



TERRAIN AWARENESS WARNING SYSTEM (TAWS) SCN 12.X OPERATOR'S MANUAL

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Revision 1 25 February 2010

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RECORD OF REVISIONS

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RECORD OF TEMPORARY CHANGES

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Temporary Change No. 34-40-01.06-2

Manual Affected

Universal Avionics Systems Corporation TAWS 12.X Operator's Manual, Report No. 34-40-01.06, Revision 1 dated 25 February 2010.

Filing Instructions:

Insert this Temporary Change adjacent Page 1 in the Introduction section.

Purpose:

To add Obstacle Database information.

Instructions:

Add the following paragraph after the last paragraph on page 1:

The world-wide obstacle database, also stored in flash memory, includes catalogued trees and man-made obstructions with a height above terrain of 50 feet or more.

NOTE: Not all obstacles may be charted by the data originators and therefore not all obstacles that are potentially hazardous to aircraft are included in the obstacle database.

INTRODUCTION

General

TAWS provides an advanced Ground Proximity Warning System (GPWS) with terrain and obstacle awareness and warning relative to current and predicted aircraft position. The obstacle function is optional. The system provides alert information to the flight-crew both visually and aurally. Based on information from the FMS, GPS, air data computer, AHRS, radio altimeter, flaps, landing gear and ILS, TAWS is able to determine the aircraft's state and intent and provide caution and warning alerts well in advance of potential hazards.

NOTE: TAWS is intended to be a tool that the flight-crew will use to identify potential flight path hazards and perform the appropriate escape procedures when an alert occurs before referencing the TAWS display. It is not intended for navigation during alert conditions.

TAWS provides displays of terrain and obstacles with flight path intent information in several views: Map, Profile and 3D perspective views. These views are available for display on video-capable devices such as UASC's Multi-Function Display (MFD), EFI-890R and FMS displays. TAWS can also be displayed on ARINC-708 devices such as weather radar indicators. When an ARINC-708 display is used, only the Map view can be displayed.

Alerts are provided if any part of the entered flight plan poses a threat when a vertical path is defined. The system provides "Flight Plan Look Ahead" alerts by comparing the FMS flight plan to the terrain databases.

TAWS supports both U.S. and European syntax aural alerts. Selection of syntax type is made during system configuration. Throughout this manual, U.S. syntax is used. European Syntax is described in the Aural and Visual Alert Messages section of this manual.

The terrain database, stored in flash memory, contains a data point approximately every one-half nautical mile worldwide. Data points are at least every one-fourth nautical mile between 60 degrees south and 70 degrees north latitude within fifteen nautical miles of every major airport. Data points are also at least every one-tenth nautical mile within six nautical miles of mountainous airports.

NOTE: All functions in this manual that are not explicitly identified as Class A or Class B apply to both TAWS classes

Limitations

When not using a Universal Avionics' FMS with SCN 604.3/704.3 or later 60X/70X, or SCN 80X.X/90X.X or SCN 100X.X/110X.X, data provided by TAWS is limited and the following will not be displayed.

Flight plan information

Flight path Intent alerts

Distance to next Waypoint

Profile View is not available

TAWS Database Subscription

Terrain databases are updated periodically and are available from Universal Avionics. Universal Avionics will notify users by way of a Service Bulletin when a database update is released.

TAWS airport database updates are available every 28 days. Obstacle database updates will be available quarterly. Contact Universal Avionics to order updates.

To receive notification of updates to the terrain, obstacle and airport databases we must be notified that you are a TAWS user.

Universal Avionics Systems Corporation
Attn: NavData
3260 East Universal Way
Tucson, AZ 85756

- Or -

Email to: navdata@uasc.com

SYSTEM DISPLAYS

TAWS Display Information

NOTE: Display of terrain and obstacle data is optional for Class B TAWS. Refer to the TAWS Installation Manual, Report Number 34-40-01 and TAWS SCN 12.X Configuration Manual, Report Number 34-40-09 for the configuration of TAWS.

TAWS provides three different display views for use as situational awareness tools. These views represent different aspects of the aircraft's position relative to terrain. Vertical and horizontal range scale and image selection are controlled on the TAWS image control pages on the FMS or by controls on Universal's MFD when TAWS is selected for display. Vertical range control is used only while Profile view is selected for display. Unlike Profile and Map views, 3D perspective view is auto ranging based on aircraft altitude. When using non-UASC radar or other compatible displays, only the Map view can be displayed and horizontal range selection is controlled by the display system.

NOTE: In multiple FMS installations, only one FMS at a time can be used to control the TAWS display. The other FMSs will be blocked from controlling TAWS displays. It is possible to install TAWS and control the range and modes from one FMS and display images on another CDU in multiple FMS installations.

The ROC/RTC Relationship

The **TERPS Required Obstacle Clearance (ROC)** is used to determine the color bands on the various TAWS displays. The **TAWS Required Terrain Clearance (RTC)** is used to determine alerts. The color band display criteria vary with phase of flight. TAWS uses the aircraft state, FMS flight plan and airport database to select the destination airport and runway. The following table identifies the Flight Phase for specific flight conditions and the associated ROCs and RTCs for alerts and displays.

Phase	Aircraft Position / Configuration	Alert RTC (feet)	Display ROC (feet)
Enroute	All other flight positions	700 – Level Flight 500 - Descent	1000
Terminal	Less than 15 NM from airport – and – ≤6500 feet above airport elevation	350 – Level Flight 300 - Descent	500
Approach	Flaps in landing position or flap override active – or – Localizer tuned and localizer deviation <2 dots and glide slope deviation <2 dots – or – Less than 5 NM from airport – and – ≤3000 feet above airport elevation	150 – Level Flight 100 – Descent (starts to taper of from 5 NM to the destination)	250
Departure	Aircraft has transitioned from Ground to Flight – or – TOGA Discrete – and – Aircraft position ≤20 NM and distance increasing from the departure airport – and – ≤4000 feet above airport elevation	40 feet per NM from Airport (up to 100 feet)	250

Display and Color Banding Definitions

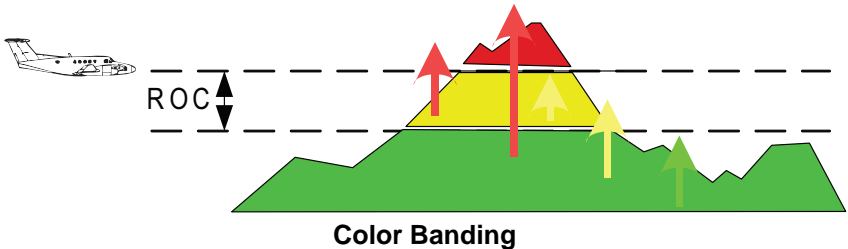
TAWS provides display of proximate terrain and obstacles. The displays are color-coded to provide visual indication of the relative vertical distance between the aircraft, terrain and obstacles. The illustration below identifies the color used for TAWS displays.

Color-coding is utilized to depict terrain and obstacles relative to the aircraft's altitude. The display of obstacles is accomplished with the use of arrows depicting an obstacle and the height of the obstacle above or below the aircraft.

Red shows terrain or obstacles above the aircraft altitude plus 50 feet. The yellow band is flight phase dependent reflecting terrain and obstacles down to 1,000 feet below during enroute, 500 feet in terminal areas, and 250 feet on approach.

NOTE: The yellow (ROC) band is not displayed on the ground.

- **Red** indicates terrain and obstacles *above* the aircraft altitude plus 50 feet.
- **Yellow** indicates terrain and obstacles *below* the aircraft altitude plus 50 feet and penetrating the ROC.
- **Green** indicates terrain and obstacles below aircraft altitude minus ROC.
- **Blue** indicates bodies of water.
- **Gray** indicates areas where terrain database is not available.



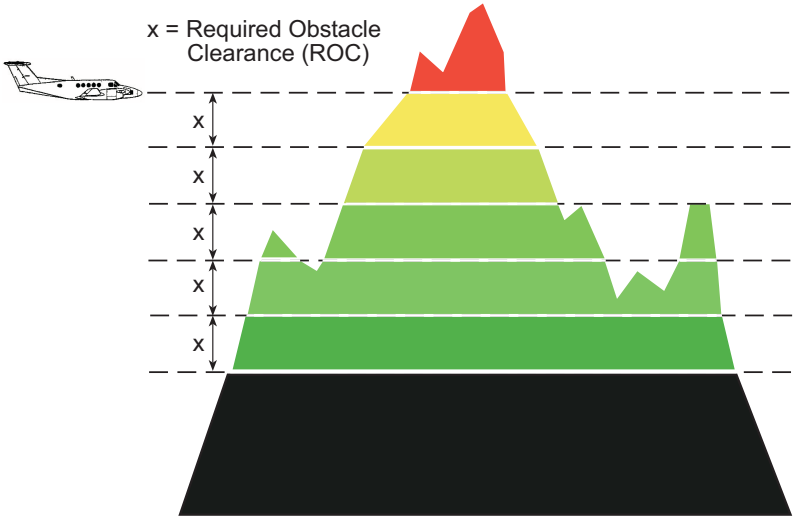
ARINC-708 Weather Radar Display

When TAWS is displayed using an ARINC-708 display device, only Map View is available for display. The following illustration identifies the color banding for the ARINC-708 TAWS displays.

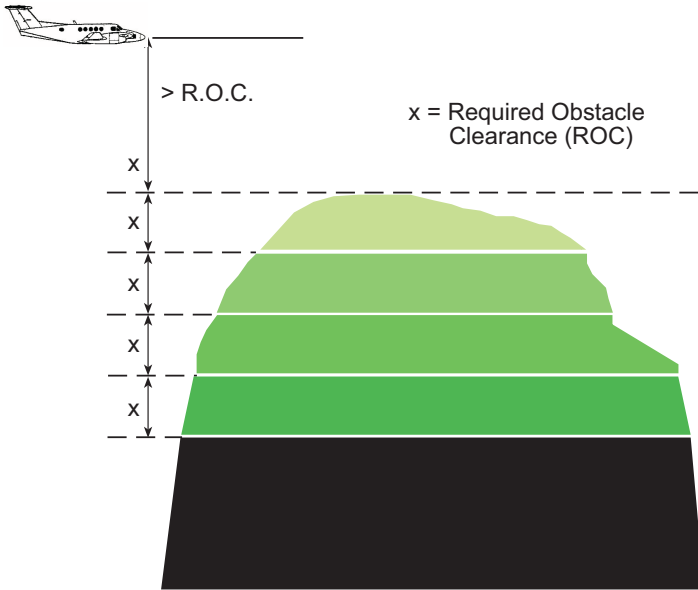
NOTE: Although the illustration of obstacle references is different than terrain, the colors described are applicable to obstacles.

NOTE: The yellow (ROC) band is not displayed on the ground.

- **Red** indicates terrain and obstacles *above* the aircraft altitude plus 50 feet.
- **Yellow** indicates terrain and obstacles *below* the aircraft altitude plus 50 feet and penetrating the ROC.
- **Green** indicates terrain and obstacles below aircraft altitude minus ROC. The texture of the green changes to show height contouring over a range of up to four ROC bands. When the aircraft is more than ROC band height above all terrain, terrain will be shown with the highest terrain in green and lower terrain contoured up to three additional bands. (See the following illustrations.)
- **Black** indicates terrain or water that is below the green terrain.
- **Blue** On 7-color ARINC-708 displays, Blue indicates areas of water, although water may be displayed as yellow depending on the ROC of the aircraft.
- **Magenta** indicates areas where terrain database information is not available.




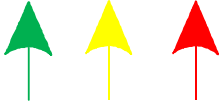
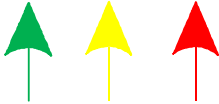






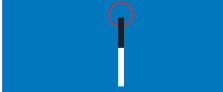



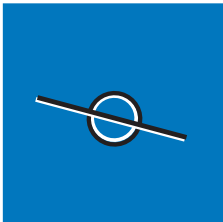
**ARINC-708 WXR Depiction of Color Banding
Within ROC Band Height**



**ARINC-708 WXR Depiction of Color Banding
Above ROC Band Height**

TAWS Symbols

Name	Description	Symbol
Terrain and Obstacle Threat Warning	Flashing, two dimensional, hollow, seven pointed star. Red with bold black border. NOTE: Star does not flash on WXR display.	
Terrain and Obstacle Threat Caution	Flashing, two dimensional, hollow, seven pointed star. Yellow with bold black border. NOTE: Star does not flash on WXR displays.	
Terrain and Obstacle Flight Plan Advisory	Two dimensional, hollow, seven pointed star (does not flash). White with bold black border. NOTE: This symbol is displayed only in Map and Profile views only.	
Obstacle Symbol – 3D View	A perspective correct 200-foot high triangle with a concave base and a pole that connects the triangle and the ground. The tip of the triangle represents the 3-dimensional position of the highest point of the obstacle.	
Obstacle Symbol – Profile View	A triangle with a concave base and a pole that connects the triangle and the ground. The tip of the triangle represents the vertical and along flight-plan position of the obstacle.	
Obstacle Symbol – Map View	A triangle with a concave base. The tip of the triangle represents the lateral position of the obstacle.	
Flight Plan Legs	Straight line between Waypoints – Active Flight Leg Color (config option) for Active Leg. White for down path legs, Gray dashed for flight legs hidden behind terrain.	

Name	Description	Symbol
Waypoint	Hollow Circle – Active Flight Leg Color (config option) for Active Leg. White for down path legs, gray for Waypoints hidden behind terrain	
Waypoint IDENT	Text – Same color as associated Waypoint. White for down path legs, gray for waypoints hidden behind terrain. In 3D Perspective View, only the TO waypoint leg Ident is displayed.	
Waypoint Post	Pole drawn from Waypoint elevation to terrain elevation. Top 1000 feet is black with remainder white.	
Aircraft Symbol	Map View Center of triangle is PPOS	
Aircraft Symbol	Profile View Center of triangle is PPOS	
Aircraft Symbol – Black Hat	3D View (Configurable option) Center of triangle is present position and elevation. Triangle (representing the fuselage) with line at base (representing surfaces) Two options available, solid black (Black Hat) or black on top and white on bottom (2 tone Hat).	
Aircraft Symbol – Banking Circle	3D View (Configurable option) Center of circle is present position and elevation. Circle (representing the fuselage) with a bisecting line (representing aircraft bank angle)	

Terrain Threat

WARNING: DURING HIGH RATES OF DESCENT OR WHILE TURNING NEAR TERRAIN, CAUTION AND WARNINGS CAN OCCUR IN SIGNIFICANTLY LESS TIME THAN THE NORMAL 50 AND 30 SECONDS PRIOR TO THREAT.

When a terrain alert is active, a terrain threat symbol is displayed on each terrain display at the point of predicted impact nearest the aircraft. A terrain threat is depicted by a terrain threat symbol. The characteristics of the symbol are consistent with the alert level.

If the alert level is **CAUTION**, the terrain alert symbol indication will be a flashing yellow star. This yellow star is issued approximately 50 seconds prior to the terrain threat. If the alert level is **WARNING**, the terrain alert symbol indication will be a flashing red star. This red star is issued approximately 30 seconds prior to the terrain threat.

When the FMS flight plan criteria have been met and the TAWS computer calculates a predicted terrain threat along the flight plan, a white star terrain threat symbol is displayed. A white star does not require immediate pilot action, but flight plan waypoint and VNAV information should be checked for accuracy.

NOTE: The symbols will not flash when displayed on non-Universal Avionics radar or other compatible displays.

Obstacle Threat

TAWS selects a subset of obstacles to be depicted within the terrain image field of view. This avoids excessive obstacle-icon clutter on the terrain images in regions of high obstacle density. When a forward looking terrain or obstacle alert is annunciated, greater emphasis is placed on the obstacle threats by reducing or eliminating the amount of decluttering. An alerting obstacle is always displayed.

When the obstacle alerting function is enabled and an obstacle alert is active, an obstacle threat is displayed on the terrain display at the location of the obstacle conflict. The symbol displayed to annunciate an obstacle threat is the same symbol that is used to annunciate a terrain threat.

If the alert level is **CAUTION**, the obstacle alert symbol indication will be a flashing yellow star. This yellow star is issued approximately 50 seconds prior to the obstacle threat. If the alert level is **WARNING**, the terrain alert symbol indication will be a flashing red star. This red star is issued approximately 30 seconds prior to the obstacle threat.

Flight Plan

The FMS flight plan is overlaid on the Map and Profile view displays. The overlay graphically indicates current aircraft position as well as waypoint locations and Idents for the TO leg and beyond legs as selected.

Connecting waypoints is done with a line between waypoints. The TO leg is the color magenta and subsequent legs are white. A valid flight plan must have more than one waypoint to be displayed on TAWS.

The user can select which waypoint names to display using one of the following options selectable through Universal's FMS CDU or MFD: **TO** – display to waypoint only, **ALL** – display all waypoints or **NONE** – display no waypoints.

To reduce clutter on the TAWS display, TAWS inhibits the display of waypoints when it has been determined that a missed approach has occurred. The waypoints will be redisplayed when they become part of the active flight plan when the aircrew activates a missed approach. If the pilot re-links the flight plan or performs a DTO such that the approach legs are again being flown by the FMS, TAWS will display them.

Waypoint Idents

The textual Ident of waypoints appears to the right and below each waypoint of the Map and Profile views. On the 3D perspective view, only the TO Waypoint is displayed to avoid clutter.

NOTE: During holding patterns, flight-plan data is suppressed.

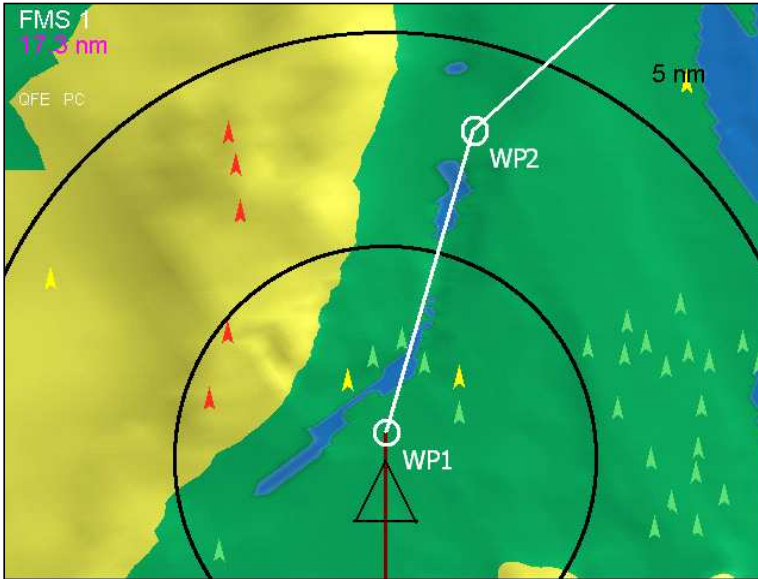
Pop-up Terrain Display

In the event of an alert, if pop-up is configured, Map view will pop-up on the FMS or other display device at the 10 NM range. Pressing any function key on the FMS will remove the pop-up and revert to the selected FMS function.

NOTE: On non-UASC radar or other compatible displays, the TAWS display will only pop-up in the currently selected range.

Map View

In Map view, the aircraft's position is represented by the apex of the aircraft position triangle. This view shows the terrain under the aircraft as seen from above.



Map View Displaying Terrain and Obstacles

This view also displays the FMS flight plan superimposed over the terrain if the aircraft is on or within the display range of the flight plan.

NOTE: The display may differ when displayed on non-Universal radar or other compatible displays.

“GAPs” or “NO LINKS” in flight plans are depicted as no connection between waypoints on either side of the GAP.

Selected heading legs and curved paths such as holding patterns, procedure turns and DME arcs are not drawn by TAWS and will appear as flight plan GAPs.

The source of FMS data in use is announced at the upper left corner of the display along with distance to the current **TO** waypoint. The current FMS Navigation leg is displayed in magenta. Subsequent legs are white. Waypoint identifiers are selectable through UASC's FMS.

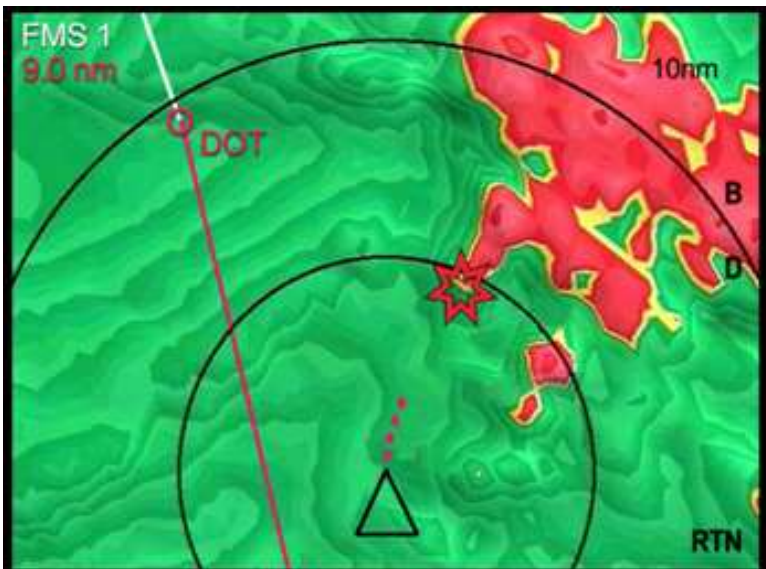
Terrain Conflict and Off Flight Plan Maneuvering

In the Map view, the aircraft's flight path trend will be shown. A dashed magenta line from the aircraft symbol represents the projected path based on current track and velocities.

If the predicted path encounters terrain or obstacles that do not provide the required clearance, a Caution or Warning threat symbol will be displayed at the closest threat location.

TAWS can detect conflicts with the Flight Plan Intent function. If the conflict is within the displayed range, a white star is depicted at the predicted point of conflict.

Waypoint (XXX) and distance information (-X.X nm) is displayed as **"FPL CONFLICT (XXX X.X nm)"** and may be a negative or positive indication indicating the closest waypoint to the conflict. A positive value indicates the conflict occurs beyond the indicated waypoint and a negative value indicates the conflict occurs before the indicated waypoint. The FROM waypoint in the FMS flight plan cannot be the indicated waypoint in the FPL Conflict message.



Profile View

NOTE: When TAWS is configured for Temperature Compensation and/or GPS altitude, TAWS will use those altitude sources whenever it is deemed those sources are more reliable and accurate than raw Baro Altitude. As a result, terrain clearances, alerting envelopes and terrain display coloring may be referenced to an elevation significantly different from the Baro Altitude displayed on the altimeter and altitudes entered into the FMS (flight deck altitude).

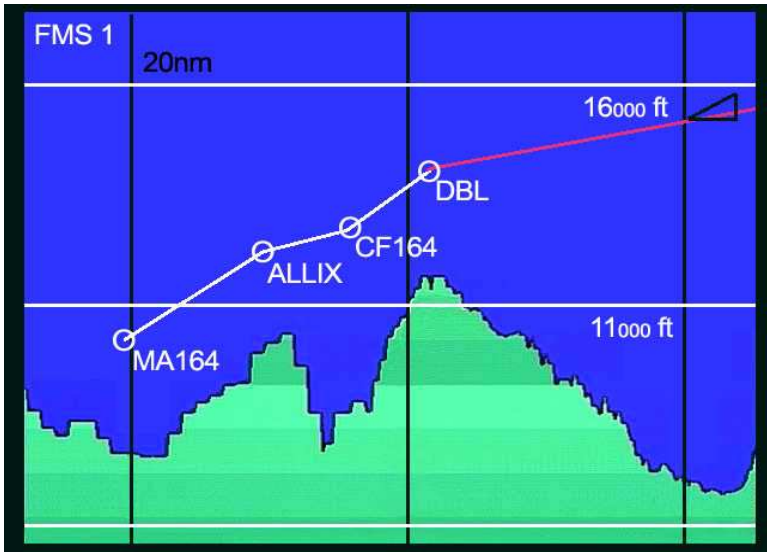
The TAWS Profile view and 3D view terrain displays always depict aircraft altitude and flight path information relative to the aircraft's Baro Altitude. Terrain and obstacles displayed on these views are adjusted up or down on the display so as to **truly display the correct relationship to the aircraft and aircraft symbol, not the flight deck altitude.** When there is large shift of terrain and obstacles on the display, terrain and obstacle elevation depicted on the display may appear higher or lower than elevations published on approach charts and VFR maps. **TAWS alerts and advisories are based on the relationship between the aircraft's actual elevation and terrain elevation, not Baro Altitude and terrain elevation.**

Profile view is a two dimensional representation of terrain along the flight path with the aircraft position and altitude depicted by a black triangle in the upper right corner of the display. The source of data is shown in white in the upper left corner of the display.

Black vertical lines indicate the distance being viewed ahead of the aircraft with both maximum horizontal range and half-range distances displayed. The maximum range selected is shown in the upper left area of the display and corresponds to the range selected on the Map View. Range can be selected on the FMS TAWS page or by line select keys on UASC's MFD.

Altitude is indicated on the right side of the display under the white horizontal reference lines.

GAPs in flight plans are depicted as no connection between waypoints on either side of the GAP. Selected heading legs and curved paths such as holding patterns, procedure turns and DME arcs are shown as flight plan GAPs.



Profile View Availability

The Profile view displays terrain within a narrow band relative to the desired FMS track. The following conditions will produce the message “**PROFILE VIEW NOT AVAILABLE**” and the display to revert to gray.

- The aircraft is more than 2.8 NM from the desired FMS track in the enroute phase.
- The aircraft is more than 1.0 NM from the desired FMS track in the terminal phase.
- The aircraft is more than 0.5 NM from the desired FMS track in the approach phase.
- The aircraft is flying an FMS selected cross-track (SXTK).
- The aircraft is flying an active DME arc or heading leg.
- Aircraft track differs from the desired FMS track by more than 135 degrees.
- There are less than two waypoints in the flight plan or no flight plan.

Holding Patterns and Procedure Turns

Profile view is unavailable under holding patterns and procedure turns, as these legs are dependent on aircraft speed. Profile view is shown both into and out of the fix but not for the procedure. Once a holding pattern or procedure turn is the active, the Profile view is unavailable.

Altitude Range

Horizontal white lines show the vertical range of altitude selected for display. The altitude of each line is shown at the right side of the display below its respective line. The actual range of the display is 25% greater than the selected range to allow for extra altitude to be displayed above the aircraft altitude.

Vertical range can be selected on the FMS TAWS page or by the line select keys on UASC's MFD. The selected range is directly displayed on the FMS TAWS page as illustrated later in this manual. On the MFD, the altitude lines change value to indicate the altitude interval.

The following vertical ranges of altitude can be selected. All Altitudes are listed in feet.

NOTE: When using Profile view, the vertical range should be selected to a value that displays terrain below the aircraft.

Vertical Range Selected	Total Display Range	Display Range Above Aircraft	Display Range Below Aircraft	Altitude Line Intervals
50,000	62,500	12,500	50,000	20,000
25,000	31,250	6,250	25,000	10,000
10,000	12,500	2,500	10,000	5,000
5,000	6,250	1,250	5,000	2,000
2,000	2,500	500	2,000	1,000
1,000	1,250	250	1,000	500
500	625	125	500	200

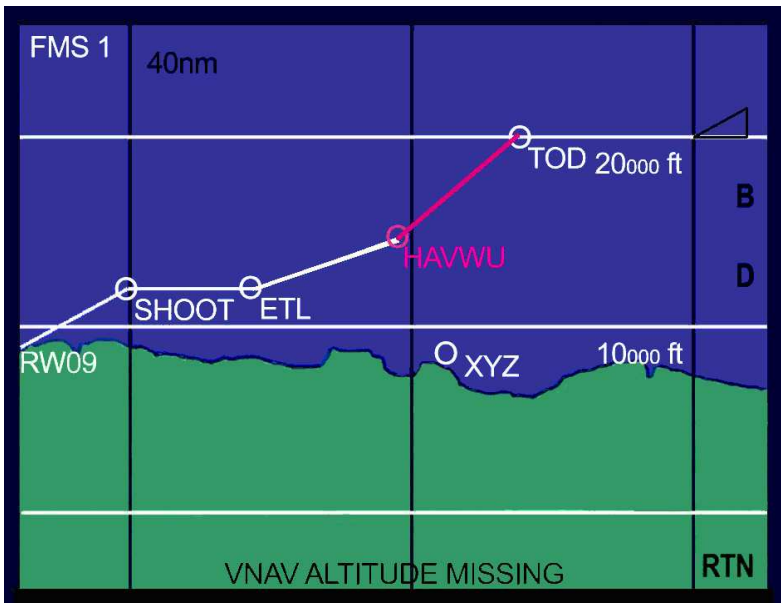
Waypoint Display

The flight plan is displayed via white lines with a magenta line depicting the active leg. Waypoint identifiers can be displayed on UASC's FMS CDU with choices of TO, ALL or NONE.

If waypoint altitudes have been entered, the waypoints will be displayed at the appropriate elevation above the terrain. Waypoints that do not have a valid altitude constraint associated will be depicted 1000 feet above the terrain (i.e. waypoint XYZ) and the message "VNAV ALTITUDE MISSING" will appear across bottom of the display.

NOTE: If the altitude information is not loaded from the navigation database, pilot must enter altitudes manually at waypoints in the FMS flight plan to optimize situational awareness in Profile view.

NOTE: The TOD waypoint is not a lateral waypoint. Once sequenced, TOD and the vertical path to the VNAV waypoint will disappear.

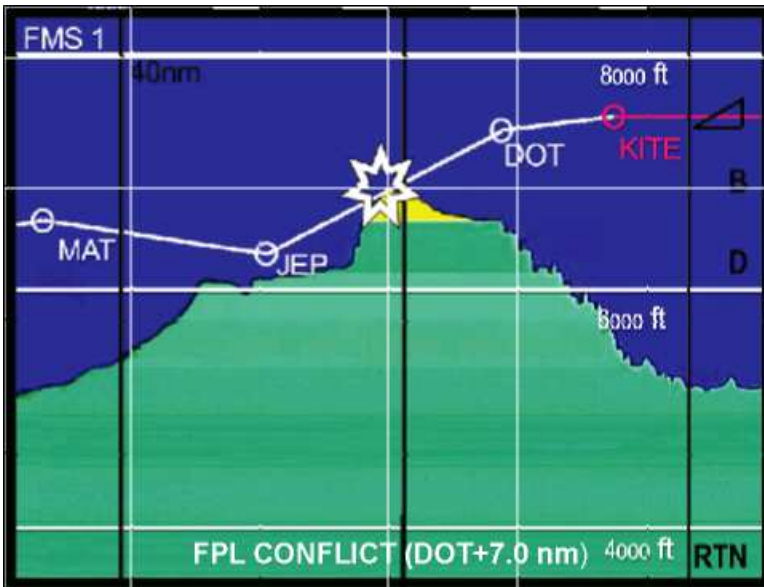


Terrain and Obstacle Conflict

When a flight plan has been entered with altitude constraints associated with the waypoints, TAWS can detect terrain conflicts with the Flight Plan Intent function. If the conflict is within the displayed range, a white star is depicted at the predicted point of conflict.

If the predicted path does not provide the required clearance, a Caution or Warning threat symbol will be displayed at the closest threat location.

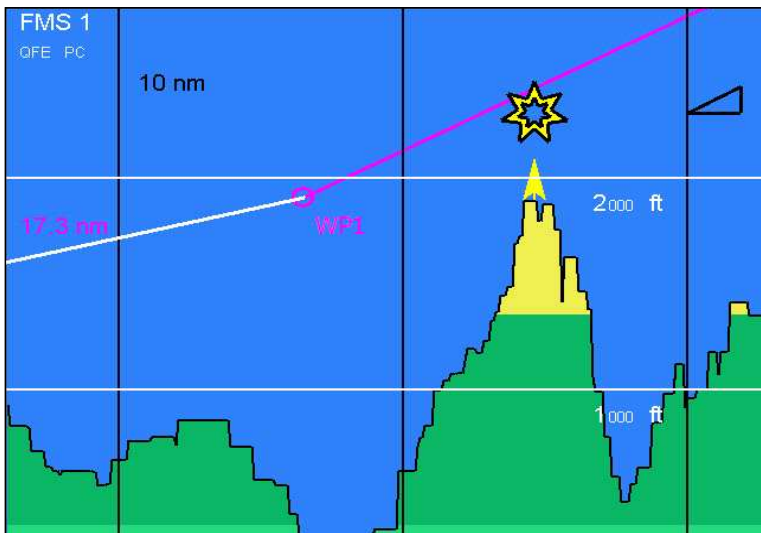
Waypoint (XXX) and distance information (-X.X nm) is displayed as **"FPL CONFLICT (DOT +7.0 nm)"** and may be a negative or positive indication indicating the closest waypoint to the conflict. A positive value indicates the conflict is beyond the indicated waypoint and a negative value indicates the conflict occurs before the indicated waypoint. The FROM waypoint in the FMS flight plan cannot be the indicated waypoint in the FPL conflict message.



Obstacles are not displayed on the Profile view unless an obstacle alert is being annunciated. When an obstacle alert is annunciated only the obstacle causing the alert will be displayed. The alerting obstacle is depicted as color-coded triangle of constant screen size with concave base and pole connected to the ground.

To avoid cluttering the terrain display with obstacles in high obstacle density regions, obstacle decluttering is performed to selectively display a subset of the obstacles.

NOTE: Obstacle decluttering is only performed for display purposes. All obstacles are used in obstacle alerting.



3D Perspective View

The 3D perspective view depicts terrain and obstacles as it would appear if viewed from 1,000 meters (3281 feet) behind the aircraft. The 3D perspective view is auto-ranging based on aircraft altitude

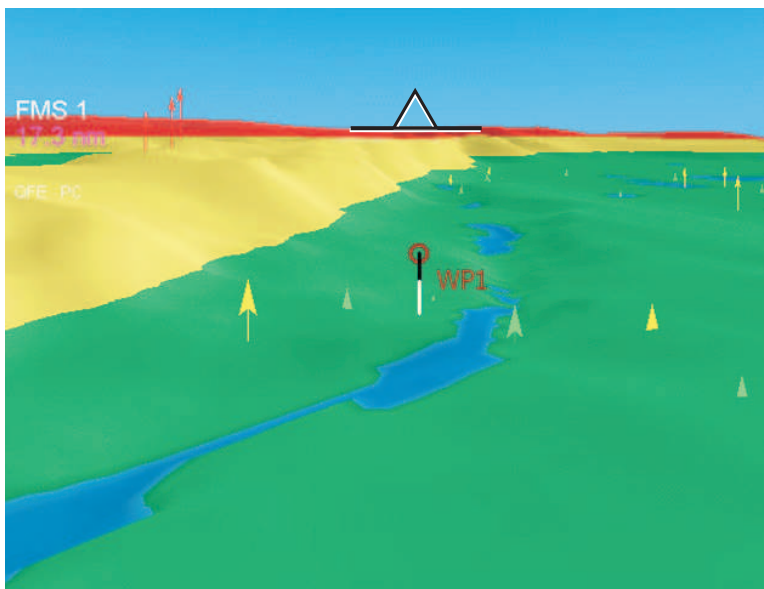
Three different aircraft depictions are available for display as configurable options at installation; a black triangle and line, a black triangle and line with white shadowing on the bottom of the triangle and line or a black circle with white shadowing and a black horizontal line with white shadowing on the bottom which banks in proportion to the aircraft actual bank angle. If the Banking Circle option is configured, and no valid bank angle is available to the TAWS unit, either because bank angle input is not configured or the input becomes invalid, the symbol will not bank and the horizontal black line will be shown as brown.

The aircraft's present position and altitude are depicted by the placement of the aircraft symbol on the display. The Banking Circle depiction represents the aircraft bank angle. No reliable attitude information is available from this display. Primary flight instruments should always be used.

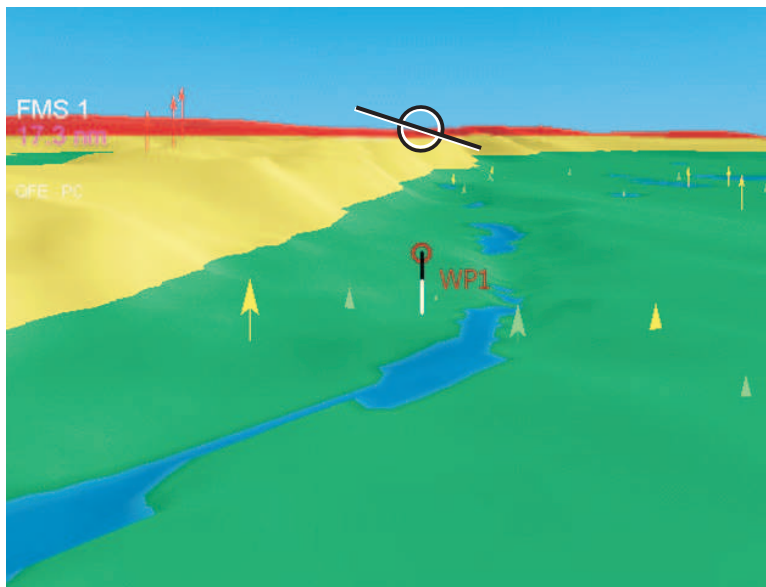
NOTE: The triangle depiction does not bank.

The FMS TO waypoint is displayed on the 3D perspective view when an altitude constraint has been input. This display will include a waypoint post. Curved paths such as holding patterns and DME arcs are not displayed.

The circle at the top of the waypoint depicts the altitude constraint in relation to the terrain. This is graphically enhanced by the black part of the post representing 1,000 feet in altitude below the altitude of the aircraft. The white portion of the post depicts the remainder of clearance altitude.



3D View with Fixed Black Hat Aircraft Symbol



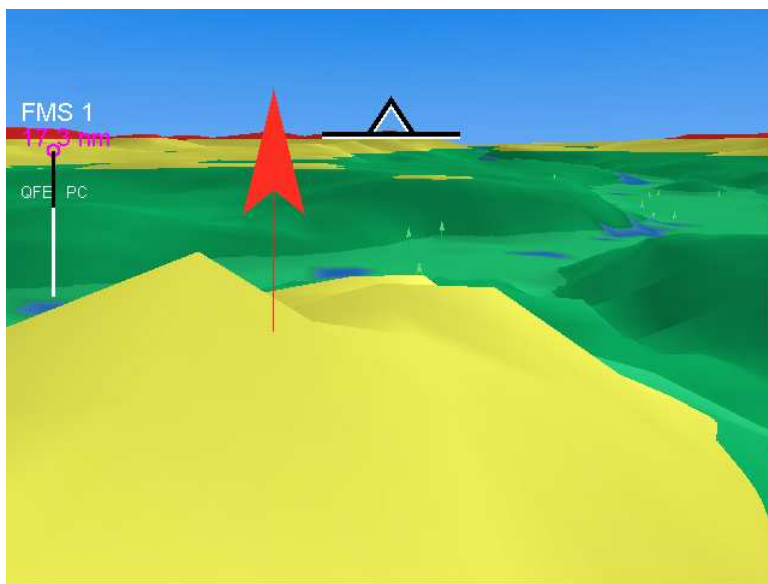
3D View with Banking Circle Symbol

Terrain and Obstacle Conflict – 3D Perspective View

When a flight plan has been entered with altitude constraints associated with the waypoints, TAWS can detect terrain conflicts with the Flight Plan Intent function.

When a flight path encounters terrain or obstacles that do not provide the required clearance, a Caution or Warning threat symbol will be displayed at the closest threat location.

Obstacles are depicted as color-coded triangles with concave bases and poles connected to the ground



ARINC-708 Display of TAWS

The TAWS system is capable of utilizing non-UASC, ARINC-708 display devices primarily used for radar display. The color banding is defined in the TAWS display Information section at the beginning of this manual. The color magenta indicates areas of terrain information that are not available.

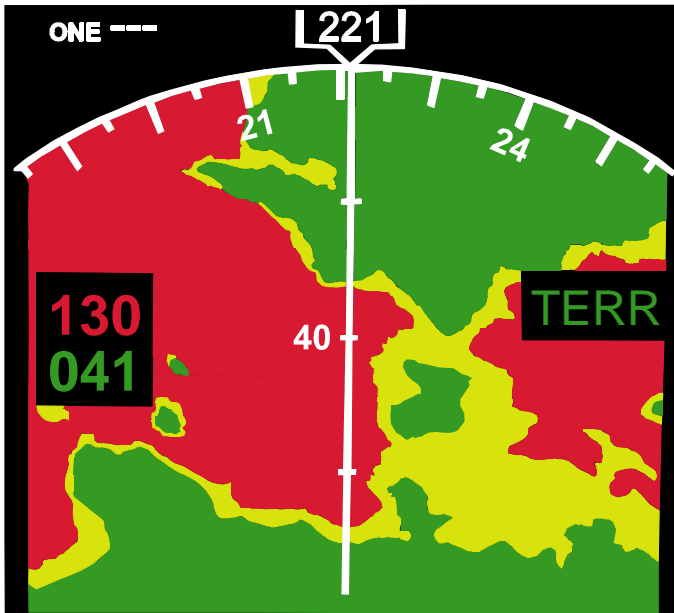
When using an ARINC-708 type display device, all terrain displays, warnings and cautions are based on aircraft trajectory.

The Caution and Warning threat symbols do not flash when using an ARINC-708 display device.

NOTE: When the TAWS system utilizes a non-UASC display device, Map View is the only display available.

NOTE: Displayed navigation information may vary depending on indicator used and inputs from other configured systems.

NOTE: The Flight plan advisory threat symbol (white star) is not displayed on ARINC-708 displays.



Typical ARINC-708 Display of TAWS

Utilizing a WXR display device, TAWS will display a text overlay to assist in the identification of the displayed information. The Map view has a terrain elevation text field on the left side of the map as shown in the illustration. The figures indicate the highest terrain in their respective colors as depicted by the terrain displayed on the map.

The top altitude displayed (red 130) represents the highest elevation in the red terrain, in this case 13,000 feet. The bottom altitude (green 041) represents the highest elevation, in the green terrain, in this case 4,100 feet. The bottom indication will be blank if the top indication is green. The resolution of the elevations is in hundreds of feet, for example, 5,100 feet MSL will be displayed as 051.

The WXR indicator displays a TERR mode annunciation on the right side of the map display. The color of the TERR annunciation indicates the following status of TAWS:

- TERR in red indicates a TAWS warning level alert.
- TERR in yellow indicates a TAWS caution alert level.
- TERR in green indicates normal operation and no active alerts.
- TERR in magenta indicates a TAWS terrain fail condition.

The altitude and mode annunciation boxes can be displayed at different points on the TAWS display to allow an unobstructed view of non-TAWS data on the indicator.

NOTE: Some integrated displays such as the ProLine 4-4000 and ProLine 21 do not have the TAWS mode annunciator. They contain a dedicated TERR mode annunciator that will not change color with the alert level.

SYSTEM ALERTS

Forward Looking Terrain and Obstacle Alerts

Flight phases Enroute, Terminal, Approach and Departure are determined by the aircraft's position and inputs from the FMS, landing gear position, flap position and glide slope. TAWS utilizes flight phase to generate values for RTC alerting.

Along track and along arc lateral/vertical envelopes are generated based on the aircraft's current position, track, turn rate and ground speed. Vertical envelopes are generated in climb, level and descent regions.

Required Terrain Clearance Alerts

Required Terrain Clearance alerts are generated when the aircraft is above terrain ahead on the flight path, but the projected clearance is considered unsafe for the phase of flight. A Terrain Caution is generated approximately 50 seconds from the point over the ground where the required terrain clearance is less than the vertical clearance required for the flight phase. At approximately 30 seconds a Terrain Warning will occur.

Since RTC is reduced in terminal, approach and departure, the system favors enroute whenever the information available to the TAWS computer is ambiguous.

Imminent Terrain Impact Alert

An Imminent Terrain Impact Alert is generated when the aircraft is below the elevation of terrain of the projected vertical flight path. Terrain Caution is generated approximately 50 seconds prior to the predicted conflict. At approximately 30 seconds prior, a Terrain Warning will occur.

High Terrain Impact Alert

A High Terrain Impact Alert is generated when the terrain ahead, along the flight path, is higher than 1500 feet above the projected vertical path. The high terrain alert will occur earlier based on the configured climb rate for the aircraft. This adds additional response time for terrain significantly higher than the aircraft.

Flight Plan Look Ahead Alerts

TAWS generates static terrain envelopes along and down the flight path. Static lateral and vertical envelopes are used for the terrain on the flight plan advisory feature. The terrain on the flight plan advisory feature uses the vertical and horizontal flight plan information to look down the flight plan for terrain threats.

Terrain threats along the flight plan are depicted by a steady white star symbol and represent the predicted first point of flight plan terrain conflict. When FMS flight plan editing or input creates this condition, an FMS message "**TAWS FPL/TERRAIN CONFLICT**" is presented.

In addition to the CFIT (white star) symbol, waypoint (XXX) and distance information (-X.X nm) is displayed as "**FPL CONFLICT (DOT +7.0 nm)**" and may be a negative or positive indication indicating the closest waypoint to the conflict. A positive value indicates the conflict occurs beyond the indicated waypoint and a negative value indicates the conflict occurs before the indicated waypoint. The FROM waypoint in the FMS flight plan cannot be the indicated waypoint in the FPL Conflict message. This displayed information is not available with the WXR displays options.

Circle to Land and VFR Approach Operations

When TAWS is operated in the visual portion of circle to land approaches at airports where sharp terrain contours exist in the circling environment, it may be necessary to activate the Terrain Inhibit function to eliminate nuisance alerts from TAWS. This is not a fault with TAWS, but a result of violating the Required Terrain Clearance. The same situation exists for visual approaches that are conducted using descent paths below a normal 3-degree approach slope.

Altimeter Setting Alert

The display of **ALTIMETER SETTING** at the bottom of the TAWS display is used to provide an informational alert to the aircrew making them aware of an altimeter problem or failure. The alert is also issued as an aural annunciation "**ALTIMETER SETTING, ALTIMETER SETTING**". The alert occurs under the following conditions:

- Barometric Altitude from the ADC is significantly different from terrain elevation plus radio altitude.
- Barometric Altitude from the ADC is significantly different from GPS altitude (separate GPS input or UASC FMS with SCN 604/704).
- ADC error or failure such as a pitot-static system problem.

This annunciation can occur when the difference is as little as 200 feet depending on terrain database resolution and GPS geometry.

NOTE: This annunciation is an advisory. Aircrew should check barometric altimeter for proper setting.

The alert is inhibited when the indicated altitude is greater than 18,000 feet or when the altimeter setting is 29.92.

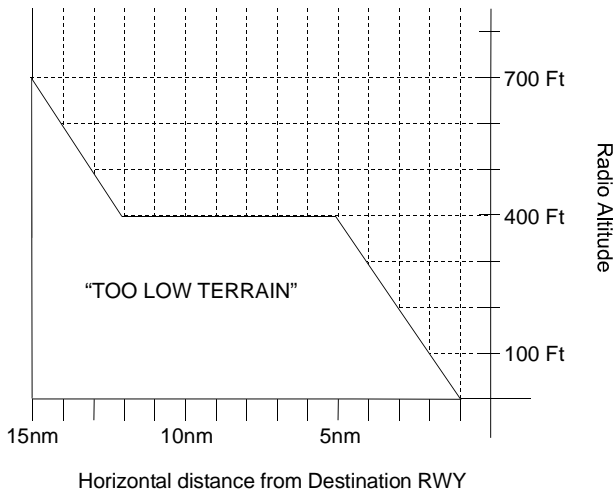
NOTE: The visual annunciation **ALTIMETER SETTING** is not available for display on ARINC 708 type displays.

Premature Descent Alerts (PDA)

TAWS generates alerts when the aircraft violates the Minimum Ground Clearance Boundary (MGCB) protection floor around an airport. The MGCB is generated from the runway end or airport reference point. The system generates a **"TOO LOW TERRAIN"** alert when the aircraft is hazardously below the normal approach path angle of three degrees. The chart below describes this alert region.

TAWS systems utilize either a valid radio altitude or a height above the terrain value obtained by comparing the barometric altitude to the terrain elevation from the TAWS system. This permits Premature Descent Alerts to function and FLTA alerts to be available.

Premature Descent Alerts are available when the aircraft is below the runway elevation. This occurs when the airport is on a mesa or hilltop and the minimum radio altitude for the alert is not obtained due to runway location.



**Minimum Ground Clearance Boundary
Envelope – Runway End**

Ground Proximity Warning System Functions

MODE 1 – Excessive Rates of Descent

Excessive Rates of Descent (DO-161A Warning Mode 1) is active for all phases of flight and provides alerts and warnings for excessive rates of descent as determined by the aircraft's vertical speed.

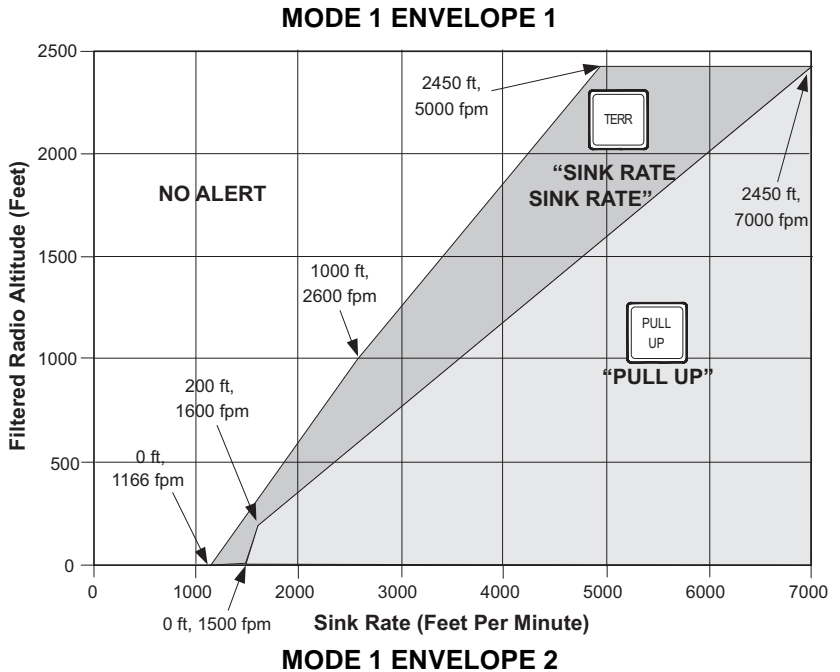
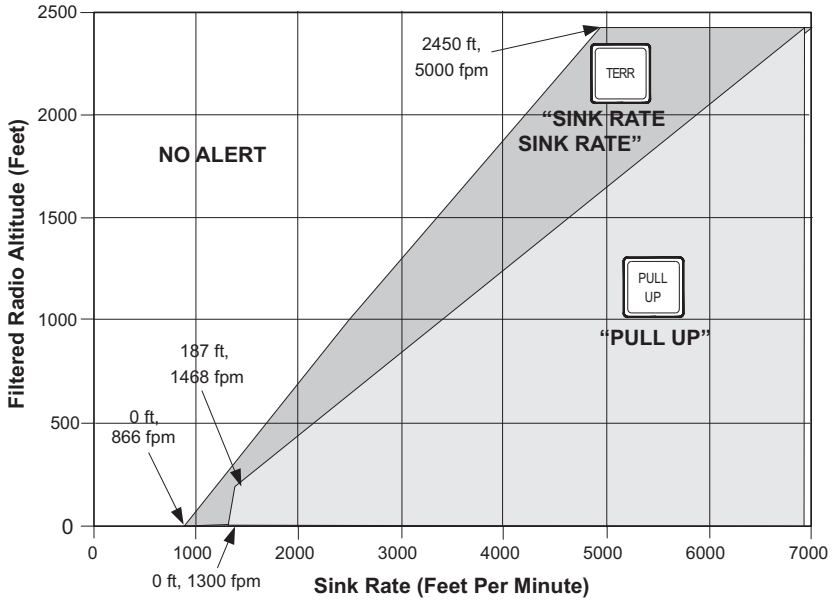
When the aircraft enters an excessive rate of descent within 2450 feet of the ground, an aural "**SINK RATE, SINK RATE**" will occur and the TERR annunciator will illuminate. Penetrating the inner warning area of the envelope will result in an aural "**PULL UP**" and the PULL UP annunciator illuminated.

Two Mode 1 Alert Envelopes are configurable. Envelope 1 is applicable to aircraft with lower approach speeds. Envelope 2 is recommended for aircraft that employ higher approach speeds requiring higher descent rates. Envelope 2 is the default envelope. Refer to the AFMS to determine the applicable Mode 1 envelope.

MODE 1 – Step Approaches

The TAWS airport database contains the approach angle for instrument approaches at each runway with an approach coded. When that approach is in the Universal FMS flight plan and the aircraft is less than 15 NM from that airport, TAWS will select that airport as the destination.

TAWS will look at the approach flight path angle and adjust the Mode 1 envelope as necessary to ensure it is appropriate to the rate of descent for that approach.

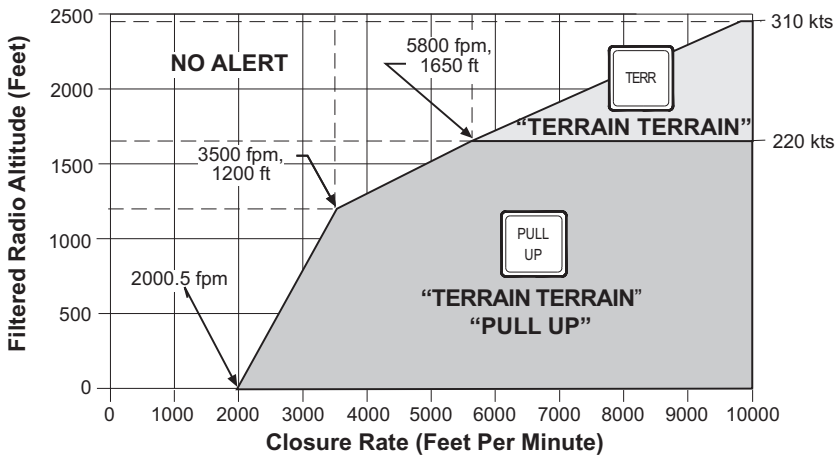


MODE 2 – Excessive Terrain Closure Rate (Class A TAWS Only)

Excessive Terrain Closure Rate (DO-161A Warning Mode 2) is active during all phases of flight. Mode 2 uses radio altitude, airspeed, flap, and gear inputs to produce warnings.

Excessive radio altitude closure rates trigger warnings. There are two sub modes to this alert; Mode 2A is active during departure, enroute and terminal operations (flaps not in landing configuration and not on glide slope).

If the aircraft penetrates the caution area the **“TERRAIN TERRAIN”** aural alert is generated and the TERR annunciator is illuminated. If the aircraft penetrates the PULL UP envelope from the No Alert area, the **“TERRAIN TERRAIN”** aural warning and PULL UP annunciator are generated followed by a continuous aural **“PULL UP”** and PULL UP annunciator until the condition no longer exists.

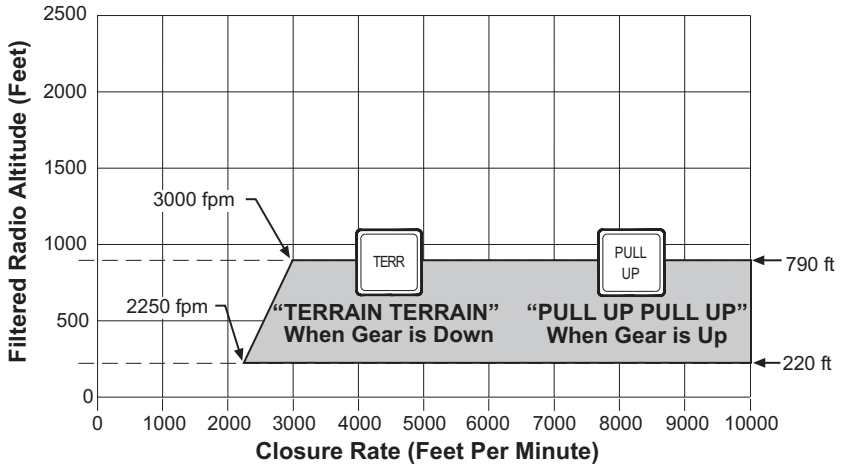


MODE 2A ENVELOPE

Mode 2B is active when the flaps are in landing configuration (or FLAP OVRD enabled), or when on an ILS approach with less than a 2 dot localizer and glide slope deviation.

When the alert envelope is penetrated and the landing gear is in the down position, **“TERRAIN TERRAIN”** aural alert is generated and the TERR caution annunciator is illuminated and repeated until the envelope is exited.

When the alert envelope is penetrated and the landing gear is in the up position, a **"PULL-UP, PULL-UP"** aural warning is generated and the PULL-UP annunciator is illuminated. The aural warning will be repeated and the annunciator will remain illuminated until the envelope is exited.



MODE 2B ENVELOPE

Operations to Plateau Airports

Some airports are located on plateaus or in areas with sharp terrain contours along final approach segments that may cause Mode 2 closure rate alerts due to radio altimeter excursions. This required GPWS function is not affected by the Terrain Inhibit function.

MODE 3 – Negative Climb Rate or Altitude Loss after Take-Off

Negative Climb Rate or Altitude Loss After Take-Off (DO-161A Warning Mode 3) is active for takeoff and go-around below 1347 feet AGL when flaps are in other than landing position and flap OVRD is not selected.

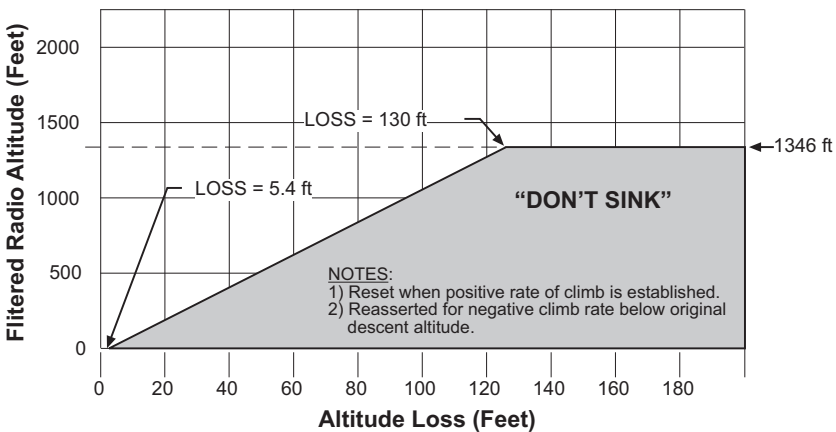
NOTE: Mode 3 and Mode 4 are not active at the same time.

TAWS uses radio and barometric altitude loss to provide this warning. The “**DON'T SINK**” aural alert is generated and the TERR caution annunciator is illuminated if sufficient altitude is lost after takeoff or go around to enter the DON'T SINK envelope. The alert is cancelled when a positive rate of climb is greater than 500 FPM or if altitude loss is not in the alert envelope.

Should it be necessary to land while Mode 3 is active (just after takeoff or a go around and the aircraft has not reached 1347 feet AGL, the Mode 3 aural alert “**DON'T SINK**” will be off when flaps are selected to landing position or if flap OVRD is selected. This does not activate Mode 4, but cancels the aural alert.

There are four ways to set Take Off – Go Around (TOGA):

- Transition WOW from Ground to Air
- While radio altimeter is less than 1347 feet AGL, manually activate TOGA
- Cycle landing gear from Down to Up (Class A only)
- A climb rate of greater than 300 fpm when radio altimeter is less than 245 feet AGL.



MODE 3 ENVELOPE

MODE 4 – Unsafe Terrain Clearance when Not in Landing Configuration (Class A TAWS Only)

Flight into Terrain When Not in Landing Configuration (DO-161A Warning Mode 4) is active in all phases of flight except initial takeoff and go-around. Mode 4 is active whenever mode 3 is inactive.

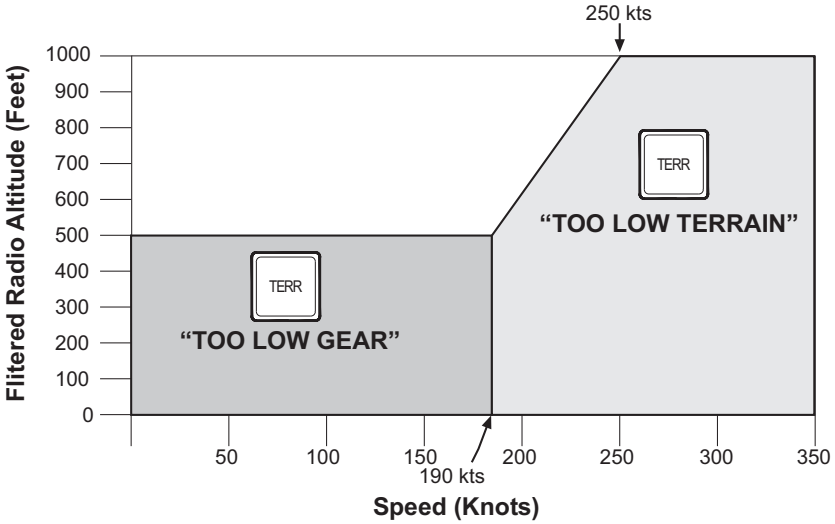
Mode 4 alerts occur when the aircraft is operated too close to terrain with the landing gear retracted or when the TAWS computer determines that the aircraft is in landing configuration with less than landing flaps. These alerts are derived from radio altitude and airspeed and are independent of closure rate. The **TOO LOW TERRAIN**, **TOO LOW GEAR** and **TOO LOW FLAPS** aural alerts are generated and the TERR caution annunciator is illuminated when the appropriate envelopes are penetrated. There are two submodes to Mode 4.

For Modes 4A and 4B at high speeds, as indicated in the following graphs and the altitude is too low, the **TOO LOW TERRAIN** aural caution sounds.

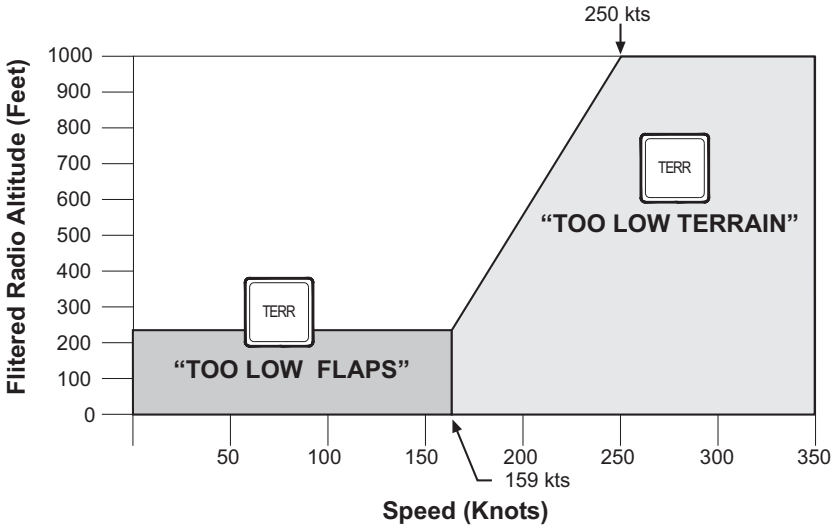
A Mode 4A alert occurs when the aircraft is too close to terrain with landing gear retracted. For Mode 4A at low speeds, if the altitude is too low, the **TOO LOW GEAR** aural annunciation sounds. Pushing the ground proximity GEAR inhibit switch to INHIBIT inhibits the **TOO LOW GEAR** caution

A Mode 4B alert occurs when the aircraft is too close to terrain with landing gear down and flaps not in landing position. If landing with flaps not in landing position, the FLAP OVRD can be selected to disable the MODE 4B annunciation **TOO LOW FLAPS**. The aural annunciation "TOO LOW TERRAIN" is not affected.

When "The aircraft is not configured for landing" conditions are no longer present, Class A TAWS cancels the respective Mode 4A **TOO LOW TERRAIN** or **TOO LOW GEAR** aural caution.

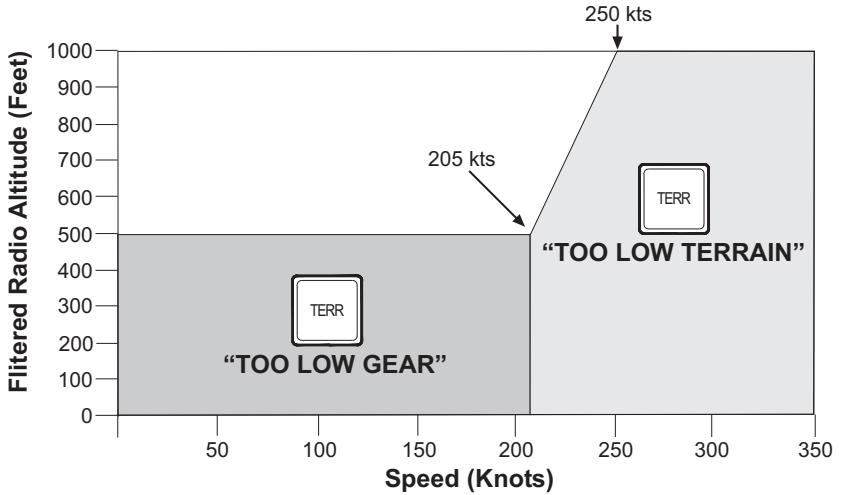


MODE 4A ENVELOPE 1

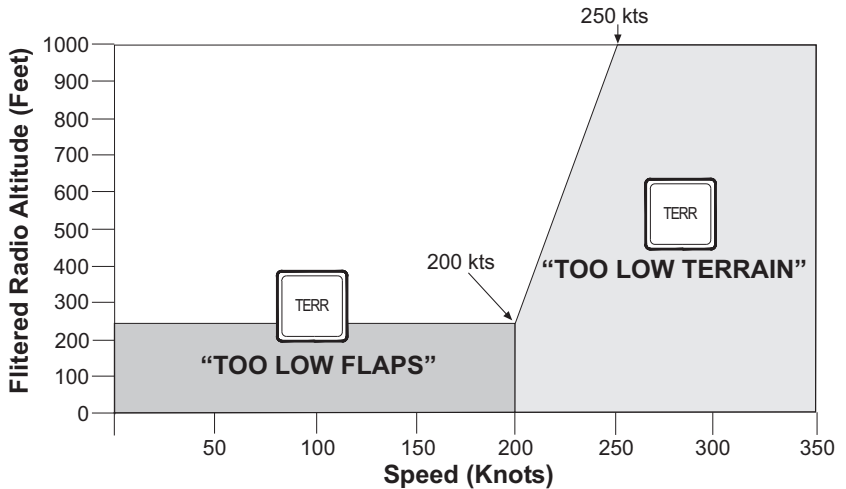


MODE 4B ENVELOPE 1

Mode 4A and 4B Envelope 2 are customized alert envelopes used to accommodate the standard flight profile of the U.S. Air Force RC-135 aircraft.



Mode 4A Envelope 2



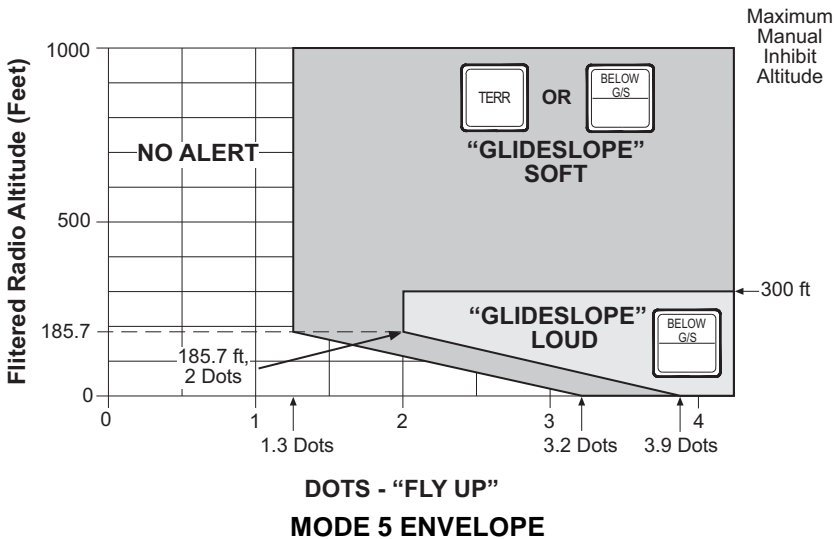
Mode 4B Envelope 2

MODE 5 – Excessive Downward Deviation from an ILS Glide Slope

NOTE: In Mode 5, **Excessive Downward Deviation from an ILS Glide Slope, Glide Slope Inhibit and Back Course** inputs are optional in TAWS Class B systems when Glide Slope and Radio Altimeter inputs are available. (Refer to TAWS Installation Manual, Report Number 34-40-01 and 34-40-09 for equipment and configuration requirements.)

Excessive Downward Deviation from an ILS Glide Slope (DO-161A Warning Mode 5) is active while below 1000 feet radio altitude and an ILS glide slope is tuned on the navigation receiver. The soft **“GLIDE SLOPE”** aural alert is generated and the TERR caution or BELOW G/S annunciator (configuration dependent) is illuminated when the flight path deviation exceeds 1.3 dots below glide slope.

If the deviation continues to increase, the loud **“GLIDE SLOPE”** aural alert is generated, and the TERR caution or BELOW G/S annunciator is illuminated when the aircraft is below 300 feet radio altitude and more than 2 dots below glide slope. These alerts will continue until the aircraft exits the envelope.



Temporary Change No. 34-40-01.06-1

Manual Affected

Universal Avionics Systems Corporation TAWS 12.X Operator's Manual, Report No. 34-40-01.06, Revision 1 dated 25 February 2010.

Filing Instructions:

Insert this Temporary Change adjacent Page 38.

Purpose:

To update the capabilities made to Mode 5 in TAWS SCN 12.1.

Instructions:

Add the following to Mode 5 section on page 38:

AC20-138C requires that if the aircraft installation provides Mode 5 alerting for ILS approaches, the same alerting must be provided for LPV approaches. TAWS can be configured to use analog deviations from the EFIS system in lieu of analog Nav deviation inputs to provide Mode 5 alerting from any approach with a vertical component selected on the EFIS. This includes ILS and FMS approaches with either SBAS or baro altitude sources.

For all digital installations, TAWS uses a process of elimination to select the appropriate flight path for monitoring. The following table lists the sources in priority order and selection criteria. When more than one glide slope source meets the selection criteria, the highest priority source will be selected and the other sources will not be monitored. If none of the sources meets the selection criteria, Mode 5 alerting is not activated.

Priority	Source	Selection Criteria
1	NAV1	All of the following are met: 1. Localizer deviation is valid and less than 2 dots 2. Glide slope is valid 3. Back Course is not active
2	NAV2	All of the following are met: 1. Localizer deviation is valid and less than 2 dots 2. Glide slope is valid 3. Back Course is not active (see note)
3	Primary FMS	FMS Flight Plan Exists
4	Secondary FMS	
5	Tertiary FMS	

This scheme gives the pilot control over Mode 5 monitoring. If the pilot tunes NAV1 and/or NAV2 to an ILS station and LOC and GS are valid from either NAV receiver, GS will be monitored. If the pilot wants TAWS to monitor the FMS, NAV1 and NAV2 should not be tuned to a valid ILS frequency.

Non-ILS Localizer Based Approaches

For the special cases of FMS LOC or BC approaches, the FMS tunes the onsite navigation receiver to the LOC/BC station. In these situations, TAWS monitors the pseudo glide path deviations.

FMS Approaches

When both NAV1 and NAV2 are not selected, TAWS will select the highest priority FMS that it has a valid flight plan. For FMS LOC and BC approaches, the FMS will tune the onsite NAV receiver to the LOC/BC frequency. TAWS will monitor lateral deviations from the NAV receiver and vertical deviations from the advisory pseudo glideslope of the FMS. In cases where NAV1 or NAV2 have a valid glide slope, TAWS will monitor the NAV glide slope.

Glide Slope Inhibit

The Glide Slope inhibit switch is an illuminated momentary contact switch. Pressing the Glide Slope inhibit switch below 2000 feet of radio altitude cancels or inhibits mode 5 alerts. If no glide slope alert is active when the Glide Slope inhibit switch is pressed below 2000 feet of radio altitude, the glide slope alert will be inhibited, and the alert will not be re-armed until either of the following conditions exist:

- The aircraft altitude exceeds 2100 feet of Radio Altitude or
- Air to Ground transitions from Ground to Air

Pressing the Glide Slope Inhibit switch when Mode 5 alerts are already inhibited re-enables the Mode 5 alert.

Back Course Approaches

The Glide Slope Inhibit function should be activated when executing localizer back course approaches to prevent nuisance alerts that may be encountered due to false glide slope alerts. This function is automatic in some aircraft installations, in this case the Glide Slope Inhibit annunciator will annunciate.

Altitude Callouts

Class A and Class B TAWS generate the advisory “**FIVE HUNDRED**” when the aircraft descends through 500 feet AGL. In Class A, and Class B TAWS systems with Radio Altitude input, additional altitude callouts may be configured specifically for each aircraft installation. Altitude callouts are available in 500-foot increments from 1000 to 2000 feet, 100-foot increments from 100 to 1000 feet and 10-foot increments from 10 to 100 feet radio altitude.

In a Class A installation and Class B with optional radio altitude and glide slope inputs, the “**FIVE HUNDRED**” callout may be configured as ENABLED or SMART. If set to SMART, this callout will be inhibited when on an ILS glide slope. This callout is required and cannot be disabled. (See TAWS Installation Manual, Report Number 34-40-01 for equipment and configuration requirements.)

Minimums Callout

When configured, TAWS receives an input from the radio altimeter when the minimum altitude set is reached. This input to TAWS generates the aural annunciation “**MINIMUMS**”. This feature only occurs during approach and may only occur once per approach.

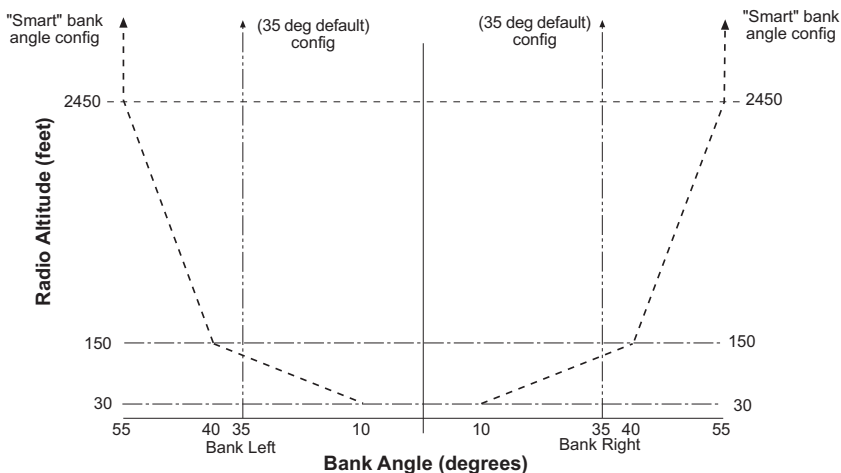
Bank Angle Callouts (Class A TAWS Only)

Bank angle is configured at the time of system installation. Refer to the Aircraft Flight Manual Supplement for bank angle information.

TAWS will monitor the aircraft bank angle and issue a **"BANK ANGLE"** aural alert when the configured bank angle limit is reached. If the aircraft continues past the limit and reaches a bank angle equal to 20 percent greater than the configured setting, a second aural alert will be issued. Decreasing the bank angle to 20 percent less than the configured setting will reset the alert.

Smart Bank Angle, which can be configured at the time of installation, can only be configured ON or OFF. Smart Bank Angle values are predetermined with respect to the radio altitude and aircraft bank angle. As the altitude of the aircraft increases, the greater the allowable bank angle at which TAWS alerts for Bank Angle. The following table illustrates when Bank Angle alerting will occur.

Radio Altitude (Feet)	Bank Angle (Degrees)
Less than 30'	Alert Inhibited
30' to 150'	Increases linearly from 10° to 40°
150' to 2450'	Increases linearly from 40° to 55°
Greater the 2450'	55°



MODE 6 ENVELOPE

Aural and Visual Alert Messages



TAWS alerts are listed in the table below. All TAWS alerts should be considered valid and the crew will react to all aural alerts, associated annunciators and TAWS display pop-ups. Every annunciation or aural alert requires appropriate action. Loss of any one or two aural or visual caution alert indications does not decrease the validity of the alert. The amber **TERR** and **BELOW G/S** annunciators indicate cautions and require immediate attention if the condition continues. The red **PULL UP** annunciator constitutes a TAWS warning and requires immediate aggressive action by the pilot.






Perceived nuisance alerts should be brought to the attention of Universal Avionics for analysis. Noting location, barometric altitude, aircraft configuration and alert annunciations (aural and visual) would prove helpful in the analysis.





If a forward-looking terrain alert is previously determined to be erroneous and is repetitive at a specific location, the terrain alerting function can be inhibited by activating the **TERRAIN INHIBIT** switch.

The tables provide US syntax and European syntax if applicable. Configuration of syntax is accomplished at system configuration.

NOTE: Aural messages associated with alerts are prioritized to avoid the confusion of multiple and simultaneous alerts occurring.

Aural Alert	Annunciator	Pilot Action
PULL UP, PULL UP		Disengage autopilot and immediately level wings. Apply full power, establish a climb attitude and climb out of the alert envelope. Continue maneuver until alert ceases or terrain or obstacle clearance is assured. NOTE: Reconfigure the aircraft as necessary to establish climb. During daytime visual conditions, take immediate action as necessary until alert ceases.
SINK RATE, SINK RATE		Arrest sink rate and fly out of alert envelope.

Aural Alert	Annunciator	Pilot Action
TERRAIN, TERRAIN		Apply power, level wings, establish a climb attitude and climb out of the alert envelope. (Class A TAWS Only)
TERRAIN, TERRAIN, PULL UP, PULL UP (US) – or – TERRAIN AHEAD, PULL UP, TERRAIN AHEAD, PULL UP (European)	 (30 second Terrain and Obstacle Warning Alert)	Disengage autopilot and immediately level wings. Apply full power, establish a climb attitude and climb out of the alert envelope. Continue maneuver until alert ceases or terrain or obstacle clearance is assured. NOTE: Reconfigure the aircraft as necessary to establish climb. During daytime visual conditions, take immediate action as necessary until alert ceases.
CAUTION TERRAIN CAUTION TERRAIN	 (50 second Terrain and Obstacle Caution Alert)	Caution alert. Followed by “Terrain Terrain” “Pull Up Pull Up” If condition continues. a. If level, apply power, establish a climb attitude and climb out of the warning envelope. b. If descending, apply power and level off. If caution continues, apply power, establish a climb attitude and climb out of the warning envelope.
TOO LOW TERRAIN TOO LOW TERRAIN		Immediately arrest sink rate and fly out of alert envelope.
TOO LOW GEAR, TOO LOW GEAR		If conditions permit, extend the landing gear; otherwise, execute go around. (Class A TAWS Only)

Aural Alert	Annunciator	Pilot Action
TOO LOW FLAPS TOO LOW FLAPS		Select landing full flaps or cancel with the FLAP OVRD switch. (Class A TAWS Only)
GLIDE SLOPE (Soft Alert)		Arrest descent rate and rejoin the glide slope.
GLIDE SLOPE (Loud Alert)		Arrest descent rate and rejoin the glide slope, consider missed approach.
DON'T SINK		Immediately level wings. Apply full power, establish a climb attitude and climb out of the alert envelope.

Alert Priorities

Class A

TAWS warnings are prioritized and interactive with other systems. The table below lists the various TAWS alerts with other possible aural alerts. A higher priority alert takes precedence over a lower alert.

NOTE: Check the AFMS to determine if windshear is enabled on your aircraft.

Priority	Description	Alert Level	Comments
1	Reactive Windshear Warning	Warning	
2	Sink Rate Pull-Up Warning	Warning	Continuous
3	Terrain Closure Pull-up Warning	Warning	Continuous
4	Terrain Warning	Warning	
5	V1 Callout	Informational	
6	Engine Fail Callout	Warning	
7	Terrain Ahead Pull-up Warning (High Terrain/Obstacle Impact Warning) Terrain Ahead Pull-up Warning (ROC)	Warning	Continuous
8	Predictive Windshear Warning	Warning	
9	Terrain Caution	Caution	Continuous
10	Minimums	Informational	
11	Caution Terrain (High Terrain/Obstacle Impact Caution) Caution Terrain (ROC Caution)	Caution	7 seconds
12	Too Low Terrain	Caution	
13	MGCB (Too Low Terrain)	Caution	
14	Altitude Callouts – 500 Feet	Informational	
15	Altitude Callouts – Other Altitudes	Informational	
16	Too Low Gear	Caution	
17	Too Low Flaps	Caution	
18	Sink Rate	Caution	
19	Don't Sink	Caution	





Priority	Description	Alert Level	Comments
20	Glide Slope (Loud)	Caution	3 seconds
21	Glide Slope (Soft)	Caution	3 seconds
22	Predictive Windshear Caution	Caution	
23	Approaching Minimums	Informational	
24	Bank Angle	Caution	
25	Flight Plan and Terrain Conflict	Advisory	
26	Altimeter Setting	Informational	


Class B


Priority	Description	Alert Level	Comments
1	Reactive Wind Shear Warning	Warning	
2	Sink Rate Pull-Up Warning	Warning	Continuous
3	Terrain Ahead, Pull Up Warning (High Terrain/Obstacle Impact Warning) Terrain Ahead, Pull Up Warning (ROC Warning)	Warning	Continuous
4	Predictive Wind Shear Warning	Warning	
5	High Terrain/Obstacle Impact Caution Caution Terrain (ROC Caution)	Caution	Continuous
6	MGCB (Too Low Terrain)	Caution	Continuous
7	Altitude Callouts – 500 Feet	Informational	
8	Altitude Callouts – Other Altitudes	Informational	Optional
9	Sink Rate	Caution	
10	Don't Sink	Caution	
11	Glide Slope (Loud)	Caution	Optional
12	Glide Slope (Soft)	Caution	Optional
13	Predictive Wind Shear Caution	Caution	
14	Flight Plan and Terrain Conflict	Advisory	
15	Altimeter Setting	Informational	Optional


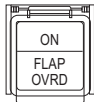
System Annunciators and Switches

The following tables describe examples of typical cockpit switches and annunciators as well as their functions in the TAWS system. Refer to the Aircraft Flight Manual (AFM) and TAWS Flight Manual Supplement for specific installation information.

Pilot's Primary Field of Vision (Glareshield)				
Annunciator/ Switch	Switch Action	Annunciator Function	Switch Function	
 PULL UP	Red	Momentary	Aural and visual alert to imminent impact with terrain or obstacle.	Provides "Initiated Self Test" initialization and termination
 TERR	Amber	None	" TERRAIN ": Aural and visual alert to required terrain/obstacle clearance.	None
 TERRAIN SELECT	Visible White	Momentary	Visible white switch legend only.	Provides manual activation of TAWS display.
 OBST INOP OBST INHIB	Amber Visible White	Alternate Action	OBST INOP is illuminated when: <ul style="list-style-type: none"> •Obstacle function is inhibited by OBST INHIB switch. •Obstacle Database is invalid or failed. •When TERR INOP /TERR INHIB is illuminated. •Obstacle alert function is inoperative due to hardware failure or lack of required input such as GPS position or altitude. 	OBST INHIB provides manual inhibit of TAWS Obstacle function.

Pilot's Primary Field of Vision (Glareshield)				
Annunciator/ Switch		Switch Action	Annunciator Function	Switch Function
 <p>Amber</p>		Momentary	<p>BELOW G/S Aural and visual alert of excessive glide slope deviation.</p> <p>G/S INHIBIT Indicates Mode 5 alerts have been cancelled or inhibited.</p> <p>G/S INHIBIT is illuminated when below 2000 feet RA. Once the aircraft climbs above 2100 feet altitude, the G/S Inhibit will reset and no longer be active.</p> <p>G/S INHIBIT is illuminated when all configured ILS sensors are failed.</p>	<p>BELOW G/S Provides glide slope aural alert inhibit/cancel activation and deactivation.</p> <p>G/S INHIBIT is available when below 2000-foot RA.</p> <p>"G/S INHIBIT" annunciator will illuminate when inhibit function is active and the aircraft is in-flight or when back course is selected.</p>

Pilot's Secondary Field of Vision (Center Instrument Panel)				
Annunciator/ Switch		Switch Action	Annunciator Function	Switch Function
 <p>Amber Visible White</p>		Alternate Action	<p>TERR INOP is illuminated when:</p> <ul style="list-style-type: none"> •TERRAIN function is inhibited by TERRAIN INHIBIT switch. •Terrain Database is invalid or failed. •Flaps reasonableness check fail. •Terrain alert function is inoperative due to hardware failure or lack of required input such as GPS position or altitude. <p>NOTE: TERR INOP will be illuminated after preflight test is completed for 1 to 3 minutes.</p> <p>TERR INHIB is a visible white switch legend only when Terrain Inhibit is active.</p>	<p>TERR INHIB provides manual inhibit of TAWS terrain alert function. When TERR INHIB is selected, the message TERRAIN INHIB SELECTED is displayed.</p>

Pilot's Secondary Field of Vision (Center Instrument Panel)				
Annunciator/ Switch		Switch Action	Annunciator Function	Switch Function
	Amber	None	<p>GPWS INOP: illuminates for GPWS Alerts function inoperative due to hardware or software failure, or lack of any required input.</p> <p>NOTE: GPWS INOP will be illuminated after preflight test is completed for 1 to 3 minutes.</p>	None
	Amber Visible White	Alternate Action (Guarded)	<p>Illuminates when FLAP OVRD is activated.</p> <p>NOTE: When illuminated the TAWS will be in Approach ROC/RTC.</p> <p>NOTE: TAWS allows the FLAP OVRD switch to be selected in the air. To prevent dispatch of the aircraft with the FLAP OVRD switch set to the Inhibit or failed state; the TERR INOP lamp illuminates 30 seconds after landing.</p>	FLAP OVRD overrides Insufficient Terrain Clearance warnings when landing with flaps in other than landing position is required.

Display Unavailable Annunciations

If the TAWS computer determines that a view is unavailable, the FMS and MFD displays will be grayed-out, ARINC-708 displays will be blank, making the loss of display self-annunciating. An appropriate message will also be displayed. Gray areas on the terrain display will also be presented when the terrain database lacks data for that area or region of the world.

NOTE: **PROFILE VIEW UNAVAILABLE** and **TERRAIN TRACK UNAVAILABLE** messages are not displayed when using an ARINC-708 display device.



TERRAIN TRACK UNAVAILABLE

The following table describes unavailable display annunciations displayed when using a UASC FMS or MFD for a display device.

FMS/MFD Display Unavailable Annunciations	
Displayed Message	Description
TERRAIN TRACK UNAVAILABLE	No valid track angle input.
TERRAIN POSITION UNAVAILABLE	No valid position input. Estimated Position Uncertainty (EPU) is not valid.
TERRAIN ALTITUDE UNAVAILABLE	No valid altitude input.
PROFILE VIEW UNAVAILABLE	Profile view is not available due to lack of a flight plan, not adhering to the flight plan or insufficient navigation accuracy.
TERRAIN DATABASE CORRUPTED	The CRC for the terrain database has failed. This includes failures that occur during the terrain database load process.
TERRAIN HEADING UNAVAILABLE	No valid heading input. NOTE: This message will only occur when configured for a heading up display (does not apply to the UASC CDU display configuration).
RENDERING TASK DISABLED	TAWS discontinues providing a display during a database load through the DTU or a configuration through the RS-232 port or the DTU.
RENDERING DISABLED NEAR POLES	TAWS discontinues providing a display while navigating above 85 degrees latitude, North or South.
AIR/GROUND FAILED	Air/Ground discrete input reasonableness checks fail
TERRAIN INHIBIT SELECTED	The flight crew has selected the TAWS TERR INHIB switch.

The following table describes Display Unavailable annunciations when using a WXR/WXPD ARINC-708 device for display of TAWS.

ARINC-708 Display Unavailable Annunciations	
Displayed Message	Description
TERRAIN TRACK UNAVAILABLE	No valid track angle input.
TERRAIN POSITION UNAVAILABLE	No valid position input.
TERRAIN ALTITUDE UNAVAILABLE	No valid altitude input.
TERRAIN HEADING UNAVAILABLE	No valid heading input. NOTE: This message will only occur when configured for a heading up display (does not apply to the UASC CDU display configuration).
DISABLE RENDER TASK	TAWS discontinues providing a display during a database load through the DTU or a configuration through the RS-232 port or DTU.
RENDERING DISABLED NEAR POLES	TAWS discontinues providing a display while navigating above 85 degrees latitude, North or South.
TERRAIN DATABASE CORRUPTED	The CRC for the Terrain Database has failed. This includes failures that occur during the terrain database load process.
TERRAIN INHIBIT SELECTED	The flight crew has selected the TAWS TERR INHIB switch.

OPERATION

All interface with TAWS is conducted through a Universal Avionics FMS, Universal Multi-function Display (MFD), EFI-890R or a non-Universal radar display device. The FMS displays TAWS pages allowing the operator the ability to change TAWS displays and operation settings.

The pages that are displayed vary depending on TAWS configuration. The most notable difference is either a two page or four-page display of TAWS controls and version data on the FMS CDU.

The two-page display configuration provides control of which view perspective is displayed, vertical and horizontal range, the number of waypoints TAWS displays and self-test.

The four-page display configuration provides the same information as the two-page, but also includes the controls for data transfer unit (DTU) operations if installed, display version data of TAWS and terrain, obstacle and airport databases.

NOTE: The four-page display option is only available using Universal's FMS with SCN 604.5/704.5 and later 60X.X/70X.X, SCN 801.2/901.2 and later SCN 80X.X/90X.X and SCN 1000.0/1100.0 and later SCN 100X.X/110X.X software versions.

NOTE: The display may differ when displayed on non-UASC radar or other compatible displays. When using a non-UASC display device, range will be controlled through the radar range control. 3D perspective and Profile views are not available for display on non-UASC display devices.

NOTE: Version, Date and CRC information on some displays may be different from that illustrated depending on SCN version installed.

NOTE: The term "data transfer unit" and "DTU" will refer to the DTU-100 and SSDTU (Solid State Data Transfer Unit).

NOTE: The term "disk" refers to any of the memory storage devices that can be used with TAWS such as the Zip disk, USB and Secure Digital (SD) data storage devices.

Barometric Altimeter

CAUTION: APPLICABLE TO INSTALLATIONS THAT ARE NOT CONFIGURED FOR GPS ALTITUDE.

TAWS RELIES ON ACCURATE BAROMETRIC ALTITUDE DATA FOR PROPER OPERATION. CORRECTION OF ALTIMETER SETTINGS FOR THE AREA OF OPERATION IS REQUIRED.

WHEN CONFIGURED FOR COLD TEMPERATURE COMPENSATION AND GPS ALTITUDE, TAWS WILL MONITOR RAW BARO ALTITUDE OR TEMP COMPENSATED BARO ALTITUDE AGAINST GPS ALTITUDE. THE SYSTEM WILL SELECT WHAT IT DETERMINES TO BE THE MOST ACCURATE SOURCE FOR DETERMINING TERRAIN CLEARANCE AND ALLOWS THE SYSTEM TO FUNCTION WITH IMPROPERLY SET ALTIMETER, IN EXTREME COLD TEMPERATURE AND WHEN ABOVE THE TRANSITION ALTITUDE, FL180 IN THE UNITED STATES AND AS PUBLISHED IN OTHER PARTS OF THE WORLD. TAWS DISPLAYS WILL ACCURATELY REFLECT THE LOCATION OF TERRAIN WITH RESPECT TO THE AIRCRAFT ALTITUDE AND NOT THE ALTITUDE INDICATED ON THE ALTIMETER.

Instrument Landing System

When two ILS receivers are interfaced to TAWS and the No. 2 ILS is being used for approach, the No. 1 ILS must also be tuned to the ILS frequency or tuned to a non-ILS frequency.

Cold Temperature Operations

NOTE: Cold Temperature Operations is applicable to installations with Temperature Compensation and GPS not configured.

TAWS uses baro-corrected altitude as the reference for Forward Looking Terrain Alerts (FLTA). TAWS does not compensate the baro altitude input for non-standard temperature lapse rates that may be encountered in extreme cold conditions, causing degraded FLTA operation and premature Descent Alerts. Basic ground proximity warning modes (1 through 6) are radio altitude based and not affected.

In extreme cold conditions, the aircraft will be operating at a lower altitude than indicated, thus resulting in TAWS alerts being delayed or missing. The color banding on the TAWS display will be offset by the cold temperature altitude error. When operating into and out of airports where cold temperatures exist, the crew should be aware of the difference between the indicated baro altitude and true altitude and the effect this has on FTLAs and the terrain display. To determine the effect on FTLA warnings consult the Airman's Information Manual Chapter 7 paragraphs 7-2-3, d-e. See the following excerpt.

AIM Paragraph 7-2-3

d. TBL 7-2-3 derived from ICAO formulas, indicates how much error can exist when the temperature is extremely cold. To use the table, find the reported temperature in the left column, then read across the top row to locate the height above the airport/reporting station (i.e., subtract the airport/reporting elevation from the intended flight altitude). The intersection of the column and row is how much lower the aircraft may actually be as a result of the possible cold temperature induced error.

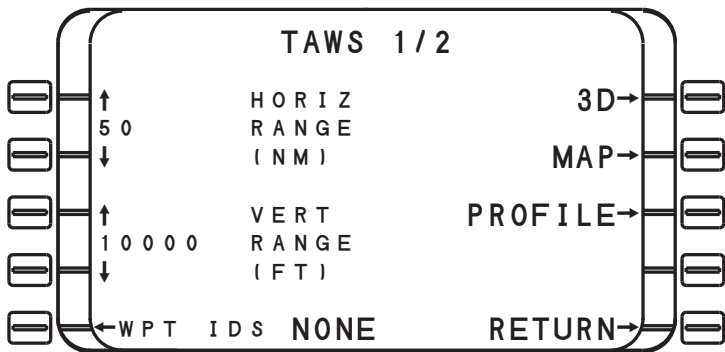
e. The possible result of the above example should be obvious, particularly if operating at the minimum altitude or when conducting an instrument approach. When operating in extreme cold temperatures, pilots may wish to compensate for the reduction in terrain clearance by adding a cold temperature correction.”

Two Page Configuration Operating Procedures

TAWS Page 1/2

Operation and control of TAWS through the FMS provides display, view and test control of TAWS. Page 1/2 is used to control TAWS displays. Page 2/2 is used to test TAWS.

The TAWS Page 1/2 is accessed from the FMS DATA page 1 by pressing the TAWS line select key [5L]. In multiple FMS installations, only one FMS at a time can access TAWS control pages. Installation options can provide for TAWS images to be displayed on any available FMS. TAWS can be controlled from one FMS and the image displayed on another FMS. TAWS images may only be displayed on one FMS at a time.

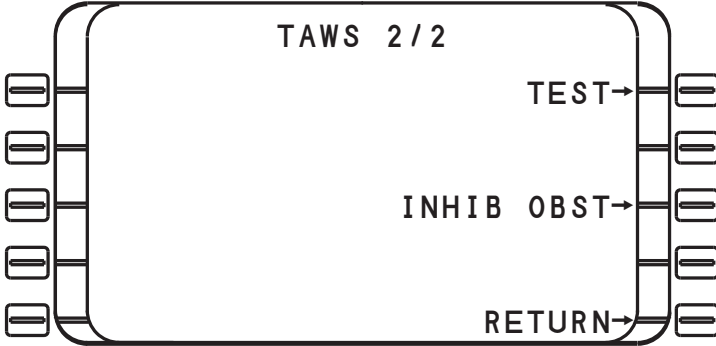


TAWS Page 2/2

TAWS Page 2/2 is accessed from TAWS Page 1/2 by pressing the PREV or NEXT key.

TEST – Not available unless in "On-Ground" state. Pressing line select key [1R] will initiate test mode.

RETURN – Pressing line select key [5R] will return the display to TAWS 1/2 page.



Four Page Configuration Operating Procedures

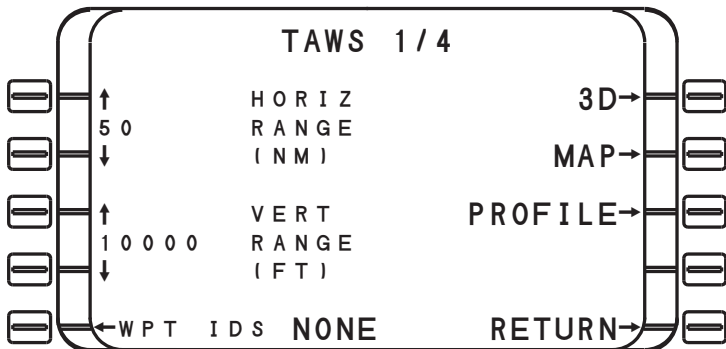
TAWS Page 1/4

Operation and control of TAWS through the FMS provides the same operation control as the two page with the addition of a data transfer unit and the display of TAWS software and database version information.

NOTE: When utilizing an MFD to display TAWS, the functions on Page 1/4 is accessed by using the keys on the MFD bezel. Pages 2/4, 3/4 and 4/4 are renumbered 1/3, 2/3 and 3/3 accordingly.

Page 1/4 controls TAWS displays. Page 2/4 is used to test TAWS and access database loading operations. Page 3/4 displays TAWS software version information and page 4/4 displays Terrain, Obstacle and Airport database information.

TAWS Page 1/4 is accessed from the FMS DATA page 1 by pressing the TAWS line select key [5L]. In multiple FMS installations, only one FMS at a time can access TAWS control pages. Installation options can provide for TAWS images to be displayed on any available FMS. TAWS can be controlled from one FMS and the image displayed on another FMS. TAWS images may be only be displayed on one FMS at a time.



HORIZONTAL RANGE (NM) – Line select key [1L] is used to increase Horizontal Range and line select key [2L] is used to decrease Horizontal Range.

VERTICAL RANGE (FT) – Line select key [3L] is used to increase Vertical Range and line select key [4L] is used to decrease Vertical Range.

WPT IDS – Pressing line select key [5L] will alternate Waypoint IDs from ALL to NONE to TO.

3D PERSPECTIVE View – Pressing line select key [1R] will display the 3D perspective view on the screen.

MAP View – Pressing line select key [2R] will display the Map view on the screen.

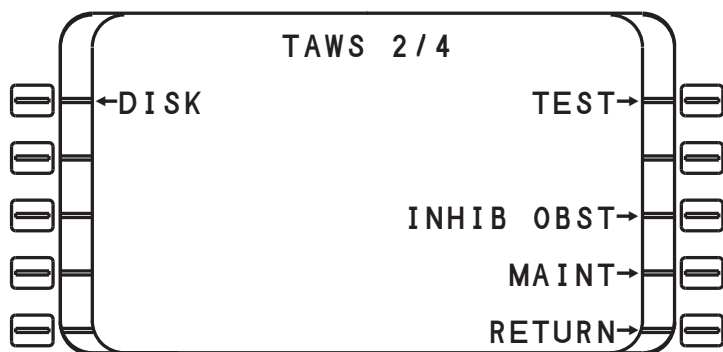
PROFILE View – Pressing line select key [3R] will display the Profile view on the screen.

RETURN – Line select key [5R] will return display to DATA page 1.

TAWS Page 2/4

TAWS Page 2/4 is accessed from TAWS Control page 1/4 by pressing the PREV or NEXT key.

NOTE: When using a UASC MFD for TAWS display, page 2/4 is renumbered 1/3.



DISK – Pressing LSK [1L] displays the TAWS DISK MENU.

NOTE: If a DTU is not installed or configured, the **DISK** selection will not be displayed.

TEST – Not available unless the aircraft is in an “On-Ground” state. If not available for use the text **TEST** will be displayed in a smaller font. Pressing LSK [1R] will initiate TEST mode. While TEST is running, **STOP TEST** is displayed.

NOTE: Upon completion of TAWS self-test, TAWS will re-boot causing the message **FMS-TAWS COMM ERROR, RESELECT TAWS** to be displayed on the FMS. This is normal while TAWS is re-booting. The message will be removed after the 1-3 minute TAWS re-boot sequence. Also, the message **TAWS FAIL** will be displayed on the FMS Message Page while TAWS is re-booting.

INHIB OBST – Displayed if Obstacle function is configured, selection of INHIB OBST LSK [3R] inhibits obstacle displays and warnings.

NOTE: INHIB OBST is available only if the obstacle inhibit discrete input is not configured.

ENABLE OBST – Displayed if INHIB OBST was previously selected, selection of ENABLE enables the Obstacle function.

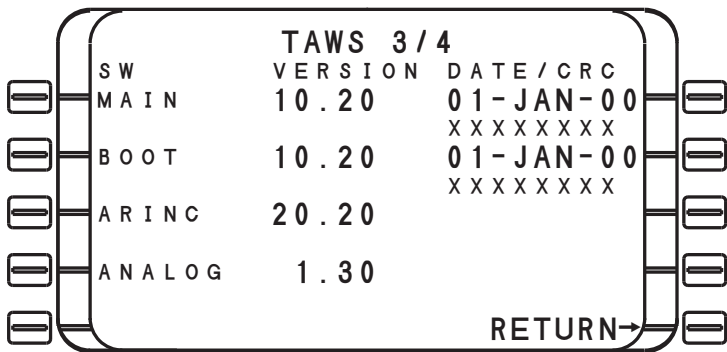
RETURN – Pressing line select key [5R] will return the display to TAWS 1/2 page.

TAWS Page 3/4

TAWS Page 3/4 is accessed from TAWS Control page 1/4 by pressing the PREV or NEXT key.

This page provides version information of installed software.

NOTE: When using an MFD for TAWS display, page 3/4 is renumbered 2/3.



TAWS Page 4/4

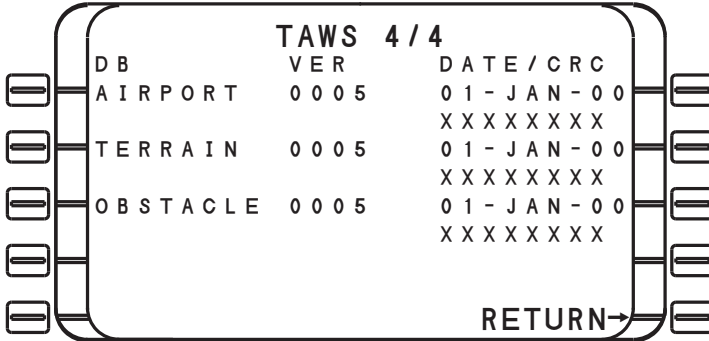
NOTE: When using an MFD for TAWS display, page 4/4 is renumbered 3/3.

TAWS Page 4/4 is accessed from TAWS Control page 1/4 by pressing the PREV or NEXT key.

This page provides part number, date and CRC information about the Airport, Obstacle and Terrain databases that have been loaded into TAWS.

If memory contains an invalid or corrupt database, the message "**DATABASE FAILED**" will be displayed with the corresponding failed database.

If the Obstacle database is not configured, the message "**DATABASE UNUSED**" will be displayed with the obstacle database.

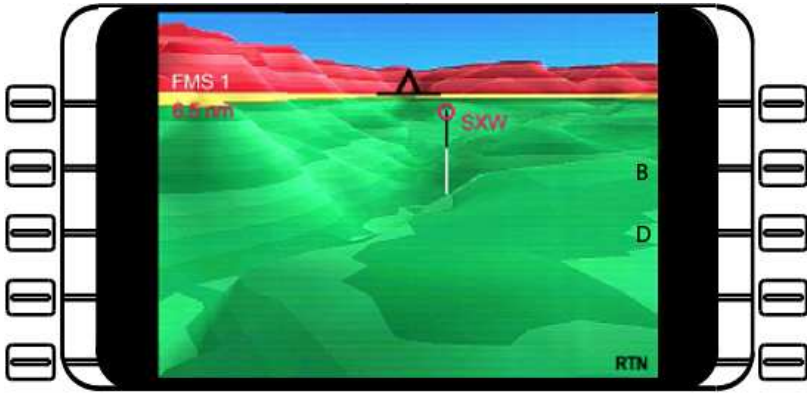


CDU Display Control

When TAWS is displayed on the FMS CDU, brightness is adjusted using line select keys 1R and 2R adjacent to the “**B**” (Brighten) and “**D**” (Dim) letters on the display.

To have the CDU revert from a TAWS display to FMS, press the line select key 5R adjacent to the “**RTN**” displayed.

NOTE: **B**, **D** and **RTN** appear on the FMS CDU display only.



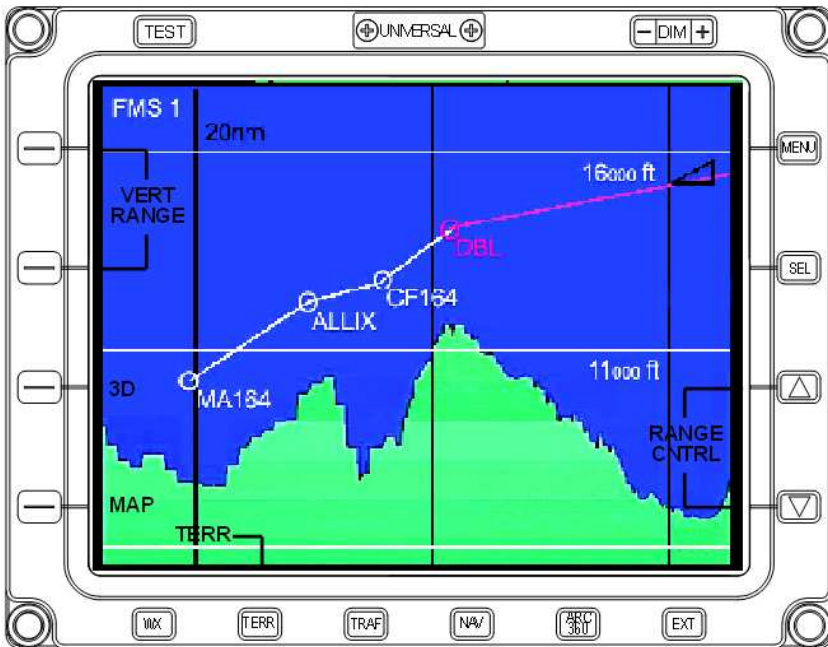
FMS CDU

Display Control

MFD Display

When TAWS is installed with the images displayed on a Universal Avionics MFD, Image Selection, Horizontal Range, Vertical Range and Waypoint ID settings are controlled through the line select, function and mode keys on the MFD bezel. Refer to the MFD Operator's Manual 34-20-02.01 for further information.

In the two-page configuration, the only page available through the FMS is 1/1. In the four-page configuration page 1/4 is no longer utilized and pages 2/4, 3/4 and 4/4 are renumbered 1/3, 2/3 and 3/3.



MFD Display

EFI-890R ND and PFD Display

In EFI-890 installations when TAWS is selected, TAWS is displayed on the EFI-890 Navigation Display (ND). To select TAWS for display on the EFI-890 ND, press TERR on the EFI-890 ND control panel. In the event of a TAWS warning,

If TAWS pop-up is configured, TAWS will automatically be displayed and the associated TAWS alert annunciations will be displayed on the PFD under the aircraft symbol and correspond to TAWS warnings as follows:

PULL UP (Red)

TERRAIN (Amber)

GLIDESLOPE (Amber)

DON'T SINK (Amber)

GPWS INOP (Amber)

Terrain Mode Annunciations are displayed on the upper right side of the display, beneath the caution annunciator data block. These are displayed only if a TAWS system is installed and indicate specific terrain display modes.

TERR INH is displayed in white if the terrain functions of TAWS are inhibited or if the TAWS system supports an inoperative signal output and TAWS is inoperative.

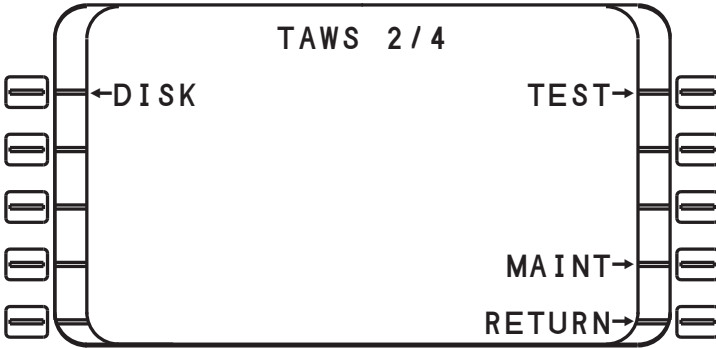
ARINC-708 and other Non-UASC Compatible Displays

When TAWS images are displayed on an ARINC 708 display, only a Map view is available and the range is controlled by the display system.

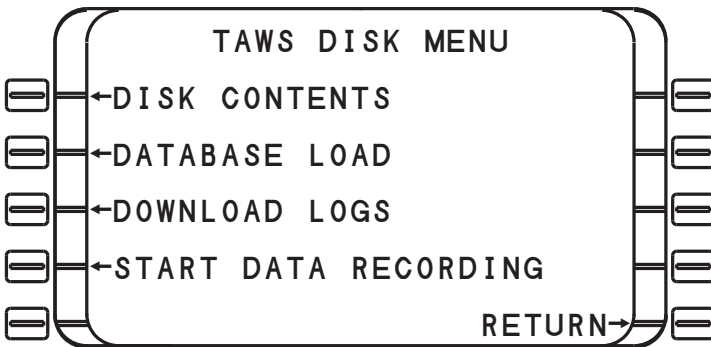
Database Loading

Installation and update of Airport, Obstacle and Terrain databases are accomplished through Universal's FMS and a DTU. If there is not an FMS installed, TAWS is updated directly using a computer, DTU and the Terminal Monitor Program. If a DTU is not installed, the **DISK** selection will not be displayed.

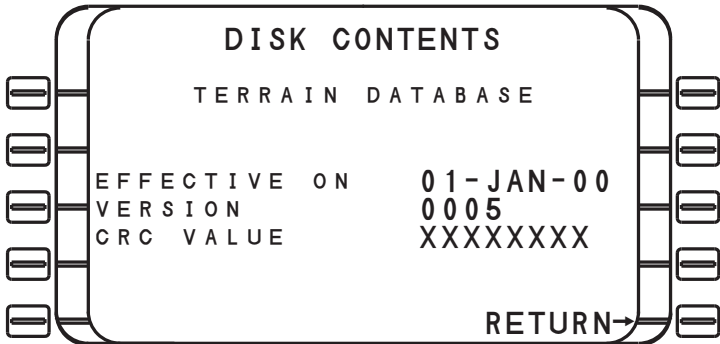
Database Loading through the FMS



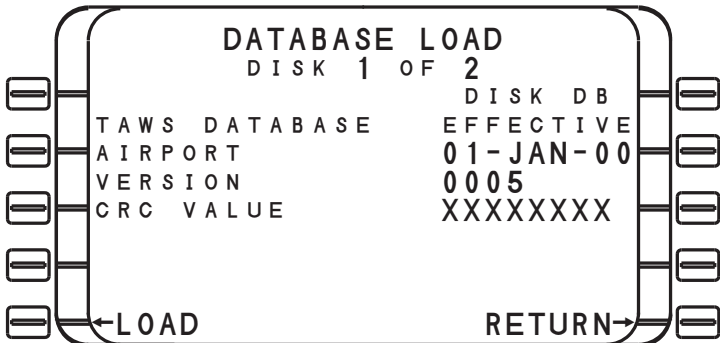
1. From the FMS select the TAWS pages for viewing. Using the FMS PREV/NEXT keys select page 2/4.
2. Open the TAWS DISK MENU page by pressing the **DISK** line select key.



3. Insert the data storage device into the DTU.
4. To view information about the Terrain, Obstacle or Airport database on the data storage device inserted in the DTU, press the **DISK CONTENTS** line select key. This will display the Effective Date, Version and CRC Value of the stored database. Press **RETURN** to exit.



5. Select **DATABASE LOAD** from the **TAWS DISK MENU** page to display the page for loading databases. Selection of this page will display information about the database on the data storage device.



6. Press the line select key adjacent to **LOAD**. Once selected, the **LOAD** text will disappear from the display. During the database loading process the text **ERASING** or **LOADING** is displayed. **COMPLETE** will be displayed after successful loading of the entire database.

When the next data storage device in the database load is required, the message "**INSERT NEXT DISK IN THE SEQUENCE**" is displayed.

NOTE: Upon completion of database load, TAWS will re-boot causing the message **FMS-TAWS COMM ERROR, RESELECT TAWS** to be displayed on the FMS. This is normal while TAWS is re-booting. The message will be removed after the 1-3 minute TAWS re-boot sequence. Also, the message **TAWS FAIL** will be displayed on the FMS Message Page while TAWS is re-booting.

NOTE: If the incorrect data storage device is inserted into the DTU, the message **INCORRECT DISK FILE FOUND** will be displayed.

NOTE: If the database load is aborted before completion, the **TERR INOP** annunciator will illuminate and the display will go blank.

Upon completion of database load, TAWS will display a message indicating TAWS is about to shut down.

NOTE: If an error is detected during the database loading process, a message corresponding to the error condition is displayed on the **DISK MENU** page.

Database Loading using a PC, Terminal Monitor Program and Data Transfer Unit

1. Connect an RS-232 cable to the TAWS RS-232 Monitor Port and the other end to a personal computer (PC).

The Terminal Monitor Program is only displayed on the computer.

2. Start the computer.
3. Apply power to TAWS and the onboard DTU or connect a portable DTU and apply power.
4. On the PC initiate the Terminal Monitor program.
5. From the Terminal Monitor menu enter **Page 30** to select the DTU Options page.
6. Insert the database into the DTU.
7. On the DTU Options page tab down to the **LOAD DB** command and press Enter.

The DTU Options page will display the Version, Effectivity Date and CRC for the database that is being loaded.

8. On the DTU Options page tab down to the **CONTINUE** command and press Enter.

9. The loading process will begin.

When the database has finished loading, **LOAD COMPLETE** is displayed and after 10 seconds TAWS will begin rebooting.

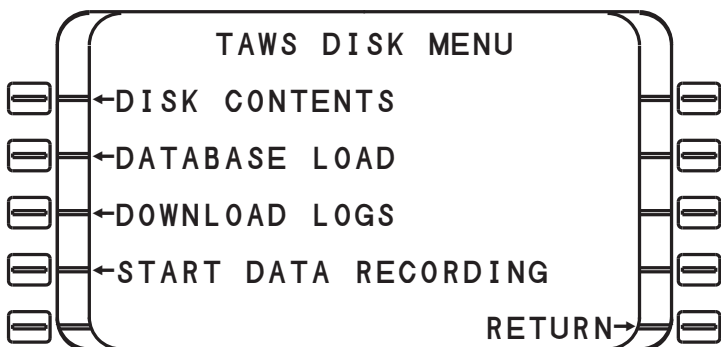
10. After TAWS has completed rebooting and the Terminal Monitor program is displayed, enter **Page 26** to select the **Misc. Data (SCNs, CRCs)** to verify that the Database and Effectivity Date of the database loaded is correct and no errors occurred during loading.
11. Disconnect and remove PC, Portable DTU (if applicable) and cables.

Download Logs

Download Logs is used to copy the fault log, alert log and configuration log to the DTU. This command is selected from the **TAWS DISK MENU**.

NOTE: This feature is available only to systems that utilize a Universal FMS and DTU. Without an FMS or DTU this function is not displayed and is accessible only by maintenance personnel through a computer connection.

1. Insert a data storage device into the DTU
2. To initiate download press the line select key adjacent to **DOWNLOAD LOGS**. The text **DOWNLOAD LOGS** will disappear until the download process is complete.



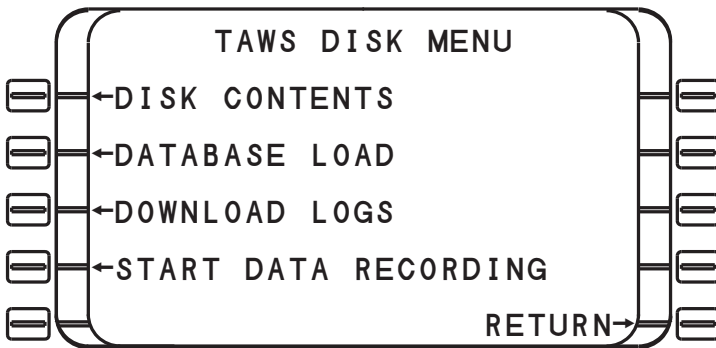
Data Recording

Start Data Recording initiates flight data recording to the DTU creating a record of the flight for troubleshooting or reconstruction of the flight for test purposes. The data recorded includes all sensor inputs and discrete positions and flight data during the flight.

NOTE: Recording must be turned on prior to events occurring to be recorded.

NOTE: This feature is available only to systems that utilize a Universal FMS and DTU. Without an FMS and DTU this function is not displayed and is accessible only by maintenance personnel through a computer connection.

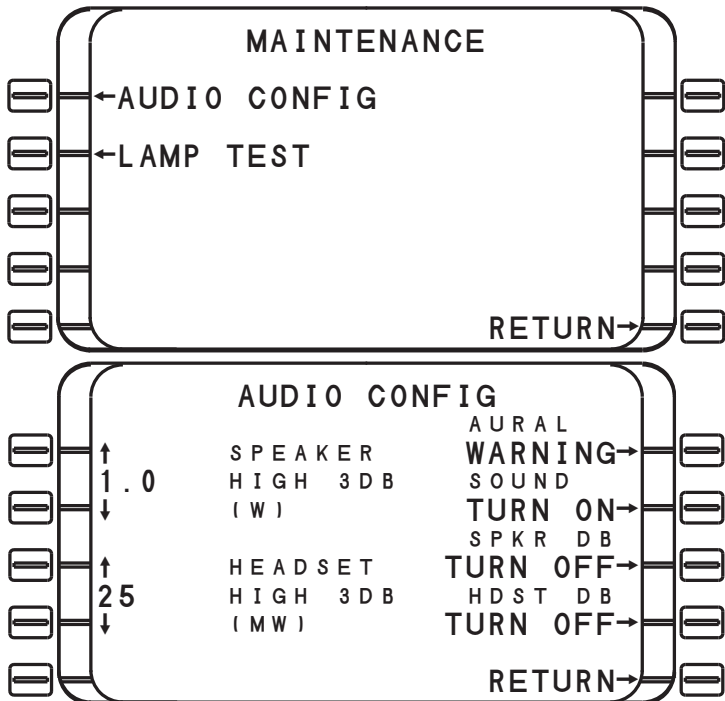
1. Insert a data storage device into the DTU.
2. To initiate recording press the line select key adjacent to **START DATA RECORDING**. The text **START DATA RECORDING** will be replaced by **STOP DATA RECORDING** until the data storage device is full or the line select key to stop the process is pressed.



Audio Configuration

The **Audio Configuration** page is used to test the different TAWS aural types and to change the audio output configuration for the headset and speakers. Changes will remain in affect for the current TAWS power cycle. Once power is removed from TAWS, the audio changes made will return to the previous configuration.

1. Select MAINT from TAWS page 2/4.
2. Press line select key [1L] to select the Audio Configuration page.
3. Use the left line select keys to adjust audio.



4. Press line select key [1L] or [2L] adjacent to the speaker audio output level to change the value up or down to the next value in the sequence
5. Press line select key [3L] or [4L] adjacent to the headset audio output level to change the value up or down to the next value in the sequence.

NOTE: The field indicating DB will be blank if the DB level is set to 0DB for the speaker or headset audio level and the SPKR DB and HDST DB fields will display **TURN ON**.

6. Press line select key [2R] to enable the aural annunciation when the different aural types are selected in the following test (should display TURN OFF if active). Press a second time to disable.
7. Press line select key [1R] adjacent to AURAL to view settings for Warning, Callout and Caution type annunciations.
8. Press RETURN, line select key [4R] to return to the MAINTENANCE page.

Emergency Procedures

In the event that the Aircraft Flight Manual requires a flap setting not normally required for landing, press the **FLAP OVRD** switch to simulate flaps in landing position.

When an off airport landing is required the Forward-Looking Terrain-Avoidance (FLTA) and Premature Descent Alert (PDA) functions should be inhibited by activation of the **TERRAIN INHIBIT** switch.

Abnormal Procedures

In the event of TAWS system or component failure, the appropriate annunciators will indicate which function or component has failed.

Failure Condition	Effect on Aircraft and Crew
Loss of FMS	Loss of inputs necessary for Terrain Advisory alerts (position, track). Loss of ability to control TAWS lateral and vertical display ranges and display mode (map, 3D) (if configured for display on FMS). Loss of graphic display. Basic ground proximity functions still available.
GPS deselected as UASC FMS sensor	Loss of flight plan waypoints on TAWS display. No loss of terrain or GPWS warnings provided GPS functions still valid.
Loss of Radio Altimeter	(Class A System) Loss of basic GPWS. (Class B System) with Mode 5 and RA enabled the G/S Inhibit light is illuminated.
Loss of Air Data Computer	None, if FMS provides valid secondary air data inputs from independent air data source. Loss of all air data inputs will result in the loss of all TAWS functions.
Loss of glide slope Input #1	Loss of Mode 5 (Below G/S) alerting.
Loss of aural alert only	Crew will still have visual alert annunciators.
Loss of visual alerts only	Crew will still have aural alert annunciators.
Failure of TERR INHIB switch input	If failed to inhibit state, all Terrain Alerts will be inhibited. If fails to perform function, crew cannot inhibit Terrain Alerts.

Failure Condition	Effect on Aircraft and Crew
Failure of GLIDE SLOPE INHIB switch input	If failed to INHIBIT state, all Mode 5 alerts will be inhibited. If fails to perform function, crew cannot inhibit or cancel Mode 5 alerts.
Failure of FLAP OVRD switch input	If failed to override state, alerts will be inhibited. If fails to perform function, crew cannot inhibit flap related alerts if flaps are not in landing condition.

SYSTEM TESTS

Built-In-Test

A Built-In-Test (BIT) function includes a Power-up Self-test, Initiated Tests and Continuous Tests. These tests are performed to warn the crew when there is a degradation of capabilities. These failures are indicated by the illumination of the **TERRAIN INOP** or **GPWS INOP** remote annunciators and the **TAWS STATUS** page of the FMS. The initiated test must be conducted on the ground to determine system status. Function tests include remote annunciators, aural annunciations and displayed test patterns.

Pre-Flight Test

Initiate a test by pressing the **TEST** line select key [1R] on TAWS page two or momentarily pressing the **PULL UP** annunciator switch. The indications listed in the following table and the display of the test pattern confirms proper TAWS operation. TAWS must be selected to view the test pattern unless **Pop-up** is configured which forces TAWS to be displayed without having to select TAWS. This feature is explained later in this section.

At the end of the test, verify that **PULL UP**, **TERR**, **BELOW G/S**, **G/S INHIBIT** and **FLAP OVRD** remote annunciators extinguish. **TERR INOP**, **OBST INOP** and **GPWS INOP** remain illuminated for approximately one minute as TAWS reboots. Verify FMS displays **TAWS FAIL** message during reboot cycle.

At the end of reboot, verify that **TERR INOP**, **OBST INOP** and **GPWS INOP** remote annunciators extinguish and the FMS clears the **TAWS FAIL** message.

NOTE: After the test is complete the TAWS will reboot and will take from one to three minutes to become operational.

NOTE: Visual display of TAWS test patterns utilizing the FMS CDU, Universal's MFD and ARINC-708 displays are illustrated later in this manual.

If the TAWS test switch (**PULL UP** annunciator) or **TEST** line select key on the FMS CDU is pressed while the aural annunciations are occurring, the test will be cancelled and TAWS will not reboot.

Aural and Remote Illuminated Annunciations

When Self-test is initiated TAWS will sequence through each of the aural annunciations. The remote annunciation corresponding to the aural annunciation will illuminate at the same time the aural annunciation occurs. Where no aural annunciation is listed, a quiet period occurs while the corresponding remote annunciator illuminates.

Aural Annunciation	Remote Annunciator
TERRAIN, TERRAIN	PULL UP
PULL UP, PULL UP	PULL UP
MINIMUMS (If configured)	No Annunciation
CAUTION TERRAIN	TERR
TOO LOW TERRAIN	TERR
FIVE HUNDRED	No Visual Annunciation
RADIO ALTIMETER (If configured)	No Visual Annunciation
TOO LOW GEAR	TERR
TOO LOW FLAPS	TERR
SINK RATE	TERR
DON'T SINK	TERR
GLIDESLOPE	BELOW G/S (If configured) - or - TERR
APPROACHING MINIMUMS (If configured)	No Visual Annunciation
BANK ANGLE (If configured)	No Visual Annunciation
ALTIMETER SETTING	No Visual Annunciation
No Aural Annunciation	GPWS INOP
No Aural Annunciation	TERR INOP OBST INOP (If configured)
No Aural Annunciation	FLAP INHIB (If configured) G/S INHIB (If configured) TERR INOP or TERR INHIB (If configured)
No Aural Annunciation	OBST INOP or OBST INHIB (If configured)
No Aural Annunciation	OBST INOP (If configured)

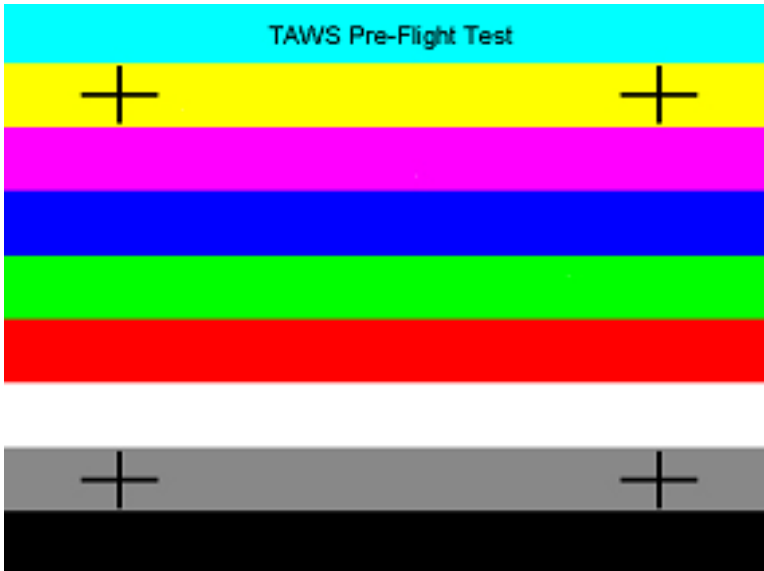
TAWS Pop-up Terrain Display

If Pop-up is configured, the Self-test color bars will pop-up on the FMS CDU or other display device that is configured to display TAWS terrain data.

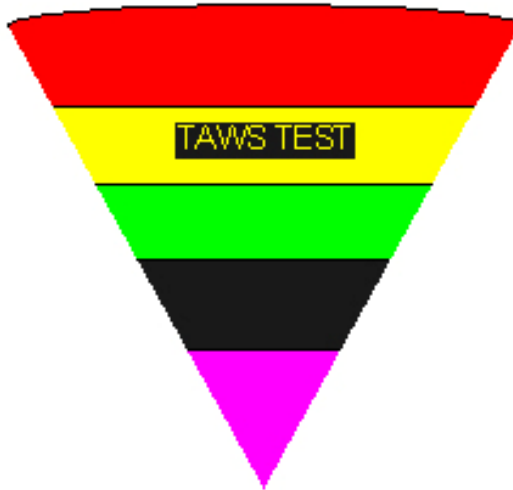
To test the pop-up feature, the display device for TAWS must be displaying data other than TAWS. When self-test is initiated, the color bars will be displayed in place of the current display data without having to select TAWS for display.

TAWS Self-Test Displays

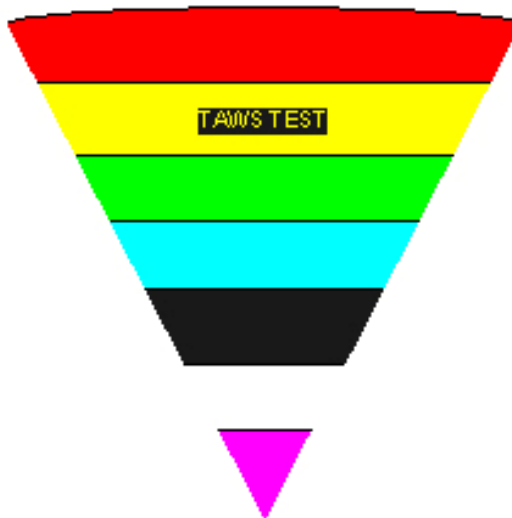
When using a UASC CDU or MFD as the display device for TAWS, the following color bar display is generated.



When using an ARINC-708 display device such as one used for the display of weather radar information, the following five-color display is generated.



If a UASC MFD is utilized to display TAWS information received through its ARINC-708 bus, the following seven-color display is generated.



GLOSSARY OF TERMS

Alert – A visual, aural or tactile stimulus presented to attract attention and/or convey information regarding system status or condition.

Airport Database – Airport information stored within a TAWS.

Aural Alert – A discrete sound, tone or verbal statement used to enunciate a condition, situation or event.

Caution Alert – An alert requiring immediate flight-crew awareness. Subsequent corrective action normally will be necessary.

Class A TAWS Equipment – A class of equipment defined in TSO C151b. As a minimum, it will provide alerts for the following circumstances:

- Reduced required terrain clearance
- Imminent terrain impact
- Premature descent
- Excessive rates of descent
- Excessive closure rate to terrain
- Negative climb rate or altitude loss after take-off
- Flight into terrain when not in landing configuration
- Excessive downward deviation from an ILS glide slope
- Descent of the aircraft to 500 feet above terrain or nearest runway elevation (voice callout "**Five Hundred**")

This class of TAWS equipment also must provide a terrain awareness display of the surrounding terrain and/or obstacles relative to the aircraft. See TSO C151, Table 11-1, to determine which operating rules and aircraft configurations require Class A TAWS equipment.

Class B TAWS Equipment – A class of equipment defined in TSO C151b. As a minimum, it will provide alerts for the following circumstances:

- Reduced required terrain clearance.
- Imminent terrain impact.
- Premature descent.
- Excessive rates of descent.

- Negative climb rate or altitude loss after take-off.
- Descent of the aircraft to 500 feet above terrain or nearest runway elevation (voice callout "**Five Hundred**").

This class of TAWS equipment does not require a terrain awareness display of the surrounding terrain and/or obstacles relative to the aircraft. See TSO C151, Table 11-1, to determine which operating rules and aircraft configurations require Class B TAWS equipment.

Controlled Flight Into Terrain (CFIT) – An accident or incident in which the aircraft, under the flight-crew's control, is inadvertently flown into terrain, obstacles or water without sufficient and/or timely flight-crew awareness to prevent the event.

Failure – The inability of the equipment or any sub-part of that equipment to perform within previously specified limits.

False Alert – A warning or caution that occurs when the design terrain warning or caution threshold of the system is not exceeded.

Forward Looking Terrain Avoidance (FLTA) – A TAWS functional requirement to provide look-ahead terrain and obstacle protection along and below the aircraft's lateral and vertical flight path.

Hazard – A state or set of conditions, which together with other conditions in the environment, could lead to an accident.

Nuisance Alert – An alert caused by improper setting of the terrain-alerting threshold.

Obstacle Database – Obstacle information stored within a TAWS.

Premature Descent Alert (PDA) – A warning system's ability to detect when the aircraft is hazardously below the normal (approximately 3 degrees) approach path for the nearest runway and to provide a timely alert.

Required Terrain Clearance (RTC) – The minimum requirements for obstacle/terrain clearance as defined by the United States Instrument Procedures (TERPS) FAA Handbook 8260.3B and the Aeronautical Information Manual (AIM).

Terrain Awareness and Warning System (TAWS) – A system that provides the flight-crew with sufficient information and alerting to detect a potentially hazardous terrain situation and take effective action.

Terrain Awareness Display – A display of the surrounding terrain or obstacle(s) relative to the aircraft.

Terrain Database – Terrain information stored within a TAWS.

Time-shared Display – A display that shows terrain information, plus additional information from other systems [e.g. an Electronic Flight Instrument System/Navigation Display/Multi-Function Display (EFIS/ND/MFD)].

Visual Alert – The use of projected or displayed information to present a condition, situation or event to the flight-crew.

Warning Alert – An alert for a detected terrain threat that requires immediate flight-crew action.

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