Black Square

ANALOG KING AIR

OPERATIONS MANUAL

For Microsoft Flight Simulator

Published By:

Just Flight

Black Square

"Virtual Aircraft. Real Engineering."

Analog King Air User Guide

Please note that Microsoft Flight Simulator must be correctly installed on your PC prior to the installation and use of this King Air aircraft simulation.

Contents

Introduction

The King Air has been a staple of the general aviation industry since the 1960's, providing safe and economical transport for large cabin volumes in a package with now more than 3,000 units flying. With two 1,050 shaft-horsepower (783 kW) PT6A-60A engines, room for up to nine passengers, and a maximum weight of 15,000 lbs, the King Air 350 is one of the most complex and demanding aircraft to fly single pilot. Even the most modern revisions of the King Air show their 1980's heritage with vast electrical panels and analog meters. Only the most skilled pilots can handle all situations while operating an original King Air with analog instrumentation, and possibly before the advent of GPS. Do you have what it takes?

Black Square's Analog King Air brings you a completely new interior and panel for the default MSFS King Air, featuring analog instrumentation (steam gauges), swappable radio configurations, and an overhauled electrical system with every circuit breaker, bus, meter, switch, and knob functioning. Users will find increased detail on the instrument panel and electrical panels when compared to default aircraft, and a similar level of detail in the cabin. The panel of the aircraft contains only fully 3D gauges, modeled and coded to meticulously match their real world counterparts, with reference to real world maintenance and installation manuals. No piece of equipment appears in a Black Square aircraft without a real world unit as reference. Radio and navigation systems are available from several eras of the King Air's history, so users can fly without GPS via an original Bendix KNS-80 RNAV system, or with the conveniences of a Garmin GTN 750 (PMS50 or TDS). Other swappable radio equipment in this aircraft includes Collins CTL NAV/COM radios, CTL-62 ADF, GNS 530, IND-42 DME, CTL-92 Transponder, APS-65 Autopilot, and a Bendix RDR1150XL Color Weather Radar. A 100 page manual provides instruction on all installed equipment, and 45+ in-game checklists with control/instrument highlighting are included for normal and emergency procedures.

Primarily analog instrumentation augmented with modern radionavigation equipment is still the most common aircraft panel configuration in the world. Challenge your piloting skills by flying IFR to minimums with a fully analog panel, and no GPS. You'll be amazed at the level of skill and proficiency you can achieve to conquer such adversity, and how it will translate to all your other flying. You also may find the analog instrumentation much easier to read with the limited number of pixels available on a computer monitor, and even more so in VR.

NOTE: **This product is an INTERIOR AND SYSTEMS OVERHAUL ONLY that makes use of the default MSFS King Air exterior visual model.** Improvements have been made to almost all aspects of the aircraft, **except** the visual appearance of the exterior. All default King Air liveries are compatible with this product.

For more information on this product's capabilities and a list of all included avionics and equipment, see the extensive operating manual at www.JustFlight.com.

Feature Overview

Model

- Accurately modeled King Air 350 interior ONLY (uses default exterior model), created from hundreds of reference photos, panoramas, and technical documentation.

- 100% MSFS native animation code for the smoothest animations and cockpit interactions using either legacy or new cockpit interaction modes

- 4096x4096 (4K) textures are used to produce the highest possible texture clarity

- PBR (Physically Based Rendering) materials with real-time environment reflections for superb quality and realism

- Detailed normal mapping for leather, fabric, plastic, stitches, scratches, carpet, and tooling marks, resulting in a texture resolution of 10,000 pixels per square inch (90.0kB)

- Extensive use of new MSFS decal system for nearly vector-graphic quality of labels, arrows, and exterior detail features

Cockpit

- Greatly enhanced instrument panel detail compared to default aircraft with every label and marking in its place. If it appears in the real aircraft, you can interact with it!

- Custom coded steam gauges with lowpass filtering, needle bounce, and physics provide ultra-realistic and silky smooth animations like you've never seen before.

- Carefully modeled components match the depth and character of the real instrumentation, based on reference photos, schematics, and real world measurements. Unlike other expensive Flight Sim aircraft, every piece of equipment that appears in a Black Square aircraft is modeled after a real piece of aircraft equipment, and will behave the same way in its primary functionality.

- Every knob, switch, and button is interactable and implemented, along with its respective electrical circuitry. Turn systems on and off or pull circuit breakers to see the impact it has on your generators and battery via the analog meters. Many pieces of equipment respond correctly to electrical configurations with warning messages and diagnostic codes.

- Fully 3D cockpit lighting technology for every gauge and panel, with ambient bounce lighting for a more immersive nighttime experience that won't leave you fumbling around in unrealistically dark spots.

- 4096x4096 (4K) PBR textures on cockpit and panel for crisp instrumentation. Even see the fingerprints on instrument glass!

- Hideable yokes, adjustable sun visors, and other cockpit aesthetics

- All placards and warning labels from the real aircraft represented

- Experimental working windshield wipers actually clear rain!

Systems

Black Square's overhauled cockpits with analog instrumentation go far beyond a visual upgrade. Included, you will find a complete redesign of all aircraft systems to more closely match the real aircraft, with a focus on electrical systems. Also included are more accurate weight and balance, lighting systems, flight dynamics, and ground handling. Enjoy features, like…

- Completely intractable electrical system with 12 buses and 165 circuits

- Selective state saving for radio selection, radio frequency memory, cabin aesthetics, etc.

- 160+ system failures, set via in-cockpit interface. Either random based on settable MTBF, or schedulable, with optional time acceleration.

- Cabin environmental control system for heating, air conditioning, ventilation, ram air cooling. Cool things off by opening a window, or watch the airplane heat up in the sun.

- Custom coded pressurization system and circuitry.

- Crew/Passenger oxygen system that depletes according to pressure altitude, passenger occupancy, and the biological demand of each passenger based on weight

- Improved turbine dynamics (ITT, TRQ, Ng, Fuel Flow, Inertial Separator), battery charging circuity, and load shedding, and ability to cause hot start

- Engine limit excursions decrease engine health and will eventually lead to failure

- Emergency gear extension hand pump, and working propeller governor tests

- Mathematically accurate VOR & ADF signal attenuation and noise, and remote compass

Checklists

Over 500 checklist items are provided for 45+ Normal, Abnormal, and Emergency procedures in textual form in the manual, and in-game, using the MSFS native checklist system with control and instrument highlighting. If it's in the checklist, it's settable in the aircraft!

Sounds

Black Square's Analog King Air features the default MSFS-native (Wwise) 3D King Air 350i sound package, inside and out. Default sounds have been carefully assigned to all interactable cockpit elements for an authentic 3D spatial experience. Additional environmental sounds have been added to represent the specific aircraft model, such as aural warning tones, and motors.

- Rich audio for every switch, button, lever and electrical system
- Added warning tones and environmental sounds
- Accurately positioned 3D sound sources (best enjoyed in VR!)

Flight Dynamics

The Analog King Air features an improved flight model compared to the default King Air 350i with tweaks based on operator feedback, and reference to operating handbook figures.

Aircraft Specifications

Length Overall	46'8"
Height	14' 4"
Wheel Base	16'3"
Track Width	17'2"
Wingspan	57'11"
Wing Area	310.0 sqft.
Flight Load Factors	+3.10/-1.24 G's (+2.4 G's with Flaps Down)
Design Load Factor	150%
Cabin W/L/H	19'6" x 54" x 57"
Oil Capacity	14 U.S. Quarts (ea. engine)
Seating	6-9
Wing Loading	48.4 lbs/sqft.
Power Loading	7.15 lbs/shp
Engines	2x 1,050 SHP (783 kW) Pratt & Whitney PT6A-60A
Propeller	4-Blade Hartzell, Constant Speed, Full-Auto-Feathering, Reversible, Aluminum, Hydraulically Actuated, 105 inch propeller.
Approved Fuel Grades	JET A (ASTM-D1666)
	JET A-1 (ASTM-D1666)
	JET B (ASTM-D1666)
	JP-5 (MIL-T-5624)
	JP-8 (MIL-T-83133 A)
	Chinese Jet Fuel No. 3 (RP-3)
Fuel Capacity	Total Capacity: 539 U.S. Gallons (3,611 lbs)
	Total Capacity Each Main Tank: 190 U.S. Gallons (1,275 lbs ea.)
	Total Capacity Each Auxiliary Tank: 80 U.S. Gallons (533 lbs ea.)

Electrical System

Voltages:	28 VDC / 26 & 115VAC
Batteries:	24V, 42 amp-hour, sealed lead acid
Starter-Generators:	2x 28V, 300 amp, in parallel
Inverters:	2x single-phase, 400 Hz, providing 26 & 115 VAC

Load Shedding

A major advantage of the King Air's multi-bus system is that the electrical loads associated with the various buses will be semi-automatically "shed" when the aircraft is reduced to either single-generator or battery-only operation, and their generator bus-tie is opened. Systems that are capable of operating after complete load shedding are adorned with a white circle around their associated toggle switch.

Aircraft Performance

Maximum Cruising Speed	312 ktas
Economy Cruising Speed	234 ktas
Takeoff Distance	3,300 ft
Landing Distance	2,692 ft
Range	1,806 nm
Rate of Climb	2,700 ft/min
Single Engine Climb Rate	622 ft/min
Service Ceiling	35,000 ft
Empty Weight	9,955 lbs
Max Ramp Weight	15,100 lbs
Max Takeoff Weight	15,000 lbs
Max Landing Weight	15,000 lbs
Useful Load	5,145 lbs
Usable Fuel Weight	3,611 lbs
Full Fuel Payload	1,534 lbs
Maximum Operating Temp.	+52°C
Minimum Operating Temp.	-54°C

V-Speeds

V1 (approx.)	95 kts	(Takeoff Decision Speed)
Vr	105 kts	(Rotation Speed)
V2 (approx.)	115 kts	(Takeoff Safety Speed)
Vs	94 kts	(Clean Stalling Speed)
Vso	81 kts	(Dirty Stalling Speed)
Vref	105 kts	(Approach Speed in Landing Configuration)
Vmc	94 kts	(Minimum Control Speed)
Vx	125 kts	(Best Angle of Climb Speed)
Vy	140 kts	(Best Rate of Climb Speed)
Va	184 kts	(Maneuvering Speed)
Vg	105 kts	(Best Glide Speed)
Vfe (app.)	202 kts	(Maximum Flap Retraction Speed)
Vfe (full)	158 kts	(Maximum Flap Extension Speed)
Vle	184 kts	(Maximum Gear Extension Speed)
Vl0	166 kts	(Maximum Gear Retraction Speed)
Vno	170 kts	(Maximum Turbulent Air Penetration Speed)
Vne	263 kts	(Do Not Exceed Speed)

Engine Limitations

Maximum ITT: 820°C (T/O) 785°C (Climb) 765°C (Cruise) 1090°C (Starting)
Maximum Torque: 101% (T/O) 100% (Continuous) 105% (Transient)
Maximum Gas Gen RPM: 102.5% (Continuous) 104.0% (Transient)
Maximum Propeller RPM: 1,700 (Continuous) 1,650 (Reverse) 1,900 (Transient)
Oil Pressure: 90-135 PSI (Continuous) 60 PSI min. (Idle)
Oil Temperature: 0-99°C (Continuous) -40-99°C (Idle) 110°C (Transient)

- For every 10°C below -30°C ambient temperature, reduce maximum allowable Ng by 2.2%.
- Reverse thrust operation limited to durations of one minute.
- Normal oil pressure is 100-120 PSI above 72% Ng with oil temperature 60-70°C.
- Oil pressures below 85 PSI are undesirable, and should only be tolerated to complete a flight, preferably at reduced power settings.
- When ITT exceeds 765°C, time at this power setting should be limited to 5 minutes.

Starter Limitations

Using Airplane Battery:
      30 seconds ON - 60 seconds OFF
      30 seconds ON - 60 seconds OFF
      30 seconds ON - 30 **minutes** OFF

Using External Power:
      20 seconds ON - 120 seconds OFF
      20 seconds ON - 120 seconds OFF
      20 seconds ON - 60 **minutes** OFF

Paint Schemes

The Analog King Air comes with two additional color schemes in the default paint layout to distinguish it from the always available default King Air 350i in aircraft selection menus, and screenshots; however, any number of additional liveries may be adapted for the Analog King Air, and require zero changes to make liveries intended for the default King Air 350i compatible with the Analog King Air. For instructions on how to use your favorite default King Air 350i liveries with the Analog King Air, see the "Liveries" section of this manual. Note: Default paint schemes for the Analog King Air can implement any tail number, which will be displayed on the interior and exterior of the aircraft.

Instrumentation/Equipment List

Main Panel

- Master Caution/Warning
- Fire Suppression Controls
- Annunciator Panels
- Quartz Analog Chronometer
- Airspeed Indicator
- Collins ALI-80A Encoding Altimeter
- Collins ADI-85A Attitude Indicator
- Collins HSI-85 Horizontal Situation Indicator (HSI)
- Collins RMI-30 Radio Magnetic Indicator (RMI)
- Vertical Speed Indicator
- Mid-Continent Turn Coordinator
- Collins IND-31C Localizer
- Collins ALI-55 Radar Altimeter
- Engine Instrumentation
- Fuel Quantity Instrumentation
- Duplicate Copilot Instrumentation

Avionics

- Integrated Audio Control Panel
- Collins PRE-80C Altitude Preselector
- Garmin GTN 750 (Com1) (PMS50 or TDS)
- Garmin GNS 530W (Com1/Com2)
- Collins CTL-22 (Com1/Com2/Com3)
- Collins CTL-32 (Nav1/Nav2)
- Collins CTL-62 (ADF1/ADF2)
- Collins CTL-92 (Transponder)
- Collins IND-42 (DME)
- Collins APS-65 Autopilot Controller
- Bendix/King KNS-80 RNAV Navigation System (incl. Nav3)
- Bendix RDR1150XL Color Weather Radar

Electrical/Miscellaneous

- 200+ Circuit Breakers
- Multi-Function Volt/Amp Meter
- DC Generator Load Meters
- AC Frequency Meter
- Collins CCU-65 Remote Compass Control and Compensator
- Flap Position Indicator
- Cabin Climb Rate Indicator
- Cabin Pressure and Pressure Differential Indicator

- Cabin Pressure Controller
- Propeller Synchrophaser
- Propeller Amps Indicator
- Vacuum Indicator
- Oxygen Pressure Gauge
- Pneumatic Pressure Gauge
- Cabin Temperature Gauge
- Yoke-Mounted Digital Chronometers
- Hobbs Timer

Installation, Updates & Support

Installation

You can install this aircraft as often as you like on the same computer system:

1. Click on the 'Account' tab on the Just Flight website.
2. Log in to your account.
3. Select the 'Your Orders' button.
4. A list of your purchases will appear and you can then download the software you require.
5. Run the downloaded installation application and follow the on-screen instructions

If you already have an earlier version of this software installed, the installation application will detect this and update your existing software to the new version without you needing to uninstall it first.

NOTE: THE FOLLOWING DOWNLOADS ARE OPTIONAL, and not required to enjoy the base functionality of this Black Square aircraft; however, they are highly recommended for the most immersive experience possible.

Installing the PMS GTN 750

1. Go to the following link, and click download for the **FREE GTN 750 Mod.
   https://pms50.com/msfs/downloads/gtn750-basic/**
2. Move the "pms50-instrument-gtn750" archive (zipped folder) from your browser's download location (downloads folder by default) to your desktop, and extract (unzip) the archive by right clicking, and selecting "Extract All".
3. Drag the resulting "pms50-instrument-gtn750" folder into your Microsoft Flight Simulator Community Folder.

   If you don't know how to locate your MSFS Community Folder, you should be able to find it in one of the following locations, based on the service you used to purchase the simulator.

   For the Windows Store install:

   C:\Users\[YourUserName]\AppData\Local\Packages\Microsoft.FlightSimulator_8wekyb3d8bbwe\LocalCache\Packages\

   For the Steam install:

   C:\Users\[YourUserName]\AppData\Local\Packages\Microsoft.FlightDashboard_8wekyb3d8bbwe\LocalCache\Packages\

Important: Windows 10 by default hides the "AppData" folder, so you will have to go to "View" in the menu of File Explorer, and select "Hidden items" so as to see it.

For the Custom install:

If you used a custom location for your Flight Simulator installation, then proceed there.

For example, you may have set:
E:\Steam\steamapps\common\MicrosoftFlightSimulator\Community

Installing The Working Title GNS 530/430

The Working Title GNS 530/430 is now in public beta, and downloadable for free from the in-game marketplace. It is recommended that users discontinue use of the PMS50 GNS 530 freeware mod in favor of the WT GNS, which has many more features, and a more realistic graphical display. The WT GNS is expected to become a part of the base simulator soon.

To download and install the Working Title GNS 530/430, click the "MARKETPLACE" tile in the MSFS main menu, and use the search bar to find "GARMIN GNS 430/530" by "Working Title Simulations". After clicking the "GET AND DOWNLOAD" button, the GPS will be ready to use.

The previously recommended PMS50 GNS 530 modification can still be accessed at:

https://github.com/pimarc/pms50-gns530/releases

TDS GTNxi 750 Integration

This aircraft's GTN 750 unit will automatically detect a valid TDS GTNxi installation and license key, and automatically switch between using the PMS GTN 750 and the TDS GTNxi 750 without any required action by the user.

The TDS GTNxi is available from: **https://www.tdssim.com/tdsgtnxi**

LIMITATIONS:

MSFS native GPS units and native flight planners will not cross-fill from the GTNxi. This could also be seen as an advantage, allowing simultaneous flight plan loading.

NOTE: These are limitations of MSFS and not this aircraft, nor the TDS GTNxi. If and when these issues are resolved, a coordinated effort from the developers of these products will be launched to remove these limitations as soon as possible.

Accessing the Aircraft

To access the aircraft:

1. Click on 'World Map'.
2. Open the aircraft selection menu by clicking on the aircraft thumbnail in the top left.
3. Use the search feature or scroll through the available aircraft to find the 'Analog King Air'.
4. After selecting the aircraft, use the 'Liveries' menu to choose your livery.

Uninstalling

To uninstall this product from your system, use one of the Windows App management features:

Control Panel -> Programs and Features
or
Settings -> Apps -> Apps & features

Select the product you want to uninstall, choose the 'Uninstall' option and follow the on-screen instructions.

Uninstalling or deleting this product in any other way may cause problems when using this product in the future or with your Windows setup.

Updates and Technical Support

For technical support (in English) please visit the Support pages on the Just Flight website. As a Just Flight customer, you can get free technical support for any Just Flight or Just Trains product.

If an update becomes available for this aircraft, we will post details on the Support page and we will also send a notification email about the update to all buyers who are currently subscribed to Just Flight emails.

Regular News

To get all the latest news about Just Flight products, special offers and projects in development, subscribe to our regular emails.

We can assure you that none of your details will ever be sold or passed on to any third party and you can, of course, unsubscribe from this service at any time.

You can also keep up to date with Just Flight via Facebook and Twitter.

Liveries

Black Square's Analog King Air comes with two complimentary paint colors (Sky Blue, and Gold Accent) in the same scheme as the default aircraft, just to help differentiate the two in menus and screenshots. You may adorn these liveries with whatever tail numbers you wish through the default aircraft configuration menu. You may also add more liveries to the Analog King Air as mod packages the same way you would add them for any other aircraft.

Compatibility

Since the Black Square Analog King Air makes use of the default King Air 350i's exterior model, all liveries for the default King Air are also compatible with the Analog King Air; however, keep in mind that "livery" mods that change the interior features of the default King Air, such as seats or panel color, will not have an effect on the Analog King Air, since it uses a completely different interior model.

Example Mod

An example addon livery mod exists within the file structure of the Analog King Air in your Community Folder. If you don't know how to locate your MSFS Community Folder, please refer to the installation section of this manual for step-by-step instructions. Once you have located your Community Folder where the Analog King Air is installed, navigate to…

bksq-aircraft-analogkingiar\SimObjects\Airplanes

Within the above folder, you will find **"bksq-aircraft-analogkingair-livery-example"**. This folder contains everything you need to create a livery mod for the Analog King Air. Inside it, you will find an **aircraft.cfg**, which defines how your livery will appear in the aircraft selection menu, and several other features. There is also the **"TEXTURE.LiveryExample"** folder. Within this folder, you will find only a **texture.cfg** file for now. Continue to the next section for how to implement this file structure to create your own livery mod for the Analog King Air.

Installation

1. Although liveries for the default King Air are fully compatible with the Analog King Air, each livery must have its own package inside the Community Folder for each aircraft. Luckily, the Analog King Air's livery mod only needs to be a reference to the default livery mod, and none of the textures need to be copied.

2. Begin by creating a new folder in your Community Folder. Name it something like, **"bksq-aircraft-analogkingiar-mylivery"**. Within this folder, make another folder named **"SimObjects"**. Within this folder, make another folder named **"Airplanes"**. Within this folder, make yet another folder with the same name as the first, **"bksq-aircraft-analogkingair-mylivery"**. (We don't make the rules around here, we just

follow them.) Lastly, make yet another folder with the name, **"TEXTURE.mylivery"**, where mylivery matches the unique name you've decided to give your livery.

3. Copy the **aircraft.cfg** file from the example livery mod we located above into the SECOND **"bksq-aircraft-analogkingair-mylivery"** folder (it should be the second to last folder you made). Next, copy the **texture.cfg** file from the example livery mod we located above into the **TEXTURE.mylivery** folder (it should be the last folder you made).

4. Open the **aircraft.cfg** file in a text editor, and rename all occurrences of **"Livery Example"** to a name of your choosing for your livery mod. Leave everything else unchanged, unless you know what you're doing.

5. Open the **texture.cfg** file in a text editor, and follow the instructions to rename the two occurrences of **"LIVERYNAME"** in the file to match the livery for the default King Air 350i that you would like to use with the Analog King Air. The provided example is for a popular livery mod for a popular cargo hauler:

   fallback.2=..\..\Asobo_KingAir350-FEDBEXFEEDER\TEXTURE.FEDBEXFEEDER

6. Lastly, you will want to copy the two thumbnail images from the livery you wish you use with the Analog King Air into the **TEXTURE.mylivery** folder. They should be named, **"thumbnail.JPG"**, and **"thumbnail_small.JPG"**. This step is not necessary to use the livery, but helps in identifying it within the aircraft selection menu.

7. Finally, download the MSFS Layout Generator by going to the following link, and clicking the **"MSFSLayoutGenerator.exe"** in the latest release at the top of the page. You may have to expand the "Assets" menu in the top section of the page. Do not download anything labeled "Source Code".

   https://github.com/HughesMDflyer4/MSFSLayoutGenerator/releases

8. Once you have moved the Layout Generator to somewhere on your computer, like your desktop, create two final files in the top most directory of your livery mod, in the FIRST **bksq-aircraft-analogkingair-mylivery** folder. The files should be plain text files, created in Windows by right clicking within the empty space in a folder, hovering over "New", and then clicking, "Text Document". Rename one of these text files to **layout.json**, and the other to **manifest.json**. Copy the following text from this document and paste it into the **manifest.json** file, replacing "mylivery" with your unique livery name.

```
{
  "dependencies": [],
  "content_type": "LIVERY",
  "title": "aircraft-analogkingair-livery-mylivery",
  "manufacturer": "",
  "creator": "Black Square",
  "package_version": "0.1.0",
  "minimum_game_version": "1.24.2",
  "release_notes": {
      "neutral": {
```

```
            "LastUpdate": "",
            "OlderHistory": ""
            }
        },
        "total_package_size": "00000000000010000000"
    }
```

9. The final step is dragging your **layout.json** file on top of the **"MSFSLayoutGenerator.exe"** executable. This will run without any graphical interface, and should populate your **layout.json** with content. Take a look in the file to see if there is text, but do not edit anything.

If you have done everything correctly, your file structure should look like this:

- ➢ **bksq-aircraft-analogkingair-mylivery**
    - ○ layout.json
    - ○ manifest.json
    - ➢ **SimObjects**
        - ➢ **Airplanes**
            - ➢ **bksq-aircraft-analogkingiar-mylivery**
                - ○ aircraft.cfg
                - ➢ **TEXTURE.mylivery**
                    - ○ texture.cfg
                    - ○ thumbnail.JPG
                    - ○ thumbnail_small.JPG

This seems like a lot of work to make a simple reference to an already existing livery mod for another aircraft, but once you have done it once and created the file structure, or once you have copied the structure from someone else's mod, it will be extremely easy to make as many new Analog King Air liveries as you like.

Alternatively: Once a livery mod has been created for the Analog King Air and shared with the community, making your own livery mod should be as easy as pasting in your new textures, changing the aircraft name in aircraft.cfg, and renaming the texture folder in texture.cfg and aircraft.cfg.

Cockpit & System Guide

Main Panel

Master Caution/Warning

The King Air is equipped with a pair of Master Caution, and Master Warning annunciators with integrated push buttons on the glareshield of the cockpit, one pair for each crew member. The Master Caution annunciator illuminates with yellow "MASTER CAUTION" text, and the Master Warning annunciator illuminates with a red background occluded by "MASTER WARNING" text. Both are latching annunciators, meaning that they illuminate when triggered by a specific aircraft condition, and remain illuminated until canceled by a crew member by pressing the annunciator's integrated push button. A Master Warning is triggered by any condition that is annunciated on the glareshield annunciator panel in RED. These conditions require immediate pilot action to rectify. A Master Caution is triggered by any condition that is annunciated on the pedestal annunciator panel in AMBER. These conditions likely require pilot action to rectify, and might lead to a more severe condition if not rectified soon.

Fire Suppression Controls

Outboard of the glareshield annunciator panel, two guarded push-buttons with integrated annunciators, each with two lenses, exist for each engine to control engine fire suppression equipment. The inboard-most push buttons illuminate with "ENG FIRE" on a RED lens when a fire is detected in the same-side engine compartment by the thermistor loop in that engine compartment. Simultaneously, the text "PUSH" will illuminate in white on the bottom half of the push button, prompting the pilot to push the button to immediately close the firewall valves, separating the rest of the aircraft's systems from the engine fire, and hopefully depriving the fire of further liquid fuel. Pushing the button will activate the firewall valves, assuming they have power, and will extinguish the "PUSH" text, and illuminate RED "CLOSED" text in the same lens when the valves are fully closed. Outboard of the above push button, the second push button has a RED lens which will illuminate with the detection of an engine fire with "EXTINGUISHER PUSH" text. Pushing the button will deploy the fire suppression chemicals in the appropriate engine compartment, and illuminate the lower lens with "DISCHARGED" text in white when the extinguisher bottle has fully discharged.

To test the fire detection and extinguisher systems, rotate the "TEST SWITCH ENG FIRE DET" rotary switch on the co-pilot's side subpanel. Rotating the switch clockwise from the "OFF"

position should illuminate the extinguisher push buttons, first right, then left. Rotating the switch counterclockwise from the "OFF" position should illuminate the firewall valve push buttons, first right, then left, again. A redundant "ENG FIRE" annunciator for each engine is also located on the main glareshield annunciator panel.

NOTE: Although the firewall valves can be reopened in the event of an accidental activation, once an extinguisher has been activated, it cannot be reset without maintenance personnel.
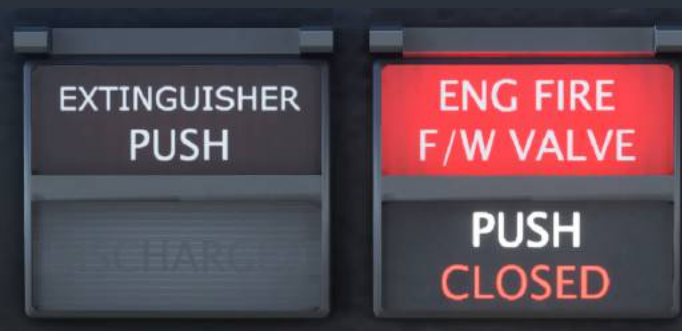
Annunciator Panels

The King Air is equipped with two main annunciator panels, one in the glareshield, and one below the main panel on the pedestal. The annunciators in the glareshield all illuminate RED behind black text. The conditions that activate these annunciators, and the Master Warning annunciator with them, are flight critical, and require immediate pilot action to rectify.

The annunciators on the pedestal panel illuminate text in either AMBER, WHITE, or GREEN, according to the severity of the condition. AMBER signifies a condition which will likely result in a more severe condition and the triggering of a Master Warning if pilot action is not taken to rectify the condition soon. These conditions trigger a Master Caution. WHITE signifies a condition which may be abnormal for the flight depending on pilot intentions, but will not adversely affect the flight in all situations. An example would be the illumination of the "CABIN ALTITUDE" WHITE annunciator, which indicates a cabin pressure altitude over 10,000 ft. If the pilot intends to stay below a pressure altitude for which pressurization or supplemental oxygen is required (12,500 ft in the U.S.), then no action is required; however, if the annunciator illuminates because the pilot improperly set the pressurization control, action will be required to avoid a potentially dangerous configuration. Lastly, GREEN annunciators denote a condition which is neither harmful, nor potentially harmful, to the flight, but may be undesirable depending on the phase of flight. An example would be "ENG ANTI-ICE", which indicates that engine anti-icing systems are activated.

All annunciators can be tested with the "TEST" push button on the glareshield annunciator panel. Annunciator brightness can be adjusted with the small "ANN DIM" adjustment knob on the main panel below the integrated audio control panel. Annunciator brightness is always full bright until the panel lighting master switch is activated, at which point the annunciator brightness will obey the annunciator dimmer setting. For more information on the panel lighting master switch, see the "Lighting Controls" section of this chapter.

L ENG FIRE	#1 AC BUS	CABIN DOOR	#2 AC BUS	R ENG FIRE
L FUEL PRES	———	CABIN ALT HI	CABIN DIFF HI	R FUEL PRES
L OIL PRES	L GEN OVHT	A/P TRIM FAIL	R GEN OVHT	R OIL PRES
L CHIP DETECT	L BLEED FAIL	A/P FAIL	R BLEED FAIL	R CHIP DETECT

L DC GEN	L GEN TIE OPEN	HYD FLUID LOW	RVS NOT READY	R GEN TIE OPEN	R DC GEN
L CHIP DETECT	L NO FUEL XFER	BAT TIE OPEN	DUCT OVERTEMP	R NO FUEL XFER	R CHIP DETECT
L ENG ICE FAIL	L FUEL QTY	BATTERY CHARGE	EXT POWER	R FUEL QTY	R ENG ICE FAIL
L BL AIR OFF	AUTOFTHER OFF	PITCH TRIM OFF	OXY NOT ARMED	RUD BOOST OFF	R BL AIR OFF
L IGNTION ON	L ENG ANTI-ICE	FUEL CROSSFEED	PROP GND SOL	R ENG ANTI-ICE	R IGNTION ON
WING DEICE	L BK DEICE ON	MAN TIES CLOSE	ELEC HEAT ON	R BK DEICE ON	———
L PROP PITCH	CABIN ALTITUDE	LDG/TAXI LIGHT	PASS OXY ON	AIR COND N$_1$ LO	R PROP PITCH

Quartz Analog Chronometer

A precision (second counting) quartz chronometer for timing IFR approach legs or departure clearance void times.
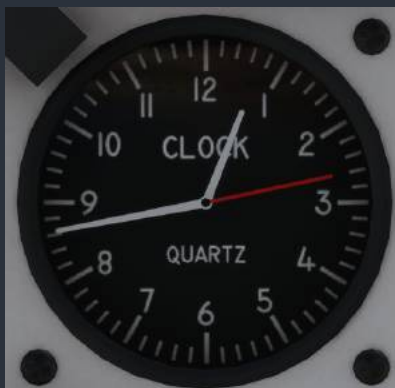
Airspeed Indicator

The King Air's airspeed indicator possesses two needles, one white needle to indicate the current indicated airspeed, and one red-and-white striped "barber-pole" needle to indicate the maximum allowable indicated airspeed, which automatically adjusts with pressure altitude. The face of the airspeed indicator is marked with a small white triangle to indicate the maximum approach flap setting operating speed, and two red and blue lines. The red line indicates Vmc, or minimum controllable speed with a single engine operating. The blue line indicates the best single engine operating climb speed. Two concentric white arcs mark the flap operating ranges. The outer arc spans from the full flap stalling speed to the clean configuration stalling speed. The inner arc spans from the clean configuration stalling speed, to the maximum full flap setting operating speed.

The barber pole speed is a constant 262 kts indicated from sea level pressure, until reaching approximately FL210. At FL210, the barber poll will begin to decrease until reaching 192 kts at approximately FL350. If flight is inadvertently continued past this altitude, the barber pole speed will continue to decrease.

Collins ALI-80A Encoding Altimeter

The ALI-80A is a single needle type altitude indicator with a digitally controlled three-drum indicator for altitude, and a digitally controlled four-drum indicator for barometric indication. The barometric setting is controlled via an adjustment knob on the face of the unit. The adjustment knob may be pulled to indicate the barometric setting in millibar instead of inches of mercury. On the opposite side of the unit from the barometric adjustment knob, a "TEST" momentary push button places the altimeter into a test mode, which should indicate 25,750 feet on the altimeter, and 29.92 inHg, or 1013 mb, depending on adjustment knob setting. NOTE: This piece of equipment is electrically powered, and will not indicate without electrical power applied. In the event of electrical failure, refer to the cross-side altimeter on the co-pilot's side, which is of normal static air indicating type.

NOTE: The choice of barometric units (inHg, or mb), will be saved and automatically restored between flights.

Collins ADI-85A Attitude Indicator

The Collins ADI-85A is one half of a sophisticated primary flight display solution with an impressive amount of functionality, developed at the peak of analog system design. In the center of the unit is a traditional attitude indicator with a "conveyor-type" display to minimize parallax effects. Traditional attitude indicating bars can be adjusted vertically using the "ATT TEST" knob on the face of the unit, and the display can be caged by pressing the same knob. Directly under the attitude display, a lateral course deviation indicator (CDI) in green and white mirror's the CDI indication of the Collins HSI-85 Horizontal Situation Indicator (HSI), below. Under the CDI is a rate of turn indicator with markings for a standard rate, two minute turn. To the left of the attitude indicator is a normally hidden, glideslope indicating needle in green and white, which mirrors the glideslope or vertical deviation from the HSI, below. The bezel of the unit also features a traditional slip indicator. On the bottom right-hand corner of the unit's face is an adjustment knob for decision height, which mechanically controls a three digit drum-type display above the knob. A separate radar altimeter transducer located on the bottom of the aircraft drives a 7-segment LCD display in the upper right-hand corner of the unit with the aircraft's current height above the ground. When the detected radar altitude closes on the decision height entered in the drum-type indicator while the aircraft is in a descent, a yellow "DH" indication illuminates on the display, as well as an additional, yellow "DH" annunciator on the pilot's side main panel. When the detected radar altitude is above 2,500 ft, or below 5 ft, dashes appear in the 7-segment LCD display.

When power is not applied to the unit, or the corresponding signal is not received, the following red flags are displayed on the unit.

- "ALT"   No radar altimeter signal
- "GS"   No glideslope or vertical deviation signal
- "ATT"   No attitude gyro information
- "CMD"   No autopilot flight director signal
- "R/T"   No rate of turn vertical gyro information
- Black Trapezoid over CDI   No CDI or horizontal deviation signal

When a coupled Collins APS-65 autopilot controller is installed in the aircraft, flight director command bars will come into view when the autopilot is activated and in an appropriate mode of operation. For more information on the flight director system, see the "Flight Director & Autopilot Disconnect" section of this manual.

Collins HSI-85 Horizontal Situation Indicator (HSI)

The HSI-85 has an automatically controlled compass card, as opposed to most directional gyroscopic compass units, which can be automatically slaved to magnetic heading, or manually controlled via the remote compass controller. The HSI has two remote control units (one under the HSI, and one on the pedestal) with two knobs for controlling the heading bug ring for visual reference, and for autopilot heading lateral navigation mode, and a knob for adjusting the course indicated with the yellow needle in the center of the display. For further clarity of selection, the HSI has a digitally controlled three-drum indicator for the currently selected course in the bottom right-hand corner. The split yellow needle acts as a course deviation indicator, where the deviation scale depends on the navigation source, and operational mode, such as enroute GPS, or ILS antenna signal. The CDI in this aircraft can be controlled by either the NAV1 source, or the RNAV source, by selecting with the switch located under the KNS-80 RNAV Navigation System when it is visible. If the KNS-80 is swapped out for other radio equipment, the CDI source will default to NAV1. When connected to a lateral navigation source other than a VOR receiver, such a GPS, or RNAV unit, the deviation flag to the right of the compass card will display "LIN", instead of "ANG", to indicate that the current course deviation being displayed is a linear course deviation, rather than an angular one. Also on the HSI compass, two red pointers are available to indicate the bearing to the NAV2 station. The direction TO the station is indicated by the diamond-shaped pointer. Under the yellow course indicating needle, two windows with white indicators show the traditional to/from VOR indication when a VOR radio source is selected. When no navigation source has a valid signal, an orange and white flag appears beside the yellow course indicating needle. When no valid signal is received from the remote compass, a red "HDG" flag appears at the top of the display. When the unit is not receiving power, both flags are visible.

On the left of the unit is a green and white, normally hidden, glideslope and vertical deviation indicating needle, which comes into view when the vertical deviation signal is valid. Text under the glideslope needle window indicates whether the needle is indicating glideslope deviation from a navigation radio receiver ("GS"), or vertical profile deviation from a GPS navigator ("VNAV"). At the top of the unit are two 7-segment LCD displays with traditional Distance Measuring Equipment (DME) information. The left display permanently shows slant-distance in nautical miles, and the right display serves multiple functions, which are cycled through with the three-position switch on the HSI's remote control unit. A text flag under the right LCD display will indicate the current display mode; time-to-go ("TTG"), speed ("SPD"), or timer elapsed time ("ET"). The elapsed time timer is controlled via a small white push button on the remote control unit adjacent to the display mode switch, and has a maximum displayable time of 99 minutes, and 59 seconds. When valid DME information is not being received, dashes will appear in the left and right displays, but the timer will still operate.

NOTE: Unfortunately, it is not possible to drive the stock MSFS autopilot system with a custom navigation source without implementing a whole new autopilot (to the best of my knowledge). It is recommended that you simply steer the autopilot via the heading bug with reference to the RNAV course deviation shown on the CDI.

Collins RMI-30 Radio Magnetic Indicator (RMI)

This RMI has an automatically rotating compass card that is driven via the aircraft's remote compass, and therefore, has no adjustment knob like an ADF. The solid yellow needle of the RMI can display the bearing to either the station tuned in the NAV1 radio, or the ADF1 radio. The hollow green needle can display the bearing to either the station tuned in the NAV2 radio, or the ADF2 radio. Both needles will point directly to the tuned radio ground station whenever signal strength is sufficient. To swap which source is used for either needle, press the illuminated push buttons on the face of the unit. Since there are no flags on this unit to indicate reception, it is necessary to properly identify the station via its morse code identifier before using the RMI indications as a source of navigation. The RMI will show a red flag when the unit is not receiving power, or when the unit is not receiving signal from the remote compass.

Vertical Speed Indicator

A vertical speed indicator displaying a maximum of +/- 4,000 feet per minute.

Mid-Continent Turn Coordinator

A DC electric turn coordinator with indicator markings for a standard rate 2-minute turn, a traditional slip indicator, and a red power flag to indicate when the unit is not receiving power.

Collins IND-31C Localizer

The IND-31C Localizer acts as a secondary radionavigation source in this aircraft, being permanently driven by the NAV2 VOR radio source. The IND-31C includes both lateral and vertical guidance needles, which can be driven from either a VOR/ILS receiver, or via the GNS 530W. The unit incorporates both vertical "GS", and horizontal "NAV" red flags to indicate when the unit has power, and when the respective navigation source is being received. Two windows with white indicators show the traditional to/from VOR indication when a VOR radio source is selected. This unit is not connected to the remote compass, and therefore, must be manually adjusted for the desired course with the omni-bearing-selector (OBS) knob on the unit's face.

Collins ALI-55 Radar Altimeter

The ALI-55 Radar Altimeter displays the height of the belly-mounted radar transducer with respect to the terrain below the aircraft. The orange indicating needle rests in a vertical position when the unit is not receiving power, a valid signal, or when the indicated altitude is below 10 feet. A yellow decision height bug can be positioned from 0 to 2,500 feet on the indicating scale with the adjustment knob. When passing the decision height in a descent, the integrated, yellow, decision height indicator will illuminate, as well as the connected "DH" annunciator on the co-pilot's main panel. Be aware that the indicating scale is non-linear.

Engine Instrumentation

Two columns of six round-dial engine instruments on the main panel are used to monitor the health of the powerplants. From top to bottom, the gauges are: Interstage Turbine Temperature (ITT), Propeller Torque (TRQ), Propeller RPM (RPM), Gas Generator RPM (Ng), Fuel Flow (FF), Oil Temperature (°C), and Oil Pressure (PSI).

Fuel Quantity Instrumentation

The King Air series is equipped with a fuel monitoring and control panel on the pilot's side cockpit wall with two integrated fuel quantity gauges. Since the King Air is equipped with two fuel tanks in each wing, main and auxiliary, a three position switch exists between the two gauges to toggle their indications from main (center position) to auxiliary (down position), and a test indication (momentary up position), which tests the aircraft fuel sensing circuitry, and the low fuel quantity caution annunciators. On each gauge face, a yellow arc labeled, "MAIN TANK ONLY" indicates the quantity of fuel in the main tanks below which the aircraft should not depart on a flight. The marking, "MAIN TANK ONLY" does not indicate anything to do with the size or quantity of fuel in the main versus the auxiliary tanks, but indicates that the do-not-takeoff fuel range should only be evaluated on the main tanks, and the marking is irrelevant for the auxiliary tanks.

To crossfeed fuel from one side of the fuel system to the cross-side engine, three conditions must be met. The crossfeed valve must be open, the supply side electric fuel boost pump must be activated, and the receiving side jet-pump and boost pump must be deactivated. In this model of King Air, several of these operations are automatic, but discipline is needed to ensure proper crossfeeding, and prevent possible fuel starvation. Placing the crossfeed valve switch towards the desired receiving side engine will also activate the supply side standby boost pump, regardless of switch position. The receiving side standby boost pump switch, however, must be in the off position, and the receiving side transfer pump override switch must also be in the automatic position.

Duplicate Copilot Instrumentation

A duplicate six-pack of primary flight instrumentation is included on the co-pilot's side of the aircraft. Notably, the directional gyroscopic instrument is a traditional DG, and is not driven by the remote compass. It must be adjusted manually at startup, and continually for drift. Additionally, a second, independently operating RMI, localizer, DME receiver, turn coordinator, and remote compass controller are also included on the co-pilot's side.

Avionics

Black Square aircraft have reconfigurable radio panels that allow you to fly with many popular radio configurations from old-school no GPS panels, to modern installations with touchscreen GPS navigators. To adjust which configuration you're flying with, use the knobs or switches on the right-hand side of the main panel, adjacent to the co-pilot's yoke bearing to select your preferred radio for Com1/Nav1, and Com2/Nav2. It might be easier to hide the co-pilot's yoke while making these selections. The radio selection will be automatically saved and reloaded at the start of your next flight. These controls are pictured below, after the Hobbs timer section.

Integrated Audio Control Panel

In the center of the main panel is an integrated audio control panel. The top row of toggle switches controls the audible signal heard in pilot and co-pilot headsets. Note: The auto-comm feature is not currently implemented in this aircraft. To send all selected audio to the overhead cockpit speakers instead of the pilot headphones, the "AUDIO SPKR" toggle can be placed in the on position. An adjacent "AUDIO EMER" switch can be used to bypass the internal audio amplifier in case of a failure. Another adjacent "HOT INTPH" switch bypasses internal voice activation circuitry, and results in an open microphone whenever the switch is placed in the on position. It should be noted that this does not mean that your cockpit audio is being transmitted outside the aircraft whenever this switch is in the on position, only that the cockpit interphone will no longer shut off when crew members are not speaking. The sensitivity of this interphone voice activation can be adjusted via a small adjustment screw below the audio panel. The overall volume of the cockpit interphone can be adjusted by one of the small adjustment knobs, along with the ground crew paging volume, Distance Measuring Equipment (DME) channel identifier volume, and the marker beacon volume. Marker beacon "OMI" illuminated annunciators are remotely located with the yellow "DH" indicator on the main panel. There is also a toggle to adjust the marker beacon sensitivity from high to low, and an illuminated push button to activate the ground crew interphone, which is accessed via various headphone and microphone ports around the aircraft and in the wheel wells. Lastly, a "VOICE/RANGE" switch for pilot and copilot allows for better reception of either voice-only, or morse-only communications from ground based navigational aids. To select between the Com1 radio, Com2 radio, and the cabin speakers for pilot or copilot voice transmission, two large rotary selector knobs are on either side of the audio panel with concentric volume knobs for audio reception.

Collins PRE-80C Altitude Preselector

Like many autopilots, the Analog King Air's APS-65 receives altitude commands from an adjustment knob and a "pre-selector", which commands altitudes at which to level-out, or hold. The PRE-80C has a three-drum altitude indication, which is mechanically controlled via a knob on the unit's face. The knob controls the thousands digit (with rollover) when pressed in, and the hundreds digit when pulled out. The PRE-80C has an integrated "ALT ALERT" push button and indicator which is a latching-type indicator. The button illuminates when within 1,000 ft of the desired altitude, and when leaving 500 ft within the desired altitude. The alert is mirrored on main panel mounted "ALT ALERT" amber indicators for redundancy, and can be canceled by pressing the PRE-80C's integrated push button. When the unit is not receiving power, or not connected to the APS-65 autopilot, a red flag appears across all digits.

Garmin GTN 750 (Com1)

This modern touchscreen GPS is implemented by a 3rd party developer. For installation instructions, and instructions on its use, see the installation section of this manual, or the developer's website. **Both PMS GTN 750 and TDS GTNxi 750 products are supported.** The aircraft will automatically switch between the installed software with no required user action.

Garmin GNS 530 (Com1/Com2)

This 2000's era full-color GPS is mostly or partially implemented by a 3rd party developer. For installation instructions, and instructions on its use, see the installation section of this manual, or the developer's website.

NOTE: To hear an audible radio station identifier, both the small adjustment knob on the GNS must be pressed, and the appropriate NAV receiver switch must be placed in the on position on the integrated audio control panel.

Collins CTL-22 (Com1/Com2/Com3)

This 1990's era Com receiver allows for direct control of communications radio frequencies, or recall of six stored frequencies. Generally, the radio's active frequency is shown in the top window, and the standby frequency in the bottom. In its simplest mode of operation, the radio can be tuned by rotating the dual concentric tuning knobs like any other radio, which adjust the standby frequency. When the correct standby frequency has been chosen, the "XFR/MEM" momentary switch can be toggled in the "XFR" direction, and the active and standby frequencies will be swapped. To bypass the traditional standby/active operation, the user can press the "ACT" push button, which will momentarily allow tuning of the active frequency directly until timeout. While in active tuning mode, "ACT" will be annunciated vertically on the unit's screen. Frequency spacing can be adjusted by pulling the inner dual concentric knob, which will annunciate the frequency spacing mode on the LCD screen. Receive volume can be adjusted with the small "V" adjustment knob. The unit can also be turned off, or placed into squelch test mode, with the rotary selector switch under the volume adjustment knob. A "TEST" button may be pressed to view any diagnostic codes saved in the unit's memory for debugging, such as low voltage conditions, or no connection to an antenna.

To recall a frequency, page through the stored frequencies by toggling the "XFR/MEM" switch in the "MEM" direction. The memory storage channel number will be briefly shown on the display, along with the stored frequency in the standby window. To activate the standby frequency, toggle the "XFR/MEM" switch in the "XFR" direction. To store a frequency, page to the channel in which you would like to store the frequency, tune the desired frequency in the standby window, and then press the "STO" push button to store the frequency in that channel.

Whenever the tuned frequency in the standby window matches ANY stored frequency currently saved in the unit, the text, "MEM" will be shown on the screen. All stored frequencies and modes associated with this unit will be automatically saved and recalled at the beginning of a new flight.

NOTE: Since there is no toggle switch on the main panel's audio controller to toggle receiving of COM3 audio, a push button adjacent to the ADF 2 radio on the pedestal has been included to serve this function.

NOTE: Pressing the inner dual concentric rotary encoder knob will toggle the radio's 8.33 kHz tuning mode for compatibility with European frequencies. The text "8.33" will be shown on the CTL-22's display when this tuning mode is active. For your convenience, COM3 on the pedestal defaults to 8.33 kHz mode.

Collins CTL-32 (Nav1/Nav2)

This counterpart to the CTL-22 operates in a very similar manner, with the exception of the rotary selector knob, which possesses a "HLD" position to place the radio in DME frequency hold mode, which is not easily implemented in MSFS. To conduct operations that require the holding of DME frequencies, the DME may be held on the IND-42 DME unit by pressing the "SEL" button until "HLD" is displayed. All stored frequencies and modes associated with this unit will be automatically saved and recalled at the beginning of a new flight.

NOTE: To hear an audible radio station identifier, both the small volume "V" adjustment knob on the CTL-32 must be turned up, and the appropriate NAV receiver switch must be activated on the integrated audio panel.

Collins CTL-62 (ADF1/ADF2)

This addition to the CTL radio suite operates in a very similar manner to the others, with the exception of the rotary selector knob, which possesses "ANT", "ADF", and "TONE" positions. "ADF" is the normal mode of operation, while "ANT" results in audio coming from only the sense-only antenna (disabling the loop antenna), which makes receiving audio-only transmissions easier in low signal strength conditions. Lastly, the "TONE" position is the same as a "BFO" mode on other ADF receivers, which toggle's the unit's beat frequency oscillator, used to listen to the tuned station's morse code identifier in low signal strength conditions. All stored frequencies and modes associated with this unit will be automatically saved and recalled at the beginning of a new flight.

NOTE: Since there is no toggle switch on the main panel's audio controller to toggle receiving of ADF 2 identifier audio, a push button adjacent to the ADF 2 radio on the pedestal has been included to serve this function.

NOTE: To hear an audible radio station identifier, both the small volume "V" adjustment knob on the CTL-62 must be turned up, and the appropriate NAV receiver switch must be activated on the integrated audio panel.

Collins CTL-92 (Transponder)

This final addition to the CTL radio suite allows for tuning of two transponder codes on one screen, which can be switched between with the two-position "1/2" toggle switch. Codes are tuned with the dual concentric rotary knobs. The outer knob controls the two mode significant digits (both with rollover), and the inner knob controls the two least significant digits. The unit can be placed in four standard transponder modes: "OFF"; "STBY", where no transponder signal is transmitted, but the unit is under power; "ON", which is standard Mode-A operation; and "ALT", which is Mode-C, altitude reporting operation. A "TEST" button may be pressed to view any diagnostic codes saved in the unit's memory for debugging, such as low voltage conditions, or no connection to a transponder control unit, or antenna. Additionally, a two-position toggle switch on the main panel controls which digital altitude encoder (pilot or copilot) is used by the CTL-92 when in altitude reporting mode.

Collins IND-42 (DME)

This implementation of a IND-42 behaves similarly to any other Distance Measuring Equipment (DME) receiver, displaying a nautical mile distance to the selected and tuned station, the current speed of the aircraft relative to the selected and tuned station, time-to-go until over the station, and the latin character identifier of the tuned station. While the nautical mile distance display is persistent, the other available data must be paged through using the "SEL" push button on the unit's face. It should be noted that, like all other DME displays, this one is similarly dependent on being within the VOR service volume, and having good line-of-sight reception of the station. It should also be noted that these distances, speeds, and times, are based on slant-range to the station, not distance along the ground, as one would draw on a map. In order to receive DME information on the IND-42, the station must be tuned in one of the two navigation radios, the station must be equipped with DME transmitting equipment, the station must have adequate signal strength, and the IND-42 must have the appropriate navigation source selected via the "CH" button on the unit's face. Lastly, the DME information from the KNS-80 can be displayed via selecting channel 3, so long as signal strength is valid, and the KNS-80 is not in DME hold mode. When displaying DME information from the KNS-80, the "ID" field will display "RNAV". Either channel one or two DME information may be held on this unit, allowing the user to tune other navigation frequencies on the NAV1 or NAV2 radios, by holding the "SEL" button for several seconds until "HLD" is illuminated on the unit's screen. This can be a useful feature for some specific instrument approaches. The unit can be turned off via the "PWR" push button.

Bendix/King KNS-80 RNAV Navigation System

See the standalone section of this manual for instructions on using the KNS-80, below. All stored frequencies, radials, and offsets associated with this unit will be automatically saved and recalled at the beginning of a new flight.

Collins APS-65 Autopilot Controller

The APS-65 autopilot controller consists of two pieces of equipment: the master autopilot control panel and master mode annunciator, and the secondary mode control panel and annunciator. The master autopilot controller has two larger buttons for engaging and disengaging the master autopilot mode ("AP ENG"), and the yaw damper ("YAW ENG"). The master autopilot button will also engage the unit's flight director output, if an appropriate mode is selected. The autopilot can be disengaged via the red autopilot disengage push buttons on either yoke. The two smaller buttons on the master autopilot controller toggle the Soft Ride

mode ("SR"), which adjusts the gain of the autopilot's flight control loop to better respond to turbulence, and toggle the Half Bank mode (1/2 Φ), which limits the autopilot to one half the normal bank limit of 30°. A rocker switch on the right of the unit controls the rate of climb or descent when in altitude changing modes. It can also be used to adjust the current airspeed target in climb or descent profile modes in one knot increments. A large knob in the center of the unit controls the roll hold mode. When placed out of the center detent, bank angles from 5° to 30° can be selected. The autopilot will automatically switch to roll hold mode from any active mode. The current overall mode of the APS-65 (such as "AP" or "YAW"), is displayed on the integrated LED screen. GREEN annunciators are normal, while AMBER indicates a disconnected system or mode, and RED indicates a failure condition. On the autopilot mode control unit, ten push buttons each activate an autopilot mode of operation, which is annunciated on the integrated LED screen. It should be noted that some annunciators are redundant between the two units, such as the master "AP" annunciator in green, and its associated "DIS" amber disconnect warning. Additionally, white "ARM" annunciators are illuminated adjacent to certain mode annunciations when these mode are selected, but not operating yet, such as would be the case when approach mode is activated, but no radio navigation source is being received. The "CLIMB" and "DSC" push buttons can be used to activate climb and descent profile modes. These modes are similar to a flight level change mode, with dynamically selected indicated airspeed targets. In climb mode, the autopilot will climb at the maximum achievable rate while targeting the following climb profile: 160kts to 10,000ft, 140kts to 20,000ft, 130kts to 30,000, and 120kts above. Manually changing target airspeed with the rocker switch, or with the "PITCH SYNC" CWS yoke-mounted button will exit either profile mode and enter IAS Hold mode. In descent mode, the autopilot will descend at the maximum achievable rate at 10 knots below the current barberpole speed. Pressing the "PITCH SYNC" button will set the target airspeed to the currently indicated airspeed. This process is simplified for use with only one cursor/hand in Flight Simulator.

Bendix RDR 1150XL Color Weather Radar

This implementation of the Bendix RDR 1150XL has six selectable modes via the mode select knob in the upper right-hand corner of the unit. When cycled through the "OFF" mode, the unit will perform a self-test upon startup, and will annunciate if signal is not received from the aircraft's external weather radar transceiver unit. In "STBY" mode, the unit is in a safe standby mode, which does not energize the radar transmitter. It is recommended that the unit be placed in standby mode whenever the aircraft is operating on the ground to avoid injuring ground personnel, or sensitive equipment on other nearby aircraft. In this mode, the unit will annunciate "STAND BY" in yellow in the center of the radar arc. In "TST" mode, the unit will continuously display a sweeping test signal from the radar unit, which should subtend the full horizontal radar arc, and contain concentric arcs of magenta, red, yellow and green. The "RT FAILURE" flag will also display in cyan. The "ON" mode is the normal mode of operation for this unit. In "ON" mode, the radar will display precipitation and severe turbulence in the above color spectrum, within the radar arc on the screen. The range of the display can be adjusted with the "RNG ^", and the "RNG v" push buttons. Nautical mile distances are displayed adjacent to the range rings on the radar display. By pressing the "VP" button, the unit can be toggled between horizontal and vertical profile modes, which are annunciated in the upper left-hand corner of the display. The "<TK" and "TK>" buttons can be used to pan the radar transceiver to the right or left, and the "TILT" knob can be used to tilt the radar transceiver up or down. The position of the radar transceiver is annunciated on the display in yellow, but there is no effect on the underlying weather radar simulation. Lastly, "BRT", and "GAIN" knobs on the left of the unit can be used to control the brightness and gain of the radar respectively. "NAV" and "LOG" modes are not implemented yet in this unit. This unit's state will be saved automatically and reloaded.

Electrical/Miscellaneous

Circuit Breakers

The Analog King Air has circuit breaker panels located on the fuel control panel to the left of the pilot's seat, and on the cockpit wall to the right of the copilot's seat, each with its own unique schema. On the fuel control panel, breakers for fuel specific equipment, engine instrumentation, alternating current (AC) supplies, and hot battery bus items are present. The remaining circuit breakers are on the copilot's breaker panel, and organized into two general groups. On the right of the panel are the avionics related circuit breakers on their own bus. This bus is fed through three bus feeders, labeled "AVIONICS BUS": "TPL FED", "L GEN", and "R GEN". On the left of the panel, all other breakers are organized in horizontal rows according to which bus they reside on, with a label to the left. Boxes around subgroups of breakers further organize them into categories of equipment, like "WEATHER", and "ELECTRICAL". Breakers may be pulled or pushed to disable electrical circuits and bus connections within the aircraft. All the corresponding electrical circuits are modeled. The status of the electrical system may be monitored via the multi-function volt/amp meter discussed below. In an emergency situation, such as the detection of smoke, acrid burning smells, loss of engine, or generator failure, all non-essential electrical systems should be switched off, workload permitting.

The Analog King Air's electrical system is based on four main buses, a Center Bus, a Left Generator Bus, a Right Generator Bus, and a Triple Fed bus. The Center Bus receives power from the aircraft's battery bus. The left and right generator buses receive their power from their respective generators, and the Triple Fed bus can receive power from all three. The main switch to control the connectivity of these buses is the "GEN TIES" switch on the pilot's side subpanel , which has positions, "MAN CLOSED" and "OPEN". This switch can be used to either manually connect the buses to the Triple Fed Bus, manually disconnect them, or automatically connect them in the switches center position. Adjacent to the "GEN TIES" switch is the "BUS SENSE" switch, which allows for the testing and resetting of bus faults. All the conditions above will be annunciated on the pedestal annunciator panel. In electrical emergencies, such as an electrical fire, the hot battery bus can be disconnected from the center bus, and thereby the rest of the aircraft, by placing the "BATT BUS" locking toggle switch on the pilot's subpanel in the "EMER OFF" position. This switch is easily identifiable with its red and white crosshatching.

NOTE: The King Air has one of the most complex electrical systems of any mid-sized general aviation aircraft, and nearly all of it is modeled in this product. A full explanation of this electrical system here would be an extensive amount of work, and would ultimately duplicate other detailed documents produced by real King Air operators. For advice on seeking more information from real world sources, see the "More Information on Operation" section of this manual, below.

Multi-Function Volt/Amp Meter

A multi-function meter and associated rotary selector knob on the overhead panel provides access to monitor many of the onboard electrical systems in the King Air. The meter consists of two indicating needles, a multi-function volt meter on the left, and a persistent ammeter on the right. The ammeter always indicates the charging or discharging current measured on the battery bus. Positive currents indicate a charging battery, and that excess electrical power is available to the systems, while negative current indicates a discharging battery that is supplementing the generators to make up for a power deficit. The voltmeter select switch allows the pilot to select between viewing the current voltage on the following buses: external power ("EXT PWR"), center ("CTR"), left generator ("L GEN"), right generator ("R GEN"), triple fed ("TPL FED"), and battery ("BAT").

The function of this voltmeter is often confusing to new operators, as the voltage on multiple different buses can either read the same when they would appear to be disconnected, or slightly different when they are connected. In the former case, such as L GEN and R GEN reading the same voltage when only the left generator is online, this is because of the aircraft's automatic bus-tie functionality. There is further discussion of the bus ties and load shedding in this manual, but a complete discussion is likely best sought from real world documentation. When two buses are directly connected, such as the TPL FED and R GEN buses, their voltage may be slightly different. This is because these buses are connected through a diode. A diode is an electrical component that limits the current that can flow from one side of the component to another to almost zero. Unfortunately, this is an imperfect process that introduces a voltage drop across the diode, sometimes around half a volt. Lastly, this meter will show voltage on the EXT PWR setting anytime there is external power available, regardless of the external power switch setting. This is because ground power units often have several voltage settings for varis aircraft, and the meter should be used to check for the correct voltage before connecting the aircraft to the ground power unit.

DC Generator Load Meters

Also on the overhead panel, two DC generator load meters, marked in percent of rated generator capacity, indicate the current load placed on each generator. While no harm is done to the generators at 100% capacity, excess current will be drawn from the battery anytime the capacity of either generator is not sufficient to supply the electrical demand on each bus. The demands on each bus, including the center bus, can differ greatly depending on which buses are currently connected to each other.

AC Frequency Meter

To the right of the other electrical meters on the overhead of the Analog King Air is an alternating current (AC) frequency and voltage meter. When any of the AC inverters are supplied with DC generator power and activated via the appropriate inverter switch, the AC frequency meter will indicate the frequency of the AC power. All inverters are designed to supply 400 Hz AC power at either 26, or 115 volts. Holding the small push button (not pictured here) at the base of the AC meter will deflect the needle to show AC voltage on the inner scale of the meter.

Collins CCU-65 Remote Compass Control and Compensator

This aircraft contains a Collins remote compass, and two remote compass controllers with integrated synchroscopes. The purpose of a remote compass is to supply several instruments, autopilots, or navigation systems with a reliable source of magnetic compass direction that is continuously corrected for gyroscopic drift. This is accomplished by integrating a fluxgate magnetometer's sensing of magnetic direction with a larger gyroscope than could fit within the housing of a single panel-mounted instrument. This remote compass erects to the correct magnetic heading when powered on, and will automatically correct for gyroscopic drift throughout the flight when the remote compass controller's toggling mode push button (labeled "DG") is depressed. In this mode, the integrated synchroscope's needle should center over the "GYRO SLAVING" text in the center of the scope window. Should the position of the remote compass become unreliable, such as during flight through magnetic disturbances or over the earth's poles, the remote compass can be placed in a manual mode by releasing the toggling mode button. In this mode, the input of the magnetometer will be ignored, and the unit will behave like a normal directional gyroscope. The position of the remote compass can be advanced in one direction or another by holding one of the two slew push buttons on the remote compass controller in either the left or right direction. In this mode, the synchroscope needle will show the set compass position's deviation from the detected magnetic heading. The Analog King Air is equipped with an additional "FAST ERECT" push button, which allows for the remote compass to be placed in fast erect mode, which will increase the speed at which the compass card seeks to the sensed magnetic heading, but will not increase the rate at which all signals are integrated to provide a robust magnetic heading.

Flap Position Indicator

The flap position indicator is located on the pedestal above the throttle quadrant, and is electrically powered off the left generator bus. The indicator is marked in percent of full flap travel, and has a white arc depicting the acceptable takeoff and approach flap setting. Since this indicator is powered off one of the generator buses, the indicator may appear not to function when only battery power is supplied to the aircraft without manually triggering the bus ties.

Cabin Climb Rate Indicator

In the center of the pedestal panel behind the throttle quadrant, a gauge with a similar appearance to a vertical speed indicator depicts the climb or descent rate of the cabin air volume. If the cabin air valves are open and the cabin is allowed to climb and descend with the aircraft's pressure altitude, this instrument can be expected to read the same as the aircraft's vertical speed indicator. During normal operation of the cabin pressurization controller, this gauge should be monitored to ensure proper cabin climb or descent rates of at least +/- 500 feet per minute are achieved. Although cabin climb rates can be adjusted on the pressurization controller, the climb/descent rate should be kept under 1,500 ft/min for passenger comfort, and ideally less than 700 ft/min.

Cabin Pressure and Pressure Differential Indicator

Also on the pedestal, behind the throttle quadrant, a dual concentric gauge indicates the current cabin air volume altitude in thousands of feet, and the cabin pressure's differential with the outside atmospheric air in pounds per square inch (PSI). While cabin altitude (outer scale) must be kept within regulatory limits appropriate to the flight, the cabin pressure differential (inner scale) must be kept below 6.5 PSI at all times. Repeated excursions beyond this limit may result in failure of the pressurization system, or catastrophic structural failure.

Cabin Pressure Controller

The cabin pressurization is controlled via a panel on the aft pedestal with two knobs and a large rotating scale under clear plastic. The left knob controls the cabin climb/descent rate from between approximately 150 ft/min to 2,000 ft/min. A position approximately one third of the knob's full rotation from the counterclockwise stop should produce a desirable climb rate of around 700 ft/min. The right knob controls the destination cabin altitude by rotating the large scale. The outer scale of this large rotating scale is used to set the desired cabin altitude from -1,000 ft to 15,000 ft. The inner scale rotates with the outer scale and depicts the approximate aircraft pressure altitude at which the pressurization controller will no longer be able to maintain the desired cabin pressure. For example, when the outer scale is set to 4,000 ft at the "CABIN ALT" index mark, the inner scale will read approximately 22,000 ft at the "ACFT ALT" index mark. This means that the pressurization controller will be able to maintain a cabin pressure equivalent to 4,000 feet pressure altitude until the aircraft reaches 22,000 feet pressure altitude. If the aircraft continues climbing without an adjustment being made to the pressurization controller, the cabin altitude will begin climbing beyond the desired 4,000 feet. If the cabin pressure differential becomes negative, or increases beyond 6.7psi, the electric dump valve will activate, rapidly dropping the pressure differential. The electric dump valve can be disabled by pulling the "CABIN PRESSURE" circuit breaker. Cabin pressure should always be dumped using the colocated switch after landing, and before opening cabin doors, or cockpit windows. Holding the same switch in the momentary "TEST" direction will bypass the weight-on-wheels sensor, allowing the cabin to pressurize while on the ground, which is required for the pressurization ground checks.

Propeller Synchrophaser

Since the Analog King Air is equipped with a propeller synchronizer, it is also equipped with a visual synchrophaser on the main panel. The synchrophaser is a small disk with alternating black and white wedge marks. When one propeller is spinning faster than the other, the disk will rotate in the direction of that propeller; counterclockwise for the left engine, and clockwise for the right engine.

Propeller Amps Indicator

The propeller ammeter gauge indicates the flow of current to the propeller hubs during deicing. Nominal current when cycled to either propeller is 26-32 amps.

Vacuum Indicator

The vacuum indicator shows the vacuum suction generated by the vacuum ejector component of the aircraft's pneumatic system, regulated by the vacuum regulator. The scale on the gauge has indicators for appropriate vacuum suctions at various pressure altitudes of operation.

Oxygen Pressure Gauge

On the copilot's subpanel, a gauge indicates the oxygen pressure available in the onboard, refillable oxygen cylinder. This cylinder is normally pressurized to 1,850 PSI when serviced on the ground. Oxygen pressure will deplete as it is consumed by passengers and crew, when activated. To activate the Analog King Air's built-in demand-type oxygen regulators for crew,

depress the red "PRESS FOR CREW OXY" tabs on the quick-donning oxygen masks located in the cockpit ceiling. Oxygen will be consumed by the crew only in accordance with the current pressure altitude of the aircraft, and the weights of the crew members. To arm the emergency passenger oxygen system, pull up on the "PULL ON SYSTEM READY" T-handle on the pilot's side of the pedestal. The passenger oxygen masks will deploy (not modeled), and passengers will begin consuming oxygen in accordance with the current pressure altitude of the aircraft, and the weights of the passengers, when the cabin pressure altitude passes approximately 13,500 feet. To manually deploy passenger oxygen masks, pull up on the "PASSENGER MANUAL DROP OUT" T-handle on the copilot's side of the pedestal. When the passenger oxygen system is activated, the sound of pressurized gas flowing through tubing will be heard. When the crew oxygen masks are activated, the sound of breathing through a diluter-demand oxygen mask will be heard.

Pneumatic Pressure Gauge

Also on the copilot's subpanel, a gauge indicates the pneumatic pressure contained within the aircraft's bleed air system. Each engine is capable of supplying bleed air through its respective bleed air valve, also controlled on the copilot's subpanel. This bleed air is regulated to 18 PSI, and distributed among pneumatic powered equipment in the aircraft. Pressures within a normal operating range of 12 to 20 PSI are acceptable. When the before takeoff runup checklist calls for testing of the deicing boots, a drop in pneumatic pressure can be observed when the airframe deicing switch is placed in either the "MANUAL" or "SINGLE" position. The drop for the "MANUAL" position should be more than double that of the "SINGLE" position, as all the deicing boots are being activated at once, rather than in a cycle. Brake de-icing is also provided by hot bleed air, and therefore will also cause a fluctuation of regulated pneumatic pressure.

Cabin Temperature Gauge

Alongside the other gauges on the copilot's subpanel, a gauge indicates the current cabin ventilation duct air temperature, to be used in conjunction with the cabin environmental controls, also located on the copilot's subpanel. This gauge should be monitored after making adjustments to the environmental controls to ensure the change has had the desired effect. Cabin vent temperature is adjusted by the cabin environmental control system manually in manual modes, or automatically in automatic mode to achieve the desired cabin temperature. A "DUCT OVERHEAT" warning light is located on the pedestal annunciator panel, which illuminates when cabin duct temperature reaches approximately 180°F, or 80°C, at which point, cabin heating systems will be disabled until the temperature decreases to an acceptable temperature. The purpose of this system is to prevent damage to the air ducts, or possible fires within the cabin that result from a failed bleed air system. Bleed air ducting failures are also possible, and will result in a "L/R BLEED FAIL" annunciator on the glareshield panel. When either of these annunciators illuminate in flight with the bleed air valves open, the failed bleed air system should be turned off via the control switch immediately, and appropriate action should be taken on the part of the pilot to minimize risk to passengers and crew.

Hobbs Timer

The included Hobbs timer in the aircraft runs from when the master switch is activated, to when it is shut off. Indicated in tenths of an hour, this meter should be a reliable source of timing for your logbook recordings, or emergency leg timing in IMC, should you find yourself in a really unusual and dire situation.

Yoke-Mounted Digital Chronometers

On each yoke, there is a digital chronometer capable of displaying two different clock modes, and one timer mode, cycled through with the "SELECT" push button. The two clock modes are Universal Time ("UT"), and Local Time ("LT"), each in 24-hour format. The Elapsed Time ("ET") mode is a count-up stopwatch, controlled via the "CONTROL" push button. The maximum displayable time in Elapsed Time mode is 99 minutes and 59 seconds. The mode of these chronometers will be automatically saved and restored at the beginning of a new flight.

Outside Air Temperature Display Unit

At the pilot's elbow, a simple outside air temperature LCD display, labeled "Free Air Temp", indicates the current outside air temperature in degrees Fahrenheit, or Celsius. To switch between display modes, press the blue push button. This unit is co-located with the emergency locator transponder, and is connected to the hot battery bus.

Lighting Controls

Lighting Panel Design Philosophy

Unlike other aircraft, the King Air's overhead lighting panel is not designed to be adjusted entirely on the fly. The lighting panel is designed to be set for general nighttime conditions, and then the entire lighting system should be toggled on and off with the "MASTER PANEL LIGHTS" switch on the overhead. The panel has two horizontal rows of lighting adjustment knobs. The top row of knobs controls general cockpit ambient lighting conditions, and the bottom row controls specific areas of panel and instrument lighting. Also on the overhead, to the right of the AC electrical frequency meter, there is an "INSTRUMENT EMERG LIGHTS" switch. In the event of an electrical bus or generator failure that leaves the majority of the aircraft's electrical systems inoperative, the blue glareshield "Instrument Indirect" lighting can be connected directly to the hot battery bus by placing this switch in the on position. This switch can also be used during cockpit preparation before turning on the master battery switch.

Cockpit Lighting

Cockpit flood lighting for pilot and copilot stations ("PILOT/COPILOT OVHD FLOOD") are adjusted via two rotary knobs in the top row of the lighting panel. These floodlights are very bright, and should only be used during pre/post flight operations, or during an emergency. Blue, indirect instrument panel lighting, mounted in the underside of the glareshield, can be adjusted via the "INSTR INDIRECT" lighting knob, also in the top row of the lighting panel. These blue lights are ideal for supplemental lighting in dawn/dusk hours, and during pre/post flight activities. They can also be turned on at any time via the "INSTRUMENT EMERG LIGHTS" switch, so long as there is aircraft battery bus power.

Panel Lighting

The second row of lighting adjustment knobs consists of seven knobs for controlling various areas of panel, subpanel, pedestal, and side panel lighting. In each of these grouped areas, there are combinations of integrated instrument lighting, light posts, and integral panel backlighting.

Cabin Lighting

Cabin lighting in the King Air is controlled via a three-position switch on the copilot's subpanel in the cockpit. The three positions are, "OFF", "DIM", and "BRIGHT". Ensure that cabin lighting is turned off during all flight and ground operations, as light bleeds from the cabin into the cockpit area, diminishing the quality of crew night vision. Keep in mind that incandescent, DC, cabin lighting presents a significant drain on the aircraft battery during operation. Use of cabin lighting should be kept to a minimum when the aircraft battery is the only source of electrical power.

State Saving

This aircraft implements "selective" state saving, meaning that not all variables are saved and recalled at the next session, but some important settings are, primarily to enhance the user experience. Of primary interest, the radio configuration is saved, as well as any preset frequencies/distances/radials/etc that are entered into radio memory. Many radio and switch settings are also saved for recall, including cabin environmental controls, and the state of other cabin aesthetics, such as sun visors, armrests, and windows. No action is required by the user to save these configurations, as they are autosaved periodically, or whenever required by the software. The state of switches that affect the primary operation of the aircraft, such as battery switches, de-icing, etc, are not saved, and are instead set when the aircraft is loaded based on the starting position of the aircraft, such as, "cold and dark", "taxi", "ready for takeoff", "cruise", "approach", and so on. Engine health and oxygen pressure are saved between flights, and can be restored to their maximum condition via the "SYSTEMS" screen on the Weather Radar.

Note: Since this aircraft uses the native MSFS state saving library, your changes will only be saved if the simulator is shut down correctly via the "Quit to Desktop" button in the main menu.

Environmental Simulation & Controls

This aircraft is equipped with a simulated environmental control system, allowing the user to learn the essentials of passenger comfort while operating this aircraft. Cabin temperature is calculated distinctly from outside air temperature. Since the walls of the aircraft are insulated, it will take time for the cabin temperature of the aircraft to equalize with the outside air temperature. The cabin will also heat itself beyond the outside air temperature during warm sunny conditions, and slowly equalize with the outside air temperature after sunset.

Without the need for any aircraft power, the cabin temperature can be partially equalized with the outside air temperature by opening the cockpit storm windows, and fully equalized by ram air cooling, so long as the airspeed of the aircraft is great enough. Cabin temperature can also be equalized with the use of the environmental control system in any mode other than "OFF". When turned on, the environmental control system will energize the DC powered vent blowers to begin circulating air. The rate at which temperature equalization, active heating, or active cooling can be achieved can be increased by positioning the "VENT BLOWER" switch in the "HIGH" position, or activating the "AFT VENT BLOWER", which requires 115V AC power.

Cabin Temperature Monitoring

A temperature monitoring system is available in this aircraft to monitor cabin temperature, and alert the pilot to when cabin temperatures have become unacceptably hot or cold. The digital LCD temperature display on the right side of the panel, above the co-pilot standby instrumentation, will display temperatures from -99° to 999° Celsius, or Fahrenheit, toggleable with the small blue push button. Backlighting for this instrument is dimmed via the side-panel light dimmer, along with the circuit breaker panels. In addition to this LCD display, two small LED's are located outboard of the pilots's airspeed indicator to indicate when cabin temperatures are unacceptably hot or cold within the pilot's primary field of view, and call their attention to the cabin temperature settings. The "CABIN TEMP LOW" light illuminates when cabin temperatures are below approximately 50°F, or 10°C. The "CABIN TEMP HIGH" light illuminates when cabin temperatures are above approximately 90°F, or 32°C.

Cabin Environmental Controls

The cabin environmental control mode selector knob has four positions. In the clockwise direction, they are "MAN COOL", "MAN HEAT", "OFF", and "AUTO". In the automatic position, the cabin temperature controller will use any available heating or cooling sources to bring the cabin to the desired temperature. The desired temperature is selected via the "CABIN TEMP" rotary knob, from 50°F (10°C) fully counterclockwise, to 100°F (38°C) fully clockwise. The two manual positions will limit the use of heating or cooling air to just the desired source, "HEAT" or "COOL". In these modes, the desired cabin temperature cannot be directly set, but the temperature of the ventilation ducts can be directly set via the "MANUAL TEMP" momentary switch. The cabin vent temperature can be observed via the cabin temperature gauge.

Heating air is supplied to the ventilation system by one of two means. When the engines are running, hot engine bleed air is used to heat the cabin. The same bleed air source is also used to pressurize the aircraft, for which the bleed air control switches must be placed in the full "OPEN" position, not "ENVIR OFF". When the engines are not running, an electric heater can be used to heat the cabin by activating the "ELEC HEAT" switch. The current required to run the electric heater is very large, so it should only be used when external power is available to the aircraft. The electric heater is also deactivated by a landing gear weight-on-wheels switch, so the system is only available when the aircraft is on the ground.

Air conditioning air is supplied by an air conditioning compressor located on the right engine's accessory gearbox. To operate the air conditioning, the right engine must be brought up to above approximately 68% gas generator RPM. In some conditions, placing the engines in high idle may be enough. Other conditions may require additional power to be applied.

Be aware that these ventilation systems increase the load required from the current power source substantially, and therefore should be used predominantly while under power, or when external power is supplied to the aircraft. Additionally, the more bleed air that is removed from the operating engines, the more ITT will be increased. Engine performance should be increased as much as possible by reducing load for high performance takeoffs.

Failure Configuration & System Status

This aircraft is equipped with an underlying software system that is capable of triggering a failure of almost any simulated aircraft system, either by random, or at a scheduled time. An interface for configuring failure settings, resetting failures, or monitoring active failures is provided in the "NAV" and "LOG" modes of the in-panel weather radar. A list of all possible failures is provided below. Failures are saved between flights, leaving you to discover what has failed during your checklists.

Systems Screen

To access the "SYSTEMS" menu, rotate the mode knob on the weather radar to "NAV". On the screen shown, you will be presented with a segmented bar graph indicating the current engine condition, and several options. Using the keys on the weather radar bezel indicated by the YELLOW text and accompanying arrows, you can repair the engines, resetting their condition to 100%, refill the oxygen system, or reset all failures. Resetting all currently active failures will return the aircraft to a state with no failures and all systems functioning normally.

Failures Screen

To access the "FAILURES" menu, rotate the mode knob on the weather radar to "LOG". On the screen shown, you will be presented with a segmented bar graph indicating the current global failure rate as a multiplier of real-time. You may increase or decrease the global failure rate by

powers of two with the keys on the weather radar bezel as indicated in YELLOW on the screen. The maximum allowable multiplier is 1024x. Random failures can be completely disabled by pressing the indicated decrease key until the global failure rate indicates "NO FAILURES". The global failure rate multiplies the probability of random failures occurring while in "RANDOM" failure mode based on their selected Mean Time Between Failure (MTBF). For Example, if a specific failure is expected to occur once in every 5,000 hrs of simulated flight time, a global failure rate of 1024x, will result in this failure occurring roughly once in every 5 hrs of simulated flight time instead. Settings between 8x and 32x are recommended to add a little excitement to your virtual flying experience, as many hundreds of hours can be flown a 1x real-time failures without encountering a single failure, while settings above 256x almost guarantee multiple failures per flight.

From the failures page, one can also toggle between "RANDOM" and "SCHEDULED" failure modes. (currently active mode is indicated in MAGENTA) All failure settings can be reset to defaults from this page, for which a confirmation warning message will be displayed. Confirming the reset will return all MTBF times to system specific default values, return all scheduled failure times to default, and disable any currently armed scheduled failures. Any currently active failures can be viewed by navigating to the "ACTIVE FAILURES" page, and failures can be configured via the "DETAILED SETTINGS". The detailed settings page is context sensitive, and will be different depending on whether the failure system is currently in random or scheduled mode.

Random Failures Screen

From the random failures screen, one can set custom failure probabilities in the form of Mean Time Between Failure (MTBF) time in hours. While real world electromechanical components follow an exponentially decaying failure probability after their fabrication, this would be inconvenient for users of virtual aircraft, since it would subject new users to high component mortality rates just after purchasing the product; therefore, the probability of component failure is

constant throughout aircraft operation. This means that the probability of failure can be considered to be exactly the mean at all times. Upon loading the aircraft for the first time, default values will be displayed for each system, which are representative of their real world counterparts. These values can be modified by navigating to a failure using the "RNG" up and down keys on the weather radar bezel, and the "TRK>" key to move the cursor over to the MTBF column. Further use of the "RNG" keys will adjust the MTBF. Use the "<TRK" key to return the cursor to the list of failures. Failures are color coded into groups. Magenta is used for catastrophic engine failures, red for major systems failures, white for electrical bus distribution failures, and cyan for circuit breaker protected systems failures. The minimum allowable MTBF is 100 hrs, and the maximum is 1,000,000 hrs.

Scheduled Failures Screen

From the scheduled failures screen, individual failures can be scheduled to occur between specific times after the current time. Failures have a constant probability of occurring between the two times listed in minutes, and will only occur after the failure's "ARM?" value has been set to "Y". Upon loading the aircraft for the first time, default values will be displayed for each time. These times can be modified by navigating to a failure using the "RNG" up and down keys on the weather radar bezel, and the "TRK>" key to move the cursor over to the other columns. Scheduled failure times can then be adjusted with further use of the "RNG" up and down keys. The "ARM?" flag can be set with either the "RNG" up or down key. Use the "<TRK" key to return the cursor to the list of failures. Failures are color coded into groups. Magenta is used for catastrophic engine failures, red for major systems failures, white for electrical bus distribution failures, and cyan for circuit breaker protected systems failures. The minimum allowable time is 1 minute, and the maximum is 480 minutes, or 8 hours.

Active Failures Screen

From the active failures screen, one can scroll through a list of all active failures affecting the aircraft. Only failure names are displayed, and they can be scrolled through using the "RNG" up and down keys on the weather radar bezel. When the blinking cursor has a failure highlighted, pressing the "TRK>" key will reset the highlighted failure, returning the system to normal operation. Failures are colored in groups. Magenta is used for catastrophic engine failures, red for major systems failures, white for electrical bus distribution failures, and cyan for circuit breaker protected systems failures.

Failure System HTML Interface

To facilitate users who wish to initiate failures instantaneously via an external software interface, such as an instructor station, webpage, or tablet interface, access has been provided into the failure system using MSFS's HTML events. Any software that is capable of sending HTML events (also known as H:Vars), is capable of triggering failures without any additional configuration. These failures will appear in the in-cockpit weather radar interface discussed above, and can be reset from the same interface, or by sending the same HTML event again.

This interface allows users to create and share profiles for popular 3rd party interface applications to trigger and reset failures, or even mimic more complex emergency scenarios. Popular software capable of sending HTML events to MSFS include:

- Air Manager
- Axis and Ohs
- Mobiflight
- SPAD.neXt
- FSUIPC
- Many other SimConnect-based interfaces

To trigger or reset any failure in any Black Square aircraft, simply send an HTML event with the prefix "BKSQ_FAILURE_", and the exact name of the failure as it appears in the in-cockpit weather radar interface with spaces replaced by underscores.

For example, to trigger or reset a failure named "L FUEL QTY", the HTML event would be:

>H:BKSQ_FAILURE_L_FUEL_QTY

Depending on your programming environment, be sure to check the exact syntax needed to trigger HTML events. Some graphical programming environments may require you to omit the leading ">" from the event, while others may require this ">" to be expressed as ">", such as in reverse polish notation.

List of Possible Failures

Major System Failures

L ENGINE FAILURE
R ENGINE FAILURE
L ENGINE FIRE
R ENGINE FIRE
VACUUM PUMP
PITOT BLOCKAGE
STATIC BLOCKAGE
L BRAKE
R BRAKE
OXYGEN LEAK
L FUEL LEAK
R FUEL LEAK
L AUX FUEL LEAK
R AUX FUEL LEAK

Electrical Bus Failures

BUS TIE FAULT
L 26V AC BUS
R 26V AC BUS
L 115V AC BUS
R 115V AC BUS
L ENG INST POWER
R ENG INST POWER
HOT AVIONICS
TPL FED AVIONICS BUS
L AVIONICS BUS
R AVIONICS BUS

Circuit Breaker Protected Failures

L FIREWALL VALVE
R FIREWALL VALVE
L FIRE BOTTLE
R FIRE BOTTLE
L STBY FUEL PUMP
R STBY FUEL PUMP
L AUX X-FER PUMP
R AUX X-FER PUMP
L FUEL QUANTITY
R FUEL QUANTITY
L FUEL QTY WARN
R FUEL QTY WARN
L FUEL PRESS WARN
R FUEL PRESS WARN
CROSSFEED VALVE
L 26V AC BUS
R 26V AC BUS
L 115V AC BUS
R 115V AC BUS
AC BUS CONTROLLER
ENTRY LIGHTS

GROUND COMM
BATTERY RELAY
BATT BUS CONTROLLER
L ITT GAUGE
R ITT GAUGE
L TORQUE GAUGE
R TORQUE GAUGE
L RPM GAUGE
R RPM GAUGE
L NG GAUGE
R NG GAUGE
L FF GAUGE
R FF GAUGE
L OIL PRESS GAUGE
R OIL PRESS GAUGE
L OIL TEMP GAUGE
R OIL TEMP GAUGE
GEAR WARNING
GEAR INDICATORS
GEAR RELAY
ANNUNCIATOR POWER
ANNUNCIATOR SENSE
L BLEED AIR WARN
R BLEED AIR WARN
L OIL PRESS WARN
R OIL PRESS WARN
STALL WARN
AUTO FEATHER
L START CONTROLLER
R START CONTROLLER
L IGNITION
R IGNITION
L FIRE DETECT
R FIRE DETECT
L ENG INST POWER
R ENG INST POWER
L CHIP DETECT
R CHIP DETECT
WINDSHIELD WIPERS
GENERATOR RESET
BUS TIE INDICATORS
BUS TIE CONTROLLER
PROP SYNC
PROP GOV TEST
TPL FED BUS POWER
L BUS POWER
R BUS POWER
L LANDING LIGHT
R LANDING LIGHT
TAXI LIGHTS
WING ICE LIGHT
NAV LIGHTS
BEACON LIGHT
STROBE LIGHT
LOGO LIGHT
SIDE PANEL LIGHTS
RADIO BACKLIGHTS
SEATBELT LIGHTS

PEDESTAL LIGHTS
L PANEL LIGHTS
R PANEL LIGHTS
FLOOD LIGHTS
CABIN LIGHTS
AVNCS ANNUNCIATORS
FLAP MOTOR
FLAP INDICATORS
L ALT ENCODER
R ALT ENCODER
ALT ALERTER
L TURN COORDINATOR
R TURN COORDINATOR
PITCH TRIM
OAT PROBE
AIRSPEED WARN
L BLEED AIR CONT
R BLEED AIR CONT
CABIN TEMP CONT
PRESSURIZATION CONT
PASS OXY CONT
HI ALT WARN
PRESS DIFF WARN
CABIN MASTER POWER
RECEPTACLE POWER
L INERT SEP MAIN
R INERT SEP MAIN
L INERT SEP STBY
R INERT SEP STBY
DEICE BOOTS
PROP DEICE
L FUEL VENT HEAT
R FUEL VENT HEAT
BRAKE DEICE
WSHLD DEICE CONT
WSHLD DEICE POWER
VOICE RECORDER
AURAL WARNINGS

ANG
COMM 1
COMM 2
COMM 3
NAV 1
NAV 2
RNAV
CABIN AUDIO
PILOT AUDIO
COPILOT AUDIO
L RADAR ALT
R RADAR ALT
L RMI
R RMI
L XPNDR
R XPNDR
AUDIO CONTROLLER
PILOT ATTITUDE
PILOT HSI
L REMOTE COMPASS
R REMOTE COMPASS
GLIDESLOPE
AP ANNUNCIATORS
RUDDER BOOST
AP SERVOS
FLT CONT SYS
ALT SELECTOR
ADF 1
ADF 2
WX RADAR CONTROLLER
WX RADAR ANTENNA
L DME
R DME
RADIO PHONE
CABIN VIDEO

Miscellaneous Systems

Autofeather

This aircraft contains a completely custom propeller autofeathering implementation, as the native functionality is lacking, and inconsistent. Users should find that the autofeather system behaves nearly identical to the real aircraft. A GREEN "AFX" annunciator will illuminate beside the torque gauge of each engine when its respective autofeathering system is armed. The system will be armed when the respective engine's gas generator is operating above 88% RPM, and its torque is above 17%. The gas generator limitation can be removed by holding the autofeather switch in the "TEST" position. In the real aircraft this is a momentary switch, but it has been made toggling for your convenience. When reducing engine power, the opposite engine's "AFX" annunciator will extinguish when torque falls below 17%. The engine's autofeather functionality will engage when torque falls below 10%. This will be confirmed by the "AFX" light extinguishing, and the propeller RPM subsequently dropping. If the opposite engine's power is reduced below 17% torque, both propellers will unfeather, and the autofeather system will be completely disabled. Be aware that the propellers will not fully feather while the engines are running, as idle torque is still enough to prevent them from doing so fully. This is why the propeller RPM will cycle up and down while completing the autofeather test.

Flight Director & Autopilot Disconnect

The primary flight display in this aircraft, a Collins ADI-85A, is equipped with a flight director command bar system. When the Collins APS-65 autopilot controller is receiving power and in an appropriate mode, yellow command bars will come into view. The command bars are adjusted to rest on top of the yellow aircraft reference symbol on the ADI-85A, the vertical position of which can be adjusted with the small knob on the bottom left of the unit's bezel. A pilot can fly the aircraft with similar precision to the autopilot by "flying" the aircraft reference symbol into the command bars. The flight director command bars will be displayed on the unit whenever the autopilot is first activated with any horizontal or vertical guidance mode. The flight director will not be displayed during any dead reckoning modes, which are indicated by the GREEN "DR" indicator on the autopilot mode control panel. These modes include, roll hold mode, pitch hold mode, and bank hold mode, which is initiated by rotating the bank hold knob.

As there is no dedicated button or switch to activate the flight director, in order to fly the aircraft manually, the autopilot must first be activated, and then disconnected by a single press of the RED autopilot disconnect button on either control yoke. In the real aircraft, this push button has two stages of activation. For your convenience, this feature is approximated by two presses of the button. The first press will deactivate only the autopilot master, allowing the user to hand-fly the aircraft. The flight director and yaw damper will remain engaged. Upon pressing the disconnect button a second time, the flight director and the yaw damper will be disengaged. When the autopilot master is disengaged after the first press, various autopilot modes can still be selected on the APS-65 mode control panel, which will apply to the command bars, just as if the autopilot was still flying the aircraft.

Propeller Governors

This aircraft has two propeller governor tests: the overspeed governor test, and the ground idle stop test. The overspeed governor test reduces the maximum governed speed from 1,700 RPM to approximately 1,600 RPM. The ground idle stop test has a latching logic, preventing the RPM from being reduced below approximately 1,500 RPM while in flight. To test, engage the toggle, then advance the propeller RPM to above 1,500 RPM. Then, reduce the power levers, and observe that the RPM is held at 1,500 RPM. When the switch is released, RPM should return to the previous idle RPM. This is not a perfect representation of the real aircraft's ground idle stop test, but it should produce the indications expected by the checklists.

Audible Warning Tones

This version of the King Air comes equipped with several warning tones to alert the operator to important configuration changes, or potentially dangerous situations. These tones can be disabled by pulling the circuit breaker for the respective tone's underlying warning system, or by pulling the "Aural Warnings" circuit breaker. The highest priority aural warning, the engine fire warning, bypasses this circuit breaker, as does the approaching altitude tone, which is a component of the Collins PRE-80C Altitude Selector. These tones are as follows:

- Altitude Alerter Tone: A traditional C-Chime will sound when the aircraft is within 1,000 ft of the selected altitude displayed on the altitude selector. The accompanying flashing annunciator can be canceled by pressing the integrated "ALT ALERT" push button.

- Landing Gear Configuration Horn: A repeating tone will sound when the landing gear handle is in the up position, and either of the two following conditions are met. Either, both engine power levers are reduced below approximately 40% of their full travel, or when the flaps are set to the full down position. The physical switches which activate this alarm are located in the throttle quadrant, and operate based on the position of the cockpit controls alone, not any of the turbine parameters, or the actual flap position. This warning horn can be silenced by pressing the "WARN HORN SILENCE" button, adjacent to the gear handle. This warning will be accompanied by the illumination of the gear handle itself, which will not be extinguished by pressing the silence button.

- Autopilot Disconnect Tone: Whenever the autopilot is disconnected via the autopilot master push button, the control yoke mounted disconnect buttons, or automatically disconnects when overpowered, a warbling tone will sound.

- Stall Warning Horn: When the aircraft is within approximately 5-10 knots of stalling speed, a constant tone warning horn will sound. This warning can be tested by holding the "STALL WARN TEST" switch on the copilots subpanel in the up position.

- Overspeed Horn: When the aircraft exceeds the barber pole airspeed on the airspeed indicator, a repeating beeping tone warning will sound until the speed of the aircraft is reduced to below the barber pole speed.

- Engine Fire Siren: When a fire is detected in either engine, a loud siren will sound to alert the pilot to take immediate action. This tone cannot be canceled or silenced except by extinguishing the engine fire. Through completing the engine fire checklists, the pilot will close the firewall valve of the affected engine, and activate the fire extinguisher bottle. Shortly thereafter, the warning sound should cease as the fire is extinguished. This warning system can only be tested by maintenance personnel, and is not activated through the normal course of fire detector tests.

- Cabin Altitude High Horn: A constant tone warning horn will sound when the aircraft's cabin pressure altitude exceeds approximately 11,000 feet. This warning will be accompanied by the "CABIN ALT HI" RED annunciator light on the glareshield. If the cabin pressure continues to climb, the passenger oxygen system will automatically deploy at approximately 14,000 feet, assuming it is armed. This warning horn can be silenced by pressing the "CABIN ALT HI WARN SILENCE" button, under the copilot's control yoke. The accompanying glareshield annunciator light will remain illuminated any time the cabin pressure altitude is above approximately 11,000 feet. The frequency of this warning horn is slightly lower than the Cabin Pressure Differential High Horn.

- Cabin Pressure Differential High Horn: A constant tone warning horn will sound when the aircraft's cabin pressure differential reaches approximately 6.7 PSI. This warning will be accompanied by the "CABIN DIFF HI" RED annunciator light on the glareshield, which illuminates at approximately 6.5 PSI. If the cabin pressure differential continues to climb, the cabin pressurization controller will open the cabin pressure dump valve to prevent the pressure vessel from being damaged. Assuming the cabin pressurization controller has not failed, this will be accompanied by an immediate increase in cabin pressure altitude, thus silencing the warning horn. There is no other method to silence this warning horn, as it indicates an immediate danger presented to the aircraft. The frequency of this warning horn is slightly higher than the Cabin Altitude High Horn.

Working Windshield Wipers

This aircraft is one of the first, if not the first, for MSFS to feature functioning windshield wipers that actually impact forward visibility during precipitation. The rate at which precipitation returns to the windshield increases with increased precipitation rate, necessitating the use of the high and low windshield wiper settings to keep the windshield clean.

ATTENTION! This is an experimental feature, and therefore can be disabled if performance (framerate) is adversely affected. Current testing shows that most modern hardware will see no to minimal performance impact from this feature; however, it can be disabled from the AnalogKingAir.xml file in the aircraft's Model directory.

To disable this feature, simply comment out the template below for "BKSQ_WIPER_SLICES_ACTIVATED", and uncomment the template for "BKSQ_WIPER_SLICES_DEACTIVATED".

VOR & ADF Signal Degradation

Unlike in the real world, navigation receivers in Microsoft Flight Simulator produce only ideal readings. Signal strength is not affected by distance, altitude, terrain, or atmospheric conditions. When a station is out of range, the signal is abruptly switched off. This is unrealistic, and does not give the feel of navigating with the physical systems of the real aircraft.

All Steam Gauge Overhaul and future Black Square aircraft solve this problem by providing variables for VOR and ADF indications with distance and height above terrain based signal attenuation and noise. This noise is mathematically accurate for the type of signal (phased VHF for VOR, and MF for NDB), and adheres to the international standards for station service volumes. Combined with the two-pole filtering and physics of the instrument's needles in the cockpit, this creates a very convincing facsimile of the real world instrument's behavior. The To-From indicators of the VOR instruments will even exhibit the fluttering that is characteristic of the "cone of confusion" directly over the ground-based stations that pilots are taught to recognize during instrument training.

FLAP MOTOR

STARTER CONTROLLER

STARTER-GENERATOR

STARTER-GENERATOR

DC AMPS

DC AMPS

STARTER CONT

FLAP MOTOR

STARTER SWITCHES

RESET

L GEN

TO AVIONICS

LEFT BUS TIE

TO INVERTERS

DC VOLTS

RIGHT BUS TIE

TO AVIONICS

R GEN

RESET

LEFT BUS

CENTER BUS

RIGHT BUS

DC VOLTS

MAIN BATTERY

24 VDC

DC VOLTS

TO INVERTERS

DC VOLTS

DC VOLTS

DC AMPS

EXT POWER

BUS TIE CONTROLLER

HOT BATTERY BUS

BATTERY BUS TIE

DC VOLTS

BUS TIE

GEAR RELAY

BATTERY MASTER

GLARESHIELD "EMERGENCY" LIGHTS

EXTERNAL POWER

LANDING GEAR MOTOR

BAT RELAY

GEN RESET

DC VOLTS

BUS TIE CONT

TRIPLE FED BUS

TO INVERTER CONT

TO AVIONICS

AC Inverter Electrical Schematic
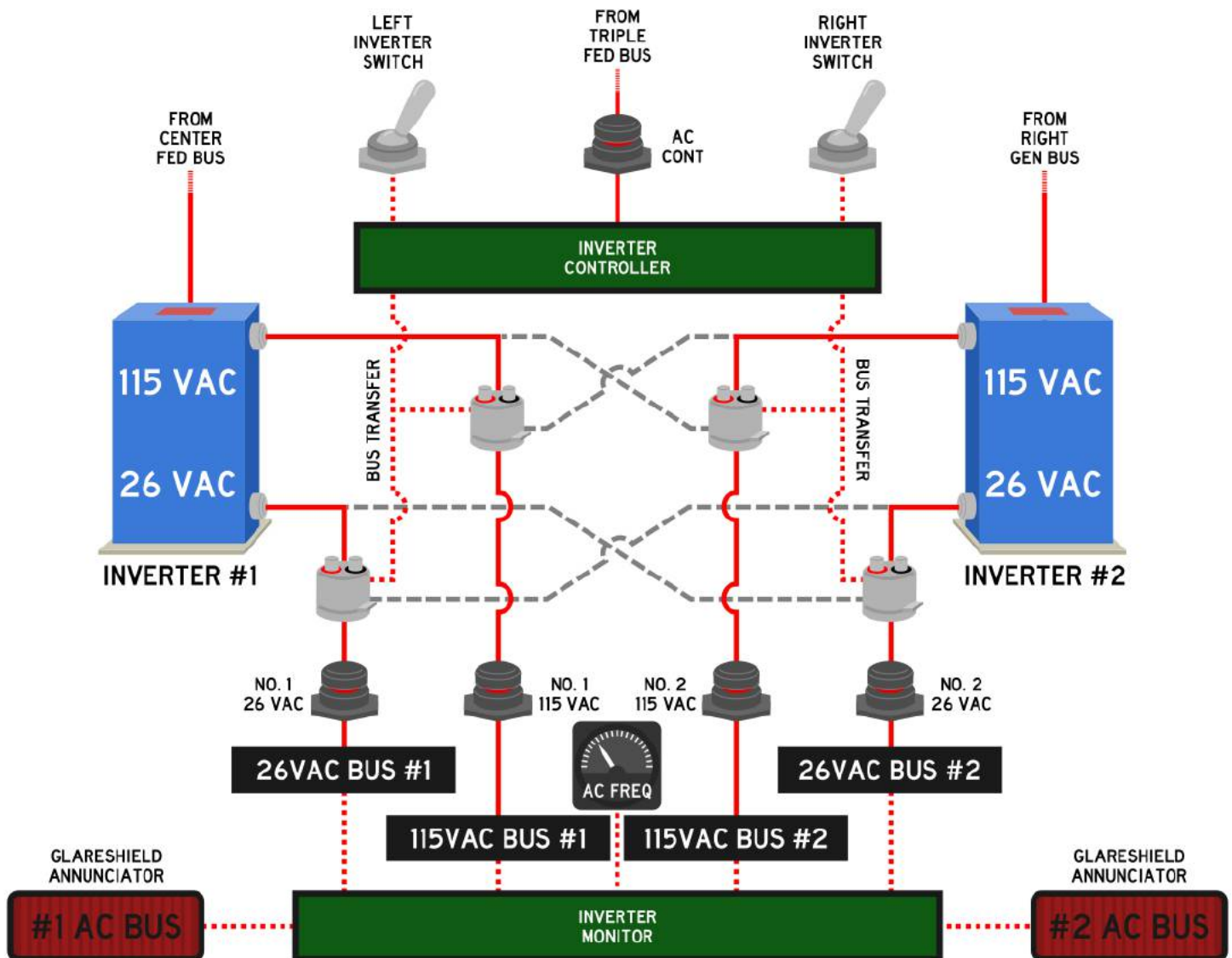
Avionics Buses Electrical Schematic
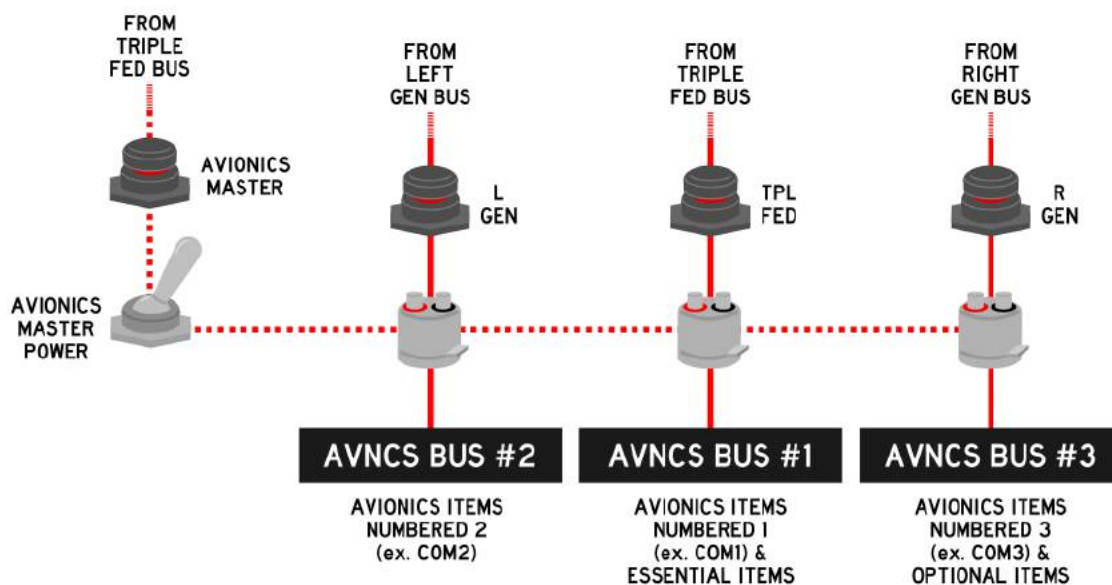
Using the KNS-80 RNAV Navigation System

The Concept

When most pilots hear the acronym "RNAV", they probably think of the modern RNAV, or GPS approach type, or precision enroute navigation for airliners; however, long before this type of navigation, there was the onboard RNAV computer. This 1980's era piece of early digital computer technology allowed pilots to fly complex routes with precision away from traditional ground-based radionavigation sources, such as VOR's and NDB's, and fly much shorter routes as a result. As the technology improved, even an early form of RNAV approaches became possible. Before GPS, the onboard RNAV computer allowed for GPS-like flying in a sophisticated package of digital electronics, marketed towards small to mid-size general aviation aircraft.

How it Works

To understand how the RNAV computer works, consider the utility of being able to place a ground-based VOR antenna anywhere you like along your route. If your destination airport does not have a radionavigation source on the field, you could simply place one there, and fly directly to or from it. You could also place an antenna 10 miles out from a runway to set up for a non-precision approach. You could even place an antenna on the threshold of a runway, set your HSI course to the runway heading, and fly right down to the runway with lateral guidance; in fact, this is how an ILS receiver works. The KNS-80 Navigation System allows the user to "move" a virtual VOR antenna anywhere they like within the service volume (area of reliable reception) of an existing VOR antenna.

"Moving" a VOR

To "move" a VOR antenna to somewhere useful, we must know how far from the tuned VOR station we would like to move it, and in what direction. These quantities are defined by a nautical mile distance, and a radial upon which we would like to move the antenna. For

example, to place a virtual VOR 10 miles to the Southwest of an existing station, we would need to enter the station's frequency, a displacement radial of 225°, and a displacement distance of 10.0 nm. Once we have entered this data into the RNAV computer, the resulting reading from this new virtual VOR station will be indicated on our HSI in the same manner as any other VOR, assuming the HSI source selector switch is set to "RNAV", and not "NAV1". This means that you can rotate the course select adjustment knob to any position you like, to fly to/from from the new virtual station on any radial or bearing, so long as you stay within the service volume of the tuned VOR station.

Data Entry

Now that you understand the basics of RNAV navigation, let's learn how to enter the data from above into the KNS-80. On the right side of the unit, you will find the "DATA" push button, and the adjacent data entry knob. Between the two exists a marking, reading, "FREQ-RAD-DST", to remind you of the order in which data should be entered, frequency first, then radial, and finally distance. At any given time, either "FRQ", "RAD", or "DST" is shown on the LCD screen to indicate which type of data is being entered. Press the "DATA" push button to cycle through the data entry process, and use the data entry knob to tune a frequency, enter a radial, and finally a distance.

Data Storage Bins

Below the data entry area on the screen, there are two numbers shown, 1-4, in either the "USE" or the "DSP" (Display) positions. The KNS-80 can hold up to four different combinations of frequency, radial, and distance data at one time. This can be greatly useful while planning a flight on the ground. The data channel being edited is indicated by the "DSP" number, and the data being used by the computer and subsequently displayed on the HSI is indicated by the "USE" number. To cycle through the two numbers, press the "USE" or "DSP" push buttons to the left of the "DATA" push button. Whenever the two numbers are different, indicating that one data channel is being edited, but another is being displayed on the navigation equipment, the "USE" numeral will flash continuously.

Distance Measuring Equipment

On the top left-hand side of the LCD display is a traditional Distance Measuring Equipment (DME) display, with a nautical mile distance to the virtual VOR station, a current speed of the aircraft relative to the station, and a time-to-go until over the station. It should be noted that, like all other DME displays, this one is similarly dependent on being within the VOR service volume, and having good line-of-sight reception of the station. It should also be noted that these distances, speeds, and times, are based on slant-range to the station, not distance along the ground, as one would draw on a map. For most procedures, it was determined that this fact did not make such a large difference as to be detrimental to the procedure, but pilots should still be aware of the distinction. Pressing the "HOLD" push button will place the unit in DME hold mode, which will hold the current DME frequency and information on the unit's display while allowing the user to change the tuned NAV frequency. This can be useful for some specific instrument approaches. This feature cannot be used in RNAV modes of operation.

Modes of Operation

Lastly, in the bottom left-hand corner of the LCD display, the KNS-80's many modes are annunciated. The KNS-80's modes fall into two categories; VOR and RNAV, and are activated by the "VOR" and "RNAV" push buttons. Further subcategories of modes are activated by pressing the appropriate push button multiple times. The VOR modes allow for the driving of an HSI with traditional VOR and ILS (including glideslope) data from the unit's third VHF navigation receiver. The VOR mode allows for behavior identical to a standard VOR receiver, with 10° of full-scale deflection to either side of the HSI's course deviation indicator (CDI). Pressing the VOR button again will enter PAR mode, which puts the CDI in a "PARallel" mode of operation, and linearizes the course deviation to +/- 5 nm full-scale deflection. This can be useful for tracking airways more accurately. Pressing the RNAV push button will enter the RNAV modes, where the CDI deflection is based on the displaced virtual VOR shown in the "USE" numeral. There are two RNAV modes, "RNAV/ENR" (Enroute), which drives the CDI with linear deflections of +/- 5 nm full-scale, and "RNAV/APR" (Approach), which drives the CDI with linear deflections of +/- 1.25 nm full-scale. Finally, when an ILS frequency is tuned in the currently USEd RNAV data, "ILS" will annunciate on the screen.

Modes in Summary:

VOR: Angular course deviation, 10° full-scale deflection, just like a third NAV radio.
VOR/PAR: Linear course deviation, 5 nm full-scale deflection, useful for existing airways.

RNAV/ENR: Linear course deviation, 5 nm full-scale deflection, displaced VOR waypoints.
RNAV/APR: Linear course deviation, 1.25 nm full-scale deflection, displaced VOR waypoints.

Other Possible Uses

Another possible use for the RNAV Navigation System is simply determining your distance away from an arbitrary point within a VOR service volume. This can be useful for many applications, such as ensuring that you remain clear of controlled airspace, or a temporary flight restriction (TFR). It could also be used for maintaining a certain distance away from a coastline, or flying circles around a target on the ground. A further possible use for the RNAV Computer is enhanced VOR "Fencing", such as for avoiding special use airspace, military operations areas, international airspace borders, or Air Defense Identification Zones (ADIZ), or descent planning, or radionavigation switchover points. Finally, one of the most useful applications of the RNAV System is in establishing holding patterns. Before GPS, holding pattern entry and flight could be even more confusing than it already is today. With an RNAV computer, a holding point entry waypoint can be placed anywhere, and flown around like there is a purpose-placed ground-based transmitter at the entry point.

Recommended Skills

1. Direct Route Navigation
2. Parallel Flight along Airways
3. Location & Distance from Waypoints
4. Enhanced Geo-Fencing
5. Maintaining Distance from Ground Points
6. Holding Pattern Entries
7. Fly a Rectangular Course

Direct Flight to Airport Tutorial

Lastly, as a first illustration of the power within the RNAV navigator, follow these steps to fly from any location within the chosen VOR service volume directly to an airport of your choosing without the need for any colocated navigational aid.

1. Locate the nearest VOR station to your desired destination, and its frequency, radial, and distance from the destination airport. While other station frequencies, radials, and distances can be found on approach, arrival, and departure charts, the easiest place to start is often with a mobile app or website that lists nearby stations along with other airport information. Examples include: ForeFlight, Garmin Pilot, FltPlan Go, SkyVector.com, and Airnav.com. These radials and distances can also be calculated during preflight planning by hand with a plotter, or with most flight planning software applications. In this case, we will use SkyVector.com to search for a destination airport, in this case, Beverly Airport in the US state of Massachustts.

   Nearby Navigation Aids

ID	Name	Freq	Radial / Range		ID	Name	Freq	Bearing / Range
LWM	LAWRENCE	112.50	154°	12.3	OW	STOGE	397	198°	29.4
BOS	BOSTON	112.70	029°	14.0	MJ	FITZY	209	302°	31.9
NZW	SOUTH WEYMOUTH	133.40	017°	26.1	ESG	ROLLINS	260	005°	38.4
MHT	MANCHESTER	114.40	145°	26.3	CO	EPSOM	216	323°	39.9

   In the fourth block of data, we are presented with four nearby VOR stations (on the left), all providing good coverage to Beverly Airport. To assess whether or not a VOR provides good service to your destination, reference the following chart for VOR service volumes published by the Federal Aviation Administration. For the vast majority of VOR stations, reception will be acceptable within 40 nm of the station while in-flight, and is usually the only volume worth considering for low altitude general aviation flights.

   For this example, we will choose the nearest VOR at Lawrence Airport, (LWM). This VOR has a frequency of 112.50 Mhz, a radial to Beverly Airport of 154°, and a distance of 12.3 nm. These are all three pieces of data that we need to fly directly to Beverly.
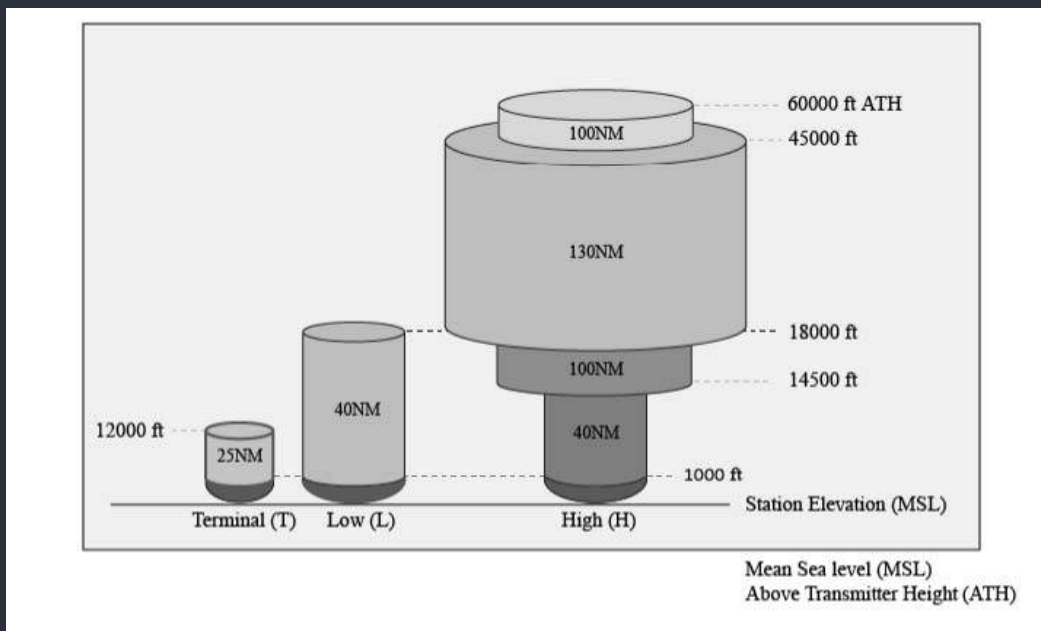
2. Enter the three pieces of data we located above into the KNS-80 RNAV computer. Once the KNS-80 is powered on, all your data entered during previous flights will be loaded from memory, and the active "display", and "use" data channels will be set to 1, and 1. First, we will use the dual concentric rotary knobs on the right of the unit to enter the frequency 112.5 Mhz into data channel 1, just as we would with any other navigation radio.

3. Once our desired frequency has been set we will use the "DATA" push button to page through the three required pieces of data in this data channel in the order "FREQ-RAD-DST". Press the "DATA" button once, and then enter the radial 154.0, again with the dual concentric rotary knobs. Should your desired radial include a decimal component, the inner rotary knob can be pulled and rotated for decimal entry.

4. When our desired radial is set, press the "DATA" push button once again to enter our desired distance offset of 12.3 nm. Again, should your desired distance include a decimal component, the inner rotary knob can be pulled and rotated for decimal entry.

5. Data entry is now complete; however, before we can begin following the CDI to the airport, we need to choose an RNAV mode of operation, probably RNAV/ENR for enroute operation, unless we need increased precision for some reason. Press the "RNAV" push button until "ENR" and "RNAV" are annunciated above the button. In RNAV modes of operation, our CDI will guide us to the displaced VOR waypoint at Beverly Airport that we just created, and all displayed DME information will be relative to that new waypoint.

    NOTE: VOR modes of operation WILL NOT provide CDI or DME information relative to the active waypoint. They are for operation as a conventional navigation radio with reference to existing VOR stations, in either angular or linear course deviation mode.

6. Lastly, make sure the HSI SOURCE switch in your aircraft is set to RNAV; otherwise, we will not see the RNAV information displayed on the HSI.

7. To fly directly to the displaced VOR waypoint at our destination airport, simply rotate the omni-bearing selector (OBS) or course (CRS) knob on your HSI, as you would to fly to a VOR, and follow the CDI needle with a TO indication. Countdown the distance and time remaining until arriving at your destination with the DME information provided on the KNS-80. When you have arrived, the TO/FROM indication will reverse, and DME distance will approach zero, just like with a conventional VOR receiver. Even at distances of 40 nm, this system is usually precise enough to place your route of flight inside the airport perimeter fence at your destination.

Checklists

Before Starting Engine

Preflight Inspection	Complete
Emergency Lights	On (at night)
Airstair Door	Locked
Emergency Exits	Unlocked
Cabin Loading	Complete
Seatbelts & Harnesses	Secure
Parking Brake	Set
Control Locks	Removed
Standby & Crossfeed Pumps	Off
Aux Transfer Pumps	Auto
Pilot Circuit Breakers	All In
Battery Bus	Norm
Gang Bar	Down
External Power	Off
Avionics Master	Off
Auto-Ignition	Off
AC Inverters	Off
Bus Sense	Norm
Bus Ties	Norm
Engine Anti-Ice	As Required
Anti-Ice Actuators	Main
Starters	Off
Auto-Feather	Off
Landing Gear	Down
Exterior Lights	Off
Ice Protection	Off
Prop Sync	Off
Power Levers	Ground Idle
Propeller Levers	Full Forward
Condition Levers	Cutoff
Flaps	Up
Friction Locks	Set
Trims	Centered
Oxy. Man. Dropout	Off (Pushed)
Passenger Oxygen	Ready (Pull)
Cabin Press. Mode	Press
Rudder Boost	On
Electric Trim	On
Cabin Master	Off
Cabin Lights	As Required
Cabin Accessories	As Desired
No Smoking & FSB	On
Vent Blower	Low
Cabin Temperature	As Desired
Temperature Mode	Off
Bleed Air Valves	Envir Off
Aft Blower	As Required
Electric Heater	Off
Oxygen Pressure	1550-1850 psi
Alternate Static Air	Normal
Copilot Circuit Breakers	All In
Lighting Master	As Required
Windshield Wipers	Off

Cockpit Lighting	As Desired
Microphone Sources	Norm
Battery Master	On
Battery Volts	23V min
Annunciators	Test
Annunciator Brightness	Set
Fuel Quantities	Check

Engine Start (Battery)

Beacon Light	On
Propeller Area	Clear
Gen Ties	Man Close (at night)
Right Starter	Start
Right Condition Lever	Low Idle Max Ng Above 12%
ITT	Less than 1090
Oil Temp & Press	Within Limits
Right Starter	Off at 50% Ng
R Oil & Fuel Press Annun.	Extinguished
Right Generator	Reset then On
R DC GEN Annunciator	Extinguished
R GEN Load	10-50%
R GEN Volts	28V
Batt Amps	Positive
Right Condition Lever	High Idle
Propeller Area	Clear
Left Starter	Start
Left Condition Lever	Low Idle Max Ng Above 12%
ITT	Less than 1090
Oil Temp & Press	Within Limits
Left Starter	Off at 50% Ng
L Oil & Fuel Press Annun.	Extinguished
Right Condition Lever	Low Idle
Left Generator	Reset then On
L DC GEN Annunciator	Extinguished
L GEN Load	10-50%
L GEN Volts	28V
Batt Amps	Positive
Gen Ties	Norm
Right Generator	Hold Reset
L GEN Volts	28V
Left Generator	Hold Reset
R GEN Volts	28V
Annunciators	Test & Consider

Engine Start (External Power)

Beacon Light	On
EXT PWR Volts	28.0-28.4V
CTR Volts	20V min
Propeller Area	Clear
Gen Ties	Man Close (at night)
External Power	On
Left Starter	Start
Left Condition Lever	Low Idle Max Ng Above 12%
ITT	Less than 1090
Oil Temp & Press	Within Limits
Left Starter	Off at 50% Ng

L Oil & Fuel Press Annun.	Extinguished
Left Generator	Reset then On
L DC GEN Annunciator	Extinguished
L GEN Volts	28V
External Power	Off
Ground Power Unit	Disconnected
L GEN Load	10-50%
Batt Amps	Positive
Propeller Area	Clear
Right Starter	Start
Right Condition Lever	Low Idle Max Ng Above 12%
ITT	Less than 1090
Oil Temp & Press	Within Limits
Right Starter	Off at 50% Ng
R Oil & Fuel Press Annun.	Extinguished
Right Generator	Reset then On
R DC GEN Annunciator	Extinguished
R GEN Load	10-50%
R GEN Volts	28V
Batt Amps	Positive
Gen Ties	Norm
Left Generator	Hold Reset
R GEN Volts	28V
Right Generator	Hold Reset
L GEN Volts	28V
Annunciators	Test & Consider
Emergency Lights	Off

Before Taxi

Fire Detector Test	Cycle
Fire Annunciators	Observe
Gear Handle Lights	Test
Stall Warning	Test
Gen Ties	Open
GEN TIE Annunciators	Illuminated
CTR Volts	Matches Batt Volts
Gen Ties	Norm
CTR Volts	28V
Bus Sense	Test
GEN TIE Annunciators	Illuminated
Bus Sense	Reset
GEN TIE Annunciators	Extinguished
TPL FED Volts	28V
Bleed Air Valves	Open
Pneumatic Pressure	Green
Temperature Mode	Auto
Duct Temperature	As Desired
Vent Blower	Auto
Electric Heater	As Required
Cabin Master	On
Cabin Accessories	As Desired
Gyro Suction	Green
AC Inverters	On
AC BUS Annunciators	Extinguished
AC Frequency	400 Hz
Weather Radar	Off/Standby
Avionics Master	On
Remote Compass	Slaved & Aligned

Flight Instruments	Set
Audio & Radios	Set
Flight Controls	Free & Correct
Annunciators	Consider
Instrument Flags	Consider
Exterior Lights	As Required
Parking Brake	Release
Brakes	Test

Before Takeoff (Runup)

Nose Wheel	Centered
Parking Brake	Set
Electric Trim	Actuate
Pitch Trim Wheel	T/O Position
Electric Trim	Cycle
Pitch Trim Annun	Observe
Yaw Damper	Engage
Rudder Boost	Cycle
Rudder Boost Annun	Observe
Heading Bug	30 Degrees Left
Autopilot Master	Engage
Autopilot Annunciators	Observe
Autopilot Heading Mode	Engage
Yoke Movement	Observe
Flight Director	Bank Left
Heading Bug	30 Degrees Right
Yoke Movement	Observe
Flight Director	Bank Right
Autopilot Disconnect	Press
Anti-Ice Actuators	Standby
Engine Anti-Ice	On
Eng Anti-Ice Annun	Illuminate
Anti-Ice Actuators	Main
Engine Anti-Ice	As Required
Eng Anti-Ice Annun	As Appropriate
Power Levers	Idle
Auto-Ignition	Arm
IGNITION Annunciators	Illuminate
Power Levers	Advance above ~17% Torque
IGNITION Annunciators	Extinguish
Power Levers	Idle
IGNITION Annunciators	Illuminate
Auto-Ignition	Off
Prop Gov Test	Hold to GOV
Power Levers (Individually)	Advance through 1600 RPM
RPM limited to 1600	Observe
Prop Gov Test	Release
Low Pitch Stop	Hold to GND IDLE STOP
PROP PITCH Annunciators	Illuminated
Propeller Levers	Cycle to Low RPM
Propeller Levers	Full Forward
Power Levers	Idle
Low Pitch Stop	Release
PROP PITCH Annunciators	Extinguished
Propeller RPM	Return to Ground Idle
PROP PITCH Annunciators	Illuminated below 1300 RPM
Auto-Feather	Hold to Test
AUTOFEATHER OFF Annunciator	Extinguished

Power Levers	Advance to 25% Torque
AFX Annunciators	Both Illuminated
Left Power Lever	Slowly Reduce
Right AFX Annun.	Extinguished Below 17%
Left AFX Annun.	Extinguished Below 10%
Left Prop RPM	Feather & Cycles
Left Power Lever	Advance to 25% Torque
AFX Annunciators	Both Illuminated
Right Power Lever	Slowly Reduce
Left AFX Annun.	Extinguished Below 17%
Right AFX Annun.	Extinguished Below 10%
Right Prop RPM	Feather & Cycles
Left Power Lever	Idle
AFX Annunciators	Both Extinguished
Right Prop RPM	Un-Feathered
Auto-Feather	Arm
Windshield Anti-Ice	High
Load Meters	Increase
Windshield Anti-Ice	Off
Propeller De-Ice	On
Prop Amps	26-32 Amps Cycle
Load Meters	Increase
Propeller De-Ice	Off
Prop Amps	0 Amps
Surface De-Ice	Single Cycle
Pneumatic Pressure	Fluctuate
Surface De-Ice	Hold Manual
Pneumatic Pressure	Fluctuate
Surface De-Ice	Release Manual
Pressurization Controller	1000ft below field elev.
Cockpit Windows	Closed
Cabin Press. Mode	Hold to Test
Cabin Alt, Diff & Climb	Observe Descent
Pressurization Controller	Set First Assigned Alt
Cabin Press. Mode	Press
Left Bleed Air	Off
Pneumatic Pressure	No Change
Right Bleed Air	Off
Pneumatic Pressure	Zero
Bleed Air Valves	Open
Flaps	As Required
Flaps Indication	Correct
Fuel Quantities	Check
Flight Instruments	Check
Battery Ammeter	Charge Current less than 10A

Before Takeoff (Cleared)

Electric Heater	Off
Generator Loads	Check
Battery Ammeter	Charging or Zero
Exterior Lights	Set for T/O
Ice Protection	As Required
Auto-Ignition	Arm if Required
Auto-Feather	Arm
Engine Anti-Ice	As Required
Transponder	On/Alt
Weather Radar	As Required
Propeller Levers	Full Forward

Condition Levers	High Idle
Annunciators	Test & Consider
Parking Brake	Release

Takeoff

Power Levers	T/O Power (See POH)
AFX Annunciators	Both Illuminated Above 88% Ng
ITT	820 max
Pitch	10 deg at Vr
Landing Gear	Up
Landing & Taxi Lights	Off
Autopilot	Engage
Flaps	Up at 125kts min
Cabin Alt, Diff & Climb	Observe Climb

Climb

Power Levers	Climb Power (See POH)
ITT	785 max
Propeller Levers	1600 RPM or As Desired
Prop Sync	On
Engine Instruments	Monitor
Exterior Lights	As Required
Ice Protection	As Required
Windshield Anti-Ice	Normal
Pressurization Controller	Set Cruise Alt

10,000 Feet

No Smoking & FSB	As Required
Exterior Lights	As Required
Cabin Pressure	Monitor

Transition Altitude

Altimeters	Standard
Cabin Pressure	Monitor

Cruise

Power Levers	Cruise Power (See POH)
ITT	765 max
Auto-Feather	Off

Descent

Pressurization Controller	Set Destination Alt
Auto-Feather	Arm
Exterior Lights	As Required
Ice Protection	As Required
Altimeters	Set Local
No Smoking & FSB	As Required

Approach

Exterior Lights	As Required
Ice Protection	As Required

Cabin Alt, Diff & Climb	Check Progress	Gang Bar	Down when Ng 15% or less
Fuel Balance	Check	Lighting Master	Off
Flaps	Approach	Parking Brake	As Desired
No Smoking & FSB	On	Emergency Lights	Off
MDA/DA & Radar Alt	Set		

Before Landing

Landing Gear	Down & Locked
Exterior Lights	As Required
Ice Protection	As Required
Engine Anti-Ice	As Required
Prop Sync	Off
Cabin Alt, Diff & Climb	Check Progress

Landing

Landing Gear	Down & Locked
Flaps	Full
Cabin Differential	Zero
Power Levers	Idle
Propeller Levers	Full Forward
Autopilot Disconnect	Press
Brake	As Required
Power Levers	Lift for Reverse
Power Lever	Idle before 30kts

After Landing

Engine Anti-Ice	As Required
Auto-Ignition	Off
Exterior Lights	As Required
Ice Protection	Off
Flaps	Up
Cabin Alt, Diff & Climb	Verify Zero
Weather Radar	Off/Standby

Shutdown & Securing

Parking Brake	Set
Auto-Feather	Off
Exterior Lights	As Required
Oxygen Handles	Off
Emergency Lights	On (at night)
Avionics Master	Off
AC Inverters	Off
Cabin Master	Off
Cabin Accessories	As Desired
Cabin Lights	As Required
No Smoking & FSB	Off
Vent Blower	Low
Temperature Mode	Off
Bleed Air Valves	Envir Off
Aft Blower	Off
Electric Heater	Off
ITT	Stabilized
Power Levers	Flight Idle
Condition Levers	Cutoff
Propeller Levers	Feather
Electrical Switches	Off

Instrument Markings & Colors

Propeller Torque:
0-100% (GREEN)
100% (RED)

Propeller RPM:
1450-1700 RPM (GREEN)
1700 RPM (RED)

Interstage Turbine Temperature (ITT):
400-820 °C (GREEN)
820 °C (RED)
1090 °C (WHITE)

Gas Generator RPM (Ng):
62-104% (GREEN)
104% (RED)

Oil Pressure:
60 psi (RED)
60-90 psi (YELLOW)
90-135 psi (GREEN)
135 psi (RED)
200 psi (RED)

Oil Temperature:
-0-100 °C (GREEN)
100-110 °C (YELLOW)
110 °C (RED)

Fuel Flow:
0 PPH (MINIMUM)
700 PPH (MAXIMUM)

Fuel Quantity:
0 lbs / 0 gal (MINIMUM)
1400 lbs / 110 gal (MAXIMUM)
0-250 lbs / 0-37 gal (YELLOW)

Oxygen Pressure:
0-500 psi (YELLOW)
1550-1850 psi (GREEN)
1950-2000 psi (RED)

Vacuum Suction:
4.5-5.5 inHg to 15,000 ft (GREEN)
4.0-5.5 inHg to 20,000 ft (GREEN)
3.5-4.0 inHg to 25,000 ft (GREEN)
3.0-3.5 inHg to 30,000 ft (GREEN)

Cabin Pressure Differential:
0-6.6 psi (GREEN)
6.6-7.0 psi (RED)

Pneumatic Pressure:
11-20 psi (GREEN)
6.6-7.0 psi (RED)

Airspeed Indicator:
SEE V-SPEEDS

Abnormal & Emergency Checklists

Starter Does Not Disengage

Battery Master	Off
External Power	Off
Condition Levers	Cutoff

Hot or Hung Start

Condition Levers	Cutoff
Starter	Starter Only
Starters	Off when ITT less than 400

Engine Clearing

Propeller Levers	Feather
Condition Levers	Cutoff
Power Levers	Idle
Starter	Starter Only
Starter	Off after 30s

Engine Failure on Takeoff

Power Levers	Idle
Brakes	Maximum
Operative Engine	Reverse Thrust until Stopping
Condition Levers	Both Cutoff
Firewall Valve	Both Close
Gang Bar	Down

Engine Failure on Climbout

Propeller Lever	Maximum Allowable
Propeller Lever	Full Forward
Landing Gear	Up
Propeller Lever	Feather for Inoperative
Condition Lever	Cutoff for Inoperative
Propeller Lever	Feather for Inoperative
Firewall Valve	Close Illuminated
Flaps	Up When Safe
Fire Extinguisher	Actuate if Illuminated
Bleed Air Valve	Off for Inoperative
Auto-Ignition	Off for Inoperative
Generator	Off for Inoperative
Auto-Feather	Off
Prop Sync	Off
Load Meters	Monitor

Engine Shutdown/Flameout

Condition Lever	Cutoff for Inoperative
Propeller Lever	Feather for Inoperative
Firewall Valve	Close Illuminated
Fire Extinguisher	Actuate if Illuminated
Bleed Air Valve	Off for Inoperative
Auto-Ignition	Off for Inoperative

Generator	Off for Inoperative
Auto-Feather	Off
Prop Sync	Off
Load Meters	Monitor

Air Start with Starter

Temperature Mode	Off
Vent Blower	Low
Aft Blower	Off
Weather Radar	Off/Standby
Windshield Heat	Off
Power Lever	Idle for Inoperative
Condition Levers	Cutoff for Inoperative
Firewall Valve	Check Open
Starter	On for Inoperative
IGNITION Annunciator	Illuminate
Condition Lever	Low Idle for Inoperative
Starters	Off at 50% Ng
Condition Levers	High Idle
Power Levers	As Desired
Generator	Reset then On
Auto-Ignition	On

Air Start Windmilling

Temperature Mode	Off
Vent Blower	Low
Aft Blower	Off
Weather Radar	Off/Standby
Windshield Heat	Off
Power Lever	Idle for Inoperative
Condition Levers	Cutoff for Inoperative
Generator	Off for Inoperative
Airspeed	Above 140 kias
Generator	Below 20,000ft
Auto-Ignition	On
Condition Levers	Low Idle for Inoperative
ITT	Stabilized
Power Levers	As Desired
Generator	Reset then On

Smoke/Fumes Electrical

Oxy. Man. Dropout	On (Pull)
Crew Oxygen	Deploy
Microphone Sources	Boom
Temperature Mode	Off
Vent Blower	Low
Aft Blower	Off
Avionics Master	Off
AC Inverters	Off
Cabin Master	Off
Cabin Accessories	Off
Cabin Lights	Off
Non-Essential Elec Equip	Off
Circuit Breakers	Check

Smoke/Fumes Environmental

Oxy. Man. Dropout	On (Pull)
Crew Oxygen	Deploy
Microphone Sources	Boom
Temperature Mode	Off
Vent Blower	High
Aft Blower	On
Bleed Air Valves	Envir Off

High Pressure Differential

Pressurization Controller	Set Higher Altitude
Cabin Climb	If No Descent...
Bleed Air Valves	Off
Cabin Press. Mode	Hold Dump
Bleed Air Valves	Open

Bleed Air Failure

Bleed Air Valves	Off
Temperature Mode	Off
Bleed Control Circuit Breakers	Check/Reset
Bleed Air Valves	Envir Off
Pneumatic Pressure	If Zero...
Bleed Air Valves	Off
Icing Conditions	Avoid

Cabin Depressurization

Crew Oxygen	Deploy
Microphone Sources	Boom
Oxy. Man. Dropout	On (Pull)
Emergency Descent	Begin
Temperature Mode	Off
Cabin Press. Mode	Hold Test
Cabin Climb	If no Climb Observed...
Pressurization Circuit Breakers	Check/Reset
Cabin Press. Mode	Hold Test
Cabin Climb	If no Climb Observed...
Bleed Air Valves	Envir Off

Crossfeed Required

Standby Fuel Pump	On for Supply Side
Standby Fuel Pump	Off for Receiving Side
Aux Transfer Pumps	Auto for Receiving Side
Crossfeed Valve	On Desired Side

Crossfeed Failure

Crossfeed Valve	Off
Standby Fuel Pump	On for Fullest Tank

Inverter Failure

Failed Inverter	Bus Transfer
AC BUS Annun	If still Illuminated...
Failed Inverter	Off

AC Frequency	If Insufficient...
Pilot Circuit Breakers	Reduce AC Load

Autopilot Failure or Trim Runaway

Autopilot Disconnect	Press
Electric Trim	Off
Autopilot Circuit Breakers	Pull Off

Duct Overheat

Temperature Mode	Off
Duct Overheat Annun	Wait to Extinguish
Cabin Temperature	As Desired
Temperature Mode	Auto
Duct Temperature	As Desired
Duct Overheat Annun	If Illuminates...
Temperature Mode	Off
Duct Overheat Annun	Wait to Extinguish
Temperature Mode	Man Heat or Man Cool
Man Temp Control	As Desired
Duct Overheat Annun	If Illuminates...
Temperature Mode	Off
Temp Control Circuit Breaker	Pull Off

Battery Overcharge

Battery Ammeter	If Steady or Increasing...
Battery Master	On
Generator Loads	Monitor

Battery Tie Open

CTR Volts	If Matches Batt Volts...
Bus Sense	Reset
BATT TIE OPEN Annun	If still Illuminated...
Battery Bus	Emerg
Gen Ties	Man Open
GEN TIE Annunciators	Illuminated
CTR Volts	Confirm Unpowered
Number 1 Inverter	Bus Transfer
Landing Gear Relay	Pull Off
Landing Gear	Extend Manually on Approach

Gen Tie Open Uncommanded

GEN Volts	If Matches Opposite Volts...
Bus Sense	Reset
GEN TIE OPEN Annun	If still Illuminated...
GEN TIE Circuit Breakers	Check/Reset
Gen Reset Circuit Breakers	Check/Reset
Bus Sense	Reset
GEN TIE OPEN Annun	If still Illuminated...
Disconnected Generator	Off
Load Meters	Do Not Exceed 100%

No Fuel Transfer

Aux Transfer Pumps	Override
NO FUEL TRANSFER Annun	If still Illuminated...
X-fer Pump Circuit Breakers	Check/Reset

Engine Anti-Ice Failure

Anti-Ice Actuators	Standby
ENG ICE FAIL Annun	Extinguish
Engine Anti-Ice	On
Eng Anti-Ice Annun	Illuminate
Eng Anti-Ice Circuit Breakers	Pull Off

Remote Compass Misalignment

Remote Compass Circuit Breaker	Pull & Reset
Remote Compass Alignment	If Misaligned...
Remote Compass	DG Mode
Compass Position	Slew to Mag. Heading

Radio Receive/Transmit Failure

Audio Amplifier	Emerg
Radio Circuit Breakers	Check/Reset
Radio Diagnostics	Check Codes

Cockpit Lighting Failure

Emergency Lights	On
Lighting Master	Off
Inst Indirect Lighting	As Desired
Lighting Circuit Breakers	Check/Reset
Lighting Master	On

Avionics Switch Failure

Avionics Bus Feeders (3)	Check/Reset
Avionics Master Breaker	Pull Off

Landing Gear Manual Extension

Landing Gear Relay	Pull Off
Landing Gear Handle	Down
Emergency Gear Handle	Pump until 3 Green

Landing Gear Up after Man Ext

Emergency Gear Handle	Stow
Landing Gear Relay	Push On
Landing Gear Handle	Up

Balked Landing

Power Levers	Max Allowable
Propeller Levers	Full Forward
Flaps	Approach at Vref+10kts
Landing Gear	Up
Flaps	Up at 125kts min

Tips on Operation within MSFS & Limitations

Turboprop Engine Simulation

As many users of MSFS are aware, the native turbine engine simulation is flawed. This product makes numerous adjustments to the natively driven turbine values displayed on the cockpit instrumentation to provide a more realistic experience, but still not without its flaws. Mainly, users will notice the following:

- Ambient temperature has a larger effect on idle ITT than it should
- Beta range not properly gated or simulated
- Propeller drag is insufficient at flight idle

Engine Limits and Failures

When you operate an engine beyond its limits, damage to the aircraft is accumulated according to the severity of the limit exceedance, and the type of limit exceeded. For instance, exceeding starting ITT limits will destroy an engine in seconds, while a slight exceedance of the maximum governed propeller RPM would not cause an engine failure for quite some time. When engine health is reduced to 25% of its initialized value, the CHIP DETECT annunciator light will illuminate. If engine parameters are not brought back within limits soon, the engine will fail.

NOTE: The "Engine Stress Failure" option must be enabled in the MSFS Assistance menu for the engine to fail completely.

Exceeding the engine starter limitations stated in this manual significantly will illuminate the GEN OVHT annunciator. If the limits are further exceeded, a bus fault will be triggered, which disables the automatic and manual bus tie connections. If the starter is not disabled soon, the starter will be disabled permanently.

Stalling Speed

Keep in mind that MSFS does not properly simulate propeller beta range. Although the propeller pitch does not reduce when the power levers are placed below the flight idle position, the engine power is further reduced. On the ground, this means that turboprop aircraft are less likely to creep forward when throttles are reduced fully, though due to reduced engine power, not reduced propeller pitch. In flight, this seems to result in beta-like propeller drag when the power levers are reduced below flight idle, for which there is no gate. For proper power-off stall performance in-flight, it seems that maintaining a throttle setting at where the flight idle gate would be (on the in-cockpit throttle quadrant), is necessary.

Electrical Systems

The native MSFS electrical simulation is greatly improved from previous versions of Flight Simulator, but the underlying equations are unfortunately inaccurate. Users familiar with electrical engineering should keep in mind that the battery has no internal resistance, and there is no real sense of AC power, inverters, or diodes. There are also some obvious bugs, most of which are mitigated by this product. The result is not a perfect electrical simulation, but should follow the indications expected by the included checklists.

Battery charging rate is correctly simulated in this aircraft, meaning that the battery charge rate in amps is proportional to the voltage difference between the aircraft generators and the battery. Battery charging rate should be kept to a minimum whenever possible, and takeoff limits should be observed. If the charge rate exceeds 10A for approximately 60 seconds, or 60A for 10 seconds, the BATTERY CHARGE annunciator will illuminate. This is acceptable after startup while the battery is recharging; however, care should be taken while taxiing to avoid overcharging the battery. If the battery charge current is in excess of 10A for an extended period of time, heating the battery, the battery will eventually become disconnected from the electrical system due to an overcharging failure. Be sure to monitor the battery charging current during ground operations to ensure the charging current is decreasing, and has approached zero before increasing engine power.

The starter-generator in a PT6 engine is connected to the accessory gearbox, where it is used to provide starting rotation to the compressor turbine, and then generate DC power when the engine is running. This renders the generator output independent from propeller RPM. Unfortunately, in MSFS, the generator output will drop below useful levels when the propeller is feathered. Please move the propeller levers out of the feather detent to ensure proper battery charging while on the ground, and monitor battery charging with the overhead ammeter.

Deicing and Anti-Icing Systems

Ice accumulation and mitigation has been buggy since the release of MSFS. As of Sim Update 11 (SU11), the underlying variables for airframe, engine, pitot-static, and windshield icing have been verified to be working correctly. Unfortunately, the exterior visual airframe icing may continue to accumulate regardless of attempted ice mitigation. Apart from the visual appearance, this should not affect the performance of the aircraft. Windshields are always able to be cleared by deicing equipment, thankfully.

The Analog King Air is equipped with propeller deicing, brake deicing, pitot heat, fuel vent heat, stall warning heat, airframe deicing boots, engine intake heat, inertial separators, and windshield heat. Electrical anti-icing works continuously, and will slowly remove ice from their respective areas of the aircraft. All other ice mitigation is provided via hot bleed air gasses from the engines. These require at least one engine to be operating, and its bleed air valve to be open. Airframe deicing is provided by pressurized boots, which are toggled with the "Surface Deice" switch. Both the "Single Cycle", and the "Manual" positions will trigger one cycle of

deicing to clear airframe ice. The switch must be toggled every time ice is to be cleared. Since ice accumulation cannot be monitored visually, it is recommended that a recurring timer be set.

Third Party Navigation and GPS Systems

There now exist a number of freeware and payware products to enhance or add advanced navigation systems to MSFS. For example, the TDS GTNxi 750/650, the PMS50 GTN 750/650, and the Working Title GNS 530/430. Several of these advanced GPS units implement their own autopilot managers out of necessity, with the Working Title GNS being the latest to do so. They may also require the use of their own special variables to be compatible with an aircraft's radionavigation equipment. Accommodating all these different products is not trivial. Black Square's hot-swappable avionics system, and failure system to a lesser extent, have compounded the difficulty.

Existing customers of the Analog King Air may have noticed undesired behavior with the publicly available beta of the Working Title GNS 530/430 available for free in the MSFS Marketplace. Reconciling all the issues created with the new capabilities of this GPS has been a long process, and we thank you for your patience. The Analog King Air should now be fully compatible with these products with version 1.3. Users should notice only minor interruptions when switching between GPS units, such as waiting for a GPS to reboot, or an uncommanded autopilot disconnect or mode change. As development continues on these 3rd party products, Black Square will continue to work with the developers to update the fleet, and bring you the most realistic flying experience possible.

More Information on Operation

Black Square aircraft are created by an avid pilot who believes that every switch, knob, and button should be interactable, and the user should be able to follow real world procedures without compromising results from the simulation. This aircraft was designed and tested using real world handbooks and procedures, and leaves little to the imagination in terms of functionality. For the most immersive experience, it's recommended that you seek out manuals, handbooks, checklists, and performance charts from the real aircraft represented in this simulation. Although this aircraft and simulation is not suitable for real world training, and should not be used for such, every effort has been taken to ensure that the simulation will represent the real aircraft until the fringe cases of instrument flying, or system failure.

In the case of this particular product, featuring the KNS-80 Navigation System, and the RDR 1150XL, additional resources are available online for the real world counterparts of these units. In particular the **"KNS-80 Pilot's Guide"**, available on Bendix/King's website, and the **"Weather Radar Pilot Training DVD"** on Bendix/King's YouTube channel.

Frequently Asked Questions

Will I still be able to fly the default G3X King Air 350i?

Absolutely! The default King Air 350i will be unaffected by this product, and will always be available in the aircraft selection menu. The two installations may sit side-by-side without interference; however, we think that once you've flown the analog systems, you won't want to go back to the generic LCD displays of the default aircraft!

Are liveries for the default MSFS King Air 350i Compatible?

Yes! They are all compatible, as they only affect the exterior model, and they can be easily integrated into this product. For more information, see the "Liveries" section of this manual.

Why is the GTN 750 GPS screen black?

Make sure you have the PMS GTN 750 or TDS GTNxi 750 installed properly in your community folder. The mod can be obtained for free from the following link. Installation instructions are included in the "Installation, Updates & Support" section of this manual.

> **https://pms50.com/msfs/downloads/gtn750-basic/**

Why do my GNS 530 displays not look like the screenshots?

Make sure you have the Working Title GNS 530/430 mod installed properly. The mod can be obtained for free from the in-game marketplace while it is still in beta. Installation instructions are included in the "Installation, Updates & Support" section of this manual.

Why won't the autopilot track to the KNS-80 RNAV waypoint?

Unfortunately, it is not possible to drive the stock MSFS autopilot system with a custom navigation source without implementing a whole new autopilot (to the best of my knowledge). It is recommended that you simply steer the autopilot via the heading bug with reference to the RNAV course deviation shown on the CDI.

Why is the state of my aircraft and radios not saved/recalled?

In order for the MSFS native state saving to work correctly, you must shut down MSFS correctly via the main menu, by clicking "Quit to Desktop", NOT by pressing the red "X" on the application window, or otherwise terminating the application window.

Do I need to have the original default aircraft installed?

Yes, but also no. This product uses models, textures, and sound from the original default; therefore, you must have it installed for this product to be able to find those files. If you do not, the exterior model might not appear, or there might be pink checkerboard textures in the cockpit, or there might be no sound. However, if you really want to uninstall the default aircraft for some reason, it is possible for advanced users to copy over the necessary files and link them in this aircraft's aircraft.cfg, and model.cfg.

Why can't I see the exterior of the aircraft, or why are there pink checkerboard textures on the inside of the cockpit?

Some files are shared between this product and the default aircraft in MSFS. The files are located within your existing installation by reference, so if you do not have the necessary default aircraft installed, you will not have an exterior model, some textures, or sound.

Why do I lose NAV radio reception when I turn off the COM radio?

This is an unfortunate limitation of MSFS at this time. It seems nobody anticipated having separate NAV and COM radio receivers. Luckily, nobody anticipated having more than three COM radios either, so the KNS-80 does not suffer from the same limitation.

Why does the engine not fail when limits are clearly exceeded?

The engine will not fail immediately upon limit exceedances, as is true of the real engine. Different engine parameters contribute differently to reducing the health of the engine. The

"Engine Stress Failure" option must also be enabled in the MSFS Assistance menu for the engine to fail completely.

Why don't the doors open?

Since this product uses the default exterior model for the King Air, it is beholden to the limitations of that model. Nothing can be done to add this functionality to a model that doesn't have it. Mods that create opening doors for default aircraft, like the C152 and TBM-930, either already have opening doors in the exterior model, or alter the exterior model, which cannot be distributed as part of a paid product.

Why can't the camera go into the aft cabin like the Caravan?

The bounding box used for the camera is part of the exterior model, which cannot be altered and redistributed as part of a paid product. It is very possible for modders to edit the default KINGAIR_350I_LOD0.bin to add this functionality by moving only six vertices. In the meantime, there is a workaround to set cockpit camera locations within the passenger cabin that is discussed on the official MSFS forums.

I have the TDS or PMS GTN 750 installed. Why do they not automatically show up on the panel?

The "automatic detection" of the TDS or PMS software refers to automatic switching between the freeware PMS, and the TDS or PMS payware products. There are six different choices for avionics available for this aircraft that must be manually selected with the two selector switches located to the right of the copilot's yoke. Your avionics selection is automatically saved and restored between sessions. For more information on selecting different avionics, see the "Avionics" section of this manual.

Why do I see ground power voltage when there is no GPU connected, and why does the EXT POWER annunciator blink?

In MSFS, ground power is always available when you are parked at a known parking location, and that parking location is equipped with ground power. The EXT POWER annunciator blinks whenever ground power is "available" to the aircraft, meaning that the ground power cable is connected to the aircraft; however, the aircraft is not electrically receiving ground power until the EXT POWER switch is placed in the ON position. The external power voltmeter will show a voltage anytime ground power is available to the aircraft so that the voltage can be confirmed to be within an acceptable range before electrically connecting the ground power to the aircraft's buses, and sensitive electronics.

Why do I see the same voltage on both the left and right generator buses when only one generator is online?

The King Air uses a five-bus system with the left, right, and center buses, sometimes connected through two bus-ties. When external power is applied, one generator is online, or the BUS TIE switch is placed in the MAN CLOSE position, both the left and right bus ties are activated, sharing voltage across all three buses. See the electrical schematics section for more details.

Why do the panel lights not work?

First, make sure the panel lighting master rocker switch on the overhead panel is in the ON position, and the dimmer knobs are set as desired. Next, make sure that both left and right buses are receiving power on the overhead voltmeter. For engine starting at night on battery power, ensure that the BUS TIE switch is in the MAN CLOSE position. See the electrical schematics section for more details.

Why does the aircraft only descend slowly in DSC mode?

Descent mode is essentially flight level change. The aircraft will pitch for a descent rate that produces an airspeed approximately 10 kts below the current barber pole speed. To increase your descent rate, reduce your power setting until you achieve the desired vertical speed.

Why is the autopilot behaving strangely, not changing modes, or not capturing altitudes?

This, and many other aircraft, recently required updates to make them compatible with the new Working Title GNS 530, which is available in the in-game marketplace. This GPS caused significant unintended consequences with hot-swappable avionics, such as are in this aircraft. Please make sure that you have updated all the avionics packages that you are using, including the TDS GTNxi 750, the PMS50 GTN 750, and the WT GNS 530. As of v1.3 of the Analog King Air, these systems should all be working well together. Please see the changelog and "Third Party Navigation & GPS Systems" section of this manual for more information.

Change Log

v1.0 - Initial Release (Changes from Preview Build)

New Features:

- Possible CTD causing variable noted by forum user Nicotine70 in the Analog Caravan preemptively eliminated in the King Air. A note to other developers: Apparently, MSFS does not play well with the Simulation Variable "WINDSHIELD WIND VELOCITY". Although it is documented in the SDK, it is not used anywhere in the vanilla codebase. There are several suitable alternatives for this value, such as "RELATIVE WIND VELOCITY BODY Z".

- Complete Climb and Descent Profile Modes. Descent mode will now continuously increase target indicated airspeed to follow the barber pole. Climb mode will now target the following climb profile: 160kts to 10,000ft, 140kts to 20,000ft, 130kts to 30,000, and 120kts above. Selecting manually changing target airspeed with the rocker switch, or with the CWS yoke-mounted button will exit either profile mode and enter IAS Hold mode.

- New aerodynamics and engine performance configurations contributed by JayDee. Single engine climb performance is improved, as a result. Best single engine climb performance is now achieved at +/-5 kts of the marked blue line speed.

- Battery voltage drop now simulated. Large DC loads will pull down voltage.

- Left/Right/Center bus overhaul and Left/Right/Center bus diodes to the Triple Fed Bus implemented. Battery bus tie controller and battery relay are now properly implemented. Electrical schematics updated to reflect diode placement.

- Airspeed hold mode on autopilot mode controller.. Pressing "IAS" will hold the current airspeed in a climb or descent. Remember that the King Air does not have auto-throttle, so the only method the autopilot has of controlling airspeed is pitch. Holding airspeed can be adjusted via the rocker switch on the mode control panel, as with other modes. Recall also that climb and descent modes are simply managed airspeed hold modes.

- Locking toggle switches animated with locking spring action.

- Radio background materials. Unlit digits and segments are now visible when equipment is off, and vary in appearance with viewing angle. Individual electrical traces are also visible.

Bug Fixes:

- Torque bloom calculations were causing artificially limited torque at high dynamic pressures. This is now fixed, and has improved fuel flow at high altitudes, and single engine climb performance.

- Automatic load shedding on dual generator failure fixed. Bus Tie Man Close switch position for nighttime start will now have the correct effect. Tip: Man Close at night is used to enable all interior and exterior lights, some of which derive power from left and right generator buses. External power will also now close the generator bus ties.

- Battery voltage curve adjusted to better match lead-acid performance, and battery voltage pulled up to bus voltage when connected through battery relay.

- Hot battery bus emergency disconnect switch behavior corrected.

- Battery Bus Tie now disconnects Triple-Fed and Center bus during bus sense test or fault. This allows for full bus isolation in case of a fault.

- Voltage meter needle no longer reads zero for all buses during battery failure.

- Propeller Amps and AC Multimeter continue to read when battery is discharged.

- Inertial separator torque reduction is now applied smoothly as the baffles are moved into position, instead of all at once at the end.

- EXT POWER annunciator now blinks when external power is available, but not on.

- Yoke Chronometer 1's minute digit fixed when elapsed time is over 10 minutes.

- Ensured the default "Autopilot Engaged" sound will not be heard.

- Connect gyro sound to turn coordinators instead of battery master.

- Interior bounce lighting no longer tied to "GENERAL PANEL" circuit.

- Light potentiometer default values (instead of zeros) load when starting from cold and dark.

- Improved battery emergency disconnect logic.

- CTL32 navigation radio active tuning mode will deactivate after 10 seconds.

- Decision height indicator brightnesses adjusted.

- DME data displays tweaked to eliminate false readings or maximum values when no signal.

- Remote compass controller model corrected so that the needle moves, and not the scale.

- Autofeather performance improved in very cold weather. Previously, autofeather may have disengaged when gas generator RPM was still within acceptable range.

- "CONDITION LEVERS - HIGH IDLE" added to Takeoff (Cleared) checklist to remind users, although this is absent from most actual King Air checklists. The PT6 engine condition lever only adjusts idle gas generator RPM in the real world, also affects the throttle set-point in the simulator.

- Panel integrity lighting missing on some load-shedding indicator rings fixed.

- Manual updated with all new features and screenshots.

V1.1 - 48-Hour Update

New Features:

- Note on MSFS generator limitations added to operating tips in manual. The underlying MSFS alternator/generator logic is faulty for free turbine engines, and will improperly limit generator output when the propeller is in feather. To ensure the battery is charged on the ground, take the propellers out of the feather detent, and monitor battery charging with the overhead ammeter. This bug must be corrected in MSFS by Asobo.

- Generators will not go online after resetting them if its starter motor is running, and generators will be tripped offline if its starter motor is activated. This will help prevent the occurrence of users leaving the starter energized long after the engine has started, and encountering a "GEN OVHT" annunciator, subsequently burning out the starter-generator, and damaging the electrical system, causing a bus fault to be detected. This is the only condition that can result in "GEN OVHT" illuminating. It does not indicate a starter-generator failure, but that one will result if the starter motor is not disengaged in approximately another 30 seconds of use.

- Redesigned pressurization controller to be fully vacuum actuated. The system now properly emulates the two valve (outflow/dump and safety), of the real aircraft. The system will now continue to function without electrical power, except for activating dump valve on landing. Cabin climb rate will also now gradually round off when approaching zero pressure differential. Hysteresis for high pressure differential safety valve actuation is overridden by a lower target altitude setting.

- Improved aerodynamics and performance by JayDee. The aircraft now have no acceleration on the ground when the throttle input is zero with standard bindings. This corresponds to a minimum power lever setting in the ground idle range while taxiing. Climb performance has been slightly reduced, reverse thrust power has been significantly reduced, new moments have been calculated to give the aircraft a slightly heavier feel, and adjustments made to the flap drag and lift coefficients to improve the accuracy of stalling speeds.

- Panel.noreg now included in the main package folder for livery creators. If you wish to create a livery mod that does not use the default, dynamically generated tail number on the exterior, simply use the line, "Panel = \..\..\bksq-aircraft-analogkingair\panel.noreg" in the livery's aircraft.cfg.

- Several new Frequently Asked Questions (FAQ) added to this manual.

Bug Fixes:

- External power cable would sometimes appear when opening cockpit windows. External power and fuel hose are now correctly coded to interact with the exterior model.

- The risk of causing a starter-generator overheat by leaving the start switch engaged when the engines are running has been reduced by 95%.

- TDS GTNxi power is currently connect to the center bus power, which can cause inadvertent reboots. The developer of the TDS GTNxi is working on a patch that will implement custom circuit settings, allowing the TDS to behave properly in the Analog King Air. This should not affect the GTNxi during normal flight operations.

- SU10 ground handling parameters are now in the correct section of flight_model.cfg.

- Triple-Fed Bus voltage is now ~0.8V lower than supply voltage due to voltage drop across the diodes feeding the Triple-Fed Bus.

- Fuel Pressure Low annunciator lights will remain illuminated when their associated firewall valve is closed, and standby fuel pumps are activated.

- Battery voltmeter will read zero when the battery emergency switch has been activated with no other sources connected to the battery bus.

- Livery Example aircraft.cfg typo changed from "caravan" to "kingair".

V1.2 - Fuel System, Pressurization, Bus Tie Logic, and SU11 Compatibility

New Features:

- SPECIAL THANKS TO JAYDEE AND NICOTINE70 – When v1.1 was released, there was a bug that would prevent the engines from starting. This was the result of an undocumented change to the engines.cfg file in SU11 Beta, which all the developers and testers of the Analog King Air just happened to be subscribed to. This allowed the bug to go unnoticed until release. As soon as the bug was reported, it took the hard work of my volunteers, and cooperation of many on the forums to find the error, and fix it. We are very sorry for this interruption in your enjoyment of the Analog King Air, and hope that you will now be able to enjoy the new v1.2 features and improved flight characteristics in this aircraft.

- New aerodynamics and engine performance that take full advantage of the SU10 propeller modeling. Propeller disk braking in flight is much more noticeable. Idle thrust on the ground is more subdued. Increased drag in flight results in more manageable approaches and landings. Reverse thrust tweaked for POH stopping performance. Starter spool-up time is more realistic. Propeller RPM during starting matches real world examples. The combination of increased drag and corrected barber pole speed (see below), should drastically improve the flying experience.

- Total overhaul of fuel system. Users can now expect very accurate behavior of the fuel system with regards to jet-pump fuel transfer, motive flow valve actuation, crossfeeding valve behavior, and crossfeeding logic. Crossfeeding procedures have been updated in the checklists, and a narrative has been added to the Fuel Quantity Indicators manual section.

- Pressurization system refinement. The manual dump valve is now also electrically actuated. Single engine operation will reduce the pressurization system's performance by approximately 30%. Pressurization bumps when operating at the maximum pressure differential are not as severe, and should be managed before activating the cabin high differential pressure warning.

- New Pressurization Related Failures! CABIN SAFETY VALVE, CABIN OUTFLOW VALVE, INFLOW CONTROL UNIT, and DOOR SEAL failures.. As part of the new pressurization system, you can now manage a number of pressurization related anomalies. How will you handle an unlikely combined outflow and safety valve failure at altitude? Loiter at lower altitudes letting pressure escape through the cracks? Try opening a window?

- Cockpit windows can no longer be opened at cabin differential pressures above approximately 2.5 psi. This would require roughly 140 lbs of force to open. The animation position of the door can be used to approximate the cabin differential pressure. Windows will now also vibrate in the wind.

- CABIN DOOR annunciator is no longer connected to cockpit windows, as it is now connected to the DOOR SEAL failure.

- Second high altitude warning added. The same warning horn will sound when passing ~10,000ft will sound again when passing ~12,000, and is canceled by the same button.

- Added support for WTT Autopilot Mod. A separate package is required to use WTT mode, available at pms50.com/msfs/. This mode limits radio equipment selection to the PMS50 GTN-750 GPS, which is a limitation of the WTT Autopilot System.

- Voltmeter select knob now spring loaded to return to triple fed bus from battery bus.

- New exterior lighting with incandescent color, and brighter landing and taxi lights.

- Recessed lighting added to the pressurization controller.

- Cockpit bounce lighting increased slightly to make dark areas more visible.

- Engine Fires are no longer recalled at the beginning of a flight like the rest of the failures, so alarms will not sound if you had an unresolved engine fire at the end of your last flight.

Bug Fixes:

- The emergency SU11b fix for v1.1 introduced an undesired condition where the engines would produce substantial thrust when condition levers were set to high idle. This has been corrected with the new performance configurations.

- Barber Pole Speed fixed. Previously the barber pole began decreasing to the FL350 limit of ~192 kts from sea level. This gave the impression of too much power at the mid-level altitudes, with the aircraft easily able to exceed its VNE speed. Now the barber pole does not decrease until FL210, which corrects this apparent performance flaw. You will even get to your destination faster now, too!

- No window opening sound attenuation bug was accidentally reintroduced in v1.1. This has been fixed again.

- Fuel Quantity Test switch position will now illuminate the low fuel quantity annunciator lights, and not change fuel quantity gauge indications.

- No Fuel Transfer annunciator lights will illuminate when the engine ignition system is activated on the same-side engine.

- L/R Low Prop Pitch annunciators now properly connected to the Right Bus for power, and are inhibited when the propeller is feathered, and when the aircraft is in flight.

- Bus Tie switch is now momentary in the MAN CLOSE position, and the MAN CLOSE annunciator will only be illuminated when battery power is being used to hold the generator bus ties closed.

- ITT curve increased by ~35 °C. ITT will now be more limiting on high performance takeoffs and high ambient temperature cruise.

- Crossfeed valve circuit breaker will now disconnect the solenoid valve from all buses, not just the triple-fed bus.

- System will not go dark if the bus ties are manually opened when both propellers are in feather. This was due to the custom implementation of the triple fed bus diodes and the MSFS bug where generators on free turbine engines do not produce electrical power.

- DC Load Meters would incorrectly fail when power was lost to the center bus.

- ADI-85A is now electrically powered, rather than vacuum powered.

- Instrument air supply connected to both engines, not just left.

- ADI-85A ATT and CMD flags were accidentally reversed in the model file.

- Manual note added to CTL-22 COM Radio systems guide: "NOTE: Pressing the inner dual concentric rotary encoder knob will toggle the radio's 8.33 kHz tuning mode for compatibility with European frequencies. The text "8.33" will be shown on the CTL-22's display when this tuning mode is active. For your convenience, COM3 on the pedestal defaults to 8.33 kHz mode."

- SU11 localization compatibility.

- Manual updated to reflect all changes. Now over 100 pages long. Happy reading!

V1.3 - Working Title GNS Support, Autopilot Usability, HTML Failures, Nav Signal Degradation & Aesthetics

New Features:

- **Full Working Title (WT) GNS 530/430 compatibility.** The new WT GNS entered public beta via the in-game marketplace shortly after version 1.2 of the Analog King Air was released. This replacement GNS GPS system offers many advanced features that will be enjoyed by many serious simmers. Unfortunately, these features proved difficult to integrate fully with the Black Square aircraft due to their hot-swappable avionics. After several months of incremental patches, this aircraft now fully supports the new GPS. **This was a laborious joint effort between TDS, PMS50, and Working Title developers. Thank you for your patience, and thank you to those who made it possible.** The WT GNS is still in active development, so there may be changes to functionality, and the possible introduction of bugs. Black Square and Working Title will continue to work together to ensure that there is as little interruption to service for this fabulous new GPS offering as possible. See the "Third Party Navigation & GPS Systems" section of this manual for more information.

  IMPORTANT: Please be sure to update all three GPS addons before trying to use this aircraft! If any of the three GPS addons are outdated, they may affect the others, even if they are not currently selected in the cockpit.

- **Optional autopilot mode control panel added to the main panel**, just above the attitude indicator. Some users have complained that the standard autopilot control panel

on the pedestal is difficult to access quickly. To alleviate this, an optional autopilot mode control panel can now be accessed by clicking on the main panel's autopilot annunciator panel. All autopilot mode controls are duplicated, with the exception of the yaw damper, softride, half bank buttons, and roll hold knob.

- **A new interface into the failure system** has been provided in all Black Square aircraft for those wishing to trigger failures from external applications. Simple HTML events can now be sent from Air Manager, Axis and Ohs, and many more, including payware instructor stations, and even your own custom web interfaces. To learn more about this new feature see the "Failure System HTML Interface" section of this manual.

- **VOR and ADF receivers now exhibit mathematically accurate signal attenuation and noise** based on the aircraft's height above the terrain and distance from the transmitter. This should greatly improve the feel of radionavigation in a flight simulator. For more information, see the "VOR & ADF Signal Degradation" section of this manual.

- **Custom propeller disk textures.** Vast improvement over default FSX-style textures. The default King Air 350i is not affected, and livery mods require no change.

- **Engine and wind sounds have been added to the interior when the cockpit windows are open.** Due to the limitations of the default aircraft's sound system, this solution is not perfect, but it should be more immersive than before. This will be the standard for new Steam Gauge Overhaul aircraft, and will sound even better in future aircraft.

- Have you ever noticed that the wind sound in all other MSFS aircraft is erroneously based on true airspeed rather than indicated airspeed? This makes wind noise during high altitude cruise far too loud. It's likely the result of there being no persistent indicated airspeed simulation variable that is not affected by pitot-static failures. **All Black Square aircraft now have wind sounds based on indicated airspeed**, which makes them much more enjoyable to fly at high true airspeed.

- **New handcrafted 4K window surface imperfections.** Scratches and smudges are slightly less pronounced than default, but the high resolution results in minimal tiling, and a much more pleasant experience during low sun angles and with VR.

- COM 3 audio and ADF 2 identifier audio may now be toggled on and off with the two push buttons adjacent to the ADF 2 radio on the pedestal. For those flying with online ATC, especially with VPilot, there is a bug in the application that requires the audio for ALL radios to be receiving to successfully monitor COM 1 & COM 2.

- Autopilot engagement is now MUCH smoother, with the aircraft maintaining its present attitude unless commanded to do otherwise. The PID reset mode is set to "current aircraft state" now, which resets the integrator upon engagement.

- Pressing the center dual concentric knob on the CTL-62 ADF receivers will increment the tuned frequency by 0.5 kHz. While this is not necessary in the real world due to the large bandwidth of ADF signals, this will allow users of MSFS to tune NDB's with 500 Hz frequency spacing.

- Increased the performance of the master battery controller. Power will now be supplied to the buses instantaneously when activating the battery master switch.

- Tertiary mouse click on heading knob will set the bug to the aircraft's current heading.

- Electric trim switches will now only actuate trim when the electric trim switch is on, and the circuit is receiving power. Electrical current draw is now indicated when the electric trim and other autopilot servos are in use. Disrupting power to the pitch trim circuitry will also cause the autopilot to disconnect, and it will not engage again until power is restored to the pitch trim circuitry.

- Better interactions for home cockpit builders. All essential switches for operation should have an associated variable, and the switch position should change with this variable.

- The autopilot will now disengage if the electric pitch trim switch is not on, or the system is not powered. The red "TRIM" indicator on the autopilot now warns of this condition.

- Checklists updated with a procedure for testing the function of the autopilot roll actuators in the runup checklist. When the autopilot is engaged on the ground, heading mode will attempt to follow the selected heading with yoke movement, just like in the real aircraft.

- Slightly dimmed GNS 530 screen backlighting at night.

- Slightly darker panel color. Text is more legible now, and easier on the eyes.

Bug Fixes:

- New failure menu blinking cursor method. On some systems, there is an HTML rendering bug that will not blink the cursor with CSS animations, despite this being the recommended method used throughout MSFS. There is a workaround, and cursors should blink regardless now.

- Left turning tendency of the default aerodynamics has been abandoned. The aircraft will now climb straight ahead with no need for aileron trim.

- Propeller disk braking effect increased at low power settings, and consequently, low power thrust reduced while taxiing. Reverse thrust has also been further reduced.

- Amber BLEED AIR annunciators will now illuminate when their bleed air switch is in the ENVIR OFF position. This should help users identify when the cabin environmental control system is not operating, and when heat and pressurization are not available.

- Amber AUTOFTHER OFF annunciator will only illuminate when gear is down and locked

- Torque bloom effect reduced from 10% to 5% based on pilot reports.

- GNS 530 push button click sounds restored.

- Yaw Damper indicator on main panel autopilot mode annunciator will now illuminate.

- Airspeed indicator approach flap airspeed marker moved from 222kts to 202kts.

- Panel.noreg has been restored to the package folder. The condition that caused this to happen in the first place has also been remedied.

- The EXTINGUISHER PUSH light will now not illuminate when a fire is detected, but only when the corresponding firewall valve has been closed, arming the fire bottle.

- Propeller RPM spike on touchdown reduced to negligible effect.

- Reminder to close cockpit windows prior to pressurization test added to checklists.

- Primary flight display's DME and Time-to-Go information will now flag to "----" when the number displayed is limited to 999.9.

- Cabin temperature monitor unit will now be saved between sessions.

- Cabin Master Switch tooltip corrected from "Aft Blower" to "Cabin Master".

- Fixed incorrect default tooltip for the OAT monitor.

- Fixed about a dozen spelling and grammar errors in the manual, generally tidied things up, and added a few clarifying statements in the systems guide.

- L & R Ignition pedestal annunciator will now illuminate when the engine start switches are placed in the "Ignition and Start" position.

- Secondary radar altimeter test will now work while in flight above 3000 feet.

- Aircraft selection menu cruising speed corrected from default to 312 KTAS.

- Possible VR collision issue fixed. The PANEL_COLLISION object was not correctly named, which acts as a sort of backdrop for the VR cursor, making it easier to interact with controls on the various surfaces inside the cockpit.

- If you are having ITT spikes over the starting redline on every start, wait for the starter to accelerate the gas generator to its maximum sustained RPM, not just 12%. The 12% Ng stated in the checklist is the minimum possible starting RPM in some operating conditions, not when fuel should be introduced before the RPM has stabilized. The engine starting checklist items have been changed from "Low Idle Stable above 12% Ng" to "Low Idle Max Ng Above 12%" to encourage best operation.

- Windshield and Airframe deicing is verified to be working properly in SU11 Beta. Windshield and pitot-static deicing work continuously, and slowly. Airframe deicing is provided by pressurized boots, which are toggled with the "Surface Deice" switch. Both the "Single Cycle", and "Manual" positions will trigger one cycle of deicing to clear ice. The switch must be toggled every time ice is to be cleared. Notes on ice mitigation have been added to the "Tips on Operation within MSFS" section of this manual.

- A handful of users have reported stuttering while in flight (as soon as the aircraft leaves the ground), while the majority have reported that the aircraft is light on frames, as it was designed to be. Several of these users have been able to isolate their stutters to the PMS GTN 750, or other mods that affect all aircraft, not just the Analog King Air. There is no behavior programmed into the Analog King Air that changes when the aircraft leaves the ground, which provides some evidence for the previous claim.

- A possible bug in the RNAV system was explored. In summary: The RNAV behavior is accurate to the real world, and matches the indications from a simultaneously monitored VOR. The apparent angular error is introduced by VOR stations with declinations where the real magnetic variation has drifted significantly since their installation. In the real world, this is most likely disregarded as a wind correction angle, but absolutely affects real aircraft. This is not an error in the operation of the RNAV system, and the courses to RNAV waypoints should be flown as they would be to any physical VOR in the real world. For VOR's with inaccurate magnetic declinations, the actual magnetic bearing to the station is the flown course that produces a centered CDI in zero wind conditions, regardless of the OBS setting. More information is available in the Analog Caravan topic on the official MSFS forums.

Credits

Analog King Air	Nicholas Cyganski
Publishing	Just Flight
Manual	Nicholas Cyganski
Testing	Just Flight Testing Team

Dedication

Out of all my aviation heroes, I thought it would be most appropriate to dedicate the King Air to a couple by the same name, John and Martha King. John and Martha have been a staple of aviation training in the United States and beyond for almost a half century, and were instrumental in countless pilots' education and enthusiasm for aviation, including my own. The couple is the only ever to both hold every category and class of FAA pilot's and instructor's certificates, and were inducted into the International Air & Space Hall of Fame in 2008. John and Martha have a history with flight simulators as well, possessing starring roles in Microsoft Flight Simulator 2000, 2002, and 2004, alongside another aviation legend, Rod Machado.

With John and Martha featuring so prominently in my aviation training and flight simulator experience, I am greatly saddened that fewer and fewer young aviators recognize the King Schools jingle and the friendly faces of John and Martha King, since gravitating towards less polished aviation training content available for free on the internet. With any luck, learning to fly some of the 90's and 2000's vintage equipment in my analog aircraft will vector newcomers to flight simulator and aviation towards John and Martha's content, as I believe they are the undisputed masters of aviation education, and always will be.

Copyright