

Unprecedented Look-Ahead Capability
Class A and Class B Options to Meet Your Aircraft Requirements

TAWS

Terrain Awareness and Warning Systems

Three Unique Views: Map, 3-D Perspective and Profile
Depiction and Alerting of Man-Made Obstacles
Obtain the Highest Degree of CFIT Protection



Offering the Highest Protection Against CFIT Accidents

Aircraft inputs such as position, altitude, air speed, glideslope and flight plan along with internal terrain and airport databases allow TAWS to predict a potential conflict between the aircraft's future flight path and terrain. The resulting unprecedented look-ahead capability provides warnings and alerts well in advance of potential hazards, allowing time for the pilot to make the necessary maneuvers or data corrections for terrain avoidance.

TAWS: Class A & B

Two classes of TAWS are offered to meet your aircraft and regulatory requirements, TAWS Class A and TAWS Class B. Providing the highest level of protection against Controlled Flight Into Terrain (CFIT) accidents, TAWS Class A provides all the functionality of the Class B system, plus a terrain awareness display to the aircraft's display system and a "fully autonomous" Ground Proximity Warning System (GPWS).

Universal Avionics' TAWS Class A system will also support smart bank angle alerts, minimum callouts and altitude callouts at selected altitudes. It also provides the class-specific, required RTCA DO-161A and TSO-C92c GPWS, warning of imminent contact with the ground.

Approved in accordance with TSO-C151b requirements, Universal's TAWS Class A and Class B systems both offer:

- Forward Looking Terrain Avoidance (FLTA) based on terrain data and the aircraft's state and predicted flight path
- Premature Descent Alerts
- Attention alerts (aural "Five Hundred" callout and alerts based on temperature-compensated GPS altitudes)
- Indications of imminent contact with the ground.

Crisp, Clear Graphics

Universal Avionics' TAWS integrates with the FMS to provide an additional unique predictive alerting feature, based on information in the flight plan.

TAWS provides an exceptionally crisp and clear graphical depiction of actual terrain, in three view formats (Map View, 3-D Perspective View and Profile View), on the FMS CDUs or flight deck displays such as the MFD-640 or EFI-890R/MFD-890R.

Terrain Data

The high-resolution terrain database is stored in internal flash memory and updated using the Data Transfer Unit via a high-speed Ethernet bus. It features a data point approximately every 0.5 mile world-wide and up to 0.1 mile at mountainous airports. The terrain database also includes data for depicting oceans and large inland bodies of water.

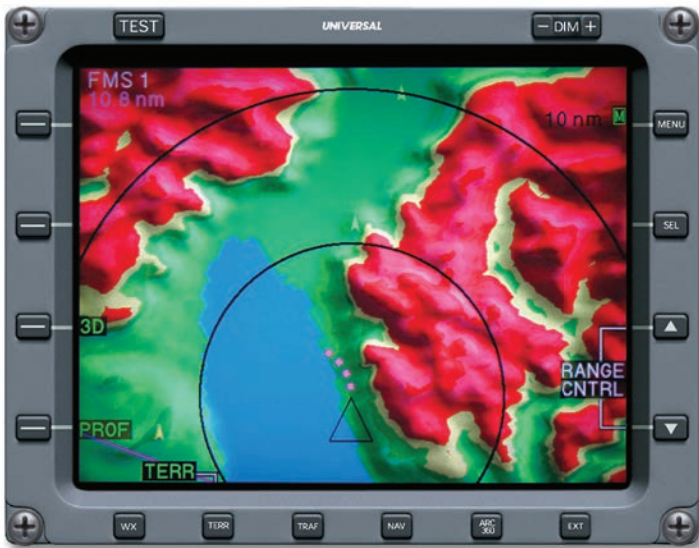


Color-coding is utilized to depict terrain relative to the aircraft's altitude. Red shows terrain above. The yellow band is flight phase dependent reflecting terrain down to 1,000 feet below during enroute, 500 feet in terminal areas, and 250 feet on approach.

Obstacle Data

Depiction and alerting of man-made obstacles is available in the Class A and Class B systems as an optional configuration in the TAWS software. The Obstacle Database, required for depiction of man-made obstacles, contains the latest obstacle features. Use of obstacle alerting requires the installation of an external annunciator on the flight deck.

Obstacle data is compiled by Jeppesen Sanderson, Inc. and is captured from digital and paper (graphic and tabular) sources provided by governmental civil aviation authorities and military agencies worldwide.



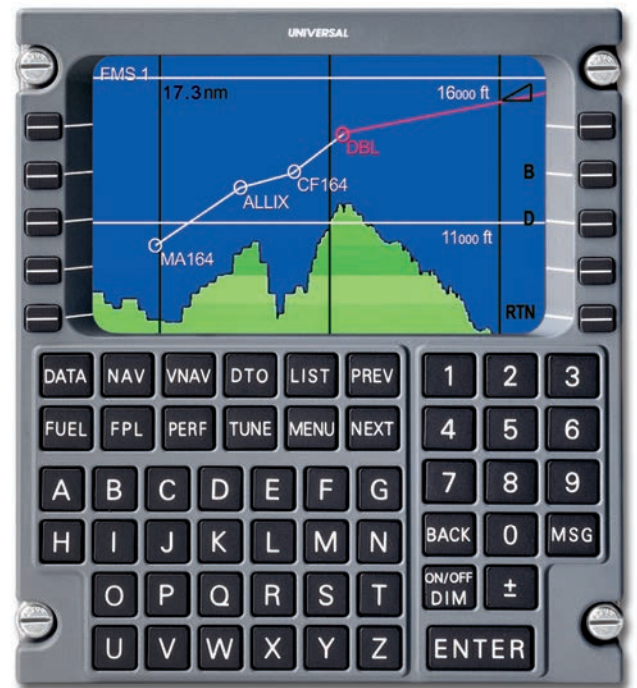
The Map View includes a trend vector depicting a 30-second flight path prediction based on aircraft state. The Map View can be configured to automatically pop up onto the display should a conflict be detected.



A map view of terrain can be output using ARINC 708 or WXPD formats for interface with various existing radar displays as well as existing EFIS. The maximum terrain elevation is also displayed.



A unique 3-D Perspective View depicts terrain and obstacles as it would appear if viewed from 1,000 meters (3,281 feet) behind the aircraft. The circle at the top of the waypoint depicts the altitude constraint. A perspective correct 200-foot high triangle with a concave base and a pole that connects the triangle and the ground represents the 3-D Perspective View Obstacle symbol.



The Profile View shows terrain under the projected flight path. VNAV waypoints from the flight plan can be shown at their respective assigned altitudes. Look Ahead conflict advisories are depicted with a white threat symbol.

Exceeding Mandated Requirements with Options to Match Your Operation*	Class A	Class B
Ground Proximity Warning functions per DO-161A and TSO-92c	■	■
Mode 1: Excessive rate of descent	■	■ Notes 1, 2, 3
Mode 2: Excessive closure rate to terrain	■	
Mode 3: Negative climb rate or altitude loss after takeoff	■	■ Notes 1, 2, 3
Mode 4: Flight into terrain when not in landing configuration	■	
Mode 5: Excessive downward deviation from an Instrument Landing System (ILS) glideslope	■	■ RA required
Mode 6: Altitude Aural Callouts		
"Five Hundred" callout	■	■ Note 1
Additional altitude callouts	■ (opt.) Note 4	■ RA required
Smart bank angle alerts / minimums callout	■ (opt.)	
Forward Looking Terrain Avoidance functions per TSO-C151b	■	■
Reduced Required Terrain Clearance Alerts – Generated when the aircraft is currently above the terrain in the projected flight path of the aircraft, but the projected value of terrain clearance is considered unsafe for the phase of flight.	■	■
Imminent Terrain Impact Alerts – Generated when the aircraft is currently below the elevation of a terrain cell along the lateral projected flight path of the airplane and, based on the vertical projected flight path, the system predicts that the terrain clearance will be less than the required terrain clearance for the phase of flight.	■	■
High Terrain Impact Alerts – Generated when the terrain ahead and along the flight path is higher than 1,500 feet above the projected vertical path.	■	■
Flight Path Intent Advisory Alerts – Generated when the terrain ahead and along the flight plan conflict.	■	■
Terrain Display function	■	■
VGA/RGBS Video (Interface to Universal MFD-640, EFI-890R and FMS CDUs. Provides contoured Map View, Profile View and 3-D Perspective View.)	■	■
Honeywell - Primus® EFIS and WXPDP displays (See Display Interfaces)	■	■
Rockwell Collins - WXR, Pro Line® and FDS 2000 displays (See Display Interfaces)	■	■
ARINC 708 weather radar displays	■	■
Appropriate visual and aural discrete signals for both caution and warning alerts	■	■
Premature Descent Alerts (PDA) – Generated when the aircraft violates the minimum ground clearance boundary (MGCB) protection along the final approach segment to an airport.	■	■
Temperature-compensated altitude	■	■
GPS altitude	■	■
TCAS and Reactive/Predictive Wind Shear Warnings Prioritization	■	■

- Required
- Included

Note 1: These select GPWS alerts can use Height Above Terrain (HAT) in lieu of Radio Altitude (RA) since RA is not required for these installations.

Note 2: If RA is available, it will be used for these alerts, and the system will revert to HAT if the RA fails.

Note 3: Class A TAWS requires a 2,500 foot or 2,000 foot RA. Either RA may be used for Class B TAWS, but neither is required.

Note 4: A large number of selected altitudes between 10 and 2,000 feet may be configured for audio callout.

* The Universal Class A and Class B TAWS meet the Canadian requirement for Enhanced Altitude Accuracy (EAA) when configured for temperature compensation and GPS altitude.

Display Interfaces

Additional interfaces under development.
Contact your Universal Avionics representative.

Universal Avionics

- EFI-890R/MFD-890R
- MFD-640
- FMS with 4-inch or 5-inch CDU

Honeywell

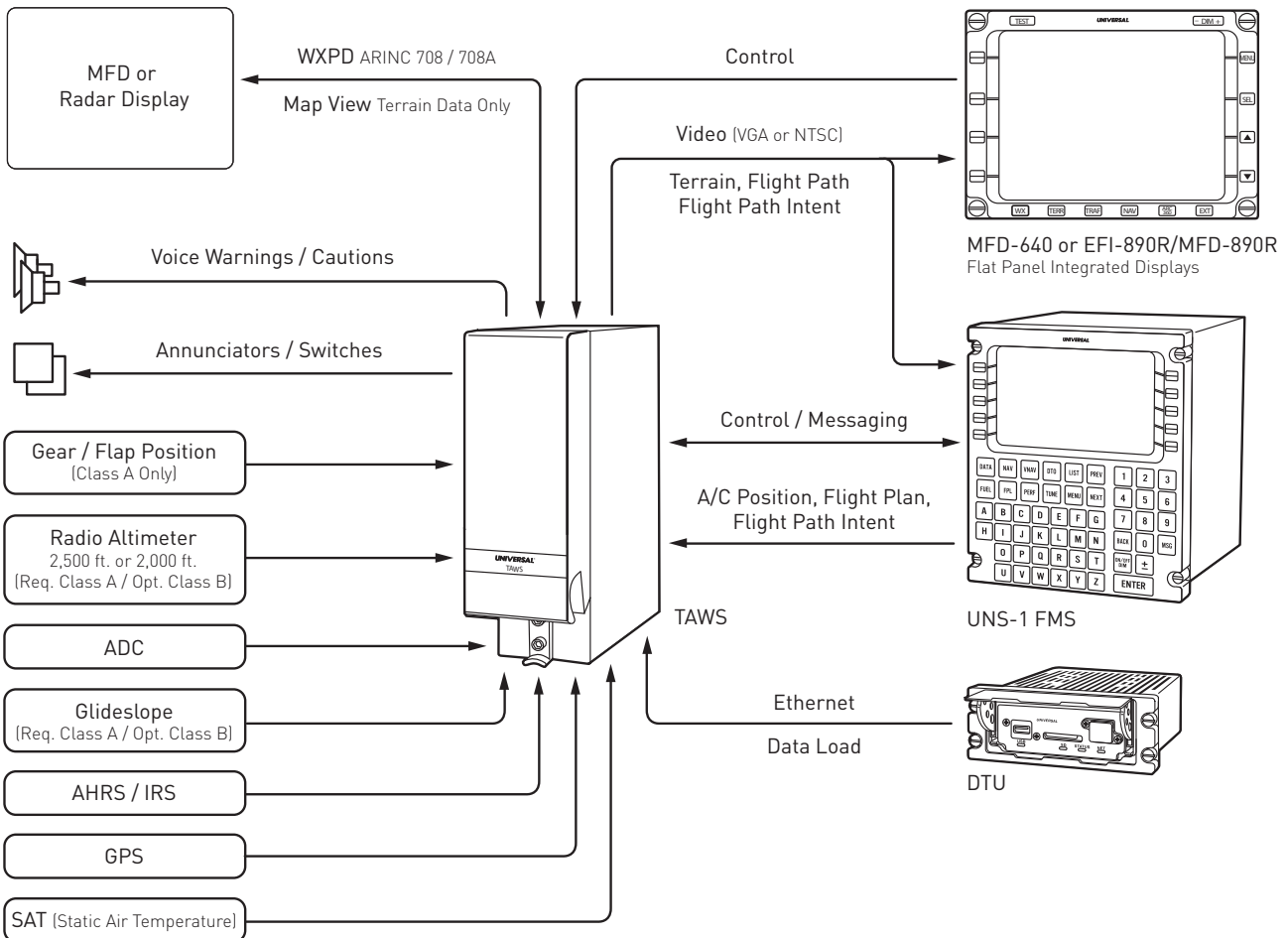
- Primus 1000
- EFIS-805 (specific versions via WXP/SCI)
- EFIS-10 (ARINC 708)
- Primus 880/660/440 series
- Primus 800/870/650 (WXP/SCI)
- RDR 4A/B

Rockwell Collins

- FDS-2000
- PL-4000 EFIS
- PL-21 EFIS
- EFIS 85/86 (via WXP-850 or WXA-1000)
- WXR-850
- WXR-70X

Specifications

- Size: 2 MCU
- Weight: 9.6 lbs (4.7 Kg)
- Cooling: Passive cooling fan
- Power: 28VDC @ 1.0 Amp nominal
- Environmental categories: DO-160D
- Minimum Performance Standards: DO-161A
- Airborne Ground Proximity Warning Equipment
- Software Certification: DO-178B Level C
- Criticality level: Major
- Terrain Database: DO-200A compliant
- TSO: C151b Terrain Awareness and Warning System, C92c Airborne Ground Proximity Warning Equipment





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System features may be limited based on interfacing equipment and type of installation.
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Primus is a registered trademark of Honeywell.
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Volume 4 Issue 1

Issue Date July 18, 2012

Subject: New Regulations for Terrain Awareness Warning Systems (TAWS)

On Wednesday, July 4th, 2012, Transport Canada issued the long expected and final amendments to the CARs affecting what aircraft do and do not require TAWS (Terrain Awareness Warning Systems).

The new TAWS regulations apply to virtually all commercial air taxi, commuter and/or airline operations. These fall into the CARs Subparts 703, 704 and 705. The new regulations will also apply to private operators of turbine-powered aircraft with 6 or more pax seats.

The new regulations are effective immediately for airplanes manufactured on or after July 4, 2012. They also apply to newly manufactured aircraft that enter Canada on a leaseback arrangement.

Aircraft manufactured before July 4, 2012 have two (2) years after the date of Final Rule to have a TSO C151b compliant TAWS Systems installed and Transport Canada certified. All TAWS Systems must be compliant with the EAA requirement within 5 years of the date of Final Rule.

Under the new regulations TAWS is required for airplanes involved in the following CARs categories of operation:

CAR Subparts	Regulatory Requirements
Subpart 605	Private turbine-powered aeroplanes and commercial aircraft configured with six or more seats, excluding pilot seats, except when operated DAY Visual Flight Rules, will be required to be equipped with Class A or B TAWS with EAA functionality.
Subpart 703	Aeroplanes configured with six or more seats, excluding pilot seats, except when operated DAY Visual Flight Rules, will be required to be equipped with Class A or B TAWS with EAA functionality.
Subpart 704	Aeroplanes configured with six to nine passenger seats, except when operated DAY Visual Flight Rules, will be required to be equipped with Class A or B TAWS with EAA functionality.
	Aeroplanes configured with 10 or more passenger seats, exclusive of pilot seats, except when operated DAY Visual Flight Rules, would be required to be equipped with Class A TAWS with EAA functionality, a terrain awareness and situational display.
Subpart 705	Aeroplanes will be required to be equipped with Class A TAWS with EAA functionality, a terrain awareness and situational display.

The full and complete published amended regulation is online at <http://www.gazette.gc.ca/rp-pr/p2/2012/2012-07-04/html/sor-dors136-eng.html>.

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Background:

According to information from Transport Canada contained in the regulatory change documents for TAWS, the number of CFIT incidents tracked from 1977 to 2009 has driven this new regulation. During that period 35 airworthy aeroplanes were flown into the ground while under pilot control. More properly termed controlled flight into terrain (CFIT) accidents, there were 100 fatalities and 46 serious injuries during that reporting period. Unfortunately there have been a rash of incidents since then that have driven those numbers significantly higher.

Transport Canada did start to look at this issue back in the mid 1990s – following FAA's TAWS rulemaking activity. Canadian TAWS rules have been bogged down since that time in a series of delays involving studies on everything from costs efficiencies through to aircraft applicability and implementation.

The CARs have required that aircraft operated under Subpart 705 - *Airline Operations* - be equipped with a Ground Proximity Warning System (GPWS) since the mid-1980s. The technology at the core of GPWS has evolved and today virtually eliminates the CFIT risk.

GPWS out - TAWS in:

The new generation of GPWS, better known as TAWS, provides:

- *Predictive* rather than *Reactive* aural and visual warnings of an impending collision with terrain or obstacles under conditions GPWS cannot;
- A “forward-looking” terrain display, based on real-time comparison of an aircraft’s location, bearing, and speed with stored terrain data; and
- Calculation of a terrain clearance “floor,” based on calculated distance to a specified runway threshold location, which provides alerts and warnings independent of landing gear or flap settings.

There are two classes of TAWS equipment available, TSO C151b Class A and Class B.

- Class A TAWS is intended for larger aeroplanes.
- Class B is intended for smaller aeroplanes.
- Both classes have the terrain look-ahead functions, called Forward Looking Terrain Avoidance (FLTA), and the unsafe terrain clearance function, called Premature Descent Algorithm (PDA), in addition to the basic GPWS function.
- Because Class B TAWS is intended for smaller aeroplanes, it has reduced GPWS modes compared to Class A TAWS and is simpler and less expensive to install.
- Class A TAWS requires a Terrain Display, while Class B TAWS does not, however we strongly recommend a Terrain Display for all TAWS installations.
- Non-TSO'd Advisory Terrain Systems and Synthetic Vision Systems do **not** meet the requirements of TSO'd TAWS Systems

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About Enhanced Altitude Accuracy Requirement . . . or EAA

The Transport Canada TAWS regulations also require that TAWS equipment incorporate *Enhanced Altitude Accuracy* functionality. Most, but not all current TAWS Systems do meet this requirement. This EAA function uses GPS Altitude or algorithms including GPS Altitude to derive an accurate altitude calculation for the aircraft at all times irrespective of the Baro-Setting of the Pilot's Altimeter. Accordingly the TAWS protection envelope is always accurate. Baro-Corrected Altitude from an AirData Computer does **not** meet the EAA requirement, as the possibility exists for the crew to input an incorrect Altimeter Baro-Setting, which would thereby inhibit the TAWS from fully protecting the aircraft from CFIT. The Transport Canada EAA requirement makes good sense in our opinion!

Note - Aircraft that are already equipped with TAWS Systems utilizing a Baro-Corrected ADC Altitude Source **will have to be upgraded** to meet the EAA requirement. Please feel welcome to call either Barry Aylward or Bill Arsenault if you have questions!

International TAWS Regulations in comparison.

In their final publication of the new TAWS regulations, Transport Canada TAWS rules have two important differences from the rest of the world. First is the *Enhanced Altitude Accuracy* requirement, and second is that the FAA and ICAO requirements apply only to turbine-powered airplanes. Transport Canada TAWS rulemaking encompasses **all** passenger-carrying aeroplanes in commercial operations.

KAAV, MC2 and TAWS Providers

Kitchener Aero and Mid-Canada Mod Center have a respected and acknowledged industry leadership in Canada for the design, installation and certification of complex avionics upgrades and mods that include TAWS. This covers all the aircraft operational categories affected by the new TAWS regulations.

As is the case with any mod or update, cost can vary widely based on the type of aircraft, the existing avionics configuration, the type of TAWS required, and of course the amount of work involved. While there can be similarities, no two airframes are ever exactly the same. Therefore every quotation for TAWS upgrades will be unique.



While a Terrain Display is required on Class A TAWS installations, it is technically optional on Class B TAWS installations. However based on working feedback from current TAWS clients and an complete understanding of the system usage and operations under real situations, a display really should be part of **all** TAWS installations. Any added cost will be offset by greatly enhanced situational awareness at all times.

KAAV and MC2 are authorized dealers for Garmin, Honeywell, Sandel and Universal – key OEM providers of TAWS systems.

For more information or discussion about TAWS or any other avionics issues, please feel welcome to contact Barry Aylward at Kitchener Aero or Bill Arsenault at Mid-Canada Mod Center.