Avionics companies prepare for coming TAWS mandate

by Stephen Pope

Cockpit Avionics Special Report

Taking into consideration the recent string of equipment mandates they have faced, many business aircraft operators probably feel as though they are nearing the end of an upgrade marathon. Recent equipment requirements and new operating rules that caused the biggest headaches for operators in the last year or so centered primarily on the installation of emergency locator transmitters (ELTs) and the recent introduction of reduced vertical separation minimums (RVSM) standards in North America.

The upgrade parade continues this month as operators and avionics shops complete leftover installation work for the new FAA mandate requiring terrain awareness and warning systems (TAWS) in most turbine-powered airplanes. The FAA TAWS mandate stipulates that Part 121 and Part 135 airplanes with 10 or more passenger seats must have class-A systems, while Part 91 aircraft with six or more passenger seats and Part 135 aircraft with six to nine passenger seats must have at least a class-B system.

For operators who have not yet selected a TAWS supplier, the good news is equipment choices abound. No fewer than seven avionics manufacturers now offer TAWS equipment that will let operators meet the mandate in time for the rule’s compliance date on the 29th of this month. And despite a contentious lawsuit over TAWS patents among a number of avionics makers, nobody has been barred from selling or servicing TAWS units thanks to court decisions and licensing agreements.

EGPWS: The Original TAWS

TAWS is the term the FAA has chosen for what many pilots probably know better as the enhanced ground proximity warning system (EGPWS). Honeywell’s terrain collision avoidance system flying in thousands of airplanes and helicopters. Like most TAWS products, EGPWS provides aural alerts in advance of a collision, as well as situational awareness through the use of a visual display of surrounding hills, mountains and obstructions.

The FAA’s TSO document describing TAWS (TSO C151a) was actually modeled after EGPWS, which is the enhanced look-ahead version of the GPWS developed in the 1970s. But EGPWS marks a vast improvement in terms of safety compared with GPWS because it uses an internal terrain and obstacle database and GPS position input to determine the relative proximity to hazards instead of relying only on the radar altimeter, which looks straight down.

“EGPWS has been one of the biggest success stories in the history of aviation, but its business success is only a part of its total success story,” noted Frank Daly, president of Honeywell air transport systems. “Perhaps the most important part of the story is that EGPWS is contributing immensely to air safety.”

In fact, there has not been a single controlled-flight-into-terrain accident of an airplane equipped with EGPWS since its maker introduced the product in 1996. According to Honeywell, EGPWS is credited with helping to prevent 30 crashes since then, including its first save of a helicopter that was headed toward an obstacle the pilots failed to spot.

“There undoubtedly have been other incidents that we don’t know about,” Daly added.

Honeywell announced recently that it has delivered more than 30,000 EGPWS units, making it the best seller among TAWS products on the market by a wide margin. Contributing to the product’s popularity is the fact that Honeywell now offers several versions of EGPWS, from a class-A system for the air transport market to units tailored for business aircraft, helicopters and light general aviation airplanes.

The TAWS Players

Following Honeywell’s early market lead, other manufacturers have introduced TAWS products, hoping to steal market share with devices ranging from high-end stand-alone class-A systems to integrated versions that reside within EFIS units or GPS navigators.

Generally speaking, class-B TAWS is priced lower than class-A systems because it does not require a situational-awareness display, nor does it need to interface with other aircraft systems such as autopilot, FMS, weather radar, flap and landing gear indicators or ILS glideslope.

The only requirement of basic class-B TAWS for Part 91 and 135 airplanes is that it feature forward-looking terrain warnings (taken from an internal terrain database that uses GPS to determine aircraft position), minimum ground clearance functions and GPWS Mode 1 (high descent rates), Mode 3 (descent after takeoff) and Mode 6 (500-foot voice callouts during descent).

By contrast, class-A TAWS performs all of the functions of class-B TAWS, as well as

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Honeywell’s EGPWS is an improvement on the company’s GPWS. The enhanced version issues warnings about hazards based on GPS position and information from a terrain database.
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well as those that pilots would typically expect from EGPWS—the most important of these, in the minds of safety experts, being the graphic portrayal of terrain in red, yellow and green on a cockpit display. At night or in low visibility this color-coding might be the only visual cue a flight crew would have to gauge the airplane’s proximity to terrain if they were to lose situational awareness.

ACSS (Aviation Communication and Surveillance Systems), a company owned jointly by L-3 Communications and Thales, gained FAA certification in 2003 for its TCAS, a class-A TAWS combined with TCAS 2000 in a single LRU. After initially netting sales to airlines and business aircraft operators seeking both TAWS and TCAS, the company went back to the drawing board to introduce TAWS+, a terrain-avoidance system in a stand-alone package that sells for less than TCAS.

Universal’s MFD-640 flat-panel multifunction display and FMS control display views: map, profile and a 3-D perspective. These views are available in two-, three- or four-screen configurations depending on an individual’s requirements, making the product a good choice for cockpits where panel space in limited.

L-3 Avionics Systems, the former Goodrich subsidiary that produces the well-known Stormscope and Skywatch lines of cockpit safety systems, last fall introduced a new class-B TAWS that stands out by including an external GPS receiver. The Landmark 8100 TAWS includes a graphics adapter that allows the unit to be used with a variety of EFIS and radar displays and a GPS receiver. According to L-3, terrain alerts and algorithms are the same as on the previous class-A TAWS 8000 system, with a major difference being the TAWS ST3400 retrofit package includes active-map views of terrain. The ST3400 is designed as a drop-in replacement for RMI indicators, making the product a good choice for cockpits where panel space is limited.

Garmin, meanwhile, announced it has gained FAA certification to add the functionality of its class-B TAWS to the GNS 530 and GPS 500 panel-mount navigators. With the addition of TAWS functionality, the GNS 530 and GPS 500 can display surrounding terrain and obstacles relative to the aircraft’s current altitude and provide aural warnings and alerts to pilots.

Another TAWS manufacturer is Chelton Flight Systems, which makes the synthetic-vision FlightLogic EFIS. Its system comes from the factory with class-C (advisory only) TAWS but can be upgraded to class-B or class-A depending on customer needs. Besides flying in hundreds of piston airplanes, FlightLogic has been certified and installed in a number of turbine-powered aircraft, including the Cessna Citation 501.

It is unclear at this point how many airplanes must still be upgraded with TAWS avionics, but if other recent mandates are a guide then probably a fair number of operators are still holding off until TAWS becomes law.

As most pilots know, on January 20 RVS aviation rules took effect in the U.S., southern Canada, South America and Mexico. Operators of the more than 6,100 U.S.-registered business jets that were already approved to fly in RVS airspace reported few problems. But operators of the remaining aircraft, as many as 3,800 of them, were planning either to wrap up approvals in the coming weeks and months or forgo RVS altogether.

A similar situation occurred when the FAA mandated the installation of ELTs in January last year. Operators waited until the last possible minute to order ELTs, which created backlogs for manufacturers and inevitable delays for operators. Fortunately, with all the equipment options available to TAWS buyers, a repeat of that type of logjam is not expected this time around.

cockpit Retrosfits Come of Age

In other significant cockpit news, avionics manufacturers are gearing up for sales of retrofit avionics gear for in-service airplanes as operators get serious about upgrading older flight decks.

The IDS-3000 retrofit avionics system from Rockwell Collins can be applied in a number of configurations depending on an individual operator’s needs, according to the company. The integrated display retrofit package includes active-matrix LCDs, sensors and software, all developed around an architecture meant to keep a tight lid on price. This is accomplished primarily by leaving the airplane’s original autopilot intact, according to David Wu, marketing director for flight deck systems.

“The new IDS-3000 is a complex avionics system, but if the airplane’s original autopilot is good, we can usually just plug it in,” he said.

The initial market for the display retrofit is Pro Line II airplanes equipped with Collins APS-85 autopilots. The launch application for IDS-3000 is the Cessna Citation 500 series through an agreement with Garrett Aviation. Garrett has launched a Citation 501-series program as part of a Williams FJ44 re-engining program. The IDS-3000 cockpit includes two displays, RVSM-compliant air-data computer, WXR-800 weather radar and the new integrated flight information system (IFIS), which allows pilots to call up navigation charts, weather data and other information on the displays.

Benefits of IDS-3000, said Wu, are lower cost of ownership, fast installation and the ability to upgrade to new capabilities, such as electronic charts, weather and enhanced moving maps, by installing an IFIS cockpit file server. He explained that because IDS-3000 is an incremental upgrade concept that allows an operator to install a modern glass cockpit while keeping the old autopilot, it will allow more operators to upgrade their current-generation flight decks.

Honeywell is also interested in the cockpit retrofit market and is moving ahead with enhancements to its Primus Epic CDS/R system, a derivative of the retrofit system that was already approved for in-service airplanes as operators get serious about upgrading older flight decks.

Honeywell has expanded their offerings to include TAWS, the FlightLogic EFIS (top and middle) and Garmin’s GNS 530 (bottom) display terrain and obstacles relative to the airplane’s path.

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integrated avionics computer, the system interfaces with graphics cards and file servers and is available with its own optional flight management system/GPS receiver.

Customers have been telling Honeywell they would like to be able to display electronic charts on the Epic CDS/R flight displays instead of on handheld electronic flight bag computers, which are relatively inexpensive but do not perform as well as electronic charts. Honeywell FlowView displays are installed on most Epic CDS/R systems and provide pilots with electronic charts that are relatively inexpensive but do not perform as well as electronic charts.

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The displays were integrated with the Collins FCC-86/APS-85 flight director autopilot and electronic flight bag computers, allowing the airplane to maintain its previous RVSM approval. Triple Laserfix, Collins TWR-850 weather radar and TCAS II were also integrated with the displays, according to Universal.

As noted above, TAWS functionality on the G-500/550 systems has made inroads in the business aviation retrofit market with its FlightLogic cockpit.

The company’s four-display upgrade for the Citation 501 rounds out a variety of retrofits that allow designers and avionics integrators to find hardware to resist. The initial FlightLogic installations in the 501 were done by Temple Electronics at Houston Hobby Airport, Chelton’s top dealer in a network of about 60 shops.
about ready for a serious foray into the cockpit retrofit arena. Exton, Pa.-based Innovative Solutions & Support (IS&S) announced it is stepping up efforts to bring commercially available glass displays and other technology to Part 23 and 25 airplanes.

The company started developing the concept a few years ago when it bought a Pilatus PC-12 and installed a single 12-inch flight display on the right side. That airplane became a testbed and marketing tool, culminating with certification of the display in 2001. Next IS&S started working on other displays ranging in size from 10 inches to 15 inches up to 17 inches.

Company engineers are now busy working on new certifications for the 10-inch and 15-inch versions, which a spokes-man said are expected soon. These would be both MFDs and PFDs, initially in Part 23 aircraft. Later IS&S hopes to move into Part 25 business airplanes, helicopters, airliners and military aircraft.

IS&S has signed memoranda of understanding with a major business airframe OEM for retrofit packages in two systems for the twin-turboprop and light jet market with “all the features of a full business jet automation: flight control systems,” including the ability to upgrade to autotrottle. TSO for the new autopilot, which does not yet have a name, is expected within the next 12 months, Flashans said.

The second initiative on tap for the Mineral Wells, Texas, company is the top-to-bottom reinvention of the company’s autopilot line, with the goal of providing additional features such as the integration of WAAS approaches.

For the cockpit retrofit market, Honeywell is enhancing its Primus Epic CDS/R system to display Jeppesen nav charts.

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“This will make single-pilot Citation operations a reality for many more owners,” said Nick Cain, Chelton’s chief pilot and director of training. “It substantially reduces workload and, with the autopilot interface that flies entire procedures hands-off, makes high-performance aircraft much easier to fly. As a bonus, the operator will probably gain more than 50 pounds of useful load.”

FlightLogic in the Citation 501 consists of four displays (two for the pilot and two for the copilot), each measuring 6.25 inches wide and 5.5 inches high. Remote-mounted equipment includes an attitude and heading reference system (AHRS), air-data computer and GPS WAAS receiver. The system is RVS-ready and comes standard with class-B TAWS. Operators can choose to upgrade to class-A TAWS for an extra $16,000.

The FlightLogic EFIS is also STC’d for the King Air 90/100/200/300, Conquest I and II, all Cheyennes, all Commanders, MU-2s, the Pilatus PC-12, Socata TBM 700, Piaggio Avanti and hundreds of other aircraft, including helicopters, through a blanket STC approval from the FAA.

**Up and Comers**

A company that many associate with RVS and air-data equipment appears to be Rockwell Collins offers the IDS-3000 as an incremental upgrade that lets the operator install a glass cockpit without replacing the autopilot.

models, although the company declined to provide specifics. Once it has established a foothold in the flight display market, IS&S plans to take a serious look at the very light jet (VLJ) market, the spokesman said. The company makes air-data systems, fuel-quantity gauges and other instruments but would look at working with partners for the FMS, attitude and heading reference system and other components of an integrated cockpit for VLJs.

IS&S is working to certify two flat-panel displays, including a 10-inch model, as MFDs and PFDs for Part 23 and, eventually, Part 25 aircraft.

### Seeing Is Believing

As business aircraft OEMs equip newer models with infrared-based enhanced-vision systems (EVS), pilots are gaining unprecedented views of the airport terminal area and surrounding terrain during nighttime operations and in certain weather conditions. Nobody was sure the idea would catch on when the first EVS units were installed in business jets, but today nearly every major business aircraft OEM has big plans for the technology.

What has helped drive demand for EVS is an important change to the Federal Aviation Regulations that permits the use of HUD-based EVS for descent below published minimums on straight-in instrument approaches. The rule lets pilots continue straight-in Category I and nonprecision approaches below decision height or minimum descent altitude to 100 feet above touchdown zone elevation (as opposed to the normal 200 feet), where they need to be able to see the runway or approach lights unaided to be legal to land.

Lower takeoff and landing minimums resulting from enhanced-vision systems increase the utility of the airplane, and that is making it easier to justify the cost of such equipment. To meet upcoming production needs, Gulfstream has placed a $20 million order with Kollsman for an undisclosed number of enhanced-vision systems. To date Gulfstream is the only OEM with a certified EVS flying in its aircraft, but other manufacturers are not far behind.

The Kollsman EVS is standard equipment in the Gulfstream G550 and G450 and an option in the G500 and G350. It is also a retrofit choice for a range of the Savannah, Ga., manufacturer’s jets, including the GV and GV-SP. Properly trained crews flying with the HUD-based infrared vision system are approved to fly below published minimums on certain approaches as long as they can see the airport using the EVS image. To date the $500,000 system has been installed in more than 100 Gulfstreams.

Bombardier has been busy developing an EVS with partners Thales and CMC Electronics for its Global Express series, including the new Global 5000 and Global XRS. The Bombardier enhanced vision system (BEVS) will be a standard feature on all new Global Express pro-

duction airplanes delivered starting later this year and will be available for retrofit through the Bombardier service network. Price is similar to the Gulfstream system’s at about $500,000 for the sensor system and related hardware, but not the HUD.

CMC Electronics has also been selected to provide the infrared camera/sensor package for the Rockwell Collins Flight Dynamics Integrated EVS/HUD in the Dassault Falcon line. CMC’s SureSight IR units will be integrated with the Flight Dynamics HGS-4860 HUD in a package offered to all future Dassault Falcon 2000EX, 900EX, 900DX and 7X buyers, according to the Montreal company. First installations of the Falcon EVS are scheduled for next year’s second quarter.

Rockwell Collins is also developing an infrared sensor-based EVS for the Boeing Business Jet (BBJ) and other 737 models, with the capability to interface with the Collins Flight Dynamics HUD. Collins has also selected the CMC SureSight infrared EVS sensor as part of that package. An STC for the BBJ system is expected by the end of this year.

Cessna, meanwhile, has selected Max-Viz of Portland, Ore., to provide a dual IR sensor-based EVS as an option aboard the Citation X and Sovereign. The Max-Viz EVS-2000 is being offered on new Citation Xs and Sovereigns, as well as a retrofit to Citation Xs already in service. But because the unit interfaces with a multifunction display and not a HUD, the Cessna EVS systems are not eligible for the take-off and landing credits that the Gulfstream jets have attained.

“‘We are planning to go from analog to digital architecture, with concept development of the new autopilots expected to be finished by the middle of this year,” Flashans said.

Bringing new vision and leadership to the company is a revamped management team, led by Michael McMillan, whose 30 years of aviation experience include senior executive positions with Raytheon and Piaggio America. McMillan took the helm at Meggitt/S-Tec on December 1 and is driving the product-line overhaul, said Flashans.