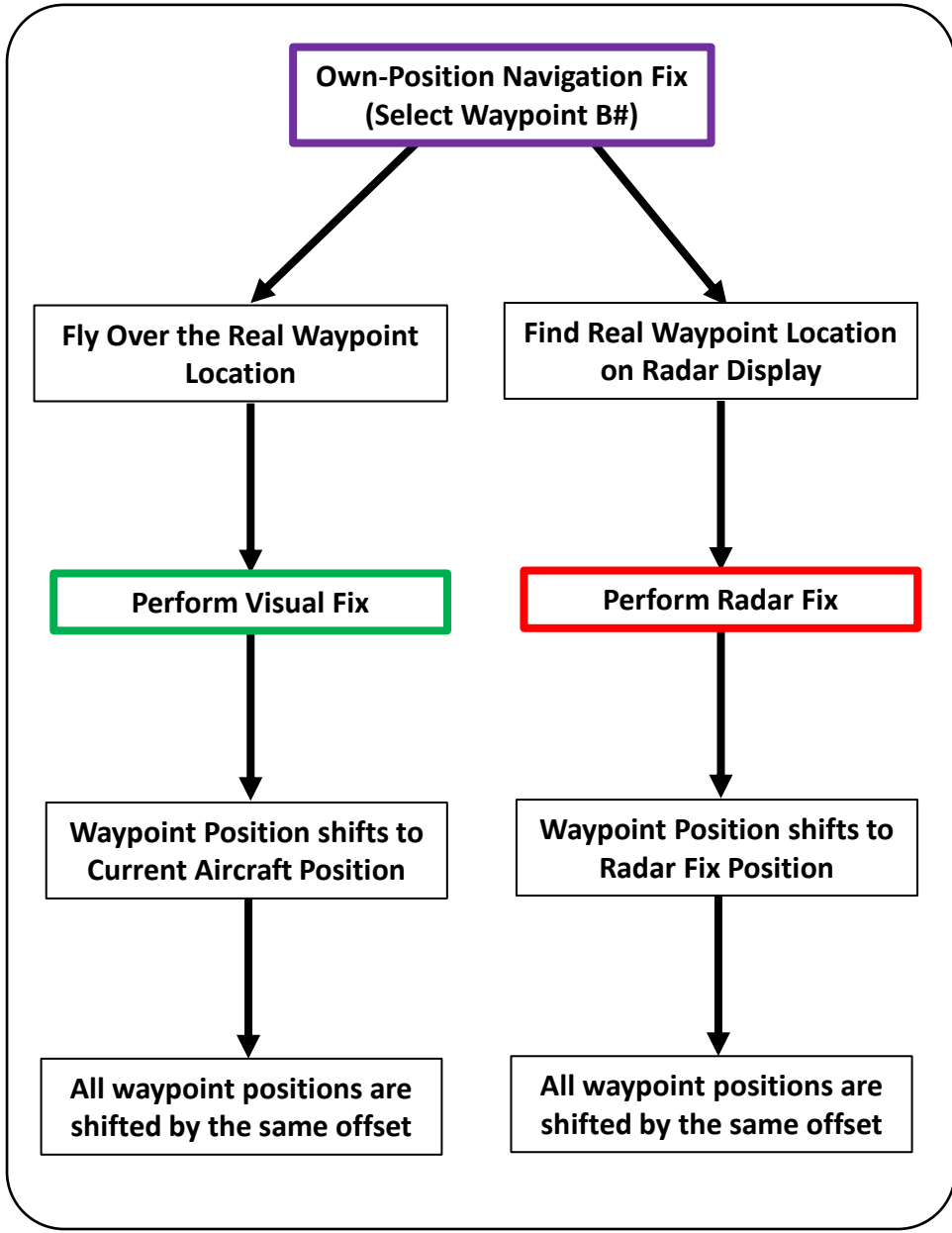
There are two categories of "fixes":

- **Own-Position (Navigation) Fixes**: This type of fix updates the position of **every** waypoints within the flight plan. This is to be used once you notice a significant drift within the navigation system, which often happens when you see a waypoint on the CI (Central Indicator) radar display and it does not match the position you expect it to be, which is generally a landmark that's easy to recognize like a city, an airport, a river or a harbor.

- **Target Fixes**: This type of fix updates the position of a single Target Point M# without changing the coordinates of the whole flight plan database. Its primary use is to designate a target on the radar and update its position. This fix does not impact the aircrafts estimation of its position, but merely moves the selected waypoint.

Each fix type can be performed with either a "Visual Fix" or a "Radar Fix". Both methods will be explored in this section.

- **Visual Fix**: The pilot creates a visual fix when flying directly above the "real position". The fix mode is prepared by depressing the first stage of the fix trigger of the radar control stick (T1). When directly above the position, the pilot depresses the second stage of the fix trigger (T1- TV-T1).

- **Radar Fix**: Using the radar to create a fix enables fixes to be made from a significant distance, even in poor weather, depending on radar picture quality. Radar fixes aid in fine-tuning waypoints at a distance on easily recognizable terrain features.

TERNAV Status
2 – TERNAV OK, Rough Search

Position Error
1 km

Longitude
41 deg 55 minutes

AKT POS Selected

13 – FIXES

13.1 – Introduction

**Own-Position Navigation Fix
(Select Waypoint B#)**

Fly Over the Real Waypoint Location

Find Real Waypoint Location on Radar Display

Perform Visual Fix

Perform Radar Fix

Waypoint Position shifts to Current Aircraft Position

Waypoint Position shifts to Radar Fix Position

All waypoint positions are shifted by the same offset

All waypoint positions are shifted by the same offset

**Target Fix
(Select Target Point M#)**

Fly Over the Real Target Point Location

Find Real Target Point Location on Radar Display

Perform Visual Fix

Perform Radar Fix

Target Point Position shifts to Current Aircraft Position

Target Point Position shifts to Radar Fix Position

All other waypoint positions are not affected

All other waypoint positions are not affected

13 – FIXES
13.1 – Introduction

Own-Position Navigation Fix Example

Target Fix Example

13 – FIXES
13.2 – Manual Fixes
13.2.1 – Own-Position (Navigation) Fixes

13.2.1.a: Visual Navigation Fix

The best way to use a "visual fix" is to use a waypoint set on a location that is easily recognizable. Coastal cities or airports are good landmarks to use to perform your visual navigation fix. In this example, we know waypoint B1 is set in the middle of Sukhumi's runway. In the screenshot below, we are almost 1 km from the runway (the point of reference we know to be where Waypoint B1 should be), yet navigation system drift has shifted the waypoint location perceived by the aircraft almost 10 km away.

In this case, we will fly over the runway, perform a "visual fix" to create an offset to "fix" the position error, then the navigation system will apply this same correction on the whole flight plan.

Location of Waypoint B1 perceived by the aircraft (with drift error)

Real Location of Waypoint B1

Position Error

Location of Waypoint B1 perceived by the aircraft (with drift error)

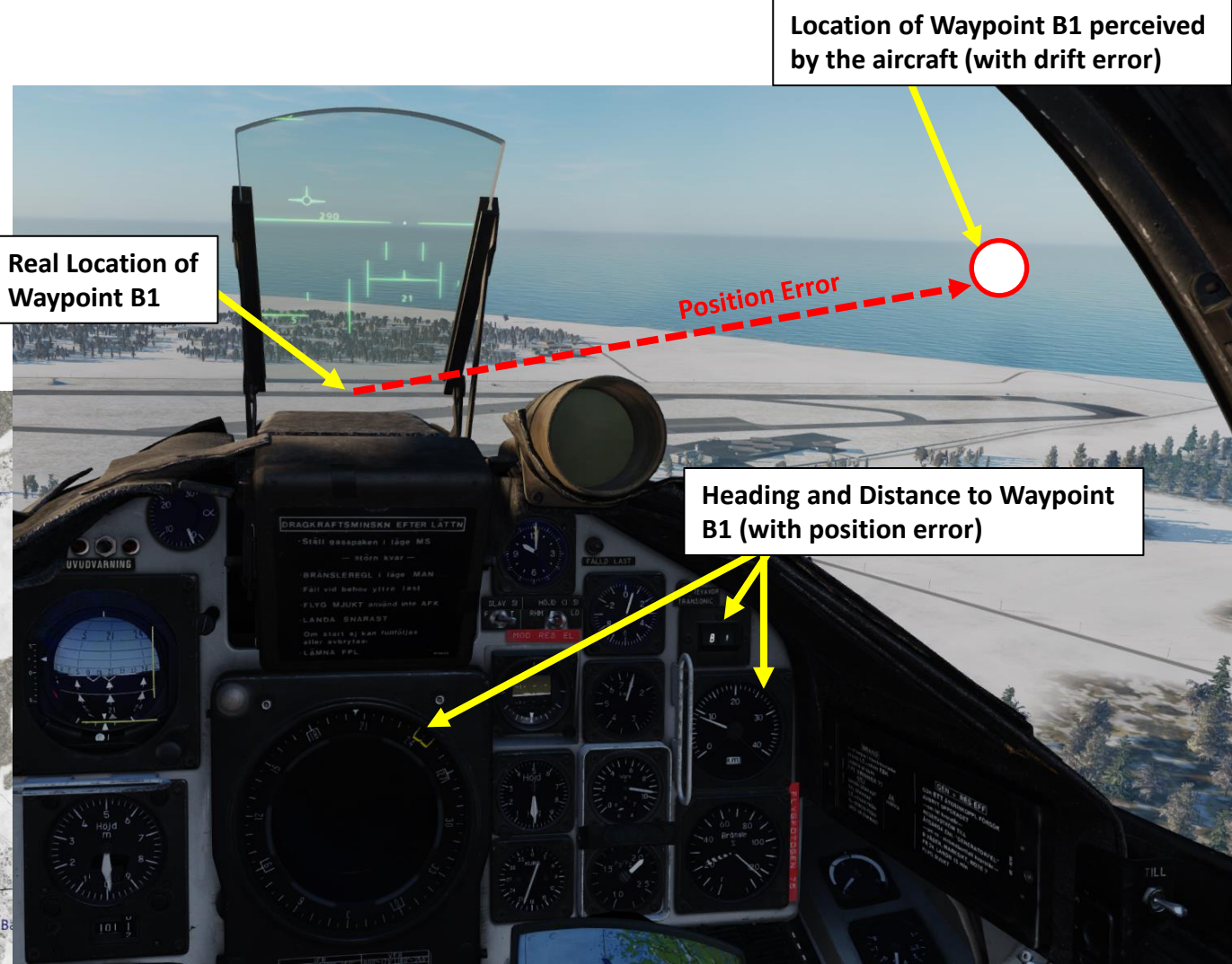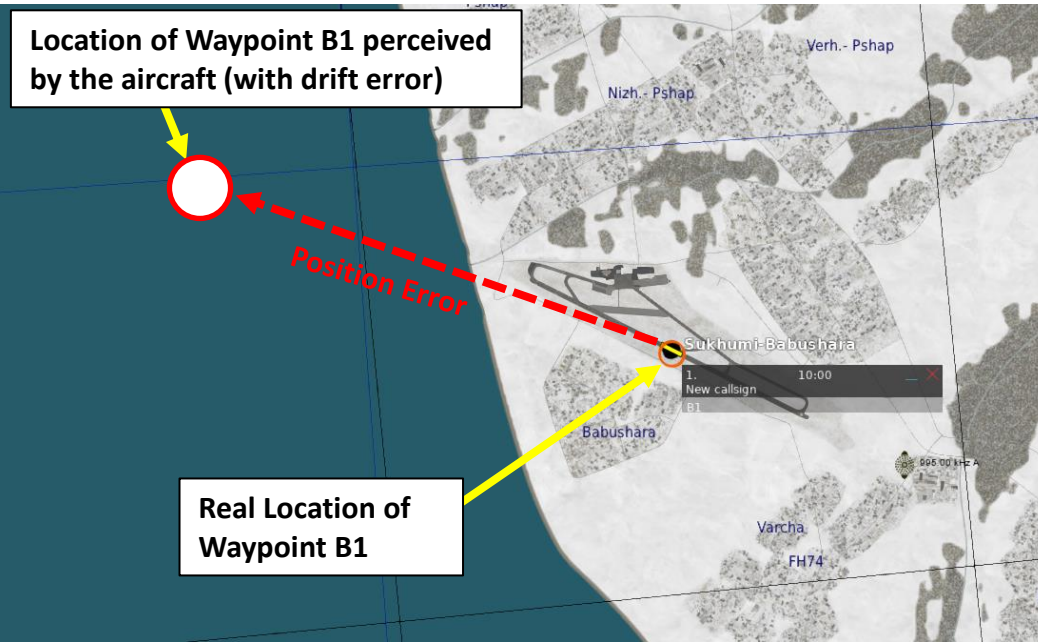**Real Location of Waypoint B1**

Heading and Distance to Waypoint B1 (with position error)

Position Error

13 – FIXES

13.2 – Manual Fixes

13.2.1 – Own-Position (Navigation) Fixes

13.2.1.a: Visual Navigation Fix

To perform the Visual Navigation Fix:

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS (Active Position) – OUTPUT
3. Select the Waypoint you want to use as a reference for the visual fix. In our case, we will take Waypoint B1 since we know its location, which is the center of the runway of Sukhumi.
4. Set Radar mode to A0 (Radar Mode Switch FWD).
5. Before you reach the reference point (real position of Waypoint B1), prepare visual fix by pressing the radar trigger to the first detent (T1).
6. While T1 is held, Destination Indicator will display "E", meaning that a nav fix is in progress. This will also make sure that the selected waypoint does not switch automatically to the next waypoint in the flight plan when you approach its location.

3 B 1

6 E 1

Radar Mode Selector – A0 **4**

NODSK HUV

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent **5**
- TV: Second trigger detent

1 BER | NAV | ANF | SPA | LANDNING NAV P/O

4

2 AKT POS / REF LOLA / BANA GRÄNS / VIND RUTA MÅL / TID / TAKT / ID-NR / RENSA
4 2 5 3 1 0

B1 Waypoint Selector **3**

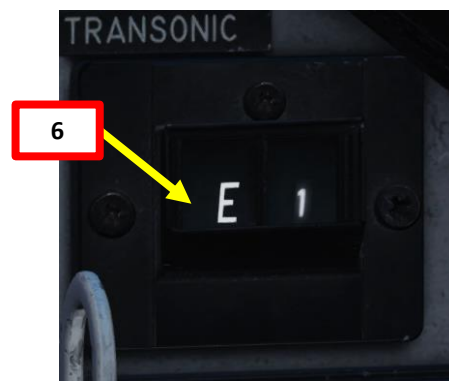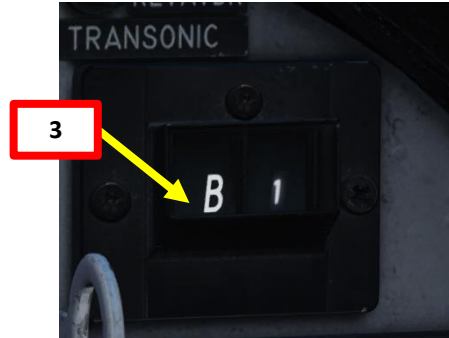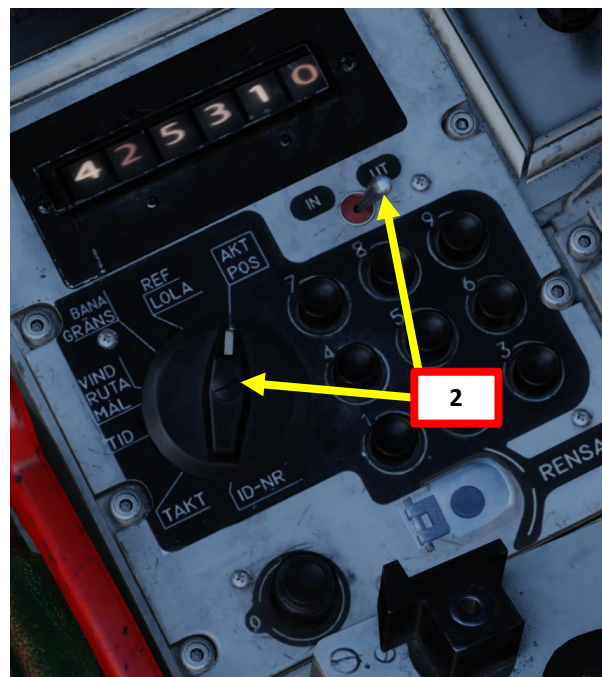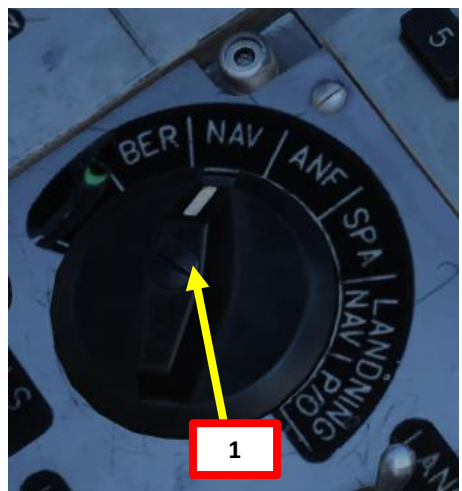B4 B7
B3 B8
BI BX
LS SKU L MÅL

451
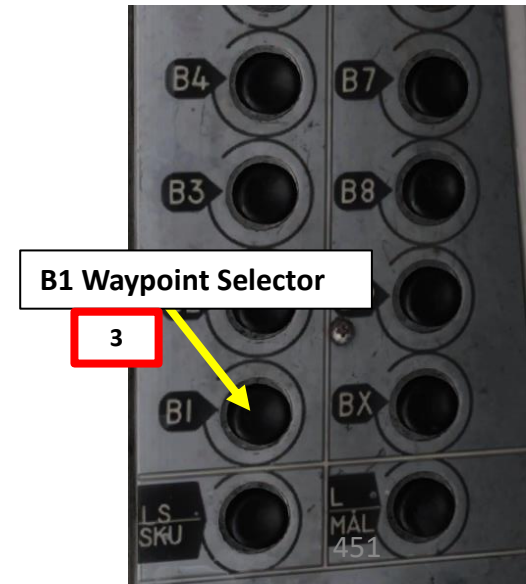
13 – FIXES

13.2 – Manual Fixes

13.2.1 – Own-Position (Navigation) Fixes

13.2.1.a: Visual Navigation Fix

7. Fly over the reference point (the real location of waypoint B1, which we know is at the center of Sukhumi's runway).
8. When directly over the target, press the radar trigger to the second detent (TV). This will complete the fix.
   - If you want to cancel the fix before pressing the second detent, release trigger (T0). This will cancel the position offset.
9. When you have pressed the second detent (TV), the visual fix is performed and the position error is corrected. Waypoint B1 with the position error/drift is shifted to your current position. **All other waypoints in the flight plan are shifted by the same offset to ensure a consistent flight path**.
10. The next waypoint in the flight plan (B2) will immediately be selected since you are now flying directly over Waypoint B1's new location.
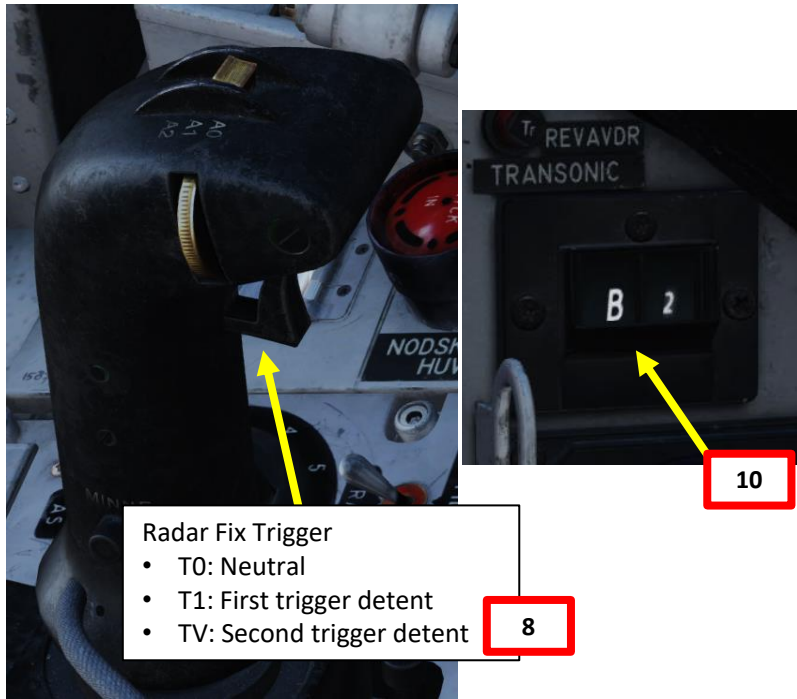
Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

13 – FIXES

13.2 – Manual Fixes

13.2.1 – Own-Position (Navigation) Fixes

13.2.1.b: Radar Navigation Fix

The best way to use a "radar fix" is to use a waypoint set on a location that is easily recognizable on the radar display. Coastal cities or airports are good landmarks to use to perform your radar fix. In this example, we know waypoint B1 is set in the middle of Ramsgate. The point of reference should be Ramsgate (where Waypoint B1 should be), yet navigation system drift has shifted the waypoint location perceived by the aircraft almost 5 km away.

In this case, we will use the radar to perform a "radar fix" to create an offset to "fix" the position error, then the navigation system will apply this same correction on the whole flight plan.

Location of Waypoint B1 perceived by the aircraft (with drift error)
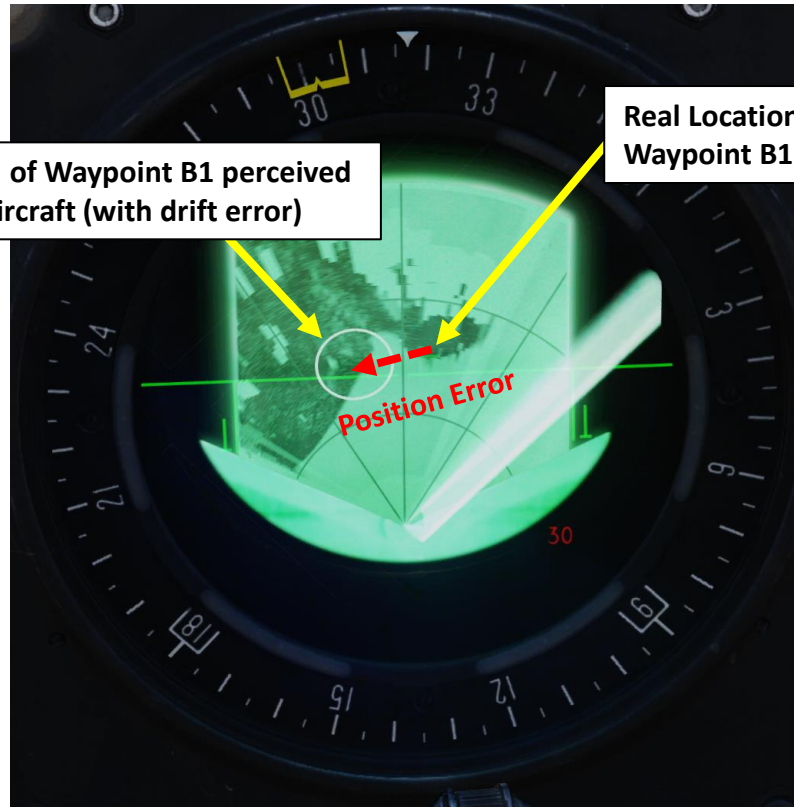
Real Location of Waypoint B1 (Ramsgate)

Position Error

Real Location of Waypoint B1

Location of Waypoint B1 perceived by the aircraft (with drift error)

Position Error

13 – FIXES

13.2 – Manual Fixes

13.2.1 – Own-Position (Navigation) Fixes

13.2.1.b: Radar Navigation Fix

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS (Active Position) – OUTPUT
3. Select the Waypoint you want to use as a reference for the radar fix. In our case, we will take Waypoint B1 since we know its location, which is the city of Ramsgate.
4. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
5. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
6. Adjust radar display range as required.
7. Navigate to B1 (Waypoint) and make sure the waypoint circle is visible on the radar display.
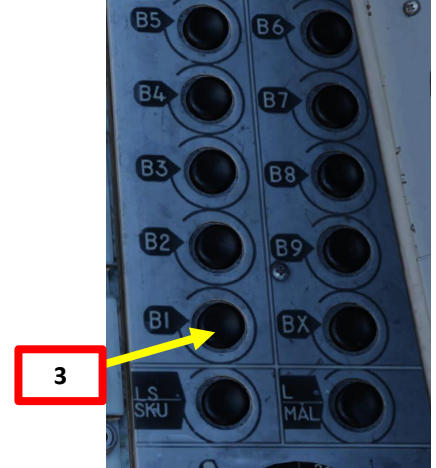
3

1

3

3

Radar Mode Selector – A1
(Wide Search with PPI)

4

5

Radar Brightness Control
(LJUS RADAR)

7
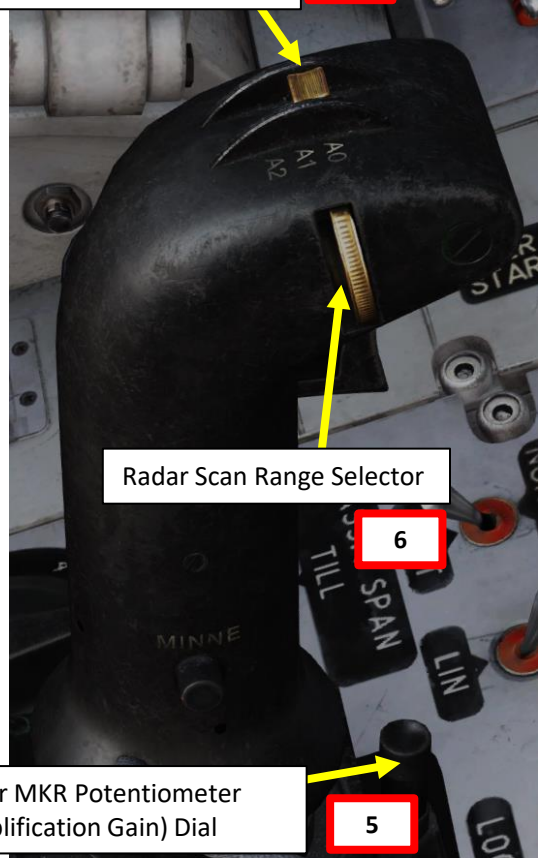
Waypoint B1
(Position with Error)

Radar Scan Range Selector

6

2b

6

Display Range: 30 km

Radar MKR Potentiometer
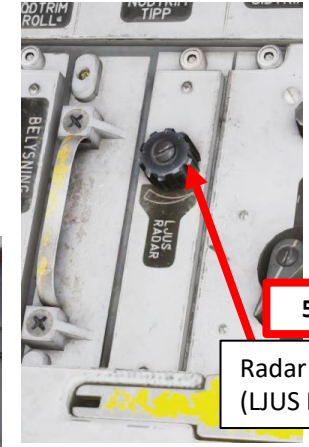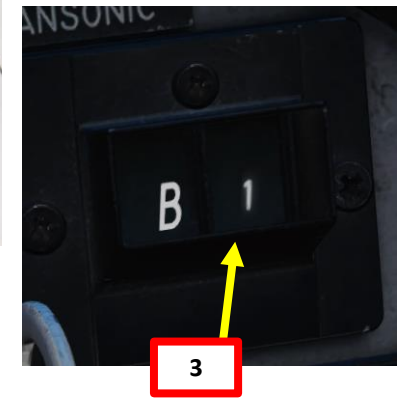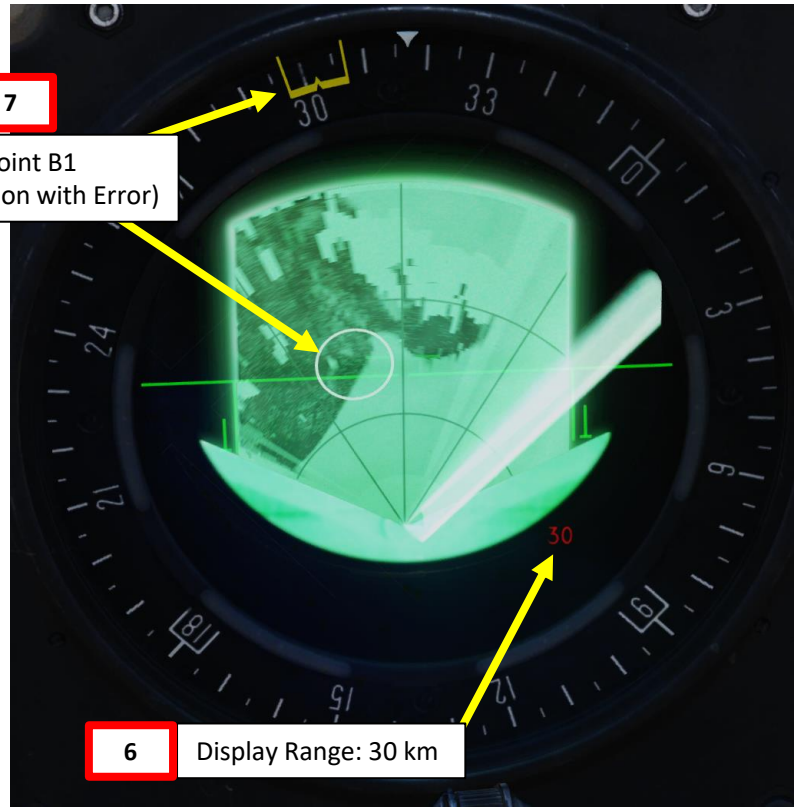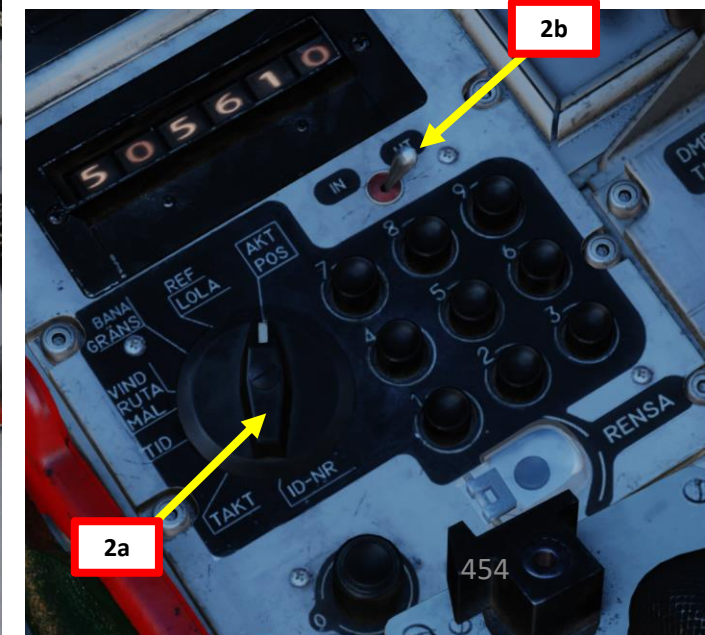(Amplification Gain) Dial

5

2a

454

13 – FIXES
13.2 – Manual Fixes
13.2.1 – Own-Position (Navigation) Fixes

13.2.1.b: Radar Navigation Fix

8. You should see the Waypoint B1 circle on the central indicator, but not quite over Ramsgate. We will now offset the Waypoint B1 on the actual location of Ramsgate by using a Radar Navigation Fix.
9. Press the radar fix trigger to "T1" (first trigger detent). Destination Indicator should display "E", meaning that a nav fix is in progress. This will also make sure that the selected waypoint does not switch automatically to the next waypoint in the flight plan when you approach its location.
10. Move crosshair over the expected/real Waypoint location using the radar stick controls.
11. Press the radar fix trigger to "TV" (second trigger detent), which will set the navigation fix on Ramsgate. This will complete the fix and become the new location of Waypoint B1.

10a

Radar Stick Control:
- Radarstick Up/Down/Left/Right

9b

E 1

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent **9a**
- TV: Second trigger detent **11a**

9b

Crosshair
(Slewable)

8

Waypoint B1 Original Location
(with error)

30

Crosshair
(Slewed)

10b

30

Radar Navigation Fix
(New B1)

11b

455
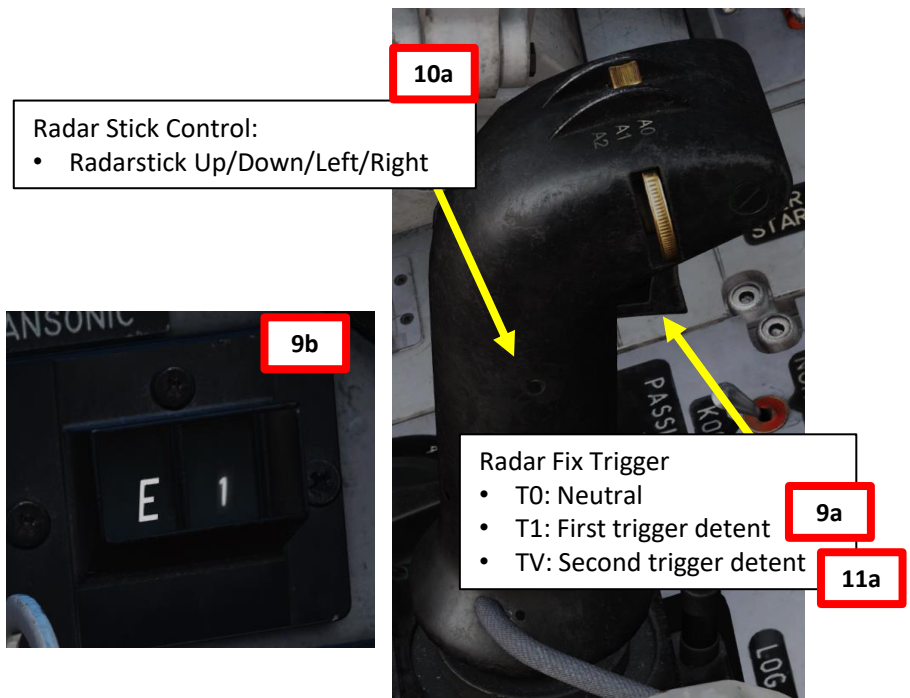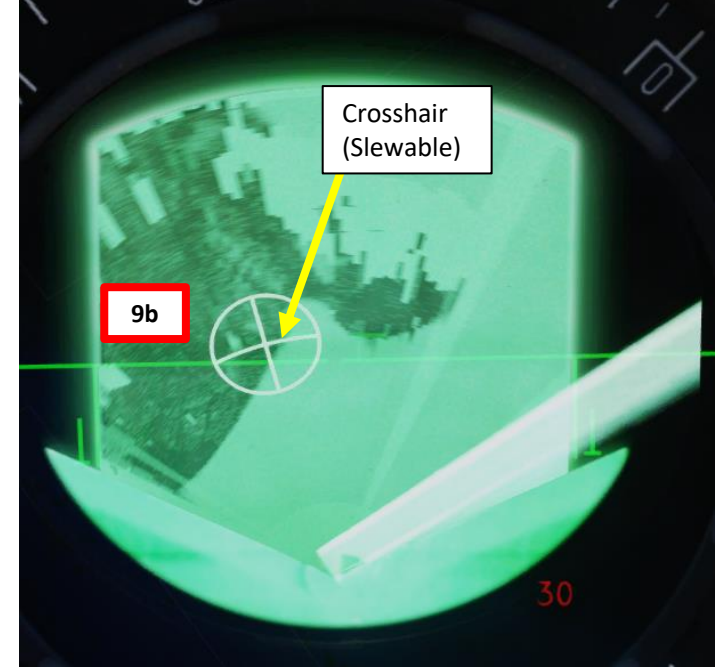
13 – FIXES
13.2 – Manual Fixes
13.2.1 – Own-Position (Navigation) Fixes

13.2.1.b: Radar Navigation Fix

12. When you have pressed the second detent (TV), the radar navigation fix is performed and the position error is corrected. Waypoint B1 with the position error/drift is shifted to the point you just designated with the radar crosshair. **All other waypoints in the flight plan are shifted by the same offset to ensure a consistent flight path**.

- Note: If you want to cancel the fix before pressing the second detent, release trigger (T0). This will cancel the position offset.
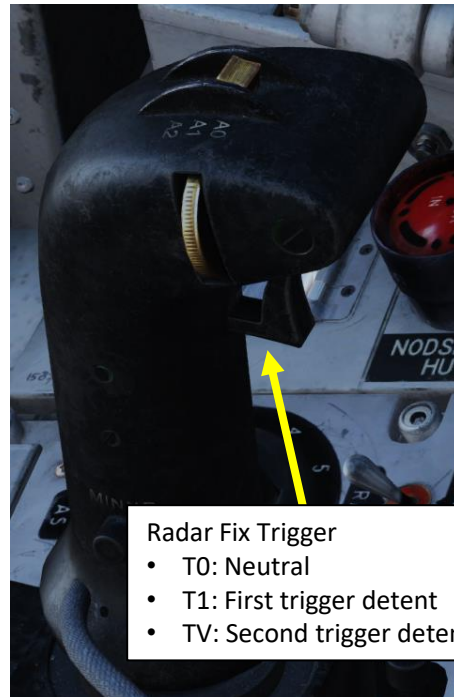
Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

12

Radar Navigation Fix
(New B1)

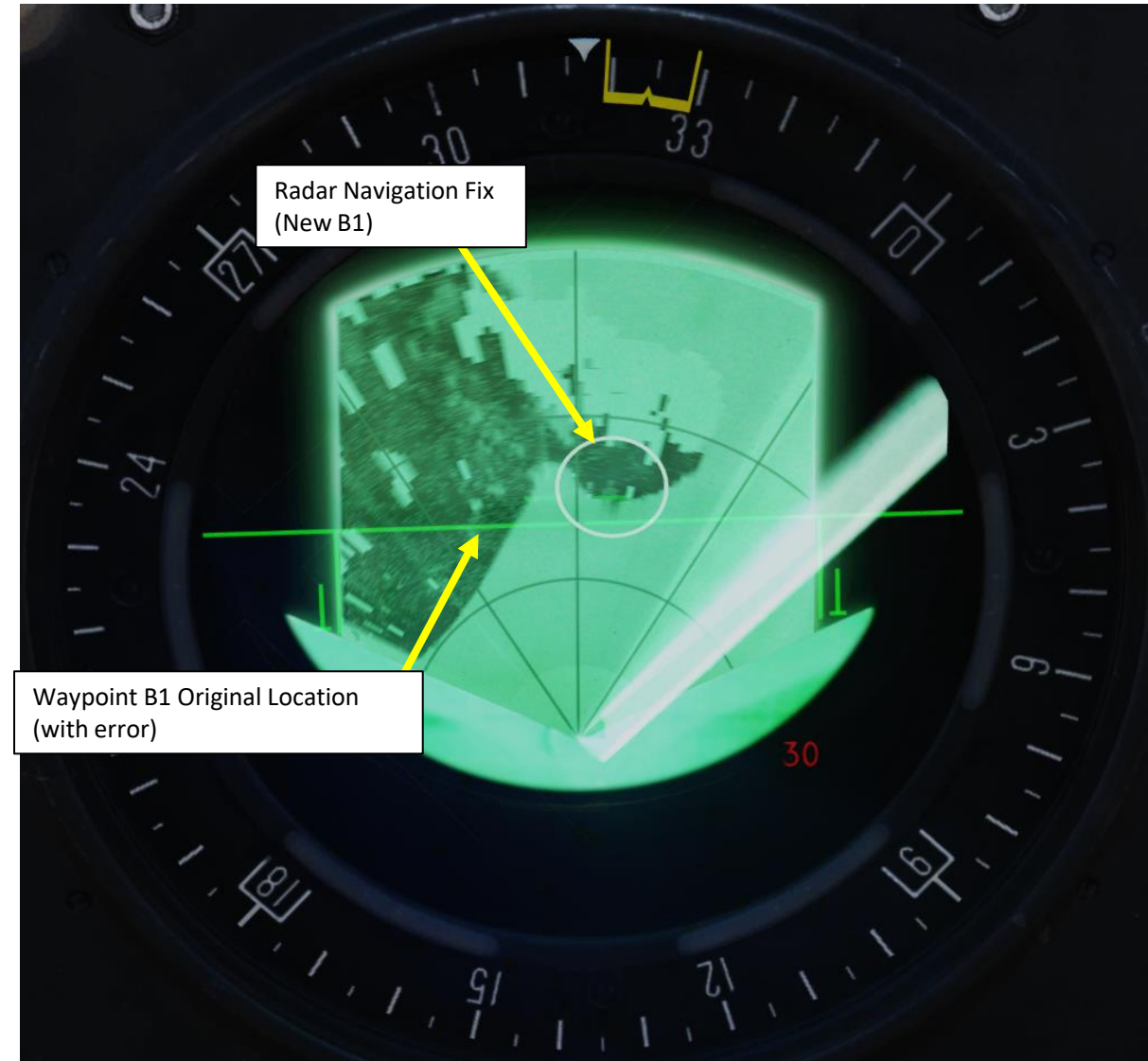Waypoint B1 Original Location
(with error)

13 – FIXES
13.2 – Manual Fixes
13.2.2 – Target Fixes

13.2.2.a: Visual Target Fix

In this example, we want to designate a target by using a visual target fix, which means selecting an existing Target Point M# (its initial location doesn't matter), flying over the target, then performing the visual target fix. The location of the aircraft when you performed the fix will be the new location of the Target Waypoint M# you selected earlier.

The main difference between a visual navigation fix and a visual target fix is that the visual target fix will not offset any other waypoint. This is useful when you find a target and want to memorize its coordinates easily by flying over it. This can be a risky business for targets that are armed though.

In this particular example, we will fly over a harbor with ships. Once we are over the ships, we will perform a fix and memorize their position on the Target Point M3.

Where we want to perform the Visual Target Fix (will become Target Point M3's coordinates once visual fix is performed)
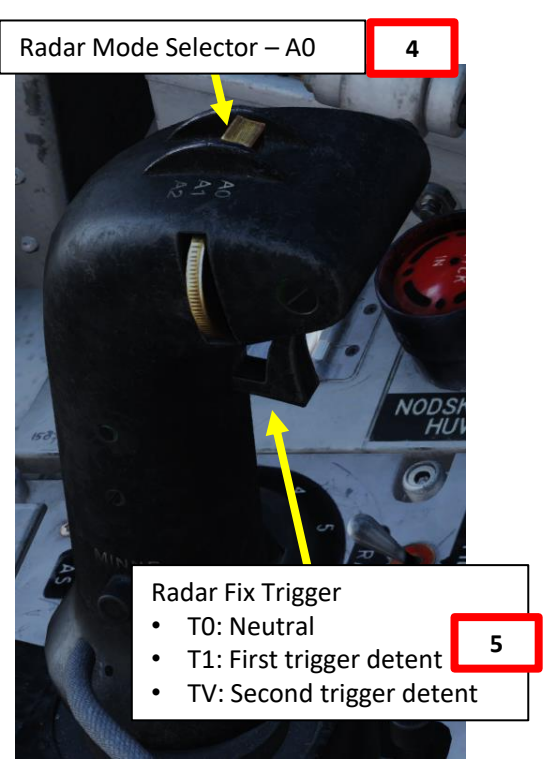
13 – FIXES
13.2 – Manual Fixes
13.2.2 – Target Fixes

13.2.2.a: Visual Target Fix

To perform the Visual Target Fix:

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS (Active Position) – OUTPUT
3. Select the Target Waypoint M# you want to use for the visual target fix. In our case, we will take the existing Target Point M3, which will be used to store the fix coordinates.
   - If you don't remember how to set a Target Point, set Data Selector to TAKT – INPUT, press "9" on the keypad, then press the Waypoint Selector Button B3 to change Waypoint B3 into Target Point M3. Set the Data Selector back to AKT POS – OUTPUT.
4. Set Radar mode to A0 (Radar Mode Switch FWD).
5. Before you reach the target, prepare visual fix by pressing the radar trigger to the first detent (T1).
6. While T1 is held, Destination Indicator will display a flashing "E", meaning that a target fix is in progress. This will also make sure that the selected waypoint does not switch automatically to the next waypoint in the flight plan when you approach its location.

3

6

Radar Mode Selector – A0   **4**

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

5

1

4
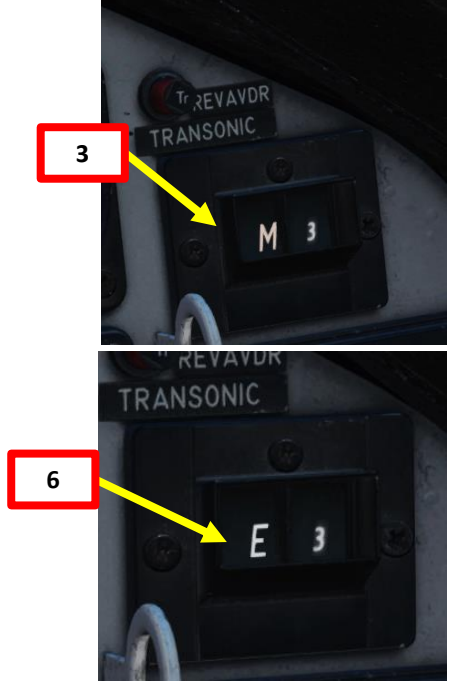
2

B3 Waypoint Selector

3
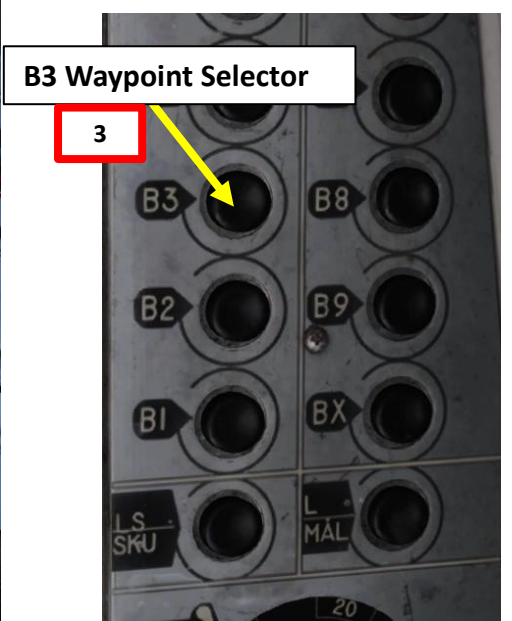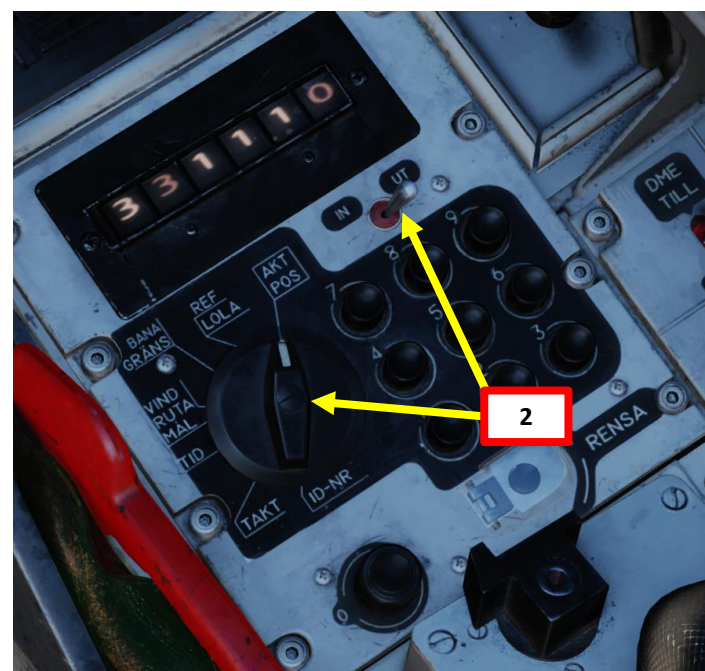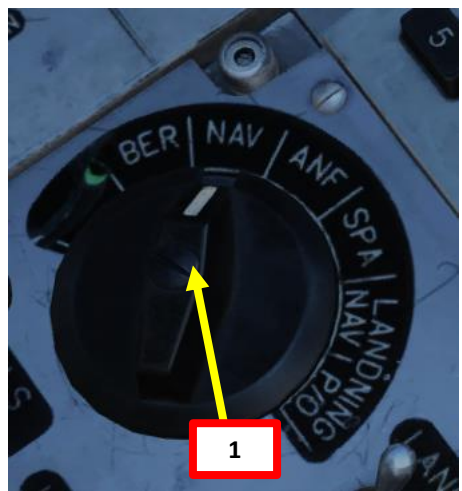
13 – FIXES
13.2 – Manual Fixes
13.2.2 – Target Fixes

13.2.2.a: Visual Target Fix

7. Fly over the Target (the ships in this case).
8. When over the target, press the radar trigger to the second detent (TV). This will complete the target fix.
   - If you want to cancel the fix before pressing the second detent, release trigger (T0). This will cancel the fix.
9. When you have pressed the second detent (TV), the visual fix is performed and the coordinates of the selected Target Point (M3) become the coordinates of the aircraft at the time you pressed the second detent. All other waypoints in the flight plan remain unaffected.
10. The next waypoint in the flight plan (B4) will immediately be selected since you are now flying directly over the Target Point M3's new location.
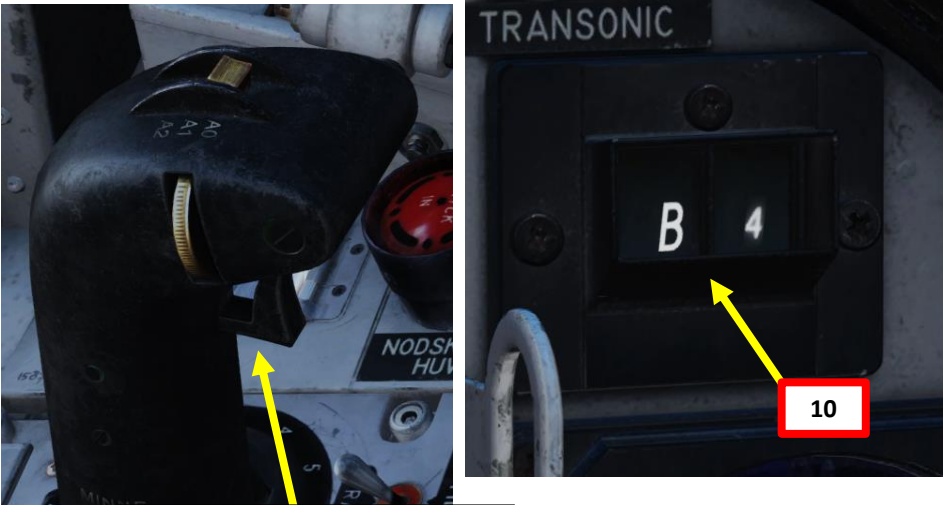
Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

13 – FIXES

13.2 – Manual Fixes

13.2.2 – Target Fixes

13.2.2.b: Radar Target Fix

In this example, we want to designate a target by using a radar target fix, which means selecting an existing Target Point M# (its initial location should be relatively close to the target), acquiring the target on the radar, then performing the radar target fix.

The main difference between a radar navigation fix and a radar target fix is that the radar target fix will not offset any other waypoint. This is useful when you find a target and want to memorize its coordinates easily by designating it with the radar. This is less precise than a visual target fix but much safer.

In this particular example, we will fly towards a ship stationed close to a harbor. Once we see the ship on the Central Indicator radar display, we will perform a radar fix and slew the existing Target Point M3 over the target, updating its coordinates in the process.

Target Point M3

Where we want to perform the Radar Target Fix (will become Target Point M3's coordinates once radar target fix is performed)
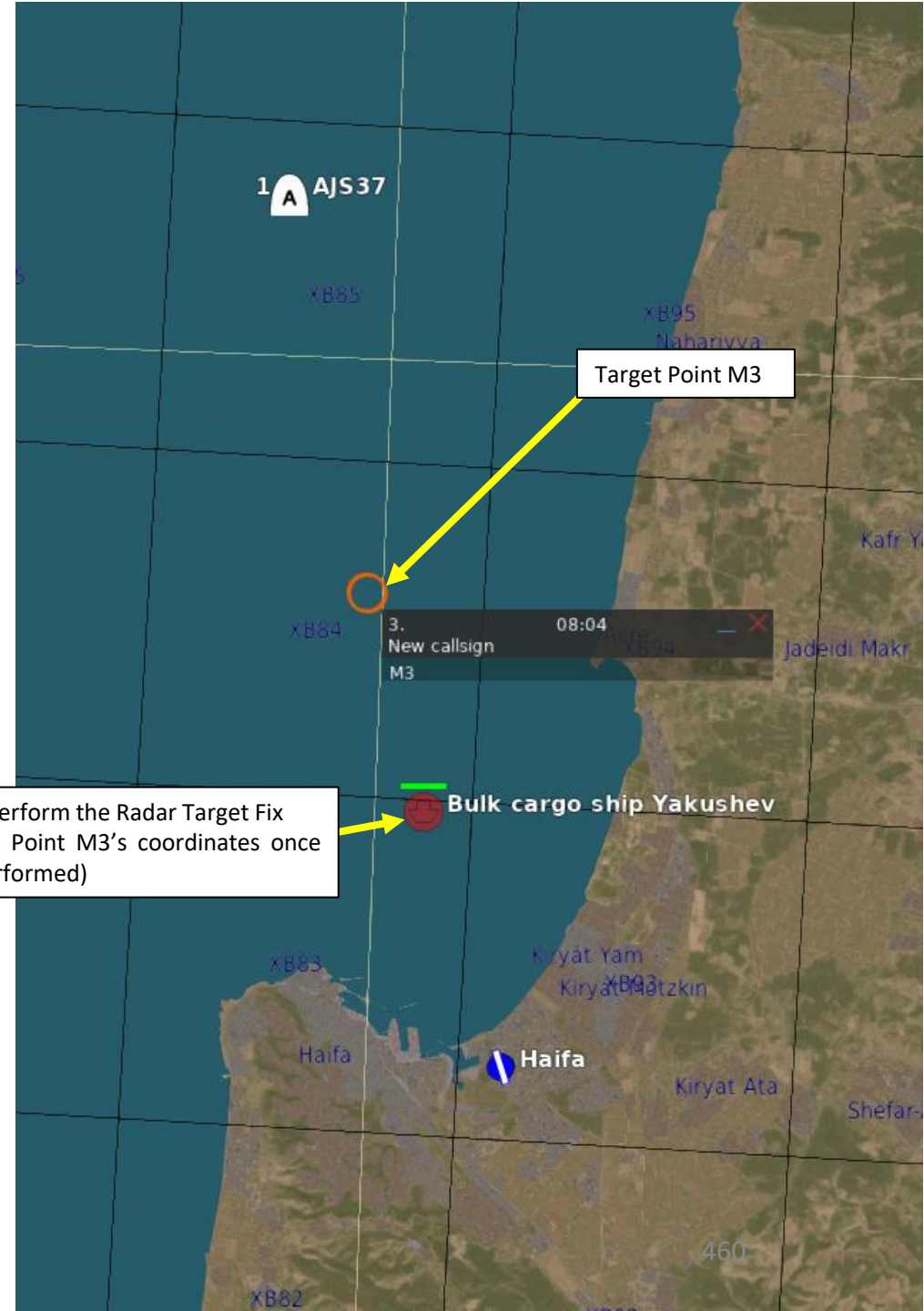
13 – FIXES

13.2 – Manual Fixes

13.2.2 – Target Fixes

13.2.2.b: Radar Target Fix

To perform the Radar Target Fix:

1. Set Master Mode to NAV
2. Set Data Selector to AKT POS (Active Position) – OUTPUT
3. Select the Target Waypoint M# you want to use for the radar target fix. In our case, we will take the existing Target Point M3, which will be used to store the fix coordinates.
   - If you don't remember how to set a Target Point, set Data Selector to TAKT – INPUT, press "9" on the keypad, then press the Waypoint Selector Button B3 to change Waypoint B3 into Target Point M3. Set the Data Selector back to AKT POS – OUTPUT.
4. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
5. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
6. Adjust radar display range as required.
7. Navigate to Target Point M3 and make sure the waypoint circle is visible on the radar display.
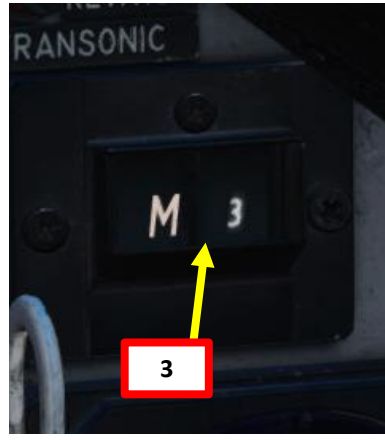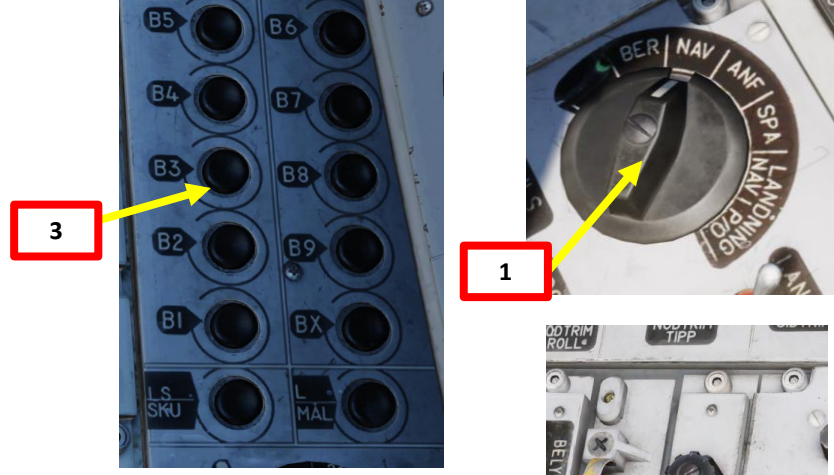
3

1

3

Radar Mode Selector – A1 (Wide Search with PPI)

4

5

Radar Brightness Control (LJUS RADAR)

7

Ship

Target Point M3

Radar Scan Range Selector

6

2b

6 Display Range: 30 km

Radar MKR Potentiometer (Amplification Gain) Dial

5

2a

461
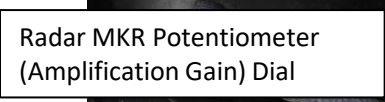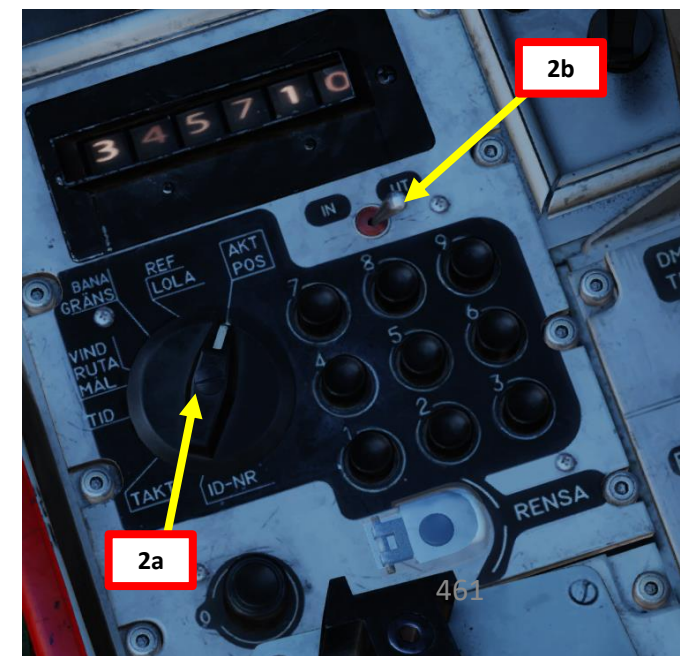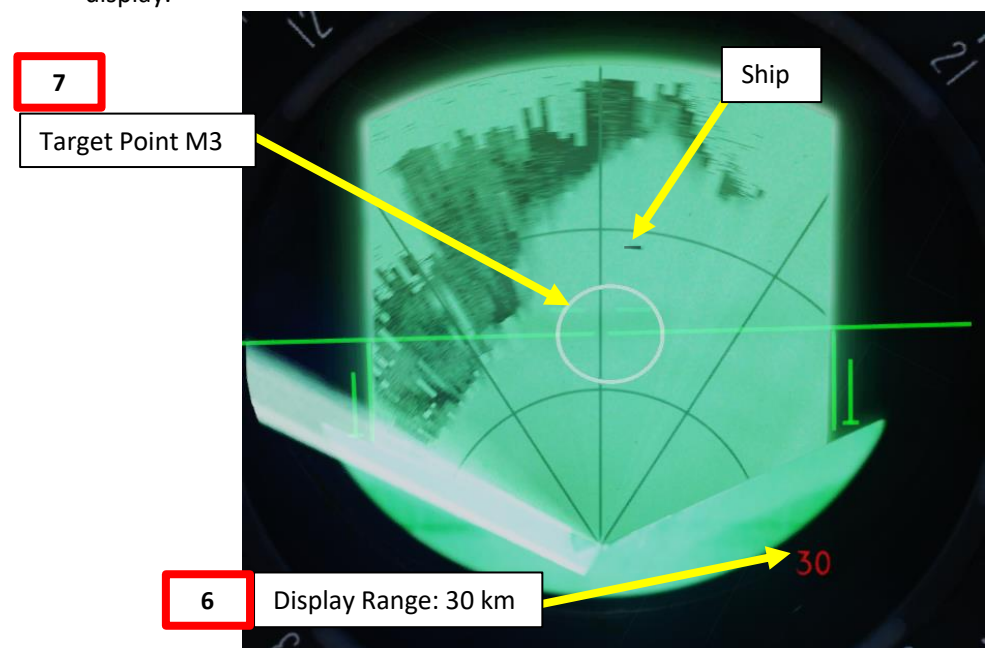
13 – FIXES
13.2 – Manual Fixes
13.2.2 – Target Fixes

13.2.2.b: Radar Target Fix

8. You should see the Target PoInt M3 circle on the central indicator, but not quite over the ship. We will now move the Target Point on the actual location of the ship by using a Radar Target Fix.
9. Press the radar fix trigger to "T1" (first trigger detent). Destination Indicator should display a flashing "E", meaning that a target fix is in progress. This will also make sure that the selected waypoint does not switch automatically to the next waypoint in the flight plan when you approach its location.
10. Move crosshair over the ship radar return using the radar stick controls.
11. Press the radar fix trigger to " TV" (second trigger detent), which will set the radar target fix on the ship. This will complete the fix and become the new location of Target Point M3.
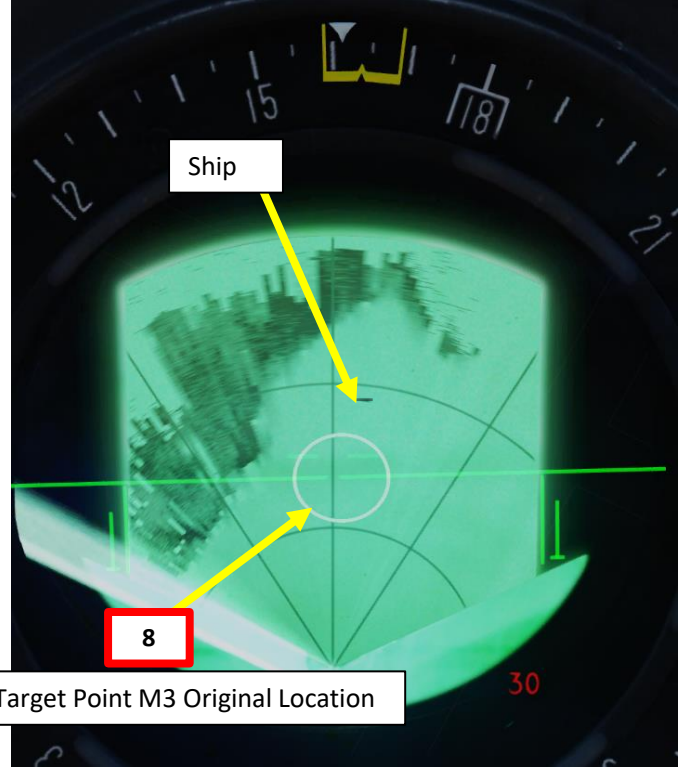
10a

Radar Stick Control:
• Radarstick Up/Down/Left/Right

9b

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent **9a**
• TV: Second trigger detent **11a**

Ship

8

Target Point M3 Original Location

Crosshair (Slewed)

10b

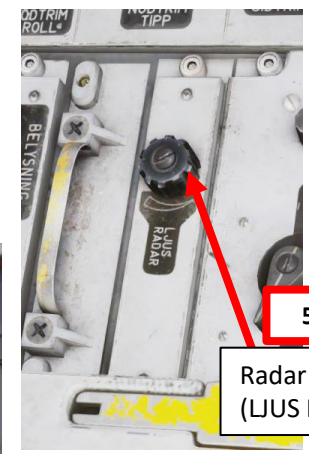Crosshair (Slewable)

Ship

9b
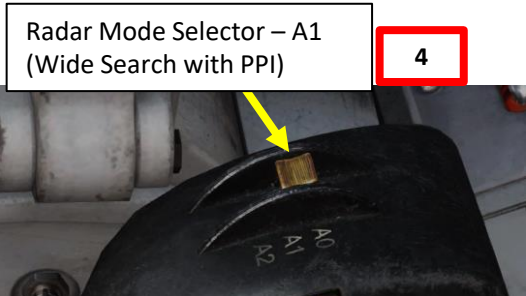
Radar Target Fix (New Target Point M3)
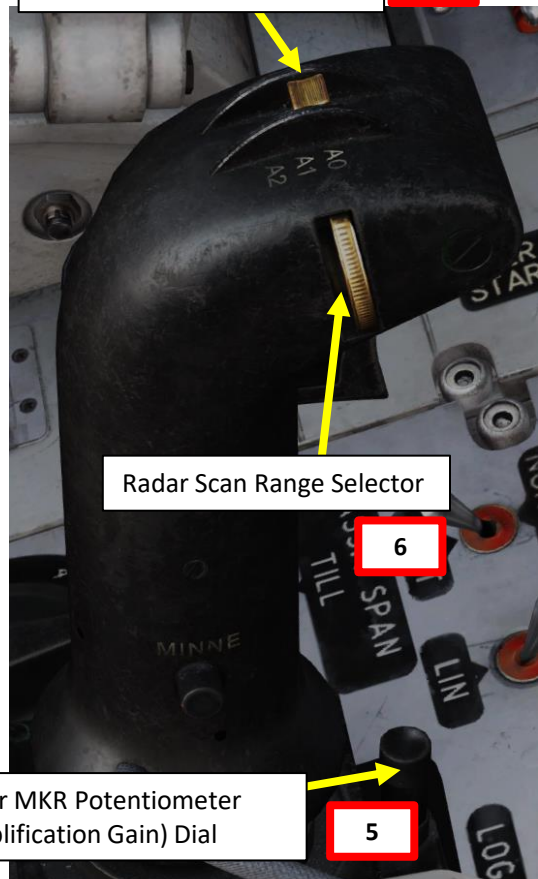
11b

13 – FIXES
13.2 – Manual Fixes
13.2.2 – Target Fixes

13.2.2.b: Radar Target Fix

12. When you have pressed the second detent (TV), the radar target fix is performed and coordinates of Target Point M3 are updated to the location of the ship you just designated. **All other waypoints in the flight plan remain unaffected**.

- Note: If you want to cancel the fix before pressing the second detent, release trigger (T0). This will cancel the position offset.
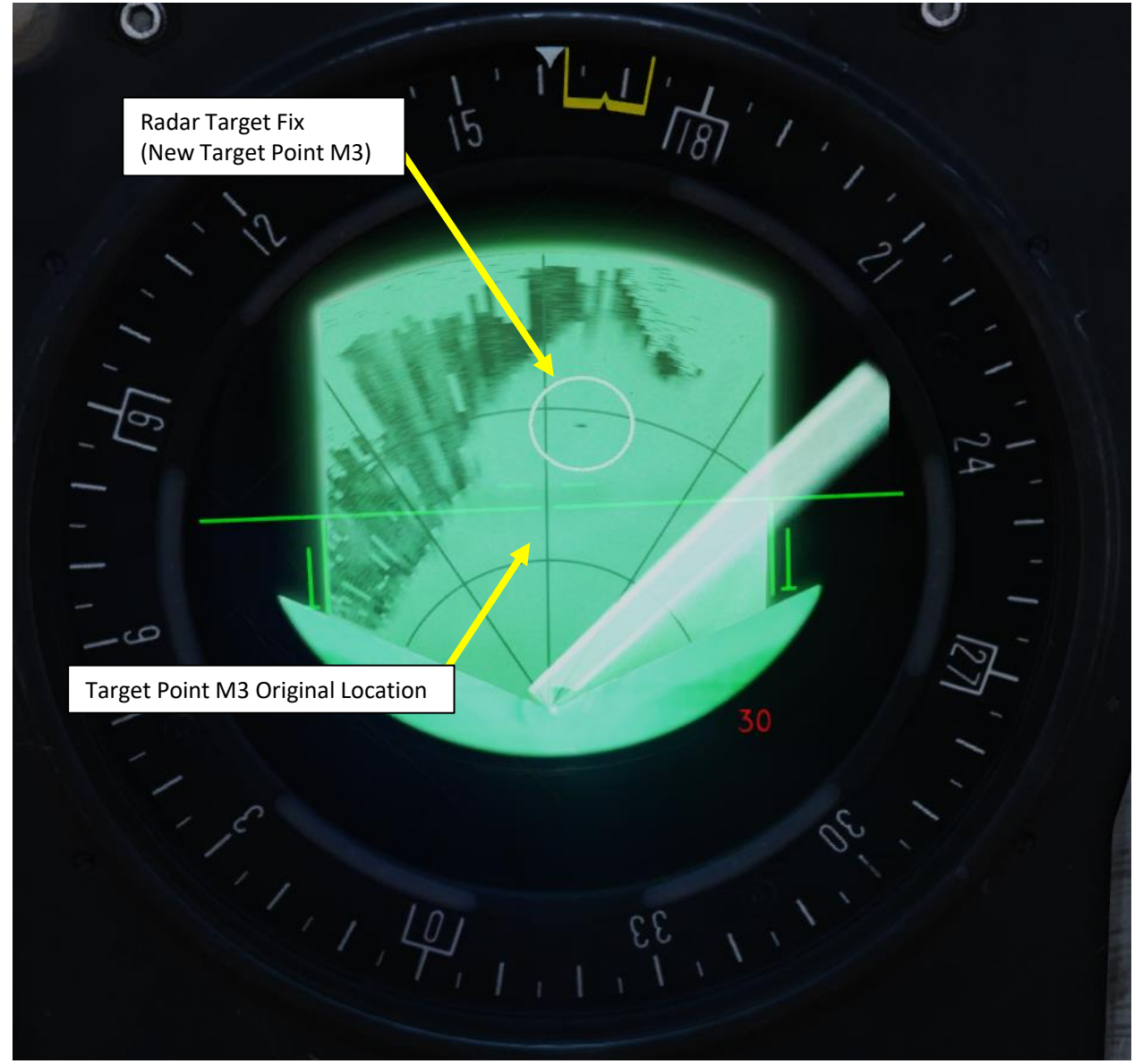
Radar Target Fix
(New Target Point M3)

Target Point M3 Original Location

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

12

30

13 – FIXES
13.3 – Automatic Fixes

13.3.1 – TILS (Tactical Instrument Landing System) Fix

During the landing's final phase, the TILS system will make automatic adjustments based on the TILS system data.

13.3.2 – TERNAV (Terrain Navigation) Fix

The TERNAV (Terrain Navigation System) will create about 2 fixes per second if the system is ready and operating.

13.3.3 – Weapon Impact Fix

When firing weapons in modes that have a reticule and a distance line such as the AKAN Gun pods in Air-to-Ground mode, ARAK rockets and certain bomb release modes, an automatic target fix is automatically performed on the projected impact point.

13.3.4 – Automatic Initial Fix

The origin point is set automatically based on the entered takeoff coordinates (either a reference number or longitude/ latitude coordinates).

The fix is made on take-off from or landing on an entered base to establish a starting point for the navigation system. The fix is set on the middle of the entered airbase or the LO/LA coordinates. Due to the fix being set on the middle of the runway, a slight position error will occur during most takeoffs.

13.4 – Fix Clearing

While airborne, it is possible to clear the own-position fixes. This is done by pressing the RENSA (CLEAR) button on the data panel (beneath a protective cover) once. This does not clear the target position fixes.

Clearing the navigation system is divided into two steps:
- The first press of the button will clear the own-position/navigation fix, and load the buffered fix.
- The second press will clear ALL of the own-position/navigation fixes.

If an own-position fix has been made after pushing the (CLEAR) button, the next push will be counted as a first push. The fix clearing feature is used if the wrong position is used for an own-position fix and the pilot is unable to correct the position using the fix system (such as taking a fix of the wrong waypoint). Fix clearing can have greatly detrimental effects on the navigation system as it will deteriorate the basic fix.

Navigation Data Clear (*Rensa*) Cover Guard

Navigation Data Clear (*Rensa*) Button

464

14 – TILS (Tactical Instrument Landing System)

14.1 – Approach Profile Summary

The TILS (Tactical Instrument Landing System) is the instrument landing system for the Swedish Air Force, introduced with the "37" Viggen system. The system is designed to allow instrument landings in poor weather.

Unlike a normal ILS (Instrument Landing System) system with a large array for glideslope and localizer constructed near the runway threshold, the TILS system is a single, smaller unit placed next to the runway.

The system consists of a transmitter unit on the airfield and a receiver unit mounted on the aircraft. The receiver interprets the signal from the transmitter and creates a steering command. The slight offset from the runway heading, combined with a landing waypoint (LB) set by the navigation system results in a slightly curved approach.

Important Note: The localizer, due to the placement of the transmitter unit (usually placed 50 meters to side of the runway at the touchdown point) will diverge from the runway heading, yielding a 3° offset approach from the runway centerline. This leads to the localizer beam intersecting the runway centerline at about 900 meters away from the runway threshold. As a result, **the TILS system cannot be used for the last portion of the approach**, however the runway should be in sight at that distance and altitude for a visual landing.

Approach Profile
The TILS approach consists of three approach segments: Phases 1, 2 and 3.
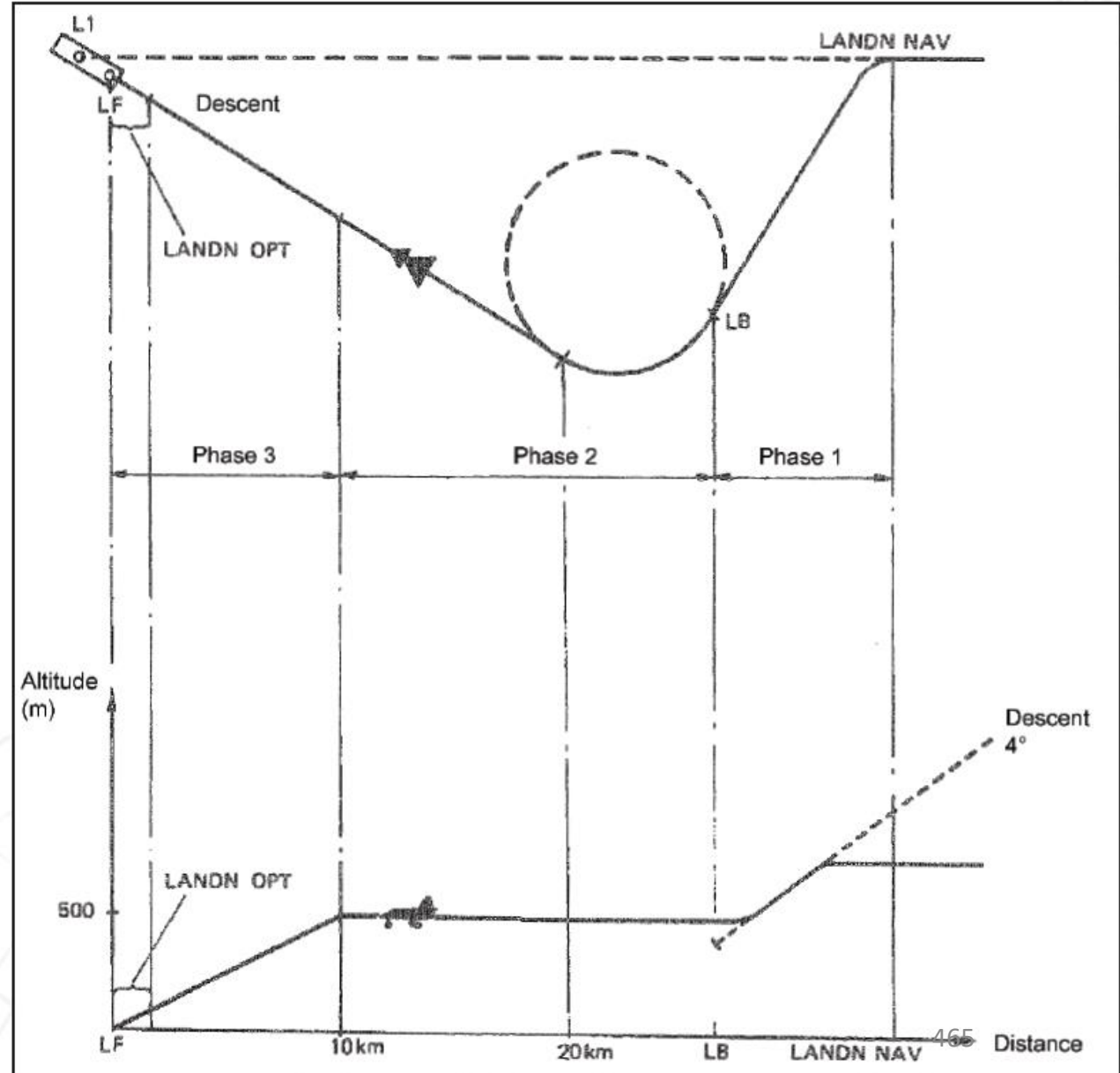
14 – TILS (Tactical Instrument Landing System)
14.1 – Approach Profile Summary

The **Approach Waypoint (LB1)** is the point where a straight line from the aircraft tangents the **Approach Circle**. The coordinates for LB1 are continuously calculated by the computer, while the aircraft is turning towards LB1. Thereby, the aircraft will intercept the circle on a tangent.

The approach circle is placed on the side of the extended runway centerline the aircraft is on. The approach circle tangents the extended runway centerline 20 km from the **Touchdown Waypoint (LF1)** and has a radius of 4100 m. The radius of the approach circle corresponds to 550 km/h with a bank angle of 30°.

LB1
Approach Waypoint

4100 m
Radius

LF1
Touchdown Waypoint

Extended runway centreline

20 km

Approach Circle

L1
Primary Landing Base

Approach Circle

Distance: 20 km
Heading 125

LB1

LF1

L1

14 – TILS (Tactical Instrument Landing System)

14.2 – Landing Preparation

By default, the Primary Landing Base (L1) is set to be the same airbase as the one you took off from. Each airbase has an assigned « 90XX » code assigned to it. As an example, Batumi is set to code « 9011 ». All these codes are accessible in your kneeboard.

We will first **select the Batumi Airbase (Code 9011):**

1. Open your kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages) « Airbases » page.
2. In our case, we want to land at Batumi, which is associated to **code 9011**. Instead of having to input coordinates manually with custom runway headings, all this data is already preset in this code.
3. Set the Data Selector knob to **REF/LOLA** (Reference number or longitude/latitude coordinate position of waypoints).
4. Set INPUT/OUTPUT data switch to INPUT.
5. Enter code **9011**. The 4 digit code corresponds to inputting 6+6 digits of longitude and latitude as well as connecting to other information regarding that locations, such as TILS channels or runway headings.
6. Press the L/MÅL (Landing Airport Selector) button to enter the Airbase coordinates data.
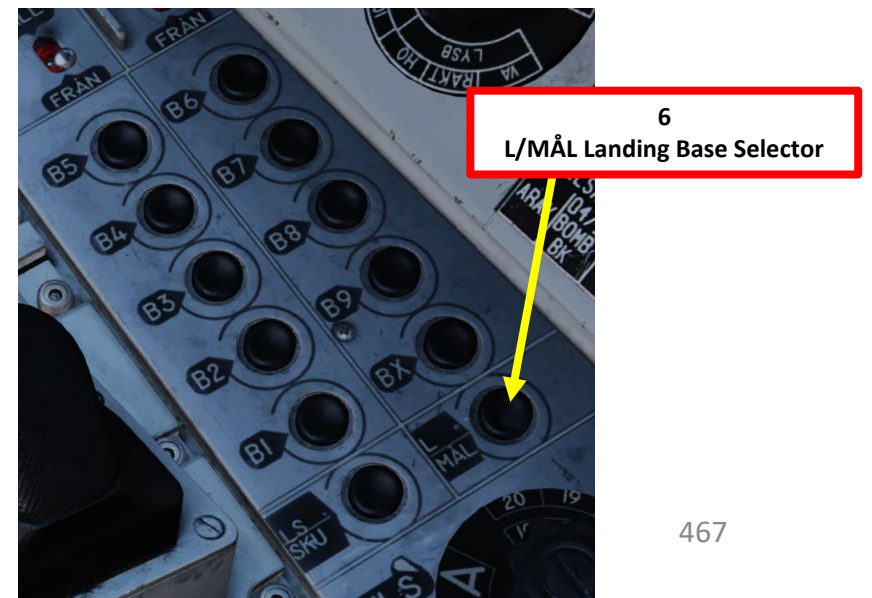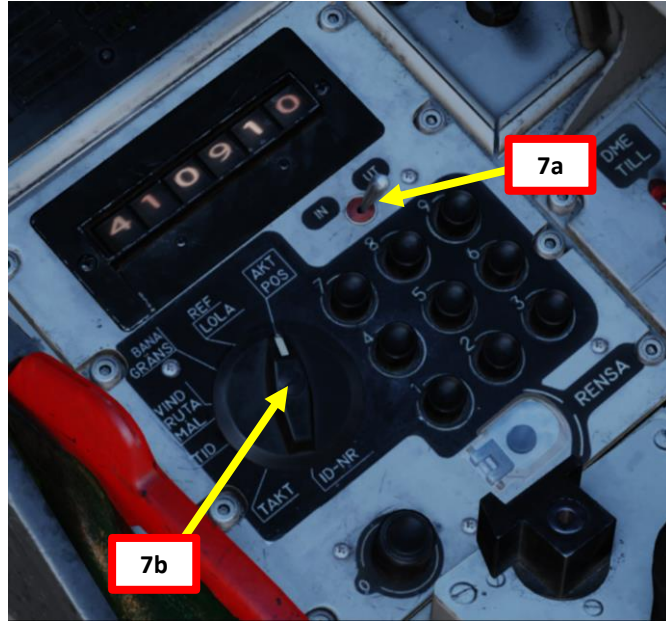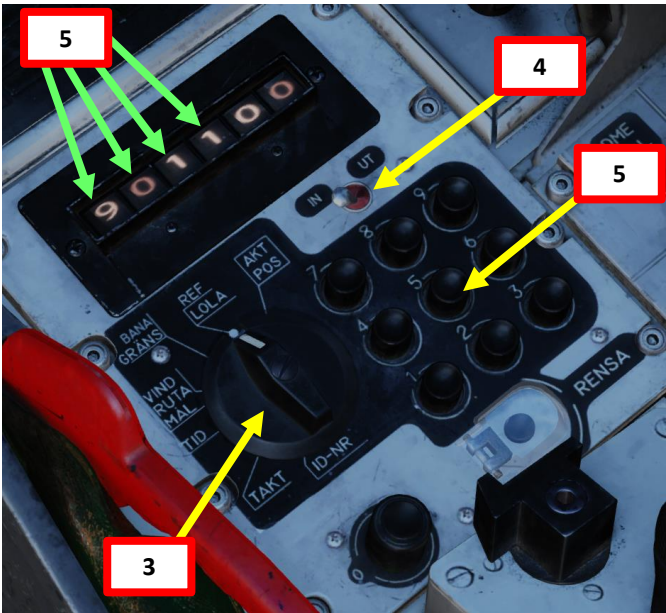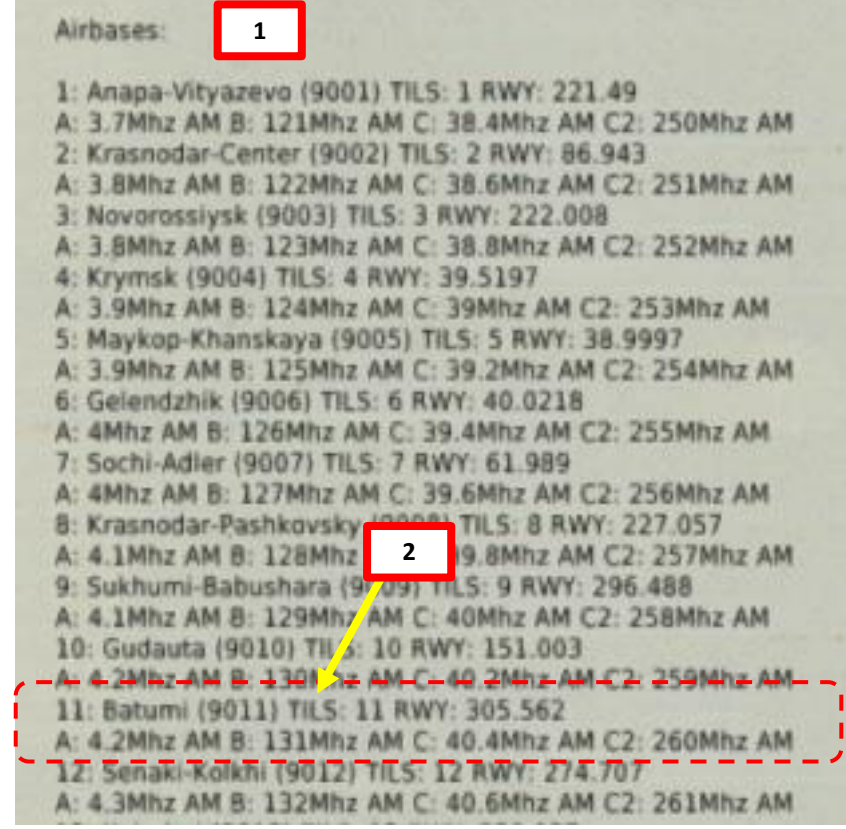7. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT and set the Data Selector knob to **AKT POS** (Active Position).

Airbases: **1**

1: Anapa-Vityazevo (9001) TILS: 1 RWY: 221.49
A: 3.7Mhz AM B: 121Mhz AM C: 38.4Mhz AM C2: 250Mhz AM
2: Krasnodar-Center (9002) TILS: 2 RWY: 86.943
A: 3.8Mhz AM B: 122Mhz AM C: 38.6Mhz AM C2: 251Mhz AM
3: Novorossiysk (9003) TILS: 3 RWY: 222.008
A: 3.8Mhz AM B: 123Mhz AM C: 38.8Mhz AM C2: 252Mhz AM
4: Krymsk (9004) TILS: 4 RWY: 39.5197
A: 3.9Mhz AM B: 124Mhz AM C: 39Mhz AM C2: 253Mhz AM
5: Maykop-Khanskaya (9005) TILS: 5 RWY: 38.9997
A: 3.9Mhz AM B: 125Mhz AM C: 39.2Mhz AM C2: 254Mhz AM
6: Gelendzhik (9006) TILS: 6 RWY: 40.0218
A: 4Mhz AM B: 126Mhz AM C: 39.4Mhz AM C2: 255Mhz AM
7: Sochi-Adler (9007) TILS: 7 RWY: 61.989
A: 4Mhz AM B: 127Mhz AM C: 39.6Mhz AM C2: 256Mhz AM
8: Krasnodar-Pashkovsky (9008) TILS: 8 RWY: 227.057
A: 4.1Mhz AM B: 128Mhz AM C: 39.8Mhz AM C2: 257Mhz AM **2**
9: Sukhumi-Babushara (9009) TILS: 9 RWY: 296.488
A: 4.1Mhz AM B: 129Mhz AM C: 40Mhz AM C2: 258Mhz AM
10: Gudauta (9010) TILS: 10 RWY: 151.003
A: 4.2Mhz AM B: 130Mhz AM C: 40.2Mhz AM C2: 259Mhz AM
11: Batumi (9011) TILS: 11 RWY: 305.562
A: 4.2Mhz AM B: 131Mhz AM C: 40.4Mhz AM C2: 260Mhz AM
12: Senaki-Kolkhi (9012) TILS: 12 RWY: 274.707
A: 4.3Mhz AM B: 132Mhz AM C: 40.6Mhz AM C2: 261Mhz AM

5
4
5
3

7a
7b

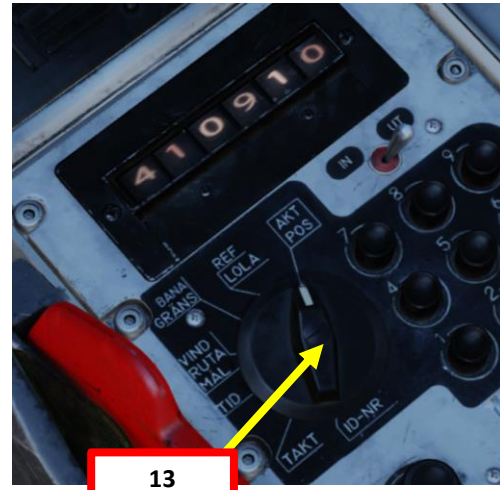**6**
L/MÅL Landing Base Selector

14 – TILS (Tactical Instrument Landing System)
14.2 – Landing Preparation

We will now **set the direction from which to approach the runway**.

8. Set the Data Selector knob to **BANA/GRÄNS** (Runway Heading)
9. Set INPUT/OUTPUT data switch to OUTPUT.
10. The default runway heading is set in a 4-digit form on the BANA/GRÄNS field data: "**3055**" represents a runway heading of **305.5.**
11. The last two digits (**11**) are the available TILS (Tactical Instrument Landing System) Unit Channel associated to the runway.
12. If you want to use the reciprocal (opposite) runway heading, press the L/MÅL (Landing Airport Selector) button. The BANA/GRÄNS field data will update the landing runway heading to **125.5**. In this tutorial we will set the runway heading to **125.5**.
13. Once data transfer is complete, set the Data Selector knob to **AKT POS** (Active Position).
14. Set the TILS channel selector to A (Automatic)

Touchdown Point

Heading: 125

13
AKT POS

10a | 11 | 9
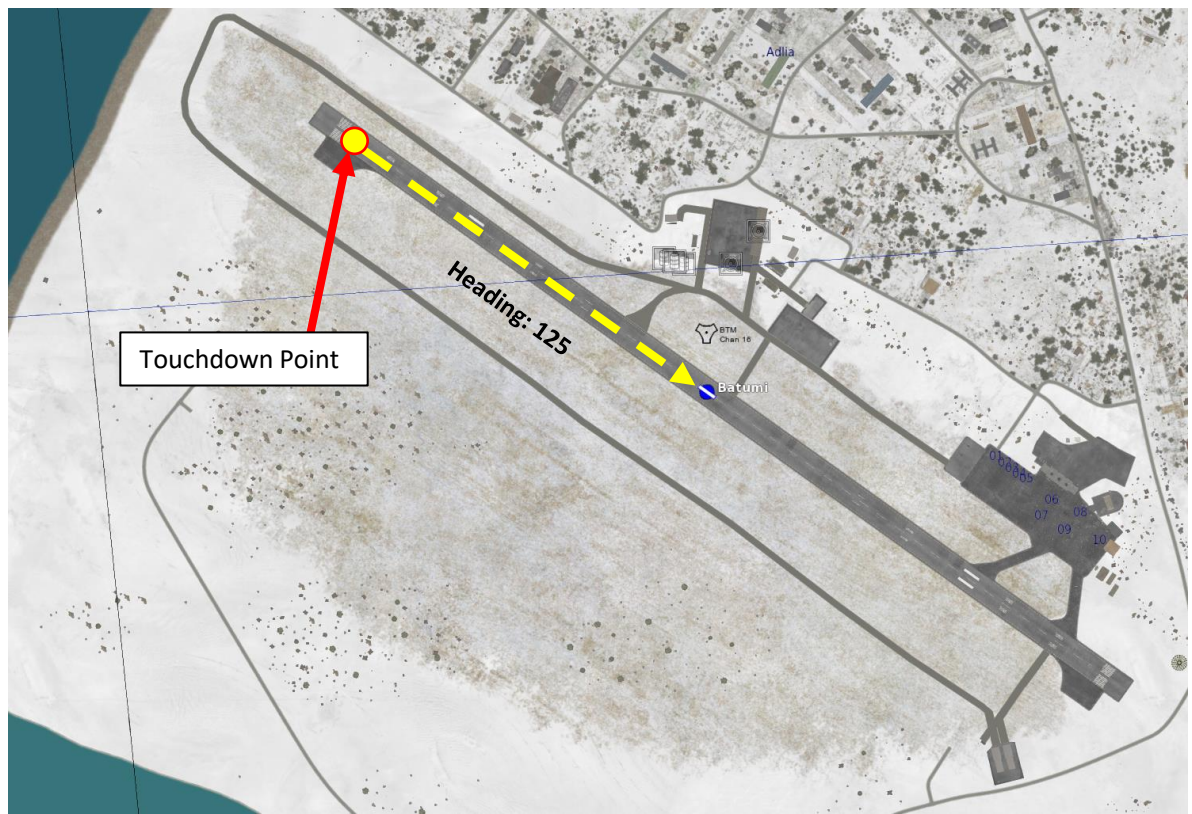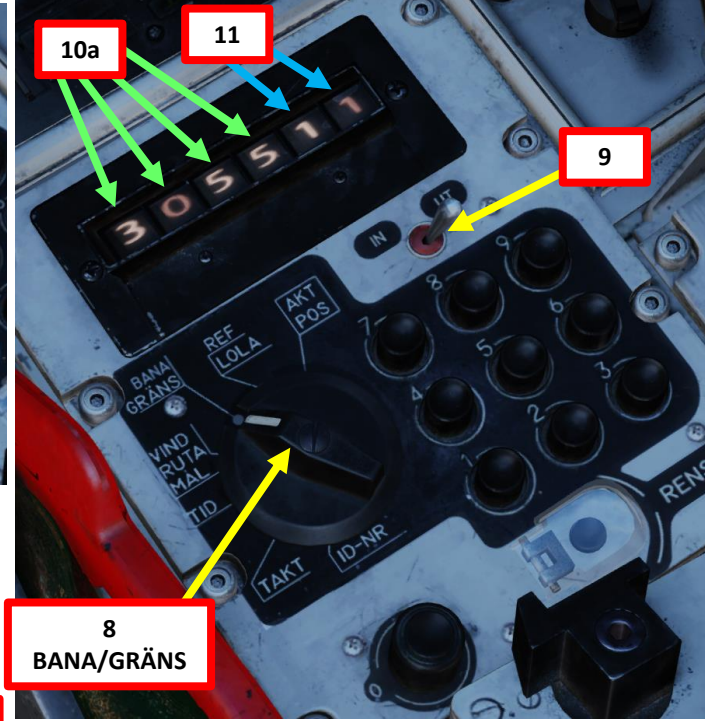
8
BANA/GRÄNS
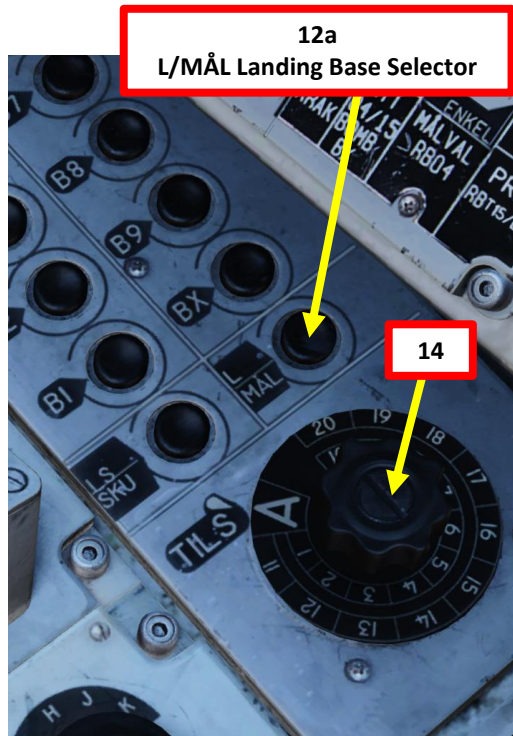
12a
L/MÅL Landing Base Selector

12b | 11

14

468

14 – TILS (Tactical Instrument Landing System)
14.2 – Landing Preparation

15. Look at your kneeboard by pressing "LSHIFT+K" and scroll through the kneeboard pages to the Waypoint Page using "[" and "]" keys. Find your Landing waypoint's QFE if available.
    - In this example, we have a QFE of 1051.9 hPa.
16. Set the Altimeter Setting to 1051.
17. Set HUD to the DOWN (Takeoff/Landing) position and line up with the runway.
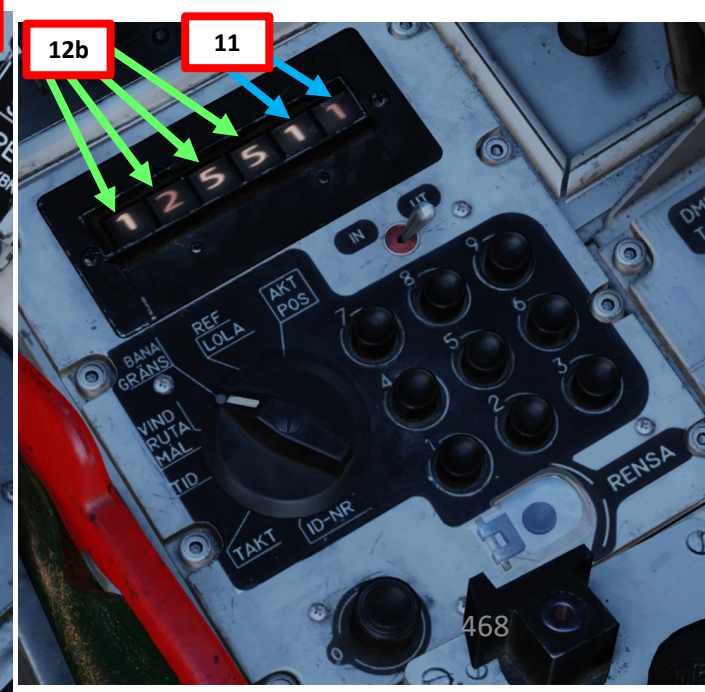18. Reduce airspeed to 550 km/h during approach. This can be done by moving the throttle manually or by engaging the AUTOTHROTTLE lever (DOWN).
19. When using an airbase, odds are that you will have a decent runway length available. If you do not want to use reverse thrust, leave the Thrust Reverser lever disarmed (pushed IN). In our case, we will pull Thrust Reverser lever to arm it.
20. Set HUD/SI Slave Switch to T (*TILL*, ON). This activates LOWNAV (Decluttered HUD mode) when altitude is lower than 100 m above ground level.
21. Set Altitude Source Selector (HÖJD CISI) to RHM. This will ensure the radar altimeter is used as the primary altitude source, which has a more accurate altitude reading at low altitudes.
22. Deploy Landing Gear by setting Landing Gear Lever DOWN
23. Set Landing/Taxi (*Strålkast*) Lights Switch – ON (DOWN)

DATE 2016-01-21	MISSION ID tempMission	CALLSIGN 111 Strike	TASK
FUEL WBGHT 4477	LOADOUT 0	TOTAL WEIGHT 16277	V2 373
ENGINE START TIME 13:55:00	TAKE-OFF TIME 14:00:00	RUNWAY HEADING 20541	QNH 1053.2

WAYPOINT NAME Take-Off Senaki-Kolkhi			
COURSE (T) 20541	HEADING (M) 28	G/S 500	IAS 499
DISTANCE 0.0	TOF 00:00:00	ETA 14:00:00	QFE 1051.5
ALTITUDE 13	VERTICAL ANGLE 0	FUEL RESERVE 100	BINGO FUEL 20

WAYPOINT NAME B1			
COURSE (T) 238	HEADING (M) 245	G/S 555	IAS 488
DISTANCE 61.0	TOF 00:06:35	ETA 04:06:35	QFE 1053.2
ALTITUDE 2000	VERTICAL ANGLE 2	FUEL RESERVE 95	BINGO FUEL 17

WAYPOINT NAME B2			
COURSE (T) 217	HEADING (M) 224	G/S 555	IAS
DISTANCE 26.1	TOF 00:02:49	ETA 18:16:01	QFE 10 3.2
ALTITUDE 2000	VERTICAL ANGLE 0	FUEL RESERVE 93	BINGO FUEL 17

WAYPOINT NAME Landing Batumi			
COURSE (T) 119	HEADING (M) 126	G/S 500	IAS 140
DISTANCE 44.1	TOF 00:05:17	ETA 08:30:13	QFE 1051.9
ALTITUDE 10	VERTICAL ANGLE -3	FUEL RESERVE 90	BINGO FUEL 13

15

18a

22a

**22b
Gear Down**

**19
Armed**

16

23

20

21

18b
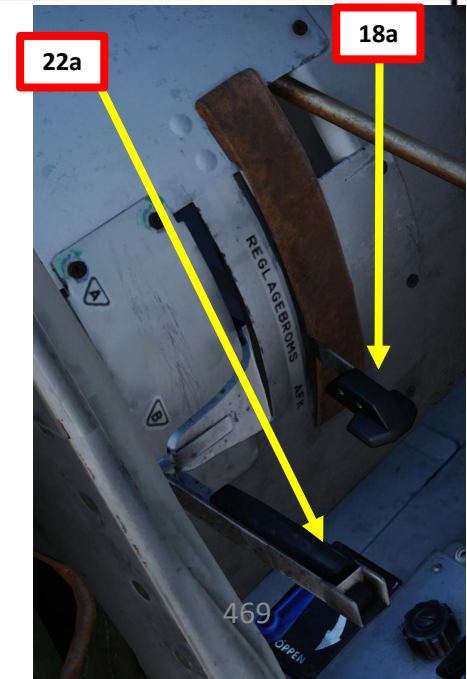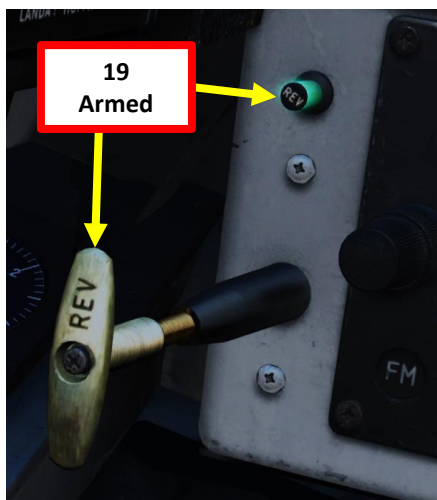
14 – TILS (Tactical Instrument Landing System)

14.3 – Phase 1 Approach

24. Set Master Mode Selector to NAV (Navigation)
25. Turn radar ON by setting A0/A1/A2 switch to Mode A1 (PPI, or Plan-Position Indicator).
26. Set the Navigation Data selector to AKT POS (Actual Position) and press L/MÅL (Landing Airport Selector) to select landing waypoint L1 (Primary Landing Base).
27. On destination change to the landing waypoint, the central indicator (CI) displays an extended runway centerline of the chosen runway. The line corresponds to 20 km and aligns along the extended runway centerline.
28. Navigate towards Waypoint L1. Steer the aircraft to:
    • Set the ADI (Attitude Director Indicator) lateral steering line to the center
    • Set the HUD's Velocity Vector in the center of the pole tracks
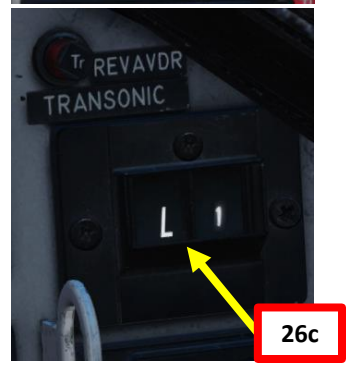   • Line up with the L1 waypoint's runway line

Distance to L1:
5 Swedish miles (50 km)

28

26a

Tr REVAVDR
TRANSONIC
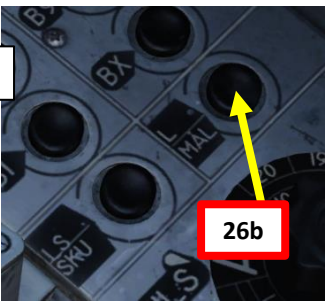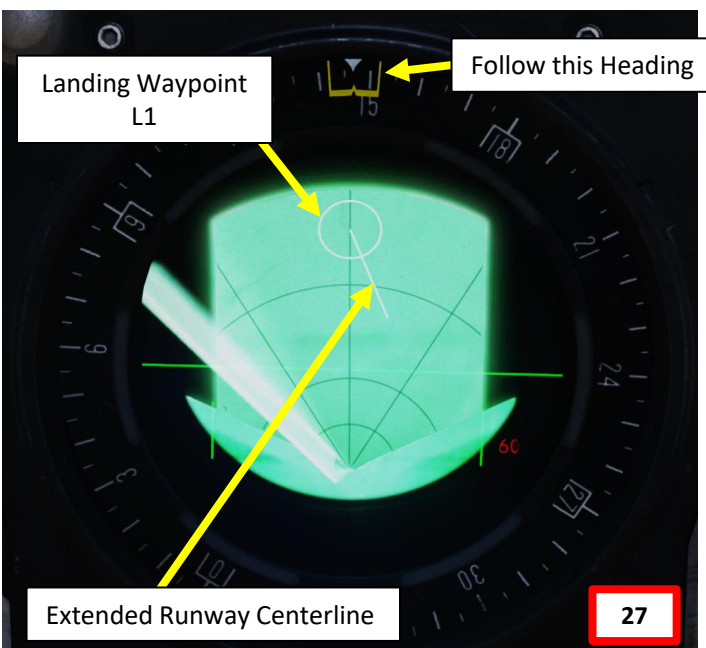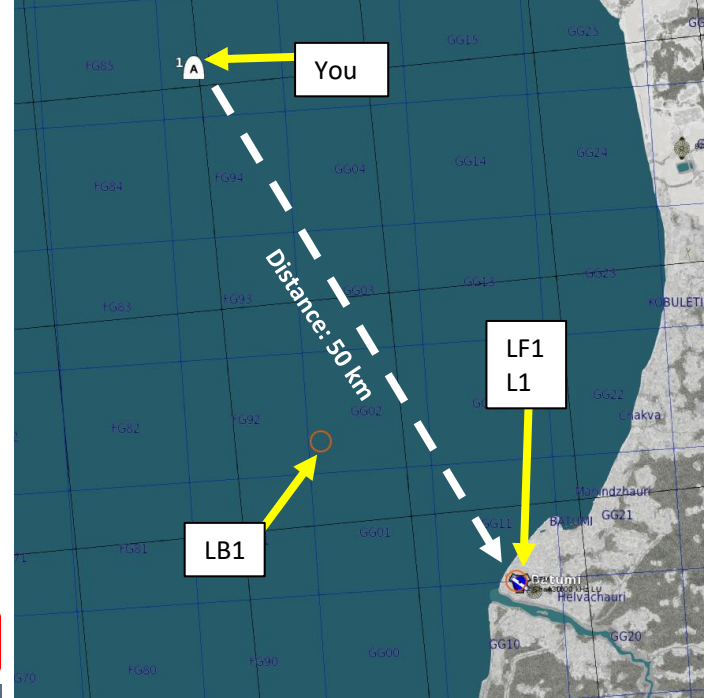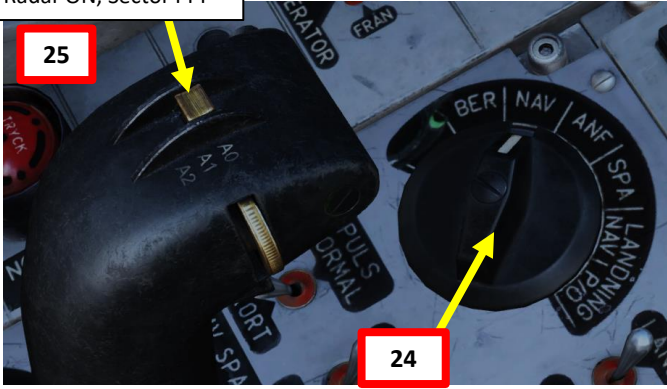
L 1

Radar Mode Selector
A0: Radar OFF
A1: Radar ON, Sector PPI

26c

25

You

Distance: 50 km

LF1
L1

LB1

28

Lateral Steering Line

Landing Waypoint L1

Follow this Heading

26b

24

Extended Runway Centerline

27

28

Flight Path Vector

470

14 – TILS (Tactical Instrument Landing System)

14.4 – Phase 2 Approach

29. Maintain airspeed to 550 km/h during approach.
30. Set Master Mode Selector to LANDNING NAV (Instrument Navigation Landing)
31. The Destination Indicator will switch from L1 (Primary Landing Base) to LB1 (Approach Waypoint), which is an automatically computed point to help you line up with the runway 20 km out from the Landing Base.
32. On the Central Indicator (CI), the Approach Waypoint and extended runway centerline are shown, indicating whether a left or right turn onto the runway centerline will be made. Thereby, the "ring" no longer corresponds to the runway centerpoint as it did previously for L1.
33. Navigate towards LB1 (Approach Waypoint). Steer the aircraft to:
    - Set the ADI (Attitude Director Indicator) lateral steering line to the center
    - Set the HUD's Velocity Vector in the center of the pole tracks
34. Use the LB1 circle as a reference on the CI display.
35. The descent command given in the HUD will require you to set the aircraft to follow a 4 deg descent towards an altitude of 500 m.

33

Distance to LB1: 40 km

31

30

You

Distance: 40 km

LF1

LB1

32

Follow this Heading

Approach Waypoint LB1

34

Extended Runway Centerline

Flight Path Vector

33

Lateral Steering Line

33

471
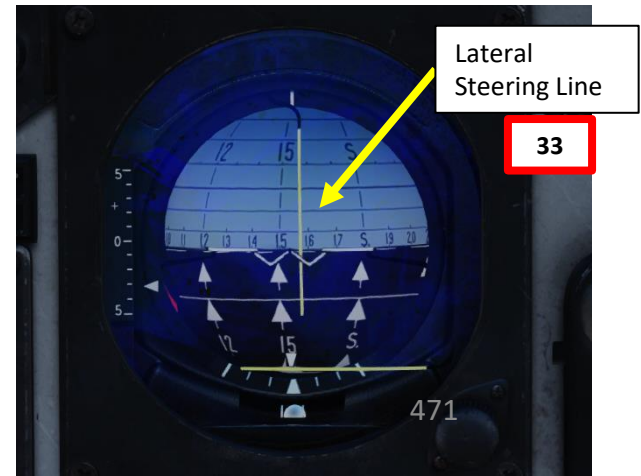
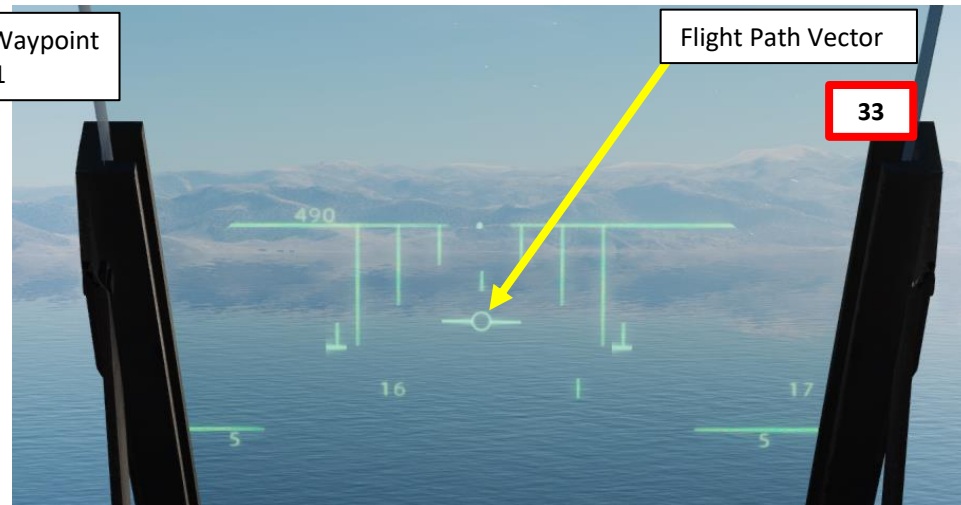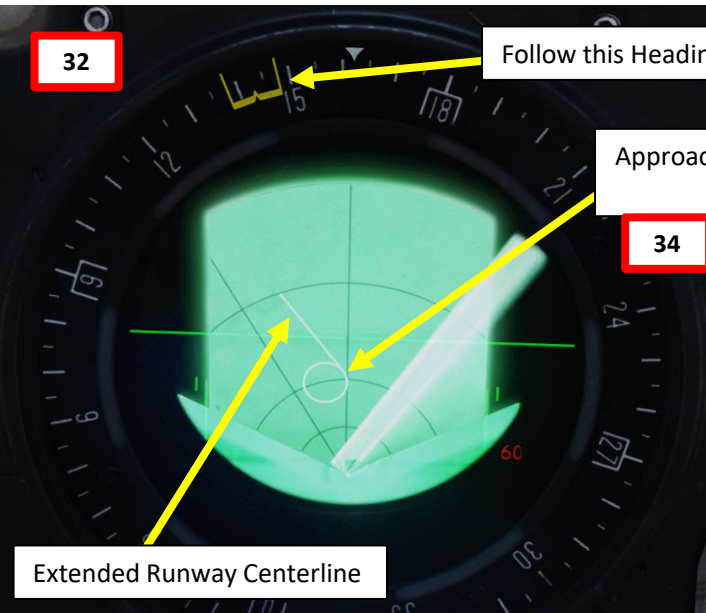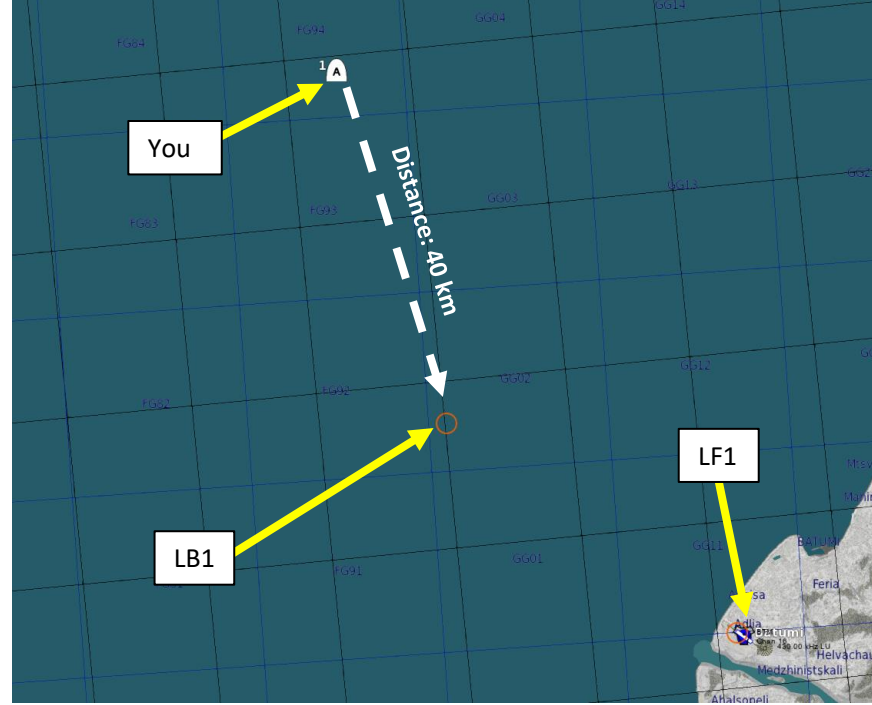# 14 – TILS (Tactical Instrument Landing System)

14.4 – Phase 2 Approach

36. When the aircraft passes near LB1 (Approach Waypoint), the Destination Indicator will automatically switch to LF1 (Touchdown Waypoint).
37. The central indicator (CI) displays an extended runway centerline of the chosen runway. The line corresponds to 20 km and aligns along the extended runway centerline.
38. Since we are landing on a road base with no TILS (Tactical Instrument Landing System) equipment available, we will Navigate towards LF1 (Touchdown Waypoint). Steer the aircraft to:
    - Set the ADI (Attitude Director Indicator) lateral steering line to the center
    - Set the HUD's Velocity Vector in the center of the pole tracks

Distance to LF1: 32 km

38

Tr REVAVDR
TRANSONIC

L F 1

36

You

Current Heading

Distance: 32 km

LB1

Distance: 20 km
Heading 125

LF1

37

Follow this Heading

Touchdown Waypoint LF1

Extended Runway Centerline

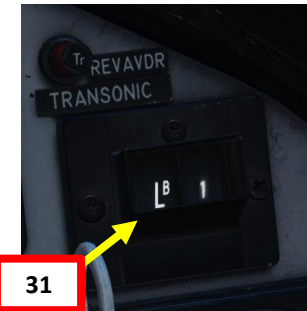**38**

Flight Path Vector

38

Lateral Steering Line

472

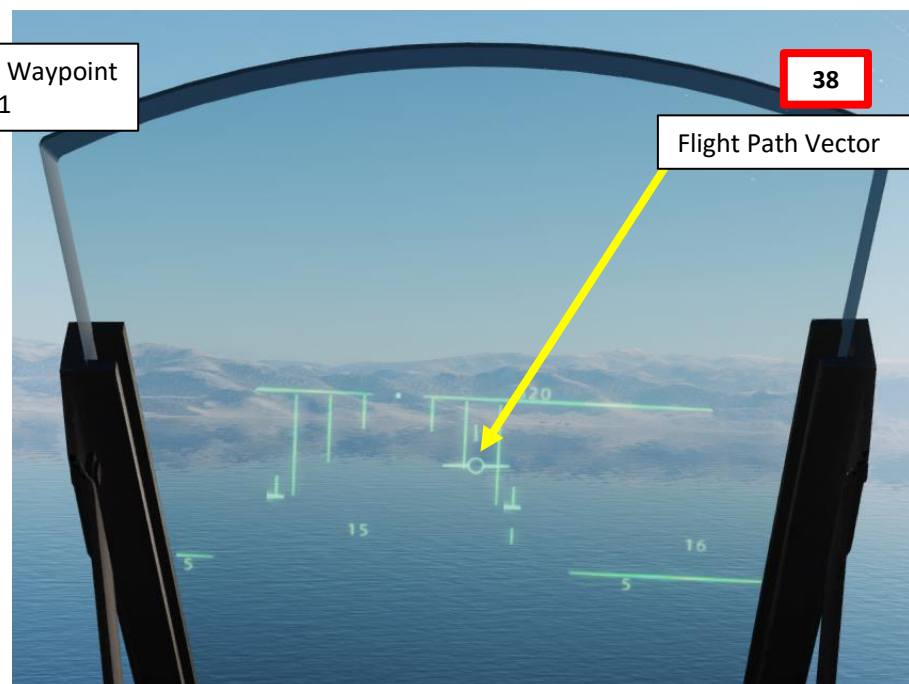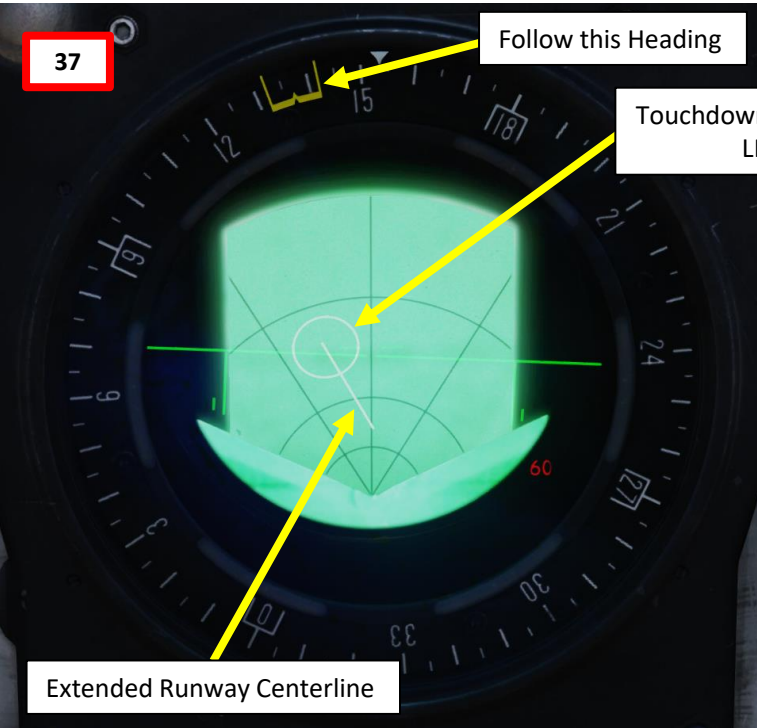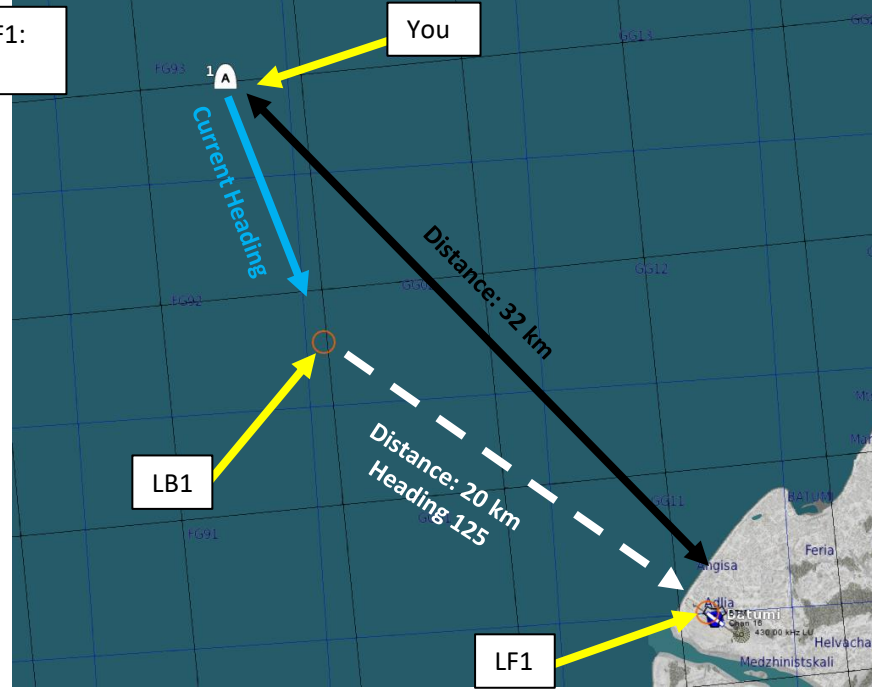# 14 – TILS (Tactical Instrument Landing System)
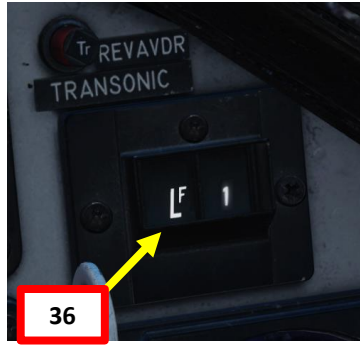
14.4 – Phase 2 Approach

39. The TILS (Tactical Instrument Landing System) light should illuminate between 20 and 25 km from the airport when the TILS system is "locked" on the glideslope and localizer.
40. On the HUD, the commanded altitude should be 500 m until the "Time Line" appears on the HUD.
41. The "Time Line" appears 40 seconds before the descent command is given,
42. Descent command is given when aircraft is 10 km away from LF1 (Touchdown Waypoint), indicated by the time line reaching the outer markers.
43. Place your Flight Path Vector between the pole tracks and line up the aircraft for the final approach.

41

42

40 s before descent   Descent

Flight Path Vector

43

Outer Marker   Outer Marker

Time Line   41

TILS

39

473
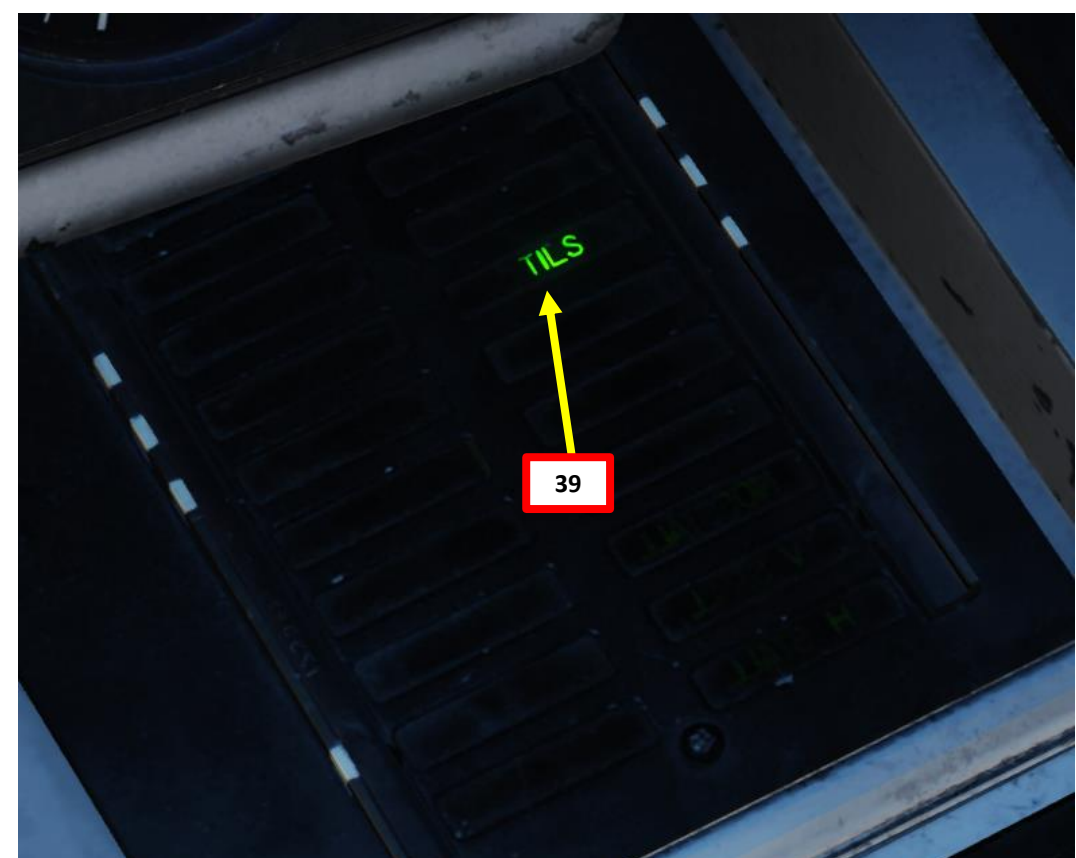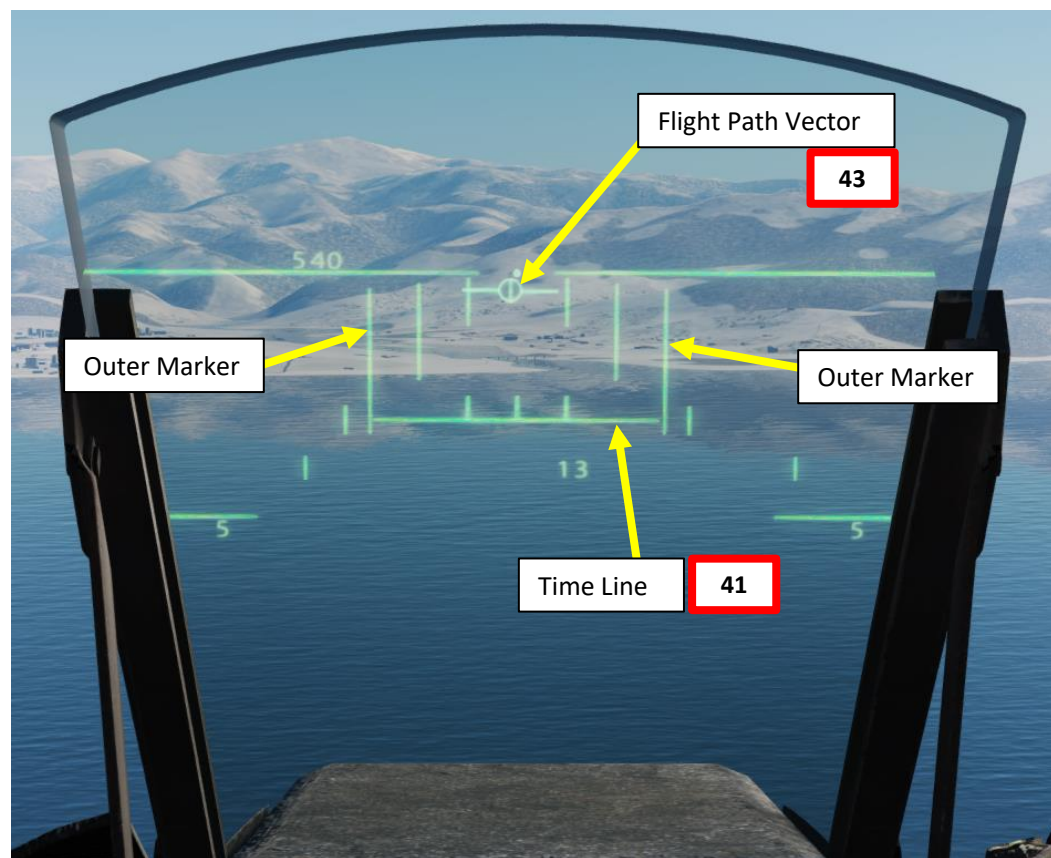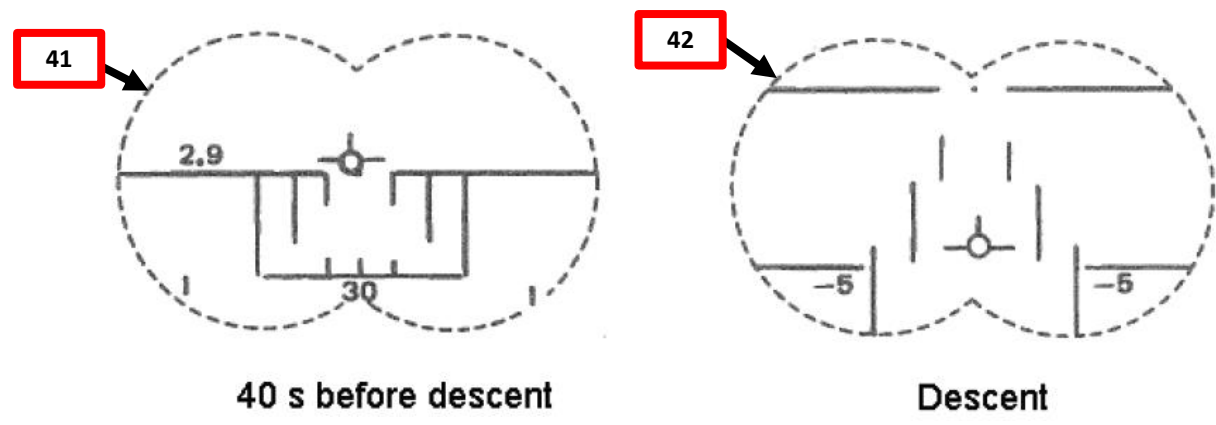
14 – TILS (Tactical Instrument Landing System)

14.4 – Phase 2 Approach

44. Follow the ADI (Attitude Director Indicator) and HUD (Heads-Up Display) steering cues to intercept localizer (lateral deviation) and glideslope (glide path vertical deviation). The glide slope should be intercepted about 10 km from the runway.

Distance to LF1: 16 km
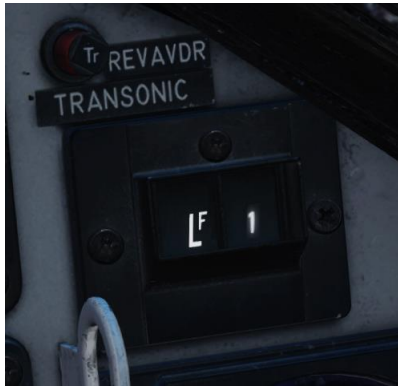
LB1

You

Distance: 16 km
Heading 105

LF1

Follow this Heading

Touchdown Waypoint LF1

Flight Path Vector

Lateral Steering Line

Extended Runway Centerline
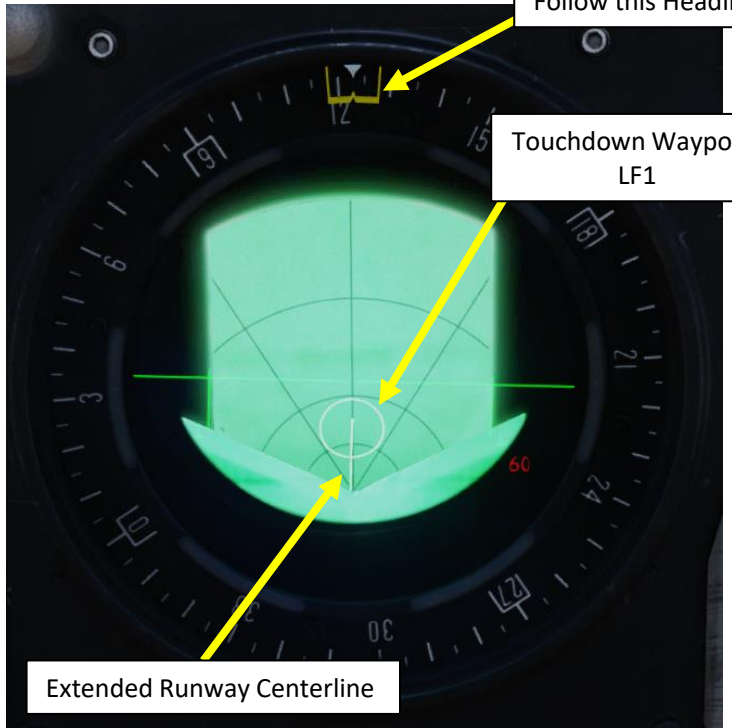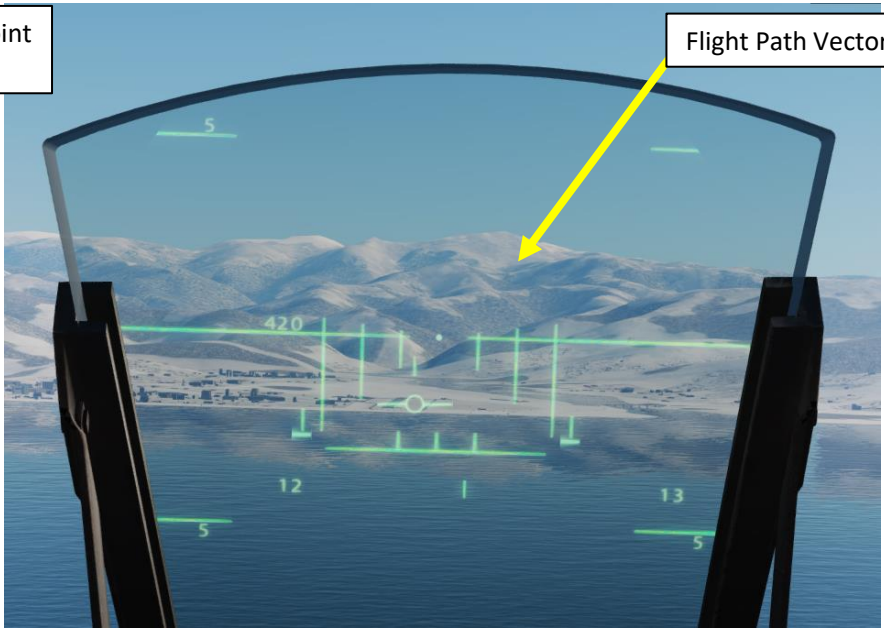
14 – TILS (Tactical Instrument Landing System)

14.5 – Phase 3 Approach

45. During phase 3, automtic TILS fixes are continually made to update the aircraft's position in the navigation system. Keep the localizer and glideslope steering bars centered.

Runway centreline

Beam

Glideslope

Transmitter

Vertical reference plane (localiser)

Flight Path Vector
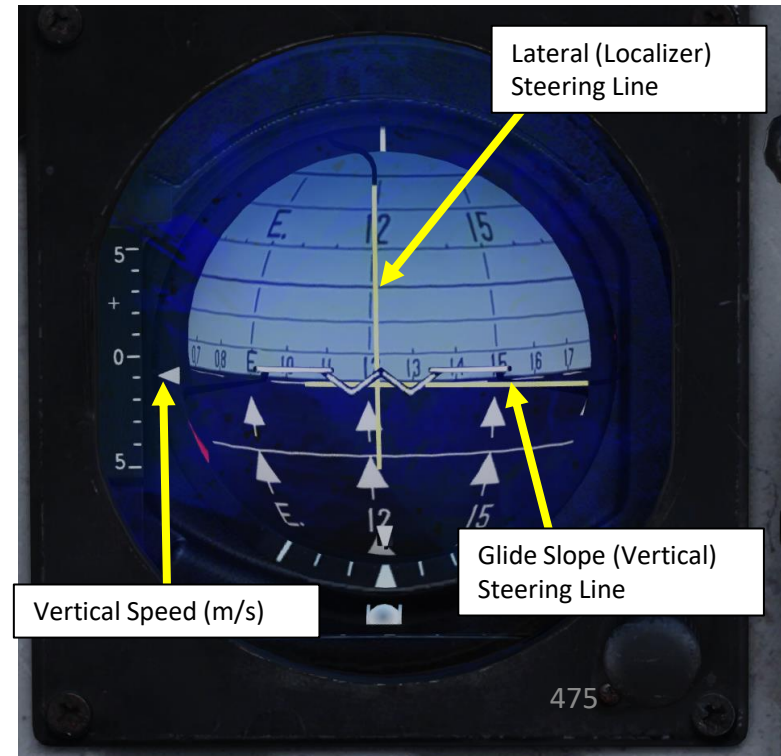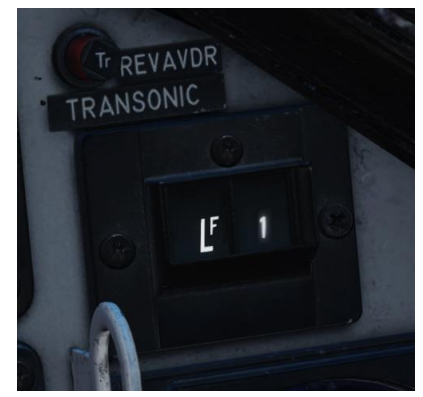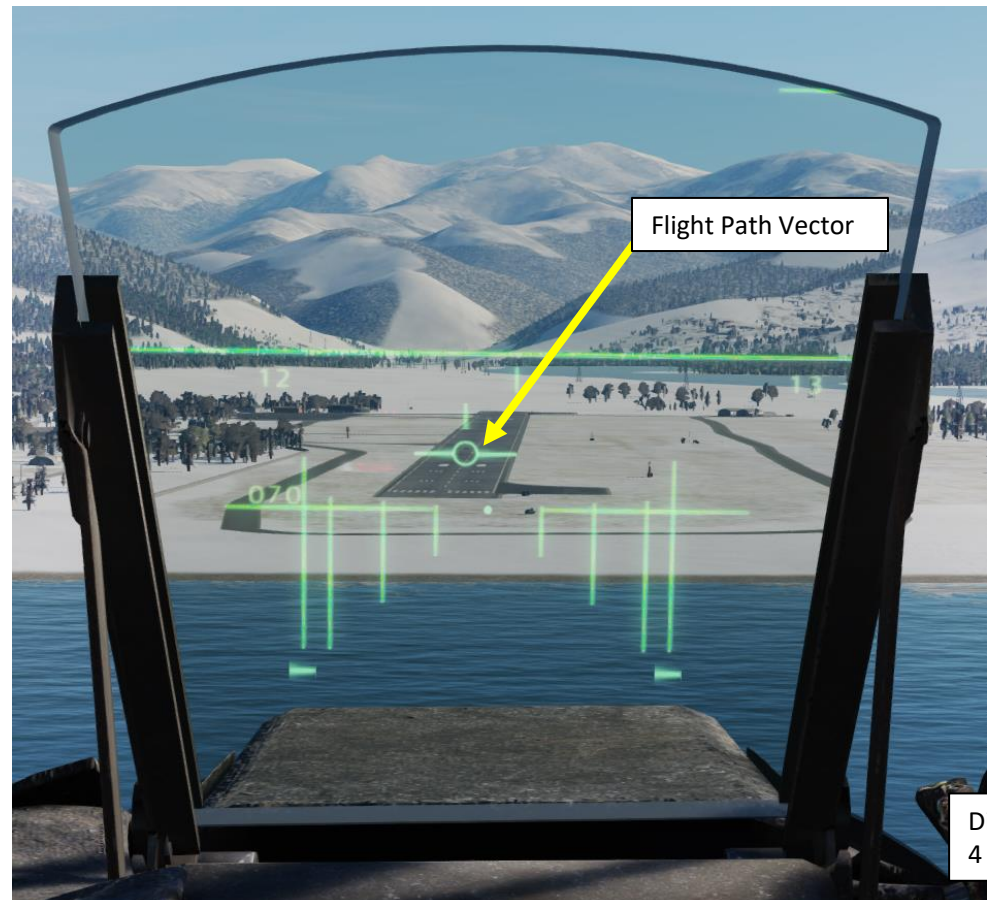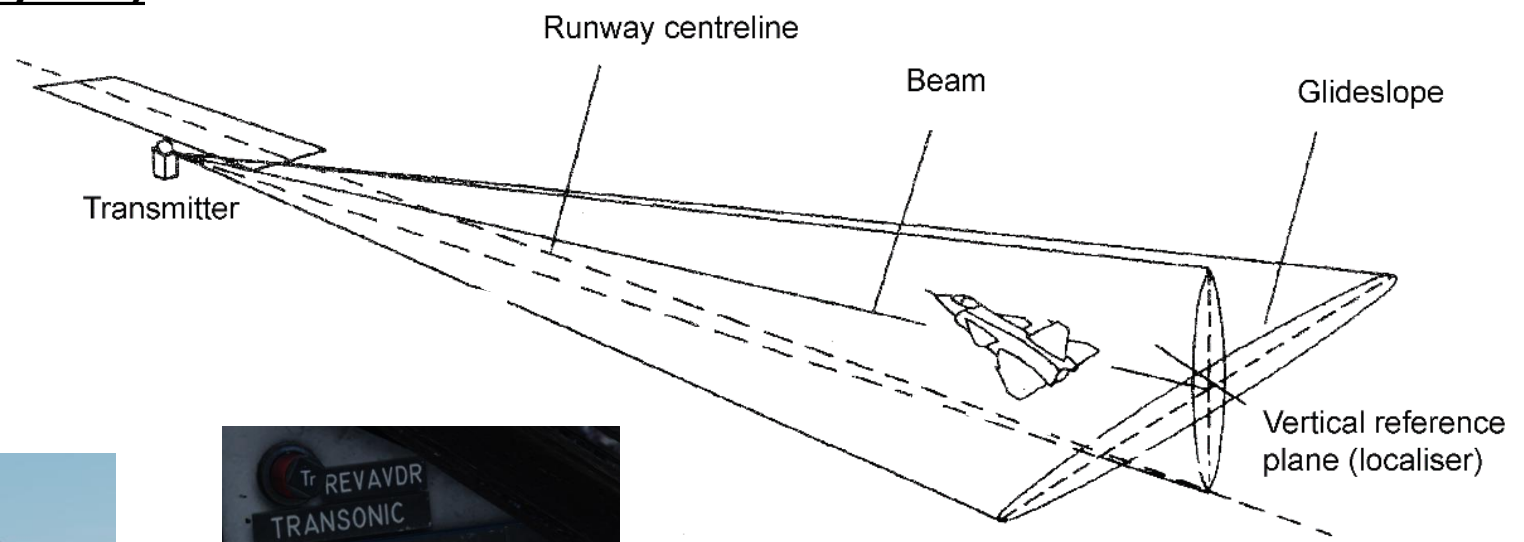
Distance to LF1: 4 km

Lateral (Localizer) Steering Line

Glide Slope (Vertical) Steering Line

Vertical Speed (m/s)

475

14 – TILS (Tactical Instrument Landing System)

14.5 – Phase 3 Approach

14 – TILS (Tactical Instrument Landing System)

14.6 – Touchdown & Thrust Reversal

46. When on final, keep your Flight Path Vector on the runway
47. Maintain a MAXIMAL AoA (Angle of Attack) of 12 deg AoA and aircraft attitude by aligning the descent line on the runway threshold. This will give you a descent angle of 3 deg.
    • Note: Do not slow down under 260 km/h.
48. When the radar altitude is less than 15 m AGL (Above Ground Level), the Flight Path Vector changes function to a sink-rate indicator. If the flight path vector is held at the glide path line, the sink rate will not exceed 2.96 m/s. If the radar altimeter is not available, the mode engages at 30 meters altitude. Keep the Flight Path Vector above the lower horizontal line (glide slope line) to ensure a safe vertical speed and smooth touchdown.

Fin centred = Airspeed correct

Fin high = Airspeed too high

Fin low = Airspeed too low.

Blinking fin = Airspeed critically low

47

Angle of Attack (deg)

HUVUDVARNING

Flight Path Vector

46

48

Flight Path Vector

In LANDNING NAV Master Mode, a glide path line is set at 2.87° below the horizon and represents the recommended glide path.

14 – TILS (Tactical Instrument Landing System)

14.6 – Touchdown & Thrust Reversal

49.   Prior to touchdown, verify that the thrust reverser lever is ARMED (pulled) and the REV light is illuminated (indicates reverser circuits are active).
50.   On touchdown, throttle back to IDLE and resist the urge to pull on the stick. Let the aircraft gently touch the ground by itself.
51.   As your main landing gear wheels touch the ground:
   •   The autothrottle will automatically disengage.
   •   The reverser flaps will close when the main landing gear is depressed but will open again until the nose landing gear is depressed.

49
Armed

14 – TILS (Tactical Instrument Landing System)

14.6 – Touchdown & Thrust Reversal

52. When your nose landing gear wheel will touches the ground, the thrust reverser flaps will deploy/engage and the thrust reverser system will produce reverse thrust.
    - If thrust reverser is engaged, throttling up will increase REVERSE thrust, which will slow you down even more.
    - Afterburner may not be used during reversal, as this would cause extensive damage to the aircraft.
    - Use of thrust reversal with a large amount of thrust combined with heavy braking will deteriorate the yaw stability of the aircraft.
53. When reversing, **do not apply the brakes** until the aircraft has come to a full stop, as this may cause the aircraft to pivot backwards.
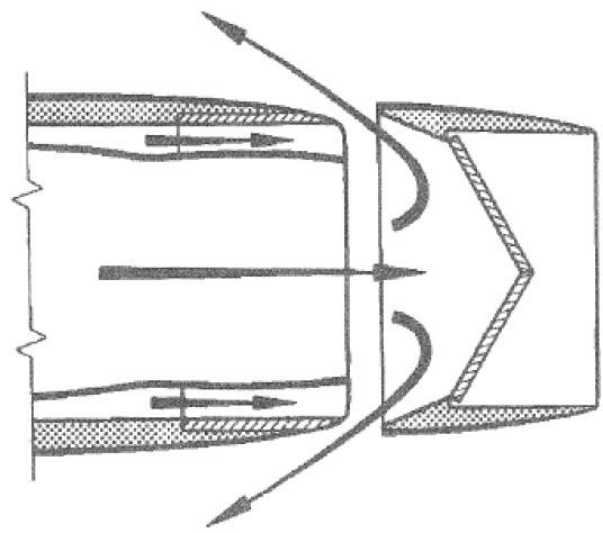
Thrust Reverser System (seen from above)

14 – TILS (Tactical Instrument Landing System)

14.6 – Touchdown & Thrust Reversal

54. During reversal, a special autopilot mode is engaged (provided SPAK is engaged) which automatically applies rudder input to maintain stability.

55. When the REV AVDR / TRANSONIC light illuminates, reduce thrust by gently throttling back to IDLE. This indicator light tells you to REDUCE THRUST.
    • This reduces the risk compressor stalls by ensuring the exhaust gases ejected forward are not ingested by the engine intake, which can potentially cause an engine flameout.

56. Push thrust reverser lever IN to DISARM the thrust reverser. Make sure the REV light extinguishes (indicates reverser circuits are inactive).

57. Taxi back to the parking spot.

56 Disarmed

F10 MAP WAYPOINTS – DATA CARTRIDGE IN MULTIPLAYER

If you play in multiplayer and don't feel like adding the waypoint coordinates every time, there is a way to create a new mission data cartridge with waypoints created by using the F10 map.

1. Make sure your aircraft's data cartridge is removed
2. Press F10 to display the map, then select the MARK LABEL button
3. Click where you want to create a point, then type "B" followed by the waypoint number you want to create. "B1" would be "Navigation Waypoint 1". For a target point, type "M" followed by the target point number you want to create. "M2" would be "Target Point 2".

481
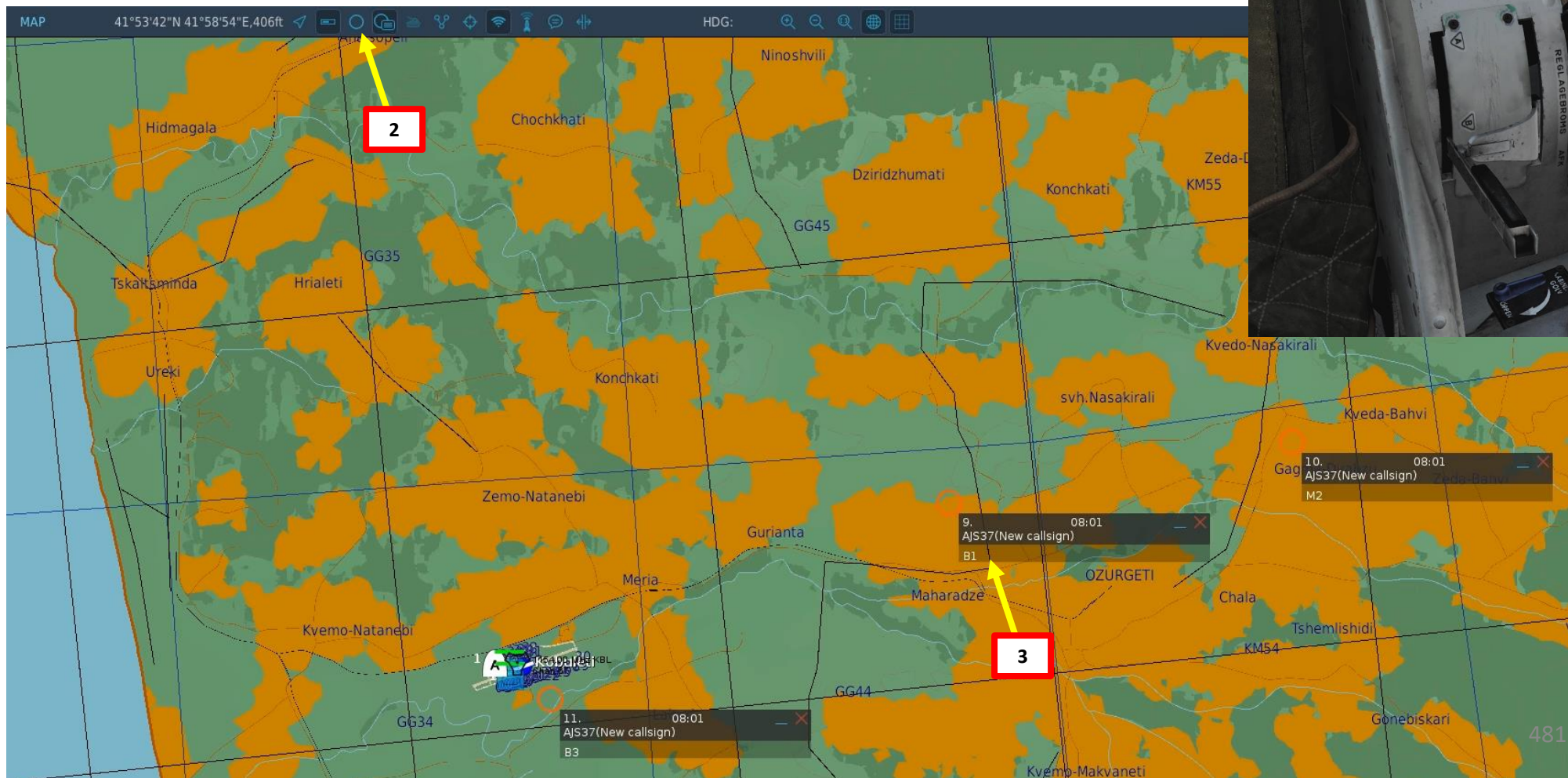
F10 MAP WAYPOINTS – DATA CARTRIDGE IN MULTIPLAYER

4. Display your kneeboard using the "RSHIFT+K" binding.
5. Cycle through pages using "[" and "]" until you reach the GROUND CREW SETTINGS page.
6. Your current selected data cartridge is indicated.
7. Change data cartridge by using the "LCTRL+LALT+C" binding until you find the "Cartridge from marks on F10 map".
8. Click on the data cartridge slot to load the new cartridge.
9. Start data cartridge loading procedure as shown in the start-up procedure.

CONTROL OPTIONS

| AJS37 | All | Reset category to default | Clear cat |

Action	Category	Keyboard
Kneeboard Next Page	Kneeboard	]
Kneeboard Next Shortcut	Kneeboard	
Kneeboard ON/OFF	Kneeboard	RShift + K
Kneeboard Previous Page	Kneeboard	[
Select Data Cartridge - Down	Navigation	LCtrl + LAlt + C
Select Data Cartridge - Up	Navigation	LCtrl + LShift + C

Groundcrew settings: **5** **4**

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
0 Mission Editor **6**

Mission plan as defined in the Mission Editor

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
14 Cartridge from marks on F10-map. **7**

Contains 3 marks.

F10 MAP WAYPOINTS – DATA CARTRIDGE IN MULTIPLAYER

LOADING UP FLIGHT PLAN

10. Load flight plan data from the mission cartridge by setting the Data Selector knob to REF/LOLA
11. Set INPUT/OUTPUT data switch to INPUT.
12. Enter code 9099 (Fictional Airport No. 99).
13. Press the LS waypoint to start data transfer process. The data transfer will be in-progress when the first "9" digit is flashing, and the process will be complete once all digits revert back to "0".
14. Once data transfer is complete, set INPUT/OUTPUT data switch to OUTPUT.
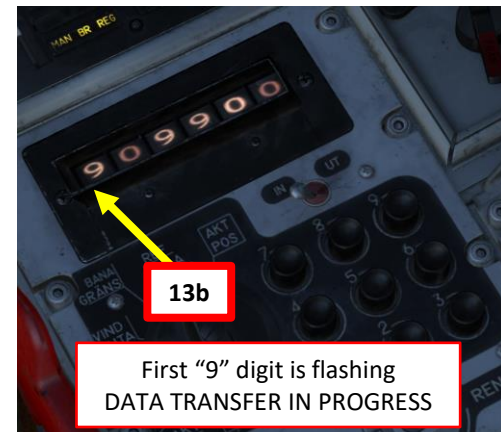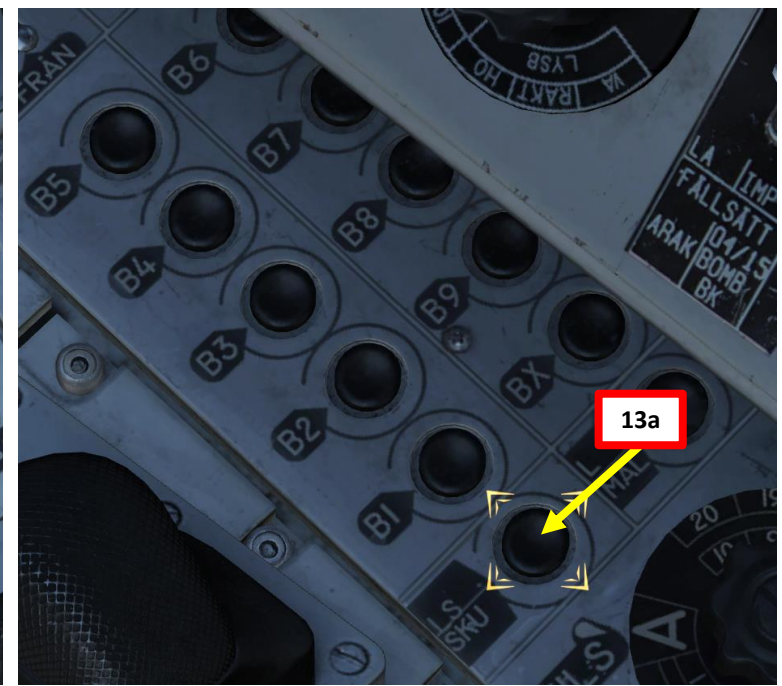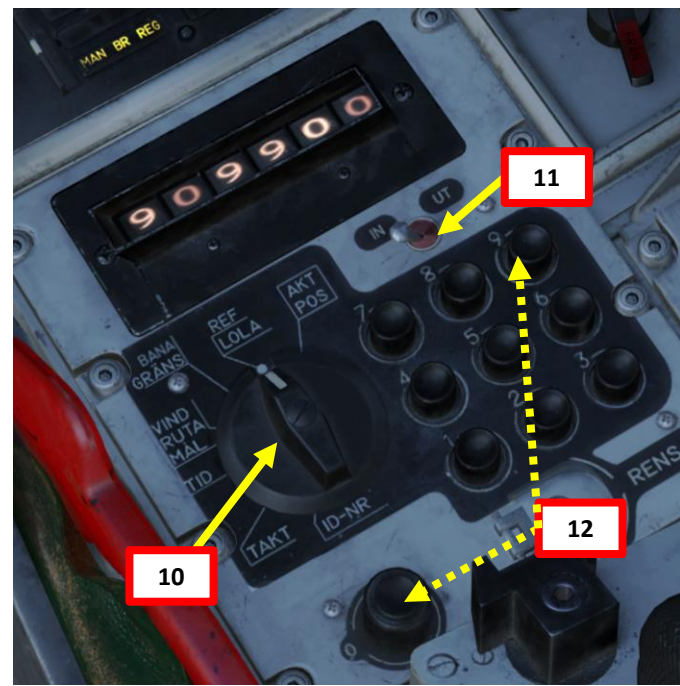
First "9" digit is flashing
DATA TRANSFER IN PROGRESS

All digits set to 0
DATA TRANSFER COMPLETE

DATA CARTRIDGE FLIGHT PLAN GENERATION

The flight plan set in the Data Cartridge can be taken from either:
- The Mission Editor
- An Auto-Generated Flight Plan from F10 Map markers
- An Auto-Generated Flight Plan from an existing unit on the map
- Generated from F10 Map markers

You can select what flight plan is on the Data Cartridge by opening the kneeboard (RSHIFT+K), cycling through pages using "[" and "]" until you reach the GROUND CREW SETTINGS page and using the "LCTRL+LALT+C" binding to cycle between flight plan types.

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
0 Mission Editor

Mission plan as defined in the Mission Editor

Generated Flight plan from Mission Editor

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
12 Autogenerated attack on marker position

Target location:
33:22:25 35:27:21

Departure-time:
09:25:41
Time-on-target:
09:31:33

Ingress direction:
180 deg

Egress direction:
045 deg

Target movement:
000 deg   0 km/h

Area weather:
Wind: 000 deg at 0 m/s
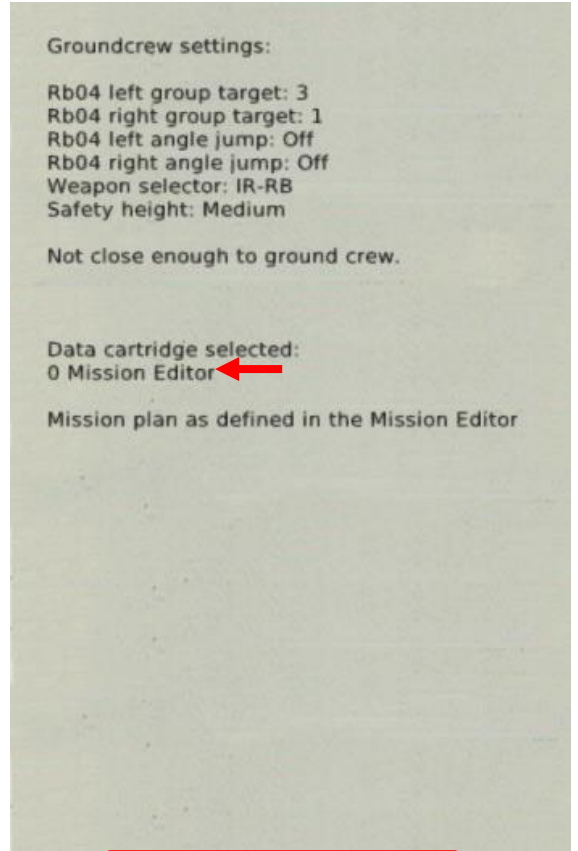QFE: 963.5

Auto-Generated Flight plan from F10 Map Marker

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
10 Autogenerated attack BTR-80 x 3

Target location:
42:02:08 41:45:58

Departure-time:
14:02:14
Time-on-target:
14:07:08

Ingress direction:
203 deg

Egress direction:
068 deg

Target movement:
080 deg   0 km/h

Area weather:
Wind: 335 deg at 3 m/s
QFE: 1006.0

Auto-Generated Flight plan from existing unit

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
29 Cartridge from marks on F10-map by New callsign

Created: 2020-12-13 02:50:16 Contains 6 marks.

Generated Flight plan from F10 Map Markers

ELINT and the U22/A ECM Pod - Introduction

Signals intelligence (SIGINT) is intelligence-gathering by interception of signals, whether communications between people (communications intelligence—abbreviated to COMINT) or from electronic signals not directly used in communication (electronic intelligence—abbreviated to ELINT). Within DCS, ELINT is used mainly to triangulate radar emitter positions

The Viggen can equip the U22 or the U22/A ECM (Electronic Countermeasures) Jammer pod. The U22/A pod is capable of performing silent recording for ELINT purposes, but the older U22 does not have this capability.

U22/A ECM Pod

KB Chaff/Flare Countermeasures Dispenser Pod

ELINT and the U22/A ECM Pod - Introduction

The Viggen uses the U22/A pod to record the emitter's signal's PRF (Pulse Repetition Frequency) and Sequence Broadcast (Scan time of radar) to identify the nature of the emitter, and the first and last time the emitter transmitted a signal to approximate a location zone. With this data, two points are generated to approximate the North-West corner and South-East corner of a zone where the emitter is. The more information you gather from an emitter, the better chance of having an accurate location estimate.

ELINT:

Emitter: 1
Freq: A PRF: 697
First signal: 8:0:2 Last signal: 0:0:0
Sequence broadca: 1s Silent: 5s
NW: 42:26:29 041:15:57 SE: 42:18:34 041:26:44

Radar Emitter's Approximated Location Zone Rectangle

Radar Emitter's Approximated Location Zone North-West Corner

Radar Emitter's Actual Location

Triangulation Zone of Radar Emitter's Location

Radar Emitter's Approximated Location Zone South-East Corner
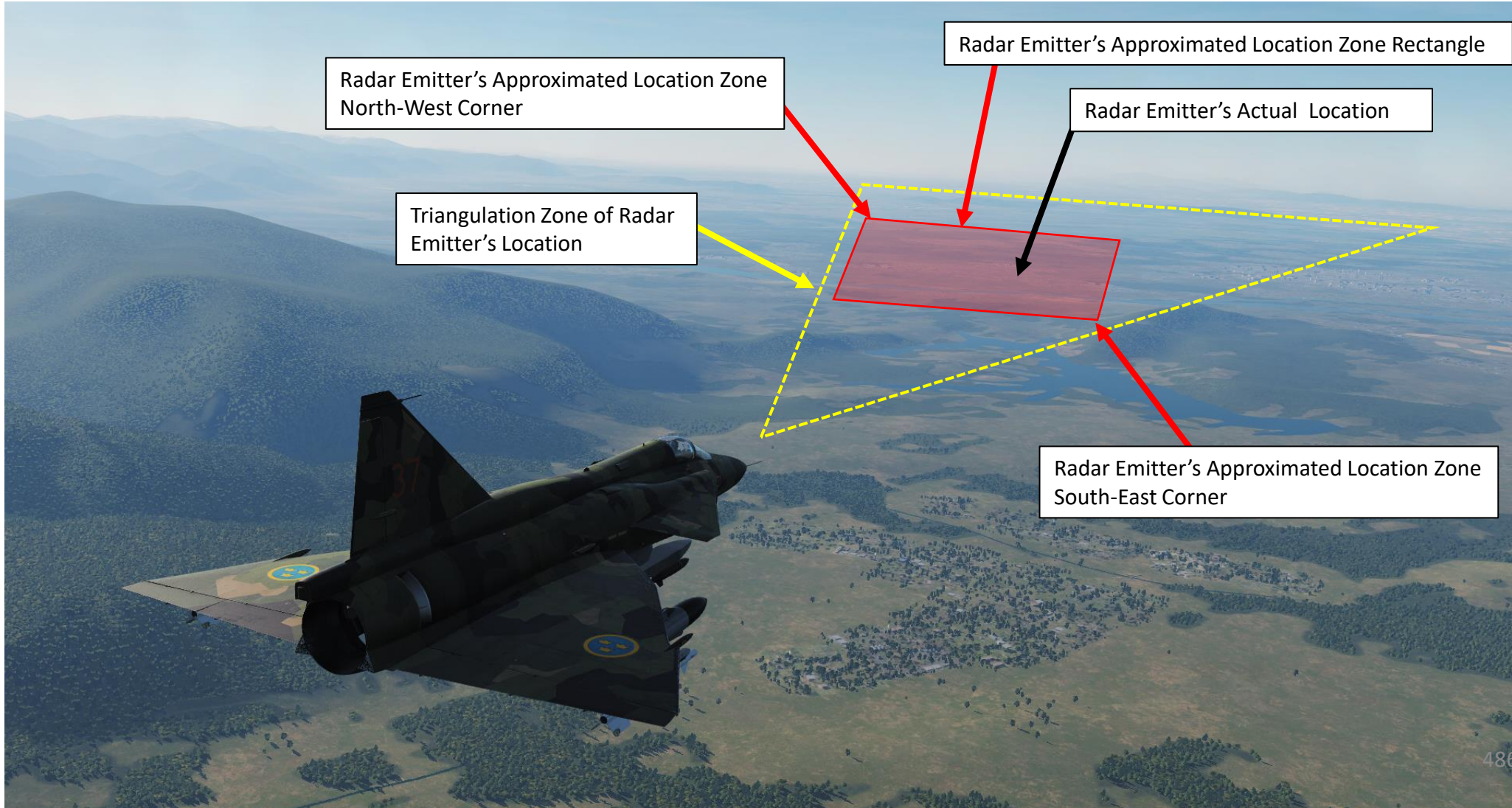
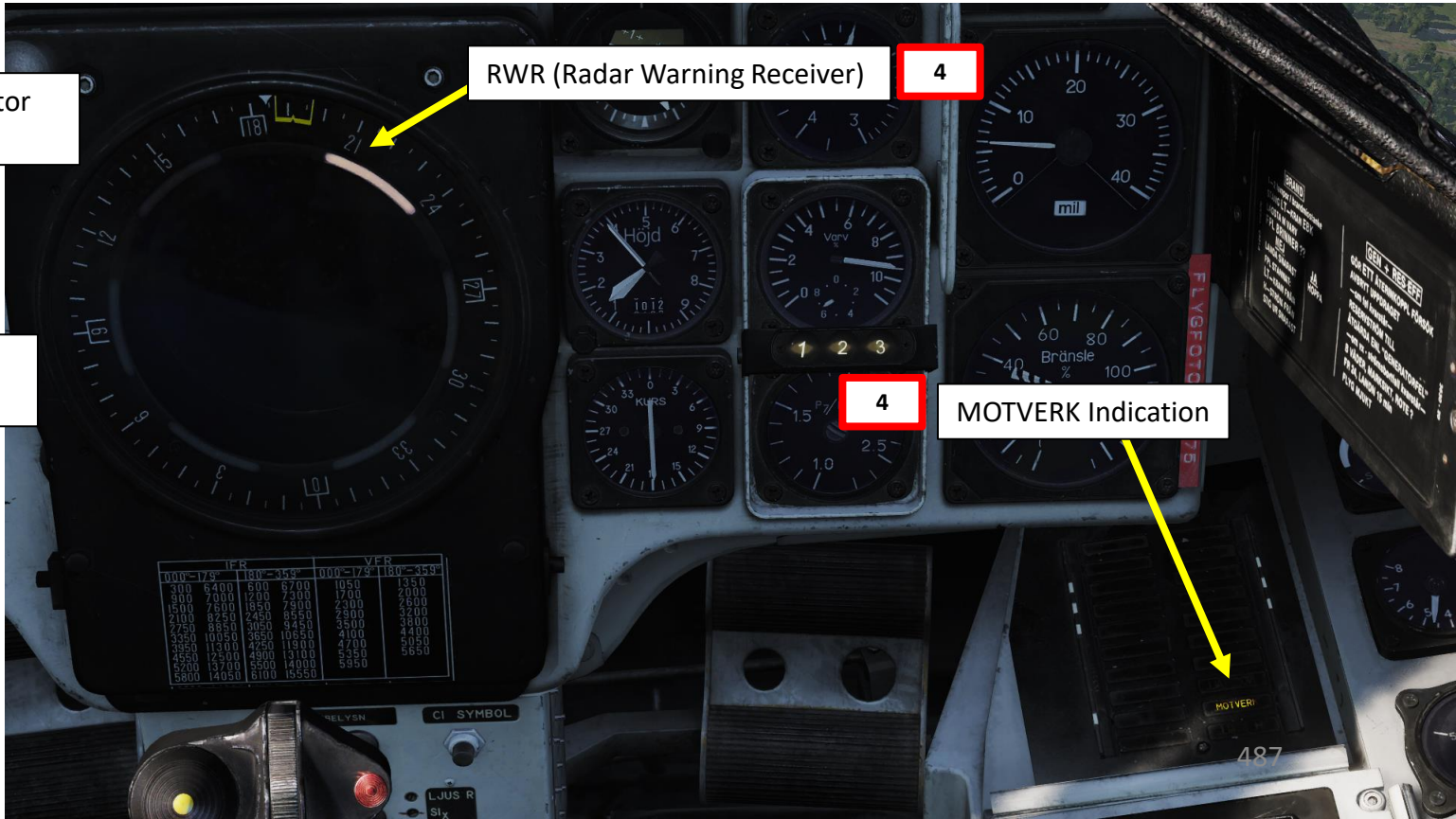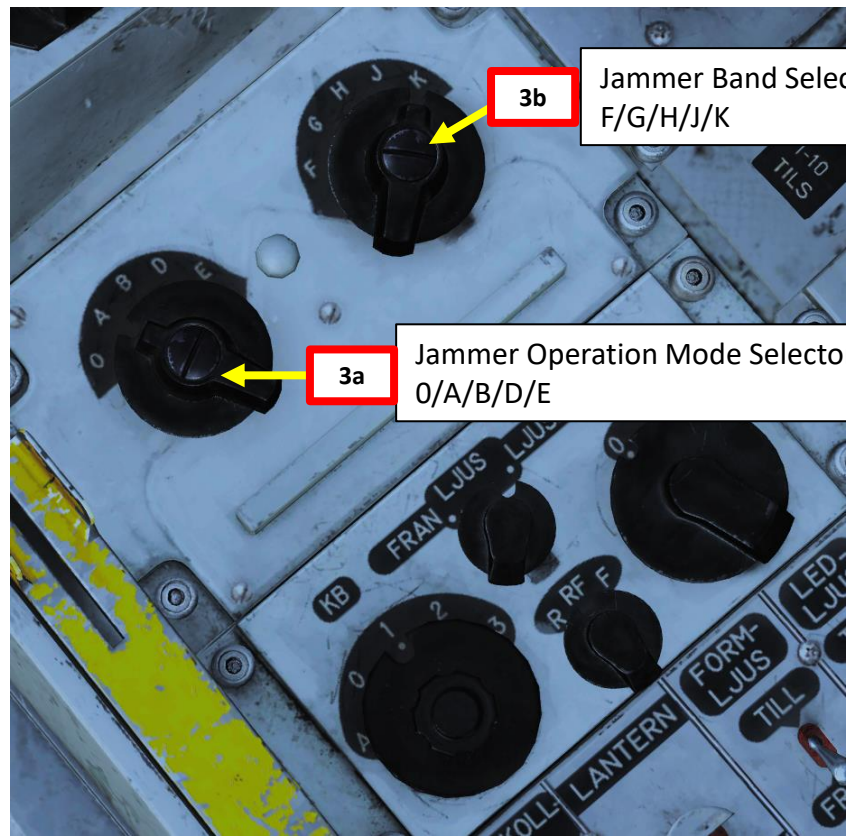# ELINT and the U22/A ECM Pod – Signal Data Gathering

1. Make sure your aircraft is equipped with the U22/A ECM Pod. I also recommend equipping the KB countermeasure pod as well to keep the aircraft weight distribution balanced.
2. Set Jammer Operation Mode Selector to A and Jammer Band Selector to F to start the jammer pre-heating sequence. This sequence takes about 3 minutes. This step is facultative but you could very well want to switch to a jammer emission mode if required.
3. Set Jammer Operation Mode Selector to A and Jammer Band Selector to K to start Silent Recording of radar emitter signals in Automatic Sensitivity Cycling.
4. Once a radar emitter is spotted by the RWR, the light MOTVERK flashes. It flashes with 8 Hz if receiving a CW (continuous wave, likely an active radar missile) or other high power emitter. It will flash with a frequency of 4 Hz if any other signal with a lower PRF is received.

| Resulting mode	U22 mode selector mode	U22 bandwidth selector mode
Off	0	No function
Preheat	A	F
Silent recording	A	G H J K
Active emission	B	F G H J K
Active emission	D	F G H J K
Active emission	E	F G H J K

Silent Recording Bandwidth Selector Sub-Modes:
- Mode A/G: Low sensitivity.
- Mode A/H: High sensitivity.
- Mode A/J: High sensitivity.
- Mode A/K: Automatic sensitivity cycling between mode A/G and A/J.

3b — Jammer Band Selector F/G/H/J/K

3a — Jammer Operation Mode Selector 0/A/B/D/E

4 — RWR (Radar Warning Receiver)

4 — MOTVERK Indication

ELINT and the U22/A ECM Pod – Signal Data Gathering

5. Three types of sound cycles can be heard.
   - 1 second tone, 1 second silent: Likely a search radar
   - 3 tones per second, 1 second silent: Likely targeting radar
   - 5 tones per second: CW or high power radar.
6. Once enough data has been gathered, land back to base.
7. Once aircraft is stopped, set Master Mode to BER (BEREDSKAP = STANDBY). You will now have access to the data recorded by the ECM pod.

7

BER | NAV | ANF | SPA | LANDNING NAV I POD

Radar Emitter's Approximate Location

Flight Plan
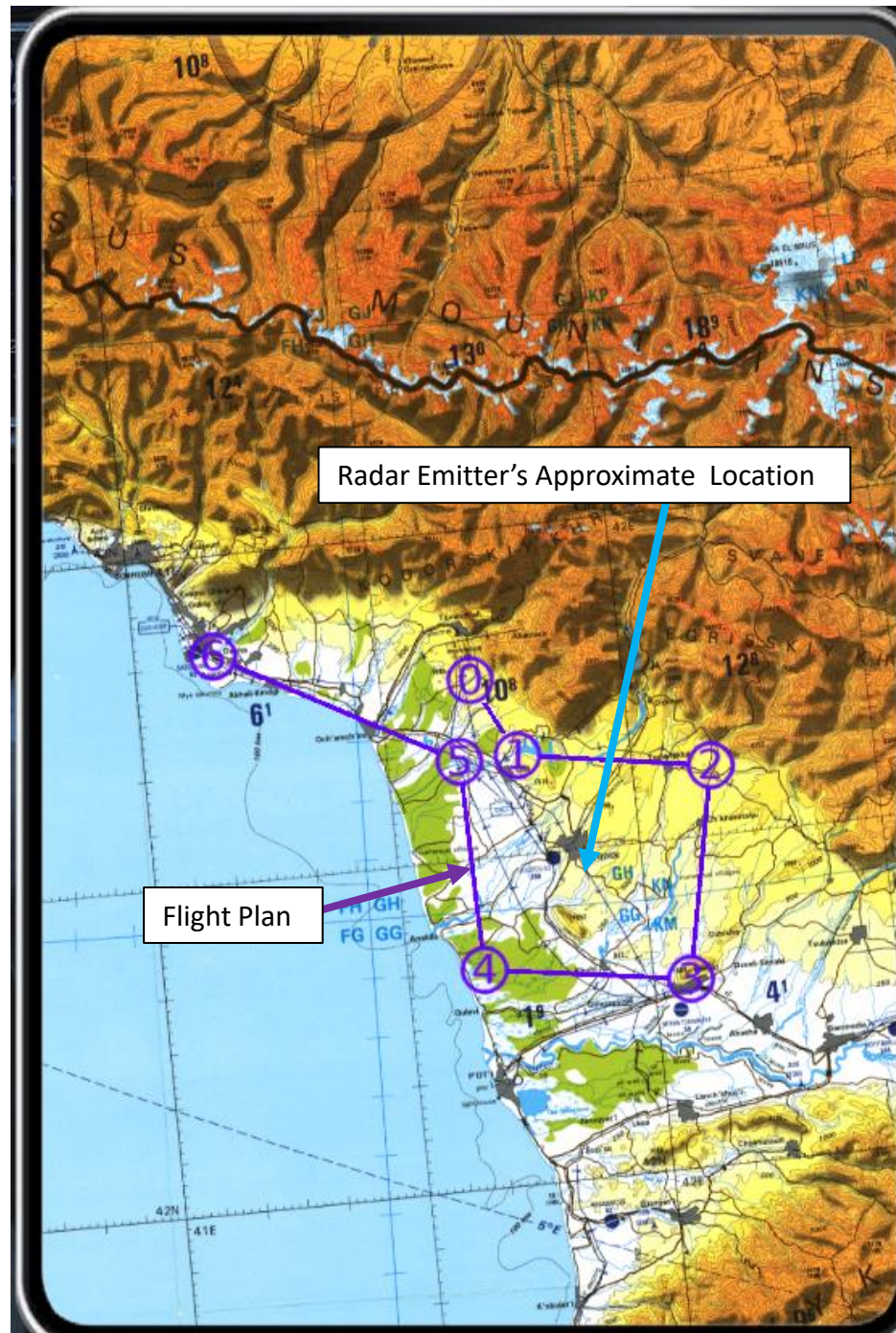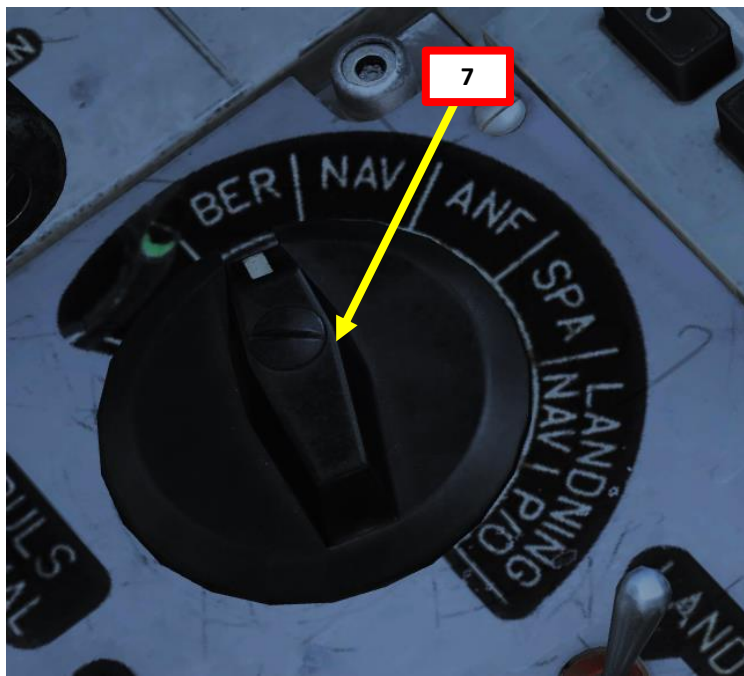
ELINT and the U22/A ECM Pod – Signal Data Analysis

1. To analyze data recorded by the U22/A ECM, make sure that the aircraft is on ground and Master Mode is set to BER.
2. Open Kneeboard ("RSHIFT+K" to open, "[" and "]" to scroll pages) and get to the ELINT page. You will have a list of emitters recorded with a Frequency Band, Pulse Repetition Frequency, First Signal, Last Signal, Sequence Broadcast and North-West and South-East corner waypoints in their approximate locations.
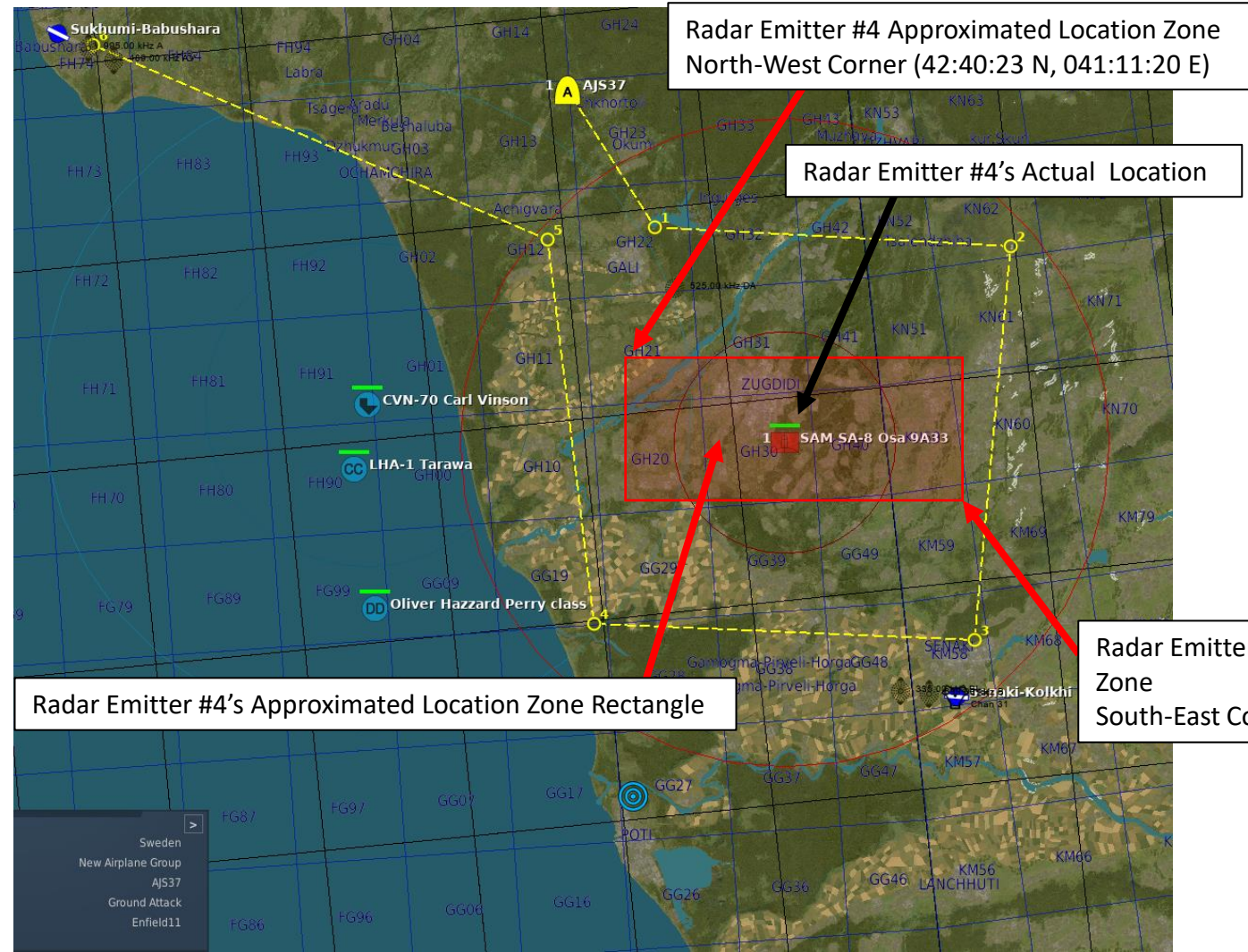
Radar Emitter #4 Approximated Location Zone
North-West Corner (42:40:23 N, 041:11:20 E)

Radar Emitter #4's Actual Location

Radar Emitter #4's Approximated Location Zone Rectangle

Radar Emitter #4 Approximated Location Zone
South-East Corner (42:08:56 N 041:35:20 E)

ELINT:

Emitter: 1
Freq: A PRF: 697
First signal: 8:0:2 Last signal: 0:0:0
Sequence broadca: 1s Silent: 5s
NW: 42:26:29 041:15:57 SE: 42:18:34 041:26:44

Emitter: 2
Freq: B PRF: 3331
First signal: 8:0:4 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:32:56 041:21:32 SE: 42:29:44 041:30:16

Emitter: 3
Freq: A PRF: 475
First signal: 8:0:43 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:40:23 041:11:20 SE: 42:08:56 041:35:20

Emitter: 4
Freq: B PRF: 2800
First signal: 8:1:6 Last signal: 0:0:0
Sequence broadca: 0.5s Silent: 1.5s
NW: 42:29:20 041:45:07 SE: 42:25:52 041:55:34

ELINT and the U22/A ECM Pod – Signal Data Analysis

3. A cool web app created by Heclak allows you to take the ECM pod's data record file and analyze it.
   LINK: https://elint-app.firebaseapp.com/
4. Click on "Choose File" and select the ELINTData.info file in your **C:\Users\[Your Username] \Saved Games\DCS_AJS37** folder. Then, click on "Open".
5. The emitter approximate location and identification will then be displayed. You could use the coordinates to Emitter #4 to plan a new mission to destroy the radar SAM site.

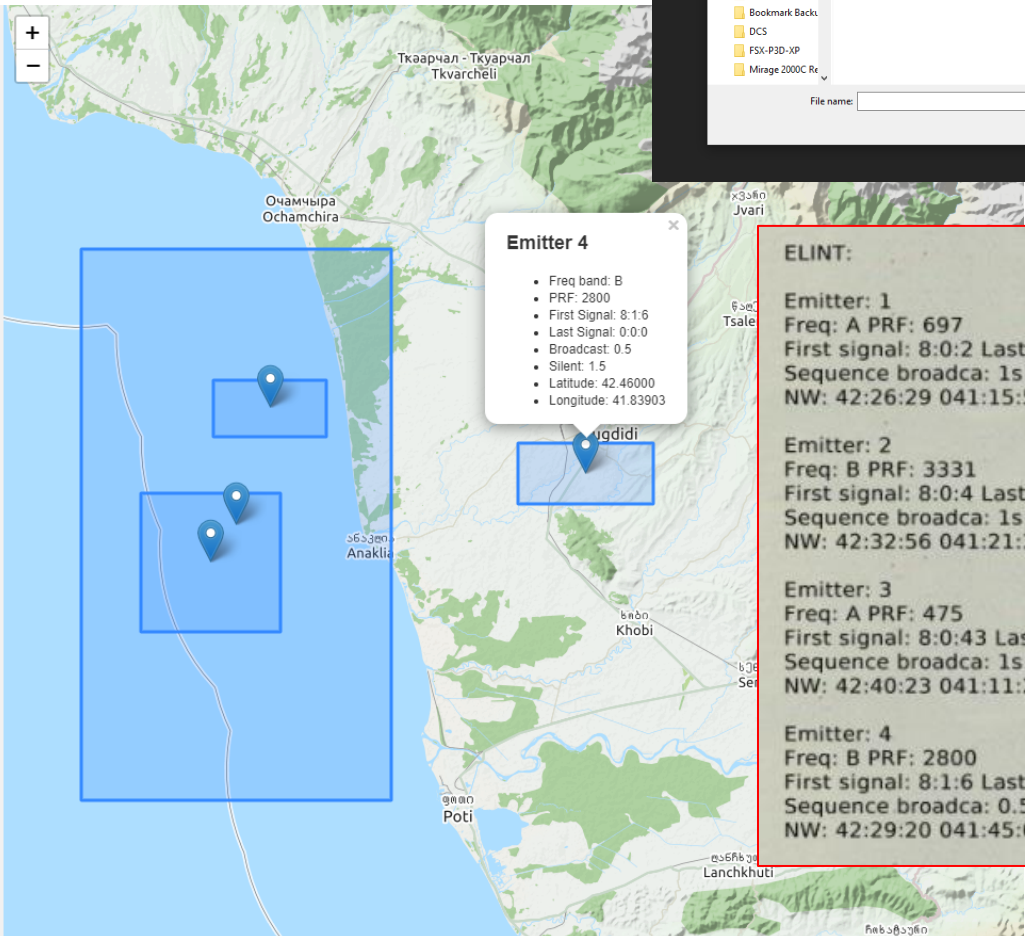**4a**

4b

4c
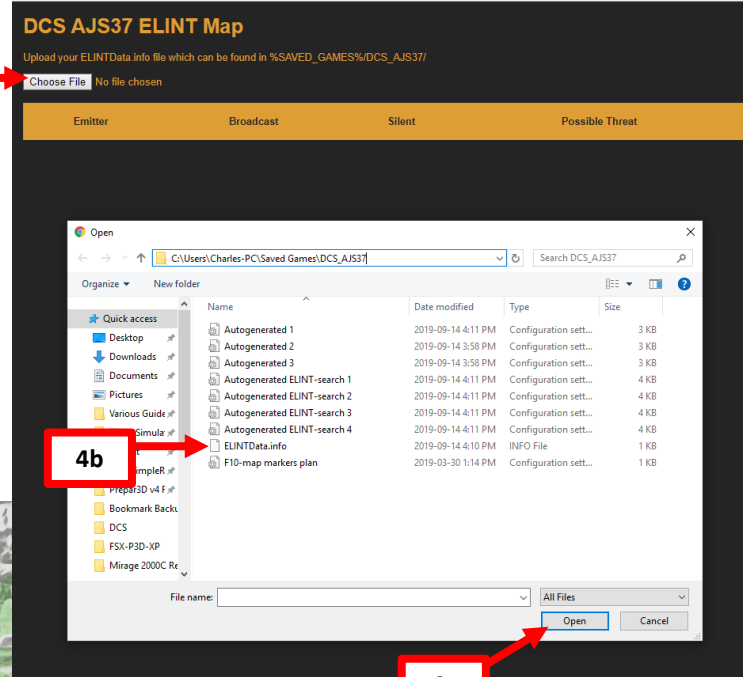
DCS AJS37 ELINT Map

Upload your ELINTData.info file which can be found in %SAVED_GAMES%/DCS_AJS37/

Choose File   ELINTData.info

Emitter	Broadcast	Silent	Possible Threat
1	1	5	unknown
2	1	2	CVN-70 Carl Vinson Search
3	1	2	unknown
4	0.5	1.5	Osa SA-8

Emitter 4
- Freq band: B
- PRF: 2800
- First Signal: 8:1:6
- Last Signal: 0:0:0
- Broadcast: 0.5
- Silent: 1.5
- Latitude: 42.46000
- Longitude: 41.83903

ELINT:

Emitter: 1
Freq: A PRF: 697
First signal: 8:0:2 Last signal: 0:0:0
Sequence broadca: 1s Silent: 5s
NW: 42:26:29 041:15:57 SE: 42:18:34 041:26:44

Emitter: 2
Freq: B PRF: 3331
First signal: 8:0:4 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:32:56 041:21:32 SE: 42:29:44 041:30:16

Emitter: 3
Freq: A PRF: 475
First signal: 8:0:43 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:40:23 041:11:20 SE: 42:08:56 041:35:20

Emitter: 4
Freq: B PRF: 2800
First signal: 8:1:6 Last signal: 0:0:0
Sequence broadca: 0.5s Silent: 1.5s
NW: 42:29:20 041:45:07 SE: 42:25:52 041:55:34

ELINT and the U22/A ECM Pod – Signal Data Analysis

Grunf has created an ELINT database table that allows you to manually determine the nature of an emitter based on its Frequency Band, Pulse Repetition Frequency (PRF), Emission Time (T_{EMIT}) and Silent Time (T_{SILENT}).

As an example, Emitter #4 is in the B frequency band, has a PRF of 2800, a T_{EMIT} of 0.5 sec and a T_{SILENT} of 1.5 s. Emitter #4 can therefore be identified as a SA-8.

```
Emitter: 4
Freq: B PRF: 2800
First signal: 8:1:6 Last signal: 0:0:0
Sequence broadca: 0.5s Silent: 1.5s
NW: 42:29:20 041:45:07 SE: 42:25:52 041:55:34
```

ELINT Database: Naval Radars

Name	Emitter	Band	f [Hz]	T_{emit}	T_{silent}
FFL Grisha	Search	B	3189	1.0	2.0
	Tracking	B	4836	0.1	0.1
CV Admiral Kuznetsov	Search	B	3844	1.0	2.0
	Tracking	B	5553	0.1	0.1
FSG Molniya	Search	B	7893	1.0	2.0
	Tracking	B	8822	0.1	0.1
CG Moskva	Search	A	800	0.5	1.0
	Tracking	A	300	0.1	0.1
FFG Neustrashimy	Search	B	3844	1.0	2.0
	Tracking	B	5553	0.1	0.1
CGN Pyotr Velikiy	Search	A	379	0.9	2.0
	Tracking	A	731	0.1	0.1
FF Rezky	Search	B	3189	1.0	2.0
	Tracking	B	4836	0.1	0.1
CG-60 Normandy	Search	A	697	0.9	2.0
	Tracking	A	1303	0.1	0.1
FFG Oliver H. Perry	Search	A	697	0.9	2.0
	Tracking	A	1303	0.1	0.1
CVN-70 Carl Vinson	Search	A	3331	1.0	2.0
	Tracking	A	4998	0.1	0.1

Courtesy of grunf

ELINT Database: Ground Radars

Name	Emitter	Band	f [Hz]	T_{emit}	T_{silent}
Early Warning Radar	Emitter 1	A	400	1.5	8.5
SA-3 Goa	Search	A	447	1.0	2.0
	Tracking	A	697	1.0	2.0
	Tracking	A	1303	0.1	0.1
SA-6 Gainful	Search	A	967	1.0	2.0
	Tracking	A	1763	0.1	0.1
SA-8 Gecko	Tracking	B	2800	0.5	1.5
SA-10 Grumble	SR SN66M	A	1110	1.0	2.0
	SR 65H6E	A	447	1.0	2.0
	Tracking	A	856	0.1	0.1
SA-11 Gadfly	Search	B	1763	1.0	2.0
	Search	A	697	1.0	2.0
	Tracking	B	2998	0.1	0.1
SA-15 Gauntlet	Emitter 1	B	5553	0.1	0.1
	Emitter 2	B	3844	1.0	2.0
SA-19 Grison	Search	B	4836	1.0	2.0
	Tracking	B	6520	0.1	0.1
ZSU-23-4 Shilka	Tracking	A	100	0.1	0.1
M163 Vulcan	Tracking	A	100	0.1	0.1
MIM-23 Hawk	SR AN/MPQ-55	A	967	1.0	2.0
	SR AN/MPQ-50	A	447	1.0	2.0
	Search	A	768	1.0	2.0
	Tracking	A	1427	0.1	0.1
MIM-104 Patriot	Search	A	447	1.0	2.0
	Tracking	A	856	0.1	0.1
Gepard	Tracking	A	100	0.1	0.1
Roland	EWR	B	1763	1.0	2.0
	Search	B	4836	1.0	2.0
	TR ADS	B	6520	0.1	0.1

Colorcode: Detectable by U22/A ECM pod.

Courtesy of grunf

ELINT Database: Airborne Radars

Name	Emitter	Band	f [Hz]	T_{emit}	T_{silent}
E-2D Hawkeye	Emitter 1	A	300	0.5	5.2
E-3A Sentry	Emitter 1	A	300	0.5	5.2
A-50 Mainstay	Emitter 1	A	200	1.0	5.2
AJS-37 Viggen	Emitter 1	B	1000	0.5	1.2
MiG-21bis Fishbed MiG-29A/G/S Fulcrum	Emitter 1	B	1000	0.5	1.2
	Emitter 2	B	3400	0.2	0.5
	Emitter 3	B	5400	0.2	0.5
Su-27 Flanker Su-33 Flanker-D	Emitter 1	B	1000	0.5	1.2
	Emitter 2	B	3400	0.2	0.5
	Emitter 3	B	5400	0.2	0.5
M-2000C Mirage	Emitter 1	B	1000	0.5	1.2
	Emitter 2	B	3400	0.2	0.5
	Emitter 3	B	5400	0.2	0.5
F-5E Tiger II	Emitter 1	B	1000	0.5	1.2
	Emitter 2	B	3400	0.2	0.5
	Emitter 3	B	5400	0.2	0.5
F-15C Eagle	Emitter 1	B	900	0.5	1.2
	Emitter 2	B	1200	0.2	0.5
	Emitter 3	B	5900	0.2	0.5

Courtesy of grunf
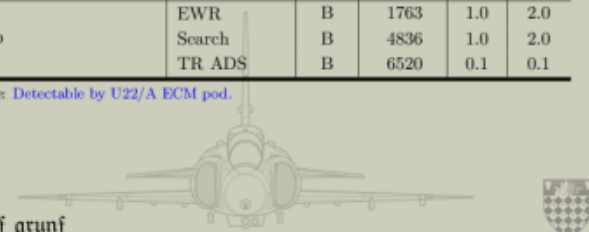
ELINT and the U22/A ECM Pod – Signal Data Analysis

Yet another sweet feature implemented by Heatblur Simulations is the fact that once the ELINT data has been recorded, the aircraft has landed and the Master Mode has been set to BER, a mission data cartridge will be automatically generated with a flight plan towards the emitter or emitters you have identified in your previous mission. See PART 17 – DATA CARTRIDGE for more details about how to select a mission data cartridge and load it into the Viggen.

ELINT:

Emitter: 1
Freq: A PRF: 697
First signal: 8:0:2 Last signal: 0:0:0
Sequence broadca: 1s Silent: 5s
NW: 42:26:29 041:15:57 SE: 42:18:34 041:26:44

Emitter: 2
Freq: B PRF: 3331
First signal: 8:0:4 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:32:56 041:21:32 SE: 42:29:44 041:30:16

Emitter: 3
Freq: A PRF: 475
First signal: 8:0:43 Last signal: 0:0:0
Sequence broadca: 1s Silent: 2s
NW: 42:40:23 041:11:20 SE: 42:08:56 041:35:20

Emitter: 4 ⬅
Freq: B PRF: 2800
First signal: 8:1:6 Last signal: 0:0:0
Sequence broadca: 0.5s Silent: 1.5s
NW: 42:29:20 041:45:07 SE: 42:25:52 041:55:34

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: BOMB + IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
13 Autogenerated search for ELINT #4 ⬅

This is an autogenerated mission.
You will search for a radar-transmitter
that has been discovered in previous mission.

Target:
ELINT #4

Search area:
4930 x 15000

Stand-off distance:
7000

Groundcrew settings:

Rb04 left group target: 3
Rb04 right group target: 1
Rb04 left angle jump: Off
Rb04 right angle jump: Off
Weapon selector: BOMB + IR-RB
Safety height: Medium

Not close enough to ground crew.

Data cartridge selected:
7 Autogenerated attack Osa 9A33 In x 1 ⬅

Target location:
42:27:52 41:53:14

Departure-time:
08:25:53
Time-on-target:
08:32:10

Ingress direction:
074 deg

Egress direction:
299 deg

Target movement:
000 deg   0 km/h

Area weather:
Wind: 000 deg at 0 m/s
QFE: 1003.5

SECTION STRUCTURE

- 1 – Introduction to Reconnaissance

- 2 – SPA (*Spaning*, Reconnaissance) Mission Profile

- 3 – RUTA (Patrol Square) & Display Mode in SPA Mode
    - 3.1 – RUTA Display
    - 3.2 – RUTA Creation Methods

- 4 – SPA/MÅL: Target Measurement Mode
    - 4.1 – Designating a Recon Measured/MÅL Target (M1-M9)
        - 4.1.1 – Radar Fix
        - 4.1.2 – Visual Fix
    - 4.2 – Recon Measured/MÅL Target (M#) Navigation
    - 4.3 – Recon Measured/MÅL Target (M1-M9) Data Output
    - 4.4 – Clearing Measured/MÅL Target (M1-M9)

- 5 – SPA/SKU: Target Tracking Mode
    - 5.1 – Tracked/SKU Target (S#) Basic Concepts
    - 5.2 – Recon Measured/MÅL Target (M#) Transfer to Tracked/SKU Target (S#)
    - 5.3 – Tracking the Tracked/SKU Target (S1-S9)
    - 5.4 – Clearing Tracked/SKU Target (S1-S9)

- 6 – Stand-Off Distance Warning

1 – Introduction to Reconnaissance

One of the Viggen's (often) overlooked roles is reconnaissance, also referred to as "recce". Naval reconnaissance was one of the primary roles of the SF-37 and SH-37 (aerial reconnaissance & maritime patrol variants of the Viggen) during the Cold War period, especially since Sweden and the Soviet Union were separated by the Baltic Sea.

Within the DCS environment, recce can actually be useful role to take within a multiplayer environment. The Viggen's radar can determine the position, course and speed of ships at sea and store this information with a timestamp within the flight computer. You can then relay this information to friendly elements and make their life much easier since they will have a good idea of where the targets are.

The operation of the AJS-37 is highly dependent on preset waypoints, therefore there is a significant advantage to sending recon target coordinates to other Viggen pilots in multiplayer. Sending coordinates over the radio allows your friends to plug in the coordinates and have a flight plan up and running in no time, which will substantially minimize their workload.

The SPA (*Spaning*, Reconnaissance) Master Mode is used for two main purposes:
• Target Measurement (MÅL), which is the position of targets such as ships with a timestamp.
• Target Tracking (SKU), which determines the course and speed for previously measured targets. This allows you to "predict" the position of a ship for other elements once they reach the area of operations.
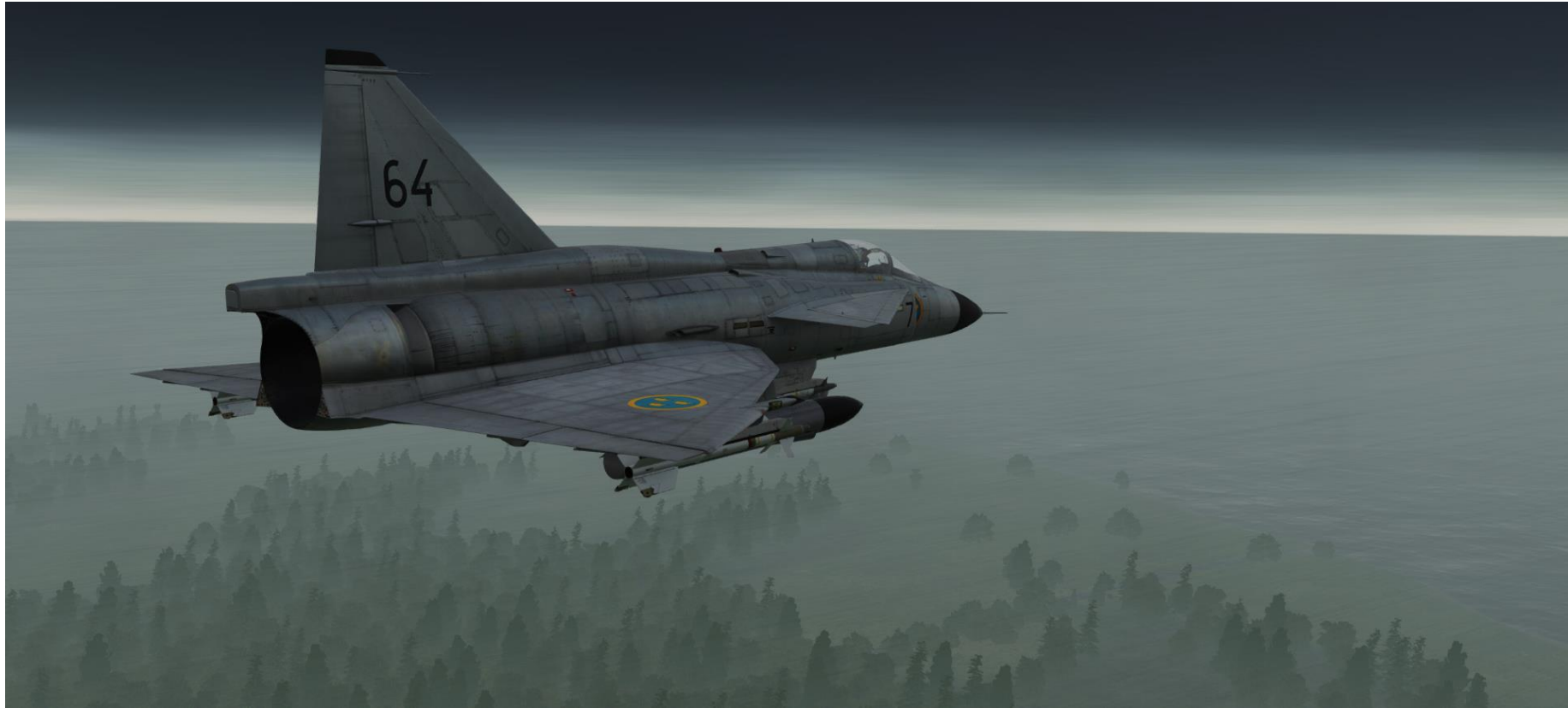
Sheet by FunkyFranky

Recon: Target Measurement SPA/MÅL

B1-B7: Navigation WP
Bx1 : Mark Point
R1-R4: Ruta Corners
R6-R7: Ruta Centers
M1-M4: MÅL Targets
S1 : SKU Target
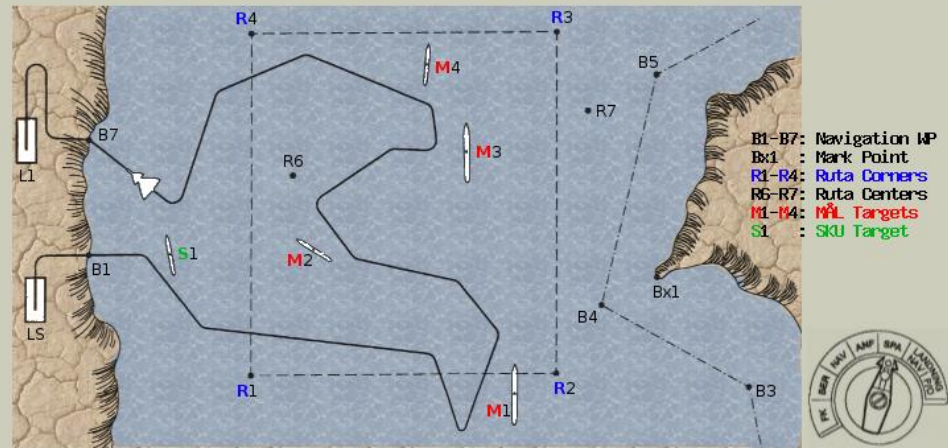
SPA/MÅL (search patrol area and record detected targets to determine their position):
- Set master mode to **SPA** and data selector to **AKT POS.**
- Switch to SPA/MÅL from SPA/SKU by pressing **L/MÅL** with data selelector in **AKT POS** or selecting a destination other than a tracked (SKU) target by pressing B1-B9.
- Discovered targets can be measured visually or by radar.
- Target fix creates a new recon WP. LO/LA and timestamp are stored as M1-M9.

RUTA (radar mode A1):
RUTA display can be toggled on/off by **TO-T1-TO** briefly.
CI will display position and shape of the patrol area.
RUTA is displayed with a circle marker and a line.
Circle marker jumps between corner points in sequence.
Line indicates direction to the adjacent corner points
alternating between the two directions every second.

<RUTA Symbology Image>

Visual fix:
- Radar mode selector **A0.**
- Prepare fix by pressing trigger to first detent **T1.**
  Data panel shows **six zeros** while **T1** is held.
- Directly overflying taget and press second detent **TV**
  to complete the fix.

Left 25° 72 km   Radar Image

Radar fix:
- Radar mode selector **A1.**
- Press and hold radar trigger at first detent **T1.**
  Data panel shows **rel. direction**, **heading** and **distance**.
- Slew CI crosshair over target radar contact.
- Radar trigger to second detent **TV** to complete fix.

Longitude Minus   Latitude M3

Completed fix (radar or visual) – trigger **TO:**
- Data panel alternates between **LO/LA** on first 5 digits.
- 6th digit alternates between:
   Minus sign "–" when **longitude** is displayed
   Recon target number (M3) when **latitude** is displayed.

Recon: Target Tracking SPA/SKU

B1-B7: Navigation WP
Bx1 : Mark Point
R1-R4: Ruta Corners
R6-R7: Ruta Centers
M1-M4: MÅL Targets
S1 : SKU Target
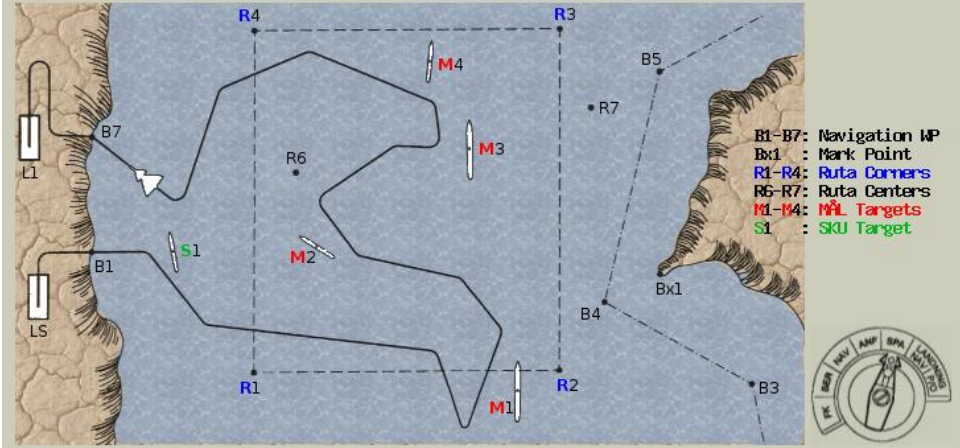
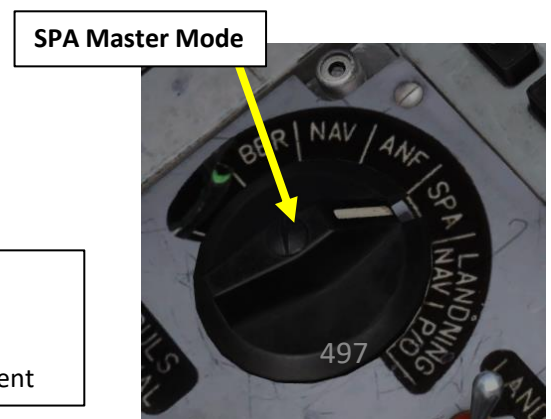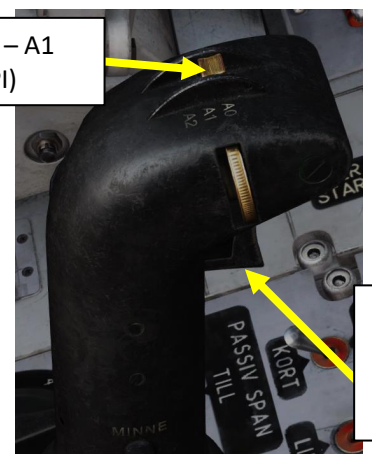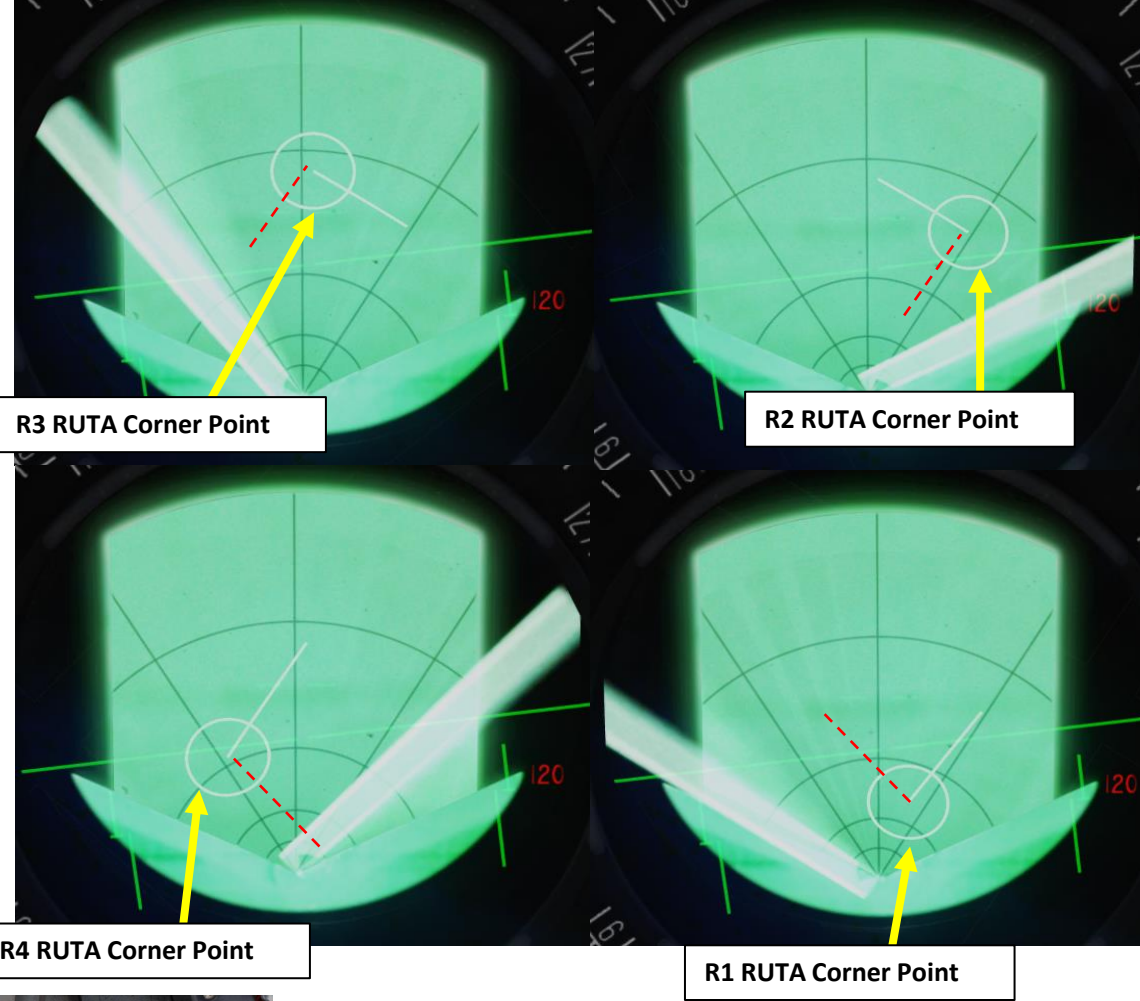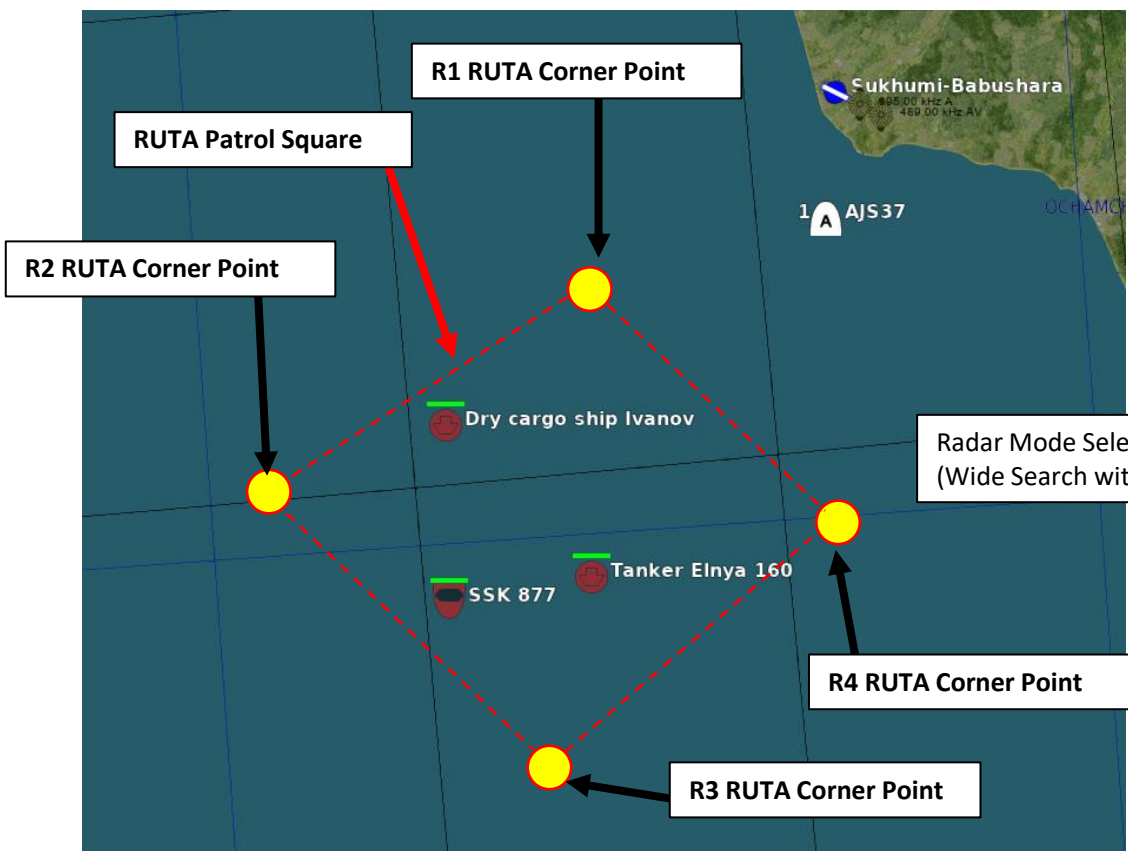**SPA/SKU** (determine course and speed of discovered targets):
- Set master mode to **SPA** and data selector to **AKT POS.** Press **LS/SKU** once.
- **Two fixes per target** can be stored from which position, course and speed are derived.
- The two fixes must be taken with at least **3 min** difference.
- SKU fixes are stored in new layer and displayed as **"S"** in the destination indicator.
- SKU fixes can be selected by pressing **1-9** on the data panel.
- MÅL fixes (Type I) can be transferred to SKU-layer by pressing **LS/SKU twice** rapidly.
- Latest fix cleared by pressing **RENSA**, 2nd press clears all fixes of current dest.

Type I fix (no target course or speed obtained):
- **"S"** is **quickly flashing** at **1.2 Hz.**
  SKU target does not yet have any fix older than 3 min → new type 1 fix.

Type II fix (results in target course and speed):
- **"S"** is **slowly flashing** at **0.6 Hz.**
  SKU target has two earlier SKU fixes. One >3 min and one <3 min old.
  Course and speed are calculated from **oldest & newest** fix.
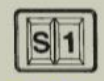
- **"S"** is **solid:**
  SKU target has one or two earlier fixes older 3 min.
  Course and speed are updated from **recent & newest** fix.

Type I fix   Course Speed

Type I/II fix – trigger **TV:**
- Fixes are made in the same way as in SPA/MÅL.
- When the fix is completed and **TV held**, the display
  on the data panel depends on the fix type:
    Type I : **Six zeros** will be displayed.
    Type II: **Course** [deg] and **speed** [knots] are displayed.

Longitude Minus   Latitude M3

Completed fix (radar or visual) – trigger **TO:**
- Data panel alternates between **LO/LA** on first 5 digits.
- 6th digit alternates between:
    Minus sign "–" when **longitude** is displayed
    Recon target number (M3) when **latitude** is displayed.

2 – SPA (*Spaning*, Reconnaissance) Mission Profile

A recon mission is meant to be flown within a specific area where targets are expected to be. This patrol area is called the "RUTA Patrol Square". The flight plan for a patrol generally consists of the following:

- Normal Waypoints B#, which are used as geographic reference points to confirm that the navigation system has a good fix before heading out to sea.
- RUTA Patrol Square Corner Points (R1 – R8)
- RUTA Patrol Square Center Points (R1 – R8, and R9)
- Recon Measured/MÅL Targets (M1-M9)
- Recon Tracked/SKU Targets (S1-S9)
- Markpoints for points of interest (Bx#)
- Departure Airfield (LS)
- Arrival Airfield (L1)

Do not confuse Recon Measured/MÅL Targets (M1-M9) with Normal Target Waypoints (White M) but entirely separate.

Normal Target Waypoint | Recon Measured/MÅL Target
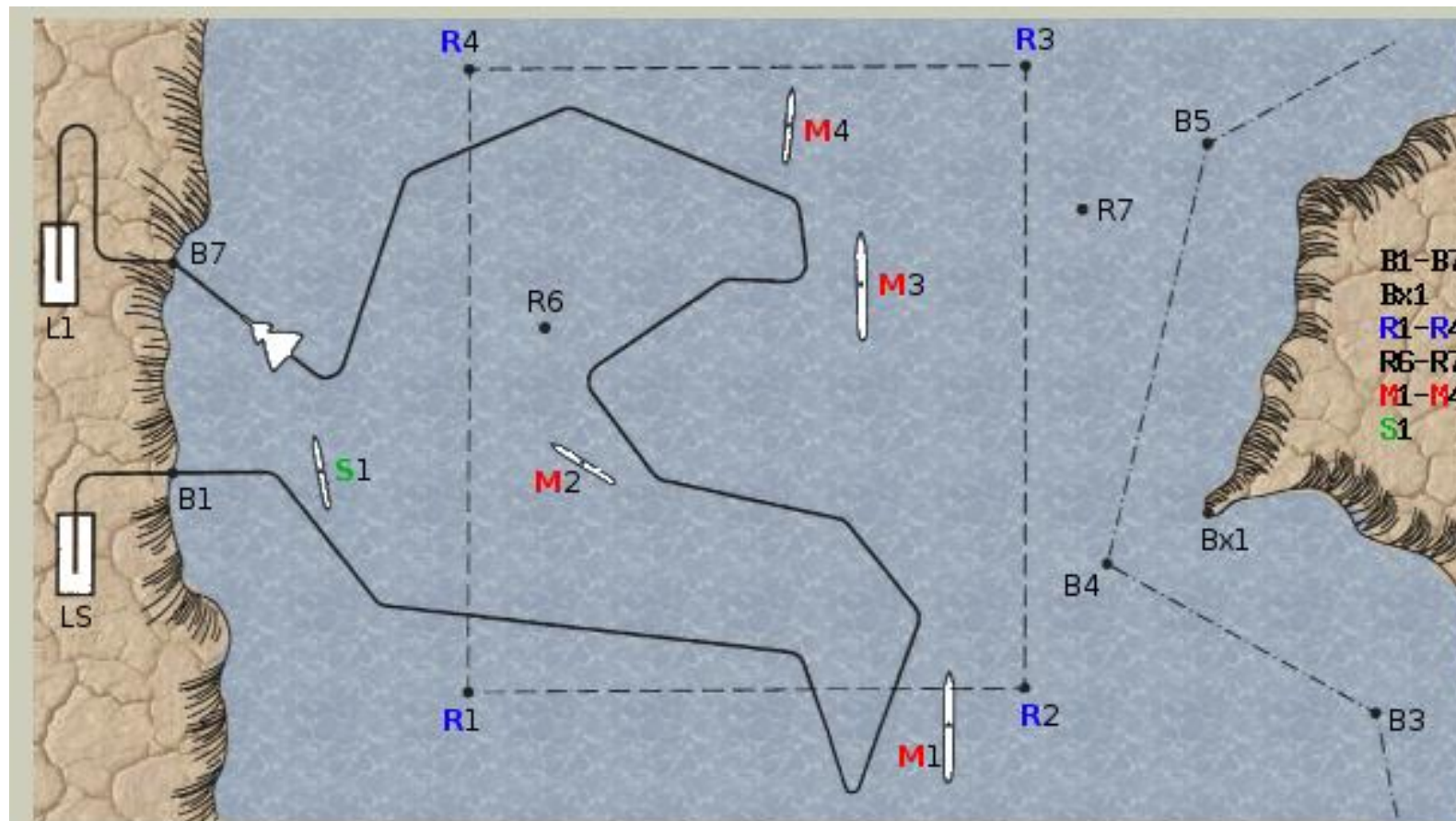
B1-B7: Navigation WP
Bx1 : Mark Point
R1-R4: Ruta Corners
R6-R7: Ruta Centers
M1-M4: MÅL Targets
S1 : SKU Target

3 – RUTA (Patrol Square) & Display Mode in SPA Mode

3.1 – RUTA Display

The RUTA patrol area is only displayed **if the Master Mode selector is in mode SPA and the radar mode selector in mode A1**. The RUTA display is automatically selected on switching to master mode SPA.

The RUTA (Corner Points R1, R2, R3 and R4) is displayed with the circle marker and a line, similar to the boundary or extended runway indicator. The circle marker will "jump" between the corner points in sequence. The line will indicate the direction of the adjacent corner points, alternating between the two directions every second.

- Note: The RUTA display can be toggled ON/OFF with the normal destination display by briefly pressing the Radar Fix Trigger to the first detent and releasing (T0-T1-T0).

R3 RUTA Corner Point

R2 RUTA Corner Point

R4 RUTA Corner Point

R1 RUTA Corner Point

R1 RUTA Corner Point

RUTA Patrol Square

R2 RUTA Corner Point

R4 RUTA Corner Point

R3 RUTA Corner Point

Radar Mode Selector – A1
(Wide Search with PPI)

SPA Master Mode

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

497

3 – RUTA (Patrol Square) & Display Mode in SPA Mode

3.1 – RUTA Display

There are two different types of RUTA points, either **corner points** or **center points**.

Corner points:
Normally constitute the boundaries of the assigned patrol area. Corner points are any points entered that are continuous from R1.
- In Example 1, R1 through R6 are entered. R7 is missing leading to R8 being a corner point.
- In Example 2, R7 is added to the sequence, leading to R7 and R8 becoming a corner point.

Center points:
Center points are points added to the polygon, but will not appear in the radar on the normal SPA display showing the boundary of the patrol area.
Instead, they are used as points of reference. Corner points are points entered, but not part of a continuous series.
R9 will always be a center point.

Example A

Example B

498
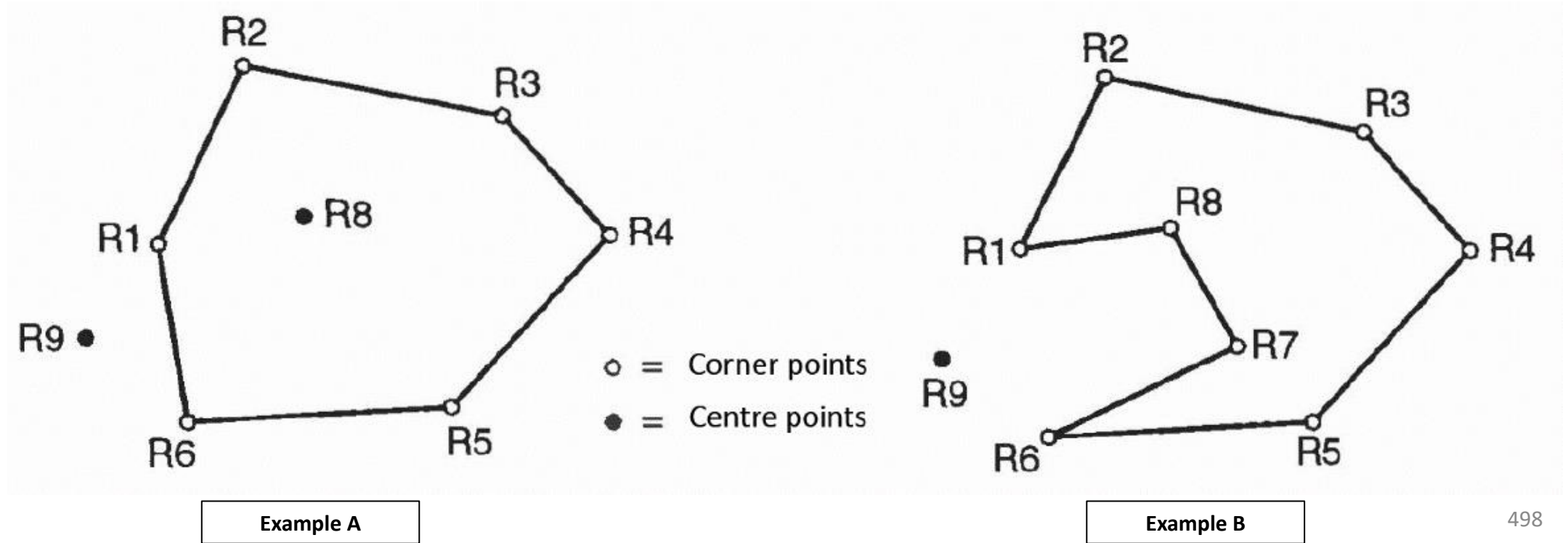
3 – RUTA (Patrol Square) & Display Mode in SPA Mode

3.2 – RUTA Creation Methods

Method 1: Mission Editor Method

You can use the Mission Editor's Navigation Target Points to place R1, R2, R3 and R4 corner points.

Method 2: F10 Map Marker Label Data Cartridge Method

You can create marker labels on the F10 map (see PART 17 - DATA CARTRIDGE section), then loading the data cartridge.

Mission Editor Method

F10 Map Marker Label + Data Cartridge Method

Mark Label
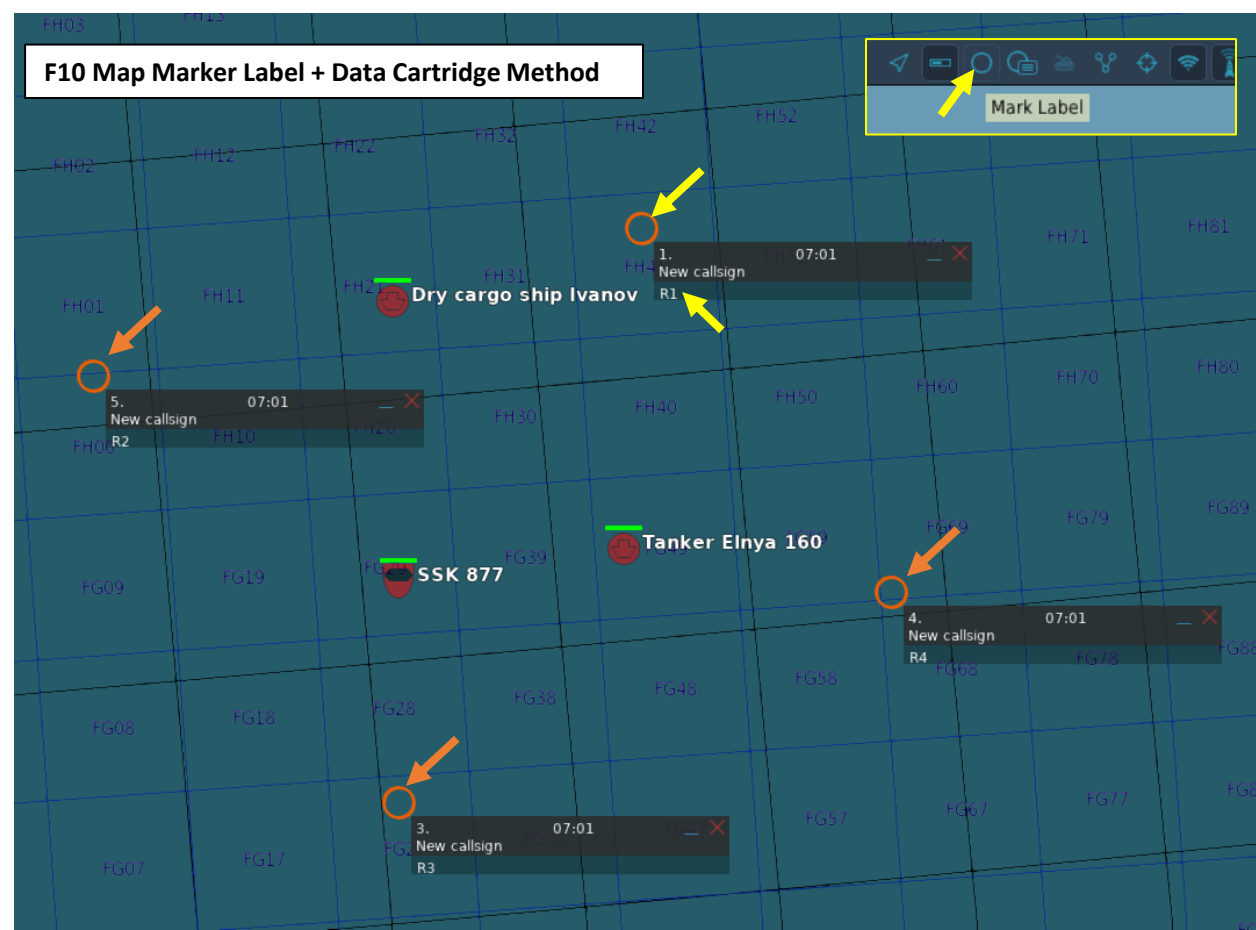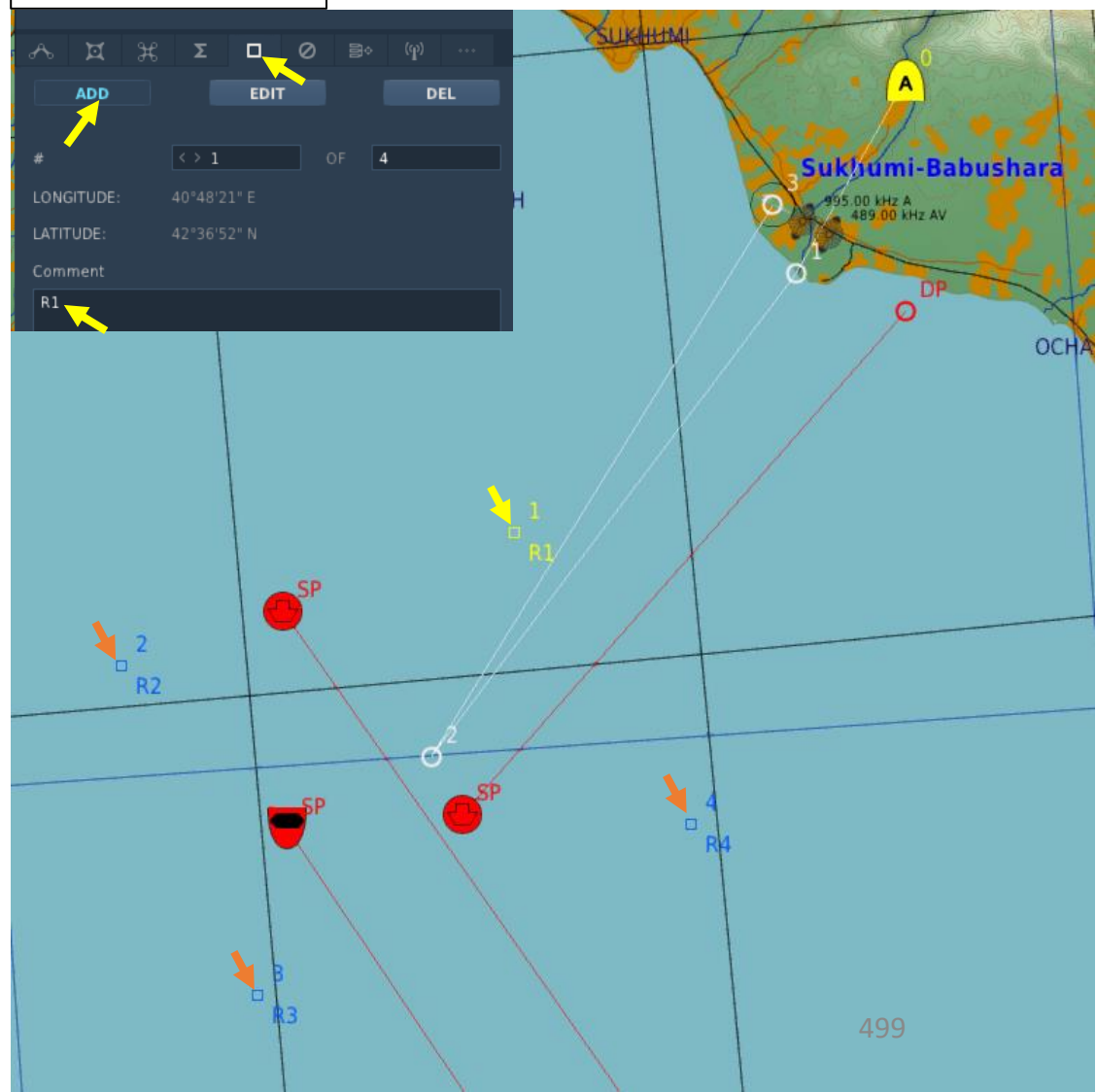
3 – RUTA (Patrol Square) & Display Mode in SPA Mode

3.2 – RUTA Creation Methods

Method 3: Input RUTA Corner Point Coordinates

You can enter the coordinates for the Corner Points manually via the CK37 Computer.

1. Verify Master Mode is set to SPA
2. Set Data Selector to VIND/RUTA/MÅL
3. Set INPUT/OUTPUT Selector to IN
4. Coordinates from the F10 map **42°35'56" North (Latitude)**, **40°45'48" East (Longitude)** are entered as **404548423556** (East coordinates first, North coordinates second).
5. Press B1 button to enter the first corner point (R1). Repeat previous steps for other corner points (B2 for R2, B3 for R3, B4 for R4).
6. Set INPUT/OUTPUT Selector to UT (Output)
7. Set Data Selector to AKT POS (Active Position)

To consult coordinates for a selected Corner Point (R2 as an example), set Master Mode to SPA, set Data Selector to VIND/RUTA/MÅL, set INPUT/OUTPUT Selector to OUTPUT, then press Waypoint Selector associated to the corner point (B2 in our case).

42°35'56"N 40°45'48"E,
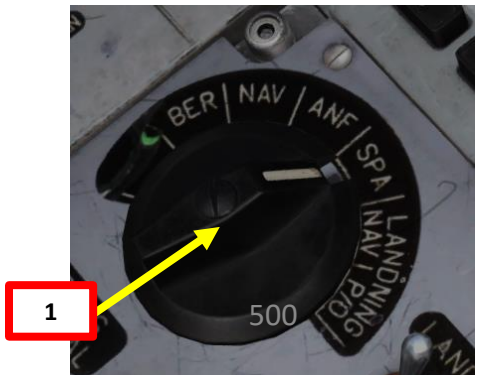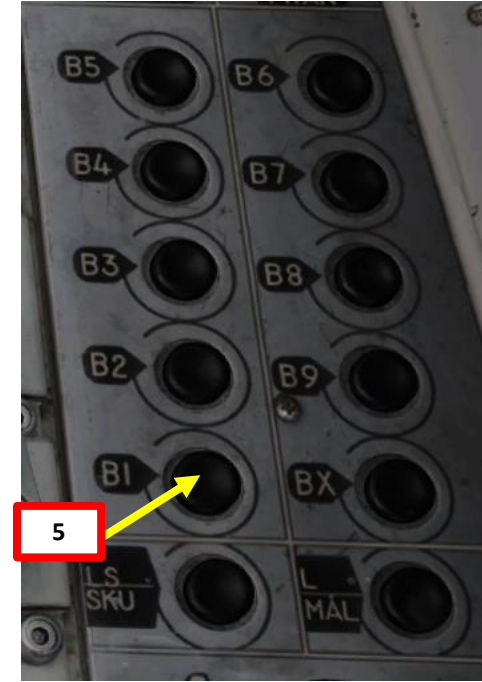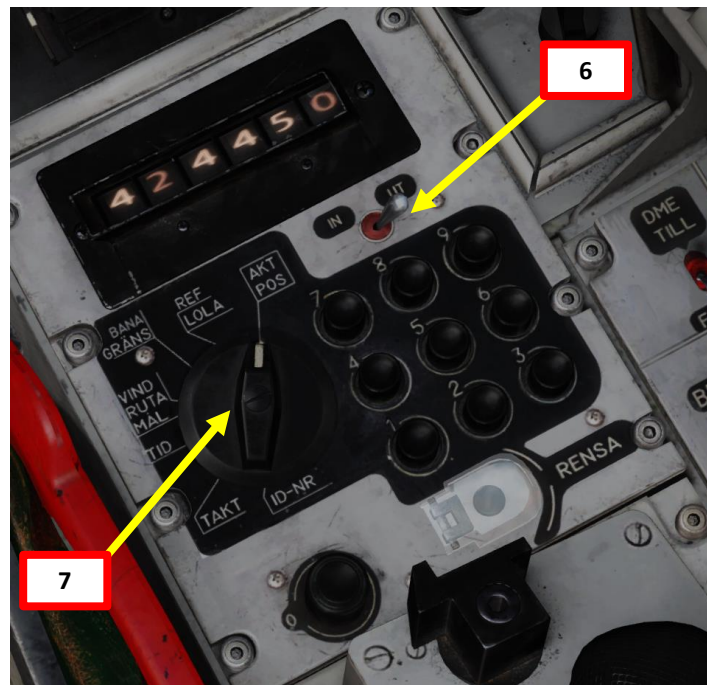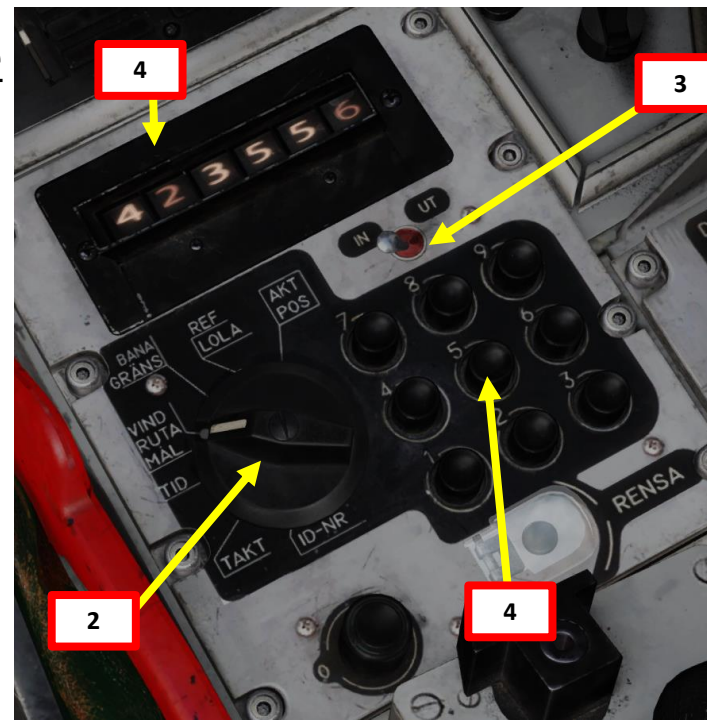
4 – SPA/MÅL: Target Measurement Mode

4.1 – Designating a Recon Measured/MÅL Target (M1-M9)

4.1.1: Radar Fix

We will now designate a Recon Measured/MÅL Target by creating a radar target fix on it.

1. Set Master Mode to SPA (Reconnaissance).
2. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
3. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
4. Adjust radar display range as required.
5. Set Data Selector to AKT POS - OUTPUT
6. Press L/MÅL button to select Target Measurement mode.
7. Once you have spotted a ship on the radar, we will designate the Recon Measured/MÅL Target using a Target Fix.
8. Verify that radar range display is sufficient to see the target. 60 or 120 km is generally a good range.
9. Press the radar fix trigger to "T1" (first trigger detent).
10. A crosshair will appear in the middle of your display. Move crosshair over target using the radar stick controls. The data panel will indicate the bearing and distance to position of the radar cursor (crosshair).

Radar Mode Selector – A1 (Wide Search with PPI)
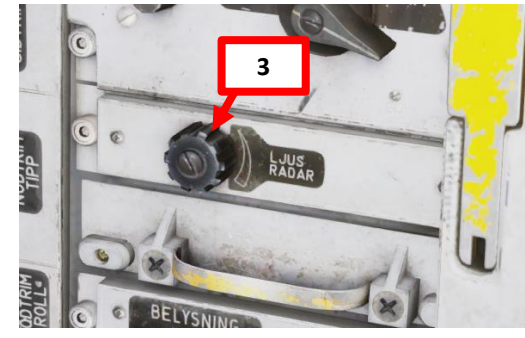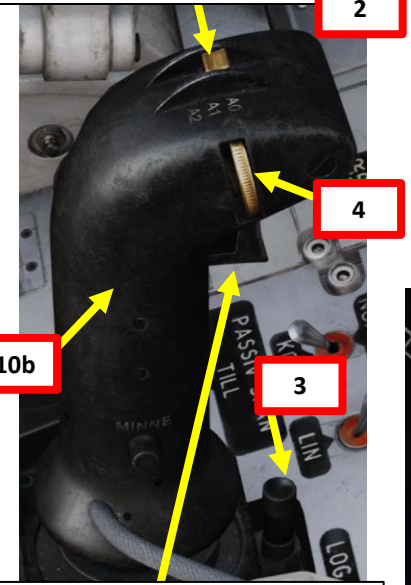
2

4

10b

3

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

9

3

1

Ship

7

Crosshair

10a

4
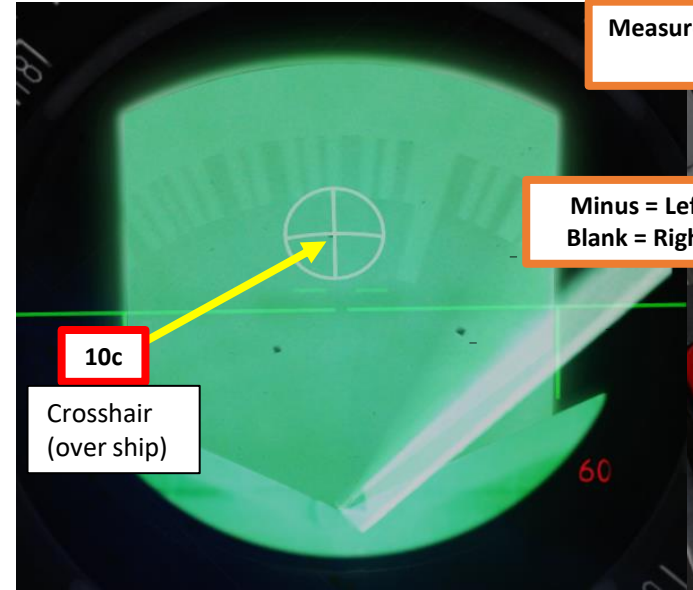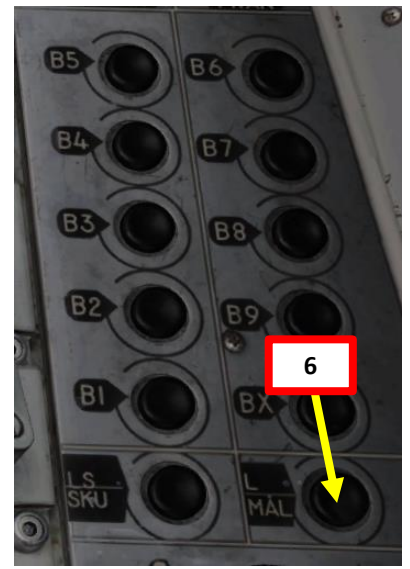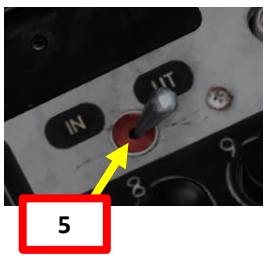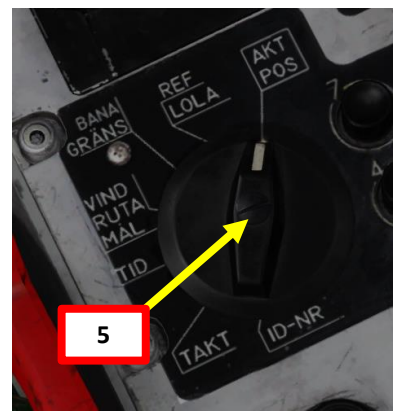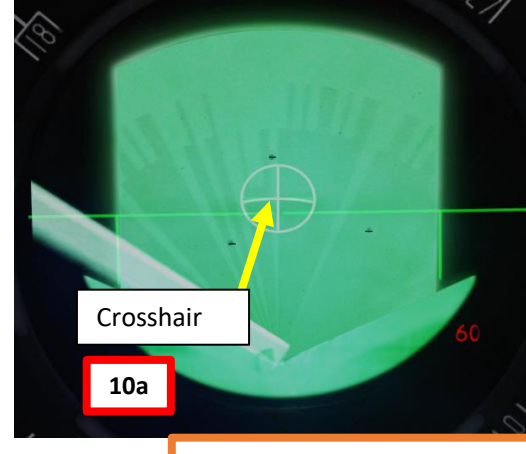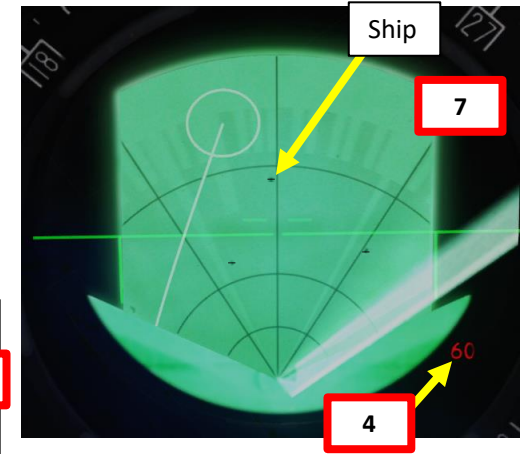
Measured Target Bearing 01 deg

Measured Target Distance 037 km

10c

Minus = Left Blank = Right
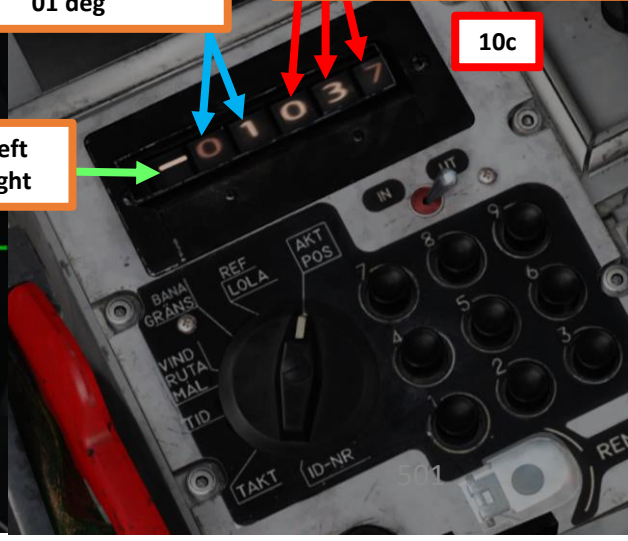
10c

Crosshair (over ship)

5

5

5

6

4 – SPA/MÅL: Target Measurement Mode

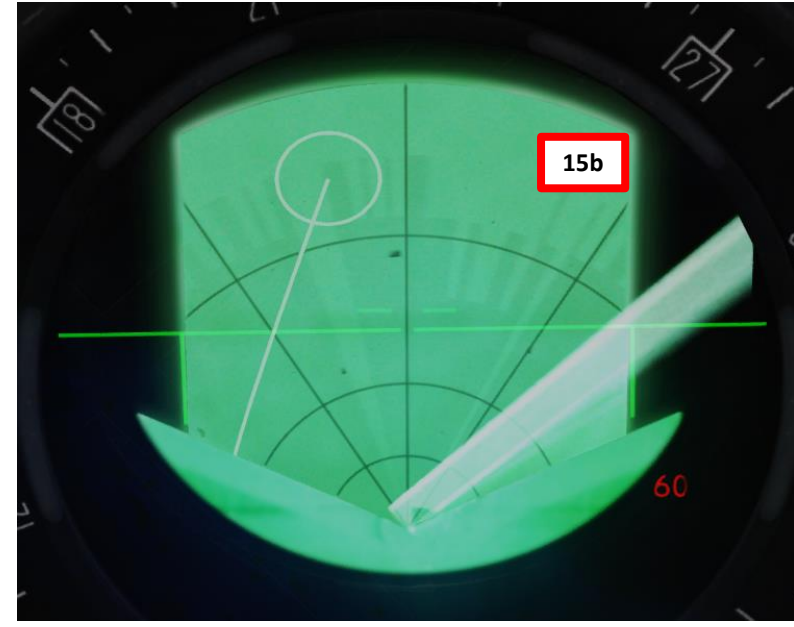## 4.1 – Designating a Recon Measured/MÅL Target (M1-M9)

4.1.1: Radar Fix

11. Press the radar fix trigger to " TV" (second trigger detent), which will set the target fix on the target. This will designate a Recon Measured/MÅL Target and enter a timestamp and position coordinate for it in the CK37 computer.
12. When the fix is made:
    a) The data panel will alternate between longitude and latitude on the first five digits. The sixth digit will alternate between a minus sign (when displaying longitude) and the reconnaissance target number (when displaying latitude).
    b) The Central Indicator will display the completed fix point with the circle marker until a new destination is set, or a new fix is prepared.
13. Each new reconnaissance Measured/MÅL Target will be stored in sequence M1-M9. Any new target will be assigned to the next number in the sequence. In our case, M1 and M2 were already designated, therefore we just created M3.
    • Note: If all the target slots are filled, the previous contacts will be overwritten one by one, starting with M1.
14. If you want to select a new destination or designate a new target, set radar trigger to "T0".

Radar Fix Trigger
• T0: Neutral
• T1: First trigger detent
• TV: Second trigger detent

15a

11a

Longitude to Recon Measured Target M3
40 deg 31 minutes 2 seconds

Latitude to Recon Measured Target M3
42 deg 22 minutes 0 seconds

Measured Target Number
"3" for "M3"

Minus = Data Displayed
is for longitude
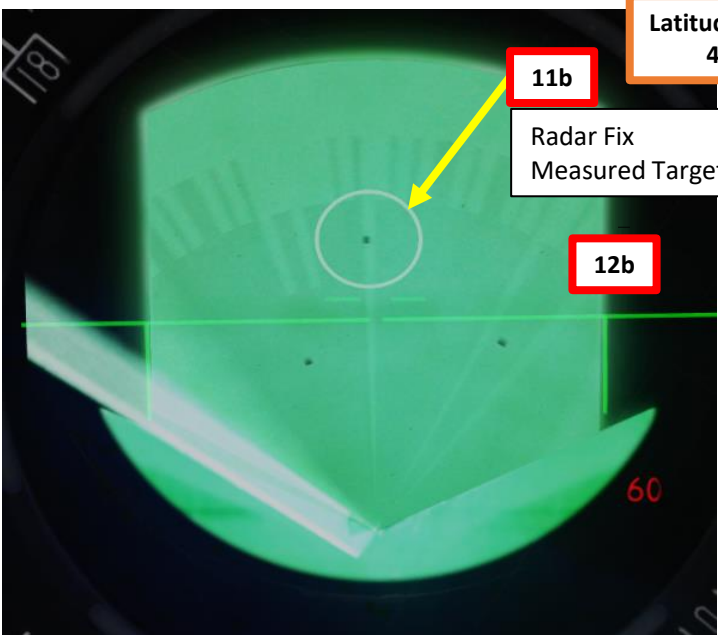
11b

Radar Fix
Measured Target M3

12b

12a

12a

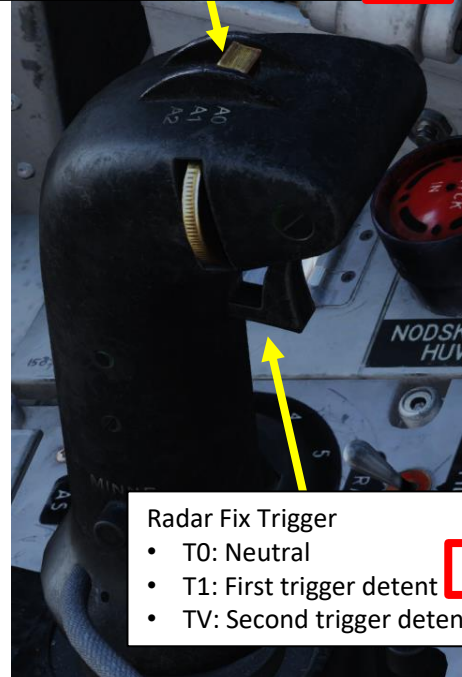# 4 – SPA/MÅL: Target Measurement Mode

4.1 – Designating a Recon Measured/MÅL Target (M1-M9)
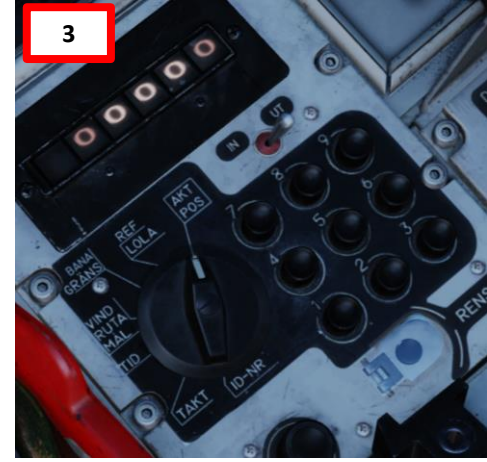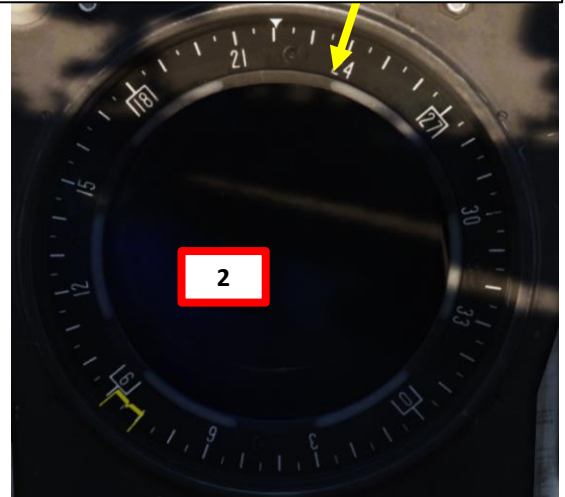
4.1.2: Visual Fix

If weather conditions are good and you are confident that the naval target is unarmed, you can perform a Visual Fix instead of a Radar Fix. This requires you to fly over the target, then designate the Visual Fix point at your current aircraft location.

1. Set Master Mode to SPA (Reconnaissance).
2. Set Radar mode to A0 (Radar Mode Switch FWD)
3. Prepare visual fix by pressing the radar trigger to the first detent (T1)
4. While T1 is held, Data panel shows six zeros.
5. Fly over the target.
6. When directly over the target, press the radar trigger to the second detent (TV). This will complete the fix.

Radar Mode Selector – A0   **2**

3

Measured Target Number "1" for "M1"

Longitude to Recon Measured Target M1

Latitude to Recon Measured Target M1

6b

6b

Minus = Data Displayed is for longitude

When the fix is made, the data panel will alternate between longitude and latitude on the first five digits. The sixth digit will alternate between a minus sign (when displaying longitude) and the reconnaissance target number (when displaying latitude).

If a contact is spiking you on radar (see radar warning receiver signals), it might be a better idea to use a radar fix instead of a visual fix. A visual fix can be dangerous to do for naval targets.

6

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

3

6a

2

4 – SPA/MÅL: Target Measurement Mode

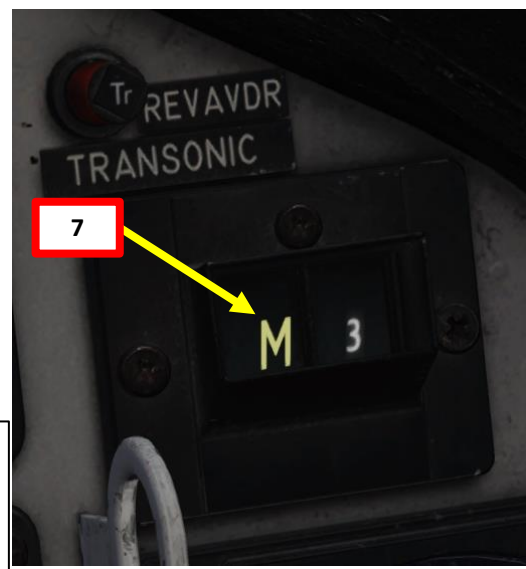### 4.2 – Recon Measured/MÅL Target (M#) Navigation

If you want to navigate to a Recon Measured/MÅL Target you have already designated:

1. Set Master Mode to SPA (Reconnaissance).
2. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
3. Set radar trigger to "T0".
4. Set Data Selector to AKT POS - OUTPUT
5. Press L/MÅL button to select Target Measurement mode
6. We want to select Recon Measured/MÅL Target M3. Press "3" on the keypad.
7. Destination Indicator will change to "M3" and CI (Central Indicator) will display symbology for the Recon Measured Target M3.
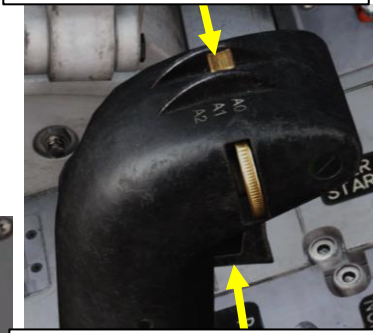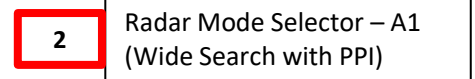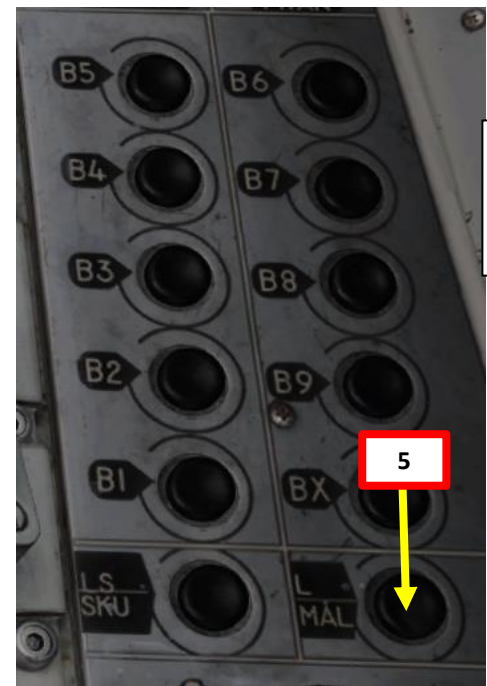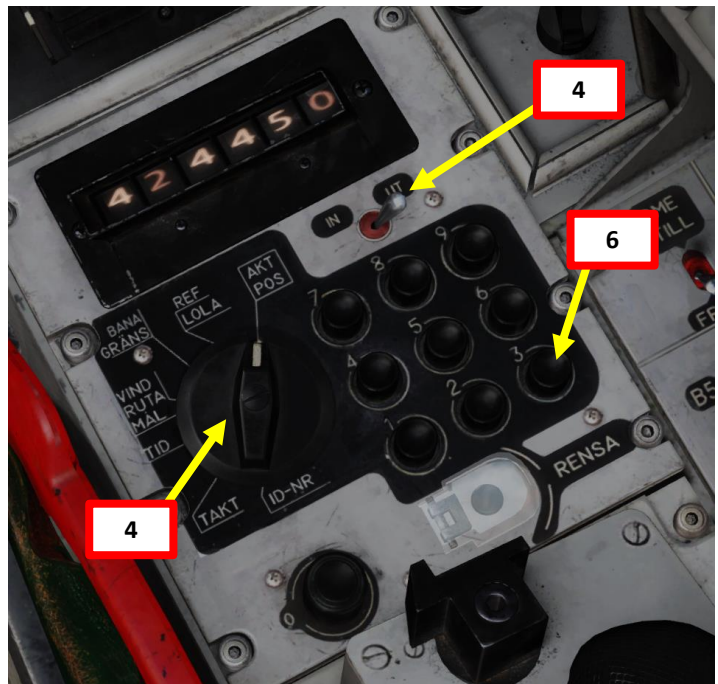
2 Radar Mode Selector – A1 (Wide Search with PPI)

7

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

3

5

4

6

1

7

4

4 – SPA/MÅL: Target Measurement Mode

## 4.3 – Recon Measured/MÅL Target (M1-M9) Data Output

Once a Measured Target has been designated, coordinates and a timestamp are saved in the flight computer. Here is how to access this data:

Coordinates Output Data:
a) Set Master Mode to SPA (Reconnaissance).
b) Set Data Selector to VIND/RUTA/MÅL – OUTPUT
c) We want to see the coordinates for Recon Measured Target M3.
d) Press L/MÅL button to select Target Measurement mode
e) Press and hold "3" on the keypad to select Recon Measured Target "M3"
f) Coordinates are displayed on the Data Display.

Timestamp Data:
1. Set Master Mode to SPA (Reconnaissance).
2. Set Data Selector to TID – OUTPUT
3. We want to see the timestamp for Recon Measured Target M3.
4. Press L/MÅL button to select Target Measurement mode
5. Press and hold "3" on the keypad to select Recon Measured Target "M3"
6. Timestamp is displayed on the Data Display.

f
Target M3 Coordinates

b

b

e

6
Target M3 Timestamp
(Hours:Minutes:Seconds)
07:05:52

2

a   1

5

d   4

2

2
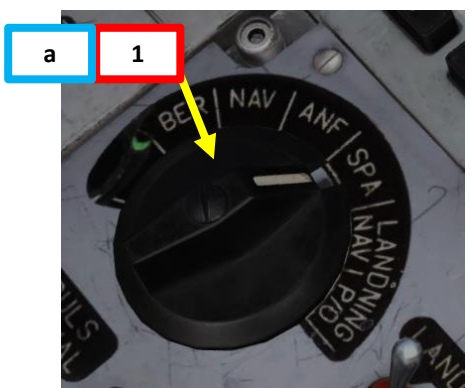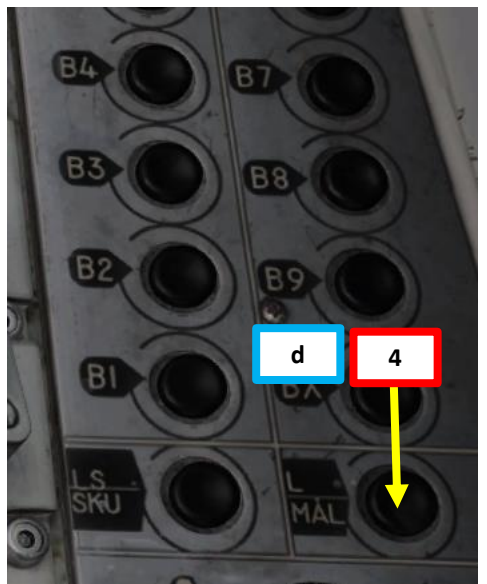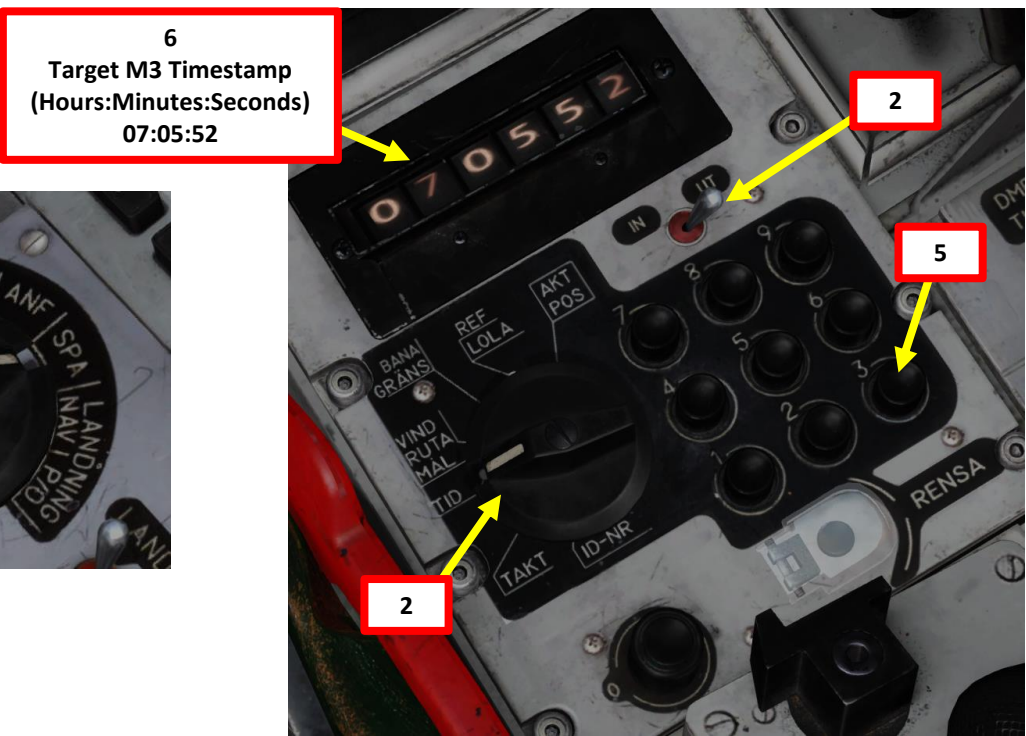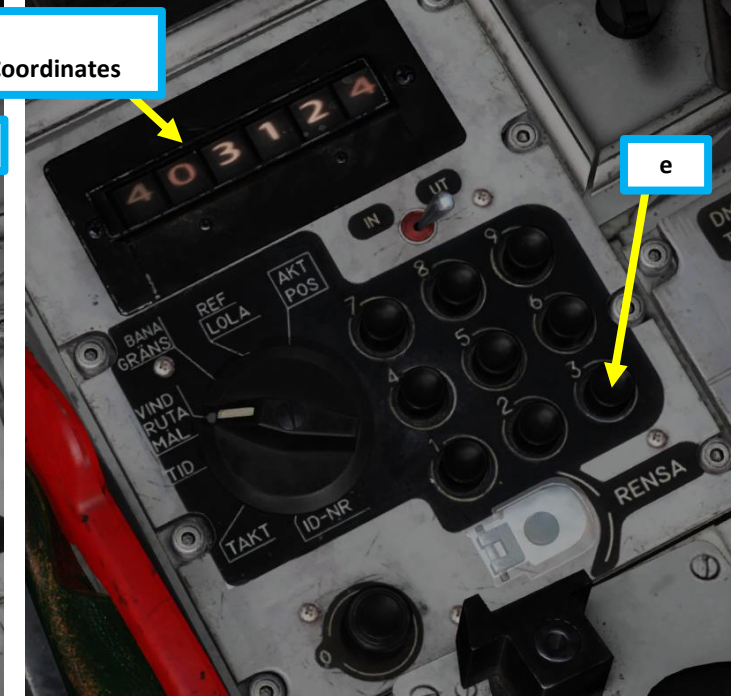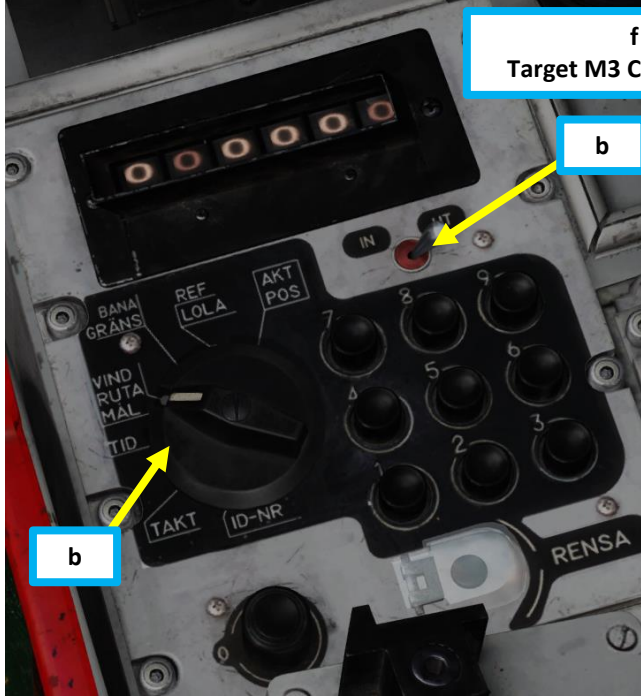
4 – SPA/MÅL: Target Measurement Mode

4.4 – Clearing Measured/MÅL Target (M1-M9)

In mode SPA / MÅL (recce target measurement), the latest selected / measured target is cleared on the first press of the RENSA (Clear) button.

The second press of the RENSA (Clear) button will clear all the measured reconnaissance targets if pressed within 2 seconds of the first press and no digit button or fix trigger has been pressed in-between.
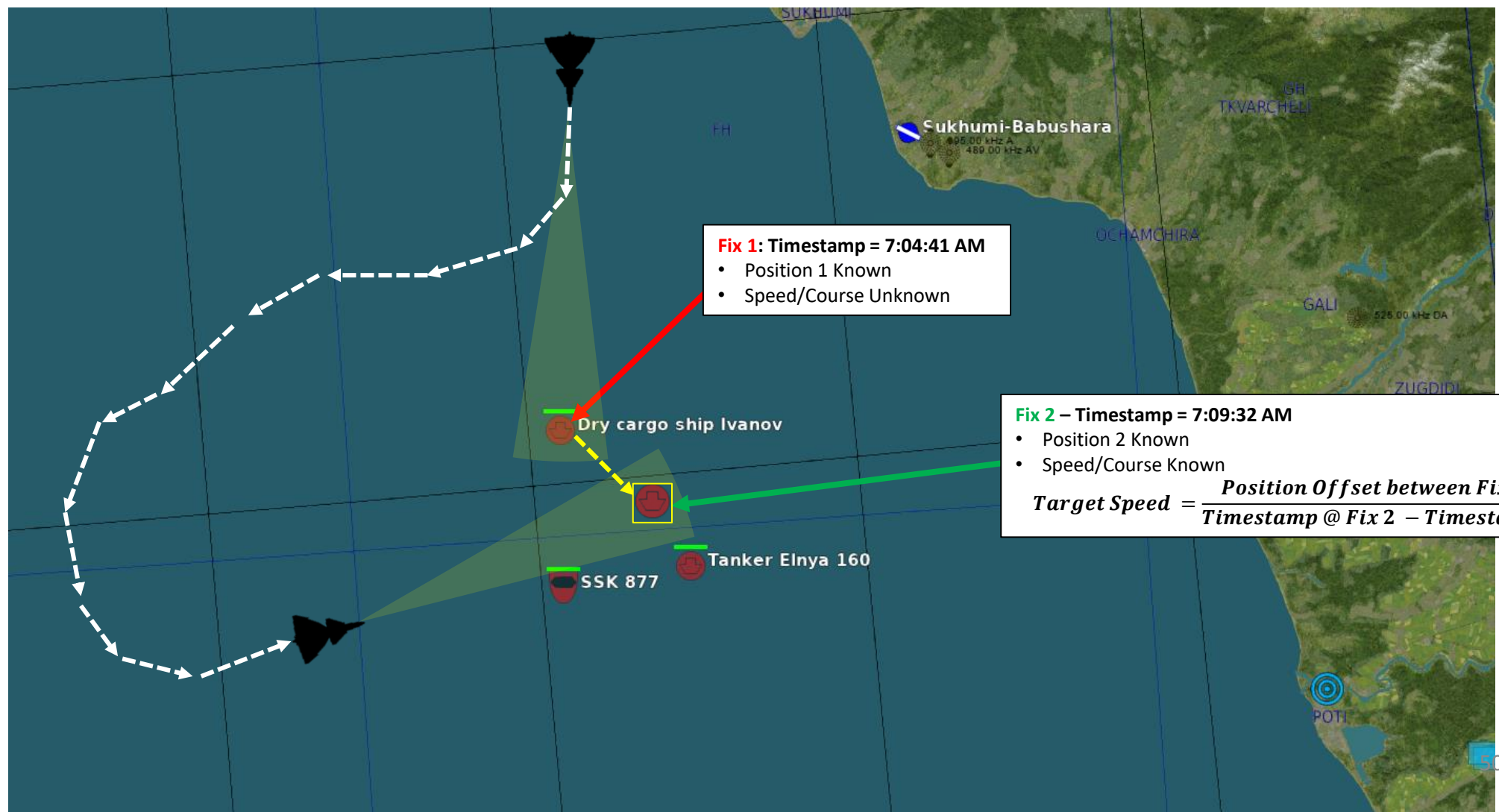
Individual targets can be cleared by entering 0 manually on the desired target.

5 – SPA/SKU: Target Tracking Mode

5.1 – Tracked/SKU Target (S#) Basic Concepts

The main goal of using the Target Tracking Mode is to obtain three things: a Target Location (which we can already obtain from a Recon Measured/MÅL Target), a Target Speed and a Target Course/Direction. With this information, you can easily predict where a target will be. For instance, with this information, a friendly flight of Viggens taking off from Sukhumi can plan their attack on a ship and predict where the ship you are tracking will be 10 to 20 minutes from now, provided the ship does not change speed or direction.
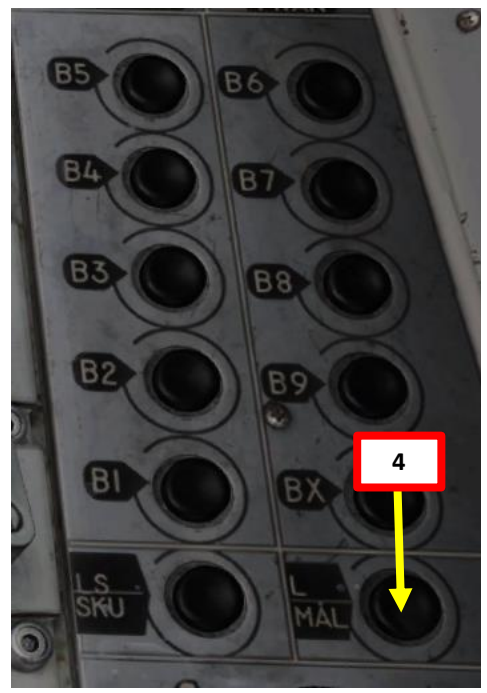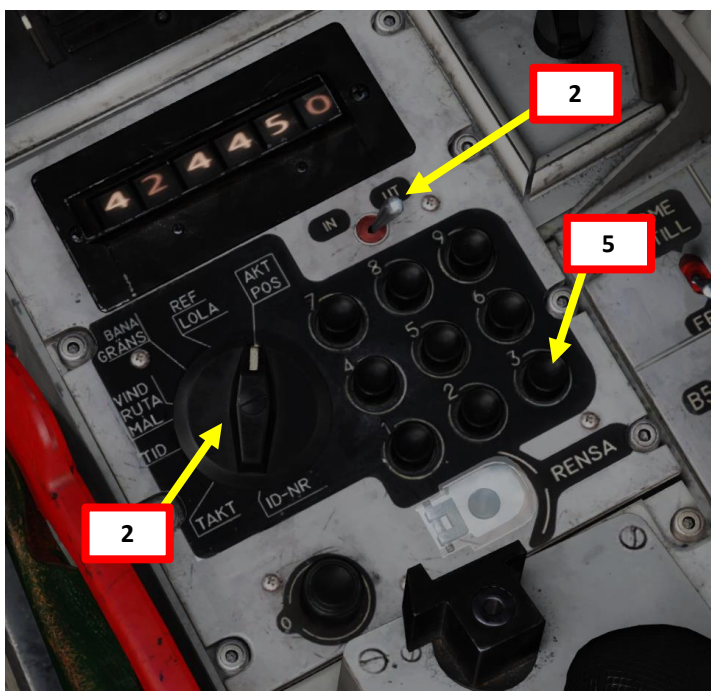

Fix 1: Timestamp = 7:04:41 AM
- Position 1 Known
- Speed/Course Unknown

Fix 2 – Timestamp = 7:09:32 AM
- Position 2 Known
- Speed/Course Known

$$Target\ Speed = \frac{Position\ Offset\ between\ Fix\ 2\ \&\ Fix\ 1}{Timestamp\ @\ Fix\ 2\ -\ Timestamp\ @\ Fix\ 1}$$

5 – SPA/SKU: Target Tracking Mode

5.2 – Recon Measured/MÅL Target (M#) Transfer to Tracked/SKU Target (S#)

The way to track a target is relatively simple:
* First **create a Recon Measured/MÅL Target** (M3 for instance) on a ship using the radar/visual fix techniques we explored earlier.
* We will then transfer the Measured Target in the **SPA/SKU (Target Tracking Mode)** layer.
* After at least 3 minutes, we will then create a second fix in the SPA/SKU layer. With two fixes created with their own coordinates and timestamps, the flight computer will then calculate a heading and speed, « tracking » it in the process.

1. Set Master Mode to SPA (Reconnaissance).
2. Set Data Selector to AKT POS - OUTPUT
3. We want to transfer the existing Recon Measured/MÅL Target M3 into the first Tracked/SKU Target available, which is S1 in our case.
4. Press L/MÅL button to select Target Measurement mode
5. Press "3" on the keypad to Recon Measured/MÅL Target M3.


Fix 1: Timestamp = 7:04:41 AM
* Position 1 Known
* Speed/Course Unknown
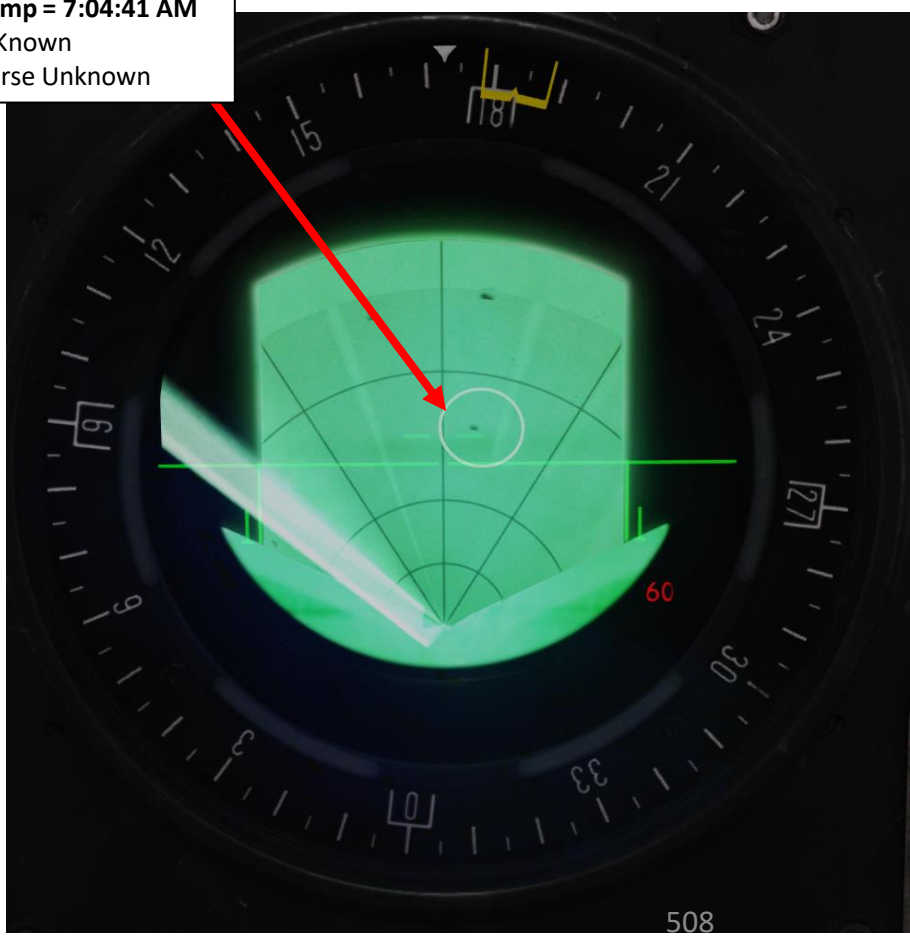
5 – SPA/SKU: Target Tracking Mode

5.2 – Recon Measured/MÅL Target (M#) Transfer to Tracked/SKU Target (S#)

6. Press the waypoint button LS/SKU twice in rapid succession.
7. A successful transfer of recon target coordinates and timestamp is indicated by the tracked target number (S1 – S9) in the destination indicator. Transferred targets are assigned the lowest available tracking slot number, which is "S1" in our case.
   - Note: A failed transfer (due to the tracking slots being full) is indicated by six minus signs on the Data Display.
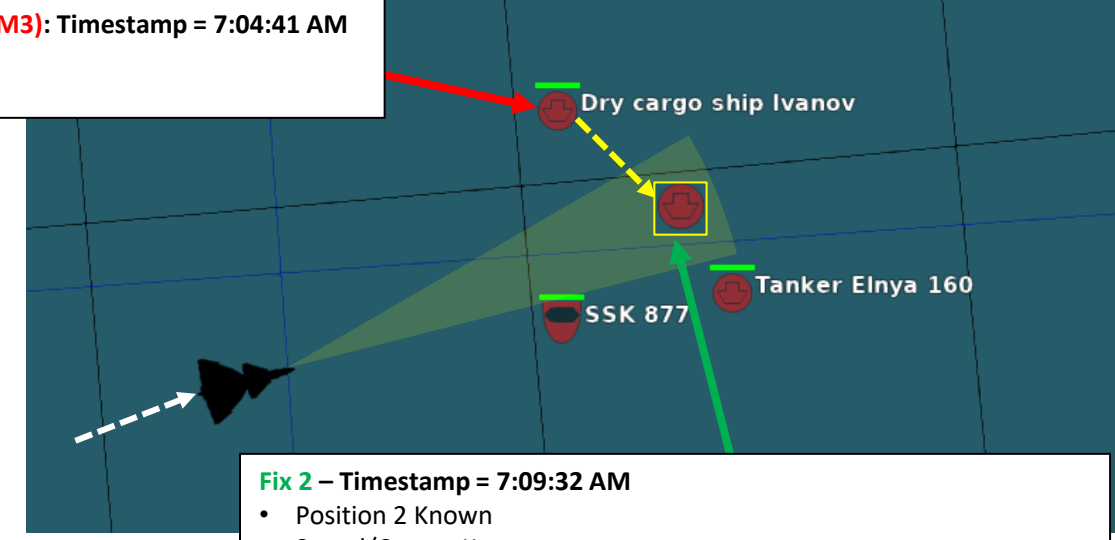
Fix 1 (Measured/MÅL Target M3):
Timestamp = 7:04:41 AM
- Position 1 Known
- Speed/Course Unknown
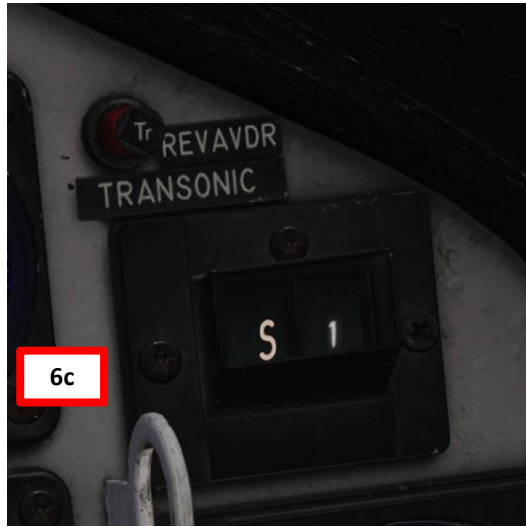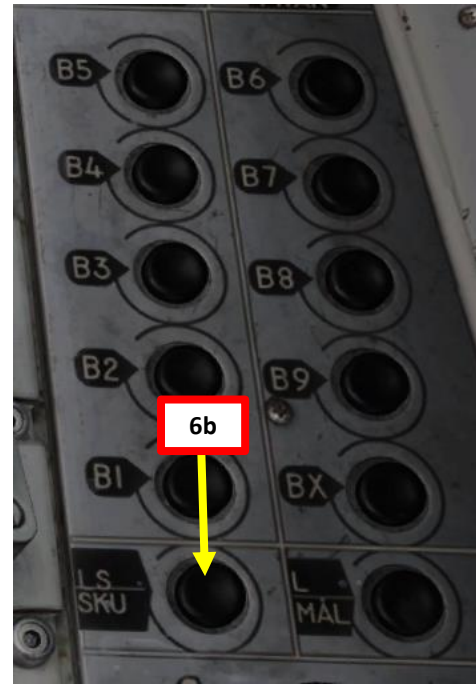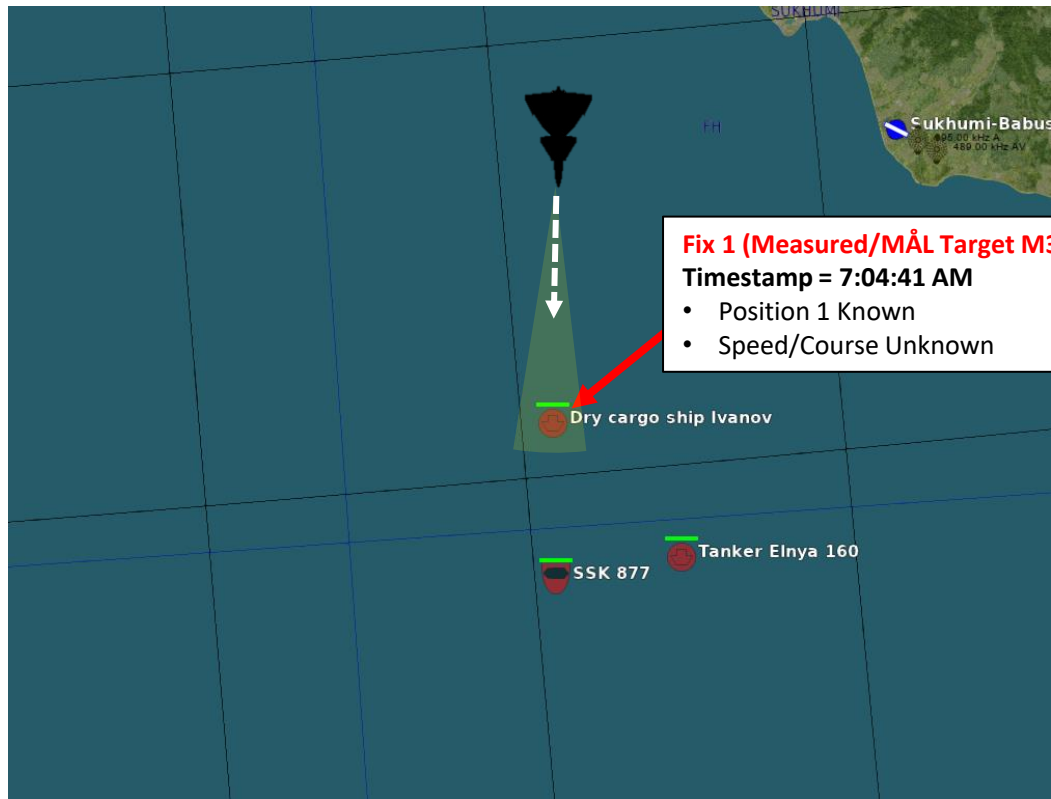
5 – SPA/SKU: Target Tracking Mode

5.3 – Tracking the Tracked/SKU Target (S1-S9)

1. Verify that Master Mode is set to SPA (Reconnaissance).
2. Set Radar mode to A1 (Radar Mode Switch MIDDLE)
3. Adjust radar brightness (LJUS RADAR) and gain (MKR) as desired.
4. Adjust radar display range as required.
5. Set Data Selector to AKT POS - OUTPUT
6. We will work with the existing Tracked/SKU Target (S1), which has been created in the previous section.
7. Press LS/SKU button to select Target Tracking mode.
8. Press "1" on the keypad to select Recon Tracked/SKU Target S1.
9. Verify that radar range display is sufficient to see the target. 60 or 120 km is generally a good range.
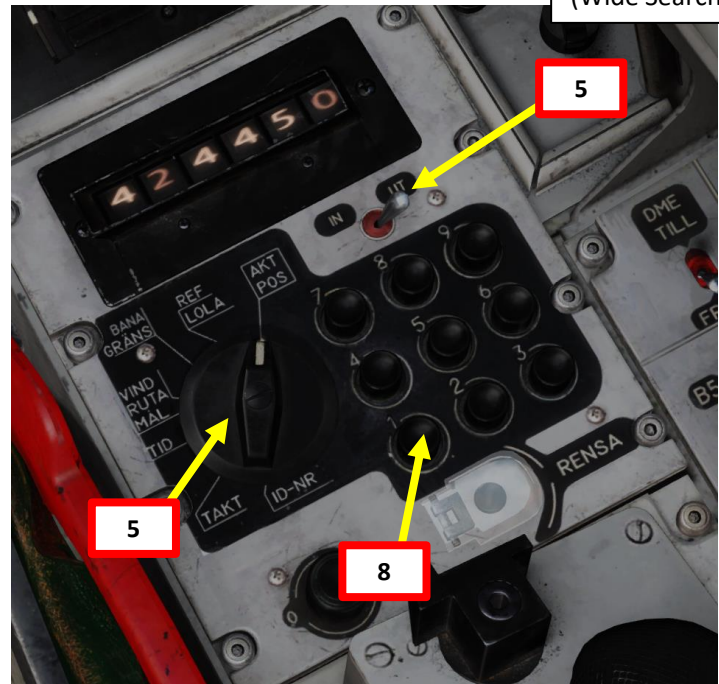
Fix 1 (Measured/MÅL Target M3): Timestamp = 7:04:41 AM
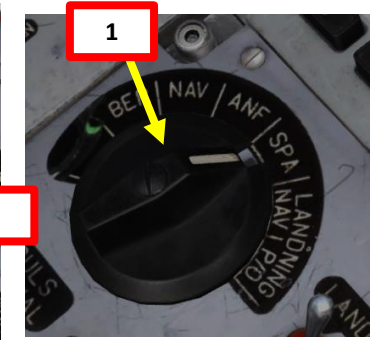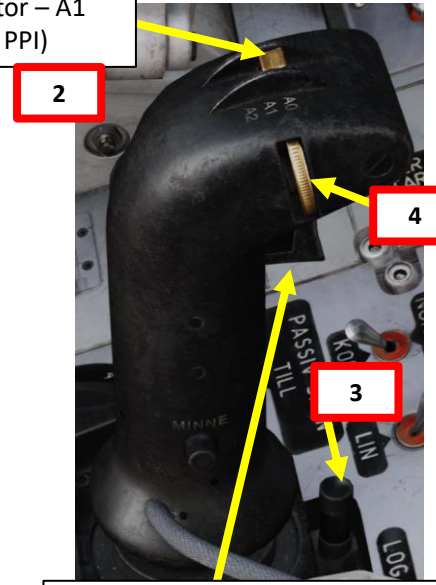- Position 1 Known
- Speed/Course Unknown

Dry cargo ship Ivanov

Tanker Elnya 160

SSK 877

Fix 2 – Timestamp = 7:09:32 AM
- Position 2 Known
- Speed/Course Known

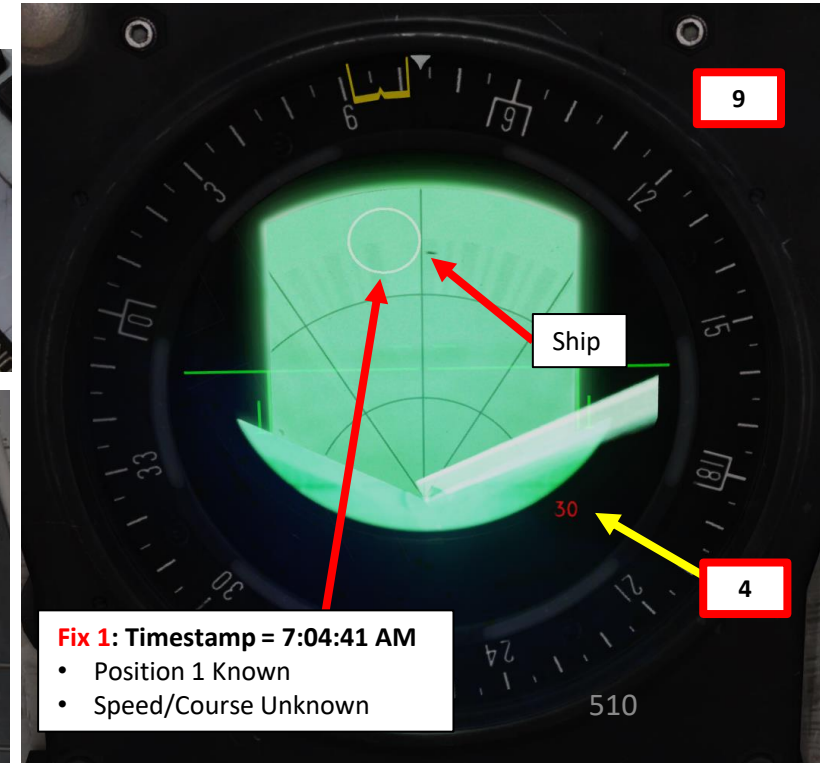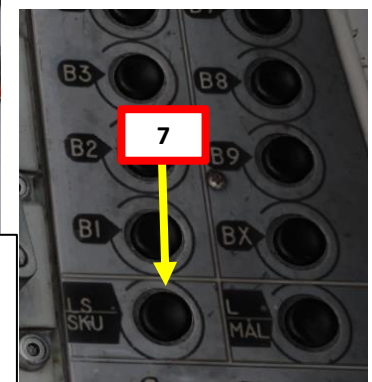$$Target\ Speed = \frac{Position\ Offset\ between\ Fix\ 2\ \&\ Fix\ 1}{Timestamp\ @\ Fix\ 2\ -\ Timestamp\ @\ Fix\ 1}$$

Radar Mode Selector – A1 (Wide Search with PPI)

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent
- TV: Second trigger detent

Ship

Fix 1: Timestamp = 7:04:41 AM
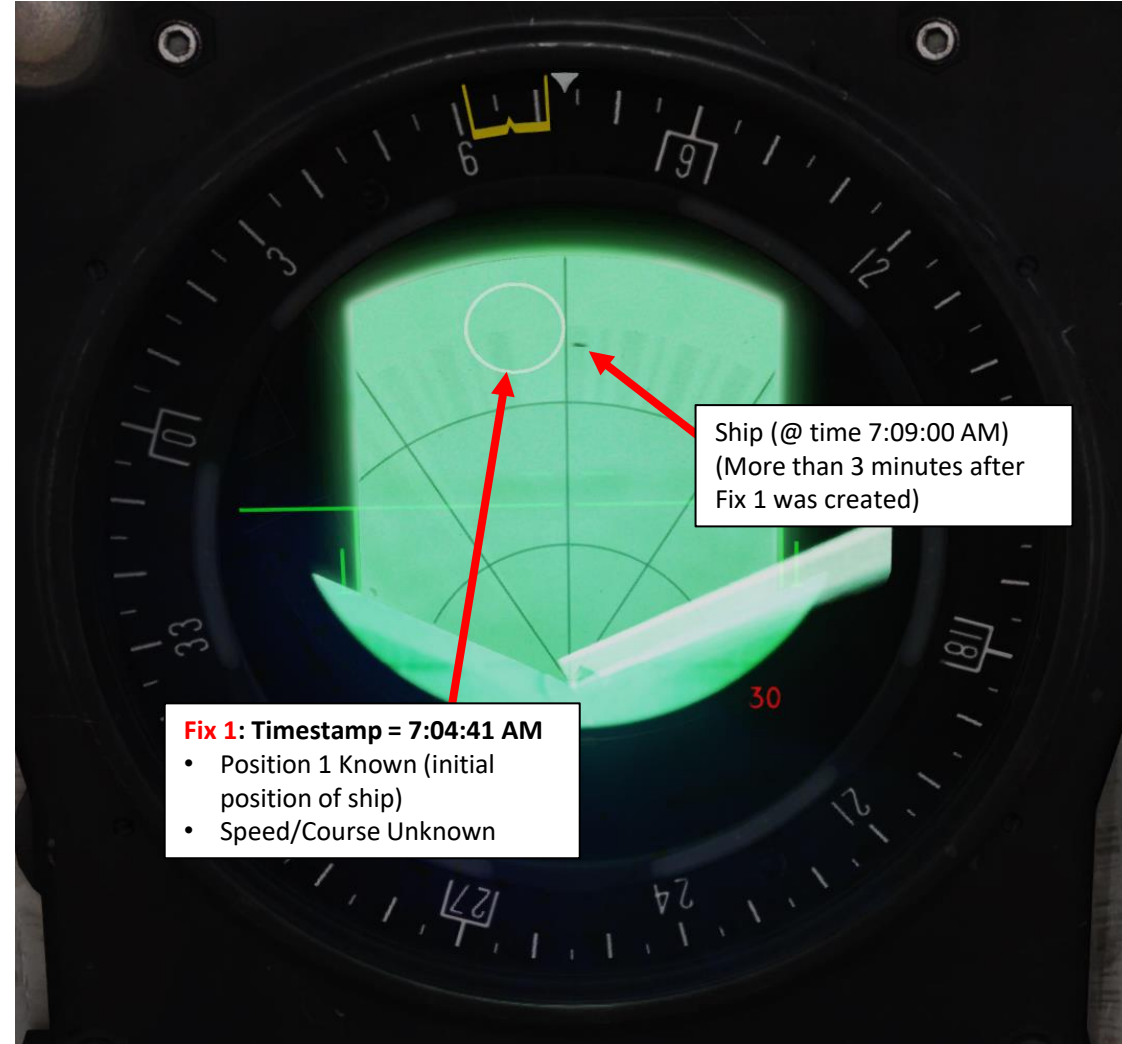- Position 1 Known
- Speed/Course Unknown

510

5 – SPA/SKU: Target Tracking Mode

5.3 – Tracking the Tracked/SKU Target (S1-S9)

10. There are two types of SKU-fix: Type I and Type II.
    - Type I: A SKU-fix that does not result in a target course and speed. A transferred target from the SPA/MÅL mode is a type I fix.
    - Type II: A SKU-fix that does result in a target course and speed is called a type II fix.
11. In order to estimate an accurate speed/course, we have to create a second fix. Take note that the two fixes must be taken with at least 3 minutes in between, otherwise no course/speed can be computed.
12. Once you have spotted the ship on the radar, we will update the Recon Tracked/SKU Target position using a Target Fix.

When preparing a SKU-fix (either visual or radar fix) the destination indicator will display a red S. It can either be solid or flashing with different frequencies (1.2 or 0.6 Hz). The display has the following meaning:
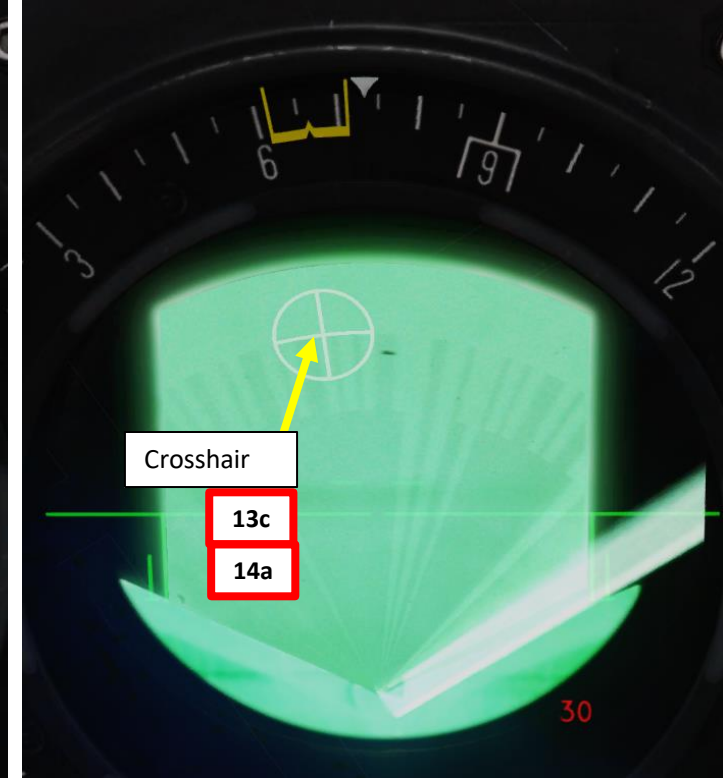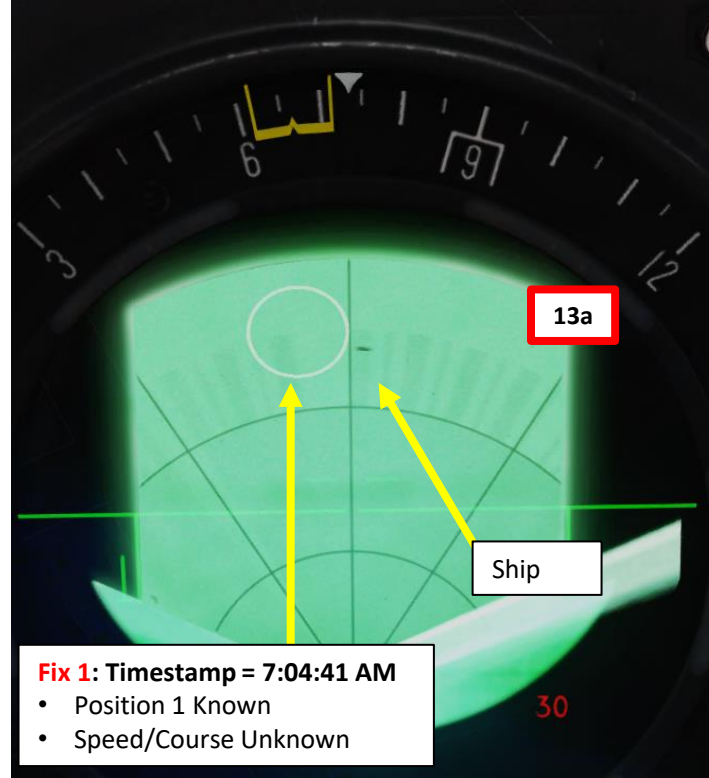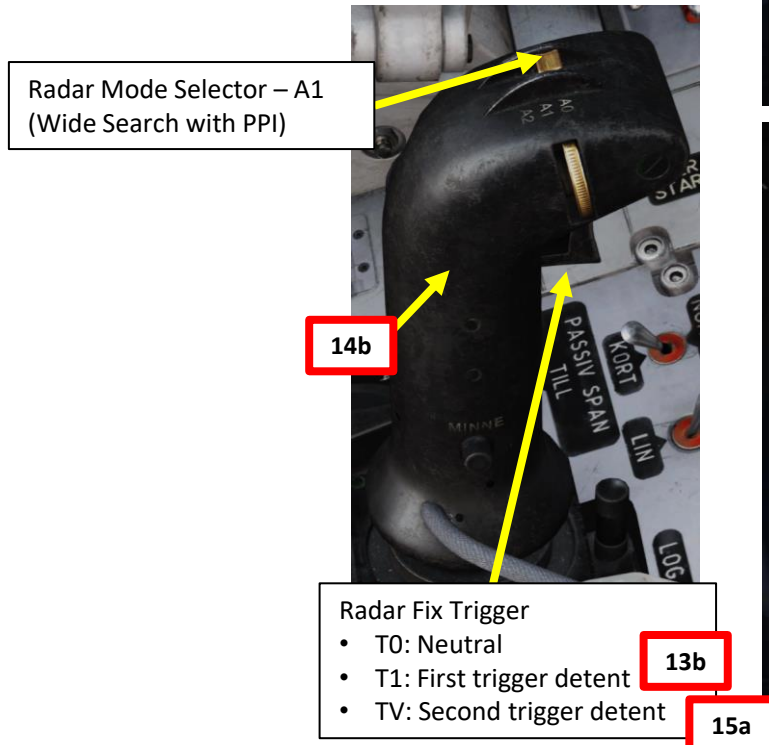
- If the S is flashing with 1.2 Hz, this means that the SKU-target does not have any SKU-fix older than 3 minutes. If the fix is completed, it will result in a new Type I fix.

- If the S is flashing with 0.6 Hz, this means that the SKU-target has two earlier SKU-fixes and one of them is older than 3 minutes and the other less than 3 minutes. If the fix is completed, a type II fix is made, resulting in course and speed of the target. It is however, calculated from the older fix, as the recent fix is too young and will be overwritten by the new fix.

- If the S is solid the SKU-target has one or two earlier SKU-fixes and it/they are older than 3 minutes. If the fix is completed, a type II fix is made. The course and speed will be calculated from the most recent fix and the new fix. The oldest fix will be overwritten.

Ship (@ time 7:09:00 AM) (More than 3 minutes after Fix 1 was created)

Fix 1: Timestamp = 7:04:41 AM
- Position 1 Known (initial position of ship)
- Speed/Course Unknown

5 – SPA/SKU: Target Tracking Mode

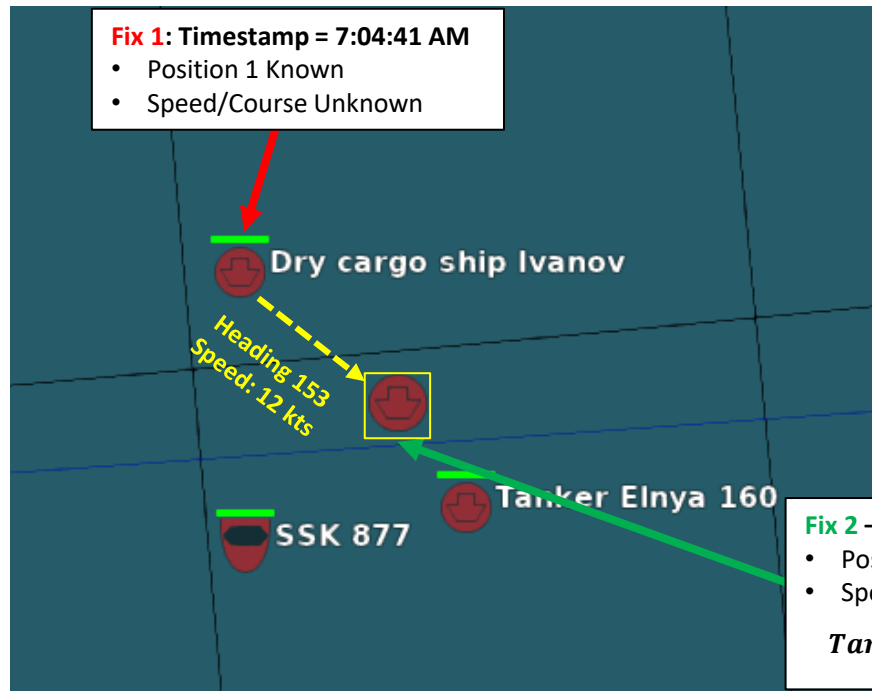### 5.3 – Tracking the Tracked/SKU Target (S1-S9)

13. Make sure 3 minutes have passed after Fix 1 was created (Recon Measured/MÅL Target M3), then press the radar fix trigger to "T1" (first trigger detent).
14. A crosshair will appear in the middle of your display. Move crosshair over target using the radar stick controls.
15. Press the radar fix trigger to " TV" (second trigger detent), which will set the target fix on the target. This will designate a Recon Measured/MÅL Target and enter a timestamp and position coordinate for it in the CK37 computer.
    - On creating a new fix, the most recent of the old fixes is kept if it is at least 3 minutes old.
    - If it is less than 3 minutes old, the oldest fix is kept and the more recent is overwritten by the new fix.

Radar Mode Selector – A1 (Wide Search with PPI)

14b

Radar Fix Trigger
- T0: Neutral
- T1: First trigger detent **13b**
- TV: Second trigger detent **15a**

13a

Ship

Fix 1: Timestamp = 7:04:41 AM
- Position 1 Known
- Speed/Course Unknown

30

Crosshair

13c

14a

30

14c

Crosshair (over ship)

30

15b

30

5 – SPA/SKU: Target Tracking Mode

5.3 – Tracking the Tracked/SKU Target (S1-S9)

16. When the fix is completed:
   a) If the fix trigger is still held beyond the second detent (TV), the display on the data panel is dependent of the fix type.
      - If the fix was a type II (it should be the case in this tutorial), the data indicator will display the target ship's course and speed (in knots).
      - If the fix was a type I, six zeroes (0) will be displayed. The circle marker will remain on the target position (if using a radar fix)
17. If you want to select a new destination or designate a new target, set radar trigger to "T0"

Tracked/SKU Target S1 Course
153

Tracked/SKU Target S1 Speed
12 kts

Fix 1: Timestamp = 7:04:41 AM
- Position 1 Known
- Speed/Course Unknown

Dry cargo ship Ivanov

Heading 153
Speed: 12 kts

Tanker Elnya 160

SSK 877

Radar Fix Trigger
- T0: Neutral   **17**
- T1: First trigger detent
- TV: Second trigger detent

Fix 2 – Timestamp = 7:09:32 AM
- Position 2 Known
- Speed/Course Known

$$Target\ Speed = \frac{Position\ Offset\ between\ Fix\ 2\ \&\ Fix\ 1}{Timestamp\ @\ Fix\ 2\ -\ Timestamp\ @\ Fix\ 1}$$

513

5 – SPA/SKU: Target Tracking Mode

5.4 – Clearing Tracked/SKU Target (S1-S9)

In mode SPA/SKU (recce target tracking), the first press of the RENSA (Clear) button will clear the latest tracking fix.

The second press of the RENSA button will clear all the tracking fixes for the current destination.

6 – Stand-Off Distance Warning

The purpose of the stand-off warning is to provide a warning so that the aircraft does not approach a reconnaissance target too closely. The set stand-off warning distance is common to all reconnaissance targets, and they cannot be set individually.

Conditions

Stand-off warning is given when the distance to any of the recon targets M1-9 or S1-9 in less than the entered value in the CK37 computer. If multiple warnings are given, only the closest target is displayed.
- Warning is not presented during start/landing, and any present warning is cancelled on selecting any of the landing master modes.
- Warning is not presented during weapons use / aiming (either in mode ANF or trigger is UNSAFE). However, any present warning is not cancelled by weapons use / aiming.

Indication

Stand-off warning is indicated by a Fully extended time / distance line in the HUD.

Cancellation

Stand-off warning is cancelled in the one of these two ways:
- Cycling the fix trigger from the first detent (T0-T1-T0). The warned target is set as the destination. Warned tracked target (SKU) is only cancelled in master mode SPA.
- Manual destination change. Warning is cancelled and selected waypoint becomes the destination.

Non-cancelled warnings last until the warning parameters are no longer fulfilled. When this occurs, the most recent waypoint (LS, B1 – B9, or L1, L2) will be selected as the destination.
Note. Fix taking is inhibited as long as the stand-off warning is active.


Stand-off Warning Distance Line

515

6 – Stand-Off Distance Warning

Stand-Off Distance Setup

In mode TAKT, a Stand-off warning distance can be entered. All targets (M1-9, S1-9) will share the same stand-off distance. Input can be made in any master mode.

Input is made on address 30:
- a) Set Data Selector to TAKT
- b) Set INPUT/OUTPUT Selector to IN
- c) Enter code "303500" on the keypad for a stand-off distance warning set for 35 km.
  - • Note: "300000" on the keypad means that no warning is given.
- d) Press LS/SKU button
- e) Set INPUT/OUTPUT Selector to UT (Output)
- f) Set Data Selector to AKT POS (Active Position)
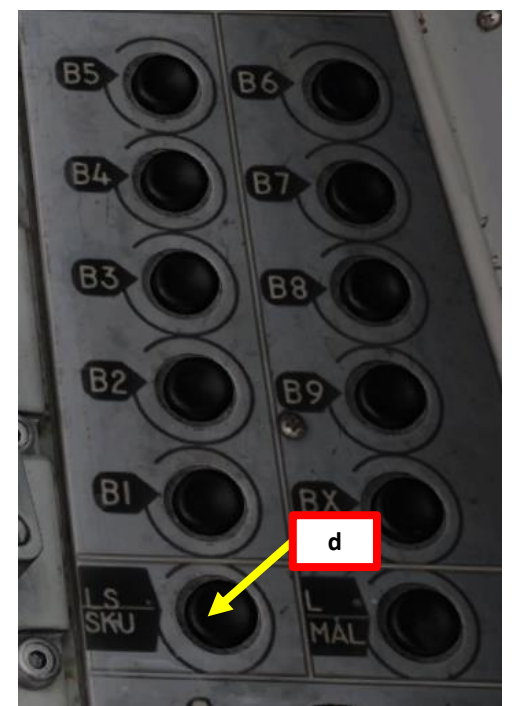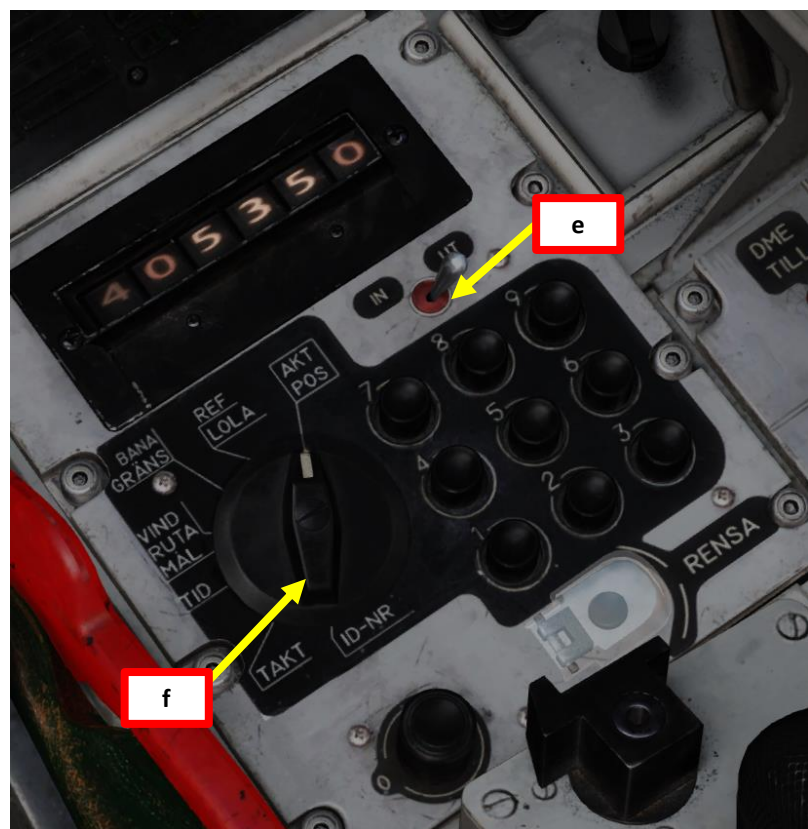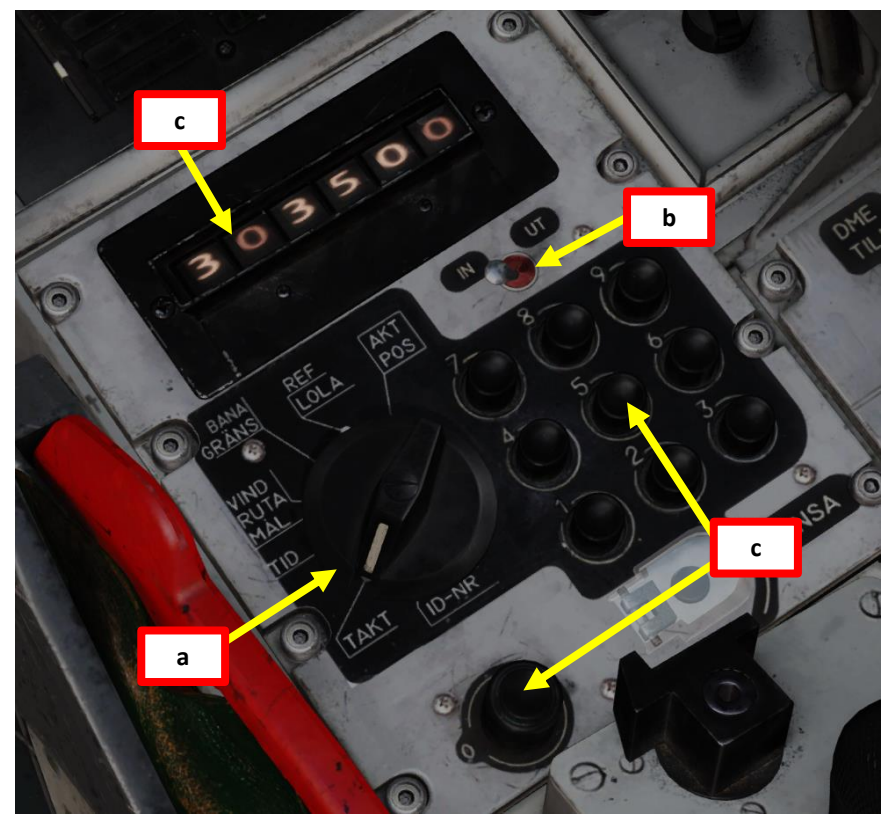
ACRONYMS

- AFK: Automatisk Fart Kontroll (Autothrottle)

- APP-27: RWR (Radar Warning Receiver)

- CI: Central Indicator

- CK-37: Central Kalkylator 37, or Central Computer

- FLI-37: Attitude Director Indicator

- HAW: High Alpha (Angle of Attack) Warning

- HUD: Heads-Up Display

- KB: Countermeasures Pod

- PS-37/A: Ground Radar

- SA-06: Autopilot

- TERNAV: Terrain Navigation System, similar to TERCOM systems in cruise missiles.

- TILS: Tactical Instrument Landing System

- U-22: ECM (Electronic Countermeasures) Pod
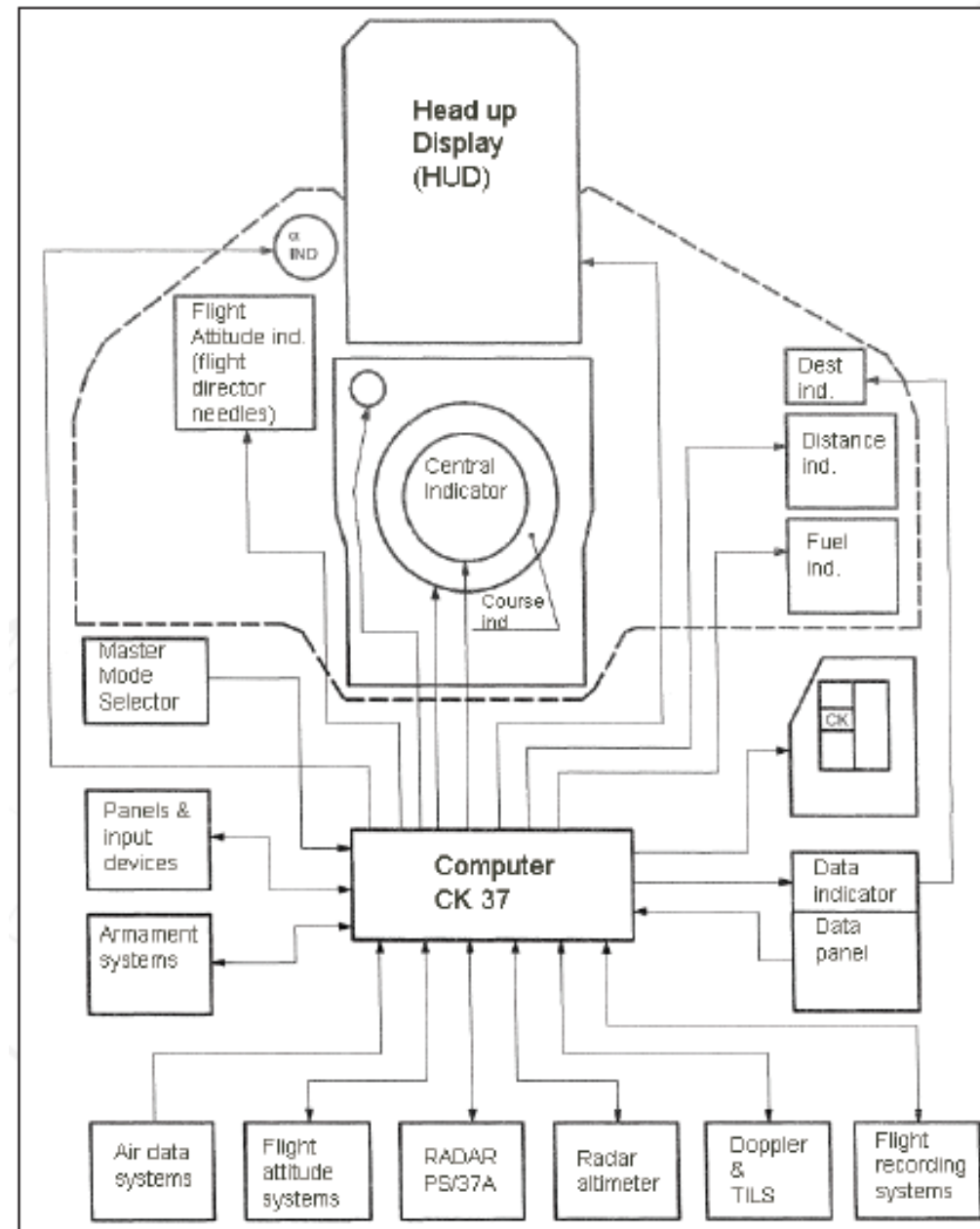
RESOURCES

Heatblur Simulations AJS-37 Viggen Manual (RC2)

AJS-37 Viggen Warfare Kneeboard Pages by FunkyFranky
https://www.digitalcombatsimulator.com/fr/files/3126659/

ViggenTools Website
http://viggentools.se/

AJS-37 Viggen Tutorials by Leadnap Gaming
https://www.youtube.com/playlist?list=PLNyD4eo0ftPRgjxDu6oHrZh3xkF9_47bg

Viggen Tutorials by xxJohnxx
https://www.youtube.com/playlist?list=PLs4yzB9MM2Sw3okBvFavzBugu-1UpkEPr

Test Flight Series by Bunyap
https://www.youtube.com/playlist?list=PLoiMNu5jyFzTzrNVgj3fQpG1x8taECYLs

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:

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- Tom "Typhoon" Wesely
- [ChazFlyz](#)
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