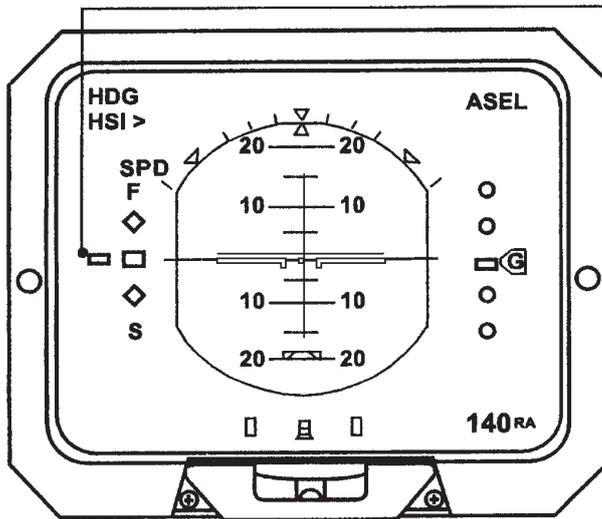


**WARNING SYSTEMS**

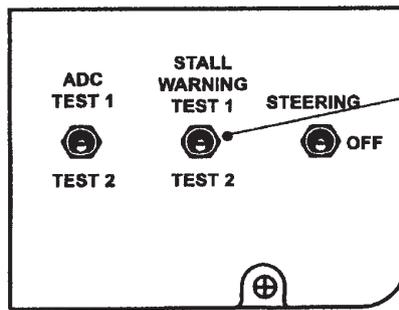
**CONTROLS AND INDICATORS**



**LEFT PILOT'S INSTRUMENT PANEL  
RIGHT PILOT'S INSTRUMENT PANEL**

**FAST/SLOW POINTER (2)**

- during approach, pointer indicates relative speed provided by the AOA sensors on both EADIs.
- pointer at centre position equals a nominal 1.3 Vs for a given flap angle and engine torque.
- speed is greater than 1.3 Vs when it moves towards F and less than 1.3 Vs when it moves toward S.
- Failure of instrument or stall warning system removes pointer from display and indicates a red "x".



**LEFT PILOT'S SIDE CONSOLE**

**STALL WARNING TEST SWITCH (two position)**

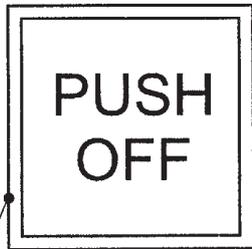
TEST 1 (momentary) - tests No. 1 SW/SP computer

TEST 2 (momentary) - tests No. 2 SW/SP computer

- switch must be held for approximately 5 seconds before test begins.
- during test, control column shakers operate and Fast/Slow Indicator move towards S(slow) on EADI.

Fast/Slow Indicator and Stall Warning Test Error

# STICK PUSHER SHUT OFF



GLARESHIELD

**STICK PUSHER SHUT-OFF SWITCHLIGHT  
(alternate action)**

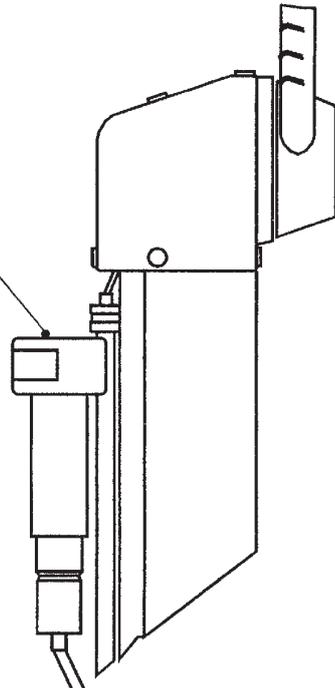
ON - nitrogen pressure accumulated in stick pusher actuator without a push command from the computers.

PUSHER SYST FAIL caution light turns on

- PUSH - relieves actuator pressure to the atmosphere
- pilot's and copilot's STICK PUSHER SHUT OFF switchlights go out
- PUSHER SYST FAIL caution light remains on
- push the same switchlight again to cancel the PUSHER SYST FAIL caution light

**CONTROL SHAKER (2)**

- attached to forward side of pilots's and copilot's control columns
- control shakers vibrate control columns at pre-determined stall threshold speed appropriate to selected flap setting
- both shakers operate together when energized by left or right stall warning computer



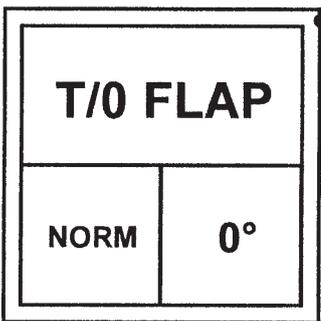
*Stick Pusher and Shaker*



**GPWS FLAP OVERRIDE SWITCH**  
(two position, alternate action)  
(amber)

- inhibits GPWS mode 4B to permit 0° flap landings without aural warning. All other GPWS modes remain active

PILOT'S SIDE CONSOLE



**T/O (TAKE-OFF) WARNING FLAP SWITCH**  
(alternate action)

- NORM segment (green)
- Take-off Warning Horn sounds when take-off flap setting is less than 5° or greater than 15°

PUSH - NORM segment (blank)  
0° segment (green)

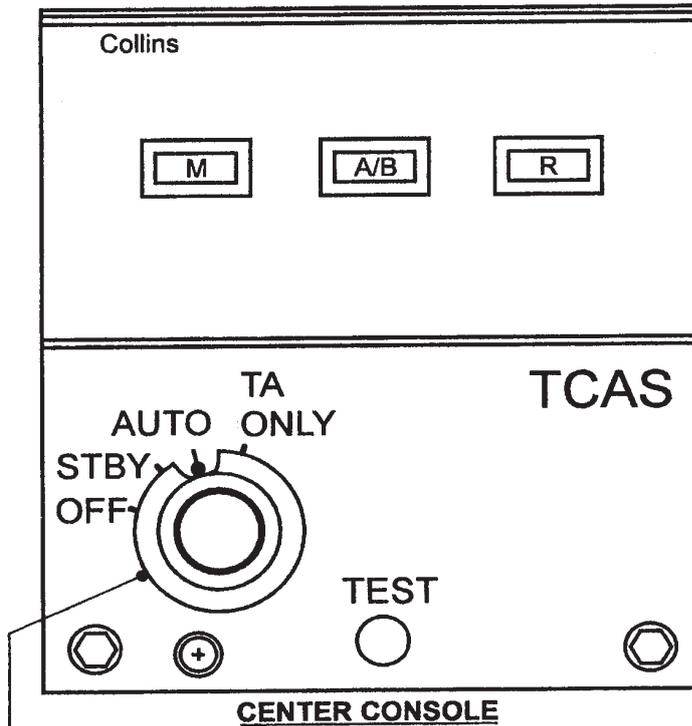
- Take-off Warning Horn is inhibited when take-off flap setting is less than 5° (permits 0° take-off flap setting)

After T/O - NORM segment (green)  
0° segment (blank)

PILOT'S SIDE CONSOLE

*GPWS Controls and indicators*





#### FUNCTION KNOB

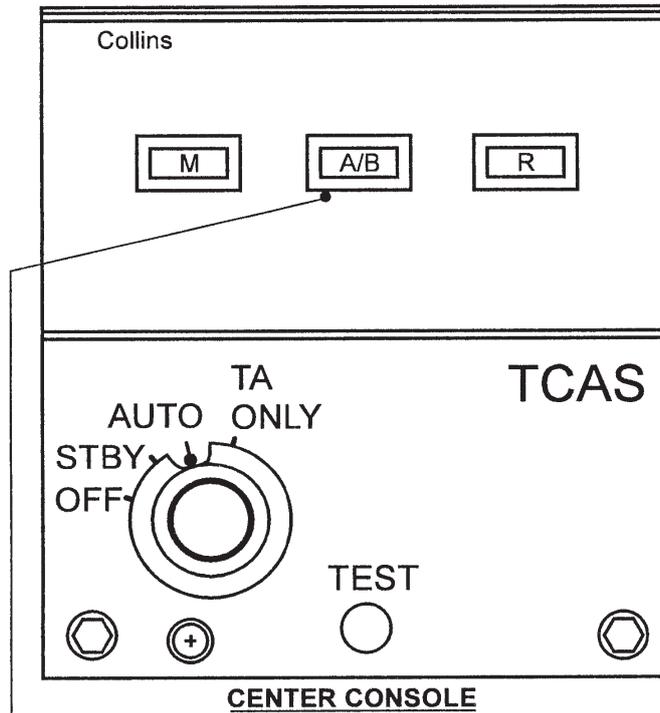
**OFF** - turns off power to the TCAS receiver-transmitter. For those units that do not have an OFF position, the aircraft avionics master switch turns on and off power to the TCAS receiver-transmitter. An annunciator "TCAS OFF" shows on the TCAS display in this mode.

**STBY** - sets the TCAS receiver-transmitter to the standby mode. TCAS does not show traffic on the display; does not give resolution advisories; and does not reply to other aircraft TCAS interrogations in this mode. The annunciator "TCAS OFF" shows on the TCAS display in this mode.

**AUTO** - is the normal mode of operation. TCAS shows traffic on the traffic display and gives traffic alerts and resolution advisories, as appropriate, in this mode.

**TA ONLY** - sets the receiver-transmitter to the traffic advisory only mode. TCAS does not give resolution advisories on the VSI/RA indicator or show RA traffic on the traffic display in this mode. Also, an annunciator (ONLY TA) shows on the TCAS displays to identify this mode.

*TCAS Control Panel*



#### A/B BUTTON

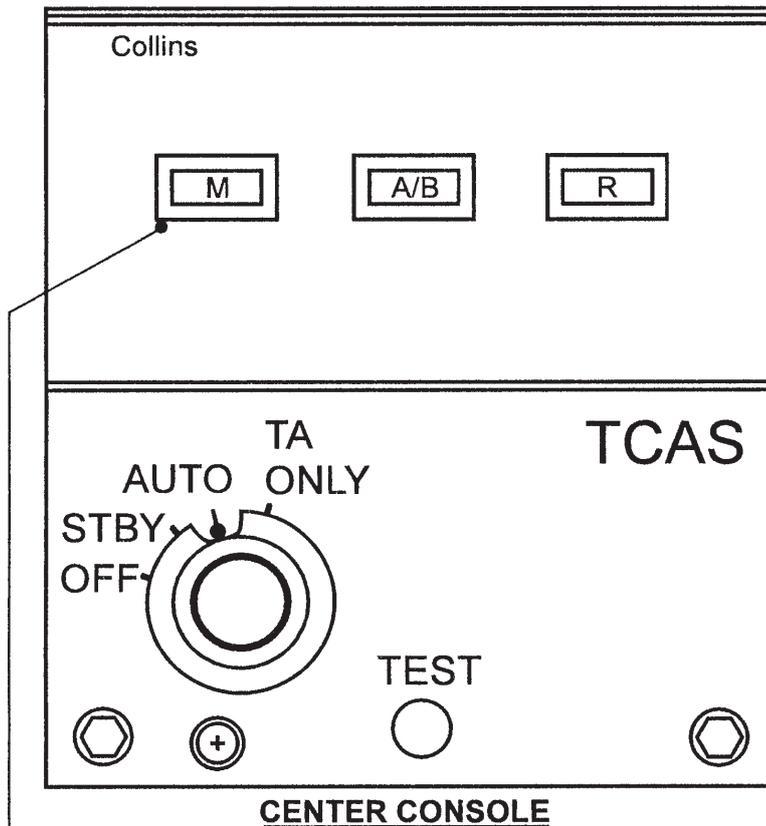
- Push the A/B button to select the altitude volume, relative to your own aircraft, for which TCAS shows Other Traffic. Successive pushes of the button cycles through the available modes. Other Traffic outside of the selected altitude volume does not show on the traffic display. Proximate, TA and RA traffic are not affected and always show on the display regardless of the selected altitude volume. (Except RA traffic does not show on the display in the TA-ONLY mode). The selected mode is annunciated on the TCAS traffic display. The available selections are:

**NORMAL** - shows Other Traffic from 2700 ft above to 2700 ft below your own aircraft.

**ABOVE** - shows Other Traffic from 9900 ft above to 2700 ft below your own aircraft.

**BELOW** - shows Other Traffic from 2700 ft above to 9900 ft below your own aircraft.

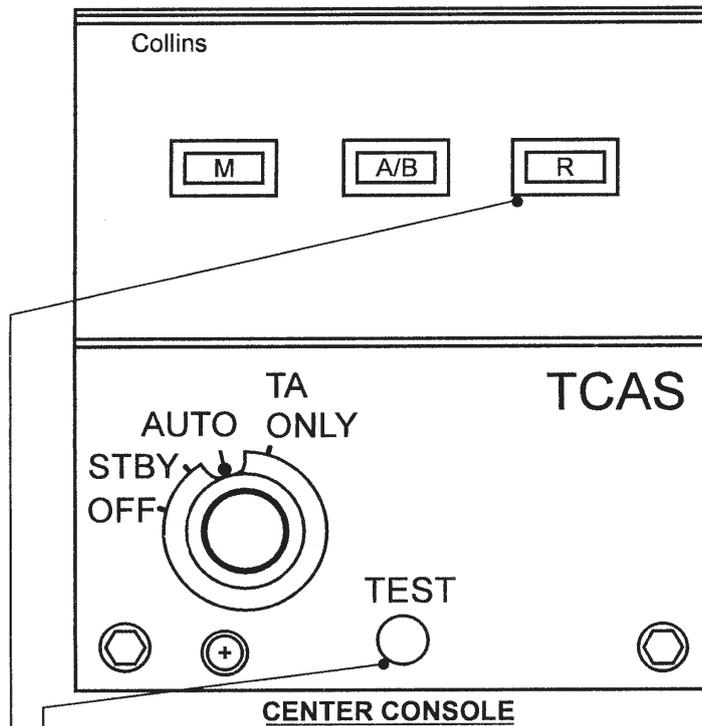
*TCAS Control Panel*



### M BUTTON

- a VSI with a part time threat only traffic display and a VSI with a full time traffic display. Successive pushes of the button cycles the display mode.
- In "the part time threat only, traffic display" mode, the TVI-920D normally shows a VSI. When TCAS detects TA or RA threat traffic, the display automatically changes to a VSI with a TCAS traffic display. When TA and RA traffic move out of the selected TCAS display range and altitude mode or when the traffic changes to Proximate or Other Traffic, the display changes back to a VSI only display in approximately 5 seconds.
- In the full time traffic display mode, the TVI-920D shows the VSI and traffic display at all times. Proximate and Other Traffic within the selected range and altitude modes also show on the traffic display.

*TCAS Control Panel*



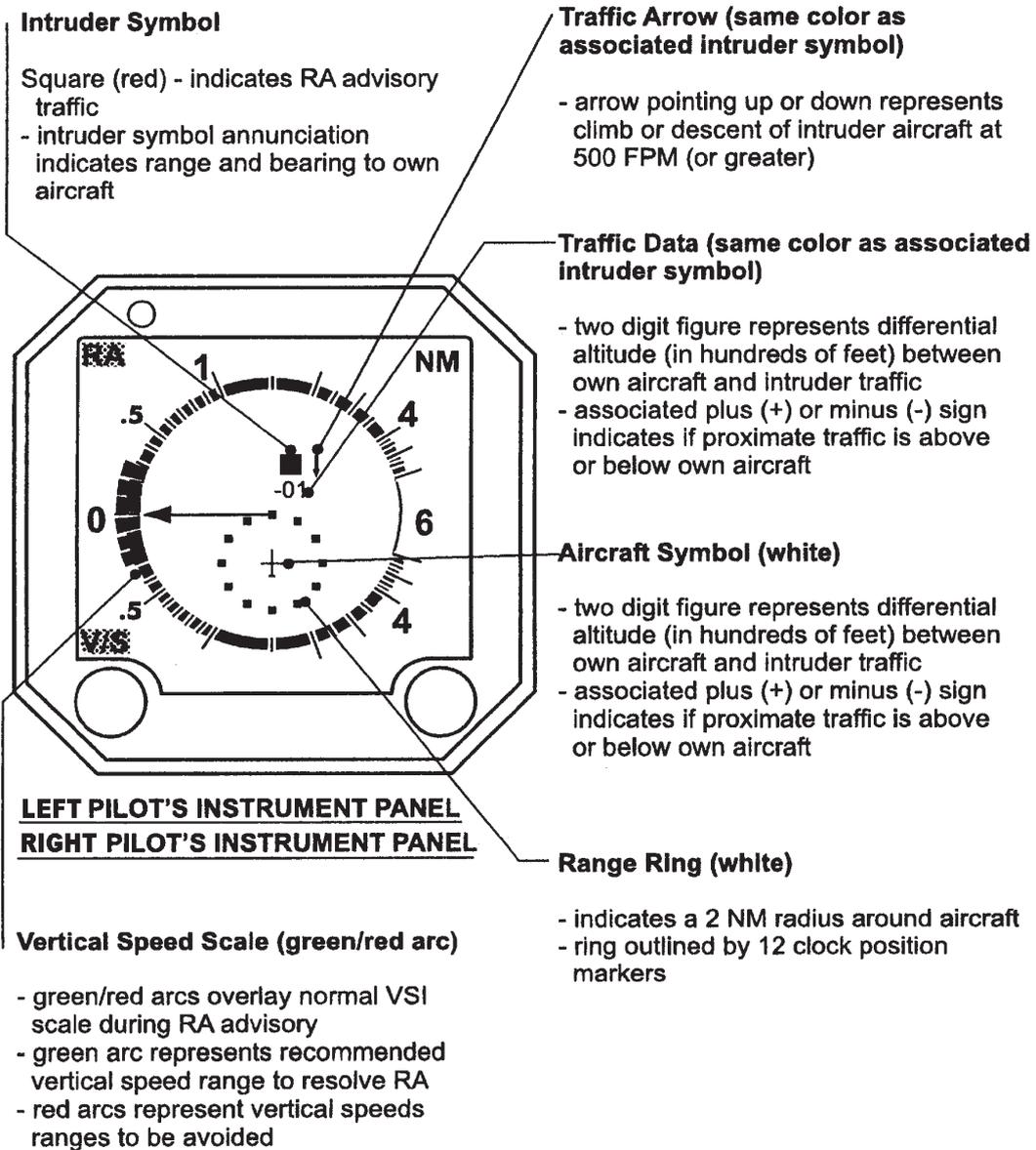
#### TEST BUTTON

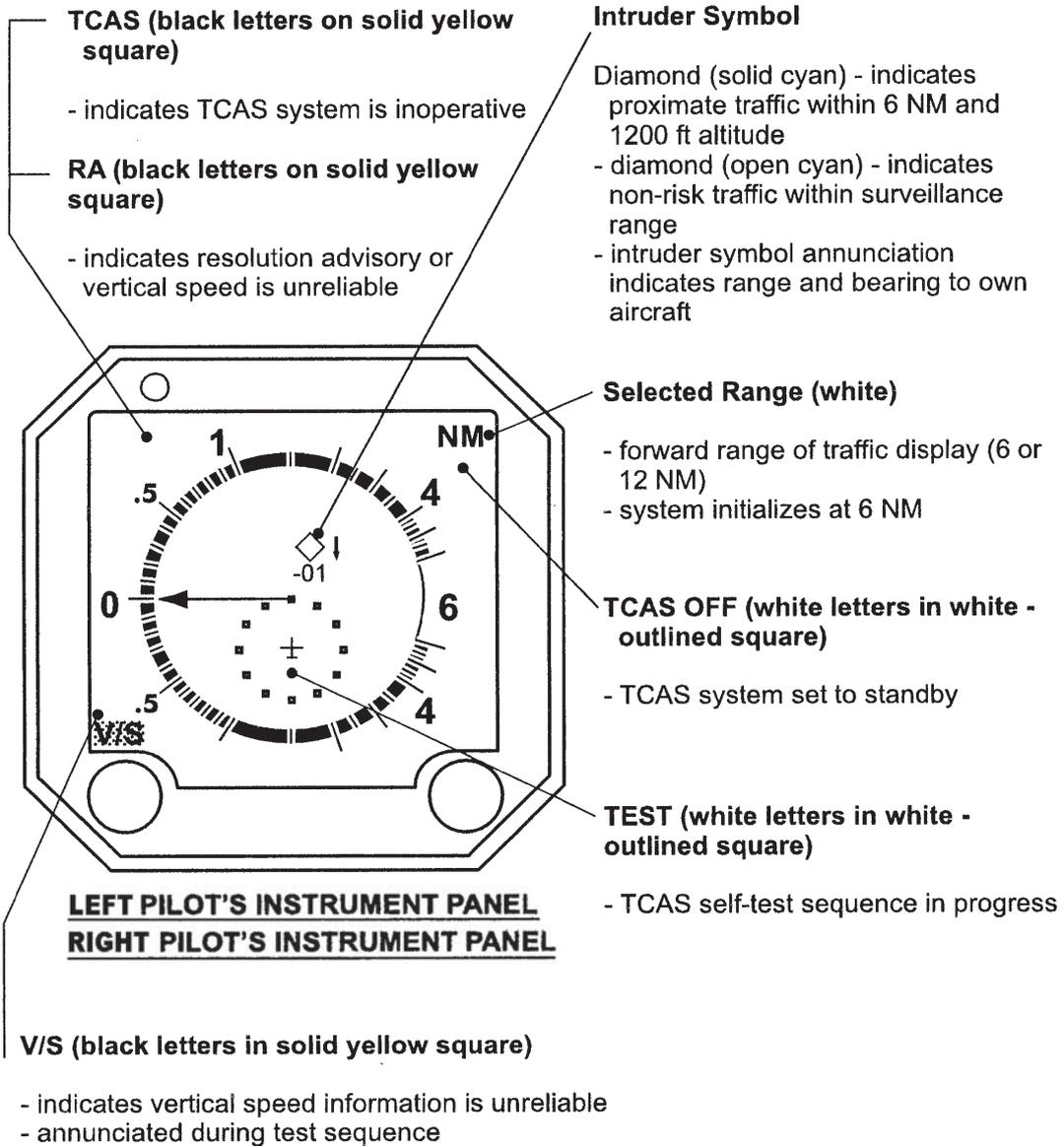
- Push the TEST button to turn on the self-test function of the TCAS-94 system. The TCAS traffic and RA displays show test pattern traffic symbols, a red and green resolution advisory, and the TEST annunciator.
- The test routine takes approximately 10 seconds to complete. After successful completion of the test, the system returns to the set operating modes and aurally annunciates "TCAS SYSTEM TEST OK" on the aircraft flight compartment audio system. If a TCAS systems failure occurs, the annunciator "TCAS" or "TCAS FAIL" shows on the appropriate TCAS display and the audio system aurally annunciates "TCAS SYSTEM TEST FAIL".

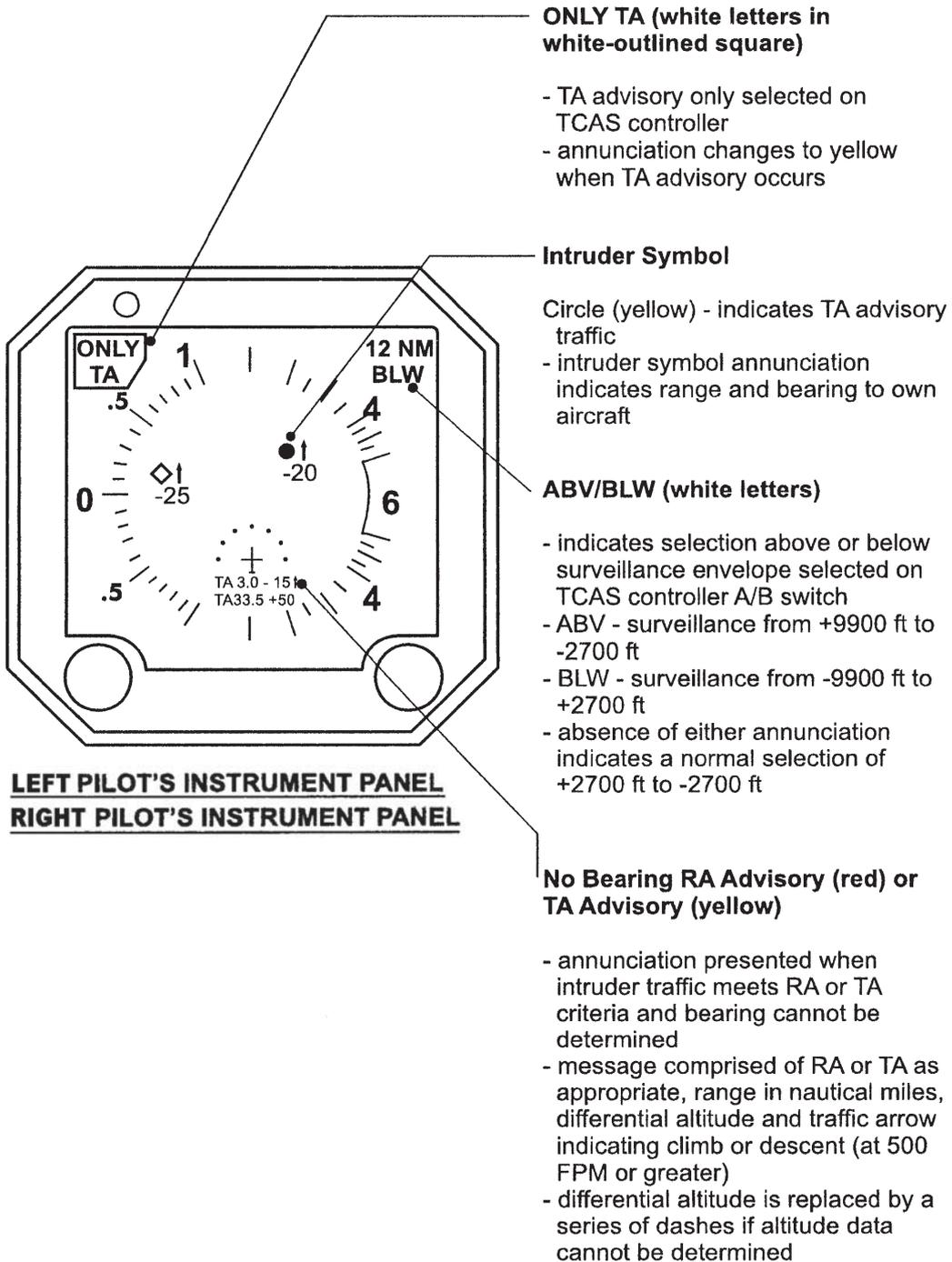
#### R Button

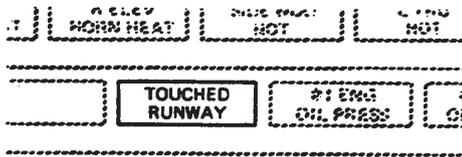
- Push the R button to set the range of the TCAS traffic display. An annunciator on the display shows the set range. Successive pushes of the button cycles through the available ranges. The ranges available are 6 and 12 nm

*TCAS Control Panel*

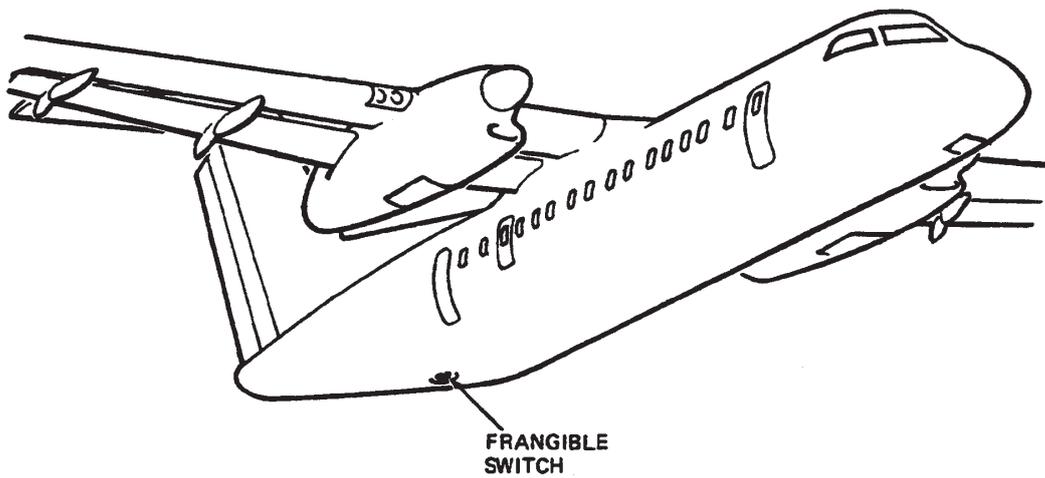
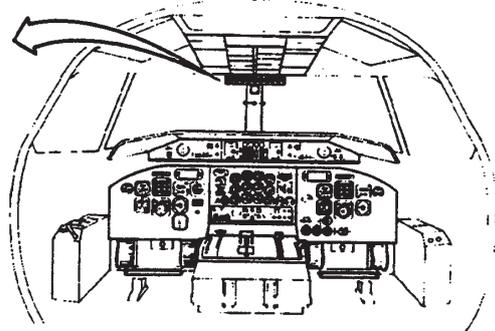




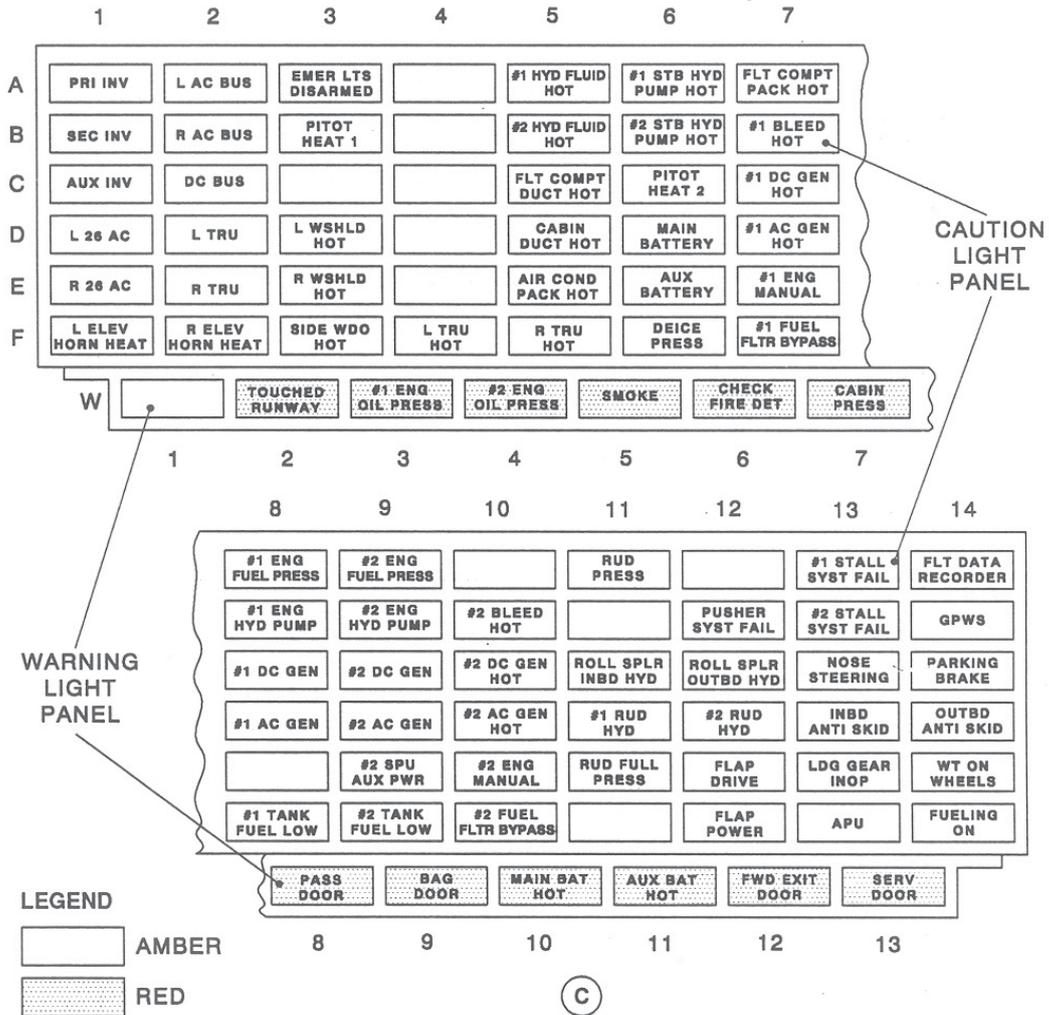
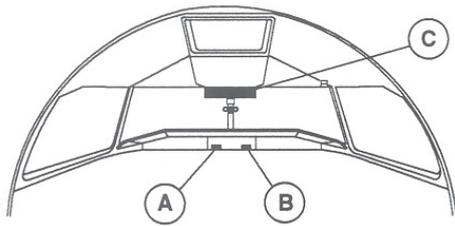




WARNING LIGHTS PANEL



TOUCHED RUNWAY SYSTEM



Warning and Caution Lights

## SYSTEM DESCRIPTION

### Stall warning/stick pusher system

#### General

The stall warning/stick pusher (SW/SP) system provides the flight crew with warnings of an impending stall during flight. The system is designed to operate from signals initiated by the airflow relative to the wing, thus maintaining a direct relationship with angle of attack (AOA). A SW/SP computer provides outputs to activate the control column shaker (stick shaker) and control column pusher (stick pusher). Two separate and independent computers (number 1 and number 2), receive inputs from the attitude and heading reference system (AHRS), air data computer (DADC), flap position, engine torque, de-ice system and raw angle of attack (AOA) data from two sensors, positioned on the left and right side of the front fuselage.

Except during pre-flight checks, stall-warning signals are inhibited on the ground, however when airborne, the functions become active through landing gear weight on wheel switches. The systems are powered from the 28 volts DC left and right essential buses respectively.

The computer stall warning reference AOA represents a trip point just prior to the stick pusher reference AOA for any given flight condition. If the AOA reaches the computer's stall warning reference AOA, the stick shakers activate. If the AOA reaches the stick pusher reference AOA, the stick pusher activates. The stall warning and pusher commands automatically deactivate when recovery from the stall is complete, and sensor inputs fall below the reference level.

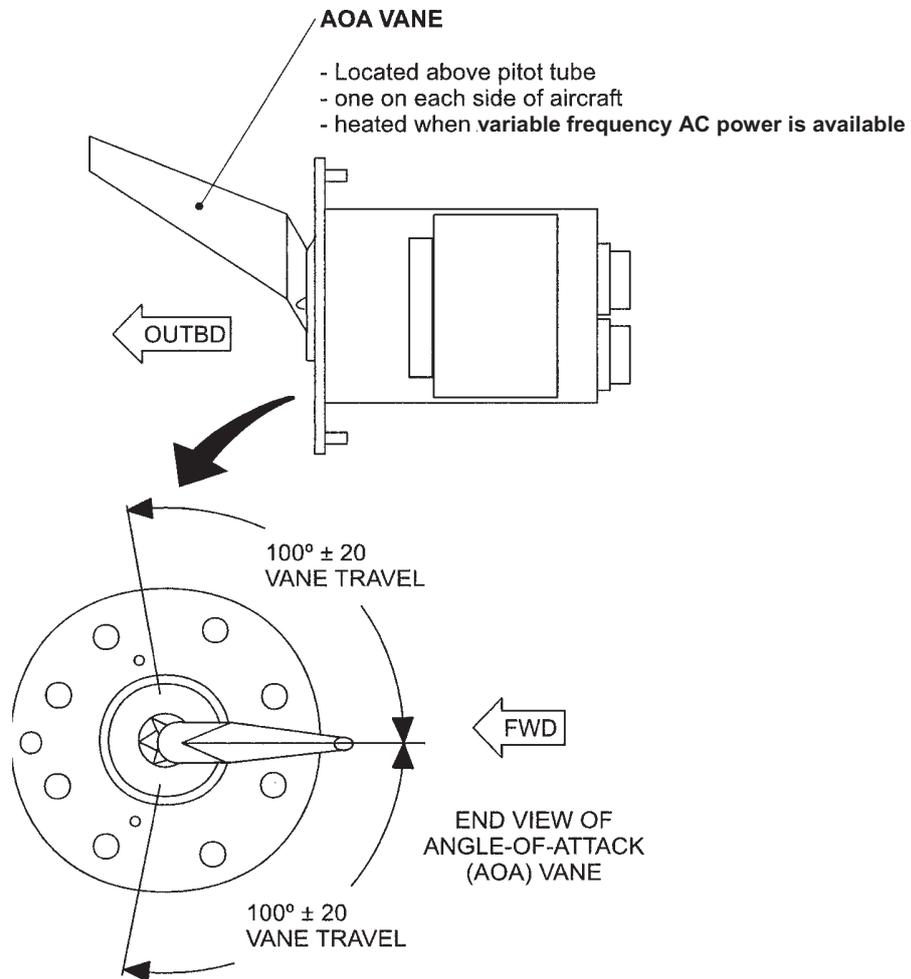
**Angle of attack (AOA) sensors**

Each AOA sensor incorporates a movable alpha vane, which aligns itself with the relative airflow to measure AOA, and presents this data to the SW/SP computer. The left AOA sensor supplies data to the number 1 computer, while the right AOA sensor supplies data to the number 2 computer. If one sensor fails, the associated STALL SYST FAIL and PUSHER SYS FAIL caution lights illuminate. The functioning system provides stall warning. The sensors receive electrical power from the 26 volt AC bus.

During the exterior inspection check the alpha vanes for freedom of movement.

**CAUTION:** If alpha vanes are stuck, do not apply external pressure. Apply heat to the vanes to remove any ice.

Two separate self-regulating heaters, one in the case and one on the alpha vane, keeps each sensor free from moisture and ice. The heaters receive electrical power from the left and right 115 volt AC variable frequency buses whenever the buses are electrically powered.



### Stick shakers

The number 1 and number 2 stall warning computers receive uncorrected AOA information from its respective AOA sensor. If one SW system fails, the functioning system still provides stall warnings. The AOA sensors supply raw AOA data to the computer, which corrects it to provide a true AOA. During flight, the computer reference AOA adjusts for flap position and engine torque and then is stored in memory. Also, during flight in icing conditions, the stall warning reference AOA is further modified when the propeller de-ice timer switch is selected to any position other than OFF.

The computer monitors the true AOA, and then compares it with the reference AOA stored in memory. During flight, if the true AOA exceeds the reference AOA and no system faults are detected, the stick shaker activates. This simultaneously disables the ground proximity warning system and disengages the autopilot (if engaged).

Stall warning output is inhibited when:

- The airplane is on the ground, except during stall warning pre-flight checks.
- Both #1 STALL SYST FAIL, and #2 STALL SYST FAIL caution lights illuminate.

### Stick pusher

The stick pusher is designed to decrease the AOA without pilot input by applying a forward (nose down) force to the pilot's elevator control quadrant, if the wing approaches the critical AOA. A pneumatic actuator system uses nitrogen to apply a push force to the left pilot's elevator control quadrant. The system is capable of delivering approximately 8 to 10 pushes to the control column. Two electrically operated solenoid valves, one for the left and one for the right computer, control the nitrogen flow to the actuator. Both valves must activate before a stick push is permitted.

In addition to data used for the stick shakers, the stick pusher computers use the AOA rate of change derived from the AHRS. Also, separate outputs from the left and right sensor feed the number 1 and number 2 average AOA. The left and right computer must have its respective stall warning data, positive pusher signals and be in agreement with each other before activating the stick pusher.

During flight, if the stick shakers activate due to an impending stall, and the AOA reaches the stick pusher reference AOA, the stick pusher will be activated. Both stick pusher and shakers remain activated until stall recovery is complete.

**NOTE:** If the pitch disconnect handle is pulled out, due to a control jam, and the stick pusher is activated, only the left pilot's control column is affected by the force applied by the stick pusher.

The push force felt at the control column is approximately 80 lbs, which is adequate for stall correction, but can still be overpowered by the pilot in the event the system cannot be disabled.

**NOTE:** The number 1 and number 2 computer must both agree to push before the stick pusher can be activated.

The stick pusher will activate when all of the following conditions are met:

- #1 STALL SYST FAIL, #2 STALL SYST FAIL and PUSHER SYST FAIL caution lights are OFF.
- The airplane is airborne.
- The airplane altitude is greater than 400 feet AGL.
- The airspeed is less than  $200 \pm 4$  KEAS.
- The stick shakers have been activated by both systems.

### **Speed command pointer (SCP)**

The number 1 and number 2 SW/SP channels use true AOA and flap angle to provide relative speed information to the speed command pointer on each EADI (FAST/SLOW pointer). The center reading of either pointer represents an approach speed equivalent to a nominal 1.3Vs for the actual flap setting.

The SCP is active through all phases of flight when the stall warning system and SCP circuits are serviceable. Failure of the SCP will not affect the SW/SP functions. If the computer detects a fault detrimental to the pointer operation, the pointer will remove out of view and the associated STALL SYST FAIL and PUSHER SYST FAIL caution lights illuminate approximately 30 seconds after touchdown.

### **Preflight test**

The built in test equipment (BITE) in the SW/SP computer, performs a system test when the STALL WARNING test switch in the flight compartment is selected to TEST 1 or TEST 2. Each test verifies the serviceability of the number 1 or number 2 stick shaker computer and all related inputs.

Selection of the test switch to TEST 1 illuminates the #1 STALL SYST FAIL and PUSH SYST FAIL caution lights. Simultaneously, the number 1 stick shaker activates and the SCP on the number 1 EADI moves through the entire pointer range (FAST to SLOW).

Selecting the test switch to TEST 2 performs a similar test for number 2 stall warning system.

Releasing the test switch deactivates the stick shakers, and causes all caution lights to go out. Continuous illumination of any caution light after the switch is released, indicates a fault in the associated system. The affected computer is inhibited and the fault logged in its memory.

Testing the stall warning system does not activate the stick pusher function. Stick pusher system checks are conducted by maintenance personnel, using separate test switches on the SW/SP computer.

When airborne all tests are inhibited.

### Take-off warning

A take-off warning horn, located in the flight compartment, sounds an intermittent tone to alert the crew if a take-off is commenced with detrimental conditions existing.

The take-off warning horn will sound when the aircraft is on the ground (weight on wheels), one or both power levers are advanced to a position representing  $\pm 50\%$  torque, and any one or more of the following conditions exist:

- Elevator trim out of the take-off range.
- Flaps extended more than 20 degrees or less than 5 degrees.
- One or both condition levers not at MAX position.
- Parking brake lever selected to PARK.
- Engine ECU rating selector not at take-off power (TOP).

An alternate action T/O FLAP switch is mounted on the aft face of the pilot's side console. The switch has an illuminated fixed T/O FLAP index section and selectable NORM and 0° sections. The selected alternate action section illuminates and the opposite section goes out.

When NORM is selected with less than 5° of flap for take-off, the TAKE-OFF WARNING HORN will sound. When 0° is selected with less than 5° of flap for take-off the TAKE-OFF WARNING HORN is inhibited.

The take-off warning will cease when the detrimental conditions are corrected or the power levers are retarded.

### Landing gear warning

A warning horn located in the flight compartment, provides an audible warning when the gear has not been extended and the aircraft is in the landing configuration. The horn activated by the PSEU at a steady 2000 Hz tone whenever the following conditions exist:

- All landing gear not down and locked, flaps selected to 15 or 35°, and both power levers at any position less than 50% torque.
- Landing gear not down and locked, one or both power levers at or near FLT IDLE and airspeed below 130 kts.

A horn-muting feature permits the horn to be silenced during single-engine training. The HORN MUTE/TEST switch on the landing gear panel, when momentarily selected to the MUTE position, will silence the horn only if the second condition stated above exits with only one power lever retarded. If both power levers are retarded the horn cannot be muted. The horn also cannot be muted when the first condition exists.

The warning horn is tested by selecting the TEST position on the HORN MUTE TEST switch. If serviceable, the horn will sound a steady 2000 Hz tone.

### **Overspeed warning**

An overspeed warning horn, located in the flight compartment, sounds an intermittent tone when the airplane exceeds its maximum operating speed (V<sub>mo</sub>). The air data computers sense airspeed and conditions effecting V<sub>mo</sub> accordingly.

The air data computers method of computing V<sub>mo</sub> and sensing airspeed using true airspeed values is more accurate than the V<sub>mo</sub> indication provided by the airspeed indicators. The result is that the airspeed overspeed warning may occur at a speed up to 6 kts greater than the V<sub>mo</sub> indication on the airspeed indicators.

The overspeed horn can be tested by selected the ADC test switch to TEST 1 or TEST 2. This sounds the overspeed horn.

### **Beta warning horn system**

The beta warning horn system is introduced to reduce the risk of inadvertent power lever setting below flight idle while the aircraft is in flight. The warning horn is operated by a micro-switch on the flight idle gate release triggers. Raising either release trigger throughout the range of power lever movement on the quadrant during flight will cause the warning horn to operate. The horn is silenced by releasing the release trigger(s) with the power levers selected above the flight idle gate. The beta warning horn system is disabled by either a signal from the radio altimeter at an altitude below 20 feet or from a weight-on-wheels signal.

### Enhanced ground proximity warning system (EGPWS)

The EGPWS is a terrain awareness and alerting system that provides terrain alerting and, when enabled, terrain display functions. The EGPWS uses the following aircraft inputs:

- Altitude.
- Radio altitude.
- Airspeed.
- Attitude.
- Glideslope.
- Geographic position.

The EGPWS will provide the appropriate alert for excessive glideslope deviation, flaps or landing gear not in the landing configuration, and bank angle and decision height call-outs.

When enabled by the flight crew, the EGPWS will use internal terrain, obstacles and airport databases to predict a potential conflict between the aircraft flight path with either terrain or an obstacle.

The EGPWS uses geometric altitude. Geometric altitude is a computed pseudo-barometric altitude that reduces or eliminates potentially induced errors in corrected barometric altitude by temperature extremes, non-standard pressure altitude conditions and altimeter set incorrectly.

The EGPWS installation includes an automatic display of terrain on the EHSI ('auto pop-up'), in the event that a caution or warning alert is triggered, and an 'Auto-range' feature when the 'Auto pop-up' occurs. Auto range automatically sets the EHSI's to a 10 NM range setting.

**NOTE:** The ground proximity warning functions (GPW) (Modes 1 through 6) are the basic functions of the EGPWS system. The primary objective of the EGPWS is to maintain the integrity of these functions independent of the Enhanced functions. Therefore, loss of the terrain awareness display function will not affect the operation of the GPW functions, provided that the input signals necessary for GPW operation are still available.

The EGPWS (Enhanced function) configuration requires the following minimum equipment to be functional:

- EGPWS computer.
- Air data computer #2 system.
- Radio altimeter.
- Flight management system.
- Weather radar.
- Attitude and heading reference system.

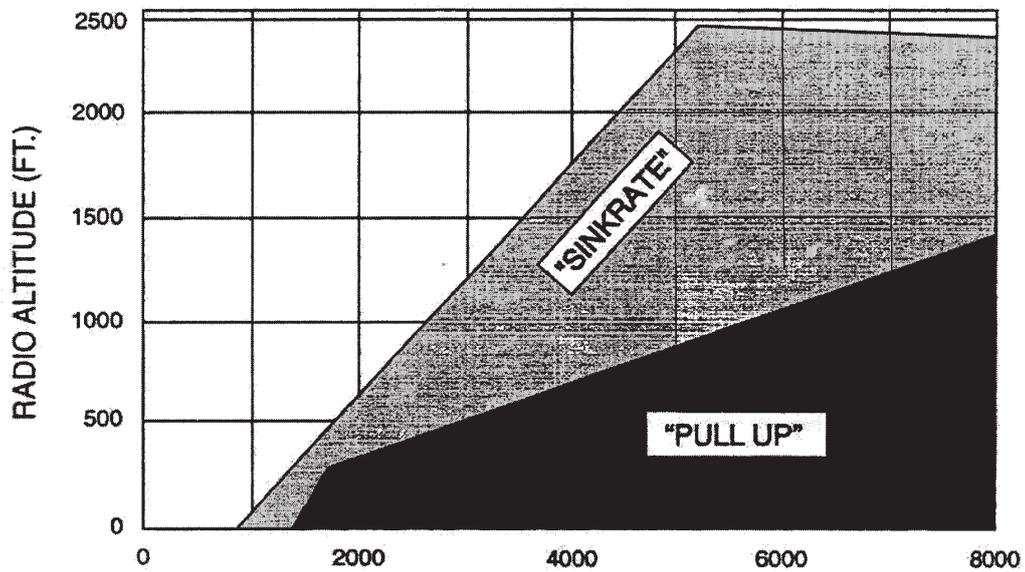
**Basic EGPWS functions (modes 1 through 6)**

The EGPWS alerts the flight crew when one of the following flight condition thresholds are violated:

**MODE 1 EXCESSIVE DESCENT RATE**

Mode 1 warns the flight crew that the rate of descent for a given altitude is excessive. When the outer warning envelope is penetrated, the red PULL UP switchlights illuminate on the glareshield panel and the aural alert "SINK RATE, SINK RATE" is annunciated.

If the rate of descent is not corrected and the inner envelope is penetrated, the aural alert changes to "PULL UP" which is repeated continuously until the inner warning boundary is exited.



DESCENT RATE (FT./MINUTE)

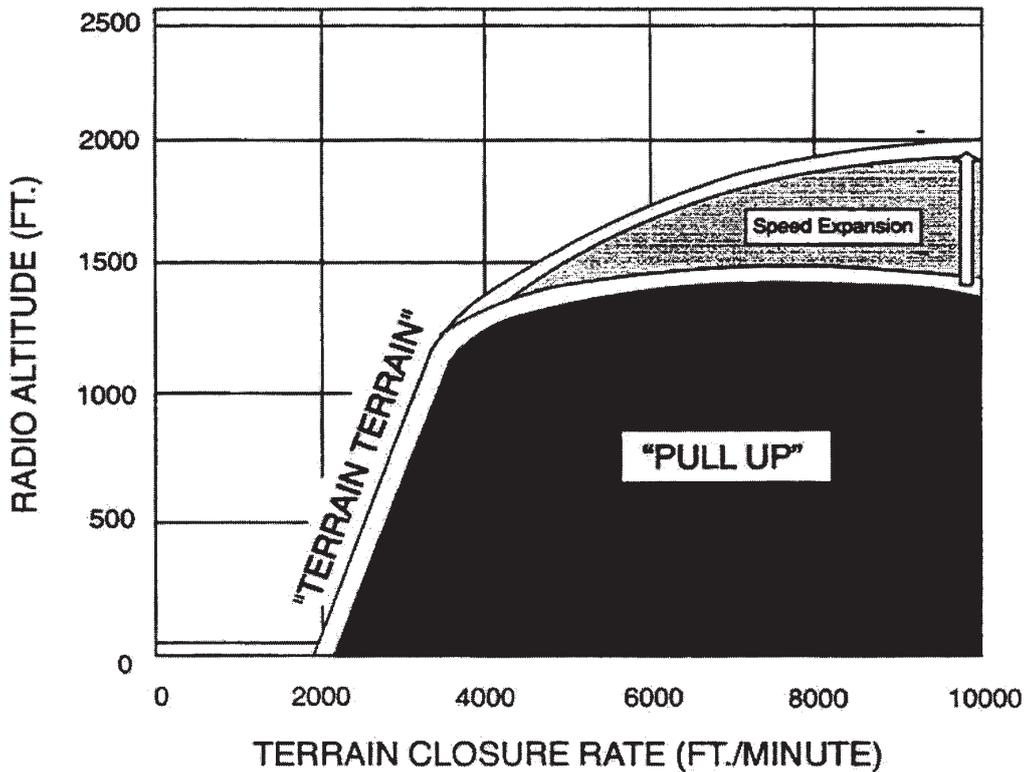
Mode 1 Excessive Descent Rate

MODE 2 EXCESSIVE TERRAIN CLOSURE RATE

Mode 2 warns the flight crew when the aircraft and terrain are closing at an excessive rate. It is not necessary for the aircraft to be descending to produce a mode 2 alert. Level flight or even a climb towards obstruction terrain can result in a hazardous closure rate. Mode 2 has two sub-modes, Mode 2A and Mode 2B, determined by aircraft configuration.

MODE 2A EXCESSIVE CLOSURE RATE TO TERRAIN (FLAPS UP)

Mode 2A warns of excessive closure rate to terrain. When the outer warning envelope is penetrated the red PULL UP switchlights illuminate and the aural alert "TERRAIN, TERRAIN" is enunciated. If the terrain closure rate continues and penetration of the inner envelope is made, the aural alert "PULL UP" is annunciated continuously until corrective action is taken or terrain changes occur, after which the warning changes to "TERRAIN, TERRAIN". This alert continues until the aircraft has gained 300 feet barometric altitude from the point where the "PULL UP" voice alert stopped or 45 seconds has elapsed. If additional warnings occur during climb, the altitude gain circuit is reset and another gain of 300 feet barometric altitude is required to turn off the "TERRAIN, TERRAIN" voice alert and PULL UP switchlights.



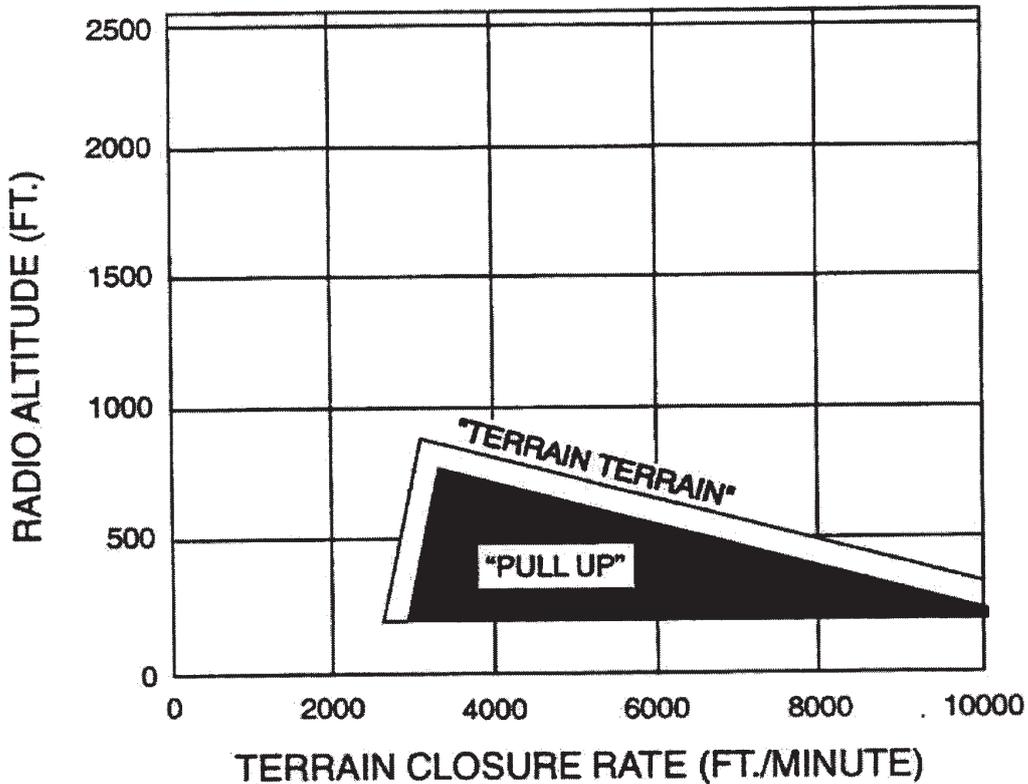
Mode 2A Excessive Closure Rate To Terrain

MODE 2B EXCESSIVE CLOSURE RATE TO TERRAIN (FLAP IN LANDING POSITION)

Mode 2B provides a desensitized alert envelope to reduce unwanted alerts during normal landing approach maneuvering. Mode 2 B is enabled whenever one of the following conditions exist:

- Flaps are selected to a landing position.
- The aircraft is flying an ILS approach and is within 2 dots of both localizer and glideslope centerlines.
- For the first 60 seconds following take-off.

When the envelope for mode 2B is penetrated, the red PULL UP switchlights illuminate and the aural alert "TERRAIN, TERRAIN" is annunciated followed by "PULL UP" if the condition persists. If both landing gear and flaps are in the landing configuration the aural alert "TERRAIN" is annunciated.



Mode 2B Excessive Closure Rate To Terrain

MODE 3 ALTITUDE LOSS AFTER TAKE-OFF OR GO-AROUND.

Mode 3 provides an aural and visual alert to the flight crew when the aircraft loses a significant amount of altitude immediately after take-off or during a go-around condition. Mode 3 is enabled whenever either the landing gear or flap is not in the landing configuration. If the aircraft penetrates the mode 3 boundary, the red PULL UP switchlights illuminate and the aural alert "DON'T SINK" is annunciated. The visual and aural annunciations will continue until a positive rate of climb is established.

MODE 4 UNSAFE TERRAIN CLEARANCE

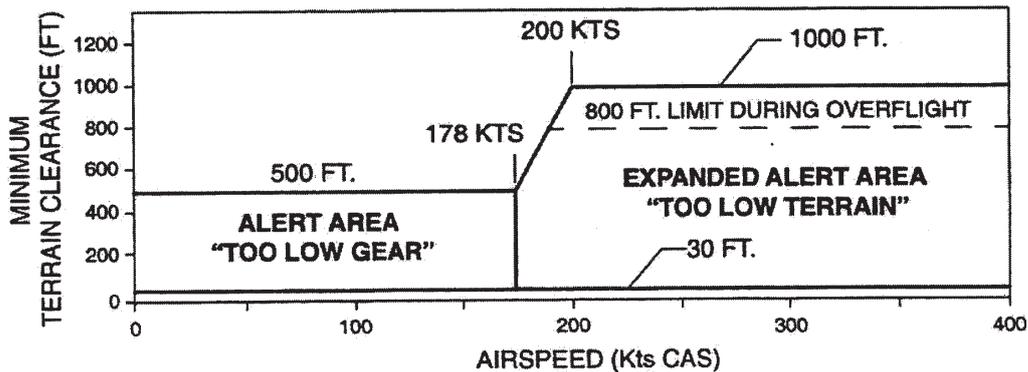
MODE 4A UNSAFE TERRAIN CLEARANCE (GEAR UP)

Mode 4A provides the flight crew with voice alert and visual indications when the aircraft landing gear is UP and terrain clearance is inadequate during the cruise and approach phase of flight. The standard upper boundary for mode 4A (Airspeed is below 178 KCAS and gear UP) is 500 feet RA. If the aircraft penetrates this boundary the aural alert "TOO LOW GEAR" is annunciated. The aural alert will continue until one of the following actions is taken:

- Gear is extended.
- Aircraft is no longer descending.
- Aircraft climbs above 500 feet RA.

The upper boundary of mode 4A increases linearly with airspeed up to a maximum of 1000 feet RA at an airspeed of 200 KCAS or greater. If the aircraft is above 178 KCAS and penetrates the upper boundary the aural alert "TOO LOW TERRAIN" is annunciated. The aural alert will continue until one of the following actions is taken.

- Airspeed is reduced.
- Aircraft is no longer descending.
- Aircraft climbs above the upper boundary area.



### MODE 4B UNSAFE TERRAIN CLOSURE (LANDING GEAR DOWN, FLAPS NOT IN LANDING CONFIGURATION)

Mode 4B is active during cruise and approach when the gear is in the landing configuration. The standard upper boundary for mode 4B (Airspeed below 148 knots – gear down) is 200 feet RA. If the aircraft penetrates this boundary the aural alert “TOO LOW FLAPS” is annunciated. The flight crew may disable the “TOO LOW FLAP” aural alert by pressing the (E)GPWS flap override switch. Pressing the (E)GPWS flap override switch a second time will re-engage the aural alert. The aural alert will continue until one of the following actions is taken:

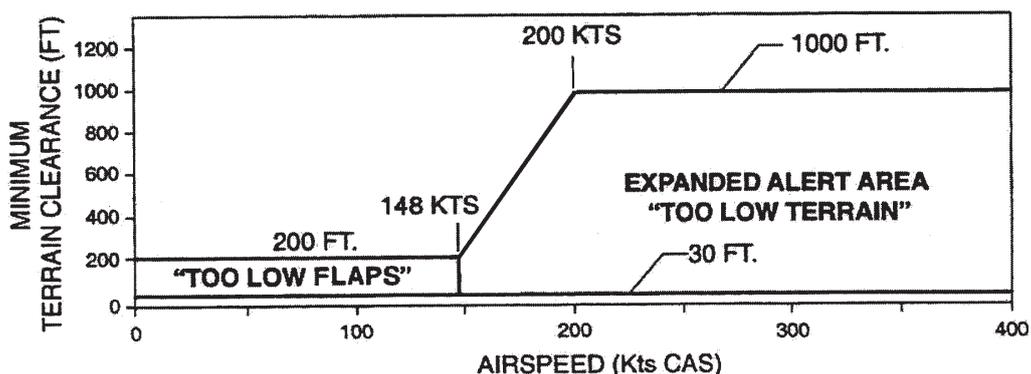
- Flaps are positioned to the selected reference landing configuration.
- The (E)GPWS flap override switch is selected.
- The aircraft climbs above 200 feet RA.

The landing flap setting must be selected prior to commencing the approach to provide reference for the (E)GPWS system. This is done with pushbuttons located on the center console.

The upper boundary of mode 4B increases linearly with the airspeed up to a maximum of 1000 feet RA at an airspeed of 200 knots or greater. If the aircraft is above 148 knots and penetrates this upper boundary the aural alert “TOO LOW TERRAIN” is annunciated. The aural alert will continue until one of the following actions is taken:

- Airspeed is reduced.
- Aircraft is no longer descending.
- Aircraft climbs above the upper boundary layer.

The mode 4B inhibit switches, installed on the center console, inhibit activation of mode 4B when matched to the actual landing flap setting. If the alert area is penetrated with the inhibit switch not matched with the actual flap setting, the “TOO LOW FLAPS” aural alert is annunciated.



MODE 4C UNSAFE TERRAIN CLOSURE (GEAR OR FLAPS NOT IN LANDING CONFIGURATION)

Mode 4C is active after take-off or during a go-around when the gear or flap is not in the landing configuration and the aircraft descending below 245 feet AGL. At take-off the Minimum Terrain Clearance (MTC) is zero feet. As the aircraft climbs the MTC is increased to 75% of the aircraft radio altitude (averaged over the previous 15 seconds). This value is not allowed to decrease and is limited to 500 feet AGL for airspeed less than 178 KCAS. Above this airspeed, the MTC increases linearly to the limit of 750 feet AGL at 200 KCAS.

If the aircraft descends to the value of the MTC, the red PULL UP switchlights and the aural alert "TOO LOW TERRAIN" is annunciated. The aural alert will continue until one of the following actions is taken:

- Aircraft is no longer descending.
- Aircraft climbs above the upper boundary layer.

## MODE 5 DEVIATION BELOW GLIDESLOPE

Below glideslope alerts are enabled when one of the following conditions exist:

- ILS 1 tuned, glideslope data valid.
- Localizer is within +/- 2 dots.
- Landing gear and flaps are selected to landing configuration.
- Glideslope cancel is not active.
- A front course approach is determined.

Mode 5 provides two levels of alerting for when the aircraft descends below glideslope. The first level alert occurs when below 1000 feet RA and the aircraft is 1.3 dots or greater below the glideslope beam. The BELOW G/S switchlight (amber) illuminates and the aural 'soft' alert "GLIDESLOPE" is annunciated at half volume. A twenty percent increase in the glideslope deviation result in "GLIDESLOPE" annunciations at a progressively faster rate.

The second level occurs when below 300 feet RA with 2 dots or greater glideslope deviation. The BELOW G/S switchlight will illuminate and remain on until glideslope deviation is less than 1.3 dot. The 'hard' aural alert "GLIDESLOPE, GLIDESLOPE" is annunciated at full volume. The alert is repeated every 3 seconds until the aircraft has exited the 'hard' envelope.

### NOTE:

- The upper altitude limit (level 1) of 1000 feet RA is for descent rates of 500 feet per minute or greater. If the rate of descent is below 500 feet per minute the upper altitude limit is reduced to a minimum of 500 feet RA.
- Mode 5 BELOW GLIDESLOPE alerts are canceled by pressing the BELOW G/S select switch any time the aircraft is below 2000 feet RA. The alerts are automatically reset when the aircraft descends below 30 feet RA or climbs above 2000 feet AGL. The glideslope cancel cannot be reset by pressing the BELOW G/S pushbutton a second time. Re-select the ILS frequency to reset this mode.

#### MODE 6 DESCENT BELOW DECISION HEIGHT OR MINIMUM DESCENT ALTITUDE

An aural announcement “MINIMUMS, MINIMUMS” is given once, when the aircraft passes through the selected radio altimeter decision height bug setting between the altitudes of 1000 feet and 50 feet. When the aircraft passes the selected decision height, the white ‘DH’ readout on the EADI changes to amber and is highlighted with a box.

This mode is engaged by turning the left inner knob of the EFIS controller clockwise and selecting the desired decision height. The mode 6 voice alert is inhibited by setting the DH bug to 0 feet.

The call-out “MINIMUMS, MINIMUMS” will sound once; it resets automatically when either 1000 feet RA or 50 feet RA are transitioned.

A “FIVE HUNDRED” foot call-out will be issued when the system detects that a non-precision approach is being performed or that the aircraft is outside of the +/- 2 dot glideslope deviation.

#### MODE 6 EXCESSIVE BANK ANGLE ALERT

The “BANK ANGLE” call-out is based on the aircraft’s bank angle versus altitude (AGL). The bank angle limit varies from 15 degrees at 10 feet AGL to 50 degrees at 210 feet AGL. If the bank angle exceeds these limits, the aural alert “BANK ANGLE BANK ANGLE” is enunciated. The aural alert is repeated every 20% increase in aircraft bank angle.

### Enhanced GPWS functions

In addition to the basic GPWS functions (mode 1-6) the EGPWS includes the terrain and obstacle awareness alerting and display functions. These functions use aircraft geographic position, aircraft altitude and terrain and obstacle database to predict potential conflicts between the aircraft flight path and terrain. Terrain threats are recognized and annunciated when terrain violates specific computed envelope boundaries forward of the aircraft flight path.

#### TERRAIN CLEARANCE FLOOR

The terrain clearance floor (TCF) function provides an increased terrain clearance envelope around the intended airport runway. In addition to mode 4, TCF provides a visual and aural alert based on sufficient terrain clearance with the aircraft in landing configuration. If the aircraft penetrates this envelope the red PULL UP switchlights illuminate and the aural alert "TOO LOW TERRAIN" is annunciated. The aural alert will continue until one of the following actions is taken:

- Aircraft is no longer descending.
- Aircraft climbs above the upper boundary layer.

#### TERRAIN AND OBSTACLE AWARENESS FUNCTIONS

Terrain awareness visual and aural alerts operate in the same manner as the standard GPWS mode alerts. The caution and warning envelope boundary uses the terrain clearance floor as a baseline and virtually looks ahead of the aircraft for terrain and obstacles. The EGPWS makes calculations (Caution Look Ahead Distance) using the aircraft ground speed and turn rate to provide an advanced warning with adequate time for the crew to react. This distance corresponds to approximately 40-60 seconds of advanced alerting. There are 2 specific envelopes that will initiate a specific visual and audio alert:

- Caution envelope boundary, and
- Warning envelope boundary.

Caution envelope boundary consists of terrain caution alert and the obstacle caution alert. If the aircraft penetrates the terrain caution alert, the red PULL UP switchlights illuminate, the aural alert "CAUTION TERRAIN, CAUTION TERRAIN" is annunciated and the conflicting terrain areas are shown in solid yellow color on the EHSI. If the aircraft penetrates the obstacle caution alert, the red PULL UP switchlights illuminate, the aural alert "CAUTION OBSTACLE, CAUTION OBSTACLE" is annunciated and the conflicting terrain areas are shown in solid yellow on the EHSI.

Warning envelope boundary consists of terrain warning alert and obstacle warning alert. If the aircraft penetrates the terrain warning alert, the red PULL UP switchlights illuminate, the aural alert "TERRAIN, TERRAIN, PULL UP" is annunciated and the conflicting terrain areas are shown in solid red color on the EHSI. If the aircraft penetrates the obstacle warning alert, the red PULL UP switchlights illuminate, the aural alert "OBSTACLE, OBSTACLE, PULL UP" is annunciated and the conflicting areas are shown in solid red color on the EHSI.

## DISPLAY COLOURS AND PATTERNS

COLOUR	TERRAIN ELEVATION
Solid red	Terrain threat area – Warning.
Solid yellow	Terrain threat area – Caution.
High density red dots	Terrain that is more than 2000 feet above aircraft altitude.
High density yellow dots	Terrain that is between 1000 and 2000 feet above aircraft altitude.
Low density yellow dots	Terrain that is 500 feet (250 feet with gear down) below to 1000 feet above the aircraft altitude.
Solid green	Shown only when no red or yellow terrain areas are within range on the display. Highest terrain is not within 500 feet (250 feet with gear down) of aircraft altitude.
High density green dots	Terrain that is 500 feet (250 feet with gear down) below to 1000 feet below aircraft altitude or terrain that is in the middle elevation band when there are no red or yellow terrain areas within the range of the display.
Low density green dots	Terrain that is 1000 to 2000 feet below aircraft altitude or terrain that is in the lower elevation band when there are no red or yellow terrain areas within range on the display.
Black	No significant terrain.
Low density cyan	Terrain elevation equal to 0 feet MSL.
Low density magenta dots	Unknown terrain.

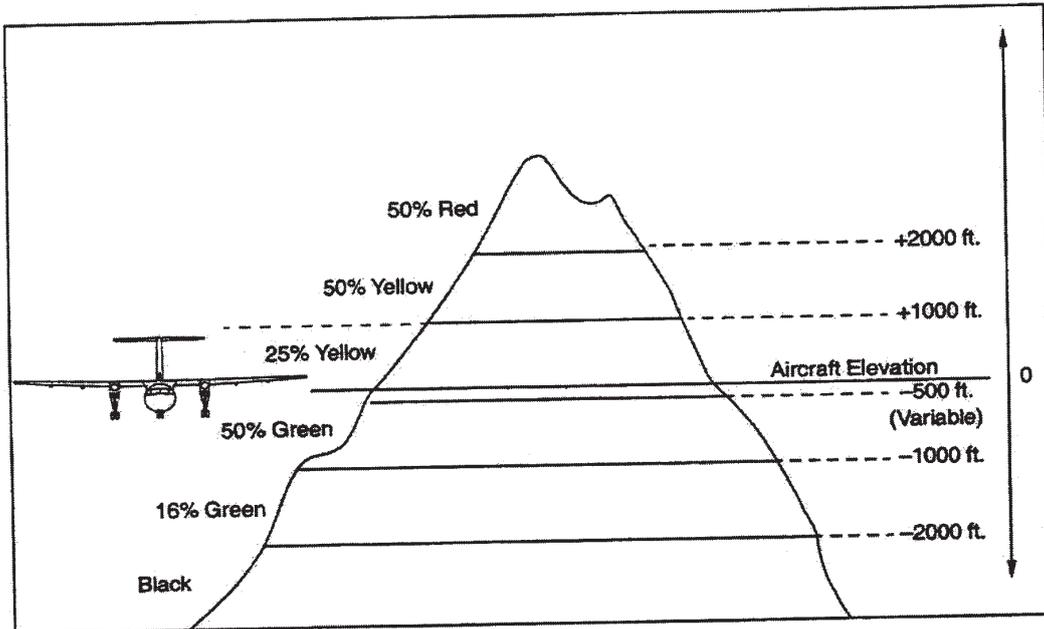
## EFIS TERRAIN DISPLAY MODE

When the terrain display information is available, it will replace the weather radar information on the EHSI when manually selected by the flight crew (by selecting the WX/TERR pushbutton on the EFIS controller) or during an auto pop-up (when either terrain/obstacle caution or terrain/obstacle warning is issued) TERR will be displayed on the EHSI to indicate terrain mode is active.

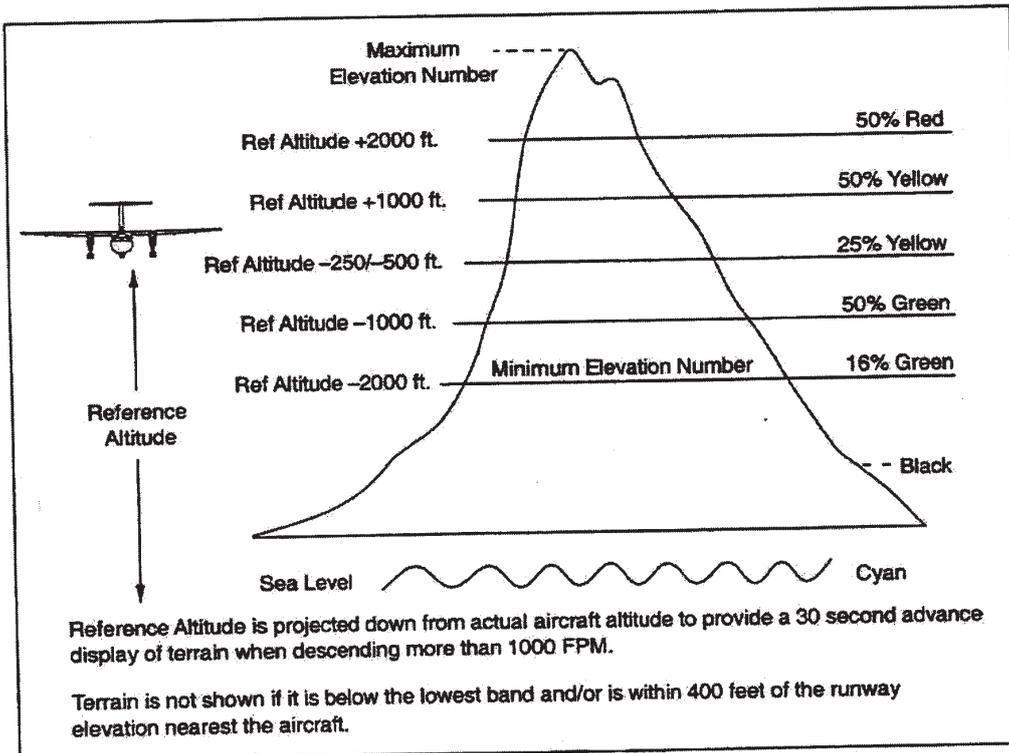
## DISPLAY COLOURS AND PATTERNS

The terrain displayed on the EHSI uses the colors and shadings patterns corresponding to the vertical displacement between the terrain elevations and the current aircraft altitude. Red and yellow dot patterns indicate terrain near or above the current altitude of the aircraft. Solid yellow and red colors indicate alert warning and caution areas relative to the flight path of the aircraft. Medium and low-density green display patterns indicate terrain that is below the aircraft and within 2000 feet of the aircraft altitude. Terrain more than 2000 feet below the aircraft is not displayed. A solid green level indicates the highest terrain. The lower density green display patterns indicate mid to upper terrain in the display area as well as terrain that is within 2000 feet of the aircraft.

Two elevation numbers are displayed in the lower RH corner of the EHSI. The elevation numbers indicate terrain in hundreds of feet above sealevel (MSL). The terrain elevation numbers are displayed with the highest number on top and the lowest number on the bottom. The color of the displayed number corresponds with the terrain shown on the display.



Display Colour and Patterns



Display Colour and Patterns

SELF TEST TERRAIN DISPLAY

The EGPWS will initiate a terrain self test pattern after power on during the preflight check. The following is a description of the terrain self test pattern:

If all required inputs are valid, the display pattern will be shown on the EHSI's for approximately 12 seconds. The test pattern consists of 9 blocks. Each block is filled with a different pattern and color to reflect all combinations that are normally used in a terrain picture on the display.

MAGENTA	HIGH DENSITY RED	LOW DENSITY CYAN
SOLID RED	HIGH DENSITY YELLOW	SOLID YELLOW
HIGH DENSITY GREEN	LOW DENSITY YELLOW	LOW DENSITY GREEN

EGPWS AURAL ALERT SUMMARY

The following is a list that identifies the various alerts by type and mode:

ALERT	WARNING	CAUTION	ADVISORY
Any "PULL UP"	1,2,TA	-	-
"TERRAIN, TERRAIN"	-	2,TA	-
"OBSTACLE, OBSTACLE"	-	TA	-
"TERRAIN"	-	2	-
"MINIMUMS, MINIMUMS"	-	-	6
"CAUTION TERRAIN"	-	TA	-
"CAUTION OBSTACLE"	-	TA	-
"TOO LOW TERRAIN"	-	4,TCF	-
"TOO LOW GEAR OR FLAPS"	-	4	-
Altitude call-outs	-	-	6
"SINK RATE"	-	1	-
"DON'T SINK"	-	3	-
"GLIDESLOPE"	-	5	-
"BANK ANGLE"	-	-	6

### Traffic alert and collision avoidance system (TCAS)

The TCAS II is an airborne traffic alert and collision avoidance system that identifies and displays potential and predicted collision threats. The system interrogates aircraft equipped with an ATC transponder and provides appropriate voice and visual advisories to the flight crew.

The TCAS II configuration requires the following equipment to be functional and operating:

- TCAS transmitter/receiver.
- 2 directional antennas.
- TCAS controller.
- 2 VSI/TRA indicators.
- Mode S transponder.
- Radio altimeter.

The system provides two levels of advisories:

- A traffic advisory (TA) is a visual display on the VSI/TRA indicators of the relative position of a threat aircraft when it is approximately 40 seconds from the closest point of approach (CPA). A “TRAFFIC, TRAFFIC” announcement occurs simultaneously. The TA provides the opportunity to visually acquire the threat aircraft and prepare for possible evasive maneuver.
- A resolution advisory (RA) is a visual indication on the VSI/TRA indicators recommending a vertical speed (VS) range that will provide adequate vertical separation from the threat aircraft when it is approximately 25 seconds from the CPA. The RA will be accompanied by an appropriate announcement.

Traffic advisories can be generated for intruder aircraft with operative mode S, mode C or mode A transponders. Mode A transponders do not provide altitude information, therefore resolution advisories will only be issued for mode S and mode C equipped aircraft. The TCAS II system provides no indication of traffic conflicts for aircraft without operative transponders.

### Limitations

- Deviation from the ATC assigned altitude is authorized only to the extent necessary to comply with an ACAS resolution advisory (RA).
- Maneuvers must not be based solely on information presented on the traffic display.
- The transponder has been demonstrated only for the purposes of surveillance modes A (Identity), C (altitude), and ACAS functions.

### TCAS II operating characteristics

- TCAS II self test is inhibited during flight.
- “INCREASE DESCENT” RA announcement are inhibited below 1450 feet AGL.
- “DESCEND” RA announcement are inhibited below 1200 feet AGL when climbing, and below 1000 feet AGL when descending.
- All resolution advisories (RA) are inhibited below 1100 feet AGL when climbing and below 900 feet AGL when descending.
- All TA announcements are inhibited below 600 feet AGL when climbing, and below 400 feet AGL when descending.
- Voice and visual “INCREASE CLIMB” RA advisories will be inhibited during the following conditions:
  - Landing gear down and flaps extended 15 degrees or greater, or
  - Propeller autofeather switch selected and the amber ARM light illuminated.
- During an engine-out condition, “CLIMB” voice and visual advisories are inhibited.
- The TCAS mode of operation automatically changes as follows:
  - TA ONLY mode to TA/RA (AUTO) mode when at 1100 feet AGL and climbing.
  - TA/RA (AUTO) mode to TA ONLY mode at 900 feet AGL and descending.

### Resolution advisory announcements

“CLIMB CLIMB”	Climb at rate shown on the green arc of the VSI/TRA indicators.
“DESCEND DESCEND”	Descend at rate shown on the green arc of the VSI/TRA indicators.
“ADJUST VERTICAL SPEED, ADJUST”	Reduce rate of decent to that shown on VSI/TRA indicators, or Reduce rate of climb to that shown on VSI/TRA indicators, or Indicates a weakening of the RA. Allows pilot the option to return to an assigned altitude.
“MONITOR VERTICAL SPEED”	Monitor present vertical speed to prevent entering restricted red arc speed.
“MAINTAIN VERTICAL SPEED, MAINTAIN”	Maintain present vertical speed and direction. Prevent entering restricted red arc speed.
“MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN”	A flight path crossing is predicted, but being monitored by TCAS. Maintain present vertical speed and direction. Prevent entering restricted red arc speed.

“CLEAR OF CONFLICT”	Range is increasing and separation is adequate; return to previous ATC assigned altitude.
“CLIMB CROSSING CLIMB, CLIMB CROSSING CLIMB”	Safe separation will best be achieved by climbing through intruder’s flight path.
“DESCEND CROSSING DESCEND, DESCEND CROSSING DESCEND”	Safe separation will best be achieved by descending through intruder’s flight path.
The following voice messages are announced when the initial RA does not provide sufficient vertical separation from an intruder.	
“INCREASE CLIMB, INCREASE CLIMB” (received after “CLIMB” advisory)	Additional climb rate is required.
“INCREASE DESCEND, INCREASE DESCEND” (received after “DESCEND” advisory)	Additional descent rate required.
“CLIMB-CLIMB NOW, CLIMB-CLIMB NOW” (received after “DESCEND” advisory)	A reversal from a descent to a climb condition is required to provide adequate vertical separation.
“DESCEND-DESCEND NOW, DESCEND-DESCEND NOW” (received after “CLIMB” advisory)	A reversal from a climb to a descent condition is required to provide adequate vertical separation.

**NOTE:**

- TCAS advisories are based on the pilot accurately flying the initial RA maneuver within approximately 5 seconds, and within approximately 2½ seconds if an additional corrective RA is issued.
- If threat aircraft track or altitude information is lost during an RA, the RA will terminate without a “CLEAR OF CONFLICT” announcement.
- (E)GPWS alert takes priority over TCAS II RA.

**WARNING:**

On receipt of a ‘crossing RA’ every effort should be made to achieve visual contact with the intruder to assure adequate separation.

**CAUTION:**

If stall warning (stick shaker) occurs during an RA maneuver, take immediate stall recovery action.

### **Touched Runway system**

The Touched Runway system provides a warning light in the flight compartment. It illuminates when the aft fuselage makes hard contact with the runway on take off or landing.

The system consists of a frangible switch located at the bottom of the aft fuselage, activating the warning light. The system is powered from the 28 Volt DC right main bus.

Once activated, the frangible switch can not be reset but must be replaced by maintenance personnel.

### **Caution and warning lights system**

The caution and warning lights systems provide a visual indication to the flight crew of a non-normal condition (caution), or warning. The lights are housed in a panel located forward of the overhead console. Amber caution lights illuminate to indicate a caution, while red warning lights illuminate to indicate a warning.

A master WARNING light and master CAUTION light, located on the center glareshield panel, flashes to alert the flight crew of a system fault or warning. Simultaneously the associated system's caution or warning light illuminates. Caution lights will be on continuously when triggered. Warning lights flash until the master WARNING light is reset. An illuminated caution / warning light remains ON as long as the non-normal condition exists.

A flashing master CAUTION light indicates a caution light has illuminated. A flashing master WARNING light indicates a warning light has illuminated. Pressing either the master CAUTION or master WARNING light, resets the master light. If a subsequent fault occurs, the master CAUTION or master WARNING light flashes with the newly illuminated fault light.

The FUELING ON caution light is the only caution light that does not trigger the master CAUTION light.

A description of each light can be found in the applicable chapter of this section.

**NON-NORMAL INDICATIONS AND OPERATION**

**Stick pusher malfunction**

If excessive pressure accumulates within the actuator without a signal from the SW/SP computer, PUSH OFF illuminates on the STICK PUSHER SHUT OFF switchlights.

Pushing either switchlight depressurizes the actuator, illuminates the PUSHER SYST FAIL caution light and turns off both STICK PUSHER SHUT OFF switchlights. The PUSHER SYST FAIL caution light goes out when the same STICK PUSHER SHUT OFF switchlight is pushed again. The PUSHER SYST FAIL caution light also illuminates if the computer detects a malfunction in the pusher system causing a loss of stick pusher function.

**Caution lights**

The #1 STALL SYST FAIL, #2 STALL SYST FAIL and PUSHER SYST FAIL caution lights provide the flight crew with visual indications of a system failure. If a fault occurs within the stall warning system, the appropriate STALL SYST FAIL caution light illuminates. If a fault occurs within the stick pusher system, the PUSHER SYST FAIL caution light illuminates. Any fault will be recorded in the computer's non-volatile memory. If a fault is intermittent, or clears during flight, the caution light goes out, however, the fault will be stored in memory until rectified by maintenance personnel.

All faults not critical to the function will be logged in memory; however, the respective caution light illuminates 30 seconds after touchdown.

**Warning and caution lights**

<div style="border: 1px solid black; padding: 2px; width: fit-content;">TOUCHED RUNWAY</div>	Rear fuselage has contacted runway during take-off or landing due to excessive nose up altitude.
Applicable ECL	TOUCHED RUNWAY.
Remarks	Pressure bulkhead or skins may be damaged causing pressurization to be affected. Aircraft should not be flown until rectified by maintenance. Switch must be replaced before further flight.

#1 STALL SYST FAIL	#2 STALL SYST FAIL
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SW/SP computer detects a fault in the applicable computer of the stall warning system.

Applicable ECL: EITHER #1 STALL SYSTEM FAILURE or #2 STALL SYSTEM FAILURE and STICK PUSHER FAILURE.

Remarks: Maintain a minimum of 1.3 Vs for all flap settings or the appropriate speed for icing conditions and other failures if applicable.  
Loss of stick pusher function.  
Also illuminated during test.

PUSHER SYST FAIL
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Malfunction of stick pusher system.  
Switchlight pushed. Dump valve opened to relieve pusher actuator of excessive pressure.

Applicable ECL: STICK PUSHER FAILURE.

Remarks: Caution light will go out when pressure is relieved and dump valve closes.

GPWS
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Ground Proximity Warning System computer failure or de-energized.

Applicable ECL: (E)GPWS FAILURE.

Remarks: Terrain and obstacle avoidance and landing configuration are not monitored.