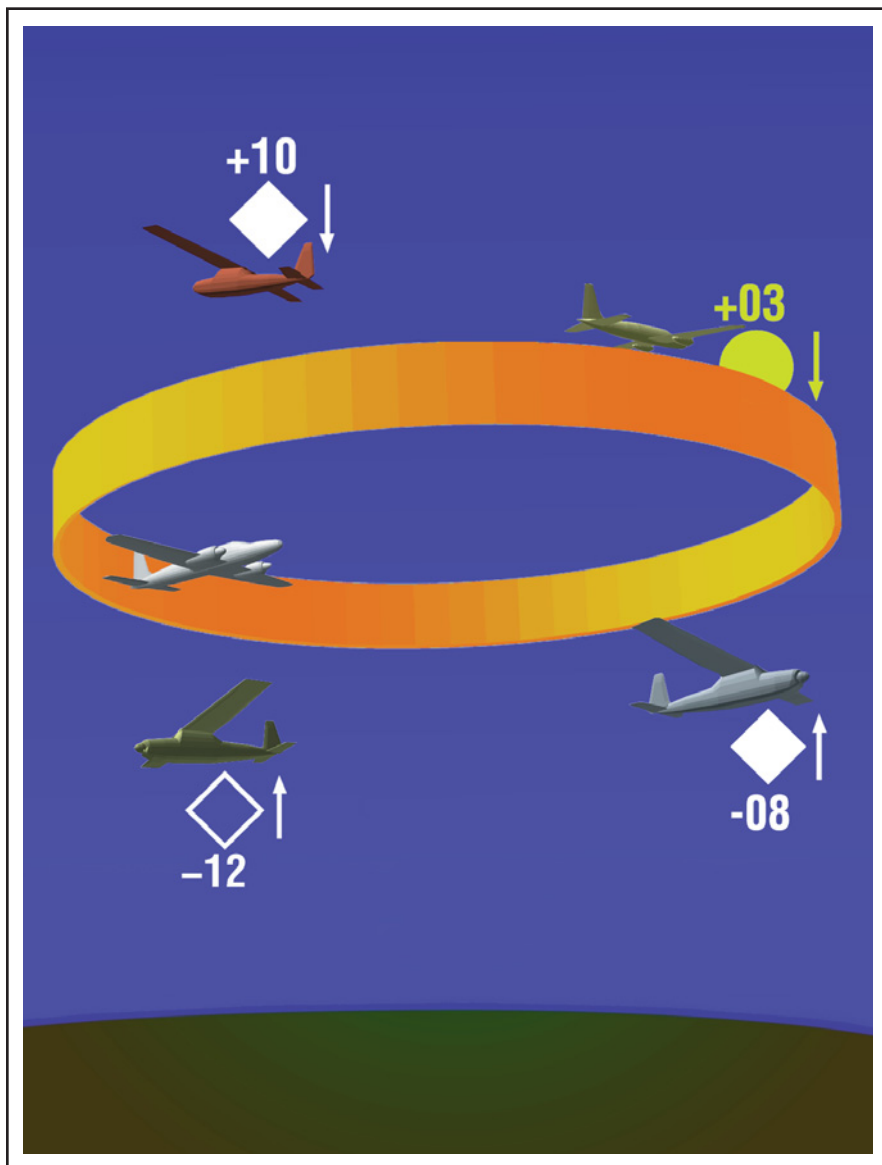


## **BENDIX/KING®** TCAS I Collision Avoidance System



The information contained in this manual is for reference use only. If any information contained herein conflicts with similar information contained in the Airplane Flight Manual Supplement, the information in the Airplane Flight Manual Supplement shall take precedence.

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# SYSTEM COMPONENTS

## TRAFFIC DISPLAYS:

IVA 81A/C/D & TID 66A/D,

Compatible Radar Indicators via GC 362A,

Compatible EFIS.

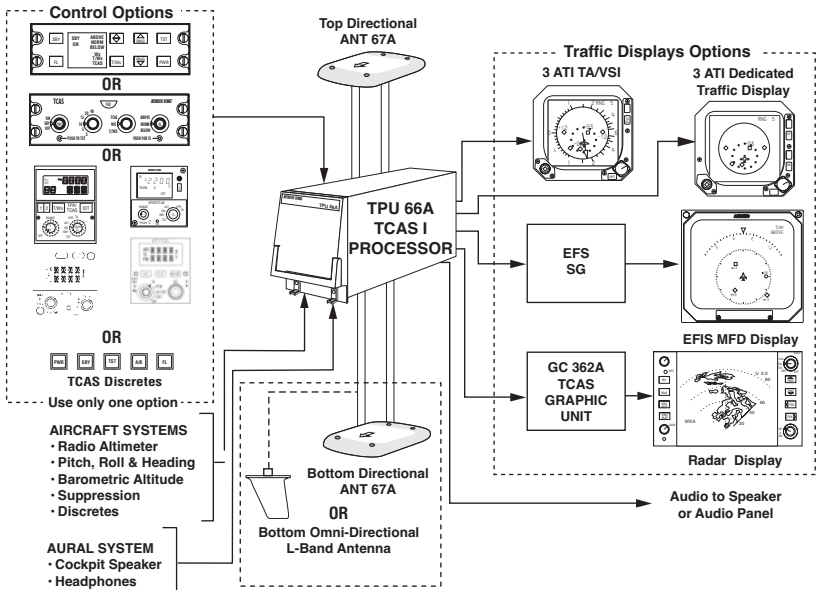
## TCAS CONTROLS

CP 66A/B TCAS I Controller

CD 671C, KFS 578A, PS 578A & PS 550 TCAS/Transponder Controllers

Discretes

## TPU 66A & ANT 67A W/ OPTIONAL OMNI.



**CAS 66A TCAS I Block Diagram**

# INTRODUCTION

TCAS (an acronym formed from the phrase Traffic Alert and Collision Avoidance System) is an airborne system used for detecting and tracking aircraft near your own aircraft. TCAS I includes a TCAS processor, antennas, a traffic display and a means to control the system. The TCAS processor and antennas detect and track other aircraft by interrogating their transponders. Aircraft detected, tracked, and displayed by TCAS are referred to as Intruders. TCAS analyzes the transponder replies to determine range, bearing and relative altitude, if the Intruder is reporting altitude. Should the TCAS processor determine that a possible collision hazard exists, it issues visual and aural advisories to the crew. The visual advisory is shown by symbols on the traffic display. Complementing the traffic display, TCAS provides appropriate synthesized voice announcements in the cockpit. A complete list of traffic symbols and announcements is given in the Theory of Operation and Symbology section of this Pilot's Guide.

***TCAS is unable to detect any Intruding aircraft without an operating transponder. TCAS can detect and track aircraft with either an ATCRBS (operating in Mode A or C) or Mode S transponders.***

The traffic display shows the Intruding aircraft's position. TCAS identifies the relative threat of each Intruder by using various symbols and colors. The Intruder's altitude, relative to your own aircraft's altitude, is annunciated if the Intruder is reporting altitude. A trend arrow is used to indicate if the Intruder is climbing or descending more than 500 feet per minute. TCAS traffic may be displayed on a weather radar indicator, on a dedicated TCAS display, on a TCAS compatible EFIS Display Unit or a TA/VSI (combination traffic display and vertical speed instrument).

TCAS modes and functions are controlled by switches located on a TCAS control panel or in combination with various other controls. A description of controls is given in the Controls and Displays section of this Pilot's Guide.

ATC procedures and the "see and avoid concept" will continue to be the primary means of ensuring aircraft separation. However, if communication is lost with ATC, TCAS adds a significant backup for collision avoidance.

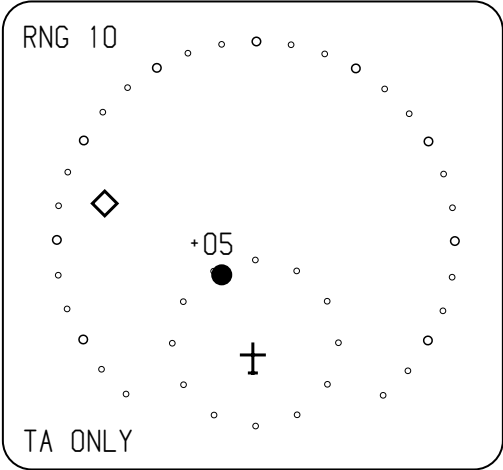
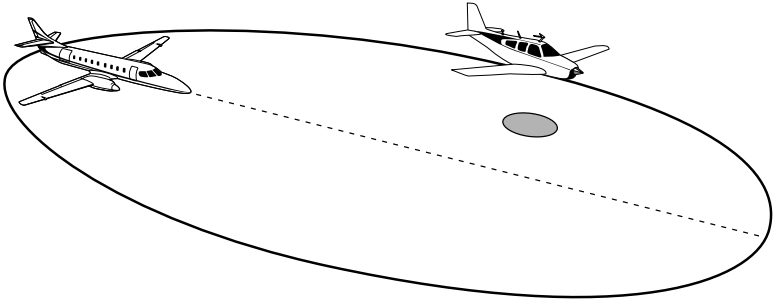
**TCAS:**

- Is compatible with the ATC System
- Determines if a threat exists from ATCRBS or Mode S Transponder equipped aircraft
- Provides display and audio announcement to the crew
  - Position information displayed on a traffic display
  - Synthesized voice
- Incorporates sensor inputs and sophisticated algorithms to minimize nuisance visual and aural annunciations.

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**SECTION I : THEORY OF OPERATION AND SYMBOLOGY**



**SECTION I DESCRIBES TCAS I THEORY OF OPERATION AND SYMBOLOGY.**

## TCAS OPERATION

TCAS monitors the airspace surrounding your aircraft by interrogating the transponder of the Intruding aircraft. The interrogation reply enables TCAS to compute the following information about the Intruder:

1. Range between your aircraft and the Intruder.
2. Relative bearing to the Intruder.
3. Altitude and vertical speed of the Intruder, if the Intruder is reporting altitude.
4. Closing rate between the Intruder and your aircraft.

Using this data TCAS predicts the time to, and the separation at, the Intruder's Closest Point of Approach (CPA). Should TCAS predict that certain safe boundaries may be violated, it will issue a Traffic Advisory (TA) to alert the crew that closing traffic is nearby.

### TCAS I SENSITIVITY LEVEL

TCAS I separates the surrounding airspace into two altitude layers. A different sensitivity threshold level for issuing TAs (traffic advisories) is applied to each altitude layer. Lower altitudes have less sensitive TA threshold levels to prevent unnecessary advisories in the higher traffic densities anticipated at lower flight levels, i.e., terminal areas.

TCAS I has two sensitivity levels (SL) which are described in Table 1, TCAS Sensitivity Levels. SL A is invoked using the following order of precedence: (1) when the TCAS aircraft is below 2,000 feet AGL (if equipped with radio altimeter) OR (2) when the landing gear is Extended (no radio altimeter installed). SL B occurs under all other flight conditions. Table 2, Typical Traffic Advisory Conditions for Sensitivity Levels describes what conditions will cause a TA to be issued. If aircraft is not equipped with either a radio altimeter or retractable landing gear, TCAS I will stay in SL B at all times.

<b>Sensitivity Level</b>	<b>DESCRIPTION</b>
SL A	In sensitivity level A, TCAS I performs surveillance and tracking functions and provides traffic advisories. The conditions for sensitivity level A are any one of the following:  (1) Own aircraft is in-flight and is below 2,000 feet AGL, if a radio altimeter is installed.  (2) Own aircraft is in-flight and the Landing Gear is extended, if a radio altimeter is NOT installed.

SL B	<p>In sensitivity level B, TCAS I performs surveillance and tracking functions and provides traffic advisories. The conditions for sensitivity level B are based on own aircraft in-flight and:</p> <ol style="list-style-type: none"> <li>(1) If radio altitude source is installed and own aircraft altitude is above 2,000 feet AGL (radio altitude).</li> <li>(2) If radio altitude source is NOT installed and own aircraft has Landing Gear Retracted.</li> <li>(3) If the aircraft has a fixed landing gear and no radio altimeter is installed.</li> </ol>
------	--

**Table 1: TCAS Sensitivity Levels**

Sensitivity Level	CONDITIONS FOR TRAFFIC ADVISORIES (TAs)
SL A	<p>The following conditions cause TCAS I to generate a TA in sensitivity level A:</p> <ul style="list-style-type: none"> <li>• TCAS calculates that if current closing rate is maintained, separation of less than 600 feet in altitude between own and Intruder will occur in 20 seconds.</li> <li>• Separation between own and Intruder is less than 1200 feet in altitude and less than 0.20 nautical mile range.</li> <li>• NAR (Non-Altitude Reporting) Intruder is within 15 seconds or 0.20 nautical mile range.</li> </ul>
SL B	<p>The following conditions cause TCAS I to generate a TA in sensitivity level B:</p> <ul style="list-style-type: none"> <li>• TCAS I calculates that if current closing rate is maintained, separation of less than 800 feet in altitude between own and Intruder will occur in 30 seconds.</li> <li>• Separation between own and Intruder is less than 800 feet in altitude and less than 0.55 nautical miles in range.</li> <li>• NAR (Non-Altitude Reporting) Intruder is within 20 seconds or 0.55 nautical mile range.</li> </ul>
Standby or Fail Mode	<ul style="list-style-type: none"> <li>• TAs are not generated.</li> </ul>

**Table 2: Typical Traffic Advisory Conditions for Sensitivity Levels**

### ***TCAS I SURVEILLANCE VOLUMES***

Surveillance volume is that volume of airspace within which other aircraft with Mode S or ATCRBS transponders are tracked by own aircraft's TCAS.

#### ***(1) Range Tracking Volumes***

The shape and size of the range tracking volume is dependent on whether Mode S or ATCRBS transponders are being interrogated, whether tracking is occurring on a directional or OMNI antenna, and attenuation levels applied to the transmitted pulses from the TCAS processor's transmitter. The typical range tracking volume is pictured as an ellipse. The distance behind own-aircraft is about one half of the forward distance. The tracking range to either side of own-aircraft is about two thirds of the maximum forward distance.

The maximum forward range for TCAS is 40 nm. TCAS reduces range tracking volumes in high density areas to reduce the number of receptions to be processed by TCAS and for interference limiting. TCAS can track as many as 45 aircraft and displays up to 30 of them.

#### ***(2) Altitude Tracking Volumes***

TCAS I tracks other transponder equipped aircraft that are within a relative altitude of +/-9,000 feet.

### ***TCAS I AURAL INHIBITS***

TCAS I will inhibit the aural annunciation using the following order of precedence: (1) below 400 feet AGL (if equipped with radio altimeter) OR (2) when the landing gear is Extended (no radio altimeter installed). For installations aboard aircraft with fixed landing gear, the aural annunciation is never inhibited by the TCAS I processor. The aural annunciation is enabled above 600 feet AGL in aircraft equipped with a radio altimeter.

**TCAS TRAFFIC DISPLAY SYMBOLS**

TCAS I will display three different traffic symbols on the traffic display. The type of symbol selected by TCAS is based on the Intruder's location and closing rate. Relative bearing and distance to the Intruder are shown by the position of the Intruder symbol in relation to the own-aircraft symbol.

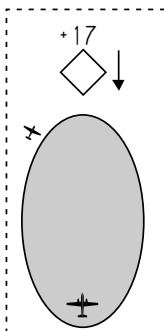
The symbols change shape and color as separation decreases between your aircraft and Intruders to represent increasing levels of urgency.

The traffic symbols may also have an associated altitude tag that shows relative altitude in hundreds of feet, indicating whether the Intruder is climbing, flying level or descending. A + sign and number above the symbol means the Intruder is above your altitude. A - sign and number beneath indicates the Intruder is below your altitude. A trend arrow appears when the Intruder's vertical rate is 500 feet per minute or greater.

No altitude number or trend arrow will appear beside any Intruder that is Non-Altitude Reporting (NAR).

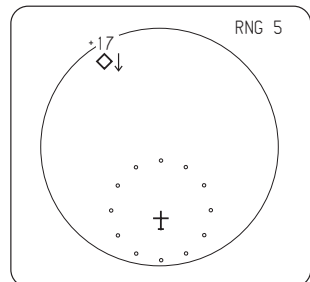
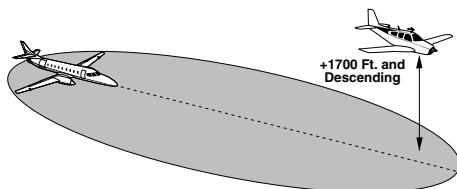
If TCAS direction finding techniques fail to locate the azimuth of another aircraft, a NO BEARING message appears on the screen when the Intruder becomes a threat.

**NON-THREAT TRAFFIC**

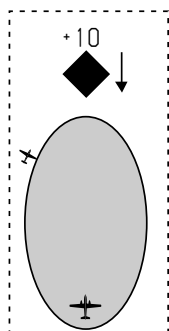


An open white diamond indicates that an Intruder's relative altitude is greater than  $\pm 1200$  feet, or its distance is beyond 5 nm range. It is not yet considered a threat.

This traffic is 1700 feet above your own altitude, descending at 500 feet per minute or greater.

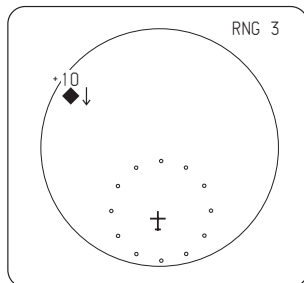
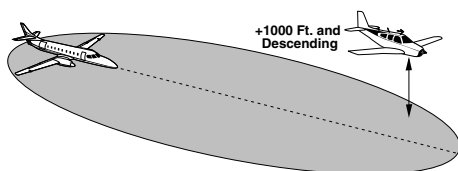


## PROXIMITY INTRUDER TRAFFIC



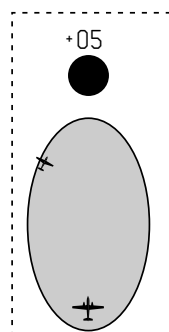
A filled white diamond indicates that the Intruding aircraft is within  $\pm 1200$  feet and within 5 nm range, but is still not considered a threat.

This Intruder is now 1000 feet above your aircraft and descending.



## TRAFFIC ADVISORY (TA)

A symbol change to a filled yellow circle indicates that the Intruding aircraft is considered to be potentially hazardous. Depending upon TCAS sensitivity level, TCAS I will display a TA when time to CPA (Closest Point of Approach) is 15 to 30 seconds.

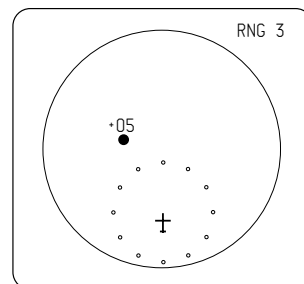
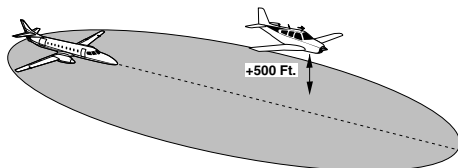


Here the Intruder is 500 feet above your aircraft. A voice is heard in the cockpit, advising:

***“Traffic, Traffic”***

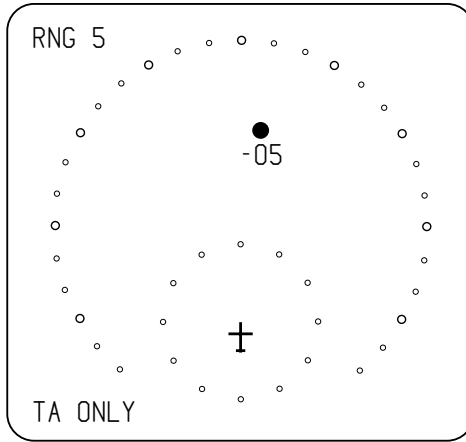
The crew should attempt to gain visual contact with the Intruder and be prepared to maneuver upon visual acquisition.

**The crew should take no evasive action based solely on the TCAS display.**

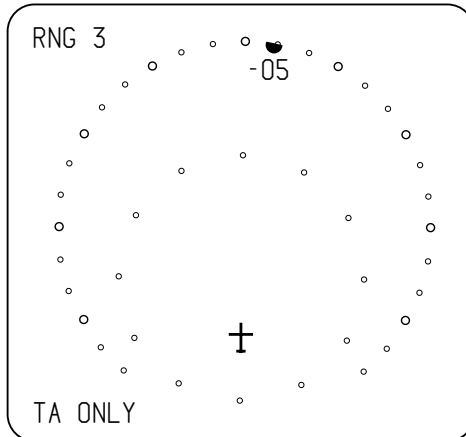


**OFF SCALE TRAFFIC**

Threat aircraft (TA's) that are beyond the selected display range are indicated by one half of the traffic symbol at the edge of the screen. The position of the half-symbol represents the bearing of the intruder.



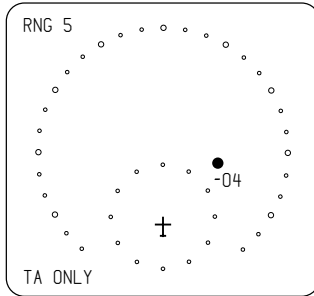
***TA traffic on 5 mile range.***



***Same TA traffic; beyond selected range.***

**INDICATIONS AND VOICE ANNOUNCEMENTS**

**“Traffic, Traffic”**



**Situation:**

One Intruder is ahead near the 2:00 o'clock position, between 2 and 3 miles, 400 feet below your altitude and closing. TCAS recognizes the threat and issues a TA.

**TCAS TRAFFIC ADVISORY ANNUNCIATION (TA):**

Aural	Visual	Crew Response
“TRAFFIC, TRAFFIC”	A filled yellow circle on the Traffic Display	Conduct visual search for the Intruder. If successful, maintain visual acquisition to ensure safe operation.

**IMPORTANT:**

*The pilot should NOT initiate evasive maneuvers using information on the Traffic Display only. Use the TA (Traffic Advisory) symbol to visually acquire the Intruder and be prepared to maneuver upon visual acquisition.*

**Audio Announcements:**

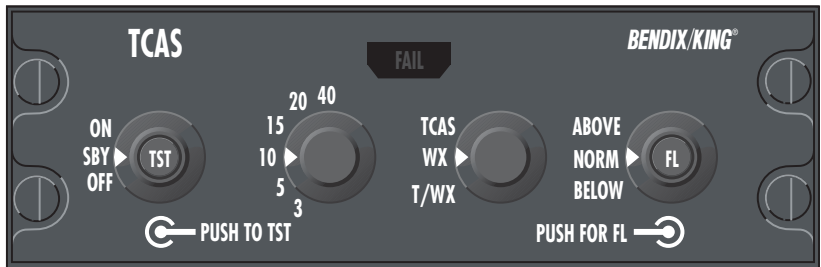
Synthesized voice announcements are issued by TCAS over the aircraft audio system. The following table lists all the audio messages, and advisories, in the TCAS I vocabulary.

**Audio Messages**

CONDITION	ADVISORY MESSAGE
Traffic Advisory	“TRAFFIC, TRAFFIC”
If Previous TA is Active	“TRAFFIC”
Self Test Passed	“TCAS SYSTEM TEST OK”
Self Test Failed	“TCAS SYSTEM TEST FAIL”



## SECTION II: CONTROLS AND DISPLAYS

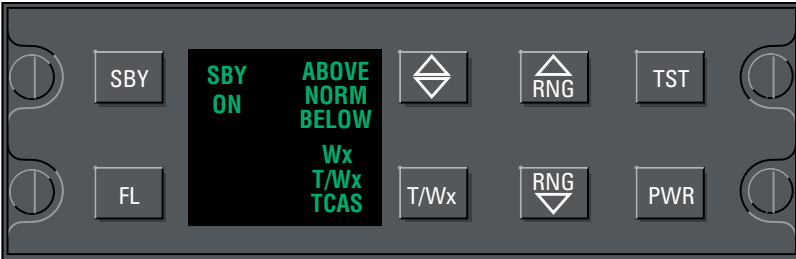


**SECTION II DESCRIBES CONTROLS AND DISPLAYS OF THE TCAS I EQUIPMENT.**

## TCAS CONTROLS

This section describes the control units for the TCAS equipment. Several types of control units are described. The TCAS functions can be controlled by various control panels or discrete switches. Not all the functions described are required in every installation.

### TCAS I CONTROL PANEL; CP 66A



**CP 66A**  
**TCAS I Control Panel**

**Note:** The controls vary depending on CP 66A/CP 66B configuration installed. All functions are the same as typical of units shown.



Pushing the **PWR** push button cycles the TCAS ON or OFF. At power down, the control panel senses whether the TCAS is in SBY or On mode. Upon power-up, the control returns the TCAS to the same condition.



Whenever TCAS is On, pressing **SBY** places the TCAS in SBY (Standby) mode. In Standby mode, all TCAS broadcast, surveillance, and tracking operations are disabled and the traffic display is blanked except for a “TCAS STBY” mode annunciation. If TCAS is in Standby, pressing the SBY button places TCAS I in the ON mode.



Pushing the **TEST** button initiates a comprehensive self test lasting approximately eight seconds. Refer to the Appendix for a description of the self test function.

The **T/Wx** (TCAS/Weather) mode button is necessary in installations using the weather radar indicator as the traffic display. In these installations, the T/Wx switch is used to select between Weather Only, Weather with TCAS Traffic and Traffic Only modes.



Details of the various modes are described later in this section under Weather Radar Indicators.

**TCAS RNG** (Range) buttons are used to select the range on the traffic display. The range selections are 3, 5, 10, 15, 20, and 40. All ranges are in nautical miles.



**Note:** This feature may not be available in all installations or this feature may be superseded by a range control on the traffic display bezel.



The **FL** (Flight Level) push button replaces Intruder's relative altitude with absolute altitude for 15 seconds. During this period the altitude is displayed in flight level format. That is, 19,000 ft. is displayed as 190. After 15 seconds the absolute reading reverts to relative altitude.

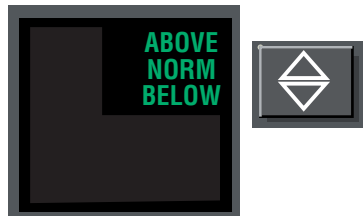


The FL function is flagged below 18,000 feet MSL on most traffic displays unless barometric corrected altitude is available from an air data source. FL is inhibited on the IVA 81A/C/D and the TID 66A/D units, but not on the Radar indicator when used with GC 362A.

If FL is selected while inhibited, "FL - -" will show in place of own flight level.

The **A/B** (Above/Below) push button selects altitude display limits. The Above/Below selection has no effect on the TCAS logic giving TAs. There are three choices available.

**ABOVE** Traffic that is between 8700 feet above and 2700 feet below own aircraft will be displayed. Typically ABOVE is used during the climb phase of flight.



**NORMAL** Traffic that is between 2700 feet above and 2700 feet below will be displayed. Typically NORMAL is used during the en route phase of flight.

## Controls and Displays

**BELOW** Traffic that is between 2700 feet above and 8700 feet below will be displayed. Typically BELOW is used during the descent phase of flight.

### ***TCAS I CONTROL PANEL; CP 66B***



***CP 66B  
TCAS I Control Panel***

The CP 66B can have up to four separate knobs as shown above. Depending upon the system interface, the Range Knob and/or Display Selector may be removed.

The CP 66B amber Fail Annunciator will light during self test and in normal operation will flash if a system failure has been detected. If a failure has been detected, turning the Power Switch to **OFF** will turn off the flashing annunciator.

#### **Power Switch:**



The **OFF** position deactivates selector switches and push buttons and extinguishes **FAIL** annunciation if on.

The **SBY** position places the TCAS in Standby mode. In Standby mode, all TCAS broadcast, surveillance, and tracking operations are disabled and the traffic display is blanked except for a “TCAS STBY” mode annunciation.

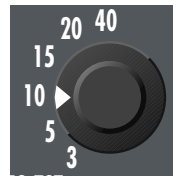
The **ON** position enables the TCAS broadcast, tracking and surveillance operations at the selected range, display and altitude limit.

Pressing the **TEST** button in the center of the knob initiates a comprehensive self test lasting approximately eight seconds. Refer to the Appendix for a description of the self test function.

**TCAS Range Knob:**

The TCAS RANGE knob is used to select the range on the traffic display. The range selections are 3, 5, 10, 15, 20, and 40. All ranges are in nautical miles.

**Note:** This feature may not be available in all installations or this feature may be superseded by a range control on the traffic display bezel.

**Display Select Switch:**

The Display Select Switch is used in installations where the weather radar indicator is the traffic display. It selects between **T/Wx** (TCAS w/Weather), **Wx** (Weather Only), and **TCAS** (Traffic Only) presentations on the radar screen. Details of the various modes are described later in this section under Weather Radar Indicators.

**Altitude Limit Switch:**

The Altitude Limit Select Switch selects altitude display limits. It has no effect on the TCAS logic giving TAs. There are three selections available.



**ABOVE** - Traffic that is between 8700 feet above and 2700 feet below own aircraft will be displayed. Typically ABOVE is used during the climb phase of flight.

**NORMAL** - Traffic that is between 2700 feet above and 2700 feet below will be displayed. Typically NORMAL is used during the en route phase of flight.

**BELOW** - Traffic that is between 2700 feet above and 8700 feet below will be displayed. Typically BELOW is used during the descent phase of flight.

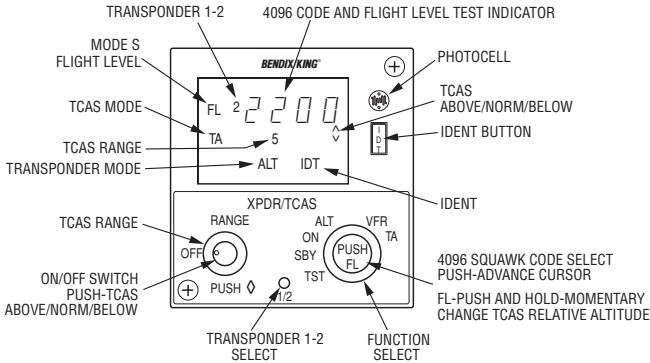
The **FL** (Flight Level) push button in the center of the Altitude Limit Select Switch replaces Intruder's relative altitude with absolute altitude for 15 seconds. During this period the altitude is displayed in flight level format. That is, 19,000 ft. is displayed as 190. After 15 seconds the absolute reading reverts to relative altitude.

The FL function is flagged below 18,000 feet MSL on most traffic displays unless barometric corrected altitude is available from an air data source. FL is inhibited on the IVA 81A/C/D and the TID 66A/D units, but not on the Radar indicator when used with GC 362A.

If FL is selected while inhibited, "FL - -" will show in place of own flight level.

**TRANSPONDER/TCAS CONTROLS**

**KFS 578A TRANSPONDER/ TCAS CONTROL UNIT**

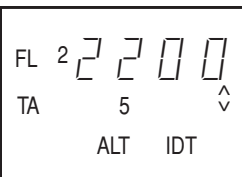


*KFS 578A Single or Dual Mode S/TCAS Control Unit (Dual Unit shown)*

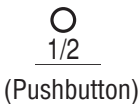
**KFS 578A CONTROLS AND DISPLAYS**

The KFS 578A Control Unit is the master control for both the TCAS system and transponder. The KFS 578A will also display the selected 4096 ATC code and current mode of operation in the display window. Versions are available to control one or two transponders. A “Fail” annunciation indicates failure of the selected transponder, antenna or control data.

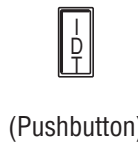
*Note: If the KFS 578A is interfaced to a MST 67A Mode S transponder and the MST 67A senses a failure, a failure annunciation will be shown. A maintenance check should be performed.*



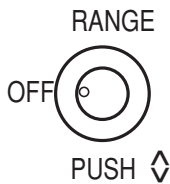
The **Display Window** Displays ATC code selection, whether transponder #1 or #2 is active, transponder mode, transponder ident, own aircraft flight level (in TEST), TCAS mode, TCAS range and TCAS above, below or normal vertical display limit selected.



**1/2** selects the active transponder. The other unit is placed in standby.



**IDT** initiates IDENT feature for ATC.



The outer knob on the left hand dual concentric switch selects the Traffic Advisory display range in nautical miles. The selected range is annunciated on the traffic display. The range annunciation is the maximum displayed range to the front of the aircraft. The selected range has no effect on the TCAS logic giving TAs.

*Note: Selected range is displayed in the upper right hand corner of a TA/VS/.*

The inner concentric knob on the left may include an on/off switch (clockwise = on) and when pushed selects Traffic Advisory altitude display limits (Above, Normal or Below). The Above/Below select knob has no effect on the TCAS logic giving TAs.

**ABOVE** 8700 feet above; 2700 feet below. Typically used during climb phase of flight.

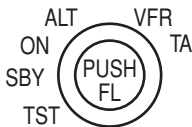
**NORMAL** 2700 feet above; 2700 feet below. Typically used during en route phase of flight.

**BELOW** 2700 feet above; 8700 feet below. Typically used during descent phase of flight.

*Note: All knobs are continuous rotatory and do not roll over or stop.*

### **KFS 578A FUNCTION SELECTOR, ATC CODE SELECT & MOMENTARY TCAS DISPLAY FLIGHT LEVEL SELECT**

The outer concentric knob on the right selects the Mode S and TCAS mode of operation.



Rotating the function knob (CCW) to the TST position initiates a comprehensive self test lasting approximately eight seconds. All segments of the display are illuminated for 2 seconds, then the code window will display the encoded altitude for four seconds, then the control unit will return to the previously selected mode. (Refer to the Test section in the Appendix for a detailed description of test functions.)

## Controls and Displays

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**SBY** places the Mode S Transponder and TCAS in standby. SBY is annunciated on the display window. Use SBY during ground operations.

**ON** activates the selected transponder without altitude reporting. TCAS is in standby. ON is annunciated in the display window.

**ALT** activates Mode S transponder with altitude reporting, TCAS system in standby.

Selecting **VFR** for more than 3 seconds changes the ATC code to the pre-programmed VFR code (Typically 1200). VFR is annunciated in the display window for the 3 seconds prior to switching the programmed code. The control unit will return to the mode selected prior to making the VFR selection.

The VFR code can be programmed to be any code by the following technique:

- a. Place the function selector to VFR.
- b. Select the VFR code as required.
- c. Push the Ident (IDT) button, or wait 3 seconds, or rotate the Function switch to the desired mode.

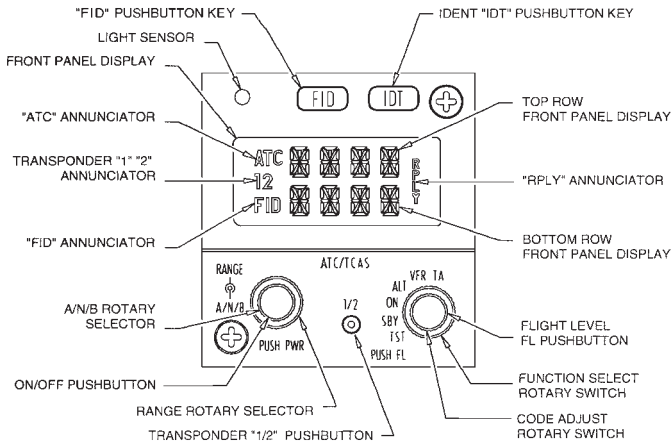
The **TA** (Traffic Advisory) mode. Activates the Mode S transponder, altitude reporting and TCAS "TA ONLY" mode. Traffic will be presented on the traffic (TA) display.. "TA" mode is annunciated in the control unit display window and "TA ONLY" will be annunciated on the TCAS traffic display(s).

The traffic display switches to the FL (flight level) display function when the inner knob is pressed in for more than four seconds. The relative altitude tags are replaced with absolute altitude (FL) tags. The traffic display will revert to relative altitude after 15 seconds.

The FL feature is usually flagged below 18,000 feet MSL unless barometric corrected altitude is available from an air data source. FL is flagged on the IVA 81A but not on the radar indicator when used with the GC 362A, traffic displays. If FL is selected while flagged, "FL---" is annunciated instead of own flight level.



### PS 578A TRANSPONDER/TCAS CONTROL UNIT

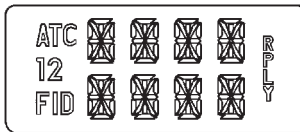


*PS 578A Single or Dual Mode S/TCAS Control Unit (Dual Unit shown)*

### PS 578A CONTROLS AND DISPLAYS

The PS 578A Control Unit is the master control for both the TCAS system and transponder. The PS 578A will also display the selected 4096 ATC code and current mode of operation in the display window. Versions are available to control one or two transponders. A "Fail" annunciation indicates failure of the selected transponder, antenna or control data.

*Note: If the PS 578A is interfaced to a MST 67A Mode S transponder and the MST 67A senses a failure, a failure annunciation will be shown. A maintenance check should be performed.*



The **Display Window** Displays ATC code selection, Flight ID (FID) selection, whether transponder #1 or #2 is active, transponder mode, transponder ident, own aircraft flight level (in TEST), TCAS mode, TCAS range and TCAS above, below or normal vertical display limit selected.

## Controls and Displays

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**1/2** selects the active transponder. The other unit is placed in standby.

(Pushbutton)

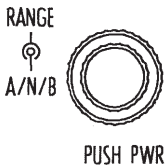


**IDT** initiates IDENT feature for ATC.

(Pushbutton)



**FID** allows entry of an alphanumeric flight identification. Selecting the right inner pushbutton will cycle through the eight characters to be changed. Rotating the right inner knob will change the contents of the selected (flashing) character.



The outer knob on the left hand dual concentric switch selects the Traffic Advisory display range in nautical miles. The selected range is annunciated on the traffic display. The range annunciation is the maximum displayed range to the front of the aircraft. The selected range has no effect on the TCAS logic giving TAs.

*Note: Selected range is displayed in the upper right hand corner of a TA/VSJ.*

The inner concentric knob on the left includes an on/off switch (push on/off) and when rotated selects Traffic Advisory altitude display limits (Above, Normal or Below). The Above/Normal/Below select knob has no effect on the TCAS logic giving TAs.

**ABOVE** 8700 feet above; 2700 feet below. Typically used during climb phase of flight.

**NORMAL** 2700 feet above; 2700 feet below. Typically used during en route phase of flight.

**BELOW** 2700 feet above; 8700 feet below. Typically used during descent phase of flight.

*Note: All knobs are continuous rotary and do not roll over or stop.*

## PS 578A FUNCTION SELECTOR, ATC CODE SELECT & MOMENTARY TCAS DISPLAY FLIGHT LEVEL SELECT



The outer concentric knob on the right selects the Mode S and TCAS mode of operation.

Rotating the function knob (CCW) to the TST position initiates a comprehensive self test lasting approximately eight seconds. All segments of the display are illuminated for 2 seconds, then the code window will display the encoded altitude for four seconds, then the control unit will return to the previously selected mode. (Refer to the Test section in the Appendix for a detailed description of test functions.)

**SBY** places the Mode S Transponder and TCAS in standby. SBY is annunciated on the display window. Use SBY during ground operations.

**ON** activates the selected transponder without altitude reporting. TCAS is in standby. ON is annunciated in the display window.

**ALT** activates Mode S transponder with altitude reporting, TCAS system in standby.

Selecting **VFR** for more than 3 seconds changes the ATC code to the pre-programmed VFR code (Typically 1200). VFR is annunciated in the display window for the 3 seconds prior to switching the programmed code. The control unit will return to the mode selected prior to making the VFR selection.

The VFR code can be programmed to be any code by the following technique:

- a. Place the function selector to VFR.
- b. Select the VFR code as required.
- c. Push the Ident (IDT) button, or wait 3 seconds, or rotate the Function switch to the desired mode.

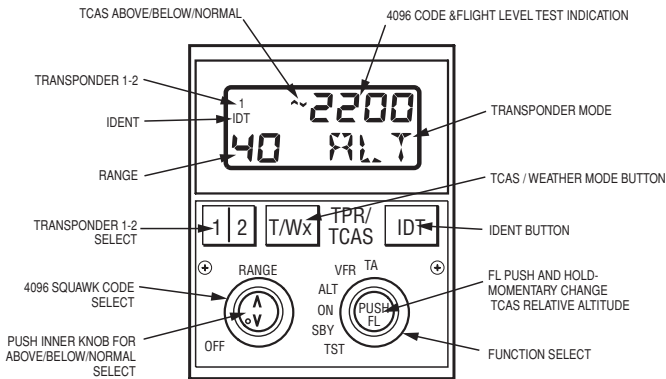
The **TA** (Traffic Advisory) mode. Activates the Mode S transponder, altitude reporting and TCAS "TA ONLY" mode. Traffic will be presented on the traffic (TA) display. "TA" mode is annunciated in the control unit display window and "TA ONLY" will be annunciated on the TCAS traffic display(s).

## Controls and Displays

The traffic display switches to the FL (flight level) display function when the inner knob is pressed in for more than four seconds. The relative altitude tags are replaced with absolute altitude (FL) tags. The traffic display will revert to relative altitude after 15 seconds.

The FL feature is usually flagged below 18,000 feet MSL unless barometric corrected altitude is available from an air data source. FL is flagged on the IVA 81A but not on the radar indicator when used with the GC 362A, traffic displays. If FL is selected while flagged, "FL---" is annunciated instead of own flight level.

### CD 671C TRANSPONDER/ TCAS CONTROL UNIT



*CD 671C Single or Dual Mode S/TCAS Control Unit (Dual Unit shown)*

### CD 671C CONTROLS AND DISPLAYS

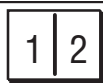
The CD 671C Control Unit is the master control for both the TCAS system and transponder. The CD 671C will also display the selected 4096 ATC code and current mode of operation in the display window. Versions are available to control one or two transponders. A "Fail" annunciation indicates failure of the selected transponder, antenna or control data.

*Note: If the CD 671A is interfaced to a MST 67A Mode S transponder and the MST 67A senses a failure, a failure annunciation will be shown. A maintenance check should be performed.*



The **Display Window** displays the ATC code selection, whether transponder #1 or #2 is active, transponder mode, transponder ident, own aircraft flight level (in TEST), TCAS mode, TCAS range and TCAS above, below or normal vertical display limit selected.

All display annunciations are seen during the control unit self-test. The "R" annunciation is only seen during self-test. "FL" on the control unit is only displayed during self-test and indicates the transponder's encoded altitude. Continuous FL mode is selected by activating Ext. SBY discrete and turning mode knob to "TST"



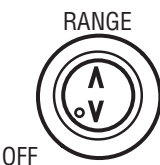
The 1/2 push button selects No. 1 or No. 2 as the active transponder. The other unit is placed in standby. The Display Window shows which transponder is the active source.



The IDT push button initiates the IDENT feature for ATC. The IDENT function is used at the request of an Air Traffic Controller, and holds the Ident reply for  $18 \pm 1$  seconds.



The T/Wx (TCAS/Weather) mode button is necessary in installations using the weather radar indicator as the traffic display. In these installation, the T/Wx switch is used to select between Weather Only, Weather with TCAS Traffic and Traffic Only modes.



The outer knob selects the traffic display range in nm (nautical miles). This knob can select 3, 5, 10, 15, 20 or 40 nm range on the TCAS traffic display. The range is displayed in the display window during range selection.

*Note: The Range knob is continuous rotary and does not roll over or stop.*

The traffic display may have another range select source. The selected TCAS range is always annunciated on the traffic display. The range annunciated is the maximum displayed range to the front of the aircraft. The range to the rear is 1/2 the annunciated range. The selected range has no effect on the TCAS logic giving TAs.

## Controls and Displays

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The inner concentric knob may include an optional ON/OFF switch; clockwise is ON. When the inner knob is pushed, the Traffic Advisory altitude (Above/Norm/Below) display limits are sequentially selected. There are three display levels to choose from.

**ABOVE;** 8700 feet above and 2700 feet below, is typically used during the climb phase of flight. A "^" (carat) will be annunciated in the display window.

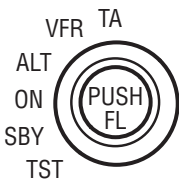
**NORMAL;** 2700 feet above and 2700 feet below, is used during the enroute phase of flight. Both the "^" and "v" (carats) will be annunciated in the display window.

**BELOW;** 2700 feet above and 8700 feet below is used during the descent phase of flight. A "v" (carat) will be annunciated in the display window.

The Above/Below selection has no effect on the TCAS logic giving TAs.

### **CD671A FUNCTION SELECTOR, ATC CODE SELECT & MOMENTARY TCAS DISPLAY FLIGHT LEVEL SELECT**

The dual concentric knobs on the right side of the unit are used to select the ATC code & TCAS/Transponder mode and the TCAS flight level feature. The outer concentric knob selects the Mode S and TCAS mode of operation. The mode is annunciated in the display window.



**TST** Rotating the outer function knob (CCW) to the TST position initiates a comprehensive self-test lasting approximately eight seconds. All segments of the display are illuminated for 2 seconds, then the code window will display the encoded altitude for four seconds, then the control unit will return to the previously selected mode.

**SBY** places the Mode S Transponder and TCAS in standby. SBY is annunciated in the display window. Use standby during ground operations.

**ON** activates the selected transponder without altitude reporting. TCAS is in standby. ON is annunciated in the display window.

**ALT** Activates Mode S transponder with altitude reporting, TCAS system in standby.

**VFR** Selecting VFR for more than 3 seconds changes the ATC code to the pre-programmed VFR code (typically 1200). VFR is annunciated in the display window for the 3 seconds before switching to the programmed code. The control unit will return to the mode selected prior to making the VFR selection. The VFR code can be programmed to any code by the following technique:

1. Place the function selector to VFR.
2. Select the VFR code as required.
3. Push the Ident (IDT) button, or wait 3 seconds, or rotate the Function switch to the desired mode.

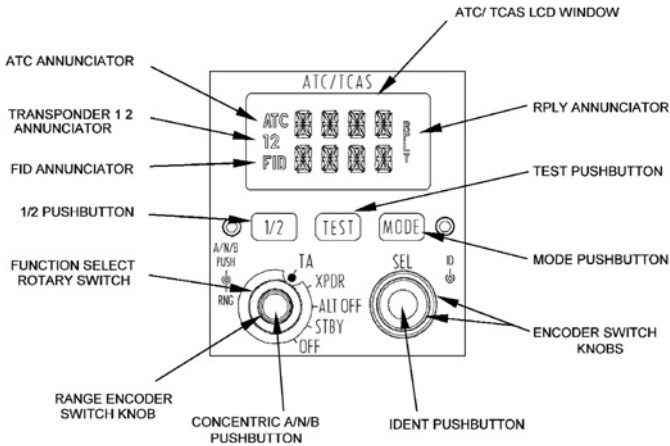
**TA** (TA Traffic Advisory) mode. TA activates the Mode S transponder, altitude reporting and TCAS "TA ONLY" mode. Traffic will be presented on the traffic (TA) display. "TA" mode is annunciated in the control unit display window and "TA ONLY" will be annunciated on the TCAS traffic display(s).

The inner concentric knob on the right selects the 4096 ATC code and when pushed and held for more than four seconds switches the TCAS traffic display to the FL (flight level) display function. To select an ATC code, momentarily push this knob to start the left hand digit in the ATC code flashing, twist the knob to change the number. Momentarily push the knob again to move the flashing digit one space to the right and twist the knob to change the digit. Repeat for the third and fourth digit of the ATC code. The flashing digit will stop flashing 3 seconds after the last change.

The traffic display switches to the FL (flight level) display function when the inner knob is pressed in for more than four seconds. The relative altitude tags are replaced with absolute altitude (FL) tags. The traffic display will revert to relative altitude after 15 seconds.

The FL feature is usually flagged below 18,000 feet MSL unless barometric corrected altitude is available from an air data source. FL is flagged on the IVA 81A but not on the radar indicator when used with the GC 362A, traffic displays. If FL is selected while flagged, "FL---" is annunciated instead of own flight level.

**PS 550 TRANSPONDER/ TCAS CONTROL UNIT**

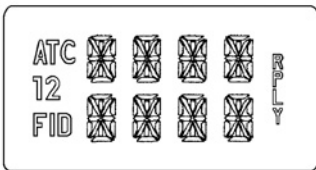


*PS 550 Single or Dual Mode S/TCAS Control Unit (Dual Unit shown)*

**PS 550 CONTROLS AND DISPLAYS**

The PS 550 Control Unit is the master control for both the TCAS system and transponder. The PS 550 will also display the selected 4096 ATC code and current mode of operation in the display window. Versions are available to control one or two transponders. A “Fail” annunciation indicates failure of the selected transponder, antenna or control data.

*Note: If the PS 550 is interfaced to a MST 67A Mode S transponder and the MST 67A senses a failure, a failure annunciation will be shown. A maintenance check should be performed.*



The **Display Window** displays the ATC code selection, whether transponder #1 or #2 is active, transponder mode, transponder ident, own aircraft flight level (in TEST), TCAS mode, TCAS range and TCAS above, below or normal vertical display limit selected.

All display annunciations are seen during the control unit self-test.





The 1/2 push button selects No. 1 or No. 2 as the active transponder. The other unit is placed in standby. The Display Window shows which transponder is the active source.



The TST push button initiates a comprehensive self-test lasting approximately eight seconds. All segments of the display are illuminated for 2 seconds, then the code window will display the encoded altitude for four seconds.



The MODE push button sequentially selects the ATC, TFC or FL mode, FID and ADC.

ATC Mode - Allows entry of the four digit ATC code.



*Honeywell MST 67A configuration:* The right outer knob selects each of the four positions for entry, and the right inner knob selects the content.

*Collins TDR-94D configuration:* The right outer knob enters the first two digits and the right inner knob enters the last two digits.

TFC Mode - (*Collins TDR-94D only*) Allows selection of the traffic display operating mode (AUTO - data Pop-up or ON - full time display).

FL Mode - (*Honeywell MST-67A only*) Allows selection of relative or absolute altitude for display. The relative altitude tags are replaced with absolute altitude (FL) tags. The traffic display will revert to relative altitude after 15 seconds

The FL feature is usually flagged below 18,000 feet MSL unless barometric corrected altitude is available from an air data source. FL is flagged on the IVA 81A but not on the radar indicator when used with the GC 362A, traffic displays. If FL is selected while flagged, "FL---" is annunciated instead of own flight level.

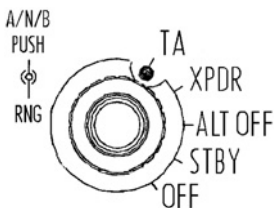
FID Mode - Allows entry of the eight digit alphanumeric flight ID code. The right outer knob selects each of the eight positions for entry, and the right inner knob selects the alphanumeric character.

ADC Mode - Allows selection of the air data computer used by the TCAS.



**ID** The ID push button in the center of the Code Selector knob initiates the IDENT feature for ATC. The IDENT function is used at the request of an Air Traffic Controller, and holds the Ident reply for  $18 \pm 1$  seconds.

### **PS 550 FUNCTION SELECTOR, TCAS RANGE SELECT & TCAS ALTITUDE LIMITS SELECT**



The dual concentric knobs on the left side of the unit are used to select the TCAS/Transponder mode, the TCAS range and the TCAS altitude limits. The outer concentric knob selects the Mode S and TCAS mode of operation. The mode is annunciated in the display window.

**STBY** places the Mode S Transponder and TCAS in standby. SBY is annunciated in the display window. Use standby during ground operations.

**ALT OFF** activates the selected transponder without altitude reporting. TCAS is in standby. ON is annunciated in the display window.

**XPDR** Activates Mode S transponder with altitude reporting, TCAS system in standby.

**TA** (TA Traffic Advisory) mode. TA activates the Mode S transponder, altitude reporting and TCAS "TA ONLY" mode. Traffic will be presented on the traffic (TA) display. "TA" mode is annunciated in the control unit display window and "TA ONLY" will be annunciated on the TCAS traffic display(s).

The inner knob selects the traffic display range in nm (nautical miles). This knob can select 3, 5, 10, 15, 20 or 40 nm range on the TCAS traffic display. The range is displayed in the display window during range selection.

*Note: The Range knob is continuous rotary and does not roll over or stop.*

The traffic display may have another range select source. The selected TCAS range is always annunciated on the traffic display. The range annunciated is the maximum displayed range to the front of the aircraft. The range to the rear is either full annunciated range or 1/2 the annunciated range, depending on the display. The selected range has no effect on the TCAS logic giving TAs.

When the inner knob is pushed, the Traffic Advisory altitude (Above/Norm/Below) display limits are sequentially selected. There are three display levels to choose from.

**ABOVE;** 8700 feet above and 2700 feet below, is typically used during the climb phase of flight. A "^" (carat) will be annunciated in the display window.

**NORMAL;** 2700 feet above and 2700 feet below, is used during the enroute phase of flight. Both the "^" and "v" (carats) will be annunciated in the display window.

**BELOW;** 2700 feet above and 8700 feet below is used during the descent phase of flight. A "v" (carat) will be annunciated in the display window.

The Above/Below selection has no effect on the TCAS logic giving TAs.

## TRAFFIC DISPLAYS



**IVA 81A/C/D TA/VS Traffic Advisory and Vertical Speed Indicators**

TCAS traffic can be displayed on a variety of instruments or indicators. The following describes the various TCAS traffic displays.

The (IVA 81A/C/D) TA/VS displays combine the vertical speed instrument with the Traffic display functions on an LCD screen. A pointer indicates the aircraft's VS (vertical speed) against the scale around the circumference of the circle. A VSI flag, which would be shown in the lower right-hand corner, will cause the VS pointer to disappear if a VS source failure is detected. The traffic

location is presented on the face of the display inside the vertical speed scale.

**Note:** "RA FAIL" may annunciate during system start up prior to air data coming on line or if air data fails. ("RA FAIL" is not a required flag for TCAS I)



**TID 66A/D TCAS I Traffic Display**

The TID 66A/D is a dedicated TCAS traffic display similar to the TA/VS without any vertical speed functions. The bearing and distance of Intruder aircraft are relative to the own-aircraft symbol. The own-aircraft symbol is located a third up from the bottom of the screen.

The full scale display range directly ahead of the aircraft is annunciated in the upper right-hand corner. The distance aft is one-half the annunciated range. The distance to the sides of the aircraft (at 90° and 270°) is two-thirds the annunciated range. A 2 nm

circle indicated by blue dots every 30° is present at every range except 40 nm.

The lower right-hand corner of the TID 66A/D annunciates the Above/Below and FL display formats. The FL feature is inhibited below 18,000 feet MSL unless barometric corrected altitude is available from an air data source. If FL is selected while inhibited, "FL - - -" is annun-

ciated. When appropriate Flight Level data is available, current aircraft Flight Level is displayed.

The lower left-hand corner annunciates the TCAS mode and TCAS flag condition. See the list of Mode & Failure Annunciations below.

Two blocks are reserved in the lower center of the screen to display No Bearing TA traffic. Occasionally TCAS can compute range and range closure but not relative bearing to Intruder aircraft. "No Bearing" traffic will be depicted as text and not a traffic symbol. A message such as "2.0NM/-020" in yellow is a No Bearing TA for an Intruder 2.0 nm away 200 Ft. above and descending.

**TA/VSI & TID CONTROLS**

**RANGE SELECT**

Pressing the "UP" or "DN" buttons on the front bezel will increase or decrease the selected display range. The "04" software versions of the TA/VSI and all TID 66A/D units will have selectable ranges of 3, 5, 10, 15, 20, and 40 nm. The range selections on earlier TA/VSI units will be 3, 5, 10, 15 nm OR 5, 10, 20, & 40 nm, depending upon aircraft wiring.



**BRT CONTROL**

This knob controls the brightness of the traffic display screen.



**TA SEL MODE ( IVA 81A/C/D ONLY)**

Depending on the configuration strapping of the display, the TA SEL MODE button will respond in one of two ways.



**LIGHT SENSOR**

The light sensor in the lower left corner controls the automatic dimming function that adjusts the display brightness to compensate for changing ambient lighting levels.



Configuration	Operation
Traffic Sel	Traffic is only shown when a "TA" intruder is present. If the display is "decluttered" and a "TA" becomes present, traffic is displayed. Pressing the button "declutters" the display of traffic. Traffic is again displayed upon any of the following events: 1. The button is pressed again while a "TA" intruder is still present. 2. A new "TA" intruder becomes present. 3. An existing intruder turns into a "TA."

**MODE & FAILURE ANNUNCIATIONS**

The following annunciations can be seen in the lower left-hand corner of the TAVSI or TID 66A/D.

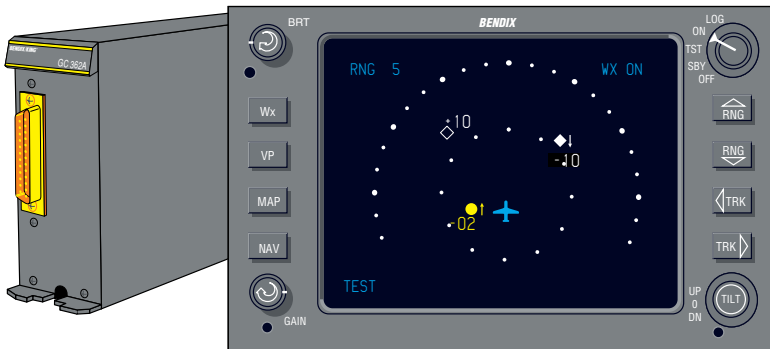
<u>Annunciation</u>	<u>Color</u>	<u>Color</u>	<u>Indicates</u>
TCAS STBY	(Blue)	(Blue)	NO TCAS
TEST	(Yellow)	(Yellow)	TEST Mode
TA ONLY	(Blue)	(Blue)	TA ONLY Mode
TCAS	(Yellow)	(Yellow)	FLAG (TCAS FAIL)

**WEATHER RADAR INDICATORS**

***RDS 81, 82, 84 & 86, RDR 2000, RDR 2100 and Primus /Collins Color Indicators***

The GC 362A TCAS Graphic Processor allows TCAS traffic to be displayed on a variety of Color Radar indicators. A T/Wx (TCAS/Weather) select button is required to switch between Weather Only, Weather with TCAS Traffic overlaid and TCAS Only display modes. The T/Wx switch may be a separate momentary push button or included on another control panel.

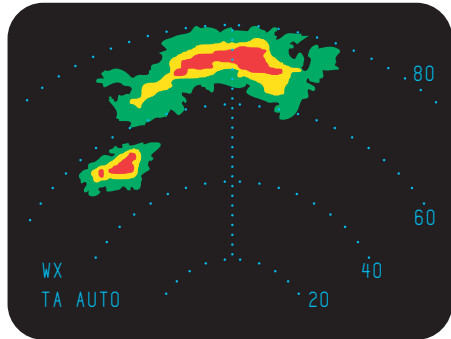
<b>Compatible Weather Radar Indicators</b>	
Brand	Model
Bendix King	RDS-81,82,84,86 & RDR 2000/2100
Collins	WXR System with IND-270
Honeywell	200/300SL/400/870/P90/650/800



### **WEATHER ONLY MODE**

In this mode of operation, only weather radar information is displayed until a Traffic Advisory is issued by the TCAS Processor. The range is controlled by the weather radar range control in this mode of operation. When a Traffic Advisory occurs, the display will revert to the default TCAS display (either TCAS Only or Weather/TCAS Overlay)

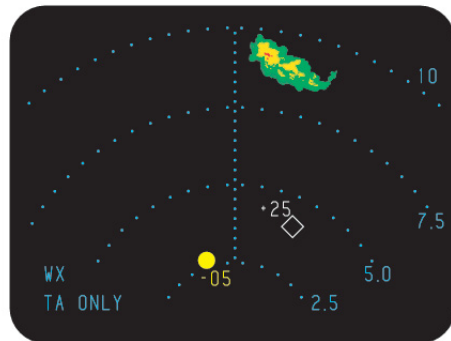
selected during installation by the pop-up default discrete. When TCAS determines the Traffic Advisory is over, the display will revert to the weather radar picture. The TCAS mode is annunciated by TA AUTO in the lower left hand corner of the screen.



### **WEATHER WITH TCAS TRAFFIC MODE**

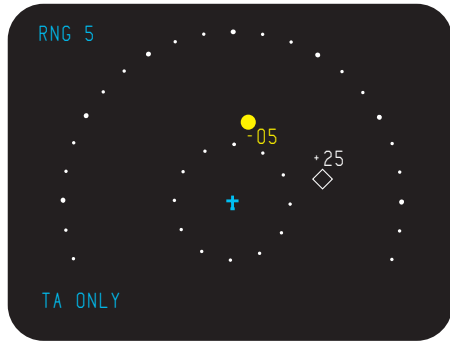
A full time TCAS display overlays the weather display in this mode. The display origin may be either at the bottom of the screen or the center of the screen, depending on the specific installation. Weather will be displayed in the upper 90° or 120° sector, depending on which radar is being used. Weather is blanked in the areas where TCAS traffic is displayed.

The range displayed in this mode is that which was selected for weather radar. If weather radar is in the standby mode or other non-radar mode, the display will be the same as that in the TCAS Only mode. This mode is maintained unless another mode is manually selected. The TCAS operational mode is annunciated along with the pilot selected weather radar mode in the lower left hand corner of the screen unless the radar is in standby, in which case the TCAS mode is displayed in the upper right hand corner.



## TCAS ONLY MODE

In this mode the screen's origin point is 1/3 up from the bottom of the screen. Only TCAS information is displayed. This mode is maintained unless another mode is manually selected. The range displayed is that selected on the TCAS control panel. A 2 nm range ring is displayed on ranges 3, 5, 10, and 15 nm. The 2 nm range ring consists of discrete dots (cyan) at each of the 12 o'clock positions. The 2 nm range ring is not displayed on ranges 20 and 40 nm; instead, a half-range ring is displayed. The half-range ring consists of discrete dashes (cyan). The TCAS operational mode is annunciated in the lower left hand corner of the screen.



**Note:** On the “TCAS ONLY” display “WX ON” will be annunciated in the upper right hand corner if the weather radar is transmitting. See Weather Radar operating guide.

At power-up the screen initially displays the Radar with TCAS Overlay mode. When the Test mode is selected on the TCAS control panel the self test pattern is displayed unless TCAS system failures are detected. If system failures are detected the screen is blanked and a list of faults is displayed.

## WX & TCAS MESSAGE FORMATS

### TCAS Mode Annunciations:

<u>TEXT</u>	<u>Color</u>	<u>Description</u>
TCAS STBY	(Blue)	TCAS in Standby
TEST	(Blue)	TCAS in TEST
TA ONLY	(Blue)	TA ONLY Mode
TA AUTO	(Blue)	TA ONLY Pop-Up

**Note:** When the Radar is placed in Standby, the TCAS mode annunciation is moved to the upper right hand corner and the display is in the WX only or TCAS/WX modes.



***TCAS Fault Annunciations:***

Weather Only and Weather with TCAS Mode.

In the event of a failure, all TCAS information will be removed from the display. One of the following failure messages will be annunciated in the upper left corner of the screen.

<b><u>TEXT</u></b>	<b><u>Color</u></b>	<b><u>Description</u></b>
TCAS	(Yellow)	TCAS System Failure.
GP FAIL	(Yellow)	GC362A Failure.

Additional failure information will be available in the TCAS ONLY mode, if the failure will permit mode change.

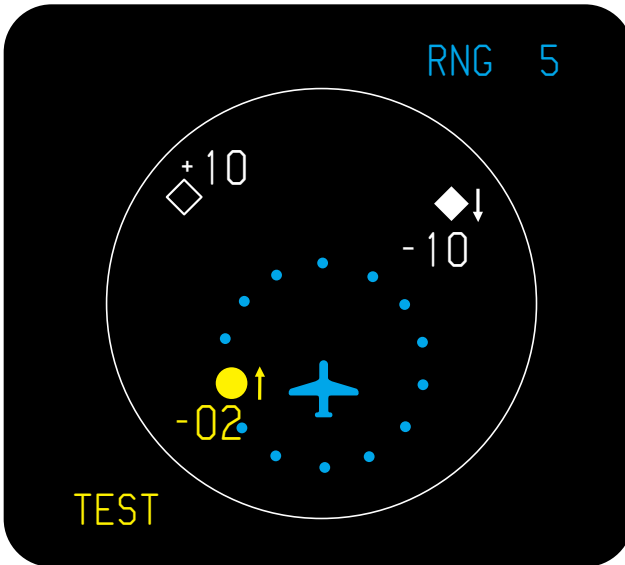
***TCAS ONLY mode***

In the event of a failure, all TCAS Information will be removed from the display. If the failure will disallow mode change, the mode shall revert to the Weather Only mode and the fault shall be displayed as above. Otherwise, one or more of the following failure message will be annunciated in yellow text.

TCAS SYSTEM FAIL	TCAS PROCESSOR
UPPER ANTENNA	LOWER ANTENNA
RADIO ALT #1	RADIO ALT #2
ATTITUDE	HEADING
TRAFFIC DISPLAY #1	TRAFFIC DISPLAY #2
RA DISPLAY # 1	RA DISPLAY # 2
ALT DATA #1 & #2	GP RAM
NO RADAR 429 DATA	NO TCAS 429 DATA

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### SECTION III: OPERATIONAL PROCEDURES



*TCAS I Traffic Display Test Page*

**SECTION III DESCRIBES OPERATION OF THE TCAS I SYSTEM.**

### **TCAS OPERATING PROCEDURES**

TCAS warns the operator with an aural and visual Traffic Advisory whenever TCAS detects another transponder equipped aircraft and predicts the Intruder to be a threat. The pilot should not initiate evasive maneuvers using information from the traffic display only or on a traffic advisory (TA) only, without visually sighting the traffic. These displays and advisories are intended only for assistance in visually locating the traffic and lack the resolution necessary for use in evasive maneuvering. The flight crew should attempt to visually acquire the intruder aircraft and maintain/attain a safe separation in accordance with the regulatory requirements and good operating practice. If the flight crew can not acquire the aircraft, air traffic control should be contacted to obtain any information that may assist concerning the intruder aircraft. Based on the above procedures minor adjustment to the vertical flight path consistent with air traffic requirements are not considered evasive maneuvers.

#### ***BEFORE TAKEOFF***

TCAS should be tested using the pilot initiated self test feature during cockpit preparation. After passing self test, TCAS should remain in SBY before takeoff.

TCAS Traffic on the Radar Display:

If the weather radar indicator is used as the TCAS Traffic Display, select Radar to "STBY", "TST" or "ON". Note that the weather radar RT is radiating when in the radar is On. See the weather radar operator's guide for proper radar operation. Select the "T/WX" (TCAS/Weather) Display Mode switch to display TCAS, i. e., "TA AUTO" or "TA ONLY".

Before taking the active runway, TCAS should be turned ON. Range, if available, may be selected to 10 nm or lower. Above/Norm/Below, if available, may be selected to ABOVE.

#### ***FLIGHT PROCEDURES***

The TCAS TA (traffic advisory) should alert the flight crew to use extra vigilance to identify the Intruding aircraft. Any time the traffic symbol becomes a yellow circle or "TRAFFIC, TRAFFIC" is announced in the cockpit, conduct a visual search for the Intruder. If successful, maintain visual acquisition to ensure safe separation.

Use of the TCAS self-test function in-flight will inhibit TCAS operation for up to eight seconds.

During initial departure, select the 10 nm TCAS range or lower because the traffic density is the greatest near the airport.

During the climb phase of flight, select the 10 nm range or greater and continue to use the Above display volume mode, if available. If a TA occurs, select the 10 nm range or lower on the TCAS traffic display.

During cruise, the longer TCAS ranges may be used. The Above/Norm/Below selection should be NORM. A 10 NM (or greater) range may be selected for high altitude cruise.

During Descent and Approach, Below may be selected using the Above/Norm/Below switch. A TCAS range of 10 nm or lower may be used.

1. If a stall warning occurs during a TA, immediately execute the stall recovery procedure. TCAS will continue to provide TA alerts during a stall warning.
2. If a TA occurs while in the landing configuration, conduct a visual search for the Intruder. A TA does not mandate a missed approach.
3. If a TA is encountered during a high speed buffet, adjust pitch force as necessary to reduce buffet.
4. While it is extremely rare, GPWS or Wind Shear may issue an alert while a TA (traffic advisory) is in progress. If this occurs, TCAS will automatically inhibit the TCAS audio alerts, but visual display of TAs will continue.

### ***AFTER LANDING***

After departing the active runway, TCAS should be turned to Standby (SBY) or Off.

### ***Post Flight***

If a failure of the TCAS system has occurred, give Maintenance as much specific information about the problem as possible. Avoid phrases such as "TCAS Inop." Provide information in terms of fault lights lit, audio announcements, test pattern discrepancies and screen annunciations that indicate which unit was observed to have failed.

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**SECTION IV: SYSTEM CONSIDERATIONS**

*TID 66A/D Traffic Display*

***SECTION IV EXPLAINS CONSIDERATIONS OF THE TCAS I SYSTEM; WARNINGS AND LIMITATION, AND NOTES.***

### LIMITATIONS AND NOTES

#### LIMITATIONS

*Refer to the Airplane Flight Manual .*

#### NOTES

The capability of TCAS is dependent upon the type of transponder in the Intruding aircraft:

The Intruding aircraft must be equipped with a properly operating transponder for normal TCAS operation. TCAS is unable to detect any aircraft without an operating transponder.

If the Intruder is Non-Altitude Reporting (NAR), TCAS will display only the range and bearing. It can issue a TA (Traffic Advisory) based on distance and direction of flight. TCAS assumes Non-Altitude Reporting (NAR) traffic is at the same altitude as your own aircraft.

Intruders considered on the ground by the system will not be displayed.

Wiring options for TCAS also include the following:

- \* TCAS can be wired to display all traffic full time or all traffic only as a result of the presence of a TA.
- \* The maximum number of targets displayed (3 - 30) can be selected by strapping.
- \* The TCAS display may have pilot selectable range or may be a fixed range controlled by the aircraft wiring.
- \* The TCAS system can be automatically placed in standby when the aircraft is on the ground.
- \* The manually initiated system self test can be inhibited in flight.
- \* An aircraft lamp test switch can be wired to control the TID 66A/D & IVA 81A/C/D sequential lamp test.
- \* TCAS can be wired to give GPWS and Wind Shear a higher aural warning priority.

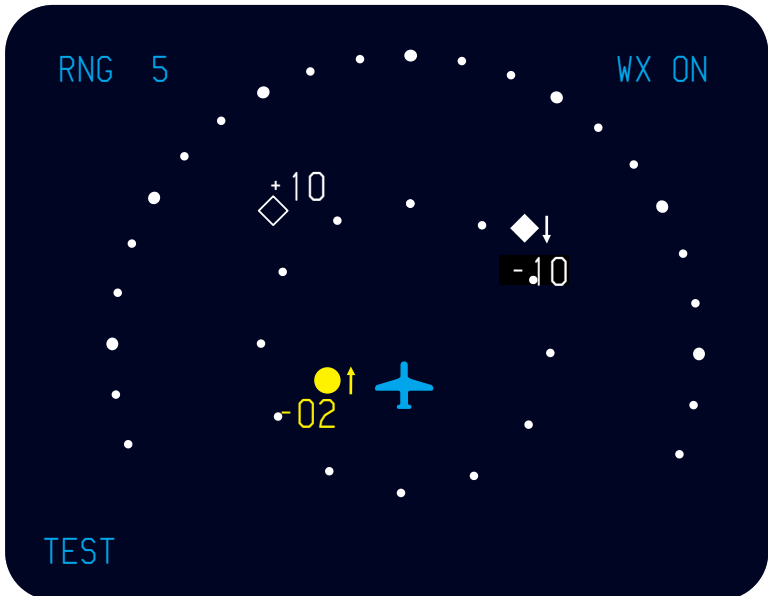
If a radio altimeter is installed, the TCAS I aural warning (TRAFFIC, TRAFFIC) is inhibited below 400 feet AGL during descent and below 600 feet during ascent. If no radio altimeter is installed, then the aural warning is inhibited whenever the Landing Gear is EXTENDED.



**NOTES (CON'T)**

It is possible to see an aircraft flying the same course and direction as your own aircraft, yet TCAS may not consider it a threat. TCAS calculates the closure rate of the Intruder, and derives the time to the Closest Point of Approach (CPA). If there is no closure rate, no advisory will be issued, unless the Intruder is very close (within approximately 0.2 mile). Conversely, traffic at the same altitude very far ahead (about 10 miles) may be shown as a TA by TCAS because of a very rapid closure rate.

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**APPENDIX: TCAS I SELF TEST**

***THE APPENDIX INCLUDES  
A DESCRIPTION OF TCAS I SELF TEST.***

## TCAS SELF TEST

The TCAS self test determines the operational status of the entire TCAS system. Select self test on the TCAS control panel. Once begun, self test continues automatically for approximately eight seconds. During self test, normal TCAS operation is inhibited. For optimum display during self test, selection of the 5 nm range is recommended.

If the traffic display is a weather radar indicator and the indicator is OFF, turn On the indicator before selecting TCAS self test. The warm up time for weather radar indicators is about five seconds.

During the first few seconds of the test sequence, the traffic display allows verification of each type of Intruder symbol. The test generates the symbols arranged as shown. The traffic display annunciates the word TEST. If the weather radar is in the TEST function, this pattern appears over the radar test pattern. If in a weather function, this test appears over the weather.

**Use of the TCAS self test function in flight will inhibit normal TCAS operation for up to 15 seconds. For this reason, the pilot should use caution when initiating the test in flight.**



***IVA 81A/C/D & TID 66A/D TCAS I Test Patterns; 5NM range***

A Traffic Advisory (yellow circle) will appear at 9 o'clock, range of 2 miles, 200 feet below and climbing.

Proximity traffic (solid white diamond) will appear at 1 o'clock, range 3.6 miles, 1000 feet below, descending.

Non-Threat traffic (open white diamond) will appear at 11 o'clock, range of 3.6 miles, flying level 1000 feet above.

At the conclusion of a successful Self Test, a synthesized voice announces:

### **“TCAS SYSTEM TEST OK”**

#### **FAILURE CONDITIONS:**

Should a failure be detected during self test, the audio message says:

### **“TCAS SYSTEM TEST FAIL”**

A “TCAS” flag will be annunciated on the traffic display. A self test failure may indicate that the auxiliary equipment required for TCAS is not operational. Check the associated equipment.

If the traffic display is a radar indicator, the appropriate failure message will be displayed. See WX & TCAS Message Format in Section II: Controls and Displays.

Should a VSI failure be detected at any time, the VSI flag will appear on the TA/VSI (IVA 81A/C/D). A “VSI” flag is not caused by the TCAS processor.

#### **CP 66A/B CONTROL PANEL TEST**

Pressing the TST button on the CP 66A/B initiates a comprehensive TCAS self test lasting approximately eight seconds. The system will return to the previously selected modes when the test is complete.

#### **IVA 81A/C/D & TID 66A/D OPTIONAL LAMP TEST**

The optional lamp test produces an array of traffic in the pattern shown. The climb/descend color bands alternate between green and red, lasting for two seconds each. The bands are blank for a one second interval in between.

**Note:** *The VSI function of the TA/VSI ( IVA 81A/C/D) will not be observed during the lamp test.*

#### **RADIO ALTIMETER**

If RALT is installed and is inoperative, TCAS will be Inoperative.

### GLOSSARY OF TCAS TERMS

#### **ABBREVIATIONS AND DEFINITIONS**

**AFM or AFMS** Airplane Flight Manual or Airplane Flight Manual Supplement.

**AGL** Above Ground Level. Height above the ground.

**ATC** Air Traffic Control. A federally operated ground based system that manages aircraft traffic flow.

**ATCRBS** ATC Radar Beacon System. A ground based secondary radar and airborne transponder system used to monitor traffic.

**Absolute Altitude** The altitude shown on a traffic display is described as Absolute whenever the FL mode has been selected. Otherwise, TCAS displays the Relative Altitude between your own aircraft's pressure altitude and the encoded altitude of the Intruder aircraft.

**Altitude Tag** Data tag shown above or below threat symbol giving the relative altitude of the Intruder.

**BITE** Built-In Test Equipment. A feature of TCAS that continuously monitors itself for operational errors.

**CPA** Closest Point of Approach. CPA refers to predicted point at which the Intruder will be closest to your own aircraft.

**FL** Flight Level. This is a TCAS mode that allows the annunciation of Absolute Altitude on the traffic display. The traffic display will indicate the altitude in hundreds of feet, I. E., 190 is 19,000 feet.

**Indicated Altitude** Altitude shown on the altimeter with barometric correction setting set to local sea level pressure. Indicated altitude is used by the crew below 18,000 feet but not used for TCAS processing.

**Intruder** Any aircraft that is in the surveillance range of TCAS.

**LRU** Line Replaceable Unit. A self-contained avionics component that can be replaced in the field.

**Mode A Transponder** ATCRBS transponder that replies to ATC interrogations sending identification code but without giving altitude data.

**Mode C Transponder** ATCRBS transponder that replies to ATC interrogations giving identification code or encoded altitude data.

**Mode S Transponder** Transponder that replies to ATC interrogations giving an ATCRBS identification code, encoded altitude and other data fields including discrete aircraft address and airspeed capability.

**NAR** Non-Altitude Reporting traffic.

**Non-Threat Intruder** An aircraft that has entered the TCAS surveillance volume at a distance greater than 5 miles or altitude greater than 1200 feet above or below your own aircraft.

**Pressure Altitude** Indicated altitude when barometric pressure is set to 29.92" Hg. (1013mb). Pressure altitude is used by TCAS to determine the relative altitude of traffic.

**Proximity Intruder** An aircraft that is within 5 miles range and within 1200 feet above or below your own aircraft but does not meet the TCAS definition of a threat.

**Rad Alt** or RALT Radio Altitude is the height above the ground as determined by a radio altimeter. RALT is used by TCAS to inhibit TAs close to the surface. Radio altitude above terrain is absolute. As such, RALT height is sometimes referred to as absolute altitude in some systems. RALT systems typically function below 2,500 ft AGL.

**Relative Altitude** The difference in altitude between two aircraft. TCAS calculates relative altitude as the difference between your own aircraft's pressure altitude and the encoded pressure altitude of the Intruder.

**Self Test** A functional test that determines equipment status. Self test differs from BITE performance monitoring because it is initiated by the crew and is not performed continually or automatically.

**Sensitivity Level** TCAS I has two sensitivity levels (SL). SL A shall be automatically invoked using the following order of precedence: (1) when the TCAS aircraft is below 2,000 feet AGL (if equipped with radio altimeter) OR (2) when the landing gear is Extended (no radio altimeter installed). SL B occurs under all other flight conditions. If aircraft is not equipped with either a radio altimeter or retractable landing gear, TCAS I shall stay in SL B at all times.

**Surveillance Volume** The volume of airspace surrounding your aircraft that TCAS scans for Intruding traffic. The TCAS system scans approximately 40 NM in front of and 9000 feet above and below the aircraft. The volume will automatically begin to decrease when flying into a high density area and may be reduced to approximately 15 NM in front of the aircraft.

## Appendix

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**TA** Traffic Advisory. An audio and visual indication that another aircraft is a potential threat.

**TA/VSI** Traffic Advisory/Vertical Speed Indicator. A flight instrument that gives standard VSI indication and plan position of TCAS traffic.

**Threat** An aircraft that has satisfied TCAS threat detection logic and thus requiring a Traffic Advisory.



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