Honeywell

MK VI and MK VIII

Enhanced Ground Proximity Warning System (EGPWS) Pilot's Guide

060-4314-000 • Rev. C - May 2004
MK VI & MK VIII EGPWS Pilot Guide

Table of Contents

Section 1

Introduction

This Pilot Guide describes the functions and operation of the MK VI and MK VIII Enhanced Ground Proximity Warning System (EGPWS).

This document is divided into four sections. Section 1 is this introduction and the following brief description of the EGPWS and its features. Section 2 provides a functional description of the EGPWS. This includes descriptions of the various system modes, Built In Test (BIT) and monitoring functions, and system features. Section 3 provides general operating procedures to follow when the system gives a caution or warning alert. Section 4 provides definitions of terms used in this manual.

This guide does not supercede FAA approved data, Flight Manuals, individual Operations Manuals, requirements, or procedures. Pilots should be thoroughly familiar with their own company policies, system configuration, requirements, and procedures with respect to the operation of aircraft with the EGPWS.

The information in this document is intended as a general explanation of the Honeywell MK VI & MK VIII EGPWS. It contains a general description of system performance assuming identified options are active, and highlights deviations in system performance resulting when a feature is disabled.

What is the EGPWS?

The EGPWS is a Terrain Awareness and Warning System (TAWS) providing basic GPWS functions plus additional enhanced terrain alerting and display features.

The EGPWS uses aircraft inputs including geographic position, attitude, altitude, airspeed, and glideslope deviation. These are used with respect to internal terrain, obstacle, and airport databases to predict a potential conflict between the aircraft flight path and terrain or an obstacle. A conflict will result in the EGPWS providing a visual and audio caution or warning alert.

Additionally, the EGPWS provides alerts for excessive glideslope deviation, too low with flaps or gear not in landing configuration, and optionally provides bank angle and altitude callouts based on system configuration selection.

WHAT IS THE EGPWS?
CONTINUED

The EGPWS incorporates several "enhanced" features:

- **Terrain Alerting and Display (TAD)** function provides a graphic display of the surrounding terrain on the Weather Radar Indicator, EFIS, or a dedicated display. Based on the aircraft's GPS position and the internal database, the terrain topography (within the display range selected) that is above or within 2000 feet below the aircraft altitude is presented on the system display. This feature is an option, enabled by system configuration selection during installation.
- **"Peaks"** function is a TAD supplemental feature providing additional terrain display features for enhanced situational awareness, independent of the altitude of the aircraft. This includes digital elevations for the highest and lowest displayed terrain, additional elevation (color) bands, and a unique representation of sea level (0 feet MSL). This feature is an option, enabled by system configuration selection during installation for compatible display systems.
- **"Obstacles"** alerting function is a feature utilizing an obstacle database for obstacle conflict alerting and display. EGPWS visual and audio alerts are provided when a conflict is detected. Additionally, when TAD is enabled, Obstacles are graphically displayed similar to terrain. This feature is an option, enabled by system configuration selection during installation.
- A process feature called **Envelope Modulation** utilizes the internal database to tailor EGPWS alerts at certain geographic locations to reduce nuisance alerts and provide added protection.
  Note: This feature is not available in the initial release (-001) for the MK VI and MK VIII.
- A **Terrain Clearance Floor (TCF)** function adds an additional element of protection by alerting the pilot of possible premature descent. This is intended for non-precision approach and is based on the current aircraft position relative to the nearest runway in the database. This feature is enabled with the TAD function.

- Similar to the TCF feature, a **Runway Field Clearance Floor (RFCF)** feature provides alerting to the pilot of possible premature descent based on the aircraft's GPS position and height above the destination runway using Geometric Altitude. This provides improved protection at locations where the destination runway is significantly higher than the surrounding terrain.
- **Geometric Altitude**, based on GPS altitude, is a computed pseudo-barometric altitude designed to reduce or eliminate altitude errors resulting from temperature extremes, non-standard pressure altitude conditions, flight in QFE environment, and altimeter miss-sets. This ensures an optimal EGPWS alerting and display capability.

Some features are optional and may not be active in a given installation. For specific effectivity, refer to an applicable Airplane Flight Manual (AFM) or EGPWS Airplane Flight Manual Supplement (AFMS).

Physical Description

The MK VI/MK VIII EGPWS is packaged in a non-ARINC rack mounted enclosure weighing less than 4 lbs. No special vibration isolation or forced air-cooling is required.

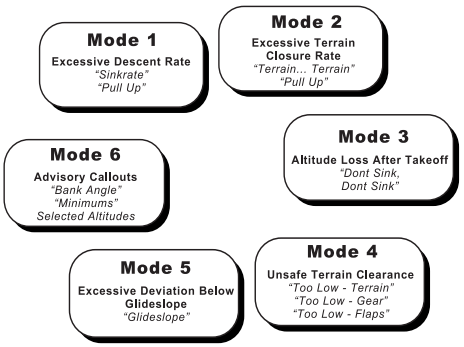
Only 28 VDC versions of the EGPWS are available. Units are available with an internal GPS receiver for required GPS data when another GPS source is not available.

For more detailed information, contact Honeywell.

Section 2

Enhanced Ground Proximity Warning System

The EGPWS incorporates the functions of the basic Ground Proximity Warning System (GPWS). This includes the following alerting modes:



The EGPWS adds to these 6 basic functions the ability to compare the aircraft position to an internal database and provide additional alerting and display capabilities for enhanced situational awareness and safety (hence the term "Enhanced" GPWS).

EGPWS Database

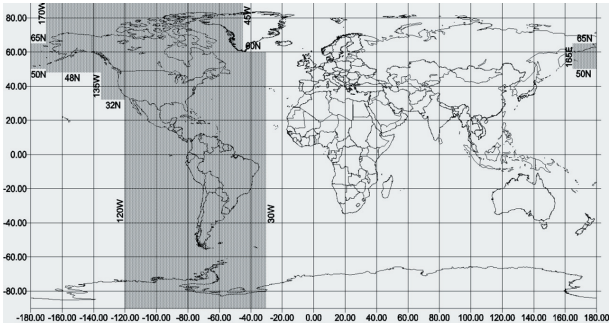
The EGPWS internal database consists of four subsets:

- Terrain data of varying degrees of resolution.
- Cataloged obstacles 100 feet or greater in height located within North America, portions of Europe and portions of Asia (expanding as data is obtained).
- Airport runway data containing information on all runways 2000 feet or longer in length. This value is configurable as 3500 feet in the MK VIII in software load -008 or later. For a specific list of the airports included, refer to Honeywell document 060-4326-000, or 060-4267-000.
  This can also be accessed on the Internet at www.egpws.com.
- An Envelope Modulation database to support the Envelope Modulation feature described later. (This feature not available in -001 release).

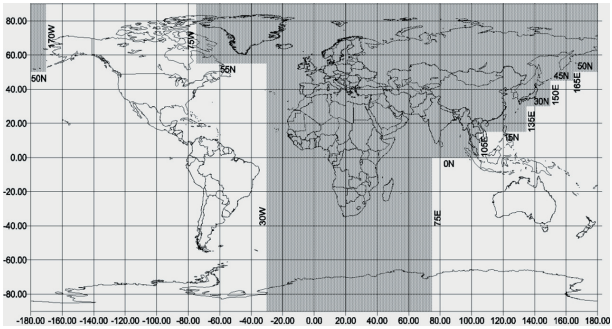
The MK VI EGPWS provides regional database coverage whereas the MK VIII EGPWS provides a worldwide database . For the MK VI, the database is divided into three regions referred to as the Americas Region, Atlantic Region, and the Pacific Region.

EGPWS DATABASE CONTINUED

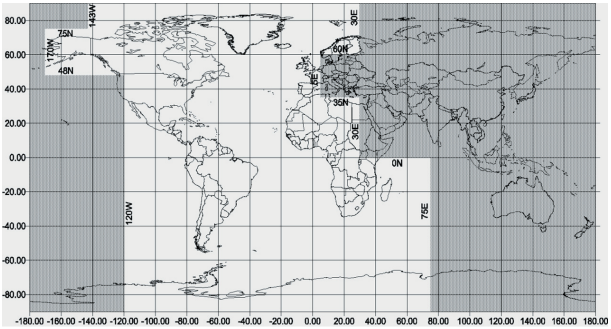
These regions are illustrated below.



Americas Region (4XXN)



Atlantic Region (4XXA)



Pacific Region (4XXP)

EGPWS DATABASE CONTINUED

There is considerable overlap between the regions, particularly Atlantic to Pacific, but once outside the installed database coverage area all enhanced functions dependent on the database are inoperative.

Honeywell is constantly striving to improve the EGPWS database in content, resolution, and accuracy. Notification of a Database update is accomplished by Service bulletin. Database updates are distributed on PCMCIA data cards and loaded via an external PCMCIA interface unit called a Smart Cable that connects to a test connector on the front panel of each EGPWS. Contact Honeywell for additional information.

Because the overwhelming majority of "Controlled Flight Into Terrain" (CFIT) accidents occur near an airport, and the fact that aircraft operate in close proximity to terrain near an airport, the terrain database contains higher resolution grids for airport areas.

With the use of accurate GPS information, the EGPWS is provided present position, altitude, track and ground speed. With this information, the EGPWS is able to present a graphical plan view of the aircraft relative to the terrain and advise the flight crew of a potential conflict with the terrain or obstacle. Conflicts are recognized and alerts provided when terrain or an obstacle violates specific computed envelope boundaries in the projected flight path of the aircraft. Caution or warning alerts are provided in the form of visual light annunciation, audio enunciation based on the type of conflict, and color enhanced visual display of the terrain or obstacle relative to the forward look of the aircraft. The terrain display is provided on a Weather Radar Indicator, EFIS display, or a dedicated EGPWS display and may or may not be displayed automatically.

The following sections provide functional descriptions of the EGPWS basic and enhanced functions and features, and system input and output requirements.

BASIC FUNCTIONS:

MODE 1

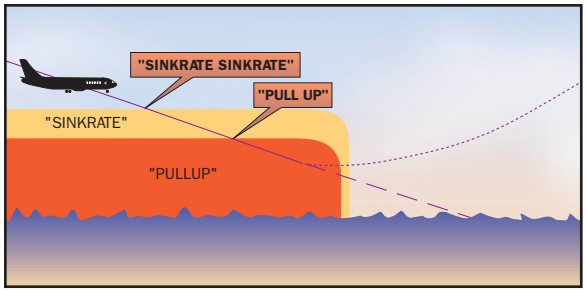
EXCESSIVE DESCENT RATE

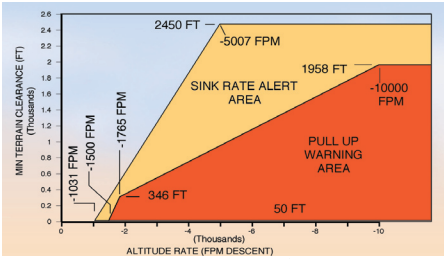
Mode 1 provides alerts for excessive descent rates with respect to altitude AGL and is active for all phases of flight. This mode has inner and outer alert boundaries as illustrated in the diagram and graphs on the next page.

Mode 1

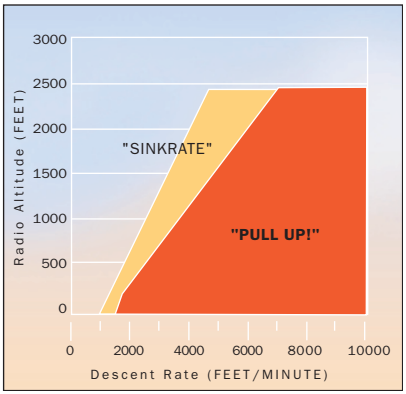
Excessive Descent Rate

continued





Excessive Descent Rate turboprop



Excessive Descent Rate turbofan (jet)

Penetration of the outer boundary activates the EGPWS caution lights and "**SINKRATE, SINKRATE**" alert enunciation. Additional "**SINKRATE, SINKRATE** " messages will occur for each 20% additional penetration of the outer boundary.

Penetration of the inner boundary activates the EGPWS warning lights and changes the audio message to "**PULL UP**" which repeats continuously until the inner warning boundary is exited.

Glideslope Deviation Bias

If a valid ILS Glideslope front course is received and the aircraft is above the glideslope centerline, the outer (sinkrate) boundary is adjusted to desensitize the sinkrate alerting. This is to prevent unwanted alerts when the aircraft is safely capturing the glideslope (or repositioning to the centerline) from above the beam.

Steep Approach Bias

The EGPWS offers a Steep Approach option that desensitizes the alert boundaries to permit steeper than normal approaches (e.g., MLS or GPS) without unwanted alerts.

Flap Override Bias

When flap override is selected, the alert boundaries are desensitized to permit higher descent rates as the result of flaps in a non-landing configuration. This bias is smaller than the steep approach bias.

Mode 2

Excessive Closure to Terrain

Mode 2 provides alerts to help protect the aircraft from impacting the ground when rapidly rising terrain with respect to the aircraft is detected. Mode 2 is based on Radio Altitude and on how rapidly Radio Altitude is decreasing (closure rate). Mode 2 exists in two forms, 2A and 2B.

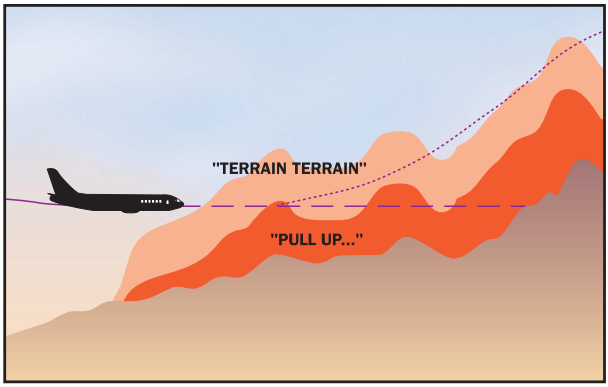
Mode 2A

Mode 2A is active during climbout, cruise, and initial approach (flaps not in the landing configuration and the aircraft not on glideslope centerline). If the aircraft penetrates the Mode 2A caution envelope, the aural message "**TERRAIN, TERRAIN**" is generated and cockpit EGPWS caution lights will illuminate. If the aircraft continues to penetrate the envelope, the EGPWS warning lights will illuminate and the aural warning message "**PULL UP**" is repeated continuously until the warning envelope is exited. Upon exiting the warning envelope, if terrain clearance continues to decrease, the aural message "**TERRAIN**" will be given until the terrain clearance stops decreasing. In addition, the visual alert will remain on until the aircraft has gained 300 feet of altitude, 45 seconds has elapsed, or landing flaps or the flap override switch is activated.

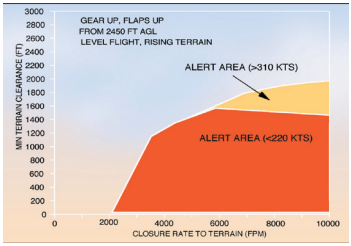
The following graph shows how the upper boundary of the Mode 2 alert envelope varies as a function of the aircraft speed. Two aircraft speed ranges are defined; 220 knots to 310 knots for faster aircraft, and 190 to 280 knots for slower aircraft (selected for the aircraft configuration at installation). The boundary expansion provides increased alert times at the higher airspeeds.

Mode 2A

Continued



The Mode 2A upper limit is reduced to 1250 feet (950 feet with version -022 and later) for all airspeeds when the Terrain Alerting and Display function is enabled and available. This is due to the enhanced alerting capability provided with TAD, resulting from high integrity GPS Altitude and Geometric Altitude data. The Mode 2A envelope is lowered in order to reduce the potential for nuisance alerts during an approach.



Mode 2B

Mode 2B provides a desensitized alerting envelope to permit normal landing approach maneuvers close to terrain without unwanted alerts. Mode 2B is automatically selected with flaps in the landing configuration (landing flaps or flap Override selected) or when making an ILS approach with Glideslope and Localizer deviation less than 2 dots. It is also active during the first 60 seconds after takeoff.

Mode 2B is selected when the aircraft is within 5nm (10nm with version -022 and later) and 3500 feet of the destination airport (independent of configuration) and the Terrain Alerting and Display (TAD) function is enabled and available. This is due to the enhanced alerting capability provided with TAD, resulting from high

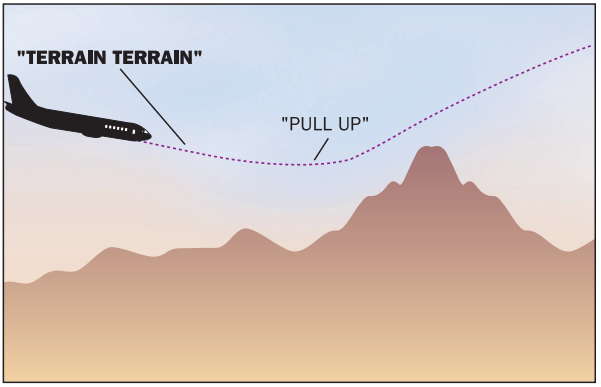
Mode 2B

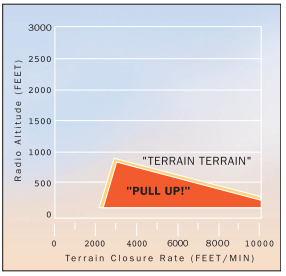
Continued

integrity GPS Altitude and Geometric Altitude data. The Mode 2B envelope is selected in order to reduce the potential for nuisance alerts during an approach.

During an approach, if the aircraft penetrates the Mode 2B envelope with either the gear or flaps not in the landing configuration, the aural message "**TERRAIN, TERRAIN**" is generated and the EGPWS caution lights illuminate. If the aircraft continues to penetrate the envelope, the EGPWS warning lights illuminate and the aural message "**PULL UP**" is repeated continuously until the warning envelope is exited. If the aircraft penetrates the Mode 2B envelope with both gear and flaps in the landing configuration, the aural "**PULL UP**" messages are suppressed and the aural message "**TERRAIN**" is repeated until the envelope is exited.

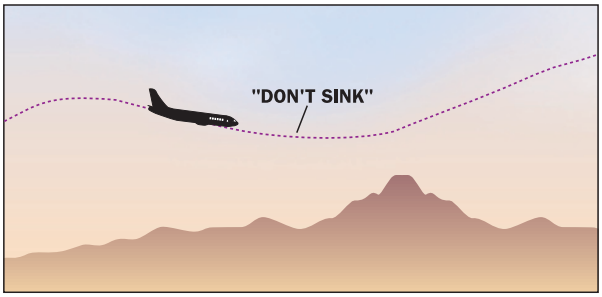
The graph below shows the Mode 2B envelope.





Mode 3

Altitude Loss After Takeoff

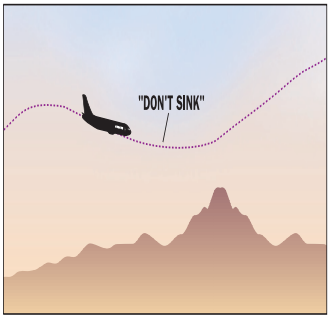


Mode 3 provides alerts for significant altitude loss after takeoff or low altitude go-around (less than 245* feet AGL) with gear or flaps not in the landing configuration. The amount of altitude loss that is permitted before an alert is given is a function of the height of the aircraft above the terrain as shown below. This protection is available until the EGPWS determines that the aircraft has gained sufficient altitude that it is no longer in the takeoff phase of flight. Significant altitude loss after takeoff or during a low altitude go-around activates the EGPWS caution lights and the aural message "**DON'T SINK, DON'T SINK**".

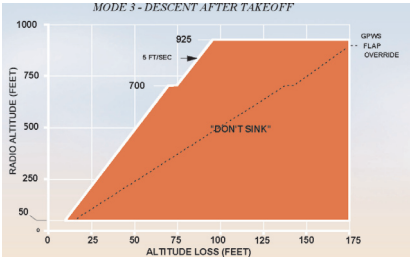
*245 feet if bizjet

170 feet if 170' Mode 4B is selected

150 feet if 150' Mode 4B is selected



Altitude loss after takeoff turbofan (jet)



Altitude loss after takeoff turboprop

Mode 3

Continued

The aural message is only enunciated twice unless altitude loss continues. Upon establishing a positive rate of climb, the EGPWS caution lights extinguish and the aural alert will cease.

Selecting flap override on turboprop aircraft increases the allowable altitude loss, enabling optional pattern work without unwanted warnings.

Mode 4

Unsafe Terrain Clearance

Mode 4 provides alerts for insufficient terrain clearance with respect to phase of flight, configuration, and speed. Mode 4 exists in three forms, 4A, 4B, and 4C.

- Mode 4A is active during cruise and approach with the gear not in the landing configuration.
- Mode 4B is active during cruise and approach with the gear in the landing configuration and flaps not in the landing configuration.
- Mode 4C is active during the takeoff phase of flight with either the gear or flaps not in the landing configuration.

Mode 4 alerts activate EGPWS caution lights and aural messages.

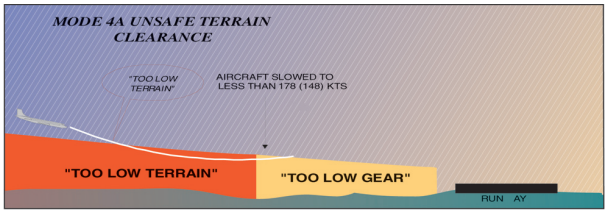
For turbofan (bizjet) aircraft, to reduce nuisance alerts caused by overflying another aircraft, the upper limit of the airspeed expansion portion of the Mode 4A/B alerting curve can be reduced (from 1000) to 800 feet. This occurs if the installation identifies an airplane type providing the 1000 foot upper limit and the airplane is above 250 knots with gear and flaps not in landing configuration and a sudden change in Radio Altitude is detected. This is intended to eliminate nuisance alerts while flying a holding pattern and an aircraft overflight occurs (with 1000 foot separation).

Mode 4 airspeed expansion is disabled (upper limit held at lowest airspeed limit) when the Terrain Alerting and Display (TAD) function is enabled and available. This is due to the enhanced alerting capability provided with TAD, resulting from high integrity GPS and Geometric Altitude data. This change to the Mode 4 envelopes further reduces the potential for nuisance alerts when the aircraft is not in the landing configuration.

Several Mode 4 alert envelope variations are defined as an option in the installation configuration. In the following Mode 4 discussions, the most common limits are provided with the alternates identified in parenthesis. For a specific application, refer to the installation documentation to obtain the defined configuration.

Mode 4A

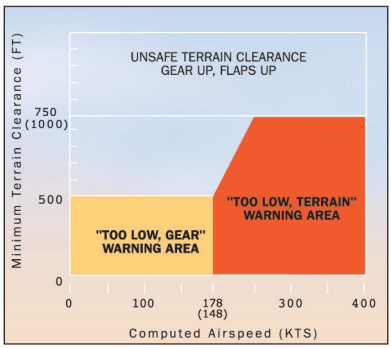
Mode 4A is active during cruise and approach with gear up. This provides alerting during cruise for inadvertent flight into terrain where terrain is not rising significantly, or the aircraft is not descending excessively. It also provides alerting for protection against an unintentional gear-up landing.



The standard boundary for Mode 4A is at 500 feet AGL. Penetration of this altitude below an airspeed of 178 knots will produce an aural alert of "**TOO LOW GEAR**". The airspeed limit is 148 knots if the alternate airspeed configuration has been selected, and it is 190 knots for turbofan (bizjet) aircraft.

Above 178 knots, the boundary increases linearly with airspeed to a maximum of 750 feet AGL at 200 knots to produce a "**TOO LOW TERRAIN**" aural alert. If the alternate airspeed configuration has been selected, the slope begins at 148 knots and ends at 170 knots and 1000 feet AGL. For turbofan (bizjet) aircraft, the slope begins at 190 knots and ends at 250 knots and 1000 feet AGL. (See following graphs)

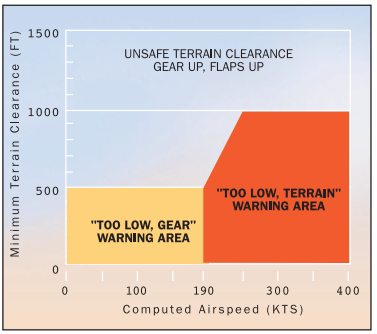
For any Mode 4A alert, subsequent aural messages occur only if penetration of the envelope increases by 20%. EGPWS alert lights extinguish and aural messages cease when the Mode 4A alert envelope is exited.



Unsafe terrain clearance gear up turboprop

Mode 4A

Continued

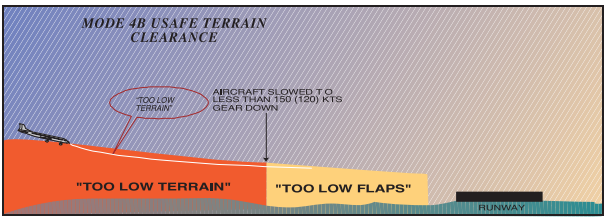


Unsafe terrain clearance gear up turbofan (Jets)

During Marginal performance go around (gear down then brought up without a landing) or extended gear up approach (gear up and either Flap Override on or flaps down) the MK VI/ VIII EGPWS is designed to delay Mode 4A "TOO LOW GEAR" alerts until the Mode 4B curve is penetrated.

Mode 4B

Mode 4B is active during cruise and approach with gear down and flaps not in the landing configuration.

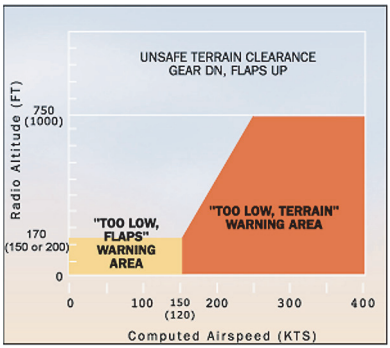


The standard boundary for Mode 4B is at 170 feet AGL. Penetration of this altitude below an airspeed of 150 knots will produce an aural alert of "**TOO LOW FLAPS**". If the alternate airspeed configuration has been selected, the boundary is 200 feet AGL and the airspeed limit is 148 knots. For turbofan (bizjet) aircraft, the boundary is 245 feet AGL and its airspeed limit is 159 knots.

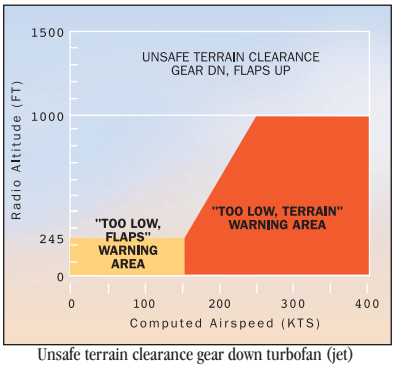
Above 150 knots, the boundary increases linearly with airspeed to a maximum of 750 feet AGL at 200 knots to produce a "**TOO LOW TERRAIN**" aural alert. If the alternate airspeed configuration has been selected, the slope begins at 148 knots and ends at 200 knots and 1000 feet AGL. For turbofan (bizjet) aircraft, the slope begins at 159 knots and ends at 250 knots and 1000 feet AGL. (See following graphs)

Mode 4B

Continued



Unsafe terrain clearance gear down turbprop



Unsafe terrain clearance gear down turbofan (jet)

If the aircraft radio altitude decreases to the value of the Minimum Terrain Clearance (MTC), the EGPWS caution light illuminates and the aural message "**TOO LOW TERRAIN**" is enunciated.

If desired, the pilot may disable the "**TOO LOW FLAPS**" alert by engaging the Flap Override switch (if installed). This precludes or silences the Mode 4B flap alert until reset by the pilot.

For any Mode 4B alert, subsequent aural messages occur only if penetration of the envelope increases by 20%. EGPWS alert lights extinguish and aural messages cease when the Mode 4B alert envelope is exited.

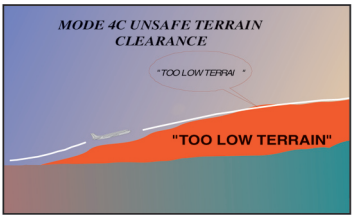
Mode 4C

The Mode 4C alert is intended to prevent inadvertent controlled flight into the ground during takeoff climb into terrain that produces insufficient closure rate for a Mode 2 alert. After takeoff, Mode 4A and 4B provide this protection.

Mode 4C

Continued

Mode 4C is based on an EGPWS computed MTC floor, that increases with Radio Altitude. It is active after takeoff when the gear or flaps are not in the landing configuration. It is also active during a low altitude go-around if the aircraft has descended below 245* feet AGL.

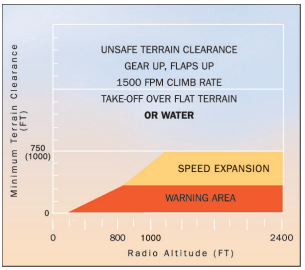


*245 feet if bizjet

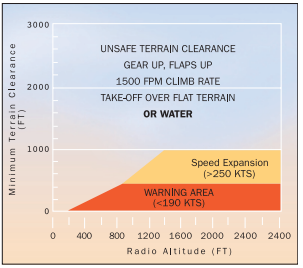
170 feet if 170' Mode 4B is selected

150 feet if 150' Mode 4B is selected

At takeoff, the MTC is zero feet. As the aircraft ascends, the MTC is increased to 75% of the aircraft's Radio Altitude (averaged over the previous 15 seconds). This value is not allowed to decrease and is limited to the same values as the Mode 4A curve. If the aircraft radio altitude decreases to the value of the MTC, the EGPWS caution light illuminates and the aural message "**TOO LOW TERRAIN**" is enunciated. The EGPWS caution lights extinguish and aural messages cease when the Mode 4C alert envelope is exited.



Unsafe terrain clearance takeoff turboprop

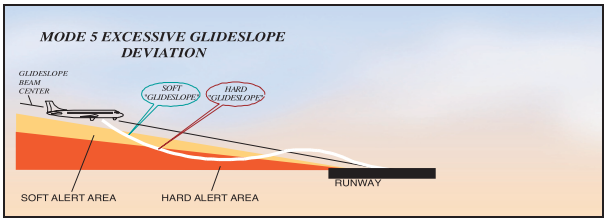


Unsafe terrain clearance takeoff turbofan (Jet)

Mode 5

Excessive Deviation BelowGlides-lope

Mode 5 provides two levels of alerting for when the aircraft descends below glideslope, resulting in activation of EGPWS alert lights and aural messages.



The first level alert occurs when below 1000 feet Radio Altitude and the aircraft is 1.3 dots or greater below the beam. This turns on alert lights and is called a "soft" alert because the audio message "**GLIDESLOPE**" is enunciated at half volume. Twenty percent increases in the glideslope deviation cause additional **"GLIDESLOPE"** messages to be enunciated.

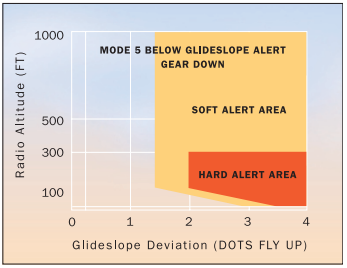
The second level alert occurs when below 300 feet Radio Altitude with 2 dots or greater glideslope deviation. This is called a "hard" alert because a louder **"GLIDESLOPE, GLIDESLOPE"** message is enunciated every 4 seconds continuing until the "hard" envelope is exited. The alert lights remain on until a glideslope deviation less than 1.3 dots is achieved.

To avoid unwanted Below Glideslope alerts when capturing the localizer between 500 and 1000 feet AGL, alerting is varied in the following ways:

- Below Glideslope alerts are enabled only if;
  - Localizer is within ± 2 dots, if available
  - Landing gear and flaps are selected,
  - Glideslope Cancel is not active,
  - A front course approach is determined
- The upper altitude limit for the alert is modulated with vertical speed. For descent rates above 500 FPM, the upper limit is set to the normal 1000 feet AGL. For descent rates lower than 500 FPM, the upper limit is desensitized (reduced) to a minimum of 500 feet AGL.

Mode 5

Continued



Excessive Deviation Below Glidescope

Additionally, both alert levels are desensitized below 150 feet AGL, to allow for normal beam variations nearer the ground, and reduce the possibility of nuisance alerts. Mode 5 alerts can be canceled by pressing the Glideslope Cancel switch (if installed, usually part of the “Below Glideslope” or amber "GPWS" annunciator) any time below 2000 feet AGL. This is automatically reset when the aircraft descends below 30 feet or climbs above 2000 feet AGL. The MK VI (only) can do this, by changing the ILS frequency. **Note:** Glideslope Cancel can not be deselected (reset) by again pressing the Glideslope Cancel switch.

EGPWS Mode 5 alerts may be inhibited during backcourse approaches to prevent nuisance alerts due to false fly up lobes from the Glideslope. The EGPWS determines a backcourse approach if a glideslope inhibit discrete is set.

Mode 6

Advisory Callouts

Mode 6 provides EGPWS advisory callouts based on the menu selected option established at installation. These callouts consist of predefined Radio Altitude based altitude and excessive bank angle voice callouts. There is no visual alerting provided with these callouts.

Decision Height (DH) based callout (“Minimums - Minimums”) require the landing gear to be down, and occur when descending through the altitude corresponding to the selected DH. These also have priority over other altitude callouts when overlapping. For example, if DH is set to 200 and both “TWO HUNDRED” and “MINIMUMS - MINIMUMS” are valid callouts, then only the “MINIMUMS - MINIMUMS” will be issued at 200 feet AGL.

Mode 6

Continued

Altitude Callouts

Following is a list of each of the possible altitude callouts:

CALLOUT	Occurs at (feet AGL)
"MINIMUMS-MINIMUMS"	DH[a]
“ONE THOUSAND”	1000
"FIVE HUNDRED"	500
"TWO HUNDRED"	200
“ONE HUNDRED”	100
“FIFTY”	50
“FORTY”	40
“THIRTY”	30
“TWENTY”	20
“TEN”	10

[a] May be MDA or DH for some aircraft types.

Each selected callout is only enunciated once per approach.

Refer to an appropriate Airplane Flight Manual or EGPWS Airplane Flight Manual Supplement for callout identification in a specific application or contact Honeywell for additional information.

To meet the AC’s for installation of EGPWS onto any aircraft there must be a form of callout for 500 ft. This can be acheived via one of three options in the EGPWS, as a “Hard 500”, “Smart 500”, or “500 Above Field” callout. These are included as options in the Callout Menu items. There are also menus without 500 foot callouts, these are included for aircraft that already have the means to announce 500 ft. The “Hard 500” foot callout will annunciate “FIVE HUNDRED” once during each approach.

Smart 500 Foot Callout

The “Smart 500” foot callout, when selected, will assist pilots during a non-precision approach by enunciating “FIVE HUNDRED” feet in addition to any other altitude callout discussed above. The EGPWS determines a non-precision approach when Glideslope is greater than 2 dots deviation (valid or not) or a back-course approach is detected.

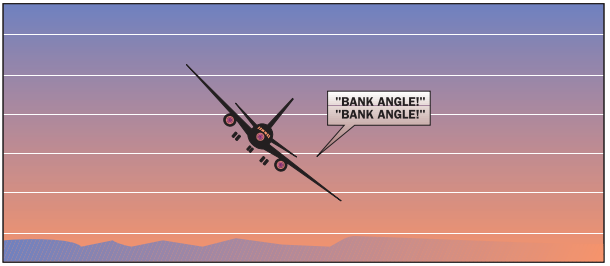
500 Above Field

The “500 Above Field “ callout will be annunciated once during each approach when the aircraft flies below 500 ft above the landing field. It compares the GPS-based geometric altitude with the closest runway. The callout may be optionally chosen to annunciate “FIVE HUNDRED” or “FIVE HUNDRED ABOVE”.

MODE 6

CONTINUED

BANK ANGLE CALLOUT



When enabled by the installation configuration, the callout "**BANK ANGLE, BANK ANGLE**" advises of an excessive roll angle. The EGPWS provides excessive bank angle limits based on the aircraft altitude above the ground (Radio Altitude) and if the AutoPilot is engaged.

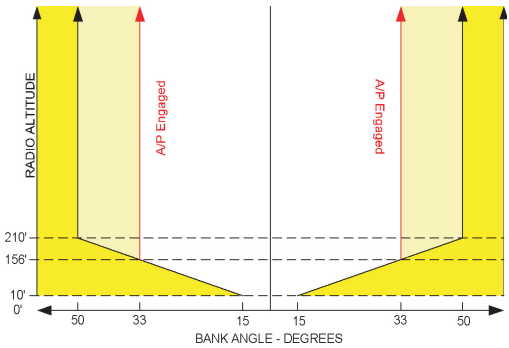
Below are the bank angle advisories for turboprop airplanes.

Without the AutoPilot engaged, roll angles exceeding (shaded):

- ±15 to ±50 degrees between 10 and 210 feet AGL,
- ±50 degrees above 210 feet AGL,

With the AutoPilot engaged, bank angles exceeding:

- ±15 to ±33 degrees between 10 and 156 feet AGL,
- ±33 degrees above 156 feet AGL,



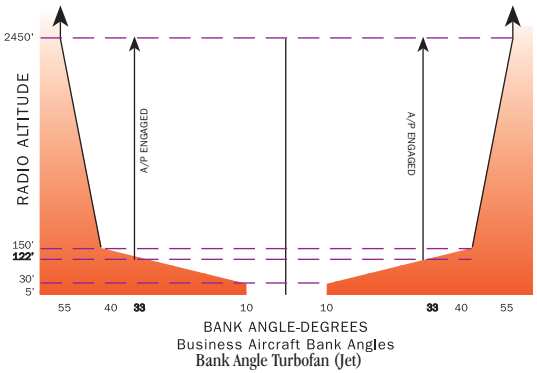
Bank Angle turbprop

Bank angle advisories are inhibited below 10 feet.

Located on the following page are the bank angle advisories for turbofan airplanes.

MODE 6

CONTINUED



- ±10 degrees between 5 and 30 feet AGL,
- ±10 to ±40 degrees between 30 and 150 feet AGL,
- ±40 to ±55 degrees between 150 and 2450 feet AGL,

With the AutoPilot engaged, bank angles exceeding:

- ±10 degrees between 5 and 30 feet AGL,
- ±10 to ±33 degrees between 30 and 122 feet AGL,
- ±33 degrees above 122 feet AGL,

Once the initial roll limit is exceeded, the **"BANK ANGLE, BANK ANGLE"** callout is given once. Another callout is not given until either:

1) a 20% increase in roll is detected, or
2) the aircraft rolls below the initial roll limit (resetting the process) and initial roll limit is exceeded again.

If the 20% increase in roll is exceeded (causing the second bank angle alert), another callout is not given until either:

1) another 20% increase in roll is detected, or
2) the aircraft rolls below the initial roll limit and another (resetting the process) and the initial roll is exceeded again.

Above the second 20% increase in roll, the callout is continuous until roll is reduced below this second 20% limit.

If roll rate exceeds the audio callout time, then the bypassed limit is not indicated (e.g., if a 20% increase is exceeded before the initial roll limit callout can be completed). Another consideration is the banking affect on Radio Altitude data during lower altitude turning operations. Higher bank angles will increase the

MODE 6

CONTINUED

effective Radio Altitude height (and rate of change) resulting in some biasing of the actual callout altitude and bank angle limit.

When the Autopilot is engaged, the 20% increases and process reset principles are applied to the reduced limit in the same manner.

ENHANCED FUNCTIONS:

ENVELOPE MODULATION

NOTE: Envelope Modulation is not available and active in the initial version of the MK VI and MK VIII EGPWS (-001 part numbered units). This feature is incorporated in later versions (-003 and later part numbered units) and is provided in this guide for informational purposes only for initial version applicability.

Due to terrain features at or near certain specific airports around the world, normal operations have resulted in nuisance or missed alerts at these locations in the past. With the introduction of accurate position information and a terrain and airport database, it is possible to identify these areas and adjust the normal alerting process to compensate for the condition.

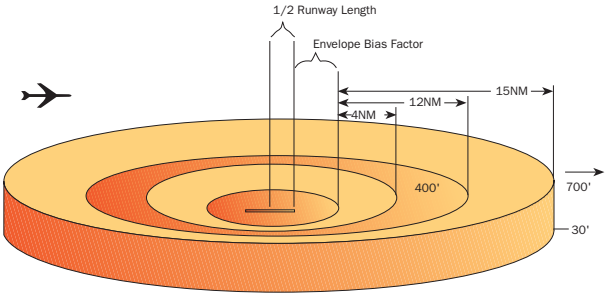
The EGPWS Envelope Modulation feature provides improved alert protection and expanded alerting margins at identified locations throughout the world. This feature is automatic and requires no flight crew action.

Modes 4, 5, and 6 are expanded at certain locations to provide alerting protection consistent with normal approaches. Modes 1, 2, and 4 are desensitized at other locations to prevent nuisance alerts that result from unusual terrain or approach procedures. In all cases, very specific information is used to correlate the aircraft position and phase of flight prior to modulating the envelopes.

TERRAIN CLEARANCE FLOOR

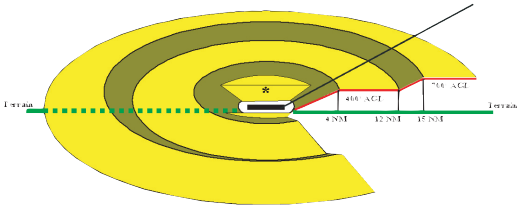
The Terrain Clearance Floor (TCF) function (enabled with TAD) enhances the basic GPWS Modes by alerting the pilot of descent below a defined "Terrain Clearance Floor" regardless of the aircraft configuration. The TCF alert is a function of the aircraft's Radio Altitude and distance (calculated from latitude/longitude position) relative to the center of the nearest or destination runway included in the database. The TCF envelope is defined for all runways as illustrated below and extends to infinity, or until it meets the envelope of another runway.

Terrain Clearance Floor
Continued

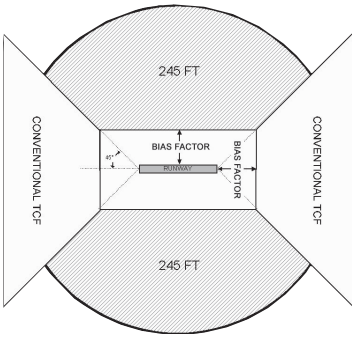


TCF Alert Envelope

The alert envelope is limited to a minimum of 245 feet AGL adjacent to the runway as illustrated in the following diagrams. The Envelope Bias Factor is reduced (moved closer to the runway) when higher accuracy aircraft position and runway position information is available. This is typically 1/3 to 1 nm, varying as a function of position accuracy, providing protection against landing short events. With version -022 and later models, the envelope bias factor is reduced to 1/4 nm if runway and position data is of high integrity.



Improved TCF Envelope



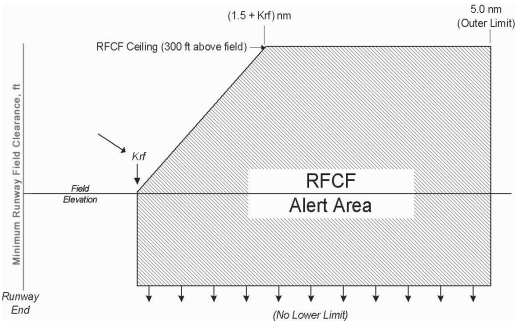
Improved TCF Envelope Plan View

Terrain Clearance Floor Continued

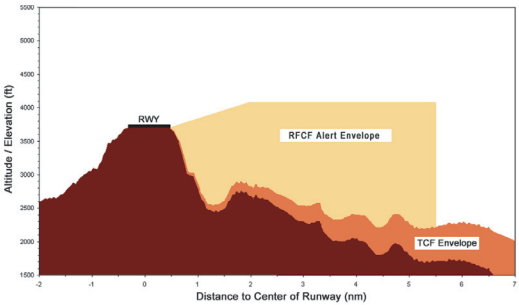
Runway selection logic incorporates comprehensive aircraft position and navigation information to evaluate proximity runways and determine the most likely destination runway for all alerting purposes.

Runway Field Clearance Floor

A **Runway Field Clearance Floor** feature is similar to the TCF feature except that RFCF is based on the current aircraft position and height above the destination runway, using Geometric Altitude (in lieu of Radio Altitude). This provides improved protection at locations where the runway is significantly higher than the surrounding terrain as illustrated below. With version -022 and later models, the inner limit of the RFCF envelope is moved from 1 nm to 1/2 nm of runway end, if runway and position data is of high integrity.



RFCF Alert Envelope

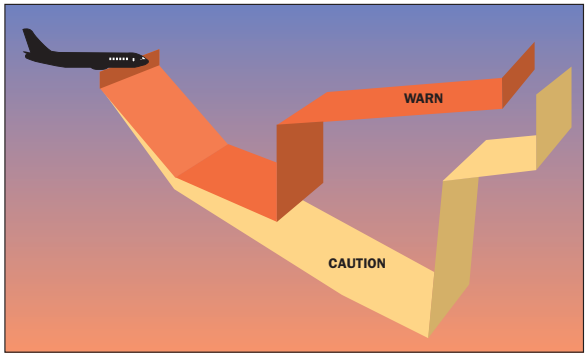


TCF and RFCF alerts result in illumination of the EGPWS alert lights and the aural message **"TOO LOW TERRAIN"**. The audio message is provided once when initial envelope penetration occurs and again only for additional 20% decreases in Radio or Geometric Altitude. The EGPWS alert lights remain on until the TCF/RFCF envelope is exited.

Terrain Alerting and Display

Another enhancement provided by the internal terrain database, is the ability to look ahead of the aircraft and detect terrain or obstacle conflicts with greater alerting time. This is accomplished (when enabled) based on aircraft position, flight path angle, track, and speed relative to the terrain database image forward the aircraft.

Through sophisticated look ahead algorithms, both caution and warning alerts are generated if terrain or an obstacle conflict with "ribbons" projected forward of the aircraft (see following illustration). These ribbons project down, forward, then up from the aircraft with a width starting at 1/4 nm and extending out at 3 degrees laterally, more if turning. The lookdown and up angles are a function of the aircraft flight path angle, and the lookdown distance a function of the aircraft's altitude with respect to the nearest or destination runway. This relationship prevents undesired alerts when taking off or landing. The look-ahead distance is a function of the aircraft's speed, and distance to the nearest runway.



A terrain conflict intruding into the caution ribbon activates EGPWS caution lights and the aural message **"CAUTION TERRAIN, CAUTION TERRAIN"** or **"TERRAIN AHEAD, TERRAIN AHEAD"**. An obstacle conflict provides a **"CAUTION OBSTACLE, CAUTION OBSTACLE"** or **"OBSTACLE AHEAD, OBSTACLE AHEAD"** message. The caution alert is given typically 40-60 seconds ahead of the terrain/obstacle conflict and is repeated every seven seconds as long as the conflict remains within the caution area.

Terrain Alerting and Display continued

When the warning ribbon is intruded (typically 30 seconds prior to the terrain/obstacle conflict), EGPWS warning lights activate and the aural message **"TERRAIN, TERRAIN, PULL UP"** or **"TERRAIN AHEAD, PULL UP"** or **"OBSTACLE, OBSTACLE, PULL UP"** or **"OBSTACLE AHEAD, PULL UP"** is enunciated with **"PULL UP"** repeating continuously while the conflict is within the warning area.

The look-ahead alerting algorithms are enhanced at higher airspeeds (about 300 Knots or greater). In this case, the look-ahead distance is designed to provide a 60-second warning alert for up to 8 nm look-ahead. With version -022 and later, the look-ahead distance is increased for descents at high speeds to improve alerting times.

The specific voice message provided is determined during the initial installation of the EGPWS as a function of enabling the terrain and obstacles features and the selected audio menu.

Refer to an applicable AFM or EGPWS AFMS for specific application information or contact Honeywell for additional information.

When a compatible Weather Radar, EFIS, or other display is available, the EGPWS Terrain Alerting and Display (TAD) feature can provide an image of the surrounding terrain represented in various colors and intensities. TAD, Peaks, and Obstacle functions are enabled by EGPWS options defined in the installation configuration.

Two types of TAD displays are available depending on the display system and options selected. Non-peaks display provides a terrain image only when the aircraft is 2000 feet or less above the terrain. The second type called "Peaks" enhances the display characteristics to provide a higher degree of terrain awareness independent of the aircraft altitude. In either case, terrain and obstacles (if enabled) forward of the aircraft and within the range selected are displayed. Obstacles are presented on the cockpit display as terrain, employing the same display-coloring scheme.

On some terrain displays, an indication of MSL altitude will appear. This altitude is the reference altitude for the display and the terrain awareness algorithm. This reference altitude is based on internally calculated Geometric Altitude (see page 38) and NOT corrected barometric altitude. It represents the aircraft's calculated true height above sea level (MSL) and serves as the reference altitude for color coding of the terrain display

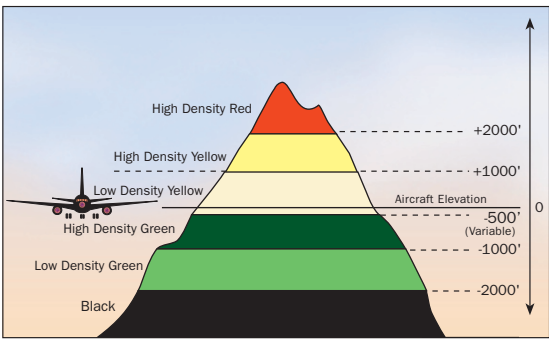
Non-Peaks display

(see page 37) and the altitude input to the look-ahead algorithm. Because it is primarily comprised of GPS altitude, this reference altitude will often differ from cockpit displayed corrected barometric altitude. This altitude is not to be used for navigation. It is presented to provide the crew with additional situational awareness of true height above sea level, upon which terrain alerting and display is based.

TERRAIN IS SHOWN IN SHADES OF GREEN, YELLOW AND RED

NOTE: With respect to Non-Peaks or Peaks display, terrain and or obstacle presentation is always based on (and scaled for) the geographic area (display range) available for display. Consequently, terrain and/or obstacles outside of the selected display range and defined display sweep are not included on the displayed image.

The Non-Peaks display provides a graphical plan-view image of the surrounding terrain as varying density patterns of green, yellow, and red as illustrated in the following graphics. The selected display range is also indicated on the display, and an indication that TAD is active is either indicated on the display (i.e., "TERR") or by an adjacent indicator.



Non-Peaks Display continued

Each specific color and intensity represents terrain (and obstacles) below, at, or above the aircraft's altitude based on the aircraft's position with respect to the terrain in the database. If no terrain data is available in the terrain database, then this area is displayed in a low-density magenta color. Terrain more than 2000 feet below the aircraft, or within 400 (vertical) feet of the nearest runway elevation, is not displayed (black). With version -022 or later, the transition to black may occur below 400 feet based on runway and terrain database integrity for a given area.

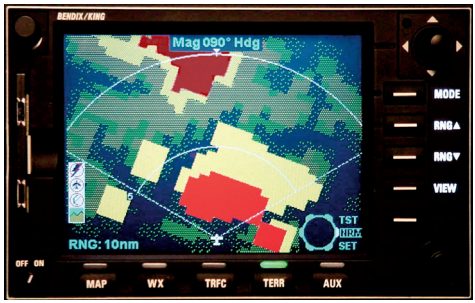
> **NOTE:** All terrain databases after 419 contain 100% of earth's terrain data, hence no magenta will be displayed except in Self-Test or on the edge of the regional database.

When a caution alert is triggered, the terrain (or obstacle) that created the alert is changed to solid yellow as illustrated below.

60 Seconds from projected impact "Caution Terrain!"

When a warning alert is triggered, the terrain (or obstacle) that created the alert is changed to solid red as illustrated below.

30 Seconds from projected impact "Terrain, Terrain, –Pull Up!"



Non-Peaks Display continued

NOTE: When a TAD caution or warning alert is active, the display image (cells) surrounding the target are enlarged (surrounding cells are illuminated). This allows a smaller terrain or obstacle (e.g., a single tower) to be better seen on the display.

The transition between green and yellow is below the aircraft in order to account for altimetry and/or terrain/obstacle height errors.

In addition, the transition altitudes between colors are biased upward proportional to the descent rate when greater than 1000 feet per minute. This provides approximately a 30-second advance display of terrain.

Essentially, pilots should note that any yellow or red painted terrain is at or above the aircraft's altitude and appropriate terrain clearance needs to be provided.

Based on the display system used, there may be additional terrain display features. These are defined as installation options and allow for:

Pop-Up and Auto-Range

Automatic display of terrain on the cockpit display (TAD "Pop-Up"). This feature occurs when a caution or warning alert is triggered as described in Terrain Alerting and Display. In some cases, an active display mode must be selected first.

"Auto-range" when Pop-up occurs. This provides for the automatic range presentation for terrain as defined for the display system configuration (typically 10 nm). In this case, if the terrain auto-range is different than the display system selected range, the displayed range value on the cockpit display is flashed or changed color until the range is manually re-selected or terrain display is deselected.

Peaks Display

Peaks Display has all the characteristics of the Non-Peaks Display but with additional terrain display features for enhanced situational awareness independent of the aircraft altitude. The principle additions are:

The digital display of the highest and lowest terrain/obstacle elevations currently displayed,

The display of additional solid or lower density color bands, including the addition of the graphic representation of sea level (0 feet MSL) for compatible displays.

PEAKS DISPLAY CONTINUED

With Terrain Display selected on, digital values representing the highest terrain/obstacle elevation and the elevation for the bottom of the lowest color band are displayed, based on the range selected (terrain in view).

> **Note:** Differences may exist between the highest terrain/obstacle being displayed and the digital elevation value/color of the "Peaks" number at or near the top and sides of the display.

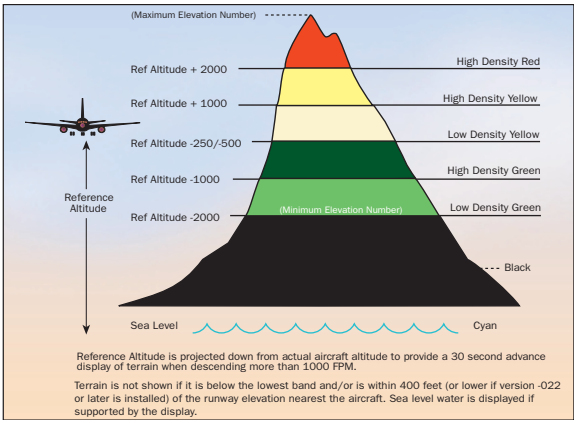
The location of the digital values can vary somewhat, as defined for the display used, but for this guide these will be shown in the lower right corner of the display. These elevations are expressed in hundreds of feet above sea level (e.g., 125 is 12,500 feet MSL) with the highest elevation on top and the lowest on the bottom. However, in the event that there is no appreciable difference in the terrain/obstacle elevations (flat terrain), only the highest value is displayed. Additionally, the color of the elevation value is presented the same as the color of the terrain display containing that elevation. In other words, if the highest displayed terrain/obstacle is red and the lowest is green, then the top numeric is red and the bottom numeric is green.

When the aircraft is 500 feet (250 with gear down) or less above the terrain in view (yellow and/or red is displayed), the Peaks color scheme is identical to the Non-Peaks display, with the exception of the addition of sea level when supported by the display.

> **Note:** some displays do not support cyan (blue) and will not display sea level in this case.

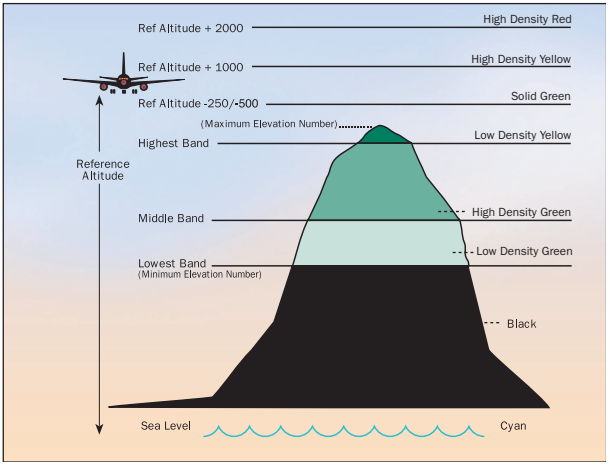
PEAKS DISPLAY CONTINUED

The following illustrates the Peaks display at a low relative altitude.



PEAKS DISPLAY CONTINUED

The following illustrates the Peaks display at a high relative altitude.



PEAKS DISPLAY CONTINUED

When the aircraft is greater than 500 feet (250 with gear down) above the terrain in view (no yellow or red displayed), additional (green) color bands are presented. These added bands are computed and displayed as a function of the highest and lowest elevations in view.

The following table indicates the TAD colors and elevations (non-Peaks and Peaks).

Color	Indication
Solid Red	Terrain/Obstacle Threat Area – Warning.
Solid Yellow	Terrain/Obstacle Threat Area – Caution.
High Density Red Fill	Terrain/Obstacle that is more than 2000 feet above aircraft altitude.
High Density Yellow Fill	Terrain/Obstacle that is between 1000 and 2000 feet above aircraft altitude.
Low Density Yellow Fill	Terrain/Obstacle that is 500 feet below to 1000 feet above aircraft altitude.
Solid Green (Peaks only)	Shown only when no Red or Yellow Terrain /Obstacle areas are within range on the display. Highest Terrain/Obstacle not within 500 feet of aircraft altitude.
High Density Green Fill	Terrain/Obstacle that is 500 feet below to 1000 below air craft altitude.
(Peaks only)	Terrain/Obstacle that is the middle elevation band when there is no Red or Yellow terrain areas within range on the display.
Low Density Green Fill	Terrain/Obstacle that is 1000 to 2000 feet below aircraft altitude.
(Peaks only)	Terrain/Obstacle that is the lower elevation band when there is no Red or Yellow terrain areas within range on the display.
Black	No significant Terrain/Obstacle.
Low Density Cyan Fill (Peaks only)	Water at sea level elevation (0 feet MSL).
Magenta Fill*	Unknown terrain. No terrain data in the database for the magenta area shown.

NOTE: Magenta may be displayed at or near the south and North poles dependent upon the airplane's flight path and location. Magenta is displayed outside of the MK VI Regional Terrain databases.

TCF/TAD INOP AND INHIBIT

The EGPWS TCF and TAD functions are available when all required data is present and acceptable. Aircraft position and numerous other parameters are monitored and verified for adequacy in order to perform these functions. If determined invalid or unavailable, the system will display Terrain inoperative or unavailable annunciations and discontinue the terrain display if active.

TAD/TCF functions may be inhibited by manual selection of a cockpit Terrain Inhibit switch. Neither loss nor inhibiting TAD/TCF affects the basic GPWS functions (modes 1–6).

If Peaks Display is not enabled and TAD becomes unavailable due to position error; terrain inoperative or unavailable is not indicated when the aircraft is greater than 8000 feet above the highest terrain or obstacle within the loaded terrain database (area in use). If indicated below the 8000 foot threshold, it is extinguished when the aircraft climbs above, and is again displayed once the aircraft descends below the 8000 foot threshold. This eliminates potentially long-term illumination of terrain inoperative or not available during the high enroute phase of flight.

GEOMETRIC ALTITUDE

Based on GPS Altitude, Geometric Altitude is a computed pseudo-barometric altitude Above Sea Level (ASL) designed to reduce or eliminate errors potentially induced in Corrected Barometric Altitude by temperature extremes, nonstandard pressure altitude conditions, and altimeter miss-sets. This ensures an optimal EGPWS Terrain display and alerting capability. Geometric Altitude also allows continuous EGPWS operations in QFE environments without custom inputs or special operational procedures.

Geometric Altitude requires a MSL based GPS Altitude input with its associated Vertical Figure Of Merit (VFOM) and Receiver Autonomous Integrity Monitoring (RAIM) failure indication, standard (uncorrected) altitude, Radio Altitude, Ground Speed, Roll Angle, and aircraft position (Latitude and Longitude). Additionally, corrected Barometric Altitude, Static Air Temperature (SAT), GPS mode, and the number of satellites tracked are used if available.

Geometric Altitude continued

The Geometric Altitude is computed by blending a calculated Non-Standard Altitude, Runway Calibrated Altitude (determined during takeoff), GPS Calibrated Altitude, Radio Altitude Calibrated Altitude (determined during approach), and Barometric Altitude (if available). Estimates of the VFOM for each of these are determined and applied in order to determine its weight in the final altitude. The blending algorithm gives the most weight to altitudes with a higher estimated accuracy, reducing the effect of less accurate altitudes. Each component altitude is also checked for reasonableness using a window monitor computed from GPS Altitude and its VFOM. Altitudes that are invalid, not available, or fall outside the reasonableness window are not included in the final Geometric Altitude value.

The Geometric Altitude algorithm is designed to allow continued operation when one or more of the altitude components are not available. If all component altitudes are invalid or unreasonable, the GPS Altitude is used directly.

The Geometric Altitude function is fully automatic and requires no pilot action.

Aural Message Priority

Two or more alerts may be activated simultaneously, so a message priority is established. The following table reflects the priority for these message callouts. Messages at the top of the list will start before or immediately override a lower priority message even if it is already in progress.

MESSAGE	MODE
"Pull Up"	1, 2
"Terrain, Terrain"	2
"Terrain, Terrain Pull Up" [a, d]	TA
"Obstacle, Obstacle Pull Up" [a, e]	TA
"Terrain"	2
"Minimums, Minimums" [a, f]	6
"Caution Terrain, Caution Terrain" [a, b]	TA
"Caution Obstacle, Caution Obstacle" [a, c]	TA
"Too Low Terrain"	4, TCF
Altitude Callouts [a]	6
"Too Low Gear"	4A
"Too Low Flaps"	4B
"Sink rate, Sink rate"	1
"Don't Sink, Don't Sink"	3
"Glideslope"	5
"Bank Angle, Bank Angle" [a]	6

Notes:

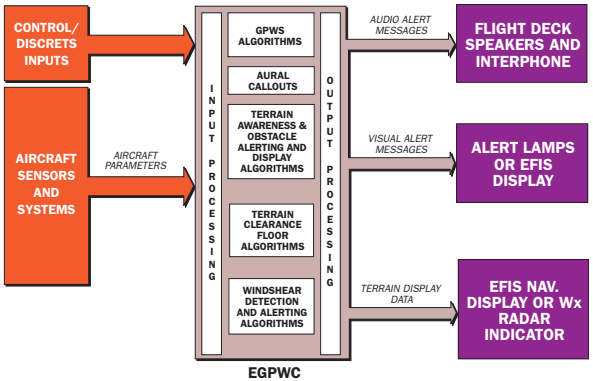
a) Message is dependent on aircraft type or option selected.
b) May also be "Terrain Ahead, Terrain Ahead".
c) May also be "Obstacle Ahead, Obstacle Ahead".
d) May also be "Terrain Ahead" preface to Pull Up.
e) May also be "Obstacle Ahead" preface to Pull Up.
f) May also be "Minimums".

TA = Terrain Look-Ahead Alerting

TCF = Terrain Clearance Floor

System Inputs

The EGPWS uses various input signals from other on-board systems. The full complement of these other systems is dependent on the EGPWS configuration and options selected. Systems providing Altitude, Airspeed, Attitude, Glideslope, and position are required for basic and enhanced functions. Inputs are also required for discrete signal and control input.



The EGPWS utilizes signals from the following systems:

Air Data

Uncorrected and corrected Barometric Altitude, Altitude rate, Computed Airspeed, and Static Air Temperature are provided by an Air Data system.

Radio Altitude

Radio Altitude is provided by a Radio Altimeter system. Decision Height is provided by a Radio Altimeter system or sub-system.

The EGPWS performs Radio Altitude reasonableness checks based on the Computed Terrain Clearance (pseudo-radio altitude). Computed Terrain Clearance is computed by subtracting the elevation of the (database) terrain below the aircraft from Geometric Altitude (ASL). Radio Altitude is considered unreasonable when it indicates a terrain clearance that is less than the Computed Terrain Clearance by more than 2000 feet. For example, if the Computed Terrain Clearance is 10,000 feet and the Radio Altitude is any value (0-2500) then the Radio Altitude is considered unreasonable. This is only performed if TAD is enabled, high integrity terrain and position data is available (based on GPS/Geometric Altitude), and the Computed Terrain Clearance is greater than 4000 feet (2500 feet with version -022 or later).

This feature reduces the potential for nuisance alerts caused by false tracking of the Radio Altimeter.

AHRS, IRS, VG, DG	Roll Attitude, Pitch Attitude, Magnetic Heading.
Global Positioning System (GPS)	Latitude and Longitude Position, True Track Angle, GPS Altitude, Groundspeed, Horizontal and Vertical Figure of Merit (VFOM/HFOM), Horizontal Integrity Limit (HIL), N/S and E/W velocity, and sensor status.
VHF Nav Reciever	Glideslope, Localizer, and ILS Tuned.
Terrain Display System	Display range. If EFIS, the EFIS display mode is used in some configurations.
Discretes	Discrete inputs are used for system configuration, signal/status input, and control input functions. Signal/status discretes include signals such as Decision Height, Landing Flap Position, Landing Gear selected, and status discretes such as Glideslope Valid, Magnetic Heading valid, and Radio Altitude Valid associated with analog signal inputs. Control discretes control EGPWS functions. These include EGPWS Test, Glideslope Cancel, Glideslope Inhibit or Glideslope Backcourse, Terrain (display) select, Terrain Inhibit, Flap Override, Audio Inhibit, Steep Approach select, Autopilot Engaged, Mode 6 Low Volume Select, and ILS Tuned discretes.
Configuration Module	An EGPWS Configuration Module is utilized to tell the system the type of aircraft it resides in and its interface. This is defined and established during the EGPWS installation. EGPWS output functions are consequently the result of the configuration state read each time the EGPWS is powered on.

System Outputs

The EGPWS provides both audio and visual outputs.

Audio outputs are provided as specific alert phrases and altitude callouts or tones provided by an EGPWS speaker and via the cockpit Interphone system for headset usage. Several audio output levels are available, they are established during the installation of the EGPWS. These EGPWS audio outputs can be inhibited by other systems having higher priority (i.e., stall warning) or cockpit switches in some cases. The EGPWS also has the ability to inhibit other system audio outputs such as TCAS.

Visual outputs provide discrete caution and warning alert and status annunciations. Terrain Display video is output to a compatible display system when available and enabled.

The discrete visual alerts coincide with audio caution and warning alerts to achieve an optimum terrain alerting capability. Status annunciations provide information to the flight crew about the status of the EGPWS (e.g., GPWS INOP) or activation of selected functions. Terrain video is generated by the EGPWS based on the aircraft current position relative to the surrounding terrain. This video is presented to a Weather Radar indicator, EFIS display, or a dedicated Terrain Display Unit (TDU).

Options

The EGPWS uses the data stored in the Configuration Module to define the installation configuration and option selection. The EGPWS has been designed for maximum flexibility while being tailored to specific aircraft equipment, sensors, and displays. The following are standard features of the EGPWS:

- **EGPWS Self-Test** – Cockpit switch initiates EGPWS Self-Test on the ground. Typically part of EGPWS “GPWS”, or "PULL UP" warning (red) lamp.
- **Glideslope Cancel** – Cockpit switch cancels Mode 5 Glideslope alerting. Typically part of EGPWS “BELOW GS”, or "GPWS" caution (amber) lamp.
- **TAD and TCF Inhibit** – Cockpit switch to disable all TAD and TCF functions.

The following are optional features of the EGPWS:

- **Altitude Callouts** – Selects desired altitude callouts from a menu of options.
- **Audio Output Level** – Selects desired audio output level from a menu of options.

- **TAD Alternate Pop Up** – If TRUE, disables automatic terrain display when TAD or Obstacle alert is active.
- **Smart "500" Callout** – Available in certain Altitude Callout options for "Five Hundred" called out at 500 feet Radio Altitude during non-precision approaches.
- **Bank Angle Enable** – Enables Bank Angle alerts.
- **Audio Voice Menu** – Selects the voice (phrase) that is used for audio alerts.
- **Peaks Enable** – Enables Peaks display mode with elevation numbers and alternate density pattern.
- **Steep Approach Enable** – Enables Steep Approach (Mode 1 Excessive Descent Rate) alert biasing.
- **Flap Reversal** – Reverses landing flap input discrete logic.
- **GPS Altitude Reference** – Defines the GPS Altitude input as referenced to WGS-84 or MSL.
- **Lamp Format** – One of two lamp formats are available.

  Lamp Format 1 specifies only Mode 5 glideslope alerts activate the caution (amber) lamp output. All other alerts activate the warning (red) lamp output

  Lamp Format 2 specifies all "Pull-Up" warning alerts activate the warning (red) lamp output. All caution alerts activate the caution (amber) lamp output (FAA requirement for new installations)

NOTE: Mode 6 advisories do not activate any lamp output.

Additional input/output discretes are used to control or define EGPWS operations:

- **Glideslope Inhibit** – Inhibits Mode 5 Glideslope alerting. Normally used for backcourse approaches.
- **Mode 6 Low Volume** – Selects reduced Mode 6 volume (-6db). This is sometimes connected to a Windshield Wiper system to increase EGPWS audio while wipers are operating
- **Audio Inhibit** – disables all EGPWS audio outputs.
- **Steep Approach Select** – Selects (activates) Steep Approach (Mode 1 Excessive Descent Rate) alert biasing to reduce nuisance alerts when Steep Approach Enable is true.

OPTIONS
CONTINUED

- **Steep Approach Discrete** – For installations that include a momentary steep approach input discrete, an associated steep approach activated lamp output is turned on whenever steep approach is activated.
- **Flap Override** – Cockpit switch to select landing flaps when not in the landing flap configuration.
- **Flap Override Discrete** – For installations that include a momentary flap overide input discrete, an associated flap overide activated lamp output is turned on whenever flap override is activated.
- **AutoPilot Engaged** - When connected to an AutoPilot engaged signal, selects reduced EGPWS Bank Angle alert threshold.

For additional options information, refer to the appropriate Installation Design Guide (IDG), 060-4314-125 or 060-4314-150 or contact Honeywell.

SECTION 3

OPERATIONAL PROCEDURES

System Constraints

System constraints for the EGPWS are:

- If terrain data is unavailable for a particular area (within the region for a regional database), then Terrain and Obstacle alerting is not available for that area and the affected display area is colored MAGENTA. If outside the regional database, the display is blank or turned off with a corresponding Terrain inoperative or unavailable indication.
- The display of terrain and obstacle information is intended to serve as a situational awareness tool. It does not provide the accuracy and/or fidelity to be the sole source for deciding terrain or obstacle avoidance. Navigation must not be predicated upon the use of the EGPWS terrain/obstacle display.
- If there is no source of aircraft position data meeting the accuracy requirements for the TAD and TCF functions, then these enhanced functions are automatically inhibited with a resultant Terrain inoperative or unavailable indication.
- TAD/TCF functions should be manually inhibited when within 15 NM and on approach to an airport or runway that is not in the airport database to avoid unwanted alerts.
- TAD/TCF functions should be manually inhibited for ditching or other off-airport landings.
- When the TAD/TCF functions are inhibited and the EGPWS is otherwise functional, the EGPWS reverts to providing basic GPWS functions (Modes 1 to 6). In this state, the EGPWS may give little or no advance warning time for flight into precipitous terrain where there are few or no preceding obstructions. This particularly applies if:
  - The aircraft is in the landing configuration,
  - The aircraft is in a stabilized descent at a normal approach descent rate,
  - There is no ILS Glideslope signal being received by the EGPWS (not tuned, not available, or inoperative)
- Terrain clearance or descent rates that are not compatible with required minimum regulatory standards for Ground Proximity Warning equipment may cause unwanted alerts.

System Constraints Continued

- The EGPWS terrain/obstacle database includes cataloged human-made obstructions greater than 100 feet high within North America, and portions of Europe and portions of Asia (expanding as data is obtained). The database is not all-inclusive and newer, smaller, or unknown obstructions could be encountered.

Refer to an appropriate AFM or EGPWS AFMS for specific system limitations and procedures.

System Activation

The EGPWS is fully active when the following systems are powered and functioning normally:

- EGPWS
- Radio Altimeter
- Air Data
- ILS or Glideslope Receiver
- AHRS, IRS, VG, DG (Attitude & Heading)
- GPS (position)
- Landing gear
- Landing flaps
- Weather Radar Indicator, EFIS, or a dedicated terrain display (if terrain/obstacle display enabled)

In the event that required data for a particular function is not available, then that function is automatically inhibited and annunciated (e.g. if position data is not available or determined unacceptable, TAD and TCF is inhibited, any active terrain display is removed, and "TERR INOP", "TERR UNAVAIL" (or equivalent) is indicated).

EGPWS status annunciations are provided for GPWS inoperative (mode 1-6 functions), and Terrain inoperative (TAD/TCF functions).

EGPWS Self-Test

The EGPWS provides a Self-Test capability for verifying and indicating intended functions. This Self-Test capability consists of six levels to aid in testing and troubleshooting the EGPWS. These six levels are:

Level 1 - **Go / No Go Test** provides an overview of the current operational functions and an indication of their status.

Level 2 - **Current Faults** provides a list of the internal and external faults currently detected by the EGPWS.

Level 3 - **EGPWS Configuration** indicates the current configuration by listing the EGPWS hardware, software, databases, and installation configuration detected by the EGPWS.

Level 4 - **Fault History** provides an historical record of the internal and external faults detected by the EGPWS.

Level 5 - **Warning History** provides an historical record of the alerts given by the EGPWS.

Level 6 - **Discrete Test** provides audible indication of any change to a discrete input state.

A Level 1 Self Test (Go/No Go) is normally performed by flight crews as part of preflight checks. All levels are typically used for installation checkout and maintenance operations.

A Level 1 Test is used to verify proper operation of the EGPWS on the ground as follows:

1. Ensure that adequate aircraft power is available and the EGPWS and associated systems are powered.
2. Ensure that any EGPWS inhibiting switches are in the normal (non-inhibiting) position.
3. Verify that EGPWS inoperative annunciations are extinguished. If an inoperative annunciation is indicated, perform the EGPWS Self-Test (below) and then seek corrective action if the inoperative condition persists.
4. If a terrain display is enabled, select terrain to be displayed.
5. Momentarily depress the EGPWS Self-Test switch.

When a Self-Test is initiated, the EGPWS first checks for any con-

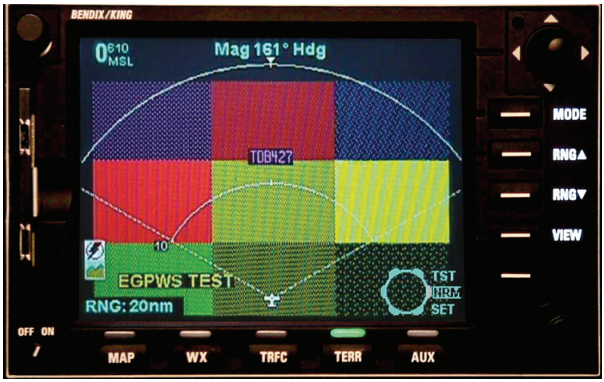
figuration (installation or database) errors. If any are detected it is audibly enunciated and the test is terminated. If none detected, the test continues through a sequence resulting in turning on and off all system annunciators, enunciating specific audio messages, and if enabled, displaying a video test pattern on the terrain display. Any functions determined inoperative are also enunciated (e.g., “GLIDESLOPE INOP”). The Self-Test terminates automatically at its conclusion.

The following is a description of the expected results of a typical Level 1 Self-Test. Actual annunciation nomenclature and sequence may differ depending on the installation.

- GPWS INOP and TERR INOP annunciators turn on.
- Flap OVRD annunciator turns on momentarily.
- Amber caution (“BELOW G/S” or "GPWS") annunciators turn on.
- “GLIDESLOPE” is announced over speaker.
- Amber caution annunciators turn off.
- G/S CANCEL annunciators turn on momentarily (if installed).
- Red warning ("PULL UP" or "GPWS") annunciators turn on.
- “PULL UP” is announced over speaker.
- “TERRAIN, TERRAIN, PULL UP” is announced over speaker.
- Terrain test pattern is displayed.

EGPWS Self-Test continued

Example of a test pattern shown below. Note that if a display is not able to display the color blue, or Peaks mode is not enabled, the upper right-hand corner square will be black. Also note that "TDB XXXY" indicates the loaded Terrain Database, where XXX is the version number (i.e. 435), and Y is region identifier (i.e. N= Americas). TDB XXXY is shown only with -020 and later versions.



- Red warning annunciators turn off.
- Terrain test pattern is turned off.
- GPWS INOP and TERR INOP annunciators turn off.

6. Verify expected indications and enunciation's during test, repeating as necessary noting any erroneous conditions.

A successful test is accomplished if all expected indications are observed and no inoperative functions or display anomalies are indicated or observed.

For more specific information, refer to an applicable AFM or EGPWS AFMS, or contact Honeywell.

Normal Procedures

The EGPWS provides visual and/or audio alerts for detected:

- potentially dangerous terrain conditions (modes 1 – 4, TCF, TAD),
- below glideslope conditions (mode 5),
- descent below predefined altitudes or excessive bank angle (mode 6),

These consist of warning, caution, and advisory alerts based on the detection alert threshold penetration.

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

ALERT	WARN	CAUT.	ADV.
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 callouts			6
“SINK RATE”		1	
“DON’T SINK”		3	
“GLIDESLOPE”		5	
“BANK ANGLE”			6

NOTE: Visual and audio indications may vary and procedures provided are representative. Refer to an applicable AFM or EGPWS AFMS for specific implementation.

Recommended response to EGPWS alerts are as follows:

Caution Alerts

1. Stop any descent and climb as necessary to eliminate the alert. Analyze all available instruments and information to determine best course of action
2. Advise ATC of situation as necessary.

Warning Alerts

1. Aggressively position throttles for maximum rated thrust. Apply maximum available power as determined by emergency need. The pilot not flying (if applicable) should set power and ensure that TO/GA power and modes are set.
2. If engaged, disengage the autopilot and smoothly but aggressively increase pitch toward "stick shaker" or Pitch Limit Indicators (PLI) to obtain maximum climb performance.
3. Continue climbing until the warning is eliminated and safe flight is assured.
4. Advise ATC of situation.

NOTE: Climbing is the only recommended response unless operating in visual conditions and/or pilot determines, based on all available information, that turning in addition to the climbing is the safest course of action. Follow established operating procedures.

NOTE: Navigation must not be based on the use of the Terrain Awareness Display (TAD).

Glideslope Alerts

Below Glideslope alerts consist of "soft" and "hard" alerts based on the degree of glideslope deviation and altitude. Respond to these alerts as necessary to correct the aircraft flight path back to the Glideslope centerline or perform a missed approach.

Advisory Callouts

Advisory callouts being advisory in nature are used to announce an event or condition (e.g., "Minimums, Minimums"). Response to these callouts should be in accordance with standard operating procedures.

Abnormal Procedures

Partial system deactivation or compensation can be accomplished for abnormal procedures as follows:

Mode 1 Excessive Descent Rates

If steep approaches are to be performed (4º or greater) EGPWS STEEP APPROACH should be enabled and selected for these operations (typically selected by a cockpit switch). When active, Mode 1 alerts are desensitized (biased 500 FPM for the caution and 200 FPM for the warning threshold) to compensate for normally higher descent rates for these types of operation, eliminating related unwanted alerts. If implemented with an alternate action cockpit switch, this requires manual deactivation. Alternatively, a momentary cockpit switch may be used, which can be cancelled by pressing the switch again, or will automatically reset when the aircraft lands or a go-around is initiated.

Additionally, Mode 1 can be desensitized by selecting the FLAP OVERRIDE switch (GA only, not Turbofan). This permits potentially higher descent rates resulting from flaps not being set to the landing position during approaches. A 300 FPM bias is applied to both the caution and warning thresholds. This bias is automatically deselected below 50 feet AGL. Steep Approach has priority over Flap Override if selected simultaneously.

Mode 3 Altitude Loss After takeoff

Selecting Flap Override (GA only, not Turbofan) increases the allowable altitude loss after takeoff. Mode 3 alerts are desensitized (as a function of altitude) when the FLAP OVERRIDE switch is activated. This is used to eliminate unwanted Mode 3 alerts if operating at low altitude after takeoff. Flap Override is automatically deselected below 50 feet AGL.

Mode 5 Descent Below Glideslope

Mode 5 Glideslope alerts can be manually canceled when below 2000 feet Radio Altitude by pressing the G/S CANCEL switch (commonly part of the amber caution annunciators “BELOW G/S or "GPWS"). This is typically selected when an unreliable Glideslope is expected or when maneuvering is required during ILS final approach. The G/S Cancel is automatically reset following landing or if the aircraft climbs above the 2000 feet.

Some aircraft may be configured with a G/S INHIBIT switch. This switch is separate from the one discussed above but also results in inhibiting Mode 5 alerting. This switch is intended for selection during back course approaches to eliminate unwanted alerts that may result.

If a discrete back course signal is available from another system, the EGPWS may be connected to that system using the G/S Inhibit input for automatic Mode 5 inhibiting.

NOTE: Implementation of the Glideslope Cancel and/or Inhibit inputs to the EGPWS varies. Verify a particular application to determine the implementation used.

Terrain Alerting and Clearance Floor

Pressing the TERRAIN INHIBIT switch inhibits TAD and TCF alerting and display, including Obstacles and Peaks when enabled. This is typically used when operating at an airport not in the terrain database. Selection of Terrain Inhibit does not cause the Terrain Inoperative or unavailable annunciation unless the aircraft is wired for this to occur. Terrain Inhibit requires manual deactivation.

Emergency Procedures

The EGPWS Flap Override, TAD/TCF Inhibit, or other switches (as installed) may be used as required for an emergency (e.g., landing with less than landing flaps, ditching, etc.).

For additional information refer to an applicable AFM or EGPWS AFMS or contact Honeywell.

SECTION 4

DEFINITIONS

Acronyms and abbreviations shall be interpreted as shown below:

AFM	Airplane Flight Manual
AFMS	Airplane Flight Manual Supplement
AGL	Above Ground Level
AHRS	Attitude/Heading Reference System
ARINC	Aeronautical Radio Incorporated
ASL	Above Sea Level
ATC	Air Traffic Control
BIT	Built In Test
CFIT	Controlled Flight Into Terrain
CTC	Computed Terrain Clearance
dB	Decibels
DH	Decision Height
EFIS	Electronic Flight Instrument System
EGPWS	Enhanced Ground Proximity Warning System
FAA	Federal Aviation Administration
FPM	Feet Per Minute
F/W	Fail Warning
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glideslope
HFOM	Horizontal Figure of Merit
HIL	Horizontal Integrity Limit
Hz	Hertz (cycles per second)
ICD	Interface Control Document
ILS	Instrument Landing System
INOP	Inoperative
IVS	Inertial Vertical Speed
KRF	Position Error + Runway Data quality + Geometric Altitude
MCP	Mode Control Panel
MCU	Modular Concept Unit
MFD	Multi-Function Display
MLS	Microwave Landing System
MSL	Mean Sea Level
MTC	Minimum Terrain Clearance

DEFINITIONS CONTINUED

PCMCIA	Personal Computer Memory Card Industry Association
PPI	Plan Position Indicator
PWS	Predictive Windshear System
QFE	A method of setting the altimeter to compensate for changes in barometric pressure and runway elevation. Pilot receives information from airfield and adjusts his altimeter accordingly and it will read zero altitude at touchdown on the runway.
QNE	The method of setting the altimeter to the standard atmosphere datum -29.92 inches of mercury (1,013.25mb). This setting is used in the United States airspace by all aircraft above FL180.
QNH	The more common method of setting the altimeter to compensate for changes in barometric pressure. Pilot receives information from airfield, adjusts his altimeter accordingly and the altimeter will read airfield elevation at touchdown.
RAIM	Receiver Autonomous Integrity Monitoring
RFCF	Runway Field Clearance Floor
SAT	Static Air Temperature
TA	Terrain Awareness
TAD	Terrain Alerting and Display
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Collision Avoidance System
TCF	Terrain Clearance Floor
TDU	Terrain Display Unit
TERR	Terrain
TO/GA	Takeoff/Go-Around
VDOP	Vertical Dilution of Precision
VFOM	Vertical Figure of Merit
VFR	Visual Flight Rules
VG	Vertical Gyro
VHF	Very High Frequency

Dear Honeywell EGPWS Customer:

This form is a request for information that will allow Honeywell to notify you of future updates to your Enhanced Ground Proximity Warning System. Please complete the information below and fax the information sheet to **Honeywell** at 425-885-8722 or return via U.S. mail to:

Honeywell International, Inc.
Attn: Sandra Slick
Technical Publications
P.O. Box 97001
Redmond, WA 98073-9701

Customer Information:

Customer Contact: _____

Company Name: _____

Shipping Address: _____

_____

Phone Number: _____

Fax Number: _____

E-mail Address: _____

Aircraft Information:

Aircraft Model _____

EGPWS Part Number _____ EGPWS Serial # _____

Aircraft Model _____

EGPWS Part Number_____ EGPWS Serial # _____

Aircraft Model _____

EGPWS Part Number_____ EGPWS Serial # _____

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