

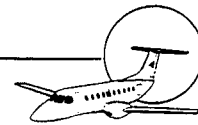


SECTION 6-11

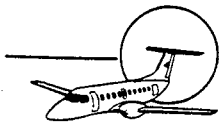
WARNING SYSTEMS

Index	Page
General Description	6-11-2A
Visual Warning System	6-11-3
Alarm/Indication Lights	6-11-4
Multiple Alarm Panel	6-11-5
Warning and Caution Lights, and Alarm Cancel Switch	6-11-8
Ind/Alarm Lights Switch	6-11-8
Alarm Lights Controller	6-11-9
Stall Warning System	6-11-10
Stall Warning Panel	6-11-12
Fast/Slow Indicators	6-11-13
Aural Warning System	6-11-14
System Operation	6-11-17
Emergency Faults	6-11-18
Abnormal Faults	6-11-20
Advisory Fault	6-11-20
Information Conditions	6-11-20
Fault Warning Cancellation	6-11-21
Turn-On Self-Test	6-11-22
Ground Proximity Warning System (GPWS) – Model MK-II	6-11-23
GPWS Controls and Indicators	6-11-24
Mode 1 – Excessive Sink Rate	6-11-25
Mode 2 – Excessive Closure Rate	6-11-26
Mode 3 – Altitude Loss After Takeoff	6-11-27
Mode 4A – Terrain Clearance – Gear Up	6-11-28
Mode 4B – Terrain Clearance – Flaps $\leq 17^\circ$	6-11-28
Mode 5 – Glide Slope	6-11-29
Mode 6 – Descent Below Decision Height (DH)	6-11-30
Aural Warning Message Priorities	6-11-30
Ground Proximity Warning System (GPWS) – Model MK-VI	6-11-31
GPWS Controls and Indicators	6-11-32
Mode 1 – Excessive Sink Rate	6-11-33
Mode 2 – Excessive Closure Rate	6-11-34
Sub-Mode 2A – Flap Not in Landing Position	6-11-34
Sub-Mode 2B – Flap in Landing Position (25° or 45°)	6-11-35
Mode 3 – Altitude Loss After Takeoff	6-11-36

16-111-001



Index	Page
Mode 4 – Insufficient Terrain Clearance	6-11-37
Sub-Mode 4A – Terrain Clearance – Gear Up	6-11-37
Sub-Mode 4B – Terrain Clearance – Flaps $\leq 17^\circ$	6-11-38
Sub-Mode 4C – Minimum Terrain Clearance at Takeoff	6-11-39
Mode 5 – Descent Below Glide Slope	6-11-40
Mode 6 – Descent Below Decision Height (DH)	6-11-41
Aural Warning Message Priorities	6-11-41
RAD/BAR Warning System – Optional	6-11-42
Traffic Alert and Collision Avoidance System (TCAS I) – Optional	6-11-43
General	6-11-43
System Description	6-11-44
TCAS Self-Test	6-11-45
TCAS Control Display Unit	6-11-47
Display Symbols	6-11-48



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OPERATIONS MANUAL

SYSTEMS DESCRIPTION
WARNING SYSTEMS

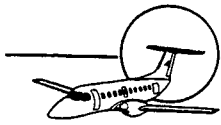
GENERAL DESCRIPTION

The aircraft incorporates an integral warning system to notify the crew of a variety of systems malfunction and abnormal configuration. Visual alerts consisting of steady or flashing lights, and a wide variety of distinct aural alerts, including vocal alerts, are provided. In addition, a stall warning system and an optional Ground Proximity Warning System (GPWS) are installed.

16-111-001

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VISUAL WARNING SYSTEM

The visual warning system consists of:

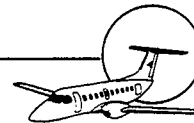
Alarm/Indication Lights – Distributed on cockpit panels, they provide information on a specific system failure.

Multiple Alarm Panel – A display of red or amber indicator modules, located on the center panel, which monitors most of the aircraft systems. By watching it, the pilot will be either informed on a specific failure or addressed to the defective system control panel.

WARNING and CAUTION Lights – They draw the pilot's attention to an alarm condition and they allow the degree of seriousness of the fault to be anticipated through different colour lights.

Control Switches – They provide test and dimming control for the multiple alarm panel and almost all alarm/indication lights (ALARM LT switch) and cancellation of the WARNING and CAUTION lights, multiple alarm panel lights, and aural warning (ALARM CANCEL switch).

Alarm Lights Controller – A remotely-mounted unit which provides dimming and test of the alarm/indication lights.



ALARM/INDICATION LIGHTS

Alarm/Indication lights provide information on a specific failure identified by the legend inscribed on them, or by a combination of that legend and the adjacent panel inscriptions.

Legends are unreadable when not illuminated and colours are assigned to the alarm lights according to the seriousness of the failure and the degree of urgency attached to the pilot's corrective action. The alarm/indication lights remain illuminated as long as the fault persists.

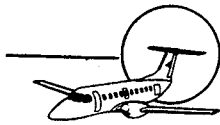
Amber Lights – Failure or malfunction not requiring immediate action.

Red Lights – Failure or malfunction requiring immediate action, for representing a hazard to the airplane being apt to lead to an unsafe flight condition.

Different colour indication lights are used to give a distinctive character to the operation of some systems:

Green Lights – Provide normal operating indication of some commonly used systems, for which a positive functioning indication is desirable.

White Lights – Used to indicate normal operating condition of systems which are not usually required or standby systems which operate when the main system has failed.



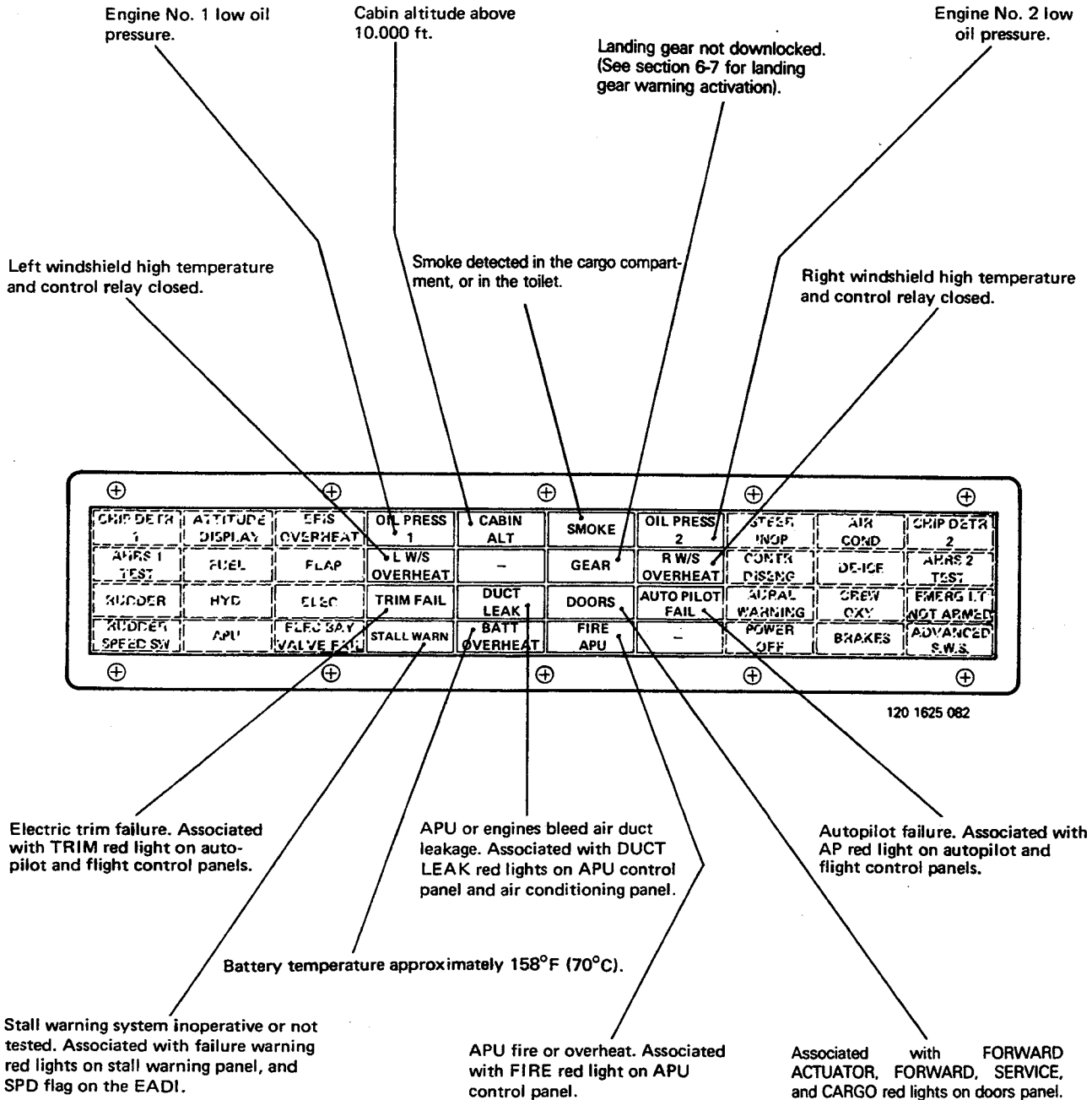
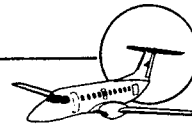
MULTIPLE ALARM PANEL

The multiple alarm panel consists of a box, forming a display of indicator modules.

Legend colours are red for warnings and amber for cautions. There are two types of legends: specific and system captions. Through the specific legends, the pilot can determine the failure without having to look for them elsewhere (Ex.: BATT OVERHEAT). The system legend is indicative of the failed system, being necessary to refer to the respective system control panel and, through the alarm/indication lights, identify the fault. All alarm/indication lights have the same colour of the associated multiple alarm panel annunciator module. When a fault occurs, the appropriate multiple alarm indicator will start flashing. After pilot recognition, when the indicator is reset by pressing the ALARM CANCEL switch (glare shield panel), the multiple alarm panel is rearmed to sense another failure input. Upon reset, the indicator becomes steady and will remain on as long as the fault persists. System legend type indicator fault signals may arise after reset operation, and in this case the indicator will start flashing again and may again be reset. The reset operation can be repeated as many times as a system legend has inputs.

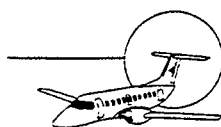
Every time a red indicator starts flashing, a signal is generated to command the red WARNING lights. When an amber indicator starts flashing, signals are generated to activate the CAUTION lights. The multiple alarm panel is supplied by two redundant 28 V DC emergency buses. Should one of these fail, the POWER OFF light (located on the multiple alarm panel) will start flashing. Once reset, the light will extinguish if either power is restored (normal condition) or the DC bus is lost (unit totally deenergized).

Two brightness levels for the alarm and indication lights are provided.



MULTIPLE ALARM PANEL RED ANNUNCIATORS

16-111-001



OPERATIONS MANUAL

Associated with ice detection system.
 Illuminated during flight in icing conditions.

Engine No. 2 reduction gearbox or
 oil tank chip detection.

NOTE: On airplanes Post-Mod.
 SB 120-79-0008 or
 S/N 120.076, 120.079 and on,
 the engine chip indication
 lights are located in the
 battery compartment.

AHRS 1 in test condition.

Pilot and copilot attitude indicators
 inconsistent.

Associated with FILTER, LOW
 PRESS and LOW TEMP lights on
 the fuel panel.

Associated with
 asymmetry, disa-
 greement, and
 control faults on
 the flap annunci-
 ator panel.

GPWS INOP	Ground proximity warning system failure
OR	
EFIS OVERHEAT	Any EFIS component in overheat conditioning

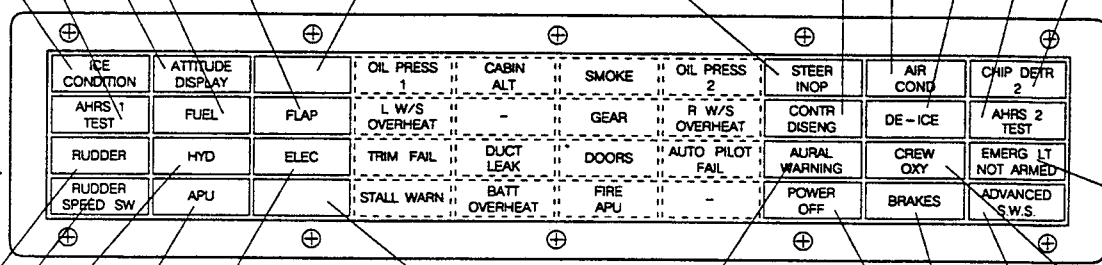
Associated with DUCT
 OVERHEAT, PACK FAIL, and
 BLEED OVERHEAT lights on air
 conditioning panel.

Aileron or
 elevator
 controls
 disengaged.

AHRS 2 in test condition.

Associated with all ice and rain
 protection amber lights.

Steering inoperative.



Associated with all electrical AC
 and DC power supply panel lights.

Aural warning unit failure.

Loss of power supply 1 or power
 supply 2 of the multiple alarm
 panel.

Associated with oil LOW PRESS,
 APU GEN OFF BUS, fire det INOP
 and bottle INOP lights on APU
 panel.

Associated with emer/park brk
 LOW PRESS, anti-skid INOP,
 and autobrake NOT ARMED
 lights.

Associated with reservoir LOW
 PRESS and LOW LEVEL, MAIN
 PUMP LOW PRESS, FILTER and
 FLUID OVERHEAT lights on
 hydraulic power panel.

Warning system activation points
 advanced, due to a flap control fault
 condition. Fast/Slow information is
 not valid.

Associated with airspeed
 indicators signal disagreement to
 the rudder electrical control.

ELEC BAY VALVE FAIL	Airplanes Pre-Mod. SB 120-53-0011
Electronic bay cooling system valve failure	
OR	
ELEC BAY OVER TEMP	Airplanes Post-Mod. SB 120-53-0011 or S/N 120.021 and on
Electronic bay internal temperature about 70°C/158°F	

Crew oxygen low pressure light.
 See Section 6-13 to find oxygen
 reserve time.

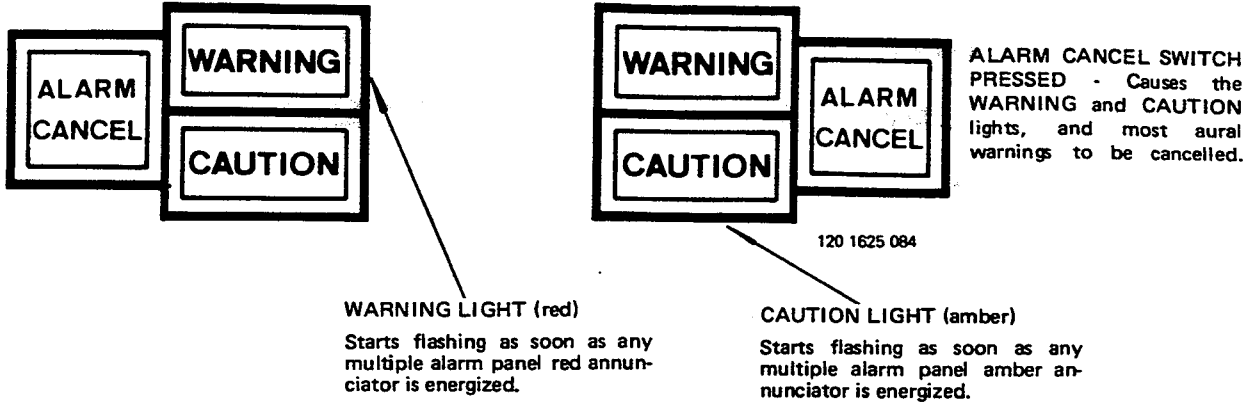
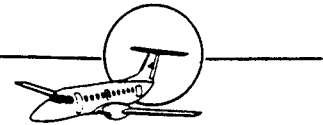
Associated with INOP and OVER-
 BOOST lights on the rudder panel.

Emergency lights not armed.

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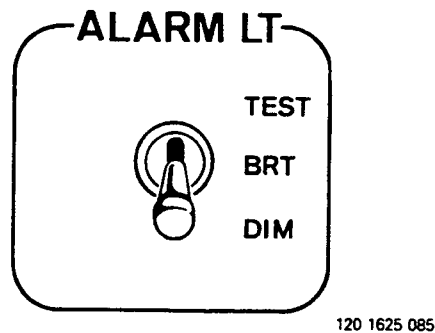
MULTIPLE ALARM PANEL AMBER ANNUNCIATORS



**WARNING AND CAUTION LIGHTS, AND ALARM CANCEL SWITCH
(PILOT'S AND COPILOT'S GLARESHIELD PANEL)**

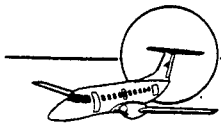
IND/ALARM LIGHTS SWITCH

- TEST - A momentary position which checks illumination of multiple alarm panel lights, WARNING and CAUTION lights, and almost all alarm/indication lights. The exceptions are: APU/engines fire detection and extinguishing system lights, and engine shutoff valve lights; flap annunciator light bars; emergency battery indication light; landing gear position indication lights, and PRESS TO TEST lights.
During test, a single chime warning will be produced by the aural warning system.
- BRT and DIM - Provides selection of bright or dim illumination modes for nearly all alarm lights. The exceptions are: red alarm lights; emergency battery indication light; WARNING and CAUTION lights.
- Once the DIM mode is selected and the airplane bus voltage drops below 18 V DC, the multiple alarm panel indicators will automatically return to the BRT mode. Such switching will be reversed if the bus voltage goes up again above 18 V DC.



**ALARM LIGHTS SWITCH
(OVERHEAD PANEL)**

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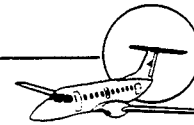


ALARM LIGHTS CONTROLLER

The alarm lights controller is a box having electronic circuits with dimming and test capabilities incorporated for almost all alarm/indication lights. Dimming is controlled by the ALARM LT switch. The alarm lights controller provides an automatic brightness mode reversion in case of failure of the dimmer circuit.

The main feature of the alarm lights controller is that which provides independent channels for each alarm/indication lights signal line, so a failure of one channel does not affect the other.

Even in case of a total alarm lights controller power loss, the alarm/indication lights will function normally, owing to a circuit incorporated for that purpose.



STALL WARNING SYSTEM

The stall warning system is designed to alert the pilots to an impending stall condition. This system prevents the airplane from attaining high angles of attack which could result in high bank angles on stall or during stall recovery, or potential loss of longitudinal control. System operation is based on angle of attack detection by sensing the direction of local airflow along the fuselage sides corrected by slip measurement giving the pilot safe and accurate control during low speed operation. The system continuously presents visual information concerning the actual angle of attack relative to stall angle of attack.

The system comprises two identical subsystems which function independently and redundantly to drive two control column shakers, two pusher servos and the aural warning system.

Each subsystem contains an angle of attack sensor, a computer, a fast/slow indicator, and a shaker. Both subsystems share one heated slip sensor and two pusher servos with mechanical clutches, to command the elevator down upon individual subsystem computer command. Failure of either subsystem will have no effect on the remaining subsystem.

The normal operation of the system is enabled 5 seconds after airplane takeoff to prevent unwanted operation on rotation. Warning of impending stall develops in a sequence first vibrating the control column (shaker function), sounding an aural warning, and finally by pushing the stick forwards. Shaker actuation also disengages the autopilot system. The actuation points are calibrated as a function of the combination of angle of attack, its rate of change, angle of sideslip and flap position.

In case of absence of flap position information (as in a flap control fault), shaker is automatically recalibrated to actuate at an angle of attack corresponding to the flap 45° position, and pusher is automatically recalibrated to actuate at an angle of attack corresponding to the flap 0° position. The FLAP and the ADVANCED S.W.S. lights will illuminate on the multiple alarm panel.

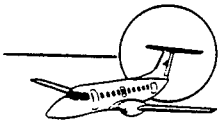
The stick pusher maintains a forward pressure until the airplane reaches a normal acceleration of 1/2 g; or pitch attitude is reduced or pilot disconnects the system. Pusher actuation is inhibited below a normal acceleration of 1/2 g.

Pressure switches, from the pitot/static system, provide an input to inhibit pusher actuation at a speed above 173 kt and to enable it below 153 kt. This prevents hardover from occur in cruise.

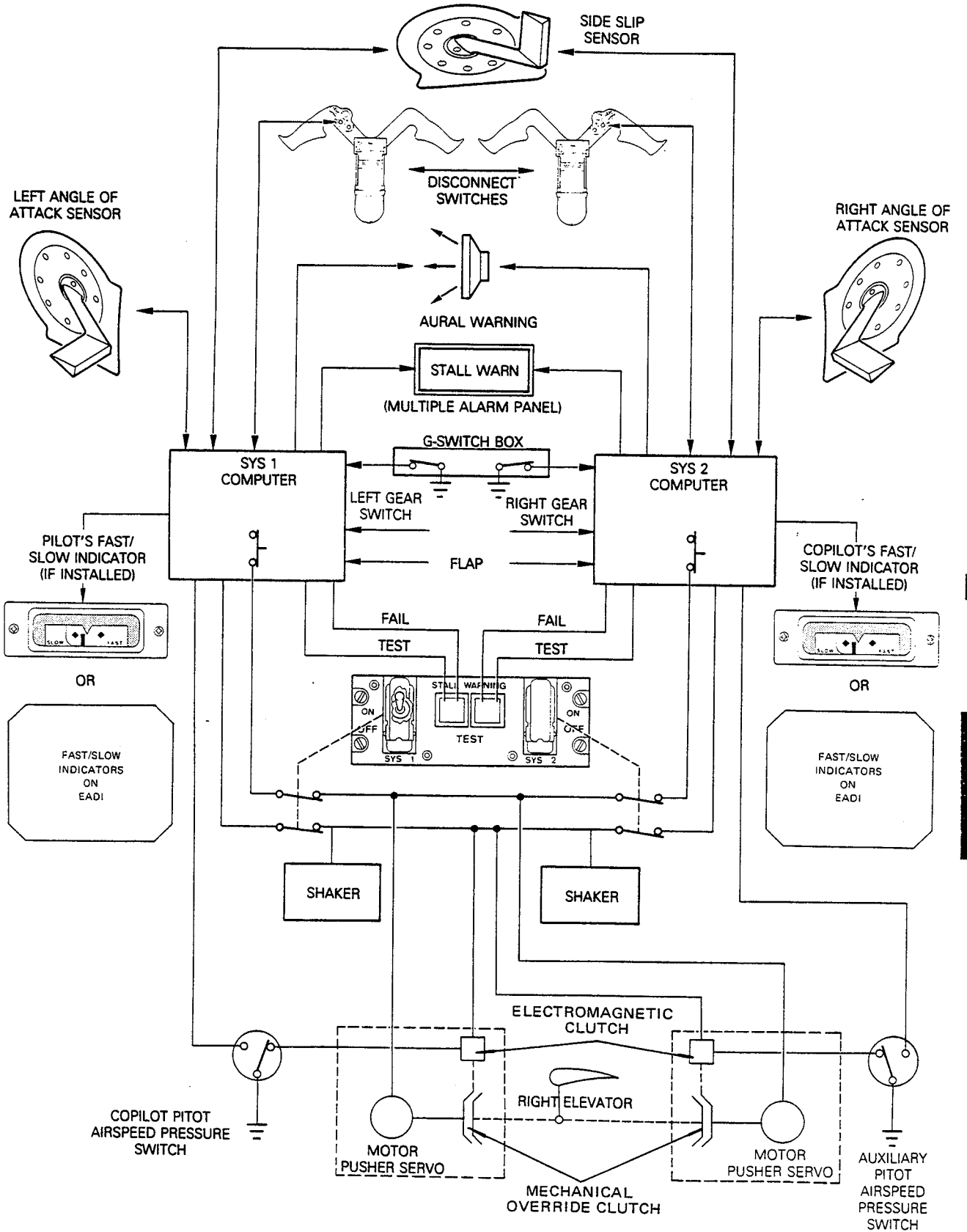
The mechanical clutch allows the pilot to override pusher actuation.

Control wheel and aft panel switches are provided to temporarily deactivate the stick pushers or to permanently dump one or both of the stall warning systems should a malfunction occur.

Subsystem test is possible only on the ground due to landing gear switch logic. Each subsystem must be tested individually.



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STALL WARNING SCHEMATIC

20 1625 086A

16-111-001



STALL WARNING SUBSYSTEM No. 1 SWITCH

ON - Activates stall warning subsystem 1.

OFF - Deactivates subsystem 1. Computer lines for the shaker, power servo electric clutch, and for pusher servo motor are interrupted.

SUBSYSTEM No. 1 FAILURE WARNING LIGHT (RED)/TEST PUSHBUTTON

FAILURE WARNING LIGHT - Illuminates when: a) a failure of the affected subsystem is detected. In this case, the corresponding stall warning switch should be positioned to OFF, which will result in the associated shaker and pusher inhibition. b) the airplane is energized and the stall system has not been tested.

The failure warning light illuminates in conjunction with STALL WARN red light on the multiple alarm panel and with the STALL WARNING voice message.

TEST PUSHBUTTON - Momentary pressing starts test cycle. After 2.5 seconds, the fast/slow indicator pointer will move toward slow side, with shaker, aural warning and pusher actuating sequentially. Each subsystem pre-flight test takes 5 seconds and after it the STALL WARN red light on multiple alarm panel and the correspondent failure warning light will extinguish if the test is successfully completed.

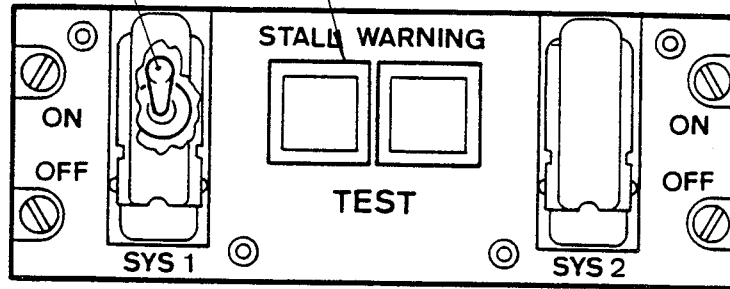
NOTE:

- If the lamp of the failure warning light burns out, the STALL WARN light will illuminate and the STALL WARNING voice message will sound indicating this condition.

- During the test, when the pusher actuates, the pilot should apply a moderate opposing force to the control column, allowing it to move forward but not reaching to the forward stop.

- If the test is not performed on the ground, the failure warning lights and the STALL WARN light will remain illuminated during the flight, but the system will function normally. The STALL WARNING voice message will also be activated; however, it may be canceled. It is not possible to perform the stall warning test in flight.

- On airplanes Post-Mod. SB 120-31-0003 or S/N 120.035 and on, the STALL WARNING voice message is inhibited on the ground.

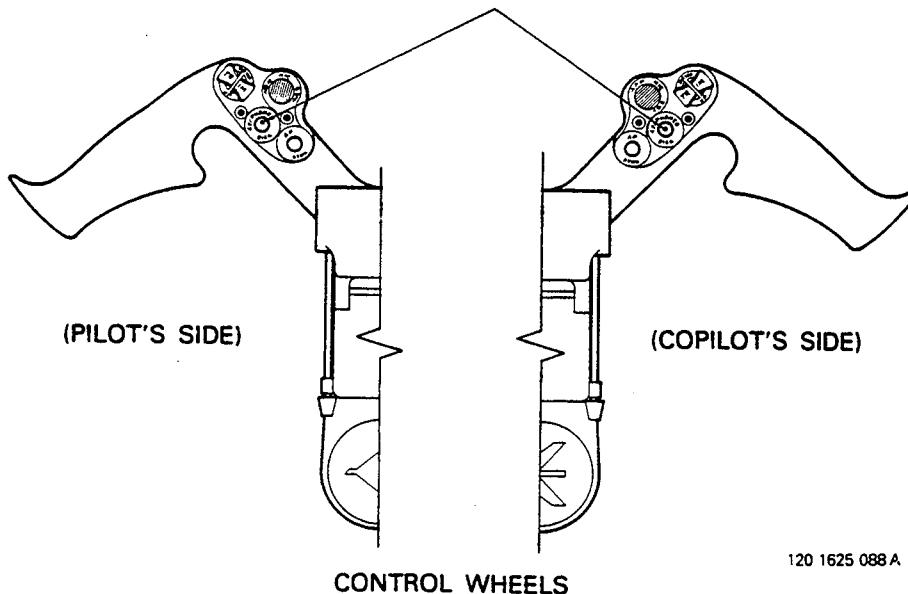


**STALL WARNING PANEL
(AFT PANEL)**

120 1625 087

AP/TRIM/PUSHER DISCONNECT SWITCH

If pressed allows momentary inhibition of both pusher servos.



120 1625 088 A

16-111-001



FAST/SLOW INDICATORS – (IF INSTALLED)

The Fast/Slow indication is an aid to the pilots during the airplane approach phase. The signals for the Fast/Slow indication are generated by the Stall Warning computer that uses the inputs from the angle-of-attack sensors and the side slip sensor. The signals are presented on the left side of the EADI display, by the Fast/Slow indicator. The Fast/Slow indicator consists of a yellow center reference mark, the F (fast) and S (slow) letters, a scale with four dots, and a diamond shaped green pointer.

NOTE: For FIS configuration the signals are presented in Fast/Slow indicator installed just above the ADI.

The pointer of the Fast/Slow, when centered, indicates that the airplane angle-of-attack is such that during approach the airplane is flying at the correct airspeed regardless of the gross weight. The Fast/Slow calibration is only adequate for load factors close to 1.0 g. Therefore, its use should be limited to the approach phase when lined on final. During the turns for the final approach the indication should be held slightly toward the Fast.

In fact, in calm air, the pilot should try to keep the pointer within $\pm 1/4$ of a dot from the center; $1/2$ of a dot at maximum is the acceptable limit. In turbulent air/gusty winds the pilot must keep the airplane toward the Fast side (approximately $1/2$ dot) aiming at keeping the speed at the threshold. If the Fast/Slow pointer moves toward the slow side (S), the airplane pitch attitude should be reduced or power added, or a combination of both, to recover a proper airspeed. Conversely, if the pointer moves toward the fast side (F), the airplane pitch attitude should be increased and/or power reduced to center the pointer again.

- For airplanes equipped with stall warning computer P/N C-81806-1 Mod. A, the Fast/Slow is calibrated for flaps and airspeeds as indicated below:

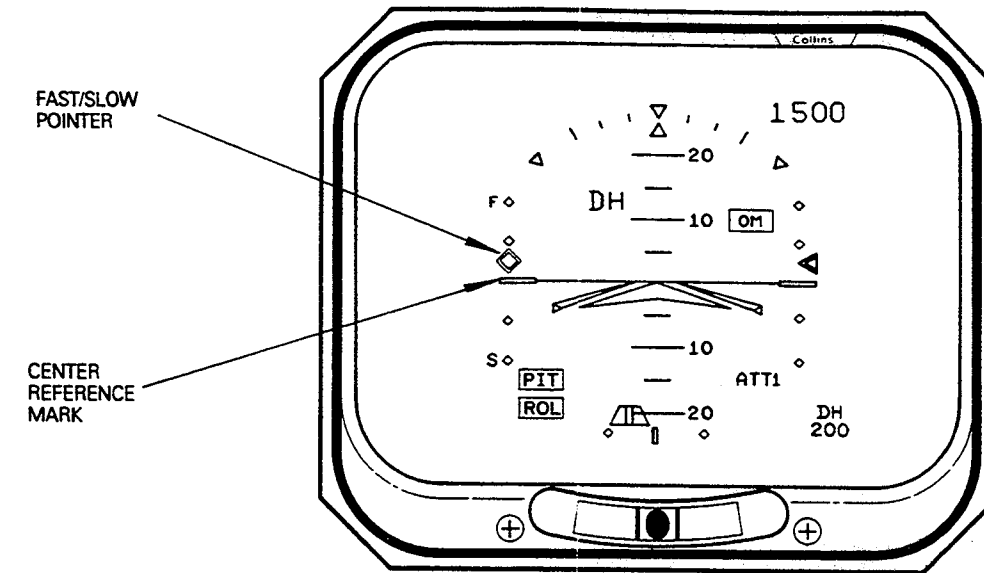
FLAPS	AIRSPEED
0°	1.3 V _S
45°	1.3 V _S

- NOTE:**
- The Fast/Slow indication is not valid for flaps 15° and 25°.
 - In case of flap control fault, the Fast/Slow indication must be disregarded.

- For airplanes equipped with stall warning computer P/N C-81806-3, the Fast/Slow is calibrated for flaps and airspeeds as indicated below:

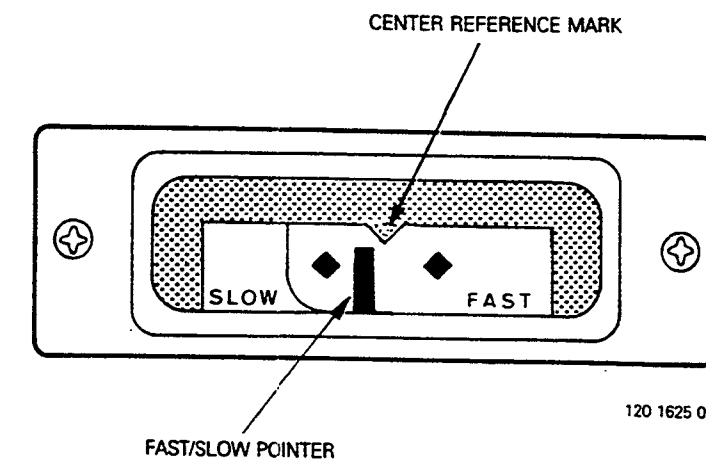
FLAPS	AIRSPEED
0°	1.3 V _S
15°	1.3 V _S
25°	1.37 V _S
45°	1.3 V _S

- NOTE:**
- In case of flap control fault, the Fast/Slow indication must be disregarded.
 - The calibration is such that the pointer touches the S dot simultaneously with the actuation of the stick pusher.



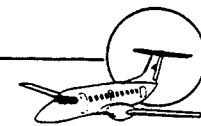
120 1625 089

FAST/SLOW INDICATOR ON EADI
(USED IN COLLINS EFIS CONFIGURATION)



120 1625 090B

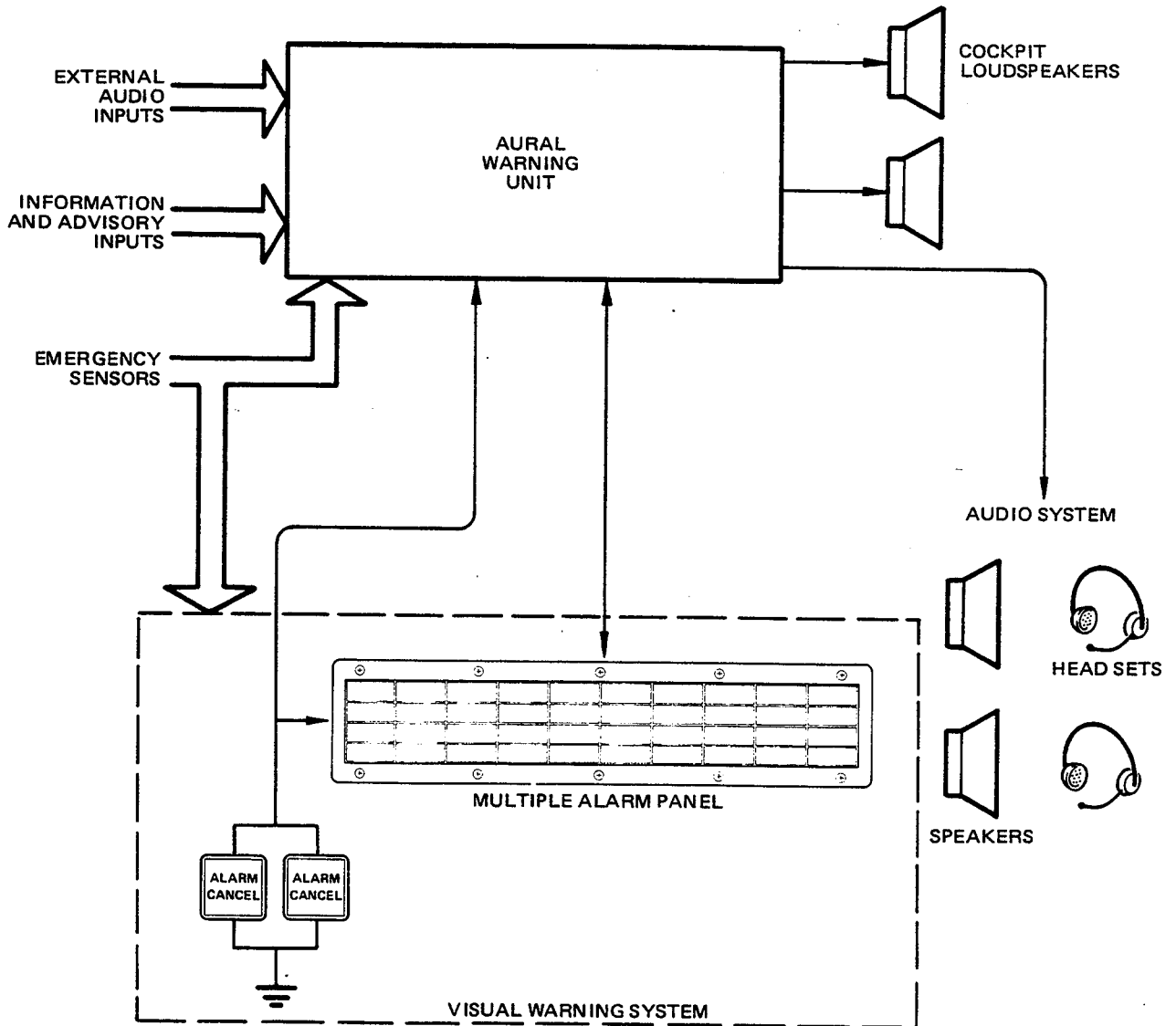
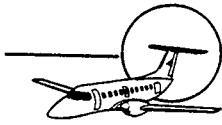
STANDARD FAST/SLOW INDICATOR
(USED IN COLLINS FIS CONFIGURATION)



AURAL WARNING SYSTEM

The aural warning system presents warning voice messages and tones to the flight crew, working in conjunction with the visual warning system. Basically, the system is composed of:

- Aural Warning Unit – Processes sensor signals and generates synthesized voice messages and tones. The unit contains a redundant channel in case of failure of the primary channel. If a failure is detected, the primary channel is automatically shut down, and the secondary channel is activated. The crew will be alerted that a failure has occurred. A failure of the secondary channel will also cause the flight crew to be alerted, and in this case the unit will be shut down.
- Speakers – Two, exclusively for aural warnings, each driven by one of the aural warning unit output amplifiers. Warnings are also heard through the audio system headsets (always) and speakers (when SPKR switches are selected in the audio panel), with preset volume.



120 1625 091

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WARNING AWS INTERFACES

16 DECEMBER 1985

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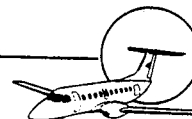
SYSTEM OPERATION

Alarms are announced according to their order of priority:

PRIORITY	LEVEL	CONDITION	CRITERIA
1ST	3	Emergency	Emergency operational or airplane systems conditions which require immediate corrective or compensatory action by the crew.
2ND	2	Abnormal	Abnormal operation or airplane systems conditions which require immediate crew awareness and subsequent corrective or compensatory crew action.
3RD	1	Advisory	Operational or airplane systems conditions which require crew awareness and may require crew action.
4TH	0	Information	Operational or airplane systems conditions which require flight deck indication but not necessary as a part of the integrated alerting system.

Besides synthesized voice messages, seven different types of discrete tones are generated: clacker, bell, whoop-whoop, beep, LEVEL 3 chimes (3 times), LEVEL 2 chime (1 time), and three 2900 Hz tones (only for airplanes not equipped with ALTITUDE ALERT voice message). Clacker tone is produced continuously, whenever a stall fault occurs. The bell tone is produced on occurrence of a fire condition. The whoop-whoop tone is generated on occurrence of a Ground Proximity Warning (GPW). The beep tone is generated in response to a manual cancel signal.

LEVEL 3 chimes take priority over an emergency fault voice message annunciation (except stall, fire, glide slope and GPWS). A LEVEL 2 chime is generated when an abnormal fault is detected. The three 2900 Hz tones are generated by the altitude alerter system.



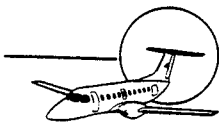
EMERGENCY FAULTS

LEVEL 3 chimes take priority over voice messages. Cycles are repeated at 1-second intervals as long as the fault has not been cleared or acknowledged by the crew, by manually cancelling the alarm.

FAULT	AURAL ALARM	VISUAL ALARM
STALL	Clacker tone output for 2 seconds out of every 4 seconds. Non-cancellable	Indication (not alarm) on the fast/slow indicators
ENGINE-WHEELWELL OR TAIL PIPE FIRE	Fire bell sounds until fault has been cleared or manually cancelled	FIRE ENG/WW and/or FIRE PIPE ZONE red lights (fire control panel)
APU FIRE		FIRE APU red light (multiple alarm panel) FIRE red light (APU fire control panel)
DESCENT BELOW GLIDE SLOPE (OPTIONAL)	GLIDE SLOPE voice message generated every 1.4 seconds	Indication (not alarm) on ADI or EADI
TRIM FAIL	TRIM FAIL voice message	TRIM FAIL red light (multiple alarm panel) TRIM amber light (autopilot and flight control panels)
AUTOPILOT FAILURE	AUTOPILOT voice message (*)	AUTOPILOT FAIL red light (multiple alarm panel) AP red light (autopilot and flight control panels)
AUTOPILOT DISENGAGEMENT (Airplanes Post-Mod. SB 120-22-0010 or S/N 120.038, 120.041 and on)		Proper annunciation on autopilot and flight control panels
EEC FAILURE	ENGINE CONTROL voice message	EEC 1 or EEC 2 red lights (glareshield panel)
SPEED EXCEEDING VMO	HIGH SPEED voice message. Non-cancellable	Indication (not alarm) on either airspeed indicator through the VMO indicator

(*) AUTOPILOT voice message for AP disengagement is generated just once. On airplanes Post-Mod. SB 120-31-0003 or S/N 120.035 and on, the AUTOPILOT voice message is inhibited when airplane is on the ground.

16-111-001



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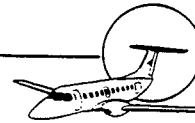
SYSTEMS DESCRIPTION
 WARNING SYSTEMS

FAULT	AURAL ALARM	VISUAL ALARM
BATTERY OVERHEAT	BATTERY voice message	BATT OVERHEAT red lights (multiple alarm panel)
LANDING GEAR NOT DOWN-LOCKED	LANDING GEAR voice message. Non-cancellable when flaps $\geq 17^\circ$	GEAR red light (multiple alarm panel)
LOW ENGINE OIL PRESSURE	OIL voice message	OIL PRESS 1 or OIL PRESS 2 red lights (multiple alarm panel)
APU OR ENGINES AIR BLEED DUCT LEAKAGE	DUCT LEAK voice message	DUCT LEAK red light (APU control panel, air conditioning panel, and multiple alarm panel)
CARGO COMPARTMENT SMOKE (cargo version)	SMOKE voice message	SMOKE red light (multiple alarm panel)
DOORS NOT CLOSED AND LOCKED OR FORWARD DOOR ACTUATOR PRESSURIZED AFTER DOOR IS CLOSED	DOOR voice message (*)	FORWARD ACTUATOR, FORWARD, SERVICE or CARGO (doors panel), and DOORS red lights (multiple alarm panel) (*)
WINDSHIELD OVERHEAT	WINDSHIELD voice message	LW/S or RW/S OVERHEAT red lights (multiple alarm panel)
CABIN ALTITUDE ABOVE 10000 FT	CABIN voice message	CABIN ALT red light (multiple alarm panel)
AIRPLANE NOT IN TAKEOFF CONFIGURATION Pre-conditions: airplane on ground and at least one power lever set for takeoff	TAKEOFF voice message, plus TRIM, or FLAPS, or BRAKES, or AUTO-FEATHER, or a combination of them, depending on which condition caused the fault. Non-cancellable for airplanes Post-Mod. SB 120-31-0018 or S/N 120.114 and on.	
STALL WARNING FAIL	STALL WARNING voice message (*)	STALL WARN red light (multiple alarm panel) Failure warning red light (stall warning panel)
INTERTURBINE OVER-TEMPERATURE	T ₆ voice message (**)	Red warning light on T ₆ indicator

(*) For the airplanes Post-Mod. SB 120-31-0003 or S/N 120.035 and on: a) the STALL WARNING voice message is inhibited on the ground and, b) the DOOR voice message and the DOORS red light (on the MAP) associated with forward and cargo door not closed and locked are inhibited on the ground when the left condition lever is set to FUEL CUTOFF.

(**) Only for airplanes Post-Mod. SB 120-31-0006 or S/N 120.064, 120.066, 120.067, 120.070, 120.071, 120.073 thru 120.076, 120.079 and on.

16-111-001



ABNORMAL FAULTS

All abnormal faults are displayed on the multiple alarm panel, by illumination of the amber lights. When a fault is detected, the corresponding light will illuminate, and a LEVEL 2 discrete chime will be generated. The chime will be repeated every 5 seconds as long as the fault persists or until the alarm is cancelled.

ADVISORY FAULT

The decision height input will cause the voice message MINIMUM output. The announcement will be made only once each time the event goes from false to true. Visual indication will be furnished by the EADI and radio altimeter indicator.

INFORMATION CONDITIONS

There are two LEVEL 0 alarm: SELCAL and altitude alerter:

- The SELCAL input will generate a SELCAL voice message. Visual information is furnished on the SELCAL panel (optional).
- An altitude alert event will be accompanied by three short 2900 Hz tones or ALTITUDE ALERT voice message, and visual information on the servo altimeter and altitude alerter preselect panel.

- NOTE:**
- Should more than one emergency fault occur at the same time, the LEVEL 3 aural chimes will sound only once. The voice messages will then be heard in order of priority with the most serious fault being heard first.
 - If stall and fire faults occur simultaneously only the stall clacker will be heard until the stall condition has been corrected. Thereafter, the fire bell will sound, if the fire condition still exists.
 - Whenever a stall or fire fault occurs at the same time as another emergency fault, the amplitude of the clacker or bell is attenuated in order to allow the crew to hear and understand more clearly the voice message.
 - When a glide slope or ground proximity warning condition exists, no other faults are presented until that prime condition is corrected, except stall or fire.



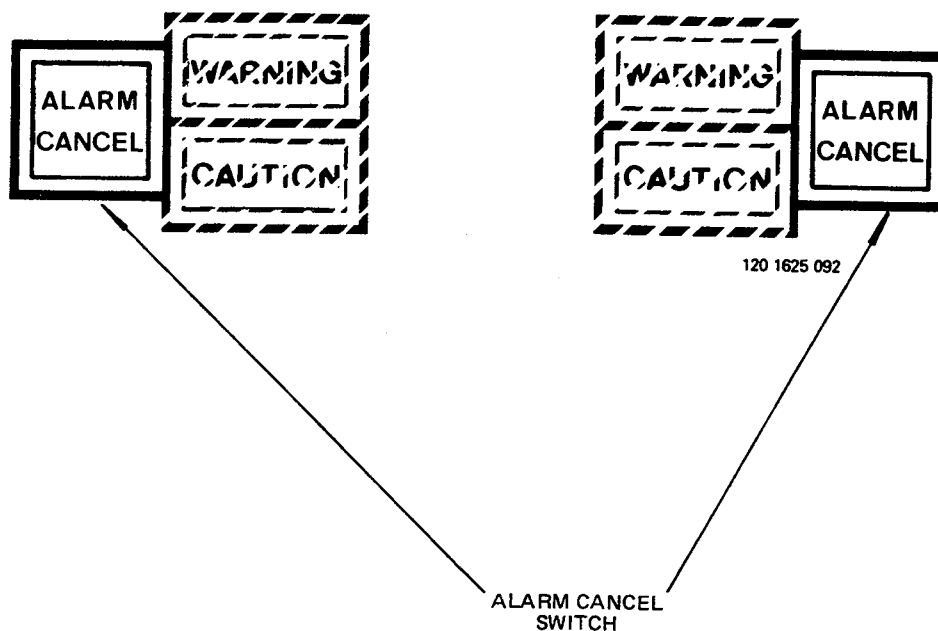
FAULT WARNING CANCELLATION

The advisory fault and information condition warnings are self-cancelling.

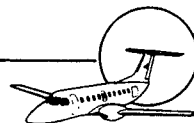
All abnormal fault warnings can be manually cancelled. When the ALARM CANCEL switch is pushed, the LEVEL 2 warning is stopped regardless of the number of pending abnormal faults.

Most emergency fault warnings can be manually cancelled through the ALARM CANCEL switch. The exceptions are: stall, glide slope, landing gear not downlocked with flaps position greater than 17°, and speed exceeding VMO.

The glide slope deviation alert (if installed) has a dedicated cancel switch located in the GPWS alert panel.



(PILOT'S AND COPILOT'S GLARESHIELD PANEL)



TURN-ON SELF-TEST

When the aural warning unit is first turned on (aircraft energized), both channels will automatically go through a functional test. If both channels are fully operational, the unit will announce AURAL UNIT OK. If either channel failed its power on test, the unit will announce AURAL UNIT ONE CHANNEL. Failures in both channels disconnect the unit, and the multiple alarm annunciator AURAL WARNING will be illuminated.

In case of power interruption lasting more than 3 minutes, the unit will restart, performing the turn-on self-test.

If power is removed for a shorter period of time, less than 3 minutes, the aural warning unit will continue operating in the state that it was prior to the power interruption occurrence.

The unit also performs periodic tests, to determine if any internal failure has occurred in normal operations.

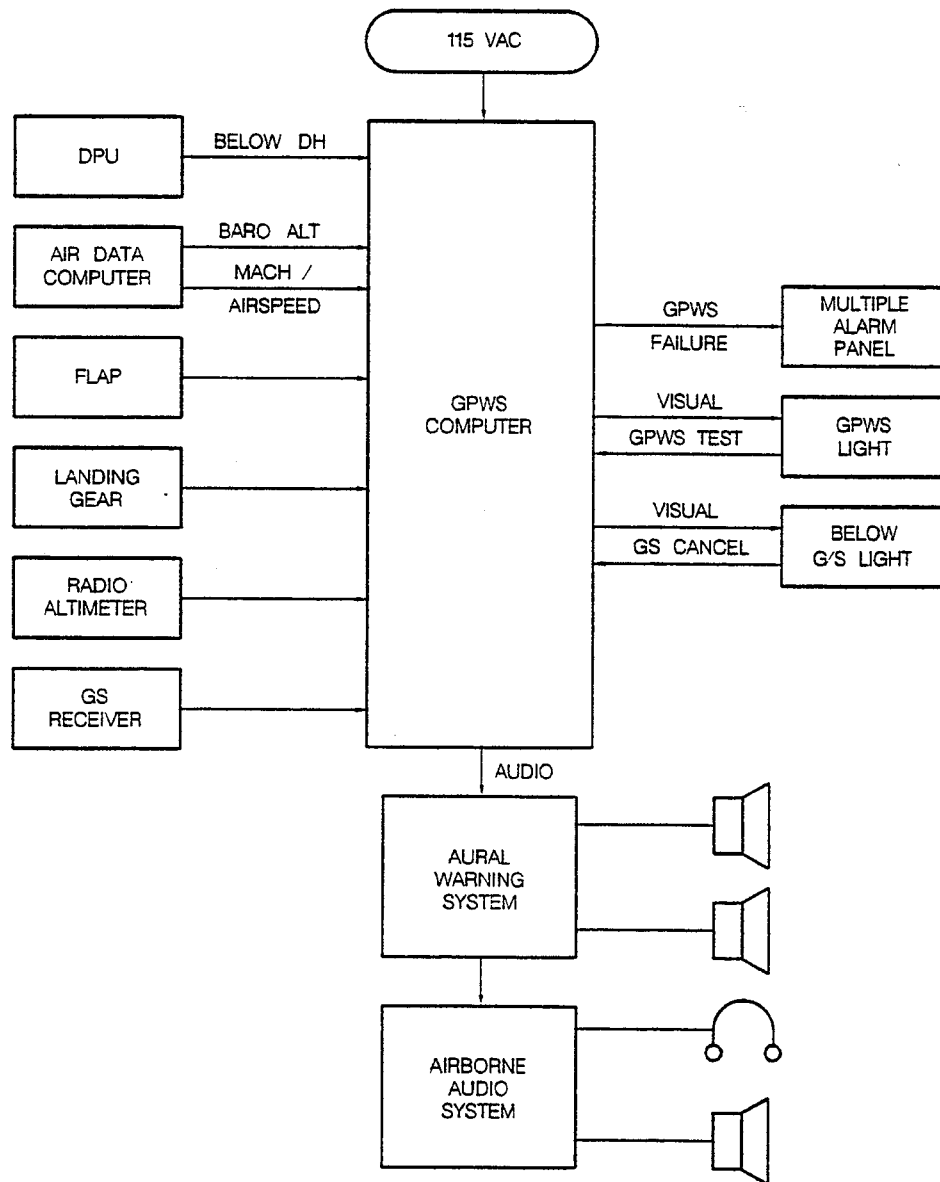


OPERATIONS MANUAL

GROUND PROXIMITY WARNING SYSTEM (GPWS) – MODEL MK-II

The ground proximity warning system monitors radio altitude, altitude rate, mach number, gear and flap down position, and glide slope deviation; it provides audio and visual warnings to the flight crew whenever the flight path condition could result in terrain impact.

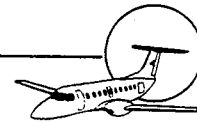
The GPWS warns of dangerous terrain proximity in six flight modes. Voice messages for the MODES 1 through 4 will continue until a new safe flight condition has been reached; MODE 5 can be cancelled by GS INHBT button. MODE 6 provides voice message on crossing decision height.



120 1625 093A

GPWS SCHEMATIC

16-111-001



GPWS - TEST BUTTON

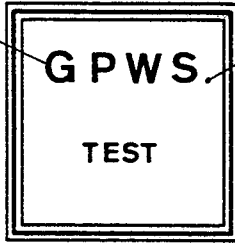
GPWS annunciator blinks when system causes audio output associated with modes 1 through 4. When pressed this button activates GPWS self-test.

The self-test sequence is as follows: BELOW G/S light illuminates, voice message GLIDE SLOPE will be heard once, one second pause. GPWS light illuminates, several repetitions of the WHOOP-WHOOP PULL-UP voice message.

An absence of voice messages or indication lights not illuminated, during test procedures, indicates that the relevant alerts on GPWS are not available. If only BELOW G/S light and GLIDE SLOPE voice message are obtained, the following modes are lost: excessive sink-rate, altitude loss after takeoff, and altitude gain function of excessive closure rate mode.

Self-test can be initiated on the ground or above 1000 ft by pressing and holding GPWS TEST button.

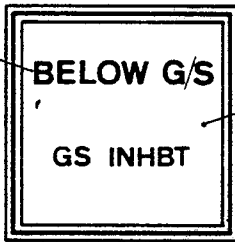
RED



BELOW G/S - GS INHBT BUTTON

BELOW G/S annunciator illuminates when the system presents mode 5 warning. When pressed cancels or inhibits mode 5.

AMBER



(PILOT'S AND COPILOT'S GLARESHIELD PANEL)

GPWS INOP - CAUTION LIGHT

Indicates a failure in the monitor sensor signals or AC power supply.

AMBER



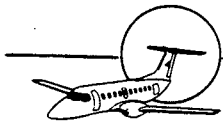
(MULTIPLE ALARM PANEL)

120 1625 094

GPWS CONTROLS AND INDICATORS

16-111-001

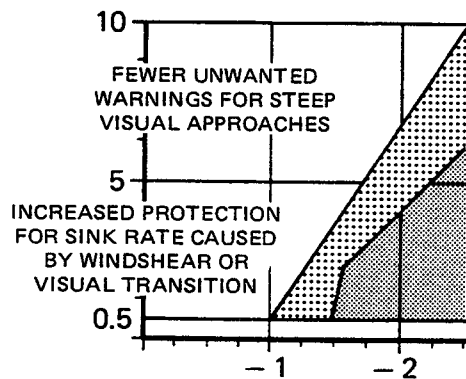
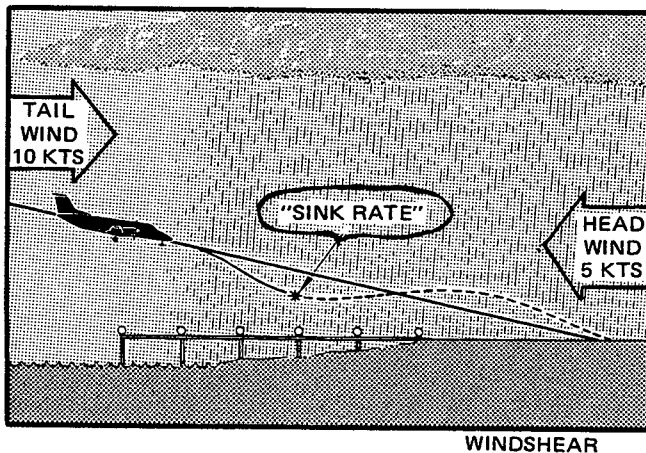
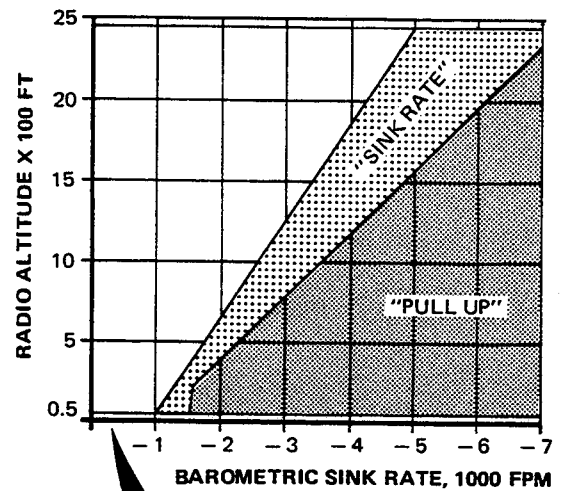
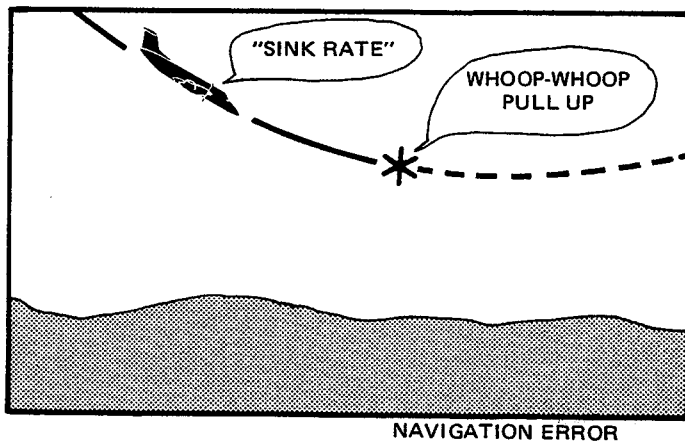
25 MARCH 1993



MODE 1 – EXCESSIVE SINK RATE

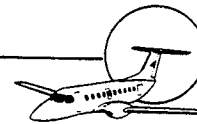
MODE 1 has two unique boundaries. The outer boundary advises the pilot that the rate of descent for a given altitude is excessive and the condition should be adjust.

When the outer boundary is penetrated, a voice message of "SINK RATE" is heard. If the rate of descent is not corrected and the second boundary is penetrated, a second message of "WHOO-PULL UP" is heard. The mode is independent of aircraft configuration. This mode provides an additional protection at lower altitude for windshear and visual transition.



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16-111-001

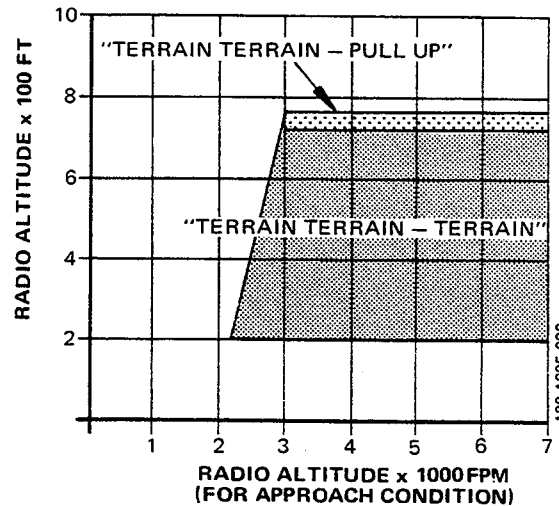
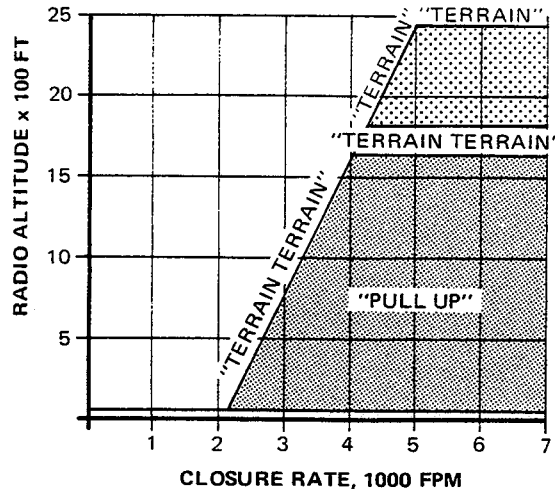
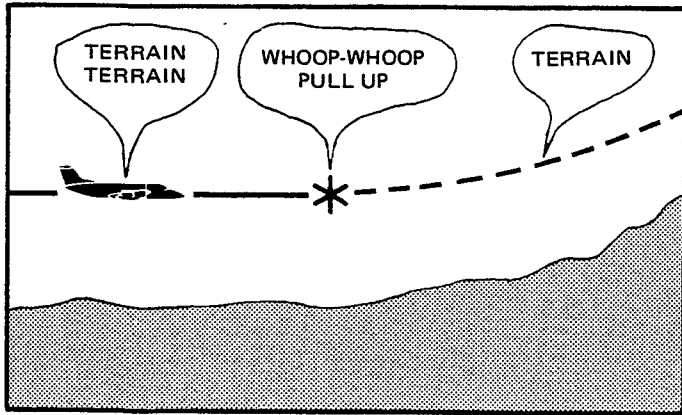


MODE 2 – EXCESSIVE CLOSURE RATE

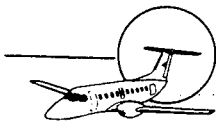
This mode is a complex function which involves airspeed or Mach number, radio altitude and its derivation, altitude rate, barometric altitude and aircraft configuration logic.

Upon penetrating the outer warning area the annunciation "TERRAIN TERRAIN" will be heard. If the closure condition remains after that, the "WHOO-WHOO PULL UP" annunciation will be heard. After the closure condition ceases and the PULL UP annunciation has shut off an altitude gain requirement function is initiated requiring a barometric altitude gain of 300 feet. The annunciation during this function is TERRAIN until the required altitude gain is achieved.

During an approach when gear or flaps are extended the altitude gain function is inhibited. The PULL-UP annunciation is replaced by TERRAIN for altitude below 700 ft with gear and flaps extended.



16-111-001



OPERATIONS MANUAL

MODE 3 – ALTITUDE LOSS AFTER TAKEOFF

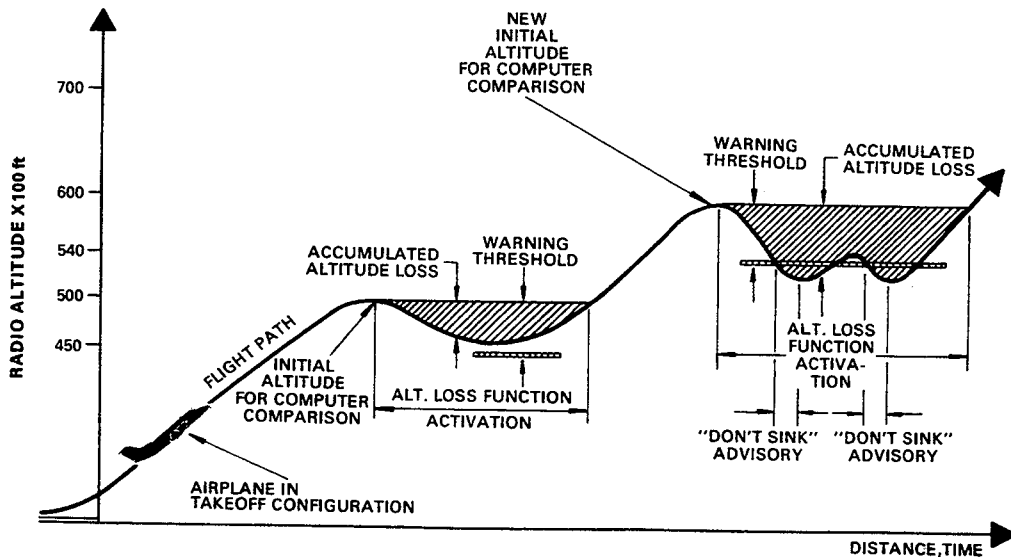
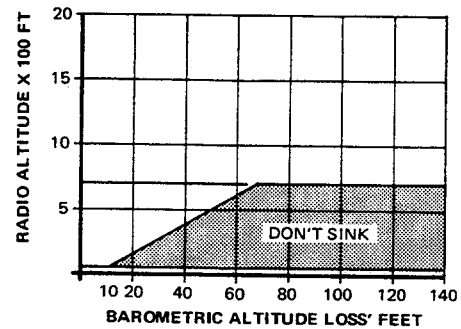
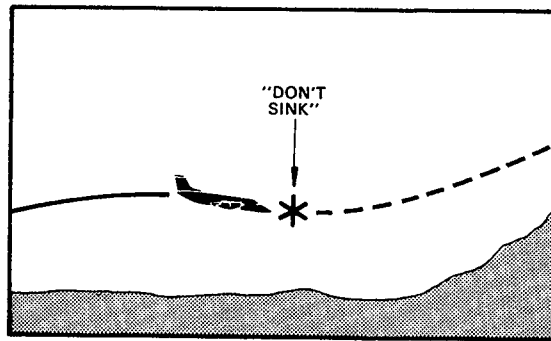
A DON'T SINK-DON'T SINK advisory will be heard if the airplane loses approximately 10% of barometric altitude after takeoff.

The altitude from which the initial descent occurs is the reference altitude used to monitor the altitude loss.

Once triggered, the advisory is cancellable only by achieving a positive rate of climb. Therefore, as long as the reference altitude is not reached again, a subsequent descent exceeding the advisory threshold value will immediately trigger the advisory.

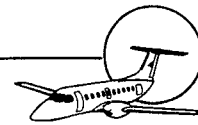
After the reference altitude is reached, the system is reset to a new altitude reference for an eventual altitude loss.

Operation in mode 3 takes place only between 65 and 700 ft radio altitude during takeoff or when either flaps or gear is retracted during a missed approach from below 200 ft. Above 700 ft radio altitude, the GPWS is switched to mode 4.



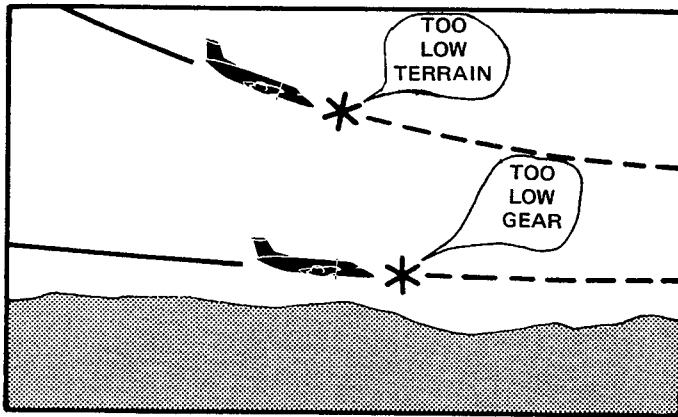
16-111-001

120 1911 010

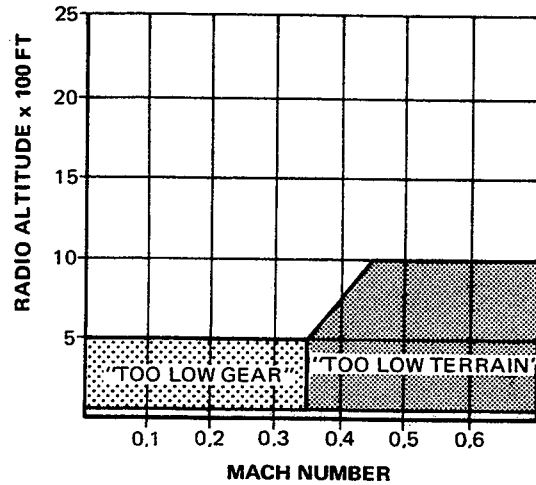


MODE 4A – TERRAIN CLEARANCE – GEAR UP

This mode is activated upon clearing 700 ft AGL after takeoff with gear up.
When flying below 1000 ft AGL close proximity to flat or gently sloped terrain generates a TOO LOW TERRAIN advisory.
When descending below 500 ft AGL with the gear not downlocked a TOO LOW GEAR advisory will be heard.

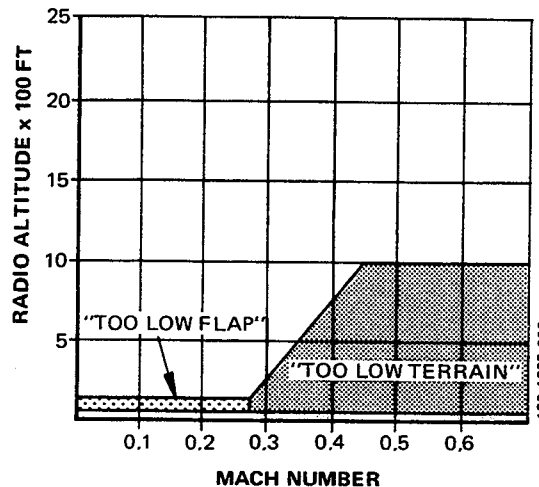
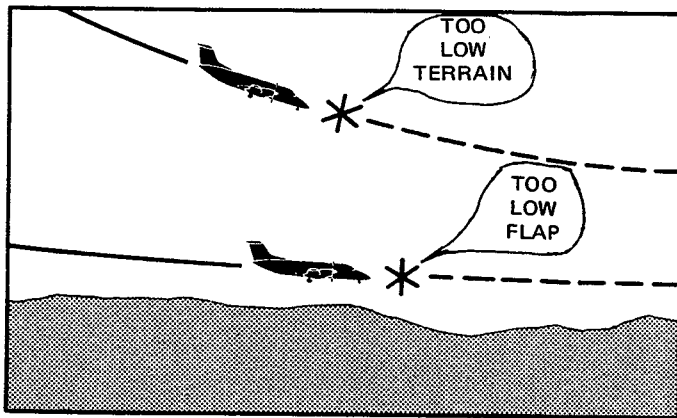


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MODE 4B – TERRAIN CLEARANCE – FLAPS ≤ 17°

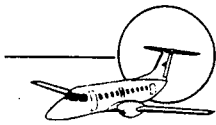
This mode provides warning when the gear is down and the flaps ≤ 17°. It is similar to MODE 4A in that flight below 1000 ft generates the TOO LOW TERRAIN advisory.
When descending below 200 ft AGL with the flaps ≤ 17° a TOO LOW FLAP advisory will be heard.



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In either case the warning is repeated until the condition is corrected. Both MODE 4A and 4B are inhibited below 50 ft for any gear or flap position. The computer automatically switches from MODE 4B to MODE 3 whenever the boundary of MODE 4B is passed in full landing configuration (gear and flap down) or whenever the aircraft is below 50 ft with gear down.

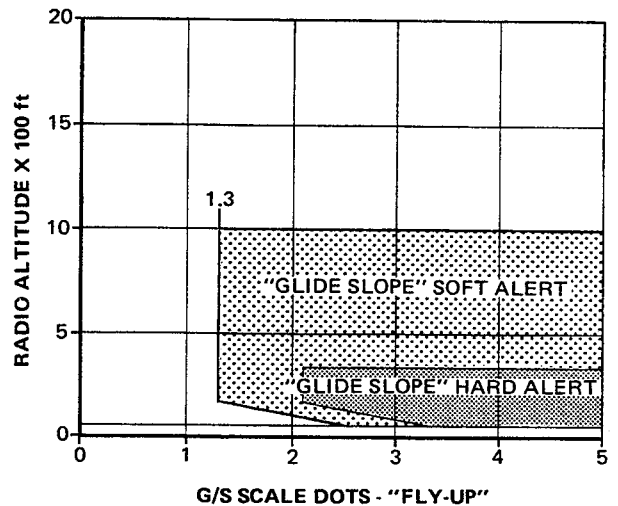
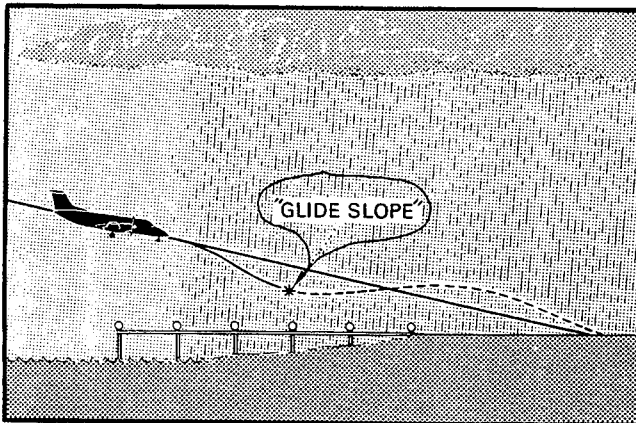
16-111-001



MODE 5 – GLIDE SLOPE

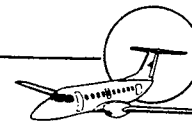
This mode advises of descent below the glide path when making an ILS approach. When the airplane penetrates the outer envelope, a GLIDE SLOPE voice warning is given softly. If the inner envelope is penetrated, the same voice warning repeats faster and at a higher volume.

The glide slope advisory light (BELOW G/S) is continuously activated. The glide slope advisory alert may be cancelled anywhere below 1000 ft altitude by pressing the GS INHBT button. The mode will automatically be rearmed by ascending above 1000 ft radio altitude.



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16-111-001



MODE 6 – DESCENT BELOW DECISION HEIGHT (DH)

The message MINIMUMS MINIMUMS is heard once when the airplane passes through the altitude setting of the radio altimeter DH SET knob between the altitudes of 1000 and 50 feet with the landing gear down. No warning lamps are turned on. This mode will not function again until either 1000 feet or 50 feet is transitioned or the landing gear is cycled up and down. A 50-foot minimum cutoff prevents unwanted messages on the ground if the DH setting is changed.

AURAL WARNING MESSAGE PRIORITIES

Due to the possibility of activating more than 1 warning at a time, the following warning priority has been incorporated. A higher priority message will immediately override a lower priority message that is in progress. A lower priority message can occur only after a higher priority message stops. Messages are listed in descending order of priority.

PRIORITY	MESSAGE	MODE
1	WHOO P WHOOP PULL UP	1 and 2
2	TERRAIN	2
3	TOO LOW TERRAIN	4
4	TOO LOW GEAR	4
5	TOO LOW FLAPS	4
6	MINIMUMS	6
7	SINKRATE	1
8	DON'T SINK	3
9	GLIDESLOPE	5



OPERATIONS MANUAL

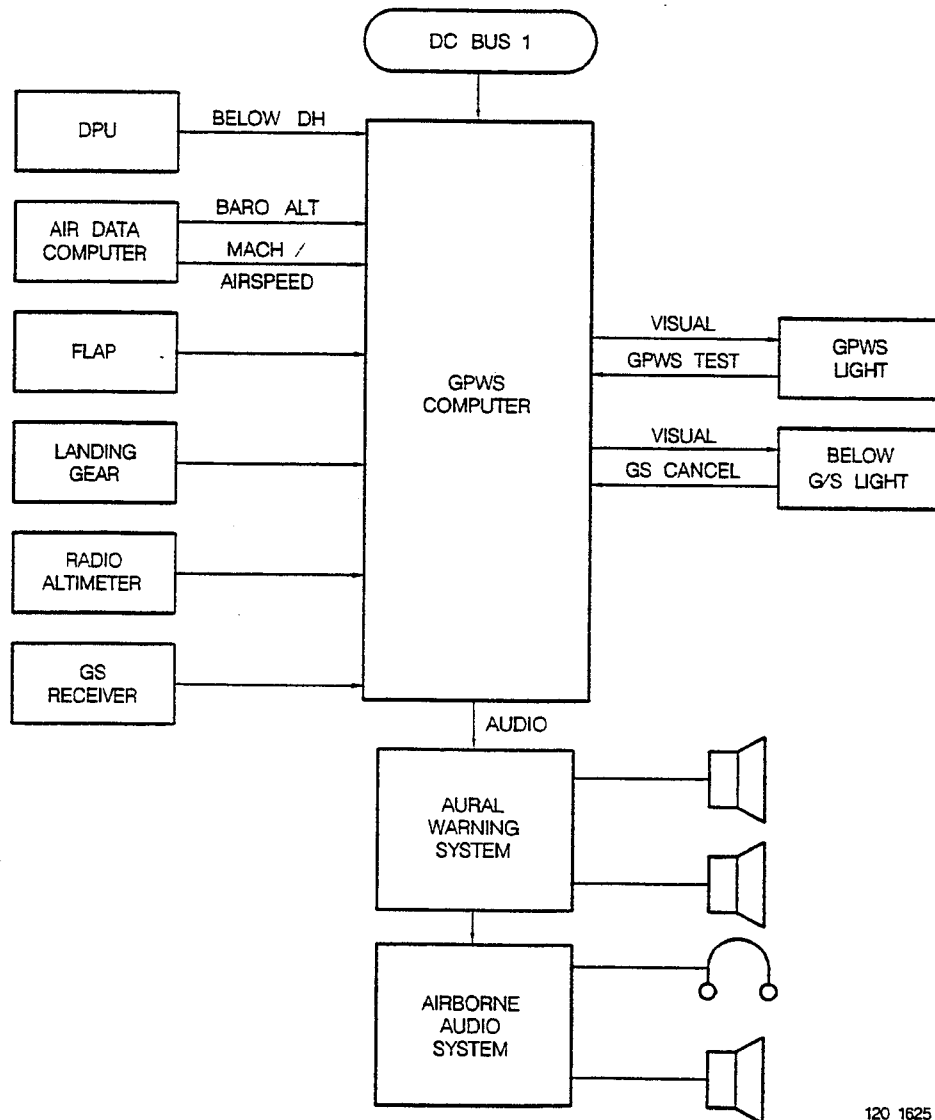
GROUND PROXIMITY WARNING SYSTEM (GPWS) – MODEL MK-VI

The ground proximity warning system monitors radio altitude, altitude rate, airspeed, gear and flap down position, and glide slope deviation; it provides audio and visual warnings to the flight crew whenever the flight path condition could result in terrain impact.

The GPWS system actuates in six different modes. MODES 1 through 4 advise flight crew of terrain proximity and voice messages will remain until a new safe flight condition has been attained. MODE 5 advises flight crew of glide slope exceedance and can be cancelled by GS INHBT button. MODE 6 provides voice message when crossing the selected decision height.

Two buttons installed on pilot's and copilot's panel provide visual warnings and permit testing the system.

NOTE: All GPWS modes, except for SUB-MODE 4C, are deactivated below 50 feet.



GPWS SCHEMATIC

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16-111-001



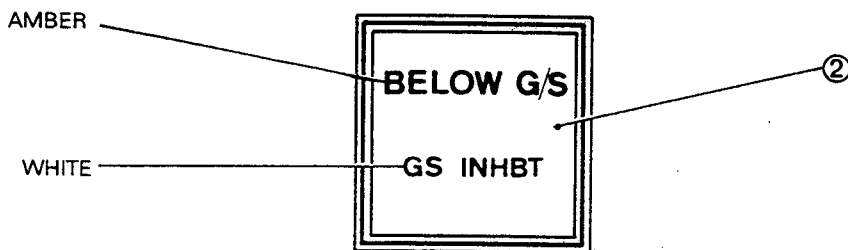
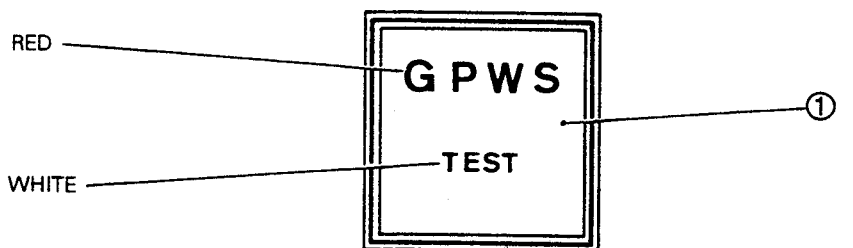
1. GPWS WARNING LIGHT AND TEST BUTTON

The GPWS warning light illuminates when modes 1 through 4 are activated. The TEST button activates the GPWS self-test. The self-test can be initiated on the ground or above 1000 ft by pressing and holding either GPWS test button. The self-test sequence is as follows: BELOW G/S light illuminated, voice message GLIDE SLOPE once, GPWS warning light illuminated and several repetitions of the voice message PULL-UP. If, during the self-test, the voice messages RADIO ALTIMETER FAULT, GLIDE SLOPE FAULT or BARO RATE FAULT are heard, or if indication lights do not illuminate or if there is an absence of voice messages, it indicates that some modes are not available. In this case, report to the maintenance personnel.

NOTE: Before repeating the test, wait at least 30 seconds for proper initialization.

2. BELOW G/S WARNING LIGHT AND GS INHBT BUTTON

The BELOW G/S warning light illuminates when the system presents mode 5 warning. The GS INHBT button, when pressed, cancels or inhibits mode 5.



(PILOT'S AND COPILOT'S PANEL)

120 1625 094



OPERATIONS MANUAL

MODE 1 - EXCESSIVE SINK RATE

This mode is independent of airplane configuration (takeoff, landing, etc). It advises the pilots that the rate of descent for a given altitude is excessive and the condition should be adjusted.

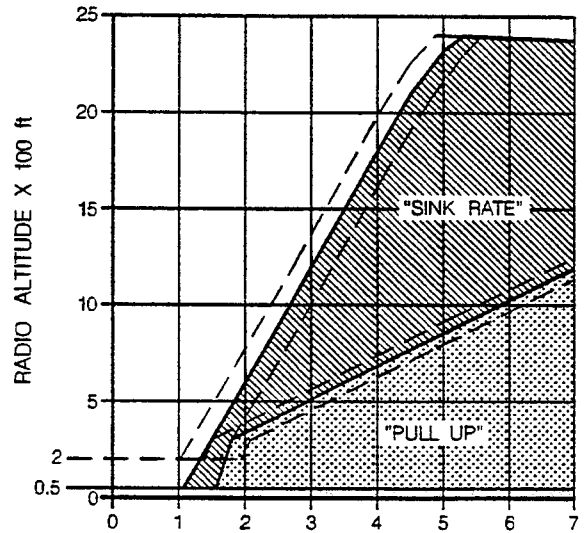
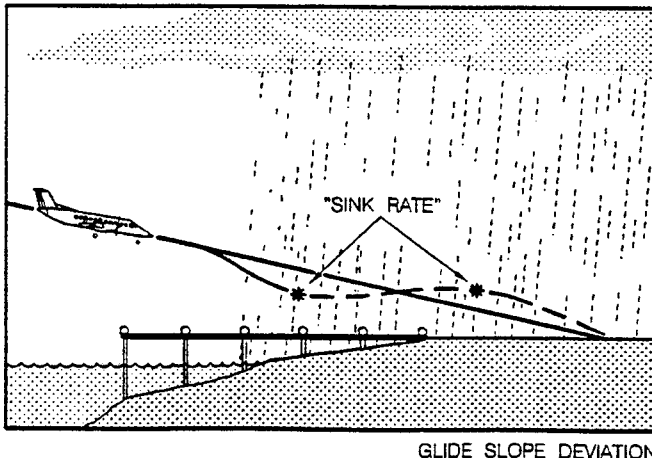
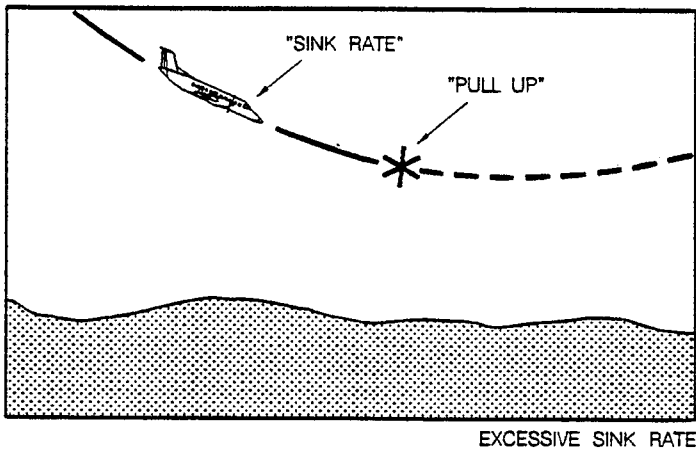
MODE 1 has two boundaries. When the outer boundary is penetrated, a voice message of SINK RATE is heard and the GPWS red light illuminates. If the rate of descent is not adjusted and the second boundary is penetrated, a second voice message of PULL UP is heard and the GPWS red light remains illuminated.

This mode is also actuated during glideslope deviations below or above the beam centerline. When the glideslope deviation is above the beam centerline, the warning envelope is shifted to the right (dashed line on the envelope), requiring additional descent rate for a GPWS output and reducing possible nuisance outputs.

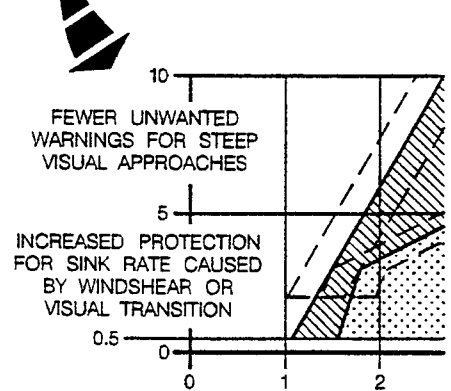
When the glideslope deviation is below the beam centerline, the warning envelope is shifted to the left (dashed line on the envelope), requiring less descent rate for a GPWS output and increasing the GPWS sensitivity.

This provides an additional protection at lower altitude for windshear and visual transition.

NOTE: The envelope shifting during glideslope deviation is available only above 200 ft radio altitude.

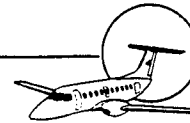


BAROMETRIC SINK RATE, 1000 FPM



16-111-001

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MODE 2 – EXCESSIVE CLOSURE RATE

This mode helps to protect the airplane against excessive closure rate to terrain, when flying over mountainous regions.

MODE 2 is divided into two SUB-MODES 2A and 2B.

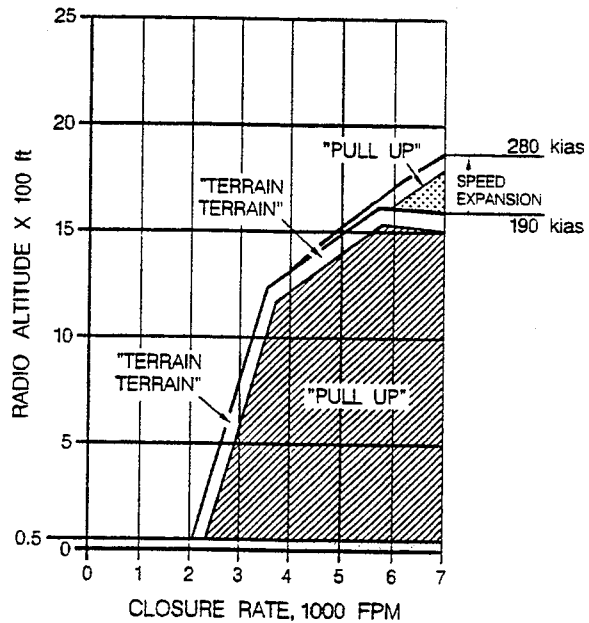
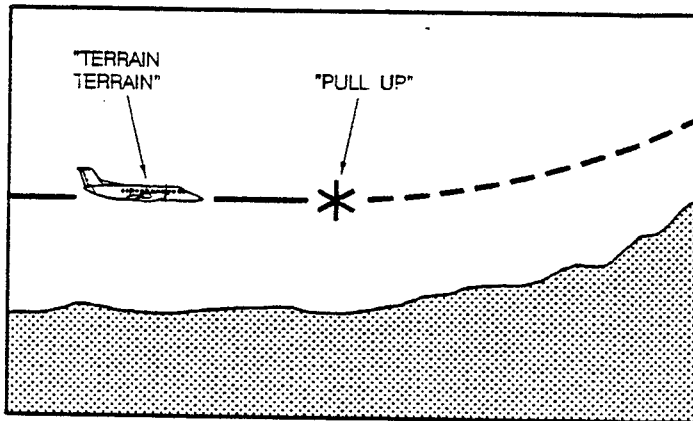
SUB-MODE 2A – FLAP NOT IN LANDING POSITION

SUB-MODE 2A is activated during routine flights, with flap not in landing position and the airplane not on an ILS approach.

SUB-MODE 2A has two boundaries. Upon penetrating the outer boundary, the voice message TERRAIN-TERRAIN will be heard once and the GPWS red light illuminates. If the closure condition remains after that and the second boundary is penetrated, the PULL UP will be heard and the GPWS red light remains illuminated.

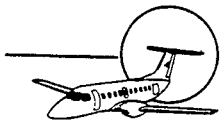
After the closure condition ceases and the PULL UP voice message had shut off, an altitude gain function is initiated requiring a barometric altitude gain of 300 ft. During this time, the GPWS red light remains illuminated, as a reminder.

SUB-MODE 2A has its upper limit envelope expanded between 190 and 280 kias, in order to improve the warning time for increasing closure rate when above 1500 ft radio altitude.



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16-111-001

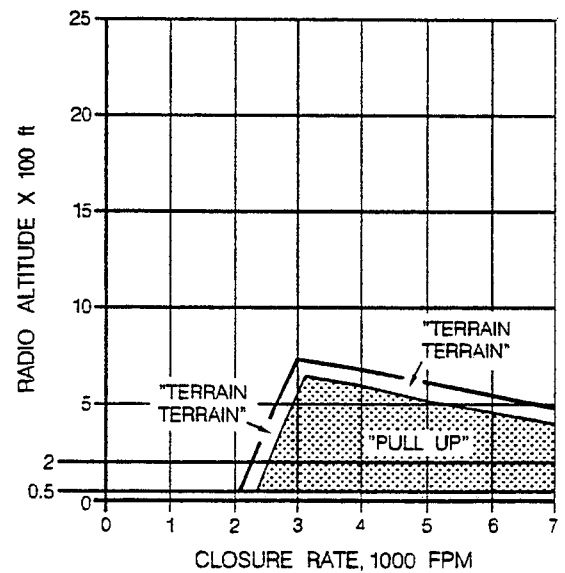
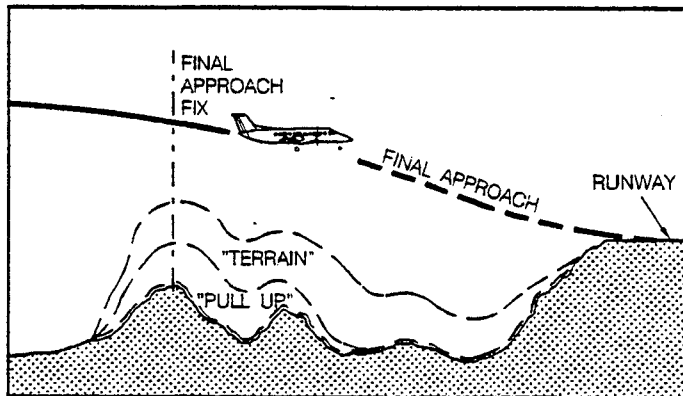


OPERATIONS MANUAL

SUB-MODE 2B – FLAP IN LANDING POSITION (25° OR 45°)

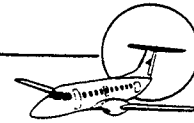
SUB-MODE 2B is activated during approaches, for altitudes below 750 ft, with the flap in landing position or the airplane in an ILS approach.

When the alert envelope of SUB-MODE 2B is penetrated, the voice message TERRAIN-TERRAIN will sound once and the GPWS red light illuminates. If the closure condition remains after that, even with the landing gear down, the TERRAIN-TERRAIN continues to sound; otherwise, if the landing gear is up, the voice message PULL UP will be heard. The GPWS red light remains illuminated in both cases. Either of the voice messages and the light will extinguish when the envelope is exited. The altitude gain function required in SUB-MODE 2A is inhibited in this sub-mode.



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16-111-001



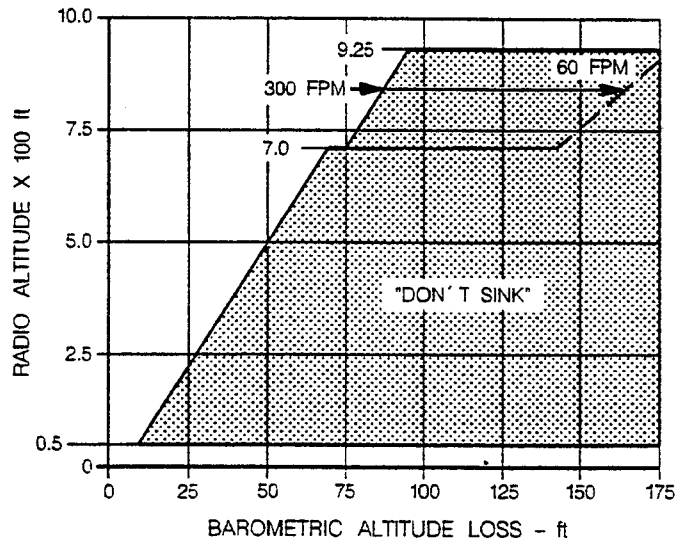
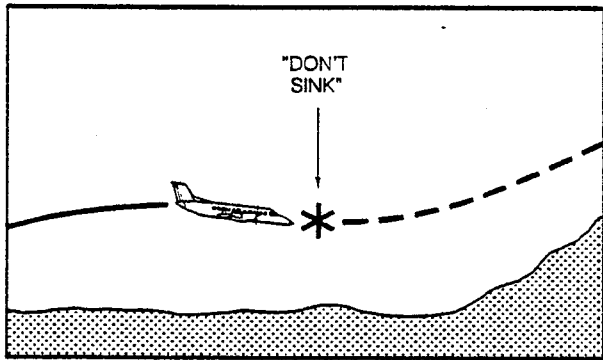
MODE 3 – ALTITUDE LOSS AFTER TAKEOFF

MODE 3 will alert the pilots to an inadvertent descent into terrain after takeoff or missed approach. A DON'T SINK voice message will be heard and the GPWS red light will illuminate after significant barometric altitude loss has occurred.

The altitude from which the initial descent occurs is the reference altitude used to monitor the altitude loss.

Once triggered, the advisory will be cancellable only by achieving a positive rate of climb. Therefore, if, during the climb, another descent is initiated, the altitude loss will trigger the advisory again. Operation in MODE 3 takes place only between 50 and 245 ft during a missed approach, since flap and gears are retracted and between 50 and 925 ft radio altitude during takeoff.

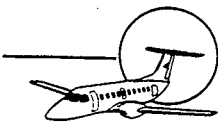
Above 700 ft, the envelope shape is variable depending on the airplane rate of descent. Starting at 300 FPM, the envelope is shifted to the right as the rate of descent decreases, as showed in the diagram below. This intend to reduce possible nuisance outputs.



120 1913 017

16-111-001

15 MARCH 1994



MODE 4 – INSUFFICIENT TERRAIN CLEARANCE

MODE 4 generates three types of alerts based on radio altitude, airspeed and flight condition. These are referred to as SUB-MODES 4A, 4B and 4C and do not occur simultaneously.

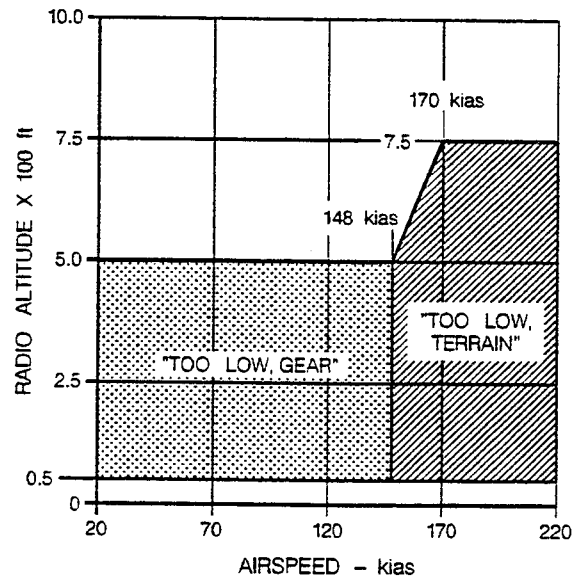
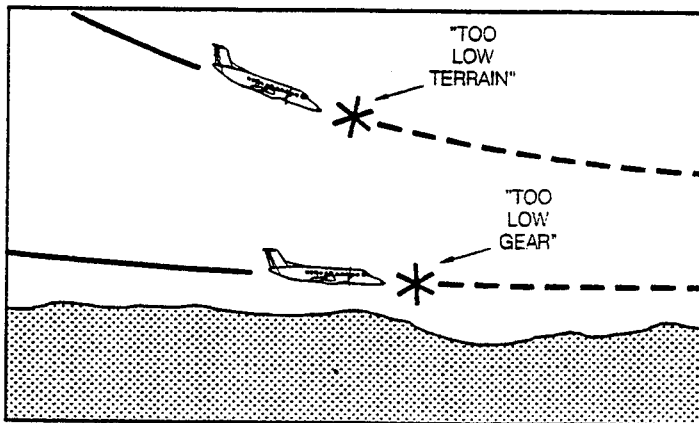
SUB-MODE 4A – TERRAIN CLEARANCE – GEAR UP

SUB-MODE 4A is activated during cruise and approach with landing gear up.

When flying below 750 ft AGL, close proximity to flat or gently sloped terrain will generate a TOO LOW, TERRAIN voice message and the GPWS red light illuminates.

When descending below 500 ft, if the envelope boundary is penetrated at speeds below 148 kias, a TOO LOW, GEAR voice message will be heard; otherwise, if the envelope boundary is penetrated at speeds above 148 kias, the TOO LOW, TERRAIN voice message will be sound. The GPWS red light remains illuminated in both cases.

Either of the voice messages and the light will continue until the landing gear is lowered or the envelope is exited.

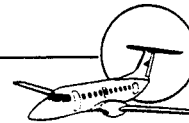


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16-111-001

15 MARCH 1994

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SUB-MODE 4B – TERRAIN CLEARANCE – FLAPS ≤ 17°

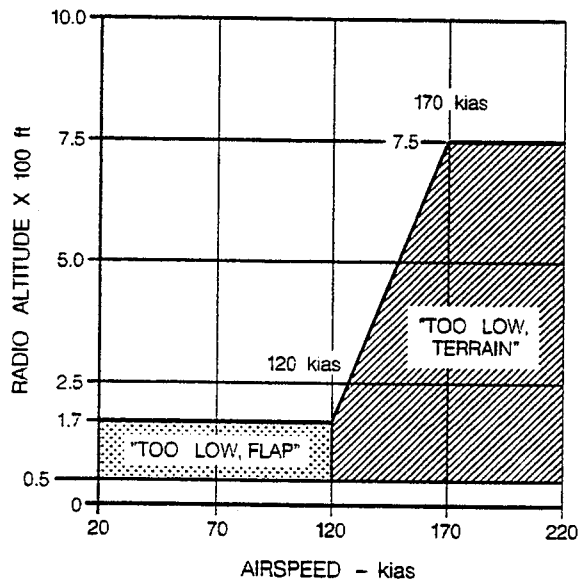
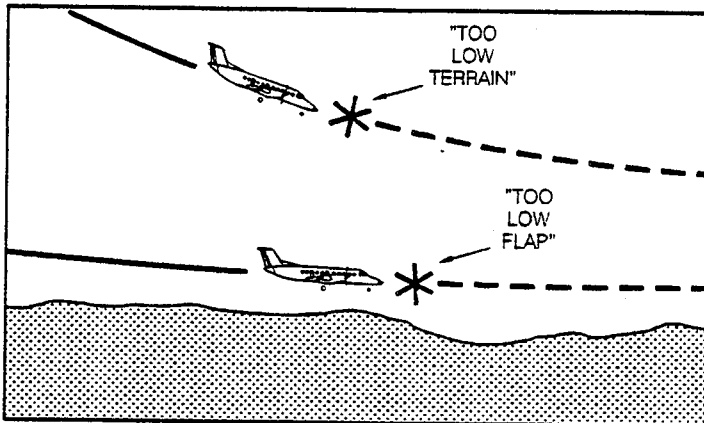
This sub-mode provides warning at below 750 ft AGL, when the gear is down and the flap is not in the landing position.

This mode is similar to SUB-MODE 4A at altitudes between 750 and 170 ft AGL, when the TOO LOW, TERRAIN voice message is generated and the GPWS red light illuminates.

When descending below 170 ft, if the envelope boundary is penetrated at speed below 120 kias, a TOO LOW, FLAP voice message will be heard; otherwise, if the envelope boundary is penetrated at speeds above 120 kias, the TOO LOW, TERRAIN voice message will be heard.

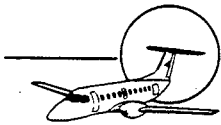
The GPWS red light remains illuminated in both cases.

Either of the voice messages and the light will continue until the flaps are lowered beyond 17° or the envelope is exited.



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16-111-001



OPERATIONS MANUAL

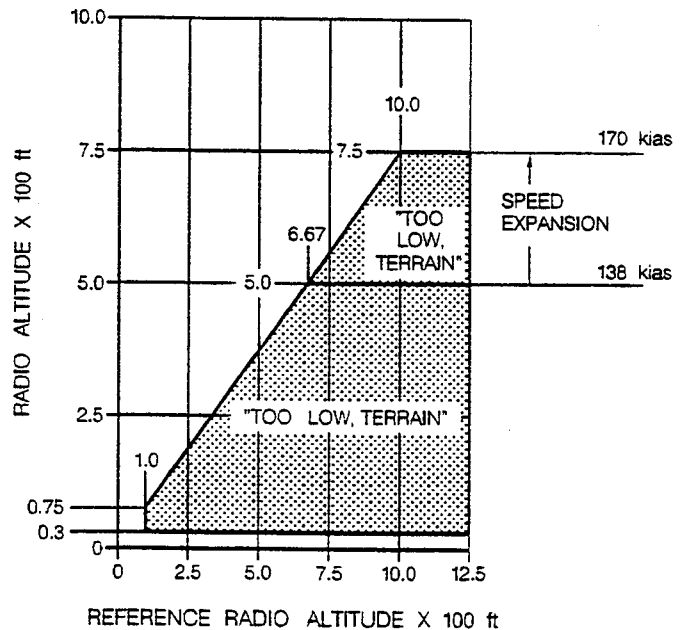
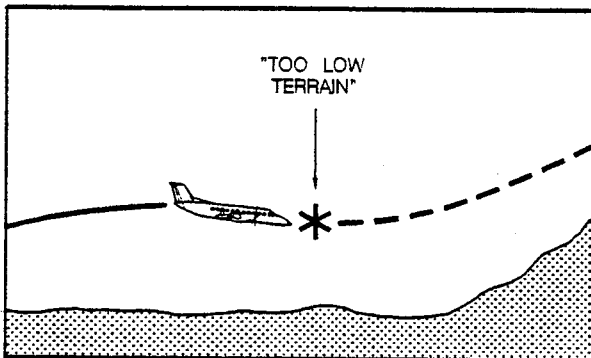
SUB-MODE 4C – MINIMUM TERRAIN CLEARANCE AT TAKEOFF

SUB-MODE 4C is based on a minimum terrain clearance during takeoff and go-around. This sub-mode is activated at 100 ft of radio altitude, during takeoff or at 200 ft during go-around, and continues until the radio altitude decreases below 30 ft or SUB-MODE 4A is activated.

The minimum terrain clearance value used as a reference in this sub-mode is the 3/4 of the highest value of radio altitude occurred during the takeoff. If the airplane descends below the reference value after the takeoff or if the terrain rises in a gradient faster than that at which the airplane is climbing, the TOO LOW, TERRAIN voice message will be heard and the GPWS red light illuminates.

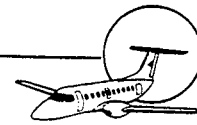
The voice message and the light will continue until the airplane has gained sufficient clearance from the terrain.

SUB-MODE 4C has its upper limit envelope expanded between 138 and 170 kias, in order to improve the warning time when above 500 ft AGL.



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16-111-001



MODE 5 – DESCENT BELOW GLIDE SLOPE

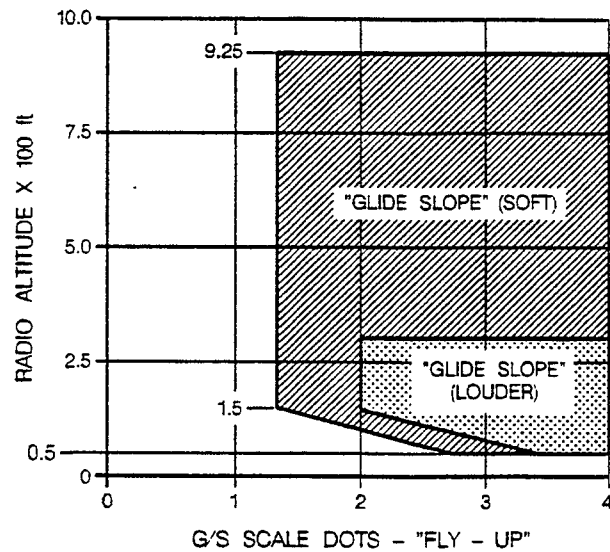
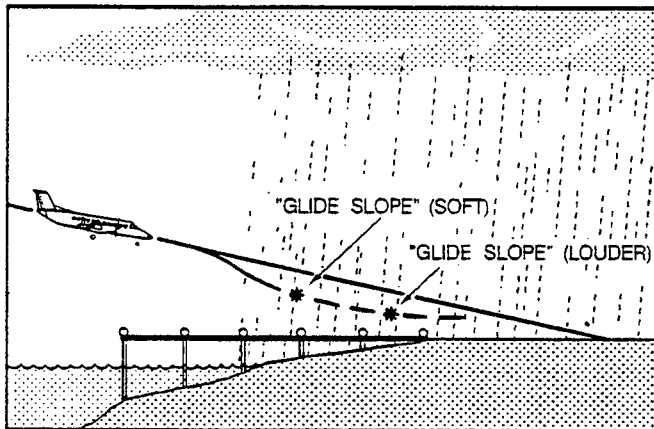
MODE 5 provides alerts for excessive glideslope deviation when making a front-course ILS approach. This mode is automatically activated when the pilot selects an ILS frequency and the landing gear is down.

NOTE: The GPWS is not connected to the copilot's ILS receiver.

The warning envelope contains two boundaries: a "soft" alerting region and a "louder" alerting region. When the airplane penetrates the outer envelope, a GLIDE SLOPE voice message is given softly. If the inner envelope is penetrated, the same voice message repeats faster and louder. The BELOW G/S warning light always illuminates with the voice message. The voice message and the warning light may be cancelled anywhere between 1900 ft and 50 ft AGL, by pressing the GS INHBT button.

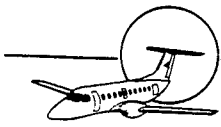
After being cancelled, MODE 5 is automatically rearmed above 1900 ft, below 50 ft or when a VOR frequency is selected.

For simultaneous actuation of MODE 5 and MODE 1, the voice message will be GLIDE SLOPE, pause, SINK RATE.



120 1913 021

16-111-001



OPERATIONS MANUAL

MODE 6 – DESCENT BELOW DECISION HEIGHT (DH)

The voice message MINIMUMS-MINIMUMS is called out once when the airplane passes through the altitude setting of the radio altimeter DH SET knob between the altitudes of 1000 and 50 ft with the landing gear down. No warning light is turned on.

This mode will not function again until either 1000 ft or 50 ft is transitioned or the landing gear is cycled up and down.

A 50 ft minimum cutoff prevents unwanted messages on the ground if the DH setting is changed. For approaches where the MINIMUMS call-out is not desired, the DH setting should be set to below 50 ft and no aural message will be annunciated.

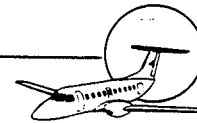
NOTE: In case different DH are set by the pilots, MODE 6 will actuate on the highest DH setting.

AURAL WARNING MESSAGE PRIORITIES

Owing to the possibility of activating more than one mode at a time, the following warning priority has been incorporated. A higher priority message will immediately override a lower priority message that is in progress. A lower priority message can occur only after a higher priority message stops. Messages are listed in descending order of priority.

PRIORITY	MESSAGE	MODE
1	PULL UP	1, 2A, 2B
2	TERRAIN-TERRAIN	2A, 2B
3	TOO LOW, TERRAIN	4A, 4B, 4C
4	MINIMUMS-MINIMUMS	6
5	TOO LOW, GEAR	4A
6	TOO LOW, FLAP	4B
7	GLIDE SLOPE AND SINK RATE	1 AND 5
8	SINK RATE	1
9	DON'T SINK	3
10	GLIDE SLOPE	5

16-111-001

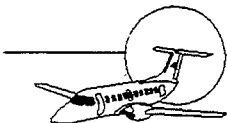


RAD/BAR WARNING SYSTEM – OPTIONAL

The Radio/barometric encoding altimeter monitors the radio and barometric altitude and the glide slope deviation, giving inputs to the aural warning system. Additionally, a DH light provides a visual indication of the airplane altitude (refer to Section 6-16). The warnings will be heard in the following conditions:

WARNING	CONDITION
TERRAIN	<ul style="list-style-type: none"> – At 2500 ft AGL and 1000 ft AGL. – When the rate of descent is greater than 3800 ± 250 ft/min, between 1000 and 2500 ft AGL. The warning will sound continuously until the rate of descent is modified to an acceptable level.
HUNDREDS	<ul style="list-style-type: none"> – Below 1000 ft AGL the system will annunciate the altitude in hundreds of feet (NINE HUNDRED, EIGHT HUNDRED etc...).
GLIDE-SLOPE	<ul style="list-style-type: none"> – When in the glide-path and below 1000 ft AGL, one-dot deviation on ADI (or EADI) will cause the warning to sound each 2 seconds. Two-dot deviation will cause the alarm to sound each second at twice its previous volume.
MINIMUM	<ul style="list-style-type: none"> – At decision height.

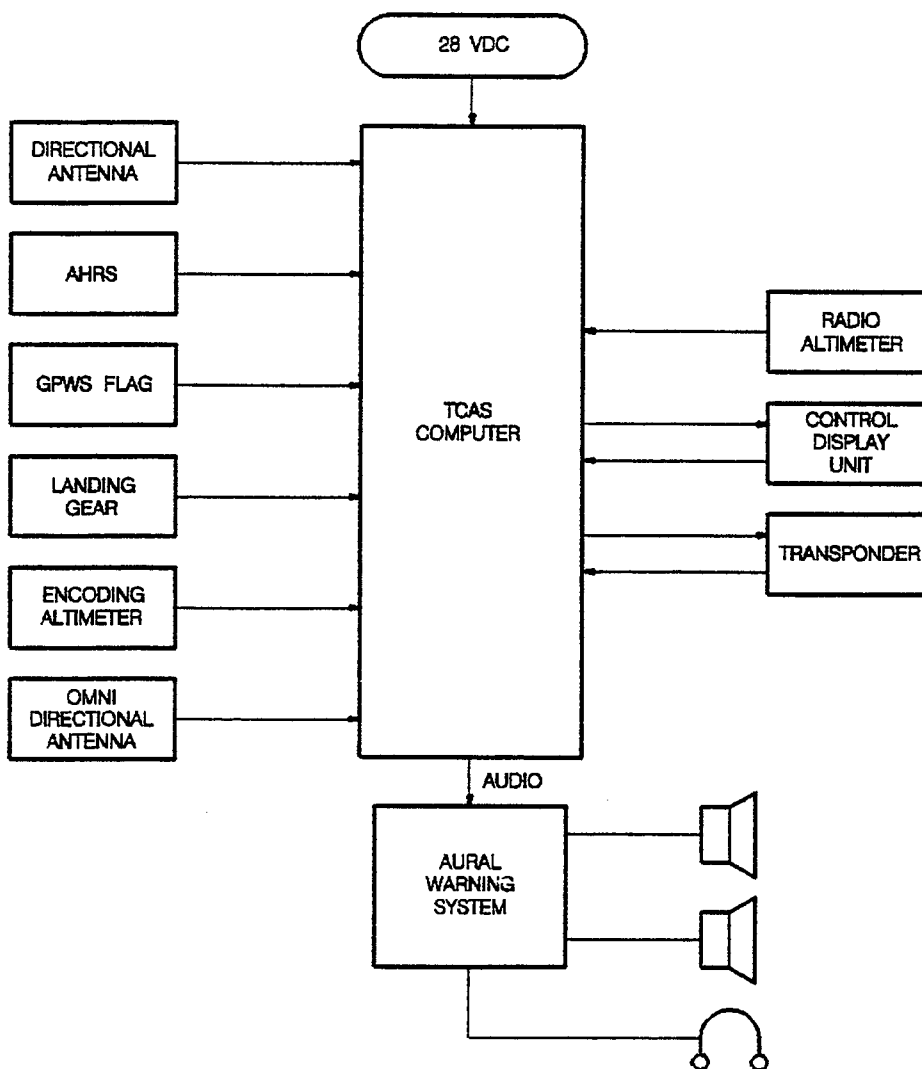
- NOTE:**
- Hundreds altitude advisory interrupts "Glide Slope" warning every time they coincide.
 - "Glide Slope" warning is discontinued below decision weight.
 - "Minimum" warning overrides other warnings.
 - Warnings are deactivated during takeoff, climb and go-around, unless a negative radio altitude is sensed.
 - If VOR 1 is not functioning properly, the "Glide Slope" warning will not sound.



TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS I) – OPTIONAL

GENERAL

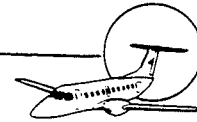
The EMB-120 may be equipped with a Traffic Alert and Collision Avoidance System (TCAS I) which provides the crew with an indication of possible traffic conflict when in flight. The system is based upon transponder signals and provides visual and aural warning.



16-111-001

120 0625 351

TCAS SCHEMATIC



SYSTEM DESCRIPTION

The TCAS consists of a Transmitter-Receiver Computer (TRC), a directional antenna, an L-band omni-directional antenna, and a Control Display Unit (CDU).

The control and test functions of the TCAS are performed through the CDU that is used to present traffic information to the pilot.

TCAS computer receives data from the installed transponder, radio altimeter, encoding altimeter, antenna signals, and landing gear air/ground switches. AHRS provides magnetic heading information to TCAS.

By interrogating other airplane transponders, TCAS determines relative altitude, range, and bearing of any airplane equipped with a Mode C or S transponder.

CAUTION: TCAS PROVIDES NO PROTECTION AGAINST AIRPLANES THAT DO NOT HAVE AN OPERATING TRANSPONDER OR AIRPLANES EQUIPPED WITH A MODE A TRANSPONDER.

The system is capable of tracking up to 35 intruders. However, to reduce display clutter, only those eight (8) targets determined to present the greatest threat will be displayed on the CDU.

Airplane intruders are displayed as symbols identified by color and shape followed by an up-or-down trend arrow, and a number. The number is a plus (+) or minus (-) followed by two digits that represent the vertical distance in hundreds of feet between the airplane and the intruder airplane. It is positive when intruder airplane is higher and negative when lower. If the intruder is at the same altitude as the airplane, the digits "00" will be displayed. If the intruder altitude is not reported, the altitude field will be blank.

The up-or-down trend arrow indicates if the intruder is either climbing or descending at a rate greater than 500 feet per minute. If the intruder is non-altitude reporting, no trend arrow will appear and the system will assume the intruder is at the same altitude as the airplane.

Selectable range scale is available through the RNG pushbutton on the CDU. The selected range (5, 10 or 20 nm) will be indicated in the upper right corner of the display.



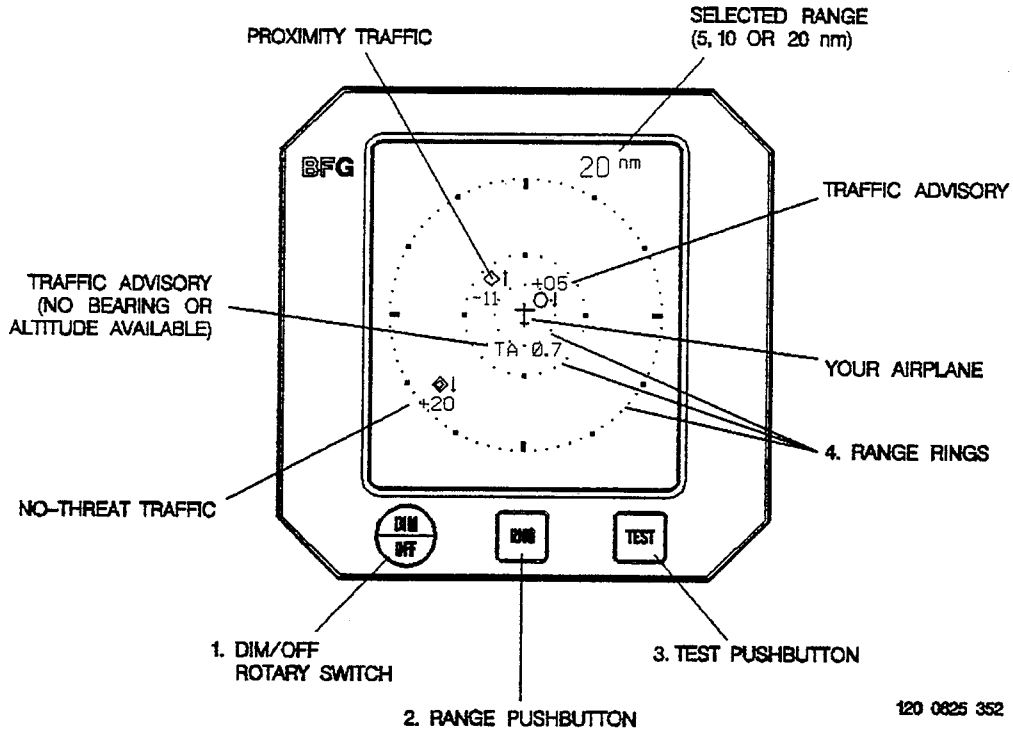
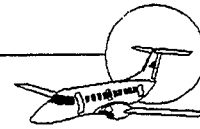
TCAS SELF-TEST

The TCAS self-test is activated through the TEST pushbutton on the CDU.

Before initiating the TCAS self-test, set pilot's barometric altimeter to 29.92 mmHg and observe the indicated pressure altitude. Then turn TCAS on and momentarily press the TEST pushbutton on the CDU. A normal 5-nm display with all intruder symbols will be presented. In addition, the following messages will be displayed: TEST on the upper left, 5 nm on the upper right, and the airplane altitude at the lower middle of the display. The altitude displayed should be within ± 250 ft of the altitude indicated on the pilot's altimeter. If the displayed altitude is out of the range, it indicates a failure of the equipment.

At the completion of the self-test, the display will return to normal, and a voice message either "TCAS TEST PASSED" or "TCAS TEST FAILED" will be heard.

NOTE: TCAS self-test is inhibited in flight.



TCAS CONTROL DISPLAY UNIT (CDU)
(FORWARD PANEL)

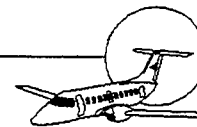
16-111-001



TCAS CONTROL DISPLAY UNIT

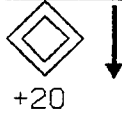
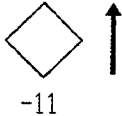
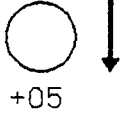
1. **DIM/OFF ROTARY SWITCH** – Controls display brightness and power to both the Transmitter-Receiver Computer (TRC) and the Control Display Unit (CDU). Power is applied by rotating the knob clockwise past the detent. Continued clockwise rotation increases display brightness.
2. **RANGE PUSHBUTTON** – Press the RNG pushbutton to select among the 5-, 10-, or 20-nautical mile ranges. The selected range will be indicated in the upper right corner of the display. Whenever the airplane is on the ground, range selection is inhibited and the system defaults to 5 nm.
3. **TEST PUSHBUTTON** – Initiates a system self-test (push to start), while the airplane is on the ground.
Test function is inhibited, whenever the airplane is airborne.
4. **RANGE RINGS** – Three or two range rings of blue dots around the blue miniature airplane represent distances surrounding your airplane.
Depending on which range is selected, the range rings will have different values as follows:

RANGE RINGS		
SELECTED RANGE	RING	DISTANCE FROM YOUR AIRPLANE
5 nm	inner	2 nm
	outer	5 nm
10 nm	inner	2 nm
	middle	5 nm
	outer	10 nm
20 nm	inner	5 nm
	middle	10 nm
	outer	20 nm



DISPLAY SYMBOLS

The symbols represent several degrees of threat. Intruders are classified as non-threat, proximity, or traffic advisory (TA) as follows:

<p>1. An open white diamond symbol is used for non-threat traffic, indicating an intruder is more than \pm 1200 feet vertically or more distant than 6 NM;</p>	
<p>2. A solid white diamond symbol is used for proximity traffic, indicating an intruder is within \pm 1200 feet vertically and within 6 NM, but it is not yet considered a threat.</p>	
<p>3. A solid yellow circle is a traffic advisory (TA). It indicates that an intruder is now considered a threat and there is a risk of potential collision within 15 to 30 seconds.</p> <p>At the moment the threat airplane is first detected, TCAS will display it as a yellow circle and the voice message "TRAFFIC, TRAFFIC" will be heard in the cockpit.</p> <p>If the threat airplane bearing is unknown, instead of the yellow circle, TCAS will display it as a "TA" followed by a number that represents the horizontal distance in NM from the airplane.</p> <p>NOTE:</p> <ul style="list-style-type: none"> • The voice message is inhibited below 400 feet AGL. • The pilot should not initiate evasive maneuvers using information from the traffic display or traffic voice message, without visually noticing the intruder. Safe visual separation should be maintained in accordance with regulation requirements and good operating practice. 	
<p>4. A solid yellow half-circle symbol is applicable only to 5-nm range selection and indicates a threat airplane located outside the surveillance range (between 6 and 5 nm). It will be displayed on the edge of the outer range ring, until the threat airplane comes within range and can be completely displayed.</p>	