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INTRODUCTION

The Radio Navigation System contains the radios and controls used for navigation purposes. Included in these systems are Terrain Awareness Warning System (TAWS), transponder, VHF navigation radios, weather radar, radio interface unit (RIU), displays and controls with FMS, Radio Communication, GPS, and TCAS.

Two separate systems are provided for radio navigation. They are designed and installed so that the failure of one system does not preclude the operation of the other system. Both are connected to the on-side and cross-side cockpit displays and controls.

Equipment, controls and wiring are designed and installed so that the operation of any of the system components will not adversely affect or will not be adversely affected by the simultaneous operation of any other radio or electronic unit or system.

The Challenger 300 is equipped with conventional navigation systems as follows:

- Integrated Navigation Receivers
- Distance Measuring Equipment
- Automatic Direction Finder

RADIO INTERFACE UNIT (RIU)

The left and right Radio Interface Units are located on their respective equipment racks forward of the entry door.The RIUs accommodate data concentration, communications and audio management, and control functions. The RIU provides an interface between the radios and the rest of the aircraft systems and equipment. They receive inputs from TAWS and TCAS and distribute digital audio signals from the audio control panels (ACPs).

VHF NAVIGATION SYSTEM

DESCRIPTION

The standard VHF navigation system includes dual VOR/localizer receivers, dual glideslope receivers, dual marker beacons, single distance measuring receiver (DME), and single automatic direction finder receiver (ADF). A second ADF and a second DME are available as options.

COMPONENTS AND OPERATION

INTEGRATED NAVIGATION RECEIVERS

The basic aircraft is equipped with a NAV-4000 receiver and a NAV-4500 receiver. Aircraft equipped with dual ADFs have two NAV-4000 receivers.

The NAV-4000 receiver is a remote mounted VOR/LOC receiver, glide slope receiver, marker beacon receiver, and ADF receiver in a single unit. The NAV-4500 contains all the features of the NAV-4000 except the ADF module.

Included in the NAV receiver module is the single-channel marker receiver, which operates at a fixed frequency of 75 MHz and has a HI/LO sensitivity control. This marker receiver provides audio and visual marker information for cockpit indications.

The ADF receiver operates in the frequency range of 190 to 1799 kHz and the maritime distress bands of 2088-2094 kHz and 2179-2185 kHz. It can operate as an AM radio receiver and automatic direction finder, with the capability of receiving keyed carrier stations via a beat frequency oscillator (BFO) signal.

VHF NAVIGATION RECEIVERS

Two VHF navigation receivers (NAV 1 and NAV 2) provide VHF omnirange (VOR), localizer (LOC), glideslope (GS) and marker beacon (MKR) signals to the navigation systems and flight crew.

System	Frequency Range	Channel Spacing
VOR	108.00 to 117.9 MHz	50 kHz (160 chan)
LOC	108.10 to 111.95 MHz	50 kHz (40 chan)
GS	329.15 to 335.00 MHz	150 kHz (40 chan)
MKR	75.00 MHz	Preset

Frequency selection is accomplished through the display control panel (DCP) or the control display unit (CDU).

MARKER BEACONS

Marker beacons indications are presented on the PFDs and audibly in the speakers and headsets if selected on during station passing. Two marker beacon antennas are installed on the bottom of the fuselage.

VHF NAVIGATION SYSTEM (Cont)

RADIO TUNING AND OPERATION

MFD TUNING

The multifunction display (MFD) and display control panel (DCP) provide single point control of both the onside and cross-side radios from the pilot's and copilot's position. The radio menu provides a summary of the radios as well as control for each. The RADIO button on the DCP shows the radio menu on the MFD. The MFD sends signals to the aircraft radios to tune frequencies, set operating modes adjusts squelch levels, and selects voice/data modes. The MFD also responds to tune/control commands from the cross-side MFD or the control display unit (CDU). Either acts as the master tuning control.

COM RADIO OPERATION

To tune the radio, execute the steps as follows:

1. Push the RADIO button on the DCP to show the radio menu if another menu/list is active.
2. Push the 1/2 button if necessary to alternately select the side 1 radio menu and the side 2 radios menu.
3. Turn the MENU knob on the DCP to move the selection box on the radio menu to the radio (COM, NAV, ATC/TCAS, etc.) frequency or channel that is to be tuned.
4. Turn the TUNE knob on the DCP to tune the desired frequency or channel.
5. Push the tune knob to acknowledge the new frequency/channel.
6. To change modes, adjust squelch, and other non-tuning functions of a radio:
   - -Turn the MENU knob to move the selection box to the appropriate radio.
   - -Push the RADIO button on the DCP to select the CONTROL menu of the radio.
   - -Turn the MENU knob to move the selection box on the CONTROL menu.
   - -Turn the DATA knob to change the mode or select an option, or push the PUSH SELECT button to step through available options
   - -Push the PUSH SELECT button to step through available options.
7. To exit the CONTROL menu, push the RADIO button. The display returns to the radio menu.

NAV RADIO OPERATION

The radio menu provides basic NAV radio tuning control. The NAV CONTROL menu controls the display for other NAV radio operation. Each NAV radio installed on the aircraft has its own NAV CONTROL menu. The active, recall, and DME frequency displays are identical to the display on the radio menu.

To set the NAV radio, execute the steps as follows:

1. Push the RADIO button on the DCP to show the radio menu on the MFD if another menu/list is active.
2. Turn the MENU knob on the DCP to move the selection box to the NAV radio (NAV1 or NAV2) display on the radio menu.
3. Push the RADIO button on the DCP to show the appropriate NAV CONTROL menu on the MFD.
4. The following operations are performed on the NAV CONTROL menu.
   - -Tune the DME frequency independently from the paired NAV radio frequency.
   - -When the DME hold is on, turn the MENU knob to move the selection box around the DME frequency.
   - -Turn the TUNE knobs to tune the desired DME frequency.

- Select the marker sense mode.
  - -Turn the MENU knob to move the selection box to the MKR SENSE control.
  - -Turn the DATA knob or push the PUSH SELECT button to select marker sense mode LO or HI.
- Select the NAV TEST mode.
  - -Turn the MENU knob to move the selection box to the TEST control.
  - -Turn the DATA knob or push the PUSH SELECT button to select the TEST mode.

VHF NAVIGATION SYSTEM (Cont)

TRANSPONDER/TCAS OPERATION

The radio menu provides basic transponder and TCAS control. The TRANSPONDER/TCAS CONTROL menu provides control display for other transponder and TCAS operations. The active beacon code, TCAS mode, and TCAS altitude limits selection that show on the left of the TRANSPONDER/TCAS CONTROL menu are identical to the TRANSPONDER/ TCAS display on the radio menu. Two transponders are installed. The active transponder selection is used to select the desired transponder. When the active transponder is set to ATC 1, the pilot's side transponder is active. When the active transponder is set to ATC 2, the copilot's side transponder is active.

To tune the TRANSPONDER/NAV radio execute the following steps:

1. Push the RADIO button on the DCP to show the radio menu on the MFD if another menu/list is active.
2. Turn the MENU knob on the DCP to move the selection box to the TRANSPONDER/TCAS display on the radio menu.
3. Push the RADIO button on the DCP to show the TRANSPONDER/TCAS CONTROL menu on the MFD.
4. The following operations are performed on the TRANSPONDER/TCAS CONTROL menu:

- Select TCAS traffic altitude mode.
  - -Turn the MENU knob to move the selection box to the TRAFFIC control
  - -Turn the DATA knob or push the PUSH SELECT button to select traffic altitude mode REL (relative) or ABS (absolute)
- Select the active transponder.
  - -Turn the MENU knob to move the selection box to the transponder control
  - -Turn the DATA knob or push the PUSH SELECT button to select ATC 1 or ATC 2 as the active transponder
- Set the Flight ID
  - -Turn the MENU knob to move the selection box to the Flight ID control
  - -Turn the TUNE knobs to set the desired Flight ID characters
- Select the ATC/TCAS TEST mode.
  - -Turn the MENU knob to move the selection box to the TEST control
  - -Turn the DATA knob or push the PUSH SELECT button to select the TEST mode

ADF RADIO OPERATION

The radio menu provides basic ADF radio tuning. The ADF CONTROL menu provides control display for other ADF radio operations. Each ADF radio installed on the aircraft has its own ADF CONTROL menu. If only one ADF radio is installed, it shows on both the on-side and cross-side menus, and will be labeled ADF CONTROL with no numerical designator. The active frequency, recall frequency, and antenna mode that show on he left of the ADF CONTROL menu are identical to the ADF display on the radio menu.

To set the ADF modes execute the following steps:

1. Push the RADIO button on the DCP to show the radio menu on the MFD if another menu/list is active.
2. Turn the menu knob on the DCP to move the selection box to the ADF radio (ADF 1 or ADF 2) display on the radio menu.
3. Push the RADIO button on the DCP to show the ADF CONTROL menu on the MFD.
4. The following operations are performed on the ADF CONTOL menu:

- Select the ADF/ANT mode.
  - -Turn the MENU knob to move the selection box to the MODE control
  - -Turn the DATA knob or push the PUSH SELECT button to select ADF or ANT mode
- Select BFO mode.
  - -Turn the MENU knob to move the selection box to the BFO control
  - -Turn the DATA knob or push the PUSH SELECT button to select ON or OFF for the BFO mode
- Select ADF TEST mode.
  - -Turn the MENU knob to move the selection box to the TEST control
  - -Turn the DATA knob or push the PUSH SELECT button to select the TEST mode

VHF NAVIGATION SYSTEM (Cont)

TUNING REVERSION

Normally, the MFD provides the master tuning control. However, if the MFD fails or is reverted to a compressed PRF format, radio tuning through that MFD is no longer available. Tuning reversion allows the pilot to select either the MFD or the CDU as the master tuning control. When the TUNE knob on the Reversion Selection Panel is set to MFD ONLY or when the TUNE knob is set to CDU ONLY, the CDUs ignore tuning commands from the MFDs and the MFD radio menu is blanked. When the TUNE knob is in the COM 1 121.50 position, tuning is as normal (MFD is the master tuning control), but the COM 1 radio is forced to the emergency 121.50.

1. Turn the TUNE knob on the REVERSION panel to the desired position.
   - The MFD ONLY position selects the MFDs as the only tuning control
   - The CDU ONLY position selects the CDUs as the only tuning control
   - The COM 121.50 position forces the COM1 radio to 121.50, but remains the MFD as the master tuner

CDU TUNING

The CDU provides tuning control of both the on-side and cross-side radios. Data entry to the CDU is made through the scratchpad and the line select keys. Information is entered on the scratchpad, then transferred to the appropriate location with the adjacent line select key. Warning messages show if the information entered is not appropriate for the data field. Access to CDU tuning is via the TUNE page.

To tune the radio using the CDU execute the following steps:

1. Push the TUN key on the CDU to show the TUNE page.
2. To tune a radio directly, do one of the following steps:
   - Enter the frequency into the scratchpad, then push the line select key for the appropriate radio
   - Enter a preset channel number (1 through 20) into the scratchpad, then push the line select key for the appropriate radio
   - NAV radios only: Enter the three letter identifier for the NAVAID, then push the line select key for the appropriate radio (NAV 1 or NAV 2)
3. To show the CONTROL page for a particular radio (to set presets, select modes, etc.), push the line select key for the radio when the scratchpad is empty.
4. To return to the TUNE page from a CONTROL page, push the line select key for the radio or push the TUN key.

VHF NAVIGATION SYSTEM (Cont)

DISTANCE MEASURING EQUIPMENT (DME)

The DME-4000 is a remote mounted, three channel unit designed to provide position navigation information, including distance. In the single DME configuration, channel 1 can be tuned by the pilot, channel 2 by the copilot. Channel 3 is used by the FMS. In the optional dual DME configuration, each pilot has control over channel 1 of the onside DME, while channels 2 and 3 of each DME are used by the onside FMS.

The DME measures line-of-sight distance between the aircraft and selected DME ground stations, calculating the rate of closure and time to reach the selected station.

The DME information is displayed on the pilot's PFD and the backup reversionary navigation display. The DME operates in the frequency range of 962 to 1213 MHz. Most DME channel assignments are paired with VOR or ILS facilities and are selected by inputting the associated VOR or ILS frequency to the DME. The frequency selection is done with the CDU or the DCP in the frequency range of 108.00 to 117.95 MHz. DME frequencies not paired with VOR or ILS facilities are arbitrarily associated with a group of frequencies (133 to 135 MHz in the VHF communications band.

STATION IDENTIFICATION

If a station identifier signal is received, the resulting audio signal is supplied to the audio control unit for selection to the flight compartment speakers or the pilot's and copilot's headsets.

The distance indication is calculated by the DME transceiver and is sent for display to the pilot's and copilot's PFDs and CDUs through the IAPS computer. The distance display is shown in a four-digit field followed by NM. When a no-computed data condition occurs, the distance indication is replaced with dashes. The maximum DME tracking range is 300 NM. Actual range under particular conditions will vary with altitude, terrain features and other factors.

DME HOLD FUNCTION

The DME hold function splits the paired tuning between DME and VHF navigation systems to enable independent operation. The DME hold function holds the DME transceiver to the current VHF navigation frequency and permits the VHF navigation receiver to be independently tuned. When DME hold is on, which is indicated by the DME frequency suffixed with an "H" below the NAV radio frequency on the radio menu or NAV CONTROL menu, turn the MENU knob to move the selection box around the DME frequency. The DME hold function permits the VHF navigation receiver to be independently tuned while the VHF navigation receiver is kept at the current frequency.

This function is selected when the DME H push button on the DCP is pressed. The paired VHF navigation frequency display is activated. If the DME H push button is pressed again, the DME hold function is canceled. The paired VHF navigation frequency display is also removed.

AUTOMATIC DIRECTION FINDER (ADF)

DESCRIPTION

The Automatic Direction Finder (ADF) System is a dual low-frequency radio system. The ADF system is used to indicate the bearing to a selected ground station. The ADF system supplies station identification and voice signals to the audio integrating system. The transmitting stations can be non directional beacons (NDBs) or standard broadcasting stations in the frequency range of 190 to 1799 kHz and maritime distress bands of 2088 to 2094 kHz. The bearing-to-station data is shown on the pilot and copilots' PFDs, and backup reversionary navigation display.

The unit receives unmodulated-voice / tone-modulated carrier or keyed carrier transmissions from Non-Directional Beacons or AM stations, then calculates the station bearing, relative to the nose of the aircraft, as an output.

Using the beat frequency oscillator (BFO) function, the receiver produces a bearing to the station and also produces a 1020 Hz output tone when a carrier is present, in addition to the residual audio/noise from the detected carrier. A data-load option may be included so that the BFO audio output will be "clean", i.e., contain no noise, even under low signal strength conditions.

MODE S TRANSPONDER SYSTEM

DESCRIPTION

The Mode S transponder system consists of two Mode S transponder units. Only one transponder unit is active at any one time, while the other has a standby role. The transponder system supplies ATC, or a traffic alert and collision avoidance system (TCAS) equipped aircraft with aircraft identification and altitude data in response to an interrogation. The transponder used with TCAS is equipped with two paired antennas to transmit and receive interrogations above and below the aircraft without the signal being masked by the airframe.

The transponder will go into ident mode for approximately 18 seconds when the ID function key is pushed and the annunciator illuminates.

COMPONENTS AND OPERATION

ATC ANTENNAS

Each transponder system has two paired antennas. Each system has an upper and lower antenna located on the forward fuselage.

TRANSPONDER MODES

ATC/TCAS mode selection is as follows:

- STBY
- TA/RA
- TA ONLY
- ALT ON
- ALT OFF

Selecting STBY on either MFD causes the TCAS to go to standby mode. At system power up on the ground, the system powers up in standby mode.

TA/RA is the normal TCAS mode. When TA/RA mode is set, the TCAS computer generates intruder traffic symbology and resolution advisory vertical speed fly to commands. The intruder traffic symbology shows on the PFD and/or MFD when selected. RA vertical speed fly to commands show on the PFD vertical speed scale when commanded by the TCAS.

RAs are not displayed when TA ONLY is the active mode. This annunciation is displayed in cyan when TA ONLY mode is selected. This annunciation turns yellow and flashes when a TA is present.

ALT ON mode is used when ATC transponder mode C operation is desired, but TCAS operation is not. The TCAS computer does not show traffic on the displays, does not issue resolution advisories, and the ATC transponder does not reply to other aircraft TCAS interrogations. Mode C is not reported when interrogated by ATC.

ALT OFF mode is used when TCAS and ATC transponder operation is not desired. The TCAS computer does not show traffic on the displays, does not issue resolution advisories, and the ATC transponder does not reply to other aircraft TCAS interrogations. Also, mode C is not reported when interrogated by ATC.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

DESCRIPTION

The TCAS II system is an airborne traffic alert and collision avoidance system that interrogates transponders in nearby aircraft and uses computer processing to identify and display potential and predicted collision threats. The system protects a volume of airspace around the TCAS equipped aircraft. The system provides appropriate aural and visual advisories to the flight crew to provide adequate separation when the computer analysis of intruding aircraft transponder replies predicts a penetration of the protected airspace. The TCAS II system provides two types of advisories. A traffic advisory (TA) indicates the relative position of an intruding aircraft that is approximately 35 seconds from the closest point of approach and may, a short time later require a resolution advisory (RA). The TA provides the flight crew with the opportunity to visually acquire the intruding aircraft. An RA will produce a threat resolution in the form of a vertical maneuver that will increase separation when the computer predicts the intruder aircraft is within approximately 25 seconds from the closest point of approach.

The TCAS II system can only generate resolution advisories for intruders equipped with operative Mode C or better transponders, which provide information on the altitude of the intruder. Traffic advisories, which display the relative position of the intruder, can be generated for aircraft with operative transponders. The TCAS II equipment is viewed as a supplement to the pilot, who, with the aid of the ATC system has the primary responsibility for avoiding mid-air collisions. The TCAS II system provides no indication of traffic conflicts with the other aircraft without operative transponders.

COMPONENTS AND OPERATION

The TCAS II system provides the following capabilities:

- Collision avoidance tracking
- Threat detection
- Threat resolution
- Communication and coordination
- Surveillance

TA and RA symbols have priority over any conflicting display space usage and will overwrite any other symbols or characters. The TCAS II has a maximum range of 40 nm and a maximum of 32 intruders can be displayed. Four different TCAS symbols are used on the TCAS page to represent TCAS targets. Indicators that represent the intruder's vertical speed and relative altitude data accompany each TCAS symbol.

Relative altitude mode is used when the altitude between own aircraft and intruder aircraft is desired. Absolute altitude mode is used when the barometric altitude of the intruder aircraft is desired. The relative (REL) or absolute (ABS) altitude of intruder aircraft is shown below the traffic symbols on the TCAS display. Relative altitude mode is the default mode. Altitude is not shown for intruder aircraft not reporting altitude data. To select REL or ABS, turn the MENU switch to position the selection box around the desired mode.

Arrows are used to indicate the vertical speed of the target aircraft. The arrow indicates that an aircraft is changing altitude at a rate of 500 fpm or greater.

Plus or minus signs along with a number symbolizes the relative altitude of the threat airplane. Plus indicates above and minus indicates below.

TCAS MODE SELECT

Line select buttons on the left and right sides of the TCAS CONTROL page control the following functions:

- MODE (TA, TA/RA, or STBY)
- TRAFFIC (ON/OFF)
- ALT TAG (REL/ABS)
- TEST
- EXT TEST (ON/OFF)
- ALT LIMITS (ABOVE, NORM, BELOW)

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (Cont)

CONTROL OPERATION

TCAS modes selection and other controls are done using the FMS CDU, MFD radio menus and the DCP.

The radio menu provides basic transponder and TCAS control. The TRANSPONDER/TCAS menu provides control display for other transponder and TCAS operations. The active beacon code, TCAS mode, and TCAS altitude limits selection that show on the left of the TRANSPONDER/TCAS menu are identical to the TRANSPONDER/TCAS display on the radio menu.

MFD controls using the DCP:

1. If the selection box is not displayed on the MFD radio menu, push the RADIO push button on the DCP
2. Turn the MENU knob on the DCP to position the selection box around the desired radio tune frequency/channel/mode display.

When using the active tune method the frequency color changes from green to white. Active tuning is used for transponder beacon code selection. Usually radio control other than frequency/channel tuning is done on the radio's sub menu. Radio control uses the selection box method as follows:

1. Repeat steps 1 and 2 above to position the selection box within the display for the desired radio on the MFD radio menu.
2. Push the RADIO push button and the sub menu for the selected radio will replace the top level menu. (The process of tuning on the MFD radio sub menu is identical to tuning on the MFD radio menu).
3. Turn the MENU knob to position the selection box around the desired radios control.
4. Turn/push the DATA knob on the DCP to select the desired state of the selected control

The selection box returns to its MFD main radio menu home position after 20 seconds of no activity on the sub menu or by again pushing the RADIO (on the DCP) push button again. Pushing a menu push button will replace the sub menu with the top level menu and operate as required for the push button. The selection box is immediately positioned around the tune frequency/channel display on the sub menu and frequency/channel is tuned if the TUNE knob is turned, or the ↕ knob is pushed.

The beacon code entry uses active tuning control operation and any code may be entered between 0000 and 7777. The IDENT switch is located on both control wheels and stays active for approximately 18 seconds when pushed.

The TRANSPONDER/TCAS mode selection and annunciation is on the TRANSPONDER/TCAS radio primary display page on the MFD and on the TRANSPONDER/TCAS control radio submenu. Selections are as follows:

- When using the DATA button the possible mode selections in order of succession are STBY, TA/RA, TA ONLY, ALT ON, ALT OFF. The order reverses if the DATA knob is turned counterclockwise
- When STBY, ALT ON or ALT OFF are selected, a 2 second delay is imposed before transmitting that mode selection to the TCAS. When STBY is selected, a 2 second delay is imposed before transmitting to ATC. The standby command delay prevents transient selection of standby during mode selection
- The transponder reports altitude in TA/RA, TA ONLY and ALT ON modes.
- The TRANSPONDER/TCAS mode selection on the MFD display is replaced with XPDR FAIL if the transponder is failed and the mode is not in STBY
- When ALT OFF is selected, a 2 second delay is imposed before transmitting the mode selection to prevent transient selection during mode selection

The altitude limits selection and annunciation is on the TRANSPONDER/TCAS radio primary display and TRANSPONDER/TCAS radio sub menu. The selections are as follows:

- When using the DATA button the possible selections are ABV, NORM, BLW, and ABV/BLW. The order reverses if the DATA knob is turned counterclockwise
- ABV selects the above altitude limit, BLW selects the below altitude limit. When both are selected, the unrestricted altitude mode is invoked. When NORM is selected, ABV and BLW are deselected
- The altitude limits selection is inoperative if XPDR FAIL is annunciated
- Relative (REL) or absolute (ABS) on the TRANSPONDER/TCAS sub menu is enlarged when selected
- An open diamond symbol represents non-threat traffic that is displayed below the TRAFFIC legend. When OFF is selected, non threat traffic is not displayed. When ON is selected all traffic is displayed
- Transponder selection is on TRANSPONDER/TCAS radio sub menu. When ATC1 or ATC2 is the active transponder, the selected transponder is enlarged

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (Cont)

- Pressing the TEST button will start a self-test program that will verify proper operation of the TA and RA displays and of the aural advisories. The TEST mode does not affect normal TCAS operation. Should an actual TA or RA occur during TEST sequence, the test is automatically terminated and the advisory is announced and displayed

THREAT LEVELS AND DATA TAGS

The system provides four types of advisories:

- Traffic Advisories (solid amber circle) - Traffic advisories (TA) symbols appear on the MFD, when target(s) is projected to converge with the TCAS equipped airplane in approximately 35 seconds, with the closest point of the approach being inside a minimum vertical separation envelope. Traffic advisories are generated for aircraft with operative Mode S, Mode C, or Mode A transponders. The relative bearing and range of the intruder are displayed

- Resolution Advisory (solid red square) - Resolution advisories (RA) symbols appear on the MFD, when target(s) is predicted to penetrate the protected vertical envelope in approximately 25 seconds. An RA display on the PFD vertical speed indicator (VSI) indicates the vertical rate that must be achieved to maintain safe separation. During an RA, red and green bands overlay the VSI scale. Red band indicates what vertical speed range should be avoided and the green band indicates the vertical speed needed to achieve safe separation. The red band indicates pitch rates that should be avoided and fly the vertical speeds within the green band. RA display can only be issued if an intruder airplane is equipped with a Mode S transponder

- Proximity Traffic (solid cyan color diamond) - Proximity traffic (PROX) symbols appear on the MFD when non-threat airplane(s), which have a flight path that approaches the collision area. The PT symbol is displayed if the target does not qualify for a TA but is currently within ± 6 nm and ± 1200 feet of the TCAS airplane

- Other Traffic (open cyan color diamond) - The other traffic (OT) is in the surveillance area, but is not a collision threat

When altitude data is available, an ALT TAG shows the altitude of each intruder aircraft on the TCAS traffic display. When the altitude of the intruder aircraft is more than that of the interrogation aircraft, ALT TAG shows above the traffic symbol. When the altitude of the intruder aircraft is less than that of the interrogation aircraft, ALT TAG shows below the traffic symbol. If the intruder aircraft altitude changes at a rate of ± 500 ft./min. or more, an arrow after the traffic symbol shows the altitude change direction.

The TCAS system provides no indication of traffic conflicts if the intruder airplane is without an operative transponder.

The TUNE and TCAS CONTROL pages on the CDU are another way to control TCAS mode selection.

RESOLUTION ADVISORY

Resolution advisories (RA) advise the pilot that corrective action is required to avoid an intruder. RAs show on the vertical speed scale to indicate forbidden/acceptable vertical speeds. TCAS overlays are available on both the PFD and MFD. A TCAS only map is available on the MFD. Identical TCAS control selections show on both onside and cross-side MFDs so that either pilot can make TCAS control selections. Also aural alerts will sound over the cockpit audio system.

TRAFFIC ADVISORY

A traffic advisory (TA) is issued when an intruding aircraft penetrating the 35 second TCAS surveillance area and is considered by the TCAS computer to be a possible threat. The traffic advisory provides the flight crew with an opportunity to use the TCAS page on the MFD to assist in visually locating the intruding aircraft.

The following advisories are shown on the PFD and MFD and heard on the speakers:

- Aural advisory TRAFFIC TRAFFIC is sounded
- Amber CAS TRAFFIC is displayed below the VSI scale on the PFD
- Amber TAs are shown on the TCAS page of the MFD as a solid amber circle

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (Cont)

TCAS VOICE RELATED AURAL ALERTS

VOICE MESSAGE	MEANING
Climb, Climb	Climb at a nominal 1500 fpm
Climb, Crossing Climb	Same as Climb, Climb, aircraft's flight path will cross the flight path of the intruder
Increase Climb	Follows a climb advisory. Climb rate should be increased to the rate on the VSI (nominally 2500 fpm)
Adjust Vertical Speed, Adjust	Reduce vertical speed to speed shown on vertical speed indicator
Descend, Descend NOW	Follows a climb advisory. TCAS indicates that a reversal of vertical speed is needed to provide adequate separation.
Descend Descend	Descend to nominal 1500 fpm
Descend, Crossing, Descend	Same as Descend, Descend, aircraft's flight path will cross the flight path of the intruder
Increase Descent	Follows a descent advisory. Descent rate should be increased to the rate on the VSI (nominally 2500 fpm).
Reduce Descent	Reduce vertical speed to speed shown on vertical speed indicator
Climb, Climb NOW	Follows a descent advisory. TCAS indicates that a reversal of vertical speed is needed to provide adequate separation.
Monitor Vertical Speed	Follow the vertical speed indicator. The present vertical speed of the aircraft is not within the area indicated by the VSI
Clear Of Conflict	Reposition to assigned altitude
Maintain Vertical Speed, Maintain	Maintain climb or descent rate
Maintain Vertical Speed, Crossing Maintain	Maintain climb rate
Traffic, Traffic	Traffic Advisory

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (Cont)

PFD TCAS INDICATIONS

Resolution Advisories are presented on the PFD.

The word TRAFFIC appears below the altitude strip display on the PFD in the colors indicated below:

- Red TRAFFIC appears for a Resolution Advisory (RA)
- Amber TRAFFIC appears for a Traffic Advisory (TA)
- White TCAS TEST appears when the system is tested
- White TA ONLY appears when RA is inhibited
- White TCAS OFF appears when the system is off

The failure messages appear on the VSI and MFD. They are:

- TCAS RA FAIL
- TCAS FAIL

TCAS RESOLUTION ADVISORIES (RA) INHIBITS

TCAS Resolution Advisories (RA) and some aural alerts are inhibited below certain radio altitudes. Radio altitudes and the associated RA status are as follows:

RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS
Below 900 ft AGL, descending Below 1100 ft climbing	All RA's inhibited. (TA ONLY) and TA Aural message inhibited
Below 1000 ft AGL descending Below 1200 ft climbing	"DESCEND RA" inhibited
Below 1450 ft AGL	"INCREASE DESCENT" inhibited

TERRAIN AWARENESS WARNING SYSTEM (TAWS)

DESCRIPTION

The primary purpose of the terrain awareness warning system (TAWS) is to provide alerts and warnings to avoid controlled flight into terrain (CFIT) and to provide detected windshear warning. The system provides the flight crew with aural alert messages and visual annunciations and displays in the event that the boundaries of any alerting envelopes are exceeded.

The TAWS contains three systems in one line replaceable unit.

- Ground proximity
- Terrain/obstacle awareness
- Windshear systems

The Ground Proximity Warning System (GPWS) produces warnings that require action based on real time input to the GPWS. These warnings help prevent CFIT and are categorized into 5 modes. Each mode has a distinct aural and visual alerts. The GPWS is also capable of providing a sixth mode, which can include altitude related callouts and excessive bank angle callout. The displays provide the PULL UP and GND PROX GPWS annunciations on the PFD.

Mode 7 provides windshear caution or warning alerts if threshold values along the flight path and perpendicular to the flight path are exceeded. The displays provide WINDSHEAR annunciations of the PFD.

The Enhanced Ground Proximity Warning Computer (EGPWC) processes all inputs and provides all aural and visual alerts and warnings.

A warning annunciation indicates a prediction of impact with terrain. All annunciations are displayed on pilot and copilot PFDs.

COMPONENTS AND OPERATION

The MFD control panel provides for the selection of the terrain (TR/WX) display on the respective MFD, while the DCP is used to display TR/WX on the PFD. Graphical terrain data is automatically displayed on the MFD when a terrain hazard is encountered. Each time the TAWS computer commands a terrain popup, the MFD automatically commands terrain overlay to be added to the current format if the onside PFD is not displaying terrain and if the MFD format is compatible with terrain. The PFD commands the normal range to 10 NM. If the current MFD format is incompatible with terrain, the format will be changed to PPOS with TR selected, with a 10nm range. Regardless of the current format, selecting TR/WX will automatically select terrain for display. Similarly, selection of WX or WX/LX automatically deselects terrain.

Terrain range is selectable from the on-side DCP RANGE knob. with selected ranges up to 300 nm. If the display range is at a value greater than 300 nm when the pilot selects terrain, the display range will automatically reduce to 300 nm. On the Challenger 300, range can be selected up to 600 nm when in plan map format. If terrain data has been selected for display, selection of display ranges greater than 300 nm will be inhibited.

The TAWS WARN control panel, located on the center instrument panel, provides for the inhibiting of GS, FLAPS, aural warnings and TERRAIN.

- GS
  - A TAWS GS WARN OFF status message is displayed when the switch is set to OFF. This switch is used by the pilot to mute nuisance “glideslope” warnings. This switch is normally selected when a backcourse approach is conducted
- FLAPS
  - A TAWS FLAPS OFF status message is displayed when the switch is set to OFF. This switch is used by the pilot to mute related GPWS warnings when a landing will be attempted with flaps not at 30 degrees
- TERRAIN
  - A TAWS TERR OFF status message is displayed when the switch is set to OFF. This switch is used by the pilot to deselect the terrain function of the TAWS

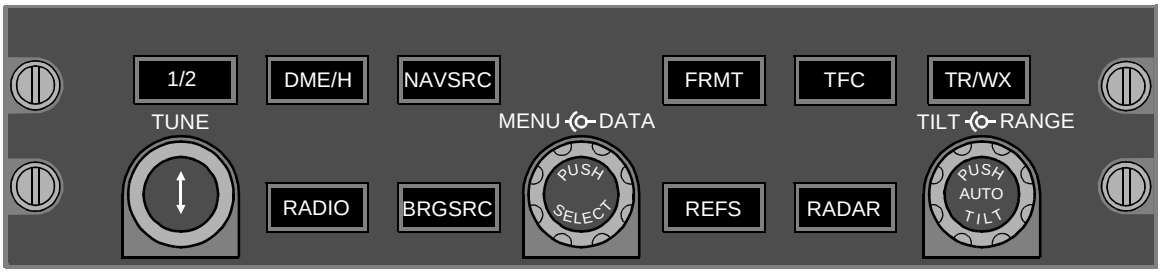
TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MFD CONTROL PANEL (MCP)

Illustration of the MFD is shown with the optional 3D Map Display switches (refer to Chapter 11-1-24 for further description).

CFO1101002_009

DISPLAY CONTROL PANEL (DCP)



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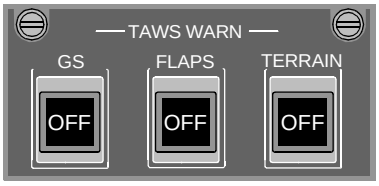
TAWS WARN PANEL



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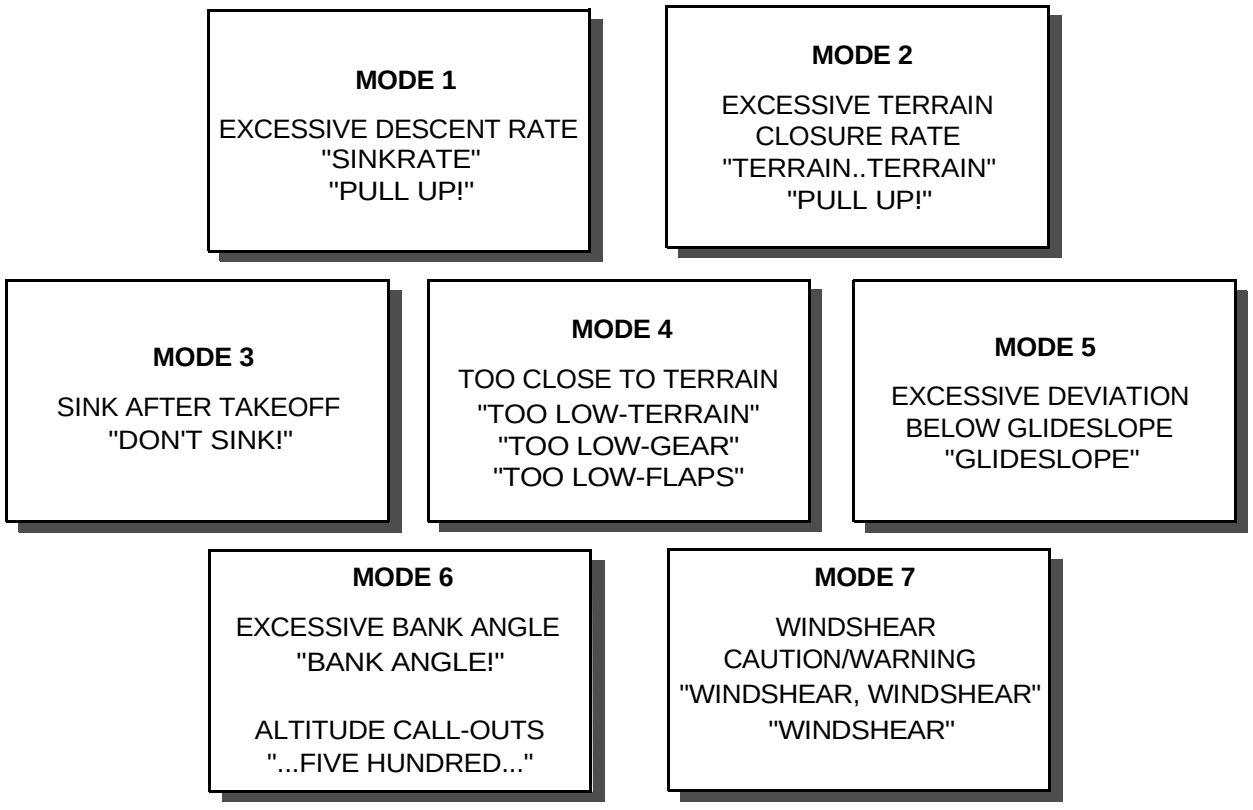
TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

TAWS MODES

TAWS modes are as follows:



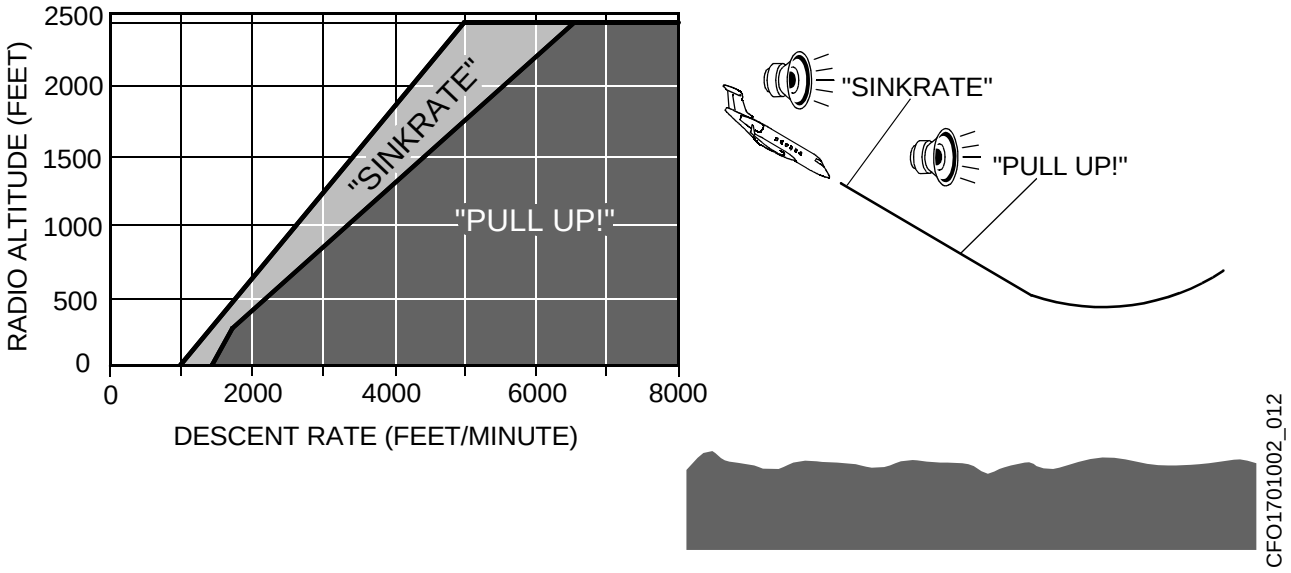
TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 1— Excessive Descent Rate

Mode 1 alerts when the aircraft descends close to the terrain. The mode is active when the airplane is less than 2500 ft. AGL. Mode 1 requires radio altitude and rate-of-descent data.

The annunciation envelope consists of two areas, alert and warning.

- Penetration of the alert area annunciates a GND PROX amber CAS alert on the PFD and generates an aural “SINKRATE, SINKRATE”. The aural alert will be annunciated once and will be repeated only if condition degrades by more than 20% based on computed time to impact. The visual alert will remain until the condition is rectified.
- Penetration of the warning area will annunciate a PULL UP red CAS alert on the PFD and generate an aural “PULL UP” warning. The aural warning is annunciated continuously until the condition is rectified.



TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

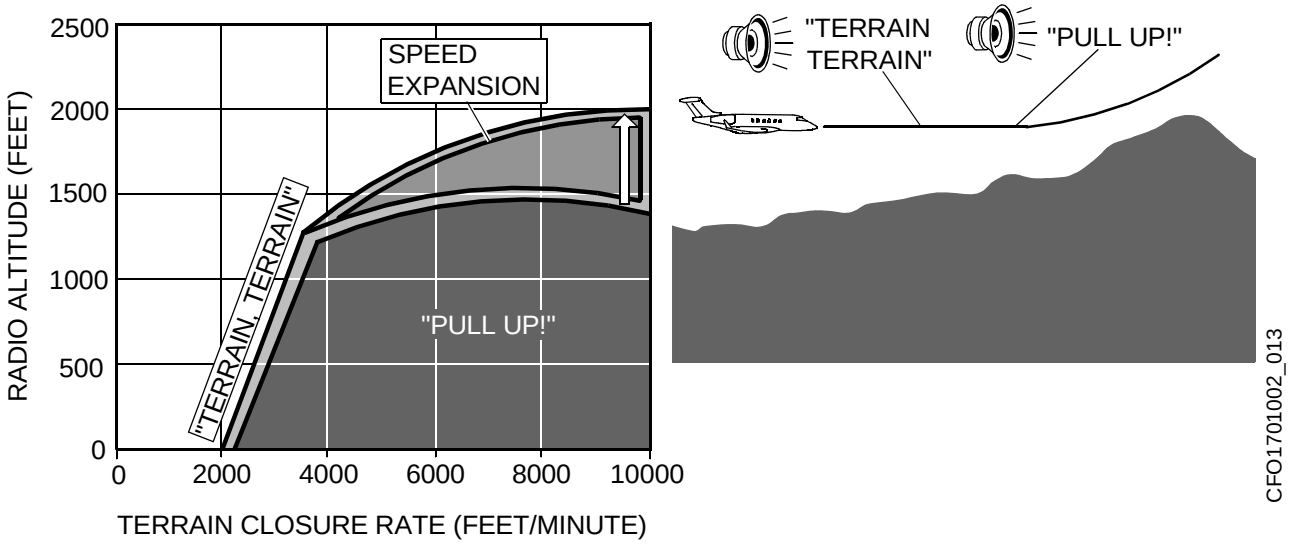
MODE 2 — Excessive Terrain Closure Rate

Mode 2 provides alerts and warnings when the TAWS detects that the closure rate between the airplane and the terrain is excessive. The airplane need not be in descent; rising terrain may be encountered in level flight or the terrain may be rising at a rate greater than the airplane rate of climb. Mode 2 uses radio altitude and vertical speed inputs.

Mode 2 has two sub-modes, Mode 2A and Mode 2B.

MODE 2A

Mode 2A is activated when flaps are not in the landing position. Penetration of the alert area will annunciate a GND PROX amber CAS on the PFD and generate an aural “TERRAIN, TERRAIN.” The aural is annunciated once and the visual alert will remain until the condition is rectified. Penetration of the warning area will annunciate a PULL UP warning CAS alert on the PFD and generate an aural “PULL UP” warning. The aural and visual warning are annunciated continuously until the condition is rectified.

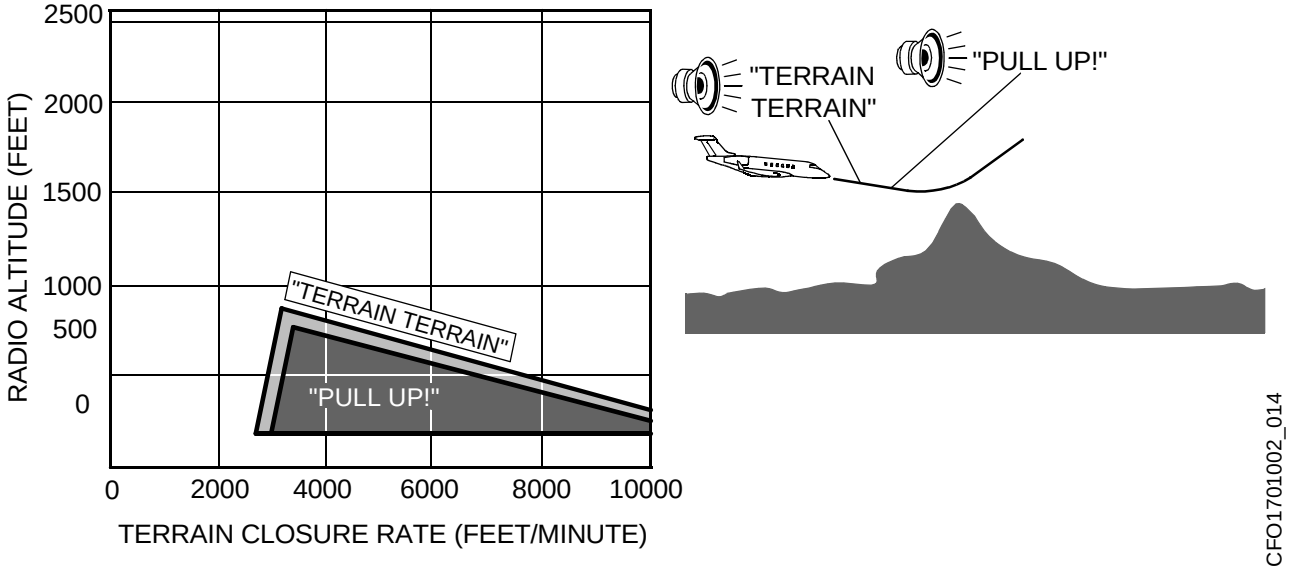


TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 2 — Excessive Terrain Closure Rate (Cont)

MODE 2B

Mode 2B is activated when flaps are in the landing configuration, or if the flaps are up and the airplane is on an ILS approach and the glideslope and localizer deviations are less than ± 2 dots and for 60 seconds after take-off. Penetration of the alert area will annunciate an amber GND PROX on the attitude display of the PFD and enable an aural “TERRAIN, TERRAIN”. The aural and the visual alerts are annunciated continuously and will remain until the condition is rectified. Penetration of the warning area will annunciate a red PULL UP on the attitude display of the PFD and generate an aural “PULL UP” warning. The aural and visual warning are annunciated continuously until the condition is rectified. The Mode 2B warning envelope is inhibited at an altitude below 30 feet AGL.



TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

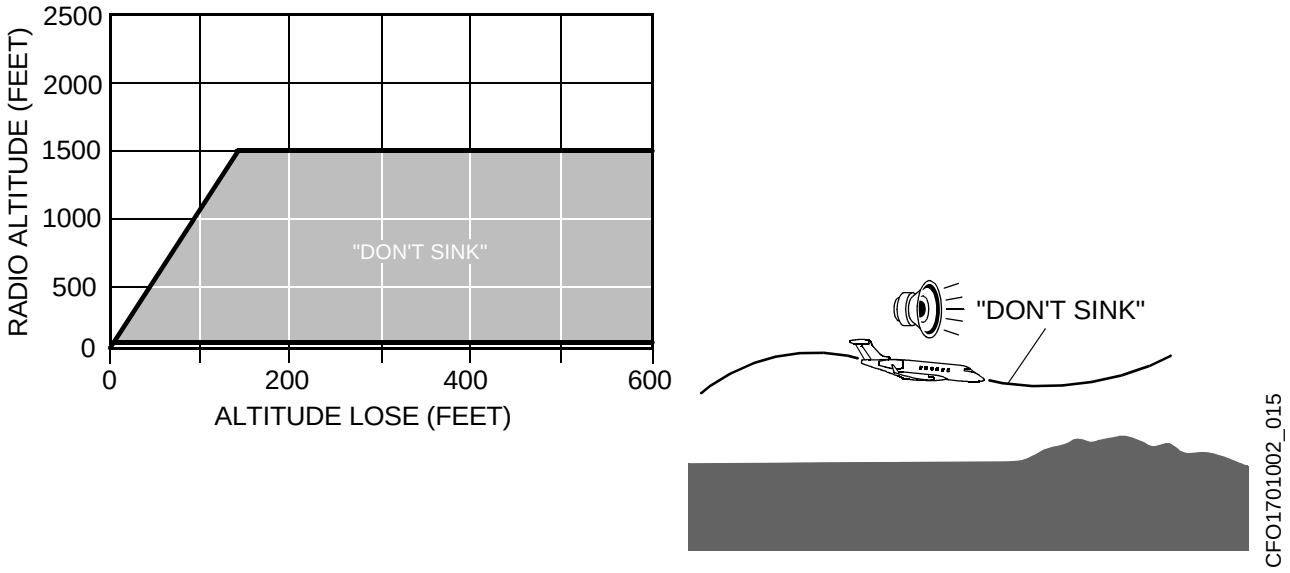
MODE 3 — Altitude Loss After Takeoff

Mode 3 provides warnings when the TAWS detects that a significant amount of altitude is lost immediately after takeoff or during go-around. Mode 3 uses radio altitude, barometric altitude and altitude rate.

Mode 3 is enabled after takeoff or go around, when landing gear or flaps are not in landing configuration. Mode 3 stays enabled until the TAWS detects that the aircraft has gained sufficient altitude that it is no longer in the takeoff phase of flight.

If a descent is initiated following takeoff or go-around, the TAWS stores the altitude value at which the descent began and compares successive altitude data to the stored value. Activation of the warning is induced when the minimum terrain clearance, as a function of altitude lost, is exceeded.

Penetration of the alert area will annunciate a GND PROX alert on the attitude display of the PFD and generate an aural “DONT SINK, DONT SINK” warning. The aural warning is annunciated only once, unless the altitude value degrades by more than 20% from the initially stored value and again at each additional 20% degradation from the initially stored value. This condition will remain until the airplane regains the initial altitude value. Mode 3 is inhibited for radio altitude values in excess of 1500 feet.



TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

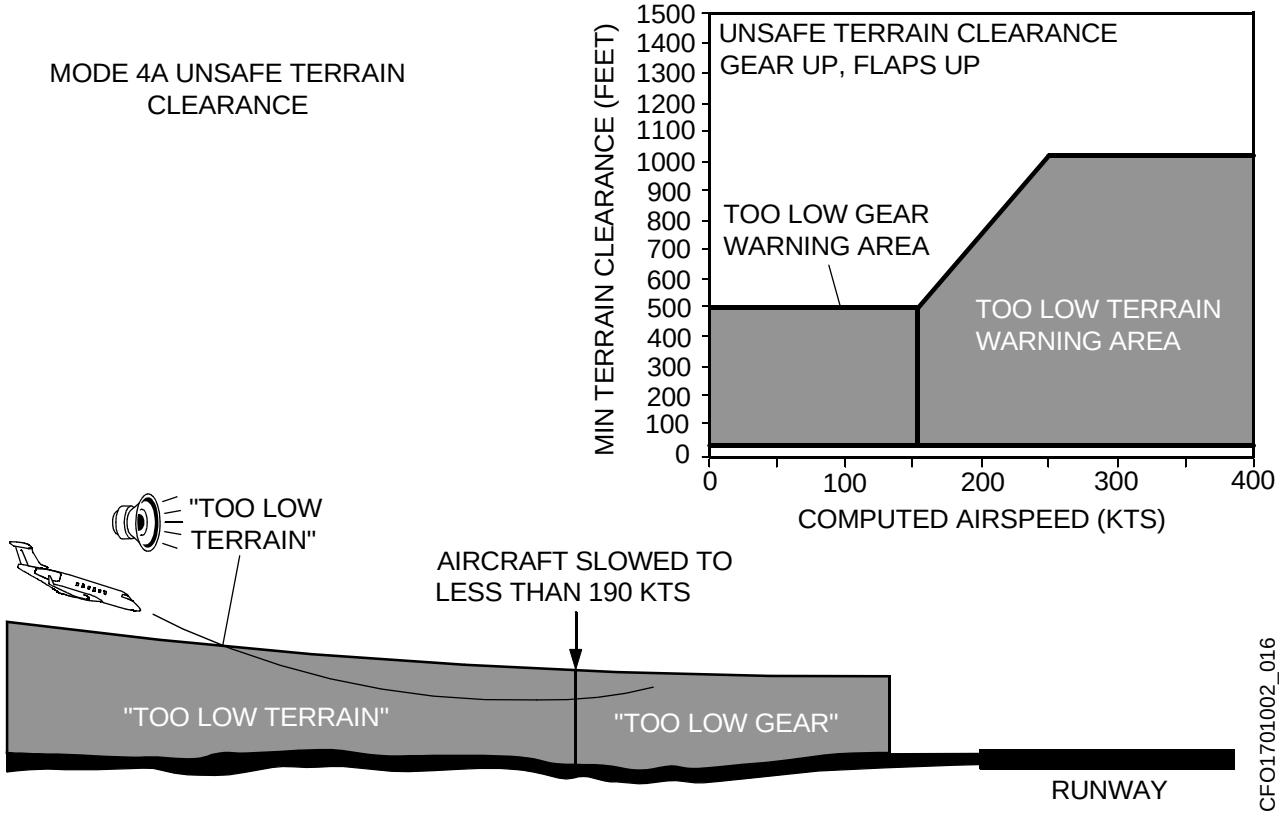
MODE 4 — Unsafe Terrain Clearance

Mode 4 provides alerts and warnings for sufficient terrain clearance based on the airplanes phase of flight and speed. Mode 4 requires radio altitude, computed airspeed, gear position and flap position inputs. The alert and warning envelopes are based on minimum allowable terrain clearance as a function of computed airspeed.

Mode 4 is divided into 3 sub-modes: Mode 4A, Mode 4B, and Mode 4C.

MODE 4A

Mode 4A is active when the airplane is in cruise or approach phase of flight and the landing gear is not in the landing position. The alert envelope for Mode 4A begins at 30 feet AGL and extends vertically to an altitude of 500 feet AGL. During penetration of the alert area above 190 knots, the upper boundary increases with airspeed to a maximum of 1000 feet radio altitude at 250 knots or more. This annunciates an amber GND PROX display and generates a continuous aural “TOO LOW TERRAIN” warning. Penetration of the alert area 190 kt, annunciates an amber GND PROX alert on the PFD and generates an aural “TOO LOW GEAR” warning. The aural and visual remains until the airplane exits the envelope.

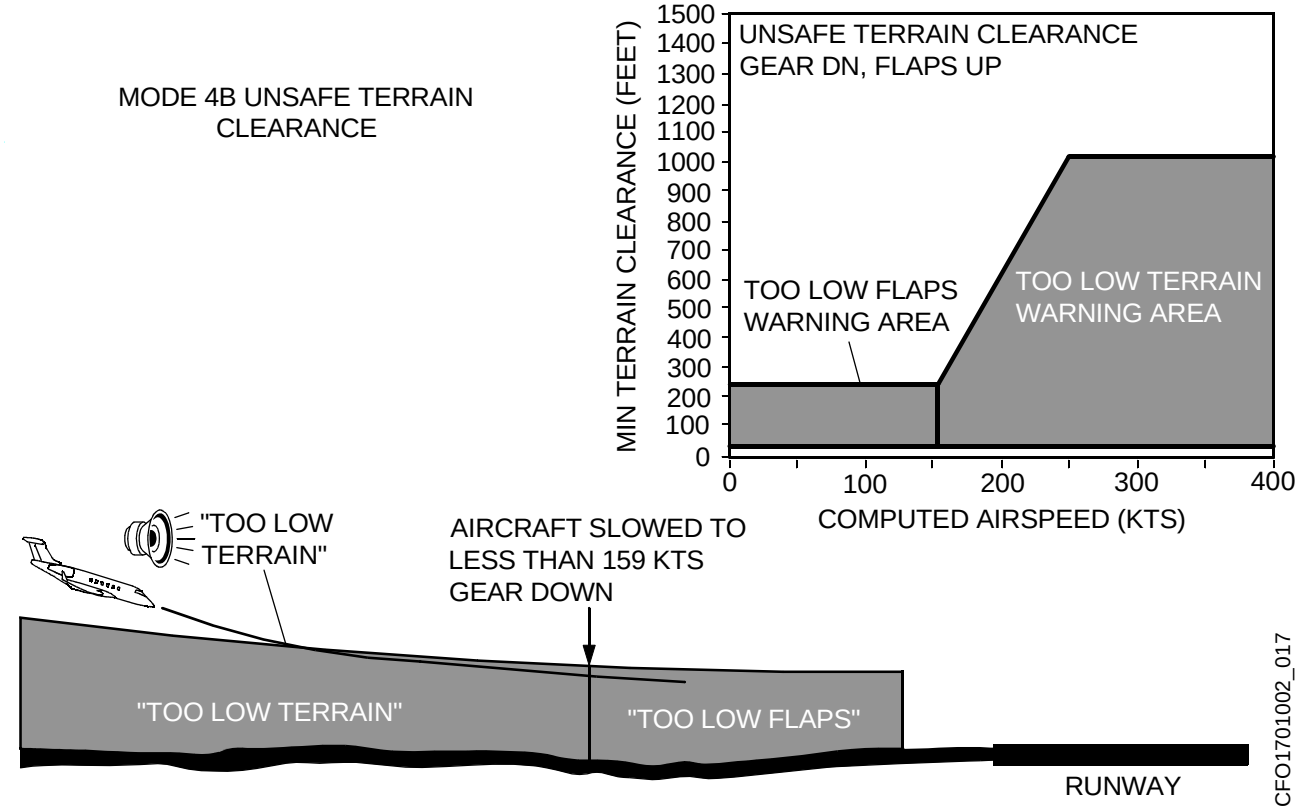


TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 4 — Unsafe Terrain Clearance (Cont)

MODE 4B

Mode 4B is active when the airplane is in cruise or approach phase of flight and the landing gear is in the DN position. The alert envelope for Mode 4B begins at 30 feet AGL and extends vertically to an altitude of 245 feet AGL. Penetration of the alert area, above 159 knots, will annunciate an amber GND PROX display on the PFD and generate a continuous aural "TOO LOW TERRAIN" warning. The aural and visual remain until the airplane exits the envelope. Penetration of the alert area, below 159 knots, annunciates an amber GND PROX display on the PFD and generates an aural "TOO LOW FLAPS" warning.



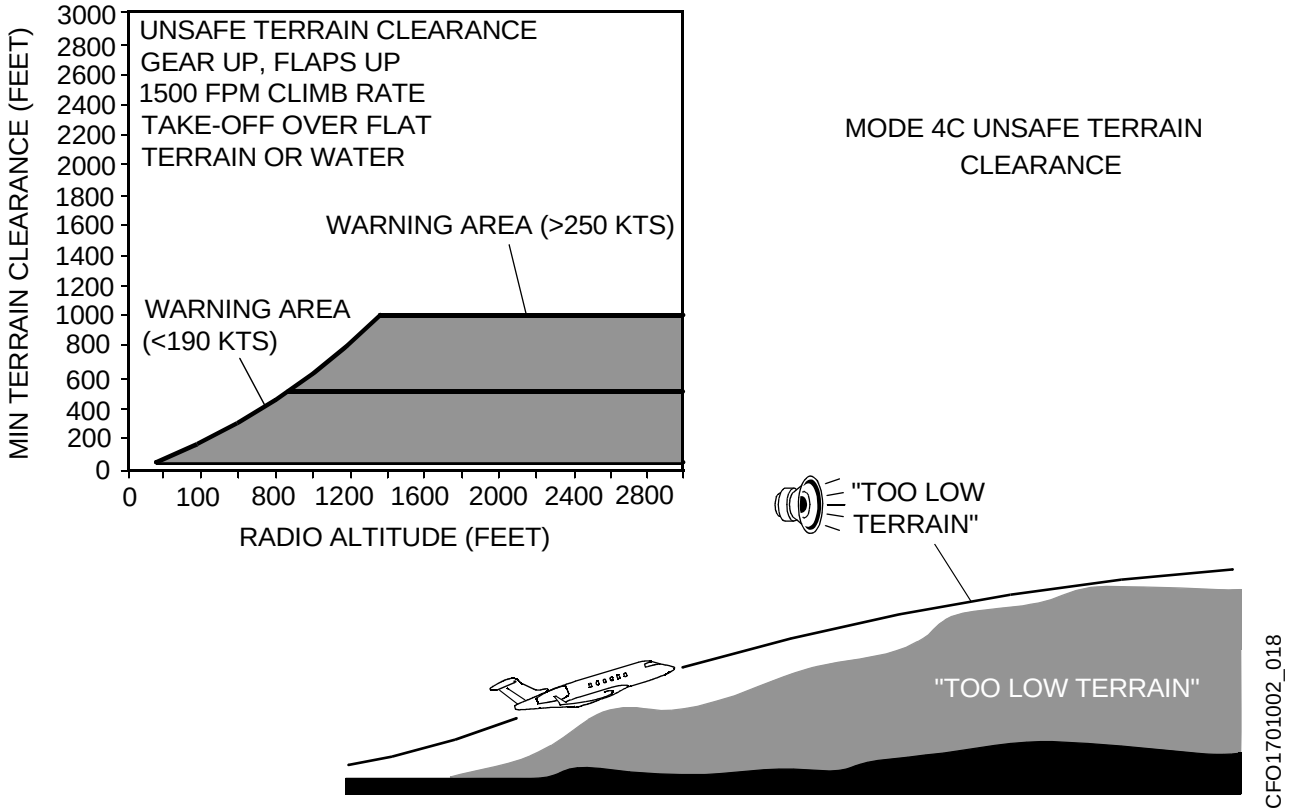
NOTE: Aural "TOO LOW FLAPS" warning can be silenced by selecting OFF on the FLAPS switch, which is located on the TAWS WARN panel.

TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 4 — Unsafe Terrain Clearance (Cont)

MODE 4C

Mode 4C is based on a minimum terrain clearance, or floor, that increases with radio altitude during takeoff. Any decrease in altitude below minimum terrain clearance will annunciate an amber GND PROX display on the PFD and generate an aural “TOO LOW TERRAIN” warning.

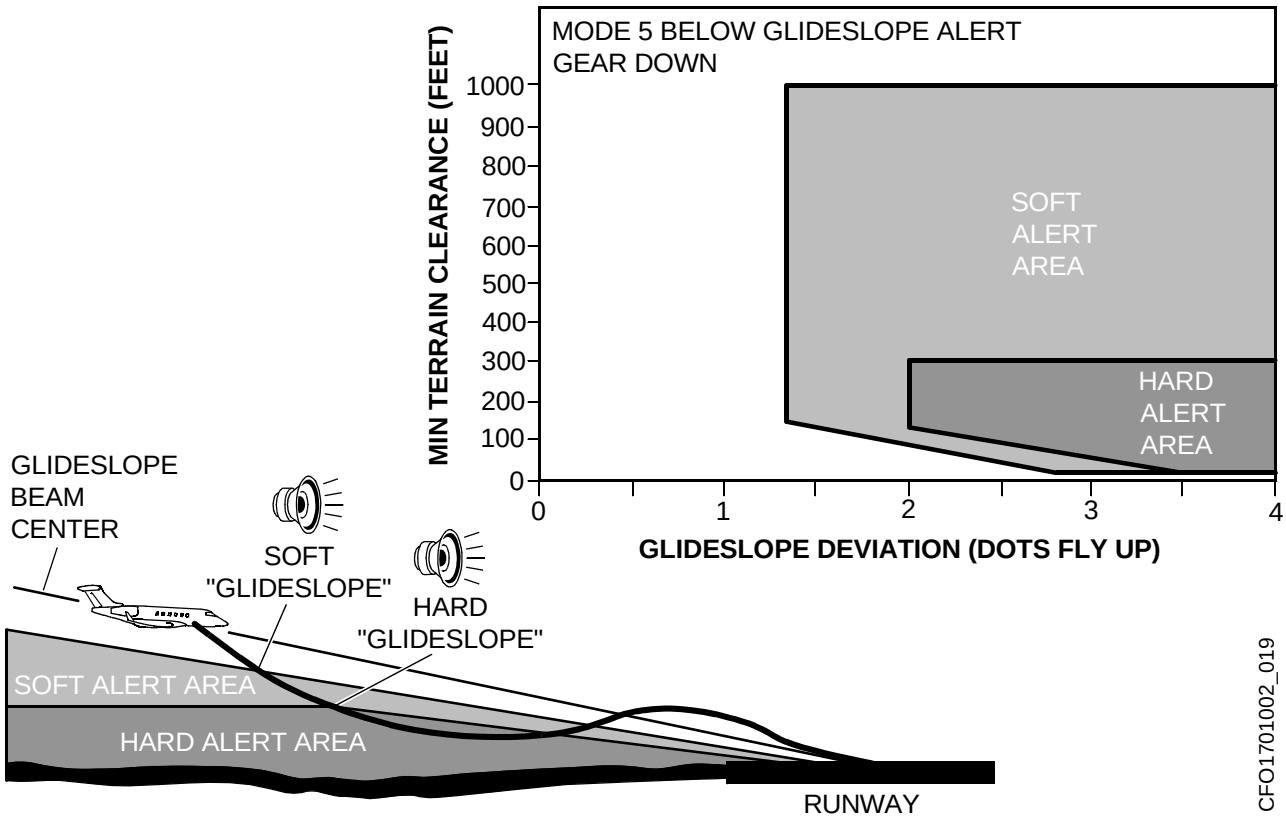


TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 5 — Descent Below Glideslope

Mode 5 provides alerts and warnings when the airplane descends below the glideslope on an ILS approach. The alerts and warnings are annunciated in two distinct tones, depending on the position of the airplane on the glideslope.

When the airplane descends more than 1.3 dots (but no more than 2 dots) below the glideslope, a quiet (6 dB) aural “GLIDESLOPE” is generated. If the airplane continues to descend and deviates more than 2 dots below the glideslope, an aural “GLIDESLOPE” warning is generated at the same volume level as all other warnings. An amber GND PROX is displayed on the PFD. The aural and visual alerts and warnings are continuously annunciated until the airplane exits the alert envelope.



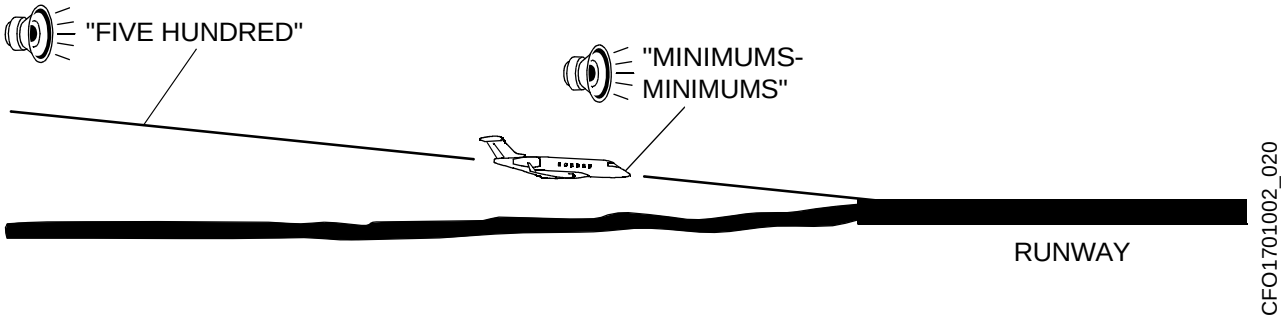
NOTE: The “GLIDESLOPE” aural warning can be muted by selecting the GS switch OFF, which is located on the TAWS WARN panel.

TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 6 — Altitude Callouts

Mode 6 provides the following advisory alerts: transition through approach minimums, altitude callouts on approach and excessive bank angles.

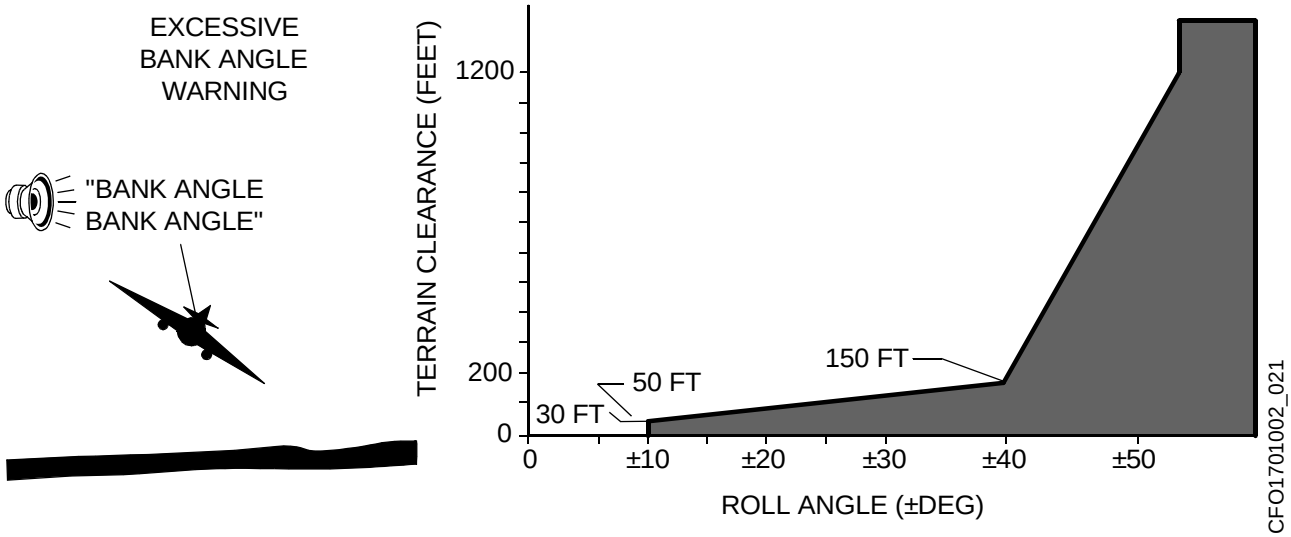
- Transition through the preset approach minimums, (APPROACHING DECISION HEIGHT or APPROACHING MINIMUMS), generates an aural “MINIMUMS, MINIMUMS” warning. The warning function is enabled between 1000 feet and 10 feet radio altitude or DH minimums and when the corrected altitude exceeds the MDA value by 200 feet. The landing gear must be down for activation of the warning.
- An altitude callout function generates annunciation for descent below predetermined altitudes. The aural “ONE HUNDRED”, “FIFTY” and “THIRTY” indicates the transition through 100, 50, and 30 feet AGL. The last annunciated or transition altitude is memorized. This will prevent the repeat annunciation of a callout, should the airplane transition through said altitudes again. The memory is cleared and reset, once the airplane climbs to an altitude greater than 1000 feet, or if a transition occurs from approach mode to takeoff mode. A “smart altitude callout” provides an aural “FIVE HUNDRED” at 500 feet radio altitude during a non-precision approach. The callout is generated during a precision approach if the airplane flight path deviates greater than ±2 dots of either the glideslope or localizer. The callout is also generated during a backcourse approach.



TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 6 — Altitude Callouts (Cont)

- The excessive bank angle alert is a function of the roll angle with respect to altitude above ground level. The alert envelope varies linearly from a 10° bank at 30 feet AGL, at 40° of bank at 150 feet AGL, to 55° of bank at 2450 feet AGL. This will generate an aural “BANK ANGLE, BANK ANGLE”. The alert is annunciated once and will repeat if the bank angle increases by 20%. The alert will be annunciated continuously if the bank angle is increased to 55°. The alert will be annunciated until the bank angle is decreased below said value.

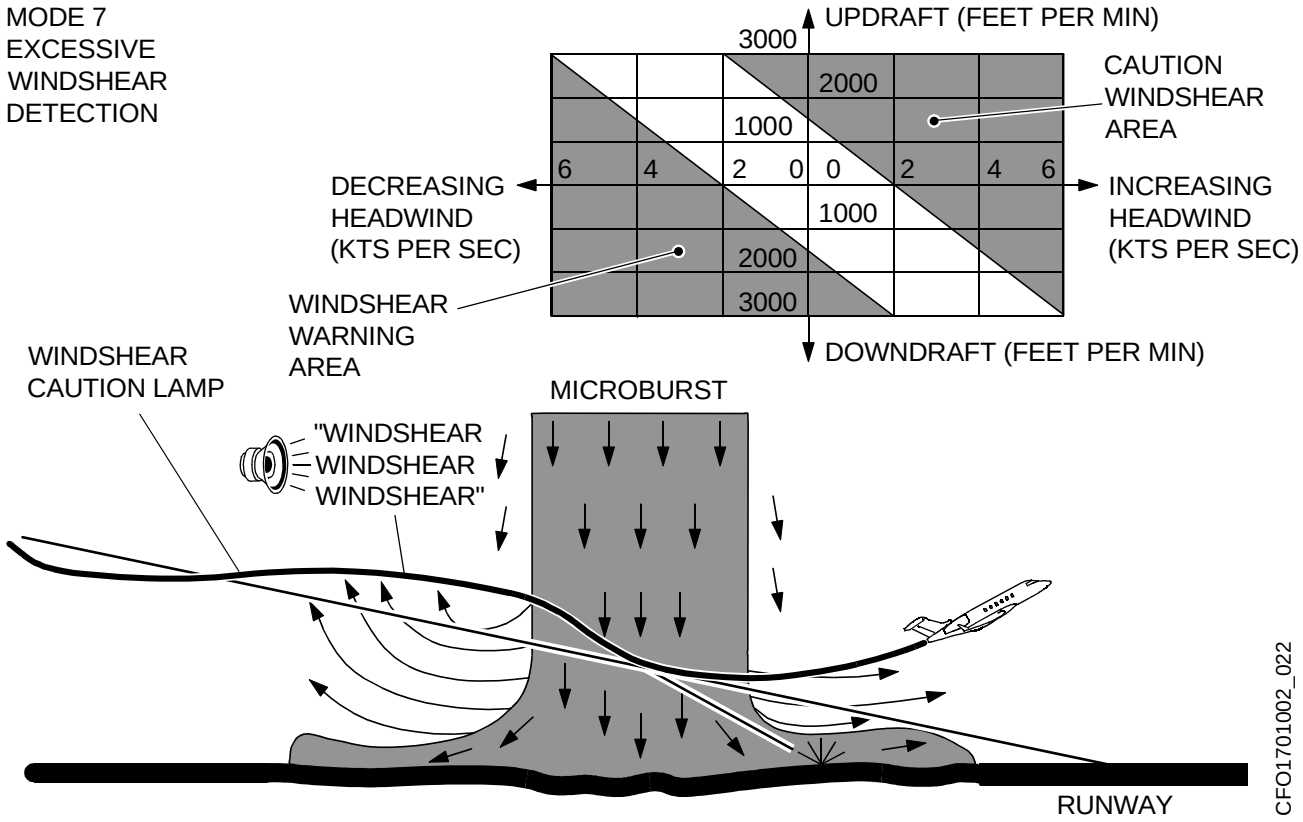


TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

MODE 7 — Windshear Warning

Mode 7 provides alerts and warnings when significant windshear is detected by the TAWS. Mode 7 is active during takeoff and landings phase of flight only, between 10 and 1500 feet AGL. There are two types of windshear warnings: increasing performance (updraft/headwind) and decreasing performance (downdraft/tailwind).

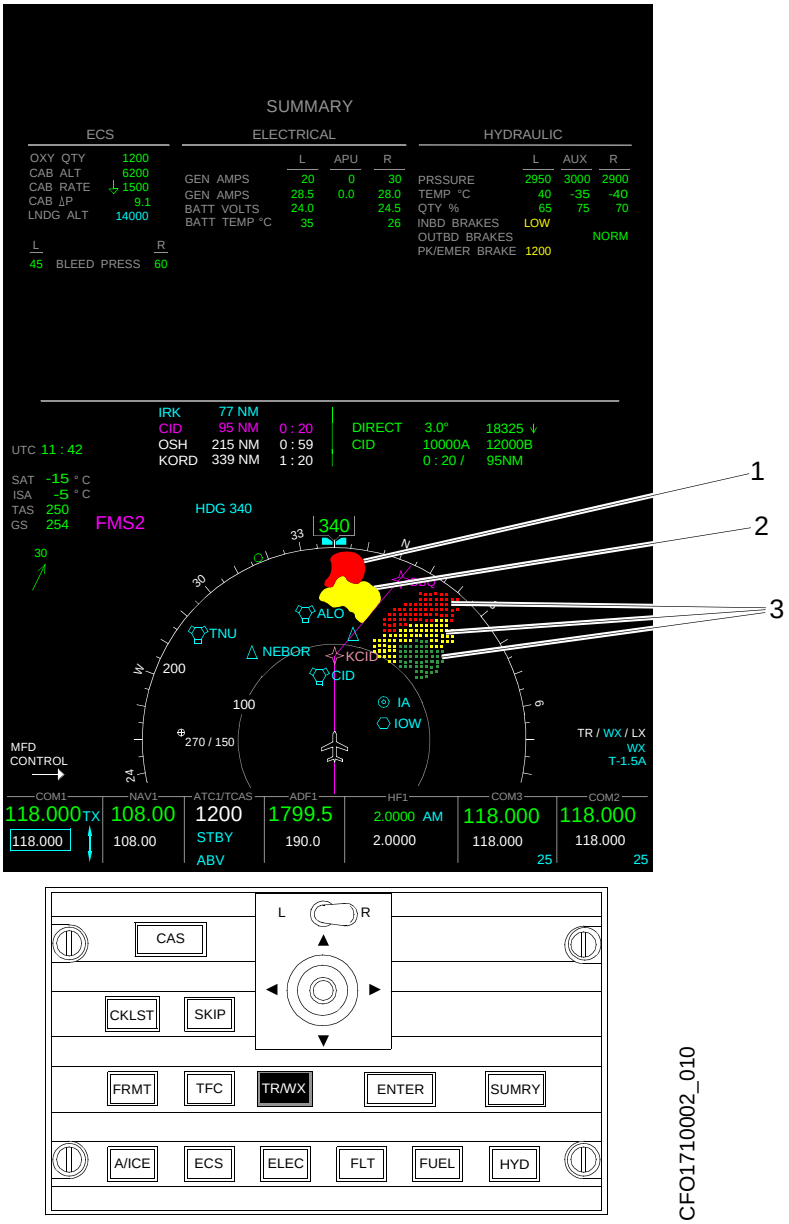
- For an increasing performance shear (updraft/headwind), the flight director display is removed from the display, an increasing performance shear WINDSHEAR (W) flashes for 5 seconds, then remains steady. An aural tone, “WINDSHEAR WINDSHEAR” warning is activated.
- For a decreasing performance shear (downdraft/tailwind), the flight director display is removed from the display, WINDSHEAR (W) flashes for 5 seconds, then remains steady. An aural tone, “WINDSHEAR WINDSHEAR” warning is activated.



TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

TERRAIN AWARENESS ALERTING

The terrain alerting function computes minimum terrain clearance envelopes for areas along the flight path of the airplane. The function uses airspeed and flight path angle data in conjunction with a database containing worldwide topographical relief information in grid format. The terrain display is available by pressing the TR/WX button on the DCP. Terrain within 2000 feet of the airplane altitude is displayed. Terrain automatically comes up, in MAP mode, on the MFD at a 10 nm range, if there is a terrain threat caution at 60 seconds from impact. When a terrain threat is detected, an aural “CAUTION TERRAIN, CAUTION TERRAIN” aural is generated and an amber GND PROX is displayed on the PFD. When alerts are activated, areas which meet the terrain threat alert criteria are depicted amber.

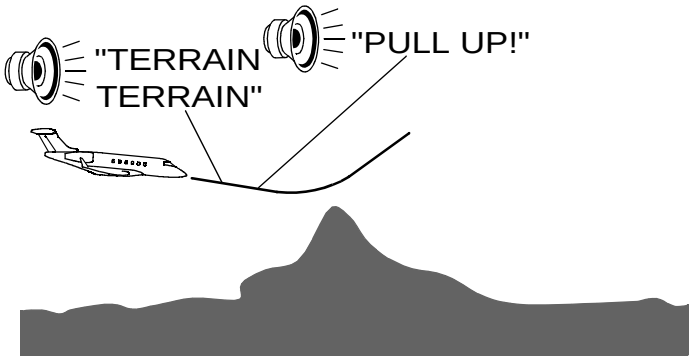


1. SOLID RED — Areas of terrain that satisfy the terrain warning alert criteria.
2. SOLID AMBER— Areas of terrain that satisfy the terrain caution alert criteria.
3. GREEN, AMBER, RED DOT PATTERN — Areas of terrain that are significantly close to the aircraft but do not satisfy warning alert or caution alert criteria.

TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

TERRAIN AWARENESS ALERTING (Cont)

When a collision with a terrain is predicted, an aural Terrain PULL UP, PULL UP" warning is generated and an amber PULL UP display is annunciated on the PFD. When warnings are activated, areas which meet the terrain collision alert criteria are depicted red. Terrain automatically comes up in MAP mode on MFD at a 10 nm range, if there is a terrain warning at 30 seconds from impact.



NOTE: When landing at an airport that is not in the database, TERRAIN functions can be inhibited by selecting the TERRAIN switch OFF. The switch is located on the TAWS WARN panel.

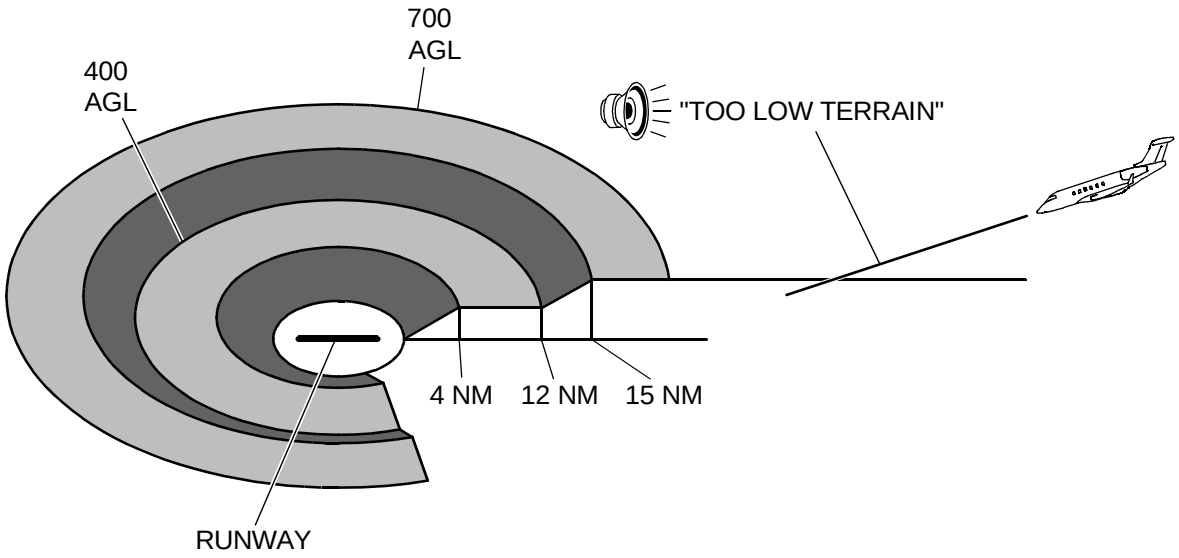
TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

TERRAIN CLEARANCE FLOOR (TCF)

The TCF function supplements the GPWS function by providing an additional terrain clearance alert envelope around airports. The TCF criteria determine alert and warning envelopes.

TCF creates an increasing terrain clearance envelope around the intended airport runway directly related to the distance from the runway. TCF alerts are based on current airplane location, nearest runway center point position and radio altitude, along with an internal database that includes all worldwide, hard-surfaced runways greater than 3500 feet in length.

Penetration of the alert envelope generates an aural “TOO LOW TERRAIN” and an amber GND PROX is displayed on the PFD. The aural alert is repeated twice and again thereafter if the radio altitude value decreases by more than 20% from the altitude at which the initial warning was issued. The amber GND PROX remains displayed until the airplane exits the alert envelope.



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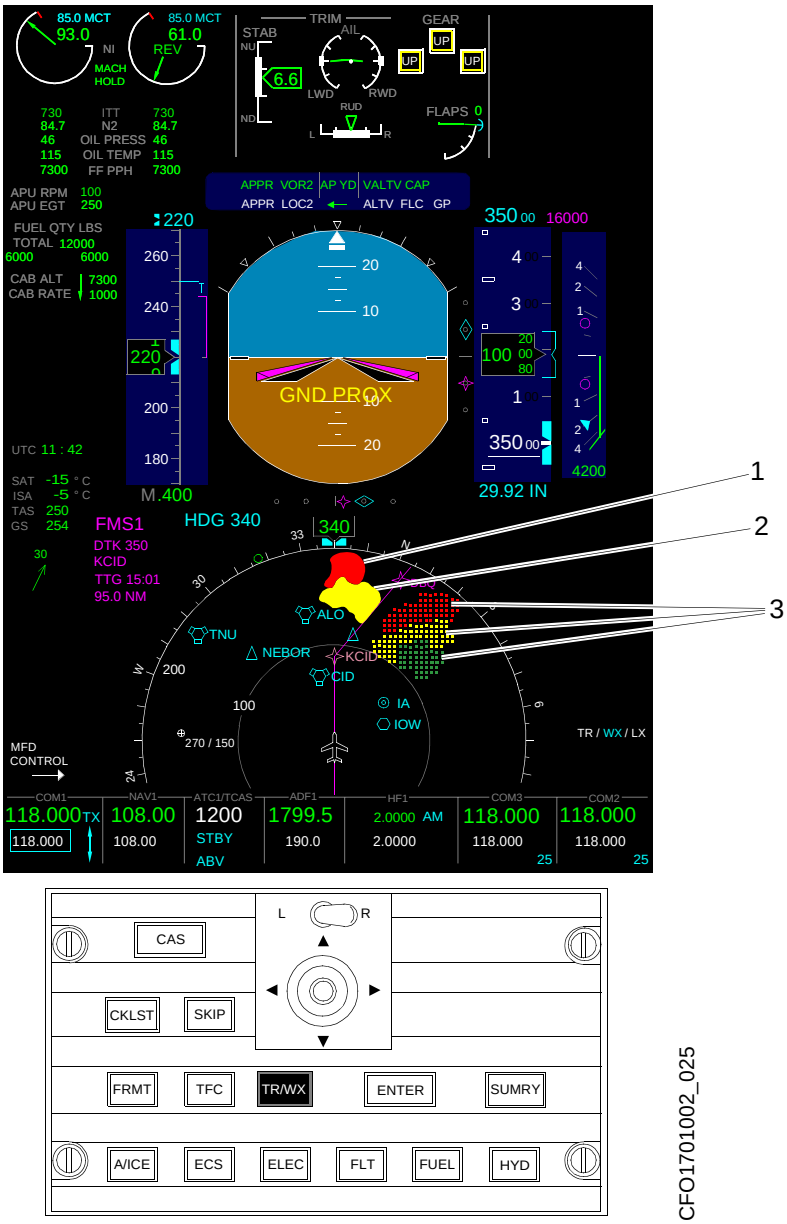
TERRAIN AWARENESS WARNING SYSTEM (TAWS) (Cont)

ANNUNCIATIONS

All terrain annunciations are displayed on the PFD and MFD.



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PFD Display Indicating Terrain Data

1. SOLID RED — Areas of terrain that satisfy the terrain warning alert criteria.
2. SOLID AMBER— Areas of terrain that satisfy the terrain caution alert criteria.
3. GREEN, AMBER, RED DOT PATTERN — Areas of terrain that are significantly close to the aircraft but do not satisfy warning alert or caution alert criteria.

WEATHER RADAR

DESCRIPTION

The weather radar is an X-band color weather radar system used for atmospheric moisture detection and ground mapping. The weather radar provides displays of radar-detectable precipitation with in ±60° of the flight path at a selectable range up to 300 nautical miles. The weather radar also provides ground mapping and incorporates features such as autotilt, ground clutter suppression, range compensation and path attenuation correction.

The system consists of a receiver transmitter antenna (RTA) and dual controllers. Radar information is normally displayed on the multifunction display (MFD) in a MAP mode. The AHRS provides stabilization input to the RTA.

In the weather detection mode, storm intensity levels are displayed in four bright colors, contrasted against a deep black background. Areas of very heavy rainfall are displayed in magenta, heavy rainfall in red, less severe rainfall in amber, moderate rainfall in green, and little or no rainfall in black (background). Areas of detected turbulence are displayed in magenta.

Range marks and identifying numerics, displayed in contrasting colors, are used to evaluate the location of storm cells relative to the aircraft.

The ground mapping (GMAP) function is used to improve resolution and identification of small ground targets at short ranges. The reflected signals from ground surfaces are displayed as green, yellow, red, or magenta (most to least reflective).

COMPONENTS AND OPERATION

WEATHER RADAR OPERATIONAL MODES

The basic weather radar operational modes can be categorized as follows:

RADAR CONTROL MENU

Weather radar functions are controlled on the radar menu. The radar menu can be displayed on the PFD by pressing the RADAR button on the display control panel. Selection of the radar display is accomplished by pressing the TR/WX button on the display control panel. Range and tilt are controlled by the respective knobs on the display control panel.

STBY MODE

STBY is the first mode selection in the RADAR CONTROL menu. The antenna is stowed in tilt-up position and is neither transmitting nor scanning, although power is still applied to the system. The radar is in this mode, after the system power up, or after the mode is selected by the pilot. This mode is automatically selected 60 seconds after the transition to ground has been performed.

WX MODE

WX is the second mode selection in the RADAR CONTROL menu. This mode is a four-color weather display representing four different precipitation rates.

WX-T MODE (WITH TURB RTA INSTALLED)

WX-T mode is the third selection in the RADAR CONTROL menu. This is a four-color weather display mode plus turbulence mode.

TURB MODE (WITH TURB RTA INSTALLED)

TURB is the fourth mode selection in the RADAR CONTROL menu. This turbulence only mode allows turbulence to be separated from heavy rainfall. After 30 seconds it reverts back to the previous selection.

MAP MODE

MAP mode is the fifth selection in the RADAR CONTROL menu. This mode is typically used for detection and display of prominent and familiar ground features as an aid to navigation.

LIGHTNING DETECTION SYSTEM (OPTIONAL)

The optional lightning detection system maps the location of thunderstorm activity 360° around the airplane to a distance of 200 nautical miles. Lightning symbology is displayed as lightning bolt icons. The lightning icons are color coded to identify different levels of lightning intensity. Light levels of thunderstorm cells (1-4 strikes) are yellow, medium level cells 5-9 strikes) are red, and heavy level cells (over 9 strikes) are magenta.

WEATHER RADAR (Cont)

TEST MODE

The test mode is the sixth selection in the RADAR CONTROL menu. In this mode, a simulated target return is used to create a rainbow like pattern of colors on the display. While the radar is in this mode, the transmitter is turned OFF.

TARGET ALERT

The target mode message TGT changes from cyan to yellow to indicate a target alert.

A target alert is issued if either channel (pilot or copilot side) of the weather radar reports a target. The TGT message flashes for 5 seconds, then remains steady as long as the radar detect a target.

SECTOR SCAN MODE

This is a reduced antenna azimuth scan mode, which restricts mechanical scan angle used and processed by the RTA.

This mode can be used with any other scanning mode of operation and is used to increase the radar update rate.

While in this mode, antenna scan range is maximum ± -30° from the aircraft heading line. If either command channel is in target mode, sector scan is disabled.

GROUND CLUTTER SUPPRESSION GCS MODE

This feature is selected, those radar returns that appear as ground clutter are suppressed. This feature eases the interpretation of rainfall when viewed from higher altitudes by eliminating much of the display caused by ground returns.

AUTOTILT MODE

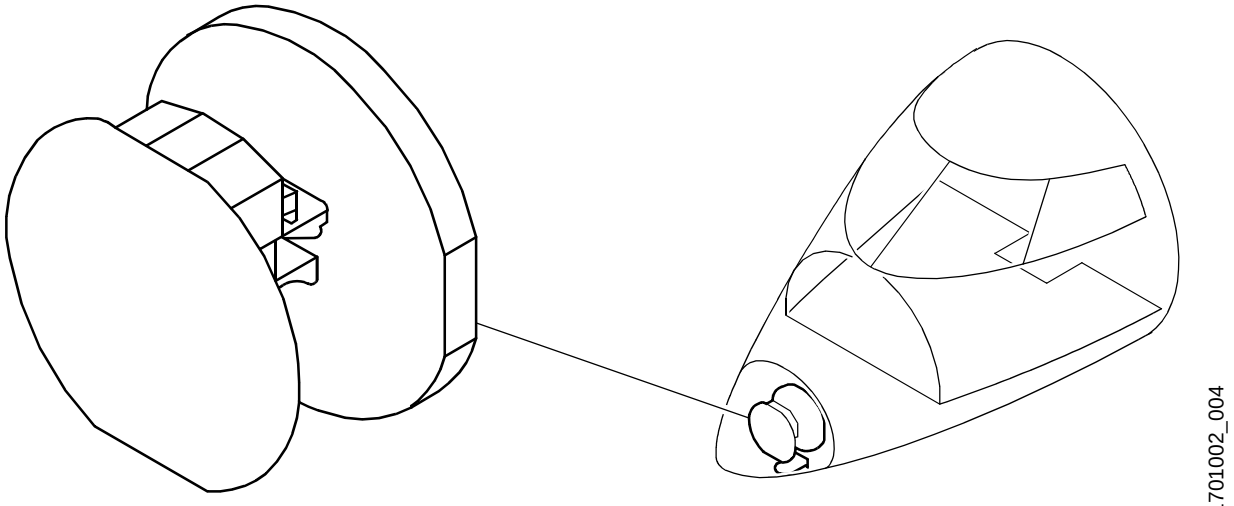
Autotilt automatically adjusts the antenna tilt angle to attempt to keep the radar scanning approximately the same region of space when the aircraft climbs and descends.

Autotilt is designed to reduce the number of times the aircrew needs to adjust the TILT control whenever the aircraft altitude or radar range setting changes.

Autotilt may be selected on or off when the RADAR menu is active, or anytime the radar tilt value show on the on-side display. Autotilt may be enable continuously as the system always uses the current manual tilt setting as the starting point.

RADAR ANTENNA

The antenna sweep is selectable for either 120 degrees (60 degrees each side of the airplane) or 60 degrees (30 degrees each side). The antenna tilt is adjusted between -15 degrees (down) and + 15 degrees (up). The antenna maintains its stabilization with respect to the horizon regardless of the airplane attitude (within -15 to +15 degrees).



ANTENNA

FLIGHT MANAGEMENT SYSTEM (FMS)

DESCRIPTION

The Rockwell Collins FMS-5000 Flight Management System single or dual FMS is a fully integrated navigation and flight management system designed to provide the pilot with the following features:

- En-route, terminal, and Non-Precision Approach Lateral and Vertical Navigation with automatic transition to the Precision Approach.
- Flight plan management.
- Multi sensor navigation.
- Maps and text data display.
- Performance management.

The system is integrated with a GPS receiver which processes the transmissions from multiple GPS satellites simultaneously to calculate navigation solutions based on information from all satellites available. A minimum of four satellites with acceptable geometry, or three satellites plus calibrated barometric altitude are required in order to calculate a navigation solution. The computed GPS position, velocity and time are inputs to the FMS, which integrates this data into the flight plan based navigation solution. AHRS, ADC, DME, and VOR systems also supply data for use by the FMS. The FMS provides necessary controls for all input sensors, when appropriate, via the control display unit (CDU).

When a single FMS system is installed, it is operated via the CDU installed on the right side of the center pedestal. When two FMS systems are installed, each CDU controls its on-side FMS.

The FMS can be initialized, waypoints and destination selected by a variety of means. SID, STAR, and airways are accommodated. A great circle route is calculated between waypoints for enroute lateral navigation (LNAV), and roll steering is provided to the flight control system (FCS). A sophisticated interface with the FCS allows the FMS vertical navigation (VNAV) function to select various FCS vertical modes of navigation. This sophisticated VNAV interface is often referred to as coupled VNAV. The VNAV and LNAV capability can be advisory only, if the FMS is not coupled. The FMS provides vertical steering when required by the FCS.

FMS interfaces with the EFIS displays to provide conventional navigation information, state-of-the art map presentation, performance and optional Vspeed data.

Refer to the *Rockwell Collins Pro Line 21 Avionics System Challenger 300 Operator's Guide* for a detailed description and operation of the flight management system. Included in the operator's guide is their website to obtain the latest performance database updates from Rockwell Collins Inc.

CONTROL DISPLAY UNIT (CDU)

FLIGHT MANAGEMENT SYSTEM (FMS) (Cont)

COMPONENTS AND OPERATION

DEAD RECKONING (DR)

When no navigation sensor data is available for the FMS to use, it begins navigating in the DR mode. In this mode, it estimates its position based only on the last known position, heading, and airspeed. To identify this mode, FMS DR is annunciated on the MFD and on the PFD if the NAV SOURCE is FMS. It also shows on the CDU message line and MESSAGES page.

FMS CALCULATED VSPEEDS (Optional)

The VSPEEDS function allows the pilot to set or adjust takeoff and approach speeds on the PFD, and show those reference speeds on the airspeed tape. FMS calculated VSPEEDS are an option on the aircraft.

The pilot can manually set the takeoff and approach reference speeds or adjust FMS calculated Vspeeds on the PFD with the REFS menu and display control panel (DCP). VSPEEDS are grouped on the REFS menu pages into takeoff speeds and approach speeds.

The pilot may accept the default or FMS calculated VSPEEDS value, or set a different value. The PFD show the reference speed as a digital readout on the speed reference table at the bottom of the airspeed tape. It also sets a reference bug for each separate VSPEED at the appropriate speed on the airspeed scale. Manually set VSPEED values show in cyan characters, FMS calculated VSPEEDS show in magenta characters. VSPEEDS can be a combination of FMS calculated and manually set values.

The FMS, however, does not compare actual aircraft data against the data manually input by the pilot on the CDU TAKEOFF REFERENCE or CDU APPROACH REFERENCE pages.

It is necessary for the pilot to verify and validate that the aircraft configuration and environmental conditions input into the FMS reflect the correct conditions for takeoff or approach.

After actual takeoff or approach configuration has been achieved, but before posting FMS computed VSPEEDS on the PFD, the aircrew should verify that the inputs that were entered into the FMS for computation of takeoff or approach performance reflect the actual or intended takeoff or approach conditions.

A summary of the takeoff performance data is presented on the MFD TAKEOFF REFERENCE page. A summary of the approach performance data is presented on the MFD APPROACH REFERENCE page. These pages can be accessed by selecting the CDU MFD DATA key while the corresponding CDU takeoff or approach reference page is displayed. It may also be accessed by pressing the CDU MFD DATA key followed by the MFD MENU key and selecting the desired page.

To manually exit the REFS menu, push another menu button on the DCP. The menu is automatically removed 20 seconds after the last activity of the MENU, DATA, OR PUSH SELECT knob, or another menu or list button is pushed.

GPS CONTROL

The GPS Control page shows position differences (POS DIFF) between each GPS sensor position and the position calculated by the FMS. Both direction and distance are shown.

The line select key for each installed GPS sensor enables or disables the use of the sensor by the FMS. If a GPS sensor has been DISABLED it remains disabled until manually enabled.

GLOBAL POSITIONING SYSTEM (GPS)

The GPS is used to determine airplane position and provides supplementary information to FMS and TAWS and the clock. The GPS calculates the latitude, longitude, altitude, accurate time, date, true heading and ground speed.

The global positioning system (GPS) is a space based navigation system, which consists of 26 satellites, at an altitude of approximately 10 900 nm and an orbital period of 12hr. Each satellite transmits a signal on the L1 (1575.42MHz – for general aviation use) and L2 (1227.6MHz– for P-code / military use only) frequencies. The signal contains digital data used to measure line-of-sight range and compute the position and time at the receiver. Pre-departure verification of GPS availability is required for GPS as a primary means of navigation before each flight.

FLIGHT MANAGEMENT SYSTEM (FMS) (Cont)

Four or more available satellites allow receiver to autonomously compute the position integrity. The position can be calculated (with the required integrity) on the basis of the 3 satellites data available in addition to an air data altitude. The system permanently performs the receiver autonomous integrity monitoring (RAIM) process, which represents the method of detecting and isolating the satellite errors by using the redundant satellite measurements. Five satellites are required to detect a satellite error and six satellites are required to isolate the error to an individual satellite and remove it from the navigation solution.

The system supports: en route (including VNAV), terminal and non-precision approach (except localizer, localizer directional aid and simplified directional functionality) capability. The system provides current position, velocity and time to FMS and TAWS.

PREDICTED RAIM

By predicting future satellite positions, GPS is capable of estimating the availability of approach accuracy. This feature is called predictive RAIM. The GPS may be used for primary navigation in oceanic and remote areas, provided a qualified GPS sensor is installed in the airplane. Qualified GPS sensors include a ground based prediction program that verifies GPS navigation availability over the planned route. Pre-departure verification of GPS availability is require for GPS as primary means of navigation before each flight.

Status and integrity of the GPS position solution shows on the MFD LRN STATUS page. RAIM is used to assure that the GPS solution meets the required accuracy criteria that follow:

- 4 nm for oceanic/remote
- 2 nm for enroute
- 1 nm for terminal
- 0.3 nm for approach

The measured accuracy limit indicates the maximum estimated error based on measurement inconsistency. When an error is detected, it is annunciated on the LRN STAUS page.

The LRN STATUS text page on the MFD shows:

- Each installed GPS
- Current latitude and longitude position of each sensor
- Current tracking direction and speed of each sensor
- Current operating mode of each sensor
- Number of satellites in use by each sensor
- RAIM accuracy limit of each sensor
- Measured accuracy limit of each sensor
- Probable error of each sensor

REQUIRED NAVIGATION PERFORMANCE (RNP)

RNP is a statement of the navigation performance accuracy necessary for operation within a defined airspace. The RNP value may be specified by the pilot by entering the value on the FMS PROGRESS page. The FMS computes its expected position accuracy based on the sensors in use. The expected position accuracy (POS ACCURACY) is also displayed on the PROGRESS page. When flying in RNP airspace the FMS position error should be less than the RNP value 95% of the time. If the expected position accuracy error is more than the RNP value, a message LOW POS ACCURACY is displayed on the CDU and navigation by other means must be utilized.

SATELLITE DESELECT

Individual satellites can be deselected from use by entering the identifier for the satellite in the FMS. This function would be used if a satellite is NOTAM'd under test. When deselected, the FMS ignores the data from the satellite.

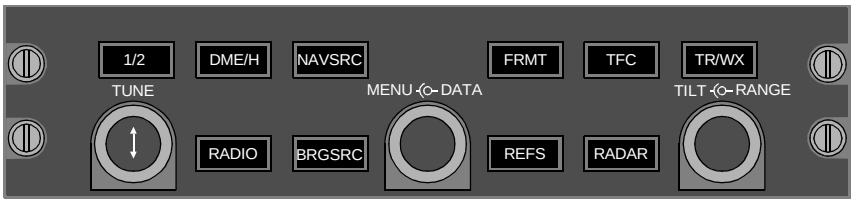
CONTROLS AND INDICATIONS

NAVIGATION COMPONENTS

AUDIO CONTROL PANEL

MFD CONTROL PANEL

CONTROL DISPLAY UNIT



DISPLAY CONTROL PANEL

CFO1701002_001

EICAS MESSAGES

The navigation system messages are shown on the EICAS. In the navigation system messages are listed. A brief explanation for each message is provided.

MESSAGE	INHIBITS	MEANING	AURAL WARNING
TAWS BASIC FAIL	TO/LAND	Some of the basic modes (Mode 1 thru 6) of the terrain awareness warning system have failed	
TAWS SYSTEM FAIL	TO/LAND	The terrain awareness warning system has failed	
TAWS TERR FAIL	TO/LAND	The terrain function of the terrain awareness system has failed	
TAWS TERR NOT AVAIL	TO/LAND	The TAWS terrain data base has no data for the current location	
TAWS WINDSHEAR FAIL	TO/LAND	The windshear function of the terrain awareness warning system has failed	
TAWS FLAPS OFF		The flap warning function of the terrain awareness warning system has been selected OFF by the crew	
TAWS GS WARN OFF		The glideslope warning function of the terrain awareness warning system has been selected OFF	
TAWS TERR OFF		The terrain warning function of the terrain awareness warning system has been selected OFF	