Glass Cockpit 2.1

for FSX Acceleration Twin Turboprops

(*originally developed for the AFG King Air 300 by Dr. Warren Lieuallen*)

Figure 1: King Air 300 Glass Cockpit

Introduction

I am totally addicted to Microsoft Flight Simulator X (FSX). I probably fly more than most commercial pilots, because I rarely take a day off. Thanks to OrbX, I do my flying mostly in Australia and New Zealand, and exclusively in the world of FSEconomy (if you don't know what this is, you definitely need to give it a look; it gives flight simulation a true purpose). And I fly the Beechcraft King Air 300 more than any other plane.

Although I started with the FSX default King Air 350, I was lucky enough to find the AFG King Air 300 (with its FSX update). This is such a wonderful plane, it keeps me coming back again and again. But after 3 years, I started to long for an upgrade. Although the model includes LCD versions of the attitude indicator and HSI (modeled after the Collins EADI-84 and EHSI-84), it's basically the good ol' six-pack set of analog gauges. I've dabbled with the G1000 version of the C172, and I have the Avidyne Entegra suite in my (Eaglesoft) Cirrus SR22. So I'd like to bring my favorite plane into the 21st century and upgrade to a glass cockpit. How hard could that be? Little did I know!

I tried copying the G1000 into it, but those gauges only work with the default FSX planes they were designed for. I eventually did find a G1000 modified for the Socata TBM, but it only really works for single-engine turboprops. I tried to find other "glass cockpit" gauges, but the ones I found turned out to be replacement GPS units (I'm glad I did, though, because I found an amazing one!). I specifically searched for "EICAS", but the ones I found were for single-engine planes or multi-engine jets. Eventually, I decided that the two gauges from the default LearJet 45 looked and worked pretty well. If I could just tweak 'em a little...!

Glass Cockpit 2.0

This panel is essentially the radio, PFD and EICAS from the FSX LearJet 45, and the fabulous replacement GPS from Gavin Munro. The original authors of those gauges deserve all the credit. I merely fiddled a little (with assistance from the kind folks at FSDeveloper.com), altered them to work in a twin turboprop and put them together.

For the King Air 300, I tried to use gauges from KingAir.dll and Kingair300_AFG.cab when I could. Other non-default gauges I added are: FP_KAFQ (for the left-side fuel gauge); the F111 autopilot modified from Bill McClellen's wonderful MiniPanel project; a simple ID plaque; the attitude indicator from the Beech Baron; and the yaw indicator from the LearJet 45. All are included in this package, except the C172's clock; you'll need to have Cessna172.dll installed in the panel's folder or in your main Gauges folder.

For the Piaggio Avanti, I used gauges from Mario Noriega's fantastic model. Skip the payware – this one is better than any of those! Everything you need is included for this model as well. Other "expansion packs" will be released for more twin turboprops in the future (see Future Plans on page 8).

To start, I altered the background image to make more room for gauges. In the King Air there's also an expanded nearly full-screen version (to include all the switches below the main instruments, just like the default 350's IFR panel) which you can access by pressing "W" while in the cockpit, and I'm now working on a completely full-screen version (not yet released), since I now have a second monitor to put the outside view on. Unfortunately, these panels are 2D only, because I cannot alter the 3D (VC) panel without having the plane's model source files. I've tried to put these new instruments onto the VC panel, but it's nearly unusable (not to mention quite ugly). So, if you're a devoted VC pilot, I'm afraid this cockpit isn't for you.

I don't think you'll find any big surprises (I hope not!). You'll have to learn to use the new GPS unit, but it's not hard and the documentation is excellent. The new glass gauges will take a little getting used to, but they present all the information you're used to seeing. Everything has a tooltip, so if you're not sure of something, just hover the cursor over it and see what it says.

Once you open or create a flight plan, you'll find lots of useful features and information in the GPS unit. To actually fly the plane, you'll adjust your settings on the autopilot panel (or just fly by hand!), set up your comm. and nav. frequencies on the radio panel (or through the GPS), and off you go!

The original version of these gauges had specific values for the King Air 300 hard-coded into them. With this release, I store this data in a hidden gauge for each plane, so they should now work with any twin turboprop! I suppose they'll work with single-engine planes (the engine #2 gauges should just show

zero all the time); I'm less certain how well they'd work with non-turboprop engines (since the data shown is really only appropriate for turboprops).

I should also mention that these panels were designed to fit my new glass cockpit gauges, and no attempt was made to recreate any real-world panel. I hope you find them usable and reasonably well laid-out. But they are purely fictional.

I also need to mention that certain settings stored in your default flight may interfere with some of these gauges. Specifically, the Flight1 King Air B200 includes a "flight for complex aircraft" file which disables GPS and VOR navigation with these gauges and prevents the AoA display. I've tried to update my gauges to address this, but if you have difficulties, be sure to load a fairly simple flight and then switch to an aircraft with this panel (and then save the flight!).

Glass Cockpit 2.1

This release tweaks a few small things in the GPS gauge, and (*mea culpa*) fixes a small bug I added. It also confirms what I had feared – this package only works in FSX Acceleration (specifically, the PFD gauge). If you do not have Acceleration, you can substitute the default LearJet 45's PFD for my gauge (edit the panel.cfg file to use the LearJet 45 gauge (Lear_45_XML!pfd); if you're really ambitious, you could unpack the Lear_45_XML.CAB file, extract the pfd files and replace my pfd gauge).

This release also adds a configuration utility to allow you to create your own settings, or edit the settings I've provided. Each plane has values for the V-speeds and RPM limits. Whenever possible, I found these values through the Internet for the specific plane; in a few cases, I had to guess! If you'd like to change one or more of the values, this utility should help. See the Twin Turbo Value File Editor documentation for more information.

Installation

This package should have unZIPped into five folders:

1. Beechcraft King Air panel – Copy this folder into your King Air, and name it "panel.glass" (you can change the word 'glass' if you prefer). Edit your aircraft.cfg file so that at least one of your King Air versions contains "panel=glass" (or whatever word you changed it to). This folder contains graphics and gauges specific to the King Air.
2. Documentation – I'm guessing you found this folder, or you wouldn't be reading this documentation! You'll also find the PDF for the GPS gauge in here.
3. Gauges – The meat of the package, the contents of this folder should be copied to your main FSX Gauges folder. These are all the gauges that make this glass cockpit work.
4. Piaggio Avanti panel – Copy this folder into your Avanti, and name it "panel.glass", just like you did for the King Air above. Edit this aircraft.cfg, too. No surprise – this folder contains graphics and gauges specific to the Avanti. You'll need to have Mario Noriega's model installed.
5. Value File Editor – Copy this file to your main Airplanes folder (you can actually put it anywhere you like, but this location makes it quicker and easier to navigate to the individual planes' folders). This program is a simple interface to make changing the data in Values.xml easier, and is completely optional. If you only use my expansion packs, and are happy with the way it works, you don't need this. But if you want to change one or more values, or if you want to adopt this panel to a different plane, this may help. See the Value File Editor documentation.

The Gauges

Let's take the new gauges one at a time....

Fuel gauge (*King Air only*)
The fuel gauge on the lower left side of the cockpit shows the fuel level in the right main and auxiliary tanks. This gauge has always been visible, but now it works! I chose to add the two right tanks together to give you a better idea as to your total fuel level (figuring that both sides should be about equal). There is also a pop-up panel (Shift-4) which shows the entire fuel gauge panel. These gauges will show the left and right main tanks. Click the Fuel Quantity switch to change the display to the left and right auxiliary tanks. Cross-feed (side to side) is also available. I haven't yet implemented a way to transfer fuel from the auxiliary tanks to the main tanks, but FSX seems to handle this on its own (as I fly, when the auxiliary tanks are empty, it automatically uses fuel from the main tanks).

Figure 2: Pop-up Fuel panel

Use the "Fuel Quantity" switch in the lower middle of the panel to switch the gauges from the main to the auxiliary tanks.

The standby pump switches are active, but are only needed if the engine-driven pumps fail (unlikely to impossible in FSX).

The crossfeed switch now works, for both the main and auxiliary tanks. Switch tanks with the lower "Fuel Quantity" switch FIRST, then use this switch to transfer fuel from one side to the other. Turn the crossfeed switch back off before switching tanks with the "Fuel Quantity" switch.

You can place this gauge into other planes, but it will only work correctly in planes with left and right main and auxiliary tanks.

Radio

Pretty self-explanatory. You can set the COM1 and COM2 radios, NAV1 and NAV2 frequencies, transponder code and ADF frequency. The upper button of the first four pairings (with the double arrow) switches the active and standby frequencies (be sure these are available for COM1 and COM2 in your aircraft.cfg file). The lower button (with the single line) let's you select which frequency to change (indicated by the yellow box). You can change the frequency by clicking on the numbers themselves, or by using the knob in the lower right corner. Click the left-side of the numbers to decrease (both before and after the decimal point), and the right-side to increase. Click to the left of the knob to decrease before the decimal point and click the left half of the inner knob to decrease after the decimal point, and *vice versa*. It's pretty intuitive once you try it.

Figure 3: Radio panel

Switch the standby and active frequency
Select standby frequency for changing

A = increase the whole part of the frequency
B = increase the fractional part of the frequency
C = decrease the fractional part of the frequency
D = decrease the whole part of the frequency

So, to change 124.850 to 122.700, click C twice (124 will become 122), and D three times (.850 will become .700). Then click the double-headed arrow button to make that the active frequency.

PFD

This is the heart of the panel, and the gauge you'll spend most of your time looking at. There are a number of additions to the default LearJet45. I made the display of the NAV2 information optional; it is turned on and off by pressing the lower left knob. I added a few V-speed bugs (V_Y [best climb speed], V_X [best angle of climb speed], V_R [rotation speed] and V_{SO} [full-flap stall speed]). More importantly, I enabled navigation using NAV2.

You toggle the navigation source by clicking the GPS/1/2 button; this cycles the control of navigation from GPS to NAV1 to NAV2. The STD button resets the barometer to 29.92; the lower right knob is used to adjust the barometer setting. Click the left side of the knob to lower the barometer, and the right side to raise it. Or, just press "B" to set the barometer to the current pressure, like always.

The speed, altitude and vertical speed bugs are set from the autopilot panel. Heading and Course (1 and 2) are also set from the autopilot panel.

Figure 4: Primary Flight Display (PFD) panel

This panel displays all the information you'll need to fly the plane.

The traditional attitude ball and HSI should already be familiar to you. Airspeed is shown on the tape to the left.

The altitude is shown on the tape to the right. The selected altitude is shown above the tape in magenta (4500 feet AGL in this example).

The radio altitude (up to 4000 ft) is shown next to this (2519 feet AGL in this example), and the barometric pressure is shown below the altitude tape (29.07 in Hg in this example).

The vertical speed is shown to the right of the HSI (set for 1500 in this example, but currently at 1300).

The navigation source (GPS in this example) is shown to the left of the HSI.

Wind direction and speed are shown to the lower left of the HSI (10 knots in this example), and ground speed is shown in cyan to the lower right (164 knots in this example).

New to version 2.0, speed reference bugs have been added for full-flap stall (S), rotation (R), best climb angle (X) and best climb rate (Y). Trend lines have been added for airspeed, altitude and turn, and show you where you will be in 6 seconds (if nothing changes). In the example above, you can see that I am slowing, climbing and turning slightly to the left.

EICAS

This isn't really a full multi-function display (MFD) like most glass cockpits, since the GPS is separate. So I think it's really an EICAS (Engine Indication and Crew Altering System). Pretty standard stuff, but it took a lot of fiddling to make this work.

Fuel is displayed as the total on-board in pounds, and broken down into the left main, other tanks, and right main in gallons. Three-axis trim is shown, as is the current flap setting. Vfe indicates the recommended maximum speed for flap deployment. (200 and 157 knots, respectively, in this example). A series of warnings can appear in the annunciator section in the upper right. The most severe will be in red; correct this or prepare to land immediately. Cautions are in yellow, and useful information is in white. Ideally this section should be blank before take-off, and stay that way.

Six standard icons are present across the bottom. These icons open up: checklist, ATC, map, GPS, fuel, and IFR panel. All 6 icons will not be present in all planes (for example, the Avanti doesn't have a fuel or IFR panel).

Figure 5: EICAS panel

This panel displays information about your engines and control surfaces, and contains the warning annunciator.

Look for documentation on your plane to find the limits for torque (over 100% is allowed for a short time during take-off, as shown to the left), prop RPM, ITT, Oil pressure and temperature. As you approach the limits, the data will turn yellow (shown for the Prop RPM and ITT in this example) and then red. Don't let it stay red for long!

To the right of the fuel display is an indication of the Time 'til Empty (TTE) and distance remaining. This is dependent on the current airspeed and fuel flow. It will not be displayed while the plane is on the ground, nor when fuel flow is below 75 pph.

OAT is Outside Air Temperature. Below 10ºC, you'll be advised to use Pitot Heat.

The lower right knob doesn't do anything yet!

Autopilot

Again, pretty self-explanatory. The buttons across the top command the autopilot to: follow the selected NAV source; follow the selected heading; use ILS Approach mode (you must have the ILS tuned on NAV1); go to and hold the selected altitude (subject to the selected vertical speed); hold the wings level; use the NAV's backcourse; go to and hold the selected indicated speed; go to and hold the selected Mach speed; toggle the yaw dampener. The lower right AP button turns the unit on and off. These buttons will turn green when they are on.

Figure 6: Autopilot panel

The lower "windows" show the currently selected: NAV1 course; NAV2 course; Heading; Altitude; Vertical Speed; Indicated or Mach Speed. Each of these values may be changed; click in the left half to decrease and the right half to increase.

Note that IAS and Mach speed hold doesn't work in the King Air (on purpose, because there is no autothrottle). These buttons will work in planes with an autothrottle (like the Piaggio Avanti).

GPS

Refer to the included GPS Gauge Installation and Documentation 1.6 PDF file – it's excellent. Note that the section on selecting a color does not apply to my version – I have put the color into the background image because I found the transparent gauge more difficult to read.

Figure 7: GPS Flight Plan screen

Figure 8: GPS moving map (with terrain and waypoint information turned on)

I cannot begin to adequately express my admiration for this gauge! It's quite different from the Garmin units that we're all used to. But once you learn to use it (and it's not hard at all), you'll never go back! It contains a wealth of information in a very well organized and easy to access system, plus it looks really cool! And the interface with the NAV radios is fantastic.

This GPS gauge will show your flight plan; allow you to select your arrival procedure; show you the nearest airports, VORs, NDBs (all with lots of detail) and more; and display a beautiful moving map complete with TCAS (other aircraft), TAWS, terrain and more!

Trust me, this gauge alone is worth the price of this entire package! Don't like my glass cockpit? Okay, no harm done. But I'll bet you'll keep this GPS gauge!

AoA

A simple Angle of Attack gauge, but I'm especially proud of it because I created it all by myself! It is modeled on the real-world Bendix-King gauge, and indicates your wings' angle of attack. Basically green is good, yellow is caution and red is "drop your nose"! Click on the gauge and the actual angle will be displayed below the gauge's graphic.

Gauge Programming (Credits)

I've always felt that my particular talents lie in plagiarism and embellishment. I am not the most creative artist, and I am not the most accomplished programmer. But I can edit and tweak other peoples' work to beat the band! That is clearly evident in this gauge package. Less than 25% is my own original work. And what little I did "create" came only with significant help from the kind folks at FSDeveloper.com.

Gauge Authors:
Side panel Fuel Gauge – Pierre Fasseaux
Pop-up Fuel Gauge – Allied FS Group (included with the AFG King Air 300)
Radio – ACES (included with FSX); slightly modified by me
PFD – ACES (included with FSX); modified by me (mostly to add NAV2 functionality)
Trend Bars – Joao Muas on FSDeveloper.com did the airspeed and altitude; I did the turns
EICAS – ACES (included with FSX); modified by me
Autopilot – Karol Chlebowski; slightly modified by me
GPS – Gavin Munro; slightly modified by me
AoA – me
Fuel Transfer (dsd_fuel_dump.dll) – Doug Dawson
Fuel Crossfeed – me
Value File Editor – me

Future Plans

This present package includes versions for the AFG Beechcraft King Air 300, and Mario Noriega's Piaggio P180 Avanti (my two favorite twin turboprops). It should work in just about any twin turboprop (you'll need to copy or make your own Values.xml file, and create your own panel). Future releases ("Expansion Packs") provided the needed panel and Values.xml for the (numbers in parentheses indicate which Expansion Pack it is in):

Small turboprop (twin)	Aero Design AC690 (4)	DeHavilland DHC-6 Twin Otter (3)
	Antonov An-28* (4)	Dornier 228 (5)
	Basler BT-67 (1)	Embraer 110 (2)
	Beechcraft King Air 200 (3)	Mitsubishi MU-2 (1)
	Beechcraft King Air 300 (base)	**Piaggio 180 Avanti** (base)
	Beechcraft King Air 350* (2)	Piper PA-42 400LS* (5)
	Beechcraft King Air C90* (4)	Shorts Skyvan (3)

Large turboprop (twin)	Antonov An-26 Curl (8) Antonov An-32 (9) ATR 72-500 (10) BAe Jetstream 32 (7) Beechcraft 1900C (6) Beechcraft 1900D (6) Bombardier Dash-8 Q400 (7) CASA CN235 (11)	Convair 580 (9) DeHavilland Dash 8 100/200 (10) DeHavilland Dash 8 Q300 (11) DeHavilland DHC-5 Buffalo (11) Embraer 120 (9) Fairchild Metro III (8) Let L 410 UVP-T (6) SAAB 340B (8)

In case anyone is interested, the selection criteria for inclusion in this distinguished group are: freeware FSX models of twin turboprops which are supported in FSEconomy.

* Those who collect these expansion packs will notice that several of them are nearly (or completely) identical to the King Air 300. This is because the original versions of those planes aliased their 2D panel to the King Air 350. It was much quicker (and easier!) for me to just adapt the original King Air 300 glass panel to these planes rather than inventing something new from scratch. And lets face it, all these glass cockpits are pretty similar.

Just a few examples of the panels for different planes:

Basler BT-67 Mitsubishi MU-2 Embraer 110 Shorts Skyvan

Versions

v 1.0 – initial release; April, 2016
v 1.1 – initial release that actually worked! (I forgot to put the gauges in the original ZIP – sheesh!)

v 2.0 – May, 2016

- updated GPS to the new 1.6 release; added some info on the map screen
- added trend bars for airspeed, altitude and turns
- new V-speed bugs, and Values gauge to store V-speed values (unique to each plane, this gauge is not displayed but simply stores the needed values)
- added Time ‘til Empty (TTE) and distance remaining
- reworked EICAS fuel system to work with any plane and any combination of fuel tanks
- added Angle of Attack and Fuel Crossfeed gauge
- lots of debugging and little graphics tweaks

v 2.1 – June, 2016

- a few more minor graphics tweaks (mostly in the GPS)
- fixed a small bug in the GPS line width code (which was my error in the first place!)
- Added Configuration utility for editing Values.xml

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(*I guess if you print this, you can use the rest of this page for notes!*)

Appendix

You may already have a favorite, but if not, here's a quick comparison on FSEconomy's twin turboprops (sorted by seats and cruise speed).

 ***Let L 410 UVP-T*** 200 kt @ 120 gph (1⅔ mpg) 5 seats; 2,650 kg; v$114,000 / v$763 332 gal → 553 nm	 ***Aero Design AC690*** 200 kt @ 60 gph (3⅓ mpg) 8 seats; 1,873 kg; v$362,250 / v$462 384 gal → 1,280 nm	 ***Mitsubishi MU-2B*** 270 kt @ 80 gph (3¼ mpg) 9 seats; 1,780 kg; v$564,000 / v$544 402 gal → 1,357 nm
 ***Piaggio 180 Avanti*** 340 kt @ 110 gph (3 mpg) 9 seats; 1,750 kg; v$700,500 / v$667 420 gal → 1,298 nm	 ***Beechcraft King Air C90*** 240 kt @ 95 gph (2½ mpg) 12 seats; 1,576 kg; v$715,350 / v$606 384 gal → 970 nm	 ***Piper PA-42-1000 400LS*** 300 kt @ 105 gph (2¾ mpg) 12 seats; 2,611 kg; v$879,750 / v$646 580 gal → 1,657 nm
 ***Beechcraft King Air 200*** 245 kt @ 113 gph (2 mpg) 14 seats; 1,995 kg; v$837,000 / v$679 550 gal → 1,192 nm	 ***Beechcraft King Air 350*** 248 kt @ 142 gph (1¾ mpg) 15 seats; 2,681 kg; v$892,500 / v$798 540 gal → 943 nm	 ***Beechcraft King Air 300*** 257 kt @ 90 gph (3 mpg) 15 seats; 2,354 kg; v$984,900 / v$585 540 gal → 1,542 nm
 ***Shorts Skyvan*** 168 kt @ 62 gph (2¾ mpg) 19 seats; 2,329 kg; v$761,700 / v$571 390 gal → 1,057 nm	 ***Antonov AN-28*** 180 kt @ 108 gph (1⅔ mpg) 20 seats; 2,377 kg; v$828,600 / v$759 574 gal → 957 nm	 ***Embraer 110*** 248 kt @ 110 gph (2¼ mpg) 20 seats; 2,185 kg; v$1,193,700 / v$767 454 gal → 1,054 nm
 ***DeHavilland DHC-6 Twin Otter*** 170 kt @ 110 gph (1½ mpg) 21 seats; 2,404 kg; v$783,000 / v$767 416 gal → 643 nm	 ***Beechcraft 1900C*** 220 kt @ 120 gph (1¾ mpg) 21 seats; 3,157 kg; v$1,032,000 / v$863 670 gal → 1,228 nm	 ***Beechcraft 1900D*** 230 kt @ 200 gph (1¼ mpg) 21 seats; 2,985 kg; v$1,140,000 / v$1,190 670 gal → 771 nm

 ***Dornier 228*** 230 kt @ 130 gph (1¾ mpg) 21 seats; 3,142 kg; v$1,270,800 / v$849 600 gal → 1,062 nm	 ***Fairchild Metro III*** 248 kt @ 120 gph (2 mpg) 21 seats; 3,343 kg; v$1,257,650 / v$863 500 gal → 1,033 nm	 ***BAe Jetstream 32*** 250 kt @ 210 gph (1¼ mpg) 21 seats; 4,031 kg; v$1,249,500 / v$1,231 560 gal → 667 nm
 ***Embraer 120*** 260 kt @ 140 gph (1¾ mpg) 32 seats; 4400 kg; v$2,133,000 / v$1,045 454 gal → 843 nm	 ***Basler BT-67*** (turbo DC-3) 205 kt @ 150 gph (1⅓ mpg) 37 seats; 5,897 kg; v$1,987,500 / v$1,131 1,584 gal → 2,165 nm	 ***SAAB 340B*** 290 kt @ 150 gph (2 mpg) 38 seats; 4,535 kg; v$2,797,500 / v$1,186 866 gal → 1,674 nm
 ***DeHavilland Dash 8 100/200*** 260 kt @ 200 gph (1⅓ mpg) 39 seats; 6,000 kg; v$2,586,000 / v$1,390 840 gal → 1,092 nm	 ***Antonov An-26 Curl*** 237 kt @ 350 gph (⅔ mpg) 42 seats; 7,420 kg; v$2,691,830 / v$2,004 1,500 gal → 1,016 nm	 ***DeHavilland DHC-5 Buffalo*** 240 kt @ 215 gph (1 mpg) 46 seats; 10,928 kg; v$2,852,250 / v$1,551 840 gal → 938 nm
 ***CASA CN235*** 245 kt @ 136 gph (1¾ mpg) 47 seats; 6,700 kg; v$3,191,700 / v$1,228 1,388 gal → 2,500 nm	 ***Antonov An-32*** 300 kt @ 340 gph (1 mpg) 53 seats; 10,200 kg; v$4,293,000 / v$2,063 1,840 gal → 1,624 nm	 ***DeHavilland Dash 8 Q300*** 285 kt @ 220 gph (1⅓ mpg) 55 seats; 7,709 kg; v$4,437,000 / v$1,572 840 gal → 1,088 nm
 ***Convair 580*** 282 kt @ 300 gph (1 mpg) 56 seats; 11,599 kg; v$4,133,400 / v$1,999 1,726 gal → 1,622 nm	 ***ATR 72-500*** 250 kt @ 200 gph (1¼ mpg) 70 seats; 9,050 kg; v$4,770,000 / v$1,690 1,320 gal → 1,650 nm	 ***Bombardier Dash-8 Q400*** 380 kt @ 250 gph (1½ mpg) 78 seats; 12,071 kg; v$8,528,906 / v$1,995 1,772 gal → 2,693 nm