M-2000C

Version 1.1.1

RAZBAM

User Manual

DCS SERIES

M-2000C FLIGHT MANUAL

INTRODUCTION

The following chapters describe the Mirage 2000C on-board systems and their employment.

The description sections cover the systems control panels and indicators. The employment section describes systems procedures and settings for efficient use. Only the features implemented in DCS are covered.

It is assumed that the user knows the basics principles of the systems. Therefore, general knowledge on how a VOR, an ILS, a TACAN, a radar, etc operates will not be explained except when found relevant, e.g. when there is a difference with the real system. Should additional information be needed on the basics, a lot of info / tutorials are available on the net.

You will find the check-lists at the end of the document (in Section 18 to be precise). There will also be separate documents with larger version of the instrument layouts for your reference that you can print separately.

EFFECTIVITY

At the beginning of the flight manual you will find the U.S.-like flight manual list of effective pages. It points to the pages where changes in the document occurred since last release, permitting the virtual pilot to identify instantly where to look for new information without having to run through the whole document. Moreover, on the indicated pages, a vertical thick black line shows exactly the portion of text or figure that has been modified. Smart, no? Pilots are. You are.

SOUND JUDGEMENT

These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and normal and emergency procedures. The instructions in this manual are for a crew inexperienced in this airplane and provide the best possible operating instructions under most circumstances. It is not a substitute for sound judgment. Multiple emergencies, adverse weather terrain, tactical environment etc… may require modifications to these procedures.

VERSION

The latest version of this manual is 1.1.0 (XX/11/2019)

DEFINITIONS

The following definitions apply to Warnings, Cautions and Notes found throughout the document.

WARNING	Operational procedures, techniques, etc., which may result in personal injury or loss of life if not carefully followed.
CAUTION	Operational procedures, techniques, etc., which may result in damage to equipments if not carefully followed.
NOTE	Important information to memorize.

NOT FUNCTIONAL This feature has not been added to the module or is not yet functional.

SECTION X Interactive link to another part / chapter within the manual.

GLOSSARY

The first aircraft were destined to the French Air Force, and thus the associated documentation was written in French. Therefore, all systems designation and cockpit lettering are in French.

When an abbreviation is in French, the corresponding meaning is in italic, followed by the English translation. This is valid throughout the document. You will find the full list of abbreviations in Section 19.

INS Inertial Navigation System

UNI *Unité de Navigation Inertielle*. Inertial Navigation System (INS).

PCA *Poste de Commande Armement*. Weapon Control Panel

PCR *Poste de Contrôle radar*. Radar Control Panel

PPA *Poste de Préparation Armement*. Weapons Preparation Panel

PCN *Poste de Commande Navigation*. Navigation Control Panel

AOA Angle-Of-Attack

PSM *Poste de Sélection de Modes*. INS Mode Selection Panel

ECM Electronic Countermeasures

AP Autopilot

AAR Air-to-Air Refuelling

QFE Atmospheric pressure measured at the active runway threshold QNH Calculated runway atmospheric pressure at medium sea level HOTAS Hands On Throttle And Stick

FBW Fly-By-Wire

CDVE *Commandes De Vol Electriques*. Fly By Wire (FBW) flight controls.

RWR Radar Warning Receiver

DA *Détecteur d'Alerte*. See RWR

AAM Air-to-Air Missile

DDM *Détecteur de Départ Missile*. Missile Launch Warning System.

1013 Standard (STD) atmospheric pressure setting.

RDI *Radar Doppler à Impulsions*. Pulse Doppler Radar.

USG US Gallons

MPH Statute Miles per Hour

KT Knots (Nautical miles per hour)

Nm Nautical miles

km Kilometers

m Meters

mi Miles

ft/min Feet per minute

l Liters

AB Afterburner

PC *Post-Combustion*. Refer to AB

HUD Head-Up Display

VTH *Visualisation Tête Haute*. See HUD

HDD Head Down Display

VTB *Visualisation Tête Basse*. See HDD

A *Arrêt*. Off.

S.A. *Semi-automatique*. Semi automatic

ACKNOWLEDGEMENTS

We would like to take a moment first to thank the following people involved on the project and who made possible the release of this aircraft.

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Also, big thanks to Colombia for its coffee, the soda companies, for their heavily caffeinated products, although we could do without all the sugar, and to Cable TV for keeping us company in the long working nights.

Date	Sect.	Ver.	Description
27/01/2020	1-2	1.1.0	Updated cockpit layout photos and instrument decriptions
	1-3	1.1.0	Updated description of WSC and CNM switches in HOTAS part.
	9-2	1.1.0	Updated frequency ranges for V/UHF and UHF radios
	9-2	1.1.0	Completely re-written the part and instructions for V/UHF radio.
	10-2	1.1.0	Updated the HUD master modes part.
	10-3	1.1.0	Added triangle (magic + radar lock) to HUD symbology
	12-3	1.1.0	Changed PCN picture, updated text to remove the ENC button
	12-5	1.1.0	Added description of new waypoint increase / decrease buttons
	13-1	1.1.0	New contact symbols heading added
	13-1	1.1.0	Added information about RDI target identification capabilities
	13-1	1.1.0	Added information about HUD FLOOD combat mode
	13-2	1.1.0	Updated RWR codes
	13-2	1.1.0	Added Spirale Box description, table of programmes and description of modes.
	14-2	1.1.0	Updated description of interior cockpit lighting knobs
	14-3	1.1.0	Added whole new section on NVGs
	15-2	1.1.0	Updates to Weapons Management section to include new functions
	15-3	1.1.0	Updates to section about the use of Magic 2 missiles
	15-3	1.1.0	Added Spiral Hud Scan description
	19-1	1.1.0	Added full list of French abbreviations and their English meanings.
	ALL	1.1.0	Fixed typos and updated text in almost all chapters
28/03/2020	10-3 15-3	1.1.1	Added MAV search patterns

SECTION 1

AIRCRAFT

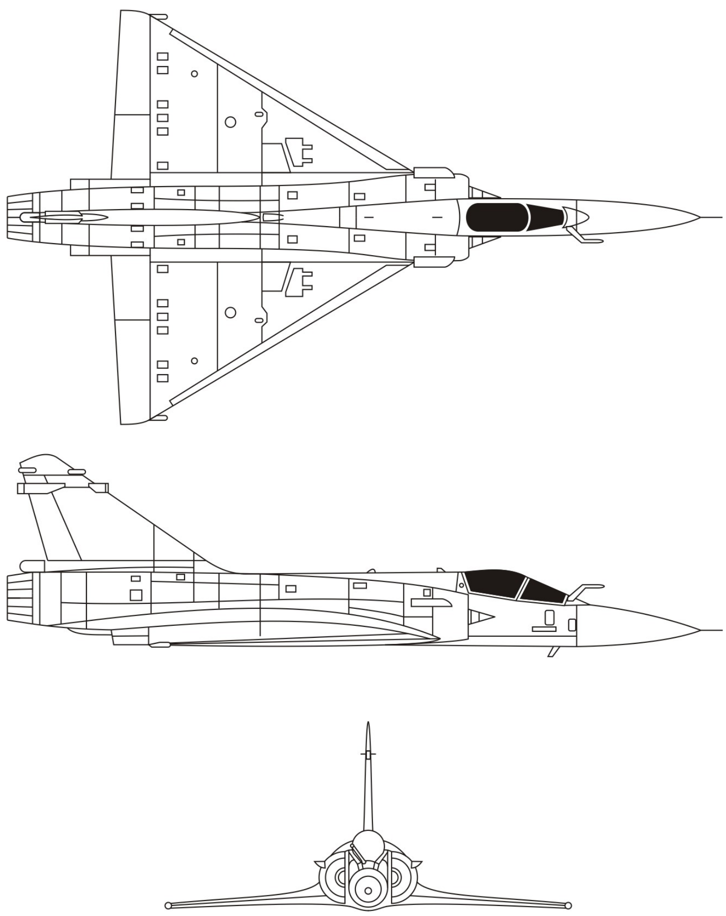
BASIC INFORMATION

The M-2000C is a fourth generation, single-seat, single-engine supersonic jet fighter aircraft. It is primarily a medium-range interceptor, but has limited secondary air-to-ground capability.

It has a delta-shaped wing, with 2-part leading edge slats and elevons on the trailing edge. These elevons act at the same time as elevators and ailerons.

Aircraft control is performed by the mean of fly-by-wire.

Air to air refuelling capability is provided via a removable probe on the right side of the windshield. It is compatible with drogue type tankers such as the KC-130, KC-135 (not all of which are equipped with drogue), S-3B and IL-78M.



M-2000C

POWER PLANT

Power is supplied by one SNECMA M53-P2 dual flow turbofan engine with afterburner on both flows.

Thrust: Dry thrust: 64.3 kN (14,500 lbf).
Thrust with afterburner: 95.1 kN (21,400 lbf).

PERFORMANCES

Speed: Mach 2.2 (2,530+ km/h, 1,500+ mph) at high altitude.
Mach 1 (1,110 km/h, 690 mph) at low altitude.

Range: 1,550 km (837 nM, 963 mi) with drop tanks.

Ceiling: 17,060 m (59,000 ft).

AIRCRAFT DIMENSIONS AND WEIGHT

Wingspan: 9.13 m (29 ft).

Length: 14.36 m (47 ft 1 in) (14.66 m with air data probe on the nose)

Height: 5.20 m (17 ft).

Weight: Empty weight: 7 600 kg (16,750 lb)
Loaded weight: 13 800 kg (30,420 lb)
Maximum takeoff weight: 16 500 kg (36,400 lb)

WEAPONS

Pylons: 4 wing pylons, 4 lateral fuselage pylons and one centre fuselage pylon

Armament: 2× 30 mm (1.18 in) DEFA 554 revolver cannon, 125 rounds per gun.

Matra R550 Magic-II infra-red homing missiles.

Matra Super 530D semi-active radar guided missiles.

Matra 68 mm unguided rocket pods, 18 rockets per pod.

Mk-82 general purpose 250 kg bombs

Mk-82SE high drag 250 kg bombs

BLG-66 "beluga" cluster bombs

BAP-100 anti-runway bombs

GBU-12 250 kg (500 lb) laser guided bombs

GBU-16 500 kg (1,000 lb) laser guided bombs

GBU-24 1 000 kg (2,000 lb) laser guided bombs

Countermeasure suite with chaff, flares and radar jammer.

Other: Under-wing tanks, Fuselage centreline tank.

HISTORY

The M-2000C is a French single engine fourth generation fighter. Designed in the late 1970s as a lightweight fighter for the French Air Force (Armée de l'Air). Later evolved into a multirole aircraft with several variants developed, with sales to a number of nations. Over 600 aircraft were built and it has been in service with nine nations.

The M-2000 was initially intended to replace the previous generation Mirage III for the export market, and was smaller and cheaper than the aircraft proposed to the French Air Force, called the Avion de Combat Futur ACF (Futur Combat Aircraft). The project was first known as the “Super Mirage III”, then “Delta 1000”, “Delta 2000”, “Super Mirage 2000” to finally settle for “Mirage 2000”.

Unlike the ACF, which was a strike aircraft with secondary capabilities as interceptor, the M-2000C was designed as an interceptor. When the ACF project was cancelled, the M-2000C was offered as a cheaper alternative to the French government and was approved on December 1978.

The M-2000C was also designed to compete with the General Dynamics F-16 in the lucrative European market, which was interested in small, but agile, lightweight fighters.

The M-2000C features a low-set thin delta wing with cambered section, 58 degrees leading-edge sweep and moderately blended root; area-ruled. The flight surfaces on the wings are composed of four elevons and four leading edge slats. Its center of lift is in front of its center of gravity, giving the fighter relaxed stability to enhance maneuverability. It incorporates negative stability and fly-by-wire controls with four analog computers and a fifth, ultimate back-up one. Airbrakes are fitted above and below each wing in an arrangement very similar to that of the Mirage III and IV. A noticeably taller tailfin allows the pilot to retain control at higher angles of attack, assisted by the small strakes mounted along each air intake.

The aircraft uses retractable Tricycle type landing gear. A runway tailhook or a fairing for a brake parachute can be fitted under the tail, which can operate in conjunction with the landing gear's carbon brakes to shorten landing distances. A removable refueling probe can be attached in front of the cockpit, offset slightly to the right of center.

Cockpit

The Mirage 2000 is available as a single-seat or two-seat multi-role fighter. The pilot flies the aircraft by means of a center stick and left hand throttle, with both incorporating hands-on-throttle-and-stick (HOTAS) controls. The pilot sits on a license-built version of the British Martin-Baker Mark 10 zero-zero ejection seat. Unlike in the F-16, the pilot sits in a conventional position, without the steep backward slope of the F-16 seat.

The instrument panel is dominated by the head-up display which presents data relating to flight control, navigation, target engagement and weapon firing, and the radar screen (or head - down display) located centrally below it. To the lower left is a stores management panel, above which are the flight instruments. The right half of the instrument panel accommodates the navigation, engine and systems displays. Located on the left side of the cockpit, just ahead of the throttle, are controls for the communications equipment.

Engine

The SNECMA M53 afterburning turbofan was developed for the ACF, and was available for the M-2000C project. The first 37 aircraft were equipped with the SNECMA M53-5 engine version; later aircraft were equipped with more powerful SNECMA M53-P2 version.The M53-P2 provides 64.3 kilonewtons (14,500 lbf) of thrust dry and 95.1 kilonewtons (21,400 lbf) in afterburner. The air intakes are fitted with an adjustable half-inlet cone-shaped center body (named *souris* - mouse - in French), which provides an inclined shock of air pressure for highly efficient air intake. Total internal fuel capacity is 3,978 litre (1,051 US gal). There are also provisions for a jettisonable 1,300-litre (340 US gal) centerline fuselage fuel tank and for a 1,700-litre (450 US gal) or 2,000-litre (528 US gal) drop tank under each wing.

Payload and armaments

The M-2000C is equipped with built-in twin DEFA 554 30 mm revolver-type cannons with 125 rounds each. The cannons have selectable fire rates of 1,200 or 1,800 rounds per minute.

The aircraft can carry up to 6.3 tons (13,900 lb) of stores on nine pylons, with two pylons on each wing and five under the fuselage. External stores can include Matra Super 530D medium-range semi-active radar-guided air-to-air missile on the inboard wing, and Matra Magic II short-range infrared-seeking AAM on either wing pylons.

SENSORS AND AVIONICS

Avionics for the M-2000C include the Sagem ULISS 52 inertial navigation system (INS), TRT radio altimeter, Dassault Electronique Type 2084 central digital computer, Digibus digital data bus and Sextant Avionique Type 90 air data computer. The communication equipment package includes the LMT NRAI-7A IFF transponder, IO-300-A marker beacon receiver, TRT ERA 7000 V/UHF com transceiver, TRT ERA 7200 UHF or EAS secure voice communications.

The aircraft has a redundant fly-by-wire automatic flight control system, providing a high degree of agility and easier handling, together with stability and precise control in all situations. The fighter's airframe is naturally unstable, and so it is coupled with FBW commands to obtain the best agility; however, in override mode it is still possible to exceed a 270 deg/sec roll rate and allows the aircraft to reach 11 g (within the 12 g structural limit), instead of 9 g when engaged.

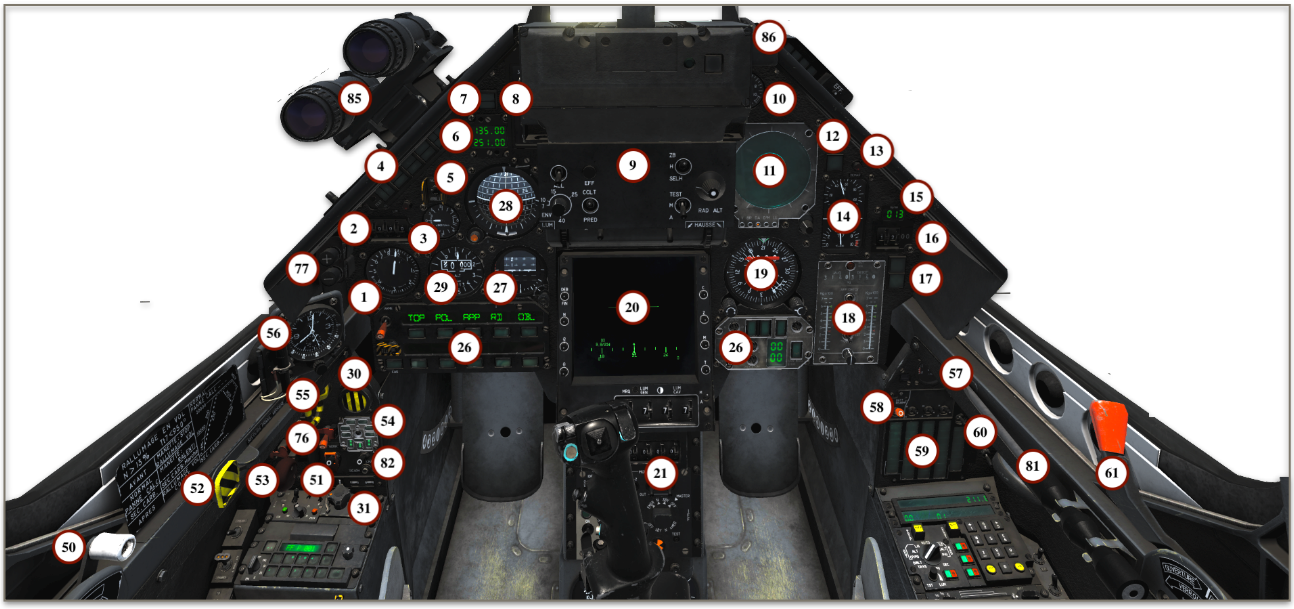
The aircraft uses the RDI pulse-Doppler radar with an operating range of 54 nm (100 km / 62 miles). This unit is a new development, the first French HFR radar, specialised for air-to-air duties and the first to provide serious look-down/shoot-down capabilities.

The M-2000C is equipped with a radar warning receiver (RWR) with antennas on the wingtips and on the rear of the top of the tail fin. It is also equipped with the Sabre radar jamming and deception in a pod below the bottom of the tail fin, with the antenna in a fairing on the front of the tail fin. Countermeasures are provided by Spirale dispensers, each fitted on the extensions behind the rear of each wing root, giving a total capacity of 112 chaff cartridges, the flares dispensers are located under the wing roots with a total of 16 cartridges.

An additional Eclair pod can be mounted under the rear fuselage, providing a bigger countermeasure payload at the expense of the brake chute or hook.

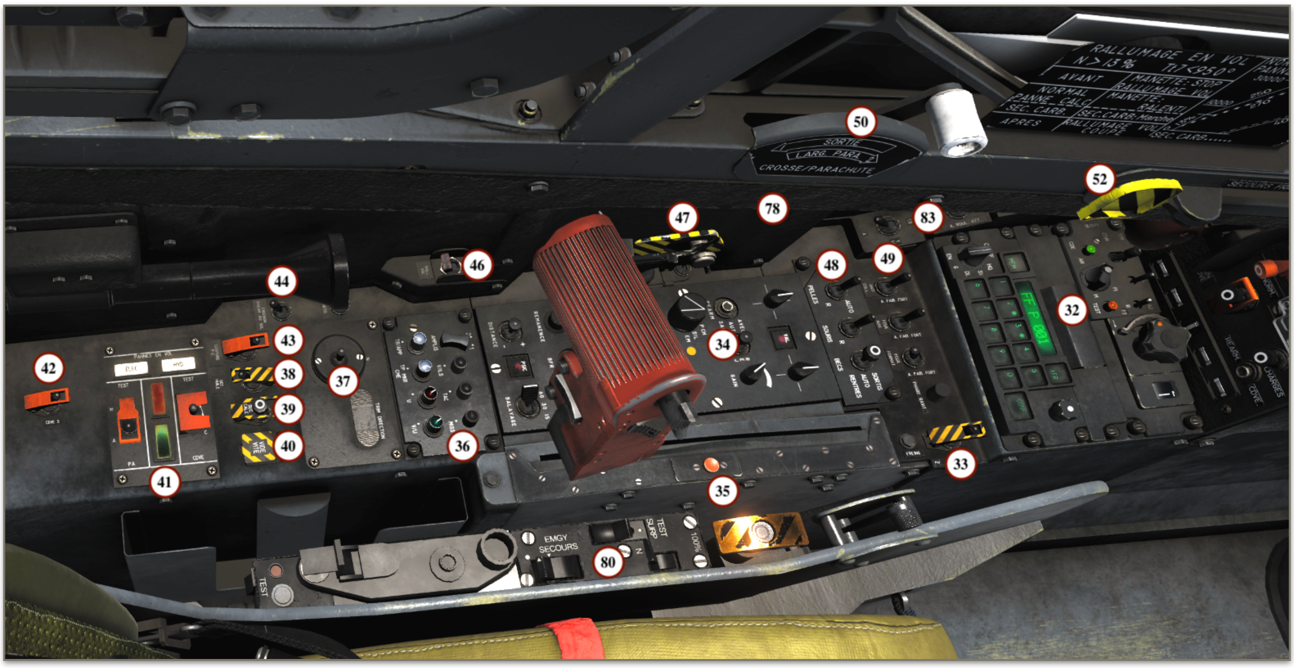
COCKPIT LAYOUT

Front Dash

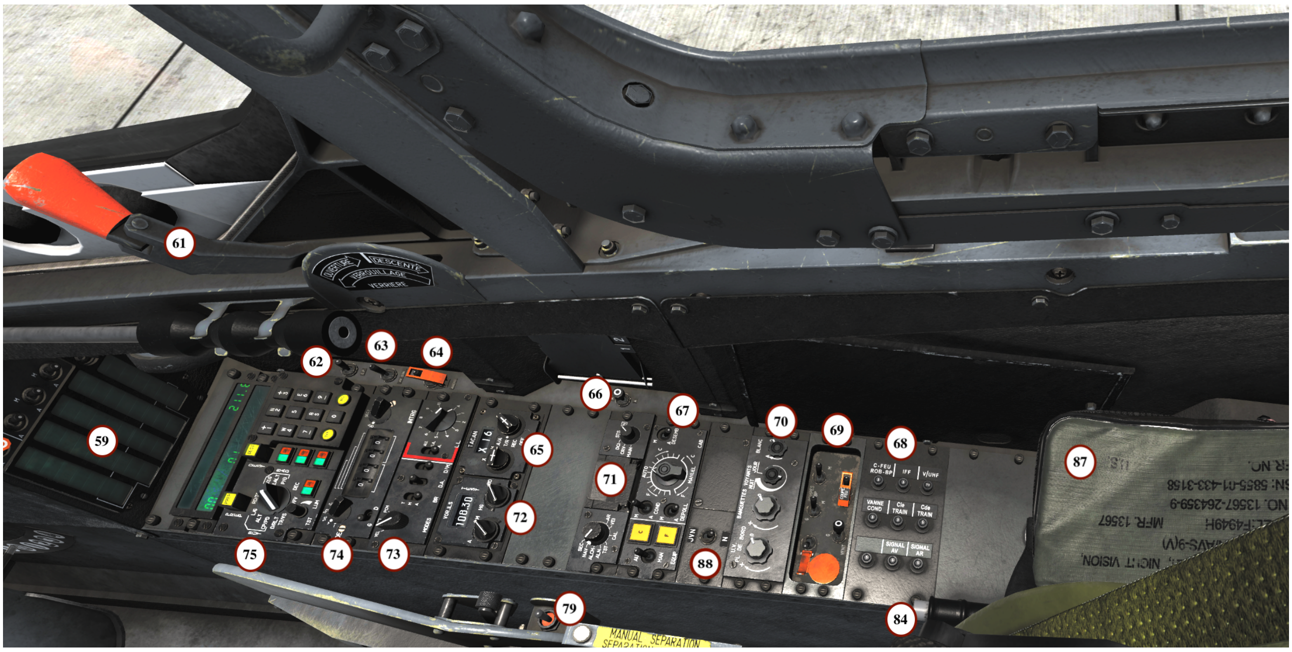


Front Dash Behind the Stick

Left Panel and Wall



Right Panel and Wall



INSTRUMENT DESCRIPTION

1. AIRSPEED INDICATOR: Displays indicated airspeed in knots and mach.

2. AUTOPILOT ALTITUDE SELECTOR: Adjust autopilot altitude hold value.

3. VERTICAL VELOCITY INDICATOR: Displays vertical velocity in feet/min.

4. AUTOPILOT CONTROLS/INDICATOR LIGHTS: Pushbuttons that enable/disable the autopilot functions and indicates the system status.

5. FLY-BY-WIRE SPIN SWITCH: Two position switch.
   - Norm: FBW system is in control
   - Vrille (Spin): FBW gives full authority to the pilot on the yaw and roll axis, and AoA limiter is overriden. To be used only in emergencies during a flat spin stall.

6. RADIO FREQUENCY DISPLAY: Indicates the selected frequencies in both radio transmitters. V/UHF main radio on top. UHF auxiliary radio on the bottom. The green light above or below the display will indicate which radio is currently transmitting / receiving.

7. MASTER CAUTION/WARNING LIGHTS: two tones lights that indicate the presence of a warning/caution condition:
   - Amber light: indicates that there is a problem, but aircraft safety is not immediately imperiled.
   - Red light: indicates that there is an emergency condition that requires urgent action. Aircraft safety is compromised.

8. AOA INDICATOR: Indicates the aircraft's current angle of attack in degrees.

9. HUD PEDESTAL: Contains the HUD controls and the HUD itself.

10. G METER: Indicates current vertical acceleration forces in G.

11. RADAR WARNING RECEIVER (RWR): Shows any radar emitters around the aircraft.

12. AFTERBURNER STATUS LIGHT: Indicates when the engine is using the afterburner.

13. ENGINE START LIGHT: Indicates that the engine is starting-up.

14. ENGINE INSTRUMENTS: Indicates engine RPM and Temperature.

15. FUEL FLOW INDICATOR: Indicates current engine fuel flow in Kg/min

16. BINGO FUEL SELECTOR: Adjust the value for the Bingo Fuel warning.

17. ENGINE FIRE WARNING LIGHTS: two lights that indicate an overtemp, possible fire condition. They correspond respectively to the engine centre and the engine tailpipe.

18. FUEL CONTROL PANEL: Indicates current fuel quantity in Kilograms and controls the tanks cross-feed valve.

19. IDN: (Indicateur de Navigation) Horizontal Situation Indicator (HSI).

20. VTB/HDD: Radar display.

21. IFF PANEL: Information Friend of Foe control panel.

22. HYDRAULIC PRESSURE SELECTOR: selects one of two options for the hydraulic pressure indicator. NOT FUNCTIONAL

23. CABIN PRESSURE INDICATOR: indicates current cabin pressure in bars.

24. HYDRAULIC PRESSURE INDICATOR: indicates hydraulic pressure for both System 1 and System 2 in bars or for Sdes (*Servitudes* - Ancillaries) and FS (*Frein Secours* - Emergency brake) dedicated sub-systems, depending on the #22 switch position.

25. RUDDER PEDALS ADJUSTMENT LEVER: adjusts the height of the rudder pedals.

26. WEAPONS MANAGEMENT PANELS: consists of two panels on both sides of the VTB.

- PCA (Poste de Commande Armement – Weapons Control Panel): This panel controls weapons selection and navigation parameters. It also controls HUD display modes.
- PPA (Poste de Préparation Armement – Weapons Configuration Panel): This panel controls how the selected weapon will be used.

27. STANDBY ATTITUDE INDICATOR: auxiliary attitude indicator. Only shows pitch and roll. It needs to be manually aligned before the flight and also requires power supply enabled by the EMERGENCY HORIZON SWITCH (66).

28. MAIN ATTITUDE INDICATOR: shows pitch, roll and heading. Additionally, it has glideslope and course deviation bars for use during ILS landings.

29. ALTITUDE INDICATOR: indicates barometric altitude (MSL) in feet

30. EMERGENCY JETTISON BUTTON: the emergency jettison button, drops all external loads except the Magic missiles.

31. THE CURRENT INDICATORS: indicate the current position for the control surfaces in the wings and tail.

32. COMMUNICATION RADIOS: both main (VHF/UHF) and auxiliary (UHF) radios. The main radio can be identified by the manual frequency selectors.

33. ANTI-SKID SWITCH: enables/disables the anti-skid system.

34. RADAR CONTROL PANEL: controls and configures radar operational parameters.

35. ENGINE SHUTDOWN BUTTON: allows the throttle to be retarded from the Ground-Idle position back to the Stop position.

36. AUDIO CONTROL PANEL: controls the volume of the following components: Communication radios, TACAN, VOR/ILS, Markers, Magic seek and lock tones.

37. TRIM CONTROL PANEL: emergency pitch/roll trim control (overrides the trim hat of the stick) and yaw trim control.

38. EMERGENCY OIL SYSTEM: enable/disables the emergency oil system.

39. CALC SWITCH: activates an emergency computer if the main computer fails. It is a get-you-home system. The CALC switch is related to the ENGINE computers. It has 3 positions:

- Forward (unstable): reset of the normal CALC engine computer.
- Middle (stable): the normal CALC computer is in use.
- Backward (garded/stable): manually enforces the use of (or confirms the automatic switch to) the *Secours Calculateur* (emergency engine computer) in case of failure for the main engine computer.

40. FUEL DUMP SWITCH: dumps all the fuel that exists in the external tanks (if mounted).

41. FLY-BY-WIRE AND AUTOPILOT TEST PANEL: tests the FBW and Autopilot controls. Must be performed after engine start and before flight.

42. FLY-BY-WIRE EMERGENCY CHANNEL (CDVE 5): the FBW emergency channel is a last resort system in case of total FBW failure. The aircraft is put in a get-you-home condition. Not to be used for normal flight.

43. AFTERBURNER CUTOFF SWITCH: disables the engine afterburner in case of normal throttle failure.

44. RADAR GROUND EMITTING AUTHORISATION SWITCH: used by maintenance personnel only. It overrides the safety system that prevents the radar from emitting while on the ground.

45. TAPE RECORDER SWITCH: self-explanatory. Yes, M-2000C uses old-school tape.

46. MID-AIR STARTUP SWITCH: starts the engine while in flight.

47. EMERGENCY THROTTLE: secondary throttle control, to be used in emergency situations.

48. FLIGHT CONTROLS PANEL: controls the aircraft's automatic flight control surface:

Pelles = Engine scoops that force airflow into the lower auxiliary intakes for increased air circulation at high AOA.
Souris = Engine shockwave cones.
Becs = leading edge slats that are controlled by the FBW system.

49. EXTERIOR LIGHTS PANEL: switch bank for the Navigation, Anti-collision strobe and Formation lights.

50. DRAG CHUTE / HOOK HANDLE: deploys and release the aircraft drag chute, or deploys the emergency hook, whichever is installed.

51. FLIGHT-BY-WIRE GAINS SWITCH: the normal automatic gains or the emergency fixed gains for the FBW. When engaged, the emergency gains mode cannot be cancelled for the rest of the flight.

52. CANOPY JETTISON HANDLE: manually triggers the explosive cord included in the canopy plexiglas in order to brake it (the same cord is also automatically triggered when the pilot ejection handle is pulled, as part of the ejection sequence).

53. LANDING GEAR LEVER: actuates the landing gear.

54. CONFIGURATION INDICATOR PANEL: indicates brakes, landing gear, hook / drag chute, NWS and Anti-Skid status.

55. EMERGENCY LANDING GEAR LEVER: lowers the landing gear in case of primary system failure.

56. CLOCK: analog clock with current ZULU time.

57. OXYGEN QUANTITY INDICATOR: indicates Oxygen supply quantity.

58. POWER SWITCHES: activate the aircraft's electrical power system:

BATT – Activates the main battery.

ALT1 – Engages Alternator 1.

ALT2 – Engages Alternator 2.

TR – Selects the Normal (up) or Emergency (down) Alternative-Continuous converter."

59. CAUTION/WARNING ADVISORY PANEL: indicates emergency/anomalous conditions in the aircraft. It is tied to the Master Caution/Warning lights.

Amber lights are caution lights indicating an anomalous condition.

Red lights are warning lights indicating emergency situations that put the aircraft in danger.

60. QRA SWITCH. Triggers the specific electric network to keep the aircraft ready to start on very short notice, when on Quick Reaction Alert on the ground. NOT FUNCTIONAL

61. CANOPY UNLOCK/LOCK HANDLE: locks/unlocks and lowers the canopy.

62. EMERGENCY HYDRAULIC PUMP SWITCH: enables/disables the emergency hydraulic pump. Three-position switch: Off – Auto – Forced On (unstable).

63. Audio Alert Switch: enables/disables the aircraft's audio alerts. It does not control landing gear, AOA and missile tone.

64. Air Probes Anti-Ice Switch: enables/disables the pitot, static and AoA probes anti-ice system.

65. TACAN panel: controls the TACAN radio.

66. Backup Attitude Switch (GCS Switch): activates the emergency artificial horizon and/or the emergency gyro-compass to provide heading data for the nav system in case of INS heading failure.

67. Environment control panel: controls the cockpit and instruments air conditioning system.

68. Circuit Breakers: electrical circuit breakers.

69. Engine Start panel: controls engine fuel pumps and startup system. It also has the engine fuel shut-off valve switch ("robinet coupe-feu").

70. Interior Lights panel: controls the interior lights system.

71. INS PSM/MIP Panel: controls INS operation. Also has the access port for navigational data cartridges.

72. VOR/ILS Panel: controls the VOR/ILS radio.

73. Electronic Warfare Panel: controls the RWR, Jammer, Missile launch detector and Chaff/ Flares operation.

74. Radar IFF panel: controls the radar IFF interrogation system.

75. PCN Panel: display and data entry panel for the INS system.

76. Gun Safety Switch: needs to be disengaged in order to enable the use of the guns.

77. Waypoint increase / decrease buttons: allow the pilot to cycle up and down through currently selected waypoint.

78. Air to Air Refuel Switch. Opens the valve and controls lights during the AAR. Positions:

- Down: valve is closed, lights are off.
- Middle (Day Refueling): valve is open, lights are off.
- Up (Night Refueling): valve is open, lights are on.

79. Seat Height Control Button: used to raise or lower pilot's seat.

80. Oxygen Control Panel: controls the flow and type of oxygen used. NOT FUNCTIONAL

81. Standby Compass: a standby magnetic compass not connected to other onboard navigation systems.

82. FBW MODE SWITCH: selects FBW operational mode.

- A/A – For air-to-air combat
- CHARGES (Stores) – For carrying any load heavier than air-to-air missiles and empty central tank. Also used during the air to air refuelling.

83. LANDING AND POLICE LIGHT SWITCHES: used to turn on the Taxi and Landing lights and to enable the Police light.

84. PARKING BRAKE: enables / disables the parking brake while on the ground.

85. NIGHT VISION GOGGLES MOUNT: a mount to hold the night vision goggles once they are taken out from the NVG bag on the right panel.

86. SPIRALE BOX: part of the ECM / countermeasures system. See SECTION 13 for more information.

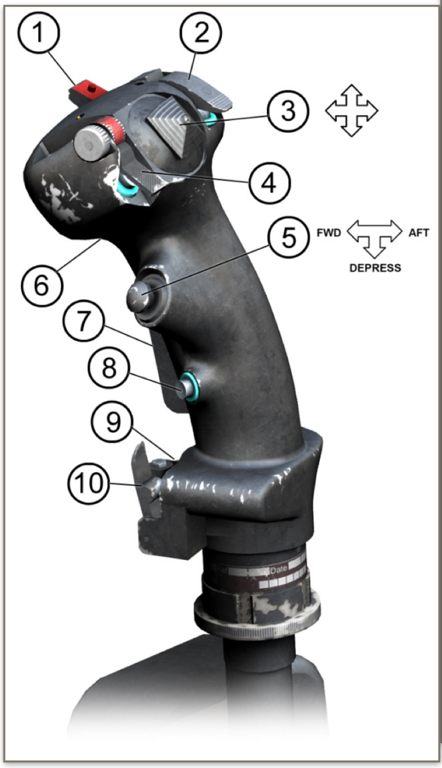
87. NIGHT VISION GOGGLES BAG: a bag for stowing the NVGs when not in use. Can be installed by the Crew Chief.

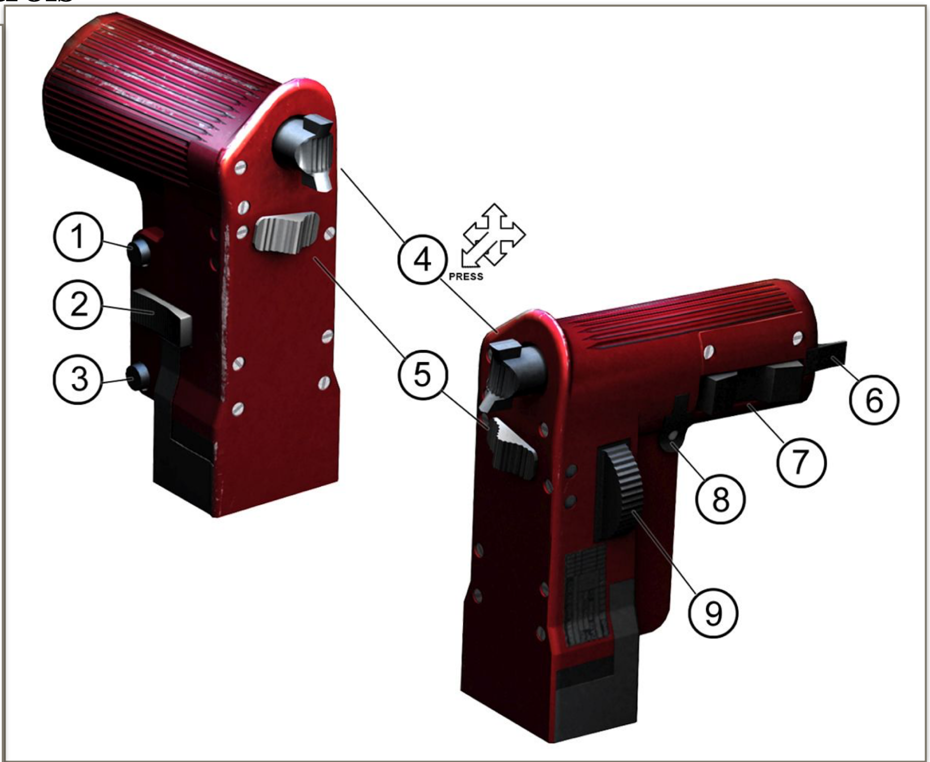
88. NIGHT VISION GOGGLES LIGHTS FILTER SWITCH: enables or disables the filter making instrument panels readable in the NVGs.

Hands on Throttle and Stick (HOTAS) System

The M-2000C has an integral HOTAS system that allows the pilot to control multiple functions without having to let go of the flight stick and / or throttle. For more details about the controls functions, refer to the relevant system description.

Stick and Throttle controls





On the next page you will find the list of stick and throttle controls in a form of a table, describing the functions of each of the switches, giving their in-game name under "HOTAS Controls" panel in the Options Menu as well as listing the default key for each one.

Control Stick

No.	Control name	Description	Action in options	Default key
1	Trigger safety indicator	When visible, the trigger is activated to fire weapons. Automatically shows when the master arm switch is set to ON.	NONE	NONE
2	Navigation update / Magic II unlock (see below)	Depending on the selected navigation or attack mode, this switch enables: • INS position update by overflying a ground reference point. • Magic II missile target unlock and returns seeker to search mode. • Switching between MAV scan modes	NAV Update / Magic Unlock	NONE
3	Trim control	Trims the aircraft in roll and pitch. When the autopilot is engaged, it is used to control the aircraft by setting the desired heading and adjusting the flight path. For more information please refer to Autopilot section.	Trim DOWN Trim LEFT Trim RIGHT Trim UP	RCtrl + W RCtrl + A RCtrl + D RCtrl + S
4	Countermeasure switch	Activates the countermeasures (chaff and/of flares and/or jammer). For more information see Countermeasures	Decoy Program release	DEL
5	Weapons System Command (see below)	Works differently depending on the selection made on the PCA, position of the Master Arm switch and HUD mode.	WSC FWD WSC Depress WSC AFT	NONE NONE BACK
6	Trigger	When activated (safety indicator visible), fires weapon or releases bombs.	Weapons FIRE / Bomb Release	SPACE
7	AP override switch	When the autopilot is engaged, maintaining the switch down enables to override the autopilot without setting it off and control manually the aircraft. Releasing the switch re-engages the autopilot	Autopilot Standby Mode	LAlt + A
8	AA Radar Modes (see below)	Locks the target under the TDC cross.	STT/TWS Toggle (Target Lock)	ENTER
9	NWS/IFF Interrogator (see below)	On ground: toggles ON/OFF the nosewheel steering. Airborne (gear up): triggers radar target identification.	Nosewheel steering / IFF Interrogate	S
10	AP Disconnect Switch	Switches off the autopilot.	AP Disconnect / Exceed Elastic Limit	LShift + A

Throttle

No.	Control name	Description	Action in options	Default key
1	Jammer control switch	Activates/deactivates the jammer emission	Jammer ACTIVATE / Standby Toggle	E
2	Radio selection switch	Selects the radio used for transmission. For more information see Radios	Main U/VHF Radio SELECT Aux. UHF Radio SELECT	LShift + Num+ LAlt + Num+
3	Panic pushbutton	Releases the emergency chaff/flare program (Program 0).	Decoy PANIC release	INSERT
4	Radar designator control	Controls up, down, left and right the radar screen designation cross.	TDC UP TDC DOWN TDC LEFT TDC RIGHT TDC CENTER	; | RAlt+Up . | RAlt+Dn , | RAlt+Lt / | RAlt+Rt NONE
5	Airbrake control	This three position sliding switch controls the speedbrakes Aft: Extends the A/B; spring-loaded position Middle: Retracts the A/B; stable position Forward: Extends the A/B; stable position.	Airbrake TOGGLE Airbrake ON Airbrake OFF	B LShift + B LCtrl + B
6	Police light control switch	Toggles ON/OFF the police searchlight.	Police Light Toggle	NONE
7	CNM Throttle Switch (see below)	Works differently depending on the selection made on the PCA, position of the Master Arm switch and HUD Mode.	AA Gun SELECT PCA Select MAGIC SELECT	C NONE NONE
8	Air-to-ground designate / Magic slave switch (see below)	In air to ground, designates a chosen ground target. In air-to-air, slaves the Magic II seeker on a target locked on radar.	Magic Slave / AG Designate / INS Position Update	NONE
9	Antenna elevation wheel	This rotating wheel with a center detent adjusts radar antenna elevation.	Radar Antenna UP Radar Antenna DOWN Radar Antenna CENTER	NONE

ADDITIONAL INFORMATION ABOUT DIFFERENT MODES:

Weapons System Command (WSC)

The use of this switch depends on several factors: position of the Master Arm switch, selection made on the PCA and the HUD mode.

NAV Mode Selected (no selection on the PCA)	
WSC FWD	Enables AA MODE BORESIGHT
WSC AFT	Enables **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Unlocks the currently locked radar target

AG [Air to Ground] Selected (air to ground weapon selected)	
WSC FWD	Switch to **AG ATTACK MODE** and load memorized settings
WSC AFT	Stay in PCA-selected mode
WSC DEPRESS	No function

AG Attack Mode	
WSC FWD	No function
WSC AFT	Memorize current PCA selection and go in **NAV MODE**
WSC DEPRESS	No function

AA [Air to Air] Selected (air to air weapon selected)	
WSC FWD	Enables AA MODE BORESIGHT or AA SUPER POINTED STT if S-530 is already in the air.
WSC AFT	Enables **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Unlocks the currently locked radar target

AA Mode Boresight active	
WSC FWD	Enables AA MODE VERTICAL SCAN if POL, MAG, CAN or nothing selected. If S-530 selected, enables AA MODE SPIRAL HUD SCAN.
WSC AFT	Cycle to **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Mode Spiral HUD scan active	
WSC FWD	Cycle back to AA MODE BORESIGHT
WSC AFT	Cycle to **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Mode Vertical scan active	
WSC FWD	Cycle back to AA MODE BORESIGHT
WSC AFT	Cycle to **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Mode BAH scan active	
WSC FWD	Cycle back to AA MODE BORESIGHT
WSC AFT	Cycle to **BA2** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Mode BA2 scan active	
WSC FWD	Cycle back to AA MODE BORESIGHT
WSC AFT	Cycle to **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Mode Super Pointed STT active (NOT FUNCTIONAL)	
WSC FWD	No function
WSC AFT	Cycle to **BAH** (HORIZONTAL SCAN)
WSC DEPRESS	Return to radar scan

AA Radar Modes

If there is no locked radar target, it will lock the target below the TDC. Otherwise it will cycle between TWS (PID) and STT (PIC) modes.

Nose Wheel Steering/IFF Interrogate

Its functionality changes on whether the aircraft is on the ground or in the air.

- On the ground: It engages/disengage the nose wheel steering system (NWS).
- In the air: If the radar IFF interrogator is enabled, it interrogates radar contacts to determine if they are friend or foe.

Magic Search/Nav Update

Its functionality depends on system Master Mode.

- NAV Mode: Starts INS Vertical Position Update (equivalent to clicking on the REC button in the PCN). Please see **INS Position update**
- AA Mode: If the selected weapon is Magic and it has a lock, it clears the lock so the seeker starts searching again.

Throttle CNM Switch

- Throttle CNM MAG Select: It selects MAGIC missiles for use and sets the system to AA MAG mode overriding any PCA weapons selection. PCA selection is saved in system memory.
- Throttle CNM GUN Select: It selects the DEFA guns for use and sets the system in AA CAN mode overriding any PCA weapons selection. PCA selection is saved in system memory. Radar is still on scan.
- Throttle CNM Neutral: with AA mode selected, it returns to the previous mode used before the CNM was set on MAG or CAN. Radar behaviour stays the same as it was in MAG or CAN.

Air-to-ground designate / Magic slave switch

Its functionality depends on system Master Mode.

- NAV Mode: Triggers 'OBL' Radar Position Update (OBL must have been selected on the PCA first). It uses the radar TAS mode to calculate the difference between INS position and the radar cross so the INS can update its position.
- AA Mode: It slaves the Magic missile seeker to the radar or viceversa. Only works when there is a locked radar target and Magic missiles have been selected.
- AG Mode: Its functionality is based on attack mode:
  - CCRP Direct (No INS): It designates the ground under the diamond reticle as a bombing target. If a target has been designated, it clears the designation.
  - INS Bombing (IP/BAD): It works similar to NAV Mode, except that it is the IP position that is updated.

SECTION 2

ENGINE

SNECMA M53-P2 ENGINE INFORMATION

The M-2000C uses the SNECMA M53-P2, afterburning turbofan engine. The M53 is single shaft driving both the turbofan and compressor. The M53 is relatively older in design in comparison to the newer engine design of the same generation, it retains very desirable traits for military use. This can cut maintenance and cost for service and reliability.

The single spool design of the turbofan engine has its draw backs. When one compressor section stalls on a single-spool fan, it directly effects the entire spool. With the two-spool engine, if the one compressor stalls, the remaining compressor and turbine continue to function independently, maintaining partial thrust, making it easier to get the stalled compressor working again, without having to rely on "wind milling" for engine to start.

The M53 is the only known single-spool turbofan extant as of 2013, while SNECMA transitioned to a more conventional two-spool design such as the M88.

General characteristics M53-P2

Type:	afterburning single-shaft turbofan
Length:	5,070 mm (199.60 in)
Diameter:	796 mm (31.33 in) inlet
Dry weight:	1,515 kg (3,340 lb)
Compressor:	8-stage axial compressor
Combustors:	annular
Turbine:	2-stage axial turbine
Dry thrust:	64.7 kN (6,600 kgp / 14,500 lbf)
Afterburning thrust:	95.1 kN (9,700 kgp / 21,400 lbf)

ENGINE CONTROL

The M53-P2 is controlled by a throttle, located on the left cockpit console, featuring a red lever in the centre of the throttle quadrant. The throttle sends pilot's orders to an electronic regulation system (named CALC for *calculateur* - (engine) computer) providing a care-free handling of the engine for the crew.

The CALC manages engine RPMs (including high T7 temperature, low and high RPMs safeties), nozzle position and afterburner use.

The CALC also features an emergency mode, named SEC CALC which translates to "Emergency (engine) Computer", in case of failure of the main engine computer.

Switching engine control to SEC CALC may be automatically triggered when the main CALC built-in-test detects its own failure; it may also be triggered by the pilot through the CALC 3-position switch:

- Middle position (stable) = normal CALC use
- Forward position (unstable / spring-loaded) = reset normal CALC
- Backward positoin (stable & guarded) = forces SEC CALC mode.

In SEC CALC, the afterburner cannot be lit. It is however kept On if it was already engaged before the switch to SEC CALC.

Under SEC CALC, the nozzle rules change, and depend on a variety of factors, and the "flaps" regulating the bypass ratio of the engine remain fully open. Expect a lower thrust than in normal mode around MIL setting.

The engine RPM are still controlled by the throttle in SEC CALC. The pilot must act smoothly on the throttle, and pay close attention to the engine parameters, as some automatic protections may be lost.

A second emergency mode is SECOURS CARBURANT (in short: SEC CARB) which translates to "Emergency Fuel", for more serious issues. SEC CARB mode is used in case of hydromechanical failure or serious regulation failure such as:

- loss of efficiency of the main throttle
- non-recoverable engine RPM drop
- constant engine overspeed not recoverable via SEC CALC
- mechanical failure of the normal driveline
- unability to relight the engine inflight in normal or SEC CALC mode (after a commanded cut-off)
- any inflight relight following an engine flame out

SEC CARB provides regulation of the engine RPM and nozzle independently of the main circuit.

The afterburner is not available in SEC CARB. The idle regime is higher than in normal mode, and the nozzle is forced open at higher RPM than usual.

This mode is triggered by lowering the yellow & black stripped plate - situated on the left of the main throttle, against the cockpit "wall" - towards the pilot.

The RPM are controlled through the tiny secondary throttle located behind the SEC CARB plate. Note that engine response is much slower than in normal mode, the pilot must anticipate his trust needs. With the nozzle open at higher RPM and the afterburner not available, the max thrust is much lower than in normal mode. Consider jettissonning heavy payloads.

It is forbidden by SOPs to return to the normal regulation inflight, after having triggered the SEC CARB following one of the above-listed failures.

The engine may be relighted in SEC CARB mode. It cannot be cut-off in SEC CARB mode via the normal button & throttle (which are shunted). To cut-off the engine after landing, the pilot must either:

- return to normal regulation to use the normal method
- use the fuel shut-off valve to starve the engine

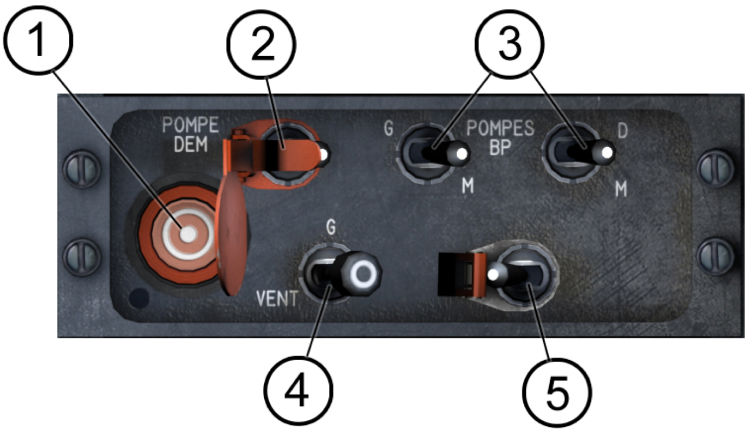
***


Screenshot by jaguara5

Engine Startup Panel

The M-2000C does not have an Auxiliary Power Unit, instead it relies on a jet starter to start the SNECMA M53-P2 engine. The jet starter uses both internal fuel and battery power to do its job, although a Power Cart is preferred to prevent draining the battery of all power and to allow INS alignment with better precision in the absence of engine vibrations.

To control the start of the engine, there is a startup and control panel on the right console that will allow this operation.



1. STARTER BUTTON (WITH COVER). Triggers the JFS engine starter.
2. STARTER FUEL PUMP. Used to supply fuel to the engine during start sequence, even when only DC power (from battery) is available. It is automatically switched into "ON" position when you open the Starter button cover.
3. BOOST FUEL PUMPS. Left (G) and Right (D) low - pressure boost fuel pumps.
4. IGNITION/VENTILATION SWITCH. Selects the jet starter ignition plug, or the crank mode. Three-position switch: Crank (VENT), Left plug (G) and Right plug (D).
5. FUEL SHUT-OFF VALVE SWITCH (WITH COVER). After opening the cover, you can set the shut-off fuel valve in the closed (left) or open (right) position.

Engine's air flow controls

The M-2000C has two devices that assure the correct air flow to the engine: the scoops that forces air through the underside auxiliary air intakes at high AoA, medium speed and high altitude, and the inlet cones that extend at high speed (> M 1.2) to prevent supersonic shockwaves to penetrate inside the air inlets themselves.

These devices are automatically operated and do not require pilot intervention except during emergencies. They are controlled by two switches located below the main radio panel.

FLIGHT CONTROLS PANEL

1. ENGINE SCOOPS CONTROL SWITCH: AUTO (Default) / R (Retracted).

2. INLET CONES CONTROL SWITCH: AUTO (Default) / R (Retracted)

Engine Instruments

The M-2000C engine gauges consist of 3 indicators that display engine RPM and temperature.

1. ENGINE RPM (N) NEEDLE, showing the % if engine power used.

2. ENGINE RPM (N) DISPLAY, showing numerical values.

3. ENGINE T7 TEMPERATURE INDICATOR, in hundreds of Celsius.

Engine Warning Lights

START UP LIGHT: The Start Up Light is located on the upper right area of the main panel. When the engine is in start mode the light will illuminate. Once the engine has started (after reaching around 49%) the light will go out.

AFTERBURNER STATUS LIGHT: the Afterburner Status Light is located on the upper right area of the main panel (next to the Start Up Light). When the Afterburner is in use, the light will illuminate.

ENGINE FIRE WARNING LIGHT: illuminates when there is a fire in the engine's secondary and/or in the afterburner chambers.

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SECTION 3

ELECTRICAL SYSTEM

ELECTRICAL POWER SUPPLY SYSTEM

The M-2000C power supply system consists of an alternating current (AC) and a direct current (DC) circuits.

- 2x 115/200 V, 20 KVA three-phase alternators (57 A per phase).
- 2x 150 A/28 V transformers-regulators (one for normal use, the other intended for emergencies).
- 1x 24 V, 40 A/h rechargeable battery.
- 1x 200 VA power converter.
- 1x 100 VA three-phase converter for the flight computer.

The aircraft also has connectors for external power supply (very often used when on the ground, to keep battery life up - in fact it is highly advisable to use the external power supply for the whole alignment process).

Electrical Power Controls

The aircraft power supply is controlled by a four-switch bank located on top of the right instruments panel, just above the Warning/Caution Lights panel.

1. MASTER BATTERY SWITCH: turns on the battery.

2. AC>DC SWITCH: enables the main converter (up) or the emergency converter (down).

3. ALTERNATOR 1 SWITCH

4. ALTERNATOR 2 SWITCH

NOTE	The yellow warning lights beneath each Alternator switch will remain ON as long as ground power source is connected.

5. LIGHTS TEST SWITCH: used to test lights and lamps in the pit

ELECTRICAL SYSTEM

CIRCUIT BREAKER PANEL: located below the Engine Start Panel, it governs several systems and allows for quick disabling the electrical power for several systems. NOT FUNCTIONAL

POWER DISTRIBUTION SCHEMATICS

Both the AC and DC circuits are divided into the following buses:

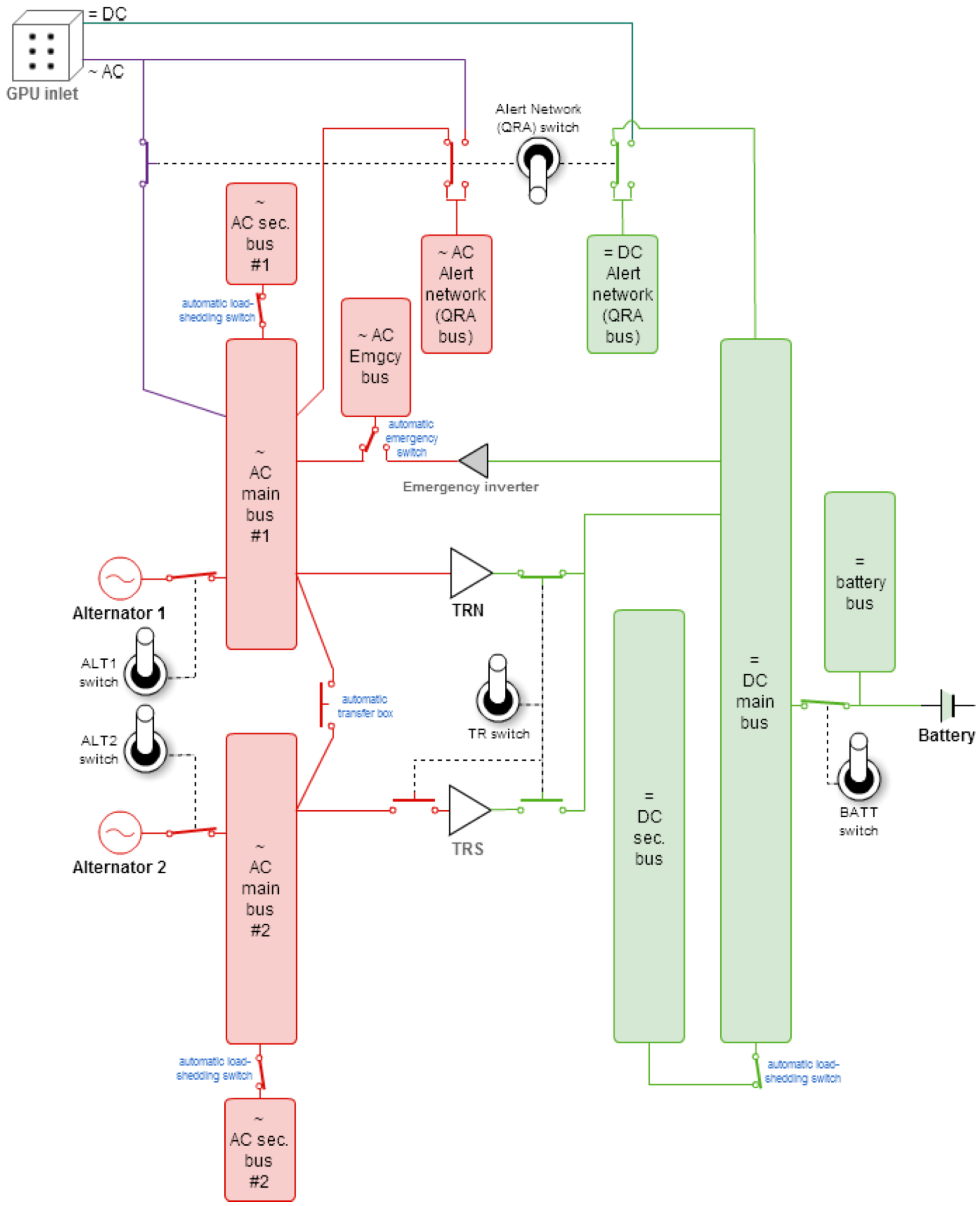
1. 6x AC buses
   1.1. AC 1 Main bus
   1.2. AC “réseau d’alerte” (QRA) bus
   1.3. AC 1 Emergency bus
   1.4. AC 1 Secondary (load-shedable) bus
   1.5. AC 2 Main bus
   1.6. AC 2 Secondary (load-shedable) bus

2. 4x DC buses
   2.1. DC Main bus
   2.2. DC "réseau d'alerte" (QRA) bus
   2.3. DC Secondary (load-shedable) bus
   2.4. Battery bus

NOTE

These are in fact part of the AC main 1 bus and the DC main bus, that can be powered separately, only when the aircraft is on the ground (with GPU) on QRA duties; those busses allow some devices to remain powered during alert so that start-up and take-off will be speeded up (most obvious example: the INS, which remain powered = aligned = ready to go). In the air, "Alert Network" switch being off, those buses are powered from the AC main 1 bus and the DC main bus.

POWER DISTRIBUTION SCHEMATICS



ELECTRICAL POWER EMERGENCY CONDITIONS

Situation	Alarm Lights	AC Buses	DC Buses	Remarks
GPU on	ALT 1 ALT 2	All on	All on	Lights are just indicating the alternators are offline, all is OK.
GPU On + BATT switch Off	ALT 1 ALT 2 BATT	All on	All on	Battery powers its own bus but is not connected nor recharged.
GPU On + QRA switch On (up)	None	AC QRA On All others Off	DC QRA On All others Off	Normal situation when aircraft is on QRA duty, on ground but ready to go. NOT FUNCTIONAL
ALT failure (or switched off)	ALT 1 or ALT 2	AC Sec. 1 Off (*) AC Main 1 On AC Emergency On AC QRA On AC Main 2 On AC Sec.2 Off (*)	All on	Both AC main buses are powered by remaining alternator (**) As a consequence, both AC Sec. buses are switched Off (*)
Double Alternator failure (or switched off)	ALT 1 ALT 2 TR	AC Emergency On All others Off	All On – powered by battery only	Anticipate quick CC failure because of battery discharge. AC Emergency bus is powered from battery via emergency inverter.
TRN failure (+ TR switch up)	TR	All On	All On - powered by TRS	TRS comes online automatically – pilot confirms this by flipping down the TR switch = the TR status light then comes off.
TRS failure (+ TR switch down) or TRN+TRS failure (whatever TR switch position is)	TR	All On	All On – powered by battery only	Anticipate quick CC failure because of battery discharge.
Battery discharge, tension on DC buses < 26V	TR CC	All On	DC Main: On DC QRA: On DC Sec: Off (*) Batt: On	Land in less than 30 minutes, battery discharge.

Situation	Alarm Lights	AC Buses	DC Buses	Remarks
Failure on main Alt bus 1 (e.g. major short circuit)	ALT 1 TR	AC Sec. 1 Off (*) AC Main 1 Off AC Emergency On AC QRA Off AC Main 2 On AC Sec.2 Off (*)	All On – powered through TRS	TRS comes online automatically – pilot confirms this by flipping down the TR switch = the status light then comes off. AC Emergency bus is powered from battery via emergency inverter.
Failure on main Alt bus 2 (e.g. major short circuit)	ALT 2	AC Sec. 1 Off (*) AC Main 1 On AC Emergency On AC QRA On AC Main 2 Off AC Sec.2 Off (*)	All On	
Battery failure	BATT	All On	DC Main: On DC QRA: On DC Sec: On Batt: Off	Provided AC power and TR are available, only the Batt bus is lost (Batt switch comes automatically offline if battery failure occurs)
Battery isolated (switch down)	BATT	All On	All On	Battery not reloaded anymore; IRL it's forbidden to do so in flight.
Battery isolated (switch down) + Double TR failure	None (***)	All On	DC Main: Off DC QRA: Off DC Sec: Off Batt: On	Near total DC failure situation.
Battery failure + Double TR failure	None (***)	All On	All Off	Total DC failure situation.

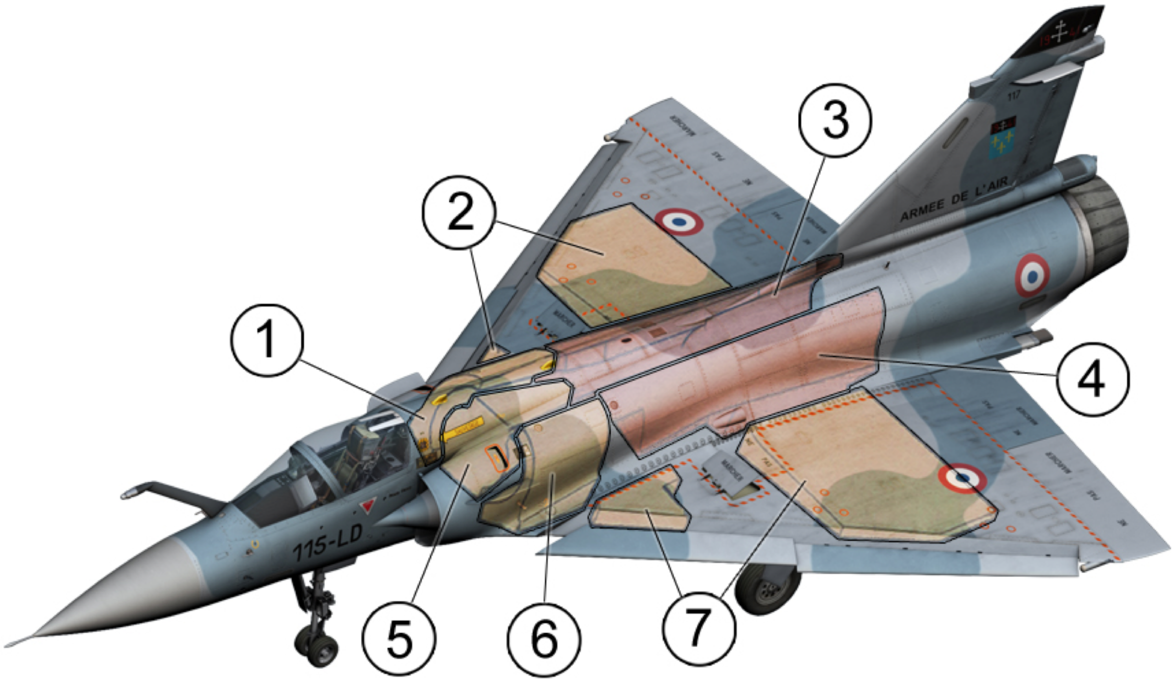
(*) by automatic load shedding
(**) powered by the remaining alternator through a transfer box between Alt1 & Alt2 main busses
(***) the alarm panel is not powered anymore: all alarms lights are off

SECTION 4

FUEL SYSTEM

FUEL SYSTEM

The M-2000C fuel system consists of left and right fuel groups each one consisting of a wing tank, a feeder tank and a forward tank in the fuselage. Also in the front of the aircraft, just aft of the cockpit the engine central tank is located. All fuel tanks are part of the aircraft structure. The aircraft also has three wet points, under each wing and under fuselage in the centerline, for three external fuel tanks that can double the total fuel load.



	Description	Kg	Lbs	US Gals	Liters
1	Right group forward tank	304.0	670.0	101.7	385.0
2	Right group wing tank	523.0	1154.0	175.0	662.5
3	Right group feeder tank	592.5	1306.0	198.1	750.0
4	Left group feeder tank	592.5	1306.0	198.1	750.0
5	Center tank	320.0	705.0	107.0	405.0
6	Left group forward tank	304.0	670.0	101.7	385.0
7	Left group wing tank	523.0	1154.0	175.0	662.5
	Total internal fuel	3160.0	6966.0	1056.6	4000.0
	RP-522 centerline tank	990.0	2182.6	343.4	1300.0
	Total internal + RP-522 fuel	4150.0	9146.6	1400	5260.0
	RP-541 wing tank (each)	1580.0	3482.3	528.6	1700.0
	Total internal + 3 ext. fuel	7310.0	16111.2	2457.2	8660.0

The aircraft has aerial refueling capability using a detachable probe on the starboard side just in front of the cockpit.

FUEL GAUGE

Displays the fuel weight and controls transfer of the fuel system. All values displayed in this gauge are in Kilograms.

1. REFUEL TRANSFER LIGHT: Lights up when Aerial Refueling Switch is on.

2. JAUGE FUEL AMOUNT COUNTER: displays Total Internal fuel amount. This number is a measure by sensors mounted inside the internal tanks (except wing ones, which are estimated by maths using the fuselage quantity and a multiplication coefficient.

3. LEFT FEEDER FUEL LEVEL INDICATOR: Displays the left feeder tank fuel amount.

4. DETOT FUEL AMOUNT COUNTER: Displays Total fuel available to the aircraft (internal + external) tanks. This number is the result of subtracting the (measured)

fuel consumption from the starting total (value set before engine start). In DCS, the starting total is automatically set at start and reset in case of refuelling. No pilot action is required.

5. AFF DETOT Fuel Display Switch: Sets information for the DETOT Fuel counter. NOT FUNCTIONAL

6. Right feeder fuel level indicator: Displays the right feeder tank fuel amount.

7. Fuel warning Lights: Indicates when a fuel tank is empty (see next page).

8. Internal Fuel Transfer Control: Allows the Fuel transfer to keep fuel level balanced. NOT FUNCTIONAL

9. TRANSF Test Switch: Test Fuel Transfer circuit. NOT FUNCTIONAL

Fuel Warning Lights

The fuel warning lights indicate when a given fuel tank is empty or, more precisely, that it doesn't transfer any fuel towards the feeders tanks. They consist of three groups:

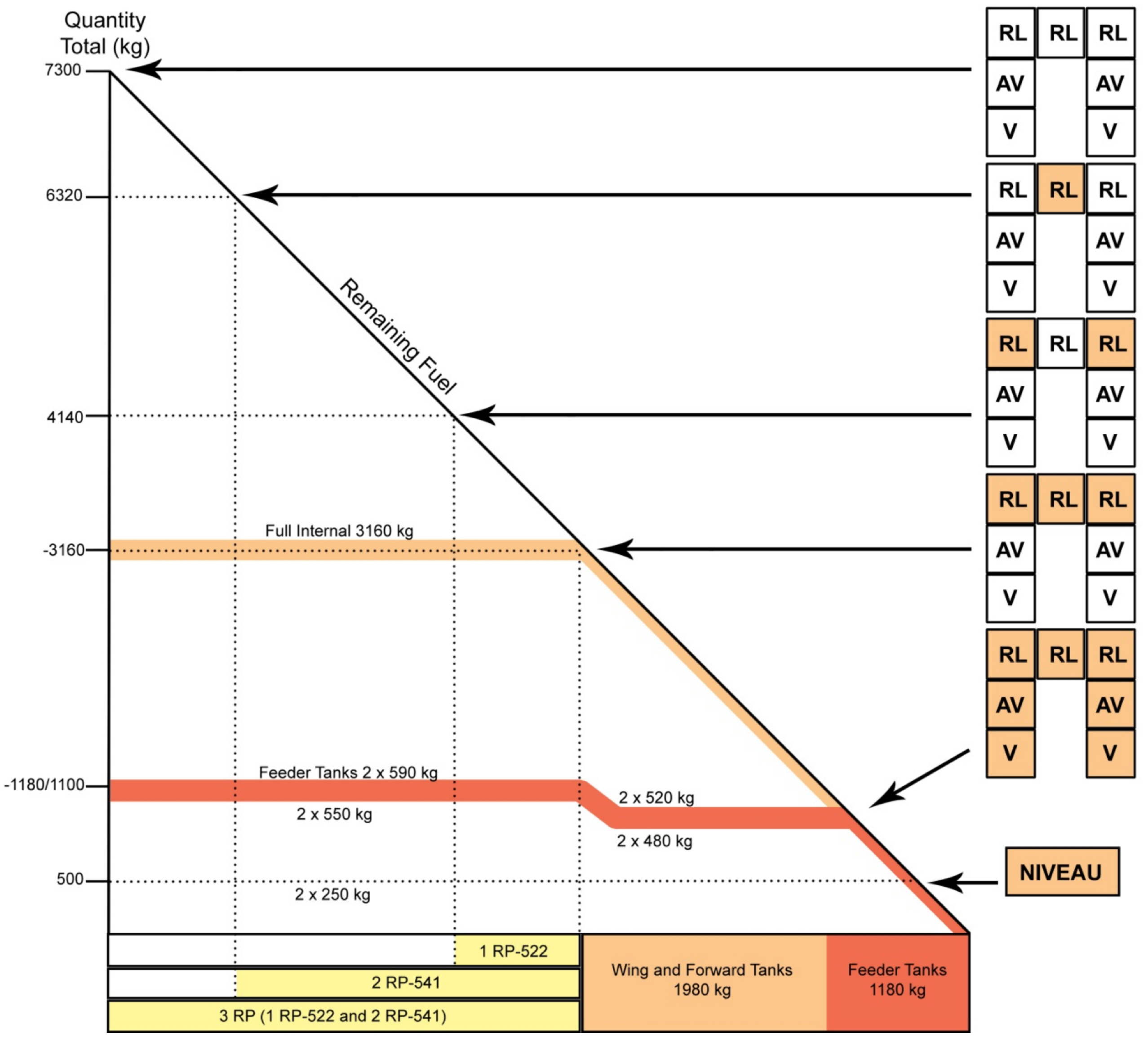
RL = (*Réservoirs Largables*) External fuel tanks. There is one light for each tank.

AV = (*AvantI)* Forward fuselage tanks. There is one light for each group: Left and Right.

V = (Voilure) Wing fuel tanks. There is one light for each group: Left and Right.

The image on the next page shows when each group of lights is lit and the amount of fuel remaining at the time.

The NIVEAU caution light will turn on when the fuel remaining falls below 500 Kgs. At that time, you have a few minutes before flameout.



Fuel Boost Pumps

The aircraft has two low pressure boost pumps (BP is for *Basse Pression*) that feed the engine during normal (g>0) maneuvres. There is no specific pump for inverted flight, and this explains that the time for inverted (or g<0) flight is very limited.

The switches for the fuel boost pumps are in the Engine Start Panel.

Fuel Flow Gauge and Bingo Selector

Located on the Main Panel it displays the current fuel flow and lets you set up the Bingo fuel alarm.

1. Fuel Flow: Displays the engine fuel consumption in kilograms per minute (Kg / min).

2. Bingo fuel selector: The drums are used to activate the Bingo Fuel Alarm on the Caution / Warning advisory panel.

“Bingo” is used to indicate the minimum amount of fuel required for a safe return to base. If an aircraft keeps flying after the “Bingo” mark it will require air refuelling to return.

NOTE

Always pay attention to your current fuel use. You can easily calculate remaining flight time if you maintain the given consumption rate. Also, do remember that the fuel consumption will be dependent on the applied thrust (obviously), but also will diminish with altitude - the higher you are, the less you are going to burn.

External Tanks Fuel Dump Switch

The M-2000C can only dump the fuel that exist in the external tanks. The switch that controls the fuel dump is in the rear of the left instrument panel, above the FBW and Autopilot Test Panel. It is a guarded switch with a yellow/black stripped cover. Once opened, you cannot close the dump valve.

Fuel Dump Times: RP-522 = 2 minutes 30 seconds

RP-541 = 4 minutes

External Tanks Jettison

You can jettison the fuel tanks just as you would any other weapon by using the selective jettison procedure (see Stores Jettison). It is advisable to do so before entering any dogfight, as even empty external tanks will increase the drag and reduce aircraft’s manoeuvrability.

CAUTION

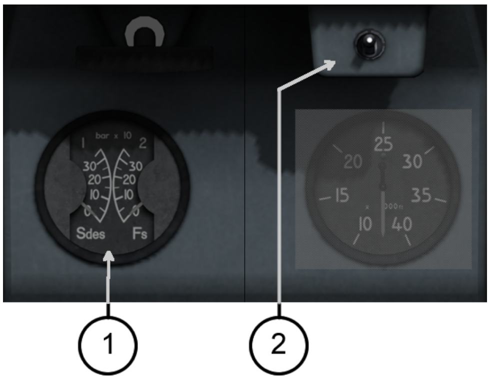
Remember to use caution when jettisoning the fuel tank to disable the selective jettison switch. Also, be mindful of the jettison location, avoid doing that over civilian - populated areas.

SECTION 5

HYDRAULICS

HYDRAULICS

The aircraft's hydraulic system includes two independent systems with the same power. Each system has a 110 liter/min self-regulating pump with 280 bars of pressure. Additionally, there is a reserve electrical pump (EP) which is connected to system 2 and that automatically starts when the pressure in system 2 falls below 160 bars. This pump provides 190 bars of pressure only, for flight controls and parking brake/emergency brakes accumulator.



1. HYDRAULIC PRESSURE GAUGE: displays

2. HYDRAULIC SYSTEM SELECTOR: for gauge display. NOT FUNCTIONAL

HYDRAULIC SYSTEM FEEDS DESCRIPTION

System 1

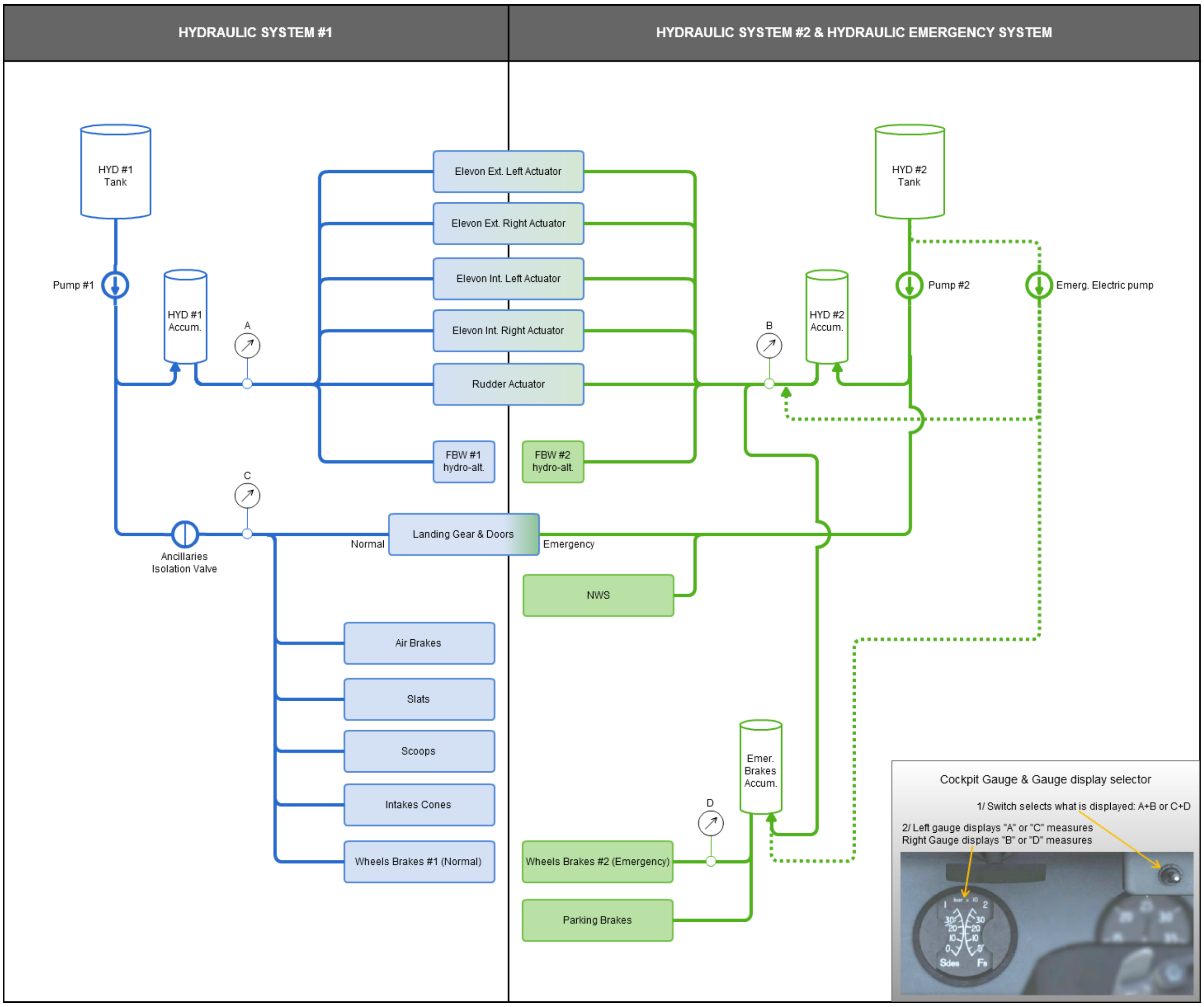
- Air brakes
- Slats (becs)
- Engine shock cones (souris)
- Engine scoops (pelles)
- Landing gear (normal)
- Wheel brakes (normal).

System 2

- Emergency landing gear actuator.
- NWS
- Emergency brakes
- Parking brakes.

As you can see on the schematics below, each hydraulic system also feature a hydro-alternator; those provide electric power, completely independently of the main electric system, to the #1 and #2 FBW channels computers respectively, so that even in case of total failure of the main electric system, the FBW remains operational as long as there is hydraulic power."

HYDRAULIC SYSTEM SCHEMATICS



SECTION 6

FLIGHT CONTROLS

M-2000C MOBILE SURFACES

The M-2000C flights controls include the following mobile surfaces.

- 4 elevons for pitch and roll control.
- 1 rudder
- 2 pairs of automatic slats (becs).

The elevons and the rudder are controlled by an electro-hydraulic servo connected to the two hydraulic circuits (HYD1 and HYD2, see SECTION 4). The servos are connected to two motor-servos (NORMAL and EMERGENCY).

The slats are controlled by a pair of motors that are actuated by HYD1 and move depending on the flight conditions.

NORMAL OPERATION

ELEVATORS

Stick displacement:

UP	Elastic stop at 43.2 mm
	Mechanical stop at 54 mm.
DOWN	Mechanical stop at 30 mm.

The elastic stop provides a restraint that limits the load factor or AOA while allowing override during hard maneuvers.

NOTE

In DCS, the ability to exceed the elastic stop is provided by using a button, as flight sim joysticks don't include a physical stop on the pitch axis. The button used is shared with the AP off feature.

The stick movement is filtered and reduced so that the total displacement + trim does not exceed the elastic stop unless that is the pilot's will. The deflection order has an airspeed limiter to prevent high loads.

Flight commands are regulated to avoid high Gs when speeds are above 300 knots. The control stick allows the pilot to control the load factor.

At low airspeed, the AOA is the primary parameter for flight control.

The aircraft stabilisation is a function of load factor, pitch angle, AOA and dynamic pressure.

AILERONS

Stick displacement: ±12°

The stick movement is filtered and reduced to maintain the roll speed limit, as a function of elevator command and load factor in order to reduce the roll speed and acceleration during high AOA and wing loads.

The aileron trim is added to the stick movement.

Aircraft stabilization is achieved as a function of roll angular speed.

RUDDER

Pedals displacement: ± 28.5 mm.

Rudder authority is limited by stick pull-up command.

A transverse accelerometer provides static stabilisation.

A yaw gyro provides with dynamic dampening.

There is a yaw stabilisation function that maintains zero lateral acceleration during steady flight (no cross manoeuvres). If active, rudder trim is redundant since both devices tend to cancel each other out. Yaw stabilisation is particularly important in aiding fast rolling and turning coordination to prevent departure from controlled flight.

NOTE

The rudder has a limited role in steering the aircraft. It is unnecessary except in certain regiments as during air refuelling, air-to-ground targeting or crosswind landing. To cover the latter case, the authority of the rudder is increased when the landing gear is down.

FLY-BY-WIRE

Delta - wing aircraft have a major drawback of having a very heavy drag at high angles of attack. In order to overcome that, a special system has been developed that replaces the conventional manual flight controls with an electronic interface. What it does, it converts the movements of the flight controls to electronic signals transmitted by wires to the computer, which in turn decide how to move the actuators of the control surfaces to achieve the required response. This system allows to fully exploit numerous advantages of the delta - wing aircraft, including low wing loading, large internal space, structural rigidity and clean flight behaviour.

It is important to remember that the M-2000 has a different philosophy in terms of flying in comparison to most aircraft.

Despite the fact that it is a fighter, the aircraft mostly flies with Autopilot engaged (see SECTION 6 for more information). Immediately after takeoff, the pilot engages the Autopilot. The system has the ability to auto trim and keeps the aircraft at the attitude that the pilot wants. The FCS constantly monitors weight and flight parameters and prevents the pilot from overstressing the airframe. The FCS of the Mirage 2000 is programmed to allow 9G manoeuvring and a roll rate of 270°/sec when configured for air-to-air combat.

The M-2000C has a Fly-By-Wire (FBW) system with 4 channels of control plus a fifth emergency one. The FBW allows the aircraft to:

- Control an unstable aircraft, especially when carrying external stores which have a significant impact on performance.
- Help the pilot to prevent loss of control by overriding flight commands that are outside their parameters.
- Improve the operational efficiency of the plane, including the flight characteristics and control of the aircraft in high AoA conditions
- Improve the safety of the pilot

SLATS (BECS)

The automatic slats are controlled by AOA. They begin to operate at $\alpha = 4°$ and are fully extended at $\alpha = 10°$. Extension depends on speed and mach. The slats are automatically retracted when the landing gear is down.

The use of leading edge slats also increase the aspect ratio during the combat manoeuvres.

NOTE

To cover certain cases when landing speed is too low due to engine damage, the slats can be extended manually, when the landing gear is down, by clicking the BECS switch to the SORTIS position.

FBW Modes Switch

The FBW mode switch is used by the pilot to adapt the FBW system to the stores loaded into the aircraft. There are two modes that are in use: Air/Air and Charges (Load).

Air/Air Mode

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

WARNING

This mode is allowed when the aircraft is clean (no load), or with a load limited to air-to-air missiles (Magic and/or 530D) and/or an empty centreline fuel tank.

Charges Mode

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

This mode must be used when the aircraft carries any of the following load: non-empty centerline droppable fuel tank, any wing droppable fuel tank, any bomb or rockets pod. This mode should also be used for AAR whatever the payload carried at the time as it offers a more gentle response..

NOTE

Both modes have been covered to greater extent in the stock campaign available with the module.

DEGRADED AND EMERGENCY MODE OPERATION

One thing to notice about the FBW is that - contrary to what might be commonly said - there is no way to disengage or turn off the FBW. However, there is a possibility to change the FBW Gain Switch to “fixed” or “emergency” mode, which should be done only in case of a serious failure, usually pitot - static or AOA sensors.

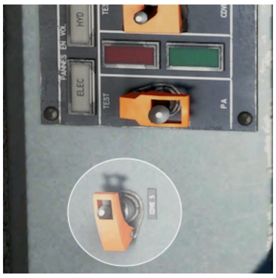
FLY-BY-WIRE SPIN SWITCH:

Two position switch.

- Norm: FBW system is in normal control mode.
- *Vrille* (Spin): FBW gives full authority to the pilot on the yaw and roll axis, and AoA limiter is overriden. To be used only in emergencies during a flat spin stall.

WARNING

The Fly By Wire system use is essential for proper functioning of the aircraft. Avoid using the SPIN position of the Spin Switch as it may result in an uncontrollable spin from which you won't be able to recover.



FLY-BY-WIRE EMERGENCY CHANNEL:

The FBW emergency channel is a last resort system in case of total FBW failure. The aircraft is put in a get-you-home condition. Not to be used for normal flight.

NOT FUNCTIONAL

***


Screenshot by AV_Partizan

SECTION 7

AUTOPILOT AND TRIM

AUTOPILOT

The autopilot (AP) provides automatic flight path control through basic and advanced modes. The M-2000C auto-pilot is designed to allow the pilot to turn it on shortly after takeoff and use the trim control to fly the aircraft. The pilot can also put temporarily the auto-pilot in standby to make a correction and then automatically return to its previous auto-pilot settings.

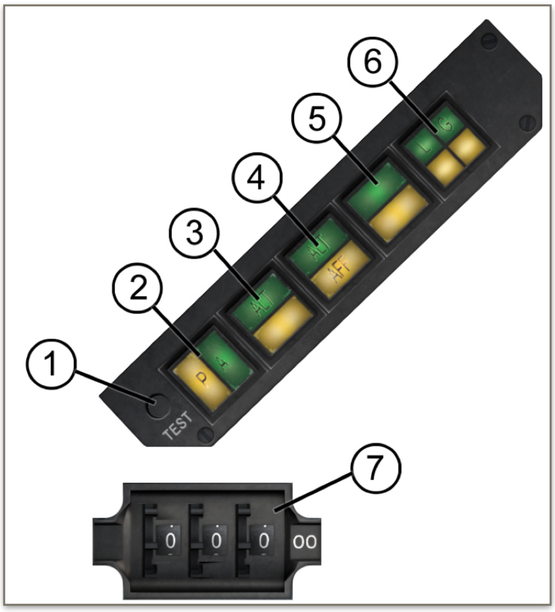
The basic mode AP is the attitude hold mode (despite its name also allowing the pilot to adjust heading and vertical flight path), while the advanced modes are current altitude hold mode, altitude capture mode and approach mode.

Operational limits

Max altitude	50,000 feet
Max pitch angle	$\pm 40^{\circ}$
Max AOA	18°
Max Roll	65° (will return to 60° when engaged)
Max speed	50 KIAS less than the operational limit for current configuration
Minimum speed	200 KIAS (unless in approach, limit is 18° AoA)
Minimum altitude	Normal mode: 500 feet
	Localizer and Glideslope hold: 200 feet
	Selected altitude hold: 1,000 feet

Autopilot Panel

The autopilot is managed through a mode selector panel, an altitude selector panel (ALT SEL) and three controls on the control stick: the AP disengage pushbutton, the AP Override / Standby "trigger" and the trim hat.



1. TEST PUSHBUTTON: press to trigger the annunciator lights test.

2. AP ENGAGEMENT PUSHBUTTON: activates the autopilot and selects the attitude hold mode.

3. ALTITUDE HOLD MODE SELECTOR PUSHBUTTON:
When the autopilot is engaged, selects the altitude hold mode.

4. ALTITUDE INTERCEPT MODE SELECTOR PUSHBUTTON:
When the autopilot is engaged and an altitude is set on the altitude selector panel, selects altitude capture.

5. NOT USED

6. ILS APPROACH MODE SELECTOR PUSHBUTTON: When the autopilot is engaged, selects the automatic ILS approach mode.

7. ALTITUDE SELECTOR: a drum used to set a target altitude, with regard to the current pressure setting on the altimeter. Three setting wheels (10,000-feet, 1,000-feet and 100-feet wheels) permit to set a desired altitude to intercept and hold. It is used in conjunction with the altitude intercept mode (button 4).

Indications

All panel pushbuttons have green and amber lights that come on to indicate AP engagement and active mode of operation. A green light indicates an active mode and amber light indicates that the mode is armed but in standby. No lights indicate that the AP is disengaged. In addition to these annunciators, the HUD displays an asterisk (*).

AUTOPILOT OPERATION

As it was mentioned earlier, M-2000C uses a very specific way of controlling the aircraft during almost all phases of flight with the exception of take-off, air-to-air refuelling, combat, short final and landing. Normally, the pilot would engage the AP soon after reaching operational limits (200 knots IAS, but it is advised to reach 250 - 300 IAS threshold) and then use the trim hat for navigating, adjusting flight parameters etc.

The two main visual aids for that are the small asterisk (*) and a AP Selected route caret (^) on the HUD and the AP Heading Bug on the HSI.

NOTE

The AP selected route cue on the HUD is displayed only if AP Selected route is more than 0.5 degree apart from current aircraft course.

The asterisk indicates the desired flight path angle. After engaging the AP if pilot wants to set the climb to, say, 5 degrees, he simply pushes the hat trim down and holds it until the asterisk reaches the given line on the Flight Path Pitch Ladder (FPPL). The aircraft will gently increase its pitch matching the Flight Path Marker (FPM) with the asterisk.

The AP Selected Route caret is synchronised with the AP Heading Bug on the HSI. Both show the heading which the autopilot should hold or turn to if in Attitude Mode.

The heading bug will move around the HSI once the left or right trim hat is pressed and held by the pilot. Use short presses for small heading corrections. If you want to make a larger turn, for instance to intercept the next waypoint on your flight path, press the trim hat left or right and hold it until the bug gets to the desired point and / or aligns itself with the wide needle.

You will notice that the AP Selected Route caret with do the same on the Heading Scale in the HUD.

AP engagement - disengagement - override

Pressing the AP engagement pushbutton (2) activates the autopilot.

Pressing the pushbutton again disengages (deactivates) the AP. Disengagement can also be accomplished by pressing the AP disengagement pushbutton on the control stick, or moving the control stick more than half of its maximum course in any direction.

The AP can be temporarily overridden (paused) by pressing and holding the AP StandBy pushbutton on the control stick. All active AP mode annunciators light up amber and the aircraft can then be flown manually with the AP in standby. When desired, the AP can be returned to previous operation by releasing the AP StandBy pushbutton.

When the AP is engaged, control stick movements will have no effect unless the AP is deactivated, overridden or stick is moved more than half of its full displacement in any direction.

AUTOPILOT MODES

All AP superior modes require the attitude basic mode of the autopilot to be engaged.

WARNING

Whatever the mode selected, the autopilot does not include an auto-thrust feature. Therefore, the pilot must constantly manage throttle settings and monitor airspeed when the autopilot is engaged.

NOTE

All altitude modes refer to the pressure setting set on the altimeter. Changing the pressure setting will cause the current barometric altitude value to change, and as a result aircraft to climb or descend to keep the memorised or set altitude.

ATTITUDE MODE

The attitude mode is automatically selected when the autopilot is engaged. At the moment of mode selection:

PITCH: The aircraft holds the current flight path angle. The flight path angle can be adjusted by moving the trim hat on the control stick up or down.

ROLL: If the roll is below 10°, wings are returned horizontal and the resulting heading value is held. If the roll is 10° or above, roll angle is held to its current value if possible, or returned to the max roll angle; the max roll angle depends on the current flight conditions (airspeed, altitude and FBW mode) and vary between 30 to 60°. If roll is above 65°, the attitude hold mode will not engage. In this mode the aircraft heading can be set moving the trim hat on the control stick left or right. In the HUD, a caret moves to the desired setting and on the HSI the green bug moves to the desired value. The aircraft banks in the appropriate direction and returns to wings level flight when the desired heading is reached.

ALTITUDE HOLD MODE

Pressing the altitude hold mode pushbutton selects the altitude hold mode. At the moment of mode selection:

The green ALT annunciator lights up.

PITCH: Current altitude is memorised and the aircraft pitch is controlled to maintain it.

ROLL: This mode has no action on the roll, which remains commanded as set by the basic Attitude mode.

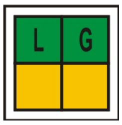
ALTITUDE CAPTURE MODE

This mode requires first setting an altitude value on the ALT SEL. At the moment of mode selection:

The amber AFF annunciator light up. The AP is armed for altitude capture.

PITCH: The pilot must set the desired flight path angle towards the desired altitude with the trim control hat or by overriding the AP. The AP then holds this pitch. When approaching the target altitude, the AP takes flight path angle control for capture (green ALT annunciator lights up) and adjusts the pitch in order to capture the altitude. Once reached, he ALT AFF capture mode is cancelled, and automatically replaced by the ALT hold mode described above.

ILS MODE



This mode requires setting the desired runway ILS frequency on the VOR/ILS panel. This mode is very basic, which means that the pilot must fly the aircraft towards the signal in order to enable the AP to intercept it and then just hold the correct approach. For example, flying towards the localizer with a 90°angle will exceed the AP capture capabilities.

At the moment of mode selection and out of a ± 3°cone from the LOC and GLIDE axis:

Both LOC (L) and GLIDE (G) amber annunciators light up, indicating the AP is armed.

PITCH: Is adjusted by the pilot via the trim hat or by override.

ROLL: Is adjusted by the pilot via the trim hat or by override.

When entering the ± 3°cone of the localizer:

The L annunciator switches from amber to green.

PITCH: The pitch axis is controlled by the AP. Flight path angle can be adjusted by the pilot via the trim hat.

ROLL: AP is in control of roll and adjusts heading to capture and follow the LOC axis. Trim hat left/right inputs have no effect.

NOTE

If the aircraft exits the ± 3° LOC cone during interception, the L annunciator reverts to amber and pitch/roll control is reverted to the pilot.

When entering the ± 3°cone of the GLIDE:

The G annunciator switches from amber to green.

PITCH: AP is in control of the pitch to follow the GLIDE descent path.

ROLL: AP is in control of the roll to follow the LOC axis.

WARNING

The autopilot does not include an autothrust feature. Therefore, the pilot must constantly manage throttle settings and monitor airspeed during the approach. Before landing, the AP must be disconnected not lower than 200 ft AGL. The AP does not include any auto-land feature and the landing must be manually performed by the pilot.

ABNORMAL OPERATION

Autopilot Failure

If the AP fails, the master warning lights up, a chime is heard and on the warning light panel the red AP light comes on.

The AP is automatically disengaged and manual control reverted to the pilot.

TRIM SYSTEM

Trimming the aircraft

Under normal operations, the autopilot takes care of keeping the aircraft trimmed at all times in both pitch and roll.

However, if the AP is off or in StandBy mode and when the weight of the ordnance is not evenly distributed, especially taking into account the underwing pylons, some manual trimming may be necessary. For instance a Super 530D missile weighs approx. 275 kilos (over 600 lbs) and after firing only one missile the resulting discrepancy in weight will be clearly visible and the aircraft should be trimmed for level flight.

Still, due to extensive use of Autopilot, the use of trim in traditional sense has a secondary role in M-2000C. Trim hat is most commonly used to steer and navigate the plane when the Autopilot is on.

Trim with the AP on

As stated before, once you have completed take off and are inside operational limits for the AP, you should immediately engage it in the Attitude Mode. Doing so will display a small asterisk (*) in your HUD, which will be your visual indication for the required flight path.

In order to operate the AP and change pitch or heading, you simply have to press and hold the trim hat long enough for the asterisk to align with the required line on the Flight Path Pitch Ladder (FPPL) and / or position the AP Selected Route Caret on the required heading. The airplane will hold the set climb / descent rate or enter a turn and level out when the FPM reaches the heading shown by the AP Selected Route Caret.

WARNING

As always remember that the autopilot does not include an auto-thrust feature. Therefore, the pilot must constantly manage throttle settings and monitor airspeed when the autopilot is engaged

SECTION 8

LANDING GEAR

LANDING GEAR

The M-2000C has a tricycle landing gear. The nose wheel is composed of two small tyres and has a steering assembly. The main gears have a single large tyre each and are equipped with carbon disk brakes. The aircraft is equipped with an anti-skid system and a parking brake.

They are operated by the HYD1 system with the HYD2 for emergency use.

1. Landing Gear Panel (see below)

2. Landing Gear Lever: Used to raise and lower the landing gear. Gear is down if the lever is in the lower position and up when the lever is in the upper position. The red handle at the end of the lever serves as Landing Gear Warning Light and blinks red whenever the gear is being lowered or raised.

3. Emergency Landing Gear Lever: Lowers the landing gear in case of primary system failure. NOT FUNCTIONAL

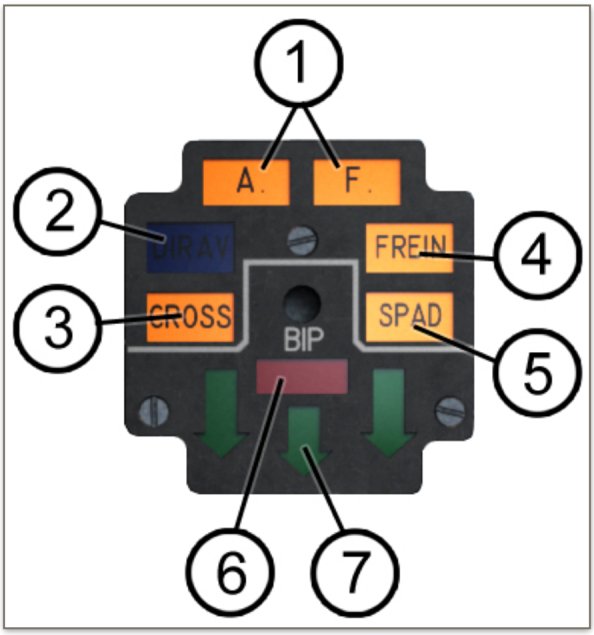
4. Brakes System Switch: Selects which HYD system to use for braking. In **default** position (switch forward, hyd 1 system), it sets Normal #1 brakes, equipped with anti-skid 'SPAD' system. In **emergency** position (switch back, hyd 2 system) there is no anti-skid. Anti - skid minimises aquaplaning and the potential tyre damage which can occur when a wheel is locked or rotating at a speed which does

not correspond to the speed of the aircraft. Anti-skid prevents tyres from skidding often caused by locked wheels.

The Landing Gear Warning Light included in the lever blinks when the landing gear is up and speed drops below 230 KIAS. The warning light is accompanied by a warning horn. The warning horn is only active when the aircraft systems are in NAV or APP modes.

CAUTION	The NWS is very sensitive, especially at speeds above 30 knots GS.
CAUTION	After landing AVOID applying brakes until your speed is below 100 knots. Prefer aero-braking at higher speeds. The braking should be made with "press and release" technique: apply brakes one second, release for one second, apply again… and so on.
CAUTION	The aircraft is very sensitive to rudder when rolling for take-off or landing, even if the NSW is not active.

Landing Gear Panel



1. AF (short for *Aéro Freins*), Air brakes advisory lights. They turn on when the airbrakes are activated.

2. DIRAV (short for *Dirigeabilité Roue Avant*, Nose Wheel Steering) advisory light. It turns on when the NSW system is engaged. Be aware that the NSW automatically disconnects when ground speed reaches 40 knots.

3. CROSS (short for *Crosse*, Tailhook) advisory light.

4. *FREIN* (Brakes) advisory light. Turns on when wheel brakes are applied or when the parking break is set (in addition to PARK caution advisory light on the Caution / Warning Advisory Panel.

5. SPAD (*Système Perfectionné Anti-Dérapant*, Anti-Skid) warning light. It lights up when the Anti-Skid is disconnected or the anti-skid system automatic test fails. It flashes when the landing gear is in transition.

6. Landing Gear in transit advisory lights.

7. Landing Gear Down and Locked advisory light. They lit on when all three wheels are down and locked.

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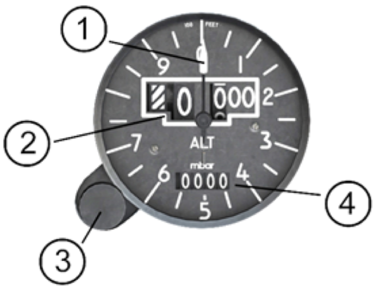
SECTION 9

AVIONICS

FLIGHT INSTRUMENTS

Altitude Indicator

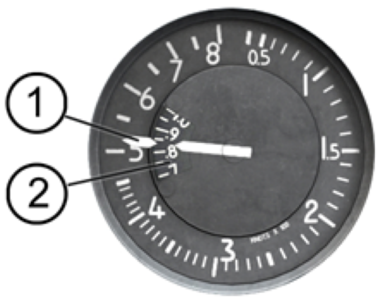
The Altitude Indicator displays the Aircraft's barometric altitude in feet above mean sea level. The readings are taken from the PS2 static port, part of the air data probe on the nose of the aircraft.



1. Hundreds feet indicator.
2. Thousands feet indicators
3. Barometric setting adjustment knob.
4. Barometric setting display (in millibars).

Airspeed Indicator

The Air Speed Indicator displays the Aircraft's speed in knots and mach. The needle rotates around the indicator to 800 Knots. While the Mach wheel rotates underneath, correlating to the knots' needle position to display the mach.



1. Knots indicator
2. Mach indicator

Vertical Velocity Indicator

Displays the aircraft vertical velocity in feet/min. The number represents 1000 feet.

Attitude Direction Indicator ADI ("Boule")

The ADI provides aircraft pitch, roll, heading and, when applicable, LOC, GLIDE deviation and marker indications. Data used to display attitude (pitch and roll) and heading comes from one of two sources, the INS or the backup gyroscope.

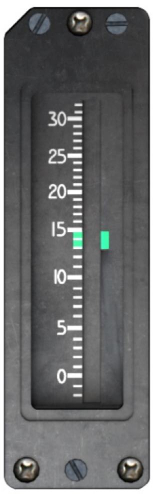
The data source is manually selected via the GCS switch located on the right-side console. INS source is the normal operating mode. In case of INS failure, backup attitude and heading are automatically obtained from the backup gyroscope.

The pitch markings on the sphere are in graduations of 5°, the Bank markings begin at 10° increments with major markings at to 30°, then 45°, and 60°. Signals are received from the pitot and INS system.

The ADI also displays Localizer and Glide slope information for ILS landing and steer modes.

1. Roll angle indicator
2. "Off" flag
3. Aircraft symbol (fixed)
4. Marker light
5. Turn slip ball
6. Course deviation needle
7. Glideslope deviation needle
8. N/P switch (P locks the ADI with the south pole towards the pilot so that it displays only black and does not confuse pilot with false indications)

AOA Indicator



The AOA Indicator displays the Aircraft's Angle of Attack. The markings go from -2º to 32º of AOA, with a green mark at 14 degrees for optimal glide pitch during landing approaches.

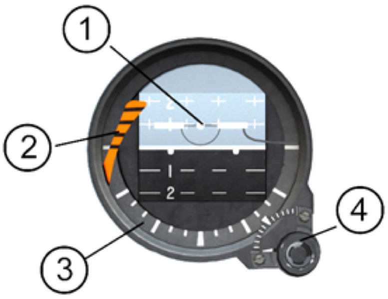
The AOA Indicator sounds an alarm when AOA values approach the aircraft flight limits. The AOA limits are configured depending on the FBW's mode switch.

The warning sound cannot be switched off and will remain on while the extreme flight condition remains.

An OFF flag appears when for any reason the AOA indicator is not operational.

Standby Attitude Indicator

The Standby attitude indicator is an independent instrument that provides pitch and roll information in case of the main ADI failure. It is powered via the GCS SWITCH.



1. Aircraft symbol (adjustable).
2. OFF flag.
3. Roll angle indicator.
4. Cage/Aircraft symbol adjustment knob.

G Force Indicator

Displays the vertical acceleration forces experienced by both the aircraft and the pilot.

Backup Gyroscope (GCS)

The backup gyroscope (*Gyro-Compas de Secours* - GCS) is a stand-alone system with a gyroscope and a magnetic field sensor (flux vane). It elaborates on its own the aircraft pitch and roll, and stabilises the magnetic heading sensed by the flux vane. This system is a backup in case of INS failure.

The only control for this system is the GCS SWITCH.

The information provided by the gyroscope is, when selected with the backup attitude (GCS) switch, displayed on the ADI, the HUD and the IDN.

Backup Attitude Switch (GCS Switch)

The three-position GCS switch is located on the right-side console. It is used:

- To power the SAI and the backup gyroscope.
- To select the attitude data source to be fed to the ADI and the HUD.
- To select the heading data source to be fed to the ADI, the HUD and the IDN.

AFT POSITION**:** no data and no power provided to the ADI and GCS.

MIDDLE POSITION: SAI and backup gyroscope are powered. Attitude and heading data provided to the HUD, ADI and IDN comes from the INS. FORWARD POSITION: SAI and backup gyroscope are powered. Attitude and heading data provided to the HUD, ADI and IDN is forced to come from the backup gyroscope.

NOTE	In case of INS failure, the change to GCS data is automatic. The GCS switch is used to force the change if needed.

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ONBOARD RADIOS

M-2000C is equipped with two onboard radios.

The V/UHF radio, providing two-way voice communication on VHF and UHF frequency range. Frequencies can be set manually or selected via a preset memory selector. The V/UHF radio is referenced by the pilots as the “green” radio, as the associated volume control knob on the audio panel is in green colour (see below). It is also often called the **main** radio.

The UHF radio provides two-way voice communication on the UHF frequency range (225.000 to 339.975 MHz). Frequencies are memorised in preset channels, 20 are available. The UHF radio is called by the pilots the “red” radio, related to the red colour of the volume control knob on the audio control panel. It is also referenced to as **auxiliary** or **secondary** radio.

SUMMARY OF CONTROLS / RADIO USE

Radio	Designation	Frequency Range	Manual select	Preset channels
V/UHF	Main / Green	118,000 to 149,970 MHz (VHF) 225.000 to 339.970 MHz (UHF)	YES	20
UHF	Auxiliary / Red	225.000 to 339.970 MHz (UHF)	NO	20

NOTE

There is no possibility to manually edit the frequency for the UHF channel in-flight. For that you have to use the V/UHF (main one). Remember that V/UHF is capable of operating on both bands (VHF and UHF) and as such is much more versatile.

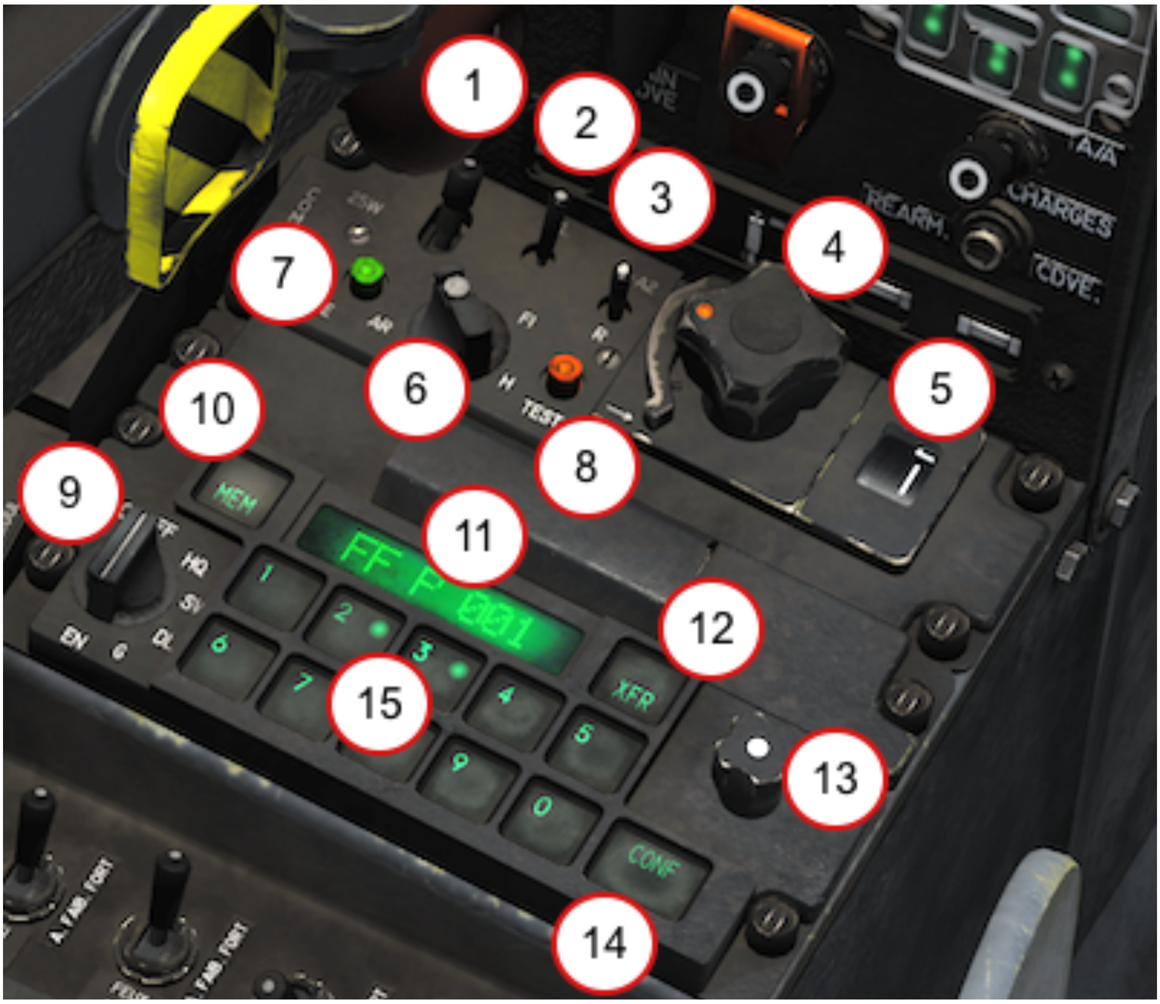
PRESET CHANNELS

The channels for both radios are set up by the ground crew before each mission according to the tactical requirements. This is the preferred and quickest way of using the radios, however needs careful planning in order to include all the important frequencies (though for the most part, this will be in the hands of mission designer).

RADIO PANELS

On the next page you will find description of all four different panels used for operating the radios and regulating the volume.

VUHF AND UHF RADIO PANEL



1.UHF RECEIVER/TRANSMITTER INVERSE SELECTOR. Not used, always set to 5W, even in real aircraft.

2. UHF SIL SWITCH. Switches ON or OFF the automatic noise suppression feature.

3. UHF TEST SELECTOR. NOT FUNCTIONAL

4. UHF CHANNEL PRESET SELECTOR. Sets the desired preset frequency channel. Change to next channel with RMB click, previous channel with LMB.

5. UHF CHANNEL INDICATOR. Displays the current selected preset frequency. 20 presets are available.

6. UHF OPERATION MODE SELECTOR. The four-position AR, M, FI, H function selector switch determines the radio operating mode:

AR: (*Arrêt*) OFF. No power is applied, the bottom row of RADIO FREQUENCY DISPLAY remains blank.

M: (*Marche*). ON. Power is applied and the main preset frequency is used.

F1: Not used.

H: Not used.

7. UHF SECURE ENCRYPTION RECEIVE LIGHT. NOT FUNCTIONAL

8. UHF TEST BUTTON. When pressed and the UHF radio is working, radio static should be heard.

9. V/UHF FUNCTION SELECTION SWITCH. The seven-position function selector switch determines the radio operating mode:

> **0**: (*zero*) OFF. No power is applied, the display remains blank.
> **FF:** FIXED FREQUENCY. Normal AM operating mode, it will set the last channel or frequency used when the mode was changed to something else.
> **HQ:** HAVE QUICK. NOT FUNCTIONAL
> **SV**: SECURE VOICE. Not used on the jet, display will show ******.
> **DL**: DATA LINK. Not used on the jet, display will show ******.
> **G**: GUARD. Switches the radio to 243.000
> **EN:** used to enter the HQ data. **NOT FUNCTIONAL**

10. MEM/CLR BUTTON. This will show the value recorded in the buffer memory (can be a channel or frequency). If keypad was used to enter frequency or channel, the button displays CLR option, used to delete the previous input.

11. V/UHF RADIO DISPLAY. Digital display showing the currently selected preset channel or frequency.

12. XFR / VAL BUTTON. XFR (TRANSFER) allows to return to the previously used channel or frequency. Whenever a new channel is used or new manual frequency is entered and validated, the previous one is placed in the buffer memory. You can switch between them using the XFR button. If keypad is used to enter frequency or channel, the button displays VAL, used to validate that input.

13. V/UHF CHANNEL PRESET SELECTOR. Sets the desired V/UHF preset frequency channel. Change to next channel with RMB click, previous channel with LMB. If you are currently in the manual mode, using the selector will switch the radio back to presets.

14. CONFIGURATION BUTTON. Replaces the digits on the keypad with the following options on the keypad:

> **READ**: when a preset channel is selected and CONF button is pressed, pressing this button will display the frequency linked to the selected preset.
>
> **SQL**: SQUELCH. Toggles squelch ON and OFF (it is set to ON by default).
>
> **GR**: GUARD MONITORING. Enables monitoring of the guard frequency in the background (greet dot is lit up when the option is enabled).
>
> **TONE**: (classified)
>
> **TOD**: (classified)
>
> **ZERO**: (classified)
>
> **5 / 20 / LOW**: enables to switch between LOW, 5 and 20 watt radio power.

15. V/UHF RADIO KEYPAD. Used to choose desired preset radio channel (as an alternative for the preset selector knob, two digits are accepted), to introduce manual frequency (five digits are accepted) or change different settings after CONF button was pressed.

Setting Manual Frequency on V/UHF Radio

In case there is a need to enter new frequency during a mission, pilot can do that at any time using the V/UHF radio.

Make sure that function selector switch is set to FF and use the keypad to type in the desired frequency. You need to introduce 5 digits and then press VAL in order to validate your input. If you press too many digits, any press beyond the fifth will bring you back to the previously used frequency or channel.

Audio Control Panel

Audio control panel is located on the left console, just behind the throttle. It permits selection of which equipment to monitor (listen) and adjust the audio volume. Multiple radios/equipments can be simultaneously monitored.

Rotating the volume control knobs clockwise (increase) or counter-clockwise (decrease) adjusts the audio volume level.

1. Amplifier selector switch. NOT FUNCTIONAL
2. VOR/ILS volume control knob. Sets the volume for the VOR / ILS.
3. TACAN volume control knob. Sets the volume for TACAN beacon identification morse code.
4. Missile volume control knob. Sets the volume of the MAGIC 2 seeker audio.
5. Intercom / Approach volume control knob. Sets the volume of the intercom, used to communicate with the ground crew..
6. TP / marker / countermeasures volume control knob. Sets the volume of the Alarm Panel (*Table de Pannes*)P, marker and countermeasure system audio.
7. UHF radio volume control knob. Sets the volume of the auxiliary (UHF) radio. Note the red colour of the knob, which gave the common name used by the pilots (RED radio).
8. V/UHF radio volume control knob. Sets the volume of the main (V/UHF) radio. Note the green colour of the knob, which gave the common name used by the pilots (GREEN radio).

NOTE

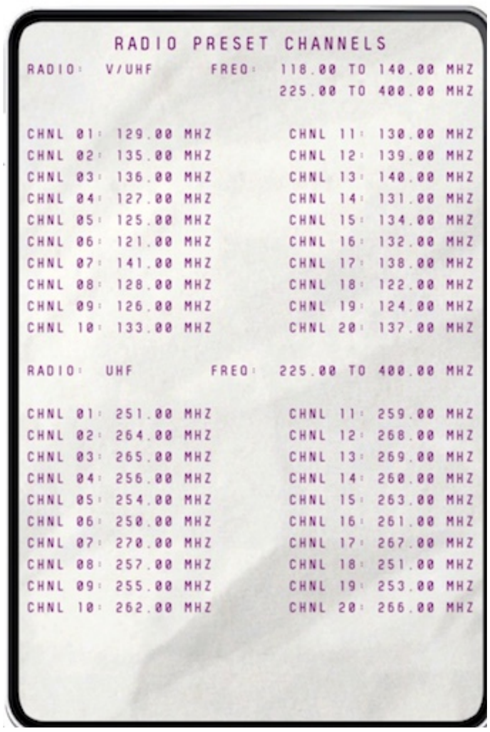
It is a good practice to turn down the volume of some of the systems during very intensive sorties. Also, it is sometimes advised to set up different volume for green and red radios in order to be able to be able to instantly recognise who is currently transmitting.

CHECKING FREQUENCIES DURING FLIGHT

With so many different frequencies assigned to 40 channels different channels on two radios, it would be very difficult to keep track of all. Remember, that you can always find all that information in the kneeboard - either the default one (see next page) or custom ones prepared by the mission creators. Always cross - check the frequencies with the briefings before each flight, good radio discipline may be paramount to the success of your mission!

Also, the current frequency set for both radios is always displayed at the Frequency Repeater on the main dashboard - the bottom one displaying Red (UHF) and the top one Green (V/UHF) radio.

Sample images of the default kneeboard and custom one from the campaign can be found below:



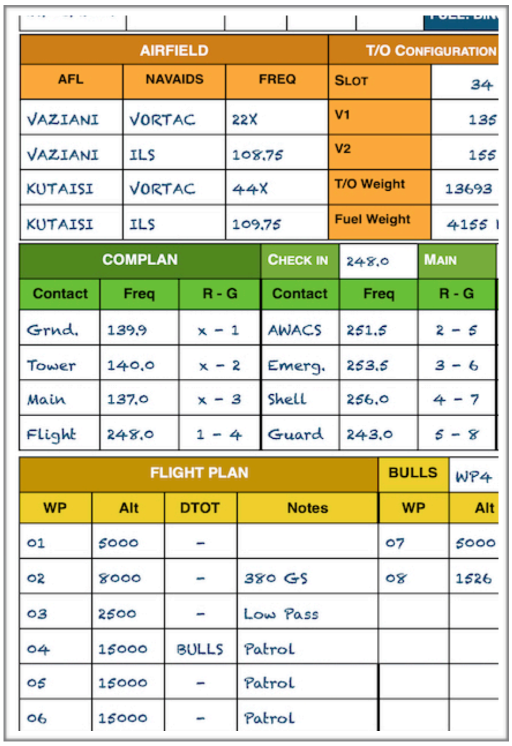
RADIO PRESET CHANNELS

RADIO: V/UHF FREQ: 118.00 TO 140.00 MHZ
225.00 TO 400.00 MHZ

CHNL 01: 129.00 MHZ	CHNL 11: 130.00 MHZ
CHNL 02: 135.00 MHZ	CHNL 12: 139.00 MHZ
CHNL 03: 136.00 MHZ	CHNL 13: 140.00 MHZ
CHNL 04: 127.00 MHZ	CHNL 14: 131.00 MHZ
CHNL 05: 125.00 MHZ	CHNL 15: 134.00 MHZ
CHNL 06: 121.00 MHZ	CHNL 16: 132.00 MHZ
CHNL 07: 141.00 MHZ	CHNL 17: 138.00 MHZ
CHNL 08: 128.00 MHZ	CHNL 18: 122.00 MHZ
CHNL 09: 126.00 MHZ	CHNL 19: 124.00 MHZ
CHNL 10: 133.00 MHZ	CHNL 20: 137.00 MHZ

RADIO: UHF FREQ: 225.00 TO 400.00 MHZ

CHNL 01: 251.00 MHZ	CHNL 11: 259.00 MHZ
CHNL 02: 264.00 MHZ	CHNL 12: 268.00 MHZ
CHNL 03: 265.00 MHZ	CHNL 13: 269.00 MHZ
CHNL 04: 256.00 MHZ	CHNL 14: 260.00 MHZ
CHNL 05: 254.00 MHZ	CHNL 15: 263.00 MHZ
CHNL 06: 250.00 MHZ	CHNL 16: 261.00 MHZ
CHNL 07: 270.00 MHZ	CHNL 17: 267.00 MHZ
CHNL 08: 257.00 MHZ	CHNL 18: 251.00 MHZ
CHNL 09: 255.00 MHZ	CHNL 19: 253.00 MHZ
CHNL 10: 262.00 MHZ	CHNL 20: 266.00 MHZ



AIRFIELD			T/O CONFIGURATION	
AFL	NAVAIDS	FREQ	SLOT	34
VAZIANI	VORTAC	22X	V1	135
VAZIANI	ILS	108.75	V2	155
KUTAISI	VORTAC	44X	T/O Weight	13693
KUTAISI	ILS	109.75	Fuel Weight	4155

COMPLAN			CHECK IN	248.0	MAIN
Contact	Freq	R - G	Contact	Freq	R - G
Grnd.	139.9	x - 1	AWACS	251.5	2 - 5
Tower	140.0	x - 2	Emerg.	253.5	3 - 6
Main	137.0	x - 3	Shell	256.0	4 - 7
Flight	248.0	1 - 4	Guard	243.0	5 - 8

FLIGHT PLAN				BULLS	WP4
WP	Alt	DTOT	Notes	WP	Alt
01	5000	-		07	5000
02	8000	-	380 GS	08	1526
03	2500	-	Low Pass		
04	15000	BULLS	Patrol		
05	15000	-	Patrol		
06	15000	-	Patrol		

In these examples you will notice that some frequencies have been assigned to channels on both on green and red radio (for instance: AWACS and Flight Frequency). This gives you some degree of flexibility which radio to use for what. For instance, you could use CH4 and CH5 on Green to be able to quickly switch between Flight and AWACS, while keeping CH3 on Red to constantly monitor Emergency channel.

Or you can choose to stay on Element on Green while listening to AWACS on Red. Such setup gives you many options to choose from - especially if most of the frequencies used are in the UHF range.

CAUTION

During some of the missions (especially in the campaign) you will be required to change preset frequencies quite often. Make sure to read all the available briefing materials and listen to all the incoming orders in order to always be aware which channels you should be listening to.

ASSIGNING PRESET CHANNELS IN THE MISSION EDITOR

Setting up your radio frequencies is only possible by using the Mission Editor. In order to do so, click on your flight, then choose the tab seen in the picture below and fill in the frequencies for each of the channels assigned to V/UHF and UHF radios.

VOR / ILS

The VOR/ILS system permits navigation and approach by using ground-based beacons. Bearing to the VOR beacon is exclusively displayed on the IDN (navigation indicator), while ILS localiser and glide information are displayed on the analogue spherical indicator (ADI) and on the HUD (when APP mode is selected).

See NAVIGATION section for more details.

Even though the VOR station may be a VOR - DME that allows distance measuring, there is no VOR - DME equipment installed in the M-2000C, so only the bearing is available. Beacon identification Morse code can be monitored via the audio control panel.

NOTE

A specific training mission covering the IMC approach using ILS and TACAN is available.

TACAN

The TACtical Air Navigation (TACAN) system, specifically used by military assets, permits navigation in a similar way as the VOR system. Operating frequencies are represented by preset channels, consisting of a letter (X or Y) and numbers, providing for a total of 248 combinations.

Bearing and distance to the selected ground beacon are displayed exclusively on the IDN (navigation indicator). Beacon identification Morse code can be monitored via the audio control panel.

A properly setup TACAN station is also necessary in order to be able to use VAD function of the IDN. See NAVIGATION section for more details.

NOTE

TACAN can also be used to provide distance (but not bearing) between two TACAN - equipped aircraft in the multiplayer mode. In order to make it work, the wingman should set up his TACAN in A/A mode 63 channels apart from the leaders setting.

NOTE

A specific training mission covering the use of TACAN offset (VAD) is available. This topic is also covered in the campaign.

VOR / TACAN PANEL

1. VOR/ILS FREQUENCY WINDOW. Displays the selected operating frequency. ILS frequencies range is 108.000 to 119.95 MHz.

2. VOR/ILS CONCENTRIC LEFT KNOBS. The two-position outer rim knob rotates to set the system **ON** (M) or **OFF** (A).

The inner knob rotates to set the digits left of the decimal from 108 to 119 by increments of 1.

3. VOR/ILS CONCENTRIC RIGHT KNOBS . The two-position outer rim knob rotates to select *Haut - Gauche* (HG) or *Bas - Droite* (BD) test positions. NOT FUNCTIONAL

The inner knob rotates to set the frequency digits right of the decimal from 00 to 95 by increments of 5.

4. TACAN CHANNEL WINDOW. Displays the set channel. Ranges from 1 to 124, plus the X or Y sub-channel. Channel 0 is not active.

5. TACAN CONCENTRIC LEFT KNOBS. The two-position outer rim knob rotates to set the X or Y band.

The inner knob rotates to set the tens and hundreds of the channel. When the value is 00, there is nothing displayed (Channel 001 will show 1).

6. TACAN CONCENTRIC RIGHT KNOBS. The four-position outer rim knob (mode knob) rotates to select:

OFF: the system is not powered.

REC: passive mode where only the bearing to the ground beacon is received. No distance information available.

T/R: active mode where the TACAN emits a signal that, when returned by the ground beacon, provides distance information in addition to the bearing.

A/A: air-to-air mode. Used to obtain bearing and range to another aircraft.

SECTION 10

HUD

HUD PEDESTAL

HUD pedestal is located at the centre dash, just above the VTB.

1. SYMBOLOGY DE-CLUTTER SWITCH. The de-clutter switch suppresses some of the HUD's symbols in order to clear the display for a better view forward. By default, it is in the Off position.

2. Target wingspan scale. Used in WVR combat to set the width of target wingspan. The available values are between 7 and 40 meters. More information in HUD DISPLAY.

3. EFF SWITCH. The EFF switch is used to temporarily declutter the HUD. Works only when pressed and returns the HUD to normal view after it is released. NOT FUNCTIONAL

4. Gun Piper Selector. NOT FUNCTIONAL

5. Brightness control. Used to increase or decrease the intensity of the HUD.

6. Power switch. Used to power up the HUD. It has two positions: **normal operation** (right - click once) and **test mode** (accessible after second right - click).

7. Backup fixed sight. Used whenever the targeting computer is non-functional.

8. Boresight adjustment. Used for manually setting gun deflection based on ballistic tables for the desired range.

9. Altimeter Selector Switch and 10. Radar Altimeter Switch. By default, only barometric altitude, Mean Sea Level altitude, is shown, if you require Above Ground Level altitude you must activate the radar altimeter:

1. Click on the radar altimeter switch once. The next click will activate the self-test.
2. Click on the altimeter selector switch. By default, it will be in the ZB (barometric altitude) position. Click once to put it in the H (radar altimeter) position. Both the barometric and radar altitudes will be visible in the HUD.
3. SELH position displays the Minimum Altitude selection on the HUD, allowing the pilot to change its setting using the minimum altitude selector.

CAUTION

Be aware that the radar altimeter has a limit of 5,000 feet AGL. Asterisks will be displayed when the aircraft AGL altitude is above 5,000 feet. Asterisks will also be displayed whenever the aircraft roll angle is higher than 20º, since at that angle the radar altimeter beam cannot give a reliable measure.

11. Minimum altitude selector. The Minimum Altitude (MA) display indicates the minimum safe altitude that you can fly. During landings and when the HUD is in APP (approach) mode, the MA also works as the Decision Height selector.

To operate the MA you need to have the radar altimeter activated. To activate it, you only need to click the altimeter selector to the HG position. The MA display will appear below the AGL altitude display.

To select the desired MA value, click on the knob located between the radar altimeter and the altimeter selector switches. The values will change in tens of feet. Left click increases the value. Right click decreases the value.

HUD MASTER MODES

The HUD display information based on the current operational mode, also known as Master Mode. The HUD current Master Mode is selected by the HOTAS and is independent from the selection made on the PCA (Armament Control Panel) or the position of the Master Arm switch.

There are four families of Master Modes:

1. **Ground mode**

Automatically selected when the aircraft is Weight-On-Wheels

2. **NAV modes**

a. Normal NAV (or Taxi/Take-Off, engaged automatically by weight-on-wheels sensor)

b. Approach APP

c. RD / TD (Desired Route / Desired Time on Target mode)

3. Air-to-Air AA

a. CAN (*Canons*) - AA guns, selected using HOTAS

b. MAG (Magic), selected using HOTAS

c. 530, selected using PCA

d. POL (Police), selected using PCA

3. **Air-to-Ground**

Selected via HOTAS. All AG weapons are selected via PCA, but system remains in NAV until AG is enabled using the WSC (Weapons System Command) switch.

a. CAS (*Canons Air Sol*) - AG guns

b. RK (*Roquettes*) - rockets

c. BL (*Bombes Lisses*) - free fall bombs, this mode uses CCRP cueing only. It is also used for GBUs.

d. BF (*Bombes Freinées*) - High - Drag bombs, this mode uses CCIP cueing only.

e. EF

Additionally, the HUD features an AUXILIARY GUNSIGHT that may help aiming in case of failure of the master mode.

HUD DISPLAY

No matter what Master Mode/Sub-mode is active all of them share the following data.

1. Calibrated Air Speed (CAS). Located to the left of the Heading Scale, it shows the current aircraft speed in knots. The display is only shown when the airspeed is above 30 knots.

2. Heading Scale (HS). The Heading Scale moves horizontally against a fixed caret index indicating aircraft magnetic heading from 0º to 360º. The scale is numbered every 10 degrees, with a dot representing the 5 degree halfway mark between two numbers. The two-digit display is expressed in degrees x 10; e.g.: 10º is displayed as 01 and 250º is displayed as 25. The | shows waterline axis of the A/C, while Δ is the current course of the aircraft.

3. Baro-Inertial Altitude (Zbi). Located to the right of the Heading Scale, it shows the current aircraft altitude above sea level. The numbers representing values below one hundred are shown in a smaller font.

CAUTION

The value displayed both here and on the Altitude Indicator is based on the pressure set up using the barometric pressure adjustment knob. Always use the value given by the ATC for QFE / QNH settings or 1013 for the STD setting when flying enroute.

4. FLIGHT PATH MARKER (FPM). The Flight Path Marker also known as the Velocity Vector Indicator (VVI) is an aircraft shaped symbols that shows in the HUD where the aircraft's instantaneous flight path is with respect to the earth. The wings of the symbol always remain parallel to the wings of the aircraft. The vertical relationship between the waterline and the FPM indicates true AOA. The FPM displacement from the HUD centerline indicates drift.

5. HORIZON LINE (HL). A component of the Flight Path Pitch Ladder (FPPL), it indicates the relative position of the horizon. The higher the aircraft's altitude, the higher the position of the HL with respect of the actual horizon. When the FPM is at the same level of the HL, the aircraft is in level flight neither climbing nor descending.

6. FLIGHT PATH PITCH LADDER (FPPL). The vertical flight path angle of the aircraft is indicated by the position of the FPPL relative to the position of the FPM. The aircraft pitch attitude is indicated by the position of the HUD waterline with respect to the FPPL about the stabilised wings of the FPM. The HL and the FPPL angle lines are displayed for each 5º with the angle value being displayed every 10º between 0 and ±90º. Positive pitch lines are solid and negative pitch lines are dashed. The tabs at the end of each segment points towards the horizon.

7. ACCELERATION VECTOR (AV). The Acceleration Vector chevrons indicate the aircraft longitudinal acceleration. It is a way to display aircraft's current energy state visually. The AV chevrons move in relation to the FPM: when the chevrons and the FPM are at the same level, the aircraft is neither accelerating nor decelerating[1]. If the chevrons are above the FPM, then the aircraft is accelerating. If the chevrons are below the FPM, the aircraft is decelerating. Chevron position above or below the FPM is relative to the acceleration rate.

NOTE

These indicators are very handy when performing a formation flight or during the air - to - air refuelling.

8. MACH NUMBER. The Mach number is displayed in all modes and only when the value is above 0.6 Mach.

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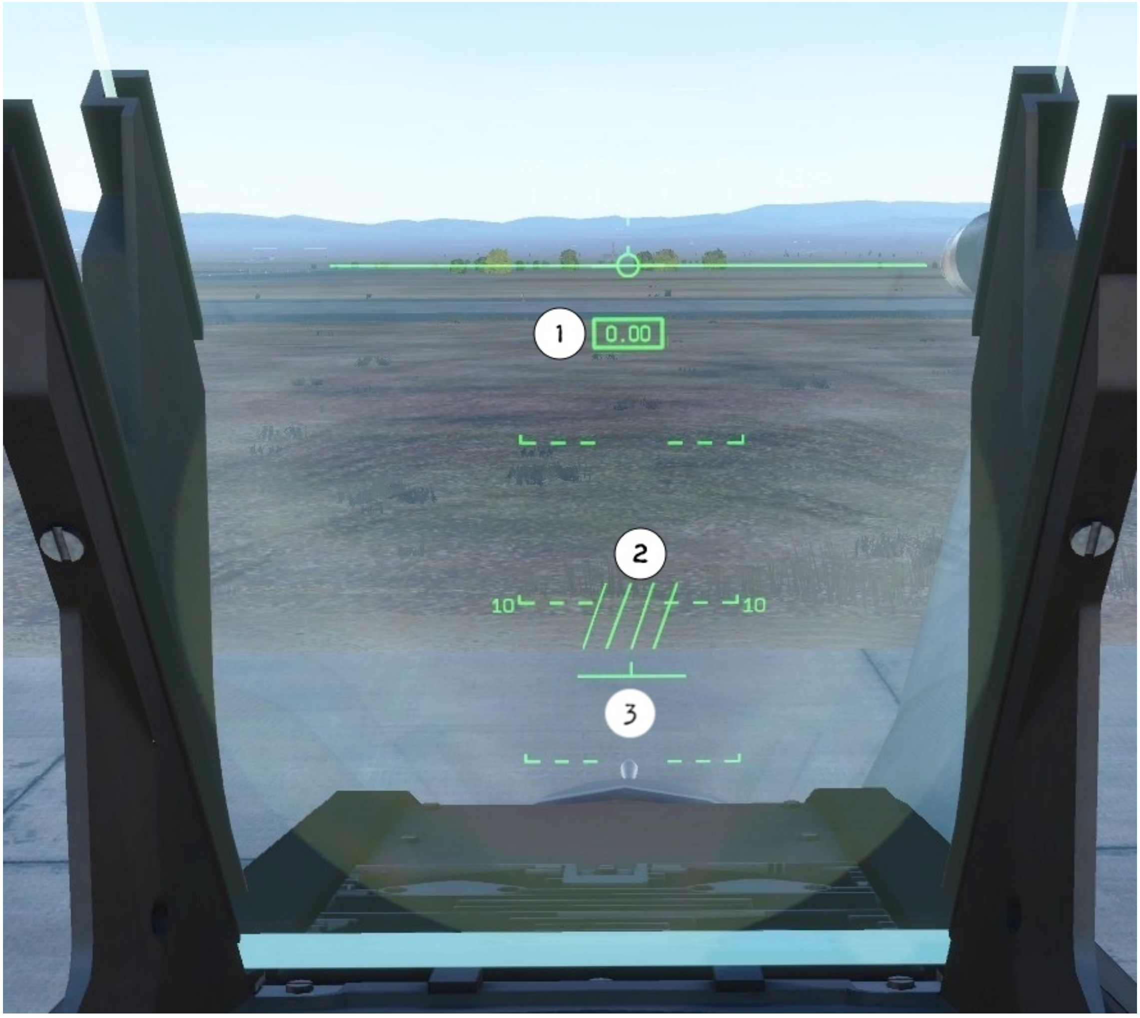
[1] In fact even if the chevrons remain in place, the CAS or Mach indication might change if the aircraft is climbing or descending due to different air densities.

ON THE GROUND

When on the ground, HUD will display two distinctive features.



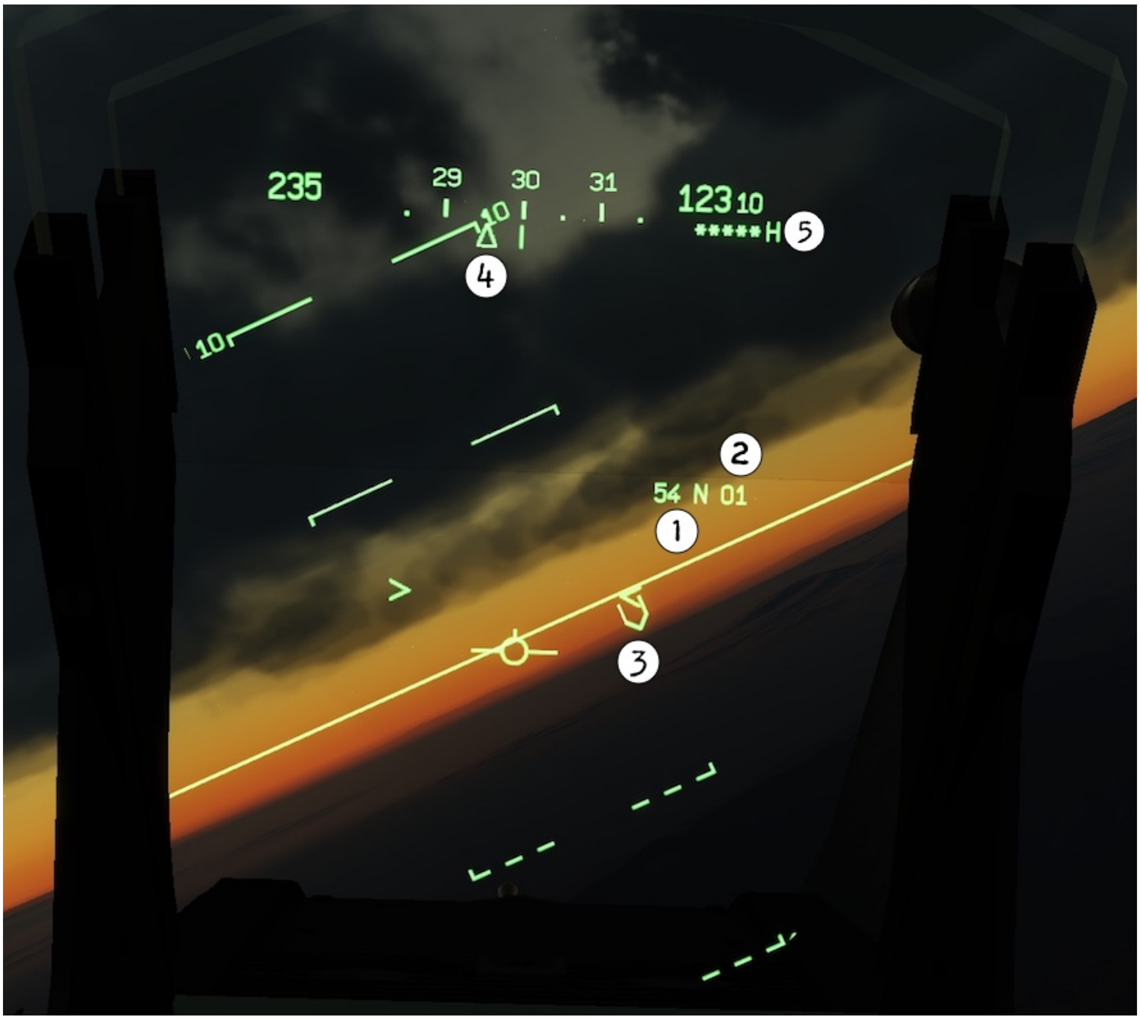
1. ACCELERATION / DECELERATION. Shows the longitudinal acceleration/ deceleration (Lx) in G unit.

2. MASTER CAUTION / WARNING. Visible if any of the Caution / Warning lights is still on. This symbol will also be visible in flight.

3. INVERTED T SIGN is a guide to take the correct take off pitch - if you put this symbol on the horizon, you are at 13° - which is the desired pitch for take off. It also helps getting the best aerobraking pitch when landing, while still avoiding tail strike.

NAV MODE

Navigation model (NAV) is the aircraft's default Master Mode. It displays navigation data and provide steer instructions as indicated by the INS.



1. Distance to Waypoint. Shows the distance to the currently selected waypoint in nautical miles.

CAUTION

Remember that the cross may be displaced in reference to the real geographical location due to the INS drift.

When the distance is below 4 nautical miles, the waypoint symbols will tend to drift. This is normal since it is a secondary effect of the large circle navigation calculations being made by the INS.

If the ENC button on the INS Panel is lit, the waypoint automatically changes to the next when distance is below 1.5 nautical miles. For more information, see section on Navigation.

NOTE

M-2000C navigation system by default will place the waypoint on the ground. If you want to have it displayed at specific altitude, you need to edit it yourself.

2. Waypoint number. Displays number of the currently selected waypoint.

3. Waypoint track angle error. Shows the course to the selected waypoint. It follows the height of the FPM in the HUD. There are two ways in which the Waypoint Track Angle Error can be displayed:

With the “house” pointing up and open bottom part: selected waypoint is in front of the airplane.

With the “house” pointing down and open top part: selected waypoint is behind the airplane.

When the distance to the waypoint is less than 10 nautical miles, the waypoint track angle error is substituted by a target cross which is placed at the exact geographical position of the waypoint.

NOTE

Waypoint Track Angle Error will only show on the HUD when the Landing Gear is in the UP position.

4. Current route. Current route (or course) of the aircraft.

5. Radar altimeter. Shows the altitude above the ground in feet. Asterisks will be displayed whenever the aircraft roll angle is higher than 20º or the altitude is higher than 5000 feet. It is not specific to the NAV mode and is available in all the modes.

APP MODE

The APP (Approach) mode is used - as the name implies - during approach and landing. It is a sub-mode of NAV, in which HUD displays the approach and ILS cues.

NOTE

In APP mode the CAS, HS and Zbi move from the top of the combiner glass down to the center. In APP mode it is necessary to move the seat up in order to increase the field of view.

The ILS-related cues of the APP mode rely on the correct settings of the ILS frequency on the VOR / ILS panel. See VOR AND TACAN for more information.

APP MODE BEFORE GLIDESLOPE CAPTURE

1. ANGLE OF ATTACK GUIDE. Indicates the optimum angle of attack for landing the aircraft. You must place both the FPM and the AV chevrons within the brackets for a perfect landing. The brackets represent an AOA value of 14° ± 0.5°.

NOTE	The analog AOA INDICATOR also has the AOA for landing zone marked in green.

2. LOCALIZER DEVIATION. Indicates the angle of deviation to the localizer signal. It is visible only after the localizer capture.

3. LOCALIZER SYMBOL. The open box symbol represents the localizer station position in the horizon. It moves laterally depending on the signal angle of deviation. It is only visible after the localizer is captured.

4. RUNWAY SYMBOL. Represents the position of the runway on the horizon.

5. ANGLE OF ATTACK READING. Displays current AOA value.

APP MODE AFTER GLIDESLOPE CAPTURE

1. ILS GUIDE. Visible only when both localizer and glideslope have been captured. It moves in relation to the FPM showing both glideslope and course deviation. To maintain a perfect approach, you have to place the FPM inside the box.

If the deviation from either glideslope or course is too large, a flashing triangle (not shown) will appear indicating that a course/elevation change is required.

2. SYNTHETIC RUNWAY. The synthetic runway symbol is an aid for locating the real runway, especially during low visibility conditions. It is only visible when:

a. The INS is on.

b. The airport is the current fly-to waypoint.

c. The runway data (heading and glideslope) were entered[2].

d. Both localizer and glideslope have been captured

e. The runway is less than 10 nautical miles away.

f. Lateral deviation is less than 7°.

The synthetic runway will be overlaid on top of the runway and the rectangle will grow as the distance to the runway decreases.

CAUTION

The green outline is not showing the place on the ground, but it "floats" a few feet above the runway. Make sure to keep that in mind during the final phase of approach and touch down.

The synthetic runway is removed from the HUD as soon as there is weight on the landing gear's wheels.

3. MARKER SYMBOL. The flashing "M" symbol is shown when the aircraft's system detects the airport's Outer, Middle and Inner markers.

4. RADAR ALTITUDE. Shown below the FPM if the radar altimeter is On and when the radar altitude is below the Decision Height value.

[2] Not functional at the moment, only possible by placing the "Landing" waypoint in the Mission Editor.

Suggestions for using the APP mode / ILS

Below you will find some tips for using the APP mode:

- Start your approach early, always ensure that you have enough space between you and the airfield.
- Make sure to check the runway heading and align yourself while still some distance away, that will save you a lot of abrupt maneuvers.
- Make sure that the airfield is set as your current DEST waypoint, that the ILS is properly set up and that your radar altimeter is on before commencing approach.
- The green dashed line will tell you where you should go in order to align yourself perfectly well. Imagine it as a line extending from the end of the runway - you want to cross it and turn towards it to intercept the proper runway heading.
- Pay close attention to your AoA. If it goes too high, the wing may generate more drag than the thrust available, making the aircraft sink faster.

NOTE: There is a separate Training Mission dedicated to using the IMC ILS landing. Use of ILS is also covered in the campaign.

CAUTION: You will notice that in the screenshot used above the shows a bad approach, with the aircraft too low in relation to the ILS glideslope.

Air to Air mode: General (Radar Lock)

1. Locked radar target. The square shows the position of the locked object. If your target is located outside the HUD, the square will become dashed and move to the left or right edge of the HUD, depending on the target position.

2. Attack Mode Data. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position), aircraft G load and aircraft AOA.

3. Interception Flight Director. Indicates the point towards where the target is flying and also the point where you should place your nose for gaining the best interception course. The Interception Director is not bound to any specific weapon and will appear for all Air-to-Air weapons. There is a special case for Air-to-Air guns, the Interception Director will be removed from the display as soon as the range to the target becomes less than 1200 meters, in order to prevent clutter in the HUD when the enemy aircraft is within gun range.

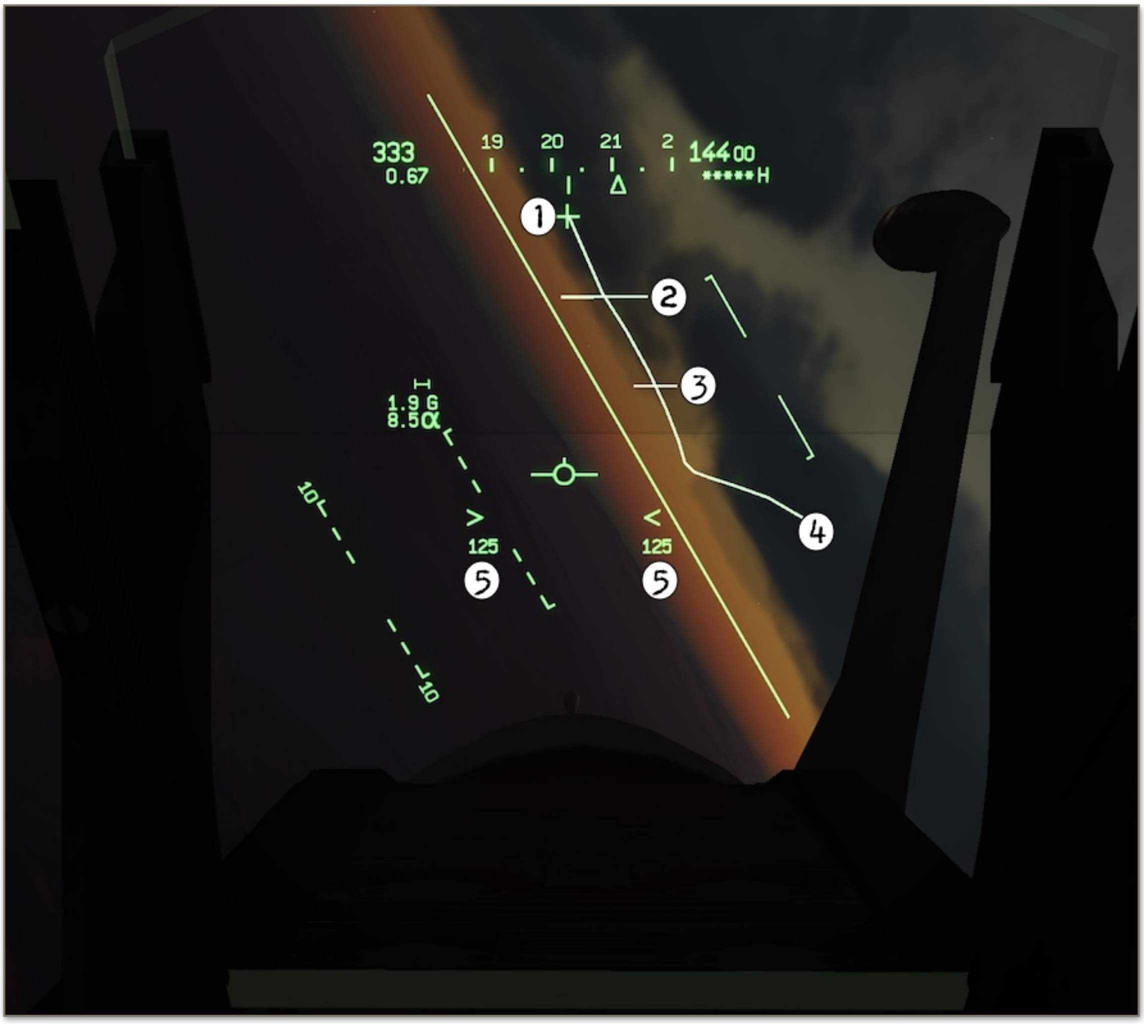
4. ASPECT RATIO. Shows the relative position between you and your target. Explained in more detail below.

Designation DOM above the number is a Magic II Domain. It warns you that your radar locked target is within the killzone of Magic II missile when you are in gun mode and have at least one Magic II missile left.

5. RANGE TO TARGET. Shows the distance to the currently locked target in nautical miles.

6. FLIGHT DIRECTION RING. Appears whenever you lock a target and the system is in AA or in POL modes. Used in conjunction with the Interception Flight Director - for the best shooting solution for missiles or quickest interception path to the target, you should place the Interception Flight Director inside the Flight Direction Ring.

AIR TO AIR MODE: GUN (NO RADAR LOCK)



1. GUN CROSS. Indicates the guns' boresight. It is placed on the conjunction of the HUD centerline and the aircraft's waterline. The boresight has a max range of 200 meters.

2. WINGSPAN MARKER (300 M) and 3. WINGSPAN MARKER (600 M). These lines are used to represent a target wingspan in order to help determine its range. The wingspan markers are not static and their width can be dynamically changed by using the ENV knob (ENV is short for *envergure*, wingspan in French). The ENV knob changes the wingspan marker width to represent a target from 7 meters up to 40 meters. The wingspan markers are visible only when there is no radar lock. See HUD PEDESTAL for more information.

4. BULLET PATH PREDICTION (GUN SNAKE). The gun snake shows the flying path of a stream of bullets fired. It has a max range of 1,000 meters (see below). The use of Gun Snake is described in more detail in GUN SNAKE USE.

5. AMMO COUNT. Shows the current count of 30 mm ammunition for each gun.

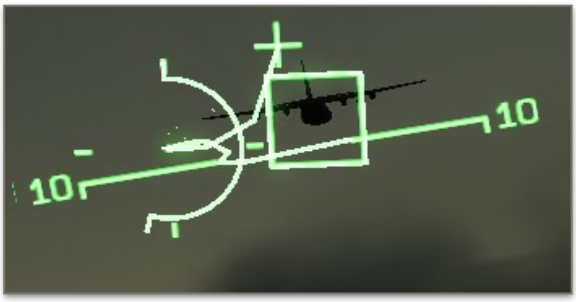
Air to Air mode: Gun (Target locked)

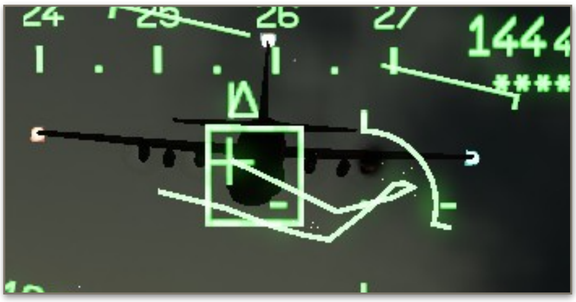
1. Gun Cross. Indicates the guns' boresight. It is placed on the conjunction of the HUD centerline and the aircraft's waterline. The boresight has a max range of 200 meters.

2. Bullet path prediction (Gun Snake). The gun snake shows the flying path that a stream of gun rounds would follow if they had been fired.. It has a max range of 1,000 meters (see below).

3. Radar gun piper. The radar gun piper gives the range to an air target that is locked with radar. It moves alongside the gun snake, indicating the exact position of the target in the bullet stream. Simply put the bandit on the path of the snake and under the piper and press the trigger.

The piper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 1200 meters. The 9 o'clock caret depicts the range of 900 meters, 6 o'clock of 600 meters and 3 o'clock of 300 meters.





4. LOCKED RADAR TARGET. The square shows the position of the locked object. When using IFF Interrogator, an "A" (*Ami* - Friend) will be displayed in the square for positive-response locked objets. If your target is located outside the HUD, the square will become dashed and move to the left or right edge of the HUD, depending on the target position.

5. RANGE TO TARGET. Shows the range from the currently locked target in nautical miles.

6. TARGET'S RELATIVE SPEED. Shows how fast the target is closing or gaining distance. Displayed in knots per hour, if the value is positive it means that this is the velocity with which you are closing to the locked aircraft. If it is negative, it gives the velocity with which it is getting away from you.

Gun snake use

The gun snake is an air gunnery targeting help. It depicts the path that a stream of gun rounds would follow if they had been fired. The "tail" of the snake is located at the gun cross. The "head" of the snake ends at the 1000 meter range.

To hit a target you must put the gun snake alongside its flight path. You must take care of placing the target at the correct snake position based on its range. The closer to the gun cross, the lower the range.

The wingspan markers are helpers to determine target range without the use of radar. When you manage to place a target's silhouette on the wingspan markers you can calculate a range approximation based on how wide the target is versus the wingspan marker's width. As you can see, a basic precondition is that you must know the approximate wingspan of your target and to adjust the wingspan marker to that value.

Once you have determined range to target, you place the target at the snake position where a hit is assured.

If you are using radar and your target has radar lock, the wingspan markers are replaced by the radar gun piper. The radar gun piper makes the gunnery easier by indicating the place in the gun snake where a hit is certain. You only have to put your target on the spot in the snake marked by the radar gun piper.

***

Air to Air mode: Missiles (S530)

1. Available missiles. Indicates how many missiles are available. G = Left (Gauche) and D = Right (Droit). The letter disappears when the corresponding missile has been fired. The number above shows the estimated time of flight of the missile to its target and will count down from that value after the missile is shot.

NOTE

If there are two missiles of the same type mounted under one wing, the corresponding letter will disappear when both are fired.

2. Selected weapon. Circle around the letter indicates which missile is ready to be fired. By default, the system selects the missile on the side of the locked target, but this order can be changed in the Armament Configuration Panel.

3. Relative position of the target. Shows relative position between your aircraft and the locked plane. See Weapons Sectionfor details.

4. RANGE TO TARGET. Shows the distance to the currently locked target in nautical miles. The three carets visible on the vertical line show (from top to bottom):

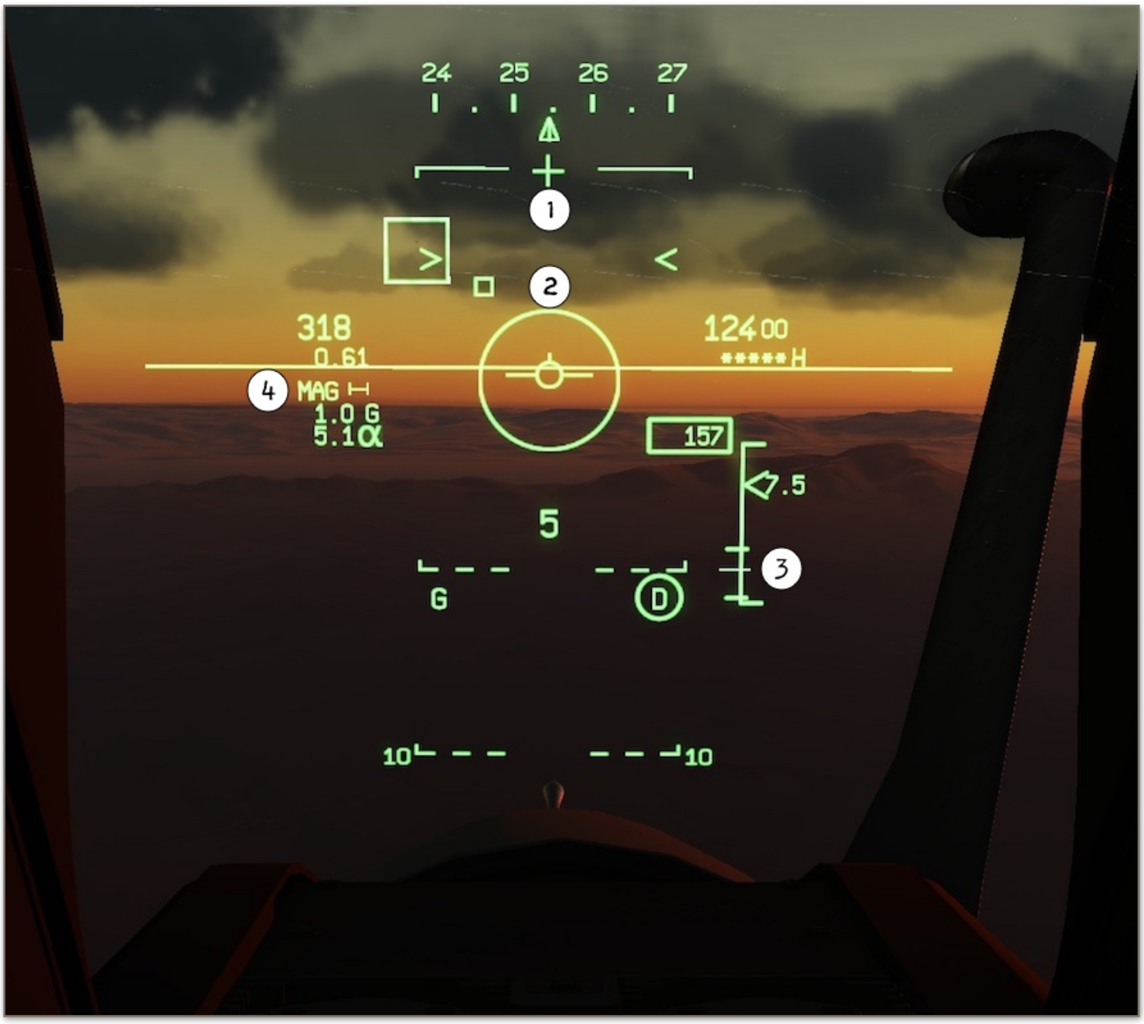
- The maximum range
- No Escape Zone range
- Minimum range

5. LOCKED TARGET and INTERCEPTION FLIGHT DIRECTOR (described earlier).

6. FLIGHT DIRECTOR RING (described earlier). When locked target enters no-escape zone for the selected missile, a second ring around the Flight Director will appear to indicate that you have the best firing solution:

The picture above shows the Flight Director Ring with the locked target within the No Escape Zone - at range of 6.7 Nm for S-530. Please note the double Flight Director ring. The closing velocity is 639 knots per hour. A command TIR (SHOOT) is displayed below it. Pilot still has two missiles left and at current range it would take them 21 seconds to reach their target.

Air to Air mode: Missiles (MAGIC II)



Most of the indications with Magic II missiles selected are exactly the same as for the Super 530, with the following differences:

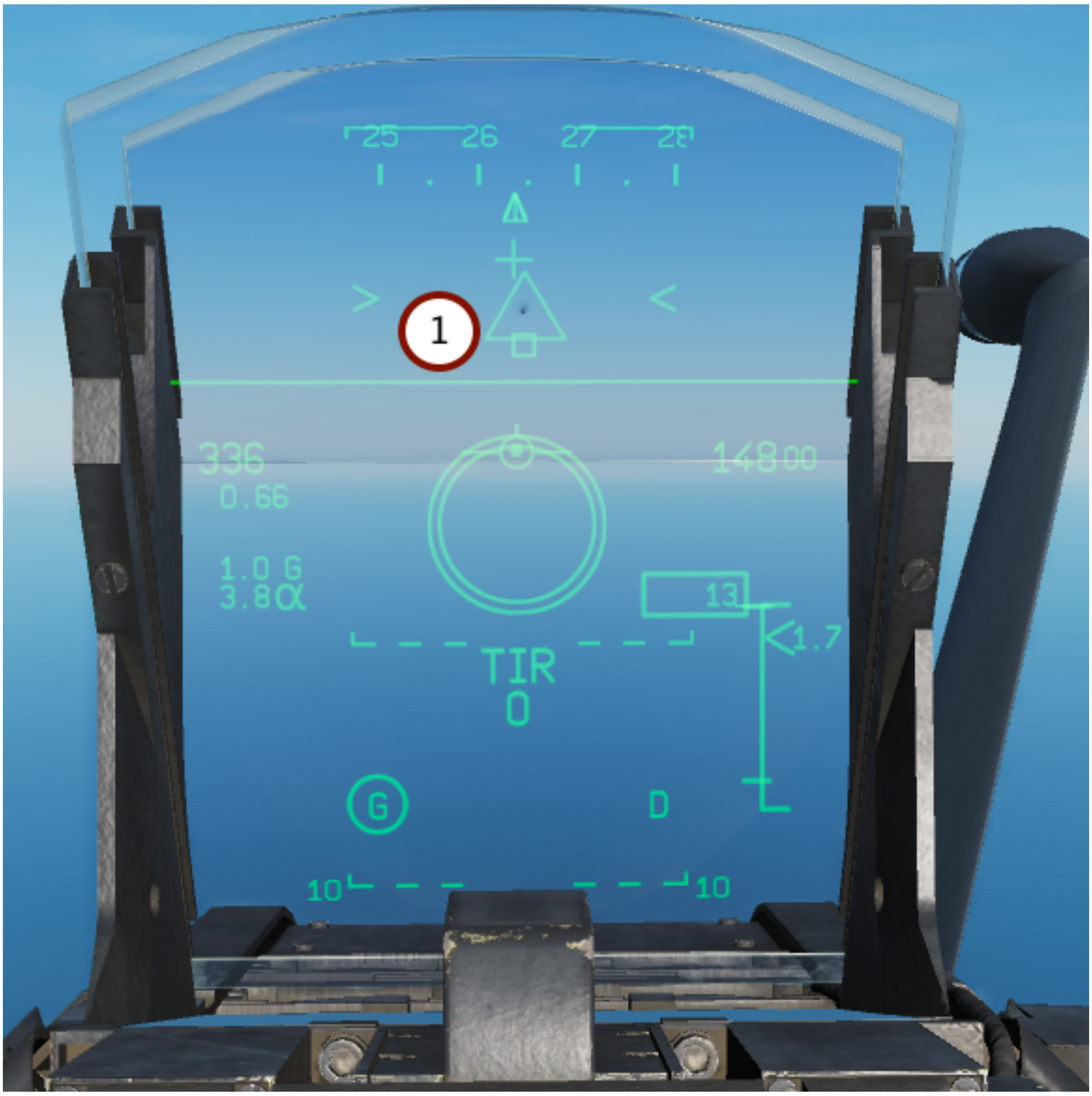
1. Gun cross. Only available when Magic IIs are selected. This is the aiming point for the Magic II missiles - in other words to successfully lock the target, you need to place it underneath the gun cross.

2. Flight Director Ring. Contrary to many other aircraft, it is not used to attain the lock in M-2000C (as stated above, you use gun cross for that). Also, the seeker for Magic II missile is not visible until you get a solid lock. The same is true for the growling sound - it can only be heard after acquiring a lock and not during the search phase.

3. Range to target. Maximum, No Escape Zone and Minimum range cues are clearly visible.

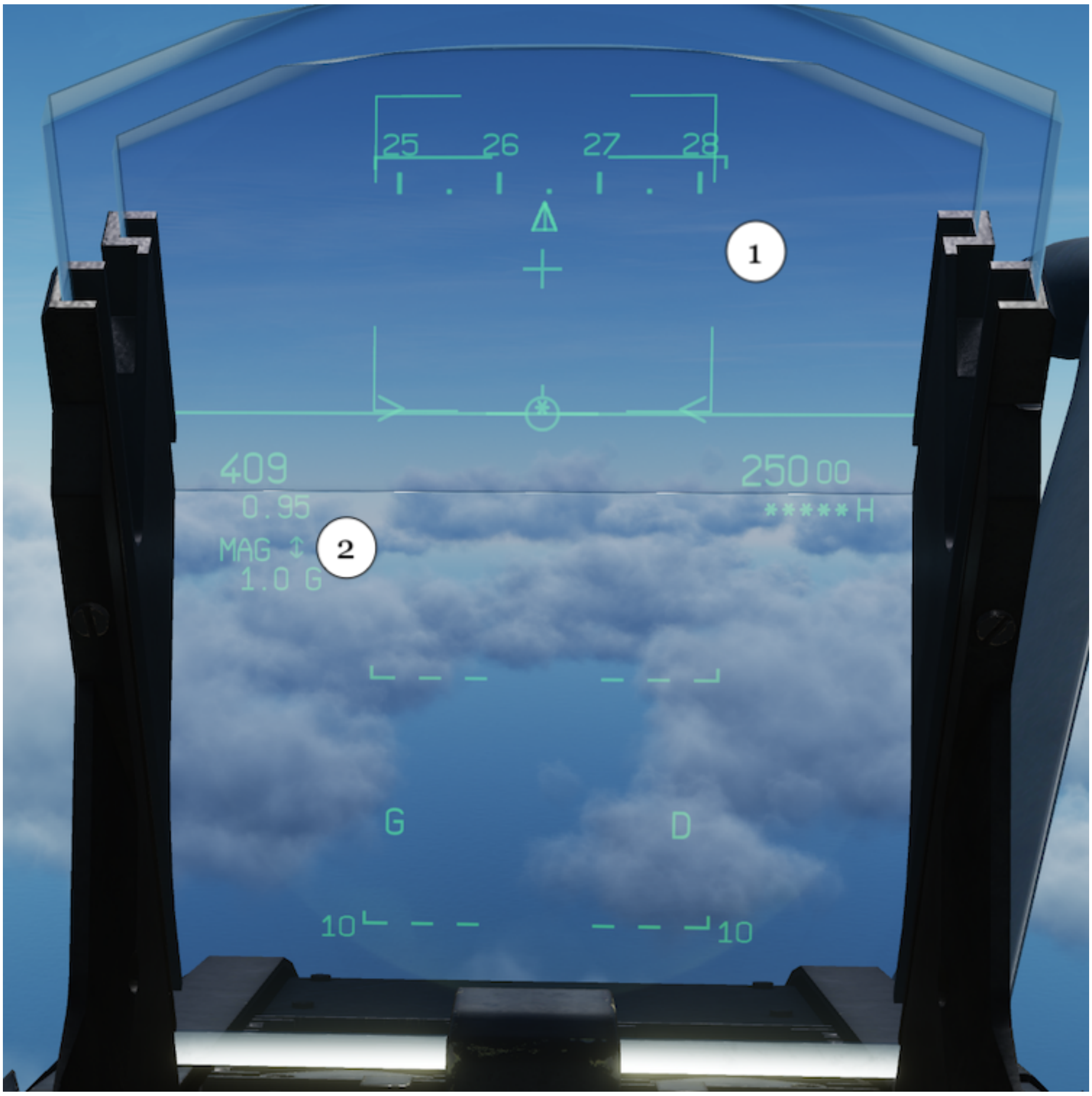
4. Attack mode data. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft AOA.

Air to Air mode: Missiles (MAGIC II) with Radar Lock



1. Radar / Magic lock indicator. When Magic II locks on the same target that the radar is currently locked on, the square (radar lock) and circle (magic lock) are replaced with a triangle. The missile will follow the locked target.

AIR TO AIR MODE: MISSILES (MAGIC II) VERTICAL NARROW SEARCH



1.VERTICAL NARROW SEARCH BOX . It is a 6° wide x 6° tall box centered around the gun cross, which is similar to the radar SVI Scan. A box is displayed indicating the HUD area where the MAGIC II seeker is searching and is removed upon missile lock.

2. VERTICAL / HORIZONTAL SEARCH INDICATOR. Denotes current general search mode of the MAGIC II missiles - either vertical or horizontal. See AIR TO AIR MODE: MAGIC II MAV SEARCH for more information.

Air to Ground mode: Gun / Rockets

1. Ammo count. Displays the current count of 30mm ammunition or 68 mm SNEB rockets.

2. Attack mode data. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft AOA. For rockets a RK abbreviation will be visible. For guns, CAS will be displayed.

3. Range to ground. Displays the current slant range to the ground at the point the piper is aiming. For more information, refer to the Weapons Management Section.

4. Gun/Rocket piper. Indicates the point in the ground where the gun shells/ SNEB rockets will hit. The aiming point is continuously calculated by the ballistics computer. For more information, refer to the Weapons Management Section.

As in the AA mode, the piper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 2400 meters. The 9 o'clock caret depicts the range of 1800 meters, 6 o'clock of 1200 meters and 3 o'clock of 600 meters.

5. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

***

AIR TO GROUND MODE: BF (CCIP)

1. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

2. RANGE TO GROUND. Displays the current slant range to the ground at the point the piper is aiming. For more information, refer to the Weapons Management chapter.

3. ATTACK MODE DATA. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position), aircraft G load and aircraft AOA.

4. "RADAR OFF" INFORMATION. Displayed if the main radar is set to any mode other than "ON" and it is impossible to compute the slant range to the ground.

5. MINIMUM RELEASE ALTITUDE CUE. Indicates the minimum altitude at which bomb release is safe. It moves from the CCIP piper to the FPM. If the cue reaches

the FPM, it is not safe to release the bombs since there is a high probability of taking damage from their detonation and a large green cross appears in the HUD (see next fig.). For more information, refer to the WEAPONS MANAGEMENT SECTION.

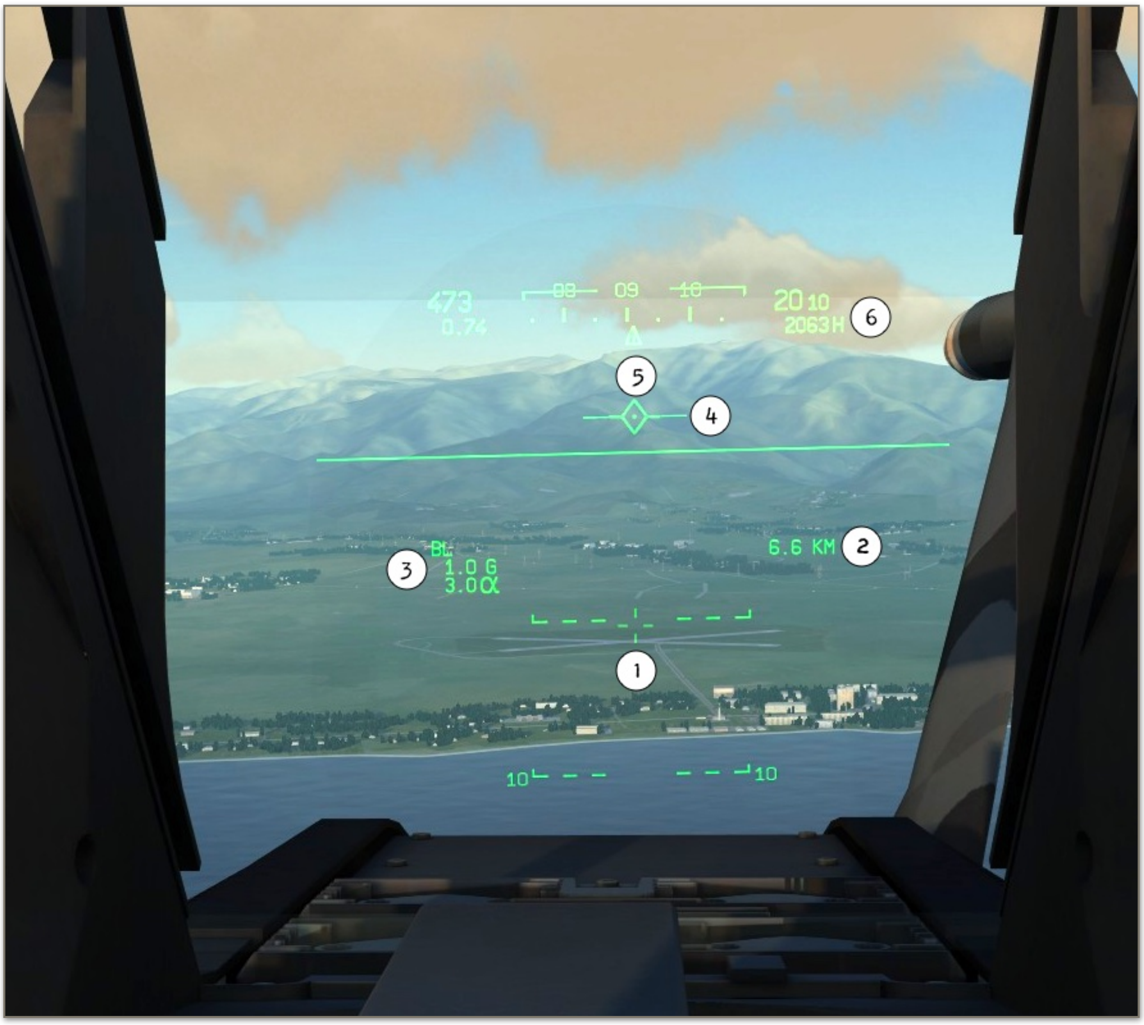
6. BOMB FALL LINE (BFL). Displays the path that the bombs will follow upon release.

1. RELEASE NOT SAFE MARKER. Shows on the HUD whenever the Minimum Release Altitude Cue reaches the FPM and indicates that the delivery at current parameters will not be safe.

2. RANGE TO GROUND. As the radar is ON, this time the slant range from the airplane to the point directly underneath the piper is being shown.

3. CCIP PIPPER. Aiming point where the bombs will impact. For more information about the CCIP bombing procedures, please refer to the WEAPONS EMPLOYMENT section.

AIR TO GROUND MODE: BL (CCRP)



1. TARGET CROSS. Shows the desired point of impact/target position (as designed by the pilot using the dedicated control).

2. RANGE TO TARGET. Indicates slant range to the target position.

3. ATTACK MODE DATA. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft AOA.

4. CCRP STEERING CUES. They appear only after a target point has been selected. They are centered on the CCRP piper and rotate to show deviation from the course to target. The aircraft is flying directly to the target when they are level.

EXAMPLE OF ALMOST PERFECT ALIGNMENT

EXAMPLE OF MIS-ALIGNMENT

5. CCRP PIPER. It remains at a fixed point and replaces the FPM when in CCRP mode. Before target selection, it is used to select a point in the ground as the target. After target selection, it is used to give the bomb release order.

6. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

***

AIR TO GROUND MODE: CCRP JUST PRIOR TO RELEASE

1. RELEASE CUE. The release cue moves from the target cross towards the CCRP piper. The bomb(s) must be released when the cue is at the center of the piper. The cue is time based and appear when time to target is 15 second.

AUXILIARY GUNSIGHT MODE

The auxiliary gunsight is selected by the pilot. It is available in all modes except Approach. The gunsight is fixed in the horizontal plane but can be moved in the vertical plane to accommodate gun deflection based on ballistic tables for the desired range. The deflection can be modified from 0 to 300 mils.

1. AUXILIARY GUNSIGHT. To activate it, click on the HAUSSE SWITCH located on the right side of the HUD control panel.

2. ANGLE OF DEFLECTION VALUE. To modify the deflection click on the HAUSSE KNOB located on the right side of the HUD control panel, to the right of the HAUSSE switch.

CLOSE COMBAT MODES

See WEAPONS Section for details.

SECTION 11

WARNING SYSTEM

MASTER CAUTION LIGHTS

Located at the Top left of the main instruments panel. Consists of two lights: One Amber for cautions and one Red for warnings.

It is directly linked with the Alarm Lights Panel, described in detail on the following pages.

CAUTIONS

When caution occurs:

- Master Caution light: On
- Audio warning (see note below): On
- System specific light on the alarm panel: On

When pilot acknowledges caution (by pressing MASTER button)	When caution is no longer valid
Master Caution light: Off	Master Caution light: Off
Audio warning: Off	Audio warning: Off
System specific light on the alarm panel: On	System specific light on the alarm panel: Off

NOTE

Note on audio warning: No warning will be heard when the caution occurs, but a double chime will be heard after the initial 20 seconds then every 3.5 seconds until the caution is acknowledged or no longer valid.

WARNINGS

When failure occurs:

- Master Warning light: On
- Audio warning (continuous): On
- System specific light on the alarm panel: On

When pilot acknowledges failure (by pressing MASTER button)	When failure is no longer valid
Master Caution light: Off	Master Caution light: Off
Audio warning: Off	Audio warning: Off
System specific light on the alarm panel: On	System specific light on the alarm panel: Off

ALARM LIGHTS PANEL

The alarm lights panel works in conjunction with the Master Warning and Master Caution lights. Like the Master Warning and Master Caution they are divided in two colours, Amber for CAUTIONS and Red for WARNINGS.

In this case, each individual light indicates the specific system/subsystem that is affected by the failure/anomalous condition. The light remains On for as long as the caution / warning condition exists.

You will find description of all the warning lights at the next page with references, where appropriate, do different sections of the manual.

Designation	Description	More information
BATT	Main Battery is disconnected or it has failed	3-1 Electrical Sys.
TR	Main or Aux Transformer is disconnected or has failed	3-1 Electrical Sys.
ALT 1	Alternator no.1 is disconnected or has failed	3-1 Electrical Sys.
ALT 2	Alternator no.2 is disconnected or has failed	3-1 Electrical Sys.
HUILE	Low oil pressure	2-1 Engine
T7	Engine T7 temperature is above 800º Celsius.	2-1 Engine
CALC	Engine Controller functionality compromised	2-1 Engine
SOURIS	Engine Inlet Cones Automatism failure; also triggered if forced retracted by the R position or the SOURIS switch	2-1 Engine
PELLE	Engine intakes Scoops Automatism failure; also triggered if forced retracted by the R position or the PELLES switch	2-1 Engine
BP	Low fuel pressure, the engine is not correctly fed	4-1 Fuel System
BP. G	Left (*Gauche*) fuel pump is off	4-1 Fuel System
BP. D	Right (*Droite*) fuel pump is off	4-1 Fuel System
TRANSF	Fuel transfer has stopped - no usable fuel or fuel jettison in progress	4-1 Fuel System
NIVEAU	Remaining fuel is below 500 kg	4-1 Fuel System
HYD. 1	Hydraulic System 1 pressure is below 195 bars	5-1 Hydraulics
HYD. 2	Hydraulic System 2 pressure is below 195 bars	5-1 Hydraulics
HYD. S	Hydraulic System 2 pressure is below 140 bars or Emergency Pump switch is set to OFF.	5-1 Hydraulics
EP	Emergency Pump is active for more than 6 seconds.	5-1 Hydraulics
BINGO	Remaining fuel is below the set BINGO level	4-1 Fuel System
P. CAB	Canopy not sealed or cabine pressure > 30,000 ft.	
TEMP	Overheat in avionics compartment; NOT FUNCTIONAL	
REG. O^2	ECS Oxygen regulator fault; NOT FUNCTIONAL	
5mn.O^2	Only 5 minutes of oxygen supply remaining	
O^2HA	Not used	
ANEMO	Air Data Sensors heating is disabled / not working.	
CC	DC Low Voltage; DC Sec. bus automatically switched Off; expect only 30 minutes of DC remaining from the warning.	3-1 Electrical Sys.
DSV	Engine ByPass ratio slats fault; NOT FUNCTIONAL	

CONDIT	ECS Heat Exchanger overheat; NOT FUNCTIONAL	
CONF	FBW A/A - Charges Mode switch is in the wrong position	6-2 Fly By Wire
PA	Problem with the autopilot system	7-1 Autopilot
MAN	Flight Controls single failure on a multi-redundant system, restricting the maneuverability (*manoeuvrabilité*)	6-1 Mobile Surfaces
DOM	Flight Controls dual failure on a multi-redundant system or on an actuator, restricting the flight envelope (*domaine de vol*)	6-1 Mobile Surfaces
BECS	Slats functionality has been compromised	6-1 Mobile Surfaces
U.S.EL	Last Emergency enabled for elevons (*Ultime Secours Elevons*)	6-1 Mobile Surfaces
ALPHA	Angle of Attack sensors fault (incoherent values or total failure)	9-2 Flight Instr.
GAIN	FBW automatic gains calculation failure and/or fixed emergency gains mode enabled	6-2 Fly-by-Wire
RPM	Engine Low RPM alarm	2-1 Engine
DECOL	Take - off configuration incorrect (not all the required checks performed / systems on)	
PARK	Parking brake is engaged	

SECTION 12

INS

THE INERTIAL NAVIGATION SYSTEM (INS)

The INS is the heart of the M-2000C navigation system. It allows the aircraft to know its position in the world and to plot a course to a geographical point.

The INS can store the following information:

- 20 navigation waypoints (defined by their latitude, longitude and altitude) and its associated data:
  - Offset waypoint (delta latitude, delta longitude and delta altitude).
  - Runway magnetic heading (QFU).
  - Runway approach glideslope (PD – *Pente Désirée*).
  - Desired arrival time (TD – *Temps Désiré*).
  - Desired arrival track (RD – *Route Désirée*).
- 3 mark points with geographic coordinates along with the mark time.
- The magnetic declination

The INS provides the following information:

- Aircraft geographical position (Latitude and Longitude).
- Horizontal components (Vx, Vy) of the inertial speed.
- Ground Speed.
- Ground Track.
- Direction and Strength of the Wind.
- True Heading.
- Magnetic Heading.
- Acceleration components (Ax, Ay, Az).
- Bearing and distance to a waypoint.
- Track error.
- Magnetic lateral deviation from desired track.
- Track error from desired track.
- Approach glideslope.
- Remaining time to reach waypoint.
- Time difference between remaining time and desired arrival time in order to maintain a constant speed.
- The aircraft load factor.

The INS is controlled from two dedicated panels in the cockpit:

THE POSTE DE COMMANDE NAVIGATION PCN (Navigation Control Panel)

THE POSTE SÉLECTEUR DE MODES PSM (Mode Selector Panel)

The INS controls the information displayed in the following instruments:

- HUD: Aircraft heading, attitude and current waypoint navigation.
- HDD: Aircraft heading, attitude and waypoint position, including bullseye.
- ADI: Aircraft heading, attitude and ILS needles.
- HSI: Aircraft heading, Double needle and DME window (the last two in Cv NAV or Cm NAV modes only).
- PCN: See The PCN chapter.

INS OPERATING PRINCIPLE

The INS is an autonomous navigation system that requires no external systems (VOR beacons, GPS satellites...) to operate. Based on a start position (the exact latitude / longitude and altitude of the starting point needs to be known) and using a very complex set of sensors and gyroscopes it keeps track of the aircraft movement in space and calculates in a continuous manner the current position, route and speed.

The INS is not a perfect tool, however, and suffers from integration drift - accumulated small errors in its velocity and acceleration measurements. As a rule of thumb, the accuracy will degrade by one mile for each hour of flight for a fully aligned (class 1) INS. This can be corrected by performing an INS position update (see INS POSITION UPDATE).

MODE SELECTOR PANEL (PSM)

The PSM is the control panel for both the PCN and the INS and is responsible for for controlling the INS operation.

1. OPERATING MODE SELECTOR KNOB. It has 8 different positions:
   - **AR** (*Arrêt*): Turns Off both the INS and the PCN
   - **VEI** (*Veille*): The gyros remain off but the system is powered and thermal regulation is on. The PCN is available for data entry.
   - **CAL** (*Calibration*): Reserved for maintenance.
   - **TST** (*Test*): Reserved for maintenance.
   - **ALN** (*Alignement normal*): Normal INS alignment procedure. (See INS ALIGNMENT for more information)
   - **ALCM** (*Alignement sur cap mémorisé*): Memory INS alignment procedure . (See INS ALIGNMENT for more information).
   - **NAV** (*Navigation*). Normal operating mode.
   - **SEC** (*Secours*): Emergency operation, the INS provides only gyroscopic information (attitude and heading).
2. DATA CARDRIDGE SLOT. Used by the ground crew or the pilot to insert information regarding the flight plan etc.
3. THE PCN OPERATIONAL MODE. It has 5 different positions:
   - **N** (*Normal*): Default position.
   - **STS** (*Status*): The PCN display the current INS alignment status.
   - **DCI** (*Données Codées Inertielles*): Inertial Codes Input. Used to visualize or enter certain paremeters into the INS memory.
   - **CRV** (*C/R de vol*): Used for maintenance only.
   - **MAIN** (*Maintenance*): used for maintenance only

NAVIGATION CONTROL PANEL (PCN)

The PCN (*Poste de Commande Navigation*) is responsible for the interface between the pilot and the INS. It is the main tool used for navigation, creating waypoints and displaying different flight parameters, including those for waypoints current aircraft position.

The main functions of the PCN are as follows:

- Visualization of the navigational data in the memory of the INS;
- Data input into the memory of the INS;
- Visualization of the INS alignment status;
- Control of saved points, register and offset waypoints as well as markpoints.

Below you will find description of all the displays and buttons:

1. UPPER LEFT LCD DISPLAY. 6 digits with identification symbols N, S, + and –. Used for displaying numerical data like latitude, altitude in feet etc.

2. UPPER RIGHT LCD DISPLAY. 7 digits with identification symbols E, W; + and –. Used for displaying numerical data like longitude, altitude in meters etc.

3. LOWER LEFT LDC DISPLAY. Contains PREP Window on the left with 2 digits indicating the current waypoint for data entry/visualization. Also, DEST Window on the right, with 2 digits indicating the current waypoint used for navigation. The data for this waypoint is displayed in the HUD, VTB, HSI and ADI.

NOTE

There is a separate, red 2 digit display between PREP and DEST used during data input. It tells you how many numbers you have already entered into the system (out of 6 available on upper left and 7 available in upper right display).

4. STATUS LIGHTS. Light up when specific conditions are met .

• **PRET** (green): INS is ready.

• **ALN** (yellow): INS is aligning

• **MIP** (yellow): A data cartridge has been inserted. Not used.

• **N.DEG** (yellow): The INS is degraded and needs alignment.

• **SEC** (yellow): The INS is in emergency mode

• **UNI** (red): The INS is damaged.

• **M91**, **M92**, **M93** (green): Indicate mark points being used.

5. FUNCTION KEYS. These are seven function keys used for choosing different modes of operation or approving certain actions.

• **PREP** (*Préparation*): Selects the waypoint to be modified or whose data will be displayed on the PCN.

• **DEST** (*Destination*): Selects the waypoint to be used for Navigation.

• **BAD** (*But Additionnel*): Selects the OFFSET waypoint as destination.

• **REC** (*Recalage*) Triggers or cancels the INS position update process (vertical mode).

• **MRQ** *(Marquage)*: Marks a geographical position.

• **VAL** (*Validation*): Used to validate alignment, position update and mark data.

The specific use of the buttons will be described later in separate sections of the manual.

6. NUMERIC KEYPAD. Used to enter data into the INS. Consists of:

• 10 numeric keys, from 0 to 9. Including keys to designate North, South, East, West, + and -.

• **EFF** (*Effacement*) key: Clears the input errors in the system.

• **INS** (*Insertion*) key: Enters the data in the system.

7. PARAMETER SELECTOR KNOB. Used to choose what data will be displayed on the LCD displays. There are three types of data: coordinates, signed values (needing plus or minus sign) and unsigned values. See DATA SELECTION part for more information.

8. LIGHT INTENSITY KNOB. Used to increase or decrease the brightness of the function keys, as well as EFF and INS keys on numeric keypad.

NOTE

The intensity of the backlight of the whole PCS is governed by the knob on the Interior Lights Panel.

PCN UTILISATION

The PCN is your main tool used for navigating, creating and modifying waypoints, using mark points or getting specific information about your current position, altitude, heading, speed etc. For more information about practical use of different functions (like waypoints) please refer to Section 12 - 5 (NAVIGATING THE M-2000C).

DATA SELECTION

To select the data to be displayed in the PCN you only have to click on the 11 position rotary knob. There are three types of data: coordinates, signed values (needing plus or minus sign / N - S - E - W) and unsigned values. Below the table containing the summary for each of the positions. You will find more details on the following pages.

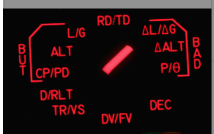
DATA SELECTION SUMMARY

	EN Name	FR Name	Type	Signed Unsigned	WP 0	WP 1+
RD/TD	Desired Time and Route	Route Désirée / Temps Désiré	CAN BE EDITED	UNSIGNED	YES	YES
ΔL/ΔG	Setting Offset Point by LAT / LONG difference	-	CAN BE EDITED	SIGNED	NO	YES
Δ ALT	Setting Offset Point by ALTITUDE difference	-	CAN BE EDITED	SIGNED	NO	YES
ρ/θ	Setting Offset Point by polar RHO / THETA	-	CAN BE EDITED	UNSIGNED	NO	YES
DEC	Magnetic Variation	Déclinaison magnétique	READ ONLY	SIGNED	YES	YES
DV/ FV	Wind Direction / Speed	Direction / Force du vent	READ ONLY	UNSIGNED	YES	YES
TR/ VS	Remaining Time / Ground Speed	Temps Restant / Vitesse Sol	READ ONLY	UNSIGNED	YES	YES
D/ RLT	Distance and Bearing	Distance / Relèvement	READ ONLY	UNSIGNED	YES	YES
CP/ PD	Runway Heading / Glideslope	Cap vrai de piste / pente désirée au but	CAN BE EDITED	UNSIGNED	NO	YES
ALT	Waypoint Altitude	Altitude	CAN BE EDITED	SIGNED	YES	YES
L / G	Waypoint Latitude / Longitude	Latitude / Longitude	CAN BE EDITED	SIGNED	YES	YES

BAD (Offset Point - *Secteur But Additionnel*)

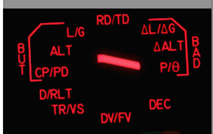
Following four positions are used for preparing and using Offset Points.

RD / TD	Desired Time and Route (*Route Desiree / Temps Desire*)				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Ground Track (in degrees)	Min. 0 Max. 359.9	INS Chronometer (minutes, seconds)	Min 0 Max 399.9
	Descr.	The Ground Track gives you the exact current heading of your aircraft. INS Chronometer measures time since powering up the INS.			
CAN BE EDITED	**WP 01+**	Selected Bearing (in degrees)	Min. 0 Max. 359.9	Selected Time (minutes, seconds)	Min 0 Max 399.9
UNSIGNED VALUE	**Descr.**	Selected Bearing allows you to arrive at the given waypoint from the predefined bearing. NOT FUNCTIONAL Selected Time allows you to arrive at the given waypoint at a predefined moment in time.			
More information		See DESIRED TIME ON TARGET function in Navigating the M-2000C Section for more information.			
Notes					

ΔL/ΔG	Setting Offset Point by LAT / LONG difference				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	N/S —.--.--	Not used	E/W ---.--.--
	Descr.	Offset cannot be set for Waypoint 0.			
CAN BE EDITED	**WP 01+**	WP Offset Latitude (in meters)	N/S max 99 997	WP Offset Longitude (in meters)	E/W max 99 997
SIGNED VALUE	**Descr.**	Enables you to set the targets coordinates using the distance in meters from the selected waypoint to the North / South for Delta-L and East / West for Delta-G.			
More information		See OFFSET POINTS in Navigating the M-2000C Section for more information.			
Notes		The use of meters/kilometers here is to help for exchanges with ground forces using those units.			

BAD (continued)

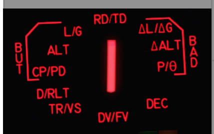
Δ ALT	Offset Point ALTITUDE difference				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	± -- ---	Not used	± - ---
	Descr.	Offset cannot be set for Waypoint 0.			
CAN BE EDITED	**WP 01+**	Offset Altitude difference (in feet)	+/- max 24 999	Offset Altitude difference (in meters)	+/- max 7 619
SIGNED VALUE	**Descr.**	Used to set the difference between the waypoint altitude and the offset point altitude.			
More information		See OFFSET POINTS in Navigating the M-2000C Section for more information.			
Notes					

ρ/θ	Setting Offset Point by polar RHO / THETA				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	+ --.--	Not used	---.-
	Descr.	Offset cannot be set for Waypoint 0.			
CAN BE EDITED	**WP 01+**	WP Offset distance (in nautical Miles)	min 0.01 max 53.99	WP Offset Bearing (in degrees)	min 0.0 max 359.9
UNSIGNED VALUE	**Descr.**	Introduced in the similar way to the bullseye calls, where RHO is the distance from the waypoint in nautical miles, and THETA the true North bearing.			
More information		See OFFSET POINTS in Navigating the M-2000C Section for more information.			
Notes		If you enter value higher than maximum, the data in left and right LCD will revert to previous value.			

OTHER PARAMETERS

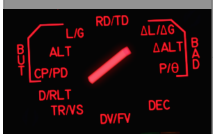
Used solely for visualisation of certain flight parameters.

<table>
<tr><th>DEC</th><th colspan="5">Magnetic Variation (Declination)</th></tr>
<tr><td rowspan="3">
</td><th>Mode</th><th>Left LCD Description</th><th>Display</th><th>Right LCD Description</th><th>Display</th></tr>
<tr><th>WP 00</th><td>Magnetic variation (in degrees)</td><td>+/- 99.9</td><td>Not used</td><td>blank</td></tr>
<tr><th>Descr.</th><td colspan="4">Displays magnetic variation in degrees between the True and Magnetic North.</td></tr>
<tr><td>READ ONLY</td><th>WP 01+</th><td>Magnetic variation (in degrees)</td><td>+/- 99.9</td><td>Not used</td><td>blank</td></tr>
<tr><td>SIGNED VALUE</td><th>Descr.</th><td colspan="4">Displays magnetic variation in degrees between the True and Magnetic North.</td></tr>
<tr><td colspan="2">More information</td><td colspan="4">See IDN (HSI) in Navigating the M-2000C Section for more information.</td></tr>
<tr><td colspan="2">Notes</td><td colspan="4">If you enter value higher than maximum, the data in left and right LCD will revert to previous value. The magnetic variation should be editable but this is currently NOT FUNCTIONAL</td></tr>
</table>

<table>
<tr><th>DV / FV</th><th colspan="5">Wind Direction / Speed (Direction / Force du vent)</th></tr>
<tr><td rowspan="3">
</td><th>Mode</th><th>Left LCD Description</th><th>Display</th><th>Right LCD Description</th><th>Display</th></tr>
<tr><th>WP 00</th><td>Wind direction (in degrees)</td><td>min 0 max 359.9</td><td>Wind speed (in knots)</td><td>min 0 max 999</td></tr>
<tr><th>Descr.</th><td colspan="4">Displays current direction and speed of the wind.</td></tr>
<tr><td>READ ONLY</td><th>WP 01+</th><td>Wind direction (in degrees)</td><td>min 0 max 359.9</td><td>Wind speed (in knots)</td><td>min 0 max 999</td></tr>
<tr><td>UNSIGNED VALUE</td><th>Descr.</th><td colspan="4">Displays current direction and speed of the wind.</td></tr>
<tr><td colspan="2">More information</td><td colspan="4">N/A</td></tr>
<tr><td colspan="2">Notes</td><td colspan="4"></td></tr>
</table>

OTHER PARAMETERS (continued)

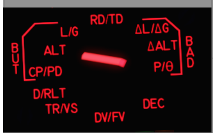
TR / VS	Remaining Time / Ground Speed (*Temps Restant / Vitesse Sol)*				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	Blank	Ground Speed (in knots)	min 0 max 1990
	Descr.	In WP 0 mode shows only current Ground Speed in the right window. Left window remains blank.			
READ ONLY	**WP 01+**	Remaining time to WP (in minutes, seconds)	min 0 max 719.59	Ground Speed (in knots)	min 0 max 1990
UNSIGNED VALUE	**Descr.**	Displays remaining time to go to reach current PREP waypoint or offset point (based on current speed). Right window shows current Ground Speed.			
More information		N/A			
Notes		Ground speed is the only available speed value that is not affected by altitude, air density etc. Therefore it is especially useful if mission briefing gives you ground speed of other assets, like tankers or planes you are required to escort.			

D / RLT	Distance and Bearing (*Distance / Relevement)*				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	Blank	True Heading (in degrees)	min 0.0 max 359.9
	Descr.	In WP 0 mode right window shows your True Heading in degrees. Left window remains blank.			
READ ONLY	**WP 01+**	Distance to WP (in minutes, seconds)	min 0 max 409.60	Bearing to WP (in degrees)	min 0.0 max 359.9
UNSIGNED VALUE	**Descr.**	Displays the distance in nautical miles and bearing to PREP waypoint or its offset waypoint.			
More information		See IDN (HSI) in Navigating the M-2000C Section for more information.			
Notes		N/A			

BUT (Waypoint - *Secteur But*)

Used for visualisation or changing / setting up Waypoint parameters. The INS can store 20 waypoints (01 to 20), that can be edited at any moment (on-ground or in flight). They are defined by the following parameters:

CP / PD	Runway Heading / Glideslope (*Cap vrai de Piste / Pente Désirée au but)*				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Not used	+ —.-	Not used	+—.-
	Descr.	Cannot be set for Waypoint 0.			
CAN BE EDITED	**WP 01+**	Runway Heading (in degrees)	min 0.0 max 359.9	Runway Glideslope (in degrees)	min 0.1 max 90.0
UNSIGNED VALUE	**Descr.**	The CP / PD displays the runway heading in the left and runway glideslope in the right window. You can also insert this data manually,			
More information		N/A			
Notes		Landing airfield has to be set as a last waypoint in the flight plan in order to work for the ILS. Currently NOT FUNCTIONAL			

ALT	Waypoint Altitude				
	**Mode**	**Left LCD Description**	**Display**	**Right LCD Description**	**Display**
	WP 00	Aircraft Altitude (in feet)	+/- 99 999	Aircraft Altitude (in meters)	+/- 30 480
	Descr.	Displays current barometric altitude of the aircraft. Not editable.			
CAN BE EDITED	**WP 01+**	WP Altitude (in feet)	+/- max 25 000	WP Altitude (in meters)	+/- max 7 620
SIGNED VALUE	**Descr.**	Allows you to check or change the set altitude of a given waypoint, for up to 25 000 feet. Left window is used to display the altitude in feet, right one in meters			
More information		N/A			
Notes		The default WP altitude for the flight plan set up in the Mission Editor will always match the elevation in the given point. You need to manually edit the altitude for each waypoint to match the altitude given in the mission briefing.			

BUT (continued)

<table>
<tr><th>L / G</th><th colspan="6">Waypoint Latitude / Longitude</th></tr>
<tr><td rowspan="2">
</td><td>Mode</td><td>Left LCD Description</td><td>Display</td><td>Right LCD Description</td><td>Display</td></tr>
<tr><td>WP 00</td><td>Current Latitude (in degrees)</td><td>N/S 90.00.00</td><td>Current Longitude (in degrees)</td><td>E/W 180.00.00</td></tr>
<tr><td></td><td>Descr.</td><td colspan="4">Displays current position of the aircraft.</td></tr>
<tr><td>CAN BE EDITED</td><td>WP 01+</td><td>WP Latitude (in degrees)</td><td>N/S 90.00.00</td><td>WP Longitude (in degrees)</td><td>E/W 180.00.00</td></tr>
<tr><td>SIGNED VALUE</td><td>Descr.</td><td colspan="4">Displays geographical location of the selected waypoint. Also allows you to add new or modify existing waypoint locations.</td></tr>
<tr><td colspan="2">More information</td><td colspan="4">See DATA ENTRY and INS ALIGNMENT in Navigating the M-2000C Section for more information.</td></tr>
<tr><td colspan="2">Notes</td><td colspan="4">N/A</td></tr>
</table>

***

INS ALIGNMENT

The core of the INS houses a computer, a small platform bearing accelerometers and three gyroscopes. The gyroscopes stabilise horizontally the platform, and the accelerometers sense the aircraft movement in the north/south and east/west directions.

Before being able to operate properly, the INS needs:

- The platform to be absolutely horizontal.
- One accelerometer oriented towards the geographical north.
- The other accelerometer oriented east-west.
- The gyroscopes to spin at the proper speed.

The phase at the end of which the INS reaches these conditions is called alignment. The amount of time required depends on the type of alignment.

FULL ALIGNMENT

Full alignment is mandatory when you start in a “cold and dark” aircraft, unless the “INS does not require alignment” option is checked in DCS OPTIONS menu (under SPECIAL / M-2000C tab). You can also disable the gyro drift from the same page (more about the drift later on in this chapter).

Full alignment is also necessary each time you have requested aircraft repairs from the ground crew.

In order to start the full alignment procedure, follow the steps listed below:

1. Set the PSM Operational Mode in N.

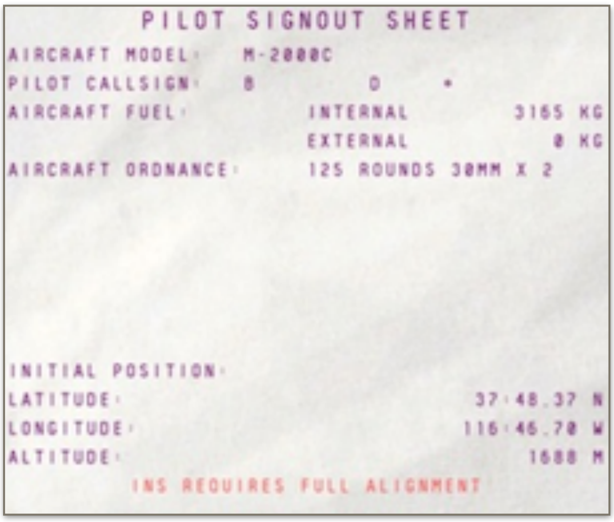
2. Set the PSM Mode in VEI. This will automatically select PREP Waypoint 00

3. Check that the Aircraft position in Latitude, Longitude and Altitude indicated by the PCN are correct. Change them as needed.

Like reality, the memorized position is imprecise, because of INS drift during the (supposed) previous flight. Error can reach 5 NM and above. Therefore, if precision is required, the displayed position must be updated before alignment.

You can find your starting position in your kneeboard (see next page) or by hovering the mouse cursor over your aircraft in the fully zoomed F-10 map mode and noting it down.

M-2000C Kneeboard page #3.



Aircraft starting position to be introduced into the PCN (including altitude)

The Kneeboard also tells you if you require a full or a quick alignment.

4. Set the PSM Mode knob in ALN when you are satisfied that all aircraft position is correct. Once the PSM is in ALN, the following will happen on the PCN:

a. The ALN yellow light will blink.

b. The **VAL** button will light up.

5. Click on the **VAL** button to start the alignment process.

a. The ALN yellow light will become steady, indicating that the INS is aligning.

b. The **VAL** button will go dark.

6. At this time, you can edit other waypoint data.

7. The alignment process will abort if:

a. You click the PSM Mode knob to another position.

b. You try to edit the Waypoint 00 data.

8. You can check the alignment process status by clicking the PSM Operational Mode knob to the STS position. You will notice that in the right window a total progress will be displayed, going from 100 to 0. In the left one you will see a digit defining how accurate the current alignment is - no digit at all meaning no alignment at all, and then from "4" for very low precision to "1" being the best.

You will also see the timer counting down to the next alignment level. Remember that the whole process will take around 8 minutes.

9. The ALN yellow light will turn off when the first coarse alignment (Class 4) has been reached. At the same time the PRET green light will start blinking. At this stage it is safe to abort the alignment process, the INS will remain aligned but its precision will be very low.

10. When the PRET green light has become steady, the alignment process has ended and the INS precision is the highest. You can now put the PSM Mode knob in NAV.

MEMORY ALIGNMENT

ALCM stands for *ALignement Cap Mémorisé*, or Memorized Heading Alignment.

The ALCM is used for aircraft set for quick reaction alert (QRA). It permits to align the INS in 1 min 30 sec, but requires to have previously performed a full alignment, shut the INS down and not moved the airplane. This case is unrealistic in the gameplay. Therefore, the stored heading alignment has been modelled to be mandatory after an aircraft rearm and/or refuel.

To start a Memory Alignment, you must:

1. Set the PSM Operational Mode in N.

2. Set the PSM Mode in VEI. This will automatically select PREP Waypoint 00. You will see a yellow N.DEG light on, informing you that you require a memory alignment.

3. Set the PSM Mode knob in ALCM position. Once the PSM is in this mode, the following will happen:

a. The ALN yellow light will blink.

b. The **VAL** button will light up.

4. Click on the **VAL** button to start the alignment process.

a. The ALN yellow light will become steady, indicating that the INS is aligning.

b. The **VAL** button will go dark.

5. The alignment process will abort if:

a. You click the PSM Mode knob to another position.

b. You try to edit the Waypoint 00 data.

6. You can check the alignment process status by clicking the PSM Operational Mode knob to the STS position. You will notice that in the right window a total progress will be displayed, going from 100 to 0. In the left one you will see a countdown going from 90 to - 0.

7. The ALN yellow light will go dark and the PRET green light will turn on when the alignment process has ended.

8. Now you can put the PSM Mode in NAV.

INS POSITION UPDATE

The INS is a very accurate instrument that uses a series of gyroscopes to provide the data it needs. Unfortunately, all gyroscopes, no matter how exact and precise are subject to gyro drift because the Earth rotates (ω, 15° per hour), and because of small accumulated errors caused by friction and imperfect balancing of the gyro. Another sort of apparent drift exists in the form of transport wander, where aircraft movement will essentially add or subtract to the effect of the Earth's rotation upon a gyroscope. The effect of these drift errors is that as time passes by the INS precision starts to suffer. In order to regain navigation precision a procedure called Position Update is required to be performed after a certain time.

CAUTION

To reflect this the INS accuracy will degrade by approximately one nautical Mile per hour of flight (30 meters / minute). While this won't be a problem during normal sorties, on longer missions (involving air to air refuelling) and for correct precision bombing it is important to perform the update.

The M-2000C INS has two methods to provide Position Update for the INS: **WAYPOINT OVERFLY** and **WAYPOINT RADAR RANGING**. Both methods require the use of a landmark with a known position and elevation. This land mark must be set up as one of the waypoints in the flight plan.

Waypoint Overfly Position Update

With this method you have to fly exactly over the selected land mark.

To perform a Waypoint Overfly Position Update, you must:

1. Fly towards the centre of the selected landmark, disregarding the INS navigation cues as soon as you have it in sight.

2. At the exact time when you fly over the landmark, you press the REC button, or, even more practical, the "Magic Unlock / Position update" button of your Stick (HOTAS).

3. The PCN will show the following information:

a. If the parameter knob is in the ΔL/ΔG position, the difference in latitude and longitude between the aircraft position and the landmark position will be shown. The values will be given in nautical miles.

b. If the parameter knob is in any other position, the difference will be shown in polar coordinates. The left LCD display will show distance difference in nautical miles while the right LCD will show the bearing difference.

4. If the difference between aircraft and landmark position is less than 15 nautical miles, the **VAL** button will turn on.

5. You review the values presented in the PCN and decide whether to accept them or not. If you accept them, then press the **VAL** button. The accumulated gyro drift will be reset to 0 and the aircraft present position will be corrected. Both **REC** and **VAL** buttons will go dark.

6. If the difference between aircraft and landmark positions are more than 15 nautical miles, the **VAL** button will remain dark and the **REC** button will start to blink.

7. If you decide to reject the PCN values or if the **REC** button is blinking, click on the REC button. The INS will not update its position and will continue using the values it already has, including the accumulated drift error.

***

Waypoint Radar Ranging Position Update

With this method you do not have to fly over the selected landmark. Instead you will use the radar to provide a precise slant or oblique range value between the aircraft and the landmark.To perform a Waypoint Radar Ranging Position Update, you must:

1. Fly towards the selected landmark (in the example above: Hoover Dam), disregarding the INS navigation cues, as soon as you have it in sight. Make sure that your radar is powered up and emitting. Note that the waypoint cross (**2**) is not directly over the dam due to the INS drift.

2. With the PCA in NAV mode, click in the OBL button (**4**). The radar will enter TAS mode (**3**) and a diamond shaped radar cue (**1**) will appear in the HUD. This cue represents the exact spot where the radar beam is pointing.

3. Maneuver the aircraft until the radar cue and the landmark are aligned.

4. Click on the TAS Ranging keyboard bind or use the button mapped on your throttle (HOTAS), which is more practical.

5. The PCN will show the following information:

a. If the parameter knob is in the ΔL/ΔG position, the difference in latitude and longitude between the aircraft position and the landmark position will be shown. The values will be given in nautical miles.

b. If the parameter knob is in any other position, the difference will be shown in polar coordinates. The left LCD display will show distance difference in nautical miles while the right LCD will show the bearing difference.

6. If the difference between aircraft and landmark position is less than 15 nautical miles, the **VAL** button will turn on.

7. You review the values presented in the PCN and decide whether to accept them or not. If you accept them, then press the VAL button. The accumulated gyro drift will be reset to 0 and the aircraft present position will be corrected. Both REC and VAL buttons will go dark.

8. If the difference between aircraft and landmark positions are more than 15 nautical miles, the **VAL** button will remain dark and the **REC** button will start to blink.

9. If you decide to reject the PCN values or if the REC button is blinking, click on the **REC** button. The INS will not update its position and will continue using the values it already has, including the accumulated drift error.

10. The radar returns to its normal operational mode.

Waypoint Radar Ranging Position Update will be cancelled if:

- You click Master ARM to the ON position.
- You click the PCA to POL mode.
- You click the PCA to APP mode.
- You select a weapon.

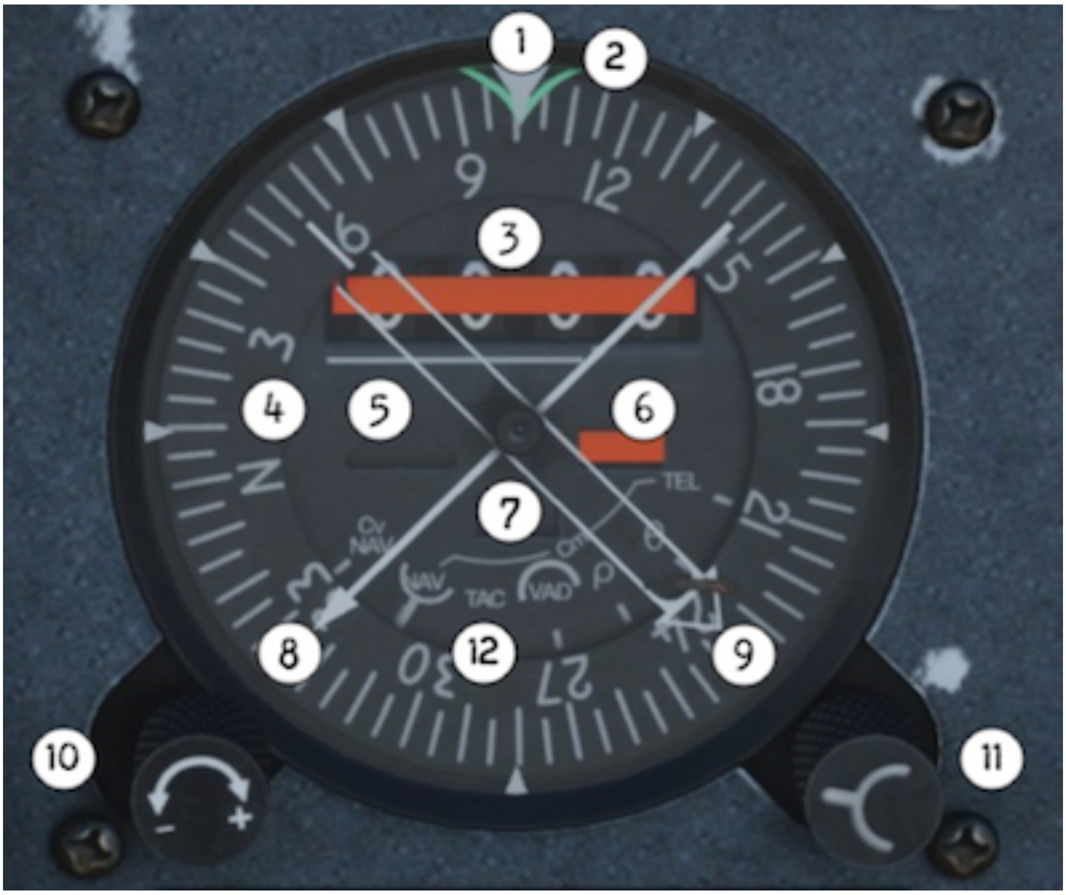
NAVIGATION INDICATOR (IDN)

The IDN (*Indicateur De Navigation*) displays the aircraft heading, distance and bearing indications (depending on the selected reference, called source), and selected heading reference for the autopilot.

Unlike standards HSI used in American aircraft, the M-2000C IDN was designed to require little to no pilot input. It consists of a compass rose to indicate aircraft true or magnetic heading, a Autopilot selected course indicator, two needles, a four-digit mechanical display, an operational mode indicator and four failure flags.

The only pilot required inputs are: Operational Mode and TACAN Offset values.

The IDN also controls the type of heading that will be used: True or Magnetic. It is important to remember that the setting selected on the IDN will be reflected on all the other navigation instruments (including the HUD, VTB etc.).



M-2000C IDN

1. CURRENT HEADING POINTER. The aircraft current heading is read in front of the pointer.

2. AUTOPILOT SELECTED COURSE INDICATOR. Called also Autopilot Heading Bug. Shows the heading which will be used by the autopilot. When the value is modified, the indicator moves along the heading scale. Once it is set on the desired value and the autopilot is engaged, the aircraft will turn until the heading pointer and the heading bug are aligned on the same value.

The value can be modified by the trim control on the stick (when the autopilot is engaged). See Section 7 (AUTOPILOT) for more information.

3. DISTANCE WINDOW (DME). Shows the distance in nautical miles to the selected reference (source). See table below. Note that the right most digit is a tenth of mile. The DME flag shows in this window if no data is available.

The distance display is also used to set the VAD data (see USING VAD)

4. CIRCULAR HEADING ROSE. The circular heading scale ranges from 001 to 360 with long marks for every 10 degrees and smaller ones every 5 degrees. Numeric values (in tens of degrees) every 30 degrees (e.g. 18 for 180°).

5. VOR FLAG. The bearing shown by the thin needle (VOR) is either invalid or missing (no signal or system failure). Disregard the thin needle indication.

6. BEARING FLAG. The bearing shown by the wide/double needle is either invalid or missing (no signal or system failure). Disregard the wide/double needle indication.

7. CAP (HEADING) FLAG. The heading information is not available (failure or no signal). Disregard the displayed heading information and use a different indicator (HUD, ADI or standby compass).

8. THIN NEEDLE. Gives the direction of a selected reference (source) - which in most cases is VOR station. The only other use is in TEL mode, which is not modelled in DCS.

9. WIDE NEEDLE, AKA DOUBLE NEEDLE. Gives the direction of a selected reference (source). Refer to the IDN INDICATION TABLE below for more information.

10. DATA SETTING KNOB. In VAD mode, a specific position from a ground beacon (bearing and distance) can be set. See TACAN OFFSET POINT (VAD) NAVIGATION for mor information.

NOTE	This knob does not have any other functions. Contrary to what is stated by some sources, it is not used to move the green Autopilot bug around the circular heading rose neither in DCS nor IRL.

11. IDN MODE SELECTOR KNOB. Used to select the navigation source. Rotating the knob moves the navigation source indicator to the desired position. Refer to the IDN INDICATION TABLE below for more information.

12. SELECTED MODE INDICATOR. A small semi-circle beneath each option shows the selected IDN Mode. Refer to the IDN INDICATION TABLE below for more information.

IDN Indication Table

Type of data displayed on the IDN depends on the setting chosen with the use of the IDN Mode Selector Knob. Depending on the choice, sometimes the data is also used by other navigation instruments.

Operational Modes

The IDN has four operational modes: INS/VOR Navigation (NAV), TACAN/VOR Navigation (TAC), TACAN Offset Point/VOR Navigation (VAD) and Ground Controlled Interception (TEL).

NAV (MAIN INS/VOR NAVIGATION MODE): In this mode, the IDN connects with the INS. The wide needle and DME display waypoint navigation information, while the thin needle shows bearing to selected VOR station. This is the only mode that allows to select between true or magnetic headings, through its two sub modes:

> **CV** NAV: In this mode the system uses true heading. Cv stands for *Cap vrai* ("true heading" in French).
>
> **CM** NAV: In this mode the system uses magnetic heading. Cm stands for *Cap magnétique* ("magnetic heading" in French).

CAUTION — The selection of Cv NAV or Cm NAV also affects the heading indicators in the following instruments: HUD, HDD, ADI.

All other following modes are part of the "Cm" category, i.e. they use only magnetic heading indications.

TACAN/VOR NAVIGATION (TAC): In this mode the IDN connects to the TACAN receiver. The wide needle shows bearing to the selected TACAN station, and the DME gives distance in Nautical Miles.

TACAN OFFSET POINT/VOR NAVIGATION (VAD): In this mode the IDN calculates and navigates towards a point offset to the current TACAN station. The offset point location is introduced in polar coordinates (distance and magnetic bearing) by using the VAD (TACAN Offset Point) input knob.

This mode has three sub modes:

> VAD: This is the operational mode. The HSI checks if it a valid TACAN Offset Point exists and calculates distance and bearing from the current aircraft position towards the offset.
>
> P (RHO): This mode is used to enter the distance in nautical miles from the TACAN station to the offset point.
>
> Θ (THETA): This mode is used to enter the magnetic bearing from the TACAN station to the offset point.

Please refer to the TACAN OFFSET POINT (VAD) NAVIGATION chapter for more information on this mode.

GROUND CONTROLLED INTERCEPTION (TEL): In this mode the IDN displays interception information: bearing, distance and interception course, towards a target. This mode is used when the aircraft is under Ground Controlled Interception (GCI). This feature was never operationaly fielded in reality, neither is it modelled in DCS and thus is NOT FUNCTIONAL.

IDN Indication Table

INDICATORS	Cv NAV	Cm NAV	TAC	VAD	ρ	θ
Heading Rose	**TRUE HEADING**	**MAGNETIC HEADING**				
CAP Flag	**HEADING GYROS FAILURE** Shows an orange tab in the bottom flag window. If it is visible, then it indicates a problem with the heading gyro and thus the heading value shown in the HSI and other heading indicators is not reliable. If shown it is recommended to use the auxiliary heading gyro.					
Wide Needle	**WAYPOINT BEARING**		**TACAN BEARING**	**VAD BEARING**	Used to set VAD	Used to set VAD
Bearing Flag	**BEARING FAILURE** Shows an orange tab in the right flag window. If it is visible, then it is not possible to show the bearing to the selected navigation point/station. The Needle 1 indicator will park itself to the 135° position.					
Thin Needle	**VOR BEARING**					
VOR Flag	**VOR FAILURE** Shows an orange tab in the left flag window. If it is visible, then it is not possible to show the bearing to the selected VOR/ILS station. The Needle 2 indicator will park itself to the 225° position.					
DME	**WAYPOINT DISTANCE**		**TACAN DISTANCE**	**VAD DISTANCE**	Used to set VAD	Used to set VAD
DME Flag	**DISTANCE FAILURE** It shows a bar across the DME indicator, blocking the value shown. If it is visible there is an error in the DME value.					
Selected Course Indicator	**AUTOMATIC PILOT COURSE**					

NOTE

The bullseye calls made by the AI in DCS use True Heading rather than magnetic. Therefore the ability to choose between the two can be very useful.

The use of IDN and of the different modes of navigation are covered in the training missions as well as the campaign included in the module.

PCA MODES DISPLAY

The PCA is located to the left of the radar display. It consists of a panel with one open switch, one guarded switch, and two rows of five LCD displays with buttons below them.

The PCA controls the aircraft's Master Modes of operation and is used for all aspects of the aircraft's flight.The options displayed in the top row change based on the system Master Mode. Most of the options are exclusive, meaning that selecting one will deselect the previous one.

In the NAV Master Mode the PCA will display the following options:

1. TOP: SPEED GUIDANCE (*Guidage en Vitesse*). A special navigation mode used in conjunction with the **DESIRED TIME ON TARGET (RD / TD MODE)**. Refer to the linked section for more information.

2. POL: POLICE MODE. The system provides guidance to a locked target for identification. No weapons are available in this mode, even if the Master Arm switch is in the ON position.

Police Mode is used during air interception of unknown aircraft to prevent accidental release of weapons. In this mode a large circle is visible in the middle of the radar screen, as presented in the picture below.

3. APP: APPROACH MODE. The system is configured for landing. Refer to **APP MODE** in Section 10-3 for more information.

4. RD: DESIRED ROUTE. **NOT FUNCTIONAL**

5. OBL: RADAR BASED INS POSITION UPDATE (*Recalage Oblique de la Centrale*). See Waypoint Radar Ranging Position Update in Section **12-4 (INS)** for more information.

WAYPOINT MANAGEMENT

The PCN installed in the M-2000C is capable of storing up to 20 WAYPOINTS (1 - 20), as well as the same number of OFFSET POINTS (one for each WP).

On top of that there are 3 MARKPOINT slots used to mark the spot on the ground directly beneath the jet when the designated key on the PCN is pressed.

PREP vs DEST

The most important thing to understand and remember is the difference between **PREP** and **DEST** functions, as well as Waypoint 00 (zero - zero, which always refers to current position of the aircraft) and other Waypoints. The main difference is as follows:

The **PREP** (preparation) waypoint is used for visualisation and editing. Whenever the PCN displays any waypoint-related data, those are always the data for the current PREP waypoint. In other words, whatever data you input or change there will not have any impact on any of the instruments used for navigating the airplane until the data prepared in PREP is transferred to DEST and hence used for navigation.

So in order to edit any of the waypoints you want to navigate to, you first have to do that in PREP mode before being able to use it as your destination.

The **DEST** (destination) waypoint is being used for navigation. The DEST waypoint data can only be visualised in the HUD, HDD, ADI and IDN. You can't display or edit the DEST data on the PCN, the DEST waypoint is used solely as a source of data for the instruments mentioned above.

Waypoint ZERO vs **Waypoints 1 - 20**

There is a similar difference between Waypoint 0 and all the other Waypoints.

Waypoint ZERO is not a real waypoint, but in fact the current position of your aircraft. Which means that not all of the data that normally is visible on the PCN can be viewed in WP 00 mode. Also, it is important to remember that WP 00 can only be set in the PREP Window, and never in the DEST window.

Other Waypoints are normal Waypoints that can be selected as DEST to navigate to them, and/or as PREP to edit/display data about them on the PCN, such as their position (LAT / LONG), elevation, time to get there... etc.

Please refer to the DATA SELECTION for full description of all the information that is available for display and / or editing, based on the position of the Parameter Selector Knob.

Waypoint selection

As indicated above, The PCN uses two waypoint indexes to operate: the Preparation (PREP) waypoint, which is the waypoint used for visualisation and editing and the Destination (DEST) waypoint, which is the waypoint being used for navigation. The DEST waypoint data can only be visualised in the HUD, HDD, ADI and IDN. There is no problem with having the same waypoint # being the PREP waypoint and the DEST waypoint at the same time.

To select a PREP waypoint:

1. Click on the PREP button. It will light up and the two digits on the left of the Lower Left LCD Display will disappear.

2. Click on the numeric pad the number of the waypoint you want to visualize and/ or modify. The valid PREP waypoint numbers are from 00 to 20. You need to enter both numbers, for numbers below 10 you need to enter the leading 0, e.g.: Waypoint 0 must be entered as 00, 8 as 08, etc.

3. As soon as the second digit has been entered the selected waypoint data will be displayed and the PREP button will go dark. You can now check and / or edit desired data in the Upper Left and Upper Right LCD Display.

To select a DEST waypoint:

1. Click on the DEST button. It will light up and the two digits on the left of the Lower Left LCD Display will disappear.

2. Click on the numeric pad the number of the waypoint you want to visualize and/or modify. The valid DEST waypoint numbers are from 01 to 20. You need to enter both numbers, for numbers below 10 you need to enter the leading 0, e.g.: Waypoint 1 must be entered as 01, 8 as 08, etc.

3. As soon as the second digit has been entered the selected waypoint data will be used for navigation and the DEST button will go dark.

4. You cannot select waypoint 00 in DEST.

5. You cannot select a waypoint number higher than the number of waypoints in the currently defined flight plan.

6. An invalid waypoint number will reset the DEST waypoint to 01.

Additionally, there are the following shortcuts for selecting waypoints:

• If you press PREP twice, without entering a waypoint number, the DEST waypoint number will be copied to PREP.

• If you press DEST twice, without entering a waypoint number, the PREP waypoint number will be copied to DEST. As long as the PREP waypoint number is higher than 00.

NOTE	Every time the PSM is placed in VEI, the PREP waypoint automatically changes to 00 and the DEST waypoint changes to 01.

Editing Waypoint information

PREP Waypoint data can be edited only under the following conditions:

- PSM Operational Mode is in N
- PSM Mode is in VEI, ALN, ALCM or NAV

There are two types of data that INS use: SIGNED and UNSIGNED.

SIGNED DATA is all that data that requires that you specify if the value you are about to enter is positive or negative (for mathematical purposes Lat/Lon coordinates North/East are considered positive while South/West are negative). The following are the INS signed data: Waypoint latitude/longitude, waypoint altitude, offset latitude/longitude, offset altitude and magnetic declination.

UNSIGNED DATA is all the data that is always assumed to have a positive value and thus do not require that you specify its sign: Waypoint runway heading, waypoint runway glideslope, selected bearing, selected time, offset bearing, offset distance.

To edit the data, you must:

1. Select the parameter you want to edit by positioning the parameter knob in the corresponding label.

2. Select either left or right data to edit.

a. To select the left data, click on the 1 or 7 keys in the numeric pad.

b. To select the right data, click on the 3 or 9 keys in the numeric pad.

3. Both the **INS** and **EFF** buttons will light up, indicating that the PCN is in edit mode.

4. The selected window will show a series of dashes, indicating the number of digits to be entered. If the data is signed both signs will be displayed indicating the need to select one.

5. To select a sign, you must click on the associated button: 2 for North, 8 for South, 4 for West and 6 for East. For positive/negative values you must click on 1 (+) or 7 (-) for the left LCD or 3 (+) or 9 (-) for the right LCD.

6. An entry example would be:

You have selected L/G and the left window (L = Latitude). The right window will continue displaying the G data and the right window displays N/S --.--.--, indicating that you must: Select either N or S and that you must enter 6 digits.

In this example, if you want to enter 38° 45.03' N then you must:

- Click on the 2 Key to select N. S in the left window will disappear.
- Enter 384503 so that all dashes have been replaced by a number
- Press **INS** button to save the data or **EFF** if you made an error. **EFF** button resets the display to the starting point.

Another example is if you want to enter waypoint altitude in feet, you select the left LCD by clicking on 1 or 7. The right window will keep displaying the current data in meters while the left one displays +/- -----. Select either + or – for values above or below sea level and afterwards you must enter 5 digits including leading zeros.

In this example you want to enter 1850 above sea level so you must:

- Click on the 1 Key to select +.
- Enter 01850 so that all dashes have been replaced by a number.
- Press **INS** button to save the data or **EFF** if you made an error. **EFF** button resets the display to the starting point.

7. If the data you entered is invalid, it will be discarded and the dashes will appear again.

8. If the data you entered is valid, both **INS** and **EFF** buttons will go dark and the selected window will show the new data.

9. Clicking on **PREP** or changing the parameter knob position will cancel the edit mode.

Creating new waypoints

Adding new waypoints to the flight plan is similar to the procedure described above. The only difference is that in this case you will be entering a completely new data instead of replacing previously stored information.

To create a new waypoint follow the steps listed below:

1. Press the **PREP** button once.

2. Select first unused waypoint in your flight plan by pressing its number on the keypad. So if your current flight plan consists of 7 waypoints, press 0 and 8, followed by **INS** button.

3. Put the selector knob in the L/G position. You will notice that no data is displayed in any of the PCN windows - this is because waypoint 8 will become a new one and require set of lat / long coordinates to be introduced before it can be used.

4. Press **1** or **7** on the keypad in order to select the left window. You will enter the latitude data, so first thing you need to do is select **NORTH** by pressing **2**. Next, enter the coordinates. Once this is done, press the **INS** button to save it. If you make a mistake, you can clear the window by pressing the **EFF** button.

5. Follow similar steps to introduce the desired longitude of the new waypoint. Press **3** or **9** in order to select the right LCD. Select **EAST** by pressing **6** and enter the coordinates. Save the data using the **INS** button.

6. The waypoint is now ready to use, however you might want to change its altitude. To do so, move the selector knob to ALT position. You have an option to use either feet or meters, displayed in left or right window, respectively.

Press **1** / **7** to select altitude in feet or **3** / **9** to use meters. Then press **1** or **3** to indicate that you will be entering positive data or **7** / **9** if the waypoint altitude is below the sea level. Depending on your choice, a small “plus” or “minus” will be displayed. Next, enter desired altitude (remember about preceding zeros) and press the **INS** button to save this value.

Changing waypoints

To quickly cycle through active waypoint, you can use the + and - buttons located on the left side of the main panel, just above the clock.

You can also introduce the desired DEST waypoint number as described above.

Note there is no automatic waypoint change system anymore.

TACAN OFFSET POINT (VAD) NAVIGATION

The IDN has a special navigation mode called VAD (*Vecteur ADditionnel*, French for Additional Vector). The VAD is an offset point calculated from the position of the selected TACAN station. The system uses the Needle 1 (Wide) and DME (numeric) indicators. The Needle 1 and DME flags will be shown if it is not possible to engage the VAD mode.

How to operate the VAD mode:

1. Set up a TACAN station in the TACAN receiver.

2. Place the IDN in TACAN mode and check that it is receiving signal from the TACAN station (the DME and Needle 1 flags should not be shown).

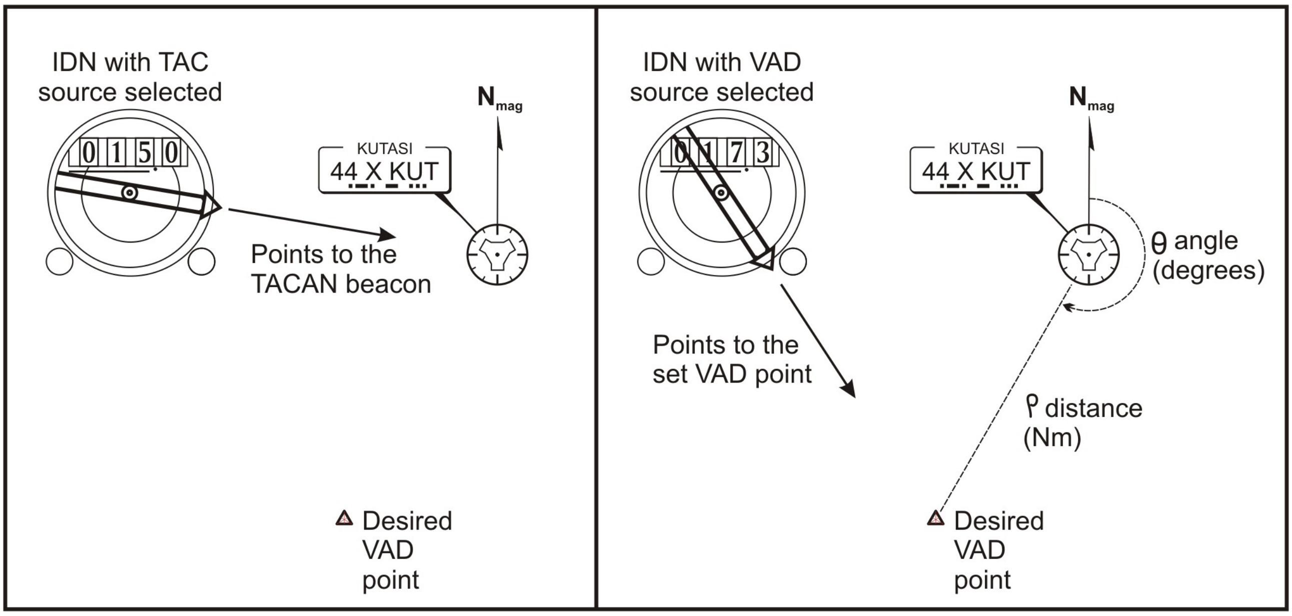
3. Place the IDN in **θ (Theta)** mode.

4. Enter the desired magnetic bearing from the TACAN station to the VAD by rotating the VAD input knob. The Needle 1 indicator will rotate towards the selected value, note that the DME window will also show the corresponding numeric value.

5. Place the HSI in **ρ (Rho)** mode.

6. Enter the distance from the TACAN station to the VAD (offset point) by rotating the VAD input knob. The DME indicator will start showing the selected distance. The valid values are from 001.0 to 999.0 nautical miles. The Needle 1 indicator will show the selected θ (Theta)

7. Place the HSI in VAD mode. The system will calculate the geographical position of the offset point from the current aircraft position: The Needle 1 indicator will show the magnetic bearing to the Desired VAD point and the DME indicator will show the distance in nautical miles (see the graphic below).



For the VAD mode to be operational the following conditions must be met:

1. A TACAN station has been selected and the signal must be received.

2. The polar coordinates from the geographical position of the TACAN station to the offset point have been entered into the system.

When all conditions are met the ADN will navigate directly towards the TACAN Offset Point (VAD) from the aircraft position.

NOTE

This option is handy, for example, to intercept an airport runway axis at a desired distance when performing an approach or to set up a rendez - vous point for your flight in case of no radio communications.

The practical example of using the VAD is included both in the training missions as well as the campaign included in the module.

***

OFFSET POINTS

Offset points are points on the ground (or in space) that are created by using another existing waypoint as a reference. They will be most commonly used for precision bombing or as points of reference given by the ground troops. Another and most widely known example is the use of bullseye call to create an offset point in order to locate your target, friendly units, landmarks etc.

Three out of eleven positions on the Parameter Selection Knob on the PCN are dedicated to Offset Points and their use. they are collectively marked with a **BAD** sign (BAD = *But ADditionnel* in French). These have been described in the NAVIGATION CONTROL PANEL (PCN, section 12-3) of the manual.

The PCN is able to store 20 offset points, one for each of the introduced waypoints. Remember that you cannot create an offset point from WP 0 (zero).

There are two ways to set up a new offset point:

- By using the distance in kilometres from the selected waypoint to the North / South and East / West by using the ΔL/ΔG position of the knob.
- By introducing the distance and bearing to the selected point from one of the waypoints. In other words, this is exactly the same as introducing bullseye calls by using the ρ/θ position of the knob.

The third position allows you to set up the difference in altitude between the original waypoint and the offset point. This is especially important for precision bombing.

Creating offset using ΔL/ΔG

Follow the following steps in order to create an offset point using ΔL/ΔG:

1. Press the **PREP** button once.

2. Choose the waypoint you want to use as a reference for your waypoint by introducing its number using the keypad (two digits).

3. Put the Parameter Selection Knob in ΔL/ΔG position. The top left window of the PCN will look in the following way: $^{N}{}_{S}$ --.--- in the left window, $^{E}{}_{W}$ --.--- in the right one.

4. Press 1 / 7 to select left window or 3 / 9 to select the right one. **INS** and **EFF** buttons will light up and. Then press the corresponding key to choose N / S for ΔL or E / W for ΔG. Only the selected letter will remain.

5. Use your keypad to introduce the distance. Remember about preceding zero if your offset point is located less than 10 km from the reference waypoint. Also, bear in mind that the maximum value is 99 997 meters.

6. Press **INS** button to save the data or **EFF** if you made an error. **EFF** button resets the display to the starting point. If the data you entered is invalid (so if you input greater value than 359.9), it will be discarded and the dashes will appear again.

7. If the data you entered is valid, both **INS** and **EFF** buttons will go dark and the selected window will show the new data.

Creating offset using ρ/θ

Follow the following steps in order to create an offset point using ρ/θ:

1. Press the **PREP** button once.

2. Choose the waypoint you want to use as a reference for your waypoint by introducing its number using the keypad (two digits).

3. Put the Parameter Selection Knob in ρ/θ position. The top left window of the PCN will show: 0.00, and the right one will show 0.0.

4. Press 1 / 7 to select left window in order to introduce the distance from the reference Waypoint to the desired Offset Point. **INS** and **EFF** buttons will light up and zeros will be replaced by dashes: --.--

5. Use your keypad to introduce the distance. Remember about preceding zero if your offset point is located less than 10 miles from the reference waypoint. Also, bear in mind that the maximum value you can put in is 53.99 nautical miles.

6. Press **INS** button to save the data or **EFF** if you made an error. **EFF** button resets the display to the starting point. If the data you entered is invalid, it will be discarded and the dashes will appear again.

7. Press 3 / 9 to select right window in order to introduce the bearing from the reference Waypoint to the desired Offset Point. **INS** and **EFF** buttons will light up and zeros will be replaced by dashes: ---.-

8. Use your keypad to introduce the bearing. For greater accuracy you can use tenths of a degree, for instance 220.5 or 180.1.

9. Press **INS** button to save the data or **EFF** if you made an error. **EFF** button resets the display to the starting point. If the data you entered is invalid (so if you input greater value than 359.9), it will be discarded and the dashes will appear again.

10. If the data you entered is valid, both **INS** and **EFF** buttons will go dark and the selected window will show the new data.

Introducing altitude difference

For precision bombing purposes you might want to introduce the altitude difference between the reference Waypoint and the Offset Point for greater accuracy. It is done in a similar way to setting the altitude of the waypoint, with the difference that you have to put the Parameter Selector Knob in the Δ ALT mode. Remember that you use the reference Waypoint altitude as a basis, which means that if Offset Point is higher, you need to use positive data, if lower - you need to put a "-" before you enter the value.

Using Offset Point as a destination

In order to use the offset point as your destination, you have to select the reference Waypoint as your **DEST**, and then press the **BAD** button located to the right of the Parameter Selector Knob. It will light up and the offset point will now be shown as your destination both in the IDN and HUD. The **ENC** button will blink as long as the is **BAD** selected to indicate that automatic change of waypoints is unavailable.

Mark Points

M-2000 C's INS is capable of setting and memorising up to three overflown mark points. You set them up by pressing the **MRQ** button and then confirming it with **VAL**.

As soon as you press the **MRQ** button (**4**) it will immediately light up, together with **VAL** (**3**). Top left and right LCD windows will show the latitude and longitude of the spot directly beneath the plane at the exact moment when the **MRQ** was pressed (**1**). Lower left display shows the number under which the markpoint will be saved.

If you want to save the markpoint, press the **VAL** button once. It will go dark together with the MRQ, and green M91 light (**5**) will show up above the keypad, as illustrated on the picture below.

From now on you can use the markpoint as a normal Waypoint. The number displayed behind M is the number you have to introduce into the INS using the **DEST** mode (**6**, you cannot edit or view markpoint data in **PREP**).

Use your markpoint slots wisely - once you use all three, there is no way to delete the ones already stored in the system.

If you try to create an additional markpoint when all three slots are taken (you can easily tell that it is the case by looking at the INS - all three M green lights will be up), the **MRQ** button will start blinking and pressing the **VAL** button will not have any effect.

DESIRED TIME ON TARGET (RD / TD MODE)

The Desired Time on Target function allows you to set up your plane to provide you with the speed cues that will facilitate arriving at the specific waypoint in a specific period of time. Note that it lets you choose how long you want it to take to reach the designated waypoint, but not at what time you will be there. In other words it is using the time of departure plus flight time function as opposed to desired time of arrival minus the flight time.

In order set it up correctly it is important to know the limitations of the system. So:

- Desired time - to - go cannot be less than 50% of the value shown under the TR / VS mode (so the time it will take to get to the waypoint if the current ground speed is constant).
- Desired time - to - go cannot be more than 150% of the value shown under the TR / VS mode (so the time it will take to get to the waypoint if the current ground speed is constant).

In order to use this mode, please do the following:

1. Set the desired waypoint in both **PREP** and **DEST** windows.

2. Set the Parameter Selector Knob to TR / VS position and check current ground speed as well as the displayed time to go.

3. Set the Parameter Selector Knob to RD / TD.

4. Press **3** or **9** to enable data input in the right window. It will change to ---.-- allowing you to introduce 5 numbers. You can choose any value of up to 359 minutes and 59 seconds, provided it is in the limits outlined above. For instance if you want to arrive at the chosen waypoint exactly 6 minutes 30 seconds after pressing **TOP**, type 00630.

5. Introduce the number and press the **INS** button.

6. To start the clock and guidance, press the **TEL** button on your PCA. A new set of cues will show on your screen:

The goal now is to place the two chevrons (**1**) into the two inverted brackets (**2**) and keep them exactly in the middle in order to arrive at the set waypoint in desired time.

If the chevrons (**1**) are too high, as in the picture below, it means you are going too fast and will arrive at your destination too early unless you slow down.

If the chevrons are too low, the opposite is true - you are going too slow and will be late unless you accelerate.

Desired Course to Waypoint (RD / TD Mode)

This function is not implemented. NOT FUNCTIONAL

WAYPOINT VISUALISATION ON THE VTB

The M-2000C allows the display of up to 5 waypoints on the VTB screen, provided that the following conditions are met:

- They are in the selected radar display range;
- They are within the radar aperture limits, i.e. +/- 60 degrees.

When added to the display, the waypoints look as follows:

In order for the waypoints to be shown, you need to:

1. Press **PREP** button and enter the desired waypoint number on your keypad.
2. Press the **VAL** button on the PCN. A "plus" sign with the waypoint number to its right will show up on the VTB.

Follow the same procedure in order to hide the selected waypoint. You can also remove all the waypoints from the VTB by using the ALLEG switch below the VTB screen.

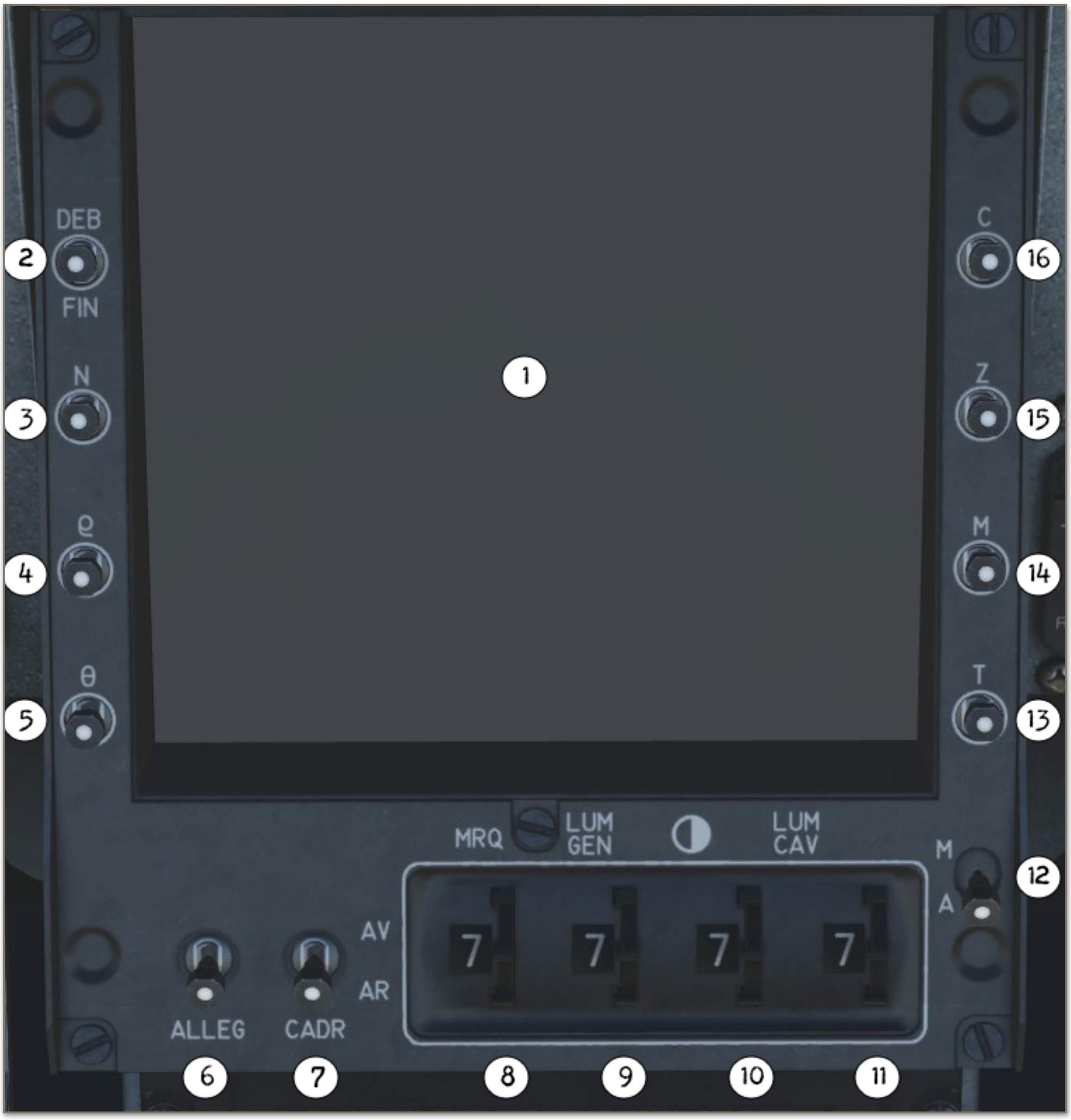
NOTE	Remember that only those waypoints that are within the currently set radar display range will be visible on the VTB, the others will be hidden from view.

SECTION 13

ELECTRONIC WARFARE

THE VTB/HDD

The *Visualisation Tête Basse* (VTB), which is French for Heads Down Display (HDD), displays radar information along with navigation data, target designation or aircraft load.



1. DISPLAY SCREEN. Displays the radar and the aircraft load.

2. START/FINISH (*Debut / Fin*) input designation. NOT FUNCTIONAL

3. RADAR N PARAMETER. Used to choose which waypoint will be used as bullseye. See NAVIGATION chapter for more information.

4. RADAR RHO PARAMETER. NOT FUNCTIONAL

5. RADAR THETA PARAMETER. NOT FUNCTIONAL

6. DE-CLUTTER VTB/HDD. De-Clutters VTB/HDD Symbology. Used to remove waypoints displayed on the VTB screen. See WAYPOINT VISUALISATION ON THE VTB in Section 12-5.

7. RADAR MAP DISPLAY SELECT. Displays the Radar map. NOT FUNCTIONAL

8. MRQ MARKER BRIGHTNESS ADJUST. Adjusts the VTB/HDD's Marker (MRQ) Brightness. NOT FUNCTIONAL

9. BACKLIGHT BRIGHTNESS ADJUST. Adjusts the VTB/HDD's Backlight Brightness. NOT FUNCTIONAL

10. CONTRAST ADJUST. Adjusts the VTB/HDD's Contrast. NOT FUNCTIONAL

11. BRIGHTNESS ADJUST. Adjusts the VTB/HDD's Brightness. NOT FUNCTIONAL

12. POWER ON/OFF. Turns On/Off the power of the VTB/HDD.

13. RADAR T PARAMETER. NOT FUNCTIONAL

14. RADAR M PARAMETER. NOT FUNCTIONAL

15. RADAR Z PARAMETER. NOT FUNCTIONAL

16. RADAR C PARAMETER. NOT FUNCTIONAL

NOTE

The Objective Designation is used for when AWACS/ Forward controllers coordinate targets for the Mirage 2000C in the theatre of operations. The AWACS/Forward controller will designate specific information to the pilot to manually input into the VTB with the 8 (4 on each side) switches to designate the target. In practice this was very rarely used and would not be practical in a small areas of operations available in DCS, hence lack of functionality.

THE RDI RADAR

The RDI Radar is a high PRF Doppler multi-mode/single function radar optimised for air-to-air combat. RDI was the first high pulse repetition frequency Doppler radar built in France. RDI is optimised for the air defence mission, therefore it has a single function, thought its mode options include:

- Air-to-air RWS search at all altitudes.
- Long-range TWS and STT, the latter allowing missile guidance.
- Short-range (<10Nm) dedicated modes with automatic STT lock, specific to selected weapon..
- Look-down, shoot-down against targets flying as low as 30 meters (98 feet).

RDI is compatible with both the Matra Magic 2 and the Matra Super 530D missiles. Fire control for cannon up to a range of 1000 meters (3280 feet) is provided. Although the RDI is primarily configured for the air defence role, it has secondary capabilities to carry out ranging for weapons delivery, low altitude navigation with ground mapping and contour mapping for terrain avoidance (mapping functions are not available in-game).

RDI radar capabilities and limitations

RADAR MODE	MAX RANGES (NM)		LOCK TYPE		DOPPLER
	Search	**Lock**	**TWS**	**STT**	**Filter**
High PRF	66	50	Yes	Yes	100%
ILV PRF	45	20	Yes	No	50%
Low PRF	25	N/A	No	No	0%

For air-to-air combat, the RDI provides a 120° cone of coverage, the antenna scanning at either 50 or 100°/s, with ±60, ±30 or ±15° scan.

In addition, the RDI features Several special autolock modes for short range air combat (< 10Nm):

- Boresight beam (scanning straight ahead).
- Horizontal scanning (parallel to the horizon) with PRF option (BAH/BA2).
- Vertical scanning (optimized for turning fights); available for MAG and CAN master modes.
- SVI Helical scanning (covering the HUD field of view); available for 530 and POL master modes.

Radar Coverage

The area scanned by the radar is determined with the use of two separate controls: number of bars (lines) and Radar Scan azimuth selector (*balayage* = sweeping angle in degrees) (see below). The wider area of scan, the longer it takes for the beam to complete the sweep, which also means longer gap between the updates and smaller range / accuracy.

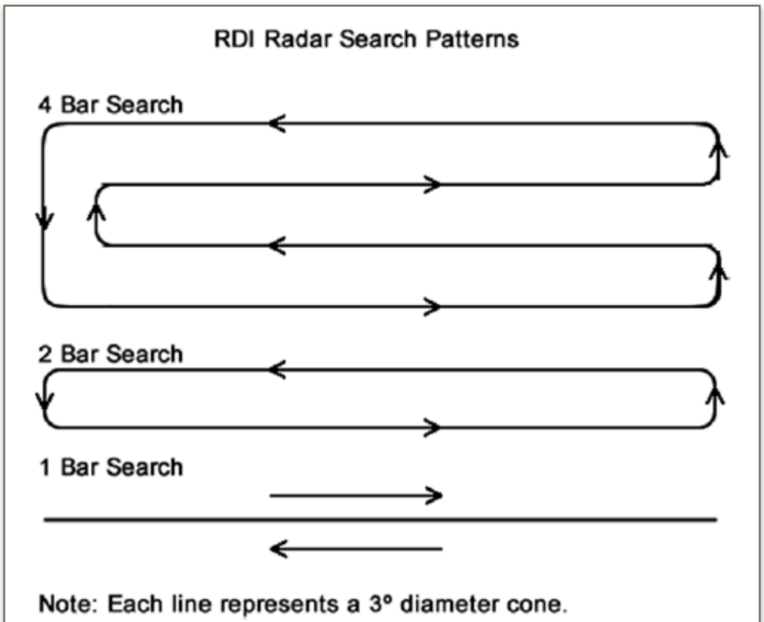


Figure 24 RDI radar antenna search pattern.

The RDI search pattern is as follows:

As noted above, with 1 Bar Search the 3° diameter cone will only move on the horizontal plane from left to right, completing the sweep very quickly, but also covering very limited area.

In 4 Bar Search the total vertical space covered by the radar will extend to 12 degrees, scanned in four horizontal 3° sweeps.
Conversely, the 2 Bar Search will cover a total of 6 degrees in two 3° sweeps

The picture on the next page illustrates the vertical coverage of the RDI Radar:

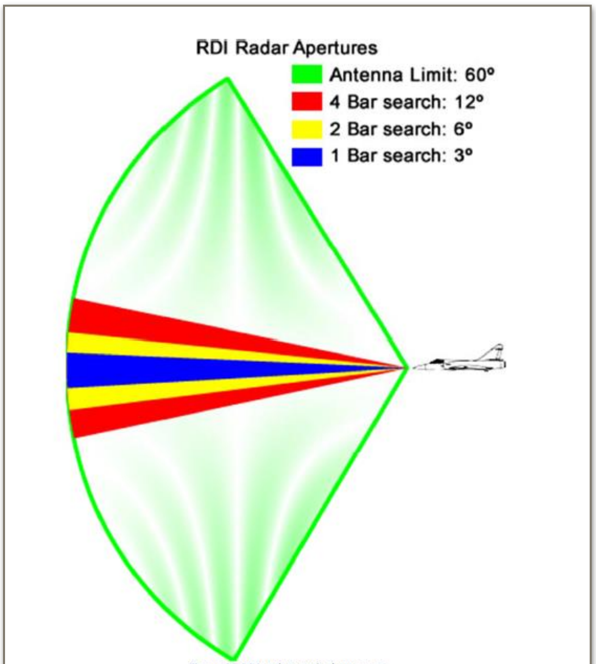


Figure 23 RDI radar vertical coverage

For the horizontal scan, you can use the azimuth selector, which allows to choose the horizontal aperture setting in which the radar will operate: 15, 30 and 60 degrees, giving the horizontal coverage of 30, 60 and 120 degrees respectively.

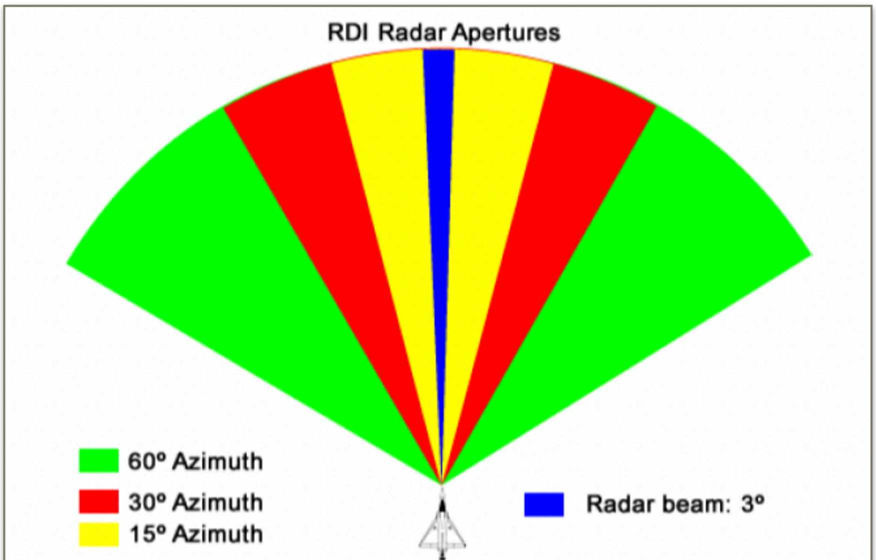
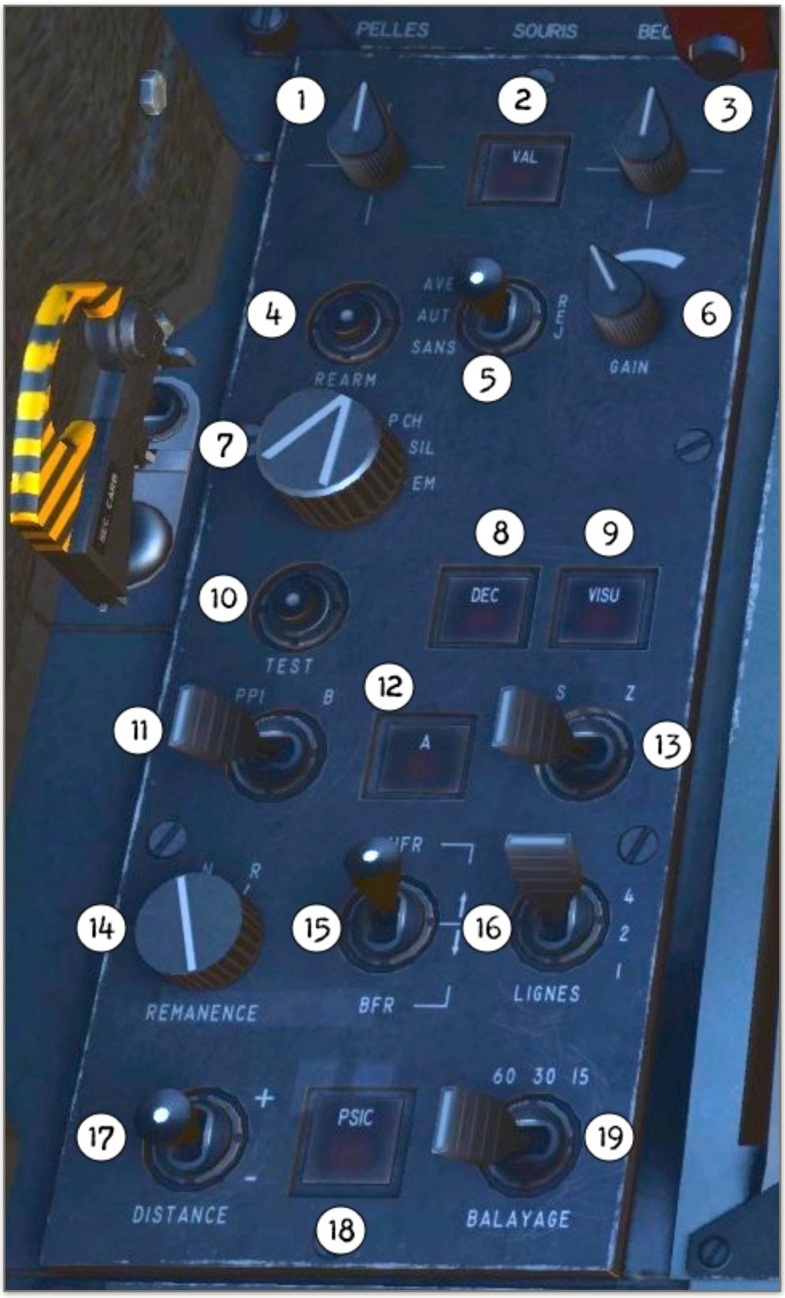


Figure 22Horizontal Radar aperture

The antenna can be moved vertically and horizontally (in 15 and 30 degree setting) to cover the space above, below or to the sides without the need to change your pitch or heading.

RADAR CONTROL PANEL

Radar Control Panel is located on the left console, behind the throttle. Below you will find the list of all the knobs and switches.



1 - 3. NOT FUNCTIONAL

4. RADAR REARM. NOT FUNCTIONAL

5. RADAR DOPPLER REJECT SELECTOR. NOT FUNCTIONAL

6. RADAR GAIN SETTING. NOT FUNCTIONAL

7. Radar Power Switch. Used to power up the radar. It has following positions:

- A (*Arrêt*): off
- P CH (*Préchauffage*): warm up
- SIL (*Silence*): standby
- EM (*Emission*): on

8. DEC. Ground avoidance mode. Displays SHB indication in the top - right part of the radar screen, but is NOT FUNCTIONAL

9. VISU. Ground mapping. NOT FUNCTIONAL

10. Radar Test Switch. NOT FUNCTIONAL

11. Radar Display Mode. Used to switch between the PPI (Plan Position Indicator) display mode and the B-Scan display mode.

12. On ground radar switch. Used for maintenance. NOT FUNCTIONAL

13. Radar TDC Mode. TDC stands for Target Designation Caret. Switches between **S** mode (that shows the radar cone maximum and minimum altitude) and the **Z** mode (showing the altitude of the radar cone centre).

14. Persistance Knob (*Rémanence* in French). Two modes - R for ON and N for OFF. Determines how long will the contact remain on VTB after being lost by radar. NOT FUNCTIONAL

15. Radar Mode. Used to choose the Pulse Repetition Frequency (or the PRF). It governs the number of radar pulses transmitted each second. It has three settings:

- HFR (*Haute FRéquence*): High pulse repetition frequency
- ENT (*ENTrelacé*): Interleaved pulse repetition frequency
- BFR (*Basse FRéquence*): Low pulse repetition frequency

16. Bars selector. Used to determine number of bars (horizontal lines) which the radar will scan during each sweep cycle. The available settings are 4, 2 and 1 (for more information see Radar Coverage above).

17. Radar Range Switch. Used to cycle through preset ranges displayed on your VTB. Available options are: 5, 10, 20, 40 and 80 miles).

18. PSIC button. From French *Poursuite Sur Informations Continues* or Single Target Track. NOT FUNCTIONAL

19. Radar Scan Azimuth Selector. From French *Balayage*. Allows you to choose the horizontal aperture setting in which the radar will operate: 15, 30 and 60 degrees (for more information see Radar Coverage above).

RADAR POWER MODES

Depending on the setting of the Radar Power Switch, the VTB will look different.

A

P CH

SIL

EM

Apart from the Radar Power Switch you also need to use the Power ON / OFF switch in the lower - right part of the VTB.

NOTE

In SIL (standby) mode the Radar is not emitting, however you can adjust all the settings, like displayed range, PRF, azimuth and bars. While doing so you will not be visible on enemy RWR.

NOTE

When selecting WEAPONS SYSTEM COMMAND FWD or AFT on HOTAS, radar will become active even if the power switch is in the SIL position. Upon deselecting one of these modes, radar will return to SIL.

RADAR SCREEN

Below you will find explanation of RADAR symbology used in different modes.

1. RADAR ANTENNA ELEVATION. Shows you the angle at each the antenna is looking up or down. Each small bar represents 10º.

2. RADAR VERTICAL SCAN COVERAGE (bars). The number shows the bar settings chosen on the BARS SELECTOR switch (1, 2 or 4 lines). The line next to the number will move up or down along the Radar Antenna Elevation scale, showing current antenna angle. Note that when set to one bar, there is no number shown, only the horizontal line on the angle scale.

3. CALIBRATED AIR SPEED. Shows the CAS in knots as well as current speed in mach below (not visible on this screenshot).

4. HEADING SCALE. Similar to the one found on the HUD, it shows the current heading of the airplane. Each vertical bar represents 10º, numbers (12, 15, 18) give the heading (120, 150, 180).

5. BAROMETRIC ALTITUDE. Shows the current barometric altitude of the airplane (3 digits in XXX format, in this case 043 - 430 feet).

6. AIRCRAFT SYMBOL AND BANK ANGLE. The symbol in the middle is static and shows your aircraft, while the two long horizontal lines will move in order to represent current bank and pitch of the aircraft.

NOTE

Think of the indicators 3-6 as a HUD repeater on your VTB. It is extremely useful for maintaining situational awareness when you are heads down working on the targets shown on your VTB.

7. RADAR SCAN RANGE. Shows the range in Nautical Miles currently covered on the screen, set with the use of RADAR RANGE SWITCH.

8. PULSE REPETITION FREQUENCY. Displays the current working mode of the radar, determined by the position of the RADAR MODE switch. Possible options:

- HFR for *Haute FRéquence* (High Frequency)
- ENT is short for *Entrelacé* (= French for Interleaved)
- BFR for *Basse FRéquence* (Low Frequency)

The PRF setting governs the number of radar pulses transmitted each second and has three settings: High, Interleaved and Low. Each of these has its advantages and limitations.

In **High PRF (HFR)** setting your radar will work as a normal Doppler Radar, which means using maximum range - around 65 nautical miles. It is good in detecting targets that are below you and it allows both Track While Scan and Single Target Track mode for weapons guidance. The cons are that it is very susceptible to notching and it will reject the low velocity targets.

Low PRF (BFR) is quite the opposite - it is good for air-to-air look up and finding low velocity targets due to the fact that there is no Doppler filtering in this mode. However, it has poor air-to-air look down capability, it gets a lot of ground clutter, it does not allow you to lock any targets and it has limited range.

Interleaved (ENT), tries to get the best of both modes, having pretty good detection capability and ability to attain a lock in Track While Scan mode at 20 miles or less - but not to guide weapons. It still fares poorly against slow moving targets, though, and has limited range - up to 45 nM.

See RDI RADAR CAPABILITIES AND LIMITATIONS table for more information.

RADAR MODE, AZIMUTH AND TDC

Depending on the settings determined by the pilot, the radar screen will look differently. Below you will find some examples of the screen with different PRF, *Balayage* and TDC settings.

1. In the example above, the BALAYAGE is set to maximum, 60° scan - the green arc on the top extends through the whole width of of the radar screen.

2. The VERTICAL SCAN COVERAGE is set to 4 bars (as indicated by number 4 to the right of the longer vertical line) and the antenna is aligned with the nose and pointing forward.

3. The PULSE REPETITION FREQUENCY is set to HFR, or High.

4. This time not only CAS is visible, you can also see the mach number below.

1. In this example, the BALAYAGE is set to medium, 30º scan - the green arc on the top does not touch the edges of the radar screen. Remember that in this setting it is possible to move the antenna left or right. When doing so, you will notice the arc will also change place indicating the new direction in which the antenna is looking.

2. The VERTICAL SCAN COVERAGE is again set to 4 bars (as indicated by number 4 to the right of the longer vertical line) and the antenna is looking 12º up.

3. The PULSE REPETITION FREQUENCY is set to HFR, or High.

TARGET DESIGNATION CROSS, CONTACTS AND IFF

The image below shows the appearance of the contacts on the Radar screen, as well as IFF identification and information provided by the Target Designation Cross.

1. IFF BEING USED. The double line at the top of radar screen indicates that the IFF system is active. It becomes active after IFF Interrogation Button is pressed and provides friend - or - foe identification for a limited time.

2. CONTACT (FRIENDLY). The V symbol indicates a contact. It also indicates that the radar is in RWS mode. A small green diamond in the middle of the contact indicates a friendly unit. The number below shows the closing velocity in mach (in this case 1.0)

3 A. CONTACT (UNKNOWN). Lack of a diamond indicates a bogey, i.e. a contact that has no transponder or with transponder emitting at a frequency that is not identified as friendly. The number below shows the closing velocity in mach (again, 1.0)

CAUTION

If the contact is not identified as friendly, it does not necessarily mean it is hostile. In the campaign and many user - made missions always wait for authorisation to open fire.

Please note that if you are using the BFR mode, the contacts will look like squares instead of V symbols:

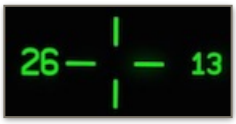
3 B. TARGET DESIGNATION CROSS. The cross can be moved around the VTB by using the TDC Hat Switch. The number on the left side of the cross shows the range from your plane to the spot directly underneath the cross.

NOTE

You can use the TDC to get the range from the contact without the need to lock him up (see more below on the TWS / STT lock).

The numbers displayed on the right side depend on the selected RADAR TDC MODE:

In S mode two numbers are displayed, giving the maximum and minimum altitude in thousands of feet covered by the Radar Cone.



In Z mode one number is displayed, showing the altitude of the radar cone centre in thousands of feet to the right from the cross.

4. DISTANCE AND BEARING to the point under the TDC from the selected waypoint. This will be covered in greater detail in the NAVIGATION SECTION. It is important to note here that in this particular case, the selected waypoint is 00, which will always be the current position of the aircraft. Having this in mind by moving the TDC around the screen you can obtain both the range and bearing to the point under the TDC from the point at which you currently are.

NOTE

This feature will be most commonly used for the Bullseye calls, but it can also be utilised for getting information about position of different targets in relation to your airplane.

Target type

M-2000 C's RDI radar has limited capability of identifying the painted target and showing the type of aircraft locked above the radar operation mode in the lower - right corner of the screen.

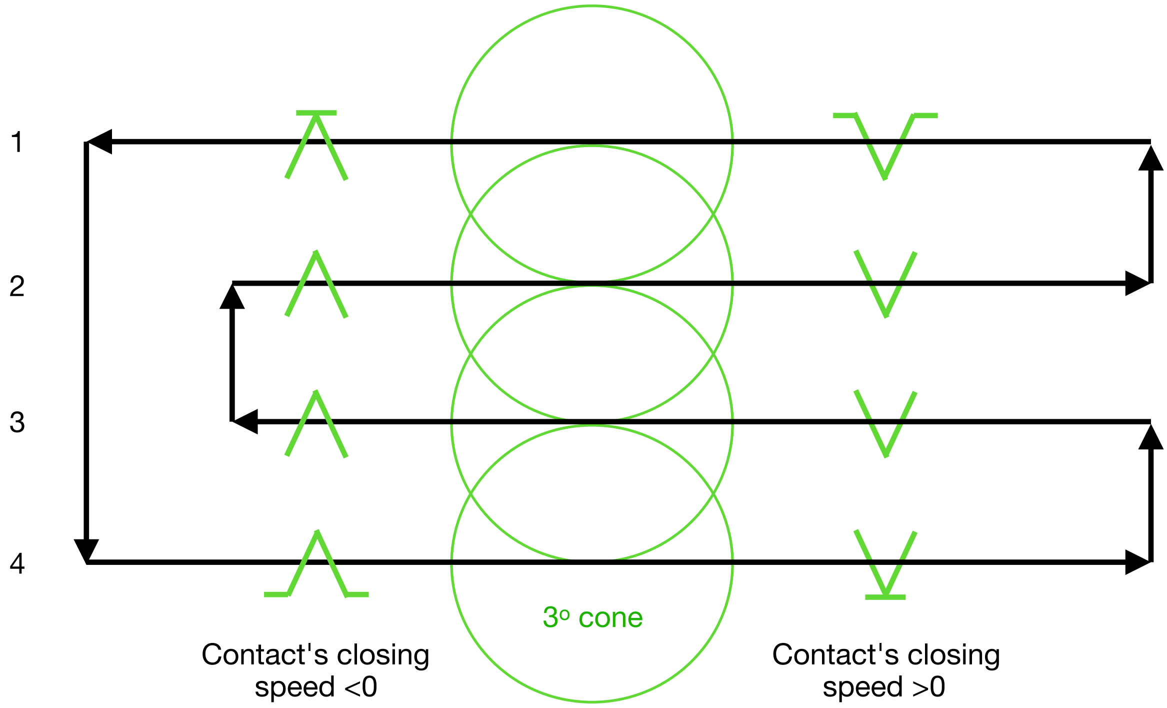
Combination of four letters / numbers used for description is self-explanatory (in the example to the left: MiG-21).

Contact symbols

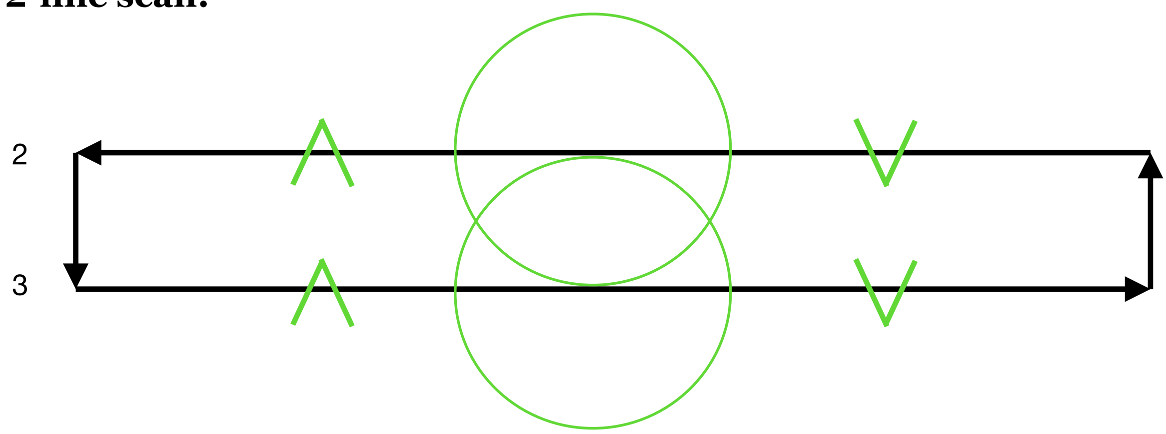
The appearance of contacts depends on the closing speed, as well as on the bar on which the given contact is detected. This helps you to understand at a single glance if you are gaining up on him or if he is getting away from you, as well as it lets you determine if he is in the middle of the radar search or on the outermost bar.

Depending on the situation, the following symbols will be displayed:

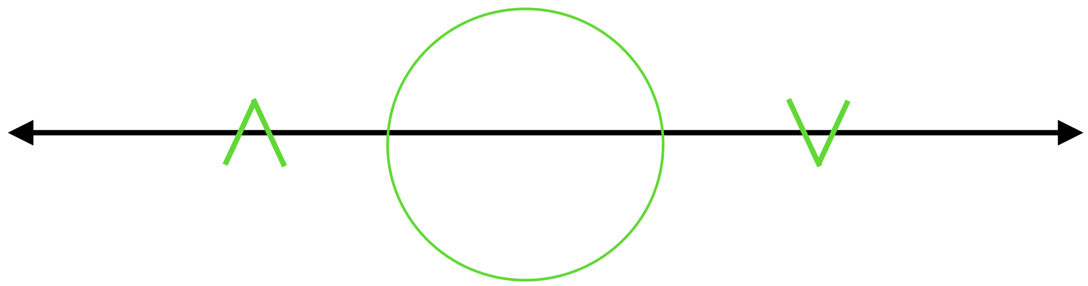
4-line scan:



2-line scan:



1-line scan:



In other words:

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

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

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

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

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

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

Contacts refresh rate

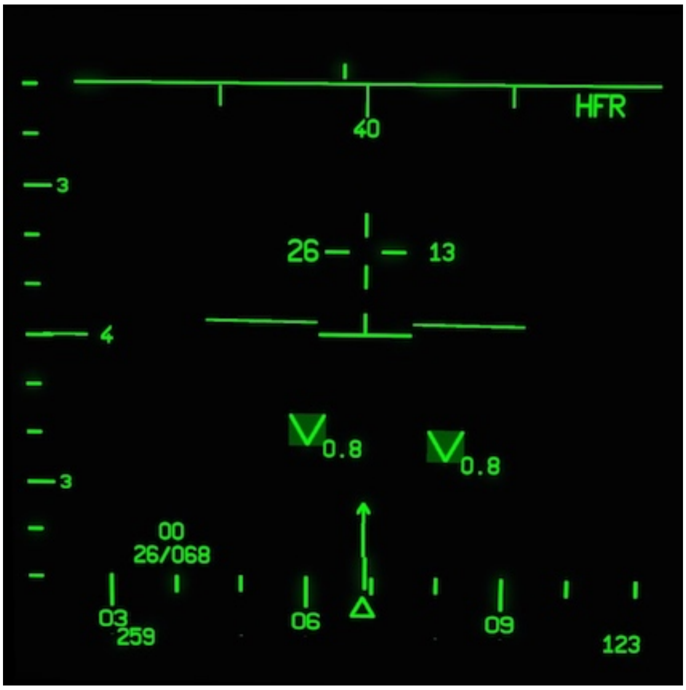
The contacts are displayed on the VTB only when the radar beam passes through them in the search mode. This means that in 4-bar scan, where the beam has to do four sweeps to cover the full 12 degree area, some of the contacts may disappear before they are painted again. This is normal - and if you experience such behaviour, reduce number of bars to 2 or 1.

Radar Display Mode

The radar can use two different display modes.

The PPI mode, in which the radar emitter is at the centre of a circle, while the contacts are marked as points inside it.

The B-Scope mode, which is commonly used in US built aircraft, the circle is flattened into a square with the bottom representing the emitter position.



RADAR SCREEN - TRACK WHILE SCANNING MODE

There are two ways of locking the contacts with a radar: Track While Scanning (TWS) and Single Target Track (STT). After acquiring a lock, additional information about the target will be displayed on the VTB.

Below is the example of information displayed in the TWS mode, or PID in French (from *Poursuite sur Informations Discontinues*).

1. Target speed in mach. Shows the current speed of the locked target.

2. Target heading. Shows current heading of the locked target.

3. Target closing velocity (VR stands for *Vitesse de Rapprochement* in French) Displays the speed at which you are approaching your target or how fast it is getting away from you (with a minus in front), measured in knots.

4. Target altitude. Given in hundreds of feet or Flight Level format (XXX - in this case 14 300 feet).

5. Bearing to target. The long line in STT mode will show the bearing to your target.

6. Distance to target. Shown next to the locked contact, it displays the distance in Nautical Miles. When the distance falls below 10 miles, it will show more detailed information in the X.X format (for instance, 4.6 miles).

7. Locked target. Indicated by two vertical lines on both sides - |V|. The closing velocity in mach is still shown beneath.

NOTE

Remember that the relation between closing velocity given in IAS (knots) and the same indication in mach (below the contact mark) depends on target's altitude - as a rule of thumb, the higher you are, the less knots you are making for a mach.

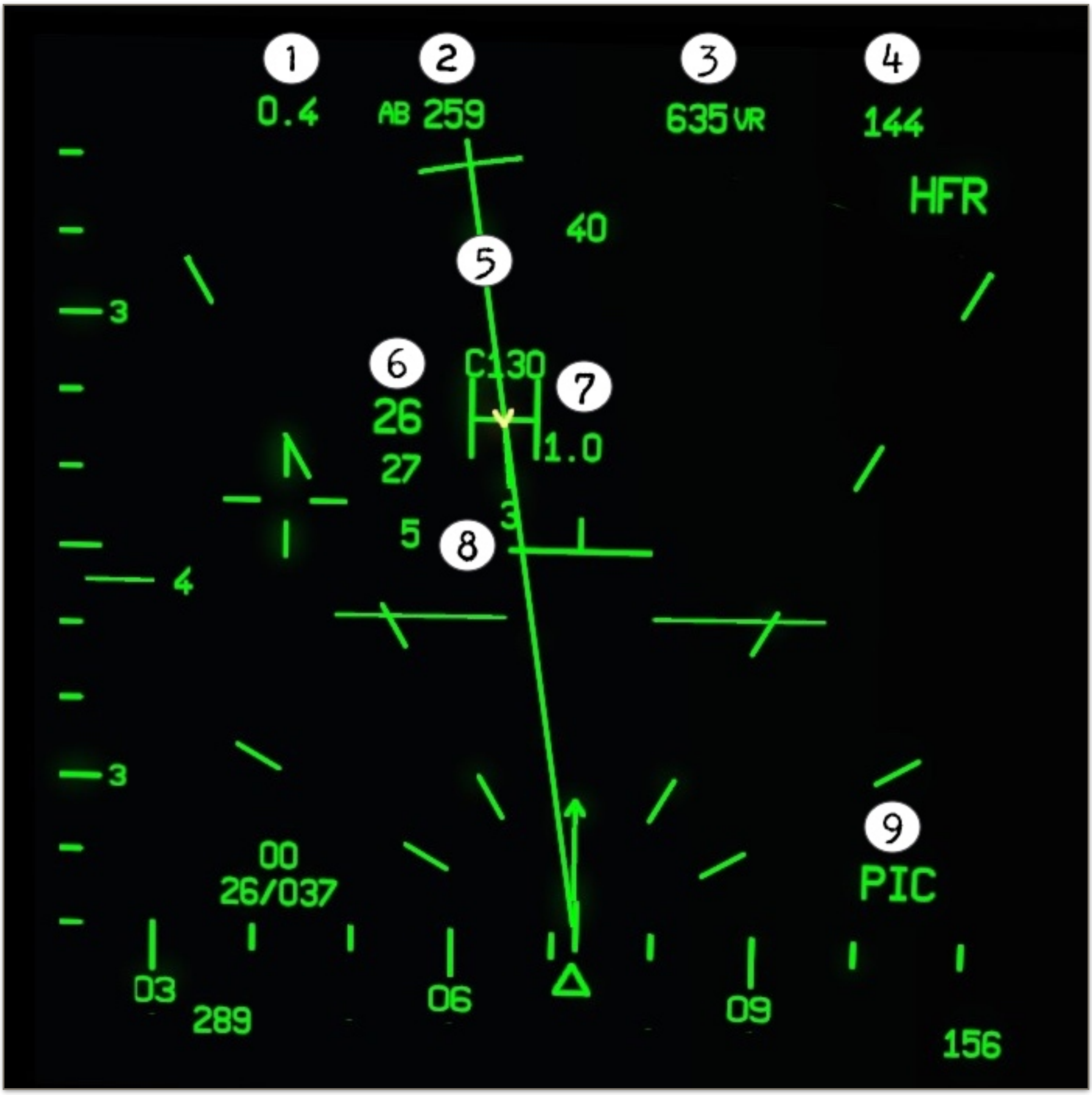
8. B-angle. It is the angle formed by the target's heading and your current heading, also known as B-angle. The small line at the centre of the locked target indicates both target velocity (it grows the faster the target travels), while the number beneath is the B-angle (and the line rotates to show direction of travel). With the B-angle you can check when the target is trying to "notch", that is to put itself perpendicular to the radar beam in order to force the radar to drop both the lock and the contact. For more information, refer to Weapons Employment section.

9. Current lock type designation. There are two options:

- PID (*Poursuite sur Informations Discontinues*): Track While Scanning. In this mode radar will partially focus on the locked target providing additional information, while continuing to scan the area with the set number of bars / horizontal angle.
- PIC (*Poursuite sur Informations Continues*): Single Target Track. In this mode, radar will focus all of its power solely on the locked target. This mode is used for employment of the S-530D missiles and for Close Combat Mode. For more information, refer to Weapons Employment section.

RADAR SCREEN - SINGLE TARGET TRACK MODE

Below is the example of information displayed in the STT mode, or PIC in French (from P*oursuite sur Information Continue*).



1. TARGET SPEED IN MACH. Shows the current speed of the locked target.

2. TARGET HEADING. Shows current heading of the locked target.

3. TARGET CLOSING VELOCITY. Displays the speed at which you are approaching your target or how fast it is getting away from you (with a minus in front), measured in knots.

4. TARGET ALTITUDE. Given in hundreds of feet or Flight Level format (XXX - in this case 14 300 feet).

5. BEARING TO TARGET. The long line in STT mode will show the bearing to your target as well as the exact azimuth of the antenna (as it will focus on the single target and turn towards it).

6. DISTANCE TO TARGET. Shown next to the locked contact, it displays the distance in Nautical Miles. When the distance falls below 10 miles, it will show more detailed information in the X.X format (for instance, 4.6 miles).

7. LOCKED TARGET. Indicated by two vertical lines with a line in the middle - H. The closing velocity in mach is still shown beneath. Above it, you have the NCTR indication. The NCTR recognises and displays the aircraft type of the target, by comparing radar returns of the actual target versus a loaded library. As it compares specific "radar signatures" from the fan of the engines, it works only when the target is facing you, and the distance between you is not too big.

8. B-ANGLE. It is the angle formed by the target's heading and your current heading, also known as B-angle. The small line at the centre of the locked target indicates both target velocity (it grows the faster the target travels), while the number beneath is the B-angle (and the line rotates to show direction of travel). With the B-angle you can check when the target is trying to "notch", that is to put itself perpendicular to the radar beam in order to force the radar to drop both the lock and the contact. For more information, refer to WEAPONS EMPLOYMENT section.

9. CURRENT LOCK TYPE DESIGNATION. There are two options:

- PID (*Poursuite sur Information Discontinues*): Track While Scanning. In this mode radar will partially focus on the locked target providing additional information, while continuing to scan the area with the set number of bars / horizontal angle.
- PIC (*Poursuite sur Information Continues*): Single Target Track. In this mode, radar will focus all of its power solely on the locked target. This mode is used for employment of the S-530D missiles and for Close Combat Mode. For more information, refer to WEAPONS EMPLOYMENT section.

CLOSE COMBAT MODES (CCM)

Close Combat Modes are a set of dedicated radar modes for close air to air engagements. In those modes, the radar will be set at a range of 10 nautical miles and it will automatically lock on the closest contact it can detect.

There are 5 search modes available in CCM:

BORESIGHT: Available with all weapons. In boresight mode, the radar is in a fixed position, centered on the aircraft's reference line. It provides a narrow search cone only 3° wide. Basically the radar is converted into a gunnery radar.

VERTICAL SCAN: Vertical Scan is available with both AA Guns and Magic missiles selected. It provides a narrow vertical beam that is 4.8° wide and 60° tall. It covers between +50° to -10° centered on the aircraft reference line.

HUD (SPIRAL) SCAN (SVI - *Spirale VIseur* - for the French acronym): available only in 530 or POL master modes. The radar covers the entire HUD area, a 20° wide cone. It searches in a spiral pattern originating from the centre of the HUD and completes the search in roughly 2 seconds.

HUD FLOOD: only available after Super 530 firing, to try to guide the missile on a target that succeeded to break your radar lock, by visually placing it inside a 3° circle in the middle of the HUD. "SVI" label is displayed on right side of the HUD.

HORIZONTAL SCAN: available with all weapons. It has two submodes: MODE 1 and MODE 2, but they work the same: The radar search a 30° Azimuth arc with two bars for a 6° x 60° search cone. Unlike the other modes, it is possible to move the radar antenna in elevation.

MODE 1 uses High PRF, while MODE 2 uses Medium PRF. Medium PRF search mode is only available in Horizontal Scan Mode 2.

NOTE

When selecting WEAPONS SYSTEM COMMAND FWD or AFT on HOTAS, radar will become active even if the power switch is in the SIL position. Upon deselecting one of these modes, radar will return to SIL

For more information, please refer to WEAPONS EMPLOYMENT section.

COUNTERMEASURES

The Mirage 2000C is equipped with a combination (suite) of countermeasure systems. Despite of all of them being able to operate independently and perform their own specific tasks, these systems can automatically communicate and work together as one in order to defend against air-to-air, ground-to-air radar and infra-red threats.

The systems are:

SERVAL. Radar warning receiver.

SPIRALE. Chaff and flare dispenser.

SPIRALE BOX. A control panel informing about current state of Spirale system.

SABRE. Radar jammer.

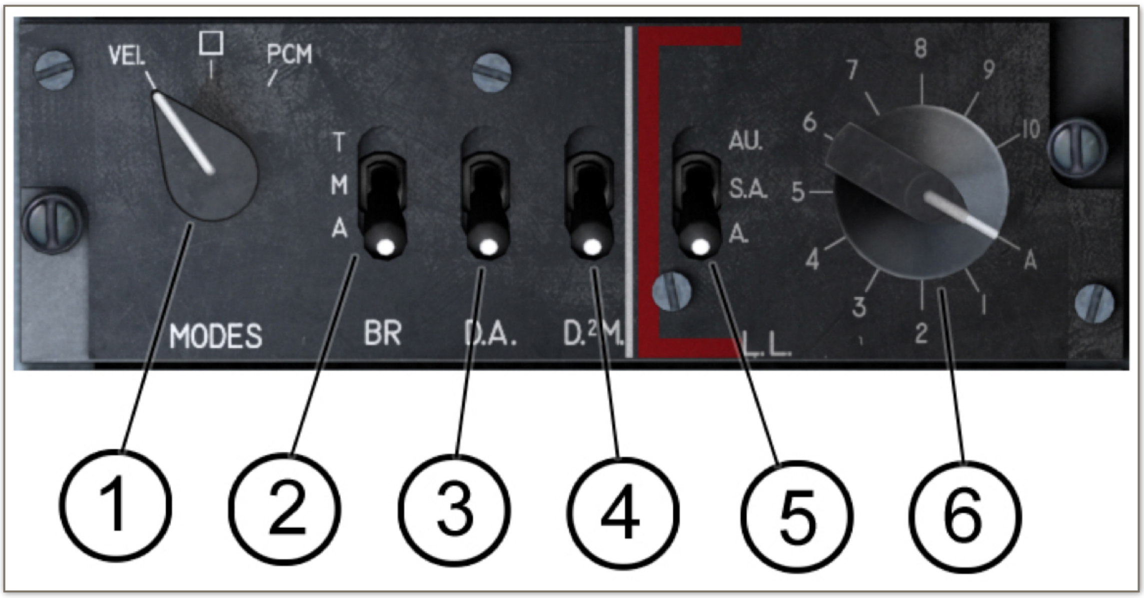
ÉCLAIR. Additional chaff and flare dispenser.

DDM. Missile launch warning system.

All these systems are controlled by a single Electronics Counter Measures (ECM) Panel located in the right instruments panel, below the INS Control Panel (PCN).

The ÉCLAIR chaff and flare dispenser is particular, as it has been developed and added later. It is an option that can be installed or removed as required.

The ECM PANEL is divided into two sections: Sensors and Emitters to the left and Decoy dispensers to the right.



1.SABRE (JAMMER) MODE SWITCH. It has three positions:

- VEI.: jammer forced to standby and will never emit.
- [ ]: jammer operates manually (triggered by the pilot)

- PCM: priority mode. Jammer operates all the time.

2. SABRE MASTER SWITCH (BR). Again, three positions:

- A: OFF
- M: ON (jammer is powered and operates in accordance with the mode switch position).
- T: Test.

3. SERVAL (RWR) MASTER SWITCH. Three positions:

- A: OFF
- M: ON
- T: Test.

4. D2M IR LAUNCH DETECTOR MASTER SWITCH. Three positions:

- A: OFF
- M: ON
- T: Test.

5. SPIRALE (DECOY DISPENSER) MODE SWITCH. Three positions:

- A: OFF
- S.A.: Semi-automatic program execution.
- AU: Automatic program execution. NOT FUNCTIONAL

6. SPIRALE PROGRAM SELECTOR. It has 11 positions:

- A: *Arrêt*. No program selected, so only the panic pushbutton is available (see below), provided the mode switch powers the dispenser
- 1-10: manual selection of the program that will be triggered by the stick button (see below)

STICK AND THROTTLE SWITCHES

The stick has a pushbutton to trigger countermeasure response. Spirale and/or Eclair dispensers will execute the decoy sequence set via the program selector.

The throttle has a "panic" pushbutton, used to release a pre-determined chaff/flares combination (Program 0 of the SPIRALE). This program is an all-purpose EM/IR combination used in case of emergency. The other button is the jammer control, switching ON and OFF the emitter (if SABRE mode switch is set to [] position). Refer to HOTAS CONTROLS for more information.

SABRE JAMMING AND DECEPTION SYSTEM

The M-2000C carries a built-in jamming and deception system. The pod is located at the bottom of the tail-fin along with the rearward antenna, while the forward antenna is housed in a fairing situated high on the leading edge of the fin.

1. SERVAL ANTENNA. See below for more information.

2. FORWARD SABRE ANTENNA. Sends the jamming signal in all directions around the aircraft. This induces that all aircraft around the jammer will receive the jamming signal.

3. POWER SOURCE AND REAR SABRE ANTENNA. Generates the jamming signal and transmits to the antennas.

The system is preprogrammed from factory and the pilot has no means to change its working parameters from the cockpit. What methods the system use to jam and spoof enemy radar is classified and no public document exists.

How to operate

The system is governed by two switches and has two operational modes: VEILLE (listening/standby) and ACTIVE JAMMING (*Brouillage*), see previous page for details.

To use the jammer the pilot should first switch the Sabre Master Switch to the M position. Later he must set the Sabre Mode Switch to the position he desires/ requires.

The following table describes the jammer operation depending on switch selection:

<table>
<tr><th colspan="3">Switch Position</th><th rowspan="2">Jammer Status</th><th colspan="2">Status Lights</th></tr>
<tr><th>BR</th><th>Mode</th><th>HOTAS</th><th>V</th><th>BR</th></tr>
<tr><td>A</td><td>Any</td><td rowspan="2">N/A</td><td>Off</td><td>Off</td><td>Off</td></tr>
<tr><td rowspan="4">M</td><td>VEI</td><td rowspan="2">Standby</td><td>ON</td><td>Off</td></tr>
<tr><td rowspan="2">[]</td><td>Standby</td><td>ON</td><td>Off</td></tr>
<tr><td>Emitting</td><td rowspan="2">Emitting</td><td>ON</td><td>ON</td></tr>
<tr><td>PCM</td><td rowspan="2">N/A</td><td>ON</td><td>ON</td></tr>
<tr><td>T</td><td>Any</td><td>Standby</td><td>BLINK</td><td>BLINK</td></tr>
<tr><td colspan="3">Malfunction</td><td>Off</td><td>ON</td><td>BLINK</td></tr>
</table>

The table above gives an overview of SABRE operations depending on the setting of the Jammer Master Switch and Jammer Operational Mode Switch, as well as the use of HOTAS controls.

Fields marked with RED mean that the jammer is not operational or the relevant status light is off.

Fields marked with YELLOW mean that the jammer is in standby mode (waiting for input) or the status light is blinking.

Fields marked with GREEN mean that the jammer is operational or the relevant status light is ON.

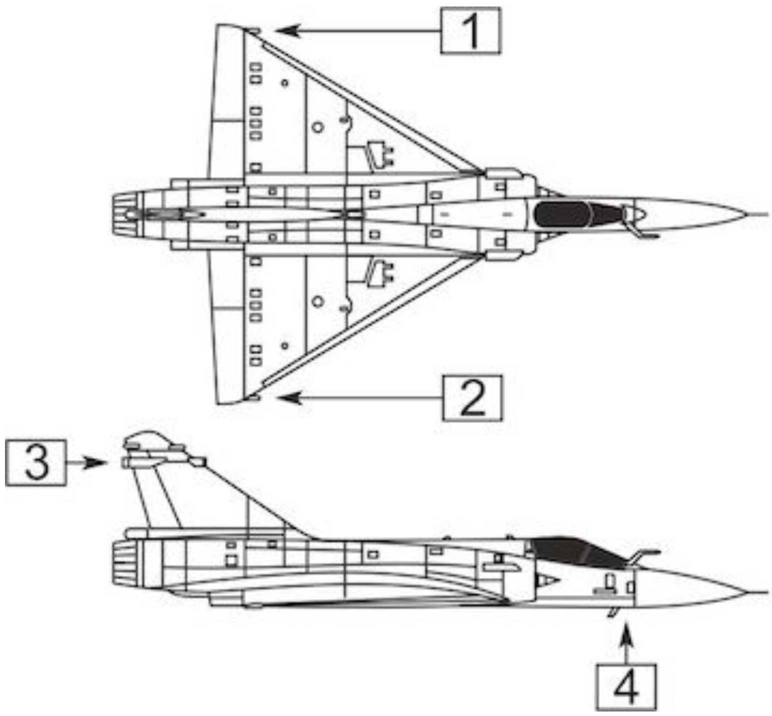
Fields marked with GREY mean that either given option is not available or specific HOTAS input is required from the pilot. In this case pressing the Jammer Control Switch on the throttle will toggle the jammer between listening-standby and listening+emitting modes.

WARNING

The jammer must be used wisely. Some missiles, like the AIM-120 AMRAAM, can switch to the home-on-jam (HOJ) mode. This means that they do not try to detect the target in the middle of the noise, they just home on the source of the jamming signal, providing a high kill probability.

SERVAL (RADAR WARNING RECEIVER)

The RWR is a sensor that detects the radio emissions of radar systems. It provides with both a visual and audio warning when a radar threat is detected. The system is completely passive so there is no danger of being detected due to using it.



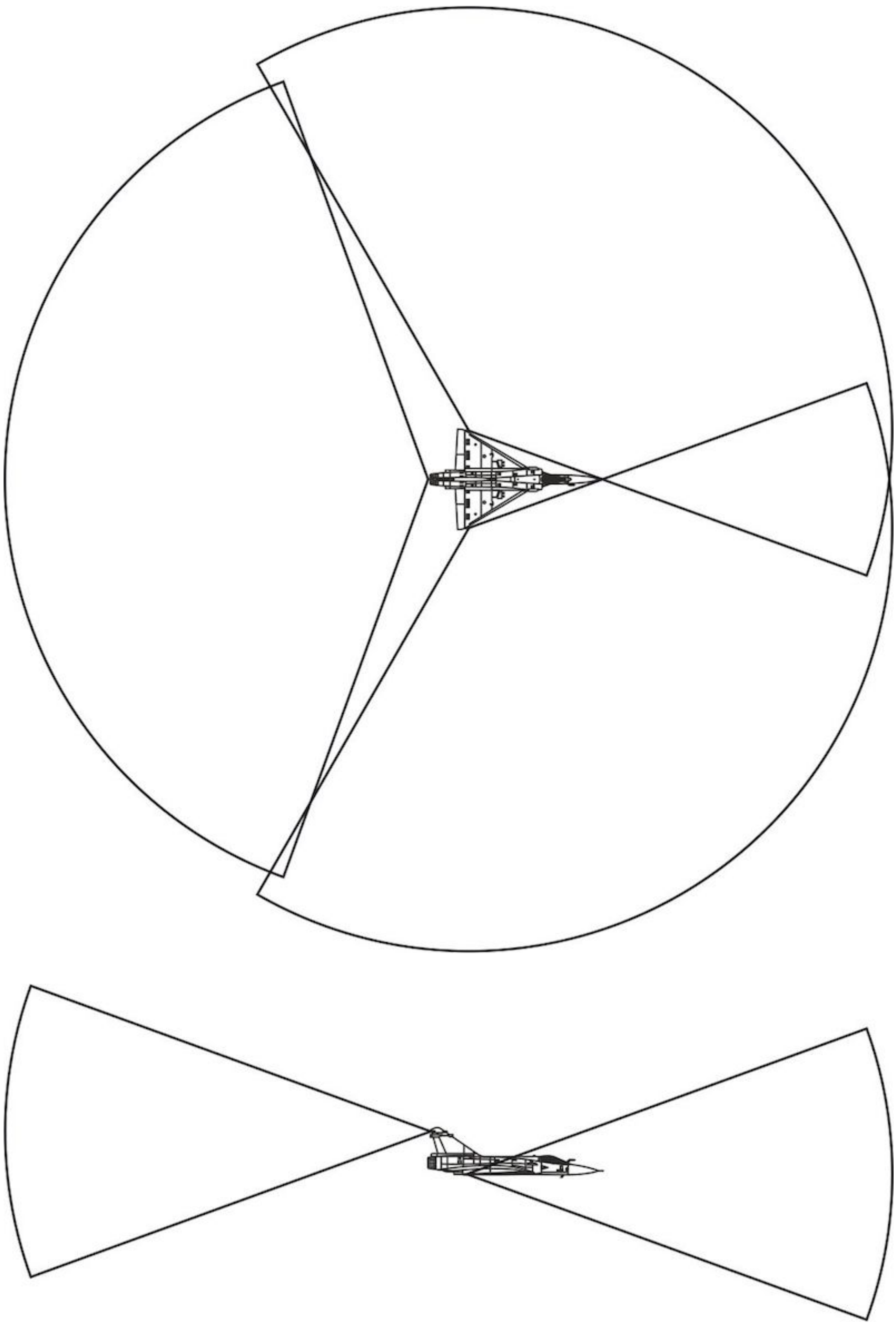
1- Wing left sensor	
2- Wing right sensor	
3- Fin rear sensor	
4- Onmidirectional sensor	

The RWR system uses four antennas that provide 360º coverage: a double antenna located on each wing, looking forward & sideways, one located on the trailing edge of the tail fin looking back. And finally an omnidirectional antenna under the nose, not marked below.

The SERVAL sensors can not scan all around the aircraft. It has been decided to favour the horizontal coverage, leaving blind spots directly above and below the aircraft. When performing sharp manoeuvres, this must be kept in mind.

The total coverage resembles to a "tyre" known as the geometrical shape "tore", with the aircraft at its centre. As such, the cockpit representation of this coverage is a circular display, centered on the aircraft and looking top down. The coverage of the omni-antenna is not included, as it is non-directional. See the schematics on the next page for graphical representation.

Sensor coverage:



Radar Warning Receiver threat display

The threat display is a panel composed of a circular LCD screen and beneath light indicators.

The screen displays graphics representing the radar sources. The graphics depend on the type of radar and its operating mode: surveillance, search or track. The position on the screen shows the relative bearing of the source, and the distance depends on the estimated danger level.

The indicators provide status of the systems of the suite.

1. THE LOW THREAT ZONE. All threats displayed inside this zone represent a possible danger to the aircraft. The radar signals displayed here are determined to be in search mode. You must decide if they are significant or not.

2. THE CRITICAL THREAT ZONE. All threats displayed inside this zone represent an imminent danger to the safety of the aircraft because they either have a radar lock or the radar is emitting guidance signals to a missile, which is interpreted as a missile launch.

If a missile radar is detected it will be displayed inside this zone, even if it is not guiding towards the aircraft.

3. BRIGHTNESS KNOB. Controls the display brightness.

4. SYSTEMS STATUS INDICATORS. Indicates if associated system is powered or active. See below for details.

V: When lit, indicates the radar jamming system is powered and ready for operation. V = *Veille*, or listening / standby.

BR: When lit, indicates the radar jammer is operating (emitting jamming signals). BR = *Brouillage*, or jamming.

DA: When lit, indicates the RWR is powered and operating.
DA = *Détecteur d'Alerte*, or [radar] alert detector.

D2M: When lit, indicates the missile warning system is operating. When blinking, indicates that the system is powered but not ready for operation (warm-up).
D2M = *Détecteur de Départ Missile*, or missile launch detector.

LL: When lit, indicates the chaff/flare dispenser system is powered and ready for operation. LL = *Lance Leurres*, or decoy launcher.

A non-lit status indicator means that the associated system is either OFF. A blinking light indicates that the system is either undergoing a test or experiencing a malfunction. See HOW TO OPERATE table for more details.

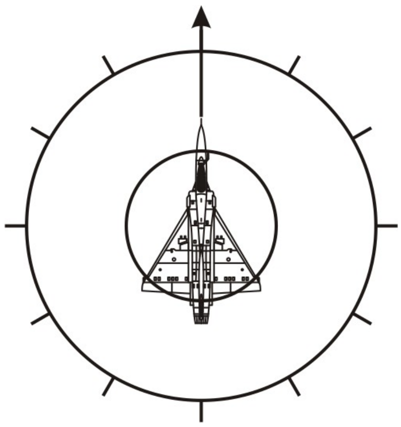
The RWR cannot determine distance to a threat, all it can do is determine signal strength. The closer the threat is to the RWR center, the stronger the signal. This can be used as an approximation to the distance between the detected radar and the aircraft, but it does not necessarily mean that the threat is close to the aircraft.

Low threat signals will not cross into the critical threat zone if they are close

Displaying the threats

Once the SERVAL system has identified the radar threat, it displays a graphic providing type, operating mode, relative bearing and level of danger.

The relative bearing is simple to read. The Mirage is at the centre of the display, and the forward direction is the 12 o'clock direction.



Threat Symbols

The RWR has an internal library that allows it to identify the category and type of radar. There are three categories: Airborne, ground and missile radars. Each category has its own symbol that identifies it.

Ground threats

Symbol	Description
A	"Gepard" and ZSU-23-4 ("Shilka") Radar Guided AA guns
S6	SA-19 TUNGUSKA 2S6
3	SA - 3 GOA
6	SA - 6 GAINFUL
8	SA - 8 GECKO
10	SA - 10 GRUMBLE FLAP LID TRACKING RADAR
CS	SA - 10 CLAM SHELL LOW ALT. ACQUIS. RADAR"
BB	SA - 10 BIG BIRD SEARCH RADAR
11	SA - 11 GADFLY TRACKING RADAR
SD	SA - 11 SNOW DRIFT SEARCH RADAR
13	SA - 13 GOPHER
15	SA - 15 GAUNTLET
DE	DOG EAR SEARCH RADAR
RO	ROLAND
PA	PATRIOT
HA	HAWK

Airborne threats - Red Coalition

Symbol	Description
15	MIG -15 Gunnery Radar
KL	JF-17 THUNDER
21	MIG-21 bis FISHBED
23	MIG - 23 FLOGGER
24	SU-24 FENCER
25	MIG-25 FOXBAT
29	MIG - 29 FULCRUM or SU-27 FLANKER
30	SU-30 FLANKER-C
31	MIG-31 FOXHOUND
33	SU-33 FLANKER-D
34	SU-34 FULLBACK
39	SU-39
50	A-50 MAINSTAY
UK	UNKNOWN (MiG-19)

Airborne threats - Blue Coalition

Symbol	Description
14	F-14
15	F-15
16	F-16
18	F/A-18
111	F-111
E3	E-3
E2	E-2
2KC	M-2000C, M-2000-5
S3	S-3
EA6	EA-6B
F4	F-4
F5	F-5
F86	F-86 (Gunnery Radar)
64D	LONGBOW APACHE

A symbol can have three states on the display:

- If a symbol is displayed with no circle around it, it indicates that the radar is in acquisition / search mode. When a new emitter is detected, a new threat tone will be heard.
- If a symbol has a circle around it, it indicates that the radar is tracking / locked on to your aircraft. When being tracked by an engagement radar, you will be provided a radar lock tone.
- If a symbol has a flashing circle around it, it indicates that the radar is supporting a missile that has been shot at you.

Examples

In this example, the RWR has detected a MiG-29 (or Su-27), a F16, E3 AWACS and one ground threat, an SA-11 launcher with tracking radar.

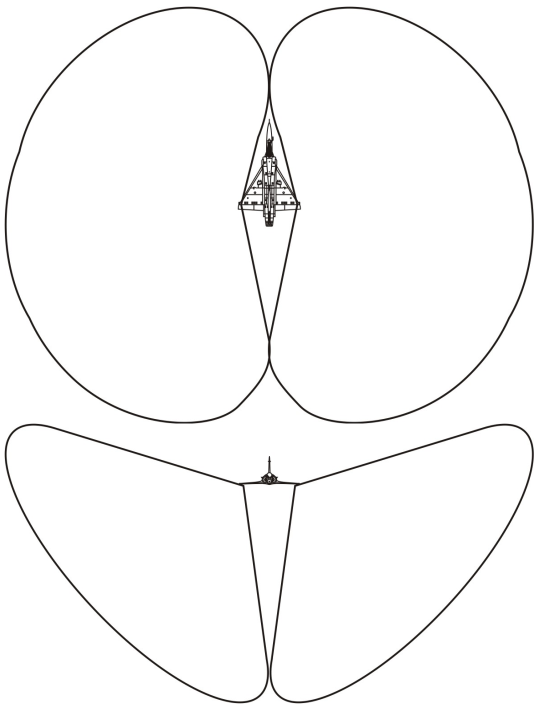
In the second example, the MiG-29 (or Su-27) has locked player's aircraft.

DDM (MISSILE LAUNCH WARNING SYSTEM)

DDM stands for *Détecteur de Départ Missile*, or missile launch detector. It is also labelled D2M.

The DDM is an optical system that detects the infra-red signature of a rocket motor. It is mainly used in close range air-to-air and air-to-ground engagements against short-range infra-red missiles. The optical sensors are located on extensions of the outer wing pylons (see below).

The sensors coverage is optimised all around the aircraft and downwards. The coverage can be seen below:



The DDM only detects the heat coming from the flame of a burning rocket motor.

Therefore:

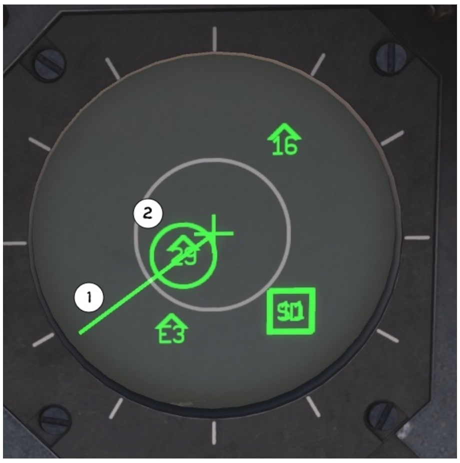
- It does not make a difference between an infra-red guided missile, a radar-guided missile or a simple rocket.
- It does not make a difference between a blue or a red missile/rocket.
- It cannot determine if the missile is going directly at you or just passing by.
- It cannot determine the distance of the missile, only the relative bearing.
- The detection range depends on the intensity of the infra-red signature. The bigger the motor, the farther it will be seen.
- If the rocket motor has totally burnt its fuel, it will not be detected (no heat source). This is typical of a missile at the end of the propelled phase

The DDM requires a warm-up time before being operational. This is indicated by the blinking D2M status indicator below the SERVAL display.

DDM Alert

The DDM provides a high frequency audio warning (1000 Hz) in the pilot's helmet, and a visual cue on the SERVAL display, in the form of a solid line originating from the centre of the display and running in the direction of the threat. The audio and visual alerts continue as long as the threat is detected.

The visual alert on the RWR will look as follows:



In this case the missile has been shot from 8 o’clock (indicated by the solid line extending from the centre of the RWR towards the mark at the edge of the threat display).

The attacking aircraft is also shown in this example - a MiG-29 with a blinking circle around it, meaning that it is guiding a missile at us.

It is also worth noting that the MiG-29 is in the inner circle of the RWR.

If the detected missile is IR - guided, there will be no indication other than a solid line and a direction from which it has been shot.

SPIRALE (DECOY DISPENSER)

All the above systems are controlled by a common control panel, except the ÉCLAIR system which, being a later addition, has is own control box. In addition, dedicated controls are on the stick and the throttle. The panel has been described at the beginning of the chapter.

1. SPIRALE (DECOY DISPENSER) MODE SWITCH. Three positions:
- A: OFF (Manual mode)
- S.A.: Semi-automatic program execution.
- AU: Automatic program execution. NOT FUNCTIONAL

2. SPIRALE PROGRAM SELECTOR. It has 11 positions:
- A: no program chosen.
- 1-10: manual selection of the program.

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

In A - manual mode - when rotary is set between 1-10, each press of Countermeasures Switch on the Control Stick releases a pre-programmed number of chaff and flares. The default programmes can be found on the kneeboard and in the table above. Bear in mind that PANIC button on the throttle will not work in this configuration.

In S.A mode, each press of the Countermeasures Switch on the Control Stick releases a pre-programmed number of chaff / flares. PANIC button on the throttle will work normally in this mode.

In AU mode, the system will determine the threat and adjust the appropriate response / program. BR (jammer) switch has to be set to M.

Each program has a defined number of chaff and / or flares and a number of cycles it will use with every press of the Countermeasures Switch.

BVR 1 to **BVR 3** programs are to be used when engaging in BVR combat. Since the threat will come from radar guided missiles, only chaff will be released. Depending on the expected threat, from SARH to ARH you can select between 1 to three cycles of chaff launch. There is a 2 second interval between each release cycle in BVR 2 and BVR 3, to allow time for you to clear the threat zone.

SAM 1 is to be used against old technology SAMs like the SA-2 or SA-6.

SAM 2 is to be used against new technology SAMs like the SA-10 and higher.

IR SAM is to be used when the threats come from any type of IR guided missile. But it is specially tailored to deal with MANPADs and mobile SAM sites.

AG Mix is designed to be used during the insertion phase in a bombing run when the target is heavily defended.

Flare Jettison: releases all the flares in a short timed burst.

PANIC program as it name implies is to be used when you are unexpectedly attacked. It releases a fixed mix of chaff and flares to deal with either IR or Radar threats. The mix in PANIC program cannot be modified by the user. It is designed for air-to-air threats.

Spirale Box

Spirale Box is located on the right part of the glare shield and consists of several lights and a knob.

1. LL LIGHT: for *Lance Leurres* (decoy launcher). Lights up whenever any decoy (flare or chaff) is dispensed.

2. EM LIGHT: starts to blink when number of available chaff is low (12 or less). Lights up when the system is not working properly or when all the chaff are expended.

3. IR LIGHT: starts to blink when number of available flares is low (6 or less). Lights up when the system is not working properly or when all the flares are expended.

4. EO LIGHT: for electrooptical countermeasures, which are not simulated in DCS. It will remain ON as no countermeasures of this type can be loaded on the aircraft.

5. EFF BUTTON: for *effacer* (delete). It clears all the indications from the Spirale Box.

ECLAIR (Decoy Dispenser)

Due to the limited original amount of flares (16) packed by the SPIRALE system, the ÉCLAIR chassis was developed later to increase the capacity. When needed, the chassis is installed under the aircraft, between the centre pylon and the engine nozzle. To be installed, it requires removing the drag chute assembly or the emergency hook. Keep this in mind when landing on short runways.

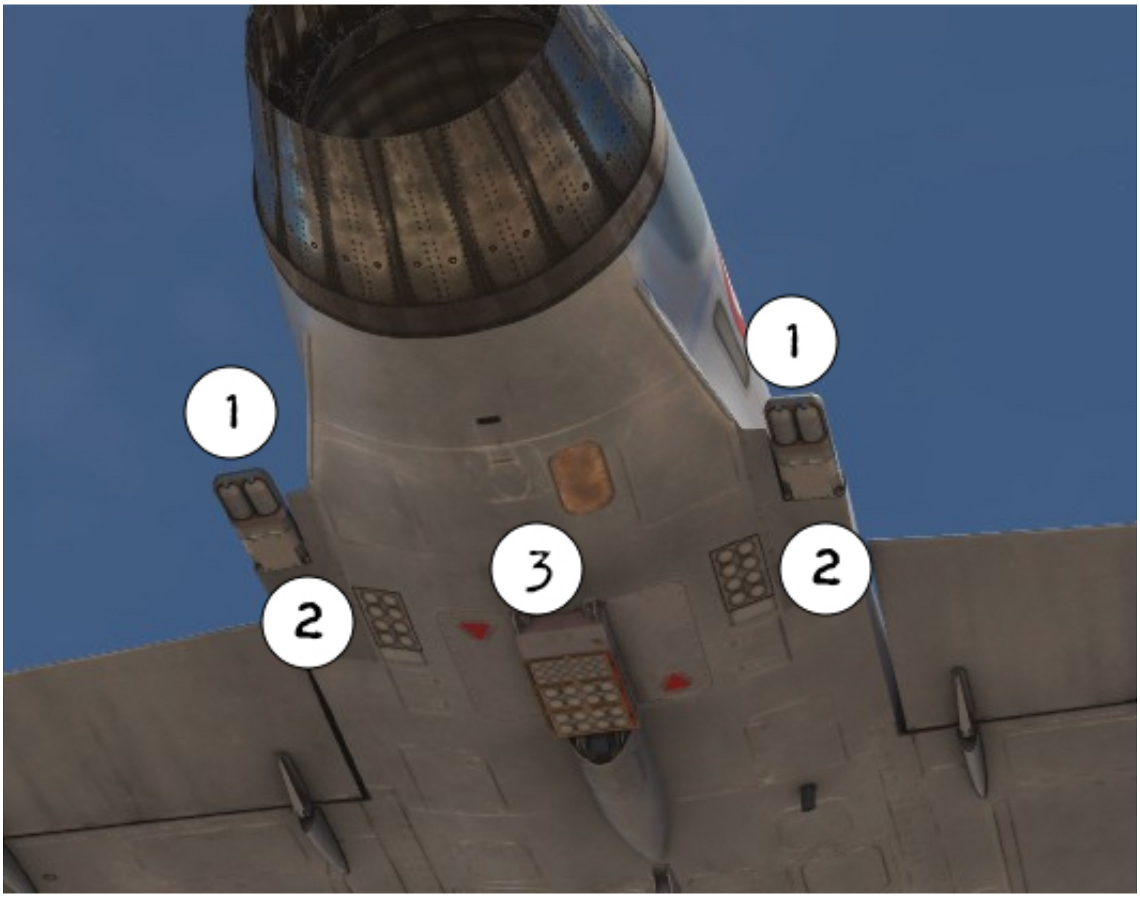
Flare cartridges (IR) are grouped by 8 in rectangular racks. Chaff cartridges (EM) are grouped by 18. These racks are inserted in the chassis installed on the aircraft. These racks are identical to the ones used by the SPIRALE system.

NOTE	It is not possible to mix two types of cartridges in a same rack.

The ÉCLAIR chassis can hold 3 racks. Therefore, it can hold 24 flares, or 54 chaff or a combination. For example, with two IR and one EM racks, it holds 2 x 8 = 16 IR and 1 x 18 = 18 EM.

The ÉCLAIR chaff and flares load complements the SPIRALE load and cartridge firing can be managed by the SPIRALE (Semi-auto and automatic mode) or independently.

SPIRALE and Éclair dispenser locations

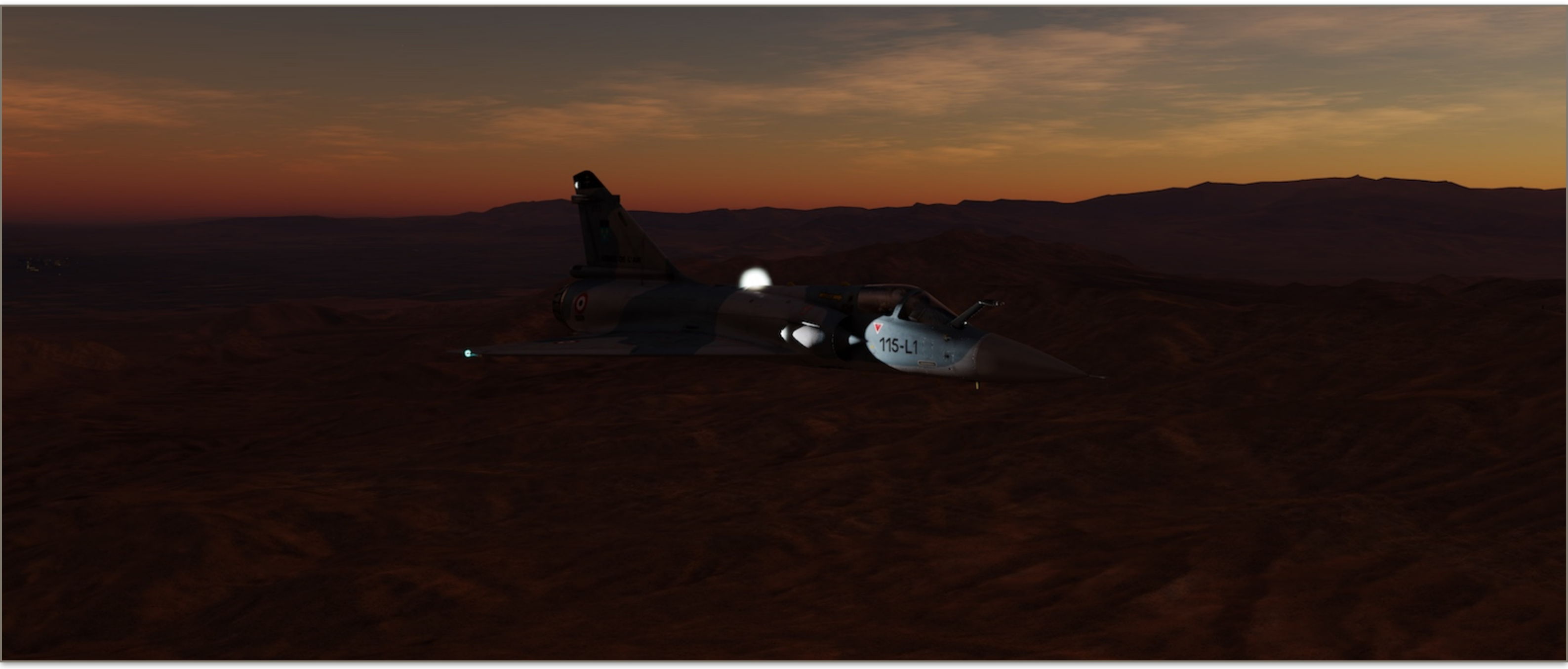


1. SPIRALE CHAFF DISPENSERS. Fires chaff only. Total capacity: 112 EM.

2. SPIRALE CHASSIS. Accepts chaff or flares racks.

3. ÉCLAIR CHASSIS. Accepts chaff or flares racks.

SECTION 14



LIGHTING

COCKPIT LIGHTING

For night operations, the cockpit has an instrument lighting system controlled via the cockpit lighting control panel located on the aft part of the right-side console. It provides cabin flood lighting as well as instruments / panels backlighting.

These features have separate controls. Intensity is adjusted by turning the knobs clockwise (increase) or counterclockwise (decrease).

The Mirage 2000C module also features night vision goggles - see SECTION 14-3 for more information.

INTERNAL LIGHTING CONTROLS

1. MAIN INSTRUMENT PANEL RED BACKLIGHTING KNOB (small one, on top).

2. MAIN INSTRUMENT PANEL FLOOD KNOB (large one, underneath no.1). It produces green flood light directed at the main dashboard, which is compatible with the night - vision goggles.

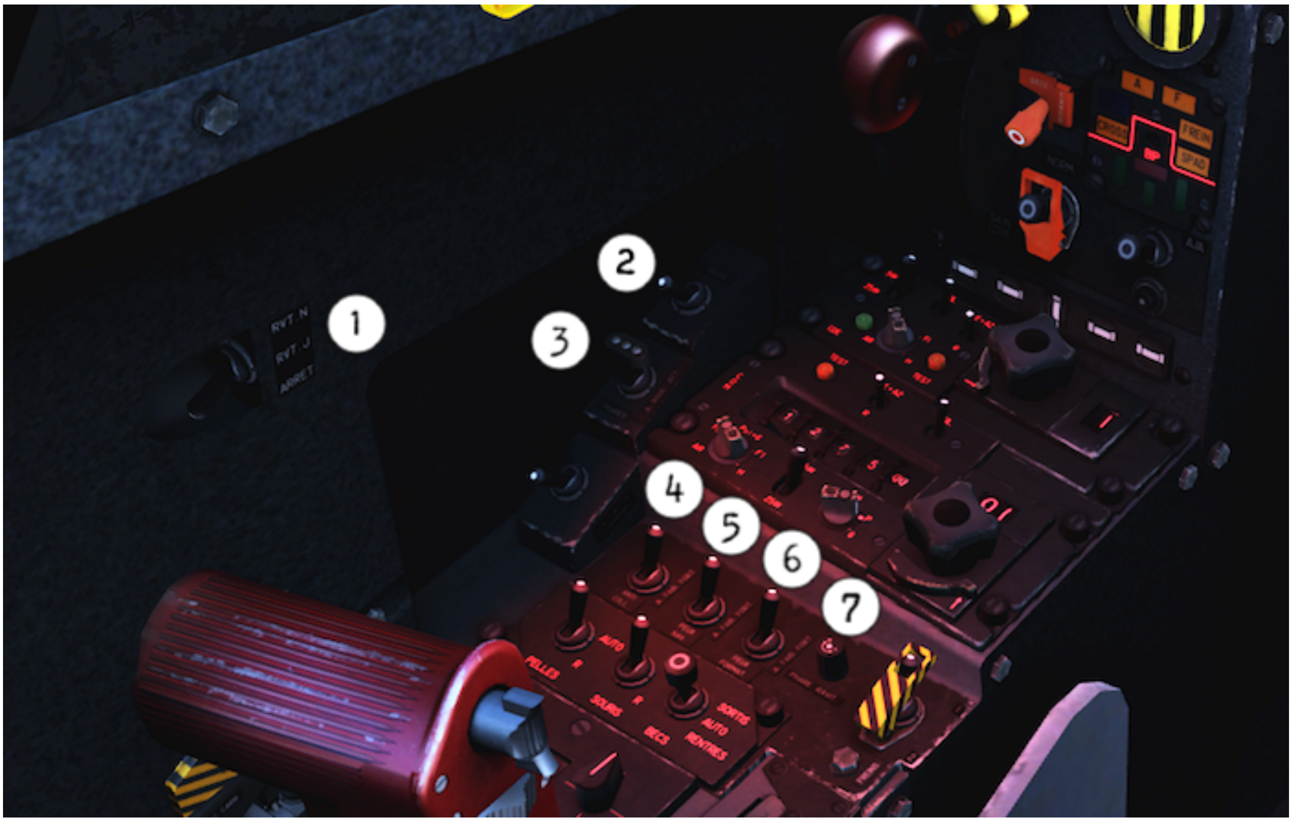
3. SIDE CONSOLES RED BACKLIGHTING KNOB (small one, on top).

4. SIDE CONSOLES FLOOD LIGHT KNOB (large one, underneath no. 3). It produces green flood light directed at the consoles, which is compatible with the night - vision goggles.

5. ANNUNCIATORS INTENSITY KNOB. Changes the intensity of the Master Caution and Warning lights on the Alarms panel, as well as radios and weapons configuration panel.

6. WHITE COCKPIT FLOOD KNOB. It mostly covers the main instrument panel.

External lights controls



1. AIR REFUELLING LIGHTS (on left bulkhead). The refuel lights extend and come on when the in-flight refuel switch is set to RVT N (*Ravitaillement Nuit* - Refuel Night) upper most position. This light must not be used above 350kt.

2. POLICE LIGHT SWITCH. Arms the POLICE light. In order to turn it on and off, you need to use the Police Light switch on the throttle.

3. LANDING LIGHTS SWITCH. It has three positions. In AFT position, landing lights are off. In middle position, the taxi light is on. If forward position, landing lights are on.

4. ANTI - COLLISION LIGHT SWITCH. Turns on and off anti-collision lights. Two intensities are available with the FEUX NAV switch: FAIB. (*faible* - low) and FORT (high).

5. NAVIGATION LIGHTS SWITCH. Controls the navigation lights. Two intensities are available with the FEUX NAV switch: FAIB. (*faible* - low) and FORT (high).

6. FORMATION LIGHTS SWITCH. Turns the formation lights on and off. Two intensities are available: FAIB. (*faible* - low) and FORT (high) with the FEUX FORMAT.

7. REFUEL LIGHTS INTENSITY KNOB. **NOT FUNCTIONAL**

EXTERIOR LIGHTS

The exterior lighting is composed of five separate systems with different purpose:

1. FORWARD FORMATION LIGHT (left, right). The formation light system provides visual cues to the wingman for night time close formation flight.

2. ANTI - COLLISION LIGHTS. The anti-collision lights system provides long distance visual position indication, by the mean of upper and lower white strobe lights. They are located one on the top middle of the aircraft spine, the second on the underside between the nosewheel and the centre pylon.

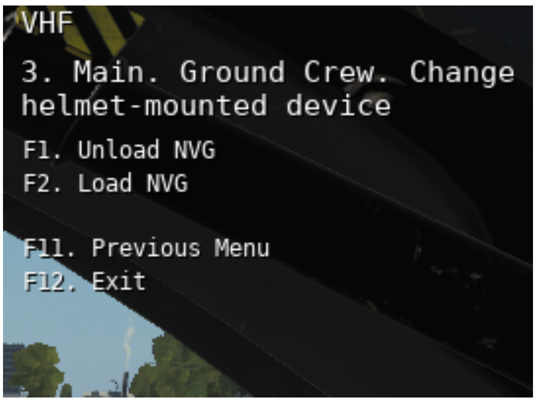
3. LEFT AND RIGHT NAVIGATION LIGHTS. The navigations lights system provides the standard red/green/white night time visual position indication. The lights are located on the wingtips (left red and right green).

4. AFT FORMATION LIGHT (left, right).

5. FIN FORMATION LIGHt (left, right).

6. FIN NAVIGATION LIGHT (white).

7. POLICE LIGHT. On the left side of the aircraft, behind the left air intake, is a high intensity floodlight oriented up and left. It is used for night time visual identification procedures, to illuminate the unknown aircraft.



The floodlight is armed via the POLICE light arm switch, and set on or off with the throttle police light switch.

8. RETRACTABLE REFUEL LIGHT. Mounted in the right fuselage, this retractable floodlight is used for illuminating ahead of the aircraft in order to locate the refuelling drogue.

9. PROBE REFUEL LIGHT. Located in the nose, destined to illuminate the tip of the refueling probe.

10. TAXI / LANDING LIGHTS. Two floodlights, located on the nose wheel strut, provide forward lighting for taxi, take off and landing.


115-L1
10

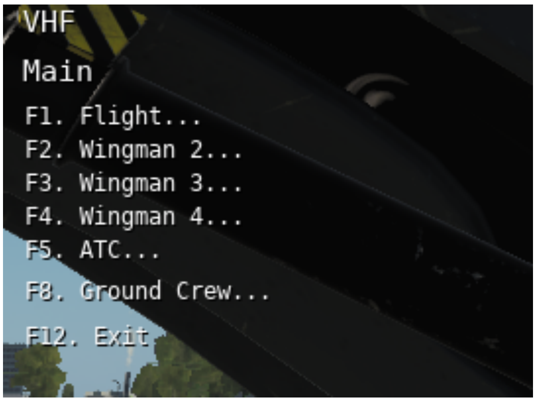
NIGHT VISION GOGGLES

M-2000c is equipped with night vision goggles (NVGs) as well as special interior lighting system adapted to use them.

By default, NVGs are not loaded into the cockpit (unless you begin your mission in the air and after sunset) and pilot has to remember to ask the Ground Crew to install the bag containing NVGs before takeoff.

Installing NVGs

In order to ask your Crew Chief to install the NVG bag, use the Radio Menu and follow the steps listed below.

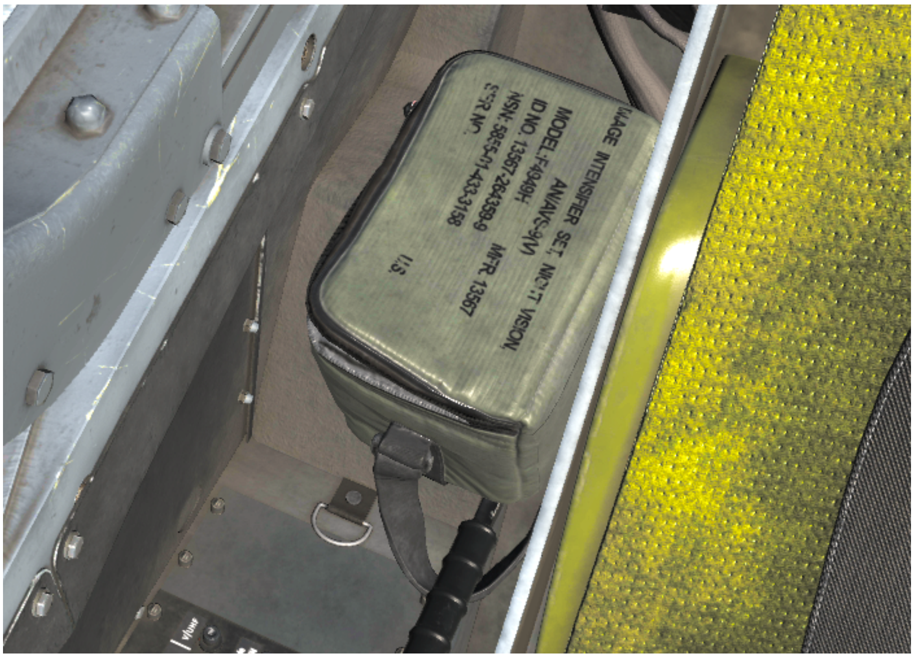


Press F8 to contact Ground Crew.

Press F5 - Change helmet-mounted device

Press F2 to load the NVGs

If you follow the steps correctly, you should see the NVG bag installed to the left from the pilot's seat:



Using NVGs

In order to be able to use the goggles, the pilot first has to take them out of the bag and place them on the NVG stand, located on the left side of the dashboard. This can be done by **LEFT** or **RIGHT CLICKING** on the bag. After doing that, the NVGs should be installed:

The last step is to mount the NVGs on the helmet. In order to do so, LEFT or RIGHT CLICK on the goggles. They will be removed from the stand and ready to use by pressing the default keybinding for NVGs.

Clicking on the stand once again will remove the goggles from the helmet and put them back on the stand. The NVGs can only be activated when mounted on the helmet.

In order to use the NVGs efficiently, it is crucial to set up the interior cockpit lighting properly - otherwise the pilot can be easily blinded by the instruments. The easiest way to achieve the required effect is to use the **Night Vision Goggles (French accronym)** switch located just above the Internal Lighting Control panel, by putting it in the upper, JVN position.

Doing so will dim all the backlight for main dashboard and side panels, (**excluding XXX**). After using NVGs, the switch should be returned to N (Normal) position.

NOTE	It is not possible to adjust the brightness of the NVGs.

NOTE	If you start a mission in-flight, you will have the NVGs installed only if you start at dusk / at night. You can also use checkbox in Mission Editor.

SECTION 15

Screenshot by Steele6

COMBAT

INTRODUCTION

The M-2000C is considered a multirole fighter due to its capability to use both Air-to-Air (AA) and Air-to-Ground (AG) weapons. However, you must be aware that the aircraft was designed as a lightweight interceptor and thus it is heavily specialised towards the air combat role at the expense of AG capabilities, so instead of being a designated multirole fighter, it should be considered as an Interceptor with secondary Close Air Support (CAS) capabilities.

WEAPONS

The M-2000C can load a number of different air - to - air missiles and air - to - ground munitions. However, due to limitations of the targeting computer, it is not possible to mix Super 530D missiles with air-to-ground weapons, and not possible either to mix different kinds of air-to-ground weapons. Doing so (for instance rockets and bombs, Mk-82s and Belougas etc.) may result in system not being able to handle the configuration and thus not work properly.

CAUTION Do not mix air - to ground weapons, use only one type for the mission. Failing to do so may result in inability to deliver any munitions.

NOT FUNCTIONAL BAP-100 bomb, though available for M-2000C, is not simulated in the DCS and thus not included in this manual.

***

AIR-TO-AIR

Type:	**Matra Super 530D**		Air to Air
Description:	Semi Active Radar Homing missile		
Warhead: 30kg	Range: 40 km	Max carried: 2	PCA: **530**

Type:	**Matra R550 Magic II**		Air to Air
Description:	IR guided missile		
Warhead: 13 kg	Range: 5 km	Max carried: 4	PCA: **MAG**

AIR-TO-GROUND

Type:	**Mark 82**		Air to Ground
Description:	500 pounds unguided low-drag general purpose bomb		
Warhead: 89 kg	Max carried: 8	PCA: **BL1**	Guided: NO

Type:	**Mk-82 Snake Eye**		Air to Ground
Description:	500 pounds unguided retarded general purpose bomb		
Warhead: 89 kg	Max carried: 8	PCA: **BF1**	Guided: NO

Type:	BLG-66 Belouga		Air to Ground
Description:	Unguided low-drag cluster bomb		
Warhead: bomblets, 1.3 kg each (151)	Max carried: 9	PCA: **BF4**	Guided: NO

Type:	GBU-12		Air to Ground
Description:	500 pounds laser guided bomb.		
Warhead: 89 kg	Max carried: 4	PCA: **EF1**	Guided: YES

Type:	**GBU-16**		Air to Ground
Description:	1,000 pounds laser guided bomb		
Warhead: 202 kg	Max carried: 1	PCA: **EF1**	Guided: YES

Type:	**GBU-24**		Air to Ground
Description:	2,000 pounds laser guided bomb		
Warhead: 429 kg	Max carried: 1	PCA: **EF1**	Guided: YES

Type:	**Matra LRF4 rocket pod**		Air to Ground
Description:	Rocket pod with 18 unguided rockets per pod		
Rocket: 68mm	Max carried: 4	PCA: **RK3**	Guided: NO

Cannons

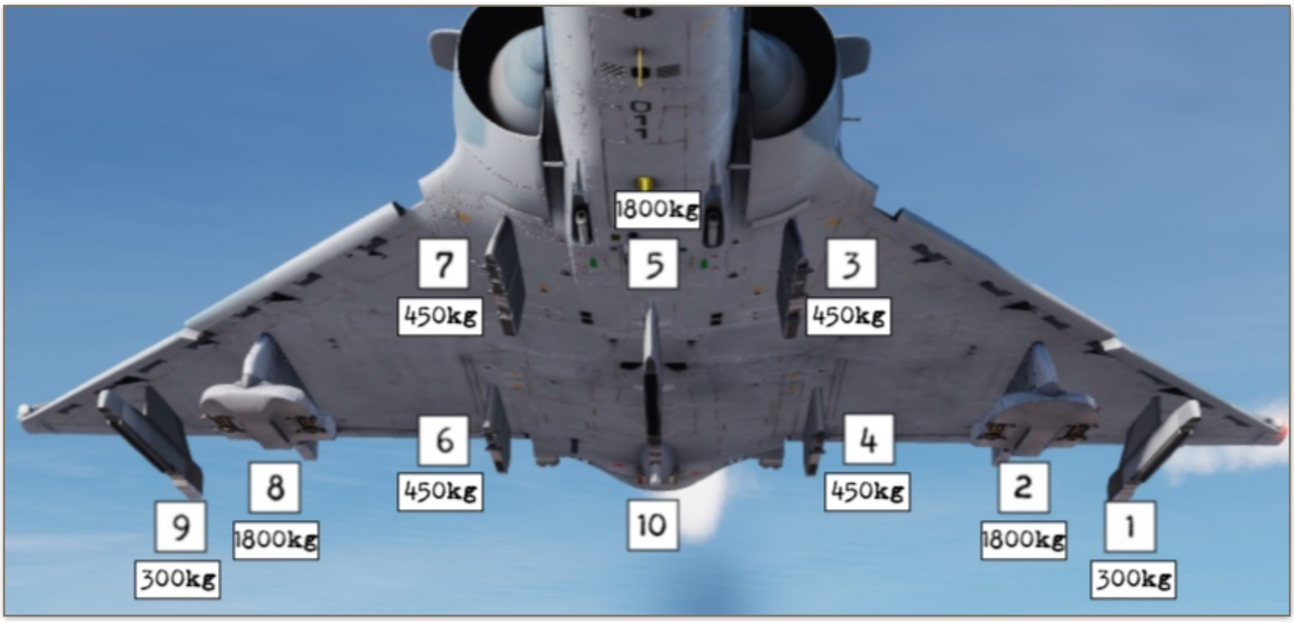
Type:	**Defa 554**		Built-in guns
Description:	30mm revolver cannons		
Ammo: 125 / each	Number installed: 2		

FUEL TANKS

Type:	**RPL 522**		Fuel Tank
Description:	Centerline fuel tank		
Capacity: 1300 litres	Max carried: 1	PCA: **RP**	

Type:	**RPL 541 & 542**		Fuel Tank
Description:	Under-wing fuel tank		
Capacity: 2000 litres	Max carried: 2	PCA: **RP**	

WEAPONS CONFIGURATION



WEAPON	PCA	STATIONS								
		9	8	7	6	5	4	3	2	1
Magic 2	MAG	1	1						1	1
Super 530D	530		1						1	
Mk-82	BL1		1/2	1	1		1	1	1/2	
Mk-82 SE	BF1		1/2	1	1		1	1	1/2	
BLG-66	BF4		1/2	1	1	1	1	1	1/2	
Rockets	RK3	1	1						1	1
GBU-12	EF1				1	1/2	1			
GBU-16	EF1					1				
GBU-24	EF1					1				
RPL 522	RP					1				
RPL 541&542	RP		1						1	

Station number 10 appears in the arming window (in-game and ME) and represents the exclusive emplacement for the additional ECLAIR chaff/flare dispenser. As it can not accommodate anything else, it is not considered as a store station and is not shown in the table. Remember, when the dispenser is installed, the drag chute is automatically removed.

WEAPONS MANAGEMENT

Weapons management is carried out by two panels located in the Main Instruments panel: the Weapons Configuration panel (PPA, French acronym for *Poste de Préparation Armement*) and the Weapons Manager Panel (PCA, French acronym for *Poste de Commande Armement*).

PPA (WEAPONS CONFIGURATION PANEL)

The PPA is located to the right of the radar display and below the HIS. It is used to configure selected weapons options, like bomb fuse type, cooling the Magic II seeker, etc.

The panel is divided in four parts.

- The upper left part is dedicated to air-to-air missile preparation and side selection.
- The lower left part is dedicated to bombs arming and ripple adjustment.
- The lower right part permits selection between partial and total weapon delivery.
- The upper right part is used for lights tests and load check.

1. MISSILE PYLON SELECTOR. This three position switch is used to control the launch order of the Super 530D missiles. The positions are:

G (from FR: *Gauche*, Left): The first missile to be fired will be the left one.

AUTO: The PPA selects the missile that is closest to the locked target. The left missile will be fired when the target is to the left or center of the aircraft. The right missile will be fire when the target is to the right of the aircraft. This is the default position.

D (from FR: *Droit*, Right): The first missile to be fired will be the right one.

The switch is only active when there are two missiles on board the aircraft. If there is only one, that missile will be fired regardless of switch position

2. SUPER 530D PREPARATION. This button is used to trigger On or Off all Super 530D missiles Preparation (BIT) and thus allowing/preventing their use. The preparation is triggered by either powering up the aircraft, clicking on the button or by selecting the missile related-mode on the PCA. The missile will take 45 seconds before becoming fully operational.

The preparation is cancelled by clicking again on the button; this is done for long ferry flight with no chance of missile use. Otherwise, OP require the preparation to be completed on the ground before taxiing, and to remain On for the whole flight.

The button has two lights:

P: Short for "*Prêt*" (Ready). Turns on when the Super 530D are ready to use. Blinking when they are undergoing the preparation process.

MIS: Turns on when there are Super 530D missiles aboard the aircraft.

3. MISSILE FIRE SELECTOR. This button is not used in the M-2000C.

4. MAGIC II PREPARATION. This button is used to trigger On or Off all MAGIC II missiles Preparation (BIT & cooling of the seeker) and thus allowing/preventing their use. The preparation is triggered by either powering up the aircraft, clicking on the button or by selecting the missile related-mode on the PCA or using the HOTAS selector.

Switching the preparation Off is used to save the MAGIC II seeker coolant supply (nitrogen). There is enough supply to keep the seeker heads active for 90 minutes, after that time the seekers become warm rendering the missiles useless. The missile will take 30 seconds before becoming fully operational.

NOTE	Each time the preparation is reactivated (switched On) will shorten the coolant supply by 10 minutes. Plan its use carefully.

The button has two lights:

P: Short for "*Prêt*" (Ready). Turns on when the MAGIC IIs are ready to use. Blinking when they are undergoing the preparation process and Dark when the missiles are in safe mode or no missiles are onboard

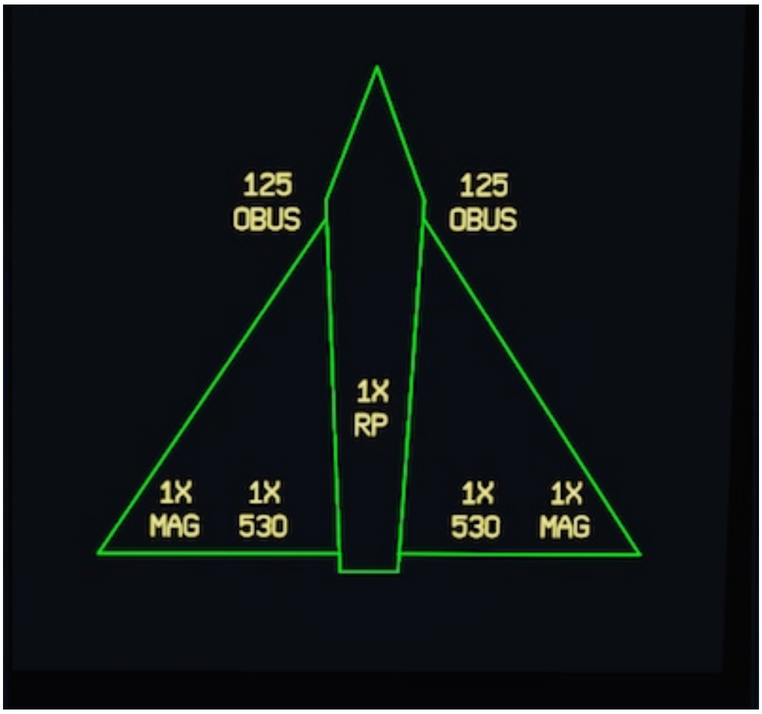
MAG: Turns on when there are MAGIC II missiles aboard the aircraft.

5. SYSTEM LIGHTS TEST/LOAD OUT DISPLAY. Three position spring loaded switch. The values are:

TEST: Tests all the PCA and PPA lights.

OFF: Default position (unmarked).

PRES: Displays in the VTB an aircraft silhouette with the current weapons load.



6. BOMB FUSING SELECTOR. Three position switch used to arm the bombs onboard by selecting which fuse to activate. The values are:

INERT: Bombs are unarmed/safe. If released with the switch in this position, they will not explode. This is the default position.

RET.: Short for *Retardé,* Delayed. This position arms the bombs' tail fuse thus allowing them to penetrate the target before exploding.

INST.: Short for *Instantané*, Contact or Instantaneous. This position arms the bombs' nose and tail fuses thus allowing them to explode as soon as they hit the target.

RET and INST values are only valid for MK-82, MK-82S and GBU bombs. For Cluster bombs, BAP-100 and RET and INST selects the same fuse.

7. BOMB RELEASE QUANTITY SELECTOR. To increase/decrease the quantity of bombs to be released you have to click on the release quantity switch. A left click will increase the value and a right click will decrease it.

8. BOMB RELEASE INTERVAL SELECTOR. This switch is used to increase/decrease the distance between each bomb release. A left click will increase the value and a right click will decrease it. This function is only active when multiple bombs are released at the same time.

9. SELECTED QUANTITY DISPLAY. The top window indicates the quantity of bombs to be released with each trigger action. The values are increased/decreased in pairs: 0, 2, 4, 8, 10. For the PPA 0 is equivalent to 1.

10. SELECTED INTERVAL DISPLAY. The bottom window indicates the interval between each individual bomb release, the value is in 10s of meters. The indicated value is in tens of meters, e.g.: 1 = 10 meters, 40 = 400 meters, etc.

Bomb release priority: in order to maintain aircraft load balance, the bombs are dropped in matching pairs from the outwards pylons to the internals. The release order is: 2, 8, 4, 6, 3, 7, 5.

11. SALVO FIRING SELECTOR. This button only applies to the following weapons: Super 530D, DEFA 554 guns and rocket pods. This button is used to select how the weapons will be fired on each trigger press. Functionality differs on weapon type

It has two values:

TOT:

- For Super 530D: It launches both missiles with a two second interval between launch.
- For Rockets and DEFA 554 guns: Rocket pods or guns keep firing for as long as the trigger is pressed.

PAR:

- For Super 530D: It launches a single missile.
- For Rockets and DEFA 554 guns: Rocket pods or guns fire in burst mode. Rocket burst count can be selected between 1, 3, 6 and 18. The rocket burst count can be selected in the Mission Editor.

PCA (WEAPONS MANAGEMENT PANEL)

The PCA is located to the left of the radar display. It consists of a panel with one open switch, one guarded switch, and two rows of five LCD displays with buttons below them.

The PCA controls the aircraft's Master Modes of operation and is used for all aspects of the aircraft's flight.

1. MASTER ARM SWITCH. Turning it on or off allows or prevents the release of ordnance.

2. SELECTIVE JETTISON CONSENT SWITCH. The guarded switch is used to jettison selected weapons from the aircraft. Refer to **SELECTIVE JETTISON** part for more information.

The two rows of LCD displays with their associated buttons are used to configure aircraft flight parameters and Master Modes. The top row is used to configure the system while the bottom row is used for weapons/stores selection.

3. A/G GUN MODE SELECTOR BUTTON. Used to put the gun in Air-to-Ground mode[3]. In order to use the gun in the Air-to-Air mode, use the A-A Gun Mode button on your HOTAS.

4. THE PCA TOP ROW. The PCA is also used for aircraft system configuration and the options displayed change based on system Master Mode. The associated buttons have a backlit S in the centre, that turns on when an option has been selected.

The options displayed in the top row change based on the system Master Mode. Most of the options are exclusive, meaning that selecting one will deselect the previous one.

[3] CAS stands for *Canons Air-Sol*.

5. THE PCA BOTTOM ROW. Unlike other systems, the PCA does not display an individual weapon and its position in the aircraft, instead it groups them by type. Since the LCD cannot display the full weapon name a code is assigned to each weapon (please see **WEAPONS, SECTION 15-1** for the PCA weapons code), this code is also displayed in the HUD when it is in attack mode. Additionally, the PCA sorts the loaded weapons based on their assigned priorities, basically AA weapons to the left and AG weapons to the right based on type.

The Weapon Codes will display in the bottom row in the following priority:

LCD 1	LCD 2	LCD 3	LCD 4	LCD 5
MAG	-	-	-	-
-	530	-	-	-
-	BL1/ BF1/BF4	BL1/ BF1/BF4	BL1/ BF1/BF4	BL1/ BF1/BF4
-	RK3	RK3	RK3	RK3
-	RP	RP	RP	RP
-	-	EL1	EL1	EL1
-	-	BF8	BF8	BF8

The associated buttons have two markings: S and P. S stands for selected and P for ready (it is the first letter of the word *Prêt*).

Weapons selection is done by clicking on the button below the selected code, when a weapon is selected the letter S will light and after an interval of time based on the weapon type, the letter P. When both S and P are lit, the selected weapon is ready for use.

The bottom row display is static and does not change, but he LCD display will go dark when the associated weapon/store has been expended/jettisoned.

PCA MODES DISPLAY

Each pushbutton is associated to a display above it. The labels on the displays vary accordingly to the active navigation or attack mode, indicating the function selected/deselected by pressing the pushbutton. When the function is selected, a S lights up on the pushbutton.

AIR TO AIR MODES

Air to Air mode has four searate submodes:

- CAN (which can only be selected using HOTAS WSC switch)
- MAGIC (which can only be selected using HOTAS WSC switch)
- S530D (selected by pressing 530 button on the PCA)
- POL (selected by pressing POL button on the PCA).

Super 530D Mode

This mode allows the use of Super 530D missile. See AIR TO AIR MODE: MISSILES section for more information.

MAGIC II Mode

In this mode pressing MAGIC button on the PCA changes MAGIC seeker search patterns, but do not select the missile. See ENGAGING WITH MAGIC II for details.

A/A Gun Mode

This mode brings up the A-A gun symbology on the HUD. See DEFA 553 CANNONS for more information.

POL Mode (Police mode)

The system provides guidance to a locked target for identification. No weapons are available in this mode, even if the Master Arm switch is in the ON position.

Abbreviations:

RDO: Target Pursuit Mode (from French: *Ralliement Designation Objectif*). It is automatically entered when locking a radar contact.

TAF: *Télé-Affichage*. NOT FUNCTIONAL

LEN: Short for *Lent* (slow). Low fire rate (guns only). Set the guns to fire 1,200 rounds per minute. This is a preferred mode for attacking ground targets.

RAP: Short for *Rapide* (fast). High fire rate (guns only). Set the guns to fire 1,800 rounds per minute. This mode is most useful in air to air engagements.

AIR TO GROUND MODES

AG (Ground Attack mode) which is selected via HOTAS. All air to ground weapons are selected via PCA, but system remains in NAV mode until AG is enabled via HOTAS using the Weapons Select Command switch. It has five submodes: CAN, BL, BF, EF and RKT.

Bombs (all types)

Bombs (all types - precision bombing)

Rockets

Guns

Abbreviations:

TAS: (short for *Télémétrie Air-Sol*). Uses the radar to obtain slant range to ground and calculate impact point - in this case to the ground under the piper.

RS: (short for *Radio-Sonde*). Uses the altitude provided by the radar altimeter to calculate slant range to the ground. It is less accurate, as it cannot take into account changes in terrain level in front of the aircraft.

ZBI: (short for *Radio-Sonde*). Uses barometric altitude to calculate slant range to the ground. Least precise of the three options, should be used only if other two are unavailable.

PI: (short for *Point initial*). Sets the Initial Point for a bomb run. Displayed only if offset point is set up and selected (**BAD** button is depressed on the PCN). See PRECISION BOMBING in Section 15-4 for more information.

EXT: (short for *Extérieurs*). Selection of the outer wing rocket pods (if installed).

INT: (short for *Intérieurs*). Selection of the inner wing rocket pods (if installed)

LEN: (short for *Lent*). Low fire rate (guns only). Set the guns to fire 1,200 rounds per minute. This is a preferred mode for attacking ground targets.

RAP: (short for *Rapide*). High fire rate (guns only). Set the guns to fire 1,800 rounds per minute. This mode is most useful in air to air engagements.

NOTE

The number of rounds fired per second also depends on the length of burst determined before the flight (in Mission Editor). So for the 1 second burst, this will be 20 rounds in LEN and 30 in RAP. For 0.5 second burst these values will be halved: 10 and 15, respectively.

STORES JETTISON

There are two ways to jettison the stores loaded in the aircraft: Selective Jettison and Emergency Jettison.

Selective Jettison

With selective jettison you can release a specific store type without affecting all the others, like jettisoning external fuel tanks.

1. Click the Selective Jettison switch cover to the open position.
2. Click the Selective Jettison switch to the left position.
3. Select the store to be jettisoned in the PCA.
4. Click the Master Arm switch to the ARMED position
5. Pull the trigger.
6. Click the Master Arm switch to the OFF position
7. Click the Selective Jettison switch to the right position
8. Click the Selective Jettison switch cover to the closed position.

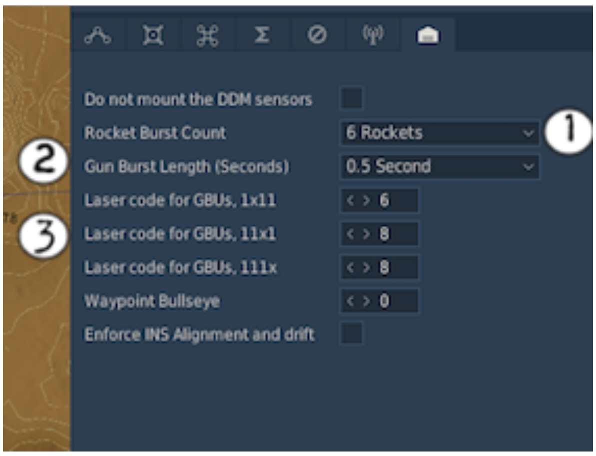
Emergency Jettison

Emergency Jettison Switch is located at the Landing Gear panel.

With emergency jettison all the stores in the aircraft will be released except for the Magic II missiles. The emergency release includes the Super 530Ds if they are loaded.

PRE - MISSION WEAPONS PREPARATION

As it was indicated before, a number of parameters can be set up or adjusted in the mission editor before the start of the mission. This simulates changes made to aircraft configuration by the ground crew. These are:

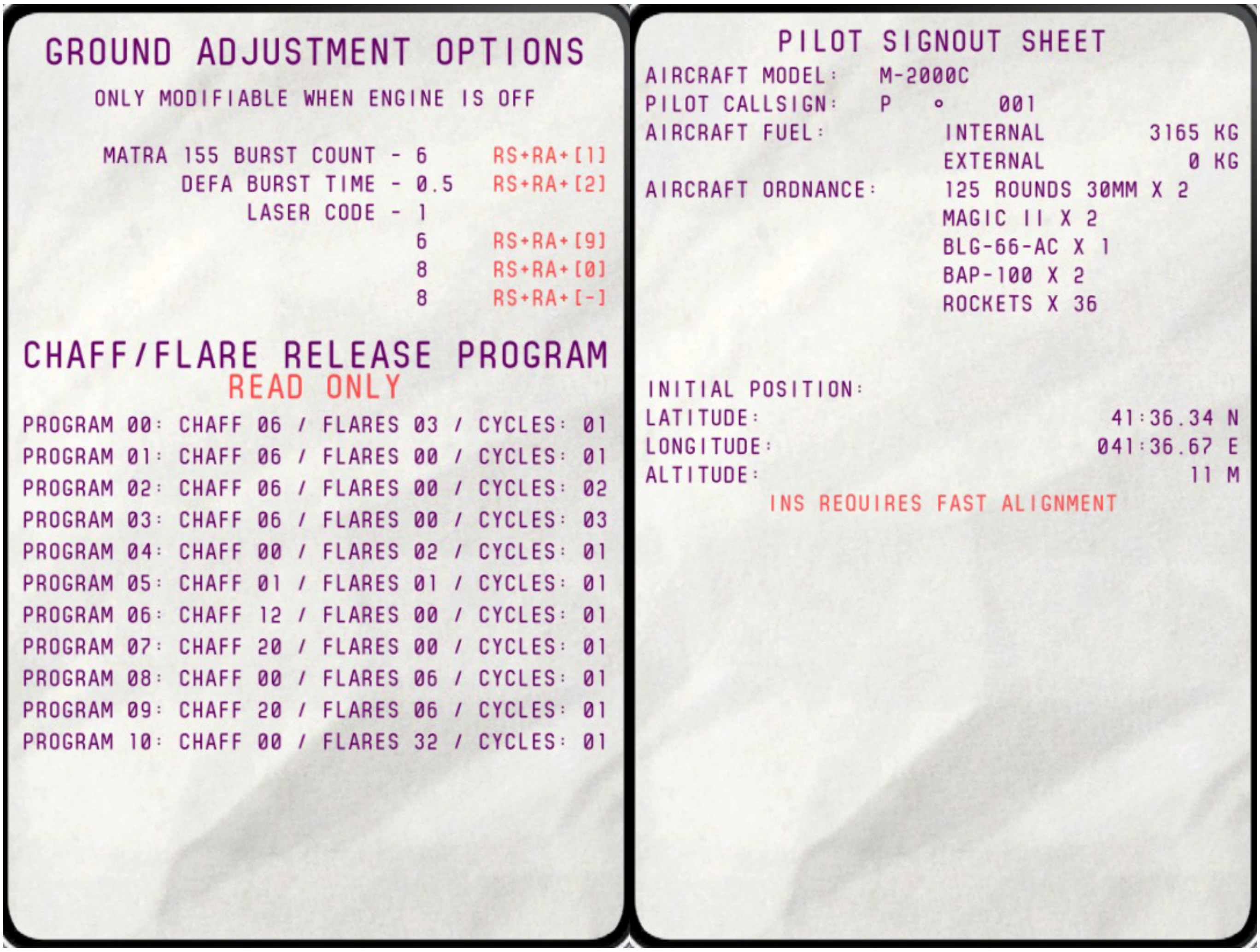


1. Rocket Burst Count. You can decide how many rockets will be fired with each press of the trigger. The available values are: 1, 3, 6 and 18 rockets.

2. Gun Burst Length (Seconds). You can decide how long will be each burst of the gun - either 1 second or 0.5 second. This will be valid as long as the Salvo Firing Selector is set to PAR mode on the PPA.

3. Laser code for the GBUs. You can set up what laser code will be used by the laser guided bombs you are carrying. This four digit number must be the same as the one used by the unit designating the target with the laser. See Using Laser Guided bombs in section 15-4 of this manual for more information.

Apart from the Mission Editor, all three values can be edited from the cockpit by using the Kneeboard. Keyboard shortcuts are listed next to the possible modifications.



Kneeboard pages with weapons adjustment options, chaff / flare release programs and available fuel / ordnance.

AIR TO AIR COMBAT PRINCIPLES

With its primary role as an interceptor, M-2000C will mostly be used to engage enemy airplanes. Although the arsenal remaining at its disposal is limited both in types of weapons (only two kinds of missiles to choose from) and in quantity (with no more than four missiles carried for mission), it still can be a potent opponent in the air. Delta wing configuration can give experienced pilot an edge, especially during the dogfights. While clearly underpowered in BVR against Fox 3-capable opponents (being itself limited to Fox 1 and Fox 2), M-2000C can stand its ground once it gets closer to the enemy.

This chapter will describe the most common techniques and information needed for effective use of S-530, Magic II and DEFA guns agains airborne targets. Some of the screens and intel will be a repetition of what has been included in the manual in the earlier sections, brought together in order to avoid the need to go back and forth through different pages.

WEAPONS PREPARATION

It is crucial to fulfil several steps before entering the AO (Area of Operations) in order to prepare for the upcoming combat. These are:

1. Fence in. While still in the comfortable distance from the possible enemy make sure to:

- Turn off your NAV and ANTI COLLISION lights. Set FORMATION lights as desired.
- Turn on and arm your COUNTERMEASURES (jammer, RWR, D2M and Spirale)
- Select the most appropriate chaff / flare programme for the anticipated threat
- Make sure that your missiles are armed and ready (a yellow P is lit on the S-530 and Magic II Preparation buttons on the PPA)
- Radar is set to ON (or as required if a more stealthy approach is needed)
- Set the waypoint number matching the mission Bullseye as the "N" waypoint on the VTB (unless done so by the mission designer)
- Master Arm switch is set to ON
- Gun safety switch is armed (see below)

GUN SAFE


GUN ARMED

Locating Bandits

Use AWACS calls and / or your radar to locate enemy airplanes.

For **AWACS**, make sure that you are on correct frequency (usually listed in the mission briefing) and request BOGEY DOPE or PICTURE.

Asked for BOGEY DOPE, AWACS will provide you with the location of the closest group of bandits in the BRAA format (Bearing, Range, Altitude and Aspect). In this case your aircraft is the reference point.

Bearing gives you the course you need to fly in order to intercept the bandits.

Range is given in nautical miles.

Altitude is given in feet MSL or in Angels (where 01 equals 1000 feet).

Aspect is relation of the bandit towards you:

Hot means he is going directly towards your position.

Flanking means that he is on perpendicular course.

Cold means that he is getting away from you.

When asked for PICTURE, AWACS will list all enemy aircraft Groups and their position. In this case Bullseye will be the reference point. In this case, at long range, the easiest way to get the exact location of a given group would be to create an Offset Point from the location of the Bullseye (which usually is one of the waypoints on your flight plan) using data provided by AWACS. See Offset Points in Section 12-5 for more information.

At shorter range, when reaction time is a factor, the best way is to match your radar's TCD to the Bullseye position given by the AWACS; TCD position is indicated relative to the Bullseye in the bottom left part of the VTB, provided you set "N" as the waypoint number corresponding to the Bullseye.

Using **RADAR** is pretty straightforward. Set up your radar scan pattern and range shown on the VTB as desired and turn towards the suspected location of your target. If needed, use up and down movement of your antenna in order to find the bandit. Remember, that large airplanes (transports, AWACS, tankers) will be detected at longer range than fighters. Also, low flying threats will be much more difficult to find. Please see Section 13-1 (VTB / Radar) for more information about the available settings and their impact on detection range and capabilities.

NOTCHING, BEAMING AND CRANKING

Notching and Beaming describe flying at 90° of the threat to try to break its radar lock (with doppler/closure rate identical to ground returns). The difference between the two is that this maneuver is called 'notching' when you are doing it, while 'beaming' if it is done by the enemy.

So in order to notch, you should try to put the bandit on your 3 or 9 while getting below him and reducing speed. If you manage to keep the bandit on the beam and force him to look down, it is very likely that he will loose his lock

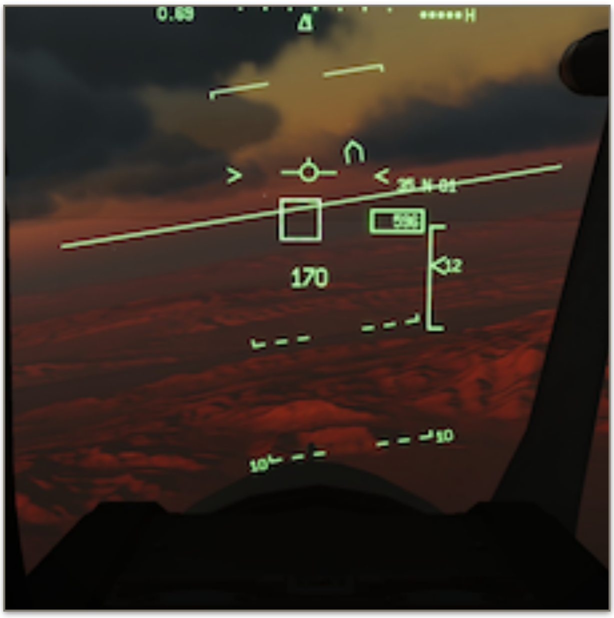
The term used to describe the maneuver destined to reduce rate of closure and get the opponent in a look-down situation, while still being able to keep lock & guide your Fox 1 missile is called Crank / Cranking.

With M-2000Cs good horizontal scan limits (60 degrees both sides) and decent look - up capability, beaming is also a good tactics after shooting your Super 530D missile. After firing on the enemy, try to put him on the edge of your VTB screen while decreasing altitude and dispensing chaff. It is possible that he will break his lock and will be forced to go full defensive, allowing you to gain initiative and enter pursuit.

ASPECT ANGLE

The aspect angle to the locked target is displayed both on the HUD and the VTB:

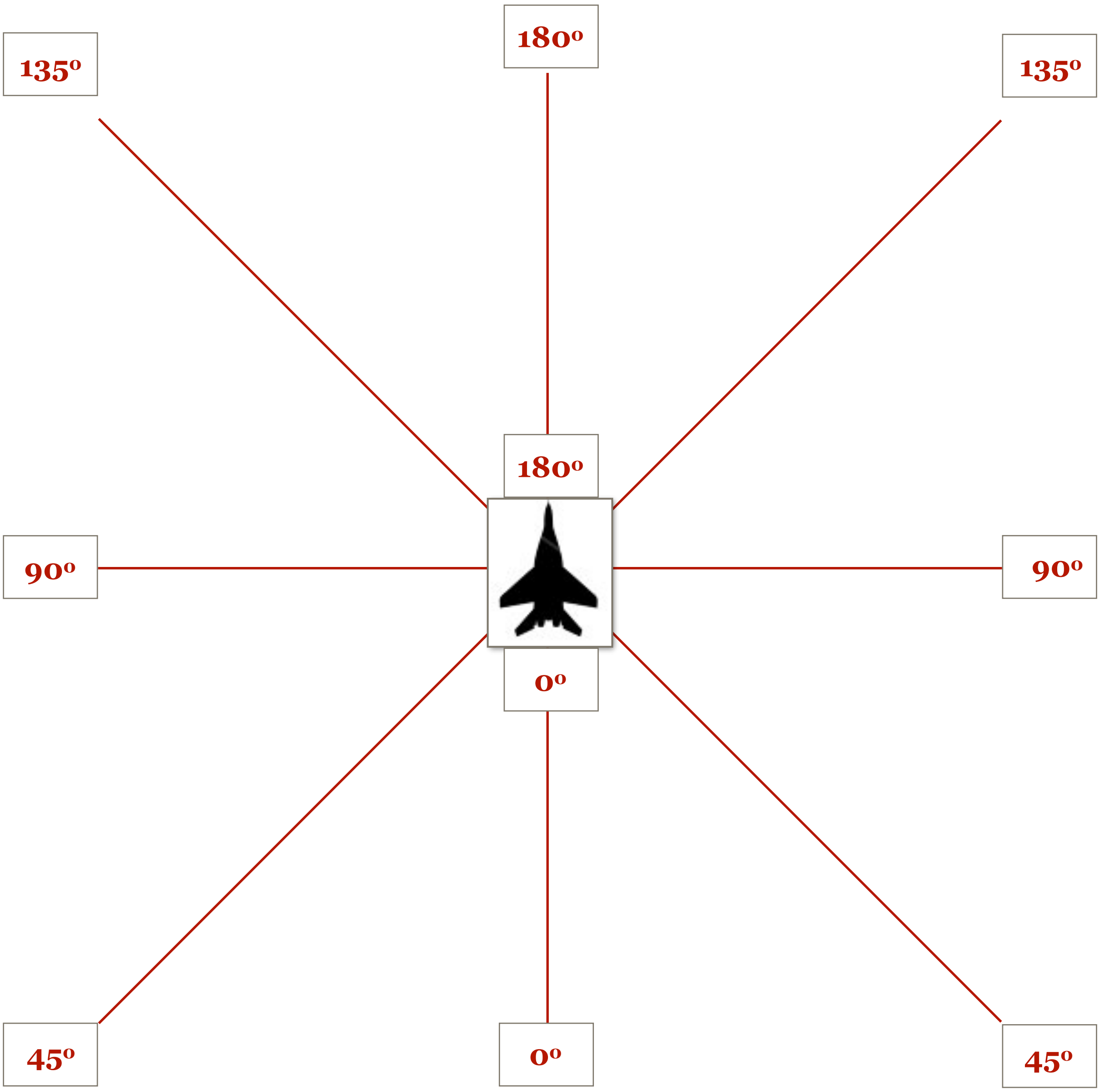
The aspect angle is shown beneath the target lock symbol - in this case it is **3**.



The aspect is beneath the lock square, showing **170**.

You will notice that the information displayed is different for both. This is because M-2000C system shows both the Angle of Tail (in HUD) and Aspect Angle (in the VTB). Both will be discussed in more details on the following pages.

Aspect angle is measured **from the bandit to the radar lock line of your plane**. In other words it shows the relation of the line drawn between the tail and the nose of the bandit to the radar lock line extending from your nose. Below the aspect drawn with the bandit in the centre. Red lines are radar lock lines.

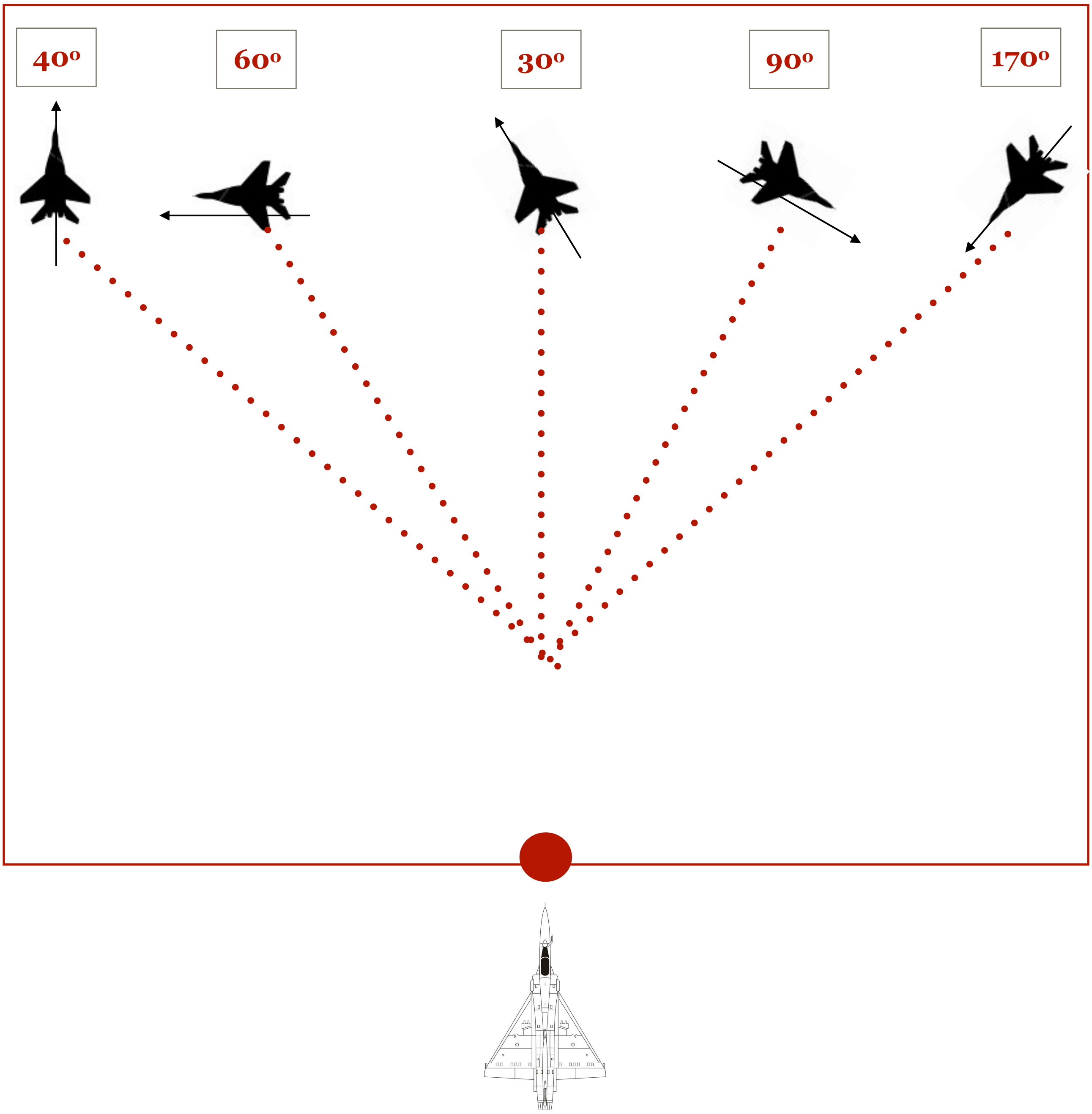


The red numbers show you the Aspect Angle shown on your HUD when the bandit is locked at the respective angle. The 180 and 0 degrees denote bandits nose and tail.

CAUTION

Remember, that the aspect angle is not measured directly from in front from your nose, but along the Radar Lock Line. This means that a beaming target will be shown as having an aspect angle of 90º only if it is directly at your 12 o'clock or is exactly at 90º from your radar lock line.

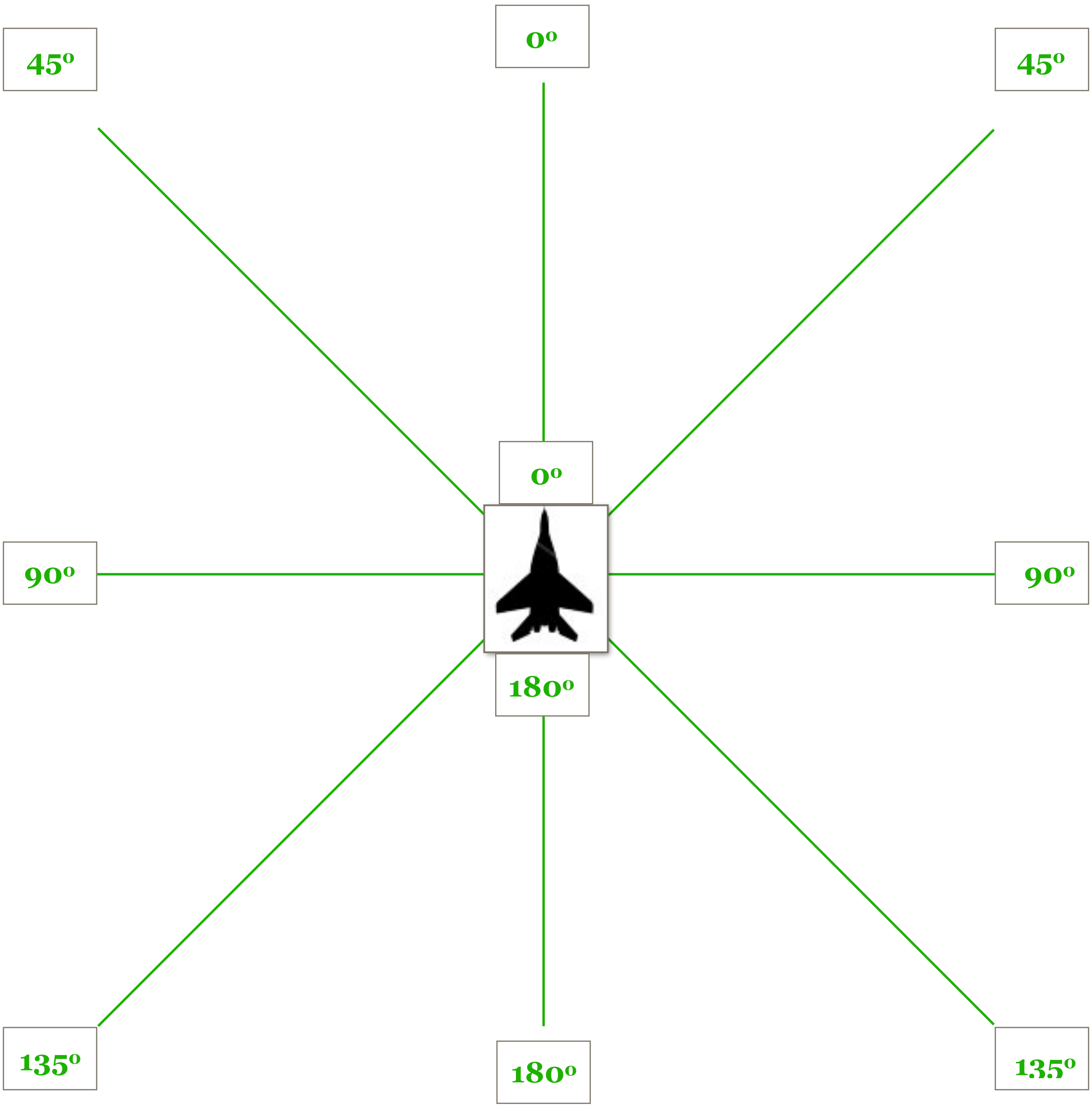
In order to better understand it, several examples of different positions and aspect angles between the M-2000C and MiG-29.



It is important to remember, that bandit's nose is treated as 180 degrees (meaning that if he is flying heads - on towards you and is at your 12 o'clock the HUD aspect angle will display 180. The same will be true if he will be flying from any angle exactly riding your radar beam).

Tail is treated as 0 degrees (so the opposite would be true: if the bandit is flying directly away from you and is on your 12 o'clock it will show 0 on the HUD. The same is going to happen if your radar beam is directly on bandit's tail and he is trying to get away).

The aspect angle shown in the VTB is exactly opposite to the one on your HUD. The green numbers below give you the Aspect Angle shown on your VTB when the bandit is locked at the respective angle. The 0 and 180 degrees denote bandits nose and tail.



The green numbers show you the Aspect Angle shown on your HUD when the bandit is locked at the respective angle. The 0 and 180 degrees denote bandits nose and tail.

CAUTION

It is crucial to remember the 180 degrees difference between the HUD Aspect Angle and the one shown on the VTB.

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ENGAGING WITH S-530D

The Matra Super 530D is a semi-active homing radar missile. To successfully use this missile, you need two conditions:

- A locked radar target
- To always keep the target in your screen during the flight time the missile needs to intercept it.

CAUTION

The Super 530D is not a fire and forget missile. You need to keep the aircraft in a easily predicted flight path until the missile either intercepts or misses, which will put you in a disadvantage for the entire missile flight time.

To select the Super 530D, click on the 530 button in the PCA.

Trigger Delay for Super 530D

There is a time delay between the moment the trigger is pressed to the instant the missile is launched; this is both a security measure and a time needed to feed the missile computer with data for launch. The delay varies depending on the selected mode:

- If the radar is in STT mode, the delay is 0.8 seconds.
- If the radar is in TWS mode, the delay will be 1 second. The radar needs to switch to STT prior to launch the missile
- If the PPA Salvo Firing Selector is in TOT mode, there will be a 2 seconds delay between each missile launch.

If the trigger is released before the delay timer runs out, no missile will be fired.

AIR TO AIR MODE: MISSILES (S530)

1. AVAILABLE MISSILES. Indicates how many missiles are available. G = Left (*Gauche*) and D = Right (*Droit*). The letter disappears when the corresponding missile has been fired. The number above shows the estimated time of flight of the missile to its target and will count down from that value after the missile is shot.

2. SELECTED WEAPON. Circle around the letter indicates which missile is ready to be fired. By default, the system selects the missile on the side of the locked target, but this order can be changed in the Armament Configuration Panel.

3. RELATIVE POSITION OF THE TARGET. Shows relative position between your aircraft and the locked plane.

4. RANGE TO TARGET. Shows the distance to the currently locked target in nautical miles. The three carets visible on the vertical line show (from top to bottom):

- The maximum range
- No Escape Zone range
- Minimum range

5. LOCKED TARGET and INTERCEPTION FLIGHT DIRECTOR (described earlier).

6. FLIGHT DIRECTOR RING (described earlier). When locked target enters no-escape zone for the selected missile, a second ring around the Flight Director will appear to indicate that you have the best firing solution:

The picture above shows the Flight Director Ring with the locked target within the No Escape Zone - at range of 6.7 Nm for S-530. Please note the double Flight Director ring. The closing velocity is 639 knots per hour. A command TIR (SHOOT) is displayed below it. Pilot still has two missiles left and at current range it would take them 21 seconds to reach their target.

ENGAGING WITH MAGIC II

A buzz-like sound will be heard when the seeker has locked on a target. In the HUD, the seeker symbol will move towards the position of the locked target.

The Magic 2 heat-seeking missile is an all aspect, fire-and-forget short range weapon.

Like the guns, the Magic 2 missile does not require a radar lock. Nevertheless, it has a short range and knowing the distance to the target increases hit probability.

When selected, the missile seeker is caged and looks straight ahead. To lock the seeker, place the HUD gun cross on the target. If the infra-red signature is sufficient, the seeker will automatically lock. A circle is displayed on the target and a continuous sound is heard in the helmet.

During very tight turns, it may be difficult to place the gun cross on the target. A solution is to achieve an automatic radar lock and press the Magic slave control. The seeker uncages and looks in the same direction as the radar, providing IR lock on the target.

Magic 2 selection is achieved with the CNM SELECTOR on the throttle (pressing the button on PCA will not select the Magic 2 missile) . Upon selection, note that the airspeed and the altitude indications drop from the top to the middle of the HUD for ease of reading during high-G manoeuvres.

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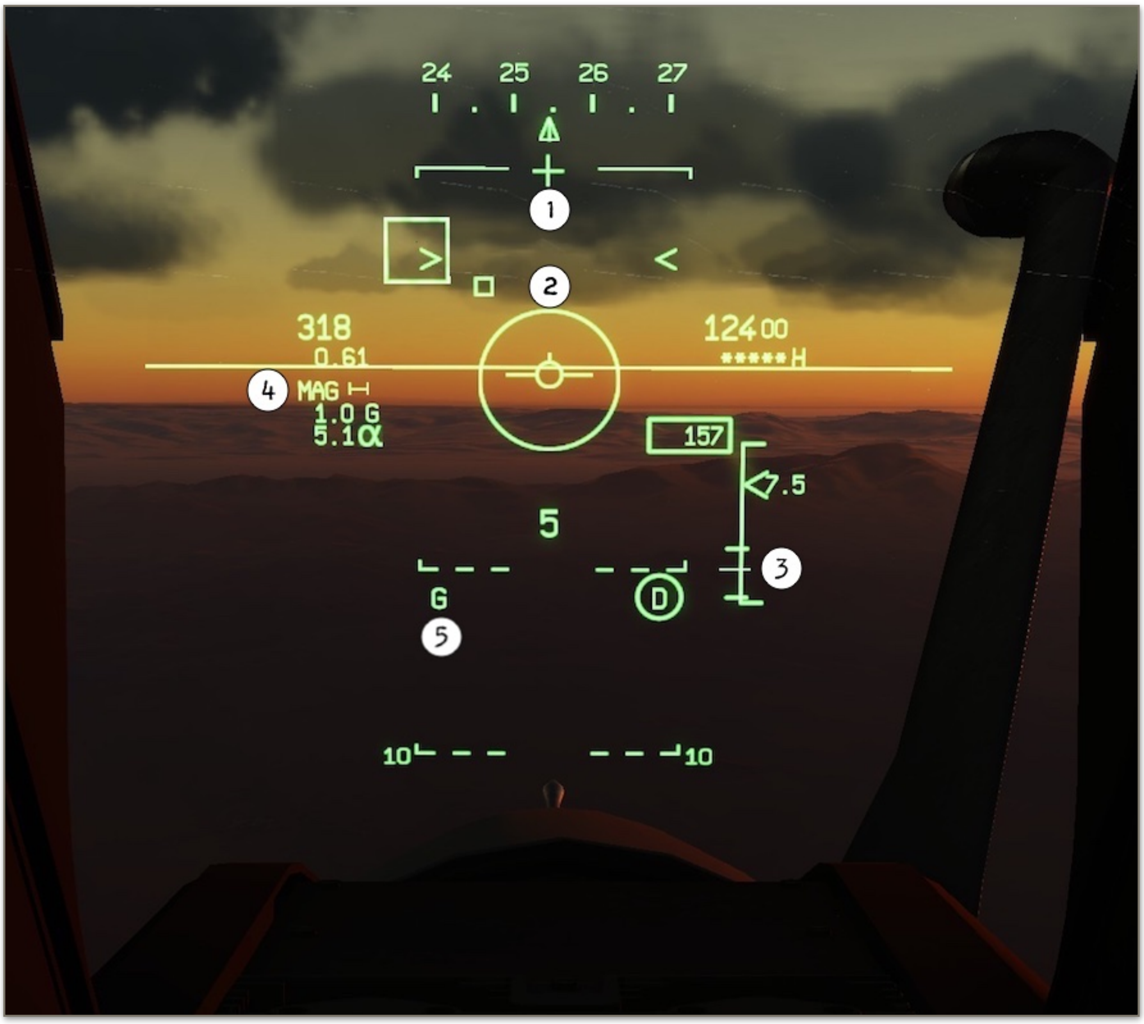
AIR TO AIR MODE: MISSILES (MAGIC II)



Most of the indications with Magic II missiles selected are exactly the same as for the Super 530, with the following differences:

1. GUN CROSS. Available when Magic IIs or Guns are selected. This is the aircraft boresight aiming point.

2. FLIGHT DIRECTOR RING. Contrary to many other aircraft, it is not used to attain the lock in M-2000C (as stated above, you use gun cross for that). Also, the seeker for Magic II missile is not visible until you get a solid lock. The same is true for the growling sound - it can only be heard after acquiring a lock and not during the search phase.

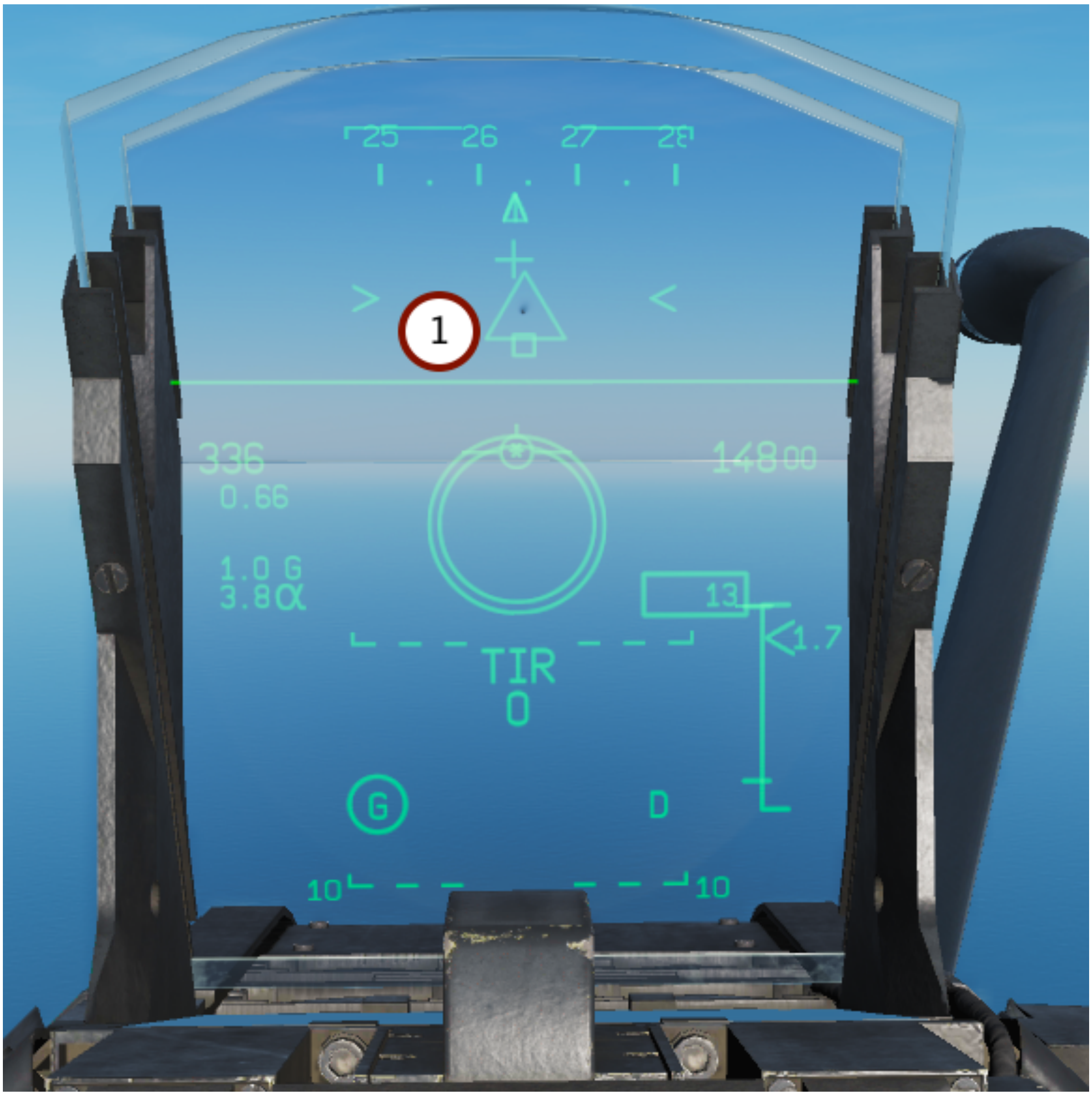
3. RANGE TO TARGET. Maximum, No Escape Zone and Minimum range cues are clearly visible.

4. ATTACK MODE DATA. Indicates selected weapon (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft AOA.

5. AVAILABLE MISSILES. Indicates how many missiles are available. G = Left (*Gauche*) and D = Right (*Droit*). The letter disappears when the corresponding missile has been fired. The number above shows the estimated time of flight of the missile to its target and will count down from that value after the missile is shot.

NOTE	If there are two missiles of the same type mounted under one wing, the corresponding letter will disappear when both are fired.

AIR TO AIR MODE: MISSILES (MAGIC II WITH RADAR LOCK)



If you lock your Magic 2 missile to target that was previously locked by the radar, the radar lock symbology **(1)** will change from square to a triangle.

AIR TO AIR MODE: MISSILES (MAGIC II) MAV SEARCH

There are three basic search patterns for the Magic II missiles, which depend whether the missile is selected and whether the MAV option is pressed on the PCA.

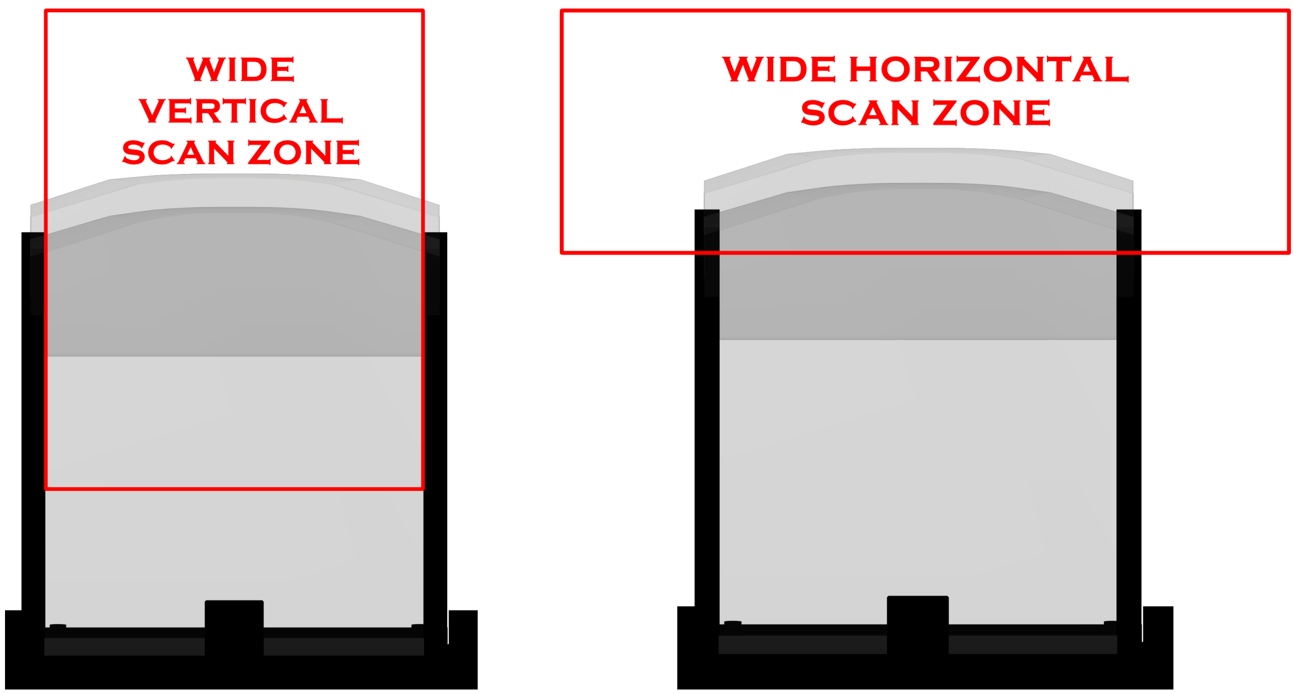
With MAGIC Missile selected (using CNM Throttle Switch), MAV search patterns are as follows:

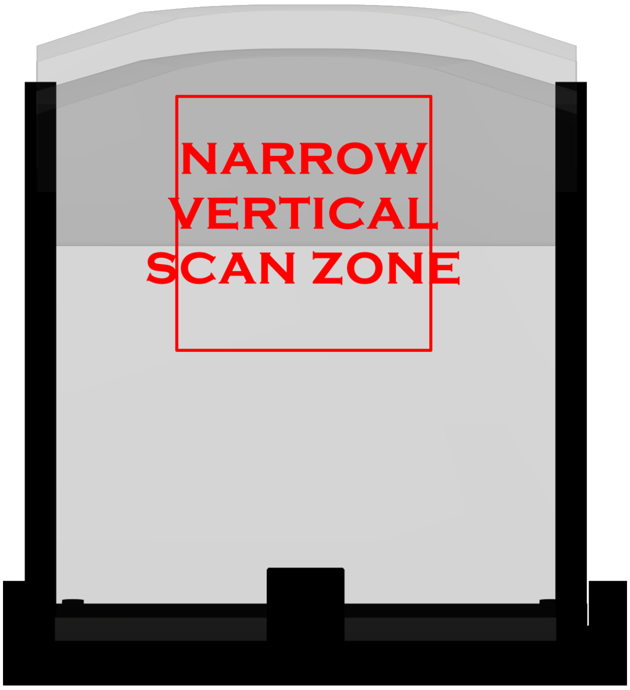
- Vertical Wide Search (default)
- Vertical Narrow Search

With MAG PCA button selected, the patterns are:

- Horizontal Wide Search (default)
- Vertical Narrow Search

MAV search zones:





VERTICAL WIDE SEARCH: a 20° wide x 40° tall search (The bottom is 10° below the gun cross), very similar to the radar Vertical Scan.

This is the default mode whenever Magic II missile is selected with the CNM Throttle Switch.

Note that part of the search zone is extending above the HUD.

HORIZONTAL WIDE SEARCH: With missiles in both wings it is a 70° wide and 15° tall search zone. With only one missile available, the search zone is smaller: 40° wide and 15° tall. It is similar to the radar BAH Scan.

This is the default mode whenever MAG PCA button is selected.

Note that parts of the zone extend beyond the HUD on both sides.

VERTICAL NARROW SEARCH: It is a 6° wide x 6° tall box cantered around the gun cross, similar to the radar SVI Scan. A box is displayed indicating the HUD area where the seeker is searching, and is removed upon missile lock.

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

Using and changing the search modes

It is possible to switch between the search modes using the NAV UPDATE / MAGIC UNLOCK HOTAS button. Depending on the way in which pilot initialises MAV mode, the following options are available:

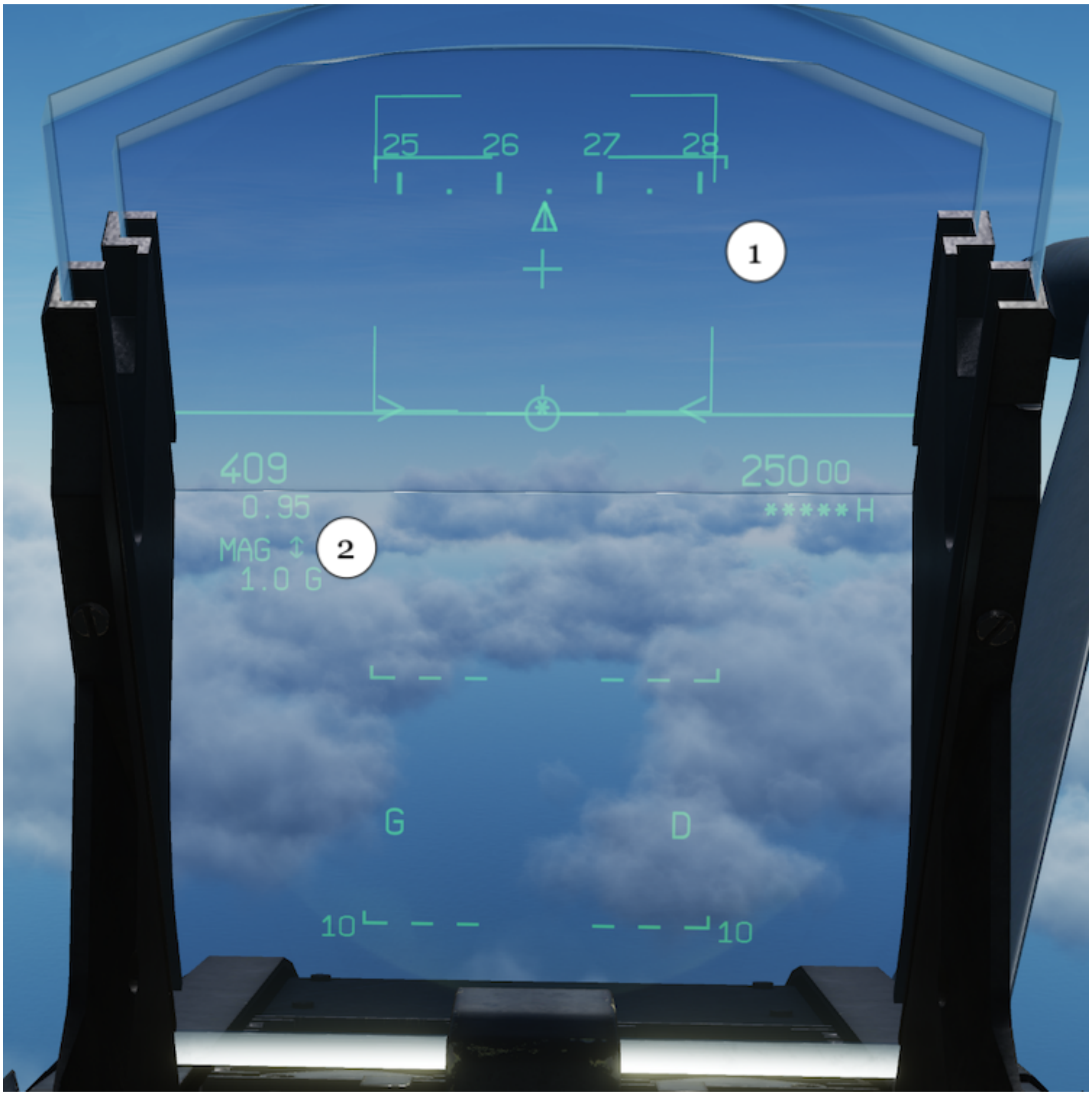
If missile is selected by using HOTAS CNM button:

Vertical Wide Search -> Vertical Narrow Search -> Vertical Wide Search

If MAG PCA button is pressed (missile does not have to be selected):

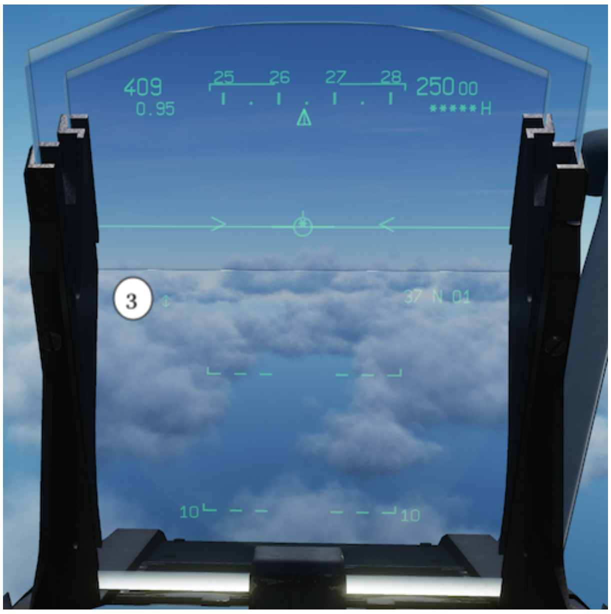
Horizontal Wide Search -> Vertical Narrow Search -> Horizontal Wide Search

It is important to note that if used in this mode, MAV search allows the MAGIC missiles to be used as an IR scanner. MAV search can also be used in the NAV Master Mode and without any AA weapon selected.



1.VERTICAL NARROW SEARCH BOX . It is a 6º wide x 6º tall box centered around the gun cross, which is similar to the radar SVI Scan. A box is displayed indicating the HUD area where the MAGIC II seeker is searching and is removed upon missile lock.

2. VERTICAL / HORIZONTAL SEARCH INDICATOR. Denotes current general search mode of the MAGIC II missiles - either vertical or horizontal.



3. VERTICAL / HORIZONTAL SEARCH INDICATOR in Vertical Wide search (on the left) and Horizontal Wide search (on the right).

PCA INDICATIONS

Magic 2 missile selected using HOTAS CNM button.

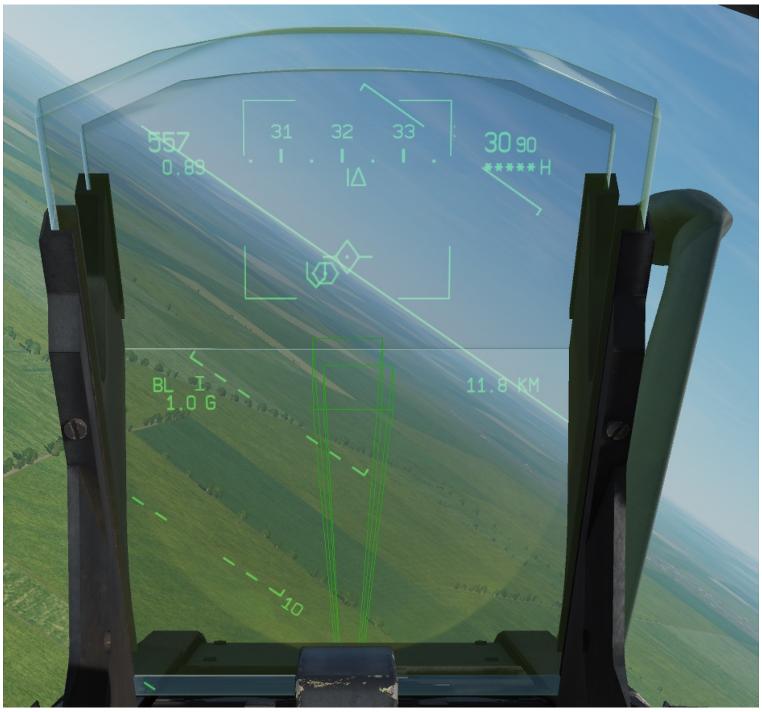
MAG button pressed on the PCA

Using Magic missiles with other weapons

It is possible to use Magic II missiles as IR scanner also with other weapons selected, which will change the symbology on the HUD as follows:

Magic missile used in conjunction with the S-530 D selected. The circle will be inside the square denouncing lock.

Magic missile used in conjunction with the guns. A triangle will be shown over the locked target.



Magic missile used for search when the airplane in in the A/G attack mode.

***

DEFA 553 CANNONS

Guns are used for close range engagements. They can be used with or without radar telemetry (lock). Gun selection is achieved when setting the master arm to on, or by using the selector on the throttle.

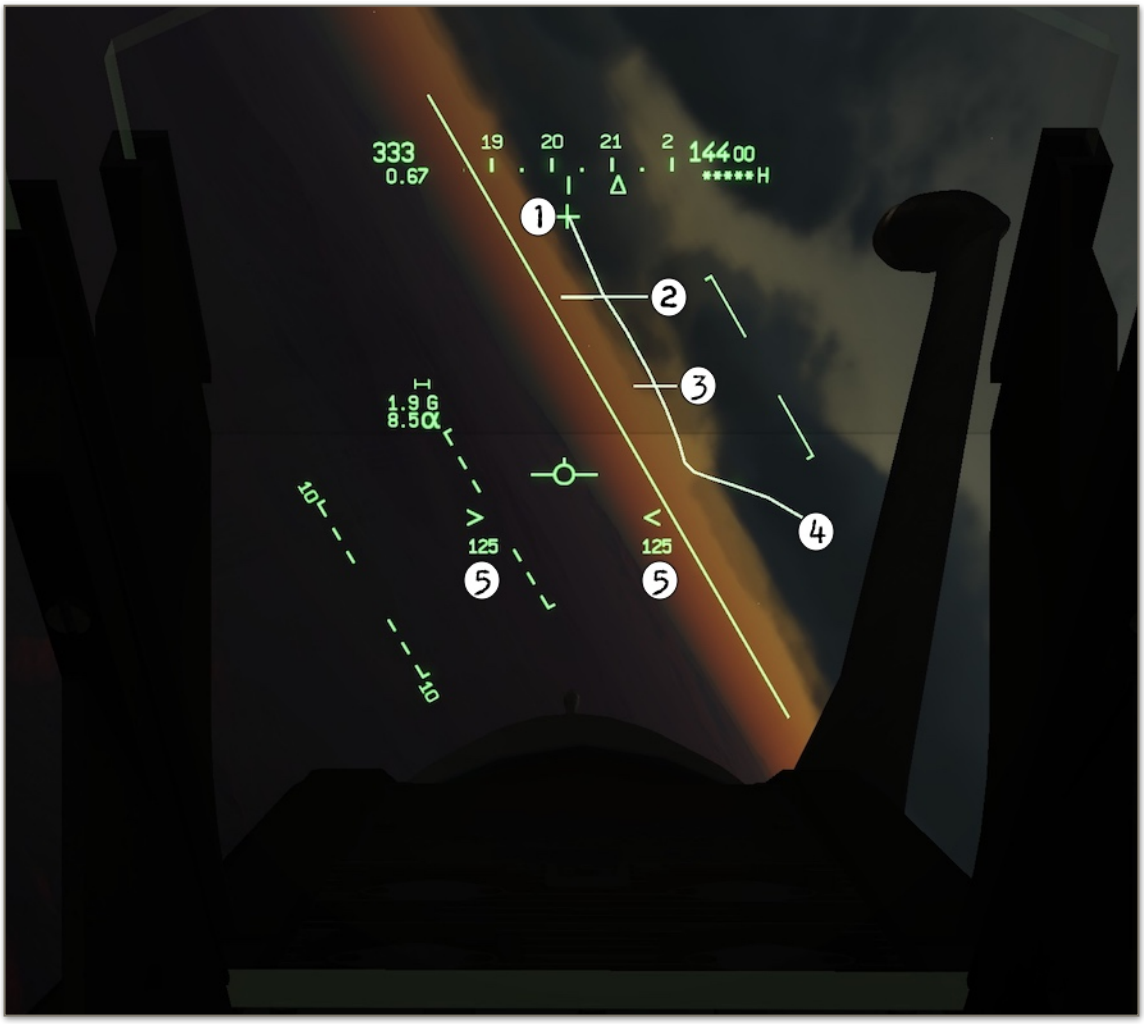
The DEFA 554 30 mm autocannons need to be armed before they are available. To electrically arm them, click on the GUN ARM switch located above the FBW GAIN switch.

GUN SAFE

GUN ARMED

To select the guns in AA mode, use the CNM SELECTOR on the throttle.

AIR TO AIR MODE: GUN (NO RADAR LOCK)



1. GUN CROSS. Indicates the guns' boresight. Guns are set at -2° from the aircraft waterline.

2. WINGSPAN MARKER (300 M) and 3. WINGSPAN MARKER (600 M). These lines are used to represent a target wingspan in order to help determine its range. The wingspan markers are not static and their width can be dynamically changed by using the ENV knob (ENV is short for *envergure*, wingspan in French). The ENV knob changes the wingspan marker width to represent a target from 7 meters up to 40 meters. The wingspan markers are visible only when there is no radar lock. See HUD PEDESTAL for more information.

4. BULLET PATH PREDICTION (GUN SNAKE). The gun snake shows the flying path that a stream of gun rounds would follow if they had been fired.. It has a max range of 1,000 meters (see below). The use of Gun Snake will be described in more detail below.

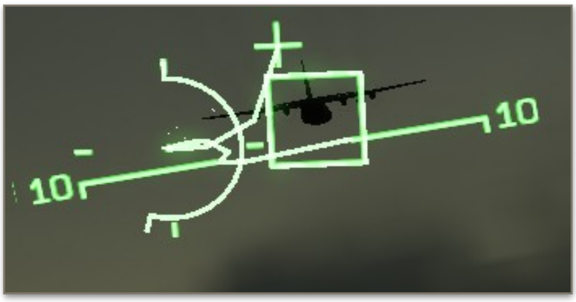
5. AMMO COUNT. Shows the current count of 30 mm ammunition for each gun.

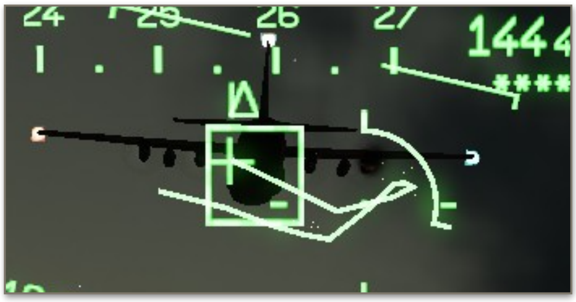
AIR TO AIR MODE: GUN (TARGET LOCKED)

1. GUN CROSS. Indicates the guns' boresight. Guns are set at -2° from the aircraft waterline.

2. BULLET PATH PREDICTION (GUN SNAKE). The gun snake shows the flying path that a stream of gun rounds would follow if they had been fired. It has a max range of 1,000 meters (see below).

3. RADAR GUN PIPER. The radar gun piper gives the range to an air target that is locked with radar. It moves alongside the gun snake, indicating the exact position of the target in the bullet stream. Simply put the bandit on the path of the snake and under the piper and press the trigger.





The piper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 1200 meters. The 9 o'clock caret depicts the range of 900 meters, 6 o'clock of 600 meters and 3 o'clock of 300 meters.

4. LOCKED RADAR TARGET. The square shows the position of the locked object. If your target is located outside the HUD, the square will become dashed and move to the left or right edge of the HUD, depending on the target position.

5. RANGE TO TARGET. Shows the range from the currently locked target in nautical miles. The "DOM" indication visible at the screenshot above appears when the target is in perfect range for a Magic missile shot. It is an incitation for the pilot to switch to Magic mode.

6. TARGET'S RELATIVE SPEED. Shows how fast the target is closing or gaining distance. Displayed in knots per hour, if the value is positive it means that this is the velocity with which you are closing to the locked aircraft. If it is negative, it gives the velocity with which it is getting away from you.

Gun snake use

The gun snake is an air gunnery targeting help. It depicts the path of a bullet stream fired from the gun. The "tail" of the snake is located at the gun cross, i.e. at 200m range. The "head" of the snake ends at the 1000 meter range.

To hit a target you must put the gun snake alongside its flight path. You must take care of placing the target at the correct snake position based on its range. The closer to the gun cross, the lower the range.

The wingspan markers are helpers to determine target range without the use of radar. When you manage to place a target's silhouette on the wingspan markers you can calculate a range approximation based on how wide the target is versus the wingspan marker's width. As you can see, a basic precondition is that you must know the approximate wingspan of your target and to adjust the wingspan marker to that value.

Once you have determined range to target, you place the target at the snake position where a hit is assured.

If you are using radar and your target has radar lock, the wingspan markers are replaced by the radar gun piper. The radar gun piper makes the gunnery easier by indicating the place in the gun snake where a hit is certain. You only have to put your target on the spot in the snake marked by the radar gun piper.

NOTE

The number of rounds fired per second also depends on the length of burst determined before the flight (in Mission Editor). So for the 1 second burst, this will be 20 rounds in LEN and 30 in RAP. For 0.5 second burst these values will be halved: 10 and 15, respectively.

NOTE

The P symbol is only lit when the missile seeker is tracking a target.

CLOSE COMBAT MODES

Close Combat Modes are a set of dedicated modes for short distance air to air engagements. In those modes, the radar will be set at a range of 10 nautical miles and it will automatically STT lock on the closest contact it can detect.

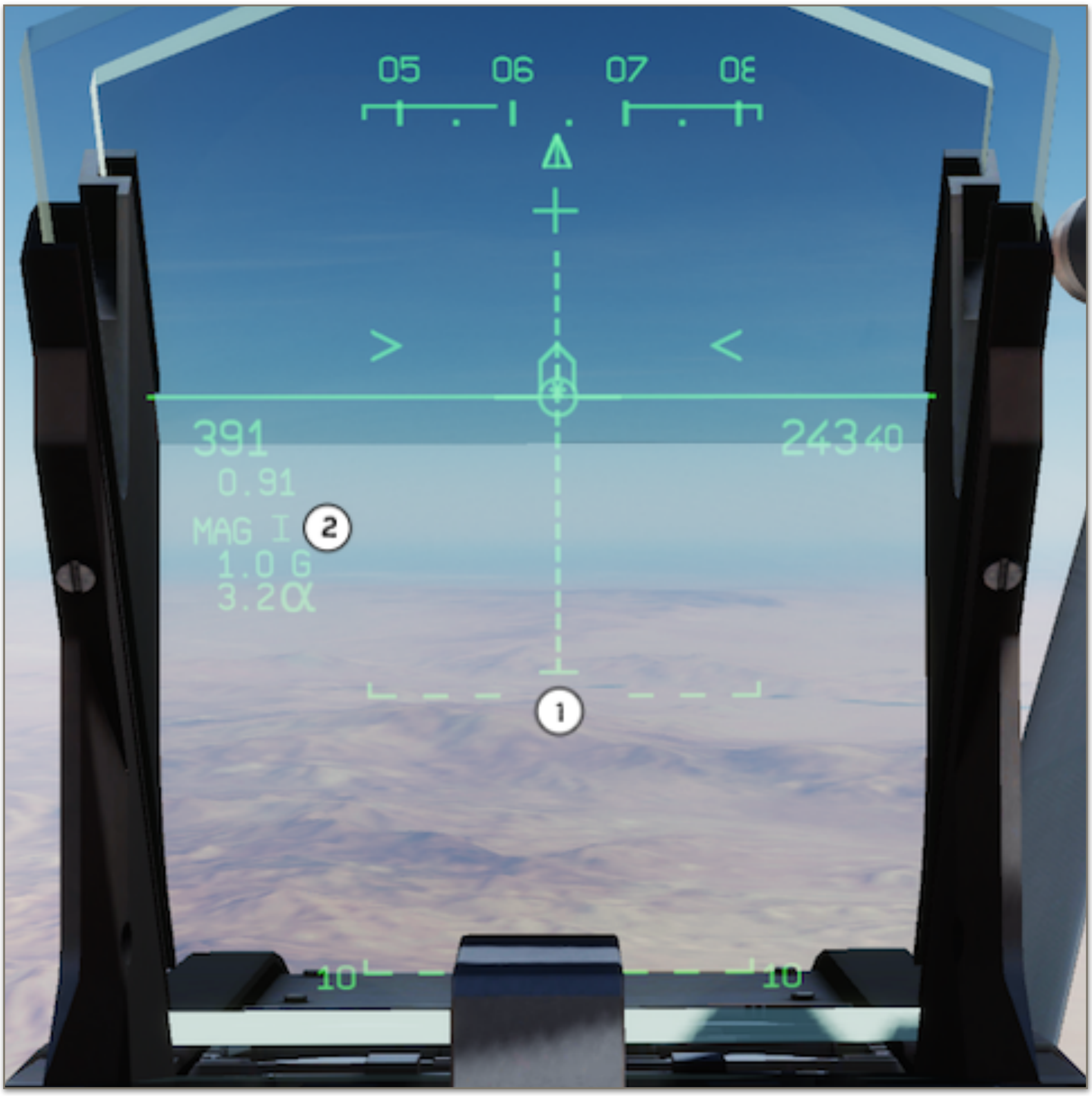
There are 5 search modes available in CCM:

BORESIGHT

Available with all weapons. In boresight mode, the radar is in a fixed position, centered on the aircraft's reference line. It provides a narrow search cone only 3° wide (**1**). Basically the radar is converted into a gunnery radar. As usual, the current Master mode (here: MAG for Magic) is displayed on the center left of the HUD (**2**).

VERTICAL SCAN

Vertical Scan is available with both AA Guns and Magic missiles selected. It provides a narrow vertical beam that is 4.8º wide and 60º tall (**1**). It covers between +50º to -10º and is centered on the aircraft reference line. As usual, the current Master mode (here: MAG for Magic) is displayed on the center left of the HUD. (**2**).



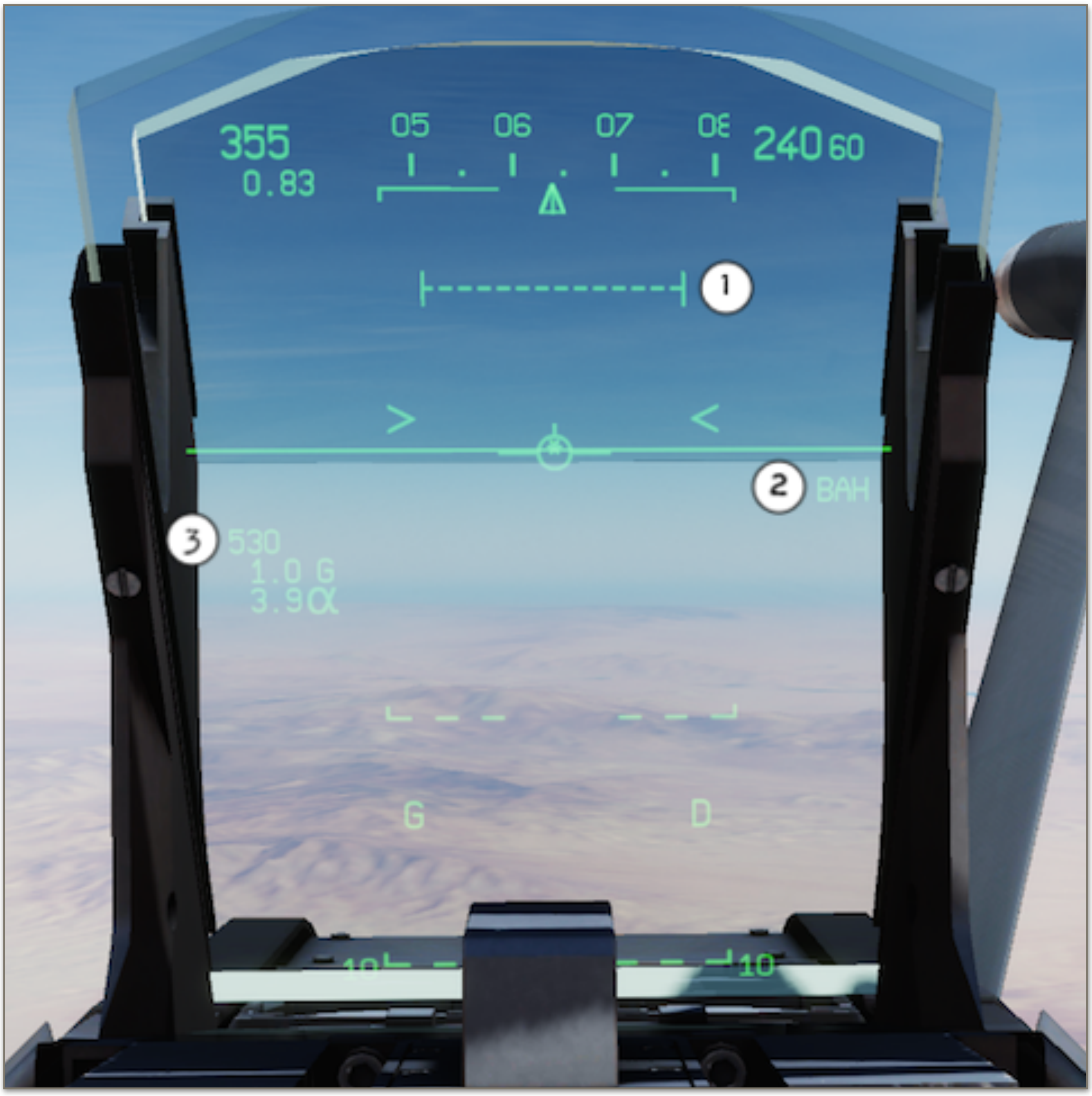
HUD SCAN

HUD Scan is available only when the 530 or POL Master missiles have been selected. The radar covers the entire HUD area, a 20° wide cone. "SVI" (*Spirale Viseur*) label is displayed on right side of the HUD (**1**).

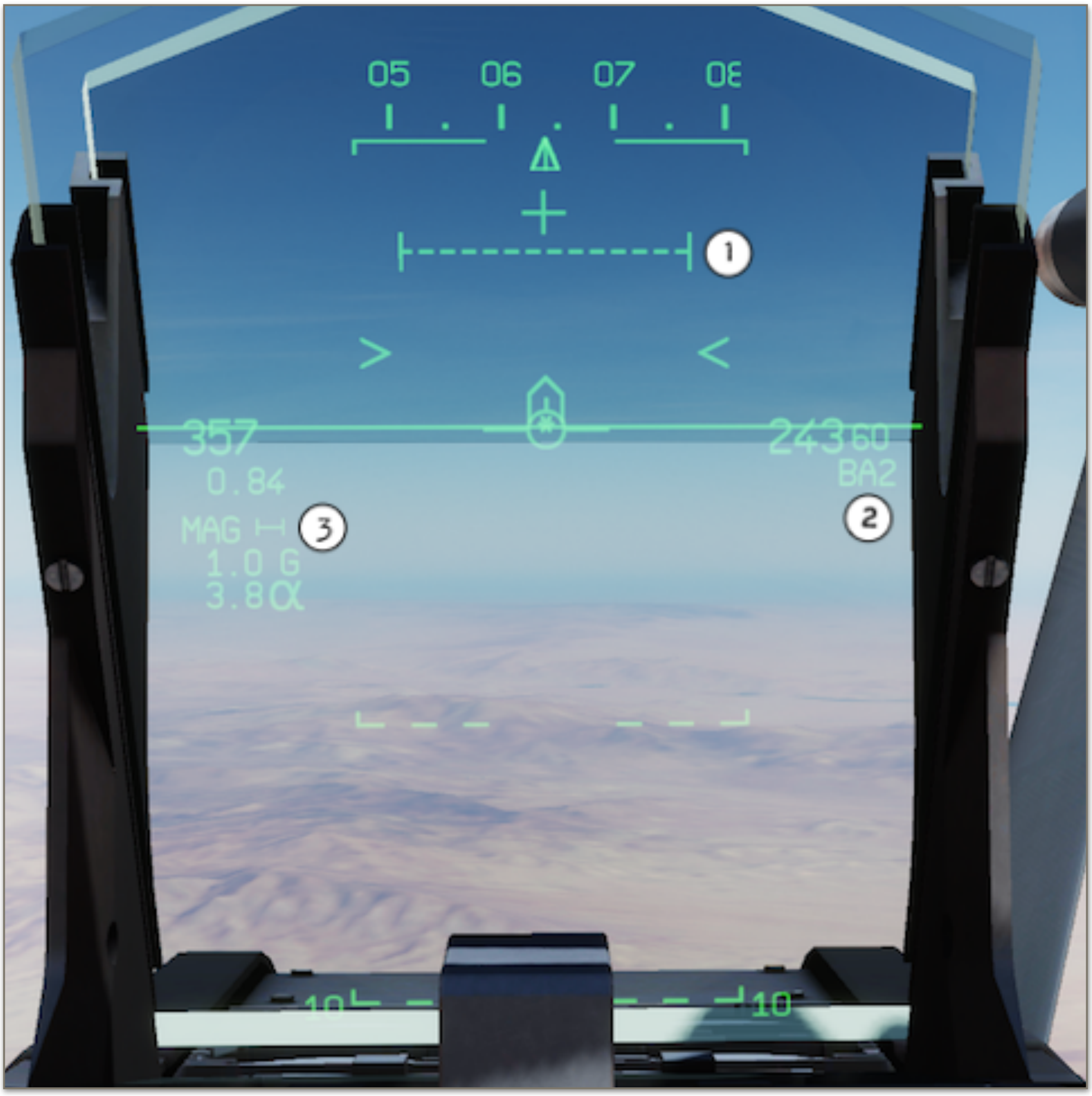
HORIZONTAL SCAN

This mode is available with all weapons. It has two submodes: Mode 1 and Mode 2, but they work the same: The radar search a 30º Azimuth arc with two bars for a 6º x 60º search cone (**1**). It is roll stabilised and unlike the other modes, it is possible to move the radar antenna in elevation. As usual, the current Master mode (here: 530) is displayed on the center left of the HUD (**3**). BAH (mode 1) is shown on the right side of the HUD (**2**).

Mode 1 uses High PRF, while Mode 2 uses Medium PRF. Medium PRF search mode is only available in Horizontal Scan Mode 2.



Horizontal Scan Mode 1



Horizontal Scan Mode 2

Master mode is visible above the G-meter (**3**). BA2 (mode 2) is shown on the right side of the HUD (**2**).

FLOOD

FLOOD mode is only available after Super 530 firing, to try to guide the missile on a target that succeeded to break your radar lock, by visually placing it inside a 3° circle in the middle of the HUD. “SVI” label is displayed on right side of the HUD (**1**).

SPIRAL HUD SCAN

Spiral shaped search pattern which scans inside a circle roughly the angular size of the HUD, starting from the middle and moving outwards. It follows the same logic as all the other BFM modes (which means that it will lock the first target it finds inside a 10 Nm range), and it completes each spiral in about 2 seconds.

To enter this mode, you need to have the S530 selected on the PCA and then press the WSC switch forward.

Selecting the CCM modes

In order to cycle between the Close Combat modes you need to use **WEAPONS SYSTEM COMMAND** switch on your HOTAS. You will find the necessary details in the table in the **HANDS ON THROTTLE AND STICK (HOTAS)** section.

M-2000C IN AIR TO GROUND ROLE

Despite its primary role as an interceptor, M-2000C can be quite a potent CAS / ground attack platform. Capable of carrying and using wide range of guided and unguided air to ground weapons, it can quickly get into the AO and quite accurately deliver required ordnance.

Two main types of ground attack performed by the M-2000C are:

- CCRP, or Continuously Computed Release Point. In this mode the pilot selects a point in the ground as the target and the ballistic computer calculates the specific time when the bombs should be released in order to hit the target.
- CCIP, or Continuously Computed Impact Point. In this mode, the ballistic computer displays in the HUD the point at which the bombs would hit the ground based on aircraft altitude, speed and pitch. To hit a target, you have to place the impact point over the target and release the bombs.

CAUTION

In the M-2000C, the bomb release mode is determined by the bomb type. MK-82s, GBU-12, GBU-16 and GBU-24 all use CCRP through the BL (*Bombes Lisses*, Free fall bombs) master mode. MK-82SE, BLG-66 use CCIP through the BF (*Bombes Freinées*, High drag bombs) master mode

Both methods require the same ingredient: target ground elevation. There are three ways to get this value: By radar ranging, calculating it from the aircraft altitude above ground and from the INS system.

• RADAR RANGING (TAS - *Télémétrie Air Sol*): to obtain radar ranging data, you need to click on the TAS button. The radar screen will go dark and the word TAS will appear in the upper right corner. This is the most precise method.

• ALTITUDE ABOVE GROUND (RS - *Radio Sonde*): To obtain altitude above ground you need to activate the radar altimeter. Then you must click on the RS button on the PCA. The system will use the same ground elevation below the aircraft as the target elevation. This method will fail if the ground continuously changes elevation.

• INS CALCULATION (PI - *Point Initial*): in this mode you need to first select an initial point for which you'll get a radar ranging and the INS will calculate the ground elevation based on the Δ ALT between the IP and the target it has in memory (the target must be located at a BAD from the IP WPT).

It is recommended that both TAS and RS are selected on the PCA. This way if there is a problem with the radar ranging data, the system will fall back to the radar altimeter.

In the screenshot above, both TAS and RS ranging means are selected on (small letter S below is lit up, **1** / **2**). You can also confirm that both are on by checking the VTB screen - both TAS and RS are on in the top - right corner.

CCRP (BL MODE) PROCEDURE AND METHODS

In CCRP (BL mode), the pilot needs to "show" to the computer the relative position of the target. This is done by placing a dedicated HUD symbol on the target and pressing the air-to-ground designation pushbutton. At this moment, the computer memorizes angle and distance to the target and a cross appears in the HUD on the target. If the position is not satisfactory, it can be cleared using the target unlock button and designated again. Then, continuously based on real-time aircraft speed and attitude, provides horizontal guidance (left/right) to fly exactly to the target, and calculates the right moment for bomb release. This enables bomb drop while pulling up and loosing sight of the target.

Distance and angle measure is based on the radar. Therefore, it needs to be operating throughout the procedure. Should the radar be unavailable, the computer bases its computation on radio-altimeter height. This backup method is less accurate, and assumes that the terrain area is flat. If it is not the case, correct computation will be impossible.

This bombing mode is exclusive to Mk-82, BGL-66 and GBU series bombs.

To do a CCRP bomb run the following procedure must be followed. (For symbols description please refer to the HUD chapter).

1. Minimum altitude should be 2000 feet AGL and speed above 350 KIAS.

2. Fly in a slight dive towards your target. It shouldn't be more than 15º.

3. Place the CCRP piper over your target

4. Click on the AG DESIGNATE button (refer to HOTAS title in Chapter 1).

5. Pull up and resume level flight.

6. The target cross will remain over the target.

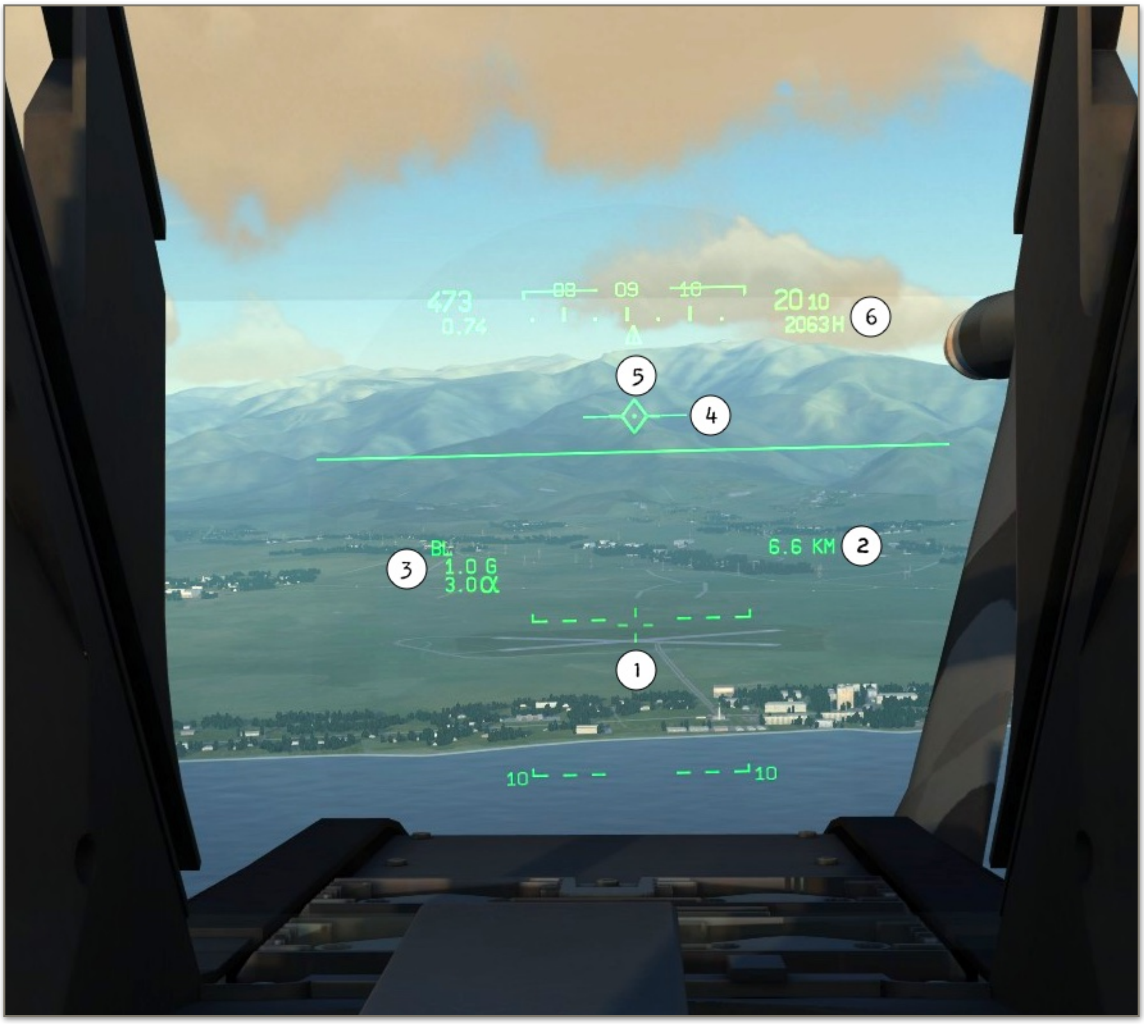
7. Fly towards the target.

8. When you are 15 seconds from the release point, the release cue will appear.

9. Press the trigger as soon as you see the release cue. Keep the trigger pressed while the cue is visible.

10. The bombs will be released automatically when the cue cross the CCRP piper.

11. The system will clear the target designation as soon as the bombs have been released.



1. TARGET CROSS. Shows the selected target position.

2. RANGE TO TARGET. Indicates slant range to the target position.

3. ATTACK MODE DATA. Indicates selected master mode (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft AOA.

4. CCRP STEERING CUES. They appear only after a target point has been designated. They are centered on the CCRP piper and rotate to show deviation from the course to target. The aircraft is flying directly to the target when they are level.

EXAMPLE OF ALMOST PERFECT ALIGNMENT

EXAMPLE OF MIS-ALIGNMENT

5. CCRP PIPER. It remains at a fixed point and replaces the FPM when in CCRP mode. Before target selection, it is used to select a point in the ground as the target. After target selection, it is used to give the bomb release order.

6. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

AIR TO GROUND MODE: CCRP JUST PRIOR TO RELEASE

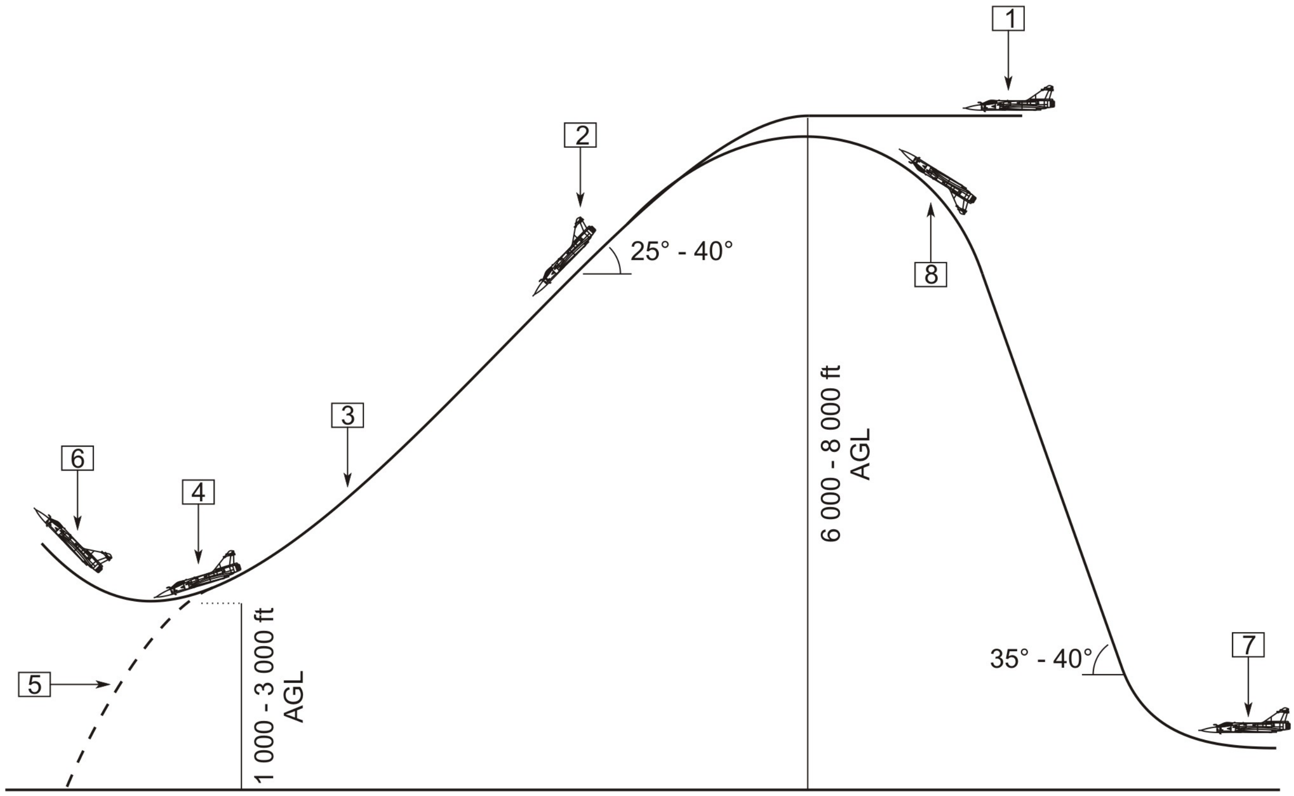
1. RELEASE CUE. The release cue moves from the target cross towards the CCRP piper. The bomb(s) must be released when the cue is at the center of the piper. The cue is time based and appear when time to target is 15 seconds.

CCRP BOMBING PROFILES

DIRECT BOMBING

This is the classical profile to drop bombs. The aircraft dives towards the target starting from 5 000 - 8 000 ft AGL, the designation symbol is placed on the target and the air-to-ground designation switch pressed. A cross appears over the target. Aircraft dive angle is then reduced while following the HUD guidance cue and maintaining the trigger pressed. The computer calculates the release point and triggers bomb release at the appropriate moment. The release occurs when the horizontal line appears at the bottom of the HUD, moves up and intercepts the flight path marker.

Dive to the target may be preceded by a "zoom". The aircraft starts at a lower height (500 - 2 000 ft) flying roughly towards the target and performs a sharp climb. During climb, visual contact is made on the target. When reaching the 5 000 - 8 000 ft zone, the aircraft rolls inverted to enter the final dive and bombing is performed as described above.



BEFORE ATTACK RUN
Radar: ON
Radio Altimeter: ON and selected (PCA RS)
Bomb quantity, interval and fusing - Set (PPA).

1. Level start. ~ 350 kias. Idle thrust when diving.

2. Target designation. Trigger held down. Follow guidance cues.

3. Start of pull up. Follow guidance cues.

4. Bomb release.

5. Bomb path.

6. Breakaway. Thrust as required.

7. (OPTIONAL) Low-level start ~ 450 to 520 kias. Full dry thrust at climb start.

8. (OPTIONAL) Reversion towards dive. Idle thrust at top of trajectory.

WARNING — The lower the bomb release, the more the impact point is precise, but the closer is the aircraft to the enemy units and their AAA defences. Moreover, if MANPADS are suspected, preventive flare release may be necessary during dive/climb and breakaway.

NOTE — Bombs will not be dropped if at the moment of the release the load factor is below +0.4 G. This is a safety to prevent flying into the bomb(s). For this reason, pull up must be initiated before reaching the release point.

BOMBING WITH INITIAL POINT [4]

This kind of attack requires longer and more careful planning and preparation. However, you don't need to manually designate the target by entering a shallow dive. Moreover, it is not necessary to obtain a visual on the place you want to bomb.

The drawback is that the position of the target must be known precisely and inserted as a BAD, and the INS requires having enough precision. To achieve INS precision, a landmark can be inserted as the waypoint to which the BAD relates and the INS position updated on it during the attack run. This waypoint is called Initial Point (IP).

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

In order to perform a precision bombing / INS attack, you need to follow several steps:

[4] Also called "Precision Bombing" sometimes, though in reality it is less precise than the CCRP or CCIP. Air Force uses the name "*Bombardement avec PI*" .

1. During mission preparation phase, or already in the cockpit, you need to create an Initial Point (IP) - waypoint placed over a landmark with a well known position.

2. You need to create an offset point from the IP using the BAD function and ΔL/ΔG or ρ/θ. Please see OFFSET POINTS chapter in Section 12-5 for more information. Do not forget about setting the altitude difference in Δ ALT.

3. Prepare your plane for the attack run. Check that your radar is working and emitting and that your radar altimeter is set to on. Select the weapon you will want to use on the PCA and set the MASTER ARM switch to ON (**4**). On Weapons Control Panel set the fusing, dispersion and release quantity according to your preferences. Finally, press both TAS and RS on the PCA (**1, 2**).

4. Set the waypoint that you want to use as the Initial Point (IP) as your DEST and then press the PI button on the PCA (**3**).

5. The following cues will appear on the HUD:

- A diamond at the bottom of the HUD for IP position update purposes.
- Normal NAV cues: "House" track error cue and "Cross" position cue when distance is below 10 NM.
- HSI will display bearing and distance to IP.

6. Turn towards the IP.

7. When you get close enough to see the IP, update its position by using the diamond to determine exact distance. Remember that you should place the diamond over the landmark, and not the marked position of the waypoint by the INS. When you do so, HUD will display radar range to IP. You can keep updating IP position as many times as you wish to increase accuracy. Please refer to the INS POSITION UPDATE chapter in Section 12-4 for more information.

8. After the first update, BAD, REC and VAL lights turn on in the PCN when IP is selected - remember **not to** press the VAL button before finishing the bomb run. Continue flying to IP using the NAV cues.

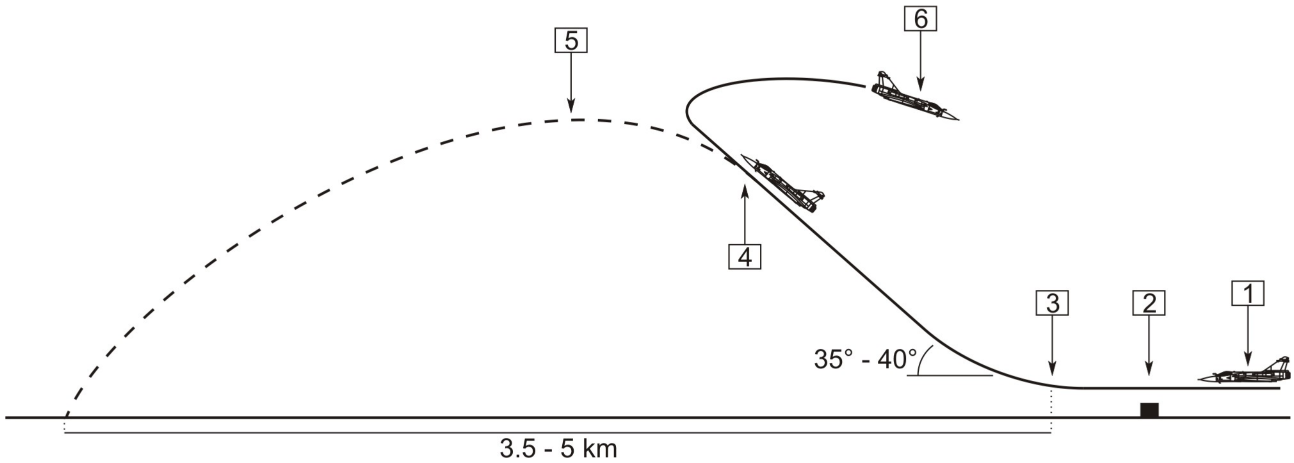
9. Once you are over the IP, HUD diamond will disappear and wings will appear on the FPM (**1**). They will provide steering cues towards the BAD. Radar range will display the range to target (**2**), nav cues will shift to BAD position (**3**) and HSI will display bearing and distance to BAD.

10. As you are almost directly over the IP, follow the navigation cues and turn towards the offset point. Try to keep the wings on your FPM level as you approach your target.

When you are in range for pull up, release cues appear in the HUD. Pull up with full aft stick for max range release, keep the wings level during the climb and press and hold the trigger. The bombs will be automatically released when the release cue cross the target cue (FPM).

TOSS BOMBING

A variant of the CCRP bombing bombing that is based on releasing the bombs during the pop-up climb, leading to a larger bomb ballistic trajectory to the target. This permits to bomb at a greater horizontal distance and make the attack to be detected at the very last moment, leaving very little reaction time to the defences.



BEFORE ATTACK RUN
Waypoint (IP) - Inserted if required.
BAD - Inserted if required.
Radar - On.
Radio altimeter - On and selected (PCA RS) Bomb quantity, interval and fusing - Set (PPA). Master Arm - On.

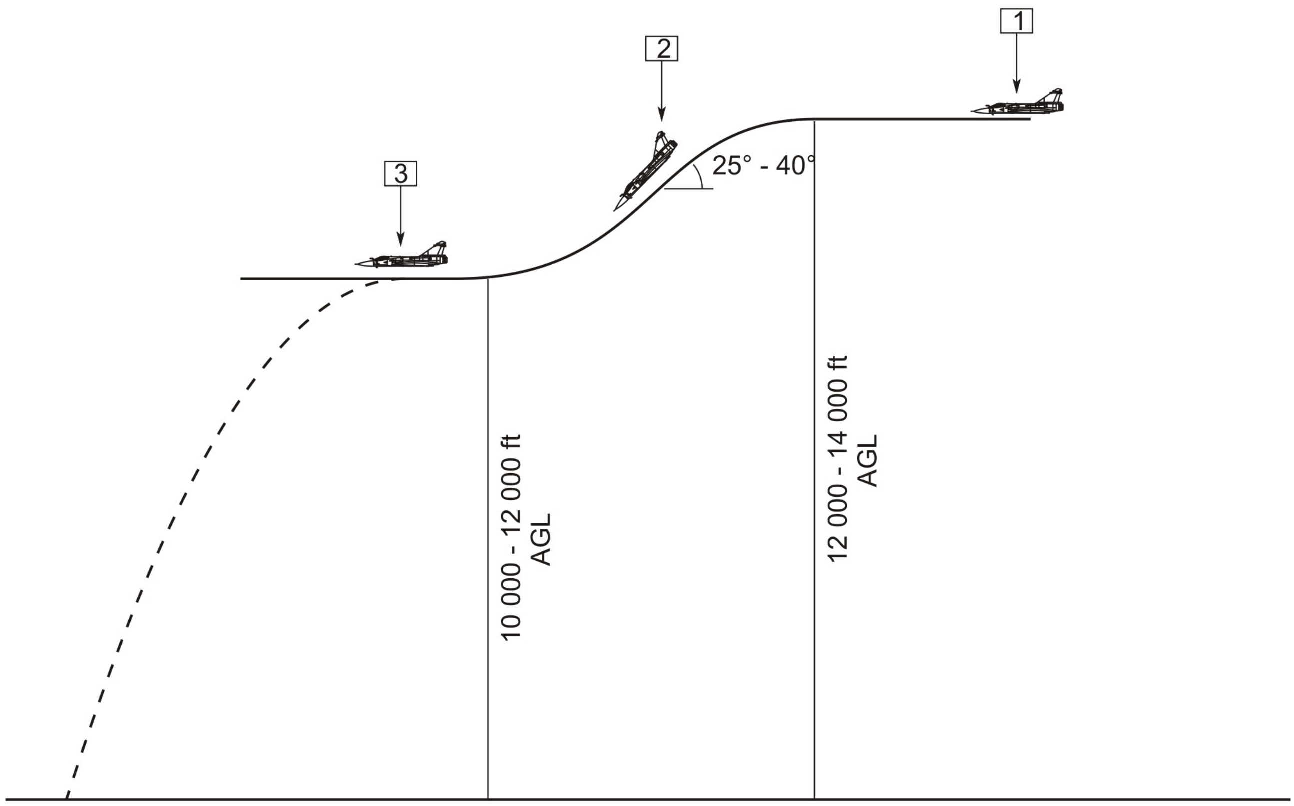
1. Height 600 - 1 000 ft AGL. 520 kias.
2. INS position update on IP (If using IP bombing).
3. Climb. Full afterburner.
4. Bomb release.
5. Bomb path.
6. Breakaway. Thrust as required.

WARNING The closer the bomb release, the more the impact point is precise, but the closer is the aircraft to the enemy units and their AAA defences.

USING GBU-12/16/24 BOMBS

Prior to GBU release, an external support unit, such as a JTAC on ground or another aircraft equipped with a targeting pod, must perform target laser designation. Once this condition fulfilled, the GBU release is performed in the same manner as the Mk-82 bombs (CCRP), except that:

- The pull up can be performed immediately after target designation and the aircraft set on a level flight.
- Dive is started much higher (14 000 - 16 000 ft) and bomb released in level flight at 10 000 - 12 000 ft. GBUs are dropped one by one only.



BEFORE ATTACK RUN
Radar - On.
Bomb fusing - Set (PPA).
Master Arm - On.

1. Level start. 520 kias max. Idle thrust when diving. Request for laser targeting.

2. Target designation. Trigger held pressed. Start of pull up. Follow guidance cues. Adjust thrust when level.

3. Automatic bomb release in level flight.

CCIP (BF MODE) BOMBING

CCIP stands for Continuously Computed Impact Point. In this mode, the HUD displays a bomb fall line ended by a pipper, which indicates in real-time the bomb impact point if release is performed. To bomb a target, fly to it and press the trigger when the pipper is on the target. Like for CCRP, the radar or radio-altimeter are used and same limitations apply.

If aircraft altitude is too high, and/or speed too low, the pipper may descend below the HUD's field of view. Therefore, it may be necessary to raise the seat and/or speed up and/or descend to bring the pipper back in sight.

This bombing method is exclusive to Mk-82SE “Snakeyes” and BLG-66 bombs.

To perform a CCIP bomb run the following procedure must be followed:

1. Upon activating the CCIP, raise the seat so your downwards view is better

2. For diving runs minimum altitude should be 1500 feet AGL. 3000 AGL feet is better, especially if you are going to do a high angle dive.

3. Minimum indicated airspeed should be 400 KIAS.

4. The CCIP pipper will appear at the bottom of the HUD.

5. When nearing your target, fly in a dive. The steeper the dive the better. 20° to 25° dives are very precise.

6. Check the safe altitude cue position.

7. Press the trigger to release the bombs when the CCIP piper is over your target

8. Pull up.

9. DO NOT release the bombs if the safe altitude cue intersects the FPM or is above it.

NOTE	With the higher speed, targeting piper will be more visible on the HUD. You will also be a much more difficult target to hit.

1. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

2. RANGE TO GROUND. Displays the current slant range to the ground at the point the piper is aiming. For more information, refer to the Weapons Management chapter.

3. ATTACK MODE DATA. Indicates selected master mode (name flashes when the Master arm switch is in the SAFE/OFF position), aircraft G load and aircraft AOA.

4. "RADAR OFF" INFORMATION. Displayed if the main radar is set to any mode other than "ON" and it is impossible to compute the slant range to the ground.

5. MINIMUM RELEASE ALTITUDE CUE. Indicates the minimum altitude at which bomb release is safe. It moves from the CCIP piper to the FPM. If the cue reaches the FPM, it is not safe to release the bombs since there is a high probability of

taking damage from their detonation and a large green cross appears in the HUD (see next fig.).

6. BOMB FALL LINE (BFL). Displays the path that the bombs will follow upon release.

1. RELEASE NOT SAFE MARKER. This big 'X' cross is displayed on the HUD whenever the Minimum Release Altitude Cue reaches the FPM and indicates that the delivery at current parameters will not be safe.

2. RANGE TO GROUND. As the radar is ON, this time the slant range from the airplane to the point directly underneath the piper is being shown.

3. CCIP PIPPER. Aiming point where the bombs will impact.

MK-82SE BOMBS

The Mk-82 bombs are designed to be dropped in CCIP at very low altitude (down to 300 ft AGL) in level flight or very shallow dive. They are equipped with strakes that automatically deploy after release, slowing the bomb down and providing enough time for the aircraft to separate and avoid the blast.

BGL-66 cluster bombs

These cluster bombs are dropped in CCIP mode and are used against soft targets (non-protected or lightly armoured). After release, the bomb ejects a large amount of small sub-munitions that cover a large area and detonate on impact. Therefore, they must be dropped high enough to permit sub-munitions deployment.

GUN / ROCKET ATTACK

Technically, the gun and rocket attack is considered to be a variation of the CCIP diving run. However, small differences exist.

For the gun it is important to remember to arm the cannons before performing the attack. Also, in order to put the gun in the A/G mode, press the A/G Gun Master Mode 'CAS' button located below the Selective Jettison Button. Please refer to the PCA (WEAPONS MANAGEMENT PANEL) chapter in Section 15-2 for more information. Also, do not forget to press the WSC switch forward to bring up the gun / rocket pipper on the HUD.

Also, it is important to activate the TAS and RS modes on the PCA and to set on the radar and enable radar altimeter before commencing the attack run.

1. AMMO COUNT. Displays the current count of 30mm ammunition or 68 mm SNEB rockets.

2. ATTACK MODE DATA. Indicates selected Master Mode (name flashes when the Master arm switch is in the SAFE/OFF position). Aircraft G load and aircraft

AOA. For rockets a RK abbreviation will be visible. For guns, CAS will be displayed.

3. RANGE TO GROUND. Displays the current slant range to the ground at the point the piper is aiming. For more information, refer to the Weapons Management Section.

4. GUN/ROCKET PIPER. Indicates the point in the ground where the gun shells/ SNEB rockets will hit. The aiming point is continuously calculated by the ballistics computer. For more information, refer to the Weapons Management Section.

The piper will be a full circle at maximum range and starts to disappear going from left to right as soon as target gets into range of 2400 meters. The 9 o'clock caret depicts the range of 1800 meters, 6 o'clock of 1200 meters and 3 o'clock of 600 meters.

This is the same principle as the 'CAN' AA gun mode, but note that the ranges carets values differ.

5. RADAR ALTITUDE. Displays current altitude above ground level (AGL). The radar altitude is not automatically displayed and must be manually selected by clicking the appropriate switches in the HUD control panel.

SECTION 16

OTHER SYSTEMS

DRAG CHUTE

The Mirage 2000C is fitted with a drag chute. It is a safety feature that can be used to reduce the landing ground roll or during a take-off abort. The parachute container is located on the underside of the aircraft, between the exhaust nozzle and the centreline pylon.

When necessary, the drag chute container can be removed and replaced by the additional ÉCLAIR chassis. Refer to the ÉCLAIR POD in Countermeasures Section for more information.

An emergency hook assembly can also replace the parachute or the Eclair pod. But this last feature is NOT FUNCTIONAL in DCS

Controls

A lever, located on the left side cockpit wall at the base of the windshield, is used for control. The initial position of the lever is forward. When pulled full aft, the drag chute deploys. When pushed back forward, the drag chute is separated from the aircraft and falls on the runway.

CAUTION

The drag chute must not be deployed until the nose gear is on the ground, in order not to damage the engine nozzle petals.

Canopy

Normal Operations

The canopy is controlled via a lever located in the cockpit, on the right side of the cockpit wall. Two main positions are available:

- When PULLED BACK, the canopy is unlocked and moves up.
- After that the lever moves back into the MIDDLE POSITION.
- When PUSHED FORWARD, the canopy is locked and sealed and cockpit pressurisation is achieved.

The aircraft must not move with the canopy fully opened. Therefore, a partially closed position is available via a rod. The canopy control shortcut cycles between the open, semi-closed and closed position.

Emergency jettison

If required, the canopy can be manually jettisoned with a dedicated control. The control must be pushed fully forward.

Remark: In real life, the canopy is not jettisoned. If seat ejection or canopy jettison is triggered, an explosive cord (running all along the canopy structure) detonates and destroys the Plexiglas.

SECTION 17

AIRCRAFT PROCEDURES

PILOT MEMO

STANDARD CONFIGURATIONS

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

TAKE OFF - ISA METEOROLOGICAL CONDITIONS

Configuration	Fuel (t)	GW (t)	Expected Jx	Vmaxrto (kt)	Vr (kt)	Vlof (kt)
CLEAN AIRCRAFT	3.1	11.0	0.68	145	120	155
STANDARD AIR TO AIR	4.1	13.2	0.55	140	125	155
STANDARD AIR-TO-GROUND	6.3	16.0 or 15.7	0.44 - 0.46	130	150	175

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

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

CLIMB - BEST EFFICIENCY

		Economic (MIL thrust)		High performances (Max AB thrust)	
Configuration	**Climb up to**	**Best CAS (kt)**	**Best Mach**	**Best CAS (kt)**	**Best Mach**
CLEAN AIRCRAFT	FL400	500	0.90	600	0.95
STANDARD AIR TO AIR	FL350	460	0.85	550	0.90
STANDARD AIR-TO-GROUND	FL300	440	0.80	550	0.90

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

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

LANDING - REMAINING FUEL / MLW

	Max remaining fuel (t)	
Configuration	**for normal MLW**	**for uprated MLW**
Clean Aircraft	**2.05**	**4.45**
Standard Air to Air	**0.85**	**3.25**
Standard Air-to Air (all missiles shot)	**1.57**	**3.97**
Standard air-to-ground (w/ 4x Mk-82s)	**< 0.5 (min. res.) = N/A option!**	**2.6**
Standard air-to-ground (w/ 2x GBU-12s)	**0.5 = min. reserve!**	**2.9**
Standard air-to-ground (all bombs released)	**1.1**	**3.5**

Remarks: *uprated MLW is a non standard procedure which should be avoided to minimize risks and aircraft wear (structural, gear, brakes, tyres...)*

When an uprated MLW landing has to be performed, it REQUIRES extra precautions: gentle sink rate at touch down, long runway, parachute use mandatory if > 1t over normal MLW... etc.

Below you will find the procedures that must be followed before and after a flight. The procedures listed here are a subset of the ones followed by the pilots of the actual aircraft.

PREFLIGHT CHECKLIST

Left Instruments Panel

	Description	Position
1	FBW/PA Auto test	Off (cover closed)
2	Emergency Afterburner Cutoff	Off (cover closed)
3	Emergency Oil Pump	Off (cover closed)
4	Engine Computer (FADEC)	Norm (cover closed)
5	Fuel Dump	Off (cover closed)
6	Tape recorder	As desired
7	FBW GAIN	Norm
8	Emergency Trim	N
9	Audio volumes panel	Check and set
10	Inflight relight switch	Off
11	Throttle	Stop
12	Radar	Off
13	Pelles (scoops), Souris (inl. Cones), Becs (slats) switches	Auto
14	External lights	Off
15	Brakes circuit switch (SPAD)	On (cover closed)
16	“Emergency fuel” engine mode	Off
17	Landing Gear Lever	Down and secured
18	FBW NORM/ULT.SEC Switch	NORM (cover closed)
19	FBW Mode AA/Charges	As required
20	Emergency canopy lever	Towards the rear
21	Parachute lever	Towards the front

Main Instruments Panel

	Description	Position
1	Master Arm switch	Off
2	Selective Jettison	Off (cover closed)
3	FBW NORM/VRILLE switch	Normal
4	HUD and HDD	On
5	TR, ALT1 and ALT2 switches	All ON
6	IFF	Out-3A-C
7	HSI	NAV (Cm or Cv)

Right Instruments Panel

	Description	Position
1	Alert Network (QRA) Switch	Off (Down position)
2	Sound warning system	Off
3	VOR/ILS - TACAN	Off
4	Fuel pumps	Off
5	Ignition/vent selector	G or D
6	Fuel Shut-Off Valve Switch	Closed (cover open)
7	Breakers panel	Check
8	INS	Off

NOTES

ENGINE START (WITH GROUND POWER)

Before Engine Start (with ground power)

	Description	Position
1	Battery	ON
2	GPU Connected & Providing Power	CHECK
3	NAV lights	ON
4	F2 view external preflight check - Payload & skin	Done - Checked
5	Altimeter Pressure setting	SET to QFE (or QNH)
6	INS (PSM panel)	SET to VEILLE
7	00 PREP WPT Position & Altitude	SET proper values
8	INS (PSM panel)	SET to ALN
9	INS Alignment	START (VAL button)
10	Fuel Panel Quantity - Crossfeed switch	CHECK - CLOSED
11	BINGO	SET BINGO Value
12	Alarm panel and Fire Warning Lights	TEST
13	HUD	ON
14	Radar main switch	SET to PCH
15	HDD (Radar display)	ON
16	Payload	CHECK (PRES switch)
17	A/A-CHARGES Switch - CONF caution light	SET - OFF
18	Emergency Hydraulic pump	TEST then OFF
19	FS emergency/parking brake pressure	CHECK > 80b (EP if req.)
20	VOR/ILS & TACAN	SET (Depart. airbase)
21	Countermeasures Panel & ECLAIR control box	SET (Pilot's discretion)
22	IFF Interrogator	SET (Pilot's discretion)
23	IFF	SET (as briefed)
24	Radios (both)	ON & set
25	If MP flight, Radio Check	Done
26	INS Waypoints 01 to 20 (depending on mission)	ENTERED & CHECKED
27	INS Alignment – 'PRÊT' light	CHECK Completed - ON
28	INS (PSM panel)	SET to NAV
29	"Ready for start-up"	Radio CALL (Leader/ATC)

Engine Start sequence (with ground power)

	Description	Position
1	Parking Brake	SET
2	ANTICOL Strob lights	ON
3	Throttle	CHECK STOP
4	**RPM** and **CALC** warning/caution lights	CHECK Both OFF
5	MASTER WARNING/CAUTION - **PANNE**/**PANNE**	ACKNOWLEDGED - Indicat. OFF
6	Canopy	CLOSED or AJAR
7	INS (PSM panel)	CHECK NAV & [N]
8	Fuel Shut-Off Valve Switch	OPEN & Cover CLOSED
9	Ignition/Vent selector	G or D as req. (odd/even day)
10	Fuel pumps “G” and “D” - **BP.G** & **BP.D** caution lights	ON - cautions OFF
11	Starting fuel pump 'POMPE DEM’ - **BP** warning light	ON - warning OFF
12	Starter button	PRESS 1 Sec.
13	When RPM 'N' > 10%, Throttle	IDLE
14	When RPM 'N' = Idle (~48%), **HUILE** and **T7** warning lights	Both OFF
15	T7 temperature	CHECK < 950°C
/!\	If any incident occurs during start sequence, or Tt7 peaks > 950°C:	**ABORT START UP**

NOTES

Post-Engine Start Checklist (with ground power)

	Description	Position
1	P MIS & P MAG (when appropriate)	Blinking - STOP if req.
2	Radar Warm-Up (HDD)	CHECK 'P' Blinking
3	HYD pressure gauge - **HYD.1** & **HYD.2** caution lights	CHECK - cautions OFF
4	GPU - **ALT.1** & **ALT.2** caution lights	DISCONNECTED - cautions OFF
5	CAP/HORIZON GCS switch (right console)	CGM+H.SEC (middle position)
6	Auxiliary Attitude Indicator	UNCAGED - NO FLAG
7	VOR/ILS - TACAN	ON - A/A or T/R
8	ANEMO heater switch - **ANEMO** caution light	ON - caution OFF
9	Emergency Hydraulic pump - **HYD.S** warning light	AUTO - warning OFF
10	Flight Controls Surfaces	TEST - CHECK
11	AP & FBW BIT tests	DONE & Green Result
12	FBW short ('C') BIT test	DONE & Green Result
13	SEC CALC & SEC CARB emergency modes tests	DONE & Passed OK
14	Airbrakes and Slats extension	TEST
15	Secondary brakes circuit & Antiskid loss	TEST
16	FORMATION lights	As Req.
17	Radio-Altimeter	ON ('SEL H')
18	"Ready for taxi"	Radio Call (Leader/ ATC)

NOTES

ENGINE START (NO GROUND POWER)

Before Engine Start (No ground power)

	Description	Position
1	Battery	ON
2	Radios (both)	ON & Set
3	If MP flight, Radio Check	DONE
4	F2 view external preflight check - Payload & skin	DONE - CHECKED
5	Altimeter Pressure setting	SET to QFE (or QNH)
6	Alarm panel and Fire Warning Lights	TEST
7	IFF	SET (as briefed)
8	Emergency Hydraulic pump	TEST then OFF
9	FS emergency/parking brake pressure	CHECK > 80b (EP if req.)
10	"Ready for start-up"	Radio CALL (Leader/ ATC)

NOTES

Engine Start sequence (No ground power)

	Description	Position
1	Parking Brake	SET
2	NAV and ANTICOL Strob lights	ON
3	Throttle	CHECK STOP
4	**RPM** and **CALC** warning/caution lights	CHECK Both OFF
5	MASTER WARNING/CAUTION - **PANNE**/**PANNE**	ACKNOWLEDGED - Indicat. OFF
6	Canopy	CLOSED or AJAR
7	Fuel Shut-Off Valve Switch	OPEN & Cover CLOSED
8	Ignition/Vent selector	G or D as requ. (odd/ even day)
9	Starting fuel pump 'POMPE DEM' - **BP** warning light	ON - warning OFF
10	Starter button	PRESS 1 SEC.
11	When RPM 'N' > 10%, Throttle	IDLE
12	When RPM 'N' = Idle (~48%), **HUILE** and **T7** warning lights	CHECK Both OFF
13	T7 temperature	CHECK < 950Â°C
/!\	If any incident occurs during start sequence, or Tt7 peaks > 950°C:	**ABORT START UP**
14	Alternators switches - **ALT.1** & **ALT.2** cautions lights	ONLINE - cautions OFF
15	Normal electric converter - **TR** caution light	ON - caution OFF
16	Fuel pumps “G” & “D” - **BP.G** & **BP.D** caution lights	ON - cautions OFF
17	HYD pressure gauge - **HYD.1** & **HYD.2** caution lights	CHECK - cautions OFF
18	Emergency Hydraulic pump - **HYD.S** warning light	AUTO - warning OFF

NOTES

Post Engine Start sequence (No ground power)

	Description	Position
1	P MIS & P MAG (when appropriate)	Blinking - STOP if req.
2	HDD (Radar display)	ON
3	Payload	CHECK (PRES switch)
4	A/A-CHARGES Switch - CONF caution light	SET - OFF
5	INS (PSM panel)	SET to VEILLE
6	00 PREP WPT Position & Altitude	SET Proper Values
7	INS (PSM panel)	SET to ALN
8	INS Alignment	START (VAL button)
9	Fuel Panel Qty & Xfeed closed - BINGO value	CHECK - INSERTED
10	Radar main switch	PCH
11	Radar Warm-Up (HDD)	CHECK 'P' Blinking
12	HUD	ON
13	Defensive suite (incl. Eclair) & IFF Interrogator	SET (Pilot's discretion)
14	VOR/ILS	SET & ON
15	TACAN	SET & A/A or T/R
16	CAP/HORIZON GCS switch (right console)	CGM+H.SEC (middle position)
17	Auxiliary Attitude Indicator	UNCAGED - No Flag
18	INS Waypoints 01 to 20 (depending on mission)	ENTER and/or CHECK
19	INS Alignment	CHECK Completed ('PRET' light)
20	INS (PSM panel)	SET to NAV
21	ANEMO heater switch - ANEMO caution light	ON - caution OFF
22	Flight Controls - Controls Surfaces	TEST - Check
23	AP BIT test	DONE & Green Result
24	FBW short ('C') BIT test	DONE & Green Result
25	SEC CALC & SEC CARB emergency modes tests	DONE & Passed OK
26	Airbrakes and Slats extension	TEST
27	Secondary brakes circuit & Antiskid loss	TEST
28	"Ready for taxi"	Radio CALL (Leader/ ATC)

TAXIING CHECKLIST

	11	Position
1	Parking Brake	RELEASE
2	PARK caution light	CHECK Off
3	Warning Sounds switch	ON
4	Caution/Warning Lights panel*	CHECK All Off
5	NWS	ACTIVATE
6	DIRAV advisory light	ON
7	NWS Travel	CHECK
8	Landing lights	TAXI
9	Formation lights	As req.
10	Radio-altimeter	ON ('SEL H')
11	Radio-altimeter warning value ('HG')	SET

* The CAB warning light, indicating that the canopy is open, may remain lit at this stage.

You can now increase throttle until the aircraft rolls out. Do not exceed 20 knots ground speed

NOTES

TAKE OFF

	Description	Position
1	Canopy	Down and locked
2	CAB warning light	Off
3	Caution/Warning Lights panel	All Off
4	Landing Lights	Landing
5	Take Off parameters (speeds & expected Jx)	Review & Memorize
6	Thottle	Max afterburner
7	PC advisory light	On
8	At 80kt	Check Jx
8	Rotate at Vr speed	Place horizon on the rotation pitch marker in the
9	Retract and stow landing gear	Before 260 Knots.

NOTES

LANDING

	Description	Position
1	Landing Gear Down	Below 230 knots
2	Landing Gear warning lights	Green
3	Anti-Skid	Check
4	HUD	APP Mode
4	Landing Lights	On
6	AOA final approach	14º
7	Brake chute (after nose gear is on the ground)	As required
8	Wheel brakes	Below 130 knots*
9	NWS	Below 40 knots

* Whenever possible, use wheel brakes only when speed is below 100kt, to lessen brakes wear.

NOTES

RUNWAY VACATED

	Description	Position
1	Landing Lights	Taxi
2	IFF	Off
3	VOR/ILS	Off
4	TACAN	Off
5	IFF interrogator, Countermeasures Panel & ÉCLAIR control box	All Off
6	ANÉMO heater switch	Off
7	Warning Sounds switch	Off

PARKING

	Description	Position
1	External power supply	Connected
2	HUD and HDD	Off
3	INS	Off
4	Radio Altimeter	Off
5	CAP/HORIZON GCS switch (right console)	Off
6	Auxiliary Attitude Indicator	Caged
4	Engine	Stop button
5	When engine has stopped: Fuel pumps G and D	Off
6	Fuel Shut-Off Valve Switch	Closed (cover open)
7	All air conditioning equipment	Off
8	All external lights	Off
9	Radios (V/UHF and UHF)	Off
11	BATT switch	Off

NOTES

SECTION 18

CAMPAIGN

INTRODUCTION

Welcome to the official campaign for the M-2000C. Below you will find some background information, basic facts about the campaign, things you should know and remember while playing the campaign to make most of it and finally the credits part with big thank you for all the voice actors and beta testers who helped to make these 13 missions what they are in their final form.

The Story So Far

8 AUGUST 2008

Short and intensive armed conflict starts first in the Georgian breakaway territory of South Ossetia, and then within a few days is being brought by Russian troops at the soil of Georgia proper.

12 AUGUST 2008

A ceasefire between Russia and Georgia is signed under the auspices of EU, led by the French Presidency. A six point peace plan is adopted, envisaging non use of force, cessation of hostilities, granting of access to humanitarian aid, return of Georgian troops to usual quarters, withdrawal of Russian forces and opening of international discussions of the modalities of security and stability of South Ossetia and Abkhazia. UN is set to formalise the deal. EU call for international peacekeeping mission is rejected by Russia.

15 AUGUST 2008

Russian forces bomb the highway connecting eastern and western Georgia, destroy the railway bridge at Kaspi, a lifeline to Georgia's economy. Moreover, the Russian air force unleashes a series of air raids on Borjomi National Park, using fire bombs to inflict serious damage on what is regarded as a national treasure. Georgian government protest in the UN Security Council. Special resolution condemning Russian actions is vetoed by Moscow. France, feeling especially responsible for maintaining the ceasefire, sends a strongly worded warning to Russia.

31 AUGUST 2008

Russian troops begin erecting fences and checkpoints at the ABL with South Ossetia and Abkhazia. Georgians protest again, but UNSC has no room of maneuver as it is blocked by Moscow. France warns Russia for the second time, and is backed by all

EU-countries. NATO issues a strong statement, calling for immediate fulfilment of the 6-point plan.

10 SEPTEMBER 2008

US and France agree on the details of their next pilot exchange programme and decide that the training will take place in Georgia, as a sign of good will for the authorities and a warning to Russia. 2 USAF pilots will be flying Mirage-2000C's as part of 12-ship squadron sent to Georgia during a deployment planned to start in January 2009. Americans provide AWACS, C&C and transport planes.

11 NOVEMBER 2008

Exchange of fire between Georgian soldiers and Russians in Orsantia, part of Georgia proper annexed and still controlled by the Russians. Russian jets overfly Georgia on numerous occasions, dropping several bombs and destroying a pipeline from Turkey. Ankara calls for establishing a "no-fly" zone over Georgia and breakaway territories for Russian planes. This issue is raised at the extraordinary NATO meeting, but no decisions are taken.

DECEMBER 2008

Russian planes enter air space over South Ossetia and Abkhazia numerous times, although they are no longer stationed in Abkhazian bases. They also fly over Georgia proper. NATO issues another warning, UNSC remains blocked.

20 JANUARY 2009

2/5 Squadron arrives in Georgia together with two US pilots taking part in the exchange programme.

25 JANUARY 2009

Today.

CAMPAIGN

The campaign puts you in the role of one of two US exchange pilots attached to French 002.05 Squadron. You arrive in Georgia after the familiarisation training and you are to go through more advanced exercise session in Vaziani, while flying missions in support of the NATO operations there.

The campaign is roughly divided in two parts. First one is more focused on honing your skills and expanding on the things you have learned in the dedicated training missions (it is strongly advised that you fly these first). Therefore you can expect to get additional information on systems that were already covered as well as on new aspects of flying the M-2000C. As the campaign progresses, the storyline evolves with it and slowly changes focus from training to more substantial duties.

Difficulty

The campaign is not excessively difficult if you talk about number of enemy assets and tasks that are given to the player. However, it is very complex and will require good preparation from your side, including reading the briefings, taking notes, listening to the comms and following orders. Below you will find several pointers that you should treat really seriously.

A) Radio comms

The campaign uses an advanced radio system which means that you need to be tuned to correct channel / frequency in order to hear other flights and assets. For that, it is ESSENTIAL THAT YOU TURN EASY COMMUNICATIONS OFF, otherwise some of the missions will not be playable.

Equally important, you should always pay attention to and follow your AMC calls on changing radio frequencies, consult the notepad available as part of mission briefing package (you will find it in the kneeboard as well) and always remember to check if you are on correct radio channel for the thing you want to accomplish. For instance, you may want to jump from your element frequency to another channel to contact AWACS to get bearings to the enemy, but then you should remember to switch back to the element, otherwise you won't hear your wingman. I can't stress enough how important the radio discipline will be for accomplishing the missions.

B) Flight plans and orders

The campaign is quite complex and contains thousands of triggers, some of which are linked to the location in which the player currently is. Therefore it is very important that you keep to the given flight plans and - as much as possible - to the fragged speeds. There are rare points in which you may even break a mission if you don't follow these. So try to keep to the briefed parameters, just as you would be expected to do in real life. Read carefully the FRAGO, briefing, notes and study the map. If you do all these things, you will be OK.

C) Instructions

You will get a lot of information and instructions. If you have trouble understanding something, I would suggest to use an active pause and then read the message that someone (usually your Flight Lead / Instructor Pilot) wants to convey to you. This campaign will require you to focus on what is happening around you and what is being said, as it will be important for completing the missions!

D) INS alignment

All the missions will start on the ground and will require a full INS alignment. In most it won't be important how much time you spend on the ground, but at least two (M11 i 13) do take into account the timing. Therefore I would recommend not to disable the need for ground alignment in the options menu.

E) Completing missions

In order to progress the campaign you not only need to fulfil at least part of the objectives, you also need to land at one of two airports listed in the briefing - your home base (Vaziani) or the backup one, which depends on the area in which most of the given sortie will take place. So if you eject or land somewhere else, you will be forced to repeat the mission. When you land, you will also be given a specific parking spot - if you taxi there you will get extra points, though this is purely optional.

F) AI during taxi and formation flying

This campaign will quite often put you in the role of a wingman, which means that you will be required to fly in formation with your lead. A word of advice - despite hours spent on fine-tuning the AI behaviour it can be quite erratic, especially just after take off and during the taxi. When taxiing behind number 1 don't come too close to him, as he might just stop moving. If your IP stops during the taxi and refuses to enter the runway (a rare occurence) try to turn around or take one of the side taxiways, that should make him going. If you loose sight of the Instructor Pilot, use radar or F10 map to locate him. Sometimes you won't be required to stay in formation, this will be noted in the briefing or told during the flight.

Also, in very rare and exceptional situations, it may happen that the unpredictable AI behaviour could ruin a mission. Don't say you haven't been warned.

G) Support and feedback

Finally if you have any problems or feedback or if you just want to share your thoughts about the campaign (which is strongly encouraged) please do so at the DEDICATED PART OF THE RAZBAM'S M-2000C EAGLE DYNAMICS FORUMS. Constructive criticism will be appreciated (praises even more so :)

Credits and thanks

First and foremost, huge thanks to the voice actors who did an outstanding job recording a total of around 1200 lines:

Nicholas “Doughboy” Barnwell (the Player’s voice, there was tons of recording there), Patrick Kasperczyk (one of the Instructor Pilots and all voiceovers for the training missions), Olivier Raunier (Berger 1-1, for his creative approach to voice acting and great mission ideas) and his wife, Kandy Sigritz - Raunier, Haley Flight (Athena and Artemis voices), John 'Brixmis' and Sharon Dixon (for Rover, Zeus, Prowler and Vaziani Ground voice, briefings proofreading, training missions testing, great spirit and support throughout the campaign), Greg “Teeter” Smiddy (the second US pilot and a RAZBAM dev), as well as other voice actors, for their work and support in mission testing:

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Gliptal (for insane amount of work put into this, including corrections to the briefings and tracking down even the smallest bugs), Sryan (who was a spiritus movens for adding M13 to the already finished campaign and had very valuable input in other missions as well), Yurgon (usual precision in finding even the smallest bugs), as well as Catseye, Divadov, Helljumper, JughedJones, The Almighty Snark, Typhoon, [E69]Zazo and others.

SECTION 19
ANNEXES

	DCS MIRAGE-2000C COCKPIT FRENCH/ENGLISH LEXICON BY JEFX	
Word/ abbr.	**Français**	**English**
A	Arrêt (voir AR)	Off
530	Matra Super 530D	Matra Super 530D
3M	Mains sur Manche et Manette	HOTAS
AF	Aérofreins	Airbrakes
ALCM	Alignement sur Cap Mémorisé	Memory INS Alignment
ALL	Allègement	Symbology Dectlutter Switch (HUD)
ALN	Alignement	Alignment (yellow: INS is aligning)
ANEMO	Anémomètre	Pitot Heat Switch
APP	Approche	Approach Mode
AR	Arrêt	Off
ARME	Armé	Armed (Mater Arm On)
ATT.	Atterrissage	Landing (lights)
AU.	Automatique	Automatic
AV	Groupe Avant	Forward Fuselage Fuel Tanks
AV SON	Avertisseur Sonore	Audio Warning switch
B	B-Scope (Écran radar)	B-Scope (Radar display)
BAD	But Additionnel	Offset point
BALAYAGE	Angle de Balayage du Radar	Radar Scan Azimuth Selector
BANQUETTES	Banquettes	Lateral Consoles
BD	Bas-Droit	Low Right
BF	Mode Air-Sol pour Bombes Freinées	CCIP A/G Mode (for High Drag Bombs)
BF	Bombes Freinées	High Drag Bombs
BF1	Mark 82 Snake-Eye, Bombe Freinée (500 Lbs)	Mark 82-SE High Drag Bomb (500 Lbs)
BF4	BLG-66 Bélouga, Bombe à Fragmentation	BLG-66 Bélouga Unguided Low drag Cluster Bomb
BFR	Basse Fréquence	Low Frequency
BIP	BIP (signal audio…)	BEEP! IRL signal sent by the pilot to confirm gear is down

BL	Bombes Lisses	Free Fall Bombs
BL	Mode Air-Sol pour Bombes Lisses	CCRP A/G Mode (for Free Fall Bombs)
BL1	Mark 82, Bombe Lisse (500 Lbs)	Mark 82 Bomb (500 Lbs)
BLANC	Blanc	White (Cockpit Flood Light)
BP	Basse Pression	Low Pressure Boost Pumps
BR	Brouilleur	Radar Jammer (ECM)
CALC	Calculateur (pour le moteur)	Engine Computer
CAN	Canon (30 mm. Revolver x 2)	Cannon (30 mm. revolver cannon x 2, 125 rounds each)
CAN.	Canon	Guns
CAP SEC	Cap Secondaire	Secondary HSI/ADI
CARB	Carburant	Fuel
CAS	Canon Air-Sol	Air-to-Ground Canon
CCLT	Calcul Continu de la Ligne de Traceurs	Continuous Computation of tracer line (HUD GUN mode)
CCPI	Calcul Continu du Point d'Impact	CCIP (continuously Computed Impact Point)
CCPL	Calcul Continu du Point de Largage	CCRP (Continuously Computed Release Point)
CDVE	Commandes de Vol Électriques	FBW
Cm	Cap Magnétique	Magnetic Heading (Inertial)
CME	Contremesures	Countermeasures
CNM	Canon Neutre Magic	Cannon, Neutral, Magic
COUPURE	Coupure Post-Combustion	Afterburner Shutdown
CP/PD	Cap de Piste (vrai), Pente Désirée (au but)	Runway Heading/Glide Slope
CROSS	Crosse	Tail Hook
Cv	Cap Vrai	True Heading (Inertial)
D	Droite	Right
D/RLT	Distance/Relèvement	Distance/Bearing
D²M	Détecteur de Départ de Missile	IR Missile Launch Detector
DA.	Détecteur d'Alertes	RWR
DEC	Déclinaison magnétique	Magnetic Variation

Defa 554	Canons 30 mm (x2)	30 mm Canons (x2)
DEMAR	Démarrage	Start-up
DESCENTE	Descente (Verrière)	Down (Canopy)
DESEMB	Désembuage	Defogging switch
DEST	Destination	Destination
DETOT.	Détotalisateur de carburant	Total Fuel Quantity (Kg)
DIRA	Dirigeabilité Roue Avant	NWS
DIST	Distance	Bomb Drop Interval
DV/FV	Direction du Vent/Force du Vent	Wind Direction/Wind Speed
ÉCLAIR	Module additionnel de Lance-Leurres	Additionnal Chaff and Flares Dispenser Pod
EF1	GBU-12 (500Lbs) Bombe à guidage laser	GBU-12 (500Lbs) Laser Guided Bomb
EF1	GBU-16 (1000 Lbs) Bombe à guidage laser	GBU-16 (1000Lbs) Laser Guided Bomb
EF1	GBU-24 (2000 Lbs) Bombe à guidage laser	GBU-24 (2000Lbs) Laser Guided Bomb
EFF	Effacement	Erase
EM	Électromagnétiques (Contremesures)	chaff
EM	Émission	On (Radar)
ENC	Enchaînement	Waypoint automatic change
ENT	Entrelacée	Interleaved
ENV	Envergure (sélecteur en mètres)	Target Wingspan Selector (in meters)
EP	Électropompe	Emergency Hydraulic Pump
EXT	Extérieur	Outer wing rocket pods (if installed)
FAIB	Faible	Low (lights intensity)
FEUX	Feux (FEUX FORMAT = Feux de Formation)	Ligths (Formation Lights)
FORT	Fort	High (lights intensity)
FRAGILISATION	Fragilisation	Jettison (canopy)
FREINS	Freins Anti-dérapage	Anti-Skid Brake Switch
G	Gauche	Left
G	Guard (radio)	Guard (radio)

GAIN CDVE	Gain Commandes de Vol Électriques	FBW Gain Mode
H	Hauteur (sur VTH)	Height (Radar Altimeter on HUD)
HAUSSE	Hausse (Canon)	Auxilliary Gunsight
HFR	Haute Fréquence	High Frequency
HG	Haut-Gauche	High Left
HUILE	Huile	Oil
IDN	Indicateur de Navigation	HSI (Horizontal Situation Indicator)
INERT	Inerte	Disarmed (Bombs)
INS	Insérer	Insert
INST	Instantané	Instantaneous (No delay)
INT	Intérieur	Inner wing rocket pods (if installed)
IR	Contremesures Infrarouges	Flares
JAUG.	Jauge de Carburant	Internal Fuel Quantity (Kg)
JOUR	Jour	Day
L G (AP)	Localiser, Glide Slope, Pilote Automatique	Localiser and Glise Slope AP (ILS)
L/G	Latitude/Longitude (BUT)	Lat/Long (Waypoint)

LEN	Lent (1200 rounds per minute GUNS only)	Slow, (1200 rounds/min. GUNS only) best for Ground Atk.
LL	Lance-Leurres	Decoy Dispenser
LOX	Liquid Oxygen	Oxygen Quantity (Liters)
LUM	Luminosité	Brightness
LUMI	Luminosité	Brightness
M	Marche	On
M	Manuel (Mode radio)	Manual (radio mode)
M91	(M91, M92, M93) Points de Dest. Marqués	Markpoints (Max 3)
MAG	MATRA R550 MAGIC II IR MISSILES	MATRA R550 MAGIC II IR MISSILES
MAGNETO	Magnétophone	Video Recorder
MIP	Module d'Insertion de Paramètres	Data Cartridge Insertion Module (not functional)
MIS	Missiles Super 530D	Missiles Super 530D
MISS	Missiles	Missiles Magic II and S-530D

MRQ	Marquage	Mark point
N	Normal	Normal
N.DEG.	Dégradé (INS)	INS Degraded, needs alignment
NAV	Navigation	Navigation
NB	Nombre	Number (selected Quatity per trigger)
NUIT	Nuit	Night
OBL	Recalage Oblique de la Centrale	Radar INS Calibration
OBUS	Obus (cartouches du canon)	Rounds (Gun)
OUVERTURE	Ouverture (Verrière)	Open (Canopy)
P	Prêt	Ready
P	Pré-sélection (Mode radio)	Preset mode (radio)
P CH	Préchauffe	Radar Warm-up
PA	Pilote Automatique	Autopilot
PANNE	Panne	Failure (Main Caution Panel)
PAR	Partiel	(Fires a single 530D, Rockets and Gun Burst mode)
PC	Post-Combustion	Afterburners
PCA	Poste de Commande Armements	Weapons Management Panel
PCM	Priorité Contremesures	Jammer Priority mode (override own radar)
PCN	Poste de Commande Navigation	Navigation Control Panel
PELLES	Pelles	Engine Scoops
PHARES	Phares	Lights (external)
PI	Point Initial	IP (displays only if offset point set+BAD depressed on PCN)
PIC	Poursuite sur Informations Continues	STT
PID	Poursuite sur Informations Discontinues	TWS
PL de BORD	Planche de Bord (Tableau de Bord)	Main Instrument Panel
POL	Police	Police mode
PPA	Poste de Préparation Armements	Weapons Configuration Panel
PPI	Plan Position Indicateur	Plan Position Indicator (Polar radar display)
PRED	Prédéfini (GUN HUD mode)	Preset Gun Hud Mode)

PREP	Préparer	Prepare
PRES	Présentation (armement sur VTB)	Presentation (displayed on HDD)
PRET	Prêt	Ready (green) INS is ready
PSM	Poste de Sélecteur de Mode (Navigation)	Mode Selector Panel
PTF, C/C	Sélecteur de Programmes du module ÉCLAIR	ÉCLAIR Program Selector (not Functional)
RALL VOL	Rallumage en vol	Engine Air Relight/Restart
RAP	Rapide (1800 rounds per minute, GUNS only)	Fast (1800 rounds per minute, Guns only, AA engagements)
RAVIT.	Ravitaillement	Refueling (in flight)
RD/TD	Route Désirée/Temps Désiré	Selected Bearing/Selected Time (RD not functional)

RDI	Radar Doppler à Impulsions	Pulse Doppler Radar
RDO	Ralliement Désignation Objectif	Target Pursuit Mode (auto. entered when locking target)
REC	Recalage	INS Position Update
REMANENCE	Rémanence (Radar)	Persistence (Radar screen) (not functional)
RENTRES	Rentrés	Retracted
RET	Retardé	Delayed
RK	Roquettes	Rockets
RK3	MATRA LRF4 Roquettes 68 mm.(18)	Matra LRF4 Rockets Pod (18)
RL	Réservoir Largable	External Fuel Tanks
ROQ	Roquettes	Rockets
ROUL.	Roulage	Taxi (lights)
RP	Réservoir Pendulaire RPL 522 1300 Litres	External Fuel Tank (Center line) 1300 liters
RP	Réservoir Pendulaire RPL 541 2000 Litres	External Fuel Tanks (Under Wing) 2000 liters
RPL 522	Réservoir Pendulaire (Central)	Centerline Fuel Tank (1300 Kg)
RPL 541	Réservoirs Pendulaires (voilure x 2)	Under-wing Fuel Tank (2000 Kg)

RS	Radio-Sonde	Uses the radar altimeter to calculate slant range to target
RVT J	Ravitaillement en vol (Jour)	In Flight Air refuelling (Day)
RVT N	Ravitaillement en vol (Nuit)	In Flight Air refuelling (Night)
RVT VOL	Ravitaillement en Vol	Air-Refuelling
S	Selectionné	Selected
S.A.	Semi-Automatique	Semi-Automatic
SABRE	Brouilleur (voir BR)	Radar Jammer,ECM (see BR)
SEC	Secours	Emergency mode
SEL	Selective Jettison	Selective Jettison
SELH	Selection de la Hauteur	Selected Height Range
SERPAM	Serpam Enregistreur de Vol	Flight Recorder (not functional)
SERVAL	Détecteur d'Alertes (voir DA.)	RWR (see DA.)
SIL	Silence	Radio Squelch- Radar on Standby
SORTIS	Sortis	Extended
SOURIS	Souris	Inlet Cones
SPAD	Système Perfectionné Anti-Dérapant	Anti-Skid System
SPIRALE	Lance-Leurres (voir LL)	Chaff and Flares Dispenser (see LL)
STS	Status	Status
SVI	Spirale Viseur	HUD close combat mode only for 530D missile
TAC	Tacan	Tacan Navigation
TAF	Téléaffichage	(not functional)
TAS	Télémétrie Air-Sol	Radar slant range to target
TIR	Tirez	SHOOT
TOP	Signal, départ du Chrono (mode TD)	Timer Start Button for TD (Selected Time) Mode
TOT	Total	Fires both 530D, keeps firing gun and Rockets
TR	Transfo-Redresseur	Inverter Transformer
TR/VS	Temps Restant/Vitesse Sol	Remaining Time/Ground Speed
TRIM DIRECT.	Trim de Direction	Rudder Trim

UNI	Unité de Navigation Inertielle	Inertial Navigation System (INS)
V	Voilure (Carburant)	Wing Fuel Tanks
VAD	Vecteur Additionnel	Offset to Tacan
VAL	Validation	INS Validation Switch
VEI	Veille	Standby
VENT	Ventilation	Dry Crank
VERRIÈRE	Verrière	Canopy
VERROUILLAGE	Verrouillage	Lock

VIDE VITE	Vide vite (carburant)	(External Tanks) Fuel Dump
VOYANTS	Voyants (illumination)	Annunciators (Light intensity)
VR	Vitesse de rapprochement	Closure speed
VRIL	Vrille	Spin (FBW Limiter Override Switch)
VTB	Visualisation Tête Basse	Heands-down Display (HDD)
VTH	Visualisation Tête Haute	Heads-up Display (HUD)
ZB	Axe Z (Altitude Barométrique sur VTH)	Barometric Altimeter (on HUD)
Δ ALT	Altitude (BAD: But Additionnel)	Offset Point by Altitude difference
ΔL/ΔG	Latitude/Longitude (BAD: But Additionnel)	Offset Point by LAT/LONG difference
ρ/θ	Polar Rho/Tetha (BAD:Distance/Relèvement)	Offset Point by Distance and Bearing
		V. 1.3 November 2019