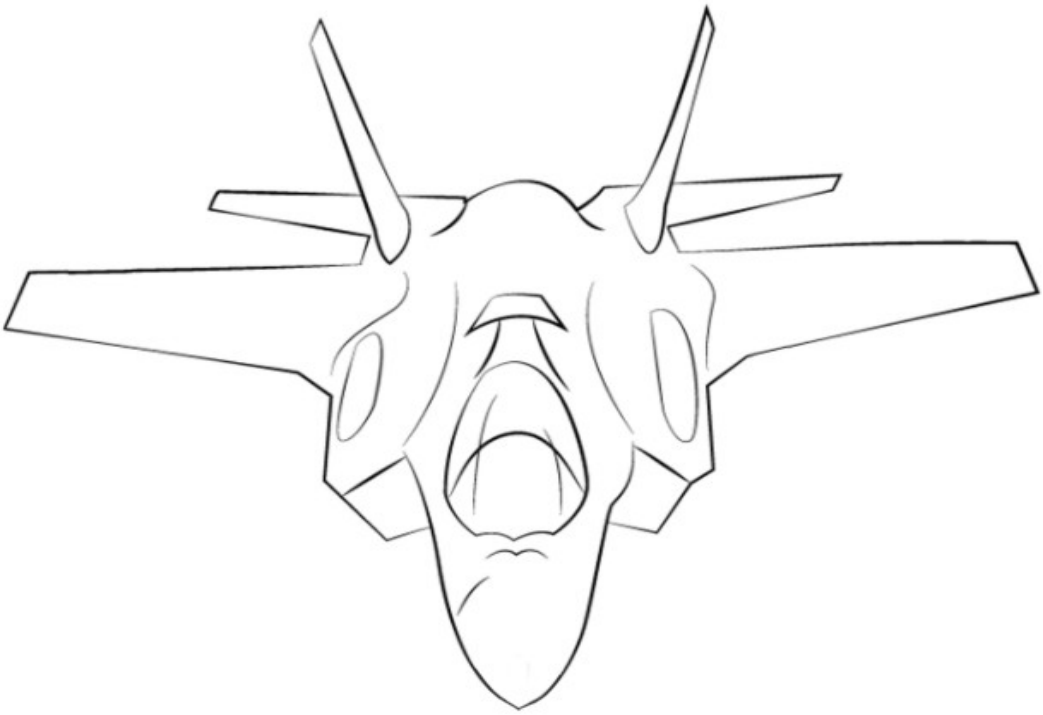
INDIA FOXT ECHO
VISUAL SIMULATIONS

F-35 LIGHTNING II AIRCRAFT for Microsoft Flight Simulator

USER MANUAL



Product Version 1.4.6 – October 2026

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.

CHANGE LOG

1.4.6
15-10-26
EXTERNAL MODELS
- Fixed missing DAS opening on fuselage top
- Minor improvements to existing DAS windows and MADL antennas
- Fixed minor glitches in GBU-12 geometry
- Improved textures of GBU-12,GBU-31,AIM-120 and AIM-132
- Minor fix to F-35A nose gear door geometry
- Reworked AAM launchers and fixed rail launch angle (approx 10 degrees down)
- Reworked inner weapon pylons and adjusted weapon anlge (approx 2 degrees down)
- Fixed minor smoothing glitches on F-35B model
- Redone canopy glass on F-35B model

COCKPIT MODELS
- Replaced stick model with a more accurate one
- Replaced throttle model with a more accurate one
- Redone all panel graphics fror better readability
- Added missing canopy switch
- Solved minor cockpit mesh glitches
- Fixed canopy lock lever animation
- Minor tweaks to seat belts
- Added multiple HOTAS animations
- Decreased Jettison Selector knob mouse area and fixed bug causing Jettison button not to be clickable
- Revised pilot visibility conditions so that it should now be visibile in multiplayer
- Minor adjustments to pilot animations
- Improvements to F-35B canopy

MISCELLANEOUS
- Adjustments to spawn static height and pitch
- Fixed script causing canopy to close when spawning cold and dark
- Fixed minor configuration errors
- Redone all thumbnails
- Minor improvements to aircraft configuration files

VEHICLE SYSTEMS
- Fixed incorrect configuration of emergency gear extension
- Afterburner now has continuously modulated thrust depending on throttle lever position
- Slightly revised flight control effectiveness when limiters are disabled
- Revised LED strobe lights frequencies

MISSION SYSTEMS
- Increased TSD plotting to 60 tracks
- Removed unnecessary code duplication on TSD
- Added support to Target (TGT) and Initial Point (IP)
- Reworked TFLIR imaging for more realistic rendering
- Reworked DAS imaging for more realistic rendering
- Reworked ASR synthetic imagery for more realistic rendering
- Added support for extended map mode (square format only)
- Fixed minor graphic glitch in ICAWS pop up mode
- Fixed multiple minor graphic glitches in SMS format
- Fixed number of gun rounds if external gun pod is mounted
- SMS format: revised main format details for realism
- SMS format: added SMS CNTL subpage
- SMS format: added SMS INV subpage to allow editing individual stores
- SMS format: added SMS SJ to allow editing Selective Jettison packages
- SMS format: added realistic countermeasures inventory and arm option
- TSD format: optimization of math functions used for track display
- TSD format: removed unnecessary code duplication
- TWD format: added countermeasures inventory and program status
- TWD format: added CM, MW and EA status captions

- General optimization of PCD code
- Reduced total number of .png files required

LIVERIES
- Added F-35A 3511 Polish Air Force Livery
- Added F-35A 24-5970 35th Fighter Wing USAF Wild Weasel
- Added F-35A 06-07 Italian Air Force Special Tail
- Added F-35A 35-01 Luftwaffe
- Added F-35A F-027 Koninklijke Luchtmacht "drone killer" (with drag chute pod)
- Added F-35A F-031 Koninklijke Luchtmacht Special Tail
- Added F-35A FL009 Belgian Air Force (with drag chute pod)
- Added F-35A 35A001 Royal Canadian Air Force
- Added F-35B CG-19 VMFA-231 U.S.M.C.
- Added F-35B ED-00 VMFA-533 U.S.M.C.
- Added F-35B ED-01 VMFA-533 U.S.M.C.
- Added F-35B ED-06 VMFA-533 U.S.M.C.
- Added F-35B ZM144 Royal Air Force
- Added F-35B ZM158 Royal Air Force
- Added F-35B ZM170 Royal Air Force
- Added nation-specific pilot patches for Belgium, Poland, Finland
- Added several squadron-specific pilot patches

1.4.5
20-4-26
- Fixed bug in stopwatch code
- Fixed minor mistakes in drop-down Checklists
- Fixed bug preventing canopy from opening if aircraft spawns in MSFS2024 walkaround mode

FLIGHT MODEL
- Minor tweaks to roll stability and induced drag

HMD
- Fixed bug in Tacan pointer behavior

PCD
- Minor fixes to graphic presentation
- Rectified minor typos in Checklist format
- Fixed bug causing TWD compass not to show correctly on portals 2 and 4

SYSTEMS
- Added support for native night vision
- Revised formation lights code

LIVERIES
- Added F-35A JF-501 Finnish Air Force Livery
- Added F-35A 22-5786 457th Fighter Squadron USAF
- Added F-35B MV-54 VMX-1 U.S.M.C.

1.4.4
25-8-25
General
- Solved minor bug causing DAS status not to be correctly updated in some cases
- Fixed regression causing remove-before-flight ribbons, covers and wheel chocks not to appear
- Fixed regression causing pilot skin modifier not to work on F-35A pilot model
PCD
- Solved minor bug causing incorrect brightness of some screens
- Added DAS sensor cooling indications in subportal mode
LIVERIES
- Added VMFA-251 DW01

1.4.3
12-8-25

General
- Fixed bug in saving/retrieving load configuration
- Fixed bug causing Tacan bearing not to show correctly in PCD/HUD portal
- Fixed bug causing ILS locator bar not to move on HMD if HMD is in CDM mode
- Minor improvements to pilot mesh skinning
- Revised SMS system to support additional symbology
- Fixed bug causing STA1 configuration not to be saved/retrived
- Master Mode is now dependent on weapon selection
- Added DGFT Master Mode
- Darker tint canopy selection will not affect external model
- SMS must be on TRAIN mode to change weapons
- Added cabin temperature simulation courtesy of Ralph Lehmann
- Fixed incorrect APP HOLD color coding
- Minor tweaks to flight model to prevent excessive roll-rate if limiters are overriden by the pilot
- TOGGLE ANNUNCIATOR SWITCH key binding now linked to Weapon Change command
- Changed brake application logic so that brake application countdown is now dependent on brake pedal total movement
- Changed standby electronic flight instrument to include baro settings both in inHG and in mbar, and added Mach number

PCD
- Fixed minor graphical glitches in the SMS page
- Fixed incorrect captions for currently selected weapon
- Rescale Target Information Box for better readability and realism
- Fixed bug causing portal configuration to be incorrect when switching back to full screen mode in certain instances
- Fixed bug very minor bug in touchscreen command handling
- Enforced limit of ONE INSTANCE per portal except TSD (as in the real plane) - YOU CANNOT HAVE DUPLICATE FUNCTIONS ANYMORE
- Major code optimization (reduced code duplication, 20% shorter XML code)
- Added A-A and A-S NTS lists to TSD in subportal mode
- Fixed incorrect "ARM/SAFE" caption on SMS page
- Enlarged SMS page mouse areas (note - to change configuration it is now REQUIRED to be in TRAIN mode)
- Live/Train status can be changed from SMS page
- Fixed bug causing IFF controls not to work if FAB is swapped
- Added SLAVED and SLEW captions to TFLIR page
- Added laser ranging caption to TFLIR page (only if A/S target is close to the crosshair)
- FAB: selected weapon is now highlighted in SMS section
- FAB:

HMD
- HMD now shows master mode, selected weapon and master arm status
- Target icon is now reported on HMD (icon changes depending on affiliation)
- Target data added to HMD if a target is selected
- Multiple minor adjustments for readability

Liveries:

F-35A
- Added Italian Air Force 6-06
- Added 159th FS Florida ANG 22-5816
- Fixed MADL antenna color on VT ANG livery

F-35B
- Added JMSDF 59-8204 livery
- Added 32-14 101mo Gruppo Aeronautica Militare Italiana
- Minor fix to 32-14 32mo Stormo Livery

1.4.2
07-4-25

GENERAL
- Solved bug causing custom catapult launch not to work in some cases.
- Tweaks to radar code
- Loadouts are now stored to permanent variables (and will carry over from a flight to the next)

PCD
- Tweaks to scale of AoA Bracket animation
- Revised target information box
- Unified all TSD displays to show 50 tracks tops
- Added separate icons for foes, friends and flight tracks
- TMS left flags current air target to FRIENDLY
- TMS right flags current air target to HOSTILE
- Link 16 page now allows the user to list Flight, Friendly and Hostile tracks
- Added IDENT function to IFF page
- IFF FAB now reports also STBY and EMER statuses
- MODE 3 and MODE C are now directly selectable from IFF page GOL
- MODE 3 and MODE C are now boxed if active in the IFF page

1.4.1
24-2-25

MINOR UPDATE

GENERAL:
- added option to disable built-in carrier functionalities from the PMD/DR page.
- increased sensitivity of RWR / TWD and reworked threat classification logic
- solved minor bug in SMS system reporting incorrect GBU-39 quantity in some cases
- solved bug causing cursor to remain visible in right part of the PCD if electrical power is not available
- solved bug causing POI green border to appear during PCD start procedure

RADAR:
- Fixed incorrect max cap of detected objects
- Revised influence of search volumes on radar range

PCD:
- HUD: fixed minor graphical glitches
- TWD: fixed orientation of air-emitter icon
- TWD: increased maximum number of threats displayed to 50 (was 60)

F-35:
- Added VMFA-251 DW-00 livery
- Added VMFA-251 DW-03 livery

1.4.0
4-2-25

NAVIGATION SYSTEM UPDATE

GENERAL
- Major redesign of navigation system for realism

PCD
- FAB: completely revised NAV section
- HUD: slight adjustments to clock graphics
- HUD: changed NAV data block to compley with real world layout
- HUD: added CDI
- HUD: fixed bug causing incorrect visualization of waterline symbol
- EFI: CDI GOL now selects CDI reference for ADI,HSI and HUD and also selects the nav source
- EFI: added CDI LRP in ADI views
- EFI: added HSI Glideslope indication
- SMS: added missing gun icon
- COM: fixed behavior of OLD COM1-2 frequencies (did not update after current frequency change)

HMD
- Harmonized HMD STOVL indication with FCS page
- Changed NAV data block to comply with real world layout
- Added LRP CDI
- Revised navigation data block
- Increased ILS bars sensitivity

F-35A
- Fixed very minor mapping glitch

1.3.9
10-1-25

GENERAL UPDATE AND BETTER MSFS2024 COMPATIBILITY

GENERAL
- Rewritten radar presentation code to get rid of fs9gps API as it is not supported by MSFS2024
- Changed HOTAS initialization code to solve a minor conflict with MSFS2024
- Solved bug allowing user to change search volume display with CSC if the HMD was the DOI
- Changed maximum brightness limit of HMD for better contrast in MSFS2024
- Changed HMD brightness code so that it is not depenent on TIME OF DAY variables
- Changed HMD and HUD brightness code so that it should have fewer compatibility issues with MSFS2024
- Fixed bug in stopwatch code
- Reworked RWR and radar electrical system logic
- Solved bug causing misalignment between target track symbol and detected track position
- Solved bug causing RWR alert sounds not to play for tracks above fusion number 20
- Solved minor glitch in TACAN course setting

RADAR SYSTEM
- Fixed bug preventing radar module from working in MSFS2024
- Rewritten radar module so that code is now split between WASM and HTML5/JS and allow for more functionality in the future

PCD
- AUTOPILOT: modes will appear boxed cyan if selected but not active, boxed white if selected and active.
- AUTOPILOT: solved minor graphic glitches in MSFS2024
- SRCH format: added search performance status.
- TSD: solved minor glitch causing incorrect bearing to show in target information box.
- TWD: RWR system status added to primary page.
- TWD: added pilot control on STBY or OPER mode. If in STBY audio alerts are inhibited.
- TWD: solved minor graphic glitches in MSFS2024.
- Fixed bug preventing target speed to appear from FAB if SPD HOLD mode is selected and active.
- PMD/DR: added option for PCD fast boot (permanent variable)
- PMD/DR: added option to disable in-flight refuel options

1.3.8
23-10-24

SYSTEMS UPDATE

GENERAL
- Fixed bug preventing additional autopilot functionalities (VOR HOLD, APP HOLD, BACK CRS) to work as intended
- Fly-by-wire landing control law preference is now a permanent variable
- Number of radar tracks processed increased to 50
- NWS LO caption changed to NWS
- NWS will automatically engage upon landing is below 145 knots
- NWS will automatically disengage if speed is above 150 knots
- Tweaks to thrustometer readings so that ground idle is now 10 as it should be in the real aircraft
- Fixed built-in refuel code, and aligned speed restrictions to ICAWS system
- Minor fixes to ICAWS captions
- Upgraded WASM radar module

- Added DISPLAY MANAGEMENT SWITCH HOTAS functionality
- Added CURSOR SLEW HOTAS Functionality
- Added several callsigns to aircraft configuration (courtesy of Richard Collens)
- Added realistic cooldown time for TFLIR and DAS systems
- GCAS warning are now affected by GCAS level and MTC
- Fixed bug preventing "Pull Up!" audio cue from playing
- Added ALOW2 and LIS "Altitude" warning
- SET NOSE WHEEL TO LIMIT key binding now also disables G-Limiter, Autotrim and Alpha limiter when the aircraft is in the air
- Hydraulic system nominal pressure set to 4000 psi
- Added Guard frequency functionality
- Changed formation light code

HELMET-MOUNTED DISPLAY
- Integrated new custom font and adjustmentes (courtesy of Cayden Nguyen)
- Revised HMD refuel and fuel dump symbology
- Revised off-axis symbology
- Added stopwatch

PANORAMIC CONTROL DISPLAY
- Revise power up sequence and conditions
- Increased display warmup time to 2 minutes
- Miscellaneuos code optimizations
- Fixed bug preventing DIM page to appear as expected
- Changed code so that clicking twice on an function that activates a input prompt will now cancel the prompt (as opposed to resetting it)
- Fixed bug causing PCD brightness to change when LITES page was selected
- Fixed bug preventing user from entering COM3 frequency from NAV page
- ILS bar on EFI page now follow velocity vector
- TWD audio option is now functional
- Radar track information is now displayed also in VSD mode
- SRCH page: Radar mode and search volumes are now selectable
- TSD: Radar search volumes can be displayed on the TSD (by clicking below the airplane icon)
- TSD: Major rework of MAP mode for better readability
- TSD: Radar tracks added to MAP mode
- TSD: Fixed several minor glitches
- TSD: Added missing ground track to HSI mode
- TSD: Added missing heading reference to HSI and HSD mode
- TSD: Improvements to bullseye data
- TSD: Track symbology will now be parked on gutter line
- SMS: Although still INOP, weapons can now be selected in the SMS page
- TWD: Audio option is now enabled
- ALT FAB: completely revised page layout
- TIME FAB: added page functionality
- IFF FAB: updated layout and functionality
- Track limit increased to 60
- TSD VSD now also shows ground tracks
- TSD VSD RCS background can be decluttered
- TFLIR BLOT-WHOT option
- Minor tweaks to TSD HSI mode
- Solved minor bug causing FAB bar graphics overlap during PCD power up if "SWAP" is commanded.

COCKPIT
- Solved very minor geometry mistakes

F-35A
- Added Polish Air Force Livery

F-35B
- Solved minor light leakage in rudder pedal area
- FCS Reset button was missing animation

F-35C

- Solved minor anomaly in external 3D model
- Added VFA-86 livery
- Fixed minor mistakes on VFA-97 livery

1.3.7
01-08-24

MINOR UPDATE

GENERAL
- Added "Automatic NWS" option in PMD/DR page. Variable setting is permanent.
- Added "Tinted Glass" option in PMD/DR page. Variable setting is permanent.
- Fixed reversed animation of rudders during V-brakes deployment
- Fixed bug causing CDI on VHUD to report VOR/ILS OBS if CDI-TCN was selected

PANORAMIC CONTROL DISPLAY
- Solved bug causing change of Nav source from TDS3/HSI mode in certain circumstances

FLIGHT DYNAMICS
- Minor tweaks to landing gear compression

F-35C
- Solved minor graphical glitch in landing gear animation
- Improved canopy frame smoothing

1.3.6
26-07-24

MINOR UPDATE

GENERAL
- Changed default external camera distance on user request.
- Minor fixes to checklists
- Fixed minor prioritization issue for anti-ice ICAWS messages
- Changed aircraft ATC string to "F35A", "F35B" and "F35C"

COCKPIT
- Redone panels backlighting texture
- Fixed Engine switch markings and mouse tooltip
- Changed reading lights angle and intensity, also they will not emit light if oriented at less than 30 degrees with respect to their rest position (to avoid visual glitches)

PANORAMIC COCKPIT DISPLAY
- Minor fixes to checklists

LIVERIES
- Added ZM138 XVII Test And Evaluation Squadron Royal Air Force

MISCELLANEOUS
- Minor improvements to flight manual
- Added list of ICAWS alert to the flight manual

1.3.5
23-07-24

MINOR UPDATE
- Fixed bug in sound configuration preventing new ICAWS sounds to play as intended
- Additional key bindings are now a permanent variable

1.3.4
12-07-24

MAJOR AVIONICS UPDATE

GENERAL
- Major rework of navigation system
- Major rework on ICAWS (more messages, EFI/HUD integration, acknowledgment option)
- TACAN and ILS/VOR now have separate course lines
- Added proper CDI functionality
- Reworked fuel system and tankage on all variants
- Reworked engine anti-ice system
- Added option to control HMD visor position
- Adjusted external camera position
- Fixed bug preventing correct TFLIR and DAS imagery below 100ft ASL.
- Nose Wheel Steering code rewritten: NWS HI and NWS LO settings are now available.
- Removed Asobo effects and replaced with custom vapour effects

PRIMARY CONTROL DISPLAY
- Complete rework of PCD mouse interface
- Major optimization of PCD logic code
- Added mouse interaction visual clue
- Complete rework of portal and subportal proportions
- CHECKLIST - minor improvements layout and more accurate interface
- CHECKLIST - revised checklists, should be closer to the real deal
- CHECKLIST - added separate initial cockpit check checklist
- EFI - Reworked heading graphics
- EFI - Reworked NAV sources graphics
- EFI - HSI OBS and CDI are now color coded depending on NAV source
- EFI - Added proper CDI functionality
- EFI - ILS bars must be toggled manually now
- FCS - minor graphical upgrades and more accurate mouse areas
- FUEL - general upgrade to latest software release
- FUEL - added refuel system opening/closing consent prompts
- FUEL - quantity in individual tanks in rounded to the nearest 50
- FUEL - miscellaneous graphical and interface improvements
- ICAWS - improved readability and added new messages
- ICAWS - added ICAWS TEST functionality
- TSD - Added HSI View Mode
- TSD - Fixed MAP Mode proportions
- TSD - Reworked VSD Mode for better efficiency
- TSD - Reworked HSD Mode for better efficiency
- COMMUNICATION POP-UP - Added guard functionality
- IDENTIFICATION POP-UP - Added emergency code
- FAB - Improved IFF section
- FAB - Improved ICAWS section and message readability
- FAB - Swap button now resets Pop-up status
- Simulator preferences moved to PDM/DR page
- PCD configuration can be saved and retrieved from the PDM/DR page
- Improved aircraft symbol in TSD/HSD MAP mode

FLIGHT CONTROL SYSTEM
- Further tweaks to roll PID
- Virtual speedbrake rudder animation reversed
- Virtual speedbrake flaperon deflection reversed if plane is on the ground
- Reworked automatic schedule of flaps animation (depending on phase of flight)

AUTOPILOT
- Revised autopilot interface to mimic the real plane. Additional functions can be toggled in the PMD/DR page.
- Reintroduced Stick Control (which can be toggled in the PMD/DR page).
- Added realistic Autopilot and Autothrottle limits COCKPIT - Added missing ICC3 switch marking on IPP panel - Added reading lights functionality GEOMETRY AND ART - New helmet model and texture set - New pilot head model and textures - Fixed minor geometry issue in F-35B Lift Fan area - Fixed multiple minor UVW issues in F-35B Lift Fan door - Fixed minor UVW distortion in F-35A lower fuselage surfaces - Fixed

geometry issue (light leakage) on F-35A model in the engine area LIVERIES - Fixed minor mistake in F-35A VT ANG livery (mirrored graphics on the left tail) - Fixed incorrect albedo in F-35B DT01 livery (incorrect compositing of intake door texture) - Fixed minor glitch in F-35A Demo Team pilot patch - Fixed incorrect name of several liveries in the livery selection menu - Fixed missing filter on several custom cover - Fixed incorrect color of several antennas on F-35A

SOUND PACKAGE (by ECHO19)
- Adjustment: wind noises at speed were increased, and new high-quality sounds added
- Adjustment: G-Force related wind sounds
- Adjustment: Internal ECS fan noise oscillation removed due to complaints, volume increased.
- Adjustment: Increased close proximity howl sound (blue note)
- Adjustment: Slightly changed close afterburner sound, increased volume slightly.
- Adjustment: Decreased range of high pitch turbine noise on aft camera angles.
- Adjustment/Fix: Further refined external idle/turbine noise for better and more consistently realistic flyby audio.
- AI package updated to reflect changes above
- Fixed: switch sound reverb issue
- Fixed: issue with AI mix bus control
- Fixed: squeaky brake pedal volume
- Added new afterburner approach sound when flying inbound fast
- Added new random variant of the slow burner pass effect
- Several sound file clean-ups / edits
- Small adjustments to volume
- Mirrored AI / MP audio changes

1.3.3
06-05-24
ECHO 19 SOUNDS AND AVIONICS UPDATE

- Fixed bug causing time indication on the control bar to show 24 instead of 00
- Removed duplicate entries in autopilot configuration
- Slight modification to effects of crosswind on flight dynamics
- Added HMD Bore-sight and GCAS preferences to permanent variables
- Reworked afterburner effects
- AoA bracket now adapts to the model (A, B or C)
- Additional key bindings are now disabled by default and can be enabled with an option in the MENU screen
- Fixed multiple minor glitches on PCD FUEL interaction
- Major restyle of HMD bore-sight and off-bore-sight graphics
- Tweaks to FBW PID coefficients
- ILS signal can now be received ONLY if the nose gear doors are open

HEAD MOUNTED DISPLAY
- Fixed FPV and ghost VV graphics
- Added proper CDM symbol
- Reworked off-bore-sight symbology
- Reworked waterline graphics

PRIMARY CONTROL DISPLAY
- FAB: added engine anti-ice captions
- FAB: reworked landing gear symbology
- ENG page and FAB: FF indication changed to ppm instead of pph
- EFI page: fixed waterline position
- FCS page: added NOSE DOOR functionality on FCS page
- HUD page: reworked graphics for better match with HMD
- HUD page: fixed FPV and ghost VV symbology, added CDM
- HUD page: fixed minor bug in clock indication
- HUD page: fixed waterline graphics and behaviour
- TWD page: added draft RWR track implementation
- TWD page: optimized code and revised symbology

SOUND
- New sound package by Echo19

LIVERIES
- Added VMFA-311 lo-viz livery
- Minor tweaks to VMFA-311 hi-viz livery
- Added RAAF 75 Squadron livery
- Minor tweaks to all Australian liveries

1.3.2
29-02-24

RED TAILS, ENGINE AND AVIONICS UPDATE

GENERAL
- User can now select between legacy and alternate autopilot logic in the MENU options:
  Legacy: default MSFS fly-by-wire autopilot (which has some issues)
  Alternate: upon engagement, autopilot will disengage the FCC (more reliable, but can create problems for some users)
- Added "permanent" variables (will be saved after a flight and retrieved on the next flight):
  - Autopilot mode (legacy or alternate)
  - STOVL dynamics (normal or optimized for moving ships)
  - Radar reflectors (mounted or not)
- Fixed multiple regressions in DAS and TFLIR camera control options
- Fixed bug that caused left and right wing tip fuel tanks to be swapped in PCD FUEL page
- Minor improvements to in-flight refuel system
- Revised engine transonic performance on all models
- Minor tweaks to engine fuel consumption on all models
- Fixed very minor mistakes in livery thumbnails
- HUD and MFD altitude readings rounded to 10 ft (like IRL)
- EFI portal now displays Flight Director information (white dot)
- NO RAD caption will turn off if ASR, A/A or A/S radar are working
- Added key/events bindings:
  TOGGLE ANNUNCIATOR SWITCH -> refuel system
  WATER RUDDER -> weapon door

F-35A
- Fixed mirrored ANG graphics on 115th FS livery
- Added 187th FS Alabama ANG "Red Tail" livery

F-35B
- fixed very minor glitch in main landing gear animation
- fixed very minor mapping and smoothing glitch in rudder surfaces
- fixed minor mistake in VMFAT-502 livery
- fixed minor typos in aircraft configuration file
- added VMFA-542 VH-01 livery
- added VMFA-542 VH-06 livery
- added VMFAT-501 VM-51 livery

1.3.1
15-12-23
MINOR UPDATE
- Minor tweaks to autopilot logic (redone AI behaviour, reverted to FCC-governed default mode, tweaks to coefficients)
- Minor tweaks to subsonic engine performance on all models, with partial roll back to 1.2.8
- Minor tweaks to subsonic drag coefficients on all models
- Minor tweaks to afterburner sound in external views

1.3.0
12-Dec-23
HOTFIX
- Temporarily Disabled STICK CONTROL feature due to problems with new autopilot logic
- Minor change to autopilot logic to fix control regression for some users

1.2.9
11-Dec-23

GENERAL
- Replaced incorrect engine start sound
- Fixed minor misalignment glitch in ENG page portals 2 and 4
- NWS engagement now can be controlled with the "SET NOSE WHEEL STEERING TO LIMIT" key binding
- Added support to 8.33KHz spacing con COM page
- NWS buttons and paddle switch on the VC stick are now functional
- Tweaks to G-limiter and fly-by-wire behaviour
- Tweaks to stability and flight controls effectiveness coefficients
- BFI, HMD, TFLIR, ASR, DAS and MAP screens can be popped-out (PC)
- Major update to engine and flight model in transonic regime, with more realistic performance and Mach wall
- Autopilot now uses an analogue flight model (FBW protection is temporarily disabled in AP mode) which should be more reliable
- Minor changes to G-limiter
- Fixed bank scale on HMD graphics

F-35A
- Added custom 495th FS engine covers
- Added Belgian Air Force FL001

F-35B
- Added VMFAT-502 WF502 livery
- Added VMFA-122 DC122 livery

1.2.8
20-Oct-23

GENERAL
- Weapon bay light enabled also on -B and -C models
- Reworked post stall rudder authority
- Fixed missing HUD ladder on HUD formats on PC (missing file)
- Fixed minor bug on PCD-HUD page clock, showing 24:00:00 instead of 00:00:00
- Fixed minor bug on PCD-HUD page clock, showing Z even if local time was selected
- Fixed minor bug that caused NWS caption to appear on HMD with launch bar selected
- Added NWS and brakes indications to PCD/HUD full screen
- Added SAFE/ARM indication to PCD/HUD

F-35A
- Added Koninklijke Luchtmacht F-037 livery
- Added Koninklijke Luchtmacht F-028 livery
- Added Koninklijke Luchtmacht F-014 livery
- Added Koninklijke Luchtmacht F-019 livery
- Added 48th FW, 115th FW specific pilot patches

F-35B
- Added VMFA-225 specific pilot patch
- Added option to switch STOVL/HOVER dynamics model:
  Default mode is better suited for static ships
  Alternate mode should work better for dynamic ships

F-35C
- fixed minor bug preventing correct weapon bay textures to load
- minor fix to VFA-125 livery
- minor fix to VFA-97 livery
- added VX-23, VFA-125, VMFA-311, Top Gun specific pilot patches

1.2.7
15-Oct-23

GENERAL

- Solved minor glitch preventing HMD Brightness "Down" from working as intended on -B and -C models
- Allowed user to activate Launch Bar with both the keystroke and the PCD
- Improved manoeuvrability and turn performance at low speed
- Improved post-stall yaw authority
- Redone canopy scratches
- Improvement FPV alignment during bank
- Added MAN/AUTO waypoint switching option
- Major modification to the sound package:
 > Redone engine exhaust sounds and cones
 > Redone engine faraway sounds
 > Redone jet whine sounds and added "howl" effect
 > Redone cockpit low-pass filter and volume levels
 > Improved dynamic wind and rattle sounds
 > Redone engine faraway sounds and adjusted loudness vs. distance curves

- FCS Reset is now automatically applied once autopilot is operated (should result in more reliable autopilot behaviour)
- Fixed bug preventing JDAM beast mode selection on A and C models
- Remapped and retextured multiple details for better resolution and more realistic look
- Added weapon bay lights (automatic activation if aircraft is on the ground and doors are open)
- Added refuel system lights (automatic activation if refuel probe/receptacles are ready for IFR)
- Added Ground Track "T" symbol to both HMD and HUD PCD format - Added Tacan "diamond" symbol to both HMD and HUD PCD format
- Added proper CAGE/UNCAGE behaviour to horizon ladder in PCD HUD format
- Added side-slip indication on HMD, and on PCD EFI and HUD formats
- Improved bank scale functionality on HMD
- Added NWS caption to HMD symbology
- Added wheel brakes indication to HMD symbology
- Added VV ghost to PCD HUD format and normalized behaviour of VV-related symbology
- Redone V/S BIT animations
- Fixed multiple minor glitches to CDI symbology (HMD and PCD)
- Minor optimizations to PCD-EFIS HSI mode
- Redone all thumbnails

F-35A
- Added USAF 493rd Fighter Squadron livery
- Added USAF 325th Fighter Squadron livery
- Added USAF 48th Fighter Wing livery
- Added L-007 livery for Royal Danish Air Force
- Minor improvements to Danish livery
- Updated USAF 495th Fighter Squadron livery
- Added custom helmet for F-35 Demo team
- Added visual variant with drag-chute "hump"
- Added Norwegian Air Force 5148 livery

F-35B
- Solved bug causing AIM-120 on STA4 and STA7 not to appear
- Solved bug causing potential horizontal speed increase during vertical take-offs
- Minor improvements to Italian Navy 4-01 livery
- Added Italian Navy 4-03 livery
- Fixed numbers on VMFA-121 VK-00 livery

F-35C
- Improved AoA indexer lights on nose gear
- Minor tweaks to VFA-97 livery - Added VFA-125 livery

1.2.6
10-Sep-23

GENERAL
- Updated radar reflectors
- Fixed configuration bug preventing localized descriptions to show in some cases
- Added afterburner projected light effect

- Improved afterburner effect
- Improvements to HMD symbology
- Minor tweaks to HUD page symbology
- Fixed bug causing Portal 3 and 4 to swap if portal 4 was maximized to full screen
- Fixed glitch preventing some radar tracks to show correctly on TSD screen
- Minor optimization of PCD code
- Fixed minor glitch in PCD commands
- Redone canopy mapping and textures on all models
- Fixed minor glitches in pilot figure geometry and smoothing and increased poly count
- Fixed bug preventing "BACK" option to work as intended
- Fixed minor bug preventing audible feedback to work on some PCD commands
- AIM-120 can now be loaded also on STA4 and 8 (non-Marketplace versions only)
- Added internal-only air-to-air configuration and multiple model-specific configurations (non-Marketplace versions only)
- Reworked ejection seat geometry and textures
- Reworked STOVL dynamics when wheel touch the ground in hover mode
- Improved cockpit shadows accuracy and resolution
- Modified steering dynamics

PC ONLY:
- Refactored Radar WASM module (with better track management and ageing options)
- Added third tag to full screen portal visualization
- Improvements to canopy geometry

F-35A
- Fixed minor geometry error on fuselage
- Added GBU-39 for STA4 and STA8 (non-Marketplace versions only)

F-35B
- Fixed audio glitch in RAF livery
- Fixed minor modelling errors in canopy actuators geometry

F-35C
- Minor tweaks to arrestor gear dynamics
- Launch bar now reacts to default keystroke
- Fixed minor canopy glass misalignment in external views
- Fixed minor geometry issues
- Fixed minor UVW mapping glitch nearby auxiliary air intake and taileron edge
- Added AGM-154 JSOW option for STA4 and STA8 (non-Marketplace versions only)

XBOX ONLY
- Solved minor glitch preventing FCS page to render correctly on Portal 1 and Portal 3 in some cases.

NOTE – Version 1.2.5 skipped to align Xbox/Marketplace and non-Marketplace versions numbering

1.2.4
23-May-23

MINOR FIX

GENERAL
- Fixed minor bug in radar reflectors menu

F-35C
- Fixed minor mistake in engine materials assignment
- Fixed minor mistake in main surfaces composite texture
- Fixed minor mapping mistake in fuselage texture (visible only in CF-01 livery)

1.2.3
19-May-23

GENERAL
- Fixed minor bug preventing functionality of some AP buttons if LITES menu is also selected
- Fixed minor glitch in AOA Bracket animation
- Changed engine sound fall-off profile
- Reorganized sound files
- Fixed minor bug causing incorrect IPP lights behaviour in rare occurrences
- Replaced behaviour templates of throttle lever, landing light switch, parking brake, rudder trim
- Revised animation of rudder pedals
- Added afterburner detent
- Added bespoke engine covers to several liveries
- Major refactoring of pilot model (new oxygen hose, additional details, new animation, new harness)
- Added pilot shoulder patch (bespoke for various countries and squadrons)
- Added "headless" option to pilot body visualization (visibility control now cycles between no pilot, headless pilot and full model)
- Added native canopy variable (for smoother animation and multiplayer sync)
- Added "refuel and repair" option to PCD MENU screen
- Added "radar reflectors" mount/unmount option to PCD MENU screen
- Added live ordnance textures (with multiple variants and warheads) to several liveries
- Updated manual

F-35A
- Fixed minor mistakes in 18-5343 livery
- Changed tail font in 08-0747 livery
- Added Wisconsin ANG livery
- Added AF-01 prototype livery

F-35B
- Fixed minor UVW mapping misalignments
- Fixed minor polygon smoothing issues
- Fixed minor modelling glitches
- Added VMFA-213 "Black Sheep" liveries (hi-viz and lo-viz)
- Added BF-01 prototype livery

F-35C
- Fixed mapping mistake on left taileron upper surfaces
- Fixed minor mistake in engine nozzle geometry
- Fixed minor mistake in remove-before-flight ribbons geometry
- Fixed minor mistake in air intake geometry
- Fixed minor mistakes in Top Gun, VFA-147 and VFA-97 liveries
- Fixed incorrect stencils on VMFA-314 livery
- Added CF-01 prototype livery
- Added VFMA-311 livery
- Added VFMA-314 VW300 livery
- Added VFA-101 NJ101 livery

1.2.2
03-Apr-23

GENERAL
- Fixed minor graphical glitch in FCS page
- ASR zoom can now be adjusted
- DAS switched to front view, turns to downward view in hover mode.
- TFLIR now has NAV and AS modes (AS modes is horizon stabilized)
- DAS and TFLIR views can be adjusted in pitch
- Fixed minor bug on TSD target designation
- Improved engine geometry on all models
- Added ground crew access panels to all models
- Solved minor glitch when selecting INOP pages
- FCS RESET BUTTON now switches from AUTO to MAN mode, also added button animation
- NAV SOURCE can be changed also on ASR, DAS and TFLIR pages
- Fixed minor bug preventing correct AoA visualization on HMD

- Minor revision to -B and -C markings
- Fixed minor bug causing slightly different engine readings in FAB and PCD ENG page
- Refined APU exhaust geometry on all models
- Fixed minor bug causing aural alert to play even without electrical power in some instances

F-35A
- Added USAF 17-5281 livery with Demo Team covers
- Added USAF 13-5081 livery
- Added JASDF 69-8701 livery
- Added IAF 911 livery
- Added IAF 909 livery
- Fixed minor mistake in Aggressor livery

F-35B
- Fixed minor regressions in 3D model (incorrect UVW) and redone minor details
- Changed taileron behaviour during STOVL operation to better match the real aircraft

F-35C
- Tweaks to arrested landing and recovery dynamics to improve compatibility with third party carriers

1.2.1
04-Mar-23

GENERAL
- Fixed minor AO mistake in cockpit textures for -A and -C models
- Fixed minor formatting issue in HMD altitude digits
- Solved bug in anti-ice system causing incorrect behaviour in AUTO and ON modes
- Solved bug causing incorrect PCD start conditions
- Replaced anti-collision effects with a much brighter one
- Reworked MENU->LITES interface so that console, indicator, formation and strobe lights can be dimmed.
- Reworked landing lights rendering
- Solved minor bug in TACAN bearing pointer indication on EFI page
- Solved minor issues in HUD altitude text formatting for smaller digits.
- Solved bug preventing FAB bar to display GCAS status correctly - Draft implementation of GCAS system (OFF/Manual/AUTO) - when set to AUTO the plane will try and avoid ground collision - Safety pins can now be reinstalled (by clicking on the left console blank panel) - Draft implementation of In-flight refuel. While in-flight:
  a) open refuel receptacle door/extend probe
  b) click on the fuel quantity summary
  c) keep the plane within 50ft and 10 kts from the initial condition
  Note: refuel rate is dependent on refuel system
  (about 5800lbs/min for A, 2500 lbs/min for B and C)
- Updated FUEL page layout
- Added DUMP Cut-off functionality
- ENGINE switch now linked to "mixture" control, can switch off the aircraft if set to OFF and throttle is retarded
- Minor tweaks to CHECKLIST page
- Minor tweaks to in-game checklists
- MFD now defaults to "Blank" configuration if powered off
- Optimization of VR collision mesh
- Improved GCAS symbology

F-35A
- Solved minor visual interference with landing gear structure and cockpit

F-35B
- Change Lift Fan door animation, angles and speed to better match the real one
- Fixed minor visual glitch in refuel probe geometry

F-35C
- Fixed minor visual glitch in refuel probe geometry

PC-ONLY

- Basic implementation of VSD functionality
- Fixed several bugs in TSD rendering
- Increased number of radar tracks to 42
- Added TSD target tracking capability (clicking on the centre of the TSD screen will update the target)

1.2.0
31-Jan-23
GENERAL:
- Fixed minor AO issue on ejection seat models
- Removed unnecessary duplicate geometry (Zeroize knob) from all cockpit models
- Clean-up of AITraffic settings
- Clean-up of unnecessary code
- General update of the product manual

SYSTEMS:
- Changed clock code to display 00:00:00 instead of 24:00:00
- Minor optimizations to clock code
- Increased auto-trim reaction speed
- Reworked flap system
- TRIM RESET now resets trim on all axis, and toggles FCC if it is switched off
- FLAP LEVER now disables FCC and AUTOTRIM
- If FCC is running (and auto-trim is active) the "AUTO" caption appears alongside the trim value
- FCS DEGRADED warning appear if airspeed is above 400 knots and user has disabled FCC
- Defog handle now controls canopy de-icing
- Rewritten Anti-Ice system (now implements Anti-Ice On-Auto-Off modes)
- Added Air Data System Heat (ADS HT) control to ENG page and implemented system simulation
- Tweaks to ENG page
- PHM and ICAWS now report FCS DEGRADED if FCC is switched off
- Fixed bug preventing Oxygen Test and BOS switches to be highlighter by the mouse
- Fixed minor text misalignment in FUEL page
- Clean-up of unnecessary code
- Fixed incorrect altitude variable in PCD HUD pages (page was reporting real altitude as opposed to indicated altitude)
- Fixed bug preventing wind direction from showing on PCD control bar
- Fixed bug preventing input of ALOW altitude in certain conditions
- Changed canopy control code so that it is now impossible to open the canopy if airspeed is above 50 kts
- Rewritten code for automatic speedbrake retraction during touch-and-go (speedbrake will retract if throttle is above 70% travel)
- Solved minor glitch on HUD page
- Added MACH HOLD AT functionality, Mach input capped at 1.60
- Added Back course option for AP (does not work too well)
- Fixed minor glitch in AP control interface if on right PCD side
- Autopilot has now default setting of 15000 ft, auto-throttle has now a default setting to 400 kts
- Fixed minor bug preventing correct rendering of DAS imagery in some cases
- Added MAP mode to TSD screens
- Added VSD option to TSD screens (INOP, for future implementation)
- Improved interface and rendering of all imagery services
- Tweaked nose wheel steer settings

F-35A:
- Changed base colour to multiple liveries for a better match with late Block3 and Block 4 colours
- Fixed reversed characters on landing gear door and other minor details in USAF livery 08-0747
- Fixed reversed characters on landing gear door and other minor details in Australian livery A35-040
- Clean up of F-35I prototype livery
- Updated Italian Air Force 6-01 livery
- Added Italian Air Force 32-13 livery (courtesy of Christoph Tantow)
- Added Royal Australian Air Force A35-001 livery 2nd OCU

F-35B:
- Changed base colour to multiple liveries for a better match with late Block3 and Block 4 colours
- Fixed minor modelling and texturing misalignment in Lift-Fan door area
- Fixed minor modelling misalignment in roll post door location

- Fixed minor modelling errors in weapon bay harnessing
- Added U.S.M.C VMFA-242 "Bats" DT-01 livery
- Added U.S.M.C VMFA-242 "Bats" DT-02 livery
- Added Italian Air Force 32-14 livery
- Fixed incorrect AI configuration entry

F-35C:
- Changed nose cone colour of VFA-147 and Top-Gun liveries and fixed minor other details
- Miscellaneous improvements to VFA-97 livery

XBOX:
- Fixed minor geometry issue in F-35A (IR sensor leftover from PC build)
- Fixed missing wheel chocks, ribbons and covers from F-35B
- Reduced video memory footprint for better stability

1.1.9
15-Jan-23
Internal evaluation build – not released to the public

1.1.8
11-Dec-22
- Fixed minor glitch in F-35B model geometry
- Minor adjustments to supersonic drag coefficients
- Adjusted waterline position
- Fixed minor mistakes in flight_model.cfg entries
- Minor optimization of FCS code
- Redone and optimized animation code of rudders, slats, tailerons and flaperons for higher frame rates and better multiplayer propagation
- Improved tires dynamics
- Tweaks to afterburner effect graphics
- Changed afterburner settings for a more gradual power curve
- Minor adjustment to engine covers (B only)
- Moved localization files to specific folders in preparation of SU11
- Removed unnecessary legacy variables
- Fixed bug preventing correct TACAN channel from displaying when in Y mode
- Fixed bug preventing user from changing TACAN mode unless new TACAN code was entered
- Fixed bug preventing correct tuning of TACAN channels 01X to 16Y
- Fixed bug preventing correct TACAN location to show on TSD in some instances
- Fixed bug preventing correct TACAN channel to show on HMD in some instances
- Added F-35C VFA-97 Warhawks Repaint
- Added F-35A 77Sqn Repaint (courtesy of Christoph Tantow)
- Added F-35B VMFAT-502 Repaint (courtesy of Christoph Tantow)
- Solved minor bug preventing user from selecting HUD on Portal in rare cases
- Corrected approach speed on PCD checklist
- Fly-by-wire control low changed to fly_by_wire_from_flaps =1
- Fixed minor bug in FCS page values
- Fixed bug causing trim control to be reversed if an analogue controller was used
- Tweaked wheel chocks geometry
- AI sound aliased from stock F/A-18E on request of the users

1.1.7
13-Sep-22
- Fixed duplicate geometry issue causing flickering of the PCD in the C variant
- Minor optimization to XML code (unnecessary code removed)
- Improved accuracy of distance measurement for TACAN stations
- Improved identification of TACAN stations

1.1.6
12-Sep-22
- Fixed minor geometry issue on F-35A model
- Fixed bug preventing fly-by-wire from working if flight is started cold and dark
- Minor tweaks to FLT files

- FCS RESET button now resets trims and controls surfaces

1.1.5
11-Sep-22
- Minor tweaks to VMFA-225 livery
- Increased toe brakes effectiveness
- Tweaked differential braking
- Fixed HMD horizon (now -90 to +90 degrees, was -85 to +85)
- Fixed HMD waterline
- Added zenith/nadir symbols to HMD and EFIS
- Minor tweaks to drag coefficients at high Mach
- Minor adjustments to reference speeds
- Complete rework of flap dynamics, which should allow better behaviour during landing and correct APP mode functionality
- Minor tweak to canopy AO for F-35B model
- Fixed minor gaps in external 3D models
- Added multiple brightness levels to HMD and PCD
- Improved HMD Off-bore-sight limits
- Solved minor glitch in FAB bar
- Corrected HYDA and HYDB captions on ENG page
- Changed engine sound samples
- Implemented sonic boom and Mach cone
- Redone Mapping and materials of B variant to solve a minor AO glitch
- Redone afterburner sound and visual effects
- Fixed BOS switch animation
- (Very) minor fix to lift fan door geometry
- Added LH/RH captions on canopy actuators on F-35B (previously missing)
- Minor graphical optimization of F-35B and C models
- Manual moved to Docs folder in the main package folder (as opposed to the SimObjects)

PC Only
- Fixed minor mistake in wheel chocks position for F-35B

1.1.4
28-Aug-22
INTERNAL BUILD – NO PUBLIC RELEASE

1.1.3
11-Aug-22
- Fixed incorrect fuel quantity on F-35C
- Fixed incorrect range for F-35C in UI
- Redone all thumbnails as wheel chocks were not compliant with Microsoft thumbnail policy
- Change parking entry from “ANY” to “MIL_COMBAT”
- Fixed conflict between “fuel and payload” menu and SMS page

PC ONLY:
- Fixed incorrect illumination of covers and streamers

10-Aug-22
- Fixed engine performance at high altitude for F-35A
- Minor tweaks to supersonic drag to the F-35A
- Fixed spelling error for Danish Air Force
- Removed HOVER / V/S HOLD SUBMODE (useless in MSFS and causing multiple problems with FBW)
- Minor tweak to HOVER logic to prevent non-zero target speed upon HOVER engagement
- Minor tweak to HOVER logic to prevent forward motion when performing vertical take-off
- Modifications to autopilot code
- Redone all thumbnails and added "thumbnail_small.jpg" where missing
- Added 58th FS livery courtesy of Christoph Tantow
- Added VMFA-225 livery courtesy of Christoph Tantow

PC only (non-marketplace version):
- Aircraft configuration can now be changed from the SMS page

XBox only:
- Increased resolution of fuselage normal and composite textures
- Increased resolution of the textures in some areas of the cockpit

1.1.1
1-Aug-22
- Fixed bug preventing TACAN bearing to show in some instances
- (PC only) Added "remove before flight" streamers and covers
- Modified autopilot logic for less erratic behaviour with the new flight model
- Added Vermont ANG livery courtesy of Christoph Tantow
- (SU10 and above) HMD "Off-Bore-sight" symbology now must be selected by the user in the MENU functions.

1.1.0
25-Jul-22
- Fixed animation of F-35B Lift Fan
- Fixed animation of F-35B In-flight refuel probe
- Added missing USAF roundels to 495th FS livery
- Added missing USAF roundels to 356th FS livery
- Changed custom fonts from OTF to TTF due to NanoVG incompatibility in SU10 preview
- Draft implementation of full fly-by-wire/FCS flight model
- Draft implementation of off-bore-sight HMD symbology
- Changes to arrestor hook logic for better compatibility with moving carriers
- Draft implementation of TCAS / Air-to-air awareness (via WASM module):tracks are reported on TSD screens (PC only)
- Fixed animation glitch on F-35B nozzle
- Fixed bug causing incorrect toggling of autopilot modes on F-35 at approximately 20000 feet
- Improvement to afterburner self-illuminating textures
- Added VR stick entries (untested)

1.0.9
02-Jul-22
AUTOPILOT, CARRIER FUNCTIONALITY AND DRAGON LIVERY UPDATE

IMPORTANT!
Starting from this release, the key binding for HOOK/STOVL is changed to the TOGGLE TAIL HOOK LEVER command.
Also, in order to use the catapult launch functionality, in addition to extending the launch bar and setting the throttle to full military, you now have to apply brakes.

- solved minor bug causing incorrect button description in some MENU areas
- changed Autopilot Hold code so that multiple slots are ignored, so that the altitude hold should be more reliable now
- added auto-trim function: auto-trim is active when AP is not engaged and gear is up. Can be toggled with the TRIM button on the stick.
- added "dragon" aggressor livery, courtesy of Christoph Tantow
- slight increase to turn capability (all models)
- draft implementation of autopilot APProach mode
- it is now possible to input the AP vertical speed (although there seems to be a 3000 ft/min hardcoded limit)
- summary of AP status is reported on FAB (similarly to real aircraft)
- replaced APP HOLD with VS HOLD
- fixed range and ceiling values in aircraft selection UI
- changed "catapult launch" logic: it is now necessary to hold the brakes (along with extending the launch bar and increasing RPM) - releasing the brakes will start the launch
- changed "catapult launch" and "arrestor wire" logic, so this is now limited to altitudes compatible with carrier decks
- changed arrestor hook configuration and logic to support “Top Gun” carriers
- restricted STOVL altitude for realism
- restored HMD default setting to "UNCAGED" following user feedback
- fixed bug preventing canopy effects to show on F-35A canopy
- fixed bug causing excessive icing effect on F-35C canopy
- change HOOK/STOVL proxy command to TOGGLE TAIL HOOK HANDLE

- added "RELEASE BRAKESFOR CATAPULT LAUNCH" caption to FCS page
- fixed minor glitch in full-page FCS mode

1.0.8
06-Jun-2022
HOTFIX
- Fixed Israeli 924 livery
- Fixed AI configuration issue preventing correct functionality of autopilot
- Removed heat blur effect from lift fan
- Engine sound volume further increased
- Added steering arrow and deviation Scale to HUD (toggled by EFI CDI command)
- Fixed minor bug in PCD-HSI mode
- Changed 3BSM roll animation (now linked to yaw control, more accurately)
- Fixed minor polygon smoothing glitch in F-35A fuselage

1.0.7
03-Jun-2022
HOTFIX
- solved minor texturing glitch on F-35A cockpit
- solved minor texturing glitch on F-35C cockpit
- slight change to default sensor configuration
- sensor imagery now does not work on battery only (like IRL)

1.0.6
24-May-2022
QUALITY OF LIFE AND GRAPHICS UPDATE
- Fixed bug in PULL UP PCD cues
- Fixed minor mistake in PCD 3D model
- General graphics optimization for lower memory consumption
- Removed duplicated texture files
- Removed unnecessary files
- Removed outdated HUD/HMD code
- Replaced landing light with better LED light effect
- Increased luminosity of afterburner exhaust
- Solved minor bug while toggling full screen mode on Portal 2
- Draft implementation of DAS (downward camera only)
- Draft implementation of FLIR (via synthetic vision)
- Draft implementation of ASR terrain mapping function
- Added automatic retraction of speed brake at high AoA and changed RPM limit to 90% for automatic retraction
- Disabled usage of the F-35 model as AI traffic
- Fixed minor geometry error in control stick model
- Fixed minor mistake in PCD checklist
- Fixed bug that allowed launch bar, tailhook and wing fold operation with aircraft not powered
- Electrical power is now required for canopy movement, IFR probe extraction and weapon door operation
- Fixed bug preventing correct PCD operation if in SWAP mode and IFF pop-up was selected
- Fixed several typos in cockpit labels
- Added departure and destination waypoints in TSD screen
- Fixed bug preventing NAV SOURCE selection on Portal 3
- Added NAV SOURCE selection functionality also to TSD screens
- Fixed bug preventing Transponder State to be correctly displayed in identification menu
- Transponder state can now be manually set in the identification menu
- Fixed bug preventing CDI needle to move correctly in EFIS page
- Fixed incorrect movement scale of CDI needle
- Fixed bug causing limited rudder pedal animation in some cases
- Added special effects from SU9 (wing vapour, low altitude, etc.)
- Added speed-brake deployment indication on HUD
- Fixed modelling bug preventing tail formation lights geometry to show
- Added 06-01 Italian Air Force livery
- Added F-35I Test Bed Israeli Air Force Livery
- Fixed minor mistakes in F-35C liveries
- More realistic drag versus Mach profile in the transonic region

- Tweaks to handling characteristics to limit max G forces and improve low speed handling and turn capability
- Tweaks to auto-flap schedule for better manoeuvrability in certain circumstances
- Full integration between external model and cockpit model (better cockpit detail in external views, and lower video memory footprint)
- Fixed minor glitch in FCS wing status symbology for C variant
- Changed surface deflection symbology on FCS page (now closer to reality)
- Minor geometry and texture fixes to F-35B model
- Minor smoothing glitch fixed in A and B models
- Improved canopy glass material
- Fixed helmet visor animation bug
- Improved pilot textures
- Fixed animation glitch in steering mechanism (C-version)
- Integrated "Better Camera Mod" by Archer374
- Added camera-dependant visibility conditions to HMD to eliminate overlap with PCD
- Revised instrument overlay for external views
- HMD now defaults to "CAGED" mode
- Added arms and legs animations to pilot figure
- Pilot figure can now be toggled in cockpit by clicking the venting port
- Solved minor bug when toggling full screen mode
- Major optimization of cockpit collision mesh
- Fixed minor AO glitch in crew access ladder (C model)
- Added L: variables list to the manual, for reference of third party modders

1.0.4
20-Mar-2022
Minor update
- Restored Norwegian livery
- Temporarily removed polygons for video rendering (as they are causing issues with third party mods)
- Added HMD CAGE / UNCAGE functionality (in HUD page)
- Added option to turn off GCAS (and all ground proximity warnings)
- Solved minor bug in HUD/HMD XML script
- Reorganization of 3d model files
- Fixed bug preventing PULL UP cues to show on PCD in certain configurations
- Unified GCAS Warnings

1.0.3
14-Mar-2022
Systems upgrade
- Added missing functionality to the "new" HMD:
a) "dial" graphics for altitude and airspeed when gear is down
b) general rework of HMD graphics
c) improved STOVL symbology
d) improved compass symbology
e) improved navigation symbology
f) added autopilot captions
g) added clock
h) added Master Arm and RAD status
i) added radio altimeter
j) added hours indication on Time To Steer on the HMD
k) added ground speed indication
- Fixed Time To Steer calculation bug
- Added basic support (Bearing and range) for pure TACAN stations
- Removed legacy tailhook and launch assistance entries
- Fixed missing polygons on the tip of the radar radome (external model only)
- Fixed animation issue of downwash effects in F-35B cockpit
- Fixed minor animation issue of F-35B Lift-Fan door in VC
- Fixed minor smoothing issue of F-35B Lift-Fan door in VC
- Fixed minor texturing and shadowing issue on F-35 wing roots area
- Fixed Incorrect colour coding of TACAN radio-source in EFIS page
- Fixed minor animation issue of F-35B tailerons
- Added Koninklijke Luchtmacht F-001 special colour
- Corrected position of PCD in all cockpit models, and redone AO accordingly

- Fixed minor glitch on FCS page braking captions

1.0.2 HOTFIX
31-Jan-2022
- Add-on repackaged (previous build had missing files and configurations)
- Minor improvement to tailhook logic
- Minor fix to FCS page (“HOOK” caption was overlapping other captions)
- IPP Cabin Pressurization knob now defaults to NORM

1.0.2
31-Jan-2022
GENERAL STABILITY UPDATE (NEW HMD), NEW REPAINTS AND MISCELLANEOUS FIXES/IMPROVEMENTS

- (Old HMD) Removed obsolete Javascript code for HUD collimation
- (Old HMD) Removed obsolete Javascript code for Flight Director functions
- (Old HMD) Removed unused Javascript code for Boeing FMA, ILS and Vertical Speed indicator
- (Old HMD) Improved symbology collimation
- NEW HMD: Entirely rewritten on the basis of the F/A-18E HUD from Asobo, with several improvements and customizations
- Changed engine sound samples and modified volume
- Added VMFA-314 livery for the F-35C (courtesy of Richard Luycx)
- Added VMFA-211 high and low viz liveries for F-35B (courtesy of Richard Luycx)
- Added VMFA-122 high and low viz liveries for F-35B (courtesy of Richard Luycx)
- Fixed texture mirroring issue on F-35B NLG Doors
- Fixed US roundel position on F-35C wings lower surfaces
- Fixed incorrect painting of air intakes inner surfaces (all models)
- Added different downwash effects (neutral, water and dust) for F-35B when in STOVL mode
- Improved Low Altitude warning logic
- Fixed incorrect material assignment in F-35C intakes (virtual cockpit only)
- Fixed visual hole in aircraft ground shadow (when viewed from the Virtual Cockpit)
- Added several sounds missing from the virtual cockpit (safety ribbons, ejection seat lever and some switches)
- Added "click" sound to PCD interaction for improved feedback
- Minor fix to ICAO codes and model names
- Reworked pilot visibility conditions (hopefully this should work in multiplayer)
- Automatic speedbrake retraction if throttle is above 85%
- Automatic speedbrake extension during landing ground roll
- Added "radio noise" filtering to LSO voices
- Improved "Prandtl-Glauert" singularity visibility conditions
- Special Effects are now visible from the cockpit *

* - NOTE: due to a glitch in the sim, if you change view when an effect is playing it may stick to "on" condition on the new view. Cycling views will typically fix the glitch.

IMPORTANT – Due to several reports of random CTD issues, we have identified the HMD code to be a cause of potential instability on some systems. To fix the problem we have created a new HMD basing it on the Asobo Super Hornet code – however it is missing some functionalities of the “complete” version. The new HMD is the default, the old one can be re-activated by following the instructions at the end of the panel.cfg file in the F-35A panel folder. DO NOT ATTEMPT to change this is you are not familiar with .cfg file editing, although backup .cfgs are included.

1.0.1
14-Jan-2022
SYSTEMS UPDATE, THROTTLE FIX AND MISCELLANEOUS IMPROVEMENTS

- Added reference to Asobo Common behaviours to fix throttle issue introduced by 1.21.18.0
- Added missing lights on IPP control panel
- Added IPP BIT sequence (slightly shorter than IRL) and cool down
- Fixed colour of BINGO line on MFD (was while, is yellow IRL)
- Added missing IPP "BURN" indication on MFD

- Rectified trim symbology in FCS page
- Rectified wing fold symbology in FCS (for C model) and added aileron icons
- Rectified hook symbol in FCS page
- Rectified trim setting colour in FCS page
- Fixed ICAO code for F-35B
- Changed ATC codes for all aircraft
- Fixed missing entries in F-35A and C engine models
- Fixed engine rating for F-35B
- Increased battery capacity for all variants
- Fixed mismatched mouse areas in COMMunications page if FAB is SWAPPED
- Fixed non working mouse areas in LITES page if FAB is SWAPPED
- Added trim readout
- Changed Wing Fold caption (now reads spread or fold, in reality they are separate commands)
- Added numerical reading on control surfaces on FCS page
- Added custom AI sound package

INITIAL RELEASE
03-Jan-2022

INTRODUCTION

WELCOME

The F-35 Lightning II is an American family of single-seat, single-engine, all-weather stealth multi-role combat aircraft that is intended to perform both air superiority and strike missions. It is also able to provide electronic warfare and intelligence, surveillance, and reconnaissance capabilities. The aircraft has three main variants: the conventional take-off and landing (CTOL) F-35A, the short take-off and vertical-landing (STOVL) F-35B, and the carrier-based (CV/CATOBAR) F-35C.

The aircraft descends from the X-35, which in 2001 beat the X-32 to win the Joint Strike Fighter (JSF) program. Its development is principally funded by the United States, with additional funding from program partner countries from NATO and close U.S. allies, including the United Kingdom, Australia, Canada, Italy, Norway, Denmark, the Netherlands, and formerly Turkey. Several other countries have ordered, or are considering ordering, the aircraft.

The F-35B entered service with the U.S. Marine Corps in July 2015, followed by the U.S. Air Force F-35A in August 2016 and the U.S. Navy F-35C in February 2019. The F-35 was first used in combat in 2018 by the Israeli Air Force. The U.S. plans to buy 2,456 F-35s through 2044, which will represent the bulk of the crewed tactical air power of the U.S. Air Force, Navy, and Marine Corps for several decades. The aircraft is projected to operate until 2070.

The scope of this package is to provide, within the limits of Microsoft Flight Simulator, a medium fidelity simulation of all the F-35 variants. Most systems and procedures have been implemented in an “as realistic as practical” fashion, on the basis of the publicly available information, while other systems are vastly simplified or not implemented at all, due to software limitations or missing information.

IMPORTANT! THIS PRODUCT IS NOT ENDORSED OR SUPPORTED BY THE REAL WORLD AIRCRAFT MANUFACTURER.

While we have tried to provide a reasonably realistic depiction of the F-35 and we have carefully studied all the publicly available information, the performance, operations and procedures shall be considered purely fictional and not representative of the performance of the real aircraft and its systems.

1. INSTALLATION, HARDWARE REQUIREMENTS AND CREDITS

1.1 MINIMUM HARDWARE REQUIREMENTS

Due to the high-detail model and textures, we suggest to use the F-35 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, 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-f35” to anything short and recognizable such as “f35” 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 F-35 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 F-35 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.

1.3 CREDITS

This software package has been produced and developed by IndiaFoxtEcho Visual Simulations, via Dei Giustiniani 24/3B 16123 Genova, Italy – copyright 2021.

STOVL code based on Rob Barendregt code for P3D / FSX.

The aircraft external models are partially based on 3D meshes by Camelot Inc. , licensed through TurboSquid

F-35 text description taken from Wikipedia.

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/

This software package has been produced by IndiaFoxtEcho Visual Simulations, via Dei Giustiniani 24/3B 16123 Genova, Italy – copyright 2021.

1.4 ABOUT THIS MANUAL

As the F-35 is still classified, this manual is the product of educated guess-work based on any 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 F-35 AIRCRAFT.

1.5 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.

1.6 COPYRIGHT AND LEGAL STATEMENTS

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...let alone the fact that the world of simulation communities is small, and we receive notifications of copyright infringements or reverse engineering attempts directly from our loyal fans very quickly.

1.7 LICENSE RESTRICTIONS

This F-35 rendition for Microsoft Flight Simulator is provided solely for non-professional use. Please contact IndiaFoxtEcho Visual Simulations for inquiries about professional applications.

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.

2. SPECIAL CONTROLS AND FUNCTIONALITIES

The F-35 package features a number of special controls and features. All of them can be completely controlled in the virtual cockpit with mouse interaction, however a couple of them have been mapped to unused standard controls of Flight Simulator, so that they can be associated to an arbitrary control.

2.1 HOOK/STOVL BUTTON

The HOOK/STOVL BUTTON is located on the upper left part of the front panel. On the F-35A and C models this button controls the extraction / retraction of the tailhook (note: the F-35A is only equipped with an emergency tailhook which has no functionality in the sim).
On the F-35B, this button toggles the STOVL-mode conversion, provided that proper conditions are met (airspeed below 240 knots, limited bank and pitch)
This command is also associated to the **TOGGLE TAIL HOOK LEVER** command in Flight Simulator.

2.2 HOVER MODE

If the F-35 is in STOVL mode and the gross weight is below 40600 lbs, the aircraft can be switched to HOVER mode (see specific chapter on STOVL mode) by selecting the HOVER option in the FCS page.
This command is also associated to **AUTOPILOT HEADING HOLD** command in Flight Simulator.

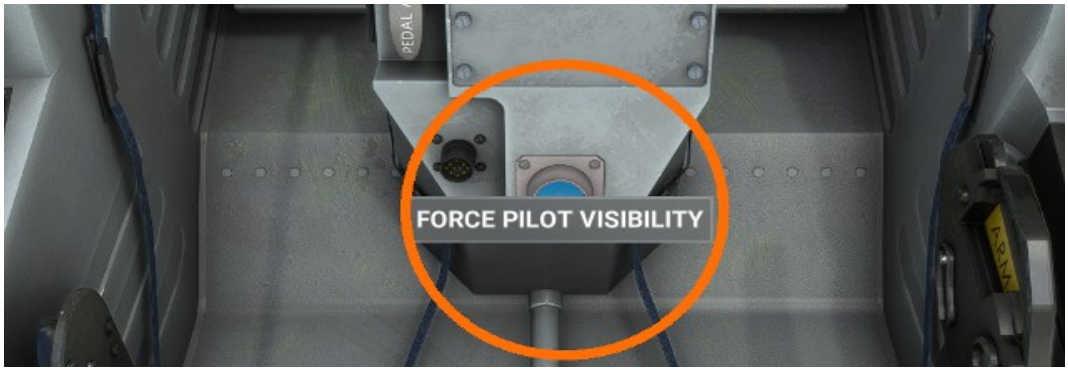
2.3 EXTERNAL CODE

Several other features are controlled by L: (Local) variables, please see APPENDIX A for a list of the main variables employed by the F-35 (for use of third party modders).

2.4 PILOT FIGURE TOGGLE

It is possible to force the visibility of the pilot figure inside the cockpit. This feature is mostly meant for video makers To do this, the user must click on the venting port in the cockpit pedestal.

NOTE: starting for version 1.2.3, the first “click” on the designated area will activate the “Sleepy Hollow” mode, that is the pilot figure will be headless – this is mostly thought for VR users who prefer this (at the expense of control accessibility). The second click will show the entire figure and a further click will make the pilot figure disappear.



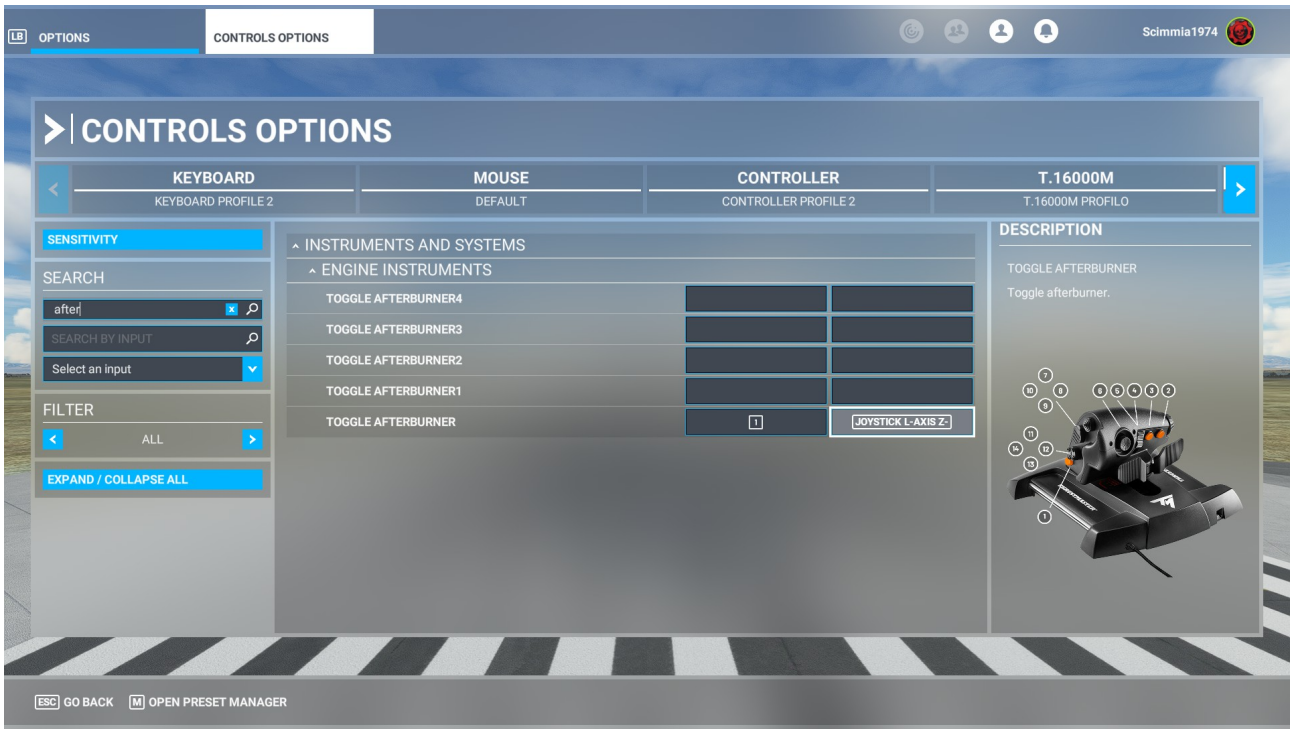
2.5 FLY-BY-WIRE TOGGLE

Following user feedback, we have allowed the user to disconnect the fly-by-wire system. This is commanded with the FLAP LEVER control: if the FLAP LEVER is in the RECTRACTED position the fly-by-wire (including auto-trim and G-limiter) is active – this is shown by the AUTO caption on the FCS page. Any other FLAP LEVER position will disconnect the FBW – this is shown by the MAN caption on the FCS page.
See FLIGHT MODEL section for further details.

2.6 AFTERBURNER TOGGLE / DETENT

Starting from version 1.2.3, and following user feedback, this F-35 includes afterburner toggle/detent controls. This means that, much like the default F/A-18, the afterburner will not engage unless the pilot actively presses a specific “toggle” button – this is done in order to mimic the afterburner detent which is present in the real world throttle lever, and it is meant to prevent an inadvertent activation from the pilot. This control is not assigned in many control presets so you may need to add it.

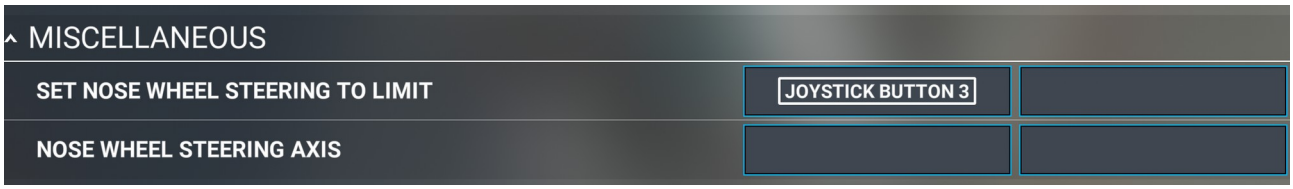
NOTE: if you do not wish to to have the afterburner toggle functionality, or you have a mechanical detent on your throttle, you can set the “TOGGLE AFTERBURNER” control to your throttle axis (as in the figure below) so that the TOGGLE is associate to throttle movement.



2.7 NOSE WHEEL-STEERING

This rendition of the F-35 implements MSFS nose-wheel steering (NWS) system and associated controls.

To associate a control to this function, you should assign a control to the “SET NOSE WHEEL STEERING TO LIMIT” command, in the MISCELLANEOUS group. This will allow the user to to cycle between NWS OFF, LOW and HIGH settings.



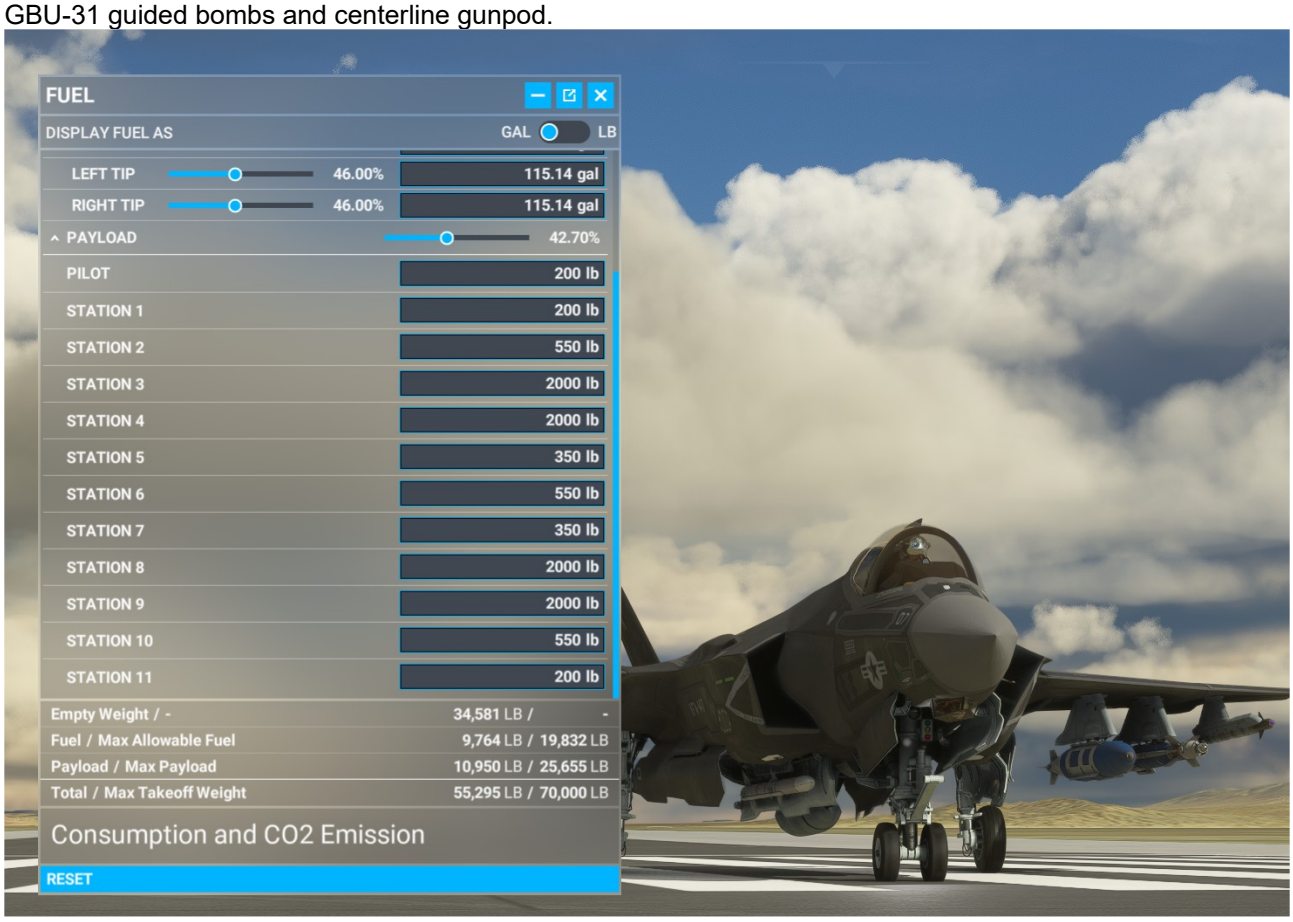
NOTES:

- The NWS system defaults to OFF and will be disabled when the aircraft is powered, and will automatically revert to OFF any time the landing gear is not down and locked.

- Starting from version 1.3.7, an automatic NWS option is available in the PMD/DR page

2.8 EXTERNAL LOADS

The external visual model includes inert air-to-air missiles (AIM-9X, AIM-132 and AIM-120), GBU-12 and GBU-31 guided bombs and centerline gunpod.



To make weapons appear, you need to enter the proper weights in the FUEL AND PAYLOAD SECTION.

Weights are as follows:

200lbs for AIM-9X SIDEWINDER – only on STATION 1 and 11

185lbs for AIM-132 ASRAAM – only on STATION 1 and 11, -B model only

350lbs for AIM-120 AMRAAM – only on STATION 4, 5, 7 and 8

550lbs for centerline gunpod – only on STATION 6, -B and -C models only

550lbs for GBU-12 laser guided bomb – on STATION 2,3,4,8,9 and 10

1080lbs for AGM-154 JSOW – only on STATION 4 and 8, -C model only

1170lbs for GBU-39 4x rack - only on STATION 4 and 8, -A model only

2000lbs for GBU-31 GPS guided bomb – on STATION 3 and 9 for all models, on STATION 2,4,8 and 10 for -A and -C models

IMPORTANT – Typical weapon presets can be selected by selecting TRAIN mode on the SMS page and then clicking on the center of the aircraft top view profile. See STORES section for further information.

2.8 CANOPY GLASS – DARKER TINT

Starting from version 1.3.7 a “dark tint” canopy glass option is available in the PMD/DR page.
This reduced brightness of the external environment but provides a much better readability for the HMD symbology during daylight.

Using this option during night operations is not recommended as it affects the brightness of airport lights.

2.9 REMOVE BEFORE FLIGHT RIBBONS AND COVERS

The 3D model includes “remove before flight” ribbons and engine covers: these will show when IPP switches are set to off, engine RPM is below 1%, aircraft is on the ground and parking brake must be set.
Ribbons will not show between 50ft and 100ft above sea level to avoid them to appear on carrier decks (which are typically depicted in flight configuration in the game).

2.10 DIFFERENCES BETWEEN PC AND XBOX VERSIONS

Due to memory limitations on XBox Series S, the XBox version of the F-35 has limited functionality in some areas with respect to the PC version.
Although the hardware limitations are due to the Series S model, this applies to both Xbox Series S and Series X consoles, as the Microsoft deployment system does not allow otherwise.

In detail the following restrictions apply:

- Radar module does not work on Xbox. This includes ASR page and SRCH page functionalities – these pages will not be available on Xbox.

- Datalink features will not work on Xbox.

- RWR module does not work on Xbox, consequently TWD page is not available.

- Some PCD pages such as DIM, CNI and PHM pages, which have basically no in-game function, are not available.

- The upper function bar left and right sections cannot be SWAPped, therefore some pages are limited to the left or right side of the PCD.

- Some textures have lower resolution on XBox

VEHICLE SYSTEMS

3. AIRCRAFT DESCRIPTION

3.1 THE F-35 LIGHTNING II

The F-35 Lightning II is a fifth-generation, single-seat, single-engine stealth multi-role fighter that can perform close air support, tactical bombing, and air defence missions.
The F-35 has three different models: The F-35A is a Conventional Take-Off and Landing variant, the F-35B is a Short Take-Off and Vertical Landing variant, and the F-35C is a Carrier-based Variant.

F-35A, F-35B and F-35C flying in formation nearby Eglin AFB.

3.2 DESIGN OVERVIEW

The F-35 resembles a smaller, single-engine sibling of the twin-engine F-22 Raptor and drew elements from it. The exhaust duct design was inspired by the General Dynamics Model 200 design, proposed for a 1972 supersonic VTOL fighter requirement for the Sea Control Ship. Although several experimental designs have been developed since the 1960s, such as the unsuccessful Rockwell XFV-12, the F-35B is to be the first operational supersonic, STOVL stealth fighter.

Some improvements over fourth-generation fighter aircraft are:

- Durable, low-maintenance stealth technology, using structural fibre mat instead of the high-maintenance coatings of legacy stealth platforms

- Integrated avionics and sensor fusion that combine information from off- and onboard sensors to increase the pilot's situational awareness and improve target identification and weapon delivery, and to relay information quickly to other command and control (C2) nodes

- High speed data networking including IEEE 1394b and Fiber Channel

- The Autonomic Logistics Global Sustainment (ALGS), Autonomic Logistics, Information System (ALIS) and Computerized Maintenance Management System, (CMMS) are to help ensure aircraft uptime with minimal maintenance manpower

- Electro-hydrostatic actuators run by a power-by-wire flight-control system

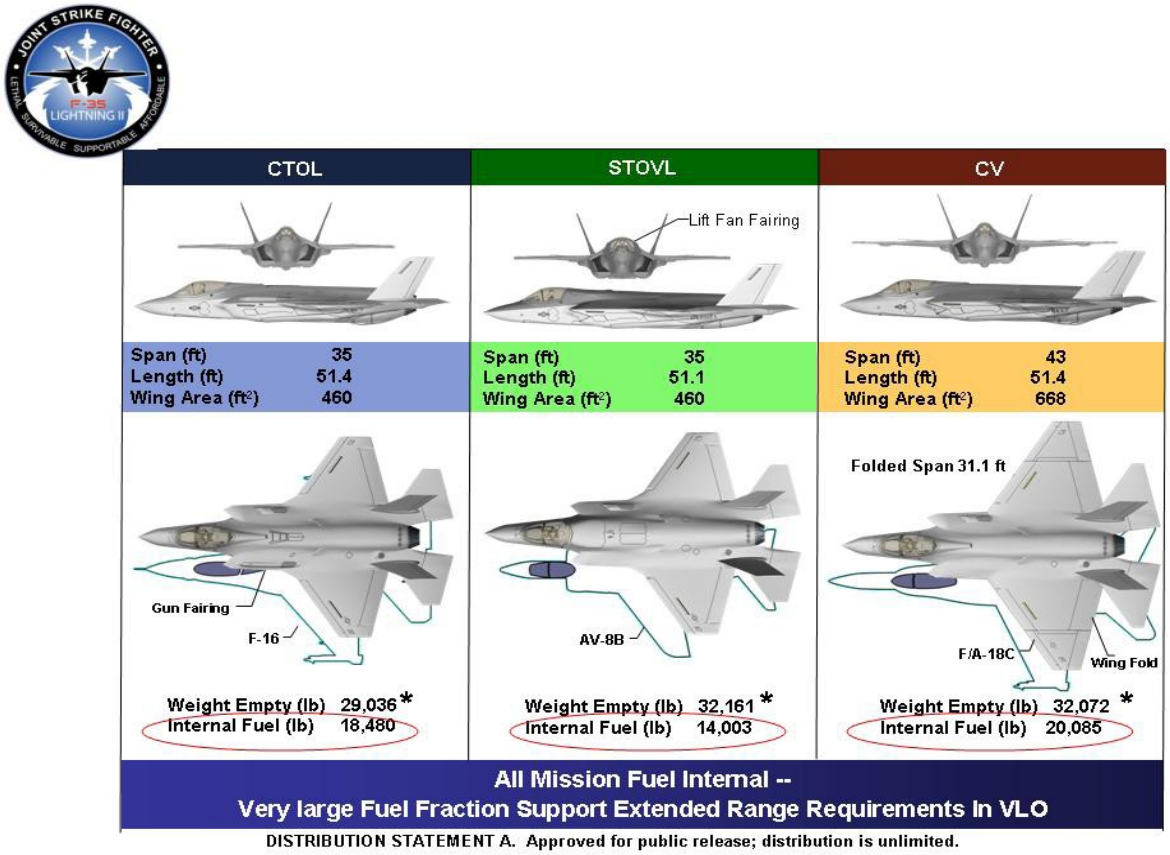
- A modern and updated flight simulator, which may be used for a greater fraction ofpilot training in order to reduce the costly flight hours of the actual aircraft.

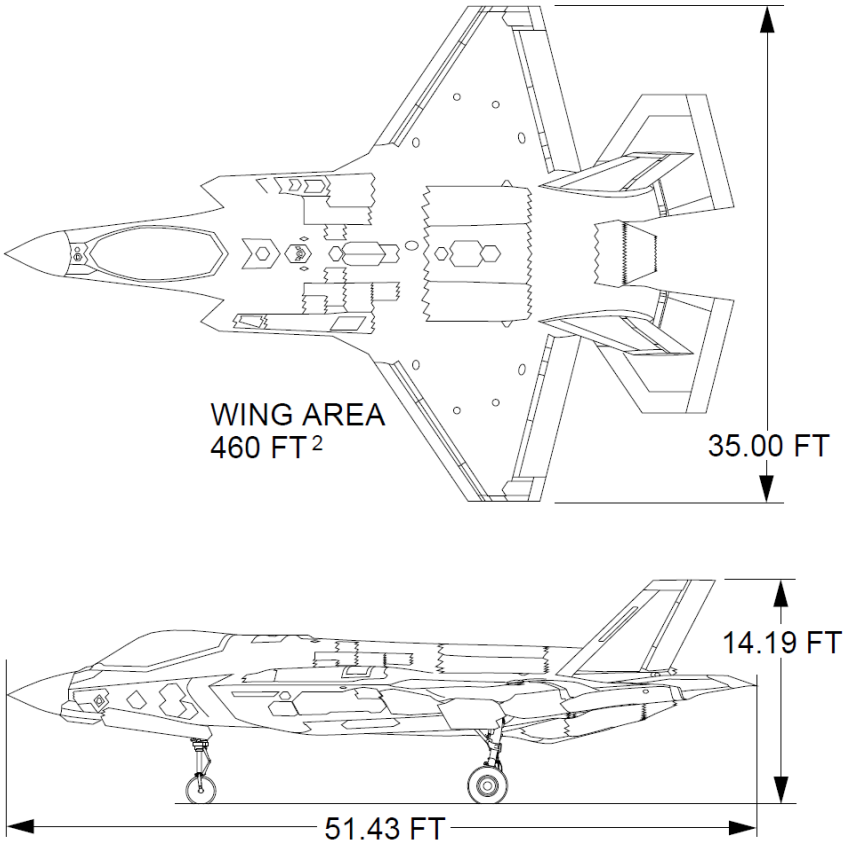
The F-35 will be the first mass produced aircraft to include structural nanocomposites, namely carbon nanotube reinforced epoxy.

3.3 F-35 VARIANTS

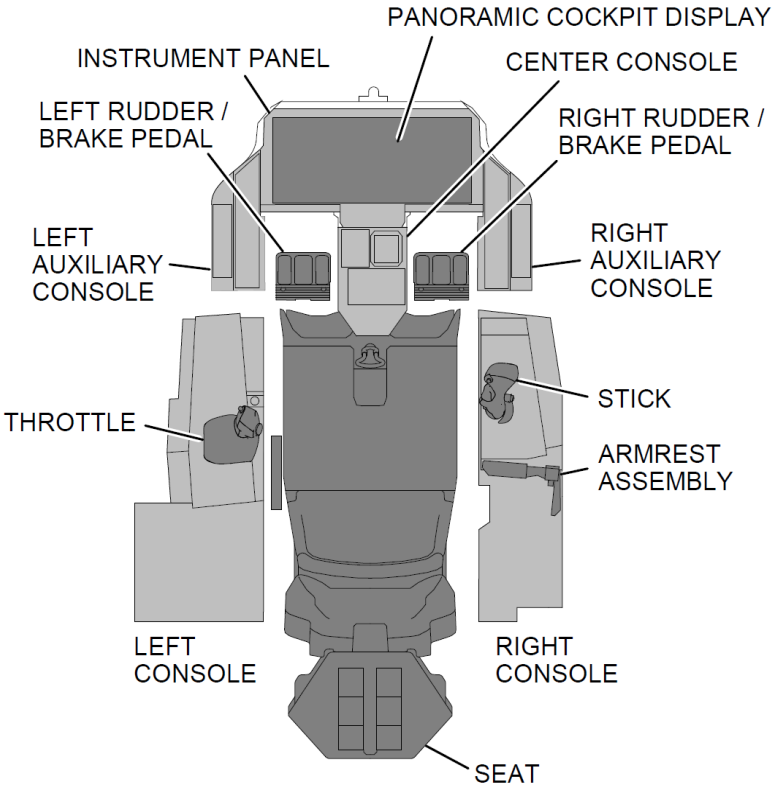
The real F-35 is planned to be built in three different versions to suit the needs of its various users.
The F-35A is the Conventional Take-Off and Landing (CTOL) variant, the F-35B is the Short Take-Off and Vertical Landing (STOVL) variant, and the F-35C is the CATapult Launch But ARrested Landing (CATOBAR) version for U.S. Navy carriers.

	F-35A CTOL	**F-35B STOVL**	**F-35C CATOBAR**
Length	50.5 ft (15.4 m)	50.5 ft (15.4 m)	50.8 ft (15.5 m)
Wingspan	35 ft (10.7 m)	35 ft (10.7 m)	43 ft (13.1 m)
Wing Area	460 ft² (42.7m²)	460 ft² (42.7 m²)	668 ft² (62.1 m²)
Empty weight	29,098 lb (13,199kg)	32,300 lb (14,700 kg)	34,800 lb (15,800 kg)
Internal fuel	18,498 lb (8,390kg)	13,326 lb (6,045 kg)	19,624 lb (8,900 kg)
Max take-off weight	70,000 lb class (31,800 kg)	60,000 lb class (27,300 kg)	70,000 lb class (31,800 kg)
Range	1,200 nautical miles (2,220 km)	900 nautical miles (1,670 km)	1,400 nautical miles (2,520 km)
Combat radius on internal fuel	613 nautical miles (1,135 km)	469 nautical miles (845 km)	610 nautical miles (1,130 km)
Thrust/weight			
• full fuel:	0.87	0.90	0.75
• 50% fuel:	1.07	1.04	0.91





AIRCRAFT GENERAL DIMENSIONS (F-35A)



COCKPIT GENERAL LAYOUT (COMMON TO ALL VERSIONS)

3.4 F-35A

The CTOL variant is intended for the US Air Force and other air forces. It is the smallest, lightest F-35 version and it is the only variant equipped with an internal cannon, the GAU-22/A. The F-35A is expected to match the F-16 in manoeuvrability, instantaneous and sustained high-g performance, and outperform it in stealth, payload, range on internal fuel, avionics, operational effectiveness, supportability and survivability. It also has an internal laser designator and infrared sensors, equivalent with the Sniper XR pod carried by the F-16, but built in to remain stealthy.
The A variant is primarily intended to replace the USAF's F-16 Fighting Falcon, beginning in 2013, and the A-10 Thunderbolt II starting in 2028.

F-35A, the Conventional Take-Off and Landing version (CTOL) in flight

The CTOL version can be easily recognized by the absence of the big fan door of the STOVL version and by the presence of the gun on the port side of the fuselage and by the retractable refuel receptacle.

The peculiar characteristics of the -A version are:

- It is the lightest and the fastest version
- It is the only version to feature an internal gun
- It is the only version equipped with a refuel receptacle instead of a probe
- In this version, pressing the “HOOK/STOVL” button in the cockpit extends an emergency tail hook.

3.5 F-35B

Similar in size to the A variant, the B sacrifices some fuel volume to make room for the vertical flight system. Take-offs and landing with vertical flight systems are by far the riskiest, and in the end, a decisive factor in design. Like the AV-8B Harrier II, the B's guns will be carried in a ventral pod. Whereas F-35A is stressed to 9 g, the F-35B is stressed to 7 g. Unlike the other variants, the F-35B has no landing hook; the "STOVL/HOOK" button in the cockpit initiates conversion instead of dropping the hook.
The British Royal Air Force and Royal Navy plan to use this variant to replace their Harrier GR7/GR9s. The United States Marine Corps intends to purchase 340 F-35Bs to replace all current inventories of the F/A-18 Hornet (A, B, C and D models), and AV-8B Harrier II in the fighter, and attack roles.
One of the British requirements was that the F-35B design should have a Ship-borne Rolling and Vertical Landing (SRVL) mode so that wing lift could be added to powered lift to increase the maximum landing weight of carried weapons. The U.S.Marine Corps are investigating the use of the SRVL method to operate F-35Bs from CVNs without disrupting carrier operations as the landing method uses the same pattern of approach as wire arrested landings. However, the aircraft is able to "bring back" 2 x 1K JDAM, 2 x AIM-120 and reserve fuel to a vertical landing.

-35B performing a vertical landing

The Short Take Off and Vertical Landing version can be easily recognized, in normal flight, by the shape of the fuselage which hosts the Lift-Fan system.
The peculiar characteristics of the -B version are:

– It is the only version capable of STOVL and it is the only operational supersonic, stealth STOVL aircraft in the world. It can hover, land or take-off vertically if its gross weight is below 40,600lbs.

– The internal weapons bay is smaller than the other versions to make room for the lift-fan engine, therefore some weapons cannot be mounted in the internal bay.

– Weapon carriage on outermost wing pylons is limited to 1,500lbs to reduce the airframe stress and extend its life.

– This version is equipped with a refuel probe.

– In this version, pressing the “HOOK/STOVL” button in the cockpit activates the conversion to STOVL mode. See the specific manual section for STOVL mode controls.

3.6 F-35C

The F-35C carrier variant has a larger, folding wing and larger control surfaces for improved low-speed control, and stronger landing gear and hook for the stresses of carrier landings. The larger wing area allows for decreased landing speed, increased range and payload, with twice the range on internal fuel compared with the F/A-18C Hornet, achieving much the same goal as the heavier F/A-18E/F Super Hornet.
The United States Navy and the United States Marine Corps will be the sole users for the carrier variant. The first production F-35C was rolled out on July 29, 2009.

F-35C in preparing for a catapult-assisted take-off from a USS Nimitz-class carrier

The F-35C is the CATOBAR version and can be easily recognized by the much larger, foldable wing and bigger control surfaces and by the different nose landing gear, with two wheels and a launch bar for catapult assisted take off. Also, the tail hook is much bigger than the one of the F-35A.

The peculiar characteristics of the -C version are:

– It is the heaviest, and slowest version, but it is also the version with the longest range

– It has a much larger wing allowing for lower approach speed and it is equipped with spoilers for better low-speed manoeuvrability

– The wing can be folded to save space on the carrier deck

– It has a more robust landing gear to tolerate the stress of naval operations

– Like the F-35B this version is equipped with a refuel probe.

– Pressing the “HOOK/STOVL” button in the cockpit extends the tail hook for carrier landings.

– The LBAR button on the MFD/FCS page extends/retracts the launch bar.

– The WINGS button on the MFD/FCS page fold/unfolds the wings.

4. COCKPIT

4.1 GENERAL DESCRIPTION

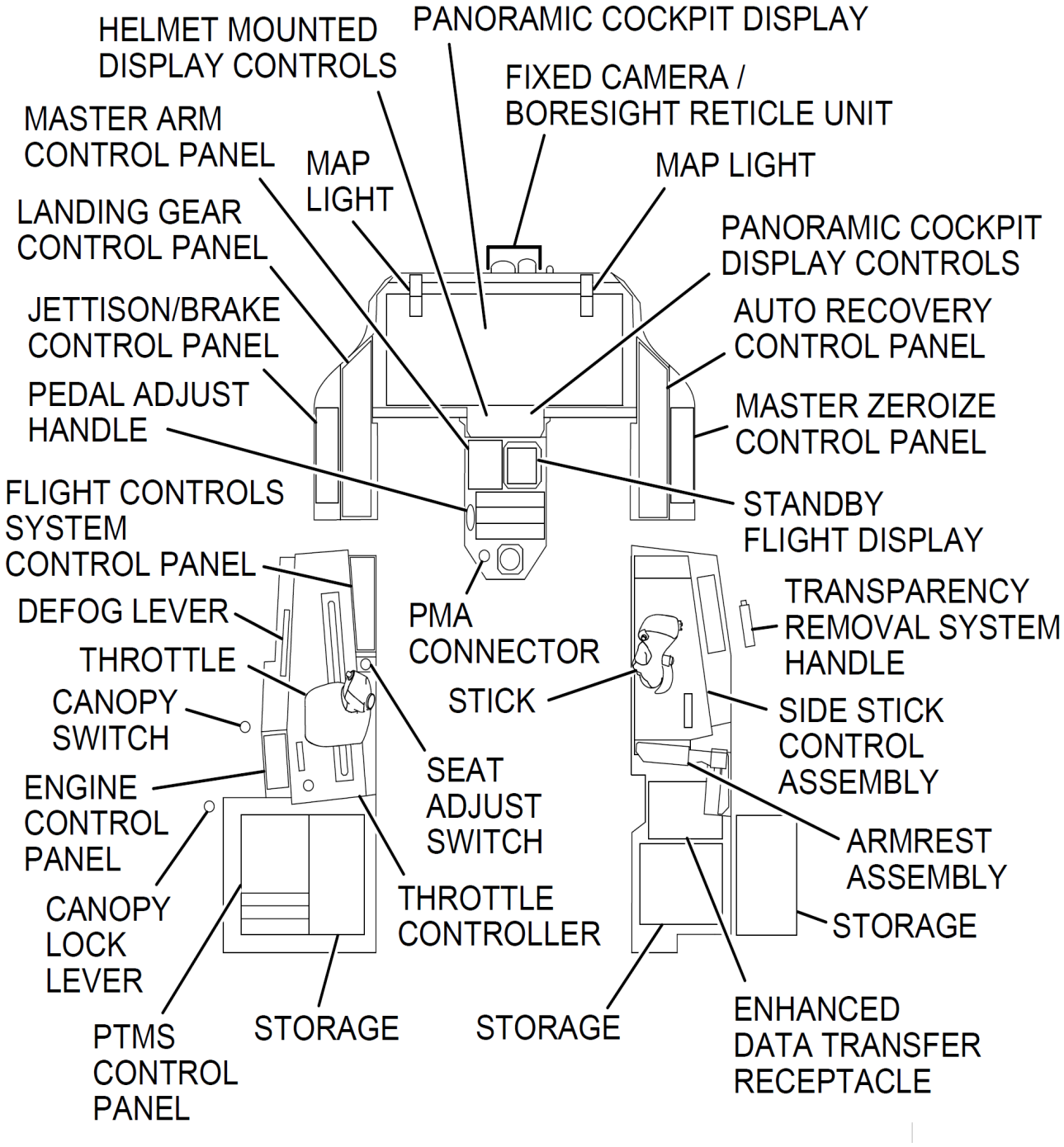
The F-35 features a full-panel-width "Panoramic Cockpit Display" (PCD) glass cockpit, with dimensions of 20 by 8 inches (50 by 20 centimetres).

A cockpit speech-recognition system (Direct Voice Input) provided by Adacel is planned to improve the pilot's ability to operate the aircraft over the current-generation interface.
The F-35 will be the first US operational fixed-wing aircraft to use this system, although similar systems have been used in AV-8B and trialled in previous US jets, particularly the F-16 VISTA. In development the system has been integrated by Adacel Systems Inc. with the speech recognition module supplied by SRI International. The pilot flies the aircraft by means of a right-hand side stick and left-hand throttle.

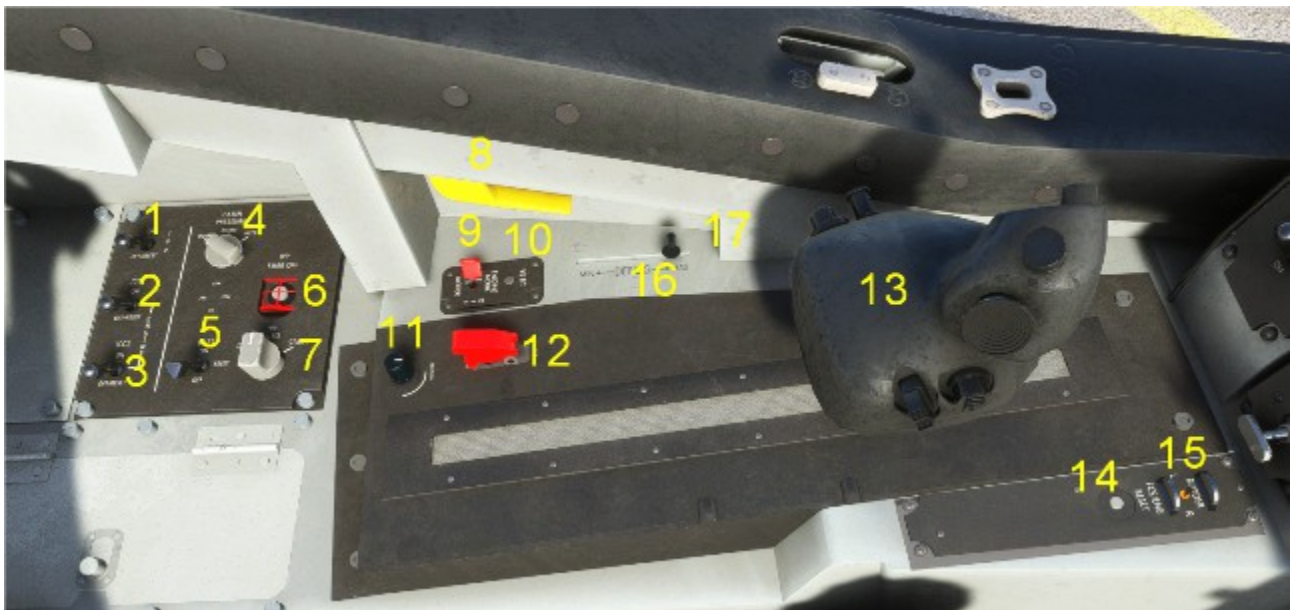
A helmet-mounted display system (HMDS) is fitted to all models of the F-35. While some fighters have offered HMDS along with a head up display (HUD), this will be the first time in several decades that a front-line tactical jet fighter has been designed to not carry a HUD.
Most of the pilot interaction happen through the multifunction display touch-screen, although, for safety and procedural reasons, several physical switches still exist.

The Martin-Baker US16E ejection seat is used in all F-35 variants. The US16E seat design balances major performance requirements, including safe-terrain-clearance limits, pilot-load limits, and pilot size. It uses a twin-catapult system that is housed in side rails.
The following pictures provide an overview of the cockpit left-to-right.

COCKPIT GENERAL VIEW – cockpit layout is identical for -A, -B and -C variants.
The geometry of -B variant cockpit is slightly different, with poorer backward visibility,
to make room for the Lift-Fan system intake.



COCKPIT PANEL LAYOUT



Cockpit, left side – This area of the cockpit hosts most of the physical switches, which cover basic functions like PTMS controls and engine start / stop functions. These switches are rarely operated during normal flight.

1 – Inverter/Controller/Converter 3 (ICC3) Switch

2 – Inverter/Controller/Converter 1 (ICC1) Switch

3 - Inverter/Controller/Converter 2 (ICC2) Switch

4 – Cabin pressurization control knob

5 – Battery Switch

6 – IPP EMERGENCY OFF push-button

7 – Engine Starter

8 – Canopy lock lever

9 – Engine/Motor Switch – *NOTE: acts as ignition switch in MSFS*

10 – V/S BIT Push-button

11 – Throttle Friction knob – *NOTE: No function in MSFS*

12 – Throttle Active Switch - *NOTE: No function in MSFS*

13 – HOTAS Throttle (nicknamed “cow pie”)

14 – FCS RESET Button

15 – Rudder Trim Switch

16 – Canopy Defog control – *NOTE: No function in MSFS*

17 – Canopy oepn/close switch - *NOTE: Not visible in the image*

Cockpit, front – The cockpit is dominated by the Panoramic Cockpit Display (PCD). The PCD is the core instrument to interact with the aircraft. It is divided to 5 areas: a top Function Access Buttons (which continuously displays critical information and provides quick-access buttons to core information and four vertical "portals". Each portal can be configured to show one of the twenty-one functional screens (called "pages") along with two sub-portals, or can be maximized to occupy a full quarter of the screen or furtherly enlarged to occupy half screen.

16 – Emergency Jettison Control – *NOTE: No function in MSFS*

17 – Remaining Parking Brake Applications

18 – Parking Brake Switch

19 – HOOK/STOVL Button (extends arrestor hook on F-35A and -C version, engages STOVL mode in F-35B, provided that proper conditions are met)

20 – Landing Gear Lever

21– Emergency Landing Gear Extension Button (guarded)

22 – Landing Light Switch

23 – Panoramic Cockpit Display

24 – Head Mounted Display (HMD) brightness control – NOTE: in MSFS allows toggles between two brightness levels, total brightness depends on the HMD mode selector.

25 – HMD mode selector – *NOTE: if set to AUTO brightness will automatically change at night*

26 – HMD video brightness control - *NOTE: No function in MSFS*

27 – HMD video contrast control - *NOTE: No function in MSFS*

28 – Panoramic Cockpit Display (PCD) day / night mode selector.

29 – PCD brightness control – NOTE: in MSFS allows toggles between two brightness levels, total brightness depends on the HMD mode selector

30 – COM A Tuning Knob

31 – COM B Tuning Knob

32 – COM C / Backup Radio Tuning Knob

33 – MASTER ARM

34 – Backup Flight Instrument (BFI)

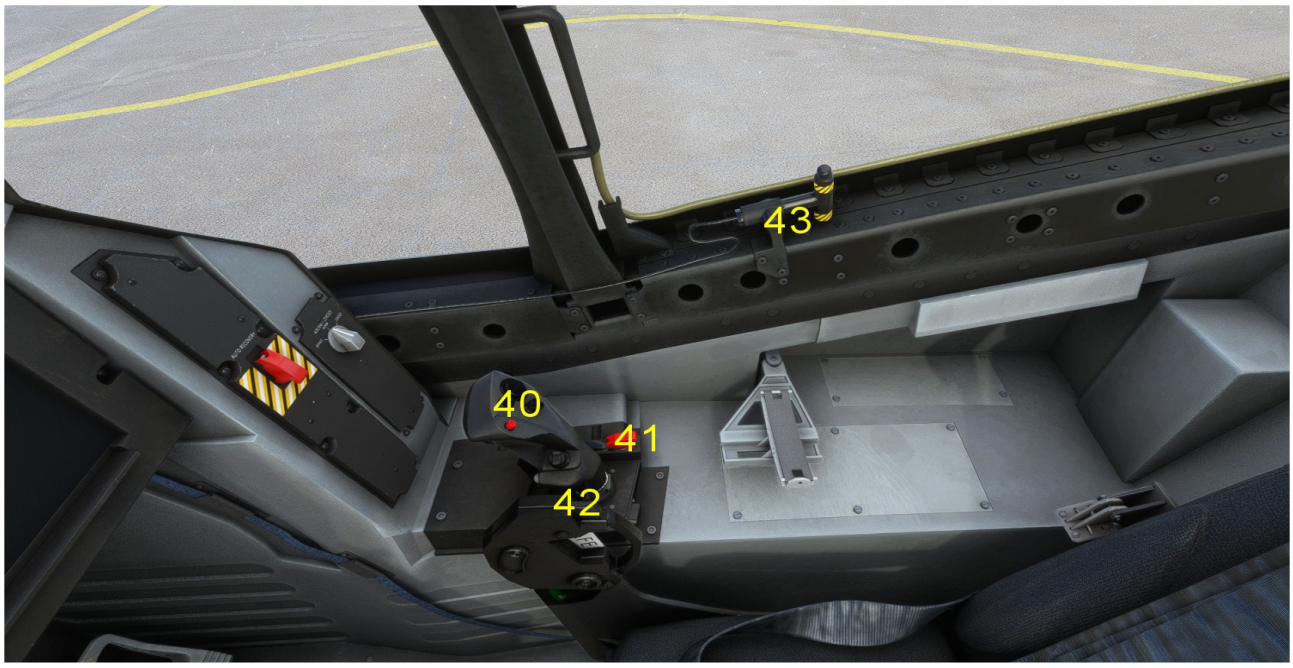
35 – BFI ALIGN button - *NOTE: No function in MSFS*

36 – BFI brightness

37 – BFI barometric setting

38 – AUTO RECOVERY switch

39 – Aircraft zeroize selector



Cockpit, right – The right side of the cockpit hosts only the main control stick and its arm rest.

40 – HOTAS Control Stick

41 – Control Stick Active switch - *NOTE: No function in MSFS*

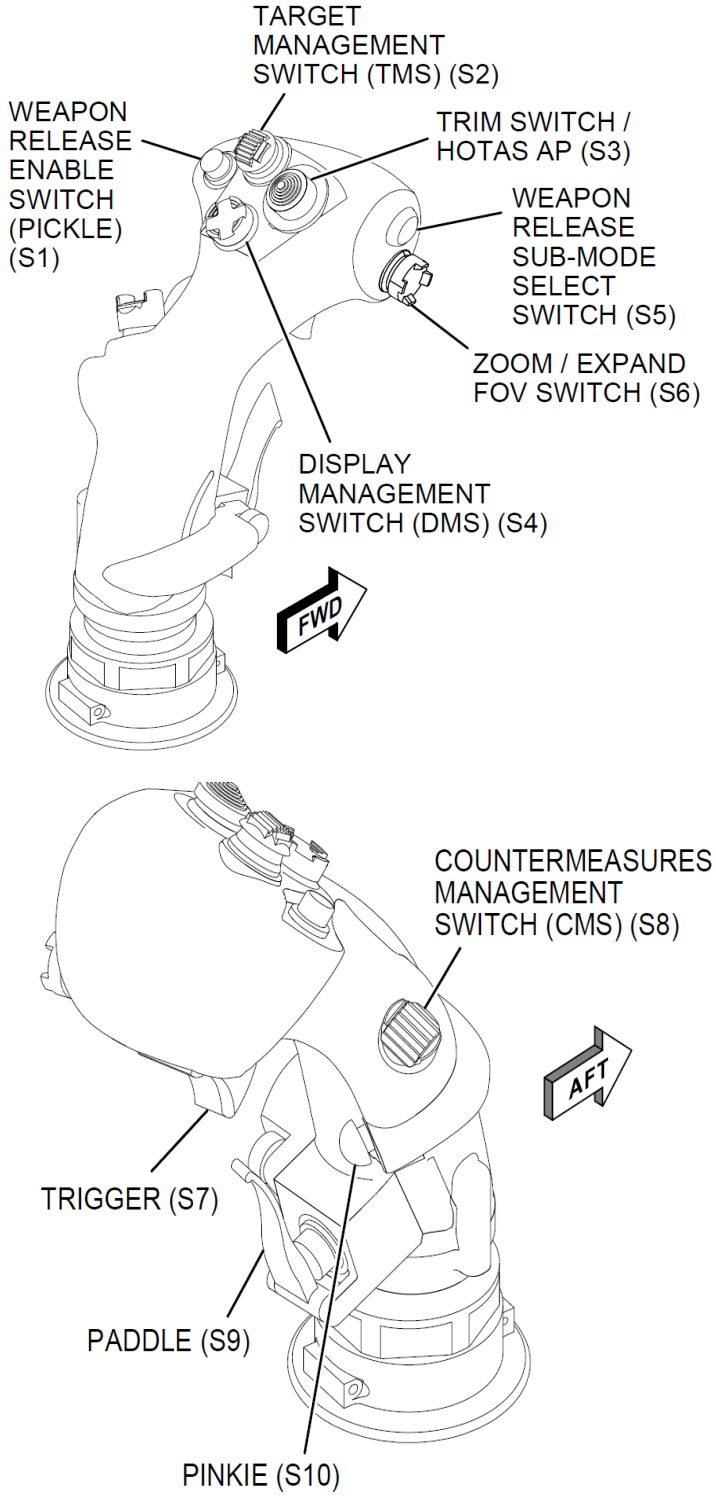
42 – Ejection seat SAFE/ARM control - *NOTE: Requires removal of safety pin to be operated*

43 –Canopy Mild Detonating Cord (MDC) control - *NOTE: No function in MSFS*

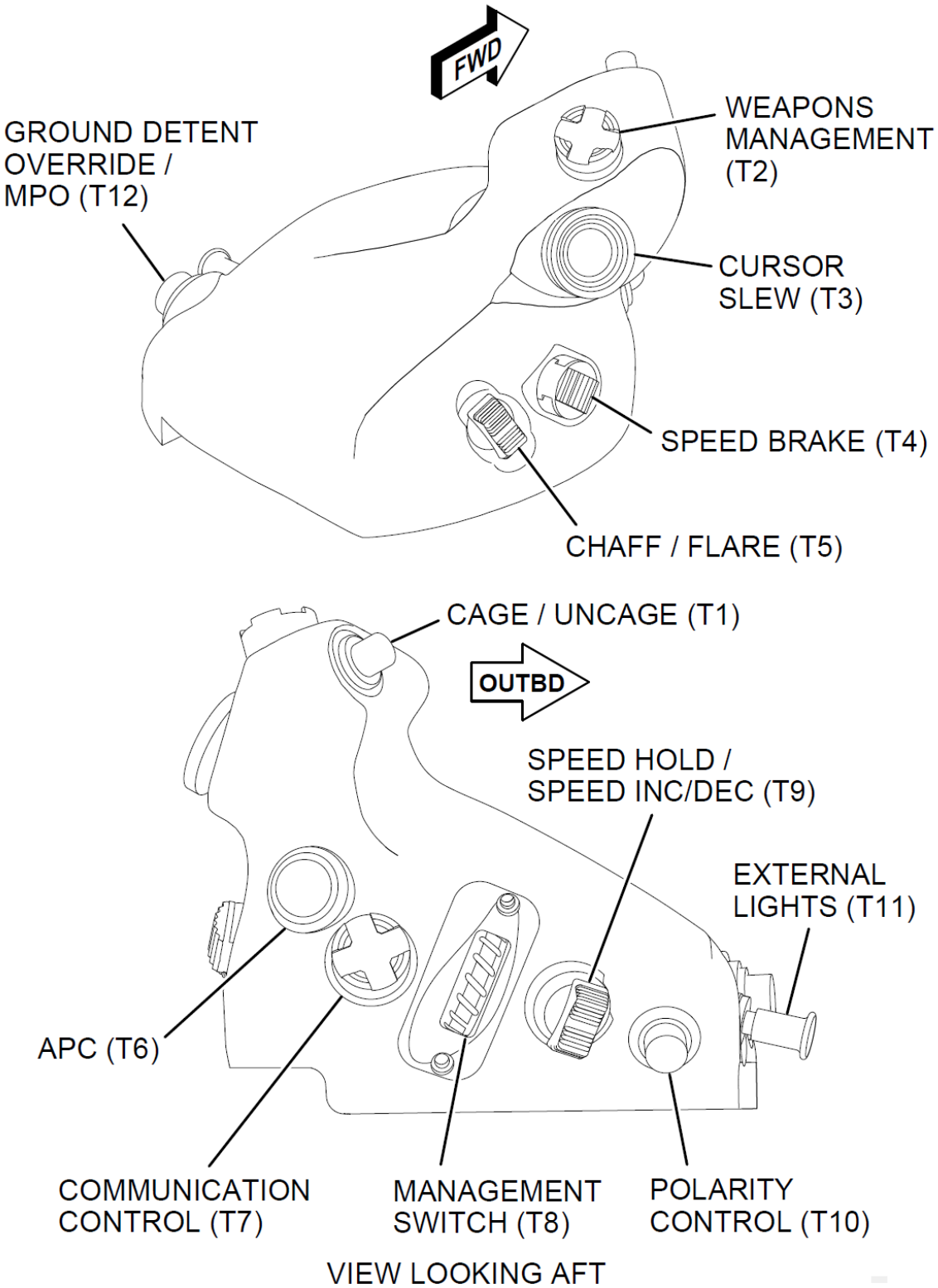
5. HANDS ON THROTTLE AND STICK (HOTAS)

5.1 HOTAS GENERAL DESCRIPTION

Like any modern jet fighter, the F-35 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 F-35 experience in Microsoft Flight Simulator, we suggest to assign as many functionalities to your control stick and throttle.



CONTROL STICK SWITCHES (REAL AIRCRAFT)



THROTTLE SWITCHES (REAL AIRCRAFT)

5.2 HOTAS FUNCTIONALITIES AND KEY BINDINGS

In this Microsoft Flight Simulator F-35 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.

5.2.1 STICK SWITCHES

Weapon release enable (pickle) (S1) button is activated is used to employ missiles and bombs.

This switch is NOT IMPLEMENTED in MSFS.

Target management switch (TMS) (S2) 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 management. TMS UP is also used in conjunction with the CSC as replacement to Touch screen controls. In MSFS it is used to cycle between targets when the Portal of Interest (POI) is a Tactical Situation Display or the Display of Interest (DOI) is the HMD.

In TSD mode, when an unknown track is selected, TMS LEFT adds the current track to the Friendly Track of Interest (FTI) list. If the track is marked as HOSTILE, TMS LEFT removes the track from the FOES list. Conversely, TMS RIGHT will mark an unknown track as HOSTILE by adding it to the FOES list, and will turn the track to UNKNOWN if the track was friendly.

With the exception of special cases linked to specific POIs, TMS UP works as a “click” in conjunction with the Cursor Slew Control (CSC). See individual subsystems for special functionalities.

Associated key bindings / events in MSFS 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)

TRIM switch (S3) is used in the real aircraft to control pitch and roll trim when the autopilot is not engaged, and to control autopilot horizontal and vertical references. In the real aircraft the switch can also be activated in the z-axis to provide different functions depending on the context.

In MSFS the trim controls are provided only via the normal trim controls, which can be associated to a 4-direction switch. Autopilot functionalities are not linked to trim controls.

NOTES:

- Manual trim is only available in certain conditions. See Flight Control System for details.

- Selecting TRIM RESET on the FCS page zeroizes pitch, roll and rudder trim settings.

Display management switch (DMS) (S4) is activated in the forward, aft, right and left directions. The switch may have different functions depending on the context but is primarily used for:

- Selecting the Display of Interest (Head Mounted Display or Primary Control Display):

PCD is selected by pressing DMS DOWN when the HMD is the Display of Interest (DOI)

HMD is selected by pressing DMS UP when the PCD is the Display of Interest (DOI).

- Selecting the Portal of Interest (POI) when the PCD is selected as DOI.

When the PCD is the DOI, a green rectangle appears around the Portal Of Interest.
Pilot can change the POI with DMS LEFT or DMS right.

- Swapping portals and subportals within a POI.
When the PCD is the DOI, DMS DOWN can be used to swapping portals and subportals functionalities, by cycling them in a clockwise direction.

Associated key bindings / events in MSFS 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)

Weapon release sub-mode select switch (S5) is activated in the Z axis only and has different functions depending on the context but typically related to weapon release sub-modes

This switch is NOT IMPLEMENTED in MSFS.

Zoom/expand FOV switch (S6) is activated in the forward, aft, up, and down directions and may have different functions depending on the context but it is typically used to change sensors Field of View.

This switch is NOT IMPLEMENTED in MSFS.

Gun enable switch trigger (S7) has two positions (first detent and second detent) and is used to fire the laser (first detent) and the gun (second detent).

This switch is NOT IMPLEMENTED in MSFS.

Countermeasures management switch (CMS) (S8) is activated in the forward, aft, left, and right directions.

This switch is NOT IMPLEMENTED in MSFS.

Paddle switch (S9) is used for a variety of functions: autopilot disconnection, tanker disconnection, G-limiter overriding and NWS disengagement.

The closest key binding in MSFS is AUTOPILOT OFF.

Pinkie switch (S10) toggles between low and high gain NWS on the ground, toggles blob on/off when the POI is the TSD and, while held, enables UA maximum AOA capability.

In MSFS this switch is associated to “SET NOSE WHEEL STEER TO LIMIT” event. When pressed with weight-on-wheels cycles between NWS OFF / ON / HI modes. When pressed with aircraft in the air, toggles AoA limiter, G-limiter and Automatic Trim modes (similar function to FCS reset, except it does not zeroize trim settings).

5.2.2 THROTTLE SWITCHES

Cage/uncage push-button (T1) has different functions depending on the context.

This switch is NOT IMPLEMENTED in MSFS.

Weapons management switch (WMS) (T2) in the real aircraft **i**t is activated in the forward, aft, left, and right directions and can also activated in the Z axis and has different functions depending on the context.

In MSFS the functionalities of this switch are simplified and only one action is available:

WEAPON SELECT CYCLE –> TOGGLE ANNUNCIATOR SWITCH

The “Weapon select cycle” action (associated to the TOGGLE ANNUNCIATOR SWITCH event) will cycle between all available weapons. Master Mode will change depending on weapon selection.

Also, TOGGLE WATER RUDDER command can be used to open/close weapon doors.

Cursor slew controller switch (T3) is activated in both the X and Y axes and in the Z axis. It is used to slew cursor symbology across the display, to slew the EOTS sensor line-of-sight, and move slewable symbology on tactical displays.

In MSFS the following key bindings/events can be used to emulate CSC functionalities.

CSC UP – DECREASE ADF2 FREQUENCY (WHOLE)

CSC DOWN - INCREASE ADF2 FREQUENCY (WHOLE)

CSC RIGHT - INCREASE ADF2 FREQUENCY (FRACT)

CSC LEFT - DECREASE ADF2 FREQUENCY (FRACT)

CSC Z-AXIS - INCREASE ADF2 (10)

In the simulation the CSC is primarily used to move the cursor when the PCD is the DOI, “click” action is provided by the TMS UP switch.

Moving the cursor across the various portals changes the Portal of Interest.

<u>When the Portal of Interest is a Tactical Situation Display:</u>

- CSC Z-AXIS toggles visualization of radar search volumes.

- After TMS UP has been pressed with the cursor at the center of the TSD screen and a radar scan volume is displayed, the cursor disappears and CSC can be used to steer the search volume azimuth (in HSD or HSI modes) or in azimuth and elevation (in VSD mode, air-to-air only). Azimuth steering will work only if the selected search volume is less than its maximum possible width.

- A further depression of TMS UP, or a selection of another POI or DOI, will bring back the cursor and disengage the volume steering mode.

Please see Tactical Situation Display and Radar sections for further details.

<u>When the Portal of Interest is TFLIR:</u>

- CSC Z-AXIS toggles TFLIR slew mode (cross-hair turns white)

- When TFLIR slew mode is active, CSC can be used to control the sensor orientation (elevation only due to MSFS limitations)

- A further depression of CSC Z-AXIS or a selection of another POI or DOI, will disengage the TFLIR SLEW mode.

Please see TFLIR section for further details.

Speed brake (SB) switch (T4) position is used to extend or retract the (virtual) speedbrake.

In MSFS speedbrake is associated to SPOILER controls, and the related key bindings can be associated at will.

Chaff/flare switch (T5) is a three position switch which is used to deploy countermeasures.

This switch is NOT IMPLEMENTED in MSFS.

Approach power compensator (APC) select (T6) switch toggles APC mode on/off.

This switch is NOT IMPLEMENTED in MSFS.

Communication control and voice recognition (VR) switch (T7) is a four direction switch that provides different functions typically related to communication control and VR switch.

This switch is NOT IMPLEMENTED in MSFS.

Management switch (T8) is a rotary switch that has different functions depending on the context.

This switch is NOT IMPLEMENTED in MSFS.

Speed hold (autothrottle) switch (T9) is a three position used to toggle autothrottle and set autothrottle reference speed.

In MSFS normal autothrottle key bindings can be used (speed hold commands, increase/decrease reference speed)

Polarity control (T10) switch has different functions depending on the context but it is primarily used to switch sensor imagery polarity (e.g. WHOT to BLOT).

This switch is NOT IMPLEMENTED in MSFS.

External lights (T11) is a three position switch which is used to control external lights.

In MSFS the closest key binding is TOGGLE LIGHTS (which also toggles internal lights), otherwise individual light controls can be assigned.

Throttle detent override/MPO switch (T12) disables afterburner detent with Weight-on-wheels and manual pitch override when held longer than one second at high AOA.

In MSFS the closest key binding is “TOGGLE AFTERBURNER” and will work only as afterburner detent toggle.

6. COCKPIT DISPLAY SYSTEM

6.1 COCKPIT DISPLAY SYSTEM

Cockpit display system provides the pilot with information and data and takes pilot input through touch screen features or via cursor slewing.

The system includes the following displays:
• Panoramic cockpit display (PCD).
• Helmet mounted display system (HMDS).
• Standby flight display (SFD).

The Cockpit Display System is technically a MISSION SYSTEM and not a VEHICLE SYSTEM, however the Panoramic Control Display is the primary interface for the aircraft and it is necessary to introduce it before discussing the vehicle systems in detail.

The Helmet-mounted Display System (HMDS) will be discussed in the MISSION SYSTEMS section.

6.2 STANDBY FLIGHT DISPLAY

The standby flight display (SFD) is a stand alone unit used to provide back-up electronic flight instrument (EFI) data in the event of primary flight display failure and/or navigation solution error.
The SFD is located just beneath the panoramic cockpit display (PCD)

6.3 DISPLAY OF INTEREST

Either the PCD or the HMD can be designated as the Display Of Interest (DOI).
The DOI is the display on which the mission system is focusing for specific HOTAS input functions.
By default the DOI is the HMD. The DOI is selected with the DMS switch:

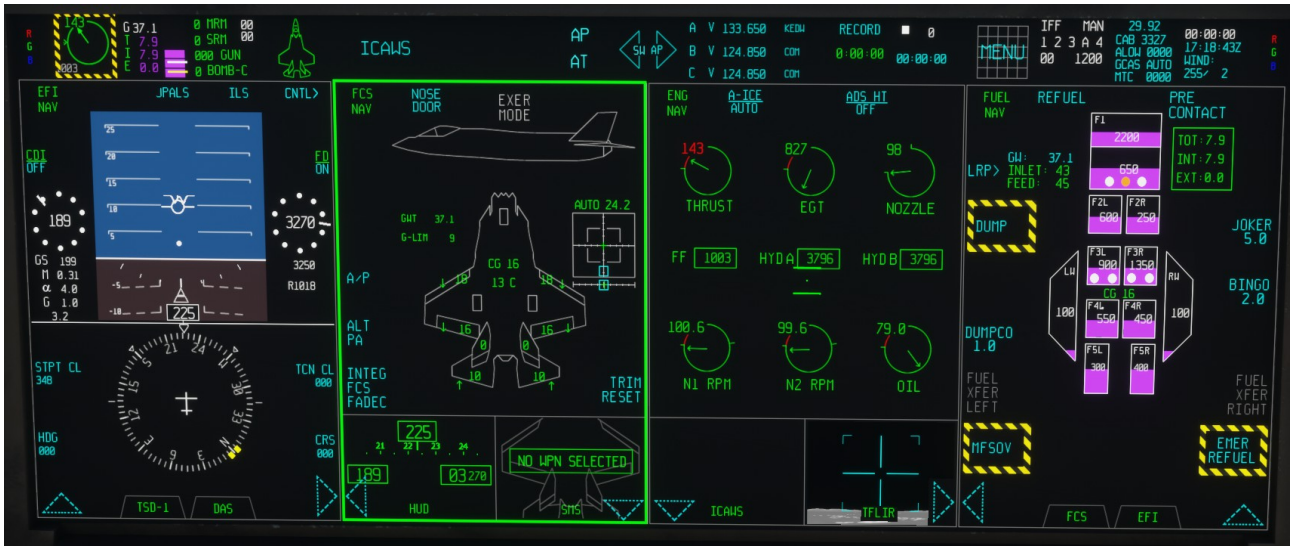
PCD is designated as DOI by pressing DMS DOWN when the DOI is the HMD.

HMD is designated as DOI by pressing DMS UP when DOI is the PCD.

6.3 PORTAL OF INTEREST

When the PCD is the DOI, a portal is designated as Portal of Interest (POI) and is indicated by a green border. Presence of the green border also indicates that the PCD is the current DOI.
The POI is the portal on which the mission system is focusing for specific HOTAS input functions.

POI can be changed with the DMS LEFT and DMS RIGHT controls, or by slewing the cursor with the CSC control.



6.4 PANORAMIC COCKPIT DISPLAY

The core of the F-35 pilot interface is a 20 by 8 inches (50 by 20 centimetres) multifunction touchscreen display. The display layout can be extensively customized by the pilot.
The vast majority of the aircraft functions can be accessed, controlled, configured and monitored via the multifunction display. In the real aircraft, multifunction display can be operated via touchscreen, cursor hooking or voice commands. In this rendition, only touchscreen (via mouse clicking) is supported.

The multi-function display is divided to five areas. An upper control bar called **status bar** and four, interchangeable and customizable sections called **portals.**
The status bar provides a summary of the most important information and quick access to some aircraft functions and systems, through “POP UP” versions of the relevant portal (namely, left to right ENG, FUEL, SMS, FCS, ICAWS, Autopilot, Communications, Navigation, Additional MENU screen, Identification and Barometric/GCAS settings).
Each portal is furtherly divided into three parts. A main window, called **main portal**, and two small windows, **called sub-portals.**
Every main portal and every sub-portal can be assigned individually to any of the 21 functions (“pages”) of the display. Therefore, each portal can host three functions at any given time. Pages are selected from a grid in a specific page called **MENU**.

6.5 COLOR CODING

Information in the PCD is colour coded as follows:

CYAN- active / TACAN pointer in EFIS screen

WHITE- on / selected

RED - threat or warning

YELLOW - unknown or caution

GREEN - friendly or advisory / ROUTE pointer in EFIS screen

MAGENTA- off board navigation / VOR pointer in EFIS screen

GREY- info box / unavailable function

LIGHT PURPLE- fuel

6.7 STATUS BAR AND FUNCTION ACCESS BUTTONS

The status bar provides a summary of critical aircraft systems status, and it is divided in multiple **FAB**s (Function Access Buttons) which provide quick access to a “POP UP” version of some of the MFD pages and to additional functionality not covered by the normal MFD pages.
POP UP portal versions are identified by a magenta POP UP indication on the upper left corner. To make the POP UP window disappear, and make the portal return to its original page, user can either click the upper left corner of the portal, or click on the relevant portion of the FAB.

From left to right, the status bar is divided in FABs as follows:

1 - ENGINE area – RPM, throttle, fuel flow settings are displayed - NOTE: when afterburner is engaged, this area is surrounded by a yellow/black striped box. Anti-ice system status is also reported in this area.
This FAB provides access to a POP-UP version of the ENGINE PAGE.

2 - FUEL area – reports aircraft gross weight, total, internal and external fuel. The fuel quantity is also displayed with light purple rectangles, with white bars indicating the JOKER and BINGO values.
This FAB provides access to a POP-UP version of the FUEL PAGE.

3 – WEAPON STATUS – MRM, SRM, GUN and Bombs quantities are shown – NO FUNCTION IN MSFS
This FAB provides access to a POP-UP version of the STORE MANAGEMENT SYSTEM (SMS) PAGE.

4 – FLIGHT CONTROL SYSTEM – three green lights indicate that landing gear is down and locked. Clicking in this area will bring the FCS– POP UP page on the portal immediately.
This FAB provides access to a POP-UP version of the FLIGHT CONTROL SYSTEM (FCS) PAGE.

5 and 6 - ICAWS (Integrated Caution, Advisory and Warning System) area – the left part indicates specific conditions that may require pilot attention while the right side indicates general warning and caution status. Clicking in this area will bring the FCS– ICAWS page.
The left side of the ICAWS area has a FAB which provides access to a POP-UP version of the ICAWS PAGE.

7 - AUTOPILOT area – This indicates weather the autopilot and auto-throttle are currently engaged. Clicking in this area will bring the AUTOPILOT – POP UP page on the portal immediately below the click area.

8 - SWAP button – clicking this button will swap the left and right sides of the top bar. The status of the portals will not be changed.

9 – COMMUNICATIONS - This area reports status of COM A, COM B and COM C radios. Clicking on this area will invoke the COMMUNICATIONS page.

10 - The VIDEO RECORDER button is inoperative in MSFS.

11 – NAVIGATION - This area reports the current waypoint, waypoint progression mode (AUTO if automatic, nothing is manual), associated RTE (GPS Route), ILS frequency - Clicking on the associated FAB will provide access to the NAVIGATION pop-up portal.

12 - MENU button – This FAB provides access to an additional MENU page, which allows the pilot to operate a number of additional functionalities which will be discussed in detail in a following paragraph.

13 – IDENTIFICATION - This area reports the current IFF Transponder codes - clicking on this area will provide access to the IDENTIFICATION page.

14 – BARO / CABIN PRESSURIZATION / GCAS / ALOW - This area shows the current Barometric setting, cabin pressurization information, Ground Collision Avoidance System (GCAS) status and ALOW (Altitude Low Warning) setting - clicking on this area will allow the pilot to set BARO and ALOW values

15 – ZULU/LOCAL TIME / WIND DIRECTION AND SPEED – This area reports the current time, along with the wind direction and speed information. Clicking on FAB will allow the pilot to access a page with clock and stopwatch functionalities.

6.8 PORTALS AND PAGES CONTROL

Each portal is identical and interchangeable with the other three and is controlled in the same way. The picture below shows a typical layout with the portal control areas highlighted:

1 - Clicking on the upper left corner of the portal will invoke the MENU page, unless the portal is displaying a pop-up function. In that case, the pop-up page will disappear and the portal will be restored to its previous status. This area shows the title of the page and the current master mode.

2 - Clicking on one sub-portal (or its tab if the portal is maximized) will swap the functions of the sub-portal and the main portal. If the sub-portal had no function assigned, the MENU screen will be shown and the pilot shall select the page he or she wants to assign.

3 - Clicking on the “DOWN” arrow in a portal, will cause the main portal to maximize and sub-portals to collapse to tabs.

4 - Clicking on the “UP” arrow in a maximized portal will restore the sub-portals to its normal size.

5 - Clicking on the “LEFT” or “RIGHT” arrows will cause the current page to be expanded to occupy two portals, while sub-portals are collapsed to tabs. NOTE: at the moment of initial release, only the following pages can be maximized to full screen: EFI, FUEL, FCS, ENG, HUD, TSD1, TSD2, TSD 3.

NOTE: like in the real plane you are allowed to have only one instance of each function, except for the TSD and pop-up screens. For example, you can have only one EFI page in a portal or subportal at any given time. If EFI is selected on a portal when it is also present on another portal or subportal, the EFI function will be assigned to the new portal and the old portal will go blank.

6.9 PORTALS MENU

Clicking on the top-left corner of each portal invokes a MENU page that allows the pilot to select the function of each portal.

Available pages are:

ASR> Air-to-Surface Radar (only available on PC)

CHKLST> Checklist (only available on PC)

CNI> Communications Navigation and Identification (page has no function in MSFS - CNI functions are accessed by the FAB - page is only available on PC)

DAS> Distributed Aperture System (starting from version 1.0.6 – draft implementation)

DIM> Data and Information Management page (page has no function in MSFS and is only available on PC)

EFI> Electronic Flight Instrumentation

ENG> Engine

FCS> Flight Control System

FUEL> Fuel page

HUD> Head-Up Display

ICAWS> Integrated Caution, Advisory and Warning System

PHM> Prognostics and Health Management (only available on PC)

SMS> Stores Management System

SRCH> Search page (only available on PC)

TFLIR> Targeting Forward Looking Infra-Red (starting from version 1.0.6 – draft implementation)

TSD-1> Tactical Situation Display 1

TSD-2> Tactical Situation Display 2

TSD-3> Tactical Situation Display 3

TWD> Threat Warning Display (functionality is only available on PC)

WPN-A> Air to Air weapons (Inoperative in MSFS)

WPN-S> Air to Surface weapons (Inoperative in MSFS)

Aircraft master modes are:

NAV – Navigation

A-A1 – Air to Air 1; A-A2 Air to Air 2 (not used in MSFS)

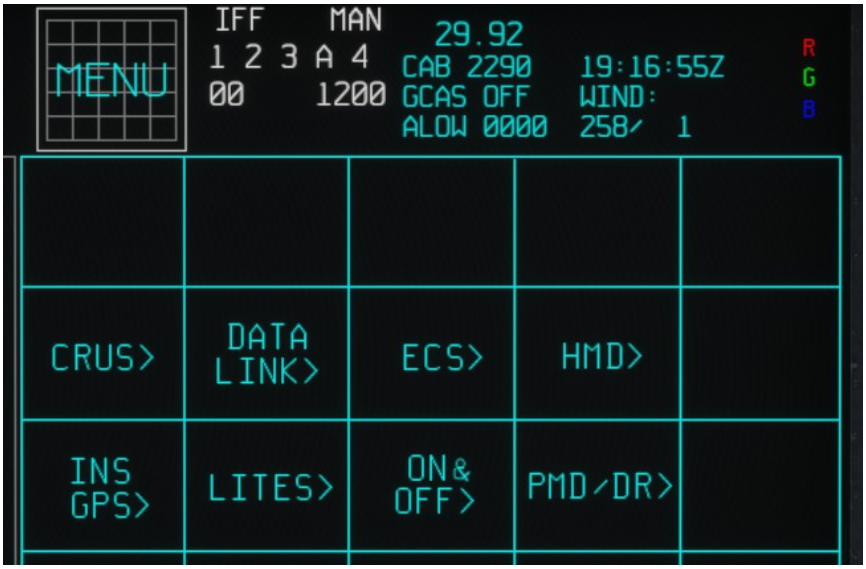
A-S – Air to Surface

DGFT - Dogfight

NOTE: in MSFS the master mode is dependent solely on the selected weapon. If no weapon is selected, Master Mode will be set to NAV. If an air-to-air missile is selected, Master Mode will be set to A-A1. If an air-to-surface weapon is selected, Master Model will be set to A-S. If gun is selected Master Mode will be set to DGFT.

6.10 MENU PAGE

The Status Bar MENU page provides access to an additional MENU which allows the pilot to operate access and operate a number of additional pages, which are only available from this button.



The additional pages are:

CRUS (Cruise) – This page provides information on current route (RTE). In the real aircraft this page also allow the pilot to select the current route between multiple preselected routes.

DATA LINK – This page provides access to LINK16 and MADL datalink network configuration and functionalities.

ECS (Environmental Control System) – This page provides information on the aircraft ECS, cabin pressurization and oxygen system-

HMD (Head Mounted Display) – This page provides information and options for the HMD, including decluttering and off-axis symbology.

INS/GPS – This page provides information on the status of the Inertial Navigation System and the GPS system. In MSFS this page is almost non-functional, while in reality it provides detailed information and control on the status of the navigation systems, including IN alignment and FIX procedures.

LITES (Lights) - This page provides information and options for the aircraft lighting system (both internal and external) except the map lights which are controlled by a separate, physical button.

ON & OFF - This page is not operational in MSFS.

PMD/DR (Personal Memory Device / Data Recorder) – In the real aircraft, this page allows the pilot to control the personal memory device and the data recorder: this includes reading waypoints and routes from the PMD, storing information and recording video from the HMD or the PCD.
In the game it is used to select preferences and store/retrieve the PCD status.

7. INTEGRATED CAUTION, ADVISORY AND WARNING (ICAW) SYSTEM

7.1 GENERAL DESCRIPTION

The Integrated Caution, Advisory and Warning System (ICAWS) is a centralized system which collects warning, caution and advisory signals from different aircraft systems and presents the alerts to the pilot in an standardized and coherent way.

All ICAWS messages are shown in the status bar and in the PCD ICAWS page.
Caution and warning messages are also shown in the HMD and EFI pages.
ICAWS messages are also accompanied by an aural cue and, depending on their severity, a voice alert.

7.2 ICAWS ALERT CATEGORIES

The ICAWS system has four alert categories, colour coded and followed by audio cues.

WARNING – These conditions require immediate pilot attention and corrective actions as they represent major risks of injuries, fatalities or loss of the aircraft. These alerts are followed by a "Whoop, whoop" sound and a voice message.
These alerts will also show on the HMD an on the ADI section of the EFI page.

CAUTION HIGH – These are potentially dangerous condition which require immediate pilot attention, however do not expose the aircraft or the pilot to immediate risk. Without a timely and correct response from the pilot, these conditions may lead to mission failure or equipment damage.
These alerts are followed by a "Deedle, deedle" sound and a voice message.
These alerts will also show the the HMD and on the ADI section on the EFI page and can be acknowledged from the status bar.

CAUTION LOW - These are potentially dangerous condition which require pilot attention, however do not expose the aircraft or the pilot to immediate risk. Without a timely and correct response from the pilot, these conditions may lead to mission failure or equipment damage.
These alerts are followed by a "Deedle, deedle" sound but no voice message
These alerts will also show the the HMD and on the ADI section on the EFI page and can be acknowledged from the status bar.

ADVISORY – These are advisories which are reported to the pilot for information only, but do not represent an risk condition or an abnormal operation of the aircraft system. These advisories are followed by a "Bong" sound but no voice message.

7.3 ACKNOWLEDGING ICAWS ALERTS

ICAWS warnings can be acknowledged with the right side of the ICAWS FAB.

Acknowledged warnings will show with "inverted" colours (yellow characters on a black background, as opposed to black characters on a yellow background), the associated audio alert will stop and the yellow "CAUTION" rectangle in the status bar will be extinguished.

Once acknowledged the ICAWS warning will not cast a new audio alert until the condition has been resolved. Once the condition has been resolved, the warning returns to an "non-acknowledged" state (will cast new a audio alert).

In the following images the case of a "OVERSPEED GEAR" warning is shown.

In the first image, the ICAWS page and the ICAWS status bar shows three alerts, one warning ("overspeed gear" which indicates that the gear is not up and locked above the maximum allowable speed) and two advisories (which simply indicate that left and right weapon doors are open).

Example: “overspeed Gear” warning (not acknowledged). The red circle indicates the area to be pressed to acknowledge the warning. Note the (flashing) “Overspeed Gear” which will appear on the EFI ADI section.

Once the acknowledgment area is pressed, the “Caution” yellow rectangle disappears, the flashing message on the EFIS ADI disappears, and the audio alerts stop.

7.4 ICAWS PCD PAGE

The Integrated Caution and Warning System has a dedicated page on the Panoramic Control Display and can be assigned to any portal. In addition the same page can be invoked as a POP UP by clicking on the left side of the ICAWS FAB area.
The only control available in this page is the ICAWS TEST option, which initiates a basic ICAWS Built-In Test (BIT).

7.5 WARNING ALERTS

The following ICAWS warning alerts are implemented in the simulation:

FLAMEOUT - Engine flameout

FIRE ENG - Fire detected in engine compartment

GWPS - Ground proximity warning / potential collision

STALL - Stall warning

FUEL CRITICAL - Total fuel below 1000 lbs

ENG RPM LOW - Engine RPM low

GEN FAIL ALL - ICC1, ICC2 and ICC3 are all offline

TEST - Test message

8.5 WARNING ALERTS

The following ICAWS caution alerts are implemented in the simulation:

BINGO - Total fuel below BINGO level

BATT LO 270V - 270V battery bus offline, or low battery is abnormally low, or battery switch is off

BATT LO 28V - 28V battery bus offline, or low battery is abnormally low, or battery switch is off

ENG LIMITS - Abnormal engine parameters (reduce throttles)

WING FOLD - RPM above 80% and wings folded

SEAT NOT ARMED - RPM above 80% and seat armed

PARKING BRAKE ON - RPM above 80% and parking brake set, or parking brake switch set to ON when aircraft is airborne

CANOPY UNLOCKED - RPM above 80% and canopy not down and locked

GEN FAIL 1 & 2 - ICC1 and ICC2 are offline

GEN FAIL 1 - ICC1 is offline

GEN FAIL 2 - ICC2 is offline

GEN FAIL 3 - ICC3 is offline

OVERSPEED - Airspeed is above 700 knots or Mach number is above 1.60

OVERSPEED AAR - Refuel system is not retracted and airspeed is above 400 knots (or Mach number is above 0.8)

OVERSPEED GEAR - Landing gear extended and airspeed above 300 knots (or Mach number is above 0.65)

OVERSPEED HOOK - Tailhook extended and airspeed above 300 knots (or Mach number is above 0.65)

AIR DATA DEGD - Air data system degraded or ice detected on air data system probes and sensors

FUEL DUMP OPEN - Fuel dump valve open

GEAR FAIL - Landing gear damaged or landing gear failure

FCS POWER LIMIT - Flight control system power limit reached

CABIN PRESS - Cabin not pressurized

LADDER UNLOCKED - Ladder not stowed and locked and RPM above 80%

FCS DEGD - Flight control system failure, or flight control system set to manual mode and airspeed above 450 knots

ENG ICE DETECTED - Engine ice conditions detected and anti-ice system disabled or inoperative

TEST - Test message

8.5 ADVISORY ALERTS

The following ICAWS advisory alerts are implemented in the simulation:

ENG START ASSIST - engine starter is active

V/S BIT NO GO - Vehicle systems built-in test not completed

V/S BIT RUNNING - Vehicle systems built-in test in progress

WINGS FOLDED - Wings folded

CANOPY UNLOCKED - Canopy not down and locked

PARKING BRAKE ON - Parking brake set

JOKER - Total fuel below Joker level

LAUNCH BAR - Launch bar extended

BOS - Backup oxygen system active

8. ENGINE

8.1 GENERAL DESCRIPTION

The F-35 is powered by a Pratt & Whitney F135 a mixed-flow after-burning turbofan derived from the F119 engine with a new fan and LP turbine.
There are 3 F135 variants with the -400 being similar to the -100, the major difference being the use of salt-corrosion resistant materials. The STOVL F-35B is outfitted with a Lift System composed of a lift fan, drive shaft, two roll posts and a "Three Bearing Swivel Module" (3BSM). The 3BSM is a thrust vectoring nozzle which allows the main engine exhaust to be deflected downward at the tail of the aircraft. The lift fan is near the front of the aircraft and provides a counterbalancing thrust using two counter-rotating blisks. It is powered by the engine's low-pressure (LP) turbine via a drive shaft and gearbox.
During slow flight most of the bypass flow is ducted to the wing nozzles, known as roll posts. Some is used for cooling the rear exhaust nozzle. At the same time an auxiliary inlet is opened on top of the aircraft to provide additional air to the engine with low distortion during the hover. The lift fan is driven from the LP turbine through a shaft extension on the front of the LP rotor and a clutch.
The engine is operating as a separate flow turbofan with a higher bypass ratio. The power to drive the fan (about 30,000 SHP) is obtained from the LP turbine by increasing the hot nozzle area.
Improving engine reliability and ease of maintenance is a major objective for the F135. The engine has fewer parts than similar engines which should improve reliability. All Line Replaceable Components (LRCs) can be removed and replaced with a set of six common hand tools.

8.2 F135-PW-100 SPECIFICATIONS

General characteristics

Type: after-burning turbofan
Length: 220 in (559 cm)
Diameter: 46 in (120 cm) max., 43 in (110 cm) fan inlet
Dry weight: 3,750 lb (1,700 kg)

Components

Compressor: 3-stage fan, 6-stage high-pressure compressor
Combustors: annular combustor
Turbine: 1-stage high-pressure turbine, 1-stage low-pressure turbine

Performance

Maximum thrust: 43,000 lbf (190 kN) max., 28,000 lbf (125 kN) intermediate
Overall pressure ratio: 28:1 overall pressure ratio
Specific fuel consumption: 0.886 lb/hr·lbf or 25.0 g/kN·s (dry)
Thrust-to-weight ratio: 7.47:1 (dry), 11.467:1 (wet/after-burning)

8.3 F135-PW-600 (F-35B) SPECIFICATIONS

General characteristics:
Type: After-burning Turbofan with shaft driven remote lift fan
Length: 369 in (937.3 cm)
Diameter: 46 in (116.8 cm) maximum, 43 in (109.2 cm) fan inlet, 53 in (134.6 cm) lift fan inlet

Components

Compressor: 3 stage fan, 6 stage high-pressure compressor, 2 stage, contra-rotating, shaft driven lift fan
Combustors: annular combustor
Turbine: Single stage high pressure turbine, 2-stage low pressure turbine

Performance

Maximum thrust: 41,000 lbf (182.38 kN) max, 27,000 lbf (120.1 kN) intermediate
Overall pressure ratio: 28:1 overall pressure ratio (conventional), 29:1 overall pressure (powered lift),
Specific fuel consumption: ~0.886 lb/(hr·lbf) or ~25,0 g/kN·s (w/o afterburner)

8.4 ENG PCD PAGE

This engine system has a dedicated page on the PCD. The page can be assigned to any portal and will show the overall thrust, EGT, nozzle position, N1, N2 and oil needles.
Fuel flow and hydraulic pressure are also reported as digital indications.
The page also hosts the controls of the Anti Ice System (A-ICE) and the Air Data System Heat (ADS HT).
The Anti-Ice system provides engine de-icing functionalities, while the Air Data System Heat provides heat to all the air data system sensors.

The following controls/options are available in this page:

A-ICE – Select between OFF, AUTO and ON options. If the AUTO option is selected, the engine and structural anti-ice systems will be automatically turned on if potential icing conditions are detected.

ADS HT - Select between OFF, AUTO and ON options. If the AUTO option is selected, ADS heaters will be automatically turned on if potential icing conditions are detected.
In addition the same page can be invoked as a POP UP by clicking on the left side of the ICAWS FAB area, which also reports throttle setting (outer chevron), thrust (arrow and green digits), fuel flow (grey digits).

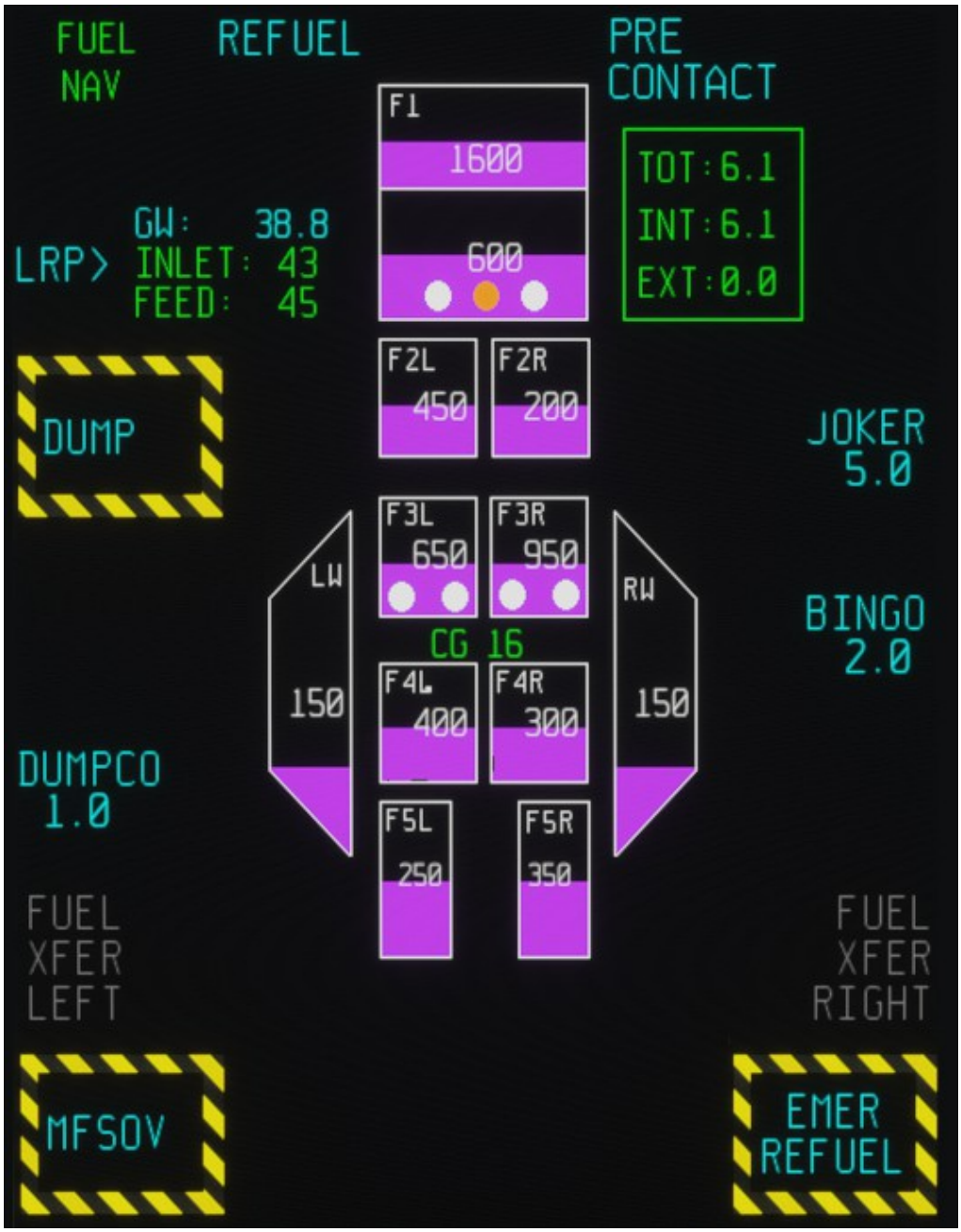
9. FUEL SYSTEM

9.1 FUEL SYSTEM DESCRIPTION

The fuel is divided in multiple fuselage and wings tanks. Tanks interconnections and pumps are operated automatically and does not normally require pilot action.
Pilot interface is provided through a dedicated PCD page.
Fuel quantity for each tank is truncated to the nearest 50 pounds and total fuel quantity is truncated to the nearest 100 pounds.

9.2 FUEL PCD PAGE

This fuel system has a dedicated page on the PCD. The page can be assigned to any portal and will show the total fuel quantity available, as well as the quantity in each individual fuel tank and the status of the refuel system and provides refuel system controls, Main Fuel Shut Off Valve (MFSOV) controls, Fuel Dump functionality control and BINGO and JOKER settings.



The following controls/options are available in this page:

REFUEL - Toggle the opening of the refuel receptacle doors in the F-35A or the extension and retraction of the refuel probe in the F-35B and F-35C (requires confirmation).

PRE-CONTACT – Allows the in-flight refuel transfer if proper conditions are met.

DUMP - Toggle the opening of the fuel dump valve with the DUMP command (requires confirmation).

DUMPCO - Set the DUMP CUT OUT quantity with the DUMPCO command - a numeric keypad appears and the pilot shall enter the desired DUMPCO fuel value. Expected format is X.Y (e.g. 1 2 becomes 1200 lbs.). Fuel dump will stop at that quantity.

JOKER - Set the JOKER fuel alert with the JOKER command - a numeric keypad appears and the pilot shall enter the desired JOKER fuel value. Expected format is X.Y (e.g. 4 2 becomes 4200 lbs.)

BINGO - Set the BINGO fuel alert with the BINGO command – a numeric keypad appears and the pilot shall enter the desired BINGO fuel value. Expected format is X.Y (e.g. 2 0 becomes 2000 lbs.)

MFSOV - Activate the Main Fuel Shut-Off Valve in case of emergency with the MFSOV command (requires confirmation). NOTE it is necessary that the throttle is below 15% of its total travel.

Notes:

An EXPERIMENTAL in-flight refuel functionality is provided, and work as follows:

- once the plane is airborne and ready to initiate the refuel procedure, press the “REFUEL SYSTEM”

- press “REFUEL SYSTEM” to open the refuel receptacle / extend the fuel probe

- clicking on the green “fuel quantity” box will initiate refueling. Pilot must keep the plane within +/-50 feet altitude and +/- 7 knots otherwise the refuel system will be disconnected.

The built-in refuel systems can be disabled by the user with “IN FLT REFUEL” button in the PMD/DR page, in order to avoid conflicts with third party modules.

In addition the same page can be invoked as a POP UP by clicking the dedicated FUEL FAB. The FAB reports the Gross Weight (G), the Internal fuel (I) and the Total fuel (T). In addition, the total fuel quantity is depicted by purple boxes, the JOKER quantity is represented by a white line and the BINGO quantity by a yellow line.

NOTE: The F-35 software presentation includes provision for External fuel (E or EXT) as the initial project included the possibility to mount external tanks. However the external tanks were not required by any customers and are not employed on the real aircraft and therefore are not available in Microsoft Flight Simulator.

10. POWER AND THERMAL MANAGEMENT SYSTEM

10.1 POWER AND THERMAL MANAGEMENT SYSTEM DESCRIPTION

The power and thermal management system (PTMS), sometimes also referred to Integrated Power Package (IPP) during JSF development, combines into a single system the functions traditionally performed by the auxiliary power system, emergency power system, and environmental control.

At the heart of the PTMS is a small gas-turbine engine "turbo-machine" that provides power to the engine-mounted starter/generator, bringing the engine to its threshold starting speed. The engine then increases to idle speed and the electrical system, which includes the engine-mounted starter/generator (ES/G) transitions from operating as a motor to operating as a generator. The PTMS is also available for in-flight emergency power.

The functions provided by the PTMS are:

- Primary electrical power for engine start and ground maintenance

- Emergency electrical power

- Cabin and avionics environmental control, defog, seal pressurization

- Anti-G pressurization

- Mission systems cooling

- Air for the OBOGS system

10.2 BLEED AND BURN MODES

The PTMS has two primary operating modes: burn mode and bleed mode:

Burn mode operates with combustion providing power for engine start, emergencies and ground maintenance. Transition between burn mode and bleed mode occurs automatically.
Bleed mode includes operation using engine bleed air alone (bleed mode) or combustion-aided bleed air (bleed and burn mode). Bleed mode provides the following functions: cabin conditioning and equipment cooling and emergency electrical power for a main generator failure.

Transition between burn and bleed mode is automatic.
Bleed and burn mode occurs only on the ground when engine bleed is insufficient to meet ECS demands.
Transition bleed and burn and bleed mode is automatic.

The combustion status of the PTMS is shown by the green light next to the IPP start knob and by the

“BURN” caption between the engine and fuel FABs.

10.3 PTMS CONTROLS AND NORMAL OPERATION

The Power And Thermal Management System is controlled by the dedicated PTMS control panel, which also hosts electrical system controls.

The primary control is the IPP knob, which starts (or stops) the PTMS in BURN mode.

NOTE: the IPP knob cannot be set to OFF mode in Microsoft Flight Simulator.

The CABIN PRESSURE knob has no function in Microsoft Flight Simulator.

The system is normally started by turning the BATTery switch to ON, and then turning the IPP mode switch to START. The green light will start blinking, indicating that the PTMS is starting. Once the PTMS start is complete a steady light indicated combustion (burn or bleed and burn) and the knob can be returned to the AUTO position and the engine can be started.

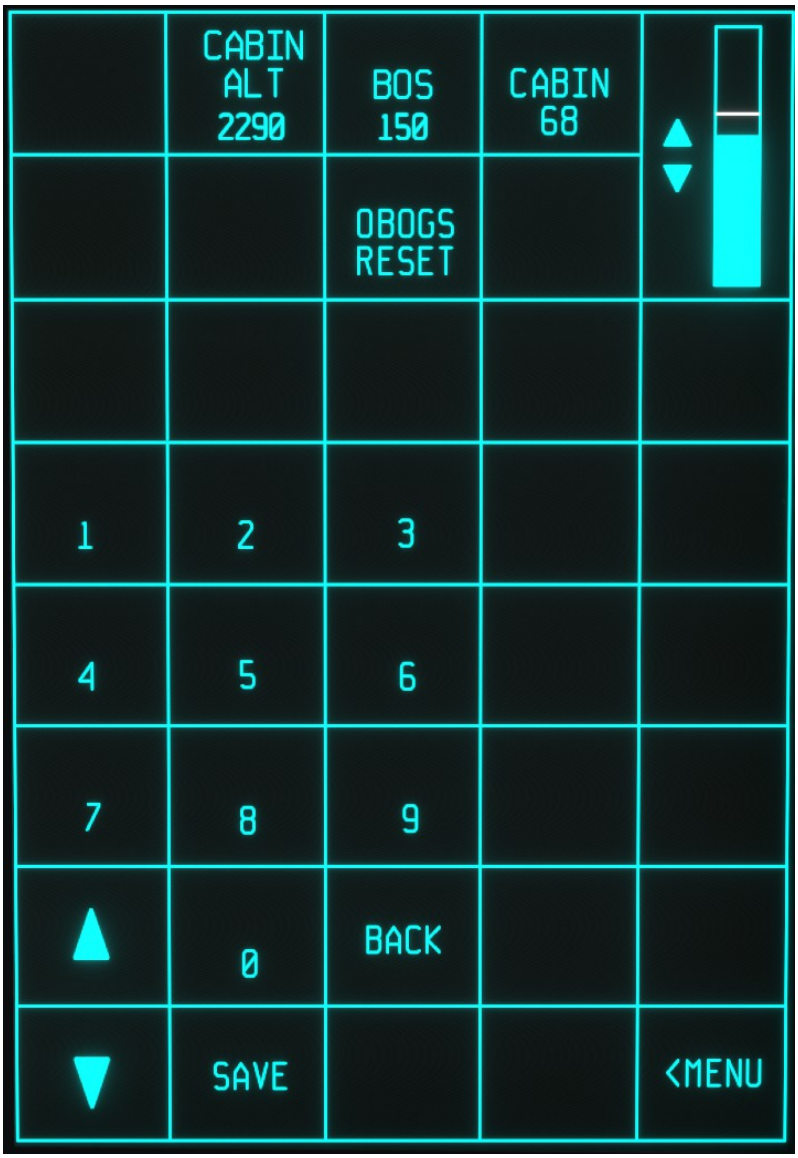
During normal operation the PTMS operates automatically and does not require pilot action.

The system shuts down automatically when the engine is stopped.

10.4 ECS (Environmental Control System) PAGE

Environmental Control System information is reported on a specific PCD page which can be accessed from the MENU FAB. The ECS page provides controls and information on the Environmental Control System, including cabin pressurization and oxygen system.

This page has a limited implementation in MSFS – information and layout are correctly represented, but the page has no functionality.



11. ELECTRICAL POWER SYSTEM

11.1 ELECTRICAL POWER SYSTEM DESCRIPTION

The Electrical Power System (EPS) generates, distributes, and controls electrical power.
The main components of the EPS are:

- The engine starter/generator (ESG)

- The integrated power package (IPP) starter/generator (ISG)

The ESG and ISG generate 270 Vdc electrical power.
A permanent magnet generator (PMG) is driven from the ESG shaft and provides unregulated electric power to each of the three converter regulators (CR) which in-turn provide regulated 28 Vdc to its internal power bus. A second PMG, driven from the ISG shaft, backs up the ESG PMG.

11.1.1 Engine Starter/Generator (ESG)

The ESG is mounted to the engine gearbox. When acting as a starter motor, the ESG turns the engine for motoring or start and can only be powered by the ISG.
Following a successful engine start, the ESG system automatically transitions from start mode to generate mode and provides primary 270 Vdc power. In generate mode, the ESG provides two separate channels (GEN (ICC) 1 and 2).

1.1.2 Integrated Power Package Starter/Generator (ISG)

The IPP (GEN (ICC) 3) provides 270 Vdc electrical power if both GEN (ICC) 1 and GEN (ICC) 2 fail or are off line. The IPP ISG is the backup generator and is turning as long as the IPP is turning. The IPP, which is normally powered by bleed air, can also be powered in a combustion mode and can be started from the internal 270 Vdc battery or by power from the main 270 Vdc bus power.

11.2 EPS CONTROLS AND NORMAL OPERATION

Electrical Power System controls are located on the PTMS control panel.

In normal conditions the system is completely automatic.

ICC 1, ICC 2, and ICC 3 switches:

The inverter/converter/controller switches (labelled ICC 1, ICC 2, and ICC 3) are referred to as GEN (ICC) 1, GEN (ICC) 2, and GEN (ICC) 3.
All three switches must be ON to provide generator power for engine motoring or electrically assisted start.
In case of abnormal operation or inoperative generators, cycling the switches from ON to OFF/RESET and back to ON may reset faults.

BATT switch

The BATT switch operates the 28 Vdc battery and has thee positions ON, OFF, and TOW.

ON – Applies 28 Vdc battery power only to some aircraft systems.

OFF – Turns the 28 Vdc battery.

TOW – Applies power for tow mode (this option is not available in Microsoft Flight Simulator).

Battery DIScharge Lights:

Amber DIS lights illuminate when the 28 Vdc or 270 Vdc batteries are discharging.

BATT LOW Lights.

Red lights illuminate if the respective battery capacity is low.

12. FLIGHT CONTROL SYSTEM

12.1 FLIGHT CONTROL SYSTEM

The F-35 FCS uses Electro-Hydrostatic Actuation System (EHAS) to power its primary and secondary flight control surfaces. This is a departure from predecessor legacy combat aircraft powered by hydraulics. The conventional system design was reliable and had a mature design concept, but it added substantial weight and volume and drove the hydraulics system's sizing and redundancy.
The FCS architectures are largely common for all three F-35 variants for the primary control of horizontal tails, flaperons, rudders, and leading edge flaps. However, the F-35A and F-35C variants also incorporate horizontal tail centering actuators, and the F-35C variant also incorporates conventional hydraulically powered ailerons.

12.2 FLIGHT CONTROLS SYSTEM DESCRIPTION

The flight controls system (FCS) is a fly-by-wire system consisting of three redundant flight control channels (FCS CH A, B, and C). Each FCS channel (FCS CH A, B, and C) is comprised of a vehicle management computer (VMC) which generates commands for the FCS surfaces, propulsion effectors, gear, and doors

The F-35 airframe is statically unstable in much of the flight envelope. This instability provides excellent manoeuvrability and performance, but requires artificial stabilization and augmentation by the FCS to provide control and agility over the wide range of weight, CG, airspeed, Mach, and angle-of-attack (AOA) that comprises the aircraft envelope.

Additionally, the FCS sets command limiters, as a function of flight condition and aircraft configuration, to minimize the potential for overstress or departure from controlled flight.

The flight control surfaces consist of horizontal stabilizers (referred to as stabs or HTs), trailing edge flaps (TEFs), dual rudders, and leading edge flaps (LEFs). Control over pitch, roll and yaw is provided as follows:

- Pitch is controlled by symmetrical movement of the stabs.

- Roll and yaw are controlled by differential deflection of the flaps and stabs in addition to symmetric movement of the rudders.

Leading Edge Flaps (LEFs) are actuated symmetrically and and are used optimize lift and drag, improve lateral-directional stability and reduce susceptibility to abrupt wing stall.

The aircraft does not have dedicate speed-braking surfaces. When pilot commands speed brakes to deploy, control surfaces are actuated in a way to maximize drag – therefore provide a braking effect.

TEFs are controlled automatically. There is no flap control in the F-35 cockpit. In MSFS the FLAPS extend/retract control is used to toggle flight control laws.

12.3 CONTROL LAWS IN FLIGHT SIMULATOR

In MSFS the FCS has two sets of control laws:

UP AND AWAY (AUTO MODE) – In this mode, trim is automatic (plane will fly in the direction it is pointed to), G-Limiter and AoA Limiters are enabled providing carefree controls.

TAKE-OFF AND LANDING (MANUAL MODE) – In this mode, trim is manual (requires pilot action), G-Limiter and AoA limiters are disabled.

Switch between these two modes happens:

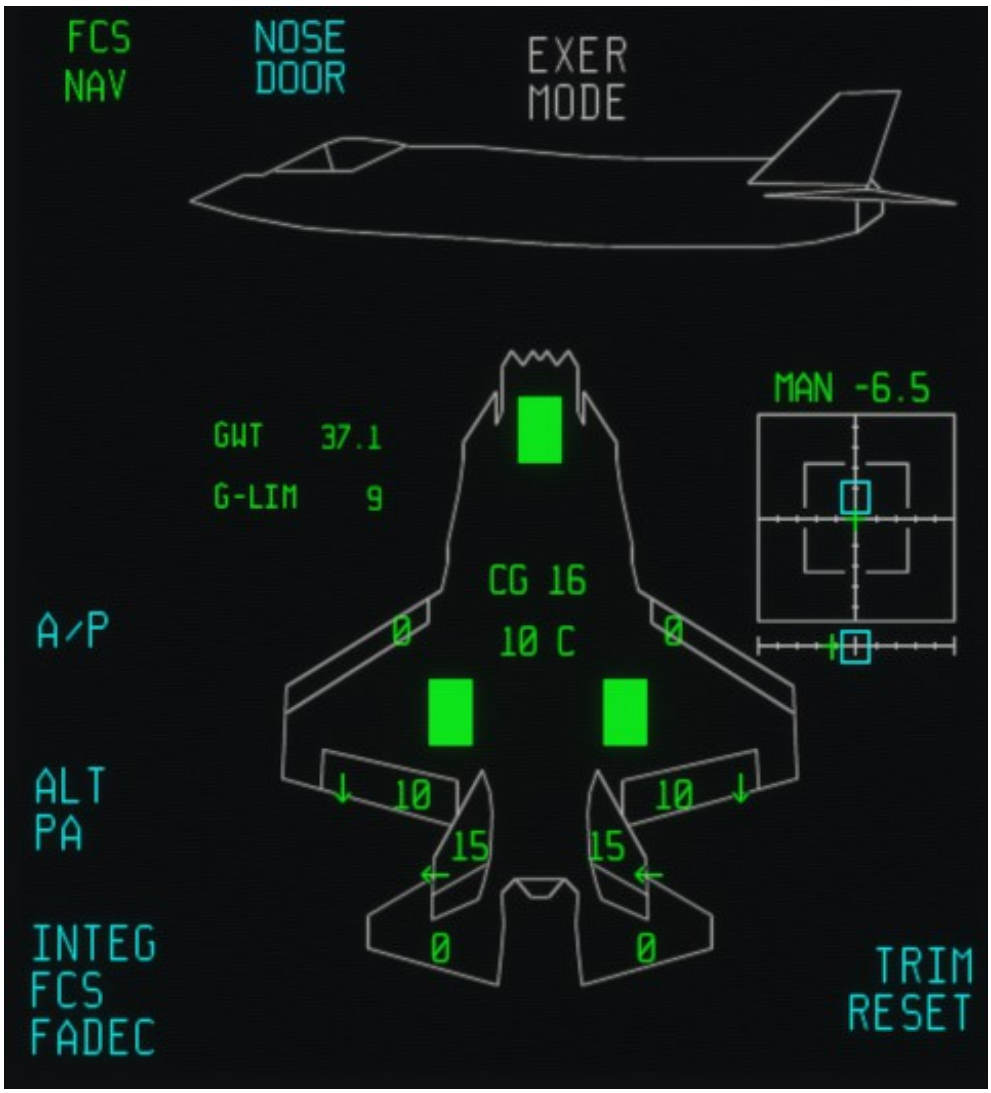
AUTOMATICALLY depending of gear position or AGL altitude (preference can be set in the PMD/DR page)

MANUALLY with the FLAP EXTEND / RETRACT controls, via the FCS RESET button, or via the pinkie switch (S9 – associated to the SET NOSE STEERING TO LIMIT) if the plane is flying.

12.4 FCS PAGE

The Flight Control System has a dedicated PCD page, which can also be invoked as a POP UP via the FCS FAB.
This page reports the positions of control surfaces (flaperons, horizontal tails, rudders and LEFs), the trim setting, the positions of the landing gear, virtual speed brakes and, on F-35A and F-35C, of the tail hook, and on the F-35C only, of the launch bar and the folding wing mechanism.
On the F-35B, this page will also show the status of the Direct Lift System, including the nozzle and lift-fan flow direction and commanded speed. Also, the current total aircraft weight is shown, as well as the maximum G limit of the selected model.

NOTE: this is the maximum G limit for the clean aircraft, and it is not updated with the load-out configuration. The FCS has some G-limiting authority but it may be possible, in some instances, to overstress the aircraft.



The following controls/options are available in this page:

NOSE DOOR – Open/Close the nose gear doors. This function is provided as the the ILS receiver is inside the nose gear well. Nose Gear doors must be open for the ILS system to work. NOSE DOOR option will only work if the landing gear lever is up and the airspeed is below 300 knots or 0.6 Mach.

A/P - engage/disengage the autopilot

LBAR- retract/extend the launch bar (F-35C only)

FOLD/SPREAD - fold/spread the wings (F-35C only, and only if a/c is on the ground and the aircraft is stationary)

HOVER - command the Direct Lift System to enter the automatic hover mode, (F-35B only, only if the STOVL Mode is engaged and if the aircraft if within the maximum hover weight limits – see details on the “Special Instructions for STOVL mode” section below).

AUTO T/O - allows the selection of the AUTO TAKE OFF option (F-35B only, only if the aircraft is static on the ground, wheel brakes are pressed and STOVL Mode is engaged)

TRIM RESET – resets pitch, roll and rudder trim settings

Notes:

- HOVER can only be commanded if the total aircraft weight is below 40600 lbs. The HOVER caption will be RED if the aircraft is in STOVL mode, but the aircraft exceeds the weight limits.

- Starting from version 1.2.0 the TRIM display, the AUTO caption indicates that the fly-by-wire system is full engaged and the auto-trim active, while the MAN caption indicates that the fly-by-wire system is disengaged and the TRIM is in manual mode. If the system is in MANUAL mode and the airspeed is above 400 kts, the FCS DEGRADED message is displayed.

- Starting from version 1.3.4 the AUTO/MAN flight by wire logic works as follows:

- *MAN mode can be selected by the pilot by either setting the simulator “flaps” command to any position but UP, or by depressing the FCS button.*
- *If the MAN mode is not selected by the pilot, the MAN mode will also be entered if the landing gear is down OR if the altitude is below 50 FT AGL, depending on pilot preference set in the PMD/DR page.*

- MSFS G-Limiter is set slightly above the real aircraft design G-limits, as the simulator limiter tends to be very aggressive. Because of that it is possible to slightly exceed the G-limits if the manoeuvring speed is very high.

- While in STOVL and HOVER mode, wind is automatically compensated

12.5 FCS LIMITATIONS AND INACCURACIES

This F-35 rendition for Microsoft Flight Simulator features a flight model which is based on performance data publicly released either by official or unofficial (but very reputable) sources, however, as of today, the performance manual of the aircraft is classified – so there is some engineering guesstimate in some areas.

The three variants have slightly different flight models which reflect the differences in the real-world counterparts.

The software implementation is fly-by-wire, non-CFD enabled MSFS “Modern” flight model. This means that the flight control system is governed by MSFS/Asobo fly-by-wire system: while features some customizations and tweaks, it is still affected by some minor bugs.

Important notes on implementation in Microsoft Flight Simulator:

- if the FCS is in if the indicated air speed is above 400 kts will toggle the FCS DEGRADED caution message, as it is possible to exceed the structural limits of the aircraft.

- after disconnecting the FBW, the auto-trim will continue working for a couple of seconds.

- Extremely high AoA issues: forcing the plane into extremely high AoA conditions can lock the flaperons and the tailerons into an high-AoA condition. If this happens pilot should manoeuvrer the plane to increase airspeed and reduce the AoA (possibly even with a half barrel roll).

- Roll bias issues: after exiting extreme roll manoeuvrers coupled with asymmetric high AoA conditions on the wings, may result in biasing the roll control (plane tends to roll left or right). This is usually solved by either resetting the FCS.

- Controllability and stability at very low speeds is not as good as the real one: some manoeuvrers typically performed during airshows may not be possible and may lead to a departure from controlled flight (which is usually easy to recover by lowering the AoA).

12.6 STOVL / HOVER MODE FLIGHT MODEL

The STOVL-hover flight model is custom coded on top of the conventional flight model. In its current implementation, the code is written in XML which is limited to 18 frames-per-second: this causes micro-stutters to some flight model variables (e.g. the flight path marker). See the **SPECIAL INSTRUCTIONS FOR STOVL OPERATIONS** chapter for more details.

12.7 AUTO RECOVERY

In case of disorientation, an AUTO RECOVERY function is provided. The function is activated by Auto-recovery switch is located on the right side of the PCD.

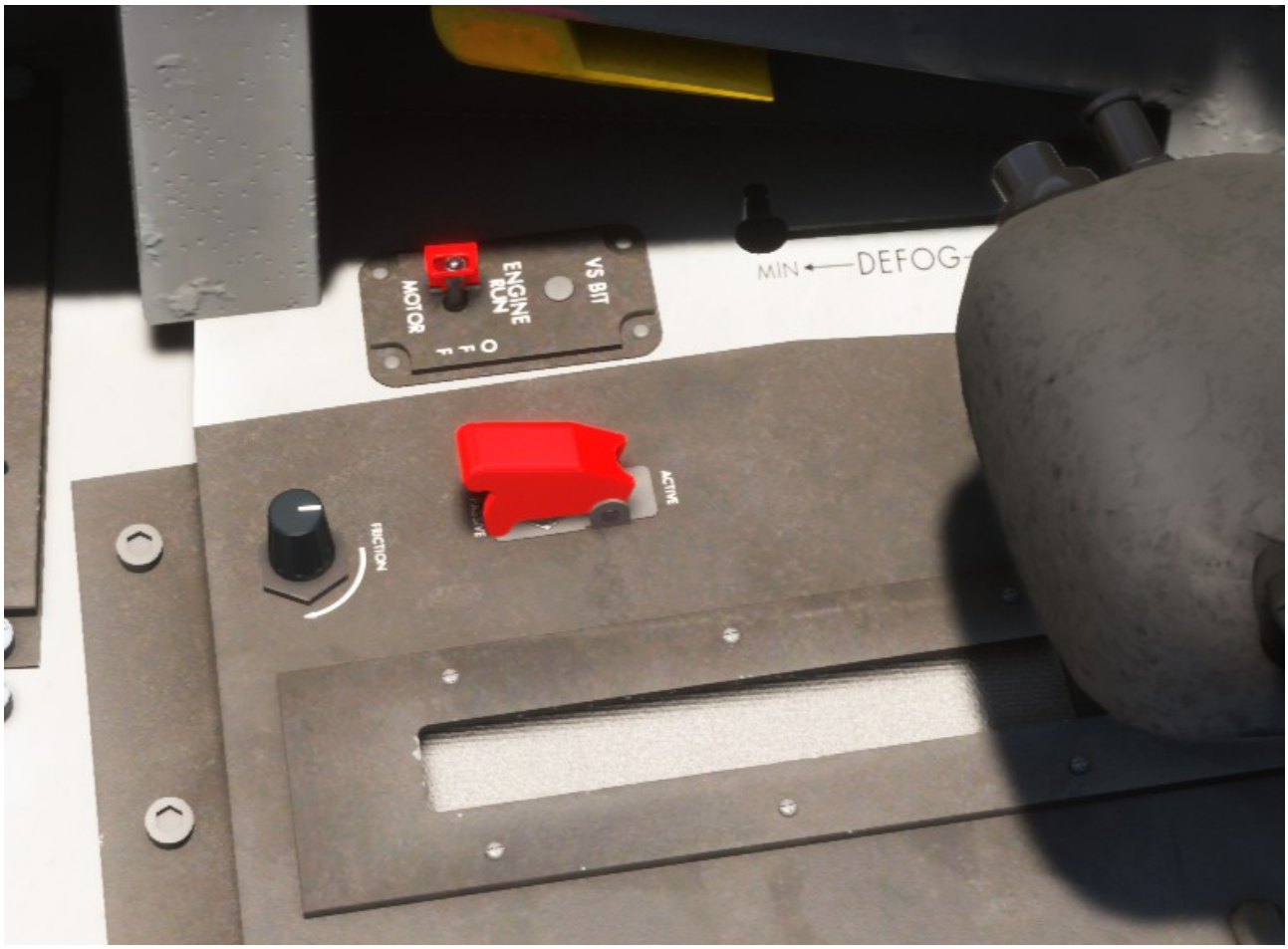
When auto-recovery is activated pilot controls will be overridden and the FCS will try and fly the aircraft level (or with a slight nose up attitude). A red AUTO RECOVERY caption will appear the PCD portals.

NOTE: Auto-recovery only commands the FCS, but has no authority over the engine, therefore, in case of low speed, it may be necessary for the pilot to advance the throttle to avoid stall.

12.7 VEHICLE SYSTEMS BIT

The Flight Control System must be checked before take-off, along all the other vehicle systems, by a Built-In Test (BIT). The test is initiated by pressing the VS BIT button located on the left console, next to the throttle panel.

The test is completely automatic and its progress can be monitored in the FCS page.
It is MANDATORY to perform a successful VS BIT before take-off – the ICAWS system will provide a advisory message if the test has not been performed.



13. AUTOPILOT SYSTEM

13.1 AUTOPILOT SYSTEM DESCRIPTION

The autopilot (AP) has the following selectable modes: attitude hold, altitude hold, heading select, altitude select, and route hold.
The autothrottle (AT) has the following modes: speed hold, speed select, and time-over-steerpoint. An approach power compensator (APC) is also available in the real aircraft (but it is not implemented in MSFS)

All autopilot functions except for the Autopilot Master are accessible through a dedicated page in the PCD which is accessed via AP AT FAB.
The in-game interface is similar to the real one, but has been slightly reworked to fit to the default MSFS AP functionalities upon which the simulation code relies – basically this page acts as a front-end interface for the default autopilot, allowing the user to enter data through the virtual keypad.

The system will also react to default autopilot commands.

The following controls are available in the Autopilot page:

ATT HOLD → toggles default autopilot attitude hold mode. This is basically a pitch hold mode, and uses the default MSFS attitude hold logic. In the real aircraft, this button toggles both pitch and bank hold modes.

ALT HOLD → toggles default autopilot altitude hold mode: autopilot will try and keep the altitude of the aircraft at the moment of selection (rounded to the nearest 100 feet).

ALT SEL → toggles default autopilot altitude hold mode: autopilot will try and keep the altitude indicated in the ALT box.

ALT box → this area allows the pilot to enter the target altitude for the ALT SEL mode via the virtual keypad. The expected data forma is three digits (XX.X) so that, fir example, 1-2-4 is 12.4 that is 12,400 feet, while 0-7-6 is 07.6 that is 7,600 feet.

HDG SEL → toggles autopilot heading hold mode: autopilot will try to reach and hold the target heading in the HDG box.

HDG box → this area allows the pilot to enter the target altitude via the virtual keypad. This value can also be entered in the EFI/HSI and TSD/HSI pages. The expected data format is three digits (XXX) so that, for example, 3-2-1 is 321 degrees, and 0-5-7 is 57 degrees.

SPEED HOLD → toggles auto-throttle indicated speed hold mode: auto-throttle will try to reach and hold the speed at the moment of the selection (irrespective of
SPEED HOLD box also engages the Autothrottle.

SPEED SEL → toggles auto-throttle speed hold mode: auto-throttle will try to reach and hold the target indicated airspeed in the SPEED box if IAS is selected, or the target Mach number if MACH is selected. If the SPEED box indication is zero, the current aircraft indicated airspeed will be used instead.
SPEED SEL box also engages the Autothrottle.

SPEED SELECTION BOX → allow the pilot to select between Indicated Air Speed (IAS) or Mach airspeed hold mode.

SPEED BOX → allow the pilot to enter the indicated reference airspeed or Mach number for SPEED HOLD mode. Expected format is three digits (XXX for knots and X.XX for Mach number).

RTE HOLD → toggles autopilot altitude RTE mode: autopilot will try to follow the loaded flight plan if present. This function disengages the HDG HOLD and VOR HOLD modes. This is equivalent to set the standard autopilot to NAV HOLD mode, with GPS DRIVES NAV option to true.

13.2 ADDITIONAL AUTOPILOT FUNCTIONS

The following functions are NOT available in the real plane, but can be enabled in the PDM/DR page in the sim.

VOR HOLD > toggles autopilot VOR mode, using the course value set in the CRS box. This function disengages the HDG HOLD and RTE HOLD modes. This is equivalent to set the standard autopilot to NAV HOLD mode, with GPS DRIVES NAV option to false.

APP HOLD > toggles the APProach mode.

NOTE: NAV Source must be set to VOR/ILS prior to engaging this function for this function to work and a valid ILS function must be entered first.

NOTE: this functionality is sometimes erratic and in any case will not lead the plane to a smooth landing. It is suggested to land the plane manually.

BACK COURSE > toggles the back-course mode

13.3 KNOWN AUTOPILOT ISSUES

The autopilot behaviour in the simulation is, in general, accurate and reliable – however there are some known issues.

The autopilot RTE generally works if engaged immediately after take-off and the plane should follow the flight plane smoothly without significant deviations, provided that a target altitude is entered and ALT HOLD engaged, however re-engagement of RTE mode after aggressive manoeuvring or if the plane is too far off from the planned route may result in an erratic behaviour.

If an erratic RTE mode behaviour is suspected, this can be usually normalized by resetting the FCS and/or by switching WAYPOINT number in the NAV page.

NOTE: The MSFS RTE autopilot will first try and bring the plane to the planned route (as opposed to fly directly to the waypoint) – this can be incorrectly interpreted as erratic behaviour in some cases.

In general if the the autopilot seems to behave erratically, it is possible to reset the FCS variables by pressing (and depressing) the FCS RESET button, and/or disconnect/reconnect the FCC – also, deselecting/reselecting the AP mode may revive the autopilot.

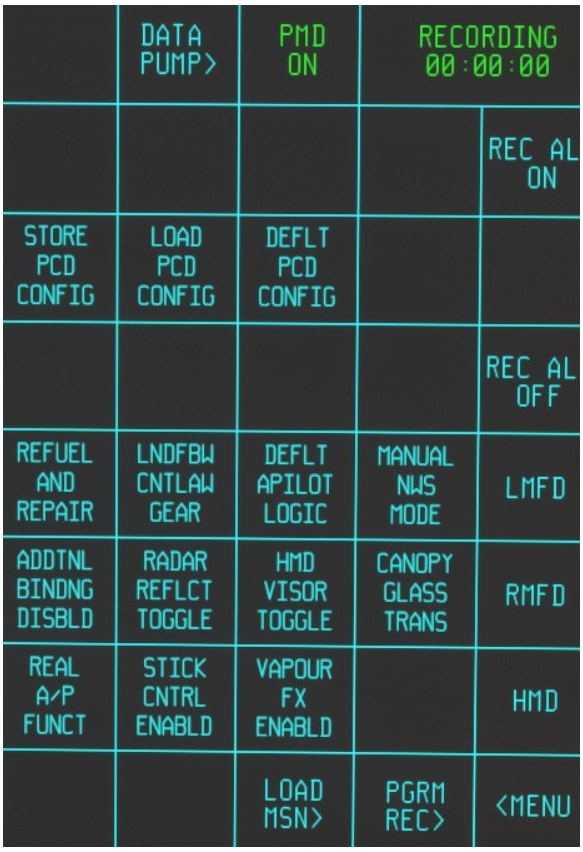
13.4 ALTERNATE AUTOPILOT LOGIC

An alternate autopilot implementation is available in the PMD/DR page. The logic and operation is identical to the default option, but every time a change is detected in the autopilot setting is detected, the FCS is reset. This may work better for some users (depending on preferences and associated hardware).

In the PMD/DR page:

DEFLT APILOT LOGIC → Default autopilot logic
ALTRN APILOT LOGIC → FCS RESET any time there is a change in the autopilot settings:

REAL A/P FUNCT → Only real-world autopilot functionalities are available in the Autopilot page
ADDTNL A/P FUNCT → Enables additional autopilot functionalities



14. HYDRAULIC SYSTEM

14.1 HYDRAULIC SYSTEM DESCRIPTION

The F-35 hydraulic system has two main functions:
- Generate hydraulic power.
- Hydraulic utility actuation.

Two engine driven hydraulic pumps (EDPs) provide hydraulic pressure to two separate systems identified as HYD A and HYD B. Each system has a rated output pressure of 4000 psi.
The hydraulic systems provide power to actuate the following functions:
- Nose wheel steering
- Weapon bay door actuation
- Horizontal Tail centering actuator
- Wheel and parking brakes
- In-flight refuel equipment
- Countermeasure doors
- Gun Drive
- Drag chute, if equipped (not implemented in MSFS)
- Tailhook

14.2 HYDRAULIC SYSTEM NORMAL OPERATION

The F-35 hydraulic system is completely automatic and does not require pilot input.

14.3 HYDRAULIC SYSTEM PCD READINGS

HYD A and HYD B pressure can be read on the ENG page, which is also available as a POP-UP screen. Please see ENGINE section for further details.

15. LANDING GEAR AND HOOK SYSTEM

15.1 LANDING GEAR AND HOOK SYSTEM DESCRIPTION

The landing gear system consists of the following subsystems:
- landing gear (LG)
- tail hook
- nose wheel steering (NWS)
- brakes and parking brake

NOTE: the landing gear subsystem is almost identical on the F-35A and F-35B, while the F-35C has a substantially different nose gear, with two wheels and a launch bar. Please see Carrier Operations section for more details.

15.2 LANDING GEAR NORMAL EXTENSION / RETRACTION

The normal extension and retraction of the landing gear is controlled by the LDG GEAR lever located on the Landing Gear Control Panel, on the left side of the Panoramic Control Display.
The landing gear movement is actuated by the hydraulic system.
The nose landing gear (NLG) doors stay open after nose landing gear extension extension.
Landing gear down-and-locked position is indicated by three green lights both on the PCD FCS page and on the FCS function access button (FAB).

15.3 LANDING GEAR ALERTS

An warning alert sound is audible when the landing gear is not down-and-locked and:
- Airspeed is below 200 knots
- Altitude is less than 7000 feet MSL
- Rate of descent is higher than 250 feet per minute

Landing gear handle will illuminate if the landing gear or the doors are in transition, or if the alert conditions above are verified.

15.4 NOSE LANDING GEAR DOORS

The ILS/ICLS antenna is located inside the Nose Landing Gear well and it is necessary that the NLG doors are open of the ILS system to work.
In order to allow the ILS signal to be received correctly without extending the landing gear, NLG doors can be commanded to open in the PCD FCS page.

15.5 ALTERNATE LANDING GEAR EXTENSION

An alternate (emergency) landing gear extension can be commanded by depressing the ALT GEAR EXTENSION button on the landing gear control panel

15.6 BRAKE SYSTEM

The brake system provides the following functions:
- Wheel braking.
- Automatic braking or wheel de-spin function during LG retraction.
- Parking brake.
- Anti-skid protection.
- Locked wheel protection at touchdown.

Wheel braking is commanded with the pedals, while the parking brake as a dedicated switch and and digital indicator that shows remaining brake applications.

NOTES:

- The parking brake can be engaged also in flight

- ICAWS will cast advisory or warning messages depending on parking brake and aircraft status

- The remaining brake application display has been removed from recent planes and has been replaced by a TOW MODE status display

- The remaining brake applications have no effect in MSFS

15.7 NOSE WHEEL STEERING (NWS)

The aircraft Nose Wheel Steering (NWS) has three modes:
- DISENGAGED (no steering)
- NWS (low gain for normal steering)
- NWS HI (high gain for low speed, tight steering)

The NWS is DISENGAGED initially and must be activated by the pilot (the associated command in MSFS is SET NOSE WHEEL STEERING TO LIMIT)

The NWS mode should be sufficient to steer the aircraft during taxi in most situations, but the pilot can switch to the NWS HI mode if tight steering is required.

NWS HI will automatically revert to NWS if speed is above 20 knots.

Upon landing, NWS is automatically activated if speed is below 145 knots with weigh-on-wheels.

During take-off, between 100 and 150 knots, the NWS authority is progressively reduced so that at 150 knots

the steering effect is only due to the rudders.

15.8 TAIL HOOK

The F-35A is equipped with an hook compatible with E-28 and BAK-12ER arrestment systems for emergency arrested landing.

The F-35C is equipped with a tailhook for arrested landing on an aircraft carrier.

The hook is lowered by pressing the HOOK/STOVL button.

NOTE: the same button activates the STOVL conversion on the F-35B.

16. LIGHTING SYSTEM

16.1 LIGHTING SYSTEM

This page is accessible from the additional MENU page though the LITES> button.

In this page the following functions are selectable:

CONSL - toggles the cockpit console pages

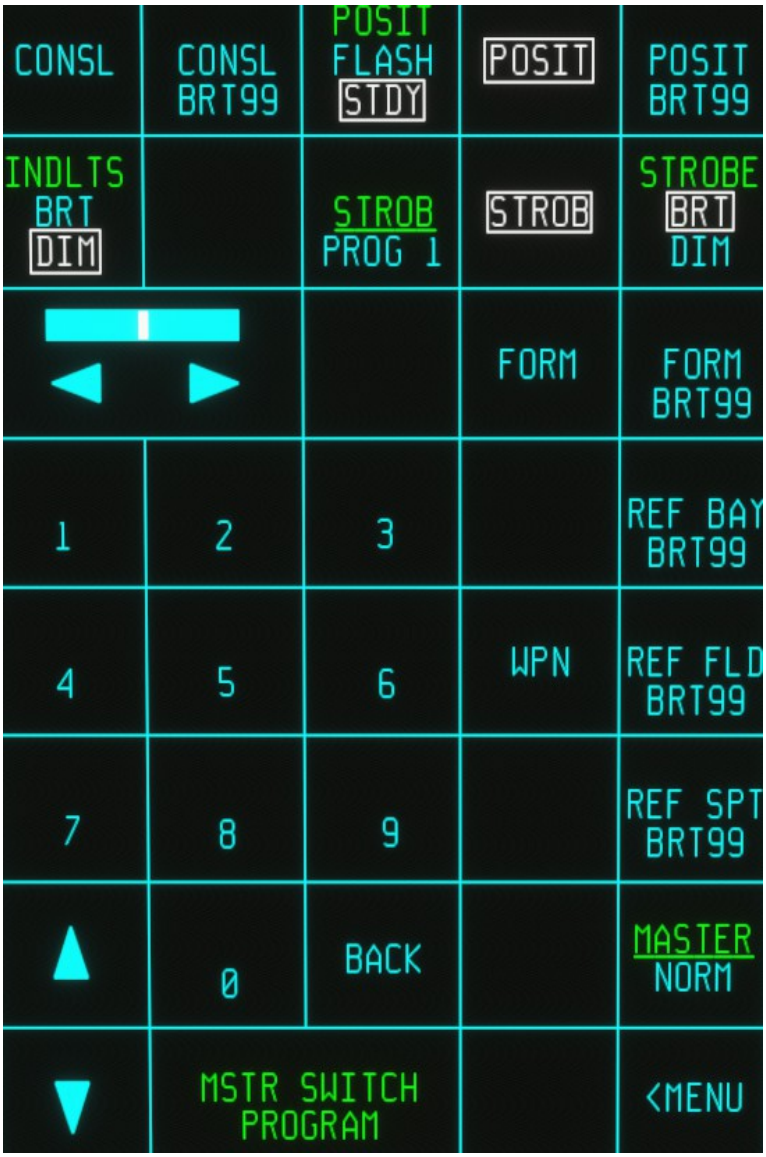
POSIT – toggles the wing navigation lights

STROB – toggles the strobe lights

FORM – toggles the formation lights

Brightness of console, position and formation lights are adjustable by selecting the "BRT" controls and adjust the brightness with the keypad.

It is also possible to adjust the balance between left and right halves of the Primary Control Display.



17. ESCAPE SYSTEM

17.1 ESCAPE SYSTEM

The escape system is composed of:
- the canopy transparency removal system (TRS)
- Martin-Baker US16E ejection seat.

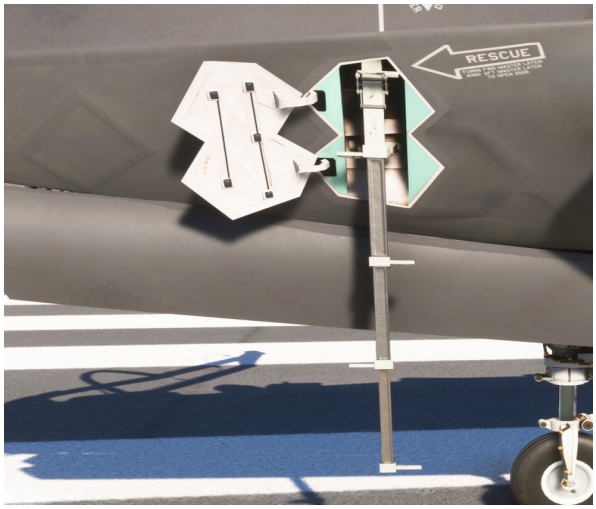
17.2 CANOPY

The one piece canopy hinges at the front and is electrically actuated, and commanded by a switch located on the left side of the cockpit and a canopy lock lever nearby the swtch control, and another switch located nearby the crew boarding ladder.
If the canopy is not closed and locked, the ICAWS will show a “CANOPY UNLOCKED” advisory if ETR is below 18 percent, or a “CANOPY ULOCKED” caution if ETR is above 18 percent.

Canopy can be operated from battery power even if the battery switch is set to OFF, in which case the 28V DIS light will turn on.

In Microsoft Flight Simulator, the crew boarding ladder is automatically deployed whenever the canopy is open, also, canopy lock lever is actuated automatically.

Location of canopy controls: 1 - Canopy open/close switch; 2 – Canopy Lock lever



Crew boarding ladder.

17.3 TRANSPARENCY REMOVAL SYSTEM

A shaped charge attached to the canopy transparency is used to remove it during ejection or when the TRS handle is pulled.

Unless the safety pin is in position, the TRS can be activated regardless of canopy or ejection seat ARMED/ SAFE/ EGRESS (ASE) lever position.

During ejection, the TRS is fired automatically. The seat can eject through the canopy using seat mounted canopy breakers even if the TRS does not activate.

In Microsoft Flight Simulator the TRS handle has no function, but it is equipped with a removable safety pin.

17.4 US16E EJECTION SEAT

The Martin-Baker US16E Ejection Seat is a fully automatic electronically controlled ejection seat. Pulling the ejection handle with approximately 40 pounds of pull retracts and locks the harness, initiates the TRS, and ejects the seat.

The Ejection system has no function in Microsoft Flight Simulator, but the ARMED/ SAFE/ EGRESS (ASE) lever must be in the ARMED position, otherwise ICAWS advisory or caution messages will be displayed.

18. LIFE SUPPORT SYSTEM

18.1 LIFE SUPPORT SYSTEM

The function of the Life Support System (LSS) is to provide breathing gas, altitude and G-protection, and communications connections.
The components of the LSS are:

• On-board oxygen generation system (OBOGS).

• Backup oxygen system (BOS).

• Service connection package (SCP)

The Service Connection package is located on the left side of the Ejection Seat and composed of the Seat Portion Assembly (SPA), the Pilot Interface Connector (PIC) and the Seat Interface Connector (SIC):
The LSS has no function in Microsoft Flight Simulator, although some of its controls can be operated.

MISSION SYSTEMS

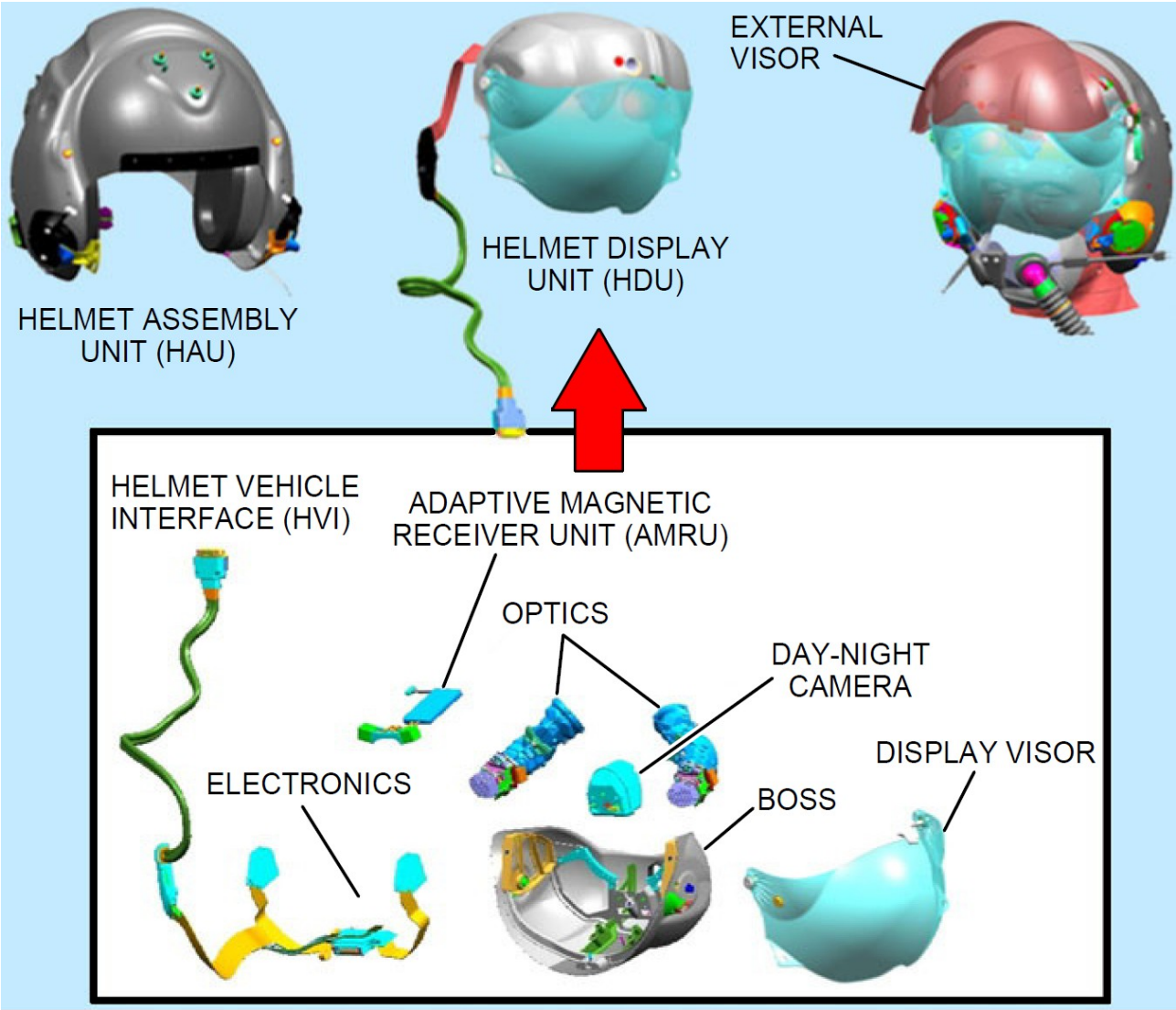
19. HELMET MOUNTED DISPLAY SYSTEM

19.1 GENERAL DESCRIPTION

The F-35 Helmet Mounted Display System (HMDS) displays biocular video and symbology information on the helmet visor, providing pilots with all information necessary to execute both day and night missions under a single integrated configuration.
The flight data are presented to the pilot in a Virtual Head Up Display (VHUD), that is it appears in front of the pilot like if it were on an exceptionally wide, frameless Head Up display.

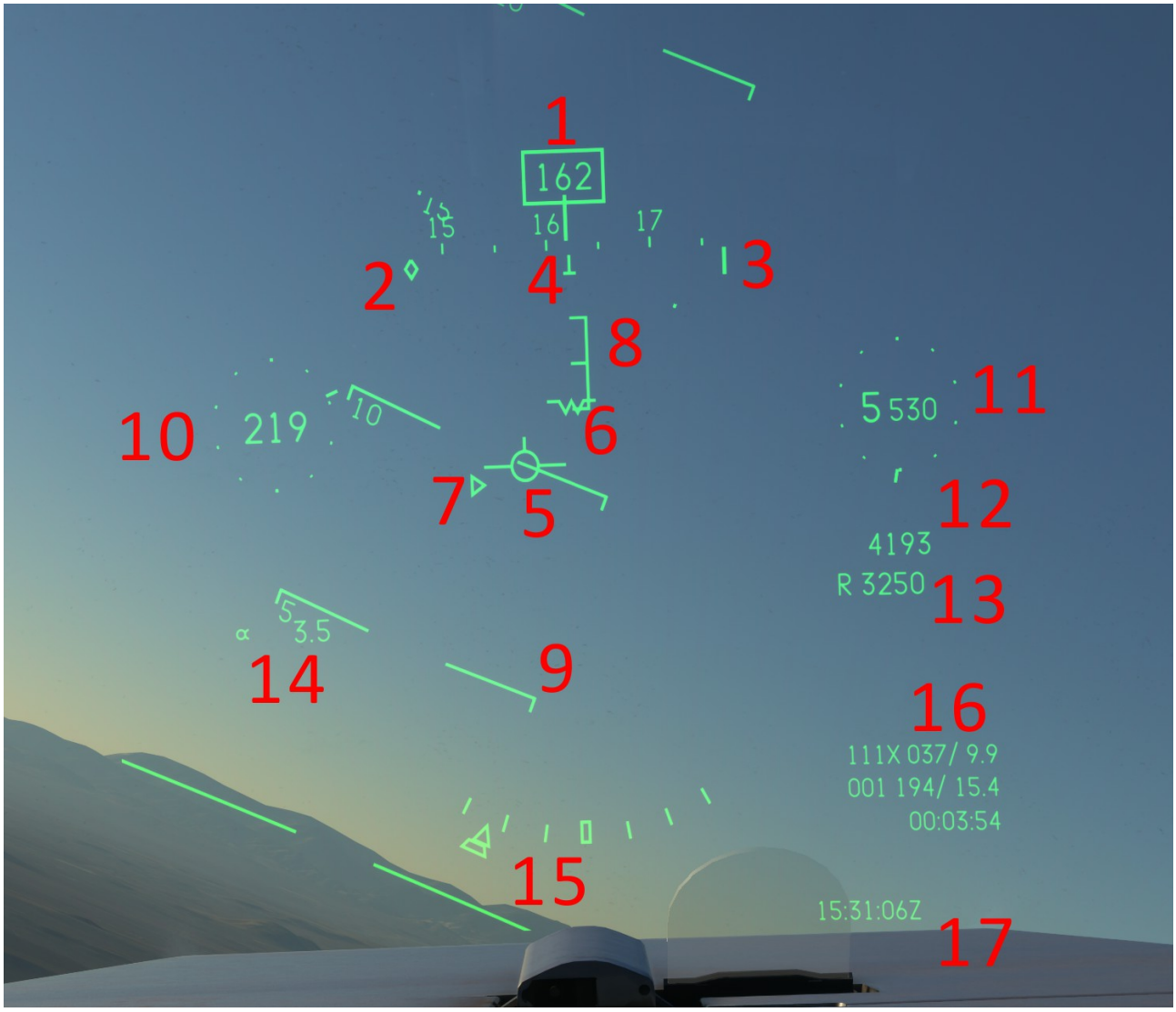
In the real-world, the system enables pilots to accurately cue onboard weapons and sensors using the helmet display. Finally, the system also provides “Enhanced Reality” features, like night vision and the possibility to look “through the aircraft” thanks to the Distributed Aperture System (DAS).

The HMD symbology is divided between “on axis” and “off axis”: when the pilot moves his head, “on axis” symbology is kept aligned with the aircraft bore-sight, while “off axis” symbology follows the pilot head movement.



Helmet-mounted Display

19.2 ON-AXIS SYMBOLOGY



VHUD (on axis) symbology – landing gear down

In the simulation, the following fixed symbology is shown (with reference to the figure above):

1 – Current heading and compass

2 – Heading to Tacan station (diamond)

3 – Heading to Waypoint

4 – Ground track (upside-down T symbol)

5 – Flight Path Vector (FPV)

Note: A vertical line pointing downward from the FPV symbol indicates virtual speedbrake extension

6 – Waterline (gear down only)

7 – Energy Cue

8 – Angle-Of-Attack Bracket

9 – Pitch Ladder

Note: if FPV is selected, the pitch ladder is affected by the relative wind (so it will drift left or right depending on wind direction). If CDM is selected, the pitch ladder will be CAGED (it will not drift left or right).

10 – Current Airspeed (indicated airspeed in knots or Mach)

11 – Current Altitude (in feet)

12 – Vertical velocity (in feet per minute)

13 – Radar Altitude

14 – Angle of attack

15 – Bank and Slip indicator

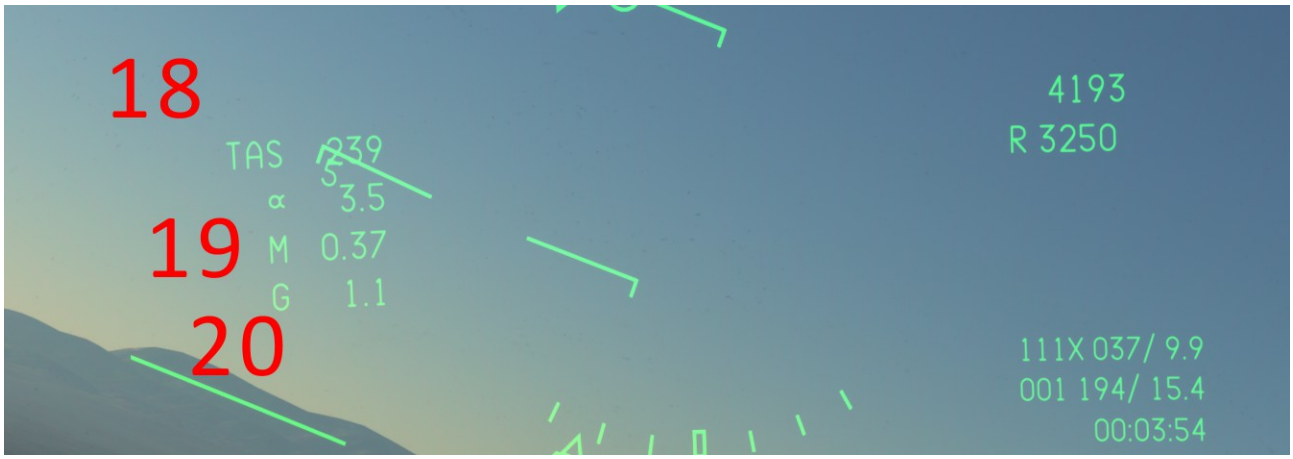
16 – Navigation data block:

First line – TACAN information (if a valid tacan signal is received): selected channel and band, bearing to station and distance to station. NOTE: if the DME is coupled to the ILS, the distance reported is the distance to the ILS source.

Second line – If a valid flight plan is loaded, WAYPOINT (steer-point) number, bearing to waypoint and distance to waypoint.

Third line – time over waypoint / steer-point

17 – Time (local or zulu) and stopwatch. Stopwatch will appear over the current time if it is either in “running” or “stop” state.



VHUD (on axis) symbology – landing gear up

If the landing gear is up, the waterline and AoA brackets will disappear and the following additional information will be shown:

18 – Ground Speed (GS) or True Air Speed (TAS)

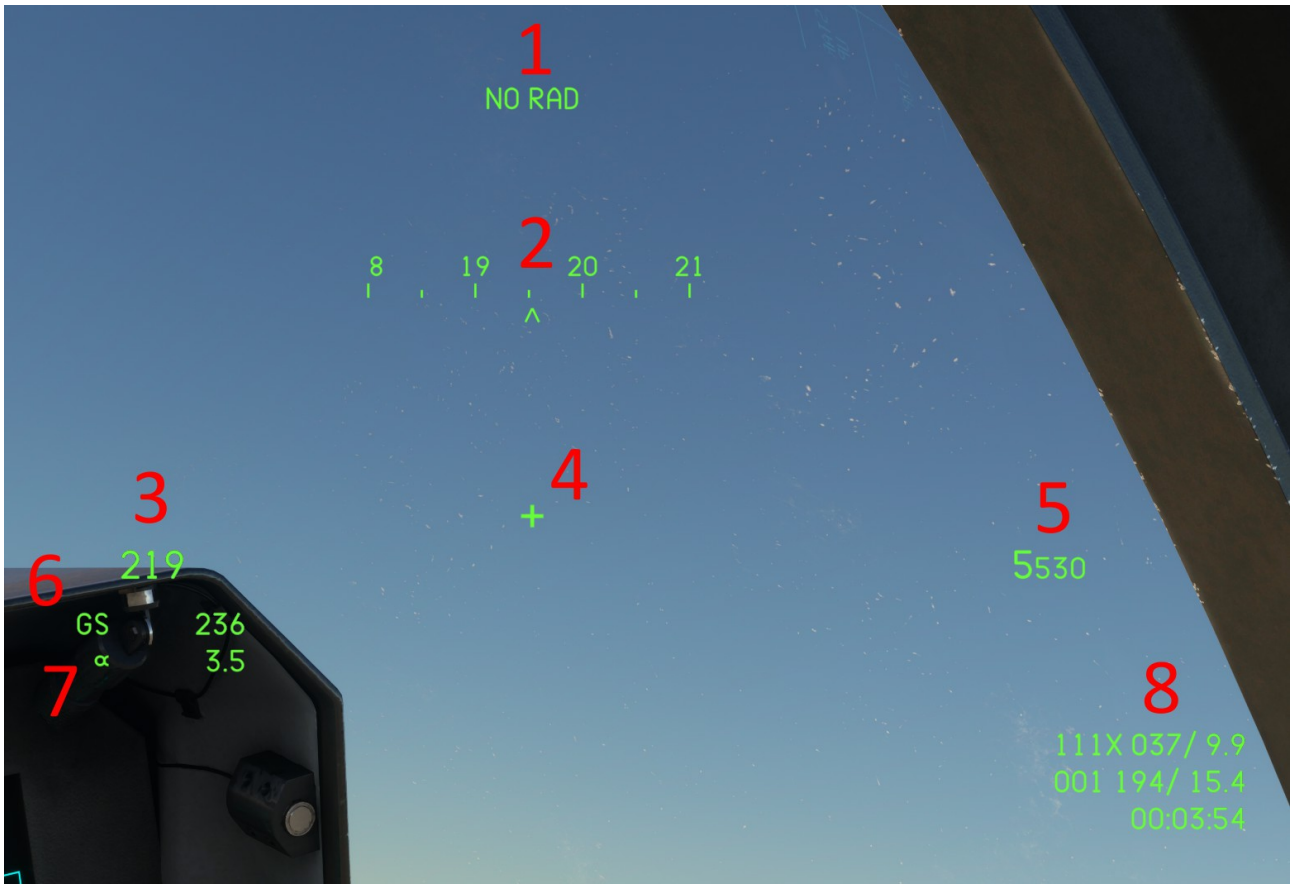
Note: pilot can switch between GS and TAS in the HMD menu

19 – Current Mach number

20 – Current G-load. Maximum G load will be also shown if 4 G's have been exceeded

19.3 OFF-AXIS SYMBOLOGY

With reference to the figure below, when the helmet line-of-sight is out of the VHUD, the “off-axis” symbology is shown.



The following symbols will be shown:

1 – NO RAD caption (if radar is not radiating)

2 – Compass and current heading

Note: due to the way data is reported in MSFS in VR, in “pancake” (non-VR) mode, the compass and heading will show the helmet LOS. That is if 250 is shown, the helmet LOS is pointing at 250°.
If the simulation is in VR mode, the compass and the heading will show the aircraft heading. That is if 250 is shown, the aircraft is pointing at 250°.

3 – Airspeed

4 – Helmet Line of Sight (LOS) elevation with respect to aircraft datum

5 – Current barometric altitude

6 - Ground Speed

7 – Angle of Attack

8 – Navigation data block (same as on-axis symbology)

Not shown in figure:

– Stopwatch will appear below the navigation data block if the stopwatch is in either in “running” or “stop” state.

19.4 AUTOPILOT INFORMATION

Basic information on autopilot modes are also shown in the HMD as part of the on-axis symbology (VHUD).

Horizontal modes:

CMD RTE → RTE HOLD mode engaged

CMD XXX → Selected Heading Hold mode engaged

Vertical modes:

CMD XXXXXX → Selected Altitude mode engaged

CMD HOLD → Altitude hold mode engaged

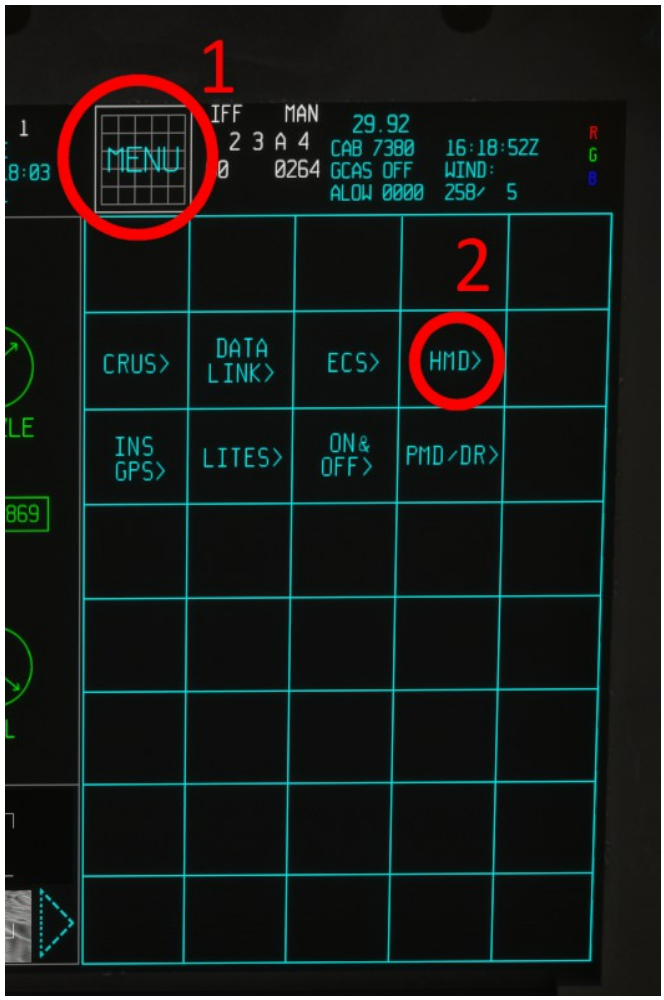
Speed modes:

CMD XXX I → Speed hold mode engaged

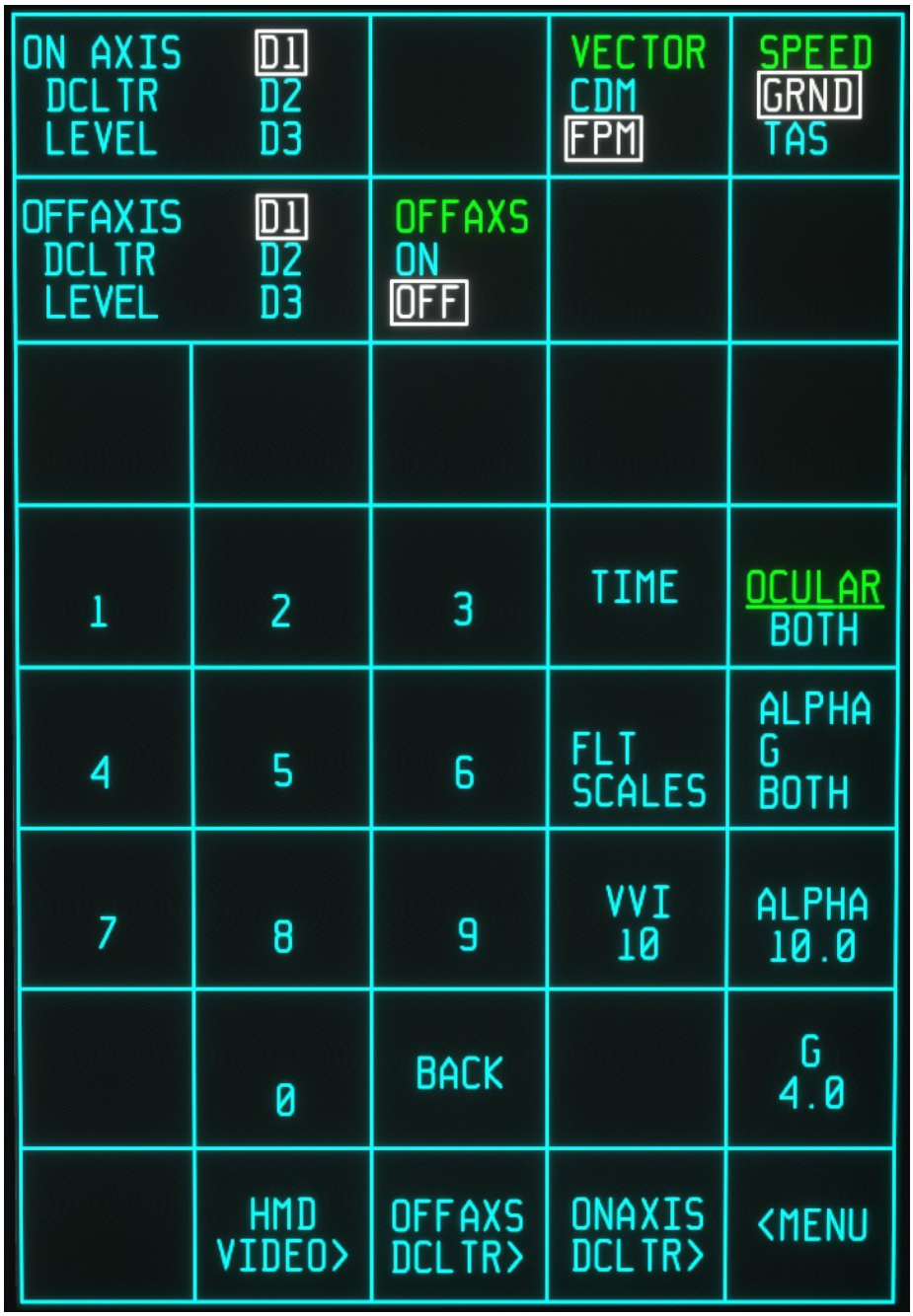
CMD X.XX M → Mach hold mode engaged

19.5 HMD OPTIONS AND CONTROLS

HMD controls and options can be accessed via the status bar MENU, by selecting the HMD page.



This page allows the user to select options and preferences for the Head-Mounted Display system.



The following controls are operational in this page:

ON AXIS DECLUTTER – Select between 3 different declutter settings for ON-AXIS symbology

OFF AXIS DECLUTTER – Select between 3 different declutter settings for OFF-AXIS symbology

CDM/FPM – Select between Climb/Dive Marker or Flight Path Marker. CDM also cages the HMD ladder.

GRND/TAS – Select between Ground Speed or True Air Speed

OFFAXS – Disable the Off-axis symbology (this option is not available in the real aircraft)

19.6 HUD PCD Format

The HMD virtual HUD (on axis symbology) is also reported on a dedicated PCD page, which can be assigned to any portal.

This page does not any operational controls (in reality the pilot can select the FLIR option to combine the HMD symbology with imagery from the FLIR sensor)

20. NAVIGATION SYSTEM

20.1 GENERAL INFORMATION

In the real-world, the F-35 relies primarily on GPS/INS navigation on a pre-programmed flight plan (RTE), which is a sequence of waypoints selected from the aircraft memory. The aircraft can store multiple RTEs and the pilot can select and edit the RTE and waypoints as desired, although this RTEs, mission information and data are typically loaded into the aircraft with the Personal Memory Device (PDM).
The real aircraft is also equipped with a Tacan receiver and an ILS receiver.
The ILS receiver is hosted inside the nose gear bay, and requires the nose gear doors to be open for operation.

In the MSFS version, in order to preserve compatibility with standard simulator controls and given the civilian nature of the simulator itself, we also added a VOR receiver which can be used for IFR navigation and a single RTE is supported. Any valid flight-plan or waypoint sequence will be shown as RTE 1.

NOTE: in MSFS there is no difference between waypoint and steerpoint, and terms wil be used interchangeably.

The system will always prioritize RTE over other navigation systems, and in general it is assumed that a flight plan has been created in the game interface and is correctly loaded into the aircraft.

Pilot can select one of the four, colour-coded, navigation references for the CDI in the EFI page – the selection will not influence the aircraft behavior, which will always assume the navigation reference is the RTE.

RTE (GPS flight plan - green) – in this mode, the Course Deviation Indicator (CDI) will follow the Flight Simulator flight plan.

NOTE: A basic flight plan can be created and altered from the PCD, but this is provided as a backup method and it not the intended way to create a flight plan, which should be created (or loaded) in the game map screen.

NOTE: The TSD HSD MAP will only show the flight plan as it is at the moment the aircraft is loaded. Once the aircraft is loaded, further changes to the flight plan – including newly created flight plans – will not show in the TSD HSD MAP mode, but will show correctly in all other instances.

VOR/ILS (magenta) – in this mode, the Course Deviation Indicator will report VOR readings or ILS locator.

If no VOR data is shown in the EFI page, the frequency is either invalid or the aircraft is not receiving any signal on that frequency.

NOTE: ILS requires the nose landing gear doors to be open for Glide-slope information to show. Also, the pilot must actively select the ILS option on the EFI for the ILS bars to show on the EFI and HMD.

TACAN (cyan) – in this mode, the Course Deviation Indicator will report TACAN readings.

NOTE: If no TACAN data is shown in the EFI page, the frequency aircraft is not receiving any signal on that channel. Note that, if a TACAN station is present in the game but has no associated VOR functionality, it may not show correctly.

LRP (Landing Reference Point – grey) - The landing reference point is a special point mostly used for fuel calculations. This can be a fixed or moving point and it is defined in the FUEL page. This function is not currently available in the simulation and the selection is only available as EFI-ADI CDI option – in which case it will point to either the destination waypoint of the flight plan, or the flight starting point if no flight plan is available.

All navigation information, except on the HMD, is colour coded as described above. For example, if the CDI is magenta, it means it reporting information for the VOL/ILS system.

NOTE: CDI can be displayed on the EFI HSI or EFI HSI/HMD/HUD or both depending on pilot preference. CNTL> can be used to switch between CDI visualization options.

20.2 PCD ELECTRIONIC FLIGHT INSTRUMENTATION (EFI) PAGE

An Electronic Flight Instrumentation page is available on the Panoramic Control Display.
The layout of the page changes if the page is not maximized: if the page is maximized the ADI occupies the upper part of the portal, while a partial HSI is shown in the lower part; if the page is not maximized, the pilot can select either the ADI or the HSI views. Note that if the portal is maximized and then minimized, the selection will be preserved.

NOTE: When shown in a sub-portal, the page will always display basic ADI information regardless of the current selection.

The following controls/options are available in this page:

ADI / HSI – switch between ADI and HSI view if the portal is not maximized.

CDI – select between RTE, VOR, TACAN and LRP (landing reference point) CDI indications.

ILS – toggle visualization of ILS bars in the EFI ADI and HMD, also couples the DME to ILS, only if a valid ILS signal is received and nose gear door are open

FD – toggle flight-director visualization

STPT – set steer-point course (inoperative in the current release)

HDG – set autopilot heading reference

CRS – set VOR/ILS course

TCN CL – set TACAN course

CNTL> select CDI visualization between EDI HSI, or EFI ADI/HUD/HMD or both

Notes:

- For the ILS bars to be selectable, the following conditions must be met:
    - Landing gear must be down or landing gear doors must be open
    - A valid ILS frequency must be entered in the NAV page
    - A glide-slope signal must be received (if so the ILS frequency shows below the ILS caption)

20.3 PCD NAVIGATION DATA PAGE

A navigation data page is accessible through the FAB and allows the pilot to type-in navaid data and manage waypoints.

The following controls are operable in the sim:

VOR/ILS frequency type-in (expected format XYZ.ABC, therefore 1 1 0 5 0 0 becomes 110.500)

TACAN channel (expected forma XYZ, therefore 0 4 2 becomes 042)

TACAN band X or Y

ILS DME → couples the DME with ILS, if ILS DME is available. Note: for this option to work, the following conditions must be met:

- nose gear doors must be open
- ILS DME signal must be valid

Once this option is selected, DME value will be report the distance from the ILS signal source instead of the distance from the TACAN signal source.

MAN/AUTO → toggles between MANual waypoint selection (waypoint will not change automatically) and AUTOmatic waypoint selection (the system will automatically switch to the next waypoint in the flight plan when the aircraft reaches the one currently selected).

Select previous or next waypoint (Arrow Up or Down)

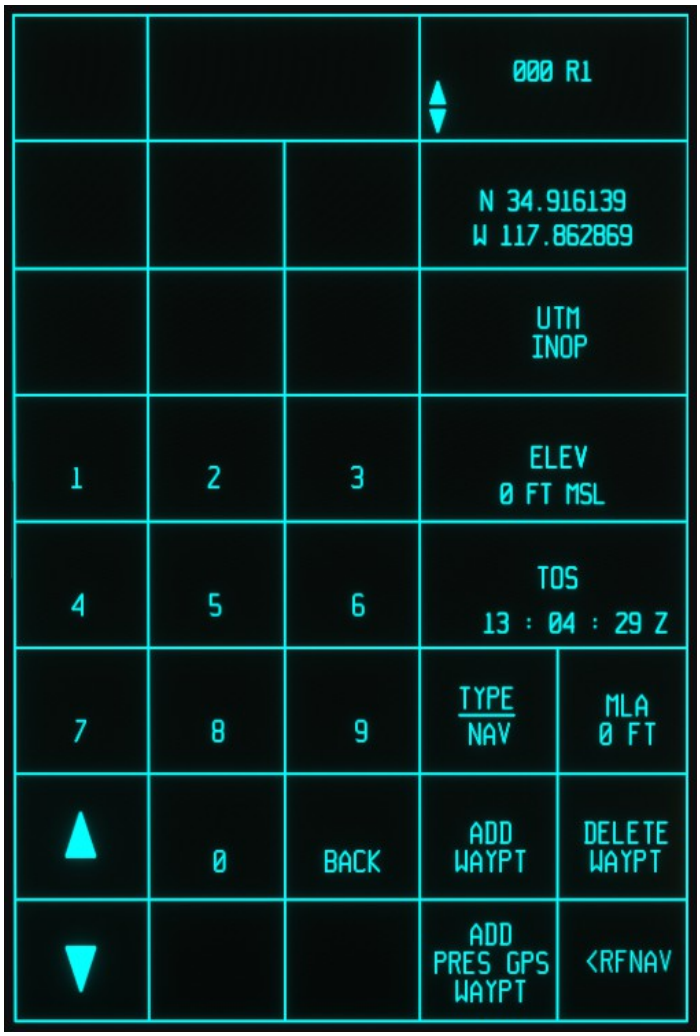
This page has two operational subpages:

REFPT > allows the selection of a waypoint as bullseye

WAYPT > allows manual editing of waypoints

20.4 PCD NAVIGATION – WAYPOINT SUBPAGE

A waypoint management subpage is accessible from the Navigation page via the WAYPT button



The following controls are available in this page:

- Select previous or next waypoint (Arrow Up or Down)

- Enter new waypoint waypoint coordinates

- ADD WAYPT: a new waypoint will be created at the selected coordinates, waypoint WILL FOLLOW the current waypoint

- DELETE WAYPT: delete the current waypoint

- ADD PRES GPS WAYPT: adds a new waypoint with using the current GPS coordinates

- TYPE button: allows the pilot to designate different coordinates/waypoints for navigation, pre-planned target, and initial point:

TYPE NAV (default) – allows the pilot to edit waypoint coordinates as indicated above

TYPE TGT – allows the pilot to designate a pre-planned target (either at new coordinates or at the current waypoint). Pre-planned target will show as a red triangle on PCD, and will be selectable on the targeting system as hostile ground target with track ID number equal to 99.

TYPE IP - allows the pilot to designate an Initial Point for the mission (either at new coordinates or at the current waypointr). Initial Point will show as grey square on the PCD.

See the NAVIGATION section for further details.
NOTE: waypoint editing is provided as backup functionality only. The intended way to create a flight plan is to use the game interface to create or load a flight plan. This is equivalent to create the flight plan off-line and load it into the aircraft as you would do in real-life through the PMD.

NOTE: edited waypoints and flight plans will NOT show in MAP mode

20.5 PCD NAVIGATION – REFERENCE POINT SUBPAGE

A subpage of the NAVIGATION page allows the pilot to select a waypoint and assign it as a BULLSEYE.
In the real aircraft this page also allows the pilot to assign reference points to TSD1, TSD2 and TSD3 pages.

The following controls are available in this page:

- Select previous or next waypoint (Arrow Up or Down)

- BULL: designate the current waypoint as BULLSEYE

20.6 PCD - CRUS PAGE

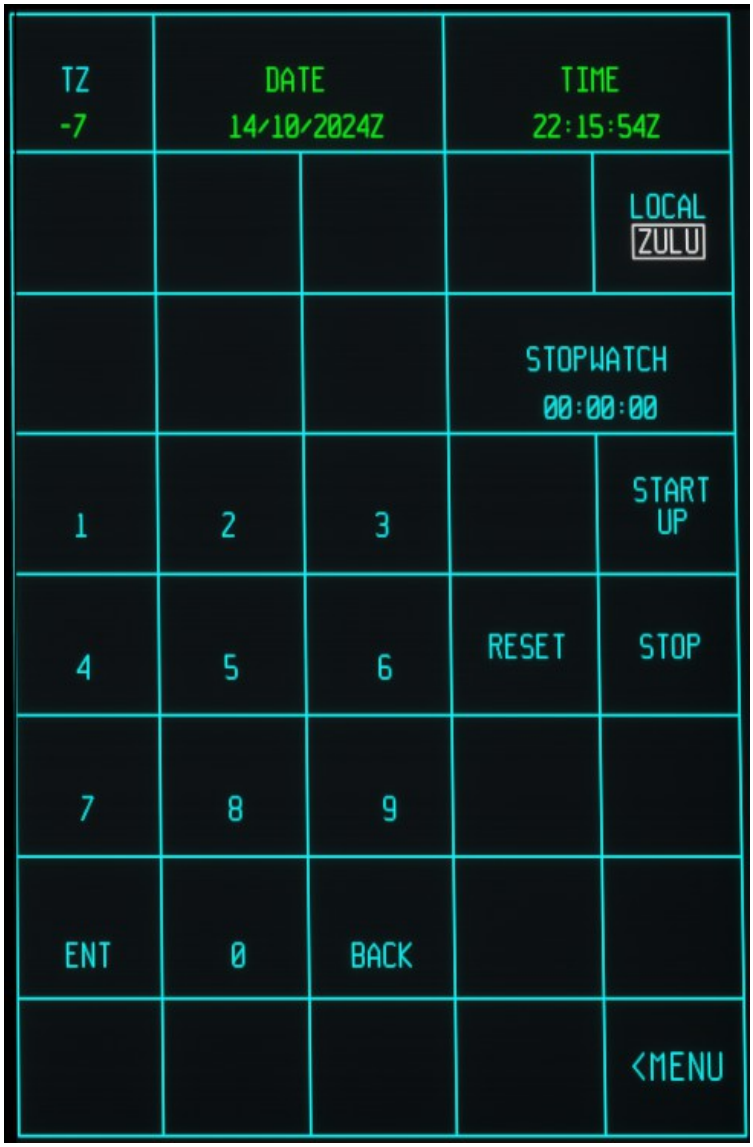
In the real aircraft this page provides information and control on aircraft RTE (the real aircraft supports multiple RTE pages).
The page is accessible from the MENU FAB but has a limited implementation in MSFS – information and layout are correctly represented, but the page has no functionality.

20.7 PCD - IN/GPS PAGE

In the real aircraft this page allows the pilot to monitor and control the Inertial Navigation System, including alignment and fix, and GPS system.
This page has a limited implementation in MSFS – information and layout are correctly represented, but the page has no functionality.

20.8 PCD TIME AND STOPWATCH PAGE

The Panoramic Control Display also hosts a page dedicated to time and stopwatch functionalities.
The page is accessible from the FAB.



On this page the pilot can:

- Select LOCAL or ZULU time. Selection will apply both to the PCD and the HMD

- Start the stopwatch

- Stop the stopwatch

- Reset the stopwatch

NOTES:

- The real aircraft has no backup for the system clock, so pilot must enter time and date manually. In the MSFS rendition, time and date are automatically loaded.

- Stopwatch will appear on the HMD off-axis and on-axis symbology and on the FAB

- In the real aircraft it is possible to configure the stopwatch for a countdown. This is not currently supported in MSFS.

20.9 TYPICAL PRESENTATION OF NAVIGATION DATA

The picture above shows a situation in which the selected NAV source is RTE, and the aircraft is also receiving signals from the VOR and TACAN receivers.

With respect to the figure above:

1 – A vertical line on the HMD compass will show the bearing to the next waypoint (if a valid flight plan is loaded).

2 – A diamond symbol on the HMD compass will show the bearing to the Tacan station (if a signal is available)

3 – Nav data is shown on the bottom right corner of the HMD.

In this case, the display reports that:
- there is a valid Tacan signal on channel 111X. Bearing to station is 328° distance is 4.8 nautical miles.
- there is a valid flight plan loaded, next waypoint number is 1, bearing to waypoint is 213, distance is 22.4 nautical miles. Time to waypoint is 4 minutes and 41 seconds.

4 – The NAVIGATION FAB will provide access to nav source selection, as well as additional subpages to enter reference points and waypoints. The caption of the button report that:
- next waypoint is number 1, waypoint sequence is AUTOmatic
- there is a valid ILS signal on frequency 110.10 MHz.

5 – RTE / Waypoint HSI indications: the green captions and arrow in the HSI show information and direction to the next waypoint, if a flight plan is available. The green arrow on the HSI compass will point directly to the waypoint. If the waypoint sequence is in AUTO mode (default), the system will automatically change the waypoint when needed according to the flight plan.

In this case, the next WAYPOINT number is 1, waypoint description/name is “Custom””, bearing 328°, distance 22.4 nautical miles.

CDI in the EFI is green, indicating that it is reporting information for the flight plan waypoints.

Note: STPL CL selection has currently no effect in the game.

Note: at the moment, unlike the real aircraft, the simulated F-35 does not support multiple routes – so the RTE number will always be 1.

6 – Heading: a yellow marker on the HSI indicates the current autopilot heading reference. This can be set either in the autopilot page or with the HDG option.

7 – VOR/ILS indications: the magenta captions and arrow in the HSI show information and direction to the VOR station currently selected, if a signal is received. The magenta arrow on the HSI compass will point directly to the VOR station.

8 – TACAN indications: the cyan captions and arrow in the HSI show information and direction to the TACAN station currently selected, if a signal is received. The cyan arrow on the HSI compass will point directly to the TACAN station.

In this case, channel is 111X, tacan id is EDW (Edwards) and the distance is 4.8 nautical miles.

Tacan course can be selected with the TCN CL option in the EFI page.

In this case, VOR id is IEDW (ILS Edwards AFB).

VOR course can be selected with the CRS option in the EFI page.

DME reading is available only if the DME is coupled to the ILS system.

9 – CDI option: this allows the pilot to select the nav data source for CDI.

10 – ILS option: this allows the pilot to show ILS deviation and glide-slope bars on the HMD and EFI-ADI. This option will only works if BOTH conditions below are valid:

- Nose gear door is open (either by lowering the landing gear or via the specific command.

- An ILS glide-slope signal is received (frequency will be shown below the ILS caption)

When the option is available, the ILS frequency will appear below the ILS caption.

11 – CNTL> In the real plane this is used to access visualization options for the EFI page. In this MSFS rendition this is only used to select display options for the CDI between:

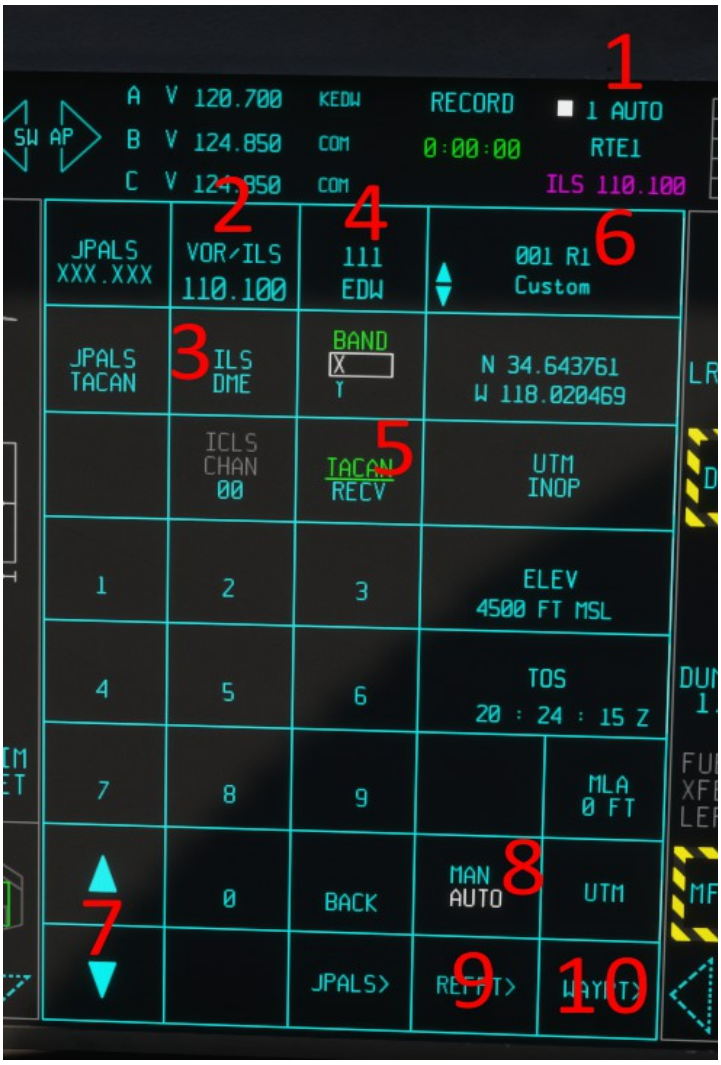
- HSI only

- ADI/HUD/HMD only

- both

20.10 NAVIGATION PAGE AND NAVIGATION SOURCE SELECTION

A dedicated navigation page is accessible from the status bar, as described in the Panoramic Control Display chapter. In the real aircraft, ICLS and JPALS frequencies/channels can also entered in this page, but those functions are not available in this simulated version.
This page allows the pilot to select waypoints, Tacan channels, VOR/ILS frequency and provides access to additional subpages such as REFPT (Reference Points) and WAYPT (Waypoint management).



With respect to the figure above:

1) Navigation page FAB, currently showing that next waypoint number is 1, associate route is 1, a valid ILS signal is received on 110.10 MHz

2) VOR/ILS frequency selection

3) DME coupled to ILS (available only if a valid ILS signal is received, nose gear down is open and a coupled DME signal is available.

4) TACAN channel

5) TACAN band

6) WAYPOINT SELECTION – enter the current waypoint between those currently in the flight plan. This option is always available, even if the navigation system is in AUTO mode.

7) UP / DOWN ARROWS – select the current waypoint between those currently in the flight plan. This option is always available, even if the navigation system is in AUTO mode.

8) MAN / AUTO waypoint selection. If AUTO is selected, the navigation system will automatically switch to the next waypoint if the aircraft is about to reach the currently selected on.

If MAN is selected, automatic progression of waypoints will be frozen and the navigation system will point to the currently selected waypoint irrespective of its distance.

9) REFPT (Reference Point) – this button provides access to the Reference Point page, which in reality is used to define bullseye and reference points for the TSD pages. In the simulation only Bullseye option is available. See Panoramic Cockpit Display chapter for further information.

10) WAYPT (Waypoint) – this button provides access to the Waypoint management page, which allows the pilot to add, edit or delete waypoints. See Panoramic Cockpit Display chapter for further information.

20.11 INSTRUMENTAL LANDING SYSTEM

The aircraft is equipped with an Instrumental landing system (ILS) which can be used by the pilot to visualize lateral and vertical deviations as graduated bars on the HMD and the EFI/ADI.

The ILS receiver is located inside the nose gear door bay, and nose gear doors must be open for the glide-slope signal to be received correctly.

With respect to the figure above:

1 – ILS EFI option: this must selected for ILS bars to appear. The option is only clickable if the tuned ILS frequency appears below the ILS caption, which in turn require the nose gear doors to be open and a glide-slope signal to be received.

2 – EFI ILS bars

3 – HMD ILS bars

4 – NOSE DOOR option

5 – VOR ILS frequency selection button

6 – ILS/DME: couples DME to ILS signal instead of TACAN (not available in this case)

20.12 CREATING A BASIC FLIGHT PLAN INSIDE THE AIRCRAFT

The intended way to navigate through a flight plan in this MSFS rendition is to create or load a flight plan from the game map screen prior to starting a flight, which is also an approximation of what will be typically done in a real plane, as the mission and flight plan can be created with a laptop, loaded in the Personal Memory Device (PMD) and then transferred to the aircraft with the PMD.

Note: In this MSFS rendition, the PMD/DR page is only used to store/retrieve user preferences. If a flight plan is available when the aircraft is loaded, it will be automatically loaded in the navigation system.

However, it is possible to create basic flight plans inside the aircraft
In the real aircraft flight plans can be created by picking waypoints from the aircraft database and assign them to a RTE (multiple routes are supported).

In the simulated aircraft, to create a flight plan when none is present, it is necessary to create a single waypoint which will be used as destination.
Once a flight plan is loaded, waypoints can be added, edited or deleted.

Note: the TSD HSD MAP mode will only show flight plans as loaded in the aircraft when the flight starts. Flight plans edited or added before the aircraft is loaded will not show correctly.

In the following example, we will create a basic “Direct-to” flight plan from Edwards AFB to Nellis AFB.

STEP 1 – SPAWN - Aircraft is spawned on the runway at Edwards AFB. No flight plan has been created or loaded previously, and the aircraft spawns without a selected nav source.

STEP 2 – ACCESS TO WAYPOINT MANAGEMENT PAGE – Press the Navigation FAB and then select WAYPT> to access to the waypoint editing page.

STEP 3 – ENTERING DESTINATION COORDINATES.

Using an online map such as Google Maps we can get the coordinates of our destination in decimal degrees format.

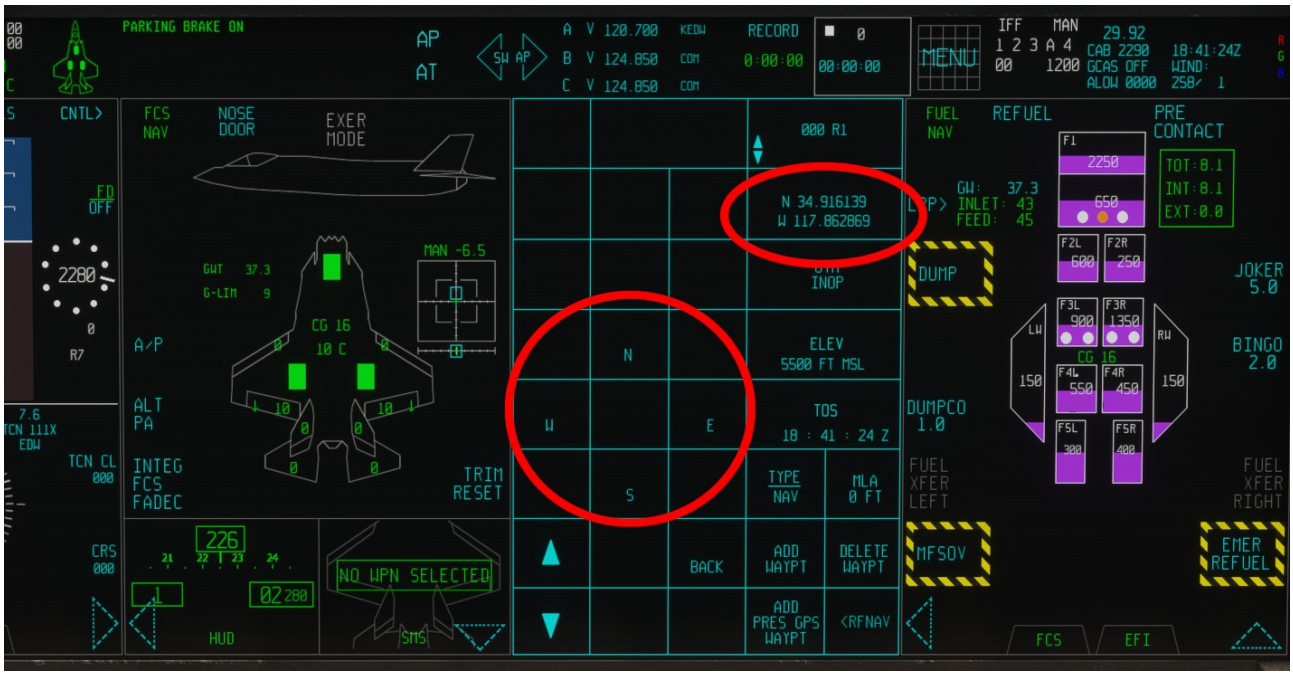
For Nellis AFB the coordinates are:

Latitude: 32.230464 North

Longitude: 115.046981 West

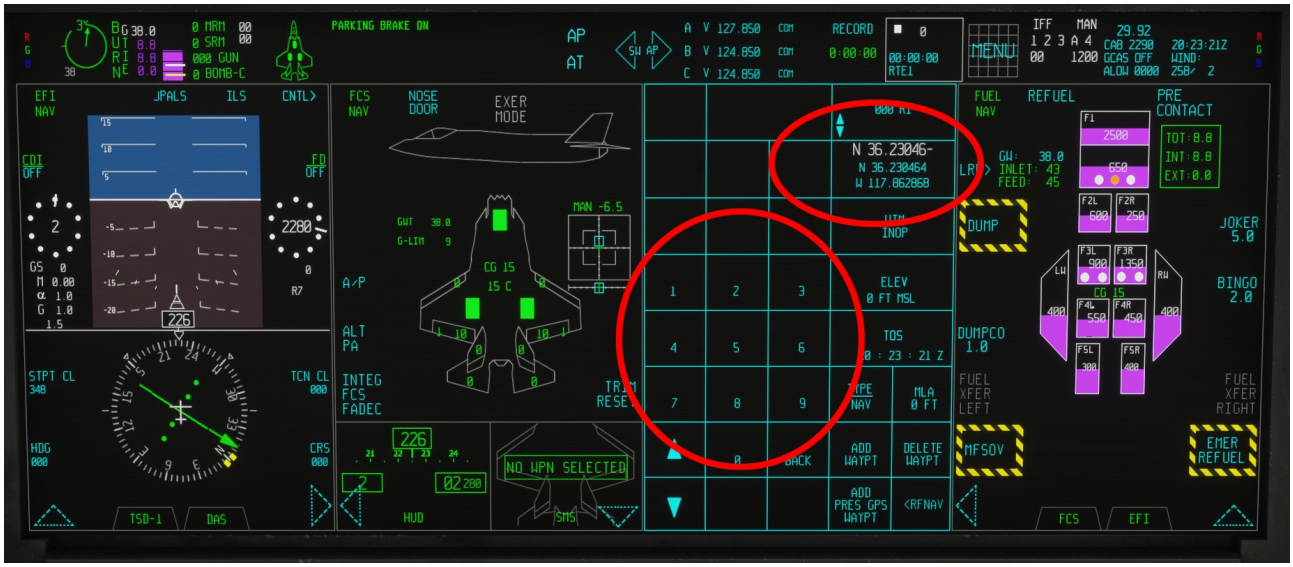
In the Waypoint management page, we see no waypoints available – while the aircraft position is currently displayed in the coordinates window.

By “clicking” on the waypoint coordinates window, you can the virtual keypad captions turn into a N, W, E, S.



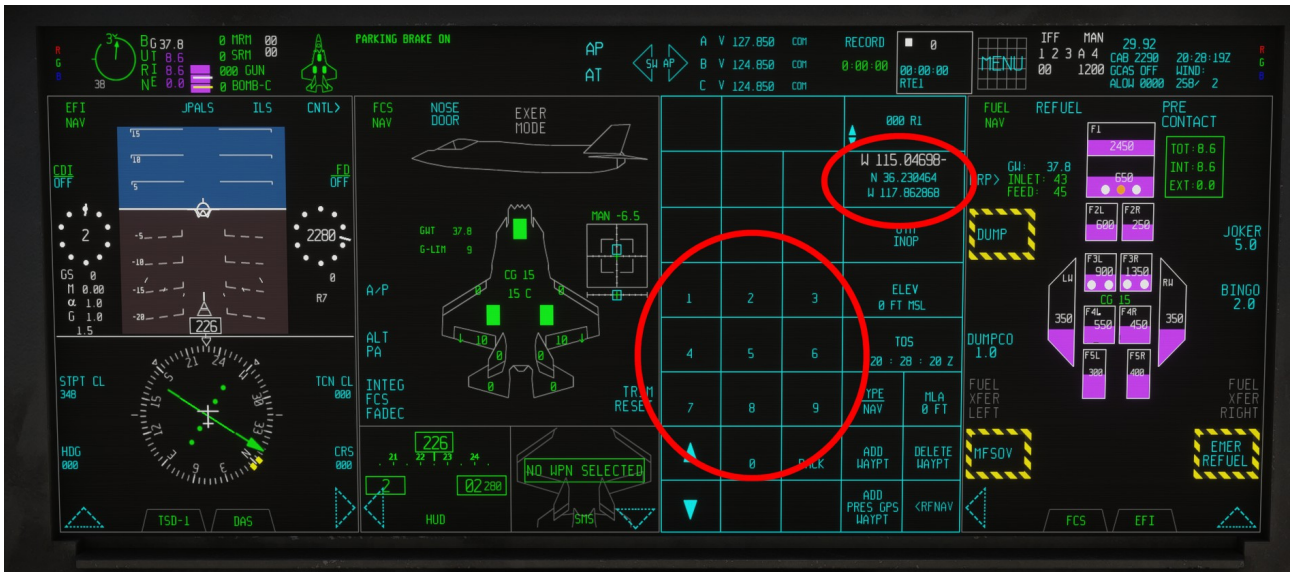
By selecting N or S we can enter the desired latitude once the virtual keypad captions have turned back to numbers.
In our case, since our destination latitude is N 32.230464 we will type:

N – 3 – 6 – 2 – 3 – 0 – 4 – 6 – 4



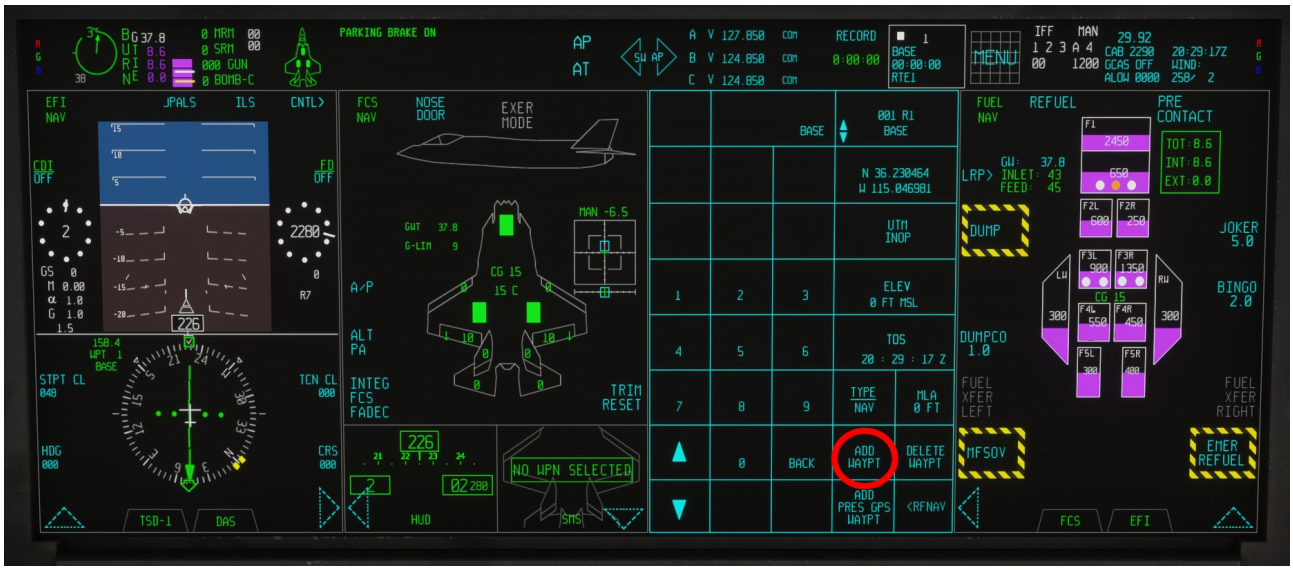
Similarly, by pressing “clicking” on the coordinates window and selecting E or W, we can enter the desired destination longitude.
In our case, since our destination longitude is W 115046981 we will type:

W – 1 – 1 – 5 – 0 – 4 – 6 – 9 – 8 - 1



STEP 4 – CREATING A NEW WAYPOINT

Once you are happy with the coordinates shown on the screen, you can press ADD WAYPT to create a new waypoint.



Once the button is pressed the following will happen:

- A new, “Direct to” flight plan will be created

- Aircraft present position will be assigned as DEPARTURE, as waypoint number 0 (“unknown”)

- New waypoint will be assigned as DESTINATION, as waypoint number 1 (“BASE”)

You can now navigate to Nellis AFB by following the indications of the nav system by selecting RTE in the navigation page as indicated in the previous paragraphs.

In the figure above the aircraft is flying from Edwards AFB to Nellis AFB with the Direct-to flight plan created with the steps described above, after having selected RTE as NAV Source. Waypoint 1 can be seen in the TSD.

20.13 ADDING OR REMOVING WAYPOINTS

Within the Waypoint management page, it is also possible to add or remove waypoints from a flight plan.

To do that, the following options are available:

ADD WAYPT → this option works exactly as described in the previous paragraph, except that the new waypoint will be placed after the waypoint currently selected. New waypoints will be named in alphabetical order, following the order of the data insertion.

DELETE WAYPT → this option deletes the current waypoint from the waypoint

ADD PRES GPS WAYPT → this option has been added for gameplay reasons, and creates a new waypoint at the current GPS coordinates of the aircraft. Waypoint will be placed after the waypoint currently selected.

Note: if a flight plan is not loaded, “ADD PRES GPS WAYPT” will create a flight plan, using the present GPS coordinates as destination.

21. COMMUNICATIONS

21.1 COMMUNICATION SYSTEM

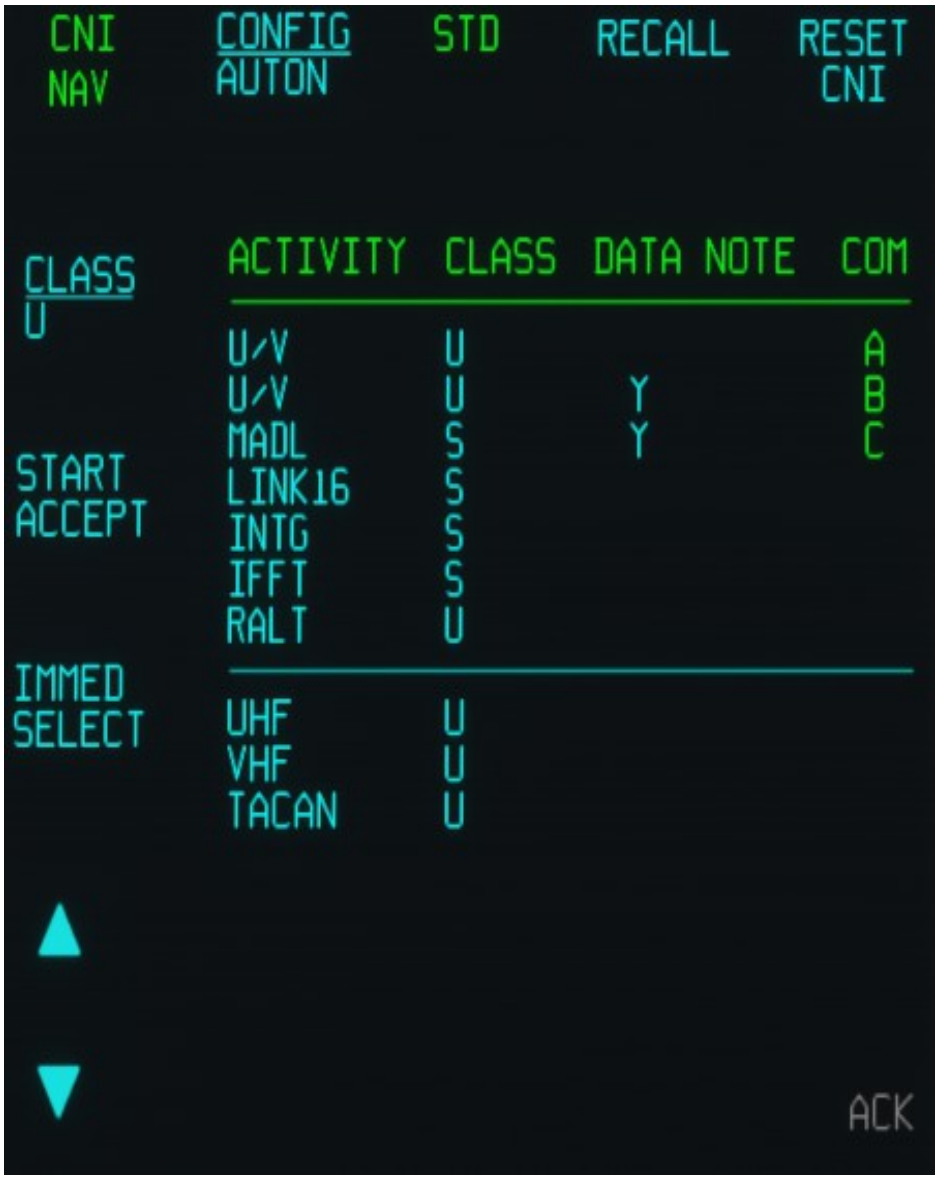
The F-35 Communication System is part of the Communication, Navigation and Identification (CNI) suite and supports voice radio communication and an advanced data-link systems.
In this Microsoft Flight Simulator representation, however, the communication system only supports voice radio communications.

21.2 VOICE RADIO COMMUNICATIONS

The CNI suite includes UHF-only (U), VHF-only (V), and UHF and VHF (UV) capable waveforms, the single channel ground airborne radio system (SINCGARS) waveform, Link 16 (L16) voice, and a backup radio (BUR) for voice communication and supports frequency hopping and encryption features.

In the real aircraft, the pilot will use the CNI PCD page to manage waveforms, but this is not simulated in this MSFS rendition – no action is required to the pilot.

CNI format is available on the PCD but it has no functionality: voice communications will be directed to the normal MSFS radio communication system. No encryption features are available in the game.



21.3 VOICE COMMUNICATIONS PAGE

This page is accessible through the FAB and allows the pilot to type-in the COM radio frequencies.

The following controls are operable in the sim:

COM A frequency type-in (expected format XYZ.ABC, therefore 1 2 0 7 0 0 becomes 120.700)

COM B frequency type-in (expected format XYZ.ABC)

COM C frequency type-in (expected format XYZ.ABC)

MUTE COM A or COM B

Select the previous COM A, COM B or COM C frequency

GUARD (sets COM1 to the emergency frequency)

21.4 DATA COMMUNICATION

The F-35 features multiple data-link systems which allow information including aircraft position and status, track and fusion, stores, threat, tasking, cooperative operations, and imagery be exchanged and shared between flight group members.

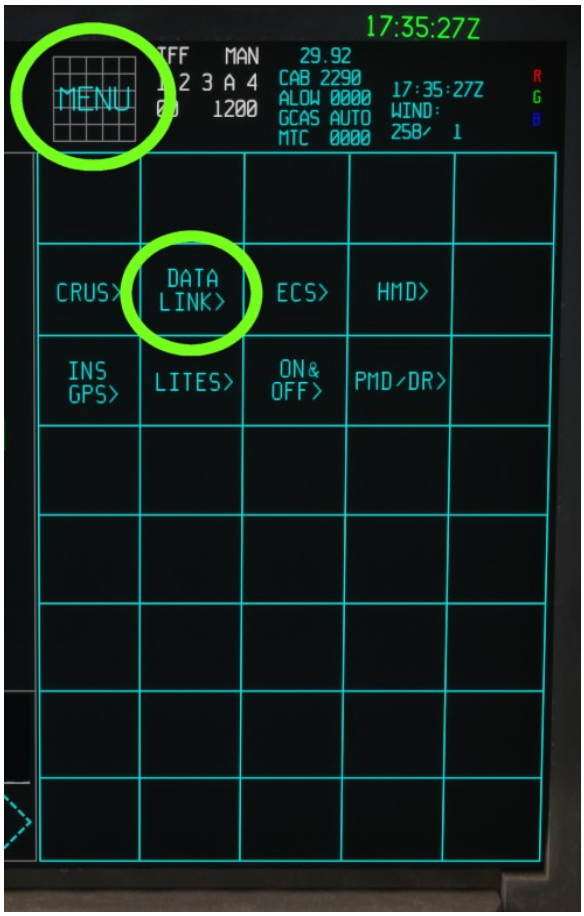
The following systems are implemented in the F-35 CNI suite:

- Multi-function Advance Data Link (MADL)

- Link 16

- VMF

A brief description of those systems is provided for information only, since Data link communication is not properly supported in MSFS. Data link functions are accessed from the MENU FAB via the DATA LINK option.



21.4.1 MADL Overview

The multi-function advanced data link (MADL) provides F-35's intra-flight data link, and supports voice ad data sharing. MADL can transmit and receive detailed aircraft position and status data, track data, fusion data, stores and threat data, tasking data, graphical data, cooperative operations data and network management data.

This function is NOT operational in MSFS at the moment.

21.4.2 Link 16 Overview

Link 16 is a military tactical data link network used by NATO members and other nations, as allowed by the MIDS International Program Office (IPO). Its specification is part of the family of Tactical Data Links.

Link 16 enables military aircraft, ships, and ground forces to exchange their tactical picture in near-real time; it also supports the exchange of text messages, imagery, and voice (the latter on two digital channels: 2.4 kbit/s or 16 kbit/s in any combination).

In MSFS Link16 can be operated to connect to a “virtual” AWACS so that SimObject tracks are reported on the TSD even if the radar is not active.

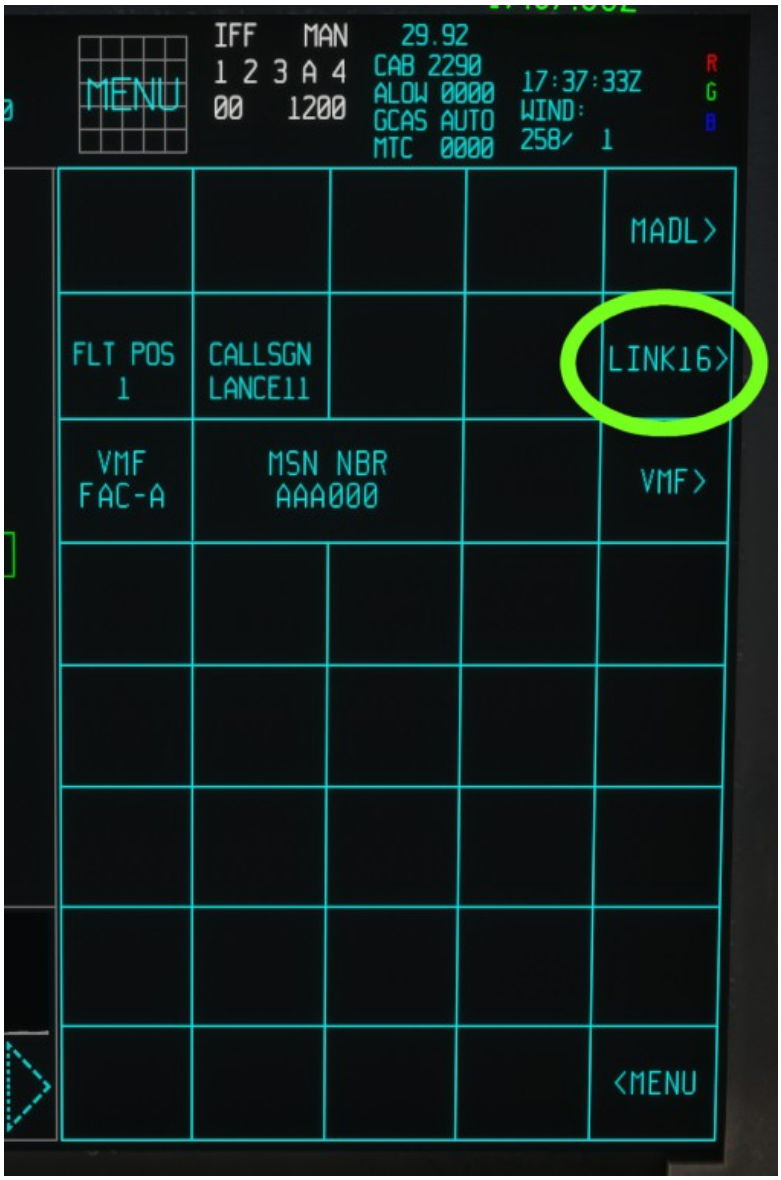
21.4.3 VMF Overview

The variable message format (VMF) is an electronic method of protocol for communicating data between aircraft and ground personnel. VMF is primarily used for close air support (CAS) missions.

This function is NOT operational in MSFS at the moment.

21.5 BASIC DATA-LINK IMPLEMENTATION

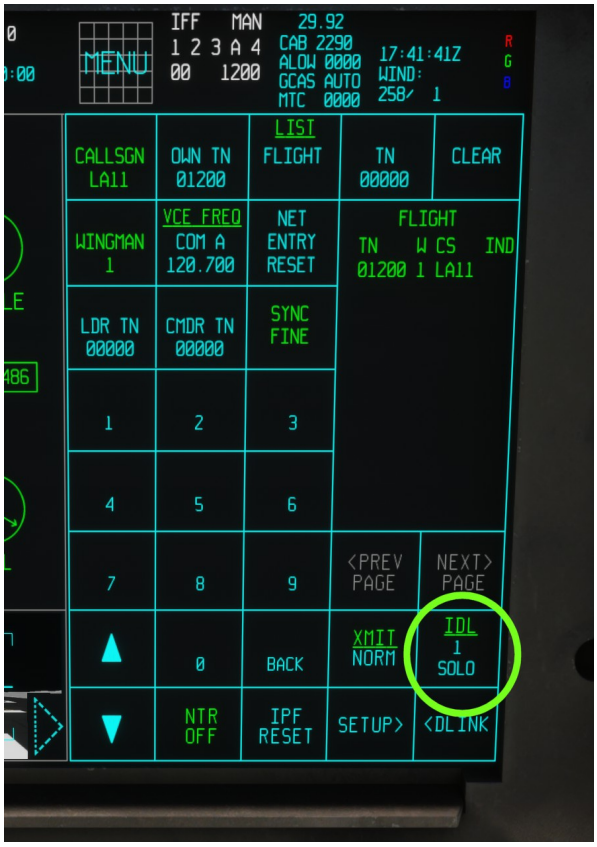
In MSFS a basic “Data link” function allows the user to get target tracks from a virtual “AWACS” plane, adding tracks to the TSD screen.
Data link functionalities in MSFS are based on the IFF code, therefore the IFF code Mode 3 is used also as a network entry, and will be used, in future implementation, to separate Friendly, Foes and other assets.



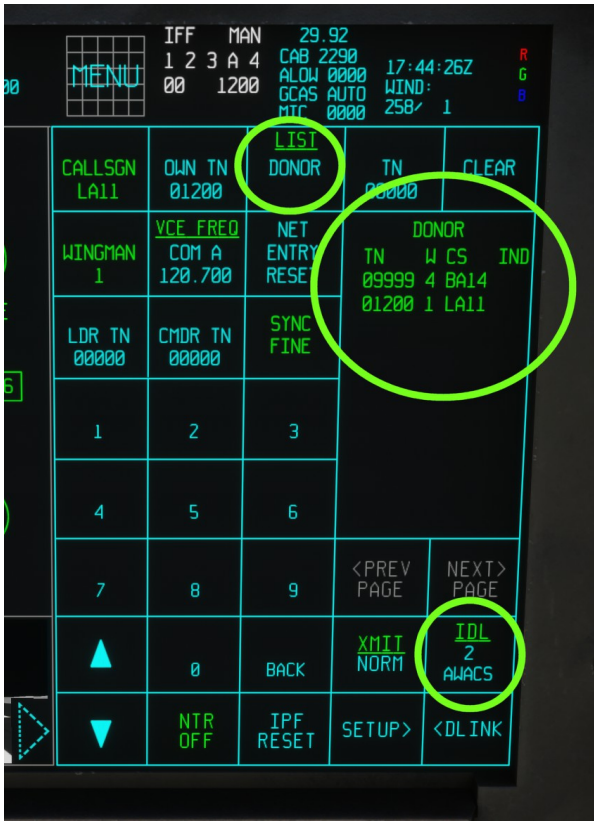
To connect to the virtual AWACS, user must:

1) Access to the DATA LINK page. The page reports the FLT POS (Flight Position) and the network Callsign. These are used both in the MADL and LINK16 pages, but are not editable at the moment.

2) On the LINK 16 page, the IDL button allows the user to select between different data-link network configurations. At the moment only 1 – SOLO and 2 – AWACS lists are available.



3) Once the IDL 2 – AWACS is selected, a “virtual” AWACS appears in the DONOR list, indicating that the aircraft is connected to a “virtual” network with the “virtual” AWACS.



4) When connected to the “virtual” AWACS, the TSD will display tracks even if radar is not operational or is not detecting them. Tracks will be fused with radar displays and TWD/RWR display. These tracks can be decluttered by deselecting F-ALL in the TSD page.

<u>21.6 DATA LINK Flight, Foes, FTI lists management.</u>
Starting from version 1.4.2 (PC only) the pilot can add radar/datalink tracks to one of thr following lists:

- FLIGHT: up to three tracks can be marked as “flight” tracks and will be represented by a light blue circle icon. NOTE: in reality “flight” tracks are represented with a green icon – light blue is for MADL tracks only.

- FRIENDLY TRACKS OF INTEREST (FTI): up to eight tracks can be marked as “friendly track of interest” (FTI) and will be represented by a green blue circle icon

- FOES: up to eight tracks can be marked as foes (red icon on the TSD). NOTE: this list is fictional.

Adding or removing tracks can be done with the TMS or though the LINK 16 page.

If a track is selected in the TSD:

TMS LEFT will add the track to the FTI list if the track is neutral, or remove it from the FOES list if the track is hostile.

TMS RIGHT will add the track to the FOES list if the track is neutral, or remove it from the FTI if the track is friendly.

Otherwise:

“LIST” can be used to select one of the lists (FLIGHT, DONOR, FTI, FOES)

Arrow UP / DOWN can be used to selec one of the available slots in the list

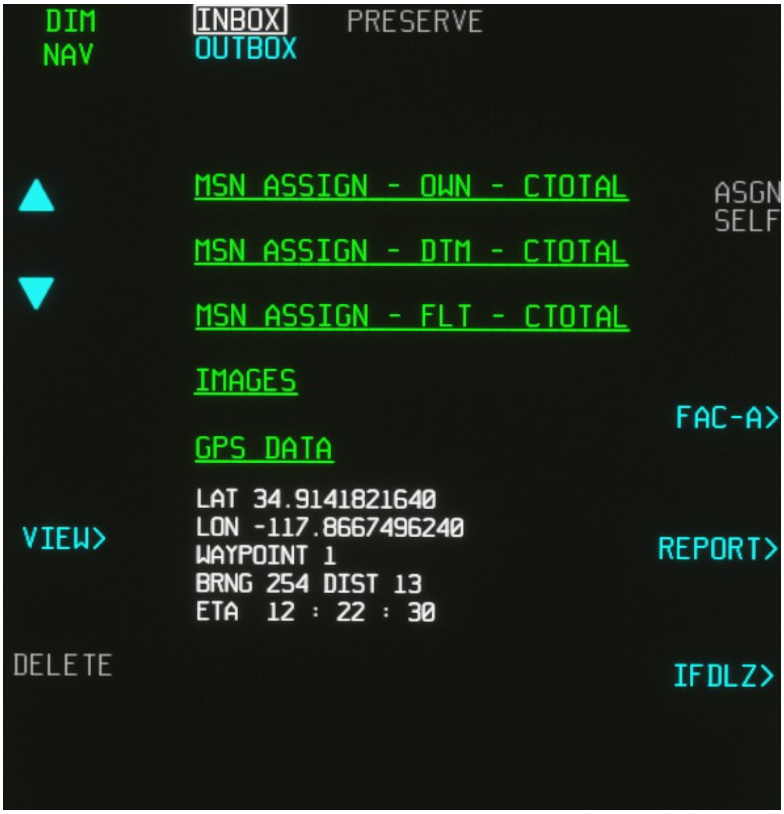
“TN” can be used to enter the IFF code to be added to the list

“CLEAR” can be used to clear the current slot.

NOTE: In MSFS the tracks are identfied by the Transponder code. This feature works only in single player.

21.7 DIM - Data and Information Management page

In the real aircraft this page is used to generate, send and receive data, including tactical information, images and videos – for example, an image acquired by the ASR can be sent to another F-35 or other allied assets. These functionalities are not available in Microsoft Flight Simulation and, while the page closely mimics the real-world one, it only shows current GPS data along with basic flight plan information.



22. IDENTIFICATION

22.1 IDENTIFICATION

Identification capabilities include the identification, friend, or foe (IFF) transponder (IFFT) and IFF interrogator (IFFI).
In this MSFS rendition, only IFF Mode 3A is supported with the same function as a civilian transponder.

The system is operated via the PCD from a dedicated page accessible from the FAB button.
This page is accessible through the FAB and allows the pilot to type-in the IFF transponder data.

The following controls are operable in the sim:

IFF MODE – Allows the user to set the IFF mode

MODE 1 (code only)

MODE 2 (code only)

MODE 3 (code and mode selection)

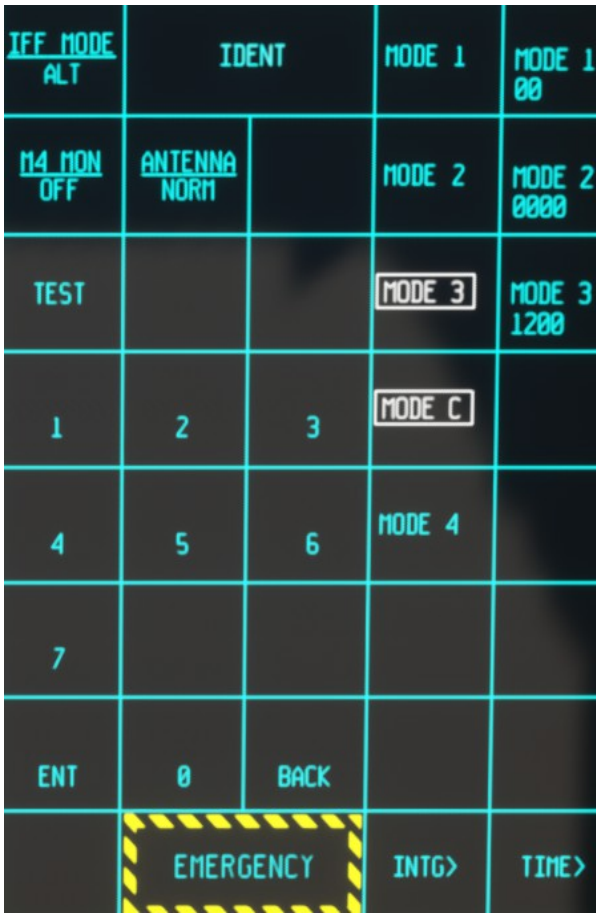
MODE C (code and mode selection)

MODE 4

IDENT

EMERGENCY – sets the MODE 3 to 7700 emergency code

NOTE: the IFF interface in MSFS is somewhat different than the real plane, as MSFS only supports civilian transponder modes. In detail, in the real plane, you can select the IFF mode without actually powering the transponder – also transponder states have been changed to mimic the MSFS convention.



23. GROUND COLLISION AVOIDANCE SYSTEM

23.1. GROUND COLLISION AVOIDANCE SYSTEM (GCAS) OVERVIEW

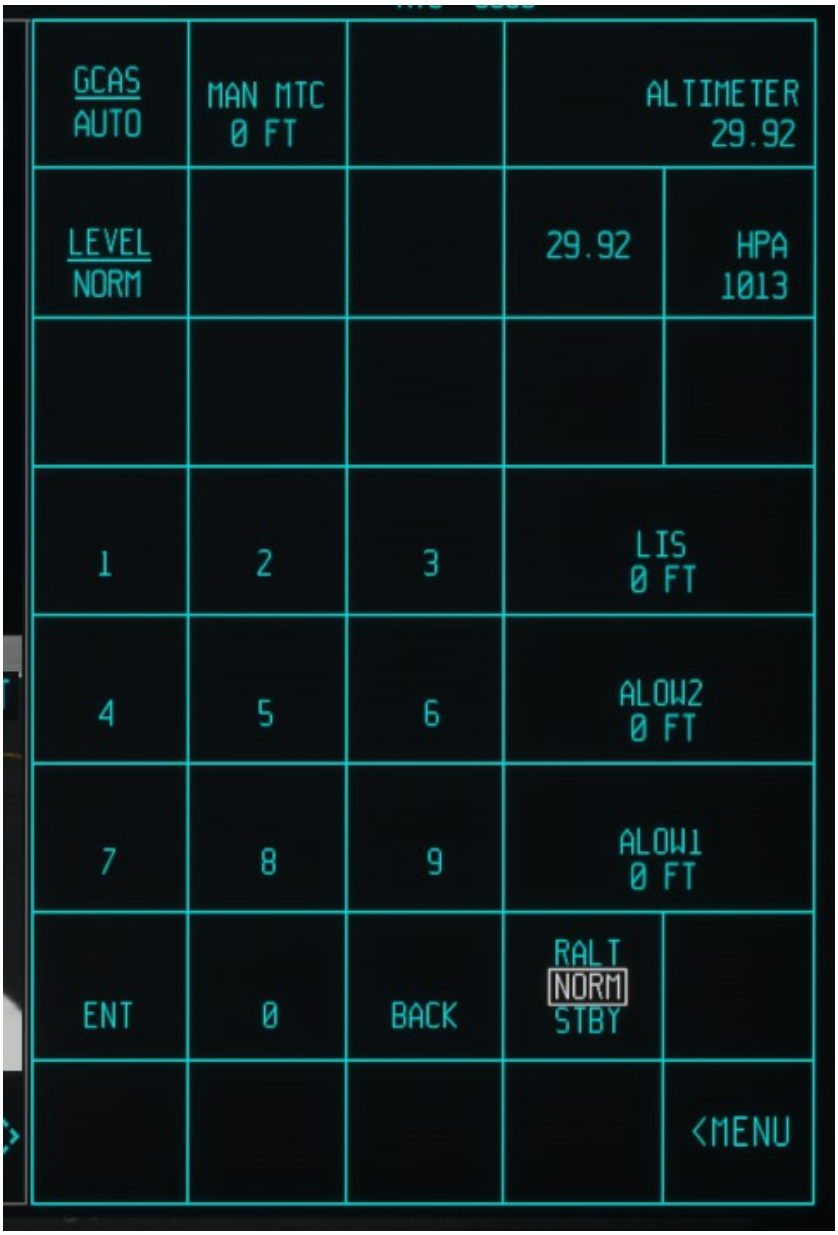
The Ground Collision Avoidance System (GCAS) is designed to reduce the occurrence of controlled-flight-into-terrain (CFIT) accidents.
The system has two main modes of operation:

Manual (MGCAS) - MGCAS generates warning messages when the aircraft is in danger of exceeding a preset safety altitude limit above the ground: pilot must promptly correct the aircraft trajectory to avoid ground collision.

Automatic (AGCAS) – In addition to the warnings generated in MGCAS mode, AGCAS can take over the control of the aircraft trajectory and avoid ground collision autonomously (provided that the plane has sufficient energy).

23.2 ALTITUDE FAB AND GCAS CONTROLS

GCAS is controlled from a the ALTITUDE FAB which also hosts, altimeter settings, radar-altimeter controls and settings for multiple altitude warnings.



23.2.1 ALTIMETER CONTROLS
From the ALTITUDE page, the pilot can set the current altimeter reference pressure with the following controls:

- ALTIMETER: Set the desired reference pressure by typing it with the virtual keypad (in inHg).

- 29.92: Set the altimeter reference pressure to 29.92 inHg

- HPA: Set the desired reference pressure in hPa (note: this function is not present in the real aircraft).

23.2.2 RADIO ALTIMETER CONTROLS
From the same page, it is also possible to switch the altimeter to Stand-by mode. In normal operations the radio-altimeter is powered up automatically and does not require pilot operation. If the radio-altimeter is on stand-by mode, RADALT readings on HMD and PCD will not be available.

- RALT: Allows the pilot to select NORM or STANDBY.

23.2.3 ALTITUDE WARNINGS
Multiple altitude warnings can be set from this page:

- LINE IN THE SKY (LIS): Activates an aural warning if the plane falls below the selected altitude. Warning will only trigger if the plane has been above the selected altitude. Altitude is calculated with respect to the standard atmospheric pressure.

- ALOW 2: Activates an aural warning if the plane falls below the selected radar altitude. Warning will only trigger if the plane has been above the specified altitude.

- ALOW1: Activates an aural and visual warnings if the plane falls below the selected radar altitude. Warnings will only trigger if the plane has been above the specified altitude.

23.2.4 GCAS CONTROLS
GCAS mode of operation and parameters are governed by the following controls:

- GCAS: this is the GCAS “master” mode selector, and has three settings:

  STBY – GCAS on STANDBY mode (system is disabled)

  MAN – MGCAS is active (no automatic recovery)

  AUTO – AGCAS is active (automatic recovery – default setting)

- LEVEL: this the pilot to have a better control on the activation of GCAS warnings. This button has three settings:

  NORM - Normal mode. This can be furtherly adjusted with the Minimum Terrain Clearance (MTC) option.

  MIN – Similar to normal mode, but MTC is always considered 0 feet.

  STRF – Relaxed conditions (for ground strafing operations).

- MTC: this allows the user to set the Minimum Terrain Clearance. MTC (in feet) will be added ON TOP of the normal GCAS conditions. For example, by setting and MTC of 2000, the CGAS alert will trigger 2000 feet above the altitude predicted by the system.

23.3 KNOWN ISSUES
After auto-recovery, the system may tend to keep the plane in a nose up altitude, which can deplete the kinetic energy, depending on engine settings. Any pilot action on the stick will return to normal FCS controls.

NOTE: The AGCAS has NO AUTHORITY over the engine system. If the airspeed is insufficient and engine setting is not promptly corrected, auto-recovery may be impossible.

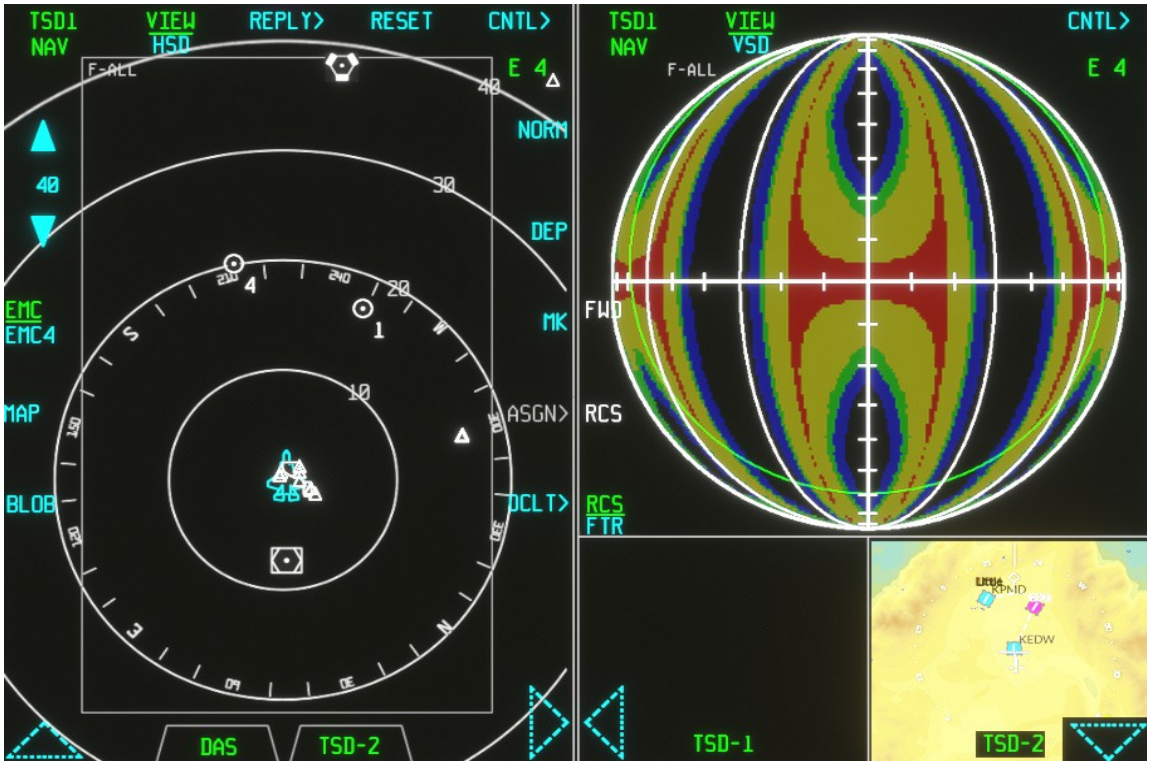
24. TACTICAL SITUATION DISPLAY

24.1 TACTICAL SITUATION DISPLAY

The tactical situation display (TSD) is the primary head-down situational awareness display providing a graphical depiction of the environment and battlespace surrounding ownship.
As a result of the sensor-fusion and network sharing approach, the data presented is a summary of everything the aircraft “knows” from its own sensors, and what it has been detected from any friendly asset capable of sharing information.

Along with sensor fusion data and shared data, in the real aircraft the display is also capable of showing radar cross section information, estimated coverage of other radars and can be used to select targets or assign targets or waypoints to other aircraft or assets.

Three independent pages (TSD1, TSD2 and TSD3) can be shown and controlled separately.
In the simulation rendition, the functionality is limited by MSFS constraints and scope.



In the real aircraft, the TSD has four modes, which can be independently selected for each TSD screen:

1) Horizontal Situation Display (HSD)

2) Vertical Situation Display (VSD).

3) Horizontal Situation Indicator (HSI)

4) Plan

The following controls/options are available in the TSD pages:

VIEW > Cycles between HSD, VSD and HSI modes.

MAP > Toggles the HSD MAP mode (only in HSD) mode

Tracks decluttering; F-ALL / TRUST / RDR (show all the tracks or only the “trusted” tracks or only the tracks detected by the aircraft radar).
RANGE CONTROLS > Allow the pilot to select the zoom level for the HSD and HSI modes. Separate zoom levels are available for the three TSD screens except for the MAP mode, which has the same zoom level for all three.

24.1 HORIZONTAL SITUATION DISPLAY

The Horizontal Situation Display is typically the main presentation of the TSD screen, showing navaids and waypoints, radar, sensor-fusion and Link-16 tracks.

NOTE: in this MSFS presentation, this is the only TSD screen than can be maximized to full screen (only on PC).

This presentation will show:

A - the departure waypoint (a flight plan is loaded), displayed as a small pentagon

B – the next waypoint of the current flight plan (if one is loaded), displayed as a small circle with a dot and the waypoint number

C – the destination waypoint of the current flight plan, displayed as a small circle with a dot and the waypoint number

D - the location of the VOR station currently tuned, if detected, with a specific symbol

E - the location of the TACAN station currently tuned, if detected, with a specific symbol

F – Air-to-Air tracks, displayed as a square with a small line. The small line represents the direction of the motion of the track.

G – Air-to-Ground tracks, displayed as a small triangle.

Not shown in the image:

Pre-planned target: red triangle, hostile ground track (ID 99)

Initial Point: grey square

The (E) and (G) items, at the moment of the release, are based on WASM code and are only available on PC versions (and not on Xbox). This data is based only on the Traffic data from Flight Simulator, so that basically only SimObject generated as Traffic are reported.

24.2 HORIZONTAL SITUATION DISPLAY CONTROLS

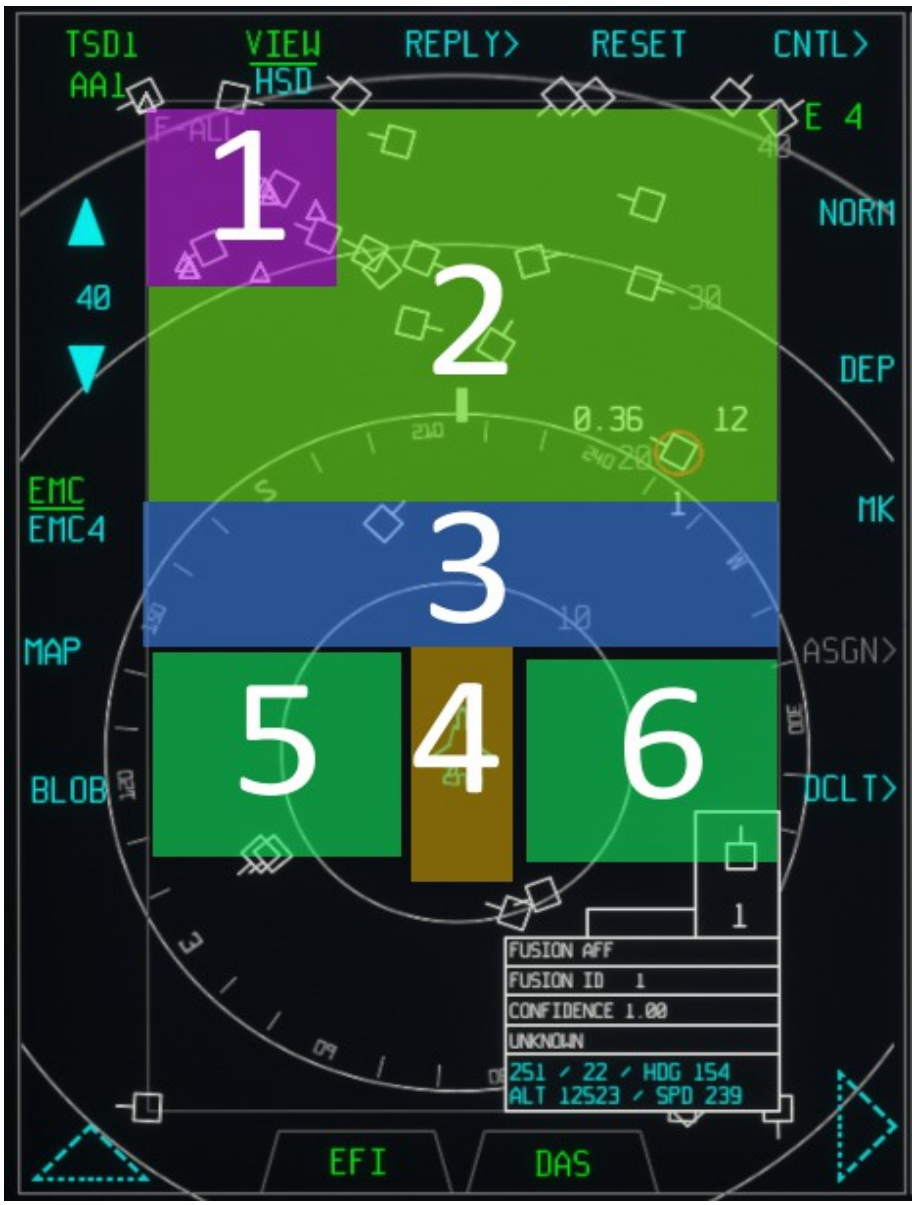
While a TSD screen is in HSD mode, a number of additional functions can be controlled via the touch-screen or via HOTAS controls:

- TARGET DESIGNATION

- TRACK DECLUTTERING (this function is also available in VSD)

- RADAR SEARCH AREAS VISUALIZATION AND AZIMUTH CONTROL (see Radar section for further details).

Below is a typical TSD-HSD situation showing multiple air-to-air and air-to-ground tracks. Track number 1 has been designated as target, and its known details are shown in the Expanded Data Window (EDW). In particular, the track is an air-to-air track (as indicated by the square shape), it is flying with an heading of 154 degrees at 12523 feet and 239 knots. Direct intercept route is 251 degrees, distance is 22 nautical miles.



In the real aircraft, symbols can be selected (and eventually dragged) on the screen either via touch-screen or cursor (by using TMS “up” as a “left click” mouse button). In this MSFS rendition this is not implemented and the TSD is instead divided in multiple areas as indicated in the screenshot above:

1 – Track filter/declutter: in the real plane this allows the pilot to select between all tracks (F-ALL), trusted tracks (TRUST), radar tracks (RDR) or tracks coming from active ESM or passive detection (ESM). In this MSFS rendition there are three settings: F-ALL (all tracks), TRUST (only trusted tracks) and RDR (radar tracks). Since all but data-link sources are “trusted” in the simulation, RDR and TRUST are identical. ESM mode is not available.

2 – SELECT NEXT TRACK AS TARGET

3 – SELECT PREVIOUS TRACK AS TARGET

4 – TOGGLE VISUALIZATION OF RADAR SEARCH VOLUMES AA1, AA2 OR AS

5 – STEER SELECTED SEARCH VOLUME TO THE LEFT

6 – STEER SELECTED SEARCH VOLUME TO THE RIGHT

See RADAR section for further details.

24.2.1 HORIZONTAL SITUATION DISPLAY HOTAS CONTROLS
In addition to the touch-screen controls, the following HOTAS controls are also available when a TSD-HSD screen is the POI.

TMS UP – SELECT NEXT TRACK AS TARGET OR, IF SEARCH VOLUME IS SELECTED AND TMS IS PRESSED NEARBY THE AIRCRAFT SYMBOL, ACTIVATES DIRECT SEARCH VOLUME STEERING CONTROL.

TMS DOWN – SELECT PREVIOUS TRACK AS TARGET

CSC Z-PLUNGE – TOGGLES VISUALIZATION OF AA1, AA2 AND AS SEARCH VOLUMES

CSC LEFT/RIGHT – SEARCH AREA STEER LEFT / RIGHT

See RADAR section for further information about search volumes and their controls.

24.3 VERTICAL SITUATION DISPLAY
Vertical Situation Display control shows the available tracks in a horizon-stabilized Azimuth vs. Elevation display. Symbology and EDW are identical to the HSD mode, except that the presentation is Azimuth vs. Elevation instead of Azimuth vs. Range.

In addition in this page:

- background colors represent Radar-Cross-Section (RCS) from the track point of view. In the real aircraft the colors are dynamic to represent the actual condition of the aircraft, and multiple bands can be selected for visualization. In MSFS the RCS can only be hidden from view.

- Aircraft horizon is displayed

- Radar air search volumes are presented in AZ vs El mode (only AA1 and AA2 volumes)

24.4 VERTICAL SITUATION DISPLAY CONTROLS

Similarly to the HSD, in this MSFS implementation, the VSD is divided into multiple regions with different effects:

1 – Track Filter / Declutter (same as HSD)

2 – If radar search volume is displayed, INCREASE SEARCH VOLUME ELEVATION. Otherwise, SELECT NEXT TRACK AS TARGET.

3 – If radar search volume is displayed, STEER SEARCH VOLUME TO THE LEFT. Otherwise, SELECT NEXT TRACK AS TARGET.

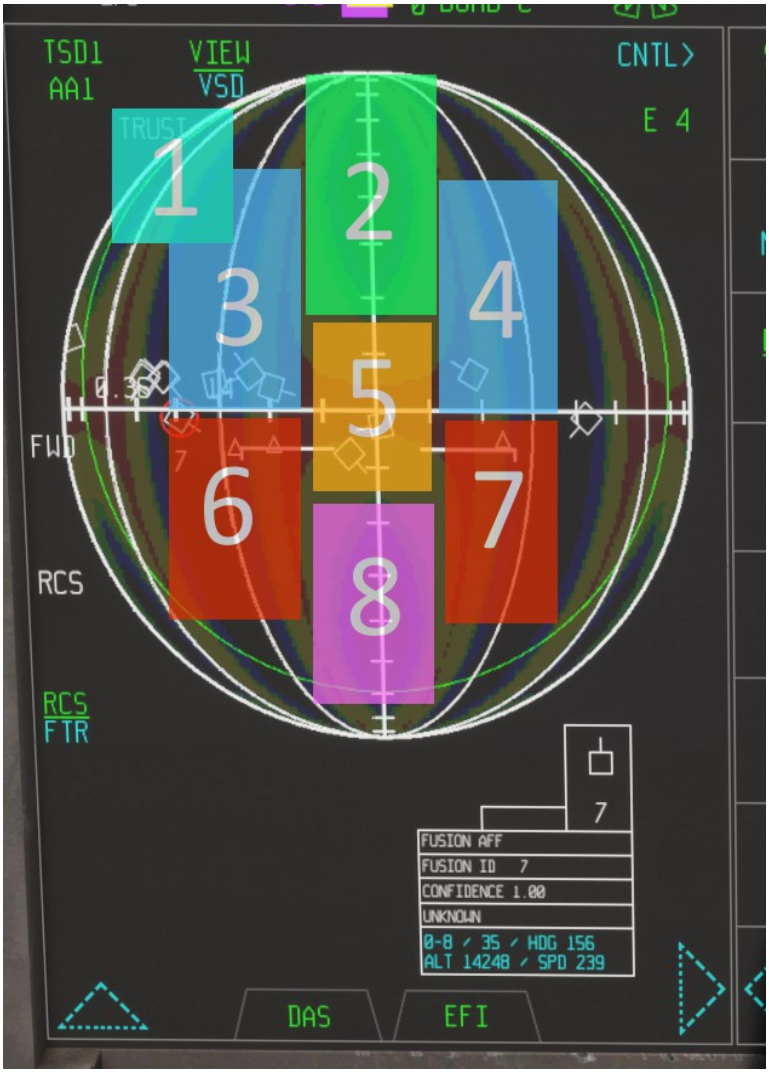
4 – If radar search volume is displayed, STEER SEARCH VOLUME TO THE RIGHT. Otherwise, SELECT NEXT TRACK AS TARGET.

5 – TOGGLE VISUALIZATION OF RADAR SEARCH VOLUMES AA1, AA2 (AS will not be displayed in VSD mode)

6 – If radar search volume is displayed, STEER SEARCH VOLUME TO THE LEFT. Otherwise, SELECT PREVIOUS TRACK AS TARGET.

7 – If radar search volume is displayed, STEER SEARCH VOLUME TO THE RIGHT. Otherwise, SELECT PREVIOUS TRACK AS TARGET.

8 – If radar search volume is displayed, DECREASE SEARCH VOLUME ELEVATION. Otherwise, SELECT PREVIOUS TRACK AS TARGET.



24.4.1 VERTICAL SITUATION DISPLAY CONTROLS

In addition to the touch-screen controls, the following HOTAS controls are also available when a TSD-HSD screen is the POI.

TMS UP – SELECT NEXT TRACK AS TARGET OR, IF SEARCH VOLUME IS SELECTED AND TMS IS PRESSED NEARBY THE AIRCRAFT SYMBOL, ACTIVATES DIRECT SEARCH VOLUME STEERING CONTROL.

TMS DOWN – SELECT PREVIOUS TRACK AS TARGET

CSC Z-PLUNGE – TOGGLES VISUALIZATION OF AA1 AND AA2 SEARCH VOLUMES

CSC UP/DOWN/LEFT/RIGHT – SEARCH AREA STEER UP / DOWN / LEFT / RIGHT

See RADAR section for further information about search volumes and their controls.

25. RADAR

25.1 AN/APG-81 AESA RADAR

The APG-81 radar is a coherent, pulse-doppler, active electronically scanned array (AESA) radar.
The radar operates through the nose radome, which has a wide bandwidth, enabling high-power transmissions over a large frequency range.

The APG-81 is designed to operate as a radar, an electronics support measures (ESM) receiver, and a jammer.
The radar includes active and passive air-to-air (AA) and air-to-surface (AS) target detection, track, and identification capabilities, as well as radar weather mode.
Many of these capabilities can be interleaved, providing near simultaneous AA and AS functionality. The sensor also supports advanced medium-range air-to-air missiles (AMRAAM), synthetic aperture radar (SAR) mapping, ground and sea moving target detection and track, and AS ranging (ASR) radar functions also include electronic protection (EP) for operation in jamming environments, low probability of intercept (LPI) features, and functions supporting system health determination and calibration.

NOTE: in this Microsoft Flight Simulator rendition, radar is simulated through a dedicated WASM module that provides the following functionalities:

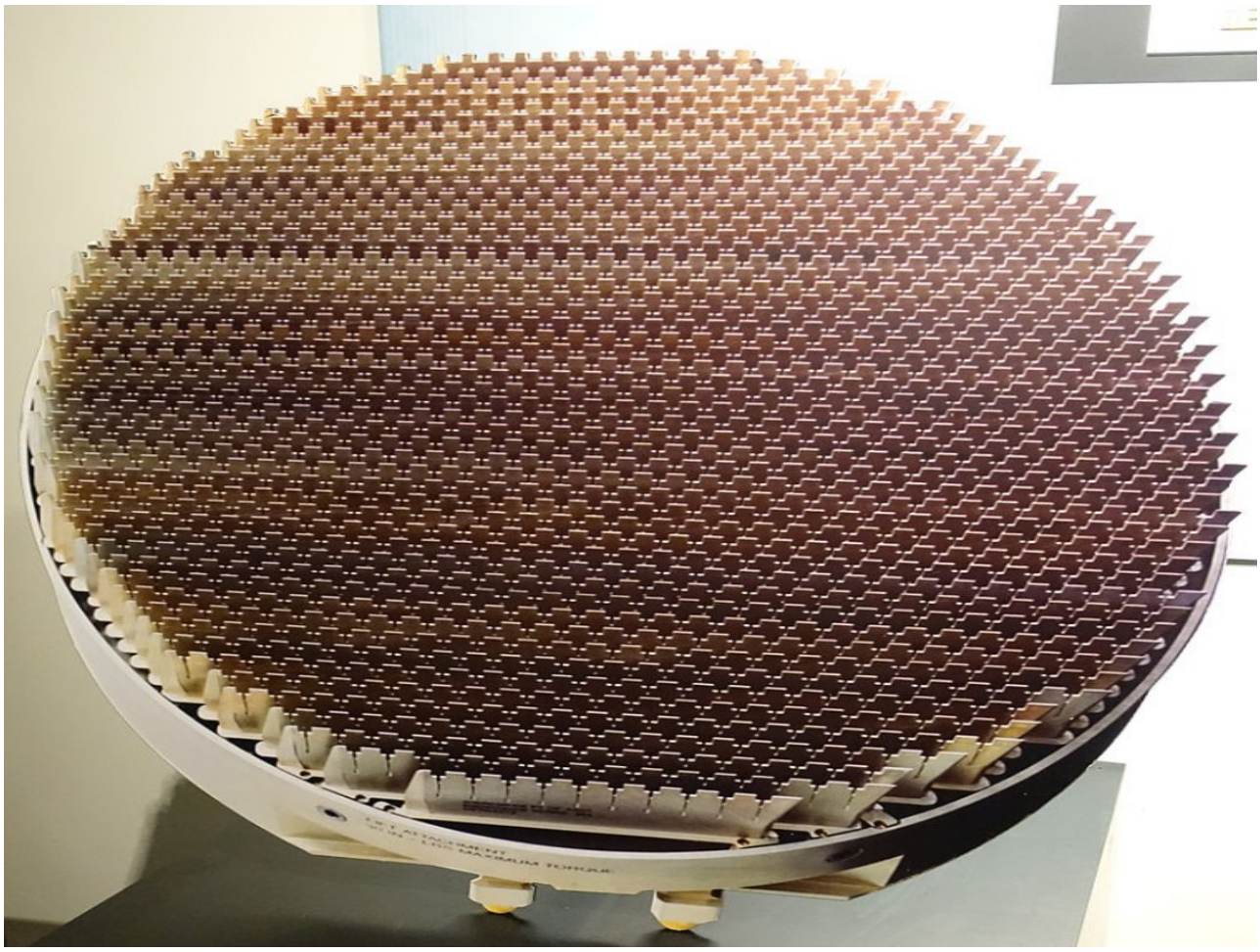
- Air-to-air SimObject detection

- Air-to-ground SimObject detection

- Simulation of multiple search volumes

- Data link / AWACS / Situational Awareness emulation

- RWR emulation



25.2 RADAR CONTROL

The main PCD page for radar control is the SRCH page, which, in the real plane, controls the target search activities of the radar and IRST system.
The search activities are organized in three, color-coded search volumes, which are organized in columns:

AAVOL1 – Air-to-air search volume 1 (second column of the SRCH page, color-coded in cyan)

AAVOL2 – Air-to-air search volume 2 (third column of the SRCH page, color-coded in purple)

ASVOL – Air-to-surface search volume (fourth column of the SRCH page, color-coded in green)

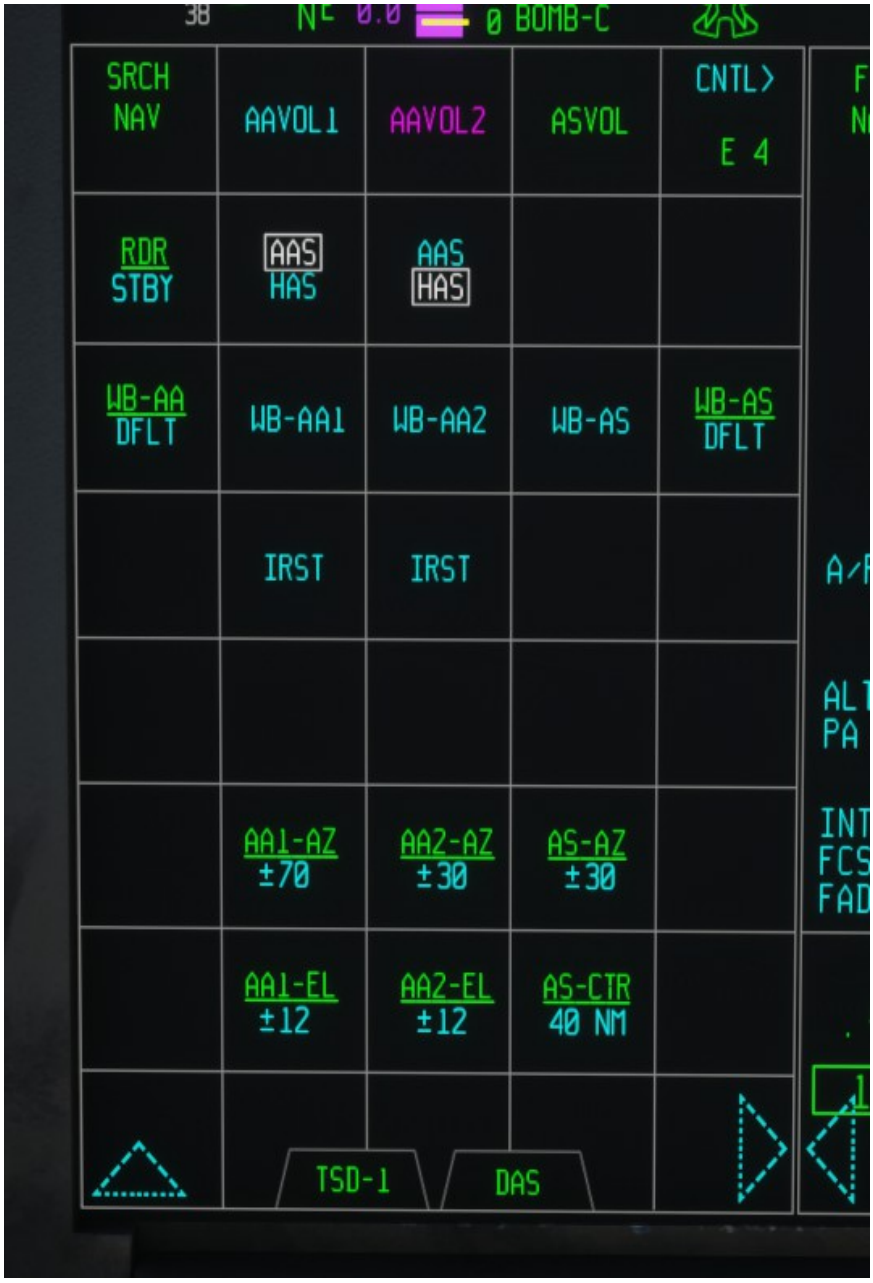
The search volume dimensions are displayed (and controlled) on the sixth and seventh rows.

The sensor activities are organized in rows:

RDR – Active radar detection (second row)

WB – Wideband passive search (third row, not simulated in MSFS)

IRST – Infra-red search and track (fourth



25.2.1 SRCH VOLUME CONTROLS

Following controls can be operated from the SRCH page:

RDR – This is the master control of the active radar search. The radar is powered up automatically when generator energy is available.
The default radar status is STBY (stand-by). The pilot can select:

NOSLP (NO SLEEP) – Air-to-air and air-to-surface search modes are operational

AASLP (AIR TO AIR SLEEP) – Only air-to-surface active search mode is operational

ASSLP (AIR TO SURFACE SLEEP) – Only air-to-air search search mode is operational

AAS / HAS Allows the pilot to select All Aspect Search or Head-on Aspect Search for Air-to-air for each search volume.
NOTE: This is not correctly simulated in MSFS: in the simulation, AAS will report any detected track regardless of its speed, while HAS will report only tracks above 250 knots (more likely to be a threat or a target).

AA1-AZ Search volume width for AA1 Azimuth (+/- 10°, 30° or 70°)

AA1-EL Search volume width for AA1 Elevation (+/- 2°, 4°, 8°, 12, LO, HI)

AA2-AZ Search volume width for AA2 Azimuth (+/- 10°, 30° or 70°)

AA2-EL Search volume width for AA2 Elevation (+/- 2°, 4°, 8°, 12, LO, HI)

AS-AZ Search volume width for AS Azimuth (+/- 10°, 30° or 60°)

AS-CTR AS search volume center (distance from ownship – 10, 20, 30, 40, 60 or 80 nautical miles)

NOTE:

In reality, LO and HI modes are designed to cover automatically specific maximum and minimum altitude limits for air-to-air tracks. Limits can be either set by the mission profile or edited by the pilot. In the simulation:

LO – sets the elevation scan width to the maximum downward coverage.

HI – sets the elevation scan width to the maximum upward coverage.

Maximum radar coverage in terms of azimuth and elevation can be achieved by setting AA1 to +/-70° width and LO elevation, and simultaneously set AA2 to +/-70° width and HI elevation (or the other way around).

NOTE:

Search volume dimensions impact the radar maximum detection range. The larger the search volume the shorter is the detection range for that volume.

NOTE:

For air-to-surface mode, pilot can set the width and the search area center (specified in distance from ownship). Radar search volume will be an area centered on the centerline of the search azimuth at the distance specified in the AS-CTR box.

Similarly to A-A search modes, the larger the width the lower is the accuracy and likelihood to detect targets.

NOTE:

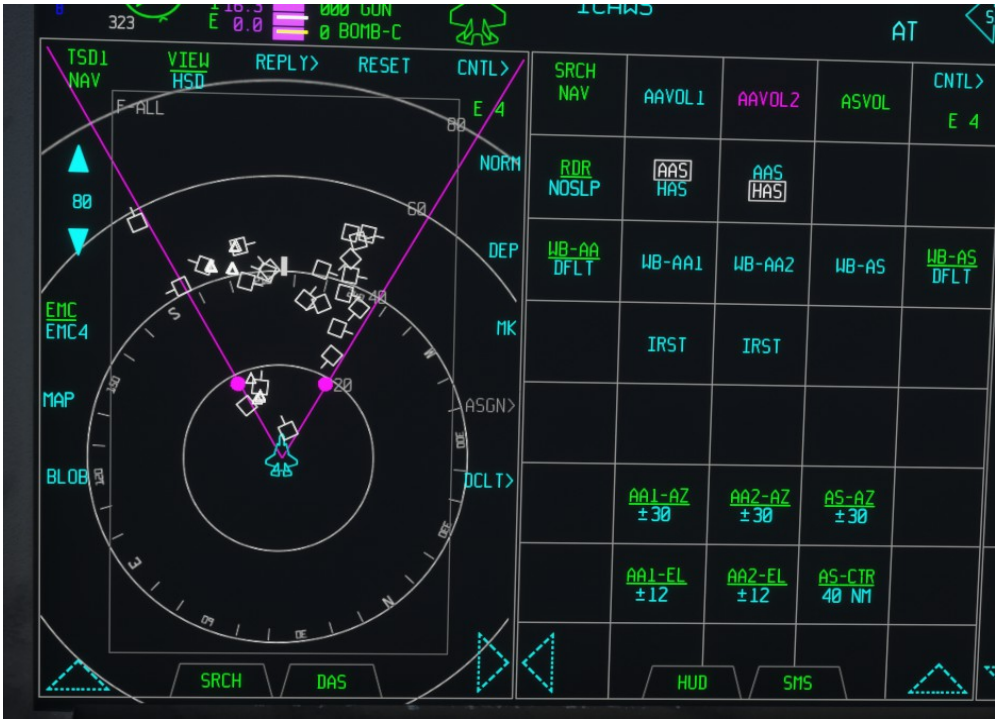
In A-S modes, in MSFS, only SimObjects that are classified as “Traffic” will be detected (basically active airplanes in airports).

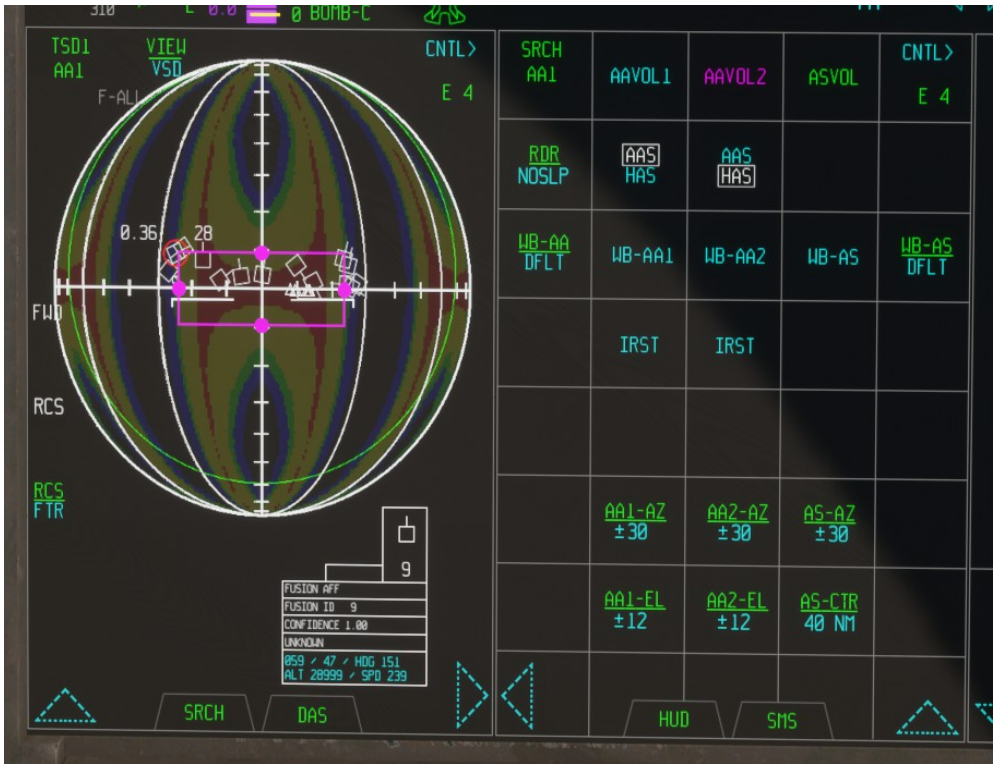
25.2.2 SEARCH VOLUME AZIMUTH AND ELEVATION CONTROLS

Search azimuth and elevation controls are set in the TSD page.
HSI and HSD modes allow the pilot to steer only the search volume azimuth, while the VSD mode allows the pilot to steer AA1 and AA2 azimuth and elevation. AS elevation is controlled automatically as function of the AS-CTR parameter.

Search volumes can be visualized by either “clicking” on the aircraft shape (in HSD or HSI modes) or overlay center (in VSD mode), or by Z-axis plunging the CSC controls.

When the search volumes are displayed, TMS up nearby the control dots will activate the “direct steer” mode so that search volumes can be steered with the CSC controls (if not maximized).
Search volumes can also be steered with through dedicated mouse areas (see Panoramic Control Display section for details).





25.3 AIR-TO-SURFACE RADAR FUNCTIONALITIES

While surface tracks detected by the radar are shown also the TSD page, a dedicated Air-to-Surface Radar (ASR) page is available. In the real aircraft this page has three main functions:

- visualize, designate and manage surface targets (mode NONE)
- designate areas for radar synthetic aperture radar mapping and map visualization (Mode SAR)
- weather radar (Mode WX)

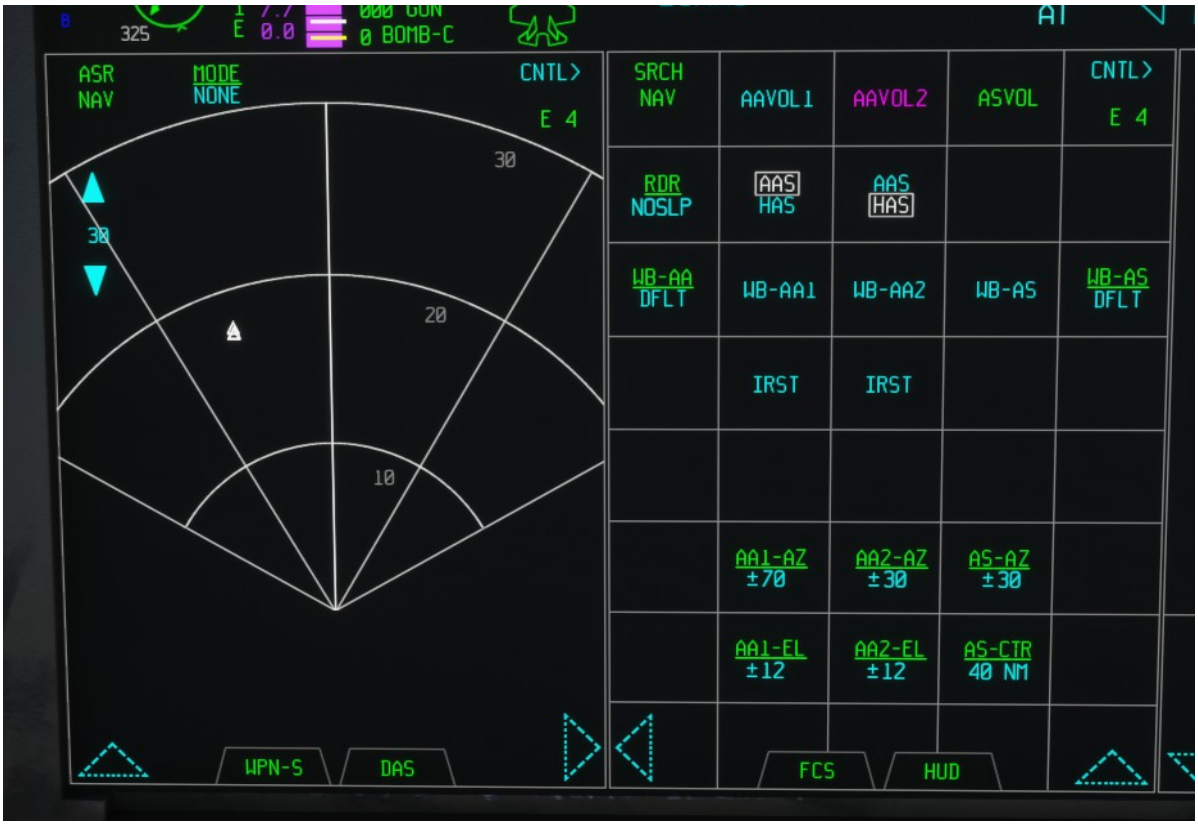
This page has limited functionality in MSFS and it is currently limited to:
- base visualization of ground tracks (Mode:NONE)
- base visualization of synthetic map imagery (Mode:SAR)

Weather radar mode is not available in MSFS at the moment.
The ASR page default presentation is Mode:NONE, which will display the current surface tracks, bullseye and waypoint locations.

In this mode, the following controls are operable:

MODE button – toggles SAR mode

Range buttons – Increase / Decrease visualization range



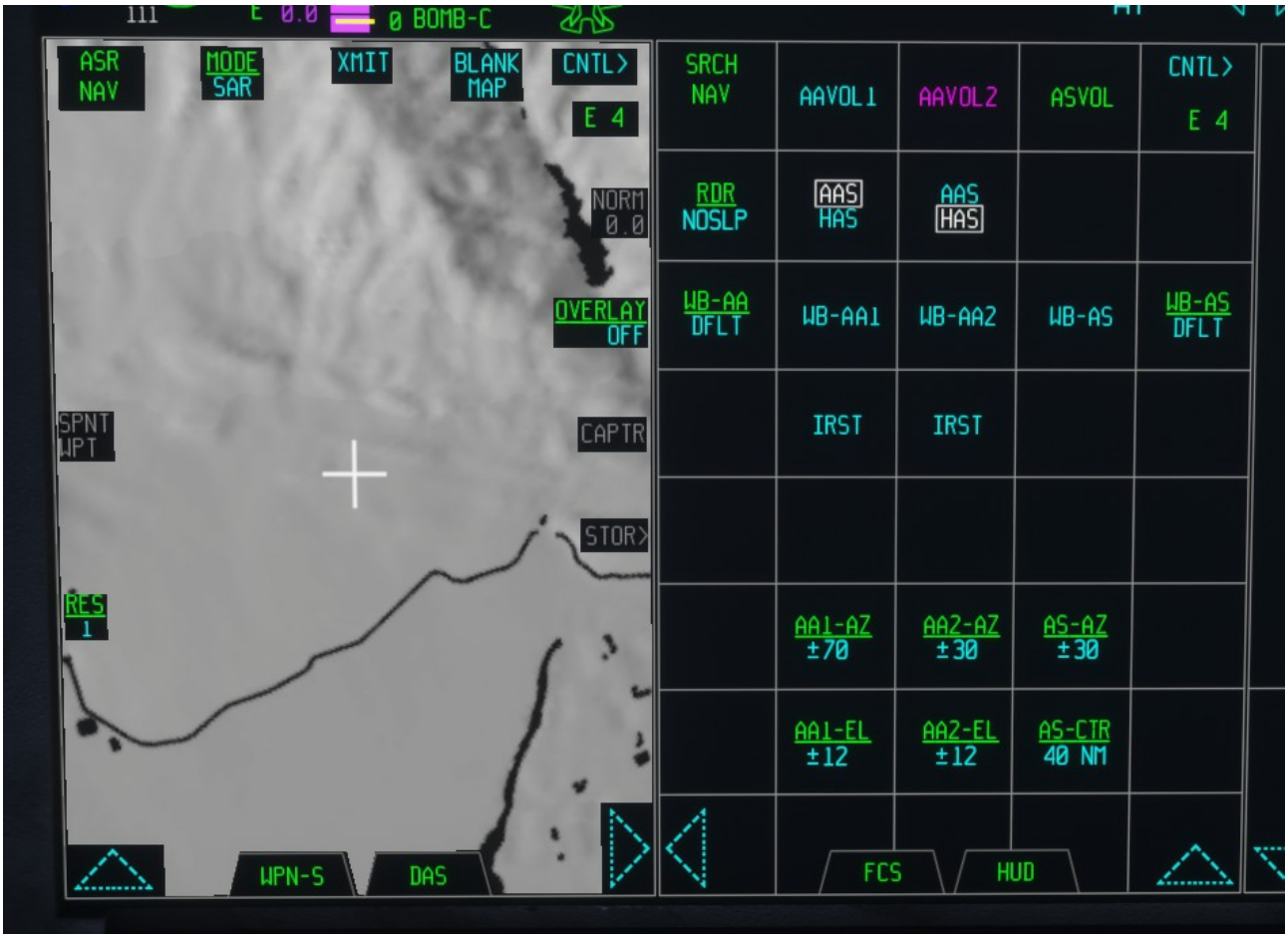
If ASR mode is selected, the MSFS synthetic imagery service is used to generate a local image of the terrain below the aircraft.

In the real world the pilot operates the ASR page (or the TSD) to identify a zone of interest, for which a high-resolution radar map is generated.
The pilot can then designate targets on the map, or use it to refine target position or edit the resulting image and send it to other units via data-link connection.

In the simulation, in ASR mode, the following controls are operable:

MODE button – toggles SAR mode

RES button – changes radar elevation



In its current state, in MSFS, the practical usage of the ASR SAR Mode is limited to high altitude reconnaissance.

NOTE:

ASR SAR mode require that the radar is either in NOSLP or in AASLP mode.

NOTE:

If altitude above ground is not sufficient to generate a clear map, or if the radar is not powered, a “NO IMAGE” message will appear instead of the map mode.

26. ELECTRO-OPTICAL DISTRIBUTED APERTURE SYSTEM

26.1 ELECTRO-OPTICAL DISTRIBUTED APERTURE SYSTEM

The AN/AAQ-37 electro-optical Distributed Aperture System (DAS) consists of six high resolution Infrared sensors mounted around the F-35 airframe in such a way as to provide unobstructed spherical (4π steradian) coverage and functions around the aircraft without any pilot input or aiming required.

The DAS provides three basic categories of functions in every direction simultaneously:

- Missile detection and tracking (including launch point detection and countermeasure cueing)

- Aircraft detection and tracking (Situational awareness IRST & air-to-air weapons cueing)

- Imagery for cockpit displays and pilot night vision (imagery displayed onto the helmet mounted display)

These functionalities are currently not supported by Microsoft Flight Simulator. In this simulation, the synthetic imagery service is used to generate a Bing Map image which can be used for navigation or reconnaissance.

The following controls/options are available in this page:

Camera angle – operating the mouse wheel on the centre of the image allows the pilot to adjust the camera angle from 0° to 90° down pitch.

27. ELECTRO-OPTICAL TARGETING SYSTEM

3.9.3 ELECTRO-OPTICAL TARGETING SYSTEM (EOTS)

The Electro-Optical Targeting System (EOTS) for the F-35 Lightning II is an affordable, high-performance, lightweight, multi-function system that provides precision air-to-air and air-to-surface targeting capability. The low-drag, stealthy EOTS is integrated into the F-35 Lightning II's fuselage with a durable sapphire window and is linked to the aircraft's integrated central computer through a high-speed fiber-optic interface. Advanced EOTS, an evolutionary electro-optical targeting system, is available for the F-35's Block 4 development. Designed to replace EOTS, Advanced EOTS incorporates a wide range of enhancements and upgrades, including short-wave infrared, high-definition television, an infrared marker and improved image detector resolution.

In the real aircraft this page is used to operate the Infra-Red sensors of the EOTS system, which is mostly used for target identification and designation, night and bad-weather navigation and IR imagery.

These functionalities are currently not supported by Microsoft Flight Simulator. In this simulation, the synthetic imagery service is used to generate a synthetic mapping image pointing forward in a way that mimics the appearance of the page in the real aircraft when used in the navigation mode. The following controls/options are available in this page:

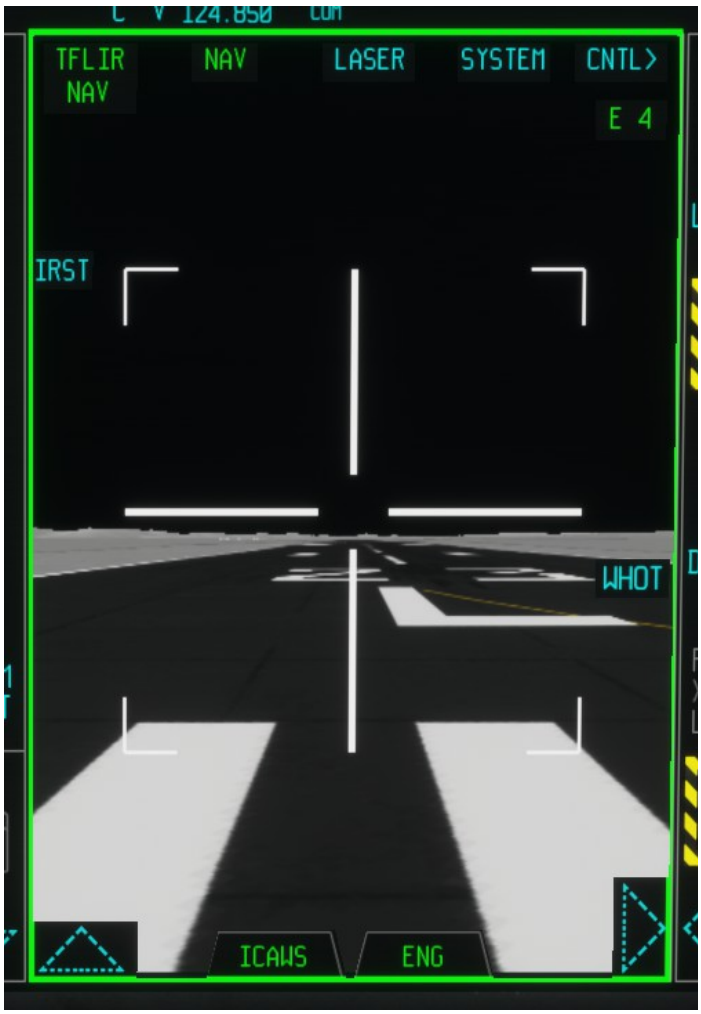
NAV/AS Modes – Select between NAV (forward looking) or AS (horizon stabilized) modes.

WHOT/BLOT options – In the real aircraft, WHOT is the “White HOT” and BLOT is the “Black HOT” mode. In MSFS, this is uses to toggle between two different grey-scales.

View Angle Control – Clicking on the cross-hair segment allow the user to control the elevation angle of the synthetic vision camera.

HOTAS Control – If the TFLIR page is the POI, Z-axis plunge of the CSC will activate direct control of the sensor elevation via the CSC Y-axis. A further Z-plunge or selection of a different POI will restore the normal HOTAS control mode. Direct control mode is indicate by the white color of the cross-hair Cursor disappears when HOTAS is in direct TFLIR control mode.

NOTE: if a surface target has been designated with the radar, and an Air-to-Surface weapon is selected, the system will automatically switch to A-S mode and will automatically track the target (in azimuth only). If a target is being tracked, HOTAS slewing will not work in the game (in reality it can be used to refine target location).



28.ELECTRONIC WARFARE COUNTERMEASURES

28.1. ELECTRONIC WARFARE AND COUNTERMEASURES – SYSTEM OVERVIEW

The F-35 is equipped with the ASQ-239 electronic warfare (EW) and countermeasures (CM) system is designed to provide air-to-air (AA) and air-to-surface (AS) threat detection and self-protection by detecting, identifying, locating and counter radio frequency (RF) and infrared (IR) threats.
The EW system supports the application of electronic support measures (ESM) through functions such as radar warning (RW) and emitter geolocation, high-gain electronic support measures (HG-ESM) and high-gain electronic countermeasures (HG-ECM) via radar multifunction array (MFA) utilization.

The CM subsystem provides multiple self-defense responses, based on available expendable payload and/or threat-specific self-protection plans.

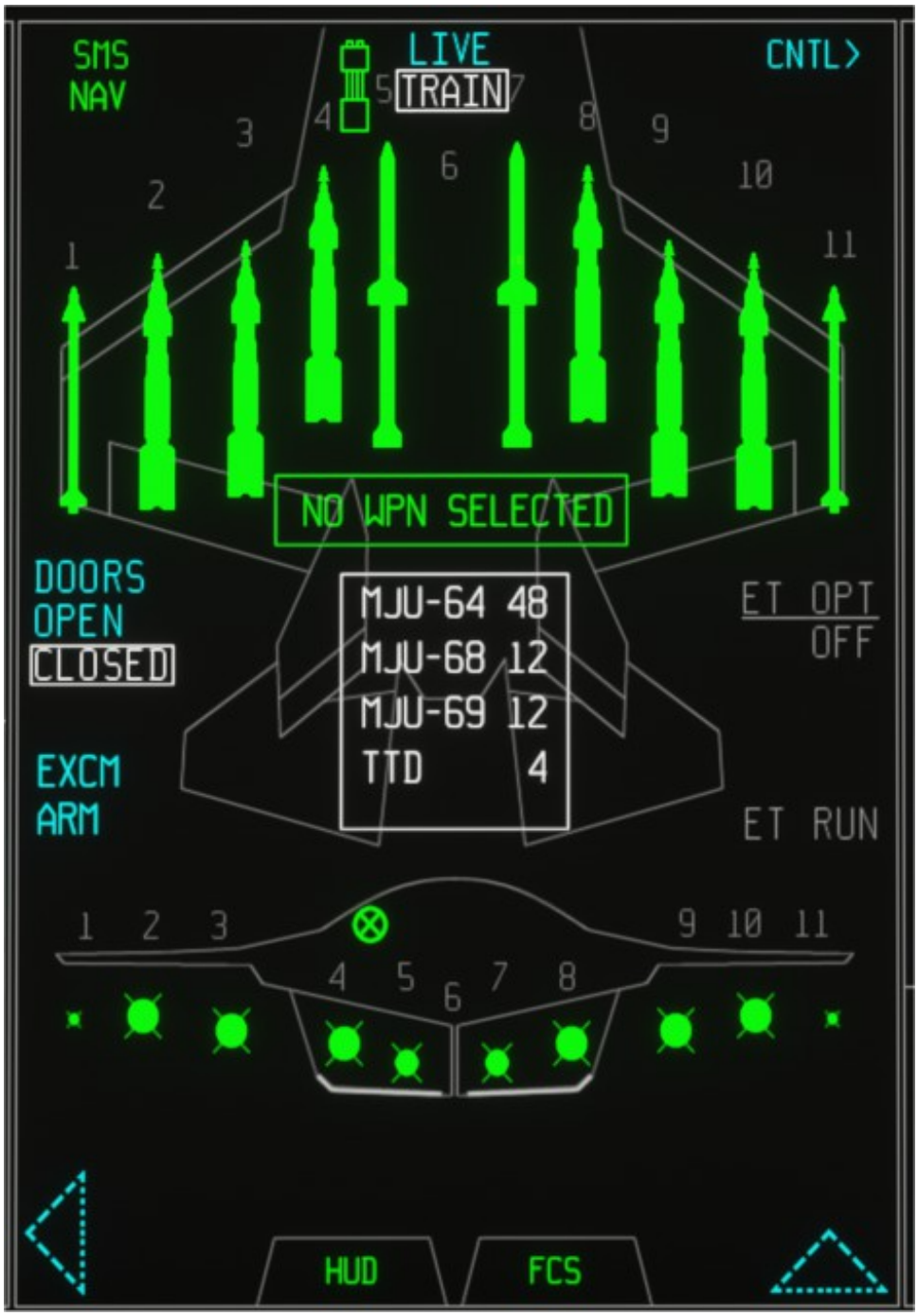
The main pilot interface to the system is the Threat Warning Display PCD page. The only control operable in the sim the the AUDIO setting which allows the generation of threat aural warnings (low-med-high).

NOTE:
In MSFS the EW system is linked to the RADAR system, and works by gathering data from the detected tracks (either by the radar system or by the Link16).

MSFS has no support for EW simulation, therefore threat severity is classified by object speed: low threat is probably a fast GA plane or a small business plane, medium severity is probably an airliner, a fast business jet or a combat aircraft, high severity is either a combat aircraft or a jet.

29. STORES

29.1 STORES MANAGEMENT SYSTEM PAGE (SMS)
Aircraft stores are managed via the Stores Management System page (SMS). This page shows a graphical depiction of both internal and external weapons, shows the currently selected weapon and its status, as well as the Master Arm status and countermeasures count and arm control.
Within this page, the pilot can select individual weapons and manually command the opening of the weapon bay doors if necessary.



The following controls/options are available in this page:

- LIVE/TRAIN MODE: if TRAIN is selected, clicking aircraft silhouette will change the aircraft configuration. If LIVE is selected, the same action will switch to the next available weapon.

- DOORS OPEN/CLOSE will toggle the opening of the weapon bay doors

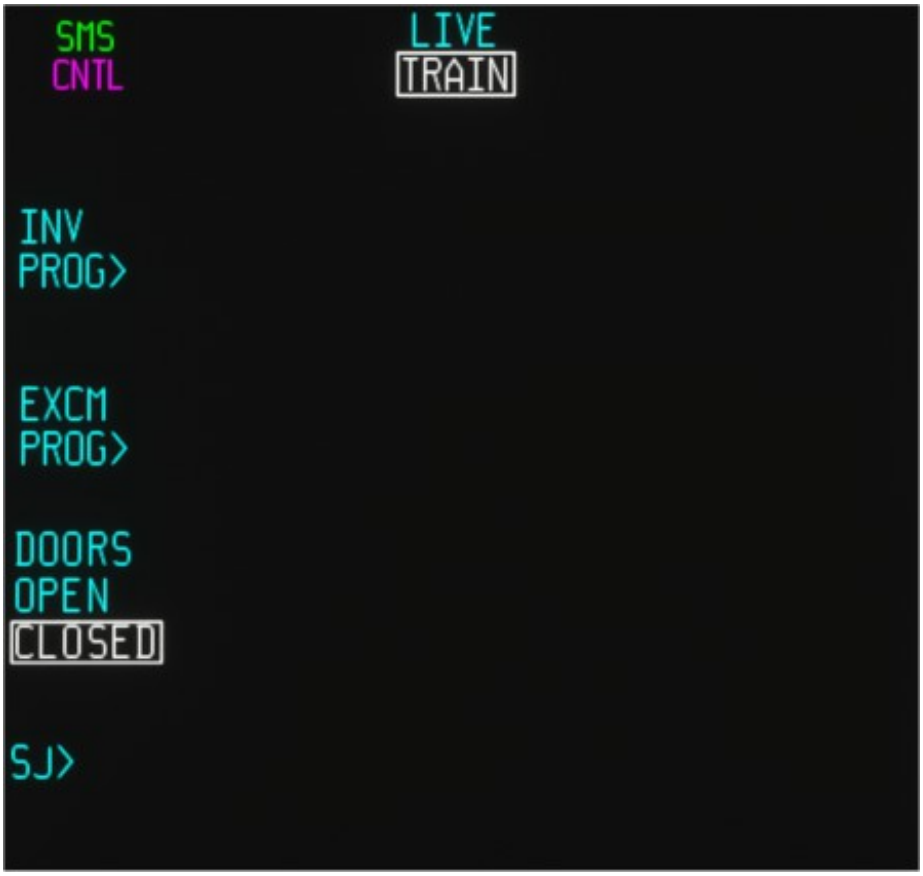
- EXCM ARM: Arms the countermeasure system

- SELECTED WEAPON: user can select a specific weapon by clicking on the selected weapon caption.

- CNTL> Control page

NOTE - The following key bindings are available: TOGGLE ANNUNCIATOR SWITCH will change the selected weapon, TOGGLE WATER RUDDER will open the weapon bay doors.

29.1.1 STORES MANAGEMENT SYSTEM CONTROL PAGE (SMS CNTL)



Pressing the CNTL button on the main SMS page, the Store Management System Control subpage will appear.

The following controls/options are available in this page:

- LIVE/TRAIN MODE: if TRAIN is selected, clicking aircraft silhouette will change the aircraft configuration. If LIVE is selected, the same action will switch to the next available weapon.

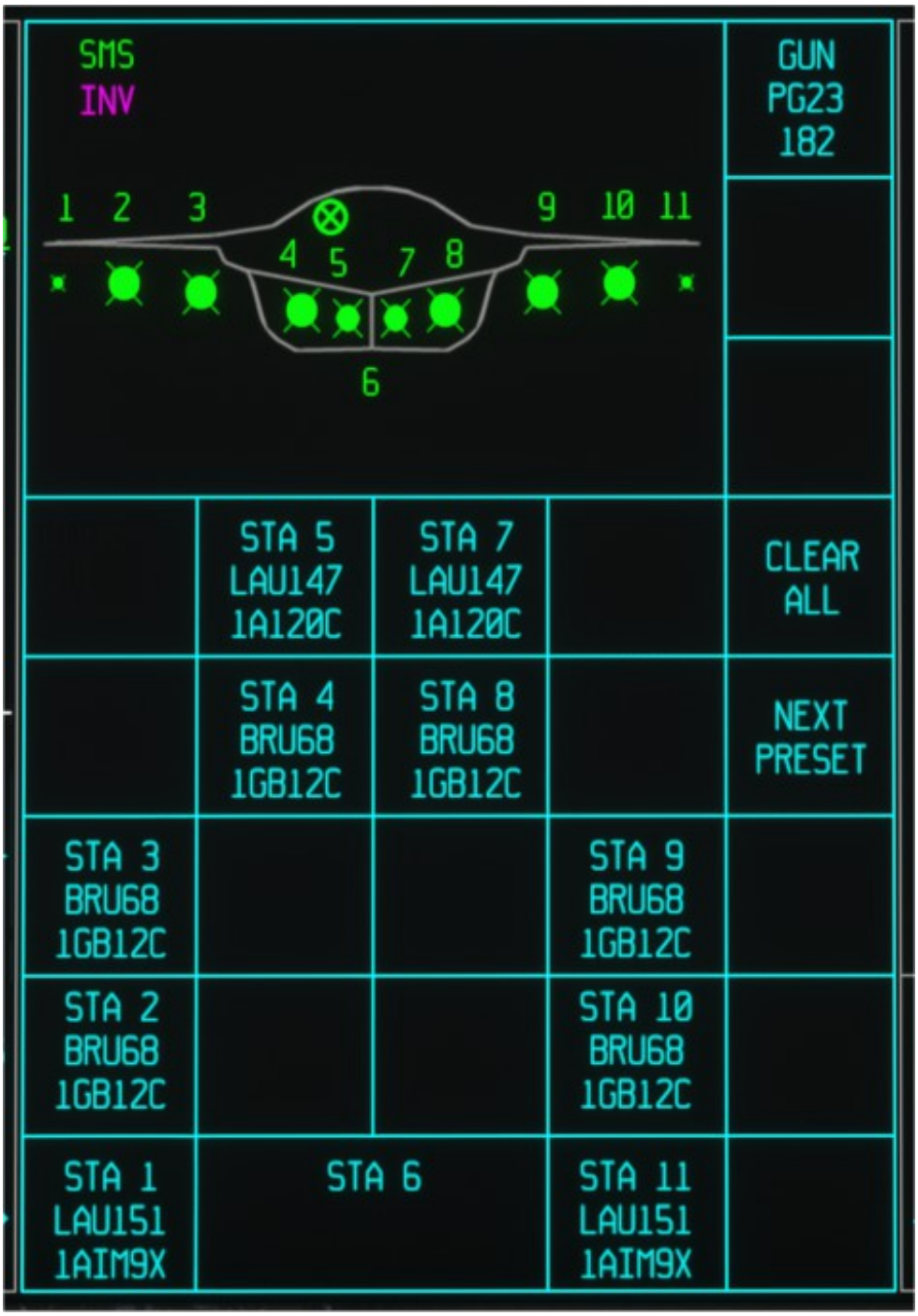
- DOORS OPEN/CLOSE will toggle the opening of the weapon bay doors

- INV PROG will invoke the SMS INVENTORY SUBPAGE that allows the user to select individual stores

- SJ will invoke the SELECTIVE JETTISON SUBPAGE that allows the user to select stores for Selective Jettison programming

In the real plane, this page also allows for programming the release of counteremasures and associate the programs to countemeasure switch positions.

29.1.2 INVENTORY MANAGAMENT SUBPAGE (SMS INV)



The SMS INVENTORY SUBPAGE that allows the user to select individual stores. The following controls/options are available in this page:

CLEAR ALL – clears all stores

NEXT PRESET – cycles through available presets

INDIVIDUAL STORES EDITING – clicking on the individual stores boxes will cycle between the available stores for that station.

29.1.2 SELECTIVE JETTISON SUBPAGE (SMS SJ)

The SMS SELECTIVE JETTISON SUBPAGE that allows the user to select individual stores for selective jettisoning. The following controls/options are available in this page:

CLEAR ALL – clears all stores

SEL ALL – adds all stores to the selective jettison program

INDIVIDUAL STORES EDITING – clicking on the individual stores boxes will assign or unassign the store to the jettison program.

29.2 WEAPON SYMBOLOGY

Starting from version 1.4.3, weapon symbology is provided on the virtual HUD on the HMD and the TSD PCD page (note – in reality these are also shown on the HUD and TFLIR pages).

In order to have weapon symbology to appear, it is necessary to:

- activate the radar in the SRCH page. Radar mode must match the type of target you are looking for (A-A, A-S or both).

- select a target in the TSD

- select a weapon in the SMS page. Weapon must match the target type.

Note: weapon selection will determine the Master Mode (A-A for air-to-air missiles, A-S for air-to-surface ordnance, DGFT for gun).

29.2.1 AIR-TO-AIR

When a radar air-to-air target is selected on the TSD, and an air-to-air missile is selected, target and launch symbology will be displayed as per the following image:

With reference to the image above:

1 – TARGET: symbol will change depending on target affiliation (diamond for hostile, square for neutral or unknown, circle for friendly). If the symbol is close to the edges of the virtual HUD, it will be parked at its borders if the error is within one degree. If the error is bigger, it will be replaced by a line which rotates around the waterline – line orientation will indicate the direction of the target.

2 – SHOOT CUE: a flashing SHOOT cue will appear if the target is in range and if speed, distance, elevation and azimuth provide a reasonably good likelihood of hitting the target.

3 – LINEAR MISSILE SCALE (LMS): a graphic depiction of the missile launch conditions is provided. The moving chevron represents the target distance from the aircraft. The upper mark on the side scale represents the maximum weapon range, the boxed area below is the “no escape” area.

NOTES:

1) in the real plane the scale is dynamic and changes with aircraft and target speeds, and expected missile performance (changes with altitude). In this rendition, the values are fixed to reasonable average values for each weapon.

2) the AIM-120 range is for non-extended range versions of the missile.

4 – TARGET INFORMATION: the following target information is displayed, top to bottom:

- closure velocity

- target aspect ratio

- distance in nautical miles

- flight time: if the target is in range this is the expected flight time for the missile to hit the target. If the target is not in range this is the time needed for the target to be in range.

29.2.2 AIR-TO-SURFACE

When a radar air-to-surface target is selected on the TSD, and an air-to-air weapon is selected, target and launch symbology will be displayed as per the following image:

With reference to the image above:

1 – TARGET: the surface target is indicated by a triangle. If the symbol is close to the edges of the virtual HUD, it will be parked at its borders if the error is within one degree. If the error is bigger, it will be replaced

by a line which rotates around the waterline – line orientation will indicate the direction of the target.

2 – IN ZONE, IN RANGE, DUD CUE (not shown in the image): IN RANGE indicates that the target is within the weapon maximum range and weapon can be released; IN ZONE indicates that multiple additional launch criteria are met and weapon can be released; DUD indicates that the weapon flight time is too short for the ordnance to arm, or there are other potential problems with the weapon release as the plane is too close to the target or too low.

3 – DYNAMIC LAUNCH ZONE (DMZ): a graphic depiction of the weapon release conditions is provided. The moving chevron represents the target distance from the aircraft. The vertical line weapon range represents “in range” condition, the boxed area below is the “in zone” area. The DUD depends on different factors but is roughly equivalent to the lower portion of the scale (below the boxed area).

NOTE - in the real plane the scale is dynamic and changes with aircraft speed and altitude. In this rendition, the values are variable but the scale is fixed (target distance is rescaled appropriately).

4 – TARGET INFORMATION: the following target information is displayed, top to bottom:

- target bearing and distance

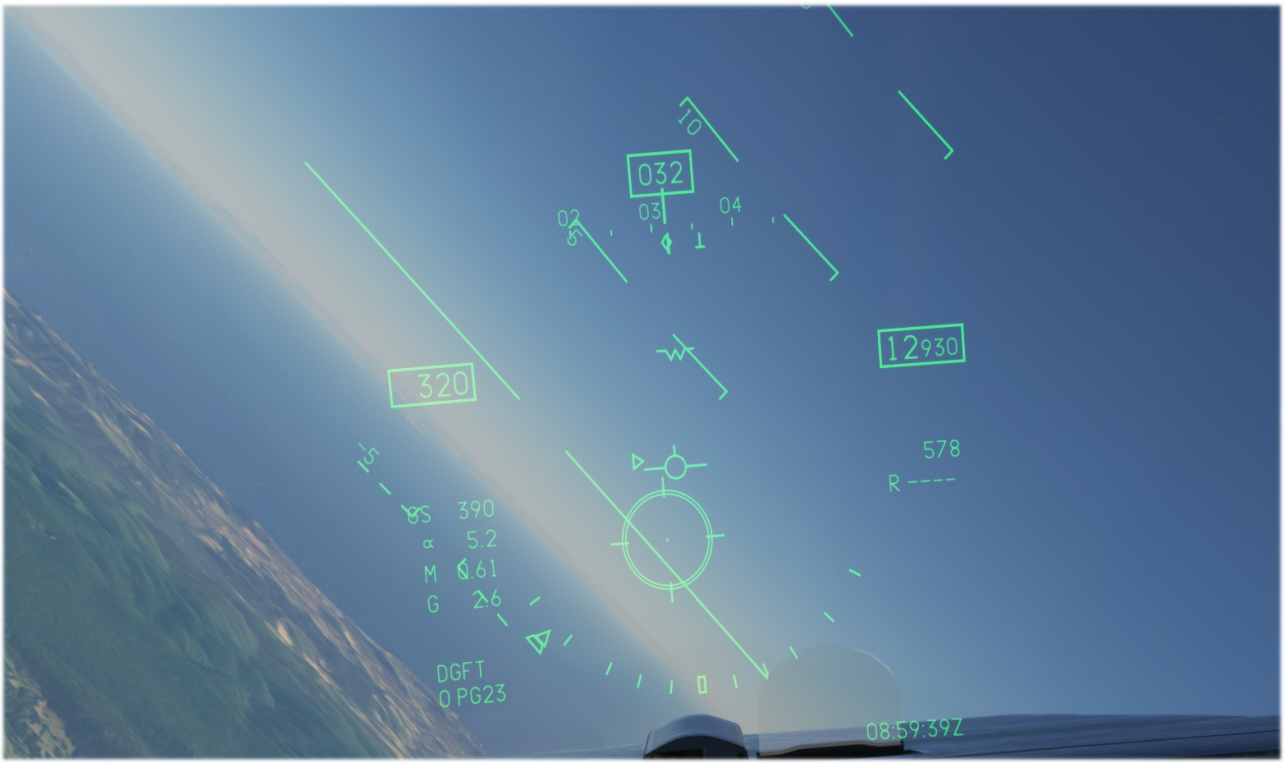
- flight time: if the target is in range this is the expected flight time for the weapon to hit the target. If the target is not in range this is the time needed for the target to be in range.

- time at impact: this is the expected time in which the weapon will hit the target if released now.

5 – WEAPON RELEAS LINE: if the target is visible in the virtual HUD, a weapon release line will appear. This represents the optimal launch direction. An horizontal line represents the target range with respect to the maximum release range (which in this case is represented by the velocity vector). If the line is above the velocity vector, the target is NOT within range. When the line reaches the velocity vector or is below it, the target is in range.

29.2.3 GUN PIPPER

If GUN is selected, gun pipper symbology is provided.



NORMAL OPERATIONS

30. NORMAL CHECKLISTS

30.1 NORMAL CHECKLISTS

Normal checklists are available in-game via the checklist drop-down menu.
A dedicated PCD page (CKLST) is also available. In the real aircraft this page will show the normal and emergency checklists, while, in this MSFS rendition, the page shows only basic checklists for normal operation. Also checklists are similar, but not identical to the real ones (real-world checklists not available to the general public). Note that PCD checklists are less verbose and detailed than the drop-down version.
The user can select the desired checklists from the menu on the left side.

The following controls/options are available in this page:

COCKPIT CHECK – initial cockpit (before engine start) checklist

ENGINE START – engine start checklist

TAXI CHECKS – taxi checklist

TAKE OFF – take-off checklist

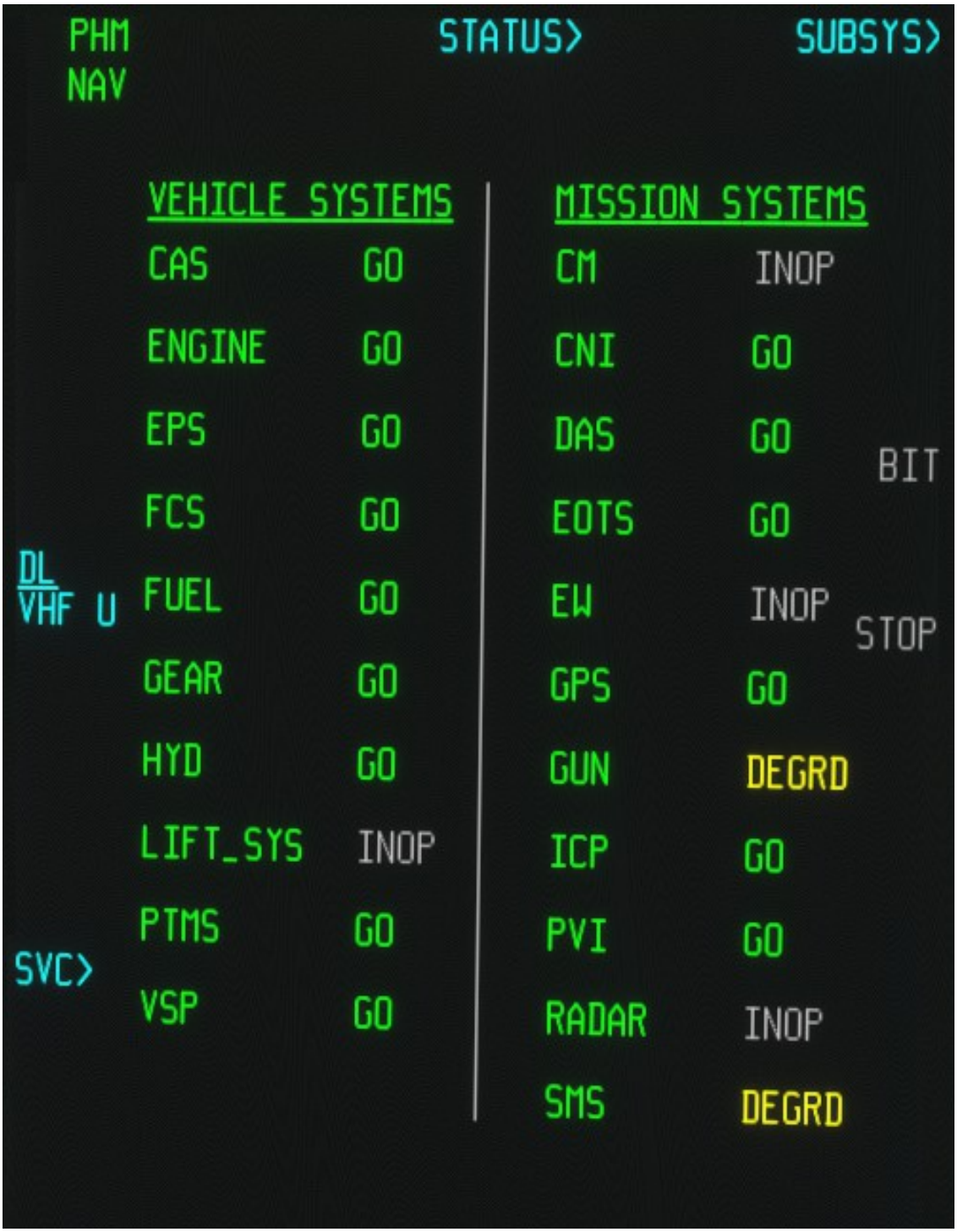
LANDING – landing checklist

POST LANDING – post-landing and shutdown checklist

31. PROGNOSTICS AND HEALTH MANAGEMENT

31.1 PHM – Prognostics and Health Management

The F-35 vehicle and mission systems and subsystems have vastly automated and comprehensive built-in test features and methods to foresee potential issues. The Prognostics and Health Management (PHM) system collects data from the various systems and the F-35 status is reported in the PCD PHM page. This system, which is central to the program's Performance Based Logistics (PBL) approach, is built on incremental capability deployment and a careful balance of on-aircraft and off-board software, systems and processes. The system is capable of monitoring the “health” status of the aircraft and report it to remote servers to allow the ground crew and the industry to plan for maintenance and relevant logistics actions.



There are no controls available in this page.

SPECIAL FUNCTIONALITIES

32. STOVL OPERATIONS (F-35B ONLY)

30.1 GENERAL INFORMATION

In this rendition, the F-35B has three main configurations:

• **CTOL-config:** for normal take-offs/landings and cruise flight. Lift-fan doors are closed, nozzle is pointed completely backwards.

• **STOL-config ("slow flight"):** (STOVL-mode, with Hover-sub-mode OFF): used for slow flight (70 - 200 knots) and short take-off/landing. Aircraft behaviour, and controls, are like in CTOL-config, but with attitude/speed restrictions. Lift-fan doors are open, nozzle is auto-controlled between 30 and 60 degrees. Airspeed depends on throttle, pitch attitude and wind.

• **VTOL-config:** (STOVL-mode, with Hover-sub-mode ON): used for vertical take-off and landings. Lift-fan doors are open, nozzle is auto-controlled between 75 and 100 degrees. Auto-throttle, and Auto-wind compensation. See below for control details. Please note that, while we tried to emulated the controls and behaviour of the real F-35B on the basis of the information publicly available, many changes have been implemented and some artistic license has been taken for better usability within the MSFS environment.

The biggest difference between this rendition and real life STOVL functionality is that STOL "slow flight" mode, if weight allows that, blends into hover mode if the pilot commands very low speeds.

30.2 STOVL LIMITATIONS

STOVL system can only be engaged in the following conditions

• Maximum airspeed for STOVL mode conversion is **250 Knots.**

• Maximum pitch & bank angles are **30 degrees.**

• Maximum weight to HOVER operation is **40600 lbs**.

Note: if the aircraft is too heavy to hover, the HOVER caption in the FCS page will be red.
You may want to dump fuel via the FUEL/DUMP command until the total weight is within the 40600 lbs. Limits

30.3 STOVL DYNAMICS IN MSFS

In this MSFS rendition, since STOVL functionality is not natively supported by the simulation, when the the slow flight or hover modes are engaged, the flight dynamics are overwritten by custom XML code.
This may cause some jittering which may increase as speed lowers.

In the PMD/DR page, the user can opt between two variants of the custom dynamics:

DEFLT STOVL LOGIC: This is the default selection: in the calculations in the custom dynamics it is assumed that the landing surface is static (airport, ground or stationary ship).

ALTERN STOVL LOGIC: If this option is selected, the custom dynamics will assume that the landing surface is moving (typically a moving ship) and may work better for some users in this specific case.

30.4 SPECIAL BUTTON ASSIGNMENTS AND CONTROLS

Before starting your first STOVL flight, please note that some standard MSFS functions have been used as "proxies" for STOL/VTOL functions, so that user can command these via keys instead of mouse operation only or, preferably, assign stick buttons to these functions:

• **TOGGLE TAIL HOOK LEVER:** this activates and deactivates STOVL-mode. Like in the real aircraft, the conversion to STOVL mode can be activated by pressing the HOOK/STOVL button on the top-left corner of the main control panel.

• **AUTOPILOT HEADING HOLD:** when in STOVL-mode, this sets VTOL-config (enables the Hover-mode ON). In the real aircraft, the “auto hover” mode is activated by pressing a button on the throttle. In this MSFS rendition, you can activate this also by pressing the HOVER area of the MFD touchscreen in the FCS page (note: the HOVER control appears only when the aircraft in in STOVL mode. If the HOVER button is red, the aircraft exceeds the weight of 40600 lbs. – which is the maximum for hover mode). The aircraft slows down to the target speed (0 by default) and keeps hovering automatically. Control scheme is different from the other modes, but very intuitive.

• **Aileron-trim:** this is used to set the desired ground speed when the aircraft is in the HOVER sub-mode: "aileron trim (centre)": set target speed to 0 (no default key, you have to assign one) "aileron trim (left)": increase target speed.

• **Altitude Hold:** this activates (in the air only) and activates Vertical-Speed-hold, when Hover mode is On. Default key is CTRL + Z.

30.5 CONTROLS IN HOVER MODE

During Hovering controls are as follows:

• Stick (elevator) back: gain altitude, proportionally.

• Stick forward: lose altitude, proportionally.

• Stick neutral: altitude remains constant. When V/S-Hold is On, the current V/S is maintained irrespective on Elevator position, so when V/S-hold is activated when stick is neutral, this means an exact Altitude Hold.

• Stick left (ailerons): roll left and gain lateral speed.

• Stick right: roll right and gain lateral speed.

• Rudder: change heading.

• Throttle: no effect, auto-thrust is engaged: the computer controls thrust/throttle.

Also, while in hover mode, the computer automatically compensates wind, so with set target speed of 0 and stick neutral, the F35B truly hovers in relation to the earth's surface.

Head/tailwind component is compensated by setting nozzle more/less than 90 degrees, while crosswind component is compensated by banking into the wind.
When the disengagement of STOVL mode is commanded in flight, full thrust is set, and the aircraft accelerates quickly; when sufficient airspeed is reached (around 180 Knots), STOVL mode control is released and you fly the plane as usual.

30.6 SHORT TAKE OFF (STO)

The typical take off for the F-35B is the Short Take Off (STO). Performing a short take off is extremely easy:

- When the aircraft is still press the HOOK/STOVL button to initiate the conversion
- After conversion is complete, advance the throttle to FULL
- Perform rotation at about 80kts
- Above 300ft radar altitude retract landing gear
- Above 500 ft and 170 knots depress HOOK/STOVL button to convert to conventional flight.

30.7 AUTOMATIC SHORT-TAKE-OFF

The F-35 features an automatic short take-off mode that will bring the airplane in the air in the shortest possible distance. To engage this mode:

- set one portal view to FCS
- engage the STOVL mode
- engage the wheel brakes
- the AUTO TO option in the FCS page will turn light blue
- select the AUTO TO in the FCS screen
- release the brakes when ready to take-off

The plane will automatically accelerate, take-off in the shortest possible distance, pilot must retract the landing gear and convert to conventional flight

30.8 SLOW FLIGHT

In order to engage slow flight mode from conventional flight, the aircraft must be below 240 kts IAS, and pitch and bank must be within +/-15 degrees from the horizon.

To transition from conventional flight to slow flight mode, the pilot shall:

- Decelerate below 240 Knots
- Engage the STOVL mode by pressing the HOOK/STOVL
- You now fly normally, with airspeeds between 75 and 200, depending on your throttle lever setting
- For stability, pitch/bank attitude is limited to +/- 30 degrees.

30.9 VERTICAL LANDING

Performing a vertical landing in the F-35 is very easy:

- Make sure that the aircraft gross weight is below 40600 lbs. Dump fuel or drop payload as needed.
- Approach the landing point in “slow flight” mode.
- When near the landing spot, convert to auto-hover sub-mode **(note: this is allowed only if the aircraft is within the 40600lbs total weight limit, otherwise command is rejected)**
- The nozzle is set to 103 degrees, and the aircraft quickly decelerates to 0 knots ground speed (“DECEL” shows in the HMD)
- Using stick, rudder and Target Speed control, hover to the landing spot; thrust/throttle is auto-controlled and wind is auto-compensated.
- Target Speed (in the air: ground speed relative to the earth surface) can be set between -20 and 50 Knots.
- When hovering over the landing spot, push the stick forward to land.
- After touchdown, the Hover-sub-mode is set Off, and thrust is set to Idle.
- Set the Parking Brakes, and move your throttle lever/wheel to Idle.

30.10 VERTICAL TAKE OFF

The F-35 is capable of vertical take-off, but this is not the intended operation of the aircraft, since to perform a vertical take-off the gross weight must be below 40600lbs., with huge constraints to fuel and ordnance load.
Therefore vertical take-off is mostly limited to testing and demonstration purposes.

To perform a vertical take-off:

- Make sure that the aircraft gross weight is below 40600 lbs.
- Initiate STOVL conversion (“slow flight” mode).
- Once STOVL conversion is complete, engage HOVER mode.
- Pull back on the stick
- Once the aircraft is safely airborne, you may want to progressively increase airspeed before converting to CTOL mode.

1 – HMD STOVL Symbology: engine RPM and nozzle orientation are reported on the HMD whenever STOVL mode is engaged

2 – TARGET SPEED: this can be controlled via the AILERON TRIM command

3 – ENGINER RPM

4 – NOZZLE ORIENTATION

5 – HOVER COMMAND (in reality it is controlled with the throttle HOTAS). The HOVER caption is RED if hover is not available (aircraft does not meet the condition), cyan if available, and white if engaged.

31. CARRIER OPERATIONS (F-35C ONLY)

31.1 GENERAL INFORMATION

At the moment of the initial release of the F-35, MSFS did not support carrier operations.
Limited carrier functionality has been added with the release of the “TOP GUN” package: in detail, the simulator now supports moving carriers and arrestor hook functionalities.
In order to have some (very basic) carrier action for the F-35C, we have added some code to provide launch and arrest functionality.

If LAUNCH BAR is deployed when the aircraft is on the ground and the throttle is advanced to 80% RPM or more and wheel brakes are engaged, the aircraft will simulate a catapult launch (once the brakes are released). This will work on any surface and any orientation as long as the plane altitude is between 50 and 100 ft (typical carrier deck altitudes).

If TAILHOOK is deployed the aircraft will simulate an arrested landing – this will work on any surface (as long as the plane altitude is between 50 and 100 ft (typical carrier deck altitudes).

If you are using a STATIC carrier scenery, we suggest you set the weather so that a wind of 25-30 knots is blowing from the ship bow, for more realistic landing speeds.

31.2 EXPERIMENTAL FEATURE – SIMPLE LSO

During the development of the MSFS F-35 we explored the possibility of creating a simple LSO. The feature is not complete but we decided to leave it in for the release.
The “Simple LSO” is activated by selecting the CALL THE BALL option in the auxiliary menu. Option is only available in the F-35 when the hook is down.

The “simple LSO” will provide basic LSO radio calls (at the moment it is limited to AoA/speed calls and Wave OFF)

APPENDIX

APPENDIX A – LIST OF L:VARIABLES EMPLOYED BY THE F-35

In order to allow third party mods to interact with the F-35 avionics and systems, here is a list of some special L: variables (local variables) which can be (safely) used. Note that the BEHAVIOR window in Developer mode can also list all the local variables and their value (and it also allows for direct modification for testing purposes).

PANORAMIC CONTROL DISPLAY

(L:MFDX_Screen, number) - Portal X (where X is 1,2,3 or 4) page currently displayed (see list of modes below). For example if L:MFD2_Screen, number) is set to 1, portal 2 will switch to ASR mode.

(L:MFDX_Sub-portal, bool) – Controls the visibility of sub-portals on Portal X. 0 = Portals invisible, 1 = Portals are visible. For example if **(L:MFD3_Sub-portal, bool)** is set to 0, portal 3 will be in the enlarged mode and sub-portals will not be displayed.

(L:MFDX_SubportalY, number) – This variable controls the page currently displayed on sub-portal Y of portal X, where X is 1 to 4 and Y is 1 or 2. **(L:MFD3_Subportal1, number)** is set to 1, the first sub-portal of portal 3 will be set to ASR mode.

(L:MFD_Top_Bar_Swap, bool) – Controls is the top bar is swapped (1) or not.

LIST OF PORTALS AND SUBPORTAL MODES:

Basic modes:

0 → MENU
1 → ASR
2 → CHKLST
3 → CNI
4 → DAS
5 → DTM
6 → EFIS
7 → ENG
8 → FCS
9 → FTA (not used anymore)
10 → FTI (not used anymore)
11 → FUEL
12 → HUD
13 → ICAWS
14 → PHD
15 → SMS
16 → SRCH
17 → TFLIR
18 → TSD1
19 → TSD2
20 → TSD3
21 → TWD
22 → WPNA
23 → WPNS

Full screen modes (NOTE these must be applied to both sides of each screen half, so they must be applied both to MFD1 and MFD2 or to MFD3 and MFD4). The mode codes are the same as the basic modes + 100. Only few modes are available.

106 → EFIS
107 → ENGINE
108 → FCS
111 → FUEL
112 → HUD
118 → TSD1
119 → TSD2

120 → TSD3

Pop up pages – some pages are available also as POP UP. Note: we discourage the modder to invoke these pages unless he/she has a good understanding of how the PCD operates.

207 → ENGINE (only MFD1 and 3)
208 → FCS (only MFD1 and 3)
211 → FUEL (only MFD1 and 3)
215 → SMS (only MFD 1 and 3)
213 → ICAWS (only MFD 2 and 4)

Pages uniquely available as POP UP

224 → AUTOPILOT (only MFD 2 and 4)
225 → MENU (only MFD 1 and 3)
226 → LIGHTS (only MFD 2 and 4)
227 → NAVIGATION (only MFD 1 and 3)
228 → IDENTIFICATION (only MFD 2 and 4)
229 → BARO setting (only MFD 2 and 4)
230 → COMM (only MFD 1 and 3)
231 → ECS (only MFD 1 and 3)

NAVIGATION SYSTEMS

(L:NAVMode,number) – Navigation source currently in use: 0 = none, 1 = GPS / RTE, 2 = VOR/ILS, 3 = TACAN

INTEGRATED POWER PACKAGE

(L:IPPMasterSwitch, bool) - Position of IPP master switch 1 (1 is ON)

(L:ICC1Switch, bool) – Position of ICC switch 1 (1 is ON)

(L:ICC2Switch, bool) - Position of ICC switch 2 (1 is ON)

(L:IPPCabinPressureSelector, enum) – cabin pressure selector 0 = dump, 1 = norm, 2 = alternate

NOTE: IPP battery switch is operated by the default master battery command, IPP START is operated by the default starter command.

MISCELLANEOUS SYSTEMS

(L:CanopyCommand, bool) - controls the commanded canopy position, (0 closed, 1 open)

(L:switch_launch_bar_position, bool) – controls the commanded launch bar position (0 retracted, 1 extended)

(L:lever_tailhook, bool) - controls the commanded tailhook position, also STOVL doors on F-35B (0 retracted, 1 extended)

(L:switch_weapon_doors, bool) - controls the commanded weapon door position, (0 closed, 1 open)

(L:switch_IFR_door, bool) - controls the commanded refuel probe/door position, (0 closed, 1 open/extracted)

(L:MasterArmSwitch,number) – Master arm switch setting (0 = SAFE; 1= ARM)

(L:SafetyPin1, bool) – Safety pin 1 (1 present, 0 removed)

(L:SafetyPin1, bool) – Safety pin 2 (1 present, 0 removed)

(L:EjectionSeatArmPilot, bool) – Ejection seat arming (if safety pin is removed): 1 ARM; 0 SAFE

APPENDIX B - REALISM AND SIMULATION FIDELITY – LIST OF KNOWN INACCURACIES

While we tried our best to provide a reasonable simulation fidelity and a level of realism that we hope can be considered acceptable for most users, this package is a very simplified simulation of the F-35.
Much of the information about this aircraft is classified including actual flight envelope and precise information on avionics.
On the other hand, there is also a lot of information publicly available – and there are more pictures, articles, pilot reports, and YouTube videos than you would think, and we advise you to check them out for very interesting information about this fantastic flying machine.

We tried to achieve a reasonable compromise between realism, educated guess-work, usability in a home-computer simulation environment and development time and resources.

It is not perfect, but we hope that the complexity and the quality will be satisfactory for most users. Here is a short list of some of the most outstanding inaccuracies and shortcomings of the package:

• Multi-function display – some pages of the MFD are quite accurate, at least if compared to the latest screenshots and training videos. Still, several pages are either INOP or incomplete – mostly because MSFS does not support specific sensors or functions. Also, in the real F-35 the TSD screen can zoom and pan to specific locations.

• Radar and sensor fusion – one of the most amazing feature of the F-35 is its radar and the ability to merge the information coming from a wide variety of sources in order to provide the pilot an unprecedented situational awareness. Unfortunately, we did not have the skill and resources to mimic this in the simulation.

Anyway, with all the inaccuracies of this package, we have good reasons to believe that this is the most realistic and complete rendition of the Lightning II ever seen in a home environment and we hope it provides an acceptable rendition of what it is like to fly what is most likely THE most advanced fighter in the world today.

Please find below a list of Youtube videos that have been used as source material for the development of this project and may be an useful introduction to the aircraft. Please note that these videos reflect different versions of the real-world software.

PRIMARY CONTROL DISPLAY OVERVIEW AND OPERATION:
https://www.youtube.com/watch?v=1oyCzT6sB_4

PRIMARY CONTROL DISPLAY OPERATION, AA AND AG MODES:
https://www.youtube.com/watch?v=5lPZDc8mzsY

F-35 SIMULATOR
https://www.youtube.com/watch?v=mmC7sJUDCqw

F-35 SIMULATOR
https://www.youtube.com/watch?v=vGU3noa1PEU

F-35 WALKAROUND
https://www.youtube.com/watch?v=4QpFUvBlqkY

F-35 WALKAROUND
https://www.youtube.com/watch?v=FolbyrJFNaE

APPENDIX C - CONTACT INFORMATION

Official Facebook page: https://www.facebook.com/p/Indiafoxtecho-100063594881948

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