ThrustSense®
Autothrottle by ISS Innovative Solutions & Support

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# ThrustSense Autothrottles Now Available in King Air

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Two years ago, Innovative Solutions & Support (IS&S) certified the first autothrottle designed for Pratt & Whitney Canada PT6A-powered light turboprops, the ThrustSense system in the Pilatus PC-12. In May, IS&S received FAA approval for installation of ThrustSense autothrottles in King Airs, the first such system available for the Beechcraft twin turboprops. **AIN** recently got the chance to observe the system in flight.

While pilots who haven't flown with an autothrottle might not fully appreciate its benefits, the King Air ThrustSense system adds more than just easier speed control and engine management. In the King Air, the IS&S autothrottles also offer a significant safety benefit in case of failure of one engine, especially on takeoff. This hazard has come under the microscope as a result of a pair of King Air takeoff accidents: in Wichita in 2014; and Addison, Texas, on July 1 this year.

Multiengine propeller-driven airplanes are vulnerable to asymmetric thrust when one engine fails. Unlike jets, where engines can be mounted closer to the airplane's centerline, propellers need more space, so the engines are mounted farther out on the wing. When one engine fails, pilots have to be careful not to slow the airplane too far while using too much power on the remaining engine. With full power on the good engine, the airplane will roll uncontrollably towards the inoperative engine once it slows to a specific airspeed and that wing stalls. The critical speed is called "velocity: minimum control (air)" or Vmca. The loss of control is commonly called Vmc rollover.

If, however, the pilot pulls back the power lever on the good engine, the airplane won't roll. If the airspeed does continue to drop too far, the airplane will stall, but straight ahead instead of rolling out of control.

With ThrustSense, if one engine quits and the pilot lets the speed get too slow, the system's Vmca-mitigation feature automatically reduces the power on the good engine to prevent Vmc rollover. It does this by monitoring engine parameters. When it detects loss of power on one engine, it "computes the amount of rudder authority loss due to the reduction of airflow over the rudder," according to IS&S. "It uses this to calculate the reduction in thrust from the remaining engine to prevent hazardous yaw..." which would ultimately cause the wing of the failed engine to stall and roll the airplane.

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Pilots might think they have the skills to prevent loss of control due to Vmc rollover, but there are plenty of accidents over the years that have occurred because of this phenomenon. In the heat of the moment, it's not hard to imagine a pilot inadvertently pulling back on the yoke in an attempt to avoid hitting the ground, thus allowing the airspeed to slow below Vmca and losing control. ThrustSense can prevent that.

During the recent **AIN** demonstration flight in IS&S's King Air B200, chief pilot Eric Smedberg showed me how ThrustSense works, including how it reduces power on the good engine to prevent Vmca rollover. The IS&S autothrottles are different from traditional autothrottles in that they use a motorized actuator with a clutchless drive mechanism instead of an actuator with a clutch.

Smedberg met me at Essex County Airport in northern New Jersey for the demo flight. After a briefing on the system, I climbed into the right seat, and he flew the King Air from the left seat.

The IS&S King Air is equipped with a full suite of IS&S avionics, including the Autothrottle Control Panel (ATCP) that manages the autothrottle system. The only other visible differences are an autothrottle disconnect button on the right power lever and a status indicator mounted between the primary-flight and multifunction displays. The ATCP also doubles as a full backup instrument. There are two modes: torque and airspeed, plus sub-modes under each of those. If the pilot pushes a power lever too far forward and is about to exceed a torque or temperature limit, the autothrottle warns the pilot by shaking the throttle.

Before takeoff, Smedberg set the King Air's takeoff weight in the ATCP, so the system can determine airspeed performance limitations. It automatically adjusts gross weight downward during the flight to account for fuel burn.

Lined up on Runway 4, Smedberg pushed the go-around button on the left power lever, and the autothrottles moved automatically to set maximum torque, in this case, 2,180 ft lb, which was displayed on the ATCP. A big advantage that the autothrottles provide for King Air pilots is that they maintain balanced torque between the two engines on takeoff, so there is no need for fine adjustments to the power levers while accelerating along the runway. "You don't need to look at the torque beyond glancing at it," Smedberg said.

After 2.5 minutes, the ATCP automatically reduced thrust to the climb-power setting. After selecting speed mode then setting airspeed to 190 knots, we flew north and climbed to 5,500 feet. When we leveled off, the autothrottles pulled the power back as needed to maintain the set airspeed, illustrating the main benefit of autothrottles, which is helping the pilot fly a particular airspeed, including during climbs and descents, without having to constantly manipulate the power levers.

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Smedberg demonstrated the built-in protections in the IS&S autothrottle system, first with a low-speed demo. He dialed the airspeed setting to the minimum (109 knots on the IS&S avionics, but it goes to 99 knots in Collins Pro Line 21-equipped King Airs). With the autopilot in heading and altitude hold, the King Air slowed down as the nose pitched up then at just above the minimum—at 111 knots—the autothrottles held power to maintain that speed.

Next was an overspeed demo, and in this case, the autothrottles maintain three knots below the Vmo of 258 knots. Smedberg set a 3,000 fpm descent on the autopilot with maximum torque, and the autothrottles stabilized the speed at 255 knots.

For the Vmca demo, we had to tap into an engineering test mode in the ATCP, which obviously isn't available in normal installations. Vmca was 86 knots. Level at 5,500 feet with full flaps and landing gear down, the test mode "failed" the left engine by pulling power back to idle, then the right engine advanced to full power, 2,250 ft lb. As the King Air slowed to Vmca, the right engine power automatically reduced to 2,070 ft lb, and the airspeed stabilized at about 89 knots, with zero rolling tendency.

After restoring power to the left engine, we returned to the airport, flying the Localizer 22 approach with the ATCP set in airspeed mode at 115 knots. Then we broke off and flew the lefthand pattern to land on Runway 10. The autothrottle isn't coupled to the autopilot during the approach, and the pilot will have to set the desired speed during IFR approaches. The autothrottles still reduce pilot workload in IFR flying, however, because the pilot doesn't have to think about power settings and can focus more on flying the airplane, which is especially useful in busy airspace.

Other benefits of the system include engine protection in all regimes, including hot-start prevention, an auto-speed setting for turbulence penetration, and RNP speed management including in-trail spacing.

IS&S is planning to certify the autothrottle system next in the King Air 300/350 then the C90 as well as additional single-engine turboprops such as the Cessna Caravan and Daher TBM series.

The complete system with installation kit retails for $67,749.00 for Pro Line 21-equipped King Airs, not including labor.