Honeywell

Honeywell
Aerospace Electronics Systems
P.O. Box 97001
Redmond, Washington 98073-9701
U.S.A

Maintenance Manual

CAS-100

Collision Avoidance System

34-45-47

Title Page T-1

Printed in U.S.A. Pub. No. 012-0680-001

1 Dec 2003

Honeywell

MAINTENANCE MANUAL

CAS-100 COLLISION AVOIDANCE SYSTEM

PROPRIETARY NOTICE

This document and the information disclosed herein are proprietary data of Honeywell. Neither this document nor the information contained herein shall be used, reproduced, or disclosed to others without the written authorization of Honeywell, except to the extent required for installation or maintenance of the recipient's equipment.

NOTICE - FREEDOM OF INFORMATION ACT (5 USC 552) AND
DISCLOSURE OF CONFIDENTIAL INFORMATION GENERALLY (18 USC 1905)

This document is being furnished in confidence by Honeywell. The information disclosed herein fall within exemption (b) (4) of 5 usc 552 and the prohibitions of 18 usc 1905.

S2003

RECORD OF REVISIONS

For each revision, put the revised pages in your manual and discard the superseded pages. Write the revision number and date, date put in manual, and the incorporator's initials in the applicable columns on the Record of Revisions. The initial H shows Honeywell is the incorporator.

Revision Number	Revision Date	Date Put In Manual	By	Revision Number	Revision Date	Date Put In Manual	By

THIS PAGE LEFT BLANK

RECORD OF TEMPORARY REVISIONS

Instructions on each page of a temporary revision tell you where to put the pages in your manual. Remove temporary revision pages only when discard instructions are given. For each temporary revision, put the applicable data in the record columns on this page.

Temporary Revision Number	Temporary Revision Date	Temporary Revision Status	Date Put in Manual	By*	Date Removed from Manual	By*

* The initial H is this column shows Honeywell has done this task.

THIS PAGE LEFT BLANK

SERVICE BULLETIN LIST

Service Bulletin	Identified Mod	Date Included in this Manual	Description

THIS PAGE LEFT BLANK

LIST OF EFFECTIVE PAGES

F Indicates a foldout page.

LIST OF EFFECTIVE PAGES

Subheading and Page	Date	Subheading and Page	Date
23	1 Dec 2003	55	1 Dec 2003
24	1 Dec 2003	56	1 Dec 2003
25	1 Dec 2003	57	1 Dec 2003
26	1 Dec 2003	58	1 Dec 2003
27	1 Dec 2003	59	1 Dec 2003
28	1 Dec 2003	60	1 Dec 2003
29	1 Dec 2003	F 61/62	1 Dec 2003
30	1 Dec 2003	F 63/64	1 Dec 2003
31	1 Dec 2003	F 65/66	1 Dec 2003
32	1 Dec 2003	67	1 Dec 2003
33	1 Dec 2003	68	1 Dec 2003
34	1 Dec 2003	69	1 Dec 2003
35	1 Dec 2003	70	1 Dec 2003
36	1 Dec 2003	71	1 Dec 2003
37	1 Dec 2003	72	1 Dec 2003
38	1 Dec 2003	73	1 Dec 2003
39	1 Dec 2003	74	1 Dec 2003
40	1 Dec 2003	75	1 Dec 2003
F 41/42	1 Dec 2003	76	1 Dec 2003
43	1 Dec 2003	F 77/78	1 Dec 2003
44	1 Dec 2003	79	1 Dec 2003
45	1 Dec 2003	80	1 Dec 2003
46	1 Dec 2003	81	1 Dec 2003
47	1 Dec 2003	82	1 Dec 2003
48	1 Dec 2003	83	1 Dec 2003
49	1 Dec 2003	84	1 Dec 2003
50	1 Dec 2003	85	1 Dec 2003
51	1 Dec 2003	86	1 Dec 2003
52	1 Dec 2003	87	1 Dec 2003
53	1 Dec 2003	88	1 Dec 2003
54	1 Dec 2003	89	1 Dec 2003

F Indicates a foldout page.

LIST OF EFFECTIVE PAGES

Subheading and Page	Date	Subheading and Page	Date
90	1 Dec 2003	1009	1 Dec 2003
91	1 Dec 2003	1010	1 Dec 2003
92	1 Dec 2003	1011	1 Dec 2003
93	1 Dec 2003	1012	1 Dec 2003
94	1 Dec 2003	1013	1 Dec 2003
95	1 Dec 2003	1014	1 Dec 2003
96	1 Dec 2003	1015	1 Dec 2003
97	1 Dec 2003	1016	1 Dec 2003
98	1 Dec 2003	1017	1 Dec 2003
99	1 Dec 2003	1018	1 Dec 2003
100	1 Dec 2003	1019	1 Dec 2003
101	1 Dec 2003	1020	1 Dec 2003
102	1 Dec 2003	1021	1 Dec 2003
103	1 Dec 2003	1022	1 Dec 2003
104	1 Dec 2003	1023	1 Dec 2003
105	1 Dec 2003	1024	1 Dec 2003
106	1 Dec 2003	1025	1 Dec 2003
107	1 Dec 2003	1026	1 Dec 2003
108	1 Dec 2003	1027	1 Dec 2003
109	1 Dec 2003	1028	1 Dec 2003
110	1 Dec 2003	1029	1 Dec 2003
F 111/112	1 Dec 2003	1030	1 Dec 2003
F 113/114	1 Dec 2003	1031	1 Dec 2003
Testing and Fault Isolation		1032	1 Dec 2003
1001	1 Dec 2003	1033	1 Dec 2003
1002	1 Dec 2003	1034	1 Dec 2003
1003	1 Dec 2003	1035	1 Dec 2003
1004	1 Dec 2003	1036	1 Dec 2003
1005	1 Dec 2003	Maintenance Practices	
1006	1 Dec 2003	2001	1 Dec 2003
1007	1 Dec 2003	2002	1 Dec 2003
1008	1 Dec 2003	2003	1 Dec 2003

F Indicates a foldout page.

LIST OF EFFECTIVE PAGES

Subheading and Page	Date	Subheading and Page	Date
2004	1 Dec 2003	2035	1 Dec 2003
2005	1 Dec 2003	2036	1 Dec 2003
2006	1 Dec 2003	2037	1 Dec 2003
2007	1 Dec 2003	2038	1 Dec 2003
2008	1 Dec 2003	2039	1 Dec 2003
2009	1 Dec 2003	2040	1 Dec 2003
2010	1 Dec 2003	2041	1 Dec 2003
2011	1 Dec 2003	2042	1 Dec 2003
2012	1 Dec 2003	2043	1 Dec 2003
2013	1 Dec 2003	2044	1 Dec 2003
2014	1 Dec 2003	2045	1 Dec 2003
2015	1 Dec 2003	2046	1 Dec 2003
2016	1 Dec 2003	2047	1 Dec 2003
2017	1 Dec 2003	2048	1 Dec 2003
2018	1 Dec 2003	2049	1 Dec 2003
2019	1 Dec 2003	2050	1 Dec 2003
2020	1 Dec 2003	2051	1 Dec 2003
2021	1 Dec 2003	2052	1 Dec 2003
2022	1 Dec 2003	2053	1 Dec 2003
2023	1 Dec 2003	2054	1 Dec 2003
2024	1 Dec 2003	2055	1 Dec 2003
2025	1 Dec 2003	2056	1 Dec 2003
2026	1 Dec 2003	2057	1 Dec 2003
2027	1 Dec 2003	2058	1 Dec 2003
2028	1 Dec 2003	F 2059/2060	1 Dec 2003
2029	1 Dec 2003	F 2061/2062	1 Dec 2003
2030	1 Dec 2003	F 2063/2064	1 Dec 2003
2031	1 Dec 2003	F 2065/2066	1 Dec 2003
2032	1 Dec 2003	F 2067/2068	1 Dec 2003
2033	1 Dec 2003	F 2069/2070	1 Dec 2003
2034	1 Dec 2003	F 2071/2072	1 Dec 2003

F Indicates a foldout page.

LIST OF EFFECTIVE PAGES

	Subheading and Page	Date	Subheading and Page	Date
F	2073/2074	1 Dec 2003	2120	1 Dec 2003
F	2075/2076	1 Dec 2003	2121	1 Dec 2003
F	2077/2078	1 Dec 2003	2122	1 Dec 2003
F	2079/2080	1 Dec 2003	2123	1 Dec 2003
F	2081/2082	1 Dec 2003	2124	1 Dec 2003
F	2083/2084	1 Dec 2003	2125	1 Dec 2003
F	2085/2086	1 Dec 2003	2126	1 Dec 2003
F	2087/2088	1 Dec 2003	2127	1 Dec 2003
F	2089/2090	1 Dec 2003	2128	1 Dec 2003
F	2091/2092	1 Dec 2003	2129	1 Dec 2003
F	2093/2094	1 Dec 2003	2130	1 Dec 2003
	2095	1 Dec 2003		
	2096	1 Dec 2003		
F	2097/2098	1 Dec 2003		
F	2099/2100	1 Dec 2003		
F	2101/2102	1 Dec 2003		
F	2103/2104	1 Dec 2003		
	2105	1 Dec 2003		
	2106	1 Dec 2003		
	2107	1 Dec 2003		
	2108	1 Dec 2003		
	2109	1 Dec 2003		
	2110	1 Dec 2003		
	2111	1 Dec 2003		
	2112	1 Dec 2003		
	2113	1 Dec 2003		
	2114	1 Dec 2003		
	2115	1 Dec 2003		
	2116	1 Dec 2003		
	2117	1 Dec 2003		
	2118	1 Dec 2003		
	2119	1 Dec 2003		

F Indicates a foldout page.

THIS PAGE LEFT BLANK

TABLE OF CONTENTS

Subject **Page**

List of Illustrations

List of Tables

INTRODUCTION

1. Proprietary, Export, and Precautionary Data

A. Proprietary Notice

(1) This document and the information disclosed herein are proprietary data of Honeywell. Neither this document nor the information contained herein shall be used, reproduced, or disclosed to others without the written authorization of Honeywell, except to the extent required for installation or maintenance of the recipient's equipment. FREEDOM OF INFORMATION ACT (5 USC 552) AND DISCLOSURE OF CONFIDENTIAL INFORMATION GENERALLY (18 USC 1905).

(2) This document is being furnished in confidence by Honeywell. The information disclosed herein fall within exemption (b) (4) of 5 usc 552 and the prohibitions of 18 usc 1905.

(3) Honeywell is a U.S. registered trademark of Honeywell. All other marks are owned by their respective companies.

B. Export Notice

(1) This document contains unrestricted technical data and is being exported under license exception TSUOTS in accordance with EAR Section 740.13(a).

(2) These commodities, technology, or software were exported from the United States in accordance with the export administration regulation. Diversion contrary to U.S. law is prohibited. ECCN: 7E994 Schedule B#4901.99.0050

C. Special Precautions

(1) Warnings, cautions, and notes in this manual give the data that follows:

- A WARNING is an operation or maintenance procedure or condition that, if not obeyed, can cause injury or death.
- A CAUTION is an operation or maintenance procedure or condition that, if not obeyed, can cause damage to the equipment.
- A NOTE gives data to make the work easier or gives directions to go to a procedure.

(2) All personnel who operate equipment and do maintenance specified in this manual must know and obey the safety precautions. The warning and cautions that follow apply to all parts of this manual.

WARNING: BEFORE YOU USE A MATERIAL, REFER TO THE MANUFACTURES' MATERIAL SAFETY DATA SHEETS FOR SAFETY INFORMATION. SOME MATERIALS CAN BE DANGEROUS.

CAUTION: MATERIALS THAT ARE NOT EQUIVALENT TO MATERIALS SPECIFIED BY HONEYWELL. MATERIALS THAT ARE NOT EQUIVALENT CAN CAUSE DAMAGE TO THE EQUIPMENT AND CAN VOID THE WARRANTY.

CAUTION: THE CAS-100 COLLISION AVOIDANCE SYSTEM CONTAINS ITEMS THAT ARE ELECTROSTATIC DISCHARGE SENSITIVE (ESDS). IF YOU DO NOT OBEY THE NECESSARY CONTROLS, A FAILURE OR UNSTATISFACTORY OPERATION OF THE UNIT CAN OCCUR FROM ELECTROSTATIC DISCHARGE. USE APPROVED INDUSTRY PRECAUTIONS TO KEEP THE RISK OF DAMAGE TO A MININUM WHEN YOU TOUCH, REMOVE, OR INSERT PARTS OR ASSEMBLIES.

2. Content Data

A. How to Use This Manual

(1) The instructions in this manual give the data necessary to do all recommended maintenance functions to put the CAS-100 Collision Avoidance System (CAS-100) in serviceable condition. Standard maintenance procedures that technicians are thought to know are not given in this manual.

(2) Refer to the table of contents to see which subheadings are included in this manual. The table of contents identifies those subheadings that are not applicable or require no special instructions.

(3) We recommend that the tests in TESTING AND FAULT ISOLATION be done before the unit is disassembled. These tests can tell the condition of the CAS-100 or most probable cause of any malfunction. Should any malfunction occur, repair as necessary.

(4) Related publications that are referred to in this manual are identified in Table Intro-1.

Table Intro-1. Related Publications

PUBLICATION	PUBLICATION No.	ATA No.
TPA-100A TCAS Processor, Part No. 940-0300-0200, Component Maintenance Manual	012-0739-001	34-45-47
CTA-100A Control Panel, Part No. 1042000, Component Maintenance Manual	012-0738-001	34-45-49
TPT-81A TCAS Interface Test Panel, Part No. 071-50004-8101, Component Maintenance Manual	I.B.1181AT	34-45-02
CTA-81A Control Unit, Part No. 071-01477-XXXX, 071-01503-XXXX, Component Maintenance Manual	I.B. 1181B	34-45-10
ANT-81A Directional Antenna Array, Part No. 071-50001-XXXX, Component Maintenance Manual	I.B. 1181C	34-45-15

Table Intro-1. Related Publications (cont)

PUBLICATION	PUBLICATION No.	ATA No.
AXT-81A TCAS Auxiliary Test Panel, Part No. 071-50012-8101, Component Maintenance Manual	I.B. 1181CT	34-45-04
IVA-81A Traffic Advisory/Vertical Speed Indicator, (TA/VSI), Part No. 066-50001-XXXX, Component Maintenance Manual	I.B. 1181D	34-45-20
IVA-81A Traffic Advisory/Vertical Speed Indicator (TA/VSI), Part No. 066-50001-XXXX, Illustrated Parts Catalog	I.B. 1181D-1	34-45-21
IVA-81B Resolution Advisory/Vertical Speed Indicator, Part No. 066-50002-XXXX, Component Maintenance Manual	I.B. 1181E	34-45-25
CTA-81B Control Unit, Part No. 071-01480-XXXX, 071-01492-XXXX, Component Maintenance Manual	I.B 1181F	34-45-11
ITA-81A Traffic Display, Part No. 066-50003-XXXX, Component Maintenance Manual	I.B. 1181G	34-45-30
CTA-81C Control Unit, Part No. 071-01515-XXXX, Component Maintenance Manual	I.B. 1181J	34-45-12
TRA-67 Mode S Transponder System, Maintenance Manual	I.B. 1167	34-54-11
TRA-67A ATC Transponder, Part No. 066-01127-XXXX, Component Maintenance Manual	I.B. 1167A-1	34-56-36
CNA-67A Control Unit, Part No. 071-01478-XXXX, Component Maintenance Manual	I.B. 1167B	34-54-22
PPI-1T Weather Radar Indicator, Part No. 2041232-XXXX, Component Maintenance Manual	I.B. 1102T	34-41-22
PPI-1U Weather Radar Indicator, Part No. 2041215-XXXX, Component Maintenance Manual	I.B. 1101U	34-41-23
PPI-4B Weather Radar Indicator with TCAS Option, Part No. 2041222-XXXX, Component Maintenance Manual	I.B. 1104B-1	34-41-23

Table Intro-1. Related Publications (cont)

PUBLICATION	PUBLICATION No.	ATA No.
Standard Repair Procedures for Honeywell Avionics Equipment Instruction Manual	A09-1100-004	
Abbreviations for Use on Drawings and in Text*	ASME Y14.38-1999 (Formerly ASME Y1.1-1989)	
Graphic Symbols for Electrical and Electronics Diagrams*	ANSI Y32.2 (1974)	
Standard Letter Symbols for Units of Measurement*	ANSI/IEEE Standard (Std) 260 (1978)	
Graphic Symbols for Logic Functions*	ANSI/IEEE STD 91 (1984)	

NOTES:
1. You can order a Honeywell publication from Honeywell as follows:
   Telephone No. (425) 885-8367
   Fax No. (425) 885-8722
   Email: Sandra.Slick@honeywell.com
2. *Available from the American National Standards Institute, New York, NY

B. Verification

(1) Verification of these technical instructions is done by performance or by simulation of the necessary procedures. Checks of the manual by the engineering staff make sure the instructions and description data agree with the applicable engineering specifications and drawings and are accurate and sufficient. The level of verification for this manual is shown in the list that follows.

Subheading	Level of Verification
Testing and Fault Isolation	By performance, 1 Dec 2003

C. Symbols

(1) The symbols in Figure Intro-1 may be used to identify static sensitive (ESDS) and moisture sensitive devices.

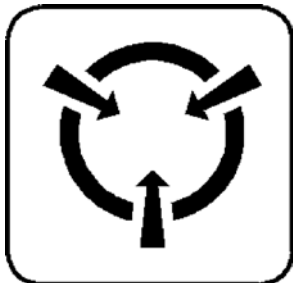


Figure Intro-1. Symbols

D. Weights and Measurements

(1) All weights and measurements are in U.S. values and S.I. (metric values).

(2) The letter symbols for units of measurement are the same as shown in the GPO Style Manual and in ANSI/IEEE Std 260.

E. Acronyms and Abbreviations

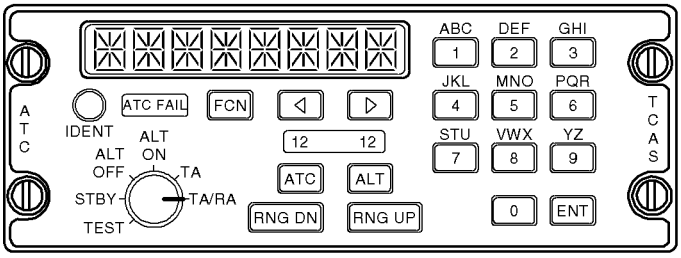
(1) The acronyms and abbreviations that follow help the reader identify terms and definitions used by Honeywell.

(2) The letter symbols for units of measurement are the same as shown in the GPO Style Manual and in ANSI/IEEE Std 260.

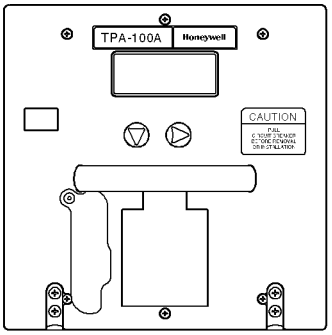
Term	Definition
ADS-B	Automatic Dependent Surveillance - Broadcast
AEEC	Airlines Electronic Engineering Committee
AGL	above ground level
AHRS	attitude/heading reference system
ANSI	American National Standards Institute
ARINC	Aeronautical Radio, Incorporated
ASME	American Society of Mechanical Engineers
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATE	automatic test equipment
BITE	built-in-test equipment
CAS	Collision Avoidance System
CFDS	centralized fault display system
CRT	cathode ray tube
DME	distance measuring equipment
DPSK	differential phase shift keying
DTIF	display traffic information file
ERP	effective radiated power
ESDS	electrostatic discharge sensitive
FAA	Federal Aviation Administration
FDR	flight data recorder
FPM	feet per minute
GPWS	ground proximity warning system

Term	Definition
Hg	mercury
ID	identification
IEEE	Institute of Electrical and Electronics Engineers
I/O	input/output
LBP	left bottom plug
LCD	liquid crystal display
LED	light-emitting diode
LMP	left middle plug
LRU	line replaceable unit
LTP	left top plug
MSL	mean sea level
MTL	minimum trigger level
NAR	non-altitude reporting
NM	nautical mile
No.	number
PC	personal computer
PPI	plane position indicator
RA	resolution advisory
RBP	right bottom plug
RF	radio frequency
RMP	right middle plug
RTCA	Radio Technical Commission for Aeronautics
RTP	right top plug
S.I.	International System of Units
SPI	special position indentifier
Std	standard
TA	traffic advisory
TA/VSI	traffic advisory/vertical speed indicator

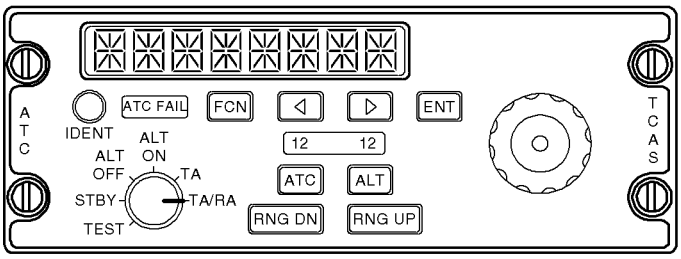
Term	Definition
TCAS	Traffic Alert and Collision Avoidance System
TNC	threaded N connector
TSO	Technical Standing Order
VSI	vertical speed indicator
VSWR	voltage standing wave ratio



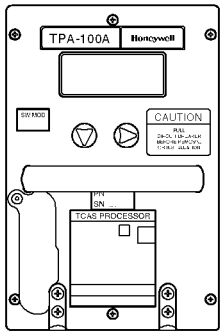
CTA-100A CONTROLLER (KEYPAD)



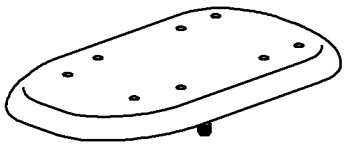
TPA-100A TCAS PROCESSOR (6MCU)



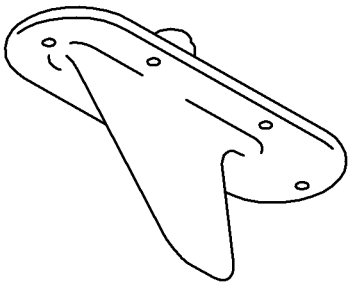
CTA-100A CONTROLLER (ROTARY)



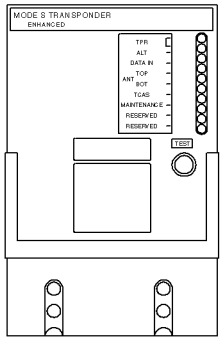
TPA-100A TCAS PROCESSOR (4MCU)



TCAS DIRECTIONAL ANTENNA



TCAS OMNI-DIRECTIONAL ANTENNA



TRA-67A TRANSPONDER (TYPICAL)

ID-130295

CAS-100 Collision Avoidance System Components
Figure 1

THIS PAGE LEFT BLANK

DESCRIPTION AND OPERATION

1. General

This section contains data for the function and the operation of the Honeywell CAS-100 Collision Avoidance System, hereafter referred as the CAS-100, TCAS, or by its full nomenclature. The CAS-100 components are shown in Figure 1.

A. Purpose of Equipment

CAS-100 is an airborne traffic alert and collision avoidance advisory system that operates without the support from Air Traffic Control (ATC) ground stations. The system senses nearby intruder aircraft equipped with transponders that reply to the Air Traffic Control Radar Beacon System (ATCRBS), Mode C, or Mode S interrogations. The danger potential of intruder aircraft to own aircraft is continuously monitored and analyzed by the Traffic Alert and Collision Avoidance System (TCAS). The nearby transponder-equipped aircraft are shown on a traffic advisory display. The TCAS system gives traffic advisory alerts and vertical maneuvering resolution advisories during danger conditions to prevent airborne collisions.

NOTE: The vertical maneuvering resolution advisories given by TCAS are calculated and given against the intruder aircraft that report altitude data in their transponder messages. Traffic advisories are given for nonaltitude reporting (NAR) aircraft only.

A traffic advisory display warns the flight crew to the position of nearby aircraft threats and possible threats. This warning improves the ability of the flight crew to see the intruder aircraft before answering the resolution advisory. The resolution advisories are shown around the edge of a Traffic Advisory/Vertical Speed Indicator.

A Resolution Advisory/Vertical Speed Indicator displays only resolution advisories around its edge. The indicator can be used if the traffic advisories are shown on another display unit.

Detection and tracking of intruder aircraft is performed by transmission and receptions from a top-mounted TCAS directional antenna. This function can also be performed with a bottom-mounted TCAS omnidirectional or bottom-mounted TCAS directional antenna.

TCAS finds the aircraft that uses a Mode S transponder by listening for the Mode S squitter transmissions. Mode S transponders tell their presence by transmitting a squitter message one time for each second. TCAS also finds the aircraft equipped with transponders that do not reply to Mode S interrogations, but do reply to Mode C interrogations. TCAS must search for Mode C equipped intruder aircraft, because Mode C transponders do not transmit squitter messages. When the presence of a Mode S or Mode C intruder is made sure, TCAS starts to track the intruder. TCAS can track a total of 30 Mode S and Mode C intruders.

Repetitious TCAS interrogations in the Mode S and the Mode C formats monitor the aircraft positions. The transponders reply after a set interval when interrogated. The measurement of time between interrogation transmission and reply reception lets TCAS find the range of the intruder. If the intruder transponder uses an altimeter input, TCAS receives the intruder altitude reports in the replies and can find the altitude of the intruder. Transmission and reception procedures for the TCAS directional antennas let TCAS find the bearing of intruder. (If an omnidirectional antenna is used as the TCAS bottom antenna, and the intruder is monitored on the bottom antenna, the intruder bearing cannot be determined. As a result, the traffic display unit will not display the intruder aircraft position.).

TCAS classifies intruders as nonthreat, proximity, traffic advisory (TA), or resolution advisory (RA) threat category aircraft. This classification is based on closing rates and relative position calculated from the reply data. TCAS gives one or more of the following visual and aural aids to the pilot:

- If a directional antenna is tracking the intruder, TCAS displays an intruder aircraft symbol on the traffic advisory display. The symbol position on the display shows relative range and bearing of the intruder. The symbol shape and color identifies if the aircraft is categorized as a nonthreat, proximity, traffic advisory or resolution advisory threat. If the intruder is reporting altitude, intruder relative altitude is shown on the display.

  NOTE: TCAS only categorizes and displays an intruder aircraft as an RA threat if the intruder is reporting altitude. Nonaltitude reporting aircraft are referred to as NARs.

- If the intruder is tracked on a bottom TCAS omni antenna and is categorized as a TA or RA, TCAS gives a TA NO BEARING or RA NO BEARING annunciation on the traffic advisory display.

- If the intruder is categorized as a TA, TCAS gives an aural traffic advisory alert on the cockpit audio system.

- If the intruder is categorized as a RA, TCAS gives an aural resolution advisory alert on the cockpit audio system. This RA category causes a visual vertical maneuvering resolution advisory on the vertical speed indicators (TA/VSIs or RA/VSIs).

A TCAS-equipped aircraft includes a Mode S air traffic control transponder and a transponder/TCAS control unit. The Mode S transponder does the functions required by TCAS and the non-TCAS functions of existing ATCRBS (Modes A and A/C) transponders.

During a condition where two TCAS equipped aircraft are threats to each other, the TCAS and Mode S transponder in each aircraft, establish an air-to-air resolution advisory coordination data link. This link is established to prevent the generation of a similar vertical maneuvering resolution advisories in the two aircraft.

TCAS equipment operates at the same transmit and receive frequencies as ground stations (1030 MHz transmit and 1090 MHz receive). TCAS and ground stations operate at transmit and receive frequencies that are inverse to transponder transmit and receive frequencies shown below:

System	Transmit Frequency	Receive Frequency
Mode S Transponder	1090 MHz	1030 MHz
Mode A/C ATCRBS Transponder	1090 MHz	1030 MHz
TCAS	1030 MHz	1090 MHz
Ground Station	1030 MHz	1090 MHz

TCAS interrogates only in Mode C and Mode S by transmitting 1030-MHz messages through the top and bottom TCAS antennas. TCAS receives 1090-MHz messages from Mode S and ATCRBS Mode A or Mode C transponders through the top directional antenna and the bottom TCAS omni or directional antenna.

If TCAS receives a Mode C reply from a Mode A transponder or a Mode C transponder that is not supplied with altitude data, it will process the reply as a NAR reporting Mode C equipped aircraft.

TCAS does not interrogate in Mode A. However, an aircraft equipped with a minimal transponder that replies to Mode A interrogations, will reply to Mode C interrogations with no altitude-encoded data present in the reply. TCAS tracks such aircraft in bearing and range, and will display the aircraft a nonthreat intruder, proximity intruder, or traffic advisory. However, a resolution advisory will not be generated since the correction maneuver (e.g., fly up, fly down) cannot be determined without intruder altitude data.

B. Equipment Part Numbers

The required and optional TCAS equipment, including aircraft systems are:

- TCAS processor (required equipment)
- Top-mounted directional antenna (required equipment)
- Bottom-mounted omni or directional antenna (required equipment)
- Installation selectable combinations of resolution advisory (TA/VSI or RA/VSI) and traffic advisory displays [TA/VSI, plane position indicator (PPI), dedicated, etc.] (required equipment)
- Mode S transponder (required equipment)
- Required aircraft equipment
- Optional aircraft equipment.

Table 1 lists the equipment type, the Honeywell part numbers, and provides a brief description of the TPA-100A TCAS processor, directional antenna array, omnidirectional antenna, TA/VSI indicator unit, RA/VSI indicator unit, dedicated TCAS traffic display, Mode S transponder, and Mode S transponder/TCAS control units. Table 2 lists accessories for the TPA-100A processor.

NOTE: Many of the units required by the CAS-100 Collision Avoidance System are part of the CAS-81 Collision Avoidance System or TRA-67 Mode S Transponder System. Currently, the only CAS-100 Collision Avoidance System units are the 4MCU and 6MCU TPA-100A TCAS Processor (The 6MCU TPA-100A TCAS Processor Unit is a direct replacement for the TPA-81A TCAS Processor Unit and the CTA-100A TCAS/Mode S Control Panel is a direct replacement for the CTA-81A Control Panel). The TPA-100A TCAS processor is examined in detail in this manual. Other TCAS equipment is examined to a level necessary for understanding total CAS-100 operation. The Mode S transponder and its control units, directional antenna, TA/VSI, RA/VSI, and dedicated TCAS traffic display are examined in detail in separate manuals recorded in Table Intro-1.

Table 1. TCAS System Components (Honeywell Supplied)

Equipment Type	Honeywell Part Number	Description
TCAS Processor TPA-100A	940-0300-001 940-0400-001	The TCAS processor is a tray-mounted ARINC 735A assembly. The processor contains the circuits that control the TCAS system and an L-band rf transmitter/receiver. The TCAS processor controls all surveillance, data acquisition, tracking, advisory, and air-to-air maneuvering coordination functions in the CAS-100 system. The TCAS processor selects directional antenna beams. The processor supplies and transfers pulsed 1030-MHz rf surveillance interrogation data to the TCAS top and bottom antennas and receives 1090-MHz rf reply data from the TCAS antennas. The TCAS processor also examines the reply data and determines the threat potential of intruder aircraft. The TCAS processor supplies ARINC 429 traffic and resolution advisory display data output to the TA/VSI, RA/VSI, and other optional display units. The processor also supplies ARINC 429 control and housekeeping data to the Mode S transponder subsystem. The TCAS processor receives ARINC 429 data that includes coordination, pressure altitude, TCAS control, own identification, and own maximum airspeed from the Mode S transponder.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment	Honeywell Part Number	Description
TCAS Processor (cont)		
TPA-100A (cont)	940-0300-001 940-0400-001	The TCAS processor receives own-aircraft data from on-board aircraft equipment on these inputs: magnetic heading, and pitch and roll attitude on an attitude heading reference system (AHRS) 429 bus or X, Y, Z synchro inputs; radio altitude from 429 digital or analog radio altimeters; discrete inputs from the aircraft switches and straps; discrete advisory inhibit inputs from ground proximity and wind shear warning systems; discrete input from an advisory cancel switch. The TCAS processor outputs a suppression pulse to on-board L-band rf equipment and receives suppression pulses from the same L-band equipment. Voice audio advisory outputs are provided to a cockpit speaker and headphones, and discrete advisory alert outputs are provided to optional tone generators and lamps. Straps are available to select loudness for the speaker and headphones. The TCAS processor input/output (I/O) is equipped to communicate with a centralized fault display system (CFDS) or maintenance computer through a bi-directional ARINC 429 data link and gives airborne test equipment (ATE) equipment test points. ARINC 429 data can be supplied to a digital flight recorder and an ARINC 573 output port is available for a nondigital flight recording.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
TCAS Processor (cont)		
TPA-100A (cont)	940-0300-001 940-0400-001	The TCAS processor monitors the failure status input from external equipment and continuously does built-in-test diagnostics. When functional test is started from the Mode S transponder/TCAS control unit, the TCAS processor does extensive system functional test diagnostics. The front panel liquid crystal display (LCD) has two controls to give the maintenance personnel the ability to check the equipment. The processor contains a front panel Personal Computer (PC) card slot where internal signal data can be recorded on a PC card or data from the PC card can be loaded into the processor. The TCAS processor receives 115 V, 360 to 800 Hz or 28 V dc primary power and 26 V ac synchro reference power from the aircraft power sources.
DIRECTIONAL ANTENNA		
ANT-81A **NOTE 1.**	071-50001	ARINC 735A assembly screw-mounted directly to fuselage of aircraft. Contains an array of four passive, steerable, radiating elements installed at 0°, 90°, 180°, and 270° in the relation to the forward axis of the antenna. During Mode S and ATCRBS Mode C interrogation message transmissions, the directional antenna receives 1030 MHz pulses on the four cabled input from the TCAS processor.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
Directional Antenna (cont)		
ANT-81A (cont)	071-50001	During TCAS receptions, each of the four directional antenna elements accepts any 1090-MHz rf signal that is present. The phasing of these received signals is calculated by the direction that the rf energy is received. These signals are directed on the same four cables that connect transmit signals between the TCAS processor and directional antenna. The ANT-81A is a passive device and does not require input power.
TCAS Omni Antenna		
One TCAS Omnidirectional Antenna **NOTE 2.**	Customer Supplied	The antenna is installed directly to bottom of the aircraft. The antenna is an L-band, blade type dipole antenna. The antenna connects to the TCAS processor through an rf cable. The antenna must have a dc ground for TCAS antenna monitoring. Omni antenna must be approved to one or more of these Technical Standard Order (TSO) specifications: C66b, C74, C112, C119
TA/VSI (Traffic Advisory/Vertical Speed Indicator)		
IVA-81A/IVA-81D **NOTE 3.**	IVA-81A: 066-50001 IVA-81D: 066-01171	Front-panel attached, solid-state display unit. High-resolution, full-color, dot matrix LCD. The unit shows the vertical speed of own aircraft, position of surrounding aircraft traffic, and vertical maneuvering RAs.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
TA/VSI (Traffic Advisory/Vertical Speed Indicator) (cont)		
IVA-81A/IVA-81D (cont)	IVA-81A: 066-50001 IVA-81D: 066-01171	The vertical speed display operates from pneumatic or air data electrical input. The display receives RA, traffic, and TCAS mode data on a high-speed ARINC 429 bus through the TPA-100A TCAS processor. RA command data is shown around the edge of the vertical speed scale. Built-in-test continuously monitors for a loss of primary power, internal IVA-81A/D failures, altitude rate input failures, and gives a discrete display valid status signal to the TCAS processor. The strap inputs are supplied to set the vertical speed input source and system variables. The IVA-81A/D receives 115 V, 400 Hz or 28 V dc primary power and 5 V ac or dc or 28 V dc panel lighting power from the aircraft power sources. The IVA-81A/D requires a ±12 V reference input if an ARINC 575 altitude rate input is used or a 26 V ac reference input if an ARINC 565 analog altitude rate input is used.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
RA/VSI (Resolution Advisory/Vertical Speed Indicator)		
IVA-81B **NOTE 4.**	066-50002	The indicator is a front-panel attached, electro-mechanical display unit. The unit displays vertical speed with a stationary vertical speed scale. A moving electromechanical scale displays vertical maneuvering advisories (RAs) with curved lamp segments around the edge of the vertical speed scale (does not give a display of adjacent intruder traffic). The vertical speed display operates from pneumatic or air data electrical input. The display receives RA and TCAS mode data on a high-speed ARINC 429 bus from the TPA-100A TCAS processor. Built-in-test continuously monitors for missing primary power, internal IVA-81B failures, altitude rate input failures, and supplies a discrete display valid status signal to the TCAS processor. The IVA-81B receives 115 V, 400 Hz primary power and 5 V ac or dc panel lighting power from the aircraft power sources. The IVA-81B requires a ±12 V reference input if a ARINC 575 altitude rate input is used or a 26 V ac reference input if a ARINC 565 analog altitude rate input is used.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
Dedicated TCAS Traffic Display		
ITA-81A	066-50003	The ITA-81A is a front-panel attached cathode ray tube (CRT) TCAS display unit. The display receives the traffic and TCAS mode data on a high-speed ARINC 429 bus from the TPA-100A TCAS processor. The unit displays an aircraft symbol and range rings with TCAS traffic and mode. The ITA-81A receives 115 V 400 Hz primary power and 5 V ac panel lighting power from the aircraft power sources.
TRA-67 Transponder Subsystem		
TRA-67A Mode S Transponder **NOTE 5.**	066-01127	The TRA-67A transponder is a tray attached ARINC 718A assembly. The transponder contains a microprocessor based Mode S/ATCRBS transponder control and processing unit. The unit also contains an L-band rf transmitter/receiver, and various synchro discrete and digital interface networks. A Mode S transponder transmits 1090-MHz Mode S or ATCRBS reply messages when it receives appropriate 1030-MHz Mode S or ATCRBS interrogations from other TCAS equipped aircraft or air traffic control ground stations. Mode S interrogations contain a unique aircraft address identification. Only the Mode S transponder assigned to that address will reply. ATCRBS interrogations do not contain a transponder address. If the transponder is connected to equipment that measures pressure altitude, the Mode S or ATCRBS Mode C reply will contain the pressure altitude.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
TRA-67 Transponder Subsystem (cont)		
TRA-67A Mode S Transponder (cont)	066-01127	Once for each second of time, Mode S transponders automatically transmit a squitter message that contains its aircraft address identification. These squitter messages tell other TCAS equipped aircraft and ground stations that the Mode S equipped aircraft is present. The Mode S transponder in TCAS equipped aircraft is connected to the TCAS processor with a two-direction ARINC 429 data link. Many data link communications between the TCAS processor and Mode S transponder are continuously interchanged. The CTA-81( ) Control Unit gives on-board control for manually selecting Mode S transponder and TCAS operating modes. Mode control data from the control unit is connected into the Mode S transponder and moved to the TCAS processor through ARINC 429 data links. A change to TCAS operating modes (i.e. sensitivity levels) can be requested from future Mode S ground stations through the messages received by the Mode S transponder. The Mode S transponder moves this mode control request data to the TCAS processor through the ARINC 429 data link. The TCAS processor routinely moves operating mode status data to the Mode S transponder. When a request from a ground station is made, the operating mode status data is put in(to) a message transmitted from the Mode S transponder.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
TRA-67 Transponder Subsystem (cont)		
		Through the directional TCAS antenna, all TCAS equipped aircraft at intervals transmit a message that tells other TCAS equipped aircraft that a TCAS equipped aircraft is present. The Mode S transponders receive the broadcast messages and tell the TCAS processor through the ARINC 429 data link that a broadcast message was received. The ARINC 429 data link is also used to move the maximum airspeed, pressure altitude, aircraft address identification, and TCAS coordination message data from the transponder to the TCAS processor. The TCAS processor also moves housekeeping and coordination update data to the transponder. Built-in-test equipment software continuously monitors for internal transponder failures, transponder control unit failures, transponder antenna failures, pressure altitude input failures, and ARINC 429 data failures. Detailed transponder subsystem failure status is reported to the TCAS processor through the 429 data link. A failure of the transponder or transponder control unit causes the FAIL light on the transponder control unit to come on.

Table 1. TCAS System Components (Honeywell Supplied) (cont)

Equipment Type	Honeywell Part Number	Description
TRA-67 Transponder Subsystem (cont)		
TRA-67A Mode S (cont)	066-01127	The Mode S transponder receives 115 V 400 Hz from an aircraft power source. If a synchro altitude source input is used, the transponder receives 26 V ac synchro reference power from an aircraft power source. The transponder is connected to the aircraft suppression bus.
Mode S Transponder /TCAS Control Units CTA-81A CTA-81B	 071-01477 071-01503 071-01480 071-01492	The Mode S Transponder/TCAS Control Units are panel-mounted ARINC 718/735A assemblies. The units contain a front mounted transponder/ TCAS mode control, altitude reporting on/off control, transponder ATC identification code select controls, and a special identifier pushbutton. The unit also contains a transponder failure indicator and ATC IDENT code display. The Mode S transponder/TCAS control unit moves the control data and failure status data to the Mode S transponder. The control unit FAIL annunciator receives the failure status from the Mode S transponder through a discrete monitor signal line. The Mode S transponder/TCAS control unit receives 115 V 400 Hz and lighting power from the aircraft power sources. A separate fault lamp source is necessary and cannot be turned fully off (day/night).
CTA-100A **NOTE 6.**	1042000-101 through -499 for Keypad entry models. 1042000-501 through -999 for Rotary Control entry models.	The CTA-100A is designed to be a drop-in functional replacement for the Honeywell CTA-81A, 81B, 81C, and 81D controllers. The controller provides data from the front panel to the system using ARINC 429 databuses and discrete interface signals.
Two Transponder Omnidirectional Antennas		The antennas are attached directly to the top and bottom of the aircraft. The units have an L-band blade type dipole antenna. The antennas are connected to the Mode S transponder through rf cables. Omni antennas must be approved to a minimum one of these TSO specifications: C66b, C74, C112, C119

Table 1. TCAS System Components (Honeywell Supplied) (cont)

NOTES:

1. One or two directional antennas can be used in a CAS-100 system. A top-mounted ANT-81A is always necessary. To find intruder bearing on bottom antenna, an ANT-81A must be installed on the bottom of the aircraft.
2. Used if ANT-81A directional antenna is not used for bottom TCAS antenna.
3. IVA-81A/D used if traffic displays are not provided on another display unit (i.e. PPI or TCAS dedicated traffic display unit) or if user requires RA and TA displays on the same unit.
4. IVA-81B is used if pointer traffic resolution displays are given on another display unit (i.e. PPI or TCAS dedicated traffic display unit) and user does not require RA and TA displays on the same unit.
5. The fundamentals of TRA-67 Mode S Transponder System operation in the CAS-100 system are shown in this manual. For more Mode S transponder and Mode S transponder control unit details, refer to TRA-67 ATC Mode S Transponder System Manual, I.B. 1167 and related Component Maintenance Manuals (refer to Table Intro-1. in the INTRODUCTION section).
6. The purpose and function for the different control units are given in paragraph 7 (Controls and Indicators) in this section of this manual.

C. TCAS Accessories

Table 2 lists accessories for the TPA-100A processor. Accessories for the dedicated display, directional antenna, TA/VSI, RA/VSI, and the Mode S transponder system are shown in applicable maintenance manuals. Refer to Table 5.

Table 2. TCAS Accessories

Equipment Type	Honeywell Part Number	Description
TCAS Processor Installation Kit-Connector	050-50000-0501	The installation kit supplies parts for assembling the TCAS processor mounting tray connector.
TCAS Processor Coax Termination Kit (requires four per directional antenna) Cable Type: RG-214 RG-393 AA-5886 AA-5887, FC-28 AA-5888 ECS-311201	 050-50005-0501 050-50005-0502 050-50005-0503 050-50005-0504 050-50005-0505 050-50005-0506	The termination kit supplies parts for connecting the directional antenna cable to the TCAS Processor mounting tray.

D. Aircraft Equipment Required But Not Supplied By Honeywell

Table 3. lists aircraft equipment not supplied by Honeywell, but required for CAS-100 operation.

Table 3. Aircraft Equipment Required But Not Supplied By Honeywell

Aircraft Equipment	Description
115 V 360-800 Hz or 28 V dc Power Source	The primary power source for TA/VSI, RA/VSI, dedicated TCAS traffic display, and Mode S Transponder System. The primary power source for TCAS Processor (115 V 360-800 Hz or 28 V dc)
26 V 400 Hz Reference Power Source	Synchro reference voltage for attitude (pitch and roll) and heading gyros.
5 V ac or dc or 28 V dc Lighting Bus	Panel lighting power source for TA/VSI, RA/VSI, and dedicated TCAS traffic display.
5 V ac or 28 V dc Power Source (separate)	Fault lamp power for Mode S transponder/TCAS control unit.
ARINC 429 Attitude/Heading Reference System (digital) OR Magnetic Compass Unit, Pitch Gyro, and Roll Gyro (synchro)	Supplies the aircraft pitch, roll, and heading on an ARINC 429 digital input to the TCAS processor. Supplies the aircraft heading, pitch, and roll on three isolated 3-wire, synchro input to the TCAS processor for each ARINC 407.
Radio Altimeter, digital type (one or two) OR Radio Altimeter, analog type (one or two)	Supplies the aircraft altitude on an ARINC 429 digital input to the TCAS processor. Supplies the aircraft radio altitude on a 2-wire, dc analog input to the TCAS processor (see Figure 2015 in the MAINTENANCE PRACTICES section for all types of altimeters that may be connected).

Table 3. Aircraft Equipment Required But Not Supplied By Honeywell (cont)

Aircraft Equipment	Description
Aircraft Switches Landing Gear Switch	Supplies the aircraft landing gear extended or retracted discrete status input to the TCAS processor.
Air/Ground Switch	Supplies the aircraft on-the-ground/ in-flight discrete status input to the TCAS processor.
Suppression Bus	Supplies mutual suppression of L-band equipment on the aircraft including the TCAS processor bi-directional bus.
Static Input Source (pneumatic) OR Altitude Rate Source (electrical)	Supplies the aircraft static pressure source input to the TA/VSI or RA/VSI. Supplies the aircraft altitude rate on an electrical ARINC 429, ARINC 565, or ARINC 575 input to the TA/VSI or RA/VSI.
Pressure Altimeter Source	Supplies the aircraft pressure altitude input to the Mode S transponder. Refer to the applicable Mode S transponder system maintenance manual for the types of pressure altimeters that can be used with the Mode S transponder.
Cockpit Speaker	Audio speaker, 8 ohms, 4 watts nominal. Annunciates voice advisory messages from the voice synthesizer in TPA-81A TCAS processor.
Miscellaneous Installation Hardware	Assembly brackets, wire, cables, nuts, bolts, screws, and etc.

E. Aircraft Optional (Nonessential) Equipment

Table 4 lists TCAS and aircraft equipment that is optional for each user specification.

Table 4. CAS-100 and Aircraft Optional Equipment

Optional Aircraft Equipment	Description
Cockpit Headphones	Augments cockpit speaker by providing headset annunciations for verbal advisory alert messages from the voice synthesizer in TPA-100A TCAS Processor.
External Tone Generator and/or Warning Indicator Lamps	Supply more visual and audible tone annunciations for advisory alerts from TPA-100A TCAS Processor.
Advisory Cancel Switch	Lets flight crew to cancel verbal advisory alerts on the cockpit speaker, cockpit headphones, tone generators, and alert lamps.
PPI Modified to Provide TCAS Traffic Displays **NOTE**	Supplies isolated or total displays of weather/map data and TCAS traffic data. The display modes are selectable from the changed PPI control panel.
ARINC 429 (Digital) or ARINC 573 (Non Digital) Flight Recorder	Records TCAS data. The digital data is received on a low-speed ARINC 429 data bus from the TPA-100A TCAS Processor. The nondigital data is received as ARINC 573 parallel data from the TPA-100A TCAS Processor.
ARINC 429 CFDS or Maintenance Computer	Provides and receives the test diagnostic data on a low-speed ARINC 429 bus into the TPA-100A TCAS Processor and shows fault analysis data received on a low-speed ARINC 429 bus from the TPA-100A TCAS Processor.
Data Recorder	PCMCIA card to monitor the internal signals.

Table 4. CAS-100 and Aircraft Optional Equipment (cont)

Optional Aircraft Equipment	Description
Performance Management Computer	Supplies the aircraft climb rate performance limit discrete input to the TPA-100A TCAS Processor.
Wind Shear System and/or Ground Proximity System	Supplies the TCAS advisory inhibit discrete input to the TPA-100A TCAS Processor during wind shear or ground proximity alarm conditions.
ARINC 615 Data Loader (airborne or portable)	Reprograms the TCAS processor program memory without requiring physical access to the unit. Programming is done through ARINC 429 input and output ports on the TCAS processor rear connector or a dedicated data loader connector on the front panel. The data loading can be done at the low-speed or high-speed ARINC 429 data transfer rate. A data loader adapter cable (Honeywell Part No. 300-80179-0501) is supplied to connect a portable data loader to the TCAS processor front panel connector.
NOTE: PPI display shows independently or total radar and TCAS traffic on the same display.	

F. Related Publications

Table Intro-1. lists related publications including the subsystems and units comprising the CAS-100 Collision Avoidance System and test equipment supporting the system.

2. System Configurations

A. System

The total CAS-100 system configuration is dependent on the equipment available in the applicable aircraft.

The following text gives the available configurations and features for the TCAS processor.

NOTE: Available configurations and features for the Mode S transponder and the control units, are shown in isolated manuals (refer to Related Publications, Table Intro-1.).

B. TPA-100A TCAS Processor

Table 5 lists the available configurations of the TCAS processor and the related features. Table 6 contains or references a short description of the processor features that are not self-explanatory.

Table 5. TPA-100A TCAS Processor, Available Configurations

Part Numbers 940-0300 and 940-0400	Features								
	Basic Unit								
-001	X								

Table 6. TPA-100A TCAS Processor Features

Feature	Description
Basic Unit	Supplies primary function and control for CAS-100. Long range active surveillance. Passive (ADS-B) only surveillance. DTIF (Strap selectable). ARINC 615-3 DL. PCMCIA. Front panel LCD maintenance interface. 4 or 6 MCU.

3. System Leading Particulars

A. TCAS Surveillance Volumes

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

(1) Range Tracking Volumes

The shape and size of the range tracking volume depends on:

- If Mode S or ATCRBS transponders are being interrogated
- If tracking is occurring on a directional or OMNI antenna
- The attenuation levels applied to the transmitted pulses from the TCAS processor's transmitter.

NOTE: The TCAS processor decreases range tracking volumes in high density areas to decrease the number of receptions to be processed by TCAS and for interference limiting.

(2) Altitude Tracking Volumes

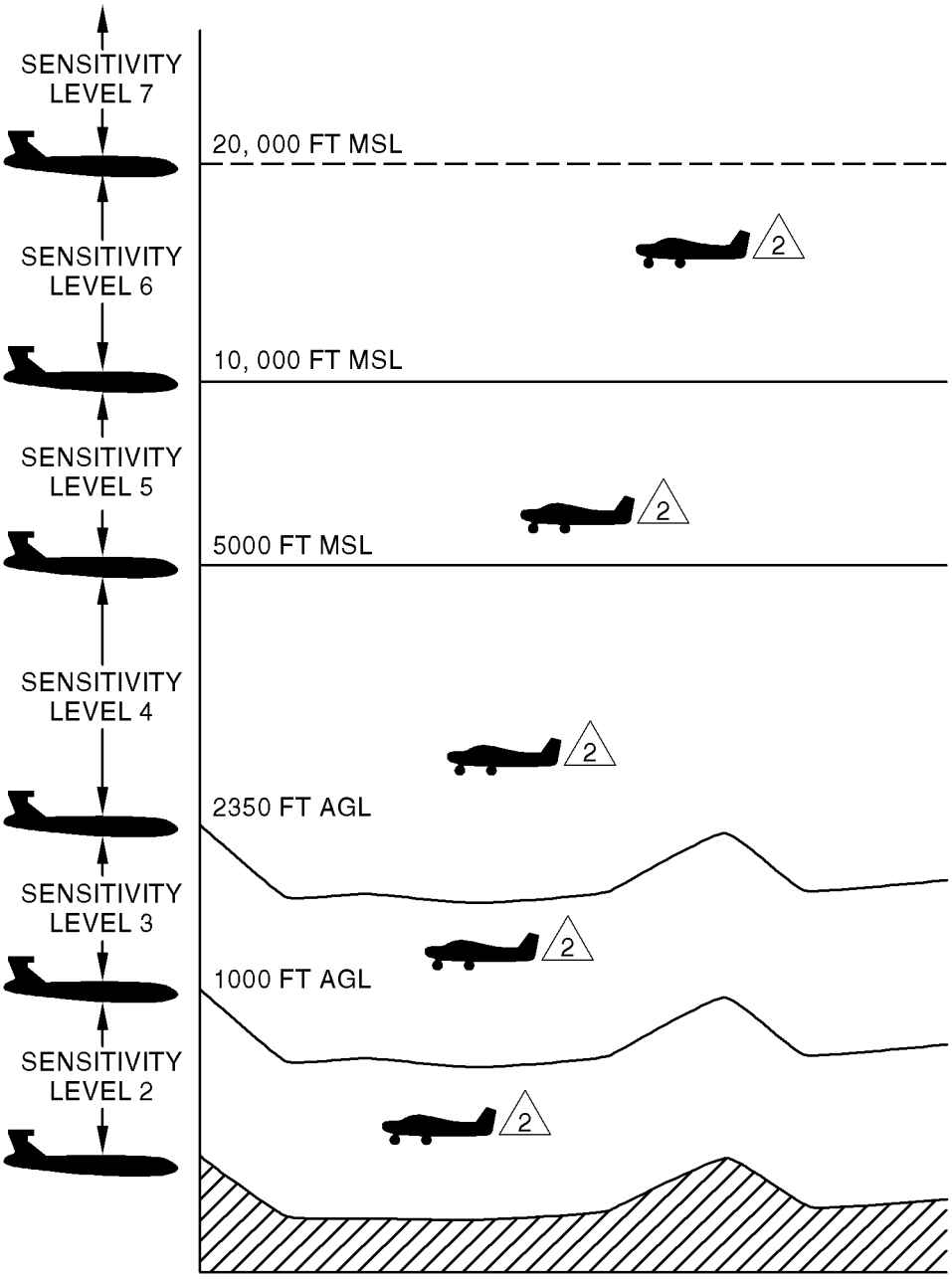
TCAS tracks other transponder equipped aircraft that are in a relative altitude range of ±10,000 feet.

NOTE: The display altitude volumes are different from the internal tracking volumes. The typical display volumes are ±8700 feet.

B. TCAS Sensitivity Level - Operating Modes

TCAS logic separates the adjacent airspace into the altitude layers as shown in Figure 2. A different sensitivity limit level for issuing RAs and TAs is applied to each altitude layer. Lower altitudes have less sensitive RA and TA limit levels to prevent unwanted advisories in the higher traffic densities anticipated at lower flight levels, i.e. terminal areas.

The following TCAS sensitivity level, resolution advisory, and traffic advisory specifications data is given as an aid to help the reader understand basic TCAS operation. The data in this manual can be superseded by the data in the Minimum Operational Performance Standards document and the latest Honeywell software documentation.



NOTES:

1. When radio (AGL) and pressure altitude (MSL) select different sensitivity levels, the lower level is selected.

2 See RA and TA criteria per sensitivity levels in Table 7.

CAS-100 Sensitivity Level Altitude Layers
Figure 2

Table 7 gives data related to sensitivity level determinations and Figure 3 gives data related to the conditions for resolution and traffic advisory limits compared to sensitivity levels. This data is used as a reference during this manual

Table 7. TCAS Sensitivity Level Determinations

Mode	Description
Sensitivity Level 0	Sensitivity level is set in automatic mode by the altitude or by the ground command. Sensitivity level 0 is set manually when the control unit function switch is in the TA/RA mode position (in-flight). This selection sets all TCAS surveillance, tracking, and resolution advisory functions.
Sensitivity Level 1	TCAS stops all surveillance, tracking, and resolution advisory functions in sensitivity level 1. The traffic advisory display is blanked, but for a STANDBY mode annunciation. The conditions for sensitivity level 1 are any one of the following: (1) CTA-100A or KFS-578A Control Unit function switch is set to TEST, STBY, ALT OFF, or ALT ON. (2) CTA-100A Control Unit function switch is set to ATC 1 TEST, ATC 1 STBY, ATC 1 ON, or any ATC 2 position, or ALT SOURCE switch set to OFF position. (3) TCAS is in STANDBY mode or TEST mode. (4) TCAS has failed.
Sensitivity Level 2	TCAS does surveillance and tracking functions in sensitivity level 2. TCAS gives traffic advisories only. The conditions for sensitivity level 2 are any one of the following: (1) Own aircraft is in-flight and TA or TA/RA is below 1000 feet above ground level (AGL). (2) Own aircraft is in-flight and transponder/TCAS control unit is set to TA. (3) Own aircraft is on the ground and transponder/TCAS control unit is set to TA or TA/RA.

Table 7. TCAS Sensitivity Level Determinations (cont)

Mode	Description
Sensitivity Level 3, 4, 5, 6, and 7	TCAS does surveillance and tracking functions in sensitivity levels 3 through 7. TCAS gives resolution and traffic advisories in these levels. **NOTE** The conditions for sensitivity level 3 through 7 are from own aircraft altitude as follows: (1) Sensitivity level 3 - Own aircraft altitude is between 1,000 and 2,350 feet AGL (radio altitude). (2) Sensitivity level 4 - Own aircraft altitude is between 2,350 feet AGL and 5,000 feet mean sea level (MSL) (pressure altitude). (3) Sensitivity level 5 - Own aircraft altitude is not higher than 10,000 feet MSL. (4) Sensitivity level 6 - Own aircraft altitude is 10,000 to 20,000 feet MSL. (5) Sensitivity level 7 - Own aircraft altitude is above 20,000 feet MSL.
NOTE: The transponder TCAS control panel must be set to the TA/RA mode for sensitivity levels 3 through 7.	

	Own Altitude (feet) See note		Up to 1000 AGL	1000 to 2350 AGL	2350 to 5000 AGL	5000 to 10,000 MSL	10,000 to 20,000 MSL	20,000 to 42,000 MSL	Above 42,000 MSL
	Sensitivity Level	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**7**
Traffic Advisory (TA) Parameters	**TA Alarm Time (seconds)**	TCAS is OFF	20	25	30	40	45	48	48
	TA Protection Volume (nmi)		0.30	0.3330	0.48	0.75	1.0	1.3	1.3
	TA Relative Altitude Threshold (feet)		850	850	850	850	850	850	1200
Resolution Advisory (RA) Parameters	**RA Alarm Time (seconds)**		Resolution Advisory not Generated at Sensitivity Level 2	15	20	25	30	35	35
	RA Protection Volume (nmi)			0.20	0.35	0.55	0.80	1.10	1.10
	Corrective RA Relative Altitude Threshold (feet)			300	300	350	400	600	700
	RA Relative Altitude Threshold (feet)			600	600	600	600	700	800

Note: When radio altitude (AGL) and pressure altitude (MSL) select different sensitivity levels, then the lower level is used by the TCAS.

Typical Resolution Advisory and Traffic Advisory Volumes for Sensitivity Levels
Figure 3 (Sheet 1 of 2)

These two conditions cause a Traffic Advisories (TAs) problem:

1. TCAS calculates that at the current closure rate and distance, the time separating own aircraft and intruder aircraft is less than TA Alarm Time

   AND

   the altitude difference between own aircraft and intruder aircraft is less than the TA Relative Altitude Threshold.

2. The separation in slant range between own aircraft and intruder aircraft is less than minimum TA Protection Volume.

These two conditions cause Resolution Advisories (RAs) to be issued:

1. TCAS calculates that at the current closure rate and distance, the time separating own aircraft and intruder aircraft is less than RA Alarm Time.

   AND

   the altitude difference between own aircraft and intruder aircraft is less than the RA Relative Altitude Threshold.

2. The separation in slant range between own aircraft and intruder aircraft is less than minimum RA Protection Volume.

Determining if the Resolution Advisory is Corrective or Preventive:

The resolution advisory is corrective if the altitude difference between own aircraft and the intruder aircraft is less than the Corrective RA Relative Altitude Threshold.

Typical Resolution Advisory and Traffic Advisory Volumes for Sensitivity Levels
Figure 3 (Sheet 2 of 2)

C. Component Leading Particulars

(1) Leading Particulars

Leading particulars for the TPA-100A TCAS Processor are given in Table 8. Leading particulars for the ANT-81A Directional Antenna are given in Table 9. Leading particulars for the IVA-81A TA/VSI are given in Table 10. Leading particulars for the IVA-81B RA/VSI are given in Table 11. Leading particulars for the IVA-81D TA/VSI are given in Table 12. Leading particulars for the ITA-81A Traffic Display are given in Table 13. Leading particulars for the Mode S transponder components are given in TRA-67 Mode S ATC Transponder System Maintenance Manual I.B. 1167.

Table 8. TPA-100A TCAS Processor, Leading Particulars

Characteristic	Description
TSO	C-119b
Form Factor	4 or 6 MCU, ARINC Specification 600
Weight (Approximate)	14 lb (6.3 kg)
Overall Dimensions	See Outline Drawing, Figure 2006 in the MAINTENANCE PRACTICES section of this manual.
Power Requirements	115 V, 400 Hz, 110 watts and 26 V ac synchro reference power per ARINC 413A
	28 V dc 160 Watts
Cooling	ARINC Specification 600. Forced air cooling is optional.
Temperature Range	
Operating	-55C to +70C
Storage	-55C to +85C
Transmitter	
Frequency	1030.00 ± 0.01MHz
Radio Frequency (RF) Peak Output Power at Rear Connector	54.0 ± 2 dBm
Interrogation Repetition Interval	1 second
Pulse Width, Rise and Fall Times	DO-185A
Receiver	
Frequency	1087 to 1093 MHz
Minimum Trigger Level (MTL)	
For Standard ACAS	-74 dBm ± 2 dBm at Antenna
For Extended Performance	-84 dBm ± 2 dBm at Antenna

Table 8. TPA-100A TCAS Processor Leading Particulars (cont)

Characteristic	Description
Receiver (cont)	
Dynamic Minimum Trigger Level (DMTL) Threshold	
ATCRBS	MTL + 13 dB
Minimum Pulse Width	300 nsec
Maximum Pulse Rise Time	0.5 μsec
Delay Difference (between top and bottom antenna channels, including transmission lines)	0.050 μsec
General Requirements:	
Surveillance Volume Range Tracking Volumes	The shape and dimension of the range tracking volume is dependent on: • the Mode S or ATCRBS transponders are being interrogated • tracking is occurring on a directional or omni antenna • attenuation levels applied to the transmitted pulses from the TCAS processor transmitter. **NOTE**
Altitude Tracking Volumes	TCAS II tracks other transponder-equipped aircraft that are in a relative range of ± 10,000 feet.
Surveillance Capacity	Minimum of 60 tracks. The 30 closest intruders go to Collision Avoidance Algorithms.
Processor Mode S Address Capacity	Minimum of 150 addresses of defected Mode S equipped aircraft.
System Delay	Resolution advisory within 1.5 seconds after threat intruder is detected.
Voice Synthesizer Output Power (speaker)	4 Watts into 8 ohms (pin programmable to lower output)
Phone Output	40 mW into 600 ohms (pin programmable to lower output)

NOTE: The TCAS processor reduces range tracking in high density areas to reduce the number of receptions to be processed by TCAS and for interference limiting.

Table 9. ANT-81A TCAS Directional Antenna Leading Particulars

Characteristic	Description
Form Factor	ARINC 735A (teardrop shape)
Antenna Base Types	Curved base (071-50001-8104) Flat base (071-50001-8102, -8103)
Temperature Range	
Operating	-55C to +70C
Storage	-55C to +85C
Maximum Weight	2.0 lb (0.91 kg)
Overall Dimensions	See Outline Drawings, Figures 2007 thru 2009.
Antenna Mounting Footprint	See Figure 2010.
Antenna Mounting	Mounts directly to aircraft using mounting screws defined in Figures 2007 thru 2009. An antenna adapter (Figure 2010) is available for mounting flat-base antenna on a curved surface.
Exterior Material	High-strength composite
Number of Antenna Array Elements	Four
Polarization	Vertical
Power Requirements	None
Transmission Frequency	1030 ±1 MHz
Receiving Frequency	1090 ±3 MHz
Connectors	
Quantity	Four
Type	See Outline Drawings, Figures 2007 thru 2009.
Pressurization	Withstands a pressure differential of 25 P.S.I.A.
Lightning Protection	Meets swept zone 2A lightning strike requirements.

Table 9. ANT-81A TCAS Directional Antenna Leading Particulars (cont)

Characteristic	Description
Main Beam Characteristics	
Operational Beam Positions	4
Half Power Azimuth Beam Width (measured over -15 to +20 elevation)	≥ 90°
Steering Quantization	90°
Omni Beam Characteristics	
Operational Beam Positions	360°
Beam Null Compared to Main Beam (at each elevation from -15 to +20)	≥ 9 dB
Input Port VSWR	1.5:1 maximum
Antenna Cable Loss Requirement	2.5 ± 0.5 dB at 1030 MHz for each coaxial cable including connectors.
Antenna Cable Differential Phase Delay	One-half wavelength maximum (approximately 5 inches)
Maximum Peak Input Power	1000W pulsed
Maximum Average Input Power	10W continuous
ARINC Characteristic	ARINC 735A
TSO	C119a (C119b for change 7 units)
Environmental Certification	In addition to environmental requirements defined in Table 14, an altitude immersion environmental requirement requires that the antenna not outgas at an altitude of 55,000 feet when submersed in water for 30 minutes.

Table 10. IVA-81A TA/VSI Leading Particulars

Characteristic	Description
Form Factor	3ATI x 7.5 inches deep
Components	Solid state, no mechanical parts
Maximum Weight	2.75 lb (1.25 kg)
Overall Dimensions	See Outline Drawing, Figure 2011.
Mounting	Front, panel mount
Power Requirements	115 V, 400 Hz, 28 Watts (maximum), or 28 V dc primary power ±12 V dc reference power if altitude rate source input is ARINC 575 analog 26 V ac reference power if altitude rate source input is ARINC 565 analog 5 V ac or dc or 28 V dc lighting power
Operating Temperature Range	-15C to +70C
Number of Intruder Aircraft Displayed	Determined by TCAS processor TA/RA display symbols maximum program strap configuration.
Display	High resolution, full color dot matrix LCD. Combination vertical speed, RA, and traffic display.
Vertical Speed Input	The IVA-81A meets the requirements of both type B and type C VSI indicators. Pneumatic or air data electrical input. Both ARINC 500 and 700 series air data input accepted.
Inputs from TCAS	High-speed ARINC 429
Front-Mounted Range Control	Optional
Front-Mounted TA SEL Switch and BRT Control	Optional

Table 10. IVA-81A TA/VSI Leading Particulars (cont)

Characteristic	Description
Pneumatic Connector (located on indicator rear panel)	See Outline Drawing, Figure 2011.
Electrical Connector (located on indicator rear panel)	See Outline Drawing, Figure 2011.
TSO	C119a, C8c
Environmental Certification	Refer to Table 14.

Table 11. IVA-81B RA/VSI Leading Particulars

Characteristic	Description
Form Factor	3ATI x 7.5 inches deep
Components	Electromechanical and solid state
Maximum Weight	2.9 lb (1.3 kg)
Overall Dimensions	See Outline Drawing, Figure 2012.
Mounting	Front, panel mount
Power Requirements	115 V 400 Hz, 20 watts primary power
	±12 V dc reference power if altitude rate source input is ARINC 575 analog
	26 V ac reference power if altitude rate source is ARINC 565 analog
	5 V ac or dc lighting power
Operating Temperature Range	-15C to +70C
Display	Lamps around the periphery of a fixed vertical speed scale and electro-mechanical needle. Combination vertical speed and RA display.
Vertical Speed Input	The IVA-81B meets the requirements of both type B and type C VSI indicators. Pneumatic or air data electrical input.
Inputs from TCAS	High-speed ARINC 429
Pneumatic Connector	See Outline Drawing, Figure 2012.
Electrical Connector	See Outline Drawing, Figure 2012.
TSO	C119a, C8c
Environmental Certification	Refer to Table 14.

Table 12. IVA-81D TA/VSI Leading Particulars

Characteristic	Description
Form Factor	3ATI x 7.5 inches deep
Components	Solid state, no mechanical parts
Maximum Weight	3.0 lb (1.4 kg)
Overall Dimensions	See Outline Drawing, Figure 2013.
Mounting	Front, panel mount; Marmon clamp or equivalent
Software Certification	D0-178B, Level B
Power Requirements	
Primary	115 V, 400 Hz or 28 V dc primary power. Maximum power dissipation of 40 Watts (short term at cold temperature), at full brightness including display warm-up at low temperature.
Lighting	5 V ac or dc, or 28 V dc
Reference	±12 V dc if altitude rate source input is ARINC 575 analog
	26 V ac if altitude rate source is ARINC 565 analog
Operating Temperature Range	-20C to +70C
Number of Intruder Aircraft Displayed	Maximum number determined by TCAS processor program strap configuration.
Display	High resolution, full color dot matrix LCD. Combination vertical speed and traffic display.
Vertical Speed Input	The IVA-81D meets the requirements of both type B and type C VSI indicators. Pneumatic or air data electrical input. Both ARINC 500 and 700 series air data input accepted.

Table 12. IVA-81D TA/VSI Leading Particulars (cont)

Characteristic	Description
Data Input	High-speed ARINC 429
Front-mounted Range Control	Optional
Front-mounted TA SEL Switch and BRT Control	Optional
Pneumatic Connector (located on indicator rear panel)	See Outline Drawing, Figure 2013.
Electrical Connector (located on indicator rear panel)	See Outline Drawing, Figure 2013.
TSO	C118, C119b, C8d
Environmental Certification	Refer to Table 14.

Table 13. ITA-81A Traffic Display Leading Particulars

Characteristic	Description
Maximum Weight	8 lb (3.7 kg)
Overall Dimensions	See Outline Drawing, Figure 2014.
Mounting	Dzus Mounting
Power Input Requirements	115 V, 400 Hz, 35 W nominal
Operating Temperature Range	-15C to +55C
Cooling	Convection (forced-air cooling not required)
Type of Display	Rectangular CRT, X-Y scan
Scan Rate	65 Hz
Inputs from TCAS	High-speed ARINC 429
	Display Enable (grounded input enables unit's power supply)
Output to TCAS	Display Valid (ground = valid, open = failure)
Electrical Connector	MS-3120E-14-19P (ITT Cannon KPT02-14-19P)
Environmental Certification	Refer to Table 14.

(2) Environmental Certification

CAS-100 equipment meets the environmental conditions of the Radio Technical Commission for Aeronautics document number DO-160D, *Environmental Conditions and Test Procedures for Airline Electronic/Electrical Equipment and Instruments*. Environmental certification categories for CAS-100 equipment are defined in Table 14.

Table 14. DO-160D Environmental Certification Categories

Certification Category: A2F2Y B B B H2U E X X X X X Z BZ A Z C WWW M A3C3 X A A		
Category Interpretation		
DO-160D Section Number	**Category**	**Description**
4	A2F2Y	Temperature and Altitude Y=300 Min. without forced air cooling
5	B	Temperature Variation
6	B	Humidity
7	B	Shock
8	H2	Vibration
9	E	Explosion Proofness
10	X	Waterproofness X= Not Applicable
11	X	Fluids Susceptibility
12	X	Sand and Dust
13	X	Fungus Resistance
14	X	Salt Spray
15	Z	Magnetic Effect
16	AB	Power Input
17	A	Voltage Spikes
18	Z	Audio Frequency Conducted Susceptibility, Power Inputs
19	C	Induced Signal Susceptibility
20	WWW	RF Susceptibility
21	M	Spurious RF Emission
22	A3C3	Lightning Induced Transients Susceptibility
23	X	Lightning Direct Effect
24	A	Icing
25	A	Electrostatic Discharge

4. System Description

A. General

The Honeywell TCAS system includes the following equipment:

- TPA-100A TCAS Processor
- ANT-81A Directional Antenna
- IVA-81A/D Traffic Advisory/Vertical Speed Indicator (TA/VSI)
- IVA-81B Resolution Advisory/Vertical Speed Indicator (RA/VSI)
- Omnidirectional Antenna
- Mode S Transponder System which includes a Mode S transponder, transponder/TCAS control unit, and two omnidirectional antennas
- Optional PPI or dedicated TCAS traffic display unit, required aircraft equipment, and optional aircraft equipment.

NOTE: The TPA-100A TCAS Processor is examined in this manual. Other TCAS equipment is examined to a level necessary for understanding total TCAS operation. Mode S Transponder System components are included in separate manuals recorded in Table Intro-1.

B. CAS-100 Functional Overview

The basic CAS-100 system does traffic alert and collision avoidance functions to give safe separation between own aircraft and other aircraft equipped with Mode S transponders, ATCRBS Mode C transponders, or ATCRBS Mode A/C transponders.

NOTE: Mode A/C transponders are Mode A transponders that respond to Mode C interrogations. CAS-100 operation can be separated into the these primary functions:

(1) Surveillance Function

- Detects the presence of Mode S or ATCRBS Mode A/C transponder equipped aircraft that are in TCAS surveillance limits.
- Determines initial range, relative bearing (if detection occurs on a directional antenna), and relative altitude (if aircraft is reporting altitude).
- Calculates closing range rate.
- Determines if the aircraft should be put in track.

(2) Tracking Function

- Tracks maximum 45 combined Mode S and Mode A/C transponder equipped intruder aircraft. Tracks range of intruder aircraft. Tracks intruder relative bearing if tracking is occurring on a directional antenna. Tracks intruder relative altitude if intruder is reporting altitude.
- Calculates estimated intruder relative position.
- Calculates closing range rate.
- Calculates altitude change rate if intruder is reporting altitude.
- Estimates miss distance.

NOTE: Surveillance and tracking functions are performed by listening for Mode S squitters, Mode S and ATCRBS Mode C interrogation transmissions, and Mode S and ATCRBS Mode C reply receptions on the top and bottom TCAS antennas.

(3) Threat Potential Evaluation Function

- Determines the threat potential of intruder aircraft based on results using tracking data.
- Categorizes intruders as RAs, TAs, proximities, or nonthreats.

(4) Collision Avoidance Computation and Resolution Advisory Display Function

When an RA threat aircraft is present, TCAS finds the applicable vertical maneuvering for own aircraft to get or keep a safe miss distance between own aircraft and intruder aircraft. This maneuvering is done while creating the least change from own aircraft vertical rate. TCAS communicates the recommended maneuver to the pilot with a resolution advisory display on the TA/VSI or RA/VSI units.

(5) Traffic Advisory Display Function

Gives a display of RA, TA, proximity, or nonthreat category traffic that are present in the adjacent airspace. The traffic display shows the position and the threat potential of intruder aircraft which alerts the flight crew to potentially dangerous conditions. Depending on the aircraft equipment, the traffic display can come into view on a TA/VSI unit or an optional PPI or dedicated TCAS display unit.

(6) Aural Alert Function

Gives voice message advisory alerts on the cockpit audio system.

(7) Air-to-Air Coordination Function

A maneuvering coordination data link is established with the intruder if the intruder aircraft is TCAS equipped and becomes a threat . This data link makes sure that the resolution advisories in the two TCAS equipped aircraft are controlled and compatible. The control links are established between the two TCAS systems through the Mode S transponder.

(8) Data Recording Function

TCAS history data is at intervals moved from the processor to the recorder if the optional data recorder is attached to the PCMCIA card interface on the TCAS processor.

(9) Data Loader Function

A TCAS processor with the data loader function can receive a software update without opening the unit if an ARINC 615-3 data loader is connected. Also, there is an option to load data through a PCMCIA card put into the PCMCIA card interface slot on the front of the processor.

5. System Component Description and Functions

A. TCAS Processor

(1) General

The TPA-100A TCAS processor is the primary control unit in the CAS-100 system. The processor has a combined computerized control system and L-band receiver/transmitter. The operation of the TCAS system is controlled by TCAS software in the computer control memory.

(2) TCAS Processor Description and Basic Functions (See Figure 4.)

The TCAS processor routinely reads and keeps the following own aircraft data:

(a) Own aircraft heading, pitch, roll, and radio altimeter input. This data with the pressure altitude data lets TCAS find own aircraft position and flight path. The data is used during tracking, RA and TA advisory, and traffic display computations.

(b) Own aircraft pressure altitude data received on the ARINC 429 data bus from the Mode S transponder. The pressure altitude is input to the transponder from own aircraft pressure altitude source. The pressure altitude is used to find own aircraft altitude related to intruder reported altitude and own aircraft flight level altitudes.

(c) The mode control requests and traffic display control inputs from the Mode S transponder through the ARINC 429 data bus. The Mode S transponder receives this data from the transponder control panel (and may in the future also receive the control input from the ground stations). This data is a factor in TCAS sensitivity level determinations and traffic display formats.

(d) Own aircraft identification (ID) code (transponder ID) received on the ARINC 429 data bus from own Mode S transponder. Own aircraft identification is input to the transponder through 24 discrete bit strapped inputs. Own aircraft identification is used by the TCAS processor during air-to-air coordination procedures.

(e) Own aircraft maximum airspeed data received on the ARINC 429 data bus from own Mode S transponder. Own aircraft maximum airspeed is input to the transponder through three discrete bit strapped inputs. This data is used in the maximum closing rate projections and RA computations.

(f) Antenna delay strap input. These 3 discrete input are used during TCAS range computations to adjust for the cable delay differences between the top and the bottom antennas.

(g) Performance limit input. These inputs are used as factors in RA computations. The performance limit inputs include:

1 Performance limit discrete input or ARINC 429 input from performance management computer.

2 Five discrete altitude limit program strap inputs (2000, 4000, 8000, 16000, and 32000).

3 Four discrete 1500 fpm Climb Inhibit inputs which are configured by the user to limit the RAs to performance functions of the aircraft. (Example: Wing flap retracted/extended switch can be connected to these input or the Increased Climb Inhibit input depending on the properties of the aircraft.)

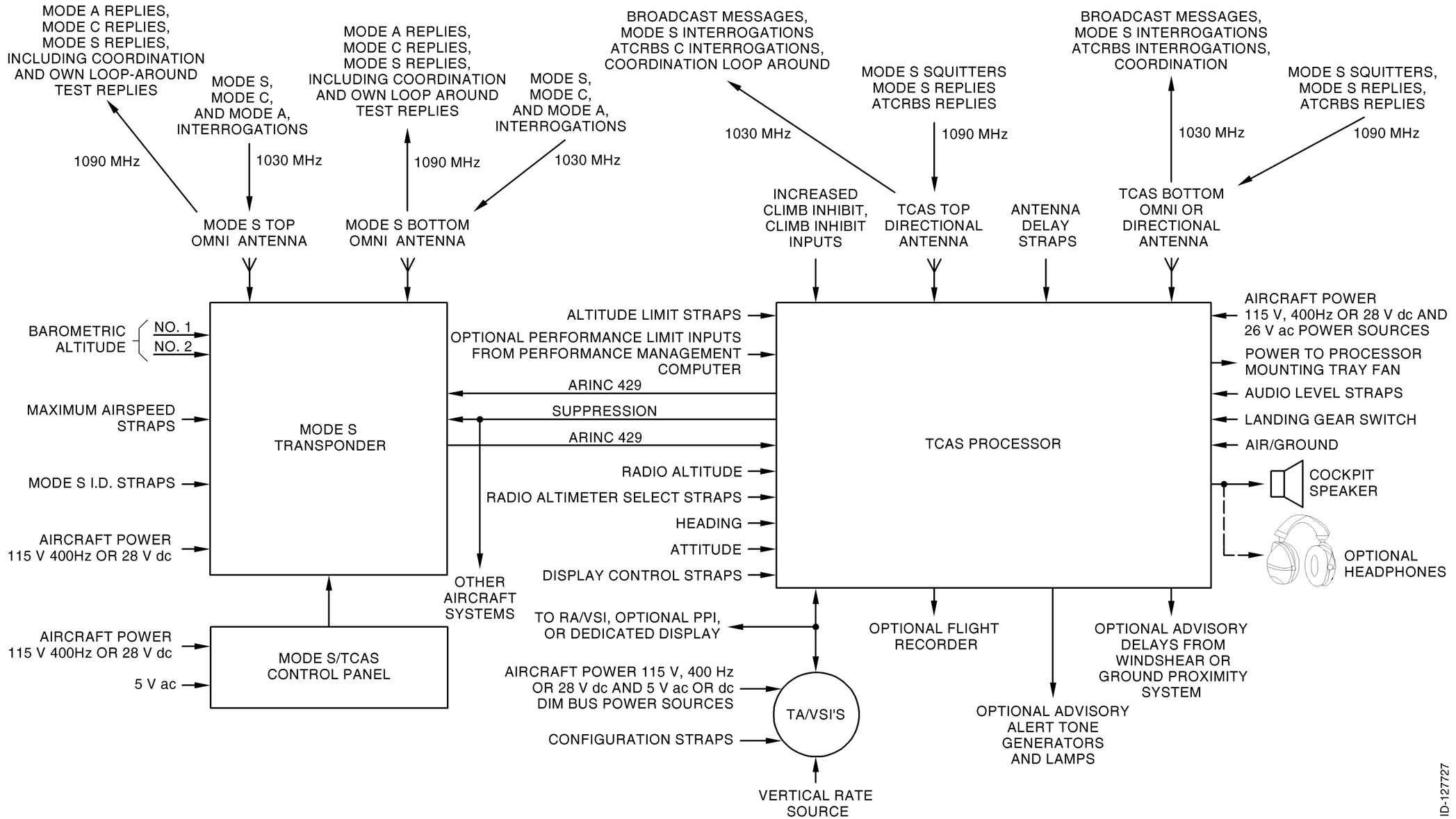
4 Four discrete 2500 fpm Increased Climb Inhibit input which are configured by the user to limit RAs to performance functions of aircraft.

NOTE: Although not specifically a part of performance limits, the discrete input from the landing gear retracted/extended switch can be for performance limit input shown in paragraphs 4 and 5 above. But, this input is for other functions, for example making a bottom directional antenna operate as an omni antenna in gear-down conditions.

(h) Discrete input from weight-on-gear (Air-Ground) strut switch. Tells TCAS if own aircraft is in-flight or on-the-ground.

(i) Advisory Delay discrete input from ground proximity and wind shear system (if applicable).

(j) Discrete input from optional Advisory Cancel switch.



Collision Avoidance System Simplified Block Diagram
Figure 4

(k) Five discrete input from RA/TA Intruder Display Limit straps. These straps determine the maximum number of aircraft that can be shown on the traffic display (from 1 to 30).

(l) Discrete input from Ground Display Mode strap. This input determines if the traffic is shown when own aircraft is on-the-ground.

(m) Discrete input from RA/TA Display All Traffic Mode strap. This input determines if all targets are shown at all times or when an RA or TA is present.

(n) Continuity/resistance checks on the top and bottom TCAS antenna ports. This data lets the TCAS processor find if an omni or directional antenna is used as the bottom TCAS antenna. The data also lets the processor find if the antenna cables are correctly connected to the top and the bottom antennas. The four ports for each directional antenna must reflect special and different resistance values because of port identification resistors attached in the directional antenna.

(o) System validity inputs. If a failure is found on any of the following input, TCAS supplies the failure annunciation data to the resolution advisory and traffic displays.

1 Discrete failure status input from the TA/VSI units, RA/VSI units, or other optional display units.

NOTE: In the event of a display unit failure, the display sets its display valid output discrete to invalid and tries to show status of the fault found. The fault is shown if the properties of the fault allow (for example, specific faults cause a blank display and do not allow the display of data).

NOTE: Loss of a TA/VSI will be reported on the maintenance bus.

NOTE: The TCAS processor will automatically go into the standby mode if both radio altimeters, both RA/VSI units, or both TA/VSI units fail.

2 Loss of continuity through the TCAS antennas.

3 Failure status data or loss of data on the ARINC 429 data link from the Mode S transponder.

4 Internal TCAS processor failures that include failure of internal power supplies.

5 Incorrect data from the radio altimeter if one is connected, or incorrect data from both radio altimeters if two are connected.

(p) The TCAS processor stops all TCAS processing and shows an applicable annunciation on the display units if a particular failure decreases the TCAS operation. TCAS processor self-tests and failure annunciations are given in the MAINTENANCE PRACTICES and FAULT ISOLATION sections of this manual.

(q) Six discrete input from synthesized Audio Level Control straps. Three of these straps determine the audio output levels to the speaker and phones when the aircraft is airborne. The other three straps determine the audio output levels when the aircraft is on the ground.

(r) Discrete input from Functional Test Inhibit Strap. This input determines if the TCAS functional test is inhibited when the aircraft is airborne.

(s) Discrete input from Transponder Interface Select Strap. This input shows if one or two transponders are installed on the aircraft.

(t) Discrete input from Radio Altimeter Interface Select Strap. This input shows if one or two radio altimeters are installed.

(u) Discrete input from RA Status Inhibit Strap. This input determines if RA display status is in operation or prevented.

(v) Discrete input from On-Ground Intruder Disable Strap. This input determines if intruders found to be ON GROUND will be shown when own aircraft is below 1750 feet (radio altitude).

(3) Real-Time TCAS Functions Controlled by Processor

(a) The TCAS processor formats and transmits the messages and listens for broadcasts. Messages are transmitted at 1030 MHz by each TCAS system to tell other TCAS equipped aircraft that own TCAS equipped aircraft is present. The messages are transmitted on the TCAS directional and omni antennas. Each TCAS, including own TCAS, keeps track of the number of broadcast messages received by its Mode S transponder. This supplies each TCAS with the number of TCAS equipped aircraft in broadcast range. This number is used in TCAS interference limiting formulas, which is for controlling the power output levels and rates for TCAS Mode S interrogations. TCAS decreases the number of TCAS Mode S interrogations and also decreases the power output levels as the number of TCAS equipped aircraft (number of broadcast receptions) increases. This decreases the detectable interrogation load on Mode S transponders in the conditions where numerous TCAS equipped aircraft are present in the same airspace volume. The effect of reducing the number of air-to-air interrogations and their transmit power levels is a decrease of unsolicited replies (fruit overload) received by the ground stations.

(b) The TCAS processor listens for Mode S transponder squitter messages from other aircraft. The Mode S transponders show their presence by transmitting a 1090 MHz squitter message once each second. The TCAS processor listens for squitters on the TCAS directional and omni antennas.

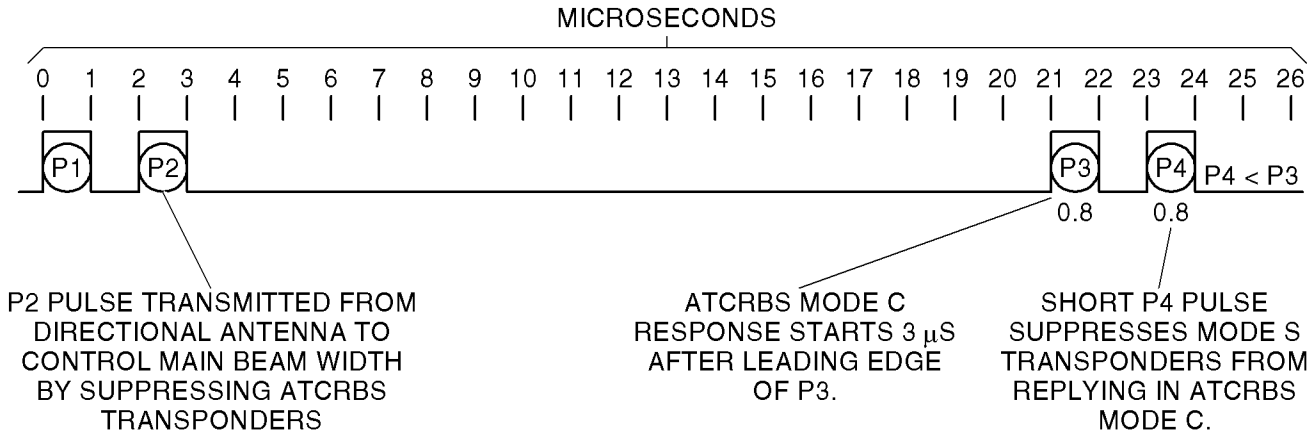
(c) The TCAS processor starts to interrogate the intruder if a correct Mode S squitter message is sensed. The Mode S equipped intruder is put into the track if an interrogated Mode S equipped aircraft is in TCAS Mode S tracking range and altitude. The mode S track changes are then done. These changes include the TCAS processor formatting and transmitting 1030 MHz Mode S interrogation messages on the directional antenna and/or the omni antenna. The processor also receives 1090 MHz Mode S reply messages on the directional antenna and/or the omni antenna. The TCAS processor sets one directional antenna beam to use for directional message transmission and reception.

(d) The TCAS processor does ATCRBS search, track initialization, and track changes. The ATCRBS equipped intruder is put into the track if an ATCRBS equipped aircraft is in TCAS ATCRBS tracking range and altitude. ATCRBS search, track initialization, and track update operations include the TCAS processor formatting and then transmitting 1030 MHz ATCRBS interrogations, and receiving 1090 MHz ATCRBS replies on the directional antenna and/or the omni antenna. The TCAS processor sets one directional antenna beam to use for ATCRBS directional message transmission and reception.

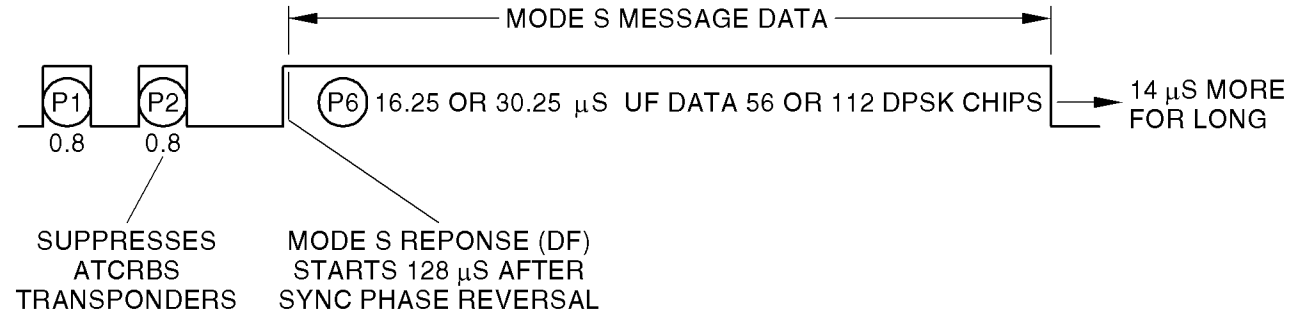
NOTE: Mode S and ATCRBS interrogation and reply message formats are shown in Figures 5 and 6.

(e) The TCAS processor does functions that find the range, bearing, and altitude of intruder aircraft from the data calculated from or contained in the reply messages. The bearing can be found for the intruder replies received on the directional antenna. The altitude can be found if the intruder is reporting altitude in its transponder reply message.

(f) Based on the data extracted or calculated from the reply, the TCAS processor examines the threat potential of the intruder by calculating the intruder closing rate and position related to own aircraft. From this analysis, the TCAS processor categorizes the intruder as a nonthreat, proximity, traffic advisory, or resolution advisory.



ATCRBS MODE C INTERROGATION FORMAT

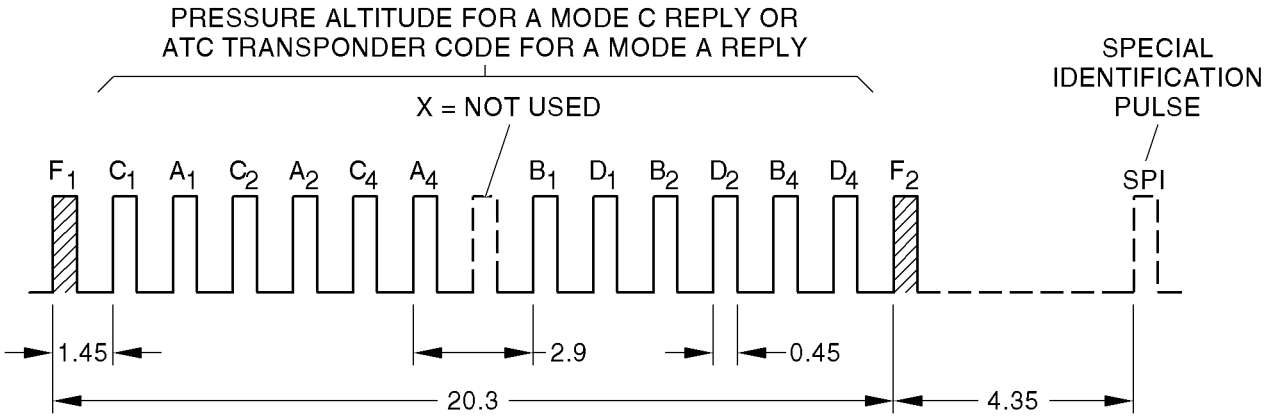


MODE S INTERROGATION FORMAT

NOTE:
P1, P3, and P4 pulses are transmitted on one of four selected main beams.

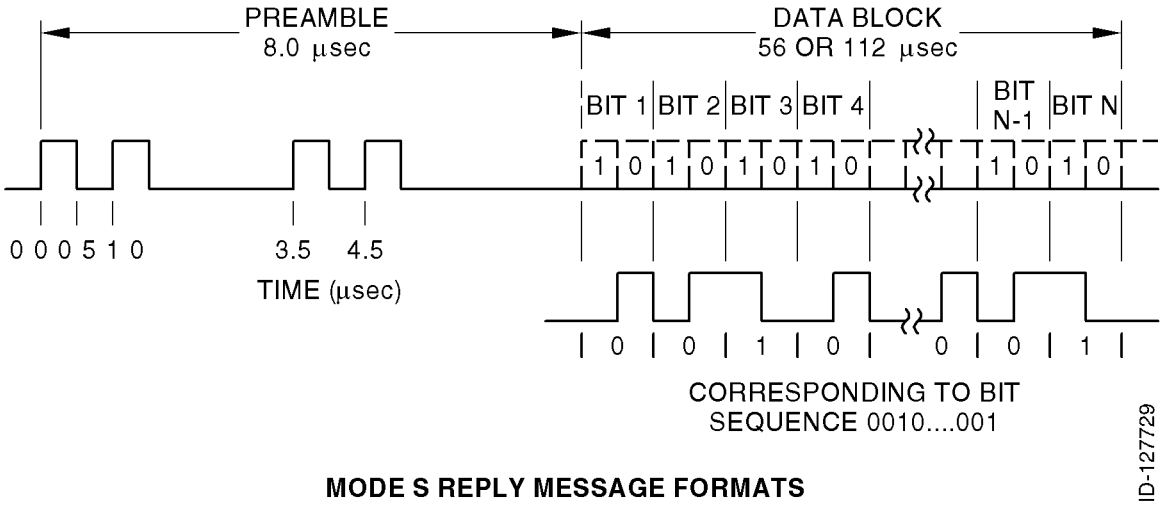
ID-127728

ATCRBS Mode C and Mode S Interrogation Formats
Figure 5



NOTE:
Times noted in μsec.

MODE C AND MODE A REPLY MESSAGE FORMATS



MODE S REPLY MESSAGE FORMATS

ATCRBS/Mode S Transponder Reply Message Formats
Figure 6

(g) The TCAS processor calculates the correct resolution advisory to keep or make sure of the safe separation between own and threat category aircraft. The TCAS processor then outputs resolution advisory data on the ARINC 429 buses to the TA/VSI or RA/VSI units. RA traffic symbol position and alert data is output on the ARINC 429 data bus to the TA/VSI or PPI display unit. Last, resolution advisory alert voice messages and alert outputs are sent to the cockpit audio system for optional tone generators and/or lamps.

(h) The TCAS processor outputs TA traffic symbol position and alert data on the ARINC 429 data bus to the TA/VSI or PPI display for the traffic advisory category aircraft. The processor also outputs traffic advisory alert voice messages and alert output for optional tone generators and/or lamps to the cockpit audio system.

(i) The TCAS processor outputs proximity or nonthreat traffic symbol position data on the ARINC 429 data bus to the traffic advisory display for proximity and nonthreat category aircraft. (The voice alerts are not supplied for proximity or nonthreat category aircraft.)

(j) The TCAS processor establishes a coordination data link with the threat category aircraft that are also TCAS equipped. The TCAS processor transmits coordination messages and receives coordination messages from the threat aircraft transponders through own TCAS antennas. Once the TCAS equipped threat aircraft has sensed own aircraft as a threat, the same procedure is started through own Mode S transponder. A full two-way coordination data link is established. The coordination data assure nonconflicting maneuvering between TCAS-equipped aircraft that are threats to each other.

(k) During each TCAS 1030 MHz transmission on the directional or omni antenna, the TCAS processor supplies a suppression pulse to other L-band equipment on own aircraft.

(l) The TCAS processor decreases fruit and synchronous interference by the following interference limiting procedures:

1 An ATCRBS P2 sidelobe suppression pulse is transmitted as an P2 pattern on the directional antenna to control the effective beam width.

2 A sequence of ATCRBS interrogations are transmitted at different power levels (whisper-shout levels). These whisper-shout levels divide the adjacent airspace into the range segments. The maximum number of whisper-shout levels (24) are used when interrogating in the forward direction on the directional antenna.

3 Interrogating more than once to check reply validity.

4 Transmitting a P2 ATCRBS suppression pulse in Mode S interrogation transmissions.

5 Transmitting a P4 Mode S suppression pulse during ATCRBS interrogation transmissions.

(m) The TCAS processor also controls:

1 Scheduling for interrogations done on the directional and omni antennas.

2 TCAS sensitivity level operating modes.

3 Generation of coasting data during the periods when tracking data is temporarily not found.

NOTE: For more details, refer to applicable Mode S Transponder manual, recorded in Table Intro-1.

(n) Use of ADS-B data by the TCAS Processor will track and display other 1090 MHz based ADS-B aircraft if the following are true:

1 The ADS-B program pin, RMP5E is strapped.

2 The Mode-S transponder(s) connected to the TCAS support the XGD protocol, for example (0,5), (0,6), (0,8), (0,9), (1,0), (1,7), (1,8) to (1,C), (2,0), (3,0), (4,0), (5,0), and (6,0).

3 The Mode-S transponder(s) connected to the TCAS implement, as a minimum, BDS registers (0,5) own aircraft position, (0, 6) own surface position, and (0,9) own velocity.

(o) When the ADS-B program pin is strapped the TPA-100A will:

1 Output on both high-speed display output busses

2 Request own aircraft position and velocity data from own transponder.

(p) The following is a brief summary about the Display Traffic Information File (DTIF):

1 The TPA-100A implements the definition of ARINC 735A supplement 1 - Attachment 20 with one exception. In the DTIF, the range data type is encoded with better resolution. This is currently approved by an Airlines Electronic Engineering Committee (AEEC) subcommittee but has not been formally adopted into a supplement of ARINC 735A.

2 The DTIF is transmitted in addition to the standard TCAS intruder display.

3 The DTIF has a consolidated list of TCAS and passive tracked aircraft.

4 The DTIF contains data that could be used by displays to give additional traffic data to the crew.

5 When relative range, relative altitude, and relative bearing data on another aircraft is available from TCAS surveillance and passive Automatic Dependent Surveillance-Broadcast (ADS-B), the DTIF relative position data will be based on TCAS surveillance.

(q) If the ADS-B program pin is strapped as part of the installation approval process, the use and display of passive/ADS-B data must be validated. Part of this process will include:

1 Ensure that the existing displays which do not process the DTIF output do still correctly receive and process the standard TCAS traffic file.

2 The consolidation and symbology associated with the DTIF must be approved and certified.

(r) The TCAS processor also supplies communication interfaces with the following optional units:

1 Flight recorder

2 CFDS or maintenance computer

3 ATE equipment

4 Data loader.

(s) The transmitter and receiver of the TCAS processor are calibrated automatically during power up, initiated functional test, and periodically. The calibration adjusts for phase shifts added by the cables, relative phase error in the receiver circuitry, and temperature effects.

(t) TCAS processors contain an Antenna System Built-In Test Equipment (BITE) test that operates when power is applied to the TCAS processor. The first function of the Antenna System test is to detect the correct input impedence to each element of the top/bottom directional antenna. The second function is to interrogate the performance characteristics of the antenna. The test measures phase coupling differences between elements J2 & J4 and J1 & J3. Failure of this test requires removal of the antenna.

(4) Power Requirements

The TCAS processor receives 115 V 360-800 Hz or 28 V dc primary power and 26 V ac synchro reference input power from the aircraft power sources.

CAUTION: TO ELIMINATE RISK OF DAMAGE TO EQUIPMENT, 28 V DC AND 400 HZ CANNOT BE SUPPLIED TO THE TPA-100A AT THE SAME TIME.

(5) Rear Connector

A six section rear connector supplies the system connects to the TCAS processor. The six sections of the connector are shown left bottom plug (LBP), right bottom plug (RBP), left middle plug (LMP), right middle plug (RMP), left top plug (LTP), and right top plug (RTP). The Figure 8 shows the external devices connected to each of the six sections of the connector. The system Interwiring Diagram, Figure 2015 in the Maintenance Practices section of this manual, shows the specified pin connections into the TPA-100A TCAS processor.

(6) Leading Particulars

TCAS processor leading particulars are given in Table 8. Refer to TPA-100A Component Maintenance Manual for more data.

B. Directional Antenna

(1) General

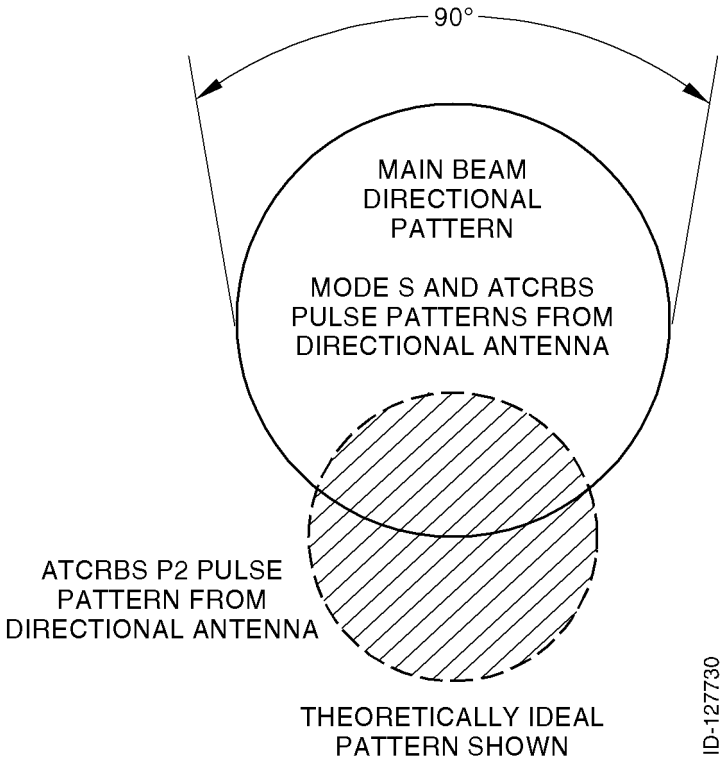
The ANT-81A Directional Antenna (Figures 2007, 2008, 2009, and 2010) lets the bearing of intruder aircraft be determined by allowing the TCAS processor to transmit the interrogations and receive replies on one of four antenna beams. By selecting the beam, the TCAS processor electronically points the antenna in a surveillance direction during TCAS transmit and receive operations.

(2) TCAS Directional Antenna Description and Basic Functions

The directional antenna is an electronically steerable phased array that has four top loaded monopole elements.

Different from mechanically steered antennas, the antenna pattern can be pointed in one of four directions without moving the antenna. This movement is achieved by independently changing the drive level and phase to the four antenna elements contained in the directional antenna.

The four beam forming elements are found on the edge of the antenna, and the full assembly is contained in an aerodynamic fiberglass enclosure just over one inch in height. The top directional antenna must be installed at, or near, the longitudinal centerline of the aircraft + 5 degrees and as far forward as practical. The bottom directional antenna or omni antenna (if used) must be put as near as possible to the vertical plane of the top directional antenna. During TCAS transmission, the directional antenna (top or bottom) radiates 1030 MHz main beam patterns under control of the four antenna element drive signals from the TPA-100A TCAS processor (see beam patterns in Figure 7).



TCAS Transmit and Receive Beam Patterns for Directional Antenna
Figure 7

All pulses in a TCAS (Mode S) message transmission from the directional antenna are radiated as a directional main beam pattern. To get the main beam pattern, the four signals representing each transmit pulse are phase shifted by the TCAS processor. The phase shifting set on the four elements shows the direction of the main beam to be transmitted (one of four beams). The resultant 1030 MHz signals radiated from the four elements of the antenna mix and cancel in a procedure that makes a main beam directional pattern for pulses transmitted.

In a TCAS/ATCRBS interrogation transmission, the TCAS message is transmitted from the directional main beam with the exception of the ATCRBS suppression pulse (P2) which is designed to meet the DO185A requirement that a transponder not reply to more than two quadrants or beams as shown in Figure 7.

To make the P2 pattern for the ATCRBS suppression pulse, the four signals representing the suppression pulse from the TCAS processor to the four elements of the antenna are of equal phase and amplitude. This causes the P2 pattern being radiated for the ATCRBS suppression pulse.

ATCRBS Mode A/C transponders in the adjacent airspace that sense a suppression beam signal larger in amplitude than the main beam signal, are prevented from replying to the interrogation. The result of the ATCRBS P2 hold back is to control the good TCAS interrogation beam width and thus limit interference from unwanted ATCRBS receptions. The effective beam width can be narrowed by increasing the amplitude of the suppression P2 pattern output or decreasing the amplitude of the main beam pattern output (and vice-versa).

During TCAS receptions, each of the four directional antenna elements receives any 1090 MHz signal that passes by the element. The phasing of these received signals is determined by the direction that the rf energy is received. These signals are received on the same four cables that connect transmit signals between the TCAS processor and directional antenna.

Many filters are used in the TCAS processor for noise suppression and pulse shaping of the received signals. Phase detectors in the TCAS processor then examine the relative phasing of the four signals from the antenna and make an analog voltage that shows the bearing of the replying intruder aircraft.

The main beam pointing angle can be redirected in microseconds to any of the four 90 pointing positions.

Four coaxial cables with type Threaded N Connector (TNC) plugs on the antenna end connect the directional antenna to the TCAS processor.

Each of the four ports of the directional antenna contains a resistor found across the antenna element to ground. Each of the four resistors is a different value. The TCAS processor at intervals does a continuity check on the antenna ports and must see the correct resistance value (through an A/D converter) if the port is not shorted or not open.

The directional antenna is a passive device and does not require aircraft power.

C. TA/VSI Display

(1) General

The IVA-81A/D Resolution Advisory/Traffic Advisory/Vertical Speed Indicator (TA/VSI) display is a high resolution, sunlight readable, full color, liquid crystal display (LCD) (Figures 2011, 2012, and 2013). The indicator lets resolution advisory and traffic data be shown in the space previously for display of vertical speed only. Vertical speed is shown on a standard circular dial with a pointer. Resolution advisories are shown as red or red/green arcs (eyebrows) on the applicable part of the circular vertical speed dial.

The center of the display is a horizontal situation presentation of the traffic around the aircraft that includes intruder altitude and vertical direction. Traffic is divided into four categories by the threat risk and identified on the display by the symbol color and shape.

The text messages are shown for TCAS and display modes, intruder data, and vertical rate input validity.

The display intensity level is controlled by a group of bezel and remote light sensors and by the lighting bus input. An optional bezel attached intensity control is also available.

Traffic display range control can be supplied at a distance from a Control Unit or locally through an optional bezel attached range control.

An optional traffic select (TA SEL) switch lets deselection of traffic format when a TA or RA is present.

The TA/VSI accepts air data ARINC 565 or ARINC 575 analog input, ARINC 575 digital or ARINC 429 high and low speed input, and pneumatic vertical speed input.

(2) Resolution Advisory Display

The resolution advisory commands shown on the TA/VSI (or RA/VSI) are the primary indications for vertical maneuvering guidance. TCAS resolution advisories on the two TA/VSI (or RA/VSI) units show vertical speeds to be used or prevented to keep or get safe vertical separation.

A pointer and vertical speed scale, which are standard VSI features, show the present vertical speed of own aircraft. For TCAS guidance, the TA/VSI shows red and green command arcs on a liquid-crystal display with the vertical speed scale and pointer.

The red and green RA command indications give corrective or preventive resolution advisory maneuvering guidance to the pilot (see Controls and Indicators, paragraph 7).

(3) Traffic Display

The TA/VSI traffic display shows adjacent intruder aircraft that have Mode S or ATCRBS Mode A/C transponders, are sensed on a directional antenna, and are in the display range.

NOTE: The TCAS processor interface also supports traffic displays on a dedicated TCAS traffic display or a PPI radar display changed for TCAS. The unit set to show traffic depends on equipment present in the aircraft and other user specifications. The TCAS processor gives traffic display and resolution advisory data output on two isolated high-speed ARINC 429 data bus outputs.

Graphics supplied on the traffic display alert the pilot to traffic advisory conditions, resolution advisory conditions, and show the TCAS operational modes and failure conditions. The selected traffic display functions as a self-sufficient auxiliary device controlled by the TPA-100A TCAS processor through one high-speed ARINC 429 data bus. The traffic displays are secondary displays in the total CAS-100 system. (Resolution advisories on the TA/VSI and RA/VSI are the primary TCAS displays). The traffic display helps the pilot visually acquire a threat intruder aircraft before resolution advisory threat conditions.

The traffic display data from the TPA-100A TCAS processor through the high-speed ARINC 429 data link includes the following:

(a) Intruder aircraft range

(b) Intruder aircraft relative altitude (if available)

(c) Intruder aircraft bearing (if available)

(d) Intruder category (resolution advisory threat; traffic advisory; proximity; or nonthreat)

(e) Own aircraft altitude, in Flight Level (FL) mode only

(f) Own aircraft operating mode (sensitivity level)

(g) Own aircraft heading (EFIS display only)

(h) Advisory alert data

(i) TCAS failure status data

(j) Display range limit control, ABOVE/NORM/BELOW nonthreat altitude display limit control, and relative/flight level altitude display control data originating from the transponder/TCAS control unit and received by the traffic display through the Mode S transponder and TCAS processor.

(k) Other strapped control data (For example, maximum number of intruders to be shown)

Refer to Controls and Indicators, paragraph 7, for traffic display indications and annunciations.

D. RA/VSI Display

The IVA-81B Resolution Advisory/Vertical Speed Indicator (RA/VSI) display. It consists of:

- An electro-mechanically driven pointer (to show vertical speed)
- A resolution advisory arc of red and green high intensity light-emitting diodes (LEDs)
- An electro-mechanical TCAS flag (To show normal and fail conditions and RA mode OFF conditions)
- Vertical speed failure flag

The resolution advisory LEDs are installed below a coated surface which makes them not seen when unlighted. The VSI face is matte black with a matte white vertical speed scale. The vertical speed pointer is controlled by a two-phase motor. The position is controlled by the processed data supplied by the display computer.

The RA/VSI accepts the air data ARINC 565 or ARINC 575 analog input, ARINC 575 digital, ARINC 429 high and low speed data, or a pneumatic vertical speed input.

Vertical maneuvering resolution advisory data (RA data) is received through a high-speed ARINC 429 data bus from the TCAS processor.

NOTE: Traffic is not shown on an RA/VSI**.**

Built-in test circuits continuously monitor for RA/VSI unit failures. Failure status is reported to the TCAS processor through discrete DISPLAY VALID signal lines.

The resolution advisories (RAs) on the electrical/electro-mechanical display of the RA/VSI are identical to the RAs on the LCD display of the TA/VSI [see paragraph 5.C.(2)].

E. ITA-81A Traffic Display

The ITA-81A Traffic Display is a CRT display for TCAS traffic data only (Figure 2014). The ITA-81A receives traffic display data from the TCAS processor through a high-speed ARINC 429 data bus. The ITA-81A does not show resolution advisories. Refer to Table 17 for the ITA-81A Traffic Display Input and Output.

F. PPI Traffic Advisory Display Option

The TCAS/PPI is a group of two displays. The first is the usual radar displays of weather, map, or auxiliary data. The second is TCAS traffic data. Each display can be presented independently or overlaid. By combining the radar and TCAS displays, the pilot can monitor traffic while avoiding weather. The PPI receives traffic display data from the TCAS processor through a high-speed ARINC 429 data bus. The PPI does not show resolution advisories.

G. Mode S Transponder

The Mode S Transponder does the following functions in the CAS-100 system:

- Automatically transmits 1090 MHz Mode S squitter messages each second. These squitter messages tell other TCAS equipped aircraft and ground stations that own Mode S equipped aircraft is present.
- Receives transmit messages from other TCAS equipped aircraft and tells own TCAS processor that transmit message was received.
- Replies to 1030 MHz Mode S interrogations from other TCAS equipped aircraft.
- Replies to 1030 MHz Mode A, Mode C, and Mode S interrogations from ATC ground stations with a 1090 MHz message in the standard procedure.
- Transmits 1090 MHz resolution advisory air-to-air coordination message data (received from the TCAS processor) during threat conditions between own and other TCAS equipped aircraft.

- Supplies the following data to the TPA-100A TCAS Processor through a ARINC 429 data link:

  -- Own aircraft identification code, pressure altitude, and maximum airspeed data.

  -- TCAS broadcast data and air-to-air resolution advisory coordination data received from other TCAS equipped aircraft.

  -- TCAS sensitivity level and other mode control data received by own Mode S transponder from own transponder/TCAS control unit.

  -- TCAS sensitivity level control data from Mode S ground control stations at 1030 MHz (future application).

  -- Mode S ARINC 604 Maintenance status.

- Receives TCAS capability, TCAS validity, sensitivity level, and TCAS coordination update data from the TCAS processor through the ARINC 429 data link and inserts this data into 1090 MHz coordination messages.

H. CTA-100( ) Control Unit

The CTA-100( ) Control Units are examined in this manual to a depth necessary to know total TCAS operation. For more data, refer to TRA-67 Mode S Transponder System Maintenance Manual, I.B. 1167.

The microprocessor based CTA-100( ) Control Unit lets the pilot do the following:

- Start or stop the Mode S transponder.
- Select TCAS operating modes, control range, above/below altitude limits, and flight level compared to related altitude displays on the TCAS traffic display unit.
- Set the ATC transponder identification code.
- Insert a special pattern identifier code (IDENT) into transponder messages to ground station interrogations.
- Start TCAS functional test.
- Set which transponder is in operation in a two transponder system.
- Set the altitude source (optional).
- The CTA-81( ) contains an annunciator lamp that shows if a transponder FAIL condition is present.

The Mode S transponder/TCAS control unit moves the control data to the Mode S transponder through an ARINC 429 data link. The transponder/TCAS control unit FAIL lamp receives a failure status discrete input from the Mode S transponder.

CTA-100( ) controls and indicators are shown in Figures 10 and 11 and are functionally given in Tables 18 and 19.

I. TCAS and Mode S Transponder Omnidirectional Antennas

TCAS can use one omni antenna installed on the bottom of the aircraft instead of a directional antenna. The Mode S transponder uses two omni antennas; one antenna installed on the bottom of the aircraft and the other antenna installed on the top of the aircraft.

These omni antennas are L-band monopoles and are the same to those omni antennas used for distance measuring equipment (DME) and ATC transponders.

The BITE circuits routinely do continuity checks on the omni antennas and their cables.

6. Operation

A. General

The data in this section gives a description of CAS-100 operation that includes:

(1) Complete Block Diagrams and Description of Input/Output Signals.

(2) TCAS Failure Monitoring.

NOTE: All data in this manual is superseded by the latest engineering software and hardware documentation.

B. Detailed Block Diagrams and Description of Input/Output Signals

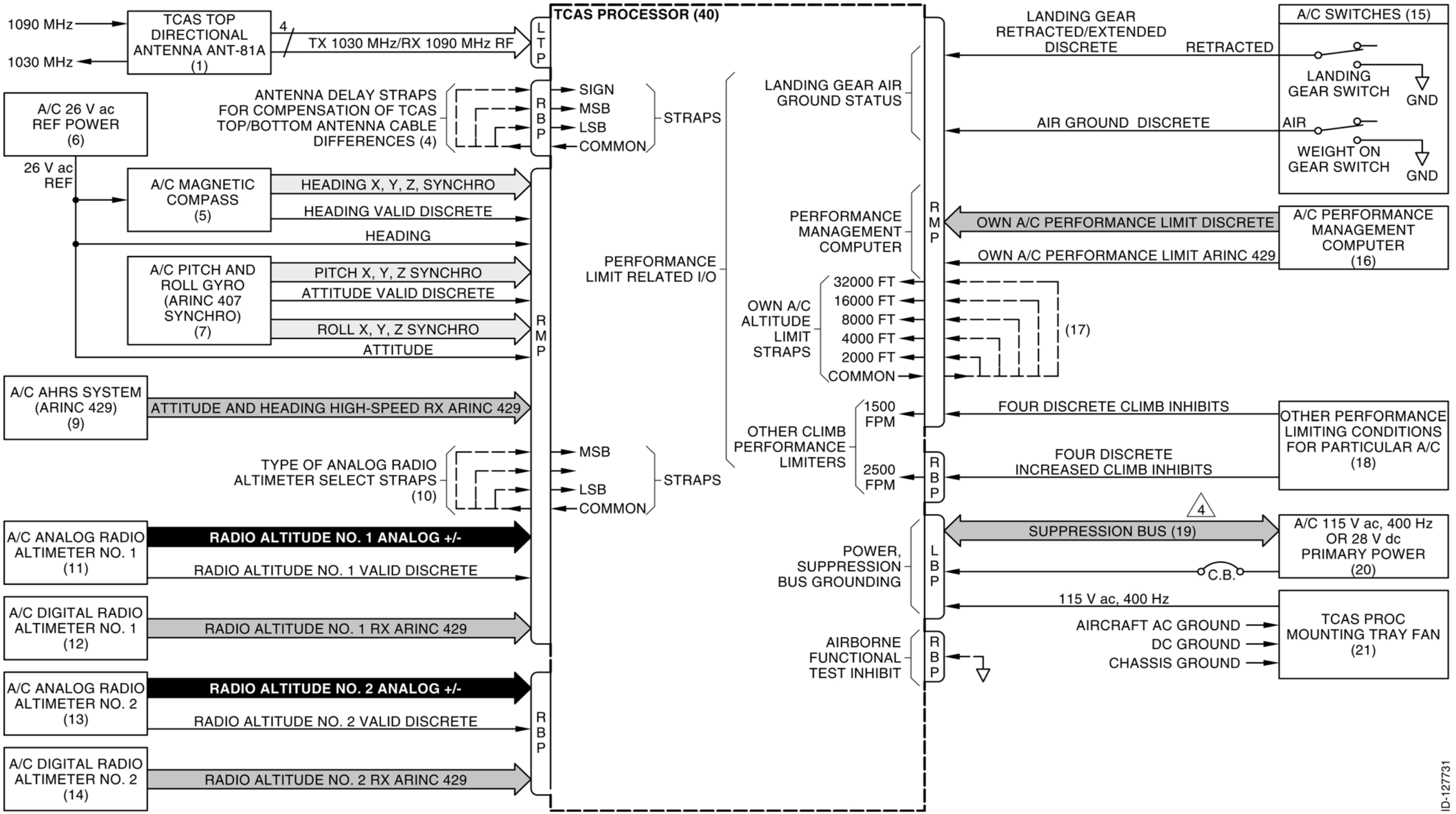
The Figure 8 is a block diagram of the CAS-100 system unit connects to the TPA-100A TCAS Processor. The Table 10 gives the TCAS Processor input/output signals. Interwiring diagram, Figure 2015 in the MAINTENANCE PRACTICES section, gives specified connect pin numbers on the TCAS processor and shows the pins on the Mode S transponders and indicators that connect to the TCAS processor.

The Figure 9 is a block diagram of the system unit connects to the IVA-81A/D TA/VSI and IVA-81B RA/VSI. The Table 11 gives the TA/VSI and RA/VSI input/output signals. Interwiring diagram, Figure 2015 in the MAINTENANCE PRACTICES section gives specified connect pin numbers on the TA/VSI and RA/VSI.

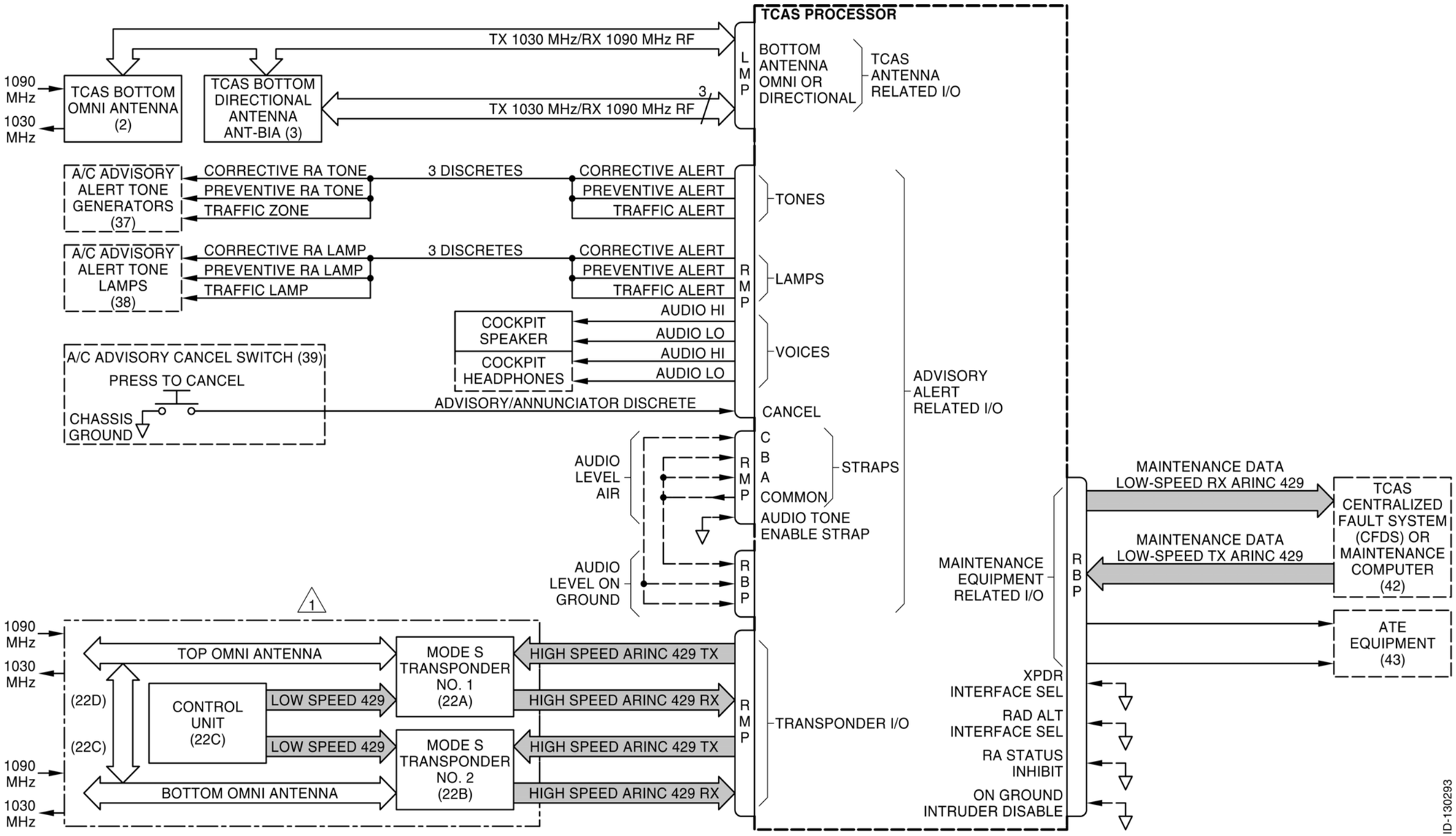
The total system connects for the Mode S transponder and control units are shown in the applicable maintenance manual.

Specific connect pin numbers on the TCAS processor and a PPI or dedicated display are given on the Interwiring diagram, Figure 2015 in the MAINTENANCE PRACTICES section. The system connects into the optional PPI are shown in the associated maintenance manual recorded in Table Intro-1.

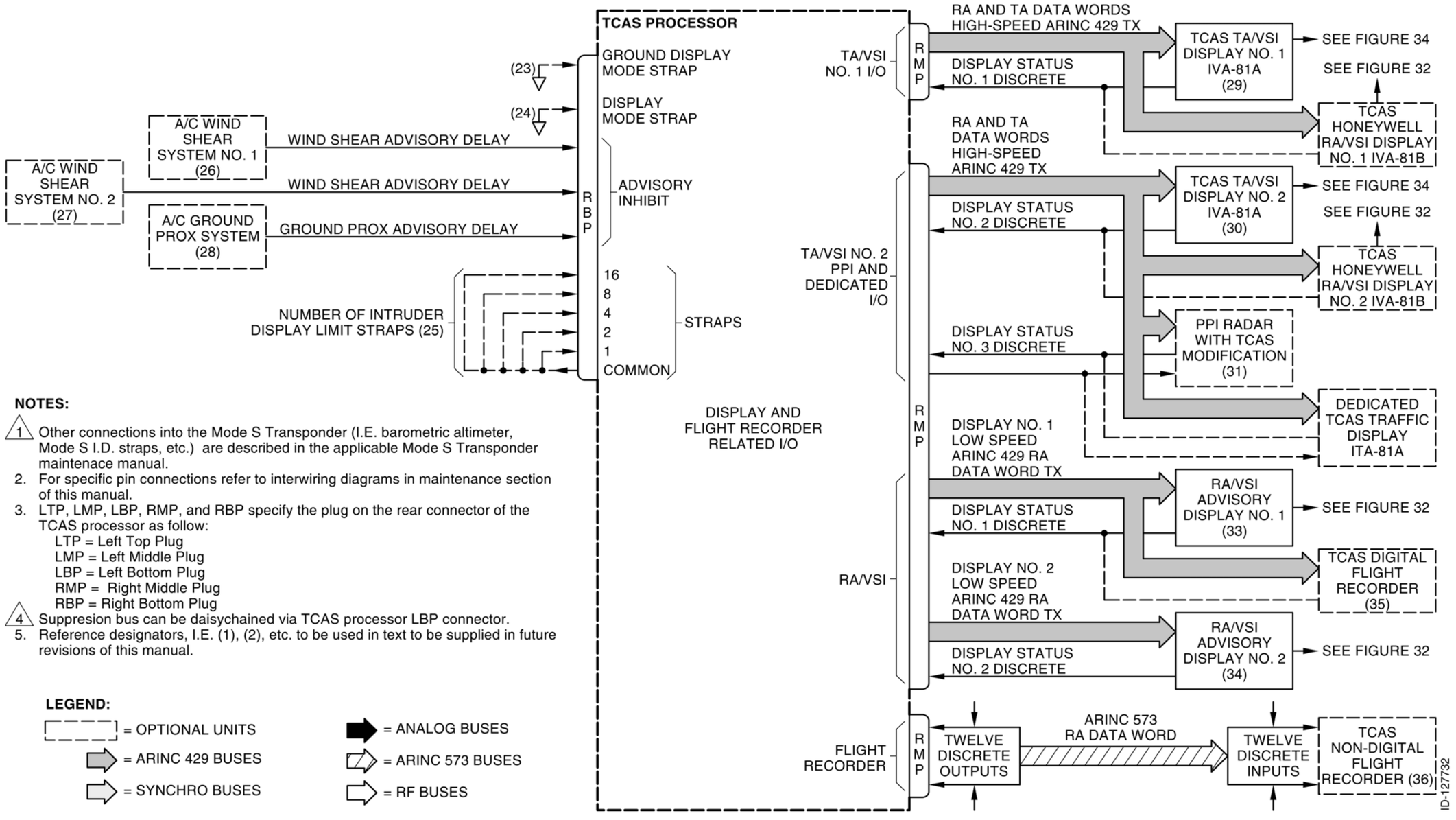
Refer to Table 15 for the TPA-100A TCAS Processor input and output. The IVA-81A/D TA/VSI and IVA-81B RA/VSI input and output are shown in Table 16. Table 17 shows the input and output of the ITA-81A Traffic Display.



TCAS Processor System Interconnect Block Diagram
Figure 8 (Sheet 1 of 3)



TCAS Processor System Interconnect Block Diagram
Figure 8 (Sheet 2 of 3)



NOTES:

1. Other connections into the Mode S Transponder (I.E. barometric altimeter, Mode S I.D. straps, etc.) are described in the applicable Mode S Transponder maintenace manual.
2. For specific pin connections refer to interwiring diagrams in maintenance section of this manual.
3. LTP, LMP, LBP, RMP, and RBP specify the plug on the rear connector of the TCAS processor as follow:
   - LTP = Left Top Plug
   - LMP = Left Middle Plug
   - LBP = Left Bottom Plug
   - RMP = Right Middle Plug
   - RBP = Right Bottom Plug
4. Suppresion bus can be daisychained via TCAS processor LBP connector.
5. Reference designators, I.E. (1), (2), etc. to be used in text to be supplied in future revisions of this manual.

LEGEND:

- = OPTIONAL UNITS
- = ARINC 429 BUSES
- = SYNCHRO BUSES
- = ANALOG BUSES
- = ARINC 573 BUSES
- = RF BUSES

TCAS Processor System Interconnect Block Diagram
Figure 8 (Sheet 3 of 3)

Table 15. TPA-100A TCAS Processor Inputs and Outputs

Source Or Destination	Processor I/O Signal Name and Type	General Description
TCAS ANTENNA RELATED I/O		
Directional Antenna	Top and bottom directional antenna. Four rf, bi-directional, transmit/ receive channels.	1030-MHz differential phase shift keying modulated TCAS transmit messages from the TCAS processor to the directional antenna and 1090-MHz received messages from the directional antenna to the TCAS processor.
Bottom TCAS Omni Antenna	Bottom Omni Antenna. One rf, bi-directional, transmit/receive channel. (Same channel as the element No. 1 port used for the directional antenna.)	1030-MHz differential phase shift keying modulated transmit messages from TCAS processor to omni antenna and 1090-MHz received messages from the omni antenna to TCAS processor.
Three Strapped Pins on Processor Rear Connector	Antenna Delay Straps. Three discretes.	Supply calibration data base inputs to TCAS processor to adjust for the difference in the cable lengths between top and bottom antenna.
MODE S TRANSPONDER RELATED I/O		
Mode S Transponder No. 1 and No. 2	Coordination Data. 429 high-speed, transmit bus and ARINC 429 high-speed receive bus.	ARINC Real-time and periodic data from TCAS processor to the transponder includes TCAS equipment and control change data. Real time and periodic data from transponder to processor. The data from the transponder to the processor includes TCAS control, own barometric altitude, own identification, own maximum airspeed, broadcast and coordination data. If the ADS-B program pin is strapped, TCAS will request own position and velocity data from the transponder.
Strap Pin on Processor Rear Connector	Discrete input from Transponder Interface Select Strap	Tells TCAS processor if one or two transponders are installed.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
OWN ATTITUDE AND HEADING RELATED I/O		
Synchro Magnetic Compass System	Heading Synchro X, Y, Z Heading	Own heading data to TCAS processor from the aircraft synchro heading system.
	Discrete Heading Valid	Synchro heading system failure status to TCAS processor.
	26 V ac Reference Input	Heading synchro reference voltage to TCAS processor.
Pitch and Roll Gyros	Pitch Synchro X, Y, Z	Own synchro pitch attitude data to TCAS processor from pitch gyro.
	Discrete Pitch/Roll Valid	Own pitch gyro and roll gyro failure status to TCAS processor.
	Roll Synchro X, Y, Z	Own synchro roll attitude data to TCAS processor from roll gyro.
	26 V ac Reference Input	Reference voltage for pitch and roll synchro input to TCAS processor.
Attitude/Heading Reference System (AHRS or IRS)	AHRS ARINC 429 high-speed pitch/roll/magnetic heading input	Own digital ARINC 429 digital pitch/roll/ magnetic heading to TCAS processor from AHRS system.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
OWN ALTITUDE RELATED I/O		
Analog Radio Altimeter No. 1	± Analog Radio Altitude No. 1 Input	AGL altitude data to TCAS processor from analog radio altimeter No. 1.
	Discrete Radio Altitude No. 1 Valid	Radio altimeter No. 1 failure status input to TCAS processor.
Analog Radio Altimeter No. 2	± Analog Radio Altitude No. 2	AGL altitude data to TCAS processor from analog radio altimeter No. 2.
	Discrete Radio Altitude No. 2 Valid	Radio altitude No. 2 failure status input to TCAS processor.
ARINC 429 Digital Radio Altimeter No. 1	ARINC 429 Digital Radio Altitude No. 1	ARINC 429 data from digital radio altimeter No. 1 to TCAS processor.
ARINC 429 Digital Radio Altimeter No. 2	ARINC 429 Digital Radio Altitude No. 2	ARINC 429 data from digital radio altimeter No. 2 to TCAS processor.
Three Strapped Pins on Processor Rear Connector	Three discretes from Analog Radio Altimeter Select Straps	Specify the type of analog radio altimeter that is connected to the Analog Radio Altitude No. 1 and No. 2 input (for example, King, Sperry, Collins, ARINC 552A, etc.).
Strap Pin on Processor Rear Connector	Discrete input from Radio Altimeter Interface Select Strap	Tells TCAS processor if one or two radio altimeters are installed.
OWN AIRCRAFT PERFORMANCE LIMIT AND FLIGHT STATUS RELATED I/O		
Optional Performance Management Computer	Climb Performance Limit Discrete	Tells TCAS processor that after considering own altitude, attitude, cargo weight factors, etc. a performance management computer has found if it is possible or not possible for own aircraft to climb at a rate of 1500 feet for each minute.
	Climb Performance Limit ARINC 429	Digital equivalent of climb performance discrete from a performance management computer.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
OWN AIRCRAFT PERFORMANCE LIMIT AND FLIGHT STATUS RELATED I/O Cont		
Five Strapped Pins on Processor Rear Connector	Five discretes from Altitude Limit Straps	Show the maximum altitude at which own aircraft can get a climb rate of 1500 feet for each minute.
Air/Ground Strut Switch	Air/Ground Strut Discrete	Air/Ground Strut Discrete
Strap Pin on Processor Rear Connector	Discrete input from Functional Test Inhibit Strap	Sets on inhibits functional test when the aircraft is airborne.
Landing Gear Retracted/Extended Switch	Landing Gear Up/Down Discrete	Tells TCAS processor if own aircraft landing gear is retracted or extended.
Optional Aircraft Equipment that Monitor the Aircraft Factors Relating to 1500 Feet For Each Minute Climb Rate Performance	Climb Inhibit 1, 2, 3 and 4. Four discrete inputs.	Tell the TCAS processor that conditions exist to prevent or not prevent an own aircraft climb rate of 1500 feet for each minute.
Optional Aircraft Equipment that Monitor the Aircraft Factors Relating to 2500 Feet For Each Minute Climb Rate Performance	Increase Climb Inhibit 1, 2, 3 and 4. Four discrete inputs.	Tell the TCAS processor that conditions exist to prevent or not prevent an own aircraft climb rate of 2500 feet for each minute.
TCAS Valid Monitor	TCAS System Valid Output Discrete	Available to accommodate retrofit installations where instrumentation may need to monitor TCAS system status.
RA AND TA DISPLAY RELATED I/O		
TA/VSI No. 1 or RA/VSI No. 1, PPI, or dedicated display.	Display No. 1, high-speed ARINC 429, RA and TA data words	Resolution advisory, traffic display, operating mode, and failure data from TCAS processor to TA/VSI No. 1, the RA/VSI No. 1, a PPI, or a dedicated display.
	Display Status No. 1 Discrete	TA/VSI No. 1 or RA/VSI No. 1 failure status output to TCAS processor.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
RA AND TA DISPLAY RELATED I/O (cont)		
TA/VSI No. 1 or RA/VSI No. 1, PPI, or dedicated display. (cont)	Display Status No. 3 Discrete (Optional for maintenance reporting.)	Failure status output of PPI or dedicated display connected to TA/RA Display No. 1 high-speed ARINC 429 bus.
TA/VSI No. 2 or RA/VSI No. 2, PPI or dedicated display	Display No. 2, high-speed ARINC 429, RA and TA data words	Resolution advisory, traffic display, operating mode, and failure status data from TCAS processor to TA/VSI No. 2, or RA/VSI No. 2, a PPI, or a dedicated display.
	Display Status No. 2 Discrete	TA/VSI No. 2 or RA/VSI No. 2 failure status output to TCAS processor.
	Display Status No. 4 Discrete (Optional for maintenance reporting.)	Failure status output of PPI or dedicated display connected to TA/RA Display No. 2 high-speed ARINC 429 bus.
RA/VSI No. 1 (RA/VSI that accepts low-speed data 429 input data)	Display No. 1, low-speed ARINC 429 RA data words	Resolution advisory, operating mode, and failure status from TCAS processor to low-speed 429 RA/VSI No. 1 or optional flight recorder.
	Display Status No. 1 Discrete	RA/VSI No. 1 failure status output to TCAS processor.
RA/VSI No. 2 (RA/VSI that accepts low-speed 429 input data)	Display No. 2 low-speed ARINC 429 RA data words	Resolution advisory operating mode, and failure status data from TCAS processor to low-speed 429 RA/VSI No. 2.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
RA AND TA DISPLAY RELATED I/O (cont)		
RA/VSI No. 2 (RA/VSI that accepts low-speed 429 input data) (cont)	Display Status No. 2 Discrete	RA/VSI No. 2 failure status output to TCAS processor.
Five Strapped Pins on Processor Rear Connector	Intruder Display Limit Straps. Five Discrete Inputs	Show the maximum number of intruder aircraft (0-30) to be shown on the traffic displays.
One Strapped Pin on Processor Rear Connector	Ground Display Mode Strap Discrete	Controls if traffic is shown when own aircraft is on-the-ground. If strapped to not show traffic on-the-ground, TCAS goes to STANDBY on-the-ground.
One Strapped Pin on Processor Rear Connector	RA/TA Display Mode Strap Discrete	Shows either all traffic or TA/RA and near traffic only (for example, nonthreat traffic not shown).
Optional Ground Proximity System	Ground Proximity (GPWS) Advisory Delay Discrete	Puts TCAS into the TA only mode (sensitivity level 2) and prevents all audio and aural advisories.
Optional Wind Shear System No. 1 and No. 2	Wind Shear Advisory Delay No. 1 and No. 2 Discretes	Puts TCAS into the standby mode (sensitivity level 1) until wind shear condition is over.
Optional Advisory Alert Cancel Switch	Advisory Alert Cancel Discrete	When pushed and released, this switch cancels active advisory alert conditions.
Cockpit Speaker and Optional Cockpit Headphones	Audio HI and LO outputs. Speaker output - 8 ohms, 8 watts maximum. Headphone output - 600 ohms, 80 milliwatts maximum. (Adjustable using audio level program straps, below. See Figure 2005, Note 15 in MAINTENANCE PRACTICES section for adjustment ranges.)	Supplies the voice advisory message alerts to cockpit speaker and optional headset.

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
RA AND TA ALERT RELATED I/O		
Three Strapped Pins on Processor Rear Connector	Audio Level Program Straps (Airborne). Three Discrete Input.	For adjusting synthesized voice output of the TCAS processor when the aircraft is airborne.
Three Strapped Pins on Processor Rear Connector	Audio Level Program Straps (On Ground). Three Discrete Input.	For adjusting synthesizer voice output of the TCAS processor when aircraft is on the ground.
Audio Tone Generators	Aural Advisory Alerts. Three discrete outputs for Corrective RA Tone, Preventive RA Tone, and TA Tone alerts. (1 second ground, 20 milliamp maximum).	Supply TA and RA alert output that start optional tone generators found externally in the aircraft.
Strapped Pin on Processor Rear Connector.	Audio tone Enable Program Strap. Discrete Input.	When strapped, supplies interval of voice output 1 second to aural advisory output. When open, drives aural advisory discrete output.
Annunciator Lamps	Visual Annunciator output. Three discrete output for Corrective RA Lamp, Preventive RA Lamp, and TA Lamp alerts. (On = ground, 200 milliamp maximum).	Supply TA and RA alert output that start serviceable lamp indicators found externally in the aircraft.
Strapped Pin on Processor Rear Connector. **NOTE 1.**	On Ground Intruder Disable Strap. Discrete Input.	Determines if own aircraft is below 1750 feet (radio altitude), intruders found to be ON GROUND will be shown.
Strapped Pin on Processor Rear Connector	RA Status Inhibit Strap. Discrete Input.	Finds if RA display status is in operation or prevented.

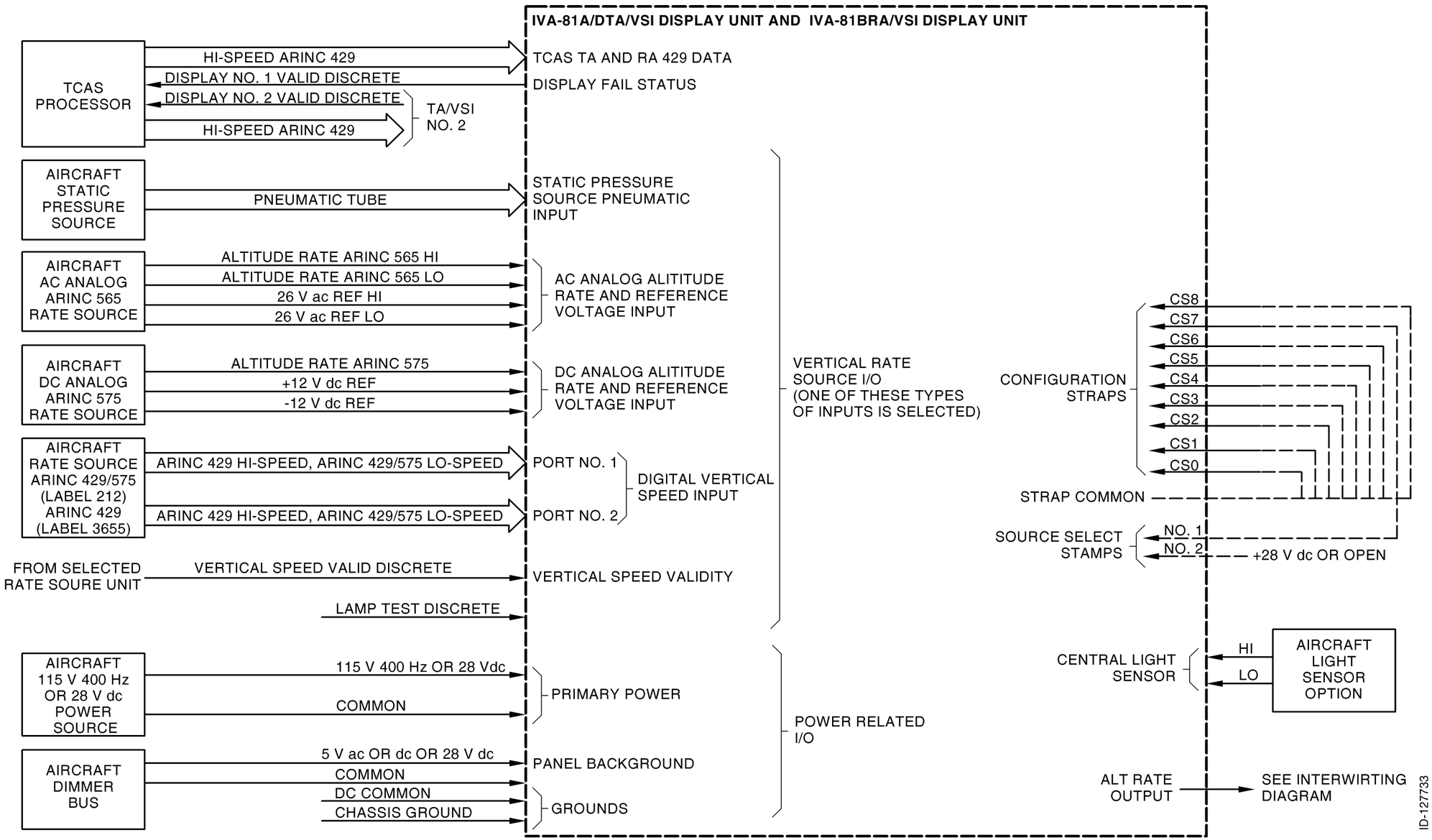
Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
MAINTENANCE RELATED I/O		
Maintenance Computer or Centralized Failure Display System (CFDS)	Maintenance Data. ARINC 429 high-speed transmit and ARINC 429 high-speed receive bus.	Maintenance digital 429 data from maintenance computer or CFDS to TCAS processor and maintenance digital 429 data from TCAS processor to maintenance computer or CFDS.
Automatic Test Equipment (ATE)	ATE Test Pins. Twenty discrete output.	TCAS processor status output to ATE monitors. Not necessary for the aircraft installation.
Data Loader	Data loader high or low-speed ARINC 429 transmit bus and receive bus. Four discrete input (3 space).	Data for software updates.
NONDIGITAL FLIGHT RECORDER RELATED I/O		
Optional Flight Recorder (NonDigital Type)	ARINC 573 Resolution Advisory (RA) Word	Resolution advisory data word output from TCAS processor to the aircraft nondigital flight recorder. **NOTE 2.**

Table 15. TPA-100A TCAS Processor Inputs and Outputs (cont)

Source Or Destination	Processor I/O Signal Name and Type	General Description
SUPPRESSION BUS RELATED I/O		
Own Aircraft L-Band Equipment	Suppression Pulse input/output	Bi-directional bus. An input pulse suppresses the TCAS receiver. An output suppression pulse suppresses other L-band equipment in the aircraft.
POWER RELATED I/O		
Own Aircraft Power Supplies Fan On TCAS Processor Assembly Tray	115 V 400 Hz or 28 V dc and 26 V ac reference power input. 115 V 400 Hz output (or from 28 V dc source).	Provide power to the TCAS processor from own aircraft power sources. Supplies energizing power from the TCAS processor to the cooling fan on the processor assembly tray.
NOTES: 1. Not used with Change 7 units. On ground intruders never shown. 2. An ARINC 429 output is also supplied for an optional digital-type flight recorder. See the output to RA/VSI No. 1.		

THIS PAGE LEFT BLANK



IVA-81A/D and IVA-81B RA/VSI System Interconnect Block Diagram
Figure 9

Table 16. IVA-81A/D TA/VSI and IVA-81B RA/VSI Inputs and Outputs

Source Or Destination	I/O Signal Name and Type	General Description
TCAS PROCESSOR RELATED I/O		
TCAS Processor	TCAS Data High-Speed ARINC 429 (Two Ports)	Traffic display and resolution advisory data from TCAS processor to TA/VSI or RA/VSI No. 1 or No. 2. (The RA/VSI uses only that data for resolution advisories.)
	Display Status No. 1 Discrete and Display Status No. 2 Discrete	Supplies TA/VSI or RA/VSI No. 1 or No. 2 failure status to TCAS processor.
VERTICAL RATE SOURCE RELATED I/O (One of the following input can be selected)		
Aircraft Static Pressure Source	Static Pressure Source Pneumatic Input	Pressure altitude from an aircraft static pressure port.
Aircraft ARINC 565 ac Analog Rate Source and Reference Voltage	Altitude Rate. AC Analog with 26 V ac High and Low Reference	Analog altitude rate which is converted by the TA/VSI or RA/VSI into vertical speed pointer position on the VSI.
Aircraft ARINC 575 dc Analog Rate Source and Reference Voltage	Altitude Rate. DC Analog with +12 and -12 V dc Reference	Same as above.
Aircraft Digital ARINC 429 (Label 212) Rate Source	Altitude Rate Data. Low-speed ARINC 429	Digital vertical speed related data which is converted by the TA/VSI or RA/VSI into vertical speed pointer position on the VSI.
Aircraft Digital ARINC 429 (Label 365) Rate Source	Inertial Vertical Speed Data. High-speed ARINC 429	Same as above.

Table 16. IVA-81A/D TA/VSI and IVA-81B RA/VSI Inputs and Outputs (cont)

Source Or Destination	I/O Signal Name and Type	General Description
VERTICAL RATE SOURCE RELATED I/O (cont)		
Aircraft Digital ARINC 575 (Label 212) Rate Source	Altitude Rate Data. Digital ARINC 575. Low-speed ARINC 419	Same as above.
Aircraft Digital ARINC 419 (Label 212) Rate Source	Altitude Rate Data. Low-speed digital vertical speed, ARINC 419.	Nonstandard ARINC 419 interface used with a general aircraft that has an air data computer which transmits ARINC 419 Label 212 at an internal rate slower than the maximum of 67 milli-seconds.
Vertical Speed Source	Vertical Speed Valid Discrete	Supplies failure status from set analog vertical rate source unit to the VSI.
ALTITUDE RATE OUTPUT		
IVA-81A/D or IVA-81B	Digital Altitude Rate Output	Buffered altitude rate output for use by remote indicators.
CONFIGURATION AND SOURCE SELECT STRAPPING RELATED I/O		
Nine Configuration Straps and Two Source Select Straps on TA/VSI or RA/VSI Rear Connector	CS0-CS8 Configuration Straps and Source Select No. 1 and No. 2 Straps. Eleven discrete input.	Show the type of vertical rate source input to the TA/VSI, RA/VSI, and other system particulars.
POWER RELATED I/O		
Own Aircraft Power Supplies	115 V 400 Hz or 28 V dc	Supplies the primary power to TA/VSI and RA/VSI.
LAMP TEST		
Lamp Test Source	Lamp Test Discrete	IVA-81A/D turns on LCD display. IVA-81B turns on TCAS eyebrow lights.
Own Aircraft Dimmer Bus	5 V ac or dc or 28 V dc	Controls panel background lighting on TA/VSI and RA/VSI.

Table 17. ITA-81A Traffic Display Inputs and Outputs

Source Or Destination	I/O Signal Name and Type	General Description
TCAS PROCESSOR RELATED I/O		
TCAS Processor	TCAS Data High-Speed ARINC 429	Traffic display data from TCAS processor to dedicated TCAS traffic display.
	Display Status No. 3 Discrete	Supplies dedicated display failure status to TCAS processor.
	Traffic Alert Display Enable Discrete	TCAS processor discrete output sets the power supply of dedicated display.
POWER RELATED I/O		
Own Aircraft Power Supplies	115 V 400 Hz	Supplies the primary power to dedicated TCAS traffic display.
Own Aircraft Dimmer Bus	5 V ac	Controls panel background lighting on dedicated display.

C. TCAS Failure Monitoring

The TCAS system includes extensive Built-In-Test Equipment (BITE) monitoring. BITE does full-time monitoring of the TCAS system components. Primary failures are shown on the screen of the PPI or dedicated traffic display, and on different FAIL lamps and flags throughout the system. BITE monitoring is totally transparent to the pilot and does not effect the TCAS operation unless a failure is found. When a primary system failure is found, specified LRU (line replaceable unit) failures are shown on the PPI or dedicated traffic display. If a PPI weather/traffic display is used in a weather mode, TCAS FAIL will be annunciated. When the display is set to TCAS mode, the specified LRU failure(s) is shown.

BITE monitors the internal operation of the system components and I/O data links.

When a TCAS FAIL condition is found, TCAS stops all surveillance and tracking functions.

NOTE: A complete description of BITE monitoring operations and their failure annunciations and indicators, is contained in the TESTING AND FAULT ISOLATION and in the MAINTENANCE PRACTICES sections of this manual.

7. Controls and Indicators

A. General

The primary manual controls used to operate the CAS-100 system are contained on the transponder/TCAS control units.

NOTE: TCAS advisory and/or serviceable status indications are given on the TA/VSI, RA/VSI, PPI, dedicated traffic display, cockpit audio system, transponder/TCAS control unit, front panel of the TCAS processor, and front panel of the Mode S transponder unit.

It is possible to supply the control of traffic advisory display range selection at a distance from the transponder/TCAS control unit or locally through a front panel range selector switch or switches. The control is supplied depending upon type of display unit used and display unit configuration strapping.

B. TCAS Input Power Control

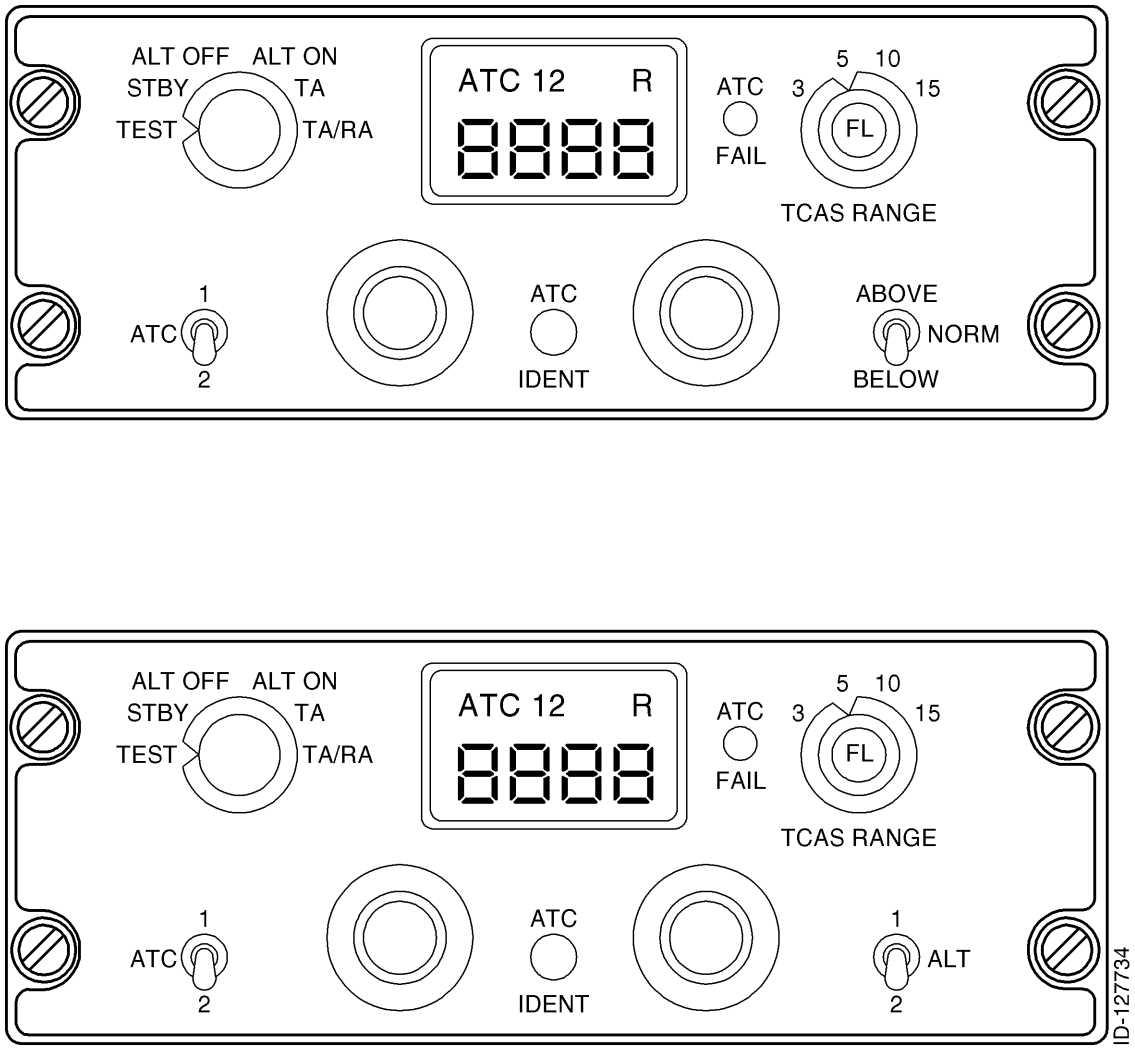
115 V 400 Hz or 28 V dc primary power, 26 V ac reference power, and 5 V ac or dc or 28 V dc background panel lighting power are applied to TCAS by closing aircraft circuit breakers. TCAS does not contain a power on/off switch or fuses.

C. CTA-81( ) Control Unit

See Figures 10 and 11. The CTA-81( ) Control Unit is the primary control for both TCAS and the transponder. The CTA-81A Control Unit is used in the installations containing two TRA-67A Mode S transponders. The CTA-81B is used in the installations containing one TRA-67A Mode S transponder and one ATCRBS transponder. The Tables 18 and 19 give the functions of the controls and indicators on the control units.

D. CTA-100A Control Unit

See Figure 12. The CTA-100A is an upgraded and enhanced microprocessor-based transponder control panel for controlling maximum two TRA-67A ATC transponders and the TPA-81A/TPA-100A TCAS processors. The CTA-100A controller is supplied with two basic front panel configurations, a rotary control version and a keypad entry version. The CTA-100A can facilitate the front panel interchangeability. It is made in all functional configurations of the CTA-81( ) control panels with the same connector configuration and is applicable for a one-for-one component change-out. The Table 20 gives the functions of the controls and indicators on the control unit.



CTA-81A Control Unit (Typical)
Figure 10

Refer to Table 18 for the CTA-81A Control Unit controls and indicators.

Table 18. CTA-81A Control Unit Controls and Indicators

Control/Indicator (See Figure 10)	Function
ATC 1-2 Switch	Sets one of two Mode S transponders to be under control of the CTA-81A Control Unit. The nonselected Mode S transponder is put in STANDBY mode.
ALT 1-2 Switch	The switch sets one of two Mode S transponder altitude source input ports.
Function Selector Switch	Rotary switch. Controls the operating modes of Mode S transponder and requests the TCAS operating modes. **NOTE 1.**
TEST Position	Holding switch in the spring-loaded TEST position for one second starts the TCAS and Mode S transponder functional self-test. If the TCAS processor Functional Test Inhibit program pin is strapped, the TCAS functional test is prevented while the aircraft is airborne. The TCAS flag shows TCAS on the RA/VSI display during the functional test (approximately 12 seconds). The traffic display shows TEST. A test pattern shown on the traffic display allows verification of each type of intruder symbol. During the first three seconds a lamp test is done on all segments of the RA/VSI. If a failure is found during functional test, the TCAS flag continues to display TCAS. Following the lamp test, a test fixed command is shown until the end of test.
STBY Position	In-flight or on-the-ground puts the Mode S transponder and TCAS in STANDBY mode (TCAS sensitivity level No. 1). In STANDBY mode, transponder power is turned on but the transponder does not transmit squitters or reply to interrogations. In STANDBY mode, all TCAS broadcast, surveillance, and tracking operations are made unserviceable and the traffic display is erased but for a TCAS STBY mode annunciation.

Table 18. CTA-81A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 10)	Function
Function Selector Switch (cont) ALT OFF Position (cont)	In-Flight - Turns on Mode S transponder to fully active state and places TCAS in STANDBY mode (TCAS sensitivity level No. 1). The Mode S transponder transmits squitters and replies to Mode S, ATCRBS Mode C, and Mode A interrogations. The Mode S transponder reply to Mode C and Mode S does not contain an altitude report. The transponder reply to Mode A contains the ATC transponder code (normal Mode A reply). All TCAS broadcast, surveillance, and tracking functions are made unserviceable. The traffic display screen is erased but for a TCAS STBY mode annunciation. On-the-Ground - Mode S transponder squitters and replies to Mode S interrogations. Depending on Mode S transponder strapping, the transponder replies or not to ATCRBS Mode C and Mode A interrogations. The transponder reply to ATCRBS and Mode S interrogations does not contain an altitude report. The transponder reply to Mode A interrogations contains the ATC transponder code. TCAS is in STANDBY mode (TCAS sensitivity level No. 1). The traffic display screen is erased but for a TCAS STBY annunciation.
ALT ON Position	In-Flight - Same effect on the Mode S transponder and TCAS as ALT OFF position (in-flight) other than the Mode S transponder reports altitude in its Mode C and Mode S replies. On-the-Ground - Same effect on the Mode S transponder and TCAS as ALT OFF position (on-the-ground) other than the transponder reports altitude in its Mode C and Mode S replies (if strapped to respond to Mode C when on-the-ground).

Table 18. CTA-81A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 10)	Function
Function Selector Switch (Cont.) TA Position (TA ONLY Mode) (Cont.)	In-Flight - Turns the Mode S transponder to the operation condition and puts the TCAS in TA ONLY mode (traffic advisory only mode) (TCAS sensitivity level No. 2). The Mode S transponder transmits squitters and replies fully to Mode S, ATCRBS Mode C, and Mode A interrogations. TCAS broadcasts and does all Mode S and ATCRBS surveillance and tracking functions. TCAS gives traffic displays for TA, proximity, and nonthreat category aircraft **(NOTE 2. for exception)**. TCAS does not categorize or display one aircraft as a RA threat symbol. TCAS gives the traffic advisory alerts, but does not give resolution advisory alerts (for example, voice RA alerts or RA indications on the traffic display are not supplied). A TA ONLY annunciation comes into the view on the traffic display. On-the-Ground - Mode S transponder squitters and replies to Mode S interrogations. Depending on transponder strapping, transponder replies fully or does not reply to ATCRBS Mode C and Mode A interrogations. Depending on TCAS strapping, TCAS goes into TA ONLY mode or STANDBY mode (traffic display screen is erased except for a TCAS STBY mode annunciation shown on the traffic display).
TA/RA Position	In-Flight - Turns on the Mode S transponder to the operation condition. If own aircraft is above 500 feet AGL, TCAS goes into sensitivity level No. 4 through No. 7 dependent on own aircraft altitude (see Table 7). The Mode S transponder transmits squitters and replies fully to Mode S and ATCRBS

Table 18. CTA-81A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 10)	Function
Function Selector Switch (Cont.) TA/RA Position (Cont.)	Mode C and Mode A interrogations. TCAS broadcasts and does all Mode S and ATCRBS surveillance and tracking functions. TCAS supplies traffic displays for RA, TA, proximity, and nonthreat category aircraft **(see NOTE 2.)**, transmits RA and TA alerts, and transmits resolution advisories on the TA/VSI or RA/VSI. A TA/RA annunciation comes into the view on the PPI or dedicated traffic display. A mode annunciation is not given on the TA/VSI for TA/RA mode. **(NOTE 3.)** On-the-Ground - Mode S transponder squitters and replies fully to Mode S interrogations. Depending on transponder strapping, transponder replies fully or does not reply to ATCRBS Mode C and Mode A interrogations or Mode S interrogations. TCAS defaults to TA ONLY mode (TCAS sensitivity level No. 2) and functions as shown for the TA position (on-the-ground) of the Function Selector Switch in this table.
FL Pushbutton Switch	Spring-loaded pushbutton switch. When pushed and released, replaces relative altitude annunciations for the intruder aircraft on the traffic display with own aircraft flight-level altitude annunciations for a period of 15 seconds. During the 15 second period, own aircraft flight-level altitude also shows on the traffic display. After 15 seconds, own aircraft flight-level altitude goes out of view from the display and intruder aircraft altitude annunciations change to relative altitude annunciations. **(NOTE 4.)** If during the 15 second period after the FL switch is pushed and released, a new RA or TA category aircraft is detected by TCAS, the 15 second flight-level display is made unserviceable and relative altitudes reappear.

Table 18. CTA-81A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 10)	Function
TCAS RANGE Switch	Four position rotary switch. Sets 15, 10, 5, or 3 nautical mile (NM) range scale for the traffic display. The set display scale is annunciated 15 NM, 10 NM, 5 NM, or 3 NM on the traffic display. **(NOTES 5., 6., and 8.)**
ABOVE/NORM/BELOW Switch	Three position toggle switch. Sets relative altitude display limits for nonthreat category aircraft (open-white diamond symbols) on the traffic display. **(NOTE 7.)**
ABOVE Position	Sets display of nonthreat aircraft maximum +8700 feet above own aircraft and down to -2700 feet below own aircraft. ABOVE is annunciated on the traffic display.
NORM Position	Sets display of nonthreat aircraft maximum +2700 feet above own aircraft and down to -2700 feet below own aircraft on the traffic display.
BELOW Position	Sets display of nonthreat aircraft down to -8700 feet below own aircraft and maximum +2700 feet above own aircraft. BELOW is annunciated on the traffic display.
ATC IDENT Pushbutton Switch	When this switch is pushed and released, in 18 seconds a Special Position Identifier (SPI) is inserted for 18 seconds into the transponder Mode A, DF-4, DF-5, DF-20 and DF-21 Mode S replies to interrogations from ground stations. If the switch is held pushed longer than 18 seconds, the SPI bit is transmitted while the switch is pushed, plus an additional 18 seconds after the switch is released. The SPI pulse is not used by TCAS.

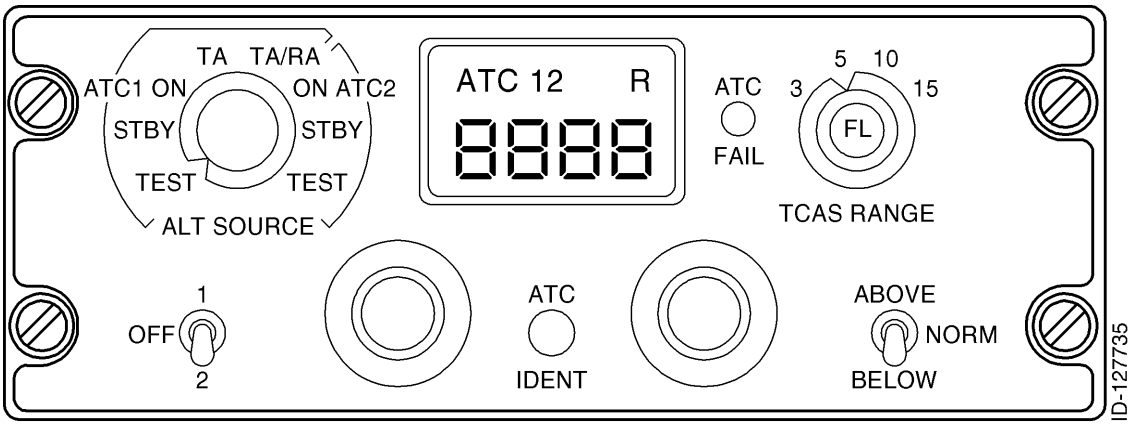
Table 18. CTA-81A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 10)	Function
Code Select Knobs	Lets selection of transponder identification code. The transponder inserts this code into replies to Mode A interrogations and Mode S ATC identification requests from ground stations. The ATC IDENT code is not used by TCAS.
ATC IDENT Code Display	Shows transponder ATC identification code set by the Code Select Knobs and annunciates which transponder is selected by the ATC 1-2 Switch.
ATC FAIL	Illuminates (amber) for some failure conditions found by the Mode S transponder (refer to TRA-67 ATC Mode S Transponder System Maintenance Manual I.B. 1167 for the details).

NOTES:

1: TCAS operating modes are requested from the transponder/TCAS control unit (i.e. TA/RA mode is requested by turning the function selector switch to TA/RA). The TCAS processor can or can not go into the requested mode dependent on prevailing conditions. For example: If TA/RA mode is requested from the control unit and own aircraft is below 500 feet AGL, TCAS automatically defaults to TA ONLY mode (TCAS sensitivity level No. 2) regardless of the TA/RA mode request from the panel.

2. TCAS can be strapped to show all traffic, all the time or when a TA or RA is present.
3. If own aircraft is below 500 feet AGL, TCAS defaults to TA ONLY mode.
4. Holding the FL switch pushed for longer than 15 seconds will not show flight level altitudes for longer than 15 seconds.
5. The range at which resolution or traffic advisories are generated by TCAS is unaffected by the TCAS RANGE switch.
6. The presence of intruder aircraft categorized RA or TA that are more than the set display range is indicated by 1/2 target symbols at the edge of the screen. An RA OFF scale or TA OFF scale annunciation on the traffic display is shown. The position of the 1/2 symbol shows the approximate bearing of the intruder. The 1/2 symbol color and shape shows if the off-scale intruder is an RA or TA (1/2 red square for off-scale RA; 1/2 yellow circle for off-scale TA). When this occurs, the aircraft symbol can be shown by increasing the set range on the TCAS RANGE switch.
7. RA, TA, and proximity category aircraft displays are inaffected by the ABOVE/NORM/BELOW switch (RA and TA aircraft in +8700 feet of own aircraft are shown regardless of the ABOVE/NORM/BELOW switch position. Proximity category aircraft are always in +1200 feet altitude of own aircraft).
8. TCAS RANGE switch is not supplied on all versions of the CTA-81A. When a PPI, TA/VSI, or dedicated traffic display having optional range selectors is used, range selection is made at the traffic display. Other versions have range selections to 40 nautical miles.



CTA-81B Control Unit (Typical)
(Used With One Mode S Transponder and One ATCRBS Transponder)
Figure 11

Refer to Table 19 for the CTA-81B Control Unit controls and indicators.

Table 19. CTA-81B Control Unit Controls and Indicators

Control/Indicator (See Figure 11)	Function
Function Selector Switch	Rotary switch. Controls operating modes of one Mode S transponder (ATC 1 positions) and one ATCRBS transponder (ATC 2 positions). Requests TCAS operating modes **(NOTES 1. and 2.)**
ATC 1 TEST Position	Holding the switch in spring-loaded TEST position for one second starts the TCAS and Mode S transponder Functional self-test. If TCAS processor Functional Test Inhibit program pin is strapped, TCAS functional test is prevented while the aircraft is airborne. The TCAS flag shows TCAS on the RA/VSI display during the functional test (approximately 12 seconds). The traffic display shows TEST. A test pattern shown on the traffic display lets verification of each type of intruder symbol. During the first three seconds of the functional test, a lamp test is done on all segments of the RA/VSI. If a failure is found during functional test, the TCAS flag continues to show TCAS. Following the lamp test, a set test command is shown until end of test.
ATC 1 STBY Position	The ATC 1 STBY position puts the Mode S transponder, ATCRBS transponder, and TCAS in STANDBY mode. The Mode S transponder power is applied, but does not transmit squitters or reply to interrogations in STANDBY mode. In STANDBY mode, all TCAS broadcast, surveillance, and tracking operations are made unserviceable and the traffic display is erased but for a TCAS STBY annunciation. The ATCRBS transponder is on in STANDBY mode, but does not respond to interrogations.

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 11)	Function
Function Selector Switch (cont)	
ATC 1 ON Position	In-Flight - Turns on the Mode S transponder to full on condition, removes power from ATCRBS transponder, and puts the TCAS in STANDBY mode (TCAS sensitivity level No. 1). The Mode S transponder transmits squitters and replies to Mode S, ATCRBS Mode C, and Mode A interrogations. The Mode S transponder reply to the Mode C and Mode S interrogations does not contain an altitude report if the ALT SOURCE switch is set to the OFF position. The transponder reply to Mode A interrogations contains the ATC transponder code (normal Mode A reply). All the TCAS broadcast, surveillance, and tracking functions are made unserviceable. The traffic display screen is erased, but for a TCAS STBY annunciation. On-the-Ground - Power is not applied to ATCRBS transponder. The Mode S transponder squitters and replies fully to the Mode S interrogations. Depending on the Mode S transponder strapping, the transponder replies or does not reply to ATCRBS Mode C and Mode A interrogations. The transponder reply to ATCRBS and Mode S interrogations will not contain an altitude report if the ALT SOURCE switch is set to the OFF position. The transponder reply to Mode A interrogations contains the ATC transponder code. TCAS is in STANDBY mode (sensitivity level No. 1). The traffic display screen is erased but for a TCAS STBY annunciation.
ATC 1 TA Position	In-Flight - Turns on the Mode S transponder to full on condition, removes power from the ATCRBS transponder, and puts the TCAS in TA ONLY mode (traffic advisory only mode).

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 11)	Function
Function Selector Switch (cont)	
ATC 1 TA Position (cont)	(TCAS sensitivity level No. 2). The Mode S transponder transmits squitters and replies to the Mode S, ATCRBS Mode C, and Mode A interrogations. The TCAS broadcasts and does all the Mode S and ATCRBS surveillance and tracking functions. The TCAS supplies the traffic displays for TA, proximity, and nonthreat category aircraft **(NOTE 3 for exception)**, but does not categorize or show one aircraft as a RA threat symbol. The TCAS gives the traffic advisory alerts, but does not give resolution advisory alerts (for example, voice RA alerts or RA indications on the traffic display are not given). A TA ONLY mode annunciation comes into view on the traffic display. On-the-Ground - Power is not applied to ATCRBS transponder. The Mode S transponder squitters and replies fully to the Mode S interrogations. Depending on the Mode S transponder strapping, the transponder replies fully or does not reply to ATCRBS Mode C and Mode A interrogations. Depending on the TCAS strapping, TCAS goes into STANDBY mode (traffic display screen is erased, but for a TCAS STBY annunciation), or is in TA mode (TA ONLY mode annunciation shows on the traffic display). TA ONLY mode operation on-the-ground is same as TCAS TA ONLY mode operation in-flight as shown above.
ATC 1 TA/RA Position	In-Flight - Turns on the Mode S transponder to full on condition and removes the power from ATCRBS transponder. If own aircraft is above 500 feet AGL, the TCAS goes into sensitivity level No. 4 through No. 7 dependent on own aircraft altitude (refer to Table 7).

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 11)	Function
Function Selector Switch (cont)	
ATC 1 TA/RA Position (cont)	The Mode S transponder transmits squitters and replies fully to the Mode S, ATCRBS Mode C, and Mode A interrogations. The TCAS broadcasts and does all the Mode S and ATCRBS surveillance and tracking functions. The TCAS gives the traffic displays for RA, TA, proximity, and nonthreat category aircraft **(NOTE 3.)**, gives RA and TA alerts, and transmits resolution advisories on the TA/VSI or RA/VSI. **(NOTE 4.)**
	On-the-Ground - The Mode S transponder squitters and replies fully to Mode S interrogations. Depending on the Mode S transponder strapping, the transponder replies fully or does not reply to the Mode S, ATCRBS Mode C, and Mode A interrogations. The power is removed from ATCRBS transponder. The TCAS defaults to TA ONLY mode (TCAS sensitivity level No. 2) and functions as shown for the Function Selector switch ATC 1 TA Position (on-the-ground), in this table.
ATC 2 ON Position	Puts the Mode S transponder and the TCAS in STANDBY mode and turns on the ATCRBS transponder to full on condition.
ATC 2 STBY Position	Puts the Mode S transponder, the TCAS, and the ATCRBS transponder in STANDBY mode.
ATC 2 TEST Position	Starts functional test for the ATCRBS transponder. Refer to the ATCRBS transponder maintenance manual for the details. The Mode S transponder and TCAS stay in STANDBY.

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 11)	Function
ALT SOURCE 1/2 Switch	Sets one of two barometric altimeter sources to the activated Mode S or ATCRBS transponder. The OFF POSITION makes unserviceable the altitude squawk (two altitude sources only).
FL Pushbutton Switch	Spring-loaded pushbutton switch. When pushed and released, the relative altitude annunciations for the intruder aircraft are replaced on the traffic display with flight-level altitude annunciations for a period of 15 seconds. During the 15 second period, own aircraft flight-level altitude also comes into view on the traffic display. After 15 seconds, own aircraft flight-level altitude goes out of view from the display and the intruder aircraft altitude annunciations change to relative altitude annunciations. **(NOTE 5.)** If a new RA or TA category aircraft is detected by the TCAS during the 15 second period, the 15 second flight-level display is made unserviceable and relative altitudes reappear.
TCAS RANGE Switch	Four position rotary switch. Sets 15, 10, 5, or 3 nautical mile range scale for the traffic display. The set display scale is shown as 15 NM, 10 NM, 5 NM, or 3 NM on the traffic display. **(NOTES 6., 7., and 9.)**
ABOVE/NORM/BELOW Switch	Three position toggle switch. Sets relative altitude display limits for nonthreat category aircraft (open-white diamond symbols) on the traffic display. **(NOTE 8.)**
ABOVE Position	Sets display of nonthreat aircraft maximum +8700 feet above own aircraft and down to -2700 feet below own aircraft. ABOVE is shown on the traffic display.

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

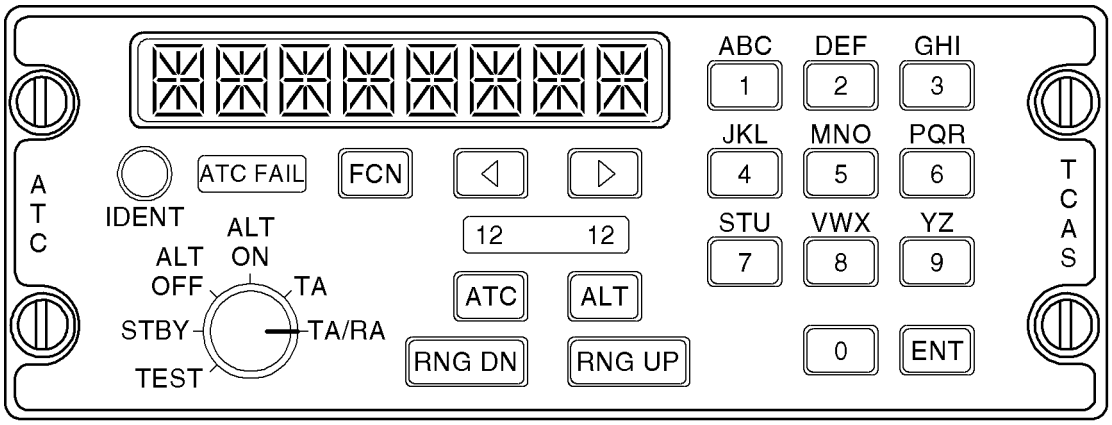
Control/Indicator (See Figure 11)	Function
NORM Position	Selects display of nonthreat aircraft up to +2700 feet above own aircraft and down to -2700 feet below own aircraft on traffic display.
BELOW Position	Selects display of nonthreat aircraft down to -8700 feet below own aircraft and up to -2700 feet above own aircraft. BELOW is annunciated on the traffic display screen.
ATC IDENT Pushbutton Switch	Within 18 seconds after the switch is pushed and released, an SPI is put into the transponder Mode A and DF-4, DF-5, DF-20 and DF-21 Mode S replies to the interrogations from ground stations. The SPI is shown for 18 seconds. If the switch is held pushed longer than 18 seconds, the SPI bit is transmitted while the switch is pushed, plus an additional 18 seconds after the switch is released. The SPI pulse is not used by the TCAS.
Code Select Knobs	Lets selection of transponder identification code. The transponder inserts this code into replies to Mode A interrogations or Mode S ATC identification requests from ground stations. The ATC IDENT code is not used by TCAS.
ATC IDENT Code Display	Shows transponder ATC identification code set by the Code Select Knobs and shows which transponder is selected by the function selector switch. The display gives an R annunciation when selected transponder is replying to interrogations.
ATC FAIL Indicator Lamp	Illuminates (amber) for some failure conditions found by the Mode S transponder (refer to TRA-67 ATC Mode S Transponder System Maintenance Manual I.B. 1167 for the details).

Table 19. CTA-81B Control Unit Controls and Indicators (cont)

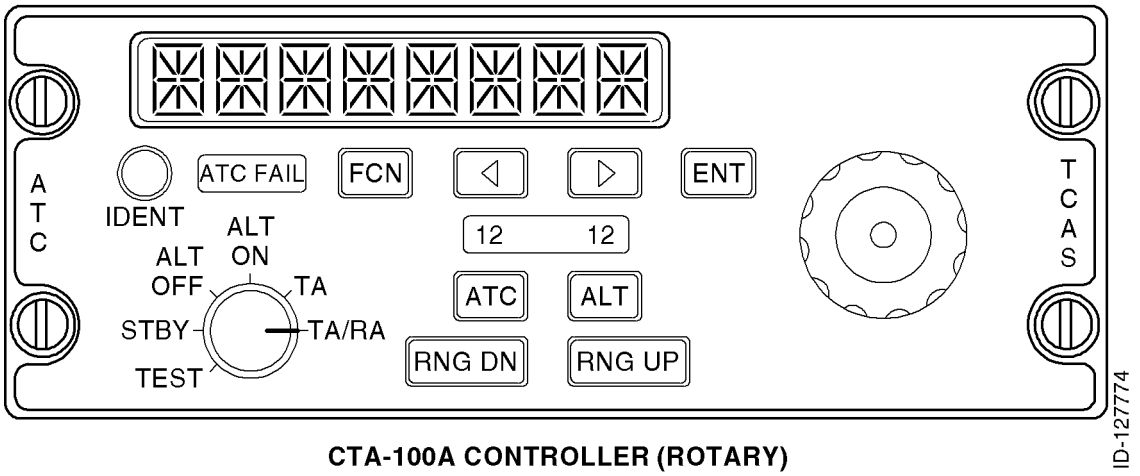
Control/Indicator (See Figure 11)	Function

NOTES:

1. The TCAS operating modes are requested from the transponder/TCAS control unit (For example, TA/RA mode is requested by turning function selector switch to TA/RA). The TCAS processor can or can not go into the requested mode dependent on prevailing conditions. For example: If TA/RA mode is requested from the control unit and own aircraft is below 500 feet AGL, the TCAS automatically defaults to TA ONLY mode (TCAS sensitivity level No. 2) regardless of the TA/RA mode request from the panel.
2. In-flight or on-the-ground status of own aircraft is calculated with the weight-on-gear (air/ground) strut switch input to the transponder and TCAS processor.
3. The TCAS can be strapped to show all the traffic, all the time or only when a TA or RA is present.
4. If own aircraft is below 500 feet AGL, the TCAS automatically ignores the TA/RA position of the switch and defaults to TA ONLY mode. The TCAS functions as shown for the ATC 1 TA position (in-flight) of the Function Selector Switch in this table.
5. Holding the FL switch pushed for longer than 15 seconds will not show flight level altitudes for longer than 15 seconds.
6. The range at which RAs or TAs are generated by the TCAS is unaffected by the TCAS RANGE switch.
7. The presence of the intruder aircraft that are categorized as RA or TA and are more than the set display range, is shown by 1/2 target symbols at the edge of the screen. The position of the 1/2 symbol shows the approximate bearing of the intruder. The 1/2 symbol color and shape shows if the off-scale intruder is an RA or TA (1/2 red square for off-scale RA; 1/2 yellow circle for off-scale TA). When this occurs, the aircraft symbol can be shown by increasing the set range on the TCAS RANGE switch.
8. RA, TA, and proximity category aircraft displays are unaffected by the ABOVE/NORM/BELOW switch. (RA and TA aircraft within +8700 feet of own aircraft are shown regardless of the ABOVE/NORM/BELOW switch position. Proximity category aircraft are always within +1200 feet altitude of own aircraft).
9. The TCAS RANGE switch is not supplied on all versions of the CTA-81B. When a PPI, TA/VSI, or dedicated traffic display having optional range selectors is used, range selection is made at the traffic display. Other versions have range selection to 40 nautical miles.



CTA-100A CONTROLLER (KEYPAD)



CTA-100A CONTROLLER (ROTARY)

CTA-100A Controllers
Figure 12

Table 20. CTA-100A Control Unit Controls and Indicators

Control/Indicator (See Figure 12)	Function
Mode Select Switch	Rotary switch. Supplies mode control for the transponders and TCAS processor. The mode selector switch can put the transponders into standby mode or active mode with altitude interrogation on or off. The mode selector switch is also used to set the TA (Traffic Advisory) or TA/RA (Traffic Advisory/Resolution Advisory) modes for the TCAS processor. The position of the mode selector switch finds the correct ARINC 429 control data to transmit to the Mode S transponders and the TCAS processor. The switch supplies a momentary TEST position, which lets the personnel start a TCAS system test. **(NOTE 1.)**
TEST Position	The TEST mode is to start the TCAS system test. The TEST mode position is a momentary switch position. When the rotary switch is held in the TEST position for a minimum of one second, the CTA-100A outputs SSM = FUNCTIONAL TEST on all ARINC 429 labels. When the rotary switch is released, the CTA-100A starts the previous SSM transmission.
STANDBY Position	The Standby/On discrete output for transponder No. 1 and transponder No. 2 are set to standby.

Table 20. CTA-100A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 12)	Function
Mode Select Switch (cont)	
ALT OFF Position	The STANDBY/On discrete output is set to ON for the set transponder. BIT 11 of ARINC label 016 is set to 1 to inhibit altitude reporting.
ALT ON Position	The STANDBY/On discrete output is set to ON for the set transponder. BIT 11 of ARINC label 016 is set to 0 to enable altitude reporting.
TA Position	In-Flight - Turns on the Mode S transponder to full on condition and puts the TCAS in TA ONLY mode (traffic advisory only mode) (TCAS sensitivity level No. 2). The Mode S transponder transmits squitters and replies fully to Mode S, ATCRBS Mode C, and Mode A interrogations. The TCAS broadcasts and does all Mode S and ATCRBS surveillance and tracking functions. The TCAS gives the traffic displays for TA, proximity, and nonthreat category aircraft **(NOTE 2. for exception)**, but does not categorize or show one aircraft as a RA threat symbol. The TCAS gives the traffic advisory alerts, but does not give resolution advisory alerts (for example, voice RA alerts or RA indications on the traffic display are not given). A TA ONLY annunciation comes into view on the traffic display. On-the-Ground - The Mode S transponder squitters and replies fully to Mode S interrogations. Depending on transponder strapping, transponder replies fully or does not reply to ATCRBS Mode C and Mode A interrogations. Depending on the TCAS strapping, TCAS goes into TA ONLY mode or STANDBY mode (traffic display screen is erased but for a TCAS STBY mode annunciation shows on the traffic display).
TA/RA Position	In-Flight - Turns on the Mode S transponder to full on condition. If own aircraft is above 500 feet AGL, the TCAS goes into sensitivity level No. 4 through No. 7 dependent on own aircraft altitude (refer to Table 7). The Mode S transponder transmits squitters and replies fully to Mode S, ATCRBS Mode C, and Mode A interrogations. The TCAS broadcasts and does all Mode S and ATCRBS surveillance and tracking functions. The TCAS gives traffic displays for RA, TA, proximity, and nonthreat category aircraft **(NOTE 2.)**, issues RA and TA alerts, and gives resolution advisories on the TA/VSI or RA/VSI. A TA/RA annunciation shows on the PPI or dedicated traffic display. A mode annunciation is not given on the TA/VSI for TA/RA mode.

Table 20. CTA-100A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 12)	Function
Mode Select Switch (cont) TA/RA Position (cont)	**(NOTE 3.)** On-the-Ground - The Mode S transponder squitters and replies fully to Mode S interrogations. Depending on transponder strapping, the transponder replies fully or does not reply to ATCRBS Mode C, Mode A, or Mode S interrogations. The TCAS defaults to TA ONLY mode (TCAS sensitivity level No. 2) and functions as shown for the TA position (on-the-ground) of the Function Selector Switch in this table.
IDENT Pushbutton	The IDENT pushbutton is used to show the aircraft identification symbol shown on the ATC display. The IDENT button has priority over all other CTA-100A functions. Whenever the IDENT button is operated, the CTA-100A must cancel the current task, transmit the IDENT command, and default to the ATC code display mode.
ATC SELECT Pushbutton	The ATC SELECT pushbutton is used to set either Transponder No. 1 or Transponder No. 2 in the TCAS system. Each operation of the ATC SELECT pushbutton alternately sets the Transponder No. 1 or Transponder No. 2. The indication of the set transponder is given by annunciators indicating either a 1 or 2. The CTA-100A controls the annunciatiors and transponder selection status.
ALT Select Pushbutton	The ALT 1/2 select pushbutton is used by the personnel to set the No. 1 or No. 2 Mode S transponder altitude source input. Each operation of the ALT 1/2 select pushbutton alternately sets the No. 1 or No. 2 input. The indication of the set transponder is given by annunciators indicating either a 1 or 2. The CTA-100A software controls the annunciators and altitude source input selection status. **(NOTE 4.)**
DISPLAY Screen	The CTA-100A controller has a display with eight alpha-numeric characters. The display supplies white segments against a black background. For an NVIS compatible version, green segments against a black background are used. The display intensity is controlled by an ambient light sensor to make sure readability in all ambient light conditions.

Table 20. CTA-100A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 12)	Function
ABOVE/BELOW Pushbutton	The ABOVE/BELOW pushbutton is used to set relative altitude display limits for nonthreat category aircraft on the traffic display. **(NOTE 4.)**
RNG DN Pushbutton RNG UP Pushbutton	The RANGE pushbutton is used to set the nautical mile range scale for the TCA display. Each operation of the RANGE pushbutton toggles through a pre-specified set of mile ranges. When the RANGE pushbutton is operated, the CTA-100A will toggle to the subsequent highest range value. **(NOTE 4.)**
FCN Pushbutton	The function of the FCN pushbutton is to set the function modes that use the CTA-100A display. When the FCN pushbutton is pushed, the CTA-100A sets and shows the subsequent available function mode.
RIGHT (>) Pushbutton	The RIGHT pushbutton shows current Flight identification when Flight ID mode is set on the display. The pushbutton is also used to set to the subsequent character position for Flight ID data entry before the timeout period.
LEFT (<) Pushbutton	The LEFT pushbutton shows the current Flight identification when The Flight ID mode is set in the display. The selection will backspace over previous character in ATC data entry mode and backspace over previous character in The Flight ID mode. The LEFT pushbutton starts the data entry mode for Flight ID when the current Flight ID value is on the display -- backspaces over all but the first two characters.

Table 20. CTA-100A Control Unit Controls and Indicators (cont)

Control/Indicator (See Figure 12)	Function
ENT Pushbutton	The ENT pushbutton is for showing current Flight identification when the Flight ID mode is set in the display. The ENT pushbutton will confirm the Flight ID data entry and send the value along the ARINC 429 databus. Selection of ENT will confirm the ATC code data entry for rotary control versions of the CTA-100A.
NUMERIC KEYPAD (Keypad CTA-100A version only)	The NUMERIC KEYPAD consists of pushbuttons for each number 0 through 9 and lets a procedure for entering transponder codes and/or flight identification data into the CTA-100A display. The NUMERIC KEYPAD buttons 0 through 7 have priority over all other CTA-100A functions other than for the Flight ID data entry mode. When a button (0-7) is operated, the CTA-100A will cancel the current task, and immediately change into ATC code data entry mode. The numeric pushbutton that was initially pushed will become the first digit of the new ATC code.
FAIL Annunciator	The FAIL annunciator will come on when the set transponder and related TRANSPONDER FAIL (No. 1 or No. 2) discrete input is in operation. The annunciator color will be amber.
ROTARY CONTROL Knob (Rotary control CTA-100A version only)	The data entry of the ATC code will use the dual concentric rotary control. The data is recorded one digit at a time, using the outer knob to forward to the subsequent digit. An underline is used to identify each digit that requires entry. The inner knob is used to move through the numbers 0-7 for each digit of the ATC code. After each digit entry, any clockwise turn of the outer knob will forward the data entry one digit to the right. The outer knob can be used to backspace over incorrectly recorded data. For each detent in the counterclockwise direction, the display will backspace one digit. After the ATC four digit code has been entered into the display, the code will be accepted into the system one of three procedures. The ENT pushbutton can be actuated, the outer knob selector can be rotated clockwise, or a 5.0 +/- 0.1 second timeout period stops if none of the two items has occurred.

NOTES:

1. In-flight or on-the-ground status of own aircraft is determined by the weight-on-gear (air/ground) strut switch input to the transponder and TCAS processor.
2. The TCAS can be strapped to show all the traffic, all the time or only when a TA or RA is present.
3. If own aircraft is below 500 feet AGL, the TCAS defaults to TA ONLY mode.
4. Not installed on all versions of CTA-100A.

E. TA/VSI

The TA/VSI displays resolution advisory maneuvering data to the pilot during threat conditions. The TA/VSI also supplies a display of airspace traffic conditions in the traffic display range and altitude volume limits. See Figure 13.

(1) Resolution Advisories

Resolution advisories can be corrective or preventive and positive or negative.

A corrective advisory requires a vertical maneuver and is always shown with red and green arcs. The red arc shows the vertical speed rates that are not permitted in the presence of the RA. The green arc shows the vertical speeds that must be flown during a corrective advisory. A preventive advisory requires no maneuver and is represented with only a red arc. (Refer to the TCAS Pilot Manual.)

The limits of the red arc are supplied to the TA/VSI from the TCAS through the 429 bus. The limits of the green arc are not supplied from TCAS. The green arc will be immediately adjacent to the red arc and have a width of approximately equal to the space between 1500 ft/min and 2000 ft/min.

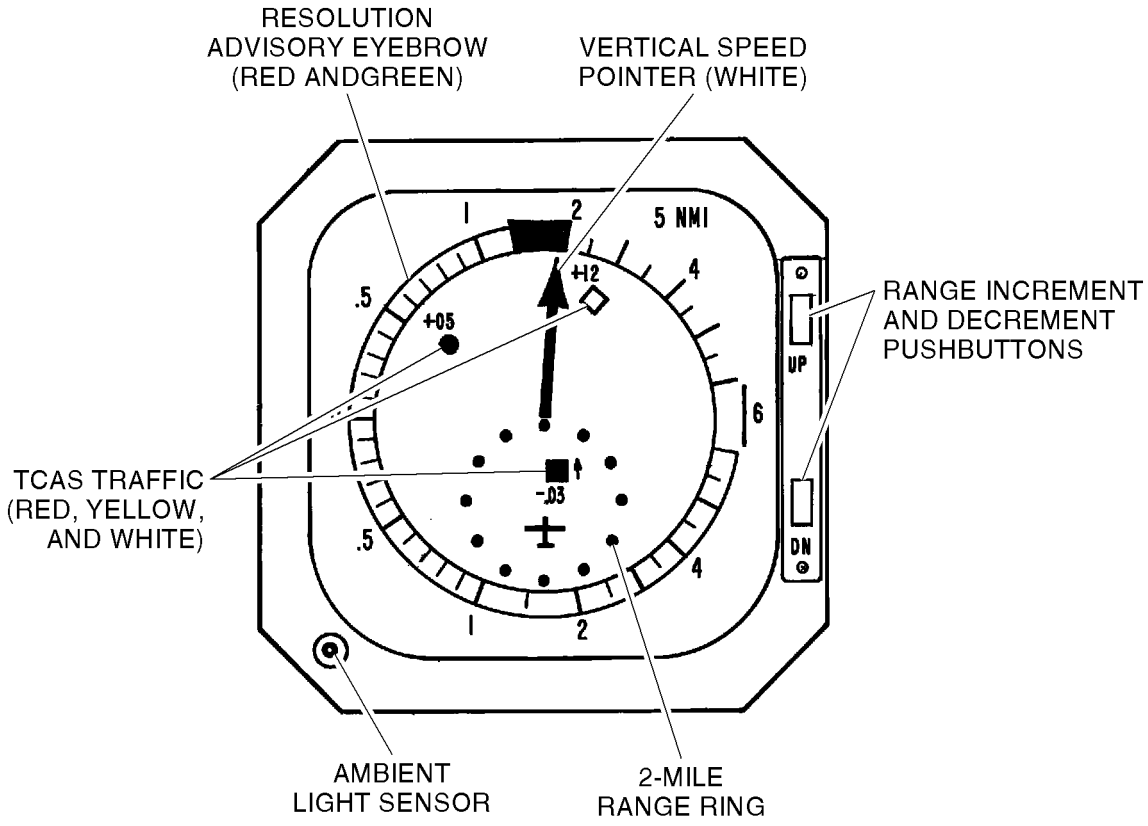
It is possible to show two red arcs at the same time with an RA for example, do not climb more than 1000 feet and do not descend more than 2000 feet. Since one procedure can be corrective, the green arc will be immediately adjacent to the red arc representing the corrective advisory. If the two procedures are preventive, only the red arcs are present. (Refer to Table 21 for TA/VSI RAs and Audio Messages.)

(2) Traffic Display

The traffic display supplies the following data:

- The standard symbol has own aircraft symbol, and a two mile range ring marker.
- Resolution advisory, traffic advisory, proximity, and nonthreat category aircraft symbols that show the range, bearing (if tracking is occurring on a directional antenna), and altitude (if the intruder aircraft is reporting altitude).
- Numerous text message annunciations relating to the presence of TAs and RAs that can not be displayed by a symbol because bearing is not available. TAs and RAs that are outside the range scale of the traffic display show operating modes and fail conditions.

NOTE: A pilot manual supplied by Honeywell gives the TA/VSI operation in detail.



SYMBOL	INTRUDER COLOR	DESCRIPTION	RECOMMENDED ACTION
■	SOLID RED	RESOLUTION ADVISORY	TAKE CORRECTIVE OR PREVENTIVE ACTION
●	SOLID YELLOW	TRAFFIC ADVISORY	POTENTIAL RA - MONITOR
◆	SOLID WHITE	PROXIMITY INTRUDER	MONITOR FOR FUTURE DEVELOPMENT
◇	HOLLOW WHITE	NON THREAT	MONITOR FOR FUTURE DEVELOPMENT

ID-127736

TA/VSI Controls and Indicators
Figure 13

Table 21. TA/VSI RA's and Audio Messages

Resolution Advisory	Audio Message
CLIMB	Climb, Climb
DESCENT	Descend, Descend
CROSSOVER CLIMB	Climb, Crossing Climb-- Climb, Crossing Climb
CROSSOVER DESCENT	Descend, Crossing Descend-- Descend, Crossing Descend
VERTICAL SPEED RESTRICTED (CLIMBING OR DESCENDING)	Adjust Vertical Speed, Adjust
ANY WEAKENING OR SOFTENING OF AN RA	Adjust Vertical Speed
PREVENTATIVE ADVISORY	Monitor Vertical Speed
MAINTAIN EXISTING VERTICAL SPEED	Maintain Vertical Speed, Maintain
MAINTAIN EXISTING VERTICAL SPEED WHILE CROSSING THREAT'S ALTITUDE	Maintain Vertical Speed, Crossing Maintain
THE FOLLOWING RESOLUTION ADVISORIES REQUIRE 2.5 SECONDS RESPONSE TIME AND UP TO 0.35 G.	
CHANGE FROM CLIMB TO DESCENT	Descend, Descend NOW-- Descend, Descend NOW
CHANGE FROM DESCENT TO CLIMB	Climb, Climb NOW-- Climb, Climb NOW
INCREASE CLIMB RATE	Increase Climb-- Increase Climb
INCREASE DESCENT RATE	Increase Descent-- Increase Descent

F. RA/VSI

The RA/VSI shown in Figure 14 gives resolution advisories same as the TA/VSI, but does not supply a traffic display.

The RA/VSI gives resolution advisories that show the vertical speeds to be avoided to keep or get safe vertical separation.

An electro-mechanical pointer and vertical speed scale, which are standard VSI features, show the present vertical speed of own aircraft. The RA/VSI includes a microprocessor based control unit and curved red and green eyebrow lamp segments around the edge of the vertical speed scale.

Maneuvering resolution advisories are shown on the RA/VSI by illuminating a related number of the red lamp segments. These advisories show the vertical speed rates to be avoided. Green arcs are illuminated to show the vertical speeds that must be flown during an advisory. (Refer to the TCAS pilot manual.)

The VSI for the TCAS applications has flags that show the TCAS operating conditions.

The Honeywell made RA/VSI receives resolution advisory and flag control data from the TPA-100A TCAS processor through a high-speed ARINC 429 data link.

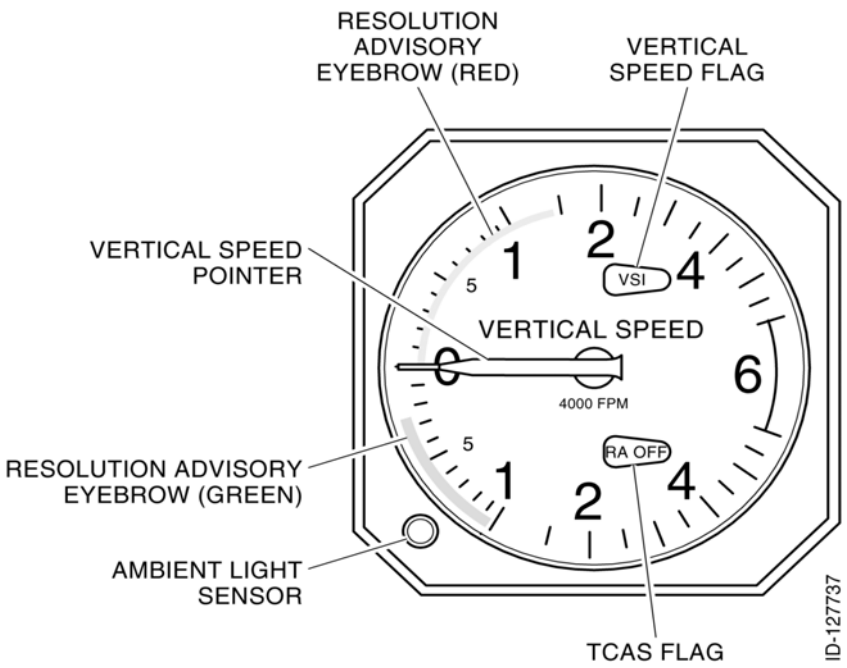
RA/VSI display units are used as the resolution advisory display when TCAS traffic displays are given on a different display, for example, a PPI Radar/TCAS display or dedicated TCAS traffic display.

NOTE: A pilot manual supplied by Honeywell gives the RA/VSI operation in detail.

G. Dedicated TCAS Traffic Display

The ITA-81A Traffic Display shown in Figure 15 gives a traffic display same as the TA/VSI, but does not give resolution advisories. As shown in Figure 15, the traffic display can be operated as a pop-up display, showing all intruders when a TA or RA is in progress. To push the optional TCAS AUTO pushbutton erases the screen and stays blank (but for the mode annunciation) until TA or RA traffic comes into view. Then all TCAS traffic is shown. To push the TCAS AUTO pushbutton again returns the display to full-time display mode. Other optional controls on this unit are RANGE Select push-buttons and ABOVE/BELOW push-buttons.

NOTE: A pilot manual supplied by Honeywell describes the dedicated TCAS traffic display operation in detail.



Two Flags		
TCAS Flag	**Color**	**Description**
RA OFF	Black RA OFF on White	Shows an impairment of the TCAS function which is due to a loss of essential aircraft data, or TCAS data, indicator power OFF, TCAS in STBY mode or TCAS in TA mode. Also appears when VSI appears.
NORMAL	Black	Shows normal operation of TCAS functions.
TCAS	Black TCAS on Amber	Shows a loss of, or invalid digital TCAS data or SSM set to Failure Warning.
VS Flag		
NORMAL	Black	Shows normal operation of VSI functions.
VSI	Black VSI on Amber	Shows a loss of or invalid digital Vertical Speed data, invalid flag for analog data sources, detected internal failures of the RA/VSI, or power loss to the RA/VSI.

RA/VSI Controls and Indicators
Figure 14

H. PPI Radar/TCAS Display

The PPI Radar/TCAS display shown in Figure 16 gives its usual separate weather radar display and can be manually controlled to show an isolated TCAS traffic display or a total weather radar/TCAS presentation.

The PPI Radar/TCAS display integration into the CAS-100 system is given in isolated manuals recorded in Table Intro-1.

NOTE: A pilot manual supplied by Honeywell gives the PPI Radar/TCAS display operation in detail.

I. Optional Aural/Lamp Advisory Outputs

Optional aural and lamp traffic advisory and resolution advisory output are available. The advisories can be activated by connecting the external tone generators and/or indicator lamps to the applicable rear connector pins on the TCAS processor.

The aural advisory output is to supply tones that accompany corrective, preventive, and traffic advisories given by the TCAS processor. The started aural advisory discrete output is given for a 1.0 ± 0.2 second period. When the aural advisory discrete output is for an installation, the Audio Tone Enable Program pin must be strapped. This strap supplies a 1.0 ± 0.2 second interval of the synthesized voice output to be properly phased with the aural advisories. The lamp advisory output can be to operate annunciator lights that identify the advisory as a corrective, preventive, or traffic advisory. The output stays on during the advisory unless cancelled (see paragraph J., below).

J. Audio Message Alerts

Audio message alerts given by TCAS on the cockpit audio system are shown in Figure 13.

K. TCAS Processor and Mode S Transponder Front Panel Indicators and TEST Switch

These front panel indicators and TEST switches give a fault isolation maintenance aid in the failure conditions where the traffic advisory display subsystem is defective and cannot show the TCAS failure annunciations. Refer to the TESTING AND FAULT ISOLATION and the MAINTENANCE PRACTICES sections of this manual for the details.

L. Optional Advisory Cancel Switch

This momentary switch cancels in operation advisory alert conditions.

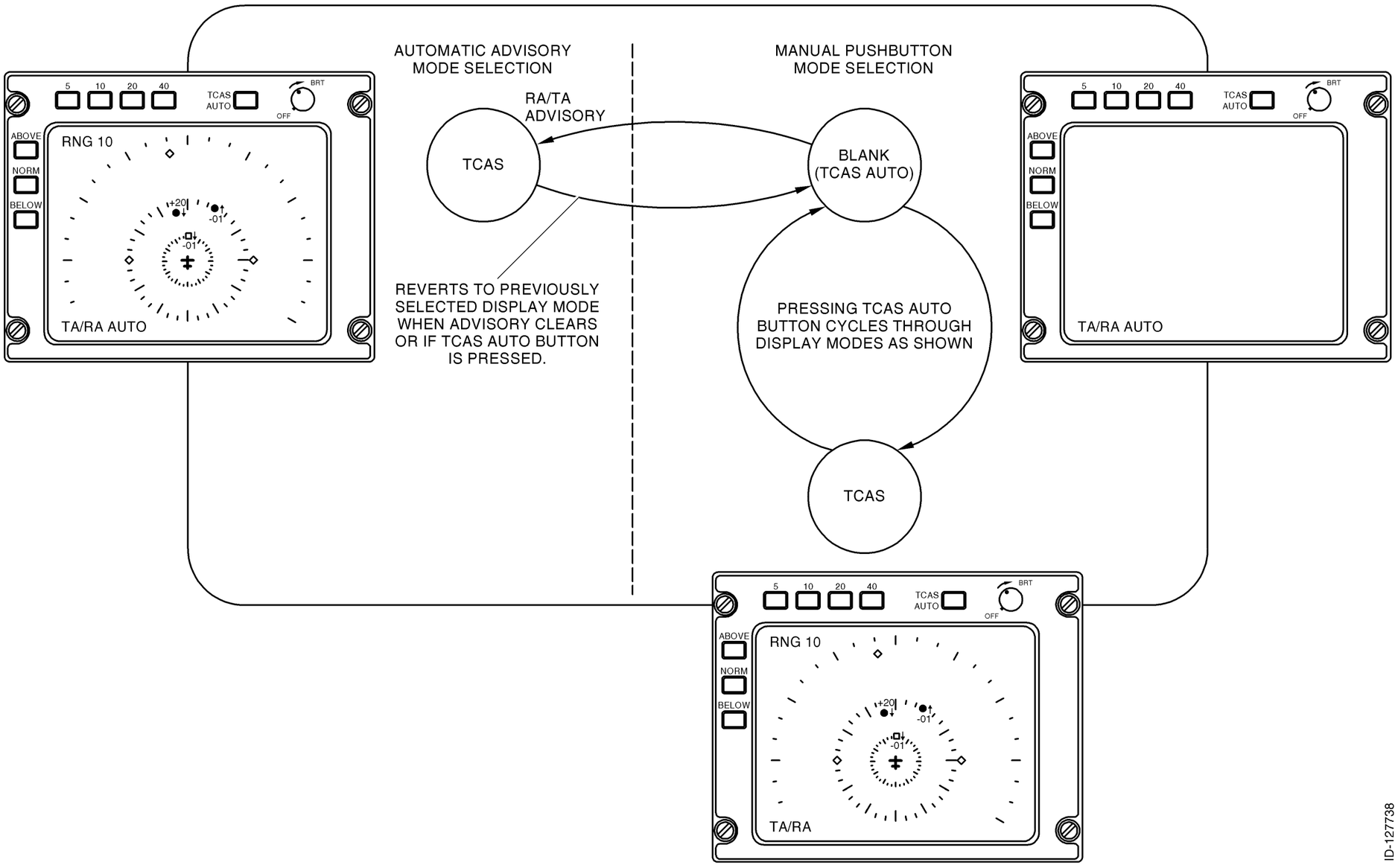
M. Range Selection and Range Rings

The traffic advisory display range selection is controlled externally, through the data input to the display on the ARINC 429 bus, or internally, using a front panel selector switch (PPI weather/traffic display). The range selection can be controlled by optional front panel pushbutton switches (TA/VSI or dedicated traffic display). The Range rings shown are a function of range set if the range selection is made at a distance or locally. Table 22 summarizes range ring distances for each possible range that can be selected on the different types of traffic displays available.

NOTE: The Range selections more than 34 nautical miles are only possible on PPI weather/traffic displays. For these displays, the range ring data in Table 22 is applicable when the display is in the TCAS mode, which shows only TCAS data.

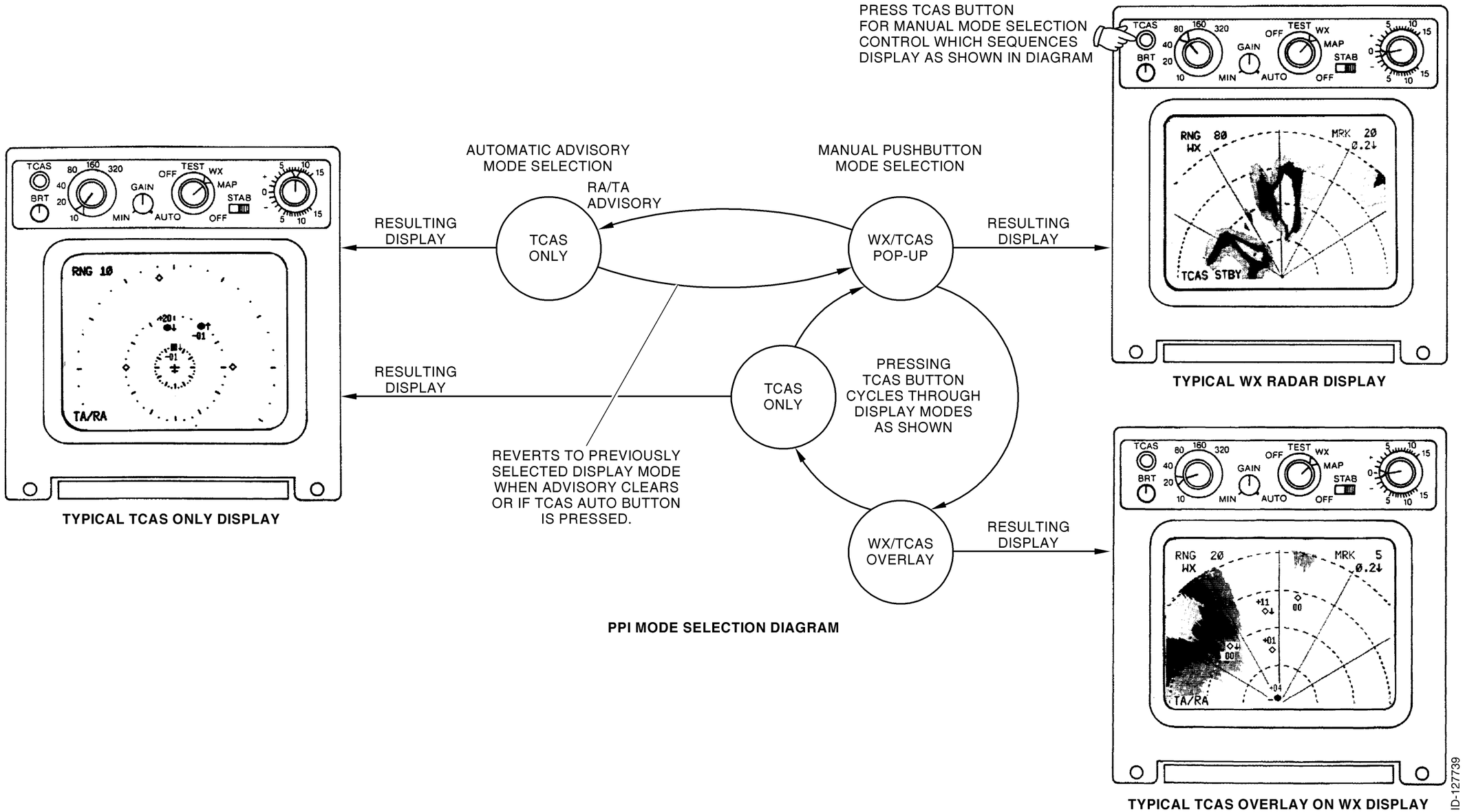
Table 22. Range Rings Displayed vs. Selected Range

Selected Range (NM)	Range Rings (NM)								
	2	3	5	10	15	20	25	30	40
3	X	X							
5	X		X						
10	X		X	X					
15	X		X		X				
20	X			X		X			
25			X	X			X		
30				X		X		X	
40				X		X			X
50				X		X			X
60				X		X			X
80				X		X			X
100				X		X			X
120						X			X
150						X			X
160						X			X
180						X			X
200						X			X
240									X
300									X
320									X



ID-127738

ITA-81A Traffic Display Controls and Indicators
Figure 15



TYPICAL TCAS ONLY DISPLAY

TYPICAL WX RADAR DISPLAY

TYPICAL TCAS OVERLAY ON WX DISPLAY

ID-127739

PPI MODE SELECTION DIAGRAM

PPI Radar/TCAS Display Controls and Indicators
Figure 16

TESTING AND FAULT ISOLATION

1. General

Fault isolation is the function to find the source of a TCAS failure at the assembly level (black box level) or the aircraft wiring level. Fault isolation for CAS-100 includes the performance of TCAS functional tests and the inspection of the TCAS failure indicators. Then the fault isolation includes the performance of applicable removal and replacement, or the aircraft wiring repair procedures to correct the problem.

CAS-100 failures can be indicated by the failure annunciations on the PPI Radar/TCAS display or dedicated traffic display unit CRT. The failures are also shown by an electro-mechanical fail flag on the RA/VSI unit, and failure indicator lamps on the front panels of the TCAS components. TCAS failures are sensed, and the applicable failure indicator is started. The failure indicator is started as a result of full-time TCAS Built-In-Test Equipment that monitors and because of manually started TCAS Functional Self-Test monitoring.

Fault isolation is usually done on the ground, as a result of failures shown during post-installation, preflight testing, or malfunctions that were seen during the flight operation.

2. Fault Isolation

A. General

The TCAS processor can find the malfunctions of the TCAS components that decrease or prevent possible collision avoidance protection. The Mode S transponder can find the malfunctions in the Mode S transponder system that decrease usual TCAS functions. During a transponder system failure, the transponder causes the transponder FAIL or ATC FAIL indicator on the control unit to light. The transponder also communicates the failure status to the TCAS processor. A failure of the Mode S or TCAS system during usual operation causes these effects by the TCAS processor:

- Gives an indication to the flight crew that an unusual condition exists.
- Causes Mode S transmissions that report own aircraft status to show that own aircraft has no on-board resolution capability.
- Prevents interrogations by own aircraft TCAS.
- Stops the usual TCAS display functions.

NOTE: Refer to pilot manual for specified failure indications that show on TA/VSI, RA/VSI, dedicated TCAS traffic display, etc.

There are two different procedures to start and monitor functional self test of the TCAS/Mode S system. The first is started at the transponder/TCAS control unit and the sensed failures are shown on the traffic display, but for the IVA-81A/D TA/VSI. The second procedure is started in the equipment bay using the two buttons found on the front panel of the TCAS processor, and then monitoring the TCAS Processor front panel LED display.

Prior to performing TCAS/Mode S system self test, make sure that these aircraft systems are energized and operate without the failure flags on the applicable cockpit instruments:

- Air Data Systems
- Radio Altimeter Systems
- Altitude (Vertical Gyro) Systems
- Heading (Compass) Systems

If the attitude and point data supplied to the TCAS system is from an AHRS, IRS, or INS, they must be aligned and in operate mode.

B. Using Transponder/TCAS Control Unit

NOTE: If a PPI Radar/TCAS display is used as the traffic display and has a TCAS mode on the selector switch, it must be turned to the TCAS position for the test. If not, the selector switch must turn to the OFF position to let the traffic display set discrete (from the TCAS processor) and turn the display ON. It takes approximately 5 seconds for the display to get warm after the test is started.

(1) Dual Mode S Equipped Aircraft

The aircraft with two Mode S units, set the transponder selector on the CTA-81A Control Unit to Position 1 to test transponder 1. Turn the function selector counterclockwise to the TEST position (ATC 1 TEST position on CTA-81B) and hold the switch in this position for the minimum one second. The self-test continues automatically for approximately 12 seconds. On the CTA-81 ( ) Control Unit, the display window shows ATC12R and the ATC FAIL lamp comes on for approximately 3 seconds.

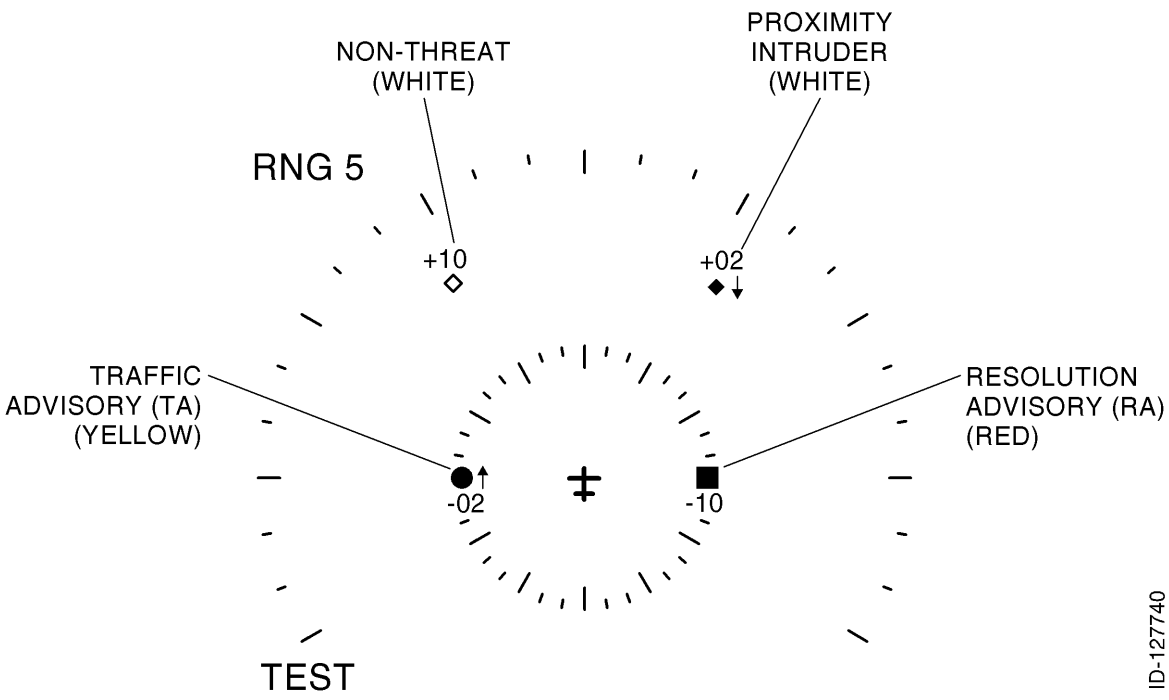
(2) No Malfunctions Reported

If there are no malfunctions, the test sequence will be as follows:

(a) A test pattern comes into view on the displays to check each type of intruder symbol. See Figure 1001.

(b) For the aircraft that have RA/VSI:

1 During the first seconds of the test, the RA/VSI red and green circumference lamps (climb/descend indicators) come on together. The TCAS flag is in the view during the test period.



Test Pattern
Figure 1001

2 After the RA/VSI sequence lamp test, the red and green climb/descend lamps show a set test command that shows a typical resolution advisory during the remaining test sequence.

NOTE: The missing correct vertical speed input causes the VSI flag to come into the view on the RA/VSI. If a TA/VSI is used, the legend VSI comes into the view on the display. A TCAS processor failure causes the TCAS flag to come into the view on the RA/VSI, and the TCAS to come into the view on the TA/VSI.

(c) For the aircraft that have TA/VSI

The TA/VSI shows a set Resolution Advisory and the traffic symbol test pattern. A TEST message is shown.

(d) For the aircraft that have PPI Radar/TCAS or dedicated display:

The PPI or dedicated display shows the TCAS display test pattern and TEST is shown.

(e) At the correct end of the self-test, the TCAS processor output on the audio bus starts the synthesized voice message, TCAS System Test OK.

(3) Failure Detected During Self-Test

If a failure is found during self-test, the voice message output from the TCAS processor is, TCAS System Test Fail. The PPI Radar/TCAS display or dedicated display will show the failed system component(s).

Possible traffic display fault annunciations are as follows:

- TCAS PROCESSOR
- UPPER ANTENNA
- LOWER ANTENNA
- RADIO ALT No. 1
- RADIO ALT No. 2
- RADIO ALT No. 1 and No. 2
- No. 1 XPNDR DATA BUS
- No. 2 XPNDR DATA BUS
- TRAFFIC DISPLAY
- RA DISPLAY No. 2
- RA DISPLAY No. 1 and No. 2
- TCAS FAIL
- XPNDR TOP ANT
- XPNDR LOWER ANT
- XPNDR TCAS DATA
- XPNDR CONTROL DATA
- XPNDR CONTROL DATA
- XPNDR CONTROL DATA
- No. 1 XPNDR ALT DATA
- No. 2 XPNDR ALT DATA
- ATTITUDE•RA DISPLAY No. 1
- HEADING
- NO TCAS (NO DATA on some versions)

(4) Test Results Not to Specification

If self test results are not to specification, do these:

(a) If PPI or dedicated display is used, check and record the fault annunciation(s). For the Mode S transponder system and TCAS line maintenance troubleshooting procedures, refer to Tables 1001 and 1002.

(b) Do the Mode S and TCAS processor self tests on the front of each unit to make the problem clear in non-PPI or dedicated display aircraft.

(5) Dual Mode S Equipped Aircraft

Set the transponder selector on the CTA-81A to 2 to test transponder 2 in an aircraft with two Mode S units. Turn the function selector to TA for 10 seconds (minimum), then do again step 2.B.(1).

(6) Self-Test Using CTA-81( ) Indicators

The following self-test data applies to the CTA-81( ) indicators:

(a) Control unit ATC FAIL lamp monitors the transponder functions only.

(b) On the control unit, letter R comes on in the TEST. The letter R comes on in the ATC-2 position for the aircraft that have a non-Mode S transponder. The letter R does not come on during usual Mode S operation in ATC-1 or ATC-2.

(c) The TCAS will not operate when the ATC FAIL lamp comes on. The TCAS system must have a serviceable Mode S transponder selected to function correctly.

CAUTION: REMOVE THE POWER BEFORE REPLACING A MODE S OR TCAS SYSTEM COMPONENT. DAMAGE TO THE EQUIPMENT CAN RESULT

Refer to Table 1001 and Table 1002 for Line Maintenance Troubleshooting Procedures.

Table 1001. Mode S Line Maintenance Troubleshooting Procedure (Fault Indication on PPI or Dedicated Display).

Fault Annunciation	Remedy
XPNDR TOP ANT XPNDR LOWER ANT	Check: Coaxial connectors, Coax cable, Coax Switches, Coax switch circuit defective, Transponder antenna
No. 1 XPNDR ALT DATA No. 2 XPNDR ALT DATA XPNDR ALT DATA No. 1 and No. 2	Check: Altitude source, Associated wiring
SELECTED XPNDR XPNDR CONTROL DATA	Check: Mode S transponder/control unit - Denotes loss/incorrect data not covered by other fault codes
XPNDR TCAS DATA No. 1 XPNDR DATA BUS No. 2 XPNDR DATA BUS	Check: Max airspeed program pins, Data bus wires (4), Mode S address wires, Suppression coax cable, Power wires/circuit breaker
NOTE: If fault is shown, do front-panel test of Mode S transponder unit to make these problems clear.	

Table 1002. TCAS Line Maintenance Troubleshooting Procedure (Fault Indication on PPI or Dedicated Display)

Fault Annunciation	Remedy
TCAS PROCESSOR UPPER ANTENNA LOWER ANTENNA ATTITUDE HEADING	Do the TCAS processor self test (paragraph 2.C.) for specifics.
TCAS FAIL/NO TCAS TRAFFIC DISPLAY	PPI or dedicated display failure.
RA DISPLAY No. 1	One RA DISPLAY or RADIO ALT FAULT will not show in a two system display unless other faults are shown.
RA DISPLAY No. 2 RA DISPLAY No. 1 and No. 2	Check ADCs, VSIs, wiring, power.
RADIO ALT No. 1 and No. 2 TD FAIL	Check the two radio altimeters. PPI defective.
NOTE: If fault is shown, do front-panel test of TCAS processor (paragraph 2.C.) to make these problems clear.	

C. Using TCAS Processor Front-Panel Buttons and LCD Display

NOTE: Refer to applicable Mode S transponder system maintenance manual for front-panel self tests of Mode S transponder.

(1) General

The TPA-100A TCAS Processor front panel contains a four-line, 16 character for each line Liquid Crystal Display (LCD) and two pushbutton controls as shown in Figure 1002. The left pushbutton is the Scroll button and the right button is the Select button.

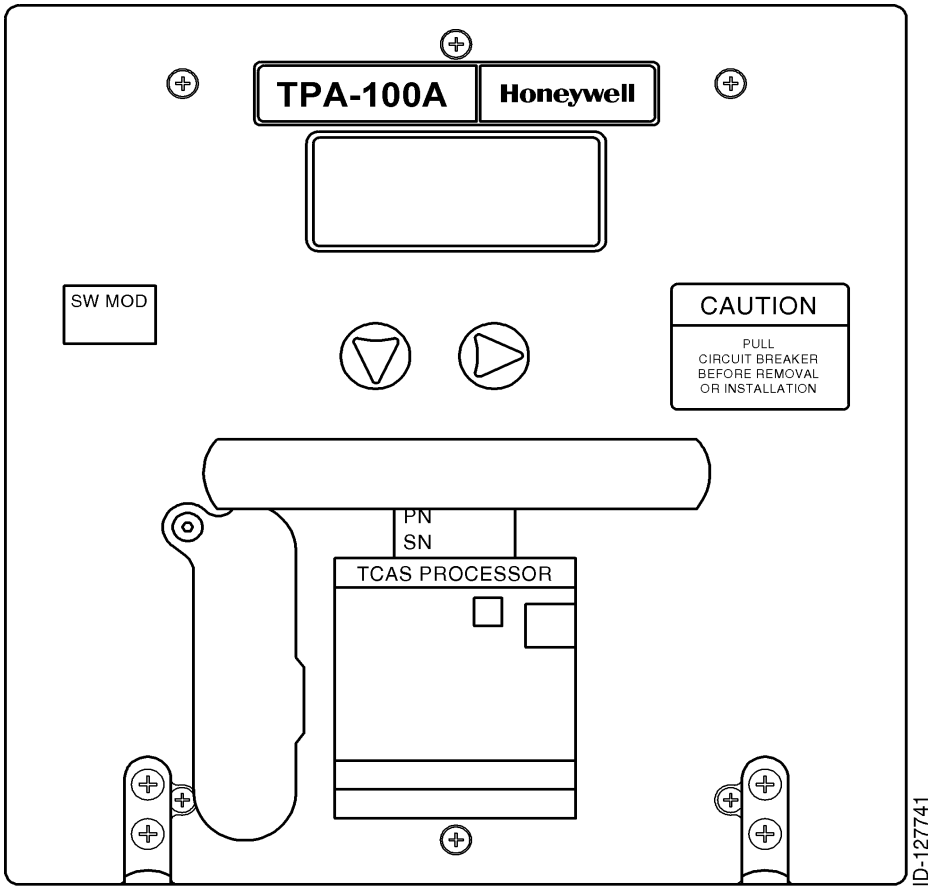
If none of the two pushbuttons is operated for one minute, the Main Menu is shown. See Figure 1005 for a typical Main Menu. The first line of each display contains a title and the page number is shown with the number of pages that comprise that display.

Any line that has an asterisk (*) in the first column shows that the line is selectable. The caret (>) shows the location of a selectable item if the Select pushbutton is pushed. When an item is chosen, a different menu is shown. Any line that does not have an asterisk or a caret is a text line and can not be selected.

The Scroll pushbutton moves the caret down the page to the subsequent selectable item or to the subsequent page if that is where the next selectable item is located.

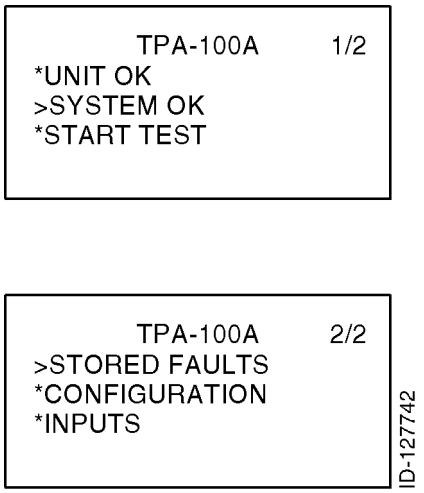
When the caret has cycled through all the selectable items on all pages of the menu, it returns to the top selectable item on the first page of the menu.

To return to the previous selection, push and hold the Scroll button while the Select button is pushed. Repeating this procedure causes the display to go back to the previous selection.



TCAS Processor Front Panel LCD and Pushbuttons
Figure 1002

The Figure 1003 shows a typical Main Menu screen. If the Select button is pushed, the system status menu is shown. If the Scroll button is pushed one time, the caret moves to START TEST. If the Scroll button is pushed again, the caret moves to STORED FAULTS on page 2 of the menu.



(Typical Pages 1 and 2 of Menu Screen)
Typical Main Menu Screen
Figure 1003

NOTE: The caret is located at SYSTEM OK.

(2) Unit OK/System Failed

If SYSTEM FAILED is the active selectable item on the Main Menu, to push the Select pushbutton starts a display entitled FAULTS. The display lists the text of all the unit faults that have occurred. Refer to Table 1003 for a list of possible unit faults.

(3) System OK/Failed Display Screen

When SYSTEM FAILED is the active selectable item, the system faults are active and the input faults can be active at the same time. When the Select button is pushed, the text for all active system and input faults are shown. The display title will be INPUT FLTS. See Table 1004 for a list of the system and the input faults.

See Table 1005 for a list of the program pin faults. The program pins being shorted to ground cause these faults except for BINT and BLIM. The BINT fault is caused by strapping fewer than 3 intruders to be shown. The BLIM fault is caused by the altitude limit program pins (RMP 6E through RMP 6J) being open.

When SYSTEM OK is the active selectable item, only input faults are in operation. To push the Select button causes the input fault text to be shown. The display title will be INPT FLTS.

Table 1003. Unit Internal Faults

Internal Faults	Fault Identification
DM CPU MCE PCI SP Fault	CPU1
DM CPU MCE PCI IO Fault	CPU2
DM CPU MCE PCI 429 Fault	CPU3
DM CPU MCE PCI Unknown Fault	CPU4
DM CPU Processor Transaction Fault	CPU5
DM CPU Memory Refresh Overflow Fault	CPU6
DM CPU Memory Select Fault	CPU7
DM CPU ECC Multi-bit Fault	CPU8
DM CPU Processor Unknown Fault	CPU9
SW Execution Error	SWn (where n = A to Z and identifies task)
DM BIT ADC Fault	BADC
DM ref 2.5	VREF
Synthesizer Initialization	SYN1
DM SDRAM Data	RAMD
DM SDRAM Program	RAMP
DM 12	P12
DM min12	PM12
DM 5	P5
DM 30Mon	P30
TRM 7	P7
DM 3.3	PD33
DM 2	PD2
DM 2.5	PD25
TRM min40	PR40
TRM min5	PRM5
TRM 3.3	PR33

Table 1003. Unit Internal Faults (cont)

Internal Faults	Fault Identification
TRM 5	PR5
TTM min8	PTM8
TTM 3.3 ref	PT3R
TTM 30v ref	PT30
TTM 32v e4	PT24
TTM 32v e3	PT23
TTM 32v e2	PT22
TTM 32v e1	PT21
TTM 2.5	PT25
TTM 6	PT6
TTM 3.3	PT3
TTM 6v Bias	PT6B
DM IO A/D Slow Conversion	DA1
DM IO A/D Invalid Ground	DA2
DM IO A/D Invalid 2.5 V ref	DA3
DM Invalid Voice Program (CRC)	DV2
DM Invalid Voice Program(Version)	DV3
DM Invalid Configuration Data	DCFG
DM Voice Synthesizer Initialization	DV1
DM TA/RA # 1 Loop Around Missing	DL1
DM TA/RA # 1 Loop Around Bad Data	DL2
DM TA/RA # 2 Loop Around Missing	DL3
DM TA/RA # 2 Loop Around Bad Data	DL4
DM RA # 1/2 Loop Around Missing	DL5
DM RA # 1/2 Loop Around Bad Data	DL6
DM TX Coord Bus # 1 Loop Around Missing	DL9
DM TX Coord Bus # 1 Loop Around Bad	DL10
DM TX Coord Bus # 2 Loop Around Missing	DL11

Table 1003. Unit Internal Faults (cont)

Internal Faults	Fault Identification
DM TX Coord Bus # 2 Loop Around Bad	DL12
DM 429 TA/RA Disp 1 FIFO Busy Error	DF1
DM 429 TA/RA Disp 2 FIFO Busy Error	DF2
DM 429 RA Disp FIFO Busy Error	DF3
DM 429 TX 1 Immediate Reg Error	DF4
DM 429 TX 2 Immediate Reg Error	DF5
DM ATCRBS Loop Around	DSP1
DM Mode S Loop Around	DSP2
DM SP Reply Data FIFO	DSP3
DM SP Reply Bearing FIFO	DSP4
DM SP Squitter Data FIFO	DSP5
DM SP Squitter Bearing FIFO	DSP6
DM SP DPSK Loop Around Fail	DSP7
DM SP Mode Decode (Mode S)	DSP8
DM SP Mode Decode (Mode C)	DSPA
DM SP Missing EOI	DSP9
Bias Ctl Offset Voltage	TB00
Bias Ctl Chan 1 - Lo	TBD1
Bias Ctl Chan 1 - Hi	TBF1
Bias Ctl Chan 2 - Lo	TBD2
Bias Ctl Chan 2 - Hi	TBF2
Bias Ctl Chan 3 - Lo	TBD3
Bias Ctl Chan 3 - Hi	TBF3
Bias Ctl Chan 4 - Lo	TBD4
Bias Ctl Chan 4 - Hi	TBF4
TX Output Power Low - Channel 1	T1PW
TX Output Power Low - Channel 2	T2PW

Table 1003. Unit Internal Faults (cont)

Internal Faults	Fault Identification
TX Output Power Low - Channel 3	T3PW
TX Output Power Low - Channel 4	T4PW
1030 TX Frequency	1030
TTM Power Leveling	TLVL
TTM Power Attenuation - Monotonicity	TATT
Cal PS1 Fault	TPS1
Cal PS3 Fault	TPS3
Cal PS4 Fault	TPS4
RX Cal Fault Top 1090	RCT0
RX Cal Fault Bot 1090	RCB0
TX Cal Top Fault	TCT
TX Cal Bot Fault	TCB
Top Bottom Antenna Phase Error	TBCL

Table 1004. System and Input Faults

Front Panel Text	Fault Description
Top Ant Fail	1. TX Cal Delta 24 or 31 Top (Antenna Failure)
Top Ant E1	1.1 Top Antenna Element 1 failed
Top Ant E2	1.2 Top Antenna Element 2 failed
Top Ant E3	1.3 Top Antenna Element 3 failed
Top Ant E4	1.4 Top Antenna Element 4 failed
Bott Ant Fail	2. TX Cal Delta 24 or 31 Bot (Antenna Failure)
Bott Ant E1	2.1 Bottom Antenna Element 1 failed
Bott Ant E2	2.2 Bottom Antenna Element 2 failed
Bott Ant E3	2.3 Bottom Antenna Element 3 failed
Bott Ant E4	2.4 Bottom Antenna Element 4 failed
Radio Alt 1	3. Radio Altitude 1 (for A330, A340, and Boeing)
Radio Alt 2	4. Radio Altitude 2 (for A330, A340, and Boeing)
Radio Alt 1	3a. Radio Altitude 1 (for A320)
Radio Alt 2	4a. Radio Altitude 2 (for A320)
Transponder 1	5. Mode-S Transponder 1
Transponder 2	6. Mode-S Transponder 2
Roll Att Data	7. Roll Angle
Pitch Att Data	8. Pitch Angle
Heading Data	9. Magnetic Heading
TA/VSI 1	10. TA/VSI 1
TA/VSI 2	11. TA/VSI 2
RA Display 1	12. RA/VSI 1
RA Display 2	13. RA/VSI 2
CMC Bus	14. CFDIU (for A320)
CMC Bus	14. CMC (for A330, A340, and Boeing)
ATC Ctl Panel	15. Mode-S Control Panel (for A330 and A340)
ATC Ctl Panel	15.1 Mode-S Control Panel (for A320 and Boeing)

Table 1004. System and Input Faults (cont)

Front Panel Text	Fault Description
FMC	16. FMC (for aircraft type not A330 and not A340)
FMC	16.1 FMC (for A340 and A330)
Suppression Line	17. Suppression Line
TCAS Unit Failed	18. TCAS Unit Fault
Power Interrupt	19. Power Supply Interrupted
Program Pin	20. Program Pin

Table 1005. Program Pin Faults

Front Panel Text	Fault Description
PP RMP 12A	Analog Radio Altimeter Prgm, RMP 12A
PP RMP 12B	Analog Radio Altimeter Prgm, RMP 12B
PP RMP 12C	Analog Radio Altimeter Prgm, RMP 12C
PP RBP 7D	Audio Tone Enable Program, RBP 7D
PP RBP 7E	Ground Display Mode, RBP 7E
PP RBP 7F	Display All Traffic Program, RBP 7F
PP RBP 7G	Cable Delay Program Sign, RBP 7G
PP RBP 7H	Cable Delay Program MSB, RBP 7H
PP RBP 7J	Cable Delay Program LSB, RBP 7J
PP RBP 8F	TA/RA Display Symbols Max Prgm, RBP 8F
PP RBP 8G	TA/RA Display Symbols Max Prgm, RBP 8G
PP RBP 8H	TA/RA Display Symbols Max Prgm, RBP 8H
PP RBP 8J	TA/RA Display Symbols Max Prgm, RBP 8J
PP RBP 8K	TA/RA Display Symbols Max Prgm, RBP 8K
PP RBP 8E	Functional Test Inhibit Prgm, RBP 8E
PP RBP 7A	Audio Level Prgm, RBP 7A
PP RBP 7B	Audio Level Prgm, RBP 7B
PP RBP 7C	Audio Level Prgm, RBP 7C

Table 1005. Program Pin Faults (cont)

Front Panel Text	Fault Description
PP RMP 6E	Altitude Limit Prgm, RMP 6E
PP RMP 6F	Altitude Limit Prgm, RMP 6F
PP RMP 6G	Altitude Limit Prgm, RMP 6G
PP RMP 6H	Altitude Limit Prgm, RMP 6H
PP RMP 6J	Altitude Limit Prgm, RMP 6J
PP TARA <3 Intrd	TA/RA Display Limit Program Pins set less than 3 Intruders
PP Alt Limit Opn	Altitude Limit Program Pins All Open
PP RBP 7K	Program Pin Common, RBP 7K
PP RMP 6K	Aircraft Alt. Limit Prgm Common, RMP 6K
PP RBP 8A	Audio Level On Ground, RBP 8A
PP RBP 8B	Audio Level On Ground, RBP 8B
PP RBP 8C	Audio Level On Ground, RBP 8C
PP RBP 4G	RA Valid Discrete Disable Program Pin, RBP 4G
PP RBP 6J	Transponder Interface Select, RBP 6J
PP RBP 6K	Rad Alt Interface Select, RBP 6K
PP RMP 5E	ADS-B (Intruder File Enable) Program Pin

(4) Unit, System, and Input Active Fault Relationship

Table 1006 shows the relation in unit, system, input active faults, and the status on the display. The asterick (*) shows that the text is selectable.

The display screen shows START TEST or TEST INHIBIT. See Figure 1004. The test is prevented in specific conditions when the Air/Ground Discrete = Air. When the Air/Ground Discrete = Ground, START TEST is shown.

To push the Select button when the caret is adjacent to the Start Test selectable item, causes the Test In Progress screen to come into the view and the test to start.

The three possible results of the test are:

(a) No faults (unit and system ok)

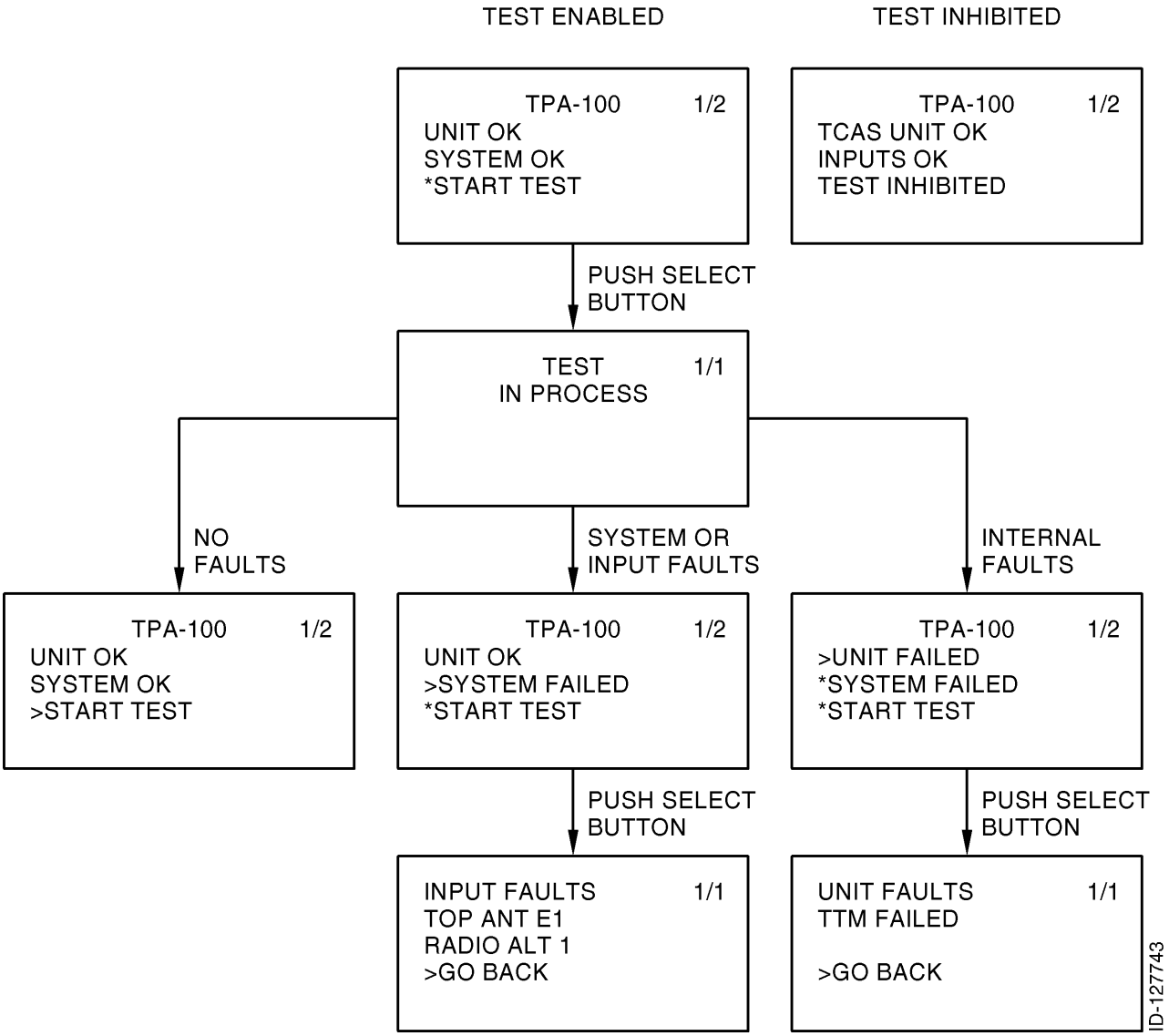
(b) System or input faults (unit ok, system failed)

(c) Internal faults (unit failed/system failed)

To push the Select button with the caret at SYSTEM FAILED or UNIT FAILED causes a display screen with the entries that include the applicable found faults. When faults are found, START TEST is selectable and a retest is possible. The selection of GO BACK causes the previous screen with a selectable item to be shown. That previous screen is the same as it was when previously visited. A GO BACK is possible when the user pushes a Select button with an in operation selectable item. To go back to the previous screen, hold the Scroll button and push the Select button.

Table 1006. Active Unit, System and Input Faults, and Display Status Indication

Active Unit Faults	Active System Faults	Active Input Faults	Unit (Status) System/Input (Status)
No	No	No	Unit OK System OK
No	No	Yes	Unit OK *Inputs Faulted
No	Yes	No	Unit OK *System Failed
No	Yes	Yes	Unit OK *System Failed
Yes	No	No	*Unit Failed *System Failed
Yes	No	Yes	*Unit Failed *System Failed
Yes	Yes	No	*Unit Failed *System Failed
Yes	Yes	Yes	*Unit Failed *System Failed



Start Test/Test Inhibited Sample Flow Diagram
Figure 1004

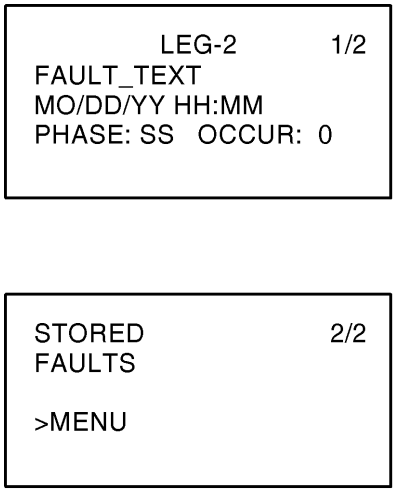
(5) Stored Faults

To push the Select button when STORED FAULTS (see main menu Figure 1003) is the active selectable item, causes the Stored Faults screen to be shown (Figure 1005). The fault data is shown five legs back from the most recent fault to the oldest fault. The title of the Stored Fault Display shows in which leg the stored fault is found. The title shows the current leg minus the number of legs to where the fault is kept. For example, LEG-2 shows the fault is found two legs back from the present leg. If the current leg equals the leg with the fault, then the title is INBOUND.

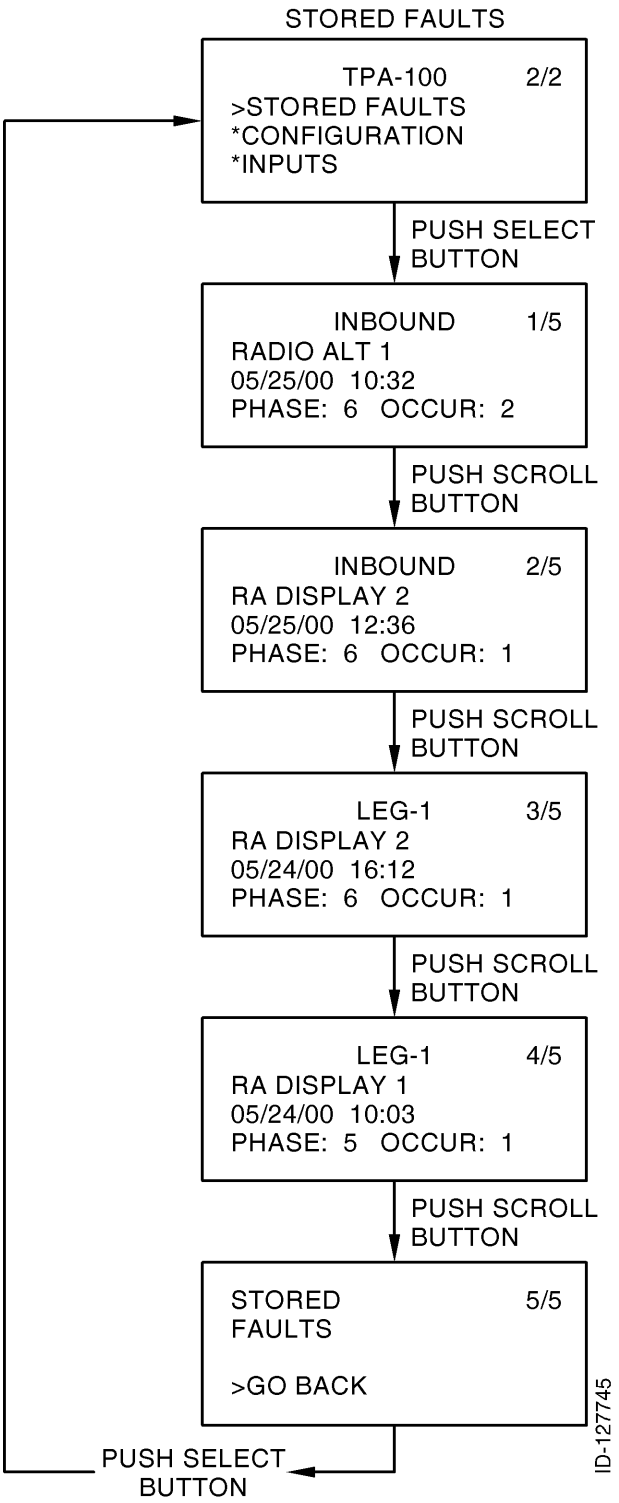
The date and time the first fault of the flight leg occurred is shown in the screen title.

PHASE shows the flight phase (1-16) of the faults first occurrence in the flight leg. OCCUR shows the number of occurrences of the fault in the fault leg.

The Figure 1006 is an example of a stored fault procedure.



Typical First and Last Pages of Stored Faults Display Screen
Figure 1005

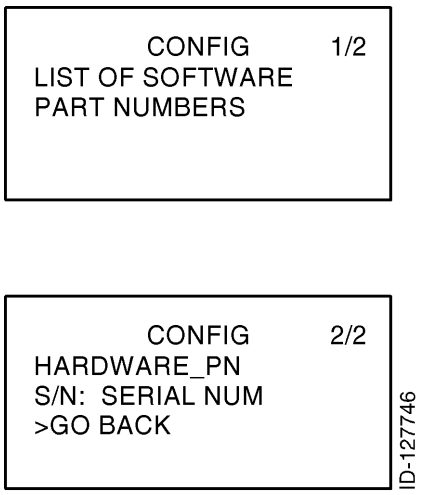


Stored Faults LCD Screen Example
Figure 1006

(6) Configuration Display Screen

To push the Select button when the Configuration is the Active Selectable Item on the Menu screen causes the Configuration Screen to come into the view. A representation of a two page Configuration screen is shown in Figure 1007.

The screen title is CONFIG. The lines two, three, and four of page 1/2 contain the software part number(s). To push the Scroll button causes page 2/2 of the CONFIG screen to come into the view. The hardware part number and the unit serial number are shown on the screen. The Active Selectable Item is GO BACK. To push the Select button while the caret is at GO BACK causes a return to the Menu screen.

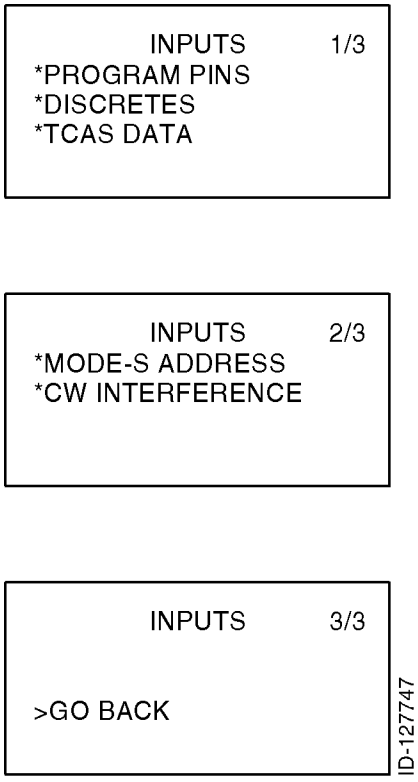


Typical Configuration Display Screen
Figure 1007

(7) Inputs Display Screen

To push the Select button when Input is the Active Selectable Item on the Menu Screen causes the Input select screen page 1/3 to come into the view. See Figure 1008. Refer to Table 1007 for Program Pin displayed text and fault descriptions.

(a) Program Pins Display Screen



Typical Input Display Screens (Pages 1-3)
Figure 1008

Table 1007. Program Pins

Program Pin	Display Text	Fault Description
PP RBP 6J	Single Xpdr	One Transponder Program Pin shows how many transponders are installed: *O = Both Transponders Installed *1 = One Transponder Installed
PP RBP 6K	Single RA	One Radio Altitude Program Pin shows how many Radio Altimeters are installed: *O = Both Altimeters Installed *1 = One Altimeter Installed
PP RBP 7A	Airborne Audio Level # 1	Airborne Audio Level Program Pins find the speaker and phones audio level output when the aircraft is airborne by strapping one or more Airborne Audio Level Program Pins to Program Pin Common RBP7K **(See NOTE)**
PP RBP 7B	Airborne Audio Level # 2	
PP RBP 7C	Airborne Audio Level # 3	
PP RBP 7D	Audio Advisory Discrete	Audio Advisory Discrete Program Pins show if there is an interval in the Synthesizer Voice output when an advisory is given: *O = No Delay *1 = 1 ± 0.2 second delay (an audio tone is output prior to the issuance of a voice command)
PP RBP 7E	Ground Display Mode	Ground Display Mode Program Pin shows the correct mode for TCAS when the aircraft is on the ground: *O = TA Only mode (Sensitivity Level = 2, RAs prevented) *1 = Standby Mode (Sensitivity Level = 1)
PP RBP 7F	Display All Traffic	Display All Traffic/Threat Program Pin calculates the traffic that is shown: *O = Display All Traffic *1 = Display TA/RA Traffic Only
PP RBP 7G	Cable Delay Sign	The Cable Delay Program Pins show the differential interval between the top and the bottom antenna.
PP RBP 7H	Cable Delay MSB	
PP RBP 7J	Cable Delay LSB	

Table 1007. Program Pins (cont)

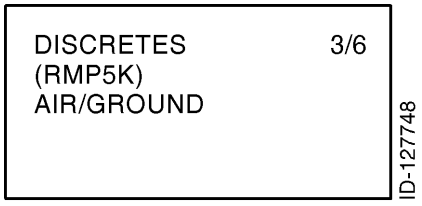
Program Pin	Display Text	Fault Description
PP RBP 8A	On Ground Audio Level No. 1	Ground Audio Level Program Pins find the speaker and phones audio level output when the aircraft is on the ground by strapping one or more Ground Audio Level Program Pins to Program Pin Common RBP7K.
PP RBP 8B	On Ground Audio Level No. 2	
PP RBP 8C	On Ground Audio Level No. 3	
PP RBP 8E	Self Test Inhibit	Test Inhibit Program Pin shows when to prevent functional test when airborne: *O = Functional Test In Air Permitted *1 = Functional Test In Air Prevented
PP RBP 8F	Disp Intruder Limit 16	TA/RA Display Intruder Limit Program Pins limit the number of intruders that can be shown (all pins = maximum traffic can be displayed = 31). There are five straps to limit the number of intruders that are shown (0-31). The pins connected to RBP7K are not shown.
PP RBP 8G	Disp Intruder Limit 8	
PP RBP 8H	Disp Intruder Limit 4	
PP RBP 8J	Disp Intruder Limit 2	
PP RBP 8K	Disp Intruder Limit 1	
PP RMP 6E	Altitude Limit 2000 ft	Altitude Limit Program Pins show the altitude Performance Limits of an aircraft. If no straps are installed the altitude Performance Limit is zero feet. If all straps are installed the Performance Limit is 62,000 feet.
PP RMP 6F	Altitude Limit 4000	
PP RMP 6G	Altitude Limit 8000	
PP RMP 6H	Altitude Limit 16000	
PP RMP 6J	Altitude Limit 32000	
PP RMP 12A	RA Type Straps A	Radio Altimeter Type Straps Program Pins show the type of radio altimeter that supplies altitude data to the TCAS system.
PP RMP 12B	RA Type Straps B	
PP RMP 12C	RA Type Straps C	

* 0 = Open, 1 = Ground (Connected to Program Pin Common (RBP7K)

NOTE: For more program pin data see the Wire Strapping Options paragraph in the MAINTENANCE PRACTICES section of this manual.

(b) Discretes Display Screen

Figure 1009 is an example of a Discrete screen. The line 1 contains the screen title, the line 2 shows the pin number followed by Open or Ground. The lines 3 and 4 are reserved for the name of the discrete. On the last Discrete page the Active Selectable Item GO BACK is shown. Table 1008 lists the discrete pins, the text shown, and a short description of the discrete.



Example of Discrete Screen
Figure 1009

Table 1008. Discrete Pin Numbers

Discrete Pin Number	Display Text	Discrete Description
RBP5A	Advisory Inhibit 1	The four input to TCAS prevent annunciations when more important events occur. The source of the four input are Input 1, Aircraft System; Input 2, Windshear System 1; Input 3, Windshear 2; Input 3, EGPWC. See Table 1009.
RBP5B	Advisory Inhibit 2	
RBP5C	Advisory Inhibit 3	
RBP5D	Advisory Inhibit 4	
RBP5E	Increase Climb Inhibit 1	The following logic applies to the four Increase Climb Inhibit Input to the TCAS from the system. (Increase Climb Inhibit 1 AND Increase Climb Inhibit 2) OR (Increase Climb Inhibit 3 AND Increase Climb Inhibit 4) = Cannot climb at 2500 feet for each minute. The low is the in operation condition.
RBP5F	Increase Climb Inhibit 2	
RBP5G	Increase Climb Inhibit 3	
RBP5H	Increase Climb Inhibit 4	
RMP1J	Climb Inhibit 1	TCAS is Climb Inhibited when the logic is as follows: (Climb Inhibit 1 AND Climb Inhibit 2) OR (Climb Inhibit 3 AND Climb Inhibit 4). The low is the in operation condition. The Climb Inhibit discretes are influenced by the landing gear position, flap position, and other aircraft configurations that give climb performance.
RMP13G	Climb Inhibit 2	
RBP5J	Climb Inhibit 3	
RBP5K	Climb Inhibit 4	
RBP6A	Data Loader Enable	Data loader enable discrete input to TCAS from the data loader.
RMP3D	Advisory/Annunc Cancel	This discrete input gives the procedure for cancelling current aural advisory, synthesized voice, and visual annunciator alerts. This is an option of the flight crew. When cancelled it stays cancelled until the currently active advisory becomes inactive and then active again or the current active advisory is replaced by a different advisory. Where 0 = Open = No Advisory Cancel 1 = Ground = Advisory Cancel

Table 1008. Discrete Pin Numbers (cont)

Discrete Pin Number	Display Text	Discrete Description
RMP5K	Air/Ground 1	The Air/Ground Discrete Input for the Air/Ground relay. The normal failure mode is the airborne condition. The following applies: RMP5K RTP5J Definition 1 1 a/c on ground, don't inhibit ATCRBS replies 1 0 a/c on ground, don't inhibit ATCRBS replies 0 1 a/c on ground, inhibit ATCRBS replies 0 1 a/c airborne, don't inhibit ATCRBS replies Where 0 = Open 1 = Ground
RMP6D	Performance Limit	The performance limit shows to TCAS when the aircraft can no longer get a 1500 feet per minute climb. When the input is GROUND the performance is not limited. When the input is OPEN the climb is limited if the altitude of the aircraft is above the value set by the Altitude Limit Program (See below). Limit Input RMP6D Relative Altitude Climb Limited Yes Open Below No Yes Open Above Yes No Gnd Below No No Gnd Above No
RMP7E	TA Display No. 1 Status	The TA Display Status input are connected to their related Traffic Display Status output (valid). If any of the Display Status discretes are not necessary they must be attached to ground as necessary for the installation.
RMP7J	TA Display No. 2 Status	
RMP14C	RA Display No. 1 Status	The RA Display 1 and 2 Status discretes indicate the validity of the resolution displays. They are connected to their respective RA Display Status output (valid).
RMP13E	RA Display No. 2 Status	
RMP13F	Landing Gear	This pin shows the position of the landing gear. The usual mode is the RETRACTED position. Where 0 = Gear Retracted = Open 1 = Gear Extended = Ground

NOTE: Advisory Inhibit and TCAS Mode Data is shown in Table 1009.

Table 1009. Advisory Inhibit and TCAS Mode Data

Advisory Inhibit				
No.1	No.2	No.3	No.4	TCAS Mode
1	X	X	X	Standby (SL=1)
0	1	X	X	TA Only (SL=2)
0	X	1	X	TA Only (SL=2)
0	X	X	1	TA Only (SL=2)
0	0	0	0	Normal

Where 0 = Open
1 = Ground
X = Don't care

NOTE: Advisory Inhibit 1 has precedence over the other Advisory Inhibit input.

(c) TCAS Data Display Screen

To push the Select button when the TCAS Data is the Active Selectable Item on the Input select screen causes the TCAS Data screen 1/8 to be shown.

The TCAS Data screen shows the validity and the value of input data for the following input used by TCAS:

- Digital Radio Altitude
- Analog Radio Altitude

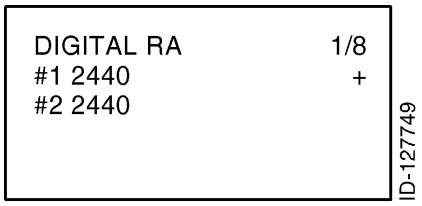
The priority of Radio Altitude sources is:

1. Digital Radio Altitude No. 1
2. Digital Radio Altitude No. 2
3. Analog Radio Altitude No. 1
4. Analog Radio Altitude No. 2

- Pressure Altitude
- Roll
- Pitch
- Heading
- Climb Inhibit Increase Climb Inhibit Discretes
- Air/Ground Discrete
- Landing Gear Discrete

1 Digital Radio Altitude

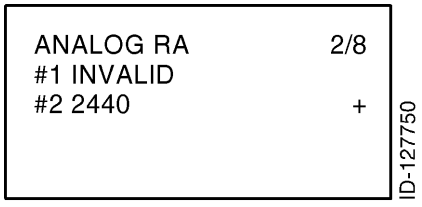
The Figure 1010 shows an example of a Digital Radio Altitude screen. The line 2 shows the correct radio altitude from the No. 1 digital data source. The plus (+) sign in position 16 of line 2 shows that Altitude No. 1 source is the active input. If the Altitude No. 1 data was incorrect, then INVALID would be shown on the line two. The line 3 shows the Altitude No. 2 data in the same procedure that line 2 shows the Altitude No. 1 data.



Digital Radio Altitude Display Screen Example
Figure 1010

2 Analog Radio Altitude

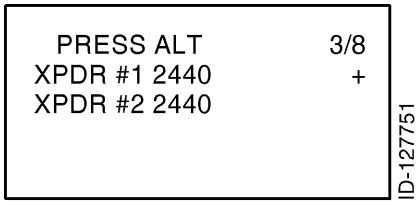
The Figure 1011 shows an example of an Analog Radio Altitude screen. The line two shows that analog radio altitude No. 1 data is incorrect. If the analog altitude No. 1 data were correct then the altitude would be shown on the line 2. A plus sign (+) in position 16 of line 3 shows that altitude source is the active input. Line 3 shows the correct altitude from analog altitude No. 2 and the plus sign shows that analog radio altitude No. 2 is the active altitude source.



Analog Radio Altitude Display Screen Example
Figure 1011

3 Pressure Altitude

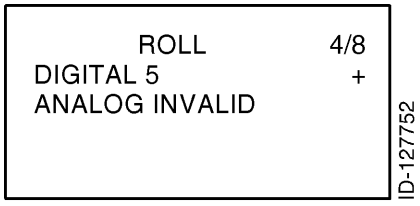
The pressure altitude data is supplied to TCAS from the transponder through XT Coordination No. 1 and No. 2 ARINC 429 data bus (Data Word Label 203). The Figure 1012 shows a sample Pressure Altitude screen. The line two contains the altitude data from XT Coordination No. 1 pressure altitude data source. In this example the data source is correct (altitude = 2400 ft.) and the plus sign shows that the XPDR No. 1 is the active source. If that data were correct then line two can show INVALID. The line three indications are almost the same except that they are for XPDR No. 2.



Pressure Altitude Display Screen Example
Figure 1012

4 Roll

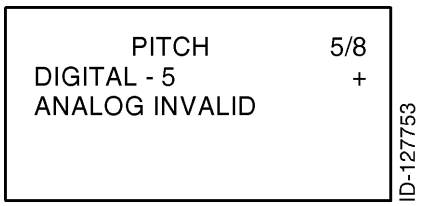
An example of a Roll display is shown in Figure 1013. The line two shows the data from ARINC 429 Mag Heading/Attitude data bus (label 325). The (+) indicated that data source is the active source. If the roll data from the 429 data source is not correct, then line two can show INVALID. The line three shows the data from a roll attitude synchro. In this case the data is incorrect.



Roll Display Screen Example
Figure 1013

5 Pitch

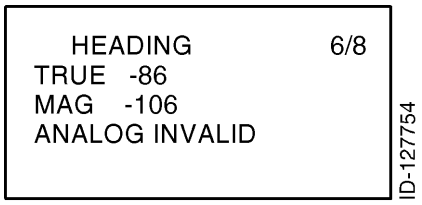
An example of a Pitch display screen is shown in Figure 1014. The line two shows the data from ARINC 429 Mag Heading/Allotted data bus (label 324). The (+) shows that source is the active source. If the Pitch data from the 429 data source is not correct, then line two can show INVALID. The line three shows the data from a Pitch attitude synchro. In this case the data is correct.



Pitch Display Screen Example
Figure 1014

6 Heading

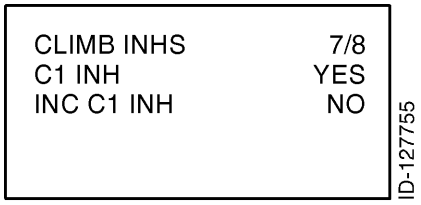
There are two types of heading data, one is ARINC 429 and the other is synchro. There are two types of ARINC 429 heading data, true and magnetic. An example of a Heading display is shown in Figure 1015. The second line shows the true heading data from ARINC 429 label 314. The (+) indicated that data source is the active source. If the data from one of the data sources is not correct, then it can show INVALID (as shown on the line three). The line three shows Magnetic heading data from ARINC 429 data source (label 320). The line four shows the data from the Magnetic Synchro data source. In this case the data is incorrect.



Heading Display Screen Example
Figure 1015

7 Climb Inhibit

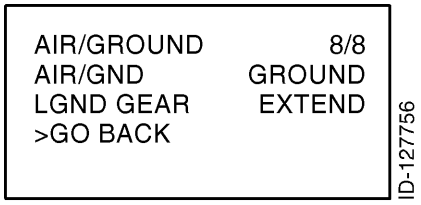
An example of a Climb Inhibit display screen is shown in Figure 1016. The second line shows if climb is inhibited or not (yes or no). The line three shows if increased climb is inhibited (yes or no).



Climb Inhibit Display Screen Example
Figure 1016

8 Air/Ground and Landing Gear

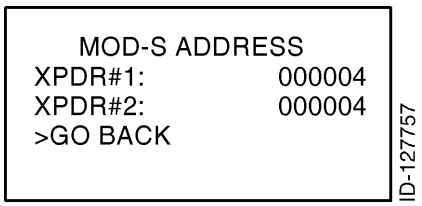
An example of an Air/Ground and Landing Gear display screen is shown in Figure 1017. The second line shows if Air/Ground Input Discretes show Ground, Air, or invalid. The line three shows if Landing Gear Discrete Input shows the gear is RETRAC or EXTEND. The Active Selectable Item is GO BACK.



Air/Ground Display Screen Example
Figure 1017

(d) Mode-S Address

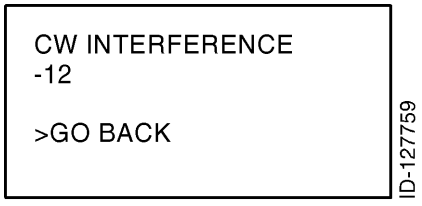
To push the Select button when Mode-S Address is the Active Selectable Item on the Input screen causes the Mode-S Address display screen to display. The Figure 1018 shows an example of the Mode-S Address screen. Line two shows the hexadecimal address of transponder No. 1 received from XT Coordination No. 1 (pins RMP 14F and RMP 14G) ARINC 429 data bus (labels 275 and 276). If the data words are not received, no address will be shown and that area of the screen will stay blank.



Typical Mode S Transponder Display Screen
Figure 1018

(e) Continuous Wave Interference

To push the Select button when the Continuous Wave (CW) Interference is the Active Selectable Item on the Input Screen causes the CW Interference display screen to be shown. The Figure 1019 shows an example of a CW Interference display screen. Line two shows the external CW Internal. If the external CW Interference is between -1 and 0, then NONE will be shown. GO BACK is the Active Selectable Item.



Continuous Wave Interference Display Screen
Figure 1019