Honeywell

MK V and MK VII

Enhanced Ground Proximity Warning System (EGPWS) and Runway Awareness Advisory System (RAAS) Pilot Guide

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MK V & MK VII EGPWS Pilot Guide

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SECTION 1

INTRODUCTION

This Pilot Guide describes the functions and operation of the MKV and MKVII Enhanced Ground Proximity Warning System (EGPWS).

The 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 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 Alerting system providing terrain alerting and display functions with additional features.

The EGPWS uses aircraft inputs including geographic position, attitude, altitude, airspeed, and glideslope deviation. These are used with internal terrain, obstacles, and airport databases to predict a potential conflict between the aircraft flight path and terrain or an obstacle. A terrain or obstacle conflict results 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 program pin selection. Detection of severe windshear conditions is also provided for selected aircraft types when enabled.

WHAT IS THE EGPWS?
CONTINUED

The EGPWS incorporates several "enhanced" features:

- **Terrain Alerting and Display (TAD)** provides a graphic display of the surrounding terrain on the Weather Radar Indicator, EFIS, or a dedicated display. Based on the aircraft's 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 program pins during installation.
- **"Peaks"** is a TAD supplemental feature providing additional terrain display features for enhanced situational awareness, independent of the aircraft's altitude. This includes digital elevations for the highest and lowest displayed terrain, additional elevation (color) bands, and a unique representation of 0 MSL elevation (sea level and its corresponding shoreline). This feature is an option, enabled by program pins during installation.
- **"Obstacles"** is a feature utilizing an obstacle database for obstacle conflict alerting and display. EGPWS caution and warning 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 program pins 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.
- A **Terrain Clearance Floor** feature adds an additional element of protection by alerting the pilot of possible premature descent. This is intended for non-precision approaches and is based on the current aircraft position relative to the nearest runway. This feature is enabled with the TAD feature.
- In -210-210 and later versions, a **Runway Field Clearance Floor** (RFCF) feature is included. This is similar to the TCF feature except that RFCF is based on the current aircraft position and height above the destination runway based on Geometric Altitude (see next page). This provides improved protection at locations where the destination runway is significantly higher than the surrounding terrain.

WHAT IS THE EGPWS? CONTINUED

- An **Aural Declutter** feature reduces the repetition of warning messages. This feature is optional, and may be disabled by system program pins during installation.
- **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, and altimeter miss-sets. This ensures an optimal EGPWS alerting and display capability.
- **Runway Alerting & Advisory System (RAAS)** The EGPWS also provides position awareness advisories relative to runways during ground operations and approach to land. This new feature is known as "Runway Awareness and Advisory System" - RAAS (only available in -218-218 or later versions).

PHYSICAL DESCRIPTION

Some of these features have been added to the EGPWS as the system evolved and are not present in all Enhanced Ground Proximity Warning Computer (EGPWC) part numbers. For specific effectivity, refer to an applicable Airplane Flight Manual (AFM) or EGPWS Airplane Flight Manual Supplement (AFMS) or contact Honeywell for assistance.

The EGPWC is packaged in a 2 MCU ARINC 600-6 rack mounted enclosure weighing less than 8 lbs. No special vibration isolation mounting or forced air-cooling is required.

115 VAC (400 Hz.) or 28 VDC versions of the EGPWC are available. Units are also available with an internal GPS receiver for required GPS data when another GPS source is not available.

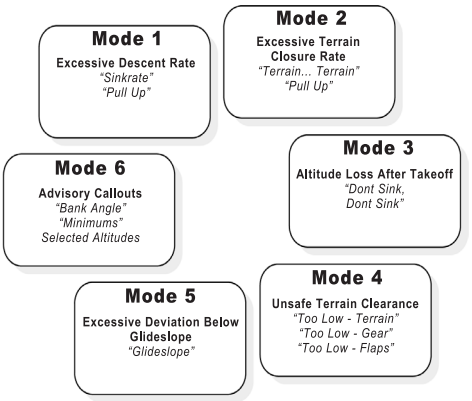
For more detailed descriptions and information, contact Honeywell.

SECTION 2

SYSTEM DESCRIPTION

Enhanced Ground Proximity Warning System

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



Additionally, Windshear alerting (Mode 7) is provided for specific aircraft types. Mode 7 provides windshear caution and/or warning alerts when an EGPWS windshear threshold is exceeded.

EGPWS Database

The EGPWS adds to these 7 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).

The EGPWS internal database consists of four sub-sets:

1. A worldwide terrain database of varying degrees of resolution.
2. An obstacles database containing cataloged obstacles 100 feet or greater in height located within North America, portions of Europe and portions of the Caribbean (expanding as data is obtained).
3. A worldwide airport database containing information on runways 3500 feet or longer in length. For a specific list of the airports included, refer to Honeywell document 060-4267-000 or access on the Internet at website www.egpws.com.
4. An Envelope Modulation database to support the Envelope Modulation feature discussed later.

EGPWS Database continued

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 downloaded via a card slot in the front panel of each EGPWC. 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, and to address prevention of airport runway/taxiway incursions, the terrain database contains higher resolution grids for airport areas. Lower resolution grids are used outside airport areas where aircraft enroute altitude make CFIT accidents less likely and terrain feature detail is less important to the flight crew.

With the use of accurate GPS or FMS information, the EGPWS is provided present position, 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 violates specific computed envelope boundaries on the projected flight path of the aircraft. Alerts are provided in the form of visual light annunciation of a caution or warning, 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 the Weather Radar Indicator, EFIS display, or a dedicated EGPWS display and may or may not be displayed automatically.

Also available with high integrity GPS data is alerting advisory information to help prevent runway/taxiway incursions in the form of audio advisory alerts.

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

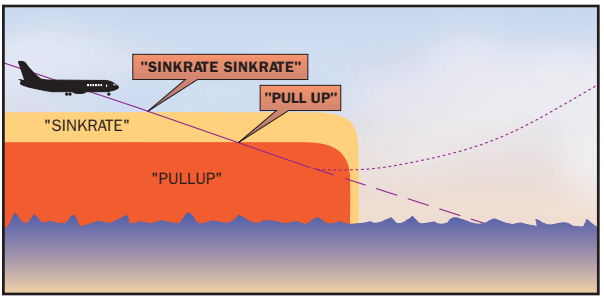
BASIC FUNCTIONS:

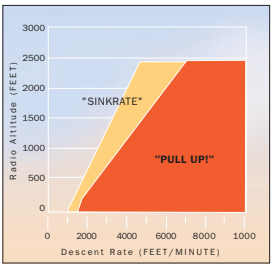
MODE 1

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 graph below.

Penetration of the outer boundary activates the EGPWS caution





lights and **"SINKRATE, SINKRATE"** alert enunciation. Additional **"SINKRATE, SINKRATE** " messages will occur for each 20% degradation in altitude.

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.

Note: "Pull Up" may be preceded by "Whoop, Whoop" in some configurations based on the audio menu option selected.

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.

MODE 1

CONTINUED

If the Aural Declutter feature is disabled, the sinkrate alert boundary remains fixed and the aural message **"SINKRATE"** repeats continuously until the outer boundary is exited.

STEEP APPROACH BIAS

The EGPWS offers a Steep Approach option for given aircraft types (typically bizjets) that desensitizes the alert boundaries to permit steeper than normal approaches without unwanted alerts.

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.

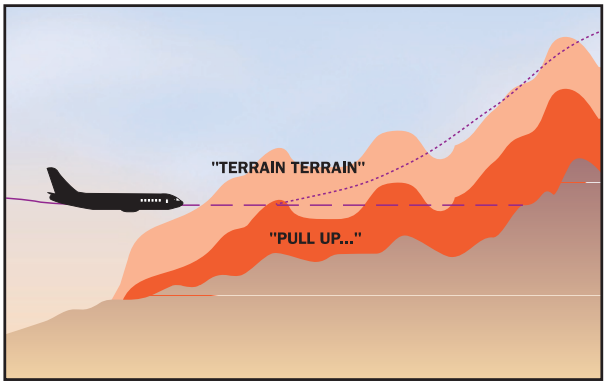
Note: "Pull Up" may be preceded by "Whoop, Whoop" in some configurations based on the audio menu option selected.

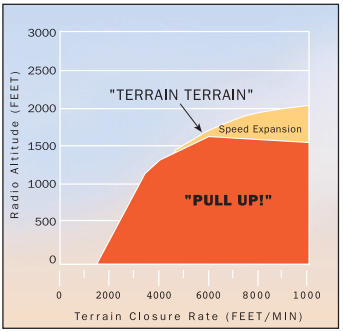
Upon exiting the warning envelope, if terrain clearance continues to decrease, the aural message **"TERRAIN"** will be given until the terrain clearance stops decreasing. In addition, the visual alert will remain on until the aircraft has gained 300 feet of barometric altitude, 45 seconds has elapsed, or landing flaps or the flap override switch is activated.

MODE 2A

CONTINUED

The graph below shows how the upper boundary of the Mode 2 alert envelope varies as a function of the aircraft speed. As airspeed increases from 220 knots to 310 knots, the boundary expands to provide increased alert times at higher airspeeds.



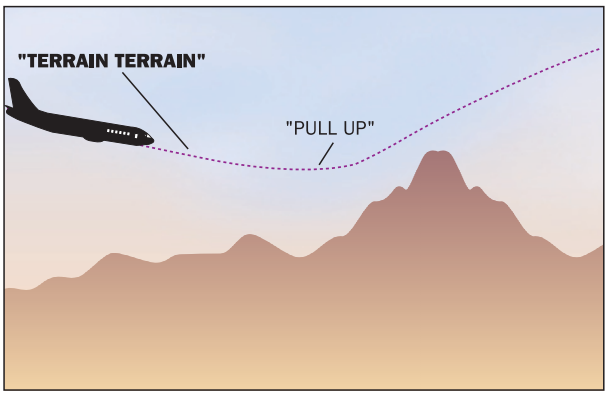


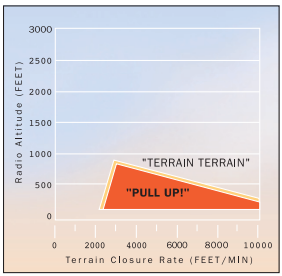
With version -210-210 and later models, the Mode 2A upper limit is reduced to 1250 feet (950 feet with version -218-218 and later) for all airspeeds when the Terrain Alerting and Display (TAD) function is enabled and available. This is due to the enhanced alerting capability provided with TAD, resulting from high integrity GPS 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 over-ride 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.

With version -210-210 and later models, Mode 2B is selected when the aircraft is within 5nm (10nm with version -218-218 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 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.





The graph above shows the Mode 2B envelope.

MODE 2B

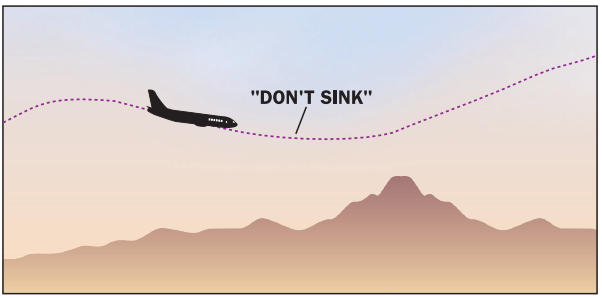
CONTINUED

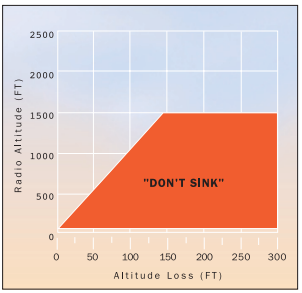
During an approach, if the aircraft penetrates the Mode 2B envelope with either the gear or flaps not in the landing configuration, the aural message **"TERRAIN, TERRAIN"** is generated and the EGPWS caution lights illuminate. If the aircraft continues to penetrate the envelope, the EGPWS warning lights 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.

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 or 150 feet, depending on aircraft type) 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





MODE 3

CONTINUED

lights and the aural message **"DON'T SINK, DON'T SINK"**. The aural message is enunciated twice for each 20% degradation in altitude. Upon establishing a positive rate of climb, the EGPWS caution lights extinguish and the aural alert will cease.

If the Aural Declutter feature is disabled, the warning is enunciated continuously until positive climb is established.

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 and flaps 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 the EGPWS caution lights and aural messages.

To reduce nuisance alerts caused by over-flying another aircraft, the upper limit of the Mode 4A/B alerting curve can be reduced (from 1000) to 800 feet. This occurs if 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 over-flight occurs (with 1000 foot separation).

With version -210-210 and later models, 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 Altitude and Geometric Altitude data. This change to the Mode 4 envelopes reduces the potential for nuisance alerts when the aircraft is not in the landing configuration.

MODE 4A

Mode 4A is active during cruise and approach with gear and flaps up. This provides alerting during cruise for inadvertent flight into terrain where terrain is not rising significantly, or the

MODE 4A

CONTINUED

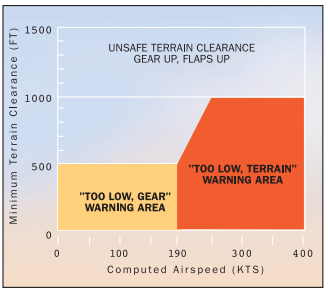
aircraft is not descending excessively. It also provides alerting for protection against an unintentional gear-up landing.

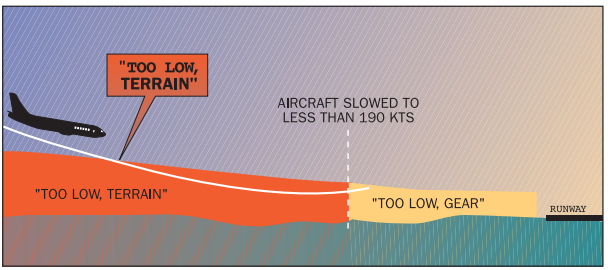
Below 1000 feet AGL and above 190 knots airspeed, the Mode 4A aural alert is **"TOO LOW TERRAIN"**. This alert is dependent on aircraft speed such that the alert threshold is ramped between 500 feet at 190 knots to 1000 feet at 250 knots.

Below 500 feet AGL and less than 190 knots airspeed, the Mode 4A aural alert is **"TOO LOW GEAR".**

For either Mode 4A alert, subsequent alert messages occur for each 20% degradation in altitude. EGPWS caution lights extinguish and aural messages cease when the Mode 4A alert envelope is exited.

If the Aural Declutter feature is disabled, mode 4A alert messages are repeated continuously until the Mode 4A envelope is exited.





MODE 4B

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

Below 1000 feet AGL and above 159 knots airspeed, the Mode 4B aural alert is **"TOO LOW TERRAIN"**. This alert is dependent on aircraft speed such that the alert threshold is ramped

MODE 4B

CONTINUED

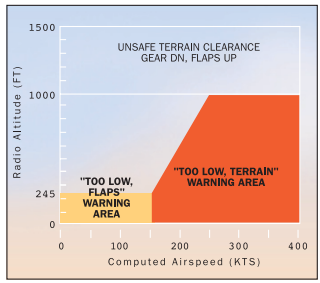
between 245 feet at 159 knots to 1000 feet at 250 knots.

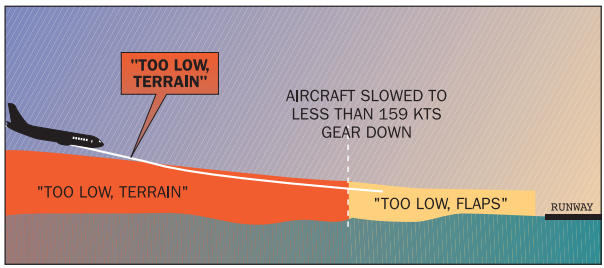
Below 245 feet AGL and less than 159 knots airspeed, the Mode 4B aural alert is **"TOO LOW FLAPS"**. For turboprop and select turbofan aircraft, the **"TOO LOW FLAPS"** warning curve is lowered to 150 feet AGL and less than 148 knots.

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.

If the aircraft's Radio Altitude decreases to the value of the MTC, the EGPWS caution illuminates and the aural message **"TOO LOW TERRAIN"** is enunciated.

For either Mode 4B alert, subsequent alert messages occur for each 20% degradation in altitude. EGPWS caution lights extinguish and aural messages cease when the Mode 4B alert envelope is exited.





If the Aural Declutter feature is disabled, mode 4B alert messages are repeated continuously until the Mode 4B 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

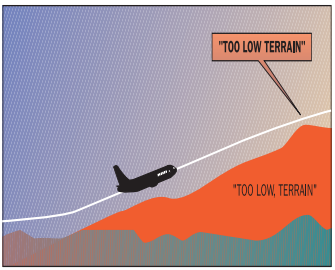
Mode 4C is based on an EGPWS computed Minimum Terrain Clearance (MTC) floor, that increases with Radio Altitude. It is active after takeoff when the gear or flaps are not in the landing configuration. It is also active during a low altitude go-around if the aircraft has descended below 245 feet AGL (or 150 feet depending on aircraft type).

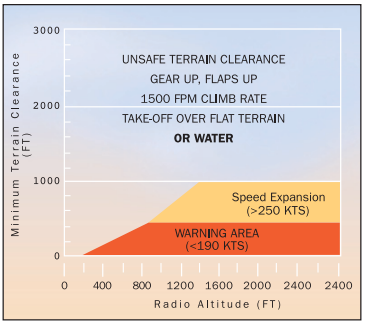
At takeoff the Minimum Terrain Clearance (MTC) is zero feet. As the aircraft ascends the MTC is increased to 75% of the aircraft's Radio Altitude (averaged over the previous 15 seconds). This value is not allowed to decrease and is limited to 500 feet AGL for airspeed less than 190 knots. Beginning at 190 knots, the MTC increases linearly to the limit of 1000 feet at 250 knots.

If the aircraft's Radio Altitude decreases to the value of the MTC, the EGPWS caution illuminates and the aural message **"TOO LOW TERRAIN"** is enunciated.

EGPWS caution lights extinguish and aural messages cease when the Mode 4C alert envelope is exited.

If the Aural Declutter feature is disabled, mode 4C alert messages are repeated continuously until the Mode 4C envelope is exited.





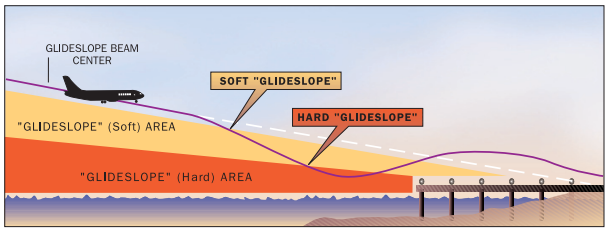
MODE 5

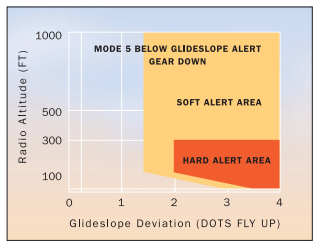
EXCESSIVE DEVIATION BELOW GLIDESLOPE

Mode 5 provides two levels of alerting for when the aircraft descends below glideslope, resulting in activation of EGPWS caution 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 the caution lights and is called a "soft" alert because the audio message **"GLIDESLOPE"** is enunciated at half volume. 20% increases in the below glideslope deviation cause additional **"GLIDESLOPE"** messages enunciated at a progressively faster rate.

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 3 seconds continuing until the "hard" envelope is exited. The caution 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 the localizer is within 2 dots, landing gear and flaps are selected, Glideslope Cancel is not active, and a front course approach is determined.

MODE 5

CONTINUED

- 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.

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.

If the Aural Declutter feature is disabled, messages are repeated continuously until the Mode 5 envelope is exited.

Mode 5 alerts can be canceled by pressing the Glideslope Cancel switch (if installed). The EGPWS will interpret this switch one of two ways depending on the installation configuration.

- A *standard* glideslope cancel switch allows for manually canceling Mode 5 alerting any time below 2000 feet AGL. This is automatically reset when the aircraft descends below 30 feet or climbs above 2000 feet AGL (1000 feet AGL for current Boeing production aircraft).
- An *alternate* glideslope cancel switch allows for manually canceling Mode 5 alerting at any time and any altitude. The cancel is reset by again pressing the cancel switch, or automatically if gear or flaps are raised, or the aircraft is on the ground. Due to the nature of the alternate cancel switch, this method requires that there be a cockpit annunciation that glideslope cancel is in effect (this configuration is currently not allowed on aircraft operating under FAA part 121 rules).

EGPWS Mode 5 alerts are inhibited during backcourse approaches to prevent nuisance alerts due to false fly up lobes from the Glideslope. The EGPWC determines a backcourse approach if either: 1) the aircraft's magnetic track is greater than 90 degrees from the runways approach course, or 2) 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 (set by program pin configuration). These callouts consist of predefined Radio Altitude based voice callouts or tones and an excessive bank angle warning. There is no visual alerting provided with these callouts.

ALTITUDE CALLOUTS

The following is a list of each of the possible altitude callouts or tones:

CALLOUT	Occurs at (feet AGL)
"RADIO ALTIMETER"	2500
"TWENTY FIVE HUNDRED"	2500
"ONE THOUSAND"	1000 [a]
"FIVE HUNDRED"	500 [a]
Five Hundred Tone (2 second 960 Hz)	500
"FOUR HUNDRED"	400
"THREE HUNDRED"	300
"TWO HUNDRED"	200
"APPROACHING MINIMUMS"	DH+80 [b]
"APPROACHING DECISION HEIGHT"	DH+100 [b]
"PLUS HUNDRED"	DH+100 [b]
"FIFTY ABOVE"	DH+50 [b]
"MINIMUMS"	DH [b]
"MINIMUMS - MINIMUMS"	DH [b]
"DECISION HEIGHT"	DH [b]
"DECIDE"	DH [b]
"ONE HUNDRED"	100
One Hundred Tone (2 second 700 Hz)	100
"EIGHTY"	80
"SIXTY"	60
"FIFTY"	50
"FORTY"	40
"THIRTY FIVE"	35
Thirty Five Tone (1 second 1400 Hz)	35
"THIRTY"	30
"TWENTY"	20
Twenty Tone (1/2 second 2800 Hz)	20
"TEN"	10
"FIVE"	5

a. May be Barometric Altitude above the field elevation for some aircraft types.

b. May be MDA or DH for some aircraft types.

MODE 6

CONTINUED

In some cases a callout is stated twice (e.g., "MINIMUMS, MINIMUMS") but in all cases a given callout is only enunciated once per approach.

Decision Height (DH) based callouts (Approaching Minimums, Minimums, etc.) require the landing gear to be down and occur when descending through the Radio 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" are valid callouts, then only "MINIMUMS" will be called out at 200 feet AGL.

DH plus based callouts (e.g., Approaching Minimums) are only applicable for aircraft providing a Decision Height altitude to the EGPWS. Consequently, not all EGPWS installations can utilize these callout options.

Due to the variety of altitude callout choices available, it is not possible to identify every combination in this guide. Refer to an appropriate Airplane Flight Manual or EGPWS Airplane Flight Manual Supplement for callout identification in a specific application or contact Honeywell.

SMART 500 FOOT CALLOUT

Another feature available in the Altitude Callouts (options) is a "Smart 500" foot callout. When selected, this callout assists 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.

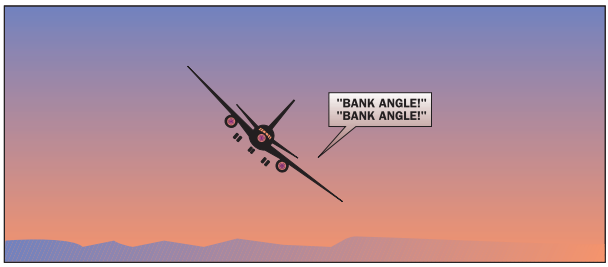
This feature has the distinction of adding the 500-foot callout during non-precision approaches and removing the 500-foot callout on precision approaches when part of the callout option.

MODE 6

CONTINUED

BANK ANGLE CALLOUT

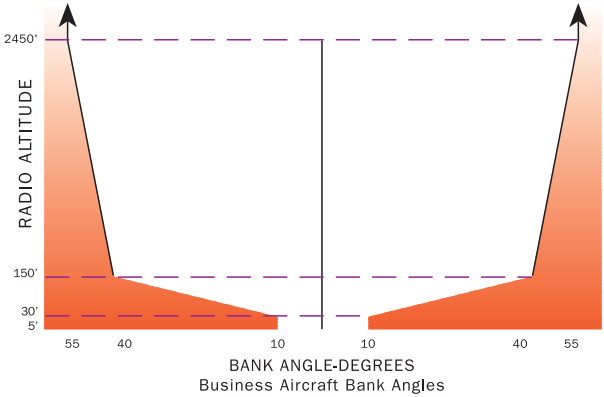
The callout "**BANK ANGLE, BANK ANGLE**" advises of an excessive roll angle. The EGPWS provides several excessive bank angle envelopes supporting Air Transport, Business, or Military aircraft types (only Air Transport and Business are addressed below).



BUSINESS BANK ANGLE

One envelope is defined for turbo-prop and jet business aircraft (see graph below). Bank angles in excess of:

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



Business Aircraft Bank Angles

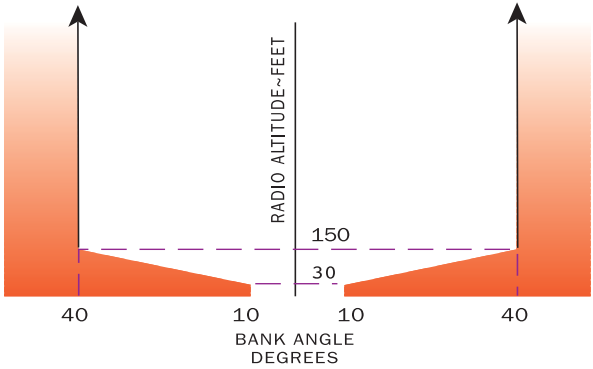
produce the bank angle advisory (shaded area). Bank angle advisories are inhibited below 5 feet.

MODE 6

AIR TRANSPORT BANK ANGLE

Three envelopes are defined for Air Transport aircraft. These are identified as Basic Bank Angle, Bank Angle Option 1, and Bank Angle Option 2 advisories.

The Air Transport Basic Bank Angle limits are similar to the Business Aircraft Bank Angle limits except above 150 feet the bank limit remains at 40 as shown below.



Bank Angle Option 1 provides bank angle advisory thresholds at 35, 40, and 45 independent of altitude. In this case, an advisory at 35 is provided and another is not given unless 40 is exceeded and then again only if 45 is exceeded. If the roll rate exceeds the audio callout time, then the bypassed limit is not indicated. Also, when any one of the thresholds is exceeded, the bank angle must reduce below 30 for the process to reset before additional Bank Angle Advisories can be provided.

For example, if greater than 40 is obtained before the 35 callout is complete, another callout is provided only if 45 is obtained or the bank angle is reduced to less than 30 and then again increases to 35.

Bank Angle Option 2 provides a combination of the Basic Bank Angle and Bank angle Option 1. The Basic Bank Angle limits are provided below 130 feet, and Bank Angle Option 1 is provided above 130 feet.

Any one of these three Bank Angle limits can be selected by program pin if the aircraft type is defined as an Air Transport aircraft.

MODE 7

WINDSHEAR ALERTING

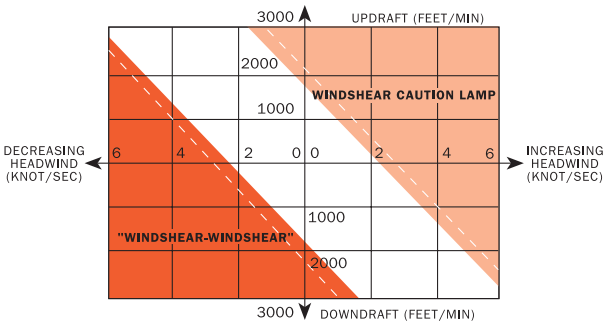
Mode 7 is designed to provide alerts if the aircraft encounters windshear. Two alerting envelopes provide either a Windshear Caution alert or a Windshear Warning alert each with distinctive aural and visual indications to the flight crew.

EGPWS windshear is provided for certain (not all) aircraft types and is a function of certain additionally required input signals and enabled internal detection algorithms. These are established during the initial installation and addressed in the appropriate Airplane Flight Manual (AFM) or EGPWS Airplane Flight Manual Supplement (AFMS).

WINDSHEAR CAUTION

Windshear Caution alerts are given if an increasing headwind (or decreasing tailwind) and/or a severe updraft exceed a defined threshold. These are characteristic of conditions preceding an encounter with a microburst.

A Windshear Caution (if enabled) results in illumination of amber Windshear Caution lights and may (if separately enabled) also be accompanied by the aural message **"CAUTION, WINDSHEAR"**. The lights remain on for as long as the aircraft is exposed to conditions in excess of the caution alert threshold. The Windshear Caution envelope is illustrated in the figure below.



The Windshear Caution alerting can be disabled by EGPWS program pin selection so that only Windshear Warning alerts are provided.

MODE 7

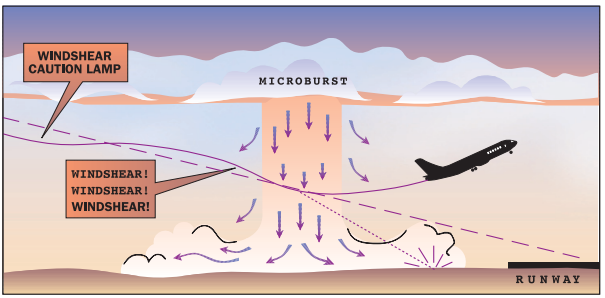
CONTINUED

Windshear Warning alerts are given if a decreasing headwind (or increasing tailwind) and/or a severe downdraft exceed a defined threshold. These are characteristic of conditions within or exiting an encounter with a microburst.

WINDSHEAR WARNING

Windshear Warning results in illumination of red Windshear Warning lights and an aural siren followed by the message "**WINDSHEAR, WINDSHEAR, WINDSHEAR**". The lights remain on for as long as the aircraft is exposed to conditions in excess of the warning alert threshold. The aural message will not repeat unless another separate windshear event is encountered. The threshold is adjusted as a function of available climb performance, flight path angle, airspeeds significantly different from normal approach speeds, and unusual fluctuations in Static Air Temperature (typically associated with the leading edge of a microburst). The Windshear Warning envelope is illustrated in the figure shown on page 23.

WINDSHEAR CAUTION



Mode 7 Windshear alerting is active under the following conditions:

- During takeoff; from rotation until an altitude of 1500 feet AGL is reached,
- During approach; From an altitude of 1500 feet down to 10 feet AGL,
- During a missed approach; until an altitude of 1500 feet AGL is reached.

ENHANCED FUNCTIONS:

Envelope Modulation

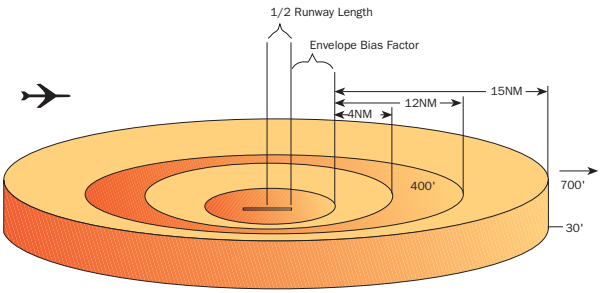
Due to terrain features at or near certain specific airports around the world, normal operations have resulted in nuisance or missed alerts at these locations in the past. With the introduction of accurate position information and a terrain and airport database, it is possible to identify these areas 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 key 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 runway in the database (all runways greater than 3500 feet in length). The TCF envelope is defined for all runways as illustrated below and extends to infinity, or until it meets the envelope of another runway. The envelope bias factor is typically 1/2 to 2 nm and varies as a function of position accuracy.

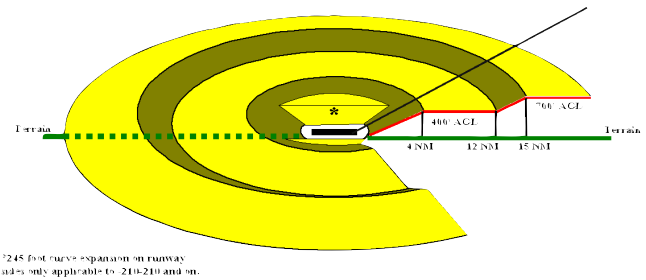


TCF Alert Envelope

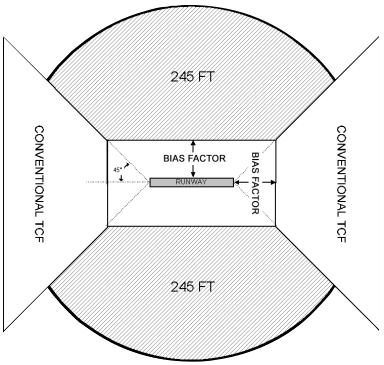
Terrain Clearance Floor Continued

In -210-210 and later versions, the TCF alert envelope and Envelope Bias Factor are improved. 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 providing greater protection against landing short events. With version -218-218 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



245 foot curve expansion on runway ends only applicable to -210-210 and on.

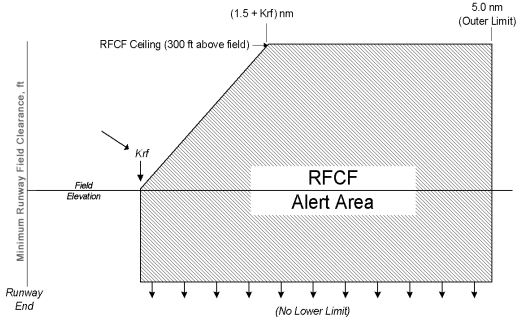


Improved TCF Envelope Plan View

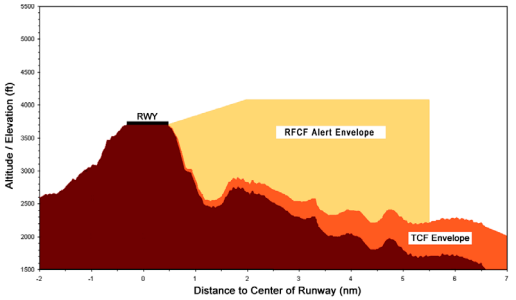
Also in -210-210 and later versions, runway selection logic is improved to better identify the destination runway. Comprehensive aircraft position and navigation information is used to evaluate proximity runways and determine the most likely destination runway for all alerting purposes.

Runway Field Clearance Floor

In -210-210 and later versions, a **Runway Field Clearance Floor** feature is included. This 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 -218-218 and later models, the RFCF envelope is moved from 1nm to 1/2nm if runway and position data is of high integrity.



RFCF Alert Envelope



TCF and RFCF alerts result in illumination of the EGPWS caution 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 Altitude. The EGPWS caution lights will remain on until the TCF envelope is exited.

Terrain Look Ahead Alerting

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.

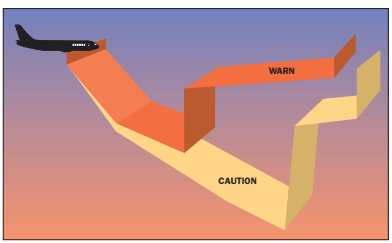
Terrain Look Ahead Alerting continued

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° laterally, more if turning. The look-down and up angles are a function of the aircraft flight path angle, and the look-down 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 60 seconds ahead of the terrain/obstacle conflict and is repeated every seven seconds as long as the conflict remains within the caution area.

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 **"OBSTACLE, OBSTACLE, PULL UP"** is enunciated with **"PULL UP"** repeating continuously while the conflict is within the warning area.



Terrain Look Ahead Alerting continued

In -210-210 and later versions, the look-ahead alerting algorithms are improved at higher airspeeds (about 300 knots or greater). The look-ahead distance is designed to provide a 60-second warning alert for up to 8 nm look-ahead (as opposed to 30-seconds or up to 4 nm). With version -218-218 and later, the look-ahead distance is increased by 12.5%, and the allowed terrain clearance height is increased for descents at high speeds to improve alerting times.

The specific aural message provided is established during the initial installation of the EGPWS as a function of whether or not the terrain and obstacles features are enabled and the selected audio menu (via program pin selection).

Terrain Alerting and Display

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

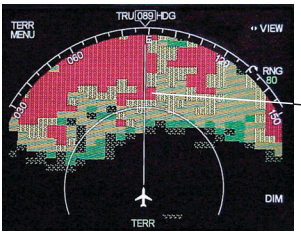
When a compatible Weather Radar, EFIS, or other display is available and enabled, the EGPWS Terrain Alerting and Display (TAD) feature provides an image of the surrounding terrain represented in various colors and intensities.

There are two types of TAD displays depending on the options selected. The original type provides a terrain image only when the aircraft is 2000 feet or less above the terrain. A second type called "Peaks" enhances the display characteristics to provide a higher degree of terrain awareness independent of the aircraft's altitude (available for selected display types in version -206-206 with additional displays added in later versions). In either case, terrain and obstacles (if enabled) forward of the aircraft are displayed. Obstacles are presented on the cockpit display as terrain, employing the same display-coloring scheme. TAD, Peaks and Obstacle functions are enabled by EGPWS program pin selection.

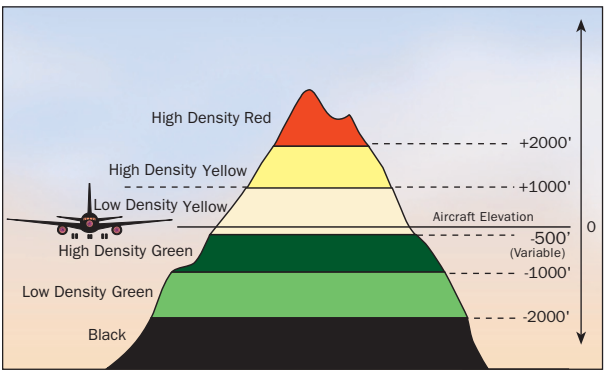
NOTE: With respect to Non-Peaks or Peaks display, terrain and or obstacle presentation is always based on (and scaled for) the geographic area available for display. Consequently, terrain and/or obstacles outside of the selected display range and defined display sweep do not have any effect on the displayed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

Non-Peaks Display

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.



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 -218-218 or later, the transition to black may occur below 400 feet based on runway and terrain database integrity for a given area.



NON-PEAKS DISPLAY CONTINUED

When a caution alert is triggered, the terrain (or obstacle) that created the alert is changed to solid yellow (100% density) as illustrated below.

60 SECONDS FROM PROJECTED IMPACT "CAUTION TERRAIN!"

CAUTION TERRAIN IS SOLID YELLOW

Honeywell MFRD shown

When a warning alert is triggered, the terrain (or obstacle) that created the alert is changed to solid red (100% density) as illustrated below.

30 SECONDS FROM PROJECTED IMPACT "TERRAIN, TERRAIN, –PULL UP!"

WARNING TERRAIN IS SOLID RED

Honeywell MFRD shown

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. Also, 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.

Non-Peaks Display continued

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.

"Pop-Up" and "Auto-Range"

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

- Automatic display of terrain on the cockpit display ("TAD pop-up") in the event that a caution or warning alert is triggered as described in Terrain Look Ahead Alerting. 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 changes color until the range is manually reselected 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's 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).

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. These are based on the range selected (terrain in view).

The location of the digital values can vary somewhat for the display used, but for this guide 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

PEAKS DISPLAY CONTINUED

is presented the same as the color of the terrain display containing that elevation (i.e., red if the terrain/obstacle with that elevation is depicted as red in the terrain plan view, yellow if yellow, etc.).

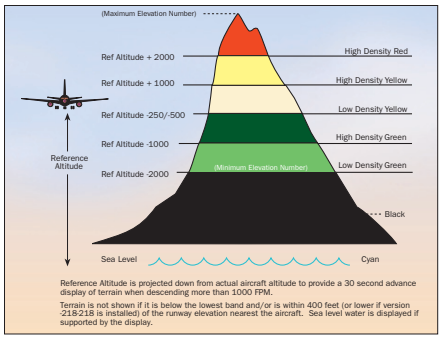
When the aircraft is 500 feet (250 with gear down) or less above the terrain in view (yellow or red is displayed), the Peaks color scheme is identical to the standard display, with the exception of the addition of sea level when supported by the display.

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

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

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

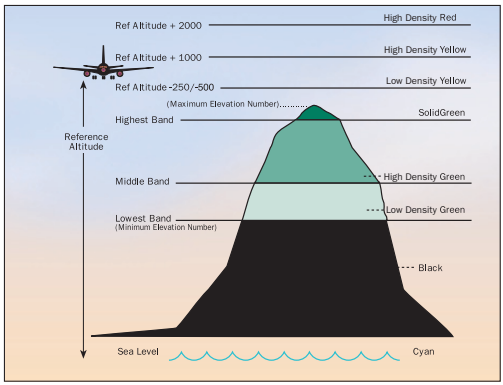
Honeywell MFRD shown



PEAKS DISPLAY CONTINUED

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

Honeywell MFRD shown



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 (250 with gear down) 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 (250 with gear down) feet of aircraft altitude.
High Density Green Fill	Terrain/Obstacle that is 500 (250 with gear down) feet below to 1000 below aircraft 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 data-base for the magenta area shown.

Note: magenta may be displayed at or near the South and North Poles dependent upon the airplane flight path and location.

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 effects the basic GPWS functions (modes 1-7).

If Peaks display mode is not active and TAD becomes unavailable due to position error, terrain inoperative or unavailable is not indicated if the aircraft is greater than 8000 feet above the highest terrain or obstacle within a 320nm radius. 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 longterm illumination of the condition 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, non-standard pressure altitude conditions, and altimeter miss-sets. This ensures an optimal EGPWS Terrain Alerting and Display capability. Geometric Altitude also allows EGPWS operations in QFE environments without custom inputs or special operational proceedures.

Geometric Altitude requires 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.

The Geometric Altitude is computed by blending a calculated Non-Standard Altitude, Runway Calibrated Altitude (determined during takeoff), GPS Calibrated Altitude, Radio

GEOMETRIC ALTITUDE continued

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. If GPS Altitude fails or is not present, then the EGPWS reverts to using Corrected Barometric Altitude alone.

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

WEATHER RADAR AUTO-TILT

In -210-210 and later versions, the EGPWC computes a optimum Weather Radar tilt angle based on the aircraft altitude (ASL) and the terrain elevation ahead of the aircraft. This is output and available to a compatible Weather Radar system so that the tilt angle may be automatically set for optimum operation.

AURAL MESSAGE PRIORITY

Two or more messages may be activated simultaneously, so a message priority has been 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
"Windshear, Windshear, Windshear" [d, j]	7
"Pull Up" [k]	1, 2
"Terrain, Terrain"	2
"Terrain, Terrain Pull Up" [h, k]	TA
"Obstacle, Obstacle Pull Up" [c, i, k]	TA
"Terrain"	2
"Minimums" [a, c]	6
"Caution Terrain, Caution Terrain" [c, f]	TA
"Caution Obstacle, Caution Obstacle" [c, g]	TA
"Too Low Terrain"	4, TCF
Altitude Callouts [c]	6
"Speed Brake, Speed Brake" [c]	6
"Too Low Gear"	4A
"Too Low Flaps"	4B
"Sink Rate, Sink Rate"	1
"Don't Sink, Don't Sink"	3
"Glideslope"	5
"Approaching Minimums" [b, c]	6
"Bank Angle, Bank Angle" [c]	6
"Caution Windshear" [c, d, e]	7
"Autopilot" [c]	6
"Flaps, Flaps" [c]	6
"RAAS Advisories"	RAAS

Notes:

a) May also be "Mininum", "Minimums, Minimums", "Decision Height" or "Decide".

b) May also be "Approaching Decision Height", "Fifty Above", "Plus Hundred".

c) Message is dependent on aircraft type or option selected.

d) Windshear detection alerts provided for some aircraft types.

e) Audio alert may or may not be enabled.

f) May also be "Terrain Ahead, Terrain Ahead".

g) May also be "Obstacle Ahead, Obstacle Ahead"

h) May also be "Terrain Ahead Pull Up"

i) May also be "Obstacle Ahead Pull Up"

j) May be preceded by siren.

k) "Pull Up" voice may be proceded by "Whoop, Whoop"

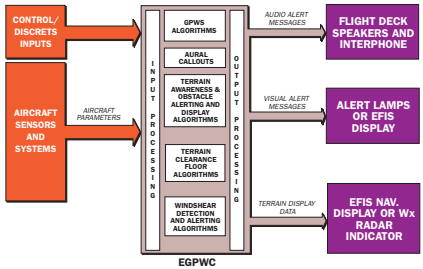
TA=Terrain Look-Ahead Alert

TCF=Terrain Clearance Floor

RAAS=Runway Awareness Advisory System

System Inputs

The EGPWS uses various input signals from other on-board systems. The full compliment 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. Accelerations, Angle-of-Attack (AOA), and Flap position is required for Windshear. Inputs are also required for discrete signal and control input.



Air Data

The EGPWS utilizes signals from the following systems:

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

Radio Altitude

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

In -210-210 and later versions, the EGPWC 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 (1500 feet with version -218-218 or later). 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 -218-218 or later).

RADIO ALTITUDE CONTINUED	This feature reduces the potential for nuisance alerts caused by false tracking of the Radio Altimeter.
FMS, IRS, AHRS, ACCELEROMETER	Pitch and Roll Attitude, Latitude and Longitude Position, Body Normal and Longitudinal Accelerations, Magnetic and True Track Angles, Magnetic and True Heading, Inertial Altitude, Groundspeed, and mode.
GLOBAL POSITIONING SYSTEM (GPS)	Latitude and Longitude Position, True Track Angle, GPS Altitude, Groundspeed, Horizontal and Vertical Figure of Merit (VFOM/HFOM), Horizontal and Vertical Dilution of Precision (HDOP/VDOP), Horizontal Integrity Limit (HIL), and sensor status. Note: Runway Awareness and Alerting System (RAAS) function requires a GPS source capable of providing latitude (fine) and Longitude (fine) data.
VHF NAV RECIEVER	Glideslope, Localizer, ILS Tuned, Selected Runway Heading.
TERRAIN DISPLAY SYSTEM	Display range, and if available the Hazard Bus from a Predictive Windshear System (PWS). If EFIS, the EFIS display mode is used in some configurations.
AOA VANE OR STALL WARNING	AOA, Stick Shaker Margin.
DISCRETES	Discrete inputs are used for system configuration, signal/status input, and control input functions. EGPWS program pins are utilized to tell the system the type of aircraft and interface that it is in. These are defined and established during the EGPWS installation. EGPWS output functions are consequently the result of the program pin state read each time the EGPWS is powered on. Signal/status discretes include signals such as Decision Height, Landing Flaps selected or Flap Position discretes, Landing Gear selected, Terrain Display Range, and status discretes such as Glideslope Valid, Localizer Valid, 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, Altitude Callout Enable, Steep Approach Enable, and ILS Tuned discretes.

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., windshear) 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 alert and status annunciations, and display terrain video when a compatible display system is 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 EGPWC based on the aircraft's current position relative to the surrounding terrain. This video is presented to a Weather Radar indicator, EFIS display, or a dedicated display unit.

Options

The EGPWC uses program pin discrete inputs (or software upgrade - RAAS only) 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 list summarizes available Operator options (excluding sensor and equipment configuration options):

- **RAAS** – Provides audio-only advisories of position during ground operations and approach to landing.
- **Flashing Lamps** – When selected causes alert annunciators to flash when active.
- **TAD and TCF Disable** – Suppresses all TAD and TCF alerting and display functions.
- **Altitude Callouts** – Selects desired altitude callouts from a menu of options.
- **Audio Output Level** – Selects desired audio output level High, Medium, or Low.
- **Alternate Mode 6 Volume** – Selects reduced Mode 6 volume (-3 dB).

- **Obstacle Awareness Enabled** – Enables obstacle alerting and display.
- **TAD Alternate Pop Up** – If TRUE, disables (or enables) automatic terrain display when TAD or Obstacle alert is active, dependent on aircraft/display type.
- **Mode 6 Volume Reduction** – Selects reduced Mode 6 volume (-6 dB).
- **Smart Callout Enable** – Enables the 500-foot smart callout. "Five Hundred" is called out at 500 feet Radio Altitude during non-precision approaches. If 500' is part of the altitude callout option selected, this callout is not given on precision approaches.
- **Bank Angle Enable** – Enables Bank Angle alerts.
- **Windshear Caution Voice Disable** – Disables Windshear Caution voice alerts providing visual alerts only.
- **Audio Declutter Disable** – Disables the Audio Declutter function so that audio alerts are constant.
- **Audio Alerting Voice Select** – Selects the type(s) of voice that are used for audio alerts.
- **Lamp Format** – One of two lamp formats are available.
  - Lamp Format 1 provides only Mode 5 "Glideslope" alerts to the caution (amber) lamp output and all other alerts (except Windshear and Mode 6 callouts) to the warning (red) lamp output.
  - Lamp Format 2 provides all "Pull Up" warning alerts to the warning (red) lamp output and all caution alerts to the caution (amber) lamp output (FAA requirement for new installations).

NOTE: Windshear annunciations are provided by separate outputs and indications and are not affected by lamp format. Mode 6 advisories do not effect any annunciation and are not affected by lamp format.

- **Peaks Enable** – Adds additional density patterns and level thresholds to the Standard Display Mode, allowing display of highest and lowest terrain/obstacle to increase situational awarness.

OPTIONS CONTINUED

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

- **EGPWS Self-Test** – Cockpit switch initiates EGPWS Self-Test on the ground. Typically part of EGPWS warning (red) lamp.
- **Glideslope Cancel** – Cockpit switch cancels Mode 5 Glideslope alerting. Typically part of EGPWS caution (amber) lamp.
- **Glideslope Inhibit** – Inhibits Mode 5 Glideslope alerting. Normally used for backcourse approaches.
- **Altitude Callout Enable** – Enables Mode 6 Callouts.
- **Mode 6 Low Volume** – Reduces Mode 6 volume (an additional) 6 dB. This is typically hardwired or connected to an external switch.
- **TAD and TCF Inhibit** – Cockpit switch to disable all TAD and TCF functions. (FAA requirement)
- **Audio Inhibit** – disables all EGPWS audio outputs.
- **Steep Approach Enable** – Enables Steep Approach (Mode 1 Excessive Descent Rate) alerts biasing.
- **Steep Approach Select** – Selects (activates) Steep Approach (Mode 1 Excessive Descent Rate) alerts biasing to reduce nuisance alerts.
- **Flap Over-Ride** – Cockpit switch to select landing flaps when not in the landing flap configuration.
- **Gear Over-Ride** – Cockpit switch to select gear down when not in the gear down configuration.
- **PLI Select/Deselect** – Used for displaying or deselecting the display of EGPWS derived Pitch Limit Indicator (PLI) signals when a Windshear warning occurs.

For additional options information contact Honeywell.

SECTION 3

Operational Procedures

System Constraints

System constraints for the EGPWS are:

- If terrain data is unavailable for a particular area, then Terrain and Obstacle alerting and display is not available for that area and the affected display area is colored MAGENTA. (normally only displayed at or near North and South Poles dependent upon airplane flight path and location).
- 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 within 15 nm on approach to an airport or runway that is not in the airport/runway database to avoid unwanted alerts.
- TAD/TCF functions should be manually inhibited during QFE operations if GPS data is unavailable or inoperative.
- 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 and Windshear). 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 recieved 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.
- If enabled, the EGPWS uses onboard measurement of air mass parameters and aircraft acceleration for detection of windshear. This is a reactive system and cannot predict windshear, which may be ahead of the aircraft.

System Constraints continued

- The EGPWS terrain/obstacle database includes cataloged human-made obstructions 100 feet high or greater within North America and portions of Europe and the Caribbean (expanding). 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
- IRS, AHRS, VG (attitude)
- GPS, FMS, or IRS (position)
- Landing gear
- Landing flaps
- Stall warning or AOA (windshear only)
- Weather Radar, 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).

Some installations utilize redundant systems so that if the primary source of data fails, the EGPWS continues on the secondary source.

System Activation continued

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

Refer to an appropriate AFM or EGPWS AFMS for specific system and status requirements.

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 EGPWC.

Level 3 – **EGPWS Configuration** indicates the current configuration by listing the EGPWS hardware, software, databases, and program pin inputs detected by the EGPWC.

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

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 Go/No Go Test is normally performed by flight crews as part of preflight checks. All other levels are typically used for installation checkout and maintenance operations.

EGPWS Self-Test continued

Level 1 Self 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.

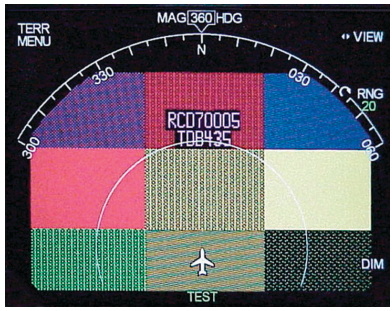
When a Self-Test is initiated, the EGPWC first checks for any configuration (installation or database) errors. If any are detected it is audibly enunciated and the test is terminated. If none detected, the test continues through a sequence resulting in turning on and off all system annunciators, enunciating specific audio messages, and if enabled, displaying a video test pattern on the terrain display (see illustration below). 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, W/S INOP, and TERR INOP annunciators turn on.
- Amber caution ("BELOW G/S" or "GPWS") annunciators turn on.
- "GLIDESLOPE" is announced over speaker.
- Amber annunciators turn off.
- G/S CANCEL annunciators turn on (if installed).

EGPWS Self-Test continued

- G/S CANCEL annunciators turn off.
- Red warning (“PULL UP” or “GPWS”) annunciators turn on.
- “PULL UP” is announced over speaker.
- Red warning annunciators turn off.
- Red Windshear warning annunciators turn on.
- (Siren) “WINDSHEAR, WINDSHEAR, WINDSHEAR” is announced over speaker.
- Red Windshear warning annunciators turn off.
- Amber Windshear caution annunciators turn on (if installed and enabled).
- Amber Windshear caution annunciators turn off.
- Red warning (“PULL UP” or “GPWS”) annunciators turn on.
- “TERRAIN, TERRAIN, PULL UP” is announced over speaker.
- Terrain test pattern is displayed (RCD XXXXX indicates loaded RAAS Configuration Database (RCD) and is shown only in RAAS enabled installations, TDB XXX indicates loaded Terrain Database (TDB) and is shown only in -218-218 or later versions).



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

6. Verify expected indications and enunciations 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),
- severe windshear conditions (mode 7)
- Runway Awareness Advisories (RAAS)

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.
(SIREN) "WINDSHEAR (3x)"	7		
Any "PULL UP"	1,2,TA		
"CAUTION WINDSHEAR"		7	
"TERRAIN, TERRAIN"		2, TA	
"OBSTACLE, OBSTACLE"		TA	
"TERRAIN"		2	
"APPROACHING MINIMUMS"			6
"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
Any RAAS Advisories			RAAS

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 and Alerting 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's flightpath 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”, "RunwayXX" - if RAAS enabled).
Response to these callouts should be in accordance with standard operating procedures.

WINDSHEAR CAUTION

This alert generally occurs due to increasing performance windshear conditions (i.e., increasing headwind, decreasing tailwind, and/or updraft). This alert is generally considered advisory in that the crew response is to be alert to the possibility of subsequent significant airspeed loss and down draft conditions. Coupled with other weather factors, the Windshear Caution should be considered in determining the advisability of performing a go-around.

Wind and gust allowances should be added to the approach speed, increasing thrust if necessary. It may be necessary to disengage autopilot or auto-throttle. Avoid getting low on the approach glidepath or reducing the throttles to idle.

WINDSHEAR WARNING

When a Windshear warning occurs, the following procedures should be followed:

1. Immediately initiate the Windshear escape maneuver in accordance with established Windshear procedures.
2. Aggressively apply maximum rated thrust, disengage autopilot and/or auto-throttle if necessary.
3. Rotate smoothly to the go-around/take-off pitch attitude, allowing airspeed to decrease if necessary. Maintain wings level. Do not retract flaps or landing gear.
4. If the aircraft continues to descend, increase pitch attitude smoothly and in small increments, bleeding air speed as necessary to stop descent. Use Stall Warning onset (stick shaker) as the upper limit of pitch attitude.
5. Maintain escape attitude and thrust and delay retracting flaps or landing gear until safe climb-out is assured.

NOTE: Engine overboost should be avoided unless the airplane continues to descend and airplane safety is in doubt.

WINDSHEAR WARNING continued

If overboost is required, adjust throttles back to maximum rated thrust as soon as safety has been assured.

Overboosting engines while at high angle of attack near airplane stall may cause engine stall, surge, or flameout.

Maintain escape attitude and thrust and delay retracting flaps or landing gear until safe climb-out is assured.

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. This may be accomplished automatically by on-board systems or manually selected by a cockpit switch. When active, Mode 1 alerts are desensitized to compensate for normally higher descent rates for these types of operation, eliminating related unwanted alerts. If implemented with a cockpit switch, this requires manual deactivation.

MODE 2 EXCESSIVE CLOSURE TO TERRAIN

When required to operate in close proximity to terrain (less than 2500' above), Mode 2 alerts can be desensitize or overridden by activating the FLAP OVER-RIDE switch to eliminate related unwanted alerts. This requires manual deactivation.

MODE 4 UNSAFE TERRAIN CLEARANCE

Mode 4 alerts can be reduced by activation of the FLAP OVER-RIDE switch, or GEAR OVER-RIDE. This is generally recommended when performing approaches with less than landing flaps selected, or landing gear not down. This requires manual deactivation.

MODE 5 DESCENT BELOW GLIDESLOPE

Mode 5 Glideslope alerts can be manually canceled when below 2000 feet Radio Altitude (or 1000 feet dependant on aircraft type) 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 or 1000 feet dependant on aircraft type.

Mode 5 Descent Below Glideslope continued

In some cases, an Alternate G/S Cancel is available. This allows the Mode 5 alerting to be canceled at any time and any altitude. In this configuration, which is defined only for certain aircraft types or by program pin, pressing the G/S Cancel switch in the cockpit has the effect of inhibiting Mode 5 alerting. It can be manually reset by again pressing the G/S Cancel switch, or it is automatically reset following landing, if flap or gear state changes (i.e., down to up), or when the aircraft climbs above a predetermined altitude (defined for the aircraft type). Because of the nature of this type of G/S Cancel, a cockpit indication of its activation is required.

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, this input to the EGPWC may be connected to that system 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 used when position accuracy is inadequate or when operating at airports or runways not in the terrain database. Selection of Terrain Inhibit does not cause the Terrain Inoperative annunciation unless the aircraft is wired for this to occur. Terrain Inhibit requires manual deactivation.

Emergency Procedures

The EGPWS Flap or Gear Over-ride, TAD/TCF Inhibit, or other switches (as installed) may be used as required for an emergency situation (e.g., landing gear up).

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

SECTION 4

DEFINITIONS Acronyms shall be interpreted as shown:

AFM	Airplane Flight Manual
AFMS	Airplane Flight Manual Supplement
AGL	Above Ground Level
AHRS	Attitude/Heading Reference System
AOA	Angle of Attack
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
EGPWC/S	Enhanced Ground Proximity Warning Computer/Systems
FAA	Federal Aviation Administration
FMS	Flight Management System
FPM	Feet Per Minute
F/W	Fail Warning
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glideslope
HDOP	Horizontal Dilution of Precision
HFOM	Horizontal Figure of Merit
HIL	Horizontal Integrity Limit
Hz	Hertz (cps)
ICD	Interface Control Document
ILS	Instrument Landing System
INOP	Inoperative
IRS	Inertial Reference System
IVS	Inertial Vertical Speed
MCP	Mode Control Panel
MCU	Modular Concept Unit
MFD	Multi Function Display
MLS	Microwave Landing System
MSL	Mean Sea Level
MTC	Minimum Terrain Clearance

PCMCIA	Personal Computer Memory Card Industry Association
PLI	Pitch Limit Indicator
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 (1,013.25 mb). 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.
RAAS	Runway Awareness Advisory System
RAIM	Receiver Autonomous Integrity Monitoring
RFCF	Runway Field Clearance Floor
SAT	Static Air Temperature
TA	Terrain Awareness
TAD	Terrain Alerting and Display
TCAS	Traffic Collision Avoidance System
TCF	Terrain Clearance Floor
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
WS	Windshear

Runway Awareness and Advisory System (RAAS) Pilot Guide

Table of Contents

SECTION 1

INTRODUCTION

This Pilot Guide describes the functions and operation of the MKV and MKVII EGPWS Runway Awareness and Advisory System (RAAS).

The document is divided into the following sections:

- Section 1 - An introduction to the RAAS;
- Section 2 - A *Quick Reference* guide to the operation of the RAAS;
- Section 3 – A detailed description of the operation of RAAS;
- Section 4 – A summary of the options available to operators to configure RAAS;
- Section 5 – Overview of the three audio levels employed for RAAS;
- Section 6 – Means for the flight crew to check the operational availability of RAAS.
- Section 7 - Frequently Asked Questions

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 and RAAS.

The information in this document is intended as a general explanation of the Honeywell RAAS. It contains a description of system performance assuming the identified options are active.

WHY RAAS?

It is well recognized that runway incursions and overruns are a high-profile operational safety issue worldwide. For example, the USA is currently experiencing at least one runway incursion per day at towered airports alone. Safety data indicate that lack of flight crew position awareness during ground operations and on approach have contributed to such occurrences worldwide. Recent industry safety recommendations advocate the need for new flight deck runway incursion prevention systems. Honeywell has developed the RAAS as a practical and low-cost system with significant input from hundreds of pilots. Extensive human factors evaluations confirm the positive operational safety benefits of RAAS: increased position awareness; enhanced crew decision-making; reduced crew workload; and superior detection of position errors leading to runway incursions.

What is the RAAS?

The purpose of the Honeywell RAAS is to provide the flight crew with supplemental information of aircraft position relative to runways during surface operations and on final approach. RAAS is an aural-only advisory function, and therefore, a visual display of the information is not provided. RAAS provides timely aural advisory messages to the flight crew in a significant number of scenarios that have led to runway incursions. It should be noted that RAAS is not intended for navigation purposes, e.g., to guide an aircraft in or around the terminal area.

RAAS is integrated with the EGPWS. EGPWS protection and operation is unaltered by the addition of RAAS. Note that RAAS advisories have a lower priority than any EGPWS terrain-related alerts, including radio altitude call-outs.

How Does RAAS Work?

The RAAS uses aircraft inputs within the EGPWS such as GPS position, heading, groundspeed and a runway database to generate the ten aural advisories shown in the tables below. Note that GPS availability is a requirement for the operation of RAAS. Aircraft position is referenced to the GPS antenna position. RAAS does not have knowledge of taxiways, Automatic Terminal Information Service (ATIS) & Notice to Airmen (NOTAM) information, other traffic, pilot intent, ATC clearance, ground markings and signage. Crews should be cognizant of the prevailing ATIS and any NOTAMs. RAAS operates automatically, without any action required from the flight crew.

Summary of Routine Advisories

Routine Advisory	Purpose
Approaching Runway - On Ground	Awareness of a runway being approached by the aircraft during ground operations (e.g., "Approaching one-one").
On Runway	Awareness of which runway the aircraft is lined-up with during ground operations (e.g., "On runway three-four left").
Approaching Runway - In Air	Awareness of which runway the aircraft is tracking on final approach (e.g., "Approaching one-six right").
Landing Distance Remaining	Awareness of aircraft position relative to the runway end (e.g., "One-thousand remaining").
Runway End	Awareness of the position of the aircraft relative to the runway end (e.g., "One-hundred remaining").

How Does RAAS Work? Continued

Summary of Non-Routine Advisories

Non-Routine Advisory	Purpose
Taxiway Take-off	Awareness of excessive taxi speeds or a take-off on a taxiway ("On taxiway! On taxiway!").
Insufficient Runway Length - On-Ground	Awareness of which runway the aircraft is lined-up with, and that the runway length available for takeoff is less than a defined nominal take-off runway length (e.g., "On runway three-four left, six-hundred remaining").
Extended Holding on Runway	Awareness of an extended holding period on the runway (e.g., "On runway three-four left, on runway three-four left").
Distance Remaining - Rejected Take-off	Awareness of aircraft position during a RTO (e.g. "two-thousand remaining")
Approaching Short Runway - In-Air	Awareness of which runway the aircraft is tracking, and that the runway length available for landing is less than a defined nominal landing runway length (e.g., "Approaching three-four right, three-thousand remaining").

Note that during normal operations, the crew would only be exposed to the five routine advisories for the entire period between push-back at the departure airport and taxi-in at the destination airport. The five advisories alone have the potential to address many classic runway incursion scenarios.

RAAS advisories are heard over the same aircraft audio systems that presently provide EGPWS audio caution and warning alerts in the flight deck. The volume of RAAS messages is controlled by the EGPWS and the RAAS message volume level is based on the expected flight operation for each advisory.

As mentioned above, RAAS operates automatically, without any action required from the flight crew. The EGPWS circuit-breaker disables all EGPWS functionality including RAAS. The EGPWS Self-Test push-button (if available) allows the crew to verify the operational availability of all EGPWS functions, including the RAAS. An optional RAAS Audio Inhibit Switch may be installed. A single push of the Audio Inhibit Switch inhibits all RAAS advisories. De-pressing the switch reactivates all RAAS advisories.

It is important to note that some RAAS features are optional and may not be active in a given installation. Therefore you will need to check the options selected by your company. Refer to an applicable Airplane Flight Manual (AFM) or EGPWS Airplane Flight Manual Supplement (AFMS) for details. Alternatively contact Honeywell for assistance.

How Does RAAS Work? Continued

The default setting for the advisories is a female voice. Advisories that include runway length in the annunciation may be annunciated in feet or metres. The default setting for these advisories is feet. These options are discussed in detail in the "RAAS Options" section of this Pilot Guide.

Appropriate flight crew actions to RAAS advisories are:

On-Ground:

If in doubt, stop, VERIFY POSITION, and contact ATC for assistance if necessary. Do not hesitate to request progressive taxi instructions.

In-Air:

If the advisory is in conflict with expectations, VERIFY POSITION, contact ATC for assistance if necessary. Consideration should be given to a go-around in accordance with company SOPs.

Information contained herein or provided by a RAAS advisory does not supercede any operator Standard Operating Procedure (SOP). Pilots should be thoroughly familiar with regulatory, company, and other approved operational procedures as required by their aircraft and type of operation. Operators should also include RAAS in their training curriculum.

Where and When Does RAAS Work?

RAAS provides advisories during surface operations and on final approach. RAAS is operationally available anytime the EGPWS is powered and the following conditions are met:

- The software for the RAAS functions have been loaded and enabled into an EGPWS by your company;
- The aircraft is on or approaching an airport in the RAAS runway database; and
- RAAS is functional (e.g. all external signals are available and not faulted, GPS position accuracy meets minimum RAAS requirements and there are no internal EGPWS faults).

Where and When Does RAAS Work? Continued

The RAAS runway database is included as part of the installed terrain/obstacle/runway database, and is updated periodically. Operators should ensure that they are using the most recent RAAS runway database. Further details of the specific airports included in the RAAS database and procedures for operators to acquire the latest RAAS database are provided on the Internet at www.egpws.com. Alternatively contact Honeywell for further assistance. The crew can verify the RAAS runway database in use for their installation by viewing the terrain display test pattern during a Go/No Go self test.

RAAS operational availability is integrated into the existing EGPWS fault monitoring and self-test functions. Consistent with approved EGPWS self-test design, the loss of RAAS functions is indicated on-ground only during a self-test. There is no automatic annunciation of the loss of RAAS functionality. RAAS status can also be displayed on the terrain display. This is active only when the aircraft is on the ground. The procedure requires the flight crew to select the terrain display followed by a change in the displayed range (to a higher or lower range). RAAS status is annunciated for two sweeps of the terrain display. This feature is available on all aircraft, but is primarily intended for those aircraft where the flight crew does not perform a self-test. The various self-test messages are presented later in the "Operational Availability" section.

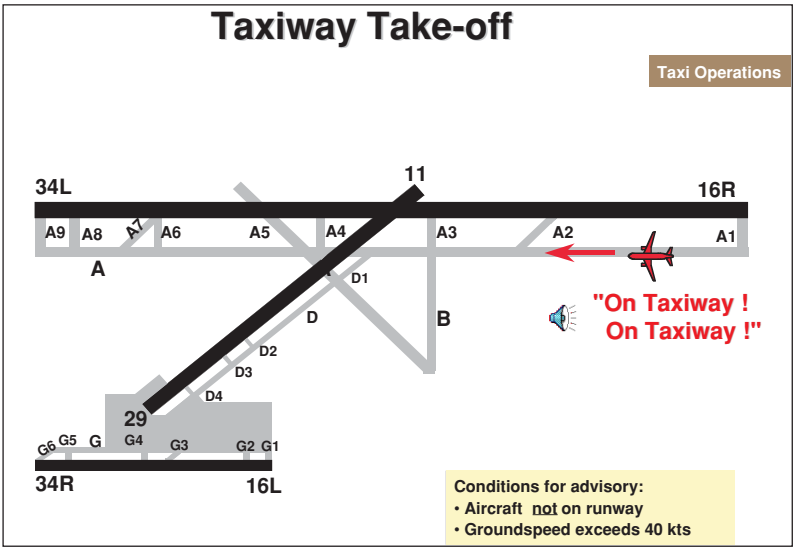
SECTION 2

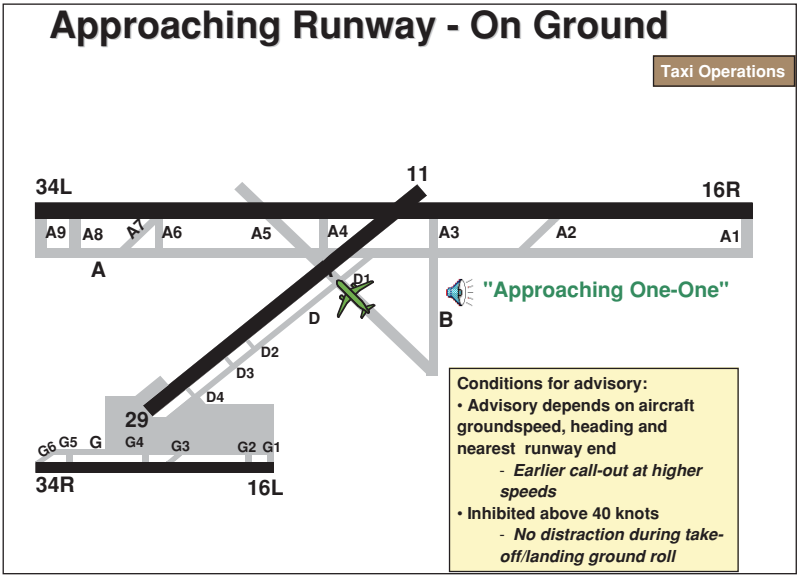
QUICK

REFERENCE

RAAS QUICK REFERENCE

RAAS Quick Reference

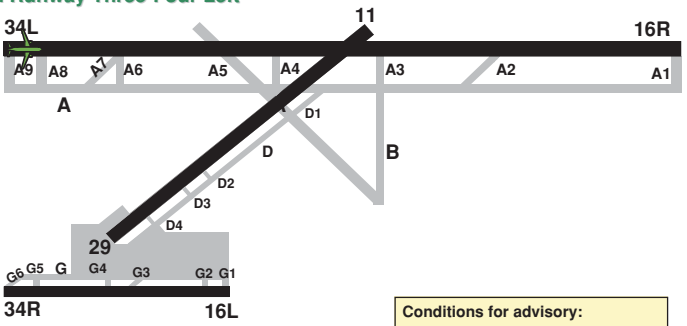




On Runway

Runway Entry

"On Runway Three-Four Left"



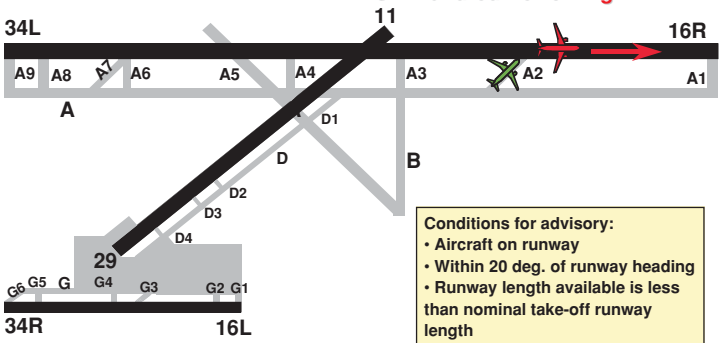
Conditions for advisory:
- Aircraft on runway
- Within 20 deg. of runway heading

Intersection Departure / Insufficient Rwy

Runway Entry

Example in metres

"On Runway Three-Four Left, Six-Hundred Remaining"



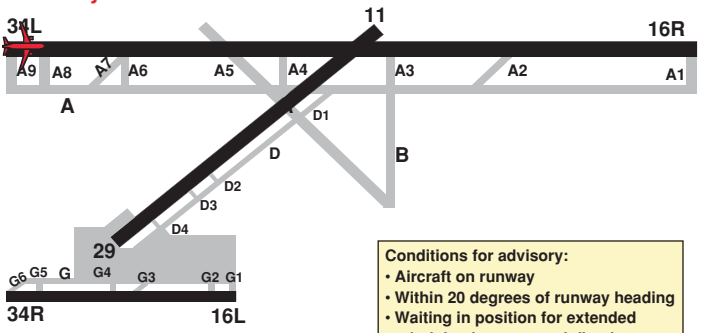
Conditions for advisory:
- Aircraft on runway
- Within 20 deg. of runway heading
- Runway length available is less than nominal take-off runway length
  - *Operator defined nominal runway length in metres or feet***

*** Confirm units using EGPWS self-test*

Extended Holding On Runway

Runway Occupancy

"On Runway Three-Four Left,
On Runway Three-Four Left"



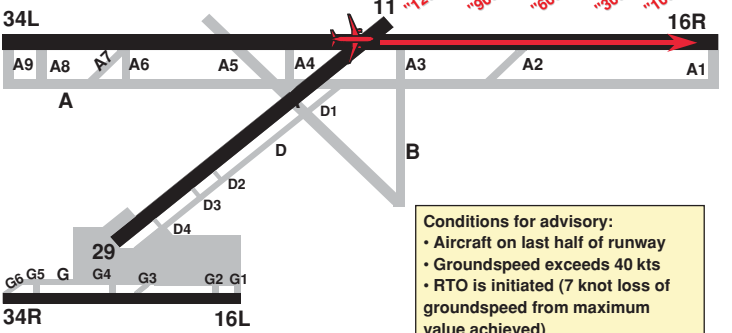
Conditions for advisory:
- Aircraft on runway
- Within 20 degrees of runway heading
- Waiting in position for extended period that is operator defined
  - e.g., 90s

Rejected Take-off

RTO

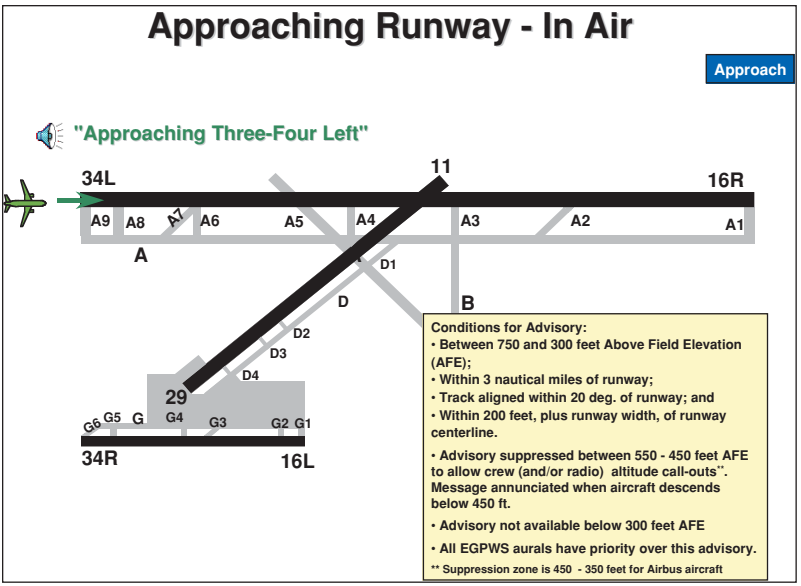
Example in metres:

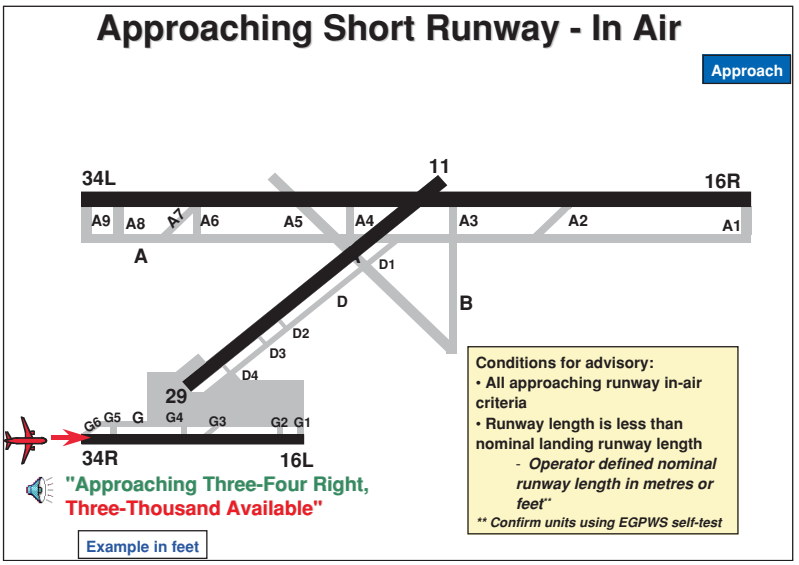
"1200 Remaining" "900 Remaining" "600 Remaining" "300 Remaining" "100 Remaining"



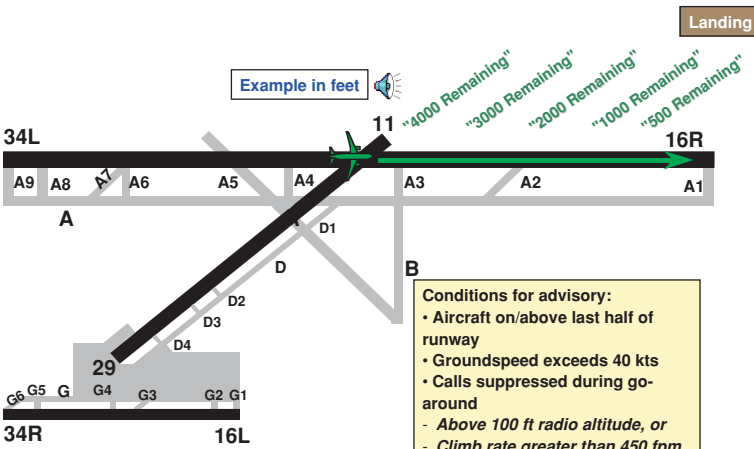
Conditions for advisory:
- Aircraft on last half of runway
- Groundspeed exceeds 40 kts
- RTO is initiated (7 knot loss of groundspeed from maximum value achieved)

*Operator defined units in metres or feet***
*** Confirm units using EGPWS self-test*

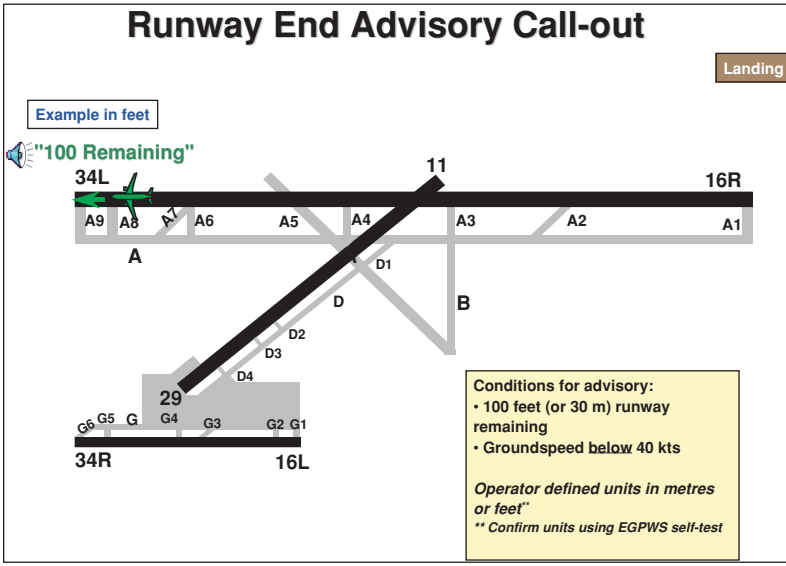

Approaching Runway - In Air
Approach
"Approaching Three-Four Left"
34L
11
16R
A9
A8
A7
A6
A5
A4
A3
A2
A1
A
B
D
D1
D2
D3
D4
29
G6
G5
G
G4
G3
G2
G1
34R
16L
Conditions for Advisory:
• Between 750 and 300 feet Above Field Elevation (AFE);
• Within 3 nautical miles of runway;
• Track aligned within 20 deg. of runway; and
• Within 200 feet, plus runway width, of runway centerline.
• Advisory suppressed between 550 - 450 feet AFE to allow crew (and/or radio) altitude call-outs**. Message annunciated when aircraft descends below 450 ft.
• Advisory not available below 300 feet AFE
• All EGPWS aurals have priority over this advisory.
** Suppression zone is 450 - 350 feet for Airbus aircraft


Approaching Short Runway - In Air
Approach
34L
11
16R
A9
A8
A7
A6
A5
A4
A3
A2
A1
A
B
D
D1
D2
D3
D4
29
G6
G5
G
G4
G3
G2
G1
34R
16L
"Approaching Three-Four Right,
Three-Thousand Available"
Example in feet
Conditions for advisory:
• All approaching runway in-air criteria
• Runway length is less than nominal landing runway length
- Operator defined nominal runway length in metres or feet**
** Confirm units using EGPWS self-test

Distance Remaining - Landing and Roll-out



Runway End Advisory Call-out



The RAAS uses aircraft inputs from the EGPWS such as GPS position, heading, groundspeed and a runway database to generate the runway awareness aural advisories. Note that GPS availability is a requirement for the operation of RAAS. Aircraft position is referenced to the GPS antenna position. RAAS does not have knowledge of taxiways, ATIS & NOTAM information, other traffic, pilot intent, ATC clearance, ground markings and signage. Crews should be cognizant of the prevailing ATIS and any NOTAMs. (Similarly, data on newly constructed runways or changes to length of existing runways may not necessarily be included in the RAAS runway database). RAAS operates automatically, without any action required from the flight crew.

The RAAS advisories are presented below for the relevant flight phases. Note that all RAAS advisories have a lower priority than any existing EGPWS alert, including radio altitude call-outs.

TAXI OPERATIONS

Taxiway Take-Off Advisory

A Honeywell runway incursion study indicates that 7% of take-offs and landings were from/onto a taxiway. The purpose of the Taxiway Take-Off Advisory is to enhance crew awareness of excessive taxi speeds or a take-off on a taxiway.

This advisory is provided for each of the following conditions:

- inadvertent taxiway take-off or excessive taxi speeds; and
- approved take-off operations on a taxiway (e.g., at airports with a single runway that is closed for surface repairs).

TAXI OPERATIONS CONTINUED

The advisory "On Taxiway! On Taxiway!" is provided once if:

- groundspeed of the aircraft exceeds 40 Kt; and
- aircraft is on a surface other than a runway.

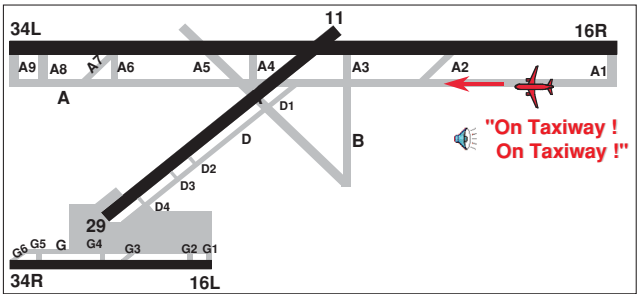
NOTE: RAAS functions are based on a database of runway locations. The system does not have knowledge of the location of taxiways, ramp areas, grass surfaces, etc.

If groundspeed reduces below 40 knots after an advisory is provided (i.e., corrective pilot action taken), the system will generate a single advisory again if the conditions above are met.

Note that there are situations where a runway may be closed (e.g. for construction) and take-off and landing operations authorized on a taxiway. In that case, this advisory serves to confirm a non-normal operation.

The advisory would also be activated at RAAS-enabled airports for take-offs on runways that are not yet included in the RAAS database, for example in the case of newly constructed runways. It is recommended that the take-off briefing include reference to this advisory.

The aural message "*On Taxiway! On Taxiway!*" is annunciated once each time the advisory is generated. For example, the advisory would not be heard continuously during an authorized take-off on a taxiway.



Taxiway Take-Off Advisory

Approaching Runway On-Ground Advisory

Safety data show that lack of position awareness has resulted in flight crews lining-up with both the wrong runway and a taxiway for take-off. In addition, in some cases crews failed to hold-short (58% of ground operations occurrences) and/or inadvertently entered an active runway. In many of these latter cases crews were unaware of their position relative to a proximate *runway* edge.

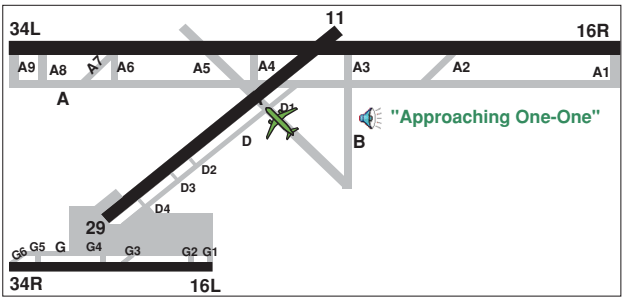
The purpose of the Approaching Runway On-Ground Advisory is to provide the crew with awareness of a proximate runway edge being approached by the aircraft during taxi operations.

This advisory depends upon aircraft groundspeed, current heading and closest runway end and is provided if:

- aircraft groundspeed is less than 40 knots; and
- aircraft is within a specified distance from the runway edge. This distance depends on aircraft groundspeed and closure angle with the runway. Approaching the runway at relatively higher groundspeeds results in an earlier advisory. The advisory is not intended to guarantee stopping the aircraft short of the runway edge.

The annunciation is inhibited above groundspeeds in excess of 40 knots. For example, the advisory would not be heard during the high-speed regime on take-off or landing – this reduces potential distraction in the flight deck. A runway crossing can be encountered below 40 knots, for example during an intersection departure. Therefore it is recommended that crews reference an anticipated low speed (below 40 knots) Approaching Runway Advisory in the take-off briefing.

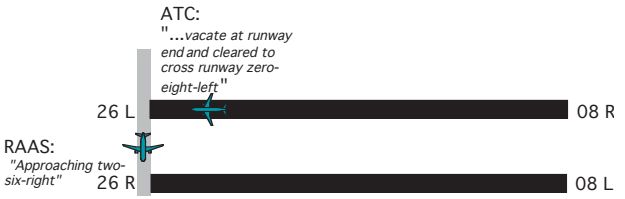
The aural message consists of the word "*Approaching*" followed by the runway identifier of the nearest runway end. For example, "*Approaching one-one*". This advisory is issued once each time the aircraft approaches a runway. For example, for an aircraft approaching a 9000-foot runway (34L / 16R) at a distance of 5000 feet from the 34L end of the runway, the advisory is "*Approaching one-six-right*".



Example of Approaching Runway On-Ground Advisory

If more than one runway meets the qualifying conditions above (e.g. two runways with headings within 20 degrees of each other), then the message "*Approaching runways*" is provided.

Note after landing on a parallel runway, ATC may clear the aircraft to cross the parallel runway at the far end of the landing runway. In this case the ATC clearance to cross the parallel runway would refer to the same landing direction but other runway, and the RAAS Approaching Runway Advisory would refer to the closest runway threshold. For example, consider an aircraft that has landed on runway 08 right, and then cleared to cross runway 08 left after roll-out. The RAAS advisory generated as the aircraft approaches runway 08 Left is "*Approaching two-six-right*." This is normal and consistent with the runway markings at the threshold of runway 26R.



Example of Crossing Parallel Runway After Landing

On Runway Advisory

Runway incursion data indicate that

- 44% of incursions involved poor crew position awareness;
- 12% of all take-offs were from the incorrect runway; and
- 7% of take-offs and landings were from/onto a taxiway.

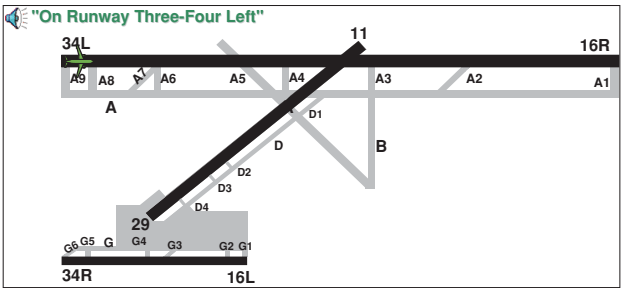
The purpose of the On Runway Advisory is to provide the crew with awareness of which runway the aircraft is lined-up with during ground operations.

The On Runway Advisory is generated when the following conditions are met:

- aircraft enters a runway; and
- aircraft heading is within 20 degrees of the runway heading.

This advisory is inhibited above a 40-knot groundspeed.

The annunciation "*On runway*" followed by the runway identifier is provided as the aircraft lines-up on the runway. For example, "*On runway three-four-left*." Note that for additional emphasis, the use of the word "*runway*" is strictly reserved for this case where the aircraft is <u>on</u> the runway. The advisory is presented once each time the aircraft enters a runway.



Example of On Runway Advisory

Insufficient Runway Length - On-Ground Advisory

Safety data indicate that loss of situational awareness on the airport surface resulted in 12% of all take-offs being conducted from the incorrect runway. In some of those cases the take-off distance available was less than that required. Data also indicates that 24% of runway incursion take-offs involved an intersection departure. While not as common, there have been instances where crews have turned the wrong direction while lining-up on a runway for an intersection departure (i.e. heading error of 180°). This situation not only creates a conflict with any aircraft on short-final, but the runway distance available may be insufficient for a safe take-off.

The purpose of the Insufficient Runway Length - On-Ground Advisory is to provide the crew with awareness of which runway the aircraft is lined-up with, and that the runway length available for takeoff is less than a defined nominal take-off runway length. The "nominal" runway distance for take-off is aircraft type specific and is set by an operator. Note: it cannot be changed by the flight crew.

This advisory is provided when the following conditions are met:

- all conditions for a routine On-Runway Advisory are satisfied; and
- available distance for takeoff is less than the defined nominal runway length.

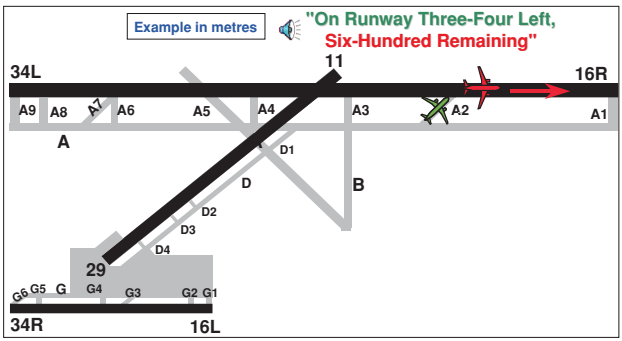
This advisory does not take into account prevailing conditions such as aircraft weight, wind, runway condition & slope, air temperature and altitude of airport. If the operator does not specify the nominal runway length, the advisory is defaulted to off, unless the operator has chosen to always advise the runway length available for takeoff.

RAAS does not account for operational data such as NOTAMs that refer to areas of runway that are not available (e.g. due construction, snow removal, etc). Crews should be cognizant of any NOTAMs and other published restrictions in effect.

Runway Entry and Occupancy Continued

The routine "On runway" message advisory is appended by runway length remaining in either feet or metres, e.g., "*On runway three-four-left, two-thousand remaining*". The "remaining" element of the message refers to the runway distance remaining in the EGPWS database to the nearest 100 feet (or 100 metres for a metric option). Note that the unit (feet or metres) is not annunciated. The unit of length used by RAAS can be confirmed by performing an EGPWS self-test (See "Operational Availability" section).

Dissimilar references to the runway heading during the Approaching Runway and the On Runway advisories are a cue to a potentially unusual situation. In this example assume that the aircraft is cleared for an intersection departure at Alpha 2 for runway 16R. The "*Approaching-one-six right*" advisory is provided as the aircraft approaches the runway at Alpha 2. However, an inadvertent turn on to runway 34L (as opposed to 16R) implies that runway identifier for the Insufficient Runway Length Advisory is runway "34L". If the crew correctly turns onto runway 16R, the runway identifier for the routine On Runway Advisory is "16R". Note that a third reference to the "intended" runway for departure, in this example, is a clearance for take-off from runway "16R" from ATC. During a back-taxi scenario, the Insufficient Runway Length Advisory would aid as a confirmation of pilot intent to back-taxi.



Example of Insufficient Runway Length - On-Ground Advisory in Units of Metres

Extended Holding On Runway

Safety data show that 17% of runway incursions involved the poor use of a line-up-and-wait clearance (or a taxi-into-position-and-hold clearance [TIPH]). The typical scenario involved Tower ATC clearing an aircraft into position-and-hold on to the departure runway. Factors such as distractions in the Tower, handling multiple frequencies, high workload and memory lapses have resulted in the tower controller simultaneously clearing other traffic to land on the occupied runway. In some cases crews issued with the TIPH clearance were holding-in-position for an unusually extended period. Industry safety recommendations suggest that flight crews holding-in-position on an active runway for an unexpected extended period should contact tower to confirm the extended holding clearance. Timely crew intervention could potentially reduce the risk of a runway incursion.

The purpose of the Extended Holding On Runway Advisory is to provide crew awareness of an extended holding period on the runway.

The aural advisory is given if the following criteria are met:

- aircraft enters a runway; and
- aircraft remains in position for a time period considered to be an extended holding period.

Your company will select the extended holding period and it cannot be changed by the flight crew. The time period can be configured for 60, 90, 120, 180, 240, or 300 seconds.

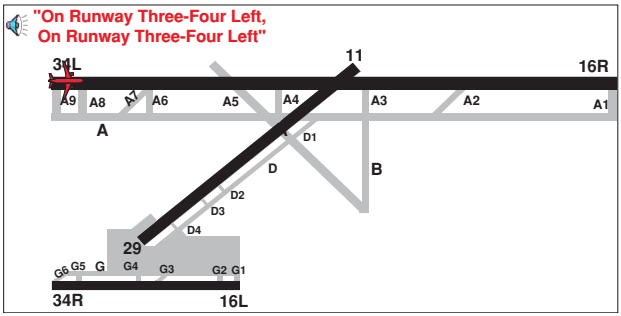
The aircraft heading must be within 20 degrees of runway heading and the aircraft must not move more than 100 ft along the runway for this advisory to be activated.

Runway Entry and Occupancy Continued

Note that if the aircraft continues to hold for a period in excess of the (initial) extended holding period, the advisory may be set to repeat for the same (or different) holding interval. The repeat advisory time may also be configured to be off. These options are selected by your company and cannot be changed by the flight crew.

The Extended Holding On Runway Advisory is suppressed after a Rejected Take-Off (RTO). The advisory is reset and available again once the aircraft exits the current runway.

After the specified extended holding period has elapsed, RAAS provides an aural message that is a double repetition of the On Runway Advisory. For example, if an aircraft has been holding-in-position on runway 34 left for an extended period (e.g., 90 seconds), the system will annunciate "*On runway three-four left, on runway three-four left*."



Example of Extended Holding On Runway Advisory

REJECTED TAKE-OFF

Distance Remaining - Rejected Take-Off Advisory

The purpose of the Rejected Take-Off Distance Remaining Advisory is to provide the flight crew with position awareness information during a RTO.

The advisory is generated if the following conditions are satisfied:

- aircraft is on the last half of the runway;
- groundspeed is greater than 40 knots; and
- an RTO is initiated (RTO status is assumed if groundspeed during the take-off roll decreases by 7 knots from the maximum value achieved).

The advisory terminates once the groundspeed decreases below 40 knots during the RTO. The Extended Holding On Runway Advisory is not provided during the period following the RTO.

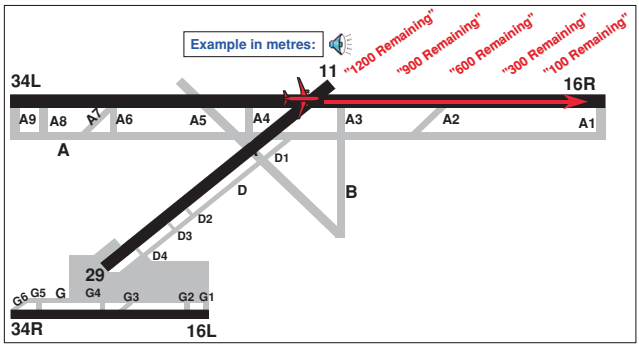
The advisories are generated at whole thousand-foot intervals if RAAS is configured in "feet", except that the last possible advisory occurs at 500 feet. For example, the following advisories would be generated during a RTO on a 9000-foot runway:

- "*Four-thousand remaining*";
- "*Three-thousand remaining*";
- "*Two-thousand remaining*";
- "*One-thousand remaining*"; and
- "*Five-hundred remaining*".

Rejected Take-Off Continued

The metric distance advisories are generated at 300-metre intervals, except that the last possible advisory occurs at 100 metres. For example, the following advisories would be provided during a RTO on a 3000-metre runway:

- "*One-thousand-two-hundred remaining*";
- "*Nine-hundred remaining*";
- "*Six-hundred remaining*";
- "*Three-hundred remaining*"; and
- "*One-hundred remaining*".



Distance Remaining - Rejected Take-off Advisory in Metres

Note that message content is identical to that for the Landing Roll-Out Distance Remaining Advisory.

APPROACH TO RUNWAY

Approaching Runway - In-Air Advisory

Safety data indicate that poor spatial awareness on approach (lining-up and/or landing on the incorrect runway) is a significant factor in runway incursions. The purpose of the Approaching Runway In-Air Advisory is to provide the crew with awareness of which runway the aircraft is tracking on final approach.

This advisory is provided when:

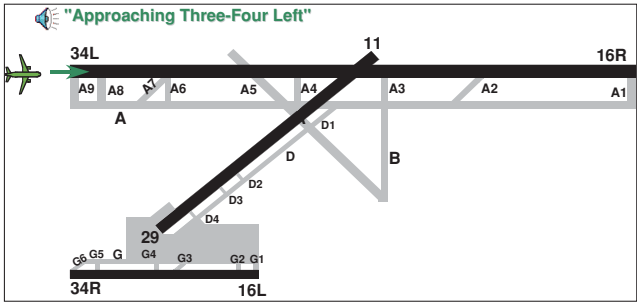
- aircraft is between 750 feet and 300 feet Above Field Elevation (AFE);
- aircraft is within approximately 3 nautical miles of the runway;
- aircraft lateral position is within approximately 200 feet, plus runway width, from the runway centerline; and
- aircraft track is aligned within 20 degrees of runway heading.

All current EGPWS alerts have a higher priority than this RAAS advisory. The Approaching Runway In-Air Advisory is suppressed between 550 feet and 450 feet above runway elevation to allow the normal 500-foot radio altitude call-out and/or crew procedures without conflict. There is an option to select an alternative suppression zone of 450 – 350 feet AFE to allow the 400-foot altitude call-out in Airbus aircraft.

The advisory is not provided below 300 feet AFE. This reduces potential distraction during high workload conditions.

Approach to Runway Continued

This advisory is annunciated once for each runway alignment when the conditions noted above are satisfied. The advisory message consists of the word "approaching" followed by the runway identifier, for example, "Approaching three-four-left." An aircraft that is required to side-step to an alternative runway while on short-final could potentially be provided with two Approaching Runway Advisory messages; one call-out for the original runway and another as the aircraft aligns with the second runway. The advisory conditions above would have to be satisfied for each runway call-out.



Example of Approaching Runway - In-Air Advisory

For some approaches more than one runway could meet the qualifying conditions above, e.g. two closely spaced runways with headings that are within 20 degrees of each other. The message "*Approaching Runways*" is provided in such cases.

Example of "Approaching Runways" Advisory

Approaching Short Runway - In-Air Advisory

Safety data indicate that loss of position awareness on approach is a factor in runway incursions – lining up and/or landing on the wrong runway. In some cases the landing distance available (on the incorrect runway) was less than that required.

Approach to Runway Continued

The purpose of the Approaching Short Runway - In-Air Advisory is to provide the crew with awareness of which runway the aircraft is tracking, and that the runway length available for landing is less than a defined nominal landing runway length. The "nominal" runway distance for landing is aircraft type specific and is set by an operator. Note that it cannot be changed by the flight crew.

This advisory is provided when the following conditions are met:

- all conditions for a routine Approaching In-Air Advisory are satisfied (see previous section for details); and
- the aligned runway is shorter than a nominal landing runway length.

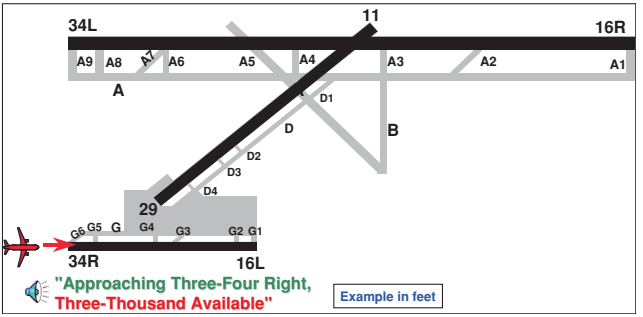
The system uses the same altitude zones to suppress this advisory that are used for the routine Approaching Runway In-Air Advisory.

Note that this advisory does not take into account prevailing conditions such as aircraft weight, wind, runway condition & slope, air temperature and altitude of airport. If the operator does not specify the nominal runway length, the advisory is defaulted to off, unless the operator has chosen to always advise the runway length available for landing.

RAAS does not account for operational data such as NOTAMs that refer to areas of runway that are not available (e.g. due construction, snow removal, etc). Crews should be cognizant of any NOTAMs and other published restrictions in effect.

Approach to Runway Continued

The Routine Approaching Runway In-Air Advisory message is appended with available runway length information, for example “Approaching three-four-right, three-thousand-available”. The "available" element of the message refers to the runway distance in the EGPWS database to the nearest 100-ft (or 100 m for the metric option). Note that the unit (feet or metres) is not annunciated. The unit of length used by RAAS can be confirmed by performing an EGPWS self-test (See “Operational Availability” section). This advisory occurs once for each runway alignment based on the conditions specified above.



Example of Approaching Short Runway - In-Air Advisory (in Feet)

Landing Roll-Out

Distance Remaining - Landing and Roll-Out Advisory

The purpose of the Distance Remaining Advisory is to enhance crew awareness of aircraft position relative to the runway end.

The Distance Remaining Advisory is provided when the following conditions are met:

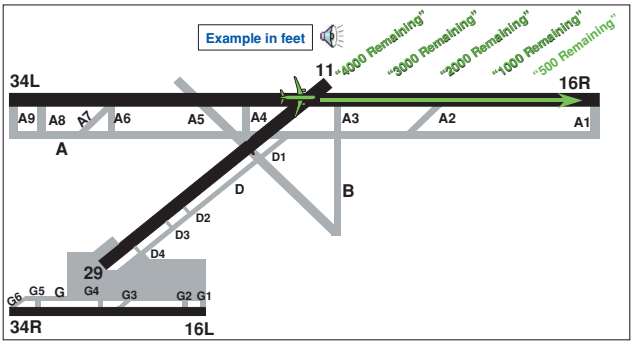
- aircraft is on, or over, the last-half of the runway; and
- aircraft groundspeed is above 40 knots.

Landing Roll-Out Continued

If the crew decides to go-around after the Distance Remaining Advisory is triggered, the call-outs continue to be annunciated at the appropriate distances along the runway. The advisories are inhibited once the aircraft attains a Radio Altitude of 100 feet or a climb rate of 450 feet-per-minute.

The advisories are generated at whole thousand-foot intervals if RAAS is configured in "feet", except that the last possible advisory occurs at 500 feet. For example, the following advisories would be generated during a landing on a 9000-foot runway:

- "*Four-thousand remaining*";
- "*Three-thousand remaining*";
- "*Two-thousand remaining*";
- "*One-thousand remaining*"; and
- "*Five-hundred remaining*".



Example of Landing and Roll-Out Advisory in Feet

The metric distance advisories are generated at 300-metre intervals, except that the last possible advisory occurs at 100 metres. For example, the following advisories would be generated during a landing on a 3000-metre runway:

- "*One-thousand-two-hundred remaining*";
- "*Nine-hundred remaining*";
- "*Six-hundred remaining*";
- "*Three-hundred remaining*"; and
- "*One-hundred remaining*".

Note that message content is identical to that for the Rejected Take-Off Distance Remaining Advisory.

Runway End Advisory

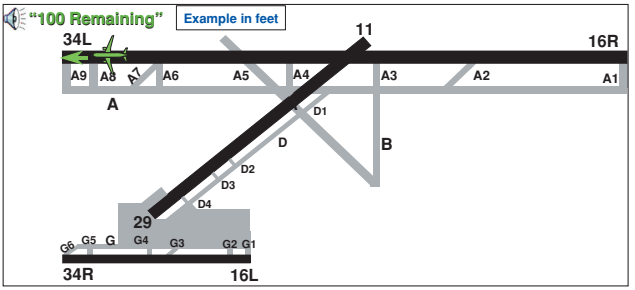
The purpose of the Runway End Advisory is to improve flight crew awareness of the position of the aircraft relative to the runway end during low visibility conditions. Note that the advisory is not intended to prevent a landing overrun.

The Runway End Advisory is provided to the flight crew when:

- aircraft is on a runway and aligned within 20 degrees of runway heading;
- aircraft approaches within 100 feet (or 30 metres for the metric option) of the runway end; and
- aircraft groundspeed is below 40 knots.

LANDING ROLL-OUT CONTINUED

The aural message is "One-hundred remaining" for systems configured in feet and "Thirty remaining" for a metric configuration.



Example of Runway End Advisory in feet

SECTION 4

RAAS OPTIONS

The options listed below are selected by your company and set-up during the installation of RAAS. The flight crew cannot configure them.

RAAS Options

Configurable Feature	Option
Distance Unit of Measurement	Feet or Metres
Voice Gender	Female or Male
GPS Antenna Location	Customer-selected location based on aircraft installation
Taxiway Takeoff	Off or On
Insufficient Runway Length - On Ground (Takeoff)	Off or on using customer - selected nominal runway length based on aircraft type, or always on
Extended Holding - On Runway	INITIAL: 60, 90, 120, 180, 240, 300, Off REPEAT: 30, 60, 90, 120, 180, 240, 300, Off
Distance Remaining - Rejected Takeoff	Off or On
Approaching Runway - In Air **Advisory suppression zone**	Off or On 550 - 450 feet AFE or 450 - 350 feet AFE
Approaching Short Runway - In Air (Landing)	Off or on using customer - selected nominal runway length based on aircraft type, or always on
Distance Remaining - Landing	Off or On
Runway End Callout	Off or On

SECTION 5

AUDIO LEVELS

RAAS advisories are heard over the same aircraft audio systems that presently provide EGPWS audio caution and warning alerts in the flight deck. The volume of RAAS advisories is controlled by the EGPWS - the RAAS message volume level is based on the expected flight operation for each advisory. RAAS employs three relative audio volume levels:

Audio Levels

Audio Level	Advisory
High	The Taxiway Take-Off Advisory is issued at the EGPWS caution and warning alert volume level plus 3 dB.
Medium	Distance Remaining Advisories are issued at the same volume level as EGPWS cautions and warnings.
Low	All other in-air and on-ground advisories (excludes Distance Remaining and Taxiway Takeoff Advisories) are issued at the same volume level as the EGPWS cautions and warnings volume level minus 6 dB.

SECTION 6

OPERATIONAL AVAILABILITY

RAAS is operationally available anytime the EGPWS is powered and the following conditions are met:

- The software for the RAAS functions have been loaded and enabled into an EGPWS by your company (with software version -218-218 (or later) and a minimum of Terrain Data base 435);
- The aircraft is on or approaching an airport in the RAAS runway database; and
- RAAS is functional (e.g. all external signals are available and not faulted, GPS position accuracy meets minimum RAAS requirements, there are no internal EGPWS faults).

Operational Availability Continued

RAAS operational availability is integrated into the existing EGPWS fault monitoring and self-test functions. Consistent with approved EGPWS self-test design, the loss of RAAS functions is indicated on-ground only during an EGPWS self-test. There is no automatic annunciation of the loss of RAAS functionality. The audio self-test messages are as follows.

RAAS Self-Test Audio Messages

Audio Message	Conditions
"Runway Awareness OK Feet"	RAAS software enabled, functioning, has good position information, and is at a validated airport. Feet will be annunciated in the gender voice option (male or female) selected for RAAS.
"Runway Awareness OK Metres"	RAAS software enabled, functioning, has good position information, and is at a validated airport. Metres will be annunciated in the gender voice option (male or female) selected for RAAS.
"Runway Awareness Not Available"	RAAS software enabled, but the system either has no position information, the accuracy of the position information is insufficient to allow RAAS to function, or the aircraft is at an airport that has not been validated for RAAS in the EGPWS Terrain Database.
"Runway Awareness Inhibited"	RAAS software enabled, but the advisories have been inhibited with the activation of an external discrete.
"Runway Awareness R-T-O"	RAAS software enabled and functioning, but RAAS has detected a Rejected Take-Off condition. To clear this message, the aircraft must be taxied off the runway area
"Runway Awareness INOP"	RAAS software enabled but function is inoperative.

Operational Availability Continued

RAAS status can also be displayed on the Terrain Display. This is active only when the aircraft is on the ground. The procedure requires the flight crew to select the terrain display followed by a change in the displayed range (to a higher or lower range). RAAS status is annunciated for two sweeps of the Terrain Display. This feature is available on all aircraft, but is primarily intended for those aircraft where the flight crew does not perform an EGPWS self-test. The displayed status messages are as follows.

RAAS Self-Test Display Messages

Audio Message	Conditions
RAAS-OK-FT (green)	RAAS software enabled, functioning, has good position information, and is at a validated airport. Distances annunciated in feet.
RAAS-OK-m (green)	RAAS software enabled, functioning, has good position information, and is at a validated airport. Distances annunciated in metres.
RAAS-N/AVBL (amber)	RAAS software enabled, but the system either has no position information, the accuracy of the position information is insufficient to allow RAAS to function, or the aircraft is at an airport that has not been validated for RAAS in the EGPWS Terrain Database.
RAAS-INH (amber)	RAAS software enabled, but the advisories have been inhibited with the activation of an external discrete.
RAAS-RTO (green)	RAAS software enabled and functioning, but RAAS has detected a Rejected Take-Off condition. To clear this message, the aircraft must be taxied off the runway area.
RAAS-INOP (amber)	RAAS software enabled but function is inoperative.

Section 7

Frequently Asked Questions

Q. How do I know that the RAAS is enabled?

A. Perform an EGPWS self-test or select the Terrain Display followed by a change in the displayed range (to a higher or lower range). RAAS status is annunciated for two sweeps of the Terrain Display. These functions available only when aircraft is on the ground.

Q. How can the flight crew determine which RAAS database is currently loaded in the EGPWS computer ?

A. The RAAS status message on the Terrain Display during the EGPWS self-test (see last question) also displays the version of the currently installed database.

Frequently Asked Questions Continued

Q. How can the flight crew determine if RAAS will work at the destination airport upon arrival?

A. RAAS status can be displayed on the Terrain Display only when the aircraft is on the ground. The crew should check in advance if the destination airport is included in the RAAS database - see answer to the next question. Once on the ground at the destination airport, RAAS status can be displayed on the Terrain Display.

Q. How can the flight crew determine what airports are enabled for RAAS?

A. Details of the specific airports included in the RAAS database and procedures for operators to acquire the latest RAAS database are provided on the Internet at www.egpws.com. A telephone number for voice contact is included as well.

Q. Who do I contact for help with a RAAS database issue (such as adding an airport to the RAAS database), or a problem encountered in the operation of RAAS at a particular airport?

A. An online form for RAAS discrepancies is provided on the Internet at www.egpws.com. A telephone number for voice contact is included as well.

877-436-2005 (In U.S.)
602-436-2005 (Outside U.S.)

Q. How do I know what units are being used for the RAAS distance related advisories?

A. This information is provided during the EGPWS self-test audio message or on the RAAS status message on the terrain display.

Q. How does RAAS account for temporary runway closures?

A. RAAS does not include knowledge of prevailing Notice to Airmen (NOTAM) and therefore factors such as closure of runways is not reflected by advisories. Crews are assumed to be cognizant of prevailing NOTAM and Automatic Terminal Information Service (ATIS) data. Similarly, data on newly constructed runways or changes to length of existing runways may not necessarily be included in the RAAS runway database.

Frequently Asked Questions Continued

Q. Why does RAAS provide an On Taxiway advisory on some runways?

A. The runway is not yet in the RAAS database, Crews are always required to use conventional means to ascertain and confirm position of runways.

Q. Why doesn't RAAS always provide an approaching runway advisory when I am at the hold-short line?

A. The Advisory is always provided at a fixed distance from the runway edge at groundspeeds below 10 knots, and in some cases the hold-short lines are not painted at positions that correspond to ICAO standards. RAAS does not have knowledge of ground markings.

Abbreviations

AFE	Above Field Elevation [ft]
ATC	Air Traffic Control
EGPWS	Enhanced Ground Proximity Warning System
GPWS	Ground Proximity Warning System
NOTAM	Notice to Airmen
RAAS	Runway Awareness and Advisory System
RTO	Rejected Take-Off
TIPH	Taxi-Into-Position-and-Hold

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

PLEASE DETACH AND SEND BACK TO HONEYWELL

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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