INDIA FOXT ECHO
VISUAL SIMULATIONS

EF-2000 AIRCRAFT for Microsoft Flight Simulator

USER MANUAL

Product Version 1.0.0 – December 2025
Manual Version 0.9.3 – December 2025

NOTICE – Although this manual and the simulated aircraft closely resemble their real-world counterparts in many aspects, neither should be used as source of real-world information about the aircraft. This package is not endorsed or supported by the real world aircraft manufacturer or by any Armed Service.

PRODUCT CHANGE LOG

Version 1.0.0
December 13th 2025

INITIAL RELEASE

INSTALLATION, HARDWARE REQUIREMENTS AND CREDITS

1.1 MINIMUM HARDWARE REQUIREMENTS

Due to the high-detail model and textures, we suggest to use the EF-2000 on systems that meet or exceed the following requirements:

CPU: 3.5GHz quad core processor or better
GPU: at least 6Gb dedicated memory, Nvidia 1060 or better recommended
RAM: 8.0Gb minimum
Hard Disk: 3.8Gb required for installation

1.2 INSTALLATION

IMPORTANT – IF YOU ARE MANUALLY UPGRADING YOUR PACKAGE FROM A PREVIOUS VERSION, PLEASE DELETE THE PREVIOUS VERSION FIRST!

This package is distributed both on the Microsoft Marketplace, SimMarket, Orbx and other vendors.

If you have purchased the package though the Marketplace or through Orbx Central and you have followed the on-screen instructions, no further action is required from your end. The plane should be available in the aircraft selection menu as the other default planes and should be automatically updated.

If you have purchased the package from an external vendor and the aircraft is provided as a .zip file without any installer, just unzip the content of the file into your COMMUNITY folder. The exact location of the folder will depend on your selection when you have installed Microsoft Flight Simulator. Once you have indicated where your COMMUNITY folder is, just follow the on-screen instructions.

If you have purchased the package from an external vendor and the product comes with an .exe installer, just follow the instructions on the screen. You will be asked to locate the COMMUNITY folder. The exact location of the folder will depend on your selection when you have installed Microsoft Flight Simulator. Once you have indicated where your COMMUNITY folder is, just follow the on-screen instructions.

NOTE: If you do not know where the community folder is located, you can follow this procedure:

Go to Options / General.

1.Click on "Developers" which you will find at the bottom of the list on the left.
2.Switch Developers Mode on.
3.On the Dev Menu select Tools / Virtual File System.
4.**The community folder location can be found under "Watched Bases"**

NOTE: If the copying the folder in the Community folder fails because of the fact that files names are too long you can proceed as follows:

1. Extract the package folder on your desktop or in any known and easily acceptable location.

2. Rename the package folder from “indiafoxtecho-efa” to anything short and recognizable such as “efa” or just “35”

3. Place the renamed package folder in the Community folder

Alternatively for EXPERT WINDOWS USERS ONLY, it is possible to edit the "LongPathsEnabled” entry in the Windows registry key:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem

Once the aircraft is installed in the Community folder, it will be available in the aircraft selection menu next time you start Flight Simulator. If Flight Simulator was running during the install process, you need to close it and restart it for the aircraft to appear.

IMPORTANT NOTE ON THE FLIGHT MODEL

Please note that the EF-2000 flight model is designed to work with the new Flight Simulator flight model (Options->General->Flight Model->MODERN) . This is the default option for Microsoft Flight Simulator and it should be your setting unless you have changed it.

However, some users may have changed the flight model to "LEGACY" in order to use older FSX-derived add-on planes – in this case you must revert to the “MODERN” flight model.

With the modern flight model, the EF-2000 should behave well and be quite stable and easy to fly within the regular flight envelope – although it may exhibit a some instability in extreme flight or weather conditions.

CREDITS

This software package has been produced and developed by IndiaFoxtEcho Visual Simulations, piazza Embriaci 5/22 16123 Genova, Italy – copyright 2025.

EF-2000 text description and images taken from Wikipedia and other websites.

We'd like to thank the Beta testing Team and everyone who supported this project and IndiaFoxtEcho.

For questions, support and contact please write an email to indiafoxtecho@gmail.com or contact us on Facebook https://www.facebook.com/Indiafoxtecho-594476197232512/

ABOUT THIS MANUAL

As the EF-2000 is still classified, this manual is the product of educated guess-work based on all publicly available information on the real-world aircraft. However this manual may not reflect the real-world aircraft flight manual, aircraft operation or procedures.

THIS MANUAL SHALL NOT BE CONSIDERED A SOURCE FOR REAL-WORLD INFOMATION OR OPERATION OF THE EF-2000 AIRCRAFT.

UPDATES

We will try our best to keep the product updated and squash significant bugs as soon as possible. Updates are typically deployed as new installers/packages and will be available from your distributor. Updates must be manually installed unless the product is purchases through the Microsoft Marketplace or Orbx Central.

LIST OF ABBREVIATIONS

SHORT TERM	DESCRIPTION
A&I	Attack and Identification
A/A	Air to Air
AB	Airbrake
AC	Alternate Current
AC	Attack Computer
ACFC	Air Cooled fuel Cooler
ACIS	Armament Carriage and Installation System
ACOC	Air Cooled Oil Cooler
ACS	Armament Control System
ADL	Automatic Data Link
ADT	Air Data Transducer
ADS	Air Data System
AFC	Automatic Frequency Control
AFCV	Air Flow Control Valve
AG	Attention Getter
AICS	Air Intake Control System
AIPT	Air Intake Pressure Transducer
AM	Amplitude Modulation
AMRAAM	Advanced Medium Range Air to Air Missile
AOA	Angle of Attack
APU	Auxiliary Power Unit
APUCU	APU Control Unit
ATC	Air Traffic Control
ATS/M	Air Turbine Starter Motor
AVS	Avionic System
AWFL	Aircraft Airworthiness Flight Limitations
AVSOV	Avionic Shut-Off Valve
BBS	Baseline Build Standard
BC	Bus Control
BIT	Built In Test
BITE	Built In Test Equipment
CAMU	Communication and Audio Management Unit
CAS	Calibrated Airspeed
CAU	Cold Air Unit
CBIT	Continuos BIT
C+D	Controls and Display Subsystem
CFG	Constant Frequency Generator
CG	Center of Gravity
CIU	Cockpit Interface Unit
COMMS	Communications
CPCV	Cabin Pressure Control Valve
CPU	Central Processing Unit
CSDB	Common Source Data Base
CSG	Computer Symbol Generator
CSMU	Crash Survivable Memory Unit
CSV	Cabin Safety Valve
CTCV	Cabin Temperature Control Valve
CTR	Center
DASS	Defensive Aids Subsystem
D+C	Display and Controls
DC	Direct Current
DECU	Digital Engine Control Unit
Deg/DEG	Degrees
DEK	Data Entry Keyboard
DIFU	DECU Interface Unit
DME-P	Distance Measuring Equipment - Precision
DRL	Data Requirement List
DTD	Document Type Definition
DVI	Direct Voice Input
DWP	Dedicated Warning Panel

SHORT TERM	DESCRIPTION
EBSOV	Engine Bleed Shut-Off Valve
ECCM	Electronic Counter Counter Measures
ECR	Electronic Counter Reconnaissance
ECS	Environmental Control System
ECU	Electronic Control Unit
EF2000	European Fighter 2000 Aircraft
EGT	Exhaust Gas Temperature
EMS	Engine Monitoring System
EPS	Emergency Power System
EPU	Emergency Power Unit
ERA	Emergency Ram Air
ERU	Ejection Release Unit
FCC	Flight Control Computer
FCOC	Fuel Cooled Oil Cooler
FCS	Flight Control System
FLIR	Forward Looking Infra Red
FRP	Flight Refuelling Probe
FRS	Flight Resident Software
FT/ft	Feet
FTI	Flight Test Instrumentation
FWD	Forward
GB	Gearbox
GCU	Generator Control Unit
GLU	Ground Loading Unit
GPC	Ground Power Connector
GPS	Global Positioning System
GPU	Ground Power Unit
GTE	Ground Test Equipment
GUH	Get-U-Home
GU	Guard UHF
GV	Guard VHF
HDD	Head Down Display
HDG	Heading
HF	High Frequency
HOTAS	Hands On Throttle and Stick
HP	High Pressure
HUD	Head Up Display
HYD	Hydraulic
IAS	Indicated Airspeed
IBIT	Initiated BIT
ICU	Interface Control Unit
IFF	Identification Friend or Foe
IFR	In-Flight Refuelling
IMRS	Integrated Monitoring and Recording Subsystem
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IPU	Interface Processor Unit
ISA	International Standard Atmosphere
KCAS	Knots Calibrated Airspeed/Knots Corrected Airspeed
KDAS	Knots Displayed Airspeed
KEAS	Knots Equivalent Airspeed
kg	Kilogramme(s)
KN	Kilonewton(s)
KPa	Kilopascal(s)
kT/kt	Knots
KW	Kilowatt(s)
LDERU	Light Duty ERU
LES	Leading Edge System
LG	Landing Gear
LGC	Landing Gear Computer
LHGS	L/H Glareshield
LINS	Laser Inertial Navigator
LP	Low Pressure
LRI	Line Replaceable Item
LTR/ltr	Liter
M	Mach

SHORT TERM	DESCRIPTION
MASS	Master Arm Safety Switch
MDE	Manual Data Entry
MDLR	Mission Data Loader and Recorder
MDP	Manual Data Panel
MDR	Manual Data Recorder
MEL	Medium Range Air to Air Eject Launcher
MHDD	Multi Function Head Down Display
MIDS	Multi-Functional Information Distribution System
MK	Mark
MLG	Main Landing Gear
MLS	Microwave Landing System
MRAAM	Medium Range Air to Air Missile
MSL	Mean Sea Level
MSOC	Molecular Sieve Oxygen Concentrator
MSOG	Molecular Sieve Oxygen Generation
N/A	Not Applicable
NBC	Nuclear, Biological and Chemical
NC	Navigation Computer
NLG	Nose Landing Gear
NM	Nautical Miles
NRV	Non Return Valve
NSCAC	Non Safety Critical Armament Controller
NWS	Nose Wheel Steering
ODM	Operational Data Manuals
OTF	On Top Fixing
PBIT	Power-Up BIT
PDC	Portable Data Carrier
PDU	Pylon Decoder Unit/Pilot's Display Unit
PIO	Pilot Induced Oscillation
PP	Present Position
PRSOV	Pressure Regulating and Shut-Off Valve
PRV	Pressure Reducing Valve
PSP	Personal Survival Pack
PTO	Power Take Off
PTT	Push to Talk
QA	Quality Assurance
QAWP	Quality Assurance and Airworthiness Panel
QTY	Quantity
RAD ALT	Radar Altimeter
RF	Radio Frequency/Rear Fuselage
RFA	Request For Alteration
RH	Right Hand
RMS	Root Mean Square
RNG	Range
ROL	Readout Lines
RPM	Revolution Per Minute
R/T	Radio Transmission
RT	Remote Terminal
RTB	Return to Base
RTO	Rejected Takeoff
RX	Receiver
SCA	Sub Contract Annex/ Software Change Amendment
SCAC	Safety Critical Armament Controller
SDR	System Design Responsibility
Sec	Seconds
SK	Softkey
SL	Sea Level
SOV	Shut-Off Valve
SPS	Secondary Power System
SPSCU	Secondary Power System Control Unit
SRD	Software Requirement Document
STOL	Short Takeoff/Landing
STTE	Special To Type Test Equipment
S/W	Software
TACAN	Tactical Air Navigation
TBA	To Be Advised
TBD	To Be Decided
TBT	Turbine Blade Temperature
TCV	Temperature Control Valve
TMC	Twin Missile Carrier
TO	Takeoff
T/R	Transmitter/Receiver
TRU	Transformer Rectifier
TSC	Twin Store Carrier
TSU	Tip Station Unit
TTU	Triplex Transducer Unit
TX	Transmitter
UCS	Utilities Control System
UHF	Ultra High Frequency
V	Volt
V/UHF	Very/Ultra High Frequency
VHF	Very High Frequency
VPROSV	Variable Pressure Regulating and Shut-Off Valve
VVR	Video Voice Recorder
VWS	Voice Warning System

AIRCRAFT

The Aircraft

The EF-2000 is a high performance, supersonic, all-weather air-superiority fighter.
Its primary mission is aerial combat, but it can also perform ground attack missions. The ECR 90 radar and the SRAAM and MRAAM missiles are the primary armament.

External stores can be carried on thirteen hardpoints, three of which can be used for external fuel tanks. Up to ten air-to-air missiles can be carried. Air-to-surface munitions can be fitted to seven of the hardpoints, while still retaining six air-to air missiles. The aircraft has a single internally mounted 27 mm Mauser gun.

The aircraft is powered by two Eurojet EJ200 MK 101 two-spool axial flow turbofan engines, with afterburner.

The aircraft features a variable camber delta wing. Automatic slats on the wing leading edges and full span inboard and outboard flaperons on the wing trailing edges provide optimum wing camber at all angles of attack. Symmetrical foreplanes provide control and additional lift. The aircraft also has a conventional rudder. The airbrake is mounted on the top side of the central fuselage.

The aircraft is aerodynamically unstable. Artificial stability is provided by a full authority quadruple "fly-by-wire" flight control system. Pitch control is by means of the foreplanes and the flaperons. Roll and yaw controls is by means of the flaperons and the rudder.

The pressurized cabin is enclosed by an electrically operated clamshell canopy.

The ejection seat provides safe escape from zero airspeed, zero height conditions.

An aircraft mounted auxiliary power unit (APU) provides compressed air to the air turbine starter motors (ATSM) for gearbox/system checking or engine starting and the environmental control system (ECS) for cockpit conditioning.

Limited electrical power is provided to the aircraft systems from the APU generator. The APU can only be operated on the ground and allows the aircraft to operate independently of ground facilities.

Aircraft Dimensions

The overall dimensions of the aircraft are as follows:

Span 10.95 meters
Length 15.97 meters
Height 5.29 meters
Wheel track 4.04 meters
Wheel base 4.22 meters

Aircraft Gross Mass

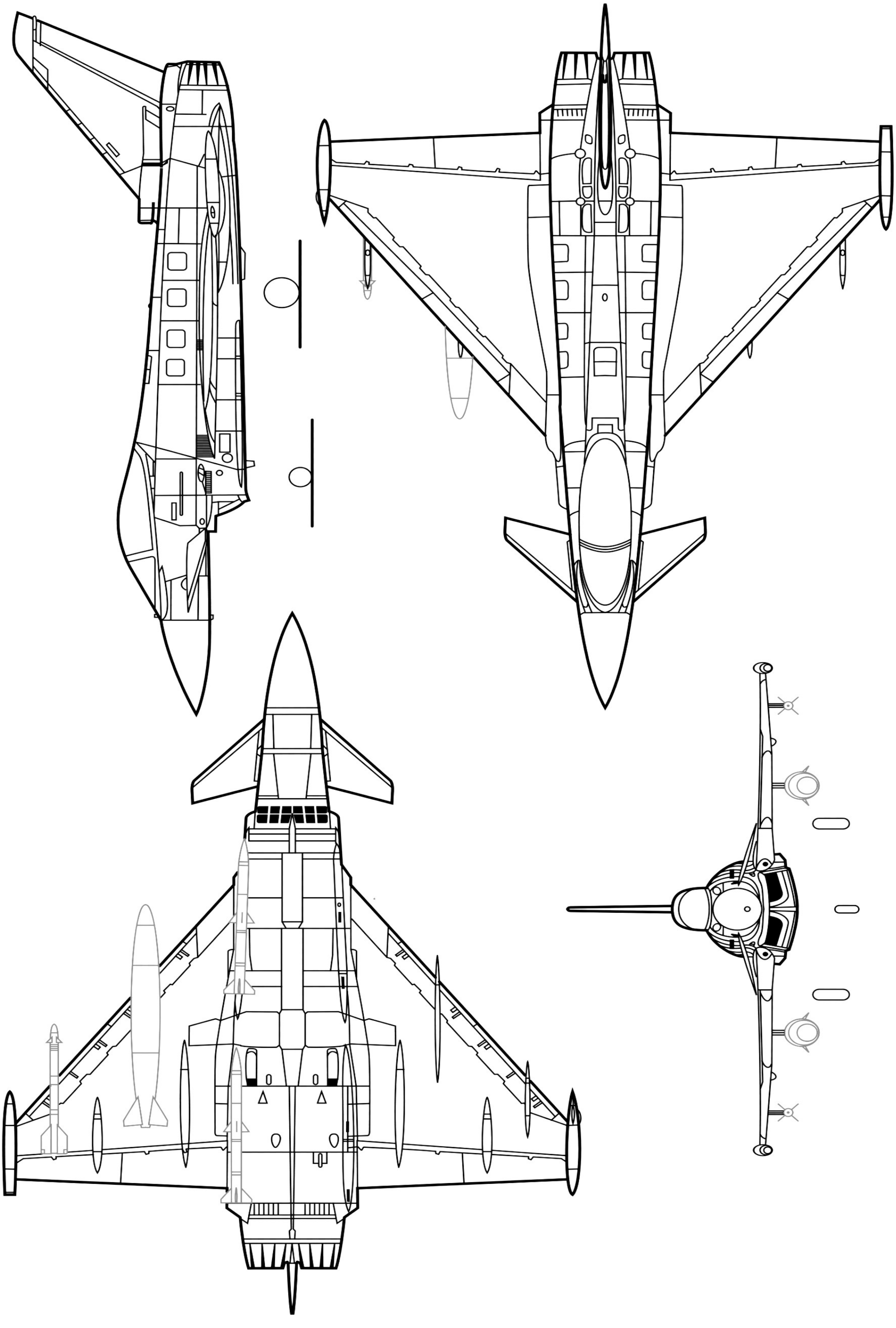
The following gross masses are approximate and shall not be used for computing aircraft performance or for any type of operation.

Empty mass: 11,000 kg (24,251 lb)

Gross mass: 16,000 kg (35,274 lb)

Max takeoff mass: 23,500 kg (51,809 lb)

Fuel capacity: 4,996 kg (11,010 lb) / 6,215 L (1,642 US gal; 1,367 imp gal) internal.



COCKPIT DISPLAYS AND CONTROLS

Cockpit Layout

The pilot face a display suite comprising a wide angle Head Up Display (HUD) and three full colour, raster/cursive Multifunction Head Down Display (MHDD).
Under normal circumstances, the MHDD and HUD present all the information required by the pilot to manage and operate the aircraft. A number of reversionary and Get-You-Home (GUH) instruments, located predominantly on the right glareshield, provide the pilot with basic flight data in the event of main display failures. During normal operation the GUH instruments (speed, Mach, altitude and vertical speed displays), on the right glareshield, are covered by a Dedicated Readout Panel (DRP).

The Manual Data Entry (MDE) facility, located on the left glareshield, enables the pilot to alter previously entered data or insert new information.

The left and right throttle arrangements, located on the left console, occupy the majority of the forward outboard area. The remaining area of the left console provide locations for various systems, controls and indicators, including flight control and communications systems. Similarly, controls and indicators for miscellaneous systems, including hydraulic, engine starting, lighting and environmental control, are arranged on the right console.

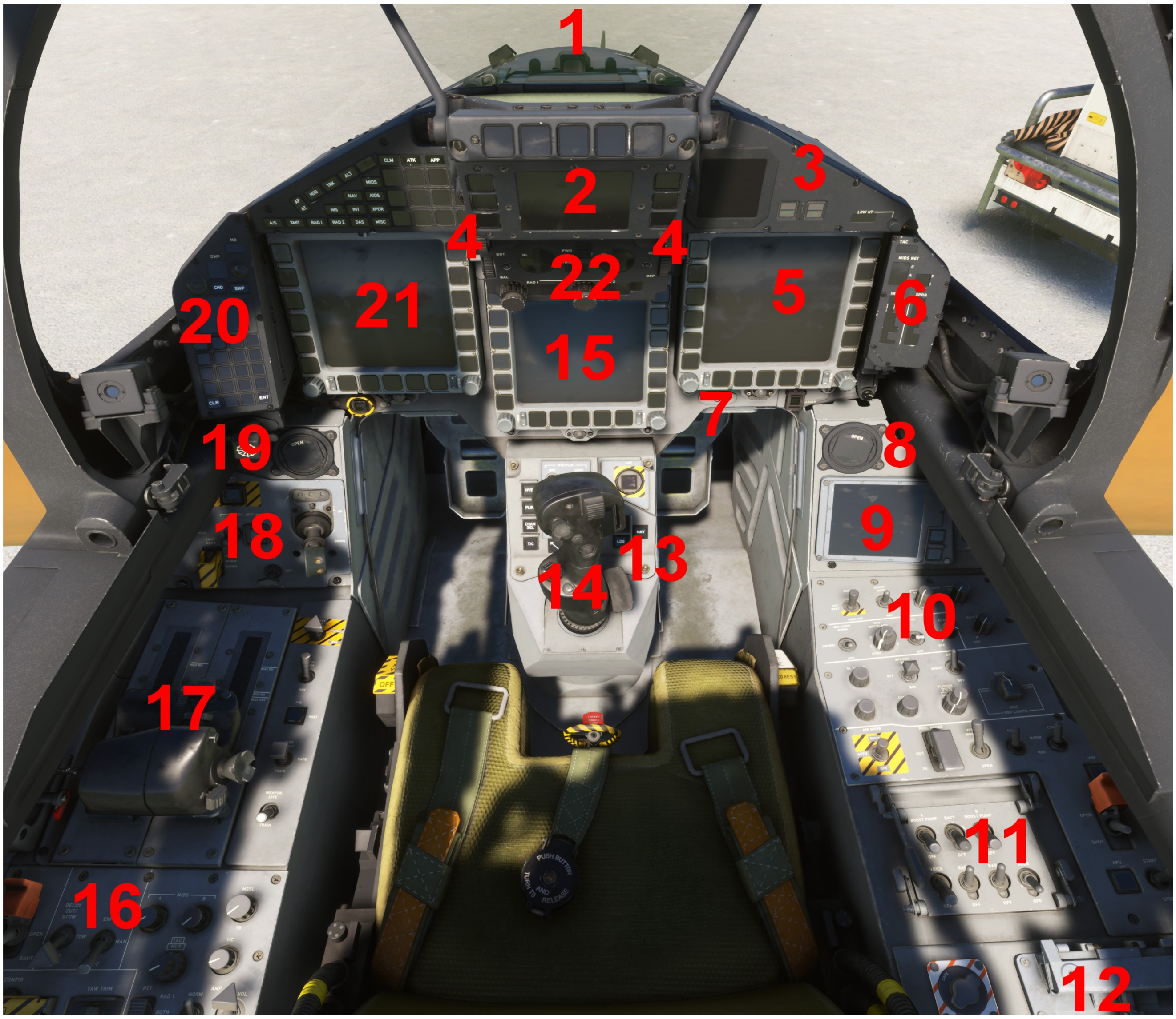
Each quarter panel incorporates an Environment Control System (ECS) vent.
The left quarter panel also contains various quick-reaction and emergency controls and indicators associated with landing, takeoff and emergency functions.

A Dedicated Warning Panel (DWP) and it's associated controls are located on the right quarter panel.

A handle, located below the right MHDD, allows the pilot to adjust the rudder pedals.

A fire indicator/extinguisher button is located on each side of the HUDCP.

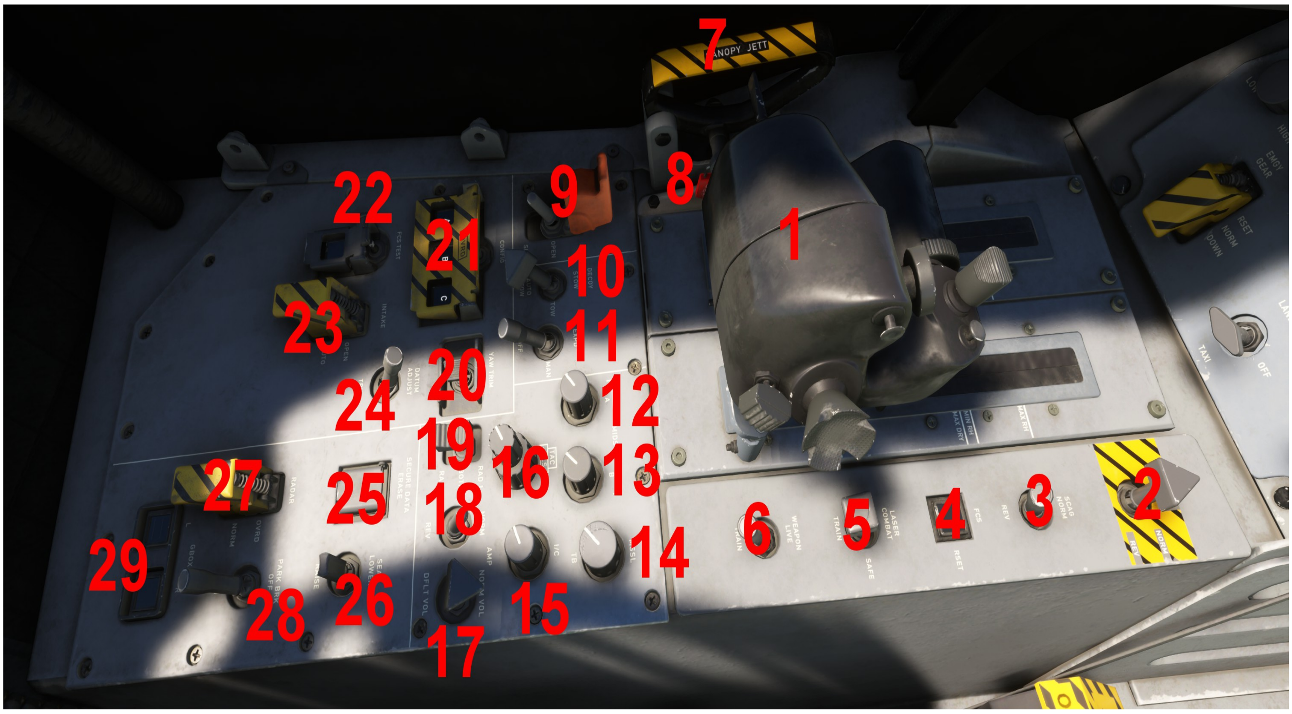
The cockpit seat and canopy safety pins are stowed on the outboard side of the right rear console. console.



1Cockpit Layout

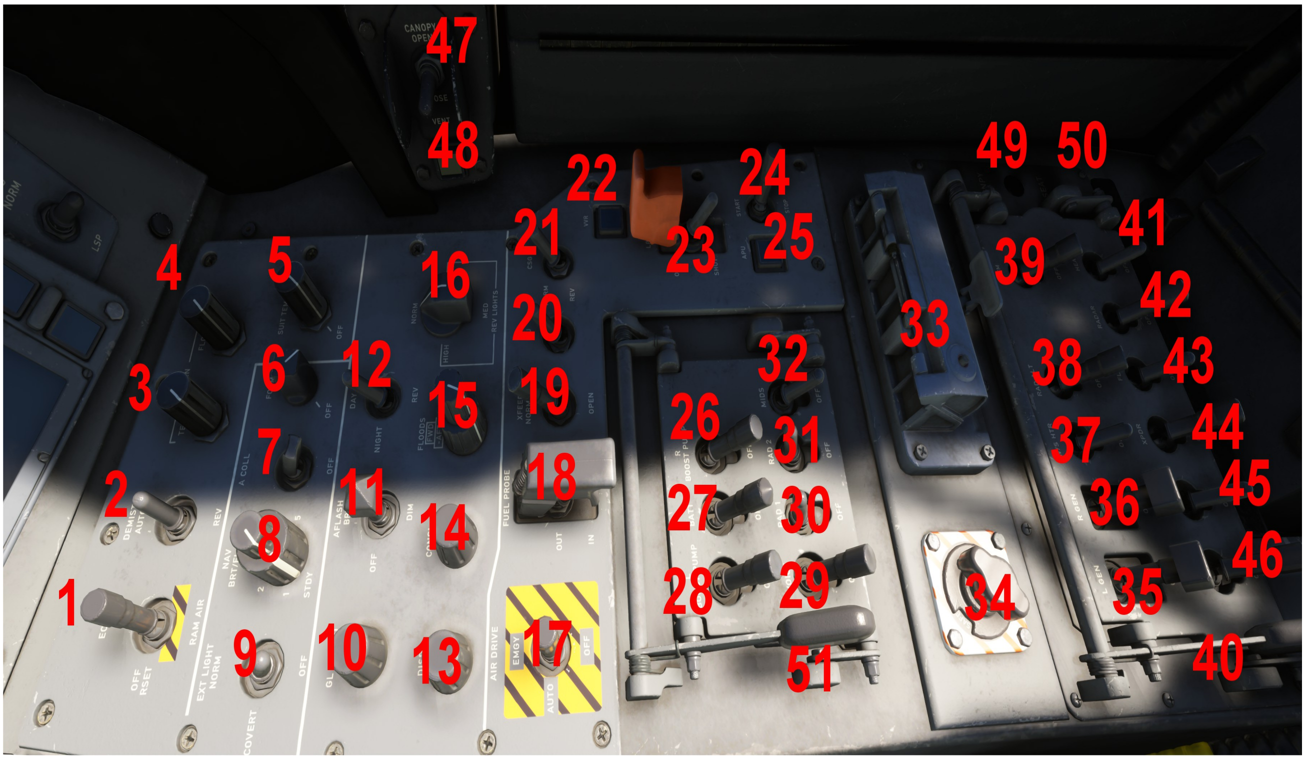
1 – Head Up Display
2 – HUD Control Panel
3 – Right Glareshield
4 – Fire Indicator/Extinguisher Buttons
5 – Right MHDD
6 – Dedicated Read Out Panel
7 – Rudder Pedal Adjustment Handle
8 – Right Quarter Panel
9 – Dedicated Warning Panel
10 – Right Console
11 – Battery Grangbar

12 – Systems Gangbar (not shown)
13 – Pedestal Panel
14- Control Stick
15 – Center MHDD
16 – Left Console
17 – Throttles
18 – Left Quarter Panel
19 – Brake Parachute Handle
20 – Left Glareshield
21 – Left MHDD
22 – Fuel And Engine Indicators



Left Consoles

1 – Throttles
2 – Brake Systems Interchange Control
3 – Safe Critical Armament Control
4 – FCS set pushbutton / Indicator
5 – Laser Combat/Safe/Train switch
6 – Weapon Live/Train switch
7 – Canopy Jettison Lever
8 – Canopy Jettison Safety Pin
9 – Left Low Pressure Cock control
10 – Towed Decoy Deployment Control
11 – Programmed Expendables Manual Control
12 – MIDS Voice Channel A Volume Control
13 – MIDS Voice Channel B Volume Control
14 – Missile Audio/Telebrief/Transmission Control
15 – General Intercom Audio Volume Control
16 – TACAN/MLS Audio Tone Volume Control
17 – Default Audio Module Volume Selection Control
18 – Radio Amplification Medium Control
19 – Duplicate Press-to-Transmit Control
20 – Yaw Trim Control
21 – Configuration Control Override Selection
22 – FCS Test Control
23 – Engine Intake Cowl Control
24 – Trim/Autopilot Datum Adjust Select Switch
25 – Cryptographic Variable Erasure Control
26 – Seat Lower/Raise Control
27 – Radar Interlock Override
28 – Parking Brake Control
29 – Gearbox Pneumatic Drive Control

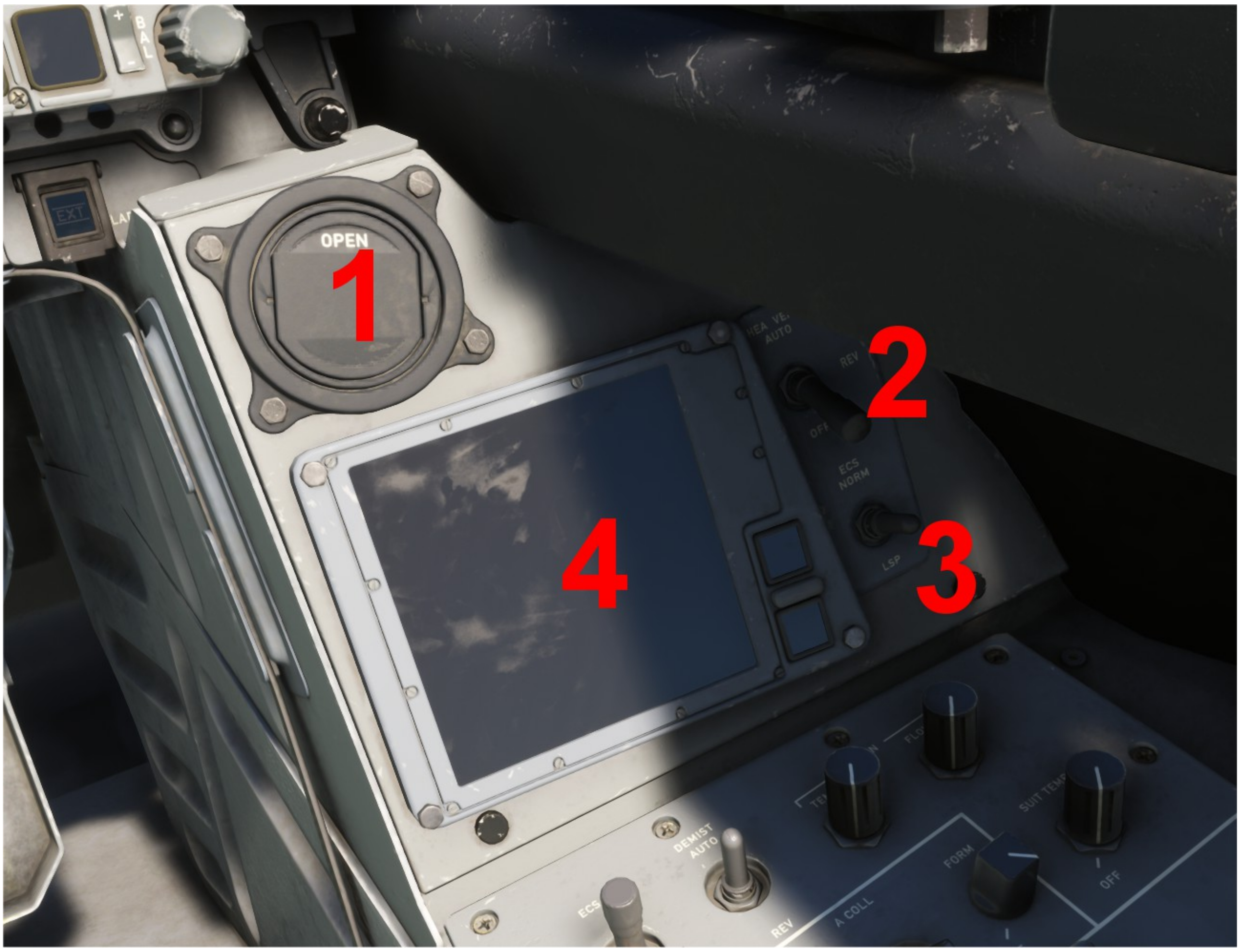


Right Consoles

1 – Air System Master Control
2 – Antimist/Demist Control
3 – Cabin Temperature Control
4 – Cabin Airflow Control
5 – Suit Temperature Control
6 – Panel Floodlights Control
7 – Anticollision Lights Control
8 – Navigation Lights Control
9 – External Lights Master Control
10 – Glareshield Luminance Control
11 – Anti-flash Lights Control
12 – External Lights Mode Control
13 – Main Display Luminance Control
14 – Console Luminance Control
15 – Floodlights Luminance Controls
16 – Reversionary Lighting Selector
17 – Air Drive Switch
18 – Flight Refuel Probe Control
19 – Fuel Cross-feed Control
20 – CIU Changeover Control
21 – CSG Changeover Control
22 – Video Voice Recorder Control
23 - Right Low Pressure Cock control
24 – APU Start/Stop Switch
25 – APU Status Indicator
26 – Right Fuel Boost Pump Switch
27 – Battery Master Control
28 – Left Fuel Boost Pump Switch
29 – Voice Warning Audio Control
30 – Radio 1 Transmitter Control
31 – Radio 2 Transmitter Control
32 – MIDS Transmitter Control
33 – Mission Data Loader/Recorder
34 – MASS Selector
35 – Left Generator Switch
36 – Right Generator Switch
37 – Windshield Heater Control
38 – Radar Altimeter Transmission Control
39 – ECM Enable Control
40 – Systems Gangbar Lever
41 – Helmet Equipment Assembly Control
42 – Radar Transmission Control
43 – FLIR Seeker Head Cooling Control
44 – IFF Transponder Control
45 – IFF Interrogator Control
46 – MAW Enable Control
47 – Canopy Control
48 – Vent Control
49 – Ejection Seat Safety Pin Stowage
50 – Canopy Jettison Safety Pin Stowage
51 – Battery Gangbar Lever

Left Quarter Panel

1 – ECS Vent
2 – Landing Gear Lever
3 – Selective Jettison Initiator Control
4 – Landing/Taxi Lights Control
5 – Jettison Selector Control
6 – Emergency Gear Selector
7 – Throttle Friction Control
8 – Emergency Jettison Initiator Control



Right Quarter Panel

1 – ECS Vent
2 – HEA Vent Control
3 – ECS Norm/LSP Control
4 – Dedicated Warning Panel

Left Glareshield

1 – Attention Getting Device
2 – Moding Keyboard
3 – Subsystem Keyboard
4 – Barometric Pressure Setting Control
5 – Set Waypoint Key
6 – Change Destination Key
7 – Data Entry Keyboard
8 – Readout Lines Display
9 – Marker Toggle Control
10 – Set and Destination Waypoints
11 – Barometric Pressure Display
12 – Autopilot/Autothrottle Selection Control
13 – Autopilot Mode Selection Displays

Right Glareshield (Reversionary Instruments Panel Open)

1 – Attention Getting Device
2 – Reversionary Attitude, Heading and AoA Indicator
3 – Transponder Emergency Control
4 – Identification Response Selection
5 – Radar Altimeter Clearance Height Setting Display
6 - Radar Altimeter Clearance Height Setting Control
7 – Reversionary Airspeed and Mach Display
8 – Reversionary Vertical Speed Indicator
9 – Reversionary Altitude Indicator

Right Glareshield (Reversionary Instruments Panel Closed)

10 – Dedicated Readout Panel
11 – Reversionary Instruments Panel Latch

Head-Up Display Control Panel

1 – HUD Aircraft Symbol Mode Generator
2 – HUD Ground speed/Mach Display
3 – HUD Declutter Level Selector
4 – HUD Rad Alt/Baro Selector
5 – HUD FLIR Display Selector
6 – MIDS Display
7 – MIDS Push-button Controls
8 – Raster Gamma Control (INOP in game)
9 – HUD Power Switch
10 – Fuel Readout Displays
11 – Right Hand Engine NL Display
12 – Depression Setting Control
13 – Radio 2 Readout and Controls
14 – Radio 1 Readout and Controls
15 – HUD Balance Control
16 – Left Hand Engine NL Display
17 – HUD PDU Luminance Control

Pedestal Panel

1 – Disorientation Recovery Function Control
2 – Phase of Flight Selectors
3 – MHDD Format Interchange Control
4 – Helmet Display Mode Selector
5 – Helmet Display Controls

COCKPIT DISPLAYS

Introduction

Integration of the aircraft systems is achieved by using electronic displays and controls.
The main integrated displays and controls are as follows:

– Head up Display (HUD)

– Multifunction Head Down Display (MHDD)

– Dedicated Warnings Panel (DWP)

– Manual Data Entry Facility (MDEF)

– Dedicated Readout Panel (DRP)

– HOTAS facility.

Head up Display

The HUD comprises a Head up Panel (HUP) and PDU. It is a flight instrument which projects flight information into the aircrew's FOV. The HUP contains the controls associated with the display of information on the PDU and a Multifunction Information Distribution System (MIDS) display with associated controls (not yet in use). The panel also displays information on fuel status, engine speed and radios. The brightness, contrast and balance of the display on the PDU can be adjusted using thumb-wheel controls.

Multifunction Head down Display

The MHDD enable information on the status of the aircraft systems to be displayed. The appropriate displays will automatically be selected upon selection a POF control on the pedestal panel. The orientation of these displays may be changed from the default by use of the display change keys also on the pedestal panel.

Each MHDD comprises a colour display, capable of displaying data in raster, cursive or raster/cursive format. The main display area is surrounded by a bezel containing 17 soft-keys, rotary controls for and HSI heading/course (Pilot Awareness format) and radar/map balance (Attack format), rocker switches for brightness and contrast, and two ambient light sensors.

Dedicated Warnings Panel

The DWP indicates aircraft system malfunctions on a reconfigurable dot matrix display. This display is capable of presenting 27 captions simultaneously, in three columns of nine. The bottom row of captions are hard wired and display one fixed warning each.

Manual Data Entry Facility

The MDEF contains data entry, subsystem and moding keys, switches and ROL. These provide subsystem control and allow inputs or updates to various subsystem data.

Dedicated Readout Panel

The DRP displays information concerning the IFF transponder (XPDR) and TACAN in ROL form. It will also provide MIDS net information (facility not yet available).
The panel is hinged on the outboard side of the right glareshield allowing access to the reversionary GUH instruments when required.

HOTAS Facility

Controls located on throttle and stick top enable the aircrew to perform weapon system moding and sensor control without the removal of hands from the flying controls.

Reversionary Aircraft Situation Display

The reversionary aircraft situation display provides the aircrew with a cross track error (to emergency airfield), attitude, slip and AOA indication for use under reversionary conditions.

Cockpit Displays

1 – Pilot Display Unit (PDU)
2 – Reversionary Aircraft Situation Display
3 – Dedicated Readout Panel
4 – Dedicated Warning Panel
5 – Head Up Panel (HUP)
6 – Data Entry Keypad and Readout Lines
7 – Left Multifunction Head Down Display
8 – Center Multifunction Head Down Display
9 – Right Multifunction Head Down Display

HEAD UP DISPLAY

Introduction

The HUD is a flight instrument which projects flight and weapons delivery information into the pilot's FOV. The information presented assists the pilot to manually steer the aircraft during normal flight and during the attack POF. The symbols are generated by one of two Computer Symbol Generators (CSG) and are focused at infinity, allowing the display to be followed in elevation and azimuth with limited head movement. Provision is made for the selection or exclusion of certain symbology appropriate to the current flight mode.

Construction

The HUD includes the following sub-assemblies:

– PDU
– HUP
– HUD video camera
– HUD mounting tray.

Pilot's Display Unit

The PDU comprises an optical assembly plus mechanical and electrical assemblies that combine to project information to the pilot. The PDU is positioned such that the combining glass is in the pilot's LOS and is not obscured.
Two light sensors mounted on the top of the PDU monitor the ambient light conditions to maintain the contrast level of the display.

Head up Panel

The HUP is located immediately below the PDU and contains the controls and indicators associated with the HUD. For information on the associated controls and indicators see Head up Display page. 1-57.

HUD Video Camera

The HUD video camera enables the recording of the 'outside world', as seen through the combiner assembly. The output of the video camera is routed to the selected CSG, where the HUD symbology is added. The result is a view of the 'outside world' with HUD symbology superimposed upon it.

HUD Mounting Tray

The HUD mounting tray enables the ground crew to harmonize the PDU with the airframe by adjusting four mounting tray adjusting studs.

HUD Symbology

HUD symbology consists of:
– Attitude/directional reference symbology
– Airdata symbology
– Autopilot symbology
– Navigation symbology
– Air to air attack symbology
– Miscellaneous symbology.

Attitude/Directional Reference Symbology

The climb/dive symbol is a winged circle which provides aircraft directional reference whilst the system is operating in climb/dive mode. The symbol has two modes of operation; locked (LOCK) and Velocity Vector (VV). These modes are controlled by the LOCK/VV selector/indicator on the HUP. In LOCK, the aircraft symbol is locked to the vertical axis of the HUD (indicated by a radial flag at the 12 o'clock position on the circle) and can be adjusted using the depression setting control on the HUP.
When in VV, the symbol is referenced to the aircraft velocity vector in elevation between +5 and -15 with respect to the LFD.

NOTE
The VV symbol does not move in azimuth.
A diamond indicates the aircraft's velocity vector.
Full freedom of movement extends to the limit of the HUD FOV, where it parks and flashes at the FOV edge.

The attitude symbol replaces the climb dive symbol if airspeed falls below 48kt to indicate aircraft pitch attitude instead of climb/dive angle.
Aircraft climb dive angles and roll attitude, relative to the aircraft symbol are displayed by a horizon bar, climb/dive bars and zenith and nadir stars.

The bank/roll pointer is an infilled triangular pointer which is rotated around a fixed bank scale to indicate current bank angle. The scale covers the range 0 to 60 with graduation marks at the 10, 20, 30 and 60 positions.

The Specific Excess Power (SEP) markers consist of two arrow heads, displayed at each side of the aircraft symbol. The displacement between these arrow heads and the aircraft symbol indicates the angle at which the aircraft should climb or dive to achieve a constant speed. When the aircraft symbol is bracketed by the SEP markers a constant speed is indicated. The markers provide an indication of climb performance, energy loss/available in turns and are useful for speed control in precision flying.

The pull up arrow alerts the pilot to pull up. The action is indicated by a flashing arrow, which rotates about its centre point such that it always points away from the ground. The command 'PULL UP' is shown boxed below the arrow.

Miscellaneous Symbology

Miscellaneous symbology is shown in figure.

Stopwatch count up presents an increasing time interval in hours, minutes and seconds. Whilst countdown presents a decreasing time interval in hours, minutes and seconds. Upon reaching '0' the digits flash for 5 seconds. Split time for the count up or countdown stopwatch may be indicated. When the split time is displayed the stopwatch continues to run.

Undercarriage state is presented on the left of the display. One of three legends is displayed to indicate the state of each landing gear leg. Gear up and locked is indicated by 'UP', gear down and locked is indicated by 'D' and gear in transit is indicated by 'X'.

The landing gear status is displayed whenever the gear is locked down or in a state of transition. Gear status is displayed for a further 10 seconds when the gear is declared up and locked.

An indication of depression angle is provided by a digital readout to a resolution of 0.1; the angle is set by the rotary depression setting control on the HUP.

The depression angle is the displacement of the aircraft symbol from the LFD during lock mode, The new value (0 to -15) is displayed for 5 seconds following any change to the depression angle setting.

The airbrake indicator is shown against the aircraft symbol when the airbrake is in any position other than closed and locked.

'LATE ARM SAFE' is displayed to indicate that the late arm control is set to the safe condition.

'GEAR' is displayed to indicate that the undercarriage limiting speed of 290kt has been exceeded and that the gear must be raised.

'XFER' is displayed to Indicate that manual fuel transfer is in progress.

'AUTO RECOVERY' is displayed to Indicate that the automatic recovery mode is enabled.
Acknowledgement of Direct Voice Input (DVI) command recognition is provided by a boxed 34 character text string. DVI is activated when the HOTAS communications control button is pressed and held.

Airdata Symbology
The symbology associated with air data is shown in figure.

The barometric altitude display comprises an analogue and a digital display (up to five digits), surrounded by a circular scale of 10 dots and a rotating pointer. The pointer rotates once per 1000ft. Display resolution is in 20ft increments at, or below 5000ft, increasing to 50ft increments above 5000ft.
Displayed airspeed is presented digitally on the left of the display to a resolution of 1kt. Ground speed or Mach number can be selected via the GS/M selector/ indicator, on the HUP. With weigh off wheels, the Mach number is displayed automatically when Mach number exceeds M0.9.

AOA is indicated by a small scale which moves against the aircraft symbol to indicated incidence during the take off and landing POF. The scale has three horizontal markers: an upper marker representing 16, a middle marker representing 14 and a lower marker representing 12.

The vertical velocity scale on the right of the display is indicated in ft/min. The display comprises a triangular pointer that moves against a fixed scale with an 'elastic' line connecting the pointer to the zero marker on the scale. The display covers the range -2000ft/min to +2000ft/min and is marked at 500ft/min, 1000ft/min and 2000ft/min. If the scale limits are exceeded the pointer rotates upwards or downwards.

Barometric pressure is set via the left glare shield. Following any change to this setting the new value is displayed on the HUD for 5 seconds as a four digit readout.

Normal g is displayed along side the energy cue, unless in ground POF when the readout is occulted. Normal g is displayed to a resolution of 0.1g.

The energy cue indicates AOA and speeds required for optimum aircraft performance. A speed scale provides a reference to relate the energy cue symbols against. The energy cue is available in the navigation, combat and air to surface POF. The energy cue symbols provide the following:
– An indication of maximum and minimum speed, via the speed scale
– An indication of the AOA for the maximum STR at current speed
– An indication of current AOA (+30 to -5). The caret symbol can be displayed -5 below the minimum marker on the speed scale
– An indication of the AOA required to achieve maximum acceleration
– An indication of the current speed, via a marker which moves between the maximum and minimum speed markers
– An indication of the speed trend, i.e., the predicated speed in 5 seconds time. The length is limited to a maximum of 30kt/sec and grows either up or down from the current speed symbol
– An indication of the speed required for the maximum Sustained Turn Rate (STR)
– An indication of the lowest speed required at which the highest Nz is available, for the current aircraft configuration is indicated

Autopilot Symbology
The symbology associated with the autopilot is shown in figure.

The barometric altitude acquire value, set by the pilot, is presented digitally at the top of the display when the autopilot barometric altitude mode has been selected. The initial value of the display is the current barometric altitude of the aircraft with higher or lower values selectable (500ft to 50 000ft, in 100ft increments) via HOTAS moding.

The altitude acquire display is shown boxed when the autopilot is engaged and the aircraft is climbing or diving to the required altitude. Upon acquisition, the digits of the barometric altitude display are boxed to indicate that the demanded value is being held.
When the autopilot heading or track acquire mode is selected, the demanded value, set by the pilot, is presented digitally at the top of the display preceded by 'HDG' or 'TRK' as appropriate. The initial value displayed is the current heading or track with new values selectable (from 0 to 359 in 1 steps). The heading or track acquire value is shown boxed when the autopilot is engaged and the aircraft is turning on to the required track/heading. Upon acquisition the value is displayed as three boxed digits. If the heading is being held the digits will be presented within the heading ribbon and centred on the lubber line, however, if a track is being held the digits are presented above the track marker.

When the auto throttle DAS or Mach mode is selected, the demanded value, set by the pilot, is presented digitally at the top of the display, preceded by the letter 'M' in the case of Mach mode. The initial value is the current aircraft airspeed or Mach number with new values selectable ('M0.18' to 'M2.00' in M0.01 increments or '110kt' to '726kt' in 1kt increments) via the HOTAS auto throttle switch. The value is shown boxed at the top of the display when the auto throttle is engaged and the speed is being acquired. Upon acquisition the digits of the displayed airspeed or Mach number are boxed to indicate that the demanded value is being held.

During operation in auto climb mode, ‘A-CLIMB DAS’ or ’A-CLIMB M’ is presented at the top of the display dependent on the mode selected. Whilst in constant airspeed mode ‘A-CLIMB DAS’ is displayed, and similarly when in constant Mach mode ‘A-CLIMB M’ is displayed. The display is mutually exclusive with the Mach/DAS acquire mode described above.

Navigation Symbology
The symbology associated with the navigation is shown in figure.

Initialization Symbology
The LINS alignment cross is a gapped cross that can be slewed within the HUD FOV. It indicates the bearing to a reference object when performing the HUD optical method of LINS alignment. The cross will remain on the HUD until the LINS mode is entered.
The LINS alignment level is a status indication to inform the pilot of LINS alignment error which is expressed in nautical miles per hour.
The TTG to the completion of LINS alignment is presented in digital form. Upon completion of LINS alignment ‘LINS RDY’ is displayed. The system is then ready to enter the navigation mode.

Steering Symbology
The heading ribbon comprises a five dot scale that moves against a fixed lubber line. Each dot represents a 5 increment with heading digits displayed every 10. Three heading digits are displayed at all times, unless minimum declutter is selected, when only one digit is displayed. When true heading is displayed, the letter ‘T’ is visible above the centre of the scale.
Current track angle is indicated by the track marker, which is read against the heading ribbon. If the marker reaches the limit of the visible ribbon it will park and rotate sideways to indicate that the track error is in excess of the scale.
The steering bug symbol is used to indicate steering required to follow navigation demands. The symbol is read against the heading ribbon and will park and rotate sideways if the steering error is in excess of the visible ribbon.

Waypoint Symbology
An analogue indication of time early/late is presented if the current Destination Way Point (DWP) has been allocated a planned time. A pointer moves against a linear scale comprising three marks: the centre mark represents 0 seconds; the left mark (annotated ‘L’) represents -60 seconds (late); the right mark (annotated ‘E’) represents +60 seconds (early). If the time, early or late, exceeds the limits of the scale the pointer parks and rotates sideways to point off the scale.
A digital readout showing the number of current DWP is displayed. A letter is displayed adjacent to the waypoint number to identify waypoint type: e.g. ‘199 C’, where:
– C represents a combat air patrol point.
– M represents a mark point
– F represents a fuel point
– No letter represents a route point.
Waypoint bearing and range is provided in a digital readout below the DWP number and is expressed in degrees and nautical miles respectively.
TTG until the current DWP is reached is expressed digitally in minutes and seconds below the early/late display.
During close navigation (65 seconds to go) a waypoint countdown circle is presented to provide a 60 second countdown to the DWP. As the aircraft approaches the waypoint the circle winds down, however, if the aircraft starts to move away from the waypoint the circle will wind up again.
Also during close navigation the direction of turn (left or right) and the planned track to the next waypoint are indicated by a triangular pointer and a digital readout respectively. However, if the track of the next waypoint after the current DWP are the same, the symbology will not be displayed.
The route destination waypoint marker is a gapped diagonal cross is used to indicate the expected LOS to the waypoint during the close navigation phase. If the aircraft is above 10 000ft the symbol is not displayed. However, if the route DWP has no height associated with it, then the system assumes that the aircraft is at zero feet AMSL. In addition, if the aircraft is below 10 000ft AMSL and starts to gain height, the symbol will not occult until the aircraft goes higher than 11 000ft AMSL.

Navigation Aids Symbology
The selected TACAN channel number is displayed as a digital readout. Range and bearing from the selected TACAN beacon are displayed digitally in degrees and nautical miles. The selected beacon is identified as an air to surface or an air to air beacon by the letters ‘AS’ and ‘AA’ respectively.

Miscellaneous Navigation Symbology
‘NO MONITOR’ is presented when the LINS/best navigation cross monitor is not available.

‘RAD ALT’ is presented digitally with up to four digits: 0 to 5000ft in 10ft increments. If RAD ALT only has been selected and the RAD ALT unlocks, or the aircraft exceeds 5000ft, the RAD ALT digits are replaced by flashing barometric altitude figures. If BARO ALT/RAD ALT mode is selected and the RAD ALT data is invalid, unlocked or off, then the digits are replaced by dashes.

Air to Air Attack Symbology
The symbology associated with air to air attack is shown as follows:
– Radar track/target symbology
– Combat steering and air to air missile symbology
– Gun, visual ident and miscellaneous symbology

NOTE

Air Attack symbology is not applicable to MSFS.

Example HUD Format (Attitude, Directional and Miscellaneous Symbology)

1 – Climb/Dive Symbol
2 – Bank/Roll Pointer
3 – Specific Excess Power Brackets
4 – Stopwatch
5 – Undercarriage Status
6 – Waypoint number, Bearing, Distance and Time To Steer
7 – Mach Number
8 – Indicated Airspeed
9 – Normal G
10 – Barometric Altitude
11 – Vertical Velocity Indicator
12 – Weapons quantities
13 – Compass And Steering Symbology
14 – Autothrottle Speed Setting
15 – Autopilot Heading Setting
16 – Autopilot Altitude Setting
17 – Velocity Vector

HEAD UP PANEL

Introduction

The Head up Panel (HUP), is located immediately below the PDU and contains the controls and indicators associated with the HUD.

– Lock/VV push button
– GS/M display push button
– Declutter level selector
– BARO/RAD push button
– FLIR display selector
– PDU raster gamma control
– Power switch
– PDU depression setting control
– PDU raster/cursive balance control
– PDU brightness control.

Lock/VV Push Button

A split caption push button, marked LOCK/VV, controls the modes of operation of the aircraft symbol. When set to LOCK, the symbol is locked to the vertical axis of the HUD (indicated by the addition of a radial flag at the 12 o'clock position on the circle) but can be adjusted using the depression setting control. When the push button is set to VV, the symbol is referenced to the aircraft velocity vector in elevation +5 to -15, with respect to the LFD. The locked tail is added when a limit is reached. On selection of either mode, the relevant caption is highlighted.

NOTE

The VV symbol does not move in azimuth.

GS/M Display Push Button

A split caption push button, marked GS/M, causes the aircraft ground speed (GS) or Mach number (M) to be displayed in the top left corner of the HUD. The displayed mode can be changed as follows:

– With GS selected, pressing the push button causes the aircraft"s Mach number to be displayed.
– With M selected, pressing the push button causes the aircraft"s ground speed to be displayed.

When selected, the applicable caption is highlighted. If the aircraft Mach number exceeds M 0.9, the system automatically displays the Mach number. Selections on the HDHUD format will affect the display on the HUD and vice versa.

DCLT Level Selector

A push button, marked DCLT, controls the operation of the three declutter levels (0, 1 and 2). Declutter is necessary to allow the pilot to see the outside world more clearly through the HUD symbology during certain POF. With each operation of the push button, the next declutter level is selected.

With level 2 selected during the ground, takeoff, navigation and combat POF, the 5, 15 and 25 pitch bars are occulted on the HUD. All other pitch lines and associated symbology are unaffected. However, in the landing POF all pitch bars are displayed.

The barometric pressure setting in level 2 is permanently displayed during the ground, takeoff and landing POF. In the combat and navigation phases, it is only displayed whilst it is being changed; after 5 seconds it will occult.

Weapons indications in level 2 are restricted to the selected weapon and the respective stores that remain. In all other declutter selections, all weapons and their remaining stores are displayed.

The width of the heading scale depends on the declutter level selected. Three widths are available, a wide ribbon showing 55, a normal ribbon showing 35 and a narrow ribbon showing 15.

The bank angle and/or the VSI will be automatically displayed depending on the POF and the declutter level selected.

BARO/RAD push button

A split caption push button, marked BARO/RAD, causes the barometric (BARO) or radar (RAD) altitude to be displayed to the right, above centre, on the HUD format. Depending on the POF the displayed data can be BARO only, RAD only, or both BARO and RAD. However, the RAD only mode is not available with autopilot BARO altitude acquire/hold selected. In addition, if the BARO only mode is selected, and the aircraft descends below 5000ft, the BARO/RAD mode will automatically be selected when RAD data is valid.

During ground operation neither the BARO or RAD altitude data will be displayed on the HUD format and selection will have no effect.

With the aircraft weight on wheels during the takeoff POF, the BARO altitude is automatically displayed on the HUD format; operating the selector will have no effect. With aircraft weight off wheels, RAD altitude is available for selection.

The default mode for the navigation and air to air POF is BARO altitude, however, both are available for selection.

During the landing POF, both BARO and RAD selections are available. With aircraft weight on wheels the system defaults to the BARO status bar illumination and altitude display.

When selected, the applicable caption is highlighted. If the altitude exceeds 5000ft with RAD selected, or the RAD altitude data is invalid, the display defaults to BARO digital altitude and the BARO digits flash. However, the selection status and indication remains at RAD, and when the RAD data becomes valid or the aircraft descends below 5000ft, the display changes back to RAD altitude.

FLIR Display Selector

A push button selector, marked FLIR, causes information derived from the FLIR system to be displayed in addition to the HUD symbology.

PDU Raster Gamma Control

A thumbwheel, labelled CON, controls the Gamma variation to enhance pilot visibility on the PDU of electro optic sensor information. Increase in display Gamma enhances the relative contrast, by increasing the grey shades of the raster display, over the higher range of the input signal levels. As a consequence, the lower range of input signal levels will be suppressed.

Power Switch
A two-position toggle switch, labelled ON/OFF, controls the power supply to the HUP, the PDU and the HUD video camera.

PDU Depression Setting Control
A thumbwheel, labelled DEP, is used to change the depression angle of the aircraft symbol in lock mode. The angle is referenced to the LFD and operates within the range zero to 305 milliradians and is displayed on the HUD. The display will occult 10 seconds after the last input.

PDU Raster/Cursive Balance Control
A thumbwheel, labelled BAL, controls the cursive luminance level relative to the raster Peak White luminance level of the PDU.

PDU Brightness Control
A thumbwheel, labelled BRT, adjusts the brightness level of the HUD. This control references the brightness level of the symbology against which the HUD auto brightness system operates.

Head-Up Display Control Panel

1 – Lock/VV Push-button
2 – GS/M Display Push-button
3 – DCLT Level Selector Push-button
4 – Baro/Rad Push-button
5 – FLIR Display Push-button
6 – HUD Power Switch
7 – HUD PDU Luminance Control
8 – HUD Balance Control
9 – Raster Gamma Control (INOP in game)
10 – Depression Setting Control

MULTIFUNCTION HEAD-DOWN DISPLAYS

General Description

The cockpit display suite has three Multifunction Head down Displays (MHDD).
The MHDD can present a variety of tactical and aircraft system information.
Formats are grouped to specific MHDD: the general concept is that the left MHDD carries tactical attack formats, the centre carries the Pilot Awareness (PA) format, while the right carries further tactical displays as well as the bulk of the aircraft system formats.

Certain formats are defined as default formats for particular POF, and are automatically displayed upon entry into that POF.

Any format can be selected at any time via the MHDD soft-keys appropriate for that MHDD format group.

NOTE
While the MHDDs in the simulation have been designed to closely resemble their real life counterparts, a number of differences is present for both gameplay purposes and limitations of the publicly available information.
Therefore, the MHDDs in the simulation are not to be used as source of real-world information or for training.

NOTE
While the package is generally designed to replicate early versions of the EF-2000, some formats may resemble more recent variants depending on available information and gameplay purposes.

MHDD Controls and Indicators

There are four sets of controls and indicators associated with the MHDD:
- Display controls
- Soft-keys
- MHDD format interchange controls
- POF selectors

MHDD Display Controls

The MHDD display controls, consist of two rotary controls, two rocker switches and a power ON/OFF switch.

Rotary Controls

The two rotary controls control the following functions:

– The left control knob controls the movement of the HSI heading marker around the compass rose when the HSI display is selected from the Pilot Awareness (PA) format.

– The right control knob controls either, the movement of the HSI course marker when the HSI format is selected (centre MHDD)

Rocker Switch Controls

The two rocker switches control the display brightness and balance as follows:

- The left rocker switch controls the display brightness

- The right rocker switch controls the cursive/raster, i.e. foreground/background, balance.

Power Switch

The power ON/OFF switch is located on the top bezel of the MHDD.

Soft-keys

There are 17 soft-keys located on the bezel surrounding the display, which enable the aircrew to select modes or data for display. The soft-keys are push button selectors containing a matrix of LED, which allows the key legend to vary according to the function it controls. The soft-key functions vary according to the format being displayed.

Display Change Selector/Indicators

Three push button selector/indicators, labelled DISP CHANGE, located on the pedestal panel, allow the aircrew to swap format groups between MHDD.

NOTE
The Display Change Selector/Indicators are inoperative in the initial release of the simulation.

POF Selector/Indicators

The Phase Of Flight (POF) currently selected is indicated on the pedestal panel.
There are five POF buttons, one for each phase, as listed. Usually, POF is selected automatically by the avionic systems, but the pilot any POF at any time by pressing the relevant POF button.

Available POF Selectors/Indicators are:

- Ground procedures (GND)
- Take-off (T/O)
- Navigation (NAV)
- Approach and landing (LDG)
- Air-to-Air (AA) is an indicator only.

Ground (GND)

The GND POF is divided into POWER UP and POWER DOWN. The system enters Ground POWER UP automatically on initial power-up.
The pilot may select POWER UP or POWER DOWN as requested via the dedicated soft key.

Take-off (T/O)

The T/O POF is enabled either by selecting the MASS to LIVE or Weight Off Wheels or opening both throttles to a position equivalent to or greater than 80% NL RPM.

Navigation (NAV)

The NAV POF is enabled when the landing gear is selected UP.

Combat (A-A)

In the real plane the system will automatically select Air-to-Air (AA) combat POF when the pilot selects an AA weapon and a target has been nominated.

In the simulation the AA POF must be selected manually.

Approach and Landing (LDG)

The LDG POF is automatically selected when the landing gear is selected DOWN.

Formats

The three MHDD provide the primary display for a number of systems and allow control selections for some systems to be made. The information is organized into the following formats:

- Attack (ATCK)
- Autocue (ACUE)
- Checklist (CHKL)
- Defensive Aids Sub System (DASS)
- Digital Map Generator (DMG)
- Disorientation Recovery Format (DRF)
- Elevation (ELEV)
- Engines (ENG)
- Forward Looking Infra-Red (FLIR)
- Fuel (FUEL)
- Head down HUD (HDHUD)
- Horizontal Situation Indicator (HSI)
- Hydraulics (HYD)
- Maintenance (MNTC)
- Pilot Awareness (PA)
- Radios (FREQ)
- Stores (STOR)
- Waypoint (WPT)

In each POF the left and right MHDD formats are automatically selected for display by default upon entering the POF.

The MNTC format is used in the real plane for for ground maintenance. In the simulation it is used to configure miscellaneous simulation options and preferences and can only be selected from the autocue format if the plane is stationary and the ejection seat is unarmed.

The autocue format is only available on the ground.

Default Formats

The default formats for each POF are as follows:

GND:

- Left MHDD: ACUE
- Center MHDD: PA
- Right MHDD: ENG (STOR after MASS is selected)

T/O:

- Left MHDD: ATCK
- Center MHDD: PA
- Right MHDD: ENG

NAV:

- Left MHDD: ATCK
- Center MHDD: PA
- Right MHDD: ELEV

LDG:

- Left MHDD: ATCK
- Center MHDD: PA
- Right MHDD: ENG

General Format Symbology

Information in colour coded:

Red is used to indicate warnings or failure conditions requiring immediate action, hostile track.

Amber indicates cautionary conditions, e.g. unknown track.

Green or white indicates correct or satisfactory conditions, e.g. friendly track.

Flashing symbology is used to alert the aircrew to:
- A change in priorities- – An illegal action, e.g. an unacceptable stores jettison program
- An action can not be achieved

MHDD Controls

1 – Power Switch

2 – Left Rotary Control (Heading Marker if the MHDD is in HSI format)

3 – Right Rotary Control (Course if the MHDD is in HSI format)

4 – Brightness Control

5 – Balance Control

6 – POF Selector/Indicators

7 -Display Change Selector/Indicator (INOP in the simulation)

8 – Control Stick Visibility Toggle (clicking on the fastenings will enable/disable the visualization of control stick for better access to MHDD and pedestal controls)

Autocue Format

The Autocue (ACUE) format is designed to support preflight activities by presenting the information necessary for safe preparation of the aircraft for its intended task.
The format is divide in five sections, divided by blue lines.

The upper section contains control prompts/switch settings and canopy/ejection seat/ladder status.
The control prompt/switch setting are shown in white with amber background, and indicate that pilot action is required on the specified switch/control.
Canopy/ejection seat/ladder status is indicated by dedicated icons on the right side.

The mid-left section displays the Flight Control System (FCS) status.
FCS READY indicates that the system is ready to enter the Flight Resident Software (FRS) by pressing the FCS RESET button. When the section is completely clear, the FRS is active and the FCS is ready for flight.

The centre section summarized the Power Up status: GO means the plane is ready for flight, NO GO indicates that there is that power up is not complete, either because there is a pending pilot action or one of the subsystems has not completed its power up sequence (or is faulty).

The mid-right section displays the Navigation System Status and shows the best available navigation mode, the LINS countdown and the GPS alignment status. “LINS READY” means that the LINS is aligned and can be selected for flight via the NAV SEL button.

The lower section displays miscellaneous information/prompts, such as XPDR and Interrogator status, IFF code, present position and simulator software version.

The soft-keys associated with the ACUE format enable the required LINS alignment mode and LINS NAV mode to be selected. Also, it is possible to switch between POWER UP and POWER DOWN modes, and select MNTC (if the plane is stationary and the ejection seat is not armed).

Maintenance Format

In the real plane, the maintenance format provides, via the autocue format, the facility to make IBIT selections for ground maintenance functions. In the simulation, this format can be used to select a number of options. The selected options will be preserved and carried to the next flight. Options are as follows:

REPAIR AND REFUEL – aircraft will be fully refuelled and all the damages hardcoded in the MSFS system will be fixed.

IN FLIGHT REFUEL CODE ENABLED/DISABLED – allow the user to deselect built-in refuelling code, in case the user intends to use third party in-flight refuel applications

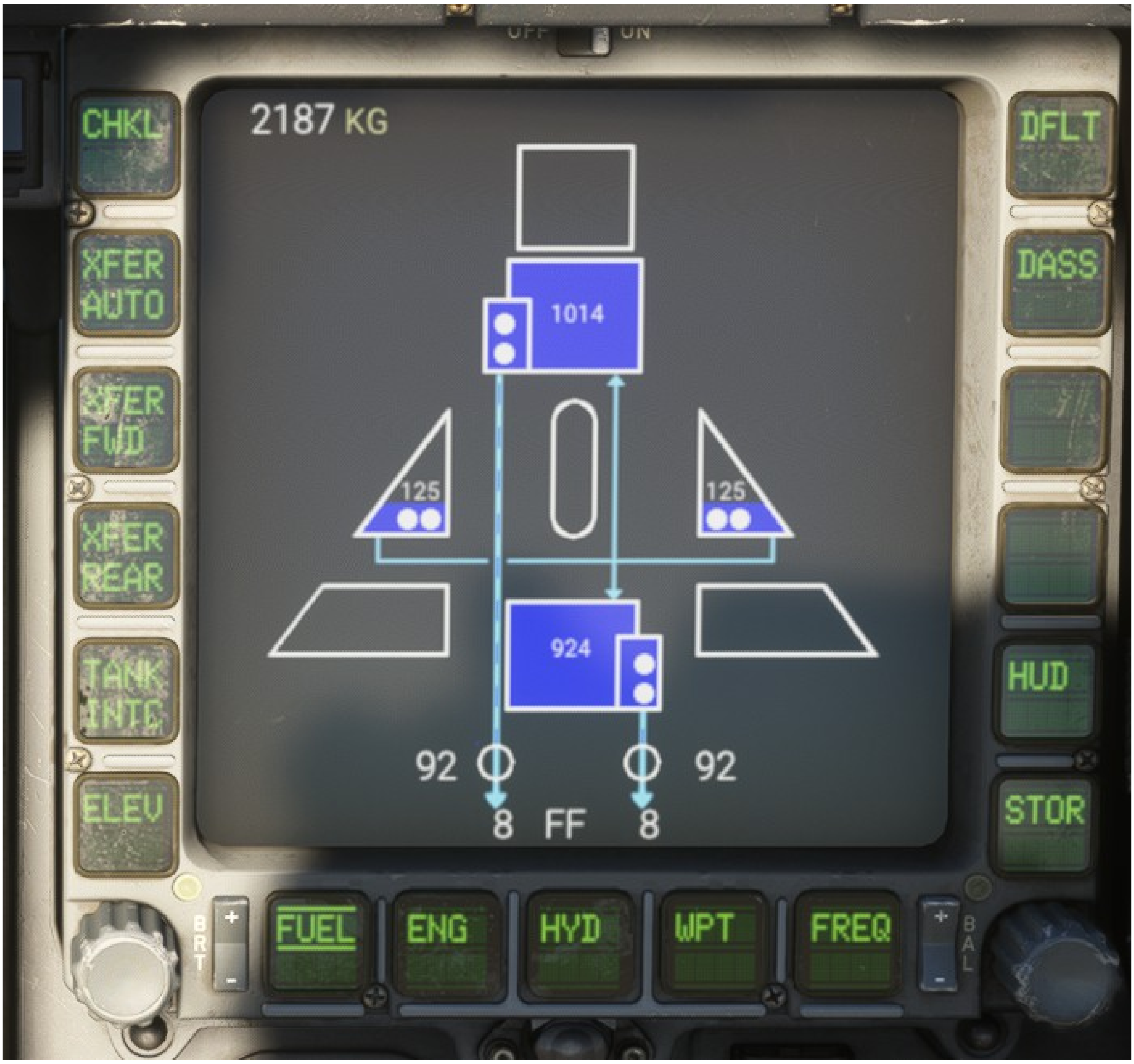
CONFIGURATION CHANGES (REALISTIC/ALWAYS ALLOWED) – if set to REALISTIC, configuration changes can only be performed while stationary and on the ground. If set to ALWAYS ALLOWED, user can change the configuration at any time.

RADAR MODULE ENABLED/DISABLED – if set to ENABLE, the radar simulation is enabled. This may cause stutters or frame rate loss for some users, especially in MSFS2020. If set to DISABLE, the radar will be permanently disabled, regardless of avionic status and controls.

NOSE WHEEL STEERING – if set to REALISTIC, the Nose Wheel Steering must be activated by the user via the FCS RESET button when the FCS is in READY condition. Otherwise the NWS will always be available.

HOTAS INTERFACE – if set to NON-HOTAS, additional soft keys functions are provided in ATCK and PA format to allow the user to operate some HOTAS-exclusive functions via Soft Keys. Otherwise these additional soft keys are removed for realism.

NOTE: This format is not available when the aircraft is in motion or the ejection seat is armed.



Fuel Format

The FUEL format displays the internal and external fuel tank contents.
Each tank has a digital readout corresponding to the fuel remaining (in kilograms).
Fuel transfer and boost pumps within the internal fuel tanks are displayed.
The status of the low pressure fuel cocks is indicated by two symbols,
each comprising a bar within a circle.

Engine feed lines are drawn between the boost pumps and the LP fuel cock symbols.
Fuel feed temperatures are indicated in digital form adjacent to the LP cock symbology.
This format also includes includes a fuel total readout, CG warnings and a
transfer selector prompt to show the recommended selection to restore fuel balance.

Engine Format

The Engine (ENG) format displays engine low pressure turbine speed (NL) with Turbine Blade Temperature (TBT) and nozzle area (AJ)represented by four circular displays (two for each engine) with important engine readings displayed by either infill, digital or analogue readouts. Each display has an alphanumeric value corresponding to the analogue data presented.

Intake positions are displayed only if auto cowl operation fails.

The fuel flow for each engine is indicated at the top of the display.

Engine-related warning captions are also shown on this format.

The soft-keys associated with the ENG format enable DECU lane selections to be made and other formats to be accessed.

Hydraulics Format

The Hydraulics (HYD) format provides a diagrammatic representation of the left and right hydraulic systems. The display shows the status of the valves and reservoirs along with associated information e.g. pressures, levels and temperatures.

Reservoir contents, flight control pressures and utilities pressures are displayed.
If a system pressure or reservoir content within the hydraulic system falls below the safe level the associated box(es) are displayed in red and the digital readout(s) of actual contents will be displayed against a red infill.

The status of the utility isolation valves is indicated by two symbols, each comprising a bar within a circle. An AUTO or MAN caption is displayed adjacent to the symbols to indicate whether the valves are being controlled automatically (by the hydraulic system) or manually (via soft-key selection).

Waypoint Format

The Waypoint (WPT) format displays the aircraft present position (as derived from the simulator GPS system), the next waypoint coordinates, range and bearing ETE and ETA for the waypoint, the destination waypoint and ETE and ETA for the destination.

Radio Format

The radio (FREQ) format presents the V/UHF frequencies for the manual channel and the 24 preset channels for radios 1 and 2. The data is presented in the form of two mutually exclusive lists one covering radio 1 details and the other covering radio 2, however, the format always displays manual channel data for both radios.

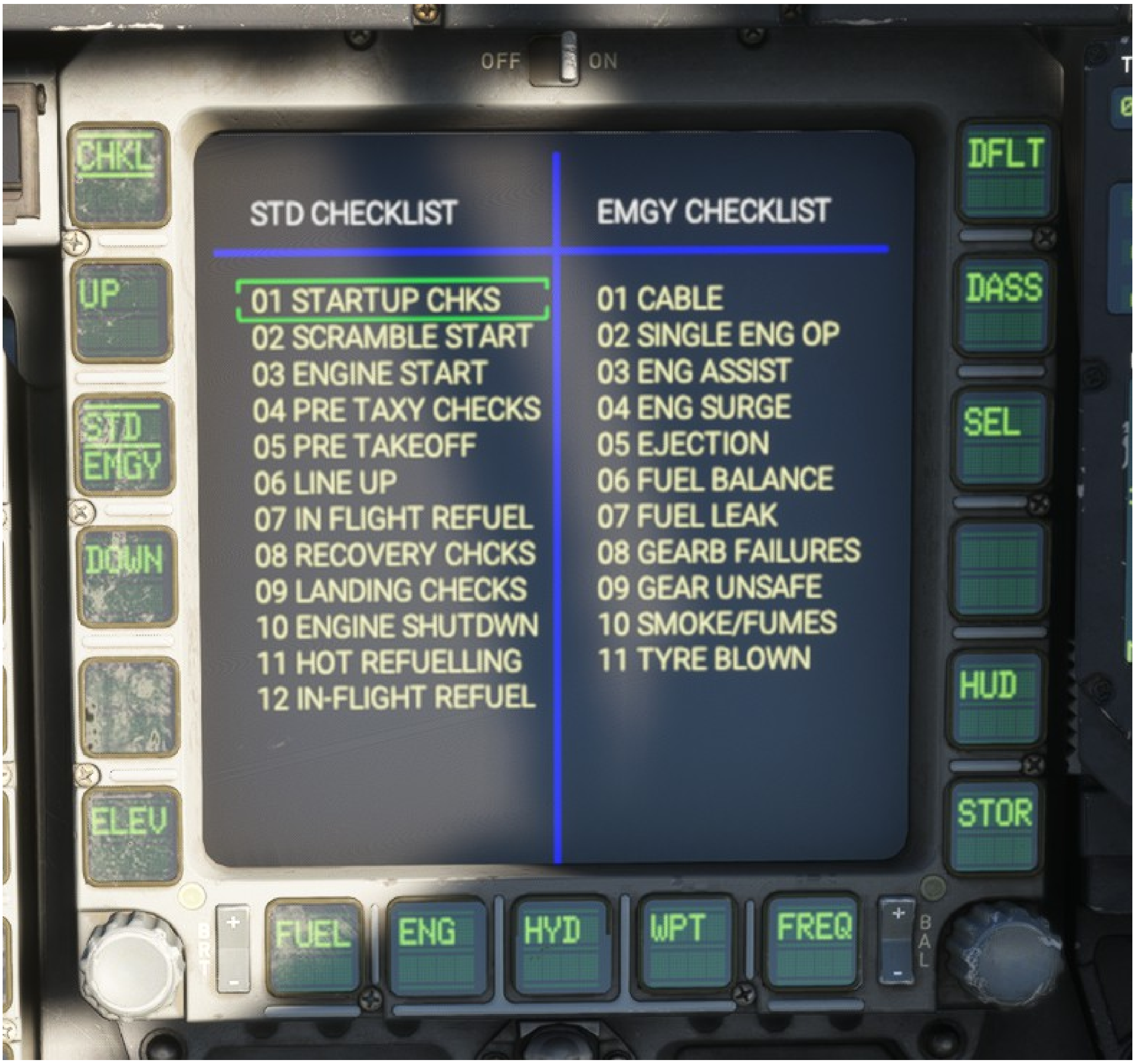
Head Down HUD Format

The Head Down HUD (HDHUD) format presents analogue and digital readouts similar to those on the on the head-up display (HUD).

DRF Format

When any auto-recovery mode is active, a dedicated Disorientation Recovery Format (DRF) is presented. The format is similar to a decluttered HDHUD – only horizon, airspeed, altitude and AoA data are presented. No soft-key selection is available.

The display will return to the format which was selected previous to the auto-recovery, as soon as the auto-recovery is disengaged.



Checklist Format

The Checklist (CHKL) format provides the aircrew with a list of standard and emergency checklists from which the required drill can be selected. Checklists are divided into Standard and Emergency Checklists.

Standard Checklist

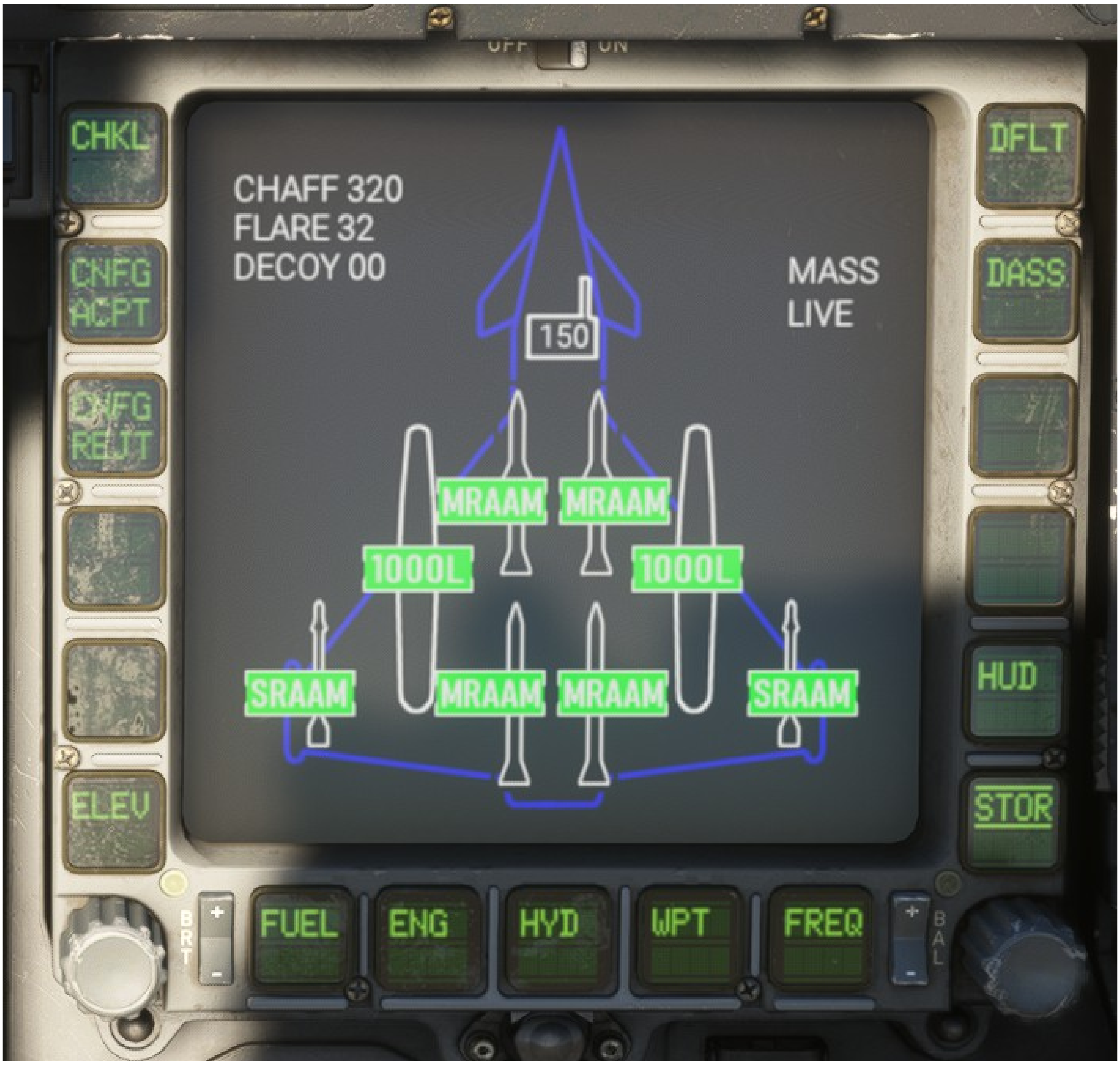
The standard checklists provide the aircrew with the drills required to perform normal aircraft and systems checks.

Emergency Checklist

The emergency checklists provide the aircrew with the emergency drills required to perform aircraft and system checks for abnormal operation.

NOTE:

Real-world checklists may differ from the ones presented in this simulation.



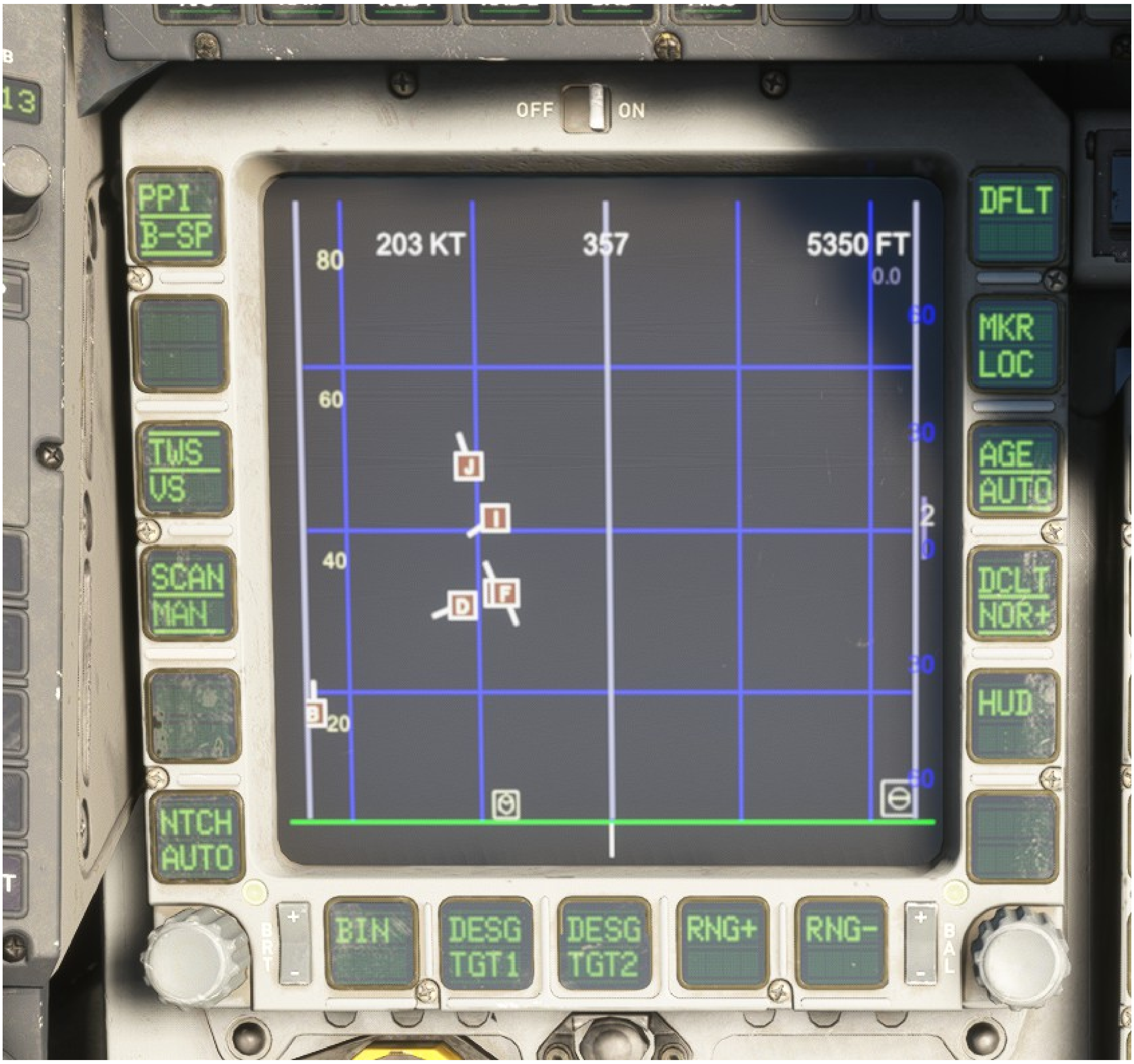
Stores Format
The Stores (STOR) format provides a graphic representation of weapon system status and current stores configuration.

Stores are represented by white outlined symbols at positions relative to their host store station.

This format allows the user to change / accept / reject configurations, create custom configurations (if the current one has not been accepted) and create jettison packages by performing an X-Y insert over the appropriate store symbol(s) (see relevant manual paragraph for details).

Available soft keys depend on user preference: if realistic configuration change is selected, when the plane is stationary on the ground, the CNFG REJT allows the user to reject the current configuration and cycle between the predefined ones. CNFG ACPT will ACCEPT the current configuration allowing the creation of jettison packages.

If the user opted to always allow configuration changes, the CNFG CHNG button will allow the user to cycle between between predefined configurations.



Attack Format (B-Scope, Track While Scan)

The Attack (ATCK) format together with HOTAS controls, enable sensor contacts to be displayed, tracked or nominated for attack. During operation in Track While Scan (TWS) mode radar contacts are displayed against one of two selectable range/azimuth display formats.

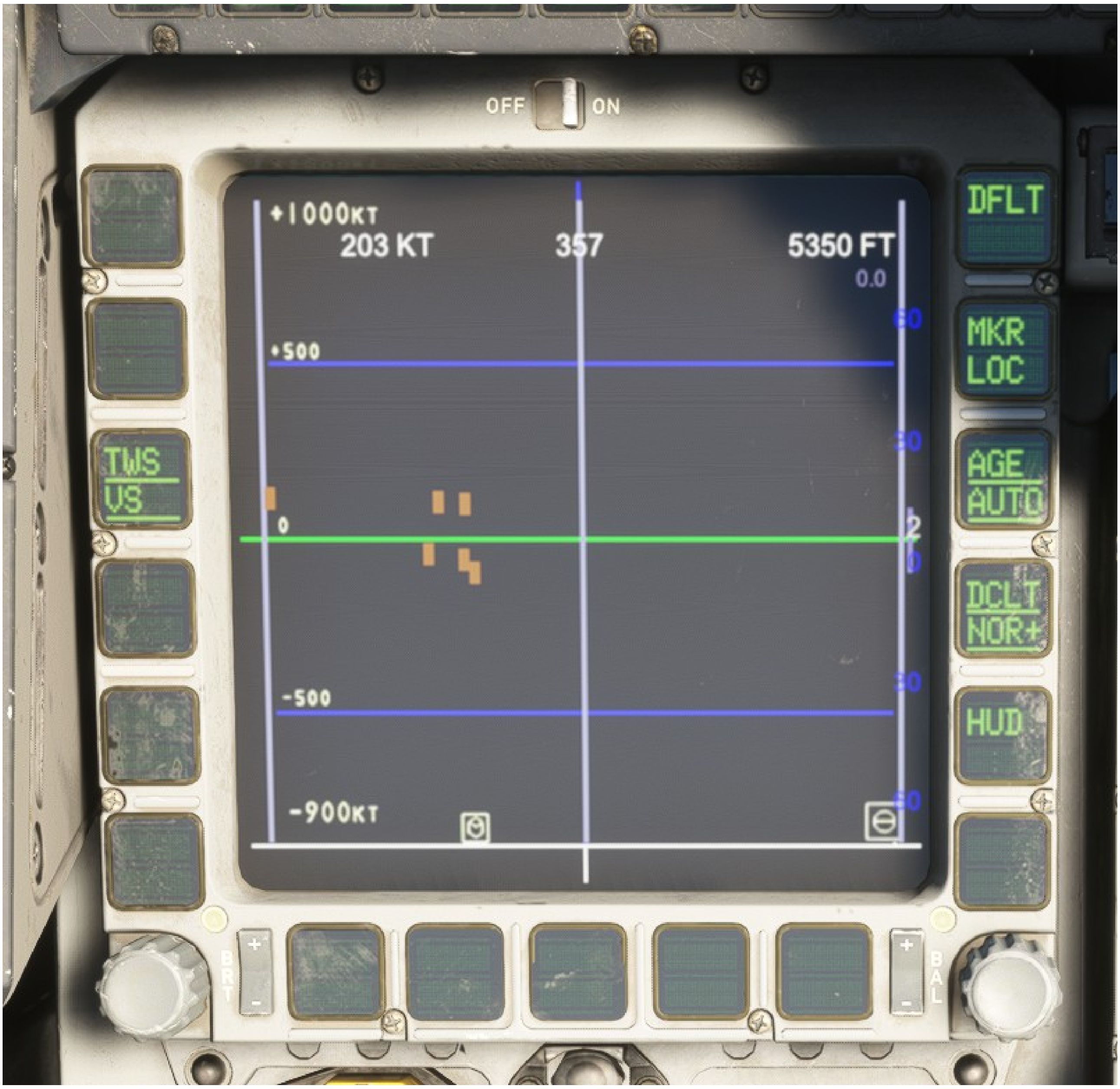
The default format is a B-Scope (azimuth versus distance) grid type presentation. Radar scan volume is indicated against the grid by three vertical lines which together represent scan width and centre and by a scanner elevation scale against which current bars scan pattern and coverage is displayed.

For additional information, refer to Radar section.

Soft-key selection enables the display to be changed to a Plan Position Indication (PPI) type presentation. A Velocity Search (VS) mode is provided as an alternative to TWS and is accessed by soft-key selection.

Attack Format (PPI, Track While Scan)

. When PPI is selected, radar contacts are displayed against a sector upon which range is indicated by arcs.



Attack format (Velocity Search)

A Velocity Search (VS) mode is provided as an alternative to TWS and is accessed by soft-key selection. When in VS mode radar plots are shown against a velocity azimuth type display.

Pilot Awareness Format

The Pilot Awareness (PA) format displays navigational information in plan form. The symbology can be displayed against a digitally generated map.

The PA format also presents track/target data and a limited amount of miscellaneous information to assist the pilot to manage the aircraft safely. The display is active and therefore gives an up to date representation of aircraft positioning at all times.

Horizontal **Situation Indicator Format**

A traditional Horizontal Situation Display can be selected from the PA format to display the TACAN or navigation system derived data.

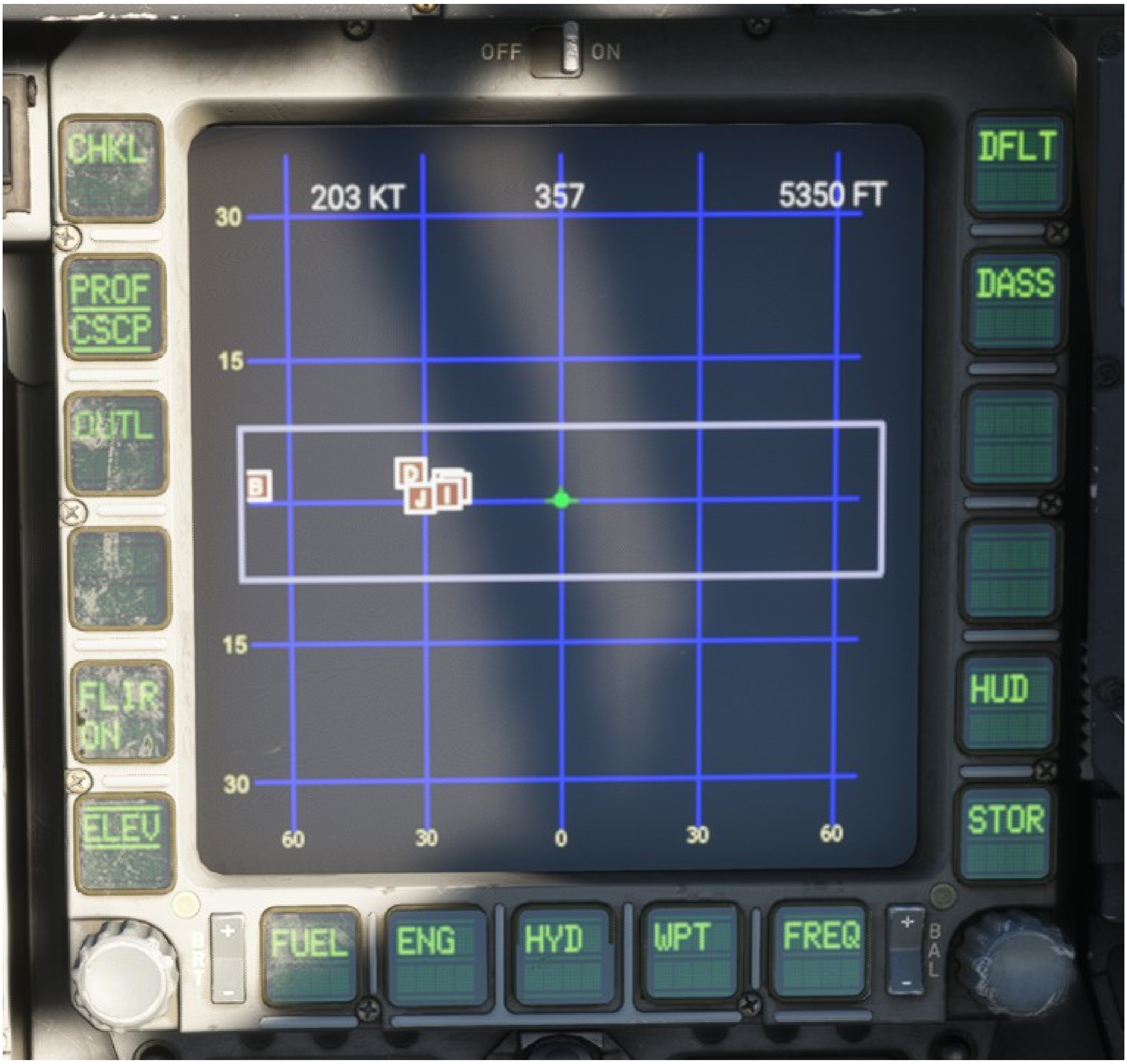
NOTE:

When in HSI mode, Heading reference and Course can be set using the rotary controls.

Elevation Format (Profile)

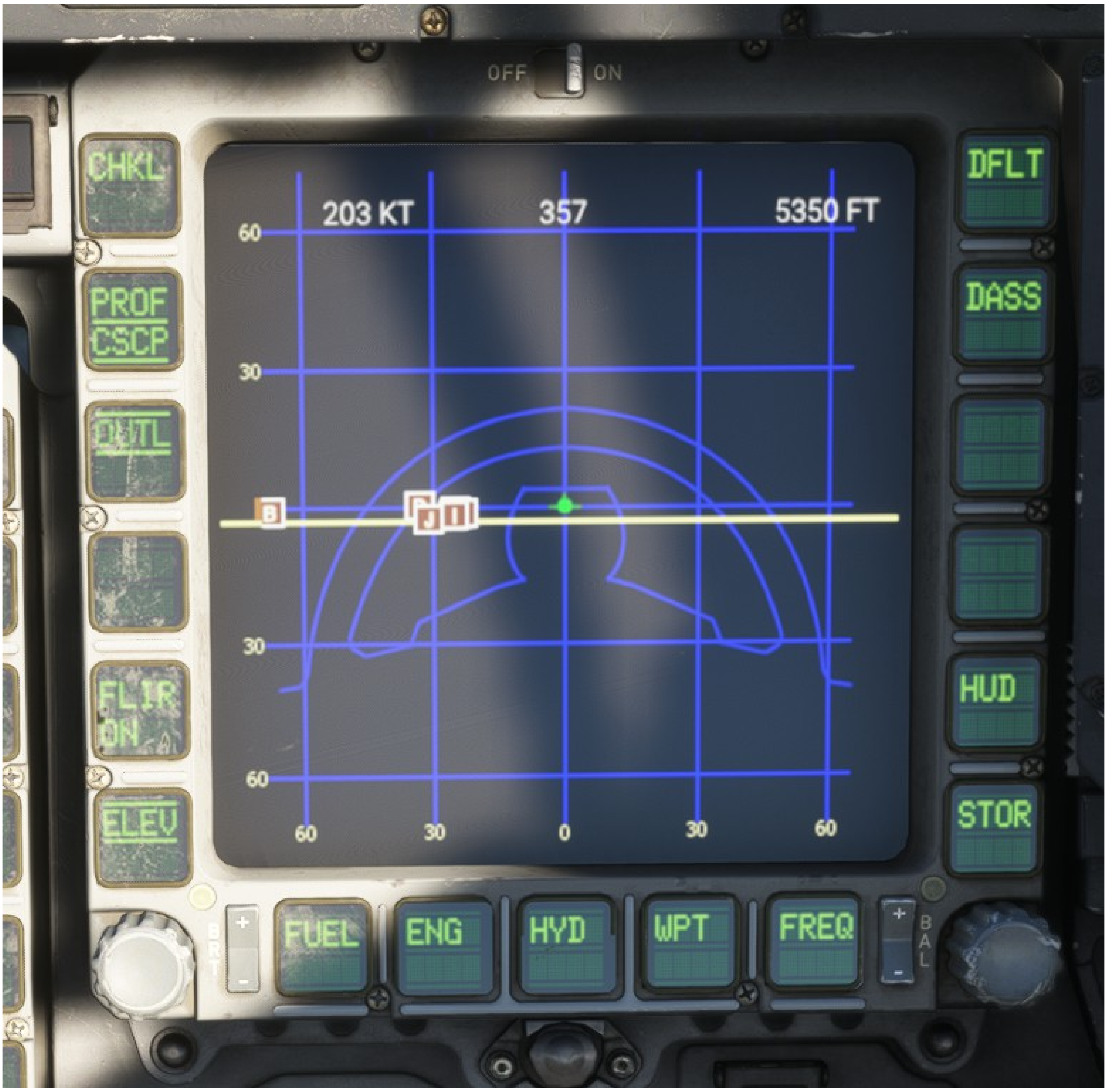
The Elevation (ELEV) format, together with HOTAS controls, enables radar contacts to be displayed, tracked or nominated for attack.
The contacts are displayed against one of two selectable formats; an altitude/range grid presentation known as 'profile', or an altitude/azimuth grid presentation known as C-scope.

With the profile format selected the X-axis represents plan range in front of the aircraft while the Y-axis represents altitude. Scanner elevation coverage is displayed by two diverging lines and the pattern can be steered with HOTAS command.



Elevation Format (C-Scope)

The C-scope presentation displays azimuth on the X-axis while the Y-axis is used to display relative altitude. Scanner volume is displayed in both azimuth and elevation.
For additional information, refer to Radar section.



Elevation Format (C-Scope - OUTLINE)

An additional visualization for the Elevation format is the C-Scope Outline.
In this presentation, the tracks are displayed, in aircraft-relative azimuth and elevation, against an outline of the cockpit – allowing for clearer identification of the tracks in some instances.

FLIR format

If the aircraft is equipped with a PIRATE system, FLIR imagery is accessible from the ELEV format by selecting the FLIR soft-key.

DASS Format

The Defensive Aids Subsystem (DASS) format displays range rings and threats as detected by the DASS system, along with chaff and flare status, towed decoys and ECM status.

NOTE:

Due to limitations of Microsoft Flight Simulator, the DASS system is only partially supported through a basic emulation. Please see the DASS section for details.

MANUAL DATA ENTRY FACILITY

Introduction

The Manual Data Entry Facility (MDEF) is located on the left glare shield It is used for moding and data entry to several avionic systems. The MDEF consists of the following:
- – Subsystem keys
- – Moding keys
- – Read Out Line (ROL)
- – Toggle switch
- – Data entry keyboard (DEK)
- – Destination waypoint (DWP) ROL
- – Change destination (CHD) push button.

Subsystem Keys

There are thirteen subsystem keys; the set waypoint key (SWP) is located separate to the other keys. The MIDS, A/S and NIS keys have no function.

The subsystem keys allow moding and data entry to the following functional groups, called the MDEF subsystems.

- – Navigation (NAV)
- – Navigation aids (AIDS)
- – IFF interrogator (INT)
- – IFF transponder (XPDR)
- – Radar transmitters (XMIT)
- – Radio 1 (RAD1)
- – Radio 2 (RAD2)
- – Defensive aids (DAS)
- – Miscellaneous (MISC)
- – Set waypoint (SWP)

Selection of a subsystem is indicated by the illumination of bars above and below the key's legend. Initially on applying power no subsystem will be selected. On selection, the default displays and optional functions for that subsystem are displayed in the ROL, on the moding keys and the data entry keys. These remain illuminated until the subsystem is deselected by pressing the key again.

On selection of a subsystem, the previously selected subsystem is automatically deselected. Another subsystem can be selected prior to completing the necessary data entries, however, the data entered is not passed to the subsystem or retained in memory.

Moding Keys

There are twelve moding keys, each key consists of two rows of four multifunction characters. The legend displayed on the key describes the function of that mode. The moding keys have three functions:

1 To indicate the current functional status of the selected subsystem

2 To enable the functional state to be changed

3 To allow subsystem data to be entered or edited via the DEK/ROL.

Selection of certain moding keys may present data on other aircraft displays and also allow data entries/ changes by use of the X-Y controller.

Read Out Lines

The ROL are displayed on a four row by 13 column display. On selection of a moding key it displays either subsystem status information or the current/ default data for the option selected when applicable. The current data displayed in some cases can be overtyped. Where no system data exists dashes are displayed where data input is required/possible. The data for some moding key selections requires more than one page of ROL information; this is indicated by a page number on the right side of the bottom row. A writer marker is automatically positioned in the ROL under the first character that can be changed. Repositioning of the writer marker is achieved by use of the toggle switch.

Toggle Switch

The toggle switch is a five position centre biased switch, which is used to position the writer marker under a variable in the ROL. The toggle switch can also be used to move between pages of a multi-page display.

Data Entry Keys

The data entry keyboard consists of eighteen multifunction keys and the dedicated clear (CLR) and enter (ENT) keys. Each of the multifunction keys can display an alphanumeric character or symbol. The characters on the keys, and the position of the writer marker in the ROL, are configured for the moding function selected.
The input data will only be supplied to the subsystem selected if it passes validation after depression of the enter (ENT) key.

Enter Key

The input of data has no effect on the selected subsystem until the ENT key is depressed.

Clear Key

The clear key (CLR) enables the quick reconfiguration of the ROL so that an input sequence can be restarted, either for a particular variable or the whole page.

Destination Waypoint Read Out Lines

The DWP ROL is a four column by two row display, which indicates the destination waypoint number on the upper row, and the subsequent destination waypoint number on the lower row. 'HOLD' will be displayed on the upper row if there is no waypoint selected, and four dashes will be displayed on the lower row if there is no subsequent waypoint.

Change Destination Moding Key

When selected, the change destination (CHD) moding key will make the waypoint shown on the key and the DWP ROL the next DWP.

MANUAL DATA ENTRY FACILITY – Controls and Indicators

1 – MODING KEYS
2 – SUBSYSTEM KEYS
3 – DATA ENTRY KEYS
4 – READOUT LINES (ROL)
5 – TOGGLE SWITCH
6 – CHANGE DESTINATION KEY
7 – WAYPOINT READOUT LINES

TRANSMISSION (XMIT) SUBSYSTEM

The XMIT subsystem key allows the pilot to have a top-level control of the airplane electromagnetic emissions. Radar, Tacan, Transponder, Interrogator and Radar Altimeter transmission can be inhibited individually or collectively.

ALL NORM → All systems will emit as required by their normal functions

ALL SLNT → Emission from all systems will be inhibited

PROG → Emissions from individual systems can be controlled by the respective moding keys

MULTIFUNCTIONAL INFORMATION DISTRIBUTION SYSTEM (MIDS) SUBSYSTEM

In the real plane, the MIDS subsystem key allows the pilot to control the Multifunctional Information Distribution System.
The system is not simulated, and this subsystem key has no practical function in the game.

NAVIGATION AIDS (AIDS) SUBSYSTEM

Pressing the AIDS subsystem key allows the pilot to control the TACAN system, enter ILS frequencies, verify the NAV MODE and GPS Present Position. Refer to the Navigation section for additional information.

NAVIGATION (NAV) SUBSYSTEM

This subsystem differs substantially from the real-world, as it is used, in the game, to control the the autopilot settings and part of the simulation navigation system.

AUTO/MAN – Automatic or manual waypoint advancement

NAV/GPS – Indicates if the MSFS autopilot is slaved to the GPS or to the NAVAIDS (not supported)

SET HDG – Sets the heading reference for the HSI and the autopilot (value will be overwritten by current heading upon HDG hold selection or via stick control)

SET CRS – Sets course reference (OBS)

SET ALT – Sets autopilot altitude hold reference (value will be overwritten by current altitude upon ALT hold selection or via stick control)

SET SPD – Sets auto-throttle reference speed

SET VV – Sets autopilot vertical velocity reference

RADIO 1 / RADIO 2 SUBSYSTEMS

The RAD1 and RAD2 subsystems allow the pilot to control the Communication Radio 1 and 2, along with the radio control knobs and HMDD FREQ format.
The moding keys allow the user to set Preset (PSET) or MAN (manual) frequencies.
See the Communication section for additional information.

IFF INTERROGATOR (INT) SUBSYSTEM

The INT subsystem key allows the pilot to control the IFF interrogator.
See the IFF section for more information.

IFF TRANSPONDER (XPDR) SUBSYSTEM

The XPDR subsystem key allows the pilot to control the IFF transponder.
See the IFF section for more information.

DEFENSIVE AIDS SUBSYSTEM (DAS)

In the real plane the DAS subsystem keys allows the pilot to control a the Defensive Aids Subsystem along with the MHDD DASS format. The support for this function in the sim is very limited. See DASS for additional information.

MISCELLANEOUS (MISC) SUBSYSTEM

The MISC moding keys allows the pilot to access a number of different functions:

- stopwatch and count up (CNTU) / countdown (CNTD) option
- zulu/local time
- bogus armament
- simulated target
- lamp tests
- bingo fuel settings
- VVR control

HANDS ON THROTTLE AND STICK (HOTAS)

HOTAS General Description

Like any modern jet fighter, the EF-2000 implements an “Hands on Throttle and Stick” (HOTAS) approach, that is control methodology one hand rests on the throttle lever, while the other rests on the control stick and buttons, dials, and switches are placed on the throttle and stick and the aircraft interface is designed so that, in most cases, that the pilot's hands need not leave the control stick and throttle, to command the aircraft.
For a better EF-2000 experience in Microsoft Flight Simulator, we suggest to assign as many functionalities to your control stick and throttle.

NOTE:

The HOTAS key binding assignment and functionalities in this Microsoft Simulator rendition are different, in some cases, from the real world counterpart. For commonality and gameplay reasons, we have kept the same assignments our other HOTAS-enabled product (F-35 and M-346) so that the user control configuration is cross compatible between these products.

Throttle Top Controls

In the real aircraft the throttle top contains eight selectable HOTAS controls (see figure on following pages):

Outboard Throttle Top:
– SRAAM reject
– Chaff/flare release
– Lights Kill
– Radar elevation control and A/S gain.

Inboard Throttle Top:
– Communication control (DVI not yet available)
– X-Y controller
– Target list rotate, re-attack
– Auto-throttle switch
– Air-brake selector.

Stick Top

In the real aircraft the stick top contains nine selectable HOTAS controls:

– A/A weapon selector
– Radar air combat mode, radar lock/break lock
– Late Arm Selector
– Pitch and roll trim control/autopilot heading and attitude datum adjust
– IFF Interrogate
– ICO/NWS disconnect switch
– Autopilot engage/disengage button
– A/A missile/gun trigger (record)
– Weapon Release Button

In-game key bindings and functionalities

In this Microsoft Flight Simulator EF-2000 implementation a number of default simulator controls have been repurposed to support HOTAS inputs.

Given the high number of HOTAS controls, some of which are useless in MSFS, the system has been slightly simplified to allow full functionality with a limited number of key bindings.

Below are the real world functions, along with the MSFS equivalent (or its nearest approximation) if supported.

The HOTAS custom functionalities are grouped into:

- Display management:

- X-Y Controller

- Target management:

Display Management Switch is activated in the forward, aft, right and left directions and is used to select the Display Of Interest (DOI)

DMS UP → selects the HUD as DOI

DMS DOWN → selects CMHDD as DOI

DMS LEFT → selects LMHDD as DOI

DMS RIGHT → selects RHMDD as DOI

The key bindings that should be associated to the DMS are:

DMS UP – INCREASE NAV 3 (WHOLE)

DMS DOWN – DECREASE NAV 3 (WHOLE) – NOTE: there is a typo in the sim so that this control is also labelled “increase”

DMS LEFT - INCREASE NAV 3 (FRACT)

DMS RIGHT - DECREASE NAV 3 (FRACT)

X-Y Controller is activated in both the X and Y axes and in the Z axis (insert action). It is used to slew cursor symbology across the Display of Interest. “Insert” command in certain areas of the display will initiate specific commands, depending on the format of the Display of Interest. Please see relevant sections for format-specific functionalities.

Below is a non-comprehesive list of X-Y Controller functionalities in MSFS, depending on DOI format.

ATTACK FORMAT → “bumping” the cursor on upper or lower borders will change the display range

PILOT AWARENESS FORMAT → “bumping” the cursor on upper or lower borders will change the display range

ELEVATION FORMAT → “bumping” the cursor on upper or lower borders will change the display altitude range

FREQUENCIES FORMAT → Insert will select a specific frequency

STORES FORMAT → X-Y controller allows the creation of jettison packages

In MSFS the following key bindings/events can be used to emulate X-Y controller functionalities.

X-Y UP – DECREASE ADF2 FREQUENCY (WHOLE)

X-Y DOWN - INCREASE ADF2 FREQUENCY (WHOLE)

X-Y RIGHT - INCREASE ADF2 FREQUENCY (FRACT)

X-Y LEFT - DECREASE ADF2 FREQUENCY (FRACT)

INSERT - INCREASE ADF2 (10)

Target management switch (TMS) is activated in the forward, aft, right and left directions. In the real aircraft it has different functions depending on the context, but typically related to target assignment and radar management.

Main functionalities are as follows:

TMS UP → browse through available tracks. Releasing the button will designate the current track as first target.

TMS DOWN → browse through available tracks. Releasing the button will designate the current track as secondary target, if a first target is designated (otherwise the track will be designated as first target)

TMS LEFT → if a target is not assigned, increases the elevation of the radar antenna scan volume

TMS RIGHT → if a target is not assigned, decreased the elevation of the radar antenna scan volume

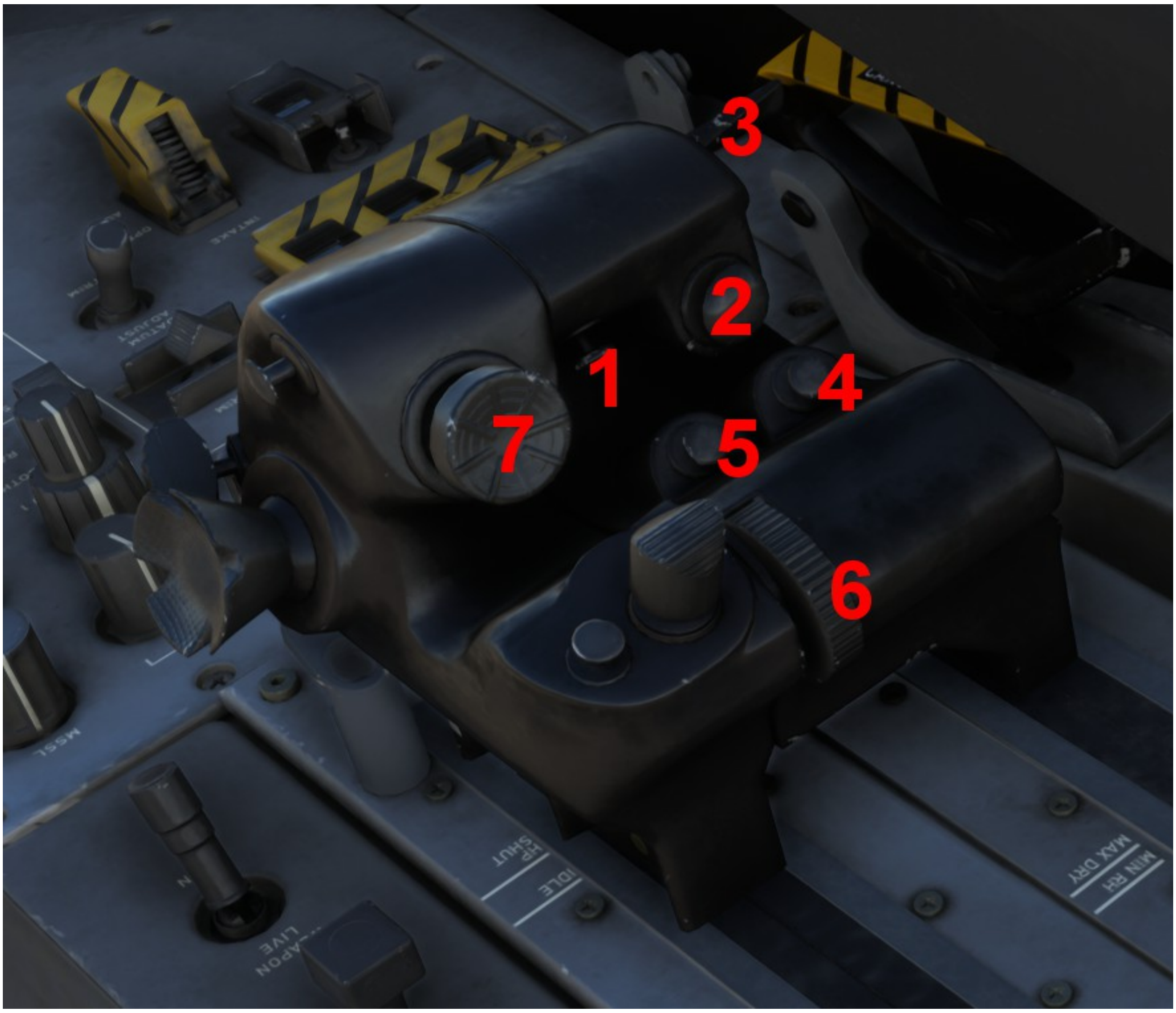
The key bindings that should be associated to the TMS are:

TMS UP – DECREASE ADF1 FREQUENCY (WHOLE)

TMS DOWN - INCREASE ADF1 FREQUENCY (WHOLE)

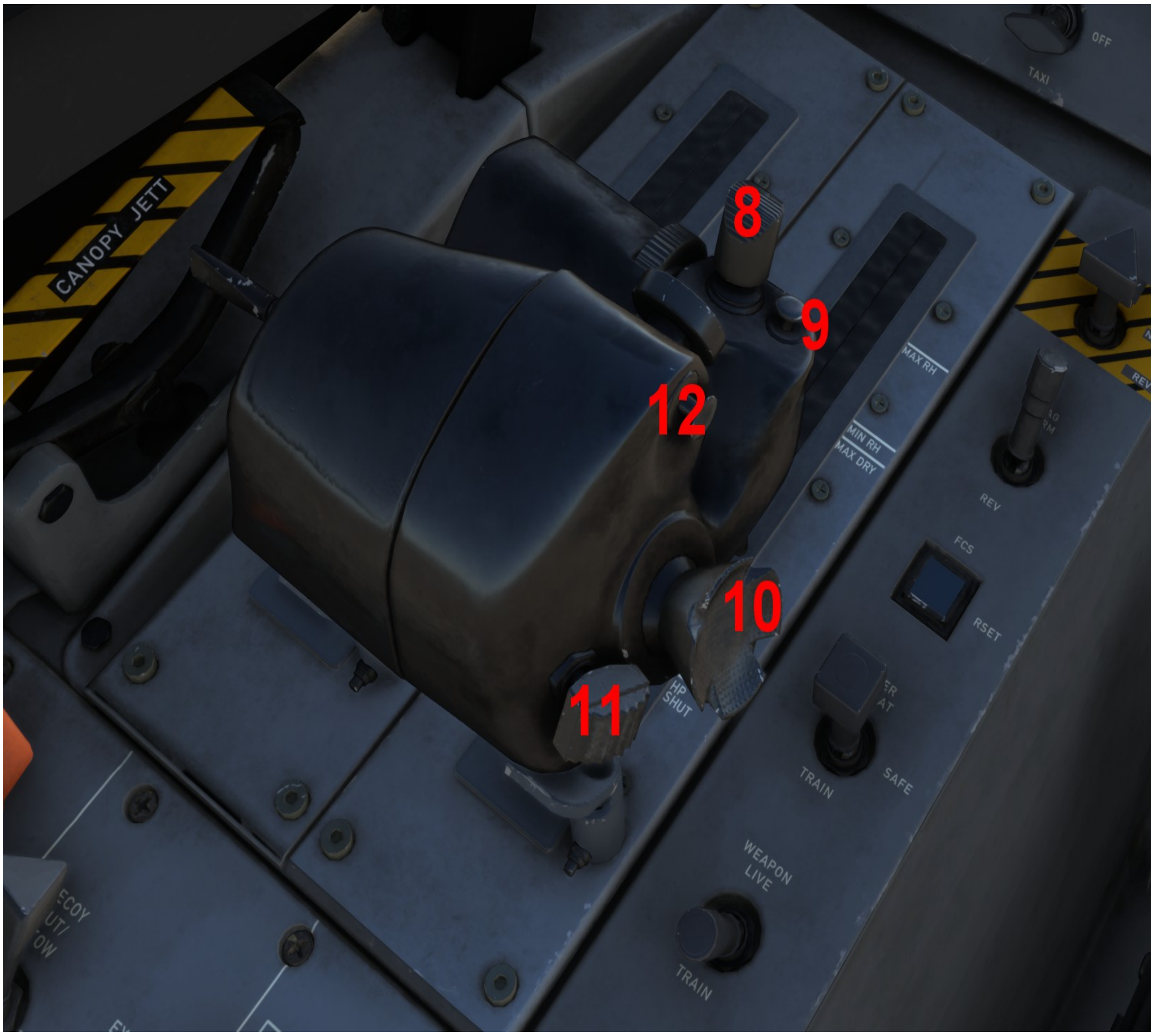
TMS LEFT - INCREASE ADF1 FREQUENCY (FRACT, CARRY)

TMS RIGHT - DECREASE ADF1 FREQUENCY (FRACT, CARRY)



OUTBOARD THROTTLE TOP

1 – SPARE
2 – SRAAM REJECT
3 – CHAFF/FLARE DISPENSER
4 – SPARE
5 – SPARE
6 – RADAR ELEVATION CONTROL AND RADAR A/S GAIN
7 – X-Y CONTROLLER



INBOARD THROTTLE TOP

8 – AUTO THROTTLE CONTROL SWITCH
9 – DTL ROTATE CONTROL AND RE-ATTACK
10 – COMMUNICATION CONTROL SWITCH
11 – AIRBRAKE SELECTOR
12 – SPARE

CONTROL STICK

1 – AIR TO AIR WEAPON SELECTOR
2 – RADIO 1 PTT
3 – RADAR AIR-COMBAT MODE, RADAR LOCK/BREAK LOCK
4 – LATE ARM SAFETY INTERLOCK/WEAPON RELEASE INHIBIT
5 – WEAPON RELEASE
6 – PITCH AND ROLL TRIM/AUTOPILOT HEADING AND ALTITUDE DATUM ADJUST
7 – IFF INTERROGATE
8 – ICO/NWS DISCONNECT SWITCH
8 – AUTOPILOT ENGAGE/DISENGAGE BUTTON
10 – AIR-TO-AIR MISSILE/GUN TRIGGER/HUD RECORD ONLY

GET-U-HOME INSTRUMENTS

Introduction
In the event of a failure resulting in the loss of the main front and rear cockpit displays, a number of reversionary GUH instruments, located on the HUD Control Panel (HUDCP), provide the necessary flight information to assist the pilot in a safe return to base.

The Dedicated Warnings Panel (DWP) can also revert to a reversionary layout enabling a number of hardwired warnings only to be displayed.

GUH instruments are as follows:
– Fuel contents displays
– Engine speed indicators
– Reversionary attitude indicator
– Reversionary heading indicator
– Slip indicator
– Reversionary angle of attack indicator
– Emergency airfield track indicator
– Emergency airfield designator code display
– Emergency airfield range display.

During normal aircraft operation, a vertical row of GUH instruments on the right glareshield is covered by the Dedicated Readout Panel (DRP). The panel, which is spring-loaded and hinged on the outboard edge of the right glareshield, may be manually released to reveal the GUH instruments listed below:
– Reversionary Mach number display
– Reversionary airspeed indicator
– Reversionary vertical speed indicator
– Reversionary altitude indicator.

Fuel Contents Displays
The fuel contents displays comprise three digital readouts, each four digits in length. The readout lines are marked FWD, REAR and TOTAL and represent the amount of fuel remaining in the forward tank group, in the rear tank group, and the total fuel content respectively.

Engine Speed Indicators
The engine speed indicators are located at the lower left and right of the HUDCP and consist of two non-linear curved gauges, each with a digital readout in the centre The gauge provides an analogue reading of engine speed whilst the readout line provides a digital reading. Each gauge represents zero to 105%.

Reversionary Attitude Indicator
The attitude of the aircraft is displayed on a 76mm Active Matrix Liquid Crystal Display (AMLCD) indicator, which is divided into two sectors. The sectors, coloured blue and brown, indicate pitch attitudes above and below the horizon.
A conventional slip indicator is incorporated immediately below the instrument.

Reversionary Heading Indicator
The reversionary heading indicator provides an indication of aircraft true heading to an accuracy of 1 over a 360 range.

Slip Indicator
The slip angle is read by the position of a solid circle (or ball) against a non-linear slip scale, with zero slip angle being in the middle of the scale. Each scale mark represents 3; and maximum deflection represents a slip angle 10.

Reversionary Angle of Attack Indicator
The aircraft AOA is displayed on a bar type indicator, against a fixed vertical scale. The range of the instrument is -15 to +40, marked in 5 steps.

Waypoint Track Indicator
Current waypoint route track angle error is displayed on the periphery of the compass rose, via a triangular pointer which moves around the outside of the heading scale.

Current waypoint number Display
This display indicates the current waypoint number within the loaded route. The display is located in the lower left of the reversionary instrument.

Waypoint Range Display
This display indicates the range to the next waypoint in the loaded route.

NOTE

In the real plane, the displays above DO NOT indicate the track, number and distance to the next waypoint in the route, but the indicate the track, identification and distance from the closest emergency airfield.

Reversionary Mach Number Display
This three digit readout, situated above the airspeed indicator.

Reversionary Airspeed Indicator
Airspeed is indicated by a pointer on a circular scale.

Reversionary Vertical Speed Indicator
Aircraft vertical speed is indicated by a pointer on a circular scale.

Reversionary Altitude Indicator
The reversionary altitude indicator comprises a circular analogue indication, one complete revolution representing 1000ft in altitude, together with a digital readout of height up to 65 530ft.

GET-U-HOME INSTRUMENTS

1 – REVERSIONARY INSTRUMENT (Attitude, Heading, Slip, Angle of Attack, Waypoint number, track and range)

2 – Fuel Content Displays

3 – Engine Speed indicators

4 – Reversionary Mach Number Display

5 – Reversionary Airspeed Indicator

6 – Reversionary Vertical Speed Indicator

7 – Reversionary Altitude Indicator

8 – DRP latch mechanism

UTILITIES CONTROL SYSTEM

Utilities Control System

The Utilities Control System (UCS) is a digital integrated control system consisting of seven computers interconnected computer.

The UCS Computers are the following:

- left and right Fuel Computers (alternately acting as Bus Controller)
- left and right Secondary Power System (SPS) Computers
- Front Computer
- Landing Gear Computer
- Maintenance Data Panel Computer.

Each UCS computer provides control, monitoring and testing of the systems or sub-subsystems allocated to it. The UCS incorporates Built-In-Test (BIT) functions to check the UCS computers as well as utility systems. The system also includes Power-Up BIT, Continuous BIT and Initiated BIT functionalities.

NOTE:
The UCS is not simulated as an interconnected system in the MSFS rendition, subsystem functionalities are simulated by independent modules.

Front Computer

The Front Computer (FC) controls, monitors and tests the functions for the following subsystems:
- engine bleed air distribution
- the air conditioning
- the windscreen and canopy
- the oxygen
- radar liquid cooling
- pilot vest conditioning
- life support
- crew escape and safety system

Landing Gear Computer

The Landing Gear Computer (LGC) performs control, interfacing, warning and indication generation, monitoring and test functions, associated with the following systems and their constituent sub-systems:
- landing gear
- brake system
- brake chute and arrestor hook

Left and Right Fuel Computers

The LH and RH fuel computers provide automatic control and monitor the fuel system, including fuel transfer system and refueling and defueling.

Left and Right SPS Computers

Two identical and interchangeable computers provide control of the Secondary Power System (SPS) and a number of associated functionalities such as:
- engine starting
- air leakage detection
- hydraulic pump depressurization
- hydraulic power generation and distribution
- ice detection

Maintenance Data Panel (MDP) Computer

The Maintenance Data Panel Computer controls the the aircraft MDP system. The MDP is the central point of the input/output for maintenance actions on the aircraft and allows rapid access to the aircraft data by the ground crew, through the display, located in the aircraft centre fuselage, and/or in a Portable Maintenance Data Store (PMDS) that can be removed for analysis after flight.

The MDP operates in two modes:
- On ground crew action
- During flight.

During flight the MDP operates automatically.

NOTE:
MDP is not simulated in the MSFS rendition.

ENGINES

Engines
The aircraft is powered by two Eurojet EJ200 twin spool turbofan engines with after-burning capability (refer to Figure 1.85), installed side-by-side in two completely independent fireproof bays. The engines are fed with air by a variable-geometry air intake with two separate ducts located below the fuselage.

The engine consists of a three stage LP (low pressure) compressor and a five stage HP (high pressure) compressor, each driven by a single stage turbine. Air bleeds are provided by both LP and HP compressors for internal cooling and aircraft services.

Specifications (EJ200)
(data from *Data from* Rolls-Royce plc):

General characteristics

Type: After-burning turbofan
•Length: 398.78 cm (157.00 in)
•Diameter: 73.66 cm (29.00 in)
•Dry weight: 988.83 kg (2,180.0 lb)

Components

•Compressor: Axial, 3-stage LP, 5-stage HP
•Combustors: Annular
•Turbine: 1-stage LP, 1-stage HP

Performance

•Maximum thrust: 60kN (13,500 lbf) and 90 kN (20,200 lbf) (with reheat)
•Overall pressure ratio: 26:1
•Bypass ratio: 0.4:1
•Air mass flow: 75–77 kg/s (165–170 lb/s)
•Turbine inlet temperature: 1,800 K (1,527°C; 2,780 °F)
•Fuel consumption: 4,536–4,968 kg/h (10,000–10,950 lb/h) and 15,228–15,876 kg/h (33,570–35,000 lb/h) (with reheat)
•Specific fuel consumption: 21–23 g/(kN·s) (0.74–0.81 lb/(lbf·h)) and 47–49 g/(kN·s) (1.66–1.73 lb/(lbf·h)) (with reheat)
•Thrust-to-weight ratio: 6.11:1 and 9.17:1 (with reheat)

Engine Oil System
The lubricating system is completely self-contained on the engine. The oil system, fully aerobatics, provides the necessary lubrication and cooling for the bearings and gears. It is regulated by the engine speed to match the oil delivery to the engine requirements.
The system contains an aerobatics oil tank, a pressure subsystem, a scavenge subsystem and a venting subsystem. Its main components are the aerobatics oil tank, the pressure pump, the scavenge pump, the gearbox and the fuel cooled oil cooler.

Engine Fuel Control System
Fuel is supplied to the main fuel metering unit (MFMU) for dry range operation, and to the reheat section when required.
Fuel is also used to cool the digital engine control unit (DECU) and the lubricating oil through the FCOC.

Digital Engine Control Unit
The Digital Electronic Control Unit (DECU) is fuel cooled and mounted on the LP compressor casing. Its main function is to control the engine according to demands from the throttle in reference to TAS, OAT, VIGV position, and nozzle area to ensure engine function within its operational limitations throughout the flight envelope.
During normal operation, signals from the aircraft systems plus speed, pressure and temperature signals from the engine are fed into the DECU. Here they are analysed, compared with limitations and demands, processed and used in the engine control system.

Engine Starting System
The engine starting system provides to ignite the engine and accelerate it to a point of self-sustained stable running.
Starting engines may be performed:
- on ground
- in flight

Engine starting on ground
Ground starting of the engine is achieved by means of SPS system or ground cart or by cross bleed when an engine is already running.
During ground starts, automatic monitoring of NH and TBT is carried out by the DECU and the start is terminated if certain criteria are not met.

Engine Starting In Flight
In case of engine unlit in-flight, an automatic restart is initiated by the DECU, without pilot actions and being throttle at IDLE or above.

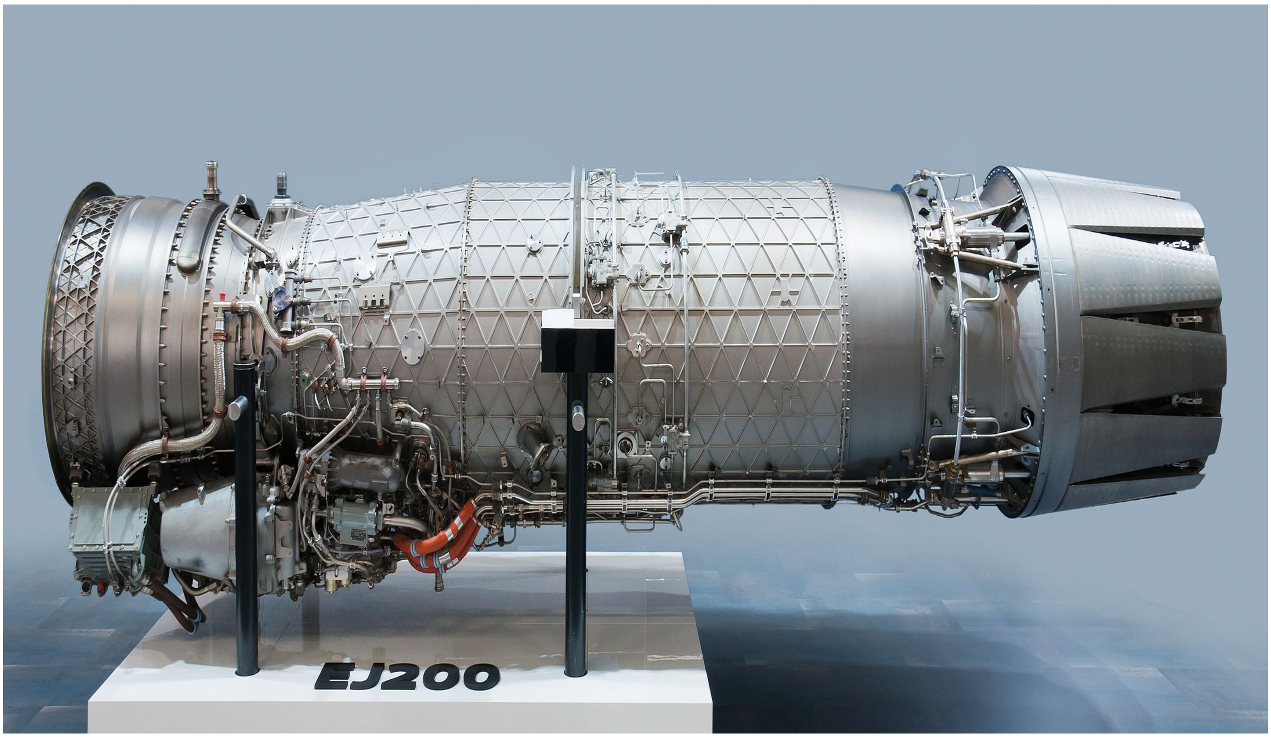
Engine Airflow Control System
A self-contained hydraulic system controls the air flow through the engine by modulating the High Pressure Compressor (HPC) Variable Inlet Guide Vane (VIGV's) and the convergent-divergent exhaust nozzle.

Engine Reheat System
The reheat system augments engine thrust by injecting fuel into the engine exhaust section. Selection of the reheat system is achieved by moving the throttle levers beyond the MAX DRY detent.
During reheat operation fuel is injected into both the hot gas exhaust stream and the by-pass stream. The

reheat system uses radial burners supplied via external fuel manifolds, and includes a multi-petal convergent-divergent nozzle capable of varying both the throat and exit areas.

Air Intake Cowls
Two air intake cowls, one on each engine intake are hinged at the lower lip of the air intake ducts. The left air intake cowl is powered through the left utility hydraulics circuit and controlled by flight control computers.

Intake cowl are normally operated automatically. If a failure of the automatic air intake cowls system is detected the air intake cowl(s) can be opened manually by holding the ENGINE INTAKE cowl control switch in the OPEN position.



Eurojet EJ200 side view (from Wikipedia)


Eurojet EJ200 on display (from Wikipedia)

ENGINE FORMAT

The engine status and controls are available in the dedicated ENG format on the right MHDD.

SECONDARY POWER SYSTEM

General

The purpose of the Secondary Power System (SPS) is to generate and use pneumatic power for engine starting and to provide hydraulic and electric power to aircraft systems during ground operation. The system also provides Built In Test (BIT) information to the SPS computers and UCS.

The main components of SPS are:

- An Auxiliary Power Unit and its Control Unit
- Two gearboxes
- Two Air turbine Starter Motors (ATS/M) and their respective control Valves
- Two SPS computers part of the Utilities Control System

Each gearbox drives a Constant Frequency Generator (CFG), a DC generator and a hydraulic pump.

The gearbox can be driven by its associated engine, or by its Air Turbine Starter/Motor. In the latter case, the necessary high pressure air can be provided either by the APU, by an external pneumatic source or by the other engine.

Main Engine Starting

The main procedures for on-ground engine starts are essentially the same whether using an external air source or the APU.

The engine is started by moving the throttle from the HP SHUT to the IDLE position. Automatic sequential starting (LH engine first) can also be performed by moving both throttles to IDLE.

Auxiliary Power Unit

The APU allows the aircraft to operate independently from ground facilities. It provides compressed air and electrical power used for engine starting and cockpit conditioning.

The APU operation can be divided into the following phases:
- starting
- steady-state
- shut-down.

APU Start

The starting procedure can be initiated placing the START/STOP switch, located on the right console, or the external start switch, present in the left wing root, provided that the BATT switch is set to ON.

APU Steady-state

At the end of the starting phase, the APU runs at its nominal speed. The APU caption and the peripheral box of the APU status indicator will be illuminated. The APU Control Unit automatically determines which operating mode is required between the following:

- Engine starting (APU is required to operate at full load)

- Gearbox motoring (APU is required to operate at a variable load)

– Stand-by (APU is required to operate a variable load depending on ECS request)

Failure Case Operation

The steady-state operation is interrupted and the shut down procedure initiated in case of abnormal conditions and/or when sensor failures are detected by the APUCU or if the APU run speed drops below 90% of the nominal value.

APU Shutdown

The shut-down procedure initiates when one of the following conditions occurs:
- APU switch is placed in the STOP position.
- the switch in the MDP bay is placed to STOP/INHIBIT by the ground crew
- the APU Control Unit receives a stop request signal when both engines are running or Weight On Wheels is not detected on wheels or the A/C speed is higher than 5 m/s or over-temperature/fire is detected in the APU bay, or an hot air leakage is detected.

APU Inhibition

The APU operation is inhibited by when one of the following conditions occurs:
- both engines are running
- SPS system failure (ATS/M overspeed)
- A/C speed higher than a 5 m/s
- A/C weight not detected on wheels.

In these conditions the APU shutdown sequence (if the APU is running) will be initiated and the START switch in the cockpit will be inhibited.

APU START/STOP Switch

This is a three-position toggle switch (START/neutral/STOP), spring-loaded to the centre (neutral) position.

- START Position: The APU Control Unit is cued to initiate the APU starting sequence.

- STOP Position: The APU Control Unit is cued to initiate the APU shutdown sequence

– Neutral Position: rest position – no effect on any previous selection.

AIR DRIVE Switch

This is a three-position toggle switch which is spring-loaded from the forward (EMGY) position to the centre (AUTO) position where it locks. It must be unlocked prior to selecting it forward or to the aft (OFF) position.

The positions and functions of the switch are:
- EMGY (Assisted Engine Relight)

- AUTO (Normal Ground/Flight position)
- OFF (Pneumatic drive not enabled).

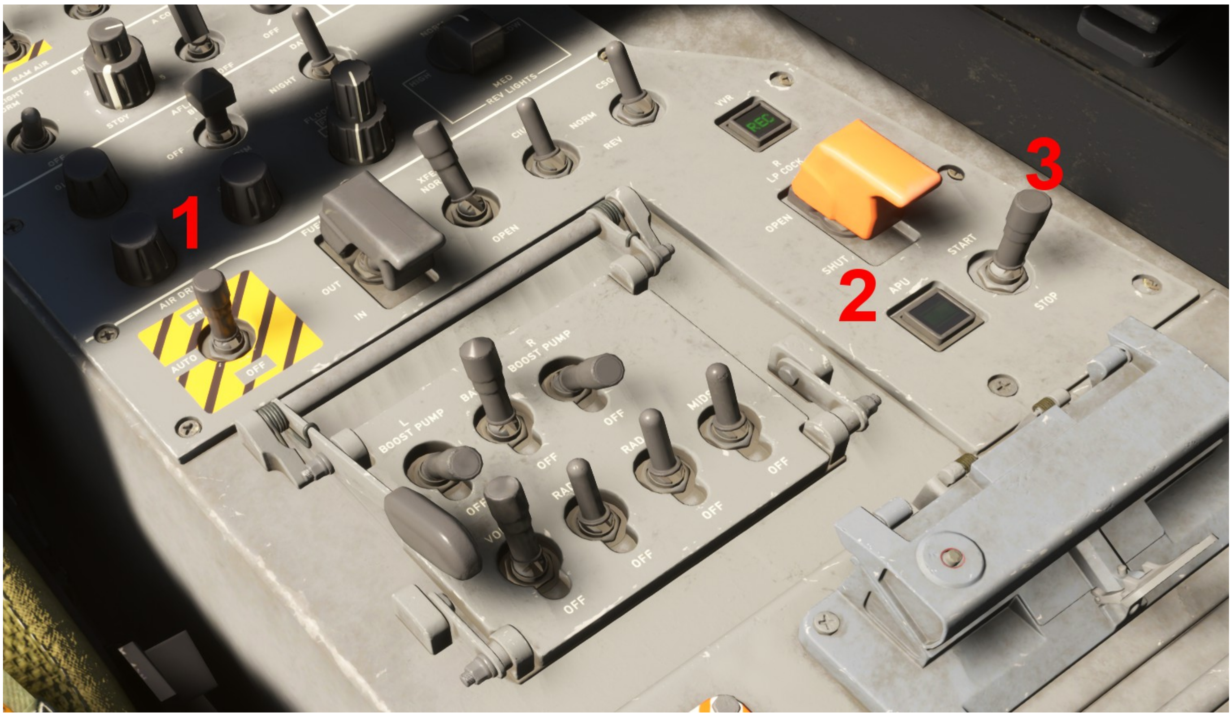
Left/Right Gearbox Air Drive Push-buttons (L/R GBOX)

Two momentary action push-buttons (L/R GBOX) are located on the left console.
They are enabled only when the AIR DRIVE switch is in the AUTO position.
Pushing either button provides pneumatic power from any active source to the appropriate ATS/M gearbox.
This can be used on the ground: for system checkout purposes (e.g. start / stop gearbox motoring).
Pushing the button a second time cancels the operation.

APU Status Indicator

APU status indications are provided as follows:

During APU starting phase (from generation of start input until 95% rpm is achieved), only the APU caption is lit.
As soon as 95% is exceeded and during steady state operation, both the APU caption and its box are lit.
As soon as the APU shut-down sequence is initiated, the APU caption is extinguished and only its box remains lit until the end of the APU shut-down sequence, when the APUCU also shuts down.



SPS CONTROLS: 1 – Air Drive Switch; 2 – APU Status Indicator; 3 – APU Start/Stop Switch

4 Left Gearbox Air Drive Push-button; 5 Right Gearbox Air Drive Push-button

ENGINE / APU FIRE PROTECTION SYSTEM

General

The engine / APU fire protection system consists of thermal detectors that provide overheat/fire detection in the engine bays and in the APU bay.
If triggered the detectors activate FIRE warnings on the DWP and ENG format, with associated voice warnings and the engine fire indicator/push-buttons illuminate.

Pressing the engine fire indicator/push-buttons causes the discharge of the fire extinguisher system.

Fire Detection System Controls and Indicators

The fire detection system controls and indicators consist of:
- engine fire warning
- APU fire warning
- voice warnings
- fire indicators / push buttons.

Engine Fire Warning

The following warning indications are displayed to indicate the Engines fire conditions:

L-FIRE: Fire or overheating in the left engine bay.

R-FIRE: Fire or overheating in the right engine bay.

APU Fire Warning

The APU fire detector signal is sent directly to the APU control unit, initiating automatic APU shutdown During the APU starting phase, if electrical power is

Fire Indicators / Push buttons

Two fire indicators / push buttons captioned “F” are provided, one on each side of the HUD control panel.

FIRE INDICATORS / PUSHBUTTONS

1 – LEFT ENGINE FIRE INDICATOR/PUSHBUTTON

2 – RIGHT ENGINE FIRE INDICATOR/PUSHBUTTON (Hidden by HUP)

FUEL SUPPLY SYSTEM

FUEL SYSTEM DESCRIPTION

The main functions of the fuel system are:
– to supply fuel to the engines
– to maintain the maximum fuel contents in the collector tanks
– to minimize Center of Gravity (CG) movement during flight.
– to provide oil cooling.
Fuel is carried internally in two fuselage tank groups,a forward transfer tank and four wing tanks.
Additionally, fuel can be carried externally in two under wing and one underfuselage jettisonable tanks.

The status of the fuel system is displayed and monitored on a dedicated FUEL format and can be controlled, when the fuel format is displayed, via dedicated soft keys.

Fuel system also provides Air-to-Air Refuelling (AAR) functionality support and fuel supply for the APU.

FUEL TANKS - DESCRIPTION

All fuel tanks are pressurized and contain fuel gauging and level sensing probes.
Fuel tanks are divided as follows:

Fuselage forward (usable fuel weight 1015 Kg)

Fuselage rear (usable fuel weight 920 Kg)

Forward Transfer Tank (1015 Kg)

Wing Forward Tanks (515 Kg x 2)

Wing Rear Tanks (475 Kg x 2)

Underwing External Tanks (760 Kg x 2)

Under-fuselage Tank (760 Kg)

NOTE

In this Flight Simulator Rendition, the fuel system is simulated in some detail and is implemented via a dedicated XML script acting upon as the “legacy” fuel system. Therefore fuel tanks are associated to legacy fuel tanks as follows:

Fuselage forward → LEFT MAIN

Fuselage rear → RIGHT MAIN

Forward Transfer Tank → LEFT AUX

Wing Forward Tanks (515 Kg x 2) → RIGHT AUX

Wing Rear Tanks (475 Kg x 2) → RIGHT TIP

Underwing External Tanks (760 Kg x 2) → EXTERNAL 1 (LEFT) AND EXTERNAL 2 (RIGHT)

Under-fuselage Tank (760 Kg) → CENTER

FUEL TRANSFER SYSTEM - DESCRIPTION

General

The function of aircraft fuel transfer system is to maintain symmetrical and balanced fuel distribution. It ensures that the maximum fuel content is maintained in the collector tanks in all flight conditions (except zero or negative g conditions in which a flapper valve maintains furl in the collector tanks).

The system is by and large automatic and during normal operation or even following a single failure, pilot intervention is unnecessary.

In any case, the pilot can control the fuel transfer sequence by manually overriding the automatic system via soft key selection on the FUEL format.

Automatic Transfer

The transfer process is normally fully automatic and transfers fuel to the fuselage tanks in the following order:

1) Underwing tanks (if installed).

2) Under-fuselage tank (if installed).

3) Forward transfer tank and left and right wing rear tanks (“Stage 1 Transfer”)

4) Left and right wing forward tanks (“Stage 2 Transfer.”)

Manual Transfer

In case of damage or failure, the pilot can override the automatic fuel transfer system via soft keys provided in the FUEL format.

Selective Transfer

XFER FWD / XFER REAR soft keys (selective transfer) can be used to correct imbalances in the fuselage groups.
Imbalances between transfer tanks, can be corrected by transferring fuel from the proper transfer stage (via the transfer override function); moving the fuel causing the imbalance.

Selective transfer and transfer override soft keys are disabled depending on aircraft CG position, in order to inhibit inadvertent selections that may lead to further imbalances.

Transfer Override

The automatic transfer sequence can be manually overridden by selecting a different stage via the transfer override soft key. Transfer sequence will start after 3 seconds from selection.
When the selected stage is complete, the system will revert to automatic transfer.

Tank Interconnect

Tank interconnect valve can be used to correct significant imbalances between forward and rear fuselage groups – manual selection is inhibited in certain manoeuvrers

Alternative Transfer
In the real plane, refuel shut-off valves can be commanded to act as transfer valve in case of failure.

NOTE

This is not simulated in this MSFS rendition.

FUEL PRESSURIZATION AND VENT SYSTEM

General description
All the fuel tanks are pressurized to assist fuel transfer and prevent fuel boiling at high temperature and altitude, except during AAR.

FUEL / OIL COOLING SYSTEM - DESCRIPTION

General description
The fuel/oil cooling system is designed to remove excess heat from certain aircraft subsystems by exchanging heat with the fuel, Heated fuel is then cooled through ram air.

ENGINE / APU FUEL SUPPLY SYSTEM

General description
The fuel for the APU is directly supplied from the forward fuselage group collector tank by gravity flow.

The engines have independent pressurized fuel supplies. The left engine is supplied by the two AC pumps located in the collector tank of the forward fuselage group and the right engine is supplied by the AC and the AC / DC pumps located in the collector tank of the rear fuselage group.

The boost pumps are controlled by the L and R BOOST PUMP switches.

From the collector tanks, fuel flows to each engine through its respective LP cock which is controlled by the applicable LP COCK switch.
The cross-feed valve, controlled by the XFEED NORMAL / OPEN switch, allows the engine fuel feed-lines to be connected.

AIR-TO-AIR REFUELING - DESCRIPTION

General
An extendible probe located in the right side of the front fuselage enables the aircraft to carry out AAR. The probe is housed in a sealed compartment and incorporates a nozzle and weak link designed to fracture on application of excessive radial loads. The probe is extended and retracted hydraulically. Selection of the FUEL format enables the status of the entire fuel system to be monitored during the refueling procedure.

Operation
Setting the FUEL PROBE switch to OUT extends and locks the probe. The extension / retraction sequence takes between 5 and 20 seconds and, is completed when the probe door closes. If the probe extension / retraction exceeds 20 seconds a Cat 3 "Amber" IFR warning caption is generated; the warning clears if the door closes.

With the FUEL PROBE switch selected to OUT the fuel system is depressurized and the normal fuel transfer sequence inhibited. As automatic transfer is suspended, fuel to the engines is taken from the fuselage groups only.

When the fuel probe is extended and locked, the AAR ready prompt (RDY) is displayed on the FUEL format and the refueling soft keys are made available. The REFU STRT soft key is highlighted by default and indicates readiness for refueling.

It is not necessary to select the REFU / STRT soft key before fuel can be taken on-board; when contact is established with the drogue of the tanker aircraft, the refueling procedure is automatically initiated.

The required refueling sequence can be selected at any time, before or during contact, using the REFU TOT / INT / SIM soft key.

The FUEL format must be monitored during AAR. Blue lines indicate normal fuel flow; amber lines indicate valve failure. Refuel must not be initiated or continued if an amber line is displayed between the fuselage groups.

FUEL SYSTEM - CONTROLS AND INDICATORS

General
After initial switch setting during the pre-flight checks, operation of the fuel system is controlled by the two fuel computers. Manual intervention is only required during Air to Air Refuelling (AAR) or in the event of certain aircraft malfunctions.

Control and monitoring of the fuel system is achieved by a combination of the following:
– Dedicated switches and indicators, including Get-U-Home (GUH) indicators.
– Multifunction Head-down Display (MHDD) and controls.
– Head-up Display (HUD).
– Dedicated Warning Panel (DWP).

Boost Pump Switches
Two lock-toggle switches on the battery gang bar, labelled L BOOST PUMP and R BOOST PUMP, control the operation of the boost pumps in the fuselage fuel groups.

Cross-feed Switch

A two-position, lock-toggle switch (lockable in both positions), located on the right console, labelled

XFEED - NORMAL / OPEN, controls the operation of the cross-feed valve. When selected to the

XFEED - NORMAL position, the valve is closed.

LP Cock Switches

Two cover-guarded switches, one on the left console, labelled L LP COCK, and one on the right console, labelled R LP COCK, control the operation of the Low Pressure (LP) cocks and the engine igniter circuits. The switches are guarded in the OPEN (forward) position but when set to SHUT the associated LP cock is closed and the igniter circuit for that engine is inhibited.

Fuel Probe Switch

A cover-guarded, two-position switch, labelled FUEL PROBE - IN / OUT, controls the extension and retraction of the fuel probe. The switch is guarded in the IN (rear) position.

HUD Control Panel

Three digital indicators on the HUDCP, labelled FWD, REAR and TOTAL, indicate the content of the forward, rear fuselage fuel groups and the total fuel contents in kg. They are referred to as GUH fuel contents indicators and are hardwired from the fuel computers. The left fuel computer supplies the rear fuselage group contents indicator, the right fuel computer supplies the forward fuselage group contents indicator.

FUEL FORMAT

The fuel system status and controls are available in the dedicated FUE format on the right MHDD.

ELECTRICAL POWER SUPPLY SYSTEM

General description

The Electrical Power Generation System (EPGS), provides AC and DC power supply to the aircraft. Electrical power is distributed under the control of two Constant Frequency Generator Control Units (CFGCU), via busbars and circuit breakers.

Internal Power Generation System

During normal system operation the EPGS operates as two independent and separate channels which consist of:

- Two Constant Frequency Generators (CFG) providing 115/200Vrms, 400Hz, 3 phase, 4-wire AC supply

- Two Transformer Rectifier Units (TRU) providing primary 28V DC power

- Two DC gearbox-driven generators providing reversionary DC power in case of TRU failure

- A 25Ah battery to provide power for APU start, limited ground use and emergency in-flight power.

- An APU generator providing a limited AC supply to both AC channels (ground only)

- A DC-DC converter, used to maintain a constant electrical power supply to some aircraft systems during battery supported APU starting.

External Power Supply

An external 3 phase AC power supply can be connected to the aircraft for use during ground servicing and preparation for flight.

Electrical Power System Controls and Indicators

Introduction

The controls and indicators associated with the electrical system are as follows:

- Battery master switch
- Dedicated Warning Panel (DWP)
- Generator Reset Controls
- Attention getters
- APU START/STOP switch
- APU status indicator

Battery Master Switch

The Battery Master Switch is a two-position toggle switch, labelled BATT / OFF, lockable to the BATT position. The switch forms part of the battery gang-bar on the right console.

Generator Reset Controls

The generator reset controls are two-position toggle switches, labelled L GEN - OFF / RSET and R GEN - OFF / RSET and are part of the systems gang-bar on the right console.

When selected to the forward position, these controls enable each generator to go on-line, provided that it passes an automatic check.

If a generator fails in flight, moving the control to the OFF / RSET position and then back to the L / R GEN position, forces a reset of the software.

APU START/STOP Switch and Status Indicator

The APU start switch is a three position, momentary action, centre biased toggle switch labelled START/ STOP. It is used to initiate the APU start or shut down sequence. The APU status indicator provides an indication of APU availability/operation.

See Secondary Power System chapter for more details.

ELECTRICAL POWER SUPPLY SYSTEM CONTROLS (right consoles)

1 – BATTERY MASTER switch

2 – LGEN – OFF/RSET switch

3 – RGEN – OFF/RSET switch

4 - APU Start/Stop switch

5 – APU Status Indicator.

HYDRAULIC POWER SUPPLY SYSTEM

General Description

Two independent hydraulic systems provide power to the primary and secondary control actuators and to the utility subsystems.
Both the left and the right hydraulic systems are supplied from a separate reservoir each pressurized by a hydraulic pump, driven by the accessory gearbox mounted on each engine.

Each hydraulic system is divided into a Flight Control Pressure circuit and a Utility Pressure circuit.

The left and the right hydraulic system supply hydraulic pressure to the primary flight control circuit comprising foreplanes, flaperons and the rudder. Each of the foreplanes, flaperons and the rudder has two independent sources of hydraulic pressure and one system function also as a back up for the other. The reduction of redundancy will however significantly reduce the manoeuvrer capability.

The left and the right utility systems supply hydraulic pressure to the SLATS, while all other secondary flight controls or hydraulic dependent functions, such as the airbrake, the nose-wheel steering or the intake cowls are powered by either the left or the right utility circuit.

Redundancy is provided for the landing gear, the wheel brakes and the IFR probe. In the case of a failure of the relevant primary system, the landing gear, the wheel brakes and the IFR probe are powered by the opposite system. Depending on system and the specific failure case automatic switch over to the opposite system is achieved, or the pilot is able to select the opposite system via dedicated cockpit switches.

HYDRAULIC SYSTEM FORMAT

The hydraulic control system status and controls are available in the dedicated HYD format on the right MHDD.

LANDING GEAR SYSTEM

General

The landing gear system is divided into the following subsystems:

- Landing gear functional system (extension and retraction system, sequencing and indication system, struts, tires, wheels and landing gear computer).
- Steering control system
- Brake control system
- Brake chute system
- Arrestor Hook System.

The landing gear (LDG) is a tricycle type, with one nose gear and two wing mounted main gears. The main landing gear (MLG) and the nose landing gear (NLG) consist of telescopic, oleo-pneumatic, two stage shock struts, each having a single wheel. The main wheels are equipped with a brake assembly. The activation part of the nose-wheel steering system is integrated in the nose gear leg.

Normal extension and retraction of the landing gear is electrically controlled and hydraulically operated by the left utility hydraulic system. If the left utility hydraulic system fails, emergency lowering of the landing gear is hydraulically operated by the right utility hydraulic system in connection with a set of restrictors inside the MLG and NLG uplocks. The changeover from the left to the right utility hydraulic system (emergency) is induced by a pilot selectable hardwired cockpit control.

Nose and main landing gear bays are closed and locked by hydraulic operated doors. Down locks, uplocks, door locks and struts are equipped with proximity sensors which are linked to the landing gear computer (LGC).
The nose-wheel steering is electrically controlled and hydraulically operated by FCS command via the flight control computers (FCCs).

The brake system has duplex hydraulic supply with integrated skid control systems in both, normal and emergency modes. An independent park brake system, hydraulically operated by electrical selection and an additional cooling fan are part of the system. Indications/information of systems status and warnings are provided via HUD, MHDD, DWP and by audio voice warning.

Landing Gear Emergency System

The emergency lowering system is supplied by the right utility hydraulic system and is independent of the normal operation. In the case of left HYD or UTILS system failure automatic changeover to the right HYD/UTILS system will occur.
The changeover from the left to the right utility system may also be initiated via a cockpit selectable emergency gear control switch (EMGY GEAR). When the switch is selected to the DOWN position, irrespective of the position of the LG selector lever, pressure is routed to the combined gear and door selector valve which is hardwired to the emergency gear control switch in the cockpit, thus bypassing the landing gear computer (LGC). Monitoring of the hardwired circuit for switch position and failure indication via the LGC is still available.

Wheel Brake System

Wheel Brake

Each main landing gear wheel is equipped with an electronically controlled and hydraulically operated carbon brake.
Brake pressure is supplied by the left utility hydraulic system for normal operation and by the right utility hydraulic system for back-up (emergency) operation.
The changeover from the left to the right utility hydraulic system is either achieved by manual selection of a cockpit controlled two position switch, or automatically, in case of left system failure (detected by CBIT or IBIT).
An anti-skid control system is integrated in both the normal and the emergency wheel brake systems.
An electrical integrated cooling fan, which is operated by wheel speed, brake pressure and WOW inputs, is also controlled by the landing gear computer (LGC) and keeps wheel brake temperatures low.
Pilot demanded brake pedal pressure is controlled independently by the left and right brake pedal transducers.

Park Brake

A park brake, electrically selected via a cockpit switch and hydraulically operated by the left hydraulic system, operates to both wheel brakes. With ON selected and aircraft weight on wheels, Max pressure (280 bar) to the left and right wheel brakes are applied.
The park brake accumulator for brake operation is charged with nitrogen and the pressure (70 bar) is indicated on the MDP. A hand pump for charging both, canopy and parking brake accumulators is provided for the left hydraulic system.

Anti Skid System

The aircraft wheel brake system is equipped with an electronically controlled and electro-hydraulically operated anti-skid system. The system is part of the brake and anti-skid control equipment comprising the landing gear computer (LGC) with inputs from wheel speed transducers, pedal transducers, brake and anti-skid manifolds, servo and shut off valves.
The system is designed to give individual wheel skid control operation.
The system provides the following functions in both modes (normal and emergency) of operation:

– Touchdown protection
– Brake and anti-skid proportional control
– Locked wheel protection
– Failure detection

Landing Gear Selector Lever
The landing gear (LDG) selector lever is on the left quarter panel and comprises a straight control shaft, which incorporates an integral uplock sleeve control and a circular handle, incorporating two red indicators for gear and door unsafe conditions.

The function of the gear selector lever when positioned to UP or DOWN (marked on the panel surface), is as follows:

– Position from DOWN to UP:

• In flight, upwards rotation of the selector lever will select the UP position. This will initiate the LDG retraction sequence, unless RSET has not been selected subsequent to an emergency DOWN selection via the Emergency Gear Control.

• Physical movement of the selector lever from the DOWN position to the UP position is prevented with aircraft weight on wheels.

• Upon selection to UP, two red indicators will be illuminated to indicate the unlocking of the LDG doors and legs, and the three greens will extinguish.

• With UP selected, operation of the landing and taxi lights are inhibited, irrespective of the selected position of the Landing/Taxi Light Control.

– Position from UP to DOWN:

• When unlocked, downward rotation of the selector lever will select the DOWN position and will initiate the extension sequence.

• Upon selection of the DOWN position, two red indicators will be illuminated to indicate the unlocking of the LDG doors and legs.
These indications are integral to the selector lever handle and will remain until all doors and legs are locked down. Doors and legs locked down are indicated by the green indicators illuminating and the three Ds in the HUD.

• With DOWN selected, operation of the landing and taxi lights is available under the control of the Landing/Taxi Light Control.

Emergency Gear Control
The emergency gear (EMGY GEAR) cover-guarded, three position toggle switch is located on the forward left hand console. The three positions are labelled RSET, NORM, DOWN, marked on the panel surface.

NOTE

In this simulation simulation only the DOWN position is functional, and will command the emergency deployment of the landing gear. Once the landing gear is deployed in emergency mode, it cannot be retracted.

Landing Gear Display
System indications are given on a dedicated position indicator on the Left Quarter Panel (LQP) and on the HUD.

Landing Gear Status Display
Three identical green circular displays are arranged on the left hand quarter panel above the LDG selector lever. Upon selection of the LDG lever to the DOWN position and/or selection of the EMGY GEAR control to the DOWN position, the left display element will be illuminated as the left main gear attains the down and locked position. Similarly, as the nose gear and right gear are locked down, the centre and right indicators are illuminated respectively.

While the landing gear is in transit, the two red displays in the LDG selector lever indicate unlocking or transit of the gear doors and legs or gear(s) and/or door(s) not locked.

Head up Display
Individual indications for each landing gear leg, whether it is locked up (UP), locked down (D) or travelling (X) and LDG doors are not locked, are displayed on the right bottom of the HUD-PDU.

Symbols are displayed for 5 seconds after wheels are UP and locked and doors locked.

The format is as follows:

UP	UP	UP
-X-	-X-	-X
D	D	D

– UP indicates respective gear uplocked and door closed.

– The bar indicates respective gear leg or door position unsafe.

– A X breaks the bar as long as the gear legs/doors are in transit.

– D indicates respective door fully open and gear downlocked.

The landing gear HUD display is occulted 10 sec. after weight is off the nose-wheel

Brake and Anti Skid Control

Cockpit control of either brake system is provided by a two position, bi-stable toggle switch, labelled EMGY BRK, NORM-REV on the left hand quarter panel.

- With NORM selected, the brakes operate on the left hydraulic system as long as no failure condition is detected. If the left system fails (detected by CBIT or IBIT) the LGC automatically selects the right utility hydraulic system. Anti-skid protection is available.

- With REV selected, the brakes operate on the right utility hydraulic system (emergency brake system). Anti-skid protection is available.

Park Brake System
A PARK BRK OFF-ON toggle switch (Front Cockpit only) when set to ON selects the parking brake provided weight is on wheels. The parking brake is independent of anti-skid function. With OFF selected, both brakes are released.
If the PRK BRK is selected to ON and advancing either throttle to beyond appr. 60% NL, or when selected ON during the approach/landing phase (landing gear DOWN) a CAT 1 warning is initiated. The MHDD/ACUE displays a prompt <PARK BRAKE> for the pilot to select the park brake to “ON”. The indication is occulted when the park brake is set to “ON”, or when park brake is selected to “OFF” after engine start.

LANDING GEAR CONTROLS (Left quarter panel)

1 – GEAR SELECTOR LEVER

2 – GEAR STATUS DISPLAY LIGHTS

PARKING BRAKE CONTROL (Left console)

1 – PARK BRAKE TOGGLE SWITCH

HEAD UP DISPLAY LANDING GEAR INDICATIONS

1 – GEAR STATUS INDICATION (gear down and locked in the example)

ARRESTER HOOK SYSTEM

Arrester Hook System
The arrester hook system can be used to decelerate the aircraft to a stop by engaging an arrester cable in a rejected takeoff or emergency landing situation.

The arrester hook system consists of a shock absorber, an arrester hook uplock and release unit, and the hook with its arm. The arrester hook is electrically controlled. It extends by gravity and an oleopneumatic shock absorber, and is retracted manually by the ground crew.

The arrester hook release pushbutton controls the extension of the arrester hook. When the pushbutton is pressed, electrical power is applied to the uplock unit to release the arrester hook. The arrester hook assembly is forced down by the combined action of the shock absorber force and the hook weight.

Arrester Hook Release Push-button/Indicator
The illuminated pushbutton, labelled HOOK, is located below the left MHDD and is protected by a concentric raised guard. The guard is black and yellow striped.
When the pushbutton is pressed, electrical power is applied to the uplock unit to release the arrester hook. The pushbutton is always illuminated when the arrester hook is not stowed and locked.

1 - ARRESTER HOOK CONTROL

ARRESTER HOOK

BRAKE CHUTE SYSTEM

Brake Chute System

The brake chute system provides additional aircraft deceleration to that provided by the wheel brakes, reducing the landing roll and decreasing tyre and brake wear.
The brake chute system consists of a main chute and a drogue chute packed in a fabric bag and stowed in a compartment in the aft fuselage at the base of the rudder (between the two end turbine nozzles). The compartment is equipped with a door, spring-loaded to the open position.

The drogue chute is spring loaded to assist its deployment into the airstream. It is released by opening the door through the action of a two-position handle in the cockpit.

A riser with a strop fitting connects the brake chute to the brake chute lock and release unit on the aircraft. The brake chute lock and release unit holds the chute strop fitting safely in position during flight by means of twin spring loaded jaws independent of the main lock jaws. The latter are normally in the open position. In case of inadvertent chute deployment (by an action other than movement of the brake chute handle) the twin spring loaded jaws are not able to withstand the loads caused by the parachute, and the chute strop fitting is released with no structural damage to the aircraft.

A break link is provided in the brake chute linkage, to protect the fuselage structure from excessive loads imposed by brake chute deployment at high speeds.

Brake Chute Handle

The brake chute handle, located outboard of the left glareshield, controls the operation of the brake chute. On pulling the handle, electrical power is supplied to the brake chute lock and release unit in order to close and lock the main lock jaws and to open the chute door.

To prevent inadvertent operation, the handle is equipped with a locking device that locks the handle in both positions. The locking device is operated by a locking lever, which unlocks the handle when is pulled. The both sides of the lever must be pulled at the same time in order to unlock the brake chute handle.

1 – BRAKE CHUTE HANDLE

FLIGHT CONTROL SYSTEM

General
The EF-2000 Flight Control System (FCS) is a quadruplex digital fly-by-wire system, designed to provide excellent handling characteristics throughout the flight envelope and to allow Carefree Handling without risk of departure or overstress.

The aircraft is a highly unstable delta wing configuration, allowing for good agility in subsonic flight, and good turning performance in the supersonic flight. The FCS controls the inherent instability and provides the pilot with conventional responses to demands, making the EF2000 is an extremely pleasant aircraft to fly, highly resistant to departure whilst maintaining a high degree of agility.

The system has no provisions for reversion to mechanical controls.

Handling Overview
The FCS provides good aircraft handling characteristics throughout the cleared flight envelope. The FCS limits aircraft response to ensure loads are maintained within structural limits irrespective of external stores configuration, internal fuel distribution and prevailing flight conditions.
The FCS also limits AOA and side-slip ensuring that the aircraft has no potential for departure.

NOTE

In this Microsoft Flight Simulator rendition, FCS is implemented using the built-in fly-by-wire logic. As result, the aircraft appears very easy to fly, as it is in reality, but handling is not totally carefree like in the real plane. Specifically, departures from controlled flight many happen at low speed and extreme angle-of -attack and during extremely aggressive manoeuvring at low speed.

It is also possible to experience an abrupt change in flight controls effectiveness when transitioning from ground to airborne and vice versa.

System Moding

Ground
The ground mode includes takeoff run until lift-off, landing roll with lift reduction and taxi.
In ground mode the pilot has direct link to foreplanes and flaperons (via control stick), rudder and nose wheel steering (via rudder pedals).
On the ground, control surface movement is reduced to prevent unnecessary activity as consequence of sensor feedback.

Airborne
After transition to the airborne mode, manoeuvrer demand control law is active.

Lift Dump
The LIFT/DUMP function reverses the direction of the lift force which generates increased drag and extra load on the main wheels to aid braking performance during landing roll. In this mode, the flaperons trailing edges are moved upwards and the foreplanes are flaperons upwards and foreplanes leading edges are moved downwards.

The LIFT/DUMP function is fully automatic with no requirement for a dedicated command by the pilot

During low speed taxi, Lift Dump is automatically not engaged to ensure that no foreplane reflection of the landing lights occur.

At engine shut down Lift Dump is engaged (DUMP) to ensure that the foreplanes are parked in a position that does not interfere with the ladder.
Lift Dump is engaged:

- with both throttles at idle, a/c above taxi speed and NW on the ground, or

- at engine shut down (to assist actuator parking).

During automatic Lift Dump, pilots stick input commands are still active and will override the flaperons deflections.

Lift Dump is not engaged and TOT is automatically set:

- with at least one throttle above idle, or

- a/c at taxi speed (below 20 kts GS), or

- NW off the ground, or

- a/c mass above landing gear limit.

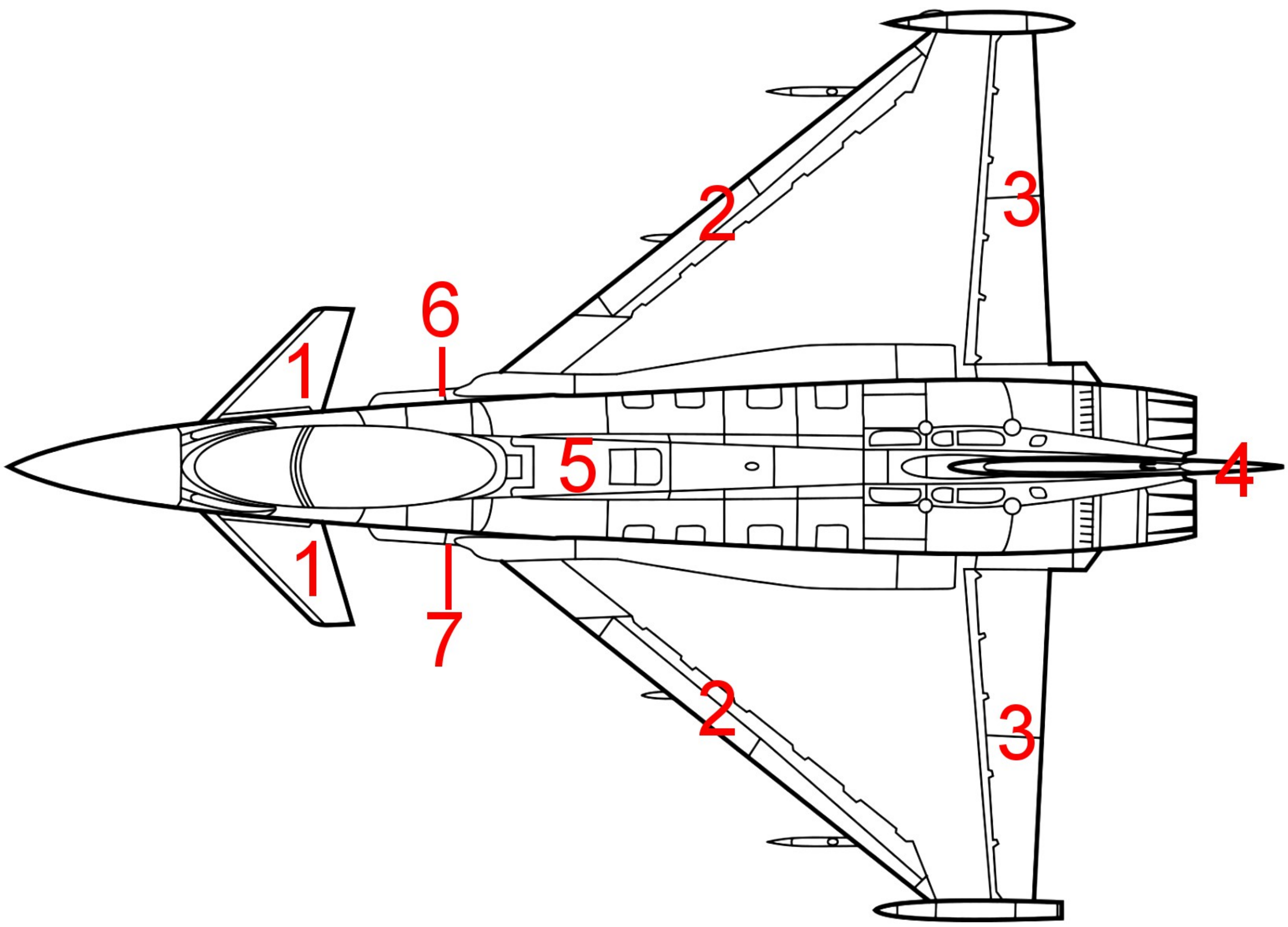
The LIFT/DUMP schedule is as follows:

- Pre-set of -25 deg foreplane and an increasing negative flap deflection as airspeed reduces.

- An additional super imposed airspeed/deceleration scheduled negative flap deflection to a level where flap induced pitch up is balanced by the pitch down provided by brake torque.

- Foreplane rotated from -25 deg to -60 deg below 90 KDAS (max drag).

There is no indication to the pilot as to whether the DUMP mode is engaged other than the control surfaces.



PRIMARY AND SECONDARY CONTROL SURFACES

1 – Symmetric Foreplanes (pitch control)

2 – Leading Edge Slats (high AoA Stability)

3 – Trailing Edge Flaperons (pitch and roll control)

4 – Rudder (yaw control)

5 – Spine speedbrake

6 – Nose Wheel Steering (not shown in the image above)

7 – Engine intakes varicowls (not shown in the image above)

CONTROL SURFACES

Foreplanes
Two identical all moving foreplanes - also known as canards - are located left and right side of the forward fuselage and are part of the primary flight control surfaces. In-flight, symmetric operation of the foreplanes and flaperons is used to provide pitch control. Max control surface deflection is:
60 deg leading edge down and 20 deg leading edge up.

Electrical failures (first and second) will have no effect on aircraft handling. A failure of one hydraulic system will lead to reduced hinge moment capability.

Flaperons
Two pairs of inboard and outboard flaperons fitted to the trailing edge of the wings are part of the primary flight control surfaces.
Pitch control is provided by the symmetric operation of the foreplanes and the four flaperons, while roll control is achieved by differential movement of the flaperons. They are scheduled automatically according to the stored control law functions to satisfy all flight conditions, e.g. approach and landing, slow flight, high speed etc. thus providing together with the other primary control surfaces the necessary stability of the aircraft.
Control surface movement of the inboard and outboard flaperons is 20 deg trailing edge up and 30 deg trailing edge down.

Rudder
The rudder is controlled through the Flight Control Computer which receive pilots commands from the pedal sensor unit (PSU) .
Since augmentation of aircraft lateral stability is required, including flight envelope regions where the lateral axis is aerodynamically unstable, the control laws stabilize the aircraft via sensor feedback signals.

The rudder pedals are also used to generate brake and nose wheel steering signals.

The maximum control rudder movement is 30 degrees left and right. Failure of one hydraulic system will lead to a reduced hinge moment.

Leading Edge System
The leading edge system is part of the secondary control surfaces and comprises one inner and one outer slat on each half of the wing running on tracks. It The slats are operating synchronously between 0 deg (UP) and -19.5 deg (DOWN).

Airbrake
The airbrake is installed on the upper surface of the fuselage just behind the cockpit. It is electrically controlled and hydraulically operated by the right utilities hydraulic system.

The airbrake is controlled via a three position sprung to centre selector mounted on the throttle top.

When selected to out, the airbrake position is indicated in the HUD by a green symbol above the aircraft symbol. It is steady when airbrake is deployed and will occult when the airbrake is fully retracted in.

In addition to the pilot input, the actual position of the air brake is affected by air data, angle-of-attack, measured, predicted and derived load factor and the airbrake activation signal.
The scheduling provides protection for speeds or load factors in excess of the A/B out schedule, but it also automatically retracts the airbrake if the nominal flight envelope limits are exceeded.

For the LDG DOWN AOA is the only input to the authority schedule. With the LDG in the DOWN position the airbrake is allowed to stay out to a higher command compared to normal low speed flight with LDG UP.

FLIGHT RESIDENT SOFTWARE

The Flight Resident Software (FRS) is the normal flight control software for aircraft operation. During aircraft power-up, FRS takes control of the FCS ONLY after the at least the Pre-flight check has been completed, hydraulic power is available AND pilot has pressed the FCS RESET button.

Upon entering FRS, the flight control surfaces will set to their datum position.

NOTE

In this Microsoft Flight Simulator rendition, regardless if the FRS has been correctly entered, the flight control surfaces will still zeroize and move correctly if the aircraft is in the air or the speed is above 10 knots. While technically incorrect, this is done on purpose to support animations in multiplayer.

FLIGHT CONTROL SYSTEM BUILT-IN-TEST

General description
The FCS incorporates extensive Built In Test (BIT) facilities to accomplish failure detection and failure isolation.

The FCS BIT includes:

- Initiated Built-In-Test (IBIT) to detect failures on ground and during pre-flight checks

- Continuous Built-In-Test (CBIT) to detect failures during flight

Status indications for the FCS IBIT are displayed on the ACUE format, on the FCS TEST button and on the FCS RSET button.

Initiated Bit (IBIT)
The on ground FCS checks are performed by the IBIT function.

The IBIT is divided into three operational levels:

- Pre-Flight Check (PFC)

- Actuator Movement Check (AMC)

- First Line Check (FLC)

Pre-Flight Check (PFC)
The PFC will run automatically when the a/c is powered up (BATT on), or can be re-run by the pilot (Repeat PFC) provided the engines are not running yet and a previous PFC failure has been detected.

Status indications are displayed on the ACUE format.

Actuator Movement Check (AMC)
After the successful completion of the PFC, the AMC can be initiated by pressing the FCS TEST button, provided hydraulic power is available. The AMC involves the physical movement of all primary and secondary actuators, except the NWS.

Entry into AMC is inhibited when the FCS has entered Fight Resident Software (FRS).

First Line Check (FLC)

The FLC will perform more comprehensive tests of the equipment and provides the facility upload mass and harmonization data.

NOTE

FLC is not simulated in this Microsoft Flight Simulator rendition.

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In Flight Continuous Bit (CBIT)
The CBIT function will be performed automatically and continuously whenever the FCS in flight software is active. FCS related failures will be indicated on the DWP.

FCS Status Indications

FCS RSET Button
Following successful completion of PFC or ACT respectively, entering FRS is only possible from the front cockpit by pressing the FCS RSET button. Simultaneously NWS and TOT are engaged and indicated in both cockpits.

Operation of the FCS RSET button causes the FCS to enter flight resident software (FRS), to engage the NWS and to set the takeoff trim (TOT). This is indicated by a low flashing (0.5 Hz) of the NWS, provided LINS is set to NAV mode, and T/O legend steady lit. The control surfaces are normally set to their datum trim position. The NWS will engage if the nose-wheel is within 46.8 deg of the centred position, which represents actuator limit.

Nose wheel **Steering (NWS)**
This process initiates and executes the moding to engage and disengage the NWS. The moding comprises basically two main modes, namely:
- NWS Pre-Take Off/Landing, and
- NWS Airborne/Approach.

The NWS provides a low speed mode (+/- 43) from 0 speed up to 30 kts, a medium speed mode (+/- 28) from 30 kts to 60 kt and a high speed mode (+/- 10) above 60 kts.

When on the ground, if NWS is engaged the NWS caption flashes when the NWS is engaged and is low speed mode, and is steady when the NWS is at medium or high speed mode.

When airborne, i.e. no weight on nose-wheel, the NWS will be disengaged and the NWS legend extinguishes. On landing, with weight on the nose-wheel the NWS legend will be lit again.

Operation of the ICO on the ground causes the NWS to disengage, the NWS legend to flash, and the DWP NWS warning is raised. Pressing the FCS RSET button will reset the NWS legend, reset the NWS warning and re-engage NWS.

In the case of a NWS failure the NWS will fade to zero by mechanical means and control law demand.

NOTE

Free caster mode is not supported in the simulation. Also, in the simulation, the default NWS blending features are used so that actual NWS angles and gain may slightly differ from the ones of the real plane.

Takeoff Trim (TOT)
This process provides the moding necessary to:

– Provide visual indication of the trim offset status on the ground,

– Allow to reset all trim offsets via the FCS RSET button on the ground,

– Automatic reset of all trim offsets if at least one throttle is advanced above IDLE on the ground.

Weight off the Nose wheel
With weight off the nose-wheel the TOT legend is extinguished. Pressing the FCS RSET button will have no affect on trim.

Weight on Nose wheel (WONW)
Upon entering FRS or when in FRS and either throttle is advanced above IDLE the control surfaces

are set to the TOT position, indicated by the TOT legend steady lit. The NWS will engage. Manual trim inputs are ignored as long as at least one throttle is out of the idle position.

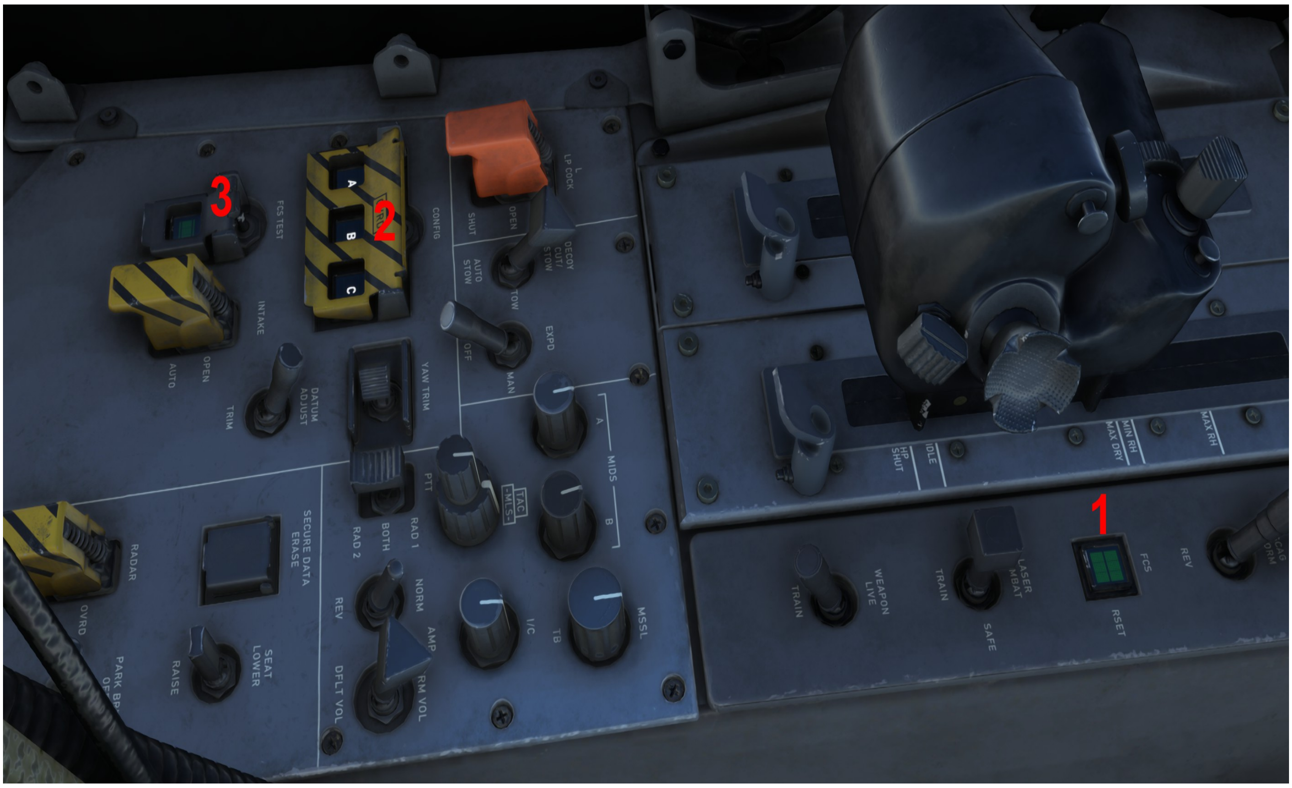
With both throttles at idle pressing the TOT button will reset the trims, if applicable, to the TOT position.

The TOT position (Take Off Trim) can be manually offset in pitch, roll and yaw causing the T/O legend to flash if the trim offsets are > 0.25 deg of the TOT position. A reset to the datum (T/O steady lit) position is achieved either by:

– Pressing the FCS RSET, or

– Advancing at least one throttle out of the IDLE position.

– Manually re-trimming of all axis to within the TOT threshold of +/- 25.



FLIGHT CONTROL SYSTEM CONTROLS AND INDICATORS

1 – FCS RESET PUSH-BUTTON / INDICATOR

2 - CONFIG OVERRIDE CONTROL (not used in this simulation)

3 – FCS TEST PUSH-BUTTON / INDICATOR

DISORIENTATION RECOVERY FUNCTION (DRF)

Disorientation Recovery Function – General Description

The disorientation recovery function (DRF) is part of the flight control system (FCS) and provides the pilot with automatic attitude and speed recovery in case of spatial disorientation and manual recovery cannot be performed.

If activated, the aircraft is recovered to normal flight from any given attitude, airspeed, and altitude in the minimum time possible, and with minimum loss of altitude.

NOTE:

In the real plane the system is designed to command different manoeuvrers depending on aircraft attitude and speed, trying to minimize the loss of altitude. In the simulation, the recovery strategy is much simplified and will try and first level the wings, and then bring the pitch to +/3°

Controls and Indicators

Disorientation Recovery Function Control

The DRF is engaged by pressing the DRF control push-button, which is located on the pedestal panel

NOTE
With the landing gear handle in the DOWN position the DRF is inhibited.

Instinctive Cut Out

If the ICO is operated during DRF, the DRF function is cancelled.

Throttles

During DRF, the thrust is controlled by the AT and it is not possible to override the AT and resume manual throttle control.

Disorientation Recovery Function Warnings and Displays

As soon as the DRF is engaged:

- The CAT 4 "Auto recover" routine voice warning is generated and played twice.

- 'AUTO RECOVERY' is displayed in the HUD

- The PA format changes to the DRF format

- The AP- and AT-engaged indicators on the LGS are illuminated.

After completion of the recovery, the cockpit displays revert to the setup prior to DRF selection.

DISORIENTATION RECOVERY CONTROLS AND DISPLAYS

1 – DRF control push-button

2 – CMHDD DRF format

AUTOMATIC LOW SPEED RECOVERY

Automatic Low Speed Recovery General Description

The automatic low speed recovery (ALSR) is part of the flight control system (FCS) and provides automatic envelope protection at very low speeds to prevent departures from controlled flight. Depending on multiple parameter, such as airspeed, flight path, angle-of-attack, weight and attitude, a high priority voice warning “Speed low recover” is triggered. If the pilot does not take action to recover the slow speed condition in 3 seconds, and if the system detects further deceleration, the ALSR system takes over and brings the plane to a safe speed and attitude, by performing the following actions:

– "Speed low recover” voice message stops

– a low priority voice warning “FCS override” is played and displays 'FCS OVERRIDE' on the HUD.
– changes the PA format to the DRF format.

– ignores all manual control inputs including instinctive cut out.

– increases the thrust to MAX DRY, if the throttle setting was less than MAX DRY at the time of ALSR engagement. Reheat has to be selected manually if desired and if the throttles were already in reheat at the time of ALSR engagement, the current throttle setting will be maintained.
Throttle cannot be moved to any setting lower than than MAX DRY during ALSR engagement

– initiates the respective recovery manoeuvrer as determined by the flight parameters at time of engagement.

– disengages the ALSR and full manual control is given back once the aircraft accelerates with more than 1 kt/second and a speed of at least 110 KDAS has been reached.

NOTE:

In the real plane the system is designed to command different manoeuvrers depending on aircraft attitude and speed, trying to always have a positive G load.

In the simulation, the recovery strategy is much simplified and will try and first level the wings, and then bring the pitch to +/3°

NOTE:

It is possible that the ALSR meets the disengagement condition when the plane is pointing towards the ground, if pitch levelling conditions are met.

AUTOPILOT AND AUTOTHROTTLE SYSTEM

Autopilot General Description

The autopilot (AP) is an integrated element of the flight control system (FCS) and provides automatic control of selected flight parameters with or without the auto throttle (AT). AP demands are direct inputs to the primary control laws in order to make full use of the functions.

NOTE:

For maximum compatibility with default commands and third party software, the Autopilot functionality in the simulation is based on the default MSFS autopilot function and will, in general react to default autopilot commands in addition to the controls in the virtual cockpit.

Autopilot Engagement

The AP is engaged by a short press of the AP engage / disengage button on the stick, with the following indications:

- The AP engaged indicator on the left glare shield (LGS) illuminates.

- The current AP engagement state is indicated on the HUD (altitude/heading datum is boxed if it is acquired or current altitude/heading is boxed if held, or the selected mode is boxed if in engagement conditions).

NOTE:

Default autopilot master control can be assigned in the simulator control preferences and can used instead of the stick “autopilot engage / disengage” mouse area.

NOTE:

The AP cannot be activated on the ground.

Autopilot Basic Modes

The following autopilot (AP) basic modes are available in the simulation:

- Baro altitude acquire and hold (ALT)
- Heading acquire and hold (HDG).

The sequence for engagement, i.e., AP, ALT, or HDG mode, and the altitude or heading datum setting, can be done in any order.

The AP operates with maximum pitch and bank angles of ±60°.

Stick deflection is referred to as stick adjust outside the dead band of more than 5% of full deflection in pitch axis and more than 7,5% in roll axis while the AP is engaged (refer to Figure 1.229).
The stick adjust feature of the AP provides full manual control without disengaging the AP. If the stick is deflected outside the dead band, the aircraft is manually controlled with the same handling characteristics as without AP. When, after completion of the manoeuvrer, the stick is released inside the dead band, the AP resumes operation again.
Stick deflections inside the dead band have no effect when the AP is engaged.

Basic Modes Datum Selection

Reference altitude and heading for autopilot ALT and HDG modes are automatically acquired once the respective modes are pre-selected, and can be adjusted with the default autopilot heading and altitude reference default commands in the simulation.

Current altitude and heading references are shown on the HUD.

For gameplay reason, it is also possible to view and modify the altitude and heading references via dedicated soft-keys within the NAV sub-system moding.

Autopilot Advanced Modes

The following autopilot (AP)advanced modes are available in the simulation:

- Track mode

The following autopilot advanced modes are selectable in the simulation but not currently supported:

- Auto-climb mode
- Auto-approach mode
- Air-to-Surface Auto-attack mode

Track Mode

The TRK mode is selected or preselected by pressing the mode selection button TRK on the LGS (button illuminates).
Pressing an unselected TRK mode button activates the mode when the AP is engaged. If the AP is not engaged, pressing an unselected TRK mode button preselects the mode. Upon AP engagement, the AP immediately engages this mode.
Pressing a selected TRK mode button cancels this mode in either AP or FD operation.

When Track mode is engaged, the airplane will automatically follow the current flight plan / route (if a valid one is loaded).

Operational Limits

The AP is available throughout the flight envelope within the AP operational limits and operates between +0.2 g and +3 g with a maximum AoB of 60° and a maximum roll rate of 20°/second.
The FD uses the AP control laws, therefore has the same authority and operational limits.
No rudder pedal inputs should be made while the AP

is engaged.

Attitude and Angle of Attack Limits
The autopilot system has the following operational limits for what concerns attitude and angle of attack.

±70° pitch attitude
±70° bank attitude
20° AoA.

If the AP operational limits in pitch and/or bank are exceeded in full or split axes operation without stick inputs (e.g., gusts), the AP is disengaged if the pitch attitude operational limit is exceeded. If only the AoB operational limit is exceeded, the AP reverts to standby operation.

Airspeed Limits
Minimum airspeed for AP operation is 115 KDAS below 12 000 kg aircraft mass and 160 KDAS above 22 500 kg aircraft mass. The minimum speed for AP operation with aircraft mass between these breakpoints is linearly scheduled. Exceeding the scheduled airspeed values will result in the AP automatically disconnecting.

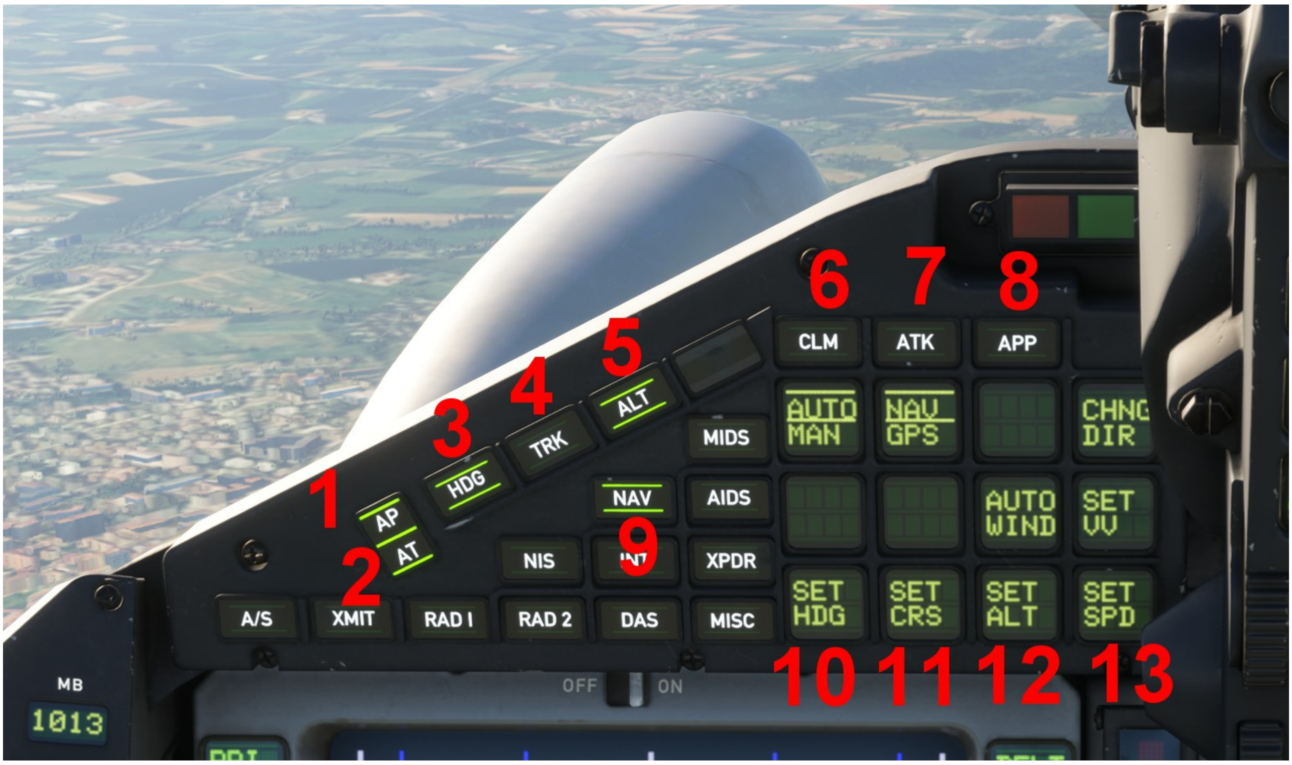
Autothrottle general description
The auto throttle (AT) system provides the following functions:
– Mach Acquire and Hold
– DAS Acquire and Hold.
In both modes, the AT either holds the current speed value (in Mach or DAS) or acquires and then holds a pilot-inserted speed datum.

With weight-on-wheels the AT is disengaged and the speed acquisition datum deleted if previously indicated although Mach/DAS selection is retained.
Autothrottle Operation

Engagement Criteria
The AT can be engaged in any flight condition by a short press. Engagement is not possible with:
- Aircraft weight on wheels
- Throttle lever asymmetry of more than 15mm.

Autothrottle Mode and Datum Selection
For gameplay reasons, it is possible to switch between auto throttle DAS and Mach modes by subsequent selections of the AT engagement switch in the game.

Reference speed (knots or Mach number depending on the auto throttle mode) can be entered via dedicated soft-keys within the NAV sub-system moding.



GLARESHIELD AUTOPILOT CONTROLS

1 – AP engagement indication (NOTE: can be used to engage/disengage the autopilot in-game)

2 – AT engagement indication (NOTE: can be used to engage/disengage the autopilot in-game and cycle between DAS and Mach Hold)

3 – Heading Capture and Hold Mode selector

4 – Track Mode selector

5 – Barometric Altitude Capture and Hold Mode selector

6 – Auto-climb Mode selector (INOP in game)

7 – Air-to-surface Auto-attack Mode selector (INOP in game)

8 – Auto-approach Mode selector (INOP in game)

9 – NAV subsystem selection

10 – Set Autopilot Heading datum

11 – Set HSI course datum

12 – Set Autopilot Altitude datum

13 – Set Autothrottle speed datum

AUTOPILOT AND AUTOTHROTTLE CONTROLS

1 – Autopilot engagement/disengagement pushbutton (control stick front)

2 – Autothrottle engagement/disengagement push-button (throttle inboard front)

AUTOPILOT AND AUTO-THROTTLE HUD SYMBOLOGY

1 – Horizontal mode

2 – Vertical mode

3 – Speed datum

4 – Heading datum

5 – Altitude datum

CANOPY

Canopy and Windscreen

The windscreen is a one-piece acrylic transparency, 22mm thick, attached to an aluminium frame. A demist facility is provided by a gold film heating element, embedded in the acrylic.

The canopy is a one-piece stretched acrylic transparency, mounted in an aluminium frame which is hinged at the rear. The canopy is opened and closed hydraulically and can be operated from inside or outside the cockpit. An anti-mist system is provided to keep the transparency clear.

The canopy is jettisoned automatically on initiation of ejection, and in the event of an emergency, the canopy can be manually jettisoned .

Canopy Raising and Lowering

Introduction

Under normal conditions the canopy may be raised and lowered using the internal or external canopy operating switches. If however, the electrical and hydraulic power fails, the canopy may be opened manually.

Normal Operation

The canopy is opened and closed electro-hydraulically,
via the internal or external canopy operating switches. When the canopy is fully closed, two microswitches (mounted on the canopy frame adjacent to the front arch) are tripped and activate the electrical lock/unlock actuator. The actuator drives the canopy locking mechanism (consisting of two shoot bolts and four hooks) via a torque tube and linkage assembly.

The canopy is closed and locked by holding the internal canopy operating switch in the CLOSE position. A warning horn sounds whenever CLOSE is selected and until the canopy is locked.

Canopy unlock is indicated on the Dedicated Warnings Panel (DWP) if the throttle levers are >33mm forward and either engine is >40%NH. In addition, CANOPY UNLOCK is also indicated on the autocue.

The canopy is opened and unlocked by selecting the internal or external canopy operating switch momentarily to OPEN.

Canopy and Windscreen Controls

Internal Canopy OPEN/CLOSE Switch

The internal canopy OPEN/CLOSE switch is a three-position toggle switch, located above the right console, under the sill, in the front cockpit. In the rear cockpit the switch is located on the right quarter panel. Operation of the internal canopy OPEN/CLOSE switch is inhibited with weight off wheels. A warning horn is activated whenever CLOSE is selected. Canopy closed/open indications are given on the Multifunction Head Down Display (MHDD) Autocue format.

External Canopy OPEN/CLOSE Switch

An external canopy OPEN/CLOSE switch is located behind the canopy switch access panel (marked CANOPY OPEN/CLOSE), at the leading edge of the left wing route. The external canopy OPEN/CLOSE switch has priority over the cockpit switch.

NOTE:
The external canopy switch is not currently included in the simulation.

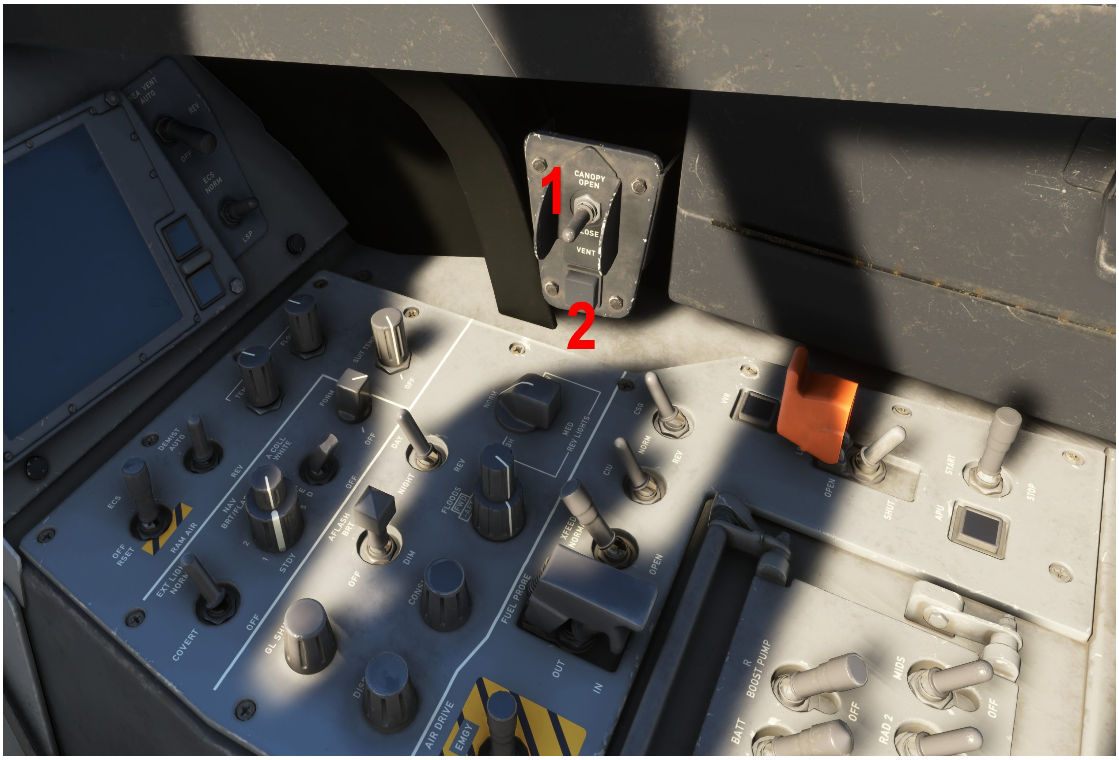
Canopy Vent Switch

The internal canopy vent switch is a push button switch located in the front cockpit, below the internal canopy OPEN/CLOSE switch. The push button is labelled CANOPY VENT. When selected and held the canopy is driven to 7 degrees open, regardless of its previous position. Operation of the CANOPY VENT switch is inhibited with weight off wheels.

External Canopy Unlock

In an emergency, with no hydraulic or electrical power available, the canopy can be released by the ground crew, if time permits.

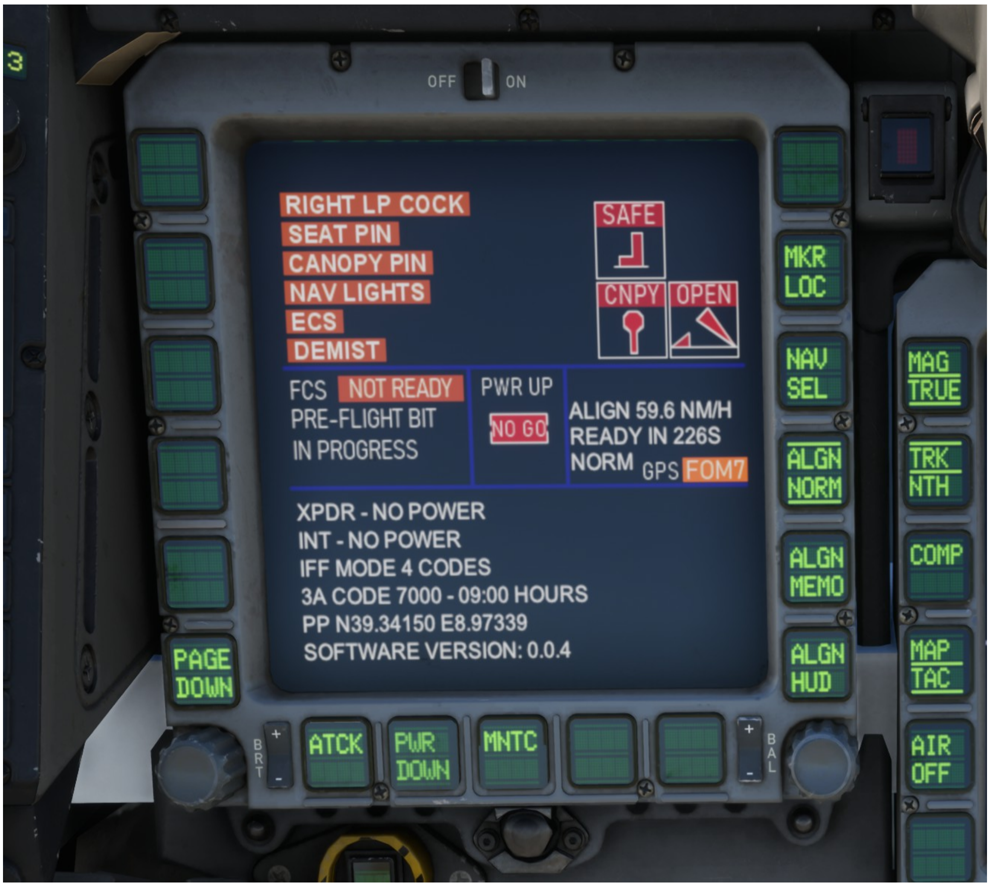
NOTE:
The external canopy unlock is not currently included in the simulation.



CANOPY CONTROLS:

1 – Internal Canopy OPEN/CLOSE switch

2 – Canopy VENT switch



AUTOCUE Format showing canopy OPEN advisory

CANOPY JETTISON INITIATOR Safety Pin location

CANOPY JETTISON HANDLE location (INOP in the simulation)

ESCAPE SYSTEM

Introduction
The escape system provides a safe means of emergency abandonment (zero altitude to 55 000 ft and 0 to 600 KCAS or Mach 2.0, whichever is lower) and provide for the safe recovery of the aircrew. The ejection sequence begins when the seat firing handle is pulled causing:

1 Retraction of the airbrake (if deployed)
2 Canopy unlock/jettison
3 Seat ejection.

NOTE

Ejection seat operation is not currently simulated.

Ejection Seat

WARNING

EJECTION SEATS ARE A POTENTIAL SOURCE OF LETHAL INJURY IF ACCIDENTLY OPERATED.

Introduction
The Mk16A ejection seat is rocket assisted, microprocessor controlled seat which is not dependent on any other aircraft system to fulfil its function.

When the seat is not in use, protection against inadvertent operation is provided by:

1 A seat safety pin inserted into the base of the seat firing handle to prevent it's operation. The seat safety pin can be removed and stowed by the ground crew prior to flight.

2 An ARMED/SAFE/EGRESS handle located on the right hand side of the ejection seat. The handle must be in the SAFE position during ingress.

Pulling the seat firing handle initiates a fully automatic ejection sequence, resulting in safe aircrew descent to the surface on a personal parachute.

If required, the seat will eject through the canopy with the aid of canopy penetrators, fitted to the top of parachute head-box, in the event of canopy jettison system failure.

Personal Services
Personal services are provided to the aircrew via:
- Aircrew Services Package (ASP)
- Head Equipment Assembly Services Module (HEASM)
- Liquid Suit Connector Assembly (LSCA)
- Auxiliary Oxygen Bottle (AOB).

Aircrew Services Package
The ASP is located on the left side of the seat pan and consists of a man portion, a seat portion and an aircraft portion. It provides the interface between the aircrew and the aircraft for breathing gas, NBC supply, anti-g trousers/flight jacket and communications (mic/tel).

Personal Equipment
The personal equipment available to the aircrew is:
- NBC Ventilation Supply Package (VSP)
- Personal Survival Pack (PSP)
- Harness assembly
- Shoulder, leg and arm restraint system
- Personal parachute
- Aircrew Equipment Assembly (AEA)

Ejection Seat Controls

The ejection seat controls are as follows:
- Seat firing handle
- ARMED/SAFE/EGRESS handle
- Auxiliary oxygen lever
- Aircrew Services Package (ASP) controls
- Go-forward lever
- Seat raise/lower switch

Seat Firing Handle
The seat firing handle is a black and yellow striped grab handle, mounted at the front of the seat pan, which is readily accessible to the aircrew without interference from the Aircrew Equipment Assembly (AEA) or aircraft controls.

ARMED/SAFE/EGRESS Handle
The seat ARMED/SAFE/EGRESS handle is located on the right side of the seat pan and is in clear view of both ground-crew and aircrew. The handle is used for normal or emergency egress to make the seat safe when the aircraft is on the ground. When ARMED or SAFE is selected, the handle is locked into position by a latch which is released by a lever inside the handle. When the handle is in the SAFE or EGRESS position, a mechanical interlock prevents the seat firing handle being accidentally pulled from its housing.
When the handle is in the SAFE position the seat is safe and the seat firing handle cannot be accidentally pulled; the visible portion of the handle is coloured white and engraved (SAFE) in black. With the handle in the ARMED position ejection may be initiated; the visible portion of the handle is coloured red and white and engraved (ARMED) in black. For manual or emergency egress when the aircraft is on the ground, the handle should be rotated beyond the SAFE position to the EGRESS position.
Locking the handle in the EGRESS position disconnects the ASP man portion, the flight jacket arrowhead connector from the Personal Survival Package (PSP) lowering line connector and the LSCA man portion.

Auxiliary Oxygen Lever
The auxiliary oxygen lever is a two position, black and yellow lever and is located on the left seat pan thigh guard. Auxiliary oxygen may be selected by rotating

the lever towards the pilot to the ON position. At the end of lever travel, the lever locks in the ON position. De-selection of the auxiliary oxygen supply is achieved by pressing the release button on the end of the lever and lowering the lever fully to the OFF position.

Aircrew Services Package Controls
The ASP controls consist of the following:
- PTT button
- Main/reversionary selector
- Anti-g valve on/off selector.

The PTT switch is used to ensure that the anti-g trousers and flight jacket inflate and that the breathing gas pressure increases for positive pressure breathing.

The MAIN/REV selector is a two position switch, which is normally set to MAIN. It can be selected to REV manually, via the switch, or automatically when the AOB is selected. When set to the REV, position the breathing gas pressure is higher than usual; providing the aircrew with a further indication that REV is selected.

The anti-g valve ON/OFF selector is two position selector which is usually set to the ON position. In this position the anti-g supply is provided to the anti-g trousers and allows positive pressure breathing when necessary. To select the OFF position the selector must first be lifted.

EJECTION SEAT CONTROLS

1 - ARMED/SAFE/EGRESS Handle

2 - Seat Safety pin

3 - Seat Firing Handle (INOP in the simulation)

ENVIROMENTAL CONTROL SYSTEM

Environmental Control System General Description

The environmental control system (ECS) uses bleed air from the engines to provide conditioned air and pressurization for the cabin and cooling air for the avionics and general equipment.
The ECS also provides pre-cooled air for the following subsystems:
- canopy seal inflation
- transparency anti-mist/demist
- molecular sieve oxygen generation (MSOG)/ radar pressurization
- anti-g

Bleed Air System

The bleed air for the ECS is taken from the 5th stage of each engine HP compressor through the engine bleed shut-off valves (EBSOVs). A check valve in each line prevents reverse flow from one engine to the other.

On the ground, in alert operation, the air for the ECS is supplied by the secondary power system (SPS).

Air Conditioning System

The pre-cooled bleed air is supplied to the air conditioning system through the environmental control system shut-off valve (ECS SOV).

Canopy and Windscreen Sealing

Canopy Sealing

A continuous inflatable rubber seal is installed along the canopy edge members and arches, to form an airtight seal between the canopy and the windscreen arch, and the canopy and the aircraft structure. This allows the cabin pressure to be maintained.
The seal is inflated by pre-cooled air supplied from the ECS through a non-return valve, a pressure reducing/relief valve and an inflation/deflation valve.

Windscreen Sealing

The windscreen/sill interface utilizes a static seal, which improves its capability as the pressure between the cabin and outside varies.

Cabin Air Supply System

The cabin air supply system receives conditioned air from the air conditioning system. The air is distributed to the cabin by means of a distributed set of ducts and vents.

Pressurization System

The pressurization system provides pressure control for the cabin. The cabin pressurization is obtained by controlling the overflow of conditioned air from the cabin through the cabin pressure control valve (CPCV). The control of the pressure schedule by the CPCV is automatic.
In the case of CPCV failure or if the cabin pressure goes to sub-atmospheric condition, the cabin safety

Avionic Air Supply System

The avionic air supply system cools the equipment installed in the centre avionic, the front avionic and the radar bays. This equipment are cooled with air from the air conditioning system or, on the ground and for a emergency operation with air from two cooling fans.

In flight, when a component malfunction or failures are detected the pilot must selects the emergency operation cooling mode by positioning the ECS switch to RAM AIR.

Avionic Liquid Cooling System

The avionic liquid cooling system is a closed circuit which removes the heat generated by the Radar and FLIR unit and dissipates it to the conditioned air supply via the liquid/air and MSOC heat exchanger.

Antimist/Demist System

The windscreen demist facility and the canopy anti-mist facility are by a pneumatic anti-mist/demist system, and the windscreen anti-mist is by an electrical anti-mist system.

Windscreen Heater Switch

A two position toggle switch, located on the right console (inside the systems gang-bar) and labelled W/S HTR - OFF, controls the operation of the windscreen heating system. When the switch is in the W/S HTR position, the windscreen heating elements are energized under control of the windscreen control unit. The windscreen heating is de-energized when the demist switch is set to REV.

Emergency Ram Air

The emergency ram air (ERA) system provides ram air for the cabin conditioning and avionics cooling in the case of an ECS failure.
By positioning the ECS switch in the RAM AIR position the ERA valve and the cabin safety valve, which are pneumatically linked, are opened.

Ice Detection

The ice detection system initiates the ICE warning (CAT 3) via the DWP when icing conditions are encountered and an ice accretion has occurred on the ice detector sensing probe.

Environmental Control System Controls

The controls of the environmental control system are located on right quarter panel and right console.

ECS Switch

A three position toggle switch labelled ECS - OFF/ RESET - RAM AIR, controls the operation modes of the ECS as follows:
ECS The ECS operates normally under UCS software control.
OFF/RESET The ECS does not operate. The UCS software of the ECS is reset. In this position the following functions of the ECS are retained:
– The anti-g supply

– The canopy seal supply
– The MSOG supply.
RAM AIR The normal operation of the ECS is disabled. The cabin is depressurized. The ERA valve is opened to supply air to the cabin. In addition, the front and centre avionic fans supply cooling air to the avionic equipment. In this position the following functions of the ECS are retained:
– The anti-g supply
– The canopy seal supply
– The MSOG supply.
The switch is locked in the centre (OFF/RESET) and aft (RAM AIR) positions, and must be unlocked prior to selection of the aft or forward positions respectively.

Demist Switch
A three position toggle switch labelled DEMIST AUTO - OFF - REV, controls the anti-mist/demist as follows:
AUTO Normal selection. The canopy anti-mist facility operates normally under software control to prevent transparency misting. A flow of partially conditioned engine bleed air is supplied over the inside of the canopy via the anti-mist SOV. This function is unavailable if the ECS switch is not selected to the ECS position.
OFF No anti-mist/demist. The anti-mist SOV is closed.
REV A continual (reversionary) flow of partially conditioned engine bleed air is supplied over the inside of the canopy and windscreen via the demist SOV and anti-mist SOV. The windscreen heater is de-energized.

Cabin Temperature Control
A circular rotary control labelled CABIN TEMP controls the air temperature of the cabin. Clockwise rotation increases the selected temperature of air flowing into the cabin, via the ECS vents. Anticlockwise rotation decreases this temperature level.

Cabin Airflow Control
A circular rotary control labelled CABIN FLOW controls the volumetric rate of airflow into the cabin. Clockwise rotation increases the selected volumetric rate of air flowing into the cabin, via the ECS vents. Anticlockwise rotation decreases this flow rate level.

Locality Specific Protection Switch
The locality Specific protection is a two position toggle switch labelled ECS NORM and LSP. When placed to ECS NORM the ECS operates normally under UCS software control. When placed to LSP and while the aircraft is on ground or aircraft elevation below 131 ft of radio altimeter, the operation is modified as follow:
– conditioned air is not provided to the cabin
– anti-mist/demist is inhibited
– heat sink for radar/FLIR and liquid conditioning vest is lost
– avionic cooling air is from the front and centre cooling fans.

Suit Temperature Control
A circular rotary control labelled SUIT TEMP/OFF controls the temperature of the liquid conditioning vest. Clockwise rotation increases the selected temperature and anticlockwise rotation decreases this temperature level.

ECS Warnings
Information of ECS failures are displayed on the dedicated warning panel (DWP). The following captions are presented:
ECS (CAT 3 - amber) Indicates the loss of cabin and avionic conditioning with engine bleed air. This warning is also generated when:
– the fans are operating when not required, or
– the fans are operating when the aircraft is outside the ERA envelope, or
– the ECS switch is in the off position when the aircraft is electrically powered.
If the warning is due to a hot leak, which has been isolated by the UCS closing the engine bleed SOVs, there is no air supply to either subsystems. If the warning is not caused by a hot leak, the air supply to the MSOG, anti-g and canopy seal subsystems remains.
The ECS caption is accompanied by attention getters and the "ECS" voice warning message.
FAN (CAT 2 - red) Indicates a loss of reversionary/ground conditioning to the avionics. Any of the avionic cooling fans are inoperative whenever required to function. The FAN caption is accompanied by attention getters and "ECS fan" voice warning message.
L (or R) ECS LK (CAT 2 - red) Indicates a hot air leak in the rear fuselage "V" bay together with a failure to close the corresponding engine bleed SOV. The captions are accompanied by attention getters and the "left ECS leak" or "right ECS leak" voice warning messages.
CABIN LP (CAT 3 - amber) Indicates a cabin pressurization failure. The cabin pressure altitude is above 26 000 feet. The caption is accompanied by attention getters and the "cabin low pressure" voice warning message.
CABIN HP (CAT 3 - amber) Indicates that the cabin differential pressure is higher than 45 KPa, due to failures of the CPCV and the cabin safety valve. The caption is accompanied by attention getters and the "cabin high pressure" voice warning message.

Oxygen System
The oxygen system consists of two subsystems:
- The molecular sieve oxygen generation (MSOG)
- The auxiliary oxygen.

The MSOG subsystem takes air from the ECS and produces breathing gas at the required oxygen concentration and flow rate. The auxiliary oxygen subsystem provides an auxiliary supply of 100% oxygen.

Within the auxiliary oxygen bottle head there is a valve for selection of the auxiliary oxygen supply. The utility control system (UCS) selects/deselects the auxiliary supply automatically as required as an auxiliary back-up to the MSOG.

Anti-G System

The anti-G system takes pre-cooled air from the ECS and inflates and pressurizes the anti-G full coverage trousers, to provide protection against the G-effects. The anti-G system consists of an anti-G valve mounted within the aircrew service package, on the left side of the seat pan. The anti-G valve opens at a loading in excess of 2G to permit anti-G full coverage trousers inflation. The G-trousers pressure varies linearly with G.

Anti-G Valve Control

A two position lever, operable in forward and rear positions with a detent at each position, controls the anti-G valve. In the forward position (ON) the anti-G trousers pressure is controlled automatically and varies in accordance with the G level. In the aft position (OFF) the anti-G valve inlet is isolated to inhibit the trousers pressurization, and the current trousers pressure is reduced (vent) to a minimum.

Anti-G Valve Press-To-Test Button

Pre-flight checks of the anti-G valve, including pressure breathing with G, are with the anti-G valve press-to-test button. When the button is pressed the anti-G trousers pressure increases, which also generates a corresponding breathing pressure increase.

Environmental Control System Controls

1 – ECS switch
2 – Demist switch
3 – Locality Specific Protection switch
4 – Suit Temperature control
5 – Cabin Airflow control
6 – Cabin Temperature control

LIGHTING SYSTEM

External Lighting
The external lights can be switched on or off by use of the external lighting controller (Figure 1.154). When selected to off the push button indicator is lit. External lighting consists of the following:
– Navigation lights
– Anticollision lights
– Formation lights
– Landing and taxi lights.

Navigation Lights

The navigation lights consist of a red light mounted centrally on the left wing tip pod, a green light mounted centrally on the right wing tip pod and a white light on the trailing edge of the upper fin. The three lights are controlled by a three position switch, labelled NAV - BRT/DIM/OFF, which is located on the right console.

Anticollision Lights
Two high intensity strobe lights, mounted on the upper and lower surface of the fuselage. They are controlled by a three position switch, labelled A COLL – RED/WHITE/OFF, which is located on the right console.

Formation Lights
Eight formation light units, each having two or three green lights, are mounted on the aircraft. Selection and brightness is controlled by a rotary switch, labelled FORM - OFF, which is located on the right console.
The formation light units are located as follows:
– Forward fuselage, left side (three green)
– Forward fuselage, right side (three green)
– Fin leading edge, left side (three green)
– Fin leading edge, right side (three green)
– Left wing tip pod, top (two green)
– Left wing tip pod, bottom (two green)
– Right wing tip pod, top (two green)
– Right wing tip pod, bottom (two green).

Landing/Taxi Light
Two combined landing and taxi lights are mounted on the main landing gear doors. Each light incorporates two halogen bulbs and are controlled by a three position switch, labelled LAND/OFF/TAXI, which is located on the left quarter panel. Power to the lights is only available when the landing gear lever is in the down position.

General
The controls associated with the external lighting system are detailed in the following paragraphs.

External Lights Switch
The three-position toggle switch on the right forward console, labelled EXT LIGHT - NORM / COVERT / OFF, controls the external lights.

Navigation Lights Control
The dual concentric rotary control on the right forward console, labelled NAV - BRT / FLASH - STDY 1, 2, 3, 4, 5, controls the navigation lights.

Inner Rotary Control - Flash Pattern: This control has six positions.

Outer Rotary Control - Brightness Control: In the fully anti-clockwise position the navigation lights are switched off.

Anti-collision Lights Switch
The three-position toggle switch located on the forward right console, labelled A COLL - WHITE / RED / OFF, controls the anti-collision light.

Formation Lights Control
The rotary control on the right console, labelled FORM - OFF, controls the formation lights.

Landing / Taxi Light Switch
The three-position toggle switch on the left quarter panel, labelled LAND / OFF / TAXI, controls the landing / taxi lights.

1 – LANDING/TAXI LIGHT (Left quarter panel)

LIGHTS CONTROL (Right console)

1 – EXTERNAL LIGHTS MASTER CONTROL

2 – NAVIGATION LIGHTS CONTROL

3 – ANTI-COLLISION SWITCH

4 – FORMATION LIGHTS CONTROL

5 – GLARESHIELD LUMINANCE CONTROL

6 – ANTI-FLASH LIGHTS CONTROL

7 – EXTERNAL LIGHTS MODE CONTROL

8 – MAIN DISPLAY LUMINANCE CONTROL

9 – CONSOLE LUMINANCE CONTROL

10 – FLOODLIGHTS LUMINANCE CONTROL

11 – REVERSIONARY LIGHTING SELECTOR

NAVIGATION SYSTEM

General

The Navigation System provides the weapon system with accurate navigational position and velocity vector data, and provides the pilot with navigation and flight path control display. The main role of the Navigation System is to enable the aircraft to be flown to a specified destination from a specified departure. It derives the essential flight data (speed, direction, height, attitude) from on-board sensors of relevant subsystem and then supplies this data to the Navigation Computer (NC) for navigation function computation.

NOTE:

In this Microsoft Flight Simulator rendition the navigation system has been modified to support the native simulator navigation system.

In the real plane, the Navigation System consists of the following equipments:

- Laser Inertial Navigation System (LINS)

- Global Positioning System Upgradable (GPS)

- Radar altimeter (RADALT)

- Navigation Computer (NC)

- Integrated Tactical Air Navigation (ITACAN)

To update the NAV store/manual route and to navigate in reversionary mode the Navigation System uses some equipment which are part of the FCS system, they are:

- Inertial Measurement Units (IMUs)

- Air Data System (ADS)

- Flight Control Computers (FCC).

NOTE:

This Microsoft Flight Simulator rendition relies only on GPS data provided by the simulator. LINS alignment procedure is simulated, but has no effect in game.

NOTE:

In this simulated version it is assumed that a flight plan is created via the map screen(MSFS2020) or in the EFB (by using the SEND TO ATC function in MSFS02024). The aircraft currently does not support manual routes/flight plans.

NOTE:

This Microsoft Flight Simulator rendition is based on early Tranche 1 avionics as it the only variant for which clear information is available on the internet. That specific version had no support for ILS, which was added on later models. In this simulated rendition ILS has been added for gameplay reasons.

Routes

In the real aircraft, the navigation system can manage two different routes: an Auto route (planned) and a Manual route (unplanned); both can be pre-planned and loaded via MDLR/GLU. Each route can contain up to 50 waypoints.
Normally, the routes will contain at least two waypoints the first one identifying the departure airfield and the second one identifying the destination airfield.

In the simulated version only one route is supported, which is equivalent to the simulator “flight plan”.

It is assumed that a flight plan is create via the game interface. This can be done by creating a flight plan in the map screen in both MSFS2020 and MSFS2024, or using the EFB in MSFS2024. If the EFB is used, the SEND TO ATC option must be used to send the flight plan to the aircraft avionics.

Creating flight plans in which the arrival and departure are the same in MSFS2024 may result in truncated flight plans in which only the airport is displayed.

NOTE:

In the simulation, the MAN / AUTO soft key is used to toggle the automatic or manual change of the current waypoint.

Navigation Steering

The Navigation Steering calculation is provided for manual steering. The system provides the pilot with some parameters that enable him to steer the aircraft along a route constructed of a series of legs, where a leg is that part of a route between two successive waypoints.
On power up, the AUTOmatic route is selected as the default route.

After takeoff (weight-off-wheels and NAV PoF), the steering data is displayed to the pilot to guide the aircraft to the destination waypoint (DWP).

NAVIGATION FORMAT DISPLAYS

The navigation format displays enable the pilot to monitor the status of the complete navigation system and moreover present a variety of navigation information to steer the aircraft during flight. The status and the navigation information is displayed on the MHDD/PA format, on the Head-Down Head Up Display (HDHUD) format and on the HUD.

MHDD Pilot Awareness Format

The MHDD Pilot Awareness (PA) format can be displayed to the pilot in all phases of flight (PoF).

The MHDD/PA and WPT formats are the main displays for navigation waypoint position and route data.

A waypoint block is shown on the MHDD/PA Format, displaying waypoint number, range and bearing and distance to go/time to go to the next waypoint and TACAN range and bearing.

The TACAN channel number and mode are also displayed on the Dedicated Readout Panel (DRP) on the right glareshield.

The selected route is displayed, with associated waypoints, with the current leg shown in white and the remainder of the route in green. In Direct steering, the current leg is shown direct from the PP to the DWP, while in Track Acquire steering it is shown as the planned track between the previous and destination waypoints. The MHDD/PA always displays the active route and its waypoints and provides a very easy and simple method to monitor the Present Position (PP) against the desired route or track.

The MHDD/PA format also provides the basic Navigation display setting functions:

- Compass Rose - A compass rose is superimposed on the MHDD/PA format to provide a heading reference. Either a 360, partial (120) rose or none can be displayed by pressing the COMP soft key on the MHDD/PA format.

- Magnetic/True Orientation - All heading references on the HUD and MHDDs can be set to either true or magnetic by pressing the MAG/TRUE soft key on the MHDD/PA format. The default orientation on power-up is "Magnetic".

Note that if the HSI is selected with TACAN as the HSI navigation data source, the aircraft heading references are automatically set to Magnetic.

- Horizontal Situation Indicator (HSI) - A conventional HSI type display presentation is provided, selected by HSI soft key on the MHDD/PA format, see Figure 1.169.

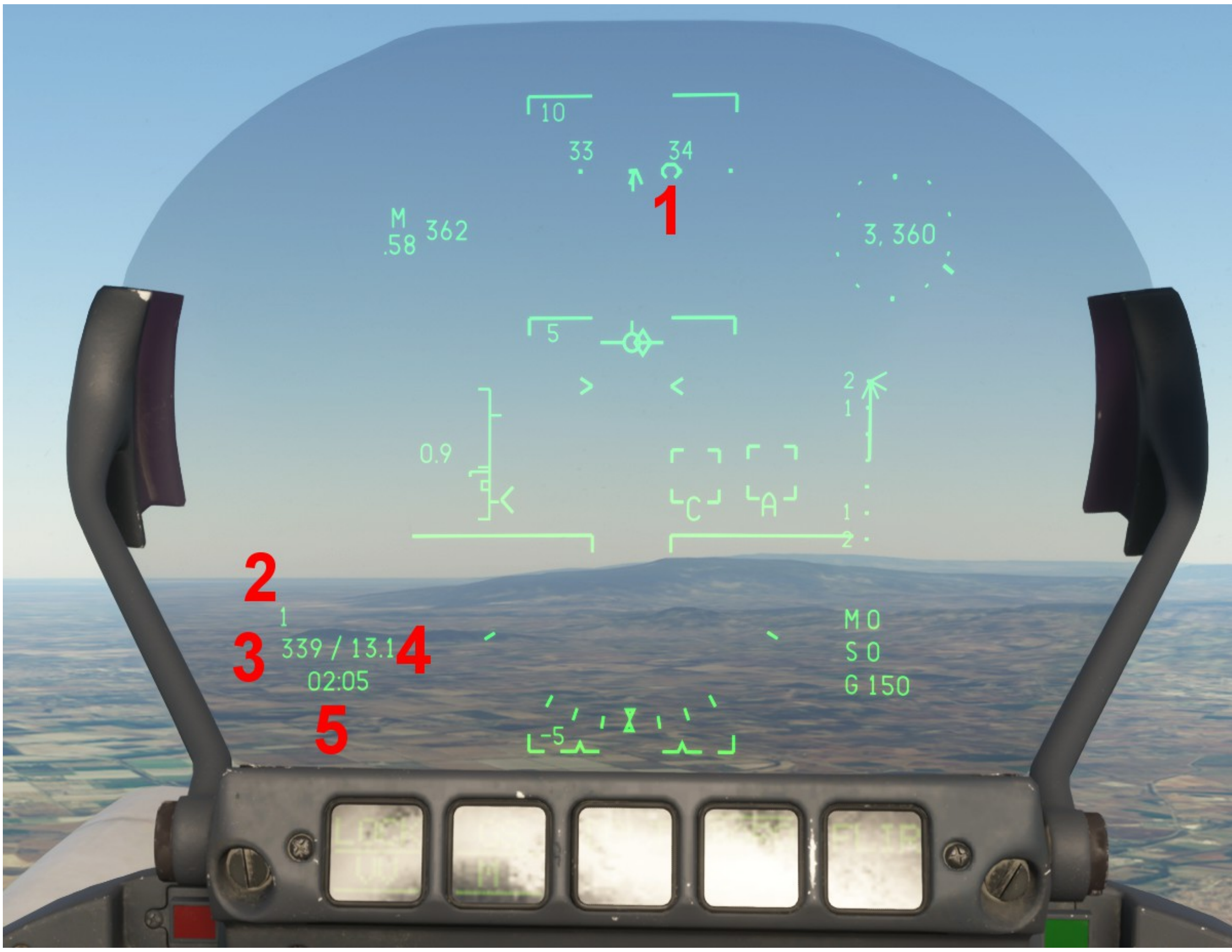
Waypoint Format
The Waypoint format is selected using the WPT soft key which is available on most RMHDD formats.

Head Up Display (HUD)
The Head Up Display presents a variety of navigation information to steer the aircraft.

- The Navigation data block shows: waypoint number and type, direct range and bearing, time to go to overhead

- The Steering cue provides the required guidance to capture or maintain the required track.

In all phases, the Steering Cue command is limited by a simple schedule based on Calibrated Airspeed to ensure that the bank angle limit will allow maximum turning performance, avoiding an



undesirable flight condition (e.g. buffet, stall, etc.).

HEAD UP DISPLAY – ROUTE NAVIGATION SYMBOLOGY

1 – WAYPOINT BEARING MARKER

2 – WAYPOINT NUMBER

3 – WAYPOINT BEARING

4 – WAYPOINT DISTANCE

5 – TIME TO STEER

HEAD UP MHDD FORMAT – ROUTE NAVIGATION SYMBOLOGY

1 – WAYPOINT BEARING MARKER

2 – WAYPOINT NUMBER

3 – WAYPOINT BEARING

4 – WAYPOINT DISTANCE

5 – TIME TO STEER

PILOT AWARENESS MHDD FORMAT – ROUTE NAVIGATION SYMBOLOGY

1 – ROUTE

2 – WAYPOINT NUMBER

3 – WAYPOINT BEARING

4 – WAYPOINT DISTANCE

5 – TIME TO STEER

HSI MHDD FORMAT – ROUTE NAVIGATION SYMBOLOGY

1 – WAYPOINT BEARING POINTER

2 – WAYPOINT NUMBER

3 – WAYPOINT BEARING

4 – WAYPOINT DISTANCE

5 – AUTOPILOT HEADING MARKER

6 – INDICATED AIRSPEED

7 – HEADING

8 - ALTITUDE

WAYPOINT MHDD FORMAT

1 – CURRENT AIRCRAFT GPS COORDINATES, ALTITUDE, AIRSPEED AND TRUE HEADING

2 – CURRENT WAYPOINT GPS COORDINATES; ALTITUDE, DISTANCE, BEARING, ETE AND ETA

3 – DESTINATION WAYPOINT NUMBER, ETE, ETA AND CURRENT TIME

RADAR ALTIMETER

General

The Radar Altimeter integrated into the Navigation System provides height above ground information for any type of terrain currently overflown, up to a maximum of 5000 ft., with a measurement accuracy of 2% of the measured height or 2 ft (whichever is greater).
It consists of:
– a transmitter/receiver
– a transmitter antenna
– a receiver antenna.
Height information, routed through the AVS data bus, is displayed on the HUD and on the MHDD/ HDHUD format (refer to Figure 1.174).
The radar altimeter clearance height setting control and display select and indicate the low height datum, respectively.
In addition, based upon the height information the low height audio/visual warning is generated.
The radar altimeter is powered by the PP4 bus.

Radar Altimeter Controls and indicators

Radar Altimeter Clearance Height Setting Control

The clearance height can be set by means of the LOW HT rotary control, located on the right glareshield. A clockwise rotation increases its value.

The clearance height setting control has two levels of resolution as follows:

- from 0 to 300 ft: 10 ft increments
- from 300 to 5000 ft: 50 ft increments

Similarly, counter-clockwise rotation will decrement the clearance height setting value of the appropriate steps. During NAV and A/A (A/A and A/S) POF, when the aircraft is below the selected clearance height setting, the warning facility activates a CAT 1 audio/visual warning consisting of flashing attention getters accompanied by the LOW HEIGHT audio voice message.

In addition a pull up indication is displayed on the HUD and on the MHDD/HDHUD format by means of a flashing arrow which rotates about its centre point, such that it always points away from the ground and the LOW HEIGHT caption below it.
As soon as best height becomes greater than 3% of clearance height datum, low height warnings are reset. The low height warning is processed by the NC.

NOTE

Low height warning generation is delayed by 15 seconds when the WOW transition between ON to OFF occurs and NAV or A/A POF is engaged.

Radar Altimeter Clearance Height Setting Display

A four digit display, adjacent to the clearance height setting control, indicates the selected clearance height value.

Radar Altimeter Transmission Control Switch

A two position "RAD ALT / OFF" toggle switch located on the right console systems gang-bar controls the radar altimeter transmission. The switch is physically protected in order to prevent an accidental selection of the OFF position (missing low height warning generation in flight. The switch shaft must be pulled up before OFF can be selected. The switch functions are indicated below:

- RAD ALT (fwd). When selected, the Radar Altimeter transmits

- OFF (aft). When selected, the Radar Altimeter does not transmit.

HUD Navigation Format

The radar altimeter height datum is displayed on the HUD Navigation format (in 10 ft increments). If radar altimeter unlocks or when flying above 5000 ft the indication is replaced by the flashing baro figures if radar altimeter only has been selected.

MHDD/HDHUD Format

The radar altimeter height datum is displayed on the MHDD/HDHUD format (in 10 ft increments). If radar altimeter unlocks or when flying above 5000 ft the indication is replaced by the flashing baro figures if radar altimeter only has been selected.

Radar Altimeter Modes of Operation

The radar altimeter has two main operating modes: STANDBY and TRANSMIT.

STANDBY Mode

On ground, at electrical power-up the radar altimeter performs a Start up BIT (SBIT), after which, if successful, standby mode is entered.
In standby mode the radar altimeter emissions are inhibit: this condition can be meet either automatically or manually.

TRANSMIT mode

The transmit mode is the normal operational mode of the radar altimeter; the RAD ALT transmission control switch must be set to RAD ALT position.

CBIT / IBIT Facilities

The system incorporates the CBIT and IBIT facilities.
CBIT starts automatically once SBIT has been successfully completed, and does not prevent the normal operation of the radar altimeter (provided that no failures are detected).
CBIT is performed at fixed rates.
IBIT may be carried out by the ground crew via MDP, it lasts 10 seconds as maximum.

TACAN

Introduction

The tactical air navigation (TACAN) system is a radio navigational aid. The equipment consists of two antennas, a transmitter/receiver unit and an antenna switching unit. Control is via the Manual Data Entry Facility (MDEF).

The TACAN equipment provides conventional Air to Surface (AS) and Air to Air (AA) modes. Using the AS Receive mode the system provides magnetic bearing and in AS or AA Transmit/Receive mode the system also provides slant range in nautical miles. The antenna switching unit automatically selects the antenna receiving the strongest signal.

NOTE

In Microsoft Flight Simulator only AS receive mode is actually supported. Tacan will always behave as an AS receiver, regardless of selections and settings.

Function

The TACAN system defaults to 'on' following power up. The MIDS toggle switch on the right hand console located within the battery gang-bar has two positions. When selected to MIDS the TACAN operates in the Transmit/Receive mode. When selected to OFF the TACAN operates in the Receive mode only.

When AS Receive mode is selected, or when TACAN silent mode is selected via the MDE (XMIT subsystem key), the on-board TACAN transmitter is inhibited. In this situation the TACAN will only provide magnetic bearing against a ground beacon, and no slant range.

A beacon confirms its identity via the Communications and Audio Management Unit (CAMU) to the aircrew's headset with an audio tone in morse code. The volume of the audio tone is adjusted using a rotary control located on the left rear console.

The range (RNG) and bearing (BRG) information is displayed digitally in boxes on the MHDD/PA format.

Selecting the NAV/TAC soft-key to TAC, on the MHDD/HSI format, will still display the range and bearing information but also the TACAN channel number, type and mode in-lieu of the navigation waypoint data.

In the real world, TACAN has the following three modes of operation:

- Air to Surface Receive Mode

- Air to Surface Transmit/Receive Mode

- Air to Air Transmit/Receive Mode

In the simulation, only Air to Surface Receive mode is actually supported.

Operation

This mode of operation and channel selection is via the Navigation AIDS subsystem soft-key, moding keys and the MDEF on the left glareshield. Pressing the TAC ON moding key will set the system to TAC SBY, pressing the moding again will return the system to TAC ON.

To Edit TACAN Channel - Input New Channel

To update the current (CRNT) TACAN channel number the pilot can overtype the previous (PREV) TACAN channel number in ROL 3. The pilot can also change the TACAN type in ROL 3 from X to Y by selecting the Y key on the Data Entry Keyboard (DEK), this action will leave the DEK showing X.

To Edit TACAN Channel - Select/Clear Previous

In the NAV POF the TAC DATA moding key is selected as default; TAC DATA can be manually selected in any other POF. The ROL will reconfigure to display the current (CRNT) and previous (PREV) TACAN channel number. If there is no PREV channel number then ROL 3 will show NEW ---X.

To select the PREV channel number, select the ENT key on the DEK. The PREV channel number is sent to the system to be used as the CRNT channel number and the information in ROL 2 and ROL 3 is switched.

To clear the PREV channel number select the CLR key on the DEK; in ROL 3 the channel number will be set to dashes and the PREV legend will change to NEW; the channel type will default to X. The CRNT channel number will not change.

To Change the TACAN Course

Tacan course can be changed by the right rotary control in the Center MHDD when HSI is in TAC mode.

HSI TACAN FORMAT

1 – Left rotary control (rotate to set heading)
2 – Right rotary control (rotate to set TACAN course)
3 – HSI format selected
4 – TAC mode selected
5 – Current TACAN channel and mode
6 – Bearing to station
7 – Slant range to station
8 – Course
9 – Heading bug
10 – Bearing to Station (green arrow)
11 – Course Deviation and TO/FROM arrow

Editing the TACAN Channel

1 – Select the AID subsystem soft-key (SSK)

2 – Select TAC DATA moding key

3 – Enter the new channel via the Data Entry Keyboard (DEK)

4 – Current TACAN channel is also displayed on the right Dedicated Readout Panel

INSTRUMENT LANDING SYSTEM

The instrument landing system (ILS) is a precision radio navigation system that provides short-range guidance to aircraft to allow them to approach a runway at night or in bad weather.

NOTE

The avionic version we have replicated in this Microsoft Flight Simulator rendition did not have support for ILS. ILS is currently supported, on modern EF-2000 models, through the Multi Mode Receiver, which is not included in this simulation.
For gameplay reasons, we have introduced basic support for ILS and replicated the current course deviation and glide-slope deviation symbology on the HUD and HDHUD.

ILS Frequency Setting
ILS frequency can be set via the AIDS subsystem by selecting the ILS/MLS option. Required frequency can be entered via the Data Entry Keyboard.

ILS Data on HUD
The glide-slope and ILS information is presented on the HUD as described below.
Glide-slope deviation: it represents an indication of the aircraft angular deviation from the selected glide-path, with positive values of this data represent a “fly down” indication (deflection of the needle downwards on the scale), i.e. the aircraft displacement is above the glide-path

Course deviation: it represents an indication of the aircraft angular deviation from the selected course line, with positive values of this data represent a “fly right” indication (deflection of the needle to the right on the scale), i.e. the aircraft displacement is left of the course line.

Instrument Landing System

1 – AIDS Subsystem key
2 – ILS/MLS soft key
3 – Read-out line and Data Entry Keyboard
4 – HDHUD Course Deviation (negative in the example, “fly left”)
5 – HDHUD Glide-slope Deviation (positive in the example, “fly down”)
6 – HUD Course Deviation (negative in the example, “fly left”)
7 – HUD Glide-slope Deviation (positive in the example, “fly down”)

COMMUNICATION SYSTEM

Communication Equipment

The communication system provides clear and secure air-to-air and air-to-ground communications and audio management. On the real plane, the system consists of two identical and independent V/UHF transceivers, a lower V/UHF Antenna, a fin tip Combined antenna. Communications are managed by the Communications and Audio Management Unit (CAMU). In the simulation the two radios support only VHF communications

V/UHF Radio

Two identical and independent V/UHF transceivers provide transmission and reception of radio signals in all different combinations of clear/secure and fixed-frequency/ECCM modes.

NOTE:

In the simulation, only VHF clear mode is supported.

Communications and Audio Management Unit

The communications and audio management unit (CAMU) performs the control and management of the aircraft communication system.

Communication Equipment Operation

The communication equipment is operated by controls on the head up panel (HUP), the left hand glareshield, the rear left hand console, the rear right hand console (Battery Gangbar) and the throttles.

Freq Format

The communications equipment (RAD1 and RAD2) data can be displayed on the Multifunction Head Down Display (MHDD) radio format page.
The MHDD can display the status of either RAD1 or RAD2, but only half of the list of channels can be displayed at any one time, requiring the pilot to select the required page using the PAGE UP or PAGE DOWN soft-key or by placing the X-Y insert over the page up/page down symbol.
RAD1 and RAD2 can be selected by using the appropriate soft-key on the MHDD or by positioning the X-Y insert over the RAD select icon.

Head Up Panel Controls

The HUP contains the radio 1 and radio 2 volume controls, the radio 1 and radio 2 channel selector knobs, and the radio 1 and radio 2 readout displays.

Radio 1 and Radio 2 Volume Controls

The radio 1 and radio 2 volume controls are circular rotary controls. Clockwise rotation increases the audio volume of the respective radio in the pilot headset. Counter-clockwise rotation decreases the audio volume.

Radio 1 and Radio 2 Channel Selector Knobs

Each radio channel selector knob is concentrically installed with its respective radio volume control in a single control arrangement, but operates independently. The radio channel selector knob is smaller in diameter and protrudes out of the radio volume control. The radio channel selector knob has two positions: in and out.
In the "in" position, rotation of the knob selects a number of discrete positions. Clockwise rotation of the knob increases the selected radio channel number in steps of 1, from 1 to 25 (1 to 24, are preset channels, and 25 a manual channel). If channel 25 is set, further clockwise rotation selects 1, 2, 3 and so on. Counter-clockwise rotation of the knob, decreases the selected channel in steps of 1.
When pulled to the "out" position (left click), the knob selects the emergency frequency 121.500 MHz for transmission and reception.

Radio 1 and Radio 2 Readout Displays

Adjacent to its respective radio volume control and channel selector knob, the radio readout display shows the selected channel, operating mode and transmission/reception symbols.

NOTE:

To preserve compatibility with default MSFS radio system and with automatic communications management, the simulator can change the frequency automatically when needed irrespective of pilot channel selection. The HUP will therefore always show the currently selected frequency, which may differ from the frequency associated to the currently selected channel, if it has been changed automatically by the simulator.

NOTE:

Radio presets can be set by the user, on PC, by editing the MissionDataLoader.xml – which can be commanded to load from the MNTC format. Please see APPENDIX A for details.

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Left Hand Glareshield Controls

The Manual Data Entry Facility (MDEF), on the left hand glareshield, contains the radio 1 and radio 2 subsystem keys and the associated moding keys. Data relevant to the radio 1 and radio 2 subsystems is able to be displayed on the read out lines and entered/edited via the data entry keyboard.

Radio 1 and Radio 2 Subsystem Keys

The radio 1 and radio 2 subsystem are identical in operation and are selected/deselected using the RAD1 or RAD2 subsystem keys (SSK).

Associated Moding Keys

Upon selection of the applicable SSK (RAD 1 or RAD 2 shows boxed) the following modes/data entry options are available on the moding keys (MK):

NRW/BRD Controls reception over a broad or narrow band (no function in the sim)

MAN/PSET Allows the operating frequencies to be defined by the pilot for both manual and preset channels.

SQ ON/OFF Deselects the automatic squelch facility, to assist in hearing weak signals at the expense of increased background noise (no function in the sim).

GRDU/GRDV Selects the guard receiver to either the UHF or VHF guard frequency, or selects the receiver OFF (no function in the sim).

NORM/LOW Selects between NORMal and LOW transmitter power output, to reduce emission power and enhance stealth characteristics (no function in the sim).

HAIL ON/OFF Allows the pilot to select the Saturn Hail facility (no function in the sim).

TX TIME Allows the pilot to transmit his time (time of day, TOD) to a receiving platform (no function in the sim).

RX TIME Allows the pilot to receive an operating time from another platform (no function in the sim).

The boxed moding keys correspond to the current channel selected on the radio channel selector. To alter this, press the corresponding moding key (the applicable caption will show boxed).

Rear Left Hand Console Controls
The rear left hand console contains the duplicate PTT switch, the TACAN/MLS volume controls, the amplifier selector switch, the default volume selector switch, the missile audio/telebrief volume control and the MIDS A / B volume control.

Rear Right Hand Console Controls
The radio 1 and radio 2 transmit switches and the voice warning control switch are contained on the rear right hand console, inside the battery Gangbar.

MHDD RADIO FORMAT

1 – PAGE UP/DOWN*
2 – RADIO 2 (not selected)*
3 – CURRENT CHANNEL IN USE*
4 – CHANNEL IDENTIFIER (if available)**
5 – CLEAR/SECURE STATUS
6 -CHANNEL FREQUENCY
7 – CHANNEL NUMBER (“M” FOR MANUAL)
8 – RADIO 1 (selected)*

* - can be operated with XY Controller ** - can be configured via an external file (PC only)

COMMUNICATION EQUIPMENT – CONTROLS AND INDICATORS (1 of 3)

1 – RADIO 1 SUBSYSTEM KEY
2 – RADIO 2 SUBSYSTEM KEY
3 – MANUAL/PRESET MODING KEY
4 – SQUELCH MODING KEY
5 – BANDWIDTH MODING KEY
6 – POWER SELECTION MODING KEY
7 – GUARD RECEIVER MODING KEY
8 – HAILING FUNCTION MODING KEY
9 – RADIO 1 CHANNEL SELECTOR KNOB
10 – RADIO 1 VOLUME CONTROL
11 – RADIO 1 FREQUENCY
12 – RADIO 1 OPERATING MODE, GUARD MODE AND TRANSMIT/RECEIVE
13 – RADIO 1 SELECTED CHANNEL (“M” FOR MANUAL)
14 – RADIO 2 VOLUME CONTROL
15 – RADIO 2 CHANNEL SELECTOR KNOB
11 – RADIO 2 FREQUENCY
12 – RADIO 2 OPERATING MODE, GUARD MODE AND TRANSMIT/RECEIVE
13 – RADIO 2 SELECTED CHANNEL (“M” FOR MANUAL)

COMMUNICATION EQUIPMENT – CONTROLS AND INDICATORS (2 of 3)

1 – COMMUNICATION CONTROL SWITCH
2 – MIDS A CONTROL
3 – MIDS B CONTROL
4 – MISSILE TONES CONTROL
5 – TACAN AND MLS VOLUME CONTROL
6 – INTERCOM VOLUME CONTROL
7 – DUPLICATE PTT SWITCH
8 – AMPLIFIER SELECTION SWITCH
9 – DEFAULT VOLUME SELECTOR SWITCH

COMMUNICATION EQUIPMENT – CONTROLS AND INDICATORS (3 of 3)

1 – VOICE WARNING CONTROL SWITCH
2 – RADIO 1 TRANSMIT SWITCH
3 – RADIO 2 TRANSMIT SWITCH
4 – MIDS SWITCH

WARNING EQUIPMENT

Audio Warning Equipment
The Communications and Audio Management Unit (CAMU) provides and controls the communications. When a failure occurs to which the crew need alerting, the relevant system sends the warning to the master CSG, where it is categorized and prioritized. The CSG outputs the warnings to the Dedicated Warning Panel (DWP), triggers the attention getters and CAMU to output the necessary attensons and voice warnings.
Voice warnings, except catastrophic warnings, can be disabled by selecting OFF at the voice warning audio control to the rear of the right console.

Warnings Management and Failure Analysis

Introduction
Under normal operating conditions, all on-aircraft systems are automatically monitored for failures. Failures that directly affect aircraft operation or require pilot compensation or corrective action are warned to the pilot through the warning system. Failures that do not directly affect aircraft operation are not warned to the pilot, but are recorded through the Integrated Monitoring and Recording System (IMRS) for subsequent investigation and fault analysis.

The warnings are presented by some, or all of the following devices:
- flashing attention getters
- a caption on the Dedicated Warnings Panel (DWP)
- an attention getting sound (attenson)
- a voice warning message

All warnings are either related to aircraft systems or are of a procedural nature and are assigned a category according to the POF, and are also prioritized within each category. The categories are Catastrophic, 1, 2, 3 and 4 in descending order of priority.

During start-up/shutdown, warnings are suppressed to prevent an array of warnings due to inactive equipment or systems.

Catastrophic Warnings
A catastrophic failure is an event which makes it impossible for the aircraft to continue safe flight and handling. Immediate pilot action is advised which, under some circumstances, may be immediate ejection.

Category 1 Warnings
A category 1 warning is of a procedural nature and warns of a hazardous situation that requires immediate action.
Upon receipt of a category 1 warning, the attention getters flash and the voice warning message is heard. Pressing one of the attention getters acknowledges the warning.

Category 2 Warnings
A category 2 warning is related to aircraft systems and warns of a primary failure that requires immediate action.
Upon receipt of a category 2 warning, the attention getters and the related DWP red caption flash, and an attenson is heard, which is followed by a voice warning message.

Category 3 Warnings
A category 3 warning is also related to aircraft systems and warns of a primary failure that requires attention.

Category 4 Warnings
A category 4 warning is procedural only and provides advice or information of a procedural nature.
Upon receipt of a category 4 warning, a voice warning message is played twice and then stops. It can also be stopped by pressing one of the attention getters (even though they are not flashing - not active for this category of warning).
There are no DWP warning indications for a Category 4 warning.

Get-U-Home Warnings
The GUH warnings are all category 2, except for one (CPT DISP) which is category 3. They are presented to the pilot as described for other category 2 and 3 warnings.

Dedicated Warning Panel
The Dedicated Warnings Panel (DWP) is situated on the right quarter panel. It consists of a reconfigurable, dot matrix type display capable of presenting 27 captions simultaneously, in three columns of nine. The bottom row of three is reserved for captions related to catastrophic warnings.

The captions are presented in the order of priority, from the top to the bottom of the display. Captions associated with systems on the left of the aircraft are displayed on the left of the display; similarly on the right.

The captions are presented such that any red captions always appear at the top of the DWP, with any amber captions beneath them, in their appropriate columns.

Warning Panel Mode Push Button/ Indicator
The warning panel mode push button/indicator, under normal circumstances, is available for selection at all times. This is indicated by illumination of the status bars on the REV push button. Upon selection the DWP enters a reversionary "get-u-home" mode of operation. In addition to manual selection, reversionary mode is engaged automatically when the DWP loses one of its two power supplies, or the avionics data bus fails.
After a manual selection of the reversionary mode, further selection of the push button causes the panel to revert back to the normal mode of operation.

Warning Panel Paging Push Button/ Indicator
The warning panel paging push button/indicator, enables the pilot to scroll through two pages of warnings (if a second is present). If the number of warnings that have been triggered exceed two pages, captions for additional warnings are not displayed.

Fire Warning System
Introduction
Engine bay fires are detected by fire-wire detectors located in each engine bay. When a fire is detected a category 2 warning is initiated, with the associated flashing attention getters. A Dedicated Warnings Panel (DWP) caption is displayed, and an attenson and voice warning message are played.

Get-U-Home Warnings
General
In the event of a failure of the displays and/or warning systems associated data bus, or a loss of one of its two power supplies, the Dedicated Warnings Panel (DWP) enters a reversionary GUH mode. This mode is also selected when a fault is detected within; the DWP, the link between the DWP and Computer Symbol Generator (CSG), or if data from the CSG is in error. The reversionary mode can also be selected manually via the REV push button indicator next to the DWP. For further details of DWP operation, refer to Dedicated Warning Panel pag. 1-

The GUH warnings are listed, with captions, as follows:
- Left engine fire (L FIRE)
- Essential DC failure (ESS DC)
- Right engine fire (R FIRE)
- Double AC failure (AC)
- Low hydraulic pressure in left control circuit (L CONT P)
- Loss of oxygen system (OXY)
- Low hydraulic pressure in right control circuit (R CONT P)
- APU fire (APU FIRE)
- Double CSG/CIU failure (CPT DISP).

I
n addition, the DWP also displays any catastrophic warnings. These warnings are hardwired and, therefore, can also be displayed in the event of a total loss of power to the DWP. All GUH warnings and the associated audio messages are identical to those in normal operation.

DEDICATED WARNING PANEL

1 – Warning Panel Mode Push-button/Indicator

2 – Warning Panel Paging Push-button/Indicator

CATASTROPHIC WARNINGS

CAUSE	***VOICE MESSAGE***	***CAPTION***
Double Hydraulic System Failure	Double Hyd Fail	HYD TOT
FCS related problems that impact handling	Reversionary Envelope	REV ENV

REVERSIONARY WARNINGS

CAUSE	***VOICE MESSAGE***	***CAPTION***
Left Engine Fire	Left Engine Fire	L FIRE
Left Control Circuit Hydraulic Pressure	Left Control Pressure	L CONT P
Essential DC Failure	Essential DC	ESS DC
Double AC Generator Failure	Double AC	AC
Double CIU/GSG Failure	Cockpit Display	CPT DISP
Oxygen	Oxygen	OXY
APU Fire	APU Fire	APU FIRE
Right Engine Fire	Right Engine Fire	R FIRE
Right Control Circuit Hydraulic Pressure	Right Control Pressure	R CONT P

CATEGORY 1 WARNINGS

CAUSE	**VOICE MESSAGE**
MASS Not Live (depending on PoF)	Mass Not Live
Gear Down Limit Speed	Gear Limit
Landing Gear not lowered and - airspeed below 180 knots and - altitude below 300 feet and - throttle levers below 75%	Landing Gear
Radar Altimeter Low Height (depending on Pof)	Low height
Low speed	Speed Low Recover
Park brake (takeoff and landing only)	Park Brake

CATEGORY 2 WARNINGS

CAUSE	***VOICE MESSAGE***	***CAPTION***
Left Engine Fire	Left Engine Fire	L FIRE
Right Engine Fire	Right Engine Fire	R FIRE
APU Fire	APU Fire	APU FIRE
Left Control Circuit Hydraulic Pressure	Left Control Pressure	L CONT P
Right Control Circuit Hydraulic Pressure	Right Control Pressure	R CONT P
Low Pressure in Left Utility Hydraulic Circuit	Left Util	L UTIL P
Low Pressure in Right Utility Hydraulic Circuit	Right Util	R UTIL P
Left Engine Flameout	Left Engine Flameout	L HEAT
Right Engine Flameout	Right Engine Flameout	R HEAT
Left Engine Performance	Left Engine Performance	L ENG P
Right Engine Performance	Right Engine Performance	R ENG P
Left Engine Oil Pressure	Left Oil Pressure	L OIL P
Right Engine Oil Pressure	Right Oil Pressure	R OIL P
Essential DC Failure	Essential DC	ESS DC
Double AC Generator Failure	Double AC	AC
Nose Wheel Steering	Nose Wheel Steering	NWS
Canopy Not Locked	Canopy Not Locked	CANOPY
Ladder Not Stowed And Locked	Ladder Not Stowed	LADDER

CATEGORY 3 WARNINGS

CAUSE	***VOICE MESSAGE***	***CAPTION***
Left AC Generator Failure	Left Generator	L GEN
Right AC Generator Failure	Right Generator	R GEN
Environmental Control System Failure	ECS	ECS
Fuel Low Level	Fuel Low	FUEL LOW
Nose Wheel Steering	Nose Wheel Steering	NWS

CAUSE	*VOICE MESSAGE*	*CAPTION*
Fuel Transfer	Fuel Transfer	XFER
Electrical First Fail	Electrical First Fail	ELEC 1
ACS Failure	ACS Fail	ACS FAIL

CATEGORY 4 WARNINGS

CAUSE	*VOICE MESSAGE*
Radar Altimeter Low Height (depending on PoF)	Low Height
Throttle override	Auto-throttle
Autopilot override or autopilot out of limits	Auto-pilot
Auto-recover selected	Auto-recover
Auto-pull-up	Auto-pull-up
FCS override	FCS override
Passing 5000ft check height	Five Thousand Feet
Disengagement of baro alt autopilot dropout	Altitude mode drop-out
Supersonic advance warning	Transonic
Bingo 1	Bingo 1
Bingo 2	Bingo 2
Bingo 3	Bingo 3
Bingo 4	Bingo 4
Autocue failure	Autocue
DWP failure	DWP fail
VVR failure	VVR fail
VVR run time check	Check VVR
VVR tape end	VVR tape end
Terrain valid for GPWS	Terrain Valid
Obstacle valid for GPWS	Obstacle Valid
Mode 4 Incorrect own response	Mode 4 Response
IFF transponder ACC available	Transponder ACC available
IFF interrogator ACC available	Interrogator ACC available
MASS Not Live (depending on PoF)	MASS Not Live
Maximum Speed Exceeded	Max Speed-brake
Auto-throttle reheat required	Select Reheat
Chaff Empty	Chaff Empty
Flares Empty	Flares Empty
Center Line Tank Empty	Center Tank Empty
Wing Tanks Empty	Wing Tanks Empty
Radios Common Tuning	Frequency

SUIRVELLANCE/ATTACK AND IDENTIFICATION

Surveillance/Attack and Identification Subsystem General Description

The Attack and Identification Subsystem enables detection, acquisition, identification, prioritizing and engagement of air, ground and sea targets, during day and night, in all weather conditions and consists of the following equipment:
- RADAR
- IFF Interrogator
- IFF Transponder
- Attack Computer

NOTE
In the initial version of the simulation the system can only air targets.

NOTE
Actual system performance and some operational details are classified. This simulation should not be considered a reliable source of information on the real systems and sensors performance and operation.

NOTE
Some details in the operation and performance of the sensors and the surveillance subsystems have been altered for gameplay reasons and/or to avoid exposing potentially restricted information.

Sensor Data (Plots, Tracks, Targets)

Types of sensor data
Sensor data will be presented as plots, tracks or targets.

Plots
Plots are detections of the radar or IFF interrogator which have not been correlated with previous detections. A maximum of 60 plots will be displayed.
Plots detected by the radar are displayed as
3 x 1.5 mm amber coloured rectangles.
The plots are displayed for a finite time: the "ageing" time of the plots is usually controlled automatically (AUTO) but can be defined by selecting the "AGE" soft key. Settings of 5, 10 and 15 seconds will be available by toggling through the displayed menu options on the attack format using the plot ageing soft-key and leaving the boxed symbol over the desired option for three seconds. The new plot ageing option is displayed on the soft-key

Tracks
Tracks are detections of one or more sensors which have been correlated with previous detections.
In TWS the radar will automatically determine which plots are to be tracked (up to 20 tracks), dependent on relative priorities of sensor detections.

Different track symbology outline indicates which sensors are supporting a track. The pilot may use this information to reschedule the search priorities of a sensor e.g. Radar.

NOTE
In the initial version of the simulation the system can only supports tracks detected by the radar.

The correlated track symbols will be displayed with velocity vector and the various Extra Information, which contain the accumulated knowledge from all available sensors and provide the best understanding of track movement and track identity.

Targets
Tracks can be nominated as targets for attack by using the XY controller and the target management switch.

NOTE
In the initial version of the simulation the system can only support two targets.

Indication of Track/Target Data

Display of Track/Target Data on MHDDs
Tracks are displayed with a bright white outline.
Targets are displayed with a double white outline.
To differentiate the number one target track symbol it has a bright white double thickness outline.

Display of Track/Target Data on HUD
Targets are displayed on the HUD in three different sizes of Target Designation (TD) boxes to give an indication of track range. The largest TD box indicates range less than 10 NM, medium indicates between 10 and 20 NM, and the smallest indicates range greater than 20 NM.
A maximum of eight TD boxes can be displayed on the HUD at any one time.
The TD box for the number one DTL target is displayed on the HUD at all times; when the target moves out of HUD-FoV the TD moves along the HUD boarder and blinks.
TD boxes, which have a medium range missile in flight against them are marked by a cross and will disappear outside HUD-FoV.
A range countdown circle indicates that the number one target is less than 12 000 feet.
Memorized objects are displayed as follows, because no colour is available on HUD

Simulated Target
For training purpose the Attack Computer can generate a synthetic track, selectable on the MDEF via the MISC SSK and SIM TGT MK.
It will be presented with the following default values:
– Azimuth: 20 left of own heading
– Altitude: 10 000 ft below own aircraft height (minimum 5000 ft above MSL)
– Slant range: 50 NM
– Ground speed: 400 Kts
– Ground-track: straight and level opposite of own heading.
To start again with default values, the SIM TGT function must be de- and reselected on the MDEF.

Extra Track/Target Information

Extra information on tracks/targets are shown in two Read Out Lines (ROL) on the bottom of the Attack format either on default or by selecting with XY controller.
The left ROL displays number one target information only and will be blank if no number one target is available.
The right ROL shows information of second priority target.

Manual Deletion of Targets

Targets. which tactically can be ignored, can be deleted when for example causing the automatic scan centring facility to scan in a non optimal scan volume.
The deletion of the track will only be temporary if the track is of sufficient priority and still detectable within the scan volume.
Target or track deletion can be done in TWS only and is achieved by "picking up" the Bin icon by XY insert on the bin, positioning the bin by XY over the required target or track, and inserting again.

Bogus Weapons

To allow the pilot to train with a variety of different weapons and associated attack profiles, a "Bogus" weapon facility is provided within the Armament Control System (ACS). Air-to-air weapons are simulated within the ACS when the facility is enabled, and - in terms of moding and displays and controls response - the system behaviour is almost identical to that when real weapons are carried.
Bogus weapons are only available when there are no "real" weapons carried on the aircraft. A mix of real and bogus weapons will not be accepted from the ACS. This also relates to the gun - bogus is not available if there are any gun rounds loaded. The only "real" stores that may be carried while still accessing Bogus are external fuel tanks and SRAAM training (acquisition) rounds or ACMI pods. Also, for Bogus to be available, the mission PDS load must be configured with bogus stores whilst on the ground, as must the Maintenance Data Panel (MDP). The ACS compares the PDS with the MDP on initialization, and will only provide Bogus if both configurations agree. Failures will be indicated on the MHDD Autocue and Stores format with an “all stores inhibit cross” and “red infilled boxes” at the affected store.

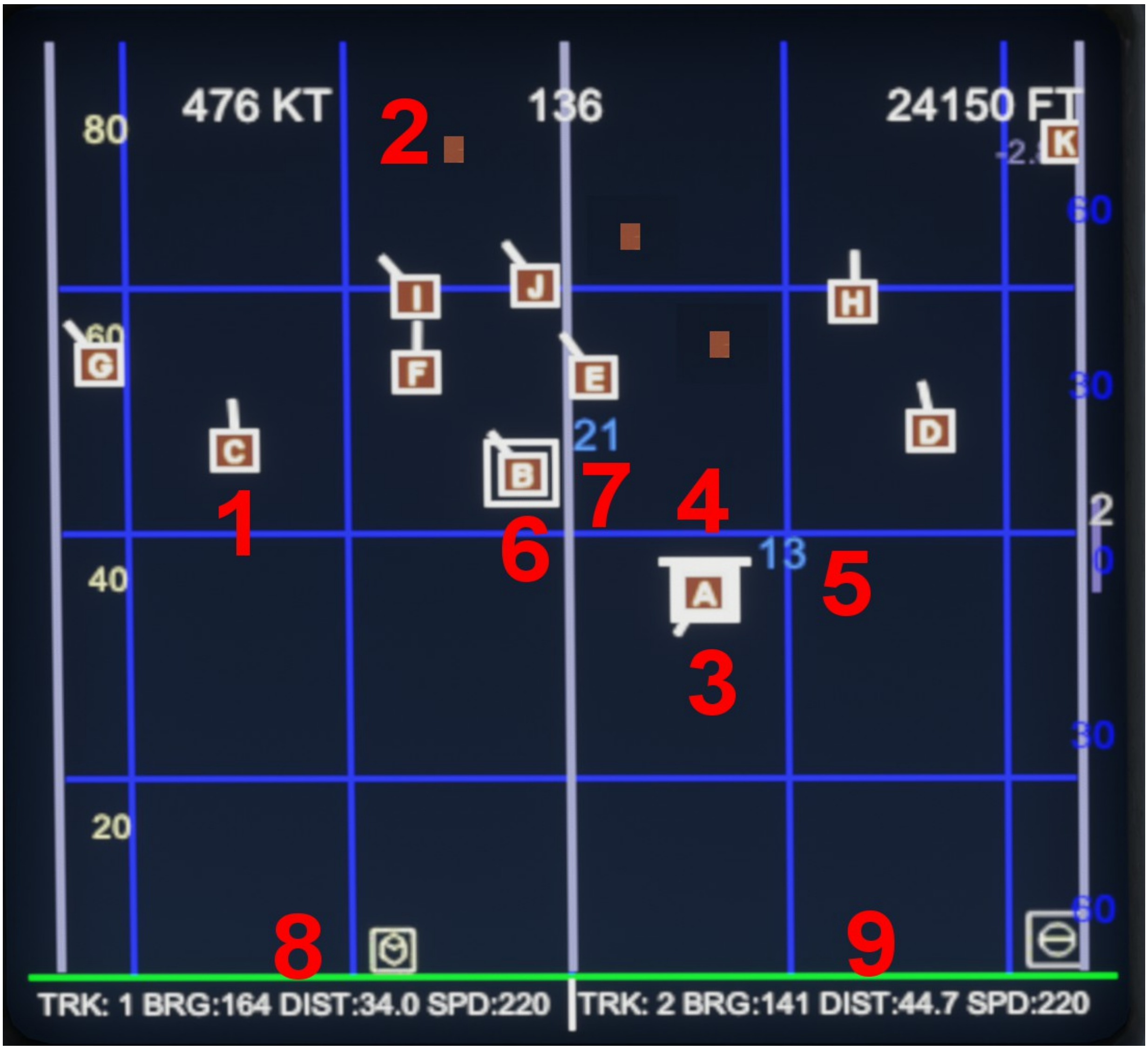
TYPICAL AIR-TO-AIR MHDD CONFIGURATION

Radar is operating in Track While Scan (TWS mode)

LMHDD – Attack format, B-Scope option

CMHDD – Pilot Awareness format

RMHDD – Elevation format, Profile option



TYPICAL PRESENTATION OF RADAR PLOTS, TRACKS AND TARGETS

1 – Track icon. The letter insider the track ("C" in the example) identifies the track. The line starting from the track centre indicates the direction of the track. A maximum of 20 tracks can be displayed

2 – Plot icon. This indicates that the radar has detected an object but it is not assigned to a track.

3 – Primary target icon.

4 – Relative altitude icon. A line on the top of the icon indicates that the target is at least 10,000 feet below the plane. A line on the bottom of the icon, indicates that the target is at least 10,000 feet above the plane.

5 – Target altitude in thousands of feet (13 = 13,000 feet).

6 – Secondary target icon.

7 – Secondary target altitude in thousands of feet.

8 – Primary target data: track number, bearing, distance, speed (knots)

9 – Secondary target data: track number, bearing, distance, speed (knots)

See radar section for further information

RADAR

General

The Radar is the primary sensor for target detection, tracking and engagement.
The radar with a high degree of automation of functions to minimize pilot workload and to provide optimum performance over a wide range of ambient and target conditions.

The radar provides Air-to-Air (A/A) search, Lock Follows (LF) and Air Combat Modes (ACM) against Air-to-Air targets and Air-to-Surface (AS) mapping.

The Hands On Throttle And Stick (HOTAS) concept utilizes switches on the stick and throttle to allow the pilot to control the weapons, sensors and displays during time critical portions of the attack. After a target is visually detected, the pilot never needs to look away or remove his hands from the throttles and the control stick.

Attack steering information is automatically presented on the Head-Up Display (HUD) and on the Attack Format (AF) of the Multifunction Head Down Display (MHDD).

The radar provides the following modes:
- Air-to-Air Modes (A/A), including Air Combat Modes (ACM)
- Air-to-Surface Modes (A/S), (RBGM only)

NOTE

In the initial release of the simulation, only A/A search and track modes are supported. Lock-Follow, ACM and AS mapping modes are not supported in the initial release.

Air-to-Air Modes

In the simulation, the radar operates in the following air-to-air modes:
A/A Search and Track Modes
- Track-While-Scan (TWS)
- Velocity Search (VS)

Track-While-Scan (TWS)

TWS is the most important and most used radar search mode. It detects and automatically tracks airborne returns and provides outputs of track range, bearing, velocity, altitude, heading, approximate RCS and aspect angle.

TWS can be entered directly by selection TWS on the MHDD/ATCK format from any other primary mode.

The TWS mode's primary function is to provide medium- to long-range situational awareness. TWS is required to provide simultaneous target detection and tracking over a large scan volume.
The scan volume and scan centre is manually definable by the pilot. The scan centre is also controlled automatically by the radar when Auto Scan Centring facility (ASC) is selected or when a track is nominated as target.

When either Scan Centring (Auto/Manual) option is selected, and no targets are nominated, the elevation bars are automatically adjusted according to the selected range on the attack format.

With TWS selected the radar is capable of tracking up to 20 tracks and subsequently detecting and displaying 60 additional plots.

Velocity Search (VS)

Velocity search is used against targets with closure rates greater than own ship ground speed and therefore preferred against forward aspect targets. Generally, VS is used to detect long range targets. VS provides target detection as a function of target velocity relative to the own aircraft velocity (doppler shift) and provides an output of closing speed and bearing. Target data is presented in a B-scope velocity-azimuth format as a `plot'.

A/A Lock-Follow Modes (LF)

General

Three lock-follow modes, which are optimized for their specific tasks, are available as follows:
- Single-Target-Track (STT)
- Visual Identification (VISident); if no weapon is selected
- Gun; if gun is selected as weapon type

NOTE

Lock-Follow Modes are not supported in the simulation

Air Combat Modes (ACM)

General

The radar air combat modes are designed for the short range, air combat manoeuvring, where rapid automatic radar acquisition and lock on of a visually detected target is desired.

The following radar air combat modes are available:

- Slaved Acquisition (SACQ),
- Vertical Acquisition (VACQ),
- HUD Acquisition (HUDACQ).

NOTE

Lock-Follow Modes are not supported in the simulation

Radar Mode Transition After Takeoff or Landing

On ground the radar automatically enters the SBY mode after switch-on and warm up. On T/O, weight off-
wheels, the radar is automatically put into the TWS mode, provided no other radar mode, e.g. VS has been pre-selected.

Radar Controls
Moding and function control selections requiring pilot action is performed via:

- Radar switch on and switch off (hardwired)

- Radar Protective Interlock Override switch on left console

- MDE Subsystems Keys (SSK) and Moding Keys (MK) on the Left Glareshield (LGS).

- HOTAS radar control switches (Stick and Throttles):

• Stick Controls (ACM modes, Radar Lock/ Break Lock)

• Throttles Controls (Elevation Scan control, X-Y controller)

- SKs (located left, right and bottom of the MHDD formats)

- Right Console - Gangbar RADAR/OFF switch

After switch on the radar will perform PBIT functions and warm-up, for a total of approximately 4 minutes.

Transmit and receive operations are inhibited during warm-up on ground and in flight.

Left Console - Radar Protective Interlock Override switch
The cover-guarded, two position toggle switch labelled RADAR selects either the OVRD or NORM operating status.

Left Glareshield – MDEF XMIT (SSK)
After power up the SSK XMIT is available for selection. The SSK XMIT will enable a set of Moding Keys (MK) described below to manage radar modes, channels and transmission inhibit.

RDR SBY/RDR ON (MK)
The MK RDR SBY or RDR ON will be displayed when SSK XMIT is selected, provided the radar is powered up, i.e. switched on (gang-bar RADAR) and PBIT cycle is completed. On ground the radar is defaulted to SBY.

RDR CHAN
RDR CHAN has no function in the simulation.

ALL NORM
Boxed by default, indicating that all transmitters are enabled for transmitting. The MKs for the individual transmitters are displayed for pre-selections of the program mode.

ALL SLNT
If selected, ALL SLNT is boxed, indicating that all transmitters are inhibited from transmitting.

PROG
If selected PROG is boxed; ALL NORM or ALL SLNT MK are deselected. Any of the system controls set to SLNT will be boxed, those set to NORM will not be boxed.

RDR NORM/SLNT
This individual transmitter MKs act as preselectors when PROG is not selected. The pre-selections for this individual transmitters are default to NORM when XMIT is pressed, but can be modified through a PDS load. When ALL NORM is selected (boxed) any selection of an individual transmitter key will preselect the relevant transmitter to either SLNT or NORM.

HOTAS Controls and Functions
The following functions are selectable via the switches on the control stick and throttle.

The following HOTAS controls can be used to control the radar functionality:

- Radar Elevation

- Primary and Secondary Target Designation

- Scan width and scan volume centre (depending on MHDD mode)

- Elevation bar scan settings (depending on MHDD mode)

- Rejection of designated targets

See the description of individual radar presentation format in the following pages for details on HOTAS controls.

Sensor Management

Scan Volume/Center
In Air-to-Air search modes the radar scan volume (azimuth/elevation in RWS/TWS, velocity in VS) can be adjusted with XY controller as long as the maximum frame time is not exceeded.
Note that there is no range selection for A/A modes beside the range selection on the Attack Format, which only selects the displayed range.
The following default scan volume is set after first radar switch on since aircraft power up:
- two bars
- maximum azimuth width
- elevation angle zero (horizon stabilized)
- 80 NM range scale in TWS on AF or
- maximum velocity scale in VS on AF.

The default volume is also accessed via the SK DFLT on the AF as well as on initial entry of the TWS mode.
On subsequent radar power up the previous scan volume parameters are used.

When the default selections are altered via PSMK this pre-defined default conditions will be restored. The centre of the scan area can either be adjusted manually or is set automatically when Auto Scan Centring facility (ASC) is selected.

Automatic Radar Scan Centring

In TWS mode an Auto Scan Centring facility (ASC) is available. This can be selected manually via the SK SCAN MAN/AUTO or is selected automatically when a track is nominated as target.
This enables the radar to automatically position the search volume in a way, where all actual search tracks can be optimally maintained. This means that the radar scan centre in azimuth and elevation is automatically positioned to the geometric centre of all current radar tracks.

Automatic Radar Bar Setting

If the pilot manually modifies the radar scan centre, ASC is automatically deselected. If no radar tracks are available the position of the radar scan centre for ASC equals the last scan centre position prior to the ASC selection.
Selection of Lock Follow will not cancel ASC, return to TWS will centre on the last lock position.
If the last remaining track is deleted then the radar centre remains space stabilized with respect to the scan centre at the time when track was deleted.

Manual Radar Scan Control

NOTE

In the real plane, manual scan volume control in azimuth is achieved by “dragging” the elements in the radar formats via the XY Cursor.

In the simulation, azimuth control is achieved similarly via the XY Cursor, but INSERT must be performed on specific areas of the format.

Azimuth Scan Center

For all search modes the scan centre can be moved by XY controller in azimuth and elevation within the radar gimbal limits. Insert anywhere within four mm of the scan volume line or centerline, slew as required, and insert to drop at the desired position. The scan volume will always remain symmetrical and when the radar gimbal limit is reached no further centerline movement is possible.
Any changes in the scan centre will be reflected on the Attack, Elevation, and PA formats.
With radar at maximum azimuth scan width no centerline adjustment is possible.
When the radar is in warm up, in Passive or inhibited from transmitting, the line is shown dashed.

Azimuth Scan Width

The scan width (length of the bars) can be moved with the XY controller by inserting anywhere within four mm of either scan width line and slewing it to the desired angle. The scan width then alters symmetrically on both sides about the centre line. A second insert will “drop” the scan coverage line at the desired position.
When the radar is in warm up, in Passive or inhibited from transmitting, the lines are shown dashed.

Elevation Scan Center

The elevation angle in relation to the horizon is controlled by the scanner elevation control wheel on the throttle top. The current radar elevation scan centre is indicated on the AF top right corner with a positive or negative two digit number. Manual control is only active in VS, TWS and RBGM. In ACM or LF the elevation is controlled automatically, in SBY not acknowledged.

Elevation Scan Height

The elevation scan height (number of bars) is adjusted by selecting the white bar icon on the right side of the AF with the XY controller. Stepping through the number of bars (1, 2, 4, 6 or 8) is displayed with this icon. Default on initial power up will be two bar (unless PSMK defined). The scan coverage symbol length will vary with number of bars selected. Shortest with one bar selected and longest with eight bars selected. The radar bars will be positioned symmetrically about the elevation scan centre When the radar is in ground mapping mode the length of the line will be fixed as for two bar scan.

NOTE
All manual scan settings may be cancelled quickly by selecting SCAN to AUTO or selecting DFLT on the AF.

Designate primary and secondary targets

Primary and Secondary targets can be designated via the HOTAS commands (see HOTAS section) or via the dedicated soft-keys.

The dedicated soft keys can be occulted in the maintenance menu for realism, as they have been added to the simulation for gameplay purposes.

Attack Format (ATCK) – B-Scope

The MHDD/ATCK format provides the primary display and feedback to the pilot for sensor control, attack conversion cueing, and weapon launch cueing. The MHDD/ATCK format is automatically displayed by default on the LMHDD in T/O, NAV, CMBT and APP/LDG POFs. The default presentation is B-Scope, that is azimuth versus distance. Note that the radar detection ranges IS NOT affected by the display range setting. If a primary target is designated, display range will change automatically to adapt to the primary target distance.

1 – Radar scan volume centre (line is dotted if radar is not operational). If the radar scan volume is not maximized, it is possible to steer it by INSERTing the XY Cursor at the centre of the display, and then moving the XY Cursor left or right. A further INSERT command will release line and return to normal XY Cursor.

2 – Radar scan volume left limit.

3 – Radar scan volume left limit “insert” area. Placing the XY Cursor in this area, and commanding an INSERT allows the user to adjust the scan width. A further INSERT will make the XY Cursor to return to the normal state.

4 – Radar scan volume right limit.

5 – Radar scan volume left limit “insert” area. Placing the XY Cursor in this area, and commanding an INSERT allows the user to adjust the scan width. A further INSERT will make the XY Cursor to return to the normal state.

6 - “BIN” icon – XY Cursor INSERT on this icon will delete the secondary target first, and then the primary target.

7 – Manual Elevation bar setting (“2” shown in the example means 2 bars)

8 – Analogue radar elevation coverage

9 – Digital elevation value of the scan volume centre

10 – B-Scope upper limit: bumping the XY cursor against the upper border will increase the display range (but has no effect on the radar range)

11 - B-Scope lower limit: bumping the XY cursor against the upper border will decrease the display range (but has no effect on the radar range)

The following SKs are available in the simulation

PPI / B-SP – switches between PPI and B-Scope presentations

TWS/VS – switches between Track-While-Scan and Velocity Search radar modes

SCAN – switches between AUTO and MANUAL scan modes

AGE AUTO – selects plots and tracks ageing value

DFLT – resets the radar to default values

The following SKs are available in the simulation, if the player does not opt to occult them in the MNTC menu (these are not present in the real-world, but have been added for gameplay):

BIN - deletes the secondary target first, and then the primary target.

DESG TGT1 – cycles between available tracks to designate the primary target.

DESG TGT2 – cycles between available tracks to designate the secondary target.

RNG + - increases the display range (but has no effect on the radar range).

RNG - - decreases the display range (but has no effect on the radar range)

Attack Format (ATCK) – PPI

The Plan Position Indication (PPI), is an alternate presentation of the Attack format when the radar is in TWS mode. In PPI, azimuth and distance information is presented on a “plan” format, and distance marks are represented by concentric arcs originating from the aircraft. Apart from the general presentation, the functionality and the controls are identical to the B-Scope presentation and, like in the B-Scope presentation, the radar detection ranges IS NOT affected by the display range setting. If a primary target is designated, display range will change automatically to adapt to the primary target distance.

1 – Radar scan volume centre (line is dotted if radar is not operational). If the radar scan volume is not maximized, it is possible to steer it by INSERTing the XY Cursor at the centre of the display, and then moving the XY Cursor left or right. A further INSERT command will release line and return to normal XY Cursor.

2 – Radar scan volume left limit.

3 – Radar scan volume left limit “insert” area. Placing the XY Cursor in this area, and commanding an INSERT allows the user to adjust the scan width. A further INSERT will make the XY Cursor to return to the normal state.

4 – Radar scan volume right limit.

5 – Radar scan volume left limit “insert” area. Placing the XY Cursor in this area, and commanding an INSERT allows the user to adjust the scan width. A further INSERT will make the XY Cursor to return to the normal state.

6 - “BIN” icon – XY Cursor INSERT on this icon will delete the secondary target first, and then the primary target.

7 – Manual Elevation bar setting (“2” shown in the example means 2 bars)

8 – Analogue radar elevation coverage

9 – Digital elevation value of the scan volume centre

10 – B-Scope upper limit: bumping the XY cursor against the upper border will increase the display range (but has no effect on the radar range)

11 - B-Scope lower limit: bumping the XY cursor against the upper border will decrease the display range (but has no effect on the radar range)

The following SKs are available in the simulation

PPI / B-SP – switches between PPI and B-Scope presentations

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SCAN – switches between AUTO and MANUAL scan modes

AGE AUTO – selects plots and tracks ageing value

DFLT – resets the radar to default values

The following Sks are available in the simulation, if the player does not opt to occult them in the MNTC menu (these are not present in the real-world, but have been added for gameplay):

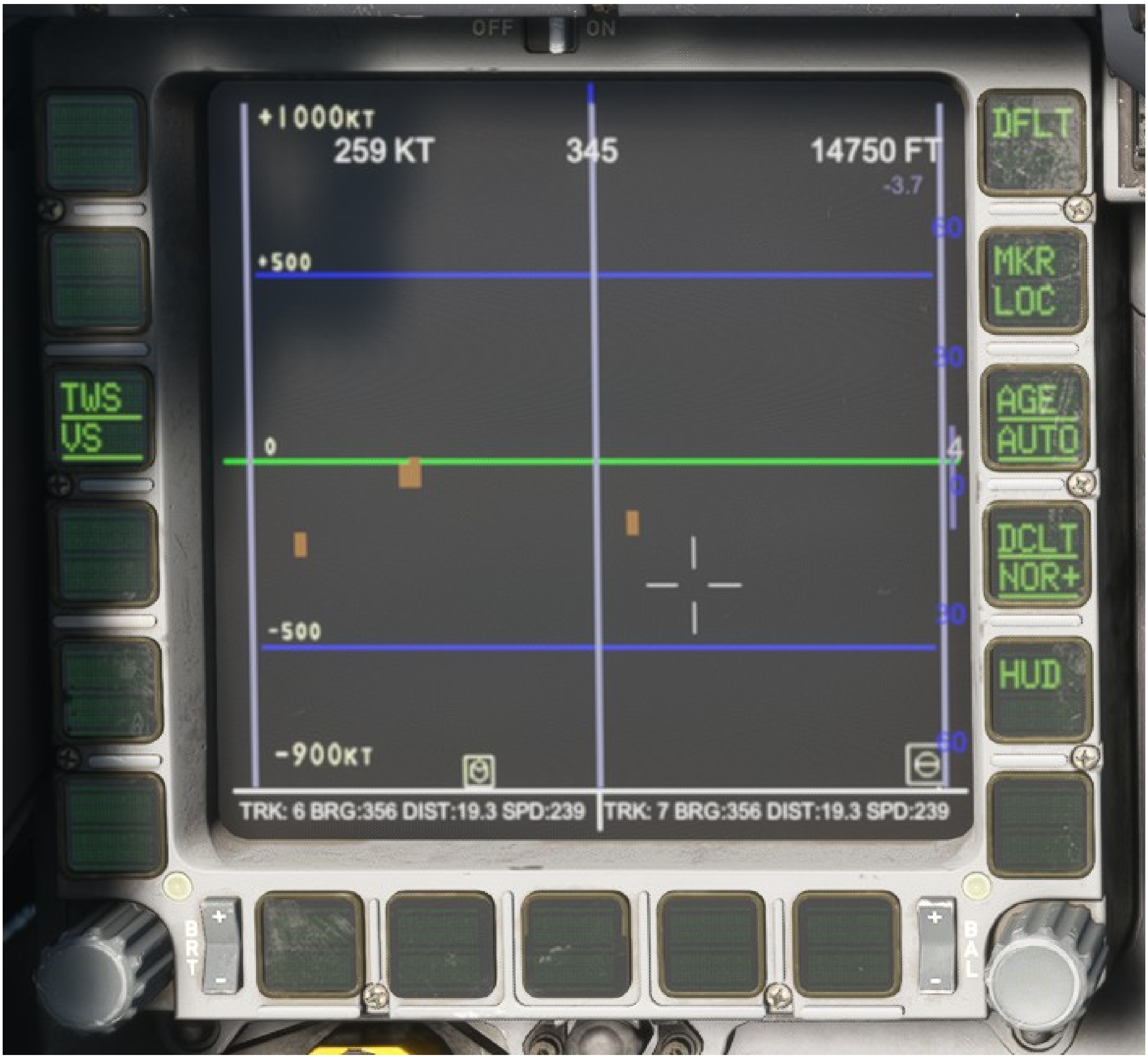
BIN - deletes the secondary target first, and then the primary target.

DESG TGT1 – cycles between available tracks to designate the primary target.

DESG TGT2 – cycles between available tracks to designate the secondary target.

RNG + - increases the display range (but has no effect on the radar range).

RNG - - decreases the display range (but has no effect on the radar range)



Velocity Search Format (VS)

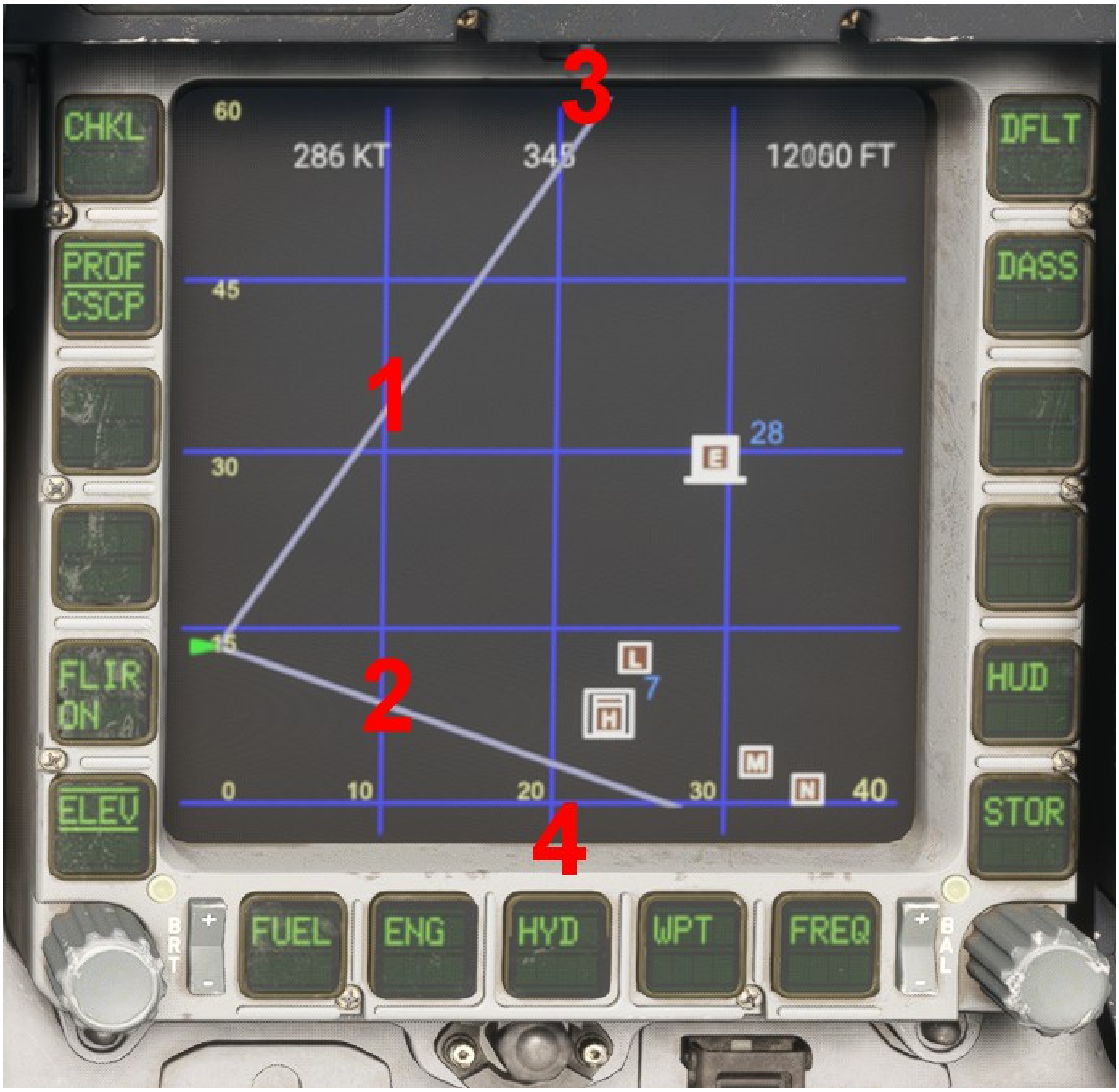
The vertical scale represents the plots contribution to the closing velocity. The bottom of the scale represents -900 KT (opening) and the top of the scale represents either +1000 KT (default). Own aircraft velocity is shown by the green line at zero range rate.

The following SKs are available in the simulation

TWS/VS – switches between Track-While-Scan and Velocity Search radar modes

AGE AUTO – selects plots and tracks ageing value

DFLT – resets the radar to default values



Elevation Format (ELEV), Profile

Radar plots and tracks are also shown on the MHDD/ELEV format, which can be selected to present either a profile or a C-Scope format. The profile format is a range/elevation format on which radar data is presented at true slant range and elevation from aircraft position. Unless a target has been designated, the elevation of the radar scan volume can be controlled via HOTAS commands (see HOTAS section)

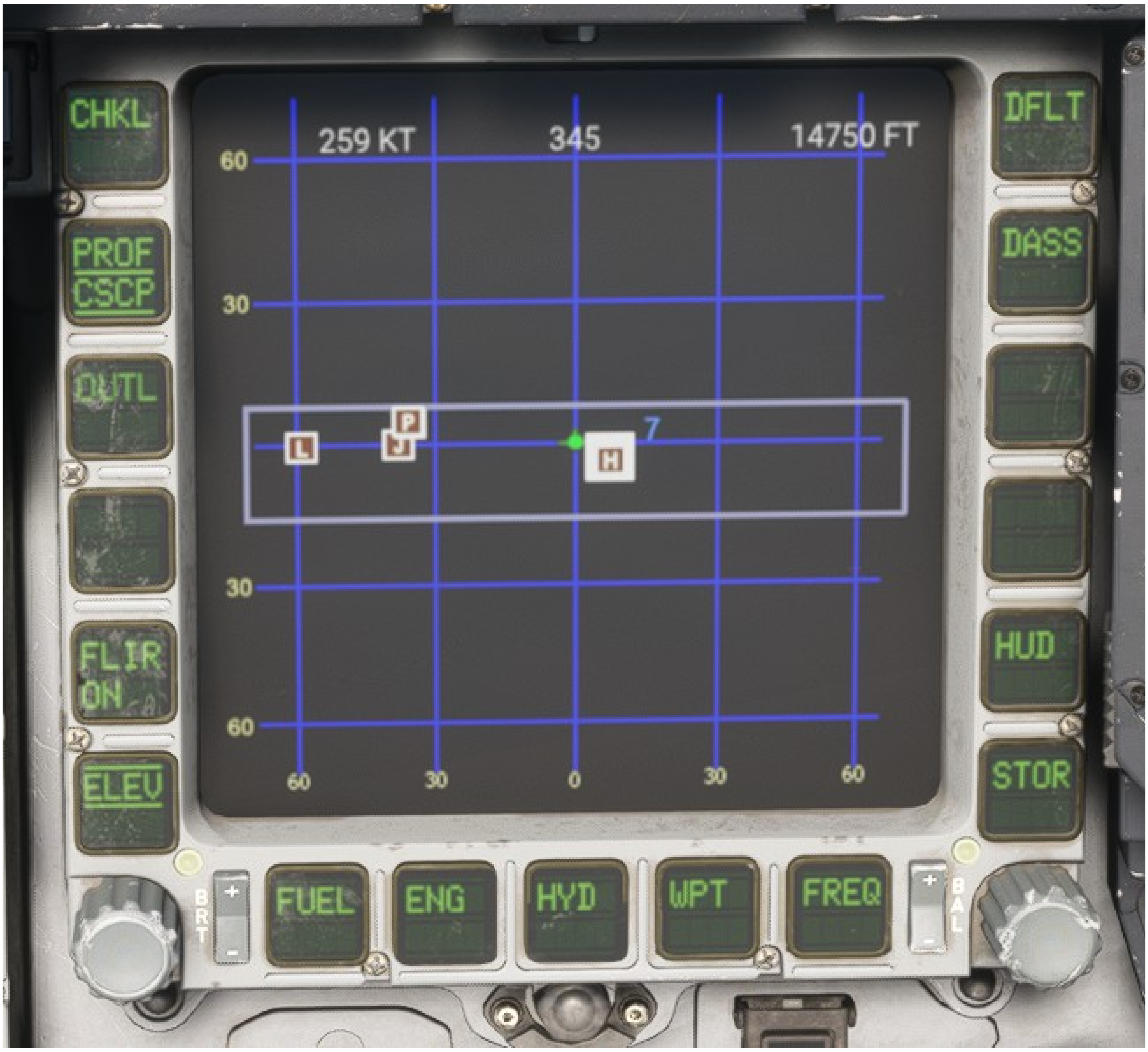
1 – Radar Scan Volume upper limit

2 – Radar Scan Volume lower limit

3 – Elevation presentation upper limit: bumping the XY cursor against the upper border will increase the maximum display altitude.

4 – Elevation presentation lower limit: bumping the XY cursor against the upper border will increase the minimum display altitude. If a primary target is designated, selection will be adjusted so that the target is always within the display range.

If the plane is equipped with PIRATE, the FLIR ON SSK provides access to the FLIR format.



Elevation Format (ELEV), C-Scope (no outline)

C-Scope is an elevation/azimuth display with a selectable canopy outline image. The profile or the C-Scope format is selectable by the SK PROF/CSCP. In this presentation, radar scan volume boundaries are represented by a light blue rectangle. Display scale changes depending on target distance.

If the plane is equipped with PIRATE, the FLIR ON SSK provides access to the FLIR format.

OUTL SSK can be selected to superimpose a cockpit outline to the presentation.

PROF/CSCP SSK can be selected to return to the PROFILE presentation.

Elevation Format (ELEV), C-Scope, outline

The outline presentation is an alternate C-Scope presentation in which the a Cockpit outline is superimposed on the presentation. Azimuth and elevation data is presented in an aircraft-relative way, instead of an horizon-stabilized way.

If the plane is equipped with PIRATE, the FLIR ON SSK provides access to the FLIR format.

OUTL SSK can be selected to return to the normal C-Scope presentation.

PROF/CSCP SSK can be selected to return to the PROFILE presentation.

IDENTIFICATION FRIEND OR FOE SYSTEM

Introduction

The Identification Friend or Foe System (IFF) comprises of the IFF Interrogator and the IFF Transponder. For identification of other aircraft the interrogator will transmit an interrogation signal which will or will not be answered by a recognizable transponder signal. The answers are then categorized friendly or unknown and are displayed against the radar plots.

NOTE:

In Microsoft Flight Simulator, only civilian transponder is actually supported in the sim. The IFF interrogator and transponder in the sim will have realistic interface and will accept inputs also for other modes, but these will have no actual function in the simulation.

IFF Interrogator (INT)

The IFF Interrogator function is to identify unknown platforms by updating their status from unknown to friendly. The result of the interrogation process will be displayed on the Attack and the PA Format.

NOTE:

In Microsoft Flight Simulator, the interrogator has no real function and all tracks will be automatically interrogated by the system upon track initialization, although realistic INT moding interface and controls are provided.

IFF Transponder (XPDR)

The IFF Transponder provides automatic self identification in response to interrogations from other platforms or transponds on pilot's action (IDENT) when requested by ATC.
The equipment is also capable to transmit EMERGENCY replies in either civilian or military modes as pre-selected by the pilot.

NOTE:

In Microsoft Flight Simulator, EMERGENCY reply will always be in civilian mode.

IFF/SSR Protocol Modes

The military modes (Identification Friend or Foe (IFF)) are defined by the numbers 1, 2, 3 and 4, and the civilian modes (Secondary Surveillance Radar (SSR) are defined by the letters A, C and S.
SSR modes, also called Air Traffic Control (ATC) modes, are also used by military aircraft. As IFF Mode 3 uses the same formats as SSR Mode A, it is called Mode 3/A. The IFF/SSR system operates in the following protocol modes:

Mode 1 Military mission identification code.

Mode 2 Military personal identification code.

Mode 3/A Civilian and military ATC identification code.

Mode 4 Military identification, using one of two crypto-variable code sets (A or B).

Mode C Civilian and military aircraft barometric altitude information.

Mode S (Level 2 Basic Surveillance) Civilian and military cooperative, surveillance and data link system for Air Traffic Management (ATM).

In addition to the common modes there are the following specific modes for the interrogator and the transponder:

NOTE:

In Microsoft Flight Simulator, regardless of selections in the XPDR page, only civilian Mode 3/A and Mode C are actually supported in the sim. Whenever Mode 1 and Mode 3A codes are selected, shown or entered, Mode 1 code will be ignored and only Mode 3A will be ignored.

Interrogator Moding

Manual and Automatic Interrogations

In the real plane tracks may be interrogated either manually or automatically. In this simulation all tracks are interrogated automatically.

All Tracks Interrogation

In the real plane, the INT ALL function will specifically interrogate all existing A/A radar tracks held within the system and within scan coverage. In this simulation all tracks are interrogated automatically on tracks initialization.

Automatic Code Change

In the real plane, this facility enables automatic selection and use of Mode 1 and 3/A codes, with the codes automatically changing at pre-defined times. The code set to be used, the start time, and the time interval between changes are loaded via PDS.

The codes for this functionality can be configured by editing th MissionDataLoader.xml.

Pilot Identity Override

The pilot may override the system defined identity of a track using the XY controller with the Pilot Identity Override icon on the Attack Format.

Default Moding

On initial power up, several modes are automatically selected as default; the pilot may change these at any time, and the revised settings are retained for use thereafter. The default mode selections are:
– NORM (transmission inhibit by WoW on GND)
– Mode 1

– Mode 3A
– 1/3A CODE
– MANual (ACC/MAN MK is not present if ACC codes are not loaded or no longer valid. System will operate in MAN mode.)
– AUTO SPFC
All other modes are deselected.

Transponder Moding

Automatic Code Change
In the real plane This facility enables automatic selection and use of Mode 1 and 3/A codes, with the codes automatically changing at pre-defined times. This function is not available in the sim.

Mode S (Level 2 Basic Surveillance)
The Mode S will allow to interrogate more data from specific aircraft which can include:
– Mode 3/A Code
– Mode C Barometric Altitude (-1000 to +126750 ft).
– Aircraft Registration Number or Aircraft Identification.
– Mode S Aircraft Address.
– On-Ground Indicator.
– Maximum Cruising True Airspeed.
– Data Link Capability Report.

This function is not available in the sim.

MIL/CIV
In the real plane selects either the civilian or military emergency code which will be transmitted by the Emergency function on the RHGS. The two modes are mutually exclusive, the default being MIL.

In the simulation, if the emergency function is selected, the civilian mode will be used regardless of this setting.

Emergency
To transmit either MIL or CIV emergency distress codes select the EMGY button on the RHGS.

Identification
The Ident function (ID) will transpond in Mode 1, 2, 3/A and S for about 20 seconds if this modes are selected, a minimum of one mode must be selected. When ID is re-triggered within that period the time is extended accordingly.

In the simulation only Mode 3A is supported for this function.

Default Moding
On initial power up, several modes are automatically selected as default; the pilot may change these at any time, and the revised settings are retained for use thereafter. The default mode selections are:
– SBY
– Mode 1
– Mode 2
– Mode 3A
– Mode 4A (when codes are loaded only)
– Mode C
– MIL
– 1/3A CODE (MDE DEK & ROL are configured for manual entry of mode 1 and 3 codes
– MANual (ACC/MAN MK is not present if ACC codes are not loaded or no longer valid. System will operate in MAN mode.)

IFF system controls:

Right Console - Gangbar

IFF Transponder switch
The two positions of the toggle switch are labelled XPDR and OFF. Following XPDR switch on and completion of the PBIT, the transponder is automatically defaulted to the standby mode of operation “SBY”.

IFF Interrogator switch
The two positions of the toggle switch are labelled INT and OFF. Following Interrogator switch on and completion of the PBIT, the Interrogator is automatically defaulted to the normal mode of operation “NORM” and will operate and transmit normally, unless:

1 The stealth requirements (SLNT) are selected via MDE.
2 INT STBY has been selected via MDE.
3 Inhibited by WOW.

Left Console

SECURE DATA ERASE switch
The cover-guarded switch SECURE DATA ERASE will erase all loaded secure data of the XPDR and Interrogator.

Right Hand Glareshield (RHGS)

RGS Flap
The system status (SBY, ACC, MAN, SLT) and currently selected modes are displayed on the RGS flap.

Transponder Emergency Control
Pressing the recessed EMGY pushbutton on the RHGS will start transmission, upon interrogation, of either MIL or CIV emergency codes as preselected. Stby and stealth state will be overridden during that time.

Identification Response Selection
The identification pushbutton, labelled ID, is used to transpond for about 20 seconds when requested by ATC. The ID button will not be illuminated in SBY. Stealth state will be overridden during that time.

XPDR Sub-system (CODE INFO selected)

1 – XPDR Subsystem selection

2 – SBY/NORM:Toggles the status of the transponder

3 – CODE INFO:Displays the code in use (*)

4 – CODE INFO ROL (**)

5 – 1/3A MODE: Allows the pilot to enter manual codes for Mode 1/3A

6 – ACC/MAN – Toggles automatic code change on/off

7 – Transponder modes (*)

(*) - in order to mimic the real-worl interface, all codes in the simulation are six digits in the XX YYYY format: XX is the Mode 1 code, while YYYY is the Mode 3A code. Only mode 3A and C are supported by Microsoft Flight Simulator, so you can use any value for the first two digits and it will have no effect in the sim. For exmple if you are requested to adopt squawk 2310, you can use 00-2310, 42-2310, 67-2310 or any XX-2310 code and it will be the same for the simulation.

(**) - ACC mode is actually supported via the MissionDataLoader.xml file (on PC only), although ACC times may not be reported correctly in the display.

XPDR Sub-system (1/3A MODE Selected)

Upon selection of the 1/3A MODE soft key, the ROL will change to allow the pilot to type in up to 8 Mode 1/3A codes, split between two pages each containing 4 codes. Arrow up/down allows the pilot two switch between slots. The first time the 1/3A MODE is pressed, all 8 slots will be blank (- -   - - - -): pilot can select any slot and type the desired code. The slot currently selected is indicated by "< >" brackets.
If a code is already in the slot, the ENT button will make it so that the code in the slot will be adopted as current IFF code, while typing a new code will overwrite it.

In the example shown in the picture above, the pilot has:
- Selected the 1/3A MODE option
- used the "down" arrow 4 times to access the second page
- entered 12 4500 in the slot number 5 (upon pressing ENT the code is adopted as current IFF code)
- used the "down" arrow 2 times to access the slot number 7
- entered 12 2144 ub the slot number 7 (upon pressing ENT the code is adopted as current IFF code)

If the pilot uses the "up" arrow two times, and returns to slot 5, for example, just pressing ENT will make 12 4500 the current code (no need to retype the code)

1) 1/3A MODE: changes the ROL and keypad to allow the pilot to enter codes manually

2) 1/3A MODE ROL (second page shown in the example)

3) Keypad configured for manual entry of IFF codes. Arrow UP/DOWN can be used to select codes or change page.

INTSub-system (1/3A MODE Selected)

In this Flight Simulator rendition, there INTerrogator function is not properly supported and, while the INT subsystem interface is presented in a realistic way, the functionality are basically the same as the XPDR page, although the list of manual code is separate from the one in the XPDR page.

1) INT Subsystem selection

2) PAGE 2: switches to the second page (to access the CODE INFO option)

3) 1/3A MODE: Allows the pilot to enter manual codes for Mode 1/3A

4) 1/3A MODE ROL (second page shown in the example)

DEFENSIVE AIDS SUBSYSTEM

Introduction

The Defensive Aids Sub-System (DASS) is an integrated self-defense system that senses threats to the aircraft, from radar emitters, passive and active missiles, and laser emitters. The system then automatically applies the appropriate countermeasure with minimal pilot involvement.

NOTE

The DASS system functionality is beyond the scope of the Microsoft Flight Simulator environment, and therefore the system is not simulated.
Data presentation is based on available traffic information and threat priority is assigned depending on the traffic flight parameters, since emission data is not available.

Most of the information in this section is taken from Wikipedia and reported for information only.

The DASS system is a modular system consisting of:

- antennas for electronic countermeasures (ECM)
- electronic support measures (ESM)
- missile approach warning systems (MAW)
- countermeasure dispenser systems
- laser warning receivers (LWR)
- towed radar decoy (TRD).

ESM-RWR

The DASS includes electronic support measures (ESM) and is equipped with radar-warning-receivers (RWR). The RWR is designed to detect threat radars using super heterodyne, digital receiver antennas which are located into the wing tip pods giving full 360° coverage with an accuracy better than 1° in azimuth. These passive antennas can identify radio frequencies of 100 MHz up to 10 GHz, which is sufficient to detect nearly all types of radar systems and even to detect other RF sources such as radios or data-link systems. The data is compared with the database of radar signatures stored in the Electronic Support Measures suite (ESM). Using this information the ESM allows the identification of the radar and thus the platform it is deployed from and presents it on a moving map or multifunction display producing a 360° threat picture around the aircraft including identifying targets and even their zones of lethality. This allows the pilot to fly around these zones to avoid detection or being engaged. Thus the system not only warns a pilot but it helps him to look out for potential targets.

Laser Warning Receiver (LWR)

To counter the threat of laser guided weapons a Laser Warning Receiver, LWR, are installed on UK and Saudi Typhoons.
These LWRs are optimized for low false alarm rates and can detect lasers pointing at the aircraft and find the direction of the laser source.

ECM

The Typhoon features an internal electronic countermeasures system (ECM) that uses a digital radio frequency memory (DRFM) and a digital frequency techniques generator to jam multiple airborne and ground-based radar systems at the same time and at long ranges. Each transmitter and receiver modules (T/R) consists of antennas that can passively locate emitters. The antennas are located in front of the wing tip pods, and another at the rear end of the left pod thus ensuring a 360 ° coverage.

Missile Approach Warner (MAW)

To track missiles launched at the Typhoon, the DASS incorporates three Missile Approach Warner (MAW), one in each wing root and one in the tail to provide a full 360° azimuth coverage around the aircraft.
Since the units are active they are able to detect not only radar guided ordnance but also passive weapons such as infrared guided short range missiles. They can detect multiple missiles launched towards the aircraft in all weather conditions and even after the rocket motor's burnout phase. Once a missile is detected it will identify the threat according to whether it is radar or IR guided and display its location on the MFDs. The MAW can automatically activate the chaff/flare dispensers as required.

Countermeasure Dispenser Systems

The EF-2000 includes four chaff/flare launchers mounted under the wing.
These countermeasures are controlled automatically and, in response to an immediate threat, by the Missile Approach Warners or even manually by the pilot.

Towed Radar Decoy (TRD)

In addition to the onboard ECM, another active countermeasure is the Towed Radar Decoy or TRD. Either one or two Ariel Mk II TRD from Leonardo will be carried in the rear of starboard wing-tip pod, and deployed from the pod on a 100 m long Kevlar cable containing a Fibre-optic link and a separate power line. The TRDs are effective against a variety of different radar systems like mono-pulse, TWS, or CLOS (Command Line Of Sight) radars. As the TRD is an off-board jammer, radar systems featuring a home on jam mode (HOJ) will not be able to directly lock on to the aircraft itself. The effectiveness is further enhanced by the release of Chaff clouds making the decoy a more attractive target for the missile.

DASS format

1 – Threats icon (UNKnown type)

2 – Chaff and flares quantity

3 – Towed decoy status

4 – Radar elevation coverage

5 – Range rings (outer ring represents 40 nautical miles from the aircraft)

WEAPON SYSTEM AND STORES

Introduction
In this simulated version of the Typhoon, the following cosmetic (non-functional) weapon models are available:

Short range air-to-air missiles:
- AIM-9L SIDEWINDER
- IRIS-T
- AIM-132 ASRAAM

Medium range air-to-air missiles:
- AIM-120C AMRAAM
- METEOR

Air-to-ground ordnance:
- GBU-12

Also, the following additional stores are available:
- 1000l external fuel tanks
- Targeting pod
- Smokewinders

Stores can be loaded by:

- directly modifying the station weight in the WEIGHT AND BALANCE menu in MSFS2020. See the

- rejecting the store configuration in the STORE MHDD format when the plane is stationary on the ground during start-up, using the CNFG RJCT SSK. This will allow the user to cycle between the predefined stores.

- creating a custom configuration in the STORE MHDD format using the XY Cursor during the start-up phase.

Changes are possible until the configuration is ACCEPTED (CNFG ACPT SSK). Accepting the config will change the STORE page to allow for the creation of jettison packages.

An additional option to allow configuration changes AFTER the configuration is accepted is available in the MNTC format.

Weapon Stations
The 13 weapon stations are located under the fuselage and under the wings, and are numbered from STA1 to STA13.

NOTE:
Station numbering in the simulation is different from the real-world airplane.

They are as follows:

– Four underfuselage (STA5, STA6, STA8 and STA9) stations dedicated to the Medium Range Air to Air Missiles and configured to a low drag missile installations on ejector launchers.

– One centre underfuselage station (STA7) where either pylon equipped with one Advanced Heavy Duty Ejector Release Unit or the 1000l Supersonic Fuel Tank (SFT) equipped with the Tank Ejector Unit (TEU) can be fitted.

– Six underwing stations (STA 2, STA3, STA4, STA 10, STA11 and STA12).
STA4 and STA10 carry the inboard wing pylons equipped with AHDERUs.
In the simulation, STA3 and STA11 can only be equipped with 1000 lt Supersonic Fuel Tanks (SFT) equipped with Tank Ejecting Unit (TEU). These stations can also be equipped with AHDERUs in real life.
STA2 and STA12 are the outboard wing pylons equipped with Advanced Light Duty Ejector Release Units (ALDERU). A Multi Function Rail Launcher (MRFL) can be installed on each outboard pylon.

– Two underwing Integrated Tip Stub Pylon Launchers (ITSPL, STA1 and STA13) are dedicated for carrying/firing of SRAAM missiles.

AIM-9L SIDEWINDER
The AIM-9L Sidewinder is an all-aspect, short range, infra-red homing, air-to-air missile. The “Lima” version was was the first “all aspect” Sidewinder with the ability to attack from all directions, including head-on, which had a dramatic effect on close-in combat tactics.

AIM-9L missiles can be loaded on STA1 and STA13, and on STA2 and STA13 using the MRFL.

Store weights are as follows:

STA1 and STA13: 188lbs (missile only)
STA2 and STA12: 588lbs (missile+pylon+launcher)

IRIS-T
The IRIS-T (infrared imaging system tail/thrust vector-controlled) is a short range, infra-red homing air-to-air missile. The missile was developed in the late 1990s–early 2000s by a German-led program to produce a short to medium range infrared homing air-to-air missile to replace the AIM-9 Sidewinder in use by some NATO ember countries at the time. A goal of the program was for any aircraft capable of firing the Sidewinder to also be capable of launching the IRIS-T.

IRIS-T missiles can be loaded on STA1 and STA13, and on STA2 and STA13 using the MRFL.

Store weights are as follows:

STA1 and STA13: 192lbs (missile only)
STA2 and STA12: 592lbs (missile+pylon+launcher)

AIM-132 ASRAAM
The Advanced Short Range Air-to-Air Missile (ASRAAM), also known by its United States

designation AIM-132, is an imaging, infra-red homing, air-to-air missile that is designed for close-range combat. It is in service in the Royal Air Force, replacing the AIM-9 Sidewinder. The ASRAAM is designed to allow the pilot to fire and then turn away before the opposing aircraft can close for a shot.

AIM-132 missiles can be loaded on STA1 and STA13, and on STA2 and STA13 using the MRFL

Store weights are as follows:

STA1 and STA13: 194lbs (missile only)
STA2 and STA12: 594lbs (missile+pylon+launcher)

AIM-120C AMRAAM
The AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) is an American beyond-visual-range missile, capable of all-weather day-and-night operations. It uses active transmit-receive radar guidance instead of semi-active receive-only radar guidance.

AIM-120 missiles can be loaded on STA5, STA6, STA8 and STA9 and on STA2 and STA13 using the MRFL

Store weights are as follows:

STA5, STA6, STA 8 and STA9: 348lbs (missile only)
STA2 and STA12: 748lbs (missile+pylon+launcher)

METEOR
The Meteor s a European active radar guided beyond visual range (BVRAAM).
It offers a multi-shot capability (multiple launches against multiple targets), and has the ability to engage highly manoeuvrable targets such as jet aircraft, and small targets such as UAVs and cruise missile, in a heavy electronic countermeasures (ECM) environment with a range in excess of 200 kilometres (110 nautical miles).

METEOR missiles can be loaded on STA5, STA6, STA8 and STA9 and on STA2 and STA13 using the MRFL

Store weights are as follows:

STA5, STA6, STA 8 and STA9: 407lbs (missile only)
STA2 and STA12: 807lbs (missile+pylon+launcher)

GBU-12 Laser Guided bombs
500lbs, GBU-12 Laser Guided Bombs (LGBs) can be mounted on STA2, STA4, STA10 and STA12.

Store weight is 960lbs (bomb + pylon).

External fuel tanks
1000l supersonic external fuel tanks can be loaded on STA3, STA7 and STA11.

Store weight is 731lbs (tank + pylon).

NOTE

External tanks on STA3 and STA11 are associated to External Tanks 1 and External Tanks 2 in the MSFS fuel system. External tank on STA 7 is associated to Center1 tanks in the MSFS fuel system. These fuel tanks are always available, in the game interface, but their content will be immediately deleted if the external tanks are not mounted.

NOTE:

Upon mounting the external tanks, they will be empty and will cast the “Wing Tanks Empty” or “Center Tank Empty” aural warning as appropriate.
Tanks must be filled after being mounted, either through the game interface or through the REFUEL AND REPAIR option in the MNTC MHDD format.

Targeting Pod
A targeting pod can be mounted on STA 7, although it is not currently supported by the avionics.

Store weight is 440 lbs.

Smokewinders
Smokewinders can be mounted on STA1 and STA13, and activated through the “recognition light” command in the simulator.

Store weight is 150lbs.

Armament Control Sub-system
The Armament Control Sub-system (ACS) is operated by controls and indicators located in the cockpit as described in the following:

- Master Armament Safety Switch (MASS)

- SCAC Norm/Rev Switch

- EMGY JETT Push-button

- SEL JETT PROG/TANKS

- SEL JETT Push-button

- WEAPON TRAINING Switch

- HOTAS Controls

- HUD Format on both HUD and MHDD/HUD

- MHDD/STOR Format

Master Armament Safety Switch (MASS)
The Master Armament Safety Switch (MASS) is located on the front cockpit right console.
This three position switch permits the following selections:

- SAFE - In this position the MASS isolates the ACS from all electrical power

- STBY - In this position the MASS isolates the power required by the ACS for safety critical functions (arming, release, firing and jettison); in the STBY position, power is available to the logic elements of the ACS units, to allow all computation and control functions to operate

- LIVE - In this position all the required power supplies are made available to the ACS.

SCAC Switch
The SCAC NORM/REV switch is located on the front cockpit left console. This switch has no function in the simulation

EMGY JETT Push-button
This pushbutton is identified by the legend “EMGY JETT” surrounded by a raised barrier.
It is located on front and rear cockpit left quarter panel.
Upon selection of the pushbutton with the MASS in LIVE position (unless the BATT switch is selected to the OFF position) the ACS generates the outputs necessary to jettison all applicable stores/weapons from the aircraft in a fixed sequence.

SEL JETT PROG/TANKS Switch
This two position bi-stable toggle switch is locked in both the forward and aft positions and must be unlocked prior to selection to avoid inadvertent operation.
It is located on the front cockpit left quarter panel.
The switch is used in conjunction with the SEL JETT pushbutton.
The switch provides the following functions:

- PROG - The jettison of all weapon stations designated by MHDD/STOR

- TANKS - The jettison of the tanks is enabled.

SEL JETT Push-button
This pushbutton is surrounded by a raised barrier and it is located on front and rear cockpit left quarter panel. Upon selection of the JETT pushbutton with the MASS in LIVE position the ACS generates the appropriate sequence of jettison signals for the selected store(s)/weapon(s) only.

WEAPON TRAINING Switch
This two position bi-stable switch is locked in both the forward and aft positions and must be unlocked prior to selection to avoid inadvertent selection.
It is located on the front cockpit left console.
This switch has no function in the simulation.

HOTAS Controls
ACS functions are also controlled via HOTAS controls, to allow a rapid weapons management under all conditions.

Air to Air Weapon Trigger and HUD Camera
Pressing the Air to Air Trigger and HUD Camera to the first detent runs the Video/Voice Recorder (VVR) if not already running. Pressing to the second detent fires the selected weapon if an AAM or the Gun is selected. The second detent can only be reached if the Late Arm is in the armed position.
The trigger has no function in the simulation.

Late Arm Safety Interlock (LAS)
The Late Arm Safety Interlock enables the Weapon Commit/Release control and Air to Air Trigger operation.
The interlock has no function in the simulation.

Air to Air Weapon selector
The Air to Air Weapon selector is used to select the Air to Air weapons.
This selector has no function in the simulation.

Air to Surface Weapon Commit/Release Control
The Weapon Commit/Release control is used to release the pre-selected air-to-surface Weapon Package.
This selector has no function in the simulation.

SRAAM reject button
The SRAAM reject button, is used to reject the currently selected SRAAM missile and select the following in the sequence.
This selector has no function in the simulation.

X-Y Controller
The X-Y controller is used for:
– build a new SJ package
– control SRAAM seeker head when SRAAM manual mode is selected (not currently supported in the simulation)

Dedicated MASS Status Voice Warning
The voice warning message “MASS NOT LIVE” is a warning category 4 (except on GND when it is not provided and on T/O when its category is 1) and no dedicated caption appears on DWP.

The voice warning “MASS NOT LIVE” is heard by the pilot in the headset when in T/O the Master Armament Safety Switch (MASS) is not set in LIVE position and the throttles are advanced to a position above the 80% NL.

ACS controls/indicator (left consoles)

1 – EMGY JETT push-button: initiates the jettisoning of all the stores except STA1 and STA13

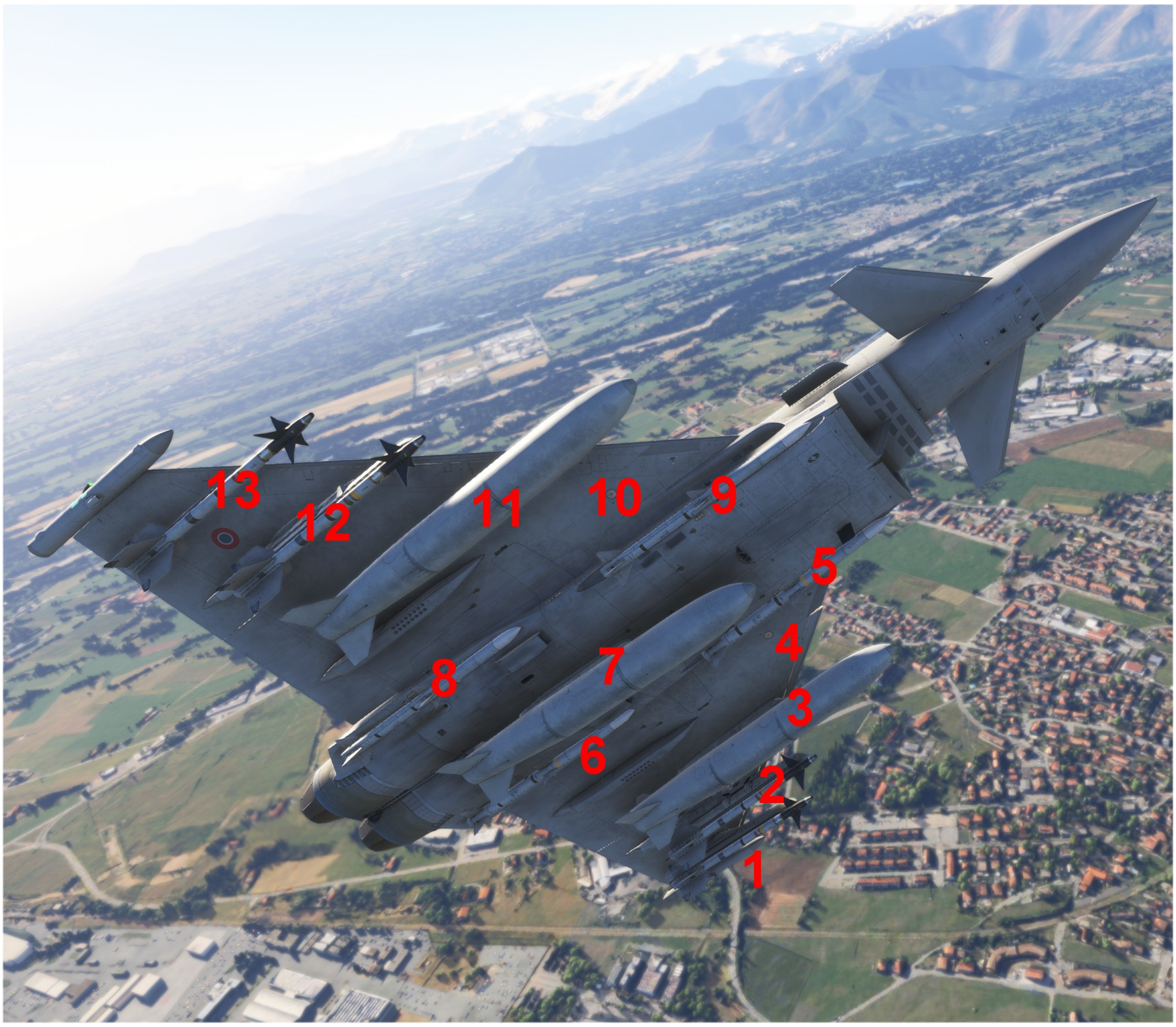
2 – PROG/TANKS switch. If set to PROG, upon pushing the JETT push-button, only the stores added to the selective jettison package will be jettisoned. If set to TANKS, upon pushing the JETT push-button, only the external tanks will be jettisoned.

3 – JETT push-button. Pushing this button initiates the jettisoning of the external tanks (if the PROG/TANKS switch is set to TANKS) or the jettison package created in the STORES page (if the PROG/TANKS switch is set to PROG)

4 – SCAC NORM/REV switch (no function in the sim)

5 – WEAPON TRAINING switch (no function in the sim)

Location of the MASS selector



Station numbering and configuration example (4 x AIM-9, 4 x AIM-120, 3 x external tanks)

1 – STA1 (loaded with AIM-9 in the example)

2 – STA2 (loaded with AIM-9 through MFRL in the example)

3 – STA3 (loaded with a 1000l external fuel tank the example)

4 – STA4 (not mounted in the example)

5 – STA5 (loaded with AIM-120 in the example)

6 – STA6 (loaded with AIM-120 in the example)

7 – STA7 (loaded with a 1000l external fuel tank the example)

8 – STA8 (loaded with AIM-120 in the example)

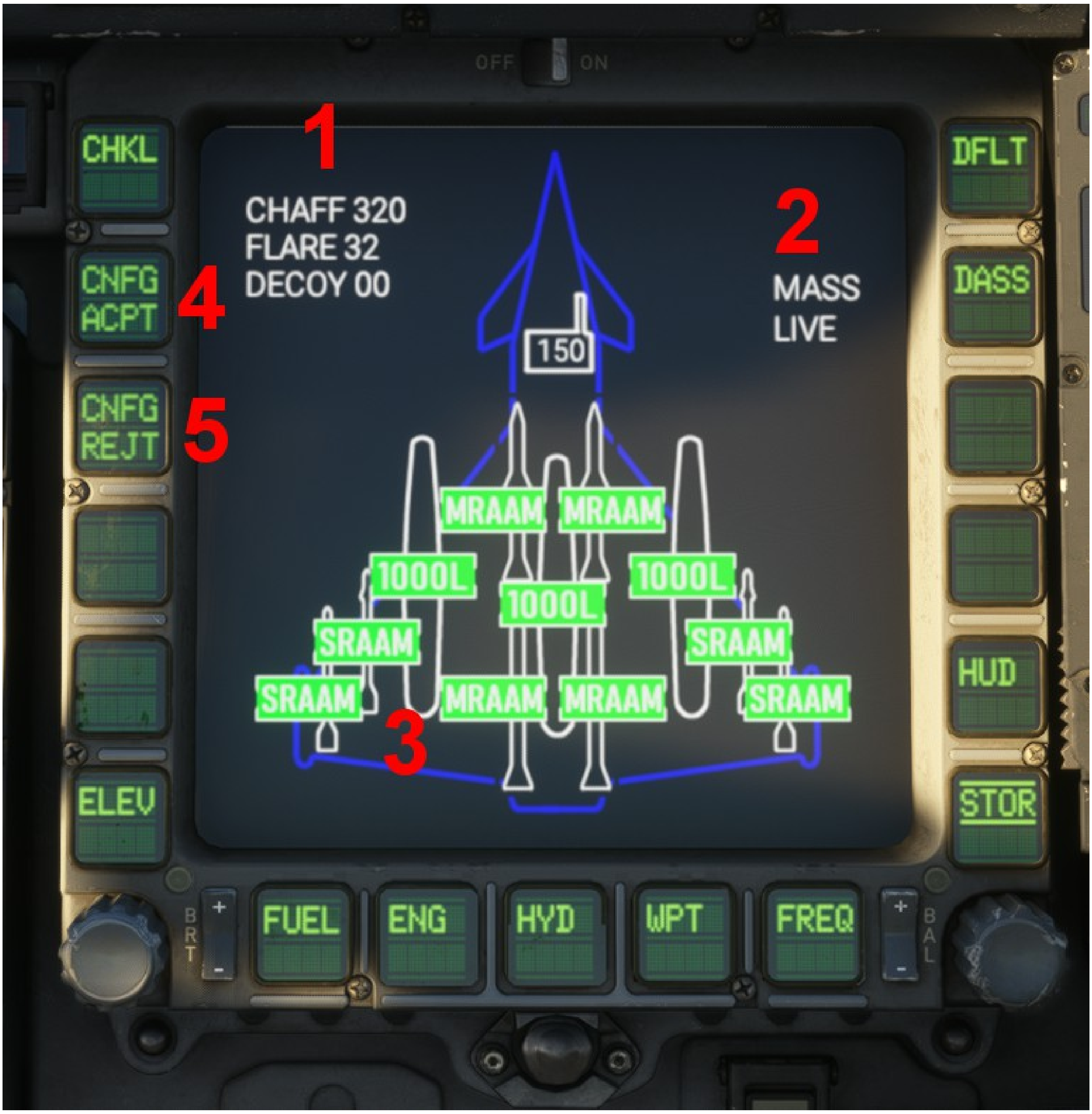
9 – STA9 (loaded with AIM-120 in the example)

10 – STA10 (not mounted in the example)

11 – STA11 (loaded with a 1000l external fuel tank the example)

12 – STA12 (loaded with AIM-9 through MFRL in the example)

13 – STA13 (loaded with AIM-9 in the example)



STORE format (configuration not accepted)

During the aircraft start up procedure, the user can change the configuration in the STORE format. The following controls/indications are available in this phase:

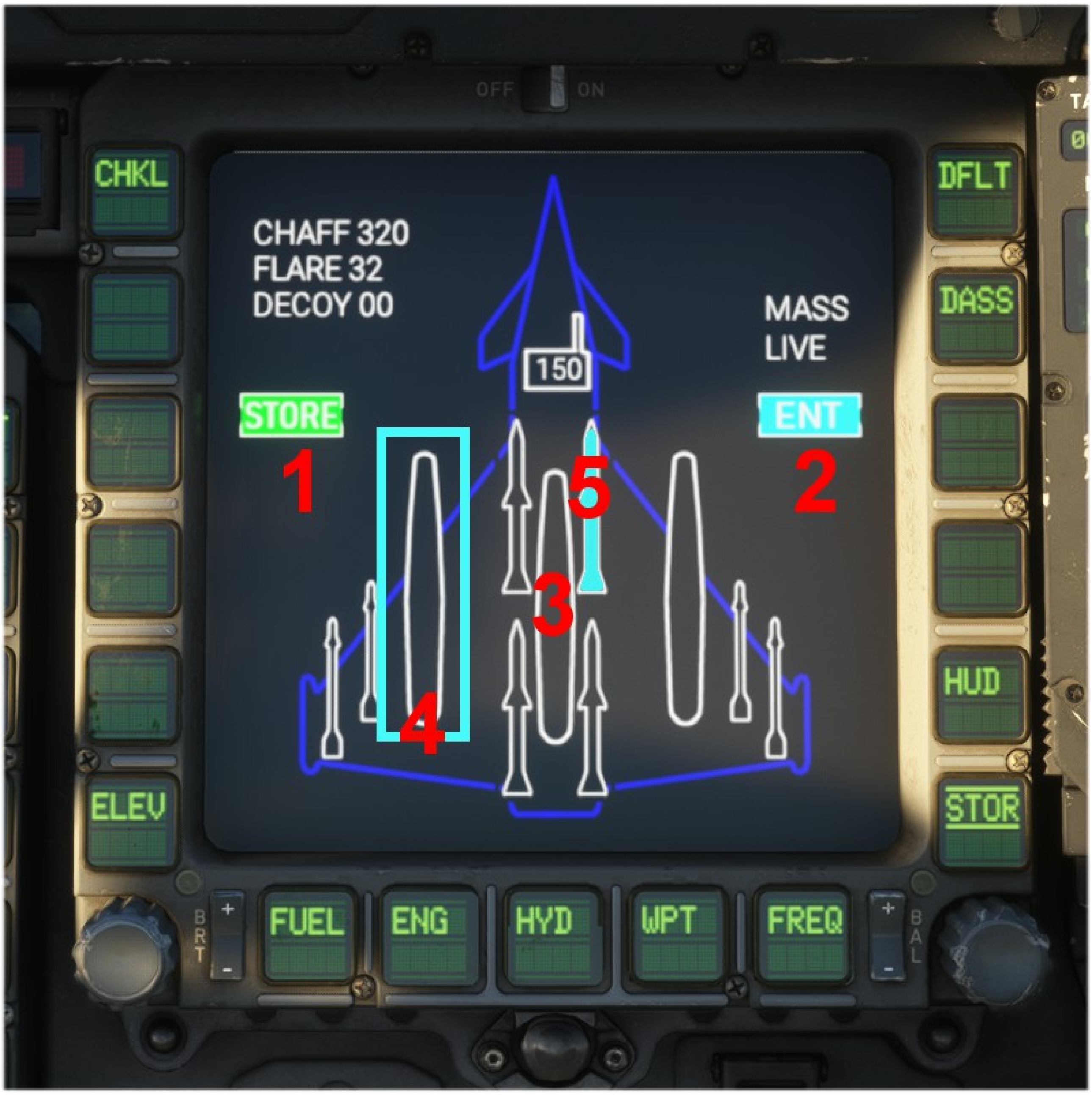
1 – CHAFF, flares and decoy quantities

2 – MASS status

3 – Stores. Individual stores can be changed by inserting the XY Cursor on each station. Labels appear after a config change, and will disappear after few seconds.

4 – CNFG ACPT → Accepts the current configuration

5 – CNFG REJT → Rejects the current configuration and cycles between the preset configurations. Configuration will be saved and reloaded in the next flight.



STORE format (configuration accepted)

After the configuration is accepted, the STORE format changes to allow the user to create a Selective Jettison package. The controls in this page can only be controlled via XY Cursor.

1 – STORE → visualize labels on the current stores.

2 – Add the selected stores to the Selective Jettison package

3 – Stores. Individual stores can be selected by inserting the XY Cursor on each station.

4 – Store selected for addition to the Selective Jettison package will appear with a light blue box around them, but not added yet. SEL1 and SEL13 cannot be selected. To add the selected store to the package, ENT must be selected.

5 – Store added to the Selective Jettison package will appear filled with light blue.

MISCELLANEOUS

Cockpit Access Ladder

Introduction

The cockpit access ladder provides a means of cockpit ingress/egress in the event that a flight line cockpit ladder is not available, or the aircraft is deployed away from its home base. The ladder is a three piece telescopic assembly which pivots around a pintle. The ladder is housed in the ladder bay which is located on the left side of the front fuselage in front of the air intake for the left engine.
The ladder can be released from within the cockpit by using a guarded push button selector/indicator (Panel marked LADDER) or externally by using an unguarded square-headed toggle switch located under the left wing apex panel. Both methods require that the aircraft has Weight-On-Wheels with both throttle levers set in the HP SHUT position.

Cockpit Egress

When the push button selector/indicator located below the right MHDD is pressed the red EXD legend is illuminated and the cockpit access ladder automatically deploys. The pilot is informed when the ladder is fully down and positively engaged in the down-lock by red status bars illuminating above and below the legend.

Ladder Stowage

The ladder must be correctly stowed before flight or when towing an aircraft. A diagram showing the stowage procedure is attached to the inside of the hinged ladder door assembly.

Controls and Indicators

The following indications will be displayed in the cockpit prior to engine start.

LADDER push button selector/indicator

• EXD is illuminated red) with status bars illuminated (red) - ladder locked in down position

• EXD is illuminated - ladder and ladder and ladder door assembly unlocked

• Unlit - ladder stowed and ladder door closed and correctly locked.

MHDD/ACUE

• Red ladder caption - indicates that the ladder door is open

• Green ladder caption - indicates that the ladder door is closed.

NOTE

The DWP LADDER caption, plus attention getters, are suppressed until the throttle levers are moved from the HP SHUT position, whereupon the voice warning ““LADDER NOT STOWED„ is given.

NOTE

In the simulation, extending the cockpit access ladder will make the external ladder disappear.

Cockpit Access Ladder Push-button Indicator

Cockpit Access Ladder (extended)

INTENTIONALLY LEFT BLANK

NORMAL PROCEDURES

NOTE

Checklist is based on AP101B-5400-14 "Typhoon Flight Crew Checklist" as publicly released by the United Kingdom Government.

While this checklist is based on its real-world counterpart, adjustments have been made for use in Microsoft Flight Simulator and this document should not be taken as a reliable source of information on the real-world aircraft or its operation.

PRE FLIGHT
Safe for Parking Checks

Safe for Parking
The aircraft is safe for parking when:
1. Seat safety lever...... SAFE
2. MASS .... SAFE
3. PARK BRK .... ON

Safe for Servicing
The aircraft is safe for servicing when:
1. Seat safety lever..... SAFE, pin inserted
2. Canopy jettison handle pin.................. Inserted
3. MASS .... SAFE
4. All other switches..... Guarded, OFF or SAFE

Initial Checks
Before exterior inspection check that:
1. PARK BRK.............. ON
2. BATT .... OFF
3. MASS ....SAFE

External Checks
The exterior inspection begins at the boarding ladder and continues around the aircraft in a clockwise direction. Check inlets and outlets are clear, doors secured, covers off and pins removed. Be alert for loose fasteners, cracks, dents, leaks and other general discrepancies.
Systematically check all pylons, launchers and stores.
Specifically accomplish the following:

Left center fuselage
1. Engine air intake cowls..........................Clear
2. External canopy jettison handle ....Secured and covered

Nose section
3. Foreplanes............. Condition
4. Radome.................. Secure (2 latches, both sides)
5. ADT .... Condition
6. Nose tire .... Condition, inflation

Right wing
7. Slats......................... Condition
8. Flaperons................. Condition
9. Main tire................... Condition, inflation

Rear fuselage/Fin
10. Arrester hook .... Secured, pin removed
11. Brake chute and door .... Marker flag visible, door closed, pin removed
12. Fin and rudder ...... Condition

Left wing
13. Flaperons...................Condition
14. Slats...........................Condition
15. Main tire ....Condition, inflation

Ejection Seat Checks

Procedure
1. Seat safety lever ...... SAFE, check pin(s) stowage
2. V strap...................... To front of negative g strap
3. Both top latch levers Correctly engaged
4. CJTDU..................... Connected and secure
5. Shoulder stap buckles................... Correctly routed
6. PSP/strap connectors............... Straps connected to harness, Connector assembly in clip
7. PSP lowering selector .... As required
8. ADU/ALIU static lines .... Secure
9. Anti-g valve............... On (fwd)
10. Oxygen regulator selector .... MAIN
11. Auxiliary oxygen handle .... Reset (down)
12. Leg restraints........ Correctly routed
13. Canopy Jettison Unit pin.................. Remove and stow
14. Seat firing handle pin.......................... Remove and stow

Internal Checks

Procedure
Prior to electrical power on:
1. PDS, VVR tape, DVVR RMM.............. Insert
2. PIC .... As required
3. PARK BRK............... ON
4. Expendable Release Manual Control........................ OFF
5. Throttles .... HP SHUT
6. LP COCKs............... OPEN, guards down
7. LASER (if present).. SAFE
8. EWTF (if present)... LIVE
9. SCAC.................... NORM

10. Landing gear lever. DOWN
11. MHDD and HUD.... ON
12. Late arm .... Safe position
9. FUEL PROBE (switch)....................... To match probe position until hydraulics available
10. Battery gangbar...... OFF
11. MASS..................... SAFE
12. Systems gangbar .. Forward
13. All other switches .. Guarded, AUTO or forward

QUICK REACTION ALERT

1. APU............................Start or ensure running
2. Strap in
3. PDS............................Insert into MDLR
4. Battery gangbar..........On
5. Radar ....SBY
6. ACUE format ....Confirm on-board ladder stowed
7. MASS.........................STBY

SCRAMBLE START

1. Engines ....Start
2. Canopy ....Close and lock
3. FCS RSET ....Press
4. Parking brake.............Release
5. MASS.........................LIVE
6. Seat safety lever ....ARMED

STARTING ENGINE

Before Starting Engines

1. Battery gangbar .... On
2. External lights .... As required
3. APU .... START
4. Cockpit lighting .... As required
5. MASS .... STBY
6. Landing gear indications.................. Three green
7. MHDD/ACUE.......... Check

Starting Engines

Acquire ground crew clearance before starting engines. To initiate ground starting move the throttle from SHUT to IDLE. Typically, IDLE is reached in approximately 35 seconds at sea level.

1. L and/or R Throttle(s) .... IDLE, check NH increasing

After Engine Start

When both engines are running the APU is automatically shut-down.

1. APU RUN...................Not lit
2. DWP ....No red captions
3. MASS ....STBY

ALTERNATIVE ENGINE START

Crossbleed Engine Start

The crossbleed engine start is done with the live engine only during parking or taxiing. For both conditions, switch off the APU, if operating.

Advance the live engine to 65% NL minimum and at stabilized RPM set the other throttle to IDLE. After the second engine is stabilized in IDLE, retard the first throttle to IDLE.

1. APU .... STOP
2. Throttle live engine . 65% NL minimum
3. Other throttle........... IDLE, check NH increasing
4. Continue with After Engine Start

Start Failures / Start Cancel

To cancel engine start, proceed as follows:

1. Throttle(s) ....HP SHUT
2. LP COCK(s) ....SHUT

TAXI/LINE UP/TAKE OFF

FCS Pre Flight Check (PFC)

The FCS PFC is automatically performed on power up.

Actuator Maintenance Check (AMC)

The AMC is initiated by pressing the FCS TEST button prior to entry into Flight Resident Software (FRS) when FCS READY condition is achieved.

Entry into Flight Resident Software (FRS)

The entry into flight resident sofware is initiated by pressing the FCS RESET button when FCS READY condition is achieved.

Upon entering FRS the full FCS mode is available and the controls are set to:
- Take Off Trim (FCS RSET - T/O steady lit) datum position.
- NWS will engage into the low speed mode (NWS legend, foreplanes at zero position)

Following entry into FRS, any manual trim offsets in pitch will cause the TOT legend on the FCS RSET button to flash. Reset can be achieved by pressing the FCS RSET (TOT steady) button.

Operation

Pre Taxi Checks

1. Areas........................ Check clear
2. AMC......................... Perform if required
3. ASP .... Test
4. FCS RSET................. Press when FCS READY is available on
3. GUH .... Confirm valid heading
4. LOW HT .... As required
5. XMIT.......................... Confirm RDR SBY
6. CANOPY .... CLOSED or VENT

Pre-Takeoff

1. Brakes...................... Check
2. Instruments .... Check / set
3. Fuel format............... Confirm no failures
4. Pins .... 2 stowed
3. Harness / visor / oxy /fuel .... Check
4. Canopy.................... Closed and locked
5. Seat safety lever...... ARMED
6. External lights......... As required
7. Radar...................... Set up if required
8. PARK BRK............ ON (for 5 seconds)

Line Up

1. JETT..........................As required
2. XPDR....................... As required
3. VVR/DVVR............. As required
4. Radar....................... As required
5. Weapons................. De-select
6. MASS...................... LIVE
7. ACUE .... Check
8. Landing lights........... As required

Takeoff

MAX REHEAT Takeoff Technique

Aircraft acceleration in reheat power is extremely quick. Takeoff data should be considered in respect to the PDM taking into account all relevant factors.

NOTE

In the interest of low pitch oscillations during the take off run it is recommended to release the brakes already at 70% NL.

As the airspeed passes 110 KDAS smoothly and progressively apply aft stick of approximately three quarters of stick (75%).

Once a positive rate of climb has been established, raise the landing gear.

Reheat thrust should be cancelled at approximately 250 KDAS. Do not delay landing gear retraction to avoid exceeding the normal landing gear retraction limit (290 KDAS).

After Takeoff

With weight off the nosewheel, the FCS will fade into the airborne mode.

FCS RSET - NWS LEGEND

The NWS legend will extinguish as soon as weight is off the nosewheel.

FCS RSET - T/O LEGEND

The T/O legend will extinguish as soon as weight is off the nosewheel. The LDG indication of the HUD will extinguish.

AIR TO AIR REFUELING

In-flight Refueling

Procedure

1. Altitude.......................Below 35 000 ft
2. Speed .... 200 to 300 KDAS / below 0.85 M
3. AoA/g........................ 20 / 0 to + 2g
4. Late arm ....Safe
5. XMIT ....ALL SLNT
6. Nav and a/coll lights...As required
7. FUEL PROBE...........OUT
8. FUEL format ....REFU options as required

After refueling:

9. FUEL PROBE...........IN
10. XMIT ....ALL NORM
11. Nav and a/coll lights...As required

DESCENT/RECOVERY

Recovery Checks

1. FUEL format............. Contents/balance
2. Instruments............. Check/set
3. Radios...................... Check/set
4. Altimeter.................. Set
5. Late Arm................. Safe
6. EXPD..................... OFF
7. AIDS........................ Check/set
8. Landing lights.......... On

Pre Landing

1. Landing gear............ Below 250 knots, DOWB, 3 greens, DDD

AFTER LANDING

After Landing

1. MASS........................STBY
2. Brake Chute.............. As required
3. Seat Safety lever....... SAFE
4. XMIT.......................... ALL SLNT
5. External lights........... As required
6. VVR/DVVR............... OFF
7. Systems Gangbar..... RADAR OFF
ECM OFF
MAW OFF
8. ACUE format............ Check brakes

Engine Shut Down

On engine shut down Lift Dump is set to “engaged” (DUMP) to ensure that the foreplanes are parked in a position which does not interfere with the ladder deployment.

1. PARK BRK............... ON

NOTE

If APU GEN not required:

2. L & R throttle .... HP SHUT
3. SECURE DATA........ ERASE when required

4. FCS TEST................ Press
5. BATT........................ OFF (within 2 sec.)
6. MASS....................... SAFE
7. PDS / VVR .... Remove

If APU GEN required:

2. L or R throttle .... HP SHUT
3. MASS.........................SAFE
4. APU............................START, confirm boxed
5. L & R BOOST
PUMPS ....OFF
6. Throttle (live engine) ..HP SHUT