Traffic Alert Collision Avoidance Systems—TCAS
Buyer's Guide

BY DALE SMITH

From tiny pocket portables to top-end systems that tell you which way to go to avoid "trading paint" with other aircraft, today there is no reason not to take advantage of all the additional safety tools collision avoidance technology has to offer.

I can tell you from personal experience that it only takes one alert from your traffic advisory system to make you never want to fly without it again. Having that extra set of electronic eyes that can see "traffic" above, behind, below you, through haze, precipitation, clouds, darkness—you name it, is something no pilot should ever want to leave home without.

But realizing that you need it is just the beginning. Next, you have to decide which type of traffic avoidance system is right for your type of flying. The first step is to understand what the primary technologies are, and what they can, and cannot do. AEA's *Pilot's Guide To Avionics* has put together this "Consumer's Guide" of the different technologies to help you make an informed choice.

Passive Receivers

Passive units 'listen' for the transponder signals from other aircraft in your immediate area. When one or more are detected, these units provide a visual and/or aural signal that it's time to start looking out the window. Because they use a single antenna, they often suffer from "blind spots." Passive technology is what you find primarily in portable units, which are great for renter pilots and flight instructors.

Traffic Information System

Any Mode S transponder equipped aircraft can utilize the Traffic Information System (TIS). The TIS is a ground-based service that utilizes the Mode S datalink to communicate collision avoidance information to the aircraft. The system can show location, direction, altitude and climb/descent trends of other transponder-equipped aircraft within 5 nm and 1,200 feet of your aircraft. Threat traffic information can be displayed on the Mode S transponder or a variety of cockpit units including many popular multi-function displays. The only real drawback is that TIS coverage is currently not available in all areas.

Traffic Advisory System

Traffic Advisory Systems (TAS) monitors the airspace around your aircraft and indicates where to look for nearby transponder-equipped aircraft. TAS systems are 'active' because they provide

a greater degree of information from surrounding aircraft by actually interrogating another aircraft's transponder for critical position and trend information. When they receive a reply from an aircraft that's current course will bring it within the critical area, information about the 'threat' aircraft's position is displayed and an aural warning is given. Many TAS units will also give a "LOOK UP/LOOK DOWN" clue to help you locate the threat aircraft. Like the TIS system, their traffic information can be displayed on many leading MFD units.

Traffic Alert Collision Avoidance System (TCAS) I and TCAS II

TCAS consists of a transmitter, receiver, directional antennas, computer and cockpit displays. TCAS sends out a signal, called an interrogation, that is picked up by another aircraft's transponder, which sends back a reply. The TCAS computer uses that reply to calculate distance and direction of the replying aircraft. The information also displays relative altitude and whether the target aircraft is climbing or descending. Should the aircraft be determined to be a threat, this information is used to display a "Traffic Advisory" (TA). During a TA, a synthesized voice announces, "Traffic, Traffic" and the symbol on the display changes from a white diamond to a solid yellow circle.

TCAS II adds an additional function called a Resolution Advisory (RA). During an RA the threat aircraft's symbol changes from a solid yellow circle to a red square, and the aural system will demand a maneuver such as "Climb, Climb" or "Descend,

Descend," or it may tell the pilot NOT to maneuver. Regulations permit only commands for vertical maneuvers, not turns.

When a TCAS II issues an RA involving another TCAS II-equipped aircraft, it coordinates with the other aircraft's system to avoid mirror-image maneuvers, such as having both aircraft climb.

Automatic Dependent Surveillance—Broadcast (ADS-B)

ADS-B is the first leg of the FAA's "Free Flight System" where each aircraft is responsible for its own navigation and separation. An ADS-B equipped aircraft sends its identification along with speed and precise vertical and horizontal positions to the Global Navigation Satellite System (GNSS) constellation. This information is instantly broadcast over the entire GNSS network to other ADS-B equipped aircraft, as well as, ADS-B ground stations which then send it along to ATC in real time. Everyone virtually knows what everyone else in their vicinity is doing without a word being spoken.

And unlike radar, ADS-B is not affected by an aircraft's altitude or range from a station so you can even track aircraft on the ground. And since it is independent of ground-based radars, it provides perfect location and traffic information in mountainous terrain or in the middle of the ocean. The only drawback is that there are so few aircraft equipped with ADS-B, so for the foreseeable future, you'll still be flying under the watchful eye of ATC.

Garmin

Garmin's GTX 330/330D is an IFR-certified panel-mount transponder with datalink capability including such services as ADS-B and local traffic updates. Their GNS 430 or GNS 530 displays Traffic Information Services (TIS), with outputs including traffic location, direction, altitude, and climb/descent information. Garmin's GTX 330 and GTX 330D meet requirements of Level 2 Mode-S to satisfy upcoming European Mode-S Mandate for Elementary Surveillance.

The 330/330D features easy-to-read DSTN Liquid Crystal Display and an innovative keypad with dedicated VFR button. The unit also provides several timing and display functions, remote indent, plus altitude monitor with voice alerting.

The GTX 330D adds antenna diversity for improved visibility to TCAS-equipped aircraft flying above you.

The GDL 90 is a Universal Access Transceiver (UAT) that is certified to support a broad array of ADS-B broadband services. It broadcasts your aircraft's position, velocity, projected track, altitude, and flight identification to other equipped aircraft, as well as FAA ground-based transceivers. Pilots equipped with the GDL 90 and operating within the ground station coverage area will receive TIS-traffic, FIS-B weather, and TRF-services free of charge.

The broadband datalink transceiver is capable of data transmission rates in excess of one megabit per second, supporting the transmission of large graphical weather files, TFRs, and traffic updates in real time. The

TCAS COMPARISONS

TIS - TRAFFIC INFO SYSTEMS

Model	Description	Price
Honeywell www.bendixking.com		
 KT 73	Mode S Data Link Transponder. Compact, panel-mounted unit with Mode-S capability. Provides aircraft surveillance and reporting capabilities through a unique address code. High-speed data link function ensures future upgrades to Free Flight. Enhanced backlighting for easy readability and one-touch VFR. Optional interface with Bendix/King KMD550 or KMB 560 MFDs.	Suggested Price (Not Installed) $5,030
Garmin www.garmin.com		
 GTX 330/330D	Mode-S Transponders. IFR-certified panel-mount transponder with datalink capability, including ADS-B and local traffic updates. DSTN Liquid Crystal Display and keypad with dedicated VFR button. Provides several timing and display functions, remote indent, plus altitude monitor and voice alerting. GTX 330D adds antenna diversity.	Suggested Price (Not Installed) GTX 330 $4,995 GTX 330D $9,995

TCAD - TRAFFIC and COLLISION ALERT DEVICE

Model	Description	Price
Ryan International Corp. www.ryaninternational.com		
 9900B	Traffic Alert and Collision Avoidance Device. Passive reception unit that features 6 nm range. Displays up to three threats at one time using TCAS symbology. 360 degree coverage. Displays bearing to threat and interfaces with all major MFD and EFIS systems. Upgradable to 9900BX TAS capabilities.	Suggested Price (Not Installed) $7,990 w/o display $9,280 with 1/2 3ATI display

TAS - TRAFFIC ADVISORY SYSTEM

Model	Description	Price
L-3 Communications Avionics Systems www.l-3com.com		
 SkyWatch	TAS. Tracks up to 30 intruder aircraft. Generates aural and visual traffic advisories, including a "Look Up/Look Down" altitude display. Selectable 2 nm and 6 nm range. Displays up to eight conflicting targets.	Suggested Price (Not Installed) $18,525 w/o display $23,295 with dedicated display

TAS - TRAFFIC ADVISORY SYSTEM continued...		
Model	**Description**	**Price**
L-3 Avionics Systems www.as.l-3com.com		
SkyWatch HP	TAS. Tracks up to 35 intruder aircraft within 35 nm surveillance range. Generates aural and visual traffic advisories, including a "Look Up/Look Down" altitude display. With TCAS I antenna, Skywatch can be installed as TCAS.	Suggested Price (Not Installed) $25,375 TAS configuration w/o display $30,145 TAS configuration with dedicated display
Ryan International Corp. www.ryaninternational.com		
9900BX	TAS. Adds active transponder interrogation of possible threat aircraft. Audible Position Alerting includes bearing, distance and vertical position. Over 20 nm range. Tracks up to 50 targets, displays up to nine.	Suggested Price (Not Installed) $20, 990 w/o display $22,300 with 1/2 3 ATI display $28,980 with stand-alone Multi-Hazard Display

ADS-B		
Model	**Description**	**Price**
Garmin www.garmin.com		
GDL 90	ADS-B. Universal Access Transceiver (UAT) certified to support broad array of ADS-B broadband services. Broadcasts aircraft's position, velocity, projected track, altitude and flight identification to other equipped aircraft and FAA ground-based transceivers. Broadband datalink transceiver capable of data transmission rates in excess of one megabit per second, supporting large graphical weather files, TFRs and traffic updates in real time. Built in TSO-C145a WAAS GPS sensor. Designed to interface with optional Garmin MX20 MFD.	Suggested Price (Not Installed) $7,995

All prices are subject to change. Please contact the individual manufacturer or authorized dealer for current pricing.

TCAS BUYER'S GUIDE
unit also features a built in TSO-C145a WAAS GPS sensor.

The GDL 90 is designed to interface with the optional Garmin MX20 multi-function display unit.

Honeywell

Honeywell's KT 73 transponder is a compact, panel-mounted unit that gives U.S.–based pilots Mode-S capability. It provides improved aircraft surveillance and reporting capabilities through a unique address code. High-speed data link function ensures future upgrades to 'Free Flight' traffic management environment.

The KT 73 is equipped with enhanced backlighting for easy readability and one-touch VFR

and optional interface with Bendix/King KMD 550 or KMD 560 multi-function units to display traffic information and warning messages. It meets European Mandate for most piston aircraft and is fully upgradable to 1090 ADS-B capabilities.

Their KTA 970 is a remote mounted, TCAS I unit that tracks up to 60 aircraft and shows graphical information on up to 30 at one time. It displays aircraft up to 8,700 feet above and 2,700 feet below and has eight pilot-selectable ranges from 2 nm to 40 nm. The KTA 9770 displays three-levels of intruders: Non-threat, proximity intruder, and Traffic Advisory (TA).

System features include two directional antennas designed for greater accuracy and to minimize interference with existing antennas. Selectable "above" view and "below" view optimize performance during takeoffs and landings.

Like the KTA 970, the KMH 980 is also a remote mounted unit but combines the capabilities of TCAS I with an Integrated Hazard Avoidance System (IHAS).

The KTA 970 features the addition of the KGP 560 Enhanced Ground Proximity Warning System (EGPWS), which is specifically developed to protect light turbine and piston aircraft from the threat of Controlled Flight Into Terrain (CFIT). It includes a world-wide terrain database in three regions—Americas, Pacific or Atlantic.

L-3 Communications

The SkyWatch Traffic Advisory System uses TCAS-like symbol-ogy to display real time collision avoidance information including the tracking of up to 30 intruder aircraft. It generates aural and visual traffic advisories including a "Look Up/Look Down" altitude display, and selectable 2 nm and 6 nm horizontal display ranges.

The SkyWatch HP extends the capabilities of the SkyWatch by adding a 35-mile surveillance range, increased closure rates, and EFIS/MFD interface compatibility. It can be certified as a TAS or TCAS I, depending on display and antenna configuration. It tracks up to 35 intruder aircraft and, like the SkyWatch, generates aural and visual traffic advisories.

When a Stormscope WX-1000 processor is installed, both of these units can toggle between the SkyWatch and Stormscope displays. They can be interfaced with the optional i-linc full-color, flat panel, multi-function display, and they interface with L-3 LandMark for terrain awareness.

The TCAS 791 is a TCAS I system that provides most of the capabilities of TCAS II but at a significantly lower price. The system tracks up to 35 intruder aircraft simultaneously and generates aural and visual Traffic Advisories. It has selectable 5, 10, and 20 nm horizontal display ranges and three "Look Up/Look Down" relative altitude display modes. The TCAS 791 is STC'd for most popular turboprops and business jets.

Ryan International Corp.

Ryan's 9900B Traffic Alert and Collision Avoidance Device is a passive reception unit that features 6 nm range to provide significant traffic awareness in radar environments. It displays up to

TCAS I & II - TRAFFIC ALERT & COLLISION AVOIDANCE SYSTEMS

Model	Description	Price
Honeywell www.bendixking.com		
KTA 970	TCAS I. Remote mounted. Tracks up to 60 aircraft, shows graphical information on up to 30 at one time. Displays aircraft up to 8,700 feet above and 2,700 feet below. Eight pilot-selectable ranges from 2 nm to 40 nm. Displays three levels of intruders: non-threat, proximity intruder and traffic advisory (TA). Two directional antennas.	Suggested Price (Not Installed) $28,720 $30,860 with Traffic Module for KMD 550/850
KMH 980	TCAS I/EGPWS. Remote mounted, combines TCAS I with IHAS. Features the KGP 560 EGPWS to protect from CFIT. Includes worldwide terrain database in Americas, Pacific or Atlantic.	Suggested Price (Not Installed) $42,560
L-3 Communications Avionics Systems www.l-3com.com		
SkyWatch HP	TCAS I. Tracks up to 35 intruder aircraft within 35 nm surveillance range. Generates aural and visual traffic advisories, including a "Look Up/Look Down" altitude display. With TCAS I antenna, Skywatch can be installed as TCAS.	$28,500 TCAS I configuration w/o display
TCAS 791	TCAS I. Tracks up to 35 intruder aircraft within 35 nm. Generates aural and visual traffic advisories, including a "Look Up/Look Down" altitude display. Selectable 5, 10 and 20 nm horizontal display ranges.	Suggested Price (Not Installed) $62,740 w/o display $73,820 with dedicated display
ACSS www.acssonboard.com		
TCAS 2000	TCAS. Extended range surveillance of up to 80 nm active, 100+ nm passive. Enhanced ATCRBS Range, Altitude and Bearing Tracker algorithms provide greater than 99 percent track probabilities, while reducing false tracks to less than 0.5 percent. Designed for future functionality requirements, Change 8, ASAS, ADS-B Hybrid Surveillance.	List Price $150,888
T^{2}CAS	TCAS/TAWS. Combines actual aircraft climb performance–based TAWS capabilities into the TCAS 2000 line-replaceable unit (LRU). Provides avoidance alerts based on actual aircraft performance data, virtually eliminating nuisance warnings. Avoidance alerts are based on the aircraft's actual ability to climb, not on standard climb rates.	(w/ GPS option) List Pricing $230,135

All prices are subject to change. Please contact the individual manufacturer or authorized dealer for current pricing.

three threats at one time using standard TCAS symbology. The patented Directional Top and Bottom Antenna system provides full 360-degree coverage. It displays bearing to threat and interfaces with all major multi-function and EFIS systems. The 9900B is software upgradable to the 9900BX TAS capabilities.

The 9900BX Traffic Advisory System has all the features of the 9900B and adds active transponder interrogation of possible threat aircraft. It also has Audible Position Alerting, which gives direction and location of the traffic target and an integral Altitude Alerter with audio warnings of altitude deviations. The 9900BX provides over 20 nm range to give pilots more time to take evasive actions. TSO Certified, it meets requirements from the Traffic Advisory System and performance specifications of TCAS I.

ACSS

The TCAS 2000 system has extended range surveillance of up to 80 nm active, 100+ nm passive. The enhanced ATCRBS Range, Altitude and Bearing Tracker algorithms developed by ACSS provides greater than 99 percent track probabilities, while reducing false tracks to less than 0.5 percent. The TCAS 2000 system meets or exceeds the latest requirements of RTCA DO-185A and ARINC 735A, and is fully compliant with the ICAO SARPS (Standards and Recommended Practices) and associated ACAS II mandate. It features an internal data recorder with external PC-based data analysis tool that enables operators to perform

on-board software upgrades.

The T^{2}CAS avionics system combines actual aircraft climb performance-based TAWS capabilities into the TCAS 2000 line-replaceable unit (LRU). The T^{2}CAS provides avoidance alerts based on actual aircraft performance data, virtually eliminating nuisance warnings. Avoidance alerts are based on the aircraft's actual ability to climb, not based on standard climb rates.

T^{2}CAS meets and exceeds all the terrain safety features required by the TAWS TSO-C151a and Windshear C117a standards. ∎