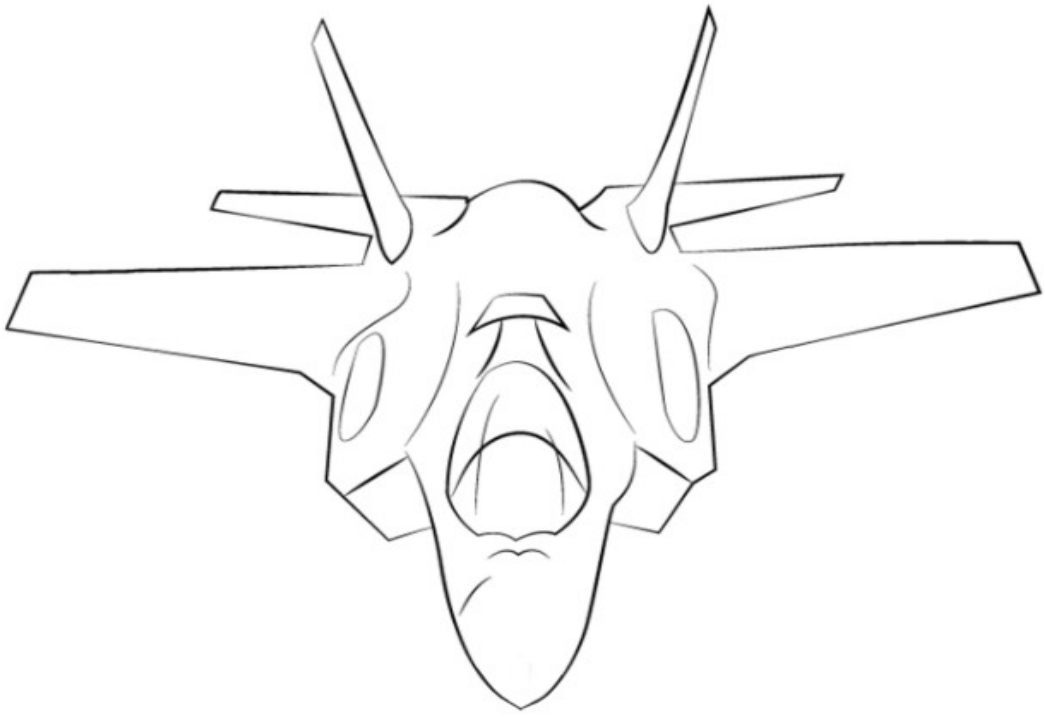
INDIA FOXT ECHO
VISUAL SIMULATIONS

F-35 LIGHTNING II AIRCRAFT for Microsoft Flight Simulator

USER MANUAL



Product Version 1.0.0 – January 2022

CHANGE LOG

INITIAL RELEASE
03-Jan-2022

WELCOME

The Lockheed Martin F-35 Lightning II is an American family of single-seat, single-engine, all-weather stealth multirole 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. Lockheed Martin is the prime F-35 contractor, with principal partners Northrop Grumman and BAE Systems. The aircraft has three main variants: the conventional takeoff 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 Lockheed Martin X-35, which in 2001 beat the Boeing 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 airpower 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.

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.

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

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 recognizeable 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 aicraft 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.

CREDITS

Alessandro Schimicci.....	Cockpit 3D modeling
Giuseppe Didiano.....	Flight model
Dino Cattaneo ….....	Development lead, 3D modeling, texturing, coding, Project management

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 its wikipedia page: https://en.wikipedia.org/wiki/Lockheed_Martin_F-35_Lightning_II

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

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

ABOUT THIS MANUAL

As the 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.

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.

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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.

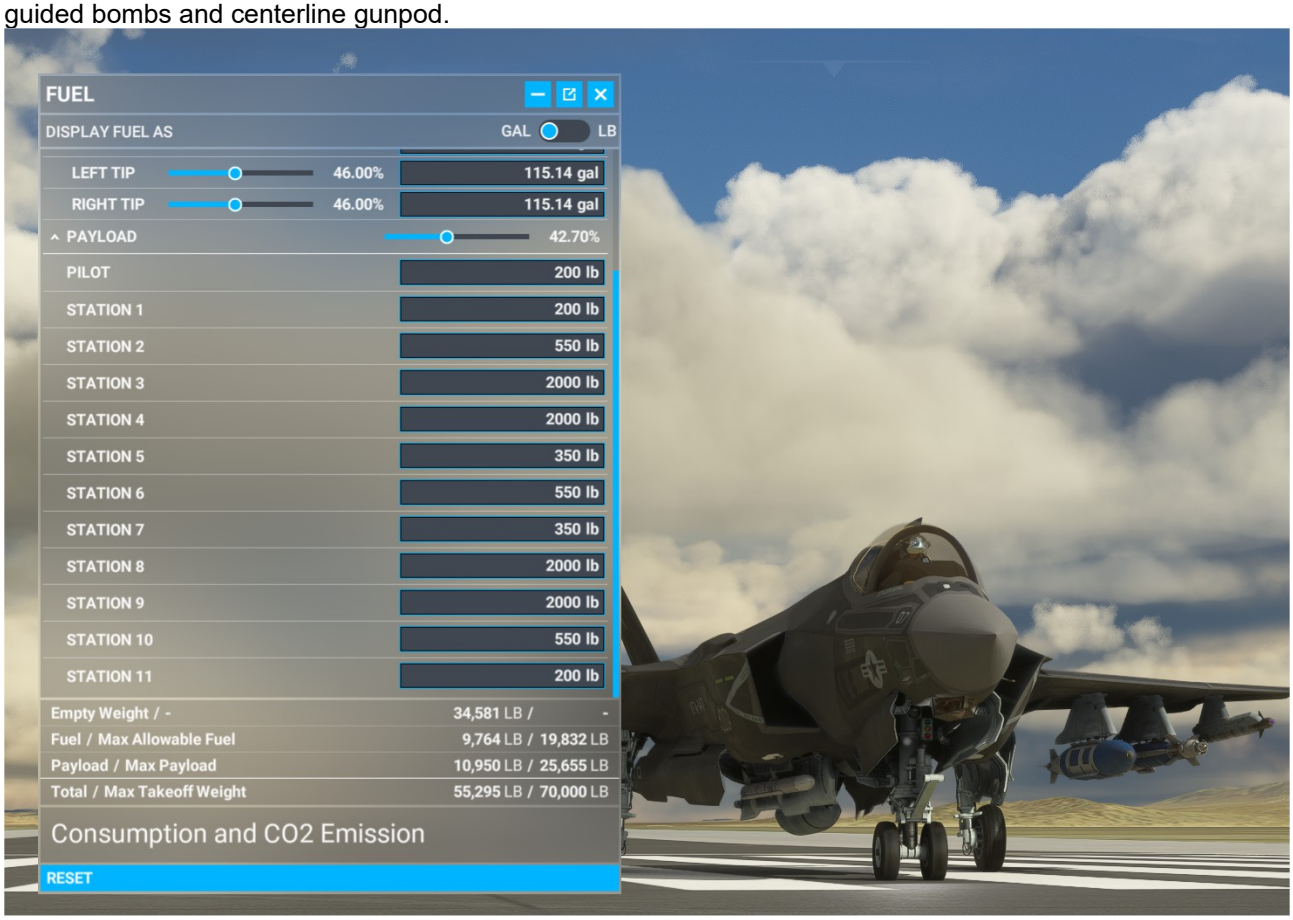
LICENSE RESTRICTIONS

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 closerly 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 Lockheed Martin Corporation or by any Armed Service.i

EXTERNAL LOADS

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



The weapon models will only we available on copies purchased outside the Microsoft Marketplace, as weapons are not allowed on that platform.

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

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

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

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

THE F-35 LIGHTNING II

The F-35 Lightning II is a fifth-generation, single-seat, single-engine stealth multirole fighter that can perform close air support, tactical bombing, and air defense 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.

DESIGN OVERVIEW

The F-35 resembles a smaller, single-engine sibling of the twin-engine Lockheed Martin 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 fiber 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 of pilot training in order to reduce the costly flight hours of the actual aircraft.

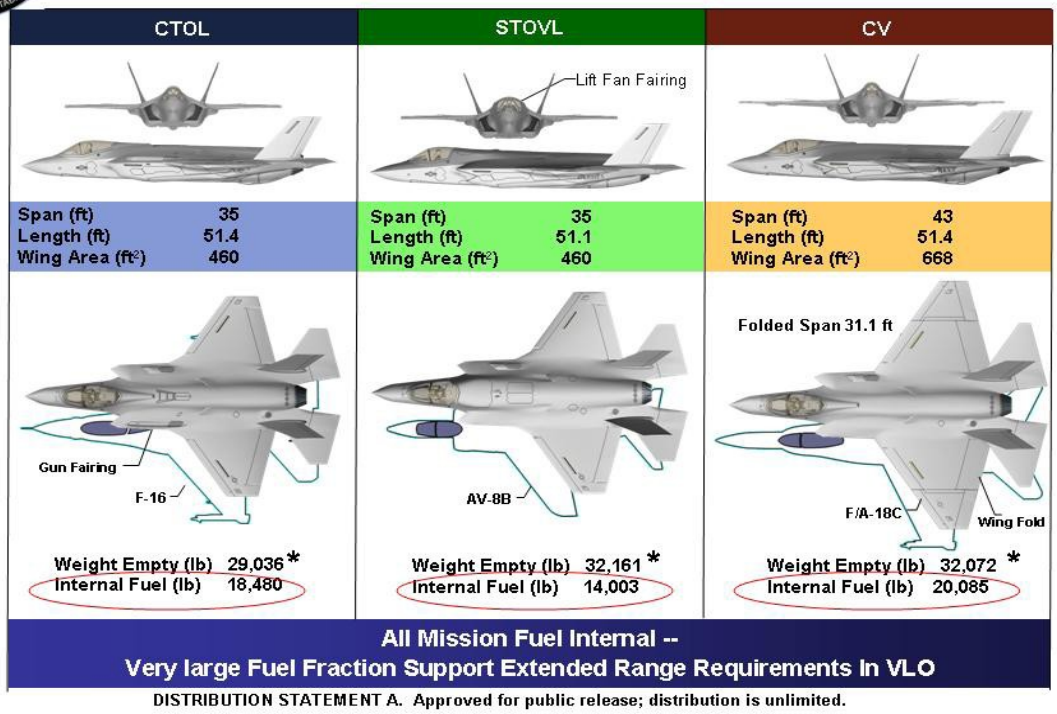
The F-35 will be the first mass produced aircraft to include structural nanocomposites, namely carbon nanotube reinforced epoxy.

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.

Differences between variants

	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 takeoff 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 nmi (2,220 km)	900 nmi (1,670 km)	1,400 nmi (2,520 km)
Combat radius on internal fuel	613 nmi (1,135 km)	469 nmi (845 km)	610 nmi (1,130 km)
Thrust/weight			
• full fuel:	0.87	0.90	0.75
• 50% fuel:	1.07	1.04	0.91



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 maneuverability, 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.

F-35B

Similar in size to the A variant, the B sacrifices some fuel volume to make room for the vertical flight system. Takeoffs 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.

F-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.

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 maneuverability.

– 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.

ENGINE

The F-35 is powered by a Pratt & Whitney F135 a mixed-flow afterburning 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 the Rolls-Royce Lift System, designed by Lockheed Martin and developed by Rolls-Royce. The Lift System is 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.

Specifications (F135-PW-100)

General characteristics

Type: afterburning 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/afterburning)

Specifications (F135-PW-600 for F-35B)

General characteristics:
Type: Afterburning 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 ratio (powered lift),
Specific fuel consumption: ~0.886 lb/(hr·lbf) or ~25,0 g/kN·s (w/o afterburner)

INTEGRATED POWER PACKAGE

The aircraft's integrated power package (IPP) 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 IPP is a small gas-turbine engine "turbomachine" 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 IPP is also available for in-flight emergency power.

SENSORS AND AVIONICS

NOTE – DUE TO MICROSOFT FLIGHT SIMULATOR LIMITATIONS THE MISSION SYSTEMS AND SENSORS ARE NOT SIMULATED IN THIS RENDITION. IN DETAIL, RADAR, EOTS, DAS, TWR AND ECM ARE NOT OPERATIONAL IN THE SIM.
THE FOLLOWING PARAGRAPHS ARE PROVIDED FOR GENEAL INFORMATION ONLY.

The F-35's sensor and communications suite has situational awareness, command and control and network-centric warfare capabilities. The main sensor on board is the AN/APG-81 Active electronically scanned array-radar, designed by Northrop Grumman Electronic Systems. It is augmented by the nose-mounted Electro-Optical Targeting System (EOTS) that provides the capabilities of an externally mounted Sniper Advanced Targeting Pod with a reduced radar cross-section. The AN/ASQ-239 (Barracuda) system is an improved version of the F-22's AN/ALR-94 electronic warfare suite, providing sensor fusion of Radio frequency and Infrared tracking functions, advanced radar warning receiver including geolocation targeting of threats, multispectral image countermeasures for self-defense against missiles, situational awareness and electronic surveillance, employing 10 radio frequency antennae embedded into the edges of the wing and tail. In September 2015, Lockheed unveiled the "Advanced EOTS" that offers short-wave infrared, high-definition television, infrared marker, and superior image detector resolution capabilities. Offered for the Block 4 configuration, it fits into the same area as the baseline EOTS with minimal changes while preserving stealth features.
Six additional passive infrared sensors are distributed over the aircraft as part of Northrop Grumman's electro-optical AN/AAQ-37 Distributed Aperture System (DAS), which acts as a missile warning system, reports missile launch locations, detects and tracks approaching aircraft spherically around the F-35, and replaces traditional night vision devices. All DAS functions are performed simultaneously, in every direction, at all times. The electronic warfare systems are designed by BAE Systems and include Northrop Grumman components. Functions such as the Electro-Optical Targeting System and the electronic warfare system are not usually integrated on fighters. The F-35's DAS is so sensitive, it reportedly detected the launch of an air-to-air missile in a training exercise from 1,200 mi (1,900 km) away, which in combat would give away the location of an enemy aircraft even if it had a very low radar cross-section.

The communications, navigation and identification (CNI) suite is designed by Northrop Grumman and includes the Multifunction Advanced Data Link (MADL), as one of a half dozen different physical links. The F-35 will be the first fighter with sensor fusion that combines radio frequency and IR tracking for continuous all-direction target detection and identification which is shared via MADL to other platforms without compromising low observability. The non-encrypted Link 16 is also included for communication with legacy systems. The F-35 has been designed with synergy between sensors as a specific requirement, the aircraft's "senses" being expected to provide a more cohesive picture of the battlespace around it and be available for use in any possible way and combination with one another; for example, the AN/APG-81 multi-mode radar also acts as a part of the electronic warfare system.

Much of the F-35's software is written in C and C++ due to programmer availability, Ada83 code also is reused from the F-22. The Integrity DO-178B real-time operating system (RTOS) from Green Hills Software runs on COTS Freescale PowerPC processors.
The electronic warfare and electro-optical systems are intended to detect and scan aircraft, allowing engagement or evasion of a hostile aircraft prior to being detected.

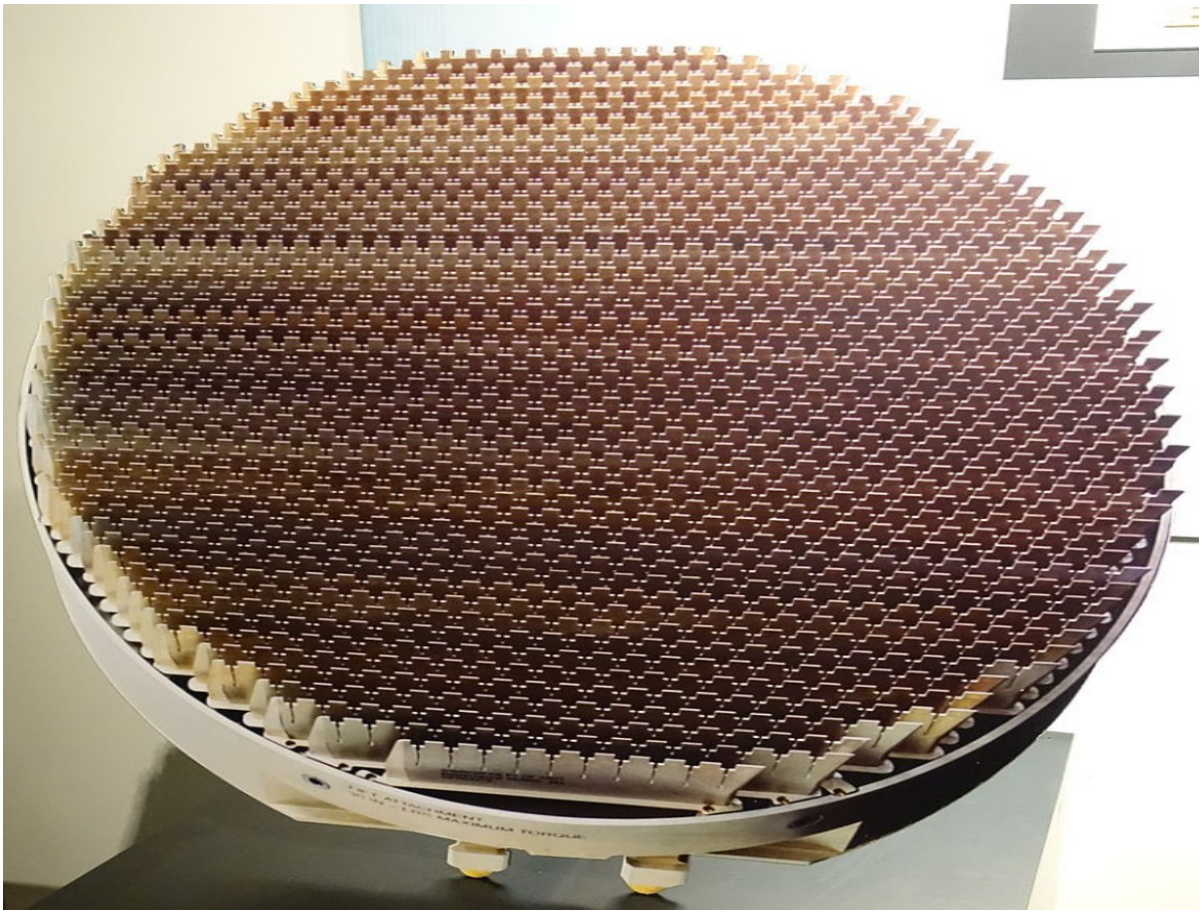
AN/APG-81 AESA RADAR

The F-35 is equipped with the AN/APG-81 Active Electronically Scanned Array (AESA) radar system designed by Northrop Grumman Electronic Systems.

The Joint Strike Fighter AN/APG-81 AESA radar is a result of the US government's competition for the world's largest AESA acquisition contract. Westinghouse Electronic Systems (acquired by Northrop Grumman in 1996) and Hughes Aircraft (acquired by Raytheon in 1997) received contracts for the development of the Multifunction Integrated RF System/Multifunction Array (MIRFS/MFA) in February 1996. he AN/APG-81 is a successor radar to the F-22's AN/APG-77. Over three thousand AN/APG-81 AESA radars are expected to be ordered for the F-35, with production to run beyond 2035, and including large quantities of international orders. As of October 2013, over one hundred APG-81s have already been produced and delivered. The first three blocks of radar software have been developed, flight tested, and delivered ahead of schedule by the Northrop Grumman Corporation. Capabilities of the AN/APG-81 include the AN/APG-77's air-to-air modes, plus advanced air-to-ground modes, including high resolution mapping, multiple ground moving target indication and track, combat identification, electronic warfare, and ultra- high bandwidth communications. The current F-22 production radar is the APG-77v1, which draws heavily on APG-81 hardware and software for its advanced air-to-ground capabilities.

A demonstration of the AN/APG-81 capabilities can be seen here:

https://www.youtube.com/watch?v=wIwAOupjMeM



AN/AAQ-37 DISTRIBUTED APERTURE SYSTEM

The AN/AAQ-37 electro-optical Distributed Aperture System (DAS) is the first of a new generation of sensor systems being fielded on the Lockheed Martin F-35 Lightning II Joint Strike Fighter. 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)

The F-35's DAS was flown in military operational exercises in 2011 and has also demonstrated the ability to detect and track ballistic missiles to ranges exceeding 800 miles (1300 kilometers) and has also demonstrated the ability to detect and track multiple small suborbital rockets simultaneously in flight.

A demonstration of the DAS system can be seen here:

https://www.youtube.com/watch?v=e1NrFZddihQ

ELECTRO-OPTICAL TARGETING SYSTEM (EOTS)

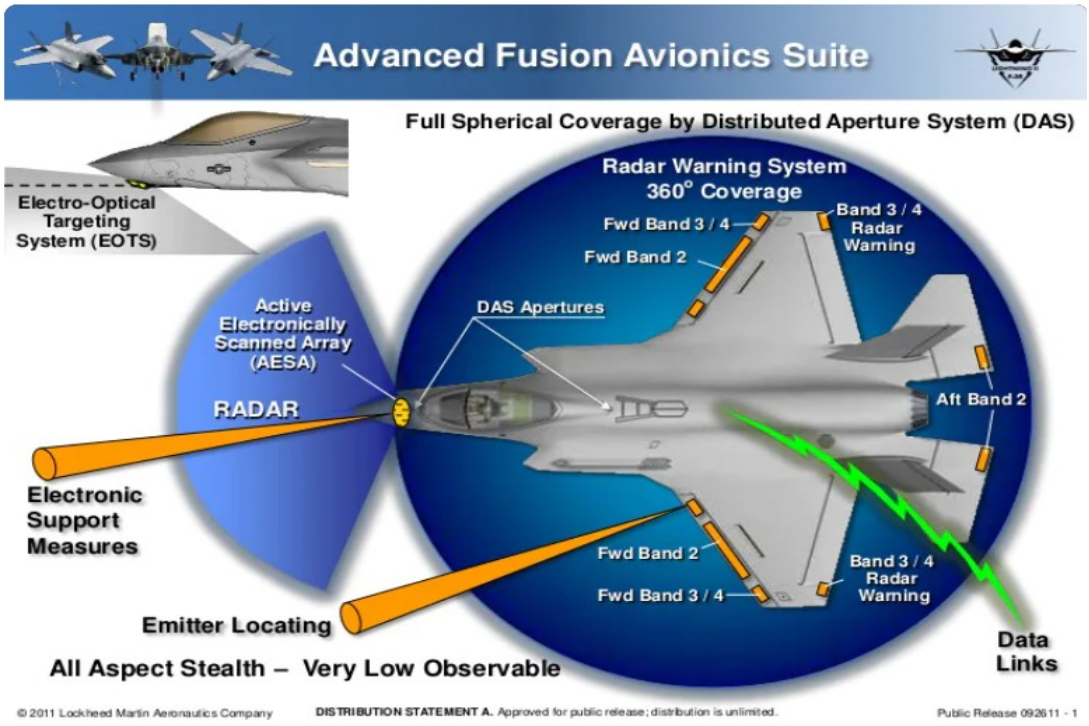
The Electro-Optical Targeting System (EOTS) for the F-35 Lightning II is an affordable, high-performance, lightweight, multi-function system that provides precision air-to-air and air-to-surface targeting capability. The low-drag, stealthy EOTS is integrated into the F-35 Lightning II's fuselage with 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.

A demonstration of the EOTS system can be seen here:

https://www.youtube.com/watch?v=vZ0nwQ4wO2s

SENSOR FUSION

A key feature of 5th generation fighters is sensor/information fusion: information coming from different subsystems (Radar, Radar Warning Systems, EOTS, DAS and datalink) is collected, compared and integrated in a single intuitive battlespace depiction in the Tactical Situation Display, providing the pilot with unparalled situational awareness. The F-35 can also easily share this information with other assets.



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.

IMPORTANT NOTES FOR THE SIMULATION:

FLAPS – Flaps are completely computer controlled. In the simulation, flap will deploy automatically during takeoff (half) and landing (full) depeding on speed and landing gear status. They will also deploy automatically during maneuvering at any time in which they will provide an advantage to the aircraft maneuvarability and handling.

AUTO-TRIM – The real aircraft has an auto-trim functionality, so that trim action is not required by the pilot. In the simulated version, following feedback from the testers, the autotrim feature was disabled from the initial release. The aircraft will react to pilot flap inputs in MSFS, but will almost immediately revert to the scheduled position.

VIRTUAL SPEED BRAKED – 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.

AUTOMATIC LIFT DUMP – The real-world aicraft has an automatic lift dump function, so that, after touchdown, control surfaces are actuated to minimize lift and braking distance. This feature is not present in the initial release of the simulated aircraft.

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

COCKPIT

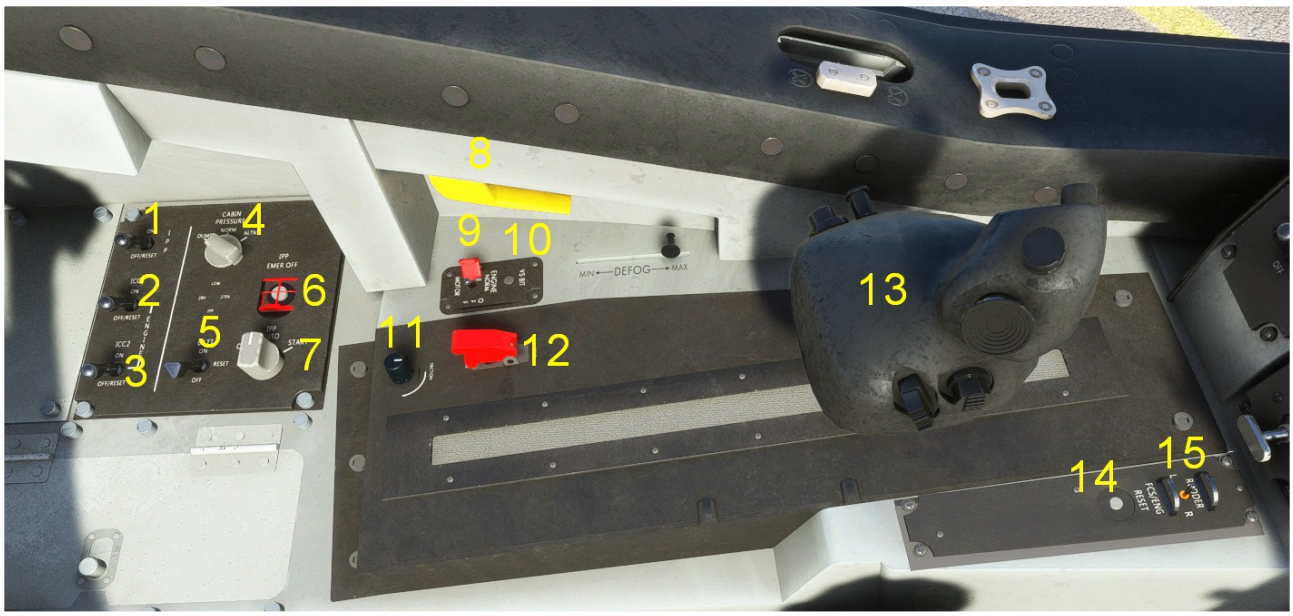
The F-35 features a full-panel-width "Panoramic Cockpit Display" (PCD) glass cockpit, with dimensions of 20 by 8 inches (50 by 20 centimeters).

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

1 – Integrated Power Package (IPP) Master 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 pushbutton

7 – Engine Starter

8 – Canopy control lever

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

10 – V/S BIT Pushbutton – *NOTE: INOP in the initial release*

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 – *NOTE: No function in MSFS*

15 – Rudder Trim Switch

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)

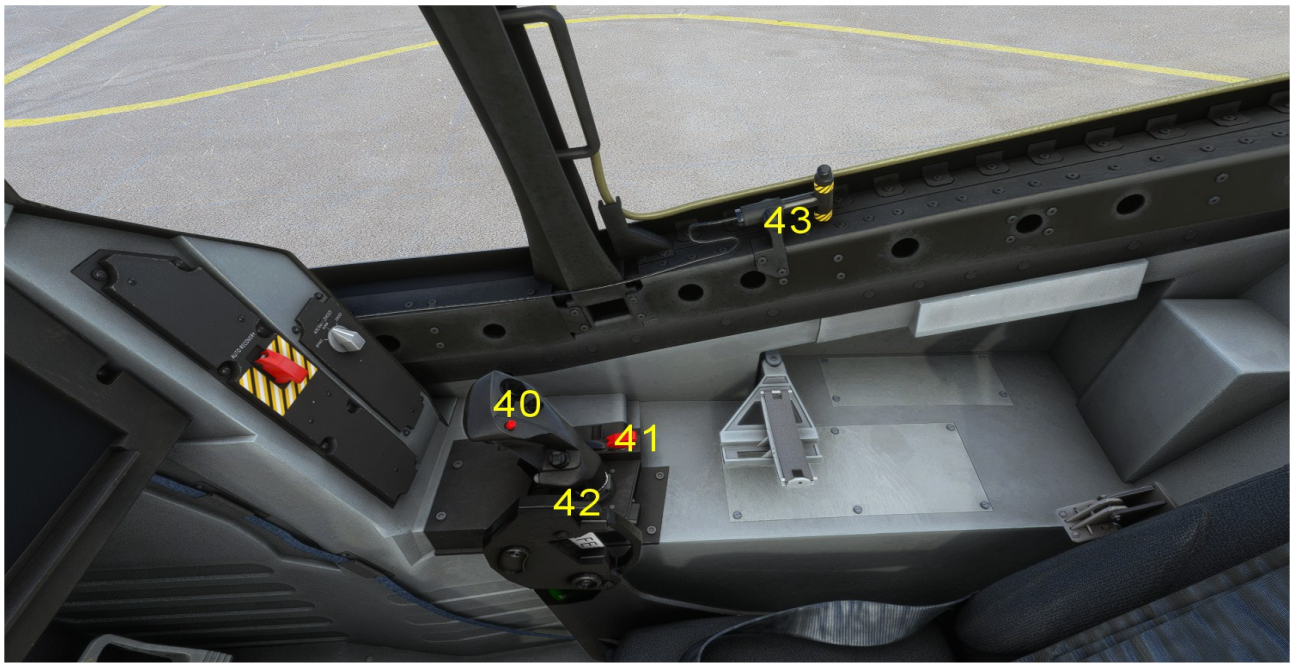
35 – BFI ALIGN button - *NOTE: No function in MSFS*

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*

PANORAMIC COCKPIT DISPLAY

The core of the F-35 pilot interface is a 20 by 8 inches (50 by 20 centimeters) 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 FAB (Function Access Buttons) and four, interchangeable and customizable sections called **portals.**

The FAB 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**.

COLOR CODING

Information in the PCD is color 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

FUNCTION ACCESS BUTTONS

The FAB provides a summary of critical aircraft systems status, as well as quick access to the a “POP UP” version of some of the 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 upper FAB is divided as follows:

1 - ENGINE area – RPM and throttle settings are displayed - NOTE: when afterburner is engaged, this area is surrounded by a yellow/black striped box.

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.

3 – WEAPON STATUS – MRM, SRM, GUN and Bombs quantities are shown – NO FUNCTION IN MSFS

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

5- 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.

6 - 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.

7 - 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.

8 – COMMUNICATIONS - This area reports status of COM A, COM B and COM C radios. Clicking on this area will invoke the COMMUNICATIONS pop-up portal

The VIDEO RECORDER button is inoperative.

9 – NAVIGATION - This area reports the current NAVIGATION SOURCE (Nav source): RTE (GPS Route), VOR or TACAN - Clicking on this area will invoke the NAVIGATION pop-up portal.

10 - MENU button – Clicking in this area will make an additional MENU page to appear. This page allows the pilot to access a number of additional functions such as lights control (LITES)

11 – IDENTIFICATION - This area reports the current IFF Transponder codes - clicking on this area will invoke the IDENTIFICATION pop-up portal

12 – BARO / CABIN PRESSURIZATION / GCAS / ALOW - This area reports 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.

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.

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 (Inoperative in MSFS)

CHKLST> Checklist

CNI> Communications Navigation and Identification (Inoperative in MSFS – CNI functions are accessed by the FAB)

DAS> Distributed Aperture System (Inoperative in MSFS)

DIM> Data and Information Management page (Inoperative in MSFS)

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

SMS> Stores Management System

SRCH> Search page (Inoperative in MSFS)

TFLIR> Targeting Forward Looking Infra-Red (Inoperative in MSFS)

TSD-1> Tactical Situation Display 1

TSD-2> Tactical Situation Display 2

TSD-3> Tactical Situation Display 3

TWD> Threat Warning Display (Inoperative in MSFS)

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-A – Air to Air

A-S – Air to Surface

CKLST – Checklist

This page will show the basic checklists along with basic A/C weight data.
The page interface has been vastly revised from the original, and checklists are generic and for the most part fictional, as the real-world checklists are still classfied, but based on the ones of comparable real-world aircrafts.
The user can select the desired checklists from the menu on the left side.

Detailed in-game checklists are also provided and are accessible from the checklist menu.

EFI – Electronic Flight Instrumentation

This page will show a quite complete Electronic Flight Instrumentation page, including Attitude and Direction Indicator and Horizontal Situation Indicator.
The layout of the page changes a bit if maximized or not.
If the page is maximized, as usual, 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.

In this page, the navigation source / navaids data is displayed with the following color convention:

GREEN – RTE (GPS route) – will only be displayed if a flight plan is loaded.

CYAN – TACAN – will only be displayed if a TACAN station is currently tuned.

MAGENTA – VOR – will only be displayed if a VOR station is currently tuned.

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

In this page the pilot can:

– Switch ADI and HSI views if the portal is not maximized

– Select HEADING and CouRSe angles, by clicking on their respective areas

– Toggle the Course Deviation Indicator (CDI) on/off

– Toggle the Flight Director on/off

- Select the NAV SOURCE (RTE, VOR or TACAN)

ENG – Engine

This page will show the folloing engine performance data:

THRUST (as percentage of maximum thrust)

EGT

NOZZLE OPENING

N1 RPM percentage

N2 RPM percentage

OIL pressure

FUEL FLOW

HYDRAULIC PRESSURE (1 and 2)

Any condition that may require pilot attention will be highlighted in red.
The only control available in this page is the A-ICE button that will activate all the anti-ice devices of the aircraft.

FCS – Flight Control system

This page will show the flight control system status. 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.

Within this page the pilot can:

- engage/disengage the autopilot

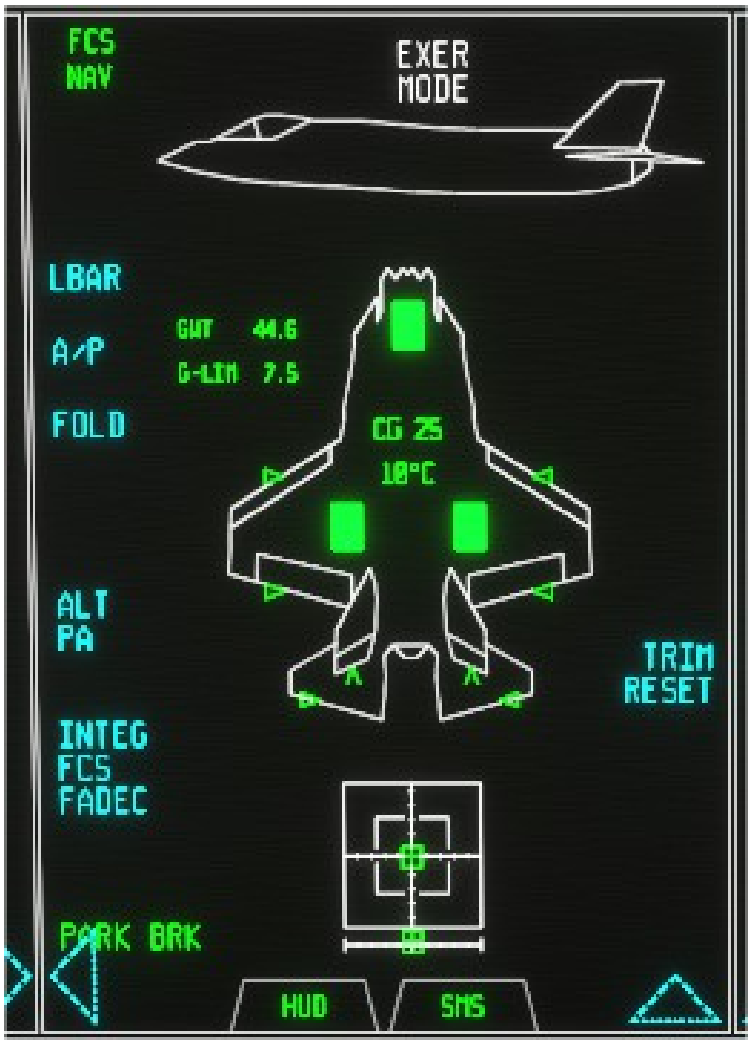
- retract/extend the launch bar (F-35C only)

- fold/spread the wings (F-35C only, and only if a/c is on the ground and speed is very slow)

- command the Direct Lift System to enter the automatic hover mode, (F-35B only – see details on the “Special Instructions for STOVL mode” section below).

- 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)

NOTE: HOVER can only be commanded if the total aircraft weight is below 40600 lbs.



FUEL – Fuel system management

This page shows the total fuel quantity available, as well as the quantity in each individual fuel tank and the status of the refuel system.
Within this page the pilot can:

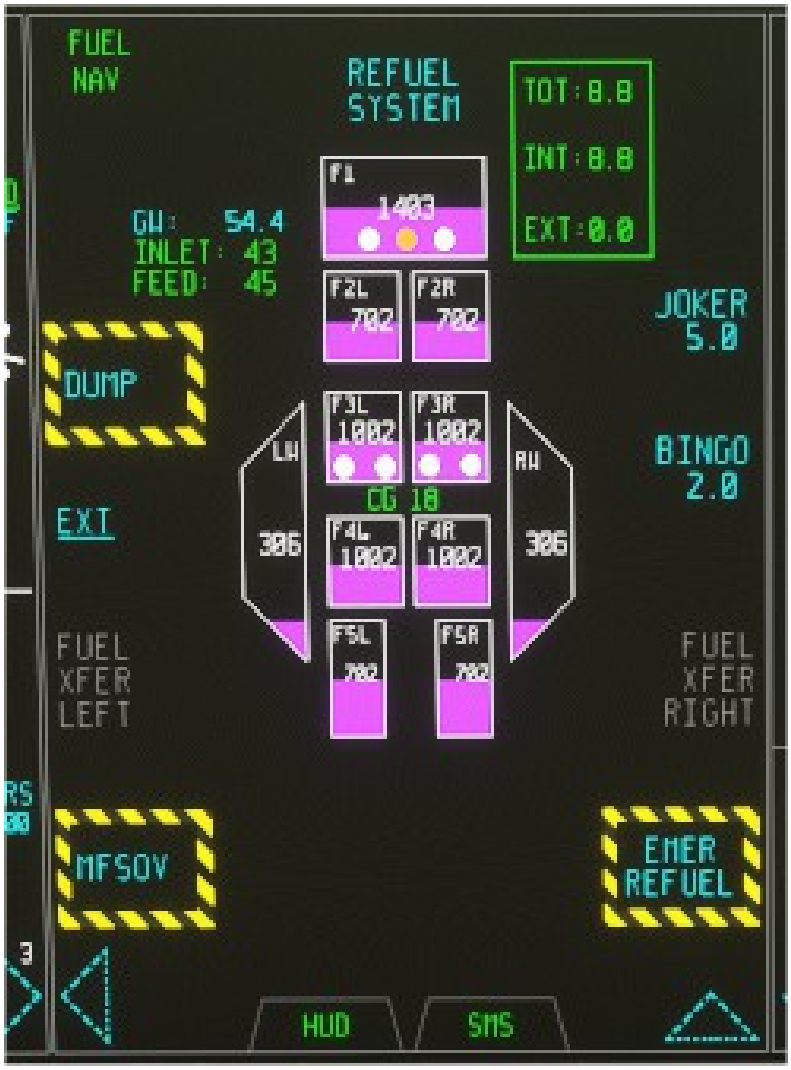
– Toggle the opening of the fuel dump valve with the DUMP command (requires confirmation from the pilot).

– Toggles 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 with the REFUEL SYSTEM command.

– Activate the Main Fuel Shut-Off Valve in case of emergency with the MFSOV command (requires confirmation from the pilot)

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

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



HUD – Head Up Display

This page shows on the MFD the same information shown on the Virtual Head Up Display function of the Helmet-Mounted Display.
For several reasons, however, only the main data are shown in this rendition.
Specifically, most of the essential flight data information is shown, but the weapons information is not.
Within this page the pilot can use the TFLIR command to slave the TFLIR sensor to the boresight of the aircraft.

ICAWS – Integrated Caution, Advisory and Warning System

The Integrated Caution and Warning Systems collects all the advisory messages from the various F-35 systems and presents them in a clear and unified way.
In the real thing, this page is also used to command the BIT (Built-In Test) procedures.
In this rendition, only a few systems are monitored and presented and BIT is not implemented. However, the ICAWS conditions are correctly color coded and implemented.

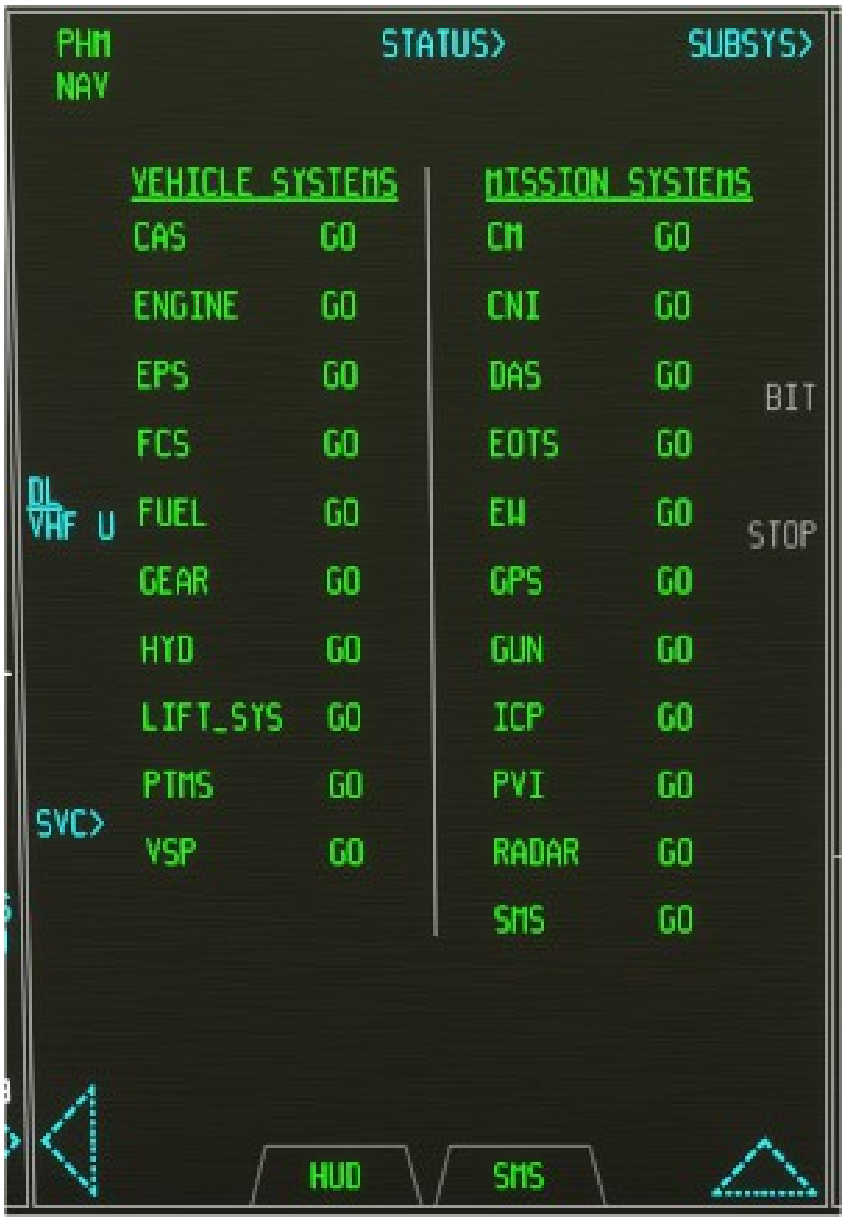
RED (WARNING) – These conditions require immediate pilot attention and corrective actions as they represent major risks of injuries, fatalities or loss of the aircraft.

YELLOW (CAUTION) – These are potentially dangerous condition which require immediate pilot attention, however do not expose the aircraft or the pilot to immediate risk.

GREEN (ADVISORY) – These alerts represent conditions which require pilot attention, but should not represent a risk condition.

PHM – Prognostics and Health Management

This page shows the status of the Prognostics and Health Management (PHM) system.
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.



SMS – Stores Management System

This page shows the status of the Stores Management System, with 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 the CHAFFS and FLARES count.

Within this page, the pilot can select individual weapons and manually command the opening of the weapon bay doors if necessary.

In the Microsoft Flight Simulator rendition the only operable command in this page is the DOOR OPEN/CLOSE control.

TSD-1 – Tactical Situation Display 1 – 2 – 3
The Tactical Situation Displays show, in a simple and effective way, a horizontal projection of everything the aircraft systems know about the surrounding area: navigation, mission and tactical information are presented clearly to provide the best possible situational awareness to the pilot.
As a result of the sensor-fusion and network sharing approach, the data presented is a synthesis of what the aircraft knows from its own sensors, and what it has been detected from any friendly asset capable of sharing information.
Three independent pages can be shown and controlled separately.
In this rendition, the functionality is limited and the pages will only show the position of:

- the current waypoint location

- the location of the VOR station currently tuned, if detected

- the location of the TACAN station currently tuned, if detected

The only operable control in this page is the RANGE INCREASE/DECREASE: which allows to increase/decrease the range of the current TSD view.

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

MUTE COM A or COM B

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

NAVIGATION PAGE

This page is accessible through the FAB and allows the pilot to type-in the navaids data.

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

Select previous or next waypoint (<WAYPT or WAYPT>)

IDENTIFICATION PAGE

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:

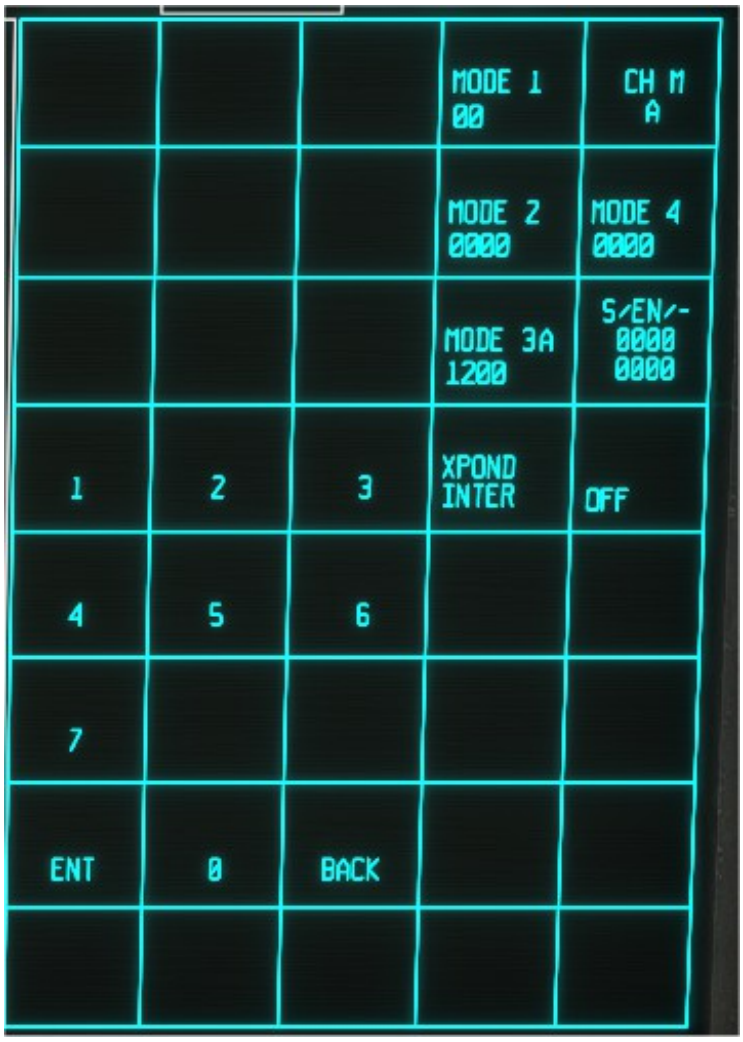
MODE 1

MODE 2

MODE 3

MODE 4

NOTE: in Flight Simulator, only MODE 3 is actually used in the sim. Other modes are implemented only for future developments but have no effect in game.



BAROMETER SETTING PAGE

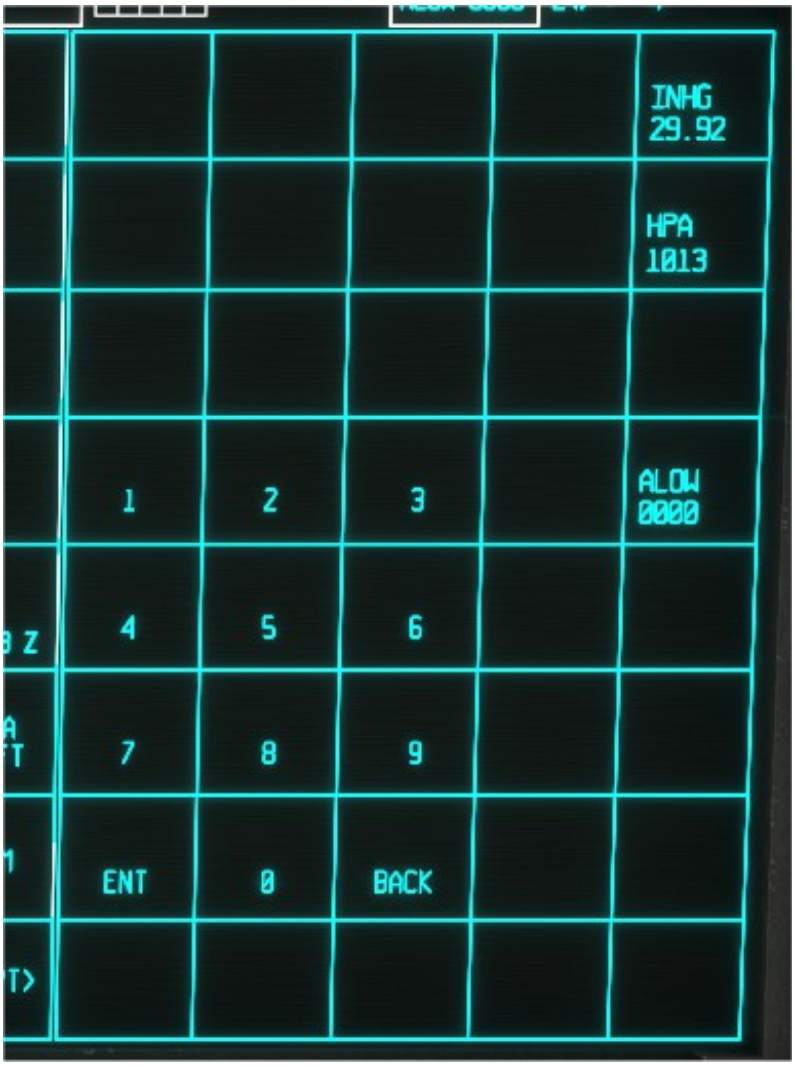
This page is accessible through the FAB and allows the pilot to type-in the barometric setting, in inHG or in hPa. This page also allows the pilot to set the Altitude Low Warning (ALOW).

The following controls are operable in the sim:

INHG – Barometric setting in INHG (expected format X Y Z W, therefore 2 9 9 3 becomes 29.92 inHG) – this also changes the barometric display to inHG.

HPA – Barometric setting in hPa (expected format X Y Z W, therefore 1 0 1 2 becomes 1012 hPa) – this also changes the barometric display to hPa.

ALOW – Altitude Low Warning Type-in (expected format X Y , therefore 05 becomes 500 feet)



ADDITIONAL MENU PAGE

This page is accessible through the FAB and allows the pilot to access a number of additional functions.

For the initial release only two options are selectable:

CRUS > will restore the PCD configuration to the default

LITES > allows the access to the LITES page

LITES PAGE

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

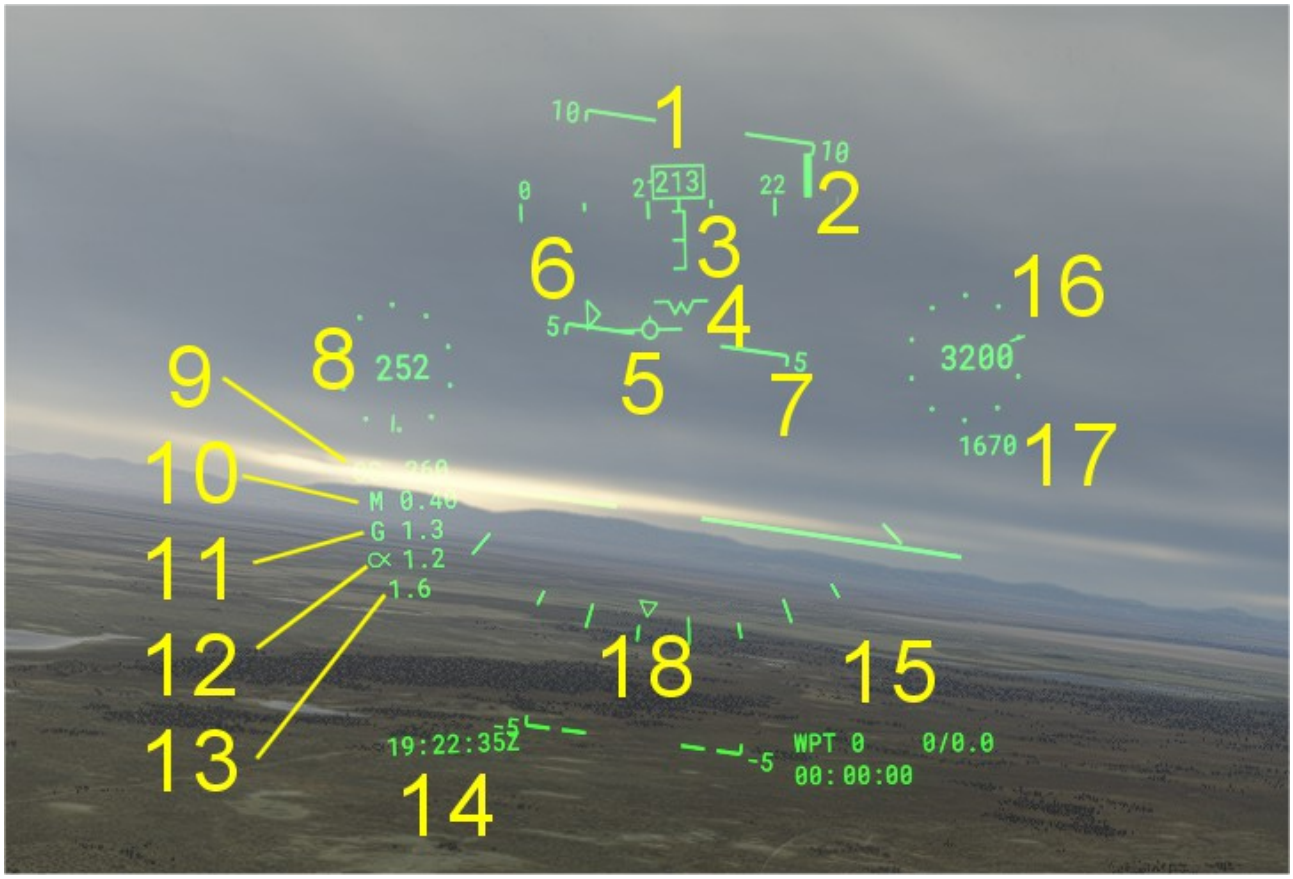
STROB – toggles the strobe lights

FORM – toggles the formation lights

HELMET MOUNTED DISPLAY SYSTEM

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, 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). When the pilot moves his head, part of the VHUD symbology is kept aligned with the aircraft boresight, while the rest follows the pilot head movement.



In the simulation, only the following fixed symology is shown (with refence to the figure above):

1 – Current heading and compass – NOTE: if the autoilot HEADING HOLD mode is selected, the commanded heading will be displayed above the current heading preceeded by the “CMD” caption

2 – heading to the selected nav source

3 – AoA bracket (only if gear is down)

4 – Waterline (only if gear is down or Velocity Vector is outside visibility boundaries)

5 – Velocity Vector

6 – Energy Caret (only if gear is down)

7 – Attitude scale

8 – Current Airspeed – NOTE if the autothrottle SPEED HOLD mode is selected, the commanded speed will be displayed above the current speed preceeded by the “CMD” caption

9 – Ground speed

10 – Current Mach number

11 – Current G value

12 – Current ALPHA angle

13 – Maximum G value achieved after the last reset

14 – Clock

15 – Navigation source data

16 – Current Altitude – NOTE f the autopilot ALTITUDE HOLD mode is selected, the commanded altitude will be displayed above the current altitude preceeded by the “CMD” caption

17 – Radar altitude (if a valid value is available) – NOTE Radalt value will flash if lower than the selected ALOW value

18 – Bank scale

NAVIGATION

In the real-world, the F-35 relies primarily on GPS/INS navigation on a pre-programmed flight plan. The aircraft is also equipped with a TACAN receiver and an ILS receiver.

In the MSFS version, for technical reasons and given the nature of the simulator itself, we also added a VOR receiver which can be used for IFR navigation. Therefore the aircraft has three NAV SOURCES, which are color coded in the EFI display:

RTE (GPS route) – in this mode, the navigation systems will follow the Flight Simulator flight plan.

NOTE: in the initial release there is no way to alter the flight plan within the aircraft: flight plan must be created with the game interface of with external tools. It is, however, possible to select a specific flight plan.

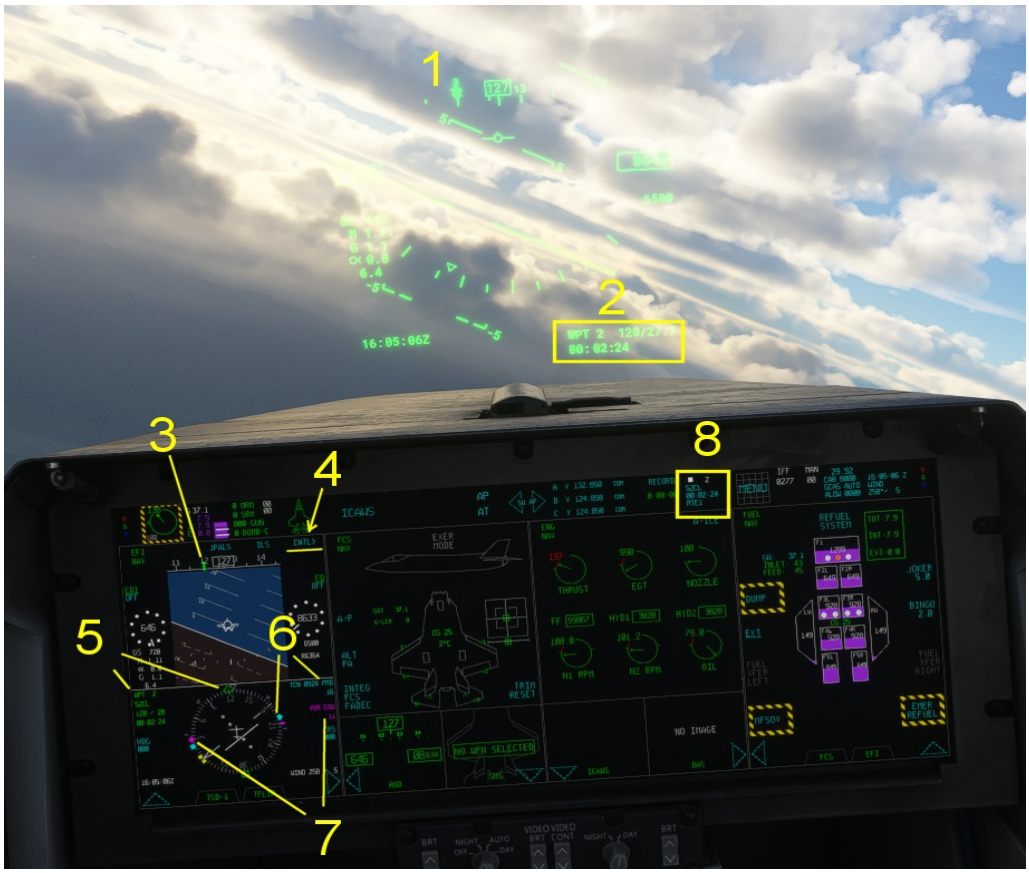
NOTE: RTE is the default navigation mode if a flight plan is loaded. Otherwise no nav source will be selected by default.

VOR/ILS – in this mode, the navigation system will be slaved to the VOR station selected in the NAV menu. 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.

TACAN – in this mode, the navigation system will be slaved to the TACAN station selected in the NAV menu.

NOTE: in the initial release the TACAN system is simulated as a secondary NAV radio. Selected TACAN channels are converted to the equivalent VOR frequency.

NOTE: If no TACAN data is shown in the EFI page, the frequency aircraft is not receiving any signal on this channel 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.



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 reference to the previous picture:

1 – The vertical steering bar on the HMD shows the bearing to the current NAV source. In this particular case, since the selected NAV source is RTE, it shows the pilot that he/she has to steer left to 120° to be flying towards the next waypoint in the flight plan.

2 – Nav source data is shown on the botton right corner of the HMD.

In this case, the display reports that the navigation system are pointing towards WAYPOINT 2, bearing is 120°, distance is 27.7 nautical miles, estimated time to get to the waypoint is 2 minutes and 24 seconds

3 – The steering bar on the EFI/ADI compass shows the bearing to the current NAV source, similarly to the one on the HMD. The bar will change color depending on the NAV source selected.

4 – The CNTL command allows the pilot to cycle thorugh the NAV sources.

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. The system will automatically change the waypoint when needed according to the flight plan.

In this case, WAYPOINT 2, waypoint name is “52CL”, bearing 120°, distance 28 nautical miles, estimated time to get to the waypoint in 2 minutes and 24 seconds.

6 – 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 092X, tacan id is PMD (Palmdale) and the distance is 16 nautical miles

7 – VOR 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.

In this case, VOR id is EDW (Edwards AFB) and the distance is 11 nautical miles

8 – NAVigation area in the FAB bar: this area shows the current nav source and allows access to the NAVigation page.Information shown changes depending on the NAV source, in this case: WAYPOINT 2, waypoint ID 52CL, ROUTE 1*

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

SPECIAL INSTRUCTIONS FOR STOVL OPERATIONS (F-35B ONLY)

In this rendition, the F-35B has three main configurations:

• **CTOL-config:** for normal takeoffs/landings and cruise flight. Lift-fan doors are closed, nozzle is pointed completely straight backwards.

• **STOL-config:** (STOVL-mode, with Hover-sub-mode OFF): used for slow flight (70 - 200 knots) and short takeoff/landing. Aircraft behavior, 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 takeoff 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 behavior 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. 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:

• **WING LIGHTS:** 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.

• **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 (center)": 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

<u>Restrictions to mode conversion are as follows:</u>

• You cannot convert from CTOL-config into STOL-config when the airspeed is above than **250 Knots.**

• In STOL-config, pitch & bank attitude is limited to **30 degrees.**

• In STOL-config, you cannot activate the Hover mode if you are too heavy for VTOL operation (**total weight > 40600 lbs.**); in this case the HOVER button of the FCS will be red. **You may want to dump fuel via the FUEL/DUMP command until the total weight is within the 40600 lbs. limit (HOVER button turns cyan)**

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.

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 aicraft 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.

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 acceleate, take-off in the shortest possible distance, retract the landing gear and convert to conventional flight

SLOW FLIGHT

In order to engage slow flight mode from conventional flight, the aicraft 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 to 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.

VERTICAL LANDING

Perfoming a vertical landing in the F-35 is very easy:

- Make sure that the aicraft gross weight is below 40600 lbs. Dump fuel or drop payload as needed.

- Approach 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.

VERTICAL TAKE OFF

The F-35 is capable of vertical takeoff, but this is not the intended operation of the aicraft, since to perform a vertical takeoff the gross weight must be below 40600lbs., with huge constraints to fuel and ordnance load.

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 thorttle HOTAS). The HOVER caption is RED if hover is not available (aircraft does not meet the condition), cyan if available, and white if engaged.

SPECIAL INSTRUCTIONS FOR CARRIER OPERATIONS (F-35C ONLY)

At the moment of the initial release of the F-35, MSFS does not support carrier operations.
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 whan the aircraft is on the ground and the throttle is advanced to 80% RPM or more, the aircraft will simulate a catapult launch (after 2 seconds of “hold back”). This will work on any surface.

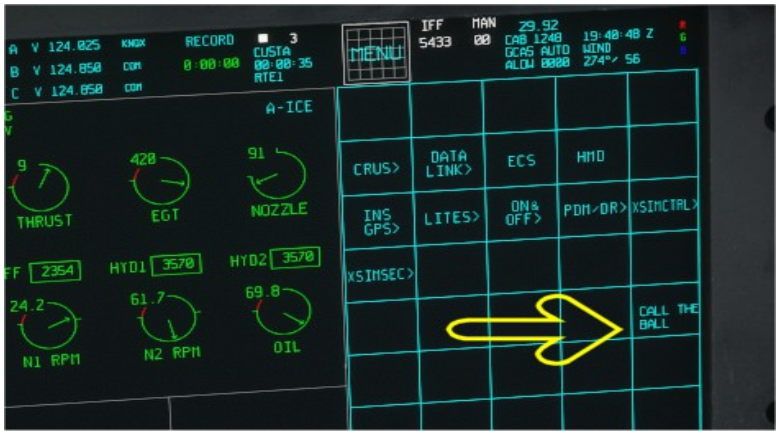
If TAILHOOK is deployed the aircraft will simulate an arrested landing – this will work on any surface.

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.

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)



CONTACTS

Look for IndiaFoxtEcho on Facebook for the official Facebook page or browse to the official blog at:

Indiafoxtecho.blogspot.com

Email address is indiafoxtecho@gmail.com