FALCON 4.0
BMS v 2.0

Manual

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FEATURE OVERVIEW

1.1 GRAPHICS ENGINE

New features include: D3D-compliant hardware and software TNL (transform and lighting), Z-Buffering, DXTn compressed texture support, light scattering, terrain vertex lighting, volumetric vertex fog, highly detailed 3D cumulus, cirrus, stratus, and overcast clouds, cloud shadows, heavy cloud transitions, lightning, rain, and an all-new particle system for high quality FX.

NOTE:

Due to fundamental changes in the weather engine, bad weather is undergoing a complete rewrite and is not yet fully implemented, and has therefore been disabled from the UI.

1.2 PERFORMANCE ENHANCEMENTS

Optimized graphics and sim performance is one of the highlights of F4-BMS 2.0. The infamous “Falcon stutters“, especially in feature-rich areas, and over the FLOT, are a thing of the past. Coupled with the offloading of graphical chores from the CPU to the GPU (video card), and SSE optimizations throughout the executable, Falcon 4 is no longer the performance dog it once was.

NOTE:

One remaining campaign pause (rare 1-2 second stutter) has eluded us so far and is currently under investigation.

1.3 ARTIFICIAL INTELLIGENCE

Various additions and bug fixes have been introduced, such as more realistic helicopter operations, improved BVR logic, individual aircraft attack speeds, and the ability to customize Air-To-Ground attack altitudes.

1.4 AVIONICS

Avionics upgrades and bug fixes constitute a significant portion of this update. Much time and effort has gone into refining many areas in the avionics department. This includes a massive Auto-Pilot overhaul, HUD enhancements and weapons employment.

1.5 SOUND ENGINE

The Falcon 4 sound engine now features doppler and distance effects, improved engine effects, and general positional sound improvements. Users may now customize their sounds more than ever via the f4sndtable.txt file, and control the properties of all sounds in any way they so choose.

1.6 2D / 3D COCKPIT

Automatic 2D cockpit resizing, a clickable 3D pit, and a host of other enhancements.

1.7 INTERACTIVE TRAINING

Interactive training missions can now be written, which can teach the user hands on how do fly the aircraft.

1.8 INPUT DEVICES

Falcon 4 now has fully native TrackIR support and a new mouselook mode. The controller polling routines have been substantially rewritten, now allowing the simultaneous use of up to 16 devices for up to 23 in-game axis.

1.9 COCKPIT BUILDING

Much work has gone into adding support for those who build their own physical cockpits. Endless callbacks and exports have been made, as well as a key file with every function and every state available in Falcon 4. This should make the cockpit builder's life much easier.

2 INSTALLATION

2.1 GENERAL INSTALLATION

The instructions provided below do not cover the installation of patches from the F4UT or FreeFalcon groups. BMS 2.0 requires Falcon SP3, SP4, or FreeFalcon 2 or FreeFalcon 3.

2.1.1.1 Back up your log book (callsign.lbk) (and any other files you may wish to retain, but NOT callsign.pop, or display.dsp!).

2.1.1.2 Install a fresh copy of Falcon 4 from your CD, followed by the 1.08US patch, then either SP3/SP4, or SP3+FreeFalcon2. Install any additional cockpit, skins, terrain tiles, or models before installing F4-BMS.

DO NOT INSTALL ANY NEW THEATERS AT THIS POINT IN TIME.

2.1.1.3 Run the F4-BMS 2.0 installer and install the patch. Following file extraction, two tools will automatically run: **LxFixer** and **TexCompress**. Do not interrupt them, they will automatically close upon completion and are vital to a successful install. Finally, the installer will launch the F4-BMS Config Editor program.

NOTE:

With the exception of 2D cockpit textures, F4-BMS no longer supports paletted textures (BMP object textures or PCX terrain tiles) in-sim. However, compatibility with all existing skin addons and terrain tiles is guaranteed with the new TexCompress and SeasonSwitcher tools.

The **TexCompress** and **SeasonSwitcher** tools replace the in-game texture compression features found in F4-BMS 1.03. **TexCompress** extracts and converts Falcon's paletted BMP textures to compressed DXTn DDS textures, and need only be used with first-time installs, or **after** adding BMP textures via F4Patch or LOD Editor. **SeasonSwitcher** offers the ability to extract terrain tiles, applying one of 4 seasons. To switch to a different season, or after installing new tiles, you must re-run **SeasonSwitcher** to compress the paletted PCX terrain tiles (texture.zip).

2.1.1.4 In the Editor, tick the "(SP) Falcon Configuration" check-box and hit "Apply". Now is a good time to go through the sub-patches and apply the options you want as there are many that are not applied by default. After checking the boxes you want, hit “Apply“ again, and close the program.

2.1.1.5 Double-click on the F4-BMS shortcut, located on your desktop, to launch F4-BMS. Once in-sim, create a new pilot, then configure your Graphics, Sound, Sim, and Input settings. Be sure to click both "Advanced" buttons in both the Graphics tab and the Controllers tab.

NOTE:

When making changes to any of the advanced Graphics options, or when changing video card and/or driver, you must restart Falcon for the changes to take effect.

2.1.1.6 Quit F4-BMS, then copy your previously saved log book (**callsign.lbk**) over to the **[FalconRoot]\config** directory.

NOTE:

TE´s and campaigns created or saved with BMS 2.0 are **NOT** compatible with any previous versions of Falcon 4. Furthermore, TE’s and campaigns created or saved with any prior version of BMS are **NOT** compatible with BMS 2.0.

2.2 THE F4-BMS CONFIG EDITOR

At this point in time, you may wish to further tailor the configuration options located in the BMS Config Editor. The following table offers descriptions and recommended settings for each configuration option in the “Settings Benchmark Sims” tree.

Table 3.2

Patch	Recommendation	Remarks
3D Clickable Cockpit	Optional	Enables the 3d Clickable Cockpit.
Aeyes DED Font Spacing Fix	Optional	Fixes issues with Aeyes 1600x1200 DED font spacing.
Any Waypoint Tasking	Optional	Select any tasking order for any waypoint, regardless of mission. For advanced users only.
Auto Scale Fonts	Optional	Automatically scales cockpit fonts one step at 1600.

Cockpit Auto Scaling	Optional	Scales various resolutions of cockpits, from one resolution to the next.
DSB1 Scan Rate Factor	Enabled (.75)	Determines how fast the DSB1 Radar image is drawn.
DSB2 Scan Rate Factor	Enabled (.85)	Determines how fast the DSB2 Radar image is drawn.
Disable High Altitude Fartiles	Optional	Never let the fartiles kick in at high altitudes.
Disable ACMI RECORDING Message	Optional	Turns off the ACMI RECORDING message shown at the top of the screen.
Disable Lens Flare	Optional	Disables the sun lens flare effect.
Disable Missile Flame	Optional	Turns off the star displayed with missile flames.
Disable UI Takeoff Sound	Optional	Disables the UI takeoff sound effect. Helpful for Multiplayer.
DisplacementCam	Optional	Activating this option makes the camera 'float' around the currently viewed (flying) aircraft while in orbit view mode.
Doppler Sound Update	Enabled (10)	How many milliseconds must elapse before the sound code updates.
Enable FCC SubNav Cycle	Optional	Enables cycling Nav steerpoint modes with the FCC submodes key.
Dynamic Roll Inertia	Optional	The roll inertia will now increase when you add stores to your aircraft. It is dynamic in that will account for fuel weight in wing tanks and when you drop weapons.
Enable Hud AOA Indicator	Optional	Enables the HUD AoA indicator for NON F-16 jets only.
FOV Increment	Enabled (05)	Set how much the field of view should change for each keypress in degrees.
Force Feedback Centering Fix	Enabled	Fixes centering for some force feedback joysticks.
GR Bullseye	Optional	Enables Bullseye cursor in Ground Radar modes.

Cursor		
HTML Briefings	Optional	Generates Briefings using HTML tags.
HUD Fixes	Enabled	Enables bent negative pitch ladder, extended horizon line, ghost horizon line and X'd out FPM and STPT boxes.
Large Strike Packages	Enabled	Allows for campaign to generate > 4 ship strike packages.
Maverick EXP Zoom	Enabled (2.0)	Controls the amount of zoom of the EXP modes on the Maverick.
Maverick FOV Zoom	Enabled (4)	Controls the amount of zoom of FOV mode on the Maverick
Maximum Cockpit FOV	Enabled (80)	Limits the maximum amount that the FOV can be increased.
Maximum Number of Voices	Optional	Maximum number of voices allocated by the sound code.
MultiEngine Sound	Optional	For aircraft with 3 or 4 engines, Falcon will play a sound for each engine, at the location of the engine (as specified by the dat file).
Precision Waypoints	Enabled	Fixes the “grid snap bug” when placing waypoints in 2d and via the ICP DEST.
Radio Subtitles Display Time	Optional	Governs the time a radio subtitle is drawn. This value (in the FalconBMS.cfg) is in milliseconds. If this value is too large, newer messages may not be displayed (in time).
Radio Subtitles Maximum Displayed Number	Optional	Determines the maximum number of simultanously displayed subtitles. If this number is too short, newer messages may not be displayed.
Realistic Mav Time	Enabled	Enables realistic Maverick seeker head gyro spool up time of 3 minutes.
Recon Lat/Long	Enabled	Shows the selected object’s Lat/Long in the Recon Window.
Roll-Linked NWS Rudder	Optional	Controls whether the rudder and NWS are linked to the roll input on the ground when you don't have a rudder control device.

Scramble Missions	Enabled	Enables scramble missions.
Smaller Bullseye	Optional	Scales the bullseye icon to a more realistic size. May be too small for lower resolutions.
Smaller HSD Symbols	Optional	Scales the waypoint symbols on the HSD display down to more realistic sizes. May be too small for lower resolutions.
Tex Detail Factor	Optional	Use higher resolution textures at higher altitudes.
TrackIR Pitch Percentage	Optional	Configures the up/down zones for TrackIR 2D mode.
TrackIR Sample Frequency	Optional	Configures the rate of view changes while in the 2D cockpit
TrackIR Yaw Percentage	Optional	Configures the left/right zones for TrackIR 2D mode.
Winamp	Optional	Activating this option enables WinAmp 2.xx control from inside falcon.
WinAmp Volume	Optional	Configures the inital WinAmp volume on starting up Falcon.

2.3 THEATER INSTALLATION

NOTE: All theaters released prior to F4-BMS 2.0 are not officially supported, you are on your own! That said, here is some advice to get you started:

- Install F4-BMS 2.0 per above instructions.
- Install the theater.
- It is important to note here that a proper theater installation program should copy the necessary files it needs into its own theater directory. Also, the **<theater>.tdf** and **<theater>.tga** files are copied into the **[FalconRoot]\terrdata\theaterdefinition** folder. The main benefit of this is that multiple theaters can be installed, without affecting your current BMS installation.
- Copy and paste the **[FalconRoot]\terrdata\weather** folder into the theater's **terrdata** folder. If you do not perform this step, the theater will CTD.
- **After** switching to the new theater in-game, you will need to compress textures via the **[FalconRoot]\TexCompress.exe** and **SeasonSwitcher.exe** tools.

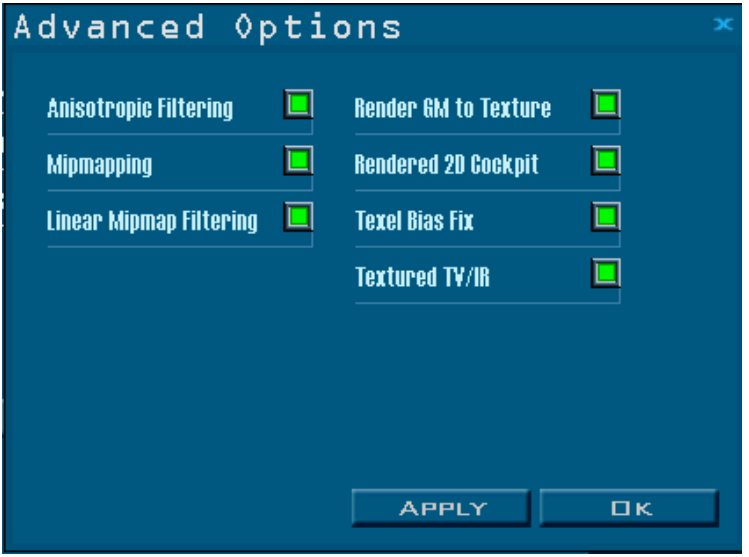
NOTE: Some theaters have their own **objects**, **art**, and **art1024** and **sounds** folders. Almost all theaters copy from existing Falcon 4 folders, then modify those, One possible exception to this is the ODS 512 theater.

3 CONFIGURATION

3.1 GRAPHICS SETUP

New options include the “3D Clouds“, “Cloud Shadows”, and “Terrain Lighting“ check boxes. The “3D Clouds“ option toggles the display of cumulus clouds, which could be a performance killer on older video cards. The “Cloud Shadows” option toggles cumulus shadows, while the “Terrain Lighting” option toggles terrain vertex lighting. These last two options may affect performance on slower processors. Finally, some old, obsolete options were removed as they are no longer used by the graphics engine.

3.2 ADVANCED GRAPHICS SETUP



Anisotropic Filtering: This enables Anisotropic texture filtering. Falcon 4 does **NOT** support forcing anisotropic filtering through video card drivers. Doing this will cause visual anomalies, such as blue outlines around cockpit parts. Therefore, your video card anisotropic settings **MUST** be set to "Application Preference."

Mipmapping: This option enables mipmapping of object textures. Enabling this will reduce texture shimmering and swimming, at the price of consuming more video memory.

Linear Mipmap Filtering: When used in conjunction with mipmapping, this option enables tri-linear filtering. However, some older video cards may suffer from a performance hit.

Render GM To Texture: With this option enabled, the GM radar will be rendered to a texture, providing a significant performance gain on most video cards.

Rendered 2D Cockpit: Enabling this will force the 2D cockpit to be rendered as polygons, instead of being "blitted" to the back-buffer, resulting in substantial performance gains.

Texel Bias Fix: Enabling this option fixes text corruption and 2D cockpit "cracking" on most modern video cards. Older video cards may need this disabled.

Textured TV/IR: Enabling this option will force all TV/IR displays to display fully textured objects and terrain.

3.3 SIMULATION SETUP

Display Infobar: Activating this option will display additional information about the currently viewed object at the bottom of the screen. This feature can also be toggled by the "ToggleInfoBar" keypress (which is not mapped by default) while in 3D. Neither color nor type of information displayed can be customized. GS refers to 'Ground Speed' while IAS is an acronym for 'Indicated Air Speed'. This feature only works while in external views.

Radio Subtitles: By activating this feature it is now possible to display the radio messages heard in the falcon universe. This feature is exclusively activated/deactivated in the configuration screen, however it can be momentarily toggled by mapping and pressing the "ToggleSubTitles" key. This key is not mapped by default. In the standard configuration, a message will be displayed for 10 seconds, and up to 10 messages will be displayed at the same time. As more messages are displayed, the more recent ones are added at the bottom of the display and move their way up as the older messages get removed. You can configure both the 'time to live' (TTL) and the maximum number of displayed messages by editing the "g_nSubTitleTTL" and "g_nNumberOfSubTitles" options in the falconbms.cfg file. The time values for the ""g_nSubTitleTTL" option are in milliseconds.

Messages are displayed in different colours, which indicate the radio channel where they originated from. The colours are as follows:

green for the "To/From flight" channels

red for the "To package" channels

yellow for the "To/From package" channels

blue for the guard (or 'team') channel

cyan for the proximity channel

dark grey for the 'broadcast' channel

black for the "To/From tower" channel

white for some other (unspecified) messages

It is possible by changing the colours by using these falconbms.cfg lines

- g_sRadioflightCol
- g_sRadiotoPackageCol
- g_sRadioToFromPackageCol
- g_sRadioTeamCol
- g_sRadioProximityCol
- g_sRadioWorldCol
- g_sRadioTowerCol
- g_sRadioStandardCol

The color has to be entered as string and in hex format, where the first byte indicates the alpha, the second byte the blue colour component, the third byte the green colour component and the last byte the red colour component. So if you wanted to set the 'flight' channel to blue you would enter 'set g_sRadioflightCol "0xFFFF0000"', if you wanted the team channel set to read, you would enter 'set g_sRadioTeamCol "0xFF0000FF"'.

Please note also that in the falcon universe way more messages are created than are actually played (as falcon plays radio messages in succession), so you may not hear all displayed messages. Please also note that sometimes audible messages 'lag' behind the displayed ones, this is again caused by the way radio messages are played.

The radio frags are located in the 'F4Talk95v1-0-0.csv' file located in your Falcon4 main directory. This came from Codec´s 'Talkview' program (which still can be gotten from the checksix file archive) so big cheers are in order for Codec and the F4 voice group who typed them up. Thanks !

You can change this file, but please take care to keep the current formatting, be especially careful not to add any newlines ! (or rather, any new frags at all). Should you mess something up, Falcon may not be able to read the .csv file any more, which would result in a deactivated subtitle option.

3.4 SOUND SETUP

New Engine Sounds: This enables a new method of playing engine sounds. The biggest difference between this method and the old, is that there is no longer an "After Burner" sound; instead, as power increases, you get an increasing roar.

Enable Doppler Effect: This enables a new method of playing engine sounds. The biggest difference between this method and the old, is that the doppler effect changes the pitch of sounds depending on the movements of the listener and the object creating the sound.

Enable Distance Effect: This attempts to simulate distance between the listener and the object emitting sound. Sounds will have to travel to the listener to be heard. This is characterized by a “pause” between when an event, such as an explosion occurs, and when it is actually heard. For fast moving objects such as aircraft, sound will appear to come from a distance behind, depending on the speed of the object, and the distance between the object and listener.

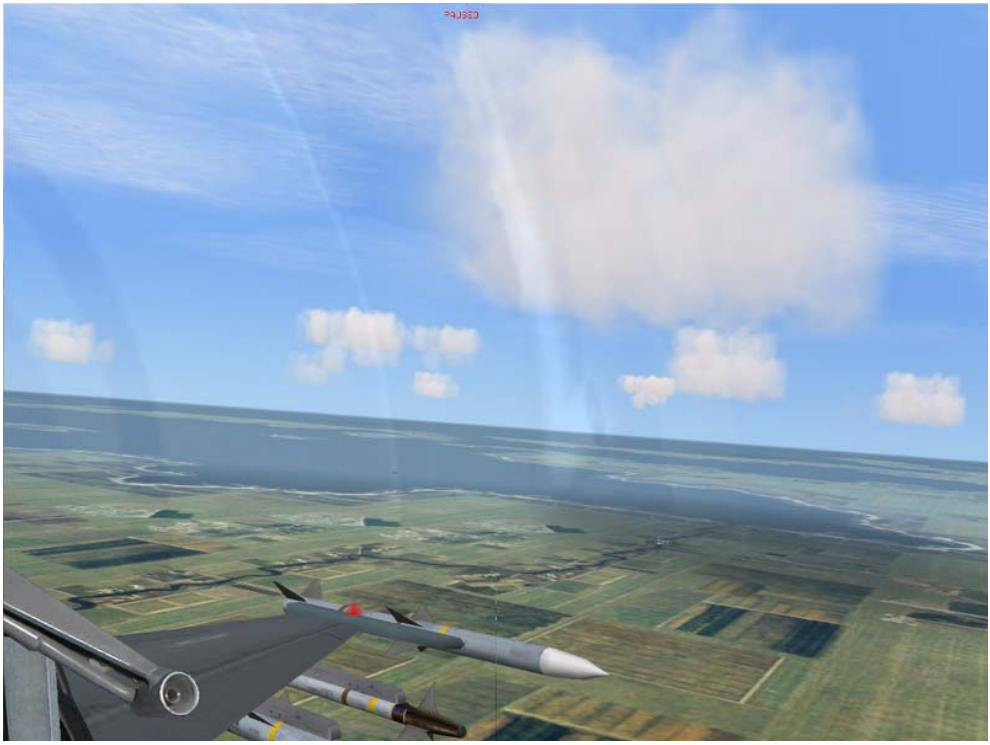
Internal Sounds Outside Cockpit: This enables or disables playing Betty sounds while in external views.

External Sound Slider: While in-cockpit, and with the canopy closed, this slider will lower or boost the volume of external sounds. This adjustment is added to the aircrafts default value for

lowering external sounds Slider ranges: Full Left: Practically silences all external sounds; Center: No extra effect; Full Right: Boosts (when possible) external sounds.

Refer to the Appendices for Sound Table information.

4 WEATHER



4.1 INTRODUCTION

BMS 2.0 features a physically-based weather engine, including real-time light scattering, terrain vertex lighting, volumetric vertex fog, highly detailed 3D cumulus, cirrus, stratus, overcast clouds, cloud shadows, heavy cloud transitions, lightning, and rain.

4.2 DYNAMIC WEATHER

The weather in Falcon 4 is now dynamic. When starting a new campaign, or entering a TE, IA, or DF scenario, a random weather condition will be generated, along with all relevant atmospheric conditions. The weather will gradually change over time, a maximum of once per day. After saving a campaign, the current weather at that point in time will also be saved. The current weather at any point in time may be overriden by selecting one of 4 pre-set conditions in the Graphics Setup tab.

NOTE:

The MP (Multiplayer) weather implementation has undergone extensive changes. Unfortunately, this means that BMS is no longer compatible with the SP3 executable. Furthermore, TE´s and campaigns created or saved with BMS 2.0 are **NOT** compatible with any previous version of Falcon 4.

4.3 TURBULENCE

The virtual universe just became more dynamic. BMS 2.0 introduces a sophisticated turbulence model that takes into account a wide variety of conditions. A player will experience different turbulence intensities and durations depending on weather conditions, time of day, altitude, vicinity to clouds, and terrain. Also modeled is tropopause boundary turbulence (35k-36k altitude).

5 ARTIFICIAL INTELLIGENCE

- If placed at an airbase, helos will spawn on the ground and wait until their takeoff time before taking off. Helo formation and altitude flying have been adjusted as well. When the mission is over, helos will return to the base and land (no more #1 landing while the rest stay stuck at 500 feet).
- Helicopter AI will now fire Hellfires at the correct stand-off distance.
- BARCAP station area increased to 50NM. Please note that you must request and receive permission from AWACS to leave your station area for the mission to be a success. According to MPS standards, you must remain in station area (now 50NM), complete station time, and ask permission to leave. If you request relief before station time is completed, AWACS will give permission if you are "Bingo" fuel (that is calculated at internal fuel/3) or if you are out of missiles. If conditions are met, AWACS will grant you permission to leave. If you don't get that permission, don't leave until you do.
- Fixed aircraft flying with flaps down during waypoints. Aircraft will raise flaps > 200 VCAS.
- Aircraft stuttering (0.5 second lurches) with A/G mode is fixed.
- Separate/Bugout: The AI will now no longer endlessly tail-chase an aircraft. The AI will test itself to see if it is tail-chasing and if doing so for a certain period of time, will disengage. Note, if a player attempts to turn back toward a separating bandit, the bandit will reengage the fight.
- Changed certain hard-coded waypoint and attack speeds to reflect individual aircraft capabilities. Previously, Falcon was not taking into account the variety of AI aircraft and flight models. The previous hard-coded values were not appropriate for all aircraft types (like the A-10). The new code now bases certain waypoint and attack speeds on the individual aircraft using a multiple of the cornerspeed setting in the .dat file. This allows the speed range to be tailored for each aircraft (assuming the .dat file corner speed is set correctly).
- The default values (which WERE hardcoded prior to variable export) are:
  - set g_fA2GHarmAlt 0.0f
  - set g_fA2GAGMAlt 4000.0f
  - set g_fA2GGBUAlt 13000.0f
  - set g_fA2GDurandalAlt 250.0f
  - set g_fA2GClusterAlt 5000.0f
  - set g_fA2GGenericBombAlt 11000.0f
  - set g_fA2GGunRocketAlt 7000.0f
  - set g_fA2GCameraAlt 7000.0f

6 AVIONICS

BMS contains a myriad of new avionics enhancements. Some features have been added, while others have been refined. This section explains these new features and what they do.

6.1 DOPPLER BEAM SHARPENING (DBS)

In all previous versions of Falcon 4, the DBS 1 and 2 modes were taking way too long to draw. There are mixed opinions as to what the most suitable setting are, therefore two new configuration variables have been added to the falconbms.cfg:

set g_fDBS1ScanRateFactor 0.25

set g_fDBS2ScanRateFactor 0.05

In addition, the magnification levels were disproportionate to real world magnification levels and did not reflect the area between the tick marks in DSB1. DSB2 used to provide a magnification of 8:1 versus 64:1, this has now been fixed.

6.2 TRACK WHILE SCAN(TWS) / "TWIZ"

Previously, the Target Acquisition Cursor attached itself to targets even with radar lock or designation broken, or gimbal limits exceeded. This has now been fixed.

6.2.1.1 TWS (Track-While-Scan) Radar Sub-mode

The TWS radar mode has undergone a complete overhaul in how it is mechanized. It should operate much more like the real thing than ever before. This includes the number of targets it can track at once (which was previously unlimited), how it builds and maintains track files, how it dumps them and the azimuth and elevation limits of TWS.

6.2.1.2 How to use TWS (Twiz)

To switch to the CRM-TWS (combined radar mode) sub-mode, the pilot may either hit OSB 2 three times or TMS right to switch from CRM-RWS to CRM-TWS. Upon entering TWS, the radar azimuth will initialize to an "A2" or 50 degree azimuth scan (25 degrees on either side of boresight) and the elevation will initialize to a 3-bar "3B" scan.

6.2.1.3 TWS Mechanization

As its name implies, TWS tracks multiple targets while searching for others. It is mechanized to begin forming track files (triangles, or hollow squares with a tic if you're using EPAF radar cues)

automatically from RWS search hits (solid squares) when the radar receives two hits (meaning the radar detects something twice) in 6.5 seconds. The radar is able to track 10 targets simultaneously. Since the radar does not pause on the track files while scanning, the track's positions are extrapolated in between updates (when the radar detects them again). If a target is not updated, i.e., detected in 13 seconds, the radar will dump the track file until the target is detected again upon which it will rebuild it into a track file. A dump could happen for a number of reasons including a target moving out of the radar's current azimuth scan, elevation scan, or both. Also for example, if the pilot is tracking 10 targets and decides to designate on a search target, the radar will dump the lowest priority track and automatically upgrade the search target into a track file. If the radar has not received a hit on a track on its return scan where the track should be (or rather, where the radar thinks it should be based on the target's last heading and speed), the track file will turn from yellow to red to indicate this. When the track is detected again, it will turn back to yellow. If a track is no longer detected, it will turn red like previously mentioned and extrapolate for 13 seconds total. The last 5 seconds before the radar dumps the track, the track will begin to flash. Tracks are prioritized by range and the order in which they were built.

Three scan patterns are available in TWS. They are:

± 60, 2 bar

± 25, 3 bar

± 10, 4 bar

Without a bugged target, the azimuth scan centers on the cursors and elevation is controlled manually. When a target is bugged, the azimuth is biased to keep the bugged target in the scan and the elevation is centered on the bugged target. If the antenna elevation is tilted while the pilot has a bugged target, upon dropping the bug, the elevation scan will move according to what the pilot commanded to reflect the position set by the antenna elevation controls.

There are two ways to bug targets. The pilot may either slew the cursors over to a track file (or a search target) and designate or may TMS-right to bug the closest track file. Further TMS-right's will step the bug to the next highest priority track file. The pilot may enter STT (Single Target Track) by TMS-forward on a bug. This will erase all search targets and tracks from the radar, although the tracks will extrapolate for 13 seconds. If the pilot undesignates (TMS-aft) to return to TWS, the extrapolated tracks will reappear and the target will be bugged. If TMS-aft is commanded again, the pilot will drop the bug and the radar will continue to TWS. If TMS-aft is commanded a third time, the radar will dump all tracks and begin rebuilding tracks automatically. If TMS-aft is commanded a fourth time, the radar will go back into CRM-RWS.

6.3 NON F-16 HUD SYMBOLOGY

For **non-F-16** aircraft, the sim may now be configured to show an AOA indicator that will appear in the HUD. This AOA indicator has the Greek Alpha symbol. Since most aircraft have this, the indicator defaults to on. It may be turned off by setting g_bhudAOA to 0.

set g_bhudAOA 0

Note: This feature is disabled on the F16.

6.4 VOICE MESSAGING SYSTEM (VMS) / BITCHING BETTY

The **VMS - MAL/IND** button now plays all VMS words once while holding the push button (release the button and the litany will stop). Also added a bit to the shared memory to indicate if the Autopilot is engaged or not. Useful for driving the correct sort of magnetically held toggle switch for a physical cockpit MISC panel.

VMS – SOUND: Updated sound code to allow the VMS system to play the test message on the ground, but only if the MAL/IND light is pressed. Code updated to use the proper sample that has Betty say all the words in her vocabulary once each for the test.

6.5 UHF RADIO FIX

UHF panel controls should only affect the COMM1 UHF radio, not VHF COMM2. UHF function knob does nothing now; instead the UHF panel channel controls are activated when the AUX COMM panel CNI switch is in "backup" (per the real jet). The reverse video for transmitting should work properly in all cases now (it used to only get drawn highlighted properly if the UHF radio was displayed in line one of the DED).

6.6 ANTENNA ELEVATION

BMS 1.03 changed the way the antenna elevation tracking works. This was done to fix a bug where the ACQ cursor would occasionally show 0/0 for the altitude limits after an undesignate command in situations where it should not tilt the antenna down. Study of this bug revealed that the game code wasn't managing antenna elevation very well. New code makes the antenna elevation knob the reference value so that for all but STT and TWS (with a bugged target) the antenna elevation is set to whatever the knob position says it should be. This is how it works in the real jet as far as we can tell. This gets rid of the situation where the 0/0 radar elevation limit values were broken so that bug should be gone. It also means that you have a better way to keep track of the antenna elevation position simply by looking at/feeling the knob position. This also makes it easier to sync HOTAS control positions to the game. It also, by the way, means that the knob position can be set independent of the radar mode (if you are in STT and move the knob, when you undesignate, the elevation will revert to wherever you moved the knob to during STT!). Also changed is the way "attach" works for SAM AUTO mode. Now the cursor should attach more readily again but as per a previous fix it will not stay attached if the radar track degrades or is dropped or if you make a 360° turn.

6.7 MAVERICKS

A new variable has been added to allow Mavericks to take 3 minutes for seeker gyro spool up instead of 5 seconds. This reflects real life and thus the “NOT TIMED OUT” message will disappear after 3 minutes and Mavericks will be ready to launch. The default setting is “0”, i.e., OFF.

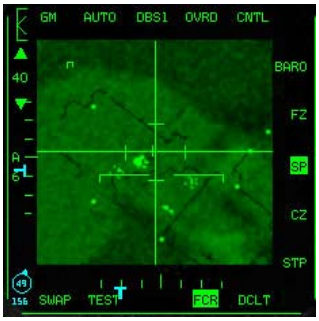
6.8 OTHER FIXES / ENHANCEMENTS

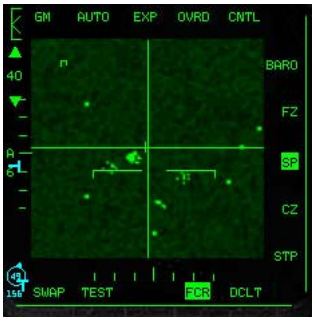
The AA radar bar scan indication has been swapped. Instead of showing “B 4” (vertically) it now says “4 B”. The AG radar SA cue (a “+” sign in EXP/DBS1/2) was previously too large. It is now half the size it was.

The “New Guy” RWR sound (beep beep beep) no longer plays when a new emitter is detected. Instead it now plays a short burst of audio of the target emitter instead of that generic new guy beeping sound. In real life, new guy audio consists of 3 bursts of audio in 1.5 seconds at the PRF (i.e., sound) of the new emitter. This will be adder later on.

TWS cursor attach bug fixed. Cursor will no longer stay attached to targets when radar lock or designate is broken, or gimbal limits have been exceeded.

DBS2 magnification corrected to reflect the area between the tick marks in DBS1 mode. DBS2





now provides greater magnification (64:1 instead of 8:1).

The Maverick seeker Weapon) MFD has been adjusted. The crosshairs have been tweaked, the Field-of-view (FOV) box has been increased to the proper size and the 5°, 10°, and 15° tick marks have been positioned correctly.

Changed the MFD OSB label #3 on the FCR to read "NORM" instead of "NRM".

Changed the heading shown for a bugged target in the MFD to round up or down, i.e., to show 110, 120, 130, etc. instead of 110, 111, 112, etc.

Tweaked the flash rate for the ALOW radar alt and the break-X. They flashed too slow prior to this fix.

Added EXP FOV to RWS.

Air-to-Ground GM SnowPlow mode has received a significant overhaul to be more realistic. The following is a brief description of its changes and how it functions. Pay special attention on how to enable cursor slewing.

Depress OSB 8 next to the SP mnemonic to select the snowplow option. The mnemonic highlights indicating that you are in the SP mode. SP sighting directs each sensor line-of-sight straight ahead in azimuth, disregarding any selected steerpoints. In the GM, GMT, and SEA modes, the ground map cursor will be positioned at half the range selected, i.e., the center of the MFD. The cursors remain at this range while the ground map video moves, or "snowplows," across the MFD. At this point, there is no SOI, and the cursors cannot be slewed. The cursors can be slewed to a target or aimpoint with the CURSOR/ENABLE switch after you ground stabilize them by using TMS forward. TMS forward establishes the radar as the SOI and enables cursor slewing. TMS forward again over a target to command single target track. All cursor slews in SP are zeroed when SP is deselected. After ground stabilizing, the point under the cursors at the time of stabilization effectively becomes your steerpoint. All NAV and weapon delivery steering and symbology, including great circle steering, will be referenced to this "pseudo steerpoint." Displays return to the previously selected sighting point when SP is deselected. For example, SP can be used to accomplish an FCR mark on a point 5 nm in front of your position

when the steerpoint selected is 40 nm away. It may often be used with IR Mavericks where target coordinates are not known in advance. Another application of SP is for weather avoidance (not implemented).

Additionally, the GM range AUTO bumping function is revised in this version. It works more intuitively now with the range bumping up if the cursor is at 95% of the way up the MFD and bumping down if the cursor is at 42.5% of the way up the display or less. Note the bump will only happen if and when the cursor is not being slewed! As a final note, TTG (Time-to-go) has been added to the GM radar scope when you are in STP mode or SP mode with a ground stabilized aim point.

Added the missing BATR (Bullets at Target Range) circle for EEGS. It is a 6-mil circle displayed after the trigger squeeze and the bullet travels the target's range. It disappears after the last bullet passes the target range (well actually it disappears 1 second after the trigger is released--that is good enough for the time being). The BATR is nothing more than a record of where the gun cross has been pointed (corrected for gravity drop). Needs some refinement, but the basic functionality is there.

The EEGS funnel will now disappear when the trigger is pulled and reappear 1 second after trigger release.

"X SRM" or "X MRM", where "X" is the number of missiles for that type, are now drawn in missile override mode (instead of "MSL"). "MSL" is a display thing of BLK 30 F-16s and lower (i.e., mainly older software tapes).

Mach number and max g's windows are now not drawn in the HUD when in Dogfight override.

The "SpeedText" (basically the CAS [i think, but doesn't really matter ;-)] speed required to reach the current steerpoint on time) field is now not drawn in the HUD when in Dogfight override. This was never realistic.

Attack symbology (missile reticles, ASEC, ASC, DLZ, timers, etc) are blanked on the FCR/HUD when the master arm switch is in OFF (i.e., weapons safe).

The bar scans (the number of bars in the scan, rather) was incorrect for both ACM 30x20 and ACM Slewable. 30x20 was corrected from a 5B to a 4B and Slewable was corrected from a 3B to a 4B.

TMS aft is the only switch action that commands a break lock from an ACM track mode.

Added center-point dot to the gun strafe circle.

Adjusted STRAF in-range cue line to work when within 8000 feet (instead of 4000 previously) to accurately reflect in-range cue for GU-28 bullet instead of M56.

Minor fixes to HSD symbology to reflect proper size (0.05 is DEFAULT/OFF and 0.025 is half-size, i.e., ON). We recommend 0.025 for 1600x1200 resolution and 0.035 for 1024x768.

Tweaked ACMI colors/labels a bit to be a little more readable.

Fixed the ACM slewable scan search altitude display numbers to show negative numbers and red when negative. Also fixed the spacing between them so they're not scrunched up together.

Fixed the DLZ in the MFD. It was placed too far low and the Time to Active/Time to Impact numbers were way too low and to the left.

The lower/upper numbers of the cursor altitude coverage show negative numbers and turns them to red when they are negative.

In Freeze mode, a circle with a line sticking out is now displayed, instead of an airplane cross.

ILS Command Steering defaults to being on.

Fixed the HSD bugged target symbol (the]- symbol).

The pre-launch/post-launch missile time prefixes were wrong for the HUD, regarding time-until-active and time-until-impact. Changed the equations to match those of the MFD, which was correct. Small, but important realism bug fixed.

Changed the HTS cursor to be twice as fast.

Removed an unnecessary scaling factor that dealt with drag. Previously stores drag was calculated by DragIndex times (18238 divided by aircraft empty weight). Now the stores drag is just DragIndex.

The AOA Indexer next to the HUD is now operational regardless of the gear being up or down. This is per the F-16 technical order.

Adjusted blackout/greyout numbers per USAF guide on GLOC and pilot's input. This should better simulate a good AGSM and Combat Edge equipment

When Bullseye mode is off, (LIST→0, 8 , then 0 to toggle on and off), the bearing and range from the current INS steerpoint to the radar cursors is drawn in the FCR Bscope and the HSD.

The ACMI recording message, "RECORDING: ++++" that is show at the top of the screen can now be turned off by checking ACMI Record Msg Off (**set g_bACMIRecordMsgOff 1**) in the Config Editor.

Falconbms.cfg variable: set g_fHSDSymbolSize 0.025

The bullseye circle on the HSD and on the radar was too large. Set the value to "1" if you would like a smaller bull's-eye circle (NOT recommended for resolutions below 1280x1024.

Falconbms.cfg variable: set g_bSmallerBullseye 0

Default size:

New size:

The radio channels in Falcon have received a small face-lift. The functionality remains the same, but what is being shown on the DED is now a bit more realistic. “Preset” channels are now displayed instead of the name of the channel function (ie., Tower, Guard, Package1). It is recommended to not use Presets 11 & 12 when using Internal Voice Communications (IVC) for multiplayer voice comms. Use caution when using 15, as it will only work out to approximately 30 nm away from wherever you’re taking off from or if you’re close to an airfield. It was originally designed this way, although not realistic. See the SP3 manual for more information regarding Multiplayer and Internal Voice Comms.

New DED “preset”	Falcon 4 Channel Function
1	Flight1
2	Flight2
3	Flight3
4	Flight4
5	Flight5
6	Package1
7	Package2
8	Package3
9	Package4
10	Package5
11	From Package
12	Proximity
13	Guard
14	Broadcast
15	Tower

6.9 MICRO-MANAGING THE STORES MANAGEMENT SYSTEM

The Stores Management System (SMS) in Falcon has received a complete overhaul. Much of this work will be somewhat transparent to the user, but the improvements are there nonetheless. Many of the improvements have been to make the code more consistent, efficient, cleaner, and more “friendly” in terms of playing nicely with other parts of the Falcon code. The following is what the end-user will see, when comparing to previous versions of BMS and Falcon.

A long-standing problem with Falcon and it’s SMS, was the fact that it was unrealistic in jettison procedures—both selective jettison and emergency jettison. Essentially, when jettisoning stores (weapons), the entire store/pylon assembly was jettisoned from the wings. In reality, the circumstances of what comes off during a jettison greatly depends on what weapon(s) are carried, whether or not the aircraft is carrying racks (launchers) or something like a TER (Triple ejector rack). The basic point is that the wings would essentially be empty of all pylons (excluding

AA missile pylons), when the pylons (and the drag!) are actually bolted to the wings and can't be jettisoned. BMS has rebuilt the SMS code to allow such differences amongst a wide-variety of stores and their individual differences. More information about the BMS rack data and how it's built can found in the Appendices. Since Falcon is primarily an F-16 simulator, BMS focused only on the SMS of the F-16 as well as the BMS rack data file only contains store/rack information for only the F-16.

6.9.1 Selective Jettison (S-J)

The first thing the pilot will notice is some graphical differences. The line box drawn around the store/pylon(s) are gone, and now replaced by inverse labels, upon when a station's store/rack is selected for jettison. The S-J page and the S-J mastermode are selected by depressing OSB 11 adjacent to the S-J label on any SMS page. This will allow the pilot to jettison weapons and racks unarmed or unguided from selected aircraft stations. Only jettisonable stores will be displayed for selection. The pilot presses the OSB adjacent to the station displayed on the S-J page. The selected station's bottom-most store is highlighted on the S-J page, indicating that it is selected. If a jettisonable rack is also loaded, it may also be selected on the second depression of the OSB. A third depression will then deselect all stores on that station. The pilot can preselect a selective jettison configuration while in S-J mastermode, which will be remembered during mastermode transitions. The stores are jettisoned using the pickle button when the Master Arm switch is in ARM. After the stores are released, the highlighted stations are removed from the S-J page and the associated weapon quantity reads zero. The S-J mode also bypasses any other weapons settings.

6.9.2 Using the SMS in Combat

Also related to the SMS, is how it functions in combat. Previously, the SMS did not do a good job at remembering what weapons you called up for a particular mastermode. Now, it should remember the particular weapon type you select. This applies to all the mastermodes—Air-to-Air, Air-to-Ground, NAV, Dogfight, and Missile Override. What this means is the pilot can program the weapons he wants to come up first in a particular mastermode.

6.9.3 Remechanization – Hands-On Missile Select

Depress and Release (D&R) of the Missile Step switch on the sidestick controller provides hands-on selection of a stores station. When in an A-A master mode, D&R of the Missile Step switch for <0.5 seconds selects the next stores station in the rotary with the selected weapon type. The selected station is identified on the SMS Base page by inverse video. Hands-off changes remain the same.

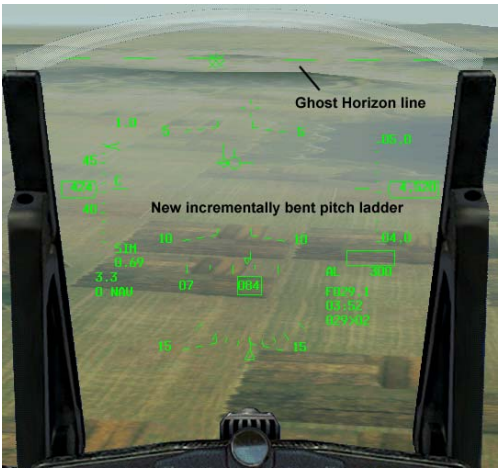
When in an A-A master mode, depress and hold the missile step switch >= 0.5 seconds to select the next missile type in the A-A weapon selection rotary. The avionics system automatically selects the next missile type in the A-A rotary and displays the newly selected weapon mnemonic adjacent to OSB #7 on the SMS Base page. The missile type (SRM, MRM) will also change on the HUD if the new missile is a different type.

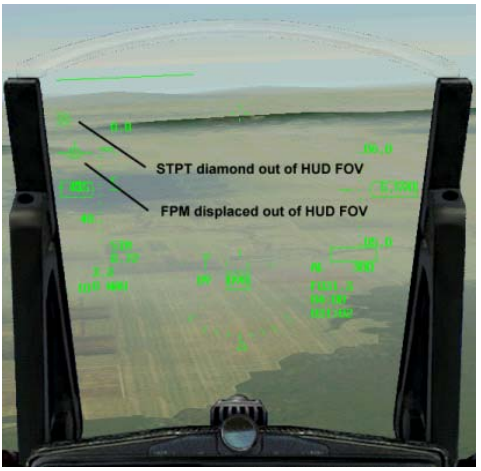
6.10 HUD / AVIONICS

The horizon line in the HUD now extends across the entire HUD FOV.

If the FPM is displaced outside the HUD FOV, it stays in the HUD FOV and has an X displaced over the symbol indicating that it is unreliable. Flight conditions such as a strong crosswinds, extreme rudder input and high G maneuvers will cause this.

When the normal horizon line is not in the HUD FOV, it is replaced by a ghost horizon line. The center of the ghost horizon line is on the outer edge of an imaginary circle with an 8° radius centered in the HUD FOV. The ghost horizon rotates around the center of the circle to indicate which direction to pull toward the real horizon.





When the aircraft is in a dive (FPM below the horizon), the dive attitude bars are bent incrementally. The minimum bend is 8.3° and the maximum bend is 45° (at 90° of dive). Also note the pitch ladder lines are different.

When the steer point diamond is out of the HUD FOV, it will be displaced in the HUD side of the shortest turn to get to the STPT and will have an “X” superimposed over it.

Some minor tweaks to the AIM-9 uncaged symbology have been made. The missile diamond flashes when the target is within maximum range and the missile reticle and missile diamond flash when the target is within the maneuver zone (between RMAX2 and RMIN2).

7 AIRCRAFT

With BMS comes great improvements to other aircraft in the Falcon virtual universe.

For aircraft specific features listed below, the appropriate settings in the aircraft data file need to be set. These settings are detailed in the BMS Appendices.

7.1 DYNAMIC ROLL INERTIA

The inertial effects of stores on the wings is now factored into the rolling inertia of aircraft. The effect also takes into account the fuel weight in external tanks. A player will notice that a fully loaded aircraft will react in a more “sluggish” manner. Both starting and stopping of rolling maneuvers will need more attention. As weapons are released and fuel is used, this inertia will decrease.

7.2 TWO ENGINES

The Falcon code now fully supports two engine operations. When flying a two engine aircraft, the player can control the left, the right, or both engines with his throttle. Each engine has its own thrust, fuel flow, damage modeling, etc. Be advised that adverse yaw and roll are also modeled when there is asymmetric thrust!

When an aircraft has two engines enabled, the upper left corner of the screen will display the current engine selection (BOTH, LEFT, RIGHT) and the rpm of both engines. To cycle between engines, use the CTRL-O key (known as the CycleEngine command when using different key mappings). When LEFT or RIGHT is selected, the throttle will only control the rpm of the engine selected.

For engine startup or shutdown, the procedures are the same as with the single engine operation except that LEFT or RIGHT engine must be selected.

7.3 F-16

Along with adding two engines, improvements have been made to the single engine functions as well. For F-16 aircraft using the PW220 Engine:

Engine idle increases from Mach 0.84 to Mach 1.4 when it will be at MIL power from 1.4 and above.

The afterburner has 3 schedule zones. Area 3 is Segment 5 no light. Area 2 is Seg 1 light only. Area 1 is no AB available. These are based on various low speed and altitude regimes.

Engine will increase idle speed based on altitude

Engine will increase spool up/down time based on altitude/speed.

For aircraft using the GE110/PW229/GE129 Engine

Engine has reduced speed excursion logic modeled. Switches between a higher or lower idle speed based on mach speed (mach 0.55 being the transition point)

Idle spools up from Mach 1.1 to Mach 1.4 where it will be at MIL power

Idle speed increases with altitude

Reduced AB schedule for low speed/high altitude regimes

7.4 F/A-18

The F/A-18 series of aircraft have the following improvements

New NAV HUD

The HUD layout for the F/A-18 is now modeled. The player will find:

- Vertical velocity indicator above altitude.
- Alpha, Mach, G, Peak G moved to their correct locations.
- AOA bracket set for (6-10 degrees AOA). The alpha display will blank out when the gear is down and FPM is in the bracket range. Also the cockpit AOA indicator lights will now match the correct F18 AOA range
- Peak Gs will only display if greater than 4 g's are pulled. If less than 4 g's are pulled, the g display will be removed when the gear is lowered.
- Mach display is removed when the gear is lowered.
- A water line indicator will appear when the FPM is constrained or the gear is lowered.

Flap Modes

The F/A-18 aircraft now have AUTO/HALF/FULL flap modes modeled. To cycle modes use the CTRL-F10 keystroke (or the AFFullFlap key command). A player should only use this keystroke to control flap settings (the other flap keystrokes should be ignored). When the flap mode is cycled the flap display will also indicate the current mode.

AUTO is the standard up and away flying mode. After takeoff, CTRL-F10 to AUTO

HALF will allow flaps to blow down under 250 knots to a maximum of 30 degrees. If speed increases past 250 knots, flaps will raise.

FULL will allow flaps to blow down under 250 knots to a maximum of 45 degrees. If speed increases past 250 knots, flaps will raise.

TEF Scheduling

The F/A-18 aircraft now have the trailing edge flaps scheduled per the -1 manual. The TEFs will deploy and retract based on both AOA and Mach.

Speedbrakes

The F/A-18 A-D model aircraft will now auto retract the speedbrake when aircraft g is 6 or greater, AOA is greater than 28, or the gear are down and airspeed is below 250 knots.

Engines

The F/A-18 engines will now spool up to full MIL power when at Mach 1.23 or greater.

7.5 F-14

The F-14 series of aircraft have the following improvements

New NAV HUD

The HUD layout for the F-14 is now partially modeled. The player will find:

- Vertical velocity indicator above altitude.
- Alpha, Mach, G, Peak G moved to their correct locations.
- AOA bracket set for (13-17 degrees AOA). The alpha display will blank out when the gear is down and FPM is in bracket range. Furthermore, the cockpit AOA indicator lights will now match the correct F18 AOA range
- Peak Gs will only display if greater than 4 g's are pulled. If less than 4 g's are pulled, the g display will be removed when the gear are lowered.
- Mach display is removed when the gear is lowered.
- Waterline indicator that appears whenever the FPM is constrained or the gear is lowered.

Flap Warning

The F-14 does not have an automatic flap retraction system. If the flaps are extended past 10 degrees and the airspeed is greater than 225 knots, a RDC SPEED warning is flashed on the HUD. This warning will also appear when a maximum airspeed of Mach 2.4 is exceeded.

Speedbrakes

The F-14 A-D aircraft will automatically retract speedbrakes when the throttle is moved to MIL power or the airspeed exceeds 400 knots.

Engines

The F-14 engines will now spool up to full MIL power when at Mach 1.4 or greater. The engines will also increase idle rpm speed if the AOA exceeds 18 degrees. Also modeled is the rich stability cutback. This feature allows only partial afterburner in various low speed/high altitude flight regimes.

7.6 F-15

The F-15 series of aircraft have the following improvements

New NAV HUD

The HUD layout for the F-15 is now partially modeled. The player will find:

- Vertical velocity indicator below altitude.
- Alpha, Mach, G, Peak G moved.
- True Airspeed (marked with a T symbol) displayed under Calibrated Airspeed.
- Peak Gs will only display if greater than 4 g's are pulled. If less than 4 g's are pulled, the g display will be removed when the gear are lowered.
- Mach display is removed when the gear is lowered.

Flap Retract

The F-15 flaps will retract if a player exceeds 250 knots. If the flaps switch is left down, the flaps will also deploy again when the airspeed decreases below 250 knots.

Speedbrakes

The F-15 speedbrake will retract if extended and 25 AOA is exceeded. If the speedbrake is left deployed, it will extend out again when the aircraft is under 25 AOA.

Engines

See F-16 (PW-220, 229).

7.7 F-4

The F-4 series of aircraft have a few improvements.

Engines

The engine operating range is modeled along with the possibility of flameout from various low speed, high altitude, or high AOA regimes (per the -1 manual). The afterburner cutoff range is also modeled.

8 AUTOPILOT

The SP series of executables introduced a much improved 3-Axis autopilot (AP) for realistic avionics users. There are however some opportunities remaining to improve upon that system.

This version of the BMS executable introduces a significant overhaul to the realistic mode autopilot.

8.1 CHANGES FROM SP3

The SP3 autopilot had a tendency to “porpoise” (significant rate and magnitude oscillations of nose position up and down) in ALT HLD mode. This tendency has been fixed by adding some damping to the autopilot altitude holding functions. The AP should now meet or exceed the real jet’s performance of holding altitude +/- 100 feet either side of the selected reference. In doing so, pitch changes when the jet is close to the selected reference altitude are very much smaller so you should end up with a rather more “straight and level” experience when selecting this mode.

Roll mode selections are now independent of the pitch mode selection. What this means is that you can select pitch ATT HLD (attitude hold) and any of the three roll modes. Fixed pitch climbing turn to waypoint heading?? No problem! Previously the SP3 autopilot would only allow pitch ATT HLD if the roll modes switch was in ATT HLD also.

Pitch ATT HLD mode completely revised. The new function is able to hold selected pitch much more effectively while also implementing stick steering as described below. The pitch reference is now driven from the same reference value used to place the FPM on the HUD pitch ladder. What this means is that when you engage pitch ATT HLD mode, you should get (near enough) the pitch displayed in the HUD as the reference value for the AP to hold.

Stick steering implemented. When you have either pitch ATT HLD or roll ATT HLD selected, you can change the pitch or roll reference angles respectively at any time by merely applying pressure to the control stick (i.e. joystick). When pressure is released again, the AP will attempt to hold the new pitch and roll at the time the pressure was released. Stick steering will work for either axis if it selected, regardless of the selected AP state of the other axis; i.e. if you have pitch ATT HLD and roll in STRG SEL, you will be able to manually change pitch by direct stick inputs but not roll (unless you also depress AP Override of course!).

Self-centering pitch mode AP control switch implementation completed. In the real jet, the right-most AP control switch is a spring loaded self-centering switch. It is held in ALT HLD or ATT HLD positions by a magnetic capture mechanism. Capturing the switch in either one of these two positions is what engages the AP. The AP will operate within limits of plus or minus 60 degrees from straight and level in both pitch and roll axes. If you exceed these limits with the AP operating, the AP function is suspended but the AP pitch switch is not released from its current position. In order to re-engage the AP in this case, you must center the pitch mode switch manually and then reselect the required AP pitch mode to turn on the AP. Also, if certain other conditions arise during AP operation, the AP will self-disconnect, releasing magnetic hold and

springing the switch back to the off/center position. The conditions implemented in the version of the game are:

- Angle of attack exceeds +15 degrees.
- Slow speed warning sounds.
- Gear handle is placed in the down position.
- The AIR REFUEL switch (FUEL panel) is put into the “OPEN” position opening the refueling door.
- There is an FLCS fault detected.
- Power is removed from the AP system
- The Trim AP Disconnect switch (MANUAL TRIM panel) is placed in the “DISC” position.
- The ALT FLAPS control (FLT CONTROL panel) is placed in the “EXTEND” position locking the trailing edges flaps in the down position.
- The manual pitch override control (MANUAL PITCH panel) is placed in the “OVRD” position.

There is now code in the BMS exe series that should fix the infamous “pitch up on landing after using autopilot during flight” bug. This bug would only happen in SP3 if you got the AP into pitch hold mode, which wasn’t easy since you’d have to cycle the left AP switch at least once all the way around to ATT HLD before attempting to put the right (pitch) switch into ATT HLD or it wouldn’t engage that pitch hold mode. By the way, this bug also affected in-flight operations if after pitch hold mode was entered and left you subsequently allowed speed to decay and commanded higher angles of attack (say when you are in a turning fight and incautiously let your jet fall well, well below corner); in this case you would have seen the jet snap into a deep stall as the bug took effect.

9 BMS AP OPERATION SUMMARY

The following charts depicts the main functions of the AP in the BMS executable.

Switch	Position	Remarks
Roll mode (left)	HDG SEL (up)	When the autopilot is on, placing the roll mode switch in this position causes the AP to turn the jet towards the heading currently selected in the HSI gauge (center console).
	ATT HLD (center)	When the autopilot is on, placing the roll mode switch in this position causes the AP to hold the current bank angle at which the aircraft is flying. Stick steering for the roll axis is available with this setting.
	STRG SEL (down)	When the autopilot is on, placing the roll mode switch in this position causes the AP to turn the jet towards the currently selected in the navigation system (note that this may be a steer point, mark point or equivalent).
Pitch mode (right)	ALT HLD (up)	Placing the switch in this position turns on the AP function. The AP will attempt to hold the altitude at which the jet is currently flying. Roll mode is determined by the roll mode switch.
	OFF (center)	Placing the switch in this position turns off the AP. All AP control is terminated.
	ATT HLD (down)	Placing the switch in this position turns on the autopilot. The AP will attempt to hold the pitch attitude at which the jet is currently flying. Stick steering for the pitch axis is available with this setting. Roll mode is determined by the roll mode switch.

Note that the roll mode selection is independent of pitch mode selection. The AP is only on and engaged when the pitch switch is in either the ALT HLD or ATT HLD position. When the AP is on the roll mode is determined only by the position of the roll modes control switch.

Note that movement of the roll mode switch when the AP is off (pitch mode switch in center position) has no effect on aircraft controls.

9.1 GUIDELINES FOR AP USE

Keep in mind that the AP manages pitch and roll inputs for you but you retain control of the throttle. Particularly with pitch ATT HLD modes, you will quickly see the AP disconnect because it exceeds available angle of attack if too low a power setting is selected via the throttle.

Use caution when engaging the pitch ATT HLD mode AP with a negative pitch angle. The jet will happily fly you into the terrain if you run out of altitude. The VMS system will of course still warn you that this is about to happen.

The AP Override control is always available if you want to take temporary control of the jet while the AP is on and engaged and you have something other than pitch and/or roll attitude hold modes selected. I.e. to change altitude when you have the AP in ALT HLD mode, depress the AP override, dial in the new required altitude with the stick and then release the AP override.

For both pitch and altitude hold modes, the AP will take a little time to “settle” at the requested altitude or pitch; sometimes this can be a minute or more. This time will likely be on the longer side for higher pitch angles and/or lower power (throttle) settings. If you select a high pitch angle with relatively low power and/or a hefty load out, the AP may not be able to settle at the requested pitch reference angle before exceeding AP operating limits and self-disengaging. This may look like the AP is not working but in practice you just requested it to hold a flight condition that is not within the AP’s flight envelope.

If it looks like the pitch mode AP switch appears not to move from the center position when you try to turn on the AP, take this as a hint that one of the conditions than causes the self-centering AP switch to self-center applies! With a real switch you’d try to move it and it would spring back. The game graphics do move the switch but it springs back in one frame so it may appear not to have moved at all.

10 INPUT DEVICES

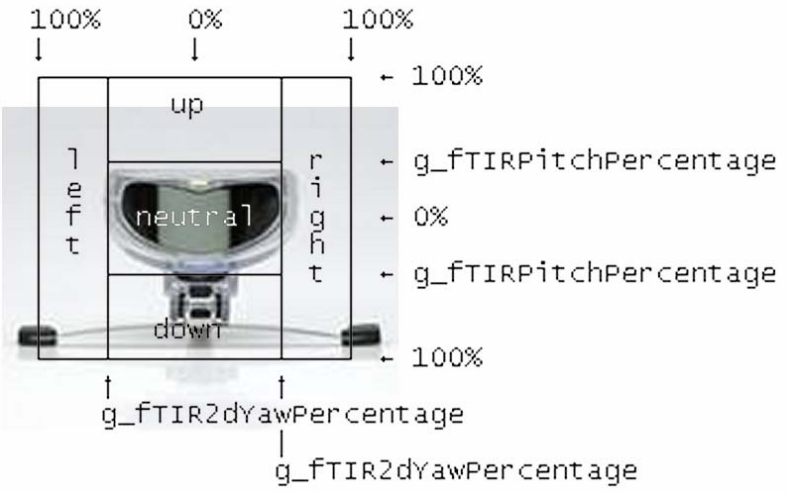
10.1 NATIVE TRACKIR SUPPORT

FalconBMS natively supports the „TrackIR“ headtracking device via its remote interface, which enables much easier panning. You have to start the Naturalpoint application prior to running Falcon. Once in the game, you may activate the TrackIR support for 2D and 3D cockpit seperately in the 'View Control'' config settings (please refer to the relevant chapter in this manual).

You are able to deactivate TrackIR at any time by using the Naturalpoint hotkeys (F9 by default), or by just breaking the LOS between the TrackIR emitter/receiver and the „dot“ which is tracked by it. After about 1 second, view control should migrate to the POV keys/keyboard. Once you enable TrackIR again (or restore LOS between tracker and dot) control should switch immediately to the TrackIR.

While in the 3d cockpit, panning will work just as with the TIRF4 application (an external program that enabled TrackIR support for the SP3 executable).

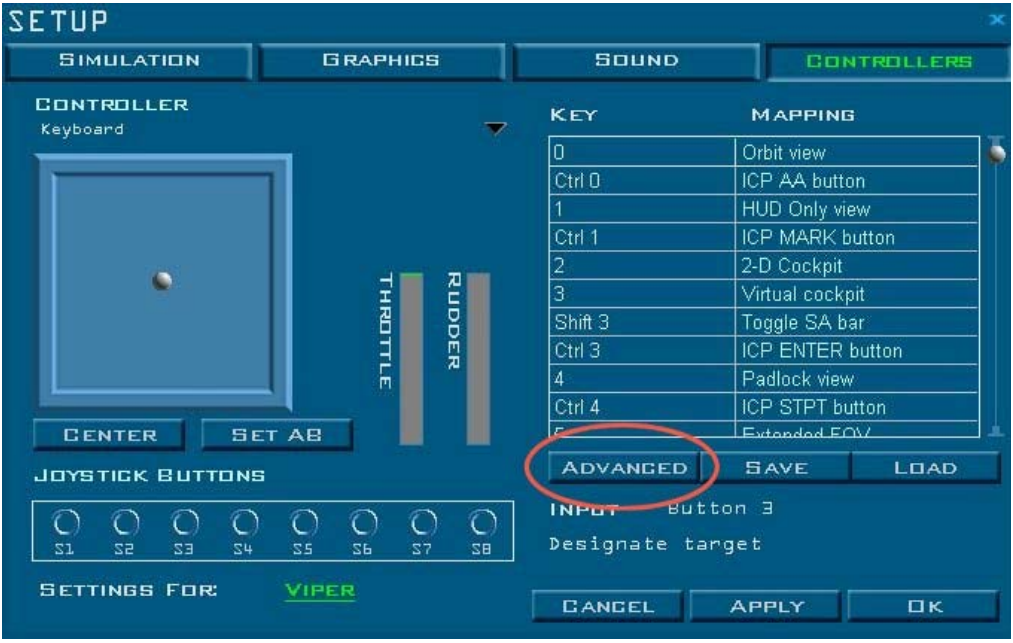
Also added was support for the 2d cockpit. In this mode, the headtracker behaves a bit like a POV hat, which means that if you look up, the program will emulate an 'up' press on the POV hat. If you look left, the program will emulate a 'left' POV hat press etc. The repetition rate of these emulated keypresses can be configured by the g_nTrackIRSampleFreq variable. The units of this variable is in milliseconds, it defaults to 512 milliseconds (about 2 emulated keypresses per second). The area where the TIR input will be interpreted as 'POV-press' can be configured as follows:



This is a view of the TIR receiver. As long as the dot stays in the 'neutral' zone (if you look directly at the receiver) no change in the 2d cockpit will happen. The two configuration variables, g_fTIRPitchPercentage and g_fTIRPitchPercentage are symmetric to the 'zero' point.

10.2 CHANGES TO THE HANDLING OF INPUT DEVICES

We have quite substantially reworked the way Falcon4 handles input devices, with the goal to make it as flexible as possible in respect to supported in-game analogue axis as well as to the different controller configurations employed by Falcon users. To manage all new options, an additional 'Advanced controller' window was added, which can be reached through the controller tab of the setup window. Click on the 'Advanced' button located beneath the key mappings to access this new window.



The advanced button used to access the advanced controller screen

- Mapping your Joysticks

Click on the 'Controller' drop down box in the setup-controller tab in order to select your flight control device, which is the joystick were your pitch and bank (x/y) axis are located. Please note that this will be the only device that plays any force feedback (FFB) effects !

Falcon will try to autodetect pitch, bank, yaw (rudder) and throttle axis located on that device; if it succeeds, the respective bars will turn coloured and will start representing the current value of this axis. Do not worry if no axis are detected, or if Falcon picks up the wrong ones, you can configure this in the advanced controller screen.

Falcon will pick up the first 32 buttons on each controller, but will only light the buttons in this screen in response to the first eight buttons pressed on the primary flight control device. However the text-readout below the keymappings should work for each button.

If the mapped device supports FFB it will be enabled by default, and you should get immediate feedback (the 'gunfire' effect) on button presses.

10.2.1 The Advanced Controller Screen

You can reach this screen by clicking the 'Advanced' button located beneath the key mappings in the setup-controller tab.

This window has 4 tabs (categories) named 'View control', 'Flight control', 'Avionics control' and 'Sound control', however, before these tabs are described in detail, some words about the handling of analogue axis in Falcon is in order:

- Analogue Axes in Falcon

Maybe the most important fact first: you will only be able to map one in-game axis to one 'physical' analogue axis ! So if you, for example, already have mapped the mousewheel axis to the viewzoom axis, you will not be able to use it to control FOV too !

- Axis properties

Axis in Falcon have three properties that may be configured in the UI by the user:

- Deadzones

A deadzone is a region around the center position of the axis in which motion is ignored. Hence, the axis always reports '0' while in a deadzone. Deadzones are always symmetrical to the '0' point of an axis.

- Saturation

A saturation zone is a zone of tolerance at the minimum and maximum of an axis. An axis value within this zone is reported as the minimum or maximum value. The purpose of this is to allow for axis (usually of the cheaper ilk) that report values less (or greater) than their maximum (or

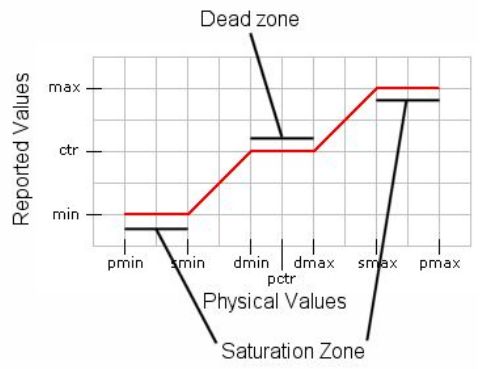
minumum) value even if their physical 'throw' is already at the maximum (or minimum). An example might be a throttle slider that just can not report 100% thrust even if it is already at its maximum positive travel. Saturation zones are always symmetrical, that is, the zones at the maximum and minumum ends of an axis are of the same size.

- Reversal

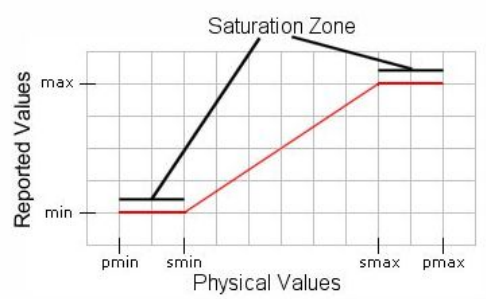
By activating this option you can reverse an axis, that is, it then reports its minimum value while at its maximum physical travel, and vice versa.

- Axis Types

Axis in Falcon can be of two types: 'unipolar' or 'bipolar'. The difference between the two is that unipolar axis report value in a non-negative range only, while bipolar axis report value symmetric to the '0' value. Because of this, some axis (bipolar ones) may be configured to have deadzone and saturation zones, while others (unipolar ones) may have a saturation zone only.



A bipolar axis can feature saturation and deadzone



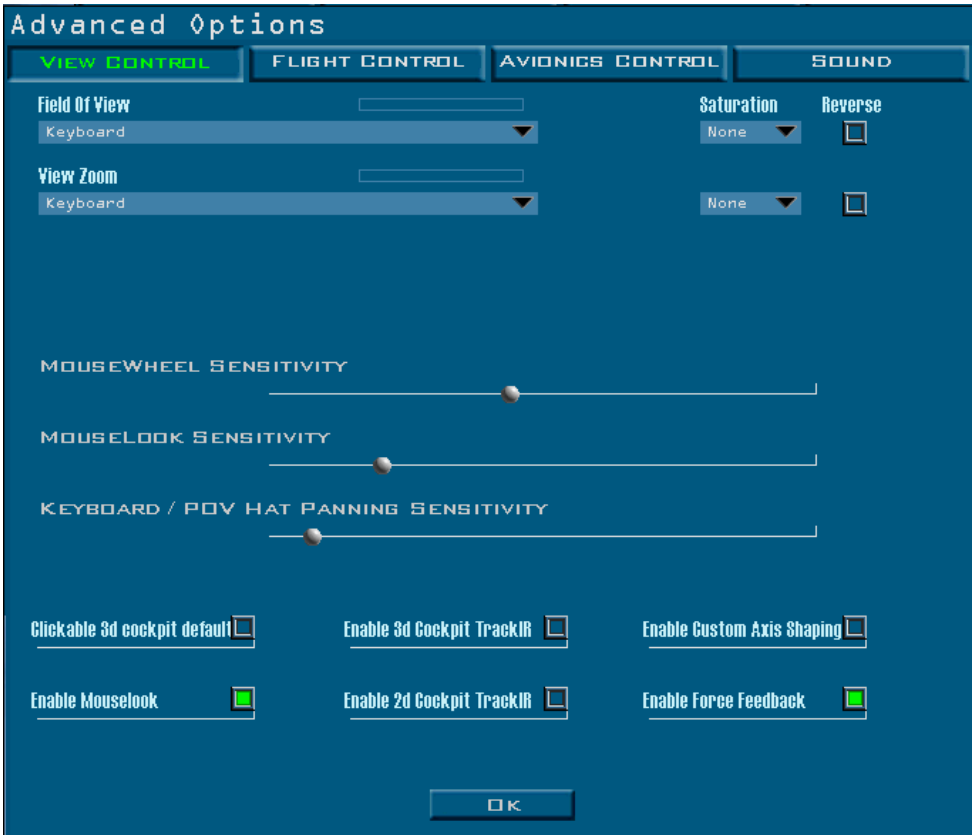
An unipolar axis does not feature a deadzone

An example for an unipolar axis is the throttle, while a classical bipolar usecase is any of the flight control axis, like pitch.

Of course there exists an exception to all this: the mousewheel axis. As the mouse is per definitonem a relative device (it is not physically bound to a certain point - desktop-size/mouselength-cable/radio-range does not count) the absolute coordinates have to be gathered 'in software', without using DirectX. So neither deadzone nor saturation settings will apply to any axis mapped to the mousewheel.

10.2.2 View Control Tab

This tab is concerned with the various ways to influence view direction in the Falcon world.



The View Control Tab of the advanced controller screen

- FIELD OF VIEW (FOV) AXIS

This axis moves the field of view inside its specified minimum and maximum values. You can set these ranges in the falconbms.cfg file. Should this axis be mapped to the mousewheel, then you will be able to reset it to its default value by pressing the 3rd mouse button (usually the wheel itself). This axis works both inside and outside of the cockpit.

- VIEW ZOOM AXIS

This axis controls the zoom range when viewing an object. Naturally, it only works while in outside views. If this axis is mapped to the mousewheel, you will be able to reset the zoom range to a default value (specified by the 3d model currently in focue) by pressing the 3rd mouse button (which is usually the mousewheel).

- MOUSELOOK SENSITIVITY SLIDER

By manipulating this slider you can configure the sensitivity of the mouseview, both inside and outside of the cockpit. The more left the slider is, the less sensitive the view will be.

- KEYBOARD / POV PANNING SENSITIVITY SLIDER

This slider lets you configure the panning speed when keyboard or POV inputs are used. The SP3 (and default) sensitivity value is almost on the extreme left.

- MOUSEWHEEL SENSITIVITY SLIDER

The last of the sliders on this page lets you set the sensitivity of the mousewheel axis (provided you have one).

- 3D CLICKABLE COCKPIT DEFAULT

Besides sporting one of the unwiedliest names of all Falcon options, this checkbox sets the default mode of the 3d clickable cockpit.

The 3d cockpit can be in one of two modes: clickable or pannable.. in clickable mode, the mousepointer is always visible, the left mouse button is active and can be used to activate buttons etc.. you can still pan by pressing (and holding) the right mouse button. In pannable mode, no mouse pointer is visible, and the left mouse button has no function. You are still able to act on buttons etc by pressing the right mouse button, moving the (now visible) cursor over the button of interest and clicking the left mouse button.

You can toggle between these modes by pressing the mouse button #4 (provided your mouse features one), or by mapping and pressing the ToggleClickablePitMode command.

An additional note about the mouse.. if it is NOT mapped to any analogue in-game axis, the mousewheel (if available) will send FOV-increase/decrease commands, and the middle mouse button (in most cases, the depressed mouse wheel acts as an additional button) will reset the FOV to its default value. Once the mousewheel is mapped to an analogue axis, the middle mouse button will either reset an axis to its default value, or just recenter it.

- ENABLE CUSTOM AXIS SHAPING

This checkbox is a bit oddly placed since it is not really related to view control. By activating it you can tell Falcon to ignore any deadzone and saturation settings and instead read the axis 'shape' from a file supplied by an external application. WIP.

- ENABLE MOUSELOOK

Using this button you can enable the mouselook mode introduced with the BMS releases. Please note that it is not possible to inverse mouse axis direction.

- TRACKIR

You have to activate the naturalpoint software before starting up Falcon ! If you fail to do so, the TrackIR related buttons will never light up, and you will be unable to change TrackIR related options ! You can enable 2D and 3D TrackIR support independently of each other, so it is no more required to activate 3d TrackIR for 2d TrackIR to work. Should initialization fail, then the button will not light up but stay dark instead. Please note the additional TrackIR configuration options in the falconbms.cfg file, which can be accessed by the BMS configuration editor. See the TrackIR chapter for a description of these options.

- CUSTOM AXIS SHAPING

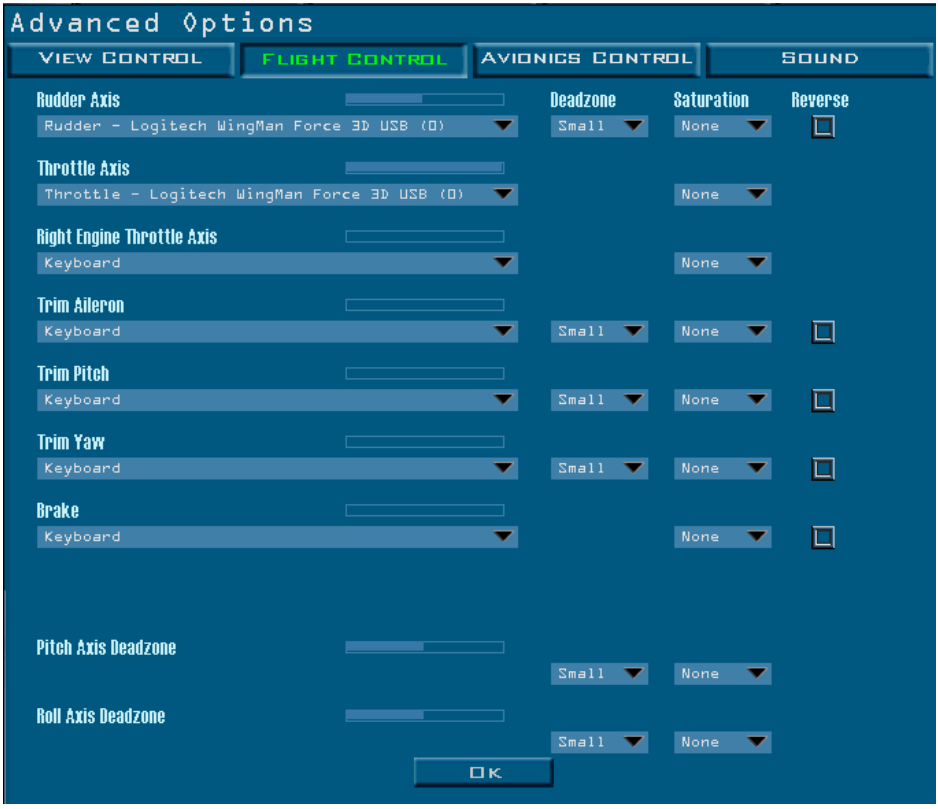
This button allows Falcon to load custom axis 'response curves' from a file generated by an external program. These response curves allow the user to change an axis' input characteristics to a nonlinear mode. This operation is sometimes also referred to as 'axis shaping'. The external program needed will be released at a latter date.

- ENABLE FORCE FEEDBACK

This button allows you to enable or disable force feedback effects on your flight controller. This button will only light up if Falcon has detected a force feedback joystick as your flight controller, otherwise it will stay dark all the time. If you disable force feedback, the joystick should enable autocentering, that is, it should emulate springs using its actuators, but it should not play any additional effects. The playback of the "stall" Force Feedback effect is deactivated while the combat autopilot is active.

10.2.3 The Flight Control, Avionics Control and Sound Control Tabs

These three tabs are going to be described together as the controls located on them are exactly the same, the only thing that changes are the axis the controls operate on. These tabs provide a list of all available in-game axis, where, depending of the nature of the axis, each of these axis may have one of the following controls:



The Flight Control tab shows mapped axes and axis value bars.

- A drop down box where you can select the physical axis you want to map it to

- A 'value bar' (located to the right of the axis name) that shows the current value of the analogue axis.

- A deadzone drop down box presents you 4 options: 'Small' 'Medium' 'Large' and 'Huge'. 'None' means exactly that, no deadzone is applied to the physical axis. 'Small' applies a deadzone of 1% the size of the physical travel to either side of the '0' point, while 'Medium' enlargens that size of 5%. 'Large' applies a 10% deadzone, and 'Huge' makes it a whopping 50% !

- And a saturation drop down box that contains 4 options: 'None' 'Small' 'Medium' and 'Large', where 'Small' specifies a saturation zone size of 1% of the physical travel, 'Medium' sets 5% and 'Large' applies 10%.

Please note that, as a consequence of the "One physical axis per in-game axis" rule, the selection of axis in the listboxes get smaller the more axis you map. If you want to exchange the mappings of two axis you will have have to temporarily map one of them to the keyboard. in order to select it in the other listbox.

- FLIGHT CONTROL TAB

Here the additional controls in the flight control tab are going to be described:

Note that you can not assign pitch and bank axis in this tab, as this selection has to be done in the 'original' controller screen. You can, however, edit the deadzones of the pitch and bank axis.

- ADDITIONAL NOTES

The changes done in the advanced controller screen are saved partly in the playeroptions save file (has the extension .pop) and a new file called "axismappings.dat", which both are located in the /config subfolder of your Falcon4 install. If you want to clear all your mappings, either simply delete this file or select the keyboard as primary flight controller in the 'original' controller screen. In addition, the optional axis response curve information is stored in a file called 'axiscurves.cal'.

- CUSTOM AXIS SHAPING

There exists an external program that lets the user configure the response curve of any in-game axis directly via directX. Because of this, all deadzone and saturation settings done for this axis in the controller UI will be disregarded. To enable custom axis shaping, activate the checkbox in the 'View control' tab. If it does not light up it means that an error occured while reading in the axiscurve file.

CHANGES TO THE JOYSTICK BUTTON ASSIGNMENTS

As now up to 16 devices with up to 32 buttons are supported the button mapping had to be slightly changed as well: In the keyboard mapping files (*.key in the /config folder of your Falcon install), button IDs 0-31 belong to the first enumerated controller (the one with the trailing '0' in its description in the Falcon UI), 32-63 belong to controller #2 etc. If all possible joysticks and buttons are used the total is 512 buttons, which opens up the possibility for cockpit builders to forego traditional keypress emulation and directly map via directX buttons, however please note that you will have to emulate 16 joysticks then ! (For example, you can not assign any key to button #64 if you do not have at least 3 joysticks connected !)

KEYBOARD MAPPING RESETS TO 'LAPTOP' IS FLIGHT CONTROL IS SET TO 'KEYBOARD'

This is a somewhat peculiar feature of the original code, that nevertheless can be quite irritating.

ANALOGUE THROTTLE CUTOFF

We have enhanced the implementation of the throttle idle cutoff value. By setting the g_bUseAnalogIdleCutoff falconbms.cfg variable to '1', you may change the idle cutoff throttle value by pressing the 'AB detent' button in the controller screen with the RIGHT mouse button. A RED line will show the selected value. Please take care to set this value LOWER than the 'AB detent' value ! This feature is mainly of interest to cockpit builders who wish to adjust the simulation to their existing hardware. Note that currently this value (as the AB detent value) applies to BOTH engines in 2-engined AC.

NOTES ON SPECIFIC IN-GAME AXIS

Here some special notes on in-game axis will be listed.

- Pitch
- Bank
- Yaw
- Throttle

Please note that you may not map the mouse wheel to this axis.

THROTTLE2

The right engine throttle can only be used AFTER the left engine throttle has been mapped to an axis ! The reason for this is that the left engine throttle is the default throttle for single engine planes ! Please note that you may not map the mouse wheel to this axis.

The throttle value bar reflecting dual analogue mapped throttles.

- PitchTrim
- BankTrim
- YawTrim
- Brakes
- Antenna Elevation
- Cursor X
- Cursor Y
- Range Knob
- Comm 1 Volume

Not implemented. This axis scales logarithmic. To use the axis effectively, either change the axis responiveness curve or use logarithmic potentiometers in your joystick.

- Comm 2 Volume

Not implemented. This axis scales logarithmic. To use the axis effectively, either change the axis responiveness curve or use logarithmic potentiometers in your joystick.

- MSL Threat Volume

This axis scales logarithmic. To use the axis effectively, either change the axis responiveness curve or use logarithmic potentiometers in your joystick.

- Threat Volume

This axis scales logarithmic. To use the axis effectively, either change the axis responiveness curve or use logarithmic potentiometers in your joystick.

- HUD Brightness
- Reticle Depression

FoV
This axis is deactivated if either actioncam or the exit menu is active.

- View Zoom
- Interface Volume

Not implemented. This axis scales logarithmic. To use the axis effectively, either change the axis responiveness curve or use logarithmic potentiometers in your joystick.

11 2D / 3D COCKPIT

11.1 3D CLICKABLE COCKPIT

A simple but functional 3D clickable cockpit system has been implemented. The list of clickable buttons is contained in 3dbuttons.dat. This file should be placed in your cockpit directory. In this release, the included dat file is designed for Aeyes f-16 3d cockpit. Currently most ICP, DED and MFD buttons have been implemented, but not all.New dat files can be written for other cockpits and other aircraft. Dat files for other aircraft should be placed in the appropriate aircraft's cockpit directory.

11.2 COCKPIT AUTO SCALING

With the g_bCockpitAutoScale set to 1, if you select a resolution without a corresponding cockpit, Falcon will attempt to scale the next best cockpit. If using 1600 resolution, if no 1600 cockpit is found, Falcon will look for the existance of a 1280 cockpit, and will scale it up to 1600. If no 1280 cockpit is found, the 1024x768 cockpit will be scaled to 1600. If using 1280 resolution, if no 1280 cockpit is found, Falcon will look for the existence of a 1600 cockpit, and will scale it down to 1280. If no 1600 cockpit is found, the 1024x768 cockpit will be scaled to 1280.

When g_bCockpitAutoScale is enabled and 800x600 or 640x480 is selected, the 1024 cockpit will be rescaled to that resolution. Font size may be an issue at these resolutions.When the resolution 1280x1024 is selected, the pit will be scaled to 1280x960 and a black bar will be drawn across the bottom 1/16 of the screen.

11.3 MOUSE SCROLL WHEEL AND MIDDLE MOUSE BUTTON

You can now use the scroll wheel and middle mouse button in Falcon. By default, the wheel will control the FOV increase and decrease functions. By default, the middle mouse button (or scroll wheel click) will set the FOV to default. Note, this will only work if the mouse wheel is NOT mapped as an analogue axis!

The behavior of the scroll wheel and middle mouse buttons can be modified by adding the following lines to your falconbms.cfg file:

set g_sScrollUpFunction "<command>"

set g_sScrollDownFunction "<command>"

set g_sMiddleButtonFunction "<command>"

Where <command> is the name of the command you wish to execute as listed in your keystrokes file.Each increment of the scroll wheel will cause the corresponding command to be executed once. Default Values:

set g_sScrollUpFunction "FOVDecrease"

set g_sScrollDownFunction "FOVIncrease"

set g_sMiddleButtonFunction "FOVDefault"

11.4 ADJUSTABLE FOV

You can now adjust the field of view in game. This has multiple uses. Increasing the FOV can dramatically increase perception of speed, and can be used in the virtual cockpit to see more of the cockpit. Decreasing the FOV allows closer inspection of far away objects, and allows closeup views of the MFD's in the virtual cockpit.

The following keystrokes can be added to your keystrokes.key file:

- FOVIncrease: Increases the field of view by the number of degrees set by FOVIncrement:.
- FOVDecrease: Decreases the field of view by the number of degrees set by FOVIncrement.
- FOVDefault: Sets the field of view to the default of 60 degrees.

FOV is retained when switching from external to internal views. Stick input will remain constant, regardless of FOV.

11.5 OTHER ADDITIONS TO THE 2D COCKPIT

In the panel declaration of the .dat file, you can now use "mfd3", "mfd4", "osb3", "osb4" in the same way you would use "mfdleft". Please refer to the Appendices for more information.

The new keystrokes for jumping to the backseat etc are: SimToggleRearView and SimToggleAltView. SimToggleRearView jumps to panel 5100, while SimToggleAltView will jump to the template defined in the manager info of the .dat file with "altpanel <panel number>;"

Cockpits can now be debugged to a certain extent by the use of the variable "g_nShow2DPitErrors " in your config file. Setting this value to 1 shows only critical errors, and setting it to 2 shows all errors. Errors will only be displayed when the simulation in run in windowed mode “F4-BMS.exe -window".

VG colors are now not see through on transparent panels. You dont have to do anything to implement this, as it will now just work.

The cockpit resizer has had an overhaul. Any pit can now be scaled to any resolution. At all resolutions, the resizer now has a predictable order of pit searching. So, if you wanted to rescale your pit to 1024, simply rename 10_ckpit.dat. Non-standard resolutions such as 1920x1440 will also be scaled to correctly now. The order is:

- Aircraft specific native resolution pit
- Aircraft specific higher resolution pit
- Aircraft specific lower resolution pit
- Default native resolution pit
- Default higher resolution pit
- Default lower resolution pit

Finally, the method of forcing a cockpit resolution has now changed. Instead of the multiple confusing lines and scale, there is one variable g_nForceCockpitResolution that should be set to 640, 800, 1024, 1280 or 1600. There is little need for this now though with the new auto-resizing code.

Cockpit rescaling looks almost perfect now. This is done by addign filtering on the cockpit textures. If you want to disable pit filtering for some reason, add "set g_bFilter2DPit 0" to your config file.

11.6 OTHER ADDITIONS TO THE 3D COCKPIT

New 3d cockpit code is now introduced. It is enabled by adding **set g_bUseNew3dpit 1** to falconbms.cfg

This will disable old style line indicator needles, and enable new code to drive instruments via DOF/Switch nodes. The Idea is that all needles are 3d objects rotated under new 3d pit DOFs and new lights are driven now under new 3d pit switches. Some instruments need more than two DOFs to operate. For example, the ADI ball uses 2 DOFs for pitch and roll. The HSI uses a lot of axes to operate, as per real life. The hard-coded limit to the number of DOFs/switches has been expanded from 127 to 255. All instruments are now aligned/scaled to F16 instruments. Modelers will use the new BMS XDOF and XSWITCH nodes to control/finetune instruments for other AC types. This can be externalised to a text cfg file in the future. For now, the new F-16 3d pit for BMS is not ready for public consumption, this information is mainly for 3d modelers that are familiar with making 3dmodels/pits for Falcon.

As a "bonus", the old, jerky dynamic pilot head movement was rewritten so as to not disort 3d pit geometry.

set g_b3dDynamicPilotHead 0 to **set g_b3dDynamicPilotHead 1** in **f4-bms.cfg** to experience a similar effect to that of the old DID EF2000 simulation.

12 ADDITIONAL FIXES / FEATURES

12.1 MISCELLANEOUS

- Added multiple fields to the player's logbook.
- Tactical Reference will now cycle through the skins when you select/reselect the model. On the pull-down menu, select your aircraft. To cycle the texture set (if there are additional ones), just reselect the same aircraft from the pull-down menu.
- The Munitions Loadout Screen now has a Change Skin button. If pressed, the skin set will cycle through the available skins. Whatever skin is displayed will be the skin chosen for the flight of aircraft in TE and Campaign. Note: this only affects the players flight (1-4 aircraft) The other squadron aircraft will retain their original skins.
- FAC. If you are on a On Call CAS (or similar mission CAS, BAI, INT), you can now use the AWACS menu "Check In" command as a FAC. If a target is ready, the FAC will give you vectors and a cleared hot call. If no targets are currently available, you will instructed to hold at CP Alpha (just hold at one of your target waypoints). In the campaign, as a target is found, you will be vectored to that target. When vectored, you need to respond with "Wilco". When finished, use Check Out to end your station time. If Check In is used when you are not tasked on an appropriate A/G mission, AWACS will reply "Unable".
- The campaign was not properly targeting various strategic type targets (factories, HQ buildings, ports, power plants, etc.). If the sliders are set for these types of missions, and the player is on the offensive, these targets will be scheduled for attack.
- Fixed A/G designate bug where the lateral range from the target was incorrectly determined. Now slant and lateral range work correctly together.
- Campaign waypoint speeds are now a direct conversion from the database. The Unit->movespeed is in Kilometers (PER MPS) and is then converted to NM by the waypoint code. Previously, the code was subject to various percentage calculations that made it difficult to accurately set the desired waypoint speeds. The percentage reductions have been removed and now what is entered in movespeed using F4browse will be what the waypoint speeds are set. Also note that Falcon does a KCAS conversion of the waypoint speed to account for differences in waypoint altitudes. If the DB is set in KM to give 350 knots after conversion, that 350 knots is the Sea Level speed. The KCAS conversion will reduce that speed in the waypoint boxes per altitude. Also the waypoint error checking code is now based on a percentage of movespeed (30% above or below).
- Sensorfusions Radian errors: There were some significant errors in calculations that are now fixed. Fixed for helo digi sfusion as well.
- AI gun sound changed to gun loop for normal gun firing sound not "bump bump". The vulcan end .wav file that was being used for the AI has been changed to the normal gun loop. Now the AI gun will actually sound like a gun.

- AIM-9x's are now available in Fighter Sweep.
- Tankers will now no longer make impossible turns except when they need to fudge the turns in order to land. This "ex-F-15 driver" 7-g turn was very noticeable in multiplayer—the tanker would yaw through the turns. After each human took on gas and finished, the tanker would execute this turn back to his first track point when ownership of the tanker transferred to the next human, thus making the entire flight chase him down again. Now, the tanker will turn slightly, but the entire flight should be able to stay with him while ownership is transferred. Also, hooking up to the boom should be easier. Pitch and roll limits (for the tanker) for connecting to the boom were very small. Since they are not needed, they were removed. Prior to this fix, it was nearly impossible to connect to the boom in a turn because of these limits. You could refuel in a turn and stay with the tanker provided you had connected to the boom when he was straight and level.
- The padlock color now matches the selected HUD color.
- Plane and Loadout configurable using text file: create m.ia (Mud Moving) and/or f.ia (for Fighter Sweep) files in the campaign/save subfolder. Open with Notepad and edit according to the following example (made for the A-10 in Mud Moving):

```
# Use F4Browse to find Plane Units (!) and Weapon IDs
##########################################################
# Own plane (Unit Information) Example: A-10
1 type
3 subtype
1 specific
##########################################################
# Weapon loadout: WeaponID (Weapon No.), WeaponAmount

#Loadout Hardpoint 0
62 W0
117 C0
#Loadout Hardpoint 1
12 W1
1 C1
#Loadout Hardpoint 2 (empty on A-10)
```

#71 W2

#19 C2

#Loadout Hardpoint 3

227 W3

3 C3

#Loadout Hardpoint 4

19 W4

3 C4

#Loadout Hardpoint 5

6 W5

3 C5

#Loadout Hardpoint 6 (empty on A-10)

#71 W6

#19 C6

#Loadout Hardpoint 7

81 W7

3 C7

#Loadout Hardpoint 8 (empty on A-10)

#215 W8

#1 C8

#Loadout Hardpoint 9

64 W9

3 C9

Use the # for any comments. Save the file and load Falcon. Enjoy.

- 1600x1200 and 1280x1024 splash screens have been enabled.
- Loading of cockpit settings now also reloads the upper MFD.
- Eye Fly works again.
- Landing AI planes won't use afterburner when drag chute is deployed.

- Swapped X/Y coordinates in Radio Messages.
- Saving briefing as text or printing it also includes some TABbing now.
- Set g_bBriefHTML. If set together with “set g_nPrintToFile 1”, this creates HTML-based mission briefings when clicking the PRINT button in a briefing. Such briefings will look much better than the old briefing.txt file, are easier to print and can be formatted according to your taste (just edit the style.css stylesheet found in the /briefings subfolder or even hack the *.b briefing templates in the campaign/save fodler to add your custom tags…).

12.2 NEW KEYSTROKES

- OTWToggleFlapDisplay

Flap position display now defaults on for manual flap aircraft. Prior to this release, the flap position output was accessed through g_bShowFlaps. The code has been changed to default the flap position indicators to ON when flying a manual flap aircraft. This flap indicator is also now controlled by a keystroke to turn it off/on.

- OTWToggleFlapDisplay -1 0 0XFFFFFFFF 0 0 0 1 "Flap Display Toggle"

Set that at the end of your keystrokes.key file then Go into your Setup->Controllers tab and map this keystroke to whatever key you wish in Falcon. This will now allow you to turn off/on the flap display for manual flap aircraft.

- SimRandomError

Immediately generates a random aircraft system failure. Good for emergency procedures training: You know that something will break – but you don’t know what.

Keystroke currently not assigned/mapped. Edit your config/keystrokes.key to add the following line:

- SimRandomError -1 0 0XFFFFFFFF 0 0 0 1 “Sim-Random Error”

You can then assign any key to the command from the Falcon Setup screen.

12.3 WINAMP SUPPORT

The user is able to control the popular WinAmp media player from inside the simulation, either through keyboard commands or through the ICP. However only basic functionality is supported.

To activate WinAmp support, check the 'WinAmp' checkbox in the BMS configuration editor. Here you can also specify the initial WinAmp volume, which is set to 80% by default. You will also have to startup WinAmp and load a playlist (or a single file) before entering the 3D part of Falcon. WinAmp versions 2 and 5 are supported without the need for plugins, WinAmp 3 will need a plugin called 'wa2mgr'.

Inside the 3D, WinAmp can be controlled either through keyboard commands or through the ICP. The supported actions are:

Command	The associated keyboard callbacks	ICP
Start Playback	WinAmpStartPlayback	
Stop Playback	WinAmpStopPlayback	
Toggle Playback	WinAmpTogglePlayback	DCS SEQ
Previous Track	WinAmpPreviousTrack	DCS UP
Next Track	WinAmpNextTrack	DCS DOWN
Volume Up (1%)	WinAmpVolumeUp	ICP NEXT
Volume Down (1%)	WinAmpVolumeDown	ICP PREV

To control WinAmp through the ICP, you will have to press the LIST button, then twice the 0 ICP button. The DED will change to show the name of the currently played file, if no WinAmp window was detected, the DED will show an error message. Playback can be toggled through the DCS SEQ button, volume can be controlled through the ICP PREVIOUS/NEXT buttons, the next/previous track can be selected with the DCS UP/DOWN buttons.

12.4 DISPLACEMENT CAM

This feature makes the 'orbit cam' camera move around slightly, simulating the relative motion of whatever airborne vehicle the orbit cam is located on. This feature needs to be enabled in the falconbms.cfg file (either through the config editor or by enabling "g_bEnableDisplacementCam" manually. Once this is done, you can toggle it temporarily by pressing the "ToggleDisplacementCam" keypress.

12.5 AIR TRAFFIC CONTROL - NEW TRAFFIC CALLS

Once you call inbound on approach to a field, ATC will now call out traffic such as "Cowboy 11, traffic 2 O'Clock 4 miles." The traffic must be a possible traffic conflict to your plane or it will not be called out. Once ATC calls traffic out to you, it will continue to update you with that traffic as long as it remains a possible conflict. If you find the traffic, or just want ATC to shut up about the traffic, select the "Traffic In Sight" under the Tower menu. ATC will stop calling that specific traffic out to you unless it becomes a possible conflict again. ATC will not call out aircraft in your own flight.

Known issues: ATC speaks fairly slow in Falcon4. If there are lots of aircraft, and ATC is giving lots of vectors, the buffer can get backed up. When traffic is called out, it may have already moved from the location the traffic call was calculated for. If you have text display on, you will see the traffic call at the appropriate time, but you may hear it 5 or 10 seconds later. Also, Falcon4 is limited to the distance it can call out. It will only call traffic out in the following distances: 1, 2, 3, 4, 5, and 10 miles.

12.6 TACAN RADIO HORIZON

In previous versions of Falcon4, you could receive the TACAN no matter what altitude you were at. A radio horizon has been added that takes your altitude into account when determining if you can receive the TACAN or not. If you are 75 miles out and are receiving the TACAN, if you start to descend, you will reach an area of intermittent reception followed by no reception. The altitude that you loose the TACAN will depend on your distance from the TACAN site.

12.7 UPDATED NOSE WHEEL STEERING

The ground handling has been improved to simulate more realistic nose wheel steering movement.

Known Issues: If you turn the NWS off while in a turn, it will immediately return to center instead of a smooth transition. Also, the rate of turn at full nose wheel deflection is being looked at as it seems a little excessive.

13 MULTIPLAYER ENHANCEMENTS

BMS contains some MP tweaking that should extend multplayer experience. There were found some leftovers from previous debug and testing which ment that packets were dropped instead of being send to players. Also some tweeking with the packet size has been made.

This section explains these tweeks and how to enable/disable them.

13.1 TCP/IP MAXIMUM TRANSMISSION UNIT SIZE (MTU)

In all previous versions of Falcon 4, the TCP/IP MTU packet size was default set to 500 which ment that packet sent between players never exceeded that size even if the messages was larger. Since Windows 98 SE the use of bigger TCP/IP packets has been possible and therefore we introduce the –MTU switch. With this you are able to control what size you will use for MTU.

For example. –MTU 1514 in the commandline for Falcon would triple the amount of data in each packet and save packets send between players. (Initial testing only allowed 750 as a max value). If you do not receive a commit button you will need to reduce the size.

Make some test to see what size that gives best multiplay between players and make sure all players uses the same MTU size.

One new configuration variables has been added to the falconbms.cfg:

set g_bF4CommsMTU 1

One new commandline switch has been added:

-MTU XXX (where XXX is the maximum size of packet)

The MTU switch will only be active if the configuration variable g_bF4CommsMTU is equal 1. Otherwise it defaults to 500 in MTU size.

13.2 DISABLE PACKETS LOSS

Some leftovers (forgotten) code that simulated drop of packets can now be disabled. This means that all packets will be sent to players but it also increases the data transferred.

One new configuration variables has been added to the falconbms.cfg:

set g_bF4CommsKillPL 1

13.3 BANDWIDTH SWITCH

The following commands mean the same thing for bandwidth

-bw

-bandwidth

-bandwith

13.4 STANDARDIZE UI COMMS AND BANDWIDTH SETTING

Too remove any misunderstanding between use of UI coms setting and the bandwidth setting set by commandline these are the rules. All setting is in Kbps and is converted to Bps (Byte pr. Second) with this formular value/8*1000.

This gives following table:

BW switch	UI Coms	Byte pr. second
14	14.4K	1800
28	28.8K	3600
33	33.6K	4200
56	56k	4200
56	56 Single ISDN	7000
112	112k Dual ISDN	14000
256	256K Cable/DSL	32000
1500	T1 or Better	187500

Finally, Canopy and Landing Lights now work correctly.

14 REFUELING

- Increased probability AI can hookup to a tanker (boom or drogue) and refuel.
- Added slots (parent numbers) for additional tankers, booms and drogues.
- Added variables to tanker <ac>.dat file for number of booms, number of drogue stations, length of drogue, active drogue station and refueling aircraft position adjustment.
- Added variables to tanker <ac>.dat file to adjust boom and drogue optimum refueling positions.
- Added variables to aircraft <ac>.dat file for type of refueling required (boom or drogue). Tankers having both boom and drogues use this variable to provide the selected service.
- Added variable to aircraft <ac>.dat file for proper boom staorage angle.
- Raised the boom on the KC-135 and KC-10 into the stored position when not in use.
- The KC-130 is not supported in the refueling code.
- The aircraft refuelingLocation variable in the <ac>.dat file is now used to position the aircraft for proper hookup to the tanker boom/drogue.
- Added drogue basket "light" switch. "Turns on" unshaded polys when drogue is deployed.

APPENDIX A: COUNTERMEASURES PLACEMENT

BMS has support for the placement and direction of decoys. Chaff and Flare can have up to 10 dispensers, each with there own count of decoys. The code has 3 firing modes for the dispensers. These settings don't specify the number of decoys the aircraft is carrying however.

- FlareDispensers 1 - Number of dispensers.
- FlareSeq 0 - Firing Sequence
  - 0 : Alternate dispensers
  - 1 : Use up one dispenser then move to the next
  - 2 : Fire a decoy from each dispenser.
- FlarePos1 0 0 0 - location of dispenser.
- FlareVec1 0 0 200 - vector of dispenser - note velocity is built into the vector (ft/sec)
- FlareCount1 30 - possible number of flares in this dispenser.
- FlarePos10 0 0 0 - location of dispenser.
- FlareVec10 0 0 200 - vector of dispenser - note velocity is built into the vector (ft/sec)
- FlareCount10 30 - possible number of flares in this dispenser.
- ChaffDispensers 1 - Number of dispensers.
- ChaffSeq 0 - Firing Sequence
  - 0 : Alternate dispensers
  - 1 : Use up one dispenser then move to the next
  - 2 : Fire a decoy from each dispenser.
- ChaffPos1 0 0 0 - location of dispenser.
- ChaffVec1 0 0 200 - vector of dispenser - note velocity is built into the vector (ft/sec)
- ChaffCount1 30 - possible number of Chaffs in this dispenser.
- ChaffPos10 0 0 0 - location of dispenser.
- ChaffVec10 0 0 200 - vector of dispenser - note velocity is built into the vector (ft/sec)

- ChaffCount10 30 - possible number of Chaffs in this dispenser.

APPENDIX B: NEW KEYBOARD COMMANDS AND COUGAR PROFILE

A new key file has been created for BMS, intended for Cougar owners and physical cockpit builders. This key file has over 300 available commands. Users may, for example, use their numeric keypad to simulate the ICP. The keyboard map is located in the **[FalconRoot]\config** directory. Additionally, a Cougar Profile created specifically by Mav for this release (thanks bud!) is located in **[FalconRoot]\joystick\Cougar**.

APPENDIX C: AIRCRAFT CONFIG NOTES

(number is default)

- animEngineRPMMult 1000 - Rotate the Prop dof this many times the current rpm (rpm is 1.0 at Mil power).
- animSpoiler1Max 60.0 - Spoiler extends this amount at full deflection.
- animSpoiler1Rate 45.0 - Spoiler moves at this rate
- animSpoiler1OffAtWingSweep 70.0 - If the a/c has swing wings and the wings are swept past this, then the spoiler is disabled.
- animSpoiler1AirBrake 1 - Spoiler acts as airbrake
- animSpoiler2Max 60.0
- animSpoiler2Rate 20.0
- animSpoiler2OffAtWingSweep 45.0
- animSpoiler2AirBrake 1
- animExhNozIdle 0.0 - Drives Exhaust Nozzle DOF based on engine RPM.
- animExhNozMil 10.0
- animExhNozAB 0.0
- animExhNozRate 5.0
- animStrobeOnTime 0.02 - Drives new strobe light code, light is lit for this amount of time (atleast 1 frame)
- animStrobeOffTime 1.0
- animHookAngle 0.0 - Drives Tailhook DOF
- animHookRate 0.0
- animAileronRate 45.0 - On a/c with Ailerons, this is now used instead of tefRate.

The swing wing code uses a table to determine where the wings should be swept to. Each ..MachX line specifies the minimum speed at which the corresponding ..AngleX is applied. For example, the plane has to go at least .6m for the wings to be swept back 25 degrees. Also, don't confuse these angles with real world sweep angles. (ie consider that the LODs have their wings swept to there minimum position, that might be 15degrees in RL, but is 0 inside the code).

- animSwingWingStages 2
- animSwingWingMach1 0.6

- animSwingWingMach2 0.8
- animSwingWingMach3 0.0
- animSwingWingMach4 0.0
- animSwingWingMach5 0.0
- animSwingWingMach6 0.0
- animSwingWingMach7 0.0
- animSwingWingMach8 0.0
- animSwingWingMach9 0.0
- animSwingWingMach10 0.0
- animSwingWingAngle1 25.0
- animSwingWingAngle2 50.0
- animSwingWingAngle3 0.0
- animSwingWingAngle4 0.0
- animSwingWingAngle5 0.0
- animSwingWingAngle6 0.0
- animSwingWingAngle7 0.0
- animSwingWingAngle8 0.0
- animSwingWingAngle9 0.0
- animSwingWingAngle10 0.0
- animSwingWingRate 5.0 - degrees/sec
- Wheel radii - if #1 is 0, then the code is skipped.
- animWheelRadius1 0.0
- animWheelRadius2 0.0
- animWheelRadius3 0.0
- animWheelRadius4 0.0
- animWheelRadius5 0.0
- animWheelRadius6 0.0
- animWheelRadius7 0.0
- animWheelRadius8 0.0

Gears can now have visual compression/extentsion. These specify the limits and are applied as animations to dof ids 58 thru 65. if you use the TransNode to animate the strut (likely :) set the transform vector so that it's z value is 1.0.

Ex: if the gear moves up and down, then the vector would be (0, 0, 1) the distance is determined by the values below:

- animGearMaxComp1 0.0

...through

- animGearMaxComp8 0.0
- animGearMaxExt1 0.0

...through

- animGearMaxExt8 0.0
- animRefuelAngle 1.0
- animRefuelRate .5
- sndInt 0 - Intenal Engine Sound, overrides the Engine Noise in F4Browse if > 0.
- sndExternalVol -2000 When in the pit, the external sounds are lowered in volume by this amount. (note -10 = -1db)
- fuelGuageMultiplier 10

APPENDIX D: 2D COCKPIT ADDED FEATURES

RENDERED NEEDLES

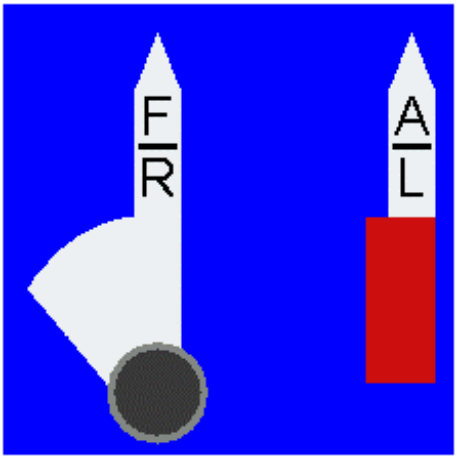
Gauge Needles can now be customized to suit individual aircraft cockpits. Example shown below:

```
#733 DIAL
        cyclebits = 0xffff;
        numendpoints = 9;
        points =  -2.562 -3.002 -3.56 -4.032 -4.608 1.1 0.593 0.148 -0.506;
        values =  0 5000 10000 15000 20000 25000 30000 35000 40000;
        radius0 = 0;
        radius1 = 70;
        radius2 = 14;
        color0 = 0xff000000;
        color1 = 0xff000ec5;
        color2 = 0xff0c0c7a;
        renderneedle = 1;
        srcloc = 2839 2728 2987 2878;;
        destloc = 252 1113 399 1260;
        callbackslot = 120;
        persistant = 0;
#end
```

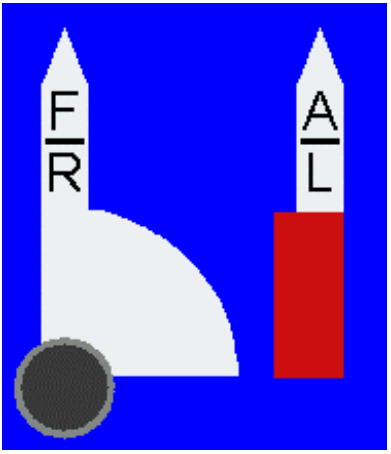
- **renderneedle =1;** is the new entry that will allow a texture to be rendered. Simply use the source location of the texture in correlation with the destination location. Make sure that both source and destination locations are the same size, i.e., 147 pixels by 147 pixels, or whatever the case may be. The base (center of rotation) of the needle/texture also needs to be in the center of the source location box you define. If you have overlapping needles (textures rather), the order in which they appear in the .dat file is the order in which they are rendered. So for example if you wanted two texture needles to be rendered on top of each other, the one you want to be on top of the other needs to be listed **second** in the .dat file. Lastly, the textures need to be sized to the size of the gauge. You can have higher resolution source graphics, but the "word" is down-sizing them to fit in the destination location does not look as good.
- A small change was made to so that the fuel quantity needles will show the proper amount of fuel in each of the two fuel tank systems (Forward-Right and Aft Left) when

the FUEL QTY switch is in NORM. This was already a feature in SP3, but did not include the information needed in the F-16's flight model data file.

- The mechanization for determining a fuel imbalance in SP3 is similar to real life, except that the quantity needles should not overlap one another (a gray needle hides a red needle). When the red needle started to appear an imbalance was occurring. New code has been written to allow for more accurate looking needles--both for looks and imbalance mechanization.
- With the new code/graphics an imbalance will look just like it does in real life, you will see the red portion of the AL pointer showing when the needles are out of tolerance. In Falcon, imbalances only occur if you feed from the FWD or AFT system, instead of NORM, or in some special circumstances when the fuel system isn't pressurized. So getting back to the needles, in the C model, the needles are approximately 600 lbs apart. In the D model, the AL system has more fuel than FR system (because of the second cockpit) and the needles will be separated by 700-1350 lbs. If the needles begin to separate by more or less than these amounts, an imbalance is occurring. NOTE: The D model's needles are different from the C model, and thus you will not get the correct indications in a D model jet with the C model needles. Here is what the needle model graphics should look like, more or less:



C model



D model

The finished product should look like this:

NEW CALLBACKSLOTS ADDED TO 2D COCKPIT

#	**LIGHTS ADDITIONS**
134	VV Dial
135	G Dial
136	RPM Tape Engine 1
137	Swing wing
138	Wing Sweep Dial
139	A0A Dial
140	TEF Dial
141	LEF Dial
142	CBETotalFuelDial
143	CBETotalFuelTape
144	Oil Pressure Dial Engine 2

145	RPM Dial Engine 2
146	InletTemp Dial Engine 2
147	Nozzle Position Engine 2
148	RPM Tape Engine 2
149	Engine #2 Warning / Fire Light
150	Lock Light
151	Shoot Light

#	BUTTONS ADDITIONS	# States
208	OSB/MFD buttons, 3rd MFD	2
209	OSB/MFD buttons, 3rd MFD	2
210	OSB/MFD buttons, 3rd MFD	2
211	OSB/MFD buttons, 3rd MFD	2
212	OSB/MFD buttons, 3rd MFD	2
213	OSB/MFD buttons, 3rd MFD	2
214	OSB/MFD buttons, 3rd MFD	2
215	OSB/MFD buttons, 3rd MFD	2
216	OSB/MFD buttons, 3rd MFD	2
217	OSB/MFD buttons, 3rd MFD	2
218	OSB/MFD buttons, 3rd MFD	2
219	OSB/MFD buttons, 3rd MFD	2
220	OSB/MFD buttons, 3rd MFD	2
221	OSB/MFD buttons, 3rd MFD	2
222	OSB/MFD buttons, 3rd MFD	2
223	OSB/MFD buttons, 3rd MFD	2
224	OSB/MFD buttons, 3rd MFD	2
225	OSB/MFD buttons, 3rd MFD	2

226	OSB/MFD buttons, 3rd MFD	2
227	OSB/MFD buttons, 3rd MFD	2
228	OSB/MFD buttons, 4th MFD	2
229	OSB/MFD buttons, 4th MFD	2
230	OSB/MFD buttons, 4th MFD	2
231	OSB/MFD buttons, 4th MFD	2
232	OSB/MFD buttons, 4th MFD	2
233	OSB/MFD buttons, 4th MFD	2
234	OSB/MFD buttons, 4th MFD	2
235	OSB/MFD buttons, 4th MFD	2
236	OSB/MFD buttons, 4th MFD	2
237	OSB/MFD buttons, 4th MFD	2
238	OSB/MFD buttons, 4th MFD	2
239	OSB/MFD buttons, 4th MFD	2
240	OSB/MFD buttons, 4th MFD	2
241	OSB/MFD buttons, 4th MFD	2
242	OSB/MFD buttons, 4th MFD	2
243	OSB/MFD buttons, 4th MFD	2
244	OSB/MFD buttons, 4th MFD	2
245	OSB/MFD buttons, 4th MFD	2
246	OSB/MFD buttons, 4th MFD	2
247	OSB/MFD buttons, 4th MFD	2
248	3rd MFD Gain Up	2
249	3rd MFD Gain Down	2
250	4th MFD Gain Up	2
251	4th MFD Gain Dn	2
252	ILS Power on (switch on rotary knob, AUDIO2 panel)	2

APPENDIX E: COCKPIT ADDED SWITCHES AND DOF'S

List of current new DOF/SWITCH nodes for better 3d pit support:

SWITCHES

COMP_3DPIT_BACKUP_ADI_OFFMARK = 100, //Backup OFF flag - only visible on ramp-start with cold jet

COMP_3DPIT_ARNWS_LIGHT = 101, //AR/NWS console NWS light

COMP_3DPIT_ARRDY_LIGHT = 102, //AR/NWS console RDY light

COMP_3DPIT_ARDISC_LIGHT = 103, //AR/NWS console DISC light

COMP_3DPIT_AOAON_LIGHT = 104, //AOA indexer console ON light

COMP_3DPIT_AOABELOW_LIGHT = 105, //AOA indexer console bellow light

COMP_3DPIT_AOAABOVE_LIGHT = 106, //AOA indexer console above light

COMP_3DPIT_ALTPNEU_FLAG = 107, //ALT instrumnet PNEU flag

COMP_3DPIT_ILS_VISIBLE = 108, //Make ILS needles on main ADI hide/show

COMP_3DPIT_EYEBROW_ENGFIRE = 109, //RIGHT EYEBROW caution light ENG FIRE

COMP_3DPIT_EYEBROW_ENGINE = 110, //RIGHT EYEBROW caution light ENGINE

COMP_3DPIT_EYEBROW_HYDOIL = 111, //RIGHT EYEBROW caution light HYD/OIL PRESS

COMP_3DPIT_EYEBROW_FLCS = 112, //RIGHT EYEBROW caution light FLCS/DBU ON

COMP_3DPIT_EYEBROW_TOLDG = 113, //RIGHT EYEBROW caution light TO/LDG CONFIG

COMP_3DPIT_EYEBROW_CANOPY = 114, //RIGHT EYEBROW caution light CANOPY OXY LOW

COMP_3DPIT_EYEBROW_TFFAIL = 115, //LEFT EYEBROW caution light TR-FAIL

COMP_3DPIT_ADI_LOC_FLAG = 116, //MAIN ADI LOC flag

COMP_3DPIT_ADI_GS_FLAG = 117, //MAIN ADI GS flag

COMP_3DPIT_ADI_OFF_FLAG = 118, //MAIN ADI OFF flag

COMP_3DPIT_ADI_AUX_FLAG = 119, //MAIN ADI AUX flag

COMP_3DPIT_HSI_OFF_FLAG = 120, //HSI OFF flag

COMP_3DPIT_HSI_TO_FLAG = 121, //HSI TO flag

COMP_3DPIT_HSI_FROM_FLAG = 122, //HSI FROM flag

COMP_3DPIT_HSI_ILSWARN_FLAG = 123, //HSI ILSWARN flag

COMP_3DPIT_HSI_CRSWARN_FLAG = 124, //HSI CRSWARN flag

COMP_3DPIT_AOA_OFF_FLAG = 125, //AOA OFF flag

COMP_3DPIT_VVI_OFF_FLAG = 126, //VVI OFF flag

DOF'S

COMP_3DPIT_ADI_ROLL = 100, //main adi ball roll

COMP_3DPIT_ADI_PITCH = 101, //main adi ball pitch

COMP_3DPIT_ASI_NEEDLE = 102, //asi instrument needle

COMP_3DPIT_BACKUP_ADI_ROLL = 103, //backup adi ball roll

COMP_3DPIT_BACKUP_ADI_PITCH = 104, //backup adi ball pitch

COMP_3DPIT_ALT_NEEDLE = 105, //alt instrument needle

COMP_3DPIT_ILSV_NEEDLE = 106, //ILS vertical needle

COMP_3DPIT_ILSH_NEEDLE = 107, //ILS horizontal needle

COMP_3DPIT_MAG_COMPASS = 108, //backup magnetic compass

COMP_3DPIT_ASIMACH_DIGIT1 = 109, //ASI mach digital readout left digit

COMP_3DPIT_ASIMACH_DIGIT2 = 110, //ASI mach digital readout right digit

COMP_3DPIT_ALT_DIGIT1 = 111, //ALT digital readout digit 1

COMP_3DPIT_ALT_DIGIT2 = 112, //ALT digital readout digit 2

COMP_3DPIT_ALT_DIGIT3 = 113, //ALT digital readout digit 3

COMP_3DPIT_HSI_HDG = 114, //HSI current heading

COMP_3DPIT_HSI_CRS = 115, //HSI desired course

COMP_3DPIT_HSI_DHDG = 116, //HSI desired heading

COMP_3DPIT_HSI_BCN = 117, //HSI beacon course

COMP_3DPIT_HSI_CRSDEV = 118, //HSI course deviation

COMP_3DPIT_HSI_DIST_DIGIT1 = 119, //HSI distance to beacon digit 1

COMP_3DPIT_HSI_DIST_DIGIT2 = 120, //HSI distance to beacon digit 2

COMP_3DPIT_HSI_DIST_DIGIT3 = 121, //HSI distance to beacon digit 3

COMP_3DPIT_HSI_CRS_DIGIT1 = 122, //HSI course beacon digit 1

COMP_3DPIT_HSI_CRS_DIGIT2 = 123, //HSI course to beacon digit 2

COMP_3DPIT_HSI_CRS_DIGIT3 = 124, //HSI course digit 3

COMP_3DPIT_FUELFLOW_DIGIT1 = 125, //FUEL FLOW digit 1

COMP_3DPIT_FUELFLOW_DIGIT2 = 126, //FUEL FLOW digit 2

COMP_3DPIT_FUELFLOW_DIGIT3 = 127, //FUEL FLOW digit 3

COMP_3DPIT_OIL_NEEDLE = 128, //OIL needle

COMP_3DPIT_NOZ_NEEDLE = 129, //NOZ needle

COMP_3DPIT_RPM_NEEDLE = 130, //RPM needle

COMP_3DPIT_FTIT_NEEDLE = 131, //FTIT needle

COMP_3DPIT_AOA = 132, //AOA tape

COMP_3DPIT_VVI = 133, //VVI tape

COMP_3DPIT_HYDA_NEEDLE = 134, //HYD A PRESS needle

COMP_3DPIT_HYDB_NEEDLE = 135, //HYD B PRESS needle

COMP_3DPIT_EPU_NEEDLE = 136, //EPU needle

COMP_3DPIT_FUEL_DIGIT1 = 137, //FUEL digit 1

COMP_3DPIT_FUEL_DIGIT2 = 138, //FUEL digit 2

COMP_3DPIT_FUEL_DIGIT3 = 139, //FUEL digit 3

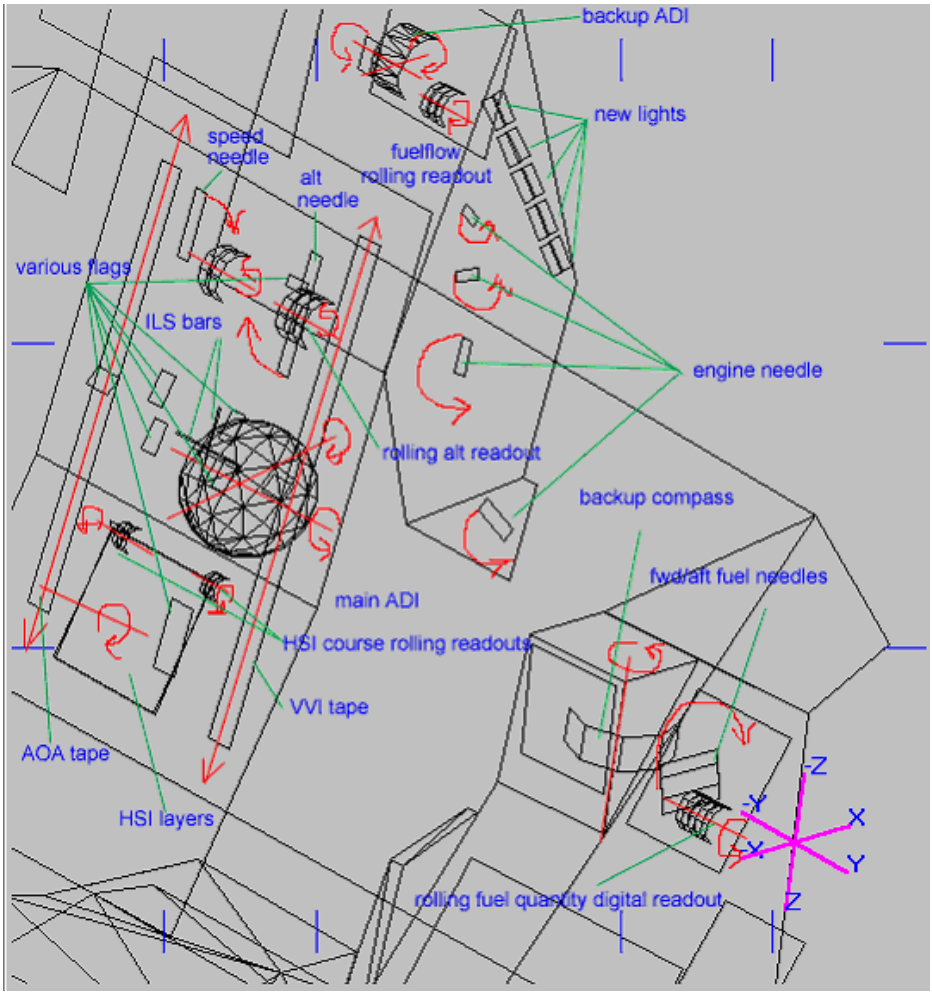
COMP_3DPIT_FUEL_DIGIT4 = 140, //FUEL digit 4

COMP_3DPIT_FUEL_DIGIT5 = 141, //FUEL digit 5

COMP_3DPIT_FUELAFT_NEEDLE = 142, //FUEL AFT

COMP_3DPIT_FUELFWD_NEEDLE = 143, //FUEL FWD

EXECUTION



Needles - polygonal needles (or simple textured quads) under rotation DOF

ADI balls - polygonal objet under nested pitch and roll DOF

AOA / VVI tapes / ILS bars - quads under TDOF (new BMS rotation to translation node)

HSI layers - quads with compass and all marks stacked on each other and using same rotation axis

New lights - quads under SWITCH node

Various mechanical ADI / HSI flags - same as lights, under SWITCH nodes

Digital rolling readouts - cylinder with 10 sections for each number from 0 to 9 with initial position to show 0

Not all instruments are modeled yet, however there are plans to implement them all.

APPENDIX F: BMS COCKPIT BUILDER'S GUIDE

INTRODUCTION

Falcon 4 is arguably the most complete, high fidelity combat simulation (without a security clearance) of a modern tactical fighter aircraft available today. The sophistication of the model of the F-16 and in particular the modeling of the avionics package make it an ideal candidate for devotees of combat flight simulations who are interested in building physical cockpit hardware to interface with their gaming experience.

Sadly, when Falcon4 was created support for cockpit builders was not high on the priority list. As a result, the facilities for interfacing physical cockpit hardware to the game are somewhat primitive. Future versions of the Falcon franchise may include more suitable interface design but until then, keyboard for input and shared memory data values for internal aircraft state outputs will have to suffice.

However, the advent of renewed work on Falcon4 code development presents an opportunity to improve on facilities that do already exist such as they are.

Improvements that will appeal to cockpit builders are intended in several areas of the game:

- Making the shared memory values exported by the game coherent and updated constantly as the game runs.
- Additional data values to supplement those already in the shared memory area.
- New keyboard callback functions that will allow a separate keystroke to be assigned to each separate position of every functional switch and knob in the cockpit.

This document will describe such additions made as part of the Benchmark simulations (BMS) project. Also contained in this document will be some description of features in the game that are of interest to general users of the game but that are not completely explained elsewhere. A number of questions have been raised in the forums about how certain features of the game work, questions that are difficult to answer without access to the source code. For example, information on how the data values in the shared memory area should be interpreted will be included here.

SHARED MEMORY AREA

Changes to Shared Memory Updates

In a number of cases, both the databit values and floating point values contained in the shared memory area were only updated when the on screen view in the game was set to display the lamp or gauge associated with the data value.

For example, the Forward and Aft fuel tank values were only updated when the cockpit art including the fuel totalizer gauge was in view. Similarly, the bit representing the state of the Master Caution lamp was only updated to the correct value when the Master Caution lamp was rendered on the screen.

Fixes are made in the BMS executable to ensure that all shared memory data values are up to date constantly independent of view shown on the screen. The principal value of this is that lamp, gauge and switch states can be kept in sync with the game while the game's view can be directed to the outside world. After all, if you have cockpit hardware to view the state of the aircraft you are virtually flying, why have the cockpit art work shown on the screen at all??

In addition, behavior for two existing values was modified. The data bits referencing the MainGen and StbyGen lights on the ELEC panel have been updated to reflect operation in the real F-16. These lights are on when there is power flowing in the electrical busses and when the respective generators are *not* running. Previously these bits in the shared memory were inverted relative to what they should have been. An incidental fix was also made in this area: owing to a typo in earlier versions of the code, the two generators were not actually treated as separate devices. Turn one on, and both would turn on and visa versa. This has now been fixed and the generators operate independently as separate devices.

New Values in the Shared Memory Area

A modest number of new internal state bits have been added to the shared memory area to provide additional functionality to cockpit builders.

Data Bit Name	Enum Mask	Location	Functional Description
WOW	0x10	lightBits	Weight on Wheels (WOW). This value is “on” if the aircraft is on the ground, the landing gear is in the down position and there are no faults in the landing gear system. Otherwise, the value is “off”. There is one value for all three gear struts (the real F-16 has a WOW switch for each separate strut).
AutoPilotOn	0x40000000	lightBits	Autopilot engaged. This value is “on“ if the pitch mode control switch on the MISC panel is in either the ATT HLD or ALT HLD positions. The real jet uses a magnetically captured three place toggle switch for this control in the MISC panel. The switch bat snaps to center (OFF) position if the magnetic coil in the switch is not energized. Use this bit to energize that coil if your switch has that capability. Note: technically, there are certain conditions under which the AP will not be engaged and funcitoning even when the switch is still captured (for example if you exceed roll or pitch limits during AP operation). Thus the bit here only really indicates whether the switch should be held out of the OFF position by the magnetic coil or not.
TFR_STBY	0x80000000	lightBits	TFR powered but not engaged. The TFR implementation in Falcon4 isn’t totally complete. The actual STBY light works a little differently. In Falcon4 this light, the lower half of the split-face indicator pushbutton in the ADV MODE position on the MISC panel is on whenever there is electrical power available and the terrain following autopilot mode is not engaged.
Power_Off	0x1000	lightBits3	No electrical power flowing. This bit is not used to drive any lamp output. Rather it is a pure state flag to indicate whether the avionics and other systems attached to the various electrical buses are receiving power. This bit is only on if no power is available, i.e. the engine is not operating and the generators (main and standby) are not online. This can be useful in some cases to support controller logic that drives lamp bits for cockpit hardware that has no actual state bits in the shared memory area (i.e. supress any lamp from being on if there is no power in the

			jet).
OuterMarker	0x4000	HsiBits	Aircraft is over the ILS approach middle marker when this bit is set to true. This should be used to light the lamp to the upper right of the HSI in the center console. Note: this lamp actually glows different colors depending on which beacon you are over. The middle marker is believed to be blue colored.
MiddleMarker	0x8000	HsiBits	Aircraft is over the ILS approach middle marker when this bit is set to true. This should be used to light the lamp to the upper right of the HSI in the center console. Note: this lamp actually glows different colors depending on which beacon you are over. The middle marker is believed to be amber colored.

Interpreting Shared Memory Area Data

A number of the data bits and floating point values are not necessarily well documented or easily understood from such documentation as does exist. This section will attempt to provide some insight.

DED Strings

The DED strings are mostly plain old strings, except for two things:

In cases where a star-like character is drawn to highlight a selection, one that can be edited for example, the game places a 0x02 (hex two) value to represent that. In Falcon's weird fonts, that appears to be the star-like glyph. Secondly, where you would ordinarily see the up/down arrow thingy that indicates a value that can be changed with the rocker that has the up and down arrows on it, you will see a 0x01 (hex one). Again in Falcon's font that means that particular up/down arrow glyph.

These values of 0x01 and 0x02 are obviously not printing characters in the usual sense. Thus the DED lines cannot be treated as straight strings (as you would for printf() arguments or something) without either: a) fixing them up first; or b) rendering them char by char as opposed to via string handling routines.

The inverted lines are yet odder. For reasons that aren't clear, even after inspecting the code, the only thing you care about is where you see a 0x02 (two) value: this means the corresponding char in the DEDlines array is to be rendered reverse video. Anything else you see in the invert lines (nulls or spaces; don't ask me why spaces..perhaps someone changed their minds halfway through coding this in the original game or something), you can safely ignore.

Data Bits

Not all bits need further explanation but a few could use a little clarification. These clarifications are presented here.

OBS – This item is not implemented in the game and will never be set while the game runs.

ENG_FIRE – This bit is only set if the engine is on fire. No big surprise. The lamp that implements this in the real jet is a split face indicator with the other half reading ENGINE (which, BTW, should be the lower half not the upper as in the default SP3 10*7 art). The ENGINE legend in this indicator does not have it's own bit in the shared memory. As a workaround, it is probably safe to light this lamp when the ENGINE FAULT caution panel bit is set. It does appear that the ENGINE and ENG FIRE lamps can come on separately under the right circumstances.

CONFIG -- This represents the stores config caution panel indicator.

HYD – If there is any problem with the hydraulics this lamp bit will be set. Note that this bit shares a physical lamp with the *OIL* bit; if either bit is set the whole lamp indicator is lit top and bottom lines (HYD/OIL and PRESS respectively).

OIL – If the RPM is less than 40% or there's any engine fault, this lamp bit is set. Note that this bit shares a physical lamp with the *HYD* bit; if either bit is set the whole lamp indicator is lit top and bottom lines (HYD/OIL and PRESS respectively).

DUAL – The block 50/52 F-16 does not have an indicator lamp labeled with this legend (it's a block 25, 30/32 and older block 40/42 thing). Rather the block 50/52 has a split face indicator that carries the legend FLCS on the top line and DBU ON on the lower line in the corresponding position. The *DUAL* bit is set when there is a fire control computer fault. There appears to be no eyebrow lamp in the block 50/52 that corresponds to this condition.

CAN – Indicates a canopy failure. However, in the current code the condition to set this lamp is for the fire control computer to fail at the same time as the HUD. Strange but true.

FltControlSys – This lamp corresponds primarily to the FLCS FAULT caution panel lamp. It is set when there is an FLCS fault. The block 50/52 also has an eyebrow indicator lamp space for this fault to be displayed with an FLCS legend. This bit should probably be used to drive both the eyebrow and caution panel lamps. NB: there is no implementation of the digital backup software that when running would cause the other half of this eyebrow split face to light up; there's no corresponding databit therefore either.

LEFlaps – this bet represents the caution panel LE Flaps indicator. This bit is only ever set when the jet experiences a complete electrical failure as currently implemented.

SEC – this bit represents the operation of the secondary engine controls which is indicated to the pilot by illuminating the caution panel indicator with this legend. The bit is active when the RPM is below 20% in Falcon4; this is correct for the start sequence but the in flight operation of the SEC is not modeled in the game at present.

BUC – the logic to support this bit is implemented in the game but the bit is never actually set. This is consistent with the dash one that indicates this bit is not operable in this block of aircraft.

TFR_ENGAGED – this bit is set when the LANTIRN mode terrain following autopilot is active. The bit represents one half of a split face lamp indicator that includes an ACTIVE legend (top line) and a STBY legend (bottom line). There is no bit for the STBY legend.

Lef_Fault – this bit gets set when the leading edge flaps are damaged and set in different asymmetric positions or if the LE FLAPS switch in the FLT CONTROL panel is set in the Lock position. Per the dash one, this bit should be used to light the FLCS eyebrow warning light when it is set.

NEW KEYBOARD CALLBACKS

Overview

Callbacks have been added for one of two reasons:

- Functions that were always accessible via the mouse but which were not provided with a keystroke callback.
- Functions that support placing a switch or knob to each discrete position that the control can take (e.g. “on” and “off” positions for two place toggle switches).

Addition of new callbacks for discrete positioning of cockpit controls will not replace existing toggle and increment/decrement functions. Rather, the new functions will be supplemental to callbacks already present to preserve compatibility for existing users and their game controller/joystick programming setups.

There are two problems that recommend the advantages of adding callbacks for commands that place a given knob or switch in a specific position.

Firstly, for existing commands like the SimHSIModes function (default keymapping is “i”), the game wraps the knob position at the right end of its travel so that it goes from the right-most position to the left-most in one move. The default command also only goes “right one”. These two behaviors of the SimHSIModes command make it poorly suited to supporting a real knob, which can turn physically in both directions but that likely has a physical stop at each end, as opposed to wrapping. A controller program for a physical switch can simulate a “left one” function by programming that to send three pulses of the “i” key instead of one. Not terribly satisfactory or efficient.

Secondly, synchronizing physical switch placement to that in the game is quite difficult without the ability to place the in-game switch position directly. There are potential workarounds for this but most rely on a known good physical placement of switches to match a known entry state of the jet. This works but is quite inflexible.

Having discrete commands for each switch a knob placement solves both of these classes of problem. The notion of left and right (or up and down or increment and decrement) switch movement is irrelevant when you can place the in game switch to match the motion of the physical switch precisely. Also, any motion of the switch will directly synchronize the game and the physical hardware. What's more the possibility also then exists to make a controller initialization function that commands the game into the same state as the physical hardware on entry to the game. The following fragment of EPIC controller EPL code demonstrates this for the HSI modes knob:

```
void my_init(void)
{
if (dInstrumentPanel.bTcnILS_Throw) { // this switch closed
                                    call(hsi_tcn_ils);
}
if (dInstrumentPanel.bTcn_Throw) { // this switch closed
                                    call(hsi_tcn);
}
if (dInstrumentPanel.bNav_Throw) { // this switch closed
                                    call(hsi_nav);
}
if (dInstrumentPanel.bNavILS_Throw) { // this switch closed
                                    call(hsi_nav_ils);
}
// and so on for other controls…
}
```

In the above code fragment, each of the "`call()`" invokes the function to send the keystroke that is mapped to the function that places the game's HSI mode knob in the corresponding position. The above code works well for a knob that is wired with four switch closure positions that are mutually exclusive, one per placement of the physical knob. However, given the discrete commands, it should be possible to make controller code that matches most wiring scheme choices.

Modifying the Keystroke Mapping File

There is an excellent tutorial on adding new keystroke entries to the keystroke.key file in the Falcon4\config directory at Frugal's World: http://www.frugalsworld.com/falcon4/keyboard.shtml Please refer to that source for instructions on modifying the .key file to introduce new or different key mappings.

The one piece of critical information missing from this tutorial is a list of the hex codes that are used to "name" the keys in the .key file. The following table describes all the keytop names recognized by the current game engine.

Key Name	Decimal encoding	Hex Encoding
ESCAPE	1	0x01
1	2	0x02
2	3	0x03
3	4	0x04
4	5	0x05
5	6	0x06
6	7	0x07
7	8	0x08
8	9	0x09
9	10	0x0A
0	11	0x0B
MINUS	12	0x0C
EQUALS	13	0x0D
BACK	14	0x0E
TAB	15	0x0F

Q	16	0x10
W	17	0x11
E	18	0x12
R	19	0x13
T	20	0x14
Y	21	0x15
U	22	0x16
I	23	0x17
O	24	0x18
P	25	0x19
LBRACKET	26	0x1A
RBRACKET	27	0x1B
RETURN	28	0x1C
LCONTROL	29	0x1D
A	30	0x1E
S	31	0x1F
D	32	0x20
F	33	0x21
G	34	0x22
H	35	0x23
J	36	0x24
K	37	0x25
L	38	0x26
SEMICOLON	39	0x27
APOSTROPHE	40	0x28
GRAVE	41	0x29
LSHIFT	42	0x2A

BACKSLASH	43	0x2B
Z	44	0x2C
X	45	0x2D
C	46	0x2E
V	47	0x2F
B	48	0x30
N	49	0x31
M	50	0x32
COMMA	51	0x33
PERIOD	52	0x34
SLASH	53	0x35
RSHIFT	54	0x36
MULTIPLY	55	0x37
LMENU	56	0x38
SPACE	57	0x39
CAPITAL	58	0x3A
F1	59	0x3B
F2	60	0x3C
F3	61	0x3D
F4	62	0x3E
F5	63	0x3F
F6	64	0x40
F7	65	0x41
F8	66	0x42
F9	67	0x43
F10	68	0x44
NUMLOCK	69	0x45

SCROLL	70	0x46
NUMPAD7	71	0x47
NUMPAD8	72	0x48
NUMPAD9	73	0x49
SUBTRACT	74	0x4A
NUMPAD4	75	0x4B
NUMPAD5	76	0x4C
NUMPAD6	77	0x4D
ADD	78	0x4E
NUMPAD1	79	0x4F
NUMPAD2	80	0x50
NUMPAD3	81	0x51
NUMPAD0	82	0x52
DECIMAL	83	0x53
F11	87	0x57
F12	88	0x58
F13	100	0x64
F14	101	0x65
F15	102	0x66
KANA	112	0x70
CONVERT	121	0x79
NOCONVERT	123	0x7B
YEN	125	0x7D
NUMPADEQUALS	141	0x8D
CIRCUMFLEX	144	0x90
AT	145	0x91
COLON	146	0x92

UNDERLINE	147	0x93
KANJI	148	0x94
STOP	149	0x95
AX	150	0x96
UNLABELED	151	0x97
NUMPADENTER	156	0x9C
RCONTROL	157	0x9D
NUMPADCOMMA	179	0xB3
DIVIDE	181	0xB5
SYSRQ	183	0xB7
RMENU	184	0xB8
HOME	199	0xC7
UP	200	0xC8
PRIOR	201	0xC9
LEFT	203	0xCB
RIGHT	205	0xCD
END	207	0xCF
DOWN	208	0xD0
NEXT	209	0xD1
INSERT	210	0xD2
DELETE	211	0xD3
LWIN	219	0xDB
RWIN	220	0xDC
APPS	221	0xDD

You can use these with the instructions contained in the .key file editing recipe at the Frugal's World URL to make new entries for the added keystroke callbacks.

It is probably unrealistic to contemplate making compatible additions to the existing default keystrokes.key file to cover all the new functions. Keyboard namespace, which is to say the possible combinations of key names and the various mode keys (CTL, SHF and ALT), is limited and the default key file already uses a good deal of the namespace.

Tactically it is probably a better approach to make a new file. This new file can leave out all the legacy "toggle" and "increment/decrement" functions as well as many of the key entries that are less useful (such as some of the more esoteric view commands) in order to make space for the discrete switch and knob positioning commands.

The plan is to produce such a file to make available with a future release of the BMS executable but this work is not yet complete and tested.

Keystroke Callbacks

There appears to be no other definitive source of keystroke callback routine names that can be used in the construction of a key mapping file. The complete list is presented here. The table therefore includes all the key callbacks that were present in the Falcon4 SP3 executable as a baseline. Keystroke callbacks added subsequently in the BMS executable are listed with **bold** text for the callback name.

Callback Function Name	Remarks
OTWTrackExternal	
OTWTrackTargetToWeapon	
OTWToggleScoreDisplay	
OTWToggleSidebar	
SimRadarAAModeStep	
SimRadarAGModeStep	
SimRadarGainUp	
SimRadarGainDown	
SimRadarStandby	
SimRadarRangeStepUp	
SimRadarRangeStepDown	
SimRadarNextTarget	
SimRadarPrevTarget	

SimRadarBarScanChange	
SimRadarAzimuthScanChange	
SimRadarFOVStep	
SimMaverickFOVStep	
SimSOIFOVStep	
SimRadarFreeze	
SimRadarSnowplow	
SimRadarCursorZero	
SimACMBoresight	
SimDesignate	
SimACMVertical	
SimDropTrack	
SimACMSlew	
SimACM30x20	
SimRadarElevationDown	
SimRadarElevationUp	
SimRWRSetPriority	
SimRWRSetTargetSep	
SimRWRSetUnknowns	
SimRWRSetNaval	
SimRWRSetGroundPriority	
SimRWRSetSearch	
SimRWRHandoff	
SimNextWaypoint	
SimPrevWaypoint	
SimTogglePaused	
SimPickle	

SimTrigger	
SimMissileStep	
SimCursorUp	
SimCursorDown	
SimCursorLeft	
SimCursorRight	
SimToggleAutopilot	
SimStepSMSLeft	
SimStepSMSRight	
SimSelectSRMOverride	
SimSelectMRMOverride	
SimDeselectOverride	
SimToggleMissileCage	
SimToggleMissileSpotScan	
SimToggleMissileBoreSlave	
SimToggleMissileTDBPUncage	
SimDropChaff	In Realistic Avionics mode, this command runs the selected countermeasures program.
SimDropFlare	In Realistic Avionics mode, this command runs the selected countermeasures program.
SimHSDRangeStepUp	
SimHSDRangeStepDown	
SimToggleInvincible	
SimFCCSubModeStep	
SimEndFlight	
SimNextAAWeapon	
SimNextAGWeapon	
SimNextNavMode	

SimEject	
AFBrakesOut	
AFBrakesIn	
AFBrakesToggle	
AFGearToggle	
AFGearUp	Refers to the landing gear control handle This command places the handle in the “up” position. If the gear is not already up and there are no landing gear faults, the gear is stowed. This command only operates with Realistic Avionics selected in the game.
AFGearDown	Refers to the landing gear control handle This command places the handle in the “down” position. If the gear is not already down and locked and there are no landing gear faults, the gear is lowered. This command only operates with Realistic Avionics selected in the game.
AFElevatorUp	
AFElevatorDown	
AFAileronLeft	
AFAileronRight	
AFThrottleUp	
AFThrottleDown	
AFRudderRight	
AFRudderLeft	
AFCoarseThrottleUp	
AFCoarseThrottleDown	
AFABOn	
AFIdle	
OTWTimeOfDayStep	
OTWStepNextAC	
OTWStepPrevAC	

OTWStepNextPadlock	
OTWStepPrevPadlock	
OTWStepNextPadlockAA	SP3 added this command.
OTWStepPrevPadlockAA	SP3 added this command.
OTWStepNextPadlockAG	SP3 added this command.
OTWStepPrevPadlockAG	SP3 added this command.
OTWToggleNames	
OTWToggleCampNames	
OTWSelectF3PadlockMode	
OTWSelectF3PadlockModeAA	SP3 command.
OTWSelectF3PadlockModeAG	SP3 command.
OTWSelectEFOVPadlockMode	
OTWSelectEFOVPadlockModeAA	SP3 command.
OTWSelectEFOVPadlockModeAG	SP3 command.
OTWRadioMenuStep	
OTWRadioMenuStepBack	
OTWStepMFD1	SP2 command. Synonym for DMS Left.
OTWStepMFD2	SP2 command. Synonym for DMS Right.
OTWStepMFD3	
OTWStepMFD4	
OTWToggleScales	
OTWToggleActionCamera	
OTWTogglePitchLadder	
SimPitchLadderOff	Refers to the FPM switch on the HUD control panel, right side console. This command places the switch in the “off” position. In this position the HUD is decluttered by removal of the flight path marker and the pitch ladder. This command only operates with Realistic Avionics selected in the game.

SimPitchLadderFPM	Refers to the FPM switch on the HUD control panel, right side console. This command places the switch in the "FPM" position. In this position the HUD is decluttered by removal of the pitch ladder. This command only operates with Realistic Avionics selected in the game.
SimPitchLadderATTFPM	Refers to the FPM switch on the HUD control panel, right side console. This command places the switch in the "ATT/FPM" position. In this position the HUD displays both the flight path marker and the pitch ladder. This command only operates with Realistic Avionics selected in the game.
OTWStepHeadingScale	
OTWSelectHUDMode	
OTWToggleGLOC	
OTWSelectChaseMode	
OTWSelectOrbitMode	
OTWSelectAirFriendlyMode	
OTWSelectGroundFriendlyMode	
OTWSelectAirEnemyMode	
OTWSelectGroundEnemyMode	
OTWSelectTargetMode	
OTWSelectWeaponMode	
OTWSelectSatelliteMode	
OTWSelectFlybyMode	
OTWSelectIncomingMode	
OTWShowTestVersion	
OTWShowVersion	
OTWSelect2DCockpitMode	
OTWSelect3DCockpitMode	
OTWToggleBilinearFilter	
OTWToggleShading	

OTWToggleHaze	
OTWToggleLocationDisplay	
OTWToggleAeroDisplay	SP2 command.
OTWToggleFlapDisplay	BMS command. Adds a text display to the OTW view for the position of both the TEF and LEF flicht control surfaces. Mostly useful for aircraft other than the F-16.
OTWToggleRoof	
OTWScaleDown	
OTWScaleUp	
OTWSetObjDetail	
OTWObjDetailDown	
OTWObjDetailUp	
OTWTextureIncrease	
OTWTextureDecrease	
OTWToggleClouds	
OTWStepHudColor	
OTWToggleEyeFly	
OTWEnterPosition	
OTWToggleFrameRate	
OTWToggleAutoScale	
OTWSetScale	
OTWViewLeft	
OTWViewRight	
OTWViewUp	
OTWViewDown	
OTWViewReset	
OTWViewUpRight	
OTWViewUpLeft	

OTWViewDownRight	
OTWViewDownLeft	
OTWViewZoomIn	
OTWViewZoomOut	
OTWSwapMFDS	
OTWGlanceForward	
OTWCheckSix	
OTWStateStep	
CommandsSetKeyCombo	
KevinsFistOfGod	This command manually requests the Air Tasking Manager to give the flight a different mission (Request Divert).
SuperCruise	This command artificially boosts engine thrust by a factor of 1.5X. The command is a toggle so a second invocation returns the aircraft to its properly calculated velocity.
OTW1200View	
OTW1200DView	
OTW1200HUDView	
OTW1200LView	
OTW1000View	
OTW200View	
OTW900View	SP2 command. Synonym for ghost MFD view.
OTW300View	
OTW800View	
OTW400View	
OTW1200RView	
RadioMessageSend	
SimToggleChatMode	
SimMotionFreeze	

ScreenShot	
FOVToggle	This command toggles the out-the-window (OTW) view field toggles between 60 degrees (normal) and 20 degrees (narrow).
FOVDecrease	This command increases the OTW view field by an increment that may be specified in the .cfg file.
FOVIncrease	This command decreases the OTW view field by an increment that may be specified in the .cfg file.
FOVDefault	This command returns the OTW view field to the default value (60 degrees).
OTWToggleAlpha	
SimAVTRToggle	
SimSelectiveJettison	
SimEmergencyJettison	
SimWheelBrakes	
SimECMOn	
SimECMStandby	Refers to the right throw of the HOTAS CMS switch. This command places the ECM transmitter in standby mode so that it makes no emissions. This command only operates if Realistic Avionics are selected.
SimECMConsent	Refers to the down throw of the HOTAS CMS switch (i.e. towards the pilot). This command enables the ECM transmitter to begin transmitting. This command only operates if Realistic Avionics are selected.
SimRadarElevationCenter	
SimHsiCourseInc	
SimHsiCourseDec	
SimHsiHeadingInc	
SimHsiHeadingDec	
SimAVTRToggle	
SimMPOToggle	Note: in reality, the physical switch for this control is a momentary spring-loaded action. This means it should be held in the OVRD position to be effective. The

	SimMPOToggle command does not work this way and should be considered deprecated for cockpit hardware builder use. See SimMPO instead.
SimMPO	Refers to the manual pitch override switch on the manual pitch panel. This command is a momentary that must be held to keep the switch in the OVRD position. When the key for this command is held, normal FLCS limter values are suspended. Once the key is released, the switch snaps back to the NORM position and normal FLCS limiters once more apply. This command only operates if Realistic Avionics are selected.
SimSilenceHorn	
SimStepHSIMode	
SimHSIIlsTcn	This command refers to the HSI modes knob on the INSTR panel. It places the knob in the ILS/TCN position directly. This command only operates if Realistic Avionics are selected.
SimHSITcn	This command refers to the HSI modes knob on the INSTR panel. It places the knob in the TCN position directly. This command only operates if Realistic Avionics are selected.
SimHSINav	This command refers to the HSI modes knob on the INSTR panel. It places the knob in the NAV position directly. This command only operates if Realistic Avionics are selected.
SimHSIIlsNav	This command refers to the HSI modes knob on the INSTR panel. It places the knob in the ILS/NAV position directly. This command only operates if Realistic Avionics are selected.
SimCBEOSB_1L	
SimCBEOSB_2L	
SimCBEOSB_3L	
SimCBEOSB_4L	
SimCBEOSB_5L	
SimCBEOSB_6L	
SimCBEOSB_7L	

SimCBEOSB_8L	
SimCBEOSB_9L	
SimCBEOSB_10L	
SimCBEOSB_11L	
SimCBEOSB_12L	
SimCBEOSB_13L	
SimCBEOSB_14L	
SimCBEOSB_15L	
SimCBEOSB_16L	
SimCBEOSB_17L	
SimCBEOSB_18L	
SimCBEOSB_19L	
SimCBEOSB_20L	
SimCBEOSB_1R	
SimCBEOSB_2R	
SimCBEOSB_3R	
SimCBEOSB_4R	
SimCBEOSB_5R	
SimCBEOSB_6R	
SimCBEOSB_7R	
SimCBEOSB_8R	
SimCBEOSB_9R	
SimCBEOSB_10R	
SimCBEOSB_11R	
SimCBEOSB_12R	
SimCBEOSB_13R	
SimCBEOSB_14R	

SimCBEOSB_15R	
SimCBEOSB_16R	
SimCBEOSB_17R	
SimCBEOSB_18R	
SimCBEOSB_19R	
SimCBEOSB_20R	
SimCBEOSB_GAINUP_L	
SimCBEOSB_GAINUP_R	
SimCBEOSB_GAINDOWN_L	
SimCBEOSB_GAINDOWN_R	
SimICPTILS	
SimICPALOW	
SimICPFAck	
SimICPPrevious	
SimICPNext	
SimICPLink	
SimICPCrus	
SimICPStpt	
SimICPMark	
SimICPEnter	
SimICPCom1	
SimICPNav	
SimICPAA	
SimICPAG	
SimHUDScales	
SimScalesVVVAH	Refers to the vertical velocity control switch on the HUD panel. This command places that switch in the VV/VAH position (up). The command only operates with realistic

	avionics selected.
SimScalesVAH	Refers to the vertical velocity control switch on the HUD panel. This command places that switch in the VAH position (middle). The command only operates with realistic avionics selected.
SimScalesOff	Refers to the vertical velocity control switch on the HUD panel. This command places that switch in the OFF position (down). The command only operates with realistic avionics selected.
SimHUDFPM	
SimHUDDED	
SimHUDDEDOff	Refers to the DED data control on the HUD panel. This command places the switch in the OFF (down) position. The HUD will display no DED or PFL data. The command only operates with realistic avionics selected.
SimHUDDEDPFL	Refers to the DED data control on the HUD panel. This command places the switch in the PFL (middle) position. The HUD display will include PFL data. The command only operates with realistic avionics selected.
SimHUDDEDDED	Refers to the DED data control on the HUD panel. This command places the switch in the DED (up) position. The HUD will display DED data. The command only operates with realistic avionics selected.
SimHUDVelocity	
SimHUDVelocityCAS	Refers to the velocity display control on the HUD panel. This command places the control in the CAS (up) position. The speed shown in the HUD display will be calibrated airspeed. The command only operates with realistic avionics selected.
SimHUDVelocityTAS	Refers to the velocity display control on the HUD panel. This command places the control in the TAS (middle) position. The speed shown in the HUD display will be true airspeed. The command only operates with realistic avionics selected.
SimHUDVelocityGND	Refers to the velocity display control on the HUD panel. This command places the control in the GND SPD (down) position. The speed shown in the HUD display will be

	ground speed. The command only operates with realistic avionics selected.
SimHUDRadar	
SimHUDAltRadar	Refers to the altimeter display control on the HUD panel. This command places the control in the RADAR (up) position. The altitude shown in the HUD display will be fed from the radar altimeter. The command only operates with realistic avionics selected.
SimHUDAltBaro	Refers to the altimeter display control on the HUD panel. This command places the control in the BARO (middle) position. The altitude shown in the HUD display will be fed from the barometric altimeter. The command only operates with realistic avionics selected.
SimHUDAltAuto	Refers to the altimeter display control on the HUD panel. This command places the control in the AUTO (down) position. The altitude shown in the HUD display will be fed from the radar altimeter or the barometric altimeter. If either jet altitude is at/below 1500' AGL and the jet is ascending or if the altitude is at/below 1200' AGL and the jet is descending, then altitude AGL is displayed, otherwise barometric altitude is used. The command only operates with realistic avionics selected.
SimHUDBrightness	
SimHUDBrtDay	Refers to the brightness control on the HUD panel. This command places the switch in the DAY (up) position. HUD display is in the brightest configuration. In effect this uses the largest multiplier with the SYM wheel position to calculate the brightness. The command only operates with realistic avionics selected.
SimHUDBrtAuto	Refers to the brightness control on the HUD panel. This command places the switch in the AUTO (middle) position. HUD display is in the brightest configuration. In effect this uses a medium multiplier with the SYM wheel position to calculate the brightness. The command only operates with realistic avionics selected.
SimHUDBrtNight	Refers to the brightness control on the HUD panel. This command places the switch in the NIGHT (up) position. HUD display is in the brightest configuration. In effect this uses the smallest multiplier with the SYM wheel position to

	calculate the brightness. The command only operates with realistic avionics selected.
SimHUDBrightnessUp	
SimHUDBrightnessDown	
SimCycleRadioChannel	This command has maps to the UHF preset channel selector knob on the UHF panel. This command has bee updated to match correct behavior. In this version of the game, this command will change only the UHF channel and then if and only if the CNI switch on the AUX COMM panel is in the backup position. There is no backup control for changing VHF radio channel so if the ICP is not working you are out of luck on that one.
SimDecRadioChannel	Can be used to map to the radio preset channel selector encoder knob on the UHF. This command does the inverse of the SimCycleRadioChannel command which is to say it changes the channel but cycling through the 8 choices in reverse order. This command will change only the UHF channel and then if and only if the CNI switch on the AUX COMM panel is in the backup position. There is no backup control for changing VHF radio channel so if the ICP is not working you are out of luck on that one. This command only operates with realistic avionics selected.
SimToggleRadioVolume	
RadioTankerCommand	
RadioTowerCommand	
RadioAWACSCommand	
RadioWingCommand	
RadioElementCommand	
RadioFlightCommand	
WingmanClearSix	
ElementClearSix	
FlightClearSix	
WingmanCheckSix	
ElementCheckSix	

FlightCheckSix	
WingmanBreakLeft	
ElementBreakLeft	
FlightBreakLeft	
WingmanBreakRight	
ElementBreakRight	
FlightBreakRight	
WingmanPince	
ElementPince	
FlightPince	
WingmanPosthole	
ElementPosthole	
FlightPosthole	
WingmanChainsaw	
ElementChainsaw	
FlightChainsaw	
WingmanFlex	
ElementFlex	
FlightFlex	
WingmanGoShooterMode	
ElementGoShooterMode	
FlightGoShooterMode	
WingmanGoCoverMode	
ElementGoCoverMode	
FlightGoCoverMode	
WingmanSearchGround	
ElementSearchGround	

FlightSearchGround	
WingmanSearchAir	
ElementSearchAir	
FlightSearchAir	
WingmanResumeNormal	
ElementResumeNormal	
FlightResumeNormal	
WingmanRejoin	
ElementRejoin	
FlightRejoin	
WingmanDesignateTarget	
ElementDesignateTarget	
FlightDesignateTarget	
WingmanDesignateGroup	
ElementDesignateGroup	
FlightDesignateGroup	
WingmanWeaponsHold	
ElementWeaponsHold	
FlightWeaponsHold	
WingmanWeaponsFree	
ElementWeaponsFree	
FlightWeaponsFree	
WingmanWedge	
ElementWedge	
FlightWedge	
WingmanTrail	
ElementTrail	

FlightTrail	
WingmanResCell	
ElementResCell	
FlightResCell	
WingmanBox	
ElementBox	
FlightBox	
WingmanArrow	
ElementArrow	
FlightArrow	
WingmanKickout	
ElementKickout	
FlightKickout	
WingmanCloseup	
ElementCloseup	
FlightCloseup	
WingmanToggleSide	
ElementToggleSide	
FlightToggleSide	
WingmanIncreaseRelAlt	
ElementIncreaseRelAlt	
FlightIncreaseRelAlt	
WingmanDecreaseRelAlt	
ElementDecreaseRelAlt	
FlightDecreaseRelAlt	
WingmanGiveBra	
ElementGiveBra	

FlightGiveBra	
WingmanGiveStatus	
ElementGiveStatus	
FlightGiveStatus	
WingmanGiveDamageReport	
ElementGiveDamageReport	
FlightGiveDamageReport	
WingmanGiveFuelState	
ElementGiveFuelState	
FlightGiveFuelState	
WingmanGiveWeaponsCheck	
ElementGiveWeaponsCheck	
FlightGiveWeaponsCheck	
WingmanRTB	
ElementRTB	
FlightRTB	
SimSpeedyGonzalesUp	This command artificially multiplies aircraft velocity by ¼ per invocation of the command up to a maximum of 32X.
SimSpeedyGonzalesDown	This command artificially reduces aircraft velocity that was previously inflated via the SimSpeedyGonzalesUp command. The velocity is divided by a factor of 1.25 for each invocation of the command. Repeated use of this command will reduce a previously inflated speed to the default 1.0X, i.e the original intended velocity.
ATCRequestClearance	
ATCRequestEmergencyClearance	
ATCRequestTakeoff	
ATCRequestTaxi	
ATCTaxiing	
ATCReadyToGo	

ATCRotate	
ATCGearUp	
ATCGearDown	
ATCBrake	
ATCAbortApproach	
FACCheckIn	
FACWilco	
FACUnable	
FACReady	
FACIn	
FACOut	
FACRequestMark	
FACRequestTarget	
FACRequestBDA	
FACRequestLocation	
FACRequestTACAN	
TankerRequestFuel	
TankerReadyForGas	
TankerDoneRefueling	
TankerBreakaway	
AWACSRequestPicture	
AWACSRequestTanker	
AWACSWilco	
AWACSUnable	
AWACSRequestHelp	
AWACSRequestRelief	
TimeAccelerate	

TimeAccelerateMaxToggle	
TimeAccelerateInc	Added in eRazor executables.
TimeAccelerateDec	Added in eRazor executables.
SimFuelDump	SP3 added this command.
SimCycleDebugLabels	SP3 command.
AFABFull	
BombRippleIncrement	SP3 command.
BombIntervalIncrement	SP3 command.
BombRippleDecrement	SP3 command.
BombIntervalDecrement	SP3 command.
BombPairRelease	SP3 command.
BombSGLRelease	SP3 command.
BombBurstIncrement	SP3 command.
BombBurstDecrement	SP3 command.
BreakToggle	Not implemented.
SimICPCom2	
SimToggleDropPattern	
KneeboardTogglePage	
ToggleNVGMode	
ToggleSmoke	
WingmanSpread	
ElementSpread	
FlightSpread	
WingmanStack	
ElementStack	
FlightStack	
WingmanLadder	

ElementLadder	
FlightLadder	
WingmanFluid	
ElementFluid	
FlightFluid	
SimOpenChatBox	
ExtinguishMasterCaution	
SoundOff	
SimToggleExtLights	
IncreaseAlow	
DecreaseAlow	
SaveCockpitDefaults	
LoadCockpitDefaults	
SimStepMasterArm	
SimArmMasterArm	
SimSafeMasterArm	
SimSimMasterArm	
SimSetBubbleSize	SP3 command.
SimHookToggle	SP3 command.
SimHookUp	This command refers to the HOOK switch on the landing gear panel. This command places the switch in the UP position. The hook on the aircraft is raised to the stowed position. This will also clear the hook caution panel light and master caution light. This command will only operate if realistic avionics are selected.
SimHookDown	This command refers to the HOOK switch on the landing gear panel. This command places the switch in the DOWN position. The hook on the aircraft is lowered to the deployed position. This will also set the hook caution panel light and master caution light will come on as a result also. This command will only operate if realistic avionics are

	selected.
SimThrottleIdleDetent	SP3 command.
SimJfsStart	SP3 command. Actually START2 on the ENG JET START panel; there is no command for using the START1 position. Note: this command should be used to map to the action of putting the switch in the START2 position; do not also map it to the movement of the switch back to center/off position (in other words, treat it more like a push button). This accounts for the fact that the real jet uses a magnetically captured switch that holds the bat in the START2 position until the engine comes alive (55% RPM during normal ground start) at which point the JFS engine is powered down and this switch self-centers to off.
SimEpuToggle	SP3 command.
SimEpuOff	Refers to the EPU mode control on the EPU panel. This command places the switch in the OFF (down) position. Prevents the EPU from running or terminates EPU if running. This command will only operate if realistic avionics are selected.
SimEpuAuto	Refers to the EPU mode control on the EPU panel. This command places the switch in the AUTO (middle) position. The EPU is normally off but it will run automatically provided there is EPU fuel on hand and if the main and standby generators go offline and the jet is in the air (NB: these are the only conditions checked in the game as implemented today), making normal sources of power unavailable. This command will only operate if realistic avionics are selected.
SimEpuOn	Refers to the EPU mode control on the EPU panel. This command places the switch in the ON (up) position. The EPU will start running if EPU fuel is still available. This command will only operate if realistic avionics are selected.
AFRudderTrimLeft	Added in eRazor executables. NB: this command does nothing when the Trim AP Disc switch is in the DISC position. Technically, this control doesn't exist in the jet (see instead the SimTrimYawLeft which should be mapped to the manual trim panel).
AFRudderTrimRight	Added in eRazor executables. NB: this command does nothing when the Trim AP Disc switch is in the DISC

	position. Technically, this control doesn't exist in the jet (see instead the SimTrimYawRight which should be mapped to the manual trim panel).
AFAileronTrimLeft	Added in eRazor executables. This command is for mapping to the HOTAS trim hat left throw position. NB: this command does nothing when the Trim AP Disc switch is in the DISC position.
AFAileronTrimRight	Added in eRazor executables. This command is for mapping to the HOTAS trim hat right throw position. NB: this command does nothing when the Trim AP Disc switch is in the DISC position.
AFElevatorTrimUp	Added in eRazor executables. This command is for mapping to the HOTAS trim hat down throw position. NB: this command does nothing when the Trim AP Disc switch is in the DISC position.
AFElevatorTrimDown	Added in eRazor executables. This command is for mapping to the HOTAS trim hat up throw position. NB: this command does nothing when the Trim AP Disc switch is in the DISC position.
AFResetTrim	Added in eRazor executables. NB: there appears to be no real control for this in the actual jet; trim AP Disc zeros out any input commanded from the HOTAS trim hat and the FLCS resets trim when jet speed drops below 60 knots but the game doesn't currently implement that.
AFAlternateGear	Added in eRazor executables.
AFAlternateGearReset	Added in eRazor executables.
SimFLIRToggle	Added in eRazor executables.
SimToggleTFR	Added in eRazor executables.
SimMainPowerInc	Added in eRazor executables.
SimMainPowerDec	Added in eRazor executables.
SimMainPowerOff	Refers to the electrical power switch in the ELEC panel. This command places the switch in the OFF (down) position. Power is removed from all electrical buses. This command only operates if realistic avionics are selected.
SimMainPowerBatt	Refers to the electrical power switch in the ELEC panel. This command places the switch in the BATT (middle)

	position. Power is applied from the battery to the electrical system. Generators will not run with the switch in this position. This command only operates if realistic avionics are selected.
SimMainPowerMain	Refers to the electrical power switch in the ELEC panel. This command places the switch in the OFF (down) position. Power is applied to all electrical buses and the generators are enabled. This command only operates if realistic avionics are selected.
AFFullFlap	SP2 command.
AFNoFlap	SP2 command.
AFIncFlap	SP2 command.
AFDecFlap	SP2 command.
AFFullLEF	SP2 command.
AFNoLEF	SP2 command.
AFIncLEF	SP2 command.
AFDecLEF	SP2 command.
AFDragChute	SP2 command.
AFCanopyToggle	SP2 command.
SimICPIFF	SP3 command.
SimICPLIST	SP3 command.
SimICPTHREE	SP3 command.
SimICPSIX	SP3 command.
SimICPEIGHT	SP3 command.
SimICPNINE	SP3 command.
SimICPZERO	SP3 command.
SimICPResetDED	SP3 command.
SimICPDEDUP	SP3 command.
SimICPDEDDOWN	SP3 command.
SimICPDEDSEQ	SP3 command.

SimICPCLEAR	SP3 command.
SimRALTSTDBY	SP3 command.
SimRALTON	SP3 command.
SimRALTOFF	SP3 command.
SimLandingLightToggle	SP3 command.
SimLandingLightOn	Refers to the LIGHTS switch on the landing gear panel. This command places the switch in the LANDING position which turns on the light. NB: the game only implements two positions for this control not three as in the real jet. This command only operates if realistic avionics are selected.
SimLandingLightOn	Refers to the LIGHTS switch on the landing gear panel. This command places the switch in the OFF position which turns off the light. NB: the game only implements two positions for this control not three as in the real jet. This command only operates if realistic avionics are selected.
SimParkingBrakeToggle	SP3 command.
SimParkingBrakeOn	Refers to the PARKING BRAKE switch on the landing gear panel. This command places the switch in the up or on position which engages the parking brake. The command does nothing if the jet is moving. NB: the game only implements two positions for this control not three as in the real jet. This command only operates if realistic avionics are selected.
SimParkingBrakeOn	Refers to the PARKING BRAKE switch on the landing gear panel. This command places the switch in the down or OFF position which disengages the parking brake. NB: the game only implements two positions for this control not three as in the real jet. This command only operates if realistic avionics are selected.
SimLaserArmToggle	SP3 command.
SimLaserArmOn	Refers to the LASER switch on the MISC panel. This command places the switch in the ARM position. Provided that the MASTER ARM switch is in the ARM position, the command makes the laser designator ready to fire on command from the fire control computer. This command only operates if realistic avionics are selected.

SimLaserArmOff	Refers to the LASER switch on the MISC panel. This command places the switch in the ARM position. Regardless of the MASTER ARM switch position, the command preventsthe laser designator from firing. This command only operates if realistic avionics are selected.
SimFuelDoorToggle	SP3 command.
SimFuelDoorOpen	Refers to the Refers to the air refuel switch on the FUEL panel. The commands places the switch in the OPEN position and opens the fuel door with the commensurate side effects (e.g. suspension of autopilot if engaged, FLCS landing gains engaged). This command only operates if realistic avionics are selected.
SimFuelDoorClose	Refers to the Refers to the air refuel switch on the FUEL panel. The commands places the switch in the CLOSE position and opens the fuel door with the commensurate side effects (e.g. normal FLCS gains restored). This command only operates if realistic avionics are selected.
SimRightAPSwitch	SP3 command.
SimLeftAPSwitch	SP3 command.
SimLeftAPUp	Refers to the leftmost roll mode autopilot control switch on the MISC panel. This command places the switch in the HDG SEL (up) position. If the autopilot is engaged, the jet will turn to match the heading selected in the HSI. This command only operates if realistic avionics are selected.
SimLeftAPMid	Refers to the leftmost roll mode autopilot control switch on the MISC panel. This command places the switch in the ATT HLD (middle) position. If the autopilot is engaged, the jet will hold the bank angle being commanded by the flight controls at the time when the autopilot was engaged. This command only operates if realistic avionics are selected.
SimLeftAPDown	Refers to the leftmost roll mode autopilot control switch on the MISC panel. This command places the switch in the STRG SEL (down) position. If the autopilot is engaged, the jet will turn to a heading that leads towards the currently selected waypoint. This command only operates if realistic avionics are selected.
SimRightAPUp	Refers to the rightmost pitch mode autopilot control switch on the MISC panel. This command places the switch in the ALT HOLD (up) position. This command engages the

	autopilot and causes the autopilot to maintain the altitude commanded by the flight controls at the time the autopilot was engaged. This command only operates if realistic avionics are selected.
SimRightAPMid	Refers to the rightmost pitch mode autopilot control switch on the MISC panel. This command places the switch in the A/P OFF (middle) position. This command disengages the autopilot. This command only operates if realistic avionics are selected.
SimRightAPDown	Refers to the rightmost pitch mode autopilot control switch on the MISC panel. This command places the switch in the ATT HOLD (up) position. This command engages the autopilot and causes the autopilot to maintain the pitch attitude commanded by the flight controls at the time the autopilot was engaged. This command only operates if realistic avionics are selected. NB: in the actual F-16 the physical switch for this control is spring-loaded to center and is magnetically held to the up or down position. When the autopilot encounters conditions that prevent its continued operation (excessive pitch or roll that exceed its limits for example), releasing the magnetic hold on this switch centers it and disengages the autopilot. With the current Falcon4 implementation, it would appear that the pitch ATT HOLD position can only be selected if the roll mode switch is in the center position. With the roll mode switch in any other position the pitch mode switch will appear not to go into the down position but in fact it is merely centering again instantly. This may not be correct relative to how the real jet operates. This is under investigation with “authoritative sources” ;-)
SimAPOverride	Added in eRazor executables. HOTAS control stick paddle switch.
SimWarnReset	SP3 command.
SimReticleSwitch	SP3 command.
SimReticlePri	Refers to the depressible reticle control on the HUD panel. This command places the switch in the PRI (middle) position. The primary depressible reticle used for manual bomb delivery is displayed in the HUD. This command is only operable if realistic avionics are selected.

SimReticleStby	Refers to the depressible reticle control on the HUD panel. This command places the switch in the STBY (up) position. The standby depressible reticle used for manual bomb delivery is displayed in the HUD. This command is only operable if realistic avionics are selected.
SimReticleOff	Refers to the depressible reticle control on the HUD panel. This command places the switch in the OFF (bottom) position. The primary and standby depressible reticles used for manual bomb delivery are not displayed in the HUD. This command is only operable if realistic avionics are selected.
SimTMSUp	SP3 command.
SimTMSLeft	SP3 command.
SimTMSDown	SP3 command.
SimTMSRight	SP3 command.
SimSeatArm	SP3 command.
SimSeatOn	Refers to the ACES II seat arming level on the left side of the ejection seat. This command places the lever in the down or ARMED position. The ejection seat is enabled. This command is only operable if realistic avionics are selected.
SimSeatOff	Refers to the ACES II seat arming level on the left side of the ejection seat. This command places the lever in the up or SAFE position. The ejection seat is disabled. This command is only operable if realistic avionics are selected.
SimEWSRWRPower	SP3 command.
SimEWSRWROn	Refers to the RWR switch on the CMDS panel. This command places the switch in the ON position and enables the RWR system to provide inputs to the CMDS. See also SimEWSModeAuto. This command is only operable if realistic avionics are selected.
SimEWSRWROff	Refers to the RWR switch on the CMDS panel. This command places the switch in the OFF position and prevents the RWR system from providing inputs to the CMDS. See also SimEWSModeAuto. This command is only operable if realistic avionics are selected.

SimEWSJammerPower	SP3 command.
SimEWSJammerOn	Refers to the JAMMER switch on the CMDS panel. This command places the switch in the ON position and allows the CMDS system to power on the ECM system if the CMS mode is in SEMI or AUTO modes (see also SimEWS ModeSemi and SimEWSModeAuto). Note this command is not a power on for the ECM transmitter so you can enable ECM manually with the HOTAS controls even if this switch is OFF. This command is only operable if realistic avionics are selected.
SimEWSJammerOff	Refers to the JAMMER switch on the CMDS panel. This command places the switch in the OFF position and prevents the CMDS system from powering on the ECM system if the CMS mode is in SEMI or AUTO modes (see also SimEWS ModeSemi and SimEWSModeAuto). Note this command is not a power off for the ECM transmitter so you can enable ECM manually with the HOTAS controls even if this switch is OFF. This command is only operable if realistic avionics are selected.
SimEWSChaffPower	SP3 command.
SimEWSChaffOn	Refers to the CH switch on the CMDS panel. This command places the switch in the ON position and enables the use of chaff as part of the countermeasures dispense program. This command is only operable if realistic avionics are selected.
SimEWSChaffOff	Refers to the CH switch on the CMDS panel. This command places the switch in the OFF position and disables the use of chaff as part of the countermeasures dispense program. This command is only operable if realistic avionics are selected.
SimEWSFlarePower	SP3 command.
SimEWSFlareOn	Refers to the FL switch on the CMDS panel. This command places the switch in the ON position and enables the use of flares as part of the countermeasures dispense program. This command is only operable if realistic avionics are selected.
SimEWSFlareOff	Refers to the FL switch on the CMDS panel. This command places the switch in the OFF position and disables the use of flares as part of the countermeasures

	dispense program. This command is only operable if realistic avionics are selected.
SimEWSPGMInc	SP3 command.
SimEWSPGMDec	SP3 command.
SimEWSModeOff	Refers to the countermeasures mode knob on the CMDS panel. This command places the knob in the OFF position. The countermeasures system is disabled. This command only operates if realistic avionics are selected.
SimEWSModeStby	Refers to the countermeasures mode knob on the CMDS panel. This command places the knob in the STBY position. The countermeasures system is set to standby condition but dispense programs will not run. This command only operates if realistic avionics are selected.
SimEWSModeMan	Refers to the countermeasures mode knob on the CMDS panel. This command places the knob in the MAN position. The countermeasures dispense system is armed but the selected program will only run by pilot command (see SimDropProgrammed). This command only operates if realistic avionics are selected.
SimEWSModeSemi	Refers to the countermeasures mode knob on the CMDS panel. This command places the knob in the SEMI position. The countermeasures system is armed. When the RWR detects a paint, the VMS will prompt the pilot to activate ECM (if fitted) with the “Jammer” message. If the RWR detects a missile launch event, the selected countermeasures program is run. The RWR switch on this panel must be in the ON position for the CMDS to receive input from the RWR system.This command only operates if realistic avionics are selected.
SimEWSModeAuto	Refers to the countermeasures mode knob on the CMDS panel. This command places the knob in the OFF position. The countermeasures system is enabled. When the RWR detects a paint, system will activate ECM (if fitted) unless the REQJAM option is explicitly set to “off” via the ICP. If the RWR detects a missile launch event, the selected countermeasures program is run. The RWR switch on this panel must be in the ON position for the CMDS to receive input from the RWR system.This command only operates if realistic avionics are selected.

SimEWSProgInc	SP3 command.
SimEWSProgDec	SP3 command.
SimEWSProgOne	Refers to the countermeasures program selection knob on the CMDS panel. The command places the knob in the “1” position. Program one is active. This command only operates if realistic avionics are selected.
SimEWSProgTwo	Refers to the countermeasures program selection knob on the CMDS panel. The command places the knob in the “2” position. Program two is active. This command only operates if realistic avionics are selected.
SimEWSProgThree	Refers to the countermeasures program selection knob on the CMDS panel. The command places the knob in the “3” position. Program three is active. This command only operates if realistic avionics are selected.
SimEWSProgFour	Refers to the countermeasures program selection knob on the CMDS panel. The command places the knob in the “4” position. Program four is active. This command only operates if realistic avionics are selected.
SimInhibitVMS	SP3 command.
SimVMSOn	Refers to the VOICE MESSAGE SWITCH on the ZEROISE PANEL (right console). This command places the switch in the up or ON position enabling the VMS to play audio cue messages (aka “Bitchin’ Betty“). This command only operates if realistic avionics are selected.
SimVMSOFF	Refers to the VOICE MESSAGE SWITCH on the ZEROISE PANEL (right console). This command places the switch in the down or INHIBIT position preventing the VMS from playing audio cue messages (aka “Bitchin’ Betty“). This command only operates if realistic avionics are selected.
SimRFSwitch	SP3 command.
SimRFNorm	Refers to the RF switch on the MISC panel. This command places the switch in the NORM (up) position. RF transmissions from systems that are emitters and that are active are enabled. This command only operates if realistic avionics are selected.
SimRFQuiet	Refers to the RF switch on the MISC panel. This command

	places the switch in the QUIET (middle) position. RF transmissions from systems that are emitters and that are active are reduced. In particular, the main APG-68 radar set does not transmit in this mode. This command only operates if realistic avionics are selected.
SimRFSilent	Refers to the RF switch on the MISC panel. This command places the switch in the SILENT (down) position. All RF transmissions suppressed including APG-68, CARA and TFR transmitters. This command only operates if realistic avionics are selected.
SimDropProgrammed	SP3 command. Should be used to map to the CMS hat switch on the control switch. Probably matches the “up“ (TM syntax: H4U) position. In Realistic Avionics mode, this command runs the selected countermeasures program.
SimPinkySwitch	SP2 command.
SimGndJettEnable	SP2 command.
SimGndJettOn	Refers to the GND JETT switch on the landing gear panel. This command places the switch in the ENABLE position which allows stores to be jettisoned while on the ground. This commands also allows the ECM pod to emit (this is normally disabled on the ground). This command only operates if realistic avionics are selected.
SimGndJettOff	Refers to the GND JETT switch on the landing gear panel. This command places the switch in theOFF position which prevents stores from being jettisoned while on the ground. This commands also prevents the ECM pod from emitting. This command only operates if realistic avionics are selected.
SimExtlPower	SP2 command.
SimExtlMasterNorm	Refers to the MASTER switch on the EXT LIGHTING panel. This command places the switch in the NORM position and enables the operation of the external lights. This command only operates if realistic avionics are selected.
SimExtlMasterOff	Refers to the MASTER switch on the EXT LIGHTING panel. This command places the switch in the OFF position and disables the operation of the external lights. This command only operates if realistic avionics are selected.

SimExtlAntiColl	SP2 command.
SimAntiCollOn	Refers to the ANTI-COLLISION switch on the EXT LIGHTING panel. This command places the switch in the up (i.e. on) position and turns on the anti-collision beacon light (provded the master is in the NORM position). This command only operates if realistic avionics are selected.
SimAntiCollOn	Refers to the ANTI-COLLISION switch on the EXT LIGHTING panel. This command places the switch in the off position and turns off the anti-collision beacon light. This command only operates if realistic avionics are selected.
SimExtlSteady	SP2 command.
SimLightsSteady	Refers to the position light mode switch on the EXT LIGHTING panel. This command places the switch in the STEADY position and causes the external wing and tail position lights to be on constantly (provided the master is in the NORM position and the Wing/Fuselage switch is in the BRT position – see below). This command only operates if realistic avionics are selected.
SimLightsFlash	Refers to the position light mode switch on the EXT LIGHTING panel. This command places the switch in the FLASH position and causes the external wing and tail position lights to flash alternating between on and off (provided the master is in the NORM position and the Wing/Fuselage switch is in the BRT position – see below). This command only operates if realistic avionics are selected.
SimExtlWing	SP2 command.
SimWingLightBrt	Refers to the positon light brightness switches on the EXT LIGHTING panel. Note there is only one switch throw implemented in the game for what should be two physical switches (wing and fuselage) This command places the switches in the BRT position which turns on the position lights in bright mode. This command only operates if realistic avionics are selected.
SimWingLightOff	Refers to the positon light brightness switches on the EXT LIGHTING panel. Note there is only one switch throw implemented in the game for what should be two physical switches (wing and fuselage) This command places the switches in the OFF position which turns off the position

	lights. This command only operates if realistic avionics are selected.
SimDMSUp	SP2 command.
SimDMSLeft	SP2 command.
SimDMSDown	SP2 command.
SimDMSRight	SP2 command.
SimAVTRSwitch	SP2 command.
SimAVTRSwitchOff	Refers to the flight recorder mode switch on the AVTR panel. This command places the switch in the OFF (down) position. The AVTR recorder will not run. This command only operates if realistic avionics are selected.
SimAVTRSwitchAuto	Refers to the flight recorder mode switch on the AVTR panel. This command places the switch in the AUTO (middle) position. The AVTR recorder will automatically when the first detent of the HOTAS stick trigger or HOTAS pickle switch are operated. Recording continues for 30 seconds unless manually terminated or the trigger/pickle are operated again (which resets the 30 second countdown). This command only operates if realistic avionics are selected.
SimAVTRSwitchOn	Refers to the flight recorder mode switch on the AVTR panel. This command places the switch in the ON (down) position. The AVTR recorder is turned on and will run until the switch is turned to OFF or until 30 seconds after the switch is turned to AUTO, providing no trigger or pickle events reset the 30 second countdown. This command only operates if realistic avionics are selected.
SimAutoAVTR	SP3 command.
SimIFFPower	Not implemented.
SimIFFIn	Not implemented.
SimINSInc	SP2 Command.
SimINSDec	SP2 command.
SimINSOff	Refers to the INS mode knob on the AVIONIC POWER panel. This command places the knob in the OFF position. The INS function is terminated. This command only

	operates if realistic avionics are selected.
SimINSNorm	Refers to the INS mode knob on the AVIONIC POWER panel. This command places the knob in the NORM position. The INS system performs a normal alignment. The INS is usable after 90 seconds but maximum reliability is only achieved after eight minutes of aligment. This command only operates if realistic avionics are selected.
SimINSNav	Refers to the INS mode knob on the AVIONIC POWER panel. This command places the knob in the NORM position. The INS provides location information to the navigation system. This command only operates if realistic avionics are selected.
SimINSInFlt	Refers to the INS mode knob on the AVIONIC POWER panel. This command places the knob in the IN FLT ALIGN position. The INS is realigned based on the GPS sensor as the source of position information. This command only operates if realistic avionics are selected.
SimLEFLockSwitch	SP3 command. Locks the leading edge flaps in current position and illuminates the “LE FLAPS” caution indicator. This command is a toggle so operating it again releases the LEFs to FLCS control and clears the caution panel light. This command only operates with realistic avionics mode selected.
SimLEFLock	Refers to the LE Flaps switch on the FLT CONTROL panel. The command places the switch in the LOCK position. LE Flaps are locked into their current position. This command only operates if realistic avionics are selected.
SimLEFAuto	Refers to the LE Flaps switch on the FLT CONTROL panel. The command places the switch in the AUTO position. LE Flaps are unlocked from their current position and control is returned to the FLCS. This command only operates if realistic avionics are selected.
SimDigitalBUP	Not implemented.
SimAltFlaps	SP3 command, although not present in the default keystrokes.key file. Toggle command. Manually extends the trailing edge flaps and sets the flight control gain settings to the landing mode values. A second operation of the command releases the TEFs to FLCS control. NB:

	presuming no faults, the TEFs will retract by themselves at above 370 knots CAS although they will extend again if speed then decays below 370 knots and the switch is still in the EXTEND position.
SimAltFlapsExtend	Refers to the ALT FLAPS switch in the FLT CONTROL panel. This command places the switch in the EXTEND position. Manually extends the trailing edge flaps and sets the flight control gain settings to the landing mode values. NB: presuming no faults, the TEFs will retract by themselves at above 370 knots CAS although they will extend again if speed then decays below 370 knots and the switch is still in the EXTEND position. This command only operates if realistic avionics are selected.
SimAltFlapsNorm	Refers to the ALT FLAPS switch in the FLT CONTROL panel. This command places the switch in the NORM position. Operation of the command releases the TEFs to FLCS control. This command only operates if realistic avionics are selected.
SimManualFlyup	Not implemented.
SimFLCSReset	Not implemented.
SimFLTBIT	Not implemented.
SimOBOGSBit	Not implemented.
SimMalIndLights	SP2 command. Update in BMS to ensure all indicator lamp related shared memory bits are turned on and off by this command appropriately.
SimProbeHeat	Not implemented.
SimEPUGEN	Not implemented.
SimTestSwitch	Not implemented.
SimOverHeat	Not implemented.
SimTrimAPDisc	SP2 command. Updated in BMS. Now only affects HOTAS hat trim and AP as per SimTrimAPDISC (see below).
SimTrimAPDISC	Refers to the AP DISC switch in the MANUAL TRIM panel. This command places the switch in the DISC position. Disables manual HOTAS trim hat controls and prevents autopilot engagement. Manual trim controls on this panel are still active however. This command only operates if

	realistic avionics are selected. NOTE: please be careful with the name of this one when you add it to the .key file – last four letters are upper case and that *is* significant!
SimTrimAPNORM	Refers to the AP DISC switch in the MANUAL TRIM panel. This command places the switch in the NORM position. Enables manual HOTAS trim hat controls and allows autopilot engagement. Manual trim controls on this panel are active also. This command only operates if realistic avionics are selected.
SimMaxPower	Not implemented.
SimABReset	Not implemented.
SimTrimNoseUp	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimTrimNoseDown	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimTrimYawLeft	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimTrimYawRight	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimTrimRollLeft	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimTrimRollRight	SP2 command. This commands is intended to map to the manual trim panel control. This command is functional regardless of the position of the Trim AP Disc switch.
SimStepMissileVolumeUp	SP2 command.
SimStepMissileVolumeDown	SP2 command.
SimStepThreatVolumeUp	SP2 command.
SimStepThreatVolumeDown	SP2 command.
SimTriggerFirstDetent	SP2 command.

SimTriggerSecondDetent	SP2 command.
SimRetUp	SP2 command.
SimRetDn	SP2 command.
SimCursorEnable	SP2 command.
SimStepComm1VolumeUp	SP2 command.
SimStepComm1VolumeDown	SP2 command.
SimStepComm2VolumeUp	SP2 command.
SimStepComm2VolumeDown	SP2 command.
SimSymWheelUp	SP3 command, although not present in the default keystrokes.key file. This command is for the Brightness control on the left side of the ICP. This key function is equivalent to a left mouse click on the thumb wheel and it increases the brightness of the color used for the various elements of HUD symbology (see also the SimHUDBrt* commands for multiplier effect). There are 6 levels of brightness. The lowest level is basically going to blank all the symbology. In previous versions of Falcon4, at the lowest level brightness the HUD was powered off for you. This is not true in BMS: the Sym Wheel commands merely set level. Use the SimHUDPower* commands to turn the HUD on an off. This is still consistent with the SP3 supplied checklists since those already recommend this command to power on the HUD. This command only operates if realistic avionics is selected.
SimSymWheelDn	SP3 command, although not present in the default keystrokes.key file. This command is for the Brightness control on the left side of the ICP. This key function is equivalent to a right mouse click on the thumb wheel and it decreases the brightness of the color used for the various elements of HUD symbology (see also the SimHUDBrt* commands for multiplier effect). There are 6 levels of brightness. The lowest level is basically going to blank all the symbology. In previous versions of Falcon4, at the lowest level brightness the HUD was powered off for you. This is not true in BMS: the Sym Wheel commands merely set level. Use the SimHUDPower* commands to turn the HUD on an off. This is still consistent with the SP3 supplied checklists since those already recommend this command to power on the HUD. This command only operates if

	realistic avionics is selected.
SimToggleCockpit	
SimToggleGhostMFDs	SP3 command.
SimRangeKnobUp	SP3 command.
SimRangeKnobDown	SP3 command.
AWACSRequestCarrier	SP3 command.
WingmanDropStores	
ElementDropStores	
FlightDropStores	
WingmanVic	
ElementVic	
FlightVic	
WingmanFinger4	
ElementFinger4	
FlightFinger4	
WingmanEchelon	
ElementEchelon	
FlightEchelon	
WingmanForm1	
ElementForm1	
FlightForm1	
WingmanForm2	
ElementForm2	
FlightForm2	
WingmanForm3	
ElementForm3	
FlightForm3	

WingmanForm4	
ElementForm4	
FlightForm4	
SimSMSPower	SP3 command.
SimSMSOn	Refers to the SMS power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the stores management system. This command only operates if realistic avionics are selected.
SimSMSOff	Refers to the SMS power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the stores management system. This command only operates if realistic avionics are selected.
SimFCCPower	SP3 command.
SimFCCOn	Refers to the FCC power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the fire control computer. This command only operates if realistic avionics are selected.
SimFCCOff	Refers to the FCC power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the fire control computer. This command only operates if realistic avionics are selected.
SimMFDPower	SP3 command.
SimMFDOn	Refers to the MFD power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the mutifunction displays. This command only operates if realistic avionics are selected.
SimMFDOff	Refers to the MFD power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the mutifunction displays. This command only operates if realistic avionics are selected.

SimUFCPower	SP3 command.
SimUFCOn	Refers to the UFC power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the up front controls (including ICP). This command only operates if realistic avionics are selected.
SimUFCOff	Refers to the UFC power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the up front controls (including ICP). This command only operates if realistic avionics are selected.
SimGPSPower	SP3 command.
SimGPSOn	Refers to the GPS power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the GPS recevier. This command only operates if realistic avionics are selected.
SimGPSOff	Refers to the GPS power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the GPS recevier. This command only operates if realistic avionics are selected.
SimDLPower	SP3 command.
SimDLOn	Refers to the DL power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position and enables power to the data link recevier. This command only operates if realistic avionics are selected.
SimDLOff	Refers to the DL power switch in the AVIONICS POWER panel. This command places the switch in the down or OFF position and disables power to the data link recevier. This command only operates if realistic avionics are selected.
SimMAPPower	SP3 command.
SimMAPOn	Refers to the MAP power switch in the AVIONICS POWER panel. This command places the switch in the up or ON position. The MAP function is inoperative in the block 50/52 F-16 jets. This command only operates if realistic avionics are selected.
SimMAPOff	Refers to the MAP power switch in the AVIONICS POWER

	panel. This command places the switch in the down or OFF position. The MAP function is inoperative in the block 50/52 F-16 jets. This command only operates if realistic avionics are selected.
SimLeftHptPower	SP3 command.
SimLeftHptOn	Refers to the LEFT HDPT switch on the SNSR PWR panel. This command places the switch in the up or ON position and enables the power to the left hand fuselage hardpoint. This command only operates if realistic avionics are selected.
SimLeftHptOff	Refers to the LEFT HDPT switch on the SNSR PWR panel. This command places the switch in the down or OFF position and disables the power to the left hand fuselage hardpoint. This command only operates if realistic avionics are selected.
SimRightHptPower	SP3 command.
SimRightHptOn	Refers to the RIGHT HDPT switch on the SNSR PWR panel. This command places the switch in the up or ON position and enables the power to the left hand fuselage hardpoint. In particular, the laser designator will not function if the control is not in the ON position. This command only operates if realistic avionics are selected.
SimRightHptOff	Refers to the RIGHT HDPT switch on the SNSR PWR panel. This command places the switch in the down or OFF position and enables the power to the left hand fuselage hardpoint. In particular, the laser designator will not function if the control is not in the ON position. This command only operates if realistic avionics are selected.
SimTISLPower	SP3 command. It is not at all clear what this command is meant to operate. SP3 docs don't say and the game code doesn't appear to use it.
SimFCRPower	SP3 command.
SimFCROn	Refers to the FCR swtich on the SNSR PWR panel. This command places the switch in the up or ON position and enables power for the fire control radar which is required for it to operate. This command only operates if realistic avionics are selected.
SimFCROff	Refers to the FCR swtich on the SNSR PWR panel. This

	command places the switch in the down or OFF position and disables power for the fire control radar which prevents it from operating. This command only operates if realistic avionics are selected.
SimHUDPower	SP3 command.
SimHUDOn	Refers to the on/off switch that is part of the thumb wheel control for HUD brightness on the ICP. If you roll the thumb wheel downwards, there is an on/off switch at the end of travel in that direction. Clicking past this switch in the upwards direction turns on the HUD power enabling the unit to display HUD symbology. Remainder of the thumbwheel's travel controls symbology brightness. This command only operates if realistic avionics are selected.
SimHUDOff	Refers to the on/off switch that is part of the thumb wheel control for HUD brightness on the ICP. If you roll the thumb wheel downwards, there is an on/off switch at the end of travel in that direction. Clicking past this switch in the downwards direction turns off the HUD power preventing the unit from displaying HUD symbology. This command only operates if realistic avionics are selected.
SimToggleRealisticAvionics	SP3 command.
SimIncFuelSwitch	SP3 command.
SimDecFuelSwitch	SP3 command.
SimFuelSwitchTest	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the TEST position. In this position the totalizer digits will read "6000" and the two pointers will both read "2000" on the analog card. This command only operates if realistic avionics are selected.
SimFuelSwitchNorm	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the NORM position. In this position the totalizer digits will display the total internal fuel available. The two pointers will show the values for the F/R and A/L fuel systems on the analog card. This command only operates if realistic avionics are selected.
SimFuelSwitchResv	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the RESV position. In this position the totalizer digits will display the

	total fuel in the forward and aft reservoirs and the two pointers will both show the amount of fuel in each of these reservoirs on the analog card. This command only operates if realistic avionics are selected.
SimFuelSwitchWingInt	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the INT WING position. In this position the totalizer digits will show the total fuel in the left and right internal wing tanks and the two pointers will show the quantity of fuel in the left and right tanks separately on the analog card. This command only operates if realistic avionics are selected.
SimFuelSwitchWingExt	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the EXT WING position. In this position the totalizer digits will show the total fuel in the left and right external wing tanks and the two pointers will show the quantity of fuel in the left and right tanks separately on the analog card. This command only operates if realistic avionics are selected.
SimFuelSwitchCenterExt	Refers to the fuel totalizer control knob on the FUEL QTY SEL panel. This command places the knob in the TEST position. In this position the totalizer digits will show the quantity of fuel in the centerline external fuel tank. This command only operates if realistic avionics are selected.
SimIncFuelPump	SP3 command.
SimDecFuelPump	SP3 command.
SimFuelPumpOff	Refers to the engine feed control knob on the FUEL panel. This command places the knob in the OFF position. The fuel pump operation is terminated. This command only operates if realistic avionics are selected.
SimFuelPumpNorm	Refers to the engine feed control knob on the FUEL panel. This command places the knob in the NORM position. The fuel pump operation delivers fuel from the AFT and FWD reservoirs. This command only operates if realistic avionics are selected.
SimFuelPumpAft	Refers to the engine feed control knob on the FUEL panel. This command places the knob in the AFT position. The fuel pump operation delivers fuel only from the AFT reservoir. This command only operates if realistic avionics are selected.

SimFuelPumpFwd	Refers to the engine feed control knob on the FUEL panel. This command places the knob in the OFF position. The fuel pump operation delivers fuel only from the FWD reservoir. This command only operates if realistic avionics are selected.
SimToggleMasterFuel	SP3 command.
SimMasterFuelOn	Refers to the MASTER switch on the FUEL panel. This command places the switch in the ON position. This enables fuel to flow to the engine. This command only operates if realistic avionics are selected.
SimMasterFuelOff	Refers to the MASTER switch on the FUEL panel. This command places the switch in the OFF position. This prevents fuel from flowing to the engine. This command only operates if realistic avionics are selected.
SimExtFuelTrans	Refers to the fuel transfer mode control switch on the FUEL QTY SEL panel. This command toggles placement of the switch.
SimFuelTransNorm	Refers to the fuel transfer mode control switch on the FUEL QTY SEL panel. This command places the switch in the NORM position. In this position the fuel system will empty a centerline external tank before external wing tanks if both tank types are present and have fuel in them. This command only operates if realistic avionics are selected.
SimFuelTransWing	Refers to the fuel transfer mode control switch on the FUEL QTY SEL panel. This command places the switch in the NORM position. In this position the fuel system will empty a centerline external tank after external wing tanks if both tank types are present and have fuel in them. This command only operates if realistic avionics are selected.
SimIncAirSource	SP3 command.
SimDecAirSource	SP3 command.
SimAirSourceOff	Refers to the air source selection control knob on the AIR COND panel. This command places the knob in the OFF position. Engine bleed air valves close. Cabin pressurization is disabled and the CABIN PRESS caution will illuminate if cockpit pressure altitude exceeds 27,000 feet (NB: in previous versions of Falcon4, the caution was lit at 10,000 feet; changed to 27,000 per the dash one for this version). Also, external fuel tanks are not pressurized

	which prevents fuel transferring from these tanks. This command only operates if realistic avionics are selected.
SimAirSourceNorm	Refers to the air source selection control knob on the AIR COND panel. This command places the knob in the NORM position. The environmental control system functions normally including maintaining cockpit pressurization at 8,000 feet MSL and pressurizing external fuel tanks to ensure proper fuel transfer. This command only operates if realistic avionics are selected.
SimAirSourceDump	Refers to the air source selection control knob on the AIR COND panel. This command places the knob in the DUMP position. Cabin pressurization is terminated and the cabin is vented to outside air pressure. This means cockpit pressure altitude will increase above 8,000 feet MSL. The CABIN PRESS caution will illuminate if cockpit pressure altitude exceeds 27,000 feet (NB: in previous versions of Falcon4, the caution was lit at 10,000 feet; changed to 27,000 per the dash one for this version). All other ECS functions such as external fuel tank pressurization are unaffected. This command only operates if realistic avionics are selected.
SimAirSourceRam	Refers to the air source selection control knob on the AIR COND panel. This command places the knob in the RAM position. Engine bleed air valves close. Cabin pressurization is terminated and the cabin is vented to outside air pressure. This means cockpit pressure altitude will increase above 8,000 feet MSL. The CABIN PRESS caution will illuminate if cockpit pressure altitude exceeds 27,000 feet (NB: in previous versions of Falcon4, the caution was lit at 10,000 feet; changed to 27,000 per the dash one for this version). RAM air valves are opened to ventilate the cockpit and avionics. All other ECS functions such as external fuel tank pressurization are disabled. This command only operates if realistic avionics are selected.
SimDecLeftAuxComDigit	SP3 command, although not present in the default keystrokes.key file.
SimDecCenterAuxComDigit	SP3 command, although not present in the default keystrokes.key file.
SimDecRightAuxComDigit	SP3 command, although not present in the default keystrokes.key file.

SimInteriorLight	SP3 command. Not previously listed in the default .key file however.
SimInstrumentLight	SP3 command.
SimSpotLight	SP3 command.
SimRwrPower	SP3 command, although not present in the default keystrokes.key file.
SimCycleLeftAuxComDigit	
SimCycleCenterAuxComDigit	
SimCycleRightAuxComDigit	
SimCycleBandAuxComDigit	
SimToggleAuxComMaster	
SimToggleAuxComAATR	
SimTACANTR	Refers to the TACAN domain selection switch on the AUX COMM panel. This command places the switch in the TR position. TACAN channels refer to ground stations only. Note that the game only implements two positions for this switch; there is no separate functionality for the REC (receive only) position. This command only operates if realistic avionics are selected.
SimTACANAATR	Refers to the TACAN domain selection switch on the AUX COMM panel. This command places the switch in the TR position. TACAN channels refer to air stations only. Note that the game only implements two positions for this switch; there is no separate functionality for the REC (receive only) position. This command only operates if realistic avionics are selected.
SimToggleUHFMaster	In SP3 this command erroneously changed the source of radio channel programming from the UFC to the backup controls on the UHF panel. BMS corrects this problem and now the selection of input controls for UHF channel selection is made via the CNI switch on the AUX COMM panel as per the real system.
SimTransmitCom1	SP2 command.
SimTransmitCom2	SP2 command.

SimDriftCO	Note: this switch should be a on-off-(on) type toggle switch with the momentary side used for the warning reset and the latching side used for drift cut off.
SimDriftCOOn	Refers to the upper throw of the drift cut off/warning reset switch. In the real ICP, this switch is a (on)-off-on configuration, i.e. momentary to one side which in this case is the warn reset throw. This command places the switch in the ON position. The pitch ladder and flight path marker are centered in azimuth in the HUD. This command only operates if realistic avionics are selected.
SimDriftCOOff	Refers to the upper throw of the drift cut off/warning reset switch. In the real ICP, this switch is a (on)-off-on configuration, i.e. momentary to one side which in this case is the warn reset throw. This command places the switch in the NORM position. The pitch ladder and flight path marker are displayed normally in the HUD. This command only operates if realistic avionics are selected.
SimCATSwitch	
SimCATI	Refers to the STORES CONFIG switch in the landing gear panel. This command places the switch in the CAT I position. This command only operates if realistic avionics are selected.
SimCATIII	Refers to the STORES CONFIG switch in the landing gear panel. This command places the switch in the CAT III position. This command only operates if realistic avionics are selected.
SimRegen	SP3 command.
OTWTrackExternal	
ToggleDisplacementCam	
WinAmpNextTrack	
WinAmpPreviousTrack	
WinAmpStopPlayback	
WinAmpStartPlayback	
WinAmpTogglePlayback	
WinAmpVolumeUp	

WinAmpVolumeDown	
CycleEngine	
selectLeftEngine	
selectRightEngine	
selectBothEngines	
ToggleClickablePitMode	
SimILSOn	Refers to the power switch on the ILS volume rotary knob in the AUDIO2 panel. This command turns on the ILS radio receiver; ILS will not function unless the receiver is turned on (NOTE: the recevier is on at startup by default). This command only operates if realistic avionics are selected.
SimILSOff	Refers to the power switch on the ILS volume rotary knob in the AUDIO2 panel. This command turns off the ILS radio receiver; ILS will not provide steering cues when the receiver is turned off (NOTE: the recevier is on at startup by default). This command only operates if realistic avionics are selected.

APPENDIX G: DDS AND COMPRESSED TEXTURES NOTES

BMS makes heavy use of DDS textures. These textures are similar to tga, jpg, gif, etc, except they are native to DirectX. You can open / save DDS textures by using the Nvidia DDS Photoshop plugin, located at:

http://developer.nvidia.com/object/ps_texture_compression_plugin.html

This plugin also works in Paint Shop Pro, but an older version of the plugin is required.

The object (KoreaObj) DDS textures can be in one of three formats: DXT1 - for standard, or 1-bit alpha (formerly known as chroma-keyed) textures (DXT1a); DXT3 - for 16-bit textures requiring 4 bits of alpha; DXT5 - for High Quality 32-bit alpha textures with 8 bits of alpha. Maximum supported texture resolution for these is 2048x2048. They are located in the **[FalconRoot]\terrdata\objects\KoreaObj** folder.

Terrain DDS textures must be in DXT1 compressed format. Maximum resolution is 1024x1024. When rendering tiles at night, Falcon will multi-texture the new N Tiles (night lights) with the base tiles. Terrain developers can now work with the full color palette offered by 24-bit textures to create both custom H and N tiles, without being restricted by a palette. Terrain DDS tiles are located in the **[FalconRoot]\terrdata\korea\texture\texture** folder.

If you wish to create a new DDS texture for one of the skins or terrain tiles, simply drop the dds file into the appropriate directory, replacing any existing DDS file. No information needs to be written to KoreaObj.hdr or textures.bin.

APPENDIX H: FLIGHT MODEL NOTES

CHANGES TO THE F16'S

The following data is for use ONLY in the F-16's flight model data files. The tank amounts are F-16 specific. These variables must be changed from 0 to the numbers below for the needle mechanization to work right. ***NOTE:*** These should only be added by EXPERIENCED Falcon database/flight model workers. SP4 will contain these numbers as standard so no adjustment to the FM dats is needed.

For all C or A models:	For all B or D models:
fuelFwdRes 480	fuelFwdRes 480
fuelAftRes 480	fuelAftRes 480
fuelFwd1 2772	fuelFwd1 1530
fuelAft1 2330	fuelAft1 2334
fuelWingAl 550	fuelWingAl 550
fuelWingFr 550	fuelWingFr 550
fuelFwdResRate 22.2	fuelFwdResRate 22.2
fuelAftResRate 22.2	fuelAftResRate 22.2
fuelFwd1Rate 22.2	fuelFwd1Rate 22.2
fuelAft1Rate 22.2	fuelAft1Rate 22.2
fuelWingAlRate 6.66	fuelWingAlRate 6.66
fuelWingFrRate 6.66	fuelWingFrRate 6.66
fuelClineRate 20.0	fuelClineRate 20.0
fuelWingExtRate 33.3	fuelWingExtRate 33.3
Internal fuel must be set to 7162.	Internal Fuel in the D model dat must be set to 5924.

MULTI ENGINE CODE

Multi Engine Code is now enabled.
In order to use the multi-engine code, you must map keystrokes.
OTWToggleFlapDisplay -1 0 0X18 4 0 0 1 "Flap Display Toggle"
CycleEngine -1 0 0X18 2 0 0 1 "Cycle Engine"
OTWToggleAeroDisplay -1 0 0X18 1 0 0 1 "aero-engine"

This willl have CycleEngine set to CTRL-O. When you press CTRL-O you will cycle from LEFT to RIGHT to BOTH engines. When on LEFT or RIGHT engine, the single throttle will control the RPM of the selected engine.

New features for the F18 Variants

Add the following to the f18c.dat or f18d.dat file:
typeAC 9
typeEngine 7

Revise the following:
sndFlapStart 0
sndFlapLoop 0
sndFlapEnd 0

- New NAV HUD
- New vertical velocity indicator above altitude
- Various indicators moved to correct locations
- AOA bracket set for F18 (6-10 degrees AOA). The alpha display will blank out when gear are down and FPM is in the bracket range. Also the cockpit AOA indicator lights will now match the correct F18 AOA range.
- Peak Gs will only display if greater than 4 gs is pulled. If less than 4 g's are pulled, the g display will be removed when the gear are lowered.
- Mach display is removed when gear are lowered.

Flap Modes

- Control flaps only now with CTRL-F10 keystroke. This will cycle you through AUTO/HALF/FULL
- AUTO is the standard up and away flying mode. After takeoff, CTRL-F10 to AUTO
- HALF will allow flaps to blow down under 250 knots to a maximum of 30 degrees. If speed increases past 250 knots, flaps will raise.
- FULL will allow flaps to blow down under 250 knots to a maximum of 45 degrees. If speed increases past 250 knots, flaps will raise.

TEF Scheduling

- The trailing edge flaps are now scheduled through Mach and AOA.

Speedbrakes

- Speedbrakes, if deployed, will retract under 250 knots, over 6 gs, or over 28 degrees AOA.

Engines

- Engines will spool up to MIL power at Mach 1.23 and above
- Engines will increase idle RPM as altitude increases
- Engines will take longer to spool up and down as altitude increases

New features for the F14 Variants

In the f14b.dat or f14d.dat set:
typeAc 7
typeEngine 9

- HUD Warning "RDC SPEED" when TEFs are deployed and speed goes over 225 knots. The F14 has no auto flap raise, it's up to the pilot.

Speedbrake

- If aircraft speed is over 400 vcas, or if throttles are MIL power or greater, brakes will retract.

Engines

- Engines will increase idle speed when over 18 AOA
- Engines have rich stability cutback modeled and will allow only partial afterburner in various low speed/high altitude regimes.
- Engines will spool up to MIL power past Mach 1.4
- Engines will spool up/down slower as altitude increases

New features for the F15 Variants

F15C
In the F15C.dat set::
typeAC 4
typeEngine 2

Speedbrake

- Will retract if extended when past 25 AOA. Will redeploy when AOA is under 25.

Flaps

- Flaps will blow up based on maxVcas speed. The .dat file should have: maxFlapVcas 250. The flaps will also redeploy when under 250 knots. This only occurs if flaps are inadvertantly left down.

Other

For aircraft using the PW220 Engine, Set the following:
typeEngine 2

- Engine idle increases from Mach 0.84 to Mach 1.4 when it will be at MIL power from 1.4 and above.
- The afterburner has 3 schedule zones. Area 3 is Segment 5 no light. Area 2 is Seg 1 light only. Area 1 is no AB available. These are based on various low speed and altitude regimes.
- Engine will increase idle speed base on altitude
- Engine will increase spool up/down time based on altitude/speed.

For aircraft using the GE110/PW229/GE129 Engine
Set the following:
typeEngine 3 (for 229)
typeEngine 4 (for GE110)
typeEngine 5 (for GE129)

- Engine has reduced speed excursion logic modeled. Switches between a higher or lower idle speed based on mach speed (mach 0.55 being the transition point)
- Idle spools up from Mach 1.1 to Mach 1.4 where it will be at MIL power
- Idle speed increases with altitude
- Reduced AB schedule for low speed/high altitude regimes

APPENDIX I: INTERACTIVE TRAINING

Falcon 4 BMS 2.0 includes the ability to create interactive training missions. This is accomplished by means of "training scripts." These scripts are text files that are loaded with the training mission that contain the interactive training instructions.

To create a training script for a training mission, create a .txt file with the same name as the training mission you want to write the script for. When the training mission loads, Falcon will check for the existence of a training script file to go along with the mission and a checkbox "Enable Training Script" will be available in the UI.

Training scripts are written in a simple programming language that is specifically designed to make writing scripts easy.

BASIC CONCEPTS

There are a few basic concepts that are essential to writing training scripts.

- First, the script language has no concept of variables. All functions take actual values. For the purpose of interactive training, this lack of variables in the language should not be a significant limitation.
- Second, the language is designed to never block the main Falcon process. This is accomplished by only running one command in the language per frame. One effect of this is that bigger scripts do NOT slow the simulation down. This is because, regardless of the size, only a single command executes per frame.
- Third, the exception to above is that certain functions can execute in "parallel" with others. For example, there are two print commands. Both "Print" and "WaitPrint" put a string on the screen for a set duration. The difference between the two is that "Print" immediately moves onto the next command on the next frame. "WaitPrint" on the other hand, pauses execution of the script until the time expires.
- Fourth, the code in a script can be divided into "sections" These sections are defined by simply putting the name of the section on a line by itself.
- Fifth, the action of the language is composed entirely of functions. There are no operators. So, each line of a script can contain one of the following things:
    - A function name followed by arguments
    - A section name
    - A comment starting with //
    - A blank line

- Sixth, the language has a unique and very limited form of return values. Specifically, most functions when they run have a return value of true. Certain functions, however, return false under certain circumstances (usually when they time out). The only way that return values can be used is by the use of the if and while type functions. These functions simply check the return value - either true or false - of the last executed function to determine whether to execute. This is ONLY use of return values.

- 'Seventh' - mission with scripts enabled start out in PAUSED mode.
- 'Eighth' - mission with scripts enabled have the AP mode set to STEERPOINT in order to enable the script writer to guide the player´s aircraft. The autopilot still has to be enabled manually by the script writer.

FUNCTION REFERENCE

The following is a list of all of the functions accepted by the system and the types of arguments that are accepted. The types of arguments below are as follows:

KEY:

<time> = a floating point number. 1.0 is 1 second. 0.001 is 1 millisecond.

<integer> = a whole number like 1 or 2

<float> = a floating point number

<string> = a string of characters surrounded with quote marks. For example "Hello, World"

<hex> = a hexadecimal number like 0xffffffff

<callback> = a number that represents a cockpit callback (either a button or a dial/light callback depending on the function)

<command> = the name of command as found in the keystrokes file. An example is SimTogglePaused

<callback/command> = either a command or a callback as described above. Functions that using this automatically determine which

<section> = the name of a section in the script.

FUNCTION NAME AND FORMAT	FUNCTION DESCRIPTION
"Print <time> <string>"	Prints a string to the screen using the current cursor settings for the duration of <time>. Execution moves immediately onto the next command while leaving the message printed

	for the duration.
"WaitPrint <time> <string>"	Functions identically to "Print" except that the execution does not advance to the next command until <time> has expired.
"WaitInput <time> <callback/command>"	Pauses execution of the script until the command or the callback specified is executed by the user. <time> is the amount of time to wait for the input. If the function times out, it it returns false.
"Wait <time>"	Pauses execution of the script until the specific <time> expires
"WaitMouse <time> <float (targetx)> <float (targety) > <float (distance)>	Pauses execution of the script for <time> duration or until the user moves the mouse cursor within <float (distance)> of the screen coordinates of <float (targetx)> and <float (targety)>. If the function times out, it returns false.
"WaitSoundStop <time>"	Pauses execution of the script for <time> duration or until the last sound executed by "Sound" stops playing. If the function times out, it returns false
"WaitSound <string>"	Plays the sound specific by <string> in .wav format. Execution of the script pauses until the sound finishes playing.
"Sound <string>"	Plays the sound specific by <string> in .wav format. Execution of the script continues while the sound plays.
"EndSection"	This function can be used to end a section. If there is any previous function on the call stack (generally created by using the "call" function), then execution will return to the instruction immediately after the "call" when "EndSection" is encountered. If there is nothing on the call stack, this line is ignored.
"EndScript"	Immediately ends the script
"Block <command/callback> ..."	Blocks the system from recognizing any commands or callbacks listed as arguments.

	This function accepts an unlimited number of commands/callbacks as arguments. If no arguments are provided, all commands are blocked.
"Allow"	Blocks the system from recognizing any commands other than those listed as arguments. This function accepts an unlimited number of commands/callbacks as arguments. If no arguments are provided, then all commands are allowed.
"If"	If the return value of the last command is true, then execution moves to the next instruction. If the return value is false, then the next instruction is skipped.
"IfNot"	Functions identically to "If", except the next instruction is executed if the return value of the last statement is false.
"Jump <section>"	Immediately jumps to the section identified by <section>. NOTE this does not add anything to the call stack.
"Call <section>"	Immediately jumps to the section identified by <section>. The current location is added to the call stack, and execution will return to this location when an "EndSECTION" FUNCTION IS ENCOUNTERED.
"SetCursor <float (x)> <float (y)>"	Sets the cursor position to the location specified in <float (x)> and <float (y)>. The range of the coordinate system is from -1.0 to 1.0. For example x = -1.0 is the left of the screen, 0.0 is the center and 1.0 is the right side of the screen. This cursor location is used for all print and drawing functions
"SetColor <hex>"	Sets the current cursor color to the color specified by <hex>. This cursor color is used for all print and drawing functions.
"SetFont <integer>"	Sets the current font to the font specified by <integer>. Examples of valid fonts are 1, 2 and 3. This font is used for all print functions.
"Oval <time> <float (xradius)> <float (yradius --	Draws an oval on the screen for <time>

optional)"	duration. THe size of the oval is specified by the two arguments. If only one argument is supplied, then a circle is drawn with that radius.
"Line <time> <float (x1)> <float (y1)> <float (x2)> <float (y2)>"	Draws a line for <time> duration from x1,y1 to x2,y2
"EnterCritical"	This experimental function can be used to execute multiple commands in a single frame. Execution will proceed in one frame until an "EndCritical" function is encountered. This command may be very dangerous, as the use of ANY waiting calls like "WaitPrint" will cause Falcon to stop running until it is finished.
"EndCritical"	Causes one command per frame execution to resume.
"SimCommand <command>"	Causes <command> to be executed just as if the user had pressed the keystroke.
"While"	If the prior return value is true, runs the commands until the next "EndSection". When "EndSection" is found, execution returns to the command prior to the "While" function. If the prior return value is false, then execution moves to the command after the next "EndSection"
"WhileNot"	Operates identically to the "While" statement, with the exception that a return value of false causes the while to execute.
"CallIf <section>"	If the return value of the prior statement is true, then the section identified by <section> will be called. Once an "EndSection" is encountered, execution will return to the instruction after "CallIf"
"CallIfNot <section>"	Functions identically to "CallIf" except that a false return value triggers the call.
"Clear"	Immediately removes all drawn elements from the screen (Such as those created by "Print" "Line" and "Oval" statements)
"ClearLast <integer - optional>"	If no argument is provided, the last created drawn element will be removed from the

	screen (Such as those created by "Print" "Line" and "Oval" statements). If a number is specified, then the nth last element will be removed. For example, "ClearLast 2" will remove the second to last drawn element from the screen.
"SetFlash <hex>"	Sets the rate of flashing that should occur for drawing calls. Example: "SetFlash 0x100". "SetFlash 0" disables flashing.
"SetCursorCallback <callback>"	Sets the current cursor position to the x and y position of the button specified by <callback>. If the <callback> is not found on the current panel, the location of the cursor will remain unchanged.
"SetCursorDial <callback>"	Sets the current cursor position to the x and y position of the dial specified by <callback>. If the <callback> is not found on the current panel, the location of the cursor will remain unchanged.
"WaitCallbackVisible <time> <callback>"	Pauses execution of the script until <time> expires, or until the button specified by <callback> is found on the current panel. If the timer expires, then the function returns false.
"WaitDialVisible <time> <callback>"	Pauses execution of the script until <time> expires, or until the dial specified by <callback> is found on the current panel. If the timer expires, then the function returns false.
"SetTextBoxed <integer>"	Sets the type of text boxing that should apply to print statements. Valid values are 0, 1, 2 and 3. 0 = no text boxing, 1 = text is boxed by lines, 2 = black text is drawn with a colored box, 3 = colored text is drawn with a black box. This function affects all print functions.
"MoveCursor <float (x)> <float (y)>"	Moves the cursor from its current position by x and y amount. The range of the coordinate system is from -1.0 to 1.0. For example x = -1.0 is the left of the screen, 0.0 is the center and 1.0 is the right side of the screen. This cursor location is used for all print and drawing

	functions.
"SetTextOrientation <integer>"	Sets the orientation of of the text relative to the cursor position. Acceptable values are 0, 1 and 2. 0 = left justified text, 1 = centered text, 2 = right justified text. This function affects all print functions.
"SetViewCallback <callback>"	Searches the panels for a button using <callback>, and then sets the current view to that panel. If the callback is not found, the view is left unchanged. This can be used to write scripts that are compatible with multiple different 2d cockpits.
"SetViewDial <callback>"	Searches the panels for a dial using <callback>, and then sets the current view to that panel. If the callback is not found, the view is left unchanged. This can be used to write scripts that are compatible with multiple different 2d cockpits.
"SetPanTilt <float (x)> <float (y)>"	Sets the current 3d view to the coordinates specified by <float (x)> and <float (y)>. These coordinates are in radians, and 0.0f is straight ahead in the 3d cockpit.
"MovePanTilt <float (x)> <float (y)>"	Offsets the current 3d view from its current position by the amounts specified by <float (x)> and <float (y)>. These coordinates are in radians.
"SetCursor3D <float (x)> <float (y)> <float (z)>"	Takes a camera centric point defined by the x, y and z coordinate, converts that into 2d screen space, and sets the cursor to that location.

APPENDIX J: PARTICLE EXPLOSION EFFECTS

INTRODUCTION

Falcon uses a simple particle system to replace the hardcoded special effects. The list of Special Effect (SFX) is towards the end of this section. Particles have a number of parameters, for rendering (poly,LOD,Smoke Trail); for sound, from simple physical effects like bouncing, aero & ground friction; and emitting more particles.

Particle attributes are set up in the terrdata\particlesys.ini file. Each particle type is begun with the 'id' command, which is then followed by other commands that describe that type of particle.

Many commands allow an optional [age] value to be specified. [Age] allows these attributes to be morphed as a particle ages. The [age] value is normalized from 0 at birth to 1.0 at death. You are allowed upto 10 [age] values per attribute.

Example:

This woild cause the particle to change color from red to blue as the particle ages.
color[0] = 1,0,0
color[1] = 0,0,1

Any particle can be an emitter, simple by using the 'addemitter' command and setting up the emission parameters appropriately. Each particle type can have 10 emitters. See the command section for more info.

COMMANDS

id=name

Begins a new particle definition.
All commands that follow are applied to current id, until another id command is issued
See below for the list of predefined names

lifespan=time, variation

time - in seconds
variation - in seconds

drawtype=type

POLY
NONE

alpha[age]=alpha
alpha - (0 - 1.0) 0 transparent, 1 opaque

color[age]=r, g, b
The diffuse color of the particle. The apparent color is determined by the worlds light level (from the sun and ambient light)
r, g, b - (0 - 1.0)

light[age]=r, g, b
The particle color is based soley on the light value specified. In other words, the perticle will glow in the dark
r, g, b - (0 - 1.0)

NOTE: both color and light are always applied to the particle.
It is important that when you add each component (r,g,b), that they do not exceed 1.0 - for ex. color r + light r must be <= 1

size[age]=dimension
dimension - the width/height in feet. Since particles are just texture squares at this point, this is the width/height of the square.

acceleration[0..10]=value
value - in feet per second per second. (f/s/s)

texture=filename
the file must be in the misctex directory (or a subdirectory)

gravity[age]=amount
amount - 1 equals full gravitational acceleration (32ft/s/s)

bounce=reflectamount
reflectamount - 0 = no bounce,
1.0 = bounce with same velocity as impact.
*only bounces off ground

groundfriction=feet per second per second
while in contact with the ground, the particle will slow this amount

inheritvelocity=percentage
the particle will inherit a percentage of the creator's velocity.

initialvelocity=velocity, variation
velocity - the initial velocity applied to the object. This is added to the inherited velocity. (feet/sec)
variation - random variation, the final value can be + or - this amount (feet/sec)

soundid=sound fx id number

soundlooped=0/1

soundVol[age]=volume
volume - 0=min 1-max

soundPitch[age]=pitch
pitch - 1 is nominal, 2 is 2x etc.

trailid=id
setting the trailid to non-zero, will cause the particle to generate a smoke trail object as the particle moves.
id - from trail.dat file

drag=dragvalue
dragvalue - 0 = no drag, 1 will stop the object (relative to wind) in 1 second; note that this will factor wind into the equation.

dieonground=0 or 1
when the particle touches the ground, it will die if set to 1.

modelct=ct#
This will draw a 3d Model at the location of the particle.

orientation=
none
movement - particle is aimed in the direction it is moving

addemitter
adds emitter data to the current particle
up to 10 emitters can be added to a particle

THESE APPLY TO THE CURRENT EMITTER

---

emissionid=particlename
emissionmode=
ONCE - when this particle has reached the age specified by the 'emissionrate', the particle
will emit a group of particles specified by the 'emissionrate's 'value'
PERSEC - particle will be emitted at a constant rate specified by 'emmisionrate'.
IMPACT - when this particle is in contact with the surface, it will emit a number particles of particles specified by emissionrate.
GROUNDIMPACT - when this particle is in contact with the surface, it will emit a number particles of particles specified by emissionrate.
WATERIMPACT - when this particle is in contact with the surface, it will emit a number particles of particles specified by emissionrate.

emissionrate[age]=value

emissiondomain={type},params...
type : SPHERE pos x, y, z, size x, y, z

emissiontarget= (see emmissiondomain}

PREDIFINED PARTICLE NAMES

The particle names correspond to the special effects in the SFX class
not all of these can be replaced.

$NONE
$AIR_HANGING_EXPLOSION
$SMALL_HIT_EXPLOSION
$AIR_SMOKECLOUD
$SMOKING_PART
$CLUSTER_BURST
$AIR_EXPLOSION
$EJECT1
$EJECT2
$SMOKERING
$AIR_DUSTCLOUD
$GUNSMOKE
$AIR_SMOKECLOUD2
$NOTRAIL_FLARE
$FLAMING_PART
$GROUND_EXPLOSION
$TRAIL_SMOKECLOUD
$TRAIL_FIREBALL
$MISSILE_BURST
$FEATURE_CHAIN_REACTION
$WATER_EXPLOSION
$SAM_LAUNCH
$MISSILE_LAUNCH
$DUST1
$EXPLCROSS_GLOW
$EXPLCIRC_GLOW
$TIMER
$DIST_AIRBURSTS

$DIST_GROUNDBURSTS
$DIST_SAMLAUNCHES
$DIST_AALAUNCHES
$EXPLSTAR_GLOW
$RAND_CRATER
$GROUND_EXPLOSION_NO_CRATER
$MOVING_BSP
$DIST_ARMOR
$DIST_INFANTRY
$TRACER_FIRE
$FIRE
$GROUND_STRIKE
$WATER_STRIKE
$VERTICAL_SMOKE
$TRAIL_FIRE
$BILLOWING_SMOKE
$HIT_EXPLOSION
$SPARKS
$ARTILLERY_EXPLOSION
$SHOCK_RING
$NAPALM
$AIRBURST
$GROUNDBURST
$GROUND_STRIKE_NOFIRE
$LONG_HANGING_SMOKE
$SMOKETRAIL
$DEBRISTRAIL
$HIT_EXPLOSION_DEBRISTRAIL
$RISING_GROUNDHIT_EXPLOSION_DE
BRISTRAIL
$FIRETRAIL
$FIRE_NOSMOKE
$LIGHT_CLOUD
$WATER_CLOUD
$WATERTRAIL
$GUN_TRACER
$DARK_DEBRIS
$FIRE_DEBRIS
$LIGHT_DEBRIS
$SPARKS_NO_DEBRIS
$BURNING_PART
$AIR_EXPLOSION_NOGLOW
$HIT_EXPLOSION_NOGLOW
$SHOCK_RING_SMALL
$FAST_FADING_SMOKE
$LONG_HANGING_SMOKE2
$SMALL_AIR_EXPLOSION
$FLAME
$AIR_PENETRATION
$GROUND_PENETRATION
$DEBRISTRAIL_DUST
$FIRE_EXPAND
$FIRE_EXPAND_NOSMOKE
$GROUND_DUSTCLOUD
$SHAPED_FIRE_DEBRIS
$FIRE_HOT
$FIRE_MED
$FIRE_COOL
$FIREBALL
$FIRE1
$FIRE2
$FIRE3
$FIRE4
$FIRE5
$FIRE6
$FIRESMOKE
$TRAILSMOKE
$TRAILDUST
$FIRE7
$BLUE_CLOUD
$WATER_FIREBALL
$LINKED_PERSISTANT
$TIMED_PERSISTANT
$CLUSTER_BOMB
$SMOKING_FEATURE
$STEAMING_FEATURE
$STEAM_CLOUD
$GROUND_FLASH
$GROUND_GLOW
$MESSAGE_TIMER
$DURANDAL
$CRATER2
$CRATER3
$CRATER4
$BIG_SMOKE
$BIG_DUST
$HIT_EXPLOSION_NOSMOKE
$ROCKET_BURST

$CAMP_HIT_EXPLOSION_DEBRISTRAIL
$CAMP_FIRE
$INCENDIARY_EXPLOSION
$SPARK_TRACER
$WATER_WAKE"

APPENDIX K: REFUELING NOTES

TANKER, BOOM AND DROGUE PARENTS

Boom-Equipped

A/C	A/C Parent#	Boom Parent#	Drogue Parent#
KC-135	906	1221	N/A
KC-10	907	1225	N/A
BoomTanker #1	2200	2210	2220
BoomTanker #2	2201	2211	2221
BoomTanker #3	2202	2212	2222
BoomTanker #4	2203	2213	2223
BoomTanker #5	2204	2214	2224

Drogue-Equipped

A/C	A/C Parent#	Boom Parent#	Drogue Parent#
IL-78	1218	N/A	1223
KC-130	887	N/A	1223
DrogueTanker #1	2205	N/A	2215
DrogueTanker #2	2206	N/A	2216
DrogueTanker #3	2207	N/A	2217
DrogueTanker #4	2208	N/A	2218
DrogueTanker #5	2209	N/A	2219

Note: Drogue pod must have pylon (rack) included in the model. Drogue extension animation uses Translation DOF (TDOF).

SIMDATA.ZIP <AC>.DAT VARIABLES:

Tanker

- nBooms - Number of booms on tanker (1 or 0)
- BoomStoredAngle - Angle (degrees) to move boom up when not in use.
- BoomRFPos - Adjustments (x y z) for positioning a/c at end of boom (+ feet)
- DrogueExt - Drogue extension length (feet)
- nDrogues - Number of drogue stations on tanker (max. 4)
- activeDrogue - Drogue station used for refueling (model Slot number: 0 - 3)
- DrogueRFPos - Adjustments (x y z) for positioning a/c at end of drogue (+ feet)

(X = DrogueExt +/- adjustment, Y/Z = adj for phylon displacemnt)

Refueling Aircraft

- nBooms - Boom service required (1 = yes, 0 = no)
- nDrogues - Drogue service required (1 = yes, 0 = no)
- refuelingLocation - Location of the a/c refueling port or probe port (x y z in model coordinates). **Note:** 0,0,0 uses F-16's port location (0,0,-3).
- refuelSpeed - A/C-tanker speed during refueling (knots).
- refuelAltitude - Refueling altitude (feet).
- decelDistance - Distance (feet) from tanker to start decelerating (for AI)
- AIBoomDistance - Distance (feet) from tanker when a/c is pulled into refueling position (AI and Easy refueling).

BOMBDATA

Bombs now support their own configuration files, just like the missiles do.

Bombdata needs to be setup as follows:

cbuStrengthModel: Determines which code to use to determine the Strength value.

- 0 : original code
- 1 : uses new code based on the following items:
  - cbuLethalHeight 300 - at this burst height, the strength of the CBU is 1.0
  - cbuIneffectiveHeight 6000 - at this burst height, the strength of the CBU is 0.0
  - sndFlightSfx 0 - not yet implemented, bombs can have their own sound while in flight.

NEW DOFS (FOR COMPLEX MODEL)

- Tailhook 37
- ABDof 38 (use this to drive the ScaleNode for the AB)
- Exhaust Noz 39 (put each petal on a DOF, instead making nozzle 11 states – Nozzle animates fluidly with less nodes)
- Propeller 40 ***
- Refuel 41 ***
- Lt Spoiler 1 42 *** (also can function as spoiler + airbrake)
- Rt Spoiler 1 43 ***
- Lt Spoiler 2 44 ***
- Rt Spoiler 2 45 ***
- Swing Wing 46
- Throttle 47 ***
- RPM 48 *** This one does not spin like a propeller, it moves like a gauge needle
- Wheel 1 50
- Wheel 8 57
- Strut 1 58
- Strut 8 65

***** means they also work for the Simple Model.**

APPENDIX L: SOUND TABLE NOTES

f4sndtbl.txt Description

The sound table consists of a tab (or whitespace) delimited table. Care must be taken to not have blank lines, especially at the end of the file.

Lines that begin with a "#" are considered comments, and ignored by the parser. Note that the line must not contain anything (like spaces) in front of the "#".

The format of the data in is.

Column 1:

WAV Filename - the filename is relative to the Sound directory.

Column 2:

Unused (exists purely due to historical reasons)

Column 3:

Unused (exists purely due to historical reasons)

Column 4:

MaxFeet - The maximum distance, in feet, that a sound can be heard, beyond this distance, the sound will not be played at all. At MaxFeet, the volume of the sound will be attenuated to MinVol***

Column 5:

MinFeet - The distance from the listener, in feet, at which the sound BEGINS to attenuate. At and within MinFeet, the sound is attenuated to MaxVol***

Column 6:

Vol@MinFeet - This is the maximum volume the sounds will be played. It is handled differently depending on whether or not the sound is an external type. For NON-external sounds - this is the volume the sound will be played. For external sounds - this is the volume the sound will heard at, or within, MinFeet above.

Column 7:

Vol@MaxFeet - This is volume at MaxFeet, it only effects external sounds.

Column 8:

Flags - The flags data consists of characters that describe the attributes of the sound.

- 0 (zero) - Use this if you have no flags set.
- **(only 1 of the following 4 per sound)**

- E - External sound, when heard from in the pit, extra attenuation is applied
- S - External sound, if the player's ac (self) emitted that sound, it is not attenuated when heard from the inside. (useful for things like hits to the fuselage)
- I - Internal sound, only heard while in pit
- V - VMS aka Betty - sound is always heard
- L - Sound is played looping
- F - Frequency can be adjusted
- H - High priority
- R - Reverse Doppler effect, this might be useful for Burner sounds.
- C - Uses Cone data (not implemented yet)

Notes:

Only external sounds have 3d affects applied to them.

Column 9:

Unused

Column 10:

Sound Volume Group - These coorespond to the sound level sliders in F4's Sound Setup.

Column 11:

LinkedSoundID - this is the ID number of another sound. This allows F4 to automatically play multiple sounds. This is useful where the code doesn't explicitly call internal & external sounds for the same effect. An example of this is the Vulcan cannon sounds.If you check the sound table, you'll see that the vulcan sound is already setup using this method. (New WAV files are still needed however)

Column 12:

Unused

BENCHMARKSIMS CREDITS

Lead Developer

Miro 'Jammer' Torrielli

Producer

Charles 'CobraCab' Bodiker

Developers

Charles E. 'Unz' Unzicker

Cleon 'Associator' Waterberg

Craig 'Smeghead' Rae

Erik 'Booster' Odemark

Fred 'BaldEagle' Balding

Halldor B. 'Jester' Jonsson

Jon-Paul 'mirv' Griffin

Lukas 'Retro' Friembichler

Mark 'Boxer' Doran

Martin 'MAV' Vinther

Mikal 'Wombat778' Shaikh

Mike 'mrivers' Rivers

Randall 'Mouse' Sechler

'Rik'

Robert 'Vexx' Yurystowski

Thomas 'Ataribaby" Hamarcak

Thomas 'tom2' Waelti

Tom 'Saint' Launder

Beta Testers

ATCO(87th)

Venom

Crow

MrZaggy

Sting

Elephant

Killer

Sappy

Shadow(87th)

Killer62

ninja(87th)

Dutchy(87th)

Ratty

Hero(87th)

Oden(16th)

merlin01

Goose(16th)

BenBen,

Firebird

Rilex

Jagstang

Husky(87th)

Coffin(87th)

Vexx

Zeek(87th)

Manuel Orcera