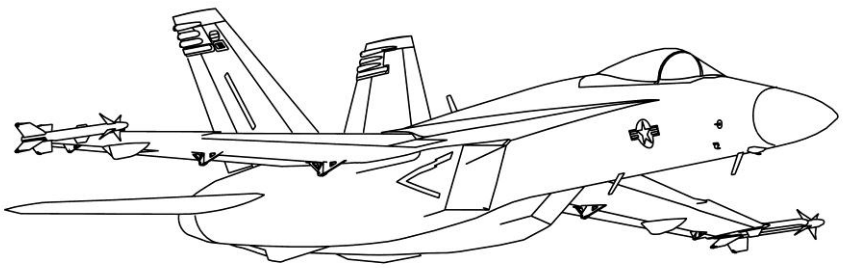
NAVY MODEL

F/A-18E

"SUPER HORNET"



Vertical Reality Simulation's®

SUPERBUG X

F/A-18 Hornet Simulator For Microsoft® Flight Simulator X

Version 1.2

www.vrsimulations.com VERTICAL REALITY SIMULATIONS

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1 GETTING STARTED

At the time of this writing, it's been about 15 months since our first release of the Superbug for FS2004. The FS2004 version was a financial failure and a critical success. It received a PC Pilot Platinum award (platinum is cooler than gold), an Avsim Gold Star (there's only one star in a gold star), and a number of other awards and favorable reviews. Considering it took about 5 years to develop, it would have needed to sell about 8,000 copies before I would have considered it a success. At that level I would have grossed about $60-$70,000 US dollars per year of work. I would have netted about $50,000 per year. Needless to say, it didn't sell 8,000 copies (or 4,000, or 3000). I could have worked at McDonald's and made more money. Being the financial wizard I am, and not willing to accept failure as an option even if it meant the Salvation Army, I and my talented partner Alvaro pushed on towards FSX.

Along the way we had inquiries from the U.S. Navy, the U.S. Air Force, The Australian Air Force, and a dozen other military contractors. If there's one thing all these guys have in common it's a never-ending supply of inquiries followed by nothing even closely resembling money. I learned a valuable lesson from a colleague who's been working with the military trying to get funding for his own project; "if you can't offer them a way to pay MORE money for something, you won't get funded." You see, in the fiasco we call government here in the U.S., if they don't keep their budgets high, next year's budget is cut. So any reasonable pitch to save them money is usually met with "We'll get back to you on that, cowboy."

Back in the real world there have been many challenges in bringing such a sophisticated aircraft to FSX, not the least of which was ensuring there were a significant number of enhancements over the FS2004 version. Some of these include firing missiles and AGMs which actually steer towards their targets. The system is animation-based, and works quite well, but there are drawbacks inherent to all animation-based solutions. The keys are in place for a true combat system. We only need to find enough financial success to make those technologies a reality going forward.

FSX has many quirks that made the transition difficult. While there are some code-level changes over previous version of MSFS that made life easier, most made things harder. Many people seem to think FSX is more technically advanced than FS2004, but unless you're speaking about graphics, that's simply not true. There are no more than a handful of core changes that offer any improvement over previous versions in terms of avionic or simulation capability, and you cut your FS2004 frame rate in half. All of that said, the FSX version of the Superbug is going to blow you away.

One annoying thing about the FS2004 version of the Superbug was the requirement to "initialize" controllers for the fly-by-wire system prior to flight. The reason for the process was that FS2004 didn't write out the controller information we needed unless some change was made to them in the axis settings. Each axis had to be inverted and then returned to normal before the controller enumerations would stick. This meant the user needed to go through a short (but uncomfortable for the uninitiated) process before the control surfaces would respond. The FSX version has no such requirements, which is not only good for you; it's great for us in terms of tech support! (edit: at least it was until release).

1.0.1 Vertical Reality Simulations

The primary reason this product took so long to market was because we're a small team. VRS is primarily three people: I, **Jon Blum**, and my good friends and partners **Álvaro Castellanos Navarro** and **Chris Tracy**. A fourth colleague, **Doug Dawson** also provided much help in developing some of our earlier-generation gauge utilities.

I started out on my own and quickly realized that in order to provide the highest quality I needed to let a true expert work on the flight dynamics. I was playing around with tools like Air Wrench initially and quickly realized it wasn't going to cut it. While Air Wrench is a great product, it doesn't make up for a novice's lack of experience. Garbage in, garbage out. I consider myself fairly adept technically, but I'm no aerodynamic engineer. The last thing I wanted to do was compromise this bird to a half-baked flight model.

Before Álvaro came along, I was working the late, great **Ron Freimuth**. Ron was a legend in the FS community and literally wrote the book on decoding the .air file. Unfortunately we lost Ron to natural causes a couple years into the project, and it was at that point I started looking for another partner. Some of Ron's work remains to this day in the form of algorithms. He was truly a talented (if eccentric) man and I miss him very much.

Álvaro was a frequent forum visitor who I approached after Ron's death. He had been posting seemingly esoteric questions about the flight modeling, so rather than get annoyed like I usually do, I asked him if he wanted "a little work." He gladly jumped on board, clearly not knowing what he was getting into. Alvaro is loco; the man has worked tirelessly for over 3 years on this project. Álvaro works for EADS, Spain, and has extensive experience with fly-by-wire systems. Spain, incidentally, operates a large fleet of F/A-18s. The work he's done is nothing short of amazing. What he wasn't able to obtain officially, he performed CFD studies on. As long as you have certain known constants, *anything* can be extrapolated accurately. Álvaro doesn't guess – he's a man on a mission from God.

I myself am the quintessential "jack of all trades." I started out working on Macintosh flight simulators with a pioneering company called Graphic Simulations in Dallas, TX. Graphsim had something special that I'd never seen before; a graphics engine using a Differential Scan Conversion algorithm. Basically they were able to create very fast fills (which translated into very fast frame rates) by drawing only those areas of the screen which changed from frame to frame. We're talking about 30FPS at 1280x960 in the year 1992. Yeah, let me repeat that: 30FPS at 1280x960 in 1992, uh huh. Everyone else was using "voxels" at 640x480 or less. This was a flat-shaded engine initially, but we were one of the first to move to the "new" 3DFX hardware platform when it arrived on the scene a few years later. I was doing primarily graphics work, building all the models and terrain databases for our F/A-18 Hornet franchise.

Some of my "bigger" models were about 200 polygons and all had to BSP sort in order to increase rendering efficiency. The 2D cockpits couldn't use more than about 20 reserved colors because the whopping 8-bit pallet had to share with the terrain for all times of day. Still, this was some really cutting edge stuff and I am very proud to have been a part of it. I long for those days and the stability of a real job:)

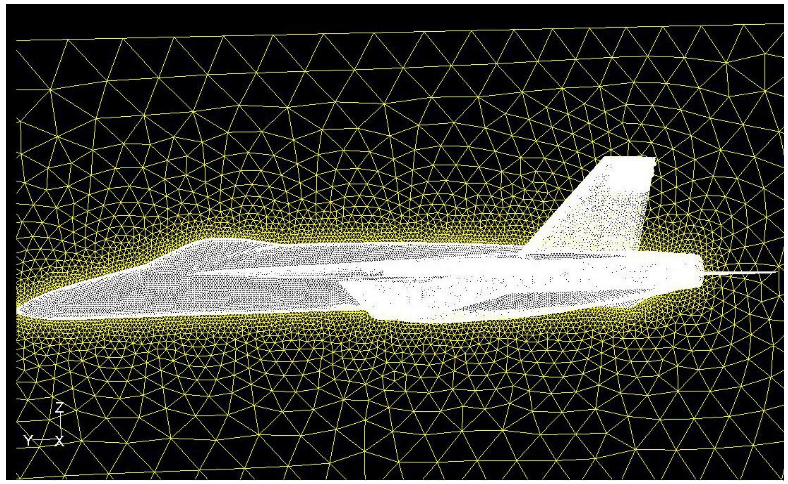
In about 2002 I decided to take a career step backwards and train in the culinary field. I spent a couple of years at Le Cordon Bleu and graduated at the top of my class (such as it was). I took an externship at a Michelin-starred restaurant called the Herb Farm in Woodinville, Washington. The only redeeming thing about working there that summer was that it was right next door to a Redhook brewery where I could go drown my woes in Hefeweizen. Six weeks later and with the prospect of making $10/hr looming over me like a headman's axe, I decided I'd pretty much had enough of that "career" path.

Dejected, depressed, and looking for an escape, I armed myself with a spiffy off-the-shelf Dell and a new copy of FS2004. I set out to look for some military add-ons, but what I found was disappointing and shallow, with very little in the way of realism or beauty. Some of them were better than others, and I won't name names, but for my money, the freeware stuff was better than the payware. It wasn't long before I started tinkering around and downloading SDKs; FS2004 had just come out, so I was using the older FS2000 documentation initially. I made a home on the Avsim panel design forums and set to work creating what I hoped would be something more fulfilling. People like Bill Leaming and Doug Dawson were my heroes (and still are), dispensing information and utilities like soda machines.

Interest led to fascination, which led to infatuation, which led to compulsion. Somewhere along the line PMDG had struck it rich with their 737 NG. I don't think anyone had achieved that sort of community status before, and from that point forward things were never the same. Add-ons were a real business now, at least for those guys. I wanted to be PMDG and dammit, I was goanna do it. Before long I was trying to do things better and better and being completely dissatisfied with limitations, started to break through some of the known "barriers" to produce what I had originally envisioned; A true military aircraft simulation worthy of any PMDG fan's attention.

1.0.2 What's So Cool?

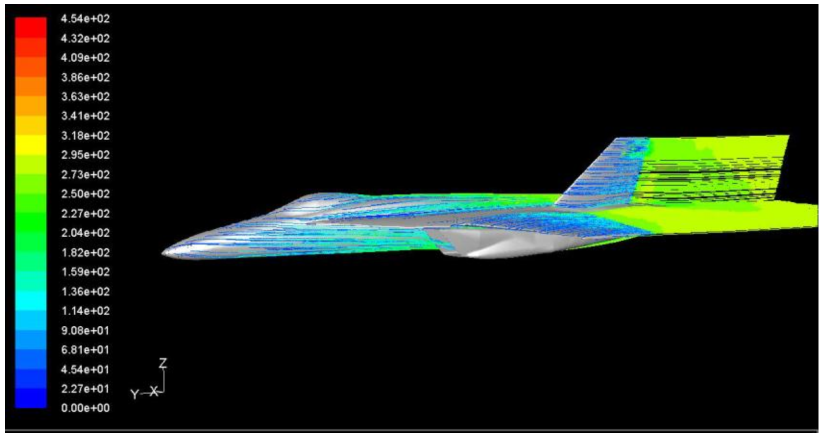
The VRS F/A-18E is the most advanced combat aircraft ever designed for Flight Simulator. That's not just a marketing slogan, it's a fact. We've taken all the things that "couldn't be done in MSFS" and done them. We were able to do many, many things that will have you seeing past previously explored boundaries, particularly where military aircraft are concerned.



We're certainly proud of our models and other visuals, but that's not where this airplane really excels. We have without a doubt the finest flight model/control law schedule that's ever been produced for a PC military aircraft simulation. It's based on two components: A neutrally statically stable base flight model and a robust “fly-by-wire” *Control Augmentation System (CAS).* The term “fly-by-wire” tends to get thrown around loosely in many circles, but true fly-by-wire requires the interception and processing of control inputs prior to sending those signals to the actual aircraft surfaces. Unless it's doing that, it's not fly-by-wire. Auto-trim alone does not make a fly-by-wire system. We can use this system for aircraft stability and control throughout the entire range of AOA (and in the F/A-18, that's a BIG range). We can use it for custom autopilot, failures (total or partial lack of control), nosewheel steering (high and low gain), anti-skid, and a vast range of other uses that are simply not possible to achieve in FS without such a system. We basically take control away from Flight Simulator and use our own.

The VRS F/A-18E models all the physics associated with carrying and delivering payload. Properties of mass, including drag (multiple forms) and weight are all simulated based on the payload being carried. We can shed the weight, reduce the drag, and adjust the aircraft centers of gravity both laterally and longitudinally, all on the fly. We do not use multiple flight models and aircraft meshes to achieve this; Using a separate flight model for each combination of weapons is a fundamentally impossible if you wish to offer the user anything but a basic set of predefined choices. Nor can that approach account for shedding the weight and drag upon payload release. The aircraft must be able to dynamically adjust its flight characteristics.

Most of the systems we simulate are based on a series of manuals developed by NATOPS *(Naval Air Training and Operating Procedures Standardization)*. These manuals are sometimes referred to as having been “written in blood.” Some of the procedures and standards developed are the result of accidents, mishaps, and tragedy associated with the hazards of naval aviation. These NATOPS manuals are serious stuff. As a civilian organization producing consumer software, we don't have access to the restricted areas of these manuals, nor would we ever wish to disseminate that information. However we do have access to sections of the F/A-18E flight manual pertinent to non-combat operations, and these are extensive. What we didn't know about weapon-specific functions, we either “borrowed” from Jane's F/A-18, or learned through other sources and/or extrapolation. Either way, you're going to know more about how an F/A-18E *really* works than anything you've flown before could teach you.



We also simulate various tactical and support operations by way of “Hostility Zones.” These are variable sized areas, centered on user-designated waypoints that become “active”, firing mock SAMs and or AAA at your aircraft. These systems can be configured for range, fire rate and lethality through our Aircraft Manager. If the aircraft fails to evade or destroy (via HARM missile) these AAW (Anti-Air-Warfare) threats, the aircraft can be hit, causing various degrees of systems damage. Yes, you can attack and be fired upon in Microsoft Flight Simulator. Countermeasures, including ECM are also modeled to a certain extent, allowing you to make use of flares, chaff, and maneuvering techniques in order to evade incoming AAW fire.

We simulate a robust air-to-air radar system with multi-mode capability based on the AN/APG-73 radar in Block 1 Super Hornets. The radar system is a true B-sweep design with search, track and ACM modes. The scan volumes can be adjusted, and we even have Doppler effects. In addition, AI aircraft can be tracked and fired upon by air-to-air missiles. Each missile type is individually modeled for range, acceleration, and maneuverability, and features authentic caged and uncaged fire control modes and HUD symbology. If an AI aircraft is destroyed it’s removed from radar as if it never existed. The AI aircraft continues to exist in the visual world, however it's a dead duck as far as the systems are concerned.

The systems and avionic modeling in this aircraft are authentic, extensive, and robust. The digital displays and Head-Up Display (HUD) are scalable to whatever resolution you're running, providing crisp vector graphics and clean update rates. The various functions for driving these displays are componentized and “talk” to each other by way of a simulated *Multiplex Bus (MUX).* The state of all systems can be monitored by way of a *Built-in-Test (BIT)* interface, and they are subject to battle damage, random failures, and *Environmental Control System (ECS)* overheating. HUD simulation in almost all previous MSFS aircraft simulations had been notoriously sup-par, with apparently no fundamental understanding of how symbology should be presented beyond what “looks good.” The VRS F/A-18E HUD is a world-calibrated instrument with full optical collimation. The distance between elements such as pitch ladder bars exactly corresponds to the outside world rather than simply being scaled in range of movement so that the zenith is visible at 90 degrees and the nadir is visible at -90. Further, the velocity vector (flight path marker in non-naval circles), is carefully calibrated to correspond to the outside world. Where the velocity vector points is where the aircraft is flying.

The virtual cockpit is simply state of the art. Almost every knob and every *function* present in the real aircraft is at your disposal. The layout and default eyepoints in the VRS F/A-18E are specifically designed to provide the optimum combination of avionic interaction and visual acuity at any aspect ratio.

1.0.3 What's Next

We'll want to continue updating the FSX version as we have done (and continue to do) with FS2004. We will be issuing service packs, not just to address any potential problems, but to add enhancements and value.

If sales are good, we plan to immediately begin work on an F version. An F/A-18F is also on everyone's wish list as well as a Growler variant. If and when we do an F/A-18F, it'll feature a full rear-cockpit and all associated avionics changes. This would be an upgrade to the F/A-18E package.

1.0.4 Special Thanks

We couldn't have pulled this one off without the help of some very dedicated and gracious testers. Some of these "testers" have gone way beyond the call of duty in providing research, marketing assistance and materials, and even offers of financial support. So I would personally like to offer my deepest thanks to **Adam Cannon**, **Henry "Black Bart" Bartholomay**, **William Call** for their tireless support and expertise. I'd also like to thank **Gino Berk**, **Ed Bird**, **Emir Yildz**, **Rob Pracic**.

Also very special thanks to **Doug Dawson**. Doug produced some of the indispensable utilities and modules we used in this project, saving us many months of work. In fact I'm not even sure if it would have been possible without his support not only to us, but the entire FS developer community. Thanks Doug!

Words cannot fully express my gratitude and admiration for **Chris Tracy** who during the last few weeks of development, and subsequent to release, really showed us his colors when he single-handedly beta tested the software and lent us his invaluable expertise and skills in diagnosing and fixing persistent problems. Chris is the Dr. House of systems administration. It was a great pleasure working with you, Chris. You literally saved my bacon on more than one occasion, and I will never forget it.

1.1 ACM ACTIVATION & REGISTRATION

Before you can use the ACM, or the VRS F/A-18E, the software must be activated. Activation requires an Internet connection and may be done either through automatic or manual web-based methods. Whichever method you choose requires no waiting.

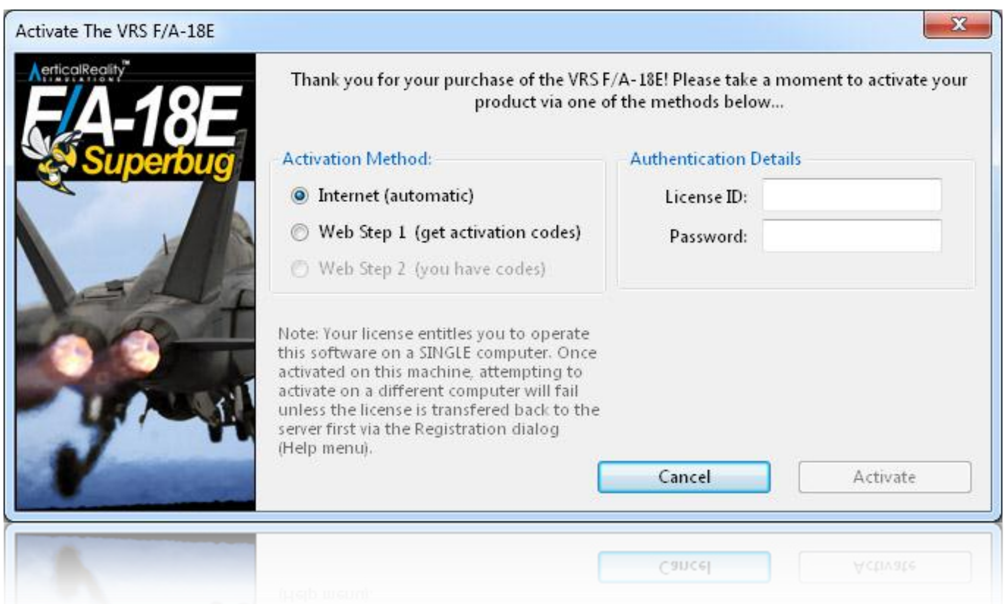
If you have an active firewall blocking outbound ports, you'll need to enable port 80 for the ACM.

1.1.1 Online Automatic Activation

Note that some screens may or may not look exactly the same as what you see here; the ACM is constantly evolving. Don't panic! It all pretty much functions exactly the same.

To enable the ACM via the automatic Internet method, simply:

- ☑ Select the appropriate *Internet (automatic)* option (this will be selected by default).
- ☑ Enter the *License ID* and *Password* from your sales receipt. If you purchased your copy from VRS directly, you created your own password when you created your shopping cart. This would have been sent to you along with your License ID.



If you purchased from a third-party, you were issued a password at the time of sale, and it may also be found in your sales receipt.

- ☑ Press **Activate**.

A moment or two later, an activation dialog will appear informing you of the activation status. You may now skip to

Registration.

1.1.2 Web (Manual/Offline) Activation

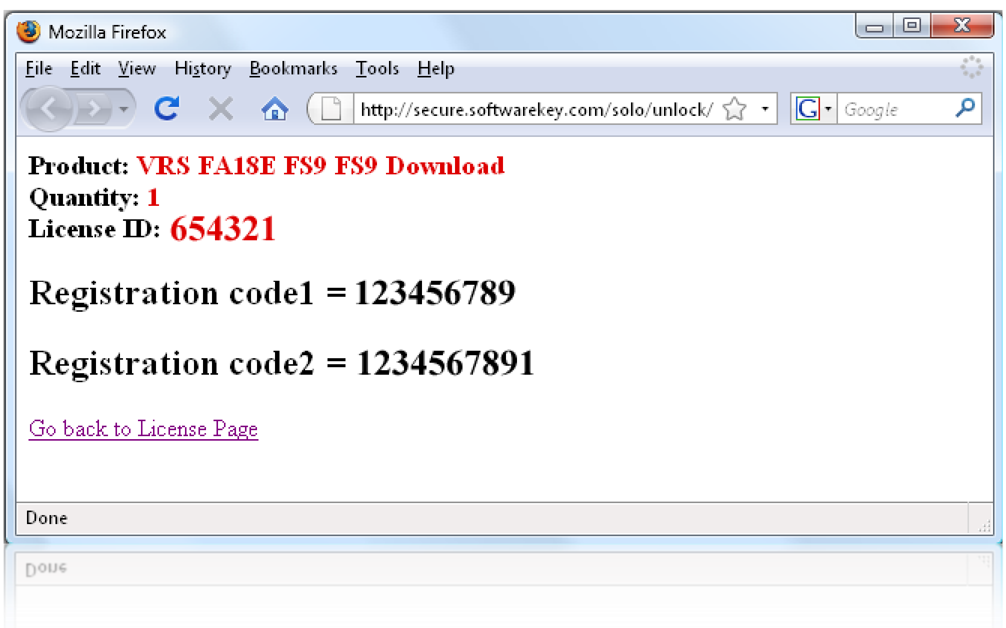
To enable the ACM manually via web browser:

- ☑ Select the Web (get activation codes) option.
- ☑ Enter your License ID and password.

The next step will depend on whether the machine is online of offline. If **ONLINE**:

- ☑ Press the **Get Web Codes** button.

Your browser should open and automatically insert your license ID and password into the session and the following screen will appear with 2 separate registration keys. Skip the next step.



If OFFLINE:

- ☑ Press **Web Step 2** option (*see image next page*).
- ☑ Go to an ONLINE machine and navigate to: http://secure.softwarekey.com/solo/unlock
- ☑ Enter your license ID and password and press **Next** in the browser.
- ☑ Enter *User Code 1* from the offline machine.
- ☑ Enter *User Code 2* from the offline machine.

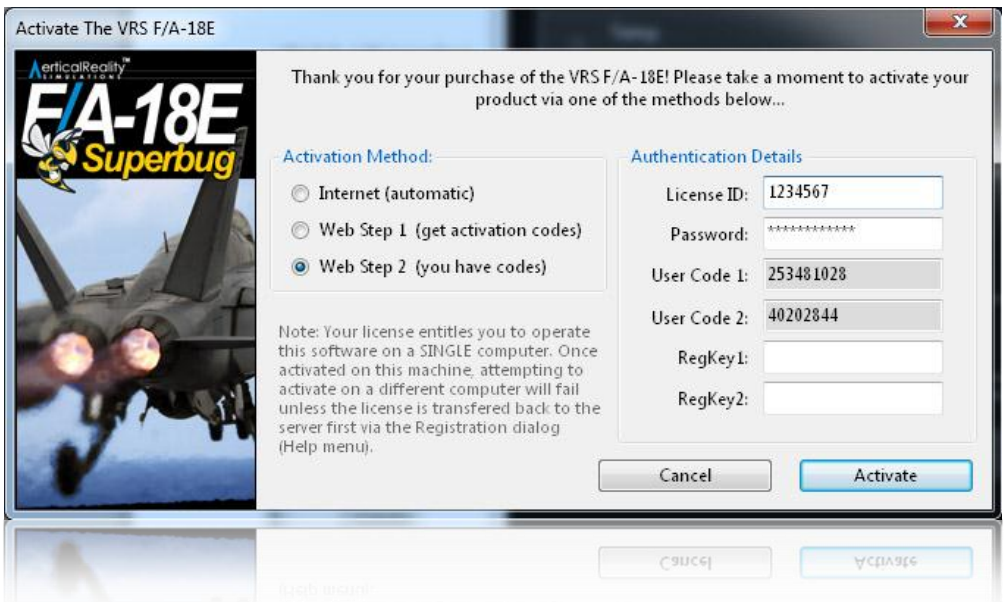
☑ Press **Next**.

The screen shown on the previous page will appear with your registration codes.

☑ Return to the ACM and select the **Web Step 2**. (you have codes) option (*see below*).

☑ Enter the registration codes from your browser into the *RegKey1* and *RegKey2* fields of the ACM (these will only be visible if you have selected the *Web Step 2* option.

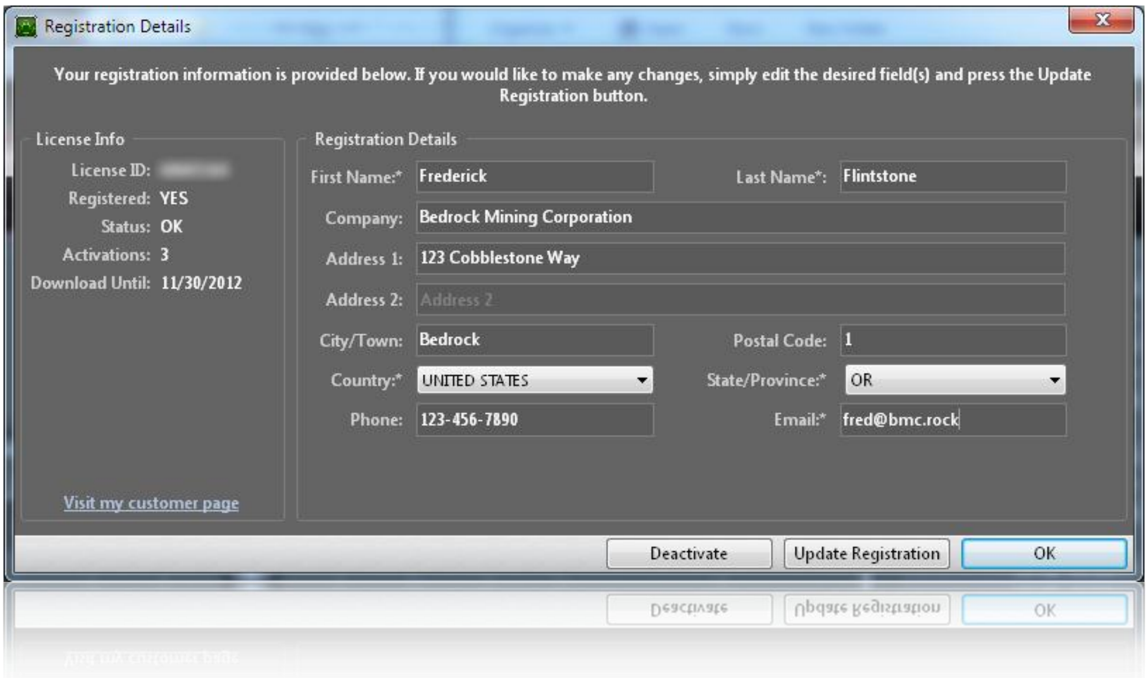
☑ Finally press **Activate**.



1.1.3 Registration

If you purchased the software directly from VRS' website, you should already be registered based on the information you provided at the time of purchase. You may review your registration information at any time, by selecting *Registration Details* from the *Help* menu. Note that the registration screen may look slightly different depending on which version of the Superbug you're running.

For a complete guide to the ACM, please see the Aircraft Manager section.



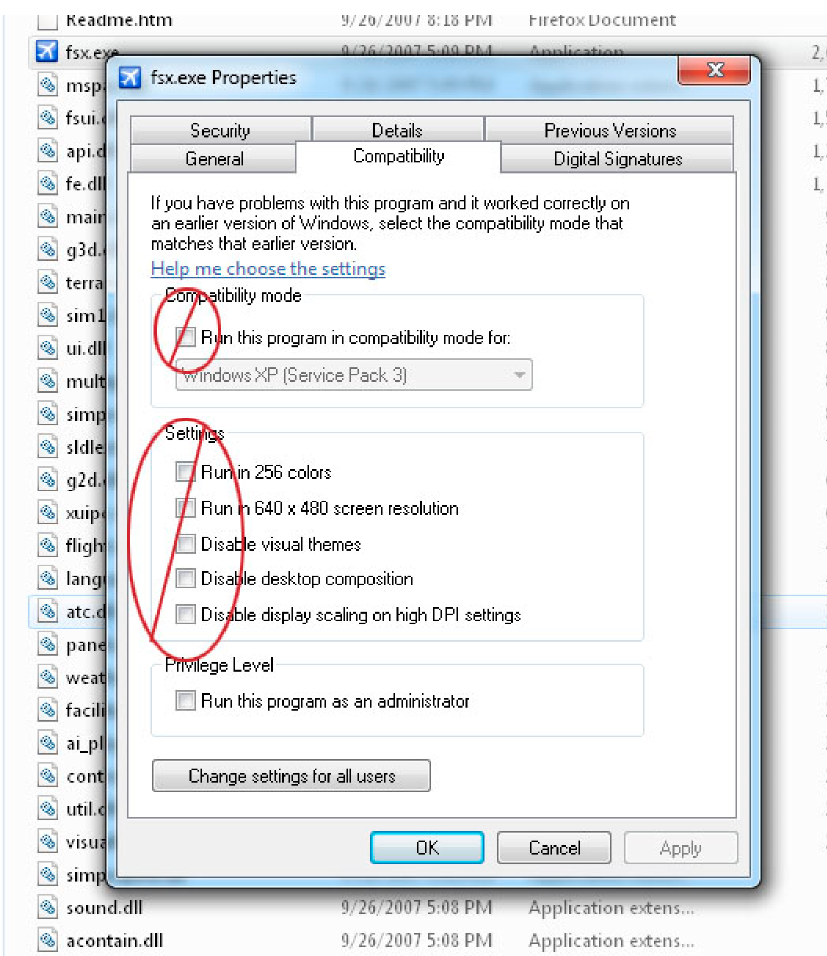
1.2 FSX SETUP

1.2.1 FSX Requirements & Setup

You'll need to ensure several items are available and installed before you can run the Superbug:

- **FSX with Service Pack 2, FSX Acceleration, or FSX Gold**. Any of these flavors of FSX is acceptable, but FSX Acceleration or FSX Gold (which is just Acceleration and FSX bundled together) are highly suggested in order to utilize carrier operations. FSX SP1 or the original FSX are not supported. The FSX Service Pack 2 can be downloaded from Microsoft here: http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=204fee1e-f8de-4b21-9a32-5a41a3e27ff0

- **FSX compatibility modes OFF!** Ensure that ALL compatibility modes are disabled for FSX. These are not necessary under any operating system or any reason and WILL cause FSX to crash with the Superbug. To disable compatibility modes, locate the FSX executable (.exe) in your FSX root directory (typically C:/Program Files/Microsoft Games/Microsoft Flight Simulator X/), right-click



FSX.exe, and select compatibility as shown in the image. Ensure than NONE of these options are selected.

- **FSUIPC4 by Pete Dowson**: FSUIPC is a free interface to MSFS that it used by almost every serious Flight simmer. It's also used by us and many other developers to "talk" to flight simulator at a level that's not normally accessible. This is what we use to intercept your controllers and bypass the normal flight simulator control system for the fly-by-wire FCS. FSUIPC must be installed and confirmed running before the Superbug will function. In fact if you try to run the Superbug without it, it WILL crash. Again, FSUIPC is free and 100% safe. There is a payware version of FSUIPC known as "registered FSUIPC" with many great features, but the Superbug doesn't require the registered version to operate. FSUIPC can be downloaded from here: http://www.schiratti.com/dowson.html

- **FS Force**. If you use a force feedback joystick, and want to be able to use the Superbug with force feedback enabled, you'll need a third piece of software called FSForce. Because we intercept control axes through FSUIPC (which does not support force feedback directly), you'll need to use this software if you want to use those features. The good news is FSForce provides FAR better force feedback than the default MSFS implementation, which is bogus at best. For example if you've invested in a lovely G-940 and aren't using FSForce, you have no idea what you're missing. FSForce can be purchased and downloaded from here: http://www.fs-force.com/

1.2.2 Preparing For Flight

The FSX version of the Superbug is quite a bit easier to setup than the FS2004 version, so those of you who are familiar with the FS2004 version will be happy to know there are no more controller initialization steps. If you're new to the Superbug, you'll never know how much fun you missed!

In order to prepare the Superbug for flight:

- ☑ **Run and Activate the ACM**. The ACM can be found in the Start Menu under the *VRS Superbug X* program group.
- ☑ **If the ACM warns you that FSUIPC is not installed, STOP NOW**. The Superbug will not operate without FSUIPC.
    - Quit the ACM and go to http://www.schiratti.com/dowson.html. Download and properly install the latest version of FSUIPC.
    - Ensure that FSUIPC IS installed properly by launching FSX, selecting a non-VRS aircraft, and pressing **[ALT]** once you're in the simulation.
    - Look for FSUIPC under the ***Add-ons*** menu.

FSUIPC is free to use, but advanced features (which are not required for the Superbug) are not available in the free version.

- ☑ **Restart the ACM** and continue from here.
- ☑ **Select the *Strike 1* package from the first screen that pops up (Payload).** Do nothing else. There may be warnings about your controllers. Ignore them until after you've loaded the Superbug once.
- ☑ **Launch FSX and set *Flight Model General Realism* to 100%**. This is necessary in order to ensure the base flight model is correctly configured and has access to all records in high resolution. *General Realism* can be found by pressing the *Settings* option (left side of screen), and then the *Realism…* option (right side of screen). Move *the General Realism slider* all the way to the right.
- ☑ **Disable Force Feedback**. If you are using a force feedback stick and have force feedback enabled in FSX, you must disable it. You can use FSForce, described above instead, but you cannot use the built-in force feedback with the Superbug. It WILL cause erratic behavior.
- ☑ **Create a new flight in the Superbug**. Once in flight, swipe your controllers by moving them in each axis.
- ☑ **Quit FSX and launch the ACM again**. The ACM can be found in the Start Menu under the *VRS Superbug X* program group.
- ☑ **Check for any errors that exist under the ACM Preferences Tab→Controllers**. If errors exist after having flown the Superbug, they will be displayed here.

1.2.3 Configuring Triggers

The VRS F/A-18E utilizes two FS internal commands, or *events*, in order to process the triggers for firing weapons. While your new aircraft has a rich set of completely custom key commands available (*see section 11 - Reference*), the actual trigger events for firing weapons should ideally be mapped to your joystick. We do this through the ***Cowl Flaps Increment*** and ***Cowl Flaps Decrement*** commands. Why? Because the F/A-18E has no cowl flaps, which makes these normally unused commands the ideal candidates. Cowl flaps increment will fire the gun and only the gun. Cowl flaps decrement will fire everything else.

There are four methods mapping the triggers for the VRS F/A-18E:

1) FSUIPC (registered) JOYSTICK MAPPING: You may use the registered, "payware" version of FSUIPC. The VRS F/A-18E does not *require* the registered version of FSUIPC, but certain extra features can make use of it. The nice thing about FSUIPC mapping is that it can be done as *aircraft specific*. Please refer to the FSUIPC documentation for mapping *cowl flaps decrement* and *cowl flaps increment* to joystick buttons.

When setting up FSUIPC, trigger one should be mapped as aircraft specific, with "select for FS control" checked. The first event (button down) should be *Cowl Flaps Inc*, and the second event (button up) should also be set to *Cowl Flaps Inc*. This will allow the trigger to function as press and hold to fire. Indeed registered FSUIPC is the only way to get this realistic behavior. All other methods require that the trigger be pressed twice; once to begin firing and once to stop.

2) FSX JOYSTICK MAPPING: You can map the trigger events via FSX's built in event mapping (explained below). However keep in mind this method is NOT aircraft specific; it will affect all other aircraft as well. For the most part this will not be an issue, however if you do use cowl flaps for other aircraft and do not wish to map those functions to your joystick triggers, you can either skip FS mapping altogether, or you can just use whatever you already have set up for cowl flaps.
3) THIRD-PARTY JOYSTICK SOFTWARE: In order for this to work, FSX must first be set up with cowl flap increment and cowl flap decrement events mapped to keys. Once this is done, you can use your joystick software to in turn map those keys to buttons. If you use this method, be sure the key(s) you choose are NOT a VRS F/A-18E custom key.
4) KEYSTROKE ONLY: The final method is to skip joystick mapping all together and use only keystrokes to increment and decrement cowl flaps. You would set this up within FS just like mapping any other keystroke.

1.2.4 Multi-Axis Throttle Option

If you have a multi-axis throttle connected (i.e. quadrant, dual, or triple), you will need to enable that functionality in the ACM. Please refer to section 3 -*Aircraft Manager* for instructions on how to do this.

1.2.5 Disable Incremental Spoilers

If you are using registered FSUIPC to control spoilers in conjunction with a slider (Saitek X52 for example), you MUST disable this function, or the aircraft will exhibit massive drag even when the spoilers appear retracted.

The spoiler "function" in the F/A-18E is an all or nothing affair; A switch, located on the throttle either sets them ON or OFF, with nothing in between. The spoiler function is explained section 4 – *The Aircraft*.

2 TUTORIAL FLIGHT

This tutorial is designed to walk you through the basic procedures needed to get in the air, navigate towards target areas, and use various systems to find and destroy "targets". We'll then return to base for a standard approach and landing.

Please note that this section is in no way a comprehensive systems study of the VRS F/A-18E. The objective of this tutorial is just to get you in the air and comfortable with the aircraft. We're going to skip all the normal start-up procedures for a "cold and dark" flight and begin with power to all systems and engines running, [almost] ready for take-off. On the other hand, this is not a "quick start" either. Be prepared to spend upwards of two hours reading through the material, pausing the flight when necessary.

2.0.1 Limitations

Note that although it's possible to simply save the flight and continue later, certain functions will not be saved with the flight. For example if a custom waypoint (a modification to the original MS flight plan) is entered into the navigation sequence, it will be purged upon quitting the simulation. In that case, the MS GPS engine will warn you that it cannot load the flight plan, and will proceed to load the flight without it. In that case, simply reload the flight plan once the simulation has finished loading.

2.0.2 Nomenclature

Throughout this tutorial a series of check marks ☑ will indicate actions which should be taken. Feel free to pause the simulation at any time. At certain points along the way we'll suggest a good place to pause while you continue reading about a particular topic.

A great deal of new terminology and acronyms will be introduced throughout the documentation which some readers may not be familiar with. When a new term is introduced it will be Italicized and Capitalized; subsequent use of the term will not. A complete glossary of terms can be found at the end of this manual.

Throughout the text, **NOTE**, **CAUTION**, and **TIP** boxes provide additional important information about the current topic. Please pay special attention to these, as they can not only save you some time, but may save your aircraft!

2.1 AIRCRAFT CONFIGURATION MANGER (ACM)

The Aircraft Configuration Manager (ACM) is an external application designed to “talk” to the aircraft. It is covered in great detail in the Aircraft Manager section of the manual, but in a nutshell the ACM can be used to:

- ☑ Load weapons, fuel tanks, and other stores.
- ☑ Change fuel quantities.
- ☑ Initiate failures.
- ☑ Set preferences for various features.

2.1.1 Launching the ACM

For this tutorial, we’re simply going to load some weapons and fuel. The ACM is covered in much more detail under *Section III: Aircraft Configuration Manager*.

CAUTION:

Always keep your sales confirmation email in a safe place. If you need to re-download the software, or require official support, VRS will need this information in order to verify your purchase and assist you.

- ☑ MSFS: **QUIT**. If Flight Simulator is currently running, please quit Flight Simulator now.
- ☑ ACM: **LAUNCH**. A shortcut to the ACM was installed in the Start Menu under VRS F/A-18E Superbug X. at the time of installation. The application itself in located in the *\SimObjects\Airplanes\VRS_FA-18E\ACM* folder of your FSX installation directory. Launch the ACM either by selecting it from the **Start→VRS F/A-18E Superbug X** menu or by launching it manually from the VRS_FA-18E aircraft directory.
- ☑ ACM: **ACTIVATE**. Upon launching the ACM for the first time, you'll be prompted to activate the product. Enter the License ID and Password contained in your sales receipt and press the **Activate** option. You should be activated immediately. If, for some reason, you prefer to activate by web, you may do so at this time.

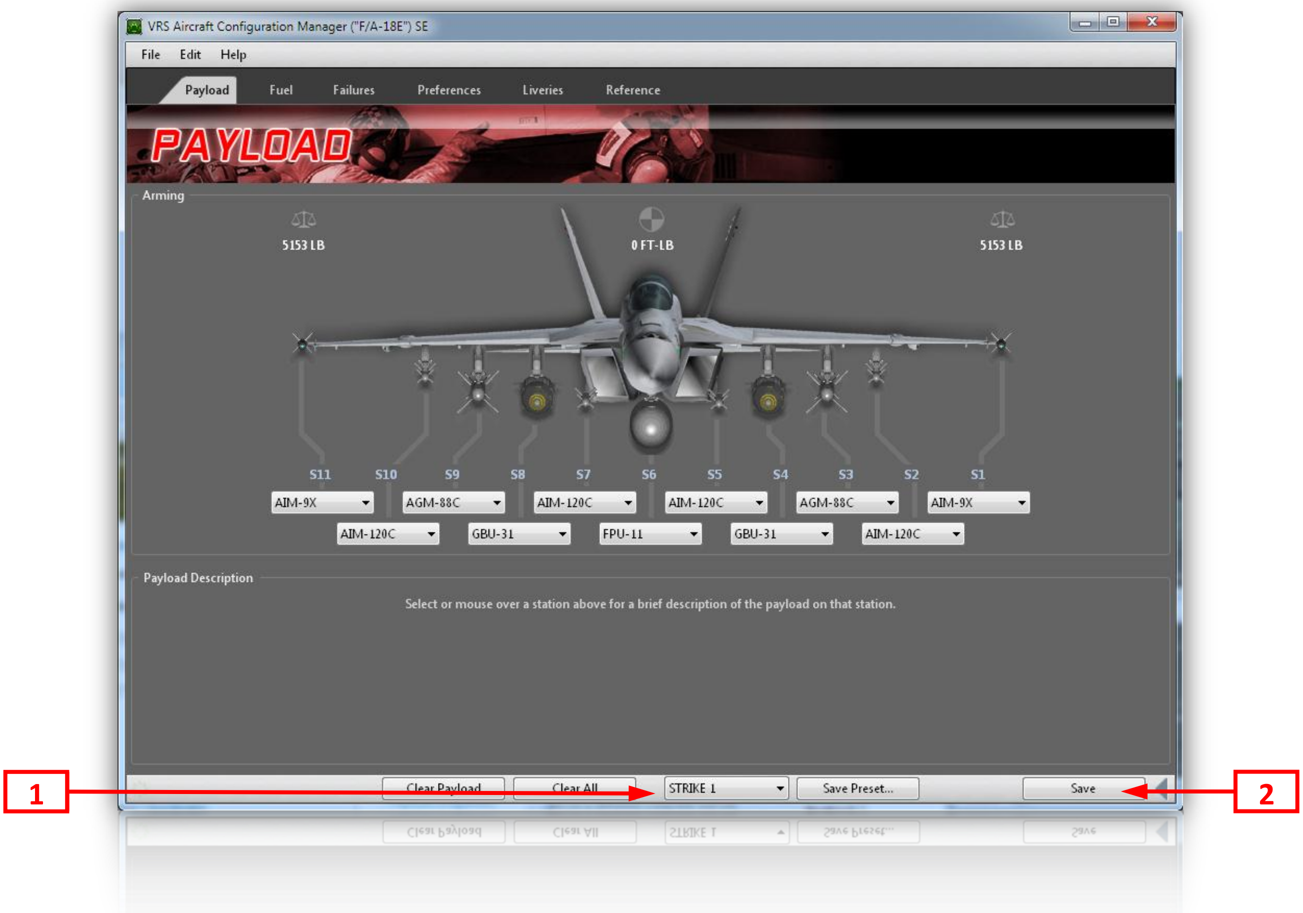
2.1.2 Payload Setup

After the aircraft loads into the ACM, a somewhat busy looking screen will appear loaded with options for outfitting the aircraft with weapons, or loading out. This is called the Payload page.

What’s unique here is that the customization options are, well, custom! You may have had experience with other add-on aircraft whereby a different model was required for each weapon configuration. The downside to that is you would have been stuck using a limited assortment of preconfigured, non-firing loadouts. Not so here; you are free to choose any available weapon or pod on any available station. Sure, there are limits to what can and cannot go on a particular station, but the number of combinations of stores on a single aircraft is quite large.

When we refer to a *Station*, we're talking about either a fuselage "cheek" location, or a wing-mounted "hardpoint." The F/A-18E has 11 stations beginning on the port (left) side of the aircraft and proceeding to the starboard (right) side. Since the aircraft is oriented nose-on in the payload diagram, station #1 is on the right side of the screen, and #11 is on the left.

For this tutorial we're going to select one of the various *Preset Packages*. Presets are a series of predefined Loadouts designed to mimic how a Super Hornet might be equipped for a particular type of mission. In this case, let's select a strike-oriented package:



☑ SELECT PACKAGE: **STRIKE 1.** From the bottom-center popup menu labeled Select Preset..., select the STRIKE 1 package **[1]**.

The armament will change visually to reflect your new choice. If you have already changed the configuration with the various pop-ups, just re-select the STRIKE1 package.

☑ ACM: **SAVE**. Press the **Save** button **[2]** on the lower-right of the screen (from any page).

☑ ACM: **EXIT**. From the **File** menu, select **Exit** (**CONTROL-X**), or simply close the application window.

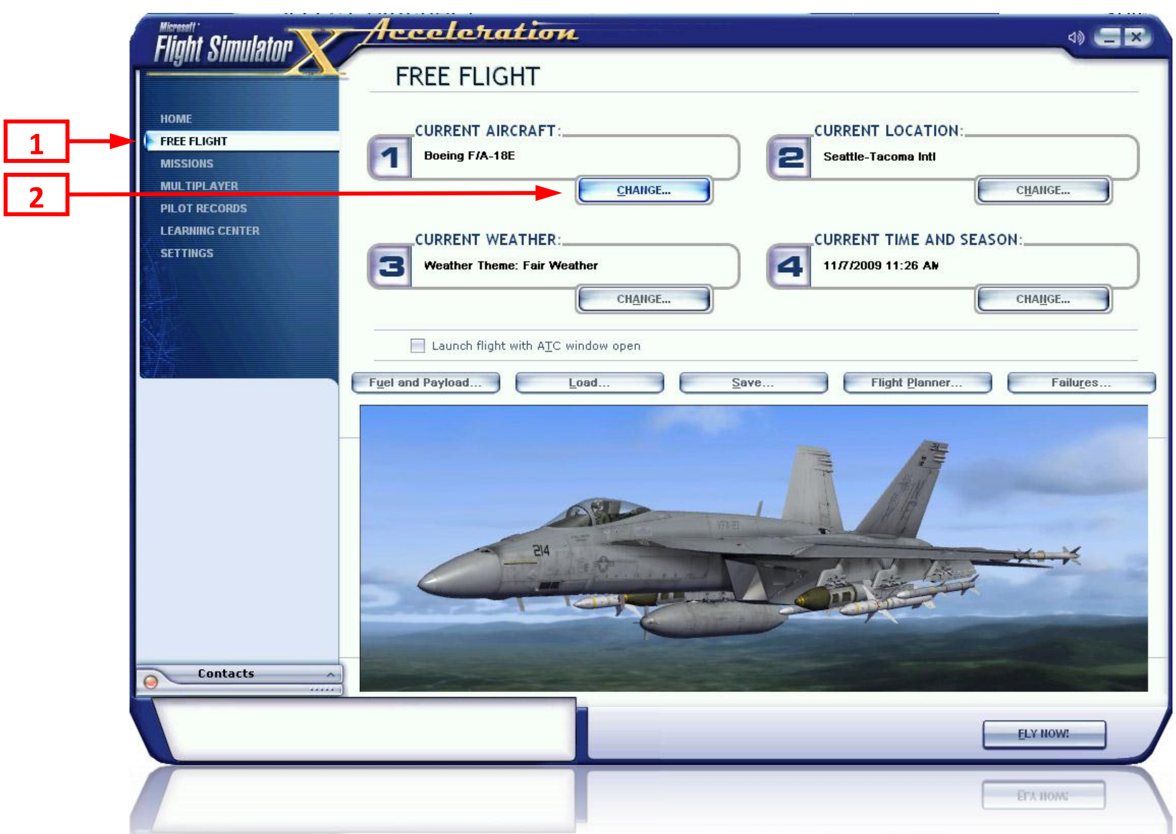
2.2 FSX AIRCRAFT SELECTION

2.2.1 Fast Track

The procedures to set up the tutorial flight are deliberately verbose in order to accommodate inexperienced MSFS users. If you are an experienced FS user and wish to fast-track the following few sections, please feel free to do so with the following 7 steps. If you encounter ANY issues with FSX stability, make SURE you read section 1.2: *FSX Setup*.

- ☑ Select the **VRS F/A-18**E under **Boeing-VRS**.
- ☑ Set conditions to **VFR**.
- ☑ Set General Realism to **FULL**.
- ☑ Open a 2-waypoint flight plan from **KSEA to KPDX**.
- ☑ Move the aircraft to the selected starting location (KSEA) and **FLY**!
- ☑ Skip to ***Cockpit Overview***, *below*.

When you first launch FSX, the main interface will appear. The aircraft you currently have selected will be based on your last flight, or the default flight which was last saved.



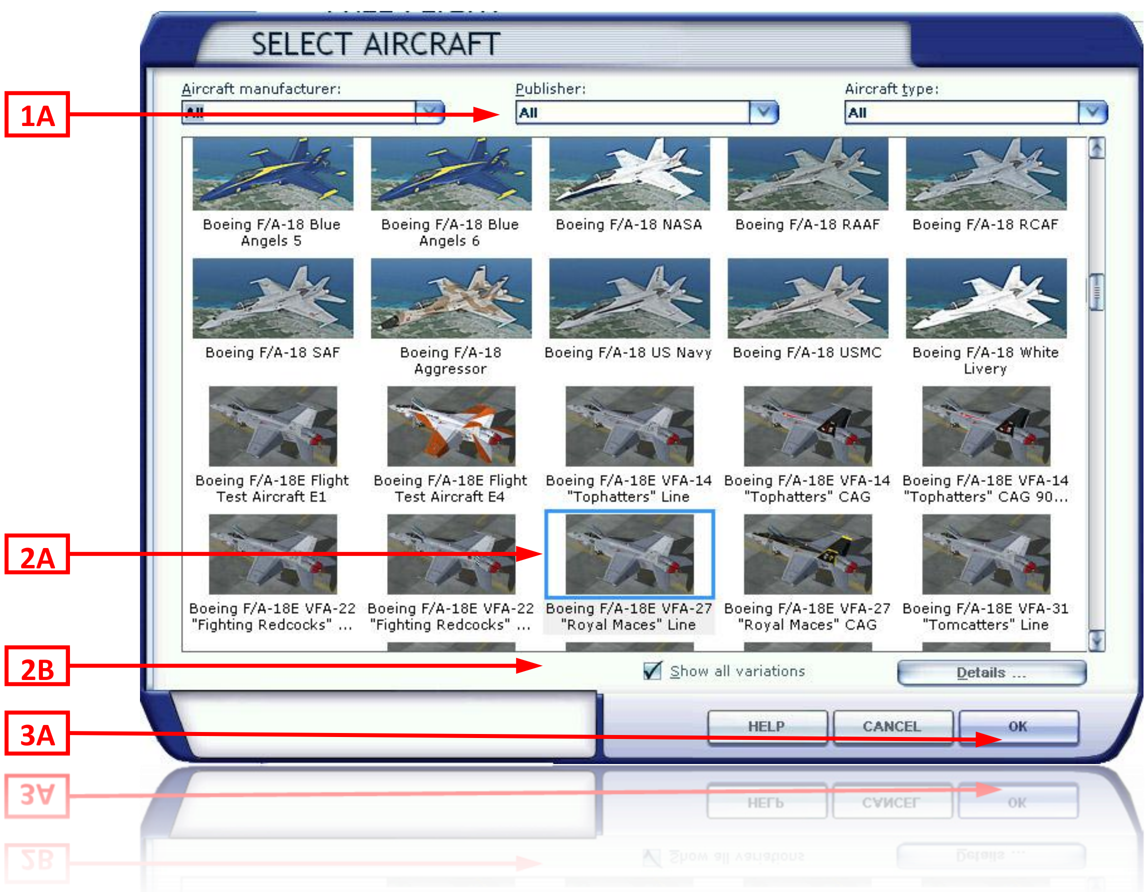
☑ LEFT SIDEBAR: **FREE FLIGHT**. Select FREE FLIGHT **[1]**.

☑ CURRENT AIRCRAFT: **CHANGE… [2]**.

☑ PUBLISHER: **VERTICAL REALITSIMULATIONS [1A]**.

☑ VARIATION: **PREFERRED LIVERY [2A]**.

☑ SHOW ALL VARIATIONS: **ENABLE [2B]**. If this option is not enabled, only one livery will be visible in the aircraft preview.

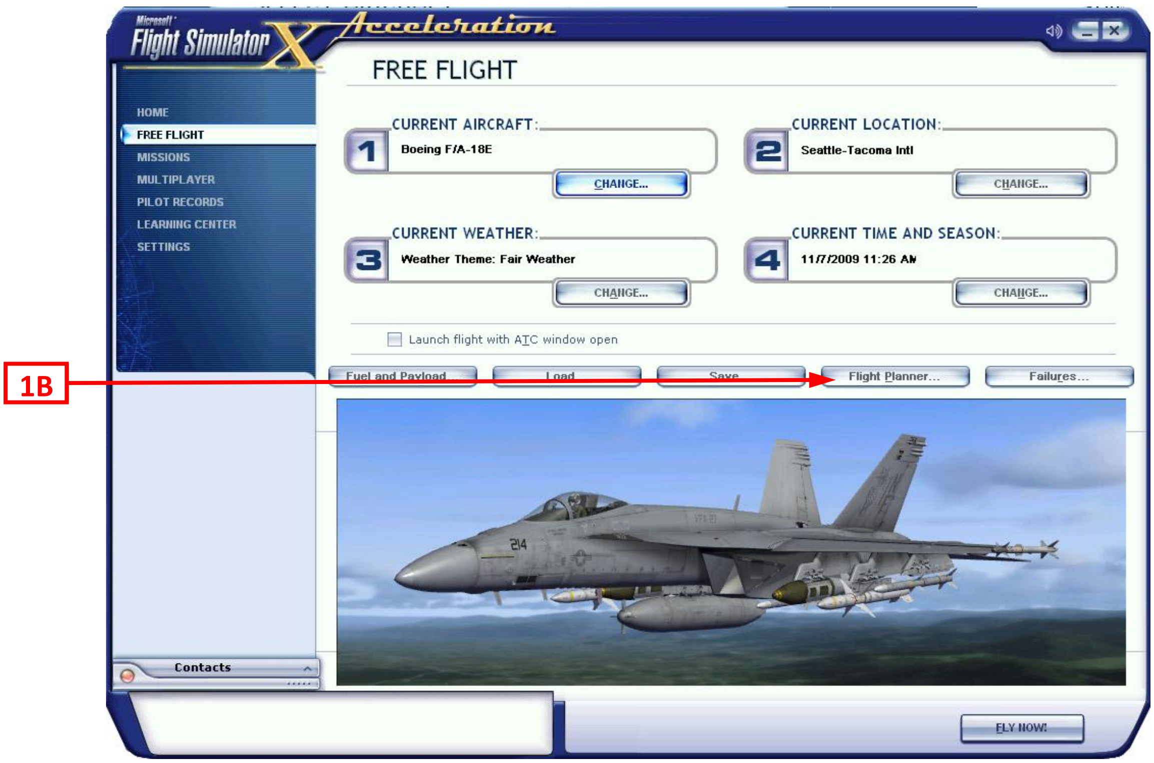


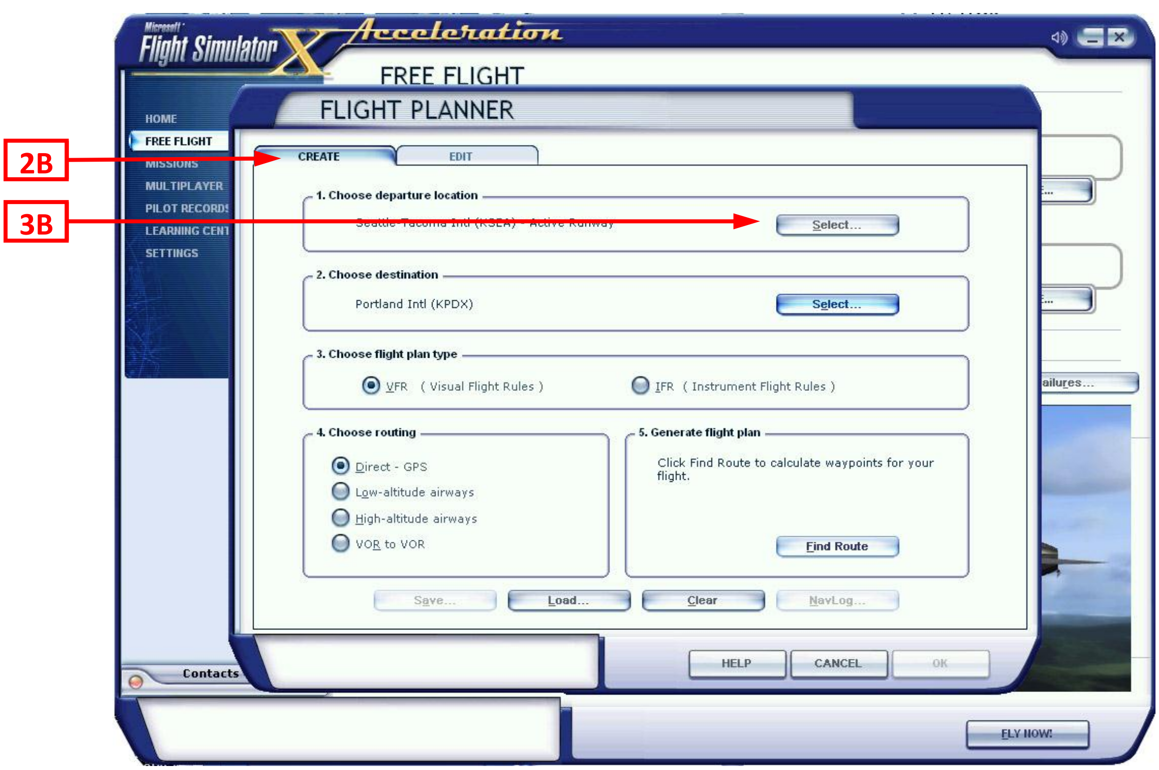
Most liveries, or paints, come in two flavors: CAG and Line. CAG aircraft are assigned to the Commander of the Air Group and usually sport a colorful paint scheme. Line aircraft are the standard low-visibility service aircraft of the squadron.

☑ BUTTON: **OK [3A]**.

2.2.2 Create a Flight Plan

Finally, we'll set up a quick 2 waypoint flight plan from KSEA to KPDX:

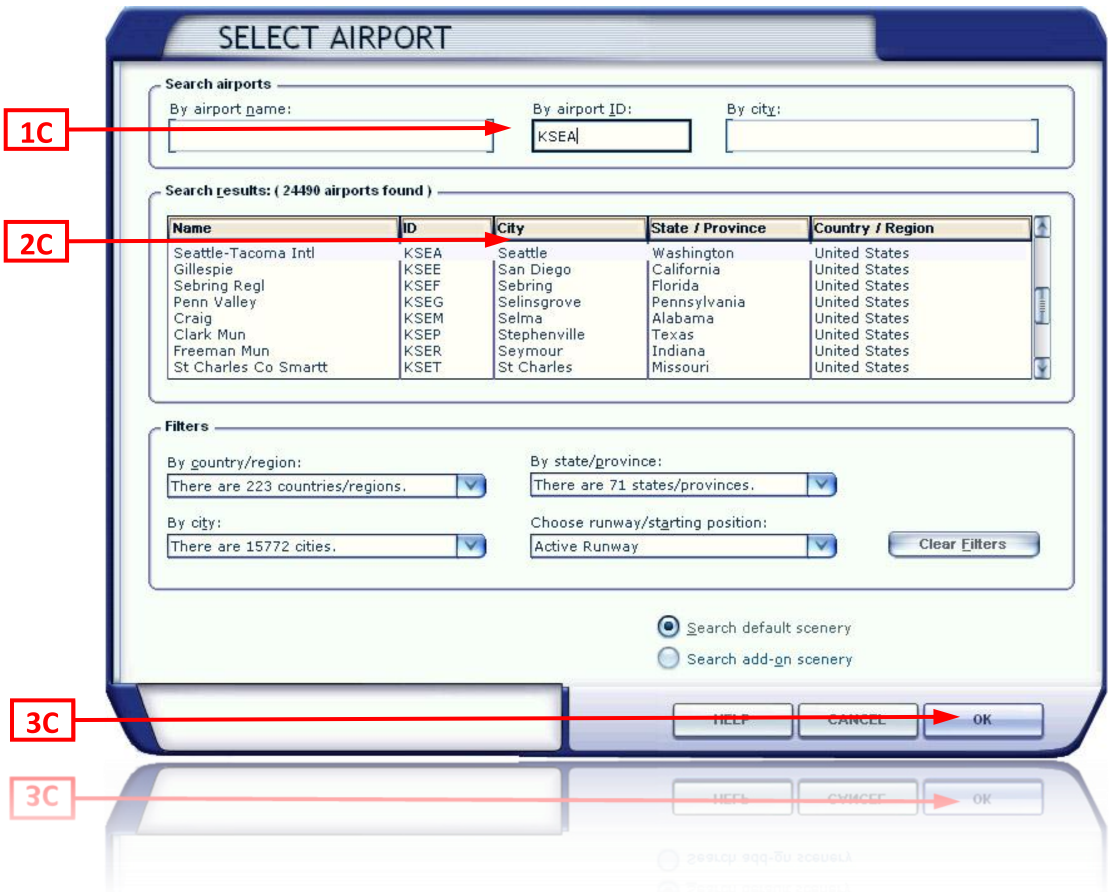




☑ CREATE A FLIGHT: **FLIGHT PLANNER [1B]**.

☑ CREATE TAB: **SELECT [2B]**.

☑ DEPATRTURE LOCATION: **SELECT… [3B]**.

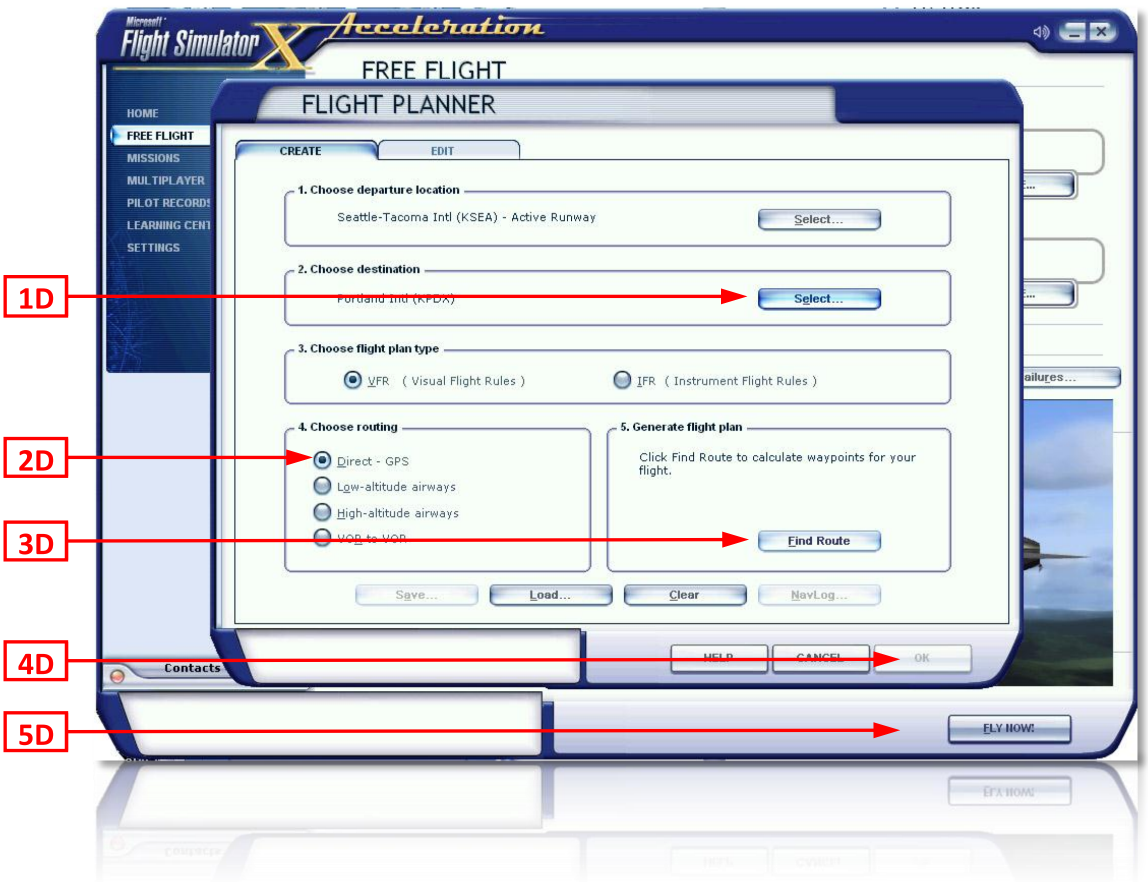


The *SELECT AIRPORT* dialog will appear.

☑ Type **KSEA** into the Airport ID: field **[1C]**.

☑ Verify that *Seattle Tacoma International* is highlighted **[2C]**.

☑ Press **OK [3C]**.



- ☑ CHOOSE DESTINATION: **SELECT...** **[1D]**.
- ☑ The *SELECT AIRPORT* dialog will reappear (not shown, see previous image).
- ☑ Type **KPDX** into the Airport ID: field.
- ☑ Verify that *Portland International* is highlighted
- ☑ Press **OK**.
- ☑ CHOOSE ROUTING: **DIRECT-GPS** **[2D]**.
- ☑ PLOT FLIGHT PLAN: **FIND ROUTE** **[3D]**.
- ☑ Press **OK** to accept the route as entered.
- ☑ When prompted, press **OK** to save the flight plan.
- ☑ When prompted, press **OK** to move the aircraft to the selected airport. For best results, ensure that *Time and Season* is set to daylight hours.
- ☑ BUTTON: **OK** **[4D]**.
- ☑ BUTTON: **FLY NOW**! **[5D]**.

2.3 COCKPIT OVERVIEW

2.3.1 Main Instrument Panel Key Components

The primary panel used in the VRS F/A-18E is called *Main Instrument Panel*. It's so named because it contains all the primary flight displays used for the majority flight. For a comprehensive list of functions, please refer to the Cockpit Systems section of the manual.

1) **Head-Up Display (HUD).** The F/A-18E's primary flight display.
2) **Angle of Attack (AOA) Indexer.** The AOA Indexer is a series of lamps which correspond to approach AOA, and cue the pilot to increase or decrease power during final approach.
3) **Left Caution and Warning Panel.** A cluster of warning, caution, and advisory lamps.
4) **Left Digital Display Indicator (LDDI).** A multi-purpose display used for support and tactical systems. Along the periphery of each DDI are twenty pushbuttons labeled PB1-PB20 beginning with 1 in the lower left, clock-wise to 20.
5) **Master Arming Panel.** Weapon arming, master mode selection and fire suppression.
6) **Emergency Jettison Button.** Jettisons all stations except the wing tips and fuselage cheeks.
7) **Selective Jettison Panel.** Allows selection of specific stations for jettison. Used in conjunction with the selective jettison panel (described in subsequent sections).
8) **Engine/Fuel Display (EFD).** Provides critical engine parameters and fuel level indication. The EFD also provides “bingo” level adjustment.
9) **Multi-Purpose Color Display (MPCD).** In the VRS Super Hornet, the MPCD provides HSI functions.
10) **Right Caution and Warning Panel.** A cluster of warning, caution, and advisory lamps.
11) **Up-Front Control Display (UFCD).** A multi-purpose touch-screen display interface for autopilot, navigation, communication, transponder, and DDI backup functions.
12) **Right Digital Display Indicator (RDDI).** Identical in every respect to the LDDI, but primarily used for tactical functions in day-to-day operations. Note that in our tutorial we're using the “lite” DDI option, so some functions on the RDDI may not be available on the LDDI and vice versa.
13) **IR Cooling/Spin Override panel.**
14) **HUD Controls.** Provides control of various HUD functions including clutter reject level, brightness, altitude (barometric or radar), and AOA indexer light brightness.
15) **Radar Warning Receiver (RWR) Azimuth Display.** Backup radar threat azimuth indication.
16) **Standby Instruments Group.** A cluster of analog “backup” instruments. These include an Attitude Direction Indicator (ADI), Airspeed Indicator (ASI), Altimeter (ALT), and Vertical Speed Indicator (VSI).

2.3.2 Console Key Components

While the main panel provides access to a great deal of information and functionality, there are numerous other controls available only from a series consoles. These are located to the left and right of

the main instrument panel.

1) **Left Auxiliary Console.** Houses the gear handle, parking brake, selective jettison, flap, landing light and launch bar switches. The items on this panel are loosely related at best, but all serve critical functions.

2) **External Power Panel.** Houses all the switches necessary to power the aircraft from an external source. In the VRS F/A-18E all of these switches have a purpose and are directly tied into the electrical bus. As long as the aircraft is on the ground, external power is available.

3) **External Lighting Panel.** Controls power to the formation strip lighting, navigation lights, and strobe lighting (including pattern selection). It also houses the wing tank isolation switch which can inhibit fuel draw from the left and right wing tanks.

4) **Fuel Panel.** Houses the inflight refueling probe (IFR) switch, external tank isolation switches, and the main fuel dump switch.

5) **FCS Panel.** Controls rudder trim, takeoff trim and FCS gain override and reset switches. Note that FCS gain override is only available in the forthcoming Pro version of the VRS Superbug. The reset switch is used to reset the flight control system after a power down and subsequent reapplication of power.

6) **Volume Panel.** Many of the aircraft audio systems have volume adjustments. These include the voice warnings, weapon tones, radar warning receiver. Other volumes, such as radio and other FSX native functions are not adjustable.

7) **Right Auxiliary Panel.** Houses the wing fold switch, hook handle, hydraulic pressure gauge, and standby caution and warning indicators.

8) **Electrical Panel.** The left and right generator and batter switches, as well as the battery gauge.

9) **Environmental Control (ECS) Panel.** Various controls related to bleed air, cabin pressurization, and engine and pitot anti-ice.

10) **Interior Light Panel.** Controls for main and console lighting, the light test switch, and interior NVG compatibility mode switching. Note that the caution and warning intensity functions as well as the map lighting serve no purpose in the VRS F/A-18.

11) **Aerial Refueling Store Panel.** If an AA42R “buddy tank” is loaded on the aircraft, this panel is used to power and control fuel transfer to and from the ARS.

12) **Sensor Panel.** Controls primary power to the radar and FLIR systems.

The various consoles in the VRS F/A-18E can be seen and accessed either by panning the view, or from the Views-->View Mode→Cockpit menu. Several cameras are provided to focus on individual panels throughout the aircraft.

2.3.3 Cockpit Interaction

The majority of knobs and switches in the cockpit are operated by the mouse wheel, or by simply left or right clicking as follows:

- **Left-Clicking** moves switches UP or LEFT.
- **Right-Clicking** moves switches DOWN or RIGHT
- **Mouse wheel UP** translates to clockwise (incrementing) knobs, and upwards rocker action in switches.
- **Mouse wheel DOWN** translates to counter-clockwise (decrementing) knobs, and downward rocker action in switches (like right-clicking).

2.3.4 Hands-On Throttle and Stick (HOTAS)

The *Hand-On Throttle and Stick (HOTAS)* concept is designed to allow the pilot to interact not only with flight controls, but also to manipulate avionics and weapons systems without removing his/her hands from the controls in order to push a button elsewhere. This system isn't perfect, but it does allow almost completely keyboard-free interaction with weapon and radar systems. Of course in order to take advantage of HOTAS you need a separate stick and throttle with an abundance of buttons which can be assigned to keystrokes.

Interacting with the displays through, for example, a cursor control mounted on the throttle, means you would assign the arrow keys to a 4-6 position switch and then use the switch to in-turn send those arrow key signals. We then intercept the arrow keys (and all other keystrokes) in a special mode called *Key Command Mode*.

The HOTAS system uses various cursors and indicators to give feedback to pilot as to where control is assigned.

2.3.5 Key Command Mode

Most functions in the cockpit, including DDI and UFCD buttons, HOTAS switches, and a variety of other commands essential to operating the aircraft can be initiated by the use of a custom keystroke mode called *Key Command Mode*. In fact some functions <u>require</u> key command mode, such as those which would be found on the stick or throttle assemblies (HOTAS) of the F/A-18E.

Key command mode is toggled on/off by the **[SHIFT-CONTROL-M]** combination by default. When key command mode is active, a solid *TDC Priority Diamond* ◆ (located in the upper-right corner of the display with priority) will appear. When it's off, the TDC diamond will be hollow◇. Another way to verify if key command mode is active is to press the **[TAB]** key several times, and observe if the solid TCD priority diamond is moving between displays. We will explain more about TDC priority below.

Key command mode overrides all other FS keys which share the same mapping. For example, by default the **[A]** key is mapped to “View (next in current category)” in MSFS. If you try to use the **[A]** key in key command mode, your view will not change. Of course you can remap the command in the ACM, or even disable it. See the ACM guide at your leisure for instructions on changing key command mode keystrokes, but please do not change them prior to running this tutorial.

The VRS F/A-18E was designed to be run strictly from key command mode. All the features of the F/A-18 you’ll ever need are mapped to a specific key or combination of keys. Even individual pushbuttons on displays can be accessed from key command mode.

All key command mode functions are re-mappable via the ACM. But take great care in doing so as you don’t want to interfere with basic FSX keys which control critical functions like view modes.

2.3.6 Throttle Designator Controller/CURSOR (TDC)

In the F/A-18, the pilot has what's known as a *Throttle Designator Controller (TDC)*. This is a switch, usually mounted on the throttle, which controls the position of a *TDC Cursor* [| |] on various displays, and to designate targets or make selections all without removing a hand from the throttle control. TDC control is mapped to the **[ARROW]** keys in key command mode. Moving the arrow keys with TDC priority on a display that accepts *TDC Slewing*, will move the TDC cursor on that display.

2.3.7 TDC Slewing

The TDC can be *slewed* (moved up/down/left/right) by using the **[ARROW]** keys from key command mode. By assigning the arrow keys to a 4-6 position HOTAS button, the TDC can be slewed hands-off.

> **NOTE:**
> When Key Command Mode is active, all Flight Simulator assignments which share the same mapping(s) are overridden.

2.3.8 TDC Designation/Undesignation

The TDC is often used to *designate* targets in various displays and the HUD. Pressing the **[ENTER]** key with the TDC cursor over the target will make a designation. To *undesignate* a target, press the **[SHIFT-**

DELETE] key combination. In addition, all visible targets can be cycled through simply by pressing **[ENTER]** *without* the TDC cursor over a target.

2.3.9 TDC Priority

The TDC system works by assigning the TDC actions to a particular display. It can be assigned to the left and right DDIs, the UFCD, the MPCD, or even the HUD. This mechanism is called TDC Priority. The display with TDC priority will be indicated in the upper-right corner by a solid diamond ◆ in key command mode, or hollow diamond ◇ if not in key command mode. All TDC slew and designations are then performed on the selected display.

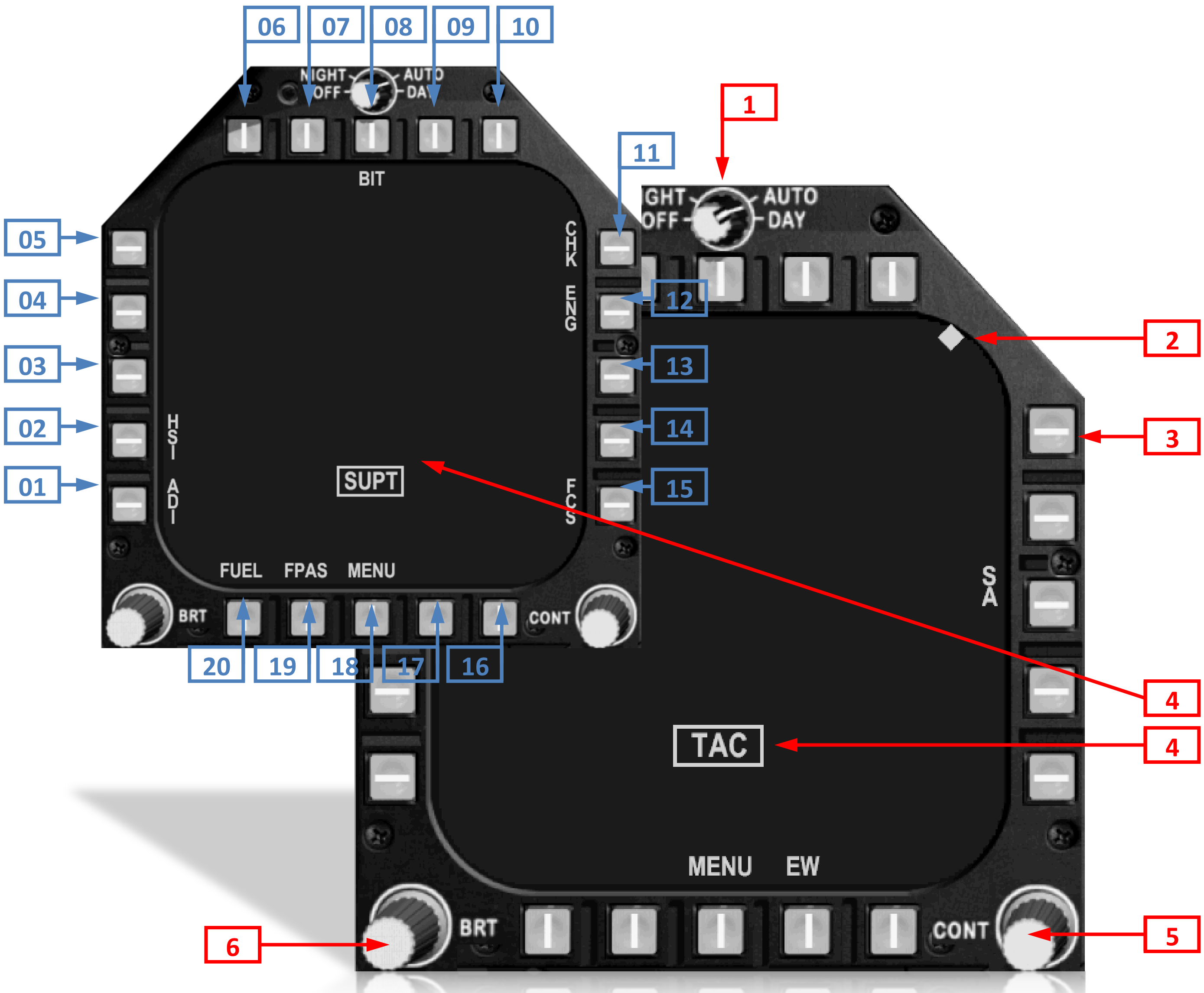
TDC priority is cycled between displays in three ways by default:

1) **Mouse Click.** Simply by clicking the mouse in the display you wish to assign TDC priority.
2) **[TAB] Key.** Pressing **[TAB]** cycles priority between displays.
3) **[CONTROL+ARROW] Keys:**
    - **[CONTROL –UP].** Assigns TDC priority to the HUD.
    - **[CONTROL –DOWN].** Assigns TDC priority to the UFCD.
    - **[CONTROL –LEFT].** Assigns TDC priority to the LDDI.
    - **[CONTROL –RIGHT].** Assigns TDC priority to the RDDI.

2.4 DDI PHYSICAL FEATURES

Before getting airborne we'll spend a little time familiarizing you with the *Digital Display Indicator (DDI)* operation, and use some *Horizontal Situation Indicator (HSI)* functions to set up navigation for our mission.

The DDIs are tri-color multi-function CRTs which are used for the majority of support and tactical functions in the aircraft. The F/A-18 legacy, or "baby" hornet, was perhaps the first true "glass" fighters,



and the F/A-18E is even more so. Throughout this tutorial we'll refer to the LEFT DDI and RIGHT DDI as *LDDI* and *RDDI* respectively.

1) **Mode Selection.** With the mouse cursor hovering over the knob, rotate the mouse wheel up to increment, and down to decrement the knob. You can also left and right-click. The DDI mode affects display brightness as follows:

   - **OFF**: Turns the display OFF. Note that turning the display completely off will save some fractional frames, but that wouldn't be much fun, would it? Any position other than OFF will power the display as well as the multiplex bus connecting it to the master computers (MC).
   - **NIGHT**: Dims the display to an appropriate level for night operations.
   - **AUTO**: Dimming of the display becomes a function of the panel light switch; if the panel lights are ON, the DDI switches to NIGHT mode. If the panel lights are OFF, the DDI switches to DAY mode.
   - **DAY**: Brightens the display to an appropriate level for day operations.

2) **TDC Priority Diamond.** Indicates the given display has TDC priority. A solid diamond means key command mode is active, a hollow diamond means it's inactive.

3) **Pushbuttons (PB).** Each DDI is surrounded by a bank of twenty pushbuttons numbered from 1 at the lower-left just above the brightness knob, clockwise to 20. These will subsequently be referred to as PB**nn** where **nn** is a number between 1 and 20.

4) **TAC/SUPT Labels.** Indicates the current DDI top-level and referred to as TAC (Tactical) and SUPT (support). Pressing the **MENU** option **[PB18]** from TAC will bring up the SUPT page. Likewise pressing **MENU** from **SUPT** will bring up the **TAC** page.

5) **Contrast Knob.** Increases/decrease the foreground contrast of the display. Note that subsequent use of the DDI mode knob will return to contrast to its default level for that mode.

6) **Brightness Knob.** Increases/Decreases the overall brightness of the display. Note that subsequent use of the DDI mode knob will return to brightness to its default level for that mode.

2.4.1 DDI Menu System

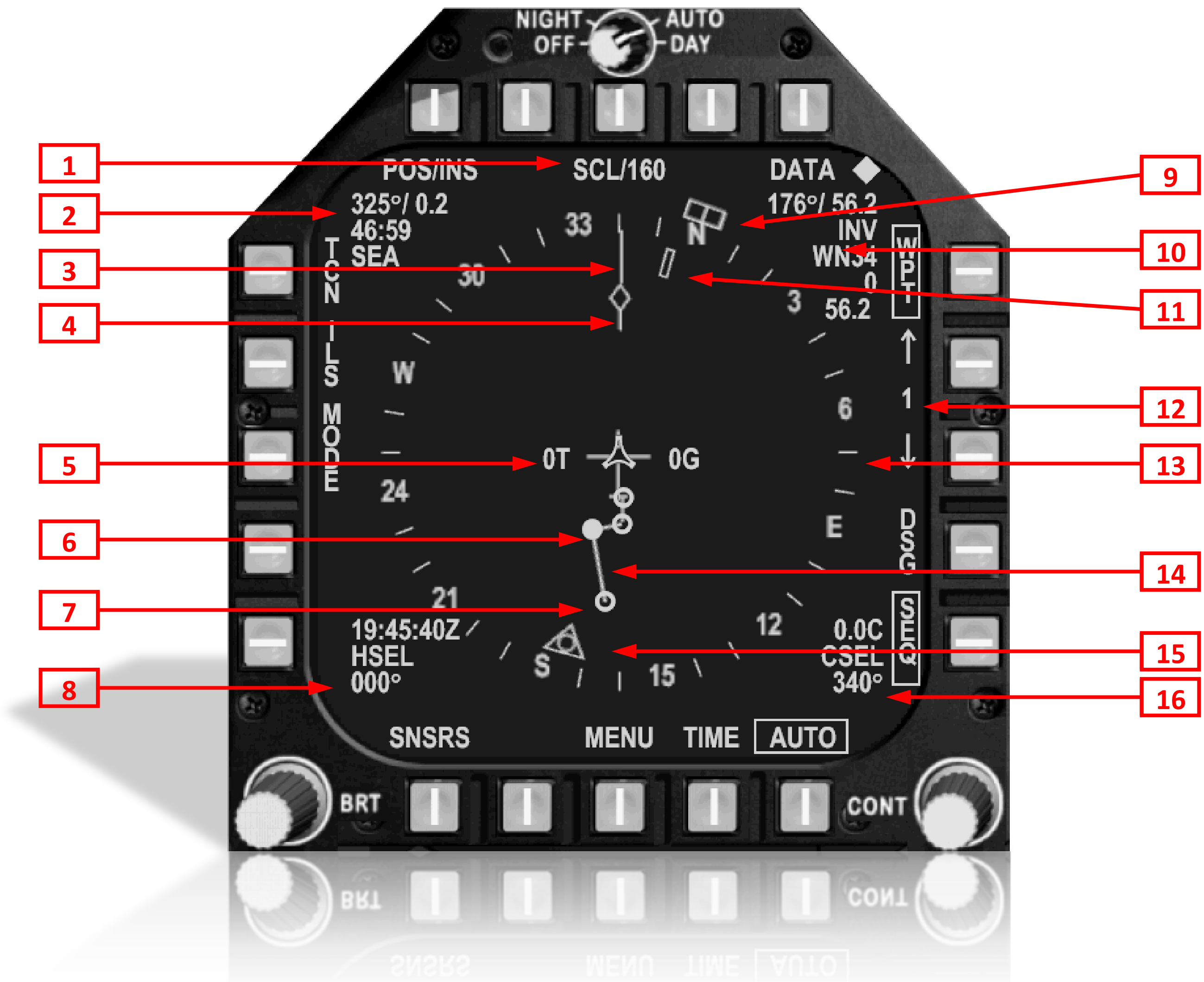
The DDIs each have 2 top-levels referred to as ***TAC*** *(Tactical)* and ***SUPT*** *(Support)*. These are the DDI “home” pages. **TAC** contains options for combat-oriented systems such as radar and stores management, and **SUPT** is used to access non-combat functions such as navigation and maintenance modes.

Branching off these two top levels are a number of DDI *sub-levels*. Sub-levels are generally referred to as *Formats*, or *Pages*. Again, these are categorized as either tactical or support oriented. Pressing **MENU** from any sub-level will almost always return to either **TAC** or **SUPT** depending on the sub-level. There is however one case where **MENU** won't return to a top-level; if there's an engine parameter which is out of spec, the **MENU** option will change to **ENG**, and pressing it will bring you straight to the Engine **ENG** format. If the out-of-spec condition ceases or the engine format has been accessed, the **MENU** option will return to normal.

2.5 BASIC NAVIGATION

2.5.1 Horizontal Situation Indicator (HSI)

The *Horizontal Situation Indicator (HSI)* should not be an unfamiliar piece of equipment for most real and "sim" pilots. The basic functions are not dissimilar to those found in civilian aircraft. There are however a number of unique functions specific to the F/A-18. The HSI is the primary navigation interface



in the aircraft, and it's available on all four primary display screens (except in certain "Lite" modes).

☑ LDDI PAGE: **SUPT**. Press **PB18**, the **MENU** option (center, bottom row) until the word **SUPT** appears on the DDI. It may already be shown.

☑ LDDI PAGE: **HSI**. Press **PB2**, the **HSI** option (second from the bottom on the left side of the DDI) until the HSI page appears on the left DDI.

The HSI can be oriented *Track-Up* (shown), *North-Up*, or *Decentered* by pressing the **MODE** option **[PB3]** followed by the *TUP*, *NUP*, or *DCTR* options. In NUP or TUP, the selected *Scale (SCL)* **[1]**, represents the distance from the *Ownship* **[5]** to the inner edge of the *Compass Rose* **[13]**. Therefore in TUP or NUP, the display is actually showing over twice the total "area" that the scale setting implies.

1) **HSI Scale.** The current display scale in nautical miles. Pressing PB8 will decrement the scale from 160nm down to 5nm, and finally back to 160nm, reducing the scale by 50% per depression.

2) **TACAN Data Block.** These 3-5 lines of text show information related to the currently tuned navigation station. If no station is tuned, the line(s) will either be blank or display INV. Shown (top to bottom) are bearing/distance, ETE, station identifier.

3) **Lubberline.** The aircraft's longitudinal axis heading. Note that this is not the same as ground track pointer (4).

4) **Ground Track Pointer.** Shows the aircraft's current Ground Track. Ground track is corrected for relative wind and crab angle. This is the actual course the aircraft is traveling over the ground.

5) **Ownship/Speed Data.** Ownship (center), true airspeed (left) and ground speed (right). Not shown is *Required Ground Speed* which relates to the *Time On Target (TOT)* option which will be covered later.

6) **Selected Waypoint/Target/OAP.** When Waypoint Steering (WPT) is enabled, the currently selected waypoint is displayed as a solid circle. Unselected waypoints are displayed as hollow circles. When a waypoint becomes a Target Waypoint (TGT), the symbol is a diamond (shown).

7) **Unselected Waypoint.** Unselected waypoints are displayed as hollow circles, and unselected targets are displayed as hollow diamonds.

8) **Heading Select Indication.** The current Heading Select (HSEL) value and, if selected for display, Zulu Time, Local Time, Elapsed Time, or Countdown Time appear in this location.

9) **Heading Select Bug.** Indicates the current heading select (HSEL) bearing. The HSEL value can be adjusted by rotating the mouse wheel over the HSEL digits in the lower left corner of the HSI **[8]**, or by typing the value directly into the UFCD and touching **HDG**.

10) **Waypoint Data Block.** These 3-5 lines of text show information related to the currently active waypoint. If no waypoint exists, no flight plan is loaded, or the MC is unable to compute the required value, the given line will either be blank or display INV.

11) **Waypoint Bearing Tail.** Shows the reciprocal heading from the selected waypoint when WPT steering is enabled.

12) **Selected Waypoint Indication.** Shows the currently selected waypoint (0-7) when WPT steering is enabled. Pressing PB12 and PB13 increments and decrements the current waypoint.

13) **Compass Rose.** The Compass Rose is a 360 degree heading indication used as the reference for the lubberline and/or ground track pointer. The digits around the circumference of the rose individually rotate such that they always appear vertically oriented.

14) **Sequence Lines.** The legs between waypoints. This is analogous to flight plan steering in a GPS.

15) **Waypoint Bearing Pointer.** Shows the direct heading to the selected waypoint when WPT steering is enabled. The waypoint bearing pointer rotates around the interior of the compass rose.

16) **Course Selection.** The current Course Select (CSEL) value appears here as well as Courseline Deviation (just above CSEL) in nautical miles. Course selection is only valid in TCN (TACAN) steering mode. The *Courseline Arrow* (not shown) is visible when TCN steering is enabled and rotates through the VOR to selected OBS.

2.5.2 Navigational Steering Modes

The basic paradigm of navigation in the F/A-18 is a concept called the *Steering Mode*. There are 3 primary steering modes in the VRS, F/A-18E as well as several sub-options. Steering modes are all mutually exclusive; when in any given steering mode all other modes are disabled in favor of the selected mode.

2.5.3 TACAN (TCN) Steering Mode

TACAN (TCN) Steering is activated by pressing PB5 from the HSI page. Symbology and steering cues in the HUD and HSI are tailored to VOR and TACAN (Tactical Air Navigation). When TCN Steering is enabled, and a valid TACAN is tuned, a TACAN symbol in the HSI (not shown) indicates the geographical position of the station. All TACAN information is displayed on the upper-left corner of the HSI display.

When TACAN steering is enabled, and the station is within the range scale of the HSI, a *Courseline Arrow* (not shown) will appear and can be rotated by moving the cursor over the display and rotating the mouse wheel. This is the OBS radial setting for both visual and autopilot reference. The courseline will pivot around the TACAN/VOR symbol while remaining coincident with the compass rose boundaries.

2.5.4 Waypoint (WPT) Steering Mode

When *Waypoint (WPT) Steering* is enabled, waypoints are plotted and steering cues, autopilot, and targeting relates to the currently selected waypoint. There are 3 types of waypoints: *Waypoints (WPT)*, *Target Waypoints (TGT)* and *Offset Aimpoints (O/S).* These various waypoint types will be described in detail in the navigation section, but we'll utilize all three types in this tutorial so you can get your feet wet. All of the following modes are subsets of the WPT steering mode and are mutually exclusive:

- **Auto-Sequential Steering**. AUTO **[PB16]** toggles the auto-sequential steering option. When this option is disabled (unboxed), the MC will not automatically select the next waypoint in the sequence. If the A/P is enabled and coupled to the sequence, the aircraft will hold over the current waypoint until another is selected.

2.5.5 Designating a NAV Target (HSI)

Perform the following steps while referring the HSI image above. Symbology and features shown will vary based on a number of factors, but following symbology applies to waypoint steering mode.

- ☑ HSI SCALE: **160**. Press **[PB8]** at the top-center of the DDI until **SCL** reads *SCL/160*.
- ☑ STEERING MODE: **WPT**. Press **[PB11]** to enable waypoint steering mode and observe that *KPDX* is displayed in the upper-right corner of the display. You should see the actual waypoints (2 of them) displayed in the HSI at their relative locations. They will appear as small solid or hollow circles. If you don't see them, make sure your **SCL** setting **[PB8]** is at *160*.
- ☑ SELECT WPT: **WPT:1**. Press **[PB12]** and **[PB13]** until waypoint *1* is displayed (it may already be).
- ☑ DESIGNATE NAV TGT: **WPT:1**. Press the **DSG** option **[PB14]**.

We just designated *WPT 1* as a *Navigation Target (TGT)*. In addition to initializing weapon employment calculations, this tells the *Mission Computer (MC)* that we would like this waypoint to act as a *Hostility Zone*, meaning certain navigation aids in that area are going to act as surrogate SAM and/or AAA sites. The *WPT* label (adjacent to PB11) will have changed to *TGT* indicating this waypoint is now a target waypoint. There are targets other than NAV targets, but for now we'll proceed to upset the inhabitants of Portland, Oregon.

2.6 GETTING AIRBORNE

2.6.1 Rig Caution

When you first enter the cockpit the left DDI (LDDI) may be displaying one or more yellow cautions. One of these cautions – **RIG,** will appear each and every time you fly unless it's disabled in the Aircraft Manager under *Aircraft Preferences (see below)*. The RIG caution is there to warn you that the flight control computers haven't yet received input signals from the controls. The secondary purpose of this caution is strictly simulation related, and that's to ensure that General Realism is set to full. This isn't to force you to alter your play style; this is to ensure that the flight model is using all available resolution. Failure to set General Realism full-right WILL result in erratic flight characteristics. This does not mean you need to turn on crash detection or any other realism setting.

The display of the RIG caution can be suppressed by checking the appropriate *Aircraft Preferences* option in the ACM under *Preferencs* (tab): *Aircraft* : *Avionic Simulation*. Note that this option cannot be disabled with less than 1 engine hour.

To clear the RIG caution:

- ☑ MASTER CAUTION: **PRESS.** When the master caution lamp illuminates, press it to acknowledge the caution and extinguish the lamp. The caution will remain on the DDI as long as the condition which invoked it still exists.
- ☑ CONTROLS: **SWIPE.** Move the stick left/right/up and down. The RIG caution should clear if you had previously pressed the master caution lamp. If it does not, check to make sure *General Realism* is set fully to the right in FSX Realism settings.

NOTE:

Master cautions are not "cured" by pressing the master caution lamp. Pressing the lamp only acknowledges the caution and allows it to be removed from the DDI if the condition causing the caution no longer exists. In other words, cautions will always remain on-screen until the master caution lamp is pressed regardless of whether the caution is still valid.

2.6.2 Configuring for Takeoff

- ☑ KEY COMMAND MODE: **ON**. Verify that we're in key command mode by pressing **[TAB]** and observing that the solid TDC priority diamond (located in the upper-right corner of any given display) is moving between displays. If not, **press [SHIFT-CONTROL-M]** to enter key command mode and press **[TAB]** several times to cycle TDC priority to the right DDI (RDDI).

- ☑ NWS: **LO.** Ensure *Nosewheel Steering (NWS)* is ON (it should be by default) by pressing the **[N]** key from key command mode. The *NWS* cue should appear in the HUD to indicate lo-gain nosewheel steering is on. The F/A-18 has 3 nosewheel steering modes:
  - **NWS***.* Normal, low-gain nosewheel steering.
  - **NWS HI.** High-gain nosewheel steering designed for maneuvering on a carrier deck.
  - **OFF** (no indication). Nosewheel steering is disabled.
- ☑ SEAT: **ARMED.** Press **[CONTROL-S]** until you hear a slight click. If the seat is not armed and the throttle is advanced, a *Master Caution Tone* will be heard, the *Master Caution Lamp* will illuminate, and the words *CK SEAT* will appear in 150% yellow text on the LDDI.
- ☑ FLAPS: **HALF**. Use your usual flap controls (or the custom command **[F])** to set *HALF* flaps. Note that setting a flap position doesn't necessarily mean they're going to that position; in the F/A-18 it's more like asking permission from the FCS. <u>Land-based takeoffs should always be performed with flaps HALF</u>.
- ☑ T/O TRIM: **SET.** Press **[CONTROL-T]** to activate *Takeoff Trim*. An acknowledgment tone will sound and an *ADV-TRIM* advisory will appear in the lower left of the left DDI. All advisories for everything from autopilot modes to engine anti-ice appear in this location. If there are more advisories than will fit, they will “spill over” to the right DDI. The same goes for cautions.

  The amount of trim set by invoking T/O trim is entirely dependent on the launch bar position. The launch bar should of course be UP, but if it’s not, press **[B]** until it is.
- ☑ PARKING BRAKE: **RELEASE.** Release the parking brake by pressing **[.]**.
- ☑ THROTTLES: **MAX.** If there are no cautions when the throttles are advanced, continue the takeoff run. In the event of a master caution, abort the run and re-check that the previous 4 conditions have been met.
- ☑ ROTATE: **135-145 KCAS**. Airspeed is located in the large boxed area on the left side of the HUD. Note that the minimum calibrated airspeed displayed is 48 KGS.
- ☑ Rotation is accomplished with <u>mild</u> aft stick assuming correct T/O trim was set (flaps HALF). Contrary to some of the misinformation floating around about “auto-takeoffs” in Hornets, that is a myth when it comes to land-based operations. Aft stick is required and always has been.
- ☑ CLIMB ANGLE: **12-15°.** Pull back on the stick until the *Velocity Vector* (**[16]**, below) is coincident with the 15 degree *Pitch Ladder* rung (**[18]**, below).
- ☑ GEAR: **UP**. Again, a number of myths have appeared over the years in various forums saying the landing gear will automatically retract as airspeed increases. Not true. Raise the gear immediately with the **[G]** key, and well before you reach **240** KCAS.

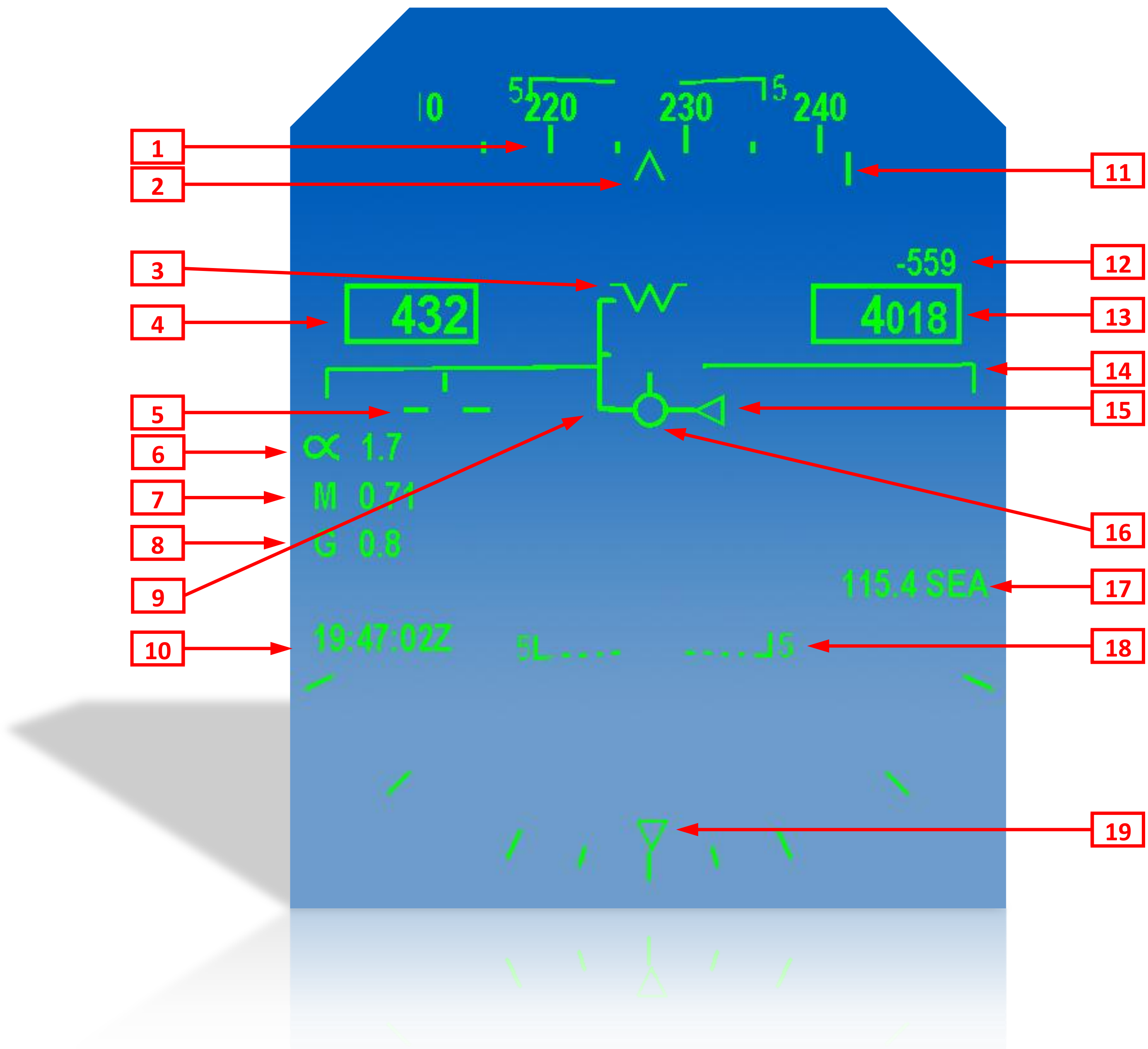
- ☑ FLAPS: **UP.** Note that failure to manually retract the flaps will have no adverse impact. The flaps will auto-retract into *Up and Away (UA)* mode at 240 KCAS regardless of flap handle position. We will go into great detail regarding the *CAS Flight Modes* in subsequent sections.
- ☑ AIRSPEED: **350-400** KCAS.
- ☑ HEADING: **160-170.** Begin a 180 degree turn towards the south (180).
- ☑ ALTITUDE: **10,000 FT.** Level out at FL10.
- ☑ SIM: **PAUSE**.

CAUTION:

Normal land-based takeoffs should <u>always</u> be performed with flaps <u>HALF</u> to prevent over-rotation. Carrier catapult launches should always be performed with flaps FULL.

2.7 COMMON HUD SYMBOLOGY

The basic *Navigation HUD* will vary based on gear position, but the following components are common:



1) **Heading Scale/Tape**. The 30° *Heading Scale* shows your current heading (true or magnetic, depending on current settings). A tape format provides natural trend information. The scale is used in conjunction with the heading caret.

2) **Heading Caret**. The *Heading Caret* [^] just below the tape is the heading reference point. 30° of heading are shown at any given time.

3) **Waterline Symbol**. The *Waterline Symbol* represents the aircraft longitudinal axis. It is located 4° up from the optical center of the HUD and is aligned with the tops of the airspeed and altitude boxes. When the gear is down or AOA exceeds 12°, the waterline symbol appears as a reference.

4) **Airspeed Box (KCAS).** *Calibrated Airspeed* is indicated airspeed corrected for installation and position error. The minimum reported value is 48 KCAS.

5) **Ghost Velocity Vector.** When sideslip exceeds 2.5°, AND the velocity vector is caged, the *Ghost Velocity Vector* appears and shows the true lateral flight path.

6) **Angle of Attack.** Shows *Angle of Attack (AOA)*, also known as incidence alpha (α).

7) **Mach.** When the gear is UP, show aircraft current Mach number.

8) **Aircraft g.** When the gear is UP, show aircraft g. *Peak g* (not shown) appears below current g when current g exceeds 4.0.

9) **Angle of Attack Bracket.** The AOA Bracket has 3 "rungs" which correspond to the AOA for approach and landing. When the top rung is aligned with the left "wing" of the velocity vector, the aircraft is SLOW (too much AOA), then the center rung is aligned, the aircraft is ON SPEED (AOA=8.1). When the bottom rung is aligned, the aircraft is FAST (too little AOA).

10) **Time**. Shows *Local time*, *Zulu Time*, a *Countdown Timer*, or *Elapsed Timer*, depending on UFCD TIME settings.

11) **Command Heading Marker**. The *Command Heading Marker* is a steering cue referenced to the heading tape 1. It shows the steering point bearing relative to your current heading. The command heading marker moves non-linearly in order to provide ample roll-out time to the commanded heading. If the current steering point is a target, the command heading marker will be a diamond◇, otherwise it will be a vertical line |.

12) **Vertical Velocity**. Just above the altitude box is the vertical velocity in feet per minute. VV will only appear in NAV master mode.

13) **Altitude Box**. Shows barometric or *Radar Altitude (RALT)*, depending on settings. When radar altitude is selected for display an 'R' will appear to the right of the altitude box. If for any reason the radar altitude becomes invalid, a 'B' will appear and flash to warn the pilot that radar altitude is no longer valid and barometric altitude is being substituted. If barometric altitude is selected for display (default), nothing will appear here.

14) **Horizon Bar**. The *Horizon Bar* is used in conjunction with the Velocity Vector **[16]** to indicate aircraft attitude. Just as in the real aircraft, the horizon bar will not always appear on the *visual* horizon simply because the Earth is round. This is perfectly normal. Remember, this is a reference pitch attitude; if the horizon bar were on the visual horizon at FL300 and the waterline of the aircraft were lined up with it, you would be rocketing towards the ground! When the VV is above horizon bar, you are ascending, below descending.

Note that the horizon bar is extended to the periphery of the HUD when the gear is down. This is called the *Extended Horizon Bar* (shown).

15) **Energy Caret**. The Energy Caret **<** shows your acceleration/deceleration. It's positioned relative to the velocity vector **[16]**. When the energy caret is pointing directly at the “right wing” of the velocity vector your airspeed is neither increasing nor decreasing. When it's below the “right wing” you're decelerating, above, accelerating.

16) **Velocity Vector**. The *Velocity Vector* is perhaps the most important single indication in the HUD. It's quite literally where the aircraft is flying at any given time. On non-naval aircraft this is referred to as a Flight Path Marker. The velocity vector relates to the pitch ladder and the two are inseparably tied together as a single functioning unit. When the VV is above the horizon bar, the aircraft is ascending, when it's below, descending. Technically speaking, the velocity vector is alpha (angle of attack), and beta (sideslip) plus wind correction. Maneuver the aircraft to place the velocity vector where you want to fly, and the aircraft will follow.

17) **Right Data Block**. This area shows information such as auto throttle cues, NAV point ID and distance (shown), and target/weapon-specific data.

18) **Pitch ladder**. The *Pitch Ladder* is a series of “rungs” which act as a reference for the velocity vector. The pitch ladder is normally tied to the velocity vector and will shift both horizontally and vertically with beta and alpha respectively. Each rung is spaced exactly 5° apart in the FS world. It's very important to note that this pitch ladder and spacing between each rung is calibrated to the FS world. This is important for a number of reasons which will be explained under more advanced topics.

Ladder rungs are solid above the horizon, and dashed below. Each rung is angled towards the horizon at an angle half that of the flight path angle. This is designed to aid in orientation during high angle or inverted maneuvers, denoting the severity of the attitude. Like the velocity vector, the pitch ladder can be caged to the waterline from NAV master mode.

19) **Bank Angle Pointer**. Indicates the bank angle relative to the bank angle scale.

☑ SIM: **UNPAUSE**.

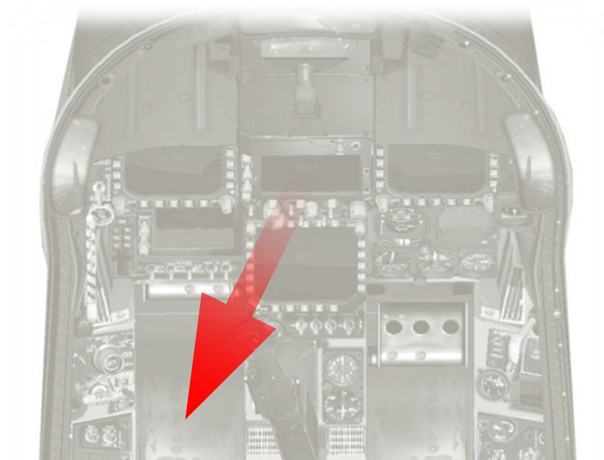
☑ AUTOPILOT: **ON.** (FSX default **[Z]**).

☑ AUTOTHROTTLE: **ON** (**[CONTROL]+[R]**). The *Auto throttle (ATC)* cue should appear in *right HUD data block*.

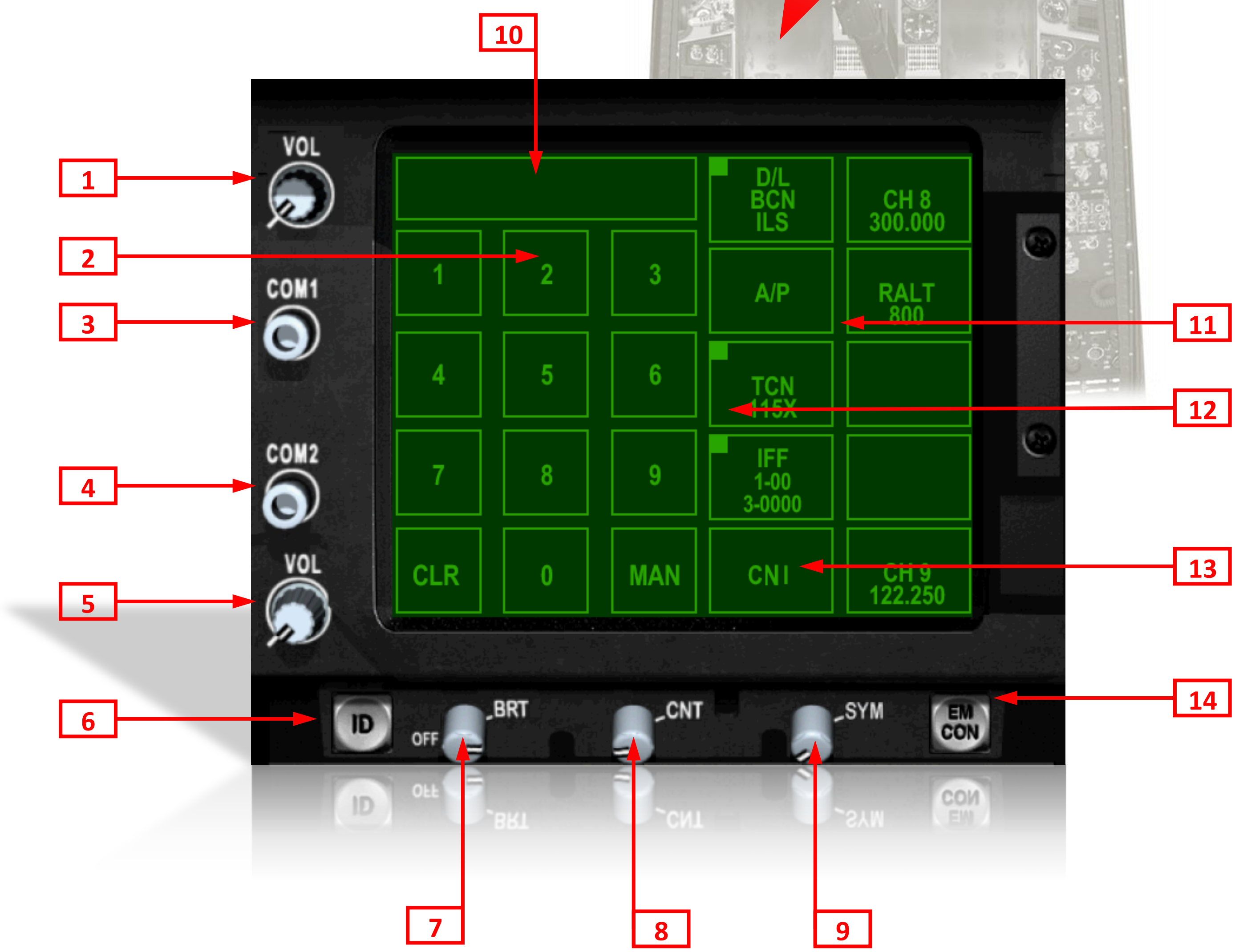
2.8 UP-FRONT CONTROL DISPLAY (UFCD)

The *UFCD*, or *Up Front Control Display*, is the *Communications and Navigation Interface (CNI)* for:

- Communications
- Navigation
- Transponder
- ILS
- Autopilot



The UFCD can also serve as a backup DDI, providing all the same functions available on either DDI. The top level of the UFCD is called the *CNI Top Level*. It is essentially the UFCD's



“homepage.”

From the CNI top level, pressing any of the data buttons **[11]** will bring up a sublevel from which various other options bay be set. From any sublevel, pressing the CNI button **[13]** will return to the CNI top level (shown).

1) **COMM 1 Volume Knob**. Rotate to power the COMM 1 radio.
2) **Keypad**. A virtual keypad used to enter data into the scratchpad.
3) **COMM 1 Channel Knob**. Rotate to cycle through COMM 1 preset channels.
4) **COMM 2 Channel Knob**. Rotate to cycle through COMM 2 preset channels.
5) **COMM 2 Volume Knob**. Rotate to power the COMM 2 radio.
6) **ID Button**. Press to indent the transponder/IFF interrogator.
7) **Brightness Knob**. Rotate to power/increase/decrease the UFCD brightness level.
8) **Contrast Knob**. Rotate to increase/decrease the UFCD contrast level.
9) **Symbology Knob**. Not implemented.
10) **Scratchpad**. The S*cratchpad* echoes information entered on the keypad for verification prior to entry. Data entered into the scratchpad is verified for validity and formatted based on the current task.
11) **Data Buttons.** The ten data buttons to the right of the keypad are used for sub-level specific functions. Data buttons generally allow for toggling options on/off. Two of these data buttons (top-right and bottom right) are dedicated to the COM radios. Pressing these buttons from any level will go directly the COMM 1 or COMM 2 sub-levels.
12) **Corner Highlight**. When a system is powered ON, a corner highlight appears in the upper-left corner of the data button of any given option. In this case, the IFF is powered.
13) **CNI Button**. The *CNI* button is available from all UFCD sub-levels and will always return the UFCD to the *CNI top-level*. If the UFCD is already at the CNI top-level, and the full non-”lite” UFCD option is enabled from the ACM preferences, a *DDI* option will display here which will place the UFCD into DDI mode when pressed..
14) **EMCON Button**. Press to enter *Emissions Control (EMCON)* Mode.

2.8.1 Autopilot Sub-level

We're going to use the CNI to change autopilot modes. The autopilot should already be on, but if it's not, don't worry. We can verify that it's on in a moment. We want to hold our current altitude and start tracking towards KPDX.

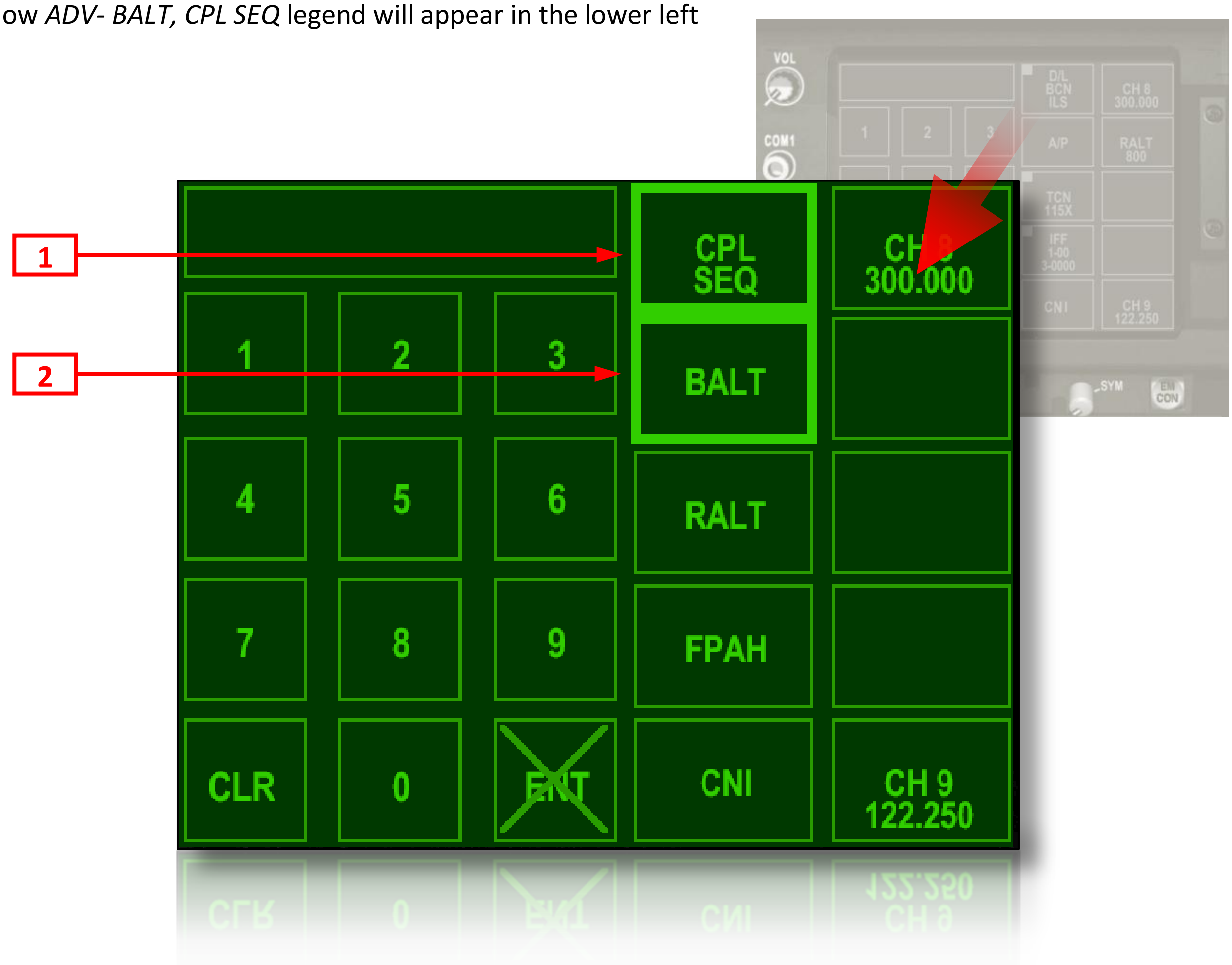
- ☑ UFCD PAGE: **[CNI]>A/P.** Bring up the autopilot (A/P) sub-level by pressing the **A/P** option button from the CNI top level. The A/P sub-level will appear (below).
- ☑ AUTOPILOT: **CPL SEQ/BALT.** Press the **CPL SEQ** *(couple sequence)* and **BALT** *(barometric altitude hold)* options. CPL SEQ will couple the autopilot's roll axis to the current sequence (route), and BALT will hold the current barometric altitude at the time of engagement.

Verify that the CPL SEQ **[1]** and BALT **[2]** options are now border highlighted by a light green box

As you come around to intercept the track to waypoint 1 (KPDX), observe the command heading marker in the HUD. This marker indicates the desired course to the waypoint.

- ☑ AUTOPILOT: **ENGAGE.** Press the **[Z]** (FSX default) key to engage the autopilot if it's not already on.
- ☑ UFCD PAGE: **[CNI].** Press the **CNI** button to return to the CNI top level.

You can verify the autopilot is on by looking for a corner-highlight in the *A/P* option button. In addition a yellow *ADV- BALT, CPL SEQ* legend will appear in the lower left



corner of the left DDI. These are called *Advisory* messages.

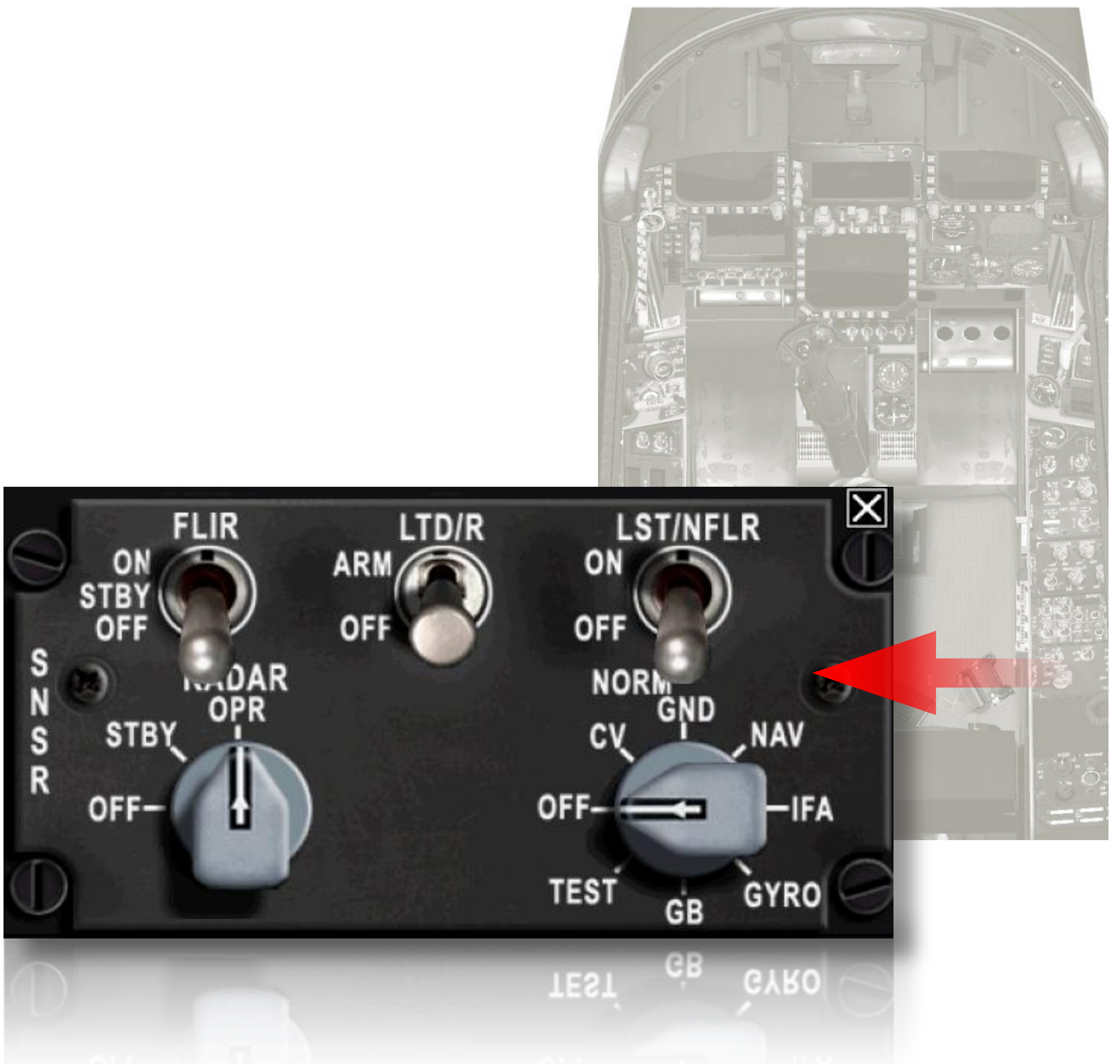
The autopilot should now be on and following the sequence towards KPDX. If you wish you can pause the simulation now, or continue on course while you read further.

2.9 A/A RADAR BASICS

2.9.1 Sensor Sub-panel

The sensor panel, located on the left-rear console as shown below, is used to access the RADAR power knob as well as FLIR functions. In order to operate the radar the switch must be rotated to the right to the OPR position. Use a left-click or mousewheel UP to rotate to the right. This applies to all switches and knobs in the Superbug.

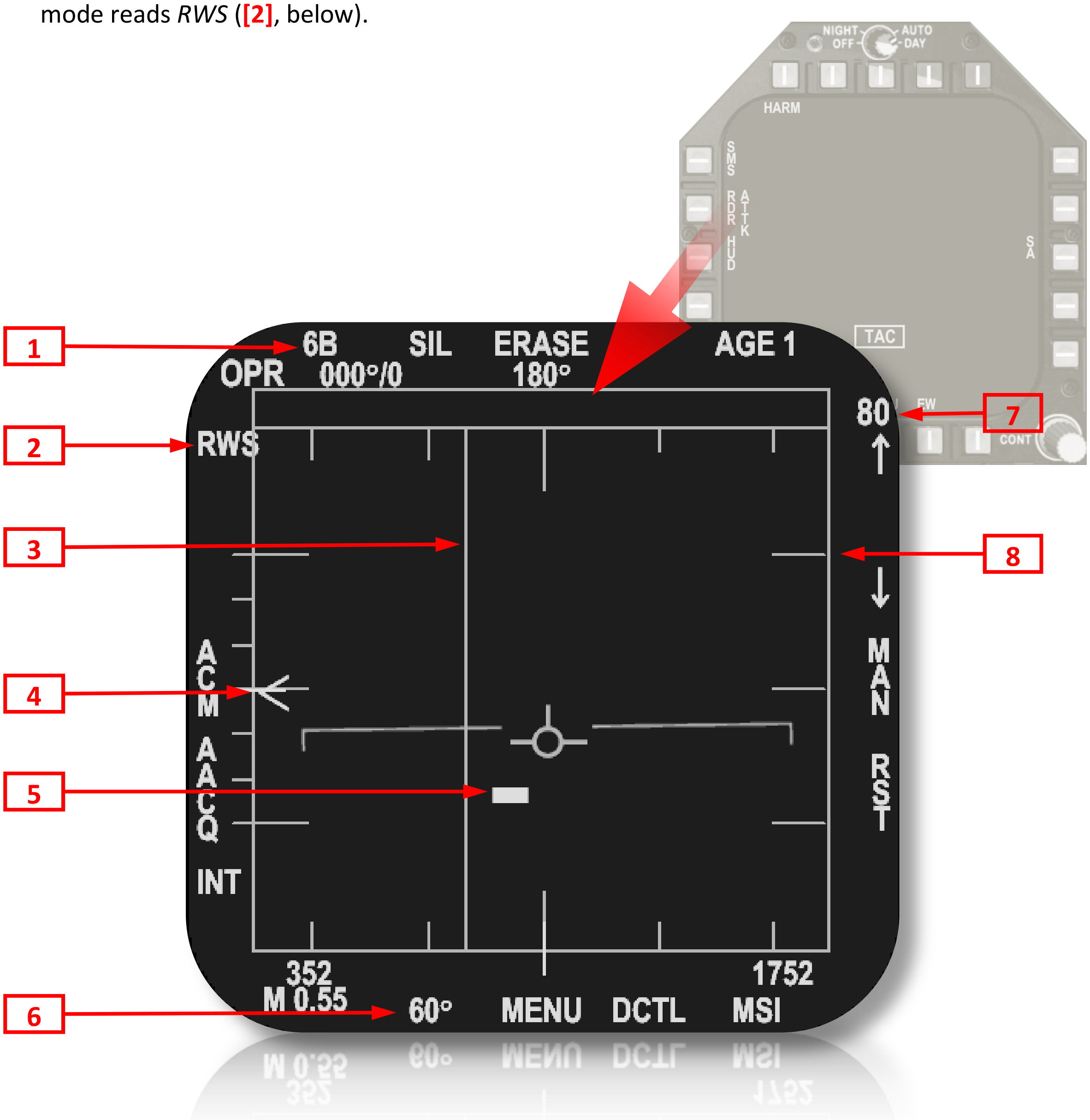
- ☑ SENSOR PANEL**:** Look at the sensor *(SNSR)* panel from the rear area of the right console.
- ☑ RADAR: **OPR**. Rotate the *RADAR* knob to the *OPR* position.



2.9.2 A/A Radar Format

If you're using a "Lite" avionics option in the ACM, the RDR format will only be available on the RDDI, otherwise it can be accessed from the LDDI or even the UFCD. Regardless, we're going to open it on the RDDI.

- ☑ RDDI PAGE: **[TAC]>RDR**. Bring up the *radar format* on the RDDI by pressing **[PB5]** from the **TAC** page. If you don't see the **TAC** label, press **MENU** until it's visible. Now press the label that reads *RDR ATTK.*
- ☑ RADAR MODE: **RWS**. Bring up *Range While Search (RWS)* mode by pressing **[PB5]** until the radar mode reads *RWS* (**[2]**, below).



1) **Elevation Scan (BAR) Volume**. Controls the number of vertical “sweeps” the radar takes before it begins another pass. Each “BAR” is approximately 2.5° in diameter, so a 2-BAR sweep would cover 5° of sky. The more BARs are scanned, the longer the radar cycle takes to complete. If a target is above or below the scan limit it will not be detected.

2) **Radar Mode**. The radar mode (Range While Search in the example image), can be changed by pressing **[PB5]**. Radar modes and simplified explanations are as follows:

3) **B-Sweep**. The *B-Sweep* is a vertical line that tracks left and right to indicate the current azimuth (left/right) position of the radar.

4) **Elevation Caret**. This symbol moves vertically to indicate the current elevation of the radar dish with respect to the nose of the aircraft

5) **Radar Contact**. In this example of the *Range While Search (RWS)* radar mode, the contacts are displayed as a synthetic “bricks”. When we refer to a radar return as *synthetic*, we mean that contacts are not displayed as a chaotic “jumble” of raw return data, but rather a clean, computer-generated symbol which represents post-processed data. For example weather radar may very well display raw data as a mass of pixels, but attack displays interpret that data and provide easy to interpret symbology instead.

6) **Azimuth Scan Volume Setting**. Just as the BAR scan controls the vertical portion of sky searched, the azimuth scan controls the horizontal search volume. The azimuth displayed is the total (left + right) scan volume on either side of the aircraft. In this example, the azimuth scan is 40° on either side of the nose of the aircraft for a total of 80°. The maximum azimuth volume which can be scanned is 140° depending on mode and BAR setting.

   Both BAR and azimuth work together to find targets, but it's important to know that there is a maximum limit to how much area can be scanned in total (BAR and azimuth combined). As you adjust one setting, the other may shrink in size in order to meet these volume requirements. Different radar modes have different maximum scan volumes.

7) **Radar Range Scale**. The radar scale is controlled by pressing **[PB11]**. In the example, the *Range Scale* is set to 80 nautical miles. It's important to point out here that this is only a range *scale*, not a range *setting*. The radar always operates at its maximum effective range, which is approximately 80nm or more depending on the size of the contact. The scale setting only adjusts the *scale of the display* relative to the outside world, *not the actual range* the radar is searching. In any radar system, actual range is determined by the power of the system and the size and/or aspect of the contact(s).

8) **Range scale reference lines**. These horizontal marks (3 of them) are used as a reference in determining the approximate range to a contact. For example if the contact falls vertically near the center reference line and the range scale is set to 40nm, the contact is roughly 20nm away.

2.9.3 Radar Modes Overview

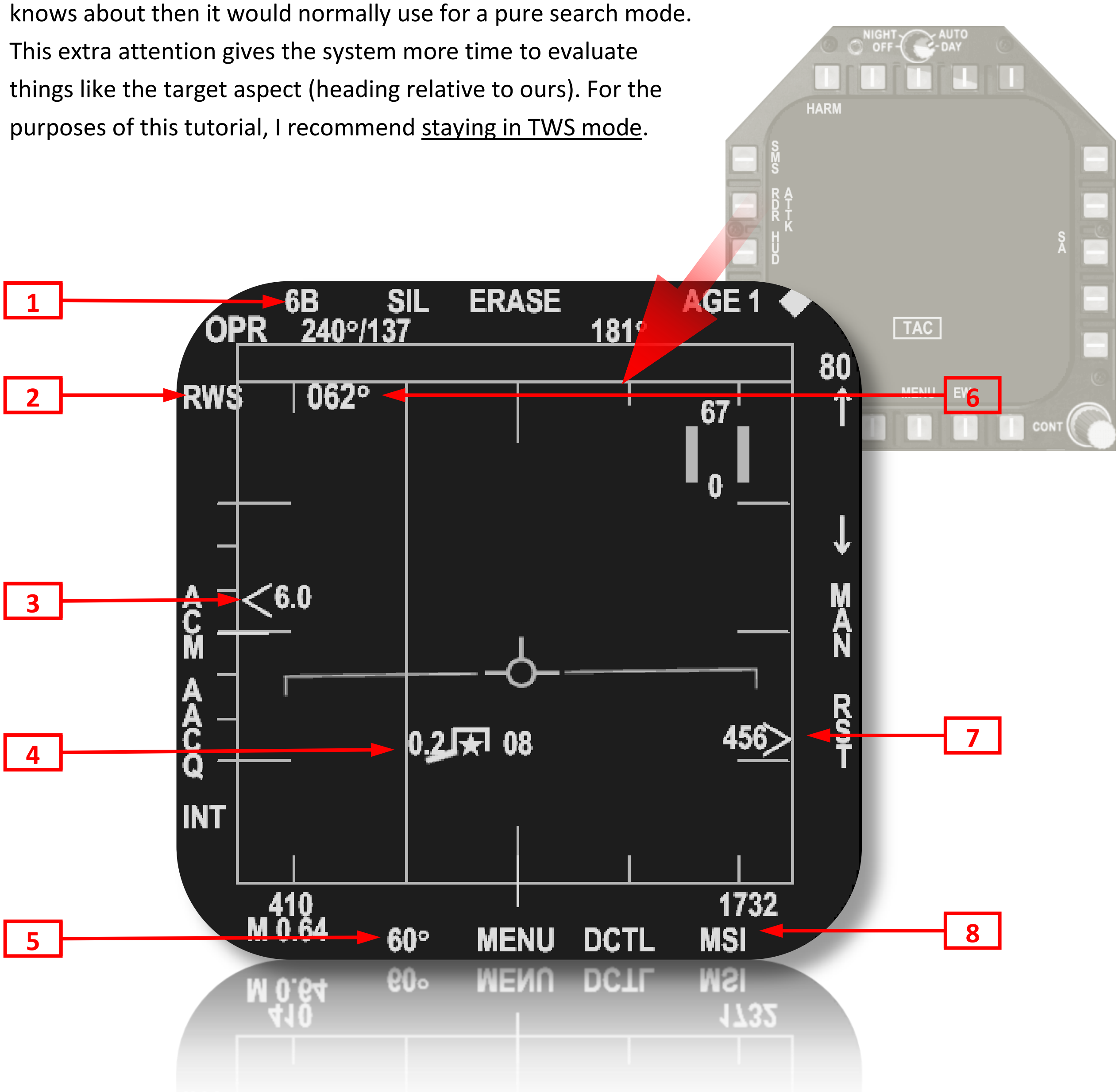
The radar operates under a number of modes designed for specific purposes. Some of these modes are designed to search, while other are better at tracking. We'll discuss all of these modes in great detail under *Air-To-Air Operations*, but briefly, these are:

- **Velocity Search (VS)**. Finds targets effectively at long range as long as they have high closing velocities.
- **Range While Search (RWS)**. A good overall mode for finding contacts out to about 80nm.
- **Track While Scan (TWS)**. A tracking radar mode that is very good at giving a detailed picture of every contact including relative range, relative aspect, target altitude, and closing velocity.
- **Single Target Track (STT)**. This is the radar's high update-rate tracking mode. This mode is not entered directly, but is entered automatically when a target is “locked up” either manually from TWS mode, or by an ACM mode.
- **Air Combat Maneuvering (ACM)**. These are preset search volumes designed to lock up targets at short range very quickly. When ACM mode is entered, the radar will immediately lock up (go to STT mode) on the first target it sees.
- **RAID**. RAID mode can be compared to an extreme “zoom.” It's designed to discriminate between single contacts and groups of contacts which might otherwise be misinterpreted as a single target. RAID works only from TWS mode (described below).

2.9.4 Track While Scan (TWS) Radar Mode

Track While Scan (TWS) is perhaps the most versatile combat radar mode and the one we will most commonly be using. It's called track *while* scan, because the radar is tracking a number of targets while continuing to search for other targets. This means it's focusing a little extra energy on the targets it knows about then it would normally use for a pure search mode.

This extra attention gives the system more time to evaluate things like the target aspect (heading relative to ours). For the purposes of this tutorial, I recommend staying in TWS mode.



NOTE:

If the radar is currently SILent as indicated by a large “iron cross” (not shown) in the lower left corner of the display, press the **SIL** button (**PB7**) until it's unboxed, and the b-sweep is moving.

When in TWS, the display will look similar to the image below, with these primary features:

1) **Elevation Scan (BAR) Volume**. Current vertical search volume setting. Exactly the same as RWS mode.

2) **Radar Mode**. The current *Radar Operating Mode*.

3) **Target Relative Altitude**. In this case it's 6.0 or 6000 feet above us. If the target were 300 feet below us, it would read -0.3. All radar modes, with the exception of VS*,* are *range versus azimuth* formats. not *boresight* formats. We will discuss the boresight format a little later under HARM operation. So the relative altitude of each target is not *visually* apparent in the display despite the fact that the information is there as a numeric value.

4) **L&S Target/HAFU Symbol**. The *Launch and Steering Target (L&S)* is the "primary target" the radar is focusing its attention on. If a missile were to be released at any given time, the L&S would be the first target. Other secondary and tertiary targets can exist as well. *HAFU* stands for *Hostile Ambiguous, Friendly, Unknown*. In the VRS Super Hornet, we do not go to great lengths to distinguish between these 4 categories, as our available traffic information is limited. We will surely upgrade this in the future, but for now, all targets are considered *Unknown* under most conditions. The HAFU has 4 major features as follows:

   - **Target Mach.** To the left is a 2-digit number which indicates the target's percentage of mach. The example is traveling at 0.2 mach.

   - **L&S Symbol.** In the center is a star symbol which indicates that this is the *Launch & Steering Target*. If you were to fire an AMRAAM as this moment, and it's caged to radar, this would be the target it steers towards.

   - **Aspect Pointer.** The small line, or *Aspect Pointer,* just below the star indicates the target's relative heading. Since this is a B-scope display, the entire bottom of the display is essentially your aircraft's nose. If the aspect pointer is pointing straight down, that target is heading directly towards you.

   - **Target Altitude.** To the right of the HAFU is a 2-digit number indicating the target's absolute altitude. In the example above, it's at 8000 (08) FT. If it read 30, it would be at 30,000 FT.

5) **Azimuth Scan Volume**. This is the same as describe above under RWS, however in TWS the total volumes are smaller in order to allow the radar to update contact information faster.

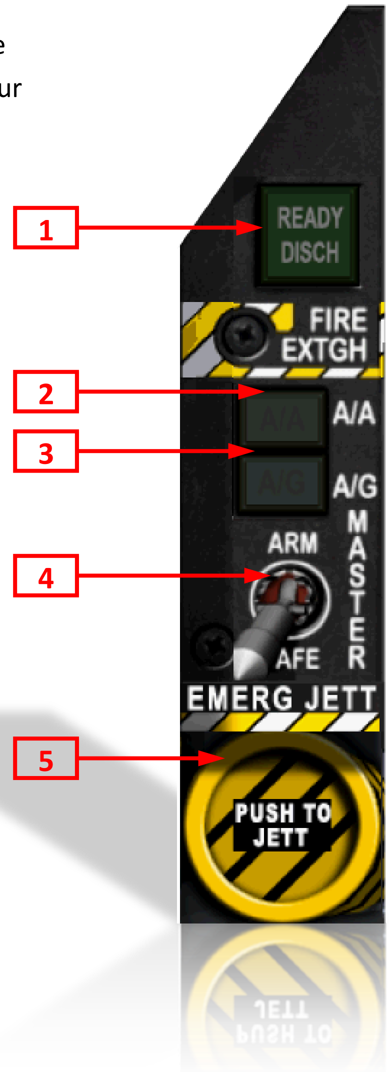
6) **L&S Target Heading**. This is the heading the target is on, *not* the bearing to the target from your aircraft.

7) **Target Closing Velocity (Vc)**. In this case the target is closing at 684 knots. The closing velocity is a vector sum of your aircraft's speed and the target aircraft's speed.

8) **MSI Option [PB16]**. In the VRS Super Hornet, the MSI option is essentially a cheat. Pressing (boxing) this option shows all radar targets currently within the entire 140 degree azimuth limit of the radar.

2.10AAM EMPLOYMENT

As we head Portland, let’s see if we can't clear the sky of some of these nasty airliners. Surely they must contain at least *some* terrorists, and our President, in all of his wisdom, has given us the “weapons free” order to shoot one down.



2.10.1 Master Arm Panel

On the far left of the main instrument panel you'll find the *Master Arm Panel (right)*. The master arm panel has the following functions:

1) **Fire Extinguisher Discharge Button**. Discharges fire retardant into the avionic and engine bays.

2) **Air-to-Air Master Mode Button**. Enters A/A master mode (landing gear UP). Default key equivalent: **[M]** to cycle.

3) **Air-to-Ground Master Mode Button**. Enter A/G master mode (landing gear UP). Default key equivalent: **[M]** to cycle.

4) **Master Arm Switch**. Enables “weapons free” launch and command functions. A weapon will not fire or launch unless master arm is enabled and weight is off the wheels. Default key equivalent: **[CONTROL-A]** to toggle.

5) **Emergency Jettison Button**. Immediately jettisons all stations except the wing tips (station 1 and 11) and fuselage “cheek” (*5 and 7*) stations. Default key equivalent: **[SHIFT-CONTROL-J]**.

2.10.2 Master Modes

The F/A-18E has 3 primary operating, or *Master Modes*: *Navigation (NAV)*, *Air-to-Air (A/A)*, and *Air-to-Ground (A/G)*. The A/A and A/G master modes are available only with the gear up. The NAV master mode is entered automatically whenever none of the other modes are operating, or the landing gear are down.

The master mode determines what HUD and display symbology is visible, as well as what weapons are available for selection (if any). When you switch master modes, you're essentially telling the MC which functions you'd like to perform. The computers then set up default displays which are most appropriate for the task at hand.

☑ MASTER MODE: **A/A.** Press the **A/A button** once, or until *A/A* is illuminated.

☑ MASTER MODE: **NAV.** Press the **A/A button** a second time. You are now back in NAV master mode. NAV master mode doesn't have a button of its own; it's the default mode whenever you're *not* in either AA or AG master mode, or any time the gear is down.

☑ MASTER MODE: **A/A.** Press the **A/A button** one more time and verify that we're in A/A master mode by observing the green AA lamp in the button has illuminated.

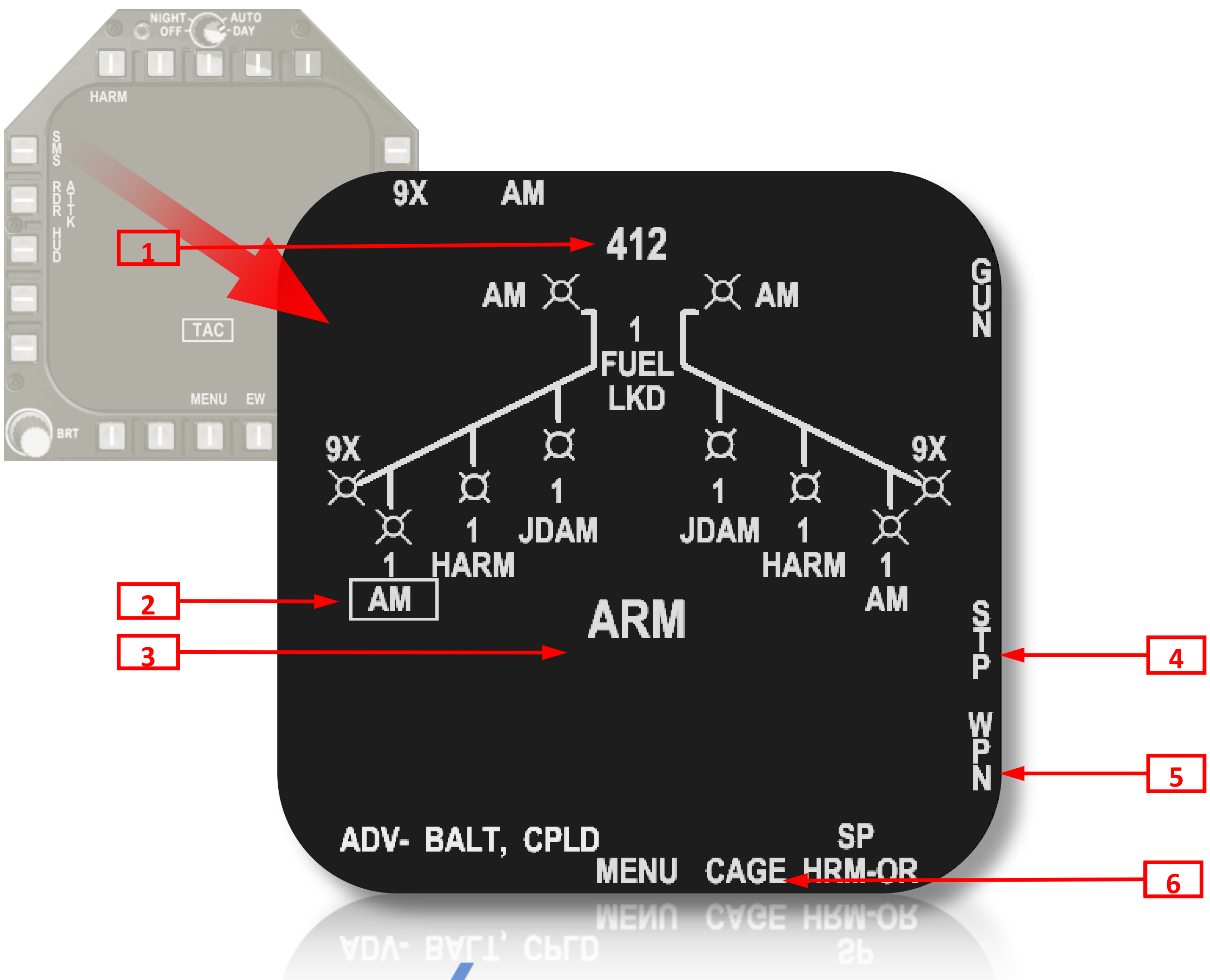
☑ MASTER ARM: **ARM.** Click the **Master Arm Switch** near the bottom of the arming panel.

As soon as you entered A/A master mode, the SMS page should have been brought up automatically. If for some reason you don't see the SMS display on the LDDI, press **MENU [PB18]** until *TAC* is displayed in the bottom-center of the LDDI, then press **SMS [PB5]** on the left.

Let's switch weapons so we can concentrate on a BVR shot.

2.10.3 Stores Management System (SMS)

The *Stores Management System (SMS)* page provides for selection of weapons based on the current



master mode. When in A/A master mode, all A/A weapons, including the cannon, can be selected and cycled through.

1) **Gun Rounds**. The remaining number of rounds in the cannon.
1) **Selected Station Box**. The currently selected weapon is *Boxed*, indicating it's the weapon "under the trigger", or ready to fire.
2) **Master Arm State**. This large cue will read either *ARM* or *SAFE* depending on the master arm state.
3) **Weapon Step Option**. Steps through all available weapons of the same type.
4) **Weapon Select Option**. Selects the next available weapon of a different type as long as it's the same class (A/A, or A/G, depending on master mode).
5) **Cage/Uncage State**. This option is boxed if the current weapon is caged, and unboxed if it's uncaged. More on caged vs. uncaged in a moment.

- ☑ WEAPON: **AIM-120**. Press the **WPN** option **[PB15]** until an *AIM-120 (AM)* is selected. A box will appear over the selected station indicating that is the currently selected weapon.
- ☑ WEAPON: **CYCLE**. Press **STP [PB14]** to cycle through all the weapons of the same type.

2.10.4 Caged vs. Uncaged Firing Modes

If you look in the HUD now, you'll see that the symbology has changed considerably from the navigation mode we were previously in. It should be showing a large segmented circle at the HUD center, as well as the words *AM x* near the bottom. *X* is the number of AIM-120s on board.

Under *AM x* may be the word *VISUAL*. Whether it's there or not depends on wheter the radar has a target or not, and whether the AIM-120 is currently *caged*. Again, VISUAL indicates that the AMRAAM is either not currently *caged* to the radar <u>with</u> a valid *DT* (target), OR it's in the *uncaged* firing mode. *When* VISUAL, it will track the first target it acquires using its own on-board radar. It will then home in without any further control. Let me rephrase: It will track without *any* control. It could quite literally destroy the first target it picks up after becoming active, and there's nothing we could do about it. Most weapons have both caged and uncaged firing modes so that they can be employed without radar if need be.

- ☑ SMS MODE: **CAGED**. Press (box) the **CAGE** option **[PB17]** from the SMS page, or press **[CONTROL-U]**. The AIM-120 is now caged to radar. The segmented circle and the word VISUAL may still remain depending on whether or not the radar is on and there is an L&S target currently locked.
- ☑ RDDI PAGE: **[TAC]>RDR.** If the RDDI is not displaying the *RDR* page, return to it now.

- ☑ RDR MODE: **TWS**. If you're not in TWS mode, press **[PB5]** until the legend reads *TWS*.
- ☑ RDR SCALE: **40nm**. Press **PB11**/**PB12** until the range scale just above the arrows reads *40*.
- ☑ A/P: **OFF.** Use your default FS A/P toggle (**[Z]** FSX default) to disconnect the autopilot. Verify the A/P is off by looking for the absence of autopilot advisories in the lower left LDDI and/or no corner highlight on the *A/P* option of the UFCD CNI top level.

2.10.5 Acquiring an Airborne Target

We're looking for a target that is not too close and not too far. Based on the current range scale (40nm), we would be looking for something to appear about halfway up the screen or more.

- ☑ RADAR: **AQUIRE**. Begin slowly turning until a target **[7]** appears. If a target has not appeared by the time you've made a 360, try increasing the BAR setting **[PB6]** in order to scan a larger vertical volume.

If that still doesn't work, press the **MSI** option **[PB16]**. *MSI,* or *Multi-Sensor Integration,* is essentially a cheat mode in the VRS Super Hornet. In the real aircraft it links external surveillance aircraft and ground radar systems to your own aircraft's systems. It works much the same way here, but it shows *everything* currently visible.

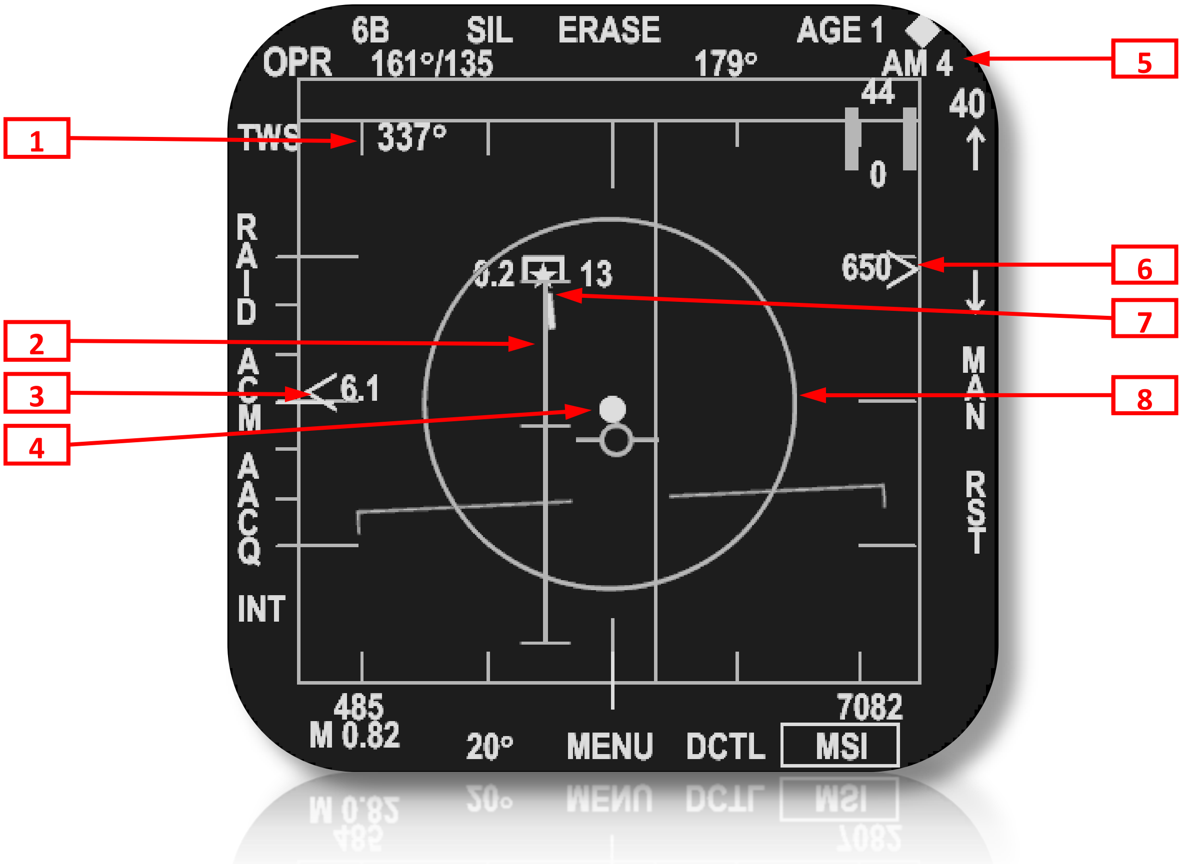
Assuming we now have a target, the radar display should look similar to the image below:

- ☑ HEADING: **ADJUST**. Turn the aircraft to keep the *HAFU Target Symbol* **[7]** centered horizontally in the screen.
- ☑ SIM: **PAUSE**.

2.10.6 Radar TWS AIM-120 (caged) Symbology

As you can see in the example display below, the target is acquired, and just about 30 nm out. Your target may be closer or farther, and that's fine. Vertically along the left and right sides of the radar display are small horizontal ticks, 3 of them on each side of the display, which divide the display into 4 vertical sections. These are designed to help you judge the range of the target. Since our example range is 40nm, each “section” is 10nm. Use these ticks as a guide for estimating range. The screen above shows the *TWS AIM-120 symbology* and the major components are as follows:

1) Target Heading. This is the targets heading, *not* the target's bearing from you.



2) **Launch Envelope Bar**. The minimum and maximum ranges based on the currently selected weapon and radar range scale.

3) **Target Relative Altitude**. Altitude relative to ownship. Positive values are above. In thousands of feet.

4) **Steering Dot**. As long as the steering dot is inside the ASE circle [8], the geometry is acceptable for a shot.

5) **Selected Weapon/Count**.

6) **Target Closing Velocity (Vc).** The vector sum of your velocity and the target's velocity.

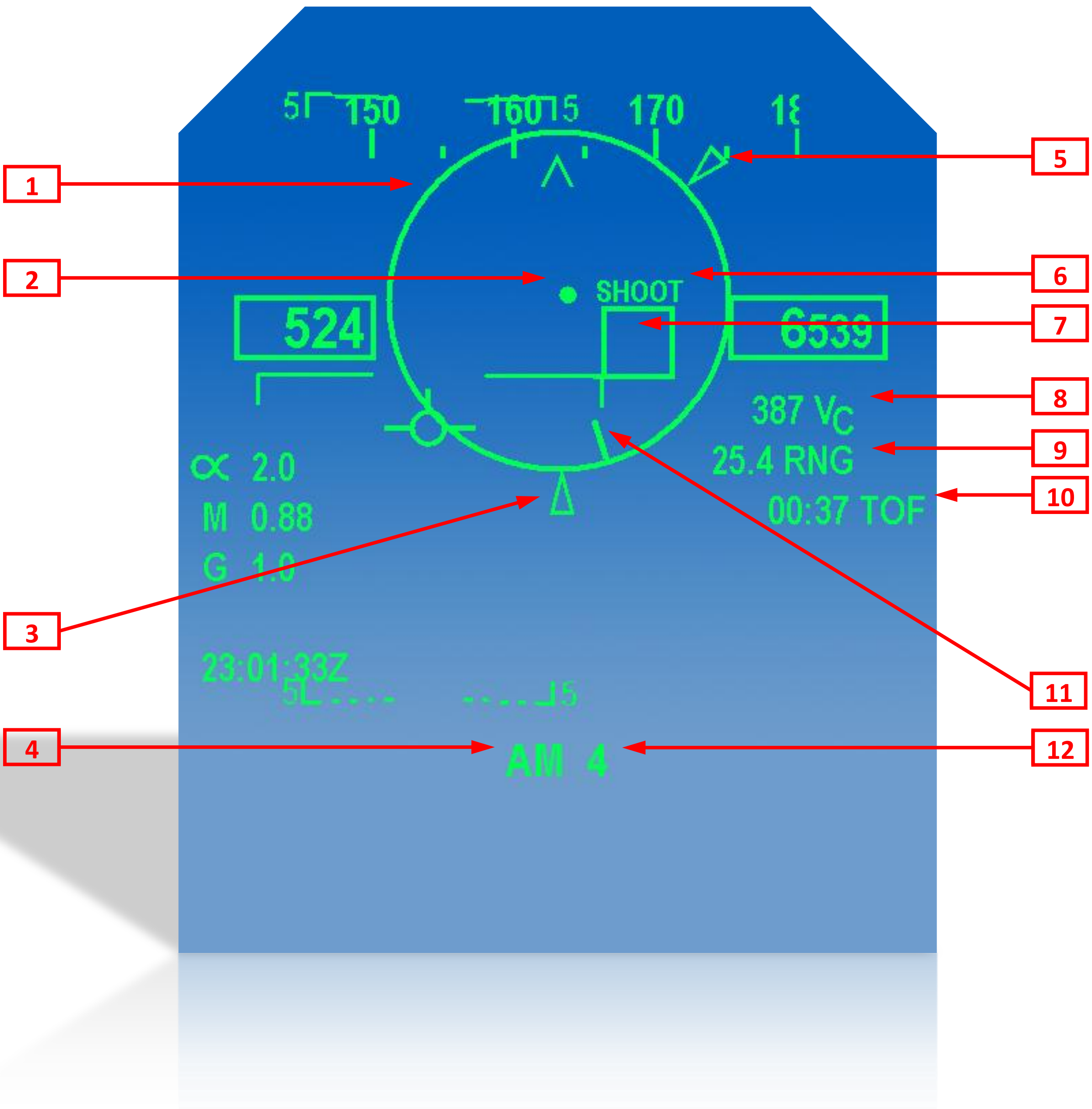
7) **HAFU**. Hostile Ambiguous, Friendly, Unknown. This represents the *Launch and Steering Target*. In the SE version of the VRS F/A-18E, a HAFU only has one, generic meaning, and the symbol will always be a star and an inverted "U".

8) **Azimuth Steering Error (ASE) Circle**. The *Azimuth Steering Error (ASE)* circle, used in conjunction with the *Steering Dot*, represents the weapon's vertical and horizontal employment envelope.

2.10.7 HUD AIM-120 (caged) Symbology

When we acquired a target in TWS, the radar automatically designated it as the *Launch and Steering Target (L&S)*. You didn't have to “lock it up”, and in fact it's not locked up at all. The radar is still scanning for additional contacts and you may even have multiple contacts on your screen. But the one we're concerned with right now is the L&S target.

The HUD will have also changed dramatically from the previous uncaged (VISUAL) state, showing symbology similar to what's on the radar screen. All of these components represent a group of targeting symbology known as the *Normalized In-Range Display*, or *NIRD*.



1) **Azimuth Steering Error (ASE) Circle**. The *Azimuth Steering Error* circle, part of the NIRD symbology, is used as a reference for the steering dot.

2) **Steering Dot**. As long as the steering dot is inside the ASE circle, the geometry is acceptable for a shot.

3) **Maximum Range Indicator**. Used in conjunction with the relative range (11) bar to indicate the maximum range firing envelope.

4) **Selected Weapon**. In Air-To-Air master mode, the currently selected AAM (or GUN) will appear here.

5) **Minimum Range Indicator**. Used in conjunction with the relative range bar to indicate the minimum range firing envelope.

6) **SHOOT Cue**. When the selected target is within range and the steering error margin of selected weapon, SHOOT will appear directly above the *Target Designator Box (TD)*.

7) **Target Designator (TD) Box**. The TD box represents the target's location in 3D. If the target is outside the bounds of the HUD, the TD box will flash at the edge of the display coincident with the location of the target.

8) **Closing Velocity (Vc)**. The rate in knots at which ownship and the target are closing. This figure is based on the vector sum of both aircraft.

9) **Target Range.** Range to the target in nautical miles.

10) **Time of Flight.** The estimated time of flight for the weapon under the trigger (pre-launch).

11) **Relative Range bar**. This bar rotates within the ASE circle circumference and shows the target's relative range. When the range bar is between the minimum and maximum range indicators, the weapon is in range for firing.

12) **Selected Weapon/Count**. Shows the selected weapon and weapon count. Note that air-to-ground weapons may not display in this area.

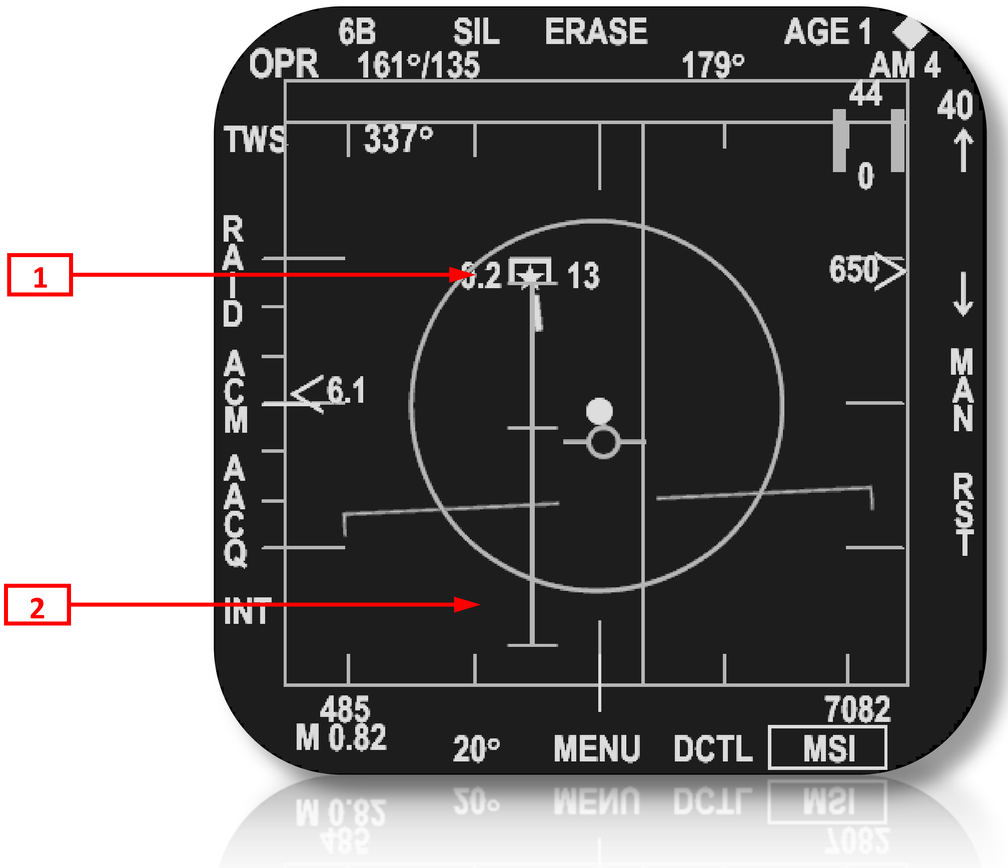
☑ SIM: **UNPAUSE**

Continue to fly towards the target until you have a *SHOOT Cue* in the radar and HUD (located just above the TD box.

☑ TRIGGER1: **FIRE**

Watch right data block in the HUD as the *TOF (Time of Flight)* changes to *TTA (Time to Active)*. This is the time until the missile goes completely self-sufficient using its on-board radar. Once the missile is active, TTA will change to *TTG (Time To Go)*. When the timer reaches zero, the missile will be near the target location.

The radar format on the RDDI, should also be showing a triangular missile *Flyout Symbol* **[2]** moving towards the target **[1]**. This shows the actual missile's position relative to the target. If you've done everything right, in a few seconds you should be hearing the sound of an impact and the contact will drop off the radar.



NOTE:

If weapons are reloaded (**SHIFT-CONTROL-W**), the killed A/A target list will also be reset, and those targets will again be visible to radar.

2.11 RADAR WARNING RECEIVER (RWR) BASICS

If you are continuing from a previous saved flight, it will be necessary to re-set KPDX as a target hostility zone. If you are continuing from the previous section, please skip the following 5 actions.

The *Radar Warning Receiver (RWR)* is an RF detector which operates very similar in principal to how the average "fuzz buster" works; only it senses radio (radar) emissions in 360° around the aircraft.

- ☑ FLIGHT PLAN: **LOAD.** KSEA TO KPDX.
- ☑ AIR TO GROUND MODE: **Select**. If not already in A/G master mode, press the **A/G** button on the *arming panel* or press **[M]** to cycle to A/G master mode. If The A/G Master Mode button does not illuminate, check to make sure the gear is UP.
- ☑ RDDI PAGE: **[SUPT]>HSI.** Bring up the **HSI** on the LDDI.
- ☑ STEERING MODE: **WPT.** Press **[PB11]** and ensure that *WPT* steering is boxed.
- ☑ WAYPOINT: **WPT:1** Ensure waypoint *1* (*KPDX*) is selected.
- ☑ DESIGNATE TARGET: **WPT:1** Press the **DSG [PB14**] option to designate *WPT1* as a target waypoint.

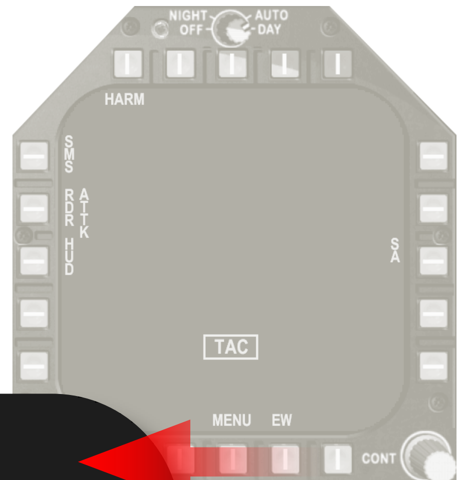
As we continue to approach PDX, our target area, we need to be increasingly vigilant regarding possible SAM activity.

- ☑ RWR: **ON.** Turn on the RWR by pressing **[R]** from key command mode. If you're not in key command mode, press **[SHIFT-CONTROL-M]** and try again. You can verify that the RWR is ON by bringing up the **EW** page as follows:
- ☑ RDDI PAGE: **[TAC]>EW.** Bring up the *EW (Early Warning)* page from the **TAC** level on the RDDI. If you don't see the EW option press **MENU** until *TAC* is displayed and then press **[PB17]**.

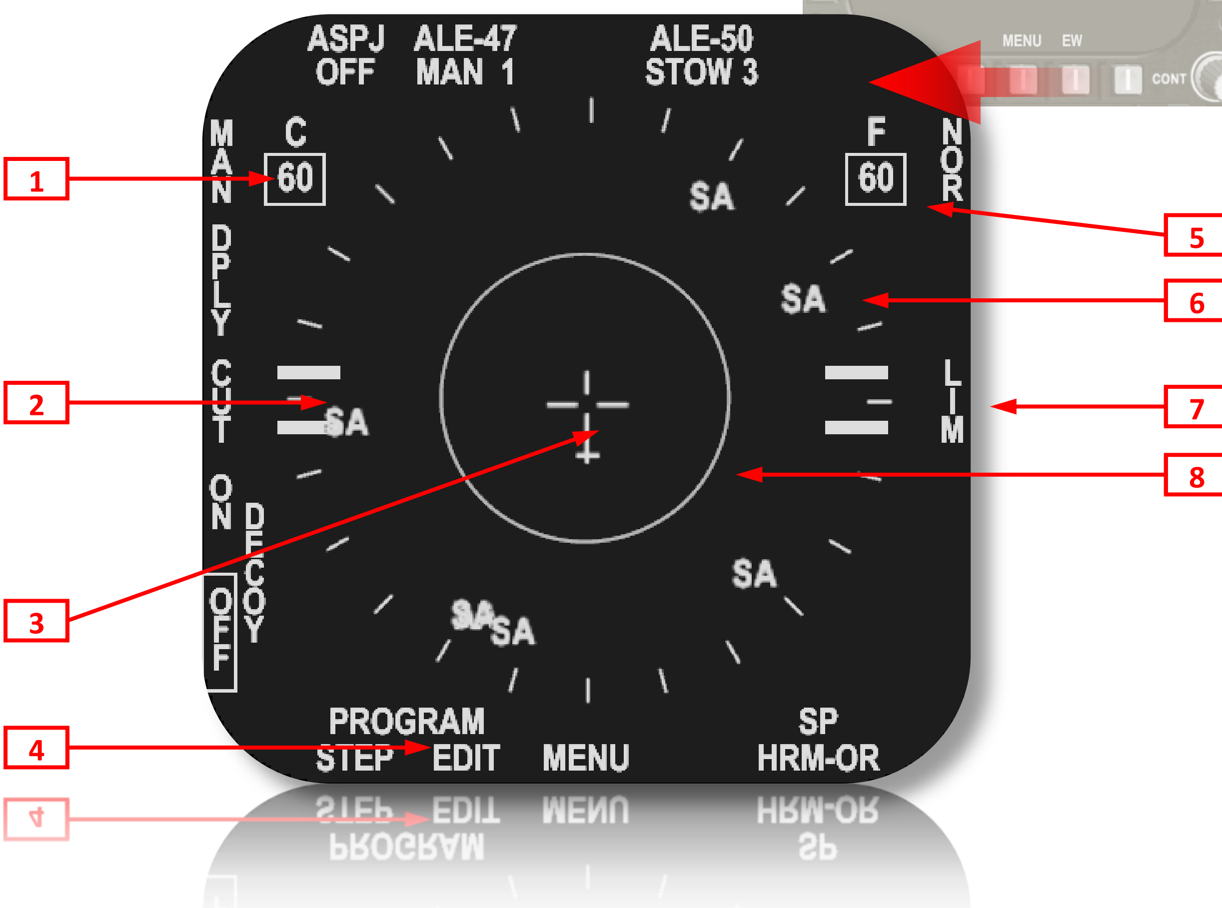
Upon activating the RWR a low, single tone should be heard indicating a new contact, or series of contacts have appeared. Contacts are identified as a two letter symbol such as *SA*, *CW*, *AA*, etc. By this time there should be a few of them on the *EW display (described below)*. If there aren't, ensure the RWR is ON by repeating the previous few steps. Every time a new contact appears, another tone will annunciate (as long as the RWR is switched on).

Although we'll be talking about the DDI EW format for this exercise, there is a second radar warning receiver display located below the Right DDI (*above right*). When the RWR is powered, this display will turn green and the letter *N*, for "Normal" operation will appear in the center of the display.

2.11.1 Early Warning (EW) Format



The EW display is the visual picture of what the RWR is seeing. It's a 360 degree top-down oriented display with your aircraft at the center. Since the RWR works much like any radio receiver, the *range* of the contact is not known, but the *azimuth* is. In fact the range to a contact is impossible to determine without triangulation. For this reason, *Target Of Opportunity* (discussed below, under HARM employment) attacks on radar installations, do not involve known ranges. About the best we can do is make an educated guess. We'll



talk more about the difference between targets of opportunity and *Pre-briefed* targets shortly when we employ a HARM missile.

Major features of the EW display are as follows:

1) **Chaff Count**. The number of chaff bundles remaining in your *ALE-47* dispensers. Pressing **C** will release a single chaff bundle.

2) **Beam Maneuvering Cue**. These pairs of solid rectangles on each side of the display are used as an aid in aligning your aircraft's beam (left or right side) with a hostile emission. When evading missiles, it's usually always desirable to fly as perpendicular to the hostility as possible. Doing so increases the angle-off between you and your foe/missile, thereby making it much more difficult for the hostile to maneuver to an intercept angle. When a missile in incoming, turn the aircraft until the hostile is aligned with one of these pairs of bars.

3) **Ownship**. In this top-down view, the ownship symbol represents the aircraft position, with emissions displayed 360° around it.

4) **CMDS Programming options**. The *Countermeasures Dispensing System (CMDS)* can be used to edit and step through a series of countermeasures programs.

5) **Flare Count**. The number of IR flares remaining in your ALE-47 dispensers. Pressing **[F]** will release a single flare.

6) **RWR Contacts**. Contacts can appear anywhere around your aircraft in 360°. They are positioned based on bearing and signal strength.

7) **Limit Option**. This option limits the number of displayed targets to 8 instead of the normal 12. The higher priority targets remain, while less threatening targets are blanked. The LIM option is shared with that of the HARM *TOO* and *SP* formats of the SMS (discussed below). Pressing LIM on either page performs the same action.

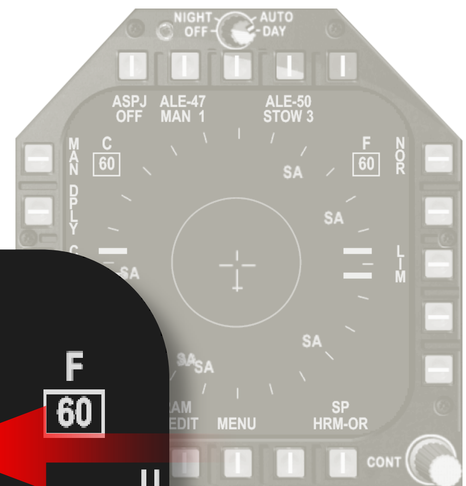
8) **Critical Band**. Contacts are positioned just <u>outside</u> this circle when RWR logic feels they are becoming *Critical*. This would include radars which are directing enough energy at your aircraft to be consistent with active tracking, but probably haven't yet fired a missile. Contacts will appear <u>inside</u> this area when they are considered *Lethal*. Lethal contacts are those which are emitting signals consistent with command guidance.

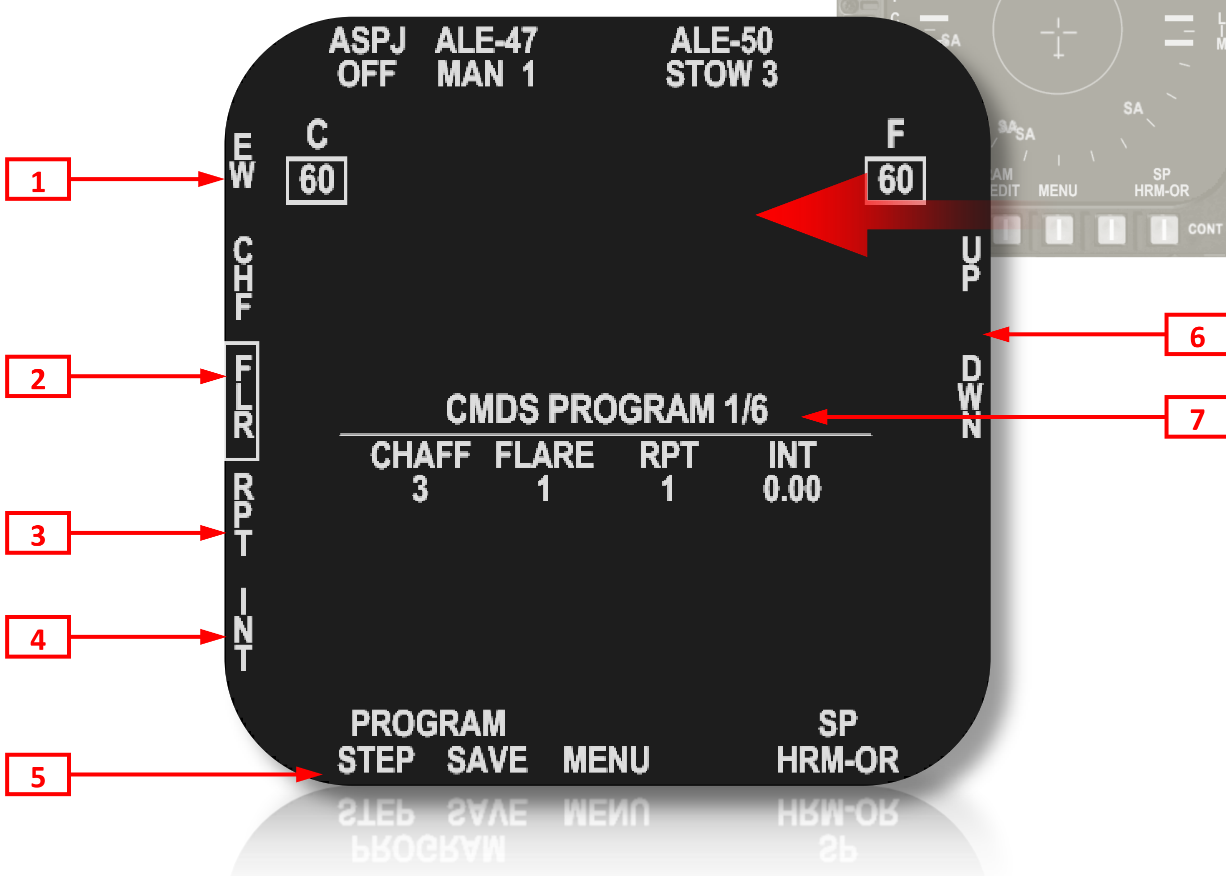
2.11.2 Counter Measures Dispensing System (CMDS) Format

The *Countermeasure Dispensing System (CMDS)* is part of *the Integrated Defense and Electronic Countermeasures IDECM* suite on board the aircraft. This includes the *Airborne Jammer (ASPJ),* ALR-67 Radar Warning Receiver (RWR), as described in the previous section, and the ALE-47 chaff and flare dispenser, which we'll describe here. All of these components talk to each other and are interfaced through the CMDS and EW formats on the DDIs.

- ☑ ALE-47 POWER: **ON**. The ALE-47 is the dispenser for flare and chaff. Power should be on by default, but if you cannot dispense flare or chaff in the following sections, you can toggle it by pressing **[SHIFT-K].**
- ☑ CMDS PROGRAM: **EDIT**. From the EW page, Press the **EDIT** option **[PB19]**.

A single chaff or flare can be released at any time, but that's usually not enough to get the job done, and constantly mashing keys monopolizes your hands at what could potentially be a life-threatening time. There is a better way, through the use of a "program", to dispense a series of countermeasures automatically: Enter the *Counter Measures Dispensing System (CMDS)* page. We can use this format to edit the type, number and intervals of countermeasures dispensed by





the ALE-47. Using just a single keystroke, the program will execute the program, freeing us to do other things.

1) **EW Page**. This option will return to the previous (EW page) from which this page was entered.
2) **Item Selection**. Selecting (boxing) one of these items, allows you to adjust its value via the *UP* **[PB12]** and *DWN* **[PB13]** options. In the example, *FLR* (flares) is selected and the *UP*/*DWN* options will increase/decrease the number of flares to be dispensed per repeat cycle.
3) **Repeat Option**. Pressing this button **[PB2]** sets the number of times the selected program will repeat.
4) **Interval Option**. Pressing this button (PB1) sets the spacing in seconds between each repeat cycle.
5) **Program STEP Option**. Pressing this button (PB20) cycles through each CMDS program. A total of 6 programs can be stored.
6) **Value Increment/Decrement**. Pressing these options *UP* **[PB12]** and *DWN* **[PB13]** increments/decrements the currently selected item (*chaff, flare, repeat count,* or *interval*) **[2]**.
7) **Program Detail**. The currently selected program (1/6 in the example), the number of chaff and flare to be dispensed, the number of times the program will repeat the cycle, and the interval between each cycle.

- ☑ CHAFF: **SELECT**. Press **[PB4].** *CHF* should now be boxed.
- ☑ CHAFF COUNT: **4**. Press **[PB12]** until *CHAFF* count in area **[7]** reads *4*.
- ☑ FLARE: **SELECT**. Press **[PB3]**. *FLR* should now be boxed.
- ☑ FLARE COUNT: **2**. Press **[PB12]** until *FLARE* count reads *2*.

  If you wish, press **[PB2]** followed by **[PB12]** to increase the repeat (*RPT*) count. This is the number of times the program will execute. The *INT* option sets the number of seconds (25ms resolution) between program cycles.

- ☑ RDDI PAGE: **EW**. Press **[PB5]** to return to the *EW* page.

To test our CMDS program, press **[K]** from key command mode. We can still drop individual chaff/flares with **[C]** and **[D]**.

As we continue to approach the target area, things may start to get busy. Within 30nm of KPDX, some of our RWR contacts may go critical or lethal. When this happens, an alternating high/low tone will be heard from the RWR.

- ☑ TARGET: **INGRESS**: Continue to fly towards the target until you hear the high/low missile warning tone.

☑ SIM: **PAUSE**.

TIP:

If your aircraft is damaged at any time during this tutorial either by pilot error, or battle damage (lethality should be off by default) **SHIFT-CONTROL-R** will repair your aircraft immediately.

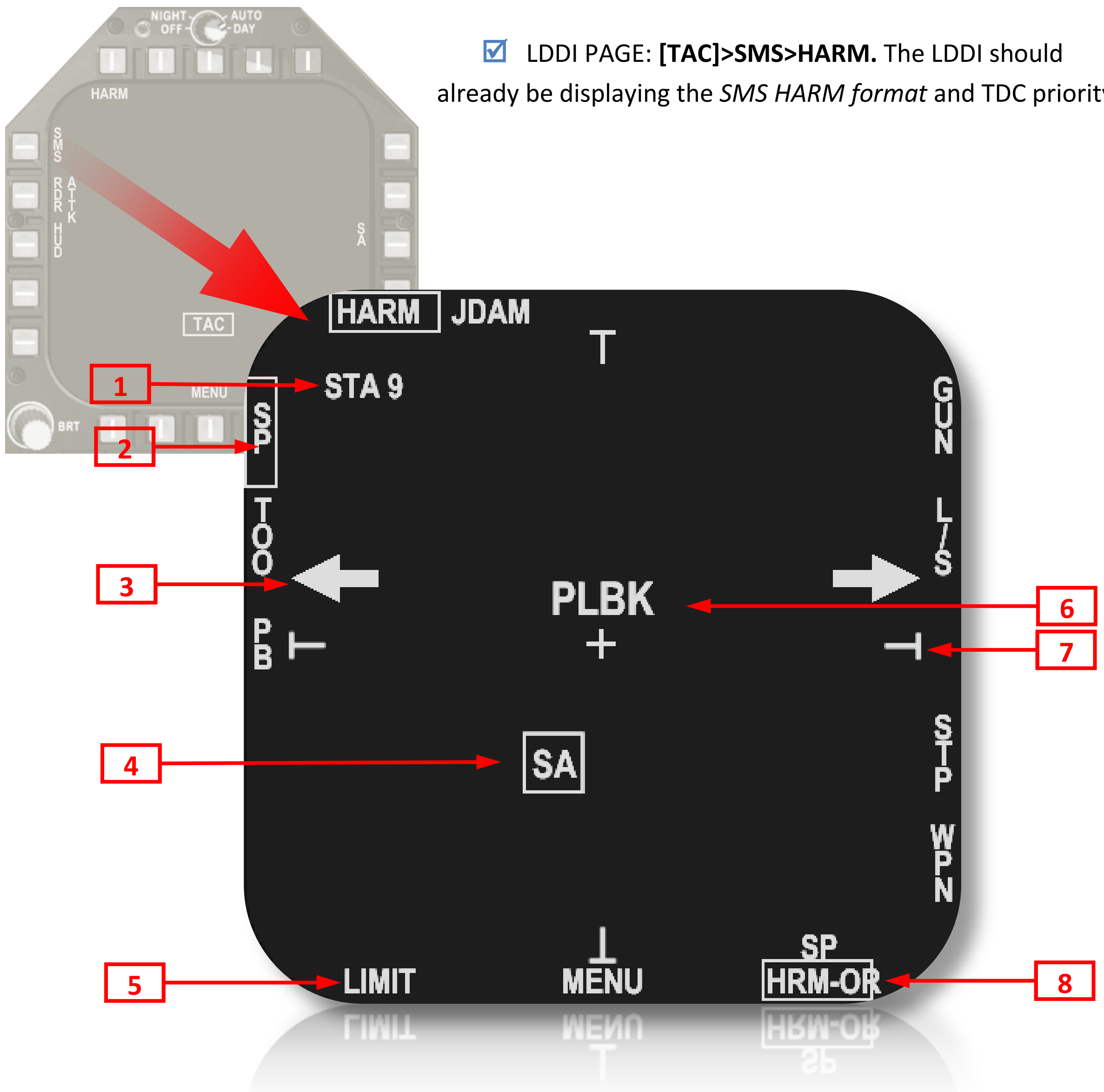
2.12 HARM EMPLOYMENT

At this point a hostile threat should be targeting you. If it isn't, continue to fly towards KPDX until you are within approximately 30nm. When you're being “lit up”, you should see and hear some changes:

A HARM should have automatically been selected and the hostility targeted. The HUD should be displaying the word *HARM* near the top, just under the heading tape. If it's *X'd out,* enable the master arm switch *(See Master Arm Panel)*. The only thing left to do would be to pull the trigger and wait for the HARM to impact the target. If you haven't already pulled the trigger, don't!

If for some reason a HARM has not been selected automatically (the LDDI does not look similar to the image below), then proceed to select a HARM as follows:

☑ LDDI PAGE: **[TAC]>SMS>HARM.** The LDDI should already be displaying the *SMS HARM format* and TDC priority



should be assigned to the LDDI. If not press the **HARM** option from the *TAC* display.

☑ TDC PRIORITY: **LDDI**. Press **[TAB]** repeatedly or **[CONTROL-LEFT-ARROW]** until a diamond appears in the upper-right corner of the LDDI.

2.12.1 HARM Self-Protect (SP) Mode

All of the previous events took place because we were in the default HARM mode called *Self-Protect Mode,* or *SP*. SP mode will drop whatever you're doing as soon as a critical or lethal threat is detected, arm a HARM and wait for you to fire. The down side to this is that if you're currently targeting something else with another weapon, that operation will be terminated in favor the HARM firing sequence. What we want to do for now is override this behavior.

☑ SP OVERIDE: **SELECT.** With the HARM display active on the LDDI, press **HRM-OR [PB16]**, to activate the *HARM Self-Protect Override* function.

Once you've overridden SP mode the word *PLBK* will be displayed on the HARM SMS format and HUD indicating that SP mode is *active*, but being *pulled-back*. Much like the leash on a dog, we're holding our Rottweiler at bay.

The *HARM Display* is a *boresight* format with the nose of your aircraft at the center of the display. The term boresight is analogous to what one might see looking down the barrel of a shotgun, or in this case, down the “barrel” of the HARM missile itself.

1) **Selected Station**. The wing station number the currently selected weapon is on. Can be cycled with the *STP* option **[PB14]**.
2) **HARM Mode**. The boxed option represents the current HARM targeting mode (*Self-Protect*, *Target of Opportunity*, or *Pre-Briefed*).
3) **Field of View Arrow**. These left and right pointing arrows, which may or may not be visible on your display, indicate additional threats are present outside the field of view of the HARM missile. In this example, there are threats left and right of our HARM maximum field of view. The HARM can't see them, but the RWR *can*.
4) **Target Designator Box**. The currently selected target. <u>Note that only TOO mode supports direct TDC selection of targets</u>. In SP mode the target is selected automatically based on threat criteria. The TD box will change to a dashed border if the target does not have sufficient energy for the HARM to lock onto. In other words, the RWR sees it, but the HARM does not.
5) **Limit Option**. Limits the number of displayed targets to 8 instead of the normal 15. The higher priority targets remain, while less threatening targets are blanked. The LIMIT option is shared with that of the *EW* page. Pressing **LIMIT/LIM** on either page performs the same action.

6) **PLBK Cue**. When a pullback conditions exists, and *HRM-OVRD* is boxed (ON), *PLBK* appears here. When HRM-OVRD is unboxed (OFF) and a pullback condition exists, *HARM* appears here.

7) **HARM FoV Boundary Indices**. These 4 indices represent the HARM maximum field of view. When an RF source is outside these indices, the HARM may no longer see it, although the RWR can.

8) **HARM Self-Protect Override Option**. As previously explained, the *HRM-ORIDE* option is available from every SMS page no matter which weapon is selected. This allows overriding the SP protection during weapon delivery so that other ordinance can be delivered without interruption.

2.12.2 HARM Target of Opportunity (TOO) Mode

The TOO display is identical to the SP display, above. TOO, or *Target of Opportunity* mode is so named because it allows you to fire on any given target you happen to run into. It's important to understand that unlike SP mode, TOO does not require that an emitter be actively tracking you, only that it's turned on and emitting energy.

NO WORKIE?:

If for any reason the weapon fails to release, and you're sure that MASTER ARM is **ON [CONTROL-A]** and the gear is **UP [G]**, please check your steps under *Assigning Triggers* in *Section I: Getting Started*.

☑ WEAPON: **HARM**. If a HARM isn't currently selected, press the **WPN [PB15]** option from any *SMS* page until it is.

☑ HARM MODE: **TOO**. Enter *TOO* mode by pressing **TOO [PB4]**.

If there are no emitters on the display, maneuver the aircraft towards either the left or right arrow **[3]** until something comes into view. If no arrows are visible and there are no targets on the display, make sure the RWR is still on with the **[R]** key.

☑ TARGET: **AS REQUIRED**. Move TDC cursor over any visible emitter by moving the **[ARROWS]** keys. The *HARM TD box* □ will appear in the HUD after a target is selected from the TOO format.

☑ HEADING: **ADJUST**. Turn towards the TD box until it's centered in the HUD.

☑ TRIGGER1: **FIRE!**

TIP:

Weapons can be reloaded at any time by pressing **SHIFT-CONTROL-W** from key command mode.

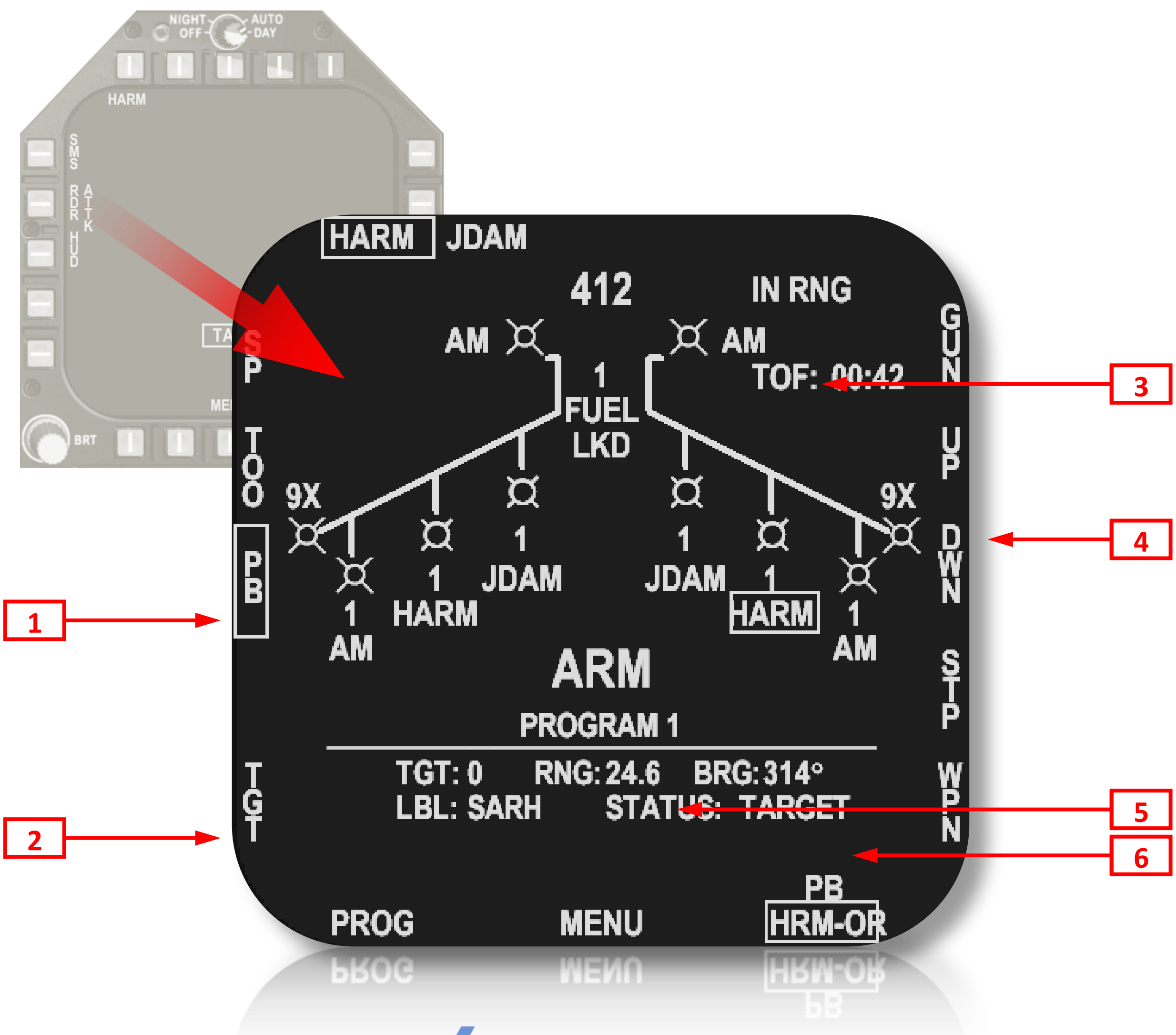
At this point you may be asking yourself why there is no information being shown in the HUD (or anywhere else) about range, time of flight, or time to go to the target. There's a good reason for that, because although we *see* an emitter on the HARM display and perhaps the EW page as well, it may not be within range of the HARM. We don't *know* whether a target is within range or not because the detected emitters are just energy waves, and not the actual source of the energy. HARMs operate by homing in on the energy *vector* of the target. They don't know how long they're going to have to fly to reach it, and neither do you. However, there is another way...

2.12.3 HARM Pre-Briefed (PB) Mode

What if we already know based on intelligence, where these RF emitters are geographically located? Fortunately there is a way to give the HARM the same information.

☑ HARM MODE: **PB.** From the HARM format, press **[PB3]** until *PB* is boxed.

The display will change to something resembling the *Iron Bomb* format. In the VRS Super Hornet, all *known* radar threats are loaded into the *Stores Management Computer (SMS)* at startup. This means



we're fortunate enough to have geographical coordinates and type data for all ground based RF sources.

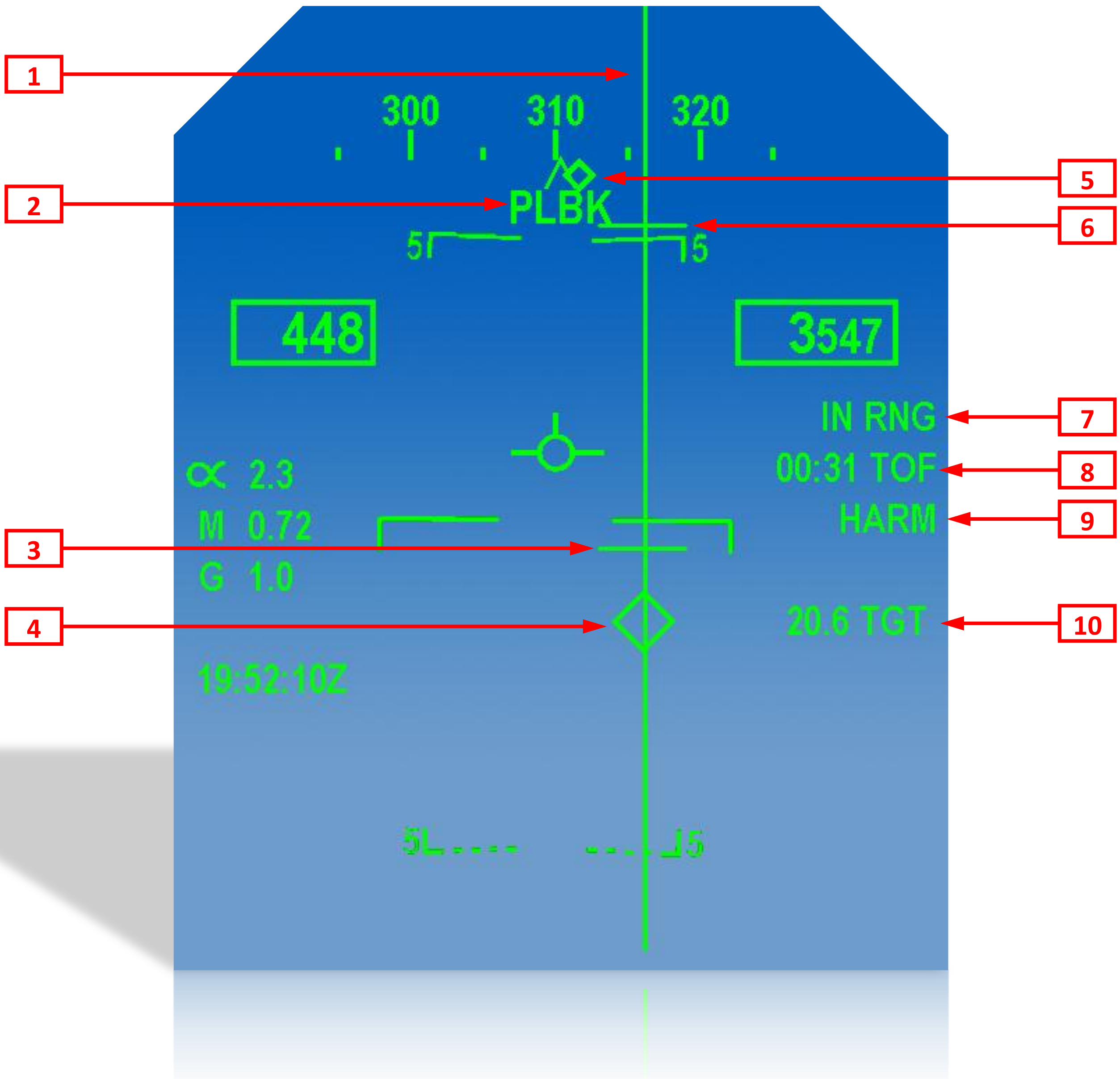
1) **Selected HARM Mode (Pre-Briefed).** Self-explanatory.
2) **Target Designation Option.** This option is used to designate a target from the pre-briefed list after selecting the target with the UP/DWN options (PB12/PB13) .
3) **Target Data Area.** The data provided will change based on whether or not the HARM has been launched yet:
   - **IN RNG.** Displays when the designated pre-briefed target is within the range/altitude limit of the HARM.
   - **TOF.** Time of Flight of the missile under the trigger. This the estimated time it will take for any un-launched missiles to strike the target.
   - **FLT.** Flight time of the missile in the air.
   - **TTG.** Estimated flight time remaining before the missile in the air strikes the target.
4) **Target UP/DOWN Options.** Pressing UP/DWN traverses the list of pre-briefed targets. Once a target is selected, the **TGT** option can be used to designate it.
5) **Target Selection Program.** This area displays information about the currently selected target. The LABEL and STATUS areas show the type of target (Semi-Active Radar Homing in the
6) **Target Status.** A pre-briefed emitter may have one of 3 statuses associated with it:
   - **ACTIVE.** The emitter has not been fired upon and is currently active.
   - **TARGET.** The emitter has been targeted with the TGT option.
   - **ENGAGED.** The emitter has been fired upon and may be destroyed.

☑ SELECT TARGET: **<30nm.** Press **UP [PB12]** and **DWN [PB13]** to cycle through pre-briefed targets, and observe *RNG* **[6]** until a suitable target within a relatively close range (20-30nm) appears.

☑ TARGET: **DESIGNATE.** Press **TGT [PB1]** to designate the target. *STATUS* will change to *TARGET* indicating this is now the current target.

☑ HEADING: **ADJUST**. After the target is designated, a *Command Heading Diamond* will appear in the HUD indicating the direction to turn in order to line up with the target. Turn the aircraft toward the diamond.

As you approach within 20° of the PB target's bearing, a vertical *Azimuth Steering Line (ASL)* will appear in the HUD (below) which corresponds to the target's azimuth (horizontal orientation). If you don't see the ASL, continue turning until you do.



Along the vertical length of the ASL is a pair of horizontal lines. These represent the minimum and maximum range of the HARM and are displayed relative to the velocity vector. When the velocity vector is between the lines, the target is in range. A target diamond will also be visible somewhere along the length of the ASL. This represents the actual location of the target in 3D space.

1) **Azimuth Steering Line (ASL)**. Represents horizontal (azimuth) position of the target.

2) **PLBK Cue.** We previously placed the HARM into HARM-OVERIDE mode so that we could freely engage targets of our choosing without the HARM automatically selecting targets for us.

3) **Minimum Range Bar**. When the velocity vector is above this line, you are within minimum range restrictions.

4) **Target Designator Diamond**. This symbol represents the physical location of the target.

5) **Command Heading Diamond**. The command heading diamond is visible any time there's an A/G target designated in A/G master mode. Steer towards this cue if the target is not visible on your current heading.

6) **Maximum Range Bar**. When the velocity vector is below this line, the missile is within maximum range.

7) **In-Range Indication**. This area will show *IN RNG* as long as the minimum and maximum range restrictions are met.

8) **Time of Flight (TOF) or Time to Go (TTG)**. Shows *Time of Flight (TOF)* if the weapon under the trigger has not been launched, and shows *Time to Go (TTG)* post-launch.

9) **Selected Weapon**. Self-explanatory.

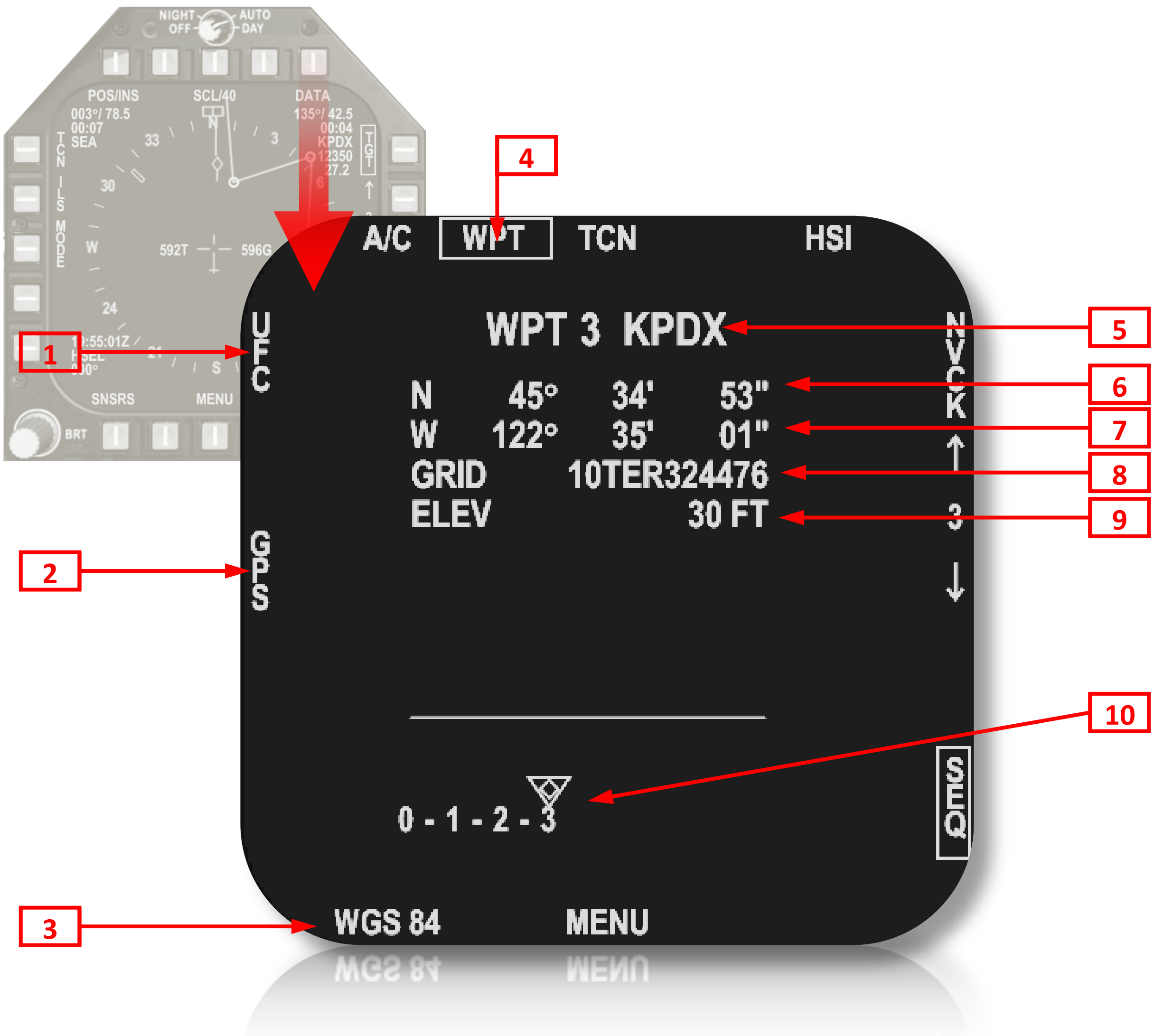
10) **Range To Target**. Range to the selected target in nautical miles. Note that this will only appear in pre-briefed mode, since otherwise the HARM/RWR has no way of knowing the range to the target.

- ☑ HEADING: **ADJUST**. Turn toward the diamond-shaped command heading marker in the HUD **[5]** until the ASL **[1]** and TD diamond **[4]** appear.
- ☑ TGT RANGE: **MONITOR**. Wait for *IN RNG* **[6]** to appear in the right data area of the HUD.
- ☑ TRIGGER1: **FIRE!**

You may have noticed by now that none of these “mock” SAM sites has had much of a temper; they made noise in the RWR, but didn't actually shoot back. In *Section 3: Aircraft Configuration Manager*, we'll explain how to arm SAMs and AAA within the hostility zones, changing their behavior from benign noise-makers to truly lethal entities which can fire on, and potentially damage your aircraft.

2.13BOMB EMPLOYMENT

With our SEAD mission complete, we'll start back towards KSEA. Along the way, we're going to expend some of our extra ordinance by delivering some virtual bombs on the Hanford nuclear power station NW of Richland, WA. *Disclaimer: We are not using real bombs, and VRS asserts no malice towards the U.S. DoE by the selection of this handy and juicy target.*



2.13.1 Entering Custom Waypoints

You may remember at the beginning of this tutorial we created a simple 2-waypoint flight plan from KSEA to KPDX. We're going to add a new waypoint by modifying that flight plan "on the fly".

- ☑ LDDI PAGE: **[SUPT]>HSI>DATA>WPT.** Bring up the *HSI Waypoint Data Page* on the LDDI as shown above by pressing the **DATA [PB10]** option from the HSI page.

☑ HSI DATA: **WPT**. Press **WPT [PB7]** [4] to select the *Waypoint (WPT) Data Page*.

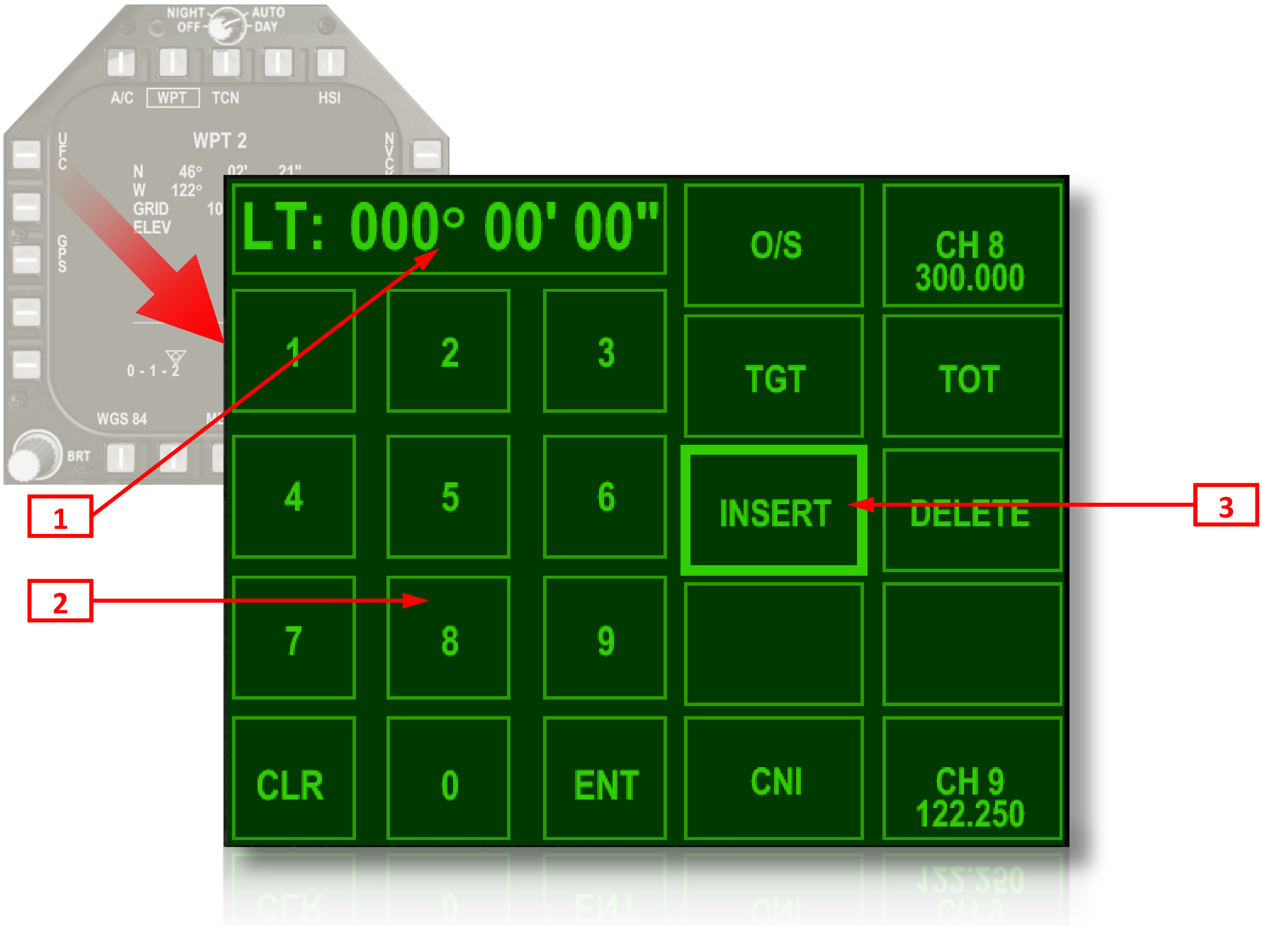
The waypoint data page shows detail about the currently selected waypoint:

NOTE:

You MUST have a flight plan loaded before any waypoint changes may be made in flight. It doesn't matter what the flight flan is, but one must be loaded. Waypoints cannot be edited, added, or removed without *some* flight plan loaded.

1) **UFC Option**. Pressing this option brings up the *Waypoint Data Entry Format* on the UFCD for adding/deleting waypoints in the sequence manually by latitude/longitude.
2) **GPS Option**. Pressing this option brings up the *GPS Insertion Format* for inserting GPS-based "nearest" waypoints into the current sequence.
3) **Datum Option.** Pressing this option cycles through the various datums available for the UTM coordinates of the Military *Grid Reference System (MGRS)* display.
4) **Waypoint Data Page Option.** Pressing this option brings up the waypoint data page.
5) **Waypoint ID.** The selected waypoint ID number and label.
6) **Waypoint Latitude**. Latitude of the selected waypoint in HMS format.
7) **Waypoint Longitude**. Longitude of the selected waypoint in HMS format.
8) **Military Grid Reference**. The location of the selected waypoint in MGRS format.
9) **Waypoint Elevation.** The elevation of the selected waypoint in feet.
10) **Target Waypoint Sequence Symbol.** This symbol shows where within the current sequence the target waypoint (if it exists) is.

☑ LDDI UFC OPTION: **PRESS**. Press **[PB5]**, the **UFC** option ([1], *above*) to bring up the *Waypoint Data Entry Page* on the UFCD (*below*).



You should begin to see how all the displays in the F/A-18E are tightly integrated. The DDIs talk to the UFCD and vice versa through what's known as the *Communication and Navigation Interface (CNI)*. The UFCD, in addition to the autopilot functions we used it for previously, can also be used to enter navigation data. Enter the coordinates for our next target:

- ☑ WAYPOINT DATA: **INSERT OPTION**. Press the **INSERT** option **[3]**.
- ☑ WAYPOINT DATA: **LATITUDE**. Using the **keypad** **[2]**, enter the following coordinates: **4-6-0-2-2-1**. You'll see the coordinates echoed in the scratchpad **[1]**. If you make a mistake, press the **CLR** key once to erase the last character entered, or twice to erase the entire entry.
- ☑ WAYPOINT DATA: **ENT KEY**. With the first set of coordinates entered in the scratchpad, press **ENT**.
- ☑ WAYPOINT DATA: **N KEY**. With the latitude entered, we must now tell the MC if our destination is in the northern or southern hemisphere. You'll notice the keypad has changed to reflect the new options (*N/S/E/W*). Press the **N** option on the UFCD.
- ☑ WAYPOINT DATA: **ENT KEY**. Press the ENT option.

☑ WAYPOINT DATA: **LONGITUDE**. Once again using the keypad, enter the following coordinates for longitude: **1-2-2-5-3-1-6**.

☑ WAYPOINT DATA: **ENT KEY**. Press the **ENT** option.

☑ WAYPOINT DATA: **W**. With the longitude entered, we must now specify whether it's east or west of the prime meridian. Press the **W** option.

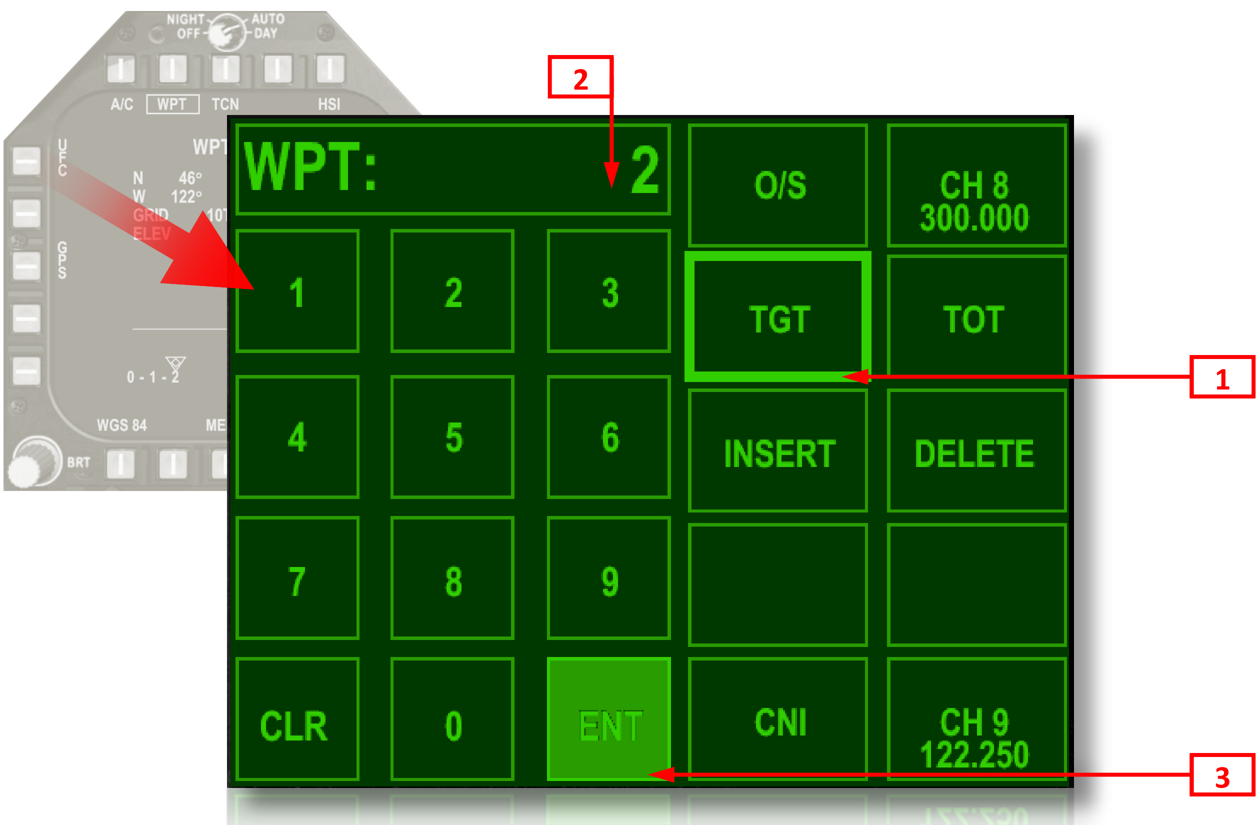
☑ WAYPOINT DATA: **ENT**. Press the **ENT** option.

2.13.2 NAV Target Designation

We've just entered a custom waypoint into the sequence, giving us a total of 3 waypoints (0-2). Now we simply need to designate our new waypoint (WPT 2) as a *NAV Target* so that steering and targeting information can be passed to the weapon systems. We've actually done this before at the beginning of the flight, but we did it via the HSI's *DSG* option. This is simply another method of performing the same task.

☑ WAYPOINT: **2**. On the **LDDI**, press the **UP/DWN** options **[PB12]/[PB13]** until the selected waypoint reads **2**.

☑ WAYPOINT DATA: **TGT OPTION**. On the **UFCD**, press the **TGT** option **[1]** (below) on the UFCD waypoint data entry page.



☑ WAYPOINT DATA: **2 KEY.** Press the **2** key on the keypad and confirm that *2* was entered into the scratchpad **[2]**.

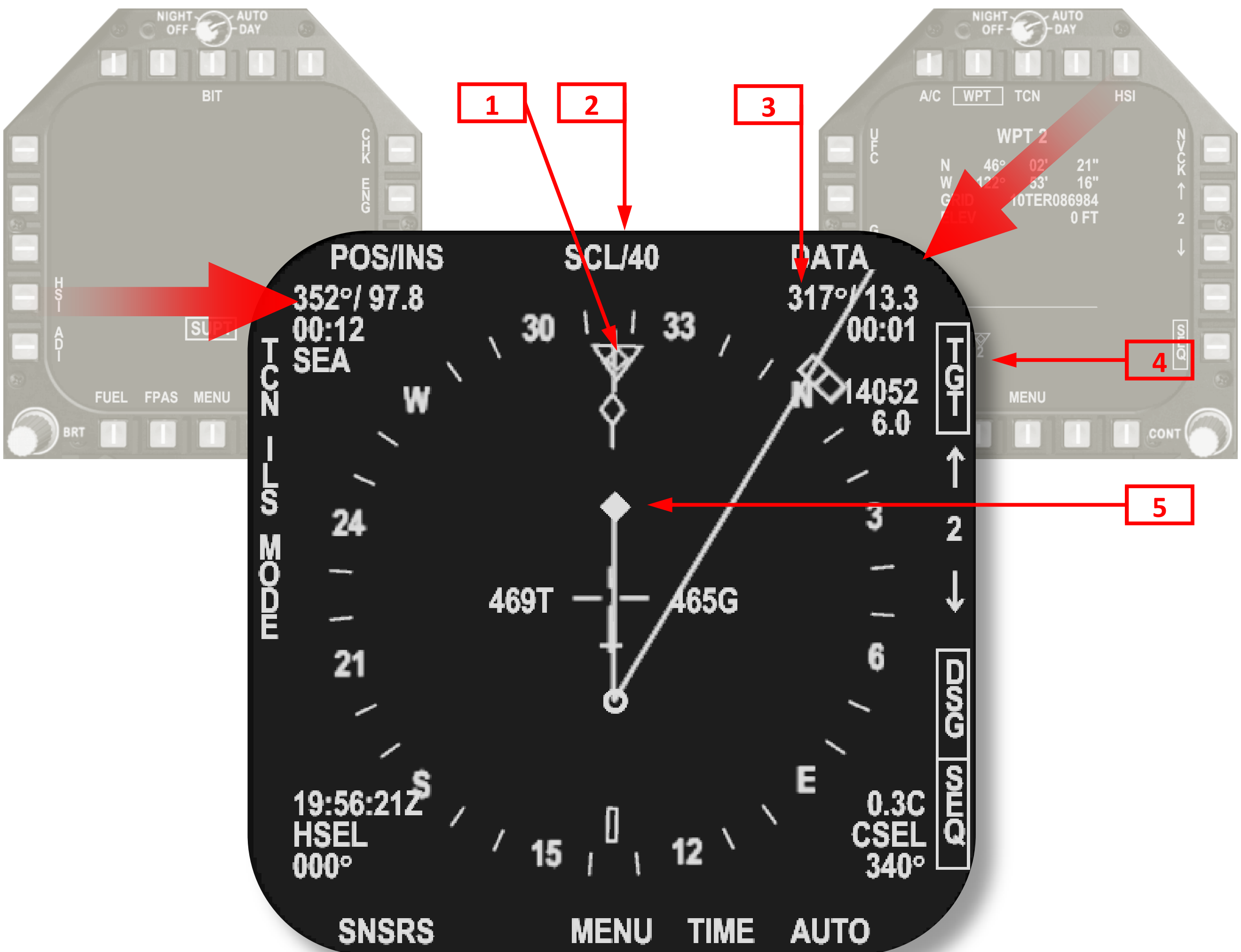
☑ WAYPOINT DATA: **ENT**. Press the **ENT** key to confirm the change **[3]**.

2.13.3 Target Ingress

Referring back to the LDDI HSI page, we can have a look at our newly created and designated waypoint, along with the overall horizontal picture of our sequence/route. Don’t worry if your display isn't oriented exactly as in the image below. We're going to start tracking towards the target using the autopilot

Waypoint 2 has now been designated as a NAV target. Let's return to the HSI to have a look at the overall picture.

☑ LDDI PAGE: **[SUPT]>HSI**. Bring up the main HSI page (below) either by pressing **[PB10]** from the



HSI waypoint data page (which may still be up), or by pressing **MENU** until *SUPT* is visible, then **HSI**.

☑ STEERING MODE: **TGT**. If *TGT* is not boxed, do so now by pressing **[PB11]** **[4]** (*below*).

☑ HSI: **SCALE**. Press **[PB8]**, **SCL** **[2]**, until the filled diamond representing the target **[5]** is visible. This should be between 40 and 80nm, but if it's not don't worry. Just cycle **SCL** until the diamond is visible.

Referring to **[3]** (*above*), make a note of the target bearing/distance. This can be seen graphically by the waypoint bearing pointer **[1]**. In the example above its 317° magnetic/ 13.3 nautical miles out, but your actual bearing and distance will certainly be different.

Now we'll use the autopilot to fly us into the target area by bringing the A/P sublevel back up on the UFCD:

☑ UFCD PAGE: **[CNI]**. If the UFCD is not currently at the top level (it's probably still on the waypoint data entry page), press the **CNI** option to return to the top level.

☑ UFCD PAGE: **[CNI]>A/P**. Bring up the autopilot *(A/P) sub-level* by pressing the **A/P** button from the CNI top level.

The A/P sub-level will appear (below):

☑ AUTOPILOT: **CPL SEQ/FPAH** Press the **CPL SEQ** *(couple sequence)* **[1]** (*below*) and **FPAH** *(flight path angle hold)* **[3]** options.

☑ AUTOPILOT: **ENGAGE**. Press the **[Z]** (FS) or **[A]** (custom) key, to engage the A/P.

Although the autopilot is ON, we can still make adjustments to pitch with FPAH engaged. When the stick is released, the aircraft will maintain the pitch angle currently set.

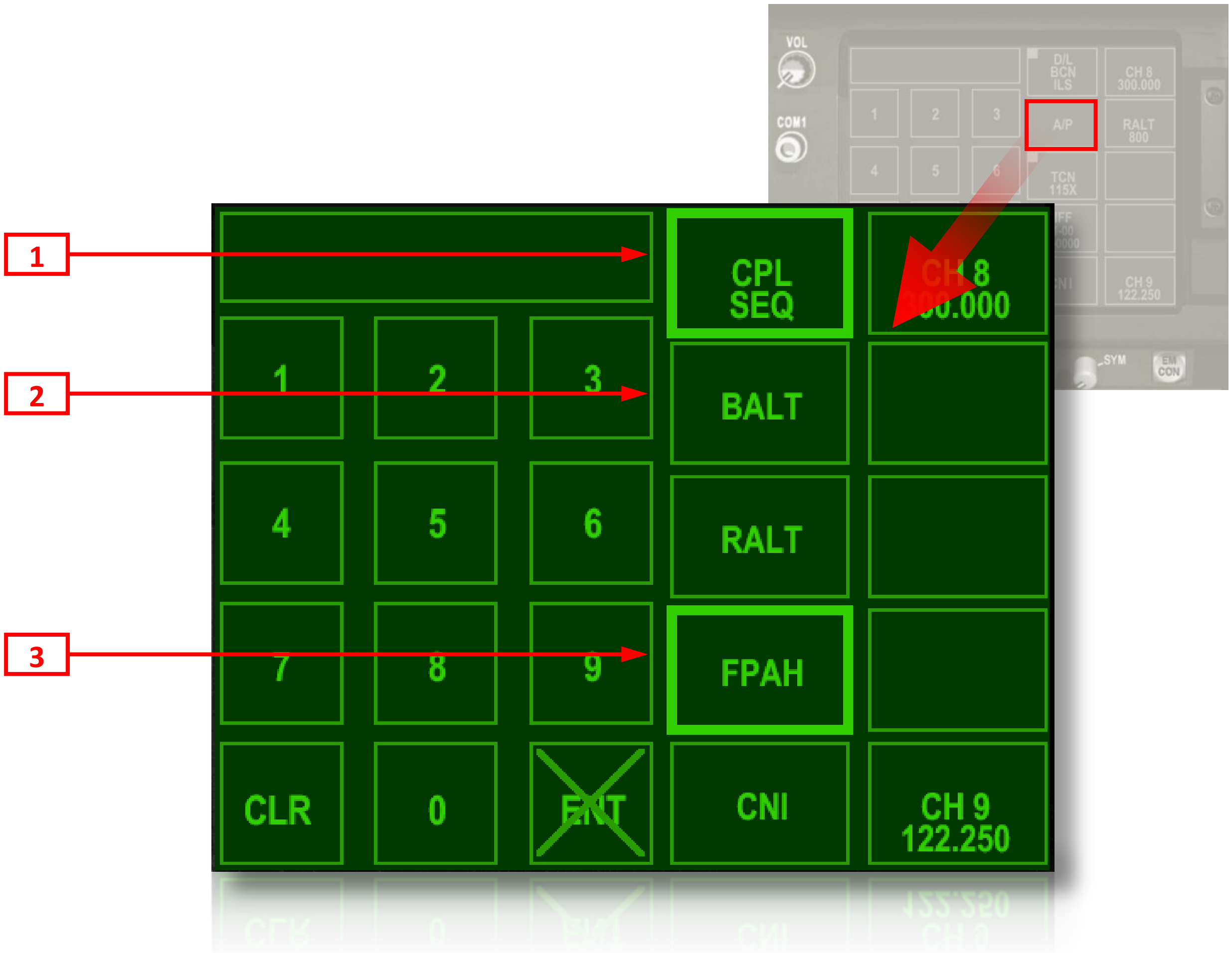
☑ ALTITUDE: **5000 FT**. Using the stick, pitch up or down by up to 10° and release the stick until you reach approximately 5000 FT.

☑ AUTOPILOT: **BALT.** Switch from FPAH to BALT by pressing the **BALT** option on the UFCD's A/P sublevel. We should now begin to hold the altitude at the time of engagement, which should be near 5000 ft. If you're significantly off altitude, simply move the stick and the A/P will switch from BALT back to FPAH automatically when you deflect the stick. When reestablished at 5000 feet, press BALT once again.

☑ AIRSPEED: **400 KCAS**. Adjust airspeed until **400 KCAS** is indicated in the HUD (left box).

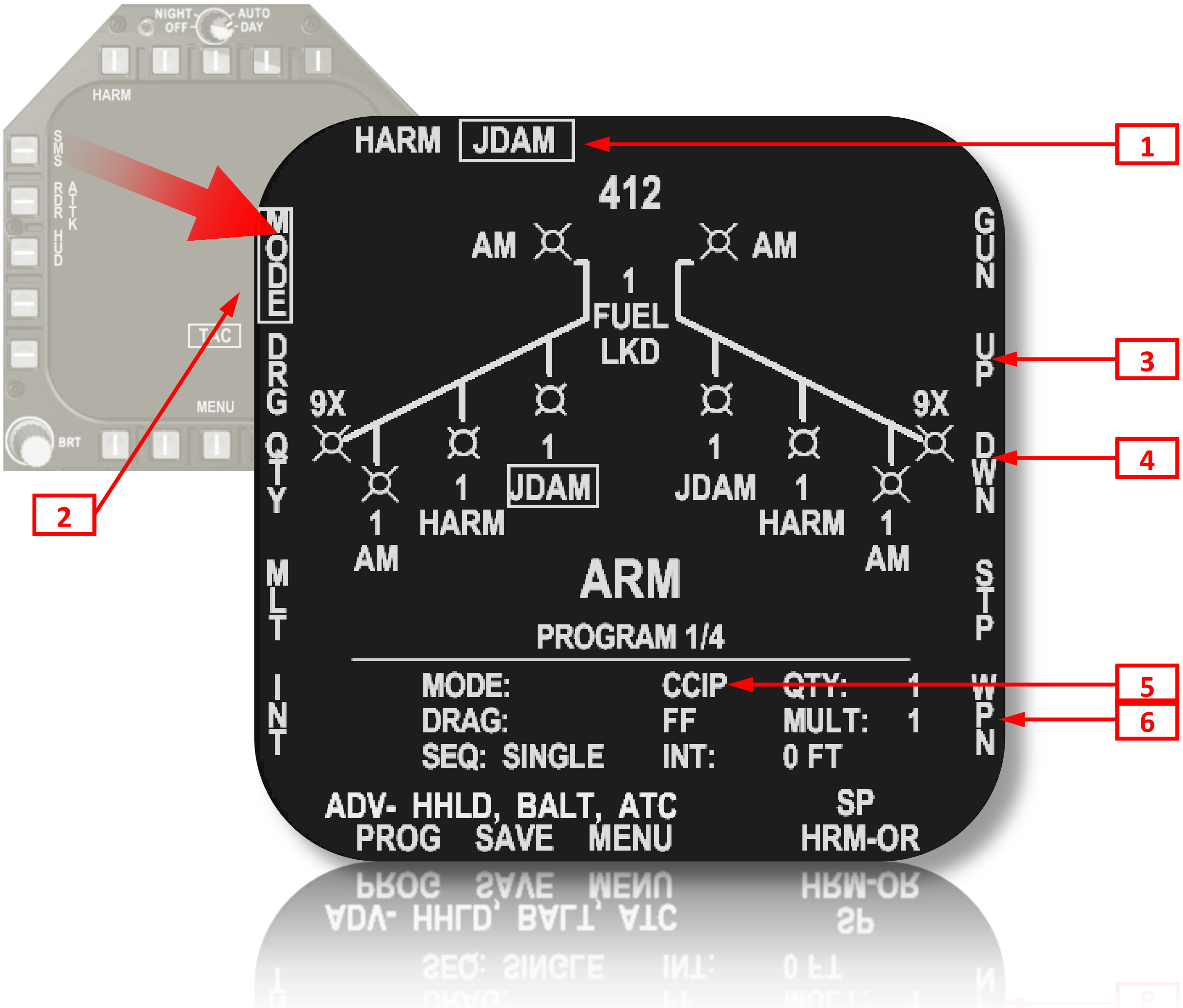
☑ AUTOTHROTTLE: **AS REQUIRED**. If you wish, engage the auto throttle using your usual FS default key combination. (FS key **[CONTROL-R]** by default).

The autopilot should now be flying us towards the new target waypoint. Our distance to the waypoint will be indicated in the upper-right corner of the HSI and in the right data block of the HUD as *xx:TGT* where *xx* represents the distance in nautical miles.



2.13.4 Auto Bombing Mode

Our track to the target will take us over the Columbia River, which is an excellent medium-altitude



ingress for a *Level Laydown* delivery. A level delivery allows us to approach the target at low altitude and high speed, and is ideal for releasing the bombs into a structure which has a significant vertical profile.

In order to deliver the bombs from a level attitude, a choice must be made as to the best *Bombing Mode* for the job. Begin by bringing up the **SMS Format** and selecting the weapon we'll be using.

- ☑ MASTER MODE: **A/G**. If not already in A/G master mode, press the **A/G** button on the arming panel (*See Master Arm Panel*).
- ☑ MASTER ARM: **ARMED**. If not already armed, toggle the **master arm** switch to the armed (up) position.
- ☑ LDDI PAGE: **[TAC]>SMS**. Select the **SMS** page on the LDDI.

☑ WEAPON: **JDAM**. Select a JDAM either directly, by pressing **[PB7]** **[1]** (*above*), or by cycling **[PB15]** **[6]** until JDAM is boxed and the display appears similar to that below.

The "Iron Bomb" SMS format may at first glance appear similar to the HARM PB display we used in the preceding section. The significant differences are the menu options and release option programming areas in the lower third of the display.

The F/A-18E has several modes for the delivery of bombs. The current mode is displayed in area **[5]**. We'll discuss these modes in more detail under *Air-To-Ground Operations*, but briefly these are:

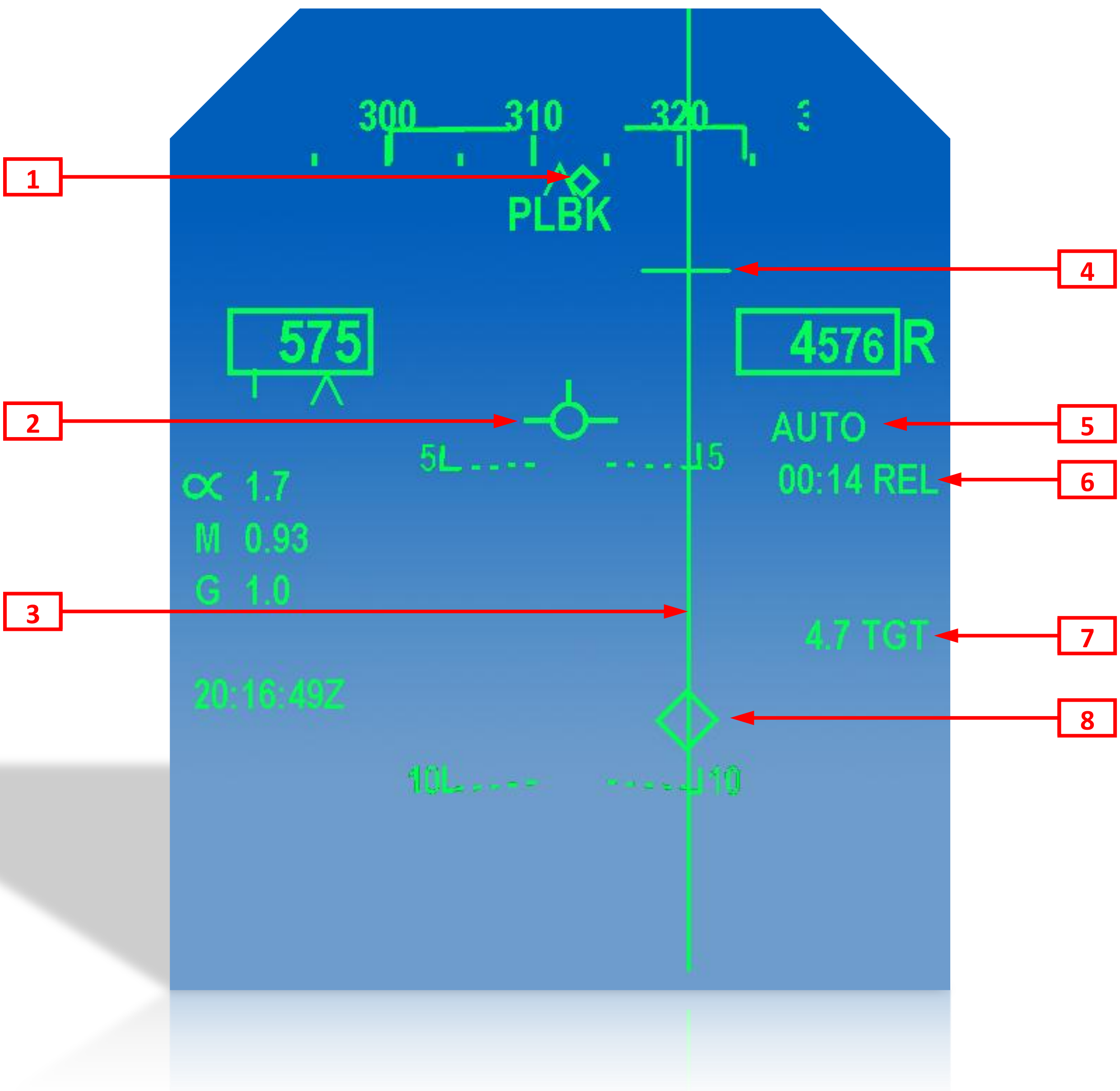
- **Manual**. This is the simplest, least accurate bombing mode. It's essentially a *degraded* option which should be used only in the case of corrupt air data, or some other system damage which prevents the MC from properly calculating the impact point.
- **CCIP**. *Continuously/Constantly Computed Impact Point*. This is a flexible and accurate bombing mode which graphically shows the impact point of the weapon at any given instant. The one drawback to this mode is that you must be able to see the target in the HUD at the time you release the weapon(s).
- **AUTO**. This is the best option for level bombing since the target doesn't actually have to be visible in the HUD when the bombs are released. We're telling the MC where the target is, and the MC is telling us when to drop the bombs in order to hit it. We'll be using this mode to attack our target.

☑ OPTION: **MODE**. Press **[PB5]**, the MODE option **[2]**.

☑ MODE: **AUTO**. Press **[PB12]** **[3]** and/or **[PB13]** **[4]** to cycle through the modes until *AUTO* is displayed in the program options (*CCIP* will be replaced by *AUTO*) **[5]**.

The AUTO mode HUD appears almost identical to the pre-briefed HARM format we used previously. Note that the AUTO mode display would be quite different if there were no designated target.

11) **Command Heading Diamond.** The command heading diamond is visible any time there's an A/G target designated in A/G master mode. Steer towards this cue until it's aligned with the heading caret.



1) **Velocity Vector**. Self-explanatory

2) **Azimuth Steering Line (ASL).** Represents horizontal (azimuth) position of the target.

3) **Release Cue**. Moves vertically along the azimuth steering line as range to the target decreases. When the release cue is vertically coincident with the velocity vector, the bombs should be released.

4) **Mode Indication.** The selected bombing mode.

5) **Time to Release (Seconds)**. The time in seconds (countdown) before the bombs should be released. When the TTR is zero, it's time to pickle (release) the weapon.

6) **Range to Target (NM)**. Self-explanatory.

7) **Target Designator Diamond**. Represents the physical location of the target in 3D.

As we approach the target we should begin lining up for the attack. Since we're using GPS-guided JDAMs and already have a designated target (DT), minor azimuth corrections are not critical. In reality the JDAM can correct its own flight path quite well after release, but since we're at a fairly low altitude it has limited room to maneuver before it impacts.

- ☑ HEADING: **AS REQUIRED**. Adjust heading until the command heading diamond is aligned with the heading caret **[1]**. The azimuth steering line **[3]** should also be aligned horizontally with the velocity vector **[2]**.
- ☑ ALTITUDE: **5000 FT**. Altitude should be approximately 5000 FT.
- ☑ AIRSPEED: **400 KCAS**. Adjust airspeed to approximately 400 KCAS.
- ☑ AUTOPILOT: **OFF**. Disconnect the autopilot (**[Z]** or **[A]** key) when range to the target **[7]** is approximately 10 NM or less.
- ☑ ATTITUDE: **WINGS LEVEL, PITCH LEVEL**.

As we continue to approach the target, the TD diamond **[8]** and the target itself will eventually disappear below the HUD field of view. The release cue will begin to move lower and lower down the ASL **[4]** until finally it reaches the vertical position of the velocity vector **[2]**. The beauty of AUTO mode is that we're able to remain in level flight, out of harm's way despite not being able to see the target.

- ☑ TIME TO RELEASE: **MONITOR**. Monitor the TTR **[6]** and/or the release cue **[4]** until the time reaches zero or the release cue is coincident with the velocity vector. This will occur simultaneously.
- ☑ TRIGGER 2: **PICKLE!** Release 2 weapons by pressing [**TRIGGER 2]** twice.
- ☑ MASTER ARM: **SAFE**. Return the master switch to the **SAFE** position.

In a few moments you should hear the sound of bomb impacting the target. Congratulations! By the way, Homeland Security would like a word with you when you land.

TIP:

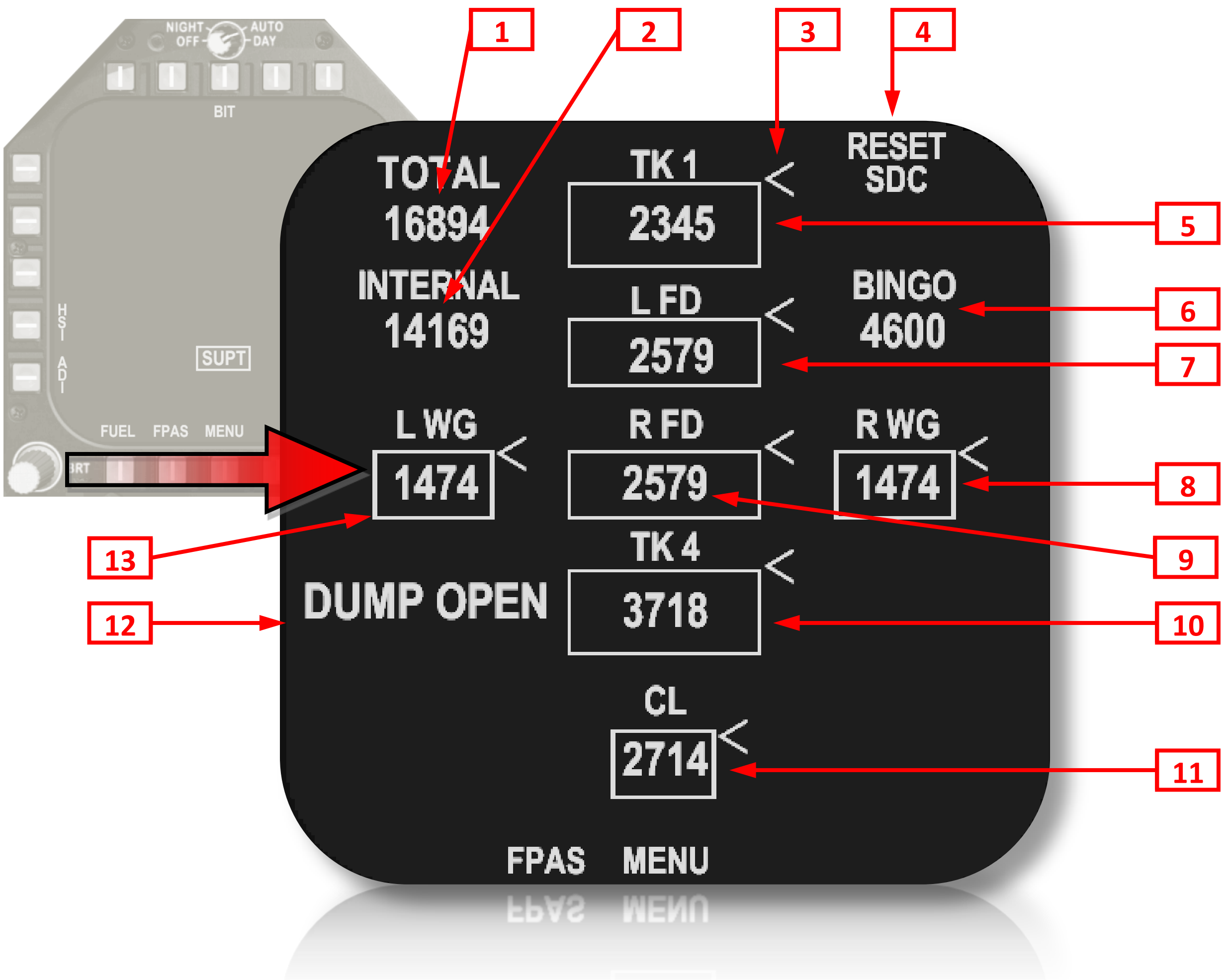
Feel free to use MSFS slew mode at any time during this tutorial. If you are too close to the target and wish to repeat the pass, enter slew mode and move back a few miles.

2.14 INTERMEDIATE NAVIGATION

It's time to go home. We're either at or below *BINGO* fuel by now and most likely receiving *HOME FUEL* cautions as well. It would be handy to know how much fuel we'll have remaining by the time we get home (or IF we can get home at all!).

2.14.1 FUEL Format

Fuel can be monitored either from a DDI, or from the *Engine/Fuel Display (EFD)*. We'll start by taking a



look at the FUEL format on the LDDI.

☑ LDDI PAGE: **[SUPT]>FUEL**. Select the FUEL format on the LDDI.

The FUEL format is designed to (approximately) mimic the relative internal tank positions in the airframe and wings. There are a total of 6 internal tanks, and up to 5 external “drop” tanks. Of the 6 internal tanks, 2 are *Feed Tanks*, meaning they feed the engines directly. The remaining 4 internal tanks are *Transfer Tanks*, meaning they transfer fuel between each other and the feed tanks.

The following list briefly describes the FUEL format components:

1) **Total Fuel (LBS)**. The total fuel among both internal and external tanks.
2) **Internal Fuel**. The total internal fuel quantity.
3) **Level Indicating Caret**. Located to the right of each tank is a caret which moves vertically to indicate relative fuel level. When the caret is coincident with the top of the tank's outline box, fuel level is full. When the caret is coincident with the bottom of the tank, fuel is empty.
4) **SDC Reset Option**. Fuel level indicating and logic takes place in the *Stores Data Computer (SDC)*. Pressing this option resets the SDC in case of invalid data, a corrupted sensor, or other anomaly. A transient fuel caution is not uncommon when resetting the SDC.
5) **Tank 1**. The *Forward Transfer Tank*. Fuel from this tank is fed to the feed tanks, which in turn feed each engine.
6) **BINGO Level**. *BINGO* fuel is and arbitrary level, set by the pilot. When fuel goes below this level, the BINGO CAUTION is annunciated. It's analogous to an alarm clock for fuel. In the example, we do not have a BINGO level set. Bingo fuel level can only be set from the EFD.
7) **Tank 2 (Left Feed Tank).** The *Left Feed Tank* feeds fuel directly to the left engine.
8) **Right Wing Tank (R WG)**. The wing tanks transfer fuel to tanks 1 and 4, which in turn transfer fuel to the feed tanks. Unlike the other internal tanks, the wing tanks can be isolated from the system in case of a leak via the WING INHIBIT switch on the left console.
9) **Tank 3 (Right Feed Tank).** The *Right Feed Tank* feeds fuel directly to the right engine.
10) **Tank 4**. The *Aft Transfer Tank*. Fuel from this tank is fed to the feed tanks, which in turn feed each engine.
11) **External Tanks (LM, LI, CL, RI, RM)**. The bottom row of the FUEL format shows the external tank quantities (if loaded). External tanks feed all other tanks prior to depletion.
12) **Message Area**. Any fuel-related messages (other than cautions) are displayed in this area. These include:
    - **DUMP OPEN.** A fuel dump is in progress.
    - **INVALID**. Fuel quantities are no longer valid due to a problem with fuel level sensing. In this case, total fuel is estimated and all other values are frozen.
13) **Left Wing Tank (L WG)**. The wing tanks transfer fuel to tanks 1 and 4, which in turn transfer fuel to the feed tanks. Unlike the other internal tanks, the wing tanks can be isolated from the system in case of a leak via the WING INHIBIT switch on the left console.

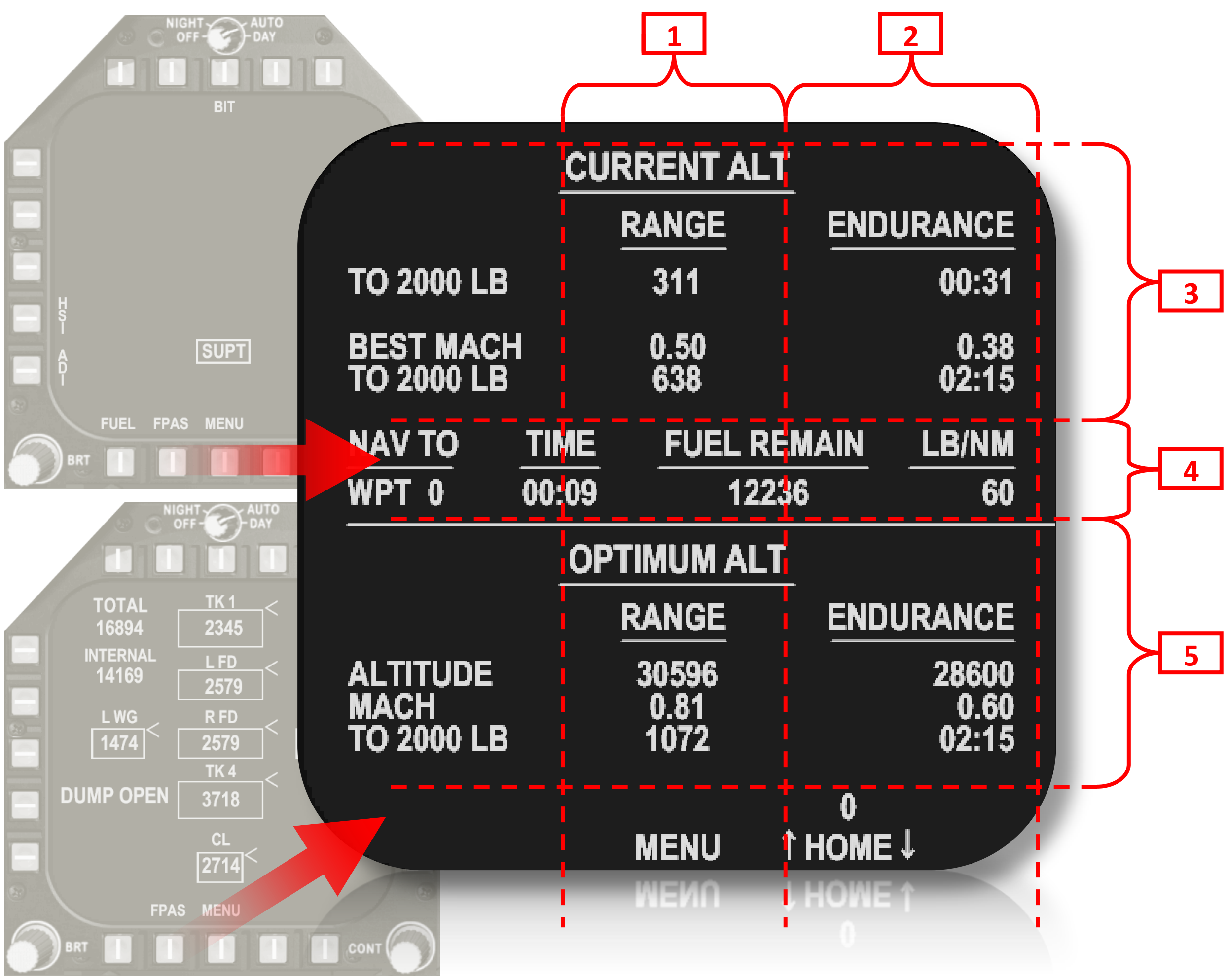
OK, so what's our total fuel and how much do we need to get home? Take a look at *TOTAL* (1), above. Is it less than 5000 LBS?

- ☑ FUEL QUANTITY: **ADD**. If less than 5000 LBS, press **[SHIFT-F]** once to add some fuel. Yes, you're cheating. No, we don't have time to explain how to get fuel from a tanker. Suffice it to say that soon, you *will* be able to!

2.14.2 Flight Performance Advisory (FPAS) Format

We're safe (for now). We've got some gas, we've blown up some targets, the weather's been nice, and we're going to sit down and have a cup of tea with Homeland Security when we get back. But how do we know we've got enough fuel to get home? Easy. Enter the *Flight Performance Advisory System (FPAS)*.

- ☑ LDDI PAGE: **[SUPT]>FPAS**. The FPAS format can be accessed either directly from the FUEL format (which may still be displayed), or from the **SUPT** level of the LDDI as shown.



The FPAS, often misused and abused in "those other" F/A-18 simulations, is actually useful in the real aircraft (and the VRS version). Its primary purpose is to help you make the most of your fuel by telling you how much you're going to have left at any given point, or how much you're using (or would use) at optimum altitude and speed. It also tells you what your endurance is (or would be) under optimal conditions.

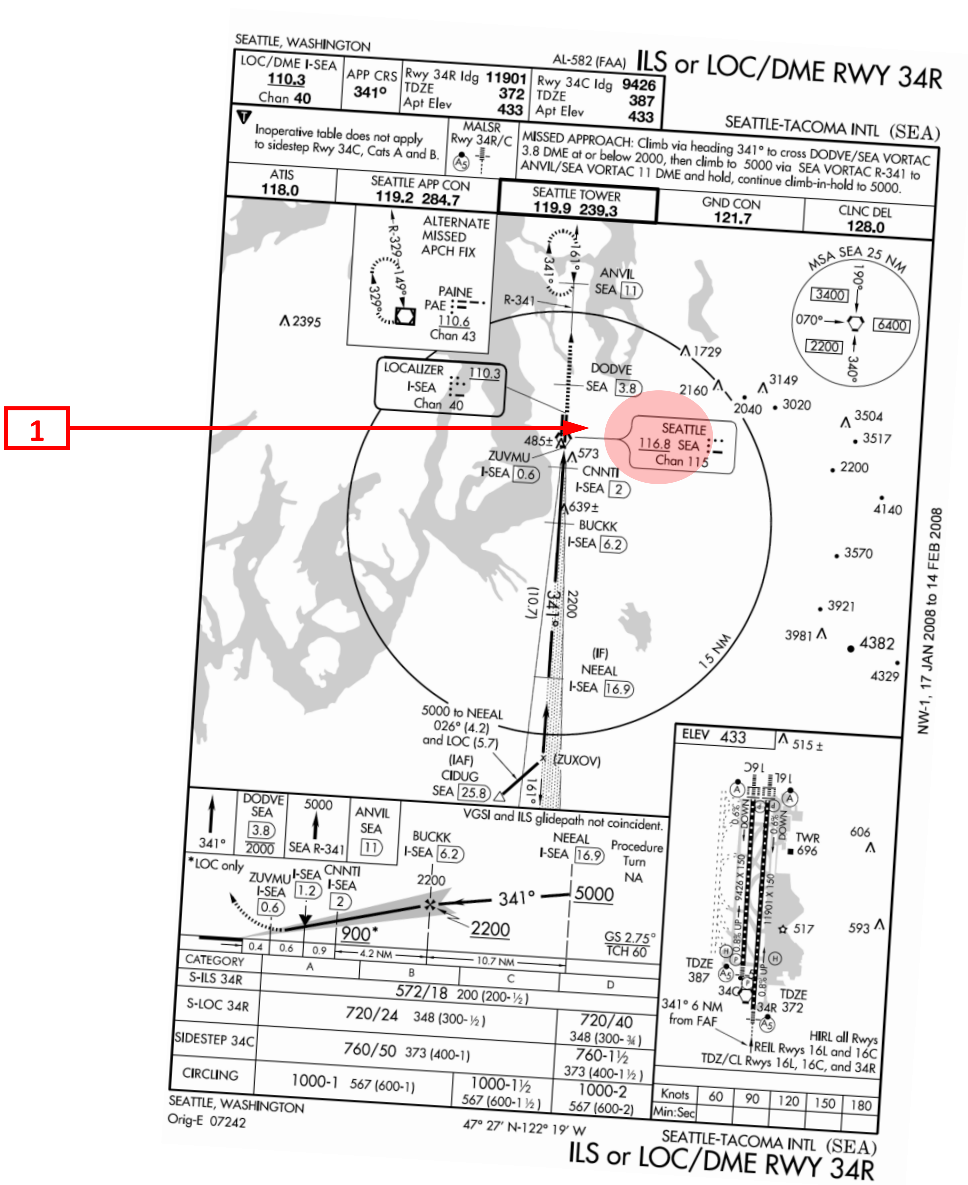
1) **Range Column**. Data within this column relates only to range.
2) **Endurance Column**. Data within this column relates only to endurance.
3) **Current Flight Conditions**. This area of the display provides current range and endurance, and the optimal mach number for best range and endurance at the current altitude:
    - **TO 2000 LB.** The current range (nm) and endurance (hh:mm) to 2000 LBS fuel at the current throttle settings and altitude. If fuel level is below 2000 LBS, the range and endurance to 0 LBS fuel is shown.
    - **BEST MACH.** The best MN to fly at the current altitude for both range and endurance.
    - **TO 2000 LB.** The resulting range and endurance if the recommended MN is flown. If fuel level is below 2000 LBS, the range and endurance to 0 LBS fuel is shown.
4) **NAV Steerpoint Status**. This area, blank if no steering mode and/or NAV point is selected in the HSI, shows:
    - **NAV TO.** The currently selected waypoint (WPT steering), or TACAN (TCN steering).
    - **TIME.** Estimated time in hours/minutes to arrive over the NAV point.
    - **FUEL REMAIN.** Estimated fuel remaining at the time of arrival.
    - **LB/NM.** Current fuel burn in LBS per nautical mile.
5) **Optimum Altitude Conditions**. Data within this area of the display predicts flight conditions at the optimum cruise altitude:
    - **ALTITUDE**. The optimal altitude to fly for range and endurance.
    - **MACH.** The optimal MN to fly in order to achieve either best range or best endurance at the suggested altitude.
    - **TO 2000 LB.** The resulting range and endurance if the recommended MN is flown at the recommended altitude. If fuel level is below 2000 LBS, the range and endurance to 0 LBS fuel is shown.

The algorithms used in the FPAS calculations are not perfect; they are designed to be used in straight and level, un-accelerated (cruise) flight conditions. Despite that, they are not trivial in their implementation, and should give you a very good idea where you stand with your fuel state and available range.

2.14.3 TACAN Navigation

At this point we could just switch back to waypoint 0 (KSEA) and proceed back under WPT steering, but there's another way we can navigate home using *Tactical Air Navigation (TACAN)*. Unlike civilian aviation, most military aircraft rely on TACAN. TACAN uses *channels* instead of specific frequencies, but their function is almost identical to VOR/DME. Flight Simulator itself has no convention for tuning to TACAN channels per se, but the navigation aids still exist in the database, and we've expanded on the use of TACAN to include all VORs as well.

We also provide A/A (airborne) TACAN simulation for use in aerial refueling, however that's beyond the scope of this tutorial.



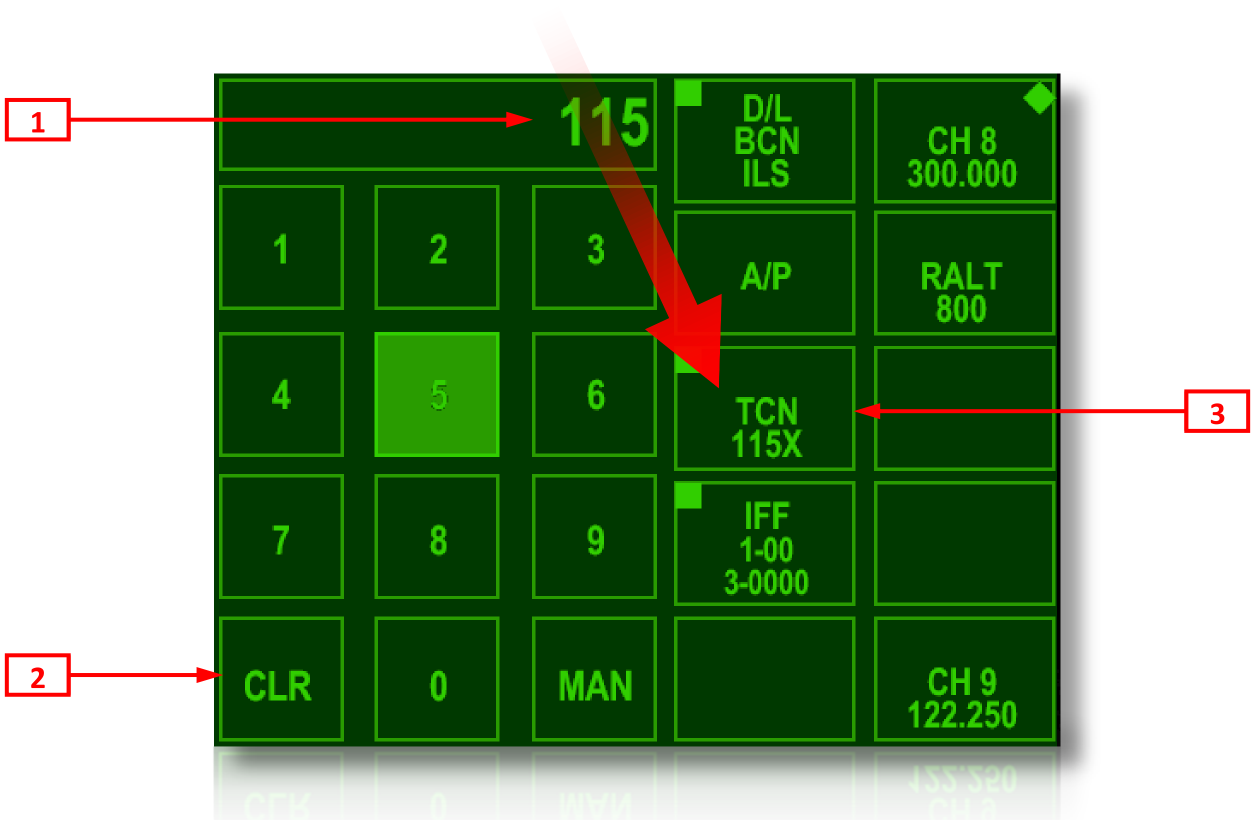
In order to use TACAN we must first find the channel which corresponds to a Flight Simulator VOR frequency. Without going into too much boring detail, TACAN channel consists of a 3-digit integer, followed by the letter *X* or *Y*. X channels cover all frequencies with 0 or 1 decimal places (0 to 9 kHz). Y channels cover any frequencies which end in 2 decimal places (0.5 kHz). For example frequency 116.80 translates to channel 115X and 116.85 becomes CH 115Y. 116.90 is CH 116X, and so on...

Taking a look at the approach for runway 34R at KSEA *(above)*, we can see that our VOR **[1]** is **116.8**. In this case since this facility has a VORTAC (combined VOR/TACAN), we can read the TACAN channel directly off the plate! The channel we want is **115**.

There will often be cases where there is no formal VORTAC, but rather a standard VOR. In these cases we can simply look up the corresponding channel on a paired frequency list. You'll find a complete list in the MSFS inflight kneeboard (help meni) under keyboard commands, as well as the appendix to this manual. The ACM also has a list of paired frequencies in the reference section.

2.14.4 NAV Radio Interaction

- ☑ UFCD: **CNI (TOP LEVEL)**. If you're not already there, return to the CNI top level by pressing the **CNI** data button. If the CNI button is not visible, you are already on the CNI top level and it looks



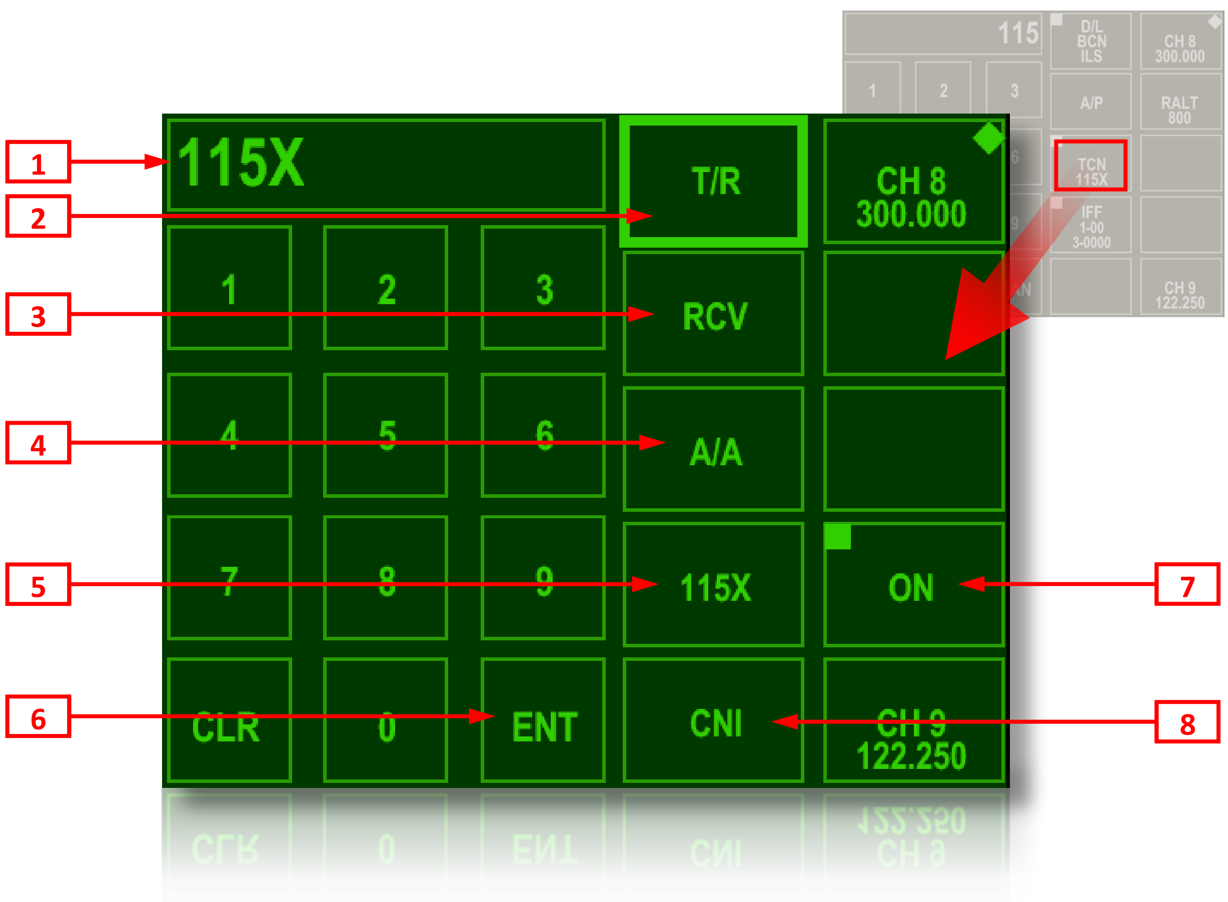
like the image below.

- ☑ TACAN: **115X**. Enter **1-1-5** into the UFCD scratchpad **[1]** by pressing the keypad digits with the mouse. If you make a mistake, just press the **CLR** key **[2]** and start over.
- ☑ UFCD: **ASSIGN TACAN CHANNEL**. With **115** "loaded" into the scratchpad, "touch" the **TCN** option button **[3]**. The channel should now be entered into the NAV radio and *115X* should be displaying just underneath the *TCN* label.

We've just preformed what's known as a *Quick Entry* into the UFCD. A quick entry is a "shortcut" for assigning values to the various options directly from the CNI top level without the need to actually enter the specific sublevel for that option.

As handy as quick entry is, it's not always enough to get the job done. For example if TACAN is OFF, or we need to adjust the channel to a Y-band, we need to go to the *TCN Sublevel* to make the adjustments.

- ☑ UFCD: **TCN SUBLEVEL**. From the CNI top level, <u>with nothing</u>



<u>in the scratchpad</u>, press the **TCN** option button **[3]** *(above)*.

1) **Scratchpad**. We previously entered channel *115* into the NAV radio via quick entry from the CNI top level. We can see here in the scratchpad of the TCN sublevel, that channel is *115X* is selected. If we

NOTE:

If you inadvertently enter EMCON at any time during this tutorial (the word EMCON appears in the HUD), please leave EMCON and ensure the TACAN has not been placed into **RCV** (receive-only) mode. If it has, select T/R mode before continuing.

need to change channels from the TCN sublevel, we would type the new channel into the scratchpad and press **ENT**.

2) **Transmit / Receive (T/R) Mode**. In *T/R mode*, both bearing and slant range are computed to the selected station. However in hostile environments, when emission control is required, the TACAN can be placed into a passive, *Receive-Only Mode*. The NAV radio is automatically placed into RCV mode whenever *Emissions Control (EMCON)* mode is activated.

3) **Receive (RCV) Mode**. In RCV mode, only bearing is computed to the selected station. All range calculations to the station become invalid.

4) **Air to Air Mode (A/A)**. Used to receive airborne signals (i.e. aerial refueling tankers).

5) **TACAN Channel**. The current TACAN channel. Pressing this option will swap to the alternate channel (X or Y).

6) **ENT Option**. The ENT key is not used from the CNI top level because quick-entry, described previously, supersedes that function. ENT is more appropriate on sublevels like this one where there's usually only one option the data in the scratchpad can be applied to.

7) **ON/OFF Option**. Applies or removes power to/from the NAV radio. When the system is ON, it will be indicated by a corner-highlight in the upper left corner of the option (shown).

8) **CNI Option**. Returns to the CNI top level.

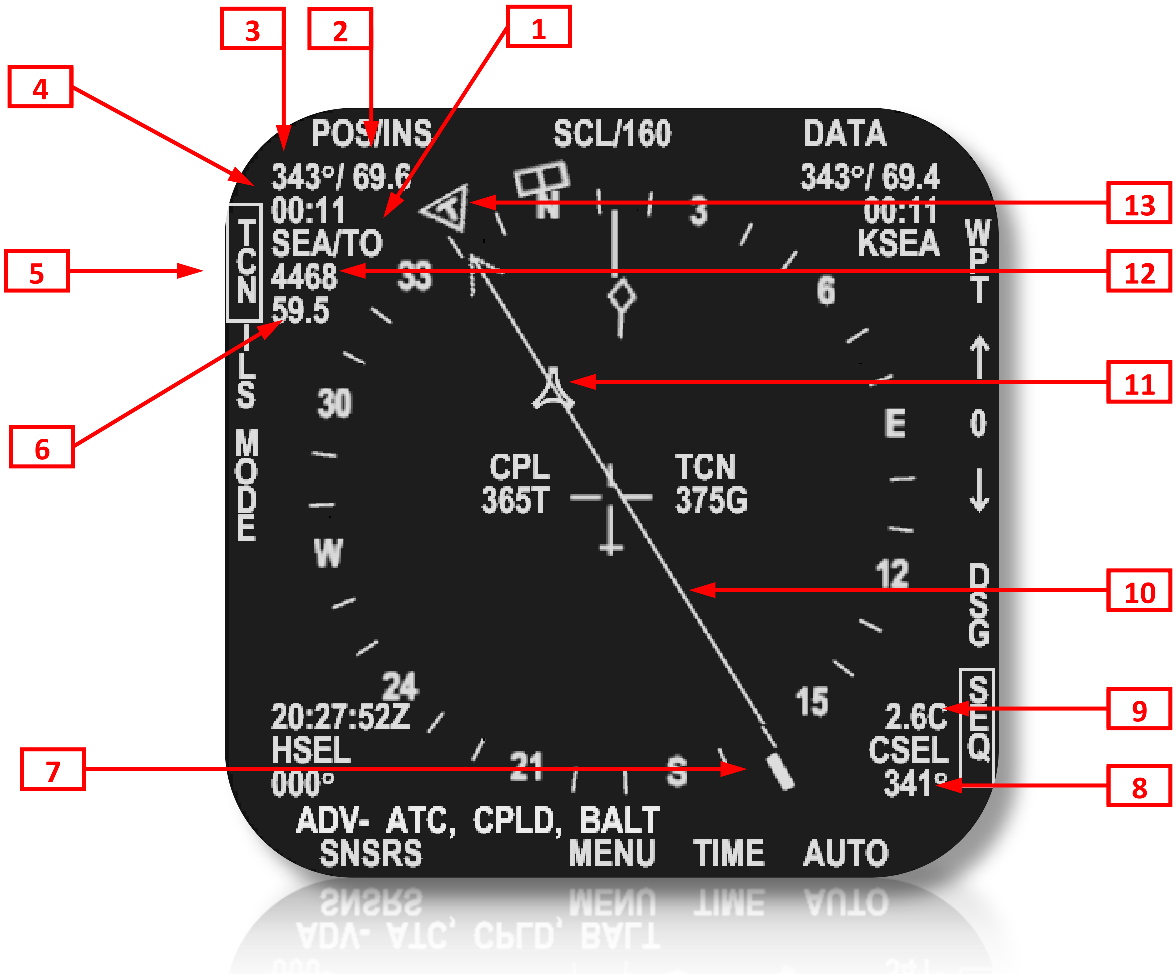
☑ TACAN: **ON**. Press the **ON**/**OFF** option **[7]** and verify TACAN is powered by observing if the option is corner-highlighted.

☑ UFCD PAGE: **CNI TOP LEVEL**. Return to the CNI top level by pressing the **CNI** option **[8]**.

TIP:

In Key Command Mode, the keyboard can be used to enter digits into the scratchpad, as long as TDC priority is assigned to the UFCD (right-upper corner filled diamond).

2.14.5 HSI TCN Steering Symbology



Our TACAN channel is entered and powered, so let's get home already...

- ☑ MASTER MODE: **NAV**. If not already in NAV master mode (no illuminated buttons on the master arm panel), please enter it now by extinguishing any lit master mode button (*see Master Arm Panel, page 67*).
- ☑ MASTER ARM: **OFF**. If the master arm switch is ARMED, switch to **SAFE**
- ☑ LDDI PAGE: **[SUPT]>HSI**. Bring up the HSI on the LDDI. If it's not already up (see image below), press **MENU** (**PB17**) until the **[SUPT]** level is displaying, then press **HSI [PB2]**.
- ☑ STEERING MODE: **TCN**. Enter *TCN Steering Mode* by pressing **PB5** **[1]**.

If receiving a valid TACAN signal, the TCN data area **[1-6]**, above will populate with data. If not, ensure that the TCN option **[5]** is boxed, and that you've performed the previous steps on this page, beginning with TACAN: **ON**, correctly. TACAN is also line of sight, so be sure you're at a sufficient altitude (5000 ft should be sufficient to clear any mountains in the area) to receive a signal.

Unlike WPT steering, TCN steering allows for *Course Selection (CSEL)*. This is similar in function to the NAV course deviation indicator (CDI) on civilian HSI equipment, however instead of a CDI, a *Courseline Arrow* **[10]** is used.

1) **Station Identifier/TO-FROM Flag**. The alphanumeric station ID followed by a TO-FROM flag which indicates the orientation of the station as it relates to the currently flown course.
2) **Range**. The slant range to the selected station in nautical miles.
3) **Bearing**. The station bearing in degrees magnetic or true (depending on the current setting).
4) **ETE**. Estimated time en route to the selected station.
5) **TCN Steering Mode Enable/Disable**. When this option is boxed (PB5), TCN steering mode is enabled.
6) **Distance to Descent**. The estimated distance in nautical miles based on current altitude when descent should begin in order to capture a 3 degree glideslope.
7) **Bearing Tail**. The reciprocal of the currently selected TACAN station's bearing.
8) **CSEL**. The currently selected TCN steering course (CSEL) in degrees magnetic or true. This value can be adjusted by scrolling the mouse wheel with TDC priority to the DDI.
9) **Perpendicular Course Error**. Often referred to as a *cross track error*, this is the perpendicular (90 degree) distance in nautical miles the aircraft is off of the CSEL. Negative values are right of course, positive values are left.
10) **Courseline Arrow**. The arrow shows the aircraft's position relative to the CSEL. The arrow rotates such that it is always coincident with the boundaries of the compass rose, while simultaneously intersecting the TACAN symbol.
11) **TACAN Station**. The location of the tuned station relative to ownship (center), and based on the current scale.
12) **Estimated Fuel Remaining**. The Estimated fuel remaining in lbs at arrival based on current consumption and ETE.
13) **TACAN Bearing Pointer**. The bearing to the tuned station.

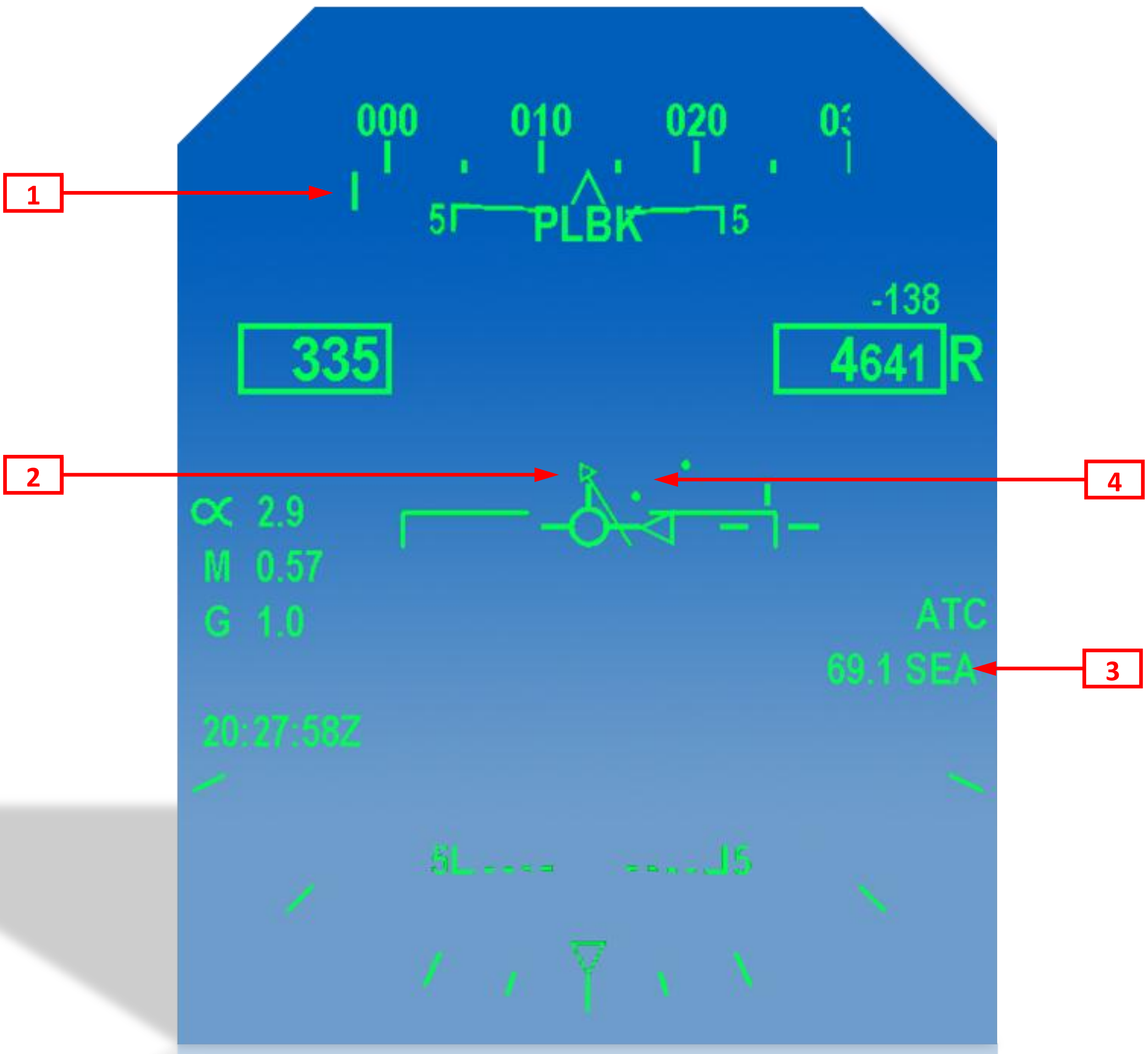
- ☑ TDC PRIORITY: **LDDI**. Assign TDC priority to the LDDI by left-clicking in the display or by pressing the **TAB** key and observing that the TDC priority indicator diamond is visible in the upper-left corner of the display.
- ☑ CSEL: **341**. Rotate the course select (CSEL) **[8]** by placing the mouse over the display and rotating the wheel until CSEL reads *341°*. This corresponds to the actual runway heading for KSEA 34R.

☑ HSI SCALE: **ADJUST**. Press **[PB8]** until the scale is just sufficient to display the TACAN symbol.

2.14.6 HUD Steering Arrow & DOTS

The HUD retains much of the same symbology in TCN steering mode as in *WPT* steering mode. The one significant difference is the addition of the *Steering Arrow and Dots* **[2 & 4]** *(below)*.

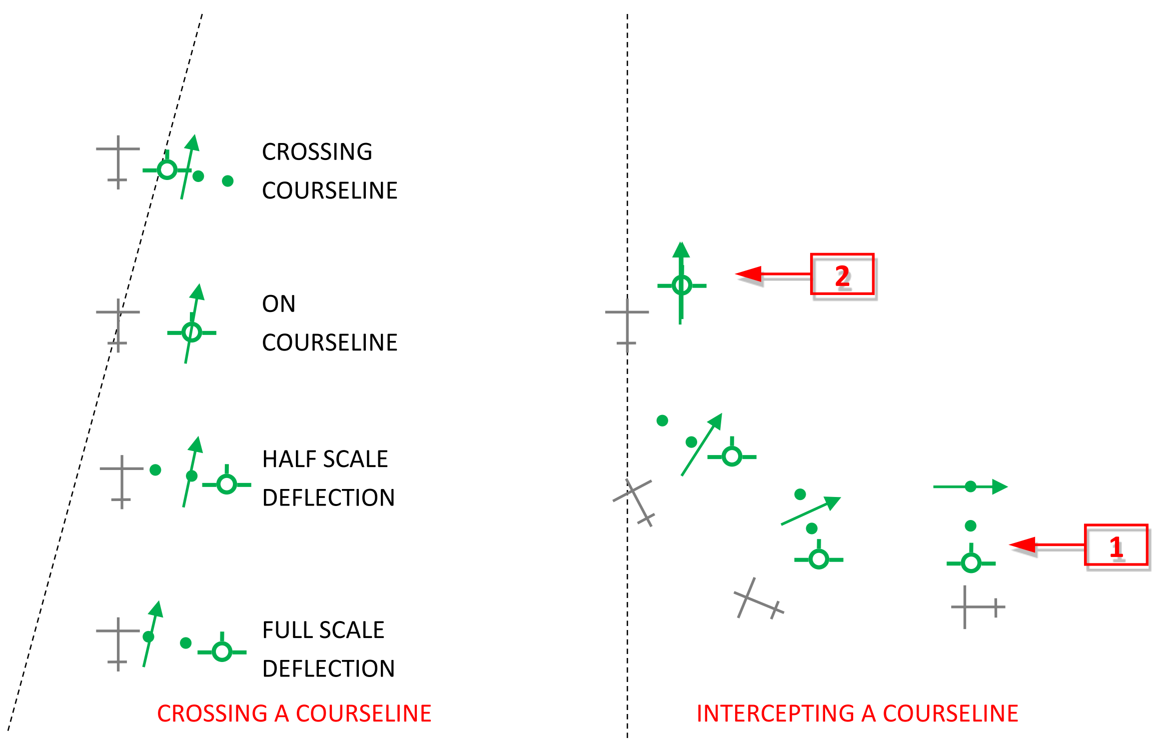
The steering arrow represents the horizontal situation with respect to the selected course. It's a head-up aid for intercepting and maintaining a course. The steering arrow is tied to the velocity vector and rotates around it based on the CSEL value. As shown below, the aircraft is to the right of the selected course and intercepting it at approximately 45°. The arrow moves inward towards the velocity vector as the distance off course (cross track error) decreases, and farther from the velocity vector as distance



increases.

The 2 *Steering Dots*, which rotate with the arrow, represent the degree of courseline deviation, or distance off course. Each dot represents 4° of perpendicular distance with the outermost dot representing 8° (full scale deflection). The steering dots are not displayed when the aircraft is on or nearly on course.

1) **Command Heading Cue**. Bearing of the selected steering point, corrected for wind drift.
2) **Steering Arrow.** Oriented top-down, the arrow shows the aircraft's position relative to the selected course (CSEL). The velocity vector represents your aircraft. If the arrow is directly over the velocity vector, the aircraft is over the courseline.
3) **DME/IDENT**. The range and station identifier of the currently selected steering point.
4) **Steering Dots**. The dots represent the cross track error, or distance in degrees the aircraft position differs from the intersection of the aircraft heading and the course. The innermost dot represents 4° (half scale) deflection and the outermost dot is 8° (full scale) deflection. When the aircraft is within 1.2° of course, the dots disappear from the display.



Think of the steering arrow as a top-down representation of the course, and the velocity vector as your aircraft. As the aircraft approaches the course, the steering arrow begins to shift closer towards the center of the velocity vector as the course error decreases. When the aircraft is within 1.2° of course, the dots disappear from the display. As the aircraft crosses the course, the dots reappear on the opposite side of the velocity vector (the side the course is on).

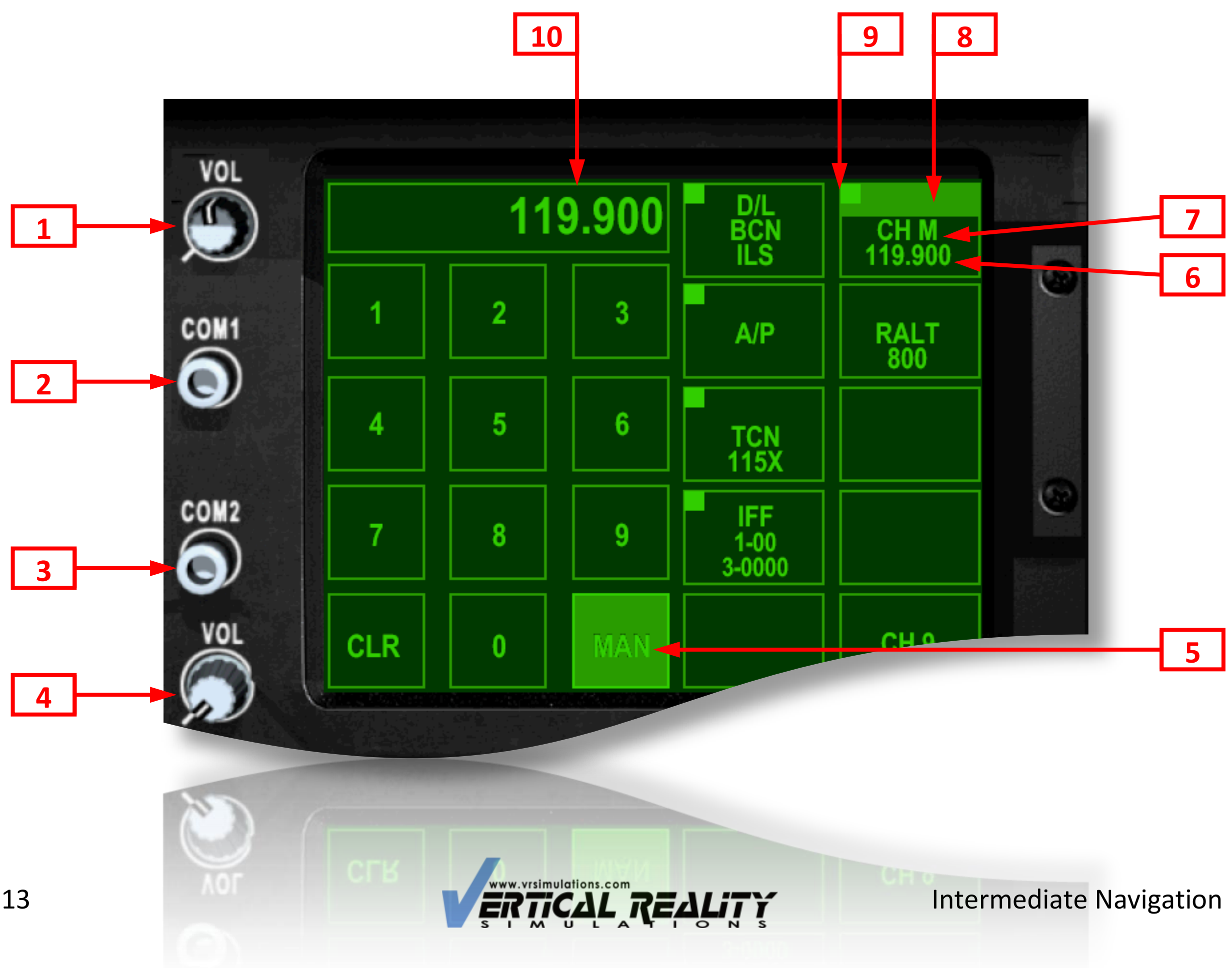
- ☑ HEADING: **ADJUST**. Steer left or right until steering arrow is roughly perpendicular to your heading **[1]**. The arrow may be pointing left or right depending on whether you're east or west of our northerly (341°) course.

As you get closer to the course (this may take a few minutes depending on distance), the arrow will begin to deflect inward, toward the center of the velocity vector. When this happens, begin a standard rate turn in the direction of the arrow. Continue the turn until the steering dots are blanked, and the orientation of the arrow is similar to **[2]**.

- ☑ AUTOPILOT: **AS REQUIRED**. If you wish, engage **BALT** and **CPL TCN** A/P modes.

2.14.7 Communications Radios

The F/A-18 is equipped with dual ARC-210 communications radios. The VHF/UHF radios, *COM 1* and *COM 2*, provide air-to-air/air-to-ground voice communication, and, in conjunction with Automatic *Direction Finding (ADF)* equipment, provide a DF function. In the VRS Super Hornet, COM1 and COMM2 operate between the 108.000 and 135.995 MHz frequency bands for voice communications, and



190.000 and 999.000 kHz for ADF/NDB.

In the real F/A-18, the radios can be operated in *Plain Mode*, *Anti-jam (Have Quick 1 or 2) Mode*, *Secure Mode (KY-58)*, or *Relay Mode* in either normal or secure voice. The VRS Super Hornet supports only plain mode at this time, however menu options are in place for secure voice operations, should they become a feature in the future.

COM1 and COM2 are interfaced though the UFCD though both hardware controls and touch screen interaction. Each radio has an independent *VOL/power* and *Preset Channel* control knob. Preset channels operate in much the same way as typical vehicular radios, in that frequencies can be stored and recalled simply by rotating the respective preset channel selection knob.

1) **COM1 Power/Volume.** Each VOL control knob controls power (on/off) and audio level to the associated COM 1 and 2 radios. Tick marks on the VOL control knobs and the face of the UFCD are used to indicate OFF. Rotating the VOL knobs clockwise (mouse wheel UP) powers the associated radio. The volume control for the radios has no effect in the VRS Super Hornet.
2) **COM1 Channel Select Knob.** Clockwise rotation of either COMM channel select knob changes the associated COM 1 or COM 2 preset channel selections in the following order:
    - **Preset Channels CH 1-10**. These are standard preset channels and can be programmed with any voice or ADF frequency.
    - **CH G (Guard)**. Functionally identical to channels 1-10, but labeled and intended to hold the *Guard* frequency.
    - **CH M (Manual)**. This channel is unique in that it holds the UFCD *Quick Entry* frequency. If a channel is entered into the scratchpad from the CNI top level and the MAN keypad option is pressed, the frequency in the scratchpad will be entered into this channel and the radio will be switched to channel M.
    - **CH C (Cue)**. Functionally identical to channels 1-10, but labeled and intended to hold the *Single Channel Ground and Airborne Radio System (SINCGARS)* frequency.
    - **CH S (Ship)**. Functionally identical to channels 1-10, but labeled and intended to hold the *Ship Maritime* frequency.
3) **COM2 Channel Select Knob**. Identical to **[2]**, above, but controls COM2.
4) **COM2 Volume/Power Knob**. Identical to **[1]**, above, but controls COM2.
5) **MAN Option.** Pressing this button from the CNI top level (shown) enters the contents of the scratchpad into the selected COM radio's *Manual Channel*, and moves to that channel immediately. This would be exactly the same as touching either COM option button with the scratchpad loaded (quick-entry method).
6) **COM1 Current Frequency**. Indicates the frequency the radio is operating on.

7) **COM1 Current Channel**. Indicates the channel which the current radio is currently using (M in this case). In other words, the frequency 119.900 is stored in channel M.

8) **Radio Selection Indicator**. This option (a horizontal bar over the top 1/3 of the option button) tells us this radio (COM 1) is selected for transmit/receive.

9) **Corner Highlight**. This square in the upper-left corner of *any* option button, tells us this system is powered.

10) **Scratchpad**. Echoes the text typed via keyboard (avionic pushbuttons keys enabed in ACM) , or touched via UFCD.

Pressing either radio option button from either the UFCD CNI top level, or *any* UFCD sublevel brings up the respective radio's sublevel where additional selections can be made. The active radio is indicated by a highlighted bar along the top 1/3 of the respective radio option button. In addition, power to each radio is indicated by the presence of a corner highlight in the associated option button.

- ☑ UFCD PAGE: **CNI TOP LEVEL**. If not already there, go to the UFCD CNI top level (shown above) by pressing the CNI option button.
- ☑ COM1 POWER: **ON**. Rotate the COM1 **VOL** knob **[1]** clockwise by moving the mouse cursor over the knob and rotating the mouse wheel UP. When power is applied to COM1, a corner highlight will appear in the COM1 option button **[9]**.
- ☑ COM1 FREQUENCY: **119.900**. Perform a COM frequency entry from the CNI top level by entering **1-1-9-9-0-0** (trailing zeros required) into the scratchpad and either touch the COMM 1 option button **[7]** (quick-entry method), or press the **MAN** option button **[5]**. If you make a mistake, press the **CLR** key twice and start over. This is the *KSEA tower frequency*.

If you like, continue the communications dialog with KSEA, requesting a full-stop landing on **34R**. Selecting communications options from the MSFS communications dialog will auto-tune the selected radio's MAN channel as required.

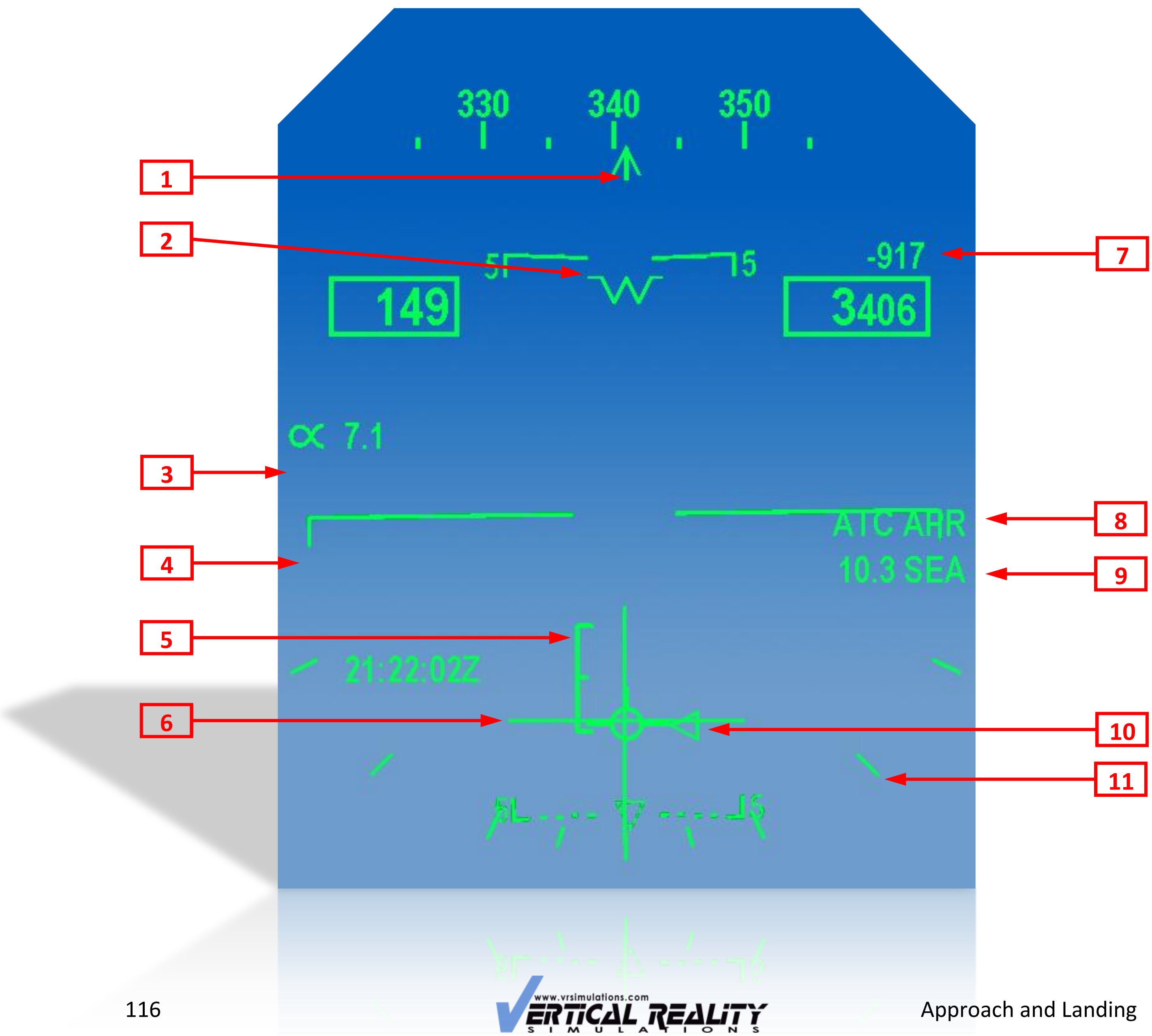
2.15APPROACH AND LANDING (LAND-BASED)

2.15.1 HUD Landing Symbology

You should now be on course for approach to KSEA 34R. Begin descending to 5000 FT and reduce airspeed under 240 KCAS.

☑ SIM: **PAUSE**. If not already paused, now would be a good time to do so.

When the landing gear are lowered, NAV master mode is automatically entered and HUD symbology changes to provide pertinent approach and landing information. Mach, g, and peak g are removed from the left data area [3], and the waterline symbol [2], angle of attack bracket [5], extended horizon bar



[4], vertical velocity [7], and bank angle scale [11] are visible.

1) **Command Heading**. Relative bearing of the selected steering point, corrected for wind drift.
2) **Waterline Symbol**. This symbol represents the *Waterline*, or pitch axis of the aircraft. When the velocity vector is aligned with the waterline, AOA=0. The tops of the airspeed and altitude boxes are purposely aligned with waterline so that in case of a degraded HUD, the waterline position can be estimated.
3) **Angle of Attack (AOA)**. Represented by the greek letter α for *alpha*, angle of attack is the most critical landing criteria. AOA is often confused with the pitch angle. AOA is not measured with respect to the horizon, or ground; whereas the pitch angle is.
4) **Horizon Bar (Extended)**. The horizon bar is extended (wider) when the landing gear are down. It acts as a visual cue that the gear are in fact down.
5) **Angle of Attack Bracket**. The AOA Bracket is an angle of attack indexing cue. When the AOA bracket is centered vertically with the "left wing" of the velocity vector 9, AOA = 8.1°; the "on speed" AOA for landing.
6) **ILS Bars**. When ILS steering is enabled, an *Azimuth Deviation Bar* (localizer) and *Elevation Deviation Bar* (glideslope) appear. When the HUD is caged, they are referenced to the waterline symbol. When the HUD is uncaged, they are referenced to the velocity vector.
7) **Vertical Velocity**. The descent/ascent rate in feet per minute.
8) **ATC CUE**. ATC (autothrottle), or ATC APR (approach autothrottle) appear here when either mode is active.
9) **DME/IDENT**. The range and station identifier of the currently selected steering point.
10) **Energy Caret**. Shows the energy state of the aircraft. If the aircraft is in equilibrium (not accelerating or decelerating), the caret will point directly at the "right wing" of the velocity vector. If the aircraft is decelerating, it will shift down with respect to the velocity vector, accelerating, up.
11) **Bank Angle Scale**. The *Bank Angle Scale* and pointer are visible with the gear down, and graphically indicates the current angle of bank (AoB) up to 45° left/right. If the AoB exceeds 47°, the pointer will flash to indicate it's no longer showing the correct bank angle.

2.15.2 HUD Caging

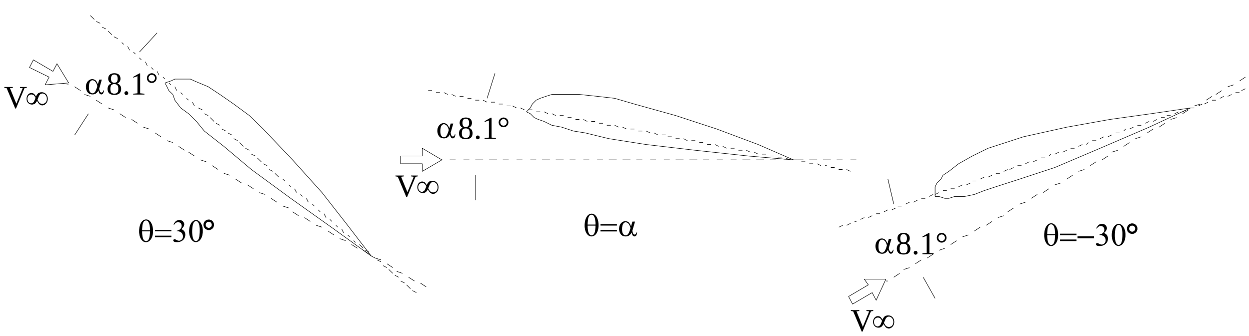
If you wish, you may cage the HUD by pressing **CONTROL-U** from key command mode. The cage command is master mode dependent; in NAV master mode, the cage command cages the HUD rather than the weapons systems. Caging the HUD forces the pitch ladder and ILS bars to be referenced to the waterline rather than the velocity vector. In addition, the velocity vector no longer shows beta (sideslip). Instead, a *Ghost Velocity Vector* appears at the true flight path location if beta exceeds ±2°.

The HUD is often caged for approach, however it is strictly up to the pilot's personal preference as to which mode works best for them. It's often easier to track a localizer/glideslope if the bars are referenced to a static position, as in the caged mode. However in light crosswinds, the loss of the initial ±2° of beta may affect landing accuracy.

2.15.3 Angle of Attack (AOA)

Before explaining how the *Angle of Attack (AOA) Indexer* works, we should briefly discuss the importance of AOA, and how it relates to landing a naval aircraft. Angle of attack, which in aeronautical terms is denoted by the Greek letter ⍰ (“alpha”), is defined as the angle between the chord line of the aircraft's airfoil (wing) and the freestream velocity vector (V∞). AOA is often confused with pitch angle, but the same AOA can occur at *any* pitch angle. The pitch angle θ (“theta”) is defined as the angle between the longitudinal axis of the aircraft and the horizon. AOA is vastly more important than pitch, simply because most of the aircraft's critical numbers, including stall, are based on a given AOA. An aircraft can stall at *any* speed or pitch angle, but only *one* maximum AOA.

AOA is particularly important to naval aviators because only at a given AOA will the aircraft be at the correct approach speed in order to successfully “trap.” Too much AOA (too little speed) risks a stall, too little AOA (too much speed) risks missing the “wire”, or damaging the landing gear. We can't just fly an

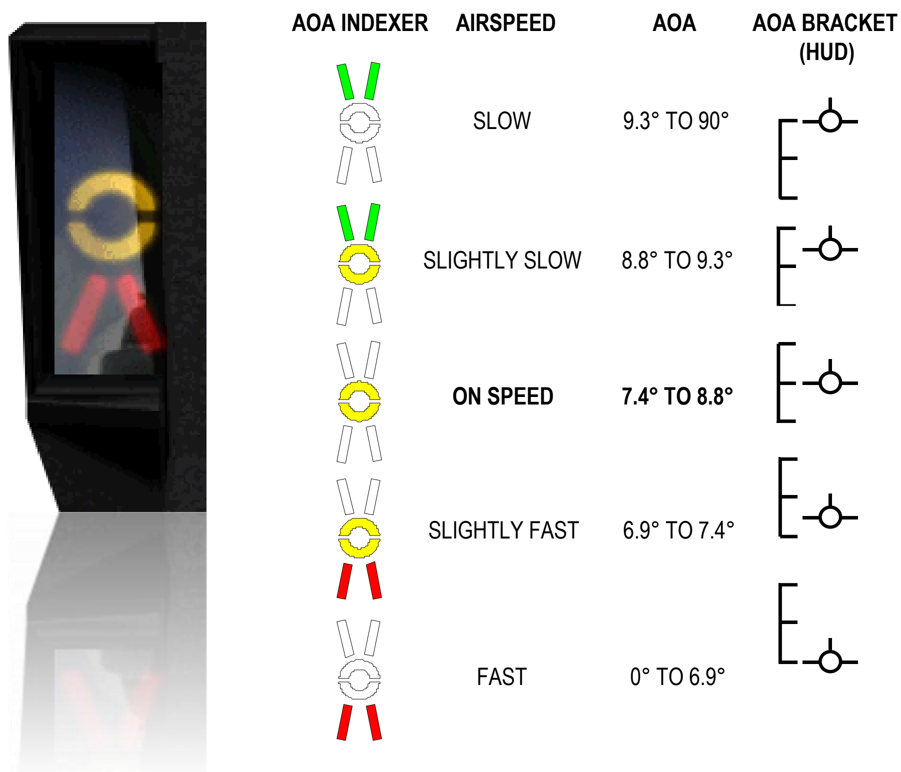


approach at a recommended speed, because aircraft weight is never constant. Well, we *could,* but we'd have our face buried in tables rather than flying, and we'd still need to know exactly how much we weigh at any given time, and that's not always practical. Two of the same aircraft type, flying the same glideslope, one weighing 30,000 LBS and the other weighing 50,000 lbs, require drastically different approach speeds at touchdown. So they don't fly the same *speed*, they fly the same *AOA*. The heavier aircraft will have a higher approach speed, but the AOA used will be exactly the same as the lighter aircraft.

AOA is best controlled through power adjustments. Although pitch will have an immediate effect on AOA, large changes should be avoided. The proper technique is to get established on the glideslope and use power adjustments to maintain the correct AOA. This brings us to the golden number: The F/A-18 (all versions) should fly approach and landing at **8.1°** (±0.7°) AOA.

The most important two indications for reading AOA are the *Angle of Attack Bracket* and *Angle of Attack Indexer*. Which indication you use is entirely up to you, as they both provide essentially the same information. I personally prefer the bracket, as it's better at providing trend information, and doesn't require scanning outside the HUD. Neither of these indicators provides a numeric value, but they're both calibrated for 8.1° AOA. If they're showing "on speed" indications, you can rest assured you're within the AOA window.

The angle of attack indexer is mounted to the left of the HUD. It displays approach angle of attack with lighted symbols. The indexer operates with the landing gear down and weight off wheels. The lighted symbols flash if the arresting hook is up and the *Hook Bypass Switch*, on the left aux panel, is in CARRIER. The symbols will not flash with the arresting hook up and the hook bypass switch in FIELD. The AOA indexer knob on the HUD control panel controls dimming of the symbols. All symbols light when the



lights test switch on the interior lights control panel (left console) is held to TEST.

The angle of attack bracket is part of the gear-down HUD symbology and resembles a vertically elongated "E." When the center horizontal tick is aligned with the "left wing" of the velocity vector, the aircraft is on speed. Please refer to the image to the right to see how the bracket position correlates to AOA.

The next question you might be asking yourself is, if AOA must remain constant, how do you flare for landing? As it happens, naval aircraft are not flared; they're simply "driven in" until the metal meets the concrete. The landing gear of the F/A-18 is designed specifically for the kinds of hard landings required for carrier ops. Descent rates of 750 FPS are commonplace.

2.15.4 CAS Operating Modes

The *Control Augmentation System (CAS)* is part of the F/A-18's *Flight Control System (FCS)*. CAS operates in two basic modes: *Powered Approach (PA)* and *Up-AUTO (UA)*. Mode selection is controlled by FLAP switch position and airspeed. With the FLAP switch in HALF or FULL and with airspeed below 240 KCAS, flight control laws are tailored for the takeoff and landing configuration (PA). With the FLAP switch in AUTO, CAS implements flight control laws tailored for up and away flight (UA). If the FLAP switch is left in HALF or FULL, the aircraft automatically transitions from PA to UA when airspeed increases above approximately 240 KCAS. This is known as “auto flap retract.” In this case, the amber FLAPS light comes on to alert the pilot to check FLAP switch position. The flight control laws utilized in each mode are tailored to provide maximum maneuverability while maintaining predictable handling qualities and departure resistance.

2.15.5 Flap and Gear Position Lights

Three flap position lights, two green and one amber, are located on the lower left main instrument panel and the left annunciator panel. The green *HALF* and *FULL* flap lights are used to indicate FLAP switch position and are not indications of actual trailing edge flaps (TEF) position.

2.15.6 Approach Auto-throttle

As you might imagine, an AOA of exactly 8.1° is not easy to achieve; you have a small margin to work with, but this is the ultimate goal, and what gets you the best marks from your *LSO (Landing Signal Officer)*. Since AOA is so critical in landing, the engineers came up with a way to help you maintain it during approach - *Approach Auto Throttle Control (ATC)*. When airspeed is below 240 KCAS and the flap switch is either HALF or FULL (PA flight), engaging the auto throttle **[CONTROL-R]**activates approach ATC. The throttles will continually adjust power, regardless of pitch angle, in order to maintain ~8.1° AOA.

CAUTION:

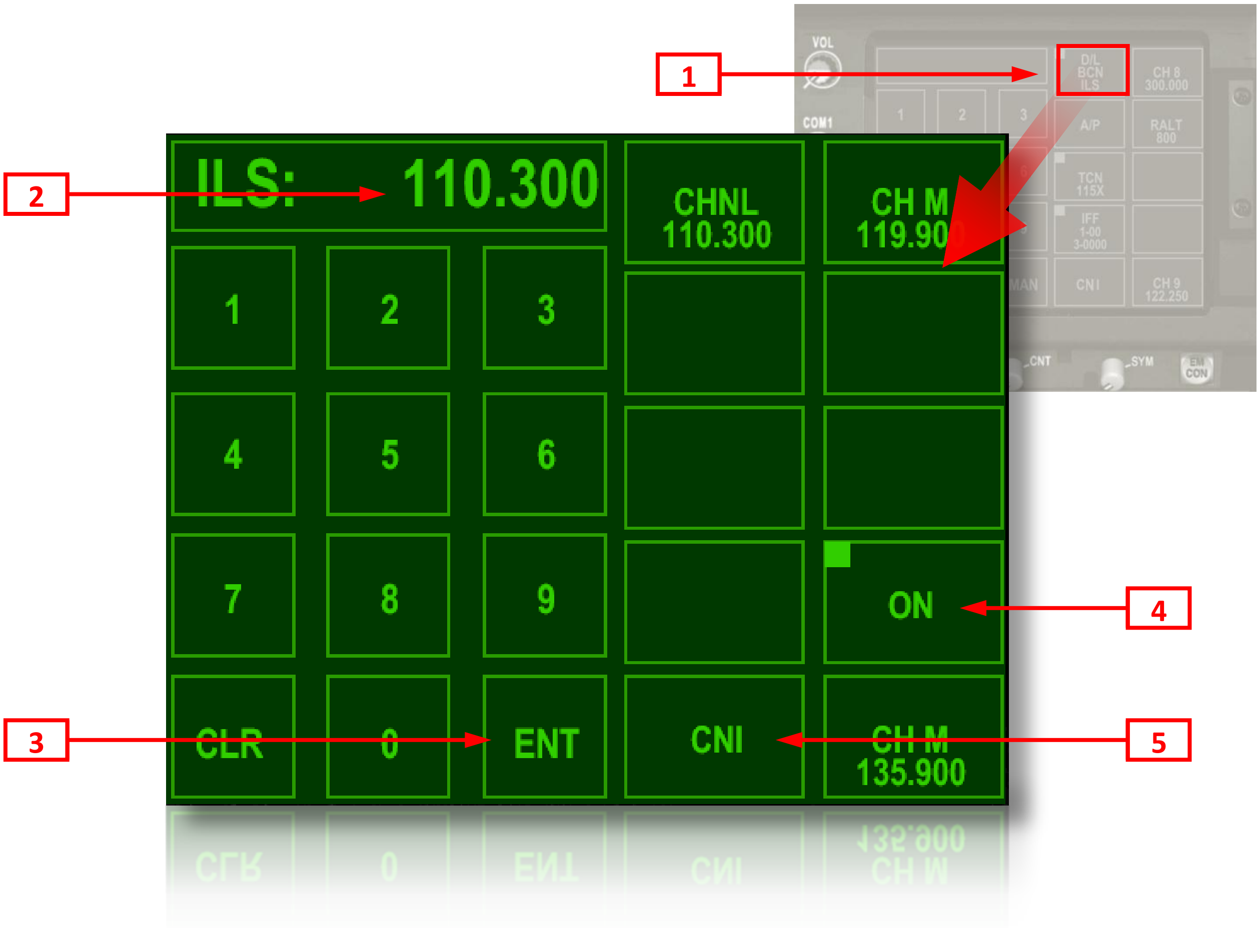
The approach ATC system is not designed to be used in maneuvering flight. The throttles cannot keep up with highly erratic pitch changes. Failure to use the ATC system properly at approach speeds can result in a stall.

Approach ATC will disengage any time the FLAP switch is placed in AUTO or if airspeed climbs above 240 KCAS (UA flight). If the ATC is disconnected (uncommanded) for any reason, the ATC FAIL master caution will be annunciated. If airspeed is above 240 KCAS and/or the FLAP switch is in the AUTO position, ATC will operate normally (cruise auto throttle), holding the calibrated airspeed at the time of engagement.

2.15.7 Instrument Landing System (ILS)

Like TACAN, ILS is activated via the UFCD. With a valid ILS signal, ILS steering azimuth (localizer) and elevation (glideslope) bars can be displayed in the HUD. Referring to the image below:

- ☑ UFCD PAGE: **CNI TOP LEVEL**. If not already on the CNI top level, press the **CNI** option.
- ☑ UFCD PAGE: **ILS**. Press **the D/L BCN ILS** option **[1]**.
- ☑ ILS CHANNEL: **110.300**. Type **1-1-0-3-0-0** into the scratchpad **[2]** (trailing zeros are required). Press **ENT** on the UFCD keypad **[3]** to accept the channel.
- ☑ ILS POWER: **ON**. Ensure the ILS is powered by looking for a corner-highlight on the power option **[4]**. If the system is off (no highlight), press the power option button until the highlight appears.
- ☑ UFCD PAGE: **CNI TOP LEVEL**. Press the **CNI** option **[5]** to return to the top level.



With ILS powered and tuned to the 34R localizer at KSEA, we only need to enable *ILS Steering Mode* and we'll have our localizer and glideslope bars displayed in the HUD. ILS steering is not mutually exclusive of other steering modes such as TCN and WPT. It can be used at any time and with any other mode active. ILS steering is enabled/disabled from the DDI HSI format a follows:

☑ LDDI PAGE: **[SUPT]>HSI**. Bring up the HSI on the LDDI. If it’s not already up (

- ☑ *HSI TCN Steering* Symbology*, 108*), press **MENU [PB17]** until the *SUPT* level is displaying, then press **HSI** (**PB2**).
- ☑ STEERING: **ILS**. Enable ILS steering by pressing **[PB4]** (*ILS*) until the option is boxed**.**

ILS localizer and glideslope bars should now appear in the HUD, standby reference attitude indicator, and DDI EADI format. The bars are referenced to the velocity vector when the HUD is uncaged (default), and the waterline symbol when caged. The bars are displayed in a standard "fly-to" form. For example, if left of the localizer, the azimuth bar will be deflected to the right. If above glideslope, the elevation bar will be deflected down, etc.

Azimuth and elevation bars are only visible when receiving valid localizer and glideslope signals respectively. Full-scale deflection for both the azimuth (localizer) and elevation (glideslope) bars is ±2°.

2.15.8 Landing

You're probably either completely overwhelmed or bored beyond recognition by now, so let's get this thing on the "deck" already!

At approximately DME 20nm:

- ☑ SIM: UNPAUSE.
- ☑ AUTOPILOT: **OFF**. Disengage the A/P (**[Z]** or **[A]**).
- ☑ ALTITUDE: **5000 ft**. At DME 20nm, be at or near 5000 ft.
- ☑ SPEED: **240 KCAS**. If necessary, deploy the speed brake function (**/**)
- ☑ FLAPS: FULL. Set **FULL** flaps (**[F8],** or **[F]** from key command mode).
- ☑ GEAR: **DOWN**. At under 240 KCAS, lower the landing gear **[G]**.
- ☑ HUD: **CAGE**. Press **[CONTROL-U]** from key command mode if you wish. The localizer/glideslope bars will be referenced to the waterline, making the display a bit less confusing. When you grow more confident, you can leave it uncaged.
- ☑ AUTOTHROTTLE: **APPROCH**. Engage approach auto throttle **[CONTROL-R**]. Make sure the FLAP switch is set to **FULL**, and airspeed is below 240 KCAS before engaging ATC.
- ☑ LOCALIZER: **ESTABLISH**. Use slight left or right bank and/or rudder to gently align yourself with the localizer bar.
- ☑ GLIDESLOPE: **ESTABLISH**. Use pitch to establish and maintain glideslope. The auto throttle will increase or decrease power as necessary in order to maintain correct AOA. Remember, approach auto throttle isn't designed for aggressive maneuvering – keep it gentle!

The AOA indexer **[1]** should be yellow, indicating you're at or near approach AOA.

The velocity vector shows exactly where your aircraft is flying **[2]**, so place it at the touchdown aim point and continue to track the localizer/glideslope.

Upon landing, the auto throttle and/or any active A/P modes will disengage, and the low-gain nosewheel steering will engage.

- ☑ SPEED BRAKE: **AS REQUIRED**. If necessary, deploy the speed brake function (**/**). Note that the speedbrake function, which is inactive in PA with weight off wheels, will work with weight on wheels, but only the primary speedbrake surface will deploy.
- ☑ WHEEL BRAKES: **AS REQUIRED**. Apply wheel brakes **[.]**. If you have rudder pedals installed, toe brakes may also be used.

We hope you've enjoyed both the tutorial and the VRS Super Hornet. We've covered a lot of topics in these few pages, so please don't feel discouraged if you don't think you've grasped every feature or concept in the first round. The remaining documentation, combined with plenty of practice, should quickly get you up to speed and able to enjoy all of the rich features the VRS F/A-18E has to offer.

3 AIRCRAFT CONFIGURATION MANAGER

The Aircraft Configuration Manager (hereafter ACM), is the heart of the VRS F/A-18E simulation. It's used to arm and fuel the aircraft, provide an interface for arming random failures, enabling *Carrier*

Operations, *Hostility Zones*, *Air-To-Air Refueling*, and setting a host of other preferences.

The ACM is also used to activate and register the aircraft, and to make changes to your registration information. Last, but not least, the ACM is your gateway to product updates and content delivery. Without an activated and registered ACM, you cannot receive product updates, or indeed even download aircraft files (if you purchased the ESD version).

3.0.1 Launching the ACM

If you've made it this far, presumably you already have the ACM installed. A shortcut to the ACM can be found in your Start menu by default from the *VRS F/A-18E Superbug X* folder. If you've already activated and registered the ACM, you may skip to the *Aircraft Arming Tab* section, below.

3.0.2 System Requirements

The ACM requires the Microsoft .NET 3.0 or greater framework be installed on your computer. If you run Vista or Windows 7, these components should already be installed. The VRS ACM runs on both 32 and 64 bit versions of Windows XP, Vista and Win 7.

3.0.2.1 .NET

The ACM requires version 3.0 or greater of the .Net framework. The .NET Framework is a key Microsoft offering and is intended to be used by most new applications created for the Windows platform. The .NET installation files can be found at http://www.microsoft.com/NET/. Chances are if you're reading this text, you already have .NET installed to at least the minimum requirements.

3.0.2.2 FSUIPC 4

FSUIPC, or *Flight Simulator Universal Inter-Process Communication* is a free .dll and supporting files that must be installed in your *Flight Simulator X/Modules* folder for versions of the Superbug prior to 1.2.0.0. The VRS F/A-18E and many other high-end add-on aircraft make use of FSUIPC for interactive functions not normally available as part of the FS SDK.

Versions of the VRS F/A-18E prior to 1.2.0.0 require FSUIPC version 4.57 or greater (freeware is fine), but FSUIPC is no longer required in subsequent versions. However, FSUIPC is recommended for advanced controller mapping and if your Superbug installer is older than 1.2.0.0, it will not let you install the Superbug until FSUIPC is installed and RUNNING inside FSX. FSUIPC for FSX can be downloaded from the author, Peter Dowson's site: http://www.schiratti.com/dowson.html.

Run the FSUIPC installer and if you wish to install the free version, press CANCEL during the FSUIPC registration dialog. After installation of FSUIPC, run FSX and verify FSUIPC installation BEFORE installing the Superbug.

3.0.3 Copy Protection

The ACM and aircraft are protected by a hardware binding algorithm. At runtime initialization, this algorithm scans for hardware changes which exceed an allowable threshold. Extensive changes to hardware including, but not limited to CPU, motherboard, drives, and other major components may be made, however if the system sees too many upgrades within a certain time frame, then it's essentially considered a new machine, and the license must be transferred before the software will function again.

Your license entitles you to run the software on one machine per license. However it doesn't have to be the *same* machine you purchased and originally activated the software on. If you wish to transfer your license, you may do so at any time, however the software will not allow you to run it on multiple computers simultaneously. The license transfer process is completely automatic and instantaneous. You don't need to call us, you don't need to write us, and you don't need our permission; It can all be done within the ACM.

We believe this is a fair solution to the rampant piracy present in this industry, and much like recycling, we all need to do our part. The copy protection is non-aggressive, transmitting no information about you or your hardware back to “big brother.” It installs no Trojans, no spyware, no viruses and is not HIV positive. The protection algorithm is run once at ACM or aircraft initialization, and has zero impact on performance.

A final word on piracy: Not to sound evangelical, but certain individuals among us – and they know who they are – are responsible for the loss of many potentially great shops and products that simply couldn't survive because of their antics. We will continue to update our software aggressively, making it impossible for illegitimate “users” to benefit. So if you’re reading this documentation and you don’t own it, I strongly suggest you think twice about running our software.

3.0.4 Permissions

By default, the ACM reads and writes VRS aircraft and configuration files based on the relative path from the ACM to your FSX installation. If for any reason your registry does not contain the proper path information for installation, aircraft files may be loaded manually via the File menu's **Open** command. In this case, you'll want to point the ACM to the FSX root directory (the folder where FSX resides). Note that this is a rare circumstance, and only a potential problem if you've used a so-called “registry cleaner” which has hosed your registry, or have suffered some other form of system corruption.

Under windows Vista, it may be necessary for you to initially run the ACM as administrator. In most cases this will not be necessary since the installer assigns conditional administrative privileges to the ACM upon installation. Regardless, if the ACM is unable to launch or load files, please try right clicking-the executable and selecting “Run as Administrator” from the list of choices. Do not do this unless it's absolutely necessary, as Windows will continue to annoy you with persistent, redundant prompts the entire time the software is set to run under administrative privilege.

Because the ACM reads and writes aircraft files, FSX should not be running simultaneously with the ACM. This is because FSX may have a file handle open to resources the ACM needs. Please quit FSX prior to running the ACM, and do not launch FSX while the ACM is running. The ACM will warn you if you attempt to start it with FSX already running.

3.0.5 Paths & Dependencies

The ACM executable is located in FSX\SimObjects\Airplanes\VRS_FA-18E\ACM. <u>Never move the ACM from this location or it will fail to operate</u>. The ACM also requires certain .dll and .ini files in order to function. These are locally stored in the ACM folder and used only by the ACM at runtime. Never tamper with these files, as it can, and will, void your software and support privileges.

CAUTION:

Never rename, move or otherwise tamper with the default aircraft installation. To do so will break dependencies which the ACM needs in order to do its job. If you've moved folders or files around, or renamed ANYHTING, you will probably need to reinstall the software.

If you have any difficulty with this, or any other procedure, please visit our support forums

3.1 ACM ACTIVATION & REGISTRATION

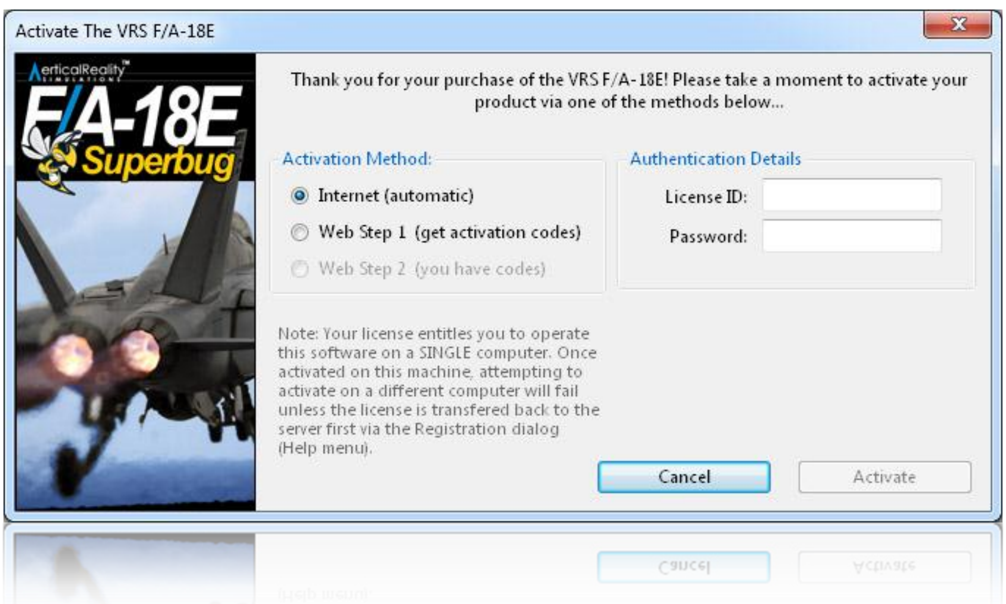
Before you can use the ACM, or the VRS F/A-18E, the software must be activated. Activation requires an Internet connection and may be done either through automatic or manual web-based methods. Whichever method you choose requires no waiting.

If you have an active firewall blocking outbound ports, you'll need to enable port 80 for the ACM.

3.1.1 Online Automatic Activation

To enable the ACM via the automatic Internet method, simply:

- ☑ Select the appropriate *Internet (automatic)* option (this will be selected by default).
- ☑ Enter the ***License ID*** and ***Password*** from your sales receipt. If you purchased your copy from VRS directly, you created your own password when you created your shopping cart. This would have been sent to you along with your License ID.



If you purchased from a third-party, you were issued a password at the time of sale, and it may also be found in your sales receipt.

- ☑ Press **Activate**.

A moment or two later, an activation dialog will appear informing you of the activation status. You may now skip to

Registration.

3.1.2 Web (Manual/Offline) Activation

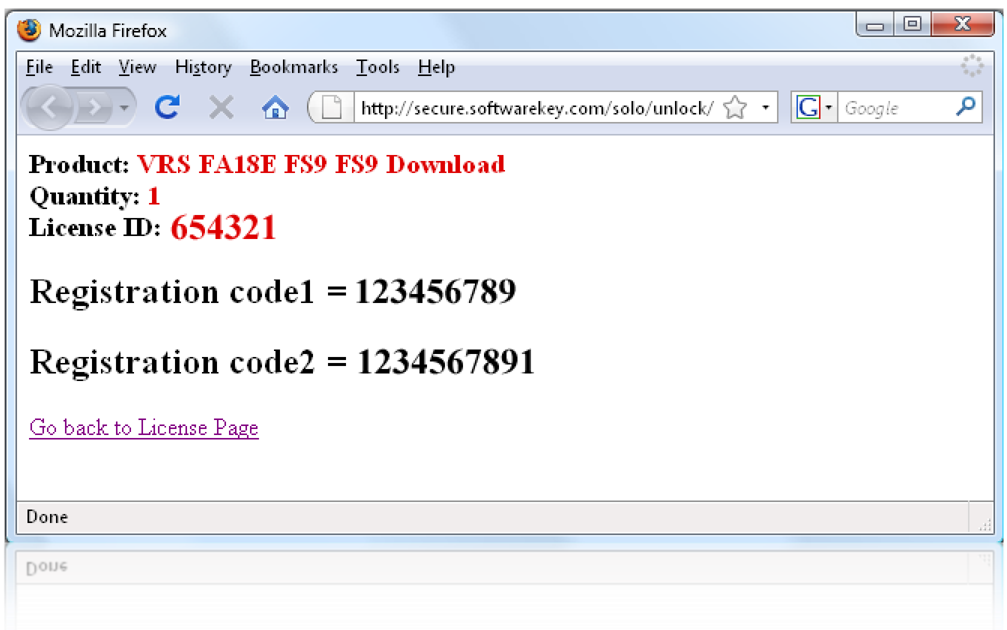
To enable the ACM manually via web browser:

- ☑ Select the Web (get activation codes) option.
- ☑ Enter your **License ID** and **password**.

The next step will depend on whether the machine is online of offline. If **ONLINE**:

- ☑ Press the **Get Web Codes** button.

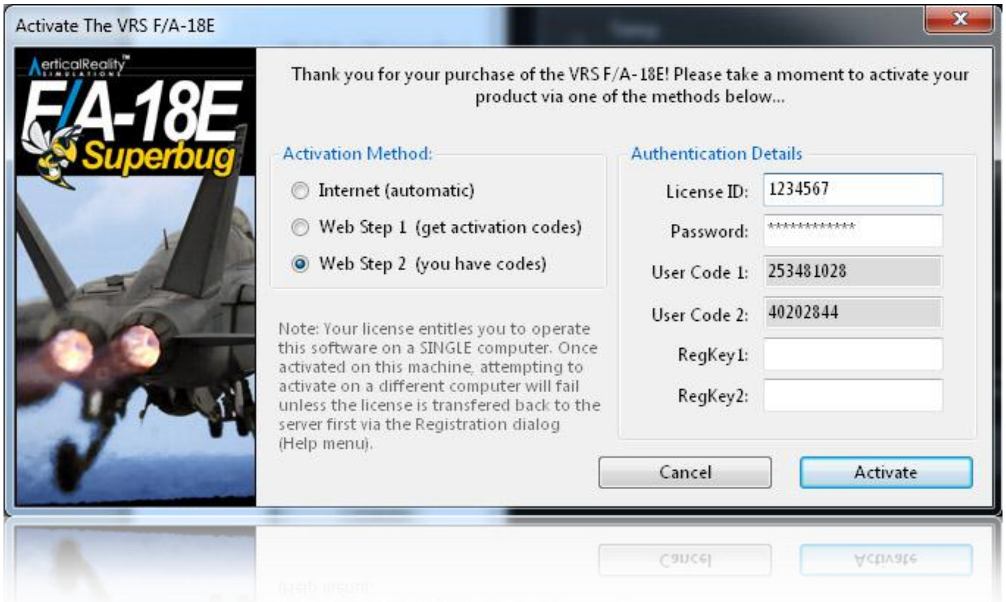
Your browser should open and automatically insert your license ID and password into the session and the following screen will appear with 2 separate registration keys. Skip the next step.



If OFFLINE:

- ☑ Press **Web Step 2** option (*see image next page*).
- ☑ Go to an ONLINE machine and navigate to: http://secure.softwarekey.com/solo/unlock
- ☑ Enter your license ID and password and press Next in the browser.
- ☑ Enter **User Code 1** from the offline machine.
- ☑ Enter **User Code 2** from the offline machine.
- ☑ Press next.

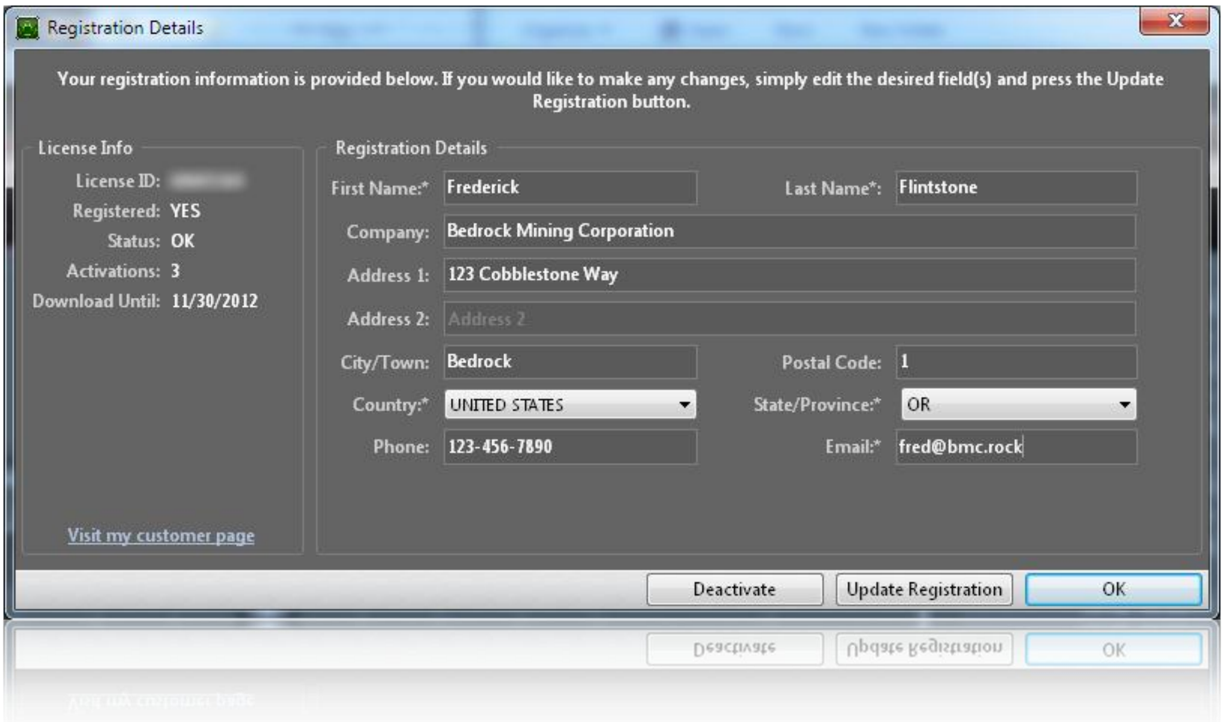
The screen shown on the previous page will appear with your registration codes.



- ☑ Return to the ACM and select the **Web Step 2**. (you have codes) option (*see previous page*).
- ☑ Enter the registration codes from your browser into the **RegKey1** and **RegKey2** fields of the ACM (these will only be visible if you have selected the *Web Step 2* option.
- ☑ Finally press **Activate**.

3.1.3 Registration

If you purchased the software directly from VRS' website, you should already be registered based on the information you provided at the time of purchase. You may review your registration information at any time, by selecting *Registration Details* from the *Help* menu. Note that the registration screen may look slightly different depending on which version of the Superbug you're running.



3.1.3.1 Deactivate Function

If you intend to run the VRS F/A-18E on a computer other than the one it's activated on, you should transfer the license back to the server first. You should do this any time you intend to reinstall the software.

To transfer the license, ensure you have an internet connection and simply press the **Deactivate** button from the Registration page. Enter your license password found in your invoice, and press OK. The license will be stored on the server and the software may now be activated on another machine, or reactivated on the same machine.

3.1.4 Retrieving Installation Files

Once you're registered, or immediately upon activation, depending on where the software was purchased, the ACM may begin checking for installation files and/or updates. Note that the ACM MUST connect to the Internet in order to retrieve installation/update files. If you are not connected to the internet, updates will be unavailable.

Once update files have been downloaded, the ACM will quit, begin the installation, and automatically re-launch itself.

3.1.5 Automatic Updates

After initial installation of your aircraft files the ACM will automatically check for software updates. These will be issued periodically to perform routine service and/or issue messages to customers. In fact you will probably receive an automatic update immediately after receiving your aircraft files.

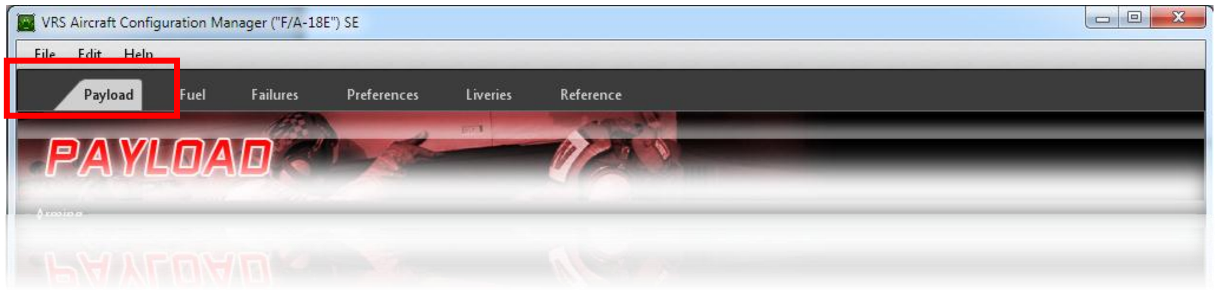
While automatic updates are not mandatory, they will be queried every time the ACM runs. If you do not have an Internet connection when launching the ACM, it will pause for a moment while trying to establish a connection, and finally time-out if not allowed to connect. The ACM will run normally thereafter regardless of whether you accept the update connection or not.

3.1.5.1 Saving Update Files

When the ACM downloads a file, it stores it in a time stamped directory located in the aircraft\downloads directory. The ACM update files are ALL called *Update.exe*. These download directories are located in *FSX\SimObjects\Airplanes\VRS_FA-18E\downloads*. Within the download directory will be other directories, each named according to the date they were downloaded. If you wish, you can copy these files to a CD for safe-keeping. Burn them along with your original installer, and then reconstitute the installation but running them in the order they're dated.

3.2 INTERFACE OVERVIEW

The ACM has a very clean and straight-forward interface based on a simple *Tab Control* for each of its

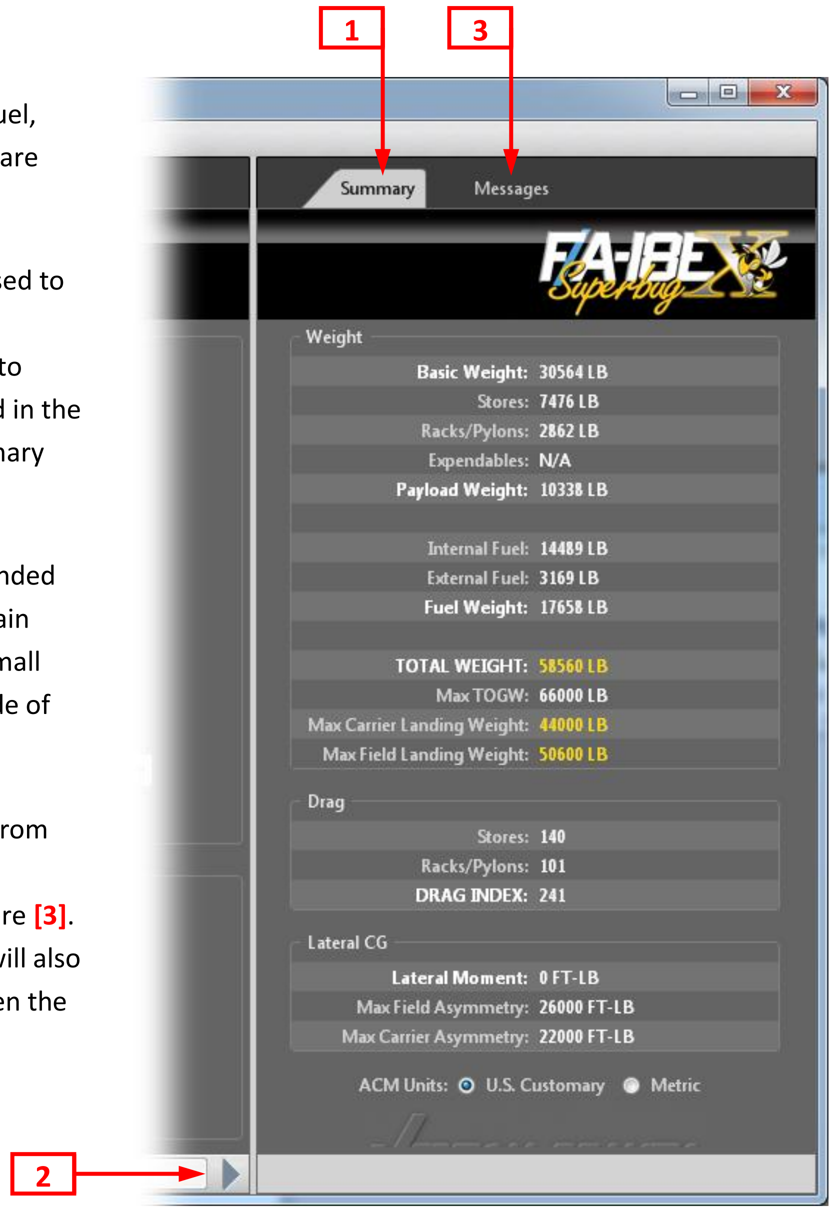


major functions. From left to right, these tabs are:

- **Payload Tab**: Allows custom arming and payload selection.
- **Fuel Tab**: Allows fueling of internal and external tanks.
- **Failures Tab**: Facilitates the creation of random failures in any number of systems. These include:
    - Avionic Failures.
    - Electrical Failures.
    - Hydraulic Failures.
    - Instrument Failures.
- **Preferences Tab**: For toggling various features including virtual cockpit LODs, aspect ratio, carrier operations, hostility zones, and local ACM preferences.
    - ACM preferences.
    - Aerial Refueling preferences.
    - Carrier Operations preferences.
    - Controls preferences.
    - Hostility Zones preferences.
    - Keyboard preferences.
    - Simulation preferences.

- **Liveries Tab**: Allows you to navigate, install, uninstall and modify livery details.

- **Reference Tab**: Allows you to navigate, install, uninstall and modify livery details.
    - Checklists.
    - Reference Tables & Charts.
    - Keyboard Reference.



- **Summary Tab**: Shows aircraft fuel, weight and balance as changes are made to payload and fuel.

  The ACM units option can be used to change the displayed units throughout the ACM from U.S. to metric. Note that the units used in the Superbug are *always* US customary regardless of this selection.

  The summary area can be expanded and collapsed relative to the main ACM window by pressing the small arrow near the bottom-right side of the main ACM window **[2]**.

- **Messages Tab**: Messages sent from the VRS server including new download alerts can be seen here **[3]**. These messages (if they exist) will also appear in a separate dialog when the ACM is first started.

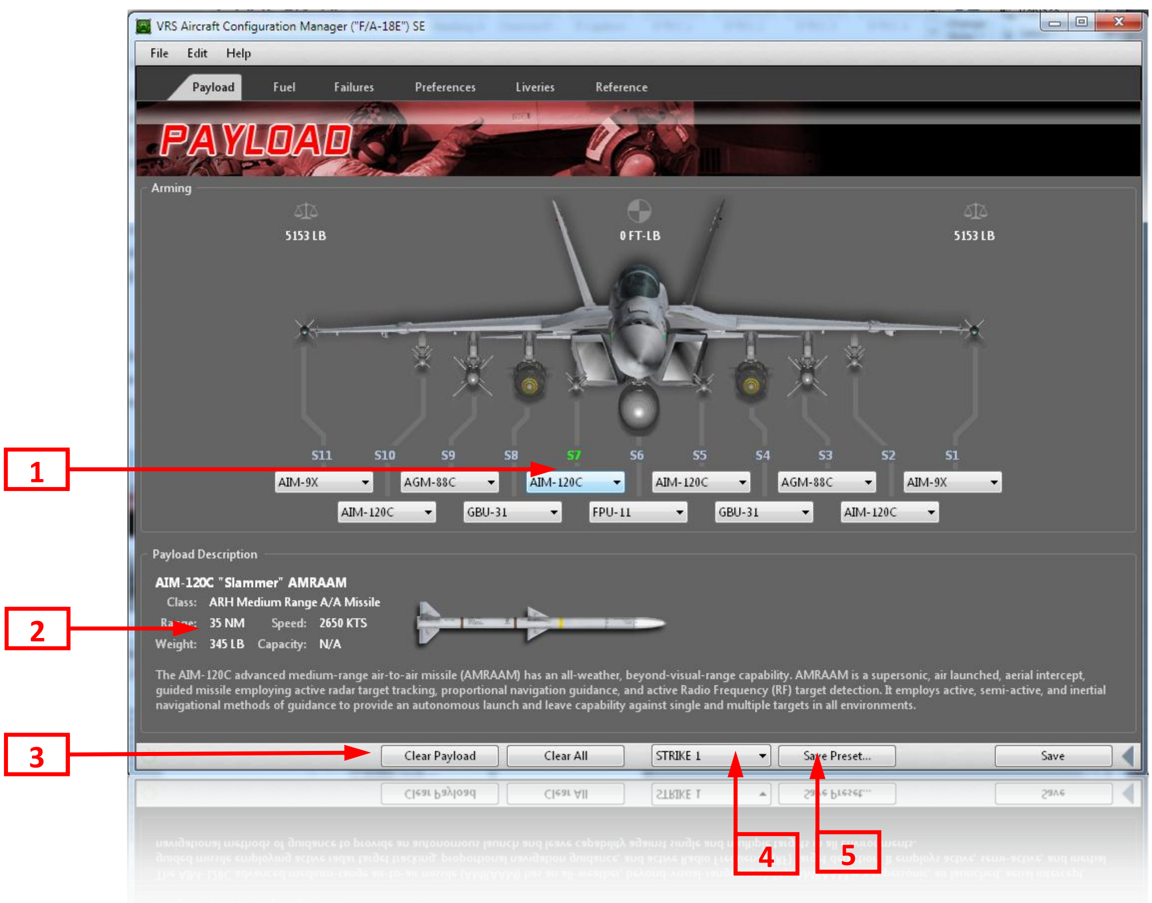
3.3 ARMING TAB

Custom arming is where the VRS Hornet begins to diverge from the usual military add-on. You don't "arm" your aircraft by selecting a different model in MSFS, you arm it through the ACM by adding the weapons and other payload to individual stations yourself. These weapons all have their own individual characteristics and associated avionic interfaces in flight. They each behave as unique objects and can be controlled individually.

Because the weapons meshes are drawn in code and treated as individual objects, rather than part of the model, they can also be animated and removed in code. Weapons are a dynamic and integral part of this simulation, not just window dressing. They have weight, drag, and individual flight characteristics.

3.3.1 Payload as Objects

The VRS F/A-18E simulates the weight, drag and moments associated with every store loaded on the aircraft. This also (of course) includes the changes in physics associated with releasing the payload. In addition to the actual weapon or pod, any station that contains a weapon will automatically be



equipped with the appropriate Rack, Launcher and/or *Pylon*.

3.3.2 Choosing Payload

Weapons, fuel tanks and pods are selected by choosing an item from the popup list directly below each Station **[1]**. The F/A-18E has a total of 11 stations. From the front, looking at the aircraft head-on, these read right-to-left and are numbered in the ACM accordingly. Certain stations are subject to weight restrictions and can therefore only carry certain combinations of stores. For example 2000lb bombs can only be loaded onto stations #3,#4,#8 and #9.

By default, selecting a particular type of weapon on one side of the aircraft will automatically select the same type of weapon on the other side in order to balance the asymmetry along the lateral axis. This option can be toggled on and off with the *Enforce Loading Symmetry* option from the Preferences->ACM tab.

A brief description and stats will appear in the bottom half of the screen **[2]** when the mouse is rolled over any station. The stats listed here are used in the simulation to model everything from weight to time of flight and range.

3.3.3 Clearing Payload

Near the bottom-left of the screen are the *Clear Payload* and *Clear All* buttons **[3]**. The Clear Payload button will clear *only* the weapons on all stations. The Clear All button will clear weapons *and* pylons.

3.3.4 Preset Packages

Preset Packages are predefined collection of weapons/pods. They are named according to their mission type and can be modified and saved. To select a predefined package, simply select the option from the drop down list **[4]**. The aircraft will immediately be loaded with the package. To save over an existing preset package:

- ☑ Select the package you with to modify **[4]**.
- ☑ Modify the package in any way you wish by selecting new stores from the drop-down lists **[1]**.
- ☑ Press the **Save Preset** button **[5]**. After being prompted to save over the existing preset, the new version of that package will be saved for future use.

3.4 PREFLIGHT SUMMARY

Stats on the current aircraft configuration can be seen by accessing the *Preflight Summary* Tab from the right side of the split application window. The summary shows vital (and not so vital) information, primarily about the aircraft's weight and drag.

From top to bottom, the displayed statistics are:

- **BASIC WEIGHT.** The weight of the aircraft prior to adding any weapons, pylons, racks/launchers, or fuel.
- **Stores.** The weight of all weapons or pods.
- **Racks/Pylons.** The weight of all racks, pylons or launchers.
- **Expendables**. Not implemented. Chaff and fares are currently added to the weight of the aircraft automatically, and quantity cannot be changed.
- **Total Payload.** The combined total of all weapons, racks, launchers and pylons.
- **Internal Fuel**. The number of pounds of fuel contained in all 6 internal tanks.
- **External Fuel**. The number of pounds of fuel contained in all external fuel tanks.
- **Total Fuel.** The sum of internal + external fuel.
- **TOTAL WEIGHT.** The sum of all weapons, racks, launchers, pylons and fuel on-board.
- **Max TOGW.** The maximum allowable takeoff weight (carrier or field), constant.
- **Max Land Field.** The maximum allowable field landing weight (constant).

- **Max Land CV.** The maximum allowable carrier trap weight (constant).
- **Payload Drag Index (stores and racks).** The drag index is a non-dimensional value which represents the total *Form Drag* of all weapons, pylons, racks and launchers. Note this does not include wave or interference drag. Since drag is a function of many, many variables including airspeed and altitude, this figure is only a reference. It does not correspond to any particular coefficient and should only be used as a very basic guide.
- **Lateral Moment.** This is the lateral (left<-->right) center of gravity in feet*lbs (or kg*m).

3.5 FUELING TAB

By default, the aircraft is fully fueled internally, however if you add external tanks and/or a refueling pod when arming the aircraft, you may need to add fuel to those additional tanks. Newly added external tanks are filled automatically by default, but the option to auto-fill external tanks can be changed in ACM preferences.

The fueling screen is split between internal **[1]** and external **[2]** tanks. Sliders are used to adjust the quantity in pounds or kilograms (depending on ACM settings) for each tank.

3.5.1 Filling Tanks

The F/A-18E has 6 internal tanks including 2 *Wing Tanks*, 2 *Feed Tanks (tanks 2 and 3),* and 2 *Transfer Tanks (tanks 1 and 2)*. The feed tanks feed the engines directly and are interconnected. The transfer tanks feed fuel to the feed tanks from the wing tanks and/or external tanks. Transfer tanks will not accept fuel until the feed tanks are full, and wing tanks will not accept fuel until the transfer tanks are

full, etc.

Up to 6 external tanks may also be carried. External tanks are filled exactly the same way as internal tanks, and require ordered filling as well. For example the center tank must be filled first, followed by the inboard and outboard tanks respectively. The tank fill order is as follows:

1) Feed Tanks
2) Transfer Tanks
3) Wing Tanks
4) External Centerline
5) External Inboard
6) External Midboard

The *Fill All Tanks* and *Empty All Tanks* buttons **[3]** can be used to quickly perform those tasks automatically.

3.5.2 Total Quantity

Near the bottom of the screen and above the filling buttons, are the current quantities in pounds for *Internal*, *External* and *Total* fuel **[4]**. These values are also reflected in the Preflight Summary Window described in the previous section.

CAUTION:

ALWAYS USE THE ACM TO MAKE FUEL AND PAYLOAD MODIFICATIONS

Never modify the quantity of a fuel tank or the weight of payload using the built-in FSX Fuel and Payload window. The VRS F/A-18E uses highly customized fuel and payload settings, and altering anything outside of the ACM will almost certainly guarantee problems.

3.6 FAILURES TAB

The VRS F/A-18E simulates three broad types of failures:

1. **Random Failures**. These occur within a specific time window and target only specific systems. These are the types of failures the ACM controls. The extent of damage caused by the failure(s) is controlled from the *Severity* setting in the ACM Simulation Preferences. Likewise, the chance that the system will fail at all is controlled by the *Reliability* setting under Simulation Preferences.
2. **Battle Damage**. This occurs as a result of missile and/or AAA damage (if *Hostility Zones* are enabled), and affects a random number of systems. The type of systems affected cannot be controlled, but the number of potentially damaged systems and the extent to which they are damaged can be controlled from the ACM's *Combat Ops Lethality* setting.
3. **Induced Failures**. These are failures that result from, for example, overheating brought on by failure to select the proper ECS cooling mode, or exceeding the recommended airspeeds associated with a given ECS mode. These types of failures can cascade into other systems and cannot be controlled directly via the ACM. However like the previous failure categories the extent of the damage *can* be controlled by the *Global Effectivity* settings.

There are five categories of failures each containing multiple systems. All of the systems available for random failures can also be affected by battle damage. A lesser number of systems are vulnerable to induced failures.

3.6.1 Arming Random Failures

The ACM failures tab deals only with *random failures*. To arm a failure:

- ☑ Select the general failure category from the left **[1]**.
- ☑ Select a specific system to arm **[2]**.
- ☑ Set the minimum time in minutes which must elapse before the system is armed for failure **[4]**.
- ☑ Set the maximum time in minutes which can elapse before the system is armed for failure **[5]**.

When the maximum value exceeds the minimum value, the system is armed for failure, and the selected system will turn red indicating it is armed.

3.6.2 Failure Effectivity

Below each failure category are two common settings that affect all failures (randomly armed and battle damage).

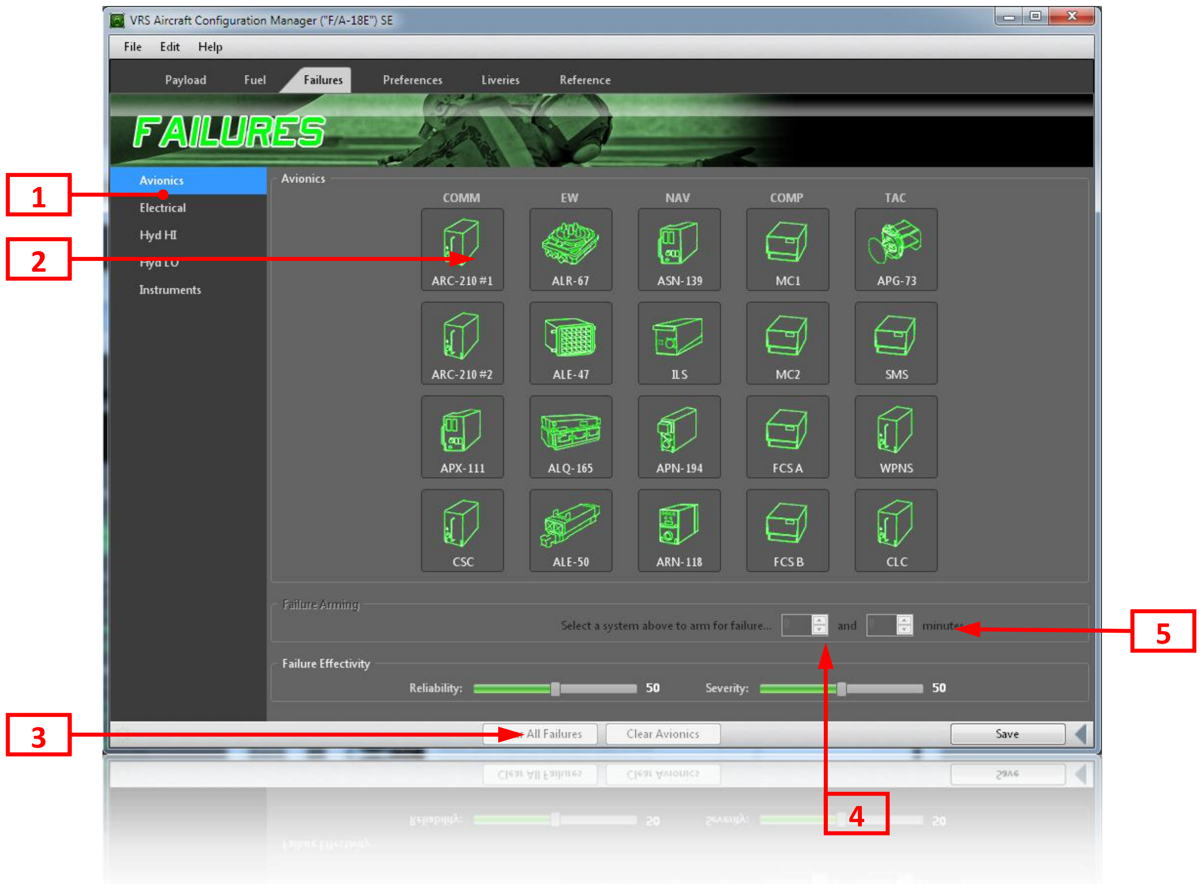
- **Reliability.** Pertains to the chance that any armed failure will actually fail within the set window. For example a 50% reliability setting means any armed system has a 50% change to fail within the window you set.
- **Severity**. Pertains to the amount of damaged received when a system does fail. This mainly applies to battle damage, but can also ally to armed failures. For example if the SMS (stores management system) fails or is hit, this value represents how many sub-systems that fall under that category may be affected.

3.6.3 Clearing Failures

Failures can be cleared for the entire category or globally for all failures by pressing either the *Clear [specific]* or *Clear All Failures* buttons respectively **[3]**.

3.6.4 Avionic Failures

Avionic systems include communications, navigation, computing, early warning/countermeasures, and tactical systems such as radar. Avionic failures include:

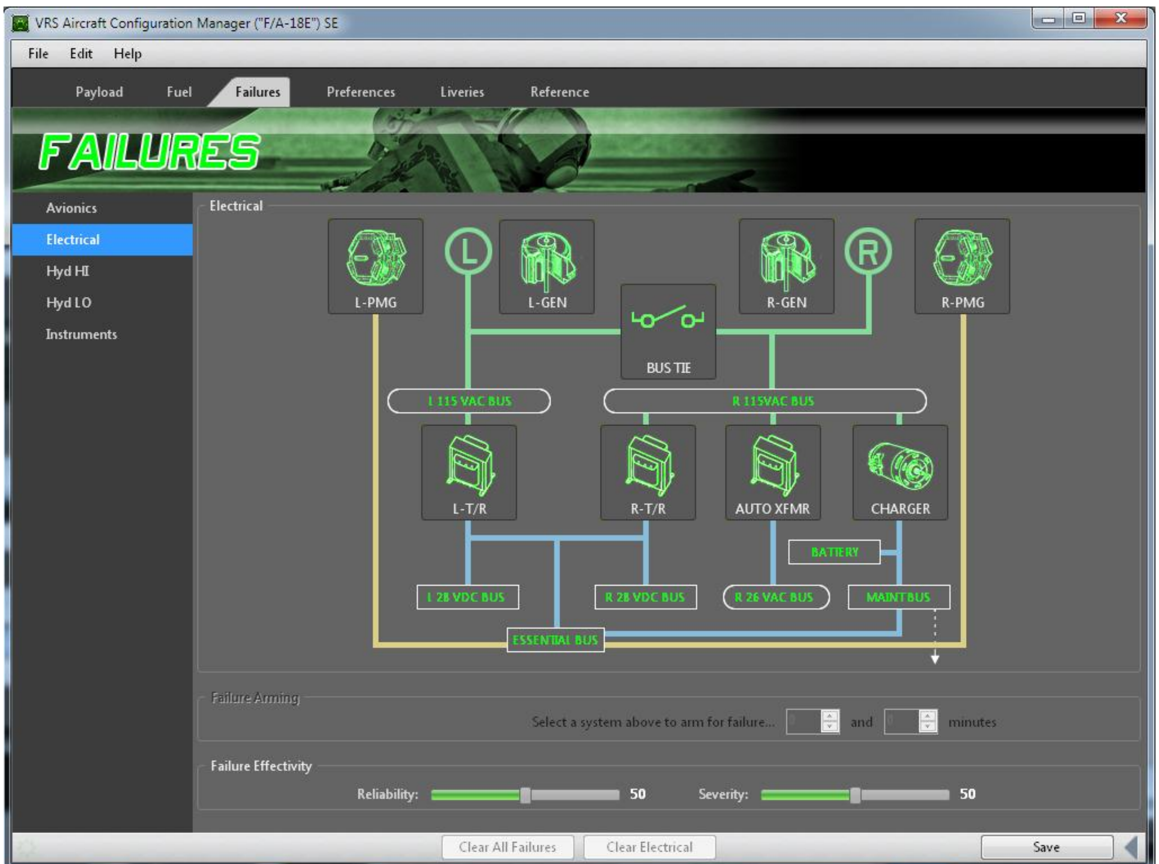


- **ARC-210 1\2**. Communications (COM) and ADF radios.
- **APX-111**. Combined Interrogator/Transponder (IFF).
- **CSC**. Communication System Control. The CSC converts non-multiplex bus (MUX) compatible signals from the mission computer(s) to CNI (communication and navigation) equipment. If the CSC fails, equipment which is not MUX compatible cannot be accessed through the UFCD.
- **ALR-67**. Radar Warning Receiver. The RWR is responsible for receiving radar emissions from friendly and enemy sources alike. It is a very, very expensive "Fuzz Buster", and without it, incoming active radar guided missiles and/or AAA fire control radar cannot be detected. The RWR also sends signals to the HARM Command Launch Computer (CLC) so that the HARM can automatically target threats that are not within its current field of view.
- **ALE-47**. This is the countermeasures dispensing unit for launching flares or chaff.
- **ALQ-165**. The Airborne Self-Protection Jammer (ASPJ). This emits RF energy designed to scatter incoming radar. It is a last line of defense against RF threats.

- **ALE-50**. The ALE-50 is a towed decoy system strung out on a wire behind the aircraft. It's designed to spoof RF threats by simulating a large radar return. The missile will home in on the decoy rather than the host aircraft. If the ASPJ is the last line of defense, the ALE-50 is the *last* last line of defense.
- **ASN-139**. The Inertial Navigation System. Note that the VRS F/A-18E (standard edition) does not simulate INS, therefore this has no functional effect on any systems.
- **ILS**. Instrument Landing System. Provides the HUD and standby ADI with CDI and GSI.
- **APN-194**. Radar Altimeter.
- **ARN-118**. TACAN radio.
- **MC 1**. Mission Computer #1. Essentially the navigation computer. Also handles primary caution annunciation and air data.
- **MC 2**. Mission Computer #2. The fire control computer. Also handles SMS and jettison functions.
- **FCS A**. Flight Control Computer A.
- **FCS B**. Flight Control Computer B.
- **APG-73**. Airborne Tactical Radar.
- **SMS**. Affects individual pylons. If a pylon fails, a store on that pylon may hang if a jettison is attempted. In addition a weapon on the effected pylon may not fire. In the case of an SMS failure, the word *SFAIL* will appear on the corresponding station(s) when viewing the SMS format.
- **WPNS**. These failures affect individual weapons. If a weapon fails is cannot be fired. A WPNS failure will be indicated by the word *WFAIL* appearing on the corresponding station(s) when viewing the SMS format.
- **CLC**. HARM Command Launch Computer. If the CLC fails, HARM function is degraded or lost.

3.6.5 Electrical Failures

Electrical systems range from generators to the battery and provide redundant function through generator bus tie circuitry and essential bus backup. When selecting electrical systems for failure, colored text will indicate what individual circuits may be affected along the path(s) those systems supply. Red text for a system indicates NOGO, orange text indicates it is running in a degraded mode (for example battery backup), and black text indicates nominal.



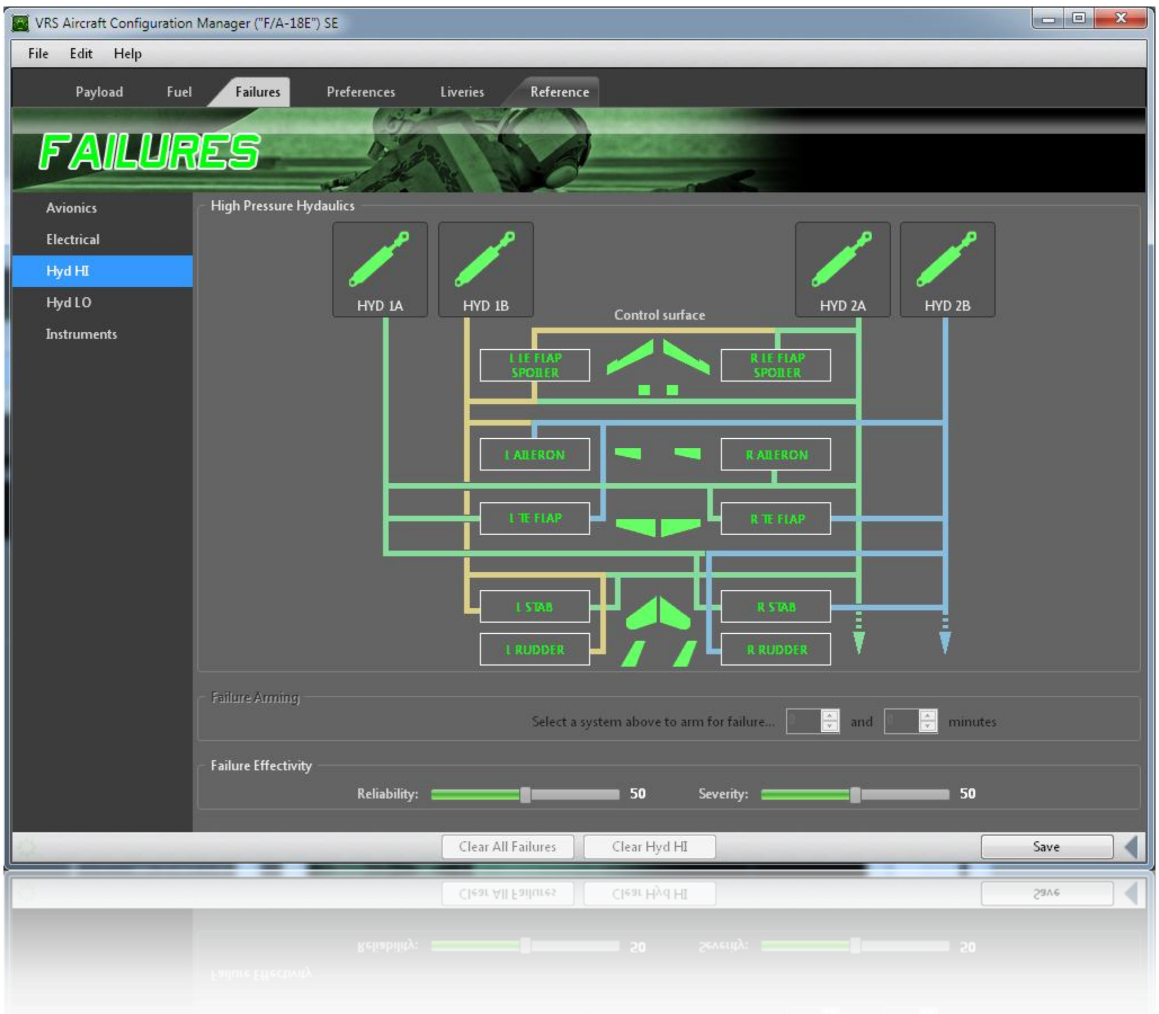
The exact details of the electrical simulation are beyond the scope of this section, however the primary electrical systems available for failure include:

- **L/R GEN**. The primary power sources. During normal operation, each generator supplies its respective left or right bus with AC power.
- **L/R PMG**. Permanent Magnet Generators (PMG). The PMGs provide 3 isolated DC sources from the primary generators. These are used for Essential Bus/Flight Control Computer backup.

- **BUS TIE**. Bus tie circuitry allows the one unaffected generator to power the entire electrical bus in the event effected generator fails or is tripped offline. In other words, any single generator can power the entire aircraft if bus tie circuitry is online.
- **L/R T/Rs**. The left and right Transformer/Rectifiers convert the 115VAC generator current to 28VDC power for use along the DC buses. If one T/R fails, the opposite T/R can supply the entire aircraft with DC power.
- **AUTO XFMR**. The Auto-Transformer supplies one 26VAC bus for use with the ADF and Magnetic Azimuth Detector.
- **CHARGER**. Along the right 115VAC bus, the battery charger pretty much does as the name implies.

3.6.6 Hydraulic Failures (HI PRESS)

These circuits operate at up to 5000 PSI (normally 3000). The hydraulic system is divided into 2 primary circuits, *HYD 1* and *HYD 2*, which are in turn subdivided into two more branches providing a total of four independent circuits. These are identified as 1A and 1B for the left system and 2A and 2B for the right. HYD 1 circuits are dedicated solely to flight controls. HYD 2A powers both flight controls and most utility hydraulic functions (explained under low pressure). HYD 2B powers the flight controls and arresting hook and pressurizes both the APU and emergency brake accumulators. We will explain accumulator function in subsequent sections.



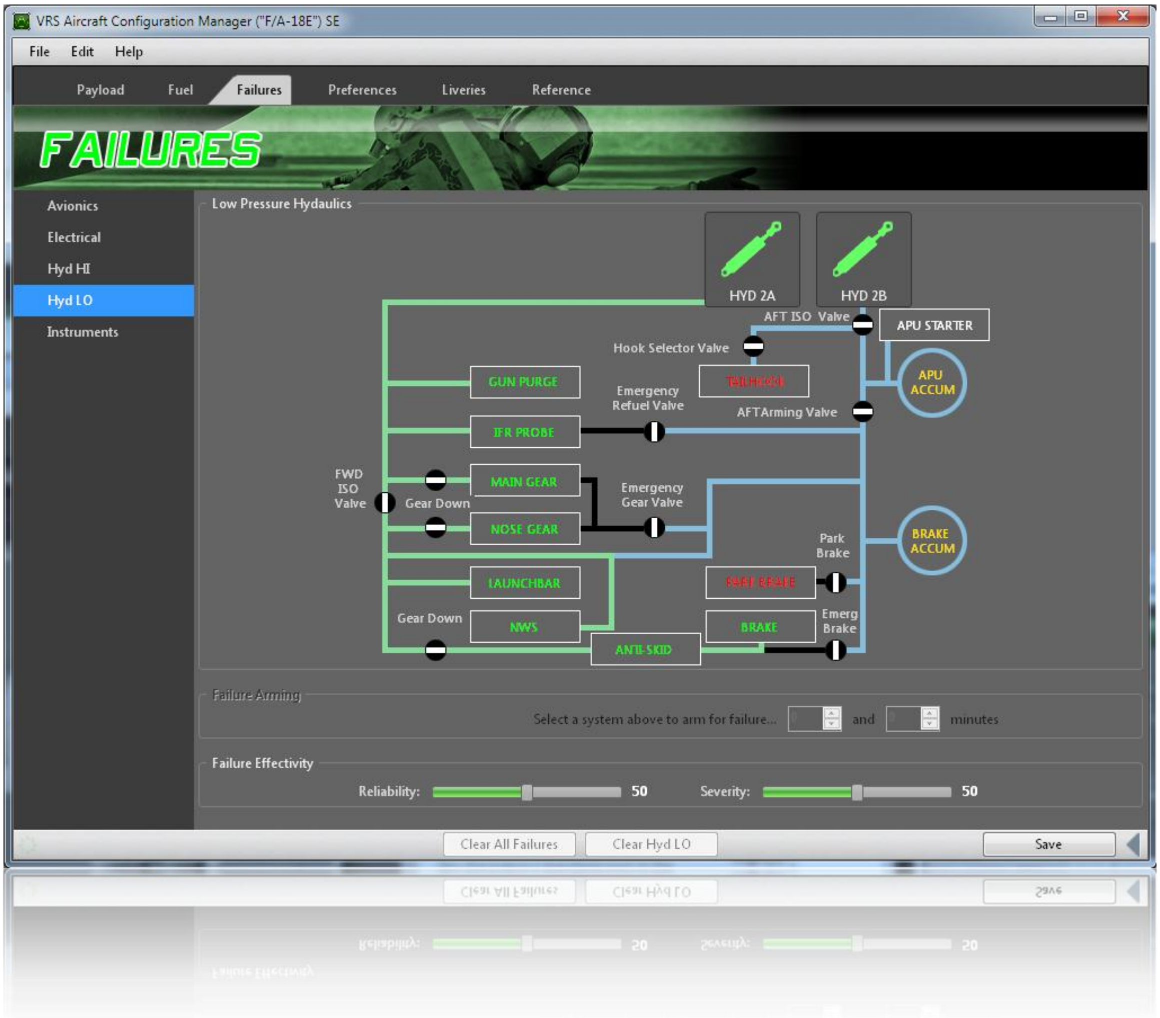
- **HYD 1A**. Supplies the right aileron, left trailing edge flap (TEF), right TEF, and right stabilator.
- **HYD 1B**. Supplies the left and right spoilers and leading edge flaps (LEFs), left aileron, left stabilator and left rudder.
- **HYD 2A**. Supplies the left and right spoilers and LEFs, right aileron, and left stabilator.
- **HYD 2B**. Supplies the left aileron and TEFs, and the right TEF, stabilator and rudder.

The ACM will graphically show the degradation in flight controls as hydraulic circuits are armed for failure. As with the electrical failures, colored text and/or graphics will illustrate the affected systems downstream of the failure.

If you've been following along with this, you may have noticed it's not easy to knock everything out. Indeed you'll need to fail at least 3 circuits before flight controls begin to degrade at all. As hydraulic circuits begin to fail individual surfaces, those surfaces will usually fare and lock at their current position and handling qualities will become noticeably sluggish.

3.6.7 Hydraulic Failures (LOW PRESS)

These circuits are under 3000 PSI at all times, however they're isolated from pressures higher than that which may be required for flight controls under extreme q conditions.



- **HYD 2A**. Supplies the gun gas ejector (not implemented), In-flight refueling probe (IFR) normal function, main and nose gears, launch bar, nose wheel steering (NWS), and anti-skid (professional version only), and normal braking.
- **HYD 2B**. Normally isolated in flight, powers the tailhook. HYD 2B can also be used as an emergency circuit if the IFR probe switch is placed in EMERG, or the *Aft Isolation Valve* is opened. In this case HYD 2B can be used to back up nosewheel steering (NWS) and breaking, and to recharge the brake and APU accumulators.

The utility function dependencies can be analyzed by clicking the various valves throughout the diagram. Systems which are red are unpowered either due to valve position or lack of hydraulic pressure. Orange systems are being powered by the APU and/or brake accumulators. Temporarily failing a system and/or changing valve position will offer some visual insight as to which systems may be affected by the failure of a given circuit in the simulation.

3.6.8 Instrument Failures

These are relatively straight forward failures which can affect high-level instruments such as standby gauges and avionic displays. These do not affect the primary systems that drive the displays such as pitot-static.

- **Indexer**. The *AoA indexer* is mounted to the left of the HUD and provides heads-up angle of attack indication.
- **HUD**. The F/A-18's primary flight display. If the HUD is lost, a standby HUD can be accessed from the left or right DDIs.
- **Compass**. A standby gyro-driven magnetic compass mounted on the right canopy frame.
- **Left DDI**. The left *Digital Display Indicator*. This is an avionic display providing pilot interaction with navigation, early warning, tactical, and aircraft support functions. It is functionally identical to the right DDI except when the *"LITE LDDI"* option is selected from the *Simulation Preferences*.

- **Right DDI**. The right *Digital Display Indicator*. This is an avionic display providing pilot interaction with navigation, early warning, tactical, and aircraft support functions. It is functionally identical to the left DDI except when the *"LITE RDDI"* option is selected from the *Simulation Preferences*.
- **UFCD**. The *Up-Front Control Display*. This is an avionic display providing pilot interaction with communication, navigation and autopilot systems. The UFCD can also display all the data available on the left and right DDIs except when the "LITE UFCD" option is selected from the Simulation Preferences. In this case the DDI functions are not present.
- **IFEI**. The *Integrated Fuel/Engine Indicator*. This is an avionic display providing critical engine and fuel data. It is driven independently of the DDIs and therefore acts as a backup monitor. The EFEI can provide some limited readings on the maintenance bus circuit for monitoring engine status prior to the generators coming online.
- **MPCD**. In the VRS F/A-18E, the MPCD provides navigation *Horizontal Situation Display* with color moving map capability.
- **ADI**. A backup Attitude Indicator with ILS CDI/GSI indication.
- **ALT**. A backup Altimeter.
- **ASI**. A backup Airspeed Indicator.
- **VSI**. A backup Vertical Speed Indicator.

3.7 PREFERENCES TAB

The VRS Aircraft Manager offers a number of options for enhancing the simulation. These range from visual options to improve performance, to combat and carrier operations.

The preferences are divided into 7 categories listed along the left side of the screen. Selecting an option brings up the page associated with the following options:

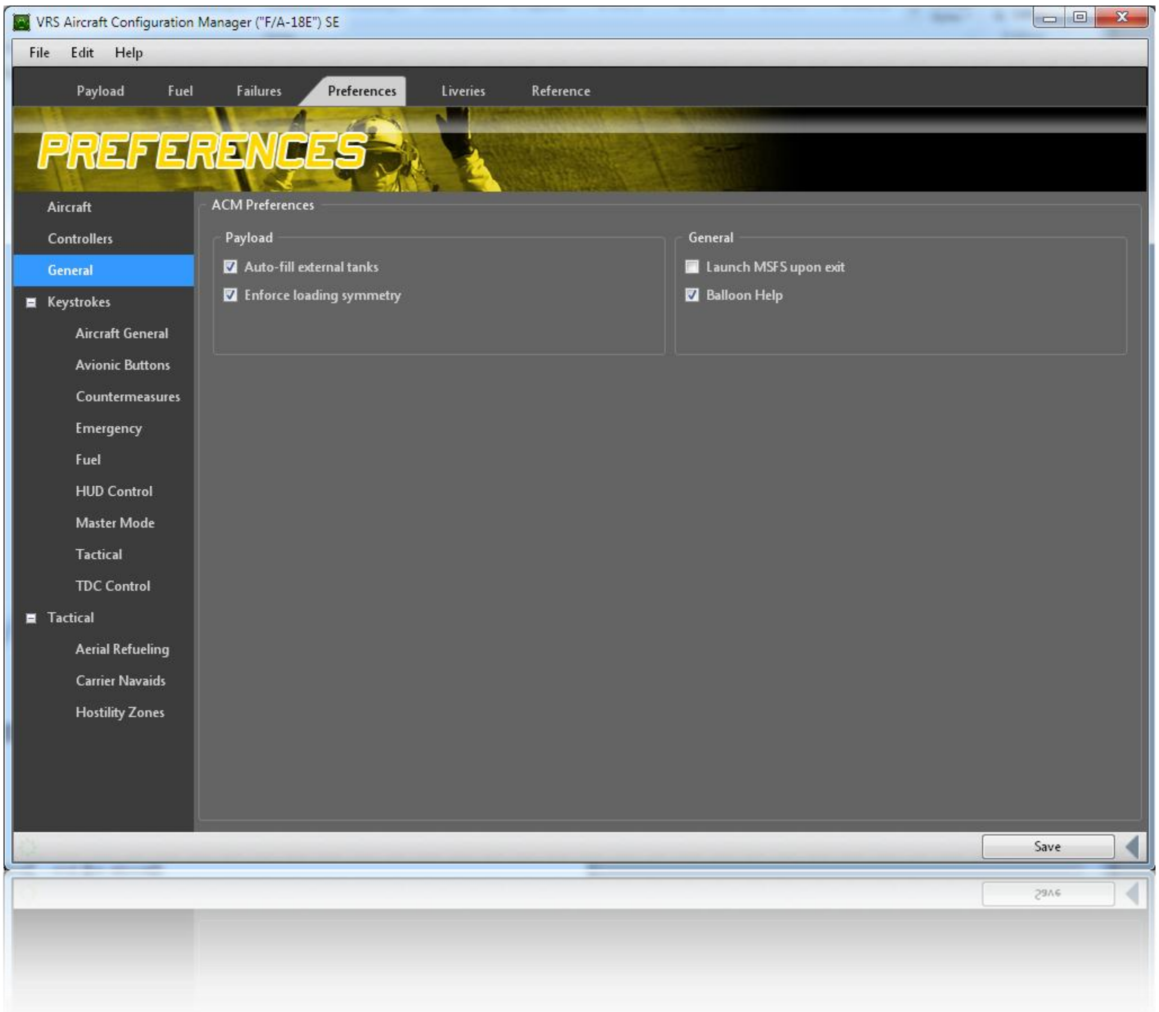
- **ACM**. Options which are only pertinent to the Aircraft Manager itself.
- **AERIAL REFULING**. Allows the activation and configuration of AI aircraft which serve are refueling tankers.
- **CARRIER OPS**. Allows enabling and disabling of moving TACAN and ILS navigation aids for AI carriers. These functions were never implemented in Flight Simulator and are critical for any serious carrier operations.
- **CONTROLS**. Allows adjustment of dead band and axis inversion for the fly-by-wire system (VRS specific settings).
- **HOSTILITY ZONES**. Allows enabling/disabling and parameter adjustment for mock SAM and AAA. These systems act like real anti-air warfare installations and can fire upon your aircraft.
- **KEYBOARD**. Allows custom keyboard mapping of almost every aircraft function.
- **SIMULATION**. Options which affect visual qualities and/or performance within the simulation.

3.7.1 General Preferences

These options pertain only to the ACM itself -- not the aircraft.

3.7.1.1 Payload Options

- **Auto-fill External Tanks.** This option will ensure that any external tanks which are loaded on the aircraft from the payload tab will automatically be filled to capacity when loaded. If this option is



not selected, any new tanks which are loaded on the aircraft will be empty by default and must be filled via the Fuel tab.

- **Enforce Loading Symmetry.** When this option is checked, stores loaded from the Payload page (except cheek stations) will be mirrored from one side of the aircraft to the other. This makes custom loading easier and helps enforce a more realistic payload. Aircraft are usually loaded symmetrically in real-world operations.

3.7.1.2 General Options

- **Launch FS Upon Exit.** When this option is checked, the ACM will launch FS immediately upon a normal exit. Note that the ACM will **not** automatically select the VRS F/A-18 as the default aircraft.
- **Balloon Tooltips.** When enabled, shows tooltips for most ACM options.

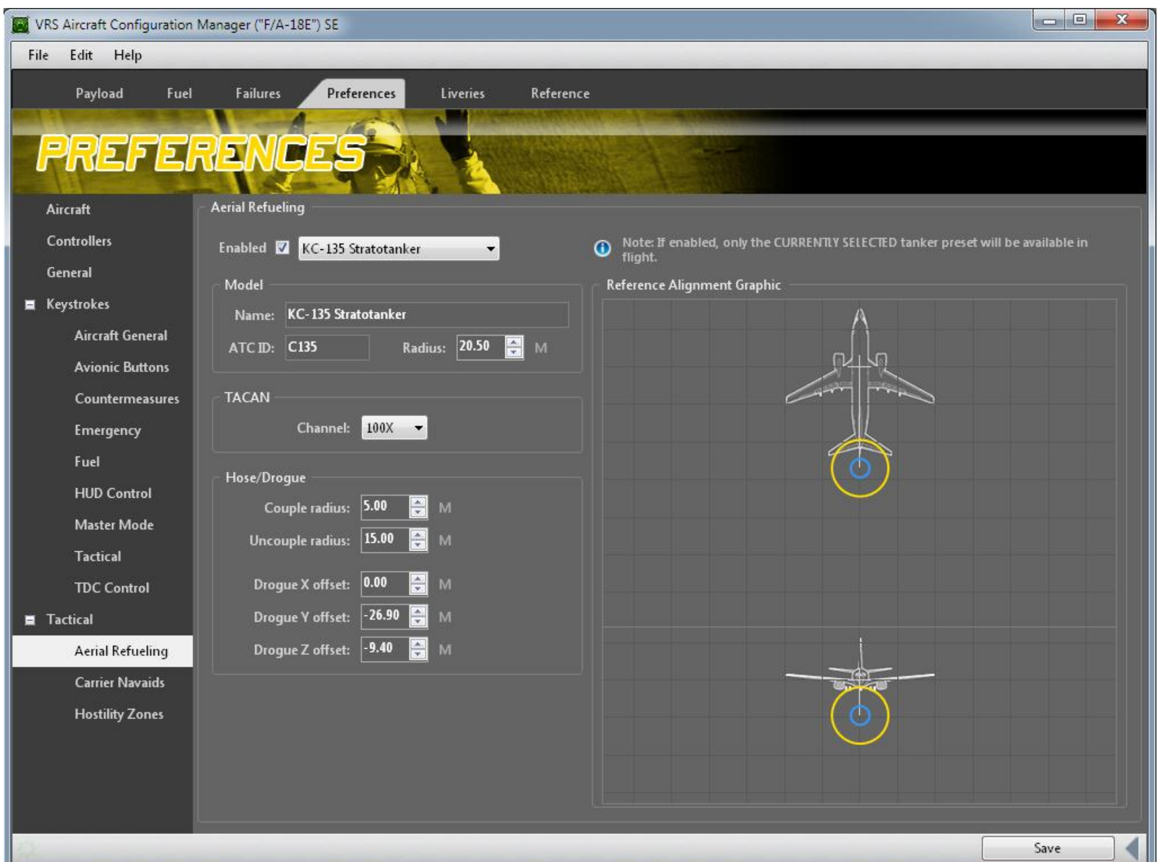
3.7.2 Aerial Refueling Preferences

NOTE: These options are not visible and do not apply when the VRS TacPack is installed. All refueling options are handled through the TacPack Manager.

These options are used for enabling/disabling *Aerial Refueling* parameters for AI aircraft. The way this system works is by searching the sky for an aircraft that matches the **ATC Model (ATC ID)** set in the AI aircraft's aircraft.cfg. The ACM interface allows you to set up a number of aircraft types and save them for use at any time. However it's important to note that <u>only the selected aircraft will be used at any given time</u>.

The image below shows that an *KC-135* is seclected and enabled. The *Reference Alignment Graphic* to the right of the refueling parameters is used strictly as a reference to aid in positioning the hose/drogue parameters. The graphic does not change with the aircraft name.

<u>This system is does not create AI traffic</u>. It simply allows the avionics to locate existing traffic based on



it's ATC Model. You must already have suitable AI traffic in the air and must know the ATC model type.

- **Enabled**. Turns on/off the refueling option. This *may* save a tiny bit of CPU if you don't plan to use refueling.
- **Tanker Preset**. Loads a predefined set of parameters describing the tanker options. Modifying these parameters and will save the associated changes to the selected tanker name when the aircraft is saved. These aircraft names are for reference only and don't necessarily correspond to any specific Flight Simulator AI aircraft. They are a name for a set of parameters, nothing more.
- **ATC Model**. Unlike the name, which is just an ACM reference, the ATC MDL option is what's

```
[General]
atc_type=BOEING
atc_model=B738
editable=0
performance="Cruise Speed        \nMach 0.785            477 kts          853 km\/h\n\nEngines      \nCFM56-

Category = airplane
```

  really used to find AI aircraft. Each AI aircraft has a parameter in its associated Aircraft.cfg called atc_model=; This is how the Superbug will find it. If there are multiple aircraft that share the same atc_model, the Superbug will select the first one it finds. So if you want your tankers to be unique, make sure you change their AI atc_models to something uncommon and use that.
- **TACAN** This is the channel you wish to use in order to communicate with the tanker (receive TACAN steering from). When you get in flight, place the TACAN radio into **A/A mode** and enter this channel into TACAN1. If the tanker is found, you'll be able to navigate to its moving TACAN in the HSI.
- **Model Radius**. This is a completely optional parameter used only in the ACM. It sets the graphical scale for the circular (red and grey) couple/uncouple radiuses as well as the hose length described below. Basically it makes the relative size of those graphic elements correspond to the scale of the aircraft image.
- **Couple Radius**. This represents the radius of the refueling "basket" (red circle). The IFR probe must be placed within this radius before refueling begins. Once connected, disconnection will only occur if the *uncouple radius (grey circle)* is exceeded. For best results, this value should be much larger than real-world.
- **Uncouple Radius**. This is the allowable radius, or "slop" distance that is allowed after a connection has been made. If this distance is exceeded the refueling drogue will disconnect. This distance should always be significantly larger than the coupling radius as it represents the normal "slack" in the refueling hose. As with the *couple radius* described above, this should be much larger than anything "real-world."
- **Drogue X Offset**. This is the horizontal drogue/boom offset from the tanker aircraft's model origin. Normally this value should be zero, but if the tanker aircraft has multiple refueling points, one of them may be specified by entering a value here. Negative values are LEFT, positive values are RIGHT.

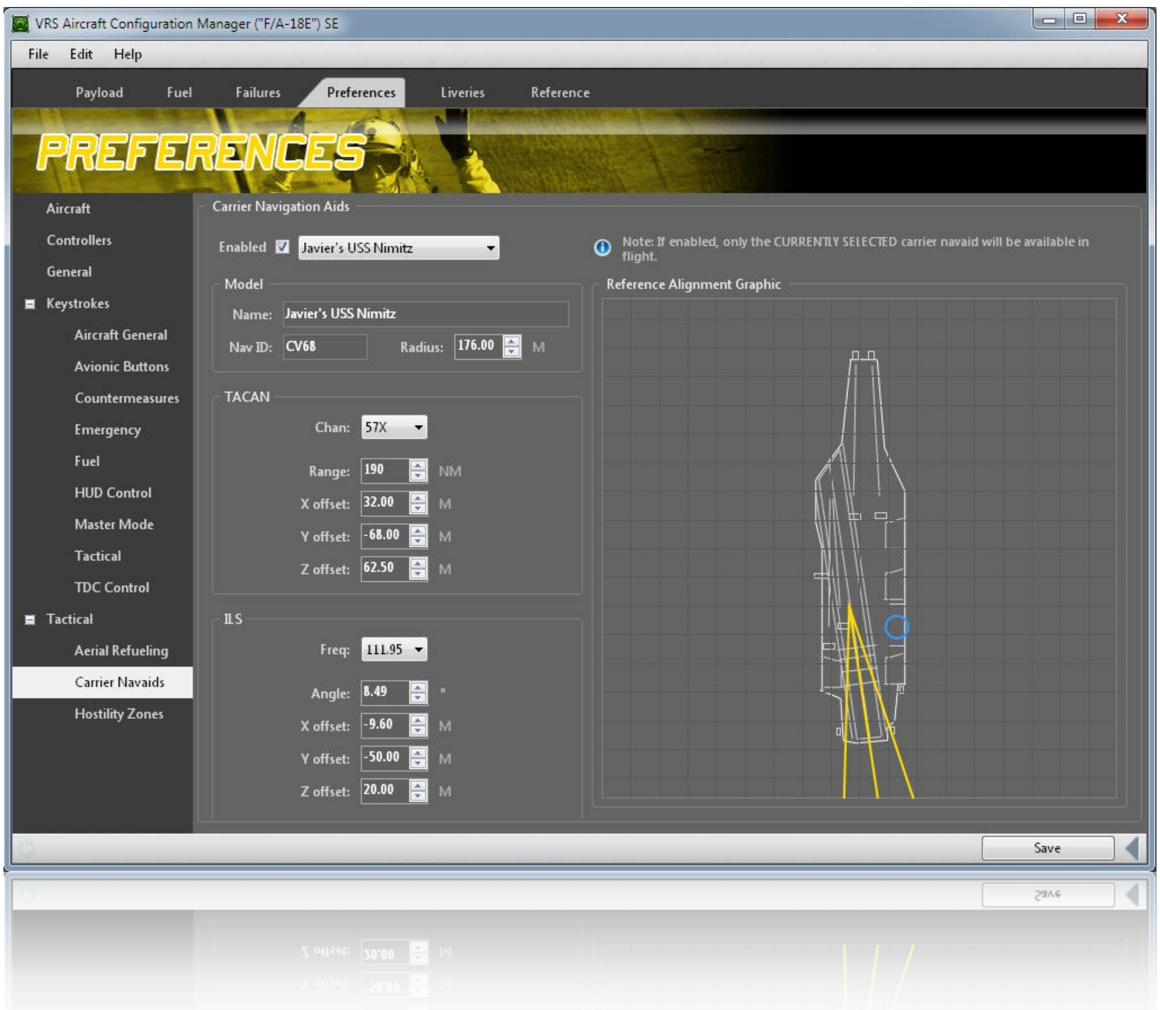
- **Drogue Y Offset**. This is the length of the hose *(blue line).* Negative values are BEHIND the aircraft origin, positive values are in front. This value should never be positive.
- **Drogue Z Offset**. This is the vertical drogue/boom offset from the tanker aircraft's model origin. This value is negative DOWN.

3.7.3 Carrier Navaids

NOTE: These options are not visible and do not apply when the VRS TacPack is installed. All carrier options are handled through the TacPack Manager.

3.7.3.1 Recommended Carriers

VRS does not supply any actual aircraft carriers with this package, however we do have some recommendations. There are many freeware and commercial carriers available, including the Flight Deck Series, the default Acceleration carriers, and a few scattered offerings from other developers. However



the best – THE BEST carrier package by far, is free! The **USS Nimitz** and **USS Eisenhower** by Javier Fernandez. This is a freeware package which exceeds by far the quality of any payware package in existence. The package can be found on various flight simulation sites, including Avsim and FlightSim.com, and the package name is **uss_nimitz_ike.zip**. If you have trouble locating this file, visit the VRS forums and somebody will help you find them. Another noteworthy carrier available for download is the Clemenceau "Le Clem" by Sylvain Parouty. Le Clem is packaged as **veh_cle.zip**. It is also available on Avsim.com and FlightSim.com.

3.7.3.2 Carrier Navigation

The aircraft carriers in FSX do not normally have any navigation aids unless they're static scenery. This includes all the Acceleration carriers which shipped with FSX Acceleration and FSX Gold, as well as the aforementioned freeware carriers. That's a problem, particularly considering they can MOVE! What the VRS Superbug can do is provide those navigation aids for you in the form of moving TACAN and moving ILS. All you need is a few details about the carrier you want to define, and the navigation aids will follow the carrier as it moves.

3.7.3.3 Carrier Definitions

This is not the first time a moving navaid system has been implemented, however ours offers a bit more flexibility by way of custom definitions. Up to 12 carriers can be defined, named whatever you like, and saved with the aircraft files. What you name them is entirely up to you, as it has no bearing on actually finding the carrier. As with refueling tanker names, the name of the carrier is irrelevant.

An aircraft carrier *Definition* is a collection of coordinates that specify the location and frequencies of TACAN and ILS navaids, as well as a radius which is used to find the model in the world. There are several carriers pre-defined in the ACM, including ones for Javier's Nimitz/Ike and the Acceleration carriers.

- **Enabled:** Enables/Disables carrier navaids. Turning these off when you're not using them may save a bit of overhead.
- **Carrier List:** Select a carrier to edit from this list.
- **Name:** The name can be changed for any carrier by editing this field.
- **NAV ID:** This field can contain any 4 character alphanumeric value and this is what you'll see as the station identifier in the HUD and HSI pages to identify the TACAN. It has no functional purpose other than that.
- **Radius:** Unlike refueling tankers, the radius for carriers is critical. This is the only parameter used to locate the carrier in the world. If the Superbug finds more than one carrier with the same radius, it will use the first one it sees. If you don't know the model radius for a carrier, you'll need to get that information from the developer. It is the radius as reported by iTrafficInfo.

3.7.3.4 TACAN

The TACAN station is the primary means of finding the carrier in the world via navigation. It works exactly the same was as land-based TACAN.

- **Chan:** The channel the TACAN radio must be tuned to via the UFCD in order to lock onto the carrier. Tune the radio to this channel, ensure the TACAN radio is ON, and if a carrier with the specified radius is within the range of the TACAN *(see Range, below),* it will appear as a TACAN symbol in the HSI as long as TCN steering is enabled (boxed) in the HSI.
- **Range:** The maximum range of the TACAN station in nautical miles.
- **X offset:** Referring to the image on the previous page of the red circle near the right edge of the carrier, the X-offset represents the horizontal displacement from the center of the ship. Positive values are RIGHT.
- **Y offset:** The longitudinal displacement from the ship's center. Positive values are FORWARD.
- **Z offset:** The vertical height above sea level. Positive values are UP. Note that there is no graphical indication of the z-value in the interactive diagram. The reason this particular example is 62 meters is because the TACAN is located at the top of the "island." So if the height of the deck is 20 meters, and the island is 42 meters (average), that's a total of 62 meters ASL.

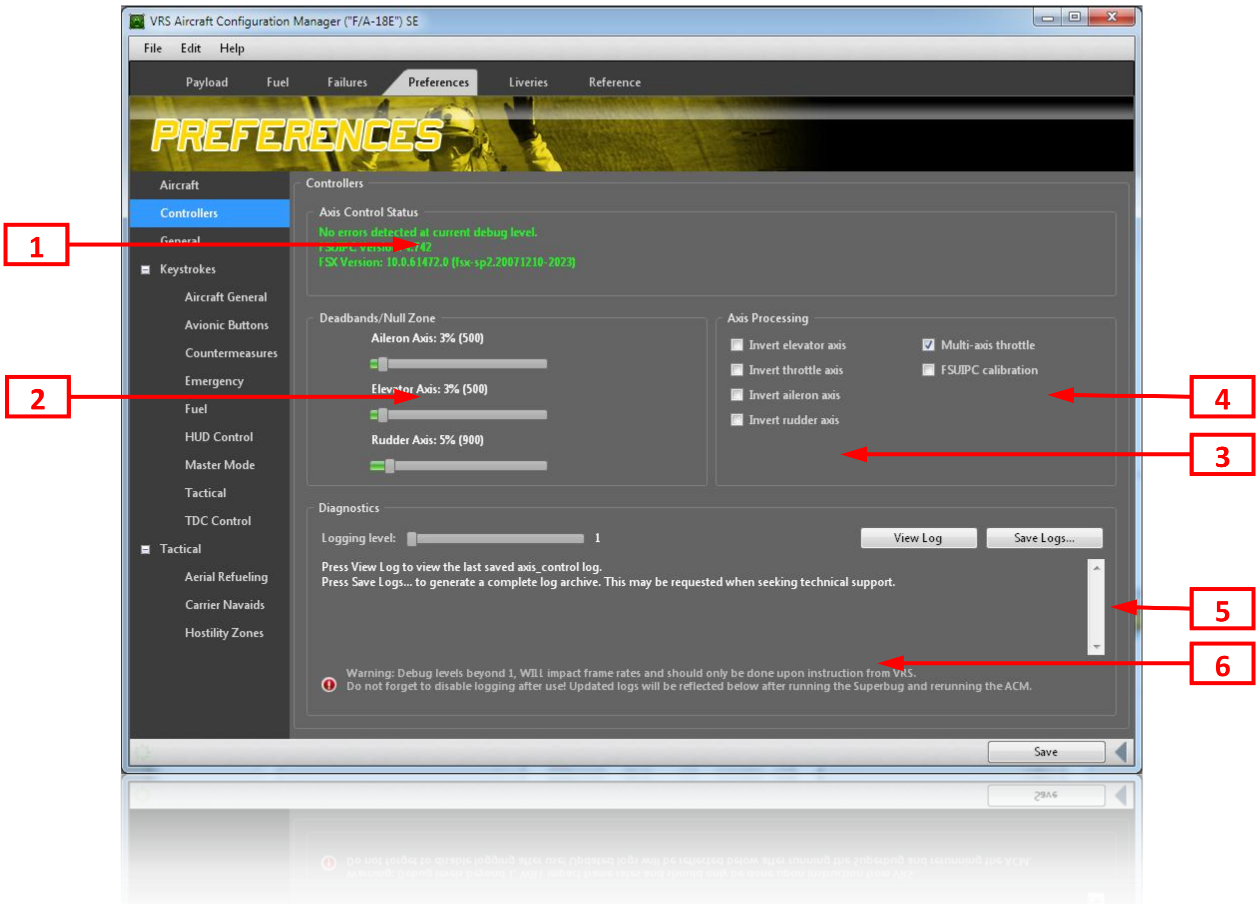
3.7.3.5 ILS

Like TACAN, ILS will move along with the ship. It's essential, particularly on a moving vessel.

- **Freq:** The ILS frequency will automatically be set to the paired equivalent of the TACAN channel if the TACAN channel is changed, however it can be any frequency available from the drop-down list and can be changed at any time. When the ILS is tuned to this frequency and ILS steering is enabled in the HSI. Localizer and glideslope bars will appear in the HUD as long as the signal is valid. **A paired equivalent table is also located in the ACM reference section.**
- **Angle:** The ILS horizontal angle. Positive values are counter-clock-wise. The ILS is represented by a blue fan-shaped object in the interactive diagram. This angle should correspond to the angle of the flight deck landing area.
- **X offset:** Referring to the image on the previous page of the blue fan, the X-offset represents the horizontal displacement from the center of the ship. Positive values are RIGHT.
- **Y offset:** The longitudinal displacement from the ship's center. Positive values are FORWARD.
- **Z offset:** The vertical height above sea level. Positive values are UP. Note that there is no graphical indication of the z-value in the interactive diagram. The 20M example is the height of the deck.

3.7.4 Controller Preferences

This page allows modification of the fly-by-wire deadband and axis assignment as well as option for assisting in debugging problems with the aircraft. The default settings here will be correct for approximately 90% of users, however if one finds that the aircraft is not trimming correctly or that an



axis is completely inverted, these settings can correct the problem.

3.7.4.1 Controller Status Area

The controller status area [1] will display common errors associated with your controllers. Errors will only be reported after a flight in the Superbug and subsequent re-running of the ACM. If errors persist, after having flown the Superbug, you should follow diagnostic procedures as described under *Diagnostics*, below.

3.7.4.2 Deadbands

This area [2] will show a list of all axes to which deadbands can be applied. You should NOT adjust deadbands unless you are sure your controller isn't fully centering. You will know this is the case if for example the aircraft isn't trimming out in a cruse configuration or for example if the BALT autopilot mode won't engage in level flight.

If you believe there's a problem with your controller, first try calibrating the device from your joystick software. NEVER use windows built-in game controller calibration. If the problems persist, AND they are related to centering as described above, begin adjusting the deadband for the affected axis in small increments, flying the aircraft, and making further adjustments only as necessary. Do not adjust any axis unless you have a clear idea of what you're doing and why.

- **Axis Control:** These checkboxes **[3]** allow you to invert the device axes. There are usually no cases where you'll need to do this, except for perhaps throttle, which is not always universal.
- **Multi-axis throttle:** If you have a throttle with more than one handle, you'll NEED to enable this option **[3]**.
- **Use FSUIPC Calibration:** If FSUIPC is installed, and you wish to use it to manage your controllers, you may select this option **[3]**. If you do not have the registered (payware) version of FSUIPC installed, or simply don't know what FSUIPC is, then please leave this option disabled.

3.7.4.3 Diagnostics

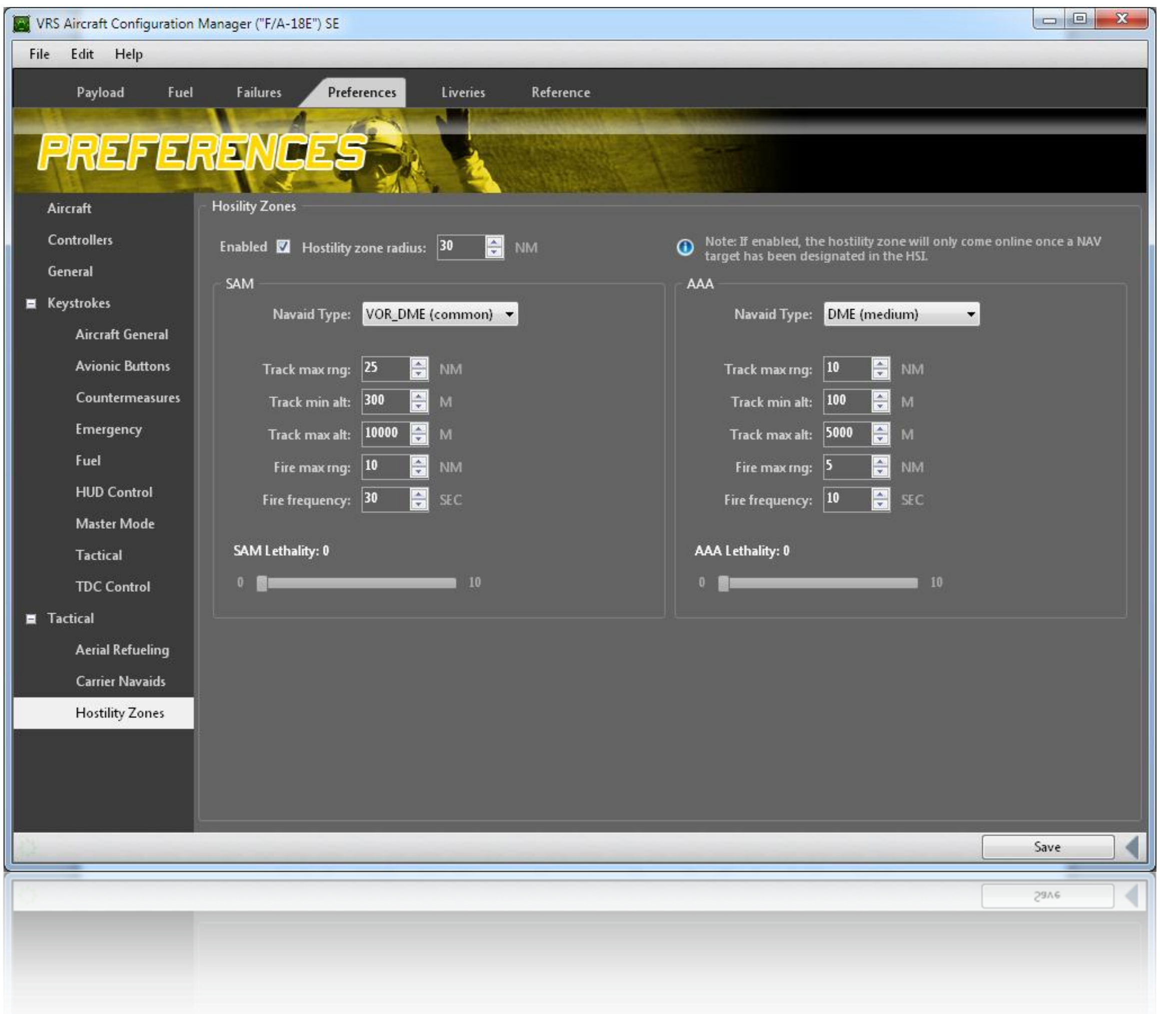
Provides functions for diagnosing and repairing errors.

- **View Log:** Every time you finish a flight, a log with variable levels of verbosity is generated and may be displayed here **[5]**. Only the last flight flown (and quit with **[CONTROL-C]**) will be available. In other words, every time you start a new flight, the old log is cleared and a new logging session is begun.
- **Debug Level:** To increase the logging level, move the *Logging Level* slider to the right **[6]**. In order to properly generate a post flight log, you should quit FSX with **[CONTROL-C].** Note: logging levels beyond 1 WILL impact frame rates, so the logging level should always be returned to 1 after logging is finished. Again, do not change this setting unless asked to do so by support staff.
- **Save Logs:** Using this option will prompt you to select a location on your hard drive to save an automatically generated collection of logs containing Superbug and FSX specific information (and nothing else). This log archive (named VRS_Logs by default), can then be uploaded to our support forums or sent to us via email along with your general description of the problem.

3.7.5 Tactical: Hostility Zones

NOTE: These options are not visible and do not apply when the VRS TacPack is installed.

Hostility zones are areas in which your aircraft becomes vulnerable to SAM and/or AAA fire. The way this works is through different types of navigation aids such as VOR. A hostility zone is always centered on a specific *Navigation Target Waypoint*. These target waypoints are designated from within the aircraft using the *Horizontal Situation Indicator (HSI)*. Once the target waypoint is designated, flight within the user-adjustable radius around that waypoint will be considered "Hostile Territory." The elements that make up a hostility zone are:



- **Enabled**. The hostility zones (both Sam and AAA) are enabled/disabled by checking this box. Even when this option is checked, hostility zones will be inactive until a specific target waypoint is designated via the HSI, and the aircraft is within the hostility *Zone Radius*.

- **Hostility Zone Radius.** The size of the hostility zone. This applies to both SAM and AAA as both threat types can exist within a zone. The hostility zone is centered on the currently designated NAV target; If no NAV target exists, no hostility zone exists regardless of whether threats are enabled or not. Once inside the hostility zone, you are vulnerable to AAW (Anti-Air-Warfare) fire from SAM and/or AAA systems.
- **NAVAID Map.** Maps the selected AAW type to this FS navaid type. Only navaids of this type will act as threats. Note: The navaid types for SAM and AAA systems must be different. Keep in mind VOR_DME is by far the most common.
- **Track Max Rng.** Sets the maximum potential tracking/detection slant range for the selected AAW system. The actual tracking distance will always be less than this value and is based on a number of factors including aspect, altitude and the emission profile of your aircraft.
- **Track Min Alt.** The minimum altitude (AGL) above which the selected system is capable of detecting/tracking aircraft. If the aircraft is below this altitude, the chances of detection are minimal.
- **Track Max Alt.** The maximum altitude (AGL) below which the system is capable of detecting/tracking aircraft. If the aircraft is above this altitude, the chances of detection are minimal.
- **Fire Max Rng.** Sets the maximum engagement/firing range of the system. If the aircraft is being tracked when it falls within this range, the system will open fire. The time it takes a SAM to reach the aircraft varies based on the slant range and closing velocity of the system, however AAA fire will reach the aircraft almost immediately.
- **Fire Frequency.** The time in seconds the system waits before firing again. Essentially this is the reload time for the system. Note that the reload process doesn't begin until the first shot either hits or misses the aircraft. This interval should generally be higher for SAMs than AAA.
- **Lethality.** The maximum potential number of aircraft systems lost as a result of a hit by this AAW type. A value of 0 (inert) will result in no systems damaged. A value of 10 can result in up to 10 systems damaged.

The method for activating hostility zones via the HSI is described in the Tutorial section of manual as part of your flight. You must have a flight plan loaded with WPT steering boxed in the HSI. Using the arrows on the HSI, select which waypoint will act as the center of the hostility zone by designating it with the TGT option. The waypoint will become a TGT WPT and the hostility zone will become active.

3.7.6 KeyStrokes

The keystroke section allows modification of keys for use with *Key Command Mode*. Key command mode is VRS' custom keystroke implementation which allows a vastly expanded number of operations specific to the aircraft. When key command mode is active, all MSFS keystrokes that share the same mapping are overridden. For this reason, and with few exceptions, almost every operation you need to perform from Master Arm, to Ejection, and every button in-between, can used without leaving key command mode.

Key command mode is entered and exited with the default combination of **[SHIFT-CONTROL-M]**. In order to determine if you're in key command mode, press **[TAB]** (default TDC assignment key) and see if the *TDC (target designator control) priority diamond*, located in the upper-right corner of each display, is moving between displays. The TDC priority diamond will be solid if you're in key command mode and hollow if not. The state of key command mode is remembered between flights.

Because key command mode does override MSFS keystrokes, it's important not to interfere with very basic MSFS keys such as those used to change views **[S]** for example, or to quit the simulation **[CONTROL-C].** Most other keystrokes are not a problem, but if you choose to enable our default DDI button keys **[0-9]** and **[CONTROL 0-9],** be advised that they will interfere with your ability to interact with ATC windows as they pop up. You'll need to leave key command mode to deal with them and then switch back.

- **Category:** The Category popup lets you choose a major subset of key commands. These are fairly self-explanatory.
- **Command Mode:** The universal keystroke that enters and exits key command mode.

3.7.6.1 Keystroke Remapping

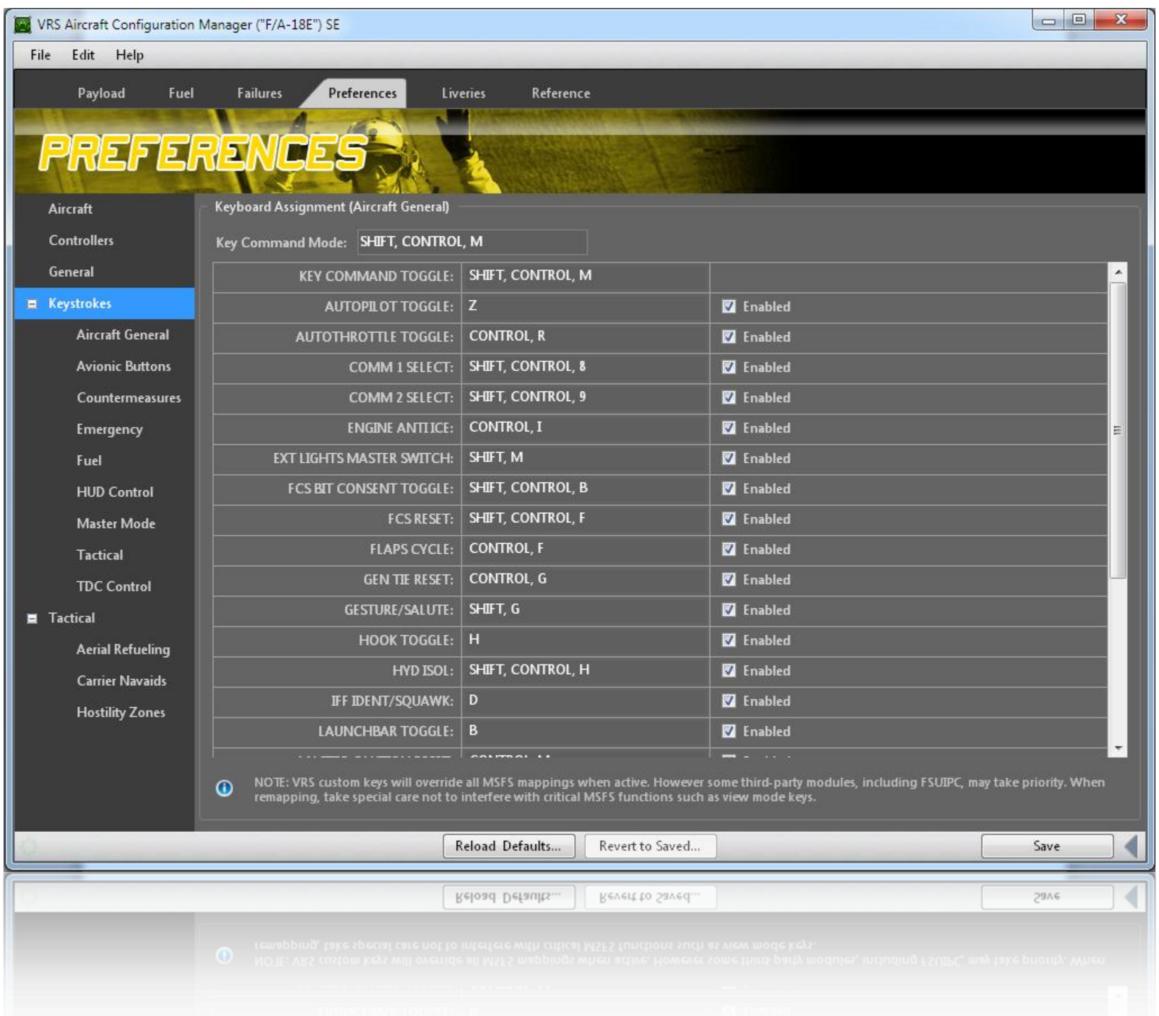
The left column describes the event, the center column allows you to change it, and the right column allows you to enable/disable it.

CAUTION:

PLEASE DO NOT CHANGE THE DEFAULT KEYS UNTIL YOU'VE HAD A CHANCE TO FLY THE TUTORIAL. THE TUTORIAL ONLY USES DEFAULT KEYS AS A REFERENCE.

To change a key, click inside the middle column and type the key(s) which you want to map. Up to 3 keys can be mapped per event by holding down each key in succession. For example press and HOLD **[SHIFT],** and with SHIFT still down, press **[CONTROL],** and with CONTROL still down, press **[LETTER]**. Releasing the keys will set the event unless there's a conflict.

Accepted keys are **[SHIFT]**, **[CONTROL]**, **[TAB]**, **[0-9]** and **[A-Z]**. **[TAB]** cannot be used in conjunction with

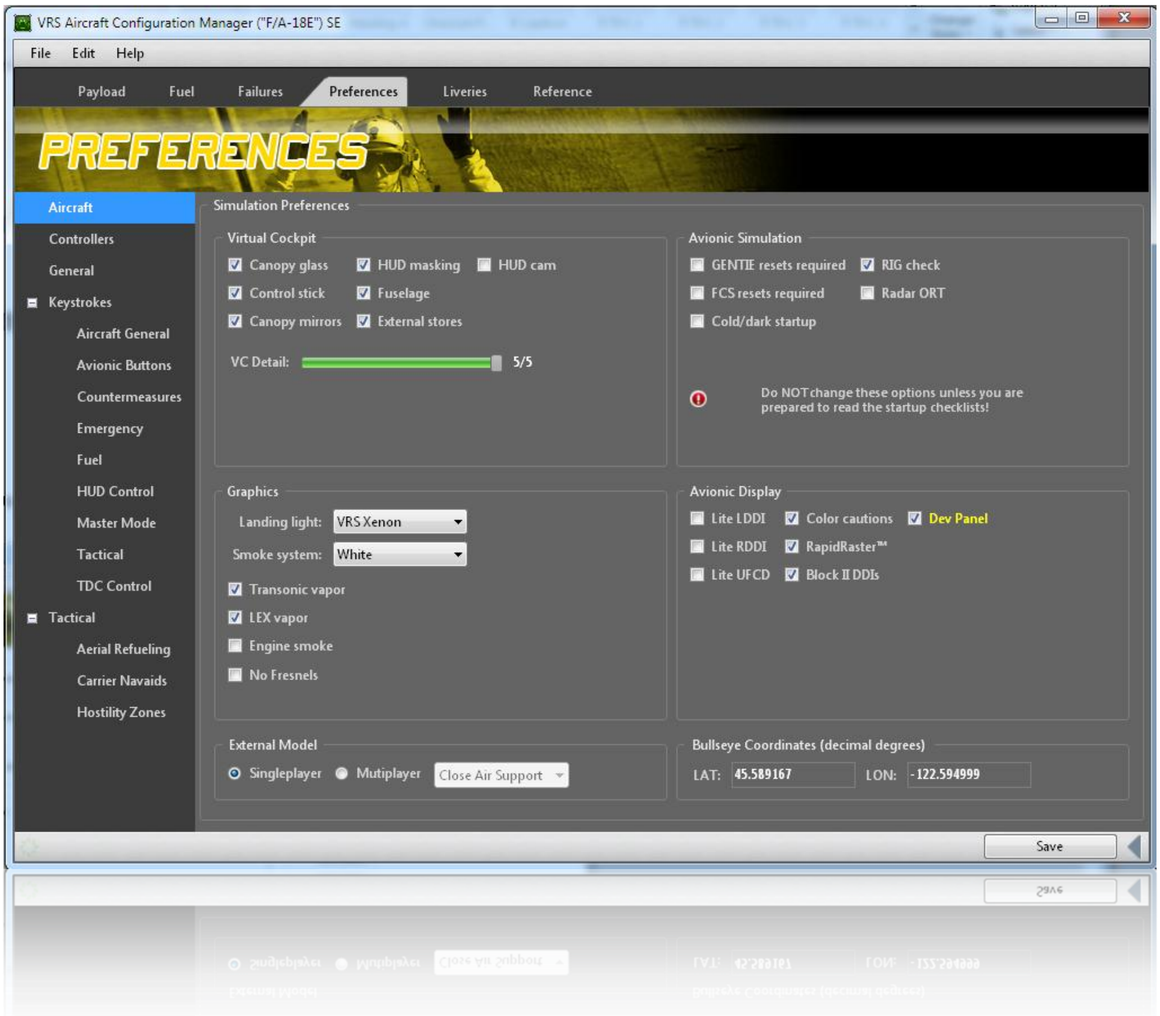


other keys and must be used by itself. The default behavior for **[TAB]** is *TDC Cycle.* **[SHIFT]** and **[CONTROL]** can only be used in combination with other keys and cannot be used on their own or together without a third key present.

In the event of a conflict with another key, a dialog will tell you what the conflict is, and the key will be returned to the original value. In order to resolve the conflict, you must do one of the following:

- Choose a different key/combination.
- Change the conflicting combination.
- Disable the conflicting combination.

3.7.7 Aircraft Preferences



These preferences are divided into several categories as follows:

3.7.7.1 External Model

Note: Model options are not available with the TacPack installed, as the methods for handing multiplayer weapons are fundamentally different, and only one model is used for both environments.

Options for the primary aircraft model:

- **Single Player**. Enables the full *single player model* with all custom animation code. The single player model features a rich set of custom animations, completely customizable loadouts, and incredible weapon launch animations. Although the single player model looks fantastic, it loses much of the custom animation functions when used in multi-player environments. One of the most annoying limitations is that all of your control surface animations, weapon firing sequences, and indeed ALL animations will be mirrored on other people's aircraft if they are also flying the Superbug.

- **Multiplayer**. Enables the *multiplayer model* and simultaneously disables custom loadouts from the Payload tab. A popup for a specific (and fixed) loadout will be enabled when the multiplayer option is selected. This loadout cannot be changed via customization.

  The multiplayer model is specifically designed for both high-performance and maximum possible functionality in multiplayer sessions. Since custom variables and events are virtually impossible to pass through the multiplayer pipeline, a number of concessions and techniques were used to allow as much shared animation as possible. One of the most important abilities is being able to see what the other Superbug players have loaded on their aircraft instead of a mirrored version of your own aircraft's ordinance as is the case when using the single player model. The multiplayer model will correctly show what your comrades (or enemy) is carrying as long as they are also using the multiplayer model. The drawback is that you will NOT be able to see animated weapons after launching. They will remain statically attached to the aircraft at all times.

  Other features include the ability to see the aerial refueling store on other aircraft extend and retract, as well as IFR probes.

  LODs are also incorporated into the multiplayer model to allow much better performance when multiple superbugs are flying, and to help improve visibility on distant aircraft.

3.7.7.2 Virtual Cockpit

Options which only affect the virtual cockpit (if selected for use):

- **Canopy Glass**. Canopy glass uses reflective materials which may reduce performance on some systems. If you experience performance issues in the VC, try disabling this option.
- **Canopy Mirrors**. Adds faux rear view mirrors to the canopy frame.
- **Control Stick**. The control stick is positioned in the VC such that it can obscure a portion of the HSI, making it difficult to see. Although all HSI functions are available from the DDIs, disabling this option may be preferable. Note: this can also be done in flight by clicking on the base of the control column.
- **Fuselage**. This option controls the display of external aircraft parts such as wings, fuselage, air brakes and tail surfaces which would be visible from VC cockpit. Although the displayed parts are fairly lean in terms of geometry, additional textures must be loaded, and this will increase draw calls, which are especially critical in multi-player environments.
- **External Stores**. If external aircraft parts (above) are enabled, this option will add weapon geometry to the wing tips and outer pylons which would be visible from the VC. Note that these

weapons will correspond to your current loadout. Disabling this option will improve performance in the VC.

- **HUD Camera**. The HUD camera is a small device located just in front of, and below the HUD. It can potentially obscure the velocity vector, particularly at approach airspeeds. The HUD camera can be clicked to make it invisible in flight, but must be re-enabled from the ACM.
- **VC Detail**. The VC detail slider adjusts the level of non-functional "eye candy" used throughout the VC. Level 1 provides good basic detail. Level 5 adds the smallest details such as nuts and bolts (at a significant cost in additional geometry).

3.7.7.3 Avionic Display

With the exception of *Cold/Dark Startup*, these options can rescue some frames by reducing the amount of code in avionic displays.

- **Lite LDDI**. Removes some tactical [TAC] functions (including radar display) from the LEFT DDI. Generally the LEFT DDI is used for support functions in RL. Enabling this option will remove redundant radar functions which are available on other displays. This will free resources, improving frame rates.
- **Lite RDDI**. Removes some support [SUPT] functions (including the HSI display) from the RIGHT DDI, freeing resources. Generally the RIGHT DDI is used for tactical functions in RL. Enabling this option will remove redundant HSI functions which are available on other displays. This will free resources, improving frame rates.
- **Lite UFCD**. This option removes all DDI functions from the UFCD. Since the DDI mode is redundant with a functioning LDDI and RDDI, it is recommended that you leave this option checked (light version). The DDI functions use a tremendous amount of resources and this will improve performance.
- **Block II DDI**. This option switches between the older green displays (Block I), or the newer white displays (Block II) for the left and right DDIs. The older green displays have a slightly better contrast ratio in the simulation, and less tendency to exhibit "rainbow" edge artifacts.
- **Color Cautions**. This option uses yellow cautions in the DDIs in order to increase contrast and thereby clutter. Although the real aircraft does not do this, we suggest you enable this option, at least while you're learning.
- **RapidRaster**. RapidRaster is a VRS technology which allows for real-time display an updates of FSX GPS-engine-driven displays such as moving map. As of this writing RapidRaster is still a beta option and it will reduce framerates somewhat.

3.7.7.4 Avionic Simulation

Note: These options are NOT available with less than 1 engine hour. This is a safeguard which we were forced to put into place because people were not following/reading instructions prior to using them and subsequently sought technical support as a result. DO NOT USE THESE OPTIONS UNLESS YOU ARE PRPARED TO READ THE STARTUP CHECKLISTS!

- **Cold/Dark**. The "cold and dark" option initializes the aircraft with both engines and all powered systems (including flight control) off. This option only affects flights which start on the ground.

CAUTION:

DO NOT USE THE COLD/DARK OPTION UNLESS YOU ARE PREPARED TO START THE AIRCRAFT MANUALLY!

- **GENTIE resets required**. This option requires resetting the generator bus tie circuitry in the event of improper startup procedure, or after single-engine shutdown. (see startup checklists). The GENTIE reset button and key equivalents are discussed in the *Aircraft* and *Keyboard* sections respectively.
- **FCS Resets Required.** Just as with GENTIE, the Flight Control System (FCS) must be manually reset under certain conditions. Failure to reset the FCS means the flight control surfaces will NOT operate. The FCS Reset button and key equivalents are discussed in the *Aircraft* and *Keyboard* sections respectively.
- **Rig Check**. Rig check is a master caution which will illuminate with weight on wheels before the aircraft "sees" the flight controllers. In order to eliminate the RIG CHECK caution, all flight controls must be moved. RIG CHECK will also annunciate if *General Aircraft Realism* is not set to 100% under FSX Preferences. This caution is there to help catch issues with controllers and or the flight model and should not be disabled until you are sure your controllers are responding properly.
- **Radar ORT**. Radar Operational Readiness Testing (ORT) is a phase or warm-up period during which time the radar performs a number of internal tests and prepares the receiver/exciter components for full duty. ORT occurs whenever the radar is powered up via the SENSOR control panel on the right console (see *Aircraft*). The ORT can be a timely process and is therefore disabled by default. If you would like to be as realistic as possible, enable this option after you've got a few hours under your belt.

3.7.7.5 Graphics

- **Landing Light**. VRS has licensed A2A Shockwave™ 3D landing lights for use in the VRS Superbug. These lights are volumetric and highly authentic, especially in low visibility, high moisture conditions. However if you wish to disable the volumetric effect, you may do so here. The default landing light is a model-based Fresnel light developed by VRS that's not too shabby either, and may work better for some.
- **Display Smoke**. Allows selection of white, red, or blue smoke for the default aerobatic smoke system. Note that the default key for the display smoke system in FSX is **[I]**, and this is used in

key command mode for the IFR probe. You will either need to leave key command mode or remap the IFR probe before smoke can be used with the default **[I]** key.

- **Engine Smoke Effect**. Enables faux "heat blur" and mild exhaust effects. Frankly, we suggest you leave it off because these types of effects are just not a substitute for true heat blur. They are also performance intensive.
- **LEX Vapor Effect**. Provides alpha-based geometry that simulates vapor condensation over the leading edge extensions and wings.
- **Transonic Vapor Effect**. Provides alpha-based geometry that simulates the transonic vapor cone characteristic of the F/A-18.
- **No Fresnels**. Fresnel ramps and certain blending modes used in the virtual cockpit (for example in the HUD) have been known to cause issues with some older Nvidia cards. Enabling this option will provide an inferior quality display with a more backward-compatible blending method for older cards. If your HUD is not visible and you KNOW the power is on (it will be unless you turn it off), then use this option and see if it makes a difference. If not, use the *Save Logs* option from *Preferences→Controllers* and upload it to Support along with a description and screenshots of the problem.

3.7.7.6 Bullseye Coordinates

Note: These options are not available with the VRS TacPack installed, as the bulleye (A/A WPT), is user-selectable as part of the TacPack's more advanced avionics suite.

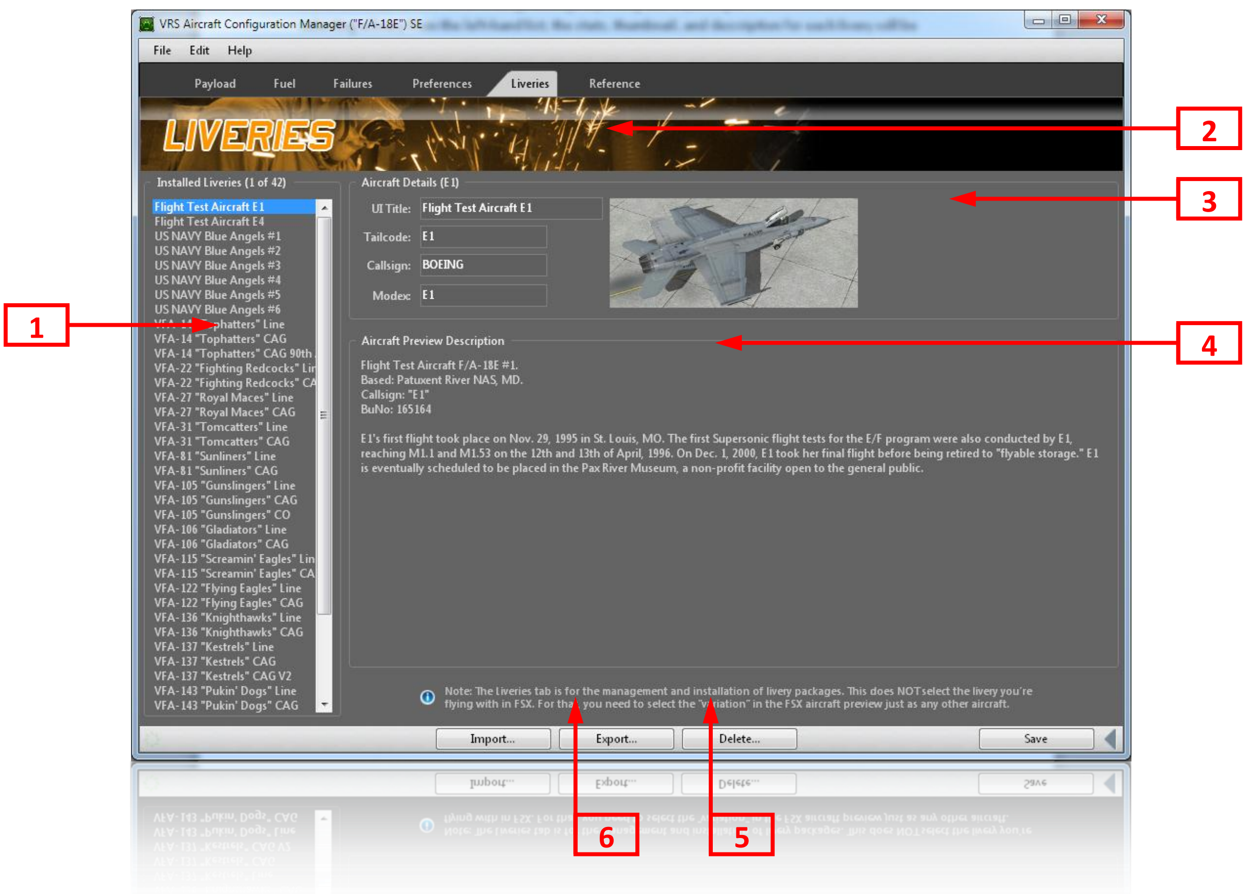
The Bullseye is an arbitrary (and usually secret) point near a battle space that tactical air groups use as a reference point when referring to hostiles or as a rendezvous reference. In the VRS Superbug, the Bullseye can be seen on the radar and HSI formats when it is within the range scale of the display. When the TDC cursor is moved in the display, the TDC's location relative to the Bullseye is shown. For example moving the TDC cursor over a target will show the targets relative location to the Bullseye, and this can be reported to other members so they'll know where to find it. The Bullseye is a circular symbol with an arrow extending from it. The arrow always points north.

3.8 LIVERIES TAB

The liveries tab allows the browsing, editing, importing and exporting of installed texture sets. After selecting a livery from the left-hand list, the stats, thumbnail, and description for each livery will be displayed. This information can be edited and saved along with the aircraft file.

3.8.1 Installed Liveries

To choose a livery, select it from the list on the left-hand side of the screen **[1]**. Right-clicking the selected livery will bring up a context-menu which allows for deleting, and moving the livery order within the list. Note that deleting a livery is permanent. No backup copies of the liveries are stored in your installation. Once this action is confirmed the aircraft will automatically be saved. There is no going back!



3.8.2 Aircraft Details

Aircraft details **[2]** such as the title as shown in the FSX preview window, air traffic control ID and other aircraft-specific data may be edited here. Note that changing the tail code or flight number will NOT graphically affect the aircraft in any way. We suggest you leave these settings alone unless you are creating new textures as part of a repaint project. See the Paint Kit documentation for complete details.

A thumbnail image **[3]** will appear if a correctly named .jpg image exists within the texture folder. The .jpg image should be named exactly the same as the texture folder that contains it.

- **Aircraft Title**: The title as it will appear in the FS aircraft preview pane.
- **ATC ID:** The ID used by air traffic control. For US aircraft, this should generally be the 2 letter carrier air wing identifier, followed by the modex (explained below).
- **ATC Airline:** The ATC system will use the specified airline name with this aircraft. This field can be used in conjunction with EditVoicepack (EVP) to create unique radio audio for your aircraft. Please refer to the EVP documentation for installing and using EVP in conjunction with this aircraft.
- **Flight Number:** This option should correspond to the "modex", located on the nose and wings of US naval aircraft. Note that changing this value will not graphically change the textures on the aircraft.
  The first digit of a modex indicates an aircraft's squadron within its carrier air wing. Modexes beginning with 1 or 2 were assigned to fighter squadrons (VF) until the F-14 Tomcat was retired. Today they are assigned to strike fighter squadrons (VFA) flying the F/A-18E/F Super Hornet. Modexes of 3 and 4 also refer to attack aircraft, including the Hornet, and formerly the A-7 Corsair.

3.8.3 Aircraft Description

As with the aircraft details, the description **[4]** appears within the FS preview window just prior to flight. This information can be freely edited, but again, we do not suggest you do this unless you're making a conscience effort to produce liveries for redistribution.

3.8.4 Export Livery

The Export Livery option **[5]** will take the currently selected livery and export a compatible *Livery Pack* (distribution folder) to the location you choose. This option is mainly designed for repainters who wish to redistribute custom paints which are currently installed and tested. The resulting redistribution folder can then be compressed and uploaded to your favorite site.

3.8.5 Import Livery

This option allows you to automatically import a compatible livery pack (texture folder) directly into the aircraft folder. Liveries will often be available for download from sites such as Avsim.com or Flightsim.com. Once downloaded and unzipped, these properly formatted folders can be browsed to and imported automatically by using this option.

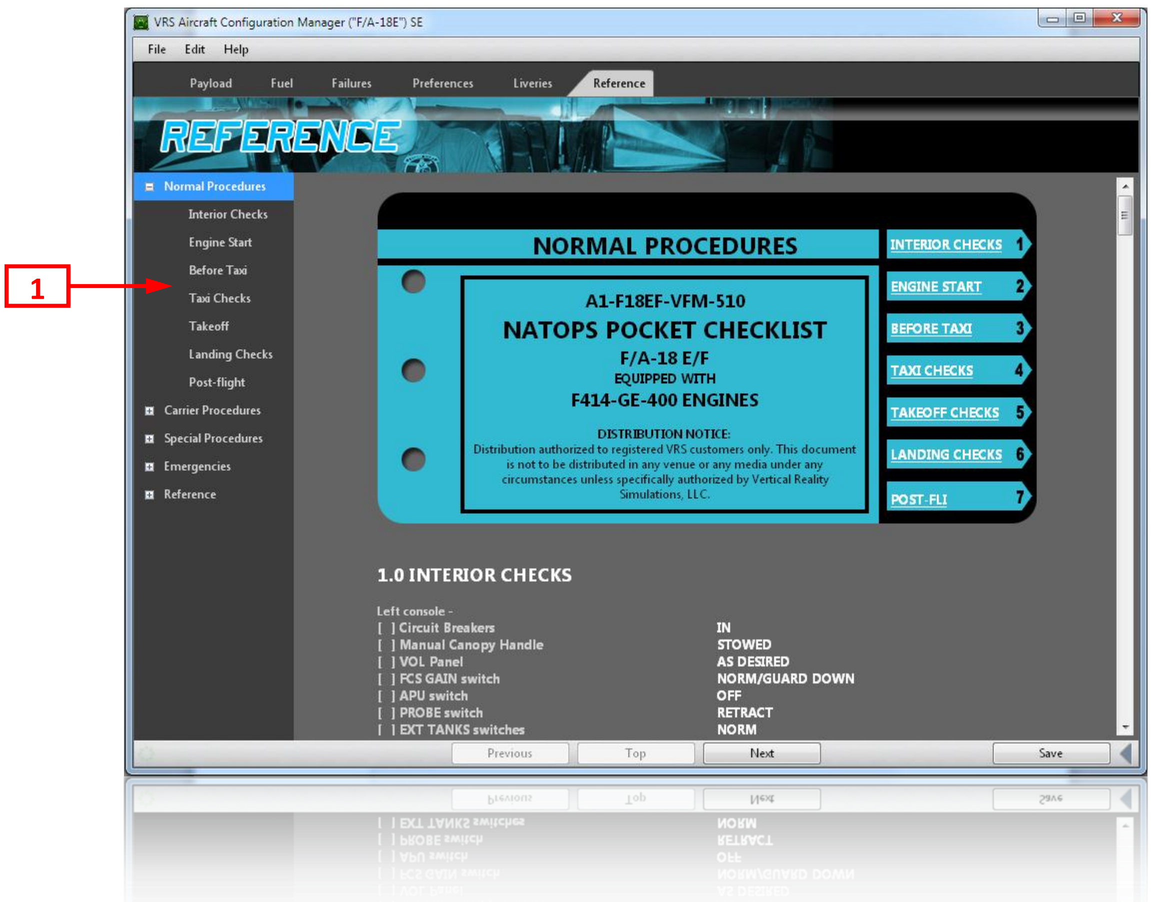
Any missing "generic" textures including VC textures can be copied into the new texture folder during import. The complete specs for building a livery pack are explained in the Paint Kit documentation available from the VRS support forums.

3.9 REFERENCE TAB

Fairly self-explanatory, the reference tab allows you to view the kneeboard checklist and reference data in HTML format. This is a more robust version of the checklist that is available in flight. The FSX inflight kneeboard functionality was heavily gimped in FSX compared to the FS9 version. Virtually all standard HTML functions, including bookmarks and even hyperlinks were disabled.

Click the document you wish to view from the left sidebar

3.9.1 Checklist



The checklist contains procedures ranging from carrier operations to in-flight emergencies. To access the data, click on one of the categories listed along the left of the reference section sidebar.

3.9.2 Reference

The **Reference** category *(left sidebar)* contains a list of *paired TACAN channels/frequencies*. Look up the frequency you wish to find the paired TACAN channel for, and use that channel to tune to the navaid via the UFCD. This list may be printed by right-clicking and selecting Print…

3.9.3 Keyboard

The reference section also contains a list of the default keys available in the Superbug. For more detailed information on keystrokes, see section 11: *Keyboard*.

4 THE AIRCRAFT

Aircraft Introduction by William Call, NAS Patuxent River

4.0.1 THE NAVY'S DILEMMA

Why did the Navy procure the Super Hornet? There really isn't one single reason; instead, it was a sequence of events. The aging A-6 Intruder was going to get a new lease on life by getting a new wing. Unfortunately, the A-6 re-wing program did not work out, so it was canceled. This opened the door for the navy to procure a new stealth attack aircraft, designated A-12 Avenger. At that time, Secretary of Defense Richard Cheney did not like the way the A-12 program was going. So he canceled it, leaving the navy with only the F/A-18A/B/C/D to carry out its attack missions. During this same time period, the Air Force was conducting a competition for its next generation fighter, called Advanced Tactical Fighter

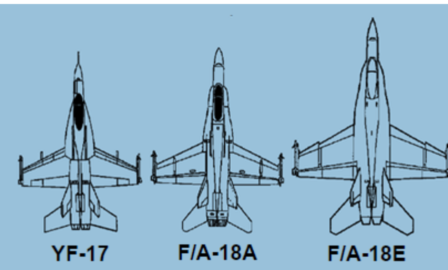
Figure 1: E1: The First Super Hornet

(ATF). There was a Navy version called the Navy Advanced Tactical Fighter (NATF), which was targeted to replace the F-14 Tomcat. Due to cost, schedule, and design weight, the Navy terminated the NATF effort. This left the Navy with an aging F-14 fleet, which was requiring a high number of maintenance man hours per flight hour. The navy decided to retire the F-14 after over thirty years of service. These events left a major void in the navy's airwing capabilities. McDonnell Douglas (now Boeing) recognized this void and submitted a proposal for an aircraft that could do the fleet defense mission of the F-14

Tomcat and have the capability to carry out attack missions. This proposal focused on meeting the navy's budget and schedule requirements, while delivering an aircraft that could do these missions with increased survivability. From this proposal the F/A-18E/F Super Hornet was born.

4.0.2 THE SUPER HORNET

The Navy could ill afford the cost and schedule impact that a new "clean sheet" aircraft design would bring. So the strategy was to procure an improved design of the F/A-18 Hornet, called Super Hornet. Although the aircraft is essentially a larger version of the Hornet, that's where the similarities end. Compared to the Hornet, the Super Hornet has a 34 inch fuselage extension, 25% larger wing, two additional weapons



Dimensions	YF-17	F/A-18A	F/A-18 E
Span (without missiles)	35.0ft	37.6ft	42.9ft
Length	56.0ft	56.0ft	60.2ft
Height	14.5ft	15.3ft	15.8ft
Tail span	22.2ft	21.6ft	23.3ft
Wheel track	06.9ft	10.2ft	10.45ft
Wing area	350sq ft	400sq ft	500sq ft
Weights			
Empty	17,000lb approx.	21,830lb	30,600lb
Fighter configuration	23,000lb	34,700lb	47,900lb

Figure 3: F/A-18 Comparison

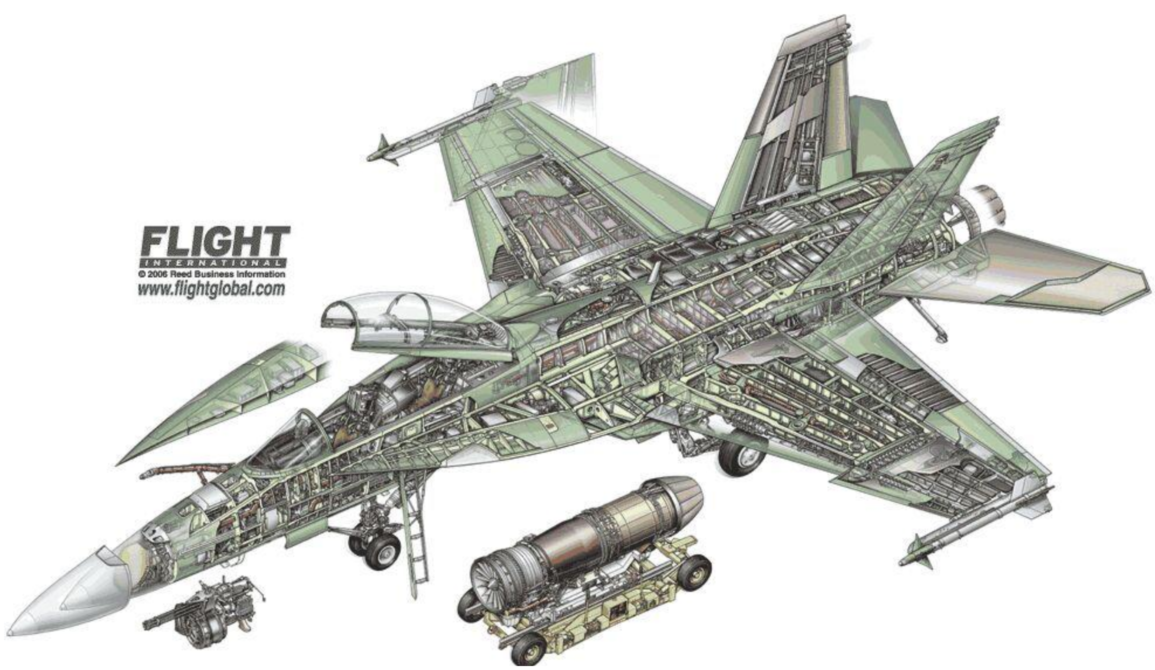
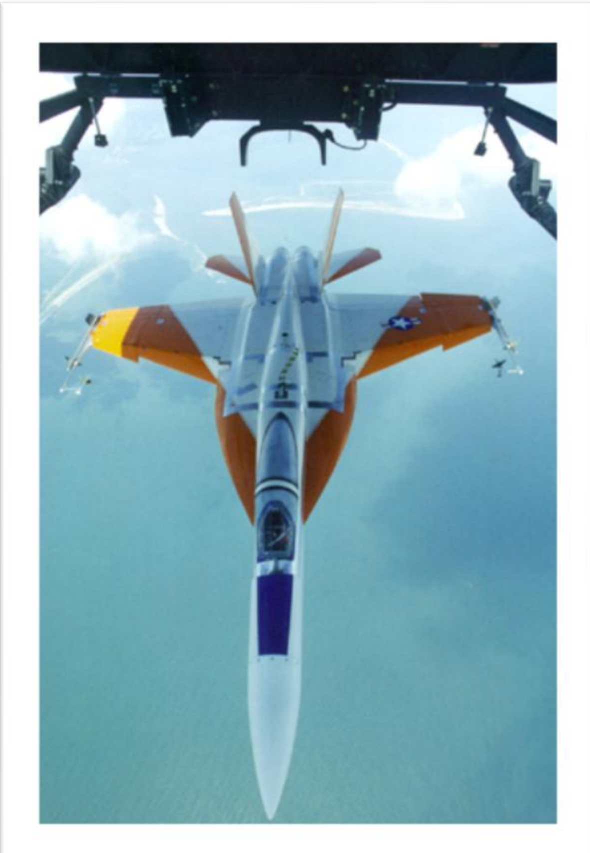


Figure 2: F/A-18F Cutaway (Flight International)

stations, 33% additional internal fuel, 15% larger vertical tail, and a 54% larger rudder.



A completely redesigned engine intake of trapezoidal configuration replaces the D-shaped intakes of earlier Hornets. These intakes provide 18 percent more air to the up-rated engines, giving better performance at high speed. ***Figure 2*** shows a comparison of the Super Hornet to the Hornet. In addition to the geometrical differences, the Super Hornet has a higher thrust General Electric F414-GE-400 engine, improved APG-79 radar, a fly by wire, quadruplex redundant flight control system (FCS), and a larger, stronger, landing gear, featuring the first production use of Aeromet 100 steel (an alloy steel). ***Figure 3*** shows a phantom view of the F/A-18E, illustrating the internal arrangement of the aircraft. The cockpit of the Super Hornet is very similar to the Hornet's cockpit. The biggest differences are the addition of a touch sensitive Up-Front Control (UFC) Display, new engine fuel display, and a larger liquid crystal multipurpose color display. When the Super Hornet was developed, a lot of emphasis was placed on survivability. Redundancy was built into the electrical system, hydraulic system, and flight control system. In fact, the flight control system has the ability to detect and correct for battle damage. Another aspect of the increase in survivability is the reduction in radar cross section (RCS). Geometric properties known as planform alignment, serrated edges, blade seals for door edges and control surfaces, radar absorbing material (RAM) coatings, laser drilled screens and vents, and an inlet device contribute to reduce the RCS of the Super Hornet.

The F/A-18E/F has an improved countermeasures system which is centered on the integrated defense countermeasures system, designated ALQ-214. This suite includes the enhanced ALR-67(V)3 radar warning receiver, the ALQ-214 countermeasures system and the fiber optic towed ALE-55 deceptive jammer. The number of flare/chaff dispensers of the ALQ-214 was doubled to 120 units.

The later production Super Hornets are equipped with the Joint Helmet Mounted Cueing System (JHMCS). This system uses a magnetic head tracker attached to the helmet that can synchronize the pilot's head movements so that he/she can train the aircraft's radar, infrared sensors, and weaponry simply by looking at the target and pressing a button on the control stick. It should be especially effective when it is integrated with the AIM-9X high off boresight air to air missile. It will no longer be necessary to maneuver the aircraft into the effective seeker arc of the missile in order to launch a missile and have it hit its target. Another targeting system that the Super Hornet uses is a system known as the ASQ-228 Advanced Tactical FLIR (ATFLIR). The system uses a forward looking infrared and laser spot tracker, and a laser designator to acquire and identify targets. This system allows for the use of greater stand-off distance weapons such as JSOW and high precision air to ground weapons such as JDAMs.

The Super Hornet can carry the Shared Reconnaissance Pod (SHARP), an all weather reconnaissance system that is contained in a pod that is carried on the centerline station. This reconnaissance system replaces the TARPS unit that was carried on the F-14. By carrying four underwing 480 gallon fuel tanks and a centerline A/A42R-1 aerial refueling pod, the Super Hornet can carry out the aerial refueling tanker mission. Other missions that the Super Hornet is capable of performing are the maritime air superiority mission, air combat fighter mission, fighter escort mission, reconnaissance mission, close air support mission, air defense suppression mission, day/night attack mission, and all weather attack mission.

4.0.3 DEVELOPMENT AND TESTING

The first flight of the Super Hornet was on 29 November 1995. Eventually there would be 5 single seat E models and 2 tandem seat F models at the Navy's flight test center at Patuxent River, Maryland, see *figure 4*. The Navy's principal research, development, test, and evaluation for naval aircraft, along with the Navy Test Pilot School are located at Patuxent River. As part of the Navy's development testing, carrier based aircraft are evaluated using Pax River's catapult and arres ting gear facilities. An example of E3

Figure 4: E3 Configured as a G (field arrestment)

configured as a G aircraft, trapping with an asymmetrical store load out, is illustrated in ***figure 5***.

Engineering and Manufacturing Development (EMD) testing started in February 1996 and consisted of 3100 flights and 4600 flight hours. One of the early EMD test aircraft was E4, shown in ***figure 6***.

Figure 6: E4

Aircraft E4 did the high AOA testing, spin testing, flying qualities and performance testing, weapon delivery and accuracy testing, and had the distinction of flying the 1000th Super Hornet flight hour. Several deficiencies were uncovered during the development testing, among them were: Horizontal tail delaminations, sub system component failures in the vertical tail, engine turbine blade failures, store separation issues, and uncommanded wing drop. These deficiencies were eventually rectified. The horizontal tail delaminations were fixed by adding fasteners to attach the composite skins to the substructure. Vertical tail sub systems were redesigned and requalified to the Super Hornet environment. The failed F414 turbine blade was a redesigned blade that was part of a weight reduction program. The fix was to go back to the original turbine blade design. Store separation analysis indicated that some bombs might collide with the side of the fuselage or with other bombs when released. This phenomenon is brought on by adverse airflow created by the airframe. To cure this problem, the underwing pylons were towed three degrees outboard.

Another problem that was encountered during development testing was wing “droop”. Basically, the problem was caused by airflow separating on one wing before the other, and it typically occurred while the aircraft was maneuvering at high angles of attack and at high g-forces. The solution to this problem was the addition of a porous wing fold fairing on the upper surface of the wing. Although the porous wing fold fairing eliminated wing drop, buffet and airframe stress were increased. During the early design phase of the Super Hornet, a pair of LEX vent control surfaces were added to the design. Wind tunnel data showed that the Super Hornet would benefit by opening these vents, to improved high speed turn performance and to break up vortices that were shed from the LEX at high angles of attack, thus sparing the vertical tails from the harsh buffeting environment that the F/A-18A experienced. Unfortunately, these benefits did not materialize during the development flight testing. So, the LEX vents were removed from the Super Hornet early in the test program.

The last flight of EMD testing was on April 30, 1999. Full Rate Production (FRP) of the F/A-18E/F Super Hornet began on February 2, 2000. In August 2003, flight testing of several aerodynamic configurations began, known as the Transonic Flying Qualities Improvement (TFQI) program. The goal of the TFQI program was to reduce the increased buffet and airframe stress that the porous fairing brought on. A configuration consisting of a 5 inch tall full chord wing fence, solid wing fold fairing, saw tooth leading edge, and aileron boundary layer trips ended up being the final fix. Unfortunately, the cost and time required to retrofit the entire F/A-18E/F fleet was prohibitive. However, the TFQI fixes would be introduced on the production line for the EA-18G Growler.

4.0.4 FLEET DEPLOYMENT

The first operational unit to get the Super Hornet was VFA-122, based at NAS Lemoore, California. This unit received their first seven planes in November 1999. This was to be the Fleet Replacement Squadron (FRS), which meant that it had the responsibility for developing the training program and for developing the tactics that would be used by Super Hornet pilots. The Super Hornet received its first taste of combat with VFA-115. VFA-115 initially flew missions over Afghanistan in support of Operation Enduring Freedom, but never expended any ordnance. Because of the increased "bring-back" capability of the Super Hornet, most of the unexpended ordnance could be recovered aboard the carrier to be used another day. In Operation Southern Watch the squadron expended 22 JDAMs against 14 targets, marking the first time that the Super Hornet dropped ordnance in anger against an enemy. The squadron also participated in Operation Iraqi Freedom, during which they dropped laser guided precision bombs and GPS guided JDAMs. Also, during these missions, some of the VFA-115 Super Hornets were equipped with the centerline A/A42R-1 aerial refueling store, which they used to refuel other members of their squadron. The squadron dropped more than 380,000 pounds of ordnance during Operation Iraqi Freedom. In addition to the three test squadrons (VX-9 Vampires, VX-23 Salty Dogs, VX-31 Dust Devils), the squadrons listed below have transitioned to the F/A-18E.

Figure 7: 5 Wet

4.0.5 VARIANTS

The F/A-18E/F is manufactured as a single seat E model or a tandem seat F model. The two seat F model has a missionized rear cockpit, allowing the weapons system officer (WSO) to conduct two missions simultaneously such as air to air combat and precision attack of multiple ground targets. It can also be

Figure 8: Growler F

configured as an aerial refueling tanker by carrying four underwing 480 gallon fuel tanks and a centerline A/A42R-1 aerial refueling pod (commonly called five wet). ***Figure 7*** shows an aircraft configured with the five wet load out. In this configuration, the Super Hornet is capable of carrying 29,000 pounds of JP-5 jet fuel. Another variant of the Super Hornet is the reconnaissance variant, when configured with a centerline SHARP pod. The latest member of the Super Hornet family is the EA-18G Growler, a two seat electronic warfare aircraft. ***Figure 8*** shows an EA-18G aircraft, note the wing fence and saw tooth leading edge, which are part of the TFQI program.

4.0.6 THE FUTURE

Early production Super Hornets were equipped with the Hughes APG-73 radar. Beginning with production Block 2, (September 2002), the Super Hornet's radar was upgraded to the APG-79 (AESA). Although the Super Hornet is relatively new, the navy is already thinking about a structural life assessment program (SLAP) that would assess extending the operational life from 6000 hours to 12000 hours. Foreign military sales of the Super Hornet are being actively pursued. The government of Australia has agreed to purchase 24 F models and the Indian government is reviewing the Super Hornet as part of their future fighter/attack aircraft. The U.S. Navy foresees a strike fighter shortage before the F-35C is operational in 2015. Current estimates are 69 F/A-18 Super Hornets will be needed to bridge the strike fighter gap.

4.1 FLIGHT CHARCTERISTICS

The flight Control System (FCS) in the VRS F/A-18E enables handling that provides “virtually carefree” maneuvering through most of the flight envelope. As such, there are some flight characteristics which are somewhat unique to the F/A-18E. A thorough understanding of these flight characteristics along with the details of the flight control system described in subsequent sections, allows the pilot to safely and effectively exploit the full capabilities of the airplane.

4.1.1 Flight Control Modes

Handling qualities differ depending on which *Flight Control Mode* the FCS is operating under. FCS mode is determined primarily by the FLAP switch position: *Powered Approach (PA)* mode is entered with the FLAP switch in HALF or FULL and airspeed under 240 KCAS. *Up/Auto (UA)* mode is entered with the FLAP switch in AUTO or airspeed above 240 KCAS. If airspeed is above approximately 240 KCAS, the flight controls switches to, or remains in, UA mode regardless of FLAP switch position.

4.1.2 PA (Flaps HALF or FULL) Handling Qualities

The FCS uses rate feedback for AOA and pitch with flaps HALF or FULL. Handling qualities are excellent up to approximately 14° AOA. Maximum AOA at full aft stick with flaps HALF or FULL is approximately 25° AOA. Because FLAPS down handling qualities begin to degrade above 14° AOA, particularly with abrupt inputs, flight at greater than 14° AOA with flaps HALF or FULL is prohibited. The FCS provides good lateral directional control of the aircraft via a *Rolling Surface to Rudder Interconnect (RSRI)* function. Sideslip and yaw rate feedback are used to coordinate lateral inputs, reducing pilot workload by reducing the requirement for rudder input to maintain coordinated flight.

Flaps HALF or FULL configurations are very departure resistant up to the 14° AOA limit for normal two-engine operation, even with asymmetric store loadings. Roll and yaw control are positive up to the 14° limit, but is better above 10° AOA with flaps HALF. Above the AOA limit, uncontrollable roll-offs are possible in either flap setting, particularly with high lateral weight asymmetry. An intermittent warning tone will sound beginning at 14° AOA.

4.1.2.1 Nosewheel Steering

The VRS F/A-18 features low and high-gain *Nose Wheel Steering (NWS).* This allows adjustable nosewheel steer angles which can be controlled based on yaw-rate feedback to control excessive side forces which may result in tip over. Although the Standard edition of the VRS F/A-18E does not provide specific yaw-rate feedback into the NWS system, low gain steering will quite forgiving. Hi gain NWS can be used on a carrier deck, or for tarmac parking. Without NWS (failure) using differential braking alone may be difficult. Crosswinds have minimal effect on takeoff characteristics and only a small amount of lateral stick into the wind is required to keep the wings level during the takeoff roll.

4.1.2.2 Takeoff

Nosewheel lift-off speeds are dependent on CG location and aircraft gross weight. At nominal and forward CG locations, the airplane requires aft stick to effect rotation. Premature aft stick application during the takeoff roll can result in early nosewheel lift-off and potential over-rotation, particularly with aft CG.

<u>Pitch attitudes in excess of 10° during takeoff rotation may result in ground contact between engine exhaust nozzles and/or stabilators.</u>

Landing gear speed limits can be easily exceeded during shallow climbs after takeoff with MAX power. With large lateral weight asymmetries, there is a slight tendency to yaw into the heavy wing during the initial ground roll and again during the takeoff rotation. Otherwise, takeoff characteristics are very similar to symmetric store loadings. <u>Directional trim may be required after takeoff for balanced flight with store asymmetries.</u>

4.1.2.3 Approach

Normal approach and landing characteristics are excellent; with good speed stability and solid lateral-directional handling qualities. With crosswinds, a wings-level crabbed approach with removal of half the crab angle just prior to touchdown minimizes deviations from runway heading and landing gear side loads during landings. Touchdown in a full crab angle results in an uncomfortable roll opposite the crab angle and upwind drift, requiring large rudder pedal inputs to align the aircraft with the runway. Likewise, removing the crab angle entirely results in downwind drift and directional transients after touchdown. A wing down, top rudder approach results in excessive bank angle and is not recommended.

4.1.3 UA (Flaps AUTO) Handing Qualities

Handling qualities in UA are somewhat unconventional in that they exhibit neutral speed stability at low AOA and the excellent maneuverability at high AOA. This offers outstanding “nose pointing” capability, particularly when used in conjunction with rudder at high AOA.

4.1.3.1 Neutral Speed Stability

Neutral speed stability is due to the FCS attempting to maintain 1g, zero pitch rate flight with hands-off the stick. This has the effect of eliminating the need for longitudinal trim adjustments. Note that the VRS F/A-18E will not attempt to maintain 1g flight in a bank, as this would in effect be the same as initiating g-onset in order to counter the loss of lift due to banking.

4.1.3.2 Longitudinal Handling

Longitudinal handling is excellent with good pitch rate and damping that combine to allow very aggressive maneuvering. The maximum commanded AOA is approximately 45-50 degrees at full aft stick. Combined with the capability to command high AOA is the ability to generate high nose-down pitch rates with large forward stick to rapidly reduce AOA, particularly below approximately 200 KCAS. This nose-down pitch rate capability is further enhanced as airspeed decreases to 150 KCAS. However, due to departure resistance concerns, the additional nose-down capability is reduced when large forward stick inputs are accompanied by even moderate lateral stick inputs. Note that the Standard Edition of the VRS F/A-18 E does not provide the same rapid AOA recovery function of the Professional Edition. This is an advanced FCS features reserved for Pro.

4.1.3.3 g-Limiter

The FCS g-limiter limits load factor under most flight conditions to the symmetric loading limit (NzREF) based on gross weight below 57,400 pounds. Above 57,400 pounds, NzREF is fixed at 5.5g even though the allowable load factor may be below NzREF. Above 57,400 pounds, the limiter does not provide adequate over-g protection and pilot action may be required to prevent an aircraft overstress.

Very abrupt full aft stick commands with aft CG conditions can defeat the limiter, causing an over-g. In addition, abrupt pushes can result in a negative over-g. Care should be taken during all abrupt maneuvers, as large lateral stick inputs combined with high pitch rate can also defeat the limiter.

4.1.3.4 Speed Brake Function

The Speed brake “function” is so-called because it’s a combination of dedicated spoiler surfaces, aileron, trailing edge flap (TEF), and rudder flare. The speed brake function provides excellent deceleration under most flight conditions.

4.1.3.5 Lateral-Directional Handling

Lateral-directional handling qualities, particularly at high AOA, are excellent. Roll rates and roll damping combine to provide very agile, yet controllable roll characteristics. The FCS attempts to maintain consistent roll response throughout the 1g flight envelope. Maximum roll rates are in the 200°/second range with clean wings and approximately 150°/second with wing tanks and/or air-to-ground stores. Note that the Professional Edition of the VRS F/A-18E has more dynamic control over reduced roll rates under high loading.

The FCS provides specific high AOA control laws which provide excellent maneuverability. At 25° AOA and above, rudder pedal deflections no longer provide yaw control inputs but instead act entirely as a roll control (identical to lateral stick input) by commanding aileron and differential stabilator with the RSRI commanding the required rudder deflection for roll coordination. Rudder pedal inputs are summed with lateral stick inputs and this combined input is limited to a value equal to a full lateral stick input. Therefore, applying pedal opposite to lateral stick cancels lateral stick inputs proportional to the pedal input, i.e. full opposite pedal cancels a full lateral stick command resulting in zero roll rate. Between 13 and 25° AOA, rudder pedal deflections gradually change from pure yaw controllers to pure roll controllers. This method of control provides enhanced departure resistance at high AOA.

Limited yaw control with rudder input is returned at low airspeed and high AOA only if lateral stick is applied in the same direction as the rudder. This feature starts becoming effective at airspeeds below approximately 225 KCAS and above 20° AOA but is most effective at approximately 120 KCAS and 34° AOA. This region of flight is ideal for performing the maneuver known as the “pirouette”, where nose pointing capability is most effective. Enabling this feature outside of these conditions (or in PA) would compromise departure resistance. When this feature is enabled, the sum of lateral stick and rudder pedal command is no longer limited to a value equal to a full lateral stick input. The excess roll command is fed to the directional axis to command sideslip. For example, adding full rudder pedal with a full lateral stick input provides a maximum roll and yaw command. Alternatively, adding lateral stick to an existing full rudder pedal input has the same effect. The resulting aircraft motion is a highly controllable nose-high to nose-low reversal also known as the “pirouette” maneuver.

Manual lateral trim changes may be required as flight conditions change with asymmetric store loadings (i.e. dropping ordinance). Additionally, small sideslip excursions (1 to 3°) are common during steep climbs and descents, even with symmetric store loadings. These excursions are non-oscillatory in nature and are controllable with minimal rudder pedal inputs.

In general, flying qualities are also very good with large lateral weight asymmetries. The aircraft tends to roll toward the heavy wing at elevated g such as during a pull off target during an air-to-ground attack; away from the heavy wing at negative g. In each case, the roll is easily countered with lateral stick. Additionally, roll coordination may be slightly degraded with large lateral stick inputs and may require rudder pedal to maintain balanced flight. At high AOA, the aircraft tends to yaw away from the heavy wing. Yaw-off should be expected above 25° AOA. Opposite rudder pedal may be required to maintain controlled flight.

4.1.4 Departure Resistance

The F/A-18E/F is extremely departure resistant throughout the operational flight envelope. A departure is defined by aircraft motion which is contrary to flight control inputs. Flight test has shown that for most symmetric loadings, the aircraft is departure free during multi-axis rolling maneuvers up to 360° bank angle change.

4.1.5 Single-Engine Performance

Single engine performance with flaps AUTO results in little to no change in handling qualities at low AOA. Yaw trim will be required to counter asymmetric thrust effects. At high AOA, engine failure results in a yaw toward the failed engine that is controllable by quickly reducing AOA and countering the yaw with rudder.

With flaps HALF or FULL, minimum controllable airspeed is a function of AOA and lateral asymmetry. Maintaining on-speed AOA is critical to avoiding a departure that can rapidly result in excessive roll attitudes. Even with MAX thrust, static and dynamic engine failures are still controllable as long as AOA is maintained near on-speed. When an engine fails, the first perceptible aircraft motion is a yaw toward the failed engine. While too much rudder pedal is not harmful, too little rudder pedal may cause controllability problems.

4.2 FLIGHT CONTROL SYSTEM

The *Flight Control System (FCS)* is a “fly-by-wire”, full authority control augmentation system (CAS). The FCS provides four basic functions:

1. Aircraft stability.
2. Aircraft control.
3. Departure resistance.
4. Structural loads management.

The base flight model in the VRS F/A-18E (and the real aircraft’s “flight model’) is statically-neutrally stable, to slightly unstable. The FCS is absolutely necessary in order to maintain stability and enforce “basic control laws.” These laws determine aircraft response to pilot inputs by intercepting the commands coming from, in this case, your game controller(s). The FCS provides departure resistance by either refusing to accept or by attenuating pilot inputs that would otherwise lead to an aircraft departure. Lastly, the FCS provides structural loads management by limiting g-available to prevent an aircraft overstress or by retracting flight control surfaces at airspeeds that would otherwise exceed the structural limits of the airframe.

4.2.1 Flight Control Surfaces

There are 12 control surfaces on the F/A-18E:

1. Leading Edge Flaps (LEF) (x2)
2. Trailing Edge Flaps (TEF) (x2)
3. Ailerons (x2)
4. Rudders (x2)
5. Horizontal Stabilators (x2)
6. Dedicated Spoilers (x2)

Most of these surfaces can work together to provide combined “functions” which increase aircraft maneuverability. The current position of each individual surface can be monitored from the *FCS* format on any DDI.

Pitch control is provided by stabilators and, in some conditions, with rudder toe-in or rudder flare. Roll control is accomplished with combinations of ailerons, differential stabilators, differential LEFs, and differential TEFs dependent on flight condition and CAS operating mode. The twin rudders deflect symmetrically for directional control. The speedbrake “function” uses as many as 8 surfaces deflecting simultaneously in addition to their “normal” functions.

Hydraulic power to the control surfaces is supplied by HYD 1 (left engine) and HYD 2 (right engine). Stabilator and TEF actuators are powered simultaneously by one HYD circuit from each system. All other actuators are powered by a single primary HYD circuit, with backup hydraulic power available through a hydro-mechanical switching valve. The aircraft can lose up to 2 circuits without any degradation in flying qualities. Each engine is capable of powering the entire aircraft. Refer Table 1: Main Surface Deflection Limits.

Table 1: Main Surface Deflection Limits

Surface	Limit
Aileron	25° TEU to 42° TED
Rudder	40° left or right
Stabilator	24° TEU to 20° TED
LEF	5° LEU to 34° LED
TEF	8° TEU to 40° TED
LEX Spoilers	0° or 60° TEU

4.2.1.1 Spoiler Surfaces

The spoilers are mounted on top of the fuselage near the aft end of the LEX. The spoilers are controlled by the FCCs and have two fixed positions: 0° (down) or 60° TEU. The 60° TEU position is activated by the speed brake function or when more than 15° TED stabilator is commanded (forward stick) above 22° AOA to aid in recovery from high AOA (Note: AOA recover function is a Pro version feature).

4.2.2 CAS Operating Modes

Handling qualities differ depending on which *Flight Control Mode* the FCS is operating under. FCS mode is determined primarily by the FLAP switch position: *Powered Approach (PA)* mode is entered with the FLAP switch in HALF or FULL and airspeed under 240 KCAS. *Up/Auto (UA)* mode is entered with the FLAP switch in AUTO or airspeed above 240 KCAS. If airspeed is above approximately 240 KCAS, the flight controls switches to, or remains in, UA mode regardless of FLAP switch position.

- FLAPS **AUTO**: Selects UA operating mode for up and away flight.
- FLAPS **HALF**: Selects PA operating mode for the takeoff and landing configuration. Sets TEF deflection and aileron droop to 30° TED (WonW or at approach speed).
- FLAPS **FULL**: Selects PA operating mode for the takeoff and landing configuration. Sets TEF deflection and aileron droop to 40° TED (WonW or at approach speed).

4.2.3 Pitch CAS

Pitch CAS (P CAS) utilizes normal acceleration, pitch rate, and AOA feedback, each scheduled based on aircraft flight conditions, to tailor aircraft response to pilot stick inputs and to provide stabilator commands. P CAS operates by comparing aircraft response to longitudinal stick input, driving the stabilators symmetrically until the difference is reduced to zero.

In UA, with neutral longitudinal stick, comparing pilot input to aircraft response has the effect of constantly trimming the aircraft to steady-state, hands-off 1g flight, essentially removing the requirement for manual trim.

4.2.4 Roll CAS

Roll CAS (R CAS) schedules aileron, differential LEF, differential TEF, and differential stabilator commands in response to lateral stick inputs to achieve the desired roll characteristics.

Differential LEFs and TEFs are only used in UA. The LEFs deflect differentially up to 5° when below 25,000 feet and above 0.6 Mach. Differential TEFs are not used above 10° AOA or below -5° AOA. At high airspeeds, aileron, differential stabilator and differential TEF travel are reduced to provide consistent roll rate response and to aid in preventing structural loads exceedances. At low airspeeds, aileron and differential stabilator travel are reduced with increasing AOA to minimize adverse yaw.

R CAS incorporates two features to reduce pitch-roll inertial coupling induced departures. Based on pitch rate and Mach number, the first feature reduces the roll command when the pilot applies an excessive combined lateral/longitudinal stick input. The second feature limits the roll command when the aircraft is already rolling and longitudinal stick is moved rapidly. This second feature is removed at low altitude and high speed since available pitch rate does not result in significant pitch-roll inertial coupling.

4.2.5 Yaw CAS

Yaw CAS (Y CAS) uses yaw rate and lateral acceleration feedback to provide directional axis damping and to augment pilot commands to the twin rudders. A rolling surface-to-rudder interconnect (RSRI) adjusted by roll-rate-to-rudder crossfeed (scheduled with AOA), and lateral acceleration feedback are used to minimize sideslip for roll coordination.

Below about 13° AOA, rudder pedal deflections provides yaw by normal rudder deflection. At about 25° AOA and above, rudder pedal deflections no longer provide yaw input, but instead act entirely as a roll controller (identical to lateral stick input) by commanding aileron and stabilator with the FCS commanding the required rudder deflection for roll coordination. Rudder pedal inputs are summed with lateral stick inputs and this combined input is limited to a value equal to a maximum lateral stick input. Applying pedal opposite to lateral stick then cancels lateral stick inputs proportional to the pedal input, For example, full opposite pedal cancels a full lateral stick 1:1 resulting in zero roll rate. Between 13° and 25° AOA, rudder pedal deflection gradually changes from pure yaw control to pure roll control. This method of control provides enhanced departure resistance at high AOA.

Limited yaw control with rudder input is returned at low airspeed and high AOA only if lateral stick is applied in the same direction as the rudder. This feature starts becoming effective at airspeeds below approximately 225 KCAS and above 20° AOA but is most effective at approximately 120 KCAS and 34° AOA. This region of flight is ideal for performing the maneuver known as the “pirouette”, where nose pointing capability is most effective. Enabling this feature outside of these conditions (or in PA) would compromise departure resistance. When this feature is enabled, the sum of lateral stick and rudder pedal command is no longer limited to a value equal to a full lateral stick input. The excess roll command is fed to the directional axis to command sideslip. For example, adding full rudder pedal with a full lateral stick input provides a maximum roll and yaw command. Alternatively, adding lateral stick to an existing full rudder pedal input has the same effect. The resulting aircraft motion is a highly controllable nose-high to nose-low reversal also known as the “pirouette” maneuver.

4.2.6 Flap Scheduling

In UA, LEFs, TEFs, and aileron droop are scheduled as a function of AOA and air data to optimize cruise and turn performance, to improve high AOA characteristics. LEFs start to deflect as AOA increases above approximately 3°, reaching full deflection (34° LED) by about 25° AOA. TEFs start to deflect above 2 to 3° AOA, are at full scheduled deflection (approximately 10 to 12° TED) from approximately 6 to 15° AOA, and begin to retract as AOA increases further. In other words, TEFs are deflected in the heart of the maneuvering envelope to produce more lift and are retracted at high AOA. In UA, aileron droop is scheduled to 50% of TEF deflection at low AOA and to 0° at high AOA.

In PA, LEFs are scheduled with AOA to maximize lift. TEFs are scheduled with airspeed, but should be at maximum scheduled deflection at approach speed. In PA, aileron droop is scheduled with TEF deflection. The following table shows flap deflections based on CAS operating mode and/or air data.

Table 2: Flap Scheduling

CAS Mode	FLAPS	Status	LEF	TEF	Aileron
UA	N/A	WonW	3° LED	4° TED	2° TED
		WoffW	Scheduled with M,AOA,Alt	Scheduled with M,AOA,Alt	50% of TEF (<10° AOA), 0° (>15° AOA)
PA	FLAPS HALF	WonW	15° LED	30° TED	30° TED
		WoffW	Scheduled with AOA	30° TED (on speed)	30° TED (on speed)
	FLAPS FULL	WonW	15° LED	40° TED	40° TED
		WoffW	Scheduled with AOA	40° TED (on speed)	40° TED (on speed)

WonW = Weight on Wheels, WoffW = Weight off Wheels, TED = Trailing Edge Down, TEU = Trailing Edge Up, LED = Leading Edge Down, LEU = Leading Edge Up, M = Mach, AOA =Angle of Attack

4.3 AVIONICS

The avionics subsystem combines the integration and automation needed for operability with the redundancy required to ensure flight safety and mission success. Key features of the system include highly integrated controls and displays, inertial navigation set with carrier alignment capability (pro version only), and extensive built in test capability. The avionics subsystems operate under the control of two mission computers.

4.3.1 Mission Computers (MC)

The mission computer system consists of two digital computers (MC1 and MC2) which are high speed, stored program, programmable, general purpose computers with core memory. Computer de-selection is made with the MC switch on the MC/HYD ISOL panel. The VRS F/A-18E simulates both computers and the functions they provide.

MC1, referred to as the navigation computer, performs processing for navigation and caution display, and as backup for MC 2.

MC2, referred to as the weapon delivery computer, performs processing for air-to-air combat, air-to-ground attack, and tactical control/display.

4.3.1.1 Cautions and Advisories

Cautions and advisories are displayed on the LDDI except when the LDDI is OFF or failed, in which case they are displayed on the RDDI. Cautions appear as 150%-size yellow text and are displayed as they occur beginning in the lower left of the display and sequence to the right and up. The 10th cautions sequences to the lower left of the adjacent display (RDDI) and continues for up to 18 cautions.

Advisory messages appear as 120%-size letters on a single line beneath the caution displays. The advisories are preceded by *ADV*- legend and separated by commas.

A caution or advisory is removed when the condition ceases. If there is a caution or advisory displayed to the right of the removed caution or advisory the display remains blank. Pressing the MASTER CAUTION light when repositions the remaining cautions and advisories to the left and down to fill the blank displays. When a caution occurs, the MASTER CAUTION light on the main instrument panel illuminates and the MASTER CAUTION tone or a voice alert is annunciated. The MASTER CAUTION light is extinguished by pressing the light.

4.3.2 Master Modes

The F/A-18 operates under a *Master Mode* paradigm. The master mode determines the initial displays and configurations which are set after entering a given mode. The three master modes are:

1. Navigation (NAV)
2. Air-to-air (A/A),
3. Air -to-ground (A/G)

Controls, displays, and the avionics equipment operation are tailored as a function of the master mode selected. The navigation master mode is entered automatically when power is applied to the aircraft, when the air-to-air or air-to-ground modes are deselected, when the landing gear is lowered, or when the aircraft has WonW. The A/A master mode is entered either by pressing the *A/A* master mode button alongside the left DDI or by selecting an A/A weapon directly by keyboard. The A/G master mode is selected by pressing the A/G master mode button or the equivalent keystroke.

4.3.3 NavigationAl Steering Modes

The sources of steering information available in the NAV master mode are *Waypoint (WPT)*, *TACAN (TCN)*, *Instrument Landing System (ILS)*, and *Data Link (DL)*. The data link modes include *Vector (VEC)* and *Automatic Carrier Landing System (ACL)*. The data link modes are only available in the Professional version of the VRS F/A-18E.

TACAN and waypoint steering are mutually exclusive; selecting one automatically deselects the other. Data link, ILS, and TACAN (or waypoint) steering can be provided simultaneously. The ACL mode is selectable only in the NAV master mode and the vector mode is available in all master modes. Steering information is used by the *Automatic Flight Control System (AFCS)* to provide coupled steering options.

4.3.4 Multi-Purpose Display Group

The multipurpose display group consists of the right and left *Digital Display Indicators (DDI)*, the *Multipurpose Color Display (MPCD)*, the *Digital Map Set (DMS)*, the *Head-Up Display (HUD)*, the CRS (course) set switch, the *Up Front Control Display (UFCD)* and the HDG/TK (heading/ground track) set switch.

The multipurpose display group presents navigation, attack, and aircraft attitude displays to the pilot. The multipurpose display group converts information received from the mission computer system to symbology for display on the right and left DDI, the MPCD, the UFCD, and the HUD. The left and right DDIs and the MPCD contain pushbuttons for display selection and selection of various equipment operating modes. The UFCD is an active matrix liquid crystal display with an infrared (IR) touchscreen for operator inputs. In the VRS F/A-18E, the UFCD can be interacted with via the mouse and/or keyboard.

These displays are described in detail in subsequent sections.

4.3.5 Built-In-Test System

The BIT/status monitoring subsystem, provides the aircrew with a simple display of system status via the DDI BIT Format. The subsystem monitors engine and airframe operational status for unit failures and caution/advisory conditions when the mission computer system is operating. When the mission computer system detects a caution/advisory condition, it commands display of the applicable caution or advisory message on one of the DDIs. The mission computer displays the subsystem BIT results on one of the DDIs.

4.3.5.1 Equipment Status Displays

Equipment status displays (BIT, caution, and advisory) provide the aircrew with continuous status of the avionics equipment and weapons. A cue to check equipment BIT status is the appearance of the *BIT advisory* display on the LDDI. A MENU selectable top level BIT format displays the status of failed, NOT RDY, or OFF systems of all avionics equipment that interface with the MC.

For a list of BIT status equipment messages, refer to *Table 3: BIT System Status Messages.*

Table 3: BIT System Status Messages

Message	System	Definition
NOT RDY	All except MC1	OFF, not installed, or initializing
OFF	RDR, MPCD, UFCD, IFF, RALT, ILS, TCN, COM1, COM2	OFF
IN TEST	All systems except MC1, MC2, RWR	Initiated BIT (IBIT) in progress
GO	All systems	BIT completed without failure
DEGD	All systems except MC1, MC2	Operation degraded
OVRHT	LDT, FLIR, NFLR, SMS, MPCD, UFCD, CSC, FCSA, FCSB, ASPJ, RWR, LTDR, ALE-50	Overheat.
MUX FAIL	CLC, FLIR, NFLR, SMS, RDR, LDDI, RDDI, MPCD, CSC, MC2, FCSA, FCSB, COM1, COM2, ASPJ,	Not communicating on MUX and on/off discrete is set to on.

	LTDR,ALE-47, ALE-50	
OP GO	NFLR, SMS, COM1, COM2, ALE-47, ALE-50	Non critical BIT failure detected
PBIT GO	All systems except MC1, MC2, RWR,FADEC	Initiated BIT has not been run since ground power-up and PBIT is not reporting any failures.

4.3.5.2 Initiated BIT

The BIT top level and nine sublevels can be used to initiate BIT. Those avionics set groups identified by the legends on the top level display periphery have an initiated BIT capability. BIT may be initiated for all operating units simultaneously except for some BIT that cannot be performed in flight. BIT for individual units within groups may be initiated through the BIT sublevel displays. Pressing *BIT* returns to the BIT top level display. Pressing *STOP* when BIT is in progress terminates initiated BIT.

Simultaneous IBIT of all equipment can be performed by selecting **AUTO** from the BIT top level display. Equipment group, acronym and status are displayed at the display options. Equipment group status Individual system status results other than GO, PBIT GO, IN TEST, SF TEST, and OP GO are displayed with a system acronym in the center of the display. If the equipment list is too long to be displayed on one page, a *PAGE* pushbutton is displayed. Pressing PAGE displays the remainder of the list that is on page 2. Pressing PAGE when page 2 is displayed returns page 1.

Initiated BIT of entire equipment groups is performed by selecting *SELBIT* (SELBIT option becomes boxed) on the BIT top level display and the desired equipment group pushbutton. Once SELBIT is boxed, pressing a desired group will perform an IBIT on the selection.

4.4 OPERATING LIMITATIONS

4.4.1 Engine Operating Limitations

Refer to Table 4: Engine Operating Limitations

Table 4: Engine Operating Limitations

Limitations		N2 (%)	N1 (%)	EGT (°C)	Nozzle(%)	Oil Press (psi)
Transient (MIL / MAX)		102	103	970	–	–
Steady state	MAX	100	100	950	50 to 100	80 to 150
	MIL			930	0 to 35	
Ground IDLE		^{3} 60	^{3} 30	250 to 500	75 to 85	35 to 90
Start		^{3} 10	–	870	–	180

4.4.2 Airspeed Operating Limitations

The airspeed limitations for the basic aircraft (with or without pylons) in smooth or moderately turbulent air with the landing gear retracted and flaps in AUTO: Subsystem AIRSPEED Operating Limitiations

Table 5: Airframe Operating Limitations

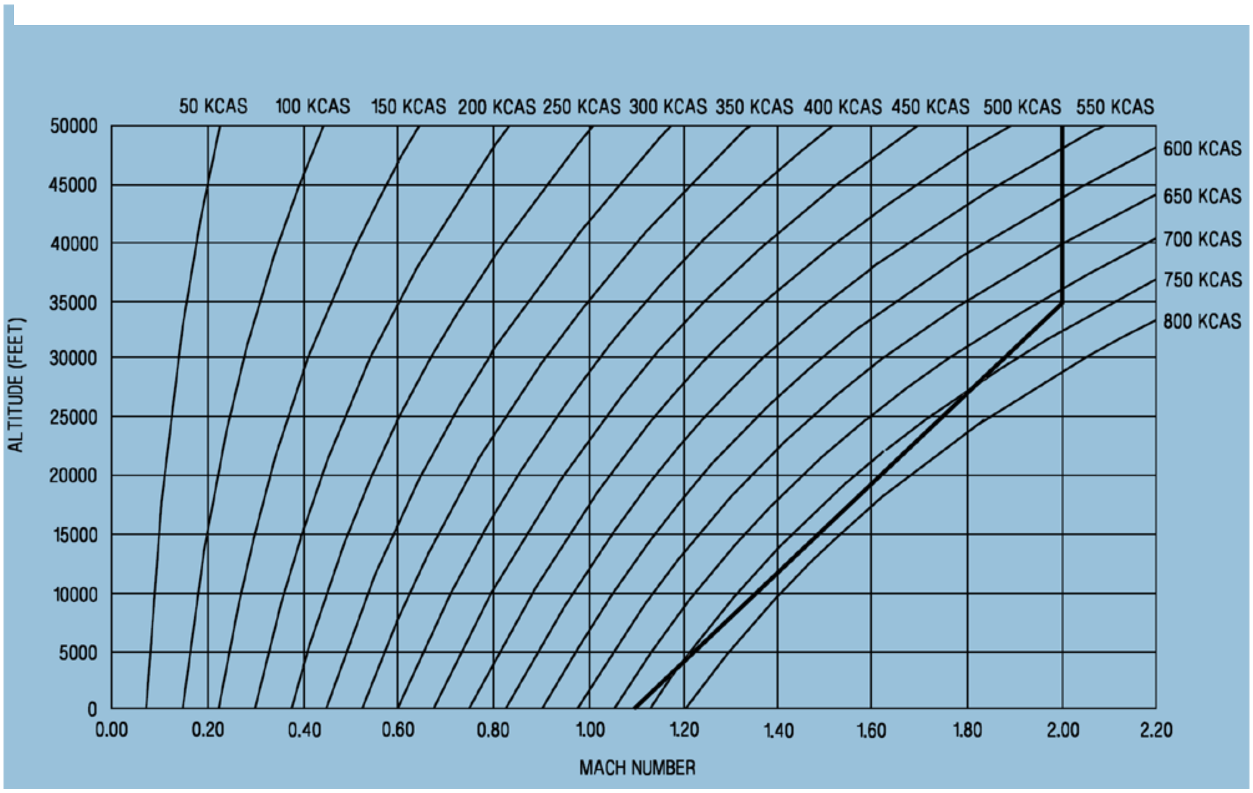


Table 6: Subsystem Airspeed Limitations

Subsystem	Position/Action	Airspeed/Groundspeed
Refueling Probe	Extension/Retraction	300 KCAS
	Extended	400 KCAS
Landing Gear	Extension/Retraction	250 KCAS
	Extended	170 KCAS
Trailing Edge Flaps	HALF-FULL	250 KCAS
Tires	Nose Gear	195 KGS
	Main Gear	210 KGS
Wingfold	Spread/Fold	60 knots
Canopy	Open	60 knots

4.4.3 Gross Weight and Lateral Weight Asymmetry Limitations

Lateral asymmetry and gross weight are calculated and provided in the Aircraft Manager's Preflight Summary Window. Refer to Table 7: Gross Weight and Lateral Asymmetry.

Table 7: Gross Weight and Lateral Asymmetry

<table>
<tr><th>Condition</th><th>Gross Weight Limitation(lbs)</th><th>Lateral Weight Asymmetry(ft-lb)</th></tr>
<tr><td>Field takeoff</td><td rowspan="2">66,000</td><td rowspan="3">26,000</td></tr>
<tr><td>Inflight</td></tr>
<tr><td>Field landing, FCLP, T&G</td><td>50,600</td></tr>
<tr><td>Catapult</td><td>66,000</td><td rowspan="2">22,000</td></tr>
<tr><td>Carrier landing / barricade</td><td>44,000</td></tr>
</table>

4.4.4 AOA Limitations - Flaps AUTO

Refer to Table 8: AOA Limitations FLAPS AUTO.

Table 8: AOA Limitations FLAPS AUTO

<table>
<tr><th>Lateral Weight Asymmetry
(1,000 ft-lb)</th><th colspan="2">Subsonic</th><th colspan="2">Supersonic</th></tr>
<tr><td>>6</td><td colspan="2" rowspan="2">Unrestricted</td><td>>+15°
Unrestricted</td><td>> +15°
Half lateral stick or half rudder pedal inputs only</td></tr>
<tr><td>>6 to >8</td><td colspan="2" rowspan="3">-6 to +15°
Single axis inputs only (2)</td></tr>
<tr><td>>8 to >12</td><td>Low/Slow
>20k ft or
>250 KT
Unrestricted</td><td>High/ Fast
>20k ft and >250 KT
>+30°</td></tr>
<tr><td>>12 to >26</td><td colspan="2">-6 to +15°
Single axis inputs only (2)</td></tr>
<tr><td colspan="5">(1) Rolling maneuvers up to abrupt, full stick (full stick in less than 1 second) are authorized within the AOA and acceleration limitations specified in figure 4-7.
(2) In ``Single axis inputs only'' regions, avoid rolling or yawing the aircraft while changing longitudinal stick position. It is acceptable to pull, stop, then roll or to pull and counter any roll-off induced by the heavy wing under g.</td></tr>
</table>

4.4.5 Flaps FULL or HALF Limitations

Refer to Table 9: FLAPS FULL or HALF Limitations.

Table 9: FLAPS FULL or HALF Limitations

Parameter	Limitation

AOA		0 to 14° (AOA tone) (1)
Bank angle		90° max 15° max during flap selection (HALF or FULL from AUTO)
Acceleration	Symmetrical	0.0 to +2.0g
	Rolling	+0.5 to +1.5g
(1). Transitory excursions above 14° may be seen during catapult launch.		

4.4.6 ARS Limitations

Refer to Table 10: ARS Operating Limitations.

Table 10: ARS Operating Limitations

Condition / Action	Limitation
Altitude	0 to 35,000 feet MSL
Power on (RAT unfeathered)	180 to 300 KCAS
Hose extended	180 to 250 KCAS
Hose extended and fuel transfer to receiver	180 to 300 KCAS or 0.80 Mach maximum
Hose retract	180 to 200 KCAS (< 25,000 feet MSL) 180 to 210 KCAS (^{3} 25,000 feet MSL)

5 COCKPIT SYSTEMS

The F/A-18 was initially designed to be a single-seat fighter without a RIO to handle many extra duties. While the Hornet has certainly evolved beyond its initial design specs, coping with the increased workload of the pilot in an inherently "busy" environment drove the designers to provide a highly efficient and ergonomic cockpit which could offer the pilot some measure of relief in dealing with multiple tasks simultaneously. The resulting design, which was arguably the most advanced in the world when it entered service, offers the pilot much flexibility and workload reduction compared to previous

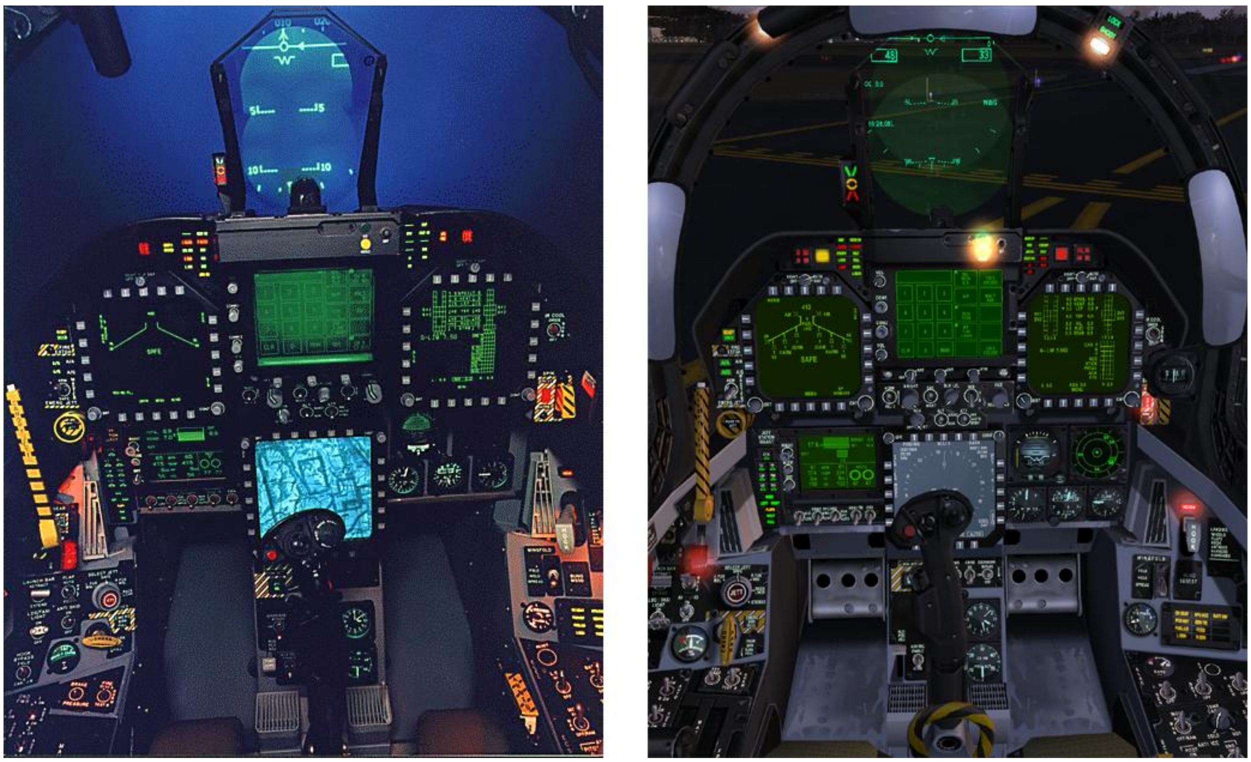


Figure 9: Actual cockpit (left), VRS cockpit (FS9 shown)

generations.

The F/A-18E cockpit shares approximately 95% of the avionics of previous generation Hornets, but improves upon earlier designs primarily by the addition of a touchscreen *Up-Front Control-Display (UFCD),* located just below the HUD. The new UFCD can not only be used as a Communications and Navigation Interface (CNI) as in legacy Hornets, but can completely duplicate the function of any DDI.

Many of the "steam" gauges traditionally present in "legacy" aircraft have been replaced with digital CRT and LCD displays. The main panel consists of the touchscreen LCD UFCD mentioned above, flanked on either side by two CRT *Digital Display Indicators (DDIs)*. Directly below the UFCD is a digital *Multi-*

Purpose Control Display (MPCD) with digital moving map capability. In the VRS F/A-18E this is a dedicated *Horizontal Situation Display (HSI)* used for navigation.

Avionic interaction is accomplished by pressing one of 20 pushbuttons surrounding each display, or by touching the virtual buttons on the UFCD. A *Hands-On Throttle and Stick (HOTAS)* arrangement, allows the pilot to control a *Target Designator Cursor (TDC)*, and to operate all weapon controls and many support functions without removing his or her hands from the flight controls. Using *Key Command Mode* (*see section XI, KEYBOARD*) in the VRS F/A-18, it is possible to completely duplicate this behavior by assigning those keystrokes to game controllers.

The pilot controls the aircraft from a solid rocket-propelled, 0/0, Martin Baker SJU-17 *Naval Aircrew Common Ejection Seat (NACES)*. “Zero/zero” implies the seat can be operated from zero altitude and zero airspeed (on the ground). The reason this capability is required is because the majority of mishaps occur at or near to the ground as a result of carrier-based hazards such as engine FOD or “cold cat” shots where the aircraft is incapable of achieving enough speed during launch. The VRS F/A-18E simulates the operation of the ejection seat.

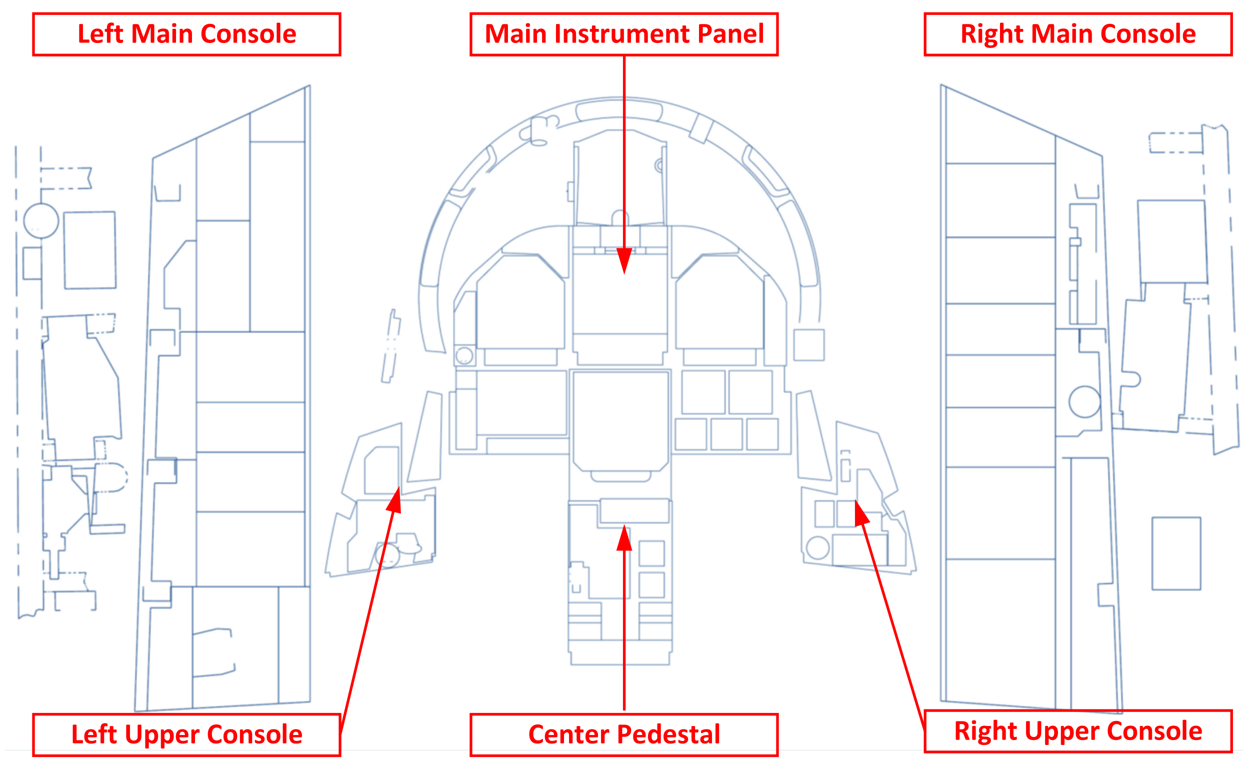


Figure 10: Cockpit major panel breakdown

To the left and right of the seat are side consoles used for a wide variety of functions ranging from lighting to external power controls. The vast majority of these functions are simulated in the VRS F/A-18.

5.0 MAIN INSTRUMENT PANEL

The main panel of the F/A-18E is comprised of the following components:

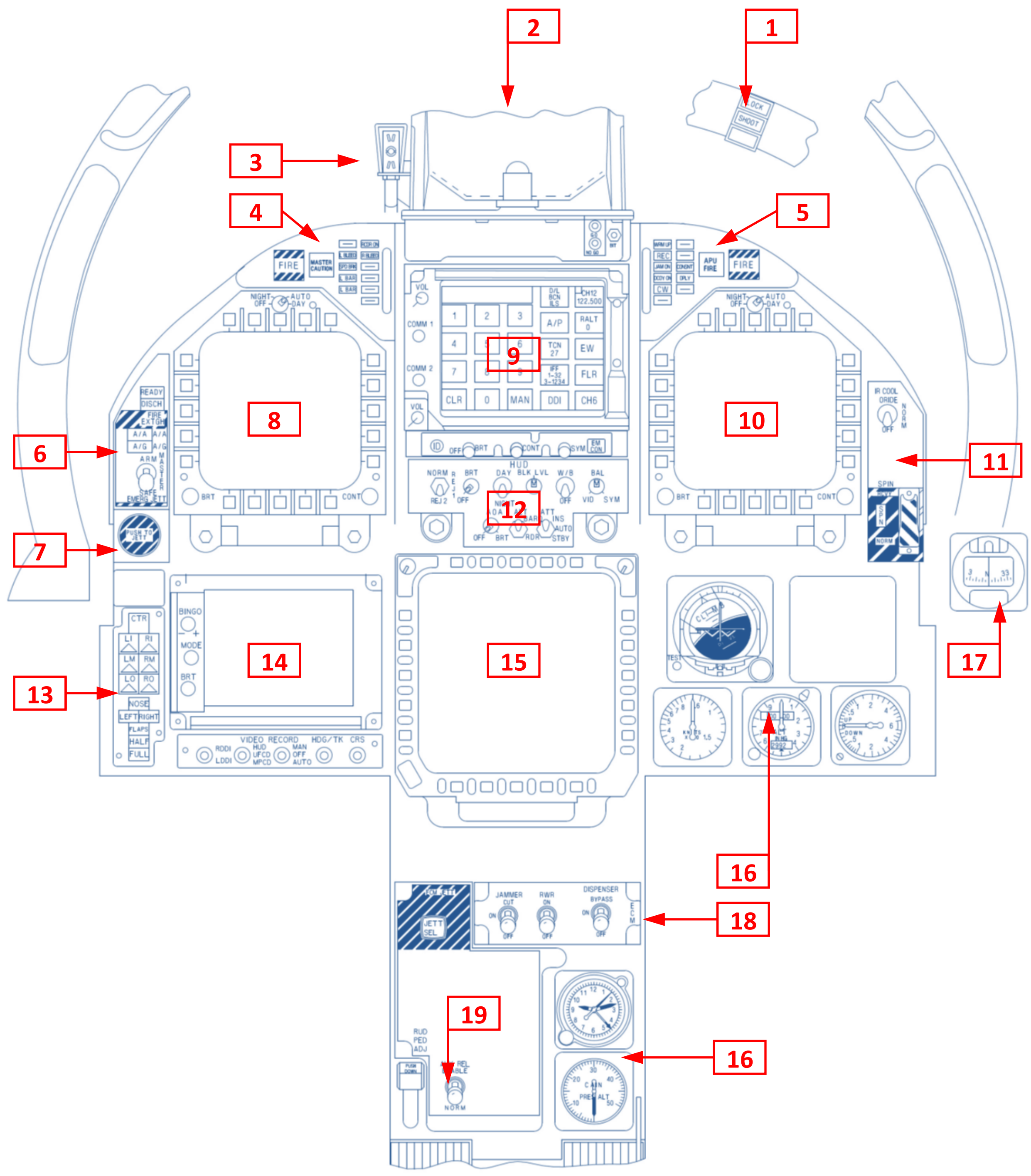


Figure 11: Main instrument panel

1) **Lock/Shoot Lights**. Provides heads-up positive radar lock and target solution indication.

2) **Head-Up Display (HUD)**. The F/A-18E's primary flight display.

3) **Angle of Attack (AOA) Indexer**: The AOA Indexer is a series of lights which correspond to approach AOA, and cue the pilot to increase or decrease power during final approach.

4) **Left Annunciator Panel**: A cluster of warning, caution, and advisory lights.

5) **Right Annunciator Panel**: A cluster of warning, caution, and advisory lights.

6) **Master Arming Panel**: Weapon arming, master mode selection and fire suppression.

7) **Emergency Jettison Button**: Pressing this button immediately jettisons all stations except cheek and wingtips.

8) **Left Digital Display Indicator (LDDI)**: A multi-purpose display used for support and tactical systems. Along the periphery of each DDI are twenty pushbuttons labeled PB1-PB20 beginning with 1 in the lower left, clock-wise to 20.

9) **Up-Front Control Display (UFCD):** Touchscreen Communications and Navigation Interface (CNI), and DDI backup function.

10) **Right Digital Display Indicator (RDDI)**: Identical in every respect to the LDDI, but primarily used for tactical functions in day-to-day operations.

11) **IR Cooling/Spin Override panel**: Allows disabling of the automatic spin recovery system and activation of the IR cooling system (Pro version only).

12) **HUD Controls**: Provides control of various HUD functions including clutter reject level, brightness, altitude selection (barometric or radar), and AOA indexer light brightness.

13) **Selective Jettison Panel**: Allows selection of specific stations for jettison. Used in conjunction with the selective jettison panel (described in subsequent sections).

14) **Engine/Fuel Display (EFD)**: Provides critical engine parameters and fuel level indication. The EFD also provides “bingo” level adjustment.

15) **Multi-Purpose Color Display (MPCD)**: In the VRS Super Hornet, the MPCD provides HSI functions.

16) **Standby Instruments Group**: A cluster of analog “backup” instruments. These include an Attitude Direction Indicator (ADI), Airspeed Indicator (ASI), Altimeter (ALT), and Vertical Speed Indicator (VSI). These “steam” gauges also include a cabin altimeter and analog clock located on the center pedestal.

17) **Standby Magnetic Compass**: Gyro driven magnetic compass.

18) **ECM/EW Panel**: Controls power to ECM and EW systems.

19) **Auxiliary Release Enable**: Enables auxiliary jettison for secondary jettison attempts of failed/hung stations.

5.0.1 Lock/Shoot Lights

The *Lock/Shoot lights* are mounted on the canopy framing and illuminate when the A/A radar is either locked onto a target and/or within firing range of the selected weapon. The top light **[1]**, indicates LOCKED when the radar has a positive lock Single Target Track. The middle light **[2]** indicates SHOOT when the selected weapon is capable of striking the target. The lower light **[3]** is a white strobe which flashes along with the SHOOT light to aid in alerting the pilot peripherally should his/her attention be focused elsewhere.

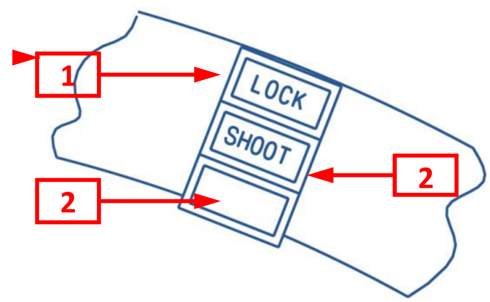


Figure 12: Lock/Shoot lights

5.0.2 Head-Up Display (HUD)

The primary flight display in the F/A-18E is a *Head-Up Display (HUD)*. The term "Head-Up" means the pilot does not necessarily need to look down into the cockpit to receive vital information about the primary flight status of the aircraft. Altitude, airspeed, heading, and angle of attack are all visible while looking through the HUD glass to the outside world. The HUD is a *Collimated* optical system that uses a combination of glass planes and a projector to display calibrated graphics, or *Symbology* over the field of view.

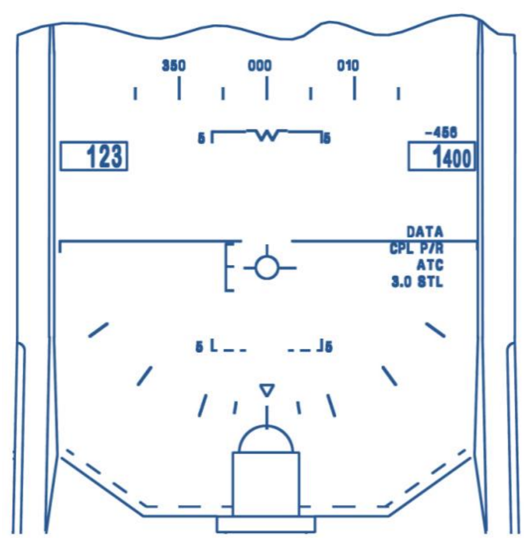


Figure 13: HUD

5.0.2.1 HUD Collimation

The term *collimated* quite literally means "tweaking" an optical instrument for the best display. In the case of a HUD, this means keeping the optics in focus and alignment regardless of where the pilot is focusing their vision or moving their head. Focusing of vision is irrelevant in the case of a 2D display device, but head movement is critical. One of the problems which need to be overcome is that the symbology displayed in the HUD must remain conformal with the outside world. This is especially important where *Velocity Vector (flight path marker)* placement is concerned, since the velocity vector must always show the pilot where the aircraft is truly flying regardless of attitude or AoA.

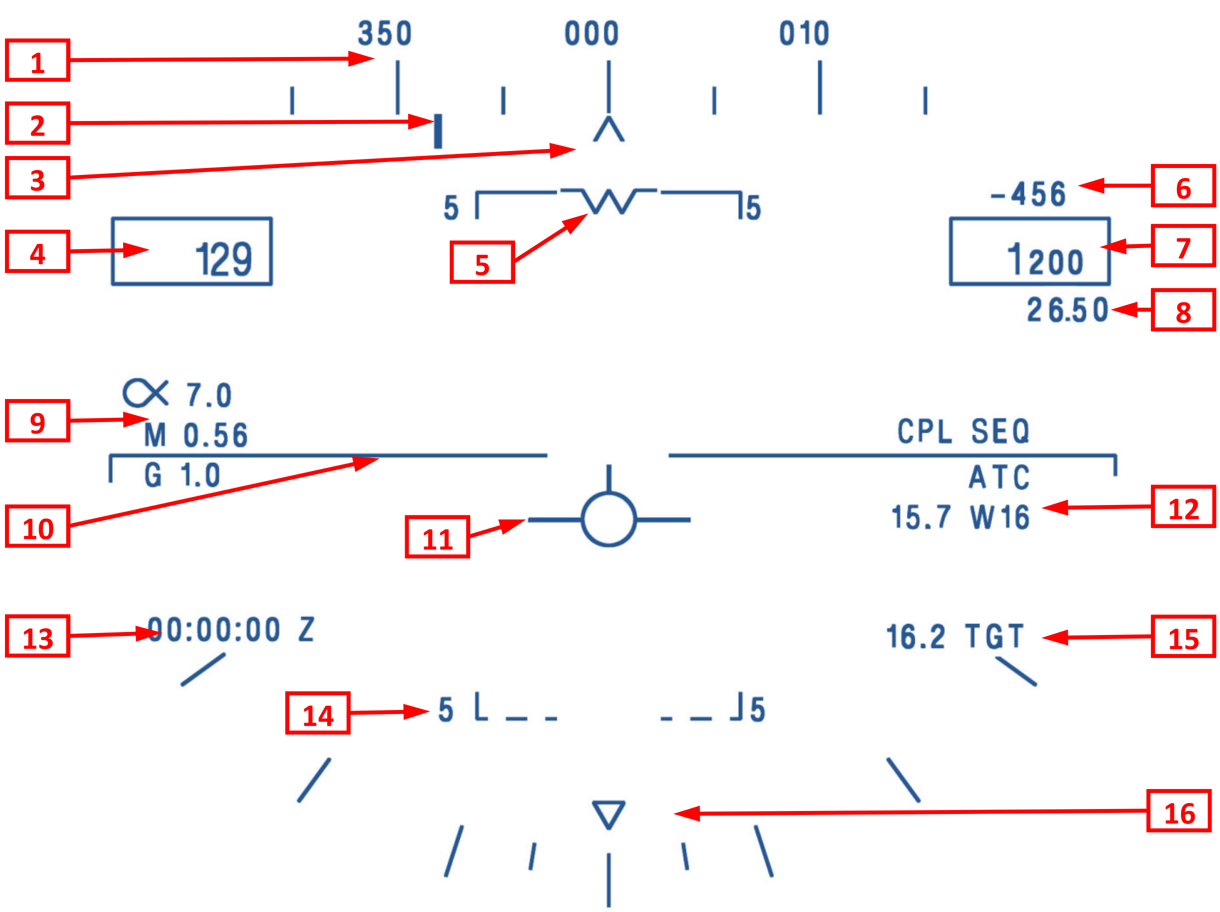
The VRS F/A-18E reproduces HUD collimation when flying in the *Virtual Cockpit (VC)*. However this functionality is not technically required unless the user is flying with a device such as a *TrackIR*, which allows the eyepoint to move along the lateral axis (left/right), or rotate along the longitudinal (forward/backward) axis. The one exception would be if the user moves the seat position up or down/left or right. In this case, the collimation will compensate just as if a TrackIR were being used.

5.0.2.2 Common HUD Symbology

Symbology is a fancy word for the "stuff" that appears in the HUD and other displays. The HUD displays information that's appropriate to the current *Master Mode*, and/or weapon system that's currently selected. Master modes were discussed in *section 4, The Aircraft*, but briefly, a master mode is one of 3 states the aircraft can be in depending on what it is the pilot wants to do. These are either *Navigation*, *Air-To-Air*, or *Air-To-Ground*. Symbology which is present in all or most master modes may be referred to as *Common Symbology,* and is as follows:

1) **Heading Tape:** The aircraft magnetic/true heading is indicated by the moving 30° heading scale 1. The moving heading scale provides trend information during turns. As the aircraft turns right, the scale moves from right to left.

2) **Command Heading Marker:** When waypoint/OAP or TACAN direct great circle steering is selected



(discussed in the Navigation Section), the command heading marker 2 is displayed just below the heading scale 1. During air to ground operations with a designated ground or NAV target, a diamond will appear here instead of a vertical bar.

3) Heading Caret: The actual aircraft heading is directly above the caret/T symbol 3. Magnetic or true heading may be selected. Magnetic heading is indicated by a caret below the heading scale (shown). True heading selection is indicated by a T symbol appearing below the current heading.

4) Calibrated Airspeed: Calibrated airspeed from the MC 4 is provided in the box on the left side of the HUD. The tops of the airspeed and altitude boxes are positioned at the aircraft waterline 5, which is 4° up from the optical center of the HUD. As in the real aircraft, the VRS F/A-18E provides actual calibrated airspeed in the HUD, NOT indicated airspeed.

5) Waterline Symbol: Visible when the landing gear are down, or any time the velocity vector is HUD-limited, the waterline symbol 5 represents the aircraft longitudinal axis. This should not be confused with the actual aircraft flight path, which is represented by the velocity vector !

6) Vertical Velocity: This value is displayed above the altitude box **[7]** and indicates vertical velocity in feet per minute. This is displayed in the NAV master mode only. Descent is indicated by a minus sign.

7) Altitude: Altitude in feet is displayed in the box on the right side of the HUD **[6]** and may be either barometric altitude or radar altitude depending on the setting of the altitude switch on the *HUD Control Panel*. When the altitude switch is in the *BARO* position, barometric altitude is displayed. When the altitude switch is in the *RDR* position, radar altitude is displayed and is identified by an *"R"* to the right of the altitude box. If the radar altitude is invalid, barometric altitude is displayed and a *"B"* next to the altitude flashes to indicate that barometric altitude is being displayed rather than radar altitude. The ten thousand and thousand digits are 150% size numbers. The hundred, ten, and unit digits are 120% size numbers, except that below 1,000 ft they are 150% size.

8) Barometric Setting: The barometric setting used by the air data function in the FCC is the value set in the standby altimeter. When the barometer setting is changed on the standby altimeter, the barometric setting is presented below the altitude on the HUD to provide a head-up baro-set capability. The display remains for 5 seconds after the change is made. In addition, the baro-set value is displayed and flashed for 5 seconds when the aircraft descends below 10,000FT at an airspeed less than 300 KCAS.

9) Left Data Block: The following information is provided in the area below the airspeed box:

- **Angle of Attack (AoA).** Angle of attack or "alpha" in degrees is displayed at the left center of the HUD.
- **Mach Number.** The aircraft Mach number is displayed immediately below the angle of attack. The Mach number is removed with the gear down.
- **Aircraft g.** Normal acceleration of the aircraft is displayed immediately below the Mach number. As with Mach number, g is not visible with the gear down.
- **Peak g.** The maximum peak positive g attained during flight. This value is only displayed once current g exceeds 4.0.

10) Horizon Bar: Then the landing gear are down, the *Extended Horizon Bar* appears. The horizon bar is not designed to remain on the visual horizon, simply because the earth is spherical. The higher the aircraft is the higher above the visual horizon the horizon bar will appear. This is perfectly normal. The horizon bar is primarily meant to serve as a reference for the velocity vector **[11]**. When the velocity vector is above the horizon bar, the aircraft is ascending, below, it's descending.

11) Velocity Vector: The *Velocity Vector* provides an outside world reference with regard to actual aircraft flight path. The velocity vector represents the point towards which the aircraft is flying (actual flight path).

The position of the velocity vector is limited to an 8° radius circle centered at the HUD optical center. If the velocity vector reaches this limit during high angle of attack flight or large yaw and/or drift angles, it flashes rapidly to indicate that it does not accurately indicate flight path (velocity vector is "HUD limited"). The flight path/pitch ladder is referenced to the waterline symbol when the velocity vector is HUD limited

In the NAV master mode, the velocity vector may be caged to the vertical center line of the HUD by the cage/uncage function from key command mode. When it is caged, a *Ghost Velocity Vector (not shown)* is displayed at the true velocity vector position if that position is more than 2° from the caged position. The flight path/pitch ladder and steering information are referenced to the caged position. The ghost velocity vector flashes when limited.

12) Right Data Block: The information contained in the right data block and varies with master mode to a large degree; therefore in this section we will only touch on the most likely information displayed in NAV Master Mode. Other possible symbology will be covered in the pertinent sections. From top to bottom up to 4 lines of text can appear in this area as follows:

1) **ACLS Data:** Contains information pertinent to the *Automatic Carrier Landing System (ACLS)* (Pro version only).

2) **AFCS Data:** Information pertinent to the *Automatic Flight Control System (AFCS)* (autopilot). This can be one of the following:

   - **CPL SEQ:** Appears with *Sequence Steering* selected (analogous to a flight plan "route", and will be explained under Navigation) and the autopilot coupled.
   - **CPL WYPT:** Appears with *Waypoint Steering* selected (analogous to a GPS "direct-to" route) and the autopilot coupled.
   - **CPL TCN:** Appears with *TACAN Steering* selected (analogous to NAV autopilot mode) and the autopilot coupled.
   - **CPL P/R:** Appears with *ACL steering* selected (Pro version only).

3) **ATC/NWS Status:**

- **ATC.** With weight off wheels, *Auto Throttle Control (ATC)* status appears here. When *Approach Auto Throttle* is engaged, this reads *APR ATC*. When *Cruise Auto Throttle* is engaged, it simply reads *ATC*.
- **NWS.** With weight on wheels, the *Nose Wheel Steering (NWS)* mode appears here. When NWS is in low-gain (normal) mode, *NWS* appears. When NWS is in high-gain, *NWS HI* appears. When NWS is disengaged, nothing appears.

4) **Station/Waypoint Distance/Identifier:** With TACAN Steering enabled, the currently tuned TACAN station slant range in nautical miles appears here followed by the *Morse Station Identifier*.

   With waypoint steering selected and no designated ground target, the range to the selected waypoint along with the waypoint ID appears here.

13) **Time:** Depending on the current time settings (please see Navigation), the HUD can display either *Local Time (LTOD), Zulu Time(ZTOD) (default), Elapsed Time (ET), Countdown Time (CD)*, or nothing at all. The time is set by pressing **TIME** from the HSI page which will bring up the CNI TIME format on the UFCD.

14) **Flight Path/Pitch Ladder:** The vertical flight path angle of the aircraft is indicated by the position of the velocity vector on the pitch ladder. The pitch angle "rungs" each represent 5° of angle between the zenith (+90°) and nadir (-90°). Positive pitch lines are solid and are above the horizon line 0. Negative pitch lines are dashed and are below the horizon line. The outer segments of the lines point toward the horizon. To aid in determining flight path angle when it is changing rapidly, the pitch lines are angled toward the horizon at an angle half that of the flight path angle. For example, the 50° pitch line is angled 25° toward the horizon. In level flight, the pitch lines are not angled. The zenith is indicated by a circle and the nadir is indicated by a circle with an X in it. Aircraft pitch angle can be determined by comparing the waterline (or tops of the altitude and airspeed boxes if the waterline is not visible) with the pitch ladder when the wings are level, but the flight path/pitch ladder normally rotates about the velocity vector and determination of pitch angle may be difficult at high roll angles.

15) **Designated Target Range:** If a target exists either as a *Ground Target* or a *NAV Target*, the range % to the designated target waypoint/offset aimpoint, or ground target, followed by TGT will appear in this location.

16) **Bank Angle Scale:** A bank angle reference scale up to 45° left/right will appear at the bottom of the HUD in NAV master mode or any time the gear is down. At bank angles in excess of 47°, the *bank angle scale pointer* is limited at 45° and flashed.

5.0.3 HUD Control Panel

The HUD control panel is located just below the UFCD in the center of the main instrument panel.

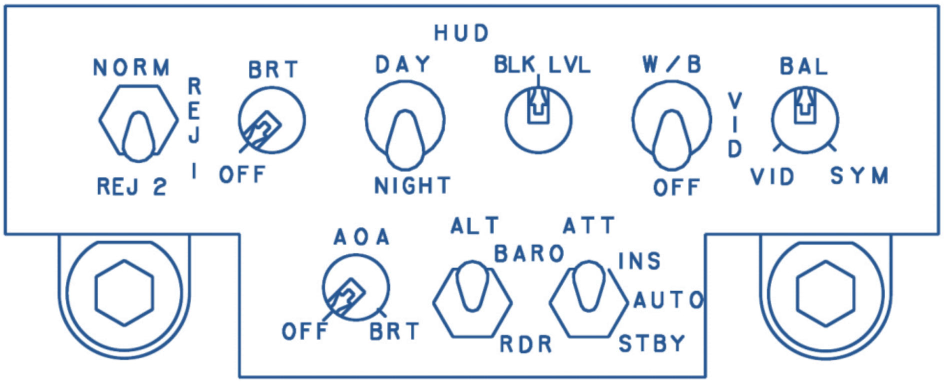


Figure 14: HUD control panel

5.0.3.1 HUD Reject Switch

Adjusts the degree of "clutter" the HUD displays by removing non-critical information.

- **NORM**: Displays full HUD symbology.
- **REJ 1**: Removes the Mach, g, and peak-g indications, the bank angle scale and pointer, the airspeed and altitude boxes, energy caret (landing gear down), and the ground speed required cue.
- **REJ 2**: Removes REJ 1 symbology and the heading scale, current heading caret, command heading marker, NAV/TCN range, and the ET, CD, LTOD or ZTOD timer.

5.0.3.2 BRT Control Knob

Powers the HUD and varies the intensity. Clockwise rotation (mouse wheel UP or left-click) increases brightness. Counter-clockwise rotation (mouse wheel DOWN or right-click) decreases intensity until the knob is full left, at which point the HUD is powered off.

5.0.3.3 Brightness Selector Switch

This is a two-position toggle switch attenuates the overall brightness of the HUD in conjunction with the HUD symbology brightness control.

- **DAY**: Provides maximum brightness.
- **NIGHT**: Attenuates the brightness by 4 shades of luminance for night operation.

5.0.3.4 BLK LVL Knob

The VRS F/A-18 for FSX supports NFLIR through-the HUD night vision enhancement. This switch increases and decreases the intensity of the NFLIR "video".

5.0.3.5 HUD Video Control Switch

This switch powers and unpowered the NFLIR night vision mode. The first position (down) is OFF, the middle and top positions are ON.

5.0.3.6 BAL Control Knob

No function. In the real aircraft, this control adjusts the stroke brightness relative to the raster brightness of HUD video.

5.0.3.7 AOA Indexer Control Knob

This control adjusts the intensity of the AOA indexer lights located to the left of the HUD (*see Angle of Attack Indexer, below*).

5.0.3.8 ALT Selector Switch

This control is used to select the primary altitude source for display on the HUD and for use in the mission computer (weapon systems calculations). When RDR is selected, an “R” will appear to the right of the altitude box in the HUD. If radar altimeter is invalid (> approx. 5000 ft or bank angle > approx. 50 degrees), a “B” will replace the “R” and flash to indicate that RALT is no longer valid.

- **BARO**: Barometric altitude will be used for display in the HUD and in weapon system delivery calculations.
- **RDR**: Radar altitude will be used for display in the HUD and in weapon system delivery calculations.

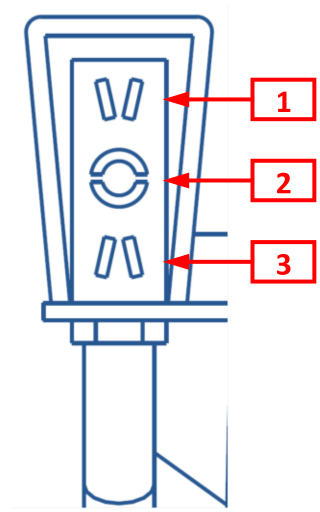
5.0.3.9 ATT Selector Switch

The ATT selector switch selects the primary attitude source used for display in the HUD and in MC and FCC computations.

- **INS**: Functions identically to the AUTO position.
- **AUTO**: If INS data is valid, aircraft attitude reference will be based on high-quality filtered gyroscopic data. If INS reference data becomes invalid, the standby ARI will be used as the attitude source.
- **STBY**: The standby ARI is used for all attitude reference functions.

Note that the SE version of the VRS F/A-18 does not simulate true INS or AINS functions. To simulate INS attitude reference information, simulation variables not subject to error are used instead. However the function of this switch is still valid and standby reference information will be substituted if this switch is placed in STBY.

5.0.4 Angle of Attack (AOA) Indexer



The angle of attack indexer, mounted on the left HUD frame, displays approach angle of attack (AOA) via 3 colored lights Figure 8: AOA Indexer and Bracket. The indexer operates with the landing gear down and weight off wheels. The symbols flash if the arresting hook is UP and the Hook Bypass Switch on the left-upper console is in the CARRIER position. The symbols will not flash with the arresting hook up and the hook bypass switch in FIELD. The AOA indexer knob on the HUD control panel can be used to dim the indexer. All symbols light when the Light Test Switch on the interior light control panel is set to TEST.

The top (green) light **[1]** indicates the aircraft is "slow" (AOA is too high), and the chevron symbol points down indicating the nose should be lowered to decrease AOA. The middle (yellow) light **[2]** indicates AOA is nearing or "on speed" and AOA within acceptable margins for landing. The bottom (red) light **[3]** indicates "fast" and corresponds to AOA being too low. The lower chevron points up indicating the nose should be raised to increase AOA.

Intermediary AOA is indicated by multiple lights lit simultaneously. For example a green (slow) and yellow (onspeed) indication means the aircraft is slightly slow. In practice, the best way to control AOA is through power settings, because despite the immediate results obtained through raising or lowering the nose, AOA will continue to be incorrect once attitude is reestablished.

The HUD also provides AOA indication when the landing gear are down by way of an *Angle of Attack Bracket*. The bracket, which looks like an elongated "E" is tied to the velocity vector and moves vertically to indicate approach AOA. When the top horizontal line of the bracket is above the left "wing" of the velocity vector, AOA is too high (slow), when the middle rung of the bracket is flush, AOA is on speed. When the bottom rung is below the "left wing", AOA is too low (aircraft too fast).

5.0.5 Up-Front Control Display

The UFCD is on the main instrument panel below the HUD. The UFCD is an active matrix liquid crystal display with an infrared (IR) touchscreen which is used for data entry inputs and control of the *Communications and Navigation Interface (CNI)* systems (autopilot modes, IFF, TACAN, ILS, data link,

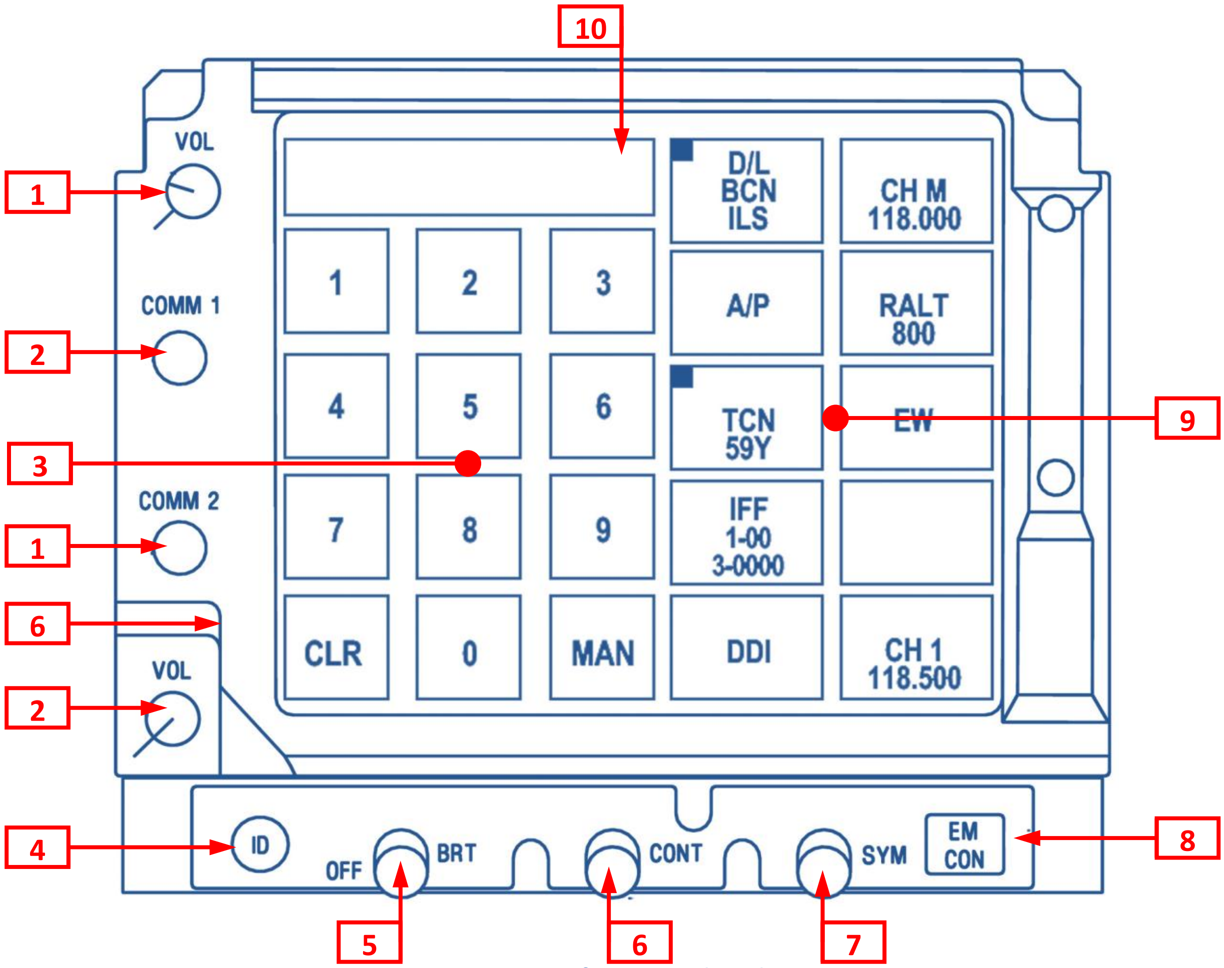


Figure 15: Up-front Control Display

radar beacon, UHF/VHF radios and ADF). In addition, the UFCD can function as a fully functional DDI.

UFCD is used in conjunction with the two DDIs and the MPCD to enter navigation, sensor, and weapon delivery data. Some formats initialize with data in the scratchpad **[10]**, e.g. the COMM sublevel of the CNI format initializes with the comm frequency in the scratchpad. When data entry is started, and preexisting digits in the scratchpad are blanked, allowing data entry.

The UFCD uses a double clear mechanism. The first selection of the ``CLR'' keypad option (not shown in the image above or available from the CNI top level) removes the last digit that was entered in the scratchpad. The second selection of the ``CLR'' option removes all the digits which have been entered in the scratchpad. If an error is made entering incorrect data, or data which does not conform to the format of a given interface, the word "ERROR" flashes in the scratchpad until new data is entered, or the CLR key is pressed.

1) **COMM 1/2 VOL Knobs**. Rotating these controls clockwise (mouse wheel UP, or left-clicking), powers the COMM 1 radio. Rotating the control fully counter-clockwise removes power from the radio. The VRS F/A-18 does not simulate volume control for the communication radios as this volume is not independently accessible via code.

   If any given radio is powered, a *corner highlight* appears over the respective COMM option (top and bottom right CNI option buttons). COMM function is explained in detail in section 6.

2) **COMM 1/2 Channel Knobs**. Rotating these knobs cycles through all available COMM 1 or COMM 2 preset channels. Channels are analogous to the presets in a car radio, and hold stored preset frequencies. The VRS F/A-18 can "remember" these frequencies from flight to flight. Each radio has 12 presets labeled 1-9, M, G, and S as follows:

   - **1-9**: Stores any preset frequency entered into the scratchpad from the respective radio's COMM sublevel.
   - **M**: Channel M is slightly different in that any frequency entered into the scratchpad from the CNI top level will go directly into channel M regardless of which channel is currently selected. Once the frequency is entered and the MAN option is selected from the CNI top level, the radio will immediately tune to channel M and whatever frequency was previously in channel M will be replaced with the newly entered frequency.
   - **G**: Identical in function to channels 1 through 9, but labeled and ideally designed to hold the *Guard* frequency.
   - **S**: Identical in function to channels 1 through 9, but labeled and ideally designed to hold the *Ship Maritime* frequency.

3) **CNI Keypad**. The keypad is used to ender data into the scratchpad. If key command mode is active and the button command keys are enabled in the ACM, the physical keyboard and be used to enter data into the UFCD.

4) **ID Pushbutton**. Squawks the currently active IFF/Transponder frequency. The transponder frequency, power and mode can be selected by pressing the IFF touch option button from the CNI top level.

5) **BRT Knob**.Controls brightness of the UFCD LCD display (power is controlled from the MPCD) Rotating the knob clockwise (mouse wheel UP or left-clicking) increases brightness. Rotating the control counter-clockwise (mouse wheel DOWN or right-clicking), decreases brightness and eventually powers off the UFD.

6) **CONT Knob**. Controls display contrast. Rotating the knob clockwise (mouse wheel UP or left-clicking) increases contrast. Rotating the control counter-clockwise (mouse wheel DOWN or right-clicking), decreases contrast.

7) **SYM Knob**. No Function.

8) **EMCON Pushbutton**.The EMCON pushbutton may be used to terminate all onboard emitters except COMM transmitters and ALQ-165. During EMCON operations, EMCON is displayed in the scratchpad for top level CNI display or vertically in the left options for DDI displays on the UFCD.

   Note that entering EMCON will, in addition to placing all transmitting equipment in STBY, place the TACAN radio into receive-only mode. Subsequently leaving EMCON will NOT return the NAV radio to transmit/receive automatically.

9) **CNI Touch Options** *(see below for more details).* Various options which usually lead to subpages where additional data can be entered.

10) **Scratchpad Display**. The scratchpad is used as a visual confirmation of data entered into the UFCD via the CNI keypad. As digits or other data are entered in, the scratchpad will echo that information and format it based on the current sublevel. If an error is made the scratchpad will flash the word "ERROR" indicating an invalid entry. Subsequently pressing he CLR key will clear the error message and reinitialize the scratchpad for entry.

5.0.5.1 CNI Data Entry Methods

Data can be entered into the scratchpad by pressing the keypad digits or by using the keyboard number keys (key command mode active and TDC priority on the UFCD). Once the scratch pad is "loaded" there are two way the data can be entered into a CNI system, depending on whether the CNI top level is being displayed or not:

- **CNI Quick Entry Method**: If, and ONLY if the CNI top level is displayed, the data in the scratchpad can be instantly entered into the ILS, COMM 1-2, TCN, IFF, or warning altitude systems simply by touching either one of those options with the scratchpad "loaded." If the data is not valid for that particular system, the ERROR message will be flashed and the input will be ignored.

  In fact there is no ENT key displayed on the CNI top level at all. Instead it's replaced by the MAN key. Pressing ENT with at least 5 different systems each of which could be the target of the data makes little sense, since the system would have no idea where the data entered was to go. So pressing MAN will attempt to place the data into the selected radio's Manual channel and tune to it. This would be exactly the same as entering data into the scratchpad and touching either radio option button.

- **Standard Entry Method**: From any sublevel (but not the CNI top level), data is entered into the scratchpad as described above, either by touching the numbers or using the keyboard, however

ENT must be pressed after the data is in the scratchpad rather than simply touching the option to receive the data.

5.0.5.2 UFCD CNI Mode

The UFCD has 2 primary modes of operation (CNI and DDI) which are further broken down into sublevels. The default mode is called the *Communication and Navigation Interface (CNI)*. This mode

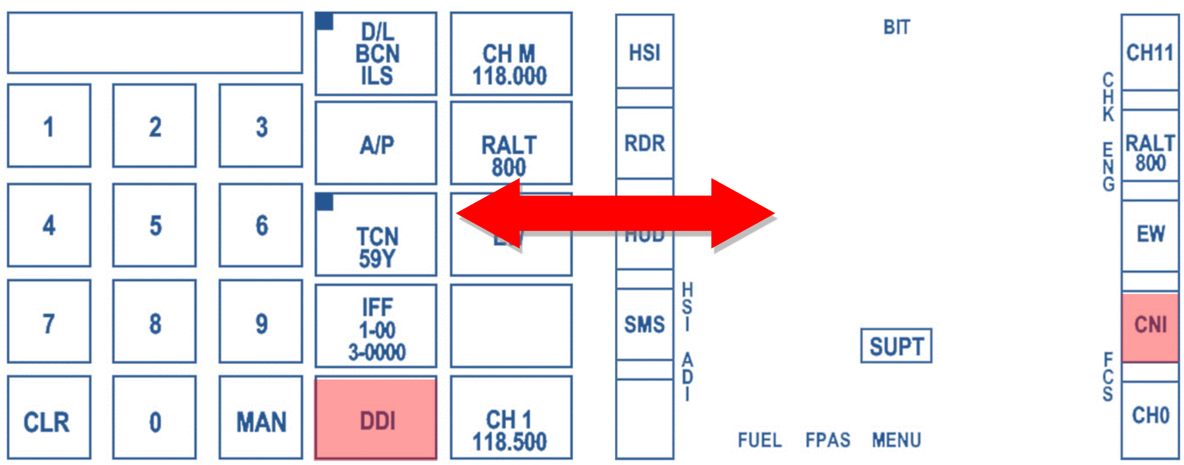


Figure 16: UFCD modes

encompasses all the functions described above including communications, navigation, autopilot, altitude warning interfaces, ILS, IFF, etc. The "Top level" for all of these functions (illustrated on the previous page) can be used to access various sublevels (*see CNI Touch Options, below*).

5.0.5.3 CNI Top-level Touch Options

These 10 options **[11]** are used to access various *CNI sublevels* dedicated to functions corresponding to their respective labels. These options change depending on the current sublevel. Options 2 and 10 (top right and bottom right respectively) are dedicated COMM options and does not change regardless of the CNI sublevel. Pressing either of these options from any sublevel or the CNI top level will immediately go to the COMM 1 or COMM 2 sublevels.

1) **D/L, BCN, ILS**: (data link, beacon and instrument landing system). Invokes the ILD sublevel for powering and/or tuning the ILS frequency.

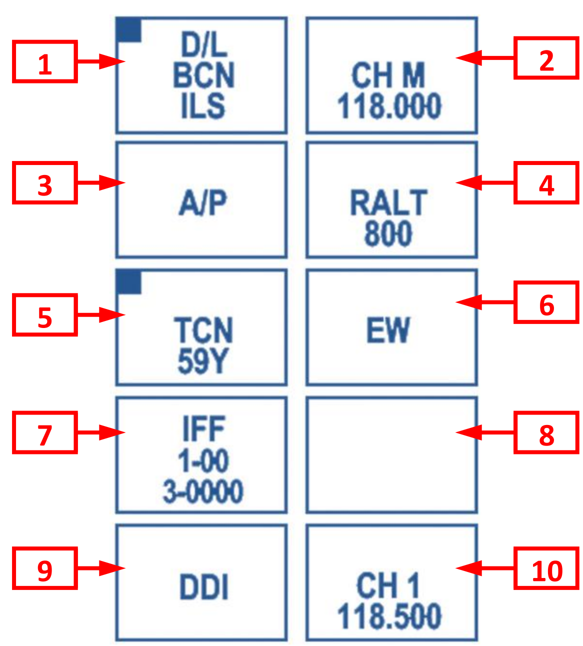


Figure 17: CNI top level options

2) **COMM 1**: Displays the currently selected COMM 1 channel and when touched, either invokes the COMM 1 sublevel or places the contents of the scratchpad into channel M if the scratchpad contains a valid com frequency (quick-entry method).

3) **A/P**: (auto pilot) sublevel. Bring up the autopilot sublevel for choosing autopilot modes.

4) **RALT**: (radar altimeter with altitude reading). Invokes the altitude warning sublevel.

5) **TCN**: (TACAN with channel number). Invokes the TACAN sublevel for powering and selecting the active TACAN channel and modes.

6) **EW**: (electronic warfare). Available when using the non "lite" UFCD (ACM option), this will cause the UFCD to switch to DDI mode and immediately go to the DDI EW format.

7) **IFF**: (identification friend or foe with mode numbers). Invokes the transponder sublevel for powering, tuning, and changing transponder modes.

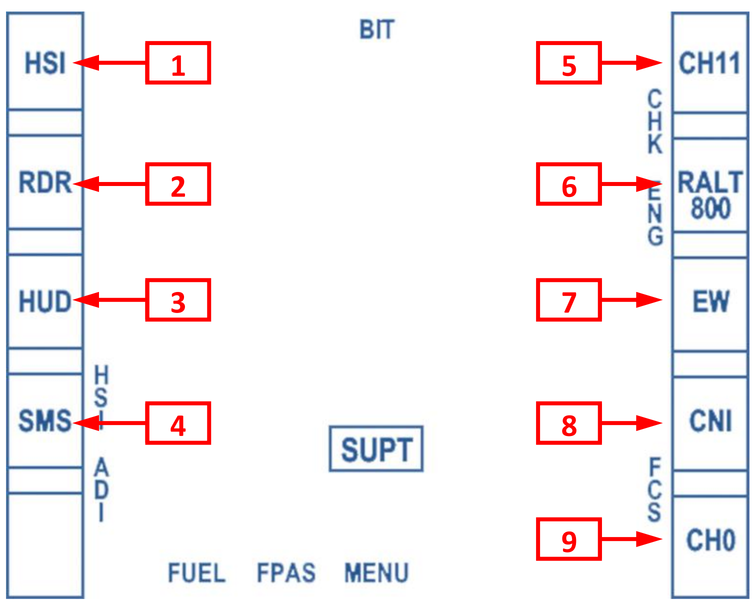
8) **FLR**: (forward looking infrared radar). As with the EW option, this function invokes the DDI mode of the UFCD and immediately switches to the FLR format (if available). If no FLIR is loaded onto the aircraft this option is blank.

9) **DDI**: (digital display indicator). Switches the UFCD to DDI mode from CNI mode. The DDI mode is a fully functional DDI and is available when the "lite UFCD" option is unchecked in the ACM preferences.

10) **COMM 2**: Displays the currently selected COMM 2 channel and when touched, either invokes the COMM 2 sublevel or places the contents of the scratchpad into channel M if the scratchpad contains a valid com frequency (quick-entry method).

5.0.5.4 UFCD DDI Mode

The second UFCD mode is a fully functional DDI ("lite UFCD" option unselected in the ACM preferences). Pressing the DDI touch option from the CNI top level switches to DDI mode. Flanking the DDI display at the center of the screen are 10 touch options as follows:



1) **HSI**: Brings up the Horizontal Situation Indicator.

2) **RDR**: Brings up the A/A radar format.

3) **HUD**: Brings up the backup HUD.

4) **SMS**: Brings up the Stores Management System display.

5) **COMM1**: (labeled CH 11 in the image at right). Immediately switches back to CNI mode and brings up the COMM 1 sublevel.

6) **RALT**: Immediately switches back to CNI mode and brings up the altitude warning sublevel.

7) **EW**: Brings up the Electronic Warfare DDI format.

8) **CNI**: Returns to the CNI top level.

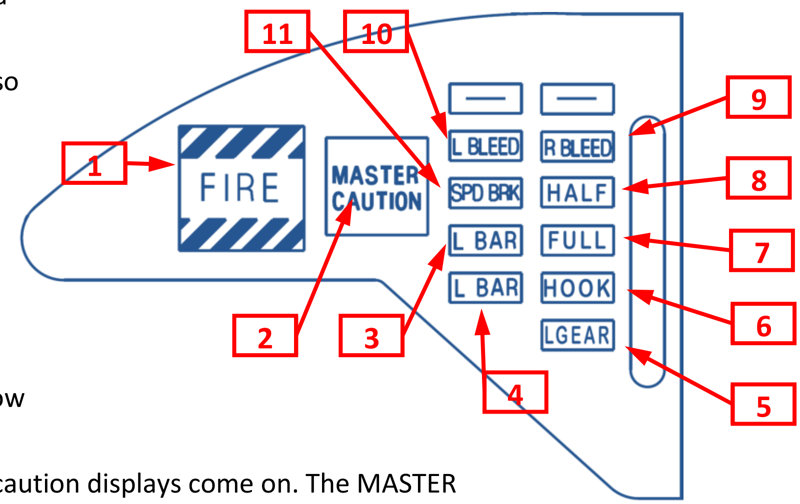
9) **COMM 2**: (labeled CH 0 in the image at right). Immediately switches back to CNI mode and brings up the COMM 2 sublevel.

Figure 18: UFCD DDI mode

When in DDI mode, the labels surrounding each menu option are touch sensitive and the mouse may be used to invoke any DDI option simply by clicking the associated label (instead of the buttons on the "normal" DDI displays). For a detailed description of various DDI formats, please see the associated avionic in sections 6 through 8.

5.0.6 Left Annunciator Panel

This panel, located to the left of the UFCD just below the instrument hood houses the *MASTER CAUTION light/button*, the *Left Engine FIRE button*, and a series of support system oriented annunciator lights.



1) **FIRE**: The left FIRE light indicates a fire condition in the left engine/AMAD bay. Each light is also a pushbutton, which is guarded to prevent inadvertent actuation. Pushing light arms the fire extinguisher bottle (FIRE EXTGH READY light on) and shuts off flue flow to the affected engine.

2) **MASTER CAUTION Light:** The yellow *MASTER CAUTION* light comes on when any of the caution lights or caution displays come on. The MASTER CAUTION light goes out when it is pressed (reset). A “tweedle, tweedle” audio tone is also initiated when the MASTER CAUTION light comes on.

   Pressing the MASTER CAUTION when it is unlighted causes the uncorrected DDI caution and advisory displays to reposition to the left and to a lower level, provided there is available space vacated by corrected caution and advisory displays. To restack the cautions and advisories when the MASTER CAUTION is lighted, the MASTER CAUTION must be pressed twice: first, to turn off the MASTER CAUTION light and second, to reposition the caution and advisory displays.

3) **L BAR (green) :** The green L BAR light indicates the launch bar is deployed, and in a manner consistent with the position of the L BAR switch.

4) **L BAR (red) :** The red L BAR light indicates the launch bar is extended in flight, or remains retracted despite the L BAR switch being placed in EXTEND with weight on wheels (WonW).

5) **L GEAR:** The L GEAR light will indicate green if all 3 gear are down and locked. The light will flash when the gear are in transit. If the gear are lowered with airspeed above 240 KCAS, the light will be amber

6) **HOOK:** The green HOOK light indicated the tailhook is down and consistent with the position of the tailhook handle.

7) **FULL:** The FULL light will be green with the FLAPS switch placed in FULL and airspeed below 240 KCAS. The light will be amber with the FLAP switch placed in FULL and airspeed above 240 KCAS.

8) **HALF:** The HALF light will be green with the FLAPS switch placed in HALF and airspeed below 240 KCAS. The light will be amber with the FLAP switch placed in HALF and airspeed above 240 KCAS.

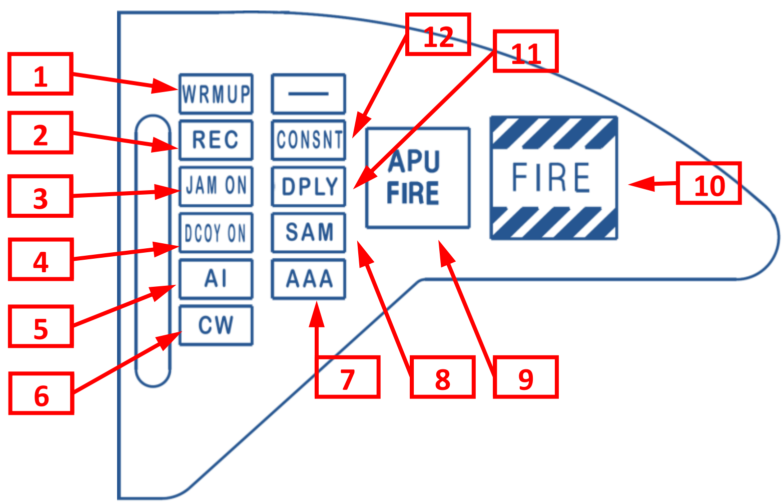
9) **R BLEED:** In the VRS F/A-18E, the R BLEED light will annunciate any time the LT TEST switch is placed in TEST. The current ECS failure simulation does not include a BALD system for bleed air leak instigation or detection.

10) **L BLEED:** *See RBLEED*.

11) **SPD BRK:** The green SPD BRK light indicates the speed brake function has been deployed.

5.0.7 Right Annunciator Panel

This panel, located to the right of the UFCD just below the instrument hood houses the *Right Engine FIRE button*, the APU FIRE button, and a series of tactical system oriented annunciator lights.



1) **WRMUP**: This light indicates the *Airborne Self-Protection Jammer (ASPJ)* is in a warm-up cycle. The ASPJ cannot transmit until it has had sufficient time to power up and perform self-diagnostics.

2) **REC:** The ASPJ has been placed into Receive Mode and is ready to transmit (jam) automatically when a qualifying RF threat has been detected.

3) **JAM ON:** The ASPJ is transmitting.

4) **DCOY ON**: An ALE-50 towed decoy has been deployed and is transmitting.

5) **AI**: In the real F/A-18, this light signifies RF energy is being directed at your aircraft consistent with *Airborne Interceptor* (airborne) tracking radar. In the VRS F/A-18E this light is not used, since we do not yet simulate AI threats.

6) **CW:** The RWR has detected *Continuous Wave* forms consistent with ground-based tracking radar. In the VRS F/A-18E this signifies a SAM system is tracking your aircraft and is ready to fire.

7) **AAA:** The RWR has detected an RF threat consistent with ground-based fire control radar. AAA is firing.

8) **SAM:** The RWR has detected an RF threat consistent with ground-based command guidance radar. A SAM has been launched.

9) **APU FIRE:** The APU FIRE light has no function in the Standard Edition (SE) of the VRS F/A-18E.

10) **FIRE**: The right FIRE light indicates a fire condition in the right engine/AMAD bay. Each light is also a pushbutton, which is guarded to prevent inadvertent actuation. Pushing light arms the fire extinguisher bottle (FIRE EXTGH READY light on) and shuts off flue flow to the affected engine.

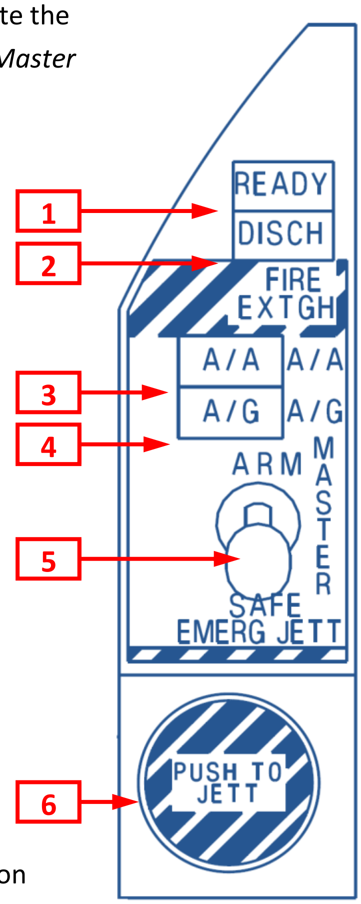
When a FIRE light is pressed, the pushbutton stays in and approximately 1/8 inch of yellow and black stripes are visible around the outer edges of the light.

11) **DLPY:** An ALE-50 towed decoy has been deployed.

12) **CONSNT:** Launch consent has been issued through secure data link for nuclear weapon delivery. This light is not used in the VRS F/A-18E

5.0.8 Master Arm Panel

This panel, located immediately to the left of the LDDI, is used to activate the *Engine Bay Fire Suppression System*, to select *Master Mode*, to enable *Master Arm*, and to activate the *Emergency Jettison System*.



1) **RDY**: This light indicates the fire extinguisher is charged (full) and ready to discharge when the button is depressed.

2) **DISCH:** This yellow light illuminates where the fire suppression system is fully discharged.

3) **A/A:** Pressing this button will select air-to-air master mode. If the gear are UP the green A/A light will illuminate indicating the A/A master mode is active. If this option is pressed, or remains depressed when the gear are DOWN, the light will not illuminate and the aircraft will remain in NAV master mode. Pressing this button when the A/A light is illuminated, will leave A/A master mode and return to NAV master mode.

4) **A/G:** Pressing this button will select air-to-ground master mode. If the gear are UP the green A/G light will illuminate indicating the A/G master mode is active. If this option is pressed, or remains depressed when the gear are DOWN, the light will not illuminate and the aircraft will remain in NAV master mode. Pressing this button when the A/G light is illuminated, will leave A/G master mode and return to NAV master mode.

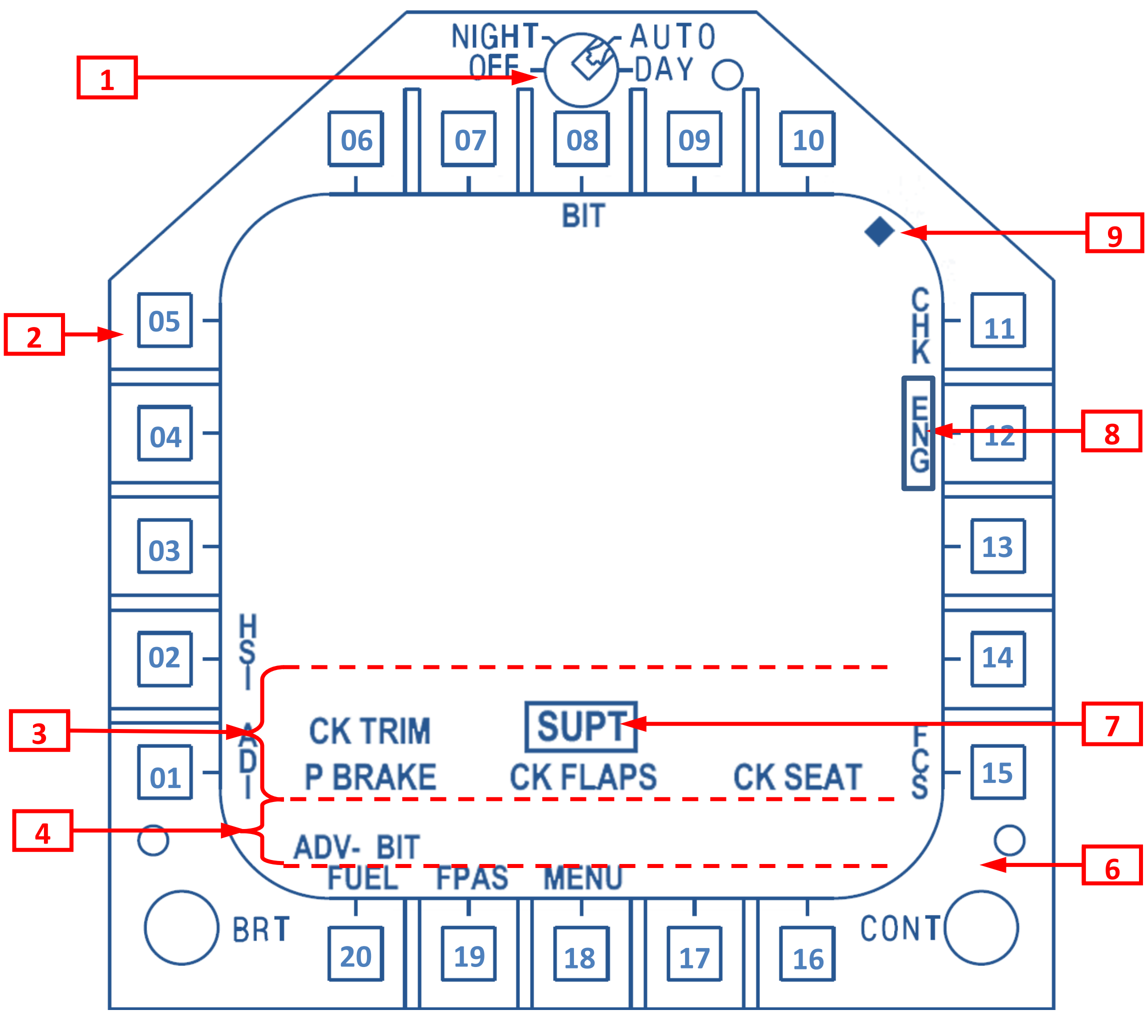
5) **ARM/SAFE**: Placing this switch in the SAFE position disarms the SMS and enabled all safeties. Placing this switch in the ARM position with the gear UP, arms all weapon systems.

6) **PUSH TO JETT:** This is the *Emergency Jettison Button.* Pressing this option with the gear UP will immediately jettison all stations except the wing tips (#1 & #11), and cheeks (#5 & #7).

5.0.9 Digital display Indicators (DDI)

The DDIs are tri-color multi-function CRTs which are used for the majority of support and tactical avionic functions. The F/A-18 legacy, or "baby" hornets, were perhaps the first true "glass" fighters, and the F/A-18E is even more so. Throughout this text we'll refer to the LEFT DDI and RIGHT DDI as *LDDI* and *RDDI* respectively.

The DDIs are surrounded by 20 pushbuttons which correspond to textual menu options, usually arranged vertically beside the corresponding button. Pressing a button corresponding to a particular text label, either enables ("boxes") that option indicating it is now ON, or (in most cases) moves to a DDI Sublevel. These individual sublevels will be described in sections pertinent to their function.



1) **Mode Selection Knob**: With the mouse cursor hovering over the knob, rotate the mouse wheel up to increment, and down to decrement the knob. The DDI mode affects display brightness as follows:

- **OFF**: Turns the display OFF. Note that turning the display completely off will save some fractional frames, but that wouldn't be much fun, would it? Any position other than OFF will power the display as well as the multiplex bus connecting it to the master computers (MC).
- **NIGHT**: Dims the display to an appropriate level for night operations.
- **AUTO**: Dimming of the display becomes a function of the panel light switch; if the panel lights are ON, the DDI switches to NIGHT mode. If the panel lights are OFF, the DDI switches to DAY mode.
- **DAY**: Brightens the display to an appropriate level for day operations

2) **Pushbuttons**.Each DDI is surrounded by a bank of twenty pushbuttons **[1-20]** numbered from 1 at the lower-left just above the brightness knob, clockwise to 20. These will subsequently be referred to as PB**nn** where **nn** is a number between 1 and 20.

3) **Cautions.** *DDI Cautions* display within these 3 lines **[3]** as yellow 150% sized text. There can be up to 9 cautions per display which progress from the lower right corner, up and to the right.

   The LDDI is the primary caution display; if the LDDI becomes saturated (more than 9 cautions), the remaining cautions will “spill over” to the RDDI. The MASTER CAUTION button, located on the left annunciator panel, can be used to re-sort the cautions in the event that gaps remain where previous cautions no longer exist.

   For a complete list of DDI caution messages, please refer to the pocket checklist either in-game, or in the checklist portion of this manual under *Emergency Procedures*.

4) **Advisories.** *DDI Advisories* are messages which alert the pilot to either the modality of systems (i.e. autopilot mode), or serve as low-level (non critical) cautions. Advisories are preceded by the word *ADV-* followed by one or more abbreviated messages. Advisories are displayed from left to right and up (2 rows) in the dashed area shown **[4]**.

   For a complete list of DDI advisory messages, please refer to the pocket checklist either in-game, or in the checklist portion of this manual under *Emergency Procedures*.

5) **BRT (brightness) Knob**. Increases/decreases the overall brightness of the display. Note that subsequent use of the DDI mode selection knob will return to brightness to its default level for that mode.

6) **CNT (contrast) Knob**. Increases/decreases the foreground contrast of the display. Note that subsequent use of the DDI mode knob will return to contrast to its default level for that mode.

7) **Top-level Labels.** Indicates the current *DDI top-level* and referred to as *Tactical (TAC)* and *Support (SUPT)*. Pressing the MENU option (PB18) from [TAC] will bring up the [SUPT] page. Likewise pressing MENU from [SUPT] will bring up the [TAC] page. All DDI formats or “pages” are accessed from one of these 2 root levels. TAC options are those which relate to tactical systems such as weapons and radar. SUPT options are those primarily used for navigation and aircraft status.

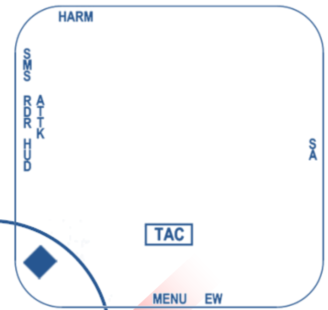
8) **Boxed Options**. Menu options which are modal and can be toggled on/off directly from a DDI button are referred to as having been "boxed" when they are ON. A rectangle will surround the option any time its state is ON. The example given here, CHK, cannot actually be boxed, since it goes to another format, but hopefully you understand the concept and can forgive the inaccuracy.

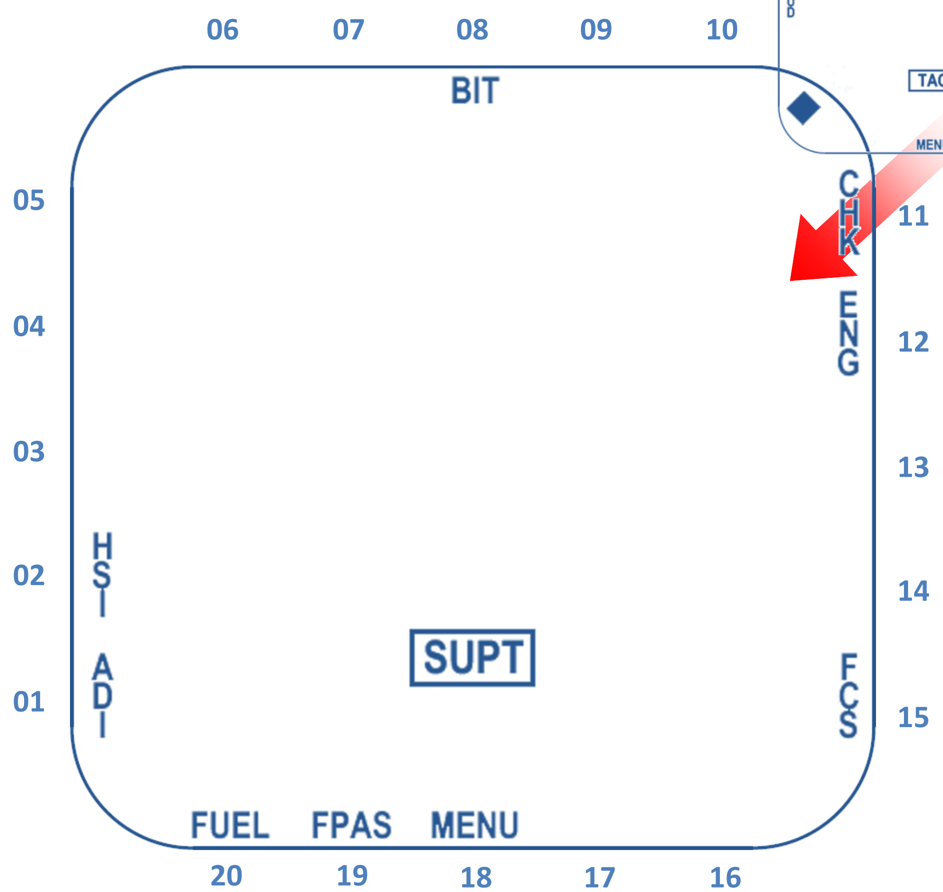
9) **TDC Priority Indicator**.This small diamond, located in the upper-right of a given display, indicates the display has *TDC Priority.* A solid diamond means *Key Command Mode* is active; a hollow diamond means it's inactive. TDC priority means that slewing (arrow key movement) will apply only to the display with priority. TDC priority also determines which display the keyboard controls when using pushbutton key equivalents such as 1-9 and CONTROL 1-9.

   TDC priority can be assigned to a specific display either by using CONTROL-ARROW keys, by clicking directly in the display with the mouse (except for the HUD), or by pressing the TAB key to cycle TDC priority from one display to the other.

5.0.10 DDI SUPT Menu Level

The *DDI Support Level [SUPT]* is one of two *DDI Top Levels*. The other top level is the *Tactical [TAC]* level. Pressing the **MENU** option from either top-level brings up the opposite top-level. SUPT options are those which





are support-oriented, such as navigation, engine, and flight control.

[PB 1] **HSI**: Brings up the *Horizontal Situation Indicator* (HSI) format.

[PB 2] **ADI**: Brings up the Electronic Attitude Direction Indicator (EADI).

[PB 3] **BIT**: Brings up the main *Built-In-Test* (BIT) format for performing diagnostic checks on select aircraft systems.

[PB 4] **CHK**: Brings up the *Checklist* format for a brief summary of common takeoff and landing.

[PB 5] **ENG**: Brings up the *Engine* format for examination of all current engine parameters.

[PB 6] **FCS**: Brings up the *Flight Control System* (FCS) format for examination of the state of all flight control system channels and related control surfaces.

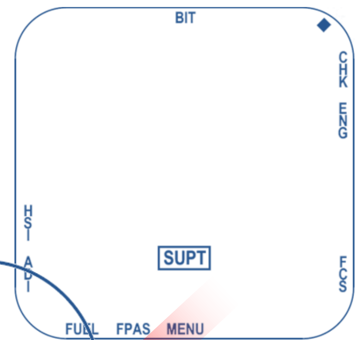
[PB 7] **MENU**: Swaps to the TAC menu level.

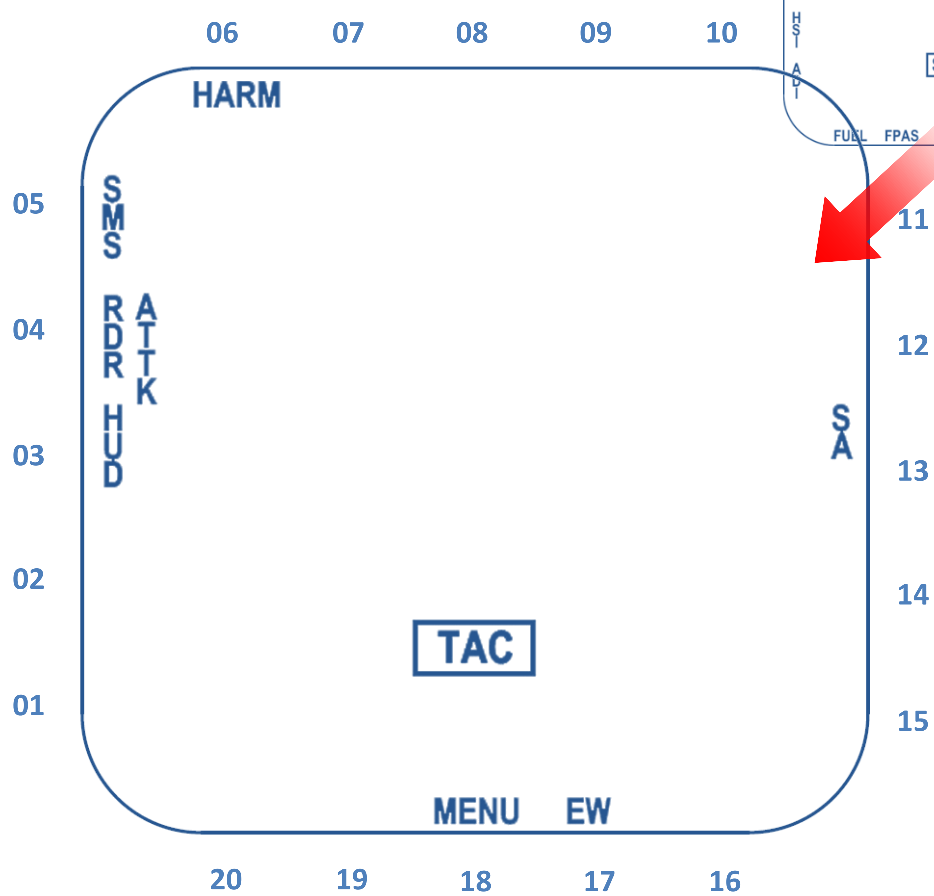
[PB 8] **FPAS**: Brings up the *Flight Performance Advisory System* (FPAS) format for a detailed summary of optimal range and endurance.

[PB 9] **FUEL**: Brings up the *FUEL* format for a graphic display of the fuel state of each tank.

5.0.11 DDI TAC Menu Level

The *DDI Tactical Level [TAC]* is one of two *DDI Top Levels*. The other top level is the *Support [SUP]* level. Pressing the **MENU** option from either top-level brings up the opposite top-level. TAC options are those which are tactical-oriented, such as radar, weapons, early warning, etc.





[PB 3] **HUD**: Used as a degraded backup, this format repeats the primary HUD. This format is only capable of displaying basic HUD data and lacks all but the most basic navigation HUD symbology.

[PB 4] **RDR ATTK**: Displays the A/A Attack radar format.

[PB 5] **SMS**: Displays the *Stores Management System* format. This display is used for weapon selection, weapon data display (HARM and Maverick), and weapon release mode programming, depending on the selected weapon.

[PB 6] **HARM**: The top row of buttons [06]-[10] in the TAC level displays all available weapons for the selected master mode. Pressing any of these options will immediately select the labeled weapon exactly as if the weapon had been cycled to from the SMS format's WPN option.

[PB 7] **SA**: Brigs up the *Situational Awareness* format for integrated sensor analysis of the tactical "picture" in 360 degrees around the aircraft.

[PB 8] **EW**: Brings up the *Early Warning* format for display of RF threat and *Countermeasures Dispensing System* (CMDS) programming options.

[PB 9] **MENU**: Swaps to the SUPT menu level.

5.1 LEFT-UPPER CONSOLE

The Left-Upper Console consists of the following items:

1) **CANOPY JETT Handle.** Pulling this handle immediately jettisons the canopy via a cartridge-initiated rocket thruster system. The canopy is thrust up and aft of the ejection seat. The canopy can be jettisoned without internal or external power applied to the aircraft.

2) **LDG GEAR Handle.** The LDG GEAR handle is a translucent, wheel-shaped lever which is pulled down to extend, or up to retract the landing gear. A red light fitted to the lever shaft illuminates and flashes when the landing gear handle does not match the position of the landing gear after a brief time threshold. The light also illuminates, accompanied by a warning tone, when the LT TEST switch is placed in TEST.

3) **LAUNCH BAR Switch.** The LAUNCH BAR switch is placed into EXTEND prior to catapult launch and held in position by HYD 2A pressure. The launch bar is mechanically retracted by spring tension. After placing the LAUNCH BAR switch in extend and mating with the catapult shuttle, the switch should be placed into RETRACT, at which point mechanical forces will hold the launch bar in place within the shuttle. After launch, when shuttle tension is released, the launch bar will spring back into position mechanically. The LAUNCH BAR switch should not be left in EXTEND during launch, or pressure placed on the seals can cause HYD 2A leakage or loss.

4) **FLAP Switch**. The FLAP switch is used to select the *CAS Operating Mode* and to position the TEFs and aileron droop for takeoff and landing.

   - **AUTO** Selects UA operating mode for *Up and Away(UA)* flight.
   - **HALF** Selects *Powered Approach (PA)* operating mode for the takeoff and landing configuration. Sets TEF deflection and aileron droop to 30° TED (WonW or at approach speed).
   - **FULL** Selects PA operating mode for the takeoff and landing configuration. Sets TEF deflection and aileron droop to 40° TED (WonW or at approach speed).

5) **LDG/TAXI LIGHT Switch**. Powers the landing/taxi lights located on the center gear strut. The LDG/TAXI LIGHT switch has green nubs on the surface to easily identify the switch, however these are simply green plastic and do not illuminate with the landing light.

6) **ANTI-SKID Switch**. The ANTI-SKID switch has no function in the Standard Edition of the VRS F/A-18E.

7) **HOOK BYPASS Switch**. With HOOK BYPASS in CARRIER and weight off wheels, the AOA indexer and approach lights flash if the hook is not down. This is a safety warning. With HOOK BYPASS in FIELD, the indexer and approach light do not flash regardless of the position of the hook.

8) **SELECT JETT knob**. This knob is used in conjunction with the jettison selection buttons located on the left-lower main instrument panel. With weight off wheels and MASTER ARM set to ARM,

Rotating the knob to the desired function and pressing the center pushbutton initiates the selective jettison function. Knob positions are as follows:

- **L FUS MSL:** Jettisons the left cheek station (#5), if it contains a missile, regardless of any pushbuttons set on the selective jettison panel.
- **SAFE:** Nothing will jettison even if the pushbutton is depressed.
- **RFUS MSL:** Jettisons the right cheek station (#7), if it contains a missile, regardless of any pushbuttons set on the selective jettison panel.
- **RACK/LCHR**: Jettisons all ordinance, racks and launchers armed via the selective jettison panel on the main instrument panel. Note that in the VRS F/A-18E, only weapons will be jettisoned, regardless of whether this option is selected or not.
- **STORES:** Jettisons only the ordinance contained on those stations which were previously armed for jettison with the selective jettison pushbuttons on the main instrument panel.

9) **Brake Accumulator Pressure Gauge**. Indicates the brake pressure (3000 PSI nominal) in the brake accumulator. A BRK PRESS switch located on the forward left main console (*see 2*)) can be used to control power to the gauge. In the forward position, power to the gauge is through the maintenance bus, and in the second position, the gauge is unpowered unless aircraft main (AC) power is applied.

10) **PARK BRAKE Handle**. The parking brake is used to lock the main landing gear wheels when the aircraft is parked. The PARK BRK caution will come on to alert the pilot that the parking brake is still set when both throttles are advanced beyond 27 degrees THA. Several aircraft systems utilize parking brake activation to enable or disable logic. For example a set parking brake is used to enable GEN TIE logic.

5.2 RIGHT-UPPER CONSOLE

The Right-Upper Console consists of the following items:

1) **HOOK Handle/Light**.Pulling this handle DOWN lowers the tailhook, UP raises the tailhook. The red light just above the handle flashes when the tailhook position does not match the handle position (i.e. transition).

2) **LANDING Checklist** .A static checklist of general tasks which should be accomplished prior to landing.

3) **WINGFOLD Switch**.In the VRS F/A-18E this is a 2-position switch which controls power to the wingfold EDU.

   - **FOLD:** Unlocks the wings (WING UNLK caution displayed), fairs the ailerons, and, when allowed by the FCCs, folds the wings.
   - **HOLD:** Not implemented.
   - **SPREAD:** Spreads and locks the wings. (WING UNLK caution removed when both wings are locked).

4) **Hydraulic Pressure Gauge**. A 2-needle (one for the left and right engines) hydraulic pressure indicator.

5) Standby Caution Panel.A general, standby caution panel which functions on maintenance bus power.

   - **CK SEAT Caution Light**: The CK SEAT caution light is located on the caution light panel and repeats the DDI CHECK SEAT caution. The caution comes on when the right throttle is at MIL or above, weight is on wheels, and the ejection seat is not armed.
   - **APU ACC Caution Light**: APU accumulator pressure low (below 2,450 psi). The APU ACCUM caution can be expected after APU start or after emergency gear/probe extension inflight.

     With WonW, the APU accumulator recharges automatically. With WoffW, the HYD ISOL switch may need to be held for up to 20 seconds following emergency gear/probe extension to remove the APU ACCUM caution and provide a full charge (up to 40 seconds following inflight APU start).

   - **BATT SW Caution Light**: The BATT SW caution and caution light are set to alert the aircrew of an improperly placed BATT switch, or a battery related malfunction. After a dual GEN failure, the BATT SW caution light must be referenced to determine whether an EBB PMG or the battery is powering the essential bus. These cautions are set in only four circumstances:

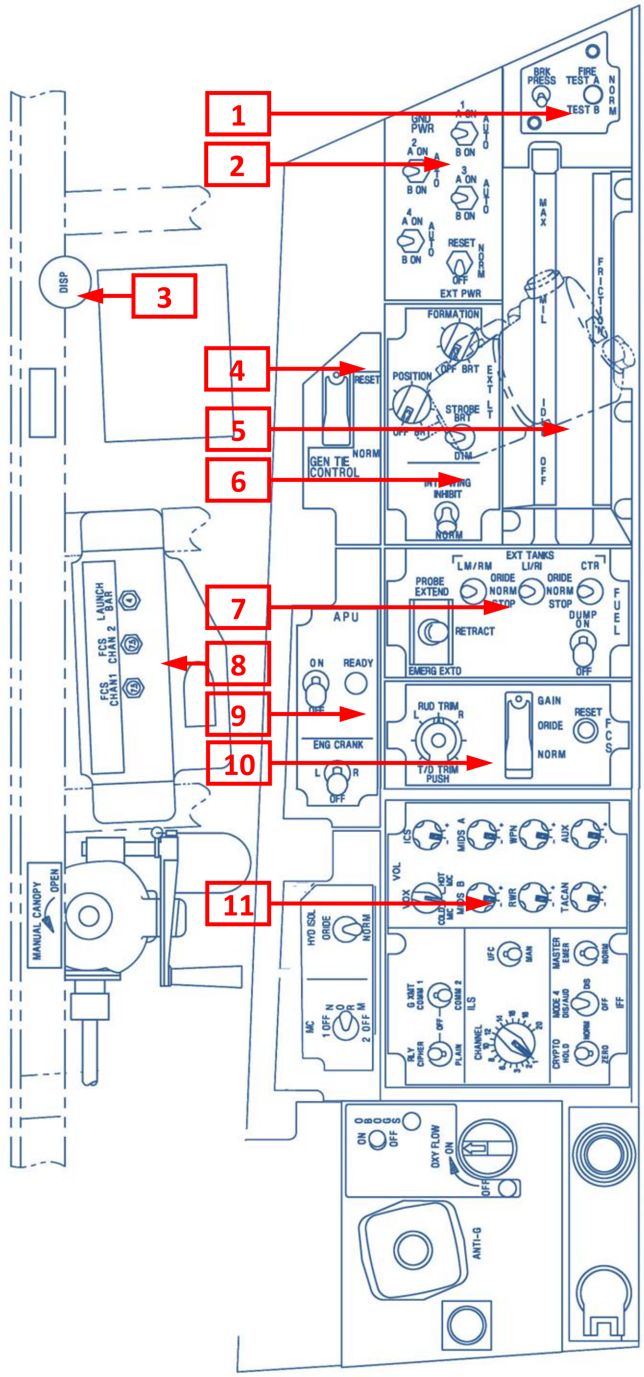
1) The BATT switch is ON on the ground in the absence of ac power (i.e., first engine start). The battery is depleting and the switch should be placed to OFF unless APU start is about to be made.
2) The BATT switch is OFF inflight and should be placed to ON to provide essential bus backup capability from the PMGs and battery.
3) The battery is not being recharged inflight (BATT switch ON). The battery charger has failed or the right generator has failed with the buses isolated (R GEN and GEN TIE cautions).
4) The battery is powering the essential bus inflight. A dual generator failure and a dual PMG failure has occurred and at least 5 to 10 minutes of battery power remains to run the FCCs.

- **FCS HOT Caution Light**: The FCCs can only operate for a short time without cooling. Placing the AV COOL switch to EMERG provides emergency ram air cooling to FCC A and the right TR through a dedicated ram air scoop. If circumstances require airspeed above 325 KCAS, delay deploying the FCS ram air scoop, as ram air temperature may actually increase FCC heating and decrease operating time. Once deployed, the FCS ram air scoop cannot be closed inflight.
- **GEN TIE Caution Light**: During initial engine start (battery or external power) GEN TIE circuitry requires a set PARK BRAKE handle to properly function. If the PARK BRAKE handle is not set during right (first) engine start, a *GEN TIE* caution light comes on when the right generator comes online. For a battery start, setting the PARK BRAKE handle and cycling the R GEN switch reties the left and right buses and clears any avionics faults that would otherwise occur. For an external power start, setting the PARK BRAKE handle, disconnecting external power, and cycling the GEN TIE switch reties the left and right buses.
- **FUEL LO Caution Light**: The fuel low level indicating system is completely independent of the fuel quantity indicating system. When the fuel level in either feed tank drops to 1,125 lb, a FUEL LO caution, caution light, and voice alert are activated.
- **FCES Caution Light**: Indicates a general FCS failure. Check the BIT page and/or FCS page for detailed information about the specific failure(s). This caution should be expected following initial engine start prior to the FCS coming online. An FCS RESET attempt clears the FCS caution whether or not the reset was successful. A successful reset is indicated by the RSET advisory and removal of all Xs from the FCS format.
- **L(R) GEN Caution Lights**: Designated generator ac power source is off line

6) **AV COOL Switch**. Provides power to the emergency avionics cooling fan which will cool FSCB in the event of degraded ECS cooling. If the *AV AIR HOT* caution appears for any reason, use this switch to provide emergency cooling until the problem is resolved.

5.3 LEFT MAIN CONSOLE

The Left Console consists of the following general items which are described in brief here, and in more detail in subsequent sections.



1) **FIRE TEST Switches:** The *Fire Test switch* will test the operation of the fire warning system in two independent circuits (A/B) , including left/right *Bleed Air Leak Detection (BALD).*

   The *Brake Pressure* switch will apply power to the brake pressure gauge on either the main bus or the maintenance bus.

2) **GND PWR Panel:** Controls power to the aircraft through external sources.

3) **Countermeasures Dispensing Button:** This button will initiate the currently active *CMDS Program*, or in the absence of a program, will dispense a single flare and/or chaff bundle.

4) **GEN TIE Panel:** This guarded switch will reset the Generator Bus Tie Logic.

5) **Throttle Panel:** The split throttle controller and engine shutoff handles.

6) **EXT LT Panel:** Controls power to the *Formation*, *Position*, and *Strobe* lights.

   Wing Inhibit ceases transfer from wing tanks to the transfer tanks.

7) **EXT TANKS Panel:** Controls *In-Flight Refueling Probe (IFR), External Tank Pressurization*, and *Fuel Dump* functions.

8) **Left Circuit Breaker Panel:** Controls fusing of FCS Channel 1/Channel 2 and *the Launch Bar*.

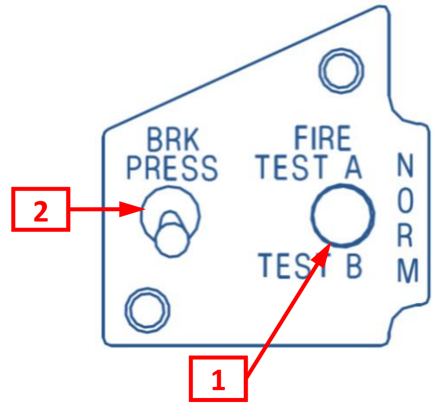
9) **APU Panel:** Controls *APU Start* and *Engine Crank* settings.

10) **FCS Panel:** Rudder trim, takeoff trim, and FCS gain override (pro only).

11) VOL Panel: Individual system volume control.

5.3.1 Fire Test Panel

The FIRE test system is used to initiate a test of the FIRE detection and *Bleed Air Leak (BALD)* systems. The fire detection circuit requires essential bus (battery) power to operate.



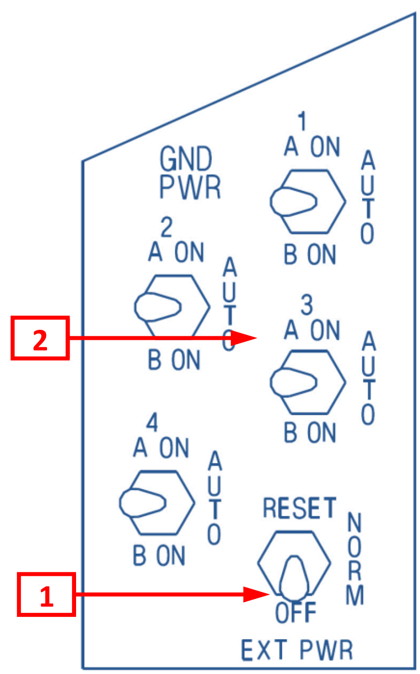
1) **FIRE TEST Switch**. A successful test of the FIRE detection and *Bleed Air Leak Detection* (BALD) systems should illuminate the left, right, and APU FIRE lights, both L BLEED and R BLEED warning lights, and should annunciate all of the following voice alerts: "ENGINE FIRE LEFT", "ENGINE FIRE RIGHT", "APU FIRE", "BLEED AIR LEFT" , "BLEED AIR RIGHT" (each repeated twice).

- **TEST A:** Initiates a test of loop A.
- **NORM**: (default) provides normal fire detection.
- **TEST B:** Initiates a test of loop B.

2) **BRK PRESS Switch.**

- **FWD:** Applies maintenance bus power to the brake accumulator pressure gauge when ac power is not applied.
- **AFT:** (unmarked) Brake accumulator pressure gauge unpowered when ac power is not applied.

5.3.2 GROUND Power Panel



External electrical power may be connected to the aircraft bus system through an external power receptacle located on the left forward fuselage. Actuation of 1 to 4 ground power switches is required to energize certain aircraft systems following application of external power. The aircraft buses are energized by external power in the same manner as if a generator were operating provided the BATT switch is OFF or the PARKING BRAKE is set.

1) **EXT PWR Switch**.The external power switch, located on the ground power panel on the left console, is spring loaded to the NORM position.

- **RESET**: Momentary actuation allows external power to be applied.

- **NORM**: Aircraft buses are energized by external power, provided the switch was first positioned to RESET. The switch returns to OFF when external power is disconnected.
- **OFF:** Disconnects external power from the aircraft.

2) **Circuit Switches**. The individual circuit switches control power to each system as follows:

- **A ON:** Only systems/instruments listed for the A position are energized by external power.
- **AUTO:** All controlled systems/instruments are deenergized with external power on the aircraft. When a generator comes online, the switch(es) automatically revert to AUTO,
- **B ON:** All controlled systems/instruments (both A and B) are energized by external power.

Switch		POSITION A	POSITION B
1		MC1, LDDI, SDC, FADEC	POS A EQUIPMENT + MC2
2		MPCD, UFCD, RDDI, HUD, RADAR	POS A EQUIPMENT + COMM1, COMM2, EFD RALT, STBY INST, CSC
3		ALQ-165, OBOGS, ANTI-SKID, RWR, ALE-47	POS A EQUIPMENT + SMS, HARM, LDT
4		ICS, KY-58	POS A EQUIPMENT + FCES

5.3.3 Countermeasures Dispensing Switch

The Countermeasures Dispense Switch (actually a large red palm-button) is located on the left sil of the cockpit.Pressing this switch executes the currently active CMDS program (identical to **CONTROL-K**). If no CMDS program exists (EW DDI page), a single chaff/flare will be released provided power is applied to the CMDS.

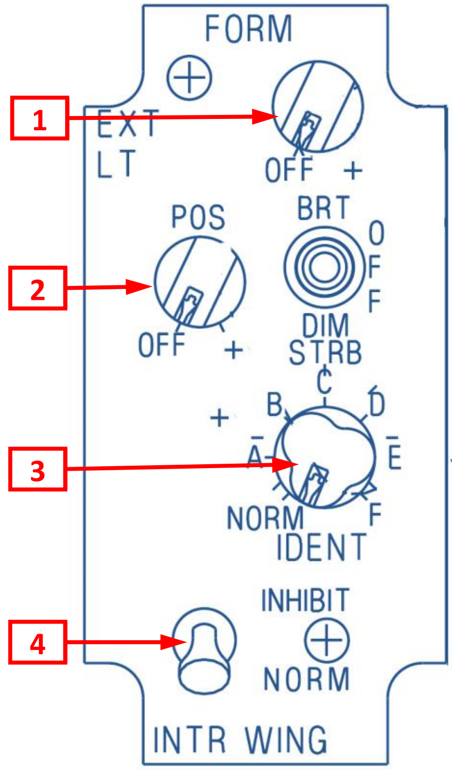
5.3.4 GEN TIE Control Panel

The red-guarded GEN TIE switch is located on the left console outboard of the exterior lights panel. When generators are tied, the left bus backs up the right bus and vice versa. This is known as “tying the busses.” At startup with weight on wheels, the busses are automatically tied as long as the parking brake is set prior to first (right) engine start.

- **RESET**: Resets the bus tie circuitry. Reset is accomplished by cycling the switch to RESET then NORM. Note that in the VRS F/A-18E this can also be accomplished with **CONTROL-G**.
- **NORM**: With the BATT switch ON, enables the bus tie, ac bus isolation and

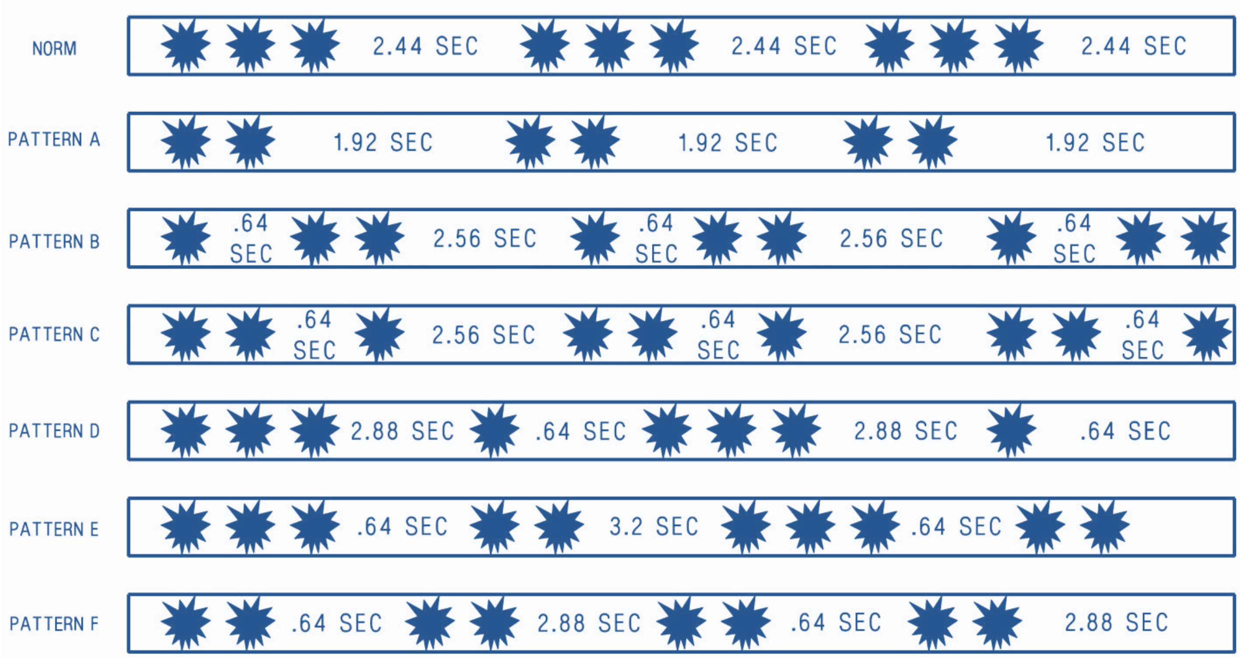
generator automatic reset circuits.

5.3.5 External Lighting Panel



This panel controls external lighting and wing tank fuel inhibit as follows:

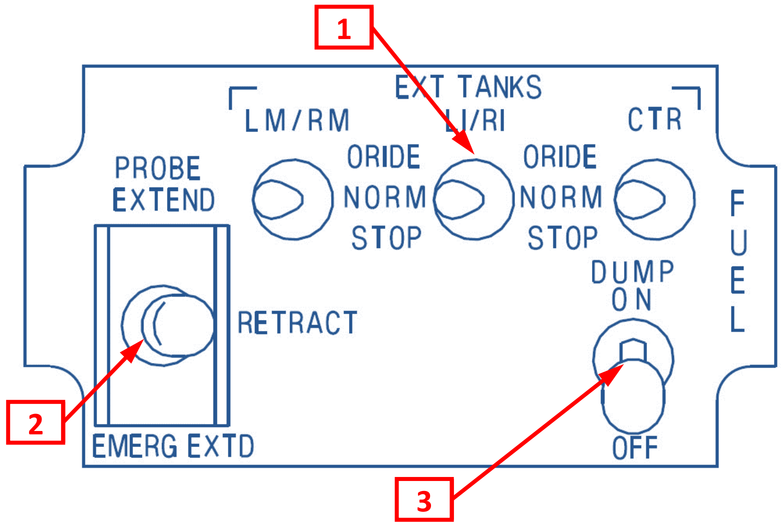
1) **FORMATION Knob**. Toggles formation "strip" lighting. These lights are electroluminescent blue/green strips used for anti-collision and formation flying at night. The VRS F/A-18 supports up to 8 descrete brightness levels for the external strip lighting.
2) **POSITION Knob**. Toggles the "Navigation" lights located on the wing tips, LEX upper surface, and midboard lower wing surfaces. These lights are red to starboard and green to port.
3) **STROBE ID Knob**. Toggles the 2 red strobes located on the outboard surfaces of the vertical stabilizers. The VRS Superbug supports all 7 strobe patterns found on the real aircraft. Each strobe pattern can be used by observers on the ground or an aircraft carrier to receive signals from the pilot in the event of radio commincation blackout or failure.



4) **INTR WING Switch**. This switch allows fuel flow to/from the 2 wing tanks to be commanded closed. This would be used in the case of a fuel leak which is determined to be originating in the wing tanks.

- **INHIBIT**: Closes both wing shutoff valves and causes all fuel flow from the wings to be diverted to tanks 1 and 4.
- **NORM**: Opens both wing shutoff valves for normal operation.

5.3.6 External TANKS Panel



1) **EXT TANKS Switches**. Labeled LM/RM, LI/RI, and CTR (left and right midboard, left and right inboard, and centerline tanks, respectively). With the external tanks pressurized, fuel transfers when the FUEL LO caution is displayed regardless of the position of the EXT TANKS transfer switches.

- **ORIDE:** Applies pressure and transfers (allows flow) fuel from all external tanks whose switches are not in STOP. May be used to transfer external fuel during extended ground operations (EXT TANK caution). Overrides any SDC stop transfer command.
- **NORM:** Permits normal transfer and refueling of controlled external tank(s).
- **STOP:** Prevents transfer and refueling of controlled external tank(s) except with a FUEL LO caution.

2) **PROBE Switch**. Used to extend and retract the inflight refueling (IFR) probe.

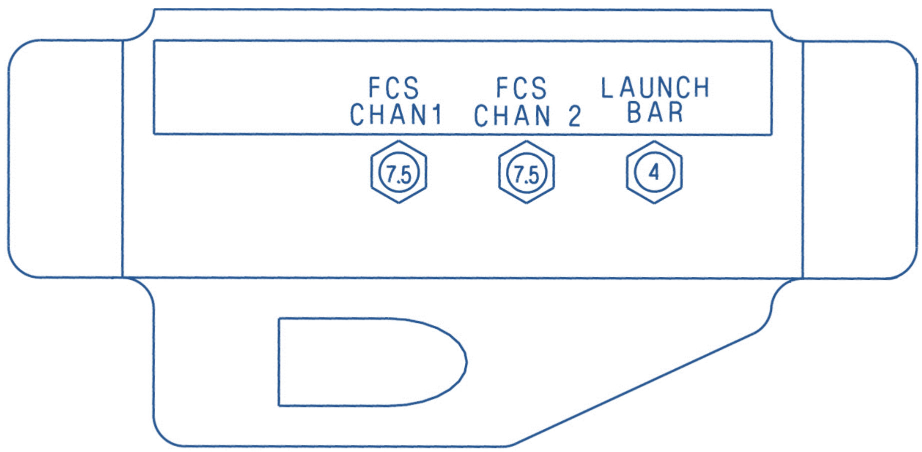
- **EXTEND**: Extends the inflight refueling probe using HYD 2A pressure, energizes the probe light , and depressurizes all internal and external tanks.
- **RETRACT**: Retracts the inflight refueling probe using HYD 2A pressure, deenergizes the probe light, and repressurizes the internal and external tanks. The probe cannot be retracted if HYD 2A pressure is not available.
- **EMERG EXTD**: Emergency extends the inflight refueling probe using either HYD 2B or APU accumulator pressure, energizes the probe light (external lights master switch in NORM), and depressurizes all internal and external tanks.

3) **DUMP Switch**. Allows fuel to be dumped via the vertical stabilizer vent tanks.

- **ON**: Opens the dump valve, allowing transfer tank and external tank fuel to be dumped. The switch is electrically controlled and reverts to OFF with a BINGO or FUEL LO caution.
- **OFF**: Closes the dump valve, terminating transfer.

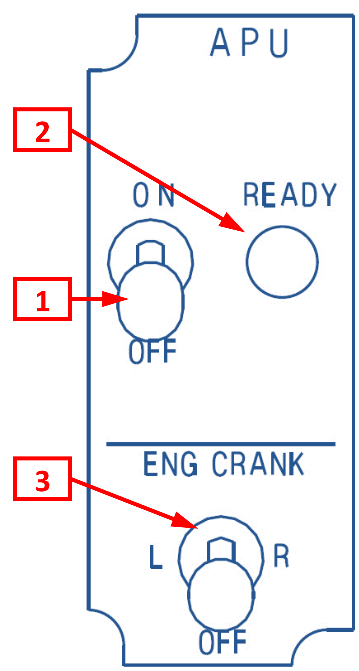
5.3.7 Left Circuit Breaker Panel

This panel controls fusing to FCS Channel 1, FCS Channel 2 and the Launch Bar. Pressing a breaker from the VC will toggle the circuit on/off.



5.3.8 APU Panel

Houses the *Auxiliary Power Unit (APU)* power switch, and the engine crank switches.



1) **APU Switch**. The APU switch is spring loaded to the OFF position and is electrically held in the ON position.

    - **ON**: Automatic start and normal APU operation. The switch returns to OFF 1 minute after the second aircraft generator comes online (BLEED AIR knob not in AUG PULL).
    - **OFF**: Manual APU shutdown

2) **APU Ready Light**. The green APU READY light comes on when the APU has completed the start cycle and is capable of supporting engine crank.

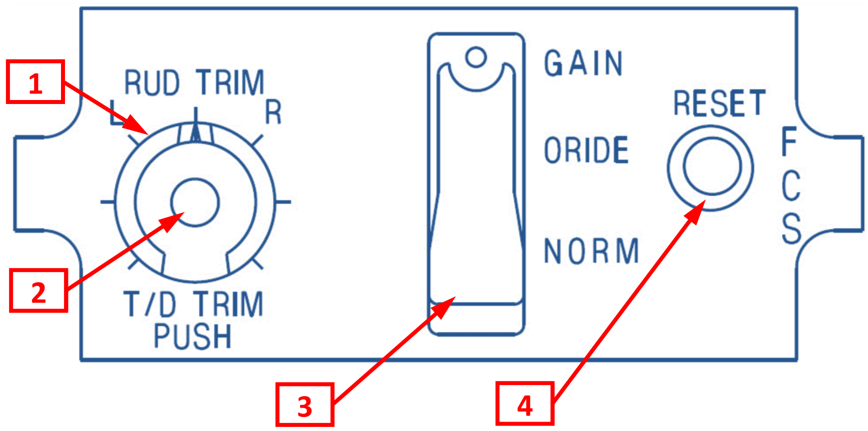
3) **ENG CRANK Switch**. The ENG CRANK switch is spring loaded to the OFF position and is electrically held in the L or R position.

    - **L**: Opens the left ATSCV and/or the ECS air isolation valve to direct pneumatic pressure to the ATS for left engine crank.

- **OFF**: Closes both ATSCVs and the ECS air isolation valve. When the left or right generator comes online following engine start, the switch automatically returns from L or R to the OFF position.
- **R**: Opens the right ATSCV and/or the ECS air isolation valve to direct pneumatic pressure to the ATS for right engine crank.

5.3.9 FCS Panel

Houses the rudder trim knob, the takeoff trim button, and FCS gain override and reset switches.



1) **RUD TRIM Knob**. Rudder trim can be adjusted by overing over and using the mouse wheel, or left/right clicking.

2) **T/O TRIM Switch**. The T/O TRIM switch, located in the center of the RUD TRIM knob will set appropriate takeoff trim (~6.5 degrees with the launch bar DOWN and ~4 degrees with the launch bar UP). Secondary activation of the T/O TRIM switch will remove any preexisting takeoff trim and center rudder and aileron trim. Once the aircraft goes WoffW, trim will automatically be returned by the FCS and the T/O trim switch will return to the UP position.

The T/O trim function can also be accessed by pressing **CONTROL-T**.

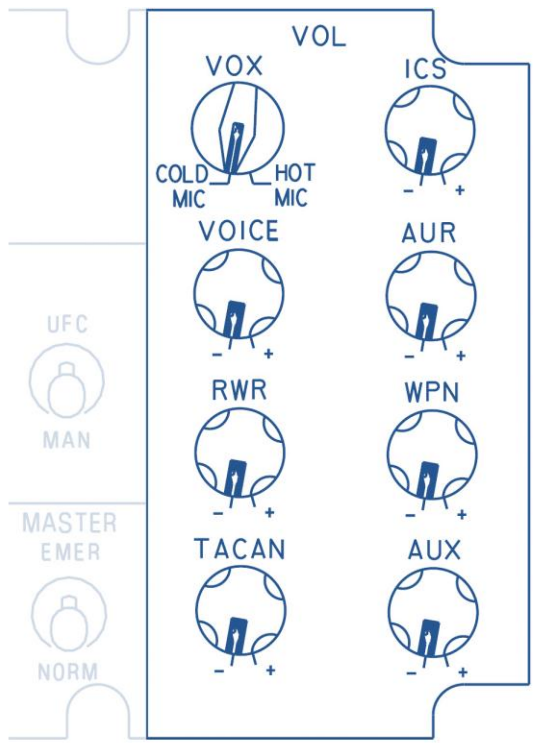
3) **FCS GAIN ORIDE Switch**. This guarded switch will override FCS gains forcing the FCC to used fixed gains based on the position of the FLAPS switch. This is a Pro version feature and will have no effect in the SE version of the VRS F/A-18.

4) **FCS RESET Switch**. Following detection of FCS related hardware and/or software failures (i.e., FCS X's from the FCS DDI format), or after first engine startup, pressing the FCS RESET button commands a reset of FCC failure detection circuitry. If the FCS related failure was momentary and no longer exists, an FCS RESET restores the failed actuator/component, removes all FCS failure indications (FCS caution, FCES caution light, and X's, and displays the DDI RSET advisory to indicate a successful reset.

   The FCS RESET button does not fix a detected failure; it merely allows components to be restored and failure indications to be removed, if and only if the failure no longer exists. Additionally, the FCS RESET button is used in conjunction with the FCS BIT consent switch on the right console to enter the FCS exerciser mode.

5.3.10 VOL PANEL

This panel, located just aft of the FCS panel, can be used to control various volumes associated with the following systems:



VOX Knob. No function. In the real aircraft, this would be used to adjust microphone gain.

ICS Knob. No function. In the real aircraft this would be used to adjust the intercom volume between fore and aft crew stations (F).

VOICE Knob. Adjusts the volume of all voice "Betty" warnings.

AUR Knob. Adjusts the volume of the master caution tone, the advisory tone, AOA warning tone, low altitude warning tone, LGCU (landing gear) warning tones, fire warning, and transponder tones.

RWR Knob. Adjusts the volume of all radar warning receiver related tones including missile launch, tracking, and new RF contact tones.

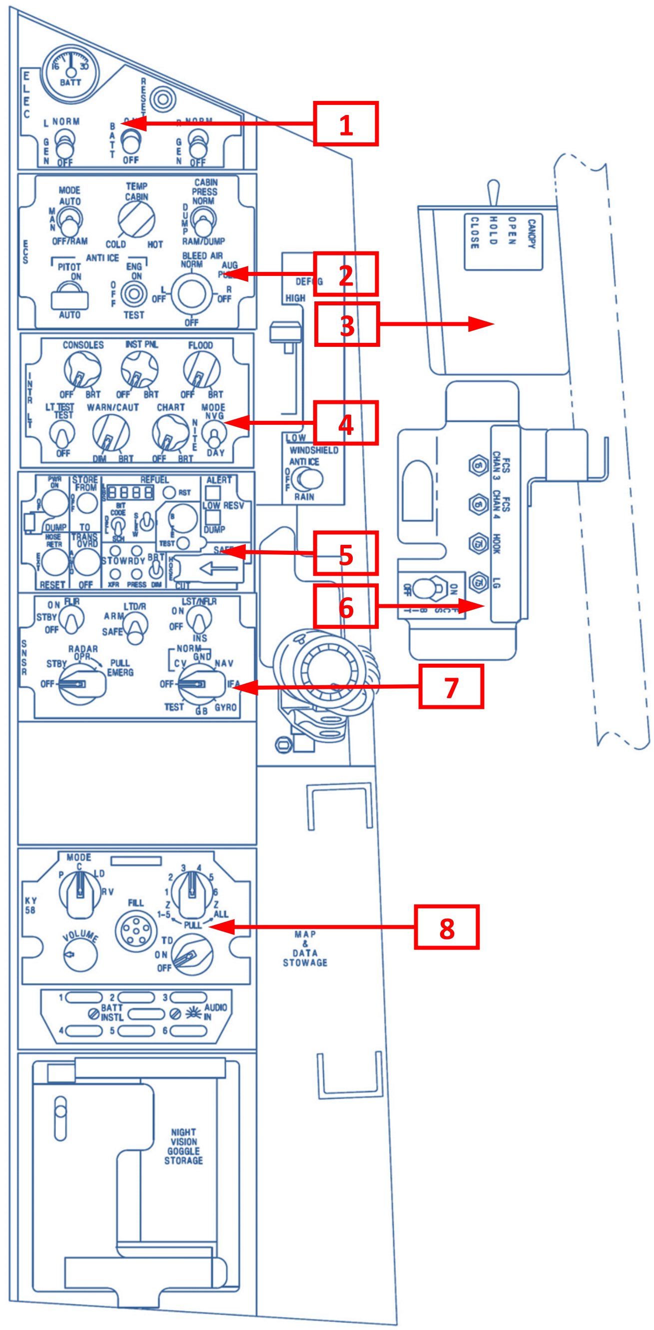
WPN Knob. Adjusts the volume of the AIM-9 tones.

TACAN Knob. Adjusts the volume of the TACAN Morse identification tones from VOR, TACAN and DME.

AUX Knob. No function.

5.4 RIGHT MAIN CONSOLE

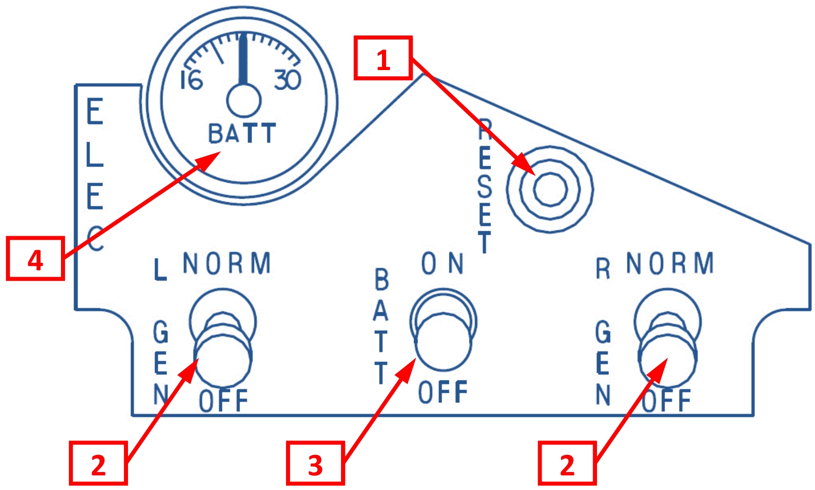
The Left Console consists of the following general items which are described in brief here, and in more detail in subsequent sections.



1) **ELEC Panel:** Contains the battery, generator and circuit reset switches as well as the battery gauge.
2) **ECS Panel:** Various switches and knobs related to environmental control. This includes anti-ice functions as well as avionic cooling modes and cabin heating.
3) **Canopy Actuator Switch:** Opens/closes the canopy electrically. Note that the HOLD function is not simulated on the VRS F/A-18E.
4) **INT LT Panel:** Functions related to internal aircraft lighting, including consoles, panel, and night vision.
5) **ARS Panel:** Aerial refueling (buddy tank) control.
6) **Right Circuit Breaker Panel:** Controls fusing of FCS Channel 3/Channel 4, hook and landing gear.
7) **SNSR Panel:** Controls power to the radar and FLIR systems, and INS operating mode (Pro only).
8) **KY-58 Panel:** Not simulated.

5.4.1 ELEC Panel

The electrical system consists of two generators, two transformer-rectifiers (TR), one battery with dedicated battery charger, and a power distribution bus. During normal operation, the left generator powers only the left buses while the right generator powers only the right buses. If one generator fails, the other generator is capable of carrying the entire electrical load of the aircraft trough the GEN TIE system. Battery power is used for normal engine start in conjunction with the APU. External electrical power can be applied to power the entire system on the ground. The bus system consists of the left and right 115 vac buses, right 26 vac bus, left and right 28 vdc buses, 28 vdc essential bus and a 28 vdc maintenance bus.



1) **RESET Button**. The electrical system RESET button is located on the electrical power panel on the right console. This button provides master reset capability for any failed generator or electrical system relay without interrupting operational circuits.

2) **GEN Switches**. Two generator control switches, labeled L GEN and R GEN, are located on the electrical power panel on the right console.

- **NORM:** Provides normal generator operation.
- **OFF:** Removes the generator ac source from the bus system.

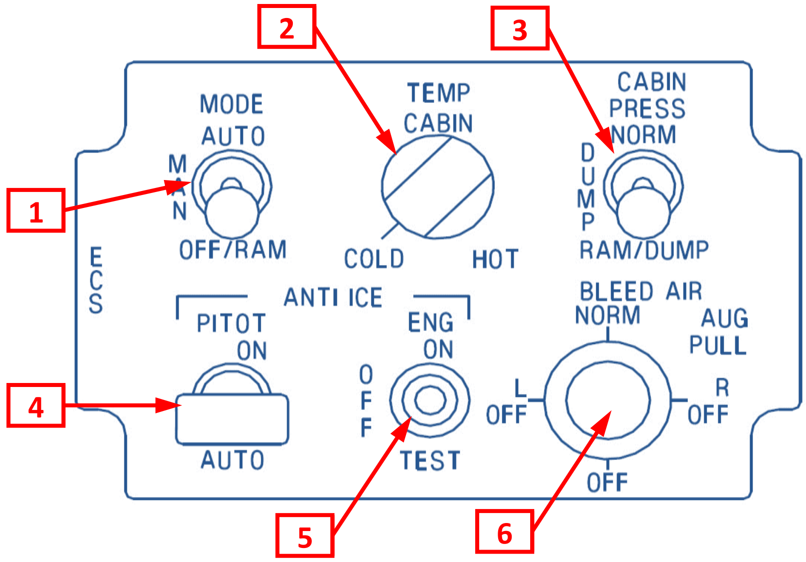
3) **BATT Switch**. The BATT switch is located on the electrical power panel on the right console.

- **ON:** Allows the battery or either PMG to power the essential bus when TR power is not available.
- **OFF:** Prevents the battery or either PMG from powering the essential bus when TR power is not available.

4) **BATT Gauge**. Nominal battery voltage should be approximately 23 to 24 vdc. Minimum battery voltage is that which provides a successful engine start (i.e., APU remains online and the EFD remains powered to provide indications of RPM and TEMP). EFD blanking and/or uncommanded APU shutdown should be anticipated with a battery voltage at or below approximately 18 vdc. If a weak battery results in an unsuccessful engine start attempt, the battery should be charged or replaced prior to takeoff, since the battery provides the last source of electrical redundancy for the FCCs.

5.4.2 ECS Panel

The ECS has three operating modes: AUTO, MAN (manual), and OFF/RAM. Each mode is selected by the corresponding position of the ECS MODE switch. On the ground, APU compressor air may be used instead of engine bleed air to run the ECS and cool the avionics (BLEED AIR knob in AUG PULL).



1) **ECS MODE Switch**.The ECS MODE switch is used to select the ECS operating mode.

- **AUTO**: With WonW and both throttles at IDLE, the aft avionics cooling fan is on and provides the primary source of avionics cooling. The ECS provides a second source of avionics cooling but at a fixed, low rate. With at least one throttle advanced to 74% N2 rpm or above (also in flight), the aft avionics cooling fan is off, and the ECS provides all avionics cooling. At these conditions the ECS controller schedules avionics airflow based on the temperature of the air being delivered (warm air equates to higher flow to increase cooling). Once a throttle has been advanced above 74% N2 rpm, the aft avionics cooling fan will not be reenergized until both throttles are retarded below 70% N2.
- **MAN**: The ECS MAN mode is a degraded operating mode. At high power settings, ECS MAN mode can significantly increase the amount of bleed air drawn from the engines, resulting in higher turbine temperatures and reduced engine life. Therefore, the ECS MAN mode should only be used when the ECS AUTO mode is degraded **and** temperatures are out of limits (e.g., cockpit temperature high or AV AIR HOT caution inflight).
- **OFF/RAM**: The ECS OFF/RAM mode is used to terminate normal ECS operation following a major ECS malfunction. With the ECS MODE switch in OFF/RAM, the ECS flow modulator valve (Item 4) is closed (terminating conditioned airflow), the cockpit RAM air scoop is deployed, and the emergency avionics cooling fan is energized (inflight only).

2) **CABIN TEMP Knob**. No Function. Cabin temperature is not simulated.

3) **CABIN PRESS Switch**. Although no ill consequences are simulated, cabin pressurization is simulated to a certain extent by way of changing pressure readings and in some cases audio effects.

- **NORM**: Cabin pressure scheduled by the cabin pressure regulator.
- **DUMP**: Dumps cabin pressurization.
- **RAM/DUMP**: Dumps cabin pressurization and terminates all ECS airflow to the cockpit.

4) PITOT ANTI-ICE Switch.

Used to power the electric heaters for the pitot-static/total temperature probes and the AOA probes.

- **ON**: Pitot and AOA heaters always ON (WonW or WoffW).
- **AUTO**: Pitot and AOA heaters automatically ON with WoffW and OFF with WonW.

5) ENG ANTI-ICE Switch. The VRS F/A-18 simulates icing detection. It is actually possible to accumulate ice in Flight Simulator; however the designers never actually added a mechanism for detecting it. VRS has overcome this limitation through the use of carefully calibrated algorithms which constantly poll aircraft weight, fuel, and payload in order to determine if significant icing has occurred.

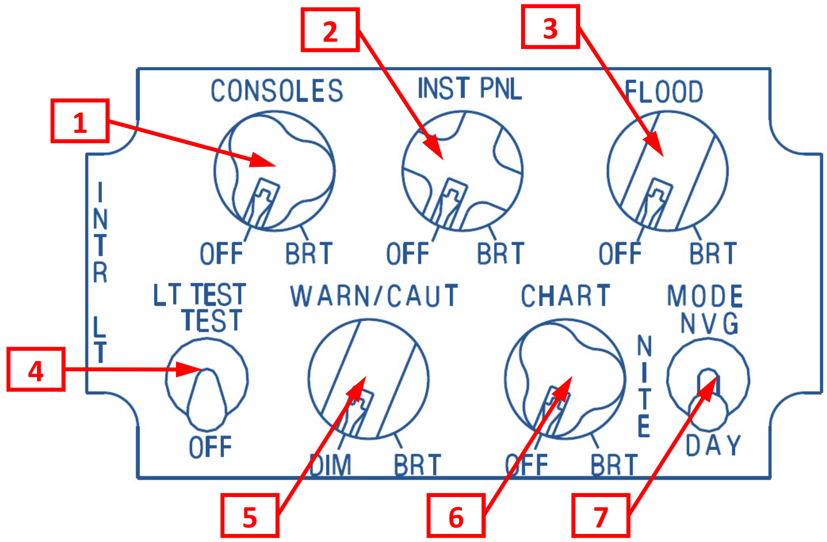
- **ON**: Activates the engine anti-ice heating system.
- **OFF**: Deactivates the engine anti-ice system.
- **TEST**: Checks ice detector operation and displays the INLET ICE caution (indicating proper operation).

6) BLEED AIR Knob. Used to select the engine bleed air source for the *Environmental Control System* (ECS).

- **NORM**: Commands both primary bleed air shutoff valves open, selecting bleed air from both engines.
- **L OFF**: Commands the left primary bleed air shutoff valve closed, selecting bleed air from the right engine only.
- **R OFF**: Commands the right primary bleed air shutoff valve closed, selecting bleed air from the left engine only.
- **OFF**: Commands all three bleed air shutoff valves closed, isolating the ECS. Closes the ECS auxiliary duct doors.
- **AUG PULL**: Commands the secondary bleed air shutoff valve closed, opens the ECS air isolation valve, and allows APU compressor air to operate the ECS.

  APU air is used instead of bleed air to run the ECS and cool the avionics. AUG PULL is generally useful if increased avionics cooling is required (e.g., AV AIR HOT caution) *AND* if both throttles must be left at ground idle, however advancing one throttle to 74%N2 rpm with the ECS MODE switch in AUTO generally provides the best avionics cooling.

5.4.3 INT LT Panel



Interior lighting options include integral backlighting for the main instrument panel and side consoles, cockpit flood lighting, and NVG-compatible green flood lighting.

1) **CONSOLES Knob**. Toggles the side console integral backlighting ON/OFF, and adjusts the intensity in 8 steps. The CONSOLES knob is disabled in the NVG compatibility mode.

2) **INST PNL Knob**.Toggles the main instrument panel integral backlighting ON/OFF, and controls the intensity level in 8 steps.

3) **FLOOD Knob**. Toggles cockpit (VC-only) white flood lighting ON/OFF. The FLOOD knob and all white floodlights are disabled in the NVG compatibility mode.

4) **LT TEST Switch**. Used to test important cockpit lighting and verify bulb integrity prior to flight. The switch requires ac electrical power (internal or external) to operate.

   - **TEST**: Powers all operating warning, caution, and advisory lights, the AOA indexer lights, and the integral background lighting on the EFD (BINGO, MODE, and BRT). Annunciates the landing gear warning tone.
   - **OFF**: Lights test off

5) **WARN/CAUT Knob**. No function.

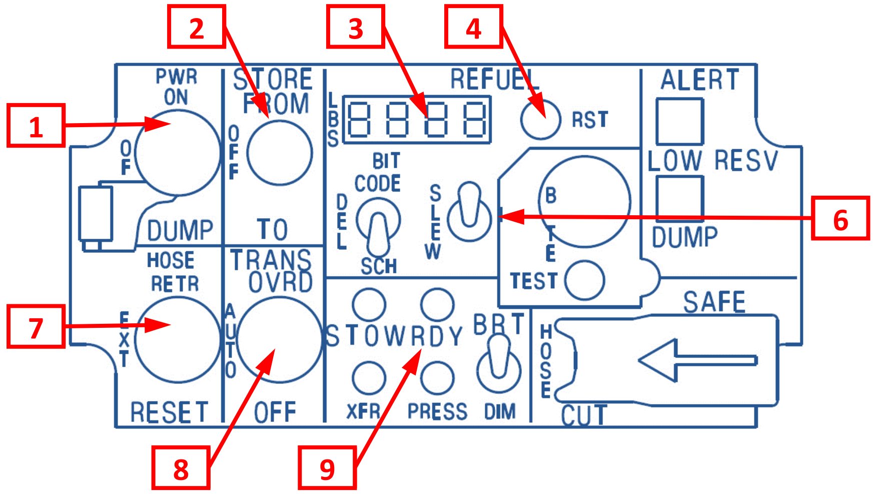
6) **CHART Knob**. No function.

7) **MODE Switch**. Toggles *Night Vision Goggle* (NVG) compatible lighting mode.

   - **NVG**: Powers the night vision compatible green flood lighting and simultaneously disables side console lighting and flood lighting (if active).
   - **NITE**: No function.
   - **DAY**: Removes power from the NVG lighting circuits and restores normal console and flood lighting function.

5.4.4 ARS Panel

The ARS (Aerial Refueling Store) control panel provides power, fuel transfer operation, fuel status indicators, and normal hose extension/retraction functions.



1) **PWR Switch**. Provides electrical and hydraulic power to the Aerial Refueling Store (ARS).

- **ON**: Power is applied to the store which unfeathers the RAT (Ram Air Turbine), which in-turn provides hydraulic power which operates the winching system and fuel pump. If the hose is extended, the PWR switch is bypassed and cannot be turned OFF.
- **OFF**: Feathers the RAT and removes electrical and hydraulic power.
- **DUMP**: Disabled (in the real unit as well).

2) **STORE Switch**. Controls fuel transfer between the store and the aircraft's other tanks .

- **FROM**: Pressurizes the store to transfer fuel from the ARS to aircraft tanks (ARS→ownship).
- **OFF**: Depressurizes the ARS.
- **TO**: Replenishes the ARS with fuel from ownship tanks. (ownship→ARS)

3) **REFUEL Display**. The four digit display indicates fuel (in pounds) delivered or scheduled. The display initially powers up with 2,500 lb scheduled.

4) **RST Button**. Returns LBS scheduled or delivered to original settings. Pounds scheduled returns to 2,500 pounds or previously scheduled quantity. Pounds delivered returns to zero.

5) **Refuel Display Switch**. The refuel data display switch is a three position toggle switch which determines what information is displayed in REFUEL display.

- **BIT CODE**: Three digit number indicates a malfunction code (if any).
- **DEL**: Pounds of fuel transferred thus far (25 lb increments).
- **SCH**: Pounds of fuel scheduled to be transferred. When scheduled point is reached, automatic transfer is terminated. 2,500 lb automatically scheduled at power up.

6) **Refuel Slew Switch**. The SLEW switch is a three position toggle switch which is spring-loaded to the center position. If the refuel data display (*above*) switch is in the SCH position, moving the switch UP

increases pounds of fuel scheduled for transfer, and DOWN decreases the fuel scheduled for transfer.

7) **HOSE Switch**. Control the hose reel extension/retraction.

- **RETR**: The hose retracts or remains retracted.
- **EXT**: The hose extends or remains extended.

8) **TRANS Switch**. The three position transfer switch defaults to the AUTO position and controls fuel transfer to the receiver aircraft.

- **OVRD**: The ARS fuel transfer pump is turned on regardless of hose position, fuel schedule, or fuel remaining in the store. The OVRD position should only be used during emergency refueling situations.
- **AUTO**: When connected to receiver aircraft, fuel flows when the following conditions are met: The hose is within the refueling range (approximately 5 to 20 feet of full trail), ARS (fuel is above 175 pounds) is not low on fuel, and the scheduled amount of fuel is not exceeded.
- **OFF**: Turns the transfer pump off regardless of hose position.

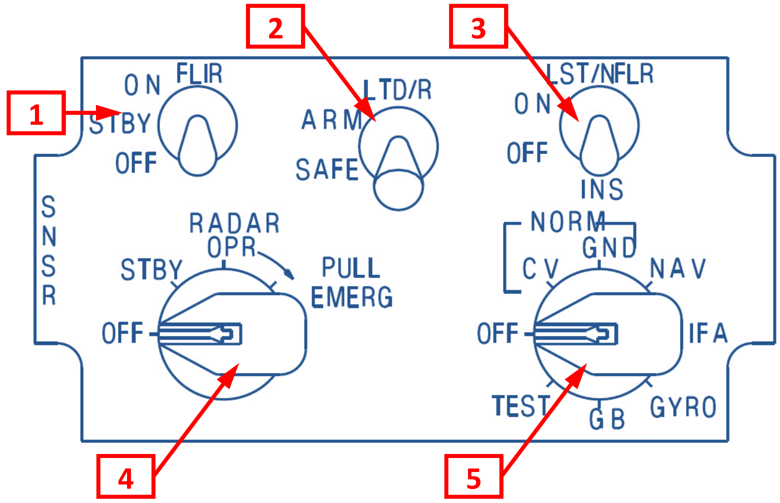
9) **Status Lights**. There are four status lights on the ARS control panel.

- **STOW**: White light comes on when hose is approximately one foot from complete stowage. If hose/drogue is not fully stowed, the indication is through a MASTER CAUTION and aural tone, and the ARS DROGUE caution appears on the DDI.
- **RDY**: Amber light illuminates when the hose is fully deployed and automatic hose response is established.
- **PRESS**: Red light illuminates when hydraulic pressure drops below 1,700 psi. Light goes out when pressure exceeds 2,000 psi.
- **XFR**: Green light illuminates when a minimum of 20 gallons/min of fuel is being transferred to the receiver.

5.4.5 Snsr Panel

The Sensor Panel controls radar, FLIR, LST and LTD power and INS alignment (INS is a Pro version-only feature).

1) **FLIR Switch**. The VRS F/A-18 does not support actual FLIR imagery. However the ATFLIR pod carried on the F/A-18E provides more than just imaging; it is also used for target lasing and spot tracking for the AGM-65E, and can be used for ground target designation.



The FLIR switch controls power only to the imaging system. Since this system is not simulated, powering on the FLIR will result in a MUX FAIL BIT on the FLIR. This will have no adverse affect, but since the BIT system can't see the FLIR subsystem, you may wish to leave this unpowered.

2) **LTD Switch**. The Laser Target Designator (LTD) is a component of the ATFLIR responsible for emitting laser energy onto a designated target. The AGM-65E "Laser Maverick" as well as the GBU series of laser-guided bombs can then home in on the reflected laser energy. We simulate this relationship in the VRS F/A-18.

- **ARM**: The laser designator is powered and available for MAN or AUTO lasing on the DDI FLIR format.
- **SAFE**: The laser designator is unpowered.

3) **LST Switch**. The ATFLIR pod can not only lase targets as explained under *LTD*, above, it can also see its own reflected laser energy in the same way mavericks and GBUs can. By measuring the time is takes for the reflected energy to return to the ATFLIR, the system can very accurately determine range to the target and provide that information to the pilot and other weapons.

- **ON**: Powers the laser spot tracker. The DDI FLIR format will display any applicable ranging information.
- **OFF**: The laser spot tracker is unpowered.

4) **RADAR knob**. Controls primary power to the radar system. The radar can also be put into SIlent mode manually via the DDI Radar format, or when EMCON is enabled.

5) **INS Knob**. The SE version of the VRS F/A-1E does not support INS. This knob has no function.

5.4.6 KY-58 Panel

The KY-58 is a secure voice module primarily used to encrypt radio communication to and from military aircraft and other tactical vehicles The VRS F/A-18 does not attempt to simulate secure voice, therefore this panel is inactive.

6 SUPERBUG PAINT KIT

The VRS Superbug offers tools in the Aircraft Configuration Manager for livery import/export and modification. These tools are designed to get liveries safely in and out of the Superbug without having to worry as much as much about editing aircraft.cfg files. Basically your end-user should be able to safely import your livery through the ACM with the click of a button.

For the repainter, these functions help streamline the distribution and care-free installation of paints. For example an existing texture folder can be duplicated and renamed, then opened in the ACM where the aircraft details (including description) can be modified. After making changes to the actual texture files, the repainter can export the repaint as “Livery Pack” containing only the required textures, an optional thumbnail, and an ACM generated text definition file.The end-user then downloads this pack, unzips it, and browses to it with the ACM. The ACM automatically installs the texture in the correct location and modifies the aircraft.cfg accordingly.

This document is designed to help you, the repainter, work with the master texture Photoshop file and create a successful livery pack. This document is NOT intended to be a painting guide. If you have no experience working with Photoshop or Paint Shop Pro graphics files, then you should stop right now!

6.0 THE PHOTOSHOP PAINT FILE

The accompanying Photoshop file for this document can be downloaded from the VRS support forums. If you don’t have a forum account, you can create one at any time, however you will need to have your license ID handy. The file is saved to maximize compatibility with older versions of Photoshop and should be compatible at least back to Photoshop 7. We do not have a Paintshop specific kit available at this time.

6.1 NEEDED FONTS

The most common font used on U.S. naval aircraft is called *Long Beach*. It’s similar to the USAF font *Amarillo* but not close enough for close inspection. VRS used a specific version of this font in the creation of this kit, and without it, font substitution will occur for many layers.

We cannot ship long Beach with this kit because it is a licensed font and no suitable freeware fonts have been found. You can purchase Long Beach from Tlai Enterprises at : http://www.tlai.com/. VRS does not support or endorse this product, but we can say that we’ve purchased from them and received our fonts a few hours later. They are excellent, high quality fonts

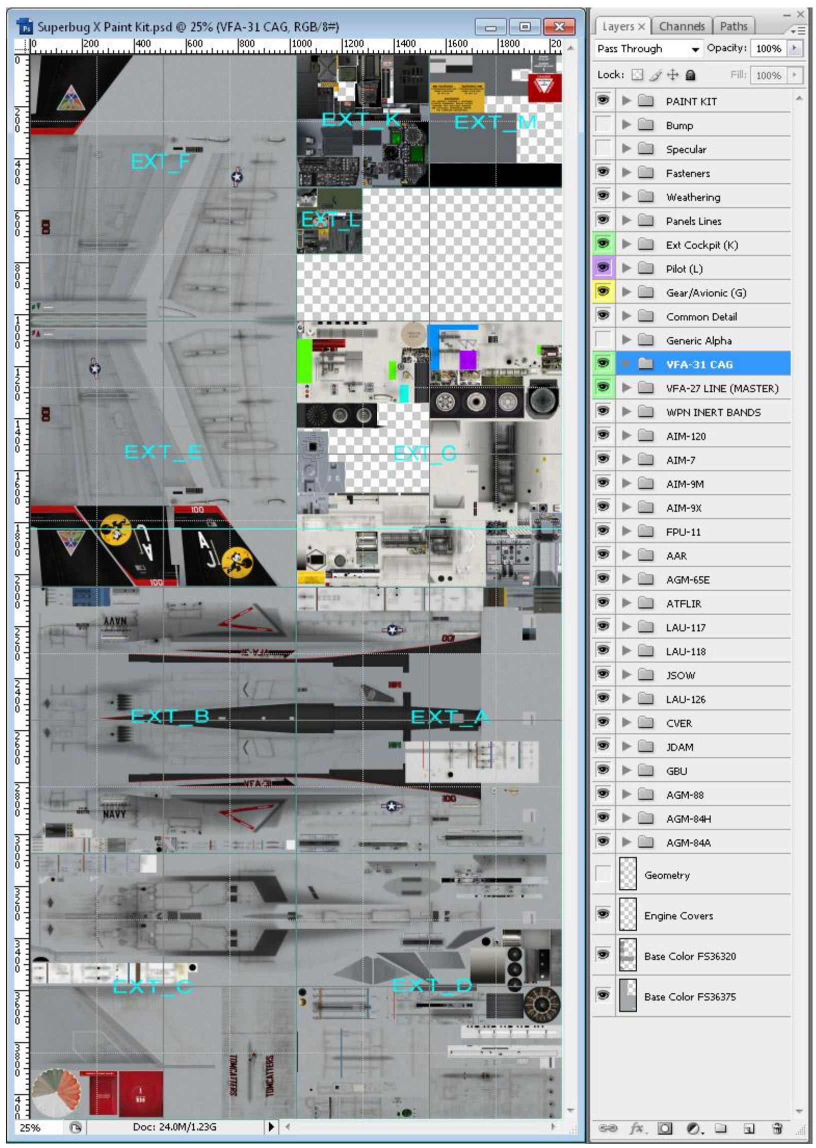
6.0 MASTER TEXTURE .PSD

The main Photoshop file, available from the VRS website, is a single 2048x4096 canvas divided into 8 sections measuring 1024x1024 pixels each. The document was designed to allow selection of entire sections for merged copying into individual 32-bit texture files. Key features of this document are:

- Descriptive comment/grid layer set (first set).
- Includes all *external* texture components.
- Sets for all common aircraft features.
- Aircraft-specific sets.
- Weapon sets.
- Geometry layer to aid in alignment.
- Base paint layers with FS standard colors (for US Navy aircraft).

6.0.1 Subdivisions

This Photoshop paint file (.psd) is dived into seven separate 1024x1024 pixel areas, two 512x512 areas, and one 256x256 area which collectively, can be used to create all external textures including specular and bump maps. Some of these textures are strictly optional and are for the most part common between aircraft. You only need to distribute some of these textures with your repaint, and the others will automatically fallback to the default texture directory. Optional and mandatory textures sheets are described below.



Alphabetically these texture sheets are as follows:

- **EXT_A** *(mandatory).* Forward-upper fuselage, cockpit and ejection seat parts, AGM-88, GBUs and several racks/launchers.

- **EXT_B** *(mandatory)*. Aft-upper fuselage, JDAM, AIM-9 missiles.
- **EXT_C** *(mandatory).* Aft-lower fuselage, AIM-120, AMG-84H, upper and lower stabilator, parachute, engine covers, remove before flight ribbons, and FPU-11.
- **EXT_D** *(mandatory)*. Forward-lower fuselage, engine intake details, N1 and N2 fans, boarding ladder, AGM-65, AA42-R, JSOW, FLIR and various racks and launchers.
- **EXT_E** *(mandatory)*. The left upper and right lower wings, right
- **EXT_F** *(mandatory)*. The right upper and left lower wings and right-inner vertical stabilator.
- **EXT_G** *(optional).* Textures associated with the landing gear and wells, radar, IFR probe and basket, tail hook, launch bar, spoiler primary surfaces and other small details generally associated with small parts.
- **EXT_L** *(optional)*. Pilot details.
- **EXT_K** *(optional)*. Cockpit details.
- **EXT_M** *(optional).* Decals and small labels (including pilot name). This texture sheet is applied on various parts of the model to bring out high-detail labels such as *NO STEP*, and of course the pilot's name. The diffuse (color) channel in this sheet is used for color and the alpha channel is used as a traditional mask. White areas will show through and black areas will be invisible.

6.0.2 Layer Sets

The layers for the most part are quite self-explanatory with a few exceptions. Each layer and or layer set is named according to its consent. For the most part, the order of these layer sets is very important. Base colors and/or geometry layers are at the very bottom, and shading and weathering are near the top. Starting from top to bottom these layers/sets are:

6) **Paint Kit**: Contains reference labels for most areas of the document as well as gridlines for copying. The preferable way to copy, as explained under Document Setup, is to create your own (real) grid rather than replying on a strictly visual reference for copying. This reference grid (red) should technically not be necessary once a proper (true) grid is established.

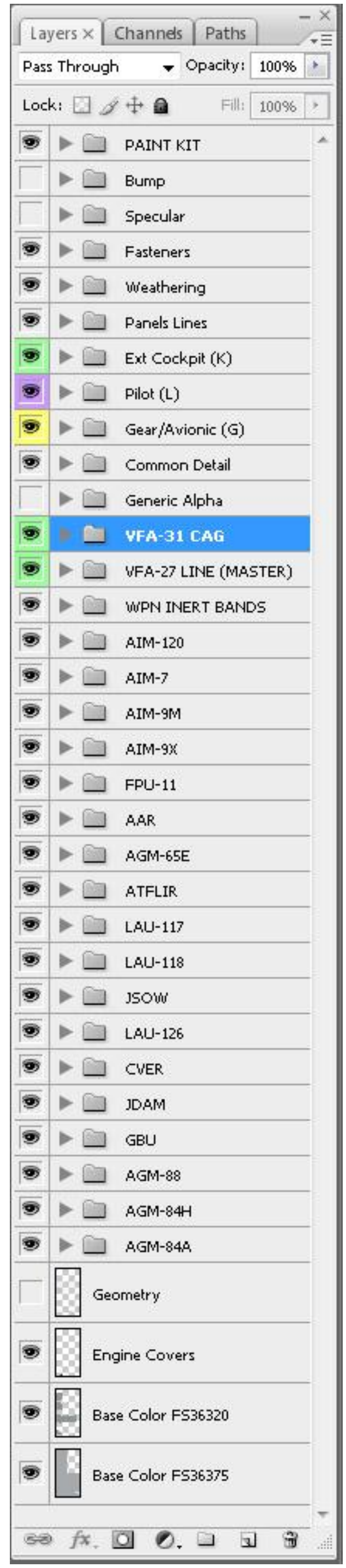
7) **Bump**: The high/low areas of the aircraft used for generating a heightmap. The techniques for doing this based on a bitmap image are discussed in the FSX SDK and are beyond the scope of this document. But there are abridged copies of several lower layers contained in this layer set such as panel lines and fasteners. It's best to use a neutral level of grey as a base and work the heights up or down from there.

8) **Specular**: This is a very tricky area to get right. It takes lots of practice and you still won't be satisfied with the results. The specular maps used in the Superbug have both diffuse and alpha channels. They control the level and falloff of specularity respectively. Great, but what does that mean? The diffuse (normal) channel controls the color and amount of specularity. Lighter areas are more specular. The color in this channel determines the color hot spots.

   The alpha channel controls the falloff, or "shininess" of the specularity. This is NOT reflection – that is controlled in the diffuse maps (described below). The brighter the area of the alpha channel, the tighter and hotter the specularity (there's probably a joke in there somewhere).

9) **Fasteners**: Nuts, bolts, screws, rivets, whatever. Be subtle.

10) **Weathering**: Shading, grunge, grime, you name it. If it's dirty, it's here. Make sure this group is above most others. One of the layers in this set, "irregularity", is a pattern overlay which applies



an overall realistic inconsistency to the paint color. It's also used in the specularity group and they should match between groups.

11) **Ext Cockpit (EXT_K)**: Layers in this group are associated with the external model's cockpit. As with the common group, above, basically everything in this group is common to all aircraft.

12) **Pilot (EXT_L)**: Details which are specific to the pilot. While most of the elements in this group are fairly generic, this group also contains the parts for the pilot's helmet. You may wish to copy the helmet elements from this layer, place them in an aircraft-specific layer (described below), and then remove the helmet components from this layer in order to allow your specific changes to sort in front.

13) **Gear/Avionic (EXT_G)**: The name of this group may be somewhat misleading. Although generally generic regardless of the paint scheme, the layers in here cover not just gear details, but almost everything not associated with an external aircraft surface of the cockpit. This includes the IFR probe and basket, ECS auxiliary door interiors, speed brake primary surface interior details, hatch interiors, radar parts, tail hook, etc.

14) **Common Detail**: This group contains layers that are common to the aircraft regardless of how it may be painted. In most cases these details will not change from paint to paint and are completely generic.

15) **Alpha**: Contains generic alpha channels for all sections. Note that these are strictly generic and would need modification for each aircraft. These would be used either in conjunction with specular mapping or in the alpha channel of the diffuse (color) maps to provide reflectivity. Again, these are just templates and should not be used arbitrarily. Take a look at how the alpha channels of the various textures are composed and decide a plan of action.

16) **VFA-31 CAG (aircraft specific group):** This group should be used as an example for creating aircraft-specific layer sets. Each aircraft-specific group should contain details that are tailored to your specific aircraft. This includes not only colors and squadron markings, but aircraft BUNO, carrier (if applicable), etc. We will explain how to copy and make your own aircraft layer sets under *Aircraft Layer Sets*.

17) **VFA-27 LINE (aircraft specific group):** Another aircraft-specific group, this time for a more generic paint. Again, all aircraft-specific details should be placed within sets/groups such as this so that the document can be kept as portable as possible for your future use and organization.

18) **WPN Inert Bands**: When creating aircraft with inert loadouts such as training or test squadron aircraft, this layer can be used to overlay SOME of the weapons with

inert (blue) bands signifying that the device doesn't contain explosives. Each weapon group may also contain layers that need to be enabled if an inert loadout is required.

19) **Stores Layer Sets (18 layer sets)**: Each of these 18 layer sets contain the individual details for the entire selection of ordinance available in the VRS F/A-18. If you wish to use inert weapons on your paint you'll need to check each of these sets to make sure any available inert colors or bands not covered by the previous layer (WNP Inert Bands) are unhidden.

20) **Geometry**: This layer contains wireframe geometry for the external model to aid in aligning textures. Note that much of this geometry is quite old and in many cases no longer applies. It is only a guide, and is most useful for getting an overall picture of the texture layout.

21) **Engine Covers**: These are the base colors used for the inlet and nozzle covers which are visible when the aircraft is parked with engines off. Any non-generic individual lettering on these objects should be places within the aircraft specific layer sets (i.e. VFA-31 CAG) you create.

22) **FS36320**: This is the US Federal Standard color (Dark Ghost Grey) used on most aircraft shipping with the VRS F/A-18. This layer covers the upper fuselage and some other parts.

23) **FS36375**: This is the US Federal Standard color (Light Ghost Grey) used on most aircraft shipping with the VRS F/A-18. This layer covers the upper fuselage and some other parts.

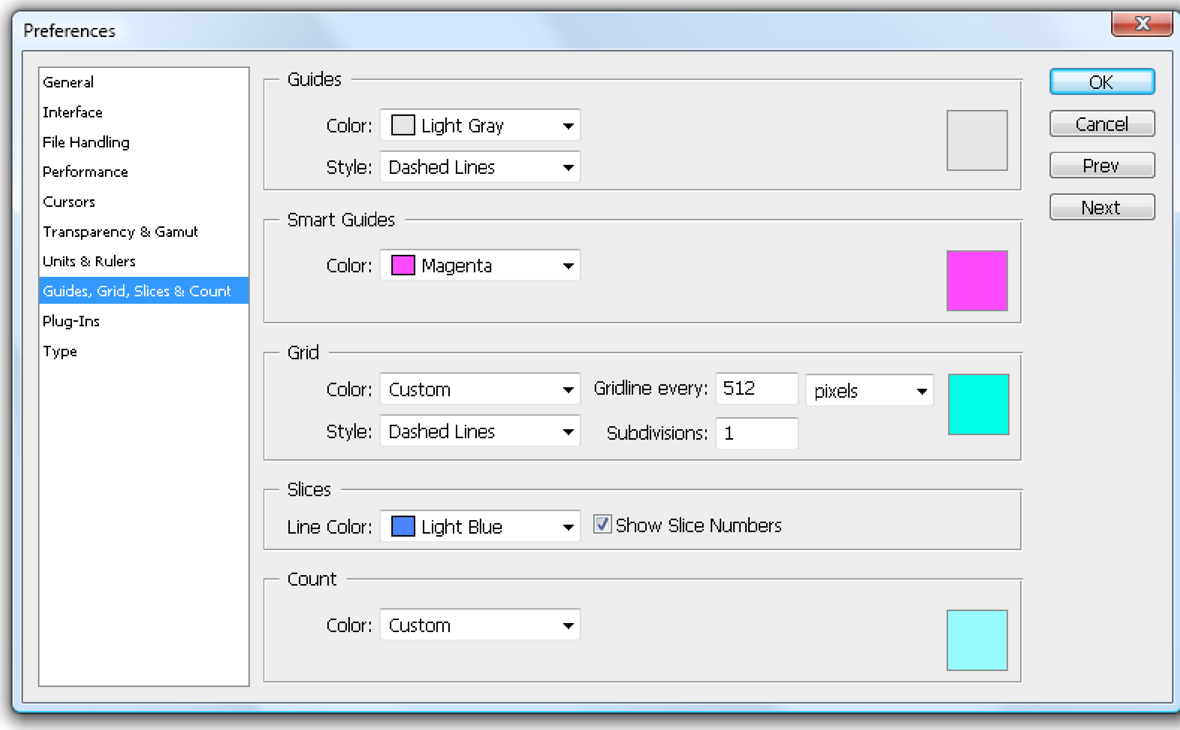
    These colors has been modified slightly in order to account for the atmospheric contribution present in real-world settings. Since FS does not alter the aircraft color to account for this, it's important to consider. If one were to use the exact RGB value without compensating for atmospheric conditions, colors would appear greener than in the real world or in photographs.

    Obviously if you are creating a non-US paint scheme, this layer should be duplicated, the original layer hidden, and the new layer adjusted for your choice of base color.

6.1 DOCUMENT SETUP

6.1.1 Grid Lines

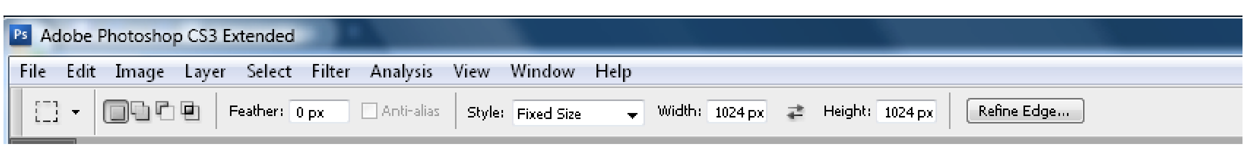
To set up the working environment, we suggest creating a grid divided into 256x256 or 512x512 gridlines. Although a template layer exists with red lines every 1024 pixels, creating your own grid setup



will ease merged copying from the master document into the individual texture files.

6.1.2 Fixed Size Selection Rectangle

A *fixed-size* selection rectangle will be needed later in order to copy textures at exactly 1024x1024. You will use this fixed sized selection in conjunction with a *grid snap*. If you set this up now, you can revert to



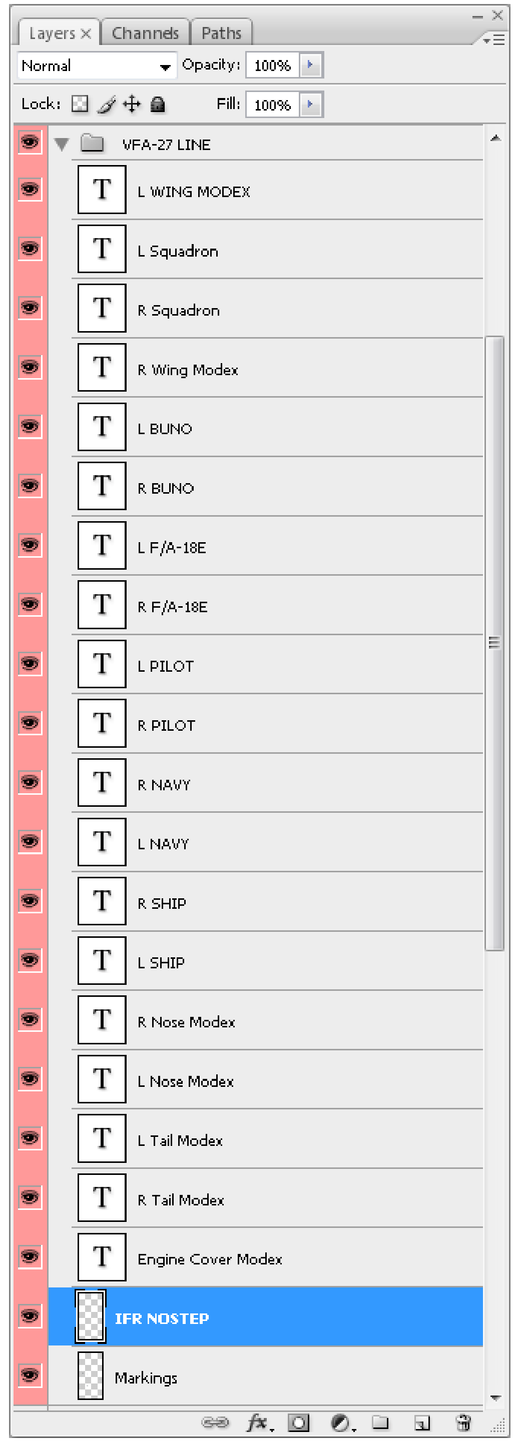
a *normal* selection rectangle for the majority of your editing.

6.1.3 Aircraft Specific Layer Sets

In the previous section we discussed keeping aircraft specific modifications (markings, etc.) within their own sets so that individual aircraft paints you build can be toggled on and off.

Two example aircraft layer sets (VFA-31 CAG and VFA-27 LINE) already exist as described above. You should copy one of these sets which most closely matches the paint you intend to create. If you intend to create a colorful show bird, copy VFA-31 CAG. Use VFA-27 LINE if you intend to create a basic low-visibility scheme.

Once you have copied the group, rename it appropriately and begin making you modifications in this group.



6.1.3.1 Example Layers

Ideally, aircraft layer sets should contain layers for everything that is not generic between all aircraft. This includes aircraft decals (EXT_M), and all other identifying graphics and markings.

In addition, since each aircraft may contain different colors layered on top of the generic base colors, those color layers should be defined at this level as well.

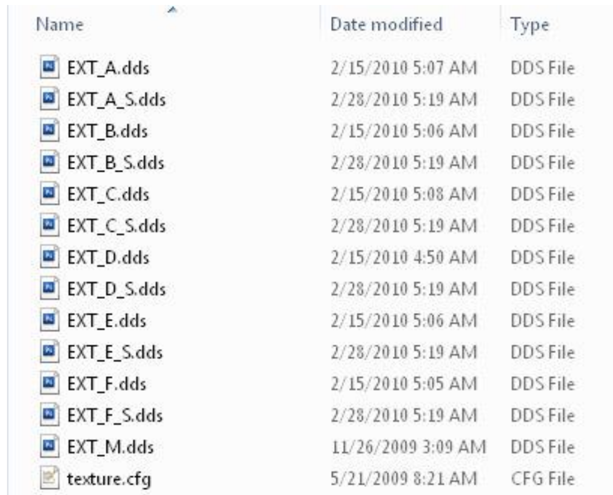
6.1.3.2 Markings

Most U.S Naval markings are angled at 9.5 degrees aft. Obviously aircraft from different nations will vary significantly, so it will be up to you to acquire any additional fonts.

6.2 CREATING TEXTURE FILES

6.2.1 Texture Directory Structure

All textures included with the VRS F/A-18 are located within *FSX\SimObjects\Airplanes\VRS_FA-18E*. They are preceded by the word “Texture” followed by a dot (.), followed by the name of the texture you provide. For example the VFA-31_CAG aircraft textures are located in the folder *FSX\SimObjects\Airplanes\VRS_FA-18E\Texture.VFA-31_CAG*.



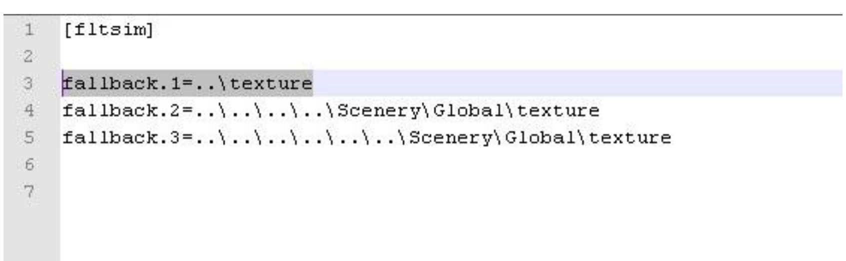
Name	Date modified	Type
EXT_A.dds	2/15/2010 5:07 AM	DDS File
EXT_A_S.dds	2/28/2010 5:19 AM	DDS File
EXT_B.dds	2/15/2010 5:06 AM	DDS File
EXT_B_S.dds	2/28/2010 5:19 AM	DDS File
EXT_C.dds	2/15/2010 5:08 AM	DDS File
EXT_C_S.dds	2/28/2010 5:19 AM	DDS File
EXT_D.dds	2/15/2010 4:50 AM	DDS File
EXT_D_S.dds	2/28/2010 5:19 AM	DDS File
EXT_E.dds	2/15/2010 5:06 AM	DDS File
EXT_E_S.dds	2/28/2010 5:19 AM	DDS File
EXT_F.dds	2/15/2010 5:05 AM	DDS File
EXT_F_S.dds	2/28/2010 5:19 AM	DDS File
EXT_M.dds	11/26/2009 3:09 AM	DDS File
texture.cfg	5/21/2009 8:21 AM	CFG File

You’re not going to messing with this texture folder – it’s just an example. Leave muh textures alone!

As you can see in the image at right, the texture folder contains some, but not all of the texture the aircraft will use. The ones contained here, some mandatory, some not, include all the external paint (EXT_A through EXT_F), the specular maps for the paint colors (EXT_A_S through EXT_F_S) and EXT_M, which is the decal sheet containing the pilots name, among other things. EXT_M and EXT_A_**S** through EXT_F_**S** are optional. The _S textures are the specular maps and if none are created, the Superbug will use generic ones in the main *Texture* folder. The Same goes for EXT_M. If it’s not created, it will use a generic one, but I’ll be the pilot…

6.2.1.1 Texture.cfg

The *texture.cfg* is located in each *.Texture* folder and defines the fallback folders for missing textures such as those specular maps described above. The primary fallback folder in most cases should be ..\texture. The 2 dots preceding the slash are an OS syntax that means “back one directory”. So if the model is loaded and the texture it’s looking for is not in the texture folder for that livery, FS will first look



```
[fltsim]

fallback.1=..\texture
fallback.2=..\..\..\..\Scenery\Global\texture
fallback.3=..\..\..\..\..\..\Scenery\Global\texture
```

in the common texture folder called “texture” which is inside the main VRS_FA-18E aircraft folder.

6.2.1.2 Thumbnail Image

Within each folder are a number individual texture files along with a JPEG thumbnail image. The thumbnail image is used by the Aircraft Manager's *Livery Browser* to display an image of the aircraft when browsing installed paints, and by FSX as a preview image when selecting a livery.

6.2.1.3 External Texture Files

Only 6 texture MUST be distributed for a valid livery pack:

1. **EXT_A. DDS**
2. **EXT_B. DDS**
3. **EXT_C. DDS**
4. **EXT_D. DDS**
5. **EXT_E. DDS**
6. **EXT_F. DDS**

All other textures including virtual cockpit and the remaining generic external textures need not be included in your distributions unless you are actually modifying them. The ACM will automatically copy those optional files from the *Texture.E1* folder when the end-user uses the *Livery Import* function.

There are many other textures which are generic covering everything from the landing gear detail to the virtual cockpit. You don't need to modify any of those, but if you do, make sure they are copies and locally contained in your aircraft's texture folder. **Never replace anything in the common texture folder!**

6.2.2 Creating Working Directories

For your work, you should create 2 folders: One to store 32-bit original (uncompressed) texture files, and one, properly named and located in the aircraft folder to test your paints. Your actual texture folder should be carefully named to maintain consistency with existing textures. Whatever you name this folder, ensure that it is preceded by ***Texture.***, and contains no spaces.

The simplest way to do this is to copy an existing texture folder and then rename the aircraft specific portion. You'll then replace the textures described above with your modified and compressed textures, one by one.

- ☑ **Create** a unique folder to hold your original uncompressed texture files.
- ☑ **Duplicate** any existing aircraft texture folder in *FSX\SimObjects\Airplanes\VRS_FA-18E\Texture*..[*My_Livery*] and rename *[My_Livery]* to whatever you wish. This step is essential to ensure ALL textures are present in your new livery folder. From now on, whenever we refer to [My_Livery] it should be substituted with your own livery name.

6.2.3 Creating Uncompressed Texture Files

Uncompressed texture files are 32-bit (RGB + 8-bit alpha). As explained in the previous section, these textures should be stored in a separate folder from the "live" textures you'll be using for testing and distribution.

- ☑ Create a new document in your paint program measuring exactly 1024x1024 pixels.
- ☑ Using the 1024x1024 fixed selection rectangle with grid-snap on, select one of the document subdivisions (A, B, C, D, E, F) described at the beginning of this guide.
- ☑ **Copy-Merged** (copies everything visible regardless of layer).
- ☑ **Paste** the merged image into your new document.
- ☑ Go back to the original master document and enable the Alpha (basic) layer set.
- ☑ Copy the alpha layer that corresponds to the subdivision you just copied.
- ☑ Return to the new document and paste your selection into the Alpha channel.
- ☑ If the alpha channel requires modification, it should be done now. Note that white areas are areas which are NOT reflective, and darker shaded areas define reflectivity. This is NOT specularity, it is reflectivity and will use the FSX environment map to reflect back areas based on how dark they are.
- ☑ With the RGB and alpha channels in place, save the image as a 32-bit BMP <u>with a name that corresponds to the correct texture</u> (i.e. EXT_A).

6.2.4 Compressing Textures

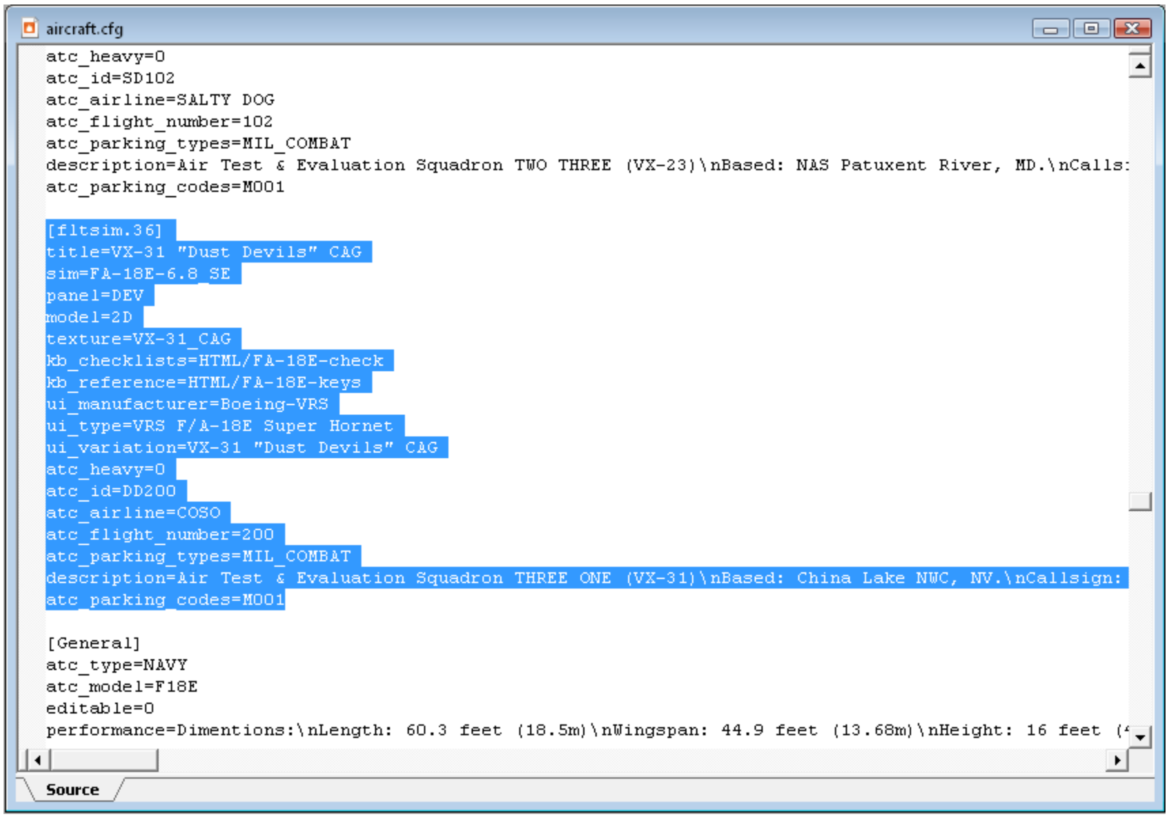
With your uncompressed 32-bit texture file(s) created and properly named:

- ☑ Flip each image vertically. That's right, the folks at MS think backwards.
- ☑ Convert each image to DDS (24+8). Nvidia has an excellent set of plugins for Photoshop which I've used extensively for this project: http://developer.nvidia.com/object/photoshop_dds_plugins.html

I'd advise against using any of the other utilities such as the OS DDS thumbnail viewer —IMO, It's unstable.

6.3 PREPARING THE AIRCRAFT.CFG

Prior to testing the final textures, the aircraft.cfg must be prepared by inserting the necessary additions in order for the textures to be recognized by the simulation. As the author of a repaint you must do this, but your target users will not need to make these modifications if they use the Aircraft Manager to



```
aircraft.cfg
atc_heavy=0
atc_id=SD102
atc_airline=SALTY DOG
atc_flight_number=102
atc_parking_types=MIL_COMBAT
description=Air Test & Evaluation Squadron TWO THREE (VX-23)\nBased: NAS Patuxent River, MD.\nCalls:
atc_parking_codes=M001

[fltsim.36]
title=VX-31 "Dust Devils" CAG
sim=FA-18E-6.8_SE
panel=DEV
model=2D
texture=VX-31_CAG
kb_checklists=HTML/FA-18E-check
kb_reference=HTML/FA-18E-keys
ui_manufacturer=Boeing-VRS
ui_type=VRS F/A-18E Super Hornet
ui_variation=VX-31 "Dust Devils" CAG
atc_heavy=0
atc_id=DD200
atc_airline=COSO
atc_flight_number=200
atc_parking_types=MIL_COMBAT
description=Air Test & Evaluation Squadron THREE ONE (VX-31)\nBased: China Lake NWC, NV.\nCallsign:
atc_parking_codes=M001

[General]
atc_type=NAVY
atc_model=F18E
editable=0
performance=Dimentions:\nLength: 60.3 feet (18.5m)\nWingspan: 44.9 feet (13.68m)\nHeight: 16 feet (
Source
```

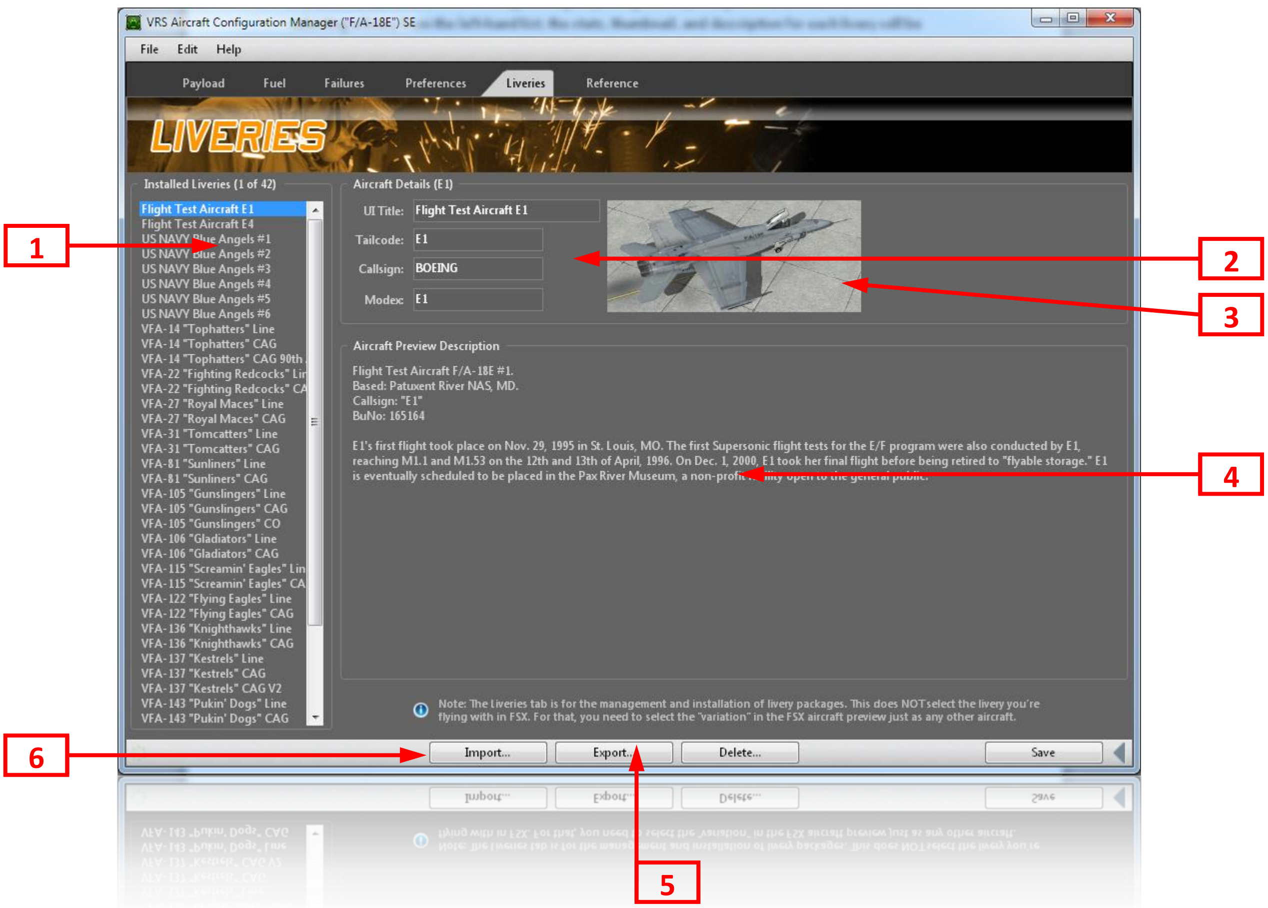
import your paints.

- ☑ Make a backup copy of *FSX\SimObjects\Airplanes\VRS_FA-18E\Aircraft.cfg.*
- ☑ Open *FSX\SimObjects\Airplanes\VRS_FA-18E\aircraft.cfg* in a simple text editor.
- ☑ Scroll down to the <u>last</u> texture entry. This will be labeled [fltsim.xx] where xx is an integer number.
- ☑ Copy the entire definition beginning with *[fltsim.xx]* and ending with the *atc_parking_codes=* line as shown below.
- ☑ Paste the selected text between the text you copied and the *[General]* section.
- ☑ Renumber [fltsim.xx] where *xx* is the next incremental integer. In this example it would be *37*.
- ☑ **title=** Whatever you desire.
- ☑ **texture=** [My_Livery], EXCLUDING the word *Texture* and the dot(.).
- ☑ **ui_variation=** The EXACT same name as *title=,* above.
- ☑ **atc_ID=** Something appropriate for your aircraft. For US naval aircraft this should be the 2-letter carrier air wing followed by the 3-digit modex (AA000).

- ☑ **atc_airline=** The squadron callsign.
- ☑ **atc_flight_number=** The aircraft modex.
- ☑ **description=** <u>Leave this alone</u>. We will change it in the ACM which will automatically format it.
- ☑ Leave all other fields alone, at least for now.
- ☑ Save and quit.

6.4 CREATING LIVERY PACKS

The VRS Aircraft Configuration Manger (ACM) features a Livery browser with import/export capabilities. The Livery browser can completely automate the process of getting your livery into correctly formatted, portable "packs" for redistribution to end-users. Once the end-user downloads and unzips your repaint, all they need to do is use the livery browser's import function [6] to locate your redistributable repaint folder and automatically insert it into the aircraft. They need not modify the aircraft.cfg in any way.



This livery pack system also ensures that virtual cockpit textures do not *need* to be distributed with your repaints. TGhey are strictly optional. All textures not above and beyond the required 6 redistributables will be automatically referenced from the main texture folder.

6.4.1 Creating a Livery Thumbnail

The ACM Livery Browser will automatically display a JPEG thumbnail image [3] for each installed livery if one exists. This thumbnail should, be a .jpg image and measure exactly 256x128 pixels. Place the thumbnail into your *Texture.[My_Livery]* Folder and name it *Thumbnail.jpg*.

6.4.2 Testing The Livery

It goes without saying that your livery should load in the simulation; If you can't browse to it, see it and fly it, then it's time to start thinking about what you missed. The most likely problem is an incorrect aircraft.cfg entry (perhaps you forgot to increment the livery ID [fltsim=n]).

6.4.3 Editing Livery Data in the ACM

Prior to exporting your redistributable "Livery Pack", and after it's been tested (perhaps multiple times), you should check to make sure that it's correctly formatted, that the thumbnail is being read, and that all data including the description is correct.

- ☑ Ensure that your livery is appearing in the ACM. If it is not, double-check your aircraft.cfg entries and ensure that the *texture=* entry in the aircraft.cfg. has exactly the same case sensitive name (minus the *texture.* portion) as the folder containing your textures.
- ☑ Ensure the thumbnail is loading. If not, ensure that is a .jpg.
- ☑ Double-check all aircraft.cfg fields to ensure they're correct.

In the previous section, *Preparing the Aircraft.cfg*, we had you ignore the *description=* line. The reason is that it's MUCH easier to edit that information within the ACM. The ACM will automatically insert all newline and carriage return characters so that your description appears to the end-user exactly as it was typed in the ACM.

- ☑ Edit livery the description **[4]**. This can be anything you want, but try to be consistent in layout.

6.4.4 Exporting a Livery PACK

Assuming your livery is appearing in the ACM when it loads, and all fields appear to be correct, it's a good idea to create a test export livery pack and then import it to ensure it's working correctly.

- ☑ With your livery selected, press the **Export Livery** button **[5]**.
- ☑ A dialog will appear prompting for a location to save the export. Select your desktop or some other easy to find location.
- ☑ Press **OK**.
- ☑ If the export was successful, a folder will have been created in the destination location named exactly the same as your actual texture folder (minus the *texture.* prefix). This *[My_Livery*] folder should contain (at a minimum) the following **8** files:

1. **EXT_A. DDS**
2. **EXT_B. DDS**
3. **EXT_C. DDS**
4. **EXT_D. DDS**
5. **EXT_E. DDS**
6. **EXT_F.DDS**
7. **Thumbnail.jpg**

8. [my livery].txt

The text file *[my livery].txt* was created by the ACM and contains generated information which will be inserted into the end-users aircraft.cfg automatically.

6.4.4.1 Testing the Livery Pack Import

To test the distribution, first make a backup copy of your *installed* texture folder: *Texture.[My_Livery]* within the VRS_FA-18E aircraft directory. We're going to use the ACM to delete your installed livery, so make sure that the folder is completely backed up before proceeding!

- ☑ Quit the ACM if it's running.
- ☑ Backup the *installed* texture folder by duplicating it. This is the folder called *Texture.[My_Livery]* located in FSX\Simobjects\Airplanes \VRS_FA-18E. <u>Do not proceed without performing this step</u>.
- ☑ Launch the ACM.
- ☑ From the Liveries Tab, select your livery from the list **[1]**.
- ☑ Right-click and select **Delete**. After confirming the deletion, your installed livery folder should be immediately and permanently deleted (you do not need to press Save from the ACM).
- ☑ Visually confirm that your *Texture.[My_Livery]* folder no longer exists within the Aircraft folder.
- ☑ Press the **Import Livery** button **[6]**.
- ☑ Browse to the location of the [My_Livery] export folder you created earlier.
- ☑ Press **OK**.
- ☑ Ensure that the livery imported properly and is again visible in the list with all data intact.

If everything worked OK and your livery imported, you may now zip up your exported livery folder in preparation for distribution!

If there were problems which prevented successful import, retrace your steps beginning with *9.3*. Ensure that you didn't inadvertently delete one of the required (bold) files listed in *6.4.4*.

6.4.5 Distributing Liveries

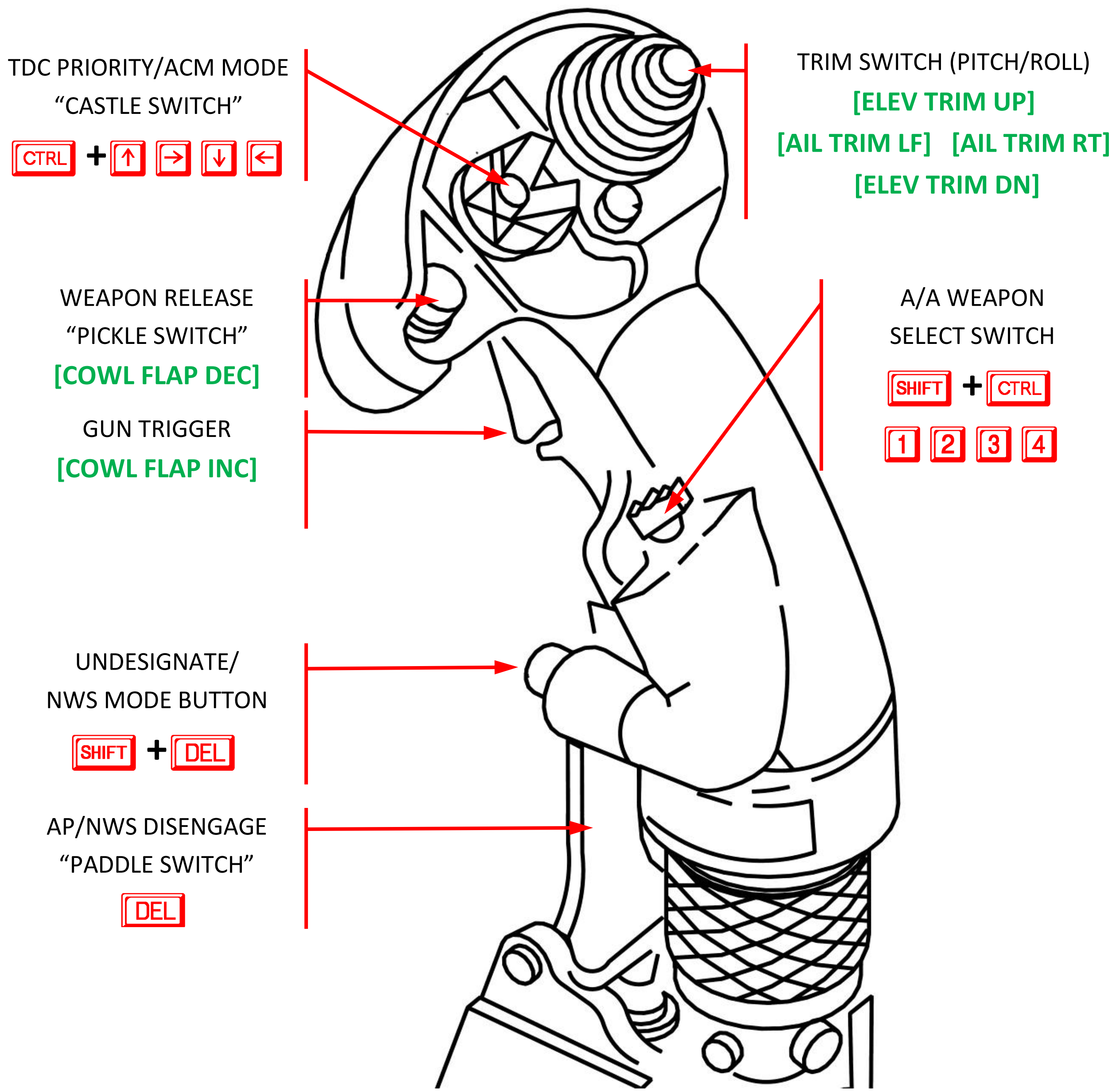
Now that your livery pack has been created and presumably fully tested(?), you're ready to .zip it up for redistribution. The nice thing about livery packs is that it makes it extremely easy for end-users to install them without the need to modify their aircraft.cfg. As long as they keep a backup of your distribution they can re-install them at any time, even after a major service update may wipe their existing aircraft.cfg and texture folders.

In documenting your distribution, it's probably a good idea of your readme echoes the procedure for getting their paints imported via the ACM. Also remind them that they should backup their livery packs because regular updates from VRS may in fact wipe any installed repaints (at least the aircraft.cfg definitions).

7 KEYBOARD REFERENCE

7.0 HOTAS SUGGESTED MAPPING

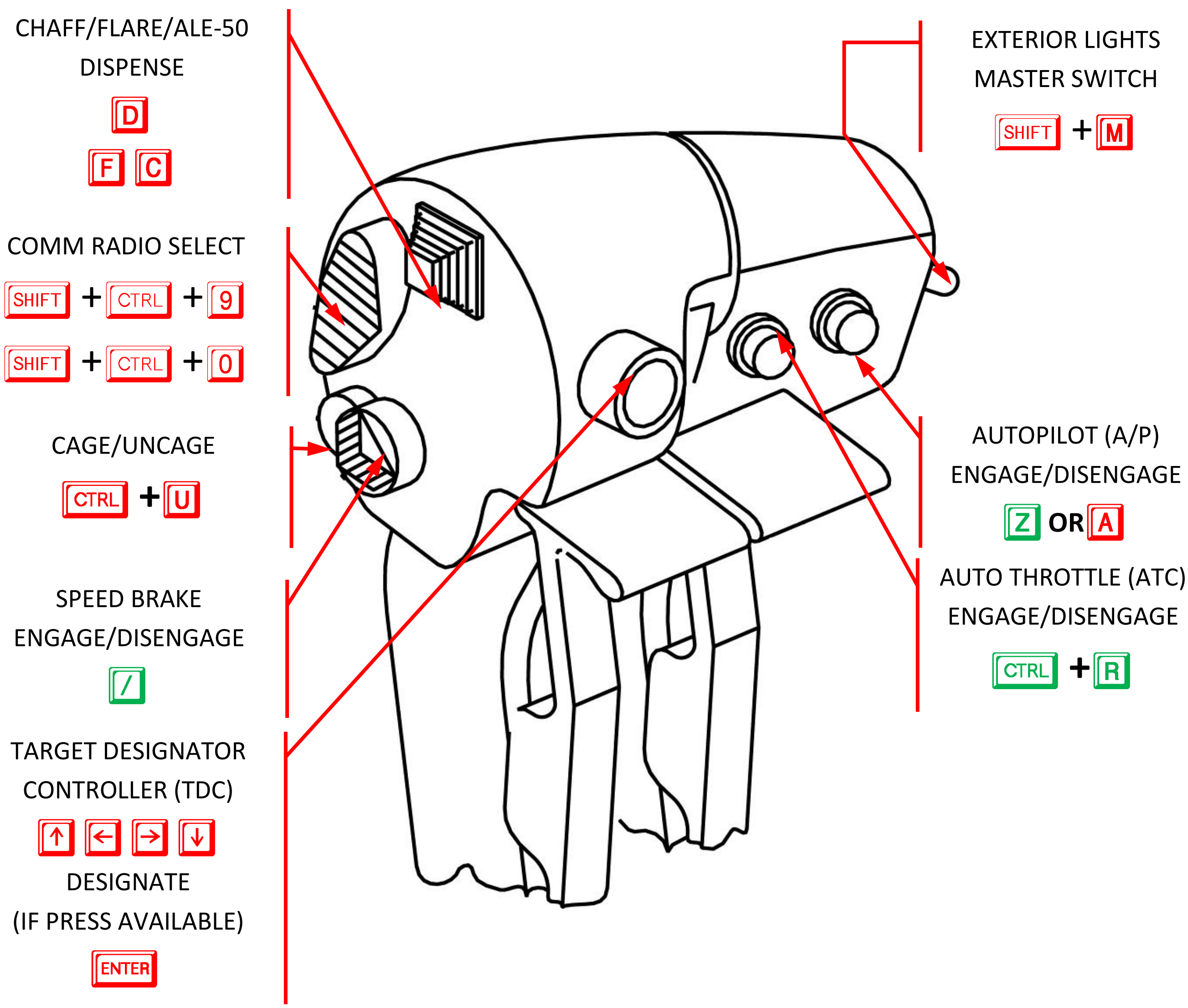
A large series of "custom" keys are available for virtually all aircraft functions when running in what we call *Key Command Mode*. Key command mode is activated by default and can be toggled on/off with the **[SHIFT-CONTROL-M]** combination.



In addition to key command mode, certain "FS native" functions should be mapped to your joystick In Flight Simulator's keystroke assignments dialog in order to enable weapon fire. The process for doing this is explained in detail in **Section I: Getting Started**.

These diagrams illustrate the suggested mappings based on the real F/A-18 *HOTAS (Hands-On Throttle and Stick)*. Your joystick and throttle (if you own a throttle) will obviously not be identical to the real thing (don't you wish), but the arrangements will be similar enough to improvise.

The red text indicates keys or combinations of key which are available in key command mode. The green text indicates functions and/or keys which are mappable to events within Flight Simulator's key assignments, or registered FSUIPC (preferred method).



7.1 KEY COMMAND MODE

The VRS custom keystroke mode is entered/exited by pressing the **[SHIFT-CONTROL-M]** combination. This key, and all custom keys can be remapped in the ACM. These are the default keys and we highly recommend you don't change them unless you have already flown the Superbug extensively.

KEY	COMMAND	NOTES
SHIFT + CTRL + M	KEY COMMAND MODE TOGGLE	Enter/Exit Custom Key command Mode
ENTER	RADAR DESIGNATE/STT	With TDC priority to HARM TOO or radar: Bugs up the target under TDC. Cycles targets when nothing is under the TDC cursor. With TDC priority to UFCD CNI: Acts as keypad 'ENT' key.
SHIFT + ↑ ↓	RADAR ELEVATION UP/DN	With TDC priority to the display with radar, moves elevation scan center up/down.
SHIFT + ← →	RADAR AZIMUTH L/R	With TDC priority to the display with radar, moves azimuth scan center scan center left/right.
⭾ **(TAB)**	TDC PRIORITY CYCLE	Cycles TDC priority between displays. A filled diamond will appear in the upper-right corner of the display with priority.
↑ → ↓ ←	TDC SLEW	Arrows slew the TDC cursor when priority is in any display. The arrows are the only way to slew the TDC cursor in the HUD.
A	**A**UTOPILOT TOGGLE	
B	LAUNCH **B**AR TOGGLE	
C	**C**HAFF SINGLE	ALE-47 power required [SHIFT-K]).
D	IFF I**D**ENT	Squaws the currently selected code (UFCD IFF page).
E	**E**MCON TOGGLE	Enters/Exits Emissions Control Mode.
F	**F**LARE SINGLE	ALE-47 power required [SHIFT-K]).
H	**H**OOK TOGGLE	
I	**I**FR PROBE TOGGLE	
J	ASPJ **J**AM TOGGLE	ASPJ power required [SHIFT-J].
K	CMDS/ALE-47 INITIATE	
M	**M**ASTER MODE SWITCH CYCLE	Cycles between air-to-air/air-to-ground/navigation master modes.
N	**N**WS STEERING MODE	(HI/LO) toggle.
O	G-LIM **O**VERIDE	(Pro version only).
R	**R**WR POWER	Radar Warning Receiver power toggle.

T	ALE-50 JAM TOGGLE	**T**owed decoy.
W	**W**EAPON CYCLE	Next available weapon of different type (master mode specific).
SHIFT + A	**A**LTITUDE TOGGLE	Toggles between HUD radar and barometric altitude reporting..
SHIFT + B	**B**INGO DECREMENT	Decrements BINGO level by 100 lbs.
SHIFT + C	**C**CIP/HARM MODE CYCLE	Bomb mode: Cycles through the 3 CCIP bombing modes regardless of the current CCIP program. HARM mode: Cycles through all 3 HARM modes.
SHIFT + F	**F**UEL ADD	Adds 25% fuel up to the maximum initially loaded for the flight.
SHIFT + D	ALE-50 **D**EPLOY	Deploys or retracts 1 ALE-50 towed with ALE-50 power on (SHIFT-T).
SHIFT + G	**G**ESTURE	Pilot salutes.
SHIFT + H	**H**UD BRIGHT/POWER KNOB	Cycles through all the positions of the HUD power/brightness knob.
SHIFT + I	TAKEOFF ASSIST	Acceleration pack/Gold. Arms the carrier catapult system once the launchbar (B, or SHIFT-U) is down.
SHIFT + J	ASP**J** POWER TOGGLE	Toggles power to the Airborne Self-Protection Jammer. Actual jamming is toggled with SHIFT-J.
SHIFT + K	ALE-47 POWER TOGGLE	Toggles power to the flare/chaff dispensers.
SHIFT + M	EXTERIOR LIGHTS **M**ASTER SW	Controls power to all exterior lights simultaneously (except landing light). Note that individual lights must still be enabled (left console).
SHIFT + N	**N**WS TOGGLE	Toggles NWS ON/OFF.
SHIFT + P	CCIP **P**ROGRAM CYCLE	Cycles through the 4 available CCIP programs for the current A/G weapon.
SHIFT + R	**R**ADAR RAID MODE TOGGLE	Enters or exits RAID mode with a L&S target, sequences through HARM targets, or cycles through FLIR FOVs depending on TDC priority and master mode.
SHIFT + T	ALE-50 POWER SWITCH TOGGLE	Toggles power to the towed decoy unit.
SHIFT + W	**W**EAPON STEP	Next available weapon of same type.
CTRL + A	MASTER **A**RM SWITCH TOGGLE	
CTRL + B	**B**INGO INCREMENT	Increments BINGO level by 100 lbs.
CTRL + D	FUEL **D**UMP TOGGLE	
CTRL + F	**F**LAPS CYCLE	Cycles through AUTO/HALF/FULL.
CTRL + G	**G**EN TIE RESET	Resets generator bus tie logic.
CTRL + H	**H**UD HUE CYCLE	Cycles through available HUD colors.

CTRL + I	ANTI-**I**CE TOGGLE	Engine inlet anti-ice toggle.
CTRL + J	SELECTIVE **J**ETTISON INITIATE	Jettisons all weapons armed for jettison via the jettison select panel/jettison select knob system.
CTRL + M	**M**ASTER CAUTION RESET	Resets master cautions identically to pressing the master caution reset button.
CTRL + S	**S**EAT ARM	Arms ejection seat.
CTRL + T	TAKEOFF **T**RIM TOGGLE	Also neutralizes rudder, aileron and pitch trim in flight.
CTRL + O	SEAT **O**VERIDE	Toggles seat override handle. Before seat can be armed override handle must be down.
CTRL + P	**P**ITOT HEAT TOGGLE	Pitot heat ON/AUTO toggle.
CTRL + R	AUTOTHROTTLE TOGGLE	Engages cruise or approach ATC depending on CAS operating mode.
CTRL + U	CAGE/**U**NCAGE TOGGLE	**NAV Mode:** Pitch ladder/VV cage. **AA/AG Mode:** SMS cage.
CTRL + W	**W**INGFOLD TOGGLE	
CASTLE SWITCH FUNCTION		
	RDR ACM mode OFF or NOT in AA master mode:	
CTRL + ↑	**NAV/AG mode:** TDC PRIORITY TO **HUD**. **AA mode:** ENABLE ACM + ENTER **BST**.	
CTRL + ↓	TDC PRIORITY TO **UFCD.**	
CTRL + ←	TDC PRIORITY TO **LDDI.**	
CTRL + →	TDC PRIORITY TO **RDDI.**	
	RDR ACM mode ON in AA master mode:	
CTRL + ↑	SET **BST** ACM MODE	
CTRL + ↓	SET **VACQ** ACM MODE	
CTRL + ←	SET **WACQ** ACM MODE	
CTRL + →	SET **AACQ** ACM MODE	
UNDESIGNATE FUNCTION		
SHIFT + DEL	**WonW:**	
	NWS HI/LO TOGGLE	
TDC Priority:	**WoffW:**	
Radar Display	If ACM active: LEAVE ACM/RETURN TO SEARCH If STT active: RETURN TO SEARCH If TWS active: SWAP DT1/DT2	

	If RWS active: UNDESIGNATE L&S
HARM Display	UNDESIGNATE HARM TARGET
FLIR Display	RESET GIMBALS
HUD	UNDEGIGNATE GROUND DT
PADDLE SWITCH FUNCTION	
DEL	**WonW:**
	NWS ON/OFF (same as SHIFT-N)
	FCS EXERCISER CANCEL
Autopilot:	**WoffW:**
ON	A/P DISENGAGE
OFF	G-LIM OVERIDE (Pro-only)

MISC/EMERGENCY		
SHIFT + CTRL + B	FCS **B**IT CONSENT TOGGLE	Toggles the FCS BIT consent switch for use with FCS exerciser mode.
SHIFT + CTRL + D	THROTTLES OFF/IDLE TOGGLE	Throttle must be fully retarded in order to switch from OFF to IDLE and back.
SHIFT + CTRL + M	KEY COMMAND **M**ODE TOGGLE	
SHIFT + CTRL + E	**E**JECT	Seat must be ARMED and override handle DOWN.
SHIFT + CTRL + F	**F**CS RESET	Resets the FCS as part of a normal cold-start or to try to clear an errant FCS failure.
SHIFT + CTRL + H	**H**YD ISOL	Allows in-flight replenishment of accumulator pressure (APU and brake) if HYD2B is GO.
SHIFT + CTRL + I	**I**FR EMERGENCY TOGGLE	IFR probe emergency extend.
SHIFT + CTRL + J	EMERGENCY **J**ETTISON	With master arm ARMED, jettisons all stations except 1, 5, 7, 11.
SHIFT + CTRL + R	**R**EPAIR + FCS RESET	Clears all battle damage and resets the FCS.
SHIFT + CTRL + W	**W**EAPON RELOAD	Reloads all stores and clears killed target list.
SHIFT + CTRL + K	CANOPY JETTISON	Immediately jettisons the “**K**”anopy.
AAM WEAPON QUICK-SELECT		
SHIFT + CTRL + 1	AA GUN	Enters AA MM or selects AA gun, and enters GACQ ACM mode.
SHIFT + CTRL + 2	AIM-9	Enters AA MM or selects AIM-9 if available and leaves ACM.
SHIFT + CTRL + 3	AIM-7	Enters AA MM or selects AIM-7 if available and leaves ACM.
SHIFT + CTRL + 4	AIM-120	Enters AA MM or selects AIM-120 if available and leaves ACM.
MASTERMODE QUICK-SELECT		
SHIFT + CTRL + 5	**NAV** MASTER MODE	Directly selects NAV master mode.
SHIFT + CTRL + 6	**AA** MASTER MODE	Directly selects AA master mode.
SHIFT + CTRL + 7	**AG** MASTER MODE	Directly selects AG master mode.
COMM RADIO SELECT		
SHIFT + CTRL + 9	COMM 1	Sets active transmit radio to COMM 1
SHIFT + CTRL + 0	COMM 2	Sets active transmit radio to COMM 2

8 CHECKLISTS

8.0 NORMAL PROCEDURES

8.0.1 INTERIOR CHECKS

Left console -

[ ] Circuit Breakers	**IN**
[ ] Manual Canopy Handle	**STOWED**
[ ] VOL Panel	**AS DESIRED**
[ ] FCS GAIN switch	**NORM/GUARD DOWN**
[ ] APU switch	**OFF**
[ ] PROBE switch	**RETRACT**
[ ] EXT TANKS switches	**NORM**
[ ] DUMP switch	**OFF**
[ ] INT WING switch	**NORM**
[ ] GEN TIE CONTROL switch	**NORM/GUARD DOWN**
[ ] EXT LT panel	**SET**
[ ] Throttles	**OFF**
[ ] External lights master switch	**FORWARD**
[ ] Throttles	**OFF**

Instrument panel -

[ ] PARK BRK handle	**SET**
[ ] LDG/TAXI LIGHT switch	**OFF**
[ ] ANTI SKID switch	**ON**
[ ] SELECT JETT knob	**SAFE**
[ ] FLAP switch	**HALF/FULL**
[ ] LAUNCH BAR switch	**RETRACT**
[ ] LDG GEAR handle	**DOWN**
[ ] CANOPY JETT handle	**FORWARD**
[ ] MASTER ARM switch	**SAFE**
[ ] EMERG JETT button	**OUT**
[ ] FIRE and APU FIRE buttons	**OUT**
[ ] L/R DDI, HUD, UFCD, MPCD knobs	**OFF**
[ ] COM 1/2 knobs	**OFF**
[ ] ALT switch	**BARO/RDR**
[ ] IR COOL switch	**OFF**
[ ] SPIN switch	**NORM/GUARD DOWN**

[ ] HOOK handle	**UP**
[ ] WINGFOLD switch	**SPREAD**
[ ] AV COOL switch	**NORM**

Pedestal panel (A/C 165660+)

[ ] ECM JETT button	**OUT**
[ ] JAMMER switch	**OFF**
[ ] RWR switch	**OFF**
[ ] DISPENSER switch	**OFF**
[ ] AUX REL switch	**NORM**
[ ] RUD PED ADJ lever	**AS DESIRED**

Right console -

[ ] Circuit breakers	**IN**
[ ] GEN switches	**NORM**
[ ] BATT switch	**OFF**

ECS panel -	**SET**
[ ] ECS MODE switch	**AUTO**
[ ] CABIN TEMP knob	**AS DESIRED**
[ ] CABIN PRESS switch	**NORM**
[ ] BLEED AIR knob	**OFF**
[ ] ENGINE ANTI ICE switch	**OFF**
[ ] PITOT ANTI ICE switch	**OFF**

[ ] DEFOG handle	**MID RANGE**
[ ] WINDSHIELD switch	**OFF**

INT LT panel -	**SET**
[ ] CONSOLES/INST/FLOOD	**AS DESIRED**
[ ] CHART/WARN	**INOP**
[ ] MODE switch	**AS DESIRED**

Sensor panel -	**SET**
[ ] FLIR switch	**OFF**
[ ] LTD/LST switches	**SAFE/OFF**
[ ] RADAR knob	**OFF**
[ ] INS knob	**INOP**

8.0.2 ENGINE START

8.0.2.1 APU START

A self-contained (battery/APU) start is the primary method for starting the engines. The aircraft also has provisions for starting on opposite engine bleed air (crossbleed) for circumstances when that may be appropriate (e.g., alert launch, low battery, maintenance, engine restart after APU shutdown, etc.).

With an external power start, all electrical systems are operative. With a battery start, power is available to operate the APU and engine fire warning systems, the caution lights panel and the EFD backup display.

The right engine is normally started first in order to provide normal hydraulics to the brakes. During first engine battery start, the EFD RPM indication typically jumps from 0 to 5 or 10%, and light-off is indicated by TEMP rising from a minimum reported value of approximately 190°C. When the corresponding generator comes online (approximately 60%N2 rpm), the engine crank switch returns to OFF. After both generators are online, the APU will run for 1 minute and then shut down automatically.

Engine start checks -

[ ] PARK BRK handle	**FULLY SET**
[ ] BATT switch	**ON**
[ ] Battery gauge	**CHECK**

Nominal voltage for a "good" battery should be 23 to 24 vdc. Minimum battery voltage is that which provides a successful engine start (i.e., APU remains online and the EFD remains powered to provide indications of RPM and TEMP). EFD blanking and/or uncommanded APU shutdown should be anticipated with a battery voltage at or below approximately 18 vdc. If a weak battery results in an unsuccessful engine start attempt, the battery should be charged or replaced prior to takeoff, since the battery provides the last source of electrical redundancy for the FCCs.

With external electrical power -

[ ] EXT PWR switch	**RESET**
[ ] GND PWR switches 1, 2, 3 and 4	**B ON**
[ ] L(R) DDI, HUD, and MPCD knobs	**ON**
[ ] COMM 1 and 2 knobs	**ON**
[ ] LT TEST switch	**TEST**
[ ] DDI/MPCD/UFCD	**ENTER DESIRED WPTS**

All starts -	**ON**
[ ] FIRE test switch	**TEST A**

[ ] FIRE test switch	**NORM**
[ ] FIRE test switch	**TEST B**

During a successful FIRE warning test ALL of the following lights should illuminate in each TEST position: both FIRE lights, the APU FIRE light, and both L and R BLEED warning lights. Additionally, the following voice aural warnings should be heard in order: "Engine fire left, engine fire right, APU fire, bleed air left, bleed air right" (each repeated twice).

[ ] APU ACC caution light	**VERIFY OFF**
[ ] APU switch	**ON (within 30 seconds)**
[ ] RGEN switch	**ON**
[ ] BLEED AIR knob	**R-OFF/OFF**
[ ] Right throttle	**IDLE (shift-control-D if OFF)**
[ ] ENG CRANK switch	**R (10% N2 minimum.)**

Oil pressure should be a minimum of 10 psi within 30 seconds. Maximum transient EGT during start is 871°C.

[ ] Battery gauge	**VERIFY 28 vdc**
[ ] L(R) DDI, HUD and MPCD knobs	**ON**

EFD - CHECK (ground idle) -

[ ] RPM	**61% min**
[ ] TEMP	**250-500c**
[ ] FF	**600-900 pph**
[ ] OIL	**35-90 psi (warm oil)**
[ ] NOZ	**77% to 83%**

If external power start -

External electrical power	**DISCONNECT**

[ ] BLEED AIR knob	**NORM**
[ ] LT TEST switch	**TEST**
[ ] ENG CRANK switch	**L**
[ ] Left throttle	**IDLE (10% N2 minimum.)**
[ ] ENG CRANK switch	**CHECK OFF (prior to lightoff)**
[ ] EFD	**CHECK**

8.0.2.2 CROSSBLEED START

[ ] APU switch	**OFF**

[ ] BLEED AIR knob	**NORM**
[ ] ENG CRANK switch	**L(R)**
[ ] Operating engine throttle	**80% N2**
[ ] Starting engine throttle	**IDLE (10% N2 minimum.)**
[ ] ENG CRANK switch	**CHECK OFF**
[ ] EFD	**CHECK**

8.0.3 BEFORE TAXI CHECKS

WARNING

Do not attempt to taxi with the right engine shut down, as normal NWS is not available due to lack of HYD 2 pressure. Although NWS is available via the brake accumulator, there is insufficient pressure available for sustained (non-emergency) steering.

[ ] WYPT 0	**CHECK/SET** (flight plan load)
[ ] RADAR knob	**OPR**
[ ] FLIR/LST/LTD switches	**AS DESIRED**

UFCD avionics -

[ ] RALT sublevel	**ON/SET**
[ ] TCN sublevel	**ON, T/R, CH SET**
[ ] IFF sublevel	**ON/MODES UNBOXED**
[ ] Time sublevel	**AS DESIRED**

[ ] WINGFOLD	**SPREAD**
[ ] FCS RESET button	**PUSH/VERIFY RSET**
[ ] FLAP switch	**AUTO**
[ ] TRIM	**CHECK**

Check pitch, roll, and yaw trim for proper movement in all directions (FCS format). Note it is not possible to trim stabilators to negative values (TED) with WonW.

Control checks -

[ ] Full aft	**CHECK 24° NU STAB**
[ ] Full forward	**CHECK 20° ND STAB**
[ ] Full L/R	**CHECK 30° differential STAB**
	CHECK 8° differential TEFs
[ ] FLAP switch	**HALF**
[ ] NWS mode	**HI**

[ ] Rudder pedals	**CYCLE 40° L/R**

[ ] SEAT	**ARMED**
[ ] T/O TRIM switch	**PRESS (TRIM advisory)**
[ ] IFR PROBE switch	**CYCLE THEN RETRACT**
[ ] Speedbrake	**CYCLE THEN OFF**
[ ] LAUNCH BAR switch	**CYCLE THEN UP**
[ ] HOOK handle	**CYCLE THEN UP**
[ ] PITOT ANTI ICE switch	**CYCLE THEN AUTO**
[ ] APU	**VERIFY OFF**
[ ] Standby attitude indicator	**VERIFY ERECT**
[ ] Altimeter setting	**SET**
[ ] Stores page	**VERIFY INVENTORY/STATUS**
[ ] BIT page	**VERIFY NO DEGD/FAIL**
[ ] Canopy	**FULL UP/DN FOR TAXI**
[ ] BIT page	**VERIFY CLEAR**

8.0.4 TAXI CHECKS

[ ] Normal Brakes	**CHECK**
[ ] Nosewheel Steering	**CHECK IN HIGH L/R**

When using brakes, apply firm, steady brake pedal pressure. Use nosewheel steering whenever possible, minimizing differential braking.

8.0.5 TAKEOFF

8.0.5.1 BEFORE TAKEOFF

[ ] Checklist page	**VERIFY FUEL TYPE**
[ ] T.O. checklist (CHK page)	**COMPLETE**
[ ] Canopy	**CHECK CLEAR/CLOSED**
[ ] IFF sublevel	**BOX REQUIRED MODES**
[ ] PARK BRK handle	**FULLY SOWED**
[ ] ENG page	**CHECK AT MIL**

8.0.5.2 NORMAL TAKEOFF

The takeoff checklist should be completed prior to taking the duty runway. For single-ship takeoffs, taxi to runway centerline and allow the aircraft to roll forward slightly to center the nosewheel. Begin the takeoff roll by releasing the brakes, advancing the throttles from IDLE to MIL, and checking EGT and RPM. If an afterburner takeoff is desired, further advance the throttles to MAX (full forward). Check for proper afterburner light-off as indicated by both nozzles opening. As the aircraft accelerates during the takeoff roll, track runway centerline using small rudder pedal inputs (e.g., NWS commands). NWS is the most effective means of directional control during takeoff. Differential braking is much less effective and should therefore be avoided. The NWS system (low gain) incorporates a yaw rate feedback input from the FCCs, which is designed to suppress directional PIO tendencies by increasing directional damping during takeoff.

<u>At nominal takeoff CG, aft stick will be required to rotate the aircraft</u>. Approaching the predicted nosewheel liftoff speed, ease the stick back to approximately 1/3 to 1/2 aft stick (1-1/2 to 2-1/2 inches). Hold this input until the velocity vector rises to approximately 3 to 5°. Capture and climb/accelerate at the desired flight path angle. When clear of the ground with a positive rate of climb, raise the LDG GEAR handle and place the FLAP switch to AUTO. In a flat takeoff attitude with MAX power selected, the aircraft will accelerate rapidly towards gear speed. If required, reduce power to MIL or below to ensure the landing gear is up and locked (light in the LDG GEAR handle is out) before passing 250 KCAS.

8.0.5.3 CROSSWIND TAKEOFF

Crosswind takeoffs should be performed using the normal takeoff technique. However, the pilot should expect to make slightly larger and more frequent rudder pedal inputs to track runway centerline. As the aircraft accelerates and the ailerons become effective, lateral stick into the wind may be desired to maintain wings level throughout the remainder of the takeoff roll and rotation. Allow the aircraft to crab into the wind at takeoff, while continuing to maintain runway centerline during the gear transition and early climbout.

8.0.5.4 AFTER TAKEOFF CHECKS

[ ] LDG GEAR handle	**UP**
[ ] FLAP switch	**AUTO**

WARNING

For safe maneuverability of the aircraft, up to 350 KCAS may be required up to 10,000 feet.

10,000 FT checks -

[ ] Cabin Altimeter	**VERIFY 8,000 FEET**
[ ] Fuel transfer	**CHECK INT/EXT**
[ ] RALT	**CHECK/SET 5,000 FEET**

8.0.6 LANDING CHECKS

Normal instrument penetration is 250 KCAS with a 4,000 to 6,000 feet per minute descent rate. For safe maneuverability of the aircraft, up to 350 KCAS may be required below 10,000 feet.

[ ] HOOK handle	**AS REQUIRED**
[ ] HOOK BYPASS switch	**AS REQUIRED**
[ ] Exterior lights	**SET FOR LANDING**
[ ] ENG ANTI ICE switch	**AS REQUIRED**
[ ] PITOT ANTI ICE switch	**AUTO**
[ ] DEFOG HANDLE	**HIGH** (if required)
[ ] WINDSHIELD switch	**AS REQUIRED** (if required)
[ ] Altimeter setting	**CHECK**
[ ] RALT	**CHECK/SET**
[ ] NAV master mode	**SELECT**
[ ] Navaids	**CROSS CHECK**
[ ] ILS	**ON/CH SET** (if required)
[ ] IFF	**AS DIRECTED**
[ ] Weapons/Sensors	**OFF AS REQUIRED**

8.0.6.1 VFR LANDING PATTERN ENTRY

Typically, the VFR landing pattern can be entered through several methods: the break, downwind entry, VFR straight-in, or low approach/touch-and-go from a GCA. Regardless of the entry method, enter the pattern at the altitudes and airspeeds prescribed by local course rules. A normal break is performed by executing a level turn to downwind with the throttles reduced to IDLE and the speedbrake function enabled (if required to reduce airspeed). The desired abeam distance is 1.0 to 1.3 nm. The g-level required to achieve the desired abeam distance will be a fallout of break airspeed.

[ ] Speedbrake	**DEPLOY (as required)**
[ ] Airspeed	**240-250 kts**
[ ] LDG GEAR handle	**DOWN**
[ ] FLAPS switch	**FULL**

As airspeed decelerates below 250 KCAS, lower the LDG GEAR handle and place the FLAP switch to FULL. If enabled, the speedbrake function will retract automatically when the FLAP switch is moved from the AUTO position as PA control laws take over. Continue to decelerate to on-speed AOA (8.1 deg). Longitudinal trim inputs are required with the flaps in HALF or FULL and speed < 240 (PA mode). Trim the aircraft hands-off and on-speed. Compare airspeed and AOA.

Onspeed AOA is 8.1 degrees (always) and equates to approximately 136 KCAS at 44,000 lb gross weight. Subtract (add) 1½ KCAS for each 1,000 lb decrease (increase) in gross weight. Complete the landing checklist. When wings level on downwind, descend to pattern altitude (600 ft AGL for the low pattern). Ensure the ground track pointer is on the exact reciprocal of runway heading.

When established downwind -

[ ] Landing checklist (CHK page)	**COMPLETE**
[ ] Report	**3 DN/LOCKED**
	FLAPS FULL/HALF

8.0.6.2 ATC APPROACHES

With flaps HALF/FULL and airspeed under 240 KCAS (PA), ATC (auto throttle control) controls power in order to maintain approach AoA (8.1°). Unlike a manual throttles approach, nose position (i.e., velocity vector placement) now controls power.

[ ] ATC	**ENGAGE (if desired)**

WARNING

Approach ATC is not designed to operate in aggressive maneuvering flight. Aggressive attitude changes cannot be countered quickly enough for predictable and consistent speed adjustments.

8.0.6.3 FINAL APPROACH

At the 180, roll into 27 - 30° AOB, add power, and adjust rate of descent to 100 to 200 fpm. Maintain onspeed AOA. This should place the velocity vector about 1° below the horizon with its wingtip just touching the horizon bar. If required, adjust rate of descent to arrive at the 90° position at 450 ft AGL. Develop an instrument scan for the turn from the 180 to the 90

At the 90, glance at runway centerline and adjust AOB to arrive on centerline. From the 90, rate of descent must be increased by reducing power and adjusting the velocity vector to 1-1/2 to 2° below the horizon, onspeed. This will produce a rate of descent of 400 to 450 fpm to arrive at the 45° position at 380 ft AGL. From the 45, continue to increase rate of descent with a power reduction to arrive at on centerline, at 320 to 350 ft AGL, with 700 to 800 fpm rate of descent, onspeed. The optimum rate of descent will vary with glideslope angle, approach speed, and headwind component.

8.0.6.4 LANDING

Maintain approach rate of descent and power setting by flying a centered ball to touchdown or by placing the velocity vector at least 500 feet past the runway threshold. After touchdown, place the throttles to IDLE and track runway centerline using small rudder pedal inputs. While the rudders are effective above 100 KCAS, NWS is the most effective means of directionally controlling the aircraft during landing rollout. Low gain NWS is activated automatically at touchdown with weight on the nose landing gear. Differential braking to maintain directional control is not as effective and should normally be avoided.

8.0.6.5 BRAKING

Best results are attained by applying moderate to heavy braking with one smoothly increasing pressure as airspeed bleeds off towards taxi speed. Below 48 kts (minimum HUD airspeed), heavy brake pedal pressure should be relaxed to prevent tire skid. . If desired, selecting aft stick (up to full) below 100 kts will increase TEU stabilator deflection and aid in deceleration.

8.0.7 POST-FLIGHT CHECKS

WARNING

Do not taxi with the right engine shut down. Normal braking and NWS are not available without HYD 2 pressure. The brake and APU accumulators will provide only enough pressure for several brake applications, and continued use of NWS will eventually exhaust APU accumulator pressure.

When clear of active runway-

[ ] SEAT ARM	**SAFE**

WARNING

Ensure that the ejection seat SAFE/ ARMED handle is locked in the SAFE position detent and that the word SAFE is completely visible on the inboard side of the handle.

[ ] FLAPS switch	**AUTO**
[ ] T/O TRIM button	**PRESS (TRIM advisory)**
[ ] Canopy	**FULLY UP/DOWN**

8.0.7.1 BEFORE ENGINE SHUTDOWN CHECKS

[ ] THROTTLES	**IDLE**
[ ] PARK BRK handle	**SET [CTRL-.]**
[ ] BIT display	**RECORD DEGD/FAILURES**

[ ] RADAR knob	**OFF**
[ ] Sensors/Avionics	**OFF**
[ ] EXT/INT LT knobs	**OFF**
[ ] Canopy	**CLEAR/OPEN**

8.0.7.2 ENGINE SHUTDOWN CHECKS

[ ] Brake Accumulator Gauge	**CHECK 3000 PSI**
[ ] NWS	**Disengage**
[ ] 5 minute engine cool down	**CONFIRM**

NOTE

Ensure that the engines are idled (<70% N2) for 5 minutes, allowing engine temperatures to stabilize.

[ ] BLEED AIR knob	**OFF**
[ ] THROTTLES	**OFF**
[ ] COMM 1 and 2 knobs	**OFF**
[ ] L(R) DDI knobs	**OFF**
[ ] HUD BRT knob	**OFF**
[ ] UFCD/MPCD knobs	**OFF**
[ ] BATT switch	**OFF**

8.1 CARRIER BASED PROCEDURES

8.1.1 ENGINE START

Engine starts should be made as per normal procedures (Normal Procedures tab), however crossbleed starts should be avoided due to the potential for injury from the associated high RPMs. Use APU starts unless instructed otherwise.

[ ] APU engine start	**PERFORM**

8.1.2 TAXI CHECKS

8.1.2.1 BEFORE TAXI CHECKS

[ ] Normal Before Taxi Checks	**PERFORM**
[ ] NWS mode	**HI**
[ ] FLAPS switch	**FULL**
[ ] CANOPY switch	**CLOSE**

CAUTION

The maximum allowable wind for canopy opening is 60 kts. Opening the canopy with headwinds over 60 kts, or in gusty conditions, could result in damage or loss of the canopy.

[ ] WINGFOLD switch	**FOLD (WING UNLK caution)**
[ ] SEAT ARM lever	**ARMED**
[ ] T/O trim switch	**PRESS**
[ ] DDI TRIM advisory	**VERIFY**

Ensure the T/O trim switch is pressed with flaps in FULL (or launchbar down). T/O trim will drive the stabilators to 6.5° TEU (minimum launch trim). Shore-based operations with flaps HALF (and launchbar UP) will drive the surfaces to 4° TEU.

8.1.2.2 CATAPULT TRIM

WARNING

The T/O trim function will set the stabilators to the <u>minimum</u> catapult trim, however unless the aircraft is light, this will generally be insufficient.
Correct stabilator trim is critical for proper (hands-off) fly-away performance and safety. Failure to properly trim the aircraft prior to catapult launch can result in excessive sink rates off the bow. Use the

following charts to set additional longitudinal trim.

[ ] Gross weight (CHK page) **RECORD**

[ ] Determine power setting (table A) **RECORD**

GW (1,000)	Power Setting
64-66	MAX
58-63	MAX (MIL optional if OAT < 90°F)
46-57	MIL (MAX optional)
32-45	MIL only

Table A

[ ] Longitudinal (TEU) trim **DETERMINE/SET**

Determine the required additional longitudinal (elevator) trim using charts A(MIL launch) or B (MAX launch).

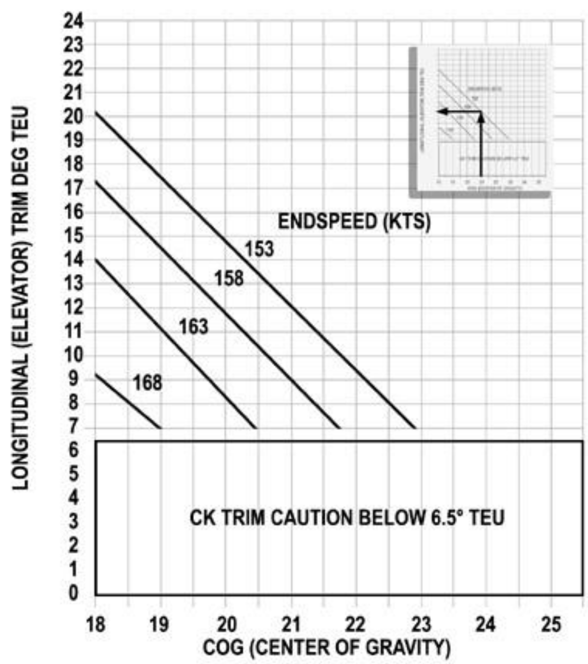
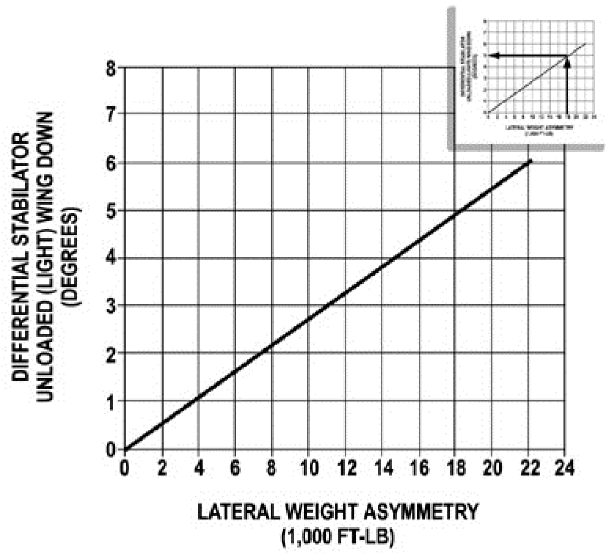


Chart A

[ ] Lateral trim **DETERMINE/SET**

Lateral (roll) trim in the F/A-18 is accomplished through differential stabilator. The flight control system does NOT compensate for lateral asymmetries, therefore it is necessary to make trim adjustments prior to launch if asymmetry exceeds 2,000 ft-lbs (ACM preflight summary window).

Use chart C to determine the required lateral trim (if any), and using standard FS trim controls, trim into the light wing while observing the FCS page.



Example: If asymmetry is 6,000 ft-lbs (heavy right wing), differential stabilator should be trimmed 1.6° into the light wing and the FCS display should read 0.8° TEU for the L STAB and 0.8° TED for the R STAB (1.6° total differential).

WARNING

At low speeds and particularly when heavy, failure to trim for asymmetric loads can jeopardize controllability. In the event of a single engine failure (for example engine FOD) during launch, degraded low-speed control can quickly become lethal.

8.1.2.3 TAXI

When taxiing aboard ship, the wings are generally kept folded until the aircraft is positioned in front of the JBD (jet blast deflector). NWS HI is recommended for carrier operations and should provide excellent turning capability for directional control on the crowded deck. Carefully manage taxi speed, particularly near catapults and pendants.

8.1.3 CATAPULT LAUNCH

PRIOR TO CATAPULT HOOKUP

[ ] T.O. checklist (CHK page)	**COMPLETE**

8.1.3.1 CATAPULT HOOKUP

For FSX: Acceleration, or FSX Gold: Taxi the aircraft over the JBD and align with the catapult track. Using as little power as possible to maintain maneuverability, taxi and line up the aircraft with the catapult track. When the aircraft is properly positioned, press **[SHIFT-U].**

[ ] WINGFOLD switch	**SPREAD (caution out)**

WARNING

If the wingfold switch is inadvertently set to FOLD while the aircraft is moving (WonW), the wings will fully or partially spread, the ailerons will fair, and the aircraft will settle. In no case will enough lift be generated from folded wings to sustain flight.

[ ] LAUNCH BAR switch	**EXTEND (green LBAR lamp)**
[ ] NWS	**DISENGAGE**

WARNING

When the launch bar is extended and enters the catapult track, do not use NWS.

8.1.3.2 CATAPULT LAUNCH

[ ] Throttles	**MIL**
[ ] LAUNCH BAR switch	**RETRACT (LBAR lamp out)**

WARNING

Due to the close proximity of the LAUNCH BAR switch to the FLAP switch, ensure that the FLAP switch was not inadvertently placed into AUTO. With flaps in AUTO, the aircraft will settle excessively during launch.

CAUTION

Failure to set the LAUCH BAR switch in RETRACT prior to launch may result in excessive wear and/or failure of hydraulic seals in the HYD 2A circuit, resulting in possible leaks.

[ ] Controls	**CYCLE**
[ ] Engine instruments	**CHECK**
[ ] Throttles	**FULL MIL/MAX**

When ready for launch -

Salute with the right hand, place the left hand firmly against the throttle detent, and place the head against the headrest. Grasp the right canopy sil handle. Do not touch the stick at any time during the launch, as it may induce PIO with the FCS. The pilot should remain out of the loop (but monitoring closely) during the entire launch sequence.

[ ] PARK BRAKE	**RELEASE**

When safely airborne -

[ ] LDG GEAR handle	**UP**
[ ] Clearing turn	**PERFORM (if required)**

With positive ROC -

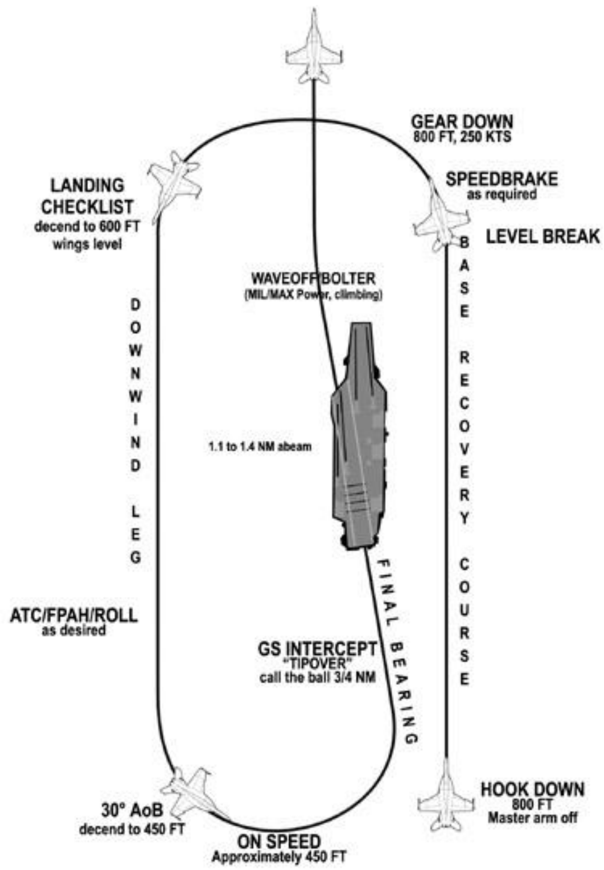
[ ] FLAP switch	**AUTO**

8.1.4 LANDING PATTERN

Pattern entry -

Typically, the VFR landing pattern can be entered through several methods: the break, downwind entry, VFR straight-in, or low approach/touch-and-go from a GCA. Regardless of the entry method, enter the pattern at the altitudes and airspeeds prescribed by local course rules. Enter the carrier landing pattern (illustration 1) with the hook down.

[ ] Altitude	**800 FT (RALT)**
[ ] HOOK lever	**DOWN**
[ ] MASTER ARM switch	**SAFE**



Level break -

A normal break is performed by executing a level turn to downwind with the throttles reduced to IDLE and the speedbrake function enabled (if required to reduce airspeed).

[ ] Speedbrake	**EXTEND (if required)**
[ ] Airspeed	**250 KCAS**
[ ] FLAP switch	**FULL**
[ ] LANDING GEAR lever	**DOWN**

Downwind leg -

The desired abeam distance is 1.1 to 1.4 nm. The g-level required to achieve the desired abeam distance will be a fallout of break airspeed.

Trim the aircraft hands-off and on-speed. Compare airspeed and AOA. Onspeed AOA is approximately 136 KCAS at 44,000 lb gross weight (max trap). Subtract (add) 1½ KCAS for each 1,000 lb decrease (increase) in gross weight. Complete the landing checklist. When wings level on downwind, descend to pattern altitude (600 ft AGL for the low pattern). Ensure the ground track pointer is on the exact reciprocal of runway heading.

To assist in achieving the desired abeam distance of 1.1 to 1.4 nm, select the 10 nm scale on the HSI display. Select ship's TCN and adjust the course line to the BRC. On downwind fly to place the wingtip of the HSI airplane symbol on the course line. Ensure the ground track pointer is on the exact reciprocal of the BRC. Select ILS if desired and available.

[ ] Altitude	**600 FT (RALT)**
[ ] LDG checklist (CHK page)	**COMPLETE**
[ ] Airspeed	**ON SPEED**
[ ] ILS	**TUNED/ON (if desired)**
[ ] TCN steering	**TUNED/ON (if desired)**
[ ] ATC	**ENGAGE (if desired)**

Approach auto throttle (ATC) may be engaged if desired. Approach autothrottle, available in PA mode, will attempt to capture and maintain proper landing AoA (8.1°) regardless of GW or attitude.

WARNING

Approach auto throttle is not designed to operate in aggressive maneuvering flight. Aggressive attitude changes cannot be countered quickly enough for predictable and consistent speed adjustments.

8.1.5 LANDING CHECKS

8.1.5.1 FINAL APPROACH

When approximately abeam the LSO platform, Begin the 180° turn to the final approach course. Coming off the 180, roll into 27 to 30° AOB and lower the velocity vector approximately 1 to 2° below the horizon. ATC will add power as the aircraft rolls into the turn. Reposition the velocity vector to maintain 300 to 400 fpm rate of descent.

Passing through the 90, lower the velocity vector slightly to pick up a 400 to 500 fpm rate of descent. When the meatball is acquired:, transmit "Call sign, BIGFOOT Ball or CLARA, fuel state (nearest 100 lb) and AUTO" (if using ATC for approach).

[ ] REPORT	**CALL SIGN** **BIGFOOT BALL OR CLARA** **FUEL (to nearest 100 lbs)** **AUTO (if ATC engaged)**

8.1.5.2 GLIDE SLOPE

Rolling wings level in the groove, lower the velocity vector further to about 3°. Power corrections required to adjust glideslope are made by repositioning the velocity vector with forward or aft stick inputs. For best results, make small corrections in velocity vector placement and be smooth. Avoid large, rapid, cyclic stick motion.

The technique for maintaining glideslope is basically the same as FCLP (Field Carrier Landing Practice) except that more power may be required. Maintaining centerline will most likely require more line-up corrections due to the angled deck.

8.1.5.3 WAVEOFF

If the waveoff signal is received, select MIL (MAX if required) and maintain onspeed AOA with the E-bracket until rate of descent is arrested. Best rate of climb occurs at onspeed AOA regardless of loading or configuration. This requires slight back stick pressure as the aircraft accelerates. If ATC is engaged, immediately disengage ATC or apply enough force to override ATC while advancing the throttles to MIL or MAX. Do not over-rotate.

8.1.5.4 ARRESTED LANDING

Fly an onspeed, on centerline, centered-ball approach all the way to touchdown, scanning the velocity vector and e-bracket.

At touchdown -

[ ] THROTTLES	**MIL**

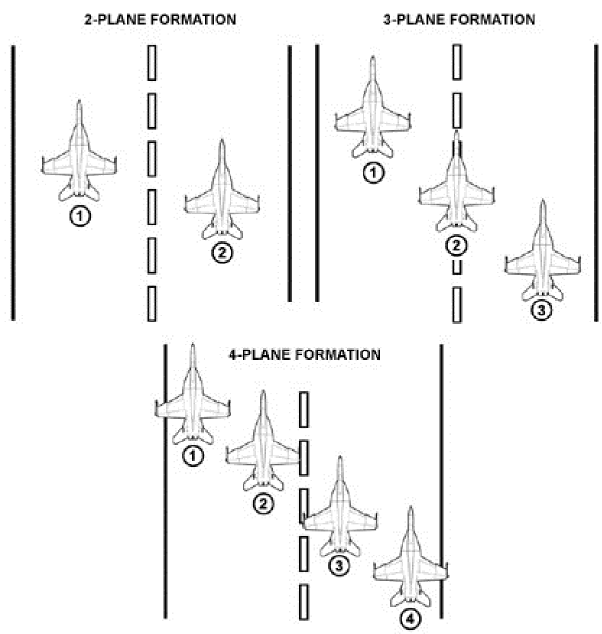
When forward motion ceases -

[ ] THROTTLES	**IDLE**
After a few seconds, the aircraft will roll aft slightly.	
[ ] BRAKES	**APPLY**
[ ] HOOK handle	**UP**
[ ] FLAPS switch	**AUTO**
[ ] WINGFOLD switch	**FOLD**
[ ] NWS	**ENGAGE/HI**

8.2 SPECIAL PROCEDURES

8.2.1 FORMATION TAXI/TAKEOFF

During taxi, ensure adequate spacing is maintained between the lead's stabilator and the wingman's wingtip/missile rail. All aspects of takeoff should be prebriefed by the lead. This should include flap and steering setting (NWS HI/LO, etc.), as well as the use of signals for gear, speedbrake and afterburner



operation. The leader will take position on the downwind side of the runway with other aircraft in tactical order, maintaining normal parade bearing (right). For three aircraft formations, line up with the lead on the downwind side, number 2 on the centerline, and number 3 on the upwind side. Wingtip/launch rail overlap should not be required but is permitted if necessary. For four plane formations, line up with the lead’s section on the downwind half of the runway and other section on the upwind half.

When Before Takeoff checks are completed and the flight is in position, each pilot looks over the next aircraft to ensure the speed brake is retracted (spoilers down), the flaps are set for takeoff, all panels are closed, no fluids are leaking, safety pins are removed, rudders are toed-in, nosewheel is straight, and the launch bar is up. Beginning with the last aircraft in the flight, a “thumb up” is passed toward the lead to indicate “ready for takeoff”.

8.2.1.1 SECTION TAKEOFF

Engines are run up to approximately 80%, instruments checked, and nosewheel steering low gain ensured. On signal from the leader, brakes are released and throttles are advanced to military power minus 2% rpm. If afterburner is desired, the leader may go into mid range burner immediately without stopping at military power. Normal takeoff techniques should be used by the leader, with the wingman striving to match the lead aircraft attitude as well as maintain a position in parade bearing with wingtip separation. The gear and flaps are retracted on signal. Turns into the wingman shall not be made at altitudes less than 500 feet above ground level. When both sections begin takeoff roll from the same point on the runway, the second section must delay takeoff roll until 10 seconds after the first section starts the takeoff roll. When 2000 feet of runway separation exists at the beginning of takeoff roll, a 5 second delay instead of 10 seconds may be used

8.2.1.2 ABORTED TAKEOFF

In the event of an aborted takeoff, the aircraft aborting must immediately notify the other aircraft. The aircraft not aborting should add max power and accelerate ahead and out of the way of the aborting aircraft. This allows the aborting aircraft to steer to the center of the runway and engage the arresting gear, if required.

8.2.2 AIR REFUELING (RECEIVER)

8.2.2.1 BEFORE PLUG-IN

[ ] Airspeed	**175-250 KCAS**
[ ] Radar	**STBY/SILENT/EMCON**
[ ] MASTER ARM switch	**SAFE**
[ ] ALE-50 transmit power	**OFF (if deployed)**
[ ] INTR WING switch	**NORM**
[ ] EXT TANK switch(es)	**AS REQUIRED**
[ ] Speedbrake switch	**RETRACT**
[ ] PROBE switch	**EXTEND**

8.2.2.2 REFUELING TECHNIQUE

When cleared to commence an approach and refueling checklists are completed, assume a position 10 to 15 feet in trail of the drogue with the refueling probe in line in both the horizontal and vertical reference planes. Trim the aircraft in this stabilized approach position and insure that the tanker (amber) ready light is on before attempting an approach. Select a reference point on the tanker as a primary alignment guide during the approach phase; secondarily, rely on peripheral vision of the drogue and hose. Increase power to establish minimum closure rate on the drogue not to exceed 5 knots. An excessive closure rate will cause a violent hose whip following contact and/or increase the danger of structural damage to the aircraft in the event of misalignment; too slow a closure rate results in the pilot fencing with the drogue as it oscillates in close proximity to the aircraft nose. During the final phase of the approach, the drogue has a tendency to move slightly upward and to the right as it passes the nose of the receiver aircraft due to the aircraft-drogue airstream interaction. Small corrections in the approach phase are acceptable; however, if alignment is off in the final phase, it is best to immediately retire to the initial approach position and commence another approach, compensating for previous misalignment by adjusting the reference point selected on the tanker. Make small lateral corrections with the rudder, and vertical corrections with the stabilator. Avoid any corrections about the longitudinal axis since such corrections cause probe displacement in both the lateral and vertical reference planes.

8.2.2.3 MISSED APPROACH

If the receiver probe passes forward of the drogue basket without making contact, initiate a missed approach immediately. If the probe impinges on the rim of the basket and tips it, initiate a missed approach. A missed approach is executed by reducing power and backing to the rear at a 3 to 5 knot opening rate. By continuing an approach past the basket, a pilot might hook the probe over the hose and/or permit the drogue to contact the receiver aircraft fuselage. Either of these hazards require more skill to calmly unravel the hose and drogue without causing further damage than to make another approach. If the initial approach position is well in line with the drogue, the chance of hooking the hose is diminished when last minute corrections are kept to a minimum. After executing a missed approach, analyze previous misalignment problems and apply positive corrections to avoid a hazardous tendency to blindly stab at the drogue.

8.2.2.4 DISENGAGEMENT

Disengagement from a successful contact is accomplished by reducing power and backing out at a 3 to 5-knot separation rate maintaining the same relative alignment on the tanker as upon engagement. The receiver probe separates from the drogue coupling when the hose reaches full extension. When clear of the drogue, place the refueling probe switch in the RETRACT position. Ensure that the PROBE UNLK caution display is out before resuming normal flight operations.

8.2.3 AIR REFUELING (TANKER)

8.2.3.1 BEFORE TAKEOFF

[ ] STORE switch	**OFF**
[ ] HOSE switch	**RETR**
[ ] PWR switch	**OFF**
[ ] Fuel TRANS switch	**OFF**

[ ] REFUEL (lb delivered)	**RST**
[ ] HOSE CUT switch	**SAFE/GUARD DOWN**

8.2.3.2 DROGUE EXTENSION

[ ] PWR switch	**ON**
[ ] Airspeed	**175-250 KCAS**
[ ] HOSE switch	**EXT**

8.2.3.3 DELIVERY

[ ] DISPLAY switch	**SCH**
[ ] SLEW switch	**AS REQUIRED**
[ ] DISPLAY switch	**DEL**
[ ] STORE switch	**TO**
[ ] FUEL TRANS switch	**AUTO**

8.2.3.4 DROGUE RETRACTION

[ ] TRANS switch	**OFF**
[ ] Airspeed	**175-200 KCAS**
[ ] HOSE switch	**RETR**
[ ] PWR switch	**OFF**

Note the power switch will not halt fuel transfer if the hose is extended. Power can only be removed from the ARS with a completely retracted hose and TRANS in OFF.

8.2.3.5 BEFORE LANDING

[ ] STORE switch	**OFF**
[ ] HOSE switch	**RETR**
[ ] PWR switch	**OFF**
[ ] TRANS switch	**OFF**

8.2.4 SATS PROCEDURES

8.2.4.1 LANDING PATTERN

Approach the break point either individually or in echelon, parade formation, at 250 KIAS. A 17 to 20 second break interval provides a 35 to 40 second touchdown interval. The landing checklist (normal procedures tab) should be completed and the aircraft should be at on-speed AOA/approach speed by the 180° position.

8.2.4.2 APPROACH

Plan for and execute an on-speed approach. Pay particular attention to maintaining the proper airspeed and correct lineup.

8.2.4.3 WAVEOFF

To execute a waveoff, immediately add full power and maintain optimum attitude. Make all waveoffs straight ahead until clear of the landing area.

8.2.4.4 ARRESTED LANDING

The aircraft should be on runway centerline at touchdown. Aircraft alignment should be straight down the runway, with no drift. Upon touchdown, maintain the throttle at the approach position. When arrestment is assured, retard the throttle to idle. Allow the aircraft to roll back to permit the hook to disengage from the pendant. When directed by the taxi director, apply both brakes to stop the rollback and raise the hook. If further rollback is directed, release brakes and allow the aircraft to be pulled back until a brake signal is given. Apply brakes judiciously to prevent the aircraft from tipping or rocking back.

8.2.4.5 BOLTER

Bolters are easily accomplished. Simultaneously apply full power and retract the arresting gear hook. Smoothly rotate the aircraft to a lift-off attitude and fly away.

8.2.5 HOT SEAT PROCEDURES

[ ] PARK BRK handle	**SET**
[ ] NWS	**DISENGAGE**
[ ] Left throttle	**OFF**
[ ] Throttle friction	**MAX**
[ ] Avionics	**AS DESIRED**

8.2.6 ALERT SCRAMBLE

The alert/scramble aircraft shall be preflighted in accordance with normal procedures every 4 hours or as local directives dictate. The pre-alert turn shall consist of full Plane Captain checks and full systems checks. Minimum requirements are

8.2.6.1 SETTING ALERT

[ ] Radar BIT status	**GO**
[ ] COMM 1/2	**SET LAUNCH FREQ**
[ ] Launch T/O Trim	**SET**

8.2.6.2 BEFORE SHUTDOWN

[ ] COMM 1/2 knobs	**ON**
[ ] EMCON	**AS DESIRED**
[ ] DDI/MPCD/HUD knobs	**ON**
[ ] Thrust Lever	**MAX (MILITARY) (F3)**

8.2.6.3 AFTER SHUTDOWN

[ ] External power	**CONNECT**
[ ] EXT PWR switch	**RESET then NORM**
[ ] GND PWR switches 1,2,3,4	**OFF**
[ ] BATT switch	**OFF**

8.2.6.4 ALERT FIVE LAUNCH

[ ] GND PWR switches 1, 2, 3, 4	**ON**
[ ] BATT switch	**ON**
[ ] APU switch	**ON (READY light < 30 sec)**
[ ] R engine	**CRANK**
[ ] L engine	**CRANK**
[ ] FCS RESET button	**PUSH (RSET DDI advisory)**
[ ] External electrical power	**DISCONNECT**
[ ] DDI T.O. checklist (CHK page)	**COMPLETE**

8.3 EMERGENCY PROCEDURES

8.3.1 GROUND EMERGENCIES

8.3.1.1 LOSS OF DC ESSENTIAL BUS

With WonW and both GENs offline, the Essential Bus is powered by the battery through the battery contactor. If the APU fails to start and APU accumulator pressure is assumed to be present, then a DC bus failure may be responsible.

[ ] BATT switch	**CYCLE**
[ ] Electrical RESET button	**PRESS**
[ ] GEN switches	**CYCLE**

8.3.1.2 ENGINE FAILS TO START

If no EGT rise within 20 seconds after throttle advance or rpm stabilizes below IDLE:

[ ] Throttle affected engine	**OFF**
[ ] Continue cranking for 3 minutes	
[ ] ENG CRANK switch	**OFF**
[ ] APU switch	**OFF**

8.3.1.3 EMERGENCY EGRESS

The canopy may be opened electrically via the CANOPY switch on the right sill, or via the CANOPY JETT handle on the left sill.

NOTE

The manual canopy crank is not operative in the VRS F/A-18.

[ ] Canopy	**OPEN BY ANY MEANS**

WARNING

Ensure that ground personal are clear prior to activating the CANOPY JETT handle.

[ ] Exit the cockpit

In the event the boarding ladder is not deployed, aircrew may: Jump from the LEX (8 ft drop), slide down an extended TEF, or step down to an installed wing tank/store.

8.3.2 GENERAL EMERGENCIES

8.3.2.1 WARNINGS, CAUTIONS, ADVISORIES

There are 3 general types of indications in the cockpit ranging from the most severe (warnings) to benign (advisories).

8.3.2.2 WARNING LAMPS

Warning lamps are located to the left and right of the UFCD, just underneath the instrument panel hood and above each DDI. Although some of the lamps share real estate with advisory lamps, all are red in color.

NOTE: Shaded cells indicate a Pro-version-only feature which may be partially or fully disabled in the Standard Edition of the VRS F/A-18.

WARNING	DESCRIPTION	ACTION
APU FIRE Warning Lamp **"APU Fire" Voice Warning**	1) Fire detected in APU bay. 2) The APU fire extinguishing system will automatically activate with WonW. Fuel to the APU is shut off and the fire bottle is armed and discharged into the bay. With WoffW, the APU fire button must be pressed on the right annunciator panel.	**INFLIGHT/GROUND -** [ ] APU FIRE lamp - PUSH [ ] FIRE EXTGH lamp - PUSH **GROUND -** [ ] Throttles - OFF [ ] Egress
LBAR Red Warning Lamp	1) Launch bar position not consistent with switch position. 2) Launch bar failed to retract.	**DECK -** [ ] Suspend catapult launch [ ] LAUNCH BAR switch - RETRACT **If LBAR fails to retract -** [ ] LBAR circuit breaker (VC only) - PULL
LBLEED or RBLEED Red Warning Lamp(s) **"Bleed Air**	1) Bleed air leak detected in indicated side. 2) Engine cranking. 2) FIRE TEST (A/B) switch(s) activated.	**If not cranking -** [ ] BLEED AIR knob affected side - OFF **If lamp still on -** [ ] Throttle affected engine - OFF [ ] Land ASAP

Left/Right" **Voice** **Warning**		**If AV AIR HOT caution -** [ ] Airspeed - <325 kts [ ] ECS MODE switch - OFF/RAM [ ] CABIN PRESS switch RAM/DUMP
FIRE (L/R) **Warning** **Lamp(s)** **"Engine Fire** **Left/Right"** **Voice** **Warning**	1) Engine fire detected on indicated side. 2) FIRE TEST (A/B) switch(s) activated.	**GROUND** [ ] Throttles - OFF [ ] FIRE LAMP (affected engine) - PRESS [ ] FIRE EXTGH LAMP - PRESS [ ] BATT switch - OFF [ ] Egress **ON TAKEOFF** [ ] ABORT or Emergency Takeoff **INFLIGHT** [ ] Throttle affected engine - OFF [ ] FIRE LAMP (affected engine) - PRESS [ ] FIRE EXTGH LAMP - PRESS [ ] HOOK Handle - DOWN
LDG GEAR **HANDLE** **flashing or** **steady red**	1) Landing gear in transit 2) Landing gear unsafe 4) Wheels warning (< 7500 FT, < 175 kt, > 250 FPM descent rate).	**STEADY** [ ] Check Gear Down indications **FLASHING** [ ] LDG GEAR handle - DOWN (or increase airspeed and/or altitude)
HOOK **Warning** **Lamp**	1) Hook position does not agree with handle position. 2) Hook not fully extended with hook handle down. 3) Hook down with WonW.	**INFLIGHT** **If hook is in the UP position-** [ ] HOOK circuit breaker - PULL **If hook fails to extend-** [ ] Divert **If hook partially down** [ ] Attempt carrier landing
RALT **Flashing** **UFCD** **Warning**	1) Aircraft is below the primary low altitude warning (LAW) setting.	[ ] Climb above LAW [ ] Reset LAW to a lower altitude [ ] Disable LAW
SPN	1) SPIN switch in the RCVY position	[ ] SPIN switch - NORM

Warning Lamp	**WARNING** Selection of the manual spin recovery mode seriously degrades recovery and controllability, preventing recovery from any departure.	[ ] GUARD - DOWN

THREAT WARNING INDICATION(S)	DESCRIPTION	ACTION
AI **Warning Lamp**	Airborne Interceptor. The RWR has detected emissions consistent with airborne attack radar.	UNIMPLEMENTED
AAA **Red Warning Lamp**	The RWR has detected emissions consistent with AAA fire control radar.	Refer to tactical procedures.
CW **Red Warning Lamp**	The RWR has detected emissions consistent with Command Guidance radar. A missile is most likely being guided toward the aircraft (SAM launch in progress).	Refer to tactical procedures.
SAM **Red Warning Lamp**	The RWR has detected Continuous Wave emissions consistent with ground-based AAW tracking radar. A missile launch is most likely imminent.	Refer to tactical procedures.

8.3.2.3 DDI CAUTIONS/CAUTION LAMPS

Cautions are normally indicated on the LDDI and are displayed in yellow 150% sized text starting at the lower left of the display and filling to the right and up. If more than 9 cautions are displayed, or the LDDI is off, the remaining cautions "spill over" to the right DDI. The Master Caution lamp is illuminated whenever a caution is annunciated. Pressing the MASTER CAUTION button will simultaneously extinguish the Master Caution lamp and resort all DDI cautions.

In addition to the DDI cautions, a dedicated caution panel connected to the essential bus is located on the right forward console. These general cautions are generally illuminated simultaneously with DDI cautions, but are available even in the event of an MC1 or DC bus failure or when generators are offline.

A number of aural cautions are annunciated either in conjunction with, or independently of the visual cautions. These aural cautions are reserved for the most severe conditions including GPWS.

MC1 is primarily responsible for the annunciation of cautions, advisories, and voice alerts. If MC1 is failed or off, MC2 will provide a limited number of backup cautions (CAUT DEGD).

CAUTION	DESCRIPTION	ACTION
ANTISKID DDI Caution	1) ANTISKID switch off 2) ANTISKID failed continuous BIT.	Pro-only
APU ACCUM DDI Caution **APU ACC** Caution Lamp	APU accumulator pressure below 2450 PSI. The APU ACCUM caution should be expected following APU start, and will recharge automatically with WonW as long as HYD 2B pressure is available. With WoffW, the accumulator will discharge following APU start or emergency IFR probe extension.	**Following APU start/emergency IFR extension -** [ ] HYD ISOL switch - ORIDE (until caution ceases) **If caution remains-** [ ] HYD ISOL switch - NORM [ ] Land ASAP.
ARS DROGUE DDI Caution	ARS PWR switch is OFF with the drogue/hose not fully retracted. The ARS will remain powered regardless of the switch position until the hose is stowed or cut.	[ ] Airspeed 175-200 KCAS [ ] ARS PWR switch - ON [ ] HOSE switch - CYCLE to EXT then RETR **If caution remains-** [ ] ARS PWR switch - OFF [ ] Obtain visual inspection. **If drogue appears stowed-** [ ] Land normally. **If drogue not retracting -** [ ] CUT switch - SELECT **If unsuccessful cut -** [ ] Field landing without arrestment gear.
ASPJ DEGD DDI Caution	The Airborne Self-Protection Jammer has failed continuous BIT.	[ ] ASPJ IBIT - PERFORM **If caution still present-** [ ] ASPJ PWR - OFF
ASPJ OVRHT DDI Caution	The Airborne Self-Protection Jammer or related equipment is overheating.	[ ] ECS Mode switch - CHECK **If caution still present-** [ ] Airspeed - <350 KCAS [ ] ASPJ PWR - OFF

ATC FAIL DDI Caution	Autothrottle uncommented disconnect. ATC capability not available. 1) FCC channel 2 or 4 failure. 2) Throttle handle split > 5°. 3) FLAP switch position change. 4) AoB > 70° in PA. 5) Gain ORIDE in PA. 6) PTS failure. 7) WonW. 8) Any engine status other than NORM.	[ ] Control throttles manually until disconnect condition ceases. ~~**If GAIN ORIDE selected in approach mode -**~~ ~~[ ] FCS RESET button - PRESS~~
ASPJ DEGD DDI Caution **FCES** Caution Lamp	The Airborne Self-Protection Jammer has failed continuous BIT.	[ ] ASPJ IBIT - PERFORM **If caution still present-** [ ] ASPJ PWR - OFF
AV AIR HOT DDI Caution	The avionic bay's temperature sensor is reporting an overheat condition. If the overheat is not rectified, powered avionic systems, including the FCS may begin to overheat and/or fail. Systems which have not yet failed due to heat damage will report OVRHT in BIT status checks. If avionics cooling is restored either through ECS, aft avionics cooling fan, or emergency cooling fan prior to failure, the system may return to normal operation within approximately 3 minutes. **WARNING** Systems continue to be vulnerable to failure even after the condition ceases until nominal temperatures are restored.	**GROUND** [ ] ECS MODE switch - VERIFY AUTO **If engine runup possible-** [ ] Either throttle - > 74% RPM **If caution remains after 3 minutes -** [ ] Do not takeoff. **If engine runup not possible -** [ ] APU switch - ON [ ] BLEED AIR knob - AUG PULL **INFLIGHT** [ ] Affected systems - power OFF (if possible). [ ] Throttle - Maintain above IDLE **If caution remains after 3 minutes -** [ ] ECS MODE switch - MAN **If caution goes out -** [ ] Land ASAP. **If caution remains after 3 minutes -** [ ] Altitude - <25,000 FT [ ] Airspeed <325 kts [ ] ECS MODE switch - OFF/RAM (emergency cooling)

		[ ] AV COOL switch - EMERG (emergency FCS cooling)
BATT SW DDI Caution **BATT SW** Caution Lamp	1) BATT switch is ON in the ground in the absence of AC power (first engine start). The battery is depleting and the switch should be placed OFF until APU start. 2) BATT switch is OFF inflight and should be placed ON in order to provide essential bus backup.	[ ] BATT switch - CONFIRM ON
BINGO DDI Caution "Bingo" Voice Warning	Internal fuel levels below BINGO setting.	[ ] Adjust BINGO setting (EFD).
BRK ACCUM DDI Caution	Brake accumulator pressure below 200 PSI. Unlike APU accumulator pressure, low brake accumulator pressure is not normal in flight.	**GROUND** [ ] Ensure the right engine (HYD 2 is started prior to the left engine before attempting to use NWS or braking. **INFLIGHT** [ ] BRK PRESS gauge - CHECK [ ] HYD ISOL switch- OVRD [ ] Extend landing gear ASAP. [ ] Consider short field arrested landing.
CANOPY DDI Caution	Canopy is not down and locked.	**GROUND** [ ] Maintain ground speed under 60 kts [ ] CANOPY switch - DOWN **INFLIGHT** [ ] Slow below 300KTS [ ] Altitude below 25,000 [ ] CANOPY PRESS switch - RAM/DUMP [ ] CANOPY switch - DOWN [ ] CANOPY PRESS switch - NORM **If caution remains -** [ ] Land ASAP.
P CAS **R CAS**	FCS rate/acceleration sensing degraded in the indicated axis.	**Complete FCS caution procedures -** **P CAS** [ ] Make smooth lateral inputs only.

Y CAS DDI Caution **FCES** Caution Lamp "Flight Controls" Voice Warning		**R CAS** [ ] Limit pedal inputs to half throw. **Y CAS** [ ] Make smooth lateral inputs only. [ ] Limit pedal inputs to half throw.
CAUT DEGD DDI Caution	MC1 is down and backup cautions are being provided by MC2. Cautions are limited to: MC1, HYD 1A, HYD 1B, HYD 2A, HYD 2B and AUTOPILOT	[ ] SDC - RESET (FUEL page) [ ] MC1 switch - CYCLE If caution remains [ ] Land ASAP.
CK SEAT DDI Caution **CK SEAT** Caution Lamp	The ejection seat is not armed with WonW and both throttles advanced beyond 27% THA,	[ ] SEAT OVERRIDE handle - DOWN [ ] SAFE/ARM lever - ARMED
CK TRIM DDI Caution	Trim is not set for takeoff with WonW and both throttles advanced beyond 27% THA. Caution annunciates when trim is less than 3.5 degrees with the launch bar UP, or 6.5 degrees with the launch bar DOWN.	[ ] T/O Trim button - PRESS [ ] CONFIRM trim advisory **If carrier based-** [ ] Make final trim adjustments for catapult launch (carrier procedures)
CK FLAPS DDI Caution	Flaps are not set for takeoff with WonW and both throttles advanced beyond 27% THA. Caution annunciates when the flaps are in AUTO with the launch bar up (field takeoff), or flaps are not FULL with the launch bar down (carrier takeoff).	**If shore based-** [ ] FLAP switch - HALF **If carrier based-** [ ] FLAP switch - FULL
L DC FAIL **R DC FAIL** DDI Caution(s)	The left/right 28 vdc bus has failed. The affected FCC channels are powered by the essential bus, but one level of redundancy is lost.	[ ] Electrical RESET button - PRESS **If caution clears -** [ ] Resume normal operation. **If caution remains -** [ ] Land ASAP.

DECOY DDI Caution	The left/right 28 vdc bus has failed. The affected FCC channels are powered by the essential bus, but one level of redundancy is lost.	[ ] Electrical RESET button - PRESS **If caution clears -** [ ] Resume normal operation. **If caution remains -** [ ] Land ASAP.
DUMP OPEN DDI Caution	Dump valve open with DUMP switch OFF. Fuel dump valve may be open despite being commanded closed.	[ ] DUMP switch - CYCLE [ ] BINGO setting - set higher than internal fuel qty. [ ] INTR WING switch - INHIBIT **If ext fuel remaining-** [ ] EXT TANK switches - STOP [ ] Land ASAP.
L ENG **R ENG** DDI Caution(s) "Engine Left/Right" Voice Warning	Abnormal engine condition due to a failure in the engine control system. Failures result in a change in ENG STATUS (ENG page) as follows: a. PERF90 - 10% or less thrust loss. b. AB FAIL - No afterburner capability, thrust limited to ~87%. c. THRUST - Thrust limited to between 40% and 87%, d. IDLE - Thrust limited to IDLE. e. SHUTDN -Engine automatically shutdown.	**GROUND** [ ] Do not takeoff. **INFLIGHT** [ ] ENG format - determine extent. **If PERF90, AB FAIL, THRUST or IDLE -** [ ] Land ASAP. **If SHUTDN** [ ] Throttle affected engine - OFF **If caution clears -** [ ] Restart affected engine. [ ] Resume normal operations.
EXT TANK DDI Caution	1) External tank(s) are pressurized with WonW (EXT TANK switch(es) in ORIDE) 2) External tanks are over pressurized with WoffW.	**GROUND** [ ] EXT TANK switch(es) - VERIFY NORM **If caution remains -** [ ] Do not takeoff. **INFLIGHT -** [ ] EXT TANK switch(es) - STOP (when EXT transfer complete)
FC AIR DAT DDI Caution	1) Pitot failure or blockage or disagreement between left and right probes. 2) Static pressure failure. WARNING With PTS degradation, HUD airspeed	**If PTS X'd in channels 1 - 4-** [ ] ANTI-ICE PITOT switch - ON. **If X's still present -** [ ] Slow below 350KTS (approx 6°-7° AOA). **For landing-** [ ] LDG GEAR handle - DN [ ] FLAP switch - HALF/FULL

	may be in error or blanked. HUD altitude may be in error or blanked, vertical velocity may be blanked.	[ ] Fly straight-in approach. [ ] Fly onspeed AOA to touchdown (ATC not available)
FCS DDI Caution **FCES** Caution Lamp "Flight Controls" Voice Warning	**Initial FCS/FCES caution procedures.** An FCS/FCES related caution/failure has occurred. The FCS page displays a series of X's to identify the location and type of failure. For FCS components. FCS RESET attempts to clear the FCS caution whether or not the reset was successful. RSET advisory will appear following an attempt, and all X's will be cleared momentarily. If X's reappear, the failure/degradation indication is most likely valid. WARNING The FCS REST function does not repair failures. It merely restores affected systems and clears failure indications IF the affected systems are no longer failed.	[ ] Cease maneuvering. [ ] Decelerate below 350 kts. [ ] FCS format - SELECT and identify failure [ ] FCS RESET button - PUSH **If no Xs remain -** [ ] Continue normal operations. **If no more than 1 X remains in any row -** [ ] Land ASAP **If more than 1 X remains in any row -** [ ] Airspeed - 200-300 kts in UA. [ ] AoA below 10° in UA/onspeed in PA. [ ] 2G maximum. [ ] Half lateral stick maximum. [ ] perform controllability check at safe altitude. [ ] Fly straight-in approach. [ ] Land ASAP.
FCS HOT DDI Caution **FCS HOT** Caution Lamp "Flight Computer Hot" Voice Warning	FCC over-temp detected. The FCCs must be constantly cooled and can only operate for a short time if an overheat condition exists. Placing the AV COOL switch to EMERG will deploy the emergency ram air cooling scoop. WARNING If airspeed is not maintained below 325 kts with AV COOL in EMERG, ram air may actually cause components to heat more rapidly due to skin friction heating.	[ ] ECS MODE switch - CONFIRM AUTO **If condition persists -** [ ] Airspeed - < 350 kts. [ ] AV COOL switch - EMERG [ ] Land ASAP.
L FLAMEOUT **R FLAMEOUT**	Designated engine flamed out. If throttle is at or above IDLE and RPM	**DUAL ENGINE FLAMEOUT-** [ ] Throttles - MAX [ ] Lower the nose to maintain RPM.

DDI Caution(s) "Engine Left/Right" Voice Warning	above 12%, the FADEC will automatically attempt a restart of the affected engine. If both engines fail, both generators drop offline when RPM decays below 60%. With both generators offline, the standby instruments must be used. The EFD running on the maintenance bus, will only display RPM and EGT. The PMGs will continue to supply power to the FCS down to approximately 20% N2.	**If no automatic relight approaching 10,000 FT -** [ ] Airspeed - <250 kts. [ ] APU switch - ON (ready light) [ ] ENG CRANK switch - R/L **If restart unsuccessful -** [ ] EJECT **SINGLE ENGINE FLAMEOUT-** [ ] Throttle affected engine - IDLE **If RPM still decreasing -** [ ] Throttle affected engine - OFF **If cause known -** [ ] Refer to engine restart procedures. **If cause unknown -** [ ] Do not restart engine. [ ] Refer to single engine landing procedures.
FLAPS OFF DDI Caution **FCES** Caution Lamp "Flight Controls" Voice Warning	1) LEF and/or TEF inoperative. 2) Speedbrake function disabled; autopilot inop; ATC inop (TEF fail). **LEF FAILURE** LEF failures may be caused by an FCS 2-channel failure or by HYD circuit failure. If a LEF actuator is shutdown, the failed surface is locked in its current position. The opposite LEF is held frozen by the FCCs except for differential control in UA. In UA, aileron droop is set to zero, and TEFs are also held fixed in their current position except for UA differential operation. In PA, TEFs and aileron droop schedule normally according to FLAP switch position. If AUTO is selected after HALF or FULL, the TEFs only retract for loads alleviation (no higher than approximately 17° TED at flap auto retract).	**Complete FCS caution procedures-** **LEF FAILURE -** [ ] Perform controllability check at safe altitude. [ ] FLAP switch - HALF/FULL [ ] Fly straight-in approach. [ ] Fly onspeed AOA to touchdown **TEF FAILURE -** [ ] Perform controllability check at safe altitude. [ ] Adjust gross weight to minimum practical. [ ] Calculate expected approach speed. **For landing-** [ ] LDG GEAR handle - DN [ ] FLAP switch - FULL [ ] Fly straight-in approach. [ ] Fly 10° - 12° AOA to touchdown (if required).

	TEF FAILURE TEF failures may be caused by a 4 channel failure or by a dual HYD 1A/2B circuit failure. TEF actuators continue to operate following 3 channel failures. If a TEF actuator is shutdown, the surface is hydraulically or aerodynamically driven to 5° TED and locked. The opposite TEF is also driven to 5° TED and locked to prevent asymmetry. In PA, both TEFs remain locked 5° TED, but aileron droop schedules normally with FLAP switch position. With both TEFs locked at 5° TED, drag is significantly reduced, approach speeds are significantly higher, and onspeed power settings are near IDLE. A 10° to 11° AOA approach may be required to attain acceptable approach speeds. Aircraft attitude is more nose-up, and field of view over the nose is reduced. Approach speeds may be in excess of nose tire speed (195 KGS) or main tire speed (210 KGS).	
FLAP SCHED DDI Caution **FCES** Caution Lamp	Flaps not scheduling properly due to pitot-static failure. Caution is inhibited in PA. For a loss of air data, the FLAP SCHED caution, multiple X'd PTS channels (FCS page), FCS caution, wheels warning tone, and FC AIR DAT cautions may also annunciate. The the caution was caused by static pressure loss, HUD displayed altitude and vertical velocity are blanked. If the caution was due to loss of total pressure, HUD displayed Mach and airspeed may also blank.	**Complete FCS caution procedures-** **If PTS X'd in channels 1 - 4-** [ ] ANTI-ICE PITOT switch - ON. **If X's still present -** [ ] Slow below 350KTS (approx 6°-7° AOA). **For landing-** [ ] LDG GEAR handle - DN [ ] FLAP switch - HALF/FULL [ ] Fly straight-in approach. [ ] Fly onspeed AOA to touchdown (ATC not available)

	WARNING Flaps will be driven to fixed values based on the position of the FLAPS switch, regardless of airspeed or altitude (scheduling is disabled). This will leave the flaps vulnerable to blowout damage. Always ensure airspeed is below approximately 180 kts by maintaining AOA between approximately 6° - 7° before deploying flaps.	
FUEL LO DDI Caution **FUEL LO** Caution Lamp "Fuel low" Voice Warning	Fuel level in either feed tank is 1125 lb or less. WARNING The fuel low level sensor is independent of fuel quantity indication. If the FUEL LO caution remains (non-transient), aircrew should assume at least one feed tank is below 1,125 lb regardless of level indication.	[ ] FPAS page - obtain best Mach number. [ ] Throttles - reduce speed to best Mach. [ ] FUEL page - check for fuel transfer failure indications. [ ] Land ASAP.
FUEL XFER DDI Caution	1) Internal wing tank asymmetry exceeds 350 lbs. 2) Tanks 1 and 4 are not scheduling properly. Wing transfer failures are usually related to valve failure. If one tank fails to transfer, the other is commanded to stop transferring when the imbalance exceeds 200 lb. With transfer tanks, when tank 4 is near full, the FUEL XFER caution is set when tank 1 drops below 400- 500 lb.	[ ] FUEL page - Confirm imbalance in wing or transfer tanks. **If wing asymmetry greater than 350 lb-** [ ] Monitor wing transfer. [ ] Roll heavy wing up 5°. **If one wing still fails to transfer, or if either wing is below 200 lb -** [ ] INTR WING switch - INHIBIT [ ] In preparation for landing, recalculate lateral asymmetry. [ ] Land ASAP. **If tank 1 empty and tank 4 full -** [ ] INTR WING switch - INHIBIT [ ] Monitor tanks 1/4 transfer. [ ] Land ASAP.
G-LIM 7.5 DDI Caution	Nz REF set to 7.5 g regardless of aircraft gross weight.	**Limit g to the following:-** GW (lb) Acceleration (g)

"Flight Controls" Voice Warning	**WARNING** The g-limiter will not prevent an over-stress at gross weights above 42,097 lb. Above that weight, the aircrew must limit g manually.	42,097 -3.0 to +7.5 45,000 -2.8 to +7.0 50,000 -2.5 to +6.3 55,000 -2.3 to +5.7 60,000 -2.1 to +5.2 66,000 -1.9 to +4.7
G-LIM OVRD DDI Caution "Flight Controls" Voice Warning	G-limiter overridden. The g override is selected by pressing the paddle switch with WoffW and the stick near fully aft. Allows approximately 10 g command at 7.5 g (Nz-REF)	Pro Only [ ] Return stick to neutral.
L GEN **R GEN** DDI Cautions **L/R GEN** Caution Lamps	Primary ac generator on the designated side is off line. **SINGLE GEN FAILURE** Any single generator is capable of powering the entire electrical bus of the aircraft. **DUAL GEN FAILURE** Primary indication: Loss of all displays. The EFD only displays RPM and EGT. Standby instruments operable. The FCCs will continue to operate indefinitely off of the PMG essential bus as long as at least one engine is operating above 60% RPM. If both engines are also inop, the FCCs will operate off the battery as long as the BATT switch is ON and remaining voltage is above 24 vdc.	**SINGLE GEN FAILURE** [ ] GEN switch - CYCLE (affected side). **If GEN fails to reset-** [ ] Electrical RESET button - PRESS **If GEN still inop -** [ ] GEN switch - OFF [ ] Land ASAP. **DUAL GEN FAILURE** [ ] Descend below 10,000 ft. [ ] RADAR knob - OFF [ ] Electrical RESET button - PRESS **If either GEN back online-** [ ] FCS RESET button - PRESS **If either GEN fails to reset-** [ ] GEN switches - CYCLE **If both GENs still inop -** [ ] GEN switches - OFF [ ] BATT switch - CONFIRM ON [ ] GEN TIE - CONFIRM no caution. [ ] Land Immediately. **If immediate landing not possible -** [ ] Slow below 250 kts (standby ASI). [ ] Prepare for a controlled ejection.
HOME FUEL DDI Caution	With a valid flight plan loaded, FPAS calculated fuel remaining to the selected HOME waypoint (FPAS page) is 2,000 lb or less. The HOME FUEL caution is disabled with WonW or with the IFR probe	[ ] Change HOME waypoint and/or reduce fuel consumption.

	extended.	
HYD 1A DDI Caution	HYD circuit 1A pressure low (< 1,400 psi). There is no effect on system operations for a single HYD 1A failure (no other circuits down).	[ ] Airspeed < 380 kts **If right aileron X's -** [ ] FCS RESET - PRESS **If flight surfaces not restored -** [ ] Refer to appropriate FCS procedures.
HYD 1B DDI Caution	HYD circuit 1A pressure low (< 1,400 psi). There is no effect on system operations for a single HYD 1B failure (no other circuits down).	[ ] Airspeed < 380 kts **If left rudder or left LEF Xs'-** [ ] FCS RESET - PRESS **If flight surfaces not restored -** [ ] Refer to appropriate FCS procedures.
HYD 2A DDI Caution	HYD circuit 2A pressure low (< 1,400 psi). Normal NWS lost, normal braking including anti-skid lost, IFR probe retraction/normal extension lost, and launch bar extension lost.	[ ] Airspeed < 380 kts **If right LEF X's -** [ ] FCS RESET - PRESS **If flight surfaces not restored -** [ ] Refer to appropriate FCS procedures. [ ] Probe switch - EMERG EXTD (if required) [ ] Make an arrested landing (if possible) **If arrested landing not possible -** [ ] Make normal landing [ ] Consider paddle switch - PRESS after touchdown to preserve APU ACCUM pressure for slow-speed NWS.
HYD 2B DDI Caution	HYD circuit 2B pressure low (< 1,400 psi). Normal NWS lost, normal braking including anti-skid lost, IFR probe retraction/normal extension lost, and launch bar extension lost.	[ ] Airspeed < 380 kts **If right rudder or left aileron X's -** [ ] FCS RESET - PRESS **If flight surfaces not restored -** [ ] Refer to appropriate FCS procedures. [ ] Probe switch - EMERG EXTD (if

		required) [ ] Make an arrested landing (if possible) **If arrested landing not possible -** [ ] Make normal landing [ ] Consider paddle switch - PRESS after touchdown to preserve APU ACCUM pressure for slow-speed NWS.
IFF OVRHT DDI Caution	IFF overheat detected.	[ ] IFF POWER button (UFCD) - OFF. **If accompanied by AV AIR HOT caution -** [ ] Follow AV AIR HOT procedures.
INLET ICE DDI Caution	Icing conditions detected on left engine inlet sensor.	[ ] ENG ANTI ICE switch - ON [ ] PITOT ANTI ICE switch - ON **When clear of icing conditions -** [ ] ENG ANTI ICE switch - OFF
LADDER DDI Caution	Boarding ladder partially or fully deployed.	**INFLIGHT -** [ ] Reduce airspeed to minimum practical. [ ] Obtain visual inspecxtion if possible. [ ] Land ASAP.
MC1 DDI Caution	Mission computer 1 failed or OFF. With MC1 failed, the only cautions available are provided by MC2 backup: MC 1, HYD 1A, HYD 1B, HYD 2A, HYD 2B, NO RATS, and AUTO PILOT. G-Limiter defaults to 7.5 g, even though the G-LIM 7.5G caution is not displayed. Autopilot INOP.	**INFLIGHT -** [ ] Use no more than 1/2 lateral stick with tanks or A/G stores on the wings. [ ] Refer to G-LIM 7.5G procedure. [ ] Land ASAP.
MC2 DDI Caution	Mission computer 2 failed or OFF. Weapons INOP.	**INFLIGHT -** [ ] Land ASAP.
NO RATS DDI Caution	Reduced Authority Thrust System (RATS) not available.	**INFLIGHT -** [ ] Cycle gear and hook. **If caution remains -** [ ] Advise carrier of NO RATS

		condition. Ship should increase wind-over-deck (WOD). **If required WOD not available -** [ ] Reduce weight to permit recovery with available WOD. **If carrier recovery not possible -** [ ] Divert.
NWS DDI Caution	1) Nosewheel steering failure. 2) Nosewheel steering disengaged.	**INFLIGHT -** [ ] Make arrested landing if possible. **GROUND -** [ ] NWS CYCLE. **If caution remains -** [ ] Do not take off.
L OIL PR **R OIL PR** DDI Caution "Engine Left/Right" Voice Warning	Designated engine oil pressure out of limits.	**INFLIGHT -** [ ] Throttle affected engine - IDLE **If caution remains -** [ ] Throttle affected engine - OFF [ ] resart for landing.
L OVRSPD **R OVRSPD** DDI Caution "Engine Left/Right" Voice Warning	Designated fan or compressor RPM high.	**INFLIGHT -** [ ] Throttle affected engine - IDLE [ ] ENG format - monitor RPM **If 108% N1 or 104% N2 rpm exceeded -** [ ] Throttle affected engine - OFF
P BRAKE DDI Caution	Parking brake still set when throttle are advanced.	[ ] Park brake handle - RELEASE
PROBE UNLK DDI Caution	Refueling probe not fully retracted and locked with PROBE switch in RETRACT.	[ ] Airspeed < 300 kts [ ] PROBE switch - CYCLE
RIG DDI Caution	In the VRS F/A-18E, this caution indicates *FS9's General Realism* not set to maximum. Unless realism is set to high, the VRS F/A-18E's flight dynamics WILL be incorrectly	[ ] General Realism (FS9 settings) - MAX. [ ] PROBE switch - CYCLE
VOICE/AUR	Voice alert or master caution aural tones INOP.	[ ] CSC BIT status - CHECK

DDI Caution	Can be triggered by MC1 INOP or CSC failure.	
WING UNLK DDI Caution	Wings not fully spread and locked (beercans down). **WARNING** Ensure the WINGFOLD switch is in the SPREAD position during takeoff checks. If the wings are commanded to unlock or fold during a catapult shot, the wings unlock, the ailerons fair, the wings may fold partially, and the aircraft will settle.	[ ] WINGFOLD switch - CHECK SPREAD

2.3 DDI ADVISORIES

Advisories are informational indications displayed starting on the lower left of the LDDI. If the LDDI is OFF or failed, advisories will be displayed on the RDDI. Advisories are preceeded by an informational tone of medium pitch.

NOTE: Shaded cells indicate a Pro-version-only feature which may be partially or fully disabled in the Standard Edition of the VRS F/A-18.

ADVISORY	DESCRIPTION	ACTION
AB LIM	The FADEC afterburner limiting function is engaged. The AB LIM function is used during MAX power catapult launches only. AB LIM limits engine power to half afterburner with the throttles at MAX. AB LIM is disabled with an FCC Ch 2 or 4, MC1, FADEC, or INS failure.	Informational
BALT	Autopilot barometric altitude hold mode engaged.	Informational
BIT	Built-In-Test failure/degredation detected.	[ ] BIT format - CHECK
CPLD	Autopilot coupled to WPT, OAP, SEQ, or TCN.	Informational
DBAD	ALE-47 dispenser fauilure.	Informational

FQTY	Failure in fuel quantity gaging system that may affect fuel quantity indications or FUEL XFER caution display.	Informational
FPAH	Autopilot Flight Path Angle Hold mode engaged.	Informational
GSEL	Autopilot Ground Track Select mode engaged.	Informational
GTRK	Autopilot Ground Track hold mode engaged.	Informational
HDG	Autopilot Heading Hold mode engaged.	Informational
LHEAT **RHEAT**	Designated engine anti-ice system is operating.	Informational
HOSE	With ARS Control Panel Power switch ON: • Drogue deployed for normal refueling (wet or dry). • Hose reel has failed to secure hose. With ARS Control Panel Power switch OFF, the ARS DROGUE caution message is displayed..	**If ARS switch ON and drogue deployed -** Information **If ARS switch ON and hose not secured -** [ ] Hose EXT/RETR switch - CONFIRM RETR **If drogue still does not retract -** [ ] Refer to ARS DROGUE caution.
HSEL	Autopilot Heading Select mode engaged.	Informational
LAND	FCS GAIN switch in ORIDE with FLAP switch in HALF or FULL.	Informational
RALT	Autopilot Radar Altitude Hold mode engaged.	Informational

8.3.3 TAKEOFF EMERGENCIES

8.3.3.1 EMERGENCY CATAPULT FLYAWAY

After catapult launch, several emergencies may cause the aircraft to settle, i.e. soft catapult, AB blowout, degraded engine performance, single engine total loss of thrust, etc. If settling cannot be stopped immediately, it is necessary to eject without delay. Priorities during emergency catapult flyaway are to establish control of the aircraft, arrest aircraft settle, and accelerate for climbout.

If flyaway airspeed available –

[ ] Throttles	**MAX**
[ ] Rudder	**FULL AGAINST ROLL/YAW**
[ ] EMERG JETT button	**PUSH**
[ ] Maintain 10°-12° pitch with waterline	
[ ] Do not exceed 14° AoA (AoA Tone)	
[ ] Do not exceed 1/2 lateral stick	

If out of control or still settling –

[ ] EJECT

If under control and settle stoped –

[ ] Accelerate to onspeed (8.1°) AoA

WARNING

If operating on a single engine (i.e FOD on launch), lateral control may be lost or degraded if AoA exceeds 14°. Do not move the FLAP switch from the FULL position, as flap retraction increases aircraft settle.

8.3.3.2 ABORTED TAKEOFF

Several emergency situations may require the use of Aborted Takeoff Procedures: The decision to abort or execute an emergency takeoff depends on the nature and severity of the emergency.

[ ] Throttles	**IDLE**
[ ] Brakes	**APPLY FULL**
[ ] STICK	**AFT (if required)**
[ ] HOOK handle	**DOWN (if required)**

8.3.3.3 EMERGENCY TAKEOFF

Several emergency situations may require the use of Emergency Takeoff Procedures: The decision to abort or execute an emergency takeoff depends on the nature and severity of the emergency.

[ ] Throttles	**MIL/MAX (if required)**
[ ] Maintain onspeed AoA (8.1°)	
[ ] EMERG JETT button	**PUSH (if required)**

8.3.3.4 LOSS OF DIRECTIONAL CONTROL DURING TAKEOFF/LANDING

A directional control problem on takeoff or landing may be caused by a NWS or brake failure. These failures may be compounded by wet or icy runways, crosswinds, hydroplaning, or single-engine operation. Your decision is crucial to the success of the takeoff or landing depending on your speed at the time the problem is encountered, the stopping distance required if landing, and the availability of arresting gear.

If decision to take off is made –

[ ] Execute Emergency Takeoff Procedure

If decision to stop is made –

[ ] Throttles	**IDLE**

If NWS failure suspected –

[ ] Paddle switch	**PRESS**

If directional control problem remains –

[ ] NWS	**ENGAGE (centered rudder)**
[ ] EMERG BRAKE handle	**PULL (brakes released)**
[ ] Use judicious braking	
[ ] HOOK handle	**DOWN (if required)**

8.3.3.5 LANDING GEAR FAILS TO RETRACT

If landing gear warning light and warning tone on with the LDG GEAR handle UP –

[ ] LG circuit breaker	**CHECK IN**
[ ] LDG GEAR handle	**DN (do not cycle)**

If three down and locked indications –

[ ] Land as soon as practical

8.3.4 INFLIGHT EMERGENCIES

4.1 AFTERBURNER FAILURE

Afterburner failure can be recognized by failure of the nozzle to open (EFD display), which may be the only apparent symptom other than lack of expected thrust levels. The afterburner continuously receives ignition above MIL power. If an afterburner does not light or blows out, reduce the throttle to MIL and reselect afterburner. If an afterburner fails to light on subsequent attempts, maintenance action is most likely required.

4.2 EMERGENCY RESTART

There are 3 methods of restarting an engine in flight listed in order of desirability.

CAUTION

Attempting to restart an engine that has failed for no apparent reason (i.e. low AoA/high airspeed and no apparent FOD) may result in engine bay fuel leak/fire.

8.3.4.1 WINDMILL START

The FADEC will automatically attempt to restart any engine in which a flameout is detected, as long as throttle for the affected engine is IDLE or above and at least 12% RPM is available. Automatic restarts are the fastest and most reliable method for airborne engine restart.

[ ] Throttle affected engine	**IDLE OR ABOVE**

8.3.4.2 CROSSBLEED START

If the affected engine has decayed below 12% N1 and/or cannot achieve it, a crossbleed start may be attempted. In order for the opposite engine to supply enough bleed air to start the affected engine, the good engine must be throttled to a minimum of 80% N2 RPM. Crossbleed starts may not be possible above 25,000 FT. Refer to chart A, below for the typical restart envelope.

[ ] Throttle opposite engine	**ABOVE 80% N2**
[ ] BLEED AIR knob	**OPPOSITE ENG/NORM**
[ ] CRANK switch	**L(R) (affected engine)**

After ignition -

[ ] BLEED AIR knob	**NORM**

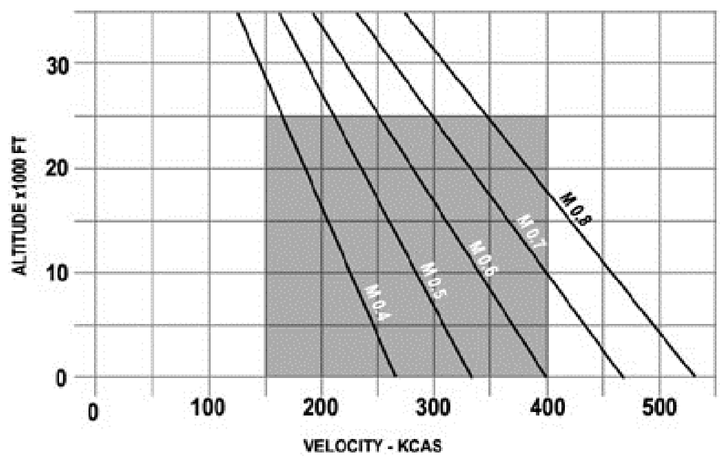


Chart A

8.3.4.3 AIRBORNE APU START

The final and least desirable method for airborne restart is via the APU, but may be unavoidable if airspeed is insufficient or in the event of a dual engine failure. The APU restart envelope is rather small; Airspeed must be under 250 kts and altitude under 10,000 ft.

Since APU accumulator pressure must be used to start the APU, the HYD Aft Isolation valve should be opened in order to allow HYD 2B to fully charged the accumulator WoffW.

WARNING

APU restart should not be attempted except as a last resort. Due to the various risk factors in airborne APU operation, the unit should be shut down immediately after ignition of the affected engine.

[ ] Throttle affected engine	**IDLE OR ABOVE**
[ ] BLEED AIR knob	**OPPOSITE ENG/NORM**
[ ] HYD ISOL OVRD switch	**OVERRIDE**
[ ] Wait approximately 10 seconds	(if prudent)
[ ] APU switch	**ON**
[ ] APU lamp	**VERIFY GREEN**
[ ] CRANK switch	**L(R) (affected engine)**

After ignition -

[ ] APU switch	**OFF**

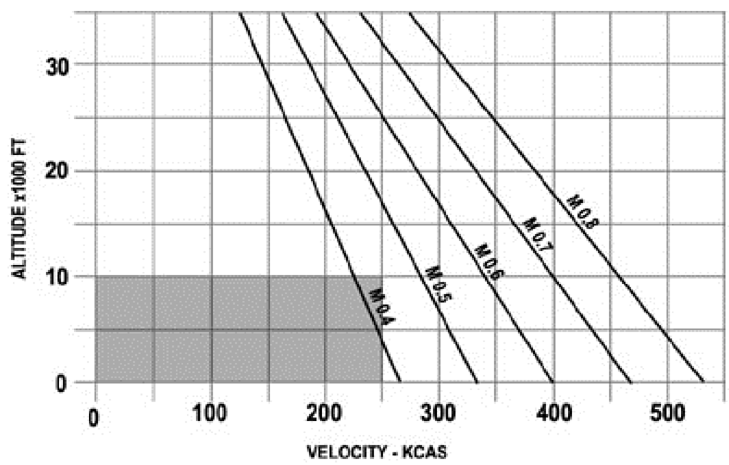


Chart B

8.3.4.4 DOUBLE TRANSFORMER FAILURE

Failure of both transformer-rectifiers (TRs) will produce a loss of the HUD (but not other displays), bleed air including cockpit airflow/pressurization, and loss of othe equipment relying on the main DC busses. NOTE: the BATT SW caution light should be out.

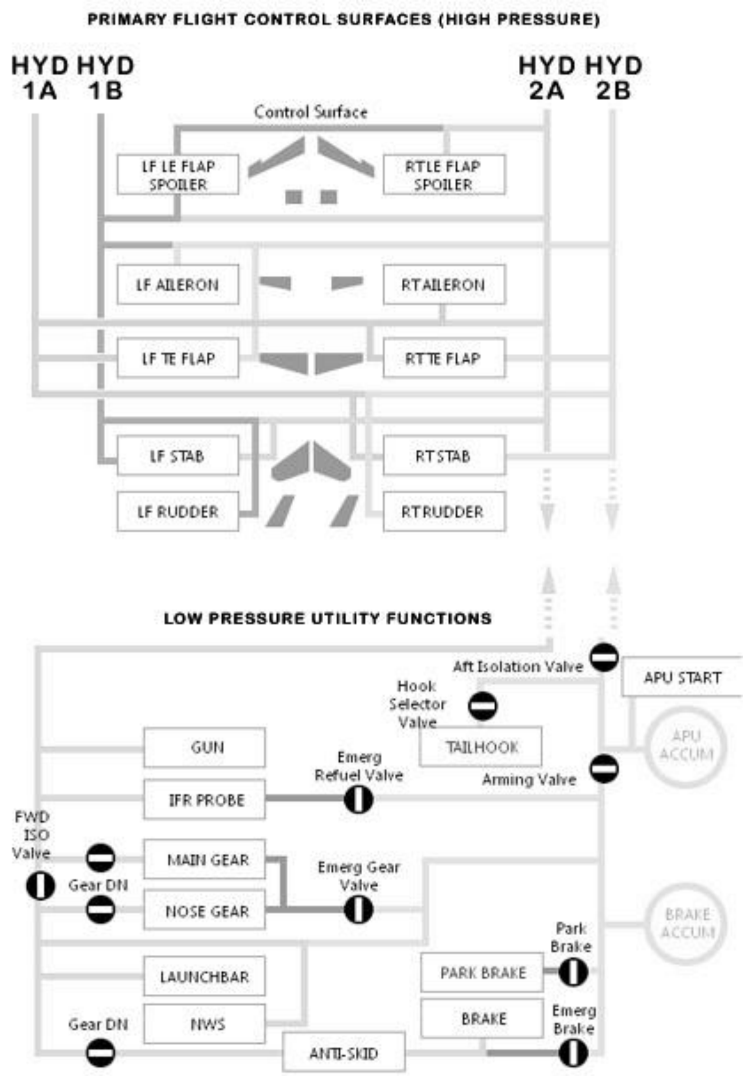
During a dual TR failure, time is not critical, and Essential Bus equipment need not be turned off. Equipment requiring AC power is not effected and does not need to be switched off.

[ ] BATT SW caution light **CONFIRM OUT**
[ ] Maintain altitude below 10,000 feet
[ ] Electrical RESET button **PRESS**
[ ] Land as soon as practical

For landing –
[ ] Make a short field arrestment (if available)
[ ] Use emergency brakes with steady brake pressure (do not pump).

4.7 HYDRAULIC FAILURES

Hydraulic failures are indicated by the HYD 1A, 1B, 2A, and 2B circuit cautions. The effects of losing one or more HYD circuits can be seen by analyzing the flow diagram below.



In general, a failure of any 2 circuits will have no impact on flying qualities. As circuits begin to degrade further, performance can range from sluggish to uncontralable. Refer to operations manual for further explanation of specific HYD cuations.

8.3.4.5 COCKPIT TEMPERATURE HIGH OR AV AIR HOT CAUTION

Hot cockpit airflow may be caused by an ECS control failure or a valve failure.

CAUTION

In ECS MAN mode, cockpit temperature can reach 190°F, if the cockpit flow valve is stuck full open.

[ ] **CABIN TEMP knob** **FULL COLD**

If temperature remains high –

[ ] **ECS MODE switch** **MAN**

If temperature still high –

[ ] **Maintain altitude below 25,000 feet.**

[ ] **CABIN PRESS switch** **RAM/DUMP**

If temperature not reduced –

[ ] **BLEED AIR knob** **OFF** (do not cycle)

[ ] **Maintain altitude below 10,000 ft.**

[ ] **Maintain airspeed below 325 KCAS (300-325 KCAS optimum)**

[ ] **ECS MODE switch** **OFF/RAM**

[ ] **AV COOL switch** **EMERG**

If AV AIR HOT caution appears OR aft avionics cooling fan disabled –

[ ] **Non-essential avionics equipment** **OFF**

[ ] **Land as soon as possible**

WARNING

If the aft avionics cooling fan has been disabled, the OFF/RAM position of the ECS MODE switch will not energize the aft avionics cooling fan. If this situation occurs, only the following essential avionics receive adequate cooling: FCC A, and the right transformer-rectifier. All other avionics systems are susceptible to failure or shutdown due to heat. Ambient temperature significantly influences the rate at which avionics systems fail.

8.3.4.6 DISPLAY MALFUNCTION

If a display malfunctions, cycle power to attempt to restore normal functioning. If a display continues to malfunction, turn if off to prevent an overheat.

[ ] **BIT Format** **CHECK**

[ ] **Affected systems(s)** **POWER OFF**

8.3.4.7 OUT OF CONTROL FLIGHT

If a display malfunctions, cycle power to attempt to restore normal functioning. If a display continues to malfunction, turn if off to prevent an overheat.

WARNING

Selection of manual spin recovery mode (SPIN switch in RCVY) seriously degrades controllability, will prevent recovery from any departure or spin, and is prohibited (Pro-only feature)

Recovery Procedures –

[ ] Controls.	**RELEASE ALL**
[ ] SPEEDBRAKE	**IN**

If still out of control –

[ ] Throttles	**IDLE**
[ ] Altitude, AOA, airspeed, and yaw rate	**CHECK**

If command arrow present –

[ ] Lateral stick	**FULL INTO ARROW**

When command arrow removed –

[ ] Lateral stick	**NEUTRAL**

When recovery indicated by YAW rate tone removed, side forces subsided, and airspeed accelerating above 180 knots –

[ ] Recover

WARNING

Failure to ensure all criteria are met may result in departure during recovery.

Passing 6,000 ft. AGL, dive recovery not initiated –

[ ] EJECT

WARNING

Post departure dive recovery initiated below 6,000 ft. AGL is not assured. Delaying the ejection decision below 6,000 ft. AGL while departed may result in unsuccessful ejection.

Post Departure Dive Recovery –

[ ] One-g roll to the nearest horizon	
[ ] Throttles	**MAX** (MIL if alt not critical)
[ ] Pull to and maintain 25° to 35° AOA until positive ROC established	

WARNING

A positive rate of climb requires wings level pitch attitude (waterline) greater than indicated AOA.

If aircraft departs during dive recovery below 6,000 ft. AGL –
[ ] EJECT

8.3.4.8 CONTROLABILITY CHECK

REQUIREMENT: Malfunction, failure, or damage, which degrades approach and landing characteristics.

PURPOSE: Determine if attempting approach or controlled ejection, safe landing configuration, and safe final approach airspeed/AOA.

[ ] Climb/maintain a safe altitude	5000-15000 ft AGL as practical.
[ ] Visual inspection	If necessary/possible.
[ ] Check emergency procedure limits	AOA, airspeed, etc.
[ ] Plan LDG GEAR extension	Distance from field (consider fuel, stores remaining, etc.)
[ ] Plan FLAPS extension	Decide timing of and setting required (field/CV).
[ ] SEL JETT	To maintain symmetry.
[ ] GEAR	**DN** (access controllability/damage)
[ ] FLAPS	**HALF/FULL** (HALF first if handling degraded)

If landing attempted, request a straight-in approach (if practical) and maintain the minimum controllable airspeed plus 10 knots. If lateral stick is required for balanced flight, plan for turns in the direction of the stick displacement (if possible).

8.3.4.9 3EXTERNAL STORES JETTISON

For emergency jettison –

[ ] WoffW	
[ ] LDG GEAR handle	**UP**
[ ] EMERG JETT	**PUSH** (all but cheek/tip)

For selective jettison –

[ ] WoffW	
[ ] LDG GEAR handle	**UP**
[ ] Find a clear area below aircraft	
[ ] LT TEST switch	**TEST** (verify all JETT lights lit)
[ ] Jettison pushtiles	**SELECT DESIRED STATIONS**
[ ] SELECT JETT knob	**ROTATE AS REQUIRED**
[ ] MASTER ARM switch	**ARM**
[ ] SELECT JETT button	**PUSH**
[ ] MASTER ARM switch	**SAFE**
[ ] SELECT JETT knob	**SAFE**

For AUX REL - (station must be H-LKD or H-ULK following a failed SELECT JET release attempt) –

[ ] WoffW	
[ ] LDG GEAR handle	**UP**
[ ] Find a clear area below aircraft	
[ ] LT TEST switch	**TEST** (verify all JETT lights lit)
[ ] AUX REL switch	**ENABLE**
[ ] Jettison pushtiles	**SELECT DESIRED STATIONS**
[ ] SELECT JETT knob	**ROTATE AS REQUIRED**
[ ] MASTER ARM switch	**ARM**
[ ] SELECT JETT button	**PUSH**
[ ] MASTER ARM switch	**SAFE**
[ ] SELECT JETT knob	**SAFE**
[ ] AUX REL switch	**NORM**

8.3.4.10 FCS FAILURE INDICATIONS

FCS failures are indicated by various cautions and by FCS format Xs. Following display or annunciation of an FCS caution, the FCS format should be used to identify the exact malfunction/failure.

With the failure of FCC channels 1 and 3, the FCS format displays the word INVALID in place of the G-LIM advisory. Subsequent FCS failures or resets will not be displayed. Refer to operation manual for further explanation of specific FCS failures and FCS Page in the DDIs.

[ ] FCS RESET switch **PRESS**

8.3.5 LANDING EMERGENCIES

8.3.5.1 SINGLE ENGINE FAILURE IN LANDING CONFIGURATION

At MIL power and below, the amount of yaw/roll caused by a single engine failure is minimal, and the aircraft is easily controllable. If an engine fails with both throttles at MAX power (e.g. waveoff), a significant amount of yaw/roll can be anticipated due to asymmetric thrust. In this case, timely rudder pedal inputs (up to FULL) are required. Too much rudder pedal is not harmful, but too little may cause controllability problems. Therefore, FULL rudder pedal to oppose yaw/roll is prudent. If lateral stick is also required to oppose roll, inputs should be limited to approximately ½ displacement. Lateral stick inputs greater than ½ throw may compromise directional controllability and result in excessive sideslip buildup. During single engine operations, restricting lateral stick inputs to less than ½ throw reduces the potential of an adverse yaw departure.

GENERAL CONSIDERATIONS –

[ ] Fly straight in approach (if practical)

[ ] Plan approach to make turns using shallow bank angle

[ ] DO NOT exceed on-speed AOA in turns

[ ] Reduce gross weight (44,000 lb max, lower if practical)

[ ] Consider crossbleed to provide HYD 2 pressure to extend the landing gear normally and to preserve APU accumulator pressure for emergency NWS.

[ ] Maintain operating engine above 80% rpm during flap and landing gear extension.

LEFT ENGINE FAILED–

[ ] FLAP switch **HALF**

[ ] LDG GEAR handle **DN**

[ ] Make a normal landing or a precautionary short field arrested landing (if practical)

RIGHT ENGINE FAILED –

[ ] FLAP switch **HALF**

[ ] Make a normal landing or a precautionary short field arrested landing (if practical)

If short field arresting gear not available and crossbleed not desired –

[ ] EMERG BRK handle **VERIFY PULLED**

[ ] Make normal landing

[ ] Use emergency brakes with steady brake pressure (do not pump)

[ ] Once stopped or clear of runway, DO NOT taxi.

CROSSBLEED CONSIDERATIONS (RIGHT ENGINE FAILED)

[ ] Do not crossbleed if engine damage is suspected.

[ ] If normal braking with anti-skid is required, verify reset of EMERG BRK handle

[ ] If APU ACCUM caution light is on, advance LEFT ENG throttle to 80% rpm minimum and switch ENG CRANK switch to R

[ ] HYD 2 pressure	**RESTORE**
[ ] HYD ISOL	**ORIDE**
[ ] APU ACCUM caution	**VERIFY REMOVED**
[ ] ENG CRANK switch	**OFF**
[ ] APU switch	**ON** (ready light within 30 sec)
[ ] ENG CRANK switch	**R**
[ ] HYD 2 pressure	**VERIFY RESTORED**
[ ] HYD ISOL switch	**ORIDE**
[ ] APU ACCUM caution	**VERIFY OUT**
[ ] Make normal landing	

8.3.5.2 FORCED LANDING

The aircraft is not designed to land on an unprepared surface. If a suitable landing site is not available, perform a controlled ejection.

5.2 LANDING GEAR UNSAFE OR FAILS TO EXTEND/RETRACT

A landing gear position of three down and locked is indicated by three steady green position lights with the landing gear warning light and warning tone out.

If the landing gear warning light and warning tone are OFF –

[ ] AOA indexer lights	**CONFIRM ON**
[ ] Landing gear position lights	**CHECK FLUSH**
[ ] LT TEST switch	**TEST**

At this point if a bulb(s) test bad it is safe to assume that the landing gear is down and locked –

[ ] Obtain visual inspection (if possible)	
[ ] Approach lights	**ILLUMINATED** (if visual possible)

[ ] Make a minimum sink rate precautionary short field arrestment (if available)

If the landing gear warning light and warning tone are ON –

[ ] AOA indexer lights	**CONFIRM OUT**
[ ] LDG GEAR handle	**CHECK FULL DN** (do not cycle)
[ ] LG circuit breaker	**CHECK IN**
[ ] Get visual inspection (if practical)	

CAUTION

If one or more landing gear indicates unsafe, a visual inspection can only confirm general position and obvious damage. There is no external indication of a locked gear.

Only if all gear indicated unsafe –

[ ] LG circuit breaker	**CYCLE**
[ ] LDG GEAR handle	**UP, pause, DN**

If any gear indicated down and locked –

[ ] LDG GEAR handle	**DO NOT CYCLE**
[ ] LT TEST switch	**VERIFY 3 LIGHTS**

If any bulb test good and any gear indicates unsafe –

[ ] Refer to Landing Gear Malfunction – Landing Guide charts in deciding landing options.

If any gear remains unsafe –

[ ] Perform positive and negative g maneuvers and gently roll and yaw aircraft to attempt to drive the unsafe gear down and locked

If any gear remains unsafe and HYD 2A is operative –

[ ] LDG GEAR handle	**UP, pause, DN**

[ ] Perform positive and negative g maneuvers and gently roll and yaw aircraft to attempt to drive the unsafe gear down and locked

If any gear still indicates unsafe –

[ ] Refer to Landing Guide charts below:

CARRIER LANDING		
GEAR CONFIGURATION	**ACTION**	**NOTES**

	NOSE GEAR RETRACTED STUB OR TRAILING	DIVERT OR BARRICADE	1, 2 ,3
	ONE MAIN GEAR RETRACTED OR TRAILING	DIVERT OR BARRICADE	1, 2, 4
	COKED NG AND/OR ONE OR MORE COCKED MAIN GEAR	NORMAL LANDING	2
	ONE OR BOTH MAIN GEAR STUB	DIVERT OR BARRICADE	1, 2, 3
	NOSE GEAR AND ONE MAIN GEAR RETRACTED OR TRAILING	RETRACT ALL GEAR. IF UNABLE TO RETRACT, EJECT.	
	BOTH MAIN GEAR RETRACTED OR TRAILING	DIVERT OR BARRICADE	1, 2, 4
	ALL GEAR UP	DIVERT OR BARRICADE WITH TANKS INSTALLED ONLY OR EJECT	1, 2, 4
	LAUNCH BAR DOWN OR RED LAUNCH BAR LIGHT ILLUMINATED	DIVERT OR REMOVED CDP'S 1 AND 4 AND MAKE NORM LANDING	

1) JETTISON ALL EXTERNAL ORDINANCE
2) RETAIN AND DEPRESSURIZE EMPTY EXT TANKS
3) HOOK DOWN BARRICADE ENGAGEMNT WITHOUT CROSS DECK PENDANTS
4) HOOK DOWN BARRICADE ENGAGEMNT WITH CROSS DECK PENDANTS

FIELD LANDING (NO ARRESTING GEAR AVAILABLE)		
GEAR CONFIGURATION	**ACTION**	**NOTES**

	NOSE GEAR RETRACTED STUB OR TRAILING	LAND	1, 2, 3, 4, 5
	ONE MAIN GEAR RETRACTED OR TRAILING	LAND	1, 2, 3, 7, 8, 9, 10
	COKED NG AND/OR ONE OR MORE COCKED MAIN GEAR	LAND	2
	ONE OR BOTH MAIN GEAR STUB	LAND	1, 2, 3, 7, 8, 9, 10
	NOSE GEAR AND ONE MAIN GEAR RETRACTED OR TRAILING	RETRACT ALL GEAR. IF UNABLE TO RETRACT, EJECT.	
	BOTH MAIN GEAR RETRACTED OR TRAILING	LAND	1, 2, 5, 9
	ALL GEAR UP	LAND	1, 2, 5, 9
	LAUNCH BAR DOWN OR RED LAUNCH BAR LIGHT ILLUMINATED	LAND	

1) JETTISON ALL EXTERNAL ORDINANCE
2) RETAIN AND DEPRESSURIZE EMPTY EXT TANKS
3) MINIMUM DESENT RATE LANDING
4) LOWER NOSE GENTLY BEFORE FALL THROUGH
5) SECURE ENGINES OF ANY GEAR RETRACTED
6) HOLD MISSING DAMAGED GEAR OFF DECK UNTIL ENGAGEMENT
7) ANTI-SKID OFF
8) LAND ON SIDE OF RUNWAY TOWARD GOOD GEAR
9) HOLD WINGS LEVEL AS LONG AS POSSIBLE
10) USE NWS AND GOOD BRAKE TO MAINTAIN CENTERLINE

FIELD LANDING (ARRESTING GEAR AVAILABLE)		
GEAR CONFIGURATION	**ACTION**	**NOTES**

	NOSE GEAR RETRACTED STUB OR TRAILING	NO ARRESTED LANDING, REMOVE CDP	1, 2, 3, 4, 5
	ONE MAIN GEAR RETRACTED OR TRAILING	MAKE ARRESTED LANDING	1, 2, 3, 6
	COKED NG AND/OR ONE OR MORE COCKED MAIN GEAR	MAKE ARRESTED LANDING	2
	ONE OR BOTH MAIN GEAR STUB	MAKE ARRESTED LANDING, REMOVE CDP	1, 2, 3, 7, 8, 9, 10
	NOSE GEAR AND ONE MAIN GEAR RETRACTED OR TRAILING	RETRACT ALL GEAR. IF UNABLE TO RETRACT, EJECT.	
	BOTH MAIN GEAR RETRACTED OR TRAILING	MAKE ARRESTED LANDING	1, 2, 5, 9
	ALL GEAR UP	NO ARRESTED LANDING, REMOVE CDP	1, 2, 5, 9
	LAUNCH BAR DOWN OR RED LAUNCH BAR LIGHT ILLUMINATED	NO ARRESTED LANDING, REMOVE CDP	

1) JETTISON ALL EXTERNAL ORDINANCE
2) RETAIN AND DEPRESSURIZE EMPTY EXT TANKS
3) MINIMUM DESENT RATE LANDING
4) LOWER NOSE GENTLY BEFORE FALL THROUGH
5) SECURE ENGINES OF ANY GEAR RETRACTED
6) HOLD MISSING DAMAGED GEAR OFF DECK UNTIL ENGAGEMENT
7) ANTI-SKID OFF
8) LAND ON SIDE OF RUNWAY TOWARD GOOD GEAR

9) HOLD WINGS LEVEL AS LONG AS POSSIBLE 10) USE NWS AND GOOD BRAKE TO MAINTAIN CENTERLINE

If at any time landing gear indicates three down and locked –

[ ] LDG GEAR handle DO NOT CYCLE

[ ] Make a minimum sink rate precautionary short field arrestment (if available)

[ ] Pin the landing gear after landing

8.3.5.3 FIELD ARRESTMENT

Using the carrier operations feature contained in the VRS ACM, you can define "cable catch" zones not just for aircraft carriers, but also on land. These can be used toe simulate field arrestment procedures. Note that the use of the tailhook is required to successfully TRAP (Tactical Recover of Aircraft and Personnel) in any defined zone. Typically runway locations for such operations are as follows:

SHORT FIELD (best) –

Located 1,500 to 2,000 feet past the approach end of the runway.

MIDFIELD –

Located near the halfway point of the runway.

LONG FIELD or ABORT –

Located 1,500 to 2,000 feet short of the departure end of the runway.

OVERRUN –

Located shortly past the departure end of the runway

8.3.6 EJECTION

The ejection seat may be used to escape from the aircraft in extreme emergency situations. The VRS F/A-18E simulates ejection seat operation in a cursory manner by providing escape sequence arming functionality and animations.

8.3.6.1 EJECTION SEAT RESTRICTIONS

During ejection seat development and testing, the SJU-17(V) 1/A and 2/A NACES seats were qualified for use by aviators with nude weights from 136 to 213 lb.

WARNING

Due to NACES ejection seat limitations, any person whose nude body weight is less than 136 lb. or greater than 213 lb. is subject to increased risk of injury from ejection.

The ejection seat catapult was designed for the qualified weight range only. Ejection seat stability is directly related to occupant restraint. All occupants should be properly restrained in the seat by the torso harness for optimum performance and minimum injury risk. Inertial reel performance may be degraded for occupants outside of the certified weight range.

8.3.6.2 AIRSPEED DURING EJECTION

[ ] Optimum speed for ejection 250KCAS and below

Between 250 and 600 KCAS, appreciable forces are exerted on the body, making ejection more hazardous. Above 600 KCAS, excessive forces are exerted on the body making ejection extremely hazardous. When possible slow the aircraft before ejection to reduce the forces on the body.

WARNING

Never actuate the manual override handle inflight, as ejection would then be impossible and the aircrew would be unrestrained during landing. When the manual override handle is actuated, the ejection seat SAFE/ARMED handle is rotated to the SAFE position, the aircrew is released from the sea, and the harness cannot be reconnected.

8.3.6.3 EJECTION PREPARATION AND INITIATION

WARNING

In order to initiate an ejection the SAFE/ARMED handle MUST be in the ARMED position. Ejection sequence will not initiate with handle in SAFE.

IMMIDIATE EJECTION –

[ ] Position body properly against seat

[ ] Pull ejection handle sharply up and towards abdomen to eject

CONTROLLED EJECTION –

IF time and conditions permit

[ ] Alert Crewmember (F/A-18F only)

[ ] Trade airspeed for altitude (zoom)

[ ] Level wings and minimize rate of decent	
[ ] IFF squawk	
[ ] Follow radio distress procedures	
[ ] Stow loose equipment	
[ ] Cabin pressure switch	**RAM/DUMP**
[ ] Shoulder harness lock lever	**LOCKED**
[ ] Lap belt and shoulder harness	**TIGHT**
[ ] Visor	**DN**
[ ] Helmet	**SECURED**
[ ] Oxygen Mask	**TIGHT**
[ ] Altimeter/Altitude	**CHECK**
[ ] Slow aircraft as much as possible	
[ ] Position body properly against seat	
[ ] Pull ejection handle sharply up and towards abdomen to eject	

8.3.7 IMMEDIATE ACTION

This section contains only immediate action items. It is intended for review only and does not contain any steps which are not immediate action nor does it contain notes, cautions, warnings, or explanatory matter associated with particular procedures.

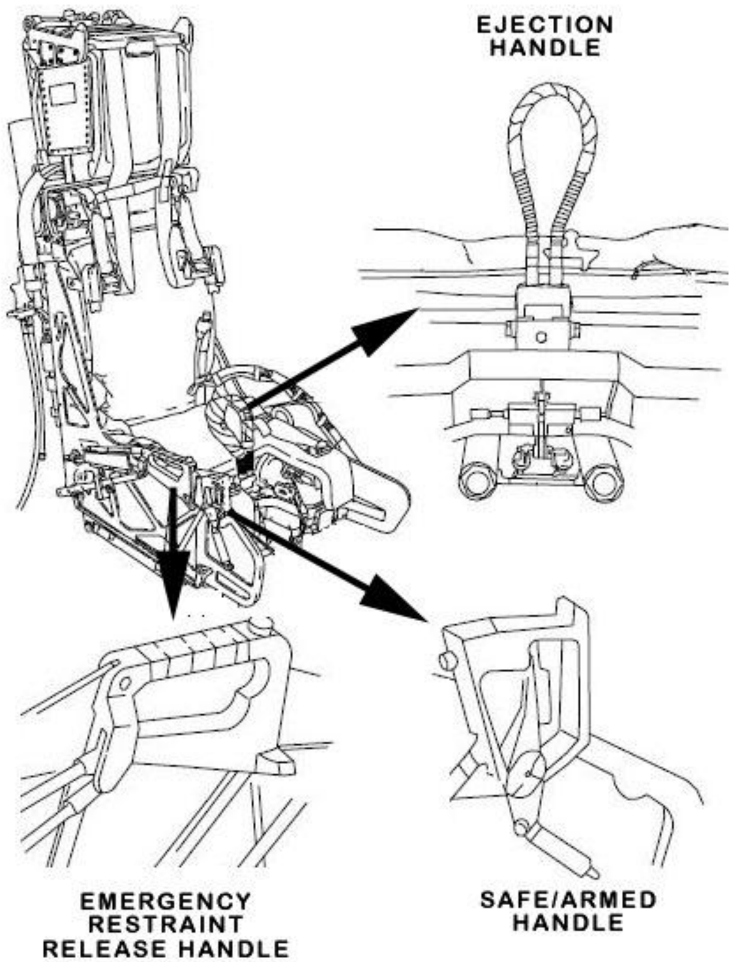
8.3.7.1 APU FIRE LIGHT

In flight or on ground –

[ ] APU FIRE light	**PUSH**
[ ] APU switch	**CONFIRM OFF**
[ ] FIRE EXTGH DISCH light	**PUSH (READY LAMP LIT)**

On ground –

[ ] Throttles	**OFF**
[ ] Egress	



8.3.7.2 HOT START

If EGT climbs rapidly thru 750° C –

[ ] Throttle affected engine OFF

8.3.7.3 ENGINE CAUTIONS

L or R EGT HIGH, L or R ENG VIB, L or R FLAMEOUT, L or R OIL HOT, L or R OIL PR, and L or R OVERPD –

[ ] Throttle affected engine IDLE

8.3.7.4 (L/R) FIRE LIGHT

GROUND –

[ ] Throttles OFF

[ ] FIRE light affected engine	**PUSH**
[ ] FIRE EXTGH DISCH light	**PUSH (READY LAMP LIT)**
[ ] BATT switch	**OFF**
[ ] Egress	

ON TAKEOFF –

[ ] ABORT or execute Emergency Takeoff Procedure

INFLIGHT –

Dual FIRE lights –

[ ] Throttles	**Minimum practical for flight**

Single FIRE light or Dual when side confirmed –

[ ] Throttle affected engine	**OFF**
[ ] FIRE light affected engine	**PUSH**
[ ] FIRE EXTGH DISCH light	**PUSH**
[ ] HOOK handle	**DN**

8.3.7.5 LOSS OF THRUST ON TAKEOFF

[ ] ABORT or execute Emergency Takeoff Procedure

8.3.7.6 ABORT

[ ] Throttles	**IDLE**
[ ] Brakes	**APPLY**
[ ] Stick	**AFT (if required)**
[ ] HOOK handle	**DN (if required)**

8.3.7.7 EMERGENCY TAKEOFF

[ ] Throttles	**MIL (MAX if requred)**
[ ] Maintain on-speed AOA and balanced flight	
[ ] EMERG JETT button	**PUSH (if required)**

8.3.7.8 LOSS OF DIRECTIONAL CONTROL DURING TAKEOFF/ LANDING

If decision to takeoff is made –

[ ] Execute Emergency Takeoff Procedure

If decision to stop is made –

[ ] Throttles	**IDLE**

If NWS failure is suspected –

[ ] Paddle switch	**PRESS**

If directional control problem remains –

[ ] NWS	**ENGAGE**
[ ] EMERG BRK handle	**PULL**
[ ] Use judicious braking on appropriate side	
[ ] HOOK handle	**DN (if required)**

8.3.7.9 EMERGENCY CATAPULT FLYAWAY

If flyaway airspeed available –

[ ] Throttles	**MAX**
[ ] Rudder pedal	**FULL AGAINST YAW/ROLL**
[ ] EMERG JETT button	**PUSH**

[ ] Maintain 10 to 12° pitch attitude with waterline symbol. Do not exceed 14° AOA (AOA tone). Do not exceed ½ lateral stick.

If uncontrollable or settle not stopped –

[ ] EJECT

If controllable and settle stopped –

[ ] Accelerate to on-speed (8.1°) AOA for climb

8.3.7.10 FCS CAUTION OR FCES CAUTION LIGHT

[ ] Cease maneuvering

8.3.7.11 L or R FUEL INLT CAUTION

[ ] Throttle affected engine	**OFF**
[ ] FIRE light affected engine	**PUSH**

8.3.7.12 HYD 1 (2) HOT CAUTION

[ ] Throttle affected engine	**OFF**

8.3.7.13 DUAL L BLEED and R BLEED Warning Lights

[ ] BLEED AIR knob **OFF (do not cycle)**

If light(s) still on –

[ ] Throttles **Minimum for practical flight**

8.3.7.14 SINGLE L BLEED or R BLEED Warning Light

[ ] BLEED AIR knob affected engine **OFF (do not cycle)**

If light still on, do the following in order until the light goes out –

[ ] Throttle affected engine **IDLE**

[ ] Throttle affected engine **OFF**

[ ] BLEED AIR knob **OFF (do not cycle)**

8.3.7.15 OCF ECOVERY PROCEDURES

[ ] Controls **RELEASE, SPEEDBRAKE IN**

If still out of control –

[ ] Throttles **IDLE**

[ ] Altitude, AOA, airspeed, and yaw rate **CHECK**

If command arrow present –

[ ] Lateral stick **FULL INTO ARROW**

When command arrow removed –

[ ] Lateral stick **SMOOTHLY NEUTRAL**

When side forces subsided, and airspeed accelerating above 180 KCAS –

[ ] Recover

Passing 6,000 ft AGL, dive recovery not initiated –

[ ] EJECT

8.3.7.16 SINGLE ENGINE FAILURE IN LANDING CONFIGURATION

[ ] Throttles **MIL(MAX if required)**

[ ] Maintain on-speed AOA and balanced flight

[ ] FLAP switch HALF

9 GLOSSARY

A

A/A	air-to-air
AACQ	automatic acquisition mode
AB	afterburner
A/C	aircraft
ac	alternating current
ACCUM	accumulator
ACLS	automatic carrier landing system
ACM	air combat maneuvering
ADB	aircraft discrepancy book
ADF	automatic direction finding
ADIZ	air defense identification zone
ADV	advisory
AFCS	automatic flight control system
A/G	air-to-ground
AGI	armament gas ingestion
AGL	above ground level
AIL	aileron
AIM	air intercept missile
AINS	aided INS
ALDDI	aft left digital display indicator
ALR-67	radar warning receiver
ALT	altitude
AMAD	airframe mounted accessory drive
AMPCD	aft multi-purpose color display
AMU	advanced memory unit
AN/ALE-47	countermeasures dispensing set
AN/APN-194	radar altimeter set
AN/ASN-139	internal navigation system
AOA	angle of attack
AOB	angle of bank
AB LIM	afterburner limiting
A/P	autopilot
APU	auxiliary power unit
AQ	align quality

ARDDI	aft right digital display indicator
ARS	air refueling store
ASL	azimuth steering line
ASRM	automatic spin recovery mode
ATARS	advanced tactical air reconnaissance system
ATC	automatic throttle control
ATS	air turbine starter
ATSCV	air turbine starter control valve
ATTH	attitude hold
AUFCD	aft upfront control display
AUG	augment
AUR	aural
AUTO	automatic
AVMUX	avionics multiplex

B

BAC1	bank angle control 1
BALT	barometric altimeter
BCN	beacon
BDA	boom drogue adapter
BIT	built in test
BLD	bleed
BLIM	bank limit
BLIN	BIT logic inspection
BNK	bank
BRG	bearing
BRK	brake
BRT	bright
BST	boresight acquisition mode

C

°C	degrees Celsius
CAS	control augmentation system
CAUT	caution
CB	circuit breaker
CC	control converter
CCW	counterclockwise

CD	countdown
CDP	compressor discharge pressure
C/F	chaff/flare
CFIP	conductive form-in-place
CFIT	controlled flight into terrain
CG	center of gravity
CH or CHAN	channel
CHKLST	checklist
CIT	combined interrogator/transponder
CK	check
CKPT	cockpit
CLR	clear
CMPTR	computer
CNI	communication, navigation, and identification
COMM	communication radio
CONT PVU	continuous precision velocity update
CPL	couple
CPLD	coupled
CPU	central processor unit
CRS	course
CSC	communication system control
CSEL	course select
CSS	control stick steering
CV	carrier
CVRS	cockpit video recording system

D

DBS	doppler beam sharpening
DBFS	dry bay fire suppression
DC	designator controller
dc	direct current
DDI	digital display indicator
DEGD	degraded
DF	direction finding
DISCH	discharge
D/L	data link
DME	distance measuring equipment
DMS	digital map set

DN	down
DSU	data storage unit
DT²	second designated target
DTD	data transfer device
ΔP (Delta P)	hydraulic filter indicator

E

EADI	electronic attitude display indicator
EBB	essential bus backup
ECS	environmental control system
EFD	engine fuel display
EFT	exhaust gas temperature
EMCON	emission control
EMIS	electro-magnetic interference shield
ENG	engine
ENT	enter
EPR	engine pressure ratio
ERF	electronic fill remote
EST	estimated
ET	elapsed time
EXT	external
EXTD	extend

F

ºF	degrees Fahrenheit
FADEC	full authority digital engine control
FCC	flight controls computer
FCCA	flight controls computer A
FCCB	flight controls computer B
FCES	flight control electronic system
FCF	functional checkflight
FCLP	field carrier landing practice
FCS	flight control system
FE	fighter escort configuration
FF	fuel low
FIP	form-in-place
FIRAMS	fight incident recording and monitoring system

FLBIT fuel low BIT
FLIR forward looking infrared
FO foldout
FOD foreign object damage
FOV field of view
FPAH flight path attitude hold
fpm feet per minute
FPT first pilot time
F-QTY fuel quantity
FRS fleet replacement squadron
FSR frequency sensing relay
ft foot, feet
FUS fuselage

G

G or g gravity
GACQ gun acquisition mode
GB gyro bias
GCU generator converter unit
GEN generator
GEN TIE generator tie
G-LIM g-limiter
G-LOC g-induced loss of consciousness
GND ground
GPS global positioning system
GPWS ground proximity warning system
GRCV guard receive
GW gross weight
GXMT guard transmit

H

HDG heading
HDG/SLV heading slaved
HI high
HMD helmet mounted display
HOBS high off-boresight
HOTAS hands on throttle and stick

HQ	have quick
HRC	helmet release connector
HSEL	heading select
HSI	horizontal situation indicator
HSIB	high speed interface bus
HUD	head-up-display
HYD	hydraulic, hydraulic system
HYD^{1}	hydraulic system 1
HYD^{2}	hydraulic system 2

I

IAF	initial approach fix
IBIT	initiated built in test
ICLS	instrument carrier landing system
ICS	intercockpit communication system
ID	identification
IDECM	integrated defensive electronic countermeasures
IFA	inflight alignment
IFF	identification friend or foe
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
IMN	indicated mach number
IMU	inertial measurement unit
INOP	inoperative
INS	internal navigation system
INST	instrument
INU	internal navigation unit
INV	invalid
IP	instructor pilot
I/P (IDENT)	identification of position
IR	infrared
IRC	in-line release connector
ISOL	isolated
IWSO	instructor WSO

J

JETT	jettison

K

KCAS	knots calibrated airspeed
kt	knots
KTAS	knots true airspeed

L

L	left
lb(s)	pound(s)
L **ACC**	lateral accelerometer
L&S	launch and steering target
L**B**A	limit basic aircraft
L BAR	launch bar
LCS	liquid cooling system
LDC	left designator controller
LDDI	left digital display indicator
LDG	landing
LED	leading edge down
LEF	leading edge flaps
LEU	leading edge up
LEX	leading edge extension
LG	landing gear
LI	left inboard
LM	left midboard
LO	left outboard
LO	low
LON	limit of NATOPS
LPU	life preserver unit
LTOD	local time of day

M

MAC	mean aerodynamic chord
MAD	magnetic azimuth detector
MAX	maximum afterburner thrust

MC	mission computer
MC^1	mission computer one
MC^2	mission computer two
MER	multiple ejector rack
MFS	multifunction switch
MIL	military thrust
min	minimum, minutes
MMP	maintenance monitor panel
MNTCD	maintenance card
MPCD	multipurpose color display
MSL	mean sea level
MSNCD	mission card
MSRM	manual spin recovery mode
MTRS or **m**	meters
MU	memory unit
MUMI	memory unit mission initialization
MUX	multiplex bus
MVAR	magnetic variation

N

N^1	fan rpm
N^2	compressor rpm
N ACC	normal accelerometer
NACES	navy aircrew common ejection seat
NATOPS	naval air training and operations procedures standardization
NAV	navigation
ND	nose down
nm	nautical miles
NORM	normal
NOTAMS	notice(s) to airmen
NOZ	nozzle
NU	nose up
NVD	night vision devices
NVIS	night vision imaging system
NWS	nosewheel steering
Nz REF	reference load factor

O

OAP	offset aim point
OAT	outside air temperature
OBOGS	onboard oxygen generating system
OFP	operational flight program
ORIDE	override guide
OVFLY	overfly
OVRSPD	overspeed
OXY	oxygen

P

PA	powered approach
PBIT	periodic BIT
P CAS	pitch control augmentation system
PCL	pocket checklist
PIO	pilot induced oscillation
PLF	parachute landing fall
PMG	permanent magnet generator
PNL	panel
POS	position
pph	pounds per hour
ppm	pounds per minute
PR	pressure
PROC	processor
PROM	programmable read only **memory**
psi	pounds per square inch
PTS	power transmission shaft
PTS	pressure transmitter set

Q

QDC	quick disconnect connector
QTY	quantity

R

RALT	radar altimeter
RAM	radar absorbing material

RAT	ram air turbine
RATS	reduced authority thrust system
R **CAS**	roll control augmentation system
RCDR	recorder
RCS	radar cross section
RCVY	recovery
RDC	right designator controller
RDDI	right digital display indicator
RDR	radar
REC	radar elevation control
REC	record or receive
RECCE	reconnaissance
REJ	reject
RI	right inboard
RLG	right laser gyro
R-LIM	roll rate limiter
RM	right midboard
RNG	range
RO	right outboard
ROE	rules of engagement
ROMA	removable optics module **assembly**
RP	replacement pilot
rpm	revolutions per minute
RSET	reset
RSRI	rolling-surface-to-rudder- interconnect
R/T	receive/transmit
RUD	rudder
RWR	radar warning receiver
RWSO	replacement WSO

S

SCT	special crew time
SDC	signal data computer
SEAWARS	seawater parachute release mechanism
SEQ	sequence
SIF	selective identification feature
SMS	stores management set
SOP	standard operating procedure

SPD	speed
SPD BRK	speedbrake
SPN	spin
SRM	spin recovery mode
STAB	stabilator
STBY	standby
STD HDG	stored heading
STT	single target track
SUPT	support
S/W	software
SW	switch

T

T1	engine inlet temperature
TAC	tactical
TAMMAC	tactical aircraft moving map capability
TAS	true air speed
TCN or **TACAN**	tactical air navigation
TCV	thermal control valve
TDC	throttle designator controller
TDP	turbine discharge pressure
TED	trailing edge down
TEF	trailing edge flaps
TEU	trailing edge up
TEMP	temperature
T&G	touch and go
THA	throttle handle angle
TK PRESS	fuel tank pressure
T/O	takeoff
TOT	time on target
TR	transformer rectifier
TTG	time to go

U

UA	up-AUTO
UFCD	upfront control display
UHF	ultra high frequency

UNLK unlock
UPDT update
UTM universal transverse mercator

V

vac volts alternating current
VACQ vertical acquisition mode
vdc volts direct current
VEL velocity
VER vertical ejector rack
VFR visual flight rules
VHF very high frequency
VIB vibration
VMC visual meteorological conditions
VOL volume
VTR video tape recorder
VVSLV velocity vector slave

W

WACQ wide acquisition mode
W DIR wind direction
W SPD wind speed
WARN warning
WDSHLD windshield
WonW weight on wheels
WoffW weight off wheels
WSO weapon system officer
WYPT waypoint

X

XFER transfer

Y

Y CAS yaw control augmentation system
yd yards

Z

ZTOD zulu time of day