TO HOLDERS OF SYSTEM DESCRIPTION AND INSTALLATION MANUAL, PUB. NO 8600200-001, T3CAS INTEGRATED PLATFORM

REVISION NO. 004 DATED 04 NOVEMBER 2014

HIGHLIGHTS

This revision is a full replacement. All pages have been updated with the new date. Due to the extent of changes, this document has been revised in whole and no revision bars are used.

Remove and discard ALL pages of the manual and replace them with the attached pages.

Pages	Description of Change
All	All pages have been revised to indicate revision 004 and to show the latest revision date.
INTRO-1	Updated the note in subsection 1 of the introduction.
Pages 1-4, 1-5, 1-6, 1-13, 1-23, 1-25, 1-30, 1-39, 1-47, 1-50, 1-60,1-61, 1-62, 1-82, 1-90, 1-92, 1-93, 1-97, 1-103, 2-2, 2-3, 3-2, 4-1, 4-2, 4-3, 4-5, 4-6, 4-37, 4-92, 4-94, 4-95, 4-97, 4-111, 4-112, 4-124, 4-126, 4-127, 4-137, 4-138, 4-145, 4-156, 5-4, 5-6, 5-7, 5-19, 5-20, 5-25, 6-3, 6-7, 6-11, 6-12, 6-13, 6-15, 6-16, 6-17, 6-18, 7-3, 10-1	Added STD 1.3 part number references.
Pages 1-6, 1-7, 1-13, 1-39, 1-50, 1-59, 1-60, 1-78, 1-93, 1-97, 1-103, 1-108, 2-2, 4-1, 4-37, 4-38, 4-114, 4-117, 4-118, 4-119, 4-128, 5-8, 5-19, 5-20, 5-25, 6-57, 6-59, 7-5, 7-10, 10-1	Updated Rel 2.0 part number references.
Pages 1-39, 4-48, 4-140	Added notes requiring RMP-5E be enabled for Hybrid Surveillance installations.

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Aviation Communication and Surveillance Systems
19810 North 7th Avenue
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U.S.A.

T3CAS Integrated Platform

System Description and Installation Manual

Pub. No. 8600200-001, Revision 004

34-45-29

Printed in U.S.A.

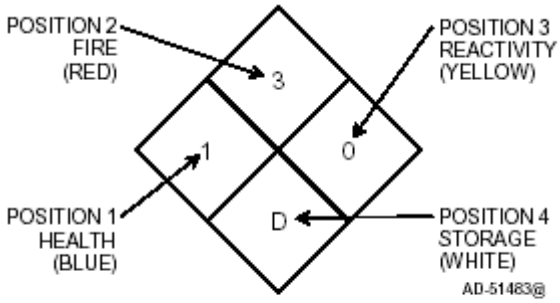
PROPRIETARY NOTICE

MATERIALS HAZARD RATING CODE

ACSS uses the National Fire Protection Association system to identify the different levels of hazards that are caused by the use of a given material. A Hazard Code identifies three effects of a material on a person: health (eat, drink, touch, and breathe), fire (when and how it burns), and reactivity (chemical explosions). Also, each material is given a storage group for safety.

Each code has three numbers and one letter (for example, 130D) as shown in the Hazard Code symbol below. The three numbers show the hazard levels for health, fire, and reactivity, in that sequence. The range of each number is 0 to 4. The higher the number, the more dangerous the hazard. You must be careful with any material that has a Hazard Code with a 2, 3, or 4. The one letter (A thru E) in the code identifies a specific storage group that is applicable for the material.

If applicable, materials used for the procedures in this manual are given a Hazard Code. More data on the health and fire levels is shown on page H-2. Get specific data on a material from the data sheet supplied by the manufacturer of the material.



Hazard Code Symbol
(The code shown is 130D.)

POSITION 1: HEALTH HAZARD

0	No important hazard
1	Irritant - Use with caution
2	Hazardous - Prevent continued exposure, inhalation, and contact
3	Dangerous hazard - Use protective clothing together with protection to breathe
4	Very bad hazard - Do not breathe vapor or come in contact with liquid without approved special protection

POSITION 2: FIRE HAZARD

0	Will not burn
1	Must increase temperature above 93.4 °C to burn
2	Must increase temperature above 37.8 °C to burn
3	Fire and explosion hazard at ambient temperature
4	Highly dangerous fire and explosion hazard

POSITION 3: REACTIVITY HAZARD

0	Usually stable
1	Unstable if heated
2	Violent chemical change is possible
3	Dangerous explosion is possible
4	Very bad explosion hazard - quickly go out of the area if materials are exposed to fire

POSITION 4: STORAGE GROUP

A	Acids
B	Alkalis, cyanides
C	Oxidizing agents
D	Chlorinated hydrocarbons, flammable liquids, materials that are not flammable
E	Neutral salts and others

HEALTH HAZARD RATING IN POSITION 1

Rating	Description	Effect of Exposure
4	Very bad health hazard	Very short exposures could cause DEATH or CRITICAL REMAINING INJURY even after fast medical treatment. Do not breathe the vapor or come in contact with the liquid without approved protection.
3	Dangerous health hazard	Short exposures could cause DANGEROUS TEMPORARY OR REMAINING INJURY even with fast medical aid. Use approved clothing.
2	Hazardous	Intense or continued exposure could cause TEMPORARY DISABILITY OR POSSIBLE REMAINING INJURY unless medical aid is given immediately.
1	Irritant	May cause IRRITATION on exposure. Only SMALL REMAINING INJURY would be the result without medical treatment. Safety glasses must be worn.
0	No Important health hazard	Not hazardous for usual conditions. Special personal protection is not necessary.

FIRE HAZARD RATING IN POSITION 2

Rating	Description	Effect of Exposure
4	Very flammable	Any liquid or gaseous material that is a liquid under pressure with a flash point below 22.8 °C. Also materials that can form explosive mixtures with air, such as dusts or combustible solids, and pressurized small drops of flammable or combustible liquid. PREVENT ALL SOURCES OF IGNITION. NO SMOKING PERMITTED!
3	Highly flammable	Liquids and solids that can start to burn in almost all conditions of ambient temperature. Liquids with a flash point at or above 22.8 °C but below 37.8 °C. Control all sources of ignition. NO SMOKING!
2	Moderately combustible	Materials that must be warm or in an area open to high temperatures before ignition can occur. This rating is applicable to liquids having a flash point above 37 °C but below 93.4 °C. Be very careful when near a source of heat.
1	Lightly combustible	Materials that must be hot before ignition can occur. This rating includes materials that will burn in air in an area open to a temperature of 815 °C for 5 minutes or less. Liquids and solids have a flash point at or above 93.4 °C.
0	Will not burn	Any material that will not burn in air in an area open to a temperature of 815 °C for 5 minutes.

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 A shows ACSS is the incorporator.

Revision Number	Revision Date	Date Put in Manual	By
1	15 Sep 2013	15 Sep 2013	A
002	22 May 2014	22 May 2014	A
003	05 Jun 2014	05 Jun 2014	A
004	04 Nov 2014	04 Nov 2014	A

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RECORD OF TEMPORARY REVISIONS

Read the location instructions on each temporary revision page to know where to put the pages in your manual. Remove temporary revision pages only when discard instructions are given. For each temporary revision, give the correct data in the applicable columns.

Temporary Revision Number	Temporary Revision Date	Date Put in Manual	By*	Date Removed from Manual	By*
1	15 Jul 2011	15 Jul 2011	A	15 Sep 2013	A
2	6 Jun 2012	6 Jun 2012	A	15 Sep 2013	A
3	15 Jan 2014	15 Jan 2014	A	26 Feb 2014	A
4	26 Feb 2014	26 Feb 2014	A	22 Apr 2014	A
5	22 Apr 2014	22 Apr 2014	A	22 May 2014	A
6	25 Jun 2014	25 Jun 2014	A	04 Nov 2014	A

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SERVICE BULLETIN LIST

Service Bulletin	Identified Mod	Date Included in this manual	Description
ATA 9005000-34-0001 (8008468-001)	E	15 Sep 2013	Makes Necessary Modifications to Revise Transmitter CCA A4, Part No.9005040-001 to Revision J and Update The T3CAS Computer Unit (CU) to Hardware Mod E.
ATA 9005000-34-6002 (8008517-001)	F	15 Sep 2013	Part No.9005000-10000; Install New T3CAS Operational Software from Master Media, Part No.9500001-004F, and Upgrade the T3CAS (Traffic Management Computer) Computer Unit to Part No.9005000-10101 with Hardware Modification F.
ATA 9005000-34-0004 (8008703-001)	H	15 Sep 2013	Part No.9005000-10101; Hardware MOD H Updates the Power Supply CCA, Part No.9005030-001 and Receiver CCA Part No.9005050-003 or 9005050-005 to Improve Reliability.
ATA 9005000-34-0005 (8008706-001)	J	15 Sep 2013	Part No. 9005000-10000, -10101, and -10202 Hardware MOD J; Replaces Processor CCA, Part No.9005020-001, Rev G (or before) with a New Processor CCA, Part No.9005020-001, H (or later) for Improved Reliability.
ATA 9005000-34-6008 (8008864-001)		15 Sep 2013	Part No.9005000-10000, -10101; Installs New Operational Software from Master Media, Part No.9500001-005F and Updates T3CAS Computer Units To Part No.9005000-10202.
ATA 9005000-34-6013 (8009096-001)		04 Nov 2014	Part No.9005000-10101, -10202; Installs New Operational Software from Master Media, Part No.9500001-007F and Updates T3CAS Computer Units to Part No.9005000-10204.

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LIST OF EFFECTIVE PAGES

Original	-	15 Feb 2010
Revision	001	15 Sep 2013
Revision	002	22 May 2014
Revision	003	05 Jun 2014
Revision	004	04 Nov 2014

Subheading and Page			Revision
Title			
	T-1		004
	T-2		004
Material Hazard			
	H-1		004
	H-2		004
Record of Revisions			
	RR-1		004
	RR-2		004
Service Bulletin			
	SBL-1		004
	SBL-2		004
List of Effective Pages			
	LEP-1		004
	LEP-2		004
	LEP-3		004
	LEP-4		004
	LEP-5		004
	LEP-6		004
Table of Contents			
	TC-1		004
	TC-2		004
	TC-3		004
	TC-4		004
	TC-5		004
	TC-6		004
	TC-7		004
	TC-8		004
	TC-9		004
	TC-10		004
Introduction			
	INTRO-1	▪	004
	INTRO-2		004
	INTRO-3		004
	INTRO-4		004
	INTRO-5		004
	INTRO-6		004
	INTRO-7		004
	INTRO-8		004
System Description			
	1-1		004
	1-2		004
	1-3		004
	1-4	▪	004
	1-5	▪	004
	1-6	▪	004
	1-7	▪	004
	1-8		004
	1-9		004
	1-10		004
	1-11		004
	1-12		004
	1-13	▪	004
	1-14		004
	1-15		004
	1-16		004
	1-17		004
	1-18		004
	1-19		004
	1-20		004
	1-21		004
	1-22		004
	1-23	▪	004
	1-24		004
	1-25	▪	004
	1-26		004
	1-27		004
	1-28		004
	1-29		004
	1-30	▪	004
	1-31		004
	1-32		004
	1-33		004
	1-34		004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs.

Subheading and Page		Revision	
	1-35		004
	1-36		004
	1-37		004
	1-38		004
	1-39	▪	004
	1-40		004
	1-41		004
	1-42		004
F	1-43/44		004
	1-45		004
	1-46		004
	1-47	▪	004
	1-48		004
	1-49		004
	1-50	▪	004
	1-51		004
	1-52		004
	1-53		004
	1-54		004
	1-55		004
	1-56		004
	1-57		004
	1-58		004
	1-59	▪	004
	1-60	▪	004
	1-61	▪	004
	1-62	▪	004
	1-63		004
	1-64		004
	1-65		004
	1-66		004
	1-67		004
	1-68		004
	1-69		004
	1-70		004
	1-71		004
	1-72		004
	1-73		004
	1-74		004
	1-75		004
	1-76		004
	1-77		004
	1-78	▪	004
	1-79		004
	1-80		004
	1-81		004

Subheading and Page		Revision	
	1-82	▪	004
	1-83		004
	1-84		004
	1-85		004
	1-86		004
	1-87		004
	1-88		004
	1-89		004
	1-90	▪	004
	1-91		004
	1-92	▪	004
	1-93	▪	004
	1-94	▪	004
	1-95		004
	1-96		004
	1-97	▪	004
	1-98		004
	1-99		004
	1-100		004
	1-101		004
	1-102		004
	1-103	▪	004
	1-104		004
	1-105		004
	1-106		004
	1-107		004
	1-108	▪	004
	1-109		004
	1-110		004
	1-111		004
	1-112		004
	1-113		004
	1-114		004
	1-115		004
	1-116		004
	1-117		004
	1-118		004
	1-119		004
	1-120		004
	1-121		004
	1-122		004
	1-123		004
	1-124		004
	1-125		004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs.

Subheading and Page			Revision
	1-126		004
	1-127		004
	1-128		004
	1-129		004
	1-130		004
	1-131		004
	1-132		004
	1-133		004
	1-134		004
	1-135		004
	1-136		004
Mechanical Installation			
	2-1		004
	2-2	▪	004
	2-3	▪	004
	2-4		004
	2-5		004
	2-6		004
F	2-7/8		004
F	2-9/10		004
F	2-11/12		004
F	2-13/14		004
F	2-15/16		004
F	2-17/18		004
	2-19		004
	2-20		004
F	2-21/22		004
F	2-23/24		004
F	2-25/26		004
F	2-27/28		004
F	2-29/30		004
F	2-31/32		004
F	2-33/34		004
F	2-35/36		004
F	2-37/38		004
F	2-39/40		004
Electrical Installation			
	3-1		004
	3-2	▪	004
	3-3		004
	3-4		004
	3-5		004
	3-6		004
	3-7		004
	3-8		004
	3-9		004

Subheading and Page			Revision
	3-10		004
	3-11		004
	3-12		004
	3-13		004
	3-14		004
	3-15		004
	3-16		004
	3-17		004
	3-18		004
	3-19		004
	3-20		004
	3-21		004
	3-22		004
	3-23		004
	3-24		004
	3-25		004
	3-26		004
Loading/Gradient Specifications			
	4-1	▪	004
	4-2	▪	004
	4-3	▪	004
	4-4		004
	4-5	▪	004
	4-6	▪	004
	4-7		004
	4-8		004
	4-9		004
	4-10		004
	4-11		004
	4-12		004
	4-13		004
	4-14		004
	4-15		004
	4-16		004
	4-17		004
	4-18		004
	4-19		004
	4-20		004
	4-21		004
	4-22		004
	4-23		004
	4-24		004
	4-25		004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs.

Subheading and Page		Revision	
	4-26		004
	4-27		004
	4-28		004
	4-29		004
	4-30		004
	4-31		004
	4-32		004
	4-33		004
	4-34		004
	4-35		004
	4-36		004
	4-37	▪	004
	4-38	▪	004
	4-39		004
	4-40		004
	4-41		004
	4-42		004
	4-43		004
	4-44		004
	4-45		004
	4-46		004
	4-47		004
	4-48	▪	004
	4-49		004
	4-50		004
	4-51		004
	4-52		004
	4-53		004
	4-54		004
	4-55		004
	4-56		004
	4-57		004
	4-58		004
	4-59		004
	4-60		004
	4-61		004
	4-62		004
	4-63		004
	4-64		004
	4-65		004
	4-66		004
	4-67		004
	4-68		004
	4-69		004
	4-70		004
	4-71		004

Subheading and Page		Revision	
	4-72		004
	4-73		004
	4-74		004
	4-75		004
	4-76		004
	4-77		004
	4-78		004
	4-79		004
	4-80		004
	4-81		004
	4-82		004
	4-83		004
	4-84		004
	4-85		004
	4-86		004
	4-87		004
	4-88		004
	4-89		004
	4-90		004
	4-91		004
	4-92	▪	004
	4-93		004
	4-94	▪	004
	4-95	▪	004
	4-96		004
	4-97	▪	004
	4-98		004
	4-99		004
	4-100		004
	4-101		004
	4-102		004
	4-103		004
	4-104		004
	4-105		004
	4-106		004
	4-107		004
	4-108		004
	4-109		004
	4-110		004
	4-111	▪	004
	4-112	▪	004
	4-113		004
	4-114	▪	004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs.

Subheading and Page			Revision
	4-115		004
	4-116		004
	4-117	▪	004
	4-118	▪	004
	4-119	▪	004
	4-120		004
	4-121		004
	4-122		004
	4-123		004
	4-124	▪	004
	4-125		004
	4-126	▪	004
	4-127	▪	004
	4-128	▪	004
	4-129		004
	4-130		004
	4-131		004
	4-132		004
	4-133		004
	4-134		004
	4-135		004
	4-136		004
	4-137	▪	004
	4-138	▪	004
	4-139		004
	4-140	▪	004
	4-141		004
	4-142		004
	4-143		004
	4-144		004
	4-145	▪	004
	4-146		004
	4-147		004
	4-148		004
	4-149		004
	4-150		004
	4-151		004
	4-152		004
	4-153		004
	4-154		004
	4-155		004
	4-156	▪	004
	4-157		004
	4-158		004
	4-159		004
	4-160		004

Subheading and Page			Revision
	4-161		004
	4-162		004
Adjustment/Test			
	5-1		004
	5-2		004
	5-3		004
	5-4	▪	004
	5-5		004
	5-6	▪	004
	5-7	▪	004
	5-8	▪	004
	5-9		004
	5-10		004
	5-11		004
	5-12		004
	5-13		004
	5-14		004
	5-15		004
	5-16		004
	5-17		004
	5-18		004
	5-19	▪	004
	5-20	▪	004
	5-21		004
	5-22		004
	5-23		004
	5-24		004
	5-25	▪	004
	5-26		004
	5-27		004
	5-28		004
Fault Isolation			
	6-1		004
	6-2		004
	6-3	▪	004
	6-4		004
	6-5		004
	6-6		004
	6-7	▪	004
	6-8		004
	6-9		004
	6-10		004
	6-11	▪	004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs.

Subheading and Page		Revision	
	6-12	▪	004
	6-13	▪	004
	6-14		004
	6-15	▪	004
	6-16	▪	004
	6-17	▪	004
	6-18	▪	004
	6-19		004
	6-20		004
	6-21		004
	6-22		004
	6-23		004
	6-24		004
	6-25		004
	6-26		004
	6-27		004
	6-28		004
	6-29		004
	6-30		004
	6-31		004
	6-32		004
	6-33		004
	6-34		004
	6-35		004
	6-36		004
	6-37		004
	6-38		004
	6-39		004
	6-40		004
	6-41		004
	6-42		004
	6-43		004
	6-44		004
	6-45		004
	6-46		004
	6-47		004
	6-48		004
	6-49		004
	6-50		004
	6-51		004

Subheading and Page		Revision	
	6-52		004
	6-53		004
	6-54		004
	6-55		004
	6-56		004
	6-57	▪	004
	6-58		004
	6-59	▪	004
	6-60		004
Maintenance Practices			
	7-1		004
	7-2		004
	7-3	▪	004
	7-4		004
	7-5	▪	004
	7-6		004
	7-7		004
	7-8		004
	7-9		004
	7-10	▪	004
Inspection/Check			
	8-1		004
	8-2		004
Cleaning/Painting			
	9-1		004
	9-2		004
	9-3		004
	9-4		004
Repairs			
	10-1	▪	004
	10-2		004
Appendix A			
	A-1		004
	A-2		004
	A-3		004
	A-4		004
	A-5		004
	A-6		004

▪ indicates changed, added, or deleted pages.
F indicates right foldout page with blank backs

Table of Contents

Subject **Page**

Subject **Page**

List of Illustrations

Figure **Page**

Figure **Page**

List of Tables

Table **Page**

Table **Page**

INTRODUCTION

1. General

This manual provides general system installation and maintenance instructions and theory of operation for the T3CAS Integrated Platform. It also provides interface information and interconnect diagrams to permit a general understanding of the overall system.

The purpose of this manual is to help install, operate, maintain and troubleshoot the T3CAS Integrated Platform in the aircraft. Common system maintenance procedures are not presented in this manual. The best established shop and flight line practices should be used.

NOTE: This article meets the minimum performance and quality control standards required by a technical standard order (TSO). If you are installing this article on or in a specific type or class of aircraft, you must obtain separate approval for installation.

2. Reference Documents

Publications on subsystems installed as part of the T3CAS Integrated Platform are identified in the list that follows:

Document Title	ACSS Publication Number
Mode S Data Link Transponder System Description and Installation Manual	A09-3839-001
RCZ-852 Mode S Transponder System Description and Installation Manual	A15-3851-001
Handling, Storage, and Shipping Procedures Instruction Manual for Avionics Equipment	A09-1100-001

3. Weights and Measures

Weights and measurements in this manual use both U.S. and S.I. (metric) values.

4. Acronyms and Abbreviations

The letter symbols for abbreviations are the same as shown in ANSI/IEEE Std 260 and ASME Y1.1, except as identified in the acronyms and abbreviations table.

Table INTRO-1: Acronyms and Abbreviations Table

Term	Definition
A/D	Analog/Digital
AAA	Aggregate ASDB and ACD
ac	Alternating Current
ACD	Aircraft Configuration Data
ADC	Air Data Computer
ADIRS	Air Data Inertial Reference System
ADL	Airborne Data Loader
ADLP	Airborne Data Link Processor
ADS-B	Automatic Dependent Surveillance Broadcast
AGL	Above Ground Level
AHRS	Attitude Heading and Reference System
ALT	Altitude
AMM	Aircraft Maintenance Manual
AMN	ACSS Material Number
ANSI	American National Standards Institute
ANT	Antenna
AOA	Angle-Of-Attack
APM	Airplane Personality Module
ASCII	American Standard Code for Information Interchange
ASDB	Aircraft Specific Database
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATN	Aeronautical Telecommunications Network
ATSAW	Airborne Traffic Situational Awareness
BCD	Binary Coded Decimal

Table INTRO-1: Acronyms and Abbreviations Table (cont)

Term	Definition
BITE	Built-In Test Equipment
BNR	Binary
BOT	Bottom
CAS	Collision Avoidance System
CCA	Circuit Card Assembly
CF	Compact Flash
CFDIU	Centralized Fault Display Interface Unit
CFDS	Centralized Fault Display System
CFIT	Controlled Flight Into Terrain
CMC	Central Maintenance Computer
CMM	Component Maintenance Manual
COMM	Communication
CPA	Collision Prediction and Alerting
CPLD	Complex Programmable Logic Device
CRC	Cyclic Redundancy Check
CS	Configuration Strap
CU	Computer Unit
DADC	Digital Air Data Computer
dc	Direct Current
ddm	Difference in Depth of Modulation
DFDAU	Digital Flight Data Acquisitioning Unit
DH/MDA	Decision Height/Minimum Descent Altitude
DISP	Display
DLP	Data Link Processor
DSWC	Digital Stall Warning Computer
EDC	Error Detection and Correction
EDDIT	Engineering Diagnostic and Data Interface Transfer

Table INTRO-1: Acronyms and Abbreviations Table (cont)

Term	Definition
EEPROM	Electrically Erasable Programmable Read-Only Memory
EFIS	Electronic Flight Instrument System
EHS	Enhanced Surveillance
ELM	Extended-Length Message
ELS	Elementary Surveillance
EPROM	Erasable Programmable Read-Only Memory
ESDS	Electrostatic Discharge Sensitive
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FDR	Flight Data Recorder
FLT	Flight
FMO	Factory Modifiable Option
FMS	Flight Management System
FPM	Feet Per Minute
FPGA	Field Programmable Gate Array
GCAM	Ground Collision Avoidance Module
GFM	General Format Manager
GND	Ground
GPIRS	Global Positioning/Inertial Reference System
GPS	Global Positioning System
GPSSU	Global Positioning System Sensor Unit
GPWS	Ground Proximity Warning System
HBM	Heartbeat Monitor
HDG	Heading
I/O	Input/Output
ICA	Instructions for Continued Airworthiness
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers

Table INTRO-1: Acronyms and Abbreviations Table (cont)

Term	Definition
ILS	Instrument Landing System
INH	Inhibit
IPC	Illustrated Parts Catalog
IRS	Inertial Reference System
JTAG	Joint Test Action Group
LAN	Local Area Network
LBP	Left Bottom Plug
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LMP	Left Middle Plug
LRU	Line Replaceable Unit
LSB	Least Significant Bit
LTP	Left Top Plug
LVL	Level
MCP	Mode Control Panel
MCU	Modular Concept Unit
MEL	Minimum Equipment List
MLS	Microwave Landing System
MMR	Multiple Mode Receiver
MMU	Memory Management Unit
Mode S	Mode Select Transponder
MSB	Most Significant Bit
MTBF	Mean Time Between Failures
MTL	Minimum Trigger Level
N/A	Not Applicable
NMI	Nautical Mile
OMS	Onboard Maintenance System
OPS	Operational Software

Table INTRO-1: Acronyms and Abbreviations Table (cont)

Term	Definition
OPT	Option
OVR RNG	Over Range
PC	Personal Computer
PCI	Peripheral Component Interconnect
PDL	Portable Data Loader
PMS	Performance Management System
POST	Power-On Self-Test
PROG	Program
PTM	Pressure Transducer Module
QFE	Queens Field Elevation
QNH	Queen's Normalized Height
RA	Resolution Advisory
RAD ALT	Radio Altimeter
RBP	Right Bottom Plug
RCB	Radio Communication Bus
RMP	Right Middle Plug
RMU	Radio Management Unit
RNG	Range
ROPS	Runway Overrun Protection System
RTCA	Radio Technical Commission for Aeronautics
RTP	Right Top Plug
RWS	Reactive Windshear
SDI	Source Destination Identifier
SDRAM	Synchronous Dynamic Random Access Memory
SPI	Special Pulse Identifier
SSM	Sign Status Matrix
STBY	Standby
SW	Software

Table INTRO-1: Acronyms and Abbreviations Table (cont)

Term	Definition
TA	Traffic Advisory
TAL	Traffic Advisory Line
TAT	Total Air Temperature
TAWS	Terrain Awareness Warning System
T2CAS	Traffic and Terrain Collision Avoidance System
T3CAS	“T cubed CAS”; TAWS, TCAS, and Transponder combined unit
TCAS	Traffic Alert and Collision Avoidance System
TCK	Test Clock
TDI	Test Data in
TDO	Test Data Out
THD	Terrain Hazard Display
TMS	Tactical Message Subfield
TRA	Traffic Resolution Advisory
TRST	Test Reset
TSO	Technical Standard Order
VDOP	Vertical Dilution Of Precision
VSI	Vertical Speed Indicator
VSWR	Voltage Standing Wave-Ratio
WBS	Weight and Balance System
WGS	World Geodetic System
WOW	Weight-On-Wheels
WSS	Windshear Detection and Recovery Guidance System
WXR	Weather
XFER	Transfer
XPDR/XPNDR	Transponder

5. Special Precautions

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

- A **WARNING** is an operation or maintenance procedure or condition, which, if not obeyed, can cause injury or death
- A **CAUTION** is an operation or maintenance procedure or condition, which, 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

All personnel who operate and do maintenance on the TCAS components and on the applicable test equipment must know and obey the safety precautions. The warnings and cautions that follow apply to all parts of the manual.

WARNING: HIGH VOLTAGES MAY BE PRESENT ON SYSTEM INTERCONNECT CABLES. MAKE SURE THAT SYSTEM POWER IS OFF BEFORE YOU DISCONNECT LRU MATING CONNECTORS.

CAUTION: ACSS HAS PREPARED AN AIRWORTHINESS CRITICAL REQUIREMENTS ANALYSIS FOR THIS AIRBORNE EQUIPMENT TO MAKE SURE THAT IT WILL NOT CAUSE A DANGEROUS IN-FLIGHT CONDITION. SPECIFIC PARTS, TESTS, AND PROCEDURES THAT ARE IDENTIFIED AS *INSTALLATION* CRITICAL IN THE ANALYSIS ARE CHANGED TO AIRWORTHINESS CRITICAL IN THIS MANUAL. IT IS NECESSARY TO DO THESE PROCEDURES AND TESTS TO GET THE APPROVED RESULTS.

CAUTION: THE T3CAS SYSTEM CONTAINS LRUS THAT ARE ELECTROSTATIC DISCHARGE SENSITIVE (ESDS). IF YOU DO NOT OBEY THE NECESSARY CONTROLS, A FAILURE OR UNSATISFACTORY OPERATION OF THE UNIT CAN OCCUR FROM ELECTROSTATIC DISCHARGE. USE APPROVED INDUSTRY PRECAUTIONS TO KEEP THE RISK OF DAMAGE TO A MINIMUM WHEN YOU TOUCH, REMOVE OR INSTALL LRUS.

SYSTEM DESCRIPTION

1. General

The T3CAS Integrated Platform combines TAWS, TCAS and a Mode S Transponder to form a combined system (T3CAS). Optionally, the T3CAS may contain obstacle alerting in addition to terrain and Eleview functions within the same LRU. The integration of the functions provides significant cost and space advantages to the customer. The implementation method used preserves the independence of the TCAS, TAWS and Transponder functions within the T3CAS LRU. The system reliability for the T3CAS LRU is greater than a federated system with separate TCAS, TAWS and Transponder LRUs.

The TCAS function, within T3CAS, determines the range, altitude, and bearing of other aircraft equipped with Mode S/Air Traffic Control Radar Beacon System (ATCRBS) transponders, with respect to the location of own aircraft. It also monitors the trajectory of these aircraft for the purpose of determining if any of them constitute a potential collision hazard. The TCAS function is responsible for estimating the projected intruder track and determining if a potential conflict exists. If so, the system displays an advisory to the pilot. The system also provides guidance for the optimum vertical avoidance maneuver. Complementary avoidance maneuvers between two TCAS equipped aircraft are ensured by coordination of mutual intentions with the other aircraft through the Mode S Transponders. The T3CAS TCAS function meets the TSO requirements referenced in Table 1-2.

The Automatic Dependent Surveillance-Broadcast (ADS-B) function accepts and decodes several types of ADS-B messages. The ADS-B message types that are supported include: Flight Identification, Surface and Airborne Position, Airborne Velocity, Target State and Status, and Aircraft Operational Status.

The ADS-B function takes the traffic information from the 1090 MHz squitters (ADS-B messages) and generates a list of the aircrafts within the receiver area. The function is a part of the ATSAW functionality and is performing the underlying tracking of targets and the correlation of ADS-B and TCAS data.

The ADS-B function correlates traffic targets, if possible, to present a single traffic with the best possible position to the other systems. This provides filtering based on the reported quality of the data provided by the traffic and filtered against the values provided by the receiving function. The filter uses quality parameters provided with the ADS-B transmissions and defined in either RTCA DO-260, DO-260A or DO-260B depending on what protocol the traffic is using. The result of the tracking calculations and the filtering is provided in a traffic list customized for each function receiving this data. The output of the ADS-B function is a graphical Display Traffic Information File (DTIF) as well as an MCDU list of traffic within receiver range and within a maximum number of traffic limits. This information forms the base for the higher-level ADS-B function of In-Trail Procedures (ITP).

The T3CAS TAWS function, within the T3CAS, provides Collision Prediction and Alerting (CPA), as well as conventional Ground Proximity Warning System (GPWS) modes of operation. The CPA uses data provided by the Flight Management Computer, the GPS receiver, and other aircraft subsystems to predict a 3-D flight path based upon a curve-fit extrapolation of the most recent position and velocity data received. This predicted flight path is then compared with the internal terrain profile of the immediate area and the CPA algorithm computes an assessment of

the potential threat of aircraft collision with terrain. When operative, CPA replaces RTCA DO-161A reactive Mode 2 since it offers superior safety margins for controlled flight into terrain (CFIT) prevention due to its predictive capabilities.

T3CAS TAWS meets the requirements of TSO-C151 Class A, refer to Table 1-2

The obstacle awareness function provides additional CPA for man-made obstacles.

The Eleview function provides additional terrain display enhanced situational awareness independent of aircraft altitude. Eleview is displayed to the flight crew by a pair of three digital MSL elevations. These numbers represent the MSL terrain elevation in hundreds of feet (e.g., 250 is 25,000 feet). The top number represents the MSL altitude of the highest display terrain and the bottom number represents the MSL altitude of the lowest displayed terrain. When above the highest terrain elevation by a user defined altitude, the Eleview function will show three shades of green to represent terrain. On supporting displays, water can be depicted in cyan.

The T3CAS Mode S Data Link Transponder function supplies surveillance functions to both ground-based and airborne interrogators and communication functions to onboard systems. The transponder contains data link functions that allow it to function as part of the Aeronautical Telecommunications Network (ATN). The data link functions allow communication with a Communication Management Unit (CMU) through a Mode S Airborne Data Link Processor (ADLP). The transponder also contains Mode S Specific functions, which are dedicated links directly to onboard systems. The transponder can be upgraded to supply an internal ADLP function. The T3CAS Transponder conforms to the ARINC 718A Mode S Transponder Characteristic for function. The T3CAS Transponder is fully compliant with the Mode S Elementary and Enhanced Surveillance (ELS/EHS) selective interrogation requirements. The transponder reports ELS Flight Identification as well as Aircraft Intent (BDS 4,0 - Selected Altitude), Track and Turn Report (BDS 5,0 - Roll Angle, True Track Angle, Groundspeed, Track Angle Rate, and True Airspeed), and Speed and Heading Report (BDS 6,0 – Magnetic Heading, Indicated Airspeed, Mach Number, Baro Altitude Rate, and Inertial Vertical Velocity).

The T3CAS transponder provides ADS-B, either per DO-260A or DO-260B based on T3CAS part number, refer to Table 1-2. This is a function for airborne and surface aircraft which transmit horizontal and vertical position and velocity as well as other pertinent information. This ADS- B functionality will support improved used of airspace, improved surface surveillance, and enhanced safety.

2. System Components

The tables that follow within this section provide information regarding the components within the system as well as related configuration information as categorized by the table caption.

Table 1-1: System Components

Component	ACSS Part No.
T3CAS Computer Unit, refer to Table 1-2 for unit configurations.	9005000-XXYYY (Note 1)
Directional Antenna (See Table 1-7 for configuration descriptions)	7514081-VAR or 7514060-VAR

Table 1-1: System Components (cont.)

Component	ACSS Part No.
TAWS Terrain Display	N/A – Installation specific
TAWS Control Panel	N/A – Installation specific
ACSS VSI/TRA Display (see Table 1-10 for configuration descriptions)	4067241-VAR
APM (Model No. AP-950)	Refer to Table 1-4
ASDB	Refer to Table 1-3
Thales VSI-TCAS (Note 4) (See Table 1-11 for configurations.)	High resolution LCD flat panel Vertical Speed Indicator with TCAS II data in RA and TA modes.
Gables G7130 Series ATC/TCAS Dual Transponder Control Panel (Note 2)	General aviation type controller that operates from +28 V DC aircraft power (Note 3)
Gables G6990, G6991, G6992 and G6993 Series Mode S/TCAS Control Panels (Note 2)	Commercial aviation type controllers that operate from 115 V ac aircraft power (Note 3)
Gables G7490 Flight ID/ATC/TCAS Control Panel	Commercial aviation type controller which operates from 115 V ac aircraft power (Note 3)
Gables G7491 Flight ID Control Panel	Commercial aviation type Flight ID Control Panel that operates from 115 V ac aircraft power (Note 3)
Omnidirectional Antenna (Notes 6 and 7)	ATC blade antenna, dc shorted, TSO C119c and C112 compliant,1030 to 1090 MHz. Installer to supply antenna.
Mounting Tray, T3CAS Computer (6-MCU size unit)	ARINC 600 6-MCU Mount, cooling air required. Installer to supply mount.
Mounting Tray, T3CAS Computer (4-MCU size unit)	ARINC 600 4-MCU Mount, utilize a unit-mounted fan (integrated fan) for cooling. Installer to supply mount.

NOTES:

1. The part number for the T3CAS Computer Unit is 9005000-XXYYY, where the five digit dash number corresponds to the hardware/software version. The first two digits following the dash number (XX) correspond to the unit hardware version. The last three digits following the dash number (YYY) correspond to the unit software version.

   XX = Hardware Configuration:

   (10 thru 39) = 6MCU (AC/DC)

   (40 thru 59) = 4MCU (DC only)

   (60 thru 99) = 4MCU (AC/DC)

2. Refer to Table 1-9 for individual part number descriptions.
3. For additional information, pricing and availability contact:

   Gables Engineering, Inc.
   247 Greco Avenue
   Coral Gables, Florida 33146
   Telephone: (305) 774-4400
   Fax: (305) 774-4465

4. For additional information, pricing and availability contact:

   Thales Communications, Inc.
   Aviation Electronics Division
   22605 Gateway Center drive
   Clarksburg, MD 20871-2001, USA
   Telephone: + 1 (240) 864-7639

5. For additional information, pricing and availability contact:

   AeroAntenna Technology, Inc.
   20732 Lassen Street
   Chatsworth, CA 91311
   Telephone: (818) 993-3842

6. A bottom omnidirectional antenna can be used as an optional replacement for the directional antenna.
7. For T3CAS LRU Part Numbers 9005000-10000, -10101, -10202, and -10204, a bottom omnidirectional antenna is not supported.

Table 1-2: T3CAS Unit Configurations

T3CAS Computer Unit Part Number/ Type Designation	Description	Applicable TSO & Deviations	Class, Comments
9005000-10000 T3CAS Standard 1	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. Part No. -10000 does not support a bottom omnidirectional antenna.	C112 - Deviation Note 6 C119c - Deviation Note 1, 2, 6, 7 C151b - No Deviation C166a - Deviation Note 3, 4, 5, 6	Class 3A7 121 011 - Class A Class A3 Transmit Only & Class A3/Type 1 Receive Only
9005000-10101 T3CAS Standard 1.1	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. Part No. -10101 does not support a bottom omnidirectional antenna.	C112 - Deviation Note 6 C119c - Deviation Note 1, 2, 6, 7 C151b - No Deviation C166a - Deviation Note 3, 4, 5, 6	Class 3A7 121 011 - Class A Class A3 Transmit Only & Class A3/Type 1 Receive Only
9005000-10202 T3CAS Standard 1.2	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. Part No. -10202 does not support a bottom omnidirectional antenna.	C112 - Deviation Note 6 C119c - Deviation Note 1, 2, 6, 7 C151b - No Deviation C166a - Deviation Note 3, 4, 5, 6	Class 3A7 121 011 - Class A Class A3 Transmit Only & Class A3/Type 1 Receive Only
9005000-10204 T3CAS Standard 1.3	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. Part No. -10204 does not support a bottom omnidirectional antenna.	C112 - Deviation Note 6 C119c - Deviation Note 1, 2, 6, 7 C151b - No Deviation C166a - Deviation Note 3, 4, 5, 6	Class 3A7 121 011 - Class A Class A3 Transmit Only & Class A3/Type 1 Receive Only
9005000-11203 T3CAS Standard 2	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. This Part No. contains software updates for DO-181E, DO-185B and DO-260A/B.	C112d - Deviation Note 9, 10 C119c - Deviation Note 1, 2, 6 C151c - Deviation Note 8, 9 C166a - Deviation Note 3, 4, 5, 9 C166b - Deviation Note 9, 10	Level 3adens, Class 1 - Class A Class A3/Type 1 Receive Only Class A3 Transmit Only

Table 1-2: T3CAS Unit Configurations (cont.)

T3CAS Computer Unit Part Number/ Type Designation	Description	Applicable TSO & Deviations	Class, Comments
9005000-11801 T3CAS Release 2	Standard 6-MCU size T3CAS unit operates from either 115 V ac, 400 Hz, or +28 V dc aircraft power. This Part No. contains software updates for DO-181E, DO-185B, DO-260B and DO-300A.	C112d - Deviation Note 9, 10 C117a - Deviation Note 9, 12 C119d - Deviation Note 1, 2, 11 C151c - Deviation Note 8, 9 C166b - Deviation Note 9, 10	Level 3adens, Class 1 Hybrid Surveillance Class A Class A3 Transmit & Receive
9005000-55801 T3CAS Release 2	Standard 4-MCU size T3CAS unit operates from +28 V dc aircraft power. This Part No. contains software updates for DO-181E, DO-185B, DO-260B and DO-300A.	C112d - Deviation Note 9, 10 C117a - Deviation Note 9, 12 C119d - Deviation Note 1, 2, 11 C151c - Deviation Note 8, 9 C166b - Deviation Note 9, 10	Level 3adens, Class 1 Hybrid Surveillance Class A Class A3 Transmit & Receive
RTCA NOTE:	DO-181C, DO-185A and DO-260A (IN & OUT) apply to Part No. 9005000-10000, -10101, -10202, and -10204. DO-181E and DO-185B applies to Part No. 9005000-11203, -11801 and -55801. DO-260A (IN) and DO-260B (OUT) applies to Part No. 9005000-11203. DO-260B (IN & OUT) applies to Part No. 9005000-11801 and -55801. DO-300A applies to Part No. 9005000-11801 and -55801. DO-160E applies to Part No. 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801.		
Deviations NOTE:	Refer to Table 1-5.		

Table 1-3: T3CAS ASDB Configuration

T3CAS ASDB Part Number/ Type Designation	Description	Applicable TSO & Deviations	Class
9200004-04802 T3CAS ASDB 1	Aircraft Specific Database(s) used with the T3CAS Release 2 System.	C112d - Deviation Note 9, 10 C117a - Deviation Note 9, 12 C119d - Deviation Note 1, 2, 11 C151c - Deviation Note 8, 9 C166b - Deviation Note 9, 10	Level 3adens, Class 1 Hybrid Surveillance Class A Class A3 Transmit & Receive

Table 1-4: T3CAS APM Part Number

T3CAS APM Part Number/ Type Designation	Description	Applicable TSO & Deviations	Class
9000001-11001 APM Version 2	Aircraft Personality Module Version 2 used with the T3CAS Release 2 System.	C112d - Deviation Note 9, 10 C117a - Deviation Note 9, 12 C119d - Deviation Note 1, 2, 11 C151c - Deviation Note 8, 9 C166b - Deviation Note 9, 10	Level 3adens, Class 1 Hybrid Surveillance Class A Class A3 Transmit & Receive

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The T3CAS unit has the following FAA approved software deviations. These do not affect the installation or performance of the system. The following table is a compilation of deviations across multiple releases. Deviation numbering within this document may not correlate to deviation numbering used elsewhere.

Table 1-5 - T3CAS Unit Deviation Notes

Deviation 1: TSO-C119c and TSO-C119d: DO-185B 2.2.4.6.2.2.4, 2.4.2.1.7.6 - Mode S Power Programming in High Density DO-185B Paragraph 2.2.4.6.2.2.4 indicates that the transmit power level of Mode S tracking interrogations to targets (but not air-to-air coordination interrogations) shall be automatically reduced as a function of range for targets within 10 NMI. The deviation allows the use of a precursor interrogation to be transmitted at the lower of either the MOPS calculated power level for power programming or a power level based on previously received replies from the intruder aircraft. If a reply is not received from the precursor interrogation, then tracking interrogations are transmitted at a higher power level according to the MOPS requirements for tracking interrogation transmissions.
Deviation 2: TSO-C119c and TSO-C119d: DO-185B 2.2.4.4.2.2b, 2.4.2.1.5.1 Mode S Preamble Reception This deviation from DO-185B allows the use of the enhanced pulse decoder techniques defined in DO-260B Appendix I of the TCAS pulse decoder techniques specified in DO-185B 2.2.4.4.2.2b. The test procedures defined in DO-185B 2.4.2.1.5.1 are replaced by test procedures defined in DO-260B section 2.4.4.4.2.2 for System Bench tests, where a DF-11 replaces a DF-17 in the test procedures. For Environmental Qualification tests, DO-260B section 2.3.2.4.6.2 is used, where a DF-11 replaces a DF-17 in the test procedure. (Note - 2.3.2.4.6.2 tests have been approved by SC-186 WG3 and will be included in release DO-260B of that document). The ADS-B Enhanced Preamble Detection techniques in DO-260B Appendix I provide a more robust implementation than the legacy TCAS Mode S Preamble Detection techniques defined in DO-185B, and therefore provide an equivalent level of safety.
Deviation 3: TSO-C166a: DO-260A 2.4.10.6.3 Report Verification of Reasonableness Test Applied to Positions Determined from Locally Unambiguous CPR Decoding This deviation from DO-260A 2.4.10.6.3 increases the tolerance from 6 NMI ±5 m to 6 NMI ±100 m for airborne participants and 0.75 NMI ±1.25 m to 0.75 NMI ±100 m for surface participants.
Deviation 4: TSO-C166a: DO-260A 2.2.3.2.7.3.2.1 TEST Message with SUBTYPE=7, Global Enable/Inhibit This deviation from DO-260A Change 2, paragraph 2.2.3.2.7.3.2.1 and 2.2.3.2.7.3.2.2 complies with the proposed change to DO-260A. The change removes the geographic filter which is defined in 2.2.3.2.7.3.2.2 and makes the default setting of the global parameter to Enable Transmission of the TEST Message with SUBTYPE=7. The transmission of the TEST message has no effect on system safety, and therefore will have an equivalent level of safety. The current system with the geographic filter enabled transmits the TEST message only in North America. The effect of the change is to allow it to be transmitted at all locations. The effect of the change provides additional ADS-B data outside North America.

Table 1-5 - T3CAS Unit Deviation Notes

Deviation 5: TSO-C166a: DO-260A 2.2.3.6 ADS-B Airborne Velocity Messages;
TSO-C112: DO-181C 2.2.16.2.6.2.4.2 Register Timeout.

This deviation from DO-260A and DO-181C sets all codes in the Airborne Velocity Message to ZEROS except the type code when a data time-out occurs. The Type Code field continues to be transmitted as 19 under this condition. Setting the data fields in the Airborne Velocity Message will signify no data available for the N/S Velocity, E/W Velocity, Vertical Rate and Difference From Barometric Altitude data fields. The Subtype Code will be set to an invalid code of zero. The ADS-B receiving system will ignore the data fields since they are set to invalid states, which provides an equivalent level of safety.

Deviation 6: TSO-C119c, TSO-C112 and TSO-C166a: DO-160E 21.4 Radiated RF Emissions

The T3CAS Processor has a high power RF transmitter which is used to generate both the 1030 MHz and 1090 MHz waveforms for TCAS, Mode S Transponder and ADS-B OUT functions. Due to the high RF power requirement and inherent non-linearities in RF transmitters, the harmonics of the transmitter exceed the RF radiated emissions limit in DO-160E Category M. The T3CAS deviates from DO-160E Section 21 Category M Radiated RF Emissions in the following frequency bands when the transmitter is active:

1030 ±60 MHz (TCAS fundamental)
1090 ±60 MHz (Transponder fundamental)
2060 ±60 MHz (2nd TCAS harmonic)
2180 ±60 MHz (2nd Transponder harmonic).
3090 ±60 MHz (3rd TCAS harmonic)
3270 ±60 MHz (3rd Transponder harmonic).
4120 ±60 MHz (4th TCAS harmonic)
4360 ±60 MHz (4th Transponder harmonic).
5150 ±60 MHz (5th TCAS harmonic)
5450 ±60 MHz (5th Transponder harmonic).

The avionics installer must conduct the appropriate testing required to ensure that other aircraft systems are not adversely affected in the above frequency bands when the T3CAS transmitter is active.

Deviation 7: TSO-C119c: DO-185B 2.3 Equipment Performance – Environmental Conditions

The T3CAS LRU is tested to the environmental test conditions set forth in Environmental Conditions and Test Procedures for Airborne Equipment, RTCA DO-160E, December 9, 2004 instead of the RTCA DO-160F standard called out in the RTCA DO-185B MOPS. The T3CAS deviates from TSO-C119c to allow the use of DO-160E Environmental Test Procedures.

Deviation 8: Alternate GPWS Curves

TSO-C151b, Appendix 1,1.3.e stated that deviations to the DO-161A alerting requirements to minimize nuiance alerting if equivalent level of safety could be provided for 5 specific conditions. In T3CAS 1.2 and other TAWS systems, ACSS has supplied alternate alerting logic and gotten it approved as part of the TSO. In TSO-C151c Class A, the phrase “the deviation is approved under the provision of 14 CFR §21.618” was added to this section. Thus, this deviation has been previously approved, but now needs to be formally listed as a deviation.

Deviation 9: TSO-C112d, TSO-C117a, TSO-C151c, TSO-C166a and TSO-C166b Part Marking requirements.

This deviation is in regards to the part marking requirements of:

- TSO-C112d, Sections 4(a) and 4(b)
- TSO-C117a, Section g(1) and g(3)

Table 1-5 - T3CAS Unit Deviation Notes

• TSO-C151c, Sections 4(a) and 4(b) • TSO-C166a, Sections 4(a), 4(b) and 4(c) • TSO-C166b, Sections 4(a), 4(b) and 4(e) This deviation allows TSO-C112d, TSO-C117a, TSO-C151c, TSO-C166a and TSO-C166b part marking details to be listed in this installation manual instead of on the article's label. See Table 1-2 in this manual for marking details.
Deviation 10: TSO-C112d and TSO-C166b: DO-160E 21.4 Radiated RF Emissions The T3CAS Processor has a high power RF transmitter which is used to generate 1090 MHz waveforms for Mode S Transponder and ADS-B OUT functions. Due to the high RF power requirement and inherent non-linearities in RF transmitters, the harmonics of the transmitter exceed the RF radiated emissions limit in DO-160E Category M. The T3CAS deviates from DO-160E Section 21 Category M Radiated RF Emissions in the following frequency bands when the transmitter is active: 2180 ±78 MHz (2nd Transmitter harmonic) Exceeds Cat M limits by as much as 20dB 3270 ±78 MHz (3rd Transmitter harmonic) Exceeds Cat M limits by as much as 20dB 4360 ±23 MHz (4th Transmitter harmonic) Exceeds Cat M limits by as much as 5dB 5450 ±23 MHz (5th Transmitter harmonic) Exceeds Cat M limits by as much as 5dB The avionics installer must conduct the appropriate testing required to ensure that other aircraft systems are not adversely affected in the above frequency bands when the T3CAS transmitter is active.
Deviation 11: TSO-C119d: DO-160E 21.4 Radiated RF Emissions The T3CAS Processor has a high power RF transmitter which is used to generate 1030 MHz waveforms for the TCAS function. Due to the high RF power requirement and inherent non-linearities in RF transmitters, the harmonics of the transmitter exceed the RF radiated emissions limit in DO-160E Category M. The T3CAS deviates from DO-160E Section 21 Category M Radiated RF Emissions in the following frequency bands when the transmitter is active: 2060 ±60 MHz (2nd Transmitter harmonic) Exceeds Cat M limits by as much as 20dB 3090 ±60 MHz (3rd Transmitter harmonic) Exceeds Cat M limits by as much as 20dB 4120 ±60 MHz (4th Transmitter harmonic) Exceeds Cat M limits by as much as 5dB 5150 ±60 MHz (5th Transmitter harmonic) Exceeds Cat M limits by as much as 5dB The avionics installer must conduct the appropriate testing required to ensure that other aircraft systems are not adversely affected in the above frequency bands when the T3CAS transmitter is active.
Deviation 12: TSO-C117a: DO-160B 2.3 Environmental Conditions The T3CAS LRU is tested to the environmental test conditions set forth in Environmental Conditions and Test Procedures for Airborne Equipment, RTCA DO-160E, December 9, 2004 instead of the RTCA DO-160B standard called out in TSO-C117a. The T3CAS deviates from TSO-C117a to allow the use of DO-160E Environmental Test Procedures.

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The following table identifies the software and airborne electronic hardware (firmware) part numbers used in each T3CAS part number.

Table 1-6: T3CAS Unit Software and Firmware Configuration Table

T3CAS Part Number	Software Part Numbers					Firmware Part Numbers				
	Part Number Table	AAA	P1	P2	P3	Input / Output	TCAS RX	XPDR RX	TX	Processor Companion
9005000-10000	N/A	9001077-002	9000904-002	9000905-002	9000906-001	9005101-001	9005102-002	9005103-001	9005104-002	9005100-002
9005000-10101	N/A	9001077-002	9000904-004	9000905-003	9000906-001	9005101-002	9005102-003	9005103-001	9005104-003	9005100-002
9005000-10202	N/A	9001077-002	9000904-005	9000905-004	9000906-002	9005101-002	9005102-003	9005103-001	9005104-003	9005100-002
9005000-10204	N/A	9001077-004	9000904-007	9000905-006	9000906-004	9005101-002	9005102-003	9005103-001	9005104-003	9005100-002
9005000-11203	N/A	9001077-003	9000904-006	9000905-005	9000906-003	9005101-101	9005102-004	9005103-002	9005104-004	9005100-002
9005000-11801	9001120-104	9001175-003	9000904-102	9000905-104	9000906-102	9005101-101	9005102-004	9005103-002	9005104-004	9005100-002
9005000-55801	9001120-104	9001175-003	9000904-102	9000905-104	9000906-102	9005101-101	9005102-004	9005103-002	9005104-004	9005100-002

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Table 1-7: Directional Antenna Configurations

Antenna Part Number	Description
7514060-901	Directional antenna with no adapter plate and 1.560-in. (39.624-mm) connector extension length. Installer must supply adapter plate to mate with aircraft fuselage.
7514060-902	Directional antenna with no adapter plate and 0.705-in. (17.907-mm) connector extension length. Installer must supply adapter plate to mate with aircraft fuselage.
7514081-901	Directional antenna with flat base, four hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-902	Directional antenna with flat base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-903	Directional antenna with a curved 61.52-in. (1,562.608-mm) radius base, eight hole mounting pattern, and 1.560-inch connector extension length.
7514081-904	Directional antenna with a curved 66.52- in. (1,689.608-mm) radius base, eight hole mounting pattern, and 1.560- in. (39.624-mm) connector extension length.
7514081-905	Directional antenna with a curved 74.02-in. (1880.108-mm) radius base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-906	Directional antenna with a curved 77.78-in. (1975.612-mm) radius base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-907	Directional antenna with a curved 99.02-in. (2,515.108-mm) radius base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-908	Directional antenna with a curved 111.02-in. (2,819.908-mm) radius base, four hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-909	Directional antenna with a curved 118.52-in. (3,010.408-mm) radius base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.
7514081-910	Directional antenna with a flat base, eight hole mounting pattern, and 0.705-in. (17.907-mm) connector extension length.
7514081-911	Directional antenna with a curved 77.78-in. (1,975.612-mm) radius base, eight hole mounting pattern, special 0.015-in. (0.381-mm) Teflon gasket, and 1.560-in. (39.624-mm) connector extension length.
7514081-912	Directional antenna with a curved 111.02-in. (2,819.908-mm) radius base, eight hole mounting pattern, special 0.015-in. (0.381-mm) Teflon gasket, and 1.56-in. (39.624-mm) connector extension length.
7514081-913	Directional antenna with a flat base, four hole mounting pattern, and 0.705-in. (17.907-mm) connector extension length.
7514081-914	Directional antenna with a curved 53.02-in. (1,346.708-mm) radius base, eight hole mounting pattern, and 0.705-in. (17.907-mm) connector extension length.
7514081-915	Directional antenna with a curved 44.80-in. (1,137.92-mm) radius base, eight hole mounting pattern, and 0.705-in. (17.907-mm) connector extension length.
7514081-916	Directional antenna with a curved 42.00-in. (1,066.8-mm) radius base, eight hole mounting pattern, and 0.705-in. (17.907-mm) connector extension length.

Table 1-7: Directional Antenna Configurations (cont.)

Antenna Part Number	Description
7514081-917	Directional antenna with a curved 85.06-in. (2160.524-mm) radius base, eight hole mounting pattern, and 1.560-in. (39.624-mm) connector extension length.

Table 1-8: Mode S Transponder Configurations

Part Number	Description
7517800-XXYYY	ACSS ATDL, 4-MCU type Mode S Data Link Transponder that operates on either 115 V ac, 400 Hz or +28 V dc aircraft power.
7510700-XXX	ACSS RCZ-852, Mode S Data Link Transponder that operates on +28 V dc aircraft power.

Table 1-9: Control Panel Configurations

Part Number	Description
4052190-902	Control Panel, Dual Mode S/TCAS, Brown Bezel
4052190-903	Control Panel, Single Mode S-Single ATCRBS/TCAS, Brown Bezel
4052190-904	Control Panel, Dual Mode S/TCAS, Gray Bezel
4052190-905	Control Panel, Single Mode S-Single ATCRBS/TCAS, Gray Bezel
4052190-906	Control Panel, Dual Mode S/TCAS, Black Bezel
4052190-907	Control Panel, Single Mode S-Single ATCRBS/TCAS, Black Bezel
4052190-908	Control Panel, Dual Mode S/TCAS, Dark Gray Bezel
4052190-909	Control Panel, Single Mode S-Single ATCRBS/TCAS, Dark Gray Bezel
Gables Control Panels	
Gables G7130-02	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Black Bezel, Operates from +28 V dc aircraft power
Gables G7130-05	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Gray Bezel, Operates from +28 V dc aircraft power
Gables G7130-06	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Black Bezel, Extended Range (80, 120 Mi), Operates from +28 V dc aircraft power
Gables G7130-07	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Gray Bezel, Extended Range (80, 120 Mi), Operates from +28 V dc aircraft power
Gables G6990-XX	Control Panel, Dual Mode S/TCAS, Pushbutton 4096 code entry, Operates from 115 V ac aircraft power

Table 1-9: Control Panel Configurations (cont.)

Part Number	Description
Gables G6991-XX	Control Panel, Single Mode S-Single ATCRBS/TCAS, Pushbutton 4096 code entry, Operates from 115 V ac aircraft power
Gables G6992-XX	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Operates from 115 V ac aircraft power
Gables G6993-XX	Control Panel, Single Mode S-Single ATCRBS/TCAS, Rotary knob 4096 code entry, Operates from 115 V ac aircraft power
Gables G7490-XX	Control Panel, Flight ID, ATC, TCAS, Operates from 115 V ac aircraft power
Gables G7491-XX	Control Panel, Flight ID (Only), Operates from 115 V ac aircraft power
Gables G7130-02	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Black Bezel, Operates from +28 V dc aircraft power
Gables G7130-05	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Gray Bezel, Operates from +28 V dc aircraft power
Gables G7130-06	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Black Bezel, Extended Range (80, 120 Mi), Operates from +28 V dc aircraft power
Gables G7130-07	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Gray Bezel, Extended Range (80, 120 Mi), Operates from +28 V dc aircraft power
Gables G6990-XX	Control Panel, Dual Mode S/TCAS, Pushbutton 4096 code entry, Operates from 115 V ac aircraft power
Gables G6991-XX	Control Panel, Single Mode S-Single ATCRBS/TCAS, Pushbutton 4096 code entry, Operates from 115 V ac aircraft power
Gables G6992-XX	Control Panel, Dual Mode S/TCAS, Rotary knob 4096 code entry, Operates from 115 V ac aircraft power
Gables G6993-XX	Control Panel, Single Mode S-Single ATCRBS/TCAS, Rotary knob 4096 code entry, Operates from 115 V ac aircraft power
Gables G7490-XX	Control Panel, Flight ID, ATC, TCAS, Operates from 115 V ac aircraft power
Gables G7491-XX	Control Panel, Flight ID (Only), Operates from 115 V ac aircraft power

Table 1-10: ACSS VSI/TRA Display Configurations

VSI/TRA Part Number	Description
4067241-84X	The VSI/TRA Display provides continuous TCAS symbology and non-ARINC display control features: 6-, 14-, 40-mile ranges and above/normal/below display volumes. It has pin programmable altitude band, range, lighting curve, and VSI source selection.
-840	Gray bezel, 55-pin connector (contains bootstrap function)
-841	Black bezel, 55-pin connector (contains bootstrap function)
-842	Brown bezel, 55-pin connector (contains bootstrap function)
-843	Gray bezel, 41-pin connector
-844	Black bezel, 41-pin connector
-845	Brown bezel, 41-pin connector
4067241-86X	This VSI/TRA Display provides a single range default (6.0 miles), continuous or "POP-UP" TCAS symbology, and a test mode display. ARINC display control features include: 6-, 12-, 14-, 20-, and 40-mile ranges and above/normal/below display volumes. It has pin programmable VSI source selection, lighting curve, format mode, and traffic filter.
860	Gray bezel, 41-pin connector
861	Black bezel, 41-pin connector
862	Brown bezel, 41-pin connector
863	Gray bezel, 55-pin connector (contains bootstrap function)
864	Black bezel, 55-pin connector (contains bootstrap function)
865	Brown bezel, 55-pin connector (contains bootstrap function)
4067241-88X	This VSI/TRA Display provides a single range default (6.0 miles), continuous or "POP-UP" TCAS symbology, and a test mode display. ARINC display control features include: 6-, 12-, 14-, 20-, and 40-mile ranges and above/normal/below display volumes. It has pin programmable VSI source selection, lighting curve, format mode, traffic filter, and a 1.6-, 3.2-, 5.0-, or 6.4-sec time constants.
880	Gray bezel, 41-pin connector
881	Black bezel, 41-pin connector
882	Brown bezel, 41-pin connector
883	Gray bezel, 55-pin connector (contains bootstrap function)
884	Black bezel, 55-pin connector (contains bootstrap function)
885	Brown bezel, 55-pin connector (contains bootstrap function)

Table 1-10: ACSS VSI/TRA Display Configurations (cont.)

VSI/TRA Part Number	Description
4067241-89X	This VSI/TRA Display provides a single range default (6.0 miles), continuous or "POP-UP" TCAS symbology, and a test mode display. ARINC display control features include: 6-, 12-, 14-, 20-, and 40-mile ranges and above/normal/below display volumes. It has pin programmable VSI display (English/Metric) VSI source selection, format mode, traffic filter, and a 1.6-, 3.2-, 5.0-, or 6.4-sec time constants.
890	Gray bezel, 41-pin connector
891	Black bezel, 41-pin connector
892	Brown bezel, 41-pin connector
893	Gray bezel, 55-pin connector (contains bootstrap function)
894	Black bezel, 55-pin connector (contains bootstrap function)
895	Brown bezel, 55-pin connector (contains bootstrap function)

Table 1-11: Thales VSI-TCAS Display Configurations

Thales VSI-TCAS Part Number	Description
Thales VSI-TCAS	The Thales VSI-TCAS display provides continuous TCAS symbology and non-ARINC display control features: mile ranges and above/normal/below display volumes. It has pin programmable altitude band, range, lighting curve, and VSI source selection.
457400XXYYYY	XX = Hardware Version as defined in Table 1-12 YYYY = Software Version as defined in Table 1-12

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Table 1-12: Thales VSI-TCAS Display Part Numbers

PART NUMBER	HARDWARE VERSIONS															SOFTWARE VERSIONS						
457400	ES	GB	JB	HB	KB	PB	MB	RB	SB	TC	WB	FB	UB	ZB	LA	0012	0312	0712	0812	1901 [7]	2101 [6]	1502
	X											X					X					
		X														X				X		X
			X	X																X		
					X								X							X		
EXSITING P/Ns						X														X		X
							X											X				
								X	X										X			
										X	X			X	X					X		
														X						X		X
HARDWARE OPTIONS																						
BEZEL COLOR																						
GREY	X	X	X		X	X		X			X	X										
BLACK				X			X			X				X	X							
BROWN									X				X									
ELECTRICAL CONNECTOR																						
RECEPTACLE 41P6	X	X			X	X	X	X	X	X	X	X	X										
(MS83723 41 PN)			X	X										X	X							
PRESSURE BOSS																						
MS 33649-5	X	X	X	X			X	X	X	X	X	X	X	X	X							
QUICK DISCONNECT					X	X																
CONTROL BUTTONS																						
SELECT RANGE “RNG”	X	OPTIONS NOT AVAILABLE								X	X	X	OPTIONS NOT AVAILABLE									
SELECT RANGE “-“ and “+”								X	X													
Altitude Band “A/B”										X	X											
TCAS TRAFFIC DISPLAY																						
Full time/Part Time “ON/OFF”	X											X										
LIGHTNING FEATURES																						
Brightness fine adjustment	X																					
Specific night luminosity law						X									X							
NVG compatible														X	X							
POWER SUPPLY																						
115v-400Hz	X	X			X	X	X	X	X	X	X	X	X										
+28 V dc			X	X										X	X							
SOFTWARE OPTIONS																						
Traffic part/full sel via ARINC																X		X	X	X		X
Traffic part/full sel via button																	X					
Range via ARINC 6-12 NMI																X						

Table 1-12: Thales VSI-TCAS Display Part Numbers

PART NUMBER	HARDWARE VERSIONS															SOFTWARE VERSIONS						
Range via ARINC 3-5-10 NMI																						
Range via ARINC 6-12-24 NMI																						X
Range via ARINC 3, 5, 6, 10, 12, 14, 15, 20, 40, 80, 120 NMI																				X		
Range via button 6-12 NMI																	X		X			
Range via button 4-8-16 NMI																		X				
Range via ARINC 5-10-20 NMI																						X (1)
Range via ARINC 5, 6, 10, 12, 20, 40 NMI																				X (1)	X (1)	
ABV/NORN/BLW via ARINC																X	X	X		X	X	X
ABV/NORN/BLW via button																			X			
Absolute altitude via ARINC																X		X	X	X		X
Vertical Speed in metric units (M/S)																					X	
TCAS Extended Test normal																X	X	X	X	X		X
TCAS Extended Test normal + text display mode																				X	X	
Specific Symbology																(2)		(3)	(4)			(5)

Note	[1]	Only when instrument is pin-programmed for operation in TCAS TRAFFIC DISPLAY only
	[2]	Specific symbology for “don’t climb” and “don’t descend” RA’s, V/S failure with background instead of yellow
	[3]	V/S pointer shorter and thicker. Traffic range version 8 NMI when in TCAS self-test.
	[4]	ABV (above) or BLW (below) message on the display when one of these modes are selected by A/B push-button on bezel
	[5]	This version is only for TCAS 1 operation (no RA DISPLAY, TCAS validity discrete output is relative to Traffic instead of RA, No ABV/BLW message displayed
	[6]	Dedicated software for ACSS (formerly Honeywell)
	[7]	This SW version replaces the previous version “1311”, “1312”, “0911”, “1100” and “2000”

3. System Description

The T3CAS is a safety system that combines TCAS, Terrain Awareness and Warning System (TAWS), ADS-B IN and OUT and a Mode S Transponder in a single LRU. The following briefly describes the functions in each T3CAS Type Designation. Refer to Table 1-2 for TSO compliance.

A. T3CAS Functionality by Type Designation

(1) T3CAS Standard 1, Standard 1.1, Standard 1.2, Standard 1.3, and Standard 2

TCAS II

The TCAS function is an onboard advisory system designed as a last resort method of preventing midair collisions or near-midair collisions between aircraft. By computing the closure rate and altitude of all transponder equipped aircraft in the surrounding airspace, the TCAS can anticipate a potential midair collision before it has a chance to occur.

TAWS/GPWS

The TAWS function within T3CAS features an innovative design aimed at preventing CFIT (Controlled Flight Into Terrain) accidents by providing timely aircrew alerts. The alerts are based upon predicted terrain clearance profiles calculated with present aircraft climb capabilities. This represents a significant advance in capability from the present Ground Proximity Warning System (GPWS) technology, and a significant improvement in CFIT safety margins over existing Terrain Awareness and Warning System (TAWS) designs:

- By providing warnings based on remaining time before pilot response is required and not based on remaining time to terrain impact
- By covering more operational situations
- By drastically reducing nuisance alerts.

As another optional part of the TAWS system, T3CAS incorporates an obstacle database in addition to the terrain database for additional safety and awareness.

T3CAS also integrates an Eleview function as an optional part of the TAWS system to display main terrain when above the hazard display altitude. Eleview incorporates a pair of three-digit MSL elevation numbers, additional green contours and water depiction (on displays supporting cyan). The top three-digit elevation numbers respresent the highest colored and textured terrain and the bottom respresent the lowest colored and textured terrain.

Transponder

The T3CAS Mode S Data Link Transponder function supplies surveillance functions to both ground-based and airborne interrogators and communication functions to onboard systems. The transponder also contains Mode S Specific functions, which are dedicated links directly to onboard systems. The transponder can be upgraded to supply an internal ADLP function. The T3CAS Transponder conforms to the ARINC 718A Mode S Transponder Characteristic for function. The T3CAS Transponder is fully compliant with the Mode S Elementary and Enhanced Surveillance (ELS/EHS) selective interrogation requirements. The transponder reports ELS Flight Identification as well as Aircraft Intent (BDS 4,0 - Selected Altitude), Track and Turn Report (BDS 5,0 - Roll Angle, True Track Angle, Groundspeed, Track Angle Rate, and True Airspeed), and Speed and Heading Report (BDS 6,0 - Magnetic Heading, Indicated Airspeed, Mach Number, Baro Altitude Rate, and Inertial Vertical Velocity).

ADS-B IN

The TCAS also includes the ADS-B IN subfunction. The ADS-B function accepts and decodes several types of ADS-B messages. The ADS-B message types that are supported include: Flight Identification, Surface and Airborne Position, Airborne Velocity, Target State and Status, and Aircraft Operational Status.

The ADS-B function receives traffic information from the 1090 MHz squitters (ADS-B messages) and outputs a traffic report for the aircraft within the receiver area. The function is a part of the ATSAW functionality and is performing the underlying tracking of targets and the correlation of ADS-B and TCAS data.

The output of the ADS-B function is a graphical Display Traffic Information File (DTIF) as well as an MCDU list of traffic within receiver range and within a maximum number of traffic limits. This information forms the base for the higher-level ADS-B function of In-Trail Procedures (ITP).

ADS-B OUT

The T3CAS transponder performs the Automatic Dependent Surveillance-Broadcast (ADS-B) OUT function. This function transmits aircraft position (latitude and longitude), velocity, integrity and other parameters. The T3CAS transponder will automatically (no external stimulus required) transmit this information based upon onboard navigation without knowledge of which users are receiving its broadcast.

(2) T3CAS Release 2

The T3CAS Release 2 contains the same TSO functionality as Standard 2 including the following enhancements:

TCAS

The T3CAS Release 2 TCAS function has been updated to incorporate the hybrid surveillance function. The hybrid surveillance function will be compliant to the DO-300A definition of hybrid surveillance.

Windshear

As an optional part of the TAWS system, T3CAS Release 2 incorporates a Reactive Windshear feature as part of its basic functionality. The Reactive Windshear function monitors wind factors that affect aircraft performance on both take-off and landing approach, in order to identify the presence of a severe low-level, downburst/microburst-type windshear.

(3) Non-TSO Functions for Standard 1, 1.1, 1.2, 1.3, & 2 only

This section is applicable to Standard 1, Standard 1.1, Standard 1.2, Standard 1.3, and Standard 2 only.

The non-TSO functions defined in this section are not part of the TSO approval. Separate aircraft level regulatory approval is required to enable these optional non-TSO functions.

These non-TSO functions do not interfere with the T3CAS' compliance to the requirements of any TSO authorization.

The software, hardware and environmental qualification levels for these non-TSO functions do not differ from the TSO functions of the T3CAS.

Airborne Surveillance and Separation Assurance Processing (ASSAP)

The ASSAP Application performs the following functionality:

- ADS-B Tracking - Identify and track ADS-B equipped Aircraft / Vehicles.
- TIS-B Tracking - Identify and track Aircraft / Vehicles by means of received TIS-B reports.
- Track Correlation - Associates tracks from different surveillance sources that relate to the same Aircraft / Vehicles.
- Best Track Selection - For correlated tracks, selection is performed based on specific criteria for the particular cross-reference type.
- Alert Consolidation and Display Track Selection - Traffic alerts received from Aircraft Surveillance Applications and TCAS are prioritized by source and consolidated into the tracks.

In-Trail Procedures (ITP)

The ITP application enables the flight crew to conduct desired Flight Level changes on a more frequent basis by conducting ITP climbs, thus improving flight efficiency and/or flight safety while maintaining safe separation from other aircraft.

Installation and operation of the non-TSO functions.

Installation and activation of these non-TSO functions will typically require additional aircraft certification and operational approval from your certification authority. Please contact ACSS for additional details.

(4) T3CAS Failure Classifications

The following table summarizes the failure classification of each T3CAS function and the rigor that the T3CAS was developed to support (which in some cases exceeds the requirements):

Table 1-13: T3CAS Failure Classification

Function No.	Function Description	Hazard Classification	T3CAS Development Level/Rigor
1	TCAS: Incorrect Resolution Advisory	Hazardous AC20-151A	Hazardous
2	Transponder Mode S Operation: Incorrect Transponder Response to SSR	Major TSO-C112/112d	Hazardous
3	Transponder to TCAS Coordination: Incorrect Transponder Response to TCAS Interrogation	Hazardous	Hazardous
4	Windshear Detection: Un-annunciated loss of false annunciation of reactive windshear alert	Major AC25-12	Major
5	TAWS/GPWS: Un-annunciated failure, hazardously misleading information (HMI), and false alerts.	Major AC25-23	Major
6	ADSB-OUT: Incorrect Transponder ADS-B Message Output	Major AC20-165A	Hazardous
7	ADS-B IN: Corruption of ADS-B IN Reports	Major	Hazardous
8	ADS-B IN: Incorrect Display of Traffic (AIRB/VSA)	Major	Hazardous
9	ADS-B IN, ITP: Incorrect ITP Distance	Major	Hazardous

NOTE1: Hazards with classifications less than Major are not listed in this table.
NOTE2: Due to the above Hazard Classifications, the T3CAS software was developed to RTCA DO-178B Design Assurance Levels C (Major) and B (Hazardous) as indicated above.
NOTE3: Due to the above Hazard Classifications, the T3CAS airborne electronic hardware was developed to RTCA DO-254 Design Assurance Level B (Hazardous).

B. System Functional Description

(1) TCAS Functional Description

Situational awareness is provided to the flight crew by aiding in visually acquiring intruding aircraft and discriminating between the intruding aircraft, threat aircraft, and other traffic in the airspace.

Vertical guidance to avoid midair collisions is accomplished by interrogating the Mode A, Mode C, and Mode S transponders of potential threat aircraft, tracking their responses, and providing advisories to the flight crew to assure vertical separation.

The first two levels of situational awareness include:

- Non-threat Traffic, indicates other targets within the range of the display whose relative altitude is greater than ±1200 feet (365.76 meters) vertically or a distance greater than six nautical miles from own aircraft.
- Proximity Traffic, indicates the target is within ±1200 feet (365.76 meters) vertically or within six nautical miles of own aircraft.

The two levels of advisories include:

- Traffic advisories (TA) indicate the range, bearing, and relative altitude of the intruder to aid in visual acquisition of the intruder.
- Resolution advisories (RA) indicate a vertical maneuver to be performed or avoided in order to assure safe separation.

Traffic advisories can be displayed on a Vertical Speed Indicator/Traffic and Resolution Advisory (VSI/TRA) display, Electronic Flight Instrument System (EFIS) or any instrument that displays the appropriate symbology and conforms to the definition of ARINC Characteristic 735b.

Resolution advisories can be displayed on the VSI/TRA display, EFIS or any other indicator that displays the appropriate symbology and conforms to the definition of ARINC Characteristic 735b.

Figure 1-1 shows the various types of intruder equipment and the resulting advisories. It should be noted that Mode A equipped intruders result in detection and display of TAs only. An intruder not equipped with a transponder is invisible to TCAS.

Communication with another TCAS-equipped aircraft is provided by the embedded diversity Mode S transponder or an external onboard diversity Mode S transponder. Only one onboard Mode S transponder is required for T3CAS operation. However, the ACSS T3CAS operates with either of two onboard Mode S transponders, one of which operates as a spare. The transponder in use is selectable from the Flight Deck. Figure 1-2 shows the communication between two TCAS equipped aircraft. Configuration A shows communication between a T3CAS with the embedded transponder and another aircraft. Configuration B shows communication between a T3CAS with an external transponder and another aircraft.

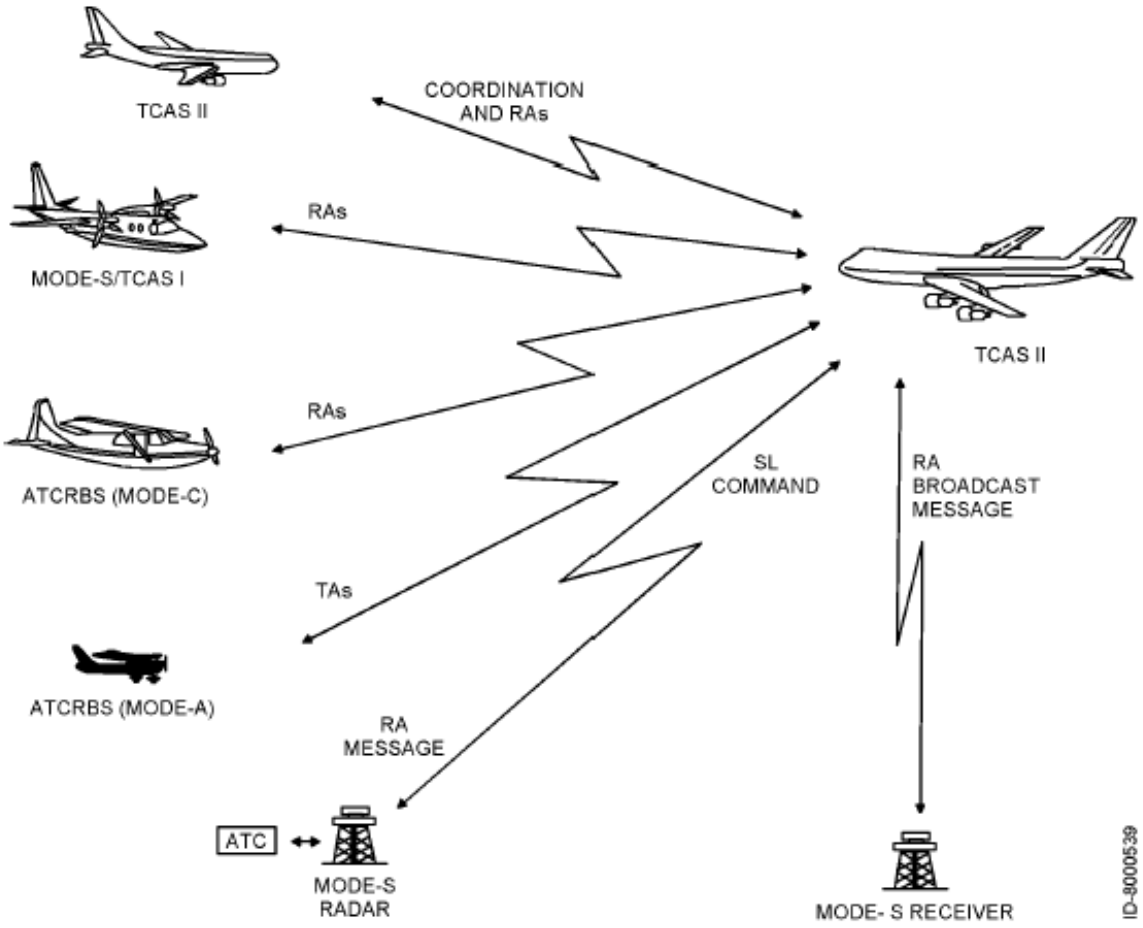

Figure 1-1: TCAS Advisory Capabilities

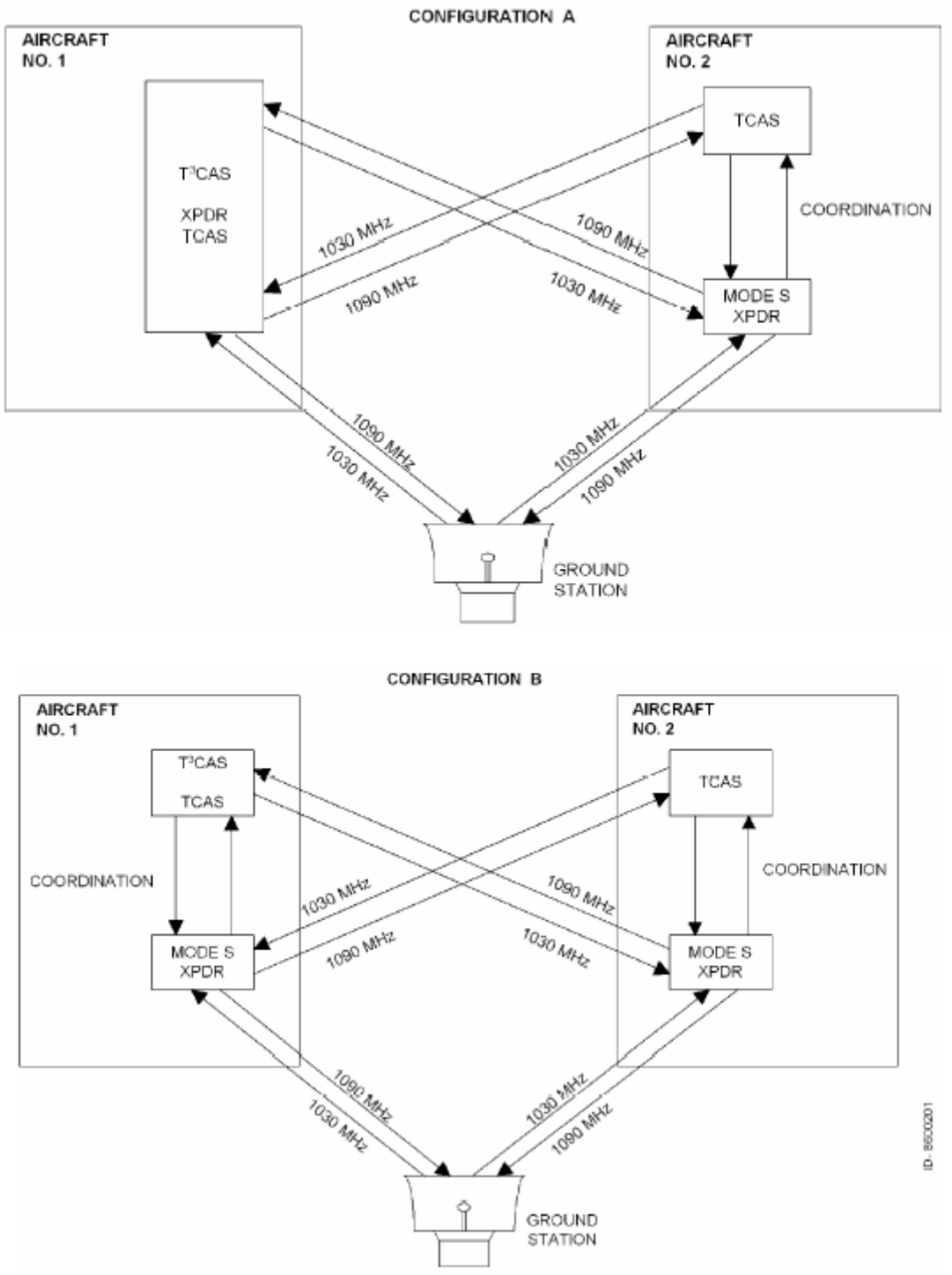

Figure 1-2: TCAS/Mode S Communication

The TCAS function generates both RAs and TAs when the TA/RA mode is selected. The two types of advisories correspond to time-based protection zones around the aircraft. The airspace around the TCAS aircraft where an RA is annunciated represents the warning area, while the larger airspace which results in a TA being annunciated is the caution area. Figure 1-3 contrasts the airspace covered by the two types of advisories.

The onboard equipment listed below must be linked to the TCAS function as shown in Figure 1-4.

- Mode S transponder with associated antennas
- Radio altimeter
- Air Data Computer (ADC) (digital or analog). If an ADC does not support vertical speed rate data, the static line can be run directly into the Thales VSI-TCAS.
- ATC/TCAS control panel. A separate control panel is not the only method of control for the TCAS. Other components, such as a Radio Management Unit (RMU) can be used.
- Antenna. The TCAS function accepts two types of bottom antennas: A standard directional antenna or an optional ATC-type omnidirectional antenna. If an omnidirectional antenna is installed, it must be supplied by the installer. If a directional antenna is installed at both top and bottom antenna locations, a bottom omnidirectional antenna is not needed.

NOTE: T3CAS LRU Part Numbers 9005000-10000, -10101, -10202, and -10204 do not support a bottom omnidirectional antenna.

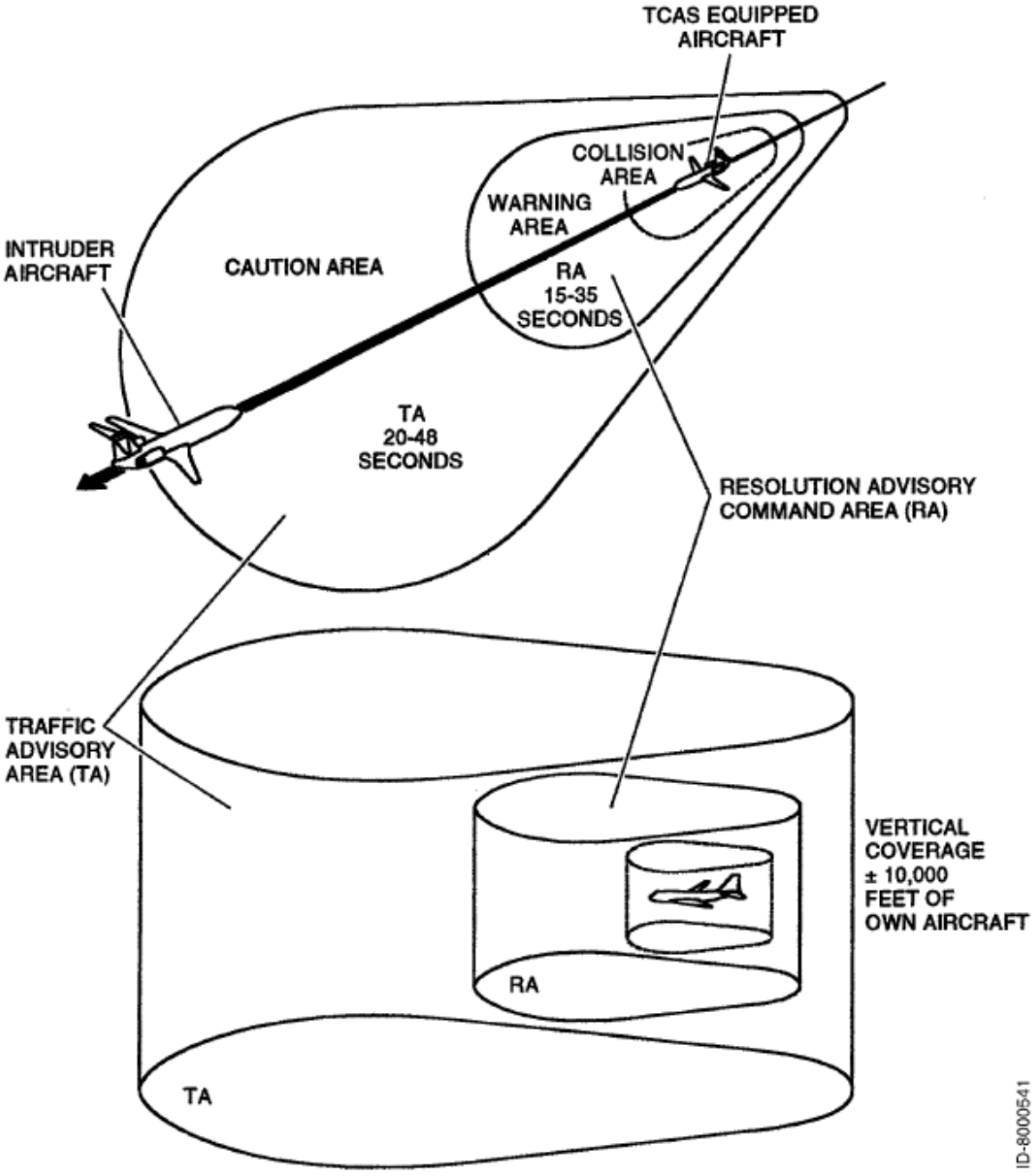

Figure 1-3: TA/RA Airspace Coverage

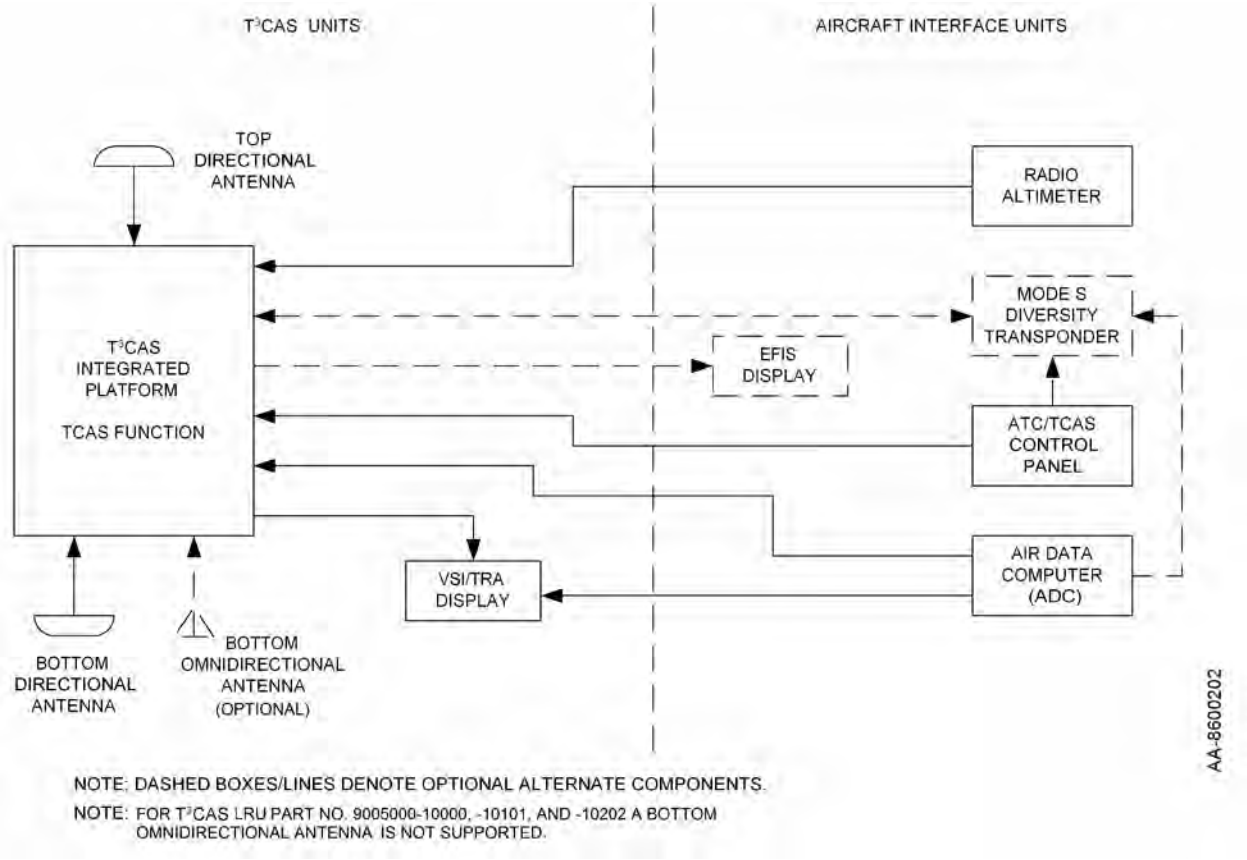

Figure 1-4: Basic TCAS Installation

(2) TAWS Functional Description

The T3CAS TAWS function provides guidance to prevent Controlled Flight Into Terrain (CFIT). This is accomplished by using vertical speed, ground speed, track angle, flight path angle, latitude, longitude, flap status, steep approach status, static air temperature, roll angle, pressure altitude and radio altitude inputs along with a built-in database for determination of alerts and display of terrain information.

The following advanced functional capabilities are featured in the T3CAS TAWS function.

(a) Collision Prediction and Alerting (CPA) Mode

This mode provides medium-term (caution) and short-term (warning) alerts when the predicted flight path will bring the aircraft dangerously close to nearby terrain (and when enabled, Obstacles). When operative, CPA conditionally replaces RTCA DO-161A reactive Mode 2 since it offers superior safety margins for CFIT prevention due to its predictive capabilities.

T3CAS uses data provided by the Flight Management Computer, the GPS receiver, and other aircraft subsystems to predict a 3-D flight path based upon a curve-fit extrapolation of the most recent position and velocity data received. This predicted flight path is then compared with the internal terrain map of the immediate area and an assessment of the potential threat of aircraft collision with terrain is computed by the Collision Prediction and Alerting (CPA) algorithm.

(b) The Premature Descent alert (PDA)

The Premature Decent Alert is based on the forward-looking Collision Prediction and Alerting (CPA) sensor. If the CPA sensor contacts a terrain cell plus the Minimum Terrain Clearance Distance (MTCD), then a comparison is performed. If a 0.25-g level-off maneuver is sufficient to clear the conflicting terrain, then the PDA alert ”Too Low Terrain” is annunciated and the Caution Alert Lamp will be activated. Otherwise, the corresponding CPA alert is annunciated. Therefore, since this alert is based off of the CPA sensor, any conditions that result in an outage of the CPA function will also result in the PDA alert being inactive.

(c) Conventional GPWS Modes of Operation

1 Mode 1: Excessive rate of descent with respect to terrain

T3CAS meets the requirement for Mode 1 alerts as defined in RTCA DO-161A. This mode provides not only a reactive short-term warning as defined in RTCA DO-161A, but also a reactive medium-term caution when the current flight path is descending toward the terrain ahead of the aircraft at an excessive rate.

2 Mode 2: Excessive closure rate to terrain

T3CAS meets the requirement for Mode 2 alerts as defined in RTCA DO-161A. This mode provides a reactive short-term warning as defined in RTCA DO-161A when the current flight path and the terrain ahead of the aircraft are closing at an excessive rate. When the CPA function is active, Mode 2 is conditionally activated when a Terrain Cell in the Terrain Database is detected to be significantly low. This can be due to a vertical error, horizontal error or terrain database error. This detection occurs if the difference between MSL Altitude and Radio Altitude is appreciably larger than the Terrain Cell Height in the Terrain DB. This detection is only calculated when Radio altitude is less than 2500 feet (762 meters).

3 Mode 3: Excessive altitude loss after take-off

T3CAS meets the requirement for Mode 3 alerts as defined in RTCA DO-161A. This mode provides an alert when there is a loss of altitude after take-off or during a missed approach. The mode uses the radar altimeter to determine proximity to the ground and the barometric altimeter to determine altitude loss. If an excessive loss of altitude occurs after take-off, a warning is issued.

4 Mode 4: Incorrect aircraft configuration with regard to terrain

T3CAS meets the requirement for Mode 4 alerts as defined in RTCA DO-161A. Mode 4 usually applies during the landing phase of flight and results in the annunciation of an alert in the event of insufficient terrain clearance when the aircraft is not in the proper landing configuration. Mode 4 consists of the following two submodes:

- Mode 4A, when the landing gear is up
- Mode 4B, when the landing gear is down, but the flaps are not in landing configuration.

5 Mode 5: Excessive glide path deviation

T3CAS meets the requirement for Mode 5 alerts as defined in RTCA DO-161A. Mode 5 applies in the event of an excessive descent below the instrument glide path when making a front-course approach with the gear down. In a back-course landing configuration, Mode 5 is automatically inhibited.

When Localizer Performance with Vertical guidance (LPV) data is provided to the T3CAS unit in the same format as the ILS Glideslope Deviation data, LPV Mode 5 operation is supported by T3CAS. Coordinate with ACSS regarding the LPV data format sourced by the T3CAS interfacing equipment installed on the aircraft to determine if the input format can be supported by the T3CAS unit.

6 Call-outs and excessive bank angle

As defined in RTCA DO-161A, T3CAS produces call-outs and alerts for descent below a set of predefined altitudes and for excessive bank angle.

(d) Terrain Display

The T3CAS TAWS function provides two outputs to ARINC 708A compatible displays to provide terrain-related information to the crew through the weather radar or EFIS displays in order to enhance flight crew situational awareness. When no threat is perceived, the TAWS display shows with different levels of colors, the height of the surrounding terrain relative to the aircraft altitude and takes into account the aircraft flight path angle. Upon detection of a potential CFIT threat, the terrain texture is modified on the terrain map in order to identify the location and level (caution/warning) of the threat.

(e) Reactive Windshear (RWS)

NOTE: The FMO “Windshear Enable” and the TAWS function must be enabled in order for the RWS function to activate. TAWS is enabled via program pin RTP-11H.

T3CAS may optionally incorporate a Reactive Windshear feature as part of its basic functionality. The reactive Windshear Warning algorithm continuously monitors wind factors that affect aircraft performance on

both take-off and landing approach, in order to identify the presence of a severe low-level, downburst/microburst-type windshear.

If these wind factors cause aircraft performance to decrease to a predetermined level, an audio warning is sounded, indicating to the crew that the aircraft net performance capability is deteriorating and rapidly approaching a critical state. In addition to the warning, the Windshear Warning algorithm provides a caution when an increasing-performance Windshear is detected, thus giving advance warning of decreasing-performance windshear.

(f) Low RNP (Required Navigation Performance) Capability

Terrain based Low RNP (not traffic based) requires the use of a qualified ARINC 743/743A GPS source. TAWS is capable of supporting LOW RNP routes providing high precision lateral and vertical navigation on airports located on mountainous regions. Please consult ACSS with specific routes to be flown.

(g) Runway Selection Function

Applicable to part number 9005000-11203, the T3CAS provides information related to the assumed landing runway on the ARINC 429 output bus. Refer to the applicable Interface Control Document (ICD) for corresponding labels. The determination of which runway is the assumed landing runway is based on aircraft trajectory and proximity to the runway. The data transmitted includes information about the runway itself (elevation, slope, landing distance available, etc.) as well as the aircraft's proximity to the runway threshold (lateral distance, longitudinal distance and height above the runway). The Runway Selection outputs from T3CAS are used by an aircraft-level function.

(3) Mode S Transponder Functional Description

(a) Radio Frequency (RF) Transmitter and Receiver

The T3CAS Mode S Data Link Transponder receives interrogations on 1030 MHz, and transmits replies to interrogations on 1090 MHz. The transponder has antenna diversity, which means it has two RF antenna ports connected to antennas on the top and bottom of the aircraft. When an interrogation is received, the transponder monitors the signal on the top and bottom antenna ports, and chooses the best port, based on signal strength and time of arrival. The transponder then replies to the interrogation on the port that contained the best interrogation. The transponder contains two independent RF receiver channels, which allow both top and bottom interrogations to be monitored simultaneously.

The T3CAS Transponder also contains data link capability, which lets it receive COMM-A (UF=20/21) uplink messages and COMM-C (UF=24, 16 Segment) Uplink Extended Length Messages (UELM).

The T3CAS Transponder can transmit COMM-B (DF=20/21) downlink messages and COMM-D (DF=24, 16 Segment) Downlink Extended Length Messages (DELM). The transmitter has the capability of transmitting sets of 16 segment DELMs at a rate of eight per second.

Depending on the transponder in use by the T3CAS system, COMM-D may be supported.

(b) ADLP Interface and ADLP Function

The initial implementation of the T3CAS Transponder function is a Level 3 transponder according to the definitions in DO-181A and ICAO Annex 10. It can process COMM-A/B/C Data Link messages and it interfaces to an external Mode S Airborne Data Link Processor (ADLP), which is defined functionally by RTCA DO-218. The T3CAS Transponder function contains four high-speed ARINC 429 data busses, a COMM-A/B Input and Output Bus, and a COMM-C Input and Output Bus. COMM-A Data received by the transponder in an interrogation are transferred to the ADLP on the COMM-A/B data bus; COMM-B data received from the ADLP are transmitted in replies to interrogations. In a similar manner, COMM-C data received by the transponder in an UELM interrogation are transferred to the ADLP on the COMM-C data bus.

There are certain XS-950 part numbers that support Level-4 functions. These can process COMM-A/B Data Link messages and interface to an external Mode S ADLP to process COMM-C/D Data Link messages, which is defined functionally by RTCA DO-218. The XS-950 transponder contains four high-speed ARINC 428 Data Busses, a COMM-A/B Input and Output Bus, and a COMM-C/D Input and Output Bus. COMM-A Data received by the transponder in an interrogation is transferred to the ADLP on the CMM-A/B data bus; COMM-B data received from the ADLP is transmitted in replies to interrogations. In a similar manner, COMM-C Data received by the transponder in an UELM interrogation is transferred to the ADLP on the COMM-C/D data bus; COMM-D data received from the ADLP is transmitted in a DELM reply to an interrogation.

NOTE: COMM-D functionality is not supported by Level 3 transponders.

NOTE: XS-950 transponders which are DO-181E-compatible are Level 3 transponders per the definitions in DO-181E and ICAO Annex 10.

(c) Altimeter Interface

The T3CAS Transponder function can accept non-corrected pressure altitude inputs from air data systems. The transponder has an interface for ARINC 429 Air Data and ARINC 575 Air Data Systems. The transponder contains two independent inputs for each source and a discrete input for source selection.

(d) Controller Interface

The T3CAS Transponder function is controlled from a standard Mode S or Mode S/TCAS control panel through an ARINC 429 input data bus and discrete inputs and outputs. The control panel interface is defined in ARINC 718. However, several variations exist for different customers

and airlines. The T3CAS Transponder function interfaces to all commonly used Mode S and Mode S/TCAS control panels.

The T3CAS Transponder function has a dedicated low-speed ARINC 429 data input for receiving the Aircraft Identification Subfield (AIS) Flight Identification from another aircraft system (i.e., a Flight Management System [FMS] or Onboard Maintenance System [OMS]). The flight ID can also be received on DAPS busses (high- or low-speed) or from the control panel on the control data bus (low-speed). The flight identification can be the aircraft flight number or tail number.

(e) Discrete Interfaces and Configuration Interfaces

The T3CAS Transponder function has discrete inputs for configuration and control of Mode S Transponder functions and interfaces, and discrete outputs for annunciating transponder status information. The T3CAS Transponder function implements the discrete inputs and outputs defined by ARINC 718. The input/output discretes default to an open state when power is removed.

(f) Maintenance Computer Interface

The T3CAS Transponder function has a maintenance computer interface that allows maintenance and test data and histories to be obtained from the unit while it is installed in an aircraft. The transponder interfaces with maintenance systems for all major airframes via low-speed ARINC 429 input and output data busses.

(g) Navigation Data ARINC 429 Interface

The T3CAS Transponder function has ARINC 429 input bus circuitry for extended squitter and enhanced DAPS capability. The transponder meets ELS/EHS requirements.

C. System Configurations

The T3CAS may be installed in different aircraft configurations depending on the current TCAS, TAWS/RWS and Transponder equipment installed on the aircraft. The T3CAS uses an Airplane Personality Module (APM) or embedded AAA to hold aircraft specific configuration data. The APM is used in place of program pin inputs to provide system configuration. An Aircraft Specific Database (ASDB) provides the aircraft specific interface requirements for the T3CAS System and is loaded into the APM at the time of system installation. The following table shows the core T3CAS configurable functions:

Table 1-14: T3CAS Configurable Functions

Function	State Definition
TCAS	TCAS is always enabled. Hybrid surveillance (applicable to -11801 and -55801) requires pin RMP-5E be enabled.
TAWS	The TAWS function can be activated or deactivated via program pin RTP-11H. Refer to SDIM Section 4.
Obstacles	The Obstacle function can be activated via program pin RTP-11F. It also requires that TAWS is enabled and a valid Obstacle Database to be loaded on the T3CAS LRU. Refer to SDIM Section 4.
Eleview	The Eleview function can be activated via program pin RTP-11C. It also requires that TAWS is enabled. Refer to SDIM Section 4.
RWS	The RWS function can be activated via a Factory Modifiable Option (FMO). The FMO file is a component of the ASDB or embedded AAA and is customized by the supplier. It also requires that TAWS is enabled. Applicable to -11801 and -55801.
Embedded Transponder	The embedded transponder function can be activated or deactivated via program pin RTP-11H. Refer to SDIM Section 4.
ADS-B IN	The ADS-B IN function can be activated or deactivated via the program pin RMP-5E ADS-B/DTIF Enable. Refer to SDIM Section 4, sub-section 2 T3CAS Interface Description. ADS-B IN provides EVaq; additional ADS-B IN functions are activated separately.
ADS-B IN Applications	In Trail Procedures application may be activated or deactivated via the program pin RBP-2A ITP Enable for 9005000-10000, -10101, -10202, -10204, and -11203. Refer to SDIM Section 4, Table 4-42 In-Trail Procedures Enable/Disable Configuration. The ADS-B IN function must be activated prior to the activation of any specific ADS-B IN applications.

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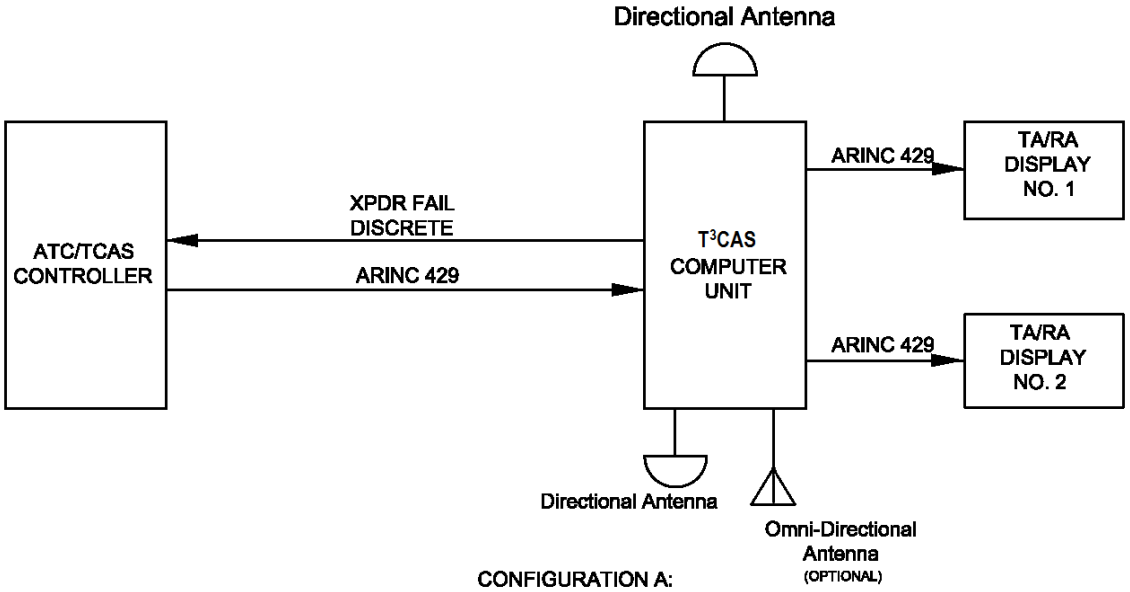
For a detailed explanation of how to activate or de-activate all of the T3CAS functions using configurable and non-configurable program pins, configuration options and ASDBs, refer to SDIM Section 4, sub-section 3 TAWS/RWS and Transponder Specifications.

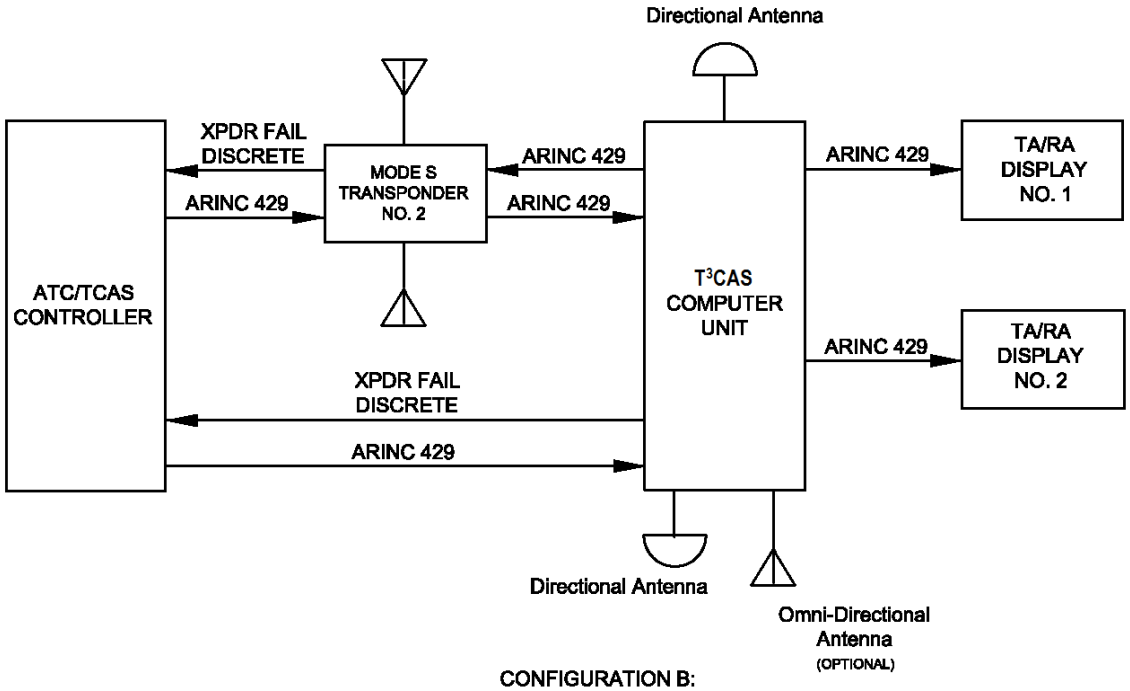
The T3CAS unit's TCAS function may be installed in several different configurations depending on the transponders used and the choice of antennas and displays. Some typical configurations are shown in Figure 1-5. Other combinations are feasible. Figure 1-5 shows the signals and overall interconnects for a typical T3CAS installation with dual transponders.

- Configuration A shows the TCAS function using only the embedded Mode S transponder.
- Configuration B shows the TCAS function linked to a single external transponder Mode S transponder system as the secondary along with the embedded Mode S transponder as the primary.
- Configuration C shows the TCAS function linked to a single external transponder Mode S transponder system as the primary along with the embedded Mode S transponder as the secondary.
- Configuration D shows the TCAS function linked to two external Mode S transponders. The system may operate with either transponder depending on the control panel selection. The second transponder acts as a backup.

Figure 1-6 illustrates a typical aircraft installation of the T3CAS. The system is designed as an integrated safety solution, available as a replacement to the existing TCAS 2000, 3000, SafeRoute Surveillance Processor, or T2CAS LRUs. Figure 1-7 is a TCAS Function System block diagram.



CONFIGURATION A:
T3CAS INSTALLATION WITH INTERNAL MODE S TRANSPONDER ACTIVE

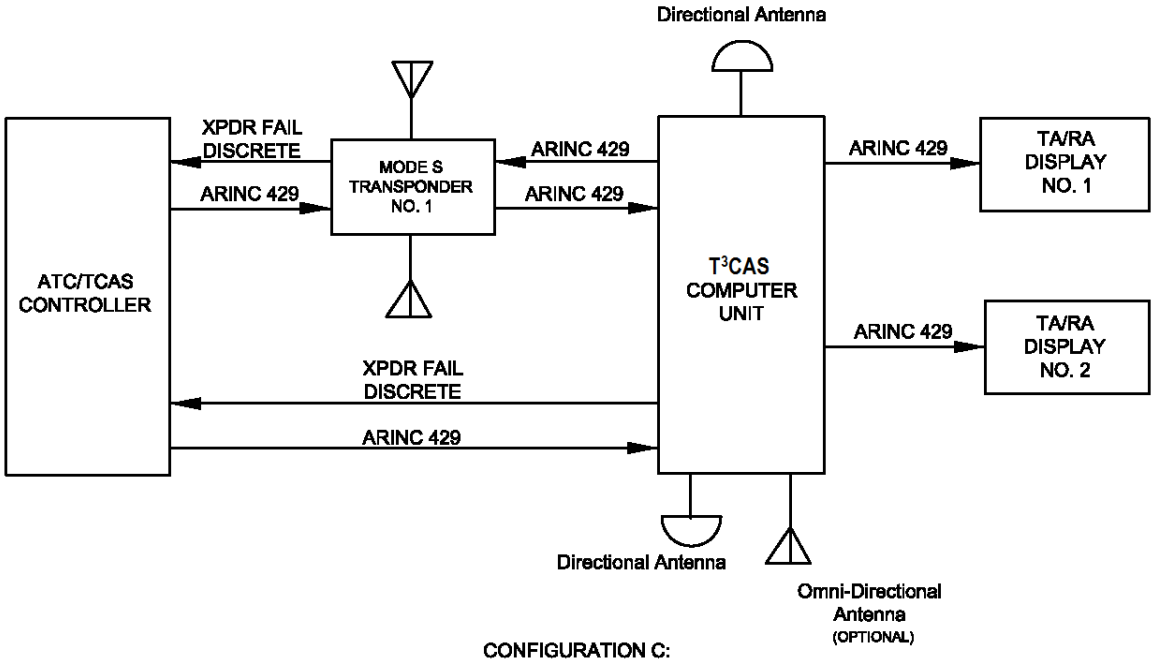


CONFIGURATION B:
T3CAS INSTALLATION WITH INTERNAL MODE S TRANSPONDER PRIMARY
AND EXTERNAL MODE S TRANSPONDER SECONDARY

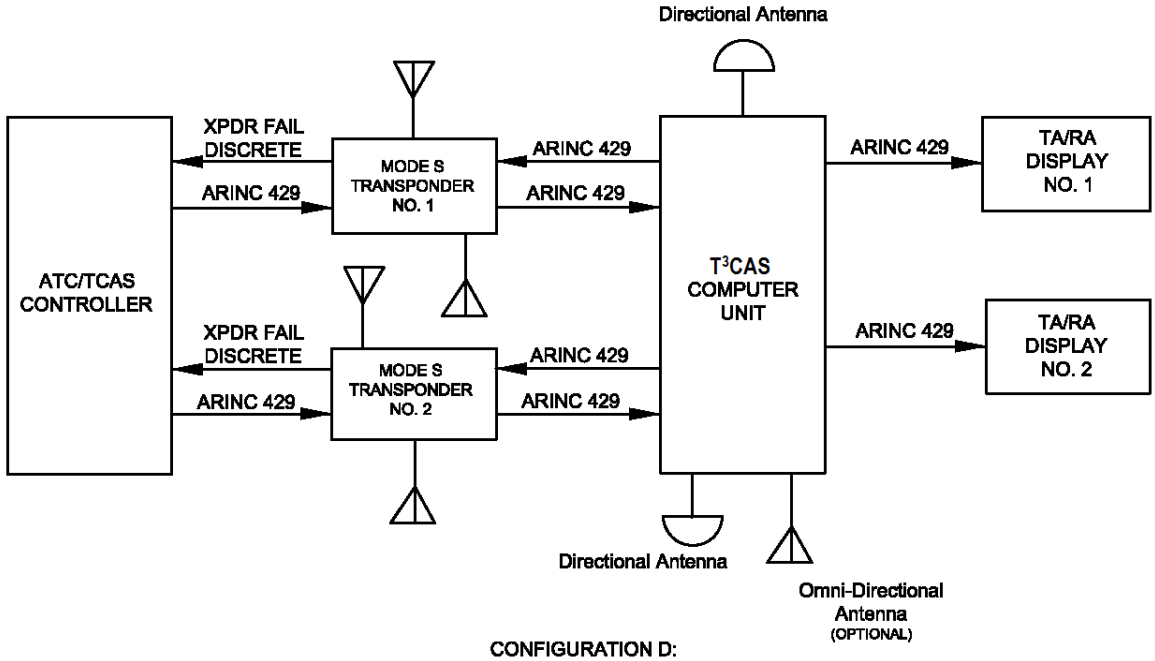
NOTE: FOR T3CAS LRU PART NO. 9005000-10000, -10101, AND -10202
A BOTTOM OMNIDIRECTIONAL ANTENNA IS NOT SUPPORTED.

AA9005000-5-1-SD-1

Figure 1-5: (Sheet 1) Typical System Configurations



CONFIGURATION C:
T3CAS INSTALLATION WITH INTERNAL MODE S TRANSPONDER SECONDARY
AND EXTERNAL MODE S TRANSPONDER PRIMARY



CONFIGURATION D:
T3CAS INSTALLATION WITH NO INTERNAL MODE S TRANSPONDER
AND 2 EXTERNAL MODE S TRANSPONDERS

NOTE: FOR T3CAS LRU PART NO. 9005000-10000, -10101, -10202,
A BOTTOM OMNIDIRECTIONAL ANTENNA IS NOT SUPPORTED.

AA9005000-5-2-SD-1

Figure 1-5: (Sheet 2) Typical System Configurations

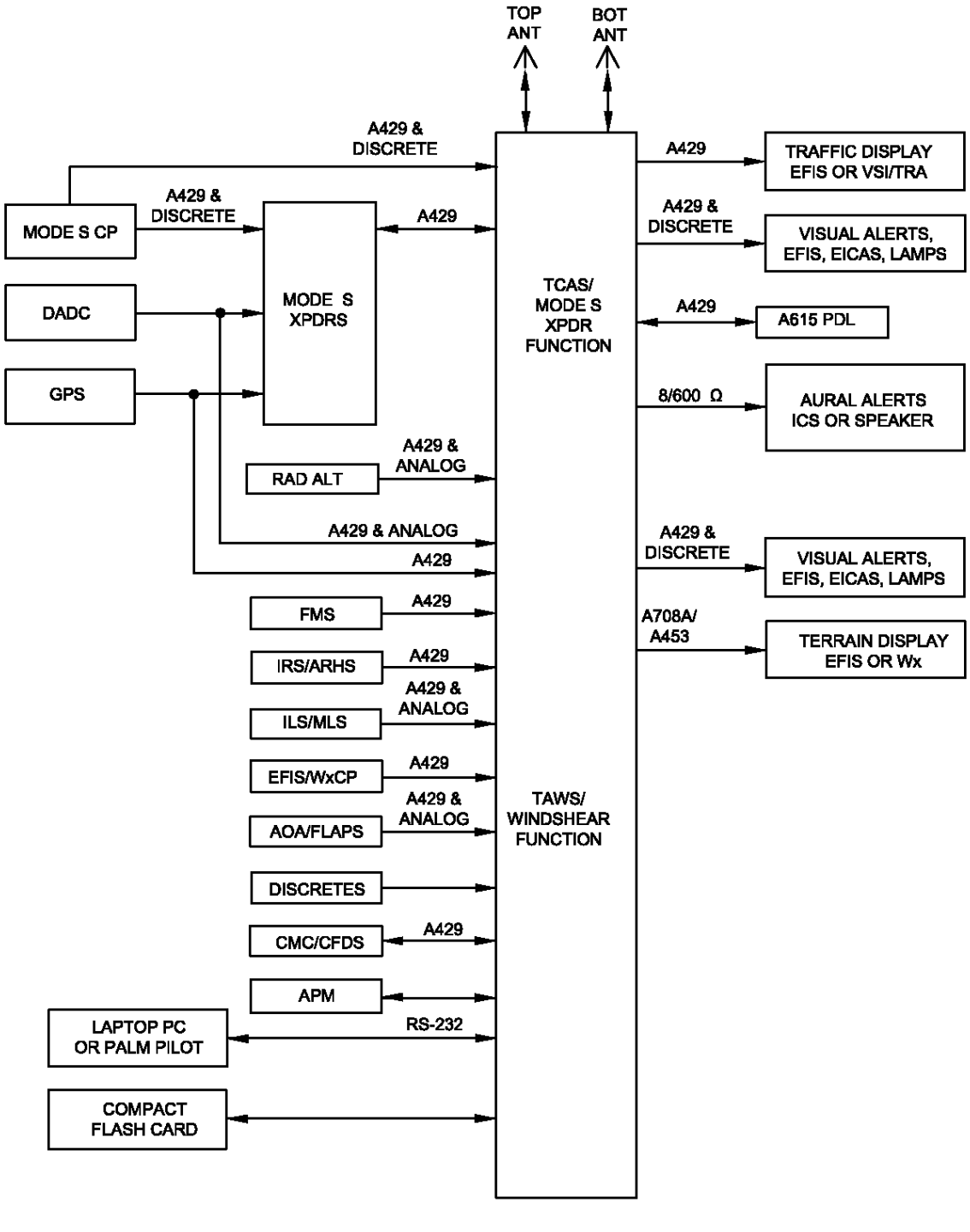
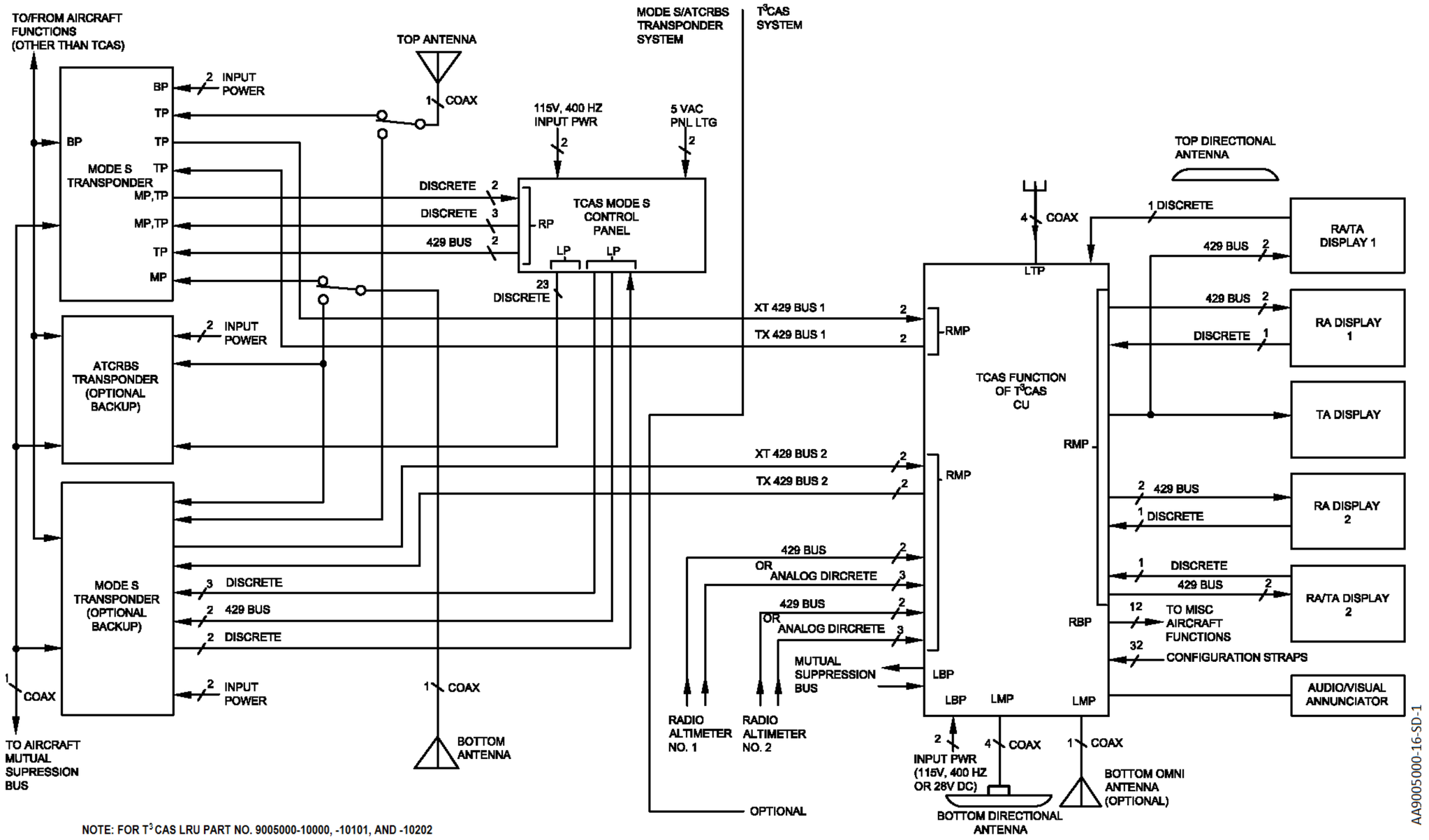


Figure 1-6: T3CAS System Aircraft Interface



NOTE: FOR T3 CAS LRU PART NO. 9005000-10000, -10101, AND -10202
A BOTTOM OMNIDIRECTIONAL ANTENNA IS NOT SUPPORTED.

Figure 1-7: TCAS Function System Block Diagram

4. Component Descriptions

A. T3CAS Computer Unit

The TCAS function contains the RF transmitter and the receivers necessary to interrogate and receive replies from other transponder equipped aircraft. Surveillance and collision avoidance algorithms determine whether an intruder aircraft should be considered a threat and then determine the appropriate vertical response to avoid a midair or near midair collision. In addition, output data is provided to drive displays that inform the flight crew what action to take or avoid.

The TCAS function also provides an interface to the onboard Mode S transponder in order to communicate with other TCAS II equipped aircraft in the airspace.

The TAWS/RWS function consists primarily of the Ground Collision Avoidance Module (GCAM). The GCAM contains the core TAWS/Windshear algorithms which utilize A/C state data, performance database variables and Terrain/Airport database information to calculate required TAWS/Windshear alarms, build a terrain display buffer, and then pass the data back to the platform. The resulting terrain information is then output to ARINC 708A compatible weather radar or EFIS displays.

The Transponder function supplies surveillance functions to both ground-based and airborne interrogators, as well as communication functions to various onboard systems. The transponder contains data link functions that allow it to function as part of the Aeronautical Telecommunications Network (ATN). The data link functions allow communication with a Communication Management Unit (CMU) via a Mode S Airborne Data Link Processor (ADLP). The transponder also has Mode S specific functions that are dedicated links to onboard systems.

The T3CAS CU also provides past and present LRU and system status through the front panel mounted TEST switch and PASS/FAIL annunciators. Software updates can be incorporated into the computer by Compact Flash Card an ARINC 615A data loader port through either the connector mounted on the front panel of the computer or the port provided on the LRU rear connector.

Figure 1-8 shows a graphical view of the T3CAS Computer Unit.

Table 1-15 provides the leading particulars.

Table 1-16 provides the DO-160E Categories.

NOTE:
The RWS function is not applicable to Part Numbers 9005000-10000, -10101, -10202, -10204, or -11203.

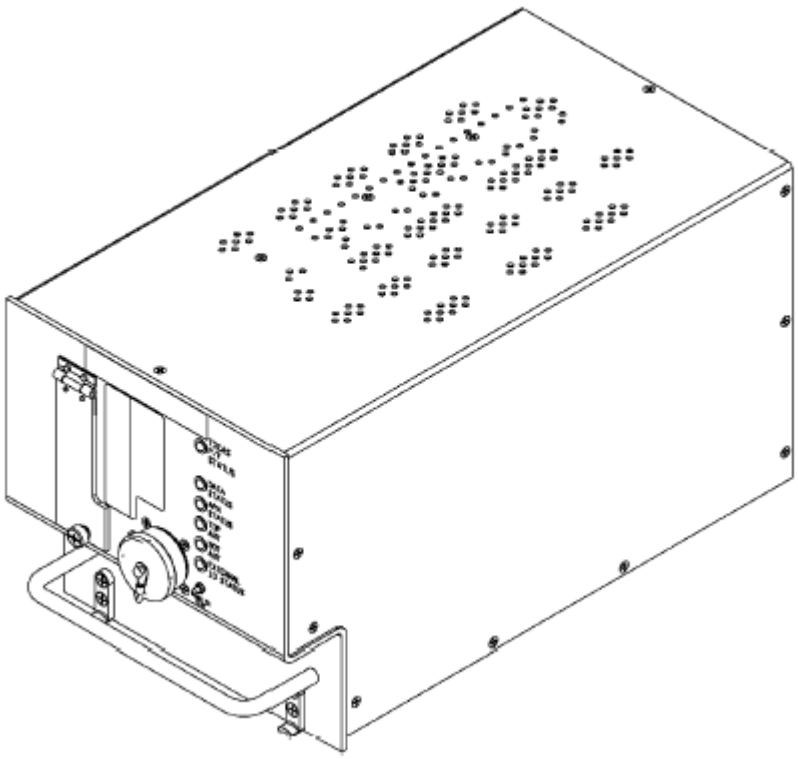


Figure 1-8: T3CAS Computer Unit

Table 1-15: T3CAS Computer Unit Leading Particulars

Item	Specification
Dimensions 6-MCU (maximum)	
• Height	7.64 in. (194.1 mm)
• Width	7.52 in. (191.0 mm)
• Length	15.26 in. (387.6 mm)
Dimensions 4-MCU DC Only (maximum)	
• Height	7.64 in. (194.1 mm)
• Width	4.90 in. (124.5 mm)
• Length	15.79 in. (401.1 mm)
Dimensions 4-MCU AC/DC (maximum)	
• Height	7.64 in. (194.1 mm)

Table 1-15: T3CAS Computer Unit Leading Particulars (cont.)

Item	Specification
• Height	7.64 in. (194.1 mm)
• Width	4.90 in. (124.5 mm)
• Length	15.79 in. (401.1 mm)
Weight 6-MCU (maximum)	17.50 lb (7.94 kg)
Weight 4-MCU DC Only (maximum)	15.80 lb (7.17 kg)
Weight 4-MCU AC/DC (maximum)	16.7 lb (7.57 kg)
Operating ac Voltage:	97 V rms minimum, 115 V rms nominal, 134 V rms maximum at 400 ±80 Hz
Operating dc Voltage:	+20.5 V dc minimum, +27.5 V dc nominal, +32.2 V dc maximum
Power Consumption	80 W standby, 95 W operational
Circuit Breaker Ratings:	
• 115 V ac Circuit Breaker	3 A Typical
• +28 V dc Circuit Breaker	10 A Typical
Mating Connector:	
• Rear Connector	Radiall Part No. NSXN3P357X0001 or equivalent
• Front Connector (J1)	ACSS Part No. 4004295-160 (ITT Part No. KJ6F18A53P) (MS 27473T18F53P with backshell M85049/49-2-18N) or equivalent
6-MCU Unit Cooling Requirements:	
• Cooling Requirements	ARINC 600 (blow through)
• Minimum Cooling Airflow Rate	46 lb/hour (21 kg/hour)
• Pressure Drop (at minimum airflow rate)	0.2 ± 0.12 in. (5 ± 3 mm) of H_2O
4-MCU Unit Cooling Requirements:	
• The 4-MCU form-factor utilizes a unit-mounted fan (integrated fan) for cooling.	
T3CAS Mounting	ARINC 600 6-MCU or 4-MCU Tray Assembly
TSO:	
• Refer to Table 1-2	

Table 1-15: T3CAS Computer Unit Leading Particulars (cont.)

Item	Specification
• Software Development Specification	DO-178B, Level B
• Environmental Specifications Applicable to 9005000-10000, -10101, -10202, -10204, -11203, -11801, and -55801.	DO-160E Refer to Table 1-16
Temperature/Altitude [A2F2]:	
• Operating Temperature	-55 to +70 degrees C (-67 to 158 degrees F)
• Ground Survival Temperature	-55 to +85 degrees C (-67 to 185 degrees F)
• Altitude	Sea Level to 55,000 ft (16764 m)
• Loss of Cooling	+40 degrees C (+104 degrees F) for 18 hours minimum
RF Transmitter Characteristics:	
• Unwanted Output Power in an Inactive State	-79 dBm (960-1215 MHz)
• TCAS Transmitter Frequency	1030 ± 0.01 MHz
TCAS RF Peak Output Power:	
• Minimum	53.5 dBm (224 W)
• Nominal	54.0 dBm (251 W)
• Maximum	57.5 dBm (562 W)
XPDR Transmitter Frequency	1090 ± 0.01 MHz
XPDR/ADS-B RF Peak Output Power (each port of directional antenna):	
• Minimum	51.4 dBm (138 W)
• Nominal	52.2 dBm (166 W)
• Maximum	55.4 dBm (347 W)
TCAS Pulse Timing Characteristics:	
• Pulse Rise Time	0.05 to 0.10 µsec
• Pulse Fall Time	0.05 to 0.20 µsec
• ATCRBS S1, P1, P3, P4 Duration	0.8 ± 0.05 µsec
• Mode S P1, P2 Duration	0.08 ± 0.05 µsec
• Mode S P6 Duration	16.25 ± 0.125 µsec (short) 30.25 ± 0.125 µsec (long)

Table 1-15: T3CAS Computer Unit Leading Particulars (cont.)

Item	Specification
XPDR Pulse Timing Characteristics:	
• Pulse Rise Time	0.05 to 0.10 µsec
• Pulse Fall Time	0.05 to 0.20 µsec
• ATCRBS S1, P1, P3, P4 Duration	0.45 ± 0.05 µsec
• Mode S P1, P2 Duration	0.5 ± 0.05 µsec
Whisper-Shout Characteristics:	
• Range	0 to 27 dB attenuation by 1 dB steps
• Absolute Tolerance	Relative to the 0 dB step, the attenuation of each step does not exceed the nominal attenuation by more than ±2 dB
• Relative Tolerance	Step increments are ±0.5 dB and monotonic
TCAS RF Receiver Characteristics:	
• Receiver Frequency Range	1087 to 1093 MHz
• Receiver MTL Over Frequency (Nominal Operation)	-77 ±2 dBm (≥90% Mode S and ATCRBS replies decoded)
Receiver Dynamic Range (Normal Operation)	-77 to -24 dBm (≥99% Mode S and ATCRBS replies for signal levels greater Than MTL +3 dB)
• Low-level Receiver Signal Rejection (Normal Operation)	-81 dBm (≤10% Mode S and ATCRBS replies decoded)
• Receiver Signal Processing	Amplitude Mono-pulse
• System Bearing Accuracy	Error less than 9 degrees RMS, 27 degrees peak from -10 to +10 degrees elevation
ADS-B RF Receiver Characteristics:	
• Receiver Frequency Range	1089 to 1091 MHz
• Receiver MTL Over Frequency (Normal Operation)	≤-87 dBm (= 90% Interrogations decoded)
• Receiver Dynamic Range (Normal Operation)	-87 to -24 dBm (≥99% for signal levels greater than MTL +3 dB)
• Reply Reception	-90 dBm (≥15% ADS-B squitter replies decoded)
XPDR RF Receiver Characteristics:	
• Receiver Frequency Range	1029.8 to 1030.2 MHz

Table 1-15: T3CAS Computer Unit Leading Particulars (cont.)

Item	Specification
• Receiver MTL Over Frequency (Normal Operation)	-75 ±3 dBm (_90% Interrogations decoded)
• Receiver Dynamic Range (Normal Operation)	-75 to -24 dBm (_99% for signal levels greater than MTL +3 dB)
• Lower Level Receiver Signal Rejection (Normal Operation)	-82 dBm (≤10% Interrogations decoded)
Receiver Signal Processing	Pulse and DPSK Modulation

Table 1-16: T3CAS Computer DO-160E Categories

DO-160E Section	Condition	Category
4.0 (except 4.5.5)	Temperature and Altitude	Category A2, Partially controlled temperature, Pressurized to 15,000 ft (4,572 m)
		Category F2, Non-controlled temperature, Non-pressurized, 55,000 ft (16,764 m) maximum
4.5.5	In-Flight Loss of Cooling	Category Y (300 minutes). Refer to NOTE following this Table.
5.0	Temperature Variation	Category B, Non-controlled temperature, Equipment mounted internal in aircraft
6.0	Humidity	Category B, Severe Humidity environment
7.0	Operational Shock and Crash Safety	Category E
8.0	Vibration	Category R, curves B and B1 Category S, curve M
9.0	Explosion Atmosphere	Category E
10.0	Waterproofness	Category X, Not Applicable
11.0	Fluids Susceptibility	Category X, Not Applicable
12.0	Sand and Dust	Category X, Not Applicable
13.0	Fungus Resistance	Category F
14.0	Salt Fog	Category X, Not Applicable
15.0	Magnetic Effect	Category Z, Less than 0.3 m for 1 degree deflection
16.0	Power Input	Category A(CF) for AC Power Inputs Category X for AC input harmonics, no tests performed

Table 1-16: T3CAS Computer DO-160E Categories (cont.)

DO-160E Section	Condition	Category
17.0	Voltage Spike	Category A, High degree of protection against voltage spikes (For both 115VAC)
18.0	Audio Frequency Conducted Susceptibility	Category R(CF) for AC Power Inputs
19.0	Induced Signal Susceptibility	Category CC
20.0	Radio Frequency Susceptibility	Category R for conducted susceptibility Category R for radiated susceptibility (CW and Pulse)
21.0	Emission of RF Energy	Category M with deviation (Refer to Table 1-5)
22.0	Lightning Induced Transient Susceptibility	Category A3 for pin injection tests Category J13 for cable bundle tests
23.0	Lightning Direct Effects	Category X, Not Applicable
24.0	Icing	Category X, Not Applicable
25.0	Electrostatic Discharge	Category A, Equipment Installed, Repaired, or operated in an Aerospace Environment
26.0	Fire, Flammability	Category C, by analysis
NOTE:	Regarding DO-160E Section 4.5.5 In-Flight Loss of Cooling, the 6-MCU unit was tested for 18 hours.	

(1) System Interfaces

The T3CAS Computer Unit supports the external system interfaces that follow. The specifications apply to the 6-MCU and 4-MCU computer. All interfaces are per ARINC 735B.

(a) Common System Interfaces

This section defines external system interfaces that are common to the T3CAS functions.

1 Radio Altimeter

The T3CAS Computer Unit accepts either analog or digital radio altimeter inputs. For each type of input, dual input ports are provided. The external connector pins for Analog/Digital Radio Altitude Inputs #1 and #2 are shared by TCAS, TAWS/RWS and XPDR. The Analog/Digital inputs have independent circuitry.

The T3CAS CU analog radio altimeter interface accepts either ARINC 552A, Collins BCA analog input, or metric analog input formats. The type of input format is selected by program discrete inputs RMP-12B, -12D, -12E, and -12F. Each analog input contains a valid discrete used to validate the analog input.

Each of the military radio altimeter types provide two outputs that are connected to the T3CAS CU input pins. The two altimeter outputs are the Analog Data Output and Analog Data Reliability signal. The T3CAS CU uses the Data Reliability signal in conjunction with the Analog Data Output to determine radio altimeter failures.

A condition exists for several military radio altimeters known as Out-of-Track. This condition occurs when the radio altimeter has not failed and the altimeter is not reading a valid altitude. Altitude data for an Out-of-Track condition should be considered invalid and not used.

The digital radio altimeter interface accepts inputs from an ARINC 707 radio altimeter on ARINC 429 low-speed input busses.

2 Voice Audio Outputs

The T3CAS contains two analog audio outputs that provide TAWS/RWS and TCAS aural advisories. The 8-ohm output has the capability to supply up to 4 Watts RMS into a speaker. The 600-ohm output has the capability to supply up to 80 milliwatts RMS into an audio distribution system.

3 Onboard Maintenance System Interface

The TCAS function contains a set of ARINC 429 low-speed busses for communication with an onboard maintenance system (1 input, 1 output). The input RBP-6G/6H is shared with the TAWS functionality. The output is RBP-6E/6F. The unit interfaces with all major airframe manufacturers maintenance computer systems. Since the maintenance computer protocol for each airframe manufacturer is different, the TCAS function automatically detects the type of airframe from the data received from the maintenance computer and sets its protocol accordingly. The TCAS OMS interface supports all Boeing and Airbus maintenance systems.

The TAWS/RWS function contains an interface to an onboard maintenance system that allows fault and diagnostic information to be retrieved. The ARINC 429 input is shared with TCAS on RBP-6G/6H. The ARINC 429 output bus, RTP-8A/8B contains OMS data; however, the output is shared with other systems and contains additional data. The OMS has capability to display BITE fault log information over the display device. Current faults and faults from previous flight legs may be displayed. In addition, information such as software part numbers may be displayed. The OMS can be used to initiate TCAS, TAWS/RWS and XPDR system tests.

The XPDR function contains an interface to an onboard maintenance system that allows fault and diagnostic information to be retrieved. The ARINC 429 input is RTP-5G/5H. The ARINC 429 output bus, RTP-8E/8F contains OMS data. The OMS can be used to initiate TCAS, TAWS/RWS and XPDR system tests.

4 Data Loader Interface

The T3CAS is provisioned for interface with an ARINC 615A data loader (Ethernet 10 Base-T). The front Portable Data Loader connector contains the signals required by the ARINC 615A specification. The interface will be used to upload future software updates to the T3CAS system.

The T3CAS also contains an access port on the front of the unit that accepts a Type I Compact PC Flash card. The Compact PC card is commercially available. The Compact PC card can be inserted in a CF card slot on a PC, or a USB serial port with an adapter. The Compact PC Flash card is used for updating the operational software. In addition, the Compact PC Flash card may be used as a data recorder.

5 RS-232/Compact Flash Card Data Recorder Interface

The Data Recorder Interface can be utilized for either internal or external data recording.

The TAWS/RWS event log contains event information due to TAWS or windshear cautions or warnings (internal data recording). The log can hold approximately three events that last up to 45 seconds each (assuming GCAM Event, GCAM parameter data and GFM parameter data selected for recording). The event log data may be downloaded to a Laptop PC over the RS-232 port, or downloaded to a Compact Flash card using the slot on the front of the unit.

The external data recording provides the capability to perform real-time recording of various T3CAS input, output and internal data. This data may be recorded using the Compact Flash card or RS-232 interface. Using a 2 Gigabyte Compact Flash card, the system can store up to 15 hours of data.

In addition, the RS-232 interface allows for LRU maintenance and troubleshooting. The maintenance log and RA event log can also be downloaded to a PC using this port. The RS-232 interface is connected to the 53-pin PDL connector on the front of the unit.

6 Control Panel

The control panels for the transponder and TCAS systems supply mode control for dual or single ATC Mode S Transponders and TCAS systems. The Control Panel for the Mode S System supplies mode control for the ATC Transponders, both Mode S and ATCRBS (if used). Communication with Mode S Transponders is accomplished via an ARINC 429 bus as defined in ARINC Characteristic 718. Control panel functions include 4096 ident code selection and display, altitude source and reporting inhibit selection, and selection between two onboard Transponders, TCAS TA or TA/RA advisory selection, selection of TCAS test, and other TCAS/XPDR related functions.

7 Flight Data Recording

The warning discretes and/or the A429 general output bus may be connected to the Flight Data Recorder (FDR) or Digital Flight Data Acquisition Unit (DFDAU).

The TCAS function contains an interface for an ARINC 429 flight data recorder. The flight data recorder function is activated by grounding a discrete input pin (RMP-11D) on the rear connector. With the discrete input grounded, flight data is output as high-speed ARINC 429 data on the RA Display No.1 and No.2 busses. With the discrete grounded, the normal RA Display bus operation is not available.

The TCAS function contains 12 discrete outputs connected to an ARINC 573 flight data recorder. The outputs are used to record information during a resolution advisory event.

8 Air Data Interface

The TAWS/RWS function uses Vertical Speed, Static Air Temperature, Computed Air Speed, and Corrected/Uncorrected Barometric Altitude from an air data system. In addition, TAWS/RWS uses True Airspeed (TAS) on installations where T3CAS is performing the RWS function.

The TAWS/RWS function accepts up to three digital ARINC 429 inputs from Digital Air Data Systems. Some of the supported system interfaces include ARINC 706 Air Data Computer (ADC), ARINC 575 ADC, ARINC 738 Air Data Inertial Reference System (ADIRS), and other non-ARINC standard interfaces that meet the minimum input signal requirements.

The Air Data source also provides altitude information to the TCAS and XPDR functions.

9 Inertial Reference Interface

TAWS/RWS function uses Ground Speed, True Track Angle, Flight Path Angle, Latitude, Longitude, Altitude MSL, Roll Angle, Pitch Angle, Inertial Vertical Speed, and True Heading from an inertial system.

Additionally, TAWS/RWS uses Body Longitudinal and Normal Acceleration on installations where TAWS/RWS is performing the RWS function.

T3CAS accepts ARINC 429 inputs from an ARINC 704 Inertial Reference System (IRS), ARINC 705 Attitude Heading and Reference System (AHRS), ARINC 738 Air Data Inertial Reference System (ADIRS), Global Positioning and Inertial Reference System (GPIRS) and other non-ARINC standard interfaces that meet the minimum input signal requirements.

10 FMC Interface

The TAWS/RWS function uses Ground Speed, True Track Angle, Flight Path Angle, Aircraft Weight, Latitude, Longitude and True Heading from an FMC system.

TAWS/RWS can accept up to two digital ARINC 429 inputs from an ARINC 702 Flight Management Computer system or other non-ARINC standard interfaces.

11 GPS/GNSS

The TAWS/RWS function uses Vertical Speed, Ground Speed, True Track Angle, Latitude, Longitude, Altitude MSL, WGS 84 altitude and True Heading from a GPS system.

NOTE: World Geodetic System (WGS) 84 altitude is another type of MSL altitude.

T3CAS accepts up to three digital ARINC 429 inputs from an ARINC 743 or ARINC 743A GPS System, or other non-standard ARINC interfaces that meet the minimum input signal requirements.

(b) TCAS System Interfaces

1 Mode S Transponder Interface

The T3CAS computer contains two sets of ARINC 429 high-speed busses for communication with two Mode S transponders. It uses ARINC 718A/735B communication protocol (2 inputs, 2 outputs). Only 1 input is used when the embedded Mode S transponder is activated.

2 TCAS Display Bus Interface

The TCAS function has four sets of ARINC output busses for display of traffic and resolution advisories.

The TA/RA Display No.1 and No.2 busses are high-speed ARINC 429 busses that contain both traffic information and resolution advisory information. The busses function according to either the ARINC 735B characteristics, or can optionally be set for the Honeywell EFIS characteristics through a program input pin (RMP-12C). For each bus, a valid discrete input is provided that indicates whether the display is functional.

The RA Display No.1 and No.2 busses are low-speed ARINC 429 busses that contain only resolution advisory information. The busses function according to the ARINC 735B characteristics. For each bus, a valid discrete is provided that indicates whether the display is functional.

The RA Display No.1 and No.2 busses can be configured for a 429 Data Recorder function by grounding programming pin (RMP-11D). In this mode, the busses are configured for high-speed operation.

3 Altitude Alerter Interface

The TCAS function contains an ARINC 429 low-speed input bus that is reserved for receiving “selected altitude” information from an altitude control source or flight control computer. The TCAS function uses the “selected altitude” information to ensure the weakening or strengthening of a Resolution Advisory (RA) is consistent with the aircrafts clearance altitude.

(c) TAWS/RWS System Interfaces

1 TAWS Display Interface

The TAWS function contains two digital 453 picture bus outputs that transmit terrain display data to ARINC 708A compatible weather radar displays or EFIS displays. The bus outputs can be configured with independent range selections. The mode and range selections are input to the system on an ARINC 429 bus.

The TAWS function also has two ARINC 429 bus outputs that contain data for alerts and annunciation of system status.

2 ILS/MLS

The TAWS/RWS function uses Selected Runway Heading, Glide Slope Deviation, Localizer Deviation, and ILS Select from an Instrument Landing System (ILS) or Microwave Landing System (MLS). TAWS/RWS can accept up to three digital ARINC 429 inputs from an ARINC 710 ILS receiver, ARINC 727 MLS receiver, or other non-ARINC standard interfaces.

3 Angle of Attack

On installations where T3CAS is performing the RWS function, the TAWS/RWS function uses the aircraft angle of attack for the windshear computation.

TAWS/RWS can accept up to two ARINC 429 inputs from a source such as a Digital Stall Warning Computer (DSWC) or other data concentrator devices.

4 Decision Height

The TAWS/RWS function uses selected decision height and/or minimum descent altitude for the generation of audio call-outs. TAWS/RWS can accept ARINC 429 inputs or a discrete input.

5 Decision Height/Minimum Descent Altitude Switch

A flight deck switch can be used to select either decision height or minimum descent altitude for audio call-out altitude determination.

6 Flap/Slat Settings

TAWS function uses Flap/Slat settings for TAWS alerts.

TAWS/RWS can accept ARINC 429 Flap/Slat setting inputs from a source such as a Digital Stall Warning Computer (DSWC) or other data concentrator devices.

7 Weight and Balance System (WBS)

The TAWS/RWS function obtains current aircraft weight from an A429 digital weight and balance system source.

(d) Transponder System Interfaces

1 ADLP Interface

The transponder is a Level 3 Transponder per the definitions in ICAO Annex 10 Volume IV Section 2.1.5. The Transponder is capable of processing COMM-A/B/C Data Link messages, and interfaces to an external Mode S Airborne Data Link Processor (ADLP).

(4) Discrete Inputs

The T3CAS has various discrete inputs available for implementing various TCAS and TAWS/RWS functions. For the TCAS function, the input logic status is defined in accordance with ARINC 735B. For the TAWS/RWS function, the input definition is defined by the ASDB for the specific aircraft type. These discrete inputs default to open when power is removed.

(5) TCAS Program Inputs

The T3CAS has various program inputs available for TCAS unit configuration and installation programming. Input logic status is defined according to ARINC 735B definition.

For Part Numbers 9005000-11801 and -55801, the T3CAS also utilizes the ASDB database for unit configuration and installation programming. ASDB software is stored on the Airplane Personality Module (APM).

The ASDB defines the assignment of the connector pins to each signal, the criteria for determining the value and status of each signal and the signal specific filtering and processing requirements.

(6) Discrete Outputs

The T3CAS TAWS function contains 7 discrete outputs that are used to provide annunciation of alerts and system status. For the TCAS function, the output logic status is defined in accordance with ARINC 735B. For the TAWS/RWS function, the output definition is defined by the ASDB for the specific aircraft type. These discrete outputs default to open when power is removed.

(7) Self-Test Function

(a) TCAS, TAWS/RWS and Transponder Maintenance Self-Test

By momentarily pushing the TEST switch on the front panel of the T3CAS Computer Unit, maintenance personnel can display fault data for the current and preceding flight legs. When TEST is initially activated, all annunciators (pass/fail lamps on front of unit) are ON for a 3-second lamp test, and then current fault data is displayed for 10 seconds. If no further activations of the TEST switch are made, the LRU display cycle is terminated at the end of the 10-second fault display period, and all annunciators are extinguished.

If during the 10-second fault display period, the TEST button is activated again, the fault display period is aborted, a 2-second lamp test cycle is done, and the fault data recorded for the preceding flight leg is displayed for 10 seconds. This procedure can be repeated up to 10 times to obtain recorded data from the previous 10 flight legs. If the TEST button is not activated again during the fault display period, the fault display cycle is terminated at the end of the 10-second fault display period and all annunciators are extinguished. If an attempt is made to display fault data for the preceding flight leg when the tenth preceding flight leg fault data is displayed, all annunciators flash for a 3-second period at a 2.5-Hz rate, after which all annunciators are extinguished.

When less than 10 flight legs have been flown since the T3CAS Computer Unit was shop tested and recertified, less than 10 previous flight legs of recorded fault data may be available for display. In this case, if an attempt is made to display fault data for the preceding flight leg when the earliest flight leg is displayed, all annunciators flash for 3 seconds at a 2.5-Hz rate and then all annunciators are extinguished.

The T3CAS Pass/Fail status annunciator indicates the status of the T3CAS Computer Unit only. All other annunciators reflect the condition of the respective sub-system.

(b) TCAS Self-Test

The T3CAS TCAS self-test is initiated from a self-test button on the TCAS/MODE S control panel. The T3CAS TCAS self-test may also be initiated from the Central Maintenance Computer.

(c) TAWS/RWS Self-Test

The T3CAS TAWS/RWS self-test is initiated from a self-test discrete input interface. The TAWS/RWS self-test discrete is further defined in the ASDB. The T3CAS TAWS/RWS self-test may also be initiated from the Central Maintenance Computer.

(d) Transponder Self-Test

The T3CAS XPDR self-test is initiated from a self-test button on the TCAS/MODE S control panel. The T3CAS XPDR self-test may also be initiated from the Central Maintenance Computer.

(8) TAWS/Transponder Pin Programming

For Part Numbers 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801 pin programming defines the operational environment of the T3CAS including the aircraft type, input/output interfaces, climb gradient, and feature selections. There are 18 program pins used for pin programming TAWS and transponder functionality. Each of the 18 program pins can be set to one of 9 states by strapping each program pin to one of eight T3CAS output discretes or leaving the connection open. During power-up initialization, the T3CAS cycles the states of the output discretes to determine its operating configuration.

Valid program pin configuration monitoring is provided via a parity pin that is connected in such a manner that the sum of program pin connections results in an odd number.

B. Airplane Personality Module Interface

The Airplane Personality Module (APM) is defined in ARINC Report 607, Attachment 3 - see Figure 1-9. A serial digital interface between the T3CAS Computer and the APM allows the APM to be programmed with aircraft and system configurations during the initial installation of the T3CAS computer. In addition, the serial digital interface allows the APM to be read during every subsequent power-on to configure the computer for proper operation. The APM is used to hold/provide information for the T3CAS configuration database, for example, registration number, aircraft type, equipment installed, et cetera. Moreover, the APM stores the Aircraft Specific Database (ASDB) which defines the Input/Output definition for the specific aircraft type and the aircraft climb performance data to support the TAWS/RWS functionality.

NOTES:

1. It is the responsibility of the installer to ensure the correct ASDB is loaded into the T3CAS system during aircraft installation. Contact ACSS to determine the applicable ASDB for a particular installation configuration (i.e., B737-400 with FMS, GPS, AHRS, etc.).
2. The APM is not applicable for Part Numbers 9005000-10000, -10101, -10202, -10204, and -11203. These part numbers are configured using pin programming.
3. The DO-160E categories of the APM are the same as listed in Table 1-16.

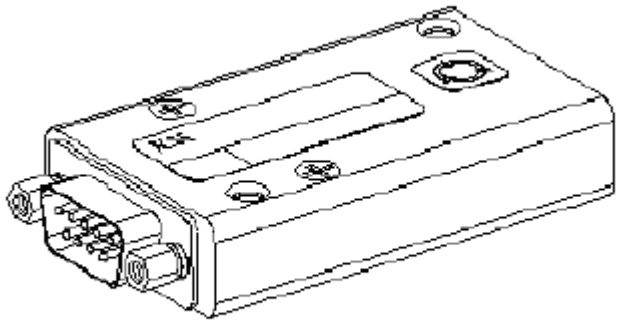


Figure 1-9: T3CAS Airplane Personality Module (APM)

C. Directional Antenna

The T3CAS directional antenna, Figure 1-10, is a four-element, vertically polarized, monopole array capable of transmitting in four selectable directions at 1030 MHz and 1090 MHz. The antenna is capable of receiving replies from all directions simultaneously with bearing information at 1090 MHz and 1030 MHz, using amplitude-ratio monopulse techniques. The antenna is also capable of transmitting omnidirectionally at 1090 MHz for transponder transmissions.

The antenna consists of a molded radome with radiating/receiving elements and is completely filled with a rigid foam. The antenna assembly uses five or nine screws to attach the radome and either four or eight screws to attach the antenna to the aircraft fuselage.

The ACSS directional antenna has a small frontal area. The circular radome has a 3:1 elliptical leading edge and an extremely low profile height of only 0.806 inches (20.472 millimeters). This yields excellent aerodynamic performance with a minimum possibility of icing, which could be a hazard for rear mounted engines.

For T3CAS TCAS system installations, the top antenna must be a directional antenna. The bottom antenna can be either a directional or omnidirectional antenna. The T3CAS Computer Unit has the capability of automatically sensing which version is installed.

NOTE: The bottom omnidirectional antenna is not an option for Part Numbers 9005000-10000, -10101, -10202, and -10204.

The directional antenna mounting screws are standard #10-32 UNF-2A pan head, corrosion-resistant (stainless) steel screws in accordance with Military Specification MS51958. The appropriate length is determined by the installer allowing 0.5 inches (12.7 millimeters) for the thickness of the antenna and adapter plate. A washer must be installed under the head of each mounting screw. The washer must be made of passivated, corrosion-resistant steel in accordance with MIL-S-5059 or MIL-S-6721. The Air Force-Navy Aeronautical Standard part number is AN960C10L. The washer has an outer diameter of 0.438 inches (11.125 millimeters), an inner diameter of 0.203 inches (5.156 millimeters), and a thickness of 0.032 inches (0.813 millimeters).

An O-ring (included with the directional antenna) is required to be installed between the directional antenna and the aircraft fuselage. The National Aerospace Standard part number for the O-ring is NAS 1613. The ACSS part number for the O-ring is 4000171-240. Table 1-17 contains the leading particulars for the ACSS directional antenna.

NOTE: For directional antennas, ACSS Part No.7514060-90X, the customer must provide an adapter plate for mounting to the aircraft. For details of the antenna base plate, to which the adapter must mate, refer to Section 2. Directional antennas, ACSS Part No.7514081-9XX, come with a preinstalled adapter plate.

NOTE: The mounting surface of the antenna base plate has an Alodine-treated surface, which provides corrosion resistance. The Alodine application material does not provide any electrical resistance or isolation. Do not sand or remove the Alodine material from the surface. In addition, sanding this surface may damage the unit beyond repair.

The average unit weight of an antenna with adapter plate is approximately 3.0 pounds (1.361 kilograms).

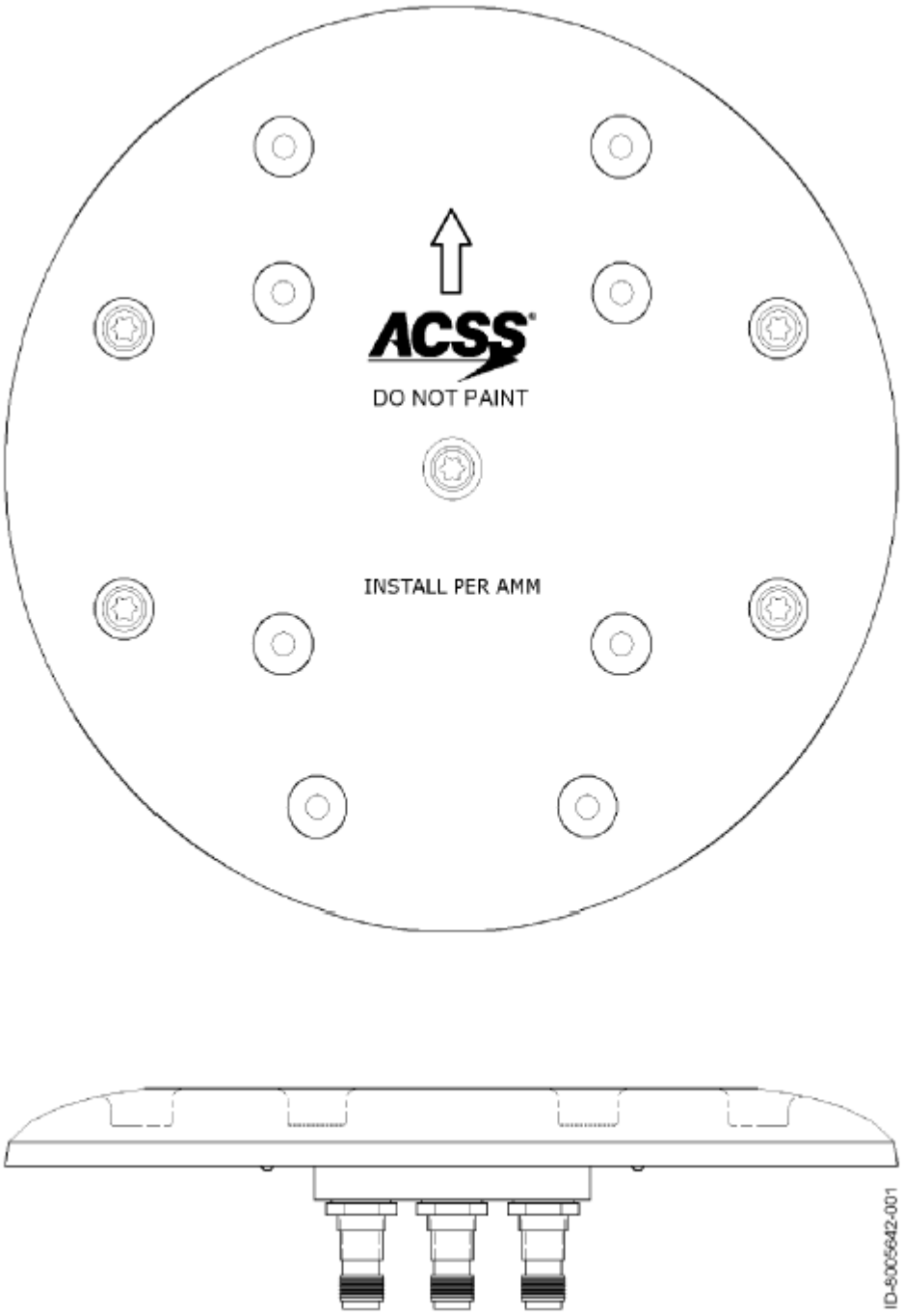


Figure 1-10: Directional Antenna

Table 1-17: ACSS Directional TCAS Antenna Leading Particulars

Item	Specification
Form Factor	ARINC 735A
Antenna Base Types	Curved base Flat base
Maximum Weight	3.2 lb (1.45 kg)
Overall Dimensions	See outline drawings, Figure 2-10 and 2-11.
Antenna Mounting	See Figure 2-10 and 2-11.
Number of Antenna Array Elements	Four
Polarization	Vertical
Power Requirements	N/A
Transmission Frequency	1030 ±1 MHz
Receiving Frequency	1090 ±1 MHz
Connectors:	
• Quantity	Four
• Type	Standard TNC Jacks
O-ring	PN-NAS 1613
Antenna Cable Loss Requirement	2.5 ±0.5 dB for each coaxial cable including connectors
Antenna Cable Length	Required to be greater than or equal to 10 ft and less than or equal to 100 ft. Refer to Note.
ARINC Characteristics	ARINC 735A
TSO	C119a
Environmental Specifications	E1F2/B/JLMYC'/E1SFDFSZXXXXM
NOTE: The T3CAS embedded transponder may fail if the directional antenna cable length is less than 10 ft or greater than 100 ft.	

D. Gables ATC/TCAS Dual Mode S Transponder Control Panel

The Gables ATC/TCAS Mode S control panel is used to independently control two Mode S transponders, and to interface with a Mode S installation with TCAS capabilities.

The control panel contains two isolated electronic modules each dedicated to a given transponder. Each module derives its input ATC code data from two dual concentric knobs. The selected code is then displayed on a four digit LCD, and subsequently transmitted to each transponder.

Figure 1-11 shows a typical front panel layout of a Gables G7130 series control panel. Table 1-18 gives items and specifications that are particular to these units.

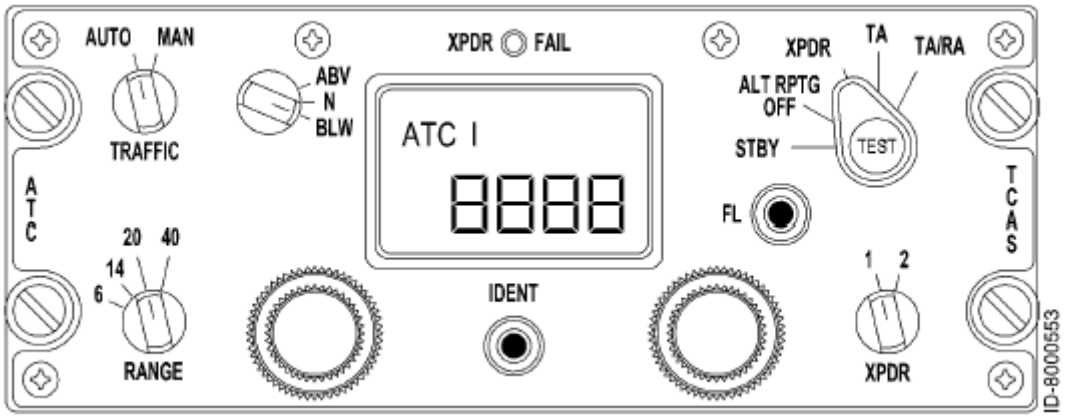


Figure 1-11: Typical Gables ATC/TCAS Control Panel

Table 1-18: Gables G7130 Series Control Panel Leading Particulars

Item	Specification
Dimensions (maximum)	
• Height	2.25 in. (57.2 mm)
• Width	5.75 in (146.1 mm)
• Length	5.80 in. (147.3 mm)
Weight (maximum)	2.0 lb (0.907 kg)
Power Requirements:	
• Primary	+28 V dc, 0.25 A maximum current
• Display and Overlay Lighting	5 V, 400 Hz (2.3 A maximum)
Display Type	Four-Digit, Dichroic LCD

Table 1-18: Gables G7130 Series Control Panel Leading Particulars (cont.)

Item	Specification
Code Select Range	0000 to 7777 (octal)
Transmitted ARINC 429 Labels	013, 015, 016, 031 (octal)
TSO	C112/C119
Environmental Specifications	/A2D1/BB/MB·/XXXXXXZZAZZRZ/xxZZ
Mating Connectors:	
• J1	M83723/75R16247 or MS24266R16B24S7
• J2	M83723/75R16248 or MS24266R16B24S8
Mounting	Four Dzus Fasteners

(1) Functional Description and Operation

Communication with Mode S transponders is accomplished through an ARINC 429 bus as defined in ARINC Characteristic 718. Control panel functions include 4096 ident code selection and display, altitude source and reporting inhibit selection, selection between two onboard transponders, TCAS TA or TA/RA advisory selection, range selection (in nautical miles) and a system functional test selection. A description of the front panel annunciator and switch functions follows.

(a) Transponder Code Display

The control panel has a single four digit LCD display common to both modules within the unit. The display shows the ATC code selected by the user and consequently transmitted to the transponders. Input to the display is controlled by the system select switch (XPDR 1-2).

In addition, certain fault indications are also indicated on the display. After a functional test has been initiated, PASS shows on the display after a successful test, or it shows FAIL if a high level failure is detected under normal operating conditions. It also shows which transponder is active by displaying ATC 1 or 2.

(b) ATC Code Selection

The ATC four-digit code is selected with two dual concentric sets of knobs. Each knob is dedicated to a single liquid crystal display (LCD) digit on the LCD code display. The two smaller knobs control the inner digits of the LCD (tens and hundreds) while the two larger knobs control the outer most digits (units and thousands).

(c) XPDR 1-2 Switch

The XPDR switch is a two position switch that allows the selection of one Mode S module in the control panel, and the activation of its associated transponder (System 1 or System 2).

(d) Mode Control Selector Switch

The rotary switch labeled STBY-ALT RPTG OFF-XPDR-TA ONLY-TA/RA allows the operator to activate the TCAS system by selecting TA, or traffic and resolution advisory (TA/RA). When STBY is selected, both transponders are selected inactive or in standby mode. Altitude reporting off (ALT RPTG OFF) selection disables the altitude data sources interrupting transmission of aircraft altitude and location information to ground controllers and causes a TCAS OFF annunciation on the VSI/TRA.

(e) ABV/N/BLW Switch

The ABV/N/BLW switch selects an altitude range (from aircraft) for traffic display on the TCAS displays. Range limits for software versions prior to Change 7 are 7000 feet (2133.6 meters) above and 2700 feet (822.96 meters) below the aircraft when in ABV mode and 2700 feet (822.96 meters) above and 7000 feet (2133.6 meters) below the aircraft when in BLW mode. Range limits for the Change 7 software version are 9900 feet (3,017.52 meters) above and 2700 feet below the aircraft when in ABV mode and 2700 feet (822.96 meters) above and 9900 feet (3,017.5 meters) below the aircraft when in BLW mode. When the normal (N) position is selected, the display range is 2700 feet (822.96 meters) above and below the aircraft.

(f) Traffic Display Switch

The TRAFFIC AUTO-MAN switch is a two position rotary switch that controls the TCAS traffic display mode of operation. When the AUTO mode is selected, the TCAS computer sets the TCAS displays to pop-up mode under a traffic/resolution advisory condition. If the MAN mode is selected, then the TCAS displays will be constantly activated advising of any nearby traffic detected within the horizontal and vertical range limits.

(g) Range Switch

The RANGE switch is a four or six position rotary switch used to select among different nautical mile (NMI) traffic advisory horizontal range displays.

(h) IDENT Key

The IDENT key is a momentary button. Upon activation, the Special Position Identifier (SPI) pulse shall be transmitted to ground controllers, in accordance with ARINC 718 Draft 5 of Supplement 4, when replying to ATRCRBS Mode A or Mode S UF-4 and UF-5 interrogations for a period of 18 ±1 seconds. The SPI pulse can be reinitiated at any time.

(i) Flight Level Button

The FL button is a momentary button used to select between relative and absolute altitude information. When absolute is selected, this mode is enabled for approximately 20 seconds and then reverts back to relative. In the event of a TA or RA, the Flight Level will automatically revert back to the relative mode.

(j) Test Button

The TEST button enables the user to initiate a system functional test. When the TEST button is pushed, the control panel initiates an internal test while a functional test output is also transmitted through ARINC 429 labels.

When installed with a TCAS system, an extended test can be initiated by continuously pushing the TEST button for at least eight seconds.

(k) XPDR FAIL Annunciator

The XPDR FAIL annunciator displays the functional status of the active transponder. The fail annunciator lights only when a failed transponder is selected on the XPDR 1-2 switch.

E. TAWS Control Panel

The TAWS controls are used to control the displayed terrain data and TAWS inhibit features. The TAWS control panels may be installed in a single or dual configuration depending on the TAWS display capabilities.

The TAWS controls can be mounted on a single control panel or they can be discrete switches individually mounted at a convenient location in the flight deck. The TAWS controls may be part of the electronic display menu selection in installations where TAWS information is displayed on an EFIS or electronic display.

F. VSI/TRA and VSI-TCAS Displays

The VSI/TRA display, Figure 1-12, is used to display current vertical speed and TCAS traffic/warning information. The display consists of an LCD panel. Table 1-19 and Table 1-20 give items and specifications particular to the units. Figure 1-13 contains an interface block diagram of the 41-pin Thales VSI-TCAS, Figure 1-14 contains the interface block diagram for the ACSS 41-pin version, and Figure 1-15 contains the interface block diagram for the ACSS 55-pin (bootstrap) version.

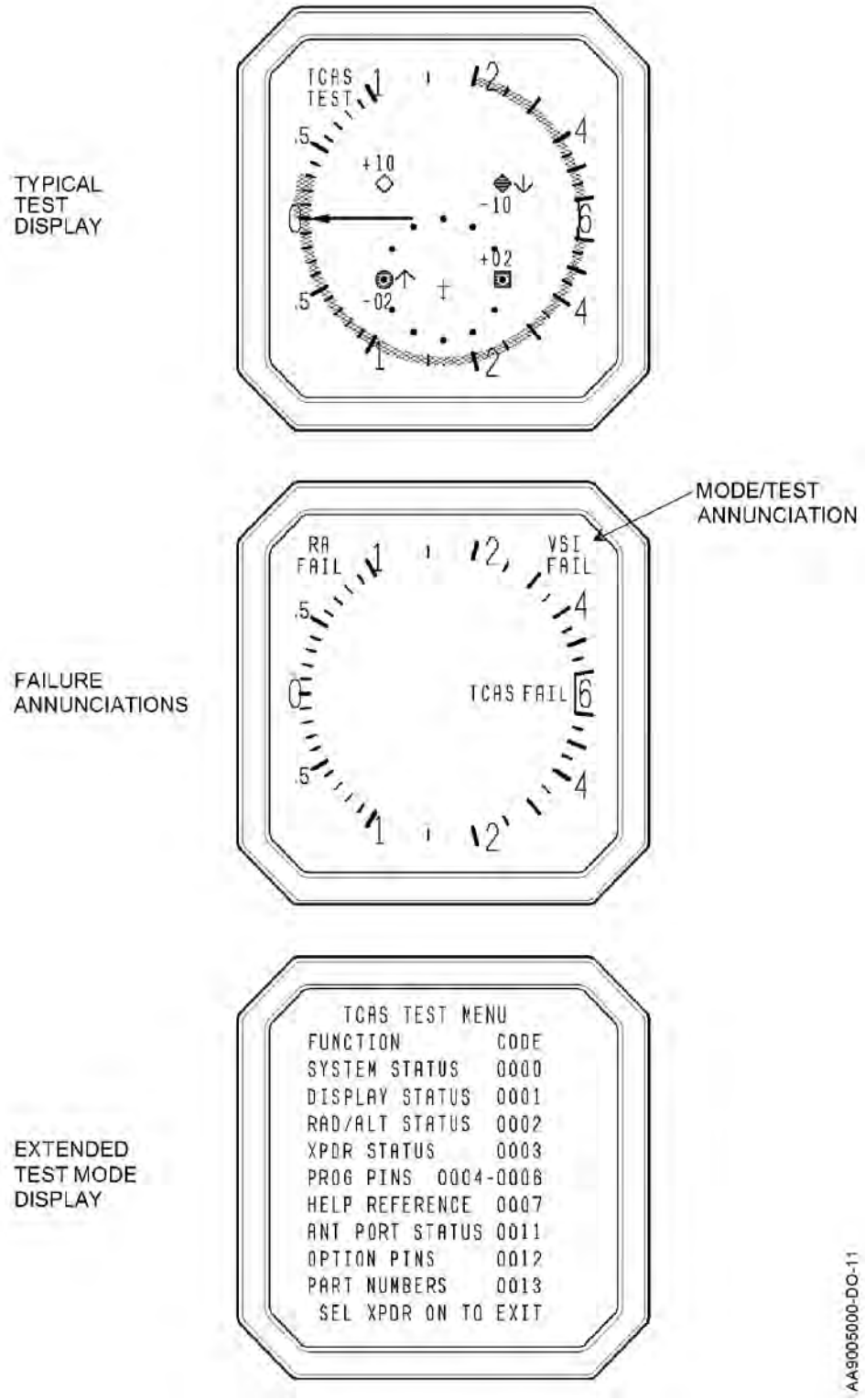


Figure 1-12: Typical VSI/TRA Display Formats

Table 1-19: Thales VSI-TCAS Leading Particulars

Item	Specification
Dimensions (maximum)	
• Height	3.26 in. (82.8 mm)
• Width	3.26 in. (82.8 mm)
• Length	7.5 in. (190.0 mm)
Weight (maximum)	3.3 lb (1.5 kg)
Power Requirements:	
• Primary	115 V, 400 Hz; 17 W nominal (Day), 12 W nominal (Night), 20 W maximum
• External Circuit Breaker Rating	1 A at 115 V ac
Display Type	LCD
Mating Connectors:	
• J1 (41 Pin)	M83723/75A-20-41-6 M83723/75A-20-41-N
• Pneumatic Fitting	MS33649-5
• Quick Disconnect (Hardware p/n KB &PB only)	40006-1B45
• Packing	MS9385-05
Mounting	3-ATI Clamp, Marmon NH1004994-30 or MSP 64311B

(1) Functional Description and Operation

The VSI/TRA has three functions. It continuously displays rate of climb or rate of descent. Traffic information is displayed and resolution advisory information is displayed against vertical speed to allow the flight crew to avoid threats.

The vertical speed display is generated from signals applied directly to the indicator. The VSI/TRA is designed to be used in place of a conventional vertical speed indicator. Four possible sources exist for vertical speed data including ARINC 429 data, dc analog signals in accordance with ARINC 575 (approximately 500 millivolts per 1000 feet per minute or per 304.8 meters per minute), ac analog signals in accordance with ARINC 565 (approximately 250 millivolts per 1000 feet per minute or 304.8 meters per minute), and ARINC 429 signals from the ACSS Pressure Transducer Module. The VSI/TRA computes vertical rate from electrical static pressure when a remote static sensor is used. These four program pin selectable configurations provide compatibility with most aircraft.

Bootstrapping of vertical speed inputs as currently implemented on L-1011, A300, A310, and A300-600 aircraft, is provided with a larger ACSS 55-pin unit connector. These units have a unique dash number assigned to them.

Table 1-20: ACSS VSI/TRA Leading Particulars

Item	Specification
Dimensions (maximum)	
• Height	3.26 in. (82.8 mm)
• Width	3.26 in. (82.8 mm)
• Length	9.42 in. (239.3 mm)
Weight (maximum)	4.0 lb (1.81 kg)
Power Requirements:	
• Primary	115 V, 400 Hz; 18 W nominal, 31 W maximum
• External Circuit Breaker Rating	1 A at 115 V ac
Display Type	LCD
Mating Connectors:	
• J1 (41 Pin Version)	M83723/75A-20-41N
• J1 (55 Pin Version)	M83723/75A-22-55N
Mounting	3-ATI Clamp, Marmon NH1004994-30 or MSP 64311B
Environmental Specifications (DO-160B)	(A2F1)AKXXXXXXAEAEZZZK

Various dash number VSI/TRA displays are available that provide unique design characteristics, which include VSI rate filter programming and selection of an English or metric rate scale.

The VSI/TRA also displays symbology corresponding to traffic in the vicinity of the aircraft. Threat information is received from the TCAS function on a dedicated high-speed ARINC 429 bus. The display uses the bearing, altitude, and range data for each threat to provide an indication of the proximity of the threat. Allowable (non-illuminated or green illuminated bands) and prohibited (red illuminated bands) vertical rates are displayed based on information received from the TCAS function. The VSI/TRA can be pin programmed to provide vertical speed data only, vertical speed and resolution advisory data, or vertical speed, resolution advisory and traffic advisory data. Display of the TCAS system fault status is provided on the VSI/TRA in response to extended TCAS control panel TEST activation.

Display dimming is controlled from several inputs consisting of an internal light sensor mounted on the bezel of the LRU, a remote light sensor, and the aircraft dimming bus. The display is dimmed by varying the brightness of the LCD panel backlighting.

(9) Software Considerations

VSI/TRA software is developed to a DO-178A category of Level ll (essential). The software continually monitors and displays vertical speed and TCAS information. Output discretes supply user components with the status of the LRU. TCAS valid indicates that the LRU is displaying valid TCAS information. On the ACSS 55-pin version, VSI valid indicates that the LRU is displaying valid vertical speed information. This is needed to support the bootstrap feature, which is exclusive to the 55-pin version of the VSI/TRA display.

(10) Built-In-Test Equipment (BITE) and Self-Test Capability

The LRU has input discretes that allow a calibration and test program to be run. This mode allows the display to be adjusted and various diagnostic tests to be performed. These tests and adjustments can only be done in a shop on a dedicated test fixture.

When the LRU application program is operating in the aircraft, the background loop continuously monitors the power supply status, the ROM integrity, and the analog range limits. A failure results in the setting of bad status output discretes. A cold start will continuously be attempted until the LRU passes the built-in-test. There is a dedicated self-test input for both versions of the VSI/TRA Display. When this pin is activated, the unit will display symbology that aids in the detection of unit faults.

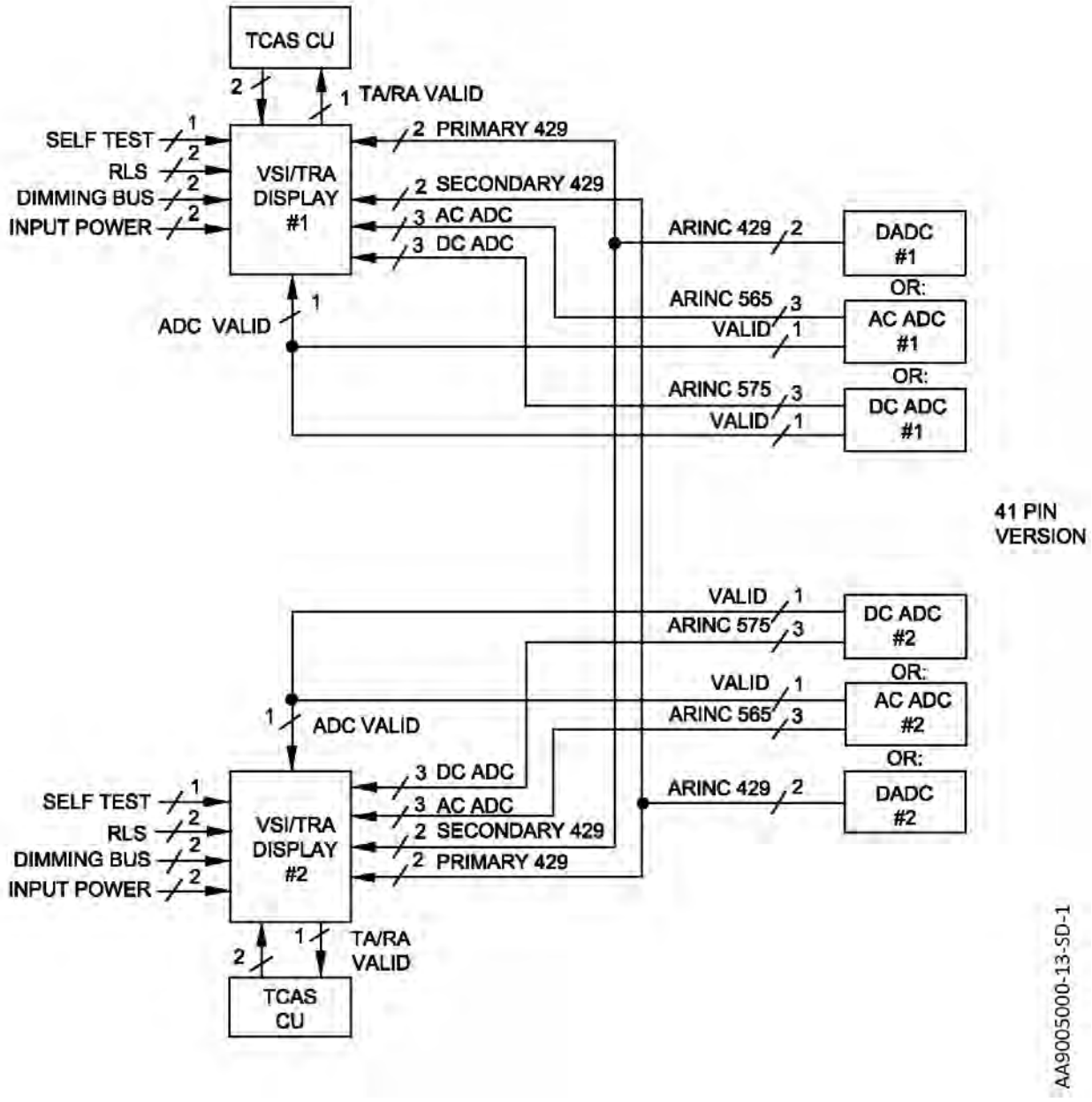


Figure 1-13: Thales VSI-TCAS Interface Diagram (41-Pin)

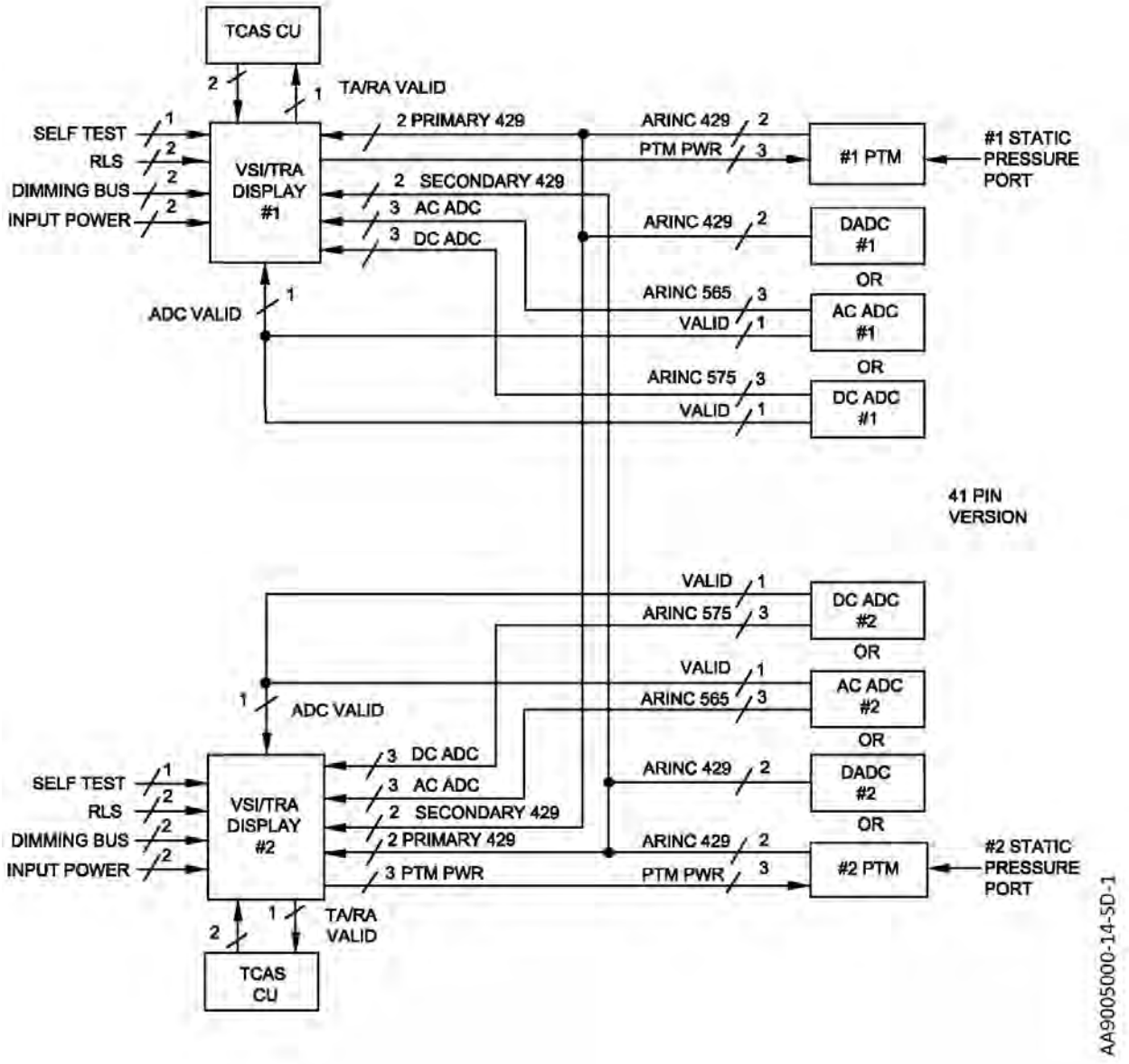


Figure 1-14: ACSS VSI/TRA Interface Diagram (41-Pin Version)

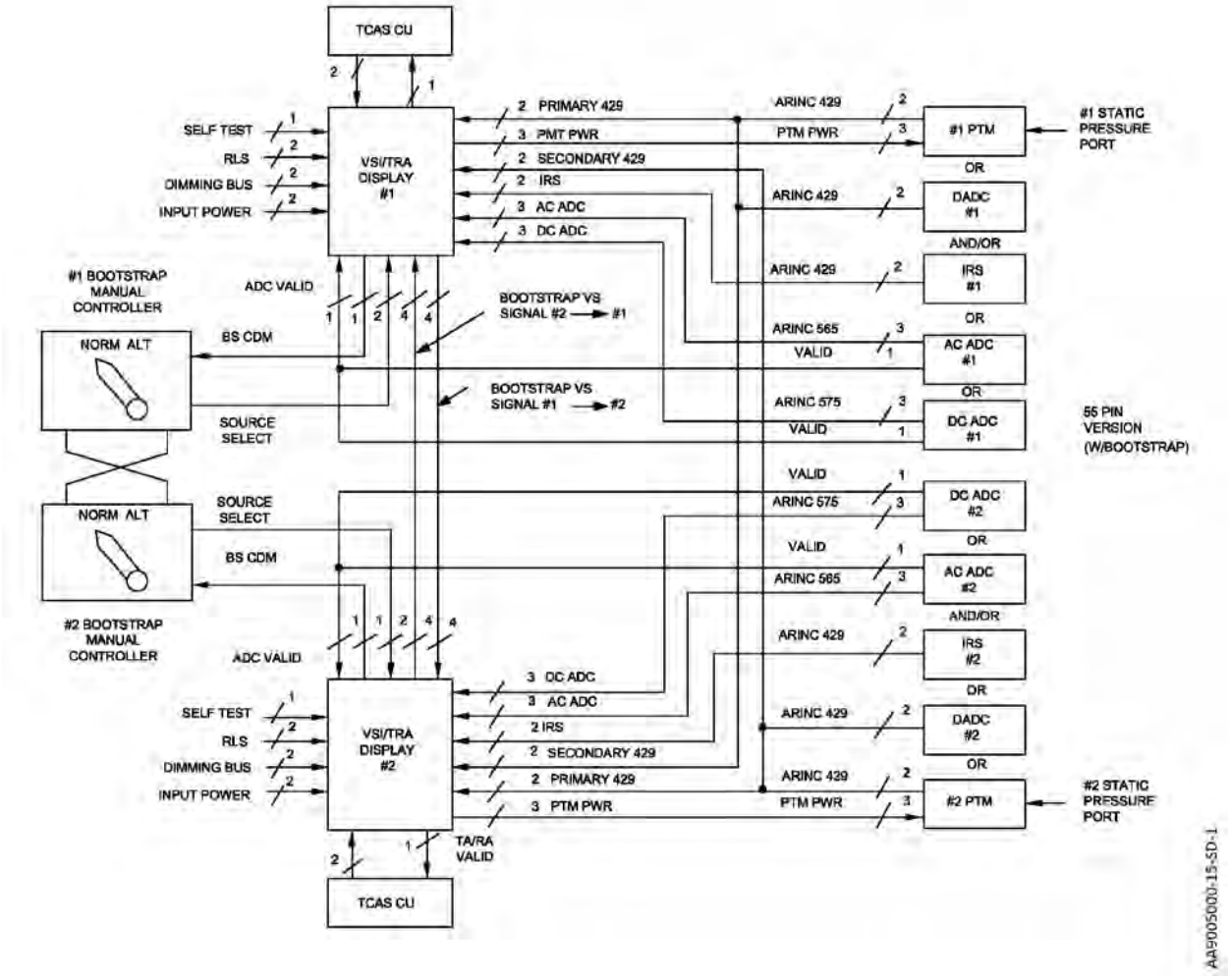


Figure 1-15: ACSS VSI/TRA Interface Diagram (55-Pin Version)

G. TAWS Terrain Hazard Display

T3CAS installations require at least one TAWS terrain hazard display. ARINC 708A WXR display and EFIS interfaces are supported. Figure 1-16 shows a typical single ARINC 708A terrain hazard display interface. The T3CAS dual-independent terrain hazard display I/O supports dual ARINC 708A terrain hazard display systems. The terrain image is transmitted via 453 bus to the display.

(1) Functional Description and Operation

The terrain hazard display function enhances situational awareness by providing a display of terrain-related hazardous situations in front of the aircraft on existing ARINC 708A-compatible weather radar or EFIS flight deck displays. The display may be either the EFIS Navigation Display (for EFIS-equipped aircraft) or the weather radar display. A crew-activated switch is used to select/deselect the terrain image on the display.

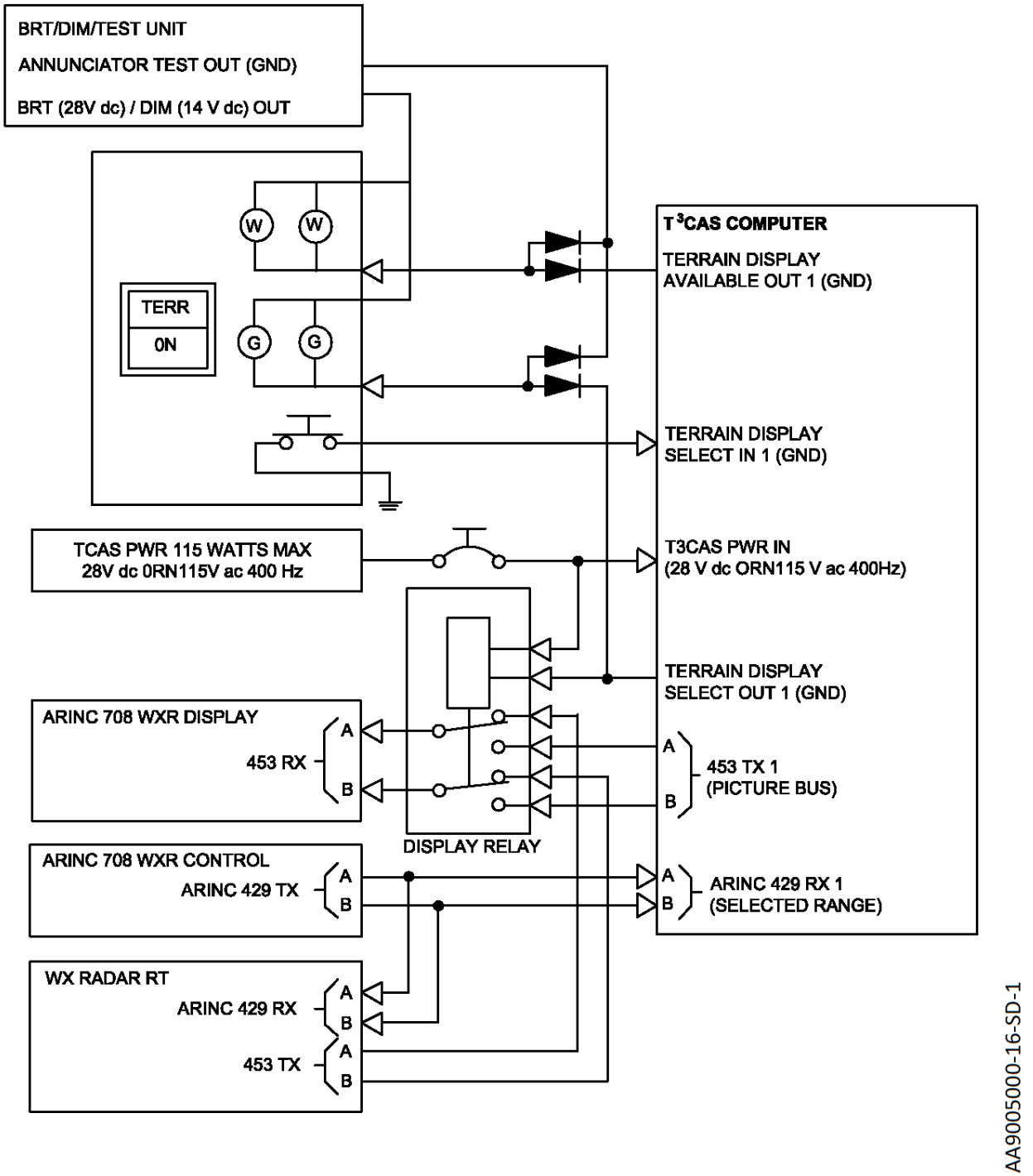


Figure 1-16: Typical T3CAS Single Terrain Hazard Display Interface

5. System Operation

A. TCAS Operation

The principal modes of operation and display features of the TCAS function are discussed in the paragraphs that follow. In-flight procedures with display examples are contained in the T3CAS Pilot's Manual, ACSS Publication No.8008010-001.

(1) Operational Modes

The TCAS function can operate in several different modes, depending on control panel selection. Several control panels are available. Only the ACSS single Mode S control panel is discussed. Other control panels provide similar features.

Four switches directly affect the TCAS operational mode: TCAS/XPDR mode selector, TA DSPLY selector, ALT RPTG selector, and TCAS TEST switch. To distinguish the modes that provide TCAS advisories from those that do not, the operational modes are discussed under TCAS modes and non-TCAS modes. The non-TCAS modes are annunciated TCAS OFF at the right center of the display.

The extended test mode is mentioned for reference. A detailed description of it use can be found in the FAULT ISOLATION section.

(a) TCAS Modes

The TA/RA and the TA-only modes are the two TCAS operational modes. The TA/RA mode gives traffic information and warnings of hazardous traffic conflicts, while the TA mode gives only traffic information. A third mode, the TEST mode, can be temporarily activated from any mode including standby (STBY). The TEST mode does not inhibit the generation of advisories. Functions available in the operational and test modes are as follows:

1 TA/RA Mode

This mode is the normal operation mode providing full TCAS coverage. In this mode, TCAS tracks all aircraft in the surrounding airspace and generates traffic advisories or resolution advisories, as the situation requires. Figure 1-3 contrasts the airspace covered for each kind of advisory.

For normal TA/RA operation, the TA/DSPLY selector must be set to AUTO or ON and the ALT/RPTG selector must be set to 1 or 2.

2 TA Mode

The TA mode provides only surveillance of the surrounding airspace. In this mode, TCAS tracks all proximate aircraft and generates traffic advisories; no resolution advisories are issued in this mode.

The flight crew uses the TA-only mode when resolution advisories would be a nuisance, or when flying over an area where only TCAS surveillance is allowed. Also, the system automatically selects this mode

when the aircraft is flying less than 1000 feet (304.8 meters) above ground level (AGL).

The TA mode is annunciated TA ONLY at the upper left corner of the display.

3 Test Mode

Pushing the TEST button on the control panel starts a self-test program which verifies proper operation of the TA and RA displays and of the aural advisories on the audio system.

The test mode does not affect normal TCAS operation, provided the selected transponder remains in normal operation during the test cycle. Should a TA or RA occur during the test sequence, the test aborts, and the advisory is announced and displayed.

The test mode just described excludes extended self-tests performed on the ground, where TCAS is inoperative.

(b) Hybrid Surveillance
(Applicable only to Part No.9005000-11801 and -55801)

The purpose of hybrid surveillance is to decrease TCAS interrogations and associated Mode S replies and use passive surveillance to track intruders that are far from being a threat without degradation of the TCAS collision protection. Another goal is to maintain tracks that may have been dropped from the display in high density traffic environments due to interference limiting.

Hybrid Surveillance includes both active and passive surveillance. Active surveillance uses the standard TCAS/transponder interrogations/replies to provide range, bearing and altitude. Passive surveillance is used to track traffic that is far from being a threat. Passive surveillance data including latitude, longitude and ground speed, must be provided by a navigation source that is typically GPS based and the data is broadcast and received through the processing of Mode S extended squitter. Under hybrid surveillance, TCAS active interrogations are used to validate the passive surveillance position.

An extension of passive surveillance is extended hybrid surveillance which is applied when ownship and intruder ADS-B position data meet certain quality and power requirements and the intruder is not a near threat in range and altitude. Under extended hybrid surveillance, the intruder is tracked with ADS-B data exclusively.

Refer to Section 6, sub-section Hybrid Surveillance Test/Fault Isolation Procedure for recommended procedures for performing hybrid surveillance checks, the recommended scheduled maintenance interval and for instructions for a required periodic reliability report.

(c) Non-TCAS Modes

The control panel selections that follow disable TCAS operation and all advisories:

- MODE S ON activates a Mode S transponder only
- STBY sets the selected transponder in standby mode
- ATC activates an ATCRBS transponder only
- ALT RPTG set to OFF inhibits altitude reporting.

When TCAS is inoperative as a result of control panel selection, TCAS OFF is annunciated on the display. When TCAS is inoperative due to a system failure, TA FAIL, RA FAIL, or TCAS FAIL is annunciated on the display. In addition, if the transponder or the altitude data source fails, the XPDR FAIL light on the control panel comes on.

(d) Extended Test Mode

The purpose of the extended test mode is to facilitate diagnosis in the event self-test has failed. Like self-test, this mode is enabled by pushing the TCAS TEST button, but only when TCAS is inoperative. The aircraft must be on the ground, and the transponder must be set to STBY. Push and hold the TCAS TEST button for longer than eight seconds to activate the extended tests. This feature is not available on all systems. Refer to the TESTING AND FAULT ISOLATION section for system requirements and test description.

(11) Display Symbology

The TCAS modes use color-coded symbols and data tags to map air traffic and locate threat aircraft on the RA/TA VSI display.

Four traffic symbols are used: solid circle, solid square, solid diamond, and hollow diamond. See Figure 1-17 for examples. A different color is assigned to each symbol type, as listed in Figure 1-17.

Table 1-21: TCAS Traffic Symbols

Graphic Symbol	Color	Display Function
Solid Circle	Amber	Traffic Advisory (TA)
Solid Square	Red	Resolution Advisory (RA)
Solid Diamond	Blue	Proximate Traffic
Hollow Diamond	Blue	Other Traffic

NOTES:

(1) TCAS traffic information displayed on EFIS displays such as crew alerting system display, navigation display, electronic horizontal situation display or multifunction display,

is similar to that on combined RA/TA VSI indicators. Traffic symbology is identical to that displayed on the RA/TA VSI.

(2) Some manufactures' displays may indicate Other Traffic with a hollow WHITE diamond. Some training materials may refer to the color BLUE as CYAN.

(a) Colors

1 Amber

Represents a moderate threat to a TCAS-equipped aircraft. A visual search is recommended to prepare for intruder avoidance. Amber is used only in conjunction with a traffic advisory.

2 Red

Represents an immediate threat to a TCAS-equipped aircraft. Prompt action is required to avoid the intruder. This color is only used in conjunction with a resolution advisory.

3 Blue

Represents proximate traffic and other traffic the TCAS surveillance logic has in its track file.

4 White

Used only for mode annunciations and for reference graphics, including aircraft home position, range ring, and VSI scale.

(b) Traffic Identification

1 Traffic Advisory

Intruder aircraft entering the caution area, 20 to 48 seconds from the TCAS 2000 collision area are represented as a solid amber circle. This type of traffic results in a traffic advisory.

2 Resolution Advisory

Intruder aircraft entering the warning area, 15 to 35 seconds from the TCAS 2000 collision area are represented as a solid red square. This type of traffic results in a resolution advisory.

3 Proximate Traffic

Aircraft within 6.0 nautical miles and ±1200 feet (365.76 meters) vertically are represented as a solid cyan diamond. Proximate traffic is shown to improve situational awareness in the event of a potential conflict with higher priority RA or TA aircraft.

4 Other Traffic

Any transponder replying to traffic not classified as an intruder or proximate traffic, and within ±2700 feet (822.96 meters) vertically and the range of the display are represented as hollow cyan diamonds (only in view with the traffic switch ON and no TA or RA in process). The predicted flightpaths of proximate and other traffic do not penetrate the collision area of the TCAS aircraft.

(c) Data Tags

A data tag, made up of a two-digit number, a plus (+) or a minus (-) sign, and may also include an arrow, appears either above or below the intruder aircraft symbol. The data tag appears in the same color as the advisory.

1 Two-Digit Number (Relative Altitude)

Represents the relative altitude difference, in hundreds of feet, either above or below the TCAS aircraft of an intruder aircraft. For an intruder above the TCAS aircraft, the data tag is placed above the traffic symbol and preceded by a plus (+) sign; for one below, the tag is placed below the traffic symbol and be preceded by a minus (-) sign.

2 Plus (+) or Minus (–) Sign

Appears adjacent to the relative altitude number and indicates whether the displayed aircraft is above (plus) or below (minus) the TCAS aircraft.

3 Arrow

A vertical arrow is placed to the immediate right of the traffic symbol if the intruder is either climbing (up arrow) or descending (down arrow) in excess of 500 feet per minute (152.4 meters per minute).

(d) VSI Scale Overlays

During a resolution advisory, red and green bands overlay the VSI scale. The red band indicates what vertical speed range is to be avoided by the pilot (prohibited vertical speed). The green band indicates the vertical speed the pilot is to attain to achieve safe separation from a threat aircraft (recommended vertical speed). The red/green band reflects the RA in progress and acts as a vertical speed advisory for the pilot.

(e) Reference Graphic and Annunciations

A white airplane symbol is displayed in the lower center of the VSI which represents the aircraft's own position. A white range ring made up of 12 white hash marks, each corresponding to a normal clock position, is included. The range ring surrounds the airplane with a radius of 2 nautical miles and is intended to assist in interpreting TCAS traffic information.

The scale of the VSI display is 6.0 nautical miles to the top display edge of the VSI (ahead of the aircraft), 4 nautical miles to the left and right edges, and 2.5 nautical miles to the bottom (behind the aircraft).

Annunciations in white letters serve as a reminder of the current operation mode. They include TCAS OFF, TA only and RA only. Fault annunciations in amber letters replace the mode annunciations in case of system failure. They include TCAS FAIL, RA FAIL, VSI FAIL, and TA FAIL (traffic display failure). Figure 1-13 shows a typical failure display.

(3) Aural Messages

The TCAS generates aural alerts or messages announced over the aircraft audio system. These messages accompany the visual TA or RA display and are softened or strengthened, depending on the urgency of the situation. The TCAS audio level is preset and is not adjustable by the aircrew.

If a logic change occurs before a message is completed and a new message is initiated, the original alert is terminated and the new alert announced immediately.

(a) Requirements and Limitations

The following is a list of the requirements and limitations for issuing an aural advisory by the T3CAS Computer Unit:

1 Voice announcements are inhibited below 500 feet (152.4 meters) above ground level (AGL).

2 The CANCEL BUTTON, which is a reserved input on the 9005000-10000, -10101, -10202, and -10204 T3CAS CUs, only halts voice announcements after the CANCEL BUTTON is activated. An aural advisory in progress is terminated and not repeated after deactivation of the CANCEL BUTTON.

3 During T3CAS computer unit self-test, an aural advisory confirms proper operation of the aural advisory system by annunciating the message “TCAS TEST”. The aural advisory system annunciates the pass/fail status of any monitored functions with the messages “TCAS TEST PASS” and “TCAS TEST FAIL”, respectively.

4 An aural advisory tone will precede each aural advisory when the audio tone enable program pin has been activated.

5 T3CAS computer unit TCAS aural alerts are inhibited when the advisory inhibit discrete inputs 2, 3, or 4 are grounded. An aural advisory in progress is disabled after the grounding of advisory inhibit discrete. The truncated message is annunciated in its entirety once the inhibit discrete has been released. This capability is used to defer all advisory (TA and RA), aural alert, and visual alert outputs until another, higher priority announcement/alert is completed. See Table 4-1 for RBP-5A, 5B, 5C and 5D.

6 Increases and decreases in the threat level are aurally annunciated. However, decreases in threat level are annunciated once and are not preceded by setting the audio tone discrete. For example, a vertical speed restriction following a climb RA is annunciated once.

(b) Traffic Advisory (TA) Message

The traffic advisory aural alert, TRAFFIC - TRAFFIC is spoken once, and then inhibited until the next TA occurs. This alert occurs when TCAS predicts an intruder will enter the collision area within 20 to 48 seconds. Simultaneously, the TCAS traffic display shows the location of the intruder.

(c) Resolution Advisory (RA) Messages

Resolution advisories indicate evasive vertical maneuvers calculated to increase separation between the TCAS aircraft and the intruder (corrective advisory), or to indicate certain changes in vertical speed are not recommended (preventive). Resolution advisory messages are repeated twice.

RAs are annunciated on the T3CAS computer unit using the voice messages listed below as determined by Collision Avoidance System (CAS) data. The following messages will not immediately follow another message from this paragraph if it causes a reversal of sense. For example, a “CLIMB, CLIMB” message cannot immediately follow a :”DESCEND, DESCEND” message.

1 “CLIMB, CLIMB”: Climb at the rate shown on the VSI or other suitable indicator.

2 “DESCEND, DESCEND”: Descend at the rate shown on the VSI or other suitable indicator.

3 “MONITOR VERTICAL SPEED”: Verify that vertical speed is out of the illuminated red VSI arc, or comply with another suitable indicator. Safe separation is based upon maintaining the current vertical speed.

4 “LEVEL OFF, LEVEL OFF”: Reduce climb or descent rate, maintain level flight.

5 “MAINTAIN VERTICAL SPEED, MAINTAIN”: Safe separation is based upon maintaining the current vertical speed.

6 “MAINTAIN VERTICAL SPEED, CROSSING, MAINTAIN”: Maintain vertical speed while crossing the intruder’s flight path.

7 “CLEAR OF CONFLICT”: Range is increasing, and separation is adequate; return to assigned clearance.

8 “CLIMB, CROSSING CLIMB—CLIMB, CROSSING CLIMB”: Safe separation is best be achieved by climbing through intruder’s flight path.

9 “DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND”: Safe separation is best achieved by descending through the intruder’s flight path.

(d) Enhanced RA Messages

Enhanced RAs are annunciated on the T3CAS computer unit using the voice messages listed below as designated by the CAS data when the initial resolution advisory does not provide sufficient vertical separation. These messages are annunciated to convey a sense of urgency. The following messages can immediately follow a message from the previous paragraph and can have a reversal of sense.

NOTE: These advisories are expected to occur only on rare occasions, usually when an intruder suddenly changes its current flightpath (Maneuvering intruder).

1 "INCREASE CLIMB, INCREASE CLIMB": (Received after a "CLIMB" advisory) Indicates additional climb rate required to achieve safe vertical separation from a maneuvering intruder.

2 "INCREASE DESCENT, INCREASE DESCENT": (Repeated two times, received after "DESCEND" advisory) Indicates additional descent rate required to achieve safe vertical separation from a maneuvering intruder.

3 "CLIMB, CLIMB NOW!—CLIMB,CLIMB NOW!": (Received after a "DESCEND" resolution advisory) Indicates a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder.

4 "DESCEND, DESCEND NOW!—DESCEND, DESCEND NOW!": (Received after a "CLIMB" resolution advisory) Indicates a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder.

(4) Operating Procedures

Basic TCAS operating procedures on the ground include pre-flight test, TCAS activation before takeoff, and TCAS deactivation after landing. In-flight procedures are contained in the pilot's manual.

(a) Pre-Flight Test

The RA/TA VSI self-test feature provides a convenient method to test the TCAS system before takeoff.

NOTE: Self-Test can be initiated at any time, on the ground or in flight (if not disabled in the air by grounding pin RBP-8E), by momentarily pushing TCAS TEST. If TAs and RAs occur while self-test is activated in flight, the test aborts, and the advisories are processed and displayed.

To perform self-test, push the TCAS TEST button on the control panel and monitor the sequence that follows:

- Aural annunciation TCAS TEST is heard on audio system.
- Test pattern with fixed traffic and advisory symbols appears on the display for eight seconds.
- Make sure the test pattern is as shown in Figure 1-17. The test pattern includes:
  - An RA symbol at 3 o'clock, 2 NMI, 200 feet (60.96 meters) above, in level flight
  - A TA symbol at 9 o'clock, 2 NMI, 200 feet (60.96 meters) below, climbing
  - A proximate traffic symbol at 3.6 NMI, 33 degrees right of the aircraft heading (approximately 1 o'clock), 1000 feet (304.8 meters) below, descending

- A non-threat intruder (other traffic symbol) at 3.6 NMI, 33 degrees left of the aircraft heading (approximately 11 o'clock), 1000 feet (304.8 meters) above, in level flight
- Red and green resolution advisory VSI overlay indicating a don't descend, don't climb > 2000 feet per minute (609.6 meters per minute) advisory
- TCAS TEST or RA OFF annunciation, depending on the capabilities of the display.
- After 8 seconds, TCAS TEST PASS is announced, and the test pattern is replaced with the normal VSI display.
- If self-test fails, TCAS TEST FAIL is announced, and TCAS FAIL appears on the display. To obtain failure data, perform the extended test mode procedure in the next section.

(b) TCAS Mode Activation

Prior to takeoff, activate TCAS as follows:

- Set TCAS/XPDR mode selector to TA/RA
- Set TA/DSPLY to AUTO
- Set ALT/RPTG to 1 or 2.

(c) TCAS Mode Deactivation

After clearing the runway following landing, set the TCAS/XPDR mode selector to STBY to disable Mode S communication.

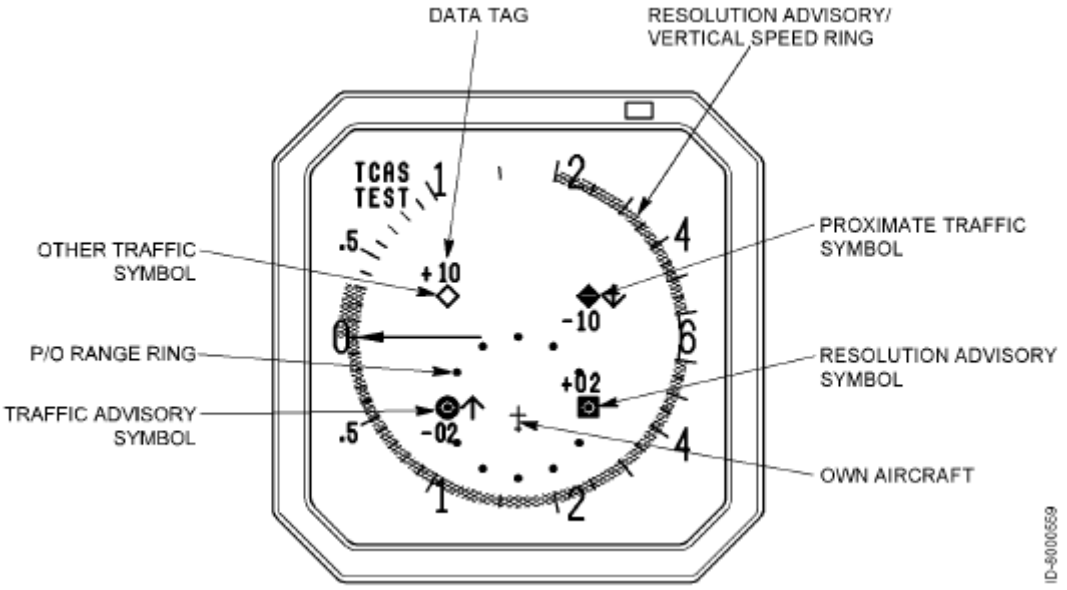


Figure 1-17: TCAS Display Test Pattern

B. TAWS/RWS Operation

The principal modes of operation and display features of the TAWS/RWS function are discussed in the paragraphs that follow. In-flight procedures with display examples are contained in the T3CAS Pilot's Guide, ACSS Publication No. 8008010-001.

(1) TAWS Operational Modes

The T3CAS TAWS function provides both conventional GPWS and Collision Prediction and Alerting (CPA) modes of operation.

The conventional GPWS modes of operation are as follows:

(a) Mode 1: Excessive Rate of Descent with Respect to Terrain

This mode provides, as defined in RTCA DO-161A, a reactive medium-term caution and a reactive short-term warning when the current flight path is descending toward the terrain ahead of the aircraft at an excessive rate. Figure 1-18 shows Mode 1 - Excessive Descent Rate Envelope.

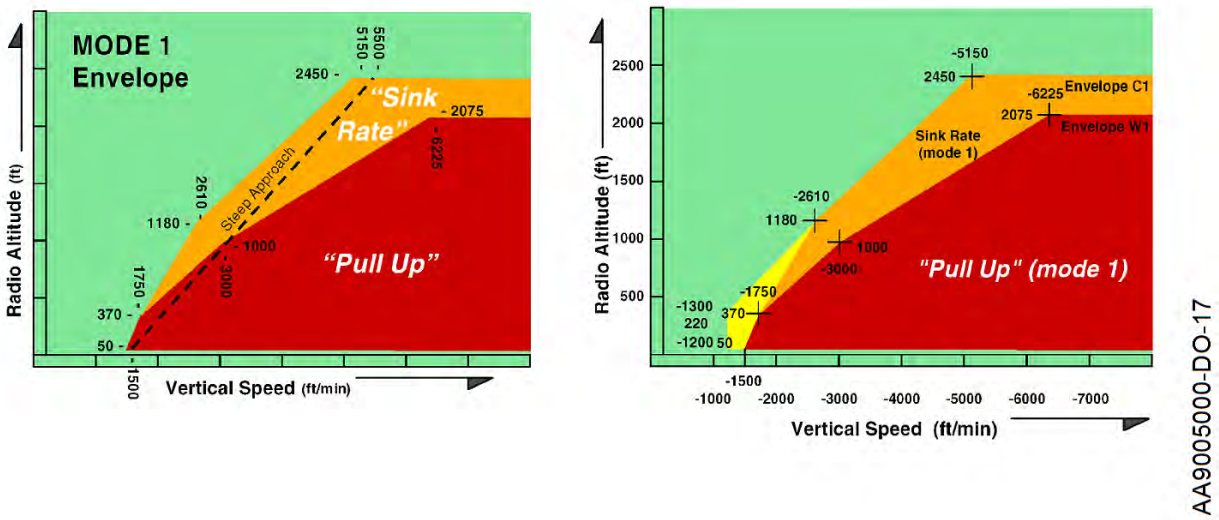


Figure 1-18: Mode 1 – Excessive Descent Rate Envelope

(b) Mode 2: Excessive Closure Rate to Terrain

When the CPA mode is inoperative, this mode provides, as defined in RTCA DO-161A, a reactive medium-term caution and a reactive short-term warning when the current flight path and the terrain ahead of the aircraft are closing at an excessive rate. When the CPA mode is operative, Mode 2 is conditionally activated when a terrain cell in the terrain database is detected to be significantly low. Figure 1-19 shows Mode 2 - Excessive Terrain Closure Rate Envelope.

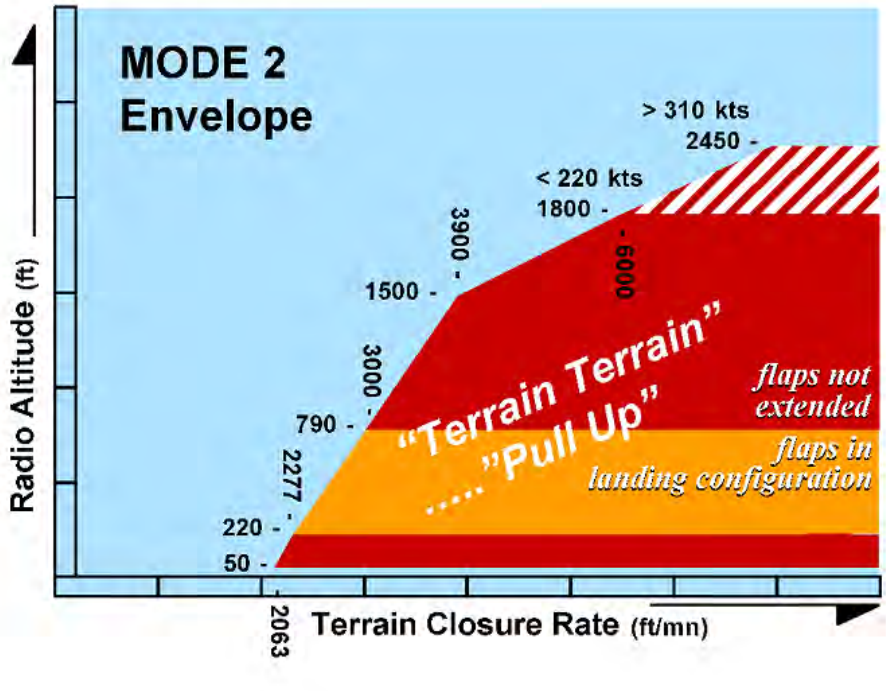


Figure 1-19: Mode 2 – Excessive Terrain Closure Rate Envelope

(c) Mode 3: Excessive Altitude Loss after Take-Off

This mode provides, as derived from RTCA DO-161A, an alert when there is a loss of altitude after take-off or during a missed approach. Figure 1-20 shows Mode 3 - Loss of Altitude after Take-Off Envelope.

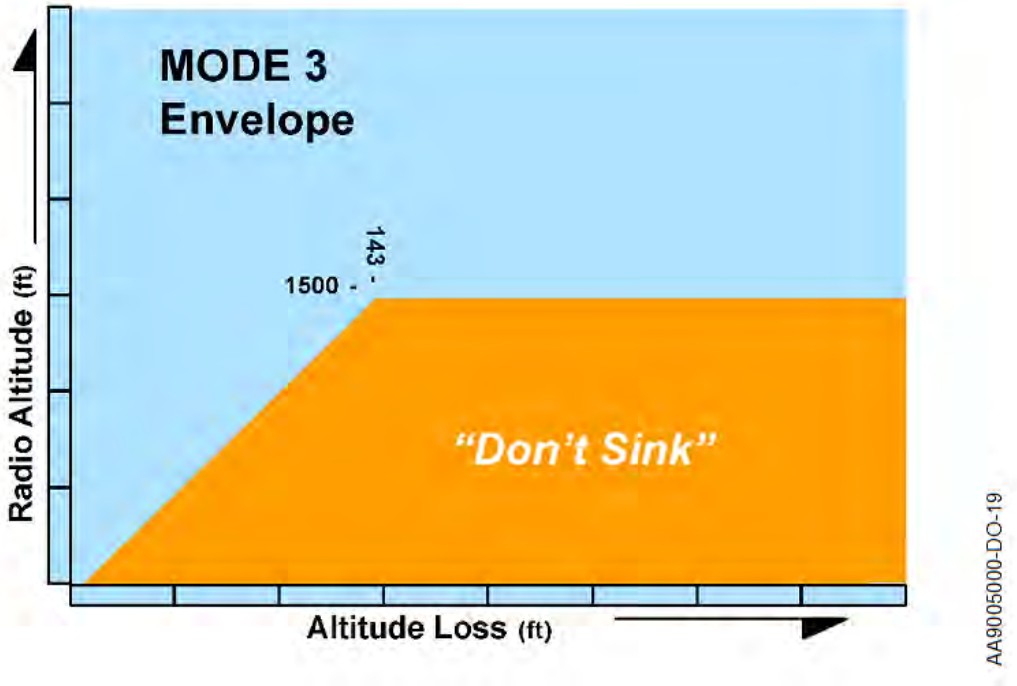


Figure 1-20: Mode 3 – Excessive Altitude Loss after Take-Off Envelope

(d) Mode 4: Incorrect Aircraft Configuration With Regard to Terrain

T3CAS meets the requirement for Mode 4 alerts as defined in RTCA DO-161A. Mode 4 applies during the landing phase of flight and results in the annunciation of an alert in the event of insufficient terrain clearance when the aircraft is not in the proper landing configuration. Mode 4 consists of the following two sub-modes:

- Mode 4A, when the landing gear is up
- Mode 4B, when the landing gear is down, but the flaps are not in landing configuration.

Figure 1-21 shows Mode 4 - Unsafe Terrain Clearance Envelope.

NOTE: For the Long Range aircraft types (A340-500-600, A340-200-300, A330), the Mode 4 envelope area of "Too Low Gear" has been extended from 190 knots to 200 knots. The Mode 4 envelope area of "Too Low Flaps" has been extended from 159 knots to 180 knots. This was decided upon consideration of computed airspeed based on aircraft type and speed approach capabilities.

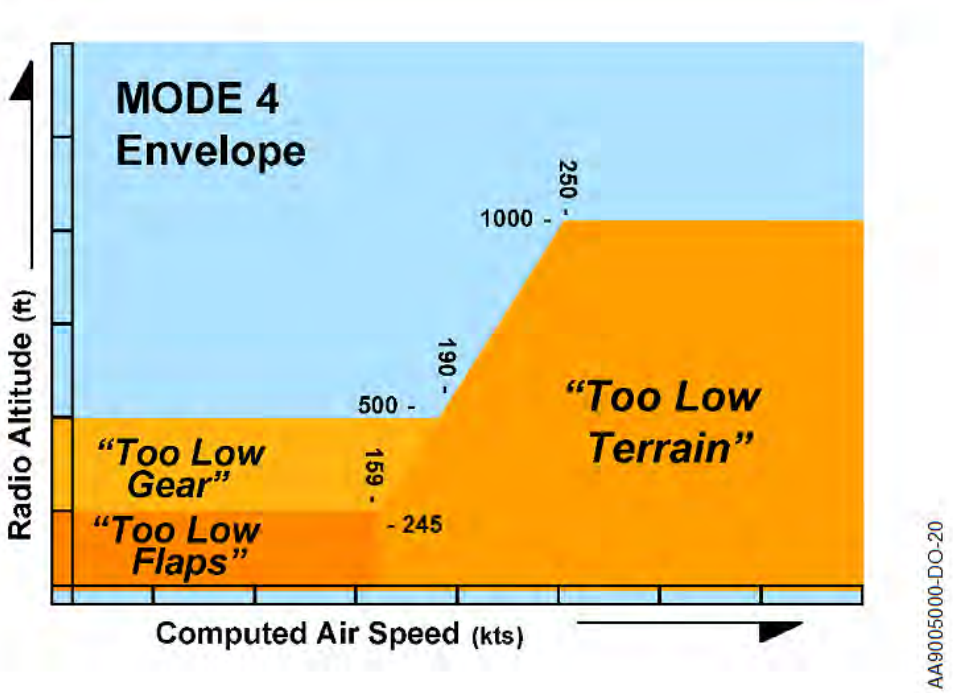


Figure 1-21: Mode 4 – Unsafe Terrain Clearance Envelope

(e) Mode 5: Excessive Glide Path Deviation

T3CAS meets the requirement for Mode 5 alerts as defined in RTCA DO-161A. Mode 5 applies in the event of an excessive descent below the instrument glide path when making a front-course approach with the gear down. Figure 1-22 shows Mode 5 - Excessive Glide Path Deviation Envelope.

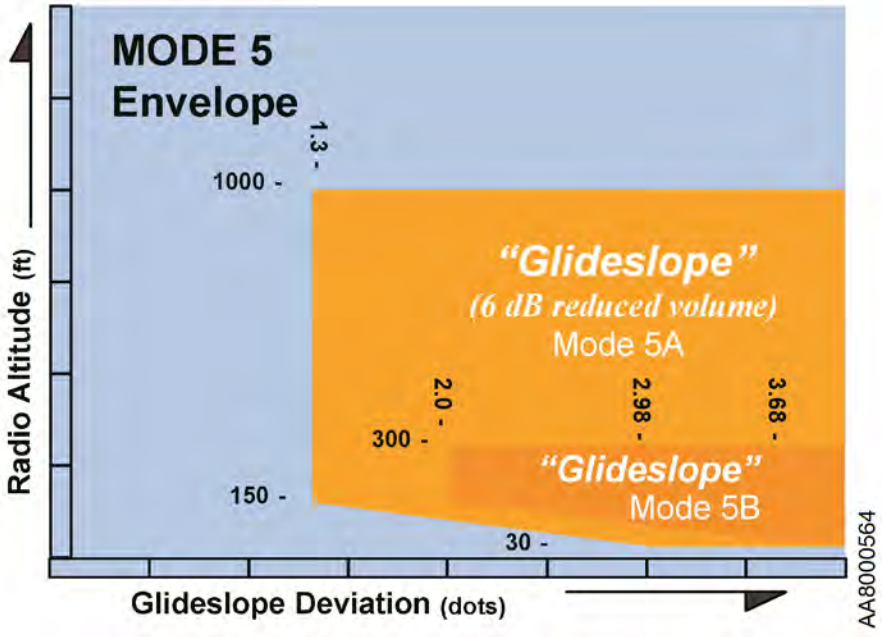


Figure 1-22: Mode 5- Excessive Glide Path Deviation Envelope

When Localizer Performance with Vertical guidance (LPV) data is provided to the T3CAS unit in the same format as the ILS Glideslope Deviation data, LPV Mode 5 operation is supported by T3CAS. Coordinate with ACSS regarding the LPV data format sourced by the T3CAS interfacing equipment installed on the aircraft to determine if the input format can be supported by the T3CAS unit.

(f) Altitude Call-Outs
(Not applicable for Part Numbers 9005000-10000, -10101, -10202, -10204, and -11203).

The T3CAS TAWS function produces call-outs and alerts for descent below a set of customer defined altitudes.

(g) Excessive Bank Angle

The T3CAS TAWS function produces call-outs and alerts for descent below a set of predefined altitudes and for excessive bank angle. Figure 1-23 shows Excessive Bank Angle Envelope.

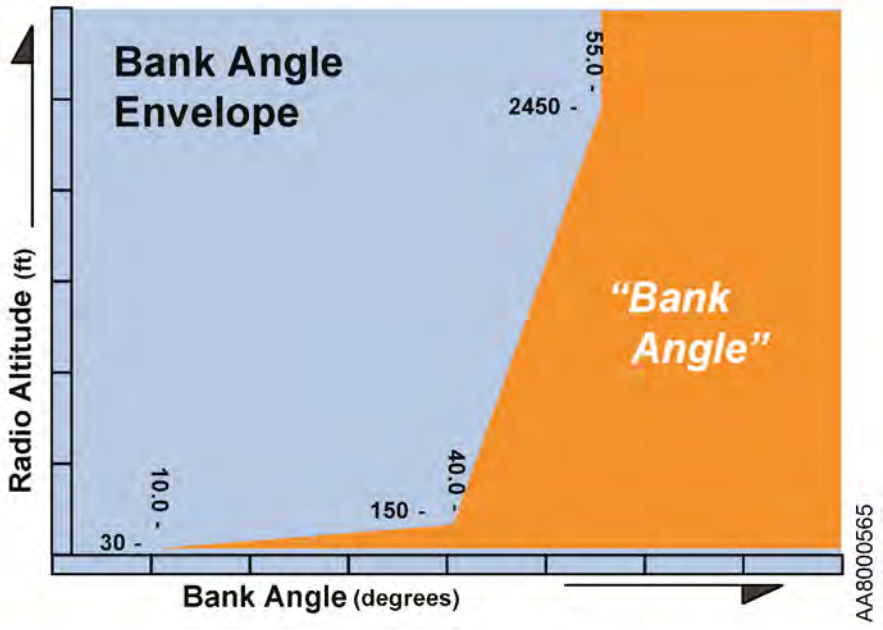


Figure 1-23: Excessive Bank Angle Envelope

The CPA mode of operation provides medium-term (caution) and short—term (warning) alerts to inform the crew that the flight path they are following is hazardous due to the presence of terrain/obstacles ahead. The objective of the CPA function is to warn the crew of an impending controlled flight into terrain/obstacles with sufficient time for them to assess the situation and safely avoid the terrain/obstacles hazard. All CPA predictions are based on the assumption that the operational escape maneuver in case of a terrain/obstacles hazard will be a “pull up” evasive action. CPA predictions model a conservative pull up escape maneuver based on current aircraft climb capability.

The T3CAS CPA function provides alerts in the following CFIT situations:

- Hazardous descent rate with respect to terrain/obstacles
- Hazardous closure rate with respect to terrain/obstacles
- Hazardous terrain/obstacles ahead situation during turns
- Hazardous high terrain/obstacles ahead situation that cannot be cleared by a pull up maneuver.

(5) RWS Operational Mode

NOTE: The FMO “Windshear Enable” and the TAWS function must be enabled in order for the RWS function to activate. TAWS is enabled via program pin RTP-11H.

Whenever wind factors cause aircraft performance to decrease to a predetermined level, an audio warning is sounded, indicating to the crew that the aircraft net performance capability is deteriorating and rapidly approaching a critical state. In addition to the warning, the Windshear Warning algorithm

provides a caution when a performance-increasing Windshear is detected, thus giving advance warning of a performance-decreasing windshear. Figure 1-24 illustrates reactive windshear detection.

NOTE: Reactive Windshear is not applicable for Part Numbers 9005000-10000, -10101, -10202, -10204, and -11203.

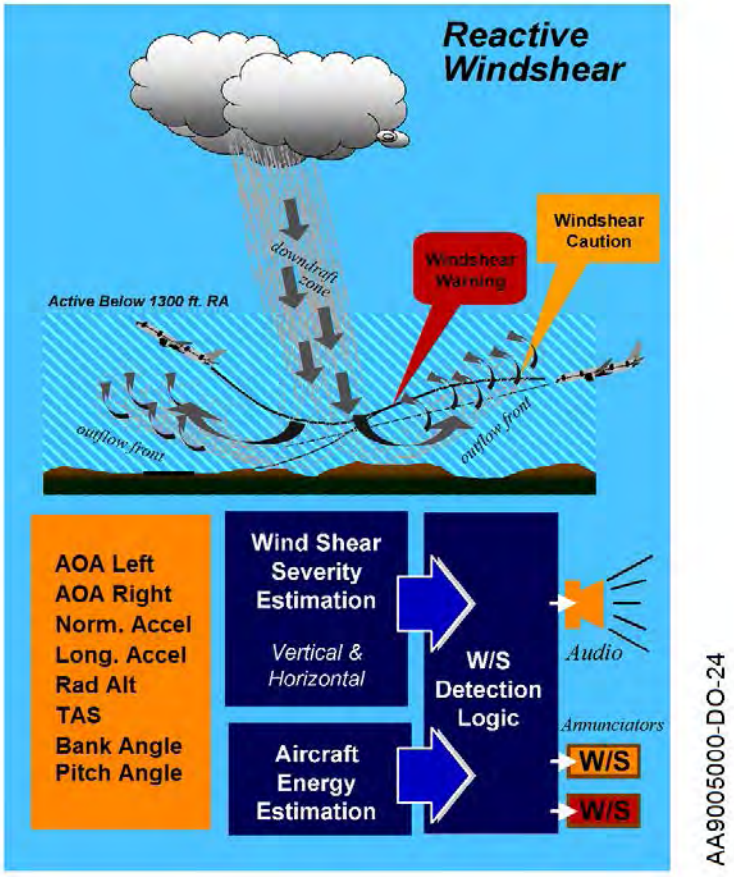


Figure 1-24: Windshear Detection

The following are the inputs required for RWS:

- Pitch Angle
- Body Angle of Attack Left
- Body Angle of Attack Right
- Body Axis Normal Acceleration
- Body Axis Longitudinal Acceleration
- TAS
- Bank Angle

- Radio Altitude

(6) TAWS Display Symbology

The terrain hazard display function generates an image that provides the following information to the flight crew:

- A Terrain Display Background consisting of shaded areas representing terrain at different altitudes relative to the aircraft altitude.
- A Terrain Advisory Line depicting the point or points where a CPA caution will occur if the aircraft continues on its current trajectory.
- Terrain Alert areas corresponding to the terrain that is causing a CPA caution or warning.Each of these features is explained in the following sub-sections.

NOTE: Obstacles will not generate the Terrain Advisory Line.

(a) Terrain Display Background

The purpose of the Terrain Display Background is to provide overall situational awareness to the crew about the relative height of the terrain near the aircraft.

The terrain is divided into “slices” based on the elevation of the terrain with respect to an aircraft reference altitude. Slices above or very near the reference altitude are typically shown as varying shades of yellow. Slices safely below the reference altitude are typically shown as varying shades of green or even black.

The reference altitude is a surface starting at the aircraft and propagating forward along the aircraft flight path angle for 30 seconds. The reference altitude surface then extends horizontally at the altitude the aircraft is expected to have at that time (i.e., 30 seconds in the future).

The specific colors and textures used for the various slices, as well as the threshold altitudes for the slices, are contained in the Aircraft Specific Database (ASDB) and thus can be tailored for specific installations. Figure 1-25 shows a typical color scheme and altitude definitions. (Note: The figure is drawn in color. If this document is printed in black and white, the different yellow and green textures representing different terrain elevations will appear as different shades of gray.)

NOTE: For Part Numbers 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801, in order to comply with the dark cockpit philosophy and to avoid covering up symbols displayed by other systems (FMS maps, trajectories, TCAS intruders) the non alerting areas are black.

For Part Numbers 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801 the terrain colored textures is as follows:

Slice 1 - Black

Slice 2 - Light Density Green (12.5% dot density)

Slice 3 - Medium Density Green (25% dot density)

Slice 4 - Medium Density Yellow (25% dot density)

Slice 5 - High Density Yellow (50% dot density)

Slice 6 - High Density Red (50% dot density)

Caution - Solid Yellow

Pull Up Warning - Solid Red

Avoid Terrain - Solid Red with Black

Unavailable Terrain - Medium Density Magenta (50% dot density)

Terrain Slice Altitude Limits are as follows:

Slice 1-2 Altitude Limit = Reference Altitude - 2000 feet (609.6 meters)

Slice 2-3 Altitude Limit = Reference Altitude - 1000 feet (304.8 meters)

Slice 3-4 Altitude Limit = Reference Altitude - MTCD . See Note Below

Slice 4-5 Altitude Limit = Reference Altitude + 1000 feet (304.8 meters)

Slice 5-6 Altitude Limit = Reference Altitude + 2000 feet (609.6 meters)

If the Eleview feature is enabled, the display will have two three-digit elevation numbers. The top number represents the highest terrain elevation and the bottom number represents the lowest terrain elevation displayed in color. Each elevation expressed in hundreds of feet (e.g., 250 is 25,000 ft MSL). The eleview slices are sized as a proportion of the terrain amplitude spread. The spread changes as the terrain in range changes. The spread percentages are configurable by ACSS. In a situation where the spread between the highest and lowest elevation is very low, the display will only show one shade of green with black. If the display supports cyan, water will be depicted. If the display does not support cyan, water will remain black.

NOTE: The MTCD margin is used in order to determine the limit between slice #3 and #4. The MTCD is the minimum safe distance between the aircraft and the terrain when considering a CFIT situation. This clearance is usually about 600 feet (182.88 meters) en route and is progressively reduced to 30 feet (9.144 meters) in the short final approach phase of flight. This allows the pilot to see the green-to-yellow terrain slice transition anytime terrain is within MTCD of the aircraft.

NOTE: Eleview digits will not be displayed in the following situations:

If the Display Spread in the Viewable area (i.e., the difference between the maximum terrain or obstacle height and the minimum terrain or obstacle height) is less than 750 feet, then the minimum elevation number is removed, regardless of height of aircraft.

If the Display Spread in the Viewable area is no higher than 200 feet above the runway, and the aircraft position is within 15 NM and 3500 ft height of the runway elevation, then the maximum and minimum elevation numbers are removed.

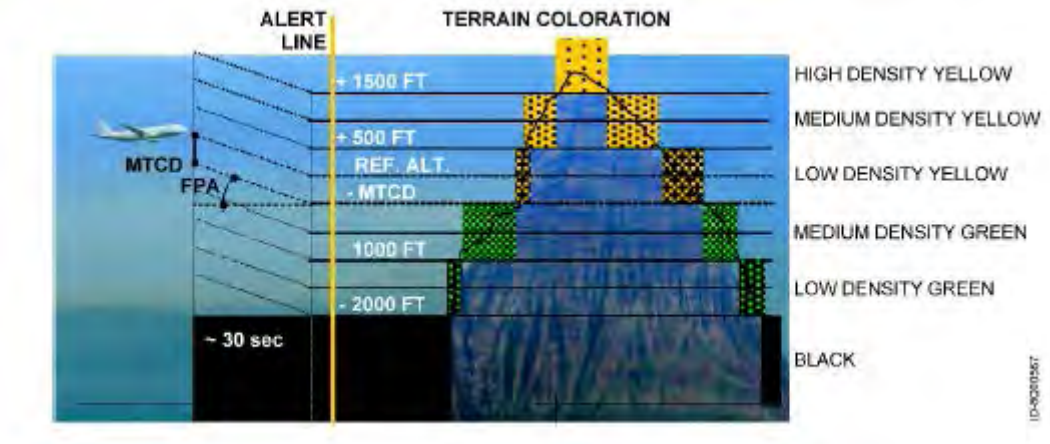


Figure 1-25: Terrain Slices

A typical terrain background image is shown in Figure 1-26.

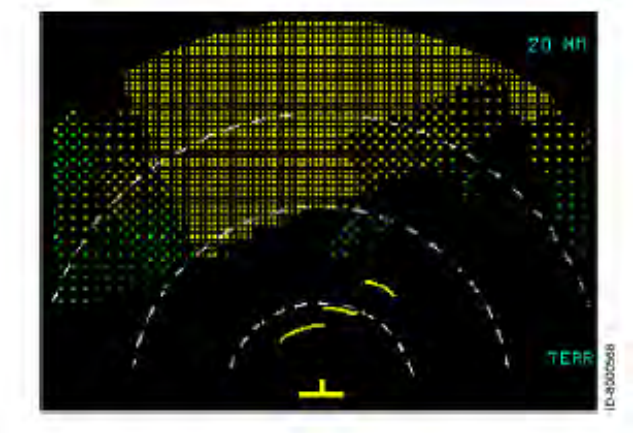


Figure 1-26: Terrain Display Background

(b) Terrain Advisory Line

The Terrain Hazard Display can also depict a Terrain Advisory Line. The Terrain Advisory Line is drawn at the points where a CPA caution will occur if the aircraft continues along its current vertical trajectory. When there are no CPA cautions or warnings active, T3CAS TAWS will determine if a Terrain Advisory Line needs to be drawn. Beginning at the current aircraft position, T3CAS TAWS looks ahead of the aircraft to determine where a CPA caution will occur. T3CAS TAWS will monitor terrain up to 120 seconds ahead of the current position. If T3CAS detects that the aircraft is within 15 nautical miles of a mountainous airport, the prediction distance of the TAL will be progressively reduced from 120 seconds down to 30 seconds at 5 nautical miles.

For the purposes of the Terrain Advisory Line, when the absolute value of the Roll Angle is within 5 degrees, the aircraft is considered to be in “wings level” flight. Under this wings level flight condition, the TAL is only calculated using an extraction aperture of 1.5 degrees on either side of the aircraft’s current track projection. This will result in a single Terrain Advisory Line and an alert if the aircraft’s current trajectory is maintained. When the absolute value of the Roll Angle is greater than 5 degrees, TAL calculation is opened up in the direction of the turn at an angle equal to 90 degrees. The TAL extraction is extended along the flight path angle to the full prediction distance of 30-120 seconds based off of the distance to nearest airport and mountainous area airports consideration. The side opposite of the turn remains at an extraction aperture of 1.5 degrees. If any CPA cautions would be triggered in this area, the Terrain Advisory Line will be drawn on the terrain hazard display.

Figure 1-27 illustrates the Terrain Advisory Line. The Terrain advisory line is the solid yellow line located at about the 5-nautical mile range ring. As the aircraft continues, this line (as well as the background terrain) would get closer to the aircraft symbol. When the Terrain Advisory Line reached the aircraft symbol, a CPA caution would occur. Thus the

Terrain Advisory Line provides the flight crew an advance indication of when CPA alerts will occur. The Terrain Advisory Line is not displayed when a CPA caution or warning is active. Obstacles will not generate the Terrain Advisory Line.

NOTE: For Part Numbers 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801, the Terrain Advisory Line Programming pin must be selected in order to display the TAL.

Figure 1-27: Terrain Advisory Line

(c) Display of Terrain and Obstacle Alerts

When a CPA caution or warning occurs, the terrain that caused the alert will be displayed on the Terrain Hazard Display. Solid yellow is used for cautions, solid red is used for pull-up warnings, and black X's on a solid red background are used for avoid terrain warnings.

In Figure 1-28 , the caution alarm is generated through the TAWS display by highlighting the hazardous terrain in yellow. An aural message is also played on the flight deck.

Figure 1-28: Terrain Hazard Display Upon Caution Alert

In Figure 1-29, the obstacle caution alarm is generated through the TAWS display by highlighting the hazardous obstacle in yellow. An aural message is also played on the flight deck.

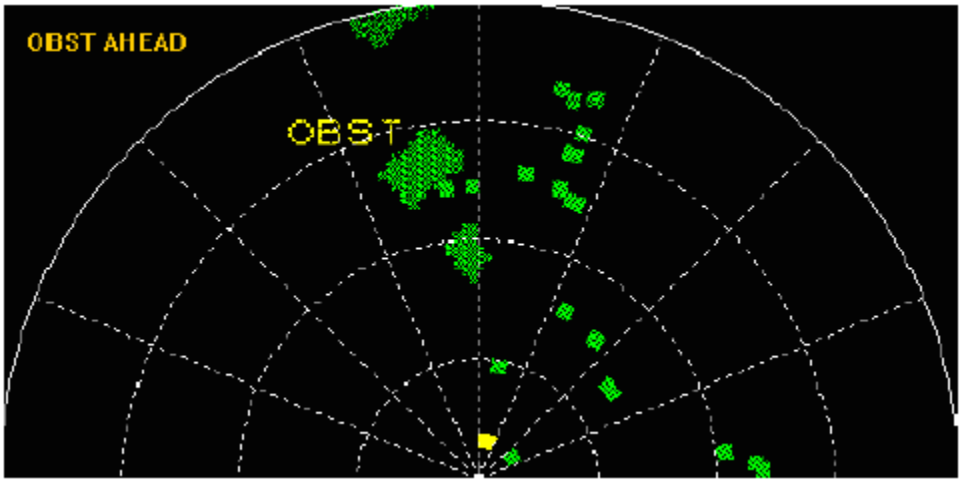


Figure 1-29: Obstacle Hazard Display Upon Caution Alert

In Figure 1-30, the warning alarm is generated through the TAWS display by highlighting the hazardous area ahead of the aircraft in red. An aural message is also played on the flight deck.

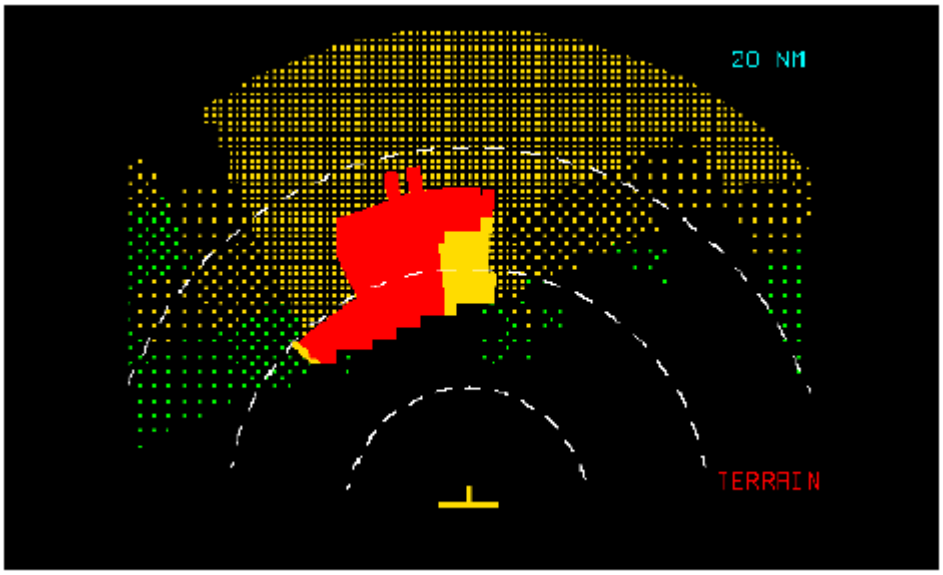


Figure 1-30: Terrain Hazard Display Upon A Pull-up Warning

In Figure 1-31, the obstacle warning alarm is generated through the TAWS display by highlighting the hazardous obstacle in red. An aural message is also played on the flight deck.

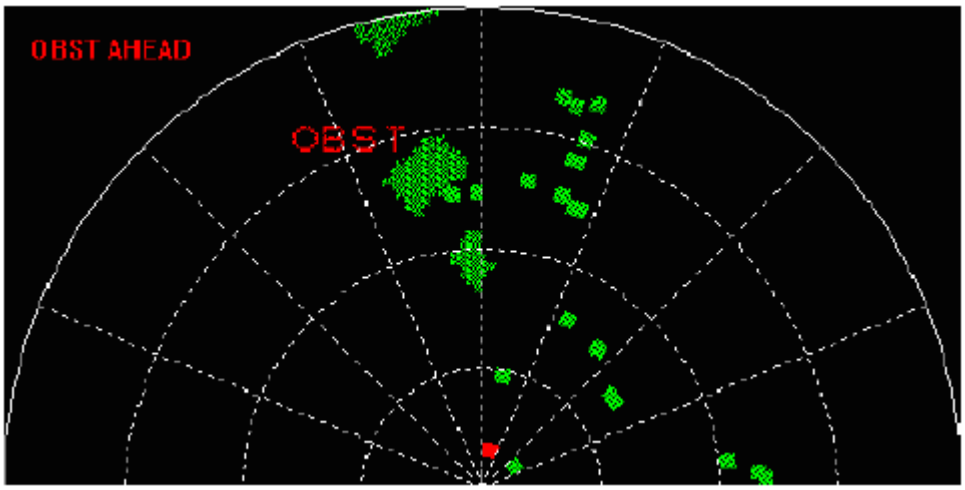


Figure 1-31: Obstacle Hazard Display Upon Pull-up Warning

In Figure 1-32, the warning alarm is generated through the TAWS display by highlighting the hazardous area ahead of the aircraft in red with black X's. An aural message is also played on the flight deck. The "pull-up" maneuver will not allow for a safe clearance with terrain, and the crew has to immediately initiate an appropriate vertical and/or turning escape maneuver in order to avoid a CFIT accident.

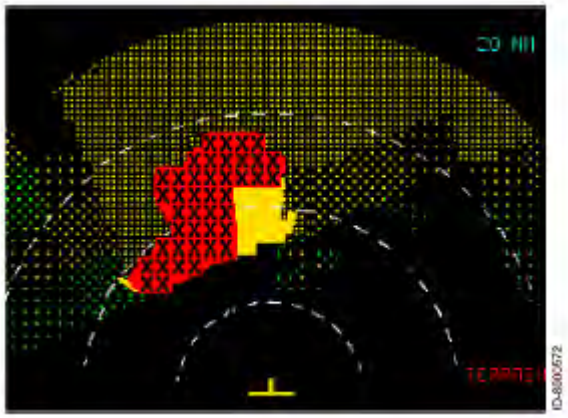


Figure 1-32: Terrain Hazard Display Upon an Avoid Terrain Warning

In Figure 1-33, the warning alarm is generated through the TAWS display by highlighting the hazardous obstacle ahead of the aircraft with a red and black "X". An aural message is also played on the flight deck. The "pull-up" maneuver will not allow for a safe clearance with the obstacle, and the crew has to immediately initiate an appropriate vertical and/or turning escape maneuver to avoid a CFIT accident.

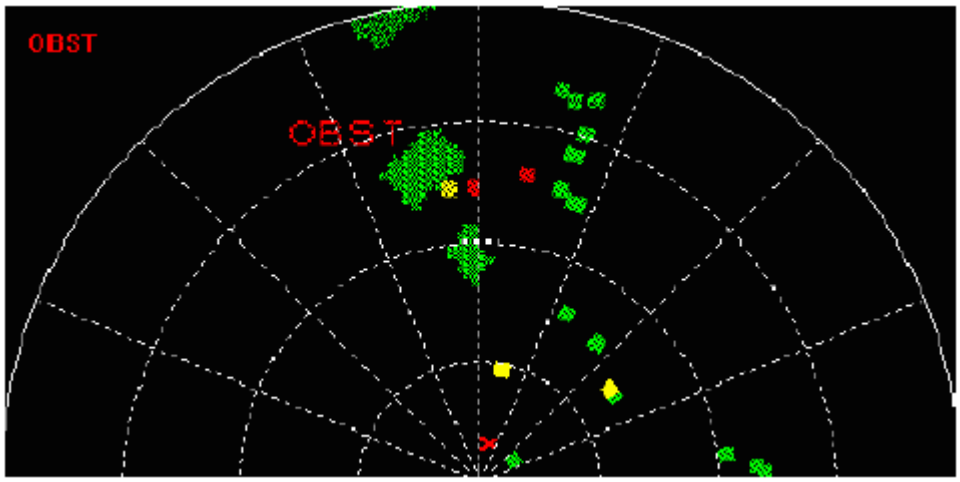


Figure 1-33: Terrain Hazard Display Upon an Avoid Obstacle Warning

Figure 1-34 shows an example of the Eleview function at low altitude while still in the hazard display mode. The highest red terrain is 6,700 feet (2042.16 meters) MSL. The lowest green terrain is 1,200 feet (365.76 meters) MSL.

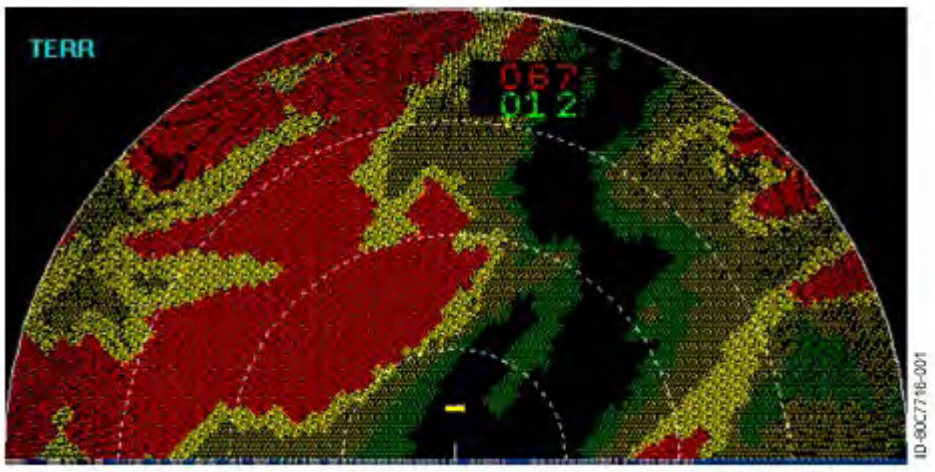


Figure 1-34: Low Altitude Eleview Display

Figure 1-35 shows an example of the Eleview function at high altitude in full Eleview display mode when the highest displayed terrain is well below the operator defined threshold. The highest terrain, shown using high density green, is 13,500 feet (4114.8 meters) MSL. The low density green terrain is at 3,400 feet (1036.32 meters) MSL. This example also contains an example of the water depiction.

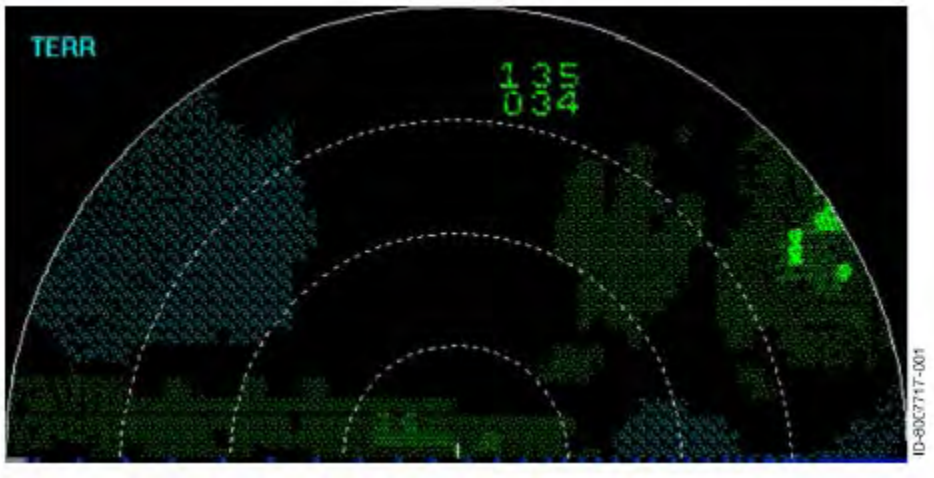


Figure 1-35: High Altitude Eleview Display

(7) TAWS/RWS Aural Messages

Aural alerts can be generated for any of the cautions or warnings generated by the TAWS and RWS functions. The specific messages are selectable from a list of several options. Additionally, the T3CAS can be configured to play the voices in either a male voice or a female voice. The list of selectable aural alerts is shown in Table 1-22.

Table 1-22: TAWS/RWS Aural Alerts

Condition	Selectable Aural Alerts
CPA Caution	“Terrain Ahead” or “Caution Terrain”
CPA Warning -Pull up	“Terrain Ahead, Pull Up” or “Terrain, Terrain, Pull Up, Pull Up” or Whoop Whoop, “Pull Up”
CPA Warning - Avoid Terrain	“Avoid Terrain” (NOTE 2)
Mode 1 Caution	“Sink Rate, Sink Rate”
Mode 1 Warning	Whoop, Whoop, “Pull Up” or “Pull Up, Pull Up” (NOTE 1)
Mode 2 Caution	“Terrain, Terrain”
Mode 2 Warning	Whoop Whoop “Pull Up” or “Pull Up, Pull Up” (NOTE 1)

Table 1-22: TAWS/RWS Aural Alerts (cont)

Condition	Selectable Aural Alerts
Mode 3 Caution	“Don’t Sink, Don’t Sink”
Mode 4 Caution	“Too Low Terrain” or “Too Low Flaps” or “Too Low Gear”
Mode 5 Caution	“Glideslope”
Bank Angle Alert	“Bank Angle, Bank Angle”
Windshear Caution	Nothing (NOTE 1) or “Caution Windshear”
Windshear Warning	“Windshear Windshear Windshear” (NOTE 1) or siren “Windshear Windshear Windshear” (NOTE 1)
Callouts	“Minimums Minimums” “Minimums” “Decision Height” “Unknown Decision Height” “Approaching Minimums” “Approaching Decision Height” “Twenty Five Hundred” “One Thousand” “Five Hundred” 500-ft (152.4-m) tone “Four Hundred” “Three Hundred” “Two Hundred” “One Hundred” 100-ft (30.48-m) tone “Eighty” “Sixty” “Fifty” “Forty” “Thirty Five” 35-ft (10.668-m) tone “Thirty” “Twenty” 20-ft (6.096-m) tone “Ten” (NOTE 1)

Table 1-22: TAWS/RWS Aural Alerts (cont)

NOTES:

1. These aural messages are not applicable for Part Numbers 9005000-10000, -10101, -10202, -10204, -11203.
2. For Part Numbers 9005000-10000, -10101, -10202, -10204, -11203, -11801 and -55801, the Avoid Terrain aural alert begins with a single “TERRAIN AHEAD PULL UP” or “TOO LOW TERRAIN” or “TERRAIN, TERRAIN, PULL UP, PULL UP” then followed by “AVOID TERRAIN” (i.e., “TERRAIN AHEAD PULL UP”, “AVOID TERRAIN”, “AVOID TERRAIN”, etc.) when an Avoid Terrain condition exists before a Pull-Up occurs.

(8) Operating Procedures

Basic TAWS/RWS operating procedures on the ground include pre-flight test, TAWS/RWS activation before takeoff, and TAWS/RWS deactivation after landing. In-flight procedures are contained in the pilot’s manual.

(a) Pre-Flight Test

- The Standard Self-Test is performed by activating either the OMS self-test or the self-test discrete input. The Standard Self-Test can only occur while on the ground.
- Upon activating the Standard Self-Test the following will occur:
- The Standard Self-Test will not be initiated if a TAWS alert is present when either the OMS self-test or the self-test discrete input is activated.
- If the T3CAS unit has the windshear function enabled, the following aural annunciation will occur:

  “TERRAIN AWARENESS AND WINDSHEAR TEST START”
- If the T3CAS unit does not have the windshear function enabled, the following aural annunciation will occur:

  “TERRAIN AWARENESS TEST START”.

During the Standard Self-Test the following will occur:

All discrete outputs implemented within a specific aircraft installation will be tested for over current and output voltage levels by activating the output for 4.0 seconds (±100 milliseconds), then deactivating the output for 2.0 seconds (±100 milliseconds), and then re-activating the output for 4.0 seconds (±100 milliseconds). Any faults found will be recorded in the T3CAS unit’s non-volatile memory.

The T3CAS unit will verify the following functional areas in accordance with Figure 1-36.

- Aircraft Personality Module (APM) (Not applicable to Part Numbers 9005000-10000, -10101, -10202, -10204, or -11203.)
- Terrain Database CRC

- External System Inputs
- Internal TAWS Parameters

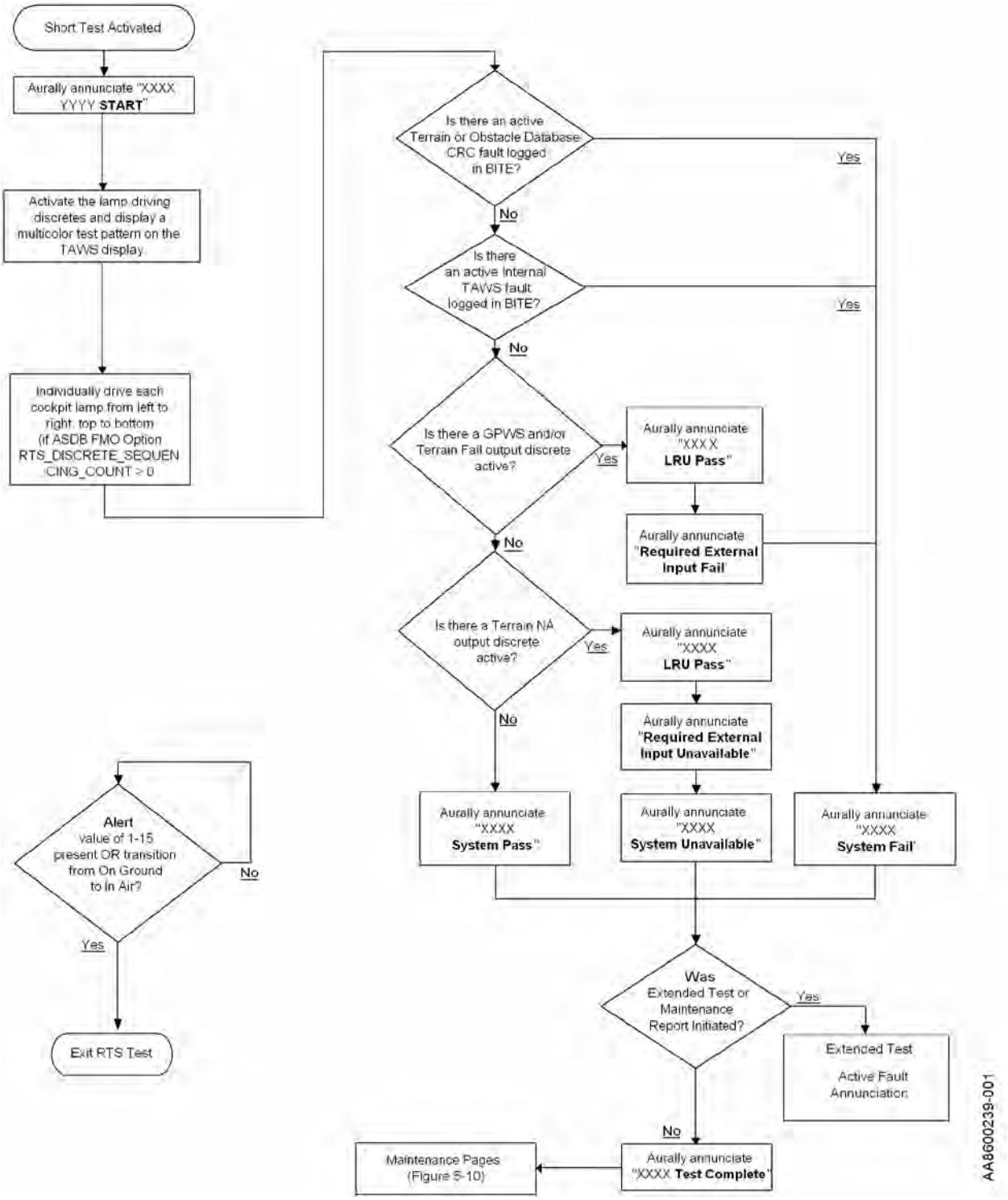


Figure 1-36: Standard Self-Test of TAWS/Windshear Functional Areas

Comment: XXXX is dependent on the Windshear enable and YYYY is dependent on the type of RTS/Short test selected. If Windshear is enabled the XXXX is “Terrain Awareness and Windshear”, whereas if Windshear is disabled the XXXX is “Terrain Awareness”. If the Standard Self-Test is selected, YYYY is “Test”, if the Extended Self-Test is selected, YYYY is “Extended Test”, and if the Maintenance Report is selected, YYYY is “Maintenance Report”.

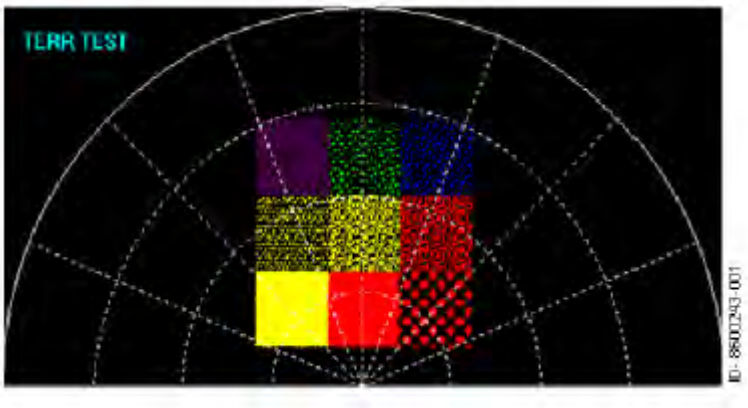


Figure 1-37: TAWS Display Test Pattern

The T3CAS unit will display a multicolor test pattern on both the captain’s and first officer’s TAWS displays. Figure 1-37 shows a typical multicolor test pattern.

NOTE: Each colored-square in Figure 1-37 represents a texture terrain image slice (2 through 6) as well as the pull-up area texture (P), avoid terrain area texture (A), and caution area texture (C) as defined in the ASDB SRS, Airplane Personality Module. Slice 1 is black in color therefore it is camouflaged into the background.

The T3CAS unit will interrupt the Standard Self-Test when any of the following alerts occur:

- “WINDSHEAR, WINDSHEAR, WINDSHEAR”
- “CAUTION WINDSHEAR”
- “TERRAIN AHEAD, PULL UP”
- “TERRAIN TERRAIN, PULL UP PULL UP”
- “≈ ≈PULL UP”
- “TERRAIN AHEAD”
- “TERRAIN CAUTION”
- “AVOID TERRAIN”
- “PULL UP, PULL UP”

- “TERRAIN, TERRAIN”
- “SINK RATE, SINK RATE”
- “DON’T SINK, DON’T SINK”
- “TOO LOW, TERRAIN”
- “TOO LOW, GEAR”
- “TOO LOW, FLAPS”
- “GLIDESLOPE”.

NOTE: “≈≈” designates a pair of varying tones from 400 to 800 Hz; where each tone is 0.3 seconds in duration, separated by 0.1 seconds, and at the end of the pair there is 0.1 seconds of silence.

NOTE: The aural annunciations listed above will depend on the Operator Selectable Options chosen during installation of the T3CAS unit.

Upon completion of the Standard Self-Test the following will occur:

- If the T3CAS unit has the windshear function enabled and the APM and Terrain Database and Internal system self-tests have passed, the following aural annunciation will occur:

  “TERRAIN AWARENESS AND WINDSHEAR SYSTEM PASS”

- If the T3CAS unit has the windshear function enabled and the Terrain Database CRC check fails, the following aural annunciation will occur:

  “TERRAIN AWARENESS AND WINDSHEAR SYSTEM FAIL”

- If the T3CAS unit has the windshear function enabled and if the Obstacle function is enabled and the Obstacle Database CRC check fails, the following aural annunciation will occur:

  “TERRAIN AWARENESS AND WINDSHEAR SYSTEM FAIL”

- If the T3CAS unit does not have the windshear function enabled and the APM and Terrain Database and Internal system self-tests have passed, the following aural annunciation will occur:

  “TERRAIN AWARENESS SYSTEM PASS”

- If the T3CAS unit does not have the windshear function enabled and the Terrain Database CRC check fails, the following aural annunciation will occur:

  “TERRAIN AWARENESS SYSTEM FAIL”

- If the T3CAS unit does not have the windshear function enabled and if the Obstacle function is enabled and the Obstacle Database CRC check fails, the following aural annunciation will occur:

  “TERRAIN AWARENESS SYSTEM FAIL”

- If the T3CAS unit has the windshear function enabled and the APM or Terrain Database or Internal system or Internal GPS self-tests have not failed, the following aural annunciation will occur:

  “TERRAIN AWARENESS AND WINDSHEAR TEST COMPLETE”

- If the T3CAS unit does not have the windshear function enabled and the APM or Terrain Database or Internal system self-tests have not failed, the following aural annunciation will occur:

  “TERRAIN AWARENESS TEST COMPLETE”.

- If the self-test passes, the system provides the following aural over the speaker system:

  “TERRAIN AWARENESS SYSTEM PASS”

  “TERRAIN AWARENESS TEST COMPLETE”

- If a T3CAS input from an external LRU is failed or a pin programming error is detected, the system provides the following aural message over the speaker system:

  “TERRAIN AWARENESS LRU PASS”

  “REQUIRED EXTERNAL INPUT FAIL”

  “TERRAIN AWARENESS SYSTEM FAIL”

- For Part Numbers 9005000-11801 and -55801, if a T3CAS input from an external LRU is invalid, the system provides the following aural message over the speaker system:

  “TERRAIN AWARENESS LRU PASS”

  “REQUIRED EXTERNAL INPUT UNAVAILABLE”

  “TERRAIN AWARENESS SYSTEM UNAVAILABLE”

- If a T3CAS input from an external LRU is NCD or functional test, the system provides the following aural message over the speaker system:

  “TERRAIN AWARENESS LRU PASS”

  “REQUIRED EXTERNAL INPUT UNAVAILABLE”

  “TERRAIN AWARENESS SYSTEM PASS”

- When the self-test is finished, the ON ND indication remains lighted with cyan TERR indication on bottom right corner of the ND (Terrain background is displayed, it can appear all black depending on the A/C location).

(b) TAWS/RWS Mode Activation

The TAWS/RWS is activated upon Aircraft Power Up and becomes available when parameters needed for normal operation of the TAWS/RWS functions are available.

(c) TAWS/RWS Mode Deactivation

The TAWS/RWS becomes deactivated upon Aircraft Power Down. Specific TAWS/RWS functions can become unavailable if an Internal or External parameter needed for normal operation of the TAWS/RWS functions is unavailable or invalid.

The TAWS predictive CPA modes may become deactivated upon the selection of the “Terrain Inhibit” switch. The purpose of the “Terrain Inhibit” switch is to allow the aircraft to operate without nuisance or unwanted warnings at airports that are not in the system database. Additionally, there may be some “VFR only” airports where unique terrain features are in close proximity to the runway. The “Terrain Inhibit” switch should NOT be engaged for normal operations.

C. Transponder Operation

An ATCRBS Transponder responds to ATCRBS interrogations with a Mode A (4096 code) reply or Mode C (altitude status) reply contingent upon the type of interrogation received. Interrogations are received by the transponder on 1030 MHz and replies are transmitted by the transponder on 1090 MHz. All ATCRBS transmissions are between the ground station and aircraft. A Mode S Transponder receives and transmits on the same frequencies as the ATCRBS Transponder and can receive and transmit ATCRBS interrogations and replies. However, the Mode S Transponder was developed for Mode S operation and can function alone as Mode S or in conjunction with TCAS. When functioning alone as Mode S, all Mode S transmissions are between the ground station and aircraft. When functioning in conjunction with TCAS, transmissions may also be from aircraft to aircraft.

Mode S System operation begins when aircraft power is applied. Initial self-test is performed automatically upon power-up and is completed in approximately 1 second. Self-testing of the system occurs continuously while in the power-on mode. If a transponder failure occurs, it is indicated on the control panel. Other failures are indicated via front panel-mounted LEDs on the transponders; however, these failure indications are not available to the pilot. All failures, whether hard or intermittent, are recorded in the transponder maintenance memory for analysis by maintenance personnel.

After power-up, the pilot enters the assigned 4096 code via the control panel. This code is the ATC identification code for that aircraft and is used during ATCRBS (Mode A) interrogations and replies. Mode S interrogations and replies use a 24-bit address code entered into transponder memory automatically upon power-up. Each aircraft has its own unique address that is permanently programmed to the airframe. No manual entry of this address is available.

The system can be placed in STANDBY mode. When the STANDBY mode is selected, the transponder reply transmit capability (Mode S or ATCRBS) is disabled. The remaining transponder functions are operational, including Built-In-Test (BIT). STANDBY mode is typically engaged while on the ground to prevent unnecessary RF traffic. It is disengaged just prior to takeoff and engaged again upon landing. In addition, an air/ground switch, which functions as part of the Weight-On-Wheels (WOW) circuitry, can disable ATCRBS Transponder reply capability while the aircraft is on the ground if this feature has been enabled. To disable ATCRBS or ground replies with the air/ground switch, the appropriate air/ground transponder discrete must be connected. Refer to the REMOVAL/INSTALLATION section of this manual for details on this interface. Mode S

Transponder replies and squitters, however, are not disabled by the air/ground switch, and aircraft status (on ground or airborne) is included in the Mode S reply data.

In a dual Mode S System, the pilot can choose either transponder from the control panel. When an ATCRBS Transponder is installed, the pilot can choose between the embedded Mode S and ATCRBS Transponders. In either case (dual Mode S or Mode S/ATCRBS) only one transponder is enabled at a time. If a Mode S Transponder failure occurs, the XPDR FAIL indicator on the control panel lights. However, the failed transponder must be the one selected on the control panel for the indicator to light. Switching between the transponders occurs without loss of system function.

An SPI is added to the ATCRBS and Mode S replies when the control panel IDENT button is pushed. The SPI is enabled for approximately 18 seconds and supplies the ground station with a more positive aircraft identification capability. This function is typically activated upon verbal command from the ground station.

Dual altitude input ports are supplied for each transponder; the capability to switch between the two is supplied by a switch on the control panel. This function lets the pilot select a second altitude source if the first fails. It also lets the ground station verbally verify one source against the other. Additionally, this switch lets the pilot disable altitude reporting altogether if the ground station finds a discrepancy between reported and actual altitude.

(1) Mode S/ATCRBS Interrogations and Replies

The Air Traffic Control Radar Beacon System (ATCRBS) has been in operation for several decades. Its purpose is to ensure safe separation and operation of aircraft, especially in busy terminal areas. ATCRBS Transponder-equipped aircraft transmit replies to interrogations from ground-based sensors (interrogators). Depending on the type of interrogation, the reply contains either the identification code currently assigned to the aircraft by ATC (Mode A), or uncorrected barometric altitude with 100-foot resolution (Mode C).

The ground station uses reply delay time to compute range to within approximately 500 feet (152.4 meters). The current angle of the rotating ground antenna determines azimuth. There is an 18 ±2 second duration SPI pulse to aid in identifying specific aircraft. Thus, ATC is provided with the information required to ensure safe separation of aircraft.

(a) Assigned Code Number

The digits of the assigned code number indicate the code groups to be used and the pulse coding within each group. The assigned code is a four-digit octal number (any of 4096) in which the first or left-most digit designates the A group; the second digit designates the B group; the third digit designates the C group; and the last or right-most digit designates the D group. Typical information pulses present in assigned reply codes are given in Table 1-23.

Table 1-23: Typical ATCRBS Reply Code Numbers

4096 Code Number	Information Pulses	4096 Code Number	Information Pulses
0000	None	3000	A1, A2
0001	D1	3100	A1, A2, B1
0002	D2	3200	A1, A2, B2
0003	D1, D2	3300	A1, A2, B1, B2
0004	D4	3400	A1, A2, B4
0005	D1, D4	3500	A1, A2, B1, B4
0006	D2, D4	3600	A1, A2, B2, B4
0007	D1, D2, D4	3700	A1, A2, B1, B2, B4
		4000	A4
0010	C1	4100	A4, B1
0020	C2	4200	A4, B2
0030	C1, C2	4300	A4, B1, B2
0040	C4	4400	A4, B4
0050	C1, C4	4500	A4, B1, B4
0060	C2, C4	4600	A4, B2, B4
0070	C1, C2, C4	4700	A4, B1, B2, B4
		5000	A1, A4
0100	B1	5100	A1, A4, B1
0200	B2	5200	A1, A4, B2
0300	B1, B2	5300	A1, A4, B1, B2
0400	B4	5400	A1, A4, B4
0500	B1, B4	5500	A1, A4, B1, B4
0600	B2, B4	5600	A1, A4, B2, B4
0700	B1, B2, B4	5700	A1, A4, B1, B2, B4
1000	A1	6000	A2, A4
1100	A1, B1	6100	A2, A4, B1
1200	A1, B2	6200	A2, A4, B2
1300	A1, B1, B2	6300	A2, A4, B1, B2
1400	A1, B4	6400	A2, A4, B4
1500	A1, B1, B4	6500	A2, A4, B1, B4
1600	A1, B2, B4	6600	A2, A4, B2, B4
1700	A1, B1, B2, B4	6700	A2, A4, B1, B2, B4
2000	A2	7000	A1, A2, A4
2100	A2, B1	7100	A1, A2, A4, B1
2200	A2, B2	7200	A1, A2, A4, B2
2300	A2, B1, B2	7300	A1, A2, A4, B1, B2
2400	A2, B4	7400	A1, A2, A4, B4
2500	A2, B1, B4	7500	A1, A2, A4, B1, B4
2600	A2, B2, B4	7600	A1, A2, A4, B2, B4
2700	A2, B1, B2, B4	7700	A1, A2, A4, B1, B2, B4

(b) Mode Select

Air traffic density has significantly increased since the inception of ATCRBS. Aircraft within the same approximate range and azimuth from the interrogator may interfere with each other's replies. Much verbal communication is also needed to coordinate ATC, causing more traffic on communication channels. This also places a heavier burden on the air traffic controllers.

Mode Select (Mode S) has been designed as an evolutionary addition to ATCRBS to supply enhanced surveillance as well as data communication capability for ATC, with greater degrees of automation in mind. Ground-air-ground data link communications can be accommodated with the surveillance interrogations and replies, permitting use of the Transponder for a number of different ATC functions. Messages can be either 56 or 112 bits in length. The same transmit and receive frequencies are used as for ATCRBS.

1 Ground and Airborne Installations

To facilitate the introduction of Mode S into ATCRBS, both ground and airborne Mode S installations include full ATCRBS capability. Mode S interrogators supply surveillance of older ATCRBS-equipped aircraft, and Mode S Transponders reply to ATCRBS interrogators. Mode S interrogators are able to command Mode S Transponders not to reply to compatible ATCRBS-only interrogations. They are also able to solicit only Mode S replies from Mode S Transponders which minimizes RF transmissions.

Another unique aspect of Mode S is that each aircraft equipped with a Mode S Transponder is assigned a unique 24-bit address. This address appears in either a coded or clear form in every Mode S reply. This not only improves aircraft identification by ATC, but also permits selective interrogation once the aircraft has been acquired by an ATCRBS/Mode S or Mode S-only All-Call interrogation. This is aimed toward reducing RF channel loading.

Another way to minimize RF traffic is the capability of locking out the transponder from replying to All-Calls, from either all interrogators or from specific ones, for retriggerable 18-second intervals. Including the station's identity code in the interrogation message enables this lockout. Probability-based replies make it possible to separate transmissions from aircraft that would otherwise be garbled when a group of aircraft might answer a single interrogation.

All transmissions for surveillance or data communications, from the ground up to the aircraft (uplink) and from the aircraft down to the ground (downlink), are protected by a 24-bit Cyclic Redundancy Code (CRC) error detection scheme, also referred to as parity. In addition, ground interrogators can perform error correction on received downlink messages.

2 Air to Air Communication

Traffic Alert and Collision Avoidance System and Mode S Transponders are an integral part of the Traffic Alert and Collision Avoidance System (TCAS). TCAS-equipped aircraft are airborne interrogators, communicating with other TCAS-equipped aircraft through their Mode S Transponders for coordination of collision avoidance maneuvers. TCAS aircraft acquire other Mode S Transponder-equipped aircraft by receiving squitter transmissions (unsolicited All-Call type replies, transmitted pseudo-randomly every 0.8 to 1.2 seconds), and thereafter by special addressed interrogations. Although either Mode S or ATCRBS Mode C Transponders aid TCAS-equipped aircraft in avoiding collisions, coordination of collision avoidance maneuvers is possible between two aircraft only if both are Mode S and TCAS equipped.

3 Mode S Messages

a Interrogation and Reply Formats

Mode S features have been added to the ATCRBS already in place. This procedure ensures that the older airborne transponders and the ground-based interrogators used in the ATCRBS are still functional. The Mode S signal formats used for this combined system operation are ATCRBS/Mode S All-Call [Mode A and Mode C], Mode S interrogation, Mode S SLS, and Mode S reply.

b Interrogation Pulses and Timing

The uplink Mode S format for the interrogation pulse group consists of pulses designated P1, P2, and P3. The time spacing between the P1 and P3 pulses determines the type of interrogation (Mode A aircraft identification or Mode C altitude reporting). Pulse P2, which follows P1 by 2 microseconds, is used for Side Lobe Suppression (SLS) in the ATCRBS. The amplitude of P2 is recognized by the airborne transponder as either a main beam or SLS interrogation. With Mode S interrogation, the basic P1 and P3 pulse system is extended to include a P4 pulse, which follows P3 by 2 microseconds. The P4 pulse uses the same spacing as between P1 and P2. However, P4 has an additional feature in that its pulse width can be either 1.6 microseconds or 0.8 microseconds, whereas the P1 and P3 pulse widths are always 0.8 microseconds.

c Replies to All-Call Interrogations and Pulse Width

In operation, when a standard ATCRBS Transponder receives this interrogation of P1, P3, and P4 pulses, it responds with the ATCRBS reply, which consists of 14 pulses that carry the identity code or the altitude code. The P4 pulse is ignored since the ATCRBS Transponder circuit is designed so that it does not recognize the P4 pulse. The response is dependent upon the presence and length of P4. When a standard P1 and P3 interrogation is received from

an ATCRBS interrogator (no P4), the Mode S Transponder responds with a standard ATCRBS reply. An uplink interrogation pulse group, which includes a P4 pulse, makes the Mode S Transponder prepare to measure the P4 pulse width. As soon as the Mode S Transponder detects the rising edge of the P4 pulse, it disables its ATCRBS reply. It then looks for a pulse width of 0.8 or 1.6 microseconds. A pulse width of 0.8 microseconds is recognized by the Mode S Transponder as an uplink ATCRBS-only All-Call, and it does not respond at all. In this case, the ground station is looking for all the aircraft in the vicinity that are equipped with ATCRBS only. In the case of a 1.6-microsecond pulse width, the Mode S interrogator wants the Mode S Transponder to respond with the Mode S All-Call coded reply. In this case, the interrogator receives the aircraft's identity, which is the unique number that is given to the Mode S-equipped aircraft. The 1.6-microsecond pulse width is in fact an All-Call interrogation for both ATCRBS and Mode S Transponders, eliciting both ATCRBS and Mode S replies. There is no interrogation addressing in this case as each system responds within its own capability.

d Mode S Interrogation

The final type of uplink interrogation is made up of P1 and P2 pulses of equal amplitude followed by a long pulse of constant amplitude called P6. This is a Mode S interrogation pulse (P6) that occurs 1.5 microseconds after P2. When the P1 and P2 pulses are of equal amplitude, the standard ATCRBS transponders see the P2 pulse and do not respond, since they interpret this as a side lobe interrogation.

e Modes S Short/Long Interrogation Messages

The Mode S Transponder sees the P1 and P2 pulses and prepares to receive P6 and the uplink Mode S message. There are two types of messages that are defined in terms of length. The first type of interrogation is a short message and is 56 bits long; the second is a long message and is 112 bits long.

4 Mode S Timing

For the ATCRBS/Mode S All-Calls the timing reference, or trigger point, for the Mode S reply is from the leading edge of pulse P4. From pulse P4, the response time for a Mode S reply is 128 ±0.5 microseconds. When responding to a standard ATCRBS interrogation, the timing reference is the leading edge of pulse P3 and the ATCRBS response time is 3 microseconds.

A typical Mode S interrogation contains the equal amplitude P1 and P2 pulses, in addition to the video pulse P6 that contains the Mode S uplink message phase encoded information.

Inside the P6 pulse, the first phase change occurs 1.25 microseconds into the pulse. This phase change is called the Sync Phase Reversal (SPR), and it is used to synchronize the transponder with the ground station. The SPR is used as the timing reference for the Mode S reply for uplink messages. Response time is 128 ±0.25 microseconds.

All the possible phase changes (chips), corresponding to the data bits, are inside the P6 pulse and occur after the SPR. Since the uplink message consists of 4 megabits per second, it means that there is a possible phase change (chip) every 0.25 microseconds. This process is called Differential Phase Shift Keying (DPSK). If there is a one in the data stream, the phase changes. However, if there is a zero in the data stream, it does not change.

All of the short 56-bit Mode S uplink messages have the following two things in common:

- The first five bits are always the Uplink Format (UF) number. For example, in a UF = 0, the first five bits are all zero (00000); in a UF = 4, the first five bits are 00100. Downlink messages are identified by the abbreviation DF for Downlink Format.
- The last 24 bits are an address/parity field. This is a means of addressing the uplink message (interrogation) and it is also a means of error detection. The last 24 bits do not carry data, but rather the unique address of the aircraft overlaid with the parity bits. A CRC system is actually used for the entire uplink message. The transponder starts to handle the uplink message only when it ensures that the message is intended for the aircraft in which the transponder is installed.

  The uplink message can be a broadcast-type message intended for all aircraft in range of the ground station. This is the Mode S-only All-Call message, which is a special format (UF = 11) that contains an all-ones address. Mode S SLS is handled by a P5 pulse, which has a pulse width of 0.8 microseconds. P5 is transmitted simultaneously with the P6 Sync Phase Reversal (SPR); the P5 pulse subsequently covers the SPR. When this occurs, the decoder in the receiver cannot see the SPR and, therefore, does not process the uplink message. This decoding procedure is different from the ATCRBS method where the amplitude of the P2 pulse must actually be detected for SLS. The Mode S reply is then generated either in response to a Mode S interrogation or by one of the ATCRBS/Mode S All-Calls. The reply includes a preamble made up of two pairs of pulses that occur 8 microseconds before the first Mode S downlink pulse. The preamble precedes the actual data on the downlink message, much like the P1, P2, and P6 pulses precede the uplink message.

There are two fundamental differences between the uplink message and the downlink message, as follows:

- The uplink burst is at 4 megabits per second, while the downlink is at 1 megabit per second.
- The uplink uses DPSK, while the downlink uses Pulse Position Modulation (PPM). Using PPM, there is one pulse for every bit, either in the first half or the second half of the bit interval (window). The first half of the window represents a 1; the second half of the window represents a 0.

The reply delay time for Mode S is 128 microseconds with respect to the P6 SPR. This is true for both long and short messages. However, the downlink message data cannot be prepared until the uplink message is complete. There is an additional derived timing specification that indicates how much time is available from the end of an interrogation until the reply starts. For a short message, it is 113 microseconds; for a long message, it is 99 microseconds. The basic Mode S transponder handles only the short messages, but this timing shows that a data link transponder, which handles long messages, has more data to process and a shorter time to prepare the message.

(2) Mode S Message Format and Data Field Descriptions

Refer to RTCA DO-181C, DO-185, DO-218B and DO-260 for further details of Mode S Message Formats and Field definitions.

Table 1-24 defines the Mode S interrogation UF (Uplink Format) messages and Table 1-25 defines the Mode S reply DF (Downlink Format) messages. The first 5 bits of the message indicate the UF/DF type. The message structure including the number of bits per subfield is included in Table 1-24 and Table 1-25. For example, UF=0 [Binary 00000] is composed of X:3 (3 bits assigned as padding), RL:1 (1 bit assigned to Reply Length) etc. The Uplink Format message field descriptions are listed in Table 1-26 and the Downlink Format message field descriptions are listed in Table 1-.

Table 1-24: Uplink Format Messages

Uplink Format		Field Description	Message Format with Number of Bits
UF=0	[00000]	Short Air-Air Surveillance	X:3, RL:1, X:4, AQ:1, DS:8, X:10 AP:24 X:Pad
UF=4	[00100]	Surveillance, Altitude Request	PC:3, RR:5, DI:3, SD:16, AP:24
UF=5	[00101]	Surveillance, Identity Request	PC:3, RR:5, DI:3, SD:16, AP:24
UF=11	[01011]	Mode S Only All-Call	PR:4, II/IC:4, CL:3, X:16, AP:24 X:Pad
UF=16	[10000]	Long Air-Air Surveillance	X:3, RL:1, X:4, AQ:1, X:18, MU:56, AP:24 X:Pad
UF=20	[10100]	Comm-A, Altitude Request	PC:3, RR:5, DI:3, SD:16, MA:56, AP:24
UF=21	[10101]	Comm-A, Identity Request	PC:3, RR:5, DI:3, SD:16, MA:56, AP:24

NOTE: PC, RR, DI and SD subfields are undefined for UF=20/21 broadcast interrogations.

Table 1-25: Downlink Format Messages

Downlink Format	Field Description	Message Format with Number of Bits
DF=0 [00000]	Short Air-Air Surveillance	VS:1, CC:1, X:1, SL:3, X:2, RI:4, X:2, AC:13, AP:24 X:Pad
DF=4 [00100]	Surveillance, Altitude Reply	FS:3, DR:5, UM:6, AC:13, AP:24
DF=5 [00101]	Surveillance, Identity Reply	FS:3, DR:5, UM:6, ID:13, AP:24
DF=11 [01011]	All-Call Reply	CA:3, AA:24, PI:24
DF=16 [10000]	Long Air-Air Surveillance	VS:1, X:2, SL:3, X:2, RI:4, X:2, AC:13, MV:56, AP:24 X:Pad
DF=17 [10001]	Extended Squitter (ADS-B)	CA:3, AA:24, ME:56, PI:24
DF=20 [10100]	Comm-B, Altitude Reply	FS:3, DR:5, UM:6, AC:13, MB:56, AP:24
DF=21 [10101]	Comm-B, Identity Reply	FS:3, DR:5, UM:6, ID:13, MB:56, AP:24

Table 1-26: Uplink Format Fields

Designator	Field	Description
AP	Address Parity	24-bit discrete address with parity check bits overlaid
AQ	Acquisition	Designates formats UF=0, 16 as acquisition transmissions or non-acquisition.
CL	Code Label	Identifies the contents of the IC field
DI	Designator Identification	Identifies the coding contained in the SD field
DS	COMM-B Data Selector	Contains the identity of the ground-initiated COMM-B register
IC	Interrogator Code	Contains either the II Code or SI Code
II	Interrogator Identification	Identifies the interrogator
MA	Message COMM-A	56-bit uplink field contains messages directed to the aircraft
MU	Message COMM-U	56-bit uplink field contains information used in air-to-air exchanges part of the long special surveillance interrogation
NC	Number of C Segments	Number of segments transmitted in ELM mode and part of a COMM-C interrogation
PC	Protocol	Operating commands to the transponder
PR	Probability of Reply	Contains commands to the transponder which specify the reply probability to the Mode S only All-Call interrogations
RC	Reply Control	Designates the transmitted segment as initial, intermediate or final

Table 1-26: Uplink Format Fields

Designator	Field	Description
RL	Reply Length	Commands a reply of DF=0 Short Message or DF=16 Long Message
RR	Reply Request	Contains length and content of the reply requested by the interrogators
SD	Special Designator	Contains control codes affecting transponder protocol
SI	Surveillance Identifier	Defines the surveillance identifier code

Table 1-27: Downlink Format Fields

Designator	Field	Description
AA	Address Announced	Contains the aircraft address
AC	Altitude Code	Field contains the aircraft altitude
AP	Address Parity	24-bit field contains the parity overlaid on the address
CA	Transponder Capability	Reports transponder communication capability
CC	Crosslink Capability	Indicates the transponder's ability to support crosslink capability
DR	Downlink Request	Requests extraction of downlink messages from the transponder by the interrogator
FS	Flight Status	Reports flight status of the aircraft
ID	Identification	Contains the Mode A identification code reporting the numbers as set by the pilot
MB	Message COMM-B	56-bit MB field contains messages transmitted to the interrogator
ME	Message Extended Squitter	56-bit downlink field used to broadcast messages
MV	Message COMM-V	Contains information used in air-to-air exchanges and is part of the long special surveillance reply
PI	Parity/Interrogator Identity	24-bit field contains the parity overlaid on the interrogator's identity code
RI	Reply Information	4-bit field reports airspeed capability and the type of reply to the interrogating aircraft
SL	TCAS Sensitivity Level	This field reports the sensitivity level at which the TCAS unit is currently operating

Table 1-27: Downlink Format Fields (cont.)

Designator	Field	Description
UM	Utility Message	Contains the transponder status readouts
VS	Vertical Status	Reports the aircraft airborne or on-ground state

(3) Mode S ELS/EHS and ADS-B OUT

Traditional Secondary Surveillance Radar (SSR) includes Mode 3/A (aircraft identification or 4096 code) and Mode C (uncorrected barometric altitude reporting). Then to increase ATC capacity which included implementing TCAS operation, Mode S was developed which made transponder interrogations addressable and transponder replies more accurate and reliable. Basic Mode S requires the aircraft to be;

- equipped with a Mode S capable transponder
- equipped with a means for the operator to enter the ATC assigned 4096 code that then provides standard ARINC 429 label 016 Mode S Control
- equipped with a source of uncorrected barometric altitude with at least 100 feet resolution via one of the following:
  - standard ARINC 429 label 203 Uncorrected Barometric Altitude
  - standard ARINC 575 label 203 Uncorrected Barometric Altitude
  - standard ARINC 407 Coarse and Fine Synchro Uncorrected Barometric Altitude
  - dual Gillham Code uncorrected pressure altitude.
  - strapped with the aircraft's unique 24-bit ICAO aircraft address.

Mode S Elementary Surveillance (ELS) was the first step of down linking additional aircraft derived data. In addition to the Mode S aircraft requirements listed above, minimally Mode S ELS requires the aircraft to be:

- equipped with a Mode S ELS capable transponder
- equipped with a means for the operator to enter Flight Identification that then provides standard ARINC 429 labels:
  - 233, 301 Characters 1 and 2
  - 234, 301 Character 3
  - 234, 302 Character 4
  - 235. 302 Characters 5 and 6
  - 236 Characters 7 and 8.
- equipped with a source of uncorrected barometric altitude source with at least 25 feet resolution with the exception of dual Gillham code uncorrected barometric altitude sources with 100 feet resolution via one of the following:
  - Standard ARINC 429 label 203 Uncorrected Barometric Altitude
  - Standard ARINC 575 label 203 Uncorrected Barometric Altitude
  - Standard ARINC 407 Coarse and Fine Synchro Uncorrected Barometric Altitude
  - Dual Gillham Code uncorrected barometric altitude.

Mode S Enhanced Surveillance (EHS) was the second step of down linking additional aircraft derived data. In addition to the Mode S and Mode S ELS requirements listed above, minimally Mode S EHS requires the aircraft to be:

- equipped with a Mode S ELS/EHS capable transponder
- equipped with sources of standard ARINC 429 labels;
  - 102 Selected Altitude
  - 325 Roll Angle
  - 103 True Track Angle or 312 Ground Speed
  - 335 Track Angle Rate
  - 210 True Airspeed (TAS)
  - 320 Magnetic Heading
  - 365 Inertial Vertical Velocity
  - 205 MACH
  - 206 Indicated Airspeed (IAS)
  - 212 Barometric Rate

Automatic Dependent Surveillance-Broadcast (ADS-B OUT) is the next step of down linking additional aircraft derived data. In addition to the Mode S, Mode S ELS, and Mode S EHS requirements listed above, minimally ADS-B OUT may require the aircraft to be:

- equipped with a Mode S ELS/EHS and ADS-B OUT capable transponder
- equipped with sources of standard ARINC 429 labels:
  - 076 GNSS Altitude (MSL)
  - 103 GNSS True Track Angle
  - 110 GNSS Latitude, Coarse or 310 Latitude
  - 111 GNSS Longitude, Coarse or 311 Longitude
  - 112 GNSS Ground Speed or else 312 Ground Speed
  - 120 GNSS Latitude, Fine
  - 121 GNSS Longitude, Fine
  - 130 GNSS Horizontal Protection Limit or else 112 Ground Speed or 312 Ground
  - Speed or else 133 VIL or else 203 Uncorrected Barometric Altitude or 370 GNSS HAE
  - 136 GNSS Vertical Figure of Merit
  - 140 GNSS UTC, Fine (binary, “0.200 sec”)
  - 150 GNSS UTC (binary, e.g., “12 h 23 m 12 s”)
  - 165 GNSS Vertical Velocity
  - 166 GNSS N/S Velocity
  - 174 GNSS E/W Velocity
  - 247 GNSS Horizontal Figure of Merit
  - 314 True Heading or else 103 GNSS Track Angle or else 313 True Track Angle
  - 370 GNSS Geodetic Height (above WGS-84 ellipsoid).

a) BDS Registers

The transponder assembles data into Binary Data Store (BDS) registers. These registers are also referred to as GICB registers since they can be down linked via Ground Initiated Comm B transactions.

The transponder's 256 BDS registers are commonly notated in hexadecimal format with the first register notated as BDS 0,0 (0016 or 0 decimal) and the last register notated as BDS F,F (FF16 or 255 decimal). Each BDS register consists of 56 bits as specified in the ICAO Manual of Mode S Specific Services and Mode S Standard and Recommended Practices (SARPs). Each BDS register contains the data payload of a specific Mode S reply or extended squitter. Registers not updated within a fixed time are cleared, i.e. filled with 0's. Refer to Figure 1-38 for a simplified block diagram of DAPS Data Processing.

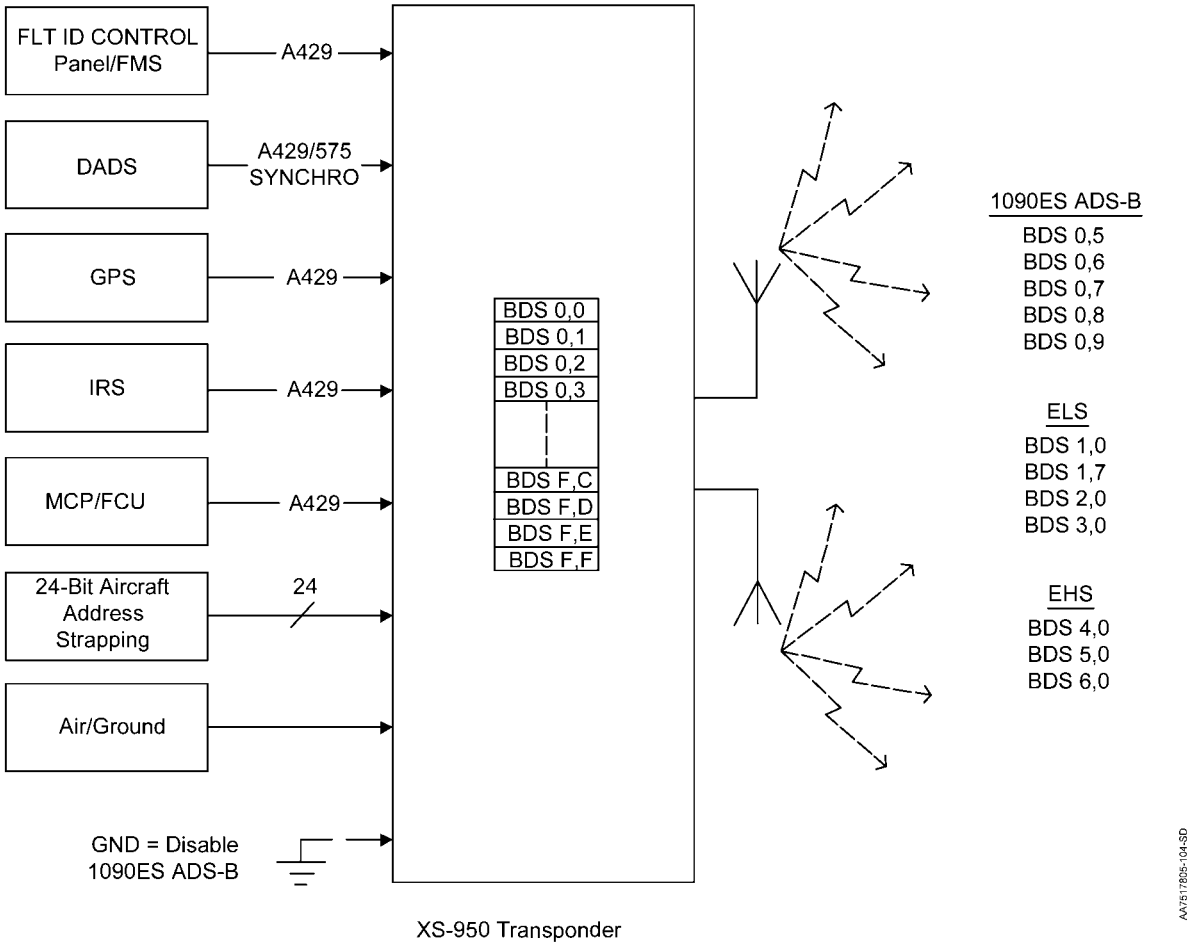


Figure 1-38: XS-950 Transponder DAPS Data Processing

BDS registers currently specific to 1090 ES ADS-B are:

- 0,5 Airborne Position
- 0,6 Surface Position
- 0,7 Status

- 0,8 Aircraft ID and Category
- 0,9 Airborne Velocity

NOTE: 1090 ES ADS-B BDS data is transmitted in the ME field of DF=17.

BDS registers currently specific to Elementary Surveillance (ELS) are:

- 1,0 Data Link Capability
- 1,7 Common Usage GICB Capability
- 2,0 Aircraft Identification
- 3,0 ACAS Active Resolution Advisory

NOTE: ELS BDS data is transmitted in the MB field of DF=20 or DF=21.

BDS registers currently specific to Enhanced Surveillance (EHS) are:

- 4,0 Selected Vertical Intent
- 5,0 Track and Turn
- 6,0 Heading and Speed

NOTE: EHS BDS data is transmitted in the MB field of DF=20 or DF=21.

b) Detailed BDS Register Descriptions

This section provides a detailed description of the BDS register data currently specific to 1090 ES ADS-B, ELS, and EHS. The first column in each of the BDS register tables that follow provides the number of bits allocated for each parameter listed that is listed in the second column. The third column provides typical transponder ramp tester parameter data. The fourth and last column provides the external sources and details that are required by the transponder to effectively assemble each parameter into the BDS register.

Refer to ICAO Annex 10, Vol III, Part 1, Chapter 5 and RTCA DO 260 for more details.

Table 1-28: BDS 0,5 Airborne Position

Bits	Parameter	Parameter Data	External Source(s)
1-5	Format Type Code	0, 9-18, 20-22	See **NOTE:**
6-7	Surveillance Status	NO INFO PERM ALERT TEMP ALERT SPI	Label 016 from ATC/TCAS control panel.
8	Single Antenna Flag (SAF)	SINGLE DUAL	
9-20	Barometric altitude or GNSS Altitude	Decoded Barometric Altitude in feet Decoded HAE in feet.	Label 203 uncorrected pressure altitude from ADC. Label 370 HAE from GPS
21	Time	N/UTC (Not UTC) UTC	Time mark from GPS.
22	CPR Format	EVEN ODD	Label 150 UTC Coarse, Label 140 UTC Fine, and Label 141 UTC Fine Fraction from GPS
23-39	Encoded Latitude	Decoded CPR format in degrees, minutes and seconds	Label 110 Latitude (coarse) and Label 120 Latitude (fine) from GPS 1 or 2 (Best HIL value) or else Label 310 Latitude from FMS or IRS
40-46	Encoded Longitude	Decoded CPR format in degrees, minutes and seconds	Label 111 Longitude (coarse) and Label 121 Longitude (fine) from GPS 1 or 2 (best HIL value) or else Label 311 Longitude from FMS or IRS
NOTE: Label 130 HIL from GPS or Label 171 RNP from FMS or IRS, or else Label 112 Ground Speed from GPS or Label 312 Ground Speed from FMS or IRS, or else Label 133 VIL from GPS, or else Label 203 Baro Altitude from ADC or label 370 HAE from GPS.			

Table 1-29: BDS 0,6 Surface Position

Bits	Parameter	Parameter Data	External Source(s)
1-5	Format Type Code	0, 5-8	See **NOTE:**
6-12	Movement	NO INFO STOPPED Speed in Knots DECELERATING ACCELERATING BACKING UP	Label 112 Ground Speed from GPS 1 or 2 (best HIL value) or else Label 312 Ground Speed from IRS or FMS or else derived from Label 174 E/W and Label 166 N/S velocities.
13	Status Heading		
14-20	Heading	N/A Decoded Heading in degrees.	Label 314 True Heading from IRS or else Label 103 Ground Track from GPS 1 or 2 (best HIL value) - only if GS > 20 kts or Label 313 True Track Angle from IRS only if GS > 20 kts.
21	Time	N/UTC (Not UTC) UTC	
22	CPR Format	EVEN ODD	Label 150 UTC Coarse, Label 140 UTC Fine, and Label 141 UTC Fine Fraction from GPS
23-39	Encoded Latitude	Decoded CPR format in degrees, minutes and seconds.	Label 110 Latitude (coarse) and Label 120 Latitude (fine) from GPS 1 or 2 (best HIL value) or else Label 310 Latitude from FMS or IRS.
40-56	Encode Longitude	Decoded CPR format in degrees, minutes and seconds.	Label 111 Longitude (coarse) and Label 121 Longitude (fine) from GPS 1 or 2 (best HIL value) or else Label 311 Longitude from FMS or IRS.
NOTE:	Label 130 HIL from GPS or Label 171 RNP from FMS or IRS, or else Label 112 Ground Speed from GPS or Label 312 Ground Speed from FMS or IRS, or else Label 133 VIL from GPS, or else Label 203 Baro Altitude from ADC or label 370 HAE from GPS.		

Table 1-30: BDS 0,7 Status

Bits	Parameter	Parameter Data	External Source(s)
1-2	Transition Rate	No capability to determine surface squitter rate High surface squitter rate selected Low surface squitter rate selected Unassigned	Label 110 Latitude (coarse), Label 111 Longitude (coarse), Label 120 Latitude (fine), and Label 121 Longitude (fine) from GPS. or Label 310 Latitude, and Label 311 Longitude from IRS or FMS.
3	Altitude Type	Barometric Altitude GPS height above ellipsoid (HAE)	
4-56	Reserved		

Table 1-31: BDS 0,8 Aircraft ID and Category

Bits	Parameter	Parameter Data	External Source(s)
1-5	Format Type Code	1-4	
6-8	Aircraft Category	A, B, C, D	
9-14	Character 1	ICAO Character	Label 233 Flight Identifier from control panel.
15-20	Character 2	ICAO Character	Label 233 Flight Identifier from control panel.
21-26	Character 3	ICAO Character	Label 234 Flight Identifier from control panel.
27-32	Character 4	ICAO Character	Label 234 Flight Identifier from control panel.
33-38	Character 5	ICAO Character	Label 235 Flight Identifier from control panel.
39-44	Character 6	ICAO Character	Label 235 Flight Identifier from control panel.
45-50	Character 7	ICAO Character	Label 236 Flight Identifier from control panel.
51-56	Character 8	ICAO Character	Label 236 Flight Identifier from control panel.

Table 1-32: BDS 0,9 Airborne Velocity Subtypes 1 & 2 – Velocity Over Ground

Bits	Parameter	Parameter Data	External Source(s)
1-5	Format Type Code	19	
6-8	Sub Type	1 (Ground Speed Normal)	Label 166 N/S velocity and Label 174 E/W velocity from GPS.
9	Intent Change Flag		
10	IFR Capability Flag		
11-13	NACv	0, 1, 2, 3, 4.	Label 247 HFOM from GPS. Label 136 VFOM from GPS.
14	Direction E/W	E W	
15-24	E/W Velocity	N/A Knots	Label 174 E/W Velocity from GPS 1 or 2 (best HIL value) or calculated from Label 112 Ground Speed from GPS, or Label 367 E/W velocity from FMS or IRS.
25	Direction N/S	N S	
26-35	N/S Velocity	N/S Knots	Label 166 N/S Velocity from GPS 1 or 2 (best HIL value) or calculated from Label 112 Ground Speed from GPS, or Label 366 N/S velocity from FMS or IRS.
36	Source of Vertical Rate	N/A BARO GEO	
37	Signe for Vertical Rate	+ -	
38-46	Vertical Rate	N/A Feet per minute	Label 165 Vertical Rate from GPS 1 or 2 (best HIL value) or Label 212 Vertical Rate from ADC. Applicable to –XX400 and subsequent: IRS Label 365 Inertial Vertical Velocity is the primary source to encode the Vertical Rate field. Label 212 Vertical Rate is an alternate data source.
47-48	Reserved		
49	Difference Sign	+ -	

Table 1-32: BDS 0,9 Airborne Velocity Subtypes 1 & 2 – Velocity Over Ground (cont.)

Bits	Parameter	Parameter Data	External Source(s)
50-56	Difference from Geo and Baro Altitudes	Feet	Label 370 Height Above Ellipsoid (HAE) from GPS 1 or 2 (best HIL value) or Label 076 Altitude (MSL) from GPS 1 or 2 (best HIL value) or Label 203 Uncorrected Barometric Altitude from ADC.
NOTE:	Subtype 1 is used when NS and EW velocities are valid and both are less than 1022 knots. Subtype 2 is used when NS and EW velocities are valid and both are greater than 1022 knots.		

Table 1-33: BDS 0,9 Airborne Velocity Subtypes 3 & 4 – Airspeed and Heading

Bits	Parameter	Parameter Data	External Source(s)
1-5	Format Type Code	19	
6-8	Sub Type	1 (Ground Speed Normal)	Label 166 N/S velocity and Label 174 E/W velocity from GPS.
9	Intent Change Flag		
10	IFR Capability Flag		
11-13	NACv	0, 1, 2, 3, 4.	Label 247 HFOM from GPS. Label 136 VFOM from GPS.
14	Status	N/A Available	
15-24	Magnetic Heading	Degrees	Label 320 Magnetic Heading from FMS or IRS.
25	Airspeed Type	IAS TAS	
26-35	Airspeed	N/A 0 to > 1021 Knots 0 to>4084 Knots	Label 206 Indicated Airspeed or Label 210 True Airspeed from ADC.
36	Source of Vertical Rate	N/A BARO GEO	
37	Sign of Vertical Rate	+ -	

Table 1-33: BDS 0,9 Airborne Velocity Subtypes 3 & 4 – Airspeed and Heading (cont.)

Bits	Parameter	Parameter Data	External Source(s)
38-46	Vertical Rate	N/A Feet per minute	Label 165 Vertical Rate from GPS 1 or 2 (best HIL value) or Label 212 Vertical Rate from ADC. Applicable to –XX400 and subsequent: IRS Label 365 Inertial Vertical Velocity is the primary source to encode the Vertical Rate field. Label 212 Vertical Rate is an alternate data source.
47-48	Reserved		
49	Difference Sign	+ -	
50-56	Difference from Geo and Baro Altitudes	Feet	Label 370 Height Above Ellipsoid (HAE) from GPS 1 or 2 (best HIL value) or Label 076 Geometric Altitude from GPS 1 or 2 (best HIL value) or Label 203 Baro Altitude from ADC.
NOTE: Subtype 3 is used when NS and EW velocities are Not valid and Airspeed is less than 1022 knots. Subtype 4 is used when NS and EW velocities are Not valid and Airspeed is greater than 1022 knots.			

Table 1-34: BDS 1,0 Data Link Capability

Bits	Parameter	Parameter Data	External Source(s)
1-8	BDS 1,0 Code		
9	Continuation Flag	YES NO	
10-15	Reserved		
Applicable to –XX400 and subsequent, See Bit 15 definition below:			
15	Overlay Command Capability	0 = No OCC 1 = Transponder has OCC	
16	Reserved for ACAS		
17-23	Mode S Sub Network Version Number	0-127	

Table 1-34: BDS 1,0 Data Link Capability (cont)

Bits	Parameter	Parameter Data	External Source(s)
37-40	Reserved for ACAS		
41-56	DTE	YES NO	
Applicable to –XX400 and subsequent, See Bits 17-23 definition below:			
17-23	Mode S Sub Network Version Number	0 = Mode S sub network not available 1-5 = Version No. 1-5 respectively 6-127 = Not Assigned	
24	Transponder Enhanced Protocol Indicator	YES NO	
25	Mode S Specific Services Capability	YES NO	
26-28	Uplink ELM Capability (Comm C)	NO UELM 16/5 ms 16/500 ms 16/250 ms 16/128 ms 16/60 ms 16/30 ms	
29-32	Downlink ELM Capability (Comm D)	NO DELM 4/15 8/15 16/15 16/500 ms 16/250 ms 16/125 ms	
NOTE:	Comm-D DELM functionality is not supported by –XX400 and subsequent.		
33	Aircraft Identification Capability	YES NO	
34	Squitter Capability Subfield (SCS)	YES NO	

Table 1-34: BDS 1,0 Data Link Capability (cont)

Bits	Parameter	Parameter Data	External Source(s)
35	Surveillance Identifier (SI)	YES NO	
36	Common Usage GICB Capability	0 1	

Table 1-35: BDS 1,7 Common Usage GICB Capability

Bits	Parameter	Parameter Data	External Source(s)
1	0,5 Extended Squitter Airborne Position	0,5	
2	0,6 Extended Squitter Surface Position	0,6	
3	0,7 Extended Squitter Status	0,7	
4	0,8 Extended Squitter Identification and Category	0,8	
5	0,9 Extended Squitter Airborne Velocity	0,9	
6	0,A Extended Squitter Event Driven Information	0,A	
7	2,0 Aircraft Identification	2,0	
8	2,1 Aircraft Registration		
9	4,0 Aircraft Intention	4,0	

Table 1-35: BDS 1,7 Common Usage GICB Capability (cont.)

Bits	Parameter	Parameter Data	External Source(s)
10	4,1 Next Way-Point Identifier		
11	4,2 Next Way-Point Position		
12	4,3 Next Way-Point Information		
13	4,4 Meteorological Routine Report		
14	4,5 Meteorological Hazard Report		
15	4,8 VHF Channel Report		
16	5,0 Track and Turn Report	5,0	
17	5,1 Position Coarse	5,1	
18	5,2 Position Fine	5,2	
19	5,3 Air-Referenced State Vector		
20	5,4 Way-Point 1		
21	5,5 Way-Point 2		
22	5,6 Way-Point 3		
23	5,F Quasi-Static Parameter Monitoring	5,F	
24	6,0 Heading and Speed Report	6,0	
25-56	Reserved		

Table 1-36: BDS 2,0 Aircraft Identification

Bits	Parameter	Parameter Data	External Source(s)
1-8	BDS Code 2,0		
9-14	Character 1	ICAO Character	Label 233 Flight Identifier from control panel, or Label 301 Tail Number from CDFIU.
15-20	Character 2	ICAO Character	Label 233 Flight Identifier from control panel, or Label 301 Tail Number from CDFIU.
21-26	Character 3	ICAO Character	Label 234 Flight Identifier from control panel, or Label 301 Tail Number from CDFIU.
27-32	Character 4	ICAO Character	Label 234 Flight Identifier from control panel, or Label 302 Tail Number from CDFIU.
33-38	Character 5	ICAO Character	Label 235 Flight Identifier from control panel, or Label 302 Tail Number from CDFIU.
39-44	Character 6	ICAO Character	Label 235 Flight Identifier from control panel, or Label 302 Tail Number from CDFIU.
45-50	Character 7	ICAO Character	Label 236 Flight Identifier from control panel, or Label 303 Tail Number from CDFIU.
51-60	Character 8	ICAO Character	Label 236 Flight Identifier from control panel, or Label 303 Tail Number from CDFIU.

Table 1-37: BDS 3,0 ACAS Active Resolution Advisory

Bits	Parameter	Parameter Data	External Source(s)
1-8	BDS Code 3,0 or 0,0	3,0 = TCAS Bus Valid 0,0 = TCAS Bus Invalid	
9-22	Active Resolution Advisories		
23-26	Resolution Advisory Compliment		
27	RA Terminated (RAT)	0 1	
28	Multiple Threat Encounter	0 1	
29-30	Threat Type Indicator (TTI)	0 1 2	
31-56	Threat Identity Data (TID)	Mode S Address of the threat	

Table 1-38: BDS 4,0 Selected Vertical Intent

Bits	Parameter	Parameter Data	External Source(s)
1	Status	N/A Available	
2-13	MCP/FCU Selected Altitude	N/A Feet	Label 102 Selected Altitude from MCP/FCU
14	Status	N/A Available	
15-26	FMS Selected Altitude	N/A Feet	Label 102 Selected Altitude from FMS.
27	Status	N/A Available	
28-39	Barometric Pressure Altitude	N/A	Label 203 Baro Alt or Label 234 Baro Alt Correction from ADC or else Label 273 Baro Pressure Setting Ref from MCP/ FCU.
40-47	Reserved		
48	Status of MCP/FCU Mode Bits		
49	Vertical Navigation(VNAV) Mode	YES NO	
50	Altitude Hold Mode	YES NO	
51	Approach Mode	YES NO	
52-53	Reserved		
54	Status of Target Altitude Source	YES NO	
55-56	Target Altitude Source	N/A UNKNOWN AIRCRAFT ALT FCU/MCP SEL ALT FMS SEL ALT	

Table 1-39: BDS 5,0 Track and Turn

Bits	Parameter	Parameter Data	External Source(s)
1	Status	N/A Available	
2	Sign	+ -	
3-11	Roll Angle	Degrees	Label 325 Roll Angle from IRS.
12	Status	N/A Available	
13	Sign	+ -	
14-23	True Track Angle	Degrees	Label 103 True Track Angle from GPS or else Label 313 True Track Angle from IRS.
24	Status	N/A Available	
25-34	Ground Speed	Knots	Label 112 Ground Speed from GPS or else Label 312 Ground Speed from IRS.
35	Status	N/A Available	
36	Sign	+ -	
37-45	Track Angle Rate	Degrees per second	Label 335 Track Angle Rate from IRS.
46	Status	N/A Available	
47-56	True Airspeed	Knots	Label 210 True Airspeed from ADC.

Table 1-40: BDS 6,0 Heading and Speed

Bits	Parameter	Parameter Data	External Source(s)
1	Status	NA Available	
2	Sign	East West	
3-12	Magnetic Heading	Degrees	Label 320 Magnetic Heading from IRS or FMS.
13	Status	NA Available	
14-23	Indicated Airspeed	Knots	Label 206 Indicated Airspeed from ADC.
24	Status	NA Available	
25-34	MACH	MACH Number	Label 205 MACH from ADC.
35	Status	NA Available	
36	Sign	+ -	
37-45	Barometric Altitude	Feet per minute	Label 212 Barometric Rate from ADC.
46	Status	NA Available	
47	Sign	+ -	
48-56	Internal Vertical Velocity	Feet per minute	Label 365 Inertial Vertical Velocity from IRS or FMS.

MECHANICAL INSTALLATION

1. General

This section contains information on how and where to mount each component of the T3CAS system. For new installations, plan installation in two stages. First, determine the location of the LRUs in the aircraft. Next, determine the length of RF and electrical interconnections for selected locations.

NOTE: The mounting surface of the antenna base plate has an Alodine-treated surface which provides corrosion resistance. The Alodine application material does not provide any electrical resistance or isolation. Do not sand or remove the Alodine material from the surface. In addition, sanding this surface may damage the unit beyond repair.

2. Equipment and Materials

For new T3CAS installations, refer to Table 1-1 for mounting tray information. For all other components, refer to the applicable Outline and Installation drawing in this section for mounting information. The Outline and Installation drawings show connector and connector contact pin/socket part number information, where applicable.

3. Mechanical Installation Design

NOTE: To assure proper grounding of the T3CAS system, the aircraft surface to which all mountings or units are attached must be clean bare metal. Mount to the airframe with a resistance of 5 milliohms or less.

A. T3CAS Computer Unit Provisions

Mechanical installation data for the T3CAS Computer Unit (6-MCU) is shown in Figure 2-4 and for the T3CAS Computer Unit (4-MCU) is shown in Figure 2-5.

The computer unit can be mounted in any convenient location in the aircraft; however, it must be located so as to maintain an antenna coaxial cable insertion loss of 2.5 ±0.5 dB in accordance with DO-185. This is approximately within 50 feet (15.24 meters) of the antenna unless low loss coaxial cable is used. Top and bottom coaxial delay timing differences can be compensated for by use of the antenna delay program pins.

The T3CAS Computer Unit is mounted in an ARINC 600 6-MCU or 4-MCU mounting tray, depending on the T3CAS unit part number. The 6-MCU computer unit requires external cooling air in accordance with ARINC 600 to maintain the highest possible Mean Time between Failures (MTBF). The 4-MCU computer unit utilizes a unit-mounted fan (integrated fan) for cooling.

The T3CAS computer tray connector is RADIALL part number NSXN3P357X0001 or equivalent. This tray connector does not come with contacts. The following contacts are required, quantities depend on specific installation:

- 22-gauge Contact Part No. 620-200 or equivalent (wire gauges 22, 24 and 26).
- 20-gauge Contact Part No. 620-310 or equivalent (wire gauges 20, 22 and 24).
- 16-gauge Contact Part No. 620-330 or equivalent (wire gauges 18, 20, 22 and 24).
- 12-gauge Contact Part No. 620-341, or equivalent (wire gauges 18, 20, 22 and 24).
- SIZE 5 Coaxial Contact Part No. 620-021 or equivalent (Coax RG 142, RG 223 and RG 400).
- SIZE 1 Coaxial Contact Part No. 620-119-100 or equivalent (Coax RG 225 and RG 393).

The required contacts for the LBP insert depend on if the computer is to be powered with +28 V dc or 115 V ac and if a 115 V ac cooling fan will be connected when the computer is powered with 115 V ac. Note that there is no output pins to support a +28 V dc cooling fan.

B. Airplane Personality Module Provisions (Not applicable to 9005000-10000, -10101, -10202, -10204, or -11203)

Reference Figure 2-6 for the mechanical installations of the ACSS T3CAS APM. The APM can be mounted to existing aircraft structure or can be mounted to the ACSS APM mounting bracket that is secured to the aft side of the T3CAS computer tray connector, reference Figure 2-6 (Sheet 2). If the customer specifies the ACSS APM mounting bracket, an APM bracket sub kit will be provided for the customer's T3CAS installations.

NOTE: 9005000-10000, -10101, -10202, -10204, or -11203 do not require an APM to be installed.

C. Antenna Provisions

The T3CAS top directional antenna should, ideally, be the most forward antenna on the top of the aircraft and should be located as close to the longitudinal centerline as possible. See Figure 2-7. A 5-degree tilt angle is allowed laterally, with 2-degree positive and 5-degree negative tilt angles allowed longitudinally. See Figure 2-8.

If a bottom directional antenna is used, it should also be the most forward antenna on the fuselage bottom. Tilt angle allowances are the same as on the top antenna. A bottom omnidirectional antenna need not be the most forward antenna, but it should be separated by at least 20 inches (508 millimeters) from any other L-band antenna.

Since the bottom antenna may be either a directional (standard) or an omnidirectional (optional for part numbers 9005000-11203, -11801 and -55801) antenna, dual notation is shown in the wiring diagram. Only one coax cable is needed for an omnidirectional antenna installation. The bottom omnidirectional antenna and connectors must have a loss of no greater than 2 dB for the 1030-1090 MHz range.

(1) Directional Antenna Installation

The directional antenna mounting and installation data is given in Figure 2-9. Figure 2-9 contains the maximum radius dimensions for the various curved antenna base part number units, the number of aircraft mounting holes and the length of the connector extension for the various part number units. The antenna must be electrically bonded (less than 5.0 milliohms bonding resistance) to the airframe to provide a ground plane for the antenna elements.

The directional antenna must be separated by at least 30 inches (762 millimeters) from any other L-band antenna, and 60 inches (1,524 millimeters) is preferred. If a bottom directional antenna is used, it should be the most forward antenna on the fuselage bottom with tilt angle allowances the same as for a top-mounted antenna.

An O-ring (included with the directional antenna) is required to be installed between the directional antenna and the aircraft fuselage. The Navy Aeronautical Standard part number for the O-ring is NAS 1613. The ACSS part number for the O-ring is 4000171-240.

NOTE: For directional antennas, ACSS Part No.7514060-90X, the customer must provide an adapter plate for mounting to the aircraft. The antenna base plate, to which the adapter must mate, is detailed in Figure 2-9. Directional antennas, ACSS Part No.7514081-9XX, come with a preinstalled adapter plate.

NOTE: The mounting surface of the antenna baseplate has an Alodine-treated surface, which provides corrosion resistance. The Alodine application material does not provide any electrical resistance or isolation. Do not sand or remove the Alodine material from the surface. In addition, sanding this surface may damage the unit beyond repair.

(2) Omnidirectional Antenna Installation

The omnidirectional antenna is a standard ATC-type antenna. It should be qualified to TSO-C119 and be dc-grounded per MIL-A-90941, B-5087B. All L-band antennas must be separated by at least 20 inches (508 millimeters). Only one coax cable is required for installation.

The omnidirectional antenna is not supplied by ACSS. To install, follow the manufacturer's installation instructions.

NOTE: The T3CAS part numbers 9005000-10000, -10101, -10202, and -10204 do not support a bottom omnidirectional antenna.

D. TCAS Control Panel Provisions

Mechanical installation data for a typical Gables GXXXX Series ATC/TCAS control panel is shown in Figure 2-11.

It should be noted that various other types of controllers (Radio Management Units or EFIS Display Controllers) can be used to control the TCAS display. If a controller other

than an ACSS ATC/TCAS control panel is used, refer to that particular unit's manual for installation data.

E. TAWS/RWS Control Panel Provisions

The TAWS controls can be mounted on a single control panel or they can be discrete switches individually mounted at a convenient location in the Flight Deck. The TAWS controls may be part of the electronic display menu selection in installations where TAWS information is displayed on an EFIS or electronic display.

Figure 2-1 shows the ACSS King Air C90 TAWS control panel/glareshield switch annunciator installation design. The TERR and WXR select switches shown are momentary but alternate action switches are also supported. The terrain INHIBIT or OVRD switches are alternate action switches and are typically guarded.

The T3CAS TAWS control/annunciator installation design will vary depending on the flight deck configuration and available space.

F. VSI/TRA and VSI-TCAS Provisions

Mechanical installation data for the Thales VSI-TCAS display is shown in Figure 2-12, and the ACSS VSI/TRA is shown in Figure 2-13. The VSI/TRA is usually used as a direct replacement for the existing 3-ATI form VSI indicator currently mounted in the Flight Deck. Replacement of the installation clamp may be necessary if the previous clamp is less than 2 inches (50.8 millimeters) deep. Some older aircraft clamps do not provide sufficient mechanical support.

If an ACSS VSI/TRA is used as the TCAS display source, and an Air Data Computer is not available to provide vertical speed signals to the display, the installation must include an ACSS PTM to supply air data signals to the VSI/TRA. These signals are derived from a static pneumatic input.

If a Thales VSI-TCAS is used as the TCAS display source, and an Air Data Computer is not available to provide vertical speed signals to the display, a static line can be run directly into the Thales VSI-TCAS from a static pneumatic input.

G. TAWS Terrain Hazard Display Provisions

ARINC 708A and ARINC 429 WXR display and EFIS interfaces are supported. T3CAS dual-independent terrain hazard display I/O supports dual ARINC 708A and dual ARINC 429 terrain hazard display systems. Figure 2-2 shows TAWS dual terrain hazard display annunciator switch panels and locations that have been used on B757, B767, and B737-300/400/500 aircraft. Figure 2-3 shows a typical single terrain hazard display annunciator switch panel.

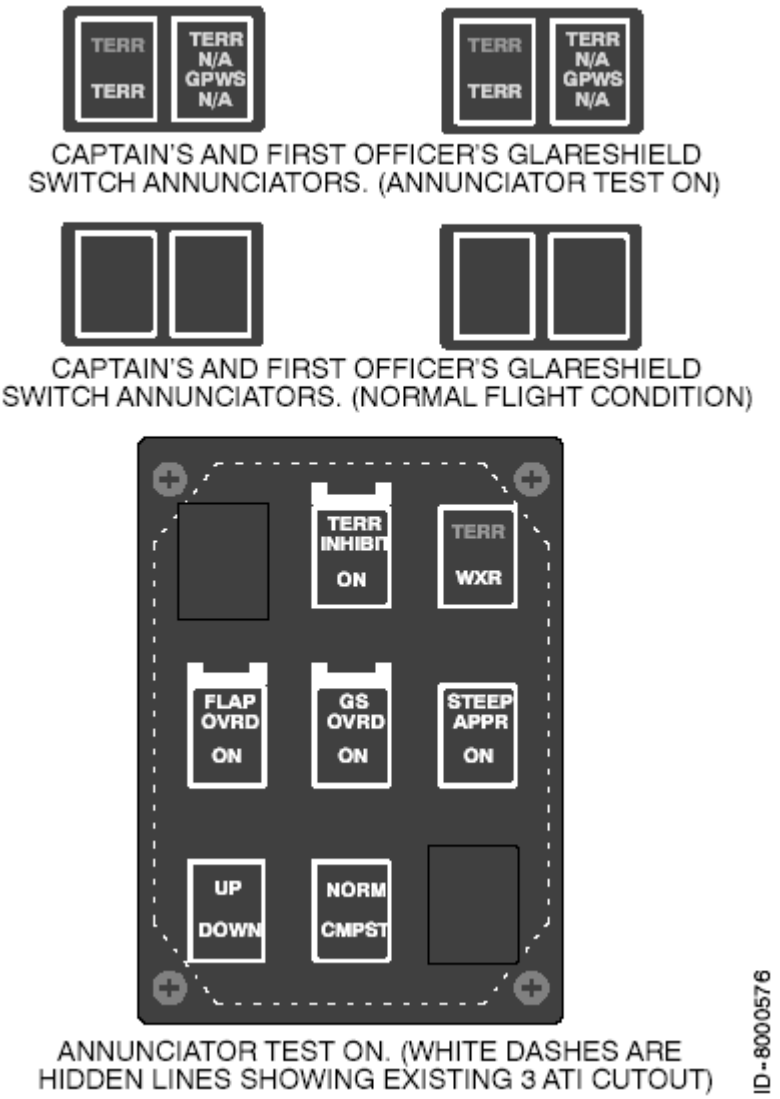


Figure 2-1: ACSS King Air C90 TAWS Control/Panel Glareshield Switch Annunciators

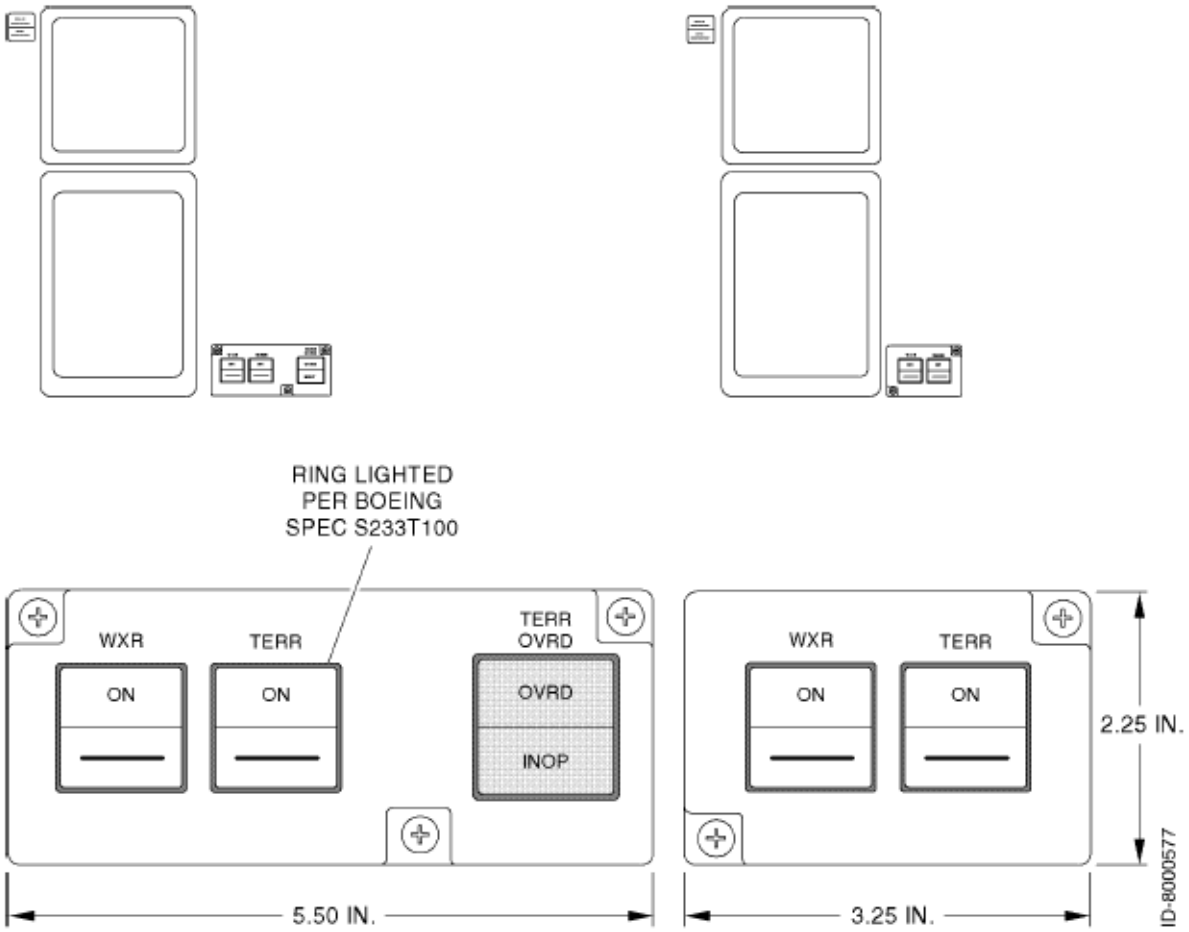


Figure 2-2: Typical Five-Button B737/757/767 Annunciator Switch Panels

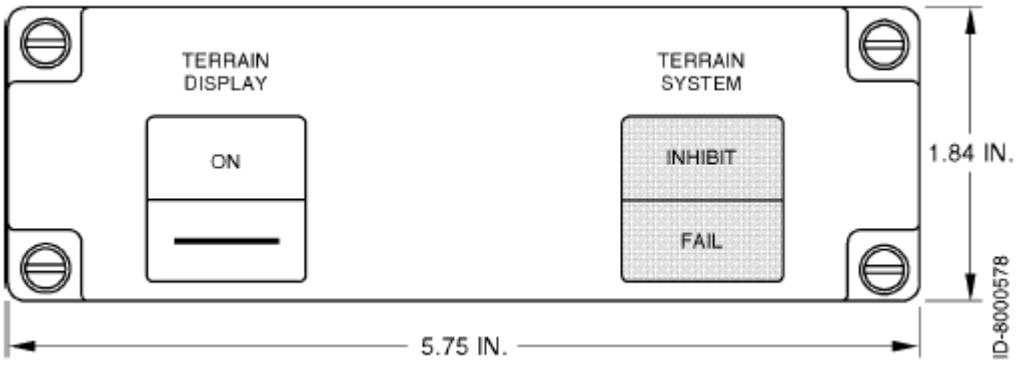
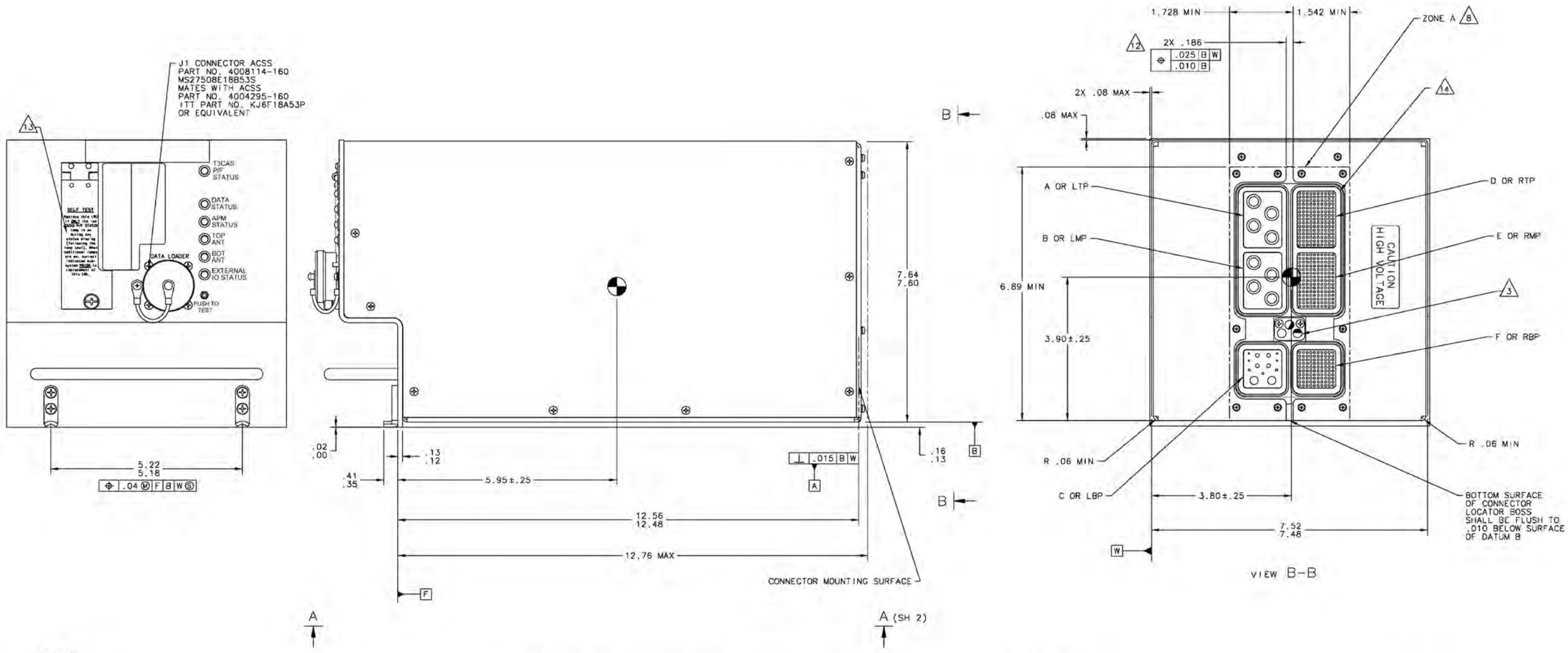


Figure 2-3: Typical Single Terrain Hazard Display Annunciator Switch Panel



NOTES:

1. UNIT WEIGHT:
   UNIT PART NUMBER 9005000-10XXX AND -11XXX (AC/DC UNIT)
   NOMINAL 17.10±0.34 POUNDS (7.75±0.16 KILOGRAMS).
2. DENOTES APPROXIMATE CENTER OF GRAVITY.
3. DARKENED PORTION INDICATES SOLID PART OF POLARIZING KEYWAY.
4. THE INSTALLATION IS IN ACCORDANCE WITH ARINC 600 6 MCU.
5. DIMENSIONS ARE IN INCHES.
6. THIS UNIT USES BLOW-THRU COOLING PER ARINC 600. THE NORMAL OPERATION COOLING AIRFLOW REQUIREMENT PER ARINC 600 IS 485 POUNDS PER HOUR PER KILOWATTS (220 KILOGRAMS/HOUR-KILOWATTS). THE PRESSURE DROP THROUGH THE UNIT IS 0.20±0.12 INCHES OF WATER (5±3 MILLIMETERS OF WATER).
7. UNIT FINISH: CHEM FILM TREATED OVER BARE ALUMINUM.
8. 0.10 MAX REAR PANEL THICKNESS IS REQUIRED IN CONNECTOR MOUNTING AREA DEFINED AS ZONE A. NO OTHER PROJECTIONS EXCEPT CONNECTOR MOUNTING HARDWARE ARE PERMITTED IN AREA DEFINED AS ZONE A.
10. THIS DRAWING DEFINES END ITEM UNITS 9005000-10YYY AND 9005000-11YYY.
    YYY = SOFTWARE CONFIGURATION FROM 000 THRU 999, AS DEFINED IN THE END ITEM DRAWING.
12. THE DIMENSION SHOWN IS TO THE CONNECTOR BOSS AND NOT THE REAR PANEL OPENING.
13. SELF TEST
    REPLACE THIS LRU IF ONLY THE RED T3CAS P/F STATUS LAMP IS ON DURING ANY STATUS DISPLAY (FOLLOWING THE LAMP TEST). WHEN ADDITIONAL LAMPS ARE ON, CORRECT INDICATED SUBSYSTEM PRIOR TO REPLACEMENT OF THIS LRU.
14. P1 CONNECTOR ACSS PART NO. 9000142-001 WITH 8 SIZE 1 COAX CONTACTS. ACSS PART NO. 7517843-2 MATES WITH RADIALL PART NO. NSXN3P357X0001 OR EQUIVALENT. THIS TRAY CONNECTOR DOES NOT COME WITH CONTACTS. THE FOLLOWING CONTACTS ARE REQUIRED; QUANTITIES DEPEND ON SPECIFIC INSTALLATION:
    22-GAUGE CONTACT PART NO. 620-200 OR EQUIVALENT (WIRE GAUGES 22, 24 AND 26).
    20-GAUGE CONTACT PART NO. 620-310 OR EQUIVALENT (WIRE GAUGES 20, 22, AND 24).
    16-GAUGE CONTACT PART NO. 620-330 OR EQUIVALENT (WIRE GAUGES 18, 20, 22 AND 24).
    12-GAUGE CONTACT PART NO. 620-341 OR EQUIVALENT (WIRE GAUGES 18, 20, 22 AND 24).
    SIZE 5 COAXIAL CONTACT PART NO. 620-021 OR EQUIVALENT (COAX RG 142, RG 223 AND RG 400).
    SIZE 1 COAXIAL CONTACT PART NO. 620-119-100 OR EQUIVALENT (COAX RG 225 AND RG 393).

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Figure 2-4: (Sheet 1) T3CAS Computer Unit Outline and Installation Drawing (6-MCU)

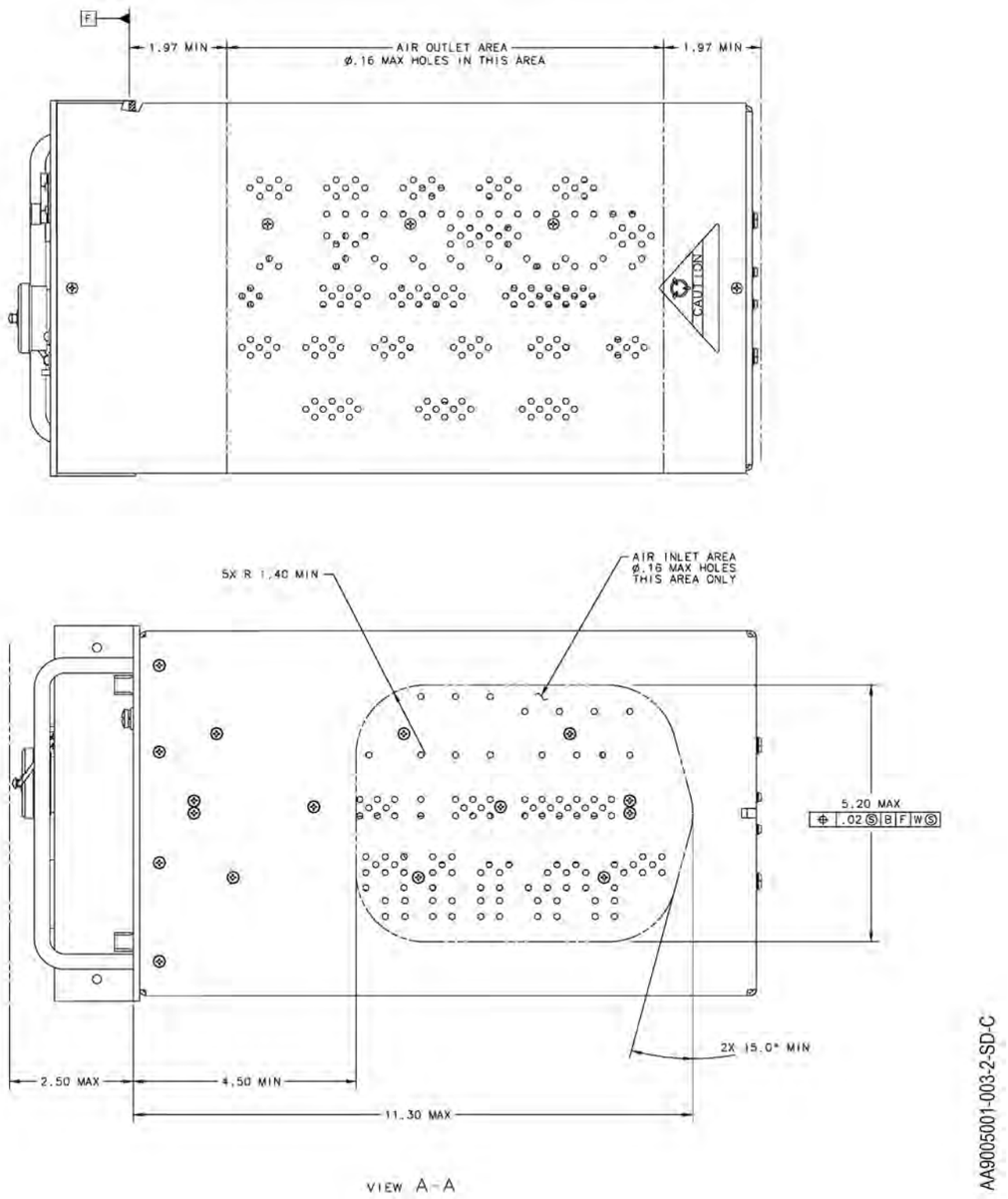
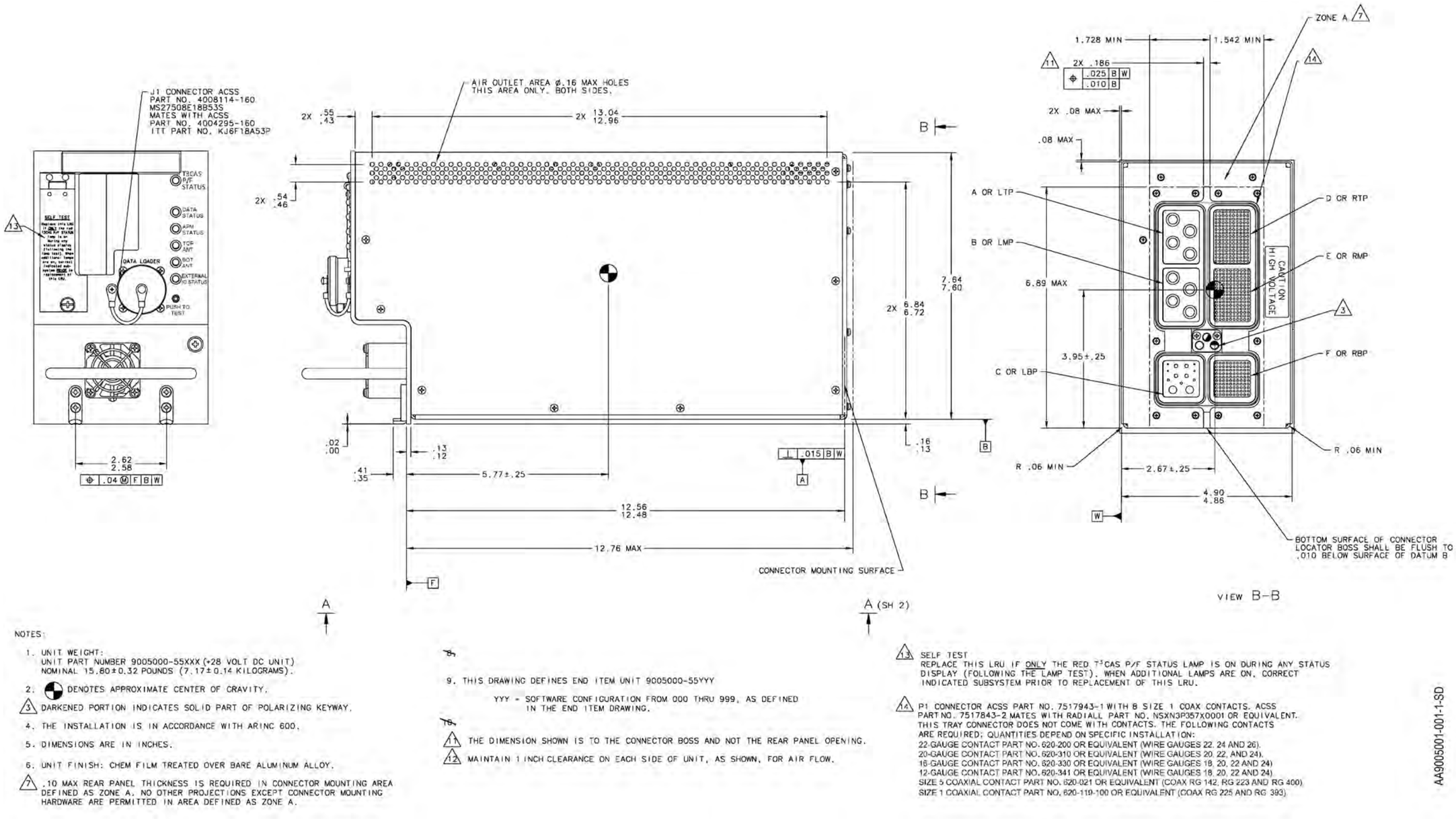


Figure 2-4: (Sheet 2) T3CAS Computer Unit Outline and Installation Drawing (6-MCU)



NOTES:

1. UNIT WEIGHT:
   UNIT PART NUMBER 9005000-55XXX (+28 VOLT DC UNIT)
   NOMINAL 15.80±0.32 POUNDS (7.17±0.14 KILOGRAMS).
2. DENOTES APPROXIMATE CENTER OF GRAVITY.
3. DARKENED PORTION INDICATES SOLID PART OF POLARIZING KEYWAY.
4. THE INSTALLATION IS IN ACCORDANCE WITH ARINC 600.
5. DIMENSIONS ARE IN INCHES.
6. UNIT FINISH: CHEM FILM TREATED OVER BARE ALUMINUM ALLOY.
7. .10 MAX REAR PANEL THICKNESS IS REQUIRED IN CONNECTOR MOUNTING AREA DEFINED AS ZONE A. NO OTHER PROJECTIONS EXCEPT CONNECTOR MOUNTING HARDWARE ARE PERMITTED IN AREA DEFINED AS ZONE A.

~~8.~~

9. THIS DRAWING DEFINES END ITEM UNIT 9005000-55YYY

   YYY = SOFTWARE CONFIGURATION FROM 000 THRU 999, AS DEFINED IN THE END ITEM DRAWING.

~~10.~~

11. THE DIMENSION SHOWN IS TO THE CONNECTOR BOSS AND NOT THE REAR PANEL OPENING.
12. MAINTAIN 1 INCH CLEARANCE ON EACH SIDE OF UNIT, AS SHOWN, FOR AIR FLOW.

13. SELF TEST
    REPLACE THIS LRU IF ONLY THE RED T3CAS P/F STATUS LAMP IS ON DURING ANY STATUS DISPLAY (FOLLOWING THE LAMP TEST). WHEN ADDITIONAL LAMPS ARE ON, CORRECT INDICATED SUBSYSTEM PRIOR TO REPLACEMENT OF THIS LRU.
14. P1 CONNECTOR ACSS PART NO. 7517943-1 WITH 8 SIZE 1 COAX CONTACTS. ACSS PART NO. 7517843-2 MATES WITH RADIALL PART NO. NSXN3P357X0001 OR EQUIVALENT. THIS TRAY CONNECTOR DOES NOT COME WITH CONTACTS. THE FOLLOWING CONTACTS ARE REQUIRED; QUANTITIES DEPEND ON SPECIFIC INSTALLATION:
    22-GAUGE CONTACT PART NO. 620-200 OR EQUIVALENT (WIRE GAUGES 22, 24 AND 26).
    20-GAUGE CONTACT PART NO. 620-310 OR EQUIVALENT (WIRE GAUGES 20, 22, AND 24).
    16-GAUGE CONTACT PART NO. 620-330 OR EQUIVALENT (WIRE GAUGES 16, 20, 22 AND 24)
    12-GAUGE CONTACT PART NO. 620-341 OR EQUIVALENT (WIRE GAUGES 16, 20, 22 AND 24)
    SIZE 5 COAXIAL CONTACT PART NO. 620-021 OR EQUIVALENT (COAX RG 142, RG 223 AND RG 400).
    SIZE 1 COAXIAL CONTACT PART NO. 620-119-100 OR EQUIVALENT (COAX RG 225 AND RG 393).

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Figure 2-5: (Sheet 1) T3CAS Computer Unit Outline and Installation Drawing (4-MCU)

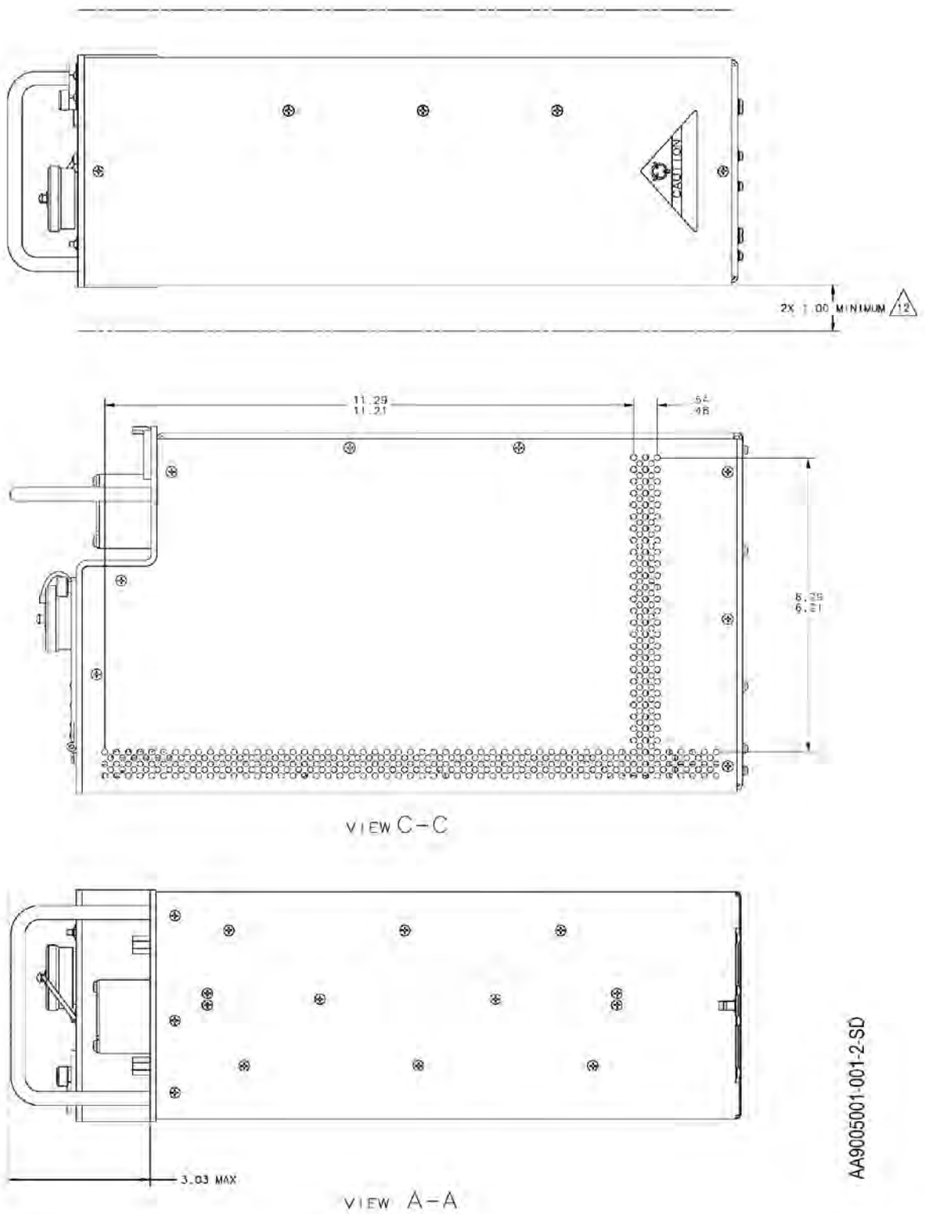


Figure 2-5: (Sheet 2) T3CAS Computer Unit Outline and Installation Drawing (4-MCU)

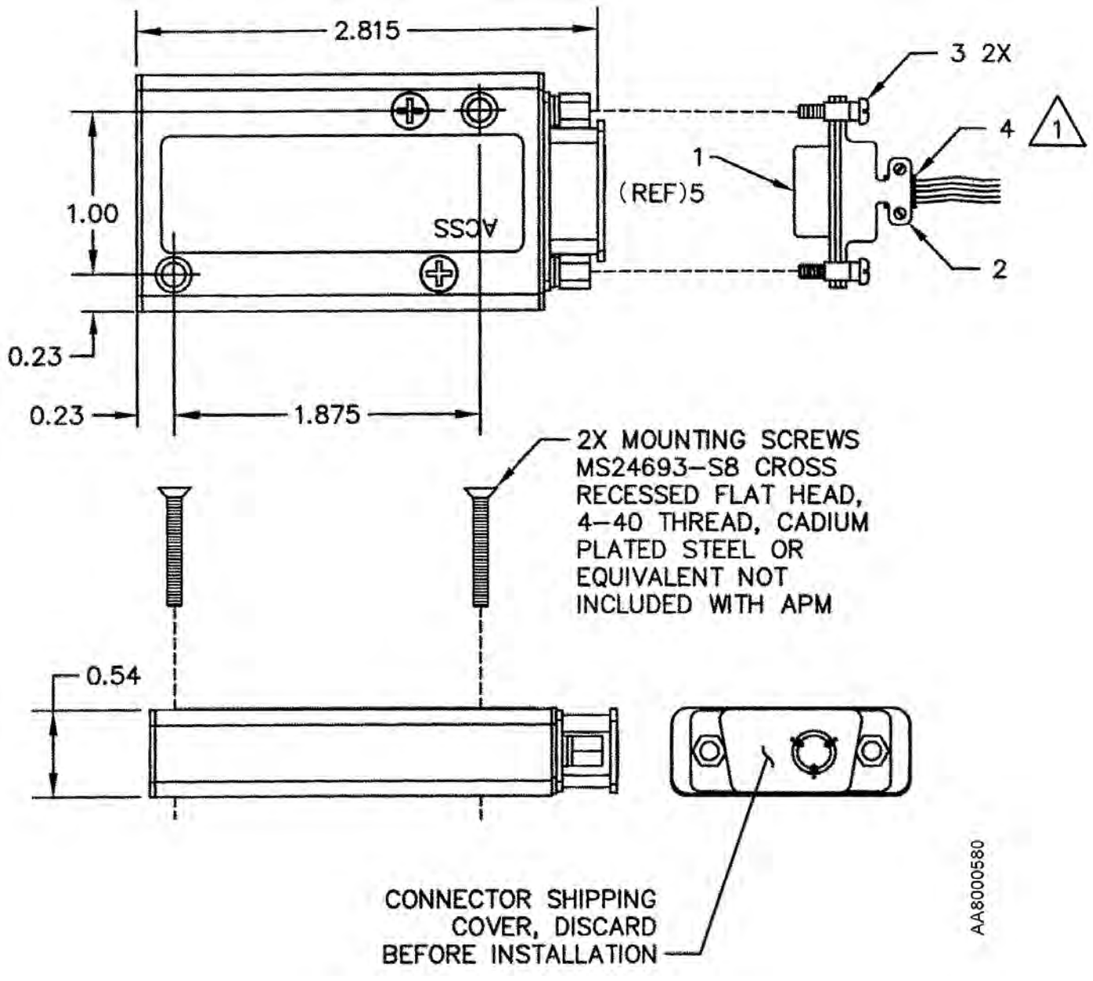
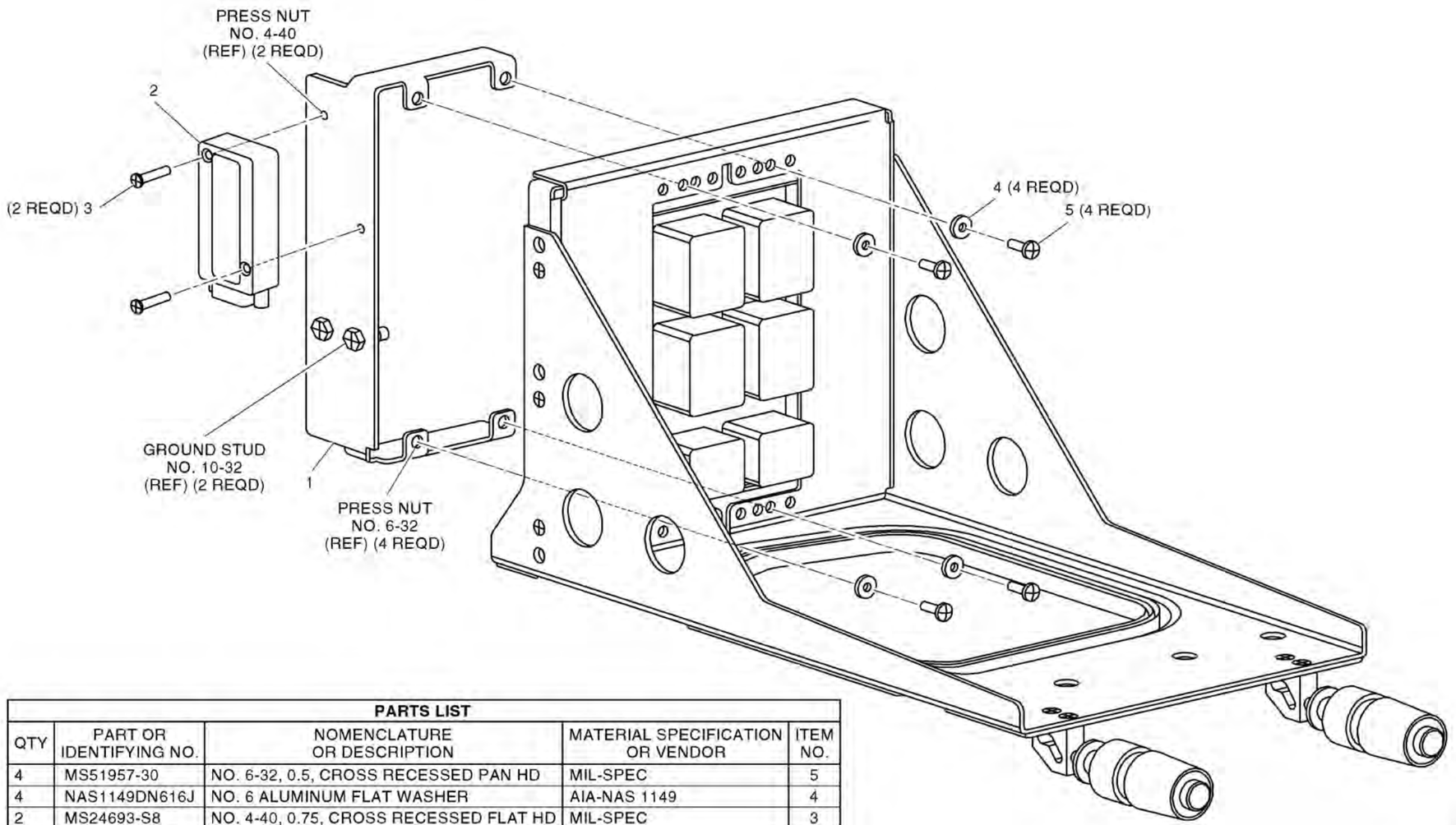


Figure 2-6: (Sheet 1) APM Outline and Installation Drawings

PARTS LIST				
QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION OR VENDOR	ITEM NO.
	031-1007-042	ALTERNATE	ITT CANNON	
REF	M39029/63-368	CONTACT, SOCKET, D SHELL CONNECTOR	M39029	5
AR	2005036-R-BK	BLACK ½ INCH WIDE SELF-FUSING TAPE	MIL SPEC A-A-59163 TYPE II	4
2	D20419-18	SCREW, D SHELL, LOCKING, MALE	ITT CANNON	3
	DE44994	ALTERNATE	ITT CANNON	
1	M85049/48-2-1	BACKSHELL, D SHELL CONNECTOR	M85049	2
	205203-3	ALTERNATE	AMP	
	DEMA9S	ALTERNATE	ITT CANNON	
	M24308/2-1	CONNECTOR, D SHELL RECEPTACLE	M24308	1
APM MATING CONNECTOR PARTS NOT INCLUDED WITH APM				

APM MATING CONNECTOR CONTACT TERMINATION INFORMATION:							
CONTACT SIZE/TYPE	SOCKET MIL PART NUMBER	INSTALLATION REMOVAL TOOL	CRIMPING TOOL	POSITIONER	SELECTOR	WIRE AWG	WIRE STRIP LENGTH
20	M39029/63-368	M81969/1-02	M22520/2-01	M22520/2-08	4	22	0.198± 0.010
22D	M39029/57-354	M81969/1-01	M22520/2-01	M22520/2-06	4	22	0.198± 0.010
D SHELL CONTACTS, REAR RELEASE							

1 SECURE CONNECTOR BACKSHELL APPLYING A MINIMUM OF 3 WRAPS OF SELF-FUSING TAPE (ITEM 4) BETWEEN BACKSHELL AND CABLE. ADD ADDITIONAL WRAPS AS REQUIRED FOR PROPER FIT OF THE BACKSHELL.



PARTS LIST				
QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION OR VENDOR	ITEM NO.
4	MS51957-30	NO. 6-32, 0.5, CROSS RECESSED PAN HD	MIL-SPEC	5
4	NAS1149DN616J	NO. 6 ALUMINUM FLAT WASHER	AIA-NAS 1149	4
2	MS24693-S8	NO. 4-40, 0.75, CROSS RECESSED FLAT HD	MIL-SPEC	3
REF	9000001-10001	AIRPLANE PERSONALITY MODULE (APM)	ACSS	2
1	TBD	APM MOUNTING BRACKET	FAB PART	1
OPTIONAL APM MOUNTING BRACKET NOT INCLUDED WITH APM				

Figure 2-6: (Sheet 2) APM Outline and Installation Drawings

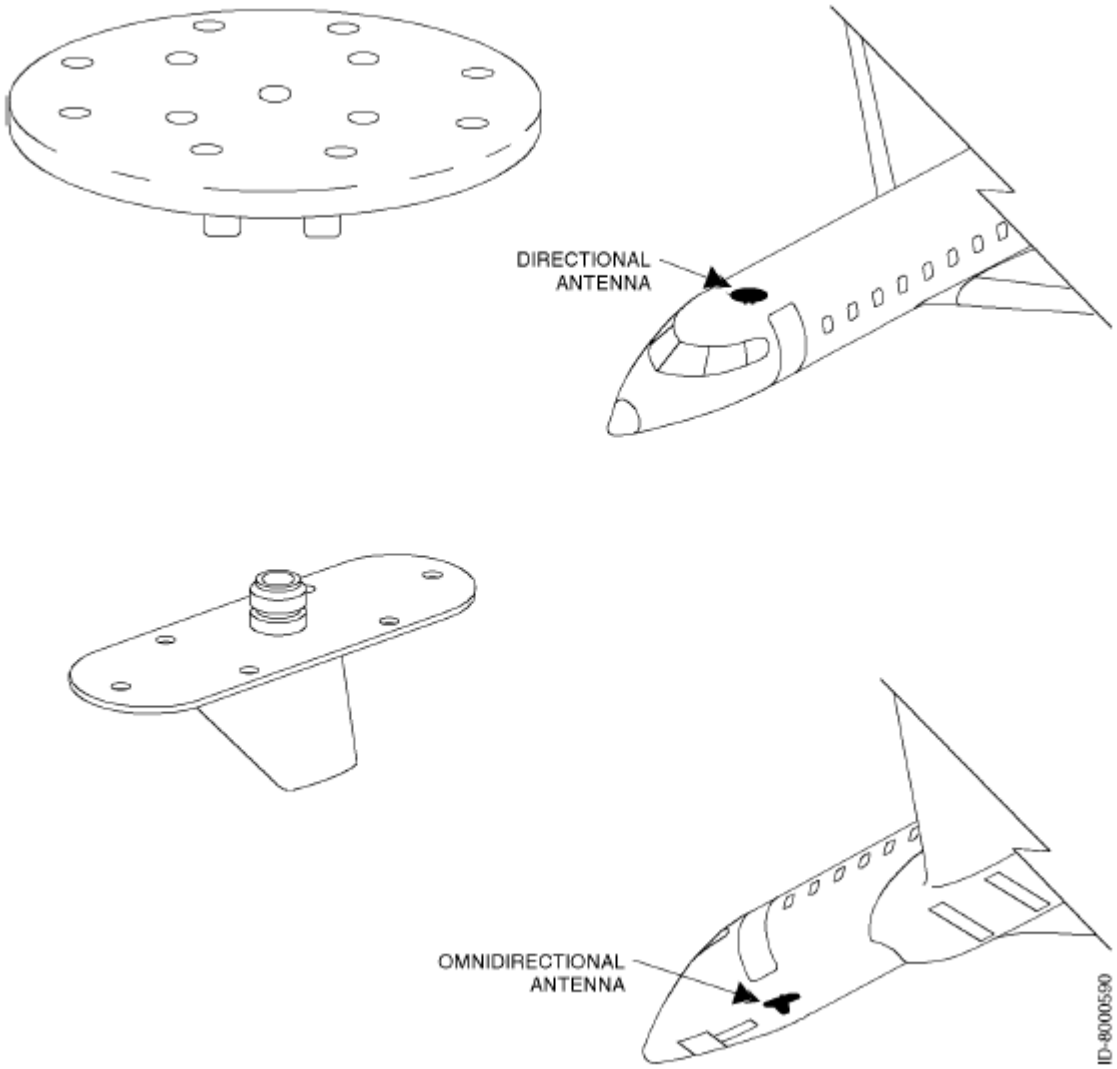


Figure 2-7: TCAS Directional and Omnidirectional Antenna Locations

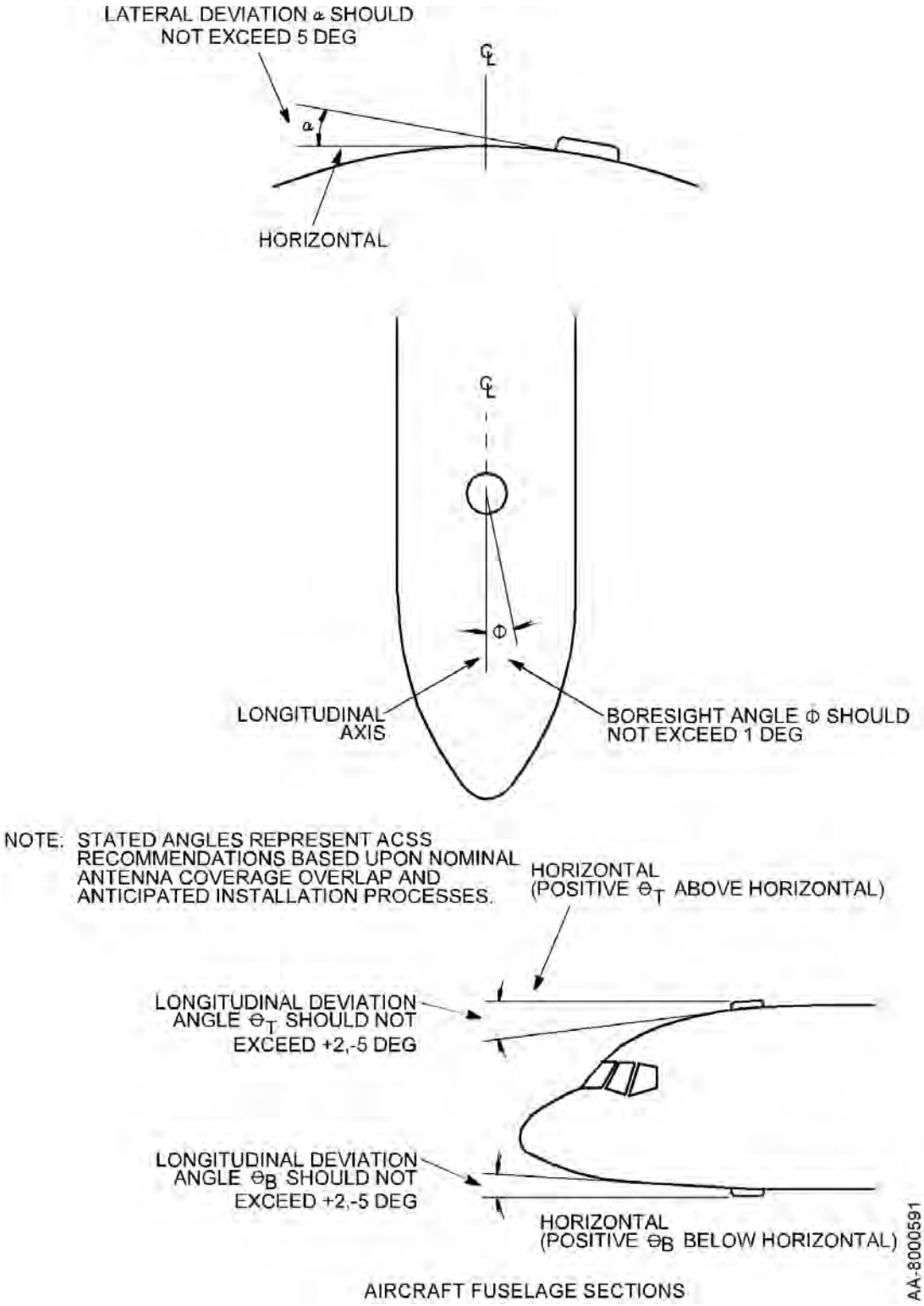


Figure 2-8: Directional Antenna Angular Orientation

NOTES:

1. ⊕ DENOTES APPROXIMATE CENTER OF GRAVITY.
2. FOR MAXIMUM UNIT WEIGHT, REFER TO TABLES 3, 4 AND 6.
3. DIMENSIONS SHOWN ARE IN INCHES. REFER TO METRIC CONVERSION TABLE FOR CORRESPONDING DIMENSIONS IN MILLIMETERS.
4. EACH ANTENNA ASSEMBLY IS SUPPLIED WITH AN O-RING (4000171-240) FOR ENVIRONMENTAL SEALING. THIS O-RING SHOULD NOT COME INTO CONTACT WITH LIQUIDS, OILS OR GREASES MADE FROM MINERAL OIL OR OTHER PETROLEUM PRODUCTS, AS PERMANENT DAMAGE TO THE O-RING MATERIAL MAY OCCUR.
5. INDICATED ASSEMBLY INCLUDES A .015 INCH TEFLON GASKET FOR PLACEMENT BETWEEN THE ANTENNA/ADAPTER ASSEMBLY AND THE AIRCRAFT.
6. ■ THE SOLID SQUARE SYMBOL DENOTES A CRITICAL PARAMETER. THE NUMBER IN THE CENTER CORRESPONDS TO THE FOLLOWING SUB-NOTE WITH THE SAME NUMBER, STATING TYPE AND NATURE OF CRITICALITY.

   ■1 INSTALLATION CRITICAL - COMPLIANCE WITH CRITICAL INSTALLATION REQUIREMENTS IS NECESSARY WHEN UTILIZING EITHER AN ACSS OR CUSTOMER SUPPLIED ADAPTER PLATE.
7. MOUNTING HARDWARE SHALL MEET THE FOLLOWING REQUIREMENTS:

   7.1. MOUNTING SCREWS MUST BE COMPATIBLE WITH THE THROUGH-HOLE DIAMETER SHOWN FOR THE ANTENNA CONFIGURATION BEING USED. CONSULT THE APPROPRIATE SHEET OF THIS DRAWING, FOR THE CONFIGURATION BEING INSTALLED, FOR THE MINIMUM AND MAXIMUM HOLE DIAMETER. ALL HOLES ARE DESIGNED FOR A #10 UNIFIED SCREW THREAD (MAJOR DIAMETER .190 INCH).

   7.2. APPROPRIATE LENGTH FOR THE INSTALLATION SCREW SHALL BE DETERMINED BY THE INSTALLER, USING THE ASSEMBLY GRIP LENGTH PROVIDED IN TABLE 3 OR TABLE 4, OR ON SHEET 6, FOR THE CONFIGURATION BEING INSTALLED. GRIP LENGTHS SHOWN DO NOT INCLUDE THE WASHER (PARAGRAPH 7.6).

   7.3. MOUNTING SCREWS SHALL POSSESS A MINIMUM MATERIAL TENSILE STRENGTH OF 80 KSI (551 MPa).

   7.4. EACH MOUNTING SCREW SHOULD BE INSTALLED SUCH THAT A MINIMUM PRELOAD OF 50% OF THE MATERIAL YIELD STRENGTH IS DEVELOPED IN THE SCREW. TABLE 7 PROVIDES APPROXIMATE TORQUE VALUES FOR VARIOUS MATERIAL STRENGTHS (SEE NOTE 7.3) AND A .190-32 UNF, STAINLESS STEEL SCREW. THE REQUIRED VALUE SHOULD BE BASED ON THE INSTALLER'S HARDWARE SELECTIONS AND STANDARD PRACTICES, BUT MUST CONFORM TO NOTE 8.

   7.5. TO EASILY IDENTIFY REMOVABLE INSTALLATION SCREWS FROM PERMANENT ANTENNA HARDWARE, IT IS RECOMMENDED THAT INSTALLATION SCREWS USE A PHILLIPS-HEAD OR SOCKET-HEAD DESIGN. USE OF TORX SCREWS, OR SCREWS WITH SIMILAR HEAD STYLE, IS NOT RECOMMENDED.

   7.6. A NAS 1149 SERIES WASHER OR EQUIVALENT, COMPATIBLE WITH THE MATERIAL PROPERTIES OF THE INSTALLATION SCREW, SHALL BE INSTALLED UNDER THE HEAD OF EACH SCREW. MAXIMUM ALLOWABLE OUTER DIAMETER OF THE WASHER IS .50 INCH.
8. TO AVOID DAMAGE TO THE ANTENNA MATERIAL, THE APPLIED TORQUE ON THE INSTALLATION HARDWARE (SEE NOTE 7.4) SHALL NOT EXCEED 37 LBF-IN (4.2 N-m).
9. FOR INSTALLATION OF 7514081-901, 7514081-902, 7514081-910, 7514081-913, 7514060-901 AND 7514060-902, THE AIRCRAFT SURFACE WHICH INTERFACES WITH THE ANTENNA SHOULD BE FLAT WITHIN .010 INCH.
10. (7514081-VAR ASSEMBLIES ONLY) MOUNTING SCREWS MUST BE USED TO SECURE THE ANTENNA TO THE AIRCRAFT AT EVERY CLEARANCE HOLE THROUGH THE ANTENNA. REFER TO TABLES 3 AND 4 FOR REQUIRED NUMBER OF AIRCRAFT MOUNTING SCREWS.
11. ALL 7514060 ANTENNAS (WHICH UTILIZE CUSTOMER PROVIDED ADAPTER PLATES) ARE SHIPPED FROM THE MANUFACTURER WITH 12 OPEN SCREW HOLES OF WHICH ALL MUST BE FILLED WITH SCREWS. EITHER FOUR OR EIGHT SCREWS MUST BE USED TO MOUNT THE ANTENNA TO THE AIRCRAFT (SEE PAGE 5 FOR MOUNTING CONFIGURATION). THE ANTENNA MUST BE SECURED TO EITHER THE ANTENNA ADAPTER PLATE OR AIRCRAFT ADAPTER/DOUBLER WITH SCREWS AT EVERY REMAINING ANTENNA CLEARANCE HOLE (EIGHT OR FOUR RESPECTIVELY) THAT IS NOT USED TO MOUNT THE ANTENNA TO THE AIRCRAFT.
12. THE TCAS DIRECTIONAL ANTENNA COMPLIES WITH THE MOUNTING FOOTPRINT OPTIONS SPECIFIED IN RTCA DO-185A.

METRIC CONVERSION TABLE	
INCHES	MILLIMETERS
0.010	0.25
0.015	0.38
0.028	0.71
0.059	1.50
0.100	2.54
0.190	4.83
0.196	4.98
0.205	5.21
0.238	6.05
0.242	6.15
0.244	6.20
0.254	6.45
0.335	8.51
0.415	10.54
0.477	12.12
0.481	12.22
0.489	12.42
0.50	12.70
0.501	12.73
0.509	12.93
0.514	13.06
0.525	13.34
0.534	13.56
0.553	14.05

METRIC CONVERSION TABLE (CONT'D)	
INCHES	MILLIMETERS
0.578	14.68
0.589	14.96
0.705	17.91
0.806	20.47
1.560	39.62
1.900	48.26
2.900	73.66
3.000	76.20
5.000	127.00
7.375	187.33
9.310	236.47
42.00	1066.8
44.80	1137.9
53.00	1346.2
61.50	1562.1
66.50	1689.1
74.00	1879.6
77.76	1975.1
77.77	1975.4
85.06	2160.5
99.00	2514.6
111.00	2819.4
111.01	2819.7
118.50	3009.9

TABLE 7

MATERIAL	TENSILE STRENGTH		TORQUE	
	KSI	MPa	LBF-IN	N-m
304 OR 316	85	586	18	2.0
A-286	130	896	33	3.7
A-286 HEAT TREATED	160	1103	36	4.1

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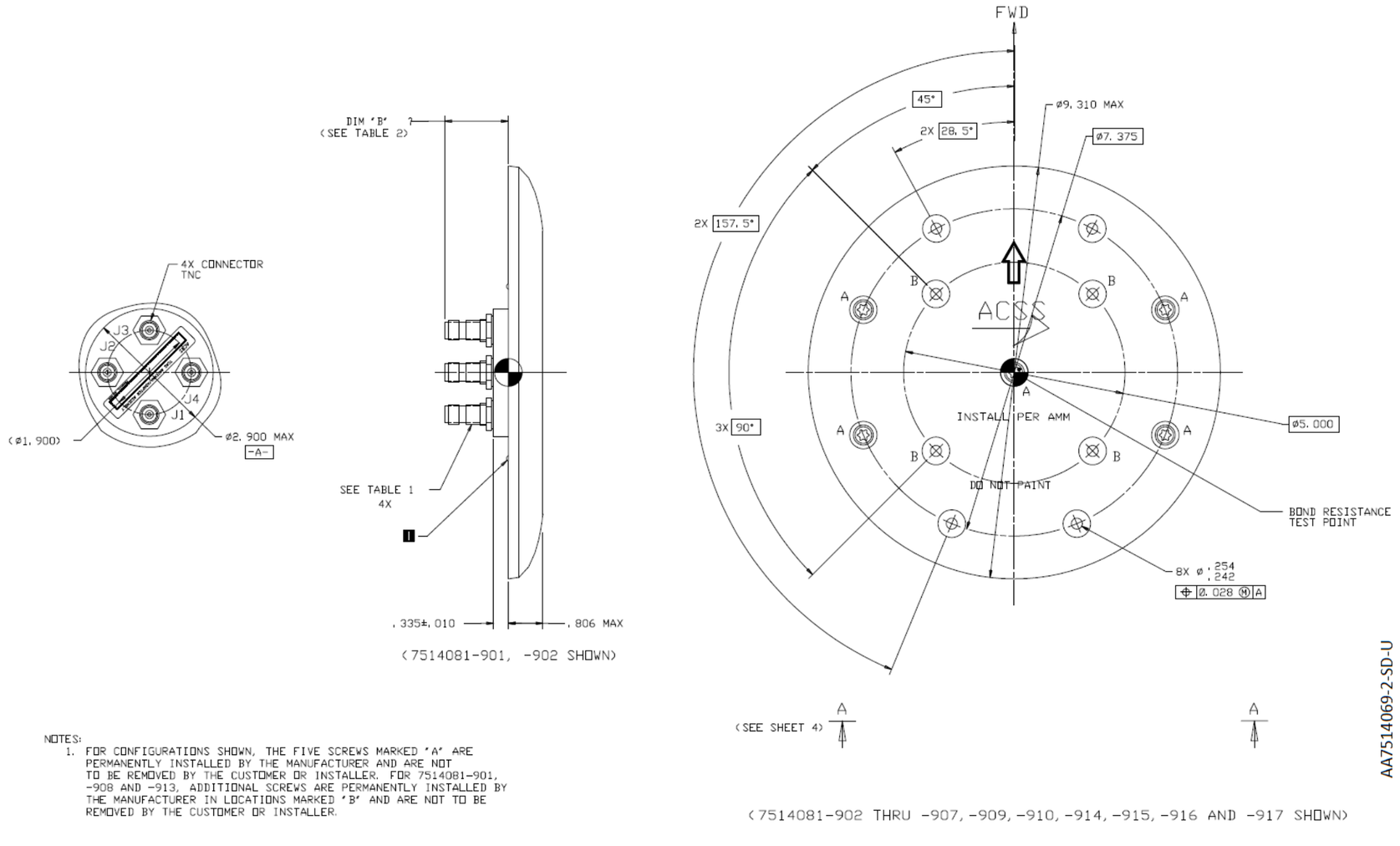
Figure 2-9: (Sheet 1) Directional Antenna Outline and Installation Diagram

TABLE 1	
REF DES	SLEEVING COLOR
J1	YELLOW
J2	BLACK
J3	BLUE
J4	RED

TABLE 2	
DIM 'B'	ANTENNA/ADAPTER ASSY PART NO.?
1.560 MAX	7514081-901 THRU -909, -911, -912 AND -917
.705 MAX	7514081-910, -913, -914, -915 AND -916



NOTES:
1. FOR CONFIGURATIONS SHOWN, THE FIVE SCREWS MARKED 'A' ARE PERMANENTLY INSTALLED BY THE MANUFACTURER AND ARE NOT TO BE REMOVED BY THE CUSTOMER OR INSTALLER. FOR 7514081-901, -908 AND -913, ADDITIONAL SCREWS ARE PERMANENTLY INSTALLED BY THE MANUFACTURER IN LOCATIONS MARKED 'B' AND ARE NOT TO BE REMOVED BY THE CUSTOMER OR INSTALLER.

Figure 2-9: (Sheet 2) Directional Antenna Outline and Installation Diagram

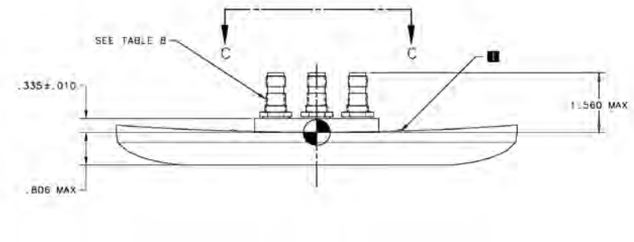
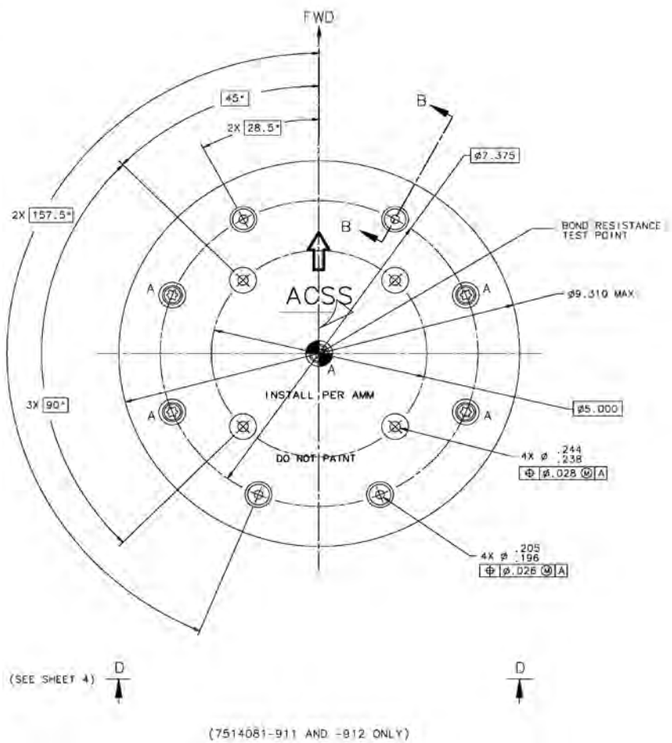
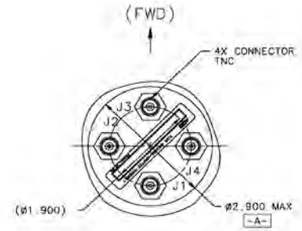
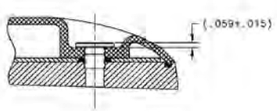


TABLE B	
REF DES	SLEEVING COLOR
J1	YELLOW
J2	BLACK
J3	BLUE
J4	RED





VIEW C-C
(ROTATED 180°)



SECTION B-B
SCALE 2/1
4 PLCS

NOTES:
1. FOR CONFIGURATIONS SHOWN, THE FIVE SCREWS MARKED "A" ARE PERMANENTLY INSTALLED BY THE MANUFACTURER AND ARE NOT TO BE REMOVED BY THE CUSTOMER OR INSTALLER.

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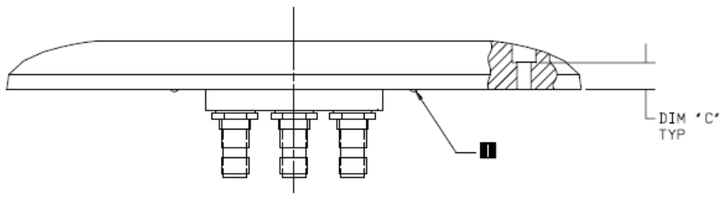
Figure 2-9: (Sheet 3) Directional Antenna Outline and Installation Diagram



VIEW A–A
(SEE TABLE 3)

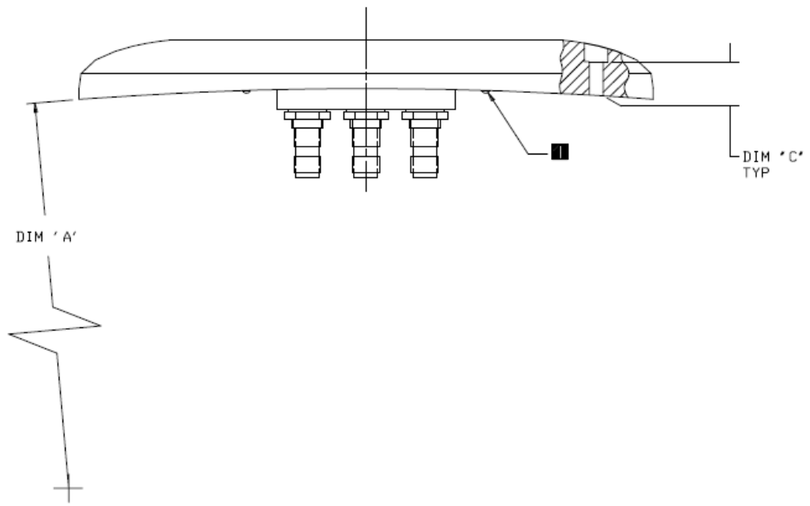
ANTENNA PART NUMBERS
FLAT ANTENNA BASE 9 10
TABLE 3

NUMBER OF AIRCRAFT MOUNTING SCREWS	ANTENNA/ADAPTER ASSY PART NO. *	CONNECTOR EXTENSION (TABLE 2 DIM 'B' REF)	MAXIMUM UNIT WEIGHT LB (KG)	DIM 'C' ±.015
4	7514081-901	1.560	2.80 (1.27)	.415
4	7514081-913	.705	2.80 (1.27)	.415
8	7514081-902	1.560	2.80 (1.27)	.415
8	7514081-910	.705	2.80 (1.27)	.415

ANTENNA PART NUMBERS
CURVED ANTENNA BASE 10
TABLE 4

NUMBER OF AIRCRAFT MOUNTING SCREWS	DIM 'A' ±.010	ANTENNA/ADAPTER ASSY PART NO. *	CONNECTOR EXTENSION (TABLE 2 DIM 'B' REF)	MAXIMUM UNIT WEIGHT LB (KG)	DIM 'C' ±.015
8	R 61.50	7514081-903	1.560	2.90 (1.32)	.534
8	R 66.50	7514081-904	1.560	2.90 (1.32)	.525
8	R 74.00	7514081-905	1.560	2.90 (1.32)	.514
8	R 77.76	7514081-906	1.560	2.90 (1.32)	.509
8	R 99.00	7514081-907	1.560	2.80 (1.27)	.489
4	R 111.00	7514081-908	1.560	2.80 (1.27)	.481
8	R 118.50	7514081-909	1.560	2.80 (1.27)	.477
8	R 77.77	7514081-911 5	1.560	2.90 (1.32)	.509
8	R 111.01	7514081-912 5	1.560	2.80 (1.27)	.481
8	R 53.00	7514081-914	.705	3.00 (1.36)	.553
8	R 44.80	7514081-915	.705	3.10 (1.41)	.578
8	R 42.00	7514081-916	.705	3.20 (1.45)	.589
8	R 85.06	7514081-917	1.560	2.90 (1.32)	.501

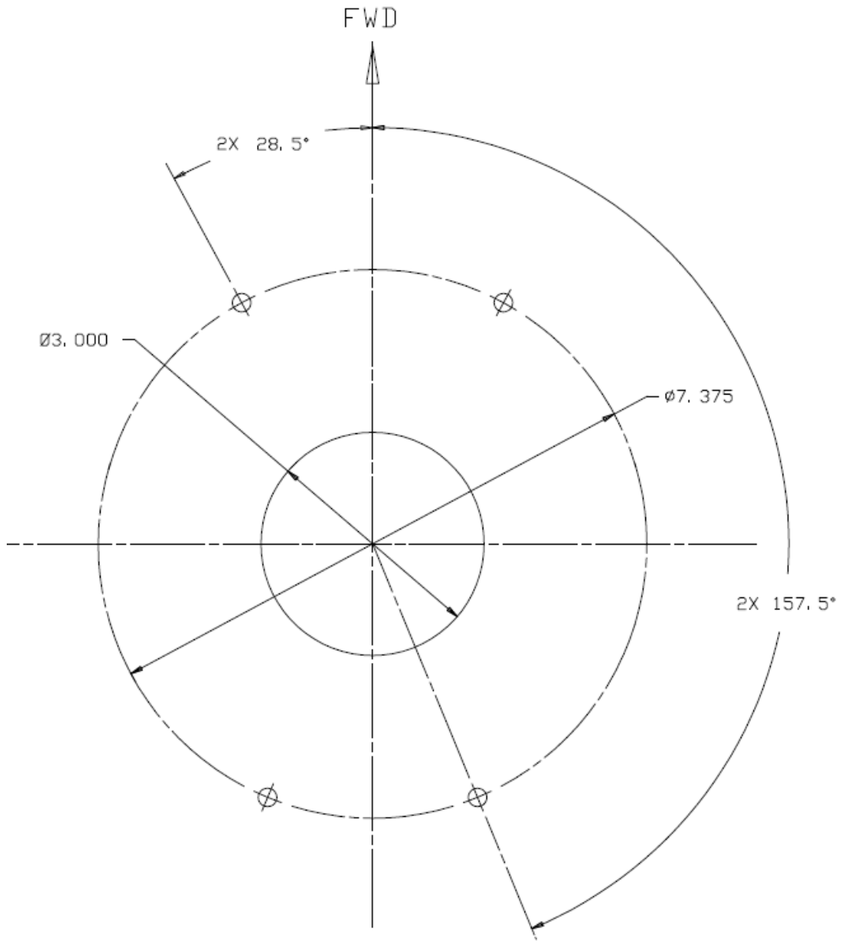
*THIS ASSEMBLY IS A COMPLETE ANTENNA ASSEMBLY READY FOR AIRCRAFT INSTALLATION.



VIEW D–D
(SEE TABLE 4)

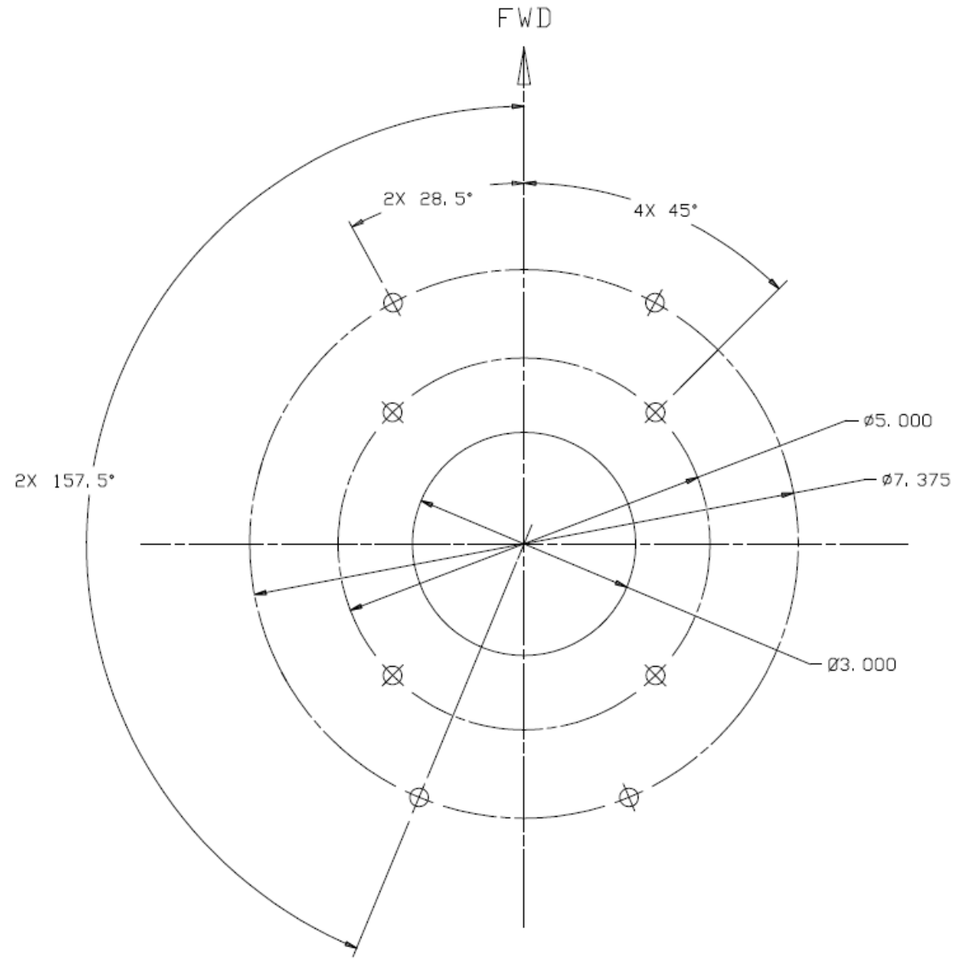
AA7514069-4-SD-U

Figure 2-9: (Sheet 4) Directional Antenna Outline and Installation Diagram



RECOMMENDED MOUNTING PATTERN

THIS CONFIGURATION IS FOR 7514081-901, 908 AND 913
THIS CONFIGURATION IS ALSO ACCEPTABLE FOR 7514060-901
AND -902, IF INSTALLED PER NOTE 11.



RECOMMENDED MOUNTING PATTERN

THIS CONFIGURATION IS FOR 7514081-902 THRU -907, -909 THRU -912, AND -914 THRU -917
THIS CONFIGURATION IS ALSO ACCEPTABLE FOR 7514060-901
AND -902, IF INSTALLED PER NOTE 11.

AA7514069-5-SD-U

Figure 2-9: (Sheet 5) Directional Antenna Outline and Installation Diagram

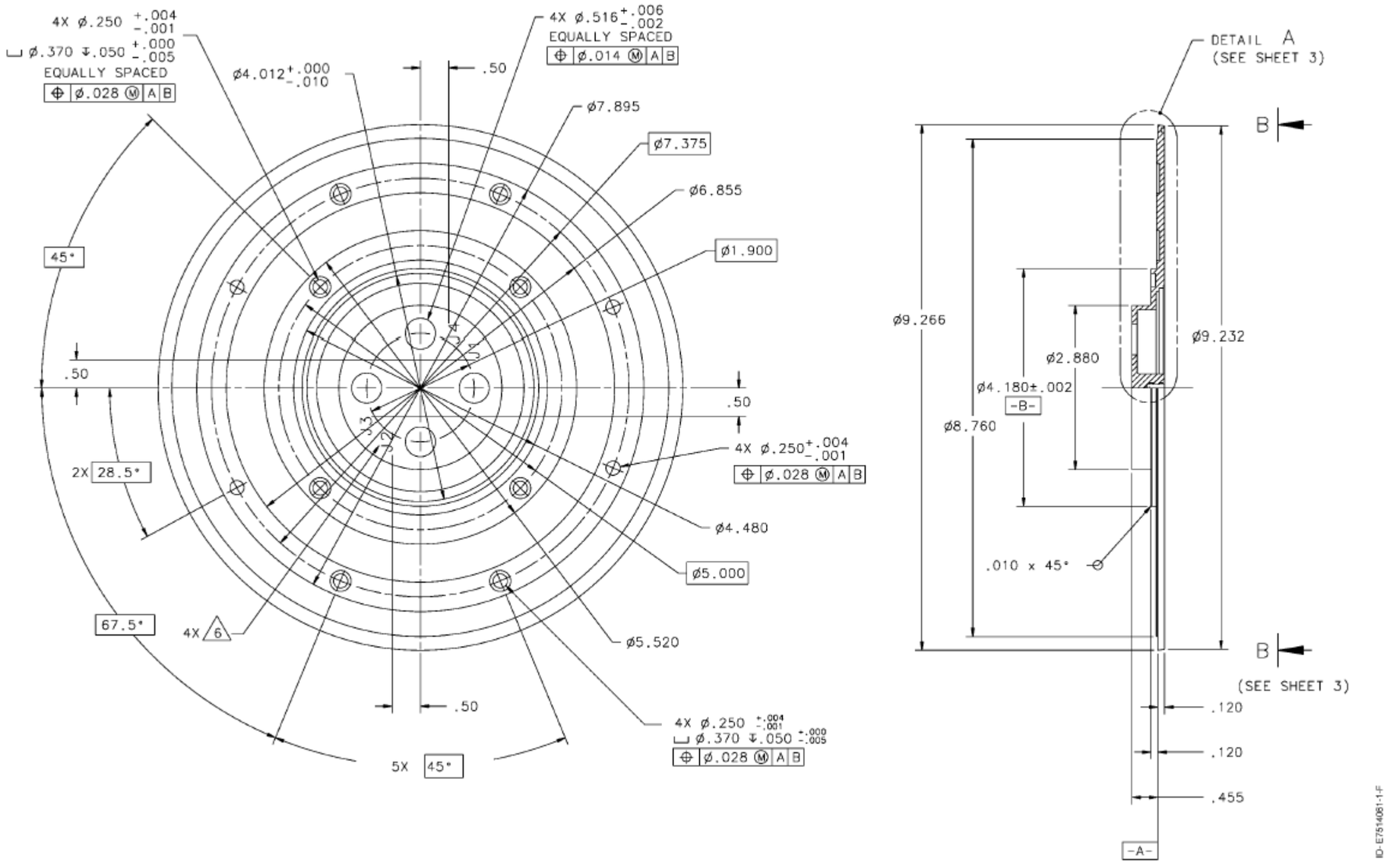


Figure 2-10: (Sheet 1) Directional Antenna (ACSS Part No.7514060-90X) Baseplate Outline and Installation Diagram

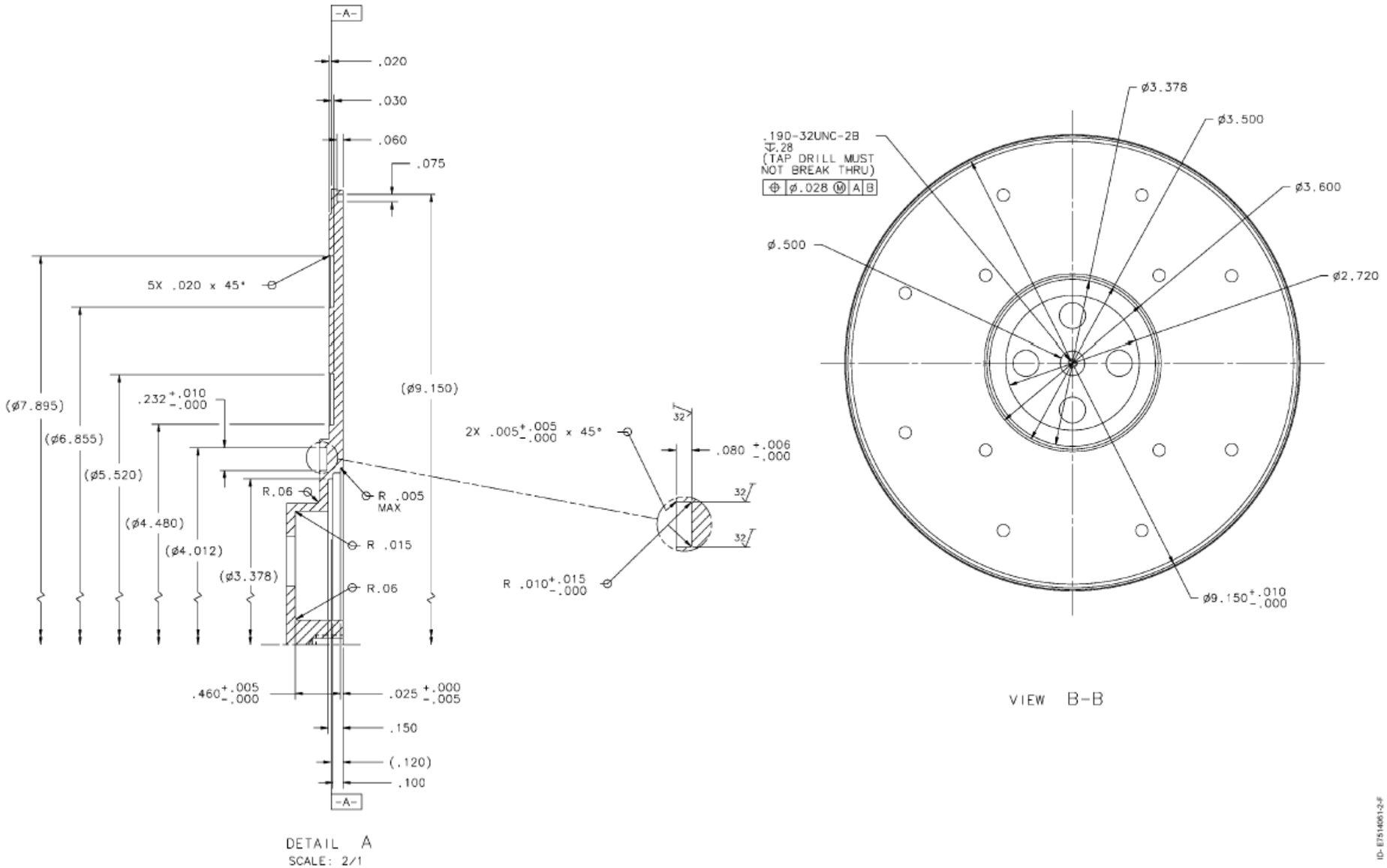
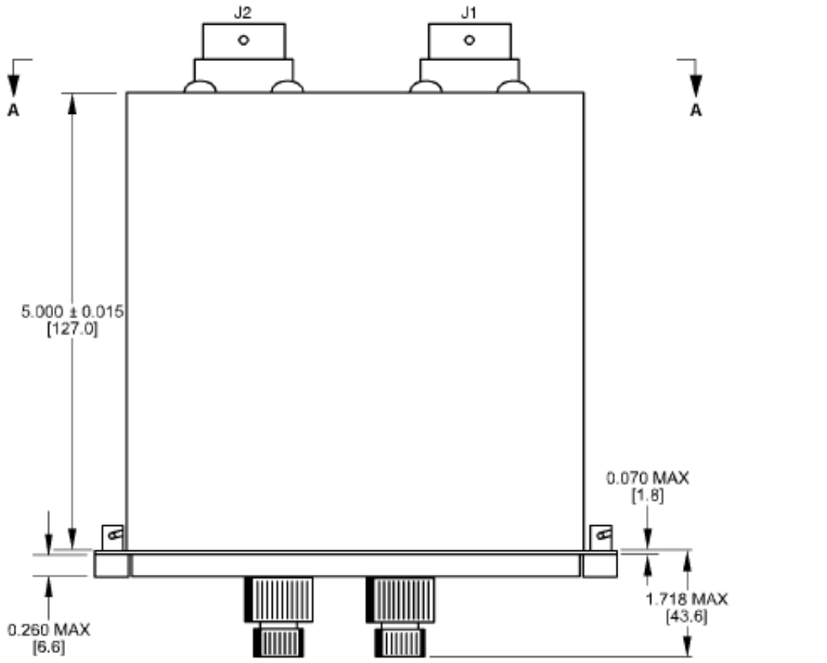
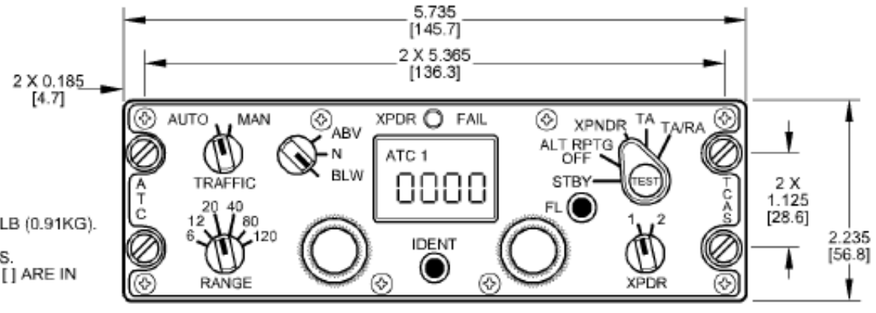


Figure 2-10: (Sheet 2) Directional Antenna (ACSS Part No.7514060-90X) Baseplate Outline and Installation Diagram



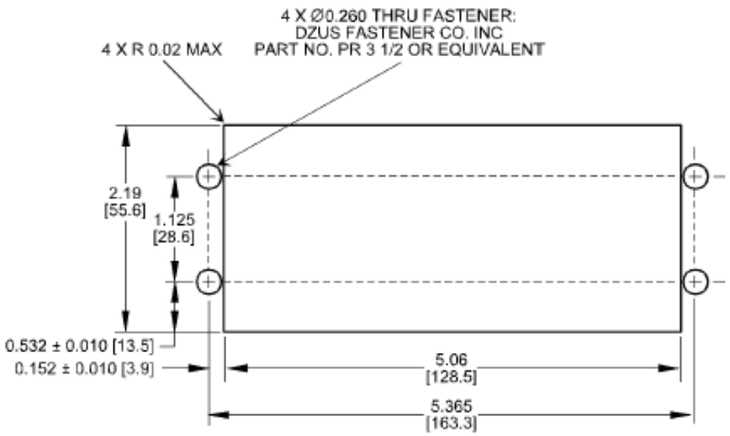
TOP VIEW



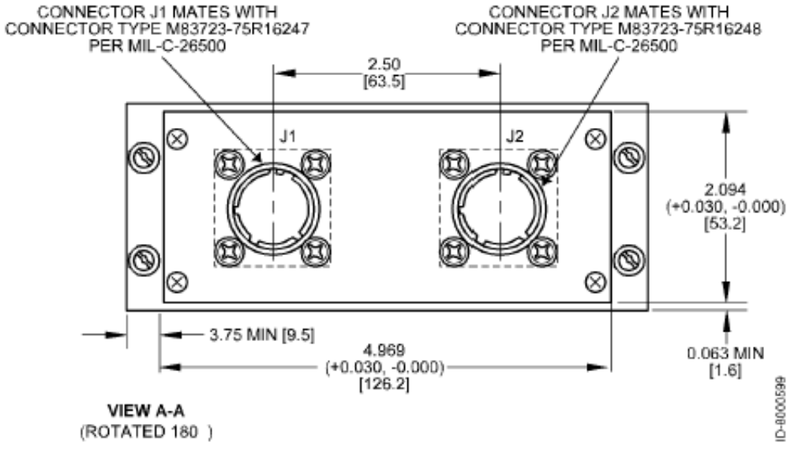
NOTES:

1. MAXIMUM UNIT WEIGHT 2.0LB (0.91KG).
2. DIMENSIONS ARE IN INCHES. DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS.

FRONT VIEW

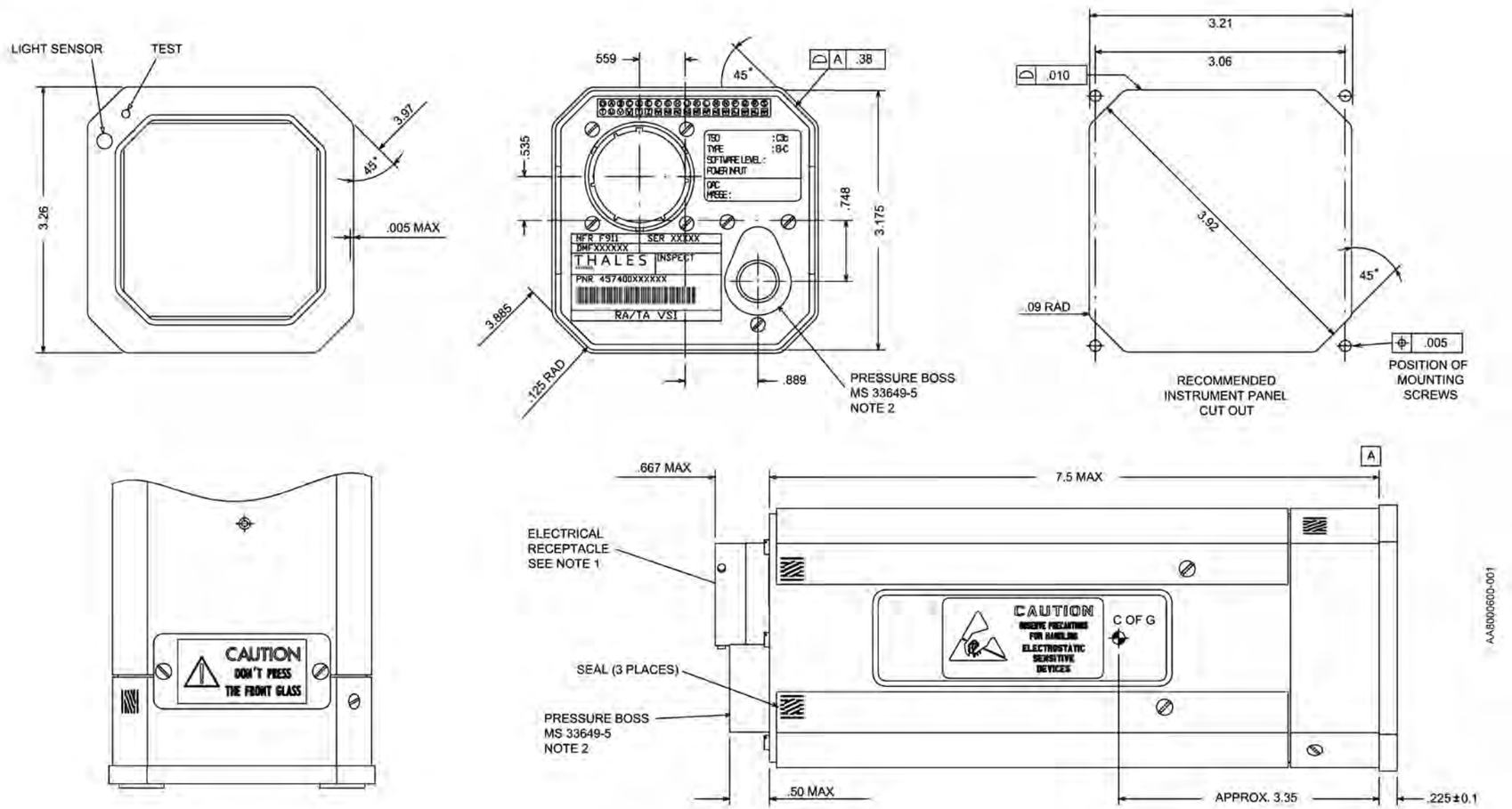


RECOMMENDED PANEL CUTOUT



VIEW A-A
(ROTATED 180)

Figure 2-11: Gable G7130-XX Control Panel Outline and Installation Diagram

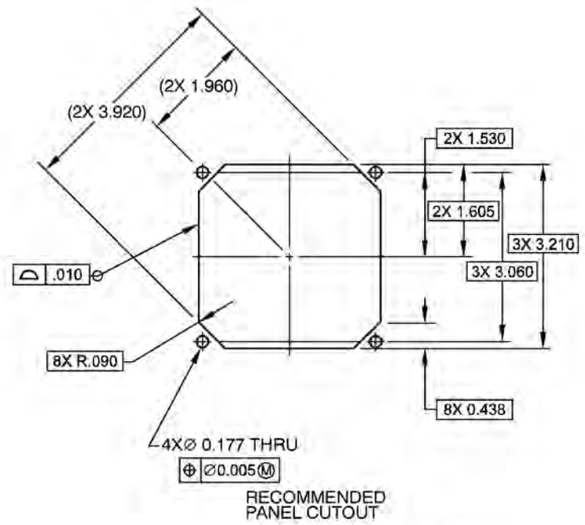


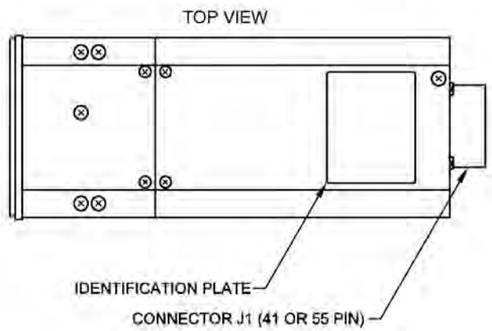
NOTE 1: ELECTRICAL MATING PLUG PART NUMBER M83723/72R20-41-6 OR EQUIVALENT SHOULD BE USED FOR 115 VAC 400HZ UNITS, PART NUMBER M83723/72R20-41-N OR EQUIVALENT FOR +28 VDC UNITS.

NOTE 2: VSI TCAS HARDWARE VERSIONS KB AND PB ARE EQUIPPED WITH A QUICK DISCONNECT 40006-1B45 FITTED ON PRESSURE BOSS MS 33649-5. ALL OTHER HARDWARE VERSIONS REQUIRE AN MS 24392 UNION OR EQUIVALENT ACCOMPANIED BY AN MS 9385-05 PACKING OR EQUIVALENT.

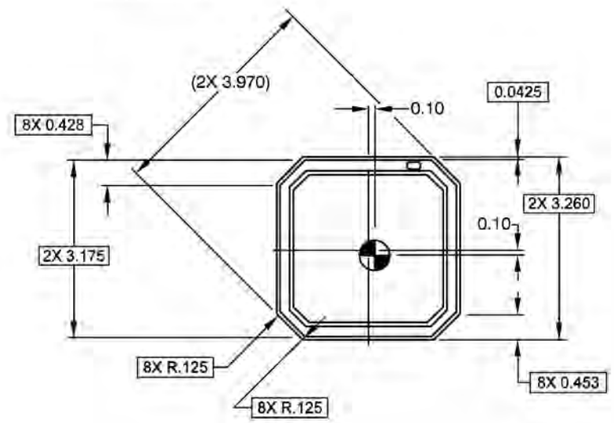
NOTE: ALL MEASUREMENTS ARE IN INCHES.

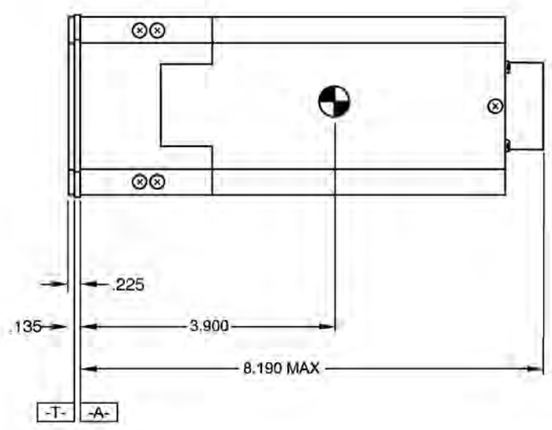
Figure 2-12: Thales VSI-TCAS Outline and Installation Diagram

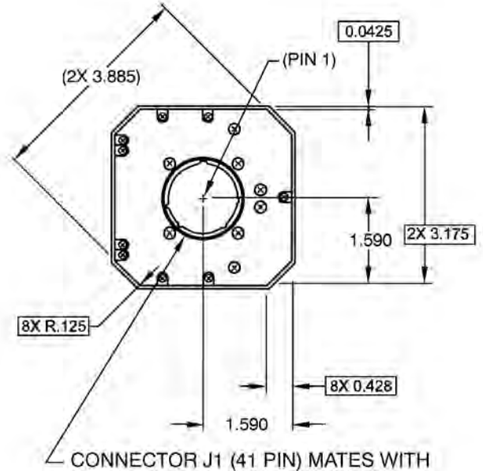




CONVERSION TABLE			
INCHES	MILLIMETERS	INCHES	MILLIMETERS
0.005	0.13	1.530	38.86
0.010	0.25	1.590	40.39
0.015	0.38	1.605	40.77
0.0425	1.08	1.960	49.78
0.090	2.29	3.060	77.72
0.100	2.54	3.175	80.65
0.125	3.18	3.210	81.53
0.135	3.43	3.260	82.80
0.177	4.50	3.885	98.68
0.225	5.72	3.900	99.06
0.428	10.87	3.920	99.57
0.438	11.13	3.970	100.84
0.453	11.51	8.190	208.03







NOTES:
1. MAXIMUM WEIGHT 4.0 LBS (1.81 KG).
2. DIMENSIONS SHOWN ARE IN INCHES. REFER TO METRIC CONVERSION TABLE FOR CORRESPONDING DIMENSIONS IN MILLIMETERS.
3. ⊕ DENOTES APPROXIMATE CENTER OF GRAVITY.

CONNECTOR J1 (41 PIN) MATES WITH M83723/75A2041N OR EQUIVALENT

41-PIN CONNECTOR BACKSHELL IS M85049/52-1-20A OR EQUIVALENT

CONNECTOR J1 (55 PIN) MATES WITH M83723/75A2255N OR EQUIVALENT

55-PIN CONNECTOR BACKSHELL IS M85049/52-1-22A OR EQUIVALENT

AAAD-38673-R1

Figure 2-13: ACSS VSI/TRA Outline and Installation Diagram

ELECTRICAL INSTALLATION

1. General

This section gives electrical installation procedures, power distribution, and interconnect information for each component on the T3CAS system.

2. Equipment and Materials

Refer to the applicable Outline and Installation Diagram in the MECHANICAL INSTALLATION section for mating connector part numbers.

3. Electrical Installation Procedure

The information necessary to provide the electrical interconnections is contained in the following paragraphs. Refer to Section 4, LOADING/GRADIENT SPECIFICATIONS, for a list of the signal names used in the interconnect diagrams and tables.

NOTE: Unless otherwise specified, all wires shall be stranded #22 AWG.

NOTE: All ARINC 429 data bus wires shall be stranded #22 AWG twisted shield wire. All outer shields shall be terminated to the airframe ground. Unshielded portions of the cable and shield ground wires should be kept to a minimum length to minimize RF susceptibility.

NOTE: All electrical installations must be in compliance with SFAR-88.

4. Electrical Installation

A. T3CAS Computer Units

Figure 3-1 shows some general types of T3CAS system installations, using various combinations of controllers (control panels) and transponders.

The various installation options require different electrical connections as described in the paragraphs that follow.

The T3CAS Computer Unit uses programming and configuration straps to select or deselect various TCAS, TAWS and transponder functions. In addition, the T3CAS may use the APM and ASDB to select or deselect various TAWS/RWS functions.

The T3CAS Computer Unit ARINC 600 connector layout is shown in Figure 3-2. The contact arrangement for the various connector plugs are shown in Figure 3-3 thru Figure 3-8. Figure 3-9 shows the connector pin layout for the DATA LOADER connector located on the front of the computer unit.

B. APM (Not applicable to 9005000-10000, -10101, -10202, -10204, or -11203. Programming pins are used)

Figure 2-6 (Sheet 1) shows a typical APM installation. An APM can be mounted to existing aircraft structure or can be mounted to the ACSS APM mounting bracket that is secured to the aft side of the T3CAS computer tray connector (reference Figure 2-6, Sheet 2). If the customer specifies the ACSS APM mounting bracket, the Contractor shall manufacture and provide this APM bracket sub kit for this customer's T3CAS installations.

C. TCAS Antennas

The electrical installation for the TCAS antennas is specified in the LOADING AND GRADIENT section. Figure 3-3 shows the T3CAS computer contact arrangement for the top directional antenna and Figure 3-4 shows the T3CAS computer contact arrangement for the bottom antenna.

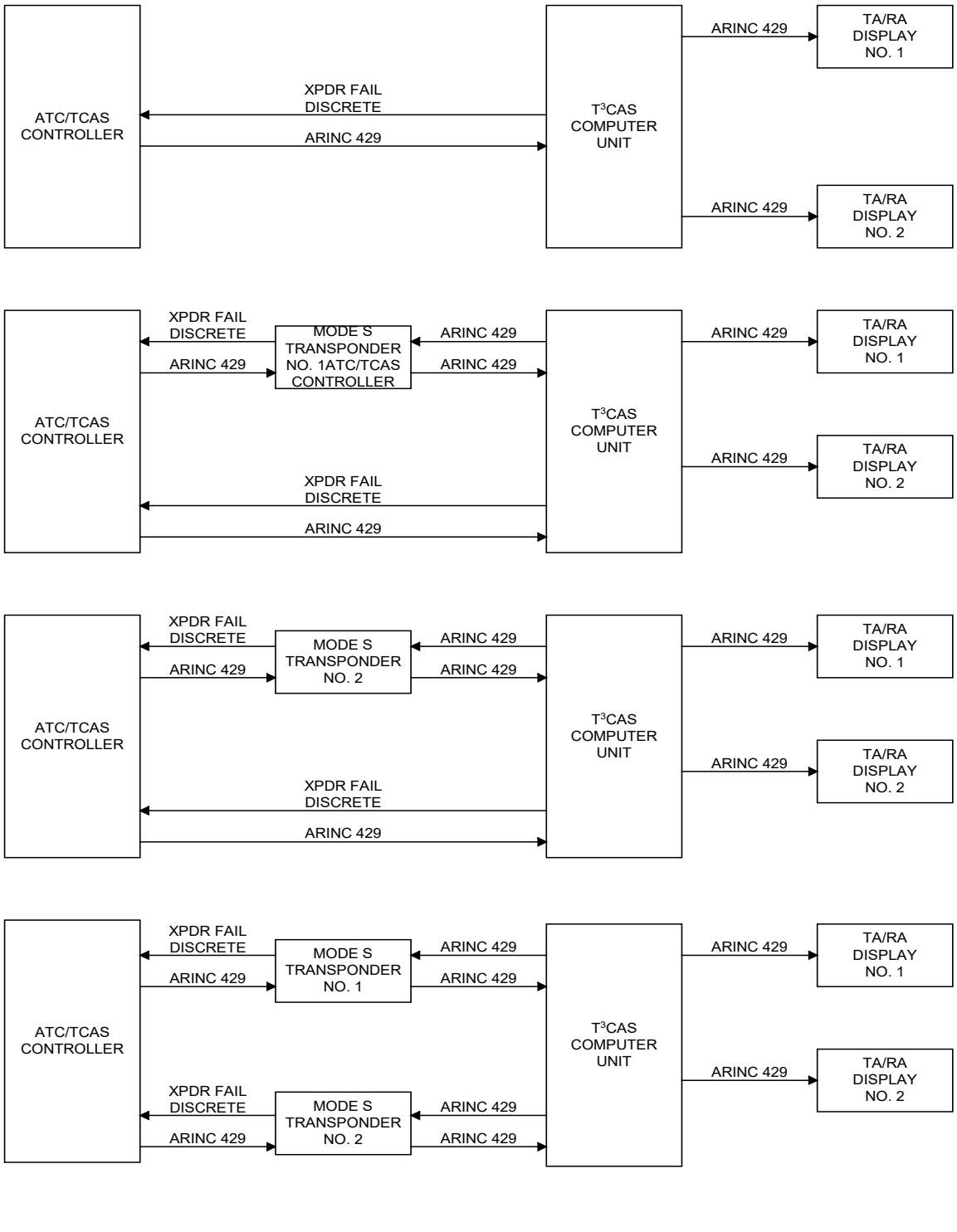


Figure 3-1: Typical TCAS Installations Types

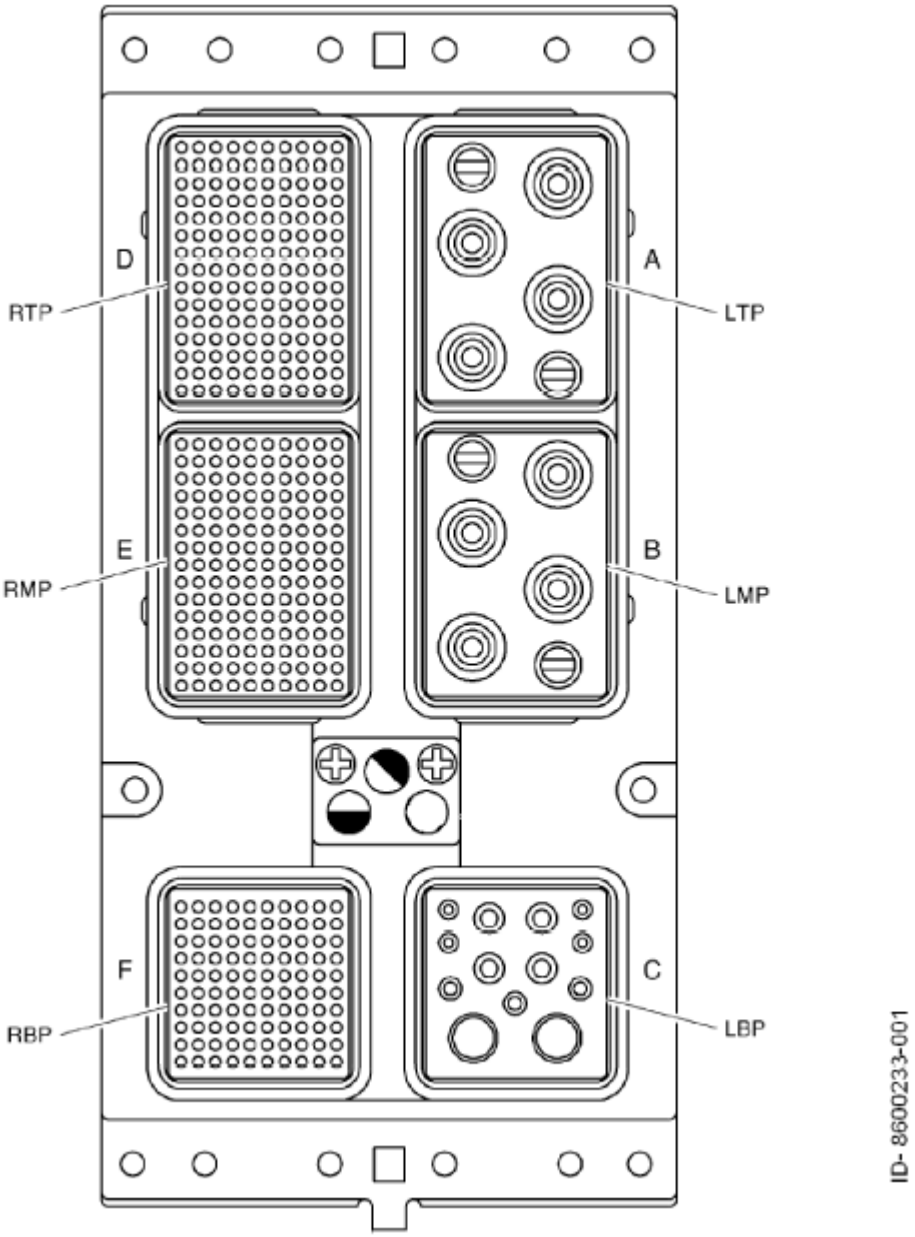


Figure 3-2: T3CAS Computer Tray Mating Connector

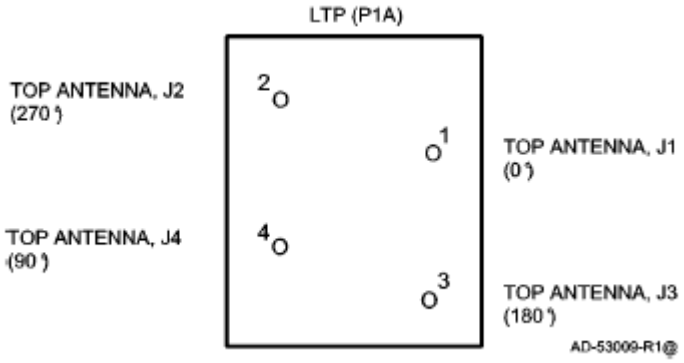


Figure 3-3: Contact Arrangement for CU Left Top Plug (LTP) Insert

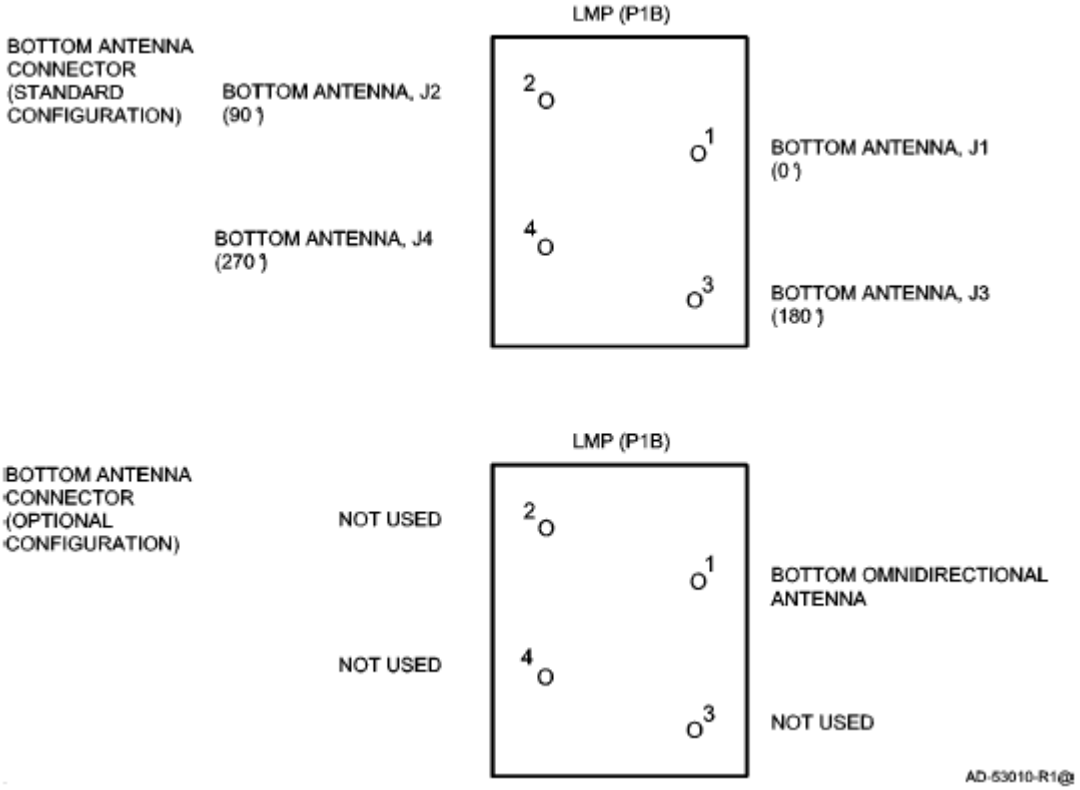
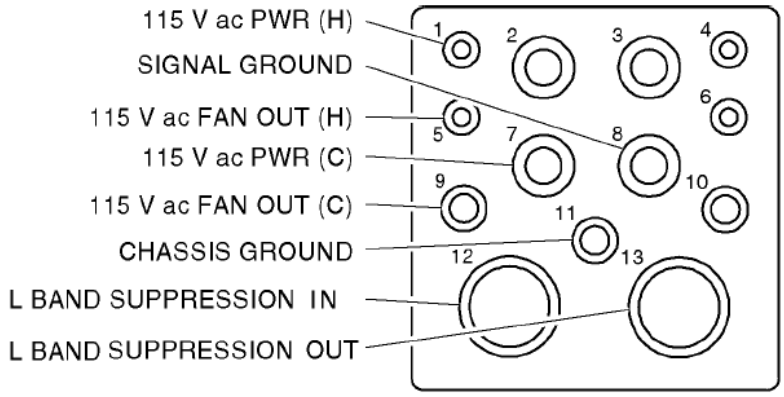
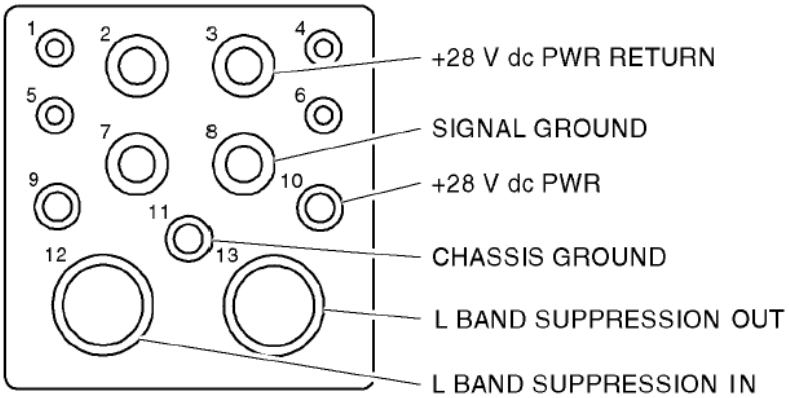


Figure 3-4: Contact Arrangement for CU Left Middle Plug (LMP) Insert



115 V ac PWR CONNECTIONS



+28 V dc PWR CONNECTIONS

SIGNAL, POWER, AND GROUND CONTACTS		
LOCATION	SIZE	RADIAL PART NUMBER
12 AND 13	5	620-021, FOR RG 142
3, 7, AND 8	12	620-340
9, 10, AND 11	16	620-330
1 AND 5	20	620-310

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Figure 3-5: Contact Arrangement for Left Bottom Plug (LBP) Insert

RIGHT TOP INSERT (RTP)

	A	B	C	D	E	F	G	H	J	K
1	453 OUT		A429 IN		453 OUT		A429 IN		A429 IN	
	O A	O B	O A	O B	O A	O B	O A	O B	O A	O B
2	A429 IN		A429 IN		A429 IN		MODE S ADDRESS			
	O A	O B	O A	O B	O A	O B	O A1	O A2	O A3	O A4
3	A429 IN		A429 IN		A429 IN		A429 IN		A429 IN	
	O A	O B	O A	O B	O A	O B	O A	O B	O A	O B
4	A429 IN		MODE S ADDRESS		A429 IN		MODE S ADDRESS		A429 IN	
	O A	O B	O A5	O A	O B	O A6	O A	O B	O A7	O A8
5	A429 IN		MODE S ADDRESS		A429 IN		MODE S ADDRESS		A429 IN	
	O A	O B	O A9	O A	O B	O A10	O A	O B	O A11	O DISC IN
6	A429 IN		MODE S ADDRESS	GND	MODE S ADDRESS	GND	GND	MODE S ADDRESS	GND	MODE S ADDRESS
	O A	O B	O A12	O DISC IN	O A13	O DISC IN	O DISC IN	O A14	O DISC IN	O A15
7	GND	MODE S ADDRESS	GND	GND	MODE S ADDRESS	GND	GND	MODE S ADDRESS	GND	GND
	O DISC IN	O A16	O DISC IN	O DISC IN	O A17	O DISC IN	O DISC IN	O A18	O DISC IN	O DISC IN
8	A429 OUT		GND	GND	A429 OUT		A429 OUT		A429 OUT	
	O A	O B	O DISC IN	O DISC IN	O A	O B	O A	O B	O A	O B
9	A429 IN		MODE S ADDRESS				A429 OUT		GND	GND
	O A	O B	O A19	O A20	O A21	O A22	O A	O B	O DISC IN	O DISC IN
10	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND
	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN
11	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND
	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN	O DISC IN
12	GND	PROGRAM PIN					+28 V dc	+28 V dc	GND	GND
	O DISC IN	O SPARE	O SPARE	O SPARE	O SPARE	O SPARE	O DISC IN	O DISC IN	O DISC IN	O DISC IN
13	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND
	O DISC IN	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT
14	GND	GND MON	GND MON	GND MON	GND	GND	MODE S ADDRESS		GND	GND
	O DISC OUT	O DISC OUT	O DISC OUT	O DISC OUT	O DISC IN	O DISC IN	O A23	O A24	O DISC OUT	O DISC OUT
15	5 Vdc	A429 OUT		APM POWER	APM GROUND	APM CLOCK	APM SERIAL	APM SERIAL	APM ENABLE	APM WRITE
	O DISC OUT	O A	O B	O	O RETURN	O	O DATA IN	O DATA OUT	O	O ENABLE

AA9005000-57-SD-1

Figure 3-6: Contact Arrangement for Right Top Plug (RTP) Insert

RIGHT MIDDLE INSERT (RMP)

	A	B	C	D	E	F	G	H	J	K
1	RESERVED FOR DISCRETE OUTPUTS O O O O				TA DISP ENABLE O DISC OUT	AURAL ADV CORR O DISC OUT	RESERVED FOR GPS O O		CLIMB INHIB NO. 1 O DISC IN	AURAL ADV PRE O DISC OUT
2	AURAL ADV TA O DISC OUT	GPS #1/TIME MARK RS422 IN O O A B		ADVISORY ANNOUNCE O COMMON	RESERVED O	SYNTH VOICE OUT 8 OHMS O O H L		RADIO ALTIMETER NO.1 INPUT ARINC 552/ANALOG O O O + - VALID		
3	VISUAL ANN CORR O DISC OUT	VISUAL ANN PRE O DISC OUT	VISUAL ANN TA O DISC OUT	CANCEL O DISC IN	RESERVED O	SYNTH VOICE OUT 600 OHMS O O H L		RESERVED O	RESERVED FOR TAWS O O	
4	RESERVED FOR TAWS O O O			SHIELD O GROUND	RESERVED FOR TAWS O O O			RESERVED FOR TAWS O O O		
5	RESERVED FOR TAWS O O		RESERVED FOR TAWS C O		RESERVED ADS-B PROG PIN O O O			RESERVED FOR TAWS O O		AIR/GND O DISC IN
6	PERF LIMIT 429 LS IN O O A B		RESERVED FOR TAWS C	PERF LIMIT O DISC IN	AIRCRAFT ALTITUDE LIMIT PROGRAM PINS O O O O O 2,000 4,000 8,000 16,000 32,000					PROGRAM O COMMON
7	RSVD MAG HDG/ATT 429 HS IN O O A B		TA/RA DISPLAY NO. 1 429 HS OUT C O A B		STATUS O DISC IN	RESERVED O	TA/RA DISPLAY NO. 2 429 HS OUT O O A B		STATUS O DISC IN	RESERVED O
8	DATA LOADER 429 HS IN O O A B		ADS-B NO. 1 429 HS IN O O A B		GEN PURPOSE 429 IN #1 O O A B		TA/RA DISPLAY CONTROL 429 IN #2 O O A B		ADS-B NO. 2 429 HS IN O O A B	
9	DATALOADER 429 HS OUT O O A B		RSVD GPS A429 OUTPUT C O A B		RSVD GPS TIME MARK IN/OUT O O A B		GEN PURPOSE 429 OUT #1 O O A B		ADS-B NO. 2 429 HS OUT O O A B	
10	RESERVED ASD-B PROGRAM INPUT O O C 1 2 3			SINGLE MODE-S TRANSPONDER O	DTIF ENABLE O DISC IN	RESERVED FOR TAWS O	RESERVED O O		O O	
11	RESERVED O	RESERVED O	MALE VOICE O PROG IN	FDR AND EXTD MAINT O PROG IN	RESERVED O O		RESERVED O O		RESERVED O O	
12	RESERVED O PROG IN	RAD ALT TYPE SEL 4 O PROG IN	TA/RA BLOCK O XFER PROG	RAD ALT TYPE SEL 3 O PROG IN	RAD ALT TYPE SEL 2 O PROG IN	RAD ALT TYPE SEL 1 O PROG IN	TRAFFIC GENERATOR ETHERNET RX O O + -		TRAFFIC GENERATOR ETHERNET TX O O + -	
13	RA DISPLAY NO. 1 A429 OUT O O A B		RA DISPLAY NO. 2 A4229 OUT C O A B		RA STATUS NO. 2 O DISC IN	LANDING GEAR O DISC IN	CLIMB INHIB NO.2 O DISC IN	RADIO ALT NO. 1 429 LS IN O O A B		TCAS SYS VALID O DISC OUT
14	TX COORDINATION NO.2 429 HS OUT O O A B		RA NO. 1 STATUS C DISC IN	SEL ALT 701/720 429 LS IN O O A B		XT COORDINATION NO. 1 429 HS IN O O A B		XT COORDINATION NO. 2 429 HS IN O O A B		TRAFFIC SELECTOR O DISC IN
15	RESERVED A429 IN O O A B		MMR/GPS #2 A429 IN C O A B		RESERVED A429 OUT O O A B		RESERVED A429 OUT O O A B		TX COORDINATION NO.1 429 HS OUT O O A B	

AA9005000-58-SD-2

Figure 3-7: Contact Arrangement for Right Middle Plug (RMP) Insert

RIGHT BOTTOM INSERT (RBP)

	A	B	C	D	E	F	G	H	J	K
1	RESERVED		RESERVED		RESERVED	GPS #2/TIME MARK RS422 IN		WD 270 BIT 18	WD 270 BIT 19	WD 270 BIT 20
	O	O	O	O	O	O A	O B	O DISC OUT	O DISC OUT	O DISC OUT
2	RESERVED		RESERVED		RESERVED	RESERVED		WD 270 BIT 21	WD 270 BIT 22	WD 270 BIT 23
	O	O	O	O	O	O	O	O DISC OUT	O DISC OUT	O DISC OUT
3	RADIO ALTIMETER NO. 2 INPUT ARINC 552/ANALOG			RADIO ALTIMETER NO. 2 429 LS IN		RADIO ALTIMETER NO. 3 ARINC 552/550A		WD 270 BIT 24	WD 270 BIT 25	WD 270 BIT 26
	O +	O -	O VALID	O A	O B	O +	O -	O DISC OUT	O DISC OUT	O DISC OUT
4	RESERVED FOR DISCRETE INPUTS						RA DISP TST INHIB	WD 270 BIT 27	WD 270 BIT 28	WD 270 BIT 29
	O	O	O	O	O	O	O PROG IN	O DISC OUT	O DISC OUT	O DISC OUT
5	ADVISORY INHIBIT DISCRETE INPUTS				INCREASE CLIMB INHIBIT DISCRETE INPUTS				CLIMB INHIBIT DISCRETE INPUTS	
	O 1	O 2	O 3	O 4	O 1	O 2	O 3	O 4	O 3	O 4
6	DATA LDR LINK A	RESERVED AUDIO INHIBITS			CFDIU 429 LS OUTPUT		CFDIU 429 LS INPUT		SINGLE MODE S	SINGLE RADALT
	O DISC IN	O 2	O 3	O 4	O A	O B	O A	O B	O PROG IN	O
7	AUDIO LEVEL PROGRAM INPUTS			AURAL ADVISORY	GND DISP MODE	DISP ALL TRAFFIC	CABLE DELAY PROGRAM PINS			PROGRAM
	1 O 9dB	2 O 6dB	3 O 3dB	O PROG	O PROG	O PROG	O SIGN	O MSB	O LSB	O COMMON
8	RESERVED FOR PROGRAM PINS				SELF TEST INHIBIT	TA/RA DISPLAY SYMBOL MAX PROGRAM				
	O	O	O	O	O PROG	O 16	O 8	O 4	O 2	O 1
9	MODE S/ ATCRBS	PRE-TRIGGER	TOP/BOT	TEST MODE PROGRAM PINS				ANTENNA DIRECTION TEST OUTPUT		TEST MODE
	O OUTPUT	O OUTPUT	O OUTPUT	O 1	O 2	O 3	O 4	O LSB	O MSB	O 5
10	TEST JTAG BUS							PRE-TRIGGER	ANTENNA WRAP	SIMULATOR SOFTWARE
	O TCK	O TDI	O TDO	O PMC TDO	O PMC TDS	O TMS	O TRST	O TTL OUT	O DISC IN	O PROG

AA9005000-59-SD-1

Figure 3-8: Contact Arrangement for Right Bottom Plug (RBP) Insert

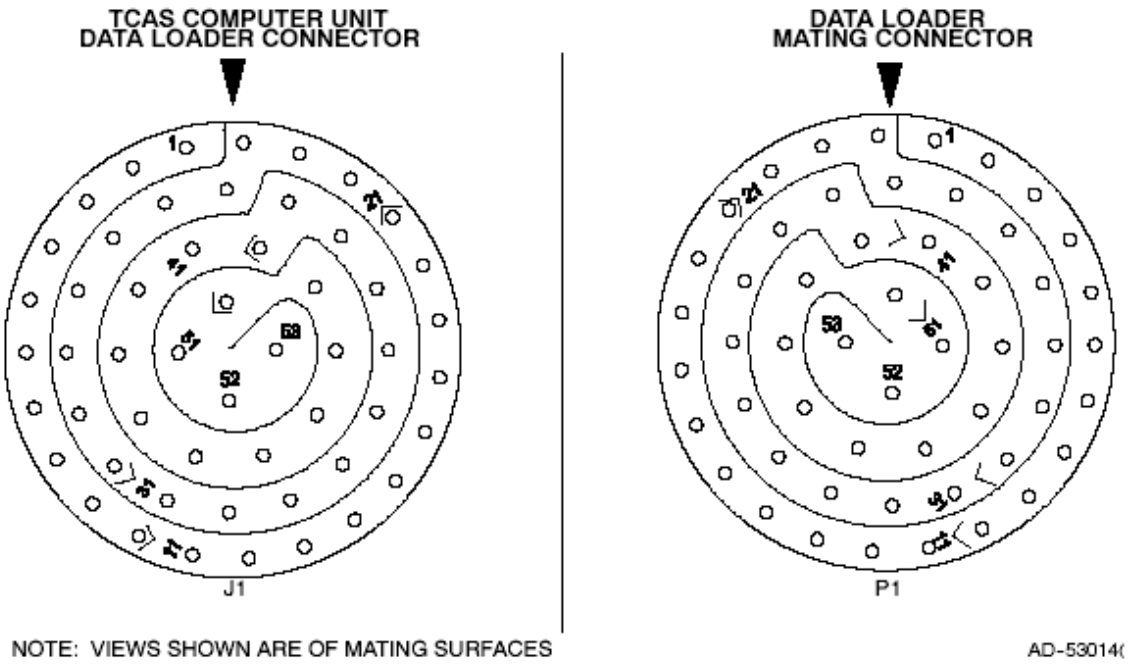

Figure 3-9: TCAS Computer Unit Data Loader Connector (J1) Pin Layout

D. Control Panels

Table 3-1 contains the interconnect data for the Gables G7130 series control panels.

Table 3-1: Gables G7130-XX ATC/TCAS Control Panel Interconnect Data

I/O	Description	Connector Pin		Connects To	Notes
(I)	5 V ac Panel Lighting (H)	J1-1	(20)	----------	Acft Lighting Source	
(I)	5 V ac Panel Lighting (L)	J1-2	(20)	----------	Acft Lighting Source	
(I)	+28 V dc Input Power (H)	J1-3	(20)	----------	Acft 28 V dc Supply	
(I)	+28 V dc Return (L)	J1-4	(20)	----------	Acft dc Ground	
(O)	Antenna Transfer Discrete	J1-5	(22)	----------	Antenna Relay	1, 2
(I)	dc Ground	J1-6	(22)	----------	Acft dc Ground	
(O)	Standby/On Output Disc	J1-7	(22)	----------	Transponder No.1	
(I)	Chassis Ground	J1-8	(22)	----------	Airframe Ground	3
(I)	Functional Test	J1-9	(22)	----------	Remote Test Switch	
(O)	Warning & Caution	J1-10	(22)	----------	Remote Warn System	2
	Reserved	J1-11				
(I)	XPDR Fail Logic No.2	J1-12	(22)	----------	Transponder No.1	
(I)	Ident Input	J1-13	(22)	----------	Remote IDENT Switch	2
(I)	XPDR Fail (High-Level)	J1-14		----------NC		2, 4
(O)	Air/Gnd Switched Discrete	J1-15		----------NC		
(O)	Alt Source Select Discrete	J1-16	(22)	----------	Transponder No.1	2
	Reserved	J1-17				
(I)	Monitor Lamp Power	J1-18	(20)	----------	Acft 28 V dc Power	
	Reserved	J1-19				
(I)	XPDR Configuration	J1-20		----------NC		2
(I)	Lamp Test	J1-21	(22)	----------	Rmt Lamp Test SW	2
(O)	ARINC 429 (A) Out	J1-22	(22)	-------S--T--S---- | |	Transponder No.1	5

Table 3-1: Gables G7130-XX ATC/TCAS Control Panel Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(O)	ARINC 429 (B) Out	J1-23 (22)	-------S--T--S---- | | GND-- --GND	Transponder No.1	5
(I)	Air/Gnd Discrete	J1-24 (22)	----------	WOW Switch	2
	Reserved	J2-1			
	Reserved	J2-2			
(I)	+28 V dc Input Power (H)	J2-3 (20)	----------	Acft 28 V dc Power	
(I)	+28 V dc Return (L)	J2-4 (20)	----------	Acft dc Ground	
(O)	Antenna Transfer Discrete	J2-5 (22)	----------	Antenna Relay	1, 2
(I)	dc Ground	J2-6 (22)	----------	Acft dc Ground	
(O)	Standby/On Discrete	J2-7 (22)	----------	Transponder No.2	
(I)	Chassis Ground	J2-8 (22)	----------	Airframe Ground	3
(I)	Functional Test	J2-9 (22)	----------	Remote Test SW	
(O)	Warning & Caution	J2-10 (22)	----------	Remote Warn Sys	2
	Reserved	J2-11			
(I)	XPDR Fail Logic No.2	J2-12 (22)	----------	Transponder No.2	
(I)	Ident Input	J2-13 (22)	----------	Remote Ident SW	2
(I)	XPDR Fail (High-Level)	J2-14	----------NC		2, 4
(O)	Air/Gnd Switched Discrete	J2-15 (22)	----------NC		
(O)	Alt Source Select Discrete	J2-16 (22)	----------	Transponder No.2	2
	Reserved	J2-17			
(I)	Monitor Lamp Pwr	J2-18 (20)	----------	Acft 28 V dc Power	2
	Reserved	J2-19			
(I)	XPDR Configuration	J2-20	----------NC	Gnd/Open	2
(I)	Lamp Test	J2-21 (22)	----------	Rmt Lamp Test SW	2
(O)	ARINC 429 (A) Out	J2-22 (22)	-------S--T--S---- | |	Transponder No.2	5

Table 3-1: Gables G7130-XX ATC/TCAS Control Panel Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	Air/Gnd Discrete	J2-24		Acft WOW Switch	2

NOTES:

1. Connect either J1-5 or J2-5 to an antenna switching relay if one set of ATC antennas is used in a dual-transponder installation.
2. Refer to Loading Gradient Specifications in Table 4-2.
3. Tie chassis ground to aircraft frame.
4. 28 V dc discrete input from Collins TDR-94D transponder.
5. Two-wire shielded cable. Tie shields to aircraft dc ground.

E. Thales VSI-TCAS and ACSS VSI/TRA Displays

Table 3-2 contains interconnect data for the Thales 41-pin connector units. Table 3-3 and Table 3-4 contain the interface information for the various ACSS VSI/TRA displays. Table 3-3 contains interconnect data for the 41-pin connector units. Table 3-4 contains the interconnect data for the 55-pin connector (bootstrap) units.

Figure 3-10 and Figure 3-11 show the connector pin layouts for the VSI/TRA. Figure 3-10 shows the 41-pin connector configuration and Figure 3-11 shows the 55-pin connector configuration.

Table 3-2: Thales 41-Pin VSI-TCAS Interconnect Data

I/O	Description	Connector Pin		Connects To	Notes
(I)	VS +dc Ref	J1-1	(22)	----------	ARINC 575 ADC	
(I)	VS dc Rate	J1-2	(22)	----------	ARINC 575 ADC	
(I)	VS -dc Ref	J1-3	(22)	----------	ARINC 575 ADC	
(I)	Primary VS (HI)	J1-4	(22)	-------S--T--S---- | |	ARINC 565 ADC or IRS	1
(I)	Primary VS (LO)	J1-6	(22)	-------S--T--S---- | | GND-- --GND	ARINC 565 ADC or IRS	1
(I)	VS 26 V ac Ref (HI)	J1-5	(22)	----------	ARINC 565 ADC or IRS	
(I)	Vert. Speed Digital Port (A)	J1-7	(22)	----------		
(I)	Vert. Speed Digital Port (B)	J1-21	(22)	----------		
(I)	VS VALID NO.1	J1-8	(22)	----------	ARINC 565/575 ADC or IRS	
(I)	5-V Lamp Dimming (LO)	J1-9	(22)	----------	Acft Lamp Dim Ckt	
(I)	5-V Lamp Dimming (HI)	J1-10			Acft Lamp Dim Ckt	
(I)	TCAS TA/RA ARINC 429 (B)	J1-11	(22)	-------S--T--S---- | |	TCAS Computer	1
(I)	TCAS TA/RA ARINC 429 (A)	J1-26	(22)	-------S--T--S---- | | GND-- --GND	TCAS Computer	1
(I)	VS No.1 ARINC 429 (B)	J1-12	(22)	-------S--T--S---- | |	Digital ADC No.1 or IRS No.1	1
(I)	VS No.1 ARINC 429 (A)	J1-27	(22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.1 or IRS No.1	1

Table 3-2: Thales 41-Pin VSI-TCAS Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(O)	26 V ac Bootstrap ref. Out	J1-13		Bootstrap instrument	
(I)	VS No.2 ARINC 429 (B)	J1-14 (22)	-------S--T--S---- | |	Digital ADC No.2 or IRS No.2	
(I)	VS No.2 ARINC 429 (A)	J1-30 (22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.2 or IRS No.2	
(I)	Config Strap Common	J1-15 (22)	----------	Config Strap Logic Gnd	5
(I)	VS 26 V ac Ref (C)	J1-16 (22)	----------	ARINC 565 ADC or IRS	
(I)	Config Strap No.3 (CS3)	J1-17 (22)	----------	Gnd/Open	
(O)	Secondary VERT SPEED Validity input (+ 28 V dc)	J1-18 (20)	-------S--T--S---- | |	ARINC 565/575 ADC	2
(O)	VERT SPEED Bootstrap ac Out (HI)	J1-19 (22)	----------	Bootstrap instrument	2
(O)	VERT SPEED Bootstrap ac Out (LO)	J1-20 (22)	----------	Bootstrap instrument	2
(I)	Chassis Ground	J1-22 (22)	----------	Airframe Ground	3
(I)	115 V ac Return (C)	J1-23 (22)	----------	Acft ac Ground	
(I)	Remote Light Sensor (LO)	J1-24 (22)	-------S--T--S---- | |	Acft Rmt Light Sensor	1
(I)	Remote Light Sensor (HI)	J1-25 (22)	-------S--T--S---- | | GND-- --GND	Acft Rmt Light Sensor	1
(I)	Configuration strap	J1-28	----------	V/S response time selection	
(O)	RA Valid Out	J1-29 (22)	----------	TCAS Computer	
(I)	Source Sel Discrete In (SS 1)	J1-31 (22)	----------	Gnd/Open	
(I)	Config Strap No.0 (CS0)	J1-32 (22)	----------	Gnd/Open	
(I)	Config Strap No.1 (CS1)	J1-33 (22)	----------	Gnd/Open	
(I)	Config Strap No.2 (CS2)	J1-34 (22)	----------	Gnd/Open	
(I)	Config Strap No.4 (CS4)	J1-35 (22)	----------	Gnd/Open	

Table 3-2: Thales 41-Pin VSI-TCAS Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	Secondary Source Select Discrete Input (SS 2)	J1-37 (22)	----------	Aircraft Switch	
(O)	VERT SPEED VALID Discrete Output	J1-38 (22)	----------		
(I)	dc Ground	J1-39 (22)	----------	Acft dc Ground	
(I)	115 V ac Input Power (H)	J1-40 (20)	----------	Acft 115 V ac Supply	
(I)	Self-test/Display Test	J1-41 (22)	----------	Aircraft Switch	

NOTES:

1. Two-wire shielded cable. Tie shields to aircraft dc ground.
2. Three-wire shielded cable. Tie shields to aircraft dc ground.
3. The chassis ground to aircraft frame.

Table 3-3: ACSS 41-Pin VSI/TRA Interconnect Data

I/O	Description	Connector Pin		Connects To	Notes
(I)	VS +dc Ref	J1-1 (22)	----------	ARINC 575 ADC	
(I)	VS dc Rate	J1-2 (22)	----------	ARINC 575 ADC	
(I)	VS -dc Ref	J1-3 (22)	----------	ARINC 575 ADC	
(I)	Primary VS (HI)	J1-4 (22)	-------S--T--S---- | |	ARINC 565 ADC or IRS	1
(I)	Primary VS (LO)	J1-6 (22)	-------S--T--S---- | | GND-- --GND	ARINC 565 ADC or IRS	1
(I)	VS 26 V ac Ref (HI)	J1-5 (22)	----------	ARINC 565 ADC or IRS	
(I)	Reserved ARINC Bus (A)	J1-7 (22)			
(I)	Reserved ARINC Bus (B)	J1-21 (22)			
(I)	VS VALID NO.1	J1-8 (22)	----------	ARINC 565/575 ADC or IRS	
(I)	TCAS TA/RA ARINC 429 (B)	J1-11 (22)	-------S--T--S---- | |	TCAS Computer	1

Table 3-3: ACSS 41-Pin VSI/TRA Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	TCAS TA/RA ARINC 429 (A)	J1-26 (22)	-------S--T--S---- | | GND-- --GND	TCAS Computer	1
(I)	VS No.1 ARINC 429 (B)	J1-12 (22)	-------S--T--S---- | |	Digital ADC No.1 or PTM No.1	1
(I)	VS No.1 ARINC 429 (A)	J1-27 (22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.1 or PTM No.1	1
(I)	Spare	J1-13			
(I)	VS No.2 ARINC 429 (B)	J1-14 (22)	-------S--T--S---- | |	Digital ADC No.2 or PTM No.2	
(I)	VS No.2 ARINC 429 (A)	J1-30 (22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.2 or PTM No.2	
(I)	Config Strap Common	J1-15 (22)	----------	Config Strap Logic Gnd	5
(I)	VS 26 V ac Ref (C)	J1-16 (22)	----------	ARINC 565 ADC or IRS	
(I)	Config Strap No.3 (CS3)	J1-17 (22)	----------	Gnd/Open	
(O)	PTM Common	J1-18 (20)	-------S--T--S------- | |	Pressure Xdcr Mdl	2
(O)	PTM Pwr Out (-15 V dc)	J1-19 (20)	-------S--T--S------- | |	Pressure Xdcr Mdl	2
(O)	PTM Pwr Out (+15 V dc)	J1-20 (20)	-------S--T--S----- | | GND-- --GND	Pressure Xdcr Mdl	2
(I)	Chassis Ground	J1-22 (22)	----------	Airframe Ground	3
(I)	115 V ac Return (C)	J1-23 (20)	----------	Acft ac Ground	
(I)	Remote Light Sensor (LO)	J1-24 (22)	-------S--T--S---- | |	Acft Rmt Light Sensor	1
(I)	Remote Light Sensor (HI)	J1-25 (22)	-------S--T--S---- | | GND-- --GND	Acft Rmt Light Sensor	1
	Spare	J1-28 (22)			
(O)	RA Valid Out	J1-29 (22)	----------	TCAS Computer	

Table 3-3: ACSS 41-Pin VSI/TRA Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	Source Sel Discrete In	J1-31 (22)	----------	Gnd/Open	
(I)	Config Strap No.0 (CS0)	J1-32 (22)	----------	Gnd/Open	
(I)	Config Strap No.1 (CS1)	J1-33 (22)	----------	Gnd/Open	
(I)	Config Strap No.2 (CS2)	J1-34 (22)	----------	Gnd/Open	
(I)	Config Strap No.4 (CS4)	J1-35 (22)	----------	Gnd/Open	
(I)	Config Strap No.5 (CS5)	J1-36 (22)	----------	Gnd/Open	
(I)	Config Strap No.6 (CS6)	J1-37 (22)	----------	Gnd/Open	
(I)	Config Strap No.7 (CS7)	J1-38 (22)	----------	Gnd/Open	
(I)	dc Ground	J1-39 (22)	----------	Acft dc Ground	
(I)	115 V ac Input Power (H)	J1-40 (20)	----------	Acft 115 V ac Supply	
(I)	Config Strap No.8 (CS8)	J1-41 (22)	----------	Gnd/Open	

NOTES:

1. Two-wire shielded cable. Tie shields to aircraft dc ground.
2. Three-wire shielded cable. Tie shields to aircraft dc ground.
3. Tie chassis ground to aircraft frame.

Table 3-4: ACSS 55-Pin VSI/TRA Interconnect Data

I/O	Description	Connector Pin		Connects To	Notes
(I)	Secondary ARINC 565 VS (LO) Input	J1-1 (22)	-------S--T--S---- | |	Cross-Side VSI/TRA	1
(I)	Secondary ARINC 565 VS (HI) Input	J1-6 (22)	-------S--T--S---- | | GND-- --GND	Cross-Side VSI/TRA	1
(I)	VS dc Rate	J1-2 (22)	----------	ARINC 575 ADC	
(I)	VS -dc Ref	J1-3 (22)	----------	ARINC 575 ADC	
(O)	Bootstrap Ref Output	J1-4 (22)	----------	Cross-Side VSI/TRA	
(I)	VS No.2 Valid Discrete In	J1-5 (22)	----------	Cross-Side VSI/TRA	
(I)	Second 26 V ac Ref In	J1-7 (22)	----------	Cross-Side VSI/TRA	

Table 3-4: ACSS 55-Pin VSI/TRA Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	VS +dc Ref	J1-8	(22)	----------	ARINC 575 ADC	
(I)	Primary 26 V ac Ref (H)	J1-9	(22)	----------	ARINC 565 ADC	
(I)	Primary VS (LO)	J1-10	(22)	-------S--T--S---- | |	ARINC 565 ADC	1
(I)	Primary VS (HI)	J1-11	(22)	-------S--T--S---- | | GND-- --GND	ARINC 565 ADC	1
(I)	VS No.1 Valid Discrete In	J1-12	(22)	----------	ARINC 565/575 ADC	
(O)	R/C Bootstrap (LO) Output	J1-13	(22)	-------S--T--S---- | |	Cross-Side VSI/TRA	1
(O)	R/C Bootstrap (HI) Output	J1-14	(22)	-------S--T--S---- | | GND-- --GND	Cross-Side VSI/TRA	1
(O)	Bootstrap Command Out	J1-15		----------NC		
	Spare	J1-16				
(I)	Config Strap No.5 (CS5)	J1-17	(22)	----------	Gnd/Open	
(I)	Config Strap No.6 (CS6)	J1-18	(22)	----------	Gnd/Open	
(I)	Config Strap No.7 (CS7)	J1-19	(22)	----------	Gnd/Open	
(I)	Chassis Ground	J1-20	(22)	----------	Airframe Ground	2
(I)	Config Strap No.5 (CS5)	J1-17	(22)	----------	Gnd/Open	
(I)	Config Strap No.6 (CS6)	J1-18	(22)	----------	Gnd/Open	
(I)	Config Strap No.7 (CS7)	J1-19	(22)	----------	Gnd/Open	
(I)	Chassis Ground	J1-20	(22)	----------	Airframe Ground	2
(I)	dc Ground	J1-21	(22)	----------	Acft dc Ground	
(I)	Config Strap No.8 (CS8)	J1-22	(22)	----------	Gnd/Open	
(I)	Remote Light Sensor (HI)	J1-23	(22)	-------S--T--S---- | |	Acft Rmt Light Sensor	2
(I)	Remote Light Sensor (LO)	J1-24	(22)	-------S--T--S---- | | GND-- --GND	Acft Rmt Light Sensor	2
(I)	TCAS ARINC 429 (A)	J1-25	(22)	-------S--T--S---- | |	TCAS Computer	2

Table 3-4: ACSS 55-Pin VSI/TRA Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	TCAS ARINC 429 (B)	J1-44 (22)	-------S--T--S---- | | GND-- --GND	TCAS Computer	2
(I)	VS No.2 ARINC 429 (A)	J1-26 (22)	-------S--T--S---- | |	Digital ADC No.2 or PTM No.2	2
(I)	VS No.2 ARINC 429 (B)	J1-45 (22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.2 or PTM No.2	2
(I)	IRS ARINC 429 (A)	J1-27 (22)	-------S--T--S---- | |	Inertial Reference Sys	2
(I)	IRS ARINC 429 (B)	J1-46 (22)	-------S--T--S---- | | GND-- --GND	Inertial Reference Sys	2
(O)	RA Valid Discrete Out	J1-28 (22)	----------	TCAS Computer	
(I)	Source Select No.2	J1-29 (22)	----------	Gnd/Open	
	Spare	J1-30			
(I)	Source Select No.1	J1-31 (22)	----------	Gnd/Open	
(I)	Config Strap No.0 (CS0)	J1-32 (22)	----------	Gnd/Open	
(I)	Config Strap No.1 (CS1)	J1-33 (22)	----------	Gnd/Open	
(I)	Config Strap No.2 (CS2)	J1-34 (22)	----------	Gnd/Open	
(I)	Config Strap No.3 (CS3)	J1-35 (22)	----------	Gnd/Open	
(I)	Config Strap No.4 (CS4)	J1-36 (22)	----------	Gnd/Open	
(I)	Config Strap Common	J1-37 (22)	----------	Config Strap Logic Gnd	
(I)	115 V ac Return (C)	J1-38 (20)	----------	Acft ac Ground	
	Spare	J1-39			
(I)	115 V ac Input Power (H)	J1-40 (20)		Acft 115 V ac Supply	
	Spare	J1-41			
(I)	5-V Lamp Dimming (HI)	J1-42 (22)	----------	Acft Lamp Dim Ckt	
(I)	5-V Lamp Dimming (LO)	J1-43 (22)	----------	Acft Lamp Dim Ckt	
(I)	VS No.1 ARINC 429 (A)	J1-47 (22)	-------S--T--S---- | |	Digital ADC No.1 or PTM No.1	2

Table 3-4: ACSS 55-Pin VSI/TRA Interconnect Data (cont)

I/O	Description	Connector Pin		Connects To	Notes
(I)	VS No.1 ARINC 429 (B)	J1-48 (22)	-------S--T--S---- | | GND-- --GND	Digital ADC No.1 or PTM No.1	2
(O)	VSI Valid Output Discrete	J1-49 (22)	----------	Cross--Side VSI/TRA	
(O)	PTM Pwr Out (--15 V dc)	J1-50 (20)	-------S--T--S---- | |	Pressure Xdcr Mdl	3
(O)	PTM Common	J1-51 (20)	-------S--T--S---- | |	Pressure Xdcr Mdl	3
(O)	PTM Pwr Out (+15 V dc)	J1-52 (20)	-------S--T--S---- | | GND-- --GND	Pressure Xdcr Mdl	3
	Spare	J1-53			
	Spare	J1-54			
	Spare	J1-55			

NOTES:

1. Two-wire shielded cable. Tie shields to aircraft dc ground.
2. Tie chassis ground to aircraft frame.
3. Three-wire shielded cable. Tie shields to aircraft dc ground.

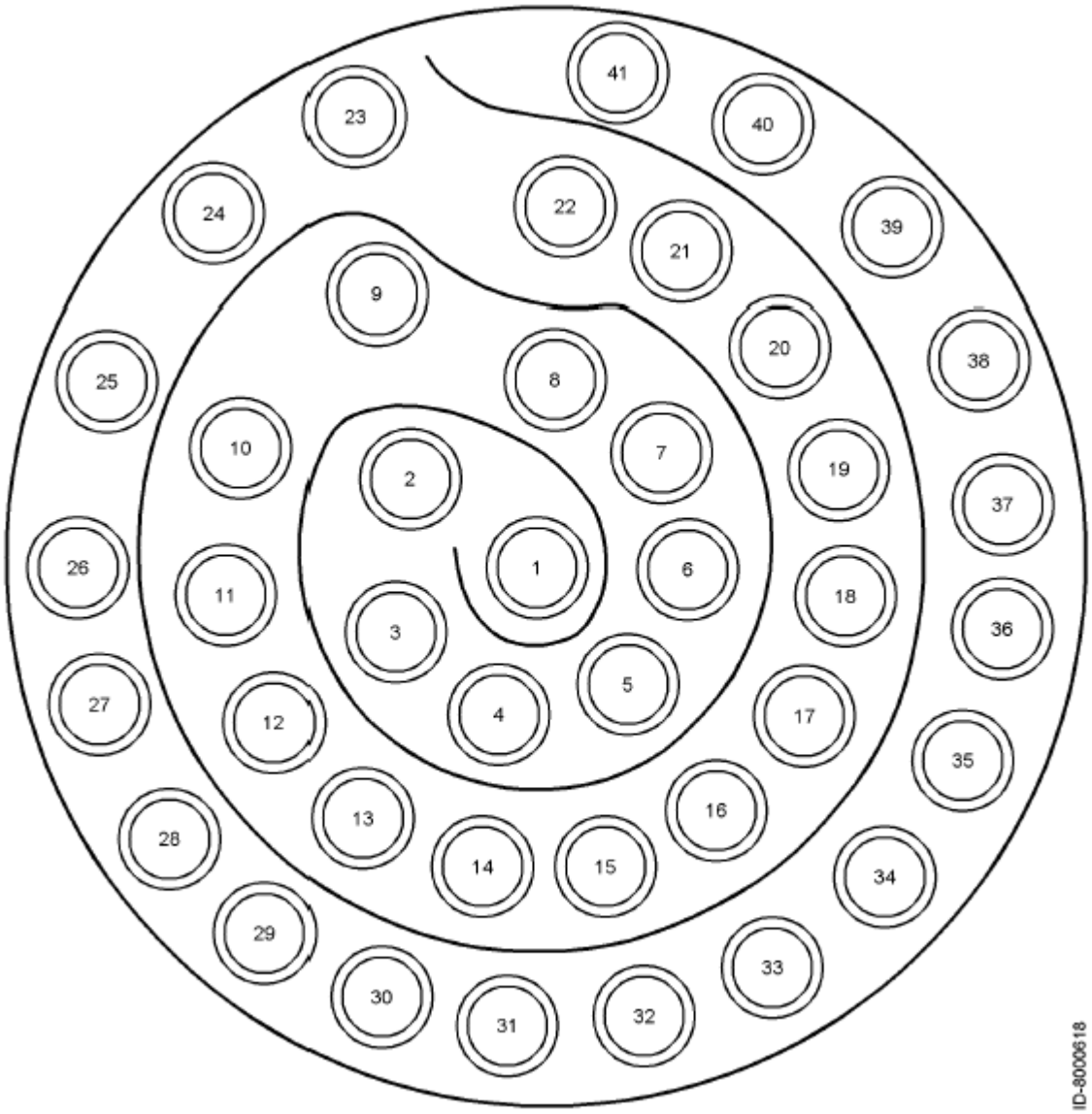

Figure 3-10: Thales VSI-TCAS and ACSS VSI/TRA 41-Pin Connector Layout

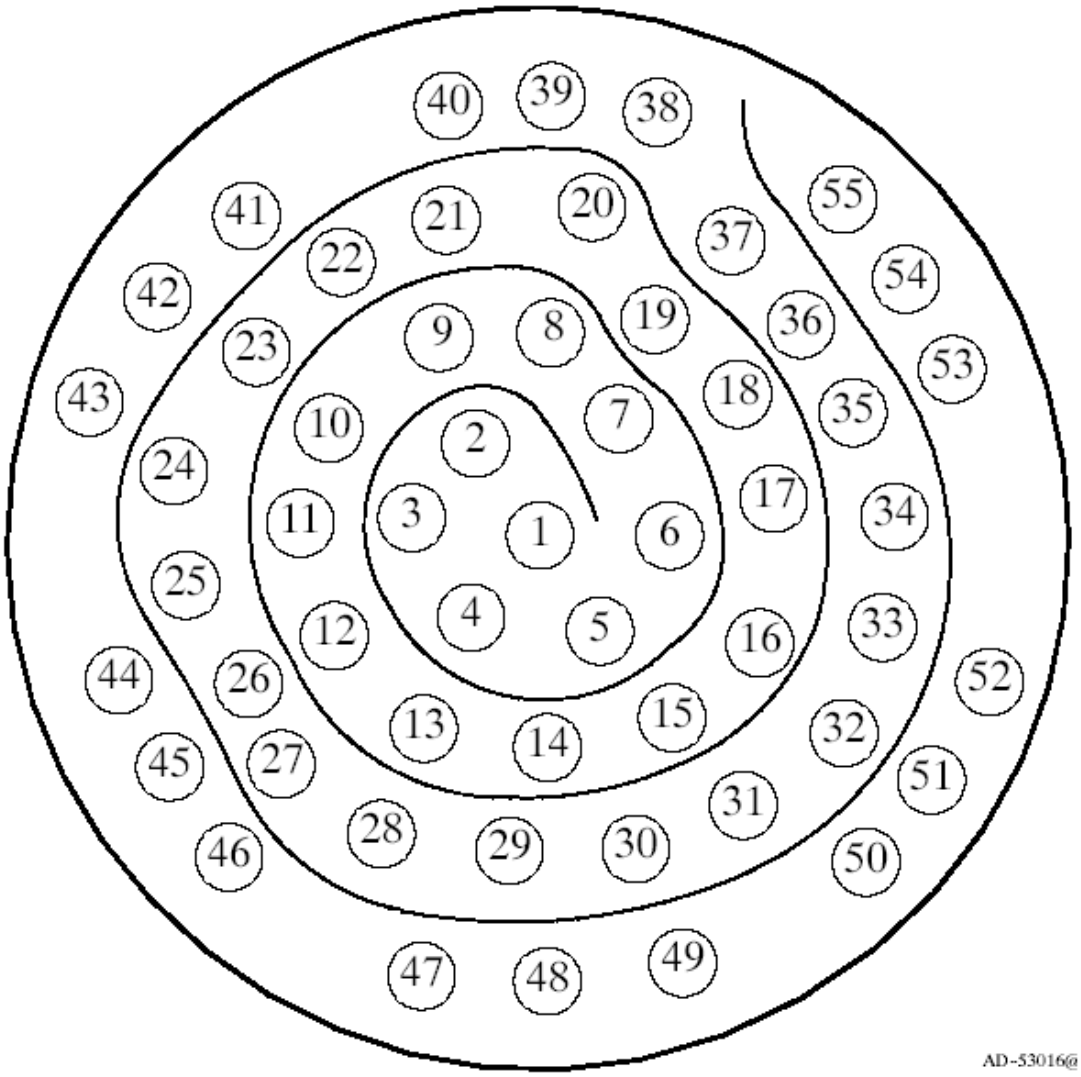

Figure 3-11: ACSS VSI/TRA 55-Pin Connector Layout

F. TAWS Terrain Hazard Display

For T3CAS installations with the TAWS function enabled, at least one TAWS terrain hazard display is required. ARINC 708 and ARINC 429 WXR display and EFIS interfaces are supported. Figure 3-12 shows a typical single ARINC 708 terrain hazard display interface. The T3CAS dual-independent terrain hazard display I/O supports dual ARINC 708 and dual ARINC 429 terrain hazard display systems. Figure 3-12 shows a typical single ARINC 708 terrain hazard display and display interface with annunciator switch panels. The TERR and WXR select switches shown are momentary but alternate action switches are also supported. The terrain INHIBIT or OVRD switches are alternate action switches and are typically guarded.

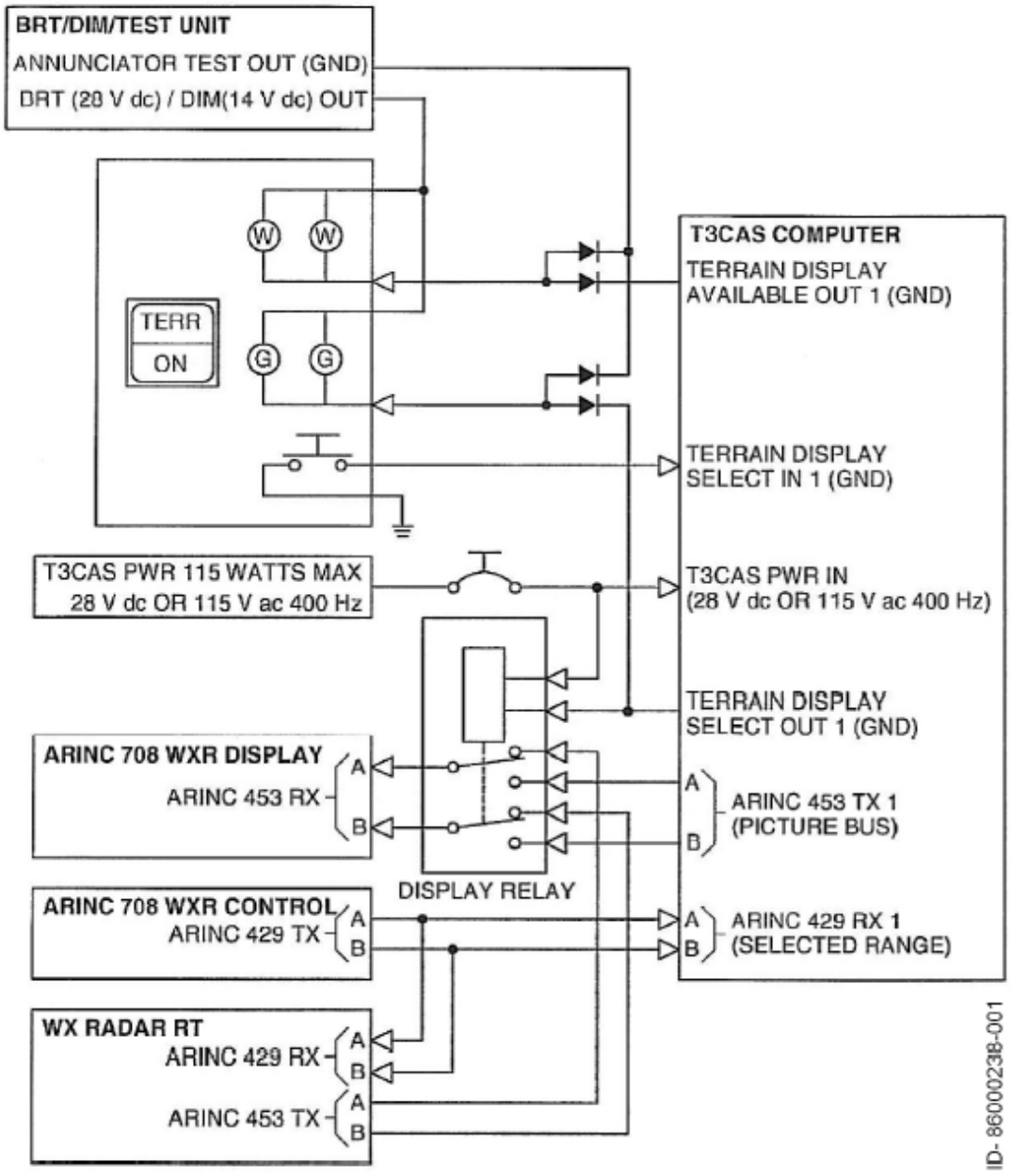

Figure 3-12: Typical T3CAS Single Terrain Hazard Display Interface

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LOADING/GRADIENT SPECIFICATIONS

1. General

This section contains the loading and gradient specifications for the input and output signals of each component of the T3CAS system. The input/output discretes default to an open state when power is removed.

2. T3CAS Interface Description

Refer to sub-section 3.A. TAWS/RWS/XPDR/DO-260B Data Configuration, sub-section (3) Programmable Digital Input/Output Pins, for the definition of the physical characteristics of each Digital signal type supported by the T3CAS. The T3CAS unit supports the following Digital signals: ARINC 429, ARINC 453, Ethernet 10 Base-T and RS-422. Refer to Table 4-1 and Table 4-2 for the T3CAS Computer Unit input and output interface definition.

Component	Table No.
T3CAS Computer Unit Interface Description (Applicable to Part No.9005000-10000, -10101, -10202, -10204, and -11203)	Table 4-1
T3CAS Computer Unit Interface Description (Applicable to Part No.9005000-11801 and -55801)	Table 4-2
Gables Control Panel Interface Description	Table 4-3
Thales 41-Pin VSI-TCAS Interface Description	Table 4-4
ACSS 41-Pin VSI/TRA Interface Descriptions	Table 4-5
ACSS 55-Pin VSI/TRA Interface Descriptions	Table 4-6

Table 4-1: T3CAS Computer Unit Interface Description
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
T3CAS Computer Unit Right Top Plug (RTP)	
RTP-1A, 1B	**ARINC 453 Terrain Display Output No.1 (CAPT): (RTP-1A [A], RTP-1B [B])** T3CAS output number 1 to the terrain awareness display.
RTP-1C, 1D	**ARINC 429 Input: MMR/GPS #1 [RTP-1C (A), RTP-1D (B)]** This high-speed 429 input is used to receive GPS label input containing position, velocity and quality information for the use of ADS-B IN applications and by the transponder function of ADS-B OUT. **NOTE:** These pins are designated for MMR/GPS #1 if T3CAS is operating as TAWS and TCAS only with internal transponder and ATSAW function disabled. Else these pins are Spares.
RTP-1E, 1F	**ARINC 453 Terrain Display Output No.2 (F/O): (RTP-1E [A], RTP-1F [B])** T3CAS output number 2 to the terrain awareness display.
RTP-1G, 1H	**ARINC 429 Input: FMC #1:EIS [RTP-1G (A), RTP-1H (B)]** This high-speed 429 input from the Flight Management Computer (FMC) Electronic Instrument System (EIS) provides position information from the FMC to the T3CAS. **NOTE:** These pins are designated for FMC #1 if T3CAS is operating as TAWS and TCAS only with internal transponder disabled. Else these pins are Spares.
RTP-1J, 1K	**ARINC 429 Input: ADIRU #2 / ADR [RTP-1J (A), RTP-1K (B)]** This low-speed 429 input from the Air Data/Inertial Reference Unit (ADIRU) #2 provides altitude, airspeed, altitude rate and temperature information to the T3CAS.
RTP-2A, 2B	**ARINC 429 Input: ADIRU #3 / ADR [RTP-2A (A), RTP-2B (B)]** This low-speed 429 input from the Air Data/Inertial Reference Unit (ADIRU) #2 provides altitude, airspeed, altitude rate and temperature information to the T3CAS.
RTP-2C, 2D	**ARINC 429 Air Data/Inertial Reference Unit (ADIRU) #2, Inertial Reference Part (IRS) Input: [RTP-2C (A), RTP-2D (B)]** This high-speed input is provided for applications to receive Inertial Reference System information.
RTP-2E, 2F	**Weather Radar/Predictive Windshear System Hazard #1: [RTP-2E (A), RTP-2F (B)]** This high-speed input is provided for TAWS application to receive predictive windshear information.
RTP-2G	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A1 (MSB). Refer to Note 5 following the table.
RTP-2H	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A2.
RTP-2J	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A3.

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-2K	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A4.
RTP-3A, 3B	**Instrument Landing System #1 (Left)** This low-speed bus inputs all signals associated with the instrument landing system to the T3CAS.
RTP-3C, 3D	**FCU #1 Interface [RTP-3C (A), RTP-3D (B)]** This low-speed input is provided for applications to receive flight control unit information.
RTP-3E, 3F	**ARINC 429 FMC (Engine Out) - Performance Limit Input: [RTP-3E (A), RTP-3F (B)]** This high-speed ARINC 429 input is provided for TAWS applications to receive climb rate performance limit information from an external device such as a Flight Management Computer. **NOTE:** These pins are designated for FMC (Engine Out) if T3CAS is operating as TAWS and TCAS only with internal transponder disabled. Else these pins are Spares.
RTP-3G, 3H	**FCU #2 Interface [RTP-3G (A), RTP-3H (B)]** This low-speed input is provided for applications to receive flight control unit information. **NOTE:** These pins are designated for FCU #2 if T3CAS is operating as TAWS and TCAS only with the internal transponder disabled. Else these pins are Spares.
RTP-3J, 3K	**ARINC 429 Input: ADIRU #1/ADR [RTP-3J (A), RTP-3K (B)]** This low-speed 429 input from the Air Data/Inertial Reference Unit (ADIRU) #1 provides altitude, airspeed, altitude rate and temperature information to the T3CAS. **NOTE:** These pins are designated for ADIRU #1 if T3CAS is operating as TAWS and TCAS only with internal transponder disabled. Else these pins are Spares.
RTP-4A, 4B	**Slat/Flap Control Computer [RTP-4A (A), RTP-4B (B)]** This low-speed bus inputs flap angle to T3CAS.
RTP-4C	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A5.
RTP-4D, 4E	**ATC/TCAS Control Panel [RTP-4D (A), RTP-4E (B)]** This low-speed bus controls the TCAS/ATC interfaces and the TCAS display. **NOTE:** These pins are designated for the ATC/TCAS control panel if T3CAS is operating in full configuration mode with TAWS, TCAS and internal transponder enabled. Else these pins are Spares.
RTP-4F	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A6.

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-4G, 4H	**ARINC 429 CFDS Input to TAWS: [RTP-4G (A), RTP-4H (B)]** This differential pair input is a low-speed ARINC 429 bus (12.5k bits/second nominal), that receives data from an onboard maintenance computer or a central fault display system to the TAWS function. **NOTE:** These pins are designated for CFDS if T3CAS is operating as TAWS and TCAS only with internal transponder disabled. Else these pins are Spares.
RTP-4J	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A7.
RTP-4K	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A8.
RTP-5A, 5B	**Weather Radar/Predictive Windshear System Hazard #2: [RTP-5A (A), RTP-5B (B)]** This high-speed input is provided for TAWS application to receive predictive windshear information.
RTP-5C	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A9.
RTP-5D, 5E	**Spare**
RTP-5F	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A10.
RTP-5G, 5H	**ARINC 429 CFDIU Input to Internal Transponder: [RTP-5G (A), RTP-5H (B)]** This differential pair input is a low-speed ARINC 429 bus (12.5k bits/second nominal), that receives data from an onboard maintenance computer or a central fault display interface unit to the internal transponder. **NOTE:** These pins are designated for CFDIU inputs if T3CAS is operating in full configuration mode with TAWS, TCAS and internal transponder enabled. Else these pins are Spares.
RTP-5J	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A11.
RTP-5K	**Strobed Program Pin** TAWS/XPDR #11: Max True Airspeed Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-6A, 6B	**FMGC #1 Own C/FMGEC #1 GEN 1 Interface: [RTP-6A (A), RTP-6B (B)]** This low-speed bus inputs all labels associated with the Flight Management Computer to T3CAS.
RTP-6C	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A12.
RTP-6D	**Strobed Program Pin** TAWS/XPDR #1: Aircraft Type. Refer to Table 4-19: Aircraft Type Configurations

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-6E	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A13.
RTP-6F	**Strobed Program Pin** TAWS/XPDR #2: Aircraft Type. Refer to Table 4-19: Aircraft Type Configurations
RTP-6G	**Strobed Program Pin** TAWS/XPDR #3: Lateral Position Priority. Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-6H	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A14.
RTP-6J	**Strobed Program Pin** TAWS/XPDR #4: Audio Menu Selection Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-6K	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A15.
RTP-7A	**Strobed Program Pin** TAWS/XPDR #5: CRT-LCD Disp Select Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7B	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A16.
RTP-7C	**Strobed Program Pin** TAWS/XPDR #6: Auto (CPA-THD) Deactivation Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7D	**Strobed Program Pin** TAWS/XPDR #7: Predictive Windshear Present Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7E	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A17.
RTP-7F	**Strobed Program Pin** TAWS/XPDR #8: Topo Mode (For Part No.-10000, -10101, -10202, -10204) GPS Source (For Part No.-11203) Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7G	**Strobed Program Pin** TAWS/XPDR #9: Vertical Display (For Part No.-10000, -10101, -10202, -10204) ADLP Installed (For Part No.-11203) Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7H	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A18.

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-7J	**Strobed Program Pin** TAWS/XPDR #10: Attitude Source Selection Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-7K	**Strobed Program Pin** TAWS/XPDR #12: Cold Temp Comp Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-8A, 8B	**ARINC 429 TAWS Output to CFDIU: [RTP-8A (A), RTP-8B (B)]** This ARINC 429 output bus transmits data from the TAWS function to an onboard maintenance computer or a central fault display system.
RTP-8C	**Discrete Input (Gnd/Open)** Internal XPDR SDI #1 Refer to Note 6 following the table.
RTP-8D	**Discrete Input (Gnd/Open)** Internal XPDR SDI #2
RTP-8E, 8F	**ARINC 429 Transponder Output to CFDIU: [RTP-8E (A), RTP-8F (B)]** This ARINC 429 output bus transmits data from the transponder function to an onboard maintenance computer or a central fault display system. **NOTE:** These pins are designated for CFDIU outputs if T3CAS is operating in full configuration mode with TAWS, TCAS and internal transponder enabled. Else these pins are Spares.
RTP-8G, 8H	**ARINC 429 TAWS Test Output** This bus outputs Event Data for flight test use. Event Data is the post filter / post source selection inputs to the Ground Collision Avoidance Module.
RTP-8J, 8K	**Reserved**
RTP-9A, 9B	**Reserved**
RTP-9C	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A19.
RTP-9D	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A20.
RTP-9E	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A21.
RTP-9F	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A22.
RTP-9G, 9H	**ARINC 429 TAWS Output** This bus outputs data for Airline troubleshooting purposes.
RTP-9J	**Strobed Program Pin** Spare Or DO-260B Config Data #7 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-9K	**Strobed Program Pin** Spare Or DO-260B Config Data Parity (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-10A	**Discrete Input (Gnd/Open)** Glideslope Cancel (Self-Test)
RTP-10B	**Discrete Input (Gnd/Open)** Audio Inhibit
RTP-10C	**Discrete Input (Gnd/Open)** GPWS Inhibit
RTP-10D	**Discrete Input (Gnd/Open)** Glideslope Cancel
RTP-10E	**Discrete Input (Gnd/Open)** XPDR Air/Ground #1
RTP-10F	**Discrete Input (Gnd/Open)** Terrain Display Select #1
RTP-10G	**Discrete Input (Gnd/Open)** Terrain Display Select #2
RTP-10H	**Discrete Input (Gnd/Open)** Landing Flaps / Landing Flap Override
RTP-10J	**Discrete Input (Gnd/Open)** Steep Approach or Landing Gear Override. Refer to Note 7 following the table.
RTP-10K	**Discrete Input (Gnd/Open)** Audio Momentary Suppress
RTP-11A	**Strobed Program Pin** TAWS/XPDR #13: Terrain Adv Lines Displayed Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11B	**Discrete Input (Gnd/Open)** WXR Radar #1 On/Off
RTP-11C	**Strobed Program Pin** TAWS/XPDR #14: Eleview Function Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11D	**Discrete Input (Gnd/Open)** WXR Radar #2 On/Off
RTP-11E	**Discrete Input (Gnd/Open)** Terrain Mode Inhibit

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-11F	**Strobed Program Pin** TAWS/XPDR #15: Obstacle Function Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11G	**Strobed Program Pin** TAWS/XPDR #16: Antenna Modes Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11H	**Strobed Program Pin** TAWS/XPDR #17: TAWS/XPDR Installed Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11J	**Strobed Program Pin** TAWS/XPDR #18: Odd Program Pin Parity Refer to sub-section 3.C. TAWS/XPDR Pin Programming
RTP-11K	**Discrete Input (Gnd/Open)** XPDR Air/Ground #2
RTP-12A	**Strobed Program Pin** Spare Or DO-260B Config Data #1 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12B	**Strobed Program Pin** Spare Or DO-260B Config Data #2 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12C	**Strobed Program Pin** Spare Or DO-260B Config Data #3 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12D	**Strobed Program Pin** Spare Or DO-260B Config Data #4 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12E	**Strobed Program Pin** Spare Or DO-260B Config Data #5 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12F	**Strobed Program Pin** Spare Or DO-260B Config Data #6 (For Part No.-11203) Refer to sub-section 3.B. TAWS/RWS/XPDR/DO-260B Data Configuration
RTP-12G	**+28 V dc Discrete Input** Spare

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-12H	**+28 V dc Discrete Input** Spare
RTP-12J	**Discrete Input (Gnd/Open), Latch** Air Data Source Select
RTP-12K	**Discrete Input (Gnd/Open)** Control Panel Source Select
RTP-13A	**Discrete Input (Gnd/Open), Latch** Extended Squitter Disable
RTP-13B	**Programmable/Strobed Ground Discrete Output** GPWS Caution /TAWS/XPDR Lamp 500 mA
RTP-13C	**Programmable/Strobed Ground Discrete Output** Spare Output /TAWS/XPDR 500 mA
RTP-13D	**Programmable/Strobed Ground Discrete Output** GPWS Warning /TAWS/XPDR Lamp 500 mA
RTP-13E	**Programmable/Strobed Ground Discrete Output** Spare /TAWS/XPDR 500 mA
RTP-13F	**Programmable/Strobed Ground Discrete Output** Spare /TAWS/XPDR 500 mA
RTP-13G	**Programmable/Strobed Ground Discrete Output** Spare /TAWS/XPDR 500 mA
RTP-13H	**Programmable/Strobed Ground Discrete Output** Spare /TAWS/XPDR 500 mA
RTP-13J	**Ground Discrete Output** Terrain Display Select #1 500 mA
RTP-13K	**Programmable/Strobed Ground Discrete Output** Spare /TAWS/XPDR 500 mA
RTP-14A	**Ground Discrete Output** Terrain Display Select #2 500 mA
RTP-14B	**Ground Discrete Monitor Output** GPWS Monitor 250 mA
RTP-14C	**Ground Discrete Monitor Output** Terrain Not Available Monitor 250 mA
RTP-14D	**Ground Discrete Monitor Output** Terrain Monitor 250 mA
RTP-14E	**Discrete Input (Gnd/Open)** XPDR Functional Test

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-14F	**Discrete Input (Gnd/Open), Latch** Standby/ON
RTP-14G	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A23
RTP-14H	**Discrete Input (Gnd/Open)** XPDR Mode S Address Bit A24
RTP-14J	**Ground Discrete Output** Spare
RTP-14K	**Discrete Output 500 mA** XPDR Fail #2
RTP-15A	**Discrete Output 5 V dc / 100 mA** XPDR Fail #1
RTP-15B, 15C	**ARINC 429 TCAS Output** This bus outputs Dataloader or ADLP COMM A data.
RTP-15D	**APM Power** +12 V dc power source for the Airplane Personality Module. Connect to APM J1-7.
RTP-15E	**APM Return** This is the Ground return for +12 V dc APM power source. Connect to APM J1-8. See pin RTP-15D
RTP-15F	**APM Clock** This is the APM Clock Output which is used to synchronize serial output to the APM. The Clock output frequency is 2.0 MHz + 1% when the APM is being accessed and is set to a logic 0 (not toggling) when the APM is not being accessed. Connect to APM J1-2.
RTP-15G	**APM Serial Data Output** This is the Serial Data Output from T3CAS to the APM Serial Data Input. APM Enable (RTP-15J) and APM Write Enable (RTP-15K) must be enabled before data can be written to the APM. Connect to APM J1-1.
RTP-15H	**APM Serial Data Input** This is the Serial Data Input to T3CAS from the APM Serial Data Output. APM Enable (RTP-15J) must be enabled before data can be read from the APM. Connect to APM J1-9.
RTP-15J	**APM Enable No.1** This pin is used to Enable Read/Write access to the APM. An APM Enable Output logic of 1 disables Read/Write access to the APM and a logic 0 enables APM Read/Write access. Connect to APM J1-3. This pin is used in conjunction with pins RTP-15G (APM serial output) and RTP-15H (APM serial input).

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RTP-15K	**APM Write Enable No.1** This pin is used to Enable Write access to the APM. An APM Write Enable Output logic of 1 disables Write access to the APM and a logic 0 enables APM Write access. Connect to APM J1-4. This pin is used in conjunction with pin RTP-15G (APM serial output).
T3CAS Computer Unit Right Middle Plug (RMP)	
RMP-1A, to RMP-1D	**Reserved Discrete Outputs (Standard Ground/Open)**
RMP-1E	**TA Display Enable Discrete Output (NO)** This output is a ground/open-type discrete used by the weather radar display to place the radar in standby mode. A ground on this pin enables the weather radar display.
RMP-1F	**Corrective Aural Advisory Discrete Output (NO)** This aural advisory discrete output is a ground/open-type discrete (Note 3) used to control external equipment that generate tones to accompany TCAS advisories. The output is active whenever a corrective advisory (RA that requires a corrective maneuver) is issued. The output remains active for the duration of the synthesized voice unless it is cancelled by the cancel discrete at RMP-3D. Only one aural advisory is active at a time. The corrective discrete and preventative discrete at RMP-1K are mutually exclusive. The active state is ground and the inactive state is open.
RMP-1G	**Reserved Discrete Output (Lamp Driver)**
RMP-1H	**Reserved Discrete Output (Lamp Driver)**
RMP-1J	**Climb Inhibit No.1 Discrete Input (NO)** This input is a ground/open-type discrete used to provide information to the T3CAS CU whether to assume the aircraft cannot achieve a climb rate of 1500 FPM (457.2 m/min). The climb inhibit discrete inputs are designed in pairs (No.1 and No.2 at RMP-13G, or No.3 at RBP-5J and No.4 at RBP-5K) but can be wired as a single input or in conjunction with other aircraft operations to achieve airframe customization of the climb inhibit feature. The 1500 FPM (457.2 m/min) climb inhibit function is assumed whenever No.1 and No.2 are ground or No.3 and No.4 are ground. See Note 1 for Ground/Open type discrete input definition.
RMP-1K	**Preventive Aural Advisory Discrete Output (NO)** Same as RMP-1F, except this discrete is active whenever a preventative advisory (RA that directs the flight crew to avoid certain maneuvers or maintain flight path) is issued.

Table 4-1: T3CAS Computer Unit Interface Description (cont)
(Applicable to Part No. 9005000-10000, -10101, -10202, -10204, and -11203)

Connector Pin Designation	Functional Description
RMP-2A	**Traffic Aural Advisory Discrete Output (NO)** Same as RMP-1F, except this discrete is active during a traffic advisory when information is being given to the flight crew regarding other aircraft in the immediate vicinity. No suggested maneuver is issued. This output is inhibited if either the corrective or preventative output is active.
RMP-2B, 2C	**GPS Time Mark #1 Input : [RMP-2B (A), RMP-2C (B)]** These RS-422 differential pair inputs are provided to receive the Time Mark signal from an external GPS receiver in order to provide synchronization with other aircraft systems. This signal is also used to remove the latency error from GPS when available.
RMP-2D	**Advisory/Announce Common** This is the return line for the aural and visual advisory discrete outputs.
RMP-2E	**Reserved Discrete Output (Lamp Driver)**
RMP-2F,2G	**8-Ohm Audio Output: (RMP-2F [HI], RMP-2G [LO])** This is a synthesized voice output supplied by the TCAS computer unit. Its level is programmable up to 8 W into an 8-ohm speaker. All aural traffic and resolution advisories are announced over this output. See RBP-7A for audio level programming.
RMP-2H, 2J	**Radio Altimeter No.1 ARINC 552/Analog Input: (RMP-2H [HI], RMP-2J [LO])** Normal aircraft configurations include either two digital or two analog radio altimeter sources. The T3CAS computer unit attempts to establish which type is present in order to obtain data from one of the two available sources. TCAS first checks the radio altimeter No.1 valid flag at RMP-2K. If No.1 is not valid then No.2 valid is checked at RBP-3C. If neither are valid then TCAS checks digital source No.1 for valid data on the ARINC 429 bus at RMP-13H and RMP-13J. If none of the above are valid then the TCAS checks the digital source No.2 for valid data on the ARINC 429 bus at RBP-3D and RBP-3E. This process is repeated until a valid flag or data is detected. Until a valid source is found, the TCAS function inhibits all surveillance, CAS, and TA/RA display functions, records failures in maintenance memory, and sets the TCAS system status discrete output at RMP-13K to invalid. The TCAS function uses radio altitude to inhibit advisories and aural annunciation when in close proximity to the ground. This analog input No.1, as well as analog input No.2, can accept data as a dc voltage from several types of radio altimeters. The type of radio altimeter is selected using the program pins RMP-12B and RMP-12D thru RMP-12F.
RMP-2K	**Radio Altimeter No.1 Valid Input (PO)** See RMP-2H. A valid condition is greater than +18.5 V dc. An invalid is open circuit.