King Air

A MAGAZINE FOR THE OWNER/PILOT OF KING AIR AIRCRAFT

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EDITOR
Kim Blonigen

EDITORIAL OFFICE
2779 Aero Park Dr.,
Traverse City MI 49686
Phone: (316) 652-9495
E-mail: editor@blonigen.net

PUBLISHERS
Dave Moore
Village Publications

GRAPHIC DESIGN
Rachel Coon

PRODUCTION MANAGER
Mike Revard

PUBLICATIONS DIRECTOR
Jason Smith

ADVERTISING DIRECTOR
Jenna Reid
King Air Magazine
2779 Aero Park Drive
Traverse City, MI 49686
Phone: 816-699-8634
E-mail: jenna.reid@vpdcs.com

ADVERTISING ADMINISTRATIVE COORDINATOR AND REPRINT SALES
Betsy Beaudoin
Phone: 1-800-773-7798
E-mail: betsybeaudoin@villagepress.com

SUBSCRIBER SERVICES
Rhonda Kelly, Mgr.
Jessica Meek
Jamie Wilson
P.O. Box 1810
Traverse City, MI 49685
1-800-447-7367

ONLINE ADDRESS
www.kingairmagazine.com

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COVER PHOTO
Courtesy of Ray Briers

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A Great Firs

Ray Briers, 53, started flying when he was 26 years old and has accumulated about 1,500 hours, flying a mix of business and recreational trips from Houston Southwest Airport (KAXH).

t Impression

B100 captures the heart of the Briers Family

by MeLinda Schnyder

When Ray Briers returned from a trip to the Bahamas with his family earlier this year, his team at The Pipe Yard, Inc.—the pipe purchasing and cleaning company he owns near Houston, Texas—fell in love with a photo Ray showed them.

It wasn't one of the images showing the family having fun among the beautiful turquoise waters and white sand beaches that Staniel Cay is known for—though, those photos were stunning—but rather a photo of 2½-year-old Geddy Lee Briers strapped in his car seat in the cabin of his dad's 1978 Beechcraft King Air B100.

"During the flight to Exumas in the Bahamas, Geddy decided to relax and look through King Air magazine," Paulina Biscamp, who works in accounting at The Pipe Yard, wrote in an email that included two photos of Geddy Lee looking captivated by the magazine. "These pictures are priceless and we wanted to share them with the staff of King Air magazine!"

Geddy Lee is named after the lead singer of the rock band Rush, one of his dad's favorite bands. Ray says his son loves opening our magazine, not just any magazine, and looking at all the pictures.

Ray Briers regularly flies his King Air B100 across Texas and in and out of Louisiana, Arkansas, Oklahoma and New Mexico for work related to his companies, The Pipe Yard and Credo Services LLC.

"Even in my car, Geddy is super intrigued when he spots my King Air magazine on the seat near him. I'm guessing it's because he loves to fly," Ray said.

Fortunately for Ray, all his children have loved to fly with him. He has daughters Carolinn (23) and Skylar (17) from his first marriage, stepson Colton (13) and Geddy Lee with wife Jessica.

Now 53, Ray started flying when he was 26 years old and has accumulated about 1,500 hours over the years, flying a mix of business and recreational trips from his homebase at Houston Southwest Airport (KAXH).

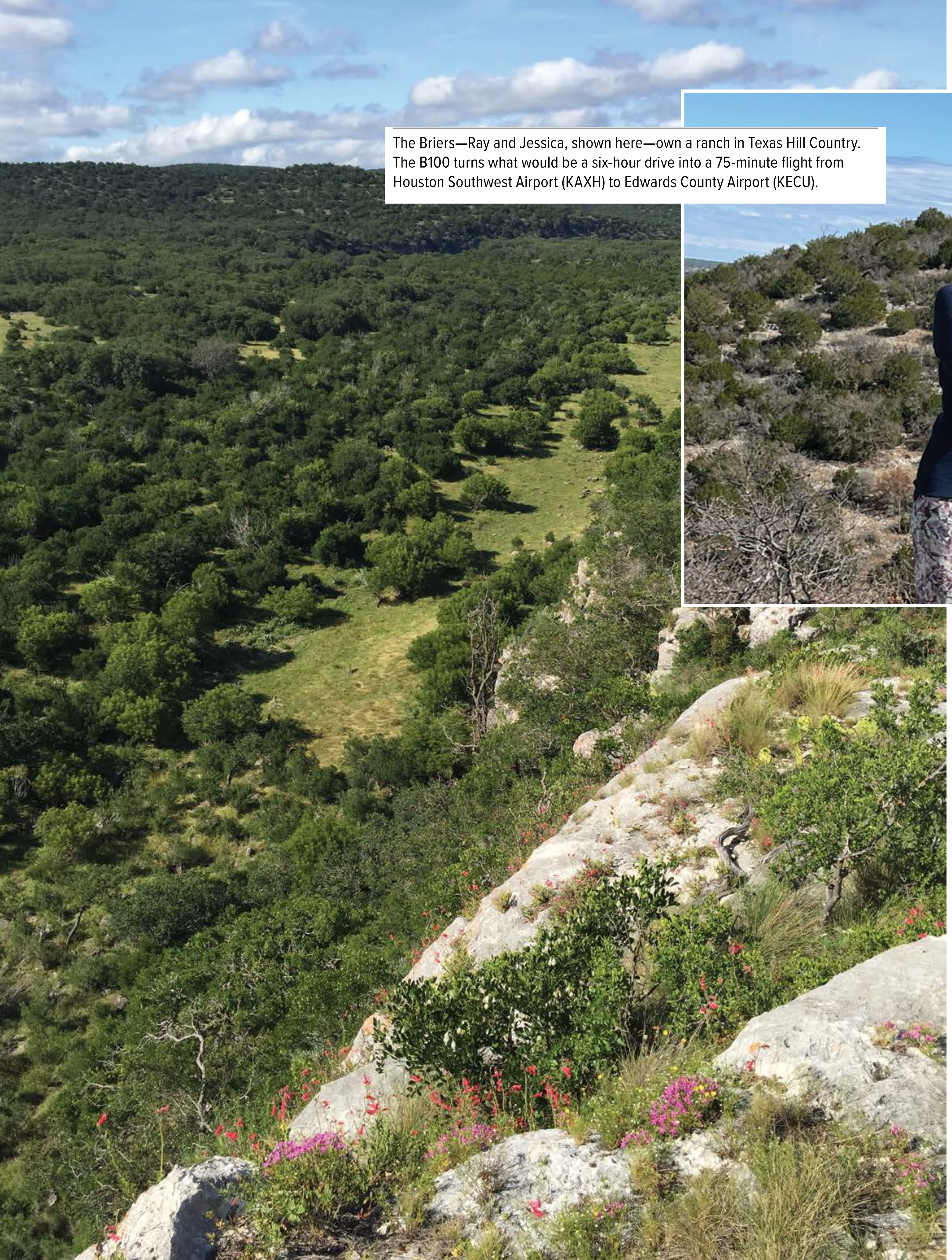
Encouraged to Fly

Ray earned his private pilot certificate in 1997, becoming the first student of a friend who had recently become a flight instructor. He was encouraged by his family, too.

"My uncle was a pilot, and I remember that my dad had an airplane at some point when I was growing up but he was never a pilot," he said. "My dad regretted never learning to fly and told me I should do it while I had the chance. So, I did. I completed my complex and high performance training right after getting my private, and then jumped right into getting my multi-engine rating. I flew multi for probably 10 years without my IFR certification, and then I went back and got my IFR."

He received a tailwheel endorsement and tried some aerobatics early on, but said, "I knew my goal was always to go farther, faster and with more weight so a twin engine airplane was the direction I went in."


GARMIN
AUTOLAND



The Briers—Ray and Jessica, shown here—own a ranch in Texas Hill Country. The B100 turns what would be a six-hour drive into a 75-minute flight from Houston Southwest Airport (KAXH) to Edwards County Airport (KECU).

In 1999, he bought his first airplane, a twin-piston Piper PA-23 Aztec, which he replaced in 2006 with a Cessna 421.

"I loved the 421, but it has those geared engines and it was a complex airplane to fly with one pilot," Ray said. "I'd heard a lot of good things about the turbines and how stable they are, so I bought the B100 in 2018 as my intro King Air. I've loved it, and I'll buy another one."

'A Great Introduction'

Looking back on the past six years of flying the B100, Ray admitted he's not sure why he bought the airplane.

"It's been such a great airplane for us, though, that I'm glad we did," he said. "The B100 really has been a great introduction to being in a turbine aircraft."

He was in the market for a King Air B200 when he came across N519RR in east Texas and couldn't pass up the good buy.

"The initial cost of the B100 was so much less than the B200, so we went and looked at it," Ray said. "The cabin was the same as the B200 and this airplane had the -10 engines. We get 250-260 knots regularly with those -10s, up to 280-320 with a tailwind."

If you're wondering, as we were, if the large R on the tail matching the signature Beechcraft B font is Ray's doing, it's not. Like the tail number, it came with the aircraft when he bought it in 2018. He's not planning any unnecessary modifications since he's already decided to upgrade, likely a newer B200 model.

Instead, he's enjoying accumulating hours in the King Air, ranging from personal flights to business travel, flying single pilot and occasional flights with Chris Prause, who is a minority owner at The Pipe Yard and a pilot and certified flight instructor.

Work missions include industry conferences and customer meetings related to The Pipe Yard, which sells new, used and surplus steel pipe and offers remediation services to customers in the oil and gas, petrochemical and energy industries. They also fly for projects involving their ancillary business, Credo Services LLC, a pipeline integrity service company offering a variety of inspection services. This work regularly takes the King Air across Texas and in and out of Louisiana, Arkansas, Oklahoma and New Mexico.

Earlier this year, Ray Briers flew his 1978 Beechcraft King Air B100 to the Bahamas for the first time. With rain on departure day, he said he was happy to be flying the King Air.

Briers regularly flies his King Air B100 across Texas and in and out of Louisiana, Arkansas, Oklahoma and New Mexico for work related to his companies, The Pipe Yard and Credo Services LLC.

This trip to Nashville, Tennessee, is one of many Ray Briers has made in the King Air B100 for customer meetings and to attend conferences in the oil and gas, petrochemical and energy industries from his homebase near Houston, Texas.

According to his dad, Geddy Lee Briers, 2 ½ years old, loves to pick up *King Air* magazine anytime he sees a copy.

Most personal flights in the King Air take family and friends back and forth from Houston's KAXH to KECU, Edwards County Airport on the western edge of Texas Hill Country. The Briers own a ranch in Rocksprings, which would be about a six-hour drive instead of a 75-minute flight in the B100.

"I have also been to many places from California to Florida on pleasure trips with my family," Ray said. That includes flying to Tempe, Arizona, while his daughter was attending Arizona State University (she now works for The Pipe Yard). And, of course, his first time flying the B100 to the Bahamas earlier this year, with Chris as co-pilot.

"Being able to fly ourselves in and out of those small islands makes owning a King Air worth it," Ray said. "We were thoroughly pleased with the B100's performance down there. The King Air did wonderful with seven of us onboard with luggage and going into a 3,000-foot runway with a cliff on one side. The weather was great during our trip but it was raining that last day so we went IFR leaving, and the B100 was a great airplane to be in." KA

"My dad regretted never learning to fly and told me I should do it while I had the chance. So, I did. I completed my complex and high performance training right after getting my private, and then jumped right into getting my multi-engine rating."

Preflighting and Preventative Measures

by Dean Benedict

Let's talk about your preflight routine. Did you know there are some simple tasks you can add to your preflight checklist that could ultimately save you thousands of dollars in maintenance costs? Your flaps are one example—do you check your flaps regularly?

Remember the old adage: "An ounce of prevention is worth a pound of cure." That's especially true in aviation maintenance because when preventive measures are not taken in time, the cure weighs much more than a mere pound. It's, unfortunately, more like a ton.

Playing With Flaps

What's the first thing I do when I walk up to a King Air? I check for play in the flaps. Most likely they're in the "up" position, so I wiggle the trailing edge up and down a little bit. If the flap is rigid with no play at all, it is a red flag. I'm looking for a little bit of movement.

Next, put the flaps in the "down" position and do the same thing. You want the same outcome as in the up position. Wiggling the trailing edge up and down, you are looking for about a quarter-inch of movement. The down position check is the most critical, as you never want to be stranded in the boondocks with your flaps stuck in the down position!

A rigid flap is usually bottomed out in the flap track. If not detected and remedied, this will cause the flap flex shaft to fail and/or the flap motor to jam or burn up. These expensive problems are easily avoided by regularly checking for a little play in your flaps.

Limit Switches Have Limits

A flap that bottoms out in the flap track has limit switches out of rig. The righthand (R/H) inboard flap is the "master" flap on all King Airs, and on many models the limit switches are found there.

You can see them with your flaps in the down position. On some older King Airs, the limit switches are mounted on the flap track assembly. On newer King Airs, an arm runs a shaft with cams that activate the switches. The flap switch in the cockpit controls the flap motor and the limit switches prevent the flaps from moving too far.

Over time, as the linkage and bushings start to wear down, the limit switches go out of rig. A flap that bottoms out repeatedly will eventually break the flap flex shaft or burn up the motor and gearbox. Avoid these problems by checking your flaps regularly and alerting your shop at the first sign of flap stiffness. Bushings can be replaced and the cam or switches can be adjusted to stop the flaps a little sooner and prevent them from bottoming out. Crisis averted.

Watch Your Washers

While you still have your flaps in the down position, there is another thing to check: the Teflon® washer

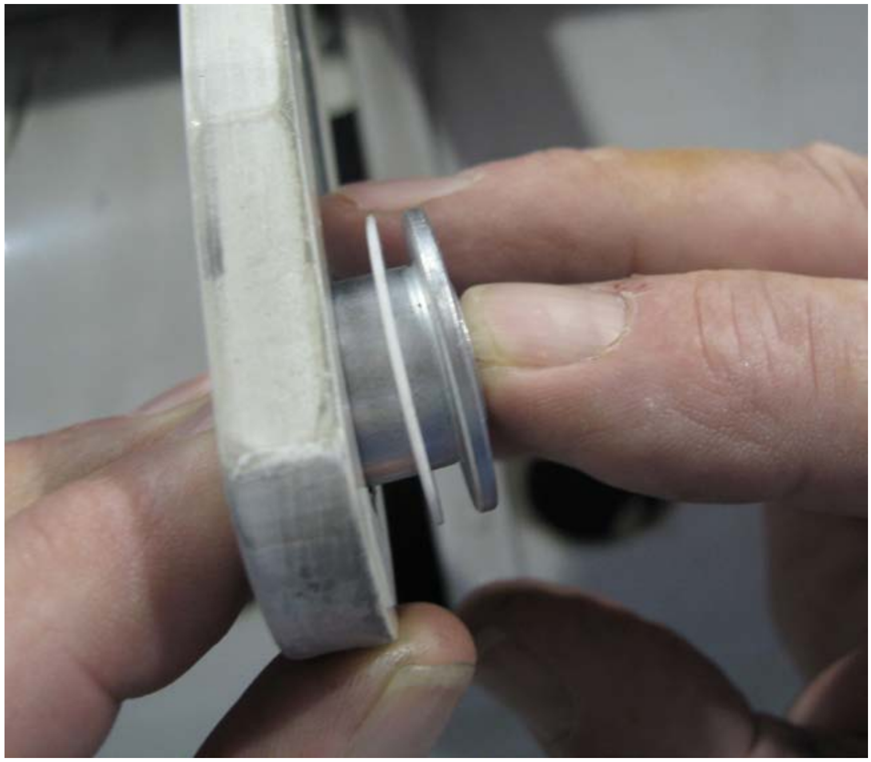


Figure 1: A close-up of the washer and roller bearing installed on the flap track assemblies. The Teflon washer is thin and white, and it's positioned under the thicker sliver roller bearing.

installed on each of the aft flap track roller bearings. Figure 1 (right) shows the thin, white Teflon washer positioned under the roller-bearing shoulder, which is thicker and appears more silver.

On King Air models 200/250 and 300/350, these washers are found in the outboard flaps only, nestled between each flap track and its corresponding roller bearing. On King Air 90s, both flaps on each wing have the Teflon washer setup. You can slide the flap slightly from side to side to get a better view of the washer. A flashlight may be helpful.

Figure 2: The wing flap in the down position is how you can check the flap track assemblies; they flank the central area of the flap as viewed from the trailing edge.

"Whenever I have the opportunity to walk around a King Air with an owner or pilot, I am forever checking flaps for play and more often than not, I find flaps that are too stiff!"

See the flap in the down position in Figure 2, above, and note the two flap track assemblies that jut out from the wing structure. They flank the central area of the flap. The correct positioning of the roller bearings and Teflon washers is relative to the center area of the flap as viewed from the trailing edge. The roller bearing is always between the flap track and the inside bracket adjacent to the center area of the flap.

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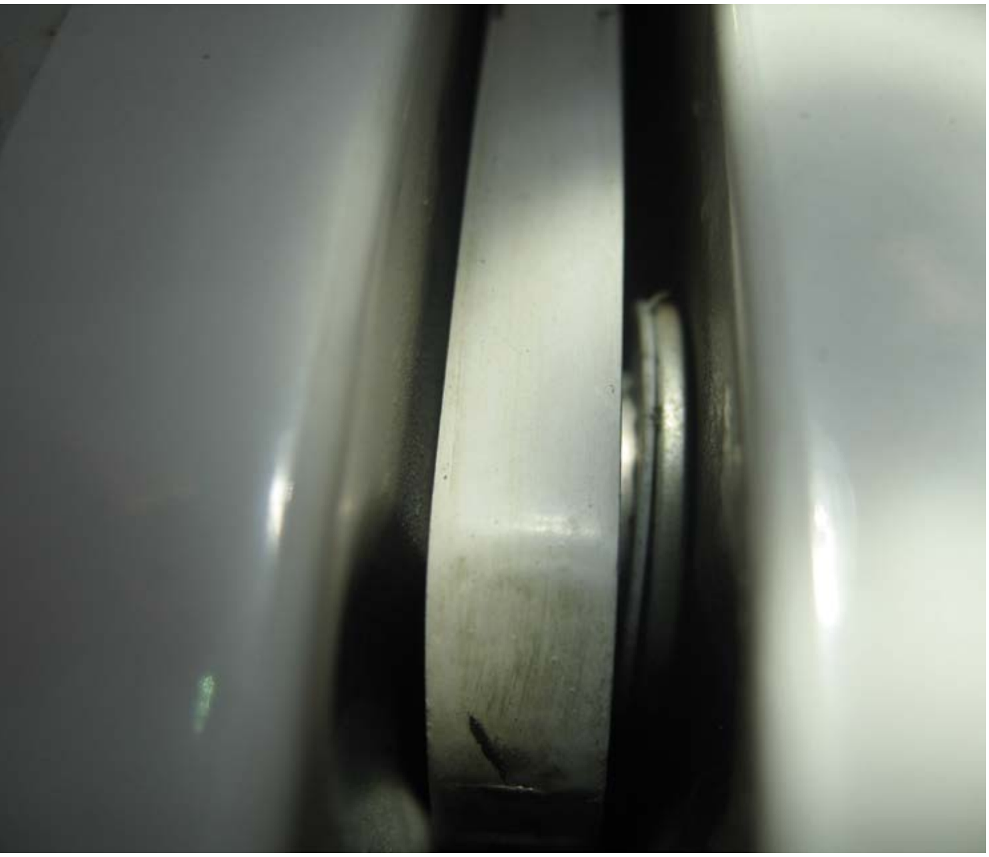
Figure 3



The left wing flap track in Figure 3 (top) and the right wing flap track in Figure 4 (bottom). Check them during your preflight routine to make sure the washers are there, positioned correctly and in good condition.

Figure 4

Figure 3, top left, shows the flap track to the left of the center flap area, with the roller bearing on the right side of the flap track, closer to the center flap area. The single Teflon washer is sandwiched between the flap track and the roller-bearing shoulder.

Figure 4, bottom left, portrays the flap track to the right of the center flap area. The setup is a mirror image of the other side—the roller bearing positioned on the left of the flap track, adjacent to the center flap area, with the Teflon washer installed between the flap track and the roller bearing.

What You Are Looking For

You want to see that: A) the Teflon washers are there; B) the washers are correctly positioned next to the flap track, under the roller bearing shoulder; C) there is only one washer per roller bearing; and D) the washers are in good condition (not warped or deformed, worn or discolored).

These washers keep the roller-bearing shoulder from gouging into the flap track. Repair or replacement of flap tracks is something you want to avoid. It is very labor-intensive, and the parts are crazy expensive. By comparison, those Teflon washers at less than $10 each are the bargain of the century. You can't afford not to check them!

It just so happens that the first article I wrote for this magazine in 2009 was on this topic of checking for play in your flaps as part of your preflight routine. Whenever I have the opportunity to walk around a King Air with an owner or pilot (such as at King Air Gatherings), I am forever checking flaps for play and more often than not, I find flaps that are too stiff!

The time it takes to check your flaps as I have described is a very small price to pay when compared to the alternative. If your flaps are bottoming out or those Teflon washers are missing or worn out, you are looking at thousands of dollars in parts and labor, plus downtime for your King Air. In this case, an ounce of prevention really is worth a ton of cure. So, give your flaps a little jiggle during your preflight routine and keep an eye on those washers.

Happy flying. KA

Note: Other flap-related articles can be found in May/June 2013 and October 2016 issues.

Dean Benedict is a certified A&P, AI with 50 years experience in King Air maintenance. He was an inaugural inductee to the King Air Hall of Fame. He owned and ran Honest Air Inc., a "Beechcraft maintenance boutique" with a strong following of King Airs, for 15 years. Currently, with BeechMedic LLC, Dean and his wife, Lisa, consult with owners, pilots and mechanics on King Air maintenance issues, troubleshooting and pre-buys. Dean performs expert witness work on request. He can be reached at 702-524-4378 or via email at dr.dean@beechmedic.com.

Deicing Safety Alert

The National Transportation Safety Board issued Safety Alert SA-097 ahead of winter in the Northern Hemisphere, reminding operators that flying in icing conditions can present operational risks, including the adverse effects of airframe and propeller icing on aircraft performance, which can make managing the airplane's flightpath and airspeed more difficult and can prevent the airplane from maintaining level flight.

As little as ¼-inch of wing leading-edge ice accumulation can increase the stall speed by 25 to 40 knots and cause sudden departure from controlled fight, according to the alert, which adds: Ice accumulation on pitot tubes can cause flight instruments to cease operating and can affect airspeed, altimeter and vertical speed indicators.

The NTSB says: Some pilots have been taught to wait for a prescribed accumulation of leading-edge ice before activating deice boots to alleviate ice accumulation on flight control surfaces because of the believed threat of ice bridging. However, performance degradation could develop if the deice boots are not activated as soon as icing is encountered.

The notice also warns that many pneumatic deice boot systems have no provision for continuous operation and require pilots to manually cycle the systems. Continuous use of the autopilot in icing conditions can deprive the pilot of the opportunity to detect the buildup of ice on the airframe through changes in longitudinal trim requirements and control forces.

What Can You Do?

- When operating in icing conditions, use the autopilot only as directed by checklists and aircraft manuals, which might call for periodically disconnecting the autopilot to better feel changes in the handling qualities of the aircraft.
- Maintain the recommended airspeed for flight in icing conditions as specified in the POH.
- Activate leading-edge deice boots and pitot heat in accordance with the POH.
- While icing conditions exist, continue to manually cycle the deice system unless the system has a provision for continuous operations.
- Review your POH for specific operational requirements to determine the most effective means of shedding ice.
- Closely monitor windshield, windshield wiper, engine air inlets and wings for ice accumulation, and do not hesitate to leave icing conditions as soon as possible to avoid ice accumulation.
- Be aware of the potential for icing conditions and use all checklists associated with operations in such conditions.

Source: National Transportation Safety Board

NTSB Special Investigation Recommends Safety Improvements for Part 135 Operators

A special investigation by the National Transportation Safety Board of more than 500 accidents involving Part 135 operations between 2010 and 2022 has resulted in the NTSB issuing three new and two reiterated recommendations to improve safety.

The investigation initiated in 2022 after a cluster of safety issues emerged from recent investigations of accidents involving Part 135 operators, including commuter air carriers, air tour operators, air ambulance services and on-demand business charters, among other operations. The report did not look at Part 121 major airline operations.

Safety issues explored in the report include:

- **Unsafe loading conditions**. Investigators cited four single-engine airplane accidents where unsafe loading conditions were identified. The NTSB said that a requirement mandating flight manifests and weight and balance documentation be recorded for all aircraft operated under Part 135 would help pilots detect and correct unsafe loading conditions. Such a requirement would also provide operators and inspectors the information needed to support proactive, comprehensive assessments to identify any related operational risk areas that may influence improper aircraft loading and mitigate them before an accident occurs.
- **Lack of certificated dispatchers for some operations**. The report identified 12 accidents in which flight dispatch and operational control were deficient because the personnel responsible for those areas were not certificated flight dispatchers nor did FAA regulations require them to be. The NTSB said that certificated flight dispatchers would expand the safety margins of many Part 135 operations because of improved quality control over functions such as preflight weather, fuel and route planning, active monitoring of conditions along the route of flight and timely notification of emergency response organizations if an aircraft is overdue.
- **Flight data monitoring**. The report noted that flight data monitoring programs could provide Part 135 operators with objective information on how their pilots conduct flights, and a periodic review of such information could assist operators in detecting and correcting unsafe deviations from company standard operating procedures.

The NTSB also called for needed improvements in the collection and reporting of aircraft accident and flight activity data used to determine accurate accident rates for certain segments of Part 135 on demand operations. The NTSB is pushing for enhancements to data collection so it can better target safety initiatives. The full Special Investigation Report AIR-24-03 is available at ntsb.gov.

Source: National Transportation Safety Board KA

King Air Electrical Systems Evolution

by Tom Clements

Obtaining a firm grasp on how a King Air's electrical system operates is one of the more difficult tasks that any new King Air pilot faces. Throughout the course of my more than 50 years of King Air pilot instruction, teaching the electrical system always ranked high on the difficulty scale, right up there with reversing propellers and their governors. Nevertheless, most pilots are indeed able to learn the system satisfactorily, so that they have a solid understanding of what to do when system abnormalities or emergencies arise.

Although all King Air models share many electrical system similarities, there are quite a few differences. I have often been asked why a particular model exhibits a certain design that is not carried over into other models. The following article addresses questions such as this by following the evolution of the electrical system in King Airs from the early to the later years. I believe my *King Air* readers will find it interesting and serve to deepen their understanding of this important aircraft system.

Introduction

The original King Air, the 65-90 model that was introduced in 1964, was basically a Queen Air with the Lycoming engines exchanged for the first version of the Pratt & Whitney PT6A powerplant and with the fuselage modified and strengthened to allow for a meager pressurization system. Two years later, the A90 model replaced the "straight 90," and with it came a number of significant improvements, including the following:

- A totally redesigned cockpit layout that included an annunciator panel;
- Offering reversing propellers as an option (and to the best of my knowledge no A90 was manufactured without that popular option);
- Driving the pressurization system's air compressor (supercharger) off the left engine's accessory case, mechanically, instead of via a hydraulic motor driven by a hydraulic pump on that same engine;
- A redesign of the electrical system into one that continues, with various modifications and improvements, as the design still in use on current production King Air 260.

The following is an overall view of the King Air's electrical system while elaborating on some significant changes that occurred along the way. I will also discuss the five-bus system that first appeared on the F90 model in 1978 and continued until model 90 production ended in 2021 while continuing today in the 360 series.

There are four sources of DC (direct current) electric power in a PT6-powered King Air: A single battery housed in the right wing's center section, in front of the main spar; two identical engine-driven generators; and—sometimes—an external power unit (EPU). The B100 model, powered by the TPE331 engine, uses two batteries, one in each wing's center section, due to the greater starter demand of its fixed-shaft turboprops.

The first battery used was a 19-cell nickel-cadmium (NiCad) without provision for air cooling. In the mid-1970s, the standard factory-installed battery became a 20-cell NiCad and the battery box included ram air cooling. This was about the same time that the battery monitoring system was included, with its battery charge annunciator that could indicate the early stage of a thermal runaway. Improved lead-acid batteries first became popular as an STC'd replacement for the more expensive and potentially more troublesome NiCads, and in the 1990s the factory discontinued the use of NiCads and went to a Concorde

VRSLAB (valve-regulated, sealed, lead-acid battery) replacement. The battery charge annunciator is no longer required with a lead-acid battery since it does not have thermal runaway potential.

The battery is typically wired directly to a bus that is always "hot" with voltage whenever the battery is installed. This bus is named the hot battery bus and is usually located in or very near the battery box. Some convenience items, as well as some components that were considered most important by the engineers, receive power from this bus. These include the door and baggage compartment lights, boost pumps and crossfeed in the LJ series and, often, standby fuel pumps and fuel firewall shutoff valves. The fuel-related items that receive power from this hot battery bus, for redundancy, also receive power from their own fuel panel bus after the battery and/or generator is switched on, as we will see.

The generators, which do double duty as the starter motors, are made by Lear-Siegler and originally were rated at 200 amperes (amps) maximum continuous output. Beginning with the C90 and the 100 series, better cooling ducts were incorporated, allowing the maximum generator output to be upped to 250 amps. Instead of presenting the generator output on a gauge marked in amps, the decision was made to mark the gauge with decimal equivalents relating to the maximum rating. For example, with the 250 amp generators, a gauge reading of 0.20 would indicate a current output from the generator of 50 amps (250 amps maximum x 0.20). In more recent years, these gauges—load meters—have been marked in units of percent, so the 0.20 reading is now 20%.

It is important to realize that there is no actual limit on maximum generator output. If a direct ground short occurs on the generator output line, the current will immediately rise to 1,000 amps or more! This excessive workload would create too

"Throughout the course of my more than 50 years of King Air pilot instruction, teaching the electrical system always ranked high on the difficulty scale … "

much heat that could, given enough time, cause the generator to undergo an ugly and expensive death. Many King Air pilots and even instructors suffer under the misconception that any ground short will be handled automatically without the need for pilot action. Not true. Although the melting of a large fuse—called a current limiter—will protect the opposite generator and the battery from harm, the only thing that saves the shorted generator from its ugly demise is the pilot turning off its switch in reaction to the load meter on that side being pegged out at more than a 100% reading.

So when it is stated that 250 amps is the maximum continuous output, it is really saying that this is the maximum output that may be sustained, under certain conditions, while still maintaining the correct output voltage and without overheating. The "certain conditions" referenced here have to do with how much airflow is pumped through the generator by the cooling fan built into the back of the unit, where the cooling duct connects. The two factors that determine the airflow most are N1 speed and altitude. The fan is turning at the same percentage of its maximum speed as the N1 gauge reads. At an idle speed of 60%, for example, the fan is also turning at 60% of its highest speed so it cannot provide the same cooling as it would at cruise power. (Actually, that is not totally correct since the maximum Ng speed of PT6s is either 101.5% or 104%, but close enough). Since air density decreases with altitude, less airflow takes place the higher one flies, even for the same N1 speed. This explains why the POH typically shows lower sustained load meter limits on the ground with idle speeds and in flight at very high altitudes.

The previous paragraph included the phrase, "…while still maintaining the correct output voltage…" The target voltage is 28.25 volts with an allowable tolerance of ±0.25 volts. Thus, any voltage between 28.0 and 28.5 is proper. No instrument can ever be totally accurate, and the typical King Air voltmeter can have up to a 0.5-volt error, yet it is still considered acceptable. That explains why in some POHs the statement appears that, during the electrical system after-starting checks, the voltage must be between 27.5 and 29.0. These numbers are derived by including the possible gauge error in the correct voltage range.

Early 90 Series

Prior to LJ-678 (C90), LW-157 (E90) and B-224 (A100), the voltage output of the generators was controlled by a carbon-pile type of device that was not nearly as accurate and predictable as what we have come to expect in the modern digital age. Keeping voltage within proper limits and making the generators share their current output equally (i.e., providing good paralleling of the load meters) were difficult aims to achieve and almost impossible to maintain over any significant period. However, beginning with the serial numbers noted above, a solid-state generator control unit (GCU) was made standard equipment, and what a nice difference it made! Now voltage rarely strays out of the expected range and generator paralleling is so perfect that an imbalance between the left and right load meters becomes the exception rather than the rule.

One can recognize that the plane was built with the new GCUs by observing whether or not the generator control switch has the third, top, "Reset" position. That reset position means GCUs are installed. With the old-style system, the generator switch was merely "On-Off," two positions, up and down.

Just as a municipality's water pressure would drop if every resident opened every spigot and tap simultaneously, causing too much water demand, no generator can maintain proper voltage when its current outflow gets too large. Although this will happen in the event of a short to ground, a more common example is when one generator is assisting with the start of the opposite engine. Have you ever monitored voltage while you activate a starter switch? It surely makes a momentary big drop, doesn't it? No wonder the lights go dim for a while.

When switched on, each generator feeds directly into its own main bus, also called the generator bus. Generally, with minor exceptions, the main buses are connected to

E90 fuel panel

the electrical components that use higher amounts of current. The landing gear motor, air conditioning motor, windshield heat and cabin electric heat (when applicable) are obvious candidates for main bus items. Not quite so obvious are avionics buses, inverters and flap motors, but they, too, almost always are fed by a main bus.

Components that use only a small amount of electric power receive that power from subpanel buses. For redundancy, these buses are fed not just from one side's main bus but from both. A circuit breaker (CB) rated at 50 amps protects the wire from each main bus into the subpanel bus. Therefore, each subpanel has two 50 amp feeder CBs associated with it. With nothing else, however, this would compromise the separateness of the two main buses since now there is a bridge between the left and right sides via the subpanel and its two feed wires. What's that I see riding over the horizon to our rescue? Why, it's Sheriff Diode!

Yes, the necessary and often-used one-way "check valve" for current flow, the lowly diode is the device that allows both main buses to feed ***to*** the subpanel but does not allow current to flow ***from*** the subpanel back into the main bus. Every subpanel feeder CB has a diode between it and the subpanel to prevent return flow.

I speculate that the designer who decided on what small components would be wired to which of the two subpanels had his reasons for placing things as he did, but I'll be darned if I know what the reasons were! Only when we get to the 100 series does logic seem to dictate the selection. For the A90, B90, C90, C90-1 and E90 systems, the only way to know which items are wired to which bus is to consult the electrical system schematic in the POH or wiring diagram manual (WDM).

Challenges arise whenever a technical writer takes a complex subject and tries to present it in an understandable manner to a nontechnical reader. If the writer makes it too simple, details that may be important for better understanding are often ignored. On the other hand, if he tries to describe every minute detail, the reader is quickly lost or put to sleep! Likewise, the drawing of the POH's electrical system schematic always becomes a compromise between accuracy and understanding. I think the Beech POH writers did an excellent job at this compromise, although others may disagree.

In the POH's schematic, each main and subpanel bus is rendered as if it were a single strip of metal with all associated components wired off the bus one by one, side by side. In the real airplane, often that is not the case. For example, although most main bus items receive power from the vicinity of the cockpit console, the inverters tap off their power from an area in the main wheel wells.

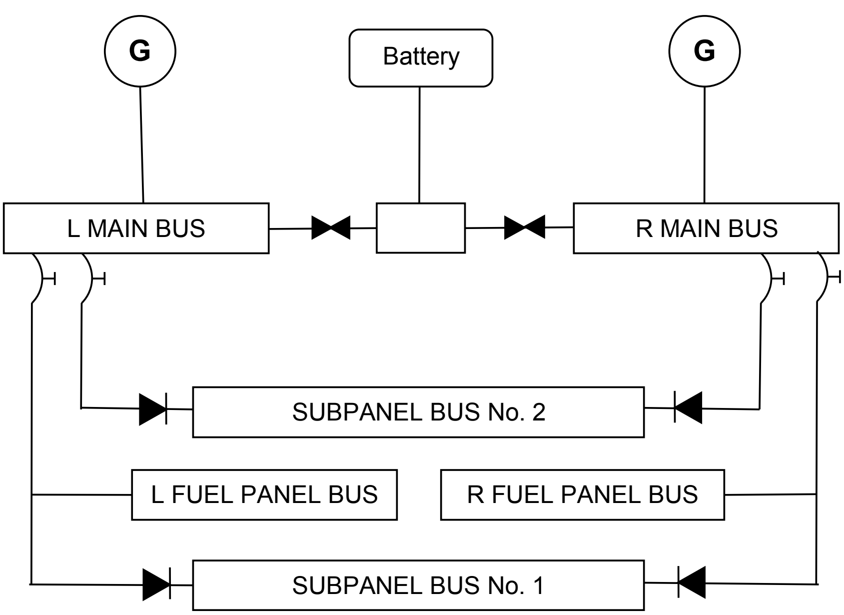
So please take what I am about to write as a compromise between accuracy and understanding. It is not technically correct in all respects, but it will generally be helpful. Here goes: The main buses are underneath and inside the cockpit pedestal, whereas the subpanel buses are generally in the area we call the instrument panel subpanels—the hard-mounted black metal ahead of the crewmembers' knees, where lots of switches and CBs are located. It follows that the 50 amp subpanel feeder CBs, as well as CBs for things like landing gear motor and windshield heat, are located on the aft end of the pedestal, whereas most of the subpanel items involve the switches and CBs in front of our knees.

Two more cockpit locations exist for electric switches and/or circuit breakers: the left and right side panel areas. The left side panel, next to the pilot's left elbow, has traditionally been devoted to the King Air's fuel panel. The right side panel is devoted mostly to CBs or fuses that protect the engine instrument circuits.

The engine instruments are definitely subpanel-connected items; the fuel panel items, however, are not. The reasoning behind the design has probably been lost in the mists of long ago. Still, the electric power received by the left and right fuel panel buses comes from two of the four subpanel feeder CBs, yet it comes via a separate wire branch that has nothing to do with either of the two subpanels. A diagram may help explain; see Figure 1, below.

As the A90 evolved into the B90, and as the B90 evolved into the C90, only minor changes occurred in the electrical system. One of the more significant changes, occurring at LJ-773, LW-278, B-241 and BE-41 (B100), involved a rewiring of the external power circuit such that the battery switch must be on before the external power relay can close, allowing the external power to flow into the airplane. Beech always specified that the battery switch should be on before the external power unit was energized and kept on while the EPU was in use, but in the later serials it is a physical requirement. By having the battery online along with the EPU, we have two power sources. An advantage of this is that a start will continue successfully even if the EPU malfunctions and cuts out before the engine reaches its self-sustaining speed. Also, the battery provides a cushioning effect, permitting the airplane to experience less voltage fluctuation than the EPU might provide.

Figure 1



100 Series

In 1969, the first long-cabin King Air was added to the model lineup: the BE-100. Although the electrical system remained nearly identical to the one in the LJ serials in production at that time (the B90 model), the decision was made to add more logic to the location of various smaller, subpanel components. Whenever there were two identical components—for example, two pitot heaters, two bleed air flow packs, two oil temperature and pressure gauges, two start switches, etc.—the left one of these would always be wired to the same subpanel bus and the right one would receive its power from the other subpanel. No longer did the electrical schematic label them "Subpanel Bus No. 1" and "Subpanel Bus No. 2." Instead, they became the "LH Loop" and the "RH Loop," reflecting where the identical left and right components were connected.

Two comments need to be made here. First, due to the diodes, the current cannot "loop" through the subpanels from one main bus to the other side's main bus, as we have discussed. Yet, looking merely at the path of the wires, it does seem that the subpanels form loops from one side to the other, so the "loop" terminology was used. Second, there are so many components not duplicated on both left and right sides that a lot of arbitrary selection must occur: Where do we put the single stall warning heater circuit, the single nav light circuit or the single pressure control CB? So both the LH Loop and the RH Loop contain many items that do not fit within the left-right separation.

Further, in the 100 series, the labels above the four 50 amp subpanel feeder CBs on the aft end of the cockpit pedestal were changed. In the 90 series, the four breakers have a single label covering the four

Models C90 and E90 right subpanel

groups: "Subpanel Feeders." When an operator wants to designate a particular one of these four, he must say, "The far left one" or "The second one from the right," etc.

In the 100 series, however, to keep following the loop concept, the four breakers are now labeled from left to right: LH #1, RH #1, LH #2, and RH #2. The first and third of these are the first and second feeders for the LH Loop, and the second and fourth are the first and second feeders for the RH Loop. The first feeder for both loops comes from the left main bus and the second feeder comes from the right main bus. Until this unusual CB labeling is explained and understood correctly, it can be very confusing: How come a CB labeled "RH" originates from the left main bus?! However, clarity is achieved when it is recognized that the LH and RH labels refer to the loops being fed whereas the #1 and #2 labels refer to the source side.

To let you in on a surprising and weird little piece of design sadism that took place, guess which subpanel CB has the branch going to the left fuel panel? The correct answer is RH #1. Vice versa, the LH #2 CB feeds the right fuel panel! Although this is not as crazy as it first seems when one associates the #1 label with the left side and the #2 label with the right side, the designer could just as easily have used LH #1 to feed the left fuel panel and RH #2 to feed the right fuel panel. The labeling mismatch would have been avoided. Oh well.

200 Series

In 1972, Beech started working on the first Super King Air, the wonderful model 200 that has become the bestselling of all the King Air models. In addition to the obvious improvements of more power, more fuel, a longer wingspan and more pressurization capability, the engineers were also tasked with improving all systems and making the airplane more maintenance-friendly.

One system improvement was eliminating the fuel panel bus weakness of the 90 and 100 series. Namely, the items were not dual-fed for redundancy but received power from a single subpanel feeder CB. To correct this, Beech went from two to four subpanel buses, with the names of, not surprisingly, Dual Fed Bus #1, Dual Fed Bus #2, Dual Fed Bus #3 and Dual Fed Bus #4. To keep the left-right thing as logical as possible, all left-side items are now associated with an odd-numbered bus and all right-side items with an even-numbered bus. Dual Fed Buses #1 and #2 have all of their CBs and/or CB-switches on the cockpit's right sidewall or on the instrument subpanels; #3 and #4, however, are exclusively located on the left sidewall, where the fuel panel is located. Unlike in the past, the CBs on the left sidewall would include some items not associated with the fuel system, flaps and ignition, for example.

Models C90 and E90 right sidewall

Also, the 200 series moved the main buses from the cockpit pedestal to a location in the cabin aisle, just aft of the main spar. A neat panel is there under a clear plastic overlay painted with labels showing exactly what's what. As in the past, two spare 325-amp isolation limiters are installed near the main buses to be available for on-the-road replacement.

The Five-Bus System

It might be said that the model 200 was a Super 100 since it had the same cabin size but offered a tremendous increase in overall performance. The Beech engineers were directed to create a similar change for the 90 series: To develop a Super 90 that would be head and shoulders above its C90 and E90 siblings.

Off to the drawing boards they went. Wow! It was 1978, and they had to modify what had been designed in 1963! What improvements they could make! Redo the nose profile to eliminate the "flat face" of the King Air and go with a sleek profile like that used on the Model 60 Duke. Use a wet-wing system and eliminate the bladder tanks. Go with a whole new wing, but use the landing gear from the 100 series to allow for a higher gross weight. Redesign the electrical system to make it more modern, copying a lot of what Boeing did on the 737. Use the T-tail, rudder boost system and cockpit layout of the 200 along with its automation of the fuel transfer system. Lastly, use the 200's stronger cabin door and dual-pane cabin windows to increase the pressurization differential. They called this model the F90.

Probably not many of my readers remember those days of the 1970s. The Carter presidency saw nearly runaway inflation and prices were soaring dramatically. After the Beechcraft financial analysts reviewed the changes that were planned, they concluded that this proposed F90 would need to cost more than its big brother, the 200, to account for these major changes that were to be paid for in late-1970s dollars! Oops that cannot be! So the engineers were sent back to the drawing boards with orders to tone it down and keep the price in line with reasonable expectations.

The pressurization increase, the T-tail, the 200-style cockpit layout, the automated fuel transfer, the landing gear from the 100 series and the 737-like electrical system were retained. The rest were tossed. So let's talk about this new electrical system that first appeared on the F90 and continued in the C90A, C90B and C90GT and all its variants, and on the entire 300 series.

Although this article cannot go into the depth required to really "teach" this new system, I will say that one of the few similarities to the older system is the presence of left and right generator (main) buses. Instead of subpanel buses, we now have a triple-fed bus, a center bus and, as before, a hot battery bus—five buses in total, with

the airplane's components distributed among them appropriately. Of special interest is the fact that three Hall effect devices (HEDs) are included. These devices—not yet available back in the '60s—allow excessive current flow to be terminated instantaneously, based on the increase in the magnetic field around the wire, instead of waiting for the heat buildup to melt a fuse or blow a CB—a safer design.

Also, the new system includes "automatic load shedding." Previously, in the rare situation in which both generators were lost, it was incumbent upon the pilot to rapidly turn off the unnecessary, heavy-load components to prevent the battery from being discharged too rapidly. In the new system, when the second generator fails, bus tie relays open automatically to disconnect the generator buses from the battery. Hence, the battery only supplies those items on the hot battery bus, the triple-fed bus and the center bus, prolonging its life significantly. (It is nearly impossible to explain this satisfactorily, but the heavy-load items on the center bus—electric heat and air conditioning motor—are also "shed" in this scenario.)

For some weird reason—perhaps because of the bus that is fed from the left generator, the right generator and the battery, too, with the name triple-fed bus—it seems that this new system was often called the "three bus system." Huh? But there are five buses! I try to be consistent and always refer to this as the five-bus system, but if you read or hear the term "three bus," it's the same thing. (The 350 kind of has a sixth bus, the dual-fed bus, but it acts as an extension of the hot battery bus.)

As in any new design, some minor shortcomings surfaced after the system got into customers' hands and feedback was received. The most significant was that the voltmeter did not allow inspection of all five buses, only three (triple-fed and left and right generator buses).

Beginning with the F90-1 in 1982, all the 300 series, and the C90A and after models, this was corrected with a voltmeter that included the missing buses. All voltmeters on five-bus airplanes also include an extra position that allows EPU voltage to be measured and assessed at the plug before the pilot turns on a new-to-this-design external power switch to allow the external power relay to close and introduce the EPU power into the airplane. With this switch, although the battery should still be on while using external power, the EPU connection will work with or without the battery switch on, just like in the early King Airs.

A controversial question that arises concerning the five-bus system is, "Do we, or do we not, manually close the generator bus ties prior to start?" In all of these systems, the start will be normal whether we do or not. Realize that when the first generator is turned on, both the left and right generator bus ties close automatically, so from that point on there is zero difference. Yet, some POHs direct us to close the ties prior to start while others don't. Why the difference?

The answer to this "discrepancy" has to do with where the rotating beacon(s) receive power. For the F90, C90A and 300 models, the beacon is wired to the left generator bus. Since this bus does not get power until either the generator is on, an EPU is in use or the bus ties have been manually closed, the beacon would not be rotating prior to the first engine start. Realize that one of the Federal Aviation Administration's (FAA) recommendations is always to have the beacon on before a propeller rotates as a safety measure to let people know that they should "step away from the airplane!"

Now, just between you and me, if an innocent bystander were standing within the arc of a PT6's propeller when someone hit the start switch, I think that the initially very slow-to-turn, free-turbine engine's propeller would probably bump into the person with a gentle nudge, just enough to encourage them to step away. No big deal, unlike the catastrophe that would have happened with a piston engine or a fixed-shaft turboprop!

So, yes, for you operators of F90s, C90As and 300s, I encourage you to do as the POH directs and close the bus ties before the first start to make the beacon operate. (But if you don't, no one will be harmed.) On the other hand, for the F90-1, the C90B and after series, and the 350 series, Beechcraft relocated the beacon to the triple-fed bus, so it works regardless of whether the generator bus ties are closed or not. Hence, those POH procedures do not initially direct the pilot to close the ties. (Only for the model 300, the fuel quantity gauges don't work until the generator buses are online, so it is especially important to close the ties manually to verify the amount of fuel onboard before starting.)

For nighttime starts, for all five-bus models, it is best to always close the generator ties prior to starting so that all external and internal lighting is available, as desired.

I hope this review of the history of the King Air's electrical design has been of interest, allowing you to better understand how the electrical system evolved in the particular model you are flying. KA

King Air expert Tom Clements has been flying and instructing in King Airs for over 50 years and is the author of "The King Air Book" and "The King Air Book II." He is a Gold Seal CFI and has over 23,000 total hours with more than 15,000 in King Airs. For information on ordering his books, contact Tom direct at *twcaz@msn.com*. Tom is actively mentoring the instructors at King Air Academy in Phoenix.

MT-Propeller's five-bladed Quiet Fan Jet composite prop.

New Five-blade Propeller for King Air 200 Series Earns INAC Venezuela Approval

The National Institute of Civil Aeronautics (INAC) Venezuela has accepted the Federal Aviation Administration's supplemental type certification (STC SA03209NY) for the installation of the Quiet Fan Jet composite propeller MTV-27-1-E-C-F-R(P)/CFR225-55f on the Beechcraft King Air 200 series powered by P&WC PT6A-41, -42, -52, -61 propeller turbines. This installation is already certified by EASA, FAA Transport Canada, ANAC Brazil and DGAC Mexico.

According to manufacturer MT-Propeller, the benefits of the installation include:

- General performance improvement (5% takeoff & climb, 3 kts cruise with 1,800 rpm).
- Approximately 25 pounds less weight than the original 4-blade propellers with aluminum blades.
- No propeller speed restrictions on ground while operating in low idle.
- Unbeatable esthetic ramp appeal.
- All models comply with the strict German noise regulations for unrestricted airport operations in Germany and other European countries.

Additionally, the MT-Propeller for the King Air 200 series has more ground clearance for less blade tip erosion and FODs due to its smaller diameter. The natural composite blades provide significant inside and outside noise reduction, have no life limitation and are repairable in case of an FOD, according to MT-Propeller, which adds, "They also provide best vibration damping characteristics for almost vibration free propeller operation and have bonded on nickel alloy leading edges for superior erosion protection of the blades."

MT-Propeller holds more than 220 STCs worldwide and is the OEM supplier for more than 90% of the European aircraft industry as well as 30% of the U.S. aircraft industry. The company has more than 30,000 propeller systems with more than 100,000 blades in service and offers a factory-certified network of 62 service centers. Find more at *mt-propeller.com.*

ForeFlight 16.8 Improves Flight Planning

ForeFlight has rolled out its latest release, ForeFlight 16.8, and it includes enhancements to streamline your workflow, making it easier to access vital information and adjust your view on the go.

A new strip at the bottom of the flight plan (FPL) drawer gives you an improved view of key flight information, with a touch control to easily resize the FPL view vertically. This flight information strip is also now visible in the navlog profile view, just like in the edit tab. Additionally, the layer selector and settings in profile view have been relocated to the top-right corner for more convenient access, and the profile view ruler has been refined for smoother use.

The new weight and balance planning with a visual representation of your aircraft's cabin layout is available for ForeFlight Performance and up subscribers. It allows you to easily input passenger and payload details with just a tap after first setting it up on the ForeFlight web access site.

New support for civil twilight allows you to accurately log day and night hours using enhanced solar data, including morning civil twilight, sunrise, sunset and evening civil twilight for any airport worldwide. This feature helps you stay compliant with FAA night flight regulations by offering a precise measurement based on latitude and longitude, determining when the sun is 6° below the horizon. You can view solar data for the current day and the next three days, accessing a total of four days of information.

New headwind/tailwind and estimated ground speed layers in profile view enhance flight planning by offering precise altitude insights and timely route analysis. By combining aircraft performance data with headwind/tailwind information, these layers provide a quick visual assessment: green for favorable conditions, while gray shows less favorable ones. Leveraging the same packed winds aloft data as the dynamic winds and temperatures layers, these new layers offer time-differentiated forecasts along your route. Find full product details at *foreflight.com*.

Atlantic Aviation Opens New Showcase Facility at KBNA

Atlantic Aviation Nashville, the newest facility in the company's network, has opened at Nashville International Airport (KBNA). The 24.5-acre Atlantic Aviation BNA includes a new 12,000-square-foot state-of-the-art terminal building and a new 30,000-square-foot heated hangar with 28-foot door clearance and adjoining office and shop space. The main terminal area offers brightly lit expanded ramp space with increased front-line aircraft parking.

The new terminal building combines advanced design, high-quality materials and a host of meaningful amenities to create an elevated experience for passengers and crews. Within the new terminal, passengers will discover a technology-equipped business center with two conference rooms and a café, and crews can enjoy an expanded crew lounge with quiet rooms and a private shower area. To provide an additional level of seclusion for those who require it, a separate private VIP passenger lounge area with direct aircraft access is available. Learn more at *atlanticaviation.com*. KA

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Jessica Haughn, Controller

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