

B737 NG



Warning Systems

Introduction

Aural, tactile and visual warning signals alert the flight crew to conditions requiring action or caution in the operation of the airplane. The character of the signals varies, depending upon the degree of urgency or hazards involved. Aural, tactile, and visual signals are used singularly or in combination to simultaneously provide both warnings and information regarding the nature of the condition.

Mach/airspeed warnings, landing gear warnings, takeoff configuration warnings, windshear warnings, and ground proximity warnings are discussed in this section. Cabin altitude warning is discussed in this section and in the Air Systems briefing, and autopilot and autothrottle disconnect warnings are discussed in the Automatic Flight briefing. The conditions which excite the fire warning bell are discussed in the Fire Protection briefing.

Conditions which require the immediate attention of the flight crew are indicated by red warning lights located in the area of the pilots' primary field of vision. These lights indicate engine, wheel well, cargo, or APU fires; autopilot, autothrottle disconnects; and landing gear unsafe conditions.

Conditions which require the timely attention of the flight crew are indicated by amber caution lights.

Blue lights inform the flight crew of electrical power availability, valve position, equipment status, and flight attendant or ground communications. Blue lights are for information and do not require immediate flight crew attention. Some system blue lights indicate a transitional state by illuminating bright as valves or components reposition, then returning to a dim blue when the required configuration is reached.

Green lights indicate a fully extended configuration, e.g., landing gear and leading edge devices.

Stall warning is provided by a control column shaker on each control column.

Various aural signals call attention to warnings and cautions. An aural warning for airspeed limits is given by a clacker, the autopilot disconnect by a warning tone, takeoff configuration and cabin altitude by an intermittent horn, and landing gear positions by a steady horn. The fire warning by a fire warning bell. Ground proximity warnings and alerts, and windshear warnings and alerts are given by voice warnings.

Generally, aural warnings automatically silence when the associated non-normal condition no longer exists.

Master Fire Warning Lights

Two master FIRE WARN lights illuminate when any fire warning condition occurs. The lights remain illuminated as long as the condition exists. Pushing either master FIRE WARN light or fire warning bell cutout switch extinguishes both lights, silences the fire warning bell and resets the system for future warnings. Further information appears in the Fire Protection section.

Master Caution Lights

Two MASTER CAUTION lights illuminate when any caution occurs outside the normal field of vision of the flight crew. The lights remain illuminated as long as the caution condition exists, or until the crew resets the system. Pushing either MASTER CAUTION light extinguishes both lights and resets the master caution system for further cautions. Pushing either annunciator light panel recalls all existing fault annunciations.

A single fault in certain redundant systems, or some simple faults, do not illuminate the MASTER CAUTION or system annunciator lights. These faults, however, are stored in the master caution system. Pushing the system annunciator recalls the single fault on the system annunciator panel.

When the MASTER CAUTION recall is pressed, all twelve system lights should illuminate while the press-to-test feature is held. If a system annunciator light does not illuminate, refer to the dispatch deviation procedures guide (DDPG).

System Annunciator Lights

Two system annunciator light panels are located on the glare shield. The annunciator light panels include only those systems located on the forward overhead, aft overhead, and fire control panels. If a caution condition exists, the appropriate system annunciator(s) and MASTER CAUTION lights illuminate.

System Annunciators and Related Amber Lights – Left Side

FLT CONT	<table border="1"> <tr> <td>FLT CONT</td> <td>ELEC</td> </tr> <tr> <td>IRS</td> <td>APU</td> </tr> <tr> <td>FUEL</td> <td>OVHT/DET</td> </tr> </table>	FLT CONT	ELEC	IRS	APU	FUEL	OVHT/DET	ELEC
FLT CONT		ELEC						
IRS		APU						
FUEL		OVHT/DET						
LOW QUANTITY LOW PRESSURE FEEL DIFF PRESS SPEED TRIM FAIL MACH TRIM FAIL AUTO SLAT FAIL YAW DAMPER STBY RUD ON			DRIVE STANDBY PWR OFF TRANSFER BUS OFF SOURCE OFF TR UNIT BATTERY DISCHARGE ELEC					
IRS	LEFT SIDE GLARESHIELD	APU						
FAULT ON DC DC FAIL GPS		LOW OIL PRESSURE FAULT OVERSPEED						
FUEL		OVHT/DET						
LOW PRESSURE FILTER BYPASS		ENGINE 1 OVERHEAT ENGINE 2 OVERHEAT APU DET INOP						

System Annunciators and Related Amber Lights – Right Side

[Option - 737-800/900, ICE DETECTOR, AIRSTAIR, ELT, HIGH ALTITUDE LANDING - INOP, lavatory SMOKE detector]

ANTI-ICE	<table border="1" style="margin: auto;"> <tr> <td>ANTI-ICE</td> <td>ENG</td> </tr> <tr> <td>HYD</td> <td>OVERHEAD</td> </tr> <tr> <td>DOORS</td> <td>AIR COND</td> </tr> </table> <p>RIGHT SIDE GLARESHIELD</p>	ANTI-ICE	ENG	HYD	OVERHEAD	DOORS	AIR COND	ENG
ANTI-ICE		ENG						
HYD		OVERHEAD						
DOORS		AIR COND						
WINDOW OVERHEAT PITOT HEAT COWL ANTI-ICE ICE DETECTOR		REVERSER EEC ALTN MODE ENGINE CONTROL						
HYD		OVERHEAD						
OVERHEAT LOW PRESSURE	ELT EQUIP COOLING- OFF EMER EXIT LIGHTS-NOT ARMED FLIGHT RECORDER-OFF PASS OXY-ON PSEU SMOKE							
DOORS	AIR COND							
FWD/AFT ENTRY AIRSTAIR EQUIP FWD/AFT CARGO FWD/AFT SERVICE LEFT/RIGHT OVERWING	ZONE TEMP DUAL BLEED PACK WING-BODY OVERHEAT BLEED TRIP OFF AUTO FAIL OFF SCHED DESCENT HIGH ALTITUDE LANDING - INOP							

Warning Systems

Intermittent Cabin Altitude/Configuration Warning

The takeoff configuration warning is armed when the airplane is on the ground and either or both forward thrust levers are advanced for takeoff. An intermittent warning horn sounds if:

- trailing edge flaps are not in the flaps 1 through 25 takeoff range, or
- trailing edge flaps are in a skew or asymmetry condition, or have uncommanded motion, or
- leading edge devices are not configured for takeoff or have uncommanded motion, or
- speed brake lever is not in the DOWN position, or
- ground spoiler interlock valve is open providing pressurized hydraulic fluid to spoiler control valves, or
- parking brake is set, or
- stabilizer trim not set in the takeoff range.

The warning indication is cancelled when the configuration error is corrected.

The Cabin Altitude Warning Horn activates when cabin altitude exceeds 10,000 feet. An intermittent warning horn is heard. The Cabin Altitude Warning Horn may be silenced by momentarily pressing the ALT HORN CUTOFF switch on the Cabin Altitude Panel.

WARNING: The Cabin Altitude and Takeoff Configuration Warnings use the same intermittent tone when activated.

Landing Gear Configuration Warnings

Visual indications and aural warnings of landing gear position are provided by the landing gear indicator lights and landing gear warning horn.

Visual Indications

The landing gear indication lights are activated by signals from each gear, the LANDING GEAR lever, and the forward thrust lever position as follows:

Green light illuminated – landing gear is down and locked.

Red light illuminated –

- landing gear is in disagreement with LANDING GEAR lever position (in transit or unsafe).
- landing gear is not down and locked (with either or both forward thrust levers retarded to idle, and below 800 feet AGL).

All lights extinguished – landing gear is up and locked with the LANDING GEAR lever UP or OFF.

Aural Indications

A steady warning horn is provided to alert the flight crew whenever a landing is attempted and any gear is not down and locked. The landing gear warning horn is activated by forward thrust lever and flap position as follows:

Flaps up through 10 –

- altitude below 800 feet RA, when either forward thrust lever set between idle and approximately 20 degrees thrust lever angle or an engine not operating and the other thrust lever less than 34 degrees. The landing gear warning horn can be silenced (reset) with the landing gear warning HORN CUTOFF switch
- if the airplane descends below 200 feet RA, the warning horn cannot be silenced by the warning HORN CUTOFF switch.

Flaps 15 through 25 –

- either forward thrust lever set below approximately 20 degrees or an engine not running, and the other thrust lever less than 34 degrees; the landing gear warning horn cannot be silenced with the landing gear warning HORN CUTOFF switch.

Flaps greater than 25 –

- regardless of forward thrust lever position; the landing gear warning horn cannot be silenced with the landing gear warning HORN CUTOFF switch.

The warning indication is cancelled when the configuration error is corrected.

Proximity Switch Electronic Unit (PSEU)

The PSEU monitors the following systems:

- takeoff configuration warnings
- landing configurations warnings
- landing gear
- air/ground sensing.

The PSEU, its sensors, and its input signals are monitored for internal faults. When designated faults are detected, a PSEU light on the aft overhead panel illuminates, and the OVERHEAD system annunciator light and MASTER CAUTION lights illuminate. The PSEU light can be reset following a maintenance BITE check or repair of the cause of the fault.

The PSEU light is inhibited:

- in flight
- when the thrust levers are advanced toward takeoff power
- for 30 seconds after landing.

Mach/Airspeed Warning System

Two independent Mach/airspeed warning systems provide a distinct aural warning, a clacker, any time the maximum operating airspeed of V_{mo}/M_{mo} is exceeded. The warning clackers can be silenced only by reducing airspeed below V_{mo}/M_{mo} .

The airspeed indicator displays red warning bands indicating maximum and minimum airspeeds. Amber bands indicate maximum and minimum maneuvering airspeeds. The top of the lower amber band indicates the minimum maneuver speed. It is the slowest speed that provides full maneuvering: 0.3 g maneuver margin (40° bank) to stick shaker (below approximately 20,000 ft) or initial buffet (above approximately 20,000 ft).

The airspeed indicator displays red warning bands indicating maximum and minimum airspeeds. Amber bands indicate maneuver capability. The top of the lower amber band indicates the minimum maneuver speed for full maneuver capability. This speed provides 0.3 g maneuver margin (40° bank) to stick shaker (below approximately 20,000 feet) or initial buffet (above approximately 20,000 feet). As airspeed is decreased below the top of the amber band, maneuver capability decreases. In 1 g flight, the speed in the middle of the amber band provides adequate capability (30° bank). The bottom of the amber band (top of the barber pole) corresponds to stick shaker or initial buffet onset speed, and increases with g loading.

When either an overspeed condition or a system test occurs, the ADIRU transmits a signal to the aural warning module, sounding the clacker. The system can only be tested on the ground.

Stall Warning System

Natural stall warning (buffet) usually occurs at a speed prior to stall. In some configurations the margin between stall and natural stall warning is less than desired. Therefore, an artificial stall warning device, a stick shaker, is used to provide the required warning.

The stall warning “stick shaker” consists of two eccentric weight motors, one on each control column. They are designed to alert the pilots before a stall develops. The warning is given by vibrating both control columns. The system is armed in flight at all times. The system is deactivated on the ground.

Two independent, identical stall management yaw damper (SMYD) computers determine when stall warning is required based upon:

- alpha vane angle of attack outputs
- ADIRU outputs
- anti-ice controls
- wing configurations
- air/ground sensing

- thrust
- FMC outputs.
- mach compensation

The SMYD computers provide outputs for all stall warning to include stick shaker and signals to the pitch limit indicator and airspeed displays and the GPWS windshear detection and alert.

Two test switches are installed in the aft overhead panel. Pushing either of these initiates a self-test of the respective stall warning channel. The No.1 activates the Captain stick shaker, and the No. 2 activates the F/O stick shaker. Either stick shaker vibrates both columns through column interconnects.

Autoland Advisory Messages

[Option – Fail-Operational Autoland Capability]

When a system failure is detected that affects autoland status, an advisory message is displayed on the upper engine display. Two advisories, NO LAND 3 and NO AUTOLAND, are available. Only one advisory message can be displayed at one time. A cancel/recall switch, located on the MFD panel, controls the display and recall of the advisory messages.

The NO LAND 3 advisory will be annunciated when a failure has occurred above Alert Height and the system is still capable of continuing to a safe landing. With this advisory, LAND 2 will be the resulting autoland status annunciation displayed following dual autopilot engagement on approach.

The NO AUTOLAND advisory is displayed any time above the Alert Height to notify the crew a failure has occurred and the system is unable to perform an automatic landing.

Altitude Alerting System

[Option - EFIS/MAP, 300/900 altitude alert]

Altitude alerting occurs when approaching or departing the MCP-selected altitude. Altitude alerting is inhibited when trailing edge flaps are extended to 25 or greater, or while G/S is captured.

Acquisition Alerting

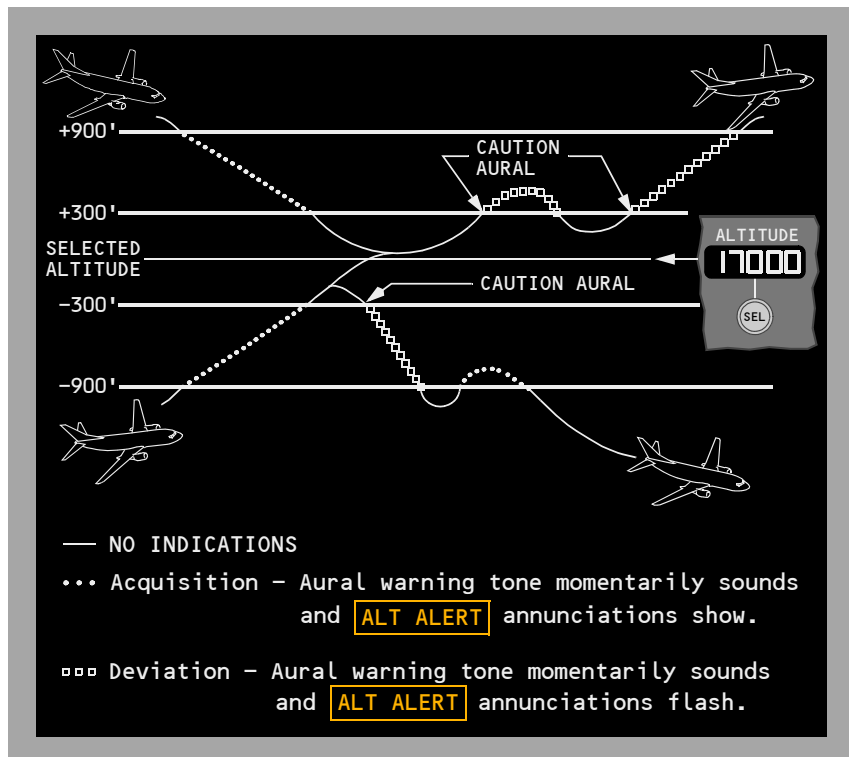
900 feet before reaching the selected altitude, both ALT ALERT annunciations show and a momentary tone sounds. At 300 feet from selected altitude, the ALT ALERT annunciations no longer show.

Deviation Alerting

When deviating by 300 feet from the selected altitude, a momentary tone sounds and the ALT ALERT annunciators flash. Flashing continues until:

- altitude deviation becomes less than 300 feet
- altitude deviation becomes more than 900 feet
- a new altitude is selected.

Altitude Alert Profile



Altitude Alerting System

[Option - PFD/ND, 300/900 altitude alert]

Altitude alerting occurs when approaching or departing the MCP–selected altitude. Altitude alerting is inhibited when trailing edge flaps are extended to 25 or greater, or while G/S is captured.

Acquisition Alerting

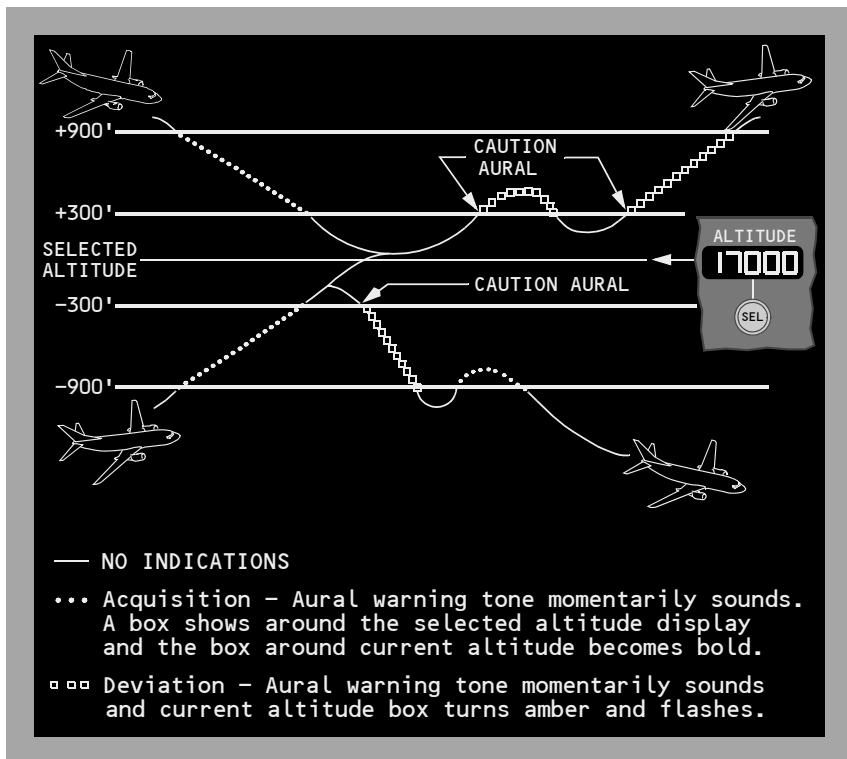
900 feet before reaching the selected altitude, a white box shows around the selected altitude display and the box around the current altitude becomes bold. A momentary tone sounds. At 300 feet from selected altitude, the selected altitude box no longer shows.

Deviation Alerting

When deviating by 300 feet from the selected altitude, a momentary tone sounds and the current altitude box turns amber and begins to flash. The amber flashing continues until:

- altitude deviation becomes less than 300 feet
- altitude deviation becomes more than 900 feet
- a new altitude is selected.

Altitude Alert Profile



Ground Proximity Alerts

The GPWS provides alerts for potentially hazardous flight conditions involving imminent impact with the ground.

The GPWS monitors terrain proximity using an internal world wide terrain data base. Proximate terrain data shows on the navigation display. If there is a potential terrain conflict, alerts are provided based on estimated time to impact. These alerts are “look-ahead terrain alerts.”

The GPWS provides alerts based on radio altitude and combinations of barometric altitude, airspeed, glide slope deviation, and airplane configuration. The alerts are for:

- excessive descent rate
- excessive terrain closure rate
- altitude loss after takeoff or go-around
- unsafe terrain clearance when not in the landing configuration
- excessive deviation below an ILS glide slope

[Option - IAN]

- excessive deviation below glidepath

These alerts are “radio altitude based alerts.”

Ground proximity alerts are accompanied by voice aural alerts and the PULL UP annunciation on the attitude indicators or, for deviation below glide slope alert, the BELOW G/S light.

Note: Terrain ahead of the airplane may exceed available climb performance. A ground proximity alert does not guarantee terrain clearance.

Look-ahead terrain alerts and radio altitude based alerts are prioritized based on the level of hazard and the required flight crew reaction time. Look-ahead terrain alerts and radio altitude based alerts are inhibited by an actual windshear warning (airplane in windshear).

Look-Ahead Terrain Alerting

The GPWS terrain data base contains detailed terrain data near major airports, and data in lesser detail for areas between airports. Terrain within 2,000 feet of airplane barometric altitude shows on the navigation display. The terrain data is not designed to be an independent navigation aid.

Note: The GPWS terrain data base, look-ahead terrain alerting, and terrain display do not account for man made obstructions.

The terrain display is generated from a data base contained in the GPWS computer and correlated to GPS position.

Terrain and weather radar cannot show together on a display. If one pilot selects terrain and the other pilot selects weather radar, each display updates on alternating sweeps. All other displays (TCAS, LNAV routing, etc.) can show with terrain data.

Look-ahead terrain alerts are based on the airplane's position, barometric altitude, vertical flight path, and ground speed.

Look Ahead Terrain Alerts

AURAL ALERT	VISUAL ALERT	DESCRIPTION
TERRAIN TERRAIN PULL UP	PULL UP on both attitude indicators Red TERRAIN message on navigation display (all modes) Solid red terrain on navigation display	20 to 30 seconds from projected impact with terrain shown solid red on the navigation display (in expanded MAP, center MAP, expanded VOR, or expanded APP modes only). Moving the ground proximity terrain inhibit switch to TERRAIN INHIBIT inhibits the alert.
CAUTION TERRAIN	Amber TERRAIN message on navigation display (all modes) Solid amber terrain on navigation displays	40 to 60 seconds from projected impact with terrain shown solid amber on the navigation display (in expanded MAP, center MAP, expanded VOR, or expanded APP modes only). Moving the ground proximity terrain inhibit switch to TERRAIN INHIBIT inhibits the alert.
TOO LOW, TERRAIN	PULL UP on both attitude indicators	Descent below unsafe radio altitude while too far from any airport in the terrain database. Moving the ground proximity terrain inhibit switch to TERRAIN INHIBIT inhibits the alert.

Radio Altitude Based Alerts

AURAL ALERT	VISUAL ALERT	DESCRIPTION
PULL UP	PULL UP on both attitude indicators	Follows SINK RATE alert if descent rate becomes severe. Follows radio altitude based TERRAIN alert if excessive terrain closure rate continues and landing gear and/or flaps are not in landing configuration.
TERRAIN	PULL UP on both attitude indicators	Excessive terrain closure rate.
DON'T SINK	PULL UP on both attitude indicators	Excessive altitude loss after takeoff or go-around.
GLIDE SLOPE	BELOW G/S P-INHIBIT lights	Deviation below glide slope. Volume and repetition rate increase as deviation increases. Pushing the ground proximity BELOW G/S P-INHIBIT light cancels or inhibits the alert below 1,000 feet RA.
SINK RATE	PULL UP on both attitude indicators	Excessive descent rate.
TOO LOW, FLAPS	PULL UP on both attitude indicators	Unsafe terrain clearance at low airspeed with flaps not in a normal landing position. Pushing the ground proximity flap inhibit switch to FLAP INHIBIT inhibits the alert.
TOO LOW, GEAR	PULL UP on both attitude indicators	Unsafe terrain clearance at low airspeed with landing gear not down. Pushing the ground proximity gear inhibit switch to GEAR INHIBIT inhibits the alert.
TOO LOW, TERRAIN	PULL UP on both attitude indicators	Unsafe terrain clearance at high airspeed with either landing gear not down or flaps not in landing position. Follows DON'T SINK if another descent is initiated after initial alert, before climbing to the altitude where the initial descent began.

Windshear Alerts

Windshear alerts are available during takeoff, approach, and landing:

- The GPWS provides a warning when the airplane is in a windshear.
- The weather radar provides alerts for excessive windshear ahead of the airplane. These are “predictive windshear alerts.”

Windshear warnings are accompanied by WINDSHEAR on the attitude indicators and voice aural alerts.

Windshear cautions are accompanied by a voice aural alert.

Windshear alerts are prioritized based on the level of hazard and the required flight crew reaction time. Predictive windshear alerts are inhibited by an actual windshear warning (airplane in windshear), look-ahead terrain alerts, or radio altitude based alerts.

Windshear Warning (Airplane in Windshear)

AURAL ALERT	VISUAL ALERT	DESCRIPTION
Two-tone siren followed by WINDSHEAR	Red WINDSHEAR on both attitude indicators.	Excessive windshear at the current airplane position detected by GPWS. Enabled below 1,500 feet RA. GPWS Windshear detection begins at rotation.

Predictive Windshear Alerts

The weather radar uses radar imaging to detect disturbed air prior to entering a windshear.

Note: The weather radar provides windshear alerts for windshear events containing some level of moisture or particulate matter.

Note: The weather radar detects microbursts and other windshears with similar characteristics. The weather radar does not provide alerting for all types of windshear. The flight crew must continue to rely on traditional windshear avoidance methods.

AURAL ALERT	VISUAL ALERT	DESCRIPTION
WINDSHEAR AHEAD	Red WINDSHEAR on both attitude indicators RED windshear symbol on navigation display Red WINDSHEAR message on navigation display (all modes)	Windshear close to and directly ahead of the airplane detected by the weather radar. Enabled during takeoff, below 1,200 feet RA. Predictive windshear symbol on the navigation display shows windshear position (expanded MAP, center MAP, expanded VOR or expanded APP modes only).
GO AROUND, WINDSHEAR AHEAD	Red WINDSHEAR on both attitude indicators RED windshear symbol on navigation display Red WINDSHEAR message on navigation display (all modes)	Windshear within 1.5 miles and directly ahead of the airplane detected by the weather radar. Enabled during approach, below 1,200 feet RA. Predictive windshear symbol on the navigation display shows windshear position (expanded MAP, center MAP, expanded VOR or expanded APP modes only).
MONITOR RADAR DISPLAY	RED windshear symbol on navigation display Amber WINDSHEAR message on navigation display (all modes)	Windshear within 3 miles and ahead of the airplane detected by the weather radar. Enabled during takeoff and approach, below 1,200 feet RA. Predictive windshear symbol on the navigation display shows windshear position (expanded MAP, center MAP, expanded VOR or expanded APP modes only).

The weather radar automatically begins scanning for windshear when:

- thrust levers set for takeoff, even if engine is off or IRS not aligned, or
- in flight below 2,300 feet RA (predictive windshear alerts are issued below 1,200 feet RA).

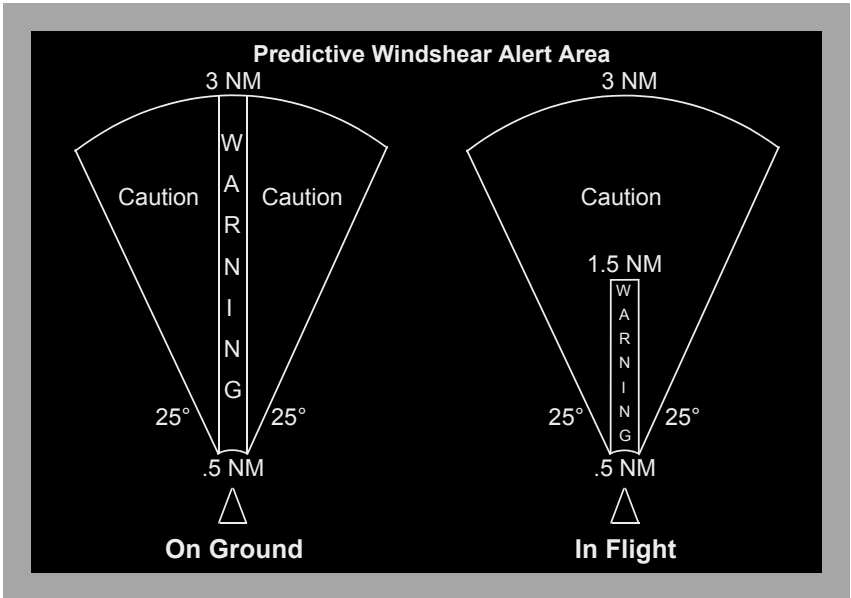
[Option - Without Collins weather radar 622-5132-632 or 622-5132-633]

Alerts are available approximately 12 seconds after the weather radar begins scanning for windshear. Predictive windshear alerts can be enabled prior to takeoff by pushing the EFIS control panel WXR switch.

[Option - With Collins weather radar 622-5132-632 or 622-5132-633]

Alerts are available approximately 12 seconds after the weather radar begins scanning for windshear. Predictive windshear alerts can be enabled prior to takeoff by pushing the EFIS control panel WXR switch. When PWS is enabled, radar antenna scan sweep is reduced.

If windshear is not detected, weather radar returns show only after pushing the EFIS control panel WXR switch.



Predictive Windshear Inhibits

During takeoff and landing, new predictive windshear caution alerts are inhibited between 80 knots and 400 feet RA, and new warning alerts between 100 knots and 50 feet RA. These inhibits do not remove existing predictive windshear alerts.

Bank Angle Alert

The GPWS provides the aural alert BANK ANGLE, BANK ANGLE when roll angle exceeds 35 degrees, 40 degrees, and 45 degrees. Once sounded, the alert is silent for that bank angle (35, 40, or 45 degrees) until the system is reset by decreasing bank angle to 30 degrees or less.

Approach Callouts

Radio Altitude Callouts

[Option - Typical]

The GPWS provides the following altitude callouts during approach:

- 2,500 feet – TWENTY FIVE HUNDRED
- 1,000 feet – ONE THOUSAND
- 500 feet – FIVE HUNDRED
- 100 feet – ONE HUNDRED
- 50 feet – FIFTY
- 40 feet – FORTY
- 30 feet – THIRTY
- 20 feet – TWENTY
- 10 feet – TEN.

Note: Callouts at 1000 feet and 500 feet are based on barometric altitude above the landing field elevation; callouts at 2,500 feet, and below 500 feet are based on radio altitude.

DH/MDA Callouts

The GPWS provides height callouts based on the altitude set by the Captain's Minimums selector.

[Option - PFD/ND]

Callouts are based on radio altitude when the MINS selector is set to RADIO. Callouts are based on barometric altitude when the MINS selector is set to BARO:

- DH/MDA plus 100 feet – PLUS HUNDRED
- at DH/MDA – MINIMUMS

[Option - EFIS/MAP]

Callouts are based on radio altitude:

- DH/MDA plus 100 feet – PLUS HUNDRED
- at DH/MDA – MINIMUMS

Traffic Alert and Collision Avoidance System (TCAS)

TCAS alerts the crew to possible conflicting traffic. TCAS interrogates operating transponders in other airplanes, tracks the other airplanes by analyzing the transponder replies, and predicts the flight paths and positions. TCAS provides advisory and traffic displays of the other airplanes to the flight crew. Neither advisory, guidance, nor traffic display is provided for other airplanes which do not have operating transponders. TCAS operation is independent of ground-based air traffic control.

To provide advisories, TCAS identifies a three dimensional airspace around the airplane where a high likelihood of traffic conflict exists. The dimensions of this airspace are based upon the closure rate with conflicting traffic.

TCAS equipment interrogates the transponders of other airplanes to determine their range, bearing, and altitude. A traffic advisory (TA) is generated when the other airplane is approximately 40 seconds from the point of closest approach. If the other airplane continues to close, a resolution advisory (RA) is generated when the other airplane is approximately 25 seconds from the point of closest approach. The RA provides aural warning and guidance as well as maneuver guidance to maintain or increase separation from the traffic.

Non-transponder equipped airplanes are invisible to TCAS. RAs can be generated if the other airplane has a mode C transponder. Coordinated RAs require both airplanes to have TCAS.

Advisories and Displays

TAs are indicated by the aural “TRAFFIC, TRAFFIC” which sounds once and is then reset until the next TA occurs. The TRAFFIC annunciation appears on the navigation display. The TA symbol appears at the proper range and relative bearing of the other airplane. Altitude and vertical motion are included with the symbol if the other airplane is using transponder mode S or C.

RAs are indicated by one or more aural listed in the RA aural table. The TRAFFIC annunciation and RA symbol which depicts the traffic’s relative bearing, range, altitude, and vertical motion are on the navigation display similar to the TA symbol.

Additional symbols are proximate traffic and other traffic. Proximate traffic is within six miles and 1200 feet vertically, but is not expected to cause a TA or RA alert. Other traffic is beyond the six mile and 1200 feet vertical criteria. Traffic symbols are revised as the TCAS system constantly reevaluates the motion of other airplanes.

If the range of the navigation display does not permit the display of a TA or RA an OFFSCALE annunciation appears on the navigation display.

TA or RA traffic detected by TCAS which do not provide a bearing generate a no-bearing text block beneath the TRAFFIC text on the navigation display. The text block contains distance, altitude, and vertical motion information.

Vertical motion information is indicated by an arrow depicting a climb or descent if a change of greater than 500 feet per minute is detected.

TCAS display automatically shows when:

- the transponder mode selector is in TA ONLY or TA/RA, and
- a TCAS TA or RA occurs, and
- neither pilot has the TCAS (TFC) display selected, and
- in MAP, center MAP, VOR, or APP modes.

Inhibits

[Option - With TCAS change 7.0 update]

INCREASE DESCENT RAs are inhibited below approximately 1,500 feet radio altitude.

DESCEND RAs are inhibited below approximately 1,100 feet radio altitude.

RAs are inhibited below approximately 1,000 feet radio altitude. Below 1,000 feet when the TA/RA mode is selected on the transponder panel, TA only mode is enabled automatically and the TCAS message TA ONLY displays on the ND.

All TCAS voice annunciations are inhibited below approximately 500 feet radio altitude.

All TCAS alerts are inhibited by GPWS and windshear warnings.

Mode Control

The TCAS operating mode is controlled from the TCAS/ATC transponder panel. TCAS is normally operated in the TA/RA mode. However, sometimes it is necessary to operate in the TA ONLY mode to prevent undesired RAs. For example, TA ONLY may be selected when intentionally operating near other airplanes such as might be found in VFR conditions at a busy airport, or on parallel approach.

ATC transponders on TCAS equipped airplanes communicate to provide appropriate coordinated avoidance maneuvers. When performance is limited, such as with an inoperative engine, select TA ONLY to prevent receiving RAs beyond the airplane's capabilities, and to prevent communicating to other airplanes an ability to perform a RA maneuver.

Resolution Advisory Aural

The following table identifies the possible callouts associated with RAs and the vertical restrictions or maneuver recommended in each case.

[Option - With TCAS change 7.0 update]

AURAL ALERTS	VERTICAL RESTRICTIONS/MANEUVER
MONITOR VERTICAL SPEED	Present pitch attitude is outside the RA pitch command area. Keep pitch attitude away from red area.
MAINTAIN VERTICAL SPEED, MAINTAIN	
MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN	
CLIMB, CLIMB	Climb at the displayed pitch
DESCEND, DESCEND	Descend at the displayed pitch
ADJUST VERTICAL SPEED, ADJUST	Reduce climb or descent rate
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	Climb at displayed pitch. Airplane climbs through traffic's altitude.
DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND	Descend at displayed pitch. Airplane descends through traffic's altitude.
INCREASE CLIMB, INCREASE CLIMB	Increase climb rate from initial pitch attitude.
INCREASE DESCENT, INCREASE DESCENT	Increase descent rate from initial pitch attitude.
CLIMB – CLIMB NOW, CLIMB – CLIMB NOW	Reversal maneuver from initial descent RA.
DESCEND – DESCEND NOW, DESCEND – DESCEND NOW	Reversal maneuver from initial climb RA.
CLEAR OF CONFLICT	RA encounter terminated. Maneuver guidance no longer displayed.

Tail Skid

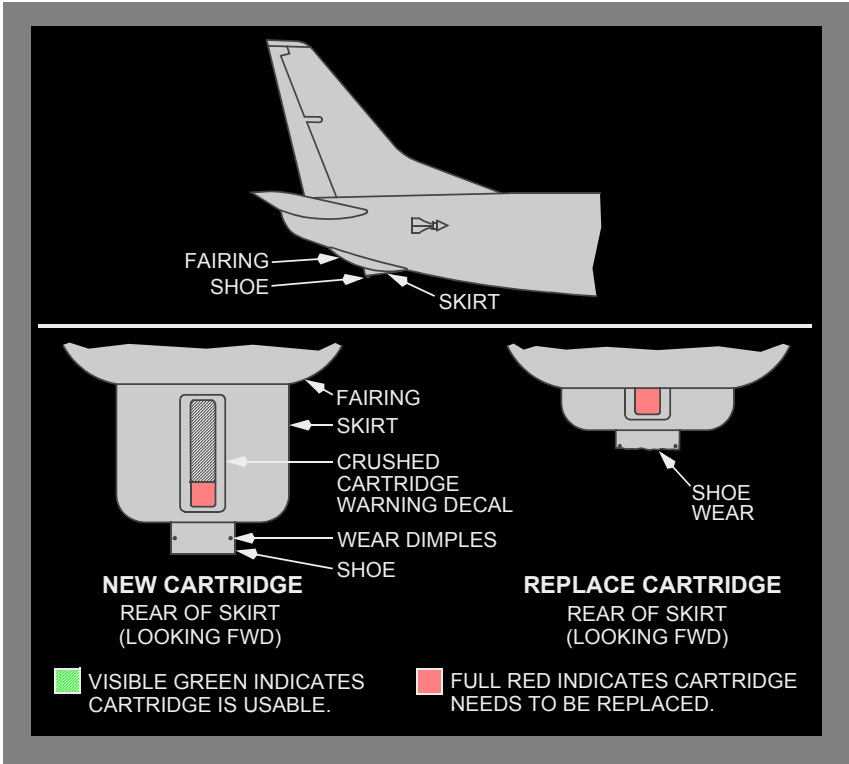
[737-800/-900]

The tail skid assembly consists of a cartridge assembly, tail skid, fairing (skirt) and shoe. The fairing provides an enclosure for the actual tail skid structure. The shoe is fitted to the bottom of the fairing.

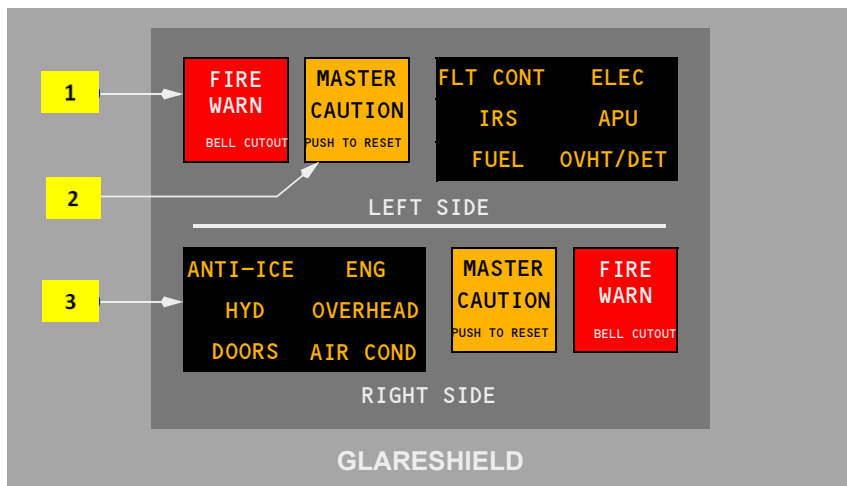
The cartridge assembly consists of a crushable honeycomb material. When the tail skid strikes the runway the skid moves upward and the honeycomb material crushes. The tail skid is serviceable when the cartridge warning decal shows both green and red. The green disappears gradually as the cartridge is crushed. When the warning decal is all red, the cartridge must be replaced.

The shoe is what contacts the runway in the event of an over rotation. The shoe surface displays “wear dimples” which serve as a reference for shoe replacement.

Tail Skid Detail



Fire Warning and Master Caution System



1 Master Fire Warning (FIRE WARN) Lights

Illuminated (red) – indicates a fire warning (or system test) in engine, cargo, APU or main gear wheel well

- fire warning bell sounds
- if on ground, remote APU fire warning horn sounds.

Push –

- extinguishes both master FIRE WARN lights
- silences fire warning bell
- silences remote APU fire warning horn
- resets system for additional warnings.

Note: Pushing fire warning bell cutout switch on overheat/fire protection panel results in same actions.

2 MASTER CAUTION Lights

Illuminated (amber) – a system annunciator light has illuminated.

Push – extinguishes both MASTER CAUTION lights

- system annunciator light(s) extinguish
- resets system for additional master caution conditions.

3 System Annunciator Panel

Illuminated (amber) – an amber light, relating to illuminated system annunciator, has illuminated on forward overhead, aft overhead or overhead/fire protection panel.

To extinguish – push either MASTER CAUTION light.

To recall – push and release either system annunciator panel

- if a master caution condition exists, appropriate system annunciator(s) and MASTER CAUTION lights illuminate
- a single fault in certain redundant systems, or some simple faults, cause the system annunciator light to illuminate during a recall. The system annunciator light will extinguish when the MASTER CAUTION light is pushed.

Proximity Switch Electronic Unit Light

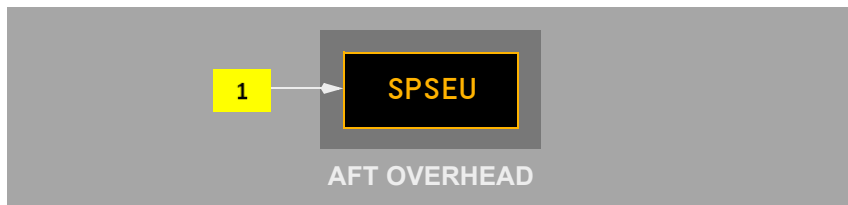


1 Proximity Switch Electronic Unit (PSEU) Light

Illuminated (amber) –

- on the ground –
 - a fault is detected in the PSEU, or
 - an overwing exit flight lock fails to disengage when commanded.
- in-flight –
 - inhibited from thrust lever advance for takeoff until 30 seconds after landing.

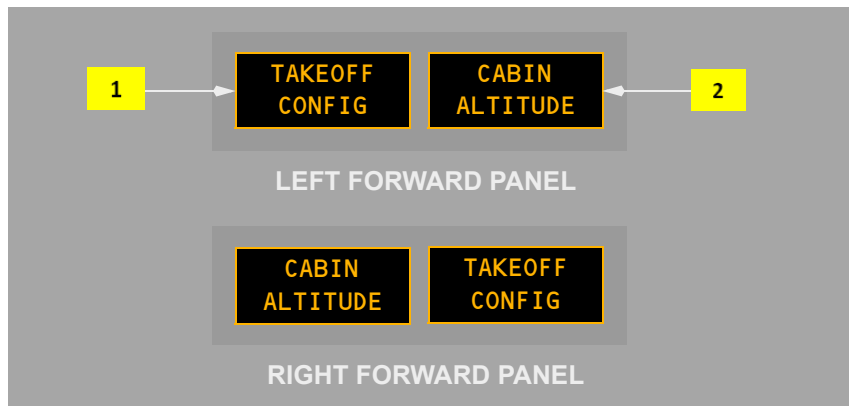
Supplemental Proximity Switch Electronic Unit Light



1 Supplemental Proximity Switch Electronic Unit (SPSEU) Light

Illuminated (amber) – a mid-exit flight lock fails to respond when commanded.

Takeoff Configuration and Cabin Altitude Warning Lights



1 Takeoff Configuration Warning Light

Illuminated (red) –

- activates on the ground as the throttles are advanced if the airplane is not configured correctly for takeoff
- activation is simultaneous with aural warning intermittent horn for TAKEOFF CONFIGURATION alert.

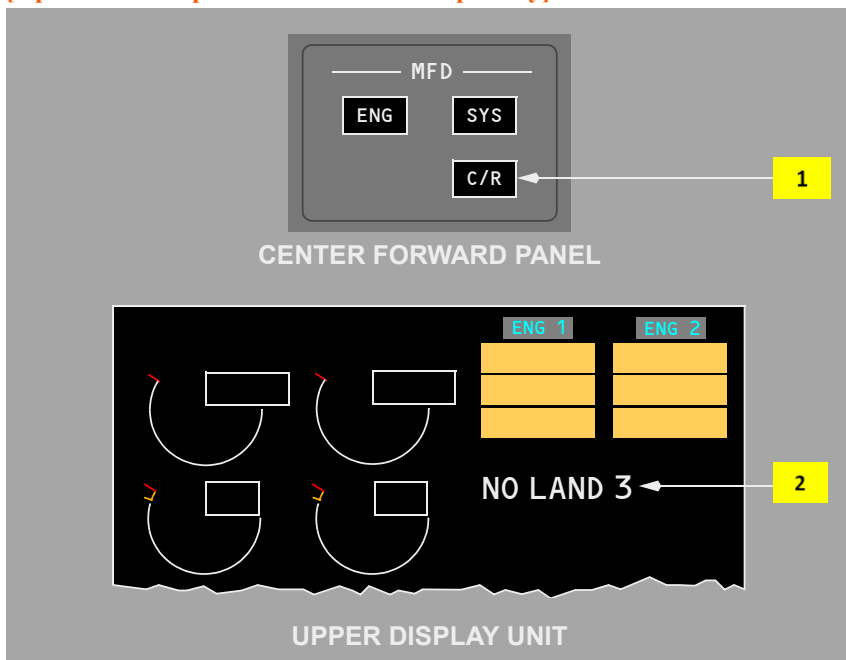
2 Cabin Altitude Warning Light

Illuminated (red) –

- illuminates at 10,000 feet if the cabin has not been pressurized
- illuminates during flight when loss of cabin pressure occurs
- activation is simultaneous with aural warning intermittent horn for CABIN ALTITUDE alert.

Autoland Advisory Message Display

[Option – Fail-Operational Autoland Capability]



1 MFD Cancel/Recall (C/R) Switch

Push (once) – Cancels autoland advisory messages.

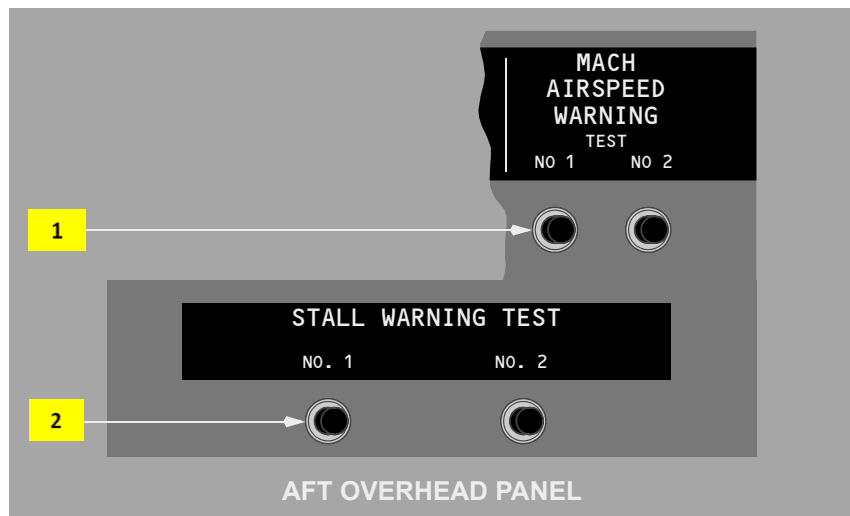
Push (again) – Recalls autoland advisory messages.

2 Autoland Advisory Message

An amber autoland advisory message appears on the upper engine display when a system fault affects autoland status. Two advisories are available:

- **NO LAND 3** – the system is still capable of continuing to a safe landing. A system failure has occurred above Alert Height, and a green LAND 2 status annunciation appears on the Capt and F/O outboard display unit.
- **NO AUTOLAND** – the system is not capable of performing an automatic landing. A system failure has occurred above Alert Height, and an amber NO AUTOLAND status annunciation appears on the Capt and F/O outboard display unit.

Mach/Airspeed Warning and Stall Warning Test Switches



1 MACH AIRSPEED WARNING TEST Switches

Push – tests respective mach/airspeed warning system

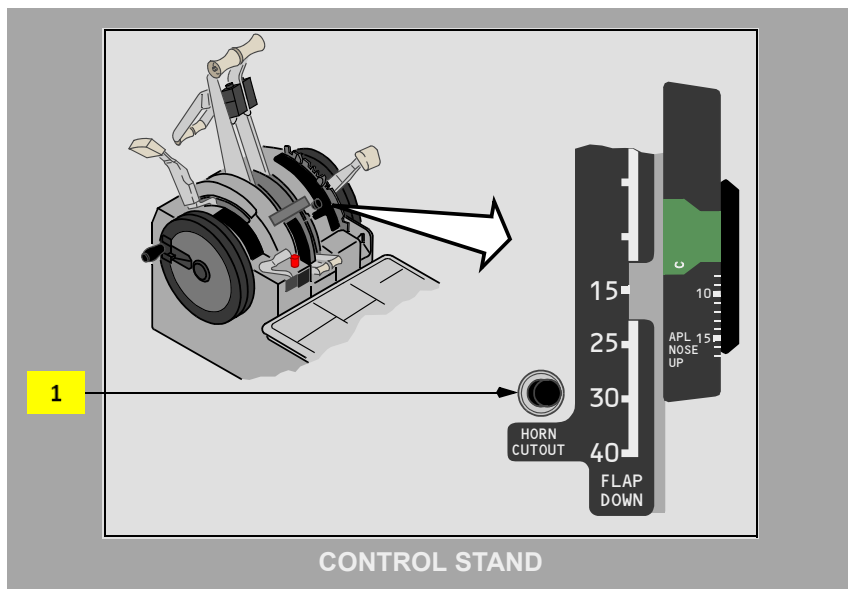
- clacker sounds
- inhibited while airborne.

2 STALL WARNING TEST Switches

Push – on ground with AC power available: each test switch tests its respective stall management yaw damper (SMYD) computer. No.1 SMYD computer shakes Captain's control column, No.2 SMYD computer shakes First Officer's control column. Vibrations can be felt on both columns

- inhibited while airborne.

Landing Gear Warning Cutout Switch



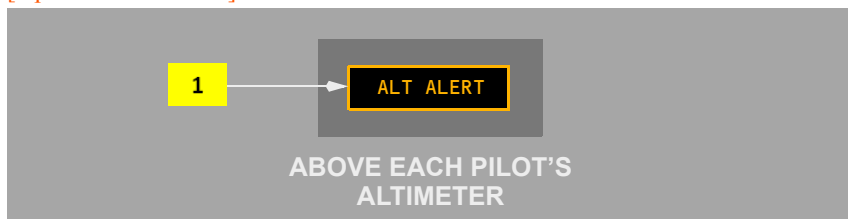
1 Landing Gear Warning Cutout Switch

Push – silences landing gear configuration warning aural indication at flaps up through 10 and above 200 feet RA.

Note: The aural indication cannot be silenced with the cutout switch at flaps greater than 10.

Altitude Alert

[Option - EFIS/MAP]



1 Altitude Alert (ALT ALERT) Annunciation

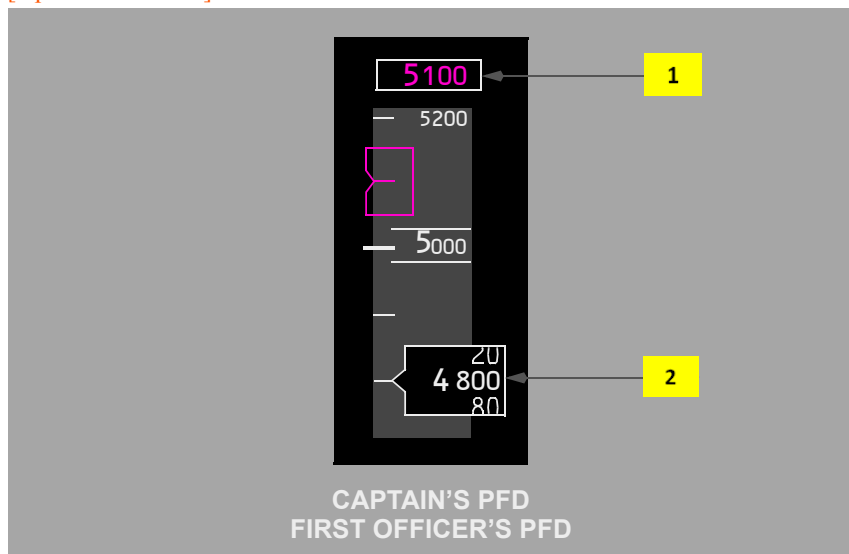
[Option - 300/900 Altitude alert]

One on each pilot's primary display above altimeter.

Displayed (amber):

- steady – acquisition alert:
 - 900 feet from MCP selected altitude
 - momentary tone also sounds
 - 300 feet from MCP selected altitude, ALT ALERT annunciation no longer shows.
- flashing – deviation alert:
 - deviation more than 300 feet from MCP selected altitude
 - momentary tone also sounds
 - flashing continues until:
 - altitude deviation less than 300 feet, or
 - altitude deviation more than 900 feet, or
 - new MCP altitude selected.

[Option - PFD/ND]



1 Selected Altitude Alert

[Option - 300/900 Altitude alert]

A white box shows around the selected altitude display between 900 feet and 300 feet before reaching the selected altitude.

2 Current Altitude Alert

[Option - 300/900 Altitude alert]

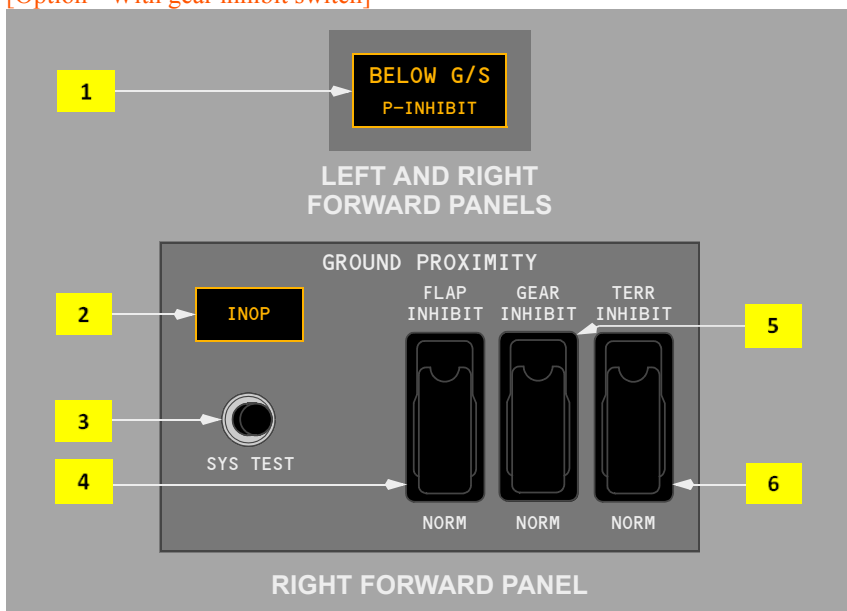
The white box around the current altitude display becomes bold between 900 feet and 300 feet before reaching the selected altitude.

The box turns amber and flashes for 300 feet to 900 feet deviation from the selected altitude.

Ground Proximity Warning System (GPWS)

GPWS Controls

[Option - With gear inhibit switch]



1 BELOW Glide Slope (G/S) light

Illuminated (amber) – below glide slope alert is active.

Push – inhibits ground proximity GLIDE SLOPE alert when below 1,000 feet radio altitude.

2 Inoperative (INOP) light

Illuminated (amber) – GPWS computer malfunction or power loss

- invalid inputs are being received from radio altimeter, ADIRU, ILS receiver, IRS, FMC, stall management computers, or EFIS control panel.

3 Ground Proximity System Test (SYS TEST) Switch

Push –

- momentarily on ground:
 - BELOW G/S and GPWS INOP lights illuminate
 - TERR FAIL and TERR TEST show on navigation displays
 - PULL UP and WINDSHEAR alerts illuminate
 - GLIDE SLOPE, PULL UP, and WINDSHEAR aural sound
 - terrain display test pattern shows on navigation displays
 - CAUTION TERRAIN aural sounds and TERRAIN caution message shows on navigation displays.
- until self-test aural begin, on ground, above indications always occur first, followed by these additional aural:
 - radio altitude based alerts
 - bank angle alert
 - approach callouts
 - windshear alert
 - look ahead terrain alerts
- system test inhibited in-flight.

4 Ground Proximity FLAP INHIBIT Switch

FLAP INHIBIT – inhibits ground proximity TOO LOW FLAPS alert.

NORM (guarded position) – Normal TOO LOW FLAPS alert active.

5 Ground Proximity GEAR INHIBIT Switch

[Option - With gear inhibit switch]

GEAR INHIBIT – inhibits ground proximity TOO LOW GEAR alert.

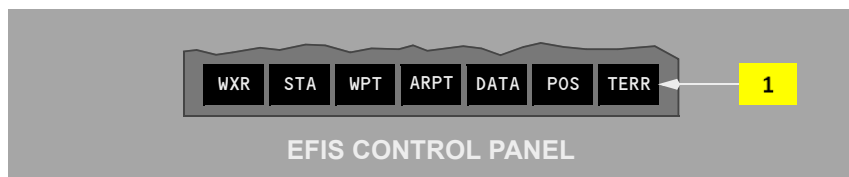
NORM (guarded position) – Normal TOO LOW GEAR alert active.

6 Ground Proximity Terrain Inhibit (TERR INHIBIT) Switch

TERR INHIBIT – inhibits look-ahead terrain alerts and terrain display.

NORM (guarded position) – Normal terrain alerts and terrain display active.

GPWS Terrain Display Select Switch



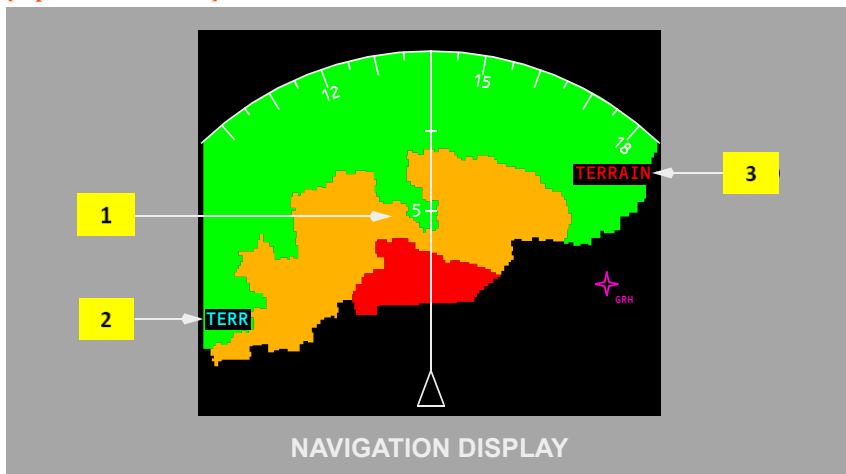
1 Terrain (TERR) Display Select Switch

Push –

- shows terrain data in expanded MAP, center MAP, expanded VOR, and expanded APP modes
- arms terrain data in PLN, center VOR, and center APP modes
- deselected weather radar display regardless of mode selector position
- second push deselected terrain display.

Terrain Display

[Option - PFD/ND]



1 Terrain Display

Color and density vary based on terrain height vs. airplane altitude:

- dotted green: terrain from 2,000 feet below to 500 feet (250 feet with gear down) below the airplane's current altitude
- dotted amber: terrain 500 feet (250 feet with gear down) below to 2,000 feet above the airplane's current altitude
- dotted red: terrain more than 2,000 feet above airplane's current altitude
- dotted magenta: no terrain data available
- solid amber: look-ahead terrain caution active
- solid red: look-ahead terrain warning active.

Note: In areas without terrain data, look-ahead terrain alerting and display functions not available. Radio altitude based terrain alerts function normally.

Note: Terrain more than 2,000 feet below airplane altitude or within 400 feet of nearest airport runway elevation does not show.

Automatically shows when:

- a look-ahead terrain alert occurs, and
- neither pilot has the terrain display selected, and
- in expanded MAP, center MAP, expanded VOR, or expanded APP modes.

Updates with a display sweep, similar to weather radar display.

2 Terrain Mode Annunciation

TERR (cyan) – Terrain display enabled (manual or automatic display).

3 TERRAIN Annunciation

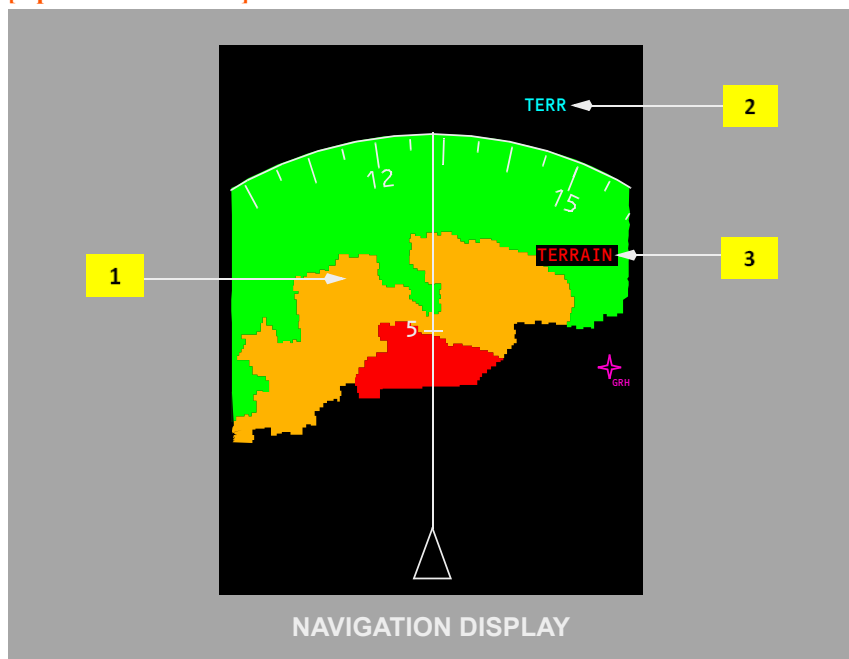
TERRAIN (amber) – look-ahead terrain caution alert active.

TERRAIN (red) – look-ahead terrain warning alert active.

Shows in all navigation display modes.

Terrain Display

[Option - EFIS/MAP]



1 Terrain Display

Color and density vary based on terrain height vs. airplane altitude:

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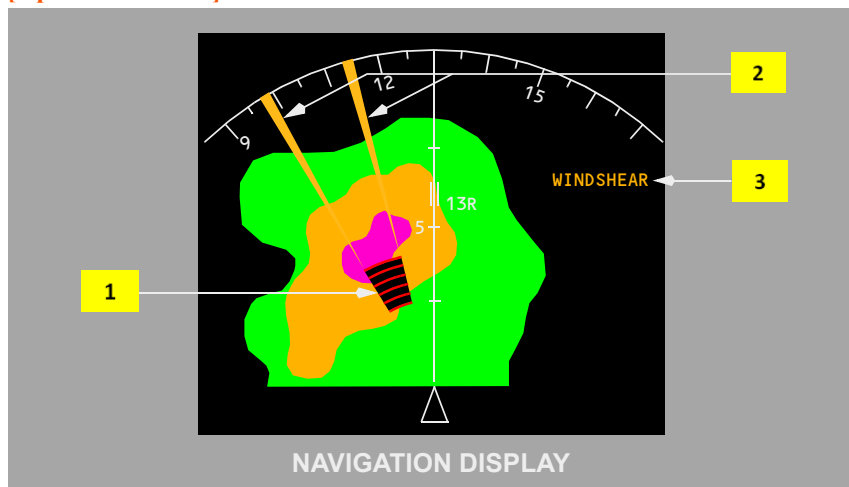
TERRAIN (amber) – look-ahead terrain caution alert active.

TERRAIN (red) – look-ahead terrain warning alert active.

Shows in all navigation display modes.

Predictive Windshear Display and Annunciations

[Option - PFD/ND]



1 Predictive Windshear Symbol

Displayed (red and black) – Predictive windshear alert active.

Shows windshear location and approximate geometric size (width and depth).

Symbol, radials, and weather radar returns automatically show when:

- predictive windshear alert occurs, and
- neither pilot has WXR display selected, and
- in expanded MAP, center MAP, VOR, or APP modes.

When terrain display is active, weather radar display replaces terrain display.

2 Predictive Windshear Symbol Radials

Displayed (amber) – Predictive windshear alert active.

Extend from predictive windshear symbol to help identify location of windshear event

3 WINDSHEAR Annunciation

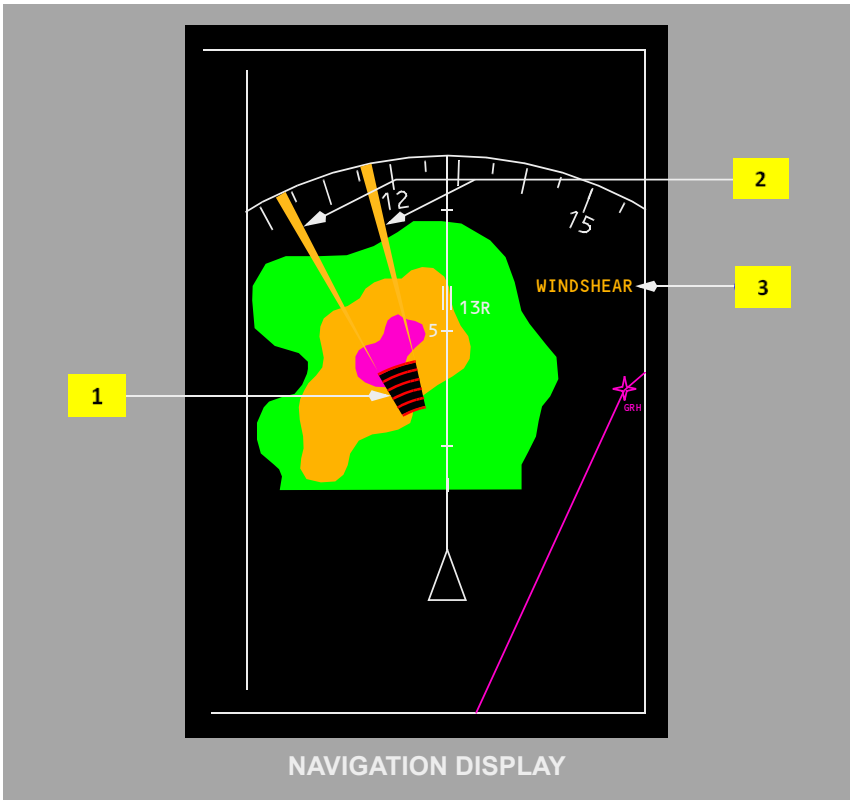
WINDSHEAR (amber) – predictive windshear caution active.

WINDSHEAR (red) – predictive windshear warning active.

Shows in all navigation display modes.

Predictive Windshear Display and Annunciations

[Option - EFIS/MAP]



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2 Predictive Windshear Symbol Radials

Displayed (amber) – Predictive windshear alert active.

Extend from predictive windshear symbol to help identify location of windshear event.

3 WINDSHEAR Annunciation

WINDSHEAR (amber) – predictive windshear caution active.

WINDSHEAR (red) – predictive windshear warning active.

Shows in all navigation display modes.

TCAS Controls (Transponder Panel)

[Option - AlliedSignal 071-01503-2601 Transponder Panel]



[Option - Gables G6992-02 Transponder Panel]



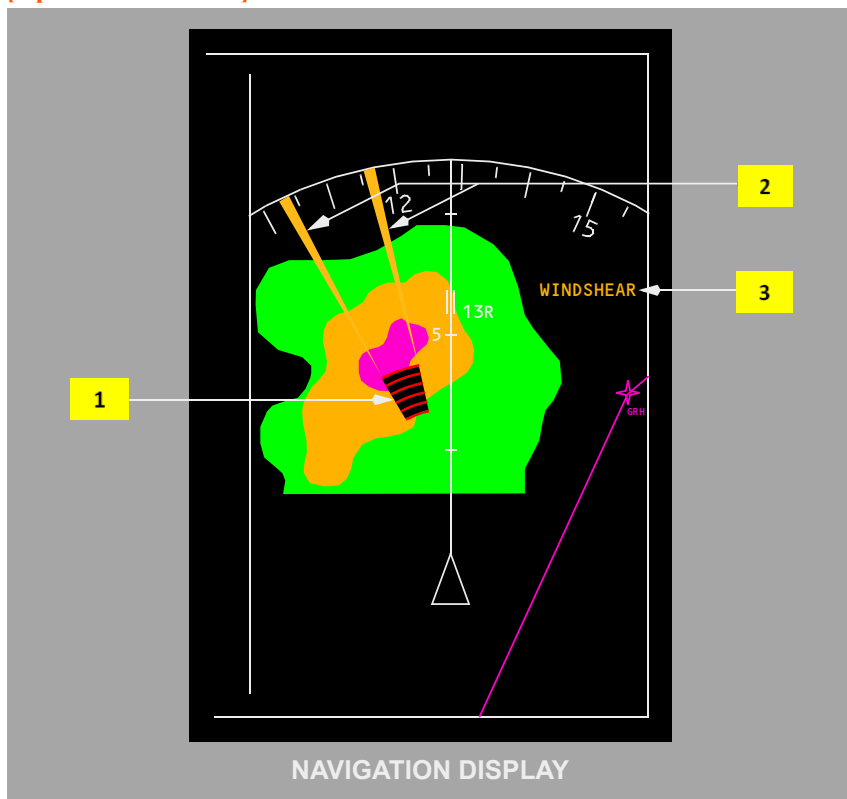
1 Transponder Mode Selector

TA (traffic advisory) – enables the display of traffic advisory (TA) targets.

TA/RA (resolution advisory) – enables the display of traffic advisory (TA) and resolution advisory (RA) targets.

Predictive Windshear Display and Annunciations

[Option - EFIS/MAP]



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