

F16 Air Show Touring Panel, Version 2

Credits: The ai Radar gauge uses a module developed by Arne Bartels. The HUD display is by Eric Marciano. The engine starter gauge is by Tim Conrad. Original F16 Viper aircraft files needed for this panel are by Kirk Olsson.

Note: Many of the gauges in this panel were designed to communicate with each other by transmitting and sharing data in various ways. Removing a gauge may have undesired effects.

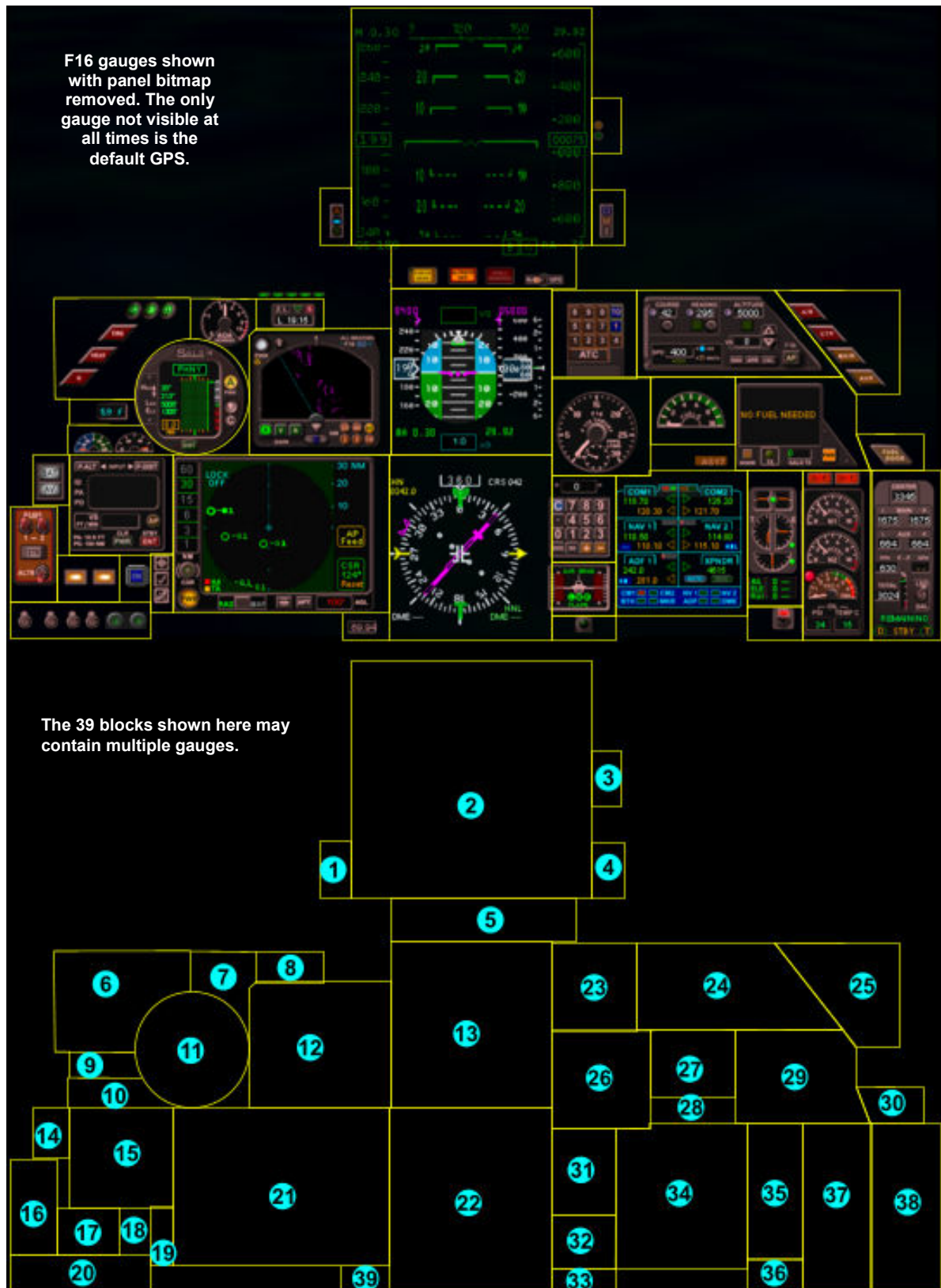


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Block 1: HUD Vertical Speed Indicator

A glance at this gauge allows the pilot to determine if the aircraft is climbing (orange up-arrow), level (blue bar), or descending (green down-arrow).



Block 2: HUD



This is the popular HUD gauge designed by Eric Marciano. It displays essential information to the pilot allowing him to keep his eyes outside the aircraft. (The F16 flying at 600 knots travels over 1 1/2 NM in 10 seconds).

Information shown on this gauge includes indicated airspeed, Mach number, pressure altitude, radar altitude, attitude, bank, altimeter setting, and ground speed.

Additional information indicates when the brakes are set and the flaps, spoilers (air brakes), and gear are extended.



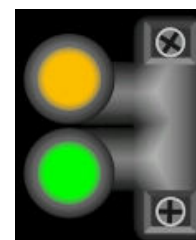
The appearance of the HUD is controlled by two HUD icons mounted on the upper, left side of the panel. The left icon, shown at right, will turn off the attitude ladder and allow a less obstructed view straight ahead of the aircraft. This is helpful during interceptions of air aircraft. The icon with the three circles controls the brightness of the HUD display. Clicking this icon will toggle the brightness value through four levels. Use this when the display blends into the background outside the aircraft making seeing the HUD difficult.



Block 3: HUD Refueling

These lights indicate the status of refueling operations for both ground and air fuel transfers. When the orange light is illuminated, fuel is being unloaded to the F16 either by a ground crew or by an airborne tanker. When the transfer is completed and the F16 tanks are full, the orange light will extinguish and the green light will blink. This blinking will continue until the refueling gauge (Block 29) is turned OFF.

If refueling operations are halted for any reason and the tanks are not full, the green light will not illuminate.



Block 4: HUD OMI

Outer, Middle, and Inner Marker indicators. The three lights on this gauge will be illuminated before engine start as a bulb test (as do many other lights on this panel). The three landing markers also provide audio if the audio function on the radio, at left, is active. All audio buttons including the Marker is located on this radio, Block 34.



Block 5: Four gauges are contained in this block; Check Gear, Alternator Warning, Stall Warning, and NAV/GPS switch. The lights are illuminated before engine start and will extinguish at various times during the startup procedure. At that time, they enter standby mode monitoring those events for which they are designed.

Check Gear: This gauge monitors the landing gear position and will warn if you attempt to land with the gear retracted. It gives a two-stage warning. The first warning is orange. This means the aircraft is between 500-1000 feet above ground and is descending. If AC climbs or landing gear is lowered, lamp will turn OFF.

The second warning is red. If landing gear is UP when above-ground altitude is below 500 feet and aircraft is level or descending, this warning lamp will illuminate. If AC climbs or landing gear is extended, the light will deactivate.

A small green diode on this gauge is illuminated during normal conditions. This shows the gauge is active and monitoring landing parameters.

Alternator Warning: This lamp will normally be off after engine start. It will remain off unless the alternator is taken off-line either intentionally or via malfunction. The alternator produces all electrical power during a flight.

Stall Warning: Multiple factors contribute to detect this condition, not just airspeed. The stall warning is both visual and audible. It means the wings have lost lift and loss of control may be imminent. Because of the high thrust to weight ratio of the F16 most stalls can be voided by a full application of power.

NAV/GPS- The position of this toggle switch determines whether Nav1 will track a VOR or GPS waypoint when the autopilot is in NAV mode.



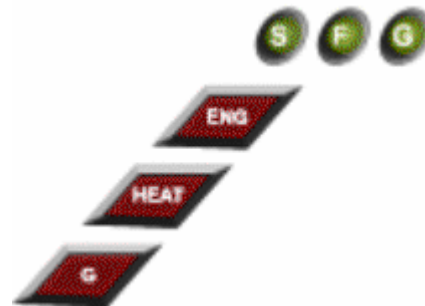
Block 6: Six lights with warning sound are grouped in this block. The top grouping of three lights warn of unsafe speeds for surface extensions. The surfaces are **S** (spoilers-airbrakes), **F** (flaps), **G** (gear). All three lights have Off, Green, and Red warning modes. When a light is OFF, it is not safe to extend that surface. When KIAS is low enough for safe extension, the lamps will glow green. If a surface is extended above the safe airspeed, the red associated light and warning sound will activate to quickly grab your attention to prevent damage.

The safe extension airspeeds are: Spoilers- 450 kts; Full flaps- 340 kts; Gear- 230 kts. These speeds are also written on the labeling located on the right side of the panel.

ENG: This lamp warns of unsafe engine RPMs that are inducing destructive vibrations within the turbines. While permissible for short periods, they contribute to shortened engine life and eventual failure. A reduction in throttle will bring the vibration into tolerable levels.

HEAT: This warning means the outside air has reached freezing levels and the Pitot and/or De-Ice heaters are OFF. Turning on both gauges (Block 17) will void this warning.

G: The F16 is rated at 9 times the force of gravity. The warning light will activate at a positive (inside loop) or negative (outside loop) G-force of 8.



Block 7: This is the Angle of Attack (AOA) gauge. The markings show degrees of nose-up attitude. During normal flight operations, this gauge registers zero. During the landing phase, the F16 makes its approach with full flaps and at a speed around 160 knots. This allows the AOA to stabilize in the safe zone below 8-degrees. Touchdowns are very controllable with the speed brakes being applied shortly after crossing the threshold prior to touchdown. This dumps IAS and allows the rear tires to be smoked between 125-140 knots, depending on fuel load. After touchdown, hold the AOA up to keep the nose of the F16 in the air and shed speed quickly. Then, drop the nose wheel and finish the landing roll with brakes applied. Braking has been increased a bit in this F16 to overcome not having a drag chute for non-military facilities, but a minimum runway length of about 5000-feet is needed.



Block 8: Clock, Zulu (Z) or Local (L), and count up/down timer with Start/Stop (S) timer operations. Pressing screen clears timer. Once the timer is placed into count up (only) timing mode, it will continue counting even if the display is returned to Zulu or Local time. Triangular button enters countdown value, in seconds, sent from panel keypad (up to 300 seconds, 5 min.) and switches timer to countdown mode. If the keypad value sent is 0, timer will switch to count-up mode. The screen digital display of both timer modes is shown at right. Count up limit is 9-hours, 59-minutes, 59-seconds.



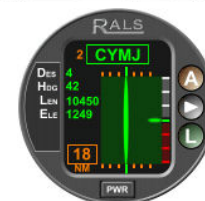
Block 9: Static air temperature (SAT) in either Celsius or Fahrenheit. Clicking the screen on this gauge will toggle these two scales.



Block 10: Two analog gauges are enclosed in this block. Battery drain (left gauge) shows charge/discharge amps. Discharge is toward the blue area. Total Bus usage in amps is shown in the gauge on the right. Both gauges can register up to 60 amps.



Block 11: Satellite Assisted Landing System (SALS) is mounted in this block. This gauge allows precision approaches into runways in the FS database regardless of airport facilities. See the included **SALS Gauge.txt** for details.



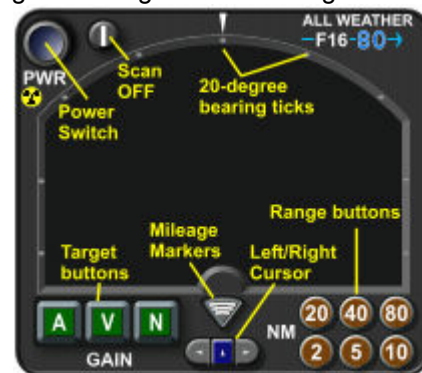
Block 12: Navigational radar redesigned especially for this F16 panel. It now contains a 180-degree scan with a larger screen that show targets 90-degrees left and right of the aircraft. By default, land borders are displayed.

A- This button allows airports to be displayed on the screen.

V- This button allows VORs to be displayed.

N- This button allows NDBs to be shown.

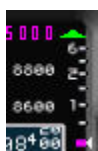
Mileage Markers- This button displays mileage ticks showing the scale of the screen. The markers can be toggled ON/OFF by pressing the button. To leave the markers on the screen, press the button and slide mouse cursor away from the button before releasing mouse. The values displayed depend on the value of the active Range button.



Left/Right Cursor- Pressing the left or right arrow will cause the on-screen cursor to rotate 10-degrees per press. The center of this three-way button will re-center the cursor.

The screen is mouse sensitive. Pressing the screen in the middle will cause IDs to be displayed beside their associated target. Other buttons are self-explanatory.

Block 13: The default 747-400 PFD has been given a major facelift for the F16. Included are a sun shade, a new attitude ladder, G-force display, more readable Mach numbers, and pressure altitude. The altimeter is set via the keypad (Block 31) mounted on the panel.



Because the F16 is capable of vertical speeds of 50,000 ft/min., green arrow diodes occupy both ends of this scale. One of these will illuminate, at left, when the VS needle goes off the scale. In conjunction with this, a vertical speed digital display has been added at the top of the gauge to keep pace with the large VS values. It shows green digits for climb, orange digits for descent and no digits when level. Other improvements are the more visible green slip indicator, more visible speed and altitude hold indicators, and a larger VS hold bar.



Block 14: This block contains two switches; Battery and the Avionics power. This is the starting point for bringing life into a cold and dark cockpit. All gauges must have battery (or alternator) power to function. In addition, other gauges such as the radio must have Avionics ON in order to be useable.



Block 15: Descentometer. This gauge has a completely redesigned exterior and modified functions plus a larger screen to better suit the personality of an F16. This gauge has an appetite for larger values which are in keeping with this high performance aircraft. Pattern altitudes and pattern distances are input via the digital keypad mounted on the F16 panel.

Pattern altitude- This value can vary from runway elevation to 10,000 feet. 3000-feet is default altitude.

Pattern distance- This value can range from the runway outward to 100 nautical miles. 20NM is default distance.

PWR/CLR- The first press of this button supplies power to the gauge. This activates the on-screen instructions to input the ICAO. In case of error, a second press on this button will clear the screen and make it ready for another input. A third press will shut down this gauge.

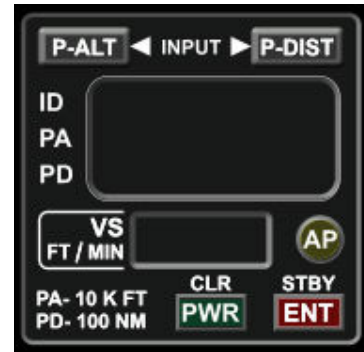
NOTE: When this gauge is awaiting an ICAO input, all entries from keyboard are captured and sent to this gauge. If, for example, you should want to PAUSE flight simulator by pressing the **P** key, the gauge will capture that letter preventing flight simulator from pausing. Once you turn this gauge on, enter the ICAO, press the ENT key and the keyboard will be returned to FS.

ENT/STBY- After entering the ICAO of your destination airport, the gauge searches for the name of the airport and displays it on the screen. If correct, then press the ENT button. This enters the data and allows the gauge to begin calculating VS values for a later descent to the destination airport according to the Pattern Alt and Pattern Dist in effect. A second press of the ENT button places the gauge in standby mode storing data until needed later in a flight.

VS- The descent vertical speed is continually calculated to a point away from the destination airport defined by the Pattern Altitude and Pattern Distance values.

ERROR- This message is displayed in red on the D'Meter screen when altitude or distance data is entered that is outside the limits of the gauge. Errors are cleared by the keypad.

AP- When the VS value has reached the descent speed you wish, press the AP button. This will send the vertical speed value to the autopilot. The autopilot must be ON and the altitude HOLD must be actuated for this to function. Being designed for combat situations, the F16 is capable of 90-degree dives so almost any value is within the limits of this aircraft. Generally, an approach descent to pattern altitude between 3000 fpm and 5000 fpm keeps the landlubbers happy.



Block 16: You go nowhere without first attending to this block. It contains two switches that control fuel flow, FUEL 1 - 2. Both of these should be ON before firing up the engine. Also, as a safety precaution, both must be OFF to stop the engine.

STR- This button activates the engine starter. That process can take place after turning ON the two fuel flow switches. Only a single press on the starter is needed. It will softly illuminate while engaged in bringing the engine up to start RPM. During start up, keep the throttle in idle position and the parking brake ON.

As you hear the engine turbines begin to spin, N1, N2 gauges (Block 37), and the Thrust gauge (Block 26) will show signs of life. The fuel flow gauge in the fuel center (Block 38) will indicate that fuel usage is climbing. As more fuel is injected, the engine will quieten for a moment. This is the calm before the storm. Wait a second and the engine will come to life kicking up the RPMs. No action is needed from the pilot because the thrust and RPMs will quickly settle back to idle as the oil temperature and pressure begin to rise to operating ranges. With the parking brake set (Block 36), the aircraft will sit quietly awaiting your next command.

ALTR- This switch is automatically switched ON during engine start should it be off. Should you switch it OFF during the flight, the Alternator Warning light on the panel will illuminate as the aircraft begins to drain power from the battery.



Block 17: This block contains two switches; pitot and de-ice heat. These illuminate as shown when active. Both these switches are tied to the HEAT warning light on left side of panel.



Block 18: The VIEW toggle switch, when ON, allows views around the aircraft without obstructions such as the wings, etc. This switch is connected to the LAND light switch (Block 20) so that activation of the landing lights turns the VIEW switch OFF. This permits the landing lights to be seen as they reflect off airport surfaces during taxi, takeoffs and landings.



Block 19: Three icons occupy this area; map, checklist, and the default GPS. The GPS is the only gauge not permanently installed on this panel. Two spaces were left vacant on the icon gauge. These can be filled with any icon gauge of your choice. The panel.cfg size for these icons is 17x17 pixels, i.e. gauge02=simicons!GPS Icon, 161, 713, 17, 17. The checklist is discussed in Block 34.

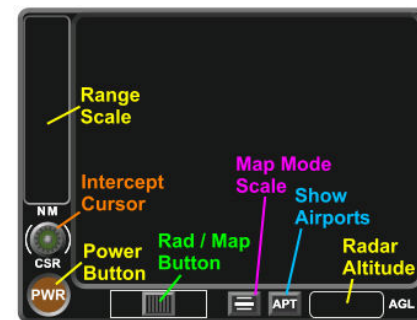


Block 20: Six light switches, 4 toggles and 2 push-buttons, are located on this control panel. They operate the lights for; panel, navigation, beacon, tail strobe, and landing. The AUTO and LAND switches control the same group of lights located on the nose wheel door; however, they operate a bit differently. The LAND button is manual. It will turn ON/OFF the landing lights any time the gear is extended. AUTO will automatically turn ON the landing lights when the gear is lowered. Gear up turns the landing lights OFF for both buttons, but AUTO mode stays active until turned OFF. All except PANEL have an associated reminder diode. These five lights, above, are located along the top, left side of the panel. They illuminate green when a toggle switch is ON. LAND also has a yellow glow to remind you that the landing lights are off before a takeoff or landing.



Block 21: This radar contains three separate modes of operation; ai Radar mode, refueling mode, and Terrain mode.

In ai Radar mode the gauge will steer you safely through local traffic or assist during intercepts with any ai aircraft of interest including a refueling tanker. This mode has a range of 1 NM to 60 NM.



In refueling mode, at left, the screen zooms so that you can monitor the tanker as it enters the zone of refueling. It will be inside this zone that the F16 drinks its fill.

Range Scale (ai Radar)- Two scales occupy this gauge window. The first is the ai Radar scale seen at right. The default range is 30 NM. The active range button displays in green; all inactive buttons display in grey. Ranges can be quickly changed by pressing the appropriate button.



Intercept Cursor (ai Radar)- This round knob will rotate the on-screen bearing cursor left or right 1-degree. If held pressed, the cursor will speed up rotation. Used in conjunction with the cursor, the green box located in the lower, right side of gauge will show the magnetic bearing of the current cursor position.

Rad/Map- This button toggles between radar and map modes.

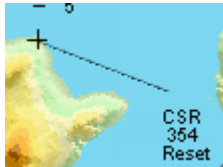
AP Feed- This yellow box will send the cursor bearing to the autopilot. This permits the radar and the autopilot to work together when intercepting ai aircraft.

CSR- This green box contains the cursor bearing. This is the value sent to the autopilot. Also contained in this area is a Reset function. This will zero the cursor back to the magnetic heading of the aircraft which is always at the top of the radar screen. When the cursor is reset, the value inside the green box will reflect the aircraft's magnetic heading.

LOCK OFF / LOCK ON (ai Radar) - When a heading value is sent to the autopilot using the AP Feed button, the blue LOCK OFF message will change to an orange LOCK ON message. This allows the cursor to rotate in sync with the F16 as the aircraft turns to make an interception.

Intercepting an ai aircraft for refueling will be covered in more detail in the **Intercept and Refueling** tutorial. An aiRadar intercept and the Refueling gauge will be demonstrated so that one can see how with a minimum of practice successful refueling operations can be completed. Doing so is the key to non-stop cross-country flights that are planned over 600 NM or so. And remember, in an F16 such flights take only about an hour to complete.

The map mode contains a moving display with range buttons, at right, from 4 NM to 120 NM with 20 NM being the default value.



The map mode also uses the Cursor knob to rotate the map cursor. Displayed in the lower, right corner of the map screen are the value of the cursor bearing and the Reset function. These can be seen at left. This cursor can be very handy for making approaches into airports.



Another feature that can be toggled in or out is a color-coded terrain elevation scale showing terrain elevation in relationship to the aircraft altitude. This is handy for predicting ground elevations that lie ahead of the aircraft.

Map Mode Scale- A press of this button will display on the screen mileage ticks. These can be seen at right. The value of the ticks depends on the active range button in effect. This button also toggles the color-coded ground elevation scale.

APT- Activating this function allows all airports within the active range of the gauge to be displayed along with their ICAO identifiers.

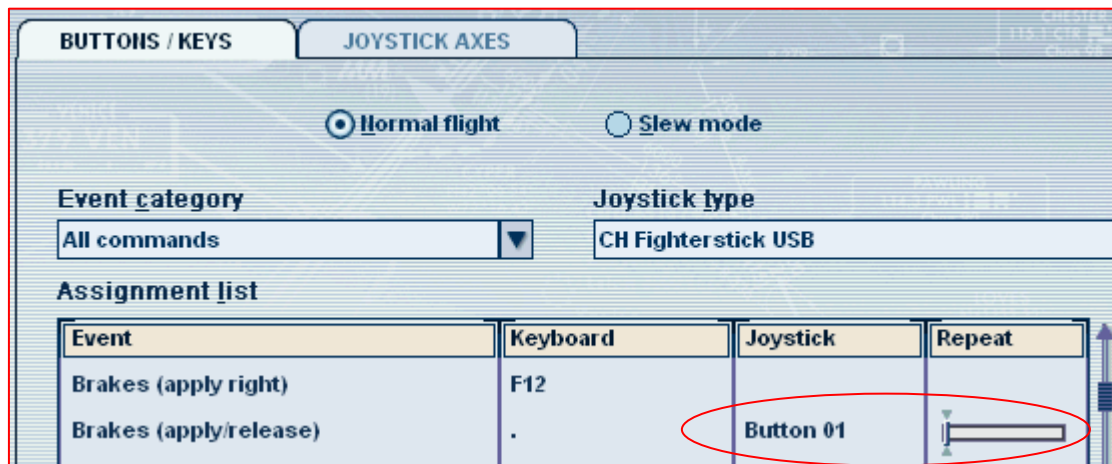
Radar Altitude- Once airborne, this small window displays the altitude of the aircraft above ground level. If this distance is below 3000-feet the digits are red; above 3,000-feet the digits are white; over 10,000-feet, the digits form a series of dashes.



Block 22: The MFD from the 747-400 forms the companion to the PFD. This gauge has also been modified to provide better readability. Some bitmaps were edited for various reasons. Frequencies were eliminated from the two VOR displays in the lower corners to give clearer digital readouts. The frequencies were not needed here because the radio is located on the right side of the panel and it contains all this data.



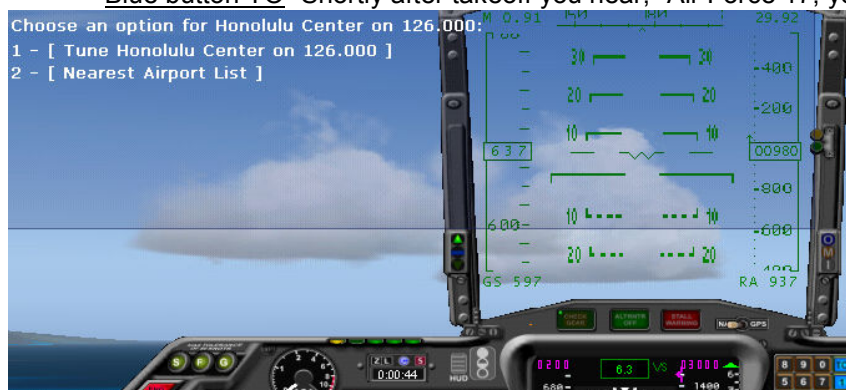
Block 23: ATC pad, a communications center. This gauge offers the convenience of responding to ATC instructions without removing your eyes from the panel. The large ATC button will open and close the ATC dialog box. The numbered buttons respond to the corresponding numbered choice shown on the ATC screen. Two other buttons have been added to eliminate ATC distractions that can occur shortly after takeoffs and before landings. Blue button #1- To work as intended, the trigger on your joystick must be assigned to activate your brakes as shown below. Blue button 1 is only active if the aircraft is airborne when brakes are no longer needed. If the aircraft is on the ground, the trigger resumes its normal programmed function.



Blue button 1 is intended to respond only to ATC choice number 1. Any other choice must use the ATC pad.

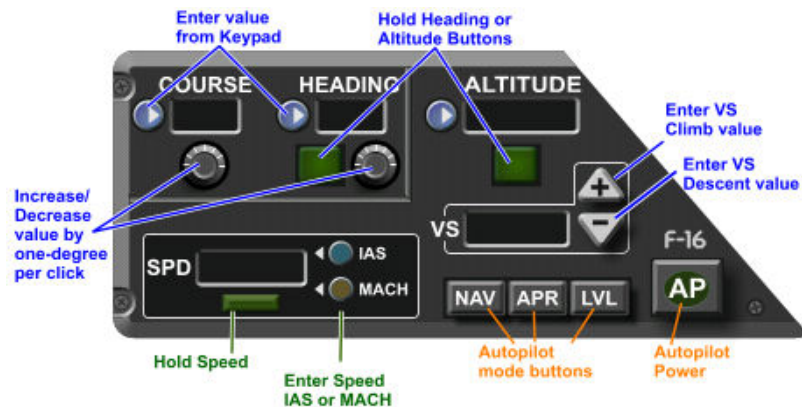
Blue button TO- Shortly after takeoff you hear, "Air Force 17, you are leaving my airspace. Frequency change approved." Then up pops the ATC dialog box shown at left. You must refocus your attention from stabilizing the climb out to closing the distracting ATC window. But, if Blue Button TO is active, you can press the joystick trigger and the ATC window will close without any response to ATC. This is a one-shot event. As soon as the TO button is used, it resets to OFF, then transfers command to Blue Button 1. From that point forward, the joystick trigger will only issue responses to ATC choice 1.

The ATC pad will allow responses and menu choices only when the radio is ON.



Block 24: The F16 autopilot occupies this gauge block. It has been designed to take advantage of the flight characteristics of this aircraft. For example, the default VS is set at 2400 fpm. Banking is set to a maximum of 60-degrees to permit faster turn times while on autopilot.

The Course, Heading, Altitude, VS, and SPD values are first set into the digital keypad located on the panel, then transferred to the desired autopilot function. For the Speed function, this value can be entered as either IAS or Mach.



Mach values are entered into the keypad without decimal. For example, if you desire to set a Mach speed of 3/4 the speed of sound, you would enter digits 75. The autopilot will interpret that value as 0.75. To set Mach 1, enter the digits 100. The autopilot will interpret that as 1.00. The autopilot has an error check to prevent incorrect entries for all input functions.

The power button and all HOLD buttons should be OFF prior to takeoff. Activating any HOLD button will also activate the Power button should it be OFF.

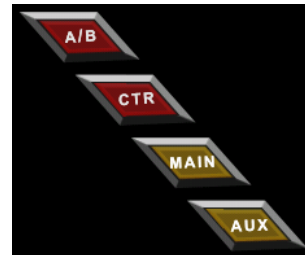
During climbs and descents, the VS will automatically change to 1800 fpm when the aircraft altitude is within 1000-feet of the set altitude. This allows the F16 to shallow its VS as the desired altitude is neared. This helps to overcome the inherent deficiencies of FS autopilot functions to acquire altitudes. High climb or descent rates that are common in the F16 can magnify these poor altitude capture characteristics.

Block 25: Four warning lights are located here. Three are associated with fuel supply. The fourth, Air Brakes warning, will keep the pilot alerted when those devices are extended. All four lights are illuminated before engine start.

The two Auxiliary fuel tanks located at the ends of each wing hold 100 gallons each. The yellow warning lights will illuminate and a warbling alert will sound one time when these tanks get below 20 gallons each. The light will stay lit until the fuel quantity rises above the warning limit. The audio warning will again sound when both aux tanks become empty.

The two Main fuel tanks hold 250 gallons each. The yellow warning lights will illuminate and a warbling alert will sound one time when these tanks get below 65 gallons each. The light will stay lit until the fuel quantity rises above the warning limit. The audio warning will again sound when both main tanks run dry.

The single Center fuel tank holds 500 gallons. The red warning light becomes active when the quantity drops below 150 gallons and the warbling alert will sound one time. The light stays lit until the quantity rises above that warning limit.



Block 26: F16 Engine Thrust gauge for Pratt and Whitney F110 jet engine producing 29000 pounds of thrust. Scale values are expressed in foot pounds per second x 1000. The larger needle shows thrust in thousands, the smaller needle shows hundreds. Idle value is about 1000. Anything above 4000-5000 will overcome a locked parking brake and start moving the aircraft.

After aligning the F16 down the runway before takeoff, set the parking brake (Block 36), advance the throttle to full open, and monitor the thrust gauge. When the needle reaches approx. 5000, release the brake. The F16 will begin the takeoff roll and quickly accelerate to rotation speed of 125 knots.



Block 27: Fuel Efficiency gauge. Lingering in the recesses of an F16 pilot's brain is fuel remaining. To squeeze the most distance from the 1200 maximum gallons of fuel on board, the needle on this gauge must be held at the highest value possible for a given flight altitude. Values are relative and linear; the brighter the green background, the higher the fuel-e. In other words, 4 is twice more better than 2.



If involved in ferry operations across oceans, high altitudes and low throttle settings are important to economize fuel consumption. The Fuel-E gauge will help optimize flight parameters for all long distance flights. On the other side of this coin, ignore the Fuel-E and you will be honing your refueling technique quite often.

These screen shots show how altitude and throttle settings affect the Fuel-E gauge. The first illustration at right shows an E-value of 4 when the altitude is 30000-feet and a throttle setting that produces an IAS of 329 kts. and a ground speed of 500 kts.



The second shot show an E-value of about 5.4. The throttle was readjusted to produce the same ground speed of 500 kts. The altitude this time is 40000-feet and the IAS now reads 268 kts.

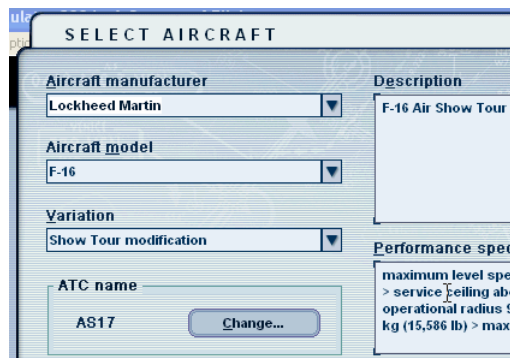


Moving up to 50000-feet altitude, the E-value now reads a tad over 8. The throttle again was set to a ground speed of 500 kts. and the IAS reads 212 kts. However, the angle of attack has climbed to 1.8-degrees nose up signaling the less dense atmosphere. The F16 AST has been modified to give a higher service ceiling of 62,000-feet. It remains stable and autopilot friendly in this rarified air. Above that altitude, the aircraft grows more unstable in the roll axis and rocking becomes a factor.



The aircraft in these three screen shots was down to about 915 pounds of fuel, about 137 gallons. Weight will have an affect on the fuel-e values because more weight requires more throttle to achieve the same ground speed.

How does the Fuel-E gauge look at 500-feet altitude with full throttle? As you might expect, it is roughly equivalent to dumping fuel.



Block 28: The call sign of the F16 displays within this block. The ID gauge is camouflaged to appear as part of the KIAS decal. The default ID is AS 17; no special reason, just looked cool. If not cool enough, you can change this call inside FS menu: Aircraft/Select Aircraft. The dialog box at left will appear. Click the **Change...** and type in your preference. ATC refers to this aircraft as Air Force 17.



Block 29: This gauge allows both ground and airborne refueling.

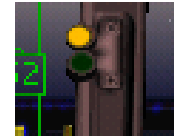
Refueling this F16 is a simple and straightforward operation. No complex routes have to be programmed and no tanker aircraft have to be downloaded and installed. This panel allows air refueling with any ai aircraft. I have refueled with a Cessna 172. While that is not recommended due to the large difference in flight characteristics between the two aircraft, it is possible.

In general, the higher the tanker and the faster it is flying, the more satisfactory the refueling operation. Airliners operating above 30,000 feet and streaming contrails are quite realistic. Your imagination will have to supply the refueling probe; however, noises from fuel door opening and closing and associated thumps and bumps that occur from probe contacts will add to the realism.

PWR- This button is operative if the battery power is ON. This allows ground refueling to be accomplished at any time. It can also be done at any location, not just near the fuel pump island. The PWR button will cause all other features of the refueling gauge to be made available.

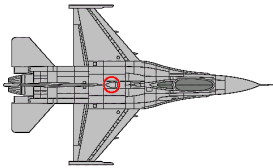
GALS TX- This window displays a running total of the quantity (gallons) of fuel that has been transferred from the tanker or ground ops to the F16. The running total starts at zero and climbs gallon by gallon to the final total required to fill all five tanks. This value is also input to the fuel center (Block 38). As fuel flows into the tanks of the F16, the fuel center will show in updated intervals the fuel status of the five tanks. Transfer rate on my system is roughly 17 gallons per second. From five empty tanks to a full load of 1200 gallons will take a little over 1-minute.

TX- When pressed, the green button, at left, will illuminate to signal that fuel transfer to the F16 is underway. Mechanical sounds also will be heard. As previously discussed, also tied to the transfer are the two HUD refueling lights shown at right.



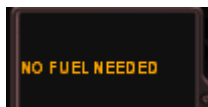
Initially, my hope was to have the fuel transfer feature automatically controlled by the distance between the F16 and the tanker. When the two aircraft were within a certain distance, the transfer would begin. Beyond a certain distance, the transfer would stop. This would

allow probe connects and disconnects to be made more realistic. However, I was not successful in finding a way to do this, so the green TX button was developed to accomplish the transfer manually.



DOOR- On an F16, the refueling port is located behind the cockpit canopy. That spot is circled in red at left. This door is opened to permit insertion of the fuel probe by the operator aboard the tanker. The door button will illuminate when activated and appropriate sounds will be played.

REFUELING SCREEN- The large screen on this gauge gives the pilot instructions and messages pertinent to the current stage of the refueling operation. Some of these are color-coded for emphasis, but most are bright green when active, grey when inactive. In the example at right, a fuel transfer has just been completed with 701 gallons of jet fuel having been on-loaded. The "TRANSFER COMPLETE" message will flash at one-second intervals as well as the green HUD fuel light. This will continue until the fuel door is closed and the PWR button is turned OFF.



At left, another example. That message will appear when the tanks are full or near full and refueling is not needed. However, if you do need fuel but are on the ground with the engine running, the red warning at right will



greet you.

There are many such instructions and messages. The data that is displayed on the screen is governed by one of three stages of refueling; pre-refueling, refueling in progress, or post refueling. With a bit of practice, these instructions will become familiar and allow you to top off the F16 tanks in an organized and methodical fashion.

All possible messages are listed below and appear in various combinations as needed.

NO FUEL NEEDED
FIRE HAZZARD SHUT OFF ENGINE
STANDBY GROUND OPS
STANDBY FUEL DOOR
CONNECT DISCONNECT
FUEL DOOR OPEN
STANDBY TX
STANDBY TANKER
MOVE INTO POSITION

FINALIZE POSTION
TX IN PROGRESS
REFUELING PAUSED
HOLD POSITION
TRANSFER COMPLETE
CLOSE FUEL DOOR
FUEL DOOR CLOSED
ENGINE START SAFE
BACK AWAY- DESCEND
RESUME SORTIE

Block 30- This light will illuminate yellow before engine start. It is a more prominent backup to the DOOR light on the refueling gauge. Closing the refueling door will extinguish this light.



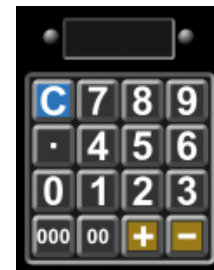
Block 31- This gauge is designed to make cockpit life a bit easier. It supplies data that is sent to the autopilot, the radio, the altimeter, countdown timer, and the Descentometer. The small screen at the top of the gauge confirms the entered value before it is sent to another gauge.

C Button- If data showing on the small screen is incorrect, press this button to clear the screen, and then reenter the data. It also clears the ERROR msg.

Decimal key- Decimal values are used for inputs to the radio and altimeter only. Mach values are not entered using the decimal point.

00 and 000 keys- These speed up entries by adding the correct amount of zeros when the desired value is in the hundreds or thousands.

Plus key- Used for altitude input to the autopilot only. To use this key, a value is first entered into the keypad. When the Plus key is then pressed, it adds the input value to the current altitude of the F16. It is this sum that is sent to the altitude function of the autopilot. This allows the altitude of an ai aircraft to be automatically calculated, and then fed to the autopilot so the F16 can climb to match that altitude.



For example, the radar screen at right shows an ai aircraft with a **+29** altitude flag. That means that aircraft is 2900-feet above the F16. To climb the F16 the 2900 feet, enter 2900 using the keyboard. At left, you can see this value on the small screen.



Now, press the Plus key. The keypad will add 2900 to the current altitude of the F16. If the current altitude is 5000-feet, the sum showing on the keypad screen will change to the 7900-feet as seen at right.



Pressing the altitude input button on the autopilot would enter this sum into the altitude function. Assuming the altitude HOLD function was active, the F16 would begin climbing to the calculated altitude of 7900-feet.

Minus key- This key functions exactly opposite the Plus key. It automatically subtracts the altitude of an ai aircraft from the current altitude of the F16. When that value is entered into the altitude function of the autopilot, the F16 will begin a descent to the calculated altitude.

Block 32- Air Brakes, Flaps, and Landing Gear display their positions inside this block. The F16 Air Brakes are either full open or closed. The Flaps can be extended through three positions. The Landing Gear icons show red when the gear is retracted, green when extended, and yellow when in transition.



The Air Brakes on the F16 are located aft on the airframe (see refueling cartoon, p 7). They are very effective in reducing airspeed and, unlike the flaps, induce little need to correct the aircraft when deployed. When extended, airspeed must be closely monitored because the F16 can drop to stall more quickly than you may be familiar. The red A/B warning light on the right side of the panel is meant as a reminder to the pilot that airbrakes are extended. The warning light will not go OFF until the airbrakes are fully retracted. A soft wind noise may also be heard.

Air brakes are normally used during intercepts to slow the F16 to match the speed of the tanker aircraft. They are also extended during a landing approach shortly after the F16 passes over the end of the runway. This drops the airspeed at the same time the aircraft is shedding the last bit of altitude for a touchdown. The air brakes are left extended until the F16's speed has dropped to 40 or 50 knots to help shorten the landing roll.

The flaps, in conjunction with the throttle, are the primary control device to regulate the speed of the F16 during refueling. At slower refueling speeds, perhaps 200 knots or less, full flaps are often necessary. Full flaps are also normal during approaches and landings. They are necessary to keep the airspeed of the F16 in the lower range, about 160 knots for an approach, because this aircraft will easily accelerate due to its streamline shape.

Block 33- The Auto Flaps gauge is an option to assist the pilot in completing the takeoff or landing procedure. The F16 is obviously a sophisticated aircraft and having an aid to automatically retract the flaps after takeoff or after landing seems in keeping with such a design. However, this gauge will not become active unless the green light is illuminated.



When activated prior to takeoff, the gauge will raise the flaps to full up three seconds after the pilot retracts the gear. This gives the pilot a bit of time to adjust the stability of the climb before the flaps start retracting.

When Auto Flaps is activated prior to landing, the gauge will raise the flaps to full up after the airspeed drops below 35 knots.

Block 34- The F16 panel supports a modified version of the ComGold radio, at right, a full-featured radio with secondary frequencies for all com and nav functions. The radio also contains a seven page Digital Checklist, at left, covering the various phases of F16 flight operations. Please read the included file,



Radio_Checklist_Gauge.txt for operation of both gauges.



The radio is controlled by the Battery and Avionics power buttons located on left side of panel. Both must be ON before use. The checklist is available with Battery power only. The checklist displays on the radio screen and can be opened using the Checklist Icon located in Block 19.

Block 35- Control surfaces of the F16 are echoed inside this five-in-one gauge. The top gauge displays the position of the ailerons. The left, middle gauge duplicates the throttle setting. The gauge on the right shows the elevator angle. The bottom gauge gives the rudder and nose wheel position. The gauge at the bottom shows trim values for the ailerons, elevators, and rudder.

The three green diodes are illuminated when a trim is at center position. To quickly center a trim, press the associated diode when it is not illuminated.



Block 36- Electro-mechanical braking on this F16 is set to Park by the toggle switch shown at left. The switch contains a red diode to highlight the ON position.

Block 37- Five engine monitoring gauges are grouped in this block. The first shows the percentage of RPMs of the forward turbine, N1. The next gauge is the aft turbine, N2. Percentages above 100 are inside the red warning range for both gauges.

Exhaust gas temperature in Celsius is displayed on the third analog gauge. Normal operating temperatures are banded in green. Temperature values below the green band may also be safe. The needle will usually lie in the brown region during idle, taxi, and some high altitude conditions. Orange temps (500-600) are permissible for short periods. Avoid allowing the needle to get over 600-degrees.

Also contained in this block is a red warning light to catch the eye of the pilot should the temp drop below 100-degrees or above 600-degrees C. At the low temp, a problem may or may not exist. The light alerts the pilot to check why the gases have cooled to that extent.

Oil pressure in pounds per square inch is digitally displayed in the lower, left window. Oil temperature in Celsius is displayed in the right window.





Associated with the two oil gauges are two red warning lights located directly above the N1 gauge. These are shown at left. These give indication that a problem may exist with the oil pressure (O/P) and/or the oil temperature (O/T). Both these lights illuminate before engine start but will extinguish after the engine is running and the oil reaches operating pressure and temperature.

Block 38- The center for monitoring fuel flow, fuel quantity, and time/distance remaining is located in this block. Quantities can be displayed in either pounds or gallons by a flip of the LBS/GAL toggle switch.

CENTER- This is the primary tank on the F16. Capacity is 500 gallons, 3350 pounds.

L and R MAIN- Each of these tanks hold 250 gallons, 1675 pounds.

L and R AUXILIARY- Each of these wingtip tanks hold 100 gallons, 670 pounds.

FF- Fuel flow expressed in either pounds per hour or gallons per hour.

TOTAL- Total fuel aboard the F16 expressed in either pounds or gallons.

An analog scale is also located inside the vertical window of this gauge. It shows at a glance the relative amount of fuel remaining. Ticks represent full, 3/4, 1/2, 1/4, and empty.



Located at the bottom of the fuel center is the Time Distance Remaining (TDR) computer. Inside this window, the remaining distance (**D**) in NM or time (**T**) in minutes can be displayed. This function is normally in the STBY mode

seen at left. It becomes active when either the **D** or the **T** button is pressed. At that time, calculation are made and displayed in the window.

The calculations are based on the current value of the fuel flow, fuel remaining, and ground speed. Only when all parameters used in this calculation are stable will the results be accurate. If the F16 is accelerating or decelerating, this value will be inaccurate. Results are displayed in the window for 5 seconds before the unit returns to STBY mode.

When the D or T button is pressed, the button changes to green to show which function is active. Units are also shown to prevent confusion. The example at right was taken while idling on the runway; therefore, the results are zero because airspeed is also zero.

Previously mentioned was how the refueling center interacts with the Refueling gauge during fuel transfer, either in the air or on the ground. As the tanks receive fuel, the fuel center does not increase the amount displayed in the capacity windows gallon by gallon or pound by pound. Instead, FS adds fuel at intervals based on a percentage of remaining capacity in the tanks. This value will fluctuate depending on how much additional fuel each tank can hold during the refueling process. When the tanks fill up, the capacity windows will show a total of 1200 gallons, 8040 pounds.



Block 39- Total Engine Time expressed in hours and decimal hours. This value is stored in the state.cfg file located in Documents/Aircraft/F16_AirShowTour/. It is updated each session so the total climbs as the engine is run. To zero this value, edit the accumulated_time value, shown below highlighted in yellow, with Notepad or WordPad and resave.

```
[engine.0]
accumulated_time=69.186777
[FltSim.0]
atc_id=AS17
```

For more details on operation of the aiRadar and Refueling gauge, please see the **Intercept and Refueling** tutorial that is part of this F16 archive. That document will take you through the process of intercepting an ai tanker and performing a refueling operation.