

Lock-On F-15C Tutorial 1

HUD, gauges and navigating

The legendary Eagle is one of the world's most successful fighter aircraft with an unmatched combat record in modern times.

The Eagle is an all weather day/night air superiority fighter aircraft powered by twin Pratt and Whitney PW-220 afterburning turbofan engines each rated at 23,830 pounds of static thrust.

This bird is capable of reaching speeds in excess of 1,400 kts and Mach 2.5 with a service ceiling of 60,000 feet. You are in for one heck of a ride!!

In this tutorial you will learn about the HUD, the panel gauges, and how to navigate using those instruments.

Starting with the HUD you can see that it is quite similar to the HUD in the A-10A so I'll go over the basics quickly.

In the center of the HUD is the Velocity Vector(VV) and the pitch ladder, on the left side is the airspeed scale and on the right the combination barometric and radar altitude scale. The heading tape is on the top of the HUD with the small inverted 'V', caret, showing current heading and the small vertical line is the heading bug. This is where the similarities end.

In the center of the HUD is a 'W' shaped symbol which is the waterline and it represents the longitudinal axis of the aircraft at all times or the exact spot the nose is pointing. The distance between the waterline and the VV is the aircraft's angle of attack.

Above the waterline and below the heading scale is the gun cross which is aimed 2 degrees above the waterline and will appear when the Master Arm switch is in the 'ARM' position.

Below the airspeed scale is the G readout and will show both positive and negative Gs.

Below the altitude scale is the navigation block which displays information regarding your current steerpoint and navigation mode.

Now we will move down to the main instrument panel. The basic 5 flight instruments that are required to keep the blue side up when we can't see anything outside the canopy are very similar to the A-10A so I won't go over them now.

Additional instruments on the panel that differ to the A-10A are the Angle of Attack indicator which displays the current angle of attack in units from 0 to 45. An index mark is set at the approximate optimum landing approach AOA, 20 to 22 units. Below it is the Accelerometer(G Meter).

Next are the engine N1 fan tachometer gauges which indicate the engine speed as a percentage of maximum RPM for both the left and right engines. The red band indicates afterburner.

Below the N1 tach's are the Fan Turbine Inlet Temperature Indicators which use an analog pointer to indicate the temperature in increments of 10 degrees Centigrade. The red band indicates excessive temperature.

Continuing down the panel, the Fuel Flow gauges show the fuel flow, including afterburner, for each engine. Flow is measured in pounds per hour.

Next, the Exhaust Nozzle Position Indicators which show the exhaust nozzle position for each engine. The display shows the position as a percentage of being completely open.

To the right, the Fuel Quantity Indicator shows the remaining fuel in the internal and external tanks measured in thousands of pounds and further right is the annunciator panel.

Ok, time to learn about the navigation information displayed on the HUD. On the NAV block, the navigation information is displayed on 3 lines, the first showing the currently selected steerpoint and NAV mode.

The second line shows the distance in nautical miles to the selected steerpoint.

The third shows time remaining to reach the steerpoint. We can cycle through the steerpoints by pressing the '~TILDE' key.

On the HUD we also have another NAV symbol, the Integrated Flight Director, which gives pitch and steering guidance. To use the flight director just maneuver the aircraft to keep the director cross in the center of the HUD.

Navigation in the F-15C is identical to the A-10A which was previously explained so there is no need to repeat it in this mission.

Lock-On F-15C Tutorial 2

BVR (Beyond Visual Range), using the Doppler radar

In this tutorial you will learn how to use the powerful Hughes AN/APG-63 pulse Doppler fire control radar to acquire and engage airborne targets.

You will learn how to use the Range While Search(RWS), Track While Scan(TWS), and Single Target Track(STT) radar modes and interpret the data on the HUD and Vertical Situation Display(VSD). Using this information you will engage airborne targets with The AIM-7M Sparrow medium range semi-active guided and the AIM-120C AMRAAM Advanced Medium Range Active radar guided missiles. Located in the nose, the APG-63 radar is a highly effective, all-weather multi-mode radar. The APG-63 combines long range acquisition and attack capabilities with automatic features to provide the instant information and computations needed during air-to-air combat operations.

We enter the Range While Search or RWS mode by pressing the '2' key. This will change the HUD and the VSD to the Beyond Visual Range search mode.

Now I'll bring up an AIM-7M Sparrow semi-active radar guided missile by cycling the hardpoints with the 'D' key and note it becoming 'RDY' on the

Programmable Armament Control Set or PACS.

I'll activate the radar with the '**i**' key and you can see the VSD come to life displaying the radar antenna sweep and other important information.

On the bottom of the VSD we can see the sweeping radar antenna azimuth caret and scale with limit circles providing illumination 60 degrees off the centerline or 120 degrees in its full sweep. We can also change the azimuth by pressing the '**CTRL+**' and '**CTL-**' keys to switch between a 30 and a 60 degree antenna sweep.

On the left side of the VSD is the antenna elevation caret and scale. The circles beside the elevation scale represent the radar beam coverage and display the maximum and minimum altitudes being scanned in thousands of feet. The elevation scan volume can be raised or lowered with the '**SHIFT-SEMI-COLON(;)**' and '**SHIFT-PERIOD(.)**' keys.

The digital number on the upper right of the VSD is the selected range which can be cycled with the '**+ and -**' keys with the minimum range being 10 and the maximum being 160 nautical miles.

The readout on the bottom right is your aircraft's true airspeed(T) and on the bottom left is its groundspeed(G).

In the center of the VSD is an artificial horizon line and the symbol with two small vertical lines, '| |', is the slewable Target Designation Cursor(TDC). We can slew the TDC with the '**PERIOD(.)**', '**SEMI-COLON(;)**', '**COMMA(,)**', and '**FORWARD SLASH(/)**' keys. Slewing the TDC up and down will also change the antenna elevation scan volume.

Contact! Solid horizontal bars are hostile airborne contacts or 'tracks' and solid circles are friendly aircraft.

I'll slew the TDC over the hostile contact and press the '**TAB**' key to lock it up and enter Single Target Track mode or STT. To undesignate or unlock a target press the '**CTRL-TAB**' keys.

We are now in Pre-Launch mode and all the radar energy is solely focused on the one aircraft, our Primary Designated Target or PDT, is providing us with information on the target including its airspeed, aspect angle, and heading displayed left to right on the upper left of the VSD.

Its altitude is next to the arrow on the elevation scale indicating 16,000 feet and our closure rate is tracking down the right side of the Dynamic Launch Zone(DLZ) scale indicating 230 knots and increasing. NCTR is indictaing a IL-76 heavy transport jet.

We are through Mach 1 now and closing fast on the IL-76. We are inside RPI, Fox 1!

On the HUD the target designation(TD) box is added showing us the location of our locked target and the ASE circle with its angle off indicator telling us which direction it's headed, indicating the same direction we are and now in a descending left turn.

Active on the bottom left of the HUD, the flashing TTI timer tells us 'Time to

Intercept' and when it counts down to zero the Sparrow has either hit or missed so we can lock up another aircraft or launch a second Sparrow. Good hit! Looks like the IL-76 is going down. Splash one!

Time to find our second target so I'll select TWS mode by pressing the '**ALT-I**' keys and press the '**D**' key to select the AIM-120C noting the indication on the PACS.

I'll extend the range and slew the elevation up to search.

Contact! Looks like several targets above us and I can see contrails in the distance. It's going to get busy!

The tracks are now grey, indicating altitude, and angle off telling us which way they are heading, head on.

Slewing the TDC over the track and 'bugging' it or designating it as the PDT now brings up the same information as seen with the Sparrow but to launch a Sparrow we would have to designate the target again to put it into STT mode.

I'll bug the second hostile track and we will engage both of them simultaneously while in TWS mode. The second track now becomes the 'Secondary Designated Target' or 'SDT' with a '1' designating it.

In TWS mode with AIM-120C's we have the ability to simultaneously designate and launch on 8 separate targets.

On the HUD, Inside the altitude scale is a DLZ, identical to the one on the VSD. On the bottom right of the HUD is the target range, the target aspect, and the Time To Active(TTA) timer for the next missile on the rail

On the bottom left is the target Mach number(TM 0.4).

We are in range as inidctaed by the STAR symbol under the TD box on the HUD. Just outside RTR, using the 'SPACEBAR' key to fire, 'Fox 3! I'll now turn right to center the steering dot on the SDT, Fox 3'!

The first AMRAAM will track the PDT and the second the SDT. Looking at the flashing Post Launch Timer we see the 'M' telling us 'Time to Active' for the next missile on the rail.

Good hit! Splash 2! Another good hit! Splash 3!

The AIM-120 can also be launched in STT mode by bugging the target a second time but anytime you have an STT target that aircraft will know you have locked him up.

Using the TWS mode allows you to remain somewhat hidden as you will only alert the enemy with a search warning while at the same time you have AMRAAM's headed his way.

It is also important to know that we can use the radar to lock and fire AIM-9M Sidewinder infrared guided dogfight missiles in STT mode only.

Lock-On F-15C Tutorial 3

PACS and TEWS

The Programmable Armament Control Set(PACS) displays the weapon inventory onboard the aircraft and the Tactical Electronic Warfare System(TEWS) receives, interprets, warns, and displays radar emitting threats to your aircraft.

We'll begin with the PACS and go over what information it displays to us. Starting at the top the external fuel tank stations are listed, Left, Center, and Right. With the 'FUEL' text indicated the PACS is telling us we have external fuel tanks loaded at each particular station. With no fuel tank loaded, the text will read, 'PYLON'. On the upper left side of the display is the gun rate indication and it will read either 'HIGH' for 6000 rounds per minute or 'LOW' for 4000 rounds per minute. The gun rate can be changed with the '**SHIFT-C**' keys.

Across the display on the upper right is the expendable countermeasures inventory. The remaining CHAFF and FLARES will be indicated here.

Down the right side is the AIM-9 infrared seeker 'COOL' indication. The AIM-9 seeker needs to be cooled before it can be used to acquire hot targets. When the 'COOL' text is boxed, the seeker is being cooled. The box will only appear when the MASTER ARM is in the 'ARM' position.

You can toggle the MASTER ARM with the '**ALT-SPACE**' keys.

On the lower left of the PACS is the 'SCAN' field. When the AIM-9 is selected in the non-radar SCAN mode the word 'SCAN' will be boxed.

The primary information you will be using the PACS for is the weapon station inventory. The PACS display represents a rough, top-down view of the aircraft, with the nose of the aircraft oriented towards the top of the display.

The large triangular brackets represent the wings of the aircraft. The locations of the eight weapon stations on the underside of the aircraft are indicated, along with the type and status of the weapon loaded at each station.

Two types of weapons can be selected, medium-range missiles(MRM) and short-range missiles indicated by 'SRM'. You can cycle the different types with the '**D**' key. When an MRM missile is selected as the active weapon, the word 'RDY' is displayed above it.

All other MRMs on the display have 'STBY' displayed above them. All SRMs have 'SRM' displayed above them. If an SRM is selected, the active SRM will have 'RDY' displayed above it and all other SRMs on the aircraft will have 'SRM' displayed above them.

Any MRM on the aircraft will have 'STBY' displayed above them. This should help you understand the Programmable Armament Control Set.

The TEWS system includes the Loral AN/ALR-56 Radar Warning Receiver which provides electronic detection and identification of both surface and airborne threats.

In addition, the TEWS allows for activation of appropriate countermeasures including electronic jamming and dispensing of expendables such as chaff and flares. The TEWS display will tell the pilot the following information.

The radar emitter mode, search, lock, or launch; the bearing of the emitter in relation to our jet; the general type of the emitter such as airborne, naval, or ground based and the specific type of emitter such as a particular SAM or aircraft. Looking at the TEWS display or scope we see a cross in the center. That cross is our aircraft from a top down perspective. Next we have the inner/lock zone ring which will display emitters that have locked onto our jet.

The outer most ring is the search zone where emitters that have detected our jet but have not locked on are placed and around the search zone of the display are several dots at the standard clock positions. These are always on the display and always remain static.

We are currently flying towards a hostile area with numerous air and land based emitters where we can see how these emitters are displayed on the TEWS and what aural warnings we will hear. We are currently being painted by several emitters, an A-50 Mainstay AWACS aircraft indicated by the '50' at 2 o'clock, an Early Warning Radar indicated by 'EW' to our 6 o'clock.

There are also search hits from a SA-11 Buk Gadfly SAM system's Snow Drift, 'SD' search radar at our 11 O'clock and SA-10 Grumble 'Big Bird(BB)' and 'Clam Shell(CS)' search radars at 1 o'clock. It is important to remember that the TEWS scope only gives bearing and level of threat information and does NOT give range to the threat.

All the TEWS display symbols are listed in the manual so be sure to have a copy of them handy when flying dangerous missions.

An SA-11 Buk TELAR now has a lock on us and has launched a SAM, note the lock on and launch tones and the '11' symbol in the inner lock ring.

I'll keep beaming the SA-11 to stay out of it's launch envelope. At this altitude and speed, we should be safe from the Buk system.

Now a Mig-31 Foxhound has spiked us, indicated by the '31' symbol

The SA-10 engagement radar has locked onto us! Note the '10' symbol on the inner ring and the lock tone.

Yikes! Now the SA-10 has launched! Note the flashing '10' symbol on the inner ring and the new launch tone.

The TEWS is really cluttered at this point but we do have some filters we can use to make it more readable in a high threat environment. Using the '**SHIFT-R**' keys we can select 2 additional filters to declutter the display.

The first is the 'SHOW ONLY LOCK' which will only display inner lock zone emitters locked on our jet. There, now you see that just the SA-10 and the Mig-31 are shown. Pressing '**SHIFT-R**' again will select the 'SHOW ONLY LAUNCH' filter and pressing it once more will return to the 'SHOW ALL' filter.

This is getting too dangerous! It's time to turn tail, dive for the deck, and get out of here!

Looks like we're clear of the SA-10 threat now. We don't want to mess with them!
What a blast racing through the valleys!
We just got locked up by a Mig-31 and spiked by the A-50!
We have to get to some deeper valleys to lose the A-50!
The Mainstay spiked us again! We are still vulnerable! Deeper valley ahead!
I hope in this chaos that you have been able to learn about the PACS and the TEWS and the symbols and tones it gives you to help manage the threats that you encounter in combat.

Lock-On F-15C Tutorial 4 **WVR (Within Visual Range), using the gun and AIM-9**

In this tutorial you will learn how to use the General Electric, they make more than just light bulbs you know, M61A1 Vulcan rotary cannon and the AIM-9M Sidewinder heat seeking short range dogfight missile. You will be using these weapons during Within Visual Range or WVR encounters and dogfights.

Starting with the gun, it is a six barreled 20mm rotary cannon capable of firing 6000 rounds per minute in the 'HIGH RATE' and 4000 rounds per minute in the 'LOW RATE'.

The ammunition drum will hold 940 rounds of PGU-38 shells. We can change the firing rate by pressing the '**SHIFT-C**' keys and note the change on the upper left of the PACS.

To bring up the gun press the '**C**' key, this puts us into 'Auto Acquisition Guns Steering Mode'. Looking at the HUD, the fixed Lead Computing Optical Sight or LCOS reticle is displayed approximately one degree below the gun cross.

Press the '**i**' key to activate the radar.

At the center of the reticle is a piper and in this mode, the radar provides a scan pattern with an auto acquisition capability that ranges from 500 feet to 10 miles in range.

The scan pattern is 60 degrees in azimuth(30 degrees each side of center) and 20 degrees in elevation noted on the VSD. If the radar detects and locks on to a target, the HUD will automatically switch to the Lead Computing Optical Sight or LCOS, Radar Track HUD mode.

There is the target ahead and now we just fly to within 60 degrees and the radar should auto-lock.

Now the radar has automatically locked the target and we see the TD box, range scale and the active LCOS reticle.

Below the altitude tape we also see the target range and aspect angle, 'T' for Tail-on.

Now we keep maneuvering to place the LCOS piper on the target and ensure we are in-range by reducing the distance so the range bar tab is inside the maximum

range dot on the outside of the LCOS reticle.

Using the 'SPACEBAR' key to fire, 'GUNS, GUNS, GUNS!' Splash 1!

When using the gun always use short bursts and most of all be patient to ensure your valuable rounds are on target.

That's the gun and now it's time to learn how to employ the AIM-9M Sidewinder in it's various non-radar modes.

We activate the Boresight mode by pressing the '**6**' key and note 'RDY 9M' on the PACS.

The HUD now displays the boresight seeker field of view with the growl tone. We must now fly the jet to place the FOV circle on the target.

Once the seeker detects a target we keep reducing the range until we get a seeker lock indicated by a high pitched lock tone.

Now that we have a good tone we can fire the Sidewinder, using the 'SPACEBAR' key to fire, 'Fox 2! Splash 2!

Next is the AIM-9 Scan Mode which we select by pressing the '**4**' key and then the '**i**' key to deactivate the radar and again, note 'RDY 9M' and the 'SCAN' boxed on the PACS.

This is another non-radar mode but look at the FOV circle on the HUD, it is displaying the field of view for the uncaged seeker rather than just the boresight in the previous mode.

The AIM-9M Sidewinder is a supersonic all aspect infrared guided heat seeking short range missile and will be your primary weapon for dogfight situations.

In this mode the seeker is searching the area within it's gimbal limits so acquiring and maintaining a lock is much easier for the seeker. Again, we fly the jet to place the target inside the FOV circle and wait for a good tone.

Using the 'SPACEBAR' key to fire, 'Fox 2!'

Splash 3!

Lock-On F-15C Tutorial 5 **WVR (Within Visual Range), using the Auto Acquisition modes with the AIM-120, AIM-7 and AIM-9**

In this tutorial you will learn how to use the AN/APG-63's Auto Acquisition modes with the AIM-120 AMRAAM and the AIM-9 Sidewinder. You will also learn how to employ the AIM-120 in visual mode, the AIM-7 in Flood mode, and how to use both the AMRAAM and Sparrow passively in the Home on Jam mode.

The APG-63 has 3 Auto Acquisition modes, they are the Guns Steering mode which we have already seen, Radar Boresight mode, and the Vertical Scan mode which are able to automatically lock up targets within 10 miles range.

We'll start with the Boresight AACQ mode which is useful for quickly engaging targets in our front quarter. To activate the Boresight mode, press the '**4**' key.

Activating this mode brings up an AMRAAM, turns on the radar and sets the antenna scan along the radar bore line.

On the HUD we see the boresight reference circle and now we maneuver the jet to place the target into the circle within 10 miles and the radar will automatically lock it up.

There we go, he's locked and we see the Target designation box and we can fire. Using the 'SPACEBAR' key to fire, Fox 3!

Splash 1! We can use the AACQ modes with any of our air to air missiles.

Next is the Vertical Scan Auto Acquisition mode which we use primarily while we are in a situation where we are performing hard turning maneuvers or in a dogfight. We activate the Vertical Scan AACQ mode by pressing the '**3**' key and the '**D**' key to bring an AIM-9 online.

The radar is on and the antenna is now scanning from 5 to 55 degrees vertically and 7.5 degrees in azimuth as noted on the VSD.

On the HUD we see the AIM-9 reference circle with a vertical line extending to the top of the HUD indicating this mode. This scan pattern is designed to lock up targets that are above the HUD and directly in line with our velocity vector.

We are merging with a fast moving F-4 Phantom so let's mix it up with him and get into a turning fight.

There is the lock and tone, using the 'SPACEBAR' key to fire, Fox 2! Splash 2!

For our next target we will use the AIM-120 AMRAAM in the visual mode. To activate this mode press the '**6**' key.

The AMRAAM is brought up, the radar is off and on the HUD we see the 12 degree dashed reference circle and the word 'VISUAL' is displayed under the altitude tape. In this mode the AIM-120 will use its on board radar to lock any target within 15 miles.

Now I'll maneuver the jet to place the target within the reference circle and using the 'SPACEBAR' key to fire, Fox 3!

I have to act quickly here so I'll activate the AIM-7 Flood mode by pressing the '**6**' key with an AIM-7 active. Using the 'SPACEBAR' key to fire, 'Fox 1!'

Splash 3 from the Visual Slammer! Splash 4 from the Flood Sparrow!

Ok, now I'll bring up an AIM-7 and with the radar on and no target locked we are in the Relaxed mode indicated by the 8 degree reference circle on the HUD but we can't target or engage anything in the relaxed mode.

The previously hurried shot was in AIM-7 Flood mode and from the relaxed mode you press the '**6**' key to enter the Flood mode. On the HUD we saw the solid 12 degree reference circle and the word 'FLOOD' on the VSD.

When in FLOOD mode the radar is providing illumination within the reference circle and you do not have to acquire a lock on the target in this mode.

You fly the jet to place the target within the reference circle and fire. You must

keep the target within the reference circle for the entire duration of the missile's flight or it will lose lock and go ballistic.

We are getting locked up by an Su-27 Flanker. I'll activate the onboard ECM jammer by pressing the '**E**' key.

The final mode you will learn today is the AIM-120 and AIM-7 Home On Jam mode. This mode is used to engage targets that are actively jamming your radar which is represented by jamming strobes on the VSD.

There are the strobes and because of the jamming we can't get a radar lock on it. Thankfully a built in feature of both the AMRAAM and the Sparrow is the ability for the missile to passively lock and track the energy emitted by the enemy aircraft's jammer.

With the AIM-7 on line I'll slew the TDC over any one of the jamming strobes and press the '**TAB**' key to lock. Now we see the solid line through all the strobes and the 'HOJ' symbol on the VSD.

'HOJ' is also displayed on the HUD and once we feel the target is within range we can fire. Fox 1 two times!

Missile inbound! I'm now beaming and punching chaff and flares!

Looks like this is going to lead to a merge... I'll activate Guns Steering AACQ mode by pressing the '**C**' key.

Looks like he is buggin' out! I don't think I'll be letting this one get away!

Finally... the fatal burst! Splash 5!

Home On Jam is very good mode to use but the missiles will only track passively as long as the target is actively jamming. Remember this because you will be actively jamming other aircraft at times and you will also be vulnerable to the enemy's Home on Jam weapons.