



1. GENERAL.

The Warning Annunciator System (WAS) monitors various parameters in the aircraft and triggers appropriate warnings and cautions when certain combinations of parameter values exceeds the warnings and cautions thresholds. Both visual (red and amber lights) and aural alerts (chime and specific alerts) are used.

WARNINGS AND CAUTIONS		
	VISUAL	AURAL
RED	Immediate action Required.	Specific aural tones and triple chimes.
AMBER	Corrective action or close attention.	Specific aural tones and single chimes.

2. MAIN COMPONENTS AND SUBSYSTEMS.

The warning electronic unit receives advisory input signals from various aircraft sensors. The signals are compared with fixed thresholds and if exceeded the circuitry will enable Master warning, Master caution or other alerts to come on. Master warnings and Master cautions are indicated by associated lights on the glareshield panel in front of each pilot and on the Central warning panel.

2. 1. Master warning.

The master warning lights on the glareshield panel and the triple chime will come on whenever one or more of the red warning annunciator lights on the central warning panel comes on due to an aircraft system malfunction. The master warning lights and the triple chime alert can be turned off and the system reset by pressing either Master warning buttonlight. After resetting, the system is rearmed and will respond again to any subsequent malfunction. The annunciator lights on the central warning panel will remain on until the fault is corrected. The warnings not announced through the Warning Annunciator System are reset through the associated system (AP disconnect) or can not be reset at all (Stall warning and Overspeed warning).

2. 2. Master caution.

The master caution light on the glareshield panel and the single chime will come on whenever one or more of the amber caution annunciator lights on the central warning panel comes on due to a aircraft system malfunction. The master caution lights and the single chime alert can be turned off and the system reset by pressing either Master caution buttonlight. System function and operation in the same manner as the Master warning described above.

2. 3. Central warning panel.

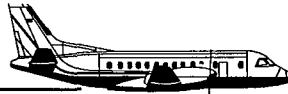
The top half of the lights on the central warning panel contains red warning annunciator lights. Eight of these are recorded by the flight data recorder. (Fig. 2.) The lights at the bottom half are amber caution annunciator lights. Some caution lights includes an arrow pointing in the direction where the indicators and the controls for the particular system are located.

2. 4. Takeoff inhibit.

The Takeoff inhibit mode is only for use during takeoff and is selected prior to takeoff. By pushing the takeoff inhibit button (T/O INH) located on the center instrument panel, nonessential warnings, not needed during the takeoff phases, are inhibited (suppressed). An integral light in the takeoff inhibit button will confirm the selection. Pressing the takeoff inhibit button a second time will reset the system and extinguish the light. Automatic reset will occur when the landing gear is retracted or when Ground Operation is selected. If any of the suppressed warnings and cautions are received by the warning electronic unit during Takeoff inhibit mode they will subsequently come on together with aural alert when Takeoff inhibit mode becomes reset.

2. 5. Ground Operation.

The Ground operation mode is only available on ground and will when selected minimize the nuisance effect of various cautionary alerts for ground handling and prior to takeoff.



Ground operation mode will inhibit all aural cautionary alerts and also inhibit the master caution lights except for those alerts listed in Table 1. Remaining cautionary visual alerts will only appear on the CWP in steady (reset) state. This push button is located on the center instrument panel directly below the Takeoff inhibit push button. An integral light in the GND OP push button will confirm the selection. Pressing the GND OP push button a second time will reset the system and extinguish the light. Automatic reset will occur when landing gear is retracted or when Takeoff inhibit is selected. Ground operation mode will also come on automatically after landing. During engine start the Warning System reverts from GND OP to T/O INH and back to GND OP due to power change from L/R ESS BUS to EMER BUS. The power change is controlled by the start relay and the speed sensor (55% Ng).

2. 6. Aural alerts.

The aural alert is divided into two general categories:

- Master warnings (triple chime).
- Master cautions (single chime).

Warning always take priority over the cautions. In addition to general alerts there are a number of special alerts which together with Master warnings and Master cautions are arranged in the following priority order:

Alert Sound

1.	Stall warning	Clacker
2.	AP disconnect	Cavalry charge
3.	Engine fire	Firebell
4.	Configuration	Intermittent horn
5.	Master warning	Triple chime
6.	Altitude alert	C–chord
7.	Master caution	Single chime
8.	Overspeed warning	Continuous horn

Whenever, two special alerts are initiated simultaneously, the higher priority alert sounds while the other is dormant. When the higher priority alert is cleared or reset, the lower priority alert will sound. If a special alert is initiated simultaneously with a Master alert, both will sound.

NOTE

The aural alerts, except altitude alert, will be repeated every 5 seconds until reset or corrective action is taken.

2. 7. Bright/Dim.

The ANNUN BRIGHT/DIM switch on the overhead panel controls the brightness of the annunciator lights, both on the overhead panel and on the central warning panel. All annunciator lights are affected except: the ground status panel lights, GPWS lights, LAMPS, FLAPS, AIR DATA, EMER PWR and EXT PWR ON.

Initially, the warning/caution lights will always come on bright, flashing, irrespective of bright/dim selection. After reset (MASTER WARNING/MASTER CAUTION pushed), the light on the central warning panel will revert to steady state, bright or dim depending on the ANNUN 2RIGHT/DIM selection.

2. 8. Lamp test.

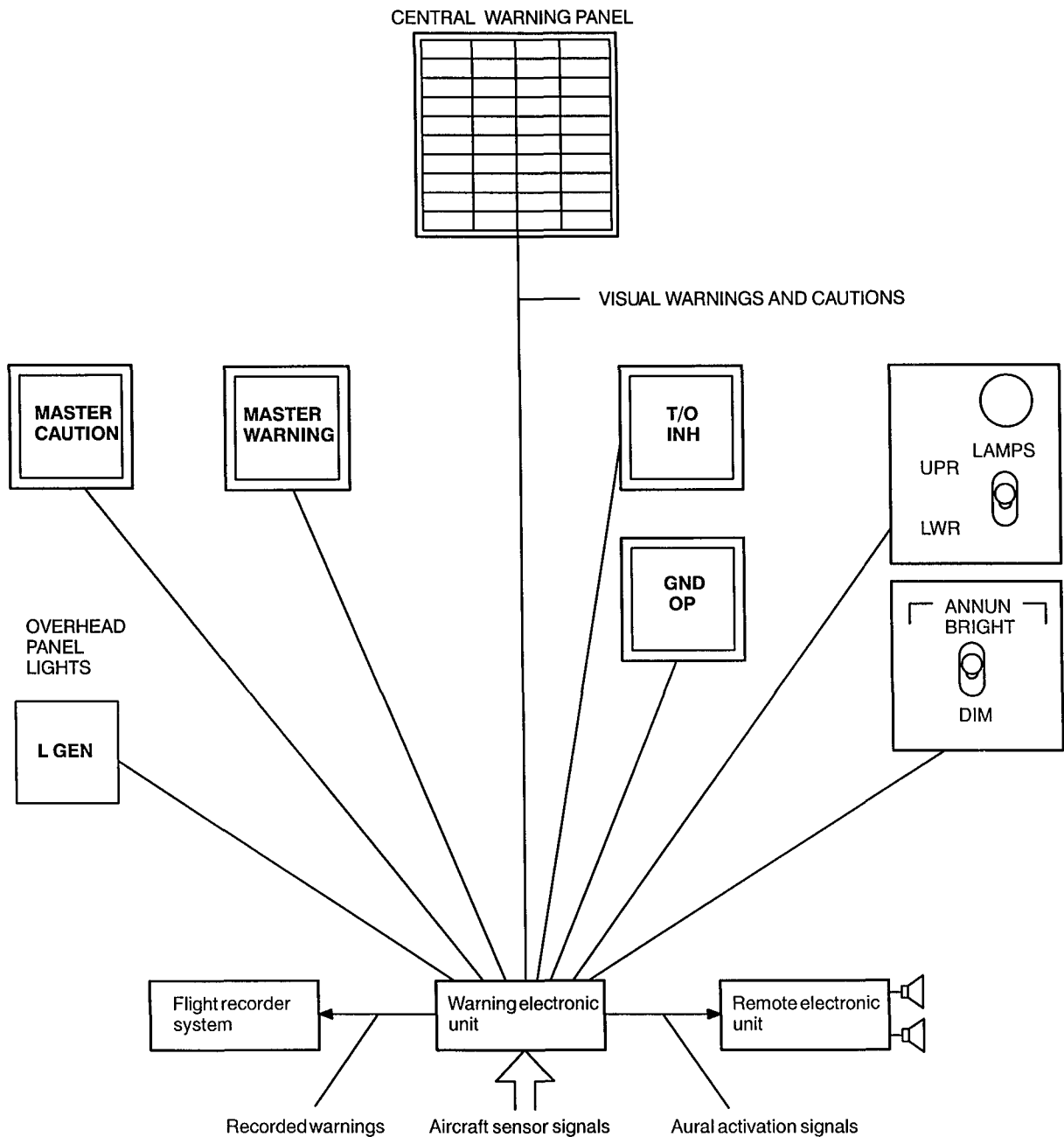
Test of the upper and lower lights can be selected by the LAMPS UPR/LWR test switch on the overhead panel. UPR will activate all annunciator lights on the overhead panel together with the single chime aural alert. LWR will activate all the annunciator lights on the glareshield and on the flight instrument panel together with triple chime aural alert. AUTO COARSEN switch must be ON for lamp test of AUTOCOARSEN ARMED light. DRIVE XFR light are not affected by the lamp test.

The annunciator lights (texts) on the central warning panel and the overhead panel are unreadable when not lit. To verify that all light bulbs (two in each light) are functioning properly, the test is sequenced so that individual bulbs are lit alternately. Any gap in the normal flash rate indicates a faulty bulb.

2. 9. Failure monitoring.

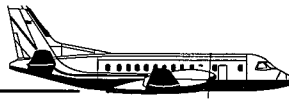
The warning annunciator system includes an extensive Built In Test Equipment (BITE). Any fault, detected by BITE, will cause the WEU status light located above the lamp test switch on the overhead panel to come on.

Illumination of this light (except during test) is an indication of a detected failure which has caused loss of system redundancy.



C0758

Fig. 1. Warning annunciator system – schematic.

GND OP(Ground Operation)

The Ground Operation mode will inhibit all aural cautions and master caution lights except for those listed below:

- L/R BLEED FAULT
- L/R BLEED AIR LEAK
- L/R DUCT OV TEMP
- L/R GEN OV TEMP
- L/R BAT HOT
- NO BAT START*
- L/R FUEL LOW TEMP
- L/R CHIP DET
- L/R FUEL FILTER
- DE-ICE OV TEMP
- TIMER
- ANTI-SKID INOP
- L/R FIRE DET FAIL
- FLAPS
- OXYGEN PRESS
- GUST LOCK
- PITCH TRIM
- ALT ALERT
- HYDRAULIC
- OVERSPEED WARN

* This caution will not generate an aural caution or master caution light.

Table 1. List of Ground Operation mode warnings and cautions.

19/1.1

T/O INH(Takeoff Inhibit)

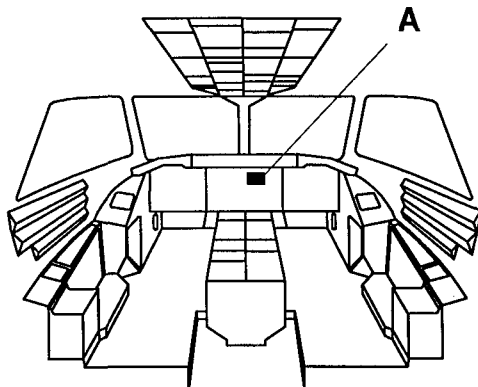
The Takeoff Inhibit mode inhibits all warnings and cautions except:

- ENGINE FIRE (L/R)
- CONFIG
- PROP BRAKE
- SMOKE (cargo, avionic, lavatory)
- TAILPIPE HOT (L/R)
- OIL PRESS (L/R)
- STALL WARNING
- PARK BRAKE
- GUST LOCK
- CABIN PRESS
- AUTO COARSEN

Table 2. List of Takeoff Inhibit mode warnings and cautions.



3. CONTROLS AND INDICATORS.



A CENTRAL WARNING PANEL

Warning lights
recorded by
the Flight Data
Recorder

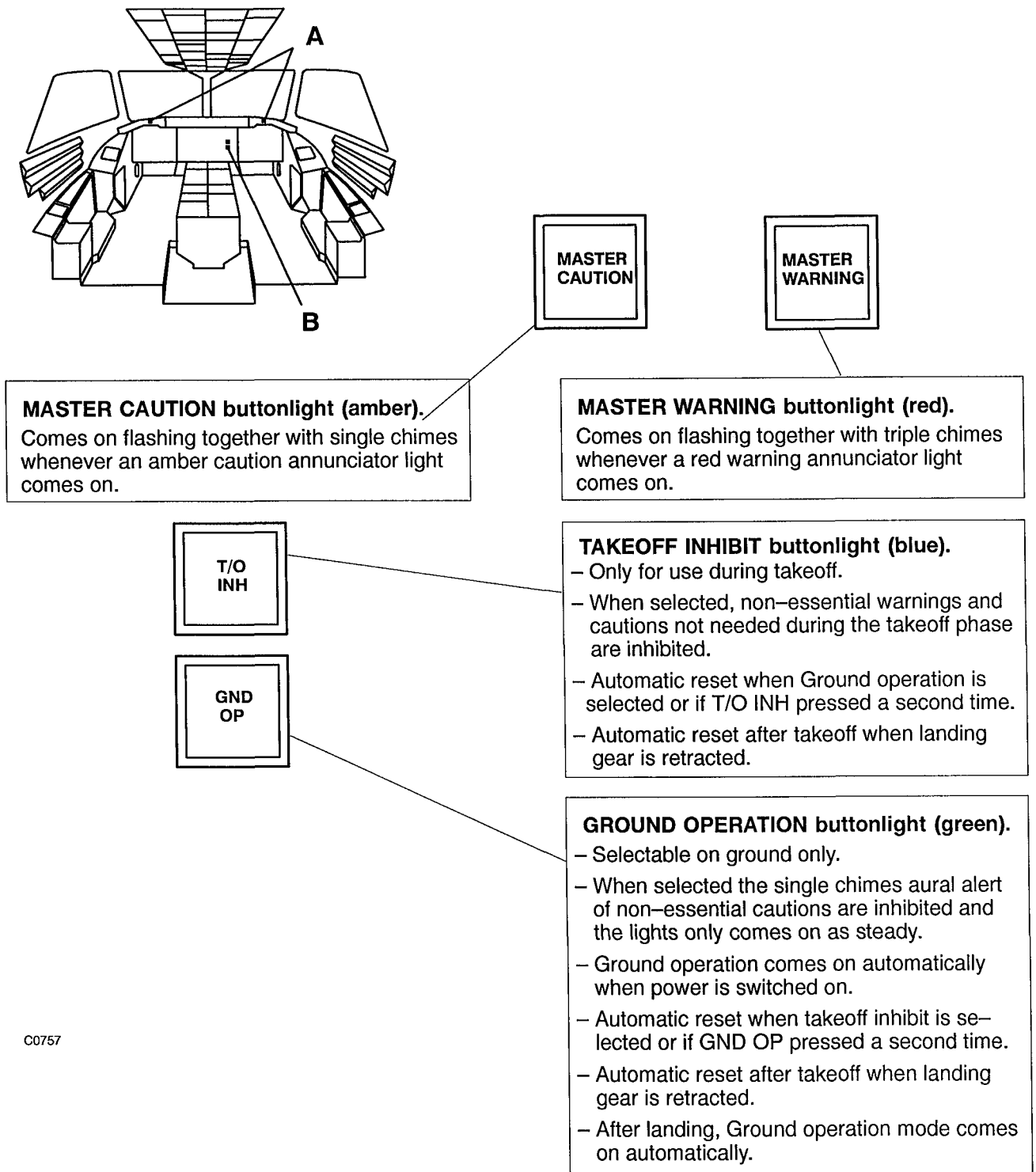
	A	B	C	D	
1	L ENG FIRE	AVIONIC SMOKE	LAV SMOKE	R ENG FIRE	1
2	L ENG OIL PRESS	CARGO SMOKE	CABIN PRESS ↓	R ENG OIL PRESS	2
3	L TAIL P HOT	=====	PROP BRAKE	R TAIL P HOT	3
4	=====	AUTO TRIM	CONFIG	=====	4
5	AUTO COARSEN	=====	PITCH TRIM	RUDDER LIMIT	5
6	L FIRE DET FAIL	FUEL ↑	ELEC ↑	R FIRE DET FAIL	6
7	ICE PROT ↑	ENGINE ↑	FLAPS	AIRCOND ↑	7
8	PARK BRK ON	HYDR ↓	EMER LTS UNARMED	OXYGEN	8
9	A-SKID ↓	AVIONICS	AVIONICS VENT	DOORS ↑	9
10	L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL	10

RED
Warning annunciator lights

AMBER
Caution annunciator lights

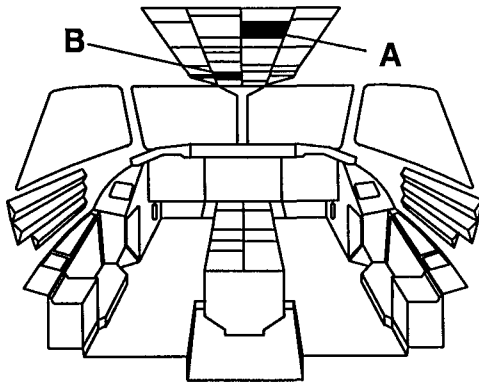
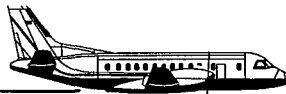
C0704

Fig. 2. Central warning panel – annunciator lights.

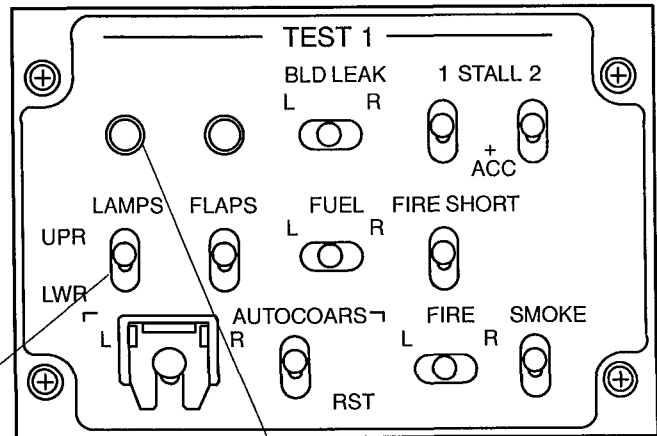


C0757

Fig. 3. Master/Caution/Warning and warning system mode lights.



A TEST PANEL



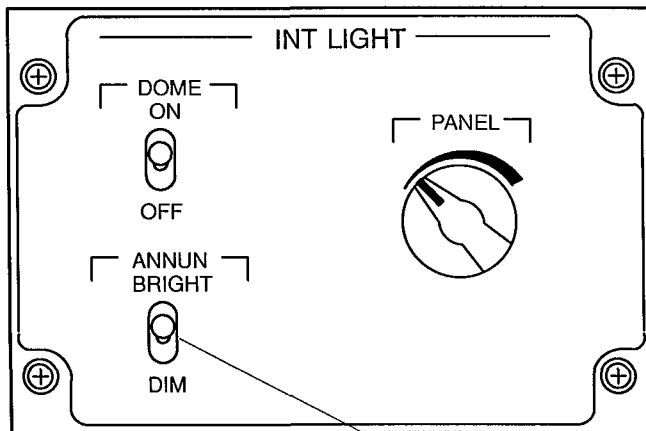
LAMPS UPR/LWR test switch.

- UPR – Tests the upper annunciator lights single chime aural alert.
- LWR – Tests the annunciator lights on the glareshield and flight instrument panels together with the triple chime aural alert.

WEU status light (white).

Comes onto indicate a failure has been detected causing loss of redundancy in the warning annunciator system.

B INTERNAL LIGHT PANEL



ANNUN BRIGHT/DIM switch.

Switch controls the brightness of the annunciator lights.

C0756

Fig. 4. Test switch, Bright/Dim switch and Failure monitoring light.



4. ELECTRICAL POWER SUPPLY.

Normal power.

Warning Annunciator System Channel 1	L ESS BUS	E-6	WARN SYST CHAN1 without mod 2328
Warning Annunciator System Channel 2	R ESS BUS	L-5	WARN SYST CHAN2 without mod 2328
Warning Annunciator System	L ESS BUS	E-4	WARN SYST TEST BRT DIM
Warning Annunciator System Channel 1	L BAT BUS	E-6	WARN SYST CHAN 1 (with mod 2328 and 300-up)
Warning Annunciator System Channel 2	R BAT BUS	L-5	WARN SYST CHAN 2 (with mod 2328 and 300-up)

Back up power.

Warning Annunciator System	EMER BUS	E-5	WARN SYST BACK UP PWR
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1. LIMITATIONS.

Not applicable

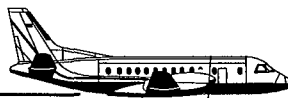
2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	<ol style="list-style-type: none"> 1. L BAT switch ON 2. R BAT switch ON 3. EXT PWR switch ON <ul style="list-style-type: none"> - If available. <p>The Warning Annunciator system is powered by L and R BAT switches or EXT PWR switch. One nuisance Master caution may come on if R BAT is switched on before L BAT switch.</p>
2.2 PREFLIGHT TEST.	<ol style="list-style-type: none"> 1. Failure monitoring light on TEST 1 panel CHECK <ul style="list-style-type: none"> - Verify to be out. 2. LAMPS UPR/LWR test switch PRESS AND HOLD UPR <ul style="list-style-type: none"> - Check the annunciator lights on overhead panel and single chime to come on. 3. LAMPS UPR/LWR test switch PRESS AND HOLD LWR <ul style="list-style-type: none"> - Check the annunciator lights on glareshield and flight instrument panel to come on together with triple chime.
2.3 OPERATION OF WARNING ANNUNCIATOR SYSTEM.	<p>On ground.</p> <ol style="list-style-type: none"> 1. GND OP buttonlight AS REQUIRED <p>Prior to takeoff.</p> <ol style="list-style-type: none"> 2. T/O INH buttonlight PRESS <ul style="list-style-type: none"> - Check buttonlight to be on. - The takeoff inhibit mode will inhibit all non-essential warnings and cautions during the takeoff phase. <p>After takeoff.</p> <ol style="list-style-type: none"> 3. T/O INH buttonlight CHECK LIGHT OFF <ul style="list-style-type: none"> - The takeoff inhibit mode is automatically reset at gear retraction.



3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 WEU STATUS LIGHT.	<p>INDICATIONS</p> <p>WEU status light on.</p> <p>ACTIONS</p> <p>1. See AOM 23, ABNORMAL PROCEDURES: WARNING SYSTEM ABNORMALITIES.</p>
3.2 TAKEOFF INHIBIT LIGHT STAYS ON AFTER TAKEOFF.	<p>INDICATIONS.</p> <p>Light in TAKEOFF INHIBIT button stays on after gear retraction.</p> <p>NOTE</p> <div style="border: 1px dashed black; padding: 5px;"> <p>This procedure should also be applied if landing gear for some reason is left down after takeoff.</p> </div> <p>ACTIONS.</p> <p>1. TAKEOFF INHIBIT button PRESS</p> <p>– Check light in button to go off indicating normal condition of warning annunciator system.</p> <p>2. End of procedure.</p>



1. GENERAL.

The Ground Proximity Warning System (GPWS) provides visual and unique aural warnings of inadvertent dangerous flight paths relative to ground. Two versions are described, MK II and MK VII (Mod. No. 2602). The GPWS processes radio altitude, vertical speed, indicated airspeed, glideslope deviation, landing gear and flap positions to determine if a dangerous situation is developing.

2. MAIN COMPONENTS AND SUBSYSTEMS.

The GPWS computer monitors and processes the inputs to determine which of 5 warning modes to be activated and if warning envelopes are being penetrated. The computer uses a synthetic voice generator to create the aural warning messages. The visual and aural warnings are generated as in the table below.

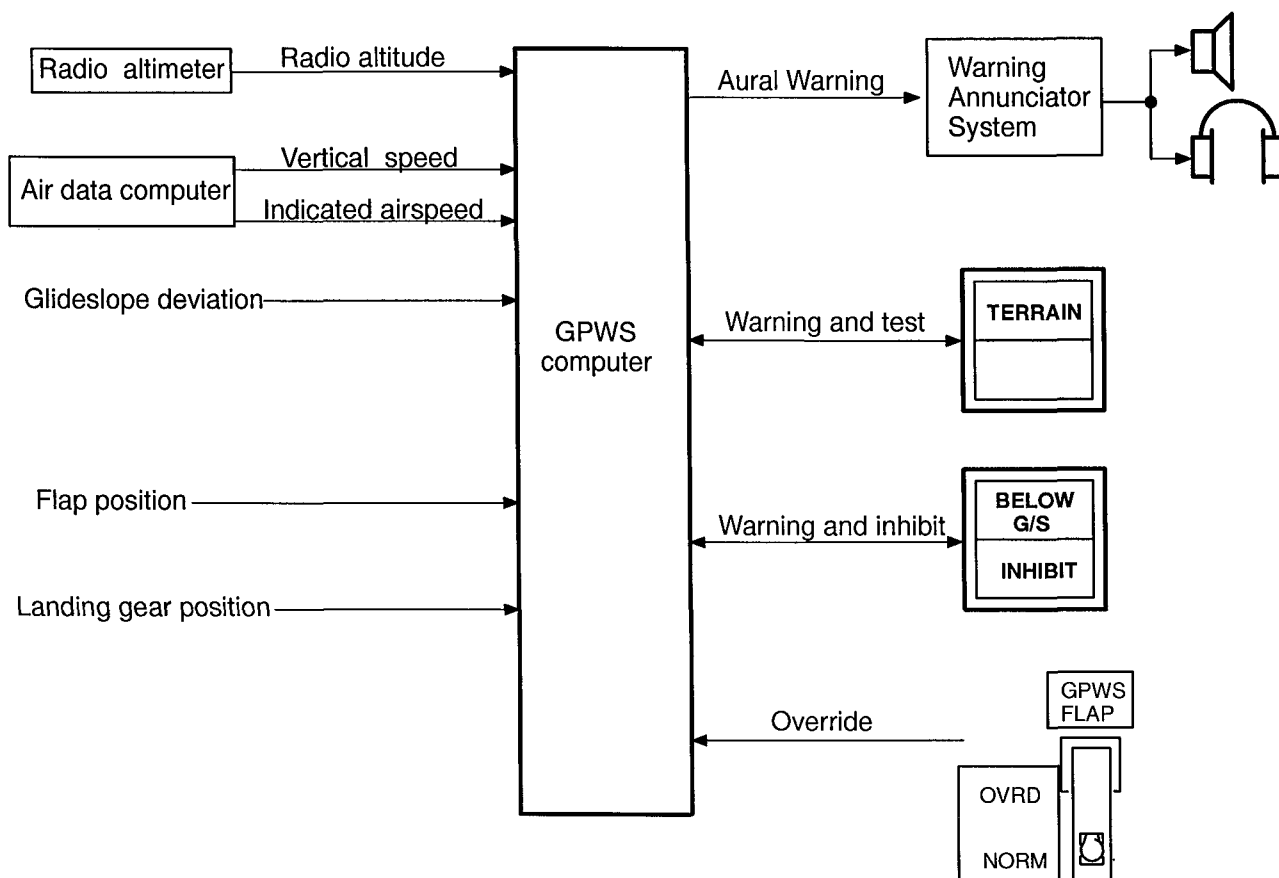
If more than one warning mode envelope is penetrated at the same time requiring conflicting aural warnings, the warnings are generated according to the following priority:

Priority	Message	Mode
1	WHOOOP WHOOOP PULL UP	1 and 2
2	TERRAIN, TERRAIN	2
3	TOO LOW TERRAIN	4A, 4B and 4C
4	TOO LOW GEAR	4A
5	TOO LOW FLAPS	4B
6	SINK RATE	1
7	DON'T SINK	3
8	GLIDESLOPE	5

The highest priority message is always provided. If a higher priority warning occurs, the higher priority warning is immediately generated. When a warning ceases, the message is completed before switching to a warning of lower priority.

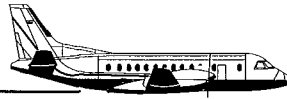
Mode	Visual warning	Aural warning
1 – Excessive sink rate	TERRAIN lights	– SINK RATE – WHOOOP WHOOOP PULL UP
2 – Excessive Terrain closure rate	TERRAIN lights	– TERRAIN TERRAIN – WHOOOP WHOOOP PULL UP
3 – Altitude loss after takeoff	TERRAIN lights	– DON'T SINK
4A– Terrain clearance (gear up)	TERRAIN lights	– TOO LOW TERRAIN – TOO LOW GEAR
4B– Terrain clearance (gear down, flaps up)	TERRAIN lights	– TOO LOW TERRAIN – TOO LOW FLAPS
4C– Minimum Terrain clearance during takeoff (With mod. no. 2602)	TERRAIN lights	– TOO LOW TERRAIN
5 – Inadvertent descent below glideslope	BELOW G/S lights	– GLIDESLOPE or – GLIDESLOPE with increased level

Table 1. Visual and Aural Warnings.



A11198

Fig. 1. GPWS – schematic.

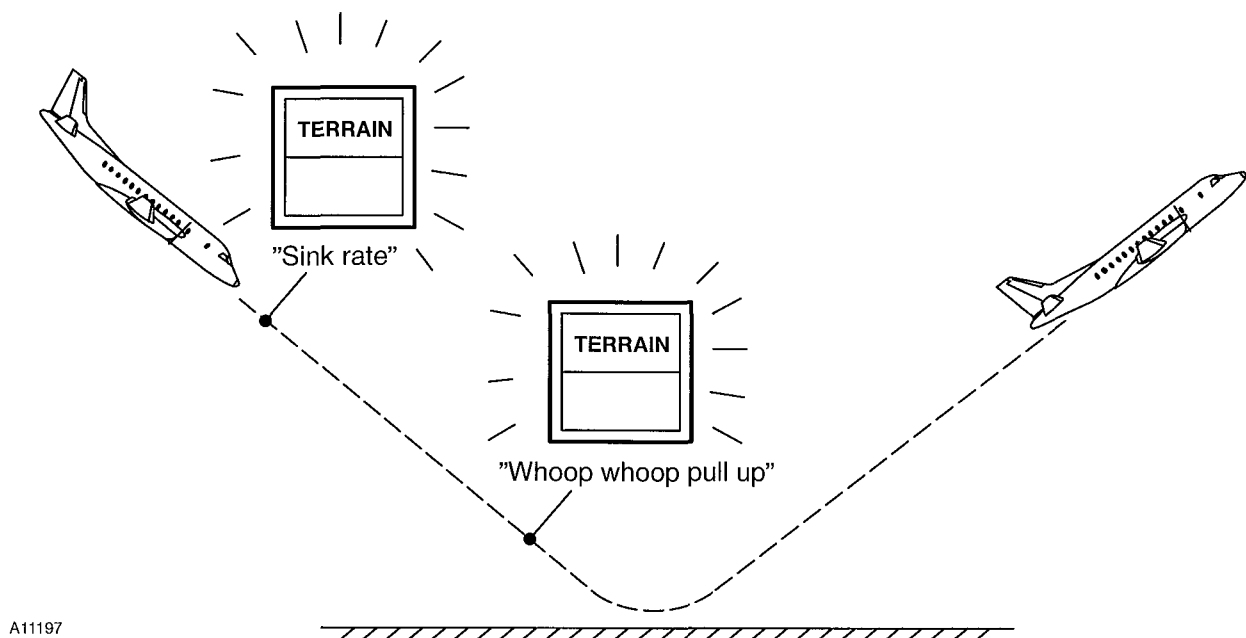


MODE 1 – EXCESSIVE BAROMETRIC SINK RATE.

This mode warns for an excessive sink rate with respect to height above ground which has developed as a result of, for example, navigation error or windshear during approach.

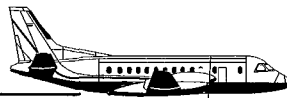
The mode has two warning envelopes that provides warning of excessive rate of descent at a given altitude. On penetration of the outer envelope the

TERRAIN lights come on flashing and the aural warning "SINK RATE" sounds and is repeated every 0.75 sec until corrective action is taken. If the descent rate is not corrected and the inner envelope is penetrated, a harder aural warning "WHOOOP-WHOOP PULL UP" sounds. The mode is independent of aircraft configuration.



A11197

Fig. 2. Excessive barometric sink rate—schematic.

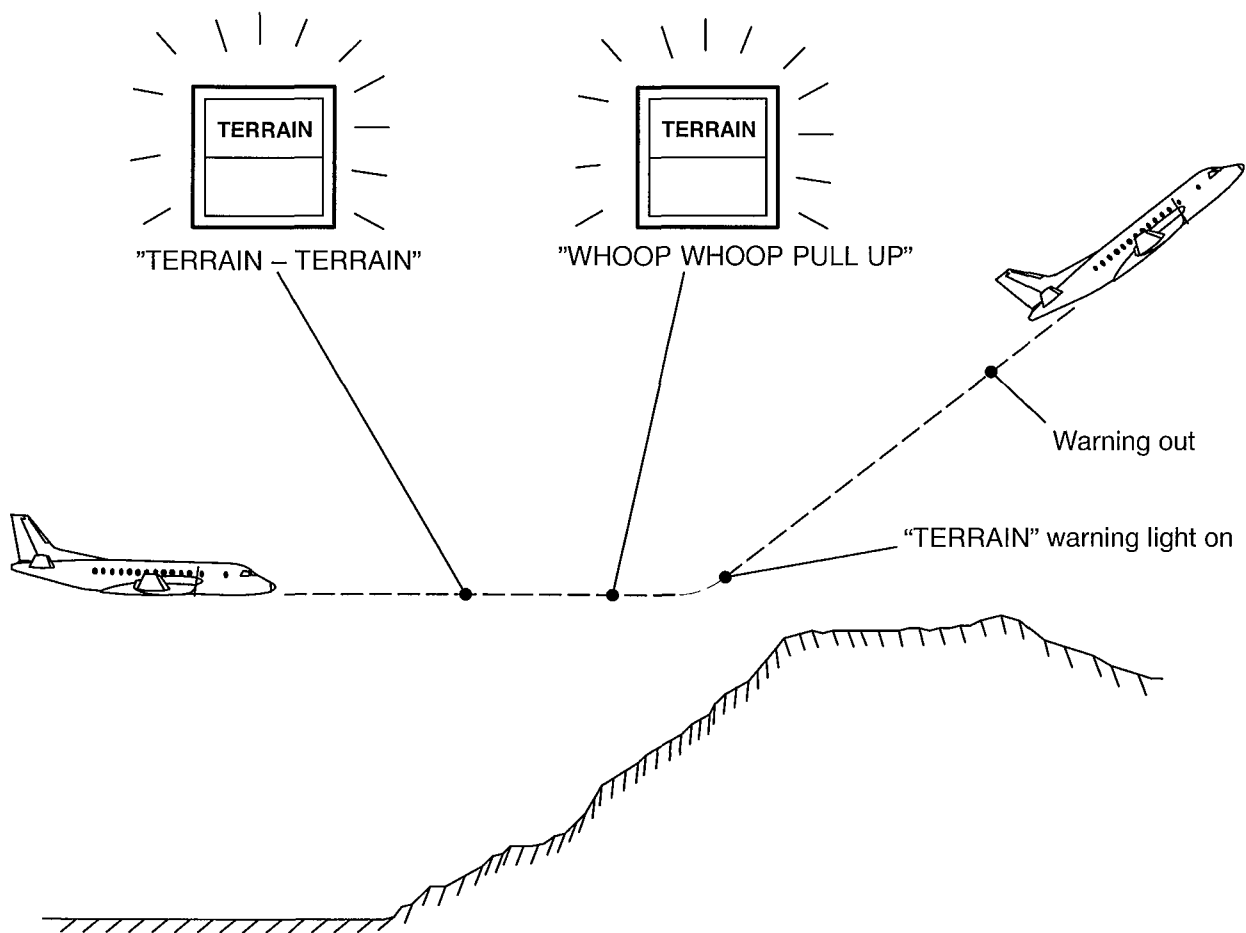


MODE 2A – EXCESSIVE TERRAIN CLOSURE RATE FLAPS UP.

Mode 2A warning is generated if the aircraft closure rate (radio altitude) is excessive against terrain with respect to the height (radio altitude). When the warning envelope is penetrated the TERRAIN lights flashes and the aural warning “TERRAIN TERRAIN” sounds. If the closure rate remains within the warning envelope for about one second the aural warning “WHOOOP WHOOOP PULL UP” sounds. This is repeated continuously until the closure rate is corrected. Even if the closure rate has been corrected the terrain lights will remain illuminated until the aircraft has

gained 300 feet barometric altitude or in addition and with mod. no. 2602, until 45 sec have elapsed since the last warning.

The warning envelope is expanded by airspeed (IAS) above 1650 ft RALT to provide the earliest possible warning.



A11199

Fig. 3. Excessive terrain closure rate – schematic.

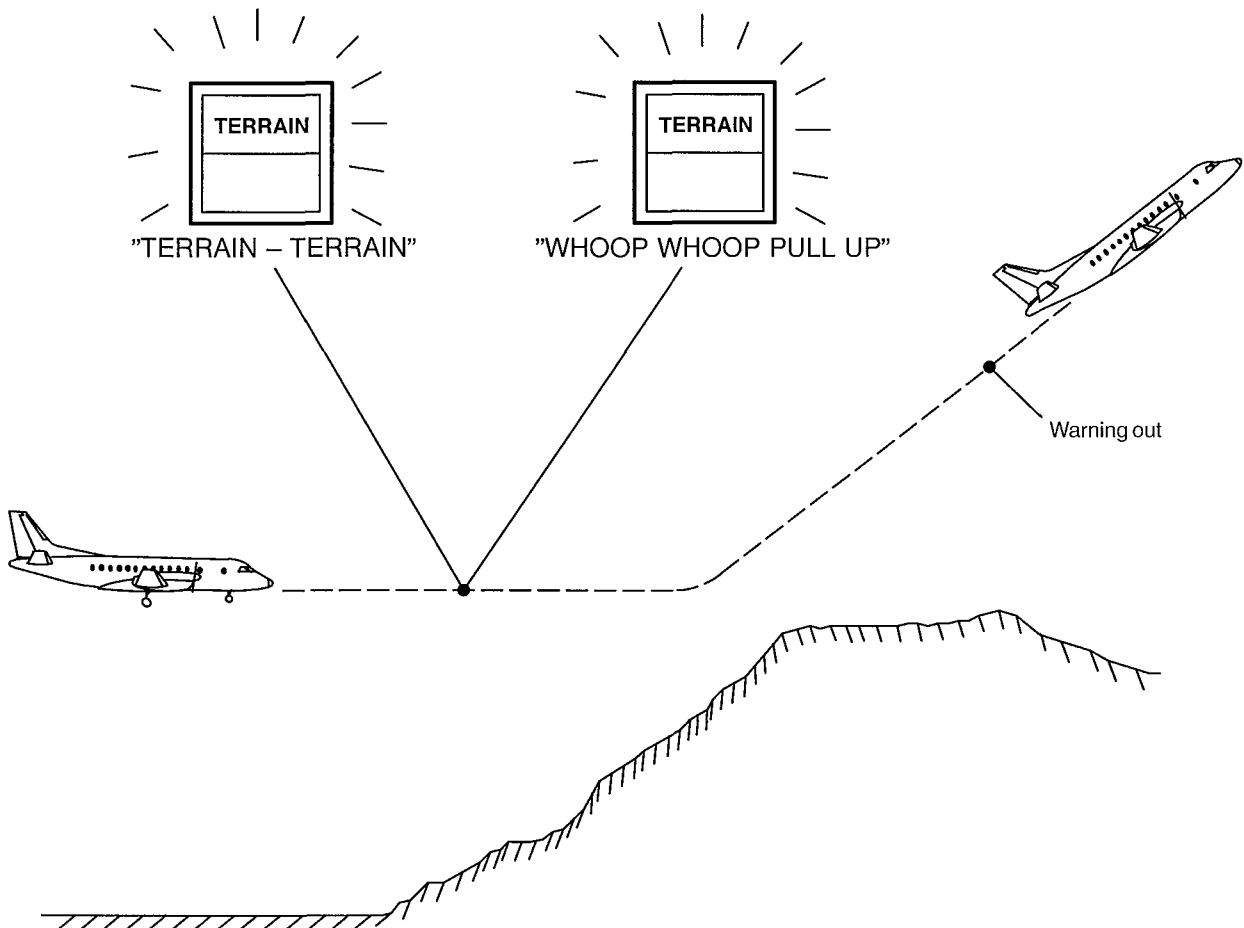


MODE 2B – EXCESSIVE TERRAIN CLOSURE RATE FLAPS IN LANDING CONFIGURATION.

When the flaps are in the landing configuration, the GPWS switches to mode 2B and the warning envelope is modified.

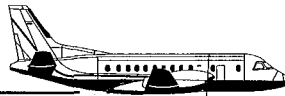
When the envelope boundary conditions for mode 2B is violated, the TERRAIN lights come on. The "TERRAIN TERRAIN" followed by "WHOOOP WHOOOP PULL UP" is repeated until the boundary is exited. Altitude gain is not required to silence the warning after leaving the warning boundary.

With both gear and flaps in landing position the "WHOOOP WHOOOP PULL UP" warning is inhibited and only the "TERRAIN TERRAIN" warning is activated.



A28485

Fig. 4. Excessive terrain closure rate – schematic.



MODE 3 – LOSS OF ALTITUDE AFTER TAKEOFF.

This mode warns for unintentional loss of altitude after takeoff or go-around. The mode is enabled between 65 and 700 ft RALT (between 30 and 1500 ft with mod. no. 2602). On penetration of the envelope, the TERRAIN warning lights come on flashing and the aural warning "DON'T SINK" sounds and is repeated

every 0.75 sec until the aircraft gains a positive climb again.

However, if loss of altitude occurs again within the envelope, another warning will be generated based on the lost altitude from the first warning.

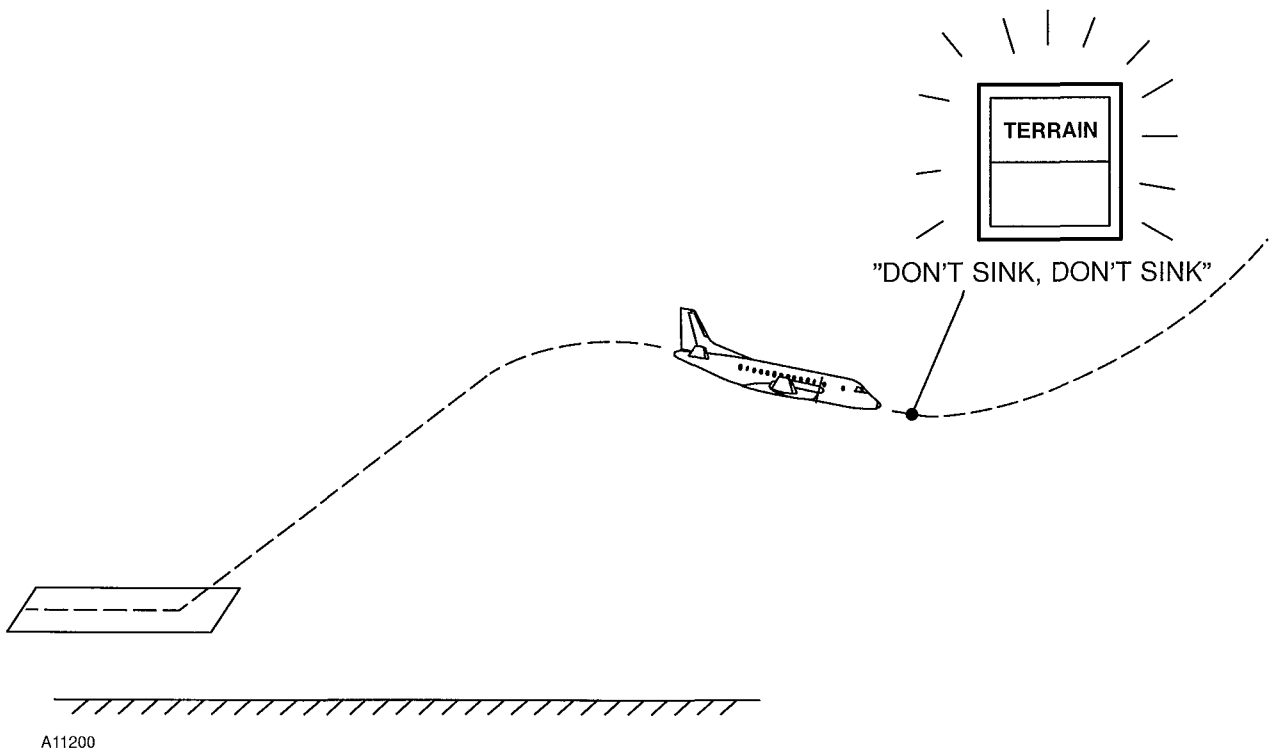


Fig. 5. Loss of altitude after takeoff – schematic.



MODE 4A – INADVERTENT PROXIMITY TO TERRAIN WITH GEAR UP.

This mode warns either for proximity to terrain outside the approach area, or aircraft not being in landing configuration (gear down) during approach. Mode 4A becomes enabled when the gear is not locked down and the radio altitude has decreased below 1000 ft. At penetration of the envelope with speed below 225 KIAS (250 KIAS with mod. no. 2602), the TERRAIN lights

come on flashing and the aural warning "TOO LOW TERRAIN" sounds and is repeated every 0.75 sec until corrective action is taken. At speeds below 175 KIAS (190 KIAS with mod. no. 2602) and below 500 ft RALT the aural warning will change to "TOO LOW GEAR".

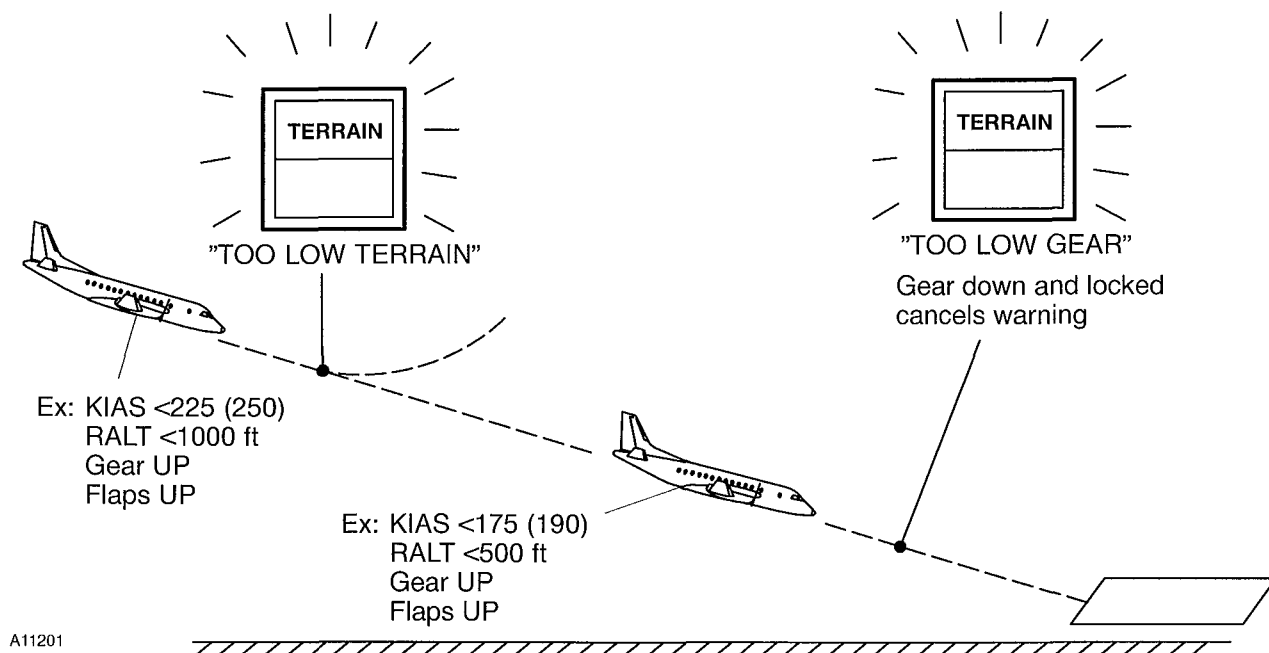
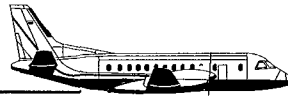


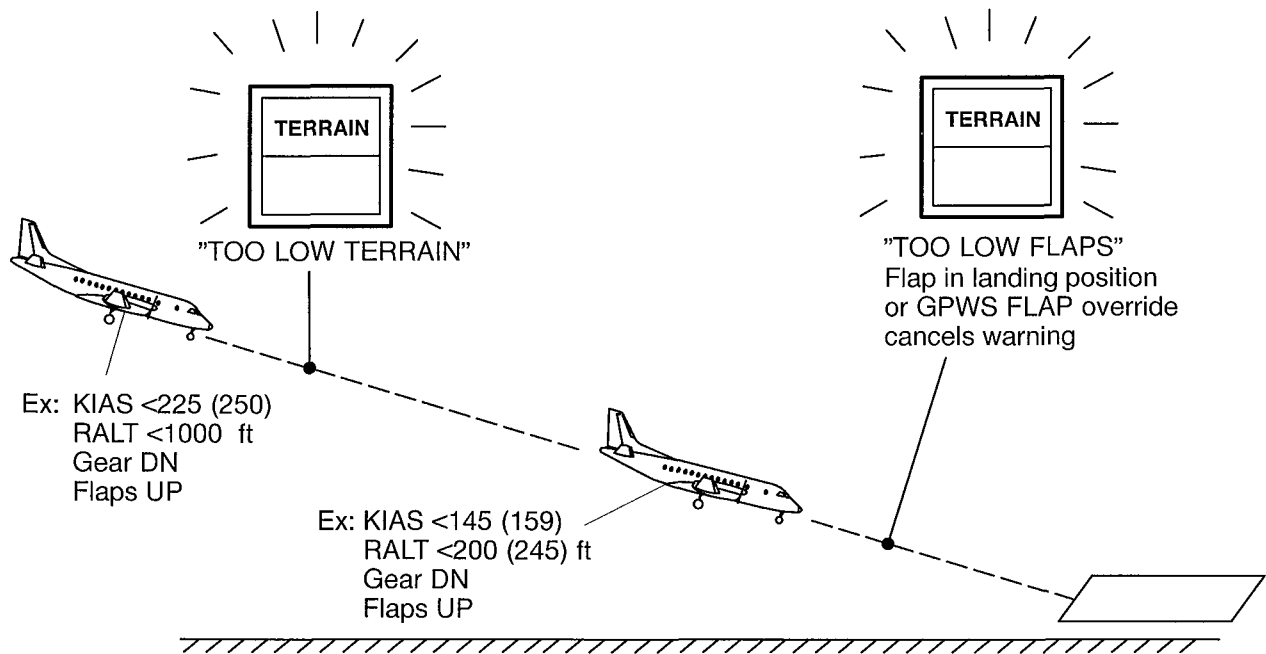
Fig. 6. Inadvertent proximity to terrain with gear up – schematic.



MODE 4B – INADVERTENT PROXIMITY TO TERRAIN WITH GEAR DOWN AND FLAPS UP.

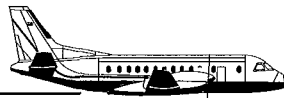
This mode warns either for proximity to terrain outside the approach area or flaps not being in landing position during approach. The mode becomes enabled when the gear is locked down and the flaps are up between 50 and 1000 ft RALT (between 30 and 1000 ft with mod. no. 2602). At penetration of the envelope with speed below 225 KIAS (250 KIAS with mod. no. 2602), the TERRAIN lights come on flashing and the

the aural warning "TOO LOW TERRAIN" sounds and is repeated every 0.75 sec until corrective action is taken. At speeds below 145 KIAS and below 200 ft RALT (159 KIAS and 245 ft with mod. no. 2602) the aural warning will be changed to "TOO LOW FLAPS". If landing without landing flap selected has been decided, selecting OVRD with the GPWS FLAP switch will override the "TOO LOW FLAPS" warning.



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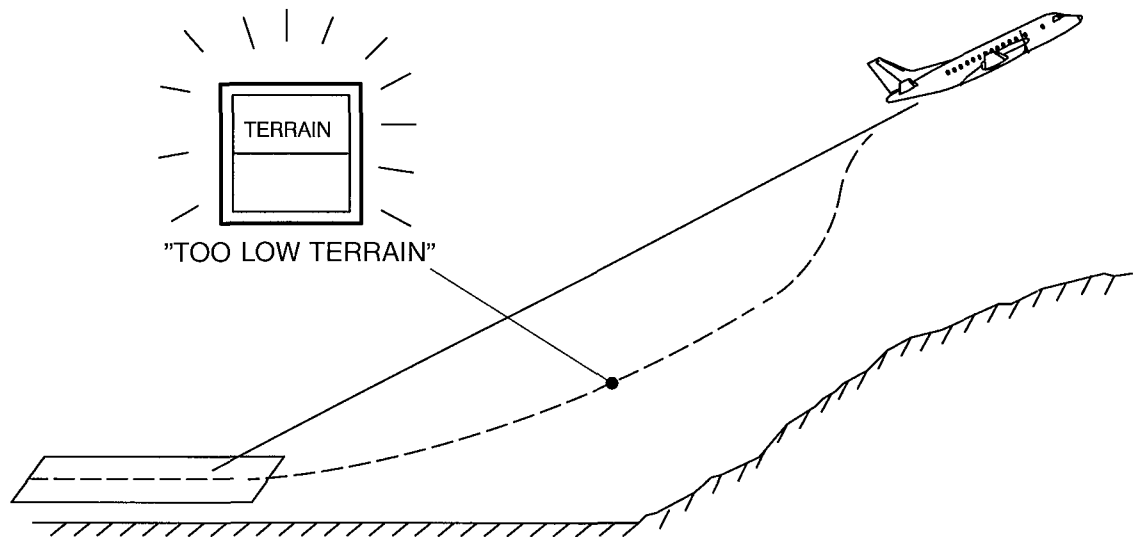
Fig. 7. Inadvertent proximity to terrain with gear down and flaps up – schematic.

**MODE 4C TERRAIN CLEARANCE DURING TAKEOFF**

Mode 4C warns for inadvertent descent or too shallow climb towards rising terrain in the takeoff area. Mode 4C is only functional with mod. no. 2602 installed.

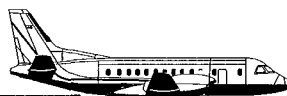
Mode 4C provides a warning based on minimum radio altitude clearance during takeoff. Mode 4C is based on a minimum terrain clearance that increases with radio altitude during takeoff. A value equal to 75% of

the current radio altitude is accumulated in a long term filter that is only allowed to increase in value. If the radio altitude should later decrease, the filter will store its maximum attained value. Further decrease of radio altitude below the stored filter value with Gear or Flaps up will cause the TERRAIN lights to come on flashing and the aural warning "TOO LOW TERRAIN" sounds.



A14409

Fig. 8. Terrain clearance during takeoff – schematic.



MODE 5 – DESCENT BELOW GLIDESLOPE.

This mode warns for unintentional deviation below the ILS glideslope. The mode becomes enabled when an ILS frequency is selected, the gear is down and between 50 and 1000 ft RALT (30 and 1000 ft with mod. no. 2602).

Additionally to enable Mode 5 and only with mod. no. 2602 installed, the rate of descend above 500 ft RALT must be greater than a sinkrate that allows the aircraft to reach 500 ft RALT within one minute. This is to reduce nuisance warnings caused by a level flight before glideslope capture. For example, if the aircraft is at 1200 ft RALT, the required sinkrate to enable Mode 5 must exceed 700 ft per minute.

The warning envelope consists of two envelopes. On penetration of the outer envelope, below 1.3 dots, the BELOW G/S INHIBIT caution light come on flashing and the aural warning "GLIDESLOPE" sounds with a soft volume and is continuously repeated with a rate

that increases with the deviation below the glideslope. If no corrective action is taken and the inner envelope is penetrated (the deviation has exceeded 2 dots and the aircraft is below 300 ft RALT), the volume of the aural "GLIDESLOPE" warning will increase with 6dB (hard alert). At corrective action, the warning will continue until the deviation is less than 1.3 dots. The amount of glideslope deviation necessary to produce a warning is increased below 150 ft RALT to eliminate nuisance warnings when the aircraft is close to the glideslope transmitter.

To allow descend below glideslope, Mode 5 can be inhibited when radio altitude is between 50 and 1000 ft RALT (30 and 2000 ft with mod. no. 2602) by pressing the BELOW G/S INHIBIT buttonlight. Mode 5 is automatically reset at climb above 1000 ft RALT (1500 ft with mod. no. 2602).

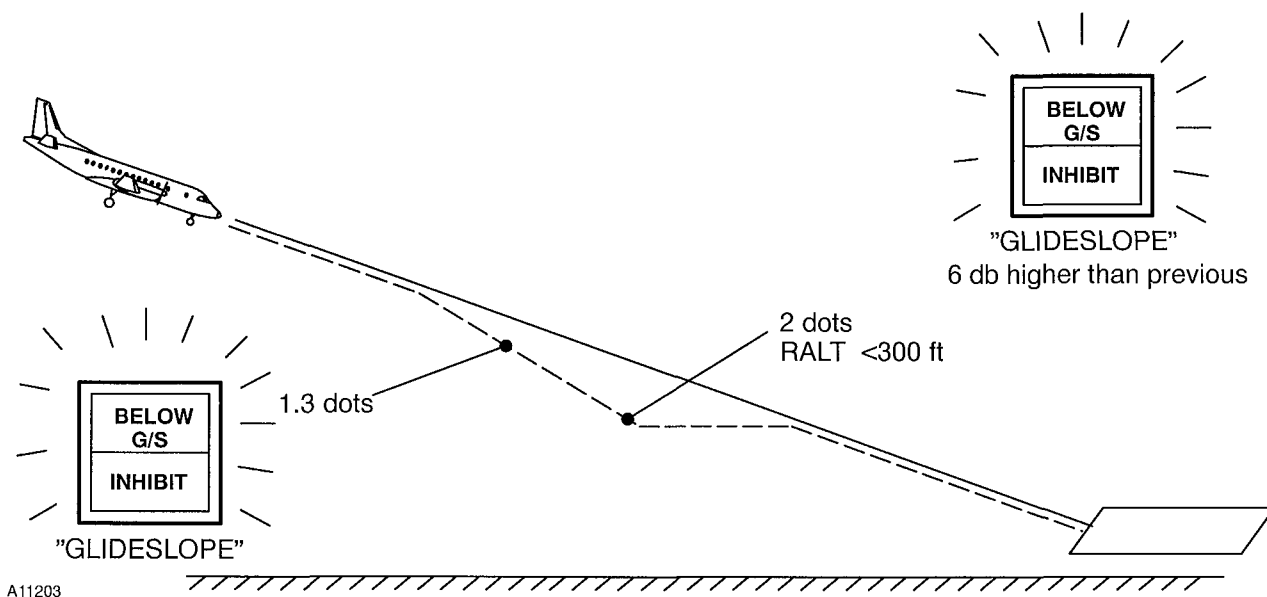
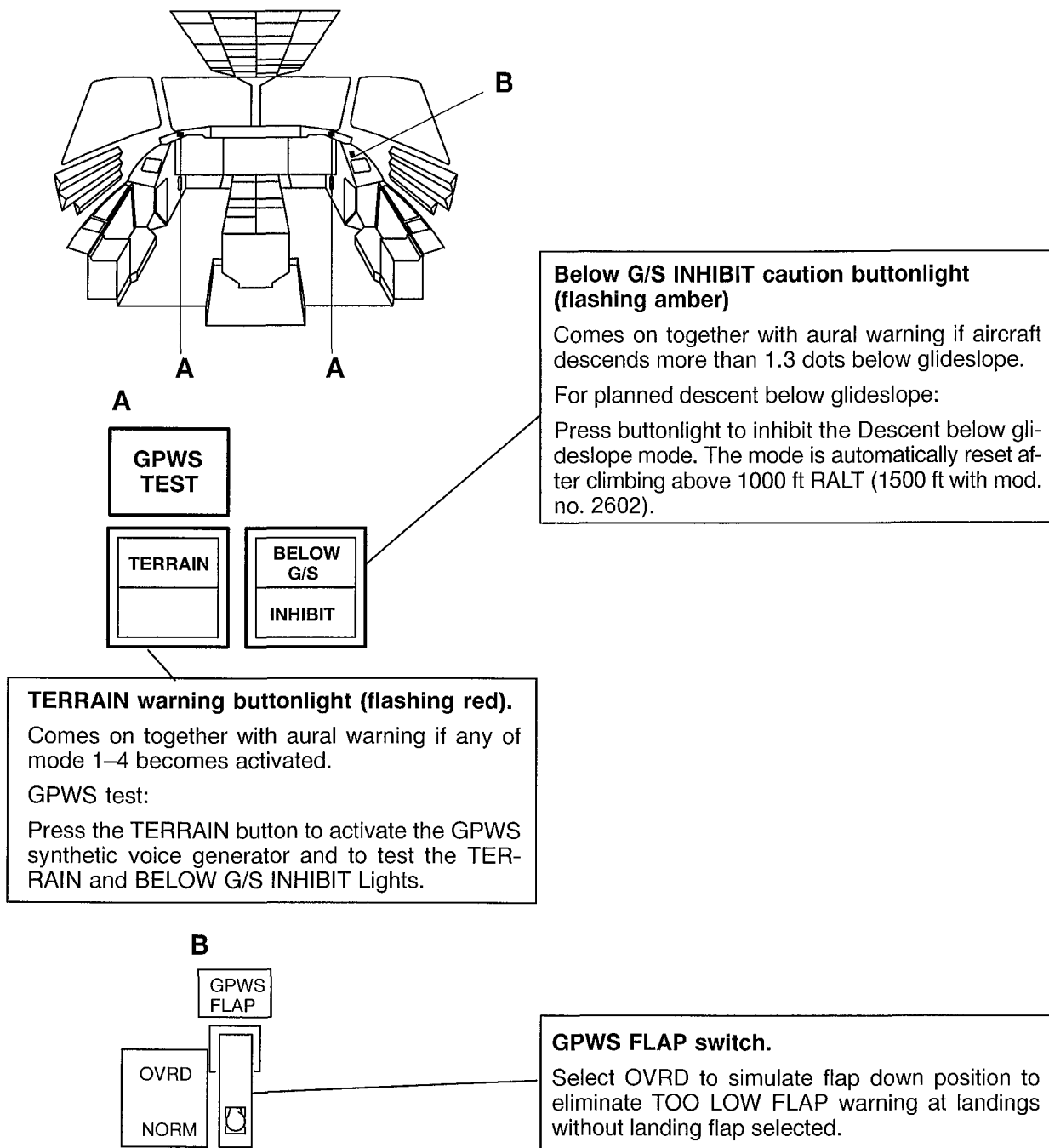


Fig. 9. Descent below glideslope – schematic.

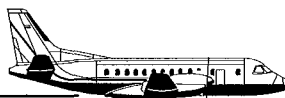


3. CONTROLS AND INDICATORS.



A11204

Fig. 10. GPWS FLAP switch and buttonlights.



4. ELECTRICAL POWER SUPPLY.

GPWS	L INV 115V AC BUS	F-17	GPWS PWR
GPWS	L ESS BUS	F-16	GPWS IND

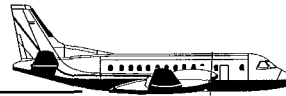


1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATIONS.

CONDITIONS	NORMAL PROCEDURES
2.1. GPWS TEST.	<p>With flap setting 0–15 degrees.</p> <ol style="list-style-type: none"> GPWS TEST button PRESS <p>Press either GPWS TEST button and check:</p> <ul style="list-style-type: none"> Both TERRAIN buttonlights illuminate. Both BELOW G/S INHIBIT buttonlights illuminate. Aural warning: "GLIDESLOPE" followed by "WHOOOP WHOOOP PULL UP" to be heard. Additional "WHOOOP WHOOOP PULL UP" callouts will be heard if button is kept depressed. <p>If flap setting more than 15 degrees, only BELOW G/S INHIBIT illuminates and aural warning "GLIDESLOPE" will be heard.</p> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>Test is inhibited in flight between 50 ft and 1 000 ft.</p> </div> <p>Experience has shown that the test might not start at the right sequence when buttonlight pressed, if not, release and press buttonlight once again.</p>
2. 1. GPWS WARNING IN FLIGHT.	<p>Ground proximity warning comes on.</p> <p>INDICATIONS.</p> <p>Aural warning and TERRAIN or BELOW G/S lamps.</p> <p>ACTIONS.</p> <p>Perform actions in accordance with section 25, FLIGHT PROCEDURES.</p>
2. 2. GPWS FLAP OVERRIDE.	<p>For intentional landing without landing flap set, override the "TOO LOW FLAPS" warning with the GPWS FLAP switch.</p> <ol style="list-style-type: none"> GPWS FLAP switch OVRD <ul style="list-style-type: none"> The switch in OVRD simulates landing flap for the GPWS.



3. ABNORMAL OPERATIONS.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. GPWS FAILURES.	<ol style="list-style-type: none"> Loss of Radio Altimeter. All warning modes will be inhibited if the Radio Altimeters fail. Loss of Vertical Speed. If the Vertical speed from the ADC fails, Mode1 and 3 will be inhibited. The 300 ft altitude gain feature of mode 2 will also be inhibited. Loss of IAS. If the IAS from the ADC fails, Mode 2 will not be expanded for earlier "TERRAIN TERRAIN" warning at increased speeds. The "TOO LOW TERRAIN" warning part of modes 4A and 4B will also be inhibited.
3. 2. GPWS FAILURE TO TEST.	<p>INDICATIONS.</p> <p>No response with TERRAIN buttonlight pressed for test. With mod. no. 2602 the aural message "SYSTEM INOP" will be heard.</p> <p>ACTIONS.</p> <p>◆ No activation of aural warnings.</p> <ol style="list-style-type: none"> MAIN INV 115V 26V CHECK – Check to be ON and light to be out. CB F-17 (GPWS PWR) CHECK/RESET End of procedure. <p>◆ No activation of TERRAIN and BELOW G/S INHIBIT buttonlight.</p> <ol style="list-style-type: none"> CB F-16 (GPWS IND) CHECK/RESET End of procedure.



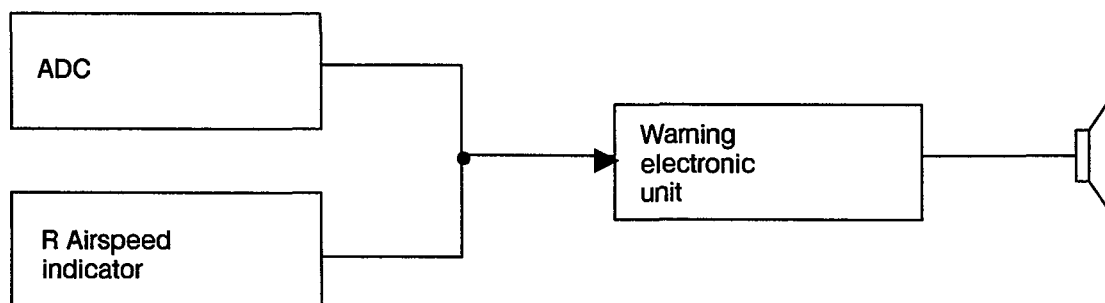
1. GENERAL

An aural overspeed warning is provided in form of a continuous horn. The warning comes on if V_{MO} should be exceeded by 1,5 – 6 knots.

The Air Data Computer (ADC) outputs the overspeed signal to the Master Warning System which generates

the aural overspeed warning. As a backup the right Airspeed indicator also provides an overspeed signal to the Master Warning System (V_{MO} exceeded by 1,5 – 6 knots).

The overspeed warning can be tested by the AIR DATA test switch on the TEST 2 panel (maintenance only).



2. MAIN COMPONENTS AND SUBSYSTEMS.

Not applicable.

2. CONTROLS AND INDICATORS.

Not applicable.

**1. LIMITATIONS.**

Not applicable.

2. NORMAL OPERATIONS.

CONDITIONS	NORMAL PROCEDURES
2. 1. OVERSPEED WARNING IN FLIGHT.	<p>Overspeed warning comes on.</p> <p>INDICATIONS.</p> <p>Aural warning.</p> <p>ACTIONS.</p> <p>Perform actions in accordance with AOM 25 FLIGHT PROCEDURES.</p>

3. ABNORMAL OPERATIONS.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. OVERSPEED WARNING FAILURE.	<p>INDICATIONS.</p> <p>Overspeed warning fails at test or does not come on if V_{MO} should be exceeded.</p> <p>ACTIONS.</p> <p>The pilot should monitor the airspeed not exceeding V_{MO}.</p>



1. GENERAL.

A dual channel stall warning system provides the flight crew with five distinct warnings of an impending stall:

- The stickshaker provides a physical warning in the form of vibrations in each control column for the respective channel.
- Autopilot disengage.
- The aural warning is a sharp continuous clacker.
- The stickpusher provides a firm forward movement of the control columns giving the aircraft a slight pitch down attitude if sufficient corrective action not taken after stickshaker and aural warning.
- The visual warning contains three amber lights located on the central warning panel and two pusher status lamps indicating PUSH 1 and PUSH 2, located on left and right pilot's instrument panel.

CAUTION

With ice accumulation on the wing, stall may be encountered before the artificial warnings above are activated. (Not applicable with Mod. No. 2650 installed).

The system consists of two independent stall warning computers, a left and a right angle of attack (AOA) sensor. There are also two stick shakers, one mounted on each control column. A stick pusher actuator is also connected to the control columns. The stall warning system can be tested by two switches in the overhead panel.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Stall warning computer.

The stall warning is based on angle of attack, flap position and the wing de-ice system. The stall warning computer determines the aircraft AOA angle from the AOA sensor information. The signal is adjusted based on flap position and de-ice system operation. Flaps 0 gives no compensation, Flaps 35 results in a 1° increased AOA signal. If the wing and stabilizer de-ice system is operated, the flap compensation is disabled and the AOA signal is reduced 0.4° to increase stall margin by 1–2 knots when the de-ice boots are inflated.

NOTE

The artificial stall warning system has an activation level designed for a clean wing only. No compensation for stall at lower AOA with ice accumulation on the wing is included in the stall warning computer. (Not applicable with Mod. No. 2650 installed).

When the activation levels are exceeded the corresponding stall warning and stall identification signals activate the stick shakers, the aural stall warning and stick pusher actuator. The signals are combined in such a way that stall warning is given to both pilots when either AOA sensor signal exceeds the stall warning threshold, while a stick push command requires that stall warning is given on both sides and that the stall identification limit is exceeded on one or both sides (one stall warning computer must be in stick shaker mode and the other computer in both stick shaker and push mode before the pusher actuator becomes activated). The stick shaker activation also disengages the autopilot if in use. The stall warning system is inhibited on ground and until seven seconds after takeoff. Monitoring circuits are included which will give failure indications on the CWP.

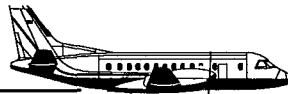
2.2. Angle of attack sensor (AOA).

There is one AOA sensor mounted on either side of the forward part of the fuselage. The sensors measure the direction of the airflow relative to the fuselage and thus the angle of attack and transfers the information to the stall warning computer. The sensors are electrically heated. A failure in a heating circuit will activate the caution L or R ALPHA light on the overhead panel. Also see 11.1. ICE AND RAIN PROTECTION.

2.3. Pusher actuator.

At pusher activation the pusher applies 80 lbs force forward on the control column to a position of 4 degrees elevator down. The actuator is a DC torque motor with a slip clutch and an electronic interface for the stall warning computers. The electronic circuit requires push command signals from the stall warning computers for activation of the slip clutch and the DC torque motor. The torque motor force is transferred to the left elevator control system via a quadrant wheel and a pushrod. Connection with the right elevator control system is by the elevator interconnect unit.

A "< 0.5 g"–switch will stop the actuator from forcing the aircraft into an unacceptable nose down maneuver.



Each pilot can disable the pusher actuator by pressing one of the two PUSHER DISARM buttons. The pusher system can then not be reset while airborne. The STICK PUSHER RESET switch is situated in the right electrical center. The pusher actuator is inhibited on ground and until 7 sec. after takeoff.

2. 4. Stick shaker.

The stick shaker consists of a rotating unbalanced weight driven by a DC motor via a gearing, giving a vibration of approximately 20 Hz. One stick shaker is mounted on each control column and is activated by the stall warning computer channel 1 and/or channel 2.



WARNINGS AND CAUTIONS, STALL WARNING Description

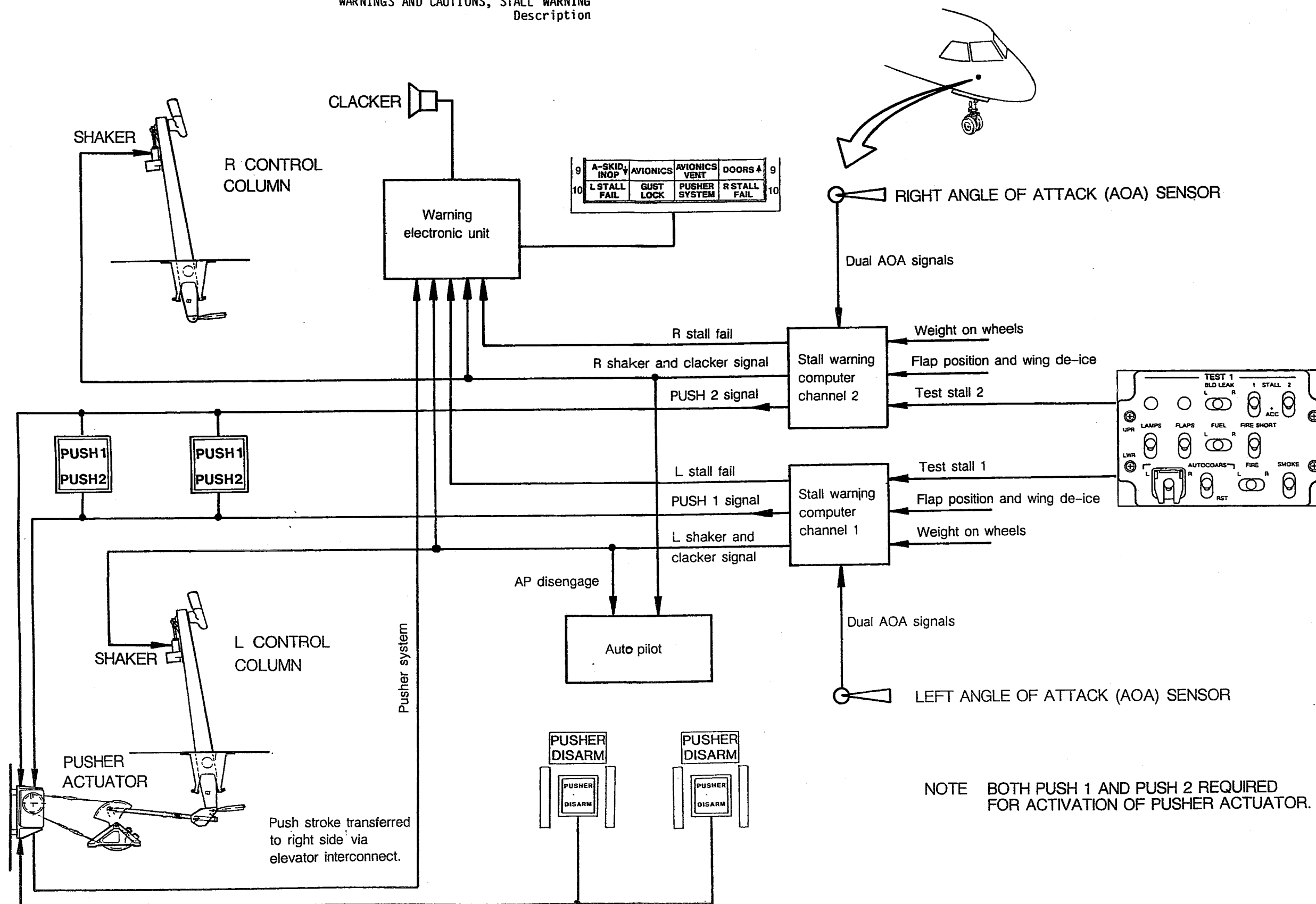
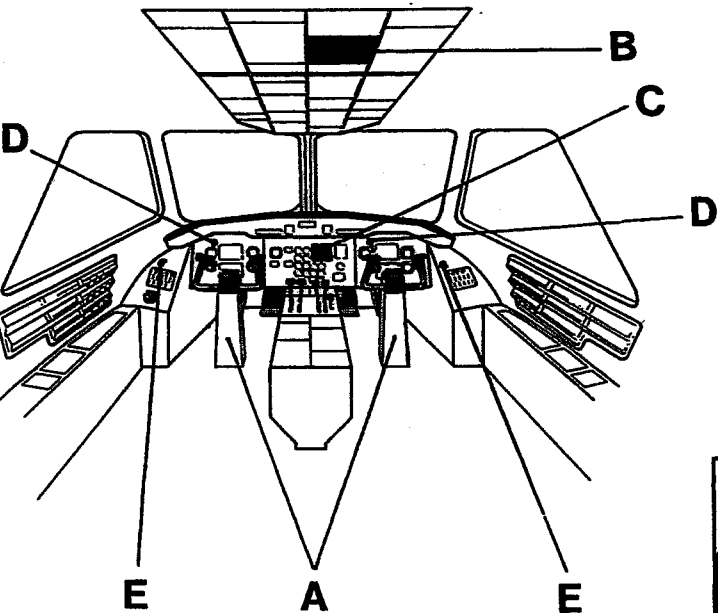


Fig. 1. Stall warning - schematic.

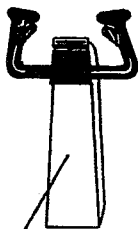


WARNINGS AND CAUTIONS, STALL WARNING
Description

3. CONTROLS AND INDICATORS.



A



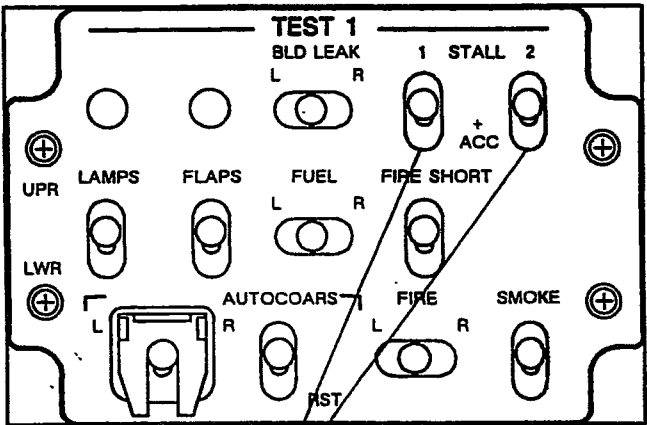
Stick shakers.

The stick shakers provide a physical warning in form of vibrations in the control column for the respective channel.

Stick pusher.

The stick pusher provides a forward movement with 80 lbs push force of the control columns. Full push stroke corresponds to 4° elevator down.

B TEST PANEL



STALL 1 and 2 test switches.

- STALL 1 upwards initiates left and right stick shaker, aural stall warning and PUSH 1 light.
- STALL 2 upwards initiates left and right stick shaker, aural stall warning and PUSH 2 light.
- STALL 1 and 2 upwards initiates left and right stick shakers, aural stall warning, PUSH 1 and 2 lights and stick push.
- STALL 1 and 2 downwards (+ ACC) initiates left and right stick shakers, aural stall warning, PUSH 1 and 2 light and no stick push (below 0.5 g condition is simulated).

C CENTRAL WARNING PANEL

6	L FIRE DET FAIL	FUEL ↑	ELEC ↑	R FIRE DET FAIL
7	ICE PROT ↑	ENGINE ↑	FLAPS	AIR CONDA
8	PARK BRK ON	HYDR ↓	EMER LTS UNARMED	OXYGEN
9	A-SKID INOP	AVIONICS	AVIONICS VENT	DOORS ↑
10	L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL

PUSHER SYSTEM.

Comes on under the following conditions:

- pusher monitoring circuit detects a short and/or open circuit within the pusher servo.
- if only one stall computer initiates PUSH with a discrepancy of > 6.5° AOA to the other stall computer.
- when PUSH 1 and/or PUSH 2 signals are initiated.

L/R STALL FAIL.

Comes on if Stall Warning Computer channel 1 or 2 detects:

- a stall computer failure.
- a difference of 2° vane angle or more between the dual AOA signals.

In both cases stall warning and push signals from respective computer are inhibited.

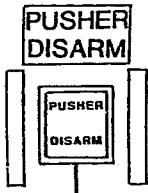
D



PUSH 1 / PUSH 2 indicator light.

Comes on and indicates if PUSH 1/PUSH 2 signals are initiated. The light is inhibited if pusher has been disarmed.

E



PUSHER DISARM buttonlight.

When pushed the stick pusher servo is disarmed. The pusher servo can only be rearmed on ground from the outside. The indicator light in both buttons comes on when either button has been depressed.

Fig. 2. Stall warning - controls and indicators.



4. ELECTRICAL POWER SUPPLY.

Left stall warning channel	L BAT BUS	E-7	STALL WARN CHAN 1
Right stall warning channel	R BAT BUS	L-6	STALL WARN CHAN 2
Stick pusher servo	R BAT BUS	L-4	STICK PUSHER

**1. LIMITATIONS.**

Not applicable.

2. NORMAL OPERATIONS.

CONDITIONS	NORMAL PROCEDURES
2. 1. PREFLIGHT TEST.	<ol style="list-style-type: none">1. Hold STALL 1 switch in upper position.<ul style="list-style-type: none">– Check both Stickshakers to come on.– Check L and R Aural Stall Warnings to sound.2. Hold STALL 2 switch in upper position.<ul style="list-style-type: none">– Check both Stickshakers to come on.– Check L and R Aural Stall Warnings to sound.3. Pull Control Column to the rear position.4. Hold STALL 1 and STALL 2 switches in upper position.<ul style="list-style-type: none">– Check both Stickshakers to come on.– Check L and R Aural Stall Warnings to sound.– Check Stickpusher to push.– Check PUSH 1 and PUSH 2 lights to come on.5. Pull Control Column to the rear position.6. Hold STALL 1 and STALL 2 switches in upper position.<ul style="list-style-type: none">– Check both Stickshakers to come on.– Check L and R Aural Stall Warnings to sound.– Check Stickpusher not to push.
2. 2. STALL WARNING AND PUSHER.	<p>Stall warning comes on.</p> <p>INDICATIONS.</p> <p>Stick shaker and aural warning (possibly also PUSH 1 and/or PUSH 2 light).</p> <p>ACTIONS.</p> <p>Perform actions in accordance with AOM 25 FLIGHT CHARACTERISTICS.</p>

3. ABNORMAL OPERATIONS.

For Abnormal Operation, see section 23, ABNORMAL PROCEDURES.



1. GENERAL.

The TCAS II system is an on-board collision avoidance and traffic situation system which monitors a radius of at least 14 nautical miles about the aircraft and, by interrogating any "intruding" aircraft's transponder, determines if a potential airspace conflict exists. This is done by computing the range, altitude, bearing and closure rate of other transponder-equipped aircraft, with respect to the TCAS-equipped aircraft.

The ACAS II system complies with TCAS II Change 7.0. There are no operational differences between ACAS II and TCAS II Change 7.0. When TCAS is mentioned in this section ACAS is also applicable. When TCAS II is mentioned in this manual it applies both to change 6.04A and 7.0, unless otherwise stated.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. TCAS II system equipment.

The TCAS II system consists of the following:

<u>Qty</u>	<u>Description</u>
1	TCAS II Transmitter-Receiver
2	RA/VSI Indicators
1	TCAS Control
2	Directional Antenna (one top, one bottom)
1	TA/MFD Indicator

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

- Air Data Computer
- Mode S Transponder
- Two TCAS II RA/VSI Indicators
- Radio Altimeter
- One TA/MFD Indicator

The TCAS II system provides two levels of threat advisories:

- If the traffic gets within approximately 45 sec. of projected Closest Point of Approach (CPA), it is then considered an intruder, and an aural and visual traffic advisory is issued. This level calls attention to a

developing collision threat using the TCAS II traffic/advisory (TA/MFD) indicators and the voice message, "TRAFFIC TRAFFIC". It permits mental and physical preparation for a possible maneuver to follow, and assists the pilot in achieving visual acquisition of the threat aircraft.

- If the intruder gets within approximately 30 sec. of CPA, it is considered a threat and an aural and visual resolution advisory (RA) is issued. This level provides a recommended vertical maneuver using the TCAS II RA/VSI Indicators and voice messages to provide adequate vertical separation from the threat aircraft or prevents initiation of a maneuver that would place the TCAS II aircraft in jeopardy.

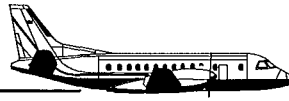
2.2. Mode S transponder system equipment.

The Mode S transponder system consists of the following equipment:

<u>Qty</u>	<u>Description</u>
1(2)	Mode S Transponder(s)
1	ATC Transponder Control
2(4)	L-Band Omni-directional Antennas (one/two top, one/two bottom)

(A second Mode S transponder can be installed as an option)

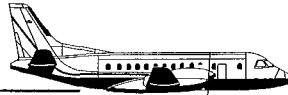
The ATC/MODE S transponder is a solid-state, airborne, air traffic control (ATC) transponder that responds to ATCRBS (Air Traffic Control Radar Beacon System) MODE A, MODE C and MODE S (SELECTIVE INTERROGATIONS) interrogations. The MODE S function is capable of being discretely addressed (so that interrogation can be directed to a specific aircraft as required by TCAS II) and for receiving and sending data link messages. It is also capable of receiving and transmitting from two antennas (for use in diversity operations for improving air-to-air surveillance and communications).



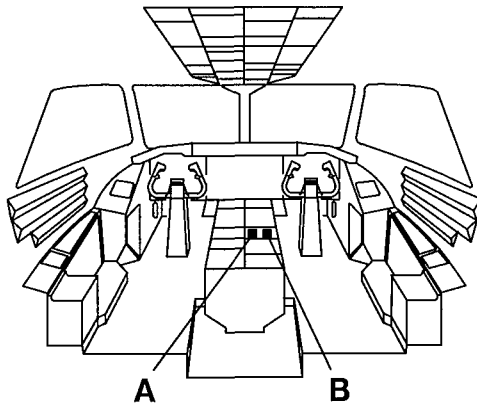
The TCAS II system will resolve multiple aircraft encounters. The TCAS II is considered a backup system to the "SEE-AND-AVOID" concept and the ATC radar environment.

2.3. Standard TCAS II definitions.

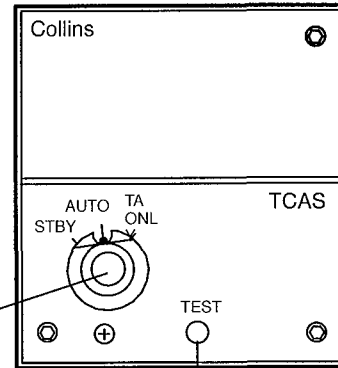
- a. ACASII/TCAS II – An ACAS (Airborne Collision Avoidance System) or TCAS (Traffic alert and Collision Avoidance System) that utilizes interrogation of, and replies from airborne radar beacon transponder and provides traffic advisories (TA) and resolution advisories (RA) in the vertical plane.
- b. Other Traffic – is defined as any other traffic within the range of the display and within ± 2700 ft vertically.
- c. Proximate Traffic – is defined to be any traffic not generating an RA or TA but which is within six nautical miles (nm) slant range and within ± 1200 ft vertically.
- d. Traffic Advisory (TA) – Information given to the pilot pertaining to the position of intruding aircraft in the immediate vicinity. The information contains no suggested maneuver.
- e. Threat – Traffic that has satisfied the threat detection logic and requires a Resolution Advisory (RA).
- f. Resolution Advisory (RA) – A display indication given to the pilot recommending a maneuver to increase vertical separation relative to an intruding (threat) aircraft.
 - (1) Corrective Advisory – A Resolution Advisory that instructs the pilot to deviate from current vertical rate.
 - (2) Preventive Advisory – A Resolution Advisory that instructs the pilot to avoid certain deviations from current vertical rate.



3. CONTROLS.



A TCAS II CONTROL



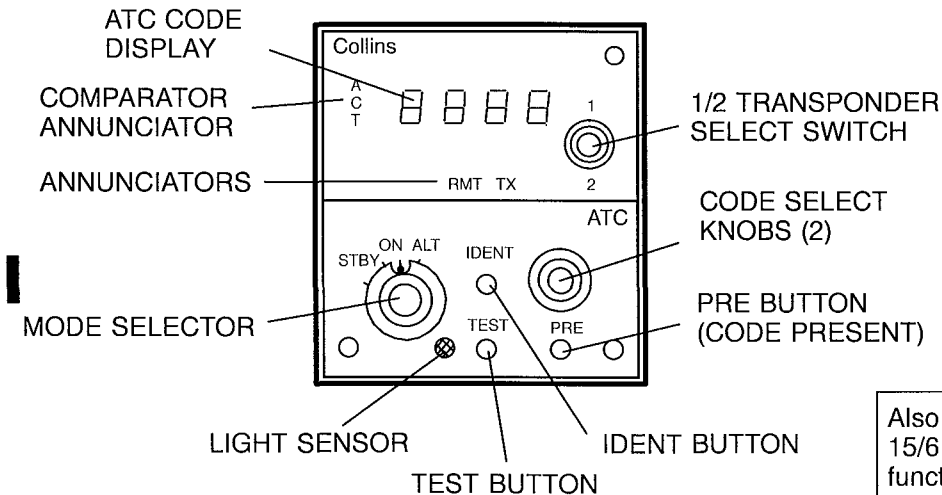
Mode Selector

- STBY – Standby
- AUTO – Traffic / resolution advisory (automatic)
- TA ONLY – Traffic advisory mode of operation

TEST Button

Push for TCAS self test

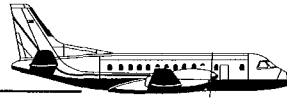
B ATC CONTROL



Also see ATC transponder 15/6 in AOM I for detailed functions

A23996

Fig 1. TCAS and ATC controls



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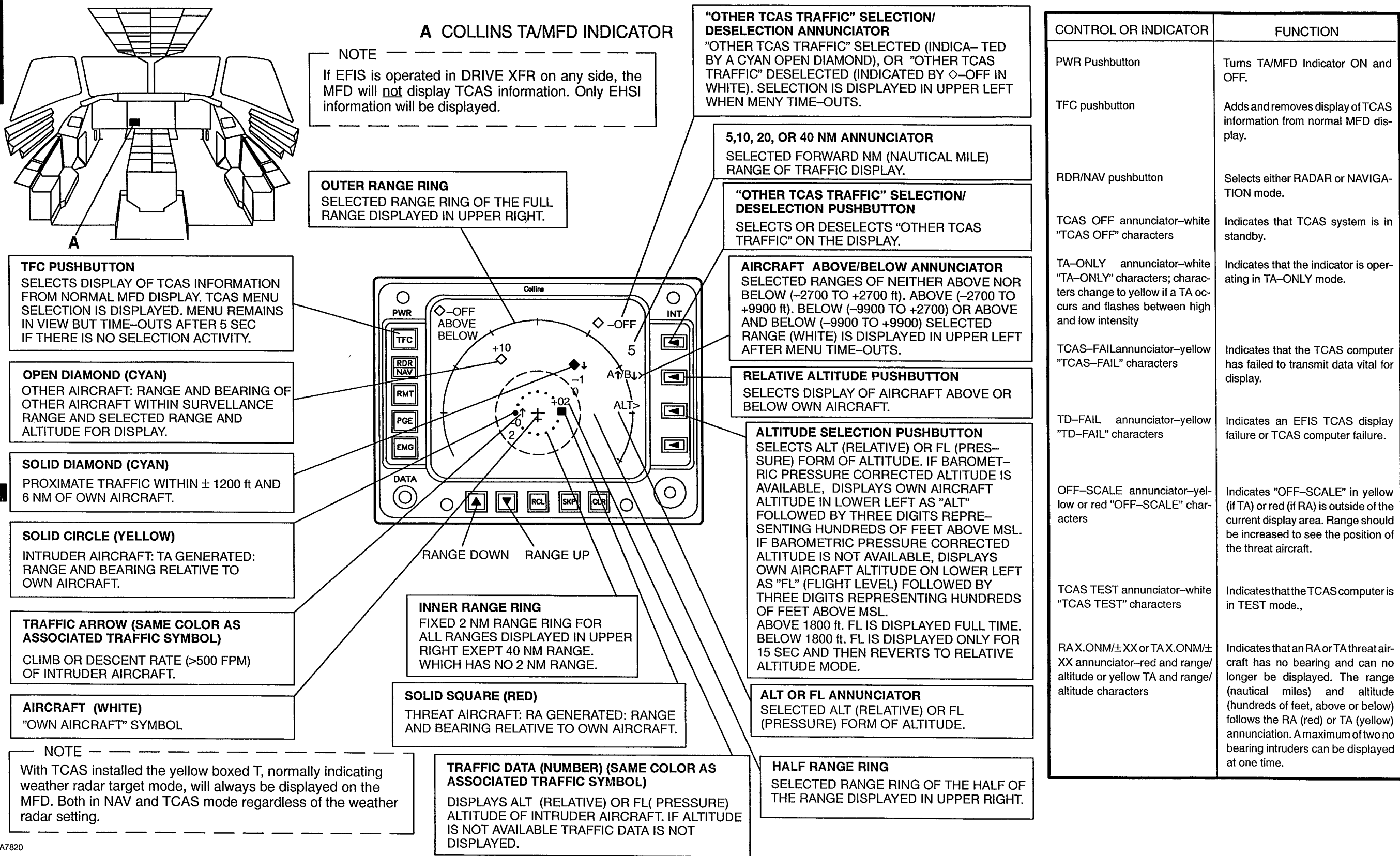
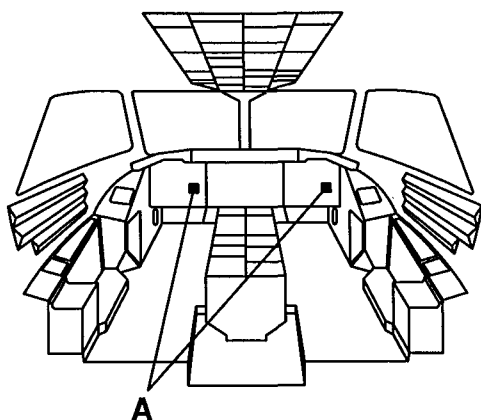


FIG. 2. Collins TA/MFD Indicator.



NOTE

The VSI is normal vertical speed indicator, and the presence of the lights or the TCAS STATUS WINDOW flags will not interfere with the ability of the needle to indicate vertical speeds.

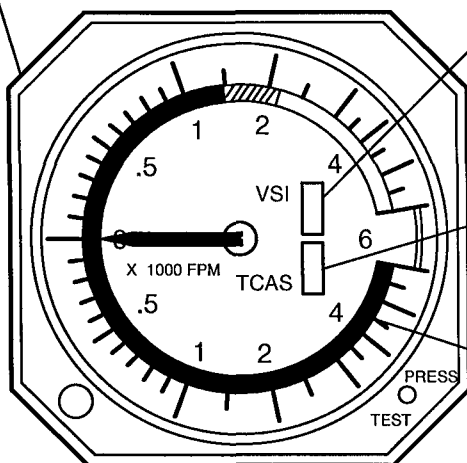
VERTICAL SPEED INDICATOR.

Indicates vertical speed in feet per minute.

VSI STATUS WINDOW FLAGS

BLACK FLAG – Normal Operation
AMBER FLAG – Indicates VSI FAULT

A KOLLSMAN RA/VSI INDICATOR



TCAS STATUS WINDOW FLAGS.

BLACK FLAG – NORMAL OPERATION
AMBER FLAG – Indicates unusable TCAS information.

RED/GREEN EYEBROW LIGHTS.

Eyebrow lights are invisible until they come "on" as part of a TCAS "RESOLUTION ADVISORY" or system "TEST". These lights come "on" to indicate a vertical speed regime which will provide safe traffic separation. A RED arc (eyebrow) is indicating the "forbidden" vertical speeds – keep the needle out of RED. A GREEN "Fly-to" arc indicates the RED ARC for corrective resolution advisory (RA). The nominal size of the GREEN "Fly-to" arc is approximately that of the distance between the 1500 and 2000 ft per minute tick marks.

WHITE LETTERS ON BLACK "RA OFF" FLAG – Always displayed when TCAS/Transponder mode selector is in STBY or TA. Will also be displayed with selector in RA/TA if "RAs" are inhibited and/or inoperative.

A9703

FIG. 3. Kollsman RA/VSI indicator functions.





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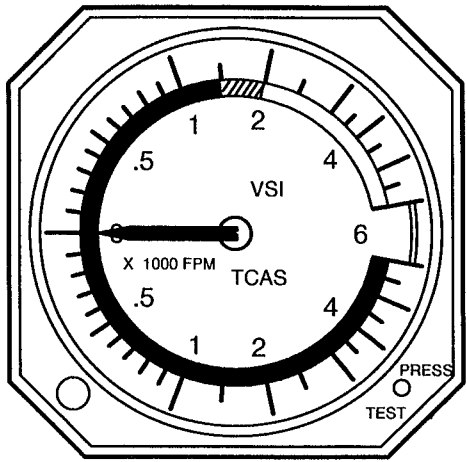


VISUAL RAs – VERTICAL SPEED SCALE

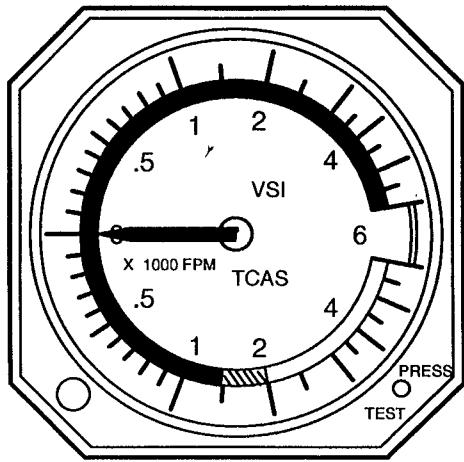
The color-coded visual advisory areas just inside, and adjacent to, the Vertical Speed Indicators scale instructs the pilot to what vertical speed region is TO BE AVOIDED (RED). If a change in vertical speed is necessary, the specific region of vertical speed the pilot is to "fly-to" is illuminated in GREEN. For example, the prohibited RED vertical speed region may extend from -6000 FPM to +1500 FPM as shown in Figure a. The GREEN "fly-to" area appears from +1500 FPM to +2000 FPM.

A Preventive Resolution Advisory is issued when The TCAS aircraft's present vertical speed is already outside the prohibited region. Those vertical speeds deemed unsafe are illuminated in RED. Preventive Resolution Advisory visual indications range from restricting rate of climb or descent, to prohibiting changes in vertical speed altogether. The aural message "MONITOR VERTICAL SPEED" accompanies the full range of Preventive Resolution Advisories.

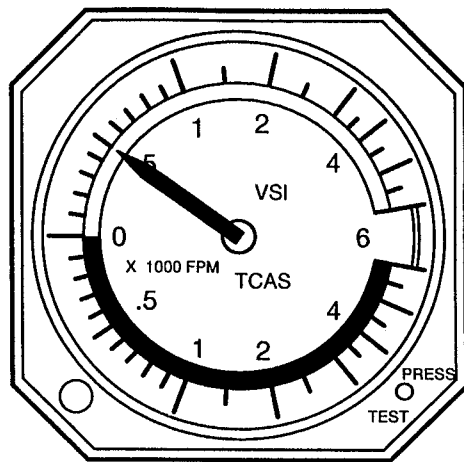
GREEN = 
RED = 



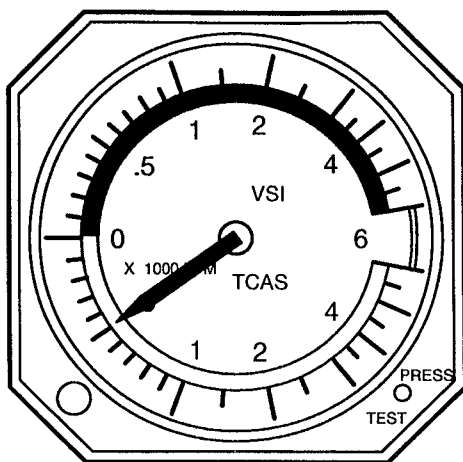
CORRECTIVE – CLIMB
Figure a



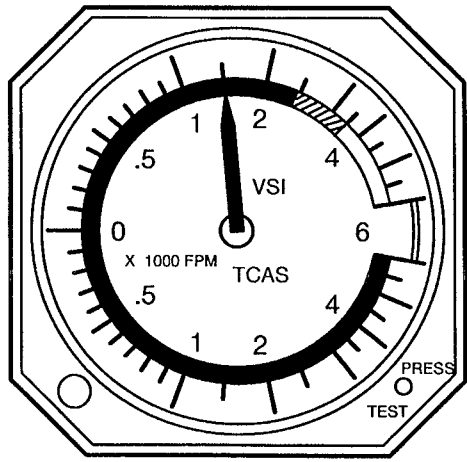
CORRECTIVE – DESCEND
Figure c



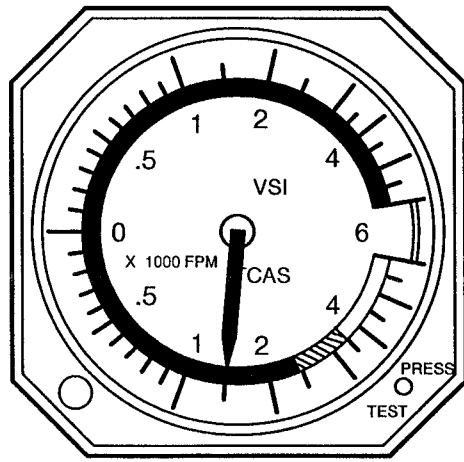
PREVENTIVE – MONITOR
VERTICAL SPEED
Figure e



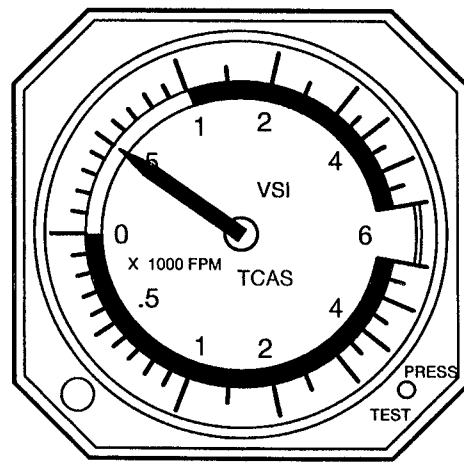
PREVENTIVE – MONITOR
VERTICAL SPEED
Figure g



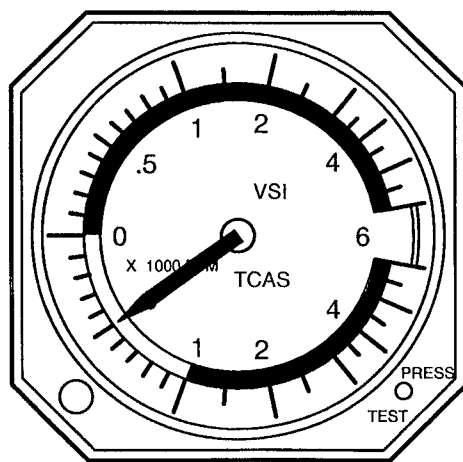
CORRECTIVE – INCREASE CLIMB
Figure b



CORRECTIVE – INCREASE DESCENT
Figure d



PREVENTIVE – MONITOR
VERTICAL SPEED
Figure f



PREVENTIVE – MONITOR
VERTICAL SPEED
Figure h

A9201

TCAS Corrective Resolution Advisory (RA) Examples

Fig 4. Visual RAs / Vertical speed scale



4. ELECTRICAL POWER SUPPLY.

TCAS	R AVIONIC BUS	L-19	TCAS
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1. LIMITATIONS.

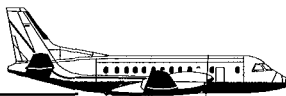
The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP	<ol style="list-style-type: none"> 1. R AVION switch ON 2. MODE S TRANSPONDER SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system. – The Mode selector located on the ATC control should be in "STBY" position before changing ATC code. 3. TCAS II SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system.
2. 2. SYSTEM TEST.	<ol style="list-style-type: none"> 1. Self-Test <ul style="list-style-type: none"> – The TCAS II system should be tested prior to flight. Put the TCAS mode selector to "AUTO" and the ATC mode selector to "ALT" and momentarily press the test button on either the TCAS control panel or the ATC control panel. – The TA/MFD indicator should present a test pattern display (test intruder set of RA, TA, Proximate traffic and Other traffic symbols with TCAS TEST). – After completion of self-test, "TCAS SYSTEM TEST OK" audio annunciation will be heard. – Use of self-test function in flight will inhibit TCAS II and Mode S Transponder operation for up to 20 sec., depending upon the number of aircraft being tracked. – If "TCAS SYSTEM TEST FAIL" is heard or if a TCAS flag appears, the TCAS system should be turned off.
2. 3. REFERENCE	Refer to TCAS II Pilots Guide, Collins No. 523–0776233, dated 6–1–90 or later, for normal system operating procedures.



CONDITIONS	NORMAL PROCEDURES								
2.4. TCAS II SYSTEM NORMAL OPERATING CHARACTER- ISTICS.	<p>If flight crew is advised by ATC to disable transponder altitude reporting, TCAS must be turned off by returning MODE selector on the ATC control to "ON" and the MODE selector on the TCAS control to "STBY".</p> <p>TCAS Resolution Advisories (RA) are inhibited below some radio altitudes. The chart below gives the TCAS inhibits created by the radio altimeter and the associated RA status.</p> <table border="1"> <thead> <tr> <th>RADIO ALTITUDE</th><th>RESOLUTION ADVISORY (RA) STATUS:</th></tr> </thead> <tbody> <tr> <td>Below 1550 FT AGL</td><td>"INCREASE DESCENT" RA inhibited</td></tr> <tr> <td>Below 1100 FT AGL</td><td>"DESCEND" RA inhibited</td></tr> <tr> <td>Below 1000 FT AGL</td><td>All RAs inhibited (TA ONLY)</td></tr> </tbody> </table> <p>a. RECOMMENDED FLIGHT CREW PROCEDURES</p> <div style="border: 1px dashed black; padding: 10px; margin-bottom: 10px;"> <p>NOTE</p> <p>Flight director pitch commands may be followed only if they result in a vertical speed which satisfies the RA command.</p> </div> <div style="border: 1px dashed black; padding: 10px; margin-bottom: 10px;"> <p>NOTE</p> <p>It is possible in some cases to have insufficient aircraft performance to follow the TCAS RA command without flying into stall warning or buffet.</p> </div> <p>Conditions where this may occur include:</p> <ul style="list-style-type: none"> ○ Bank angle in excess of 15 degrees. ○ Operation at airports outside 0–5300 ft MSL or at temperatures outside ISA \pm 50° F. ○ Speeds below normal operating speeds. ○ Buffet margin less than 0.3 G. ○ Failure to configure for go-around following a climb RA in landing configuration. 	RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:	Below 1550 FT AGL	"INCREASE DESCENT" RA inhibited	Below 1100 FT AGL	"DESCEND" RA inhibited	Below 1000 FT AGL	All RAs inhibited (TA ONLY)
RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:								
Below 1550 FT AGL	"INCREASE DESCENT" RA inhibited								
Below 1100 FT AGL	"DESCEND" RA inhibited								
Below 1000 FT AGL	All RAs inhibited (TA ONLY)								



CONDITIONS	NORMAL PROCEDURES
Cont'd	<ul style="list-style-type: none"> ○ Failure to advance thrust to full rating following a reduced power thrust takeoff. ○ Abnormal configurations which reduce performance. (e.g., gear not retractable) ○ TCAS command reversal to an "INCREASE CLIMB, INCREASE CLIMB" or a "CLIMB, CLIMB NOW". <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE — — — — —</p> <p>TCAS will continue to provide RA commands during stick shaker operation.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE — — — — —</p> <p>If high speed buffet is encountered when initially responding to RA, relax pitch force as necessary to reduce buffet, but continue the maneuver.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE — — — — —</p> <p>Select TA only mode following an inflight engine shutdown.</p> </div> <p style="margin-top: 20px;"><u>WHEN A TCAS RA OCCURS:</u></p> <p>If a maneuver is required:</p> <p>AUTOPILOT DISCONNECT</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>POWER AS REQUIRED</p> <p><u>IF TCAS "CLIMB" OR "INCREASE CLIMB" RA OCCURS WHEN CONFIGURED FOR LANDING:</u></p> <p>AUTOPILOT DISCONNECT</p> <p>POWER GO-AROUND THRUST</p> <p>FLAPS RETRACT TO GO-AROUND POSITION</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>GEAR UP WITH POSITIVE RATE OF CLIMB</p> <p>IF STICK SHAKER OCCURS DURING AN RA MANEUVER. IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE STALL RECOVERY PROCEDURE (SEE NOTES).</p>
Cont'd	



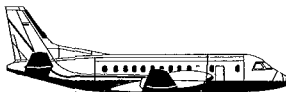
CONDITIONS	NORMAL PROCEDURES
Cont'd	<p>IF A GPWS/TAWS WARNING OCCURS DURING AN RA MANEUVER, IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE APPROPRIATE GPWS/TAWS RECOVERY PROCEDURE. If a GPWS/TAWS warning occurs, TCAS will automatically revert to TA only mode and TCAS aural messages are inhibited. Normal TCAS operation will resume when GPWS/TAWS warning ceases.</p> <p>b. The TCAS RA algorithms are based on the pilot initiating the initial maneuver within approximately 5 sec., and within approximately 2 1/2 sec. if an additional corrective RA, for example, increase or reversal, is issued.</p> <p>c. If ATC requires that transponder altitude reporting be disabled, setting MODE selector to ON on the ATC control panel will automatically cause TCAS to be in standby (TCAS OFF on TA/MFD indicator and RA OFF on RA/VSI indicator).</p>



CONDITIONS	NORMAL PROCEDURES		
2. 5. TCAS II SYSTEM TRAFFIC ADVISORY (TA) ANNUNCI- ATIONS.	Traffic advisories (TA) are shown on the TA/MFD indicator as YELLOW filled circles representing the intruder.		
	Traffic advisories (TA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"TRAFFIC, TRAFFIC"	Amber filled circle shown on the TA/MFD indicator	Conduct a visual search for the intruder. If successful, maintain visual acquisition to ensure safe separation.
2. 6. TCAS II SYSTEM RESOLUTION ADVISORY (RA) ANNUNCI- ATIONS.	Threat traffic are shown on the TA/MFD indicator as RED filled squares representing the intruder.		
	Resolution advisories (RA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"CLIMB, CLIMB"	VSI RED from -6000 FPM to + 1500 FPM and GREEN from +1500 FPM to +2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND"	VSI RED from +6000 FPM to -1500 FPM and GREEN from -1500 FPM to -2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"MONITOR VERTICAL SPEED"	Present vertical speed is outside the RED arc as shown on the VSI display.	Keep vertical speed out of RED unsafe area as indicated on the VSI display.
	"MAINTAIN VERTICAL SPEED MAINTAIN"	Present vertical speed is inside the GREEN arc as shown on the VSI display.	Maintain present vertical speed and direction. Ensure that the VSI needle does not enter the area of red-lighted scale segments on the VSI display.

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CONDITIONS	NORMAL PROCEDURES		
(Cont'd)	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"MAINTAIN VERTICAL SPEED CROSSING MAINTAIN"	Present vertical speed is inside the green arc is shown on the VSI display	A flight path crossing is predicted, but being monitored by TCAS. Maintain present vertical speed and direction. Ensure that the VSI needle does not enter the area of red-lighted scale segments on the VSI display.
	"ADJUST VERTICAL SPEED ADJUST"	VSI indicated prohibited vertical speed in RED. Goal is vertical speed in GREEN.	Promptly and smoothly adjust vertical speed to that shown in the GREEN arc as indicated on the VSI display.
	"CLIMB CROSSING CLIMB, CLIMB CROSSING CLIMB"	Same as "CLIMB" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND CROSSING DESCEND, DESCEND CROSSING DESCEND"	Same as "DESCEND" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"CLEAR OF CONFLICT"	VSI RED and GREEN areas removed. Range is increasing and separation is adequate.	Promptly and smoothly return to previous assigned clearance.



CONDITIONS	NORMAL PROCEDURES		
2. 7. TCAS II SYSTEM ENHANCED RESOLUTION ADVISORY (RA) ANNUNCI- ATIONS.	Enhanced resolution advisories (RA) will be annunciated when the initial resolution advisory (RA) does not provide sufficient vertical separation. These annunciation shall denote increased urgency:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"INCREASE CLIMB, INCREASE CLIMB"	Follows a "CLIMB" advisory VSI RED from -6000 FPM to +2500 FPM and GREEN from +2500 FPM to +3500 FPM. Indicates the vertical speed MUST BE INCREASED to ensure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"INCREASE DESCENT, INCREASE DESCENT"	Follows a "DESCEND" advisory, VSI RED from +6000 FPM to -2500 FPM and GREEN from -2500 FPM to -3500 FPM. Indicates the vertical speed MUST BE INCREASED to assure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI display.
	"CLIMB, CLIMB NOW CLIMB, CLIMB NOW"	Follows a "DESCEND" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation	Promptly and positively maneuver to establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"	Follows a "CLIMB" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation.	Promptly and positively maneuver to establish a 1500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI display.



1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP	<ol style="list-style-type: none"> 1. R AVION switch ON 2. MODE S TRANSPONDER SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system. – The Mode selector located on the ATC control should be in "STBY" position before changing ATC code. 3. TCAS II SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system.
2. 2. SYSTEM TEST.	<ol style="list-style-type: none"> 1. Self-Test <ul style="list-style-type: none"> – The TCAS II system should be tested prior to flight. Put the TCAS mode selector to "AUTO" and the ATC mode selector to "ALT" and momentarily press the test button on either the TCAS control panel or the ATC control panel. – The TA/MFD indicator should present a test pattern display like Figure 2 on page 5/6 (test intruder set of RA, TA, Proximate traffic and other traffic symbols with TCAS TEST). – After completion of self-test, "TCAS SYSTEM TEST OK" audio annunciation will be heard. – Use of self-test function in flight will inhibit TCAS II and Mode S Transponder operation for up to 20 sec., depending upon the number of aircraft being tracked. – If "TCAS SYSTEM TEST FAIL" is heard or if a TCAS flag appears, the TCAS system should be turned off.
2. 3. REFERENCE	Refer to TCAS II Pilots Guide, Collins No. 523–0776233, dated 6–1–90 or later, for normal system operating procedures.



CONDITIONS	NORMAL PROCEDURES								
2.4. TCAS II SYSTEM NORMAL OPERATING CHARACTER- ISTICS.	<p>If flight crew is advised by ATC to disable transponder altitude reporting, TCAS must be turned off by returning MODE selector on the ATC control to "ON" and the MODE selector on the TCAS control to "STBY".</p> <p>TCAS Resolution Advisories (RA) are inhibited below some radio altitudes. The chart below gives the TCAS inhibits created by the radio altimeter and the associated RA status.</p>								
	<table><tr><th>RADIO ALTITUDE</th><th>RESOLUTION ADVISORY (RA) STATUS:</th></tr><tr><td>Below 1450 FT AGL</td><td>"INCREASE DESCENT" RA inhibited</td></tr><tr><td>Below 1000 FT AGL descending; Below 1200 FT AGL climbing</td><td>"DESCEND" RA inhibited</td></tr><tr><td>Below 900 FT AGL descending; Below 1100 FT AGL climbing</td><td>All RAs inhibited (TA ONLY) and TA Aural Message inhibited</td></tr></table>	RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:	Below 1450 FT AGL	"INCREASE DESCENT" RA inhibited	Below 1000 FT AGL descending; Below 1200 FT AGL climbing	"DESCEND" RA inhibited	Below 900 FT AGL descending; Below 1100 FT AGL climbing	All RAs inhibited (TA ONLY) and TA Aural Message inhibited
	RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:							
	Below 1450 FT AGL	"INCREASE DESCENT" RA inhibited							
	Below 1000 FT AGL descending; Below 1200 FT AGL climbing	"DESCEND" RA inhibited							
Below 900 FT AGL descending; Below 1100 FT AGL climbing	All RAs inhibited (TA ONLY) and TA Aural Message inhibited								
<p>a. RECOMMENDED FLIGHT CREW PROCEDURES</p>									
<div><p>NOTE</p><p>Flight director pitch commands may be followed only if they result in a vertical speed which satisfies the RA command.</p></div>									
<div><p>NOTE</p><p>It is possible in some cases to have insufficient aircraft performance to follow the TCAS RA command without flying into stall warning or buffet.</p></div> <p>Conditions where this may occur include:</p> <ul style="list-style-type: none">○ Bank angle in excess of 15 degrees.○ Operation at airports outside 0–5300 ft MSL or at temperatures outside ISA ± 50° F.○ Speeds below normal operating speeds.○ Buffet margin less than 0.3 G.○ Failure to configure for go-around following a climb RA in landing configuration.									

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CONDITIONS	NORMAL PROCEDURES
Cont'd	<ul style="list-style-type: none"> ○ Failure to advance thrust to full rating following a reduced power thrust takeoff. ○ Abnormal configurations which reduce performance. (e.g., gear not retractable) ○ TCAS command reversal to a "CLIMB-CLIMB-NOW". <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>TCAS will continue to provide RA commands during stick shaker operation.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>If high speed buffet is encountered when initially responding to RA, relax pitch force as necessary to reduce buffet, but continue the maneuver.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>Select TA only mode following an inflight engine shutdown.</p> </div> <p><u>WHEN A TCAS RA OCCURS:</u></p> <p>If a maneuver is required:</p> <p>AUTOPILOT DISCONNECT</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>POWER AS REQUIRED</p> <p><u>IF TCAS "CLIMB" OR "INCREASE CLIMB" RA OCCURS WHEN CONFIGURED FOR LANDING:</u></p> <p>AUTOPILOT DISCONNECT</p> <p>POWER GO-AROUND THRUST</p> <p>FLAPS RETRACT TO GO-AROUND POSITION</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>GEAR UP WITH POSITIVE RATE OF CLIMB</p> <p>IF STICK SHAKER OCCURS DURING AN RA MANEUVER. IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE STALL RECOVERY PROCEDURE (SEE NOTES).</p>
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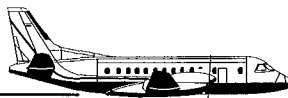


CONDITIONS	NORMAL PROCEDURES
Cont'd	<p>IF A GPWS/TAWS WARNING OCCURS DURING AN RA MANEUVER, IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE APPROPRIATE GPWS/TAWS RECOVERY PROCEDURE. If a GPWS/TAWS warning occurs, TCAS will automatically revert to TA only mode and TCAS aural messages are inhibited. Normal TCAS operation will resume when GPWS/TAWS warning ceases.</p> <p>b. The TCAS RA algorithms are based on the pilot initiating the initial maneuver within approximately 5 sec., and within approximately 2 1/2 sec. if an additional corrective RA, for example, increase or reversal, is issued.</p> <p>c. If ATC requires that transponder altitude reporting be disabled, setting MODE selector to ON on the ATC control panel will automatically cause TCAS to be in standby (TCAS OFF on TA/MFD indicator and RA OFF on RA/VSI indicator).</p>



CONDITIONS	NORMAL PROCEDURES		
2. 5.TCAS II SYSTEM TRAFFIC ADVISORY (TA) ANNUNCI- ATIONS.	Traffic advisories (TA) are shown on the TA/MFD indicator as YELLOW filled circles representing the intruder.		
	Traffic advisories (TA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"TRAFFIC, TRAFFIC"	Amber filled circle shown on the TA/MFD indicator	Conduct a visual search for the intruder. If successful, maintain visual acquisition to ensure safe separation.
2. 6.TCAS II SYSTEM RESOLUTION ADVISORY (RA) ANNUNCI- ATIONS.	Resolution advisories (RA) are shown on the TA/MFD indicator as RED filled squares representing the intruder.		
	Resolution advisories (RA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"CLIMB, CLIMB CLIMB"	VSI RED from -6000 FPM to + 1500 FPM and GREEN from +1500 FPM to +2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND, DESCEND"	VSI RED from +6000 FPM to -1500 FPM and GREEN from -1500 FPM to -2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED."	Present vertical speed is outside the RED arc as shown on the VSI display.	Keep vertical speed out of RED unsafe area is indicated on the VSI display.
	"REDUCE CLIMB, REDUCE CLIMB"	VSI indicated prohibited vertical speeds in RED. Goal is vertical speed in GREEN.	Promptly and smoothly reduce vertical speed to that shown in the GREEN arc as indicated on the VSI.
(Cont'd)			

(Cont'd)



CONDITIONS	NORMAL PROCEDURES		
(Cont'd)	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"REDUCE DESCENT, REDUCE DESCENT"	VSI indicated prohibited vertical speed in RED. Goal is vertical speed in GREEN.	Promptly and smoothly reduce vertical speed to that shown in the GREEN arc as indicated on the VSI.
	"CLIMB CROSSING CLIMB, CLIMB CROSSING CLIMB"	Same as "CLIMB" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"DESCEND CROSSING DESCEND, DESCEND CROSSING DESCEND"	Same as "DESCEND" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater DESCENT as indicated by the GREEN arc on the VSI
	"CLEAR OF CONFLICT"	VSI RED and GREEN areas removed. Range is increasing and separation is adequate.	Promptly and smoothly return to previous assigned clearance.



CONDITIONS	NORMAL PROCEDURES		
2. 7. TCAS II SYSTEM ENHANCED RESOLUTION ADVISORY (RA) ANNUNCI- ATIONS.	Enhanced resolution advisories (RA) will be annunciated when the initial resolution advisory (RA) does not provide sufficient vertical separation. These annunciation shall denote increased urgency:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"INCREASE CLIMB, INCREASE CLIMB"	Follows a "CLIMB" advisory VSI RED from -6000 FPM to +2500 FPM and GREEN from +2500 FPM to +3500 FPM. Indicates the vertical speed MUST BE INCREASED to ensure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"INCREASE, DESCENT, INCREASE, DESCENT"	Follows a "DESCEND" advisory, VSI RED from +6000 FPM to -2500 FPM and GREEN from -2500 FPM to -3500 FPM. Indicates the vertical speed MUST BE INCREASED to assure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI.
	"CLIMB, CLIMB NOW CLIMB, CLIMB NOW"	Follows a "DESCEND" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation	Promptly and positively maneuver to establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"	Follows a "CLIMB" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation.	Promptly and positively maneuver to establish a 1500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI.

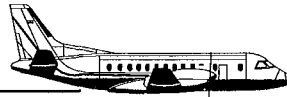


3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. TCAS II SYSTEM.	<ul style="list-style-type: none"> ◆ TCAS II system dead. <ol style="list-style-type: none"> 1. CB L-19 (TCAS) CHECK/RESET 2. End of procedure. ◆ TCAS FAIL is annunciated. <ol style="list-style-type: none"> 1. If "TCAS FAIL" is annunciated on the TA/MFD Indicator or if "TCAS FAIL" is annunciated on the RA/VSI Indicator or if "TCAS SYSTEM TEST FAIL" audio annunciation occurs, turn TCAS off. Rotate TCAS mode selector to "STBY" position. (TCAS will no longer be operable.) 2. End of procedure ◆ ADC or RALT u/s. <ol style="list-style-type: none"> 1. If ADC or RADIO ALTIMETER no longer available, turn TCAS off. (TCAS will no longer be operable.) 2. End of procedure. ◆ ACT Light flashes. <ol style="list-style-type: none"> 1. If the "ACT" light flashes continuously on the ATC control when position 1/2 switch is in either position, select "STBY" on the TCAS mode selector. (TCAS will no longer be operable.) 2. End of procedure. ◆ TA ONLY flag. <ol style="list-style-type: none"> 1. If "TA ONLY" flag appears on the TA/MFD Indicator or "RA OFF" appears on the RA/VSI Indicator, verify TCAS mode selector is selected to "AUTO". If "AUTO" is selected and "TA ONLY" or "RA OFF" flag is still in view then the Pilot with the operable VSI (with no RA OFF flag) should be briefed to conduct any subsequent maneuvers required by an RA advisory. 2. End of procedure. ◆ VSI flag. <ol style="list-style-type: none"> 1. If "VSI" flag appears on the RA/VSI indicator, then the Pilot with the operable VSI (with no VSI flag) should be briefed to conduct any subsequent maneuvers required by an RA advisory. 2. End of procedure.



CONDITIONS	ABNORMAL PROCEDURES
3. 2. MODE S TRANSPONDER SYSTEM.	ACT light flashes. <ol style="list-style-type: none">1. If the "ACT" light flashes continuously on the ATC control panel when the switch is in position 1, select position 2 or conversely.2. End of procedure



1. GENERAL.

The TCAS II system is an on-board collision avoidance and traffic situation system which monitors a radius of at least 14 nautical miles about the aircraft and, by interrogating any "intruding" aircraft's transponder, determines if a potential airspace conflict exists. This is done by computing the range, altitude, bearing and closure rate of other transponder-equipped aircraft, with respect to the TCAS-equipped aircraft.

The ACAS II system complies with TCAS II Change 7.0. There are no operational differences between ACAS II and TCAS II Change 7.0. When TCAS is mentioned in this section ACAS is also applicable. When TCAS II is mentioned in this manual it applies both to change 6.04A and 7.0, unless otherwise stated.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. TCAS II system equipment.

The TCAS II system consists of the following:

Qty	Description
1	TCAS II Transmitter-Receiver
2	TA/RA/VSI Indicators
1	TCAS Control
2	Directional Antenna (one top, one bottom)

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

- Mode S Transponder
- Air Data Computer
- Two TCAS II TA/RA/VSI Indicators
- Radio Altimeter.

The TCAS II system provides two levels of threat advisories.

- If the traffic gets within approximately 45 sec. of projected Closest Point of Approach (CPA), it is then considered an intruder, and an aural and visual traffic advisory is issued. This level calls attention to a developing collision threat using the TCAS II traffic/advisory (TA/RA/VSI) indicators and the voice message, "TRAFFIC TRAFFIC". It permits mental and

physical preparation for a possible maneuver to follow, and assists the pilot in achieving visual acquisition of the threat aircraft.

- If the intruder gets within approximately 30 sec. of CPA, it is considered a threat and an aural and visual resolution advisory (RA) is issued. This level provides a recommended vertical maneuver using the TCAS II TA/RA/VSI Indicators and voice messages to provide adequate vertical separation from the threat aircraft or prevents initiation of a maneuver that would place the TCAS II aircraft in jeopardy.

2.2. Mode S transponder system equipment.

The Mode S transponder system consists of the following equipment:

Qty	Description
1(2)	Mode S Transponder(s)
1	ATC Transponder Control
2(4)	L-Band Omni-directional Antennas (one/two top, one/two bottom)

(A second Mode S transponder can be installed as an option)

The ATC/MODE S transponder is a solid-state, airborne, air traffic control (ATC) transponder that responds to ATCRBS (Air Traffic Control Radar Beacon System) MODE A, MODE C and MODE S (SELECTIVE INTERROGATIONS) interrogations. The MODE S function is capable of being discretely addressed (so that interrogation can be directed to a specific aircraft as required by TCAS II) and for receiving and sending data link messages. It is also capable of receiving and transmitting from two antennas (for use in diversity operations for improving air-to-air surveillance and communications).

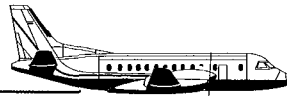


Aircraft Operations Manual

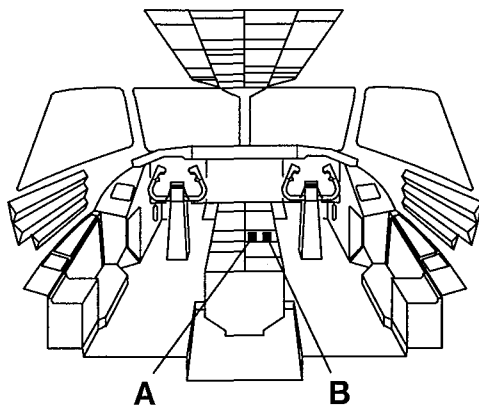
The TCAS II system will resolve multiple aircraft encounters. The TCAS II is considered a backup system to the "SEE-AND-AVOID" concept and the ATC radar environment.

2. 3. STANDARD TCAS II DEFINITIONS

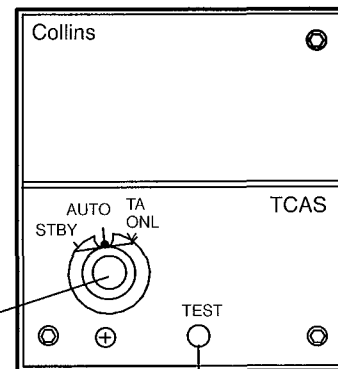
- a. ACAS II/TCAS II – An ACAS (Airborne Collision Avoidance System) or TCAS (Traffic alert and Collision Avoidance System) that utilizes interrogation of, and replies from airborne radar beacon transponder and provides traffic advisories (TA) and resolution advisories (RA) in the vertical plane.
- b. Other Traffic – is defined as any other traffic within the range of the display and within ± 2700 ft vertically.
- c. Proximate Traffic – is defined to be any traffic not generating an RA or TA but which is within six nautical miles (nm) slant range and within ± 1200 ft vertically.
- d. Traffic Advisory (TA) – Information given to the pilot pertaining to the position of intruding aircraft in the immediate vicinity. The information contains no suggested maneuver.
- e. Threat – Traffic that has satisfied the threat detection logic and requires a Resolution Advisory (RA).
- f. Resolution Advisory (RA) – A display indication given to the pilot recommending a maneuver to increase vertical separation relative to an intruding (threat) aircraft.
 - (1) Corrective Advisory – A Resolution Advisory that instructs the pilot to deviate from current vertical rate.
 - (2) Preventive Advisory – A Resolution Advisory that instructs the pilot to avoid certain deviations from current vertical rate.



3. CONTROLS.



A TCAS II CONTROL



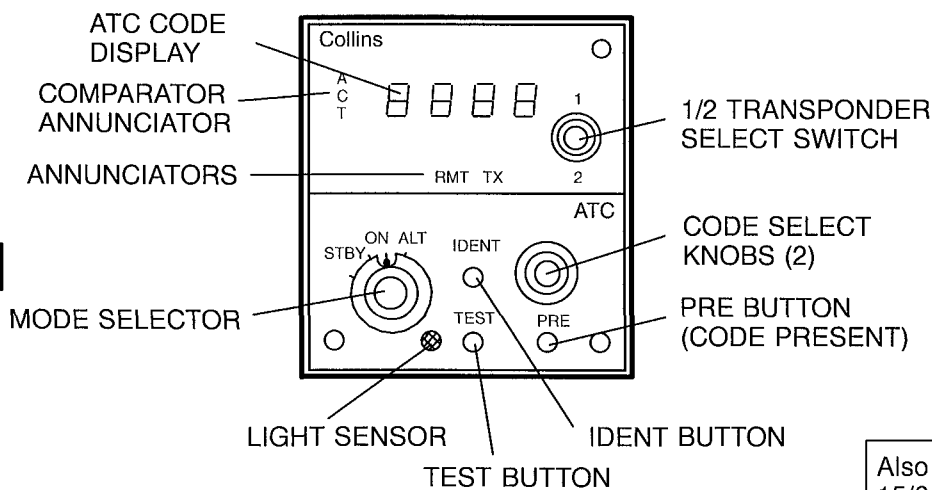
Mode Selector

- STBY – Standby
- AUTO – Traffic / resolution advisory (automatic)
- TA ONLY – Traffic advisory mode of operation

TEST Button

Push for TCAS self test

B ATC CONTROL



Also see ATC transponder 15/6 in AOM I for detailed functions

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FIG. 1. TCAS and ATC controls



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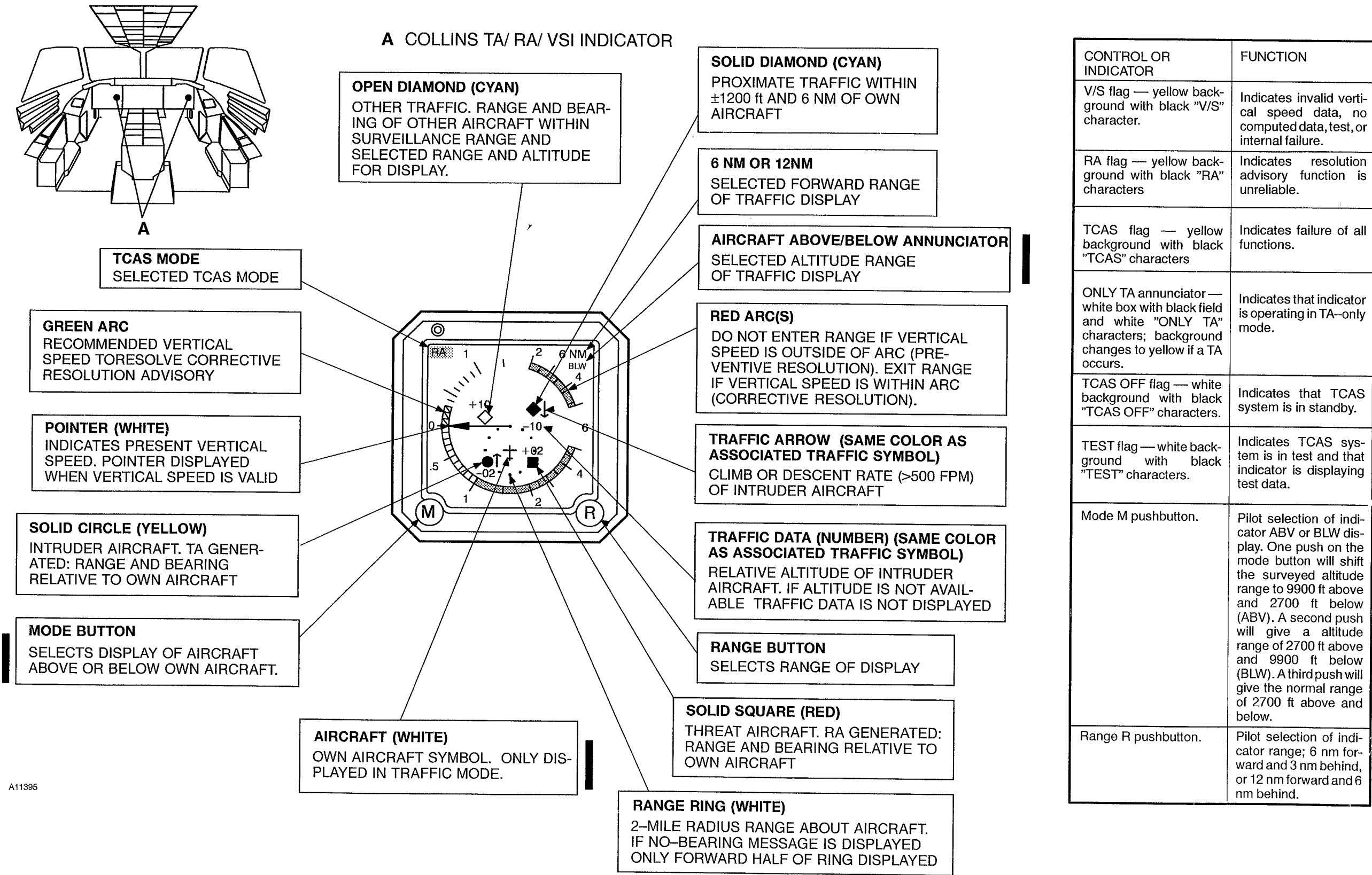
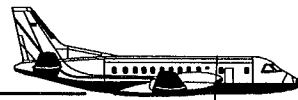




FIG. 2. Collins TA/RA/VSI Indicator.

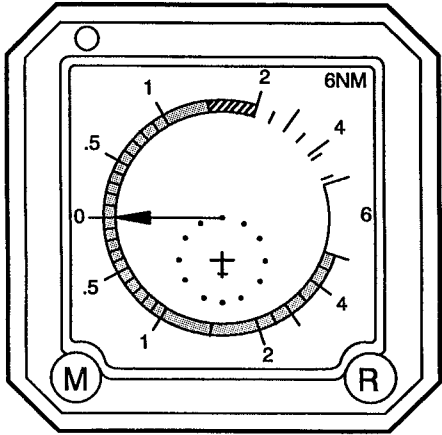


VISUAL RAs – VERTICAL SPEED SCALE

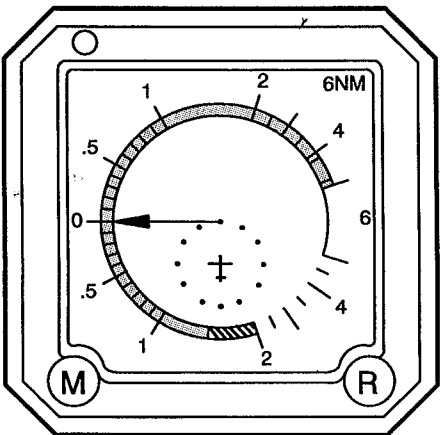
The color-coded visual advisory areas just inside, and adjacent to, the Vertical Speed Indicators scale instructs the pilot to what vertical speed region is TO BE AVOIDED (RED). If a change in vertical speed is necessary, the specific region of vertical speed the pilot is to "fly-to" is illuminated in GREEN. For example, the prohibited RED vertical speed region may extend from -6000 FPM to +1500 FPM as shown in Figure a. The GREEN "fly-to" area appears from +1500 FPM to +2000 FPM.

A Preventive Resolution Advisory is issued when The TCAS aircraft's present vertical speed is already outside the prohibited region. Those vertical speeds deemed unsafe are illuminated in RED. Preventive Resolution Advisory visual indications range from restricting rate of climb or descent, to prohibiting changes in vertical speed altogether. The aural message "MONITOR VERTICAL SPEED" accompanies the full range of Preventive Resolution Advisories.

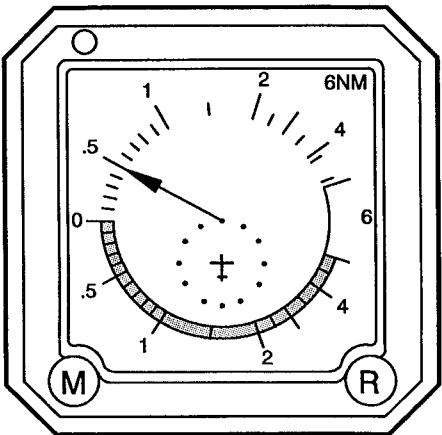
GREEN = 
RED = 



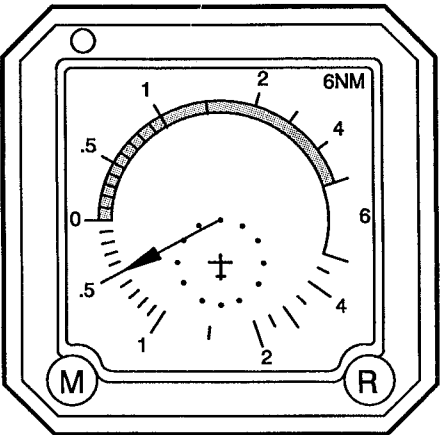
CORRECTIVE – CLIMB
Figure a



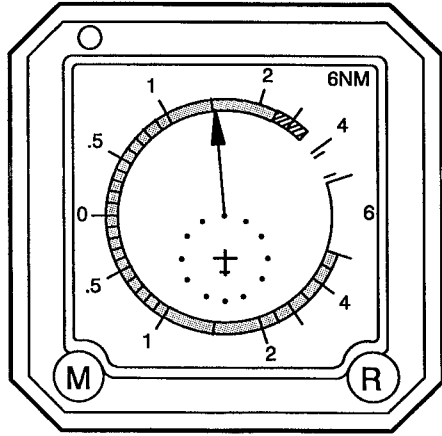
CORRECTIVE – DESCEND
Figure c



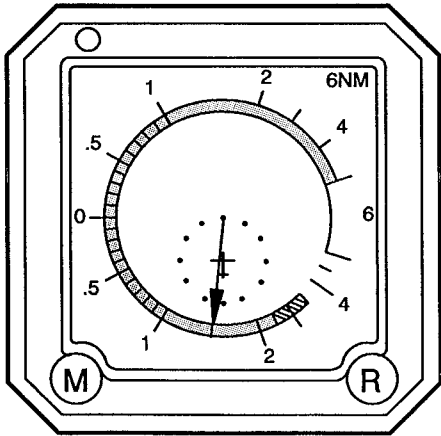
PREVENTIVE – MONITOR
VERTICAL SPEED
Figure e



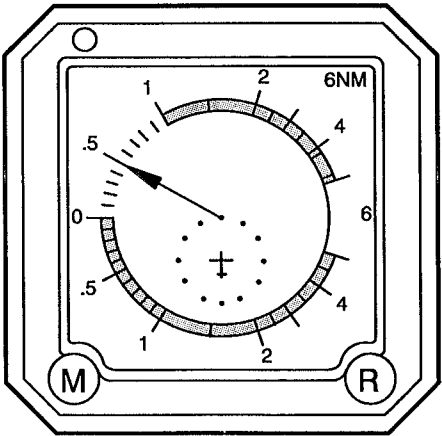
PREVENTIVE – MONITOR
VERTICAL SPEED
Figure g



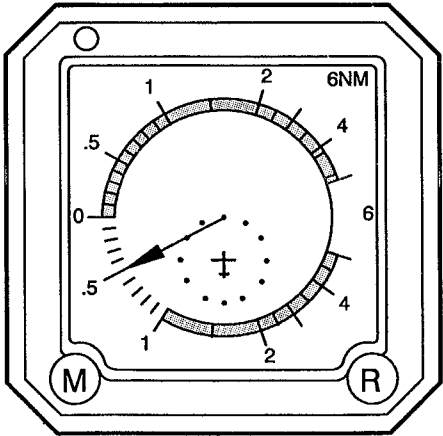
CORRECTIVE – INCREASE CLIMB
Figure b



CORRECTIVE – INCREASE DESCENT
Figure d



PREVENTIVE – MONITOR
VERTICAL SPEED
Figure f



PREVENTIVE – MONITOR
VERTICAL SPEED
Figure h

TCAS Corrective Resolution Advisory (RA) Examples

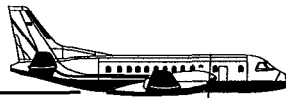
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FIG. 3. Resolution Advisory (RA) displays and annunciators.



4. ELECTRICAL POWER SUPPLY.

TCAS	R AVIONIC BUS	L-19	TCAS
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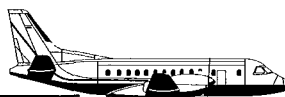


1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP.	<ol style="list-style-type: none"> 1. R AVION switch ON 2. MODE S TRANSPONDER SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system. – The Mode selector located on the ATC control should be in "STBY" position before changing ATC code. 3. TCAS II SYSTEM <ul style="list-style-type: none"> – The 1/2 switch located on the ATC control may be in either "1" or "2" position when using the MODE S or TCAS system.
2. 2. SYSTEM TEST.	<ol style="list-style-type: none"> 1. Self-Test <ul style="list-style-type: none"> – The TCAS II system should be tested prior to flight. Put the TCAS mode selector to "AUTO" and the ATC mode selector to "ALT" and momentarily press the test button on either the TCAS control panel or the ATC control panel. – The TA/RA/VSI indicator should present a test pattern. – After completion of self-test, "TCAS SYSTEM TEST OK" audio annunciation will be heard. – Use of self-test function in flight will inhibit TCAS II and Mode S Transponder operation for up to 20 sec., depending upon the number of aircraft being tracked. – If "TCAS SYSTEM TEST FAIL" is heard or if a TCAS flag appears, the TCAS system should be turned off.
2. 3. REFERENCE.	Refer to TCAS II Pilots Guide, Collins No. 523-0776233, dated 6-1-90 or later, for normal system operating procedures.



CONDITIONS	NORMAL PROCEDURES								
2.4. TCAS II SYSTEM NORMAL OPERATING CHARACTERISTICS.	<p>If flight crew is advised by ATC to disable transponder altitude reporting, TCAS must be turned off by returning MODE selector on the ATC control to "ON" and the MODE selector on the TCAS control to "STBY".</p> <p>TCAS Resolution Advisories (RA) are inhibited below some radio altitudes. The chart below gives the TCAS inhibits created by the radio altimeter and the associated RA status.</p> <table border="1"> <thead> <tr> <th>RADIO ALTITUDE</th><th>RESOLUTION ADVISORY (RA) STATUS:</th></tr> </thead> <tbody> <tr> <td>Below 1550 FT AGL</td><td>"INCREASE DESCENT" RA inhibited</td></tr> <tr> <td>Below 1100 FT AGL</td><td>"DESCEND" RA inhibited</td></tr> <tr> <td>Below 1000 FT AGL</td><td>All RAs inhibited (TA ONLY)</td></tr> </tbody> </table> <p>a. RECOMMENDED FLIGHT CREW PROCEDURES</p> <div style="border: 1px dashed black; padding: 5px; margin-bottom: 10px;"> <p>NOTE Flight director pitch commands may be followed only if they result in a vertical speed which satisfies the RA command.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin-bottom: 10px;"> <p>NOTE It is possible in some cases to have insufficient aircraft performance to follow the TCAS RA command without flying into stall warning or buffet.</p> </div> <p>Conditions where this may occur include:</p> <ul style="list-style-type: none"> ○ Bank angle in excess of 15 degrees. ○ Operation at airports outside 0–5300 ft MSL or at temperatures outside ISA \pm 50° F. ○ Speeds below normal operating speeds. ○ Buffet margin less than 0.3 G. ○ Failure to configure for go-around following a climb RA in landing configuration. 	RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:	Below 1550 FT AGL	"INCREASE DESCENT" RA inhibited	Below 1100 FT AGL	"DESCEND" RA inhibited	Below 1000 FT AGL	All RAs inhibited (TA ONLY)
RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:								
Below 1550 FT AGL	"INCREASE DESCENT" RA inhibited								
Below 1100 FT AGL	"DESCEND" RA inhibited								
Below 1000 FT AGL	All RAs inhibited (TA ONLY)								

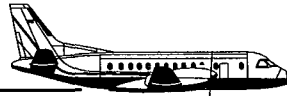
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CONDITIONS	NORMAL PROCEDURES
Cont'd	<ul style="list-style-type: none"> ○ Failure to advance thrust to full rating following a reduced power thrust takeoff. ○ Abnormal configurations which reduce performance. (e.g., gear not retractable) ○ TCAS command reversal to an "INCREASE CLIMB, INCREASE CLIMB" or a "CLIMB, CLIMB NOW". <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE — — — — —</p> <p>TCAS will continue to provide RA commands during stick shaker operation.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE — — — — —</p> <p>If high speed buffet is encountered when initially responding to RA, relax pitch force as necessary to reduce buffet, but continue the maneuver.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE — — — — —</p> <p>Select TA only mode following an inflight engine shutdown.</p> </div> <p><u>WHEN A TCAS RA OCCURS:</u></p> <p>If a maneuver is required:</p> <p>AUTOPILOT DISCONNECT</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>POWER AS REQUIRED</p> <p><u>IF TCAS "CLIMB" OR "INCREASE CLIMB" RA OCCURS WHEN CONFIGURED FOR LANDING:</u></p> <p>AUTOPILOT DISCONNECT</p> <p>POWER GO-AROUND THRUST</p> <p>FLAPS RETRACT TO GO-AROUND POSITION</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>GEAR UP WITH POSITIVE RATE OF CLIMB</p> <p>IF STICK SHAKER OCCURS DURING AN RA MANEUVER. IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE STALL RECOVERY PROCEDURE (SEE NOTES).</p>
Cont'd	



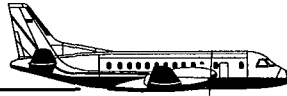
CONDITIONS	NORMAL PROCEDURES
Cont'd	<p>IF A GPWS/TAWS WARNING OCCURS DURING AN RA MANEUVER, IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE APPROPRIATE GPWS/TAWS RECOVERY PROCEDURE. If a GPWS/TAWS warning occurs, TCAS will automatically revert to TA only mode and TCAS aural messages are inhibited. Normal TCAS operation will resume when GPWSTAWS warning ceases.</p> <p>b. The TCAS RA algorithms are based on the pilot initiating the initial maneuver within approximately 5 seconds, and within approximately 2 1/2 sec. if an additional corrective RA, for example, increase or reversal, is issued.</p> <p>c. If ATC requires that transponder altitude reporting be disabled, setting MODE selector to ON on the ATC control panel will automatically cause TCAS to be in standby (TCAS OFF on TA/RA/VSI indicators).</p>



CONDITIONS	NORMAL PROCEDURES		
2. 5. TCAS II SYSTEM TRAFFIC ADVISORY (TA) ANNUNCI- ATIONS.	Traffic advisories (TA) are shown on the TA/RA/VSI indicator as AMBER filled circles representing the intruder.		
	Traffic advisories (TA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"TRAFFIC, TRAFFIC"	Amber filled circle shown on the TA/RA/VSI indicator	Conduct a visual search for the intruder. If successful, maintain visual acquisition to ensure safe separation.
2. 6. TCAS II SYSTEM RESOLUTION- ADVISORY (RA) ANNUNCI- ATIONS.	Threat traffic are shown on the TA/RA/VSI indicator as RED filled squares representing the intruder.		
	Resolution advisories (RA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"CLIMB, CLIMB"	VSI RED from -6000 FPM to + 1500 FPM and GREEN from +1500 FPM to +2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND"	VSI RED from +6000 FPM to -1500 FPM and GREEN from -1500 FPM to -2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"MONITOR VERTICAL SPEED"	Present vertical speed is outside the RED arc as shown on the VSI display.	Keep vertical speed out of RED unsafe area as indicated on the VSI display.
	"MAINTAIN VERTICAL SPEED MAINTAIN"	Present vertical speed is inside the green arc as shown on the VSI display	Maintain present vertical speed and direction. Ensure that the VSI needle does not enter the area of red-lighted scale segments on the VSI display.

(Cont'd)

(Cont'd)



CONDITIONS	NORMAL PROCEDURES		
(Cont'd)	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"MAINTAIN VERTICAL SPEED CROSSING MAINTAIN"	Present vertical speed is inside the green arc is shown on the VSI display	A flight path crossing is predicted, but being monitored by TCAS. Maintain present vertical speed and direction. Ensure that the VSI needle does not enter the area of red-lighted scale segments on the VSI display.
	"ADJUST VERTICAL SPEED ADJUST"	VSI indicated prohibited vertical speed in RED. Goal is vertical speed in GREEN.	Promptly and smoothly adjust vertical speed to that shown in the GREEN arc as indicated on the VSI display.
	"CLIMB CROSSING CLIMB, CLIMB CROSSING CLIMB"	Same as "CLIMB" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND CROSSING DESCEND, DESCEND CROSSING DESCEND"	Same as "DESCEND" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"CLEAR OF CONFLICT"	VSI RED and GREEN areas removed. Range is increasing and separation is adequate.	Promptly and smoothly return to previous assigned clearance.



CONDITIONS	NORMAL PROCEDURES		
2. 7. TCAS II SYSTEM ENHANCED RESOLUTION ADVISORY (RA) ANNUNCIATIONS.	Enhanced resolution advisories (RA) will be annunciated when the initial resolution advisory (RA) does not provide sufficient vertical separation. These annunciation shall denote increased urgency:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"INCREASE CLIMB, INCREASE CLIMB"	Follows a "CLIMB" advisory VSI RED from -6000 FPM to +2500 FPM and GREEN from +2500 FPM to +3500 FPM. Indicates the vertical speed MUST BE INCREASED to ensure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"INCREASE, DESCENT, INCREASE, DESCENT"	Follows a "DESCEND" advisory, VSI RED from +6000 FPM to -2500 FPM and GREEN from -2500 FPM to -3500 FPM. Indicates the vertical speed MUST BE INCREASED to assure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI display.
	"CLIMB, CLIMB NOW CLIMB, CLIMB NOW"	Follows a "DESCEND" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation	Promptly and positively maneuver to establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"	Follows a "CLIMB" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation.	Promptly and positively maneuver to establish a 1500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI display.

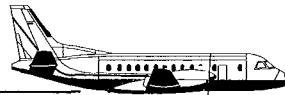


1. LIMITATIONS.

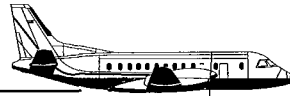
The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

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2. 3. REFERENCE.	Refer to TCAS II Pilots Guide, Collins No. 523-0776233, dated 6-1-90 or later, for normal system operating procedures.



CONDITIONS	NORMAL PROCEDURES								
2.4. TCAS II SYSTEM NORMAL OPERATING CHARACTERISTICS.	<p>If flight crew is advised by ATC to disable transponder altitude reporting, TCAS must be turned off by returning MODE selector on the ATC control to "ON" and the MODE selector on the TCAS control to "STBY".</p> <p>TCAS Resolution Advisories (RA) are inhibited below some radio altitudes. The chart below gives the TCAS inhibits created by the radio altimeter and the associated RA status.</p> <table><tr><th>RADIO ALTITUDE</th><th>RESOLUTION ADVISORY (RA) STATUS:</th></tr><tr><td>Below 1450 FT AGL</td><td>"INCREASE DESCENT" RA inhibited</td></tr><tr><td>Below 1000 FT AGL descending; Below 1200 FT AGL climbing</td><td>"DESCEND" RA inhibited</td></tr><tr><td>Below 900 FT AGL descending; Below 1100 FT AGL climbing</td><td>All RAs inhibited (TA ONLY) and TA Aural Message inhibited</td></tr></table> <p>a. RECOMMENDED FLIGHT CREW PROCEDURES</p> <div><p>NOTE</p><p>Flight director pitch commands may be followed only if they result in a vertical speed which satisfies the RA command.</p></div> <div><p>NOTE</p><p>It is possible in some cases to have insufficient aircraft performance to follow the TCAS RA command without flying into stall warning or buffet.</p></div> <p>Conditions where this may occur include:</p> <ul style="list-style-type: none">○ Bank angle in excess of 15 degrees.○ Operation at airports outside 0–5300 ft MSL or at temperatures outside ISA ± 50° F.○ Speeds below normal operating speeds.○ Buffet margin less than 0.3 G.○ Failure to configure for go-around following a climb RA in landing configuration.	RADIO ALTITUDE	RESOLUTION ADVISORY (RA) STATUS:	Below 1450 FT AGL	"INCREASE DESCENT" RA inhibited	Below 1000 FT AGL descending; Below 1200 FT AGL climbing	"DESCEND" RA inhibited	Below 900 FT AGL descending; Below 1100 FT AGL climbing	All RAs inhibited (TA ONLY) and TA Aural Message inhibited
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Cont'd									



CONDITIONS	NORMAL PROCEDURES
Cont'd	<ul style="list-style-type: none"> ○ Failure to advance thrust to full rating following a reduced power thrust takeoff; ○ Abnormal configurations which reduce performance. (e.g., gear not retractable); ○ TCAS command reversal to a "CLIMB-CLIMB-NOW". <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>TCAS will continue to provide RA commands during stick shaker operation.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>If high speed buffet is encountered when initially responding to RA, relax pitch force as necessary to reduce buffet, but continue the maneuver.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>Select TA only mode following an inflight engine shutdown.</p> </div> <p><u>WHEN A TCAS RA OCCURS:</u></p> <p>If a maneuver is required:</p> <p>AUTOPILOT DISCONNECT</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>POWER AS REQUIRED</p> <p><u>IF TCAS "CLIMB" OR "INCREASE CLIMB" RA OCCURS WHEN CONFIGURED FOR LANDING:</u></p> <p>AUTOPILOT DISCONNECT</p> <p>POWER GO-AROUND THRUST</p> <p>FLAPS RETRACT TO GO-AROUND POSITION</p> <p>PITCH AS REQUIRED TO COMPLY WITH RA</p> <p>GEAR UP WITH POSITIVE RATE OF CLIMB</p> <p>IF STICK SHAKER OCCURS DURING AN RA MANEUVER. IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE STALL RECOVERY PROCEDURE (SEE NOTES).</p>
Cont'd	



CONDITIONS	NORMAL PROCEDURES
Cont'd	<p>IF A GPWS/TAWS WARNING OCCURS DURING AN RA MANEUVER, IMMEDIATELY ABANDON THE RA MANEUVER AND EXECUTE THE APPROPRIATE GPWS/TAWS RECOVERY PROCEDURE. If a GPWS/TAWS warning occurs, TCAS will automatically revert to TA only mode and TCAS aural messages are inhibited. Normal TCAS operation will resume when GPWSTAWS warning ceases.</p> <p>b. The TCAS RA algorithms are based on the pilot initiating the initial maneuver within approximately 5 seconds, and within approximately 2 1/2 sec. if an additional corrective RA, for example, increase or reversal, is issued.</p> <p>c. If ATC requires that transponder altitude reporting be disabled, setting MODE selector to ON on the ATC control panel will automatically cause TCAS to be in standby (TCAS OFF on TA/RA/VSI indicators).</p>



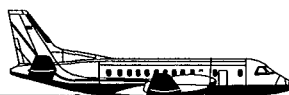
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	Traffic advisories (TA) will be annunciated as appropriate:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"TRAFFIC, TRAFFIC"	Amber filled circle shown on the TA/RA/VSI indicator	Conduct a visual search for the intruder. If successful, maintain visual acquisition to ensure safe separation.
2. 6. TCAS II SYSTEM RESOLUTION ADVISORY (RA) ANNUNCIATIONS.	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"CLIMB, CLIMB, CLIMB"	VSI RED from -6000 FPM to + 1500 FPM and GREEN from +1500 FPM to +2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater CLIMB as indicated by the GREEN arc on the VSI display.
	"DESCEND, DESCEND, DESCEND"	VSI RED from +6000 FPM to -1500 FPM and GREEN from -1500 FPM to -2000 FPM.	Promptly and smoothly establish a 1500 FPM, or greater DESCENT as indicated by the GREEN arc on the VSI display.
	"MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED"	Present vertical speed is outside the RED arc as shown on the VSI display.	Keep vertical speed out of RED unsafe area as indicated on the VSI display.
	"REDUCE CLIMB, REDUCE CLIMB"	VSI indicates prohibited vertical speeds in RED. Goal is vertical speed in GREEN.	Promptly and smoothly reduce vertical speed to that shown in the GREEN arc as indicated on the VSI.

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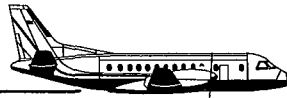
(Cont'd)



CONDITIONS	NORMAL PROCEDURES		
(Cont'd)	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"REDUCE DESCENT, REDUCE DESCENT"	VSI indicates prohibited vertical speed in RED. Goal is vertical speed in GREEN.	Promptly and smoothly reduce vertical speed to that shown in the GREEN arc as indicated on the VSI.
	"CLIMB CROSSING CLIMB, CLIMB CROSSING CLIMB"	Same as "CLIMB" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"DESCEND CROSSING DESCEND, DESCEND CROSSING DESCEND"	Same as "DESCEND" and further indicates that own flight path will cross that of the intruder.	Promptly and smoothly establish a 1500 FPM or greater DESCENT as indicated by the GREEN arc on the VSI.
	"CLEAR OF CONFLICT"	VSI RED and GREEN areas removed. Range is increasing and separation is adequate.	Promptly and smoothly return to previous assigned clearance.



CONDITIONS	NORMAL PROCEDURES		
2. 7. TCAS II SYSTEM ENHANCED RESOLUTION ADVISORY (RA) ANNUNCIATIONS.	Enhanced resolution advisories (RA) will be annunciated when the initial resolution advisory (RA) does not provide sufficient vertical separation. These annunciation shall denote increased urgency:		
	AURAL	VISUAL	EXPECTED CREW RESPONSE
	"INCREASE CLIMB, INCREASE CLIMB"	Follows a "CLIMB" advisory VSI RED from -6000 FPM to +2500 FPM and GREEN from +2500 FPM to +3500 FPM. Indicates the vertical speed MUST BE INCREASED to ensure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"INCREASE, DESCENT, INCREASE, DESCENT"	Follows a "DESCEND" advisory, VSI RED from +6000 FPM to -2500 FPM and GREEN from -2500 FPM to -3500 FPM. Indicates the vertical speed MUST BE INCREASED to assure adequate separation.	Promptly and smoothly increase the vertical speed to 2500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI.
	"CLIMB, CLIMB NOW CLIMB, CLIMB NOW"	Follows a "DESCEND" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation	Promptly and positively maneuver to establish a 1500 FPM or greater CLIMB as indicated by the GREEN arc on the VSI.
	"DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"	Follows a "CLIMB" advisory when it has been determined that a reversal of vertical speed (direction) is needed to provide adequate vertical separation.	Promptly and positively maneuver to establish a 1500 FPM or greater DESCEND as indicated by the GREEN arc on the VSI.



3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. TCAS II SYSTEM.	<ul style="list-style-type: none"> ◆ TCAS II system dead. <ol style="list-style-type: none"> 1. CB L-19 (TCAS) CHECK/RESET 2. End of procedure. ◆ TCAS FAIL is annunciated. <ol style="list-style-type: none"> 1. If "TCAS FAIL" is annunciated on the TA/RA/VSI Indicator or if "TCAS SYSTEM TEST FAIL" audio annunciation occurs, turn TCAS off. Rotate TCAS mode selector to "STBY" position. (TCAS will no longer be operable.) 2. End of procedure ◆ ADC or RALT u/s. <ol style="list-style-type: none"> 1. If ADC or RADIO ALTIMETER no longer available, turn TCAS off. (TCAS will no longer be operable.) 2. End of procedure. ◆ ACT Light flashes. <ol style="list-style-type: none"> 1. If the "ACT" light flashes continuously on the ATC control when position 1/2 switch is in either position, select "STBY" on the TCAS mode selector. (TCAS will no longer be operable.) 2. End of procedure. ◆ RA flag. <ol style="list-style-type: none"> 1. If "RA" flag appears on the TA/RA/VSI indicator, verify TCAS control mode switch is selected to "AUTO". If "AUTO" is selected and "RA" flag is still in view then the Pilot with the operable VSI (with no RA flag) should be briefed to conduct any subsequent maneuvers required by an RA advisory. 2. End of procedure. ◆ V/S flag. <ol style="list-style-type: none"> 1. If "VSI" flag appears on the TA/RA/VSI indicator, then the Pilot with the operable VSI (with no VSI flag) should be briefed to conduct any subsequent maneuvers required by an RA advisory. 2. End of procedure.



CONDITIONS	ABNORMAL PROCEDURES
3. 2. MODE S TRANSPONDER SYSTEM.	ACT light flashes. <ol style="list-style-type: none">1. If the "ACT" light flashes continuously on the ATC control panel when the switch is in position 1, select position 2 or conversely.2. End of procedure



1. GENERAL.

The Terrain Awareness Warning System (TAWS), provides unique visual and aural warnings to prevent the aircraft from approaching the ground inadvertently. The TAWS is based on the standard Ground Proximity Warning System (GPWS) with additional "look ahead" features to improve crew situational awareness and provide advanced warnings and alerts of hazardous proximity to terrain with significantly increased margins compared to the standard GPWS. The TAWS continuously compares the projected aircraft ground track (horizontal and vertical position)

with a safe altitude "floor" based on known terrain features, extracted from an internal terrain database. Accurate aircraft position data are derived from a Global Positioning System (GPS) receiver implemented in TAWS unit or from the optional FMS/GPS system.

The TAWS computer (TAWC) monitors interfacing system inputs to determine if any alert/warning envelope is being penetrated. When aircraft operation deviates into an alert/warning condition, visual warning and aural messages are generated as shown in Table 1.

Mode	Visual Warning/Alert	Aural Warning/Alert
1 – Excessive descent rate	TERRAIN / BELOW G/S lights TERRAIN lights	– SINK RATE – PULL UP
2 – Terrain closure rate	TERRAIN / BELOW G/S lights TERRAIN lights	– TERRAIN TERRAIN – PULL UP
3 – Altitude loss after take off	TERRAIN / BELOW G/S lights	– DON'T SINK
4A– Terrain clearance (gear up)	TERRAIN / BELOW G/S lights	– TOO LOW GEAR – TOO LOW TERRAIN
4B– Terrain clearance (gear down, flaps up)	TERRAIN / BELOW G/S lights	– TOO LOW FLAPS – TOO LOW TERRAIN
4C– Minimum Terrain clearance during takeoff.	TERRAIN / BELOW G/S lights	– TOO LOW TERRAIN
5 – Inadvertent descent below glideslope	TERRAIN / BELOW G/S lights	– GLIDESLOPE or – GLIDESLOPE with increased level
6 – Alerts (altitude callout, basic) (altitude callout, with Mod. No. 3151) (excessive bank angle)		– 500 – 500, 200, 100, 50, 40, 30, 20, 10, and MINIMUM–MINIMUMS at DH – BANK ANGLE–BANK ANGLE
TCF – Pre-mature Descent	TERRAIN / BELOW G/S lights	– TOO LOW TERRAIN
FLTA – Terrain/Obstacle Caution	TERRAIN / BELOW G/S lights	– CAUTION TERRAIN
FLTA – Terrain/Obstacle Warning	TERRAIN lights	– TERRAIN TERRAIN – PULL UP

Table 1. Visual and Aural Warnings/Alerts.

TCF: Terrain Clearance Floor.

FLTA: Forward Looking Terrain Avoidance

**2. MAIN COMPONENTS AND SUBSYSTEMS.****2. 1. Aural Warnings.**

The aural messages are digitally synthesized and stored in read only memories in TAWC. When an alert/warning is generated, the information stored in the appropriate read only memories is retrieved and converted to an audio signal. The audio signal is routed to the audio integrating system where it is amplified and supplied to both pilots' cockpit speakers and headsets.

2. 2. Visual Warnings.

The amber TERRAIN/BELOW G/S and red TERRAIN lamps are illuminated pushbutton activated by the TAWS computer.

If more than one warning mode envelope is penetrated at the same time requiring conflicting aural warnings, the warnings are generated according to the priority order in Table 2.

The highest priority message is always provided. If a higher priority warning occurs, the higher priority warning is immediately generated. When a warning ceases, the message is completed before switching to a warning of lower priority.

2. 3. Terrain Database.

The terrain database divides the earth's surface into grid sets referenced horizontally on the geographic coordinate system of the WGS-84. Higher resolution grids are used around airports.

2. 4. Obstacle Database.

Obstacle database is a separate file from the terrain database, containing man made obstacles with a height exceeding 100 feet. The obstacle data is processed and displayed on the EFIS and MFD in the same fashion as terrain is presented on the display, it causes same visual indications of warning and caution alerts like terrain.

Some areas may not be included in the obstacle database. The operator should check the availability of obstacle database for his area of operation.

2. 5. Geometric Altitude.

Geometric altitude is a computed aircraft altitude designed to ensure optimal operation of the terrain awareness function through all phases of flight and atmospheric conditions. Geometric altitude uses a pressure altitude calculation, GPS altitude, radio altitude, terrain and runway elevation data to reduce or eliminate errors potentially induced in correct barometric altitude by temperature extremes, non standard altitude conditions and altimeter miss-sets. Geometric altitude allows TAWS operations in QFE environments without special procedures by the flight crew.

2. 6. Terrain Awareness Display.

The weather radar adapter converts digital terrain data from the computer into Red-Green-Blue (RGB) format which is transmitted to the LH/RH EHSI on the EFIS and the MFD, via a WXR/TAWS relay.

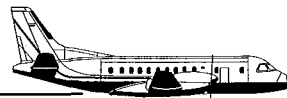
NOTE

If the composite mode is used on the EHSI the terrain data will not be displayed. The visual and aural terrain warnings and cautions will however be active.

Display of terrain is selected by pressing one of the two terrain awareness display pushbuttons on the glareshield. RR mode on the Display Control Panel must also be selected, in order to display terrain. The range of the terrain image is selected with the "range select knob" on the weather radar panel in the center pedestal. In aircraft with WXR-350 weather radar system installed, it is not possible to select the range if the WXR mode is selected to OFF on the WXP.

In aircraft with WXR-850 weather radar system installed, the WXR mode must be selected to at least STBY for proper operation of the TAWS system. If WXR mode is selected to OFF, the TERR AWARE FAULT annunciators will come on.

There is an automatic Pop-Up of the terrain image, once a terrain alert/warning is generated. A condition for this function, is that WXR display is selected on the DCP prior to the terrain alert/warning.



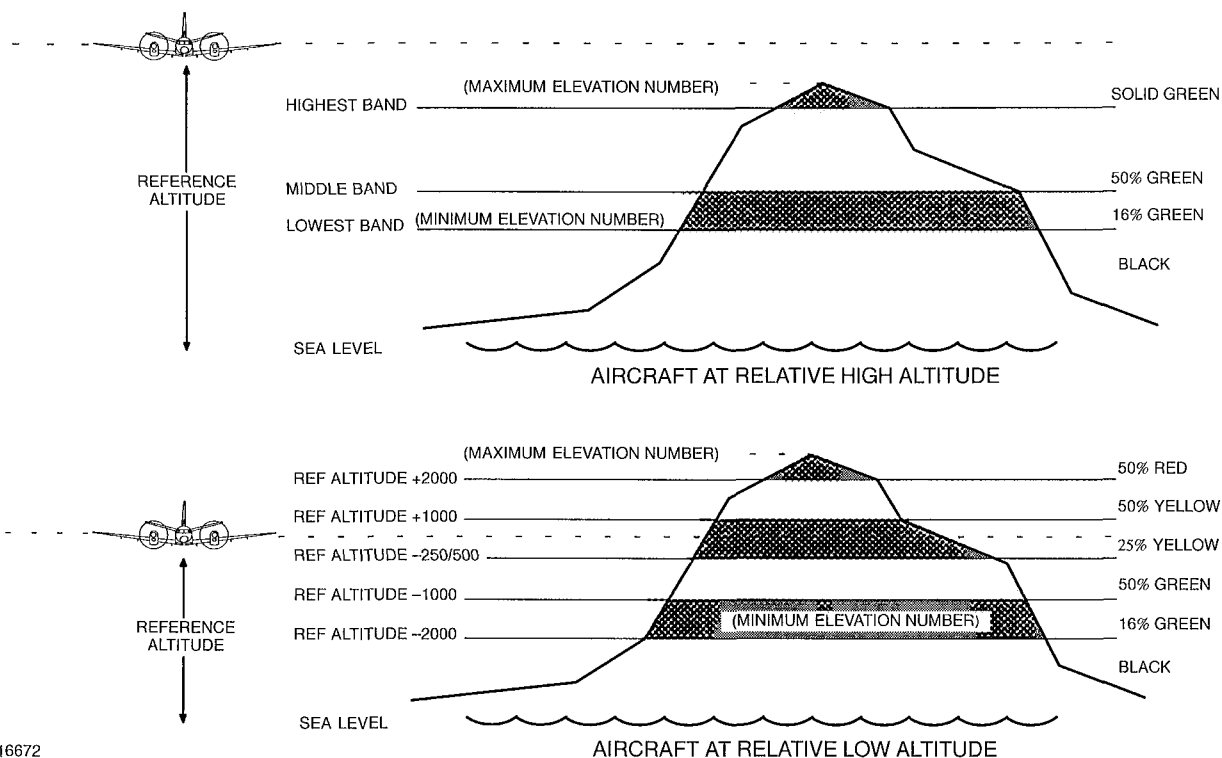
The terrain image is depicted as variable density dot patterns in green, yellow or red (see Table 3). The density and color being a function of how close the terrain or obstacle is relative to aircraft altitude.

Solid yellow or red colors indicate terrain near or above the current altitude of the aircraft. When an alert is active yellow or red colors indicates caution and warning areas relative to the flight path of the aircraft.

At altitudes safely above all terrain for the range chosen, the terrain is displayed independent of aircraft altitude emphasizing the highest and lowest elevations to provide increased situational awareness. A solid

green level indicates the highest, non-threatening terrain. The lower density green display pattern indicate mid and upper terrain in the display area as well as terrain that is within 2000 feet of the aircraft. See . 1.

There are two elevation numbers indicating that the highest and lowest terrain currently being displayed are overlaid on the display. The elevation numbers indicate terrain in hundreds of feet above sea level (MSL). The terrain numbers are displayed with the "highest" terrain number on the top and the "lowest" terrain number beneath it. A single elevation number is displayed when the screen is black as a result of flying over water or relatively flat terrain.



B16672

Fig.1. Display colors – schematic.

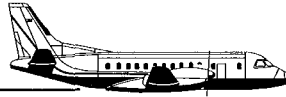


Priority	Message	Mode
1	PULL UP	1
2	TERRAIN TERRAIN	2 preface
3	PULL UP	2
4	TERRAIN TERRAIN	FLTA, Terrain awareness preface
5	PULL UP	FLTA, Terrain awareness warning
6	OBSTACLE OBSTACLE	FLTA, Obst. awareness preface ¹⁾
7	PULL UP	FLTA, Obst. awareness warning ¹⁾
8	CAUTION TERRAIN	FLTA, Terrain awareness caution
9	CAUTION OBSTACLE	FLTA, Obst. awareness caution ¹⁾
10	TOO LOW TERRAIN	4
11	TOO LOW TERRAIN	TCF, Pre-mature decent
12	Altitude Callouts	6
13	TOO LOW GEAR	4
14	TOO LOW FLAPS	4
15	SINK RATE	1
16	DON'T SINK	3
17	GLIDESLOPE	5
18	BANK ANGLE – BANK ANGLE	6

Table 2. Warning message priority.

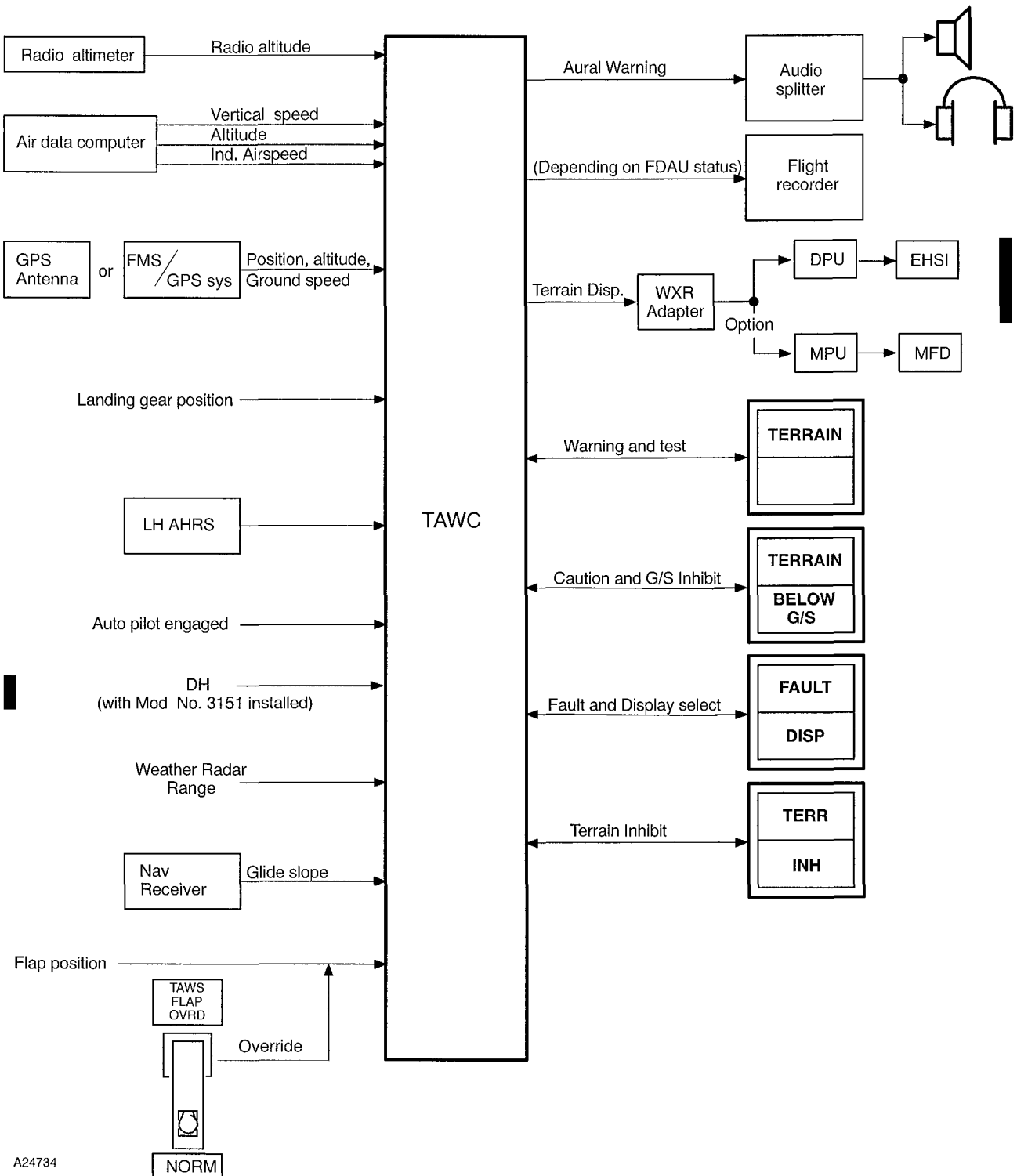
Note:

¹⁾ Alerts/warnings for man made obstacles will not be given if such obstacle data is not included in the database.



Color	Terrain Elevation.
Solid Red	Terrain Threat Area – Warning.
Solid Yellow	Terrain Threat Area – Caution.
50% Red	Terrain that is more than 2000 feet above aircraft altitude.
50% Yellow Dots	Terrain that is between 1000 and 2000 feet above aircraft altitude.
25% Yellow Dots	Terrain that is 500 (250 with gear down) below to 1000 feet above aircraft altitude.
Solid Green	Shown only when no Red or Yellow terrain areas are within range on the display. Highest terrain not within 500 (250 with gear down) feet of aircraft altitude.
50% Green Dots	Terrain that is 500 (250 with gear down) feet below to 1000 below aircraft altitude, or Terrain that is middle elevation band when there are no Red or Yellow terrain areas within range on the display.
16% Green Dots	Terrain that is 1000 to 2000 feet below aircraft altitude, or terrain that is the lower elevation band when there are no Red or Yellow terrain areas within range of the display.
Black	No significant terrain, outside coverage of regional terrain database or unknown.

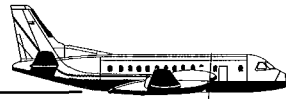
Table 3. Display colors and patterns



A24734

Fig.2. TAWS – schematic.

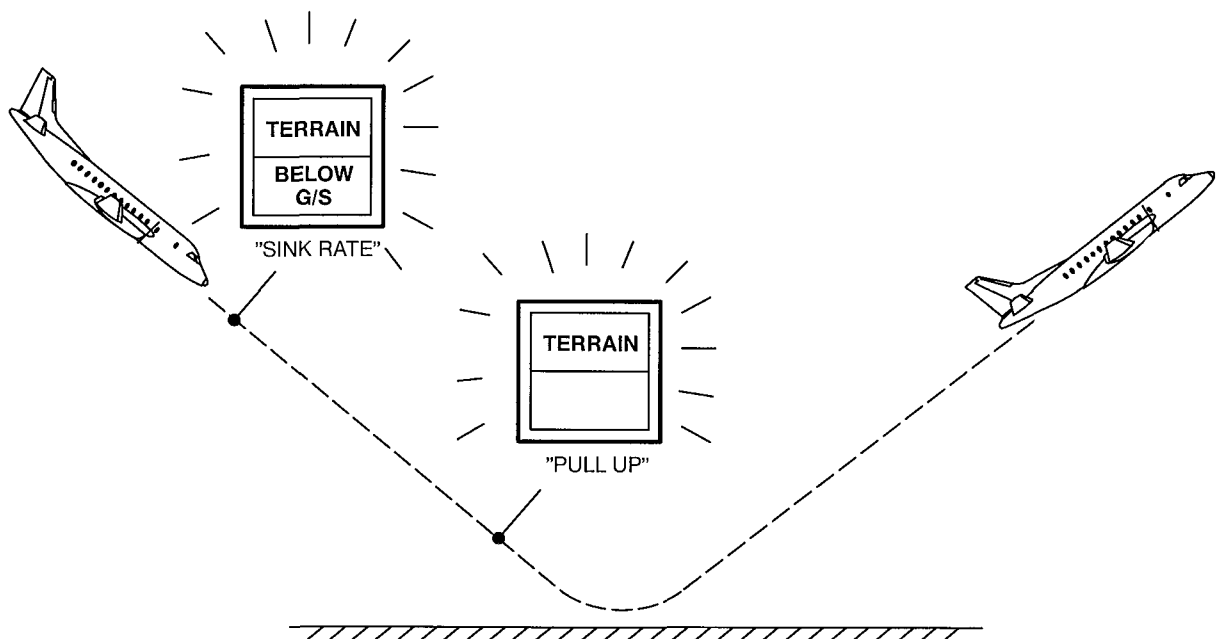
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MODE 1 – EXCESSIVE DESCENT RATE.

The mode 1 warning is generated if the aircraft barometric descent rate is excessive with respect to the height above terrain. The mode has two warning envelopes that provides warning of excessive rate of descent at a given altitude. At penetration of the outer envelope the TERRAIN / BELOW G/S lights come on flashing and the aural warning "SINK RATE" is repeated twice. It will then remain silent until the excessive decent rate condition degrades by approximately

20 %. The lamps however will be flashing continuously. This cycle will be repeated until the aircraft rate of descent is corrected. If the descent rate is not corrected and the inner envelope is penetrated, the aural warning "PULL UP" will be repeated continuously and the TERRAIN lights will start flash until the descent rate is corrected. The mode is independent of aircraft configuration.



A24742

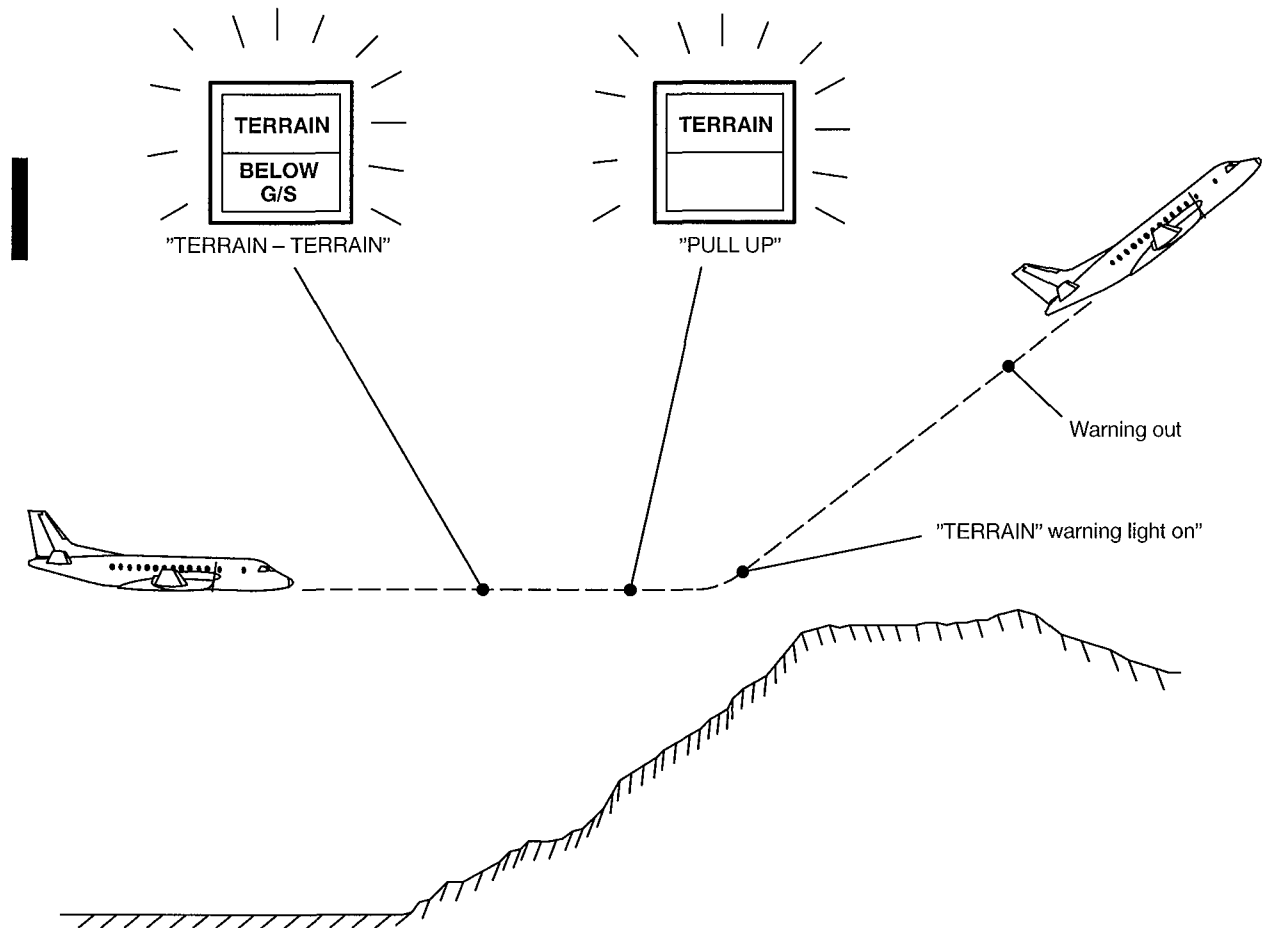
Fig.3. Excessive descent rate–schematic.



MODE 2A – EXCESSIVE TERRAIN CLOSURE RATE FLAPS UP .

Mode 2A warning is generated if the aircraft closure rate (radio altitude) is excessive against terrain with respect to the height (radio altitude). When the warning envelope is penetrated the TERRAIN BELOW G/S lights flashes and the aural warning "TERRAIN TERRAIN" sounds. If the closure rate remains within the warning envelope for about one second the aural warning " PULL UP" sounds and the terrain lights flashes. This is repeated continuously until the closure rate is corrected. If the aircraft remains within the

warning envelope for more than 3 seconds, an altitude gain function is started. Even though the closure rate has been corrected the terrain lights will remain illuminated until the aircraft has gained 300 feet barometric altitude or 45 seconds have been elapsed, from when the aircraft exited the PULL UP envelope.



A28219

Fig.4. Excessive terrain closure rate – schematic.



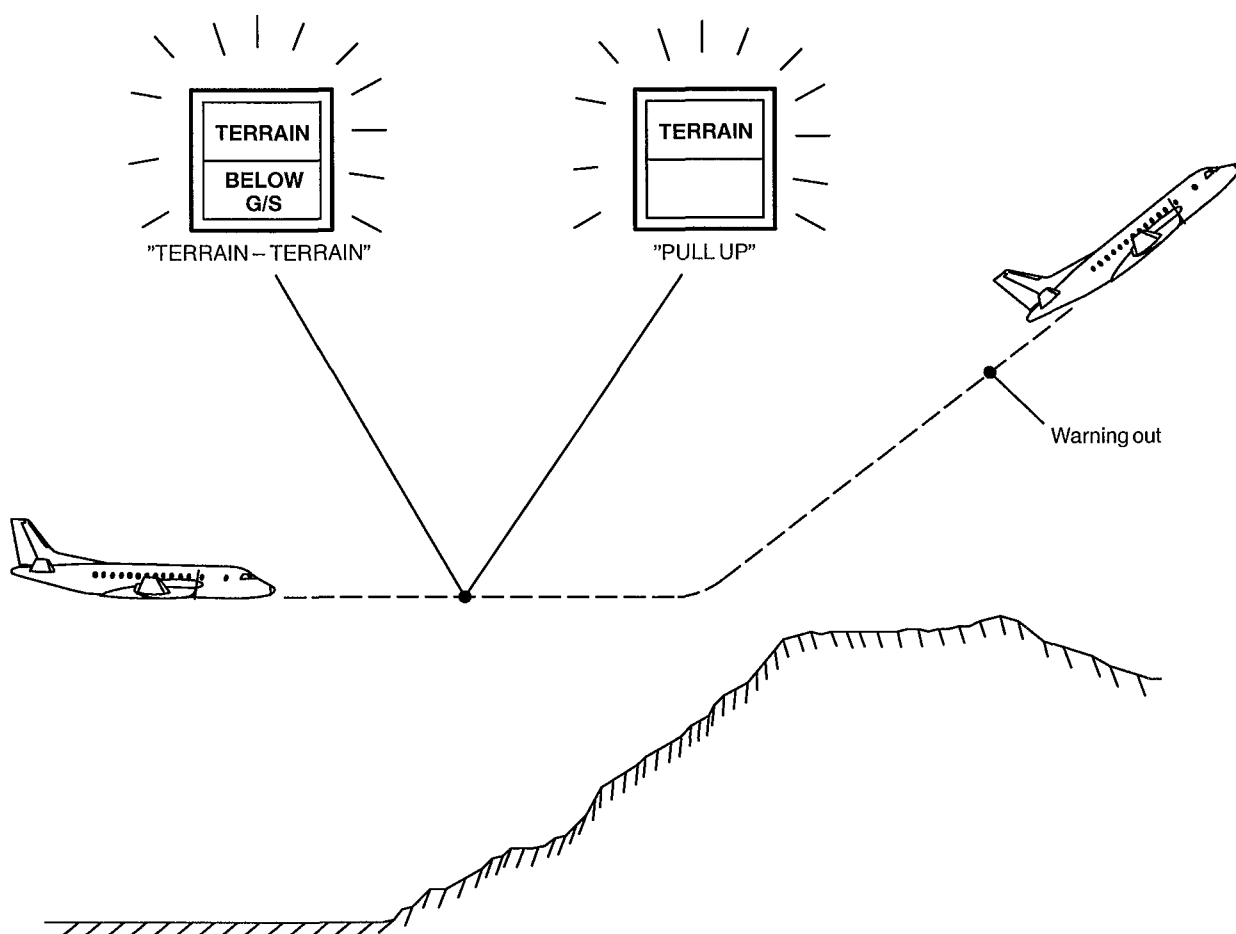
MODE 2B – EXCESSIVE TERRAIN CLOSURE RATE FLAPS IN LANDING CONFIGURATION .

When the flaps are in the landing configuration, the aircraft is on ILS approach within ± 2 dots of the Glideslope centerline or for the first 60 seconds after take-off of the TAWS switches to mode 2B and the warning envelope is modified.

When the envelope boundary conditions for mode 2B is violated, the TERRAIN /BELOW G/S and TERRAIN lights come on. The voice message is repeated until boundary is exited. If the gears or flaps are up,

the aural message will be "TERRAIN TERRAIN", followed by "PULL UP" if the condition persists. If both gear and flaps are in landing configuration the aural message will be "TERRAIN TERRAIN", and only the TERRAIN / BELOW G/S lights will come on.

To avoid nuisance mode 2A alerts due to erroneous radio altitude tracking during take-off climb, mode 2B is automatically selected during the first 60 seconds after take-off.



A24752

Fig.5. Excessive terrain closure rate – schematic.



MODE 3 – LOSS OF ALTITUDE AFTER TAKEOFF.

This mode warns for unintentional loss of barometric altitude after take off and is enabled between 50 and 925 feet. The loss of altitude required to trigger this mode varies with height above terrain. This altitude loss is displaced with an additional 5 feet per second above 700 feet barometric altitude. When the warning

envelope is penetrated, the TERRAIN BELOW G/S lights flashes and an aural warning "DON'T SINK" is given.

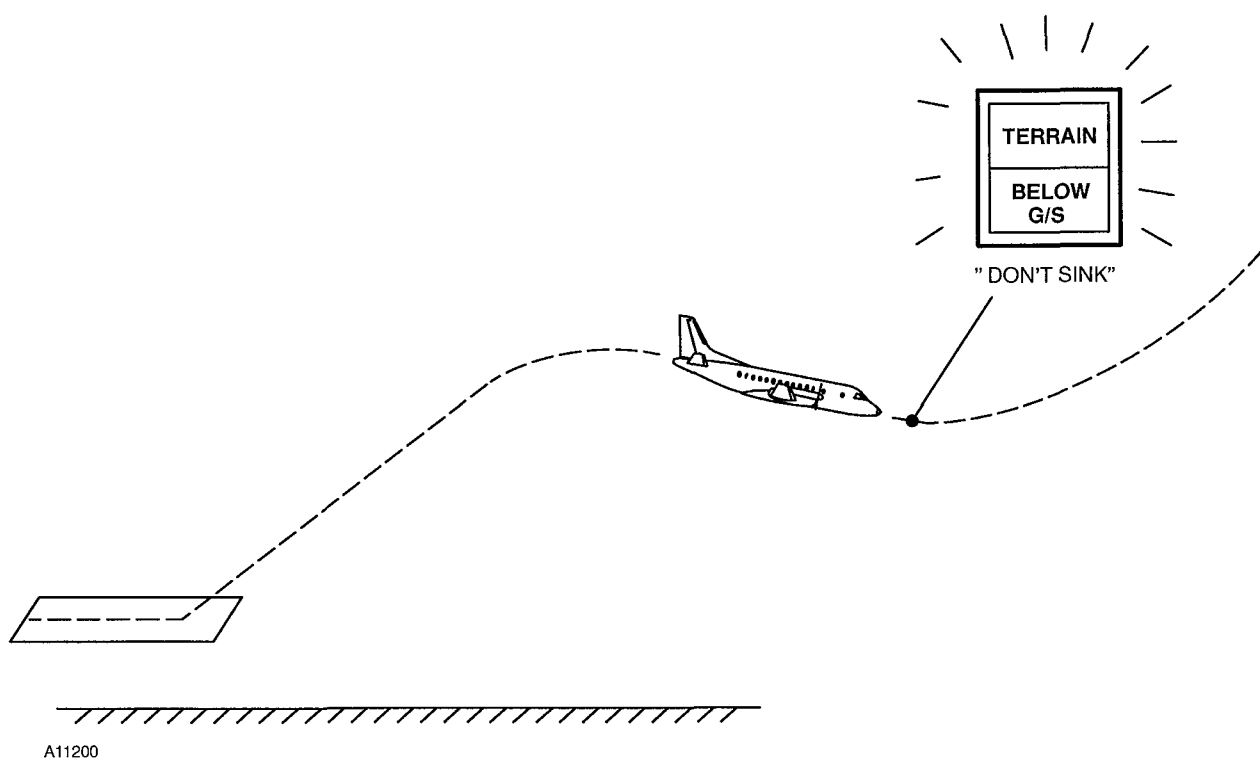


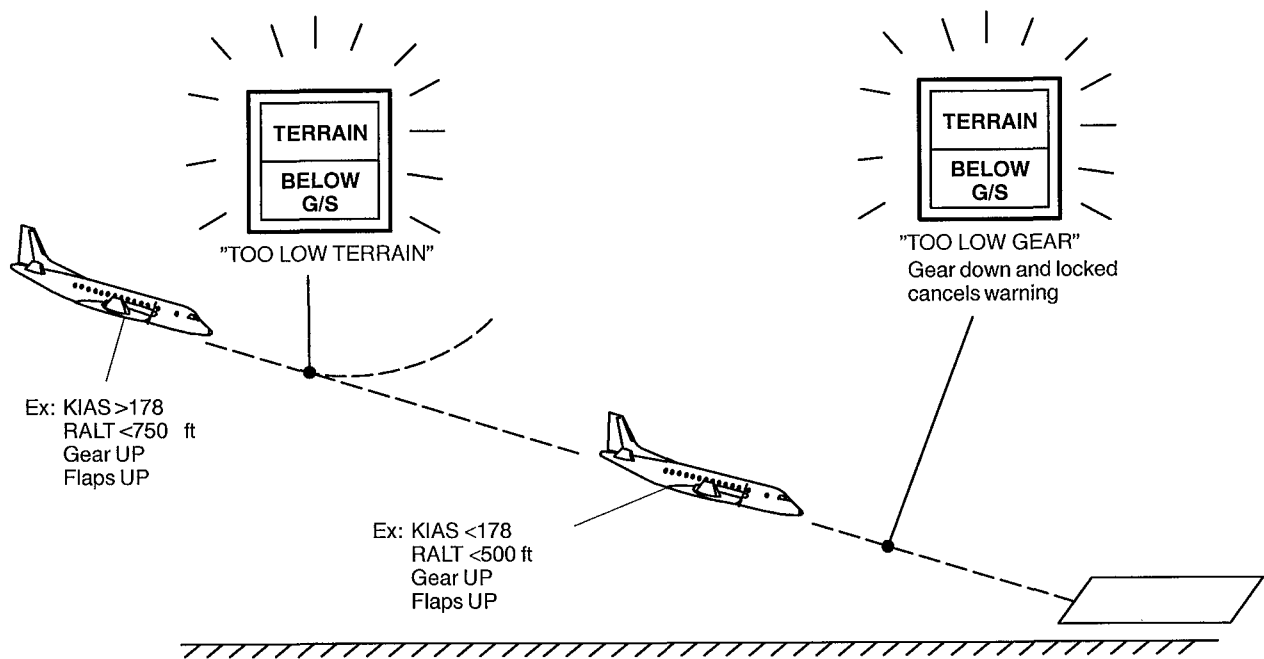
Fig.6. Loss of altitude after takeoff – schematic.



MODE 4A – UNSAFE TERRAIN CLEARANCE WITH GEAR UP.

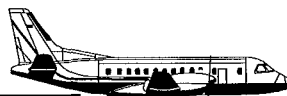
The warning for unsafe terrain clearance is generated if the aircraft descends below a pre-determined altitude with the landing gear not down and locked. With a speed below 178 knots and below 500 feet the TERRAIN / BELOW G/S lights flashes and the aural warning "TOO LOW GEAR" sounds. Further warnings are held until additional 20% radio altitude are lost. If the

speed is above 178 knots the aural warning "TOO LOW TERRAIN" sounds. In this condition the warning threshold increases linearly with airspeed to a maximum of 750 feet above terrain at 200 knots. The warning is cancelled when the warning conditions are corrected by extending the landing gear.



A24749

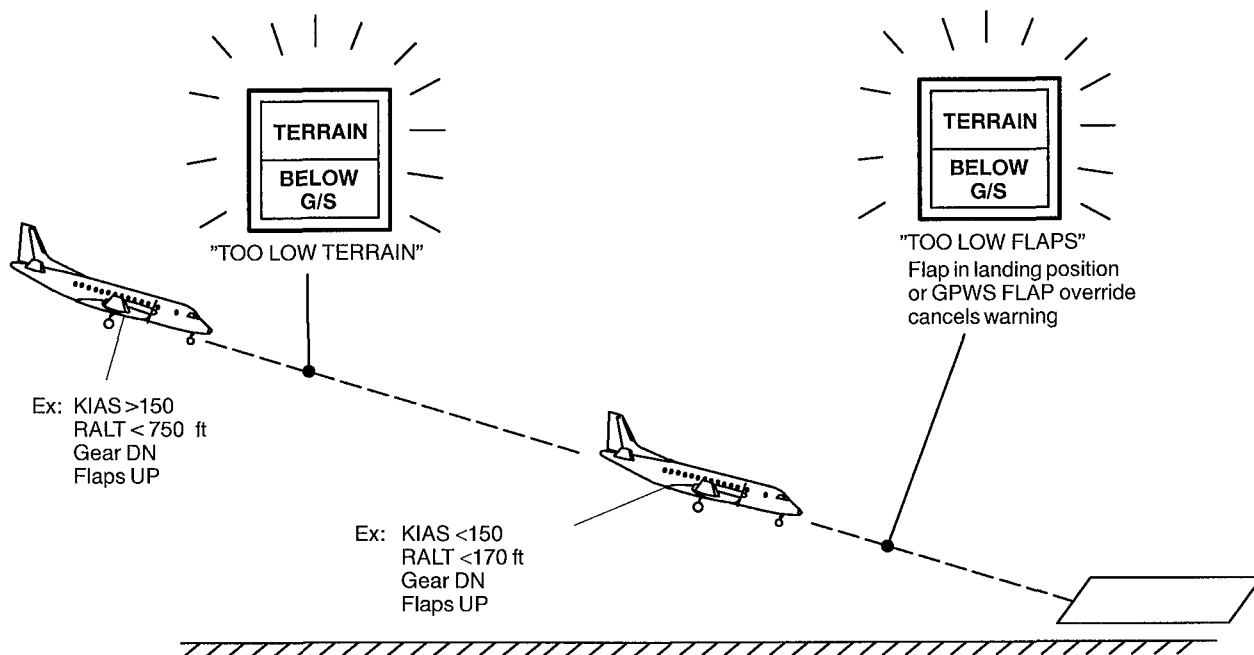
Fig.7. Unsafe terrain clearance with gear up – schematic.



MODE 4B – INADVERTENT PROXIMITY TO TERRAIN WITH GEAR DOWN AND FLAPS UP.

This mode warns either for proximity to terrain outside the approach area or flaps not being in landing position during approach. The mode becomes enabled when the gear is locked down and the flaps are up. With a speed below 150 knots and when aircraft descends below 170 feet, the TERRAIN / BELOW G/S LIGHTS flashes and an aural warning "TOO LOW FLAPS" sounds. Further warnings are held until addi-

tional 20% radio altitude is lost. At speeds above 150 knots the aural warning is changed to "TOO LOW TERRAIN" and the warning threshold increases linearly with airspeed to a maximum at 750 feet above terrain at 200 knots. If landing with flaps not in landing position has been decided, selecting TAWS FLAP switch to OVRD will exit the warning envelope.



A24748

Fig.8. Inadvertent proximity to terrain with gear down and flaps up – schematic.

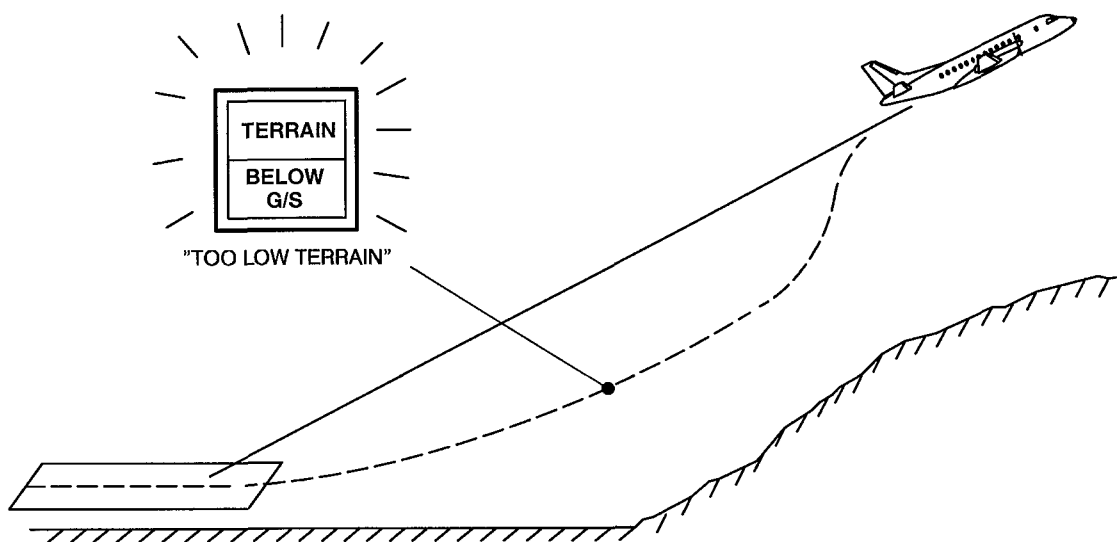
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**MODE 4C TERRAIN CLEARANCE DURING TAKEOFF**

Mode 4C warns for inadvertent descend or too shallow climb towards rising terrain in the takeoff area.

Mode 4C provides a warning based on minimum radio altitude clearance during takeoff. Mode 4C is based on a minimum terrain clearance that increases with radio altitude during takeoff. A value equal to 75% of the current radio altitude is accumulated in a long term filter that is only allowed to increase in value. If the ra-

dio altitude should later decrease, the filter will store its maximum attained value. Further decrease of radio altitude below the stored filter value with Gear or Flaps up will cause the TERRAIN / BELOW G/S lights to come on flashing and the aural warning "TOO LOW TERRAIN" sounds. Further aural warning are held until additional 20% radio altitude is lost. This continues until corrective action is taken.



A24747

Fig.9. Terrain clearance during takeoff – schematic.

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MODE 5 – DESCENT BELOW GLIDESLOPE.

This mode warns for unintentional deviation below the ILS glideslope. The mode becomes enabled when an ILS frequency is selected, the gear is down and between 30 and 1000 feet RALT

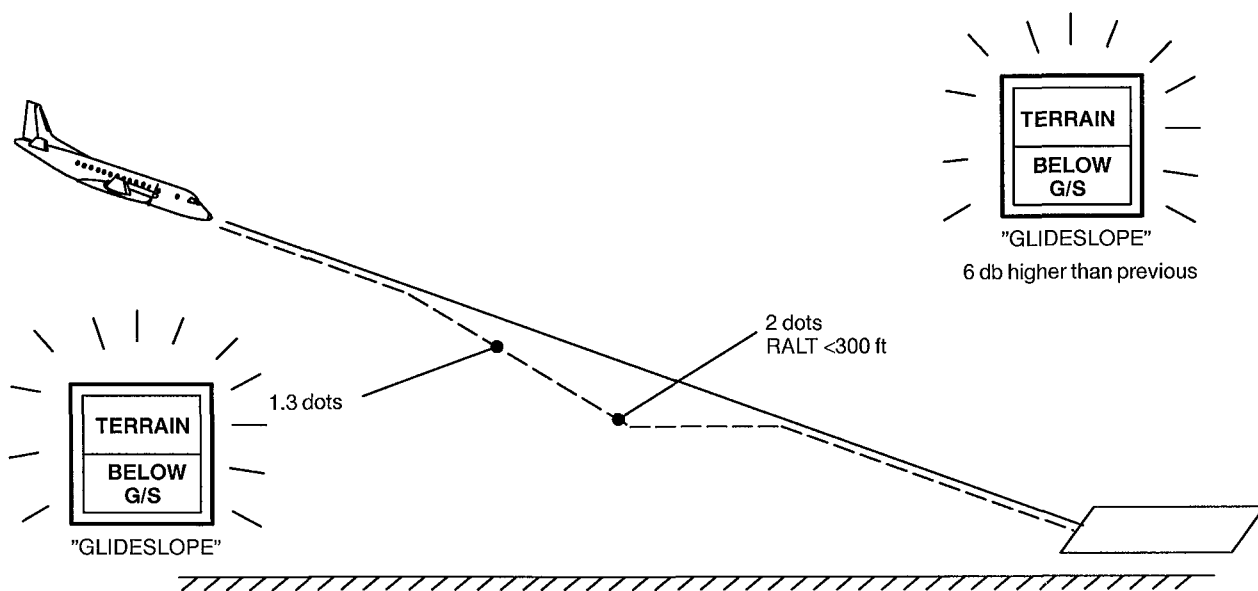
The warning envelope consists of two envelopes. On penetration of the outer envelope, below 1.3 dots, the TERRAIN / BELOW G/S caution light illuminate and the aural warning "GLIDESLOPE" is given once with a soft volume. If aircraft descends lower on the glideslope beam by approximately 20% (dots of deviation), an additional message is given. The amount of glideslope deviation necessary to initiate an alert is increased below 150 feet to eliminate nuisance alerts caused by large deviation signals when the aircraft is close to the ILS transmitter. If no corrective action is taken and the inner envelope is penetrated (the deviation has exceeded 2 dots and the aircraft is below

300 feet RALT), the volume of the aural "GLIDESLOPE" warning will increase with 6dB and the message is continuously repeated.

To allow descend below glideslope, Mode 5 can be inhibited when radio altitude is below 2000 feet by pressing the pilot's or co-pilot's TERRAIN / BELOW G/S switch. Climb to a height above 2000 feet reactivates mode 5 again, even if it has been inhibited.

Mode 5 is inhibited in following cases:

- Noisy or irregular glideslope beam.
- ILS frequency not selected.
- Landing gear not extended and locked.
- Glideslope validity signal not present.
- Aircraft not between 30 and 1000 feet.
- Inappropriate descent rate compared to altitude between 500–1000 feet when ILS is captured.
- The TERRAIN / BELOW G/S switch pressed between 30 and 2000 feet.



A24746

Fig.10. Descent below glideslope – schematic.

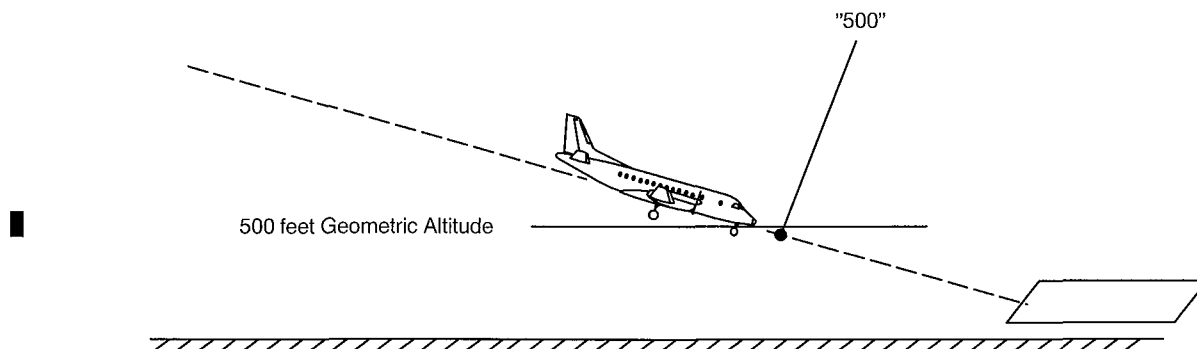


MODE 6 – ALERTS (ALTITUDE CALLOUT)

For the basic altitude callout an aural callout is given when the aircraft descends below 500 feet geometric altitude above the field. The “Above Field” implies that the “Above Field 500 Callout” algorithm uses GPS altitude and Terrain Database Runway altitude to determine when the aircraft is 500 feet higher than (above) the runway on approach. There are no visual alerts accompanied with this altitude callout.

For the additional altitude callouts with Mod. No. 3151 installed, an aural callout is given when the aircraft descends below 500, 200, 100, 50, 40, 30, 20 and 10 feet radio altitude. At decision height the aural alert “MINIMUMS–MINIMUMS” is given. There are no visual alerts accompanied with this altitude callout.

Basic altitude callouts



Additional altitude callouts (with Mod. No. 3151)

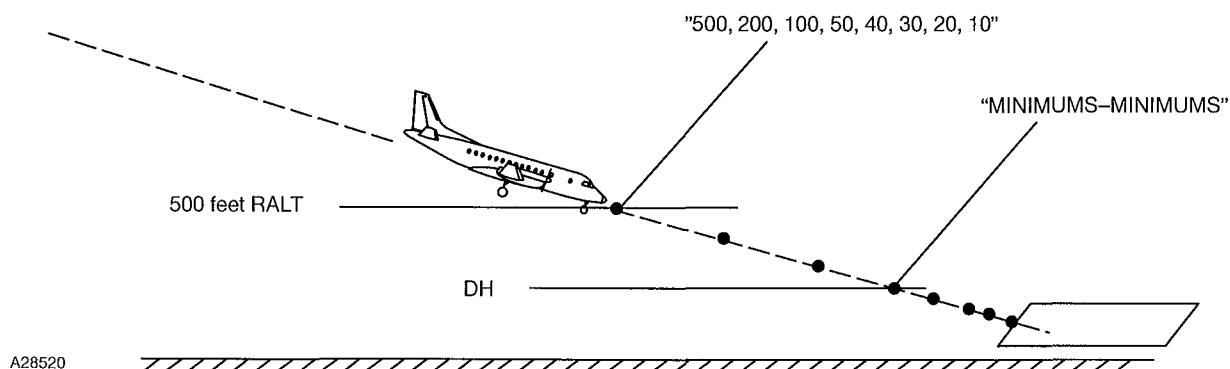
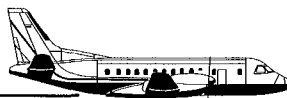


Fig.11. Altitude callout – schematic



MODE 6 – ALERTS (BANK ANGLE ALERT)

The alert logic for excessive bank angles is divided in two separate envelopes, with or without the autopilot engaged. Without the autopilot engaged, the roll angle limit varies linearly from 15 degrees at 10 feet to 50 degrees at 210 feet. From 210 feet the roll limit remains 50 degrees. With the autopilot engaged, the roll angle limit varies linearly from 15 degrees at 10 feet to 33 degrees at 156 feet. From 156 feet, the roll angle limit remains at 33 degrees.

When the aircraft roll limit exceeds the envelope limit, two voice messages "BANK ANGLE" is given. If the roll angle increases by an additional 20% the message will be repeated twice. Should the roll angle exceed 44% of the initial threshold, the messages will be repeated every three seconds. There are no visual alerts accompanied with the bank angle alerts.

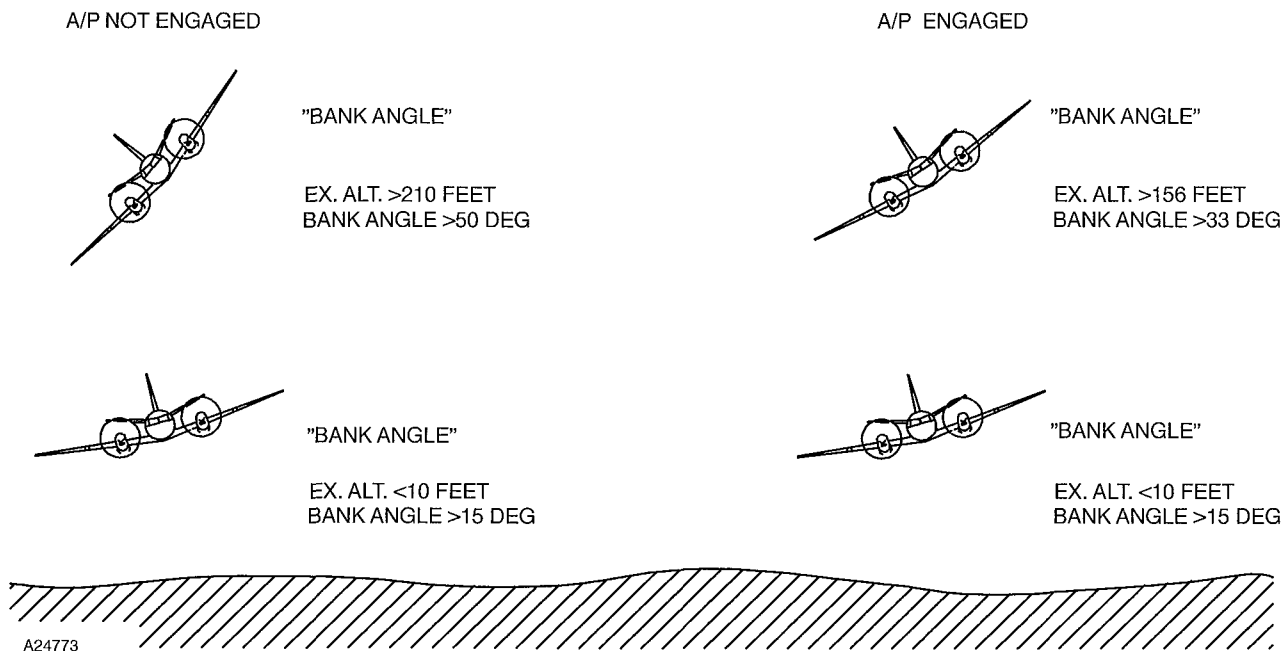


Fig.12. Alerts (Bank Angle Alert).



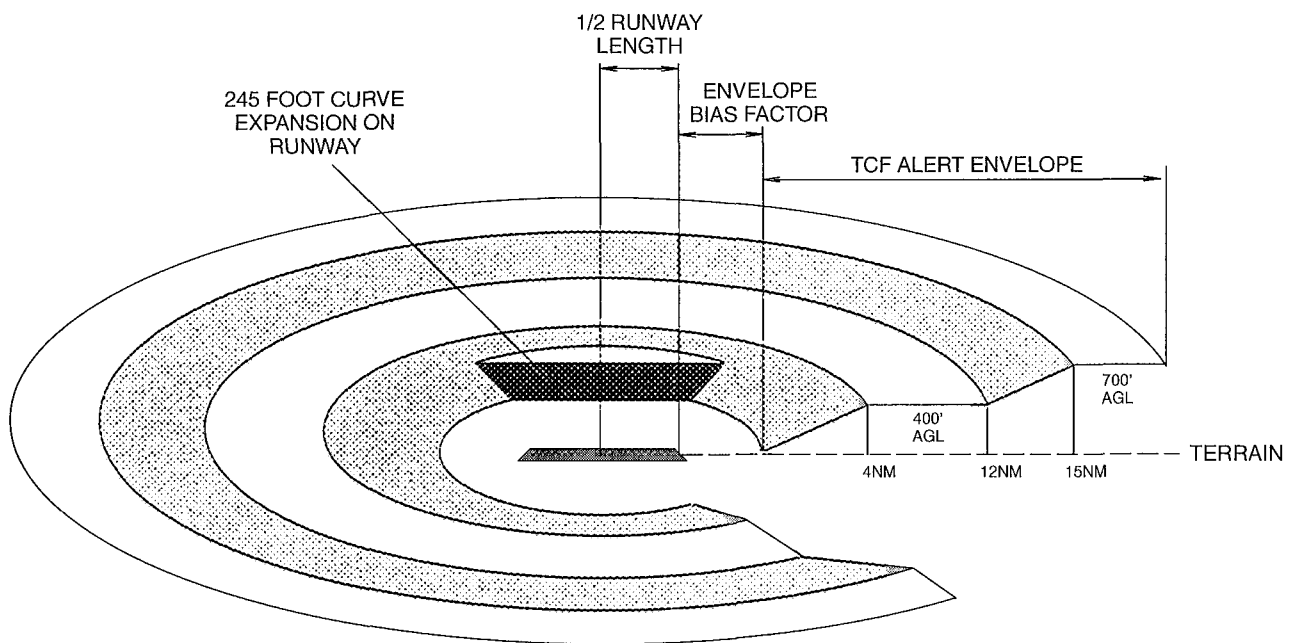
PREMATURE DESCENDS WARNING

The Premature descends warning provides warning for insufficient terrain clearance even with the aircraft in landing configuration. The alert envelope is based on a Terrain Clearance Floor (TCF) which is a circular band centered over the runway. Close to the runway the envelope is 0 and expands up to 700 feet at around 15 nautical miles plus position error from the selected runway. Close to the runway there is an improved alert envelope, with increased protection if the aircraft has a large deviation from runway centerline. When it is determined that the aircraft is to the side of the runway, the TCF curve is limited to a minimum value of 245 feet. The TCF alert envelope also provides protection for cases when runway is at high elevation, compared with the terrain below the approach path. In

this case the radio altitude show larger margin than the aircraft actually has compared with runway elevation.

When the aircraft penetrates the alert envelope, the aural message "TOO LOW TERRAIN" is given and the TERRAIN / BELOW G/S lights flashes. For each 20% degradation in radio altitude from the initial penetration, an additional aural message will be given. The TERRAIN lights will be activated until alert envelope is exited.

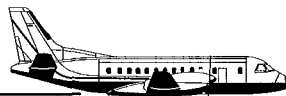
The database includes all runways in each terrain database region (Americas, Atlantic and Pacific) greater than or equal to 2000 feet in length.



A28498

Fig.13. Premature Descent – Schematic.

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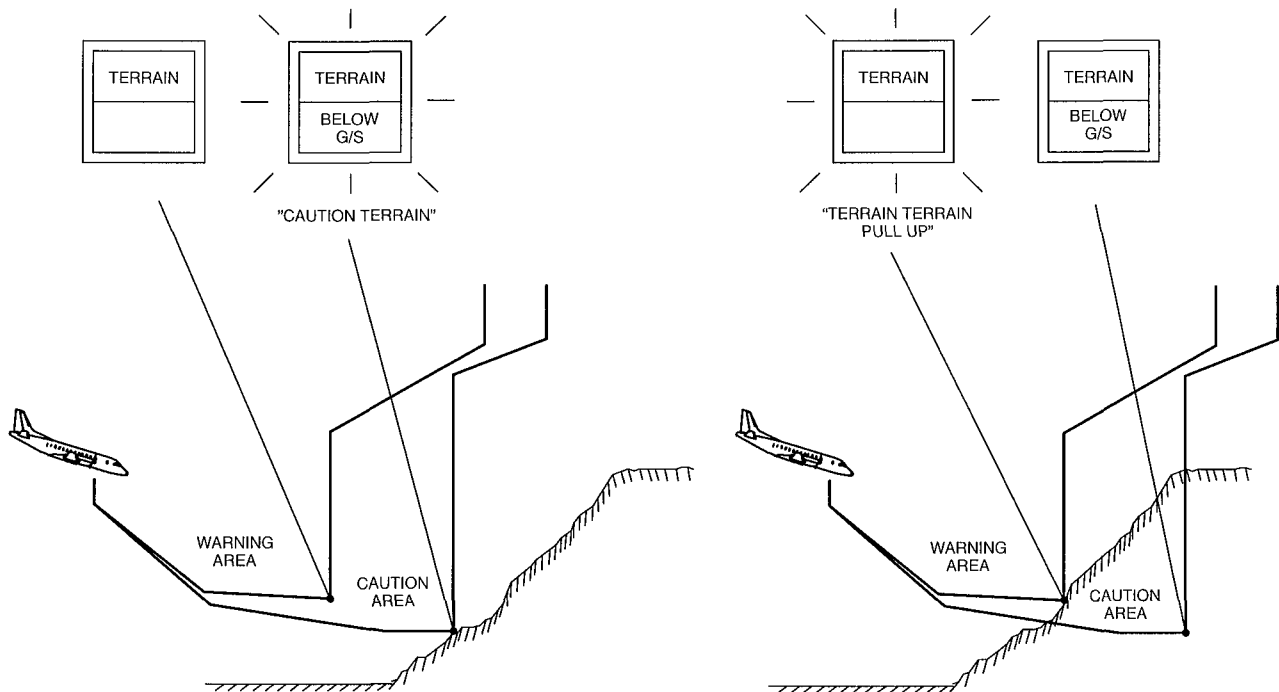


FORWARD LOOK-AHEAD WARNING

The forward look-ahead algorithm is used to predict any potential conflict between the aircraft's intended ground track and terrain. Terrain threats are recognized and annunciated when terrain violates specific computed envelope boundaries forward the aircraft path. When the TAWS detects a terrain threat in conflict with the flight path, an aural message "CAUTION TERRAIN" is given twice minimum 40 seconds before predicted impact. This message is repeated after 7 seconds, if the terrain is still in conflict with the flight path. This message is accompanied by flashing TERRAIN / BELOW G/S lights and terrain threat image on

the EFIS in solid amber areas. When corrective action is taken and no threat is present, the TERRAIN / BELOW G/S lights extinguish and the presentation of the amber solid areas on the terrain image goes away.

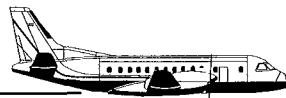
Minimum 15 seconds before predicted impact and if corrective action is not taken, an aural "TERRAIN TERRAIN PULL UP" message is generated. The TERRAIN lights start flashing and a display of the terrain threat on the EFIS in red solid areas. The "PULL UP" message is repeated until corrective action is taken.



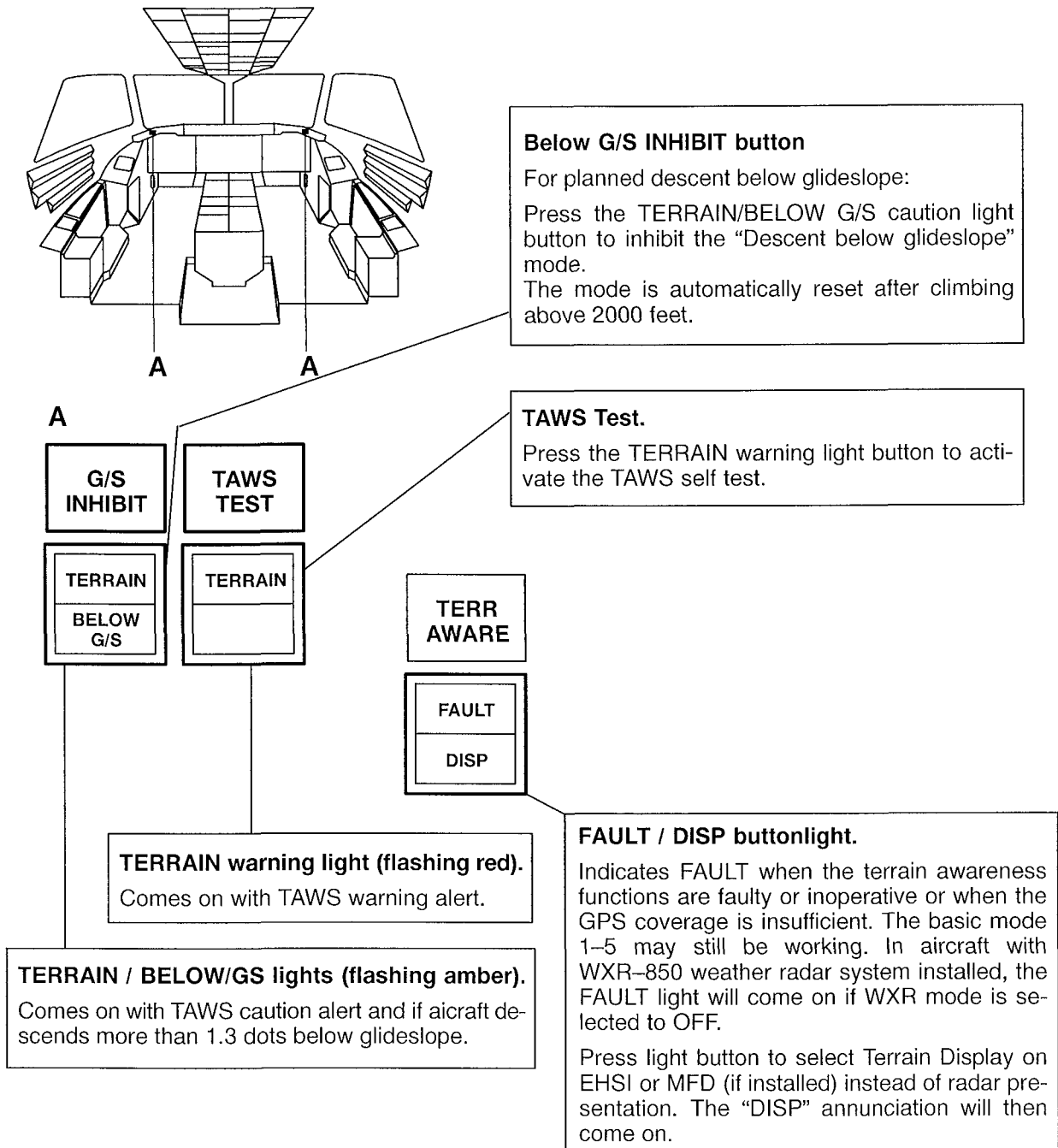
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Fig.14. Forward Look-Ahead Warning – Schematic.

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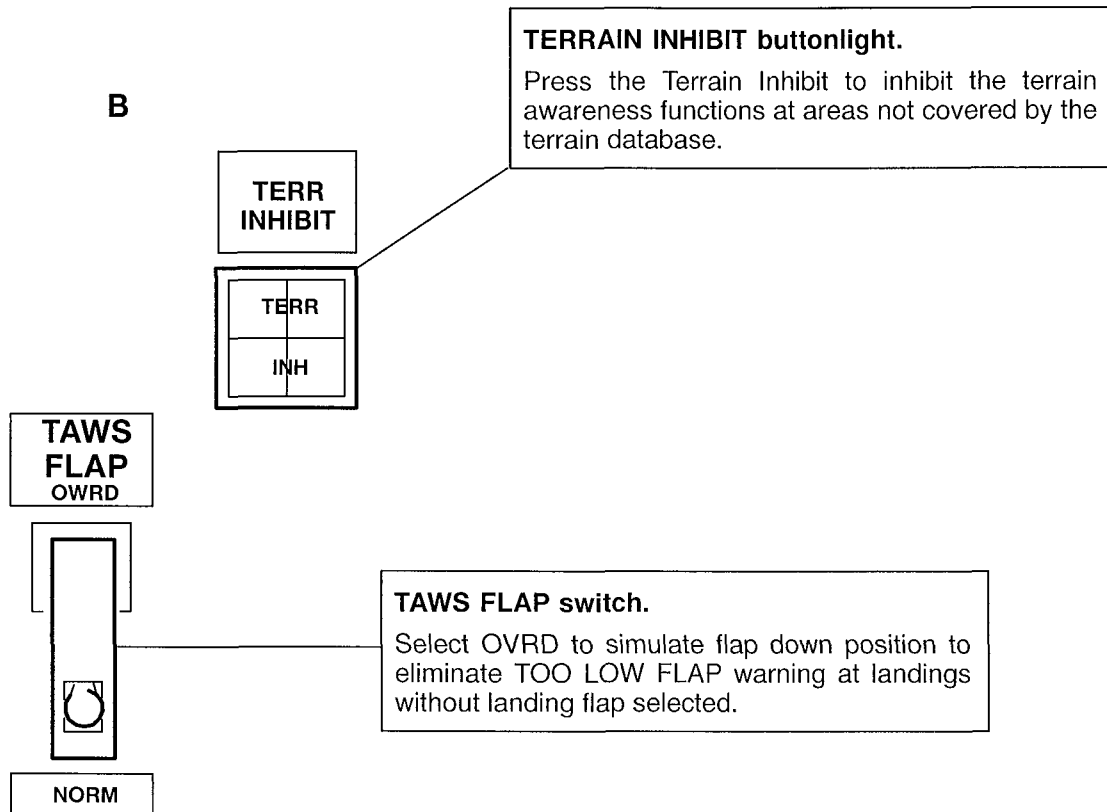
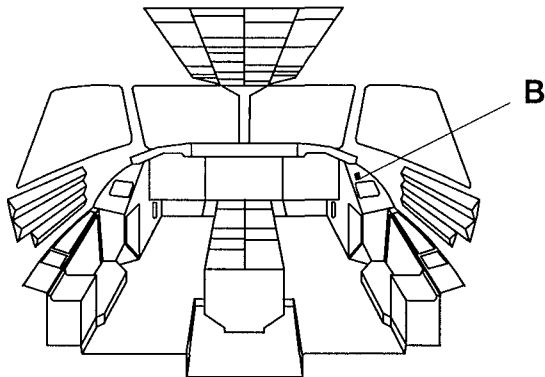


3. CONTROLS AND INDICATORS.



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Fig.15. TAWS indications and buttonlights.



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Fig.16. TAWS FLAP switch and buttonlights.



4. ELECTRICAL POWER SUPPLY.

TAWS power	L AVIONIC BUS	F-17	TAWS PWR
TAWS Indicators	L ESS BUS	F-16	TAWS IND
Weather Radar/TAWS relay	R AVIONIC BUS	M-15	TERR DISP
■ (For aircraft with WXR-350 only.)			
TAWS Audio	R BAT BUS	L-11	AUDIO TAWS



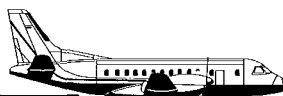
1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATIONS.

CONDITIONS	NORMAL PROCEDURES									
2.1. TAWS TEST.	<div><div><div>1. WXR on EHSI or/and MFD SELECT</div><div>2. WXR mode STBY on WXP SELECT</div><div>3. TAWS test button PRESS</div></div><div>When aircraft on ground press either TAWS test button shortly and check:</div><div><div><div>– The FAULT field in both TERR AWARE indicators illuminate.</div><div>– Both amber TERRAIN / BELOW G/S lights illuminates.</div><div>– Aural warning: "GLIDESLOPE" sounds.</div><div>– Both amber TERRAIN / BELOW G/S lights turns off.</div><div>– Both TERRAIN lights illuminate.</div><div>– Aural warning "PULL UP" sounds.</div><div>– Terrain image is turned on (see Fig. below) and the white DISP annunciators illuminates.</div><div>– Aural warning "TERRAIN TERRAIN PULL UP" sounds.</div><div>– Both red TERRAIN lights is turned off.</div><div>– The test terrain image (after several sweeps) and DISP lights is turned off .</div><div>– The FAULT field in both TERR AWARE indicators turns off.</div></div></div><div><table><tr><td>MAGENTA</td><td>50%RED</td><td>BLACK</td></tr><tr><td>SOLID RED</td><td>50% YELLOW</td><td>SOLID YELLOW</td></tr><tr><td>25% GREEN</td><td>25% YELLOW</td><td>12% GREEN</td></tr></table></div></div>	MAGENTA	50%RED	BLACK	SOLID RED	50% YELLOW	SOLID YELLOW	25% GREEN	25% YELLOW	12% GREEN
MAGENTA	50%RED	BLACK								
SOLID RED	50% YELLOW	SOLID YELLOW								
25% GREEN	25% YELLOW	12% GREEN								

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CONDITIONS	NORMAL PROCEDURES
2. 2 . TERRAIN DISPLAY SELECTION (MFD)	<ol style="list-style-type: none"> 1. WXR on MFD Select 2. DISP button Press <p>NOTE: Range selector not available when radar is off.</p>
2. 3. TERRAIN DISPLAY SELECTION (EHSI)	<ol style="list-style-type: none"> 1. Display Control Panel select RR 2. DISP button Press <p>NOTE: Range selector not available when radar is off.</p>
2. 4. TAWS WARNING IN FLIGHT.	<p>Ground proximity warning or caution comes on.</p> <p>INDICATIONS.</p> <p>Aural warning and TERRAIN or TERRAIN / BELOW G/S lamps.</p> <p>ACTIONS.</p> <p>Perform actions in accordance with AOM 25, FLIGHT PROCEDURES.</p>
2. 5. TAWS FLAP OVERRIDE.	<p>For intentional landing without landing flap set, override the Mode 4B warnings with the TAWS FLAP switch.</p> <ol style="list-style-type: none"> 1. TAWS FLAP switch OVRD <p>– The switch in OVRD simulates landing flap for the TAWS.</p>
2. 6. TERRAIN INHIBIT.	<p>For operating at regions not covered in the database.</p> <ol style="list-style-type: none"> 1. TERR INHIBIT switch TERR INH <p>– Terrain Awareness alerts inhibited.</p>



CONDITIONS	NORMAL PROCEDURES
2. 7. LOSS OF GPS POSITION.	<p>On ground only.</p> <p>GPS coverage on ground may be obscured by buildings etc. Often a change of position will improve the coverage.</p> <p>INDICATIONS</p> <p>The TERR AWARE FAULT lamps are illuminated.</p> <p>ACTIONS</p> <ol style="list-style-type: none">1. Perform a TAWS self test.2. Verify that only the normal test messages are generated. If an internal GPS is used, verify that only the normal test messages and "Internal GPS not navigating" message is generated.3. Continue normal procedures and check before takeoff that the TERR AWARE FAULT lamps are not illuminated.



3. ABNORMAL OPERATIONS.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. TAWS FAILURES.	<ol style="list-style-type: none"> 1. TAWS computer power supply fault. <ul style="list-style-type: none"> – All modes are inhibited. 2. Loss of Radio Altitude. <ul style="list-style-type: none"> – Mode 1–5, Mode 6 Bank–Angle and Terrain clearance floor are inhibited. – With Mod. No. 3151 installed, Mode 6 altitude callouts will also be inhibited. 3. Loss of position data. <ul style="list-style-type: none"> – Terrain awareness functions and Terrain clearance floor are inhibited. – Without Mod. No. 3151 installed, Mode 6 altitude callouts will also be inhibited. 4. Loss of ADC signal. <ul style="list-style-type: none"> – Mode 1,3 and 4 inhibited. – Speed expansion in mode 2A inhibited. – Vertical speed modulation in mode 5 inhibited. – Terrain awareness functions inhibited. 5. Loss of AHRS signal. <ul style="list-style-type: none"> – Mode 6 Bank Angle and Terrain awareness functions inhibited. 6. Loss of ARINC 429 range data bus from the weather radar adapter to the TAWC. <ul style="list-style-type: none"> – Terrain awareness functions and terrain display inoperative. 7. Power supply fault to WXR/TAWS switching relay and weather radar adapter. <ul style="list-style-type: none"> – Terrain awareness functions and terrain display inoperative.



CONDITIONS	ABNORMAL PROCEDURES
3. 2. TAWS FAILURE TO TEST.	<p>INDICATIONS.</p> <p>No response with TAWS test button pressed for test. ■</p> <p>ACTIONS.</p> <p>No activation of aural warnings.</p> <ol style="list-style-type: none"> 1. CB F-17 (TAWS PWR) CHECK/RESET 2. End of procedure.